

# BLACK RIFLE II

## THE M16 INTO THE 21ST CENTURY

CHRISTOPHER R. BARTOCCI



Collector Grade Publications  
INCORPORATED

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**PRODUCED AND EDITED BY R. BLAKE STEVENS**

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## *Acknowledgements*

**T**he Colt name and trademark are among the most famous and recognizable symbols of America's history and heritage. Combined with the lore of the M16 family of rifles, popularly known as "the Black Rifle", its legend in the annals of firearms history is unparalleled. Today, Colt Defense LLC ("Colt") of Hartford, Connecticut manufactures the M16 Rifle, M4 Carbine, M203 Grenade Launcher and various variants of, and components for, the Black Rifle.

No in-depth project like this can be completed without support and assistance, and I would like to acknowledge the high level of co-operation that I have received from the people of Colt, who have made available a wealth of research material and have granted me the privilege of talking with and interviewing some of the finest firearms designers in the world. Colt engineers both current and retired have spent countless hours talking with me as well as sending me components and information from their personal archives and collections to add to the completeness and accuracy of this book. Everyone involved has given me their full co-operation, even as I harassed them on a weekly and sometimes daily basis with questions and sent them countless revisions for review. If they did not have the answers immediately they dug around until they did, and no matter how long and drawn out the process was, they came through without exception.

While I appreciate the co-operation from Colt and its associated people, the views, analyses, and conclusions made in this book are based on my own independent research and work and are not necessarily attributable to Colt, and Colt bears none of the responsibility for the accuracy, completeness or usefulness of any information presented in this book.

In late 2001, while working on a separate project relating to the M16 weapon system, I contacted Colt in order to obtain some technical data and was put in touch with an engineer named David Johnson, who forwarded my request to Edwin Zalewa. From that day forth, Mr. Zalewa became my right hand at Colt, digging through archives on my behalf and answering my every question. Ed retired in December, 2003, after giving nearly 39 years of his life to Colt. The last positions he held prior to his retirement were those of Product Data Co-ordinator and Engineering Gun Vault Curator, although throughout his long career in Colt's Engineering Department Ed worked on the development of many military and commercial products. Mr. Zalewa's assistance and contacts gave me the kick-start I needed to get this project under way, and I offer him my most sincere thanks and gratitude for his major contribution to the quality and accuracy of the information contained in the following pages.

Shortly after I began working on this project Ed suggested that there was someone else I should talk to, and he gave me the name of Michael LaPlante, another firearms historian and gun enthusiast who has been in the firearms field for his entire adult life, either directly or as a consultant. Mike became my left hand at Colt, tirelessly answering my every e-mail and phone call, always insisting that it was not a bother and that he was learning a lot of interesting things as well. Mike first began working at Colt in 1973, and although he left to pursue other opportunities to gain knowledge and experience, he returned to Colt twice throughout his career, saying that of all the gun manufacturers he had worked for, Colt was the one he found the most interesting and rewarding. He has worked in several capacities at Colt, in commercial and military business units, Manufacturing Engineering as well as the Product Engineering departments, and was involved in Colt's initial ISO 9000 certification and semi-annual re-certification. Through his current position as Director of Product Engineering for Colt Defense LLC, Mike is largely responsible for the accuracy of the descriptions of the firearms presented within these pages, and I offer my thanks and gratitude for his encouragement and dedication.

## vi Acknowledgements



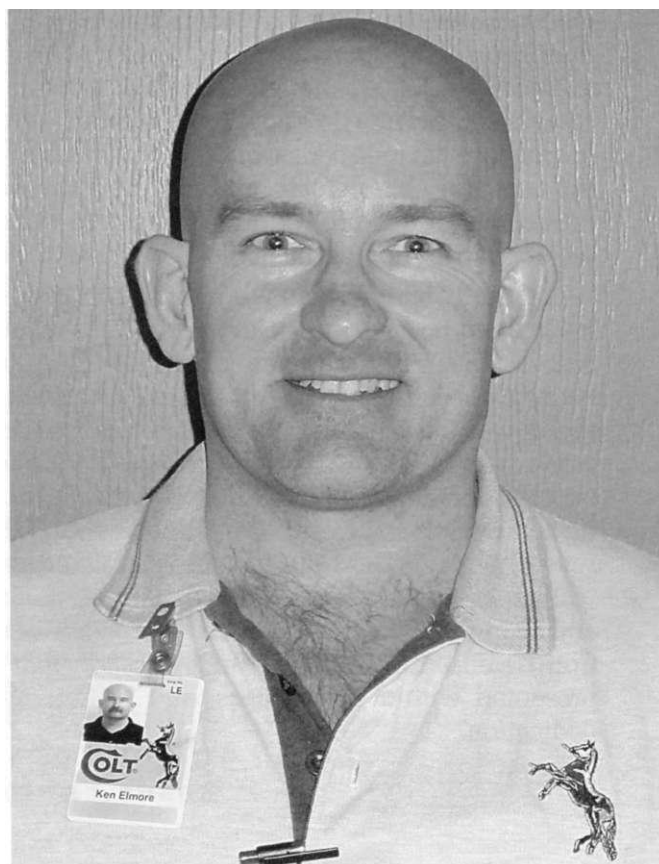
A photo taken inside the Colt factory against a backdrop of a rack of finished M4 carbines, showing Mike LaPlante (left, holding an M4 fitted with a standard-length M203 grenade launcher), and Edwin Zalewa (right, with an M4 carbine with its improved telescoping stock extended).

photo by Joe Hearon ©2003 Colt Defense LLC.

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After my last Colt Armorer School certification on the AR15/M16 weapon system had expired in April, 1998 or thereabouts, I decided I wanted to re-certify. So Bill Chartier, Colt's Law Enforcement Sales Co-ordinator, signed me up and I took the class again in 2002. There I met Ken Elmore, a longtime student of the AR15/M16 weapon system who has provided much of the technical assistance and photography used in this book. Since 1997 Ken has been a consultant to Colt's Manufacturing Co. Inc. (now Colt Defense LLC), as well as an Instructor for Colt Law

Right: Ken Elmore, founder and owner of Specialized Armament Warehouse, wearing one of his other hats as a Law Enforcement Training Instructor for Colt.



Enforcement Training, responsible for teaching police and military personnel from the United States and several foreign countries. Prior to that Ken had spent four years (1986-1990) working hard in the US Army with the 3rd Infantry Division in West Germany and the 7th Infantry Division (Light) at Fort Ord, CA. In 1989 SGT Elmore took part in combat and military police operations during the Panama invasion (Operation Just Cause) while attached to 3/27th Infantry (the Wolfhounds, *Nec Aspera Terrent*). After leaving active duty in 1990 Ken founded his own company, Specialized Armament Warehouse, which he operates in Chandler, Arizona. The company focuses mainly on Colt automatic weapons and .45 caliber handguns, which has led Ken to work directly with hundreds of police agencies and special military units around the country. Ken's education and training includes several courses of directed study in engineering and machine shop operations, as well as dozens of firearms classes and thousands of hours of hands-on experience with Colt firearms. Ken supplied many of the components and cutaways depicted in this book, and also provided some of his own component anatomy line drawings, and Ken and his wife Tina spent a considerable amount of time on the phone with me arranging for items to be shipped out so I might photograph them. Thank you, Ken and Tina, for all your time and support.

The author would next like to thank retired Colt engineer Harold Waterman, for his commitment and valued assistance in general and especially concerning the M16A2 rifle program and the ACR project, the subjects of Chapters One and Two of this book. If it were not for Mr. Waterman's detailed recollections and documentation of his intimate involvement with these programs, the degree of detail presented in these chapters would simply not have been available. Mr. Waterman held the position of Manager of Product Engineering for all military projects at Colt from 1973 through 1989, and from 1975 on, except for one year, he was also responsible for all commercial firearms projects. The development of the M16A2, the A2 Enhanced Rifle, the LMG, the ACR, the SMG, and the XM4 project all occurred during this memorable period. As Mr. Waterman recalls, "These projects were demanding and technically challenging, and were accomplished by a group of extremely talented and professional gun design engineers and technicians. We always had the full support of Colt, the Company, and all the people who worked there. It was a very good period."

Chapter Four (the cutting-edge SOCOM chapter) was made possible only with the support of the United States Special Operations Command at the Naval Surface Warfare Center in Crane, Indiana, and the author wishes in particular to thank Major Donald Heilig and Paul Miller, both of the United States Special Operations Command (SOCOM). These contacts were made possible due to the guidance of John Miller (of J.M. Enterprises), who himself spent numerous hours assisting, researching, and sending equipment to be photographed, all of which have greatly enhanced both the authenticity and scope of this chapter. Additionally, thanks are due to David Dunlap of Precision Reflex Industries, Michael Harris of Specialized Analytical Services, and many, many others.

The author would also like to thank Colt's Terri McSweeney for all his work in taking the pictures of the civilian AR-15 which appear in Chapter Ten, with additional thanks to Colt's Bill Chartier for co-ordinating this large effort. All photographs and drawings which appear in Chapter Ten are used with permission and are copyright © 2003 by Colt Defense LLC.

Thanks also to Richard Baker for his time and assistance in documenting the development of the FNMI FIRM rail system.

In addition to the above, this book is the result of input from more than a hundred people from a number of different firearms manufacturers (Colt, Diemaco, FNMI, ArmaLite), USSOCOM personnel, US military and civilian personnel at Rock Island Arsenal, Picatinny Arsenal and Aberdeen Proving Ground, ammunition designers and manufacturers, and accessory manufacturers (ARMS, Inc., ELCAN, Trijicon, EOTech, and others). Valued assistance which has helped to make this study as complete and authoritative as possible is acknowledged with gratitude from the following:

- Ian Anderson, Diemaco, Inc.
- John Bailey, EOTech, Inc.
- Chris Barrett, Barrett Firearms Manufacturing, Inc.



## viii Acknowledgements

- Susan Belanger, Trijicon, Inc.
- Michael Beltran, Aimpoint, Inc.
- Michael Brooks, US Army Criminal Investigation Laboratory
- Loren Brunton, Rock Island Arsenal
- David Cadle, photographer and graphic artist
- Carlton Chen, Vice President, General Counsel and Secretary, Colt Defense LLC
- Rod Coons, EOTech, Inc.
- Richard Costello, Colt's Manufacturing Company (ret.)
- Bryon Cox, FNMI
- MWO Gary D. Crocker, MMM CD, Life Cycle Material Manager, DSSPM, Canadian Department of National Defence
- Ralph Deeds, USSOCOM
- Greg Dennison, Remington Arms Company
- Joshua Dorsey, Colt's Manufacturing Company
- David Farris, Colt's Manufacturing Company
- Myrna Faris, Leupold & Stevens, Inc.
- John Fink, Remington Arms Company
- Peter Forras, Leitner-Wise Rifle Company
- Terry Gander, editor, *Jane's Infantry Weapons* (ret.)
- Bob Gates
- Anton Gillylan, Colt's Manufacturing Company
- Anthony Harvey, Wisconsin Air National Guard
- Joe Hearon, Design House Advertising, LLC
- Steve Hemes, Falcon Industries
- Jeff Hoffman, Black Hills Ammunition
- MSG Steve Holland, 5th Special Forces Group
- Thomas Hortobagyi, Production Engineer, Diemaco, Inc.
- Kathy Hoyt, Colt's Manufacturing Company
- Beverly Hynes, Colt's Manufacturing Company
- Gary Paul Johnston, author
- J. D. Jones, SSK Industries
- Gary Jones, Diemaco, Inc.
- Kevin Kaminski, Colt's Manufacturing Company
- C. Reed Knight III, Knight's Manufacturing Company
- Teresa Lacey, Director of Communications, ArmaLite Inc.
- Karl Lewis, Lewis Machine & Tool Company
- Aaron Matson, photographer and graphic artist
- Kenneth Maynard, Colt's Manufacturing Company (ret)
- Don Mikko, US Army Criminal Investigation Laboratory
- Frank Missurelli, Picatinny Arsenal Public Relations
- Todd Mozes, Photographic Services, Picatinny Arsenal
- Doug Olsen, Knight's Manufacturing Company
- Jeff Rankin, FNMI

- Michael Reissig, Director of Marketing, Colt's Manufacturing Company
- John E. Riutta, Leupold & Stevens, Inc.
- Marianne Rosato, Leitner-Wise Rifle Company
- Vernon Shisler, JSSAP Office, Picatinny Arsenal
- Rusty Spitzer, FNMI
- Kelly Stumpf, Creative Services Co-ordinator, Diemaco, Inc.
- the late Stanley Sudol, Picatinny Arsenal
- L. James Sullivan, firearms designer
- Richard Swan, ARMS, Inc.
- Henry Tatro, Colt's Manufacturing Company (ret.)
- James Taylor, Colt's Manufacturing Company (ret.)
- Luscious (Gus) Taylor, United States Special Operations Command
- Ray Thérroux, Diemaco, Inc.
- Kevin Thomas, Sierra Bullet Company
- Joe Unterkofler, former Chief of Light Weapons Development Team, Picatinny Arsenal
- Larry Vickers, HKM4 Project Manager, H&K Defense, Inc.
- Ginger Vossen, Knight's Armament Company
- Mark Westrom, ArmaLite, Inc.
- Paul Leitner-Wise, Leitner-Wise Rifle Company
- William H. Woodin, Woodin Laboratory

**Uncredited illustrations are from the author's collection  
and/or were photographed by the author.**

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## *About the Author*



The author during a research visit to Colt, in front of the same rack of M4 carbines shown in the photo of Mike LaPlante and Ed Zalewa in the Acknowledgements.

Chris Bartocci was born and grew up in Rochester, New York. He has been firing guns since he was old enough to pull a trigger, and a well-thumbed copy of the original edition of *The Black Rifle* was his bedtime storybook ever since he was a kid. Chris fired his first Colt AR-15 rifle when he was twelve years old and he has been hooked ever since, purchasing his first AR-15 sporter at the age of fifteen.

After leaving the Army, Chris went to Monroe Community College and received an Associate's Degree in Police Science. While in school Chris had the opportunity to work for Fred Calcagno, owner of The American Sportsman, a professional gun shop in Rochester, where he learned a great deal about firearms and ammunition. While working at The American Sportsman Chris made the acquaintance of Mr. William Houde-Walter, CEO of LaserMax, Inc., a laser sight manufacturing firm, who offered him a position as an Evaluation/Integration Engineer. While in that job, which gave him his first technical

and mechanical experience, Chris was responsible for the design, testing and evaluation of advanced laser handgun sights.

Chris went on to receive his Bachelor's Degree in Criminal Justice from the State University of New York College at Brockport in upstate New York, and he currently holds the position of Forensic Firearm and Toolmark Examiner. In his spare time he writes articles for the Krause Publications' annuals *Gun Digest* and *Handguns*, as well as numerous articles on forensic firearm identification for the Journal of the Association of Firearm and Toolmark Examiners (AFTE). In sum, Chris has been intimately involved in numerous aspects of the firearms industry throughout his life and has worn many hats, including those of an accredited forensic firearms examiner, instructor, writer, competitive shooter, reloader, consultant, collector, researcher, and designer.

Chris has always had a passion for the M16 rifle. After wearing out his original copy of *The Black Rifle*, it occurred to him that so much had happened to the M16 since that book was first published in 1987, the story needed updating. Chris's wife Heather not only agreed, but convinced him that he was the one who should do the job. With her encouragement and support, and after three years of dedicated and hard but rewarding work and research, this dream has finally become a reality.

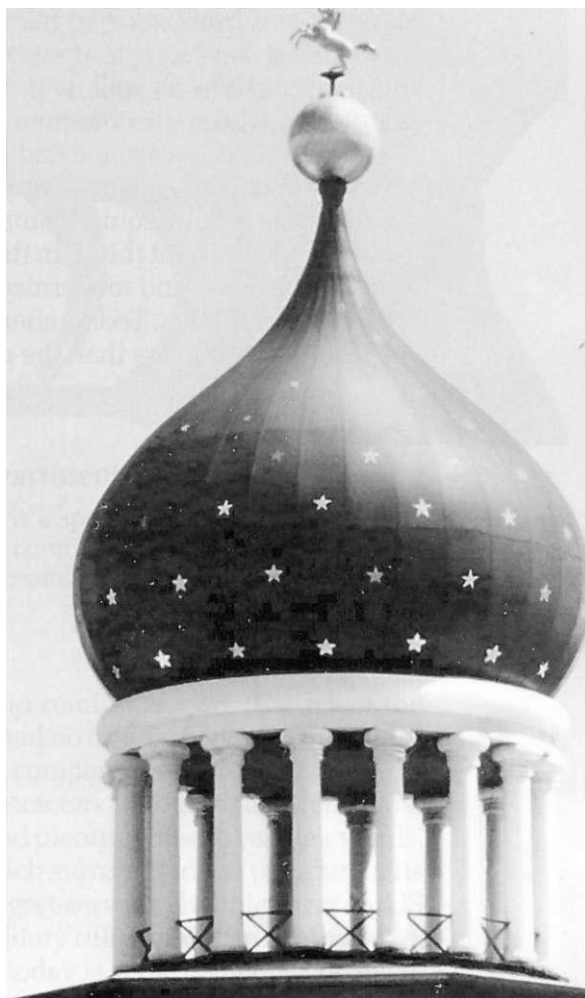
## *Dedication*

# From Walker to SOCOM

**T**his book is dedicated to the people of Colt, past, present and future. For the last 150 years, from the cavalry-and-indian battles of the Old West right up to the present day, the firm's highly skilled, conscientious and professional engineers, technicians and model makers have met the challenges posed by every theater of operations in which the United States military has been involved.

On February 19, 1959, gambling that this was indeed the rifle of the future, the Colt's Patent Firearms Manufacturing Company purchased the rights to the AR-15 from its developer, the ArmaLite division of the Fairchild Engine and Airplane Corp., whose previous attempts to divest themselves of this project had met with no success. Unfortunately, in the process of transforming the original design into a viable combat rifle, Colt's fell victim to the vast conceptual gulf which then separated two fundamentally different schools of thought about what a combat rifle should look like and do. The top echelons of the military, from the Office of the Secretary of Defense on down, had their own agenda; and the Ordnance Corps, who were firmly entrenched behind the "conventional" M14, wanted the AR-15 to fail, even at the cost of the lives of our soldiers in Vietnam.

When one thinks of military technology today, the images that come to mind are of Stealth fighters, Tomahawk missiles and "smart" bombs taking out targets with pinpoint accuracy during the recent US military operations in Afghanistan and Iraq. However, to the soldier on the ground, who values his life more than any one of these multi-million-dollar devices, nothing stands between him and the enemy's bullets except his individual weapon. To him, that rifle is every bit as important as any new piece of high-tech equipment.



The distinctive onion-shaped dome, topped with a cast-bronze rampant colt, erected by Colonel Colt on top of his factory building in Hartford as a mark of respect to greet the visiting Czar Nicholas II of Russia, as his ship steamed up the Connecticut River.

The task of providing the military with small arms is thus an incredible responsibility, as the soldiers' very lives depend on that equipment. In order to ensure that every US soldier is provided with the best possible combat rifles and carbines, their manufacturers must maintain a high degree of workmanship, attention to detail, testing and quality control, while continuing to strive diligently to improve the quality and enhance the performance of the weapons they produce.

What follows is the true story of how the M16 rifle evolved into the weapon it is today. After over forty years—already longer than any other shoulder rifle in US history—the M16 is still the US military's weapon of choice, and the standard against which all other weapons are compared.

Throughout its unprecedentedly long career, numerous expensive attempts to replace the M16-series rifles have been funded, without result. This was thanks in large part to Colt engineers such as "Mac" McCoan, Harold Waterman, Dick Brown, Ken Maynard and Jim Taylor, to name just a few, who never gave up on this weapon and who worked constantly to update and improve the basic design to meet changing needs and requirements, as well as the people in the Colt Model Shops who built, and the technicians who spent countless hours testing, the resulting prototypes.

Many rifles have come and gone throughout the intervening years, but unlike the M16 they eventually faltered because they were not improved upon and updated to meet the challenge of new requirements. Even though it is difficult for a government contractor to always "do the right thing" in the face of bureaucratic inflexibility, the story of the M16 is one of evolution and modernization, which has kept it up-to-date with ever-changing battlefield conditions. Today, after firing literally billions of rounds under test conditions, the M16 is nothing less than the most effective military rifle in the world.

Christopher R. Bartocci  
February 24, 2004

## *Editor's Foreword*



### **Really Rare Markings Department**

Left side closeup of a military M16 rifle, showing markings indicating manufacture by the Mattel Toy Company of El Segundo, California.

This is a spoof, although it did not amuse the author: no such contract ever existed, and no such markings have ever appeared on a real M16 rifle.

public domain - the Internet

**T**he above image is included right at the outset to remind readers that when the AR-15 first appeared in Vietnam, many soldiers had no trouble believing the rumor that these rifles were actually manufactured by "a toy company in California".

Today, over forty years later, the pundits and detractors who initially predicted a speedy demise for the "flimsy and toylike" M16 have had plenty of time to eat their words. Amazingly, considering the storms of controversy which surrounded the program in its early days, the M16 has gone on to become the longest-serving shoulder arm in US history, and the benchmark against which any new military rifle, American or otherwise, must now be compared. More astonishingly, the M16 today is at the center of a thriving, multi-million-dollar industry involving numerous companies and military agencies who are designing and manufacturing drop-in upper receivers in various configurations and calibers, plus complex rail systems and other high-tech accessories, all based on the M16 "platform", which thereby grows more firmly established with every passing day.

We all owe a great debt of gratitude to Chris Bartocci for taking time from his busy schedule to convince the main players in the rifle development programs of today, both corporate and military, of his genuine esteem for this rifle system, as without their implicit belief in his sincerity and commitment a good deal of what appears in these pages would never have seen the light of day in such a publication.

R. Blake Stevens  
February 24, 2004



# Part I: US Military and Law Enforcement Developments

## Chapter One

# The Third-Generation M16

## Background - from *The Black Rifle*

**T**his chapter is a modified and expanded version of Chapter Twenty-three (pages 347 - 365) of

*The Black Rifle (TBR)*, and begins with a brief introduction reprinted from page 343 of *TBR*, as follows:

### *The Marines Examine Four Future Options*

In September, 1979, with Vietnam already a six-year-old memory, a strategy meeting was held at USMC headquarters. The purpose was to examine ways to improve the status and effectiveness of the Marines' three-caliber inventory, which then consisted of 5.56mm M16A1s, 7.62 NATO M60s and .50M2 Browning machine guns . . . After some discussion, it was decided to limit the investigation to four possible avenues of approach. The first proposed the reintroduction of the M14 rifle, while

the second advocated the retention of the M16A1 as it then was. Neither idea was met with any great enthusiasm. The third suggestion was to review as many other currently available military weapons as possible in the hope of finding a clearly superior successor to the M16A1. After a quick whip-round of the free world's offerings, this search was abandoned as "disappointing". The focus then concentrated on the fourth option, improving the M16A1.

### *The USMC Statement of Requirement*

In the absence of any similar enthusiasm from the Army, whose inventory of M16A1s was still quite substantial, the Marines began unilateral negotiations with Colt's in January, 1980, contracting for the supply of three rifles modified in accordance with the USMC's primary requirements. Encouraged by NATO's acknowledgement of the enhanced range capability of the FN SS109/XM855 bullet design, the Marines later formalized their requirements as follows:

- a sight adjustable to 800 meters.
- a bullet with better accuracy at 800 meters and the capability to penetrate all known helmets and body armor at ranges of 800 meters.

- a rifle with more durable plastic parts and barrel which will take a beating during bayonet training and extended field exercises.

- the replacement of the full automatic capability with a burst mode which fires a maximum of three rounds with each pull of the trigger.

[These requirements were partially met in two new rifles, received from Colt's in the summer of 1980, which were fitted with heavy 1-in-12 barrels and two types of new handguards and heat shields. These two modified rifles, serial nos. 4833958 and 4833992, were tested alongside two standard M16A1s, serial nos. 4833967 and 788939, by the Naval Surface Weapons Center (NSWC) at Dahlgren, Virginia in August, 1980.]

## JSSAP'S Product Improvement Program ("PIP") Rifle - the "M16A1E1"



1. Right side view of the early experimental M16A1E1. This image originally appeared in *TER* as fig. 369. Note the A1-style rear sight, stock and pistol grip. The

fully-adjustable rear sight, the fired cartridge case deflector and the three-round burst control device had not yet been requested. Editor's collection



2. Three Colt employees: Harold Waterman (left), who was intimately involved in the M16A1E1 project, Richard Skowronski (center), and John Williams (right).

Richard Skowronski is holding the first production M16A1E1 rifle to come off Colt's production line to be tested by the Marine Corps, courtesy Harold Waterman



3. Left side closeup of the receiver markings on the early M16A1E1, made up on "M-16A1" lower receiver serial no. 4704772. This image originally appeared in *TBR* as fig. 370.

This rifle still has the standard M16/M16A1 pistol grip. Note the new rear sight, and the modified markings on the (3-position) selector: showing the AUTO position replaced with the new BURST position. Editor's collection

Tests with the Marines' four rifles aroused the interest of the management committee of the Joint Services Small Arms Program (JSSAP), who at the time were persevering through a long and acrimonious series of trials designed to select a new service pistol. JSSAP approved a joint-service rifle program and ordered 50 Product Improvement Program (PIP) M16A1s from Colt's for delivery in November, 1981.

JSSAP tasked the USMC Firepower Division at Quantico, Virginia to oversee the Marine portion of the trial of the new rifles. Accordingly, the Marines

conducted a modified operational test (MOT) from November 23 to December 11, 1981 using 30 of the PIP rifles and 30 standard-issue M16A1s, and employing 20 Marines and 10 soldiers from the 197th Infantry Brigade at Fort Benning. For identification purposes, the PIP rifles were designated the "M16A1E1".

The result of the Marine tests was a most favorable assessment of the PIP rifle. The final report listed a number of the M16A1E1's advantages as follows:

### *[USMC Firepower Division, Quantico, Virginia]*

## **M16A1E1 TEST RESULTS AND FINAL REPORT**

**21 May 1982**

### **[Advantages:]**

- Ease of training (handling and sight movement). [The Marines are trained to engage targets beyond combat ranges by adjusting their sights, rather than by "holding over"].
- Increased effectiveness at long ranges (more hits, better accuracy, and greater penetration). [The Marines are virtually the only fighting force

in the world who still train individual riflemen to engage targets past 300 meters].

- Improved handling characteristics and durability in hand-to-hand close combat.

Reduced barrel jump and muzzle climb during automatic and rapid fire.

Improved sighting characteristics providing quick target acquisition for moving targets and

#### 4 Adopting the M16A2

*better detection of targets in low light conditions at close ranges.*

*Increased ammunition conservation and more effective use of ammunition with [3-round] burst control device.*

*Can use NATO type improved ammunition (XM855) which provides increased performance and penetration at long ranges.*

## Adopting the M16A2



4. The Colt M16A2 rifle, shown partially disassembled. Disassembly and maintenance are identical to the procedures used with earlier versions of the rifle, the main

difference being the interchangeable handguards rather than a dedicated left and right handguard.

The product-improved (PIP) "M16A1E1" was officially type classified the M16A2 (NSN 1005-01-128-9936) in September, 1982, and adopted as Standard 'A' in November, 1983, under government drawing number 9349000 and Colt model number R0645.

As noted, the singular impetus provided to the PIP program was from the Marines, who due to "declining inventories" of M16A1s had already ordered 76,000 of the new rifles. In acknowledgement of the Marine contribution, Colt's presented M16A2 serial no. "0001 USMC" to Marine Maj. Gen. William G. Carson on March 14, 1984. The specially-marked rifle was intended to symbolize the first M16A2 off the line, although by that time the Marine Corps' MTU at Quantico had already accepted the first 1,500 rifles for use in Divisional Matches.

As noted, the Army, although the senior service, had a much less critical inventory problem, and consequently had less interest in the PIP program's recommendations: the Army did not contract for any appreciable number of M16A2s until 1986. In the face of this less-than-enthusiastic Army attitude, at the same ceremony Colt's presented M16A2 serial no. "0001 USA" to the Army's representative of the Chief of Staff.

5 (facing page). A mid-1980s Colt advertisement for the M16A2 rifle, released just after the official adoption of the rifle by the US government.

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# New Colt® M16A2

## 5.56mm NATO

**"There is no finer service rifle available in the world today."**

The stated opinion of many senior level U.S. Marine Corps officers.

The rifle you put in the hands of your military should be the best in the world.—THE NEW COLT M16A2.

### **Increased Effective Range and Penetration**

The new Colt M16A2 is designed to accommodate the entire range of 5.56mm rounds, including the 5.56mm NATO cartridge, with its heavier bullet. The improved target type rear sight makes it

possible to fully benefit from the increase in effective range and penetration made possible with this new round.

### **Combat Proven**

The M16 is one of the most proven combat weapon systems in the history of firearms. More than 6,000,000 M16's have been produced for armed forces throughout the world. Nine out of ten 5.56mm combat rifles in use today are Colt M16's.

### **Lightweight, Reliable, Rugged**

Features a new forearm, buttstock and pistol grip designed for comfort and effectiveness, and produced from new high strength materials for greater durability. The optional 3 shot burst control both increases hit probability and conserves ammunition.

### **The New Standard for all U.S. Forces**

The new M16A2 has been adopted as a standard for all U.S. Forces, and is currently the latest issue rifle for the United States Marine Corps.

If you're ready to equip your best with the best, there's only one rifle up to the task. THE NEW COLT M16A2.

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## The Thirteen Distinctive Features of the New M16A2 Rifle

Although the M16A2 utilizes the same operating mechanism as the previous M16 and M16A1 service rifles, the M16A2 is for all intents and purposes a different rifle.

Among the numerous modifications and improvements which have increased the capabilities

and durability of the M16A2 over the M16 and M16A1, thirteen major changes were incorporated in the new rifle. Starting from the barrel muzzle, these were as follows:

### 1. The New Muzzle Brake/Flash Suppressor

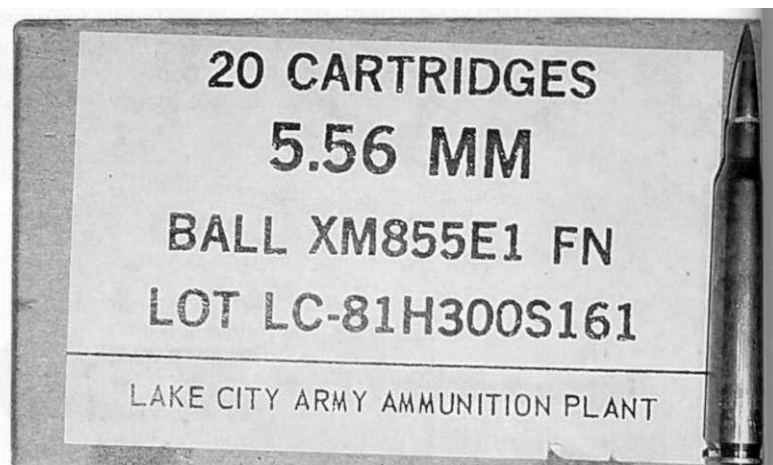
The flash suppressor went through its fourth evolution during the genesis of the M16A2 rifle. Original rifles had used the "duck bill" three-prong flash suppressor, later modified into the standard open three-prong style which, while being the most effective design, caused problems in Vietnam due to the troops catching the open prongs on brush, tree branches and vines. The answer was the "bird cage" flash suppressor (*TBR* fig. 221), which became standard on M16 and M16A1 rifles.

With the introduction of the M16A2, the design was changed again so that it would function as a muzzle brake as well as a flash suppressor. The vents were removed from the bottom, which not only helped to keep the muzzle down during burst fire, but also did not kick up nearly as much dust and dirt as had the previous designs when the rifle was fired from the prone position. Additionally, it lessened the problem of water running into the bore off the channeling slot-edges.

### 2. The Controversial "Heavy" Barrel

With the adoption of the Belgian SS109/US M855 5.56mm cartridge as the second NATO standard round in 1980, the pitch of the rifling twist in the barrels of weapons chambered for the new cartridge had to be increased in order to stabilize the longer, heavier bullets, which were a feature of the new round. Originally, the Belgians had tailored this cartridge for the M249 Minimi machine gun, which makes heavy use of tracers for directing fire and walking fire onto a target. A rifling twist of anywhere from one turn in 7 to 10 inches was found to stabilize the SS109/M855 ball bullet satisfactorily, but the 1-in-7" twist was required to stabilize the tracer bullet in all climates. Many experts believe the optimal rate of twist for the SS109/M855 cartridge is one turn in 9 to 9.5", but the decision was made by the Belgians to adopt the 1-in-7" twist in order to accommodate the tracer loading, even though this overstabilized the 62-grain ball bullet. NATO followed suit, and when the barrel was designed for the M16A2, the 1-turn in 7-inch twist was a US government-directed requirement for the rifle.

This soon became one of the most controversial modifications made to the M16A2. Many experts claimed the 1 turn in 9" twist would have been much more desirable for many reasons, primarily longevity and durability. The much faster 1-in-7" twist caused premature wear, and was found to be significantly more likely to burn out barrels on automatic/burst

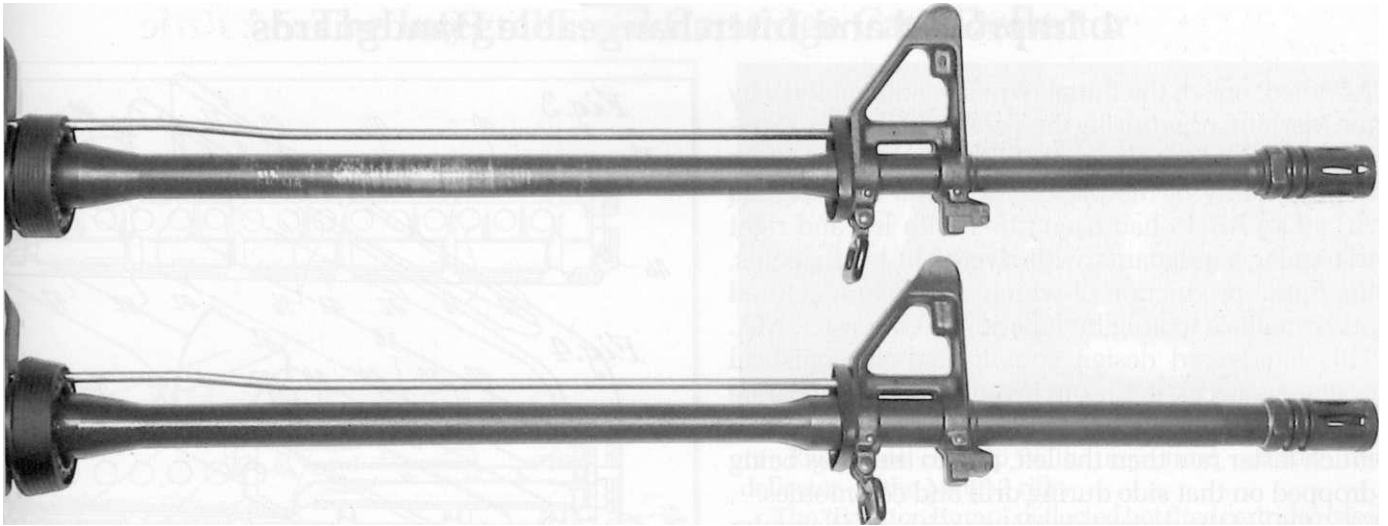


6. Typical box label and sample round for the experimental "BALL XM855E1 FN" cartridge prior to it being adopted as the 5.56mm NATO M855 ball cartridge.

fire. Additionally, the 1-in-7" twist definitely overstabilizes the 55-grain M193 ball projectile, degrading its terminal performance. Despite these concerns, the decision to standardize the 1-turn in 7-inch twist remained in force.

In another heavily criticized decision, the external profile of the barrel was also changed. Complaints had been made by Airborne divisions that the M16/M16A1 barrel was too fragile, and would bend





7. A right side comparison of two M16 barrel profiles.  
Above: original M16/M16A1.  
Below: M16A2. Note that only the area from the front sight assembly forward is enlarged, the rear portion under

the handguard being left the same so it would be compatible with the existing forward mount of the M203 grenade launcher. This was one of the most controversial features of the M16A2.

if struck on the ground when the troops landed from their jumps. Another more prevalent reason for barrels bending was the fact that bayonets installed on rifles were often used as pry bars to open crates and so on, although obviously this was not part of the requirement for the barrel design!

To answer this problem, the overall diameter of the barrel was increased, which made it 2 1/2 times stiffer, but only from the front sight assembly to the muzzle brake, while the rear portion of the barrel remained the same diameter as the standard M16/M16A1 rifle barrel. This increased strength in the area which was most prone to bending in the

field, but many experts felt that the entire barrel should have been strengthened, as had been done on the original two experimental rifles trialled by the Navy Surface Weapons Center in August, 1980 (*TBR* fig. 365). The reason given to support the action taken was that if the barrel diameter was increased throughout, existing M203 grenade launchers could not be installed without redesigning the forward mount of the M203. US government direction was therefore to keep the original contour of the barrel under the handguards, rather than introduce a new M203 clamp into inventory.

### 3. The Square Front Sight Post

Rather than retaining the 5-position round front sight post of the M16/M16A1 rifle, the new M16A2 utilizes a square-post front sight with four adjustment positions. The reason given for this change was that it would improve the sight picture by presenting a flat, non-reflective surface.



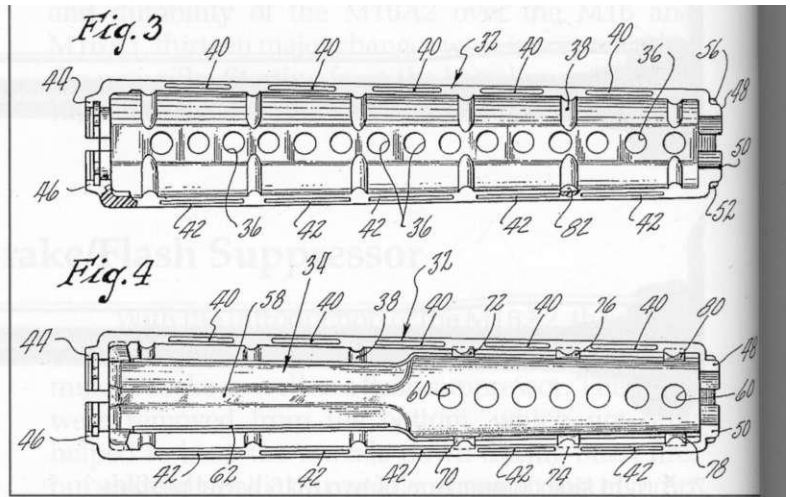
8. Top closeup of the new M16A2 four-position square front sight post.

## 4. Improved and Interchangeable Handguards

As noted, one of the initial requirements set forth by the Marine Corps during their ground-breaking Product Improvement Program (PIP) was an increase in the durability of the plastic furniture. The original ArmaLite AR-15 had been fitted with left and right triangular handguards with riveted-in heat shields, the initial production of which were manufactured on ArmaLite's tooling by Fiberite in Worcester, MA. This handguard design complicated the logistical system by necessitating an inventory of two separate parts, especially since the right handguard broke at a much faster rate than the left, due to the rifles being dropped on that side during drill and ceremonies.

One of the major complaints with the triangular handguards was the fact that the fragile "teeth" around the vent holes along the gas tube would break off. In addition the shape, along with the smooth profile, had been criticized as not providing an adequate grip. In the early 1960s Colt had designed a round handguard which was stronger by virtue of its shape, provided an improved grip, and was made of two interchangeable halves rather than separate left and right guards. Shortened versions of this handguard had been used for many years on SMG and carbine variations, going back to the early XM177s, with few known failures or breakages. In the 1970s a number of prototype round handguards were tested by the military which were reportedly well received, with the proviso that the new handguards heated up more quickly than did the triangular handguards.

During the M16A1 Product Improvement Program (PIP) and the later M16A1E1 development, the Marine Corps stated that they wanted a new improved handguard, and Colt recommended another look at the round handguard design.



9. Figs. 3 and 4 from US Patent no. 4,536,982, granted to Colt Engineers Harold Waterman and Seth Bredbury, entitled "Cylindrical Rifle Handguard Assembly".

Fig. 3 shows just the polymer handguard, and Fig. 4 shows the snap-in heat shield. US Patent Office

The new "Cylindrical Rifle Handguard Assembly" was developed by Colt engineers Harold Waterman and Seth Bredbury and patented under US Patent no. 4,536,982, dated August 27, 1985. This was an interchangeable half-round handguard that utilized snap-in heat shields instead of the riveted heat shields of the triangular handguards. The liners, whose rear portions are devoid of vent holes, interlock to reduce heat flow between mating surfaces of the handguard. The vent holes in the forward part of the liners serve to circulate air between the liner and the outer plastic shell, which helps to cool the exterior of the handguard. The interface of this new handguard is interchangeable with the earlier design, so that it could be installed on existing M16s, the then-standard M16A1, and the new M16A1E1.

## 5. Colt's New "Delta" Ring

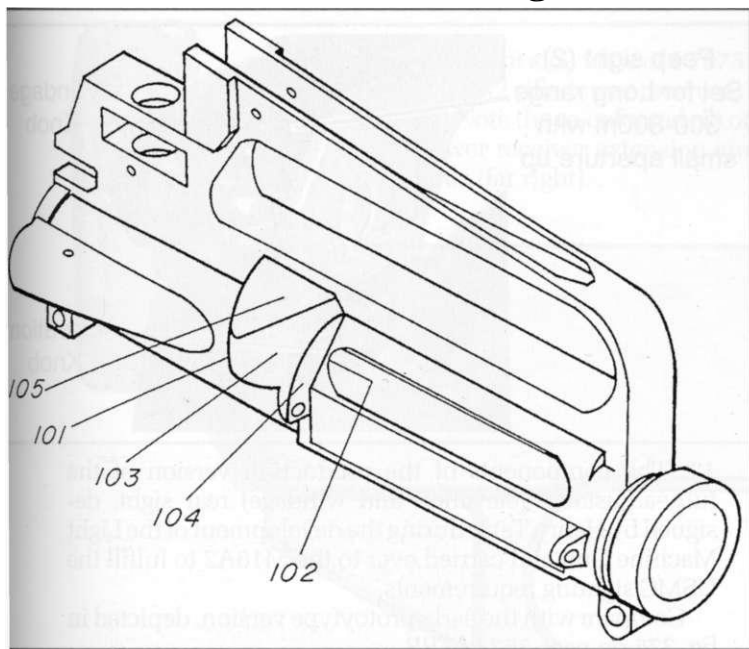
One universal complaint about the original AR-15, the M16 and the M16A1, as well as the early carbine variations, was the extreme difficulty encountered in removing the handguards for cleaning. This operation often required two people, one to pull back on

the spring-loaded slip ring and the second to remove the handguards.

To answer this problem, Colt canted the slip ring, which they now referred to as the "Delta" ring, so that a single operator could get a good grip on it and pull it back to remove the handguards.



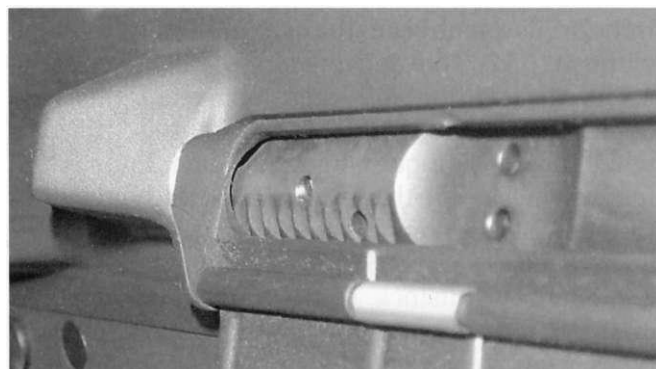
## 6. The Integral Fired Cartridge Case Deflector



10. Drawing from US Patent no. 4,691,615, granted to Rock Island Armory's Loren Brunton, entitled "M-16 Rifle, Improved To More Safely Accommodate Left-Handed Shooters".  
US Patent Office

One problem experienced with the AR-15/M16 series of rifles throughout the years had been that left-handed shooters would often get struck in the face by ejected cartridge cases. The initial fix for this was a bolt-on spent case deflector which sat right behind the ejection port, so when the cartridge case was ejected from the rifle it would strike the deflector and bounce forward, away from the operator's face. Another way of dealing with this issue when the deflectors were unavailable was to lighten the load on the ejector spring, which would alter the ejection pattern of the rifle enough to correct the problem.

In a meeting held at Colt's during the development of the M16A2, Loren Brunton of Rock Island Arsenal described research, done on his own time, in which with the aid of high-speed photography he had studied the chain of events that caused a fired cartridge case to be thrown into the face of a left-handed shooter. Mr. Brunton found that as the cyclic rate of the M16 series rifle increased, the ejection pattern slowly shifted rearward, so that at approximately 725 rounds per minute the ejected cartridge case started to miss the then-current deflector rib and spun back almost parallel to the side of the rifle, causing the extremely hot cartridge case to strike the left-handed shooter in the face or neck, sometimes



11. Right side closeup of the new fired cartridge case deflector on the M16A2 rifle.

The "Brunton Bump" deflected hot fired cartridge cases, keeping them from striking left-handed shooters in the face.

causing burns. Mr. Brunton then presented a prototype "pyramid"-shaped deflector of his own design, which could be glued to the upper receiver right behind the ejection port to keep fired cartridge cases away from the faces of left-handed shooters. This invention worked in the same way as the bolt-on deflector, but was intended to be an integral part of the upper receiver.

With the patent paperwork paid for by the Department of the Army, Mr. Brunton submitted his invention to the US Patent Office and was granted US Patent no. 4,691,615 on September 8, 1986.

The function of Mr. Brunton's invention was described in the patent disclosure as follows:

*To remedy this problem, this invention provides for a deflector which is made an integral part of the rifle positioned to the rear of the ejection port jutting out towards the right side. It provides a barrier for fired cases, preventing same from coming straight back into the shooter's face, but instead to strike and bounce off the deflector and being forced to land considerably away from the shooter's person.*

After the design was adopted, Colt added it to the rifle forgings for the upper receiver, and it has been standard on all M16 series 5.56mm rifles and carbines ever since. Only the 9mm carbines do not feature this integrated deflector, although on these guns a similar device is installed on the ejection port cover rod. This serves primarily as a gas deflector, to prevent burning powder granules from the spinning cartridge case from hitting the left-handed shooter.

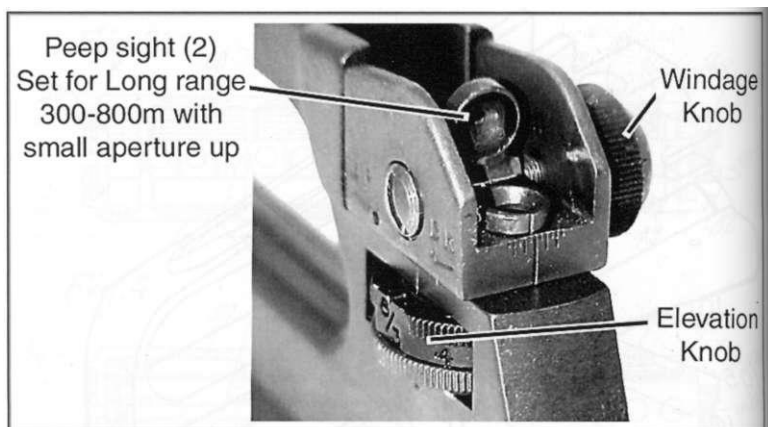
## 7. The Fully-Adjustable Rear Sight

Initial trials quantities of the M16A1E1, the prototype of the M16A2, were delivered for Marine Corps tests at Quantico without fully adjustable rear sights, case deflectors or three-round burst controls, none of which had been requested at that time. Initially the main changes were the new barrel profile and tighter rifling twist to accommodate the longer, heavier bullets of the new Belgian SS109 cartridge, and improvements to the buttstock, pistol grip, handguards and other M16A1 shortcomings. By the time these prototypes were entering their first trials, the Marine Corps had set forth requests for the three above-mentioned features—fully adjustable rear sights, case deflectors and three-round burst controls—which had not been part of the original specification.

To take advantage of the greater range of the Belgian SS109 (XM855 ball) cartridge, the Marine Corps requested that an improved rear sight be designed which could be adjusted for windage as well as elevation, with the latter being calibrated to the trajectory of the longer, heavier SS109 bullet.

Fortunately, during the development of the Colt/Diemaco LMG (Light Machine Gun, discussed in Chapter Nine), Colt's engineer Henry Tatro had already designed a sight very similar to what the Marines were asking for—so similar in fact that the design which was eventually standardized is identical mechanically to the one Henry Tatro developed—although the maximum elevation calibrations were raised from 500 to 800 meters, with the calibration read from the left side of the rear of the carrying handle rather than through a hole in the rear of the carrying handle (as shown in the two views of the prototype rear sight on page 353 of *TBR*). The diameters of the two apertures remained the same, one at 1.75mm for longer ranges and the "0-2" 5mm "battle sight" aperture for use at close ranges and under low-level light conditions. The 5mm aperture was chosen after initial M16A1E1 testing conducted by the Marine Corps at Quantico.

The US Army trains its soldiers to fire at reactive targets which pop up randomly, and for extremely short periods of time, at ranges from 25 to 300 meters.



12. The components of the production version of the fully-adjustable (elevation and windage) rear sight, designed by Henry Tatro during the development of the Light Machine Gun and carried over to the M16A2 to fulfill the USMC sighting requirements.

Compare with the early prototype version, depicted in fig. 375 on page 353 of *TBR*.

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Unlike the Army, the Marine Corps trains with known-distance "bull's-eye" targets, set at distances as great as 500 meters, for which they wanted a more accurate sight. During initial M16A1E1 testing at Quantico, a USMC major, Bruce Wincentzen, halted live-fire testing when the Army soldiers fell behind the test shooters of the 1st and 3rd Marine Divisions. He then trained the Army soldiers in the Marine Corps style of shooting at known-distance targets and, when testing resumed, the Army shooters "held their own" for the remainder of the tests.

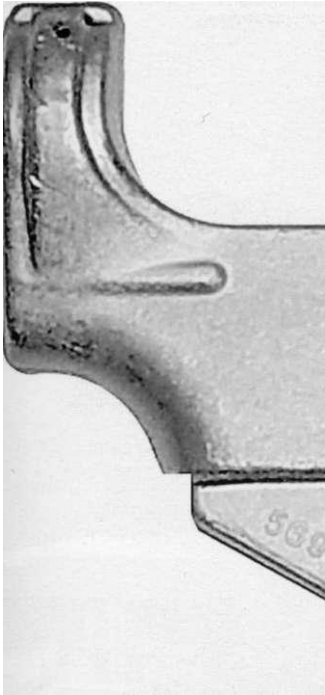
As of this writing, the Marine Corps is the only branch of the US Armed Forces which trains its troops in the use of the fully adjustable rear sight. The Army and Air Force train their people in battlesight-zero only. They zero the rifles at 25 meters at point of aim, after which the rifles will fire accurately up to 300 meters, which they consider a much more practical maximum combat range, without adjusting the elevation setting of the rear sight.

## 8. The Improved Forward Assist

Additional improvements were made to the forward assist assembly in the upper receiver. The "teardrop" forward assist thumbpiece (fig. 436) was changed to a round button-style plunger, which was simpler to manufacture and more durable.

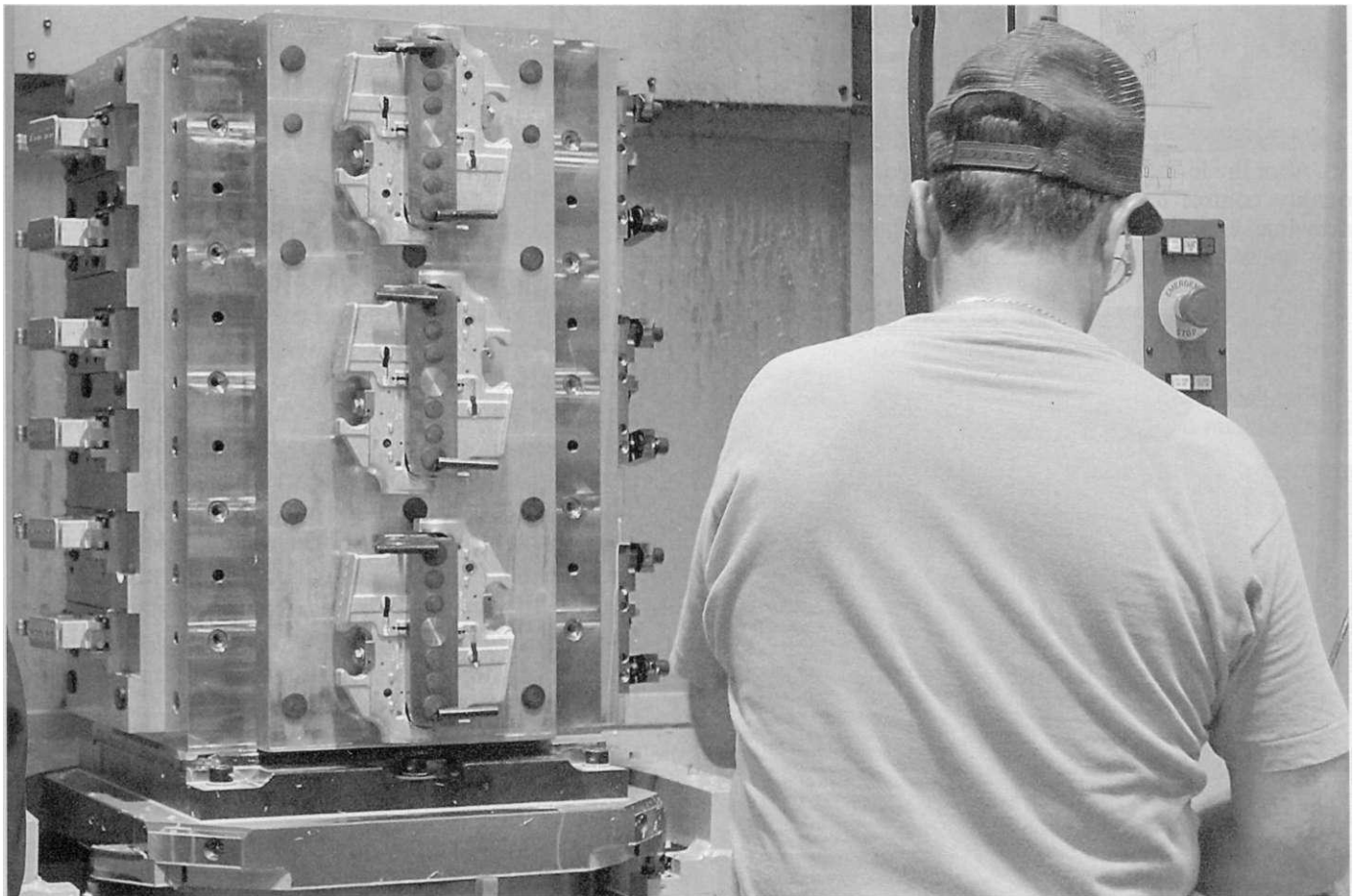
As shown in fig. 434, two different versions of the round button-style forward assist plungers exist. The early type was a large-diameter button with a flat edge on the inside, and the later (current) style features a smaller-diameter round button.

## 9. The Strengthened Lower Receiver



13. Right side view of a 7075 T6 aluminum forging for the M16A2 rifle lower receiver.

Note the re-enforced rib on the rear of the forging in the lower receiver extension area (left), and in the pivot pin area (far right).

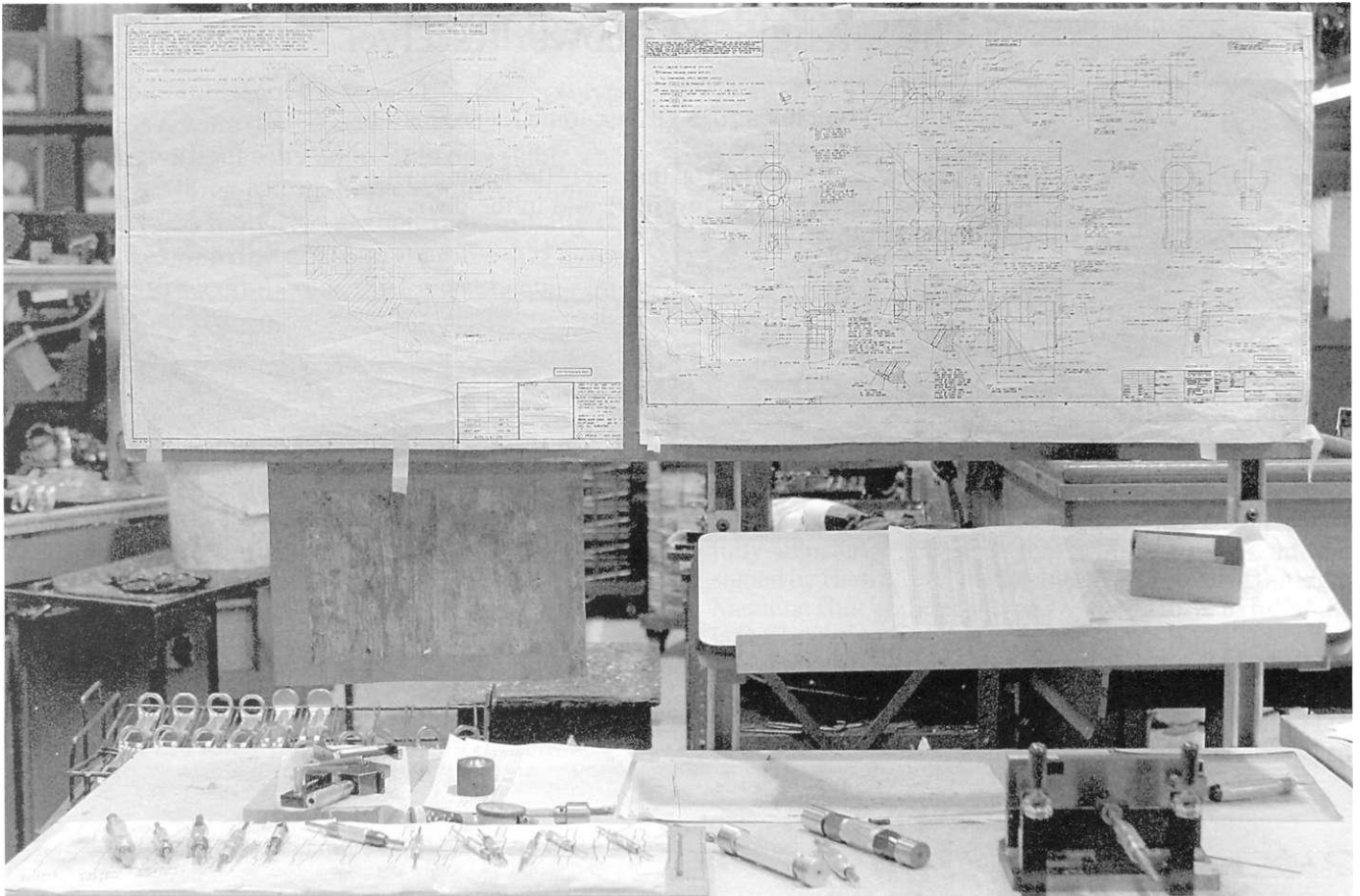


14. Lower receiver manufacturing at Colt Defense, LLC is done on state-of-the-art TOYODA horizontal machining centers, equipped with pallet changers. There are 24 forg-

ings placed on the fixture.

photo by Joe Hearon, © 2003 Colt Defense LLC.  
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## 12 Adopting the M16A2



15. After the lower receivers are machined, they go to this quality control area where they are referenced to the drawings and checked with numerous gauges to ensure they are within the military specification.

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In the interest of increased durability and longevity, two major modifications were built right into the forgings for the improved M16A2 lower receiver. First, the rear portion into which the lower receiver extension screws was strengthened, which also increased the strength of the rear takedown pin area. The second improvement was made to the front pivot pin area, which has also been significantly strengthened.

Additionally, selector lever markings have been added on the right side of the receiver, so left-handed shooters are able to see at a glance which mode of fire is selected.

16 (left). Right side closeup of the re-enforced buffer tube/receiver extension area on the finished lower receiver.

Note the round button-style plunger on the improved forward assist, and the raised rib beneath the charging handle that strengthens the receiver.

## 10. The New Pistol Grip



17. Right side closeup of a final production Colt M16A2 rifle.

Note the integral fired cartridge case deflector, the selector lever markings on the lower receiver, and the

Along with improvements to the handguards and buttstock, the pistol grip was modified as well. As per the Marine Corps' requirement for much more durable furniture, the new pistol grip is manufactured

redesigned pistol grip, as well as the new Colt "Delta Ring" (right). This modified slip-ring is canted to enable easier removal of the handguards.

from Super-Tough Nylon 80G material, with a "swell" or finger groove added below the middle-finger position and vertical striations on the back surface, to provide a more secure, non-slip grip.

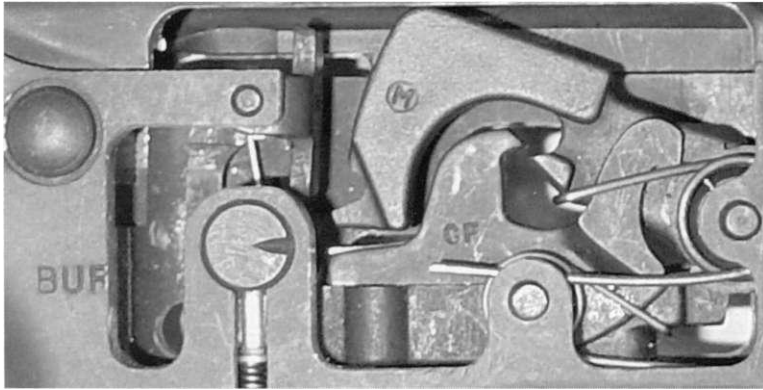
## 11. The Controversial Non-Resetting Burst Mechanism

The addition of the burst mechanism was a request made by the Marine Corps after initial weapons had been delivered. This request went to Harold Waterman at Colt's, and within three weeks Colt had submitted a proposed three-round burst mechanism based on the patented four-way (SAFE, AUTO, SEMI, BURST) design by senior product engineer

Foster E. Sturtevant (US Patent no. 3,292,492, dated December 20, 1966; *TBR* figs. 169 -171).

The substitution of the burst mechanism in place of the previous full-automatic fire capability was perhaps the most controversial of all the changes incorporated in the M16A2 rifle. Unlike many other burst control designs, the one chosen for the M16A2

## 14 Adopting the M16A2



18. Right side closeup of the M16A2 Burst mechanism as seen through a cutaway M16A2 rifle.

Note the second disconnecter on the right, with its claw engaged on the burst cam of the hammer.

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does not reset if the three-shot cycle is interrupted, either due to the trigger being released before the cycle is completed or the rifle running out of ammunition. Depending on where the cycle is interrupted, when the rifle is reloaded and/or the trigger is pressed again, it may fire one, two or three rounds. Only then is the cycle reset so that each subsequent pull of the trigger will fire a complete three-round burst.

### Accommodating the Burst Mechanism

The hammer had two modifications made to it for use with the burst mechanism. First, the disconnecter hook was extended to the right, so that the pawl on the burst disconnecter will engage and hold the hammer when the three-round cycle is completed. The second modification was to the right side of the hammer, to accommodate the burst cam and clutch spring.

Two major modifications were also made to the trigger, to accept the second disconnecter so the burst mechanism could function. First, the width of the trigger was increased so both disconnectors would fit, along with the two disconnecter springs. Second,

the front right side of the sear area was cut away to accommodate the cam on the hammer.

Two disconnectors were required, one for semi-automatic fire only and the second to operate the burst mechanism. The semi-automatic disconnecter is identical to the standard M16A1 semi-automatic and automatic disconnecter, except that its tail has been bent inward so that when the selector is moved to the BURST position it can push down and disengage the semi-automatic disconnecter. The second, or burst disconnecter, has no tail on the rear and a pawl extending forward which engages the cam on the hammer.

### Function of the Burst Mechanism

When inspecting the rifle before firing, ensure that the chamber is empty and place selector on BURST. Hold trigger to the rear and pull charging handle back and release four times, to ensure that the burst mechanism is reset and ready to fire a full burst.

When the trigger is pulled the sear on the trigger nose drops, releasing the hammer to fire the first cartridge. The pawl on the burst mechanism disconnecter holds the cam in place as the hammer falls to fire the first cartridge. Every time the hammer falls, the clutch spring releases the cam and the front hook of the burst disconnecter keeps it in place.

As the bolt assembly moves rearward, the clutch spring on the cam clutches the burst cam and causes it to rotate to the next notch as the hammer is forced rearward. When the bolt carrier assembly has made its full rearward movement, the hammer is caught and held by the auto sear.

Now the hook is fully engaged on the second notch. When the bolt assembly returns to its forward

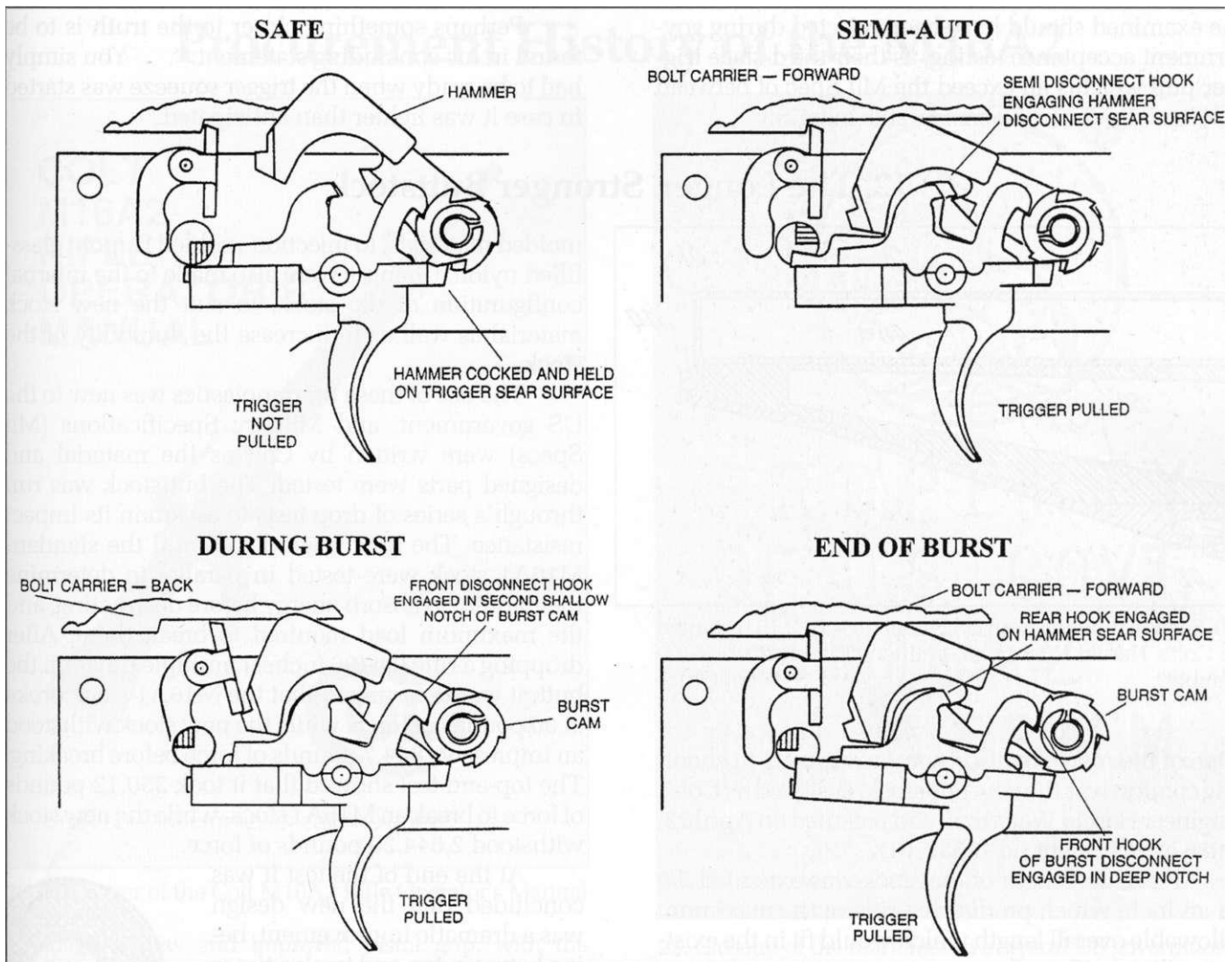
position, the bolt carrier trips the auto sear, releasing the hammer to fire the second shot.

As the bolt assembly moves rearward, the clutch spring on the cam clutches the burst cam and causes it to rotate to the next notch as the hammer is forced rearward. When the bolt assembly has made its full rearward movement the hammer is caught and held by the auto sear.

Now the hook is fully engaged on the third notch. When the bolt assembly returns to its forward position, the bolt carrier trips the auto sear, releasing the hammer to fire the third shot.

As the bolt assembly moves rearward, the hammer is forced back to the rear and is caught by the auto sear. The clutch spring of the burst cam clutches against the cam and causes it to rotate to the next notch so that when the bolt assembly moves forward and the bolt carrier trips the auto sear, the front hook of the burst disconnecter is in the stop notch, which is much deeper than the other notches, so that the front hook of the disconnecter is further forward than





19. A series of self-explanatory diagrams describing the function of the three-shot burst control mechanism chosen for the M16A2 rifle.  
courtesy Ken Elmore

before. This enables the rear hook of the burst disconnecter to engage the rear hammer notch, holding the hammer to the rear. When the trigger is released

the trigger nose holds the hammer back ready for the next burst cycle.

## The Curious Case of the Three Different Semi-Auto Trigger Pulls

One of the loudest complaints regarding the M16A2 burst mechanism emerged well after type-classification and military acceptance, and concerned its adverse effect on the semi-automatic trigger pull.

Since the burst cam is always engaged by the burst disconnecter, there actually are three different semi-auto trigger pull weights. However, despite USMC Major R. N. Jepperson's carefully documented assertions (discussed on page 358 of *TBR*) that the trigger pull gets progressively *heavier*, the truth is that

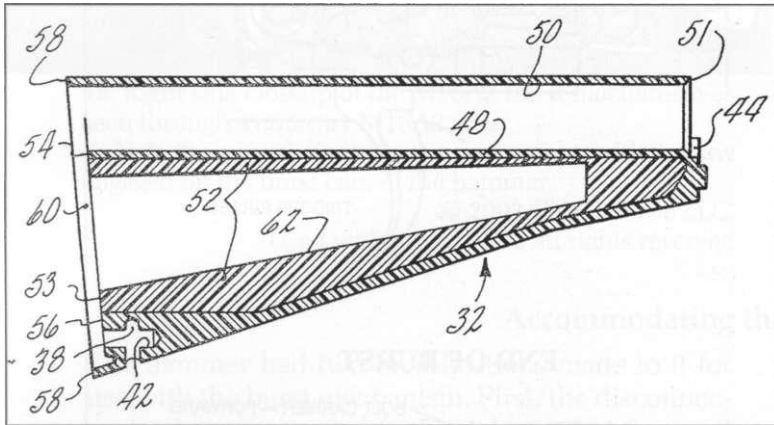
the first two pulls are quite similar, due to the burst disconnecter claw engaging the two shallow notches on the burst cam, but the third pull is fractionally *lighter*, caused by the burst disconnecter engaging in the deep notch on the cam.

Perhaps Major Jepperson was dealing with some very early pre-adoption examples of the M16A2; or maybe the method he used to measure the trigger pulls was flawed in some way. In any case, if his figures are to be believed, every one of the rifles

he examined should have been rejected during government acceptance testing, as their third-stage trigger pull weights all exceed the Mil Spec of between 5 1/2 and 9 1/2 lbs by a considerable margin.

Perhaps something closer to the truth is to be found in his concluding statement: ". . . You simply had to be ready when the trigger squeeze was started in case it was lighter than anticipated."

## 12. The Longer, Stronger Buttstock



20. Section drawing from US Patent no. 4,512,101, granted to Colt's Harold Waterman, entitled "Rifle Buttstock Assembly" US Patent Office

One of the more significant improvements in shooting comfort was the new buttstock, designed by Colt's engineer Harold Waterman and patented on April 23, 1986 as US Patent no. 4,512,101.

First, the length of the stock was extended 5/8 of an inch, which produced a rifle of the maximum allowable overall length which would fit in the existing military rifle racks.

Second, in order to increase durability, the composition of the new stock and buttplate was changed from a thermoset material of two compression-

molded materials, to injection-molded Dupont glass-filled nylon. Changes were also made to the internal configuration of the stock, to suit the new stock material as well as to increase the durability of the stock.

The use of these thermoplastics was new to the US government, and Military Specifications (Mil Specs) were written by Colt as the material and designed parts were tested. The buttstock was run through a series of drop tests to ascertain its impact resistance. The new stock design and the standard M16A1 stock were tested in parallel to determine their ability to absorb energy before destructing, and the maximum load required to break them. After dropping a rifle flat (96 inches) multiple times on the butt, it was determined that the M16A1 stock broke at 30 pounds of force, while the new stock withstood an impressive 844.7 pounds of force before breaking. The top-end test showed that it took 350.12 pounds of force to break an M16A1 stock, while the new stock withstood 2,644.20 pounds of force.

At the end of the test it was concluded that the new design was a dramatic improvement, being between ten and twelve times stronger than the existing M16A1 buttstock and buttplate.

## 13. The Improved Buttplate and Trapdoor

The M16A2 buttplate was improved as well. The buttplate was made of the same super-tough nylon (with no glass fill) as the pistol grip, and the entire surface was then heavily checkered to prevent the butt from slipping or sliding off the shooter's shoulder.

The trapdoor was also modified and improved. The latch was made easier to open by hand without

the need for a cartridge or other tool to gain access to the cleaning kit storage cavity inside the stock. The face of the trap door was also fully checkered, in keeping with the rest of the buttplate.

21 (right). The improved M16A2 buttplate, made from the same super-tough Nylon as the pistol grip. The entire buttplate and trapdoor are deeply checkered to prevent the stock from sliding off the shooter's shoulder in adverse conditions, and the latch has been changed to allow easier opening without the use of a cartridge or tool.





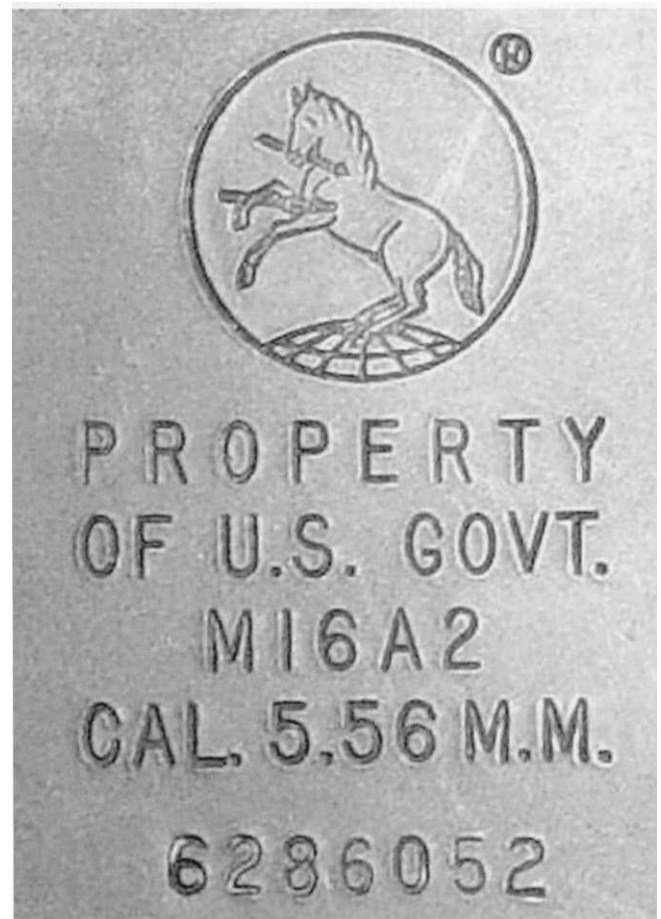
## Procurement History of the M16A2



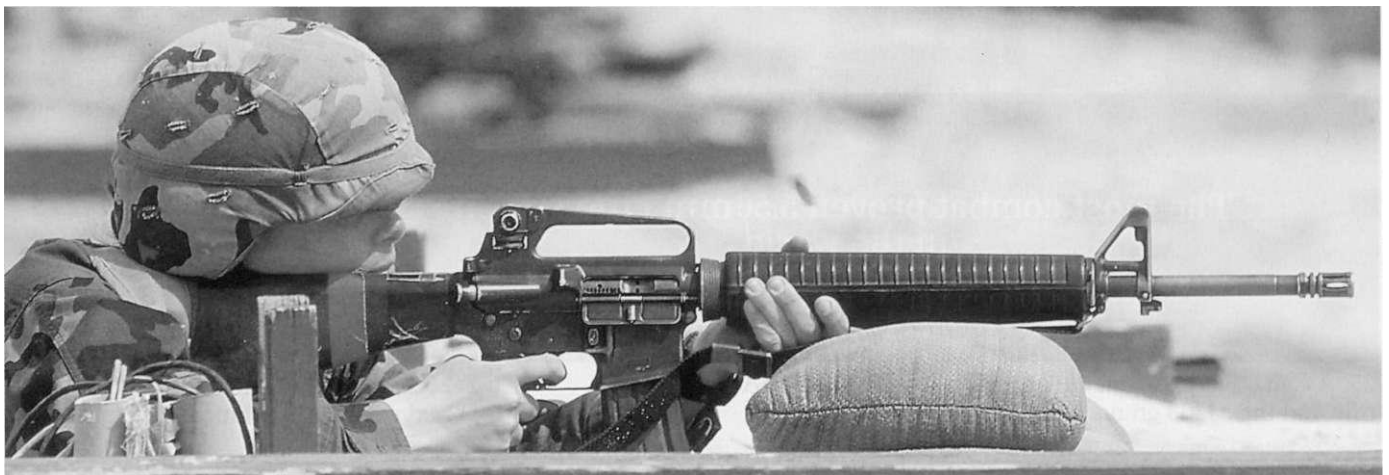
22. The cover of the Colt M16A2 Rifle Operator's Manual dated 1984.

Note the new and improved pistol grip, with the swell/finger groove in the front of the grip.


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23. Closeup of the markings on a typical US government-contract Colt M16A2 rifle.



24. US Army Basic Rifle Marksmanship (BRM) training with the M16A2 rifle.  
US Army photo



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25. A Colt advertisement circa 1985, featuring the M16A2 rifle and the M203 grenade launcher.

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Procurement of M16A1 rifles had run continuously from 1963 to 1982. On November 20, 1983 the M16A1E1 was adopted and type classified as the M16A2 rifle, and an initial quantity of 26,028 rifles was procured from Colt at the cost of \$522.65 per rifle.

A follow-on contract for 50,364 rifles for the Marine Corps was signed in June, 1984, at the cost of \$450.43 per rifle. In September, 1984 a third contract for 63,188 M16A2 rifles was awarded, for a fixed price of \$495.00 each.



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26. The Colt M16A2 family of weapons, circa 1987.

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## 20 Procurement History of the M16A2

A further contract for 116,722 M16A2 rifles was awarded for both the Army and the Marine Corps in August, 1985 with a 100% option for increased quantity, at a firm fixed price of \$455.00 each. On March 28, 1986 that option was exercised for an additional

100,176 rifles at the follow-on price of \$577.75 each, for procurement during fiscal year 1986. All M16A2 procurements through 1986 were negotiated with Colt Industries' Firearms Division, who were the mobilization base producer.

### FNMI Bids on the M16A2



27. Left side closeup of an FNMI M16A2 rifle, showing markings.  
courtesy of FN Manufacturing, Inc.

The Department of Defense (DOD) had begun looking for a new weapon to replace the aging M60 machine gun in 1979. After trials and competitive bidding the contract was won by Fabrique Nationale (FN Herstal) of Belgium, for their entry the FN MAG [*mitrailleuse à gaz*; gas-operated machine gun). Following type classification of the US version as the M240 7.62x51mm caliber machine gun, FN began work on constructing the FN Manufacturing Incorporated (FNMI) factory in Columbia, South Carolina, a 112,000 sq-ft facility employing approximately 400 people. Initial M240s were submitted for engineering tests in 1981, and the first production of US-manufactured M240 machine guns for troop issue began in 1982.

In 1988, the Department of Defense began solicitation for contractors to produce another FN design, the 5.56mm Minimi [*mini-mitrailleuse*, or mini-machine gun), known in the US as the M249

SAW (Squad Automatic Weapon), and the MK-19 40mm grenade machine gun.

On May 18, 1988, the Department of Defense issued procurement no. DAAA09-87-R-1225 for a quantity of 336,205 M16A2 rifles to be awarded on a five-year multi-year contract for competitive bidding. In keeping with government licensing agreements with Colt Industries, which prohibited the use of their proprietary technical data outside the United States and its territories, this competition was restricted to US companies which had manufactured small arms for the US government within the preceding ten years.

Two offers were received, one from Colt Industries and the other from FN Manufacturing, Inc. (FNMI). After assuring that all requirements would be met, a five-year multi-year contract, no. DAAA09-88-C-1-56, was awarded to FNMI on September 28, 1988 for 266,961 M16A2 rifles for fiscal years 1988

through 1992, at a total contract price of \$112,123,620.00 which broke down to \$420.00 per rifle. As of the year 2000, FNMI was producing

approximately 1,500 M16A2 rifles per month, and by October, 2003, FNMI had manufactured 429,766 M16A2s.

## M16A2 Military Specifications

The military specification (Mil Spec) for the M16A2 rifle is MIL-R-63997B(AR). The Mil Spec is based on the M16A2 rifle Technical Data Package (TDP), which is a comprehensive set of documents and specifications furnished to the Department of Defense for every weapon accepted for US military issue. The test weapons, four from each lot (a "lot" normally consists of 1,000 rifles, or the total number of rifles produced during the month in the factory) are selected by government inspectors at random and are each subjected to a 6,000-round endurance test.

Government inspectors examine sample rifles very closely to verify they are within all specifications as set forth. One of the most critical tests is the cyclic rate test. The minimum and maximum cyclic rates for the M16A2 rifle during the function test, using

government-issue M855 ball ammunition, are set at 700 and 900 rounds per minute.

Component interchangeability is checked, and numerous go - no-go gauges are used to inspect such parameters as bolt carrier dimensions, barrels, firing pin protrusion, the front sight group, and headspace. Trigger pull is checked to ensure that it is within the determined weight limits of between 5 1/2 and 9 1/2 pounds, and free of creep.

The rifles are all tested for accuracy. During endurance testing, set criteria are followed for cleaning and lubrication cycles, as well as what type and number of malfunctions are permissible. The acceptable malfunction criteria for the M16A2 are as follows:

### Malfunctions and Unserviceable Parts Permitted in 6,000 Rounds

Malfunction	Single Rifle	Four Rifles
Failure of bolt to lock*	2	4
Failure to fire	2	4
Failure to feed (from magazine)	4	9
Failure to eject	2	4
Failure to chamber	3	7
Failure to extract	1	2
Bolt fails/hold rear	3	8
All other malfunctions**	0	0
Total Malfunctions Combined	9	22

Unserviceable Parts	Minimum Life Rounds	Four Rifles Combined
Ejector Spring	3,000	2
Extractor Spring	2,000	1
Other Parts***	3,000	1
Total Unserviceable Parts Combined		3

\* In the event of a failure-to-lock malfunction, the forward assist will be used. Failure of forward assist to remain engaged with the bolt carrier will be considered an additional malfunction in the "other malfunctions" category.

\*\* Other malfunctions may include doubling (two rounds fired with a single pull of the trigger) during semi-auto firing, failure to stop firing when the trigger is released during auto or burst fire, etc.

\*\*\* Other parts shall be limited to trigger, disconnect, hammer springs and extractor and extractor pin.

## M16A2 Upgrade Kits



28. A typical M16A2 upgrade kit provided to the US military as it comes from the manufacturer. The contents of the kit are listed in the text below.

courtesy Anthony Harvey

In October, 1989, the Department of Defense initiated a refurbishment program to update older M16 and M16A1 rifles to the current M16A2 configuration. Some of the kits were manufactured by Colt, EMCO and FNMI, but most of them were made by Capco, Inc.

Due to costs and necessity, most of the refurbishment kits went to the Air Force and Coast Guard, while regular Army and Marine Corps units received new M16A2 rifles.

### Contents of the Upgrade Kit

The refurbishment kit consists of:

1. a complete A2 upper receiver assembly (barrel, rear sight, gas tube and handguards).
2. a new A2 (5/8" longer) buttstock assembly, butt cap spacer, and butt cap screw.
3. a new pistol grip.
4. a new fire control group (hammer, hammer spring, three-round burst cam, cam clutch spring, trigger, disconnectors (semi-auto-

only and burst), and two hammer/trigger pins).

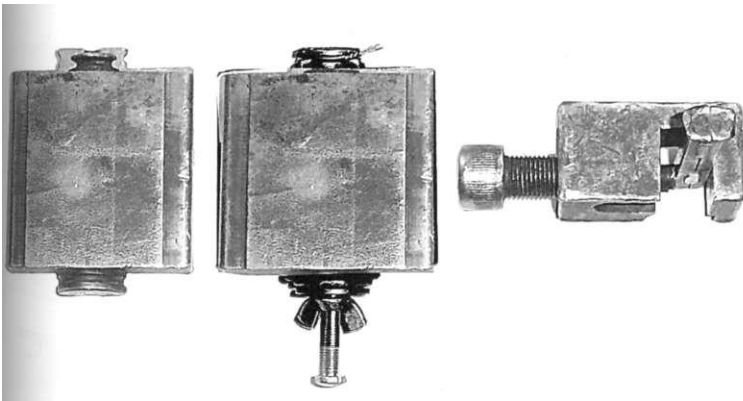
The refurbished A2 rifle keeps the original lower receiver and its extension, the charging handle, and bolt carrier group. The rest of the rifle is completely updated to the A2 configuration, with the exception of the benefits of the reinforced pivot pin and extension areas on the lower receiver.

### Re-marking the Lower Receiver

Two methods are employed to add the selector settings to the right side, change AUTO to BURST on the left, and add "A2" to the model designation on the left side of the lower receiver. The first method is

by stamping. Five metal stamps are provided (SAFE, SEMI, BURST, A2 and XXXX), along with three steel fixtures. The first fixture is a protective brace, in two halves, which are put together and inserted in the

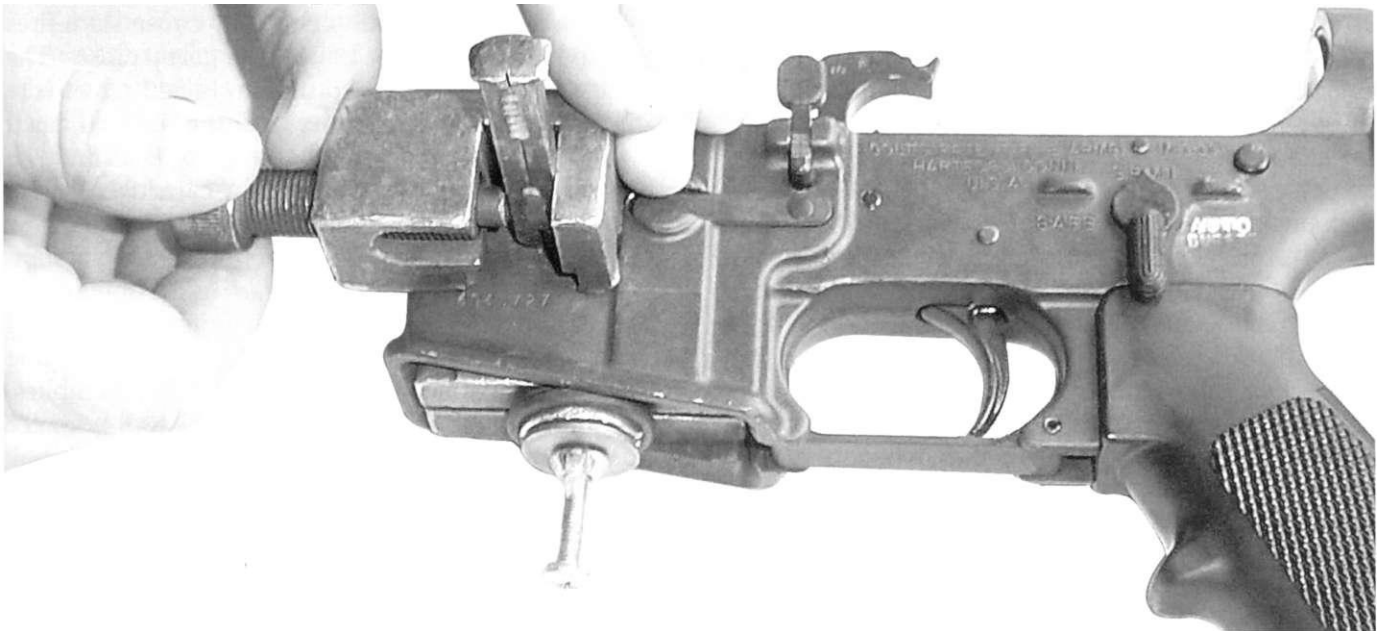




29. The two halves of the magazine well brace, left, and the "A2" punch and its positioning fixture.  
courtesy Anthony Harvey



30. The four selector marking punches, used to re-mark the selector positions on the left and right sides of the lower receiver.  
courtesy Anthony Harvey



31. With the two halves of the protective brace, above, positioned and tightened inside the magazine well, the

operator is ready to strike the "A2" punch to upgrade the receiver designation.  
courtesy Anthony Harvey



32. Right side closeup of an upgraded early rifle, showing new M16A2-style selector markings and the new selector.  
courtesy Anthony Harvey



33. Left side closeup of an upgraded early rifle, showing the "AUTO" marking Xed out and replaced with "BURST".  
courtesy Anthony Harvey

magazine well to prevent the receiver from bending when the "A2" stamp is placed next to the "M16" mark on the receiver and struck by the hammer, so that the marking will read "M16A2".

The second fixture is installed in the rear portion of the lower receiver, to serve the same purpose when the new selector setting marks are stamped in, while the final fixture holds the punches in place so they are struck squarely and in line. On the left side, the stamp with the "XXXX" is used over the original AUTO setting, and BURST is stamped in below.

Then the receiver is turned over and the SAFE, SEMI and BURST settings are stamped on the right side. After this is completed, the bright areas are touched up with black spray paint to protect the receiver from corrosion.

The second method used is laser etching, which burns the selector settings into the receivers but leaves the model marking the same. Provided the equipment is available this is the preferred method, as it is cleaner and there is less risk of damaging the lower receiver.

## **Dealing with Early (Model 01) Rifles Still in Inventory**

The biggest difficulty encountered during the retrofit program is the fact that many Air Force and Coast Guard units still have early model 01 rifles in inventory. This means that even after the upgrade kits are installed, these rifles still contain the early spring guide, early charging handle, chromed as well as phosphated smooth-sided bolt carriers, old bolts and old bolt catches, all of which were long since singled out for replacement during the numerous product improvements introduced in the 1960s and 1970s.

The old spring guides may contribute to light strikes due to bolt carrier bounce. The old bolts have proven to be not as durable because they were not shot-peened, as well as the fact that they contain the

old heavier firing pins, which may cause slam-fires due to inertia when the bolt carrier group closes. The hydrogen embrittlement problem still exists with the chrome carrier components, and the old bolt catch was found in need of strengthening to accommodate the higher cyclic rates produced by cartridges loaded with ball powder. Also the forward assist on the new A2 upper receiver will not function, as the smooth-sided bolt carriers lack the forward assist notches. So as part and parcel of the upgrade, units with these old rifles must be sure to replace the buffer, charging handle, bolt catch, and bolt carrier group assemblies, including the firing pin, and install the extractor spring buffer.

# **Fielded System Review of the M16A2 Rifle**

**Prepared by Weapon System Management Directorate, US Army Armament, Munitions, and Chemical Command, Rock Island Arsenal, IL**

In 1990, Rock Island Arsenal performed a product assessment of the M16A2 service rifle. The Fielded Systems Review was conducted to determine, from the standpoint of both users and logisticians, how the rifle was performing in the field.

Performance surveys concluded that the M16A2 did indeed perform well in the field, which was as expected, since the design intent of the M16A2 was to deal with the shortcomings of the M16A1 rifle.

One of the most frequent complaints against the M16A2 concerned the three-shot burst feature. Of the users surveyed, 27% commented negatively about the burst control, while only 9% actually favored it. Respondents stated that due to the burst feature the M16A2 provided less firepower compared to the older M16A1, with its full-automatic setting. Mechanically they disliked the burst mechanism due to the fact that it does not reset, and thus they never

knew how many shots to expect when they pulled the trigger; and the varying effect of the device on the semi-automatic trigger pull was also considered less than desirable.

Additional findings revealed a concern that the M855/M856 cartridges do not fully exploit the accuracy potential of the M16A2. These cartridges were initially designed for the M249 SAW, and were later adopted for use in the M16A2 rifle without any changes to the cartridge. The M855 bullet as manufactured is fitted with a penetrator in the tip, which can degrade the accuracy of the M16A2 rifle if it is not properly located exactly on the centerline in the bullet tip. Suggestions regarding improvements to the cartridge included more rigorous quality control, and perhaps even omitting the penetrator in favor of a thicker jacket, which might permit a two-piece bullet design which would be more accurate yet maintain good penetration.



There was also the concern that this ammunition was not compatible with existing M16A1 rifles. Operation Desert Shield was under way during this review, and it was found that soldiers armed with M16A1s with their slower 1:12" rifling twist were assigned to units equipped with the newer M16A2 with its faster 1:7" twist, and being issued with M855/M856 ammunition. It was concluded that maldistribution of ammunition during combat can be expected to result in the use of M855/M856 ammunition in M16A1 rifles, and that this problem will continue as long as the Army is equipped with two rifles which cannot fire all available cartridges without a mutual loss of effectiveness.

In the overall view, however, the M16A2 had been very well received, and no mission-stopping system problems were identified by the review.

The M855 cartridge has been a problem for the M16A2 rifle from the beginning. The SS109 cartridge was developed by FN for use in the Minimi M249

Squad Automatic Weapon for long range and improved penetration. After this cartridge was adopted by NATO, the M16A2 was designed to fire it. Due to manufacturing problems, the construction of the projectile with the penetrator core always hindered the accuracy of the M16A2. The M16A2 often would not meet government accuracy requirements due to the ammunition, not the rifle; so at the direction of the government, all accuracy acceptance testing at Colt's was done with the M193 Ball cartridge instead of the M855 cartridge.

Over the intervening years the quality of the M855 cartridge has improved, but this round is still the source of problems in the M16A2/M16A3/M16A4 and M4/M4A1. It is thought that switching to a standard 62-grain full metal jacket bullet without the penetrator core would increase the accuracy significantly with the M16 weapon system, but this would not conform to NATO specifications.

## The Critics Attack the M16A2's "Improvements"

### The Mellonics Report

A report titled "An Analysis of M16A2 Rifle Characteristics and Recommended Improvements" was prepared by Arthur D. Osborne of the Mellonics Systems Development Division of Litton Systems, Inc. This report was submitted by Seward Smith, Chief of the US Army Research Institute for the Behavioral and Social Sciences, Fort Benning Field Unit, in May, 1983.

The preamble states that the M16A2 rifle was developed jointly by the Marine Corps and Colt, and that when the Army adopted it, they made no modifications. The study then predicts that while the M16A2 did correct the major shortcomings of the M16A1, and that it met or exceeded all Marine Corps criteria, several of the new features would become problematic for the US Army.

According to the report, the M16A2 sighting system is too complex. Designed for the Marine Corps, whose marksmanship training consists of engaging known-distance targets beyond 300 meters, the elevation on the rear sight of the M16A2 is adjustable from 300 to 800 meters. In contrast, the Army "Trainfire" system teaches its recruits to engage random pop-up silhouette targets at ranges of from 25 to 300 meters without sight adjustment. In order to simulate actual combat target engagement the distance, as well as the length of time each target

remains exposed, are randomly selected, the soldiers being trained to scan the field of fire and to implement different shooting techniques.

The Army favors this marksmanship approach over the Marines' preference for long-range known-distance shooting because in combat the shooter will not know the exact distance to each target, and thus he will have no precise aiming point. The targets blend with the background and must be detected before they are engaged, and are exposed for randomly short periods of time. In addition, multiple targets may pop up at the same time. Under these conditions weapon zero cannot be confirmed, and the effects of wind and gravity cannot easily be observed.

All these considerations do not indicate which approach to marksmanship training is better, but an obvious conclusion is that Army and Marine Corps rifle requirements may be very different. Studies indicate that soldiers will not reliably engage targets beyond 300 meters in ideal conditions. The rear sight used on the M16A1, which could effectively engage human silhouette targets out to 500 meters, is perhaps more practical for Army combat use than the Marine Corps' target-style adjustable sight.

The Mellonics study recommended the development of a fixed-blade front sight and a single-ap-

erture rear sight with windage adjustment at the rear of the sight and elevation to the right, with the inclusion of luminous dots to aid in low-light firing conditions.

An additional criticism of the M16A2 rear sight was that it does not have a setting for battlesight zero, i.e. 250 meters. This study also concluded that the 5mm short range aperture was too large for use from 0 - 200 meters (even though USMC tests using the 5mm aperture in the qualification course have shown no degradation in accuracy), and that the 1.75mm aperture is probably too small to engage targets from 300 to 800 meters.

Perhaps the single most controversial change to the M16A2 remained the adoption of the three-round burst mechanism. Again, one reason the M16 rifle was adopted during the Vietnam War was that American soldiers felt outgunned by the North Vietnamese Army and Viet Cong soldiers equipped with intermediate caliber, selective-fire AK47 assault rifles. Survival in an ambush situation is often determined by who lays down the greatest volume of fire in the shortest amount of time, and After Action reports from Vietnam showed that soldiers were more likely to return fire during ambushes with automatic rather than single-shot fire. An additional factor is that individual targets are extremely difficult to detect in jungle environments, so fire—preferably full-automatic fire—is directed into the enemy's general area.

Additional testing showed that three rounds may not be the optimal burst size. In the majority of holding positions utilizing bipod-supported automatic fire of up to five and ten round bursts, the third round will many times find the limit of the group size, with subsequent rounds moving back in toward and around the initial aiming point. Therefore increased hit probability may result from five- or even six-round bursts.

Rifle	Ammunition	Start
M16A1	M193	19.03
M16A1E1	XM855	27.43

The Marines had noted that, upon completion of the test, a standard barrel straightness gauge passed though 29 of the 30 M16A1 barrels, but would not pass through 14 of the 30 M16A1E1 barrels. An investigation revealed that the offending barrels were straight enough, but that each contained sufficient jacket metal and powder fouling to stop the gauge.

Additionally, it was confirmed that the M16A2 "heavy barrel" is indeed heavy in the wrong place.

According to the Mellonics report, two main arguments had initially been put forward to support the adoption of the three-round burst mechanism over standard full-automatic fire: increased hit probability, and conservation of ammunition. Studies conducted for this report concluded that burst control did not result in increased hit probability, and as for ammunition conservation, firing a full magazine in one burst of automatic fire will expend all thirty rounds in less than 2.5 seconds, while ten three-round bursts can result in the expenditure of all thirty rounds in five seconds, showing that the difference in the elapsed time of these two modes of fire is very small. Additionally, during close-quarter fighting automatic fire can be used as a very effective means for walking fire onto a target, or to quickly saturate an area with fire, whereas the burst limiter greatly decreases speed and accuracy. The conclusion was that improved automatic fire training is probably a better solution than limiting the effectiveness of the rifleman mechanically.

The M16A2 barrel with its fast 1 turn in 7" rifling twist was another area singled out in the Mellonics report. As noted, this fast twist had been adopted to stabilize the long M856 tracer projectile in the FN M249 SAW. Concerns arose that in the M16A2, this fast twist would hinder accuracy, decrease barrel life, and adversely affect the terminal ballistics of the projectile. According to the report, a somewhat slower 1 turn in 9" twist would be the optimum, and would increase barrel life while improving accuracy and terminal performance.

The Marines had conducted only a limited 6,000-round endurance and accuracy trial with their prototype M16A1E1s, and the poor results turned in by the PIP rifles were largely attributed to "growing pains" in the fledgling XM855 ammunition production program. However, even these limited results were sobering to contemplate:

Group Extreme Spread (cm)		
3,600 rounds		6,000 rounds
	18.73	17.73
	31.23	62.23

Other than the permanent bending caused by parachute jumping and abusing the rifle by using it as a pry bar, the report asserted that the main problem with the M16A1 barrel was *temporary* bending, due to stresses imposed during certain firing positions which caused bullet strike to vary. For example, the difference between a bipod firing position and a position using a hasty sling will change the bullet strike at 300 meters by three or four feet or more. This

"bending" takes place between the receiver and the sling swivel/bayonet stud, whereas the M16A2 barrel is "heavy" only from the sling swivel to the muzzle, where it can have no effect on the problem.

Furthermore, according to the Mellonics report, the stock length should not have been increased by 5/8 of an inch, because many soldiers could no longer position their eye close enough to the rear sight, and the stock made the rifle too long to fire comfortably when wearing load-bearing (web) gear and flak vests.

It was felt that the new stock was only appropriate for males firing at known-distant targets, and it was suggested that an adjustable stock be considered.

The report singled out both magazine reliability and trigger pull as needful of improvement. Many M16 rifles were found to have hard, creepy trigger pulls, while the ideal was a clean, crisp break.

Finally, it was suggested that rubber plugs or bands be provided to protect the magazine well and other potential entry points from dust, dirt and sand.

## Controversy—On Both Sides of the Fence

The Mellonics report was considered controversial by both the Army and the Marine Corps. Many on the Army side felt that the government was wasting money procuring an expensive and complex rear sight which they did not train their soldiers to use. However, Colt had merely produced exactly what the Marine Corps had requested of them, and the end product exceeded the Marine specifications.

In contrast, many critics claimed that the Canadian government had chosen the best all-round rifle design with which to equip their soldiers. The C7

rifle, manufactured by Diemaco, Inc. under licence from Colt's, addressed many of the criticisms mentioned in the Mellonics report. As discussed further in Chapter Eight, the Canadian rifle followed the basic M16A2 design, but retained the practical M16A1-style rear sight as well as the full-automatic setting rather than a burst mechanism. Also, in keeping with a long-standing tradition in the Canadian military, spacers are available so that the stock length of each rifle can be "tailored" to fit the individual soldier.

## Summing Up the M16A2

Notwithstanding the problems and shortcomings discussed above, the M16A2 has served with distinction in Operations Desert Shield/Desert Storm, as well as Operation Just Cause (Panama) and in Somalia, Bosnia, and Afghanistan during Operation Enduring Freedom and in Iraq during Operation Iraqi Freedom. As of this writing it is still in use with American troops serving in Afghanistan and Iraq.

Although officially being phased out and replaced by the M16A4 (flat-top) rifle as well as M4/M4A1 carbines, the M16A2 will remain in service within the US military for many years to come.

34 (right). Lance Corporal Carmelo Magidin (left) and Corporal Eric Gonzales (right) of the 3rd Marine Division, in Saudi Arabia prior to going on patrol in January, 1991.

The M16A2 served with distinction during Operations Desert Shield and Desert Storm. As of this writing it is still in use with American troops serving in Afghanistan and Iraq.

courtesy Eric Gonzales



## *Chapter Two*

# Colt's Advanced Combat Rifle (ACR)

## The Forerunner: Colt's Enhanced Rifle (M16A2E1)



35. Right side view of Colt's Enhanced Rifle (Model R0645E), the predecessor of the Colt ACR rifle developed for the Advanced Combat Rifle program.

Note the flat-top upper receiver. The concept of a removable carrying handle was first implemented on this rifle. courtesy C. Reed Knight III

**B**y the time the M16A2 had been adopted as Standard 'A' on November 20, 1983, the US military had already begun searching for the next generation M16 rifle—the "Future Rifle"—in a project spearheaded by Picatinny Arsenal. The primary objective was to design an integral rail-type "Universal Mount" on top of the receiver (which was also supposed to include the then-current M16A2 adjustable rear sight), onto which could be attached a scope or any other kind of optic sight. The lower receiver would remain in the standard M16A2 configuration.

The new weapon was given the name "M16A2 Enhanced Rifle" (M16A2E1) in April, 1984. The design responsibility for the new upper receiver fell to Colt's senior engineer Henry Tatro, who had already had experience in flat-top upper receiver development within other projects, which included the M16A1 Special High Profile (Colt Model R0655) and Special Low Profile (Model R0656) sniper rifles. The basic forging die was altered to produce upper re-

ceiver forgings for the experimental development of the flat-top upper receiver.

It was envisaged that the Enhanced Rifle would utilize a flip-up emergency iron back-up rear sight and a folding front sight, and that a removable carrying handle would be provided which would embody the micro-adjustable M16A2 rear sight assembly.

The final version of the M16A2 Enhanced Rifle was delivered to the Army in April, 1985. Very little documentation remains on exactly when this project began or when it ended, although the M16A2 Enhanced Rifle is significant in that many of its design features were carried over to Colt's entry in the Advanced Combat Rifle (ACR) program.

The M16A2 Enhanced Rifle was the first rifle to use a detachable carrying handle on the flat-top upper receiver, and while the dimensioning of these components was different, they are identical in concept to those fitted to the current M4/M4A1 and M16A4 rifles and carbines.

30 The Forerunner: Colt's Enhanced Rifle (M16A2E1)

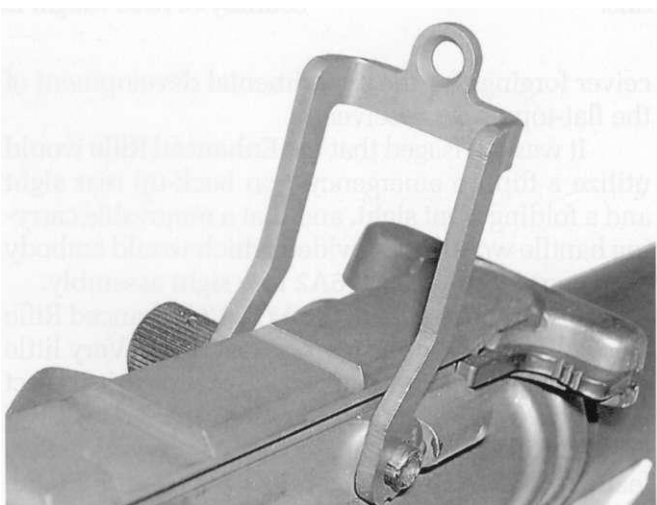


36. Right side closeup of the Colt M16A2 (M16A2E1) Enhanced Rifle.

Note the detachable carrying handle with A2-style rear

sight, and the back-up flip-up sight, folded down and stowed under the carrying handle.

courtesy C. Reed Knight III



37. Left front three-quarter closeup of the Colt-designed emergency back-up rear sight used on the M16A2 (M16A2E1) Enhanced Rifle. This folded down as shown above when not in use, and was adjustable for windage by means of the dial drum on the right side.

courtesy C. Reed Knight III

38 (below). Right side closeup of the folding front sight of the M16A2 Enhanced Rifle, which is very similar to the one used on the Mk12 MOD 0 rifle (Chapter Three).

courtesy C. Reed Knight III



# The ACR Program

## A Program Overview

Throughout the last half of the 20th century, the US Department of Defense initiated several programs aimed at replacing the M16 series rifles altogether with a new design, but as it turned out none of these was successful in producing a weapon capable of doing the job.

When the AR-15/M16 was first adopted during the early 1960s, it was considered merely an interim weapon while development of the futuristic, flechette- and grenade-firing Special Purpose Individual Weapon (SPIW) was under way. At that time it was confidently predicted that the SPIW would be classified Standard 'A' by June of 1965. Despite a great deal of costly effort, however, the SPIW concept was never perfected, nor did the program produce a weapon good enough to replace the M16.

Twenty years later, during the period 1986 to 1990, the Department of the Army tried again, by funding the Advanced Combat Rifle (ACR), or Advanced Individual Weapon System (AIWS) program.

The Armament Research, Development and Engineering Center (ARDEC) at Picatinny Arsenal, New Jersey was chosen to spearhead the ACR program, which concluded with a very well-documented and unprecedentedly thorough real-time analysis of how soldiers aim and shoot when subjected to combat-type stress.

It had been a hard but valuable lesson to learn that, due to the high levels of stress, fatigue and fear experienced during actual combat engagements, soldiers will not shoot as well as they were trained to shoot. The objective of the ACR program was to replace the M16A1, and the then-newly-adopted M16A2, with a new rifle which would increase both hit probability and combat effectiveness by 100%.

A brief description of the test facility developed for the ACR field experiment is quoted from the ACR Program Summary, a nine-chapter ARDEC document with three appendices, as follows:

*. Buckner Range was converted into a unique highly instrumented live fire test facility to compare the performance of four ACR concepts against the US military's standard M16A2 rifle. Target location and firer behaviour have been designed to stress the shooter and replicate aiming errors experienced in combat. Unisys Corp., of Huntsville, AL, designed and installed the Fort Benning, GA, range to meet the requirements . . . The two lanes of equipment and instrumentation are run independently by a computer-controlled test system consisting of instrumented fixed and moving target mechanisms. Range control data acquisition hardware and software are used for the acquisition, storage, processing and display of firing data from user-programmable scenarios. The computer system collects such data as target hits, time of all events, target miss locations and even soldier heart rates. Hit-sensitive targets, both stationary and moving, are emplaced in the natural terrain from 25 to 600 meters . . .*

While the emphasis for the purpose of this book is naturally on the Colt ACR candidate, the following further excerpts from the ACR Program Summary are quoted here to briefly describe the scope of the program and present some interesting details concerning the conduct of the program itself and the physical weapon and ammunition characteristics of the other competing entries:

### Introduction

*In April 1980 the United States Congress House Armed Services Committee requested that the Joint Service Small Arms Program (JSSAP) office conduct a study of the current combat rifle. This study concluded that the current rifle, the M16A1, met all the US Armed Forces needs but possible improvements to it should be investigated. A series of improvements have since led to the M16A2 and M16A3 rifles. For the long term, the study concluded that the technology base should be developed to support a significant improvement in capability. Revolutionary improvements in capability were envisioned to be well beyond the year 2000, leaving the opportunity for a significantly improved combat rifle in the mid-1990 time frame.*

*. . . The ACR Operational and Organizational Plan (O&O) was approved in January, 1985*

*The ACR effort caused weapon concepts to be developed under contract and prototype hardware to be produced and evaluated with troops in a field experiment . . . The program was concluded upon completion of the field experiment in 1990. The program has significantly advanced the state-of-the-art in rifle technology and will form the basis of any future individual weapon requirement.*

### **Description of Systems**

*Concepts were developed under contract to improve the soldier's hit performance in combat. Under the stress of combat where there are multiple targets, moving targets, and targets that are mostly obscured and exposed for short amounts of time, the soldier's performance is degraded. When the soldier does engage these targets, he does so hurriedly and with large aiming errors. The weapon concepts were developed to fire more than one projectile per trigger pull. The dispersion of this burst of projectiles was controlled to compensate for the soldier's aiming error.*

*. . . The technical challenge in the design of an ACR concept was to compensate for or reduce these large aiming errors. Analysis has shown that for these aiming errors, if a salvo of three projectiles is fired at a target the probability of at least one hitting the target could be increased on the order of 100%. There are two types of salvo launches. A true salvo system launches multiple projectiles at one time. The projectiles are distributed about the point of aim [and] a burst extreme spread of 6 mils is optimal for this system for the aiming errors assumed . . . The other multiple launch systems are those that launch the projectiles serially, or one behind the other . . . These can be in the form of a duplex cartridge like that developed for the Colt system, or they can be a burst of more than one round. Optimum burst extreme spread for these systems is 8 mils. This will also result in a 100% increase in hit probability over the stressed hit curve . . .*

### **History**

*The technology base efforts that were initiated in the early 1980s as a result of the Combat Rifle Study focused on the potential of salvo weapons, caseless ammunition, and optic sights. Requests for proposals to develop and demonstrate such systems were released. In 1982 the Under Secretary of the Army endorsed a potential 10-12 year rifle development program .*

*In September 1982 contracts were awarded to AAI Corporation and Heckler & Koch, Inc. [for development of a caseless weapon system prior to the Advanced Combat Rifle Program's elevation to program status] . . .*

*During the next few years the Under Secretary continued to press for an accelerated program with additional industry involvement . . .*

*In 1984 - 1985 industry conferences were held at ARDEC and Fort Benning to detail the needs and goals of the program. Shortly thereafter, contracts were competitively awarded to AAI, ARES, Colt, McDonnell Douglas, and Steyr . . . These efforts called for the development and fabrication of the proposed rifle systems for evaluation in government tests. The contracts were phased, with no commitment on the part of the government to proceed into the next phase.*

## **ACR Candidates - Weapon Summaries**

### **The Two "Drop-Outs": from ARES and McDonnell Douglas**

Both the ARES and McDonnell Douglas contracts were terminated before the final ACR field experiment took place, due to "lack of maturity" of their systems.

Nevertheless, both these developments were extremely interesting and represented some novel approaches to the problems under consideration, and for this reason a brief description of both these "also-ran" contenders is included, as follows:

***ARES: Industry Alternative Contract #DAAA21-86-C-0363***

39. Left side view of a wooden mock-up of the bullpup Phase I ARES weapon, with drum magazine fitted and bipod open. . . . . courtesy Gary Paul Johnston

***Background***

*ARES was one of the two contractors terminated prior to the ACR field trials. Contractually, there were no problems with the ARES contract. This effort was adequately funded throughout its existence. During the proposal evaluation phase, this had been the highest rated concept proposal . . . Unfortunately, there were apparently subtle conceptual problems which prevented the concept from being acceptably demonstrated in a timely fashion . . . The basic nature of the problem was that the weapon concept called for plastic [cartridge] cases for reduced weight. Being plastic, with insufficient stiffness relative to brass, the round tended to compress under the bolt forces, resulting in misfires. Attempts to solve this problem, which was not apparent as a critical conceptual defect until very near the time of demonstration, were determined to be insufficiently effective to warrant the risk of a failed development if the contractor were allowed to proceed further into the hardware production phase.*

***Weapon***

*The ARES ACR is a bullpup design incorporating a novel rising chamber mechanism. The weapon fires from the quasi-open bolt. With an exception being after the last round in the magazine has been fired, there is always a round in the rising chamber block, even when the weapon is out of battery. This feature could possibly represent a major deficiency, especially in an overheated weapon where a cook-off might occur. Admittedly, with a plastic-cased, telescoped projectile and a chamber which is not constantly in contact with the hot barrel, there is a greatly reduced opportunity for a cook-off to occur.*

*A demonstration was held at the end of the Phase I effort during which all participants who had fired the weapon stated that it was exceptionally easily controlled. This is partially a testimonial to the efficiency of the ARES muzzle device. However, the ammunition at that time was low in both velocity and pressure [and] there is some indication that the rising chamber mechanism does not provide the normal "jerk" to the weapon. This movement, traditionally caused by the bolt slamming home in open-bolt mechanisms, tends to decrease the ability to accurately fire in the semi-auto mode . . .*

*The ARES 60-round drum magazine offers the soldier almost a doubling of firepower between reloads, but the trade-offs include a bulky magazine which might interfere with the shooter in certain positions and a somewhat higher degree of magazine complexity, cost, and malfunction opportunity. The original magazine design had a gun-driven plastic tape, which was objectionable in that it trailed and might catch on bushes or other objects. ARES changed the design to a gun-driven linked belt . . .*



## 34 ACR Candidates - Weapon Summaries



40. Right side view of the bullpup Phase II ARES weapon, fitted with the normal trigger guard.

Note the configuration of the magazine, and the three rounds of plastic-cased tracer ammunition (right) in disintegrating links.  
courtesy Gary Paul Johnston



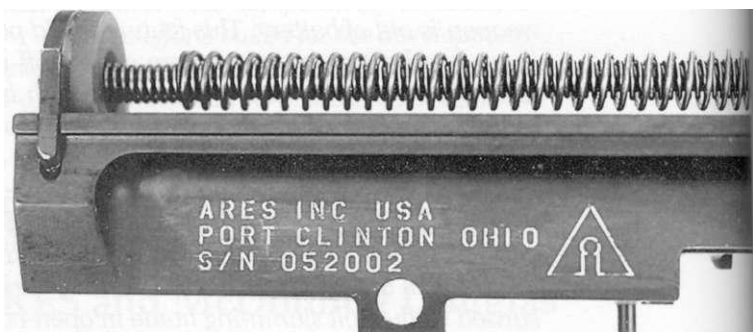
41. Right side view of the Phase II ARES weapon, serial no. 052001, shown partially stripped.  
Note the winter trigger guard.

courtesy Gary Paul Johnston

*The primary feature of this system resides not in the hardware, but in the proposed method of weapon employment; that is, the "closed loop fire control" tactic. The basis of this tactic is that the shooter employs the visual feedback offered by a visible tracer stream to alter the aim point of his weapon, thereby improving his probability of hit performance.*

### **Ammunition**

*ARES ACR ammunition is 100% traced. The projectile is fully telescoped within a plastic case of GTX-910 material, with a brass battery cup and primer. There is a plastic end cap which is ultrasonically welded to the case body for waterproofing and anti-tampering purposes. The plastic case has internal fins to serve the dual pur-*



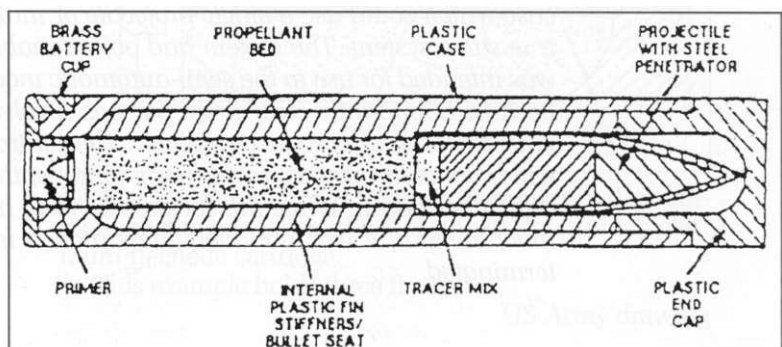
42. Right side closeup of the second Phase II ARES weapon, serial no. 052002, showing markings.

courtesy Gary Paul Johnston



MUZZLE VELOCITY.....3150 ft/sec  
SEMI AUTO  
FULL AUTO .....560 rnds/min  
AMMUNITION  
TYPE .....5mm plastic cased  
telescoped  
BULLET.....45 grain- traced  
PROPELLANT.....Ball type-25 grains  
CARTRIDGE WT.....109 grains

poses of keeping the projectile centered within the case body and act as a projectile seat. The remaining volume is occupied by the propellant charge [and] the case head, made of the same GTX-910, is pre-scored for projectile exit.



44 (right). Fig. B6 from the ACR Program Summary, a diagrammatic sectioned view of the ARES cartridge. All rounds were intended to be traced. US Army drawing

## 36 ACR Candidates - Weapon Summaries

*The projectile itself is 5mm [in diameter] and has a 45 grain total weight. It has a steel penetrator, hacked by consolidated lead wire and two grains of pyrotechnic mix. The projectile is encased in a gilding copper jacket. The tracer burns out between 300 and 400 meters.*

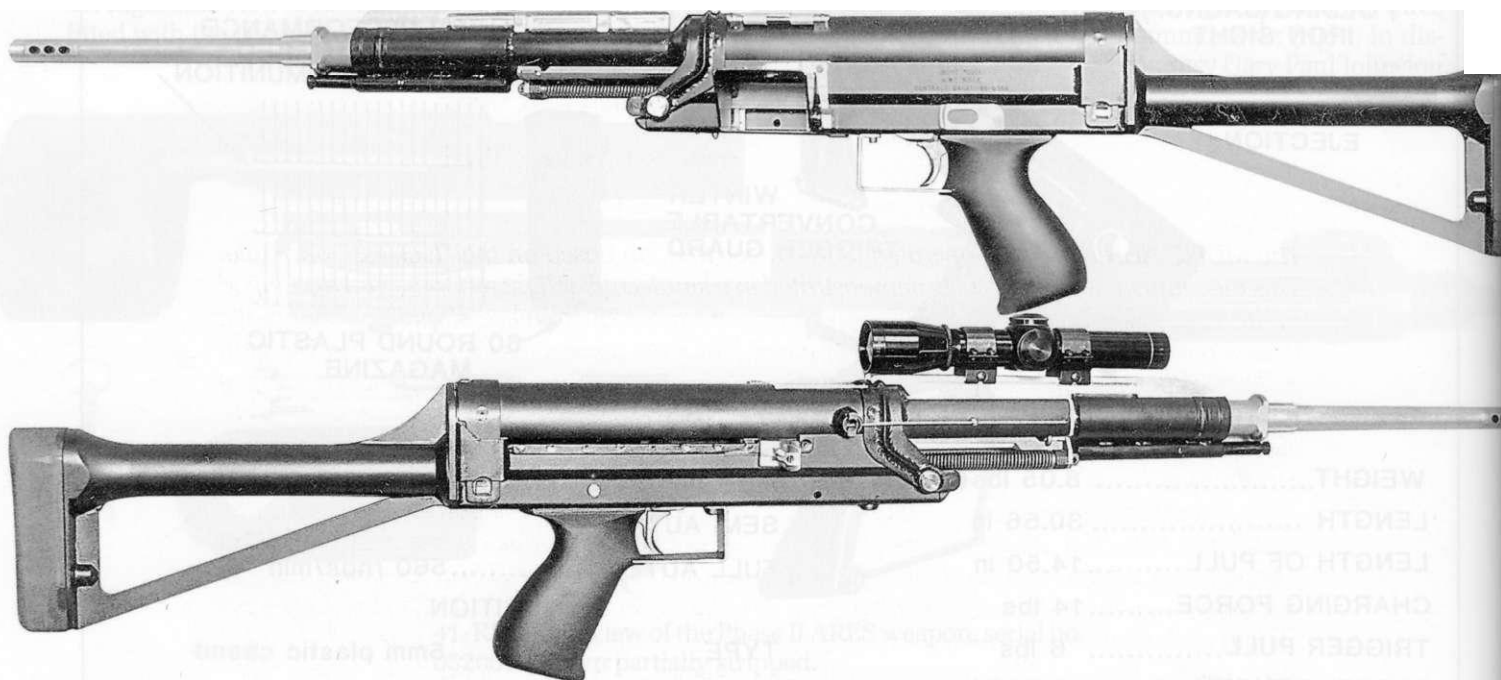
*The ammunition has a limited effective range and does not currently meet the criterion of dual use in both the ACR and a follow-on light machine gun . . .*

*The ARES round, at 111 grains, weighs 60% of the 185-grain M855. This may be regarded to be a major combat load improvement for the individual soldier.*

### **Summary**

*In summary, the ARES ACR, had it continued in development, was to have an unproven tactical use and the potential for a failure with a live round chambered in the out-of-battery position. This is considered to represent a greater than negligible safety hazard to the shooter. The closed loop fire control tactic proposed by ARES could not be demonstrated.*

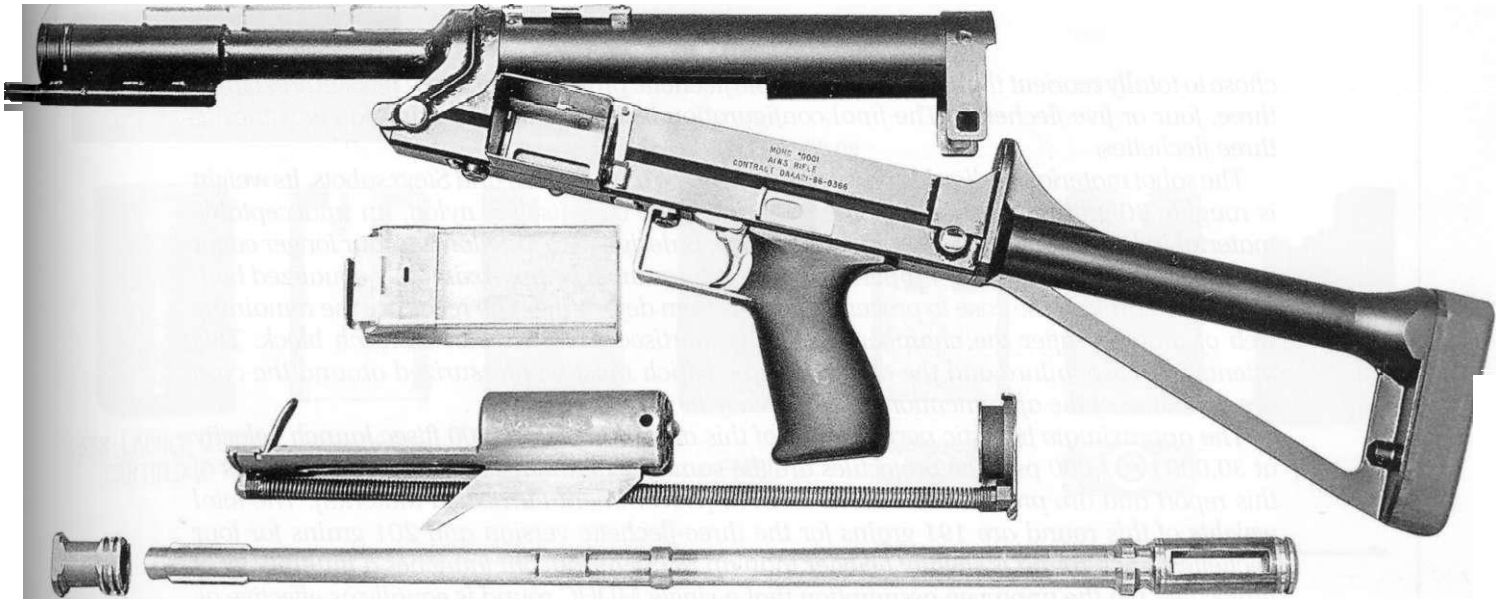
### **McDonnell Douglas: Industry Alternative Contract #DAAA21-86-C-0366**



45. Left and right side views of the McDonnell Douglas AIWS rifle, serial no. 0001. courtesy L. James Sullivan

### **Background**

McDonnell Douglas Helicopter Company (MDHC) was the second contractor concept terminated for inability to demonstrate the system in a timely fashion. Unlike ARES, this concept was further behind in development status with numerous inherent problems that became obvious during the course of development. The concept was designed around a flat cylindrical case which could use a single projectile or multiple projectiles for the desired salvo effect. A true salvo system. The system had objectionably high recoil and was the sole system which was intended for use in the semi-automatic mode of fire only. At the time of demonstration, it became abundantly clear to all persons involved that this concept was simply not ready to enter the program production phase. The contract was well-funded for the original intent, but when the contractor met with early failures, the system concept was altered, and financial difficulties began. While this lockless concept has been successfully demonstrated as a light machine gun, it was not adequately proven in the assault rifle version and the effort was terminated.



46. Right side view of the McDonnell Douglas AIWS serial no. 0001, shown partially stripped.

courtesy L. James Sullivan

### Weapon

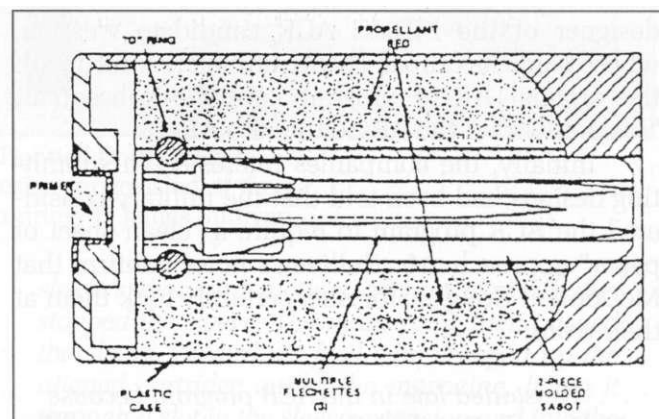
The MDHC ACR is a recoil-operated .338 caliber weapon based on the "lockless" principle. This mechanism was previously demonstrated in a small caliber light machine gun developed in the 1970s. The barrel and breech are produced from a single piece of material where the breech is separated from the barrel by a mortise slot. This slot acts as the chamber of the gun. A sleeve slides over this mortise slot to seal the chamber and is retracted to permit feeding of the next round. During the course of feeding, the new "live" round ejects the prior round; either an expended round or a misfire. A muzzle device is incorporated into this rifle to help reduce recoil.

The magazine has a capacity of ten rounds, protrudes from the weapon side like a handle, and is positioned immediately under the chamber. Ejection for this reason is upward. The weapon is long, has a shotgun-type sight rib and should point quite well in quick-fire situations.

This entire effort represents a change from the system developed by MDHC in the first phase of their ACR contract. As such, the design was not fabricated for the first time until the end of May, 1988. It was insufficiently mature for the purposes of demonstration in the field trials.

### Ammunition

The MDHC ammunition is a "chiclet"-shaped rectangular solid. The projectile package sits in the center of the longest dimension directly in front of the primer. The case is plastic and the inserted primer is of standard brass construction. Propellant is charged into the cavity on either side of the projectile package and gases from the burning propellant are vented into the central cavity by means of ports, which are exposed as the sabot passes by. The round is extremely inefficient, requiring a charge weight of 90 grains of propellant to launch a projectile weight of 70 grains. The original projectile package under development was multiple bullets (duplex and triplex), similar to the Colt duplex round. The recoil impulse from this massive projectile package was unacceptably high. MDHC then



47. Fig. B9 from the ACR Program Summary, a diagrammatic sectioned view of the McDonnell Douglas "chiclet" multi-flechette cartridge.

This example holds three flechettes.

US Army drawing

*chose to totally reorient their effort to a multiple flechette projectile package consisting of either three, four or five flechettes. The final configuration before contract termination was that of three flechettes.*

*The sabot material is a liquid crystal polymeric type as in the AAI and Steyr sabots. Its weight is roughly 30 grains. Temporarily, the material of the case itself is nylon, an unacceptable material in later stages of development. The case is designed to fail along its four longer edges because the case is not fully supported and pressures must be approximately equalized both within and around the case to prevent the reeds from deforming. The reeds are the remaining web of material after the chamber volume is mortised from the barrel/breech block. This intentional case failure and the added volume which must be pressurized around the case are the cause of the aforementioned inefficiency in round design.*

*The approximate ballistic performance of this ammunition is 4,700 ft/sec launch velocity at 30,000 to 37,000 psi. The projectiles are the same flechettes discussed in other sections of this report and are provided to MDHC as GFM [Government Furnished Material]. The total weights of this round are 191 grains for the three-flechette version and 201 grains for four flechettes. Each round is slightly heavier than an M855 round, but launches a multiplicity of projectiles. On the unproven assumption that a single MDHC round is equally as effective as three or four M855 rounds, this design might represent a very substantial weight savings to the soldier . . .*

#### **Summary**

*The switch from a multiple bullet approach to a multiple flechette approach had cost MDHC a substantial amount of time . . . Remaining identified problems included launch reliability and dispersion. The multiple flechette approach has the inherent problem that, in past similar efforts, none of the flechettes go to point of aim. This is not a problem where the aim error is high; but in the relatively low aiming error in longer range engagements, this system would likely exhibit extremely poor hit probability performance . . . Assuming that the hit performance improvements could be obtained from this system, then it would perform extremely well in the other measure of effectiveness, expected casualties per combat load. This is based upon the fact that one round takes the place of a multiplicity of rounds in any other system . . .*

## **Further Notes on the McDonnell Douglas AIWS**

**(December, 1987 - June, 1988)**

The following interesting information has been excerpted from a letter to the editor from the noted independent firearms designer L. James Sullivan, the designer of the MDHC ACR candidate weapon, whose name has already been intimately linked with the original AR-10 program and the subsequent "scale-down" of the AR-10 into the AR-15.

Initially, the companies interested in submitting designs had been told that the military considered the ACR program to require a "clean sheet of paper" approach. Mr. Sullivan's notes confirm that McDonnell Douglas, for one, certainly took them at their word:

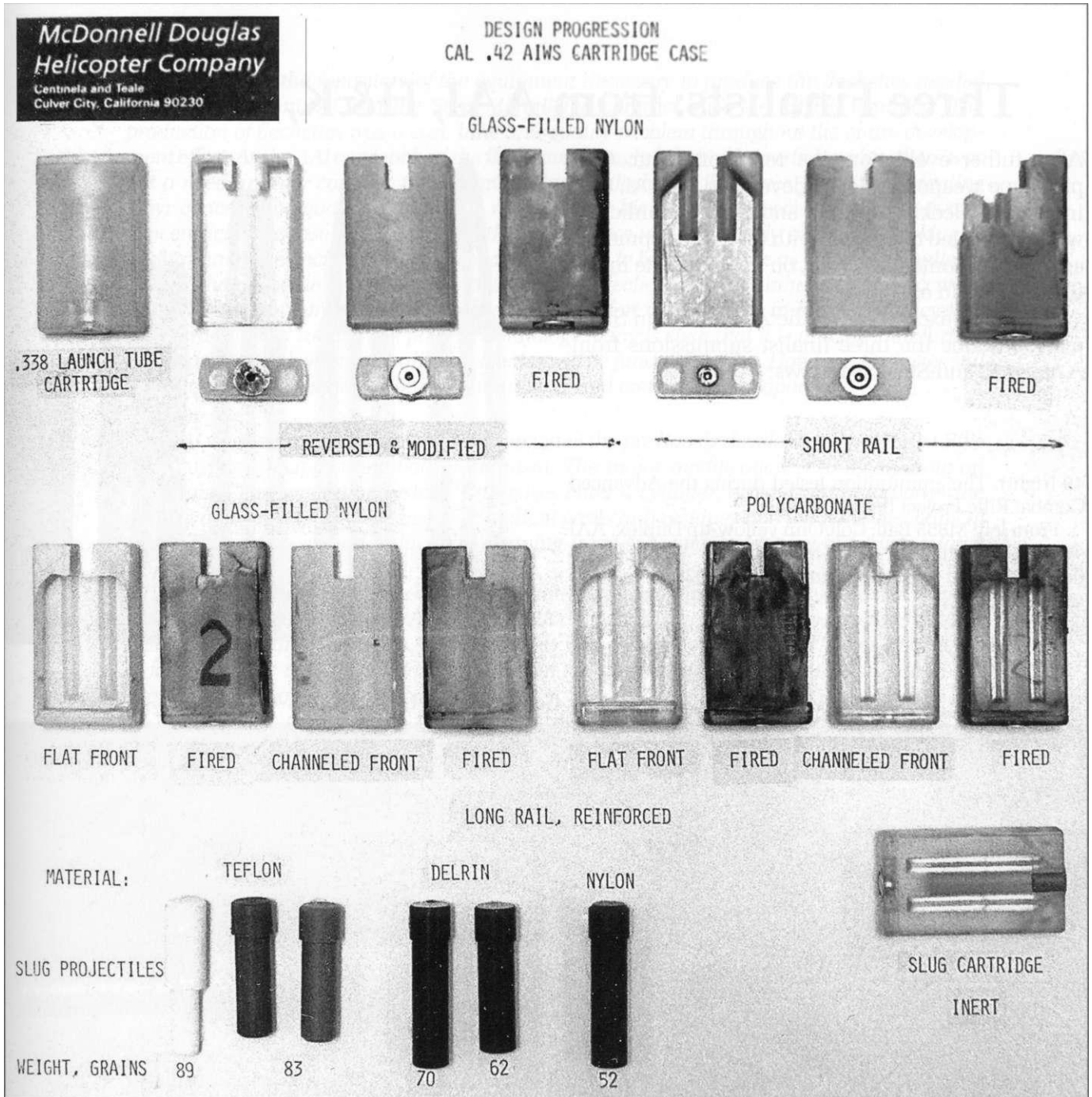
*. . . We started late in the ACR program because McDonnell Douglas' first proposal was turned down, as was Stoner's ARES proposal (for an almost conventional automatic rifle firing 100% tracer). ARES and McDonnell Douglas cried foul, and got funded, but there was only six months left to deliver . . .*

*The Army's declared goal was to double the hit probability of the M16. McDonnell Douglas wanted to use their proprietary (Hughes) lockless telescoped plastic case. We decided not to go the full-auto route but to fire five flechettes per shot using a four-piece puller sabot, and fire semi-auto only from a 10-shot magazine. This way the rifleman could easily stay on target and fire 50 projectiles in the same time a full-auto M16 fires 30.*

*The flat-sided rectangular cartridge fits in a rectangular chamber cut through the sides of the barrel near the breech. It is sealed by piston rings fore and aft of the chamber and by a sleeve that slides over the chamber. When the sleeve is withdrawn the cartridge case in the chamber can be pushed out one side and a fresh cartridge pushed into the chamber from the opposite side.*

*The gun was recoil-operated. The barrel and sleeve recoiled together for a short distance until chamber pressure dropped. Then a strong spring stopped and returned the barrel to its forward*





48. A display chart from the McDonnell Douglas Helicopter Company, illustrating the design progression of their .42 caliber AIWS cartridge. courtesy L. James Sullivan

position while the sleeve with its ejector and feed cam blade continued rearward, uncovering the cartridge in the magazine, which moved inward from mag spring force and stopped against a surface that aligned it with the barrel chamber above it

As the sleeve approached its full rear position a leg on the ejector hit an actuator that caused the ejector to swing upward through the chamber, ejecting the fired cartridge case up and out through an ejection port. The hammer was cocked by the

sleeve's rearward motion, and an elastic buffer stopped the sleeve. The mainspring then pushed the sleeve forward, its feed cam scooped up the aligned cartridge out of the magazine, lifting it through a slot in the sleeve extension and into the chamber. The sleeve slid over the chamber and piston rings, sealing the cartridge in the chamber ready for the next shot.

. . . The gun and ammunition worked, but there wasn't time to debug problems . . .

## Three Finalists: from AAI, H&K, and Steyr

After further evaluation, the remaining four ACR prototype weapon systems, developed by AAI, Colt Industries, Heckler & Koch, and Steyr-Mannlicher, were contracted to proceed with their developments, and all four contenders went on to participate in the final ACR field experiment.

Further excerpts from the ACR Program Summary describe the three finalist submissions from AAI, H&K, and Steyr as follows:

49 (right). The ammunition tested during the Advanced Combat Rifle Project field experiment.

From left: M855 Ball; Colt/Olin yellow-tip Duplex; AAI sabot flechette; Steyr-Mannlicher plastic-cased flechette round with ring primer; H&K 4.92mm caseless cartridge.

US Army photo



### **AAI: Industry Alternative Contract #DAAA21-86-C-0365**



50. The AAI ACR rifle, firing a 5.56x45mm subcaliber flechette round, as it appeared during the ACR field experiment.

US Army photo

### **Background**

*Contractually, the problem with the AAI contract was that it was originally underestimated by AAI. This led to numerous, low-value cost growths. As might be expected, every time there was a change to the requirements of any kind, major or minor, there had to be a cost-bearing contract modification.*



AAI was also the repository of the equipment necessary to produce the flechettes needed for both their contract and the Steyr-Mannlicher contract (and the MDHC contract). The production of flechettes was a cost, time and quality problem throughout the entire development effort. As the AAI concept had the flechettes strongly crimped into a brass case, there was not a need, in their concept, for extremely straight flechettes. However, with the competing Steyr concept, the quality of flechettes needed to be higher with respect to straightness and concentricity because the crimp from the plastic case was not nearly as strong. Looking at performance, the flechette round was not ever made to be as accurate as a standard bullet round. There is some controversy as to whether the flechette round is inherently less accurate and whether any amount of future development effort would result in equal accuracy to a standard bullet round. The pace of technology today is such that it is unlikely that further development work on small-caliber flechettes will be funded for rifles. However, flechettes still offer significant potential for bursting munitions and crew-served weapons.

### Weapon

The AAI weapon is a 5.56mm modified version of the previously developed Serial Bullet Rifle (SBR) using a reciprocating bolt mechanism. The major modification is to incorporate an "entrapped gas" operating system. Gun gases enter a cylinder, drive a piston to power the system, and prevent any leakage of propellant gases and residues into the other mechanical parts. This action should reduce the cleaning frequency and incidences of fouling-related stoppages.

The weapon has two modes of fire: semi-automatic and three round salvo burst at a cyclic rate of 1,800 shots per minute. A removable 4X optic with lighted reticle was also used on ACR field trial configured weapons. As the trajectory of the flechette round launched at 4,600ft/sec is fairly flat, the optic had horizontal lines in the internal lighted reticle to compensate for projectile drop between 300 and 600 meters.

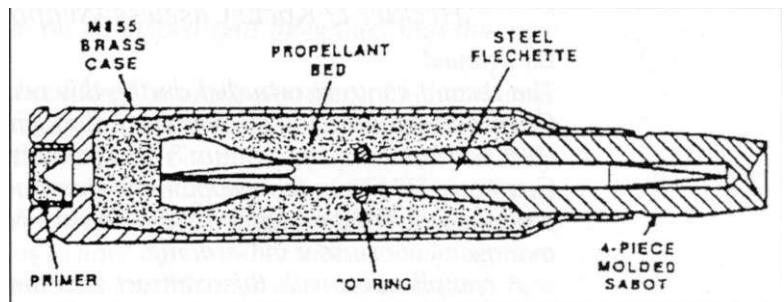
There is a long sight rib section on the upper surface to aid the soldier in unaided fire situations.

The basic SBR design is a well-proven, mature design which performed in a reliable fashion during the FY90 Advanced Combat Rifle (ACR) field trials.

### Ammunition

The AAI round uses the standard 5.56mm M855 brass case with M41 primer. The projectile is a 10.2 grain sub-caliber flechette. The sabot is a liquid crystal polymeric compound (plastic), which is designed in four segments held together by a neoprene "O" ring at the rearmost point of the sabot segments. The sabot segments, when assembled together with the flechette and "O" ring produce a package of 5.56mm diameter. The sabot is designed to have a chamfer on the nose to prevent "stopping" of the round during feeding. Behind the approximately 1/4-inch-long chamfer, a full diameter bourrelet section begins. Near the mid-point of the bourrelet is a molded crimp groove into which the neck of the brass case is rolled, giving a "shot start" or minimum pressure buildup before movement of the projectile assembly can begin. Aft the approximately 1/2-inch-long bourrelet, there is a radius and a 3/8-inch-long ramp down in diameter to a thin section where the "O" ring sits . . .

There are no technical barriers envisioned in the correction of deficiencies which are known or anticipated with the weapon; however the ammunition does suffer from being heavy as compared to the caseless or plastic-cased ammunition . . .



51. Fig. 3.3 from the ACR Program Summary, a diagrammatic sectioned view of the AAI serial flechette cartridge.

US Army drawing

### **Summary**

*In summary, the AAI ACR is regarded to consist of a relatively mature weapon of known reliability characteristic coupled with a slightly lighter, high-launch-reliability, flatter-trajectory, brass-cased, sub-caliber flechette round.*

## **A Brief Retrospective on Caseless Efforts**

As noted, there were two original awards for the development of caseless weapon systems prior to the Advanced Combat Rifle Program's elevation to program status. These contracts were awarded to the

AAI Corporation of Hunt Valley, MD, as well as to Heckler & Koch (H&K) Inc., of Sterling, VA.

The ACR Program Summary describes the development of these initial contracts as follows:

*. . . The purpose of both contracts was to develop demonstrator hardware incorporating caseless ammunition, an optic sight, and the salvo weapon concept. A key to the effort was to develop a solution to the two traditional and historically encountered technological barriers of a caseless gun system; cook-off and round vulnerability to an incoming projectile.*

### **AAI: Caseless Weapon Contract #DAAK10-82-C-0331**

#### **Background**

*AAI was developing an advanced combat rifle concept capable of firing molded propellant caseless ammunition. The AAI caseless weapon system offered a high-rate burst capability along with improved fire control through the use of an advanced reflex sight with a detachable three-power scope. The AAI contractual development was terminated because of AAI's inability to fabricate a round of ammunition which would withstand gun feeding forces. Under the other caseless contract, H&K worked with Dynamit Nobel AG (DNAG) of Nuremberg, West Germany, to successfully develop a caseless ammunition propellant that solved these problems. However, this information could not be divulged to AAI because it was protected under license agreement. An in-house effort to investigate the combination of the AAI weapon concept with the H&K/DNAG propellant was cancelled due to lack of funds . . .*

### **Heckler & Koch: Caseless Weapon Contract #DAAK10-82-C-0332**

#### **Background**

*The second contract awarded during this period of time was to Heckler & Koch GmbH of Oberndorf am Neckar, West Germany, through their wholly-owned subsidiary in Sterling, VA. H&K had formed a "consortium" with Dynamit Nobel AG (DNAG) located in Nuremberg, West Germany. H&K was the weapon designer and manufacturer, while DNAG developed and produced the caseless ammunition. The two companies formed a firm named GHGS to be a management overseer in Germany.*

*A complication with this contract was the fact that Germany was, at the time, totally committed to replacement of their worn-out supply of G3 (7.62mm) assault rifles with the caseless weapon, termed G11 in Germany. The same technology development was in fact funded by both Germany and the US under the ACR program. From a technical viewpoint, it was virtually impossible to separate what work was being funded by which nation.*

*H&K along with DNAG had managed to conduct a cook-off test where 100 rounds were fired at an average cyclic rate of 85 shots per minute. The 101st round did not cook-off when allowed to remain chambered for thirty minutes. Near the point in time when this technical milestone was achieved, the ACR program was initiated and the H&K contract was modified to a wider ranging development program culminating in the delivery of weapons and ammunition for troop testing. All of this was to be done under an accelerated acquisition schedule. The requirement to accelerate the program caused the newly-formed Advanced Combat Rifle (ACR) program office to modify the existing contract with H&K, rather than take the more time-consuming route of terminating the existing contract and making a new award*



52. The innovative H&K bullpup ACR rifle, firing a 4.92x34mm caseless round, as it appeared during the ACR field experiment.

Note the single-row, 45-round magazine, above and in line with the barrel. US Army photo

### **Weapon**

*The H&K weapon system is a revolutionary caseless mechanism with semi-auto, salvo three-round-burst, and full-automatic modes of fire. Because the chamber is radially reciprocating, rocking back and forth 90 degrees between the load and fire positions, a number of novel weapon mechanism innovations had to be developed and integrated into this new weapon system.*

*The original US-funded effort employed a "shouldered" round with a ring mid-chamber for the round to seat against. The chamber was rotary and the round was inserted from either end. The resulting seating ring was therefore a thin ring and became a hot spot, the most likely point to initiate a cook-off. A chamber redesign of major proportion ensued. The projectile was telescoped into the round body and the mid-chamber ring was eliminated. While the round could still be fed from either end, the design was to have the chamber radially reciprocate so that the round was always fed from the same end. This modification dictated an entirely new interior ballistic sequence, or method of function. The first problem was to get the chamber sealed to the housing in which it sat. The projectile then had to be induced to enter the forcing cone of the barrel so that total seating was accomplished, and then the projectile could be accelerated down bore. A booster pellet was added to the interior of the round to assist in accomplishing this process. After primer ignition, the booster pellet, seated immediately in front of the primer, ignited and accelerated the projectile out of the still intact round body and into the forcing cone. This process initiated the sealing of the chamber and propellant ignition*

*The H&K caseless weapon had been under development in Germany for a period of time prior to US involvement. Originally, it is believed that the design departed from more standard linearly reciprocating mechanisms due to the difficulties envisioned with the extraction cycle for duds, misfires, broken rounds, etc. There was no simple, reliable method envisioned to remove a round or fragments if that were necessary. The rotary chamber, conversely, did offer a method whereby this extraction might take place reliably . . . This chamber must rotate accurately and precisely at extremely high rates to accomplish its intended purpose. In the salvo mode of fire, the chamber must accept a round, rotate exactly ninety degrees to be in*

line with the barrel, fire the round and obturate the mechanism to seal the chamber, then counter-rotate exactly ninety degrees again to be in the loading position at over 2,000 times a minute. The weapon has long ago demonstrated its ability to perform just as described.

For extraction of a round, whole or broken, the firer must turn a crank on the side of the weapon. When this is done, the chamber rotates into the vertical position (loading position), and the next round pushes the old round or its fragments out of the chamber and through a hole in the bottom of the housing which has a cover that opens momentarily at just the correct time.

Continued rotation of the handle will load a new round into the chamber for firing. An incomplete rotation of the cocking lever will result in a misfire when the trigger is pulled because the primer is not adjacent to the firing pin. To clear the weapon, one must retract the magazine partially (or totally) and repeat the misfire/dud removal cycle. Then, instead of the next round pushing out the prior round, an extractor pushes the round out through the bottom port. While this system works reliably, the mechanism to accomplish all of these activities is very complex.

As the mechanism is so very complex, H&K has decided that the soldier will not normally open the plastic housing of the weapon except for cleaning. During cleaning, the weapon is broken down into major sub-assemblies but not fully disassembled . . .

The magazine is a single-row, forty-five-round-capacity unit. The square "rounds" of ammunition are loaded back-to-back, nose down, into the magazine. The magazine is situated above and in line with the barrel and has a short white line on top to aid the shooter in point fire engagements. This magazine is quite long and likely to interfere with a maneuvering soldier, so H&K has also designed and developed a half-length, 25-round magazine. This shorter magazine was not tested in the ACR field experiment.

. . . the mechanism has been highly reliable, with minimum weapon-related stoppages or other form of malfunction traceable to the weapon mechanism. The majority of the malfunctions/stoppages experienced in the field experiment were ammunition-related.

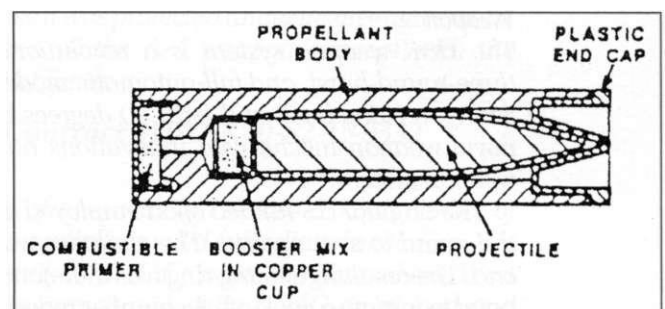
### Ammunition

H&K's caseless ammunition is square in cross section with an indentation at the front end to permit front end identification without direct vision. The round consists of propellant body, bullet projectile, plastic end cap, primer and booster.

The projectile is a gilding metal clad, steel penetrator, lead wire backed unit of 4.92mm diameter. This projectile . . . is a high-precision part which requires close tolerances in order to perform properly. A major portion of the ballistic cycle calls for the bullet to enter the forcing cone, stop momentarily, and then proceed down bore. To do this reproducibly requires high projectile precision. With such high-tolerance parts required, the cost of manufacture is necessarily higher than for similar more conventional projectiles.

The round body is composed of a true high-ignition-temperature propellant relative to standard nitrocellulose propellants. The basic composition is a nitramine named "Her Majesty's Explosive", HMX, with an energetic binder, a small percentage of fiber for strength, and an induced porosity . . .

The H&K round is completely waterproof, with or without exterior coatings. The round is extremely hard, but not friable; and is very hard to break. The basic constituent of the propellant is a polymorph of HMX not normally considered to be an end product here in the United States . . . This is primarily a cost problem. Other constituents of the H&K round are extremely hazardous to synthesize and alternative materials will not be easily or cheaply substituted. This round is, and will continue to be, expensive to produce.



53. Fig. 3.9 from the ACR Program Summary, a diagrammatic sectioned view of the H&K caseless cartridge.

US Army drawing

### **Summary**

*In conclusion, the H&K ACR is a revolutionary radially-reciprocating caseless-ammunition rifle. The weapon incorporates a variety of novel technologies. The most important is probably the unique IOFS [internal operating floating system] with hydraulic buffer, which allows the third round of a high-rate salvo burst to leave the muzzle before the shooter can feel the recoil impulse. Virtually every other innovation was developed to compensate for the rotary chamber's unique requirements. The feasibility of a caseless ammunition rifle system has been successfully demonstrated with this effort.*

### **Steyr-Mannlicher: Industry Alternative Contract #DAAA21-86-C-0364**



54. The Steyr-Mannlicher bullpup ACR entry, firing 5.56x45mm plastic-cased subcaliber fléchette ammunition, as it appeared during the ACR field experiment.

US Army photo

### **Background**

*The Steyr system was similar to the ARES system in that it fired using a rising chamber mechanism. However the Steyr ACR fired a single fléchette from a plastic case using a radial ring primer. Initiation of the ring primer was from the side of the case near the base. The problem of insufficient case stiffness and misfires as a result of this feature never arose.*

*In Steyr's system, the fléchette package was crimped by the plastic case head of the round. This was simply not as strong as the compression applied by a roll-crimped brass case as in the AAI system. Accordingly, the fléchette package left the mouth of the case at a much earlier point along the pressure-time curve, with the result that round-to-round accuracy suffered when compared to the AAI round. As mentioned earlier, fléchette accuracy has not been at the same level as bullets even under the best of circumstances. With this system, fléchette dispersion was, at best, twice as wide as the standard bullet system, and often wider than that. This deficiency became noticeable at the longer ranges . . .*

### **Weapon**

*The Steyr ACR weapon bears a remarkable resemblance to the ABES weapon insofar as the basic mechanism type is concerned. Both are rising chamber mechanisms. Where the ARES gun was a quasi-open bolt with a live round normally in the chamber in the out-of-battery*

condition, the Steyr gun is a true open-bolt mechanism in that there is a spent case normally in the chamber in the out-of-battery condition. A live round only enters the chamber after the trigger has been pulled . . .

Aside from the novelty embodied in the basic rising chamber mechanism, there are a number of other innovations which lead to a simple weapon. The first is the gas system, which has the gas "piston", actually a hollow cylinder, mounted annularly to the barrel so that the barrel's outside diameter acts as the inside surface of the gas system, and the "piston" inside diameter acts as the outside surface of the gas system. The weapon slide is welded to the outside of the gas piston. After the projectile passes the gas port, the piston moves rearward, with the attached slide. The slide, a flat strip on either side of the barrel, acts on a pin protruding through tabs on the underside of the chamber. In rearward motion, the pin and chamber are forced down by a cam to the load position, cocking the spring which drives the chamber upward. After the gas piston contacts the buffer, the recoiling mass moves forward, pushing the chamber pin out of the lower detent position, driving the chamber up into the firing position . . . When the slide is in its most rearward position, a projection from the slide is positioned immediately behind the topmost round in the magazine. As the slide moves forward, this round is stripped directly into the chamber; at the same time ejecting the spent round from the chamber forward and downward to a port in the plastic stock of the weapon. As the chamber approaches top dead center, a fixed firing pin mounted in the top of the housing protrudes through a hole in the top of the chamber where it impacts the plastic case above the ring-shaped primer to ignite the round.

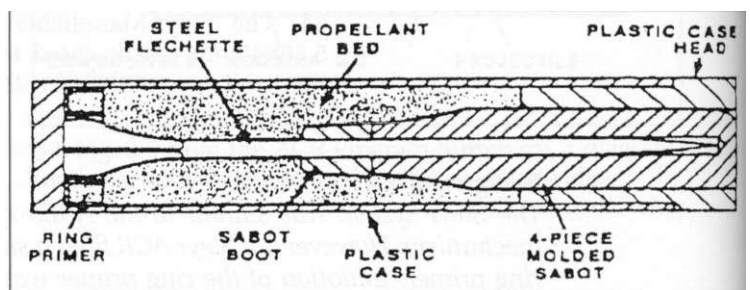
To allow direct feed of rounds from the magazine into the chamber, the plastic magazine has a transition zone where the round stacking goes from two staggered rows to a single row. This adds undesirable height to the magazine. To keep the magazine protrusion from being lower than the shield around the trigger/pistol grip, the round capacity of the magazine was reduced to 24 instead of 30 rounds. This will have an adverse effect on expected casualties per combat load . . . Steyr also has a high-capacity, drum-type magazine design which was not fabricated for the ACR field trials . . .

The weapon has been designed from its conception with eventual manufacture in mind. Numerous design changes have already been implemented strictly for manufacturing purposes. The result is that the projected cost to manufacture is approximately \$375 - \$400; less than the current cost of the M16A2 . . .

### Ammunition

The Steyr round is a fully-telescoped, plastic-cased flechette round based almost 100% on the ARDEC designed flechette/sabot package. The flechette provided as GFM was shortened slightly by Steyr to allow it to fit in the available case/chamber design. The flechette projectile weighs 9.85 grains . . . The low impulse of this round permits the salvo cyclic rate to be fired at about 1,200 rpm . . .

The round consists of four parts; case body, case head, ring primer, and projectile package. The projectile package is in itself an assembly of a single flechette, four-segment sabot, and a boot to hold it all together



55. Fig. 3.12 from the ACR Program Summary, a diagrammatic sectioned view of the Steyr plastic-cased flechette cartridge. US Army drawing

The Steyr round, like their weapon, is both simple and cheap to produce. Of all ACR candidates, this is the least costly ammunition round. It is expected to cost about 40% of an M855 round when in full production . . .

An inherent drawback to the Steyr system lies in sabot hazard to friendly troops. This is a safety concern that exists in the AAI system as well . . .

### **Summary**

*In conclusion, the Steyr ACR represents the simplest weapon, the simplest round, and the most cost-effective approach of any of the ACR contenders. Its greatest current deficiency is its poor round-to-round dispersion characteristics.*

## **The Colt ACR Submission**

### **Testing the HEL Sight Rib**



56. Top and right side views of a special, experimental M16A1, modified by the Human Engineering Labs (HEL) for faster target acquisition.

Note the heightened sighting rib. The stated position

The Army HEL (Human Engineering Laboratory) had proposed a sighting rib which had a narrow white stripe to aid in quick target acquisition by providing a visual cue as to where the barrel was pointing. The actual design trialled was a shotgun-style ventilated sighting rib, elevated above the top surface of the handguard, running the entire length from the front of the carrying handle on the upper receiver to the front sight, with the top surface lying 0.223" below the plane of the iron sights. A test, titled "An Evaluation of the Hitting Performance of the M16A1 Rifle with and without a Sight Rib", had been conducted by HEL engineers at Aberdeen in January, 1985. Twenty-seven combat riflemen equipped with M16A1 rifles, with and without the sight rib fitted, participated in the evaluation, firing at pop-up 'E'

was that the HEL sighting rib was not required on the ACR, but would be looked very favorably upon if utilized in ACR candidates.

editor's collection,  
courtesy the late Dr. Edward C. Ezell

silhouettes arrayed in two semicircles at 30 and 75 meters. The targets were presented either for two or 3.5 seconds, the range and time the targets remained exposed being randomly selected. Both aimed- and point-fire techniques were used during the test. The results showed that the use of the sight rib significantly improved the soldiers' ability to score a hit when the target was exposed briefly and the rifleman shot quickly.

The HEL sighting rib was viewed very favorably by the trials officers at Aberdeen, whose stated position was that while such a rib was not required, it would be looked upon very favorably if utilized on ACR candidates. This resulted in the eventual inclusion of a version of the sight rib on the McDonnell Douglas, Steyr, and Colt ACR candidates.

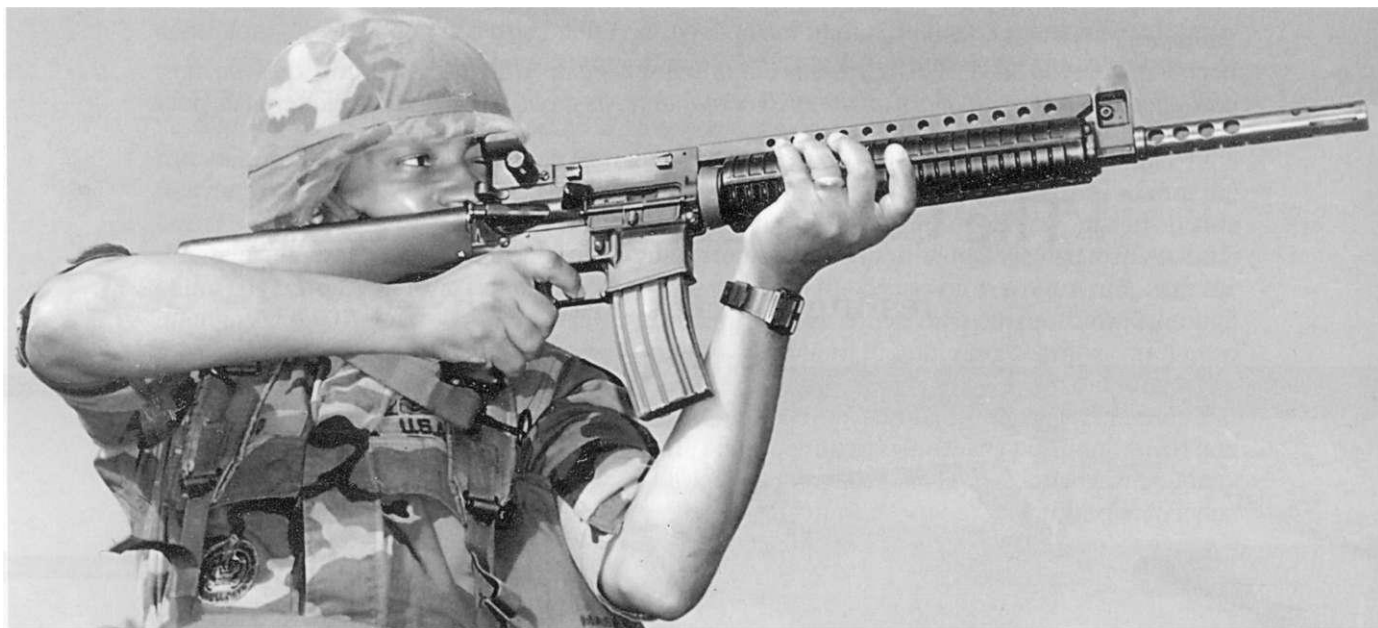
## **Conduct of the Colt ACR Contract**

Solicitation Request for Proposal DAAA21-85-R-0477 was released by the Department of Defense on February 5, 1986, and the final contract awarded to Colt's was no. DAAA21-86-C-0367.

The rifle Colt proposed was based on their proven M16A2, modified to meet the government's

request for increased hit probability and combat effectiveness. It was thought at the time that by decreasing recoil and introducing some ergonomic changes in the replacement weapon, combat effectiveness could be increased. Therefore, the proposed modifications for the Colt ACR rifle included an





57. A US Army trial of another experimental M16A1 utilizing the HEL sighting rib.

This is possibly the upper receiver redesigned by the military as a forerunner to the later rail systems. As mentioned in Chapter Thirteen, tests of this receiver were

unsatisfactory, leading to the realization that the attachment of accessories for particular missions had to be accomplished without permanent modifications to the rifle or carbine.

US Army photo

improved muzzle brake/compensator (MBC); improved furniture with better handling characteristics; a duplex-bullet cartridge for increased hit probability with each shot; and better pointing and sighting potential. The established baseline requirements for improvement were derived from human factors engineering (FIFE) studies and recommendations.

During mid-1985, Colt had begun working with IVI Canada (the ammunition contractor for the Canadian government, located in Valcartier, Quebec); the Winchester Division of Olin on the duplex ammunition; and Knight's Armament Company of Vero Beach, Florida on the design of a Muzzle Brake/Compensator (MBC).

By September, 1986, Colt had done considerable work and the team had made excellent progress toward the final design. Colt hosted a kick-off meeting on October 7, 1986 which brought in representatives from these other companies to assist in the

development of the ACR. Colt formed a team which included the Winchester Group of the Olin Corporation for development of duplex ammunition compatible with current M193 and M855 Ball ammunition; Knight's Armament for the muzzle brake/compensator; Ernst Leitz Canada Limited, of Midland, Ontario, for the development of an optic system; and Dunlap and Associates, Inc., for input on the human engineering factors. Short-term commitments and discussions of the technical elements of the program were made and given at this initial meeting.

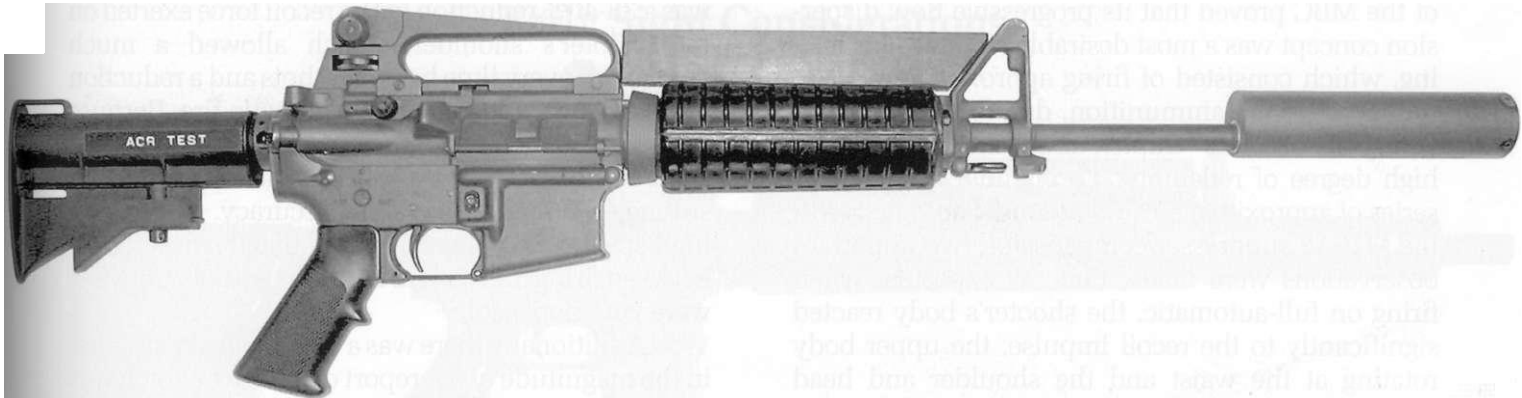
It was determined that development of the Colt ACR would proceed in three phases. Phase I of the Colt contract, awarded in September, 1986, had government commitment for three months, and was extended to March 31, 1987. Phase II was awarded that same month and extended to May 26, 1988. Phase III was awarded in May, 1988.

## Phase I of Colt's ACR Program

Phase I was scheduled to be completed within six months, and was primarily concerned with the functional viability of the ACR. This version of the Colt ACR was chambered for the special "baseline" cartridge, which was basically an M193 (5.56x45mm) cartridge case with a longer neck to contain duplex

projectiles in both full and sub-calibers. The extended neck of the cartridge case was thought necessary to provide sufficient support for the duplex projectiles when the cartridge case was crimped.

Preliminary tests were conducted to determine if the new long-neck chamber would have adverse



58. Right side view of an experimental Colt ACR carbine prototype, built on the M16A2 Enhanced Rifle upper receiver with folding back-up sight and removable

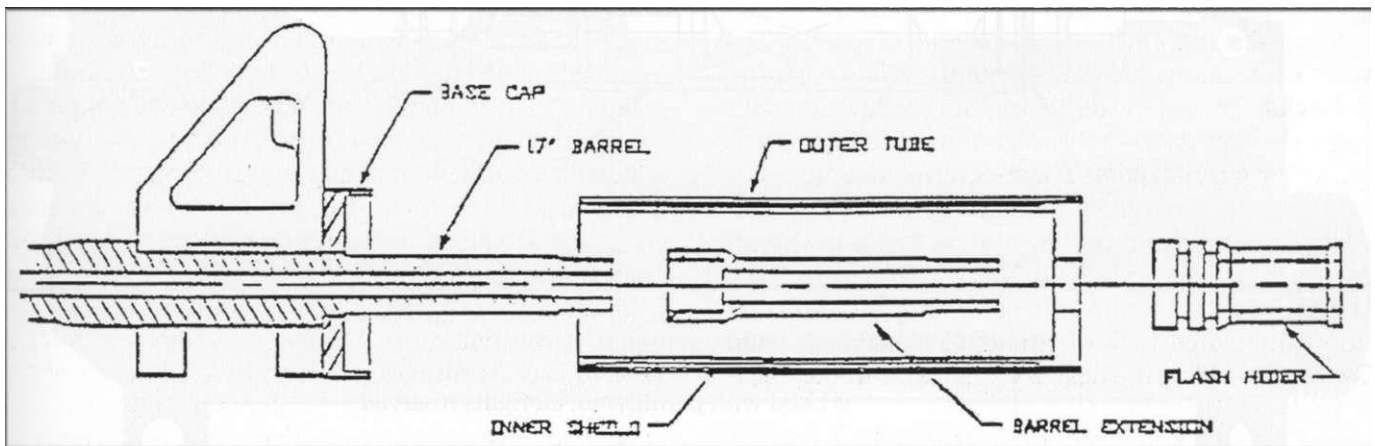
ing handle (fig. 36).

Note the sight rib, as well as the early muzzle brake/compensator. courtesy C. Reed Knight III

effects on the gas system and cyclic rate of a rifle using standard ammunition. The effect of extending the chamber neck by .1272" was found to be minimal, resulting in a decrease in cyclic rate of from 840 to 800 rounds per minute when using M855 ammunition.

By the conclusion of Colt's Phase I, Winchester had determined that multiple projectiles could be effectively controlled in a standard M193/M855 cartridge case, and consequently work on the extended-neck "baseline" case configuration was abandoned.

## The Knight's Armament Muzzle Brake/Compensator (MBC)



59. A line drawing showing a cutaway view of the Muzzle Brake/Compensator, designed by Knight's Armament Company for use on the Colt ACR.

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The MBC (Muzzle Brake/Compensator) developed by Knight's Armament Co. combined the functions of three devices: a muzzle brake, a flash hider, and a recoil controller with initial noise reduction capabilities. The MBC reduces recoil by capturing a portion of the gases which normally exit the barrel and turning and tunneling these gases in such a way that they use their energy to push the gun in an anti-recoil

direction (away from the shooter). These gases are slowed enough during this process to cool slightly, so that both the flash and noise from these expanding gases are either reduced or eliminated altogether.

The ACR rifle action was mechanically the same as that of the M16A2, and all testing of the MBC was compared against results obtained with the issue M16A2 flash suppressor/compensator. Initial testing

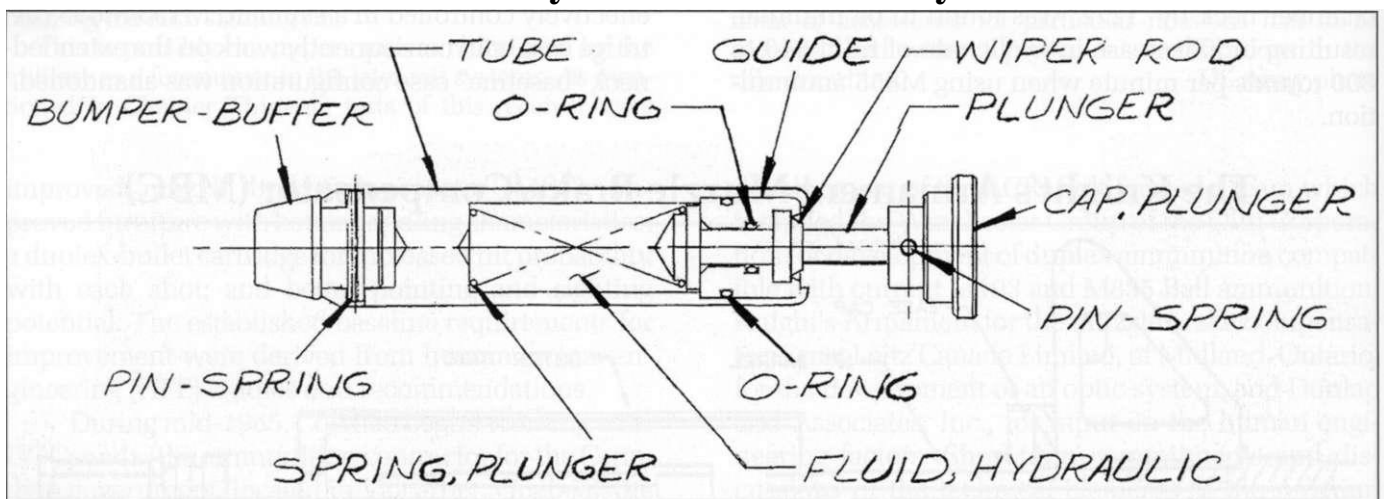
of the MBC proved that its progressive flow dispersion concept was a most desirable feature. This testing, which consisted of firing approximately 1,500 rounds of M855 ammunition, due to limited availability of "baseline" duplex ammunition, showed a high degree of reliability. Throughout another test series of approximately 1,800 rounds, fired first with the M16A2 suppressor/compensator, two important observations were made. First, as expected, when firing on full-automatic, the shooter's body reacted significantly to the recoil impulse, the upper body rotating at the waist and the shoulder and head moving rearward. This resulted in a vertical climb of the bullet impacts on the target. When the same test was conducted with the MBC installed, observations showed similar shooter behavior but with a significantly lower magnitude of reaction. The net result

was a 38-40% reduction in the recoil force exerted on the shooter's shoulder, which allowed a much quicker recovery time between shots and a reduction in muzzle climb during full-automatic fire. Because the shooter was experiencing less recoil, recovery from the initial impulse was significantly faster, resulting in a higher degree of accuracy. The use of high-speed video film confirmed that the differences between firing the M16A2 with and without the MBC were very noticeable.

Additionally there was a 13.5-decibel reduction in the magnitude of the report of the shot, which was a significant reduction in the noise level experienced by the shooter.

It was concluded that the Knight's MBC significantly improved controllability of the ACR, particularly during full-automatic fire.

### The Hydraulic Buffer Study



60. A line drawing showing a cutaway view of the final design of hydraulic buffer, as used in the Colt ACR.

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A buffer study program had been initiated right at the outset of the ACR program, the sole purpose of which was to investigate what options were available to further reduce perceived recoil. To aid in hit probability, the use of the oil-spring hydraulic buffer initially developed for the CMG-2 (Colt Machine Gun No. 2) was considered, which decreased the rate of fire to approximately 650 rounds per minute.

A total of four buffer designs were tested. The effectiveness of the hydraulic buffer was measured in a test fixture wherein the measurements were

taken from a rigidly mounted instrument, and were compared to results obtained with an M16A2 carbine with a force gauge placed between the stock and the shooter's shoulder. This device, which utilized a force transducer mounted between two plates, provided a force-time history of recoil measured in an elastic system.

Results showed that the use of the hydraulic buffer reduced perceived recoil, decreased the cyclic rate of fire, and enhanced controllability.

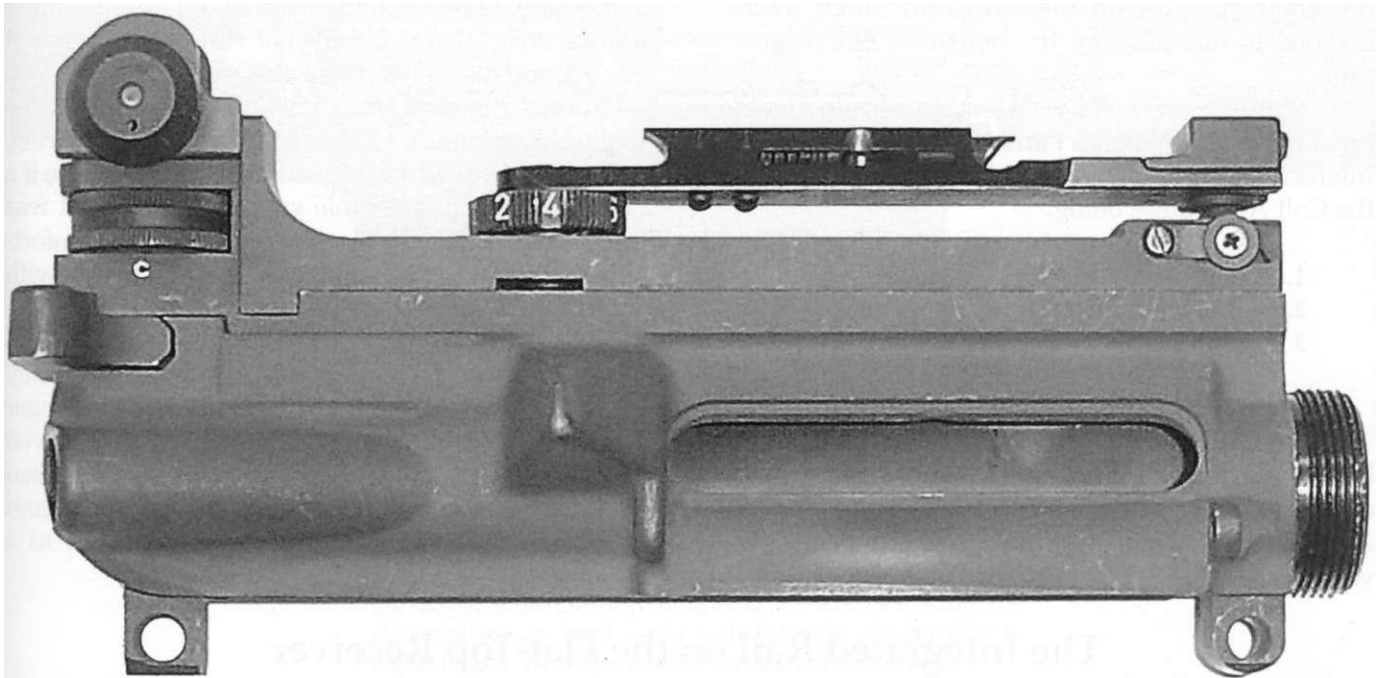
## Early Sight Considerations



61. Right side view of the first prototype Colt ACR. The odd-shaped sliding stock, pistol grip and handguards are made out of wood, with a storage compartment in the stock

for the optic sight, which was a commercial Colt 3x scope.

Note the early muzzle brake/compensator design, and the sighting rib.  
courtesy Harold Waterman



62. Right side view of the upper receiver chosen for the first Colt ACR prototype.

Note the A2-style adjustable rear sight, and the scope mount forward of the rear sight.

courtesy Richard Costello

One of the performance criteria stipulated for the ACR was an improvement in "point-fire" accuracy, as the assumption was that 80% of combat engagements would entail this mode of fire rather than "aimed" fire. The desired characteristics to optimize reflex/point-fire were:

1. An extended shotgun rib close to the line of sight.
2. An iron sight which could be folded away when not in use.
3. A quick-detachable optical sight which would retain zero when removed and re-placed.
4. Protection for the shooter's eye from opposing direct-energy weapons or laser beams, by means of a multi-layer protective coating on the optical sight.

## The Semi-Beavertail ACR Handguard

Early in Phase I, a modified M16A2 handguard was utilized for firing demonstrations. The final ACR handguard, lengthwise, had a semi-beavertail shape with a finger groove depression on either side, and was flared at the muzzle end to prevent the operator's hand from touching a potentially hot MBC. Later, during Phase III, a hot test was conducted on the

ACR, which revealed that when compared to the standard M16A2 handguards, the ACR handguards remained substantially cooler under identical conditions. The material used for the ACR handguard, a thermo-set polymer with an added elastomer, held up to all test conditions, and was approved for use in the final Phase III delivery.

## Human Engineering Factors

In the development of the Colt ACR, much attention was paid to the small details that would help achieve the mandated 100% increase in hit probability. One of the preliminary tests indicated a need for the buttplate-to-trigger dimensions to be adjustable. As with the handguards, early prototype buttstock assemblies were made of wood. Later, prior to the development of the final thermoplastic mold, it was decided to manufacture the buttstock from aluminum.

Multi-position stock assemblies were developed throughout Phases I and II, with three areas of interest heavily stressed during the development of the Colt ACR, these being:

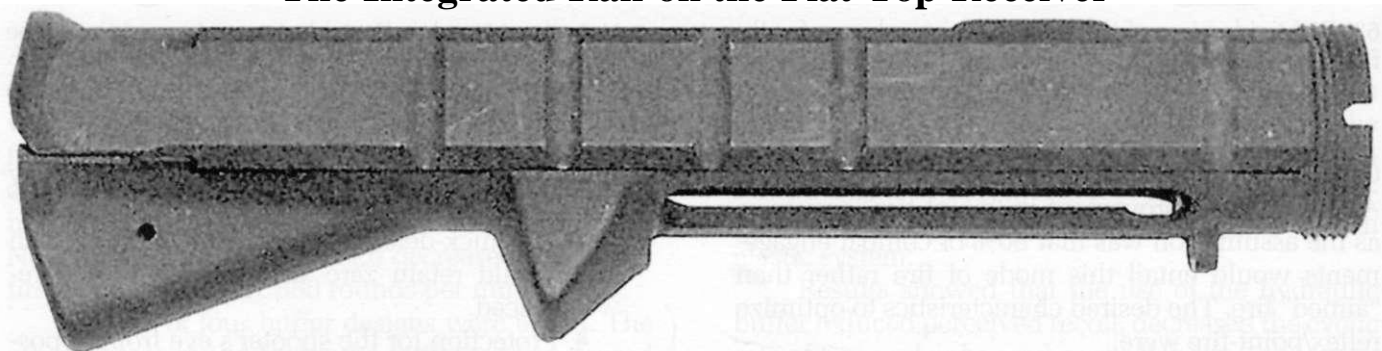
1. The anthropomorphic "fit" of the weapon;
2. Sighting system characteristics;
3. The impact of weight and balance on system performance.

During February, 1987, the Colt ACR team had begun researching initial aim error with the aid of the electronic shooting simulator manufactured by Firearms Training Systems (FATS), to compare sight variations of the ACR and M16A2. Numerous sight-

ing rib variants were tested, and the best was chosen for inclusion on the final Colt ACR. Colt contacted Firearms Training Systems (FATS), the manufacturer of the electronic shooting simulator, and arrangements were made to adapt their system to the needs of the ACR. As well as simulation on the FATS system, other approaches including the use of laser sights and video filming were taken to determine aiming error. It was found that simulated ranges of 36, 70 and 90 yards were the most practical. An additional aim error study was conducted during the first week of March, 1987, which included live firing.

The pistol grip was examined, to determine if a more natural or preferable grip was feasible. It was discovered that a longer grip would be more comfortable and would furnish a better grasp for troops with large hands, as well as troops wearing gloves. The M16A2 finger groove can limit proper hand placement for large, or gloved, hands, because they may not fit between the trigger guard and the finger groove. The pistol grip was thought to be improved if its major axis was vertical, thus giving increased resistance to recoil and allowing the shooter's hand to be positioned with his forearm and hand in a straight line.

## The Integrated Rail on the Flat-Top Receiver



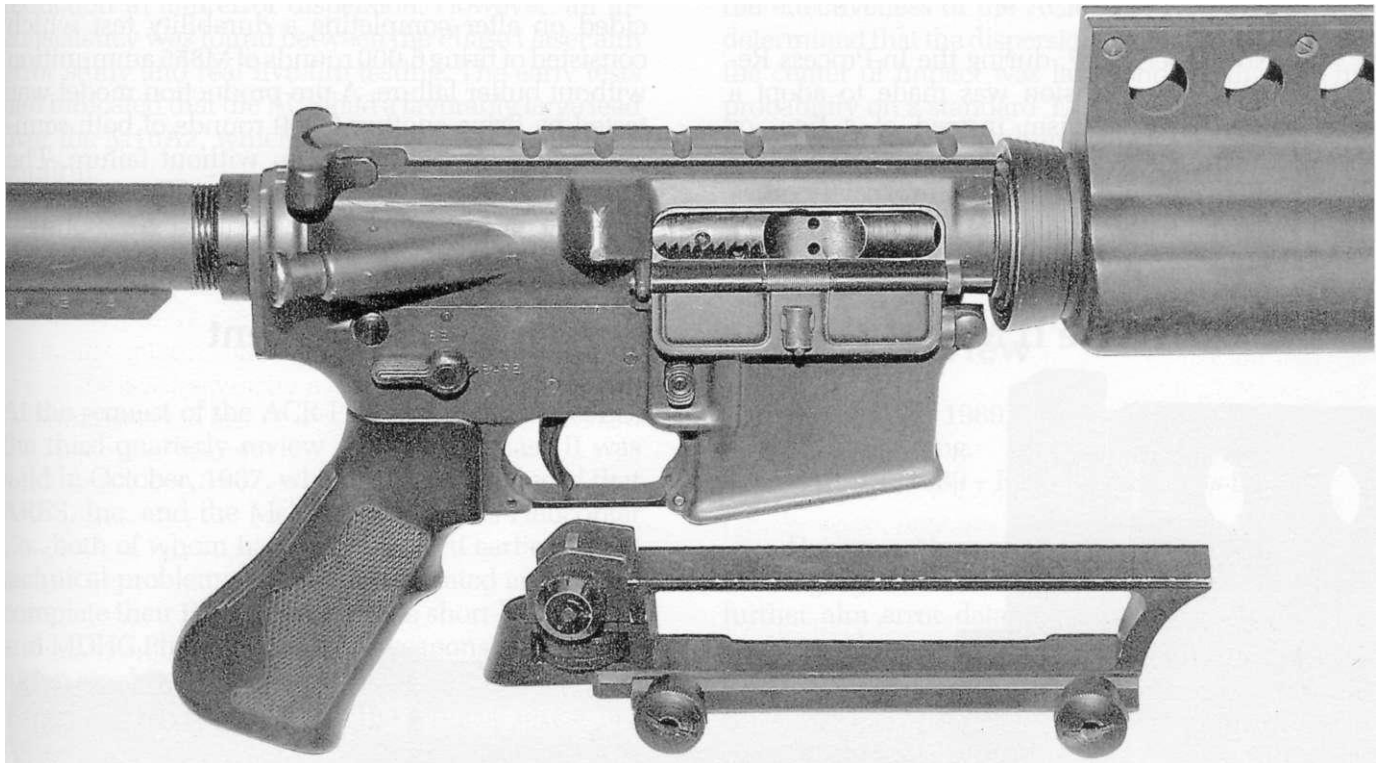
63. Top view of the final design of upper receiver used on the Colt ACR.

Note that the transverse notches are round, rather than the current square design. courtesy Richard Costello

Another innovation incorporated into the ACR was an integral rail on the flat top of the upper receiver. Upper receiver prototypes, produced during the early part of Phase I, were completely machined internally but with the tops left unfinished so they could be easily adapted to various experimental rail designs. As noted, Colt had produced several designs of flat-top upper receivers through the years, and the design and concept of the integrated rail on the ACR receiver was similar to the upper receiver developed by senior engineer Henry Tatro for the Colt Enhanced Rifle project, which had run from 1983 to 1985.

Numerous rail configurations were experimented with during the ACR project. The solicitation for the ACR did not state a requirement for any interchangeability with existing equipment, and the ACR rail dimension, as well as the detachable carrying handle and Leitz optic sight, were therefore proprietary on ACR-delivered hardware, and not compatible with the later MIL-STD-1913 rail. The ACR rail was narrower, with a rounded profile on the grooves rather than the square groove profile of the MIL-STD-1913 rail. The dovetail itself was also quite different from the current standard.

### Detachable Carrying Handle and Iron Sights



64. Right side closeup of the Colt ACR, showing the detachable carrying handle with A2-style adjustable iron sight, below. Note the ambidextrous selector lever.

official US Army photograph by Todd Mozes,  
Photographic Services, Picatinny Arsenal

The Colt ACR also featured a detachable carrying handle fitted with an M16A2-type rear iron sight, adjustable for both windage and elevation. The only difference between the ACR rear iron sight and the M16A2 version is the elevation characteristic. Rather than being adjustable from 300 to 800 meters as on the M16A2, the sight on the removable ACR carrying handle is adjustable from 300 to 600 meters.

The front sight used was the standard A2-style square post, adjustable for elevation only. The square

post gives the shooter a flat surface to focus on for sighting and aiming. When installed, the ACR iron sights are zeroed in exactly the same manner as on the M16A2 rifle, with a Battlesight Zero.

Initial ACR iron sights were calibrated in yards, while later versions were calibrated to read in meters. The ACR is zeroed to point of aim, point of impact at 25 meters, so that with the arc of the bullet's trajectory, the shot will hit that same point of aim at 25 and 300 meters.

With the carrying handle removed, any suitably dimensioned optic sight could be installed on the rail. The main optic used on the ACR was the Leitz ELCAN 3.5 power optical sight, with adjustable

mount. Zeroing the optical sight was done in a similar point of aim/point of impact fashion as used for the iron sights.

## Phase II

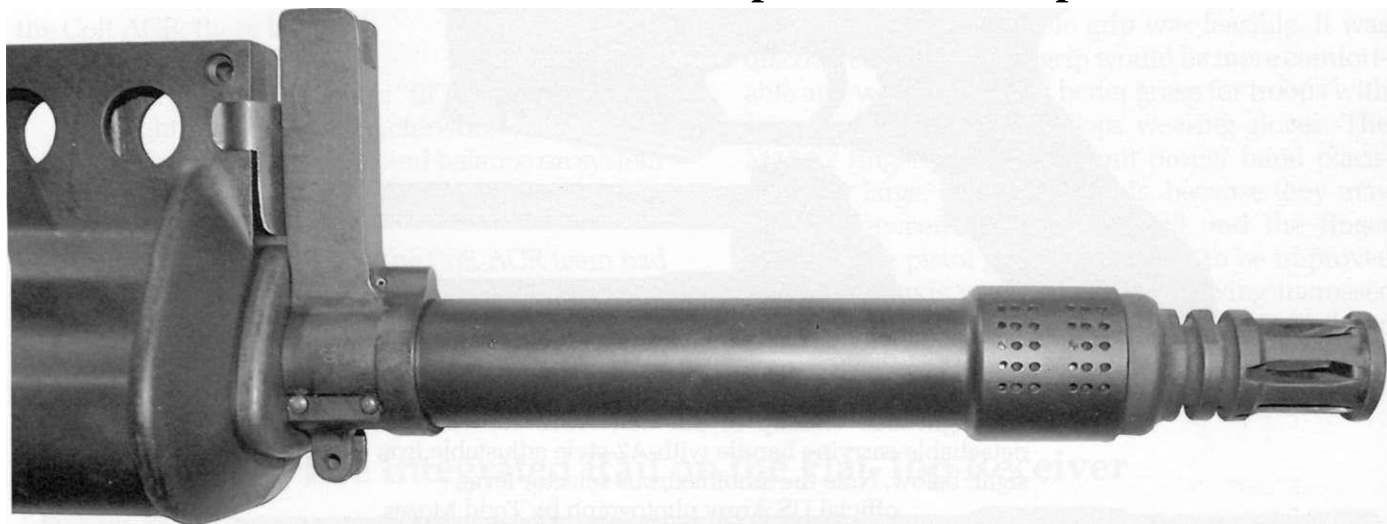
Phase II of Colt's ACR Program, awarded in March, 1987, was concerned with improved interface design, lowering the overall weight, and examining the feasibility of using sub-caliber ammunition for increased external ballistics. During Phase II, Colt experimented with a two-shot burst mechanism which, contrary to previous thinking, did not improve hit capability.

In November, 1987, during the In-Process Review meeting, the decision was made to adopt a fully-automatic mechanism instead of a two- or three-round burst device. Additionally, the ACR was fitted with an ambidextrous fire control/safety selector lever, which made it more adaptable to left-handed shooters.

Due to the fact that numerous types of ammunition were being fired, it was thought that a re-evaluation of the M16 gas system should be conducted. After this evaluation it was concluded that the various ammunition types being used did not have adverse affects on ACR reliability.

The finalized hydraulic buffer design was decided on after completing a durability test which consisted of firing 6,000 rounds of M855 ammunition without buffer failure. A pre-production model was tested by firing another 6,000 rounds of both semi- and full-automatic fire, again without failure. The hydraulic buffer decreased the rate of fire to the mid 600-rpm range, which was determined to be optimal.

### Phase II Muzzle Brake/Compensator Development



65. Right side closeup of the finalized Colt ACR muzzle brake/compensator.

Compare with figs. 58 and 61: note the greatly reduced diameter of the finalized version.

courtesy C. Reed Knight III

During this phase of development, the designers at Knight's Armament focussed primarily on reducing the size and weight of the MBC, by reducing the diameter as well as changing the material from stainless steel to titanium. Unfortunately, it was found that when recoil control was optimized, the sound level increased, and vice versa. Colt opted for a trade-off of

less weight and size for some increase in recoil control, but with less sound reduction.

Subsequent endurance testing revealed unacceptable heat buildup in the titanium outer sleeve, due to its reduced diameter. The search for the solution to this problem was held up until some duplex ammunition became available.



By changing the material again and fabricating the MBC from high-temperature stainless steel instead of titanium, weight and bulk were optimized. Tests, successfully completed in January, 1988, showed that recoil effects had been minimized while the noise level of each shot was decreased by approximately 15 to 20 dB.

Colt then requested Knight's Armament to modify the MBC by adding a flare to the rear end of

the inner tube in order to break up carbon and dirt deposits, which collected on the inside diameter of the outer tube. Additional changes were made involving the pattern of the exit holes in the forward end of the outer tube. The final change also incorporated a refinement to the seating lip on the forward end of the inner tube.

## The Live-Fire Aim Study

Conclusions from this test were that the use of the Leitz ELCAN optical sight produced a substantial reduction in aim error dispersion. However, an inconsistency was found between the Phase I laser aim error study and real live-fire testing. The early tests had indicated that the ACR had a favorably large lead over the M16A2, which the live fire testing did not confirm.

Another study was conducted on burst dispersion, which showed that the center of impact of the third shot of a three-round burst was below that of

the first two shots, which seemed to confirm that utilizing a three-round burst device would increase the effectiveness of the ACR rifle. However, it was determined that the dispersion of the third shot about the center of impact was large enough that the hit probability on a standard 'E' silhouette target would not be improved using burst fire. As a result, it was concluded that for shooting at close range from an unsupported firing position, fully-automatic fire was more desirable.

## The Phase II Third Quarterly Review

At the request of the ACR Project Office at ARDEC, the third quarterly review meeting of Phase II was held in October, 1987, where it was announced that ARES, Inc. and the McDonnell Douglas Helicopter Co., both of whom had been dropped earlier due to technical problems, had been reinstated and would complete their Phase II rifles. (The short-lived ARES and MDHC Phase II candidate weapons and ammunition are described above.)

At the same meeting the project office announced a series of scheduled milestone dates which would be incorporated into the Phase III contract:

- January 6, 1989 - Deliver five weapons & 15,000 rounds to BRL.
- March 17, 1989 - Deliver fifteen weapons to Fort Benning.

- March 31, 1989 - Deliver 115,000 rounds to Fort Benning.
- April 1, 1989 - Field Experiments begin.

During a November In-Process Review (IPR) meeting, agreement was reached on a procedure for further aim error data collection which would be performed by varying the ACR's weight and balance, in order to determine whether a causal relationship existed between these factors and aim error. However, it was decided that the data would only be collected using trained shooters, which contradicted previous data confirming that training, or a lack thereof, was the overwhelming reason for poor shooting performance. (As discussed in Chapter One, the Army does not train its soldiers to fire at known-distance targets, as the Marine Corps does.)

## The Phase II Fourth Quarterly Review

At Colt, the fourth quarterly review meeting was conducted in January, 1988. The initial battle sight zero had been preliminarily set for 300 meters for M855 ammunition and 225 meters for the duplex cartridge, but the decision was taken to zero both at the same point of impact using the same sight set-

tings, which would be the sighting requirements utilized by the ELCAN scope.

Another IPR meeting, conducted in February, 1988, resulted in the adoption of the modified version of the Knight's Armament MBC, which now measured 5" in length with an overall diameter of 1". All hardware was delivered at this meeting, including

the MBC and the ELCAN scope, meaning that Colt's was now able to assemble the first complete Phase II prototype.

In late February, the "proof composite buttstock from tooling was delivered. It was endurance tested by swinging a weighted weapon onto a paved surface. The finalized glass-filled composite stock assembly had a full-length triangular cheek piece on each side, to aid in obtaining good stock weld, and a checkered buttplate to prevent it from slipping off the shooter's shoulder. The stock was adjustable, with seven different positions, each 1/2 inch apart, giving a variation in overall ACR length from a minimum of 36 3/4" to a maximum of 40 1/4". The buffer tube was marked from 2 to 7 on the right side (fig. 72), to show stock position. This new stock design was intended to allow the operator to "custom-fit" both trigger pull length and eye relief when using the optical sight. Some minor dimensional changes were made before this design was delivered during Phase III.

Due to the lower port pressure produced when using duplex ammunition, it was found that the bolt would occasionally fail to lock open after the last round was fired. Several series of tests were conducted to determine the optimal gas port size for the ACR. After a successful performance demonstration, a design freeze was declared for the Colt ACR.

At this meeting the final decision was taken to use full 5.56mm caliber duplex ammunition in the Colt ACR. At the conclusion of testing, it was decided that the barrel for the ACR would be 17" long, with the standard M16A2 chrome-plated chamber and bore, and the standard US government M16A2 chamber dimensions. With the addition of the Muzzle Brake/Compensator, the overall barrel length was 20 1/2". The barrel was free-bored the length of the MBC, and slots were machined into the barrel bore for MBC bleed-off. Since the free bore had to accommodate both duplex and conventional ammunition, this was a feature which required significant development and testing.

## Phase II ACR Systems Overview

During the month of April, 1988, attention focussed on further improvements in recoil control, using high-speed motion pictures taken of the bolt carrier and buffer while firing. Modifications and improvements to this subsystem continued, with the goal of producing the most compact rifle that could still be easily handled and controlled. By this time the design of the hydraulic buffer had been finalized for production.

Cyclic rate testing showed that when firing duplex ammunition, the rate of fire was 624 rounds per minute, compared to 664 rounds per minute when using standard M855 ammunition. Rate variations confirmed that the interior ballistics of the duplex ammunition caused these slightly slower cyclic rates, which were still well within the allow-

able limits for normal production tolerances of the rifle mechanism and ammunition.

Another field experiment showed that when soldiers were wearing chemical protective clothing that included a gas mask, the ability to use iron sights and scopes was significantly decreased. However, even when wearing protective masks these soldiers exhibited increased hit probability using the ACR, due to the sighting rib which enhanced their ability to engage targets reliably.

On November 20, 1988, in accordance with their government contract, Colt held the End of Phase II Maturity Demonstration. This demonstration was successful, and Colt was then authorized to move forward into Phase III as previously funded.

## Phase II Optical Sight

The first ELCAN 3.5-power scope with a 3-inch eye relief was tested in January, 1989. The final design dimensions were as follows:

### Weights:

Sight . . . . . 77 lb.  
Mount . . . . . 64 lb.

### Dimensions:

Length . . . . . 6.30"

Height . . . . . 2.83"  
Width . . . . . 2.17"  
Magnification . . . . . 3.5x  
Field of View . . . . 240 ft. @ 600m  
Entrance Pupil Dia. . . . 1.10"  
Exit Pupil Dia . . . . . 32"  
Eye Relief . . . . . 2.83"



66. Right side view of the "early finalized" version of the Colt ACR (as yet without the angled front sling attachment point as shown in figs. 70 and 71), with the 3.5X ELCAN

scope attached and the optional carrying handle with iron sight at upper left. © 2003 by Colt Defense LLC.

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The mount contained windage and elevation zeroing mechanisms, calibrated from 300 to 800 meters in 100-meter increments for M855 ammunition. The scope body was covered with a chemical- and impact-resistant synthetic rubber casing. Inter-

nally, the fully immersion-proof sight body was purged with dry nitrogen gas before being sealed.

The reticle design, illuminated with a tritium light source, utilized tapered crosshairs, the vertical being marked with stadia lines calibrated for 400, 500 & 600 meters when shooting M855 ammunition.

## ACR Duplex Ammunition Development

Colt and Olin tested three different concepts for creating the required duplex ammunition. Colt's objective was to create an improved cartridge that would be compatible with current M855 ball ammunition, as introducing a new case configuration rather than utilizing the standard 5.56x45mm cartridge case would lead to obvious logistic complications.

Nevertheless, the original "baseline" concept, designed using the PRODUS aeroballistic computer, focussed on subcaliber (sub-.224") duplex projectiles made of tungsten alloy loaded into special long-necked cartridge cases. The question then became whether it was necessary to have the trailing projectile held in place by the long neck of the special case, or if it could be seated within the powder charge and remain in a stable location within the standard case.

A second concept involved the use of sabotated subcaliber projectiles in the SLAP (Sabot Launched Armor Piercing) configuration, loaded in a standard

5.56x45mm cartridge case. Two 27-grain .158"-diameter projectiles, fabricated from solid tungsten bar stock, were inserted into each sabot. All ammunition for this testing was handloaded. An evaluation utilizing high-speed photography indicated that projectile launch, sabot break-up and sabot discard were all satisfactory. Throughout initial testing this approach was considered to produce the "best ballistic solution" possible.

The third and most practical option, due to its compatibility with standard service ammunition, consisted of two full-caliber (.224" diameter) armor-piercing projectiles with hardened steel cores, both (lead and trailer) the same weight, loaded into the standard 5.56x45mm cartridge case. Initial trials indicated that if separation was not correct, the lead projectile could be hit by the trailer and knocked out of its flight path. This was solved in the final production version of the cartridge.

## Final Ammunition Selection

The solution to this rifle/ammunition problem involved what was probably the most demanding and intense effort of the entire ACR program. After more

than two years of parallel development effort on both full- and subcaliber duplex loadings, it was concluded that both duplex bullet *types* and weights (full

and sub-caliber) possessed certain potential down-range and terminal ballistic advantages. They also shared certain common problems, these being accuracy and downrange dispersion. The solution to both problems involved careful attention to interior barrel configurations and the separation of the lead and trailing projectiles, both in-bore and immediately after they exited the muzzle.

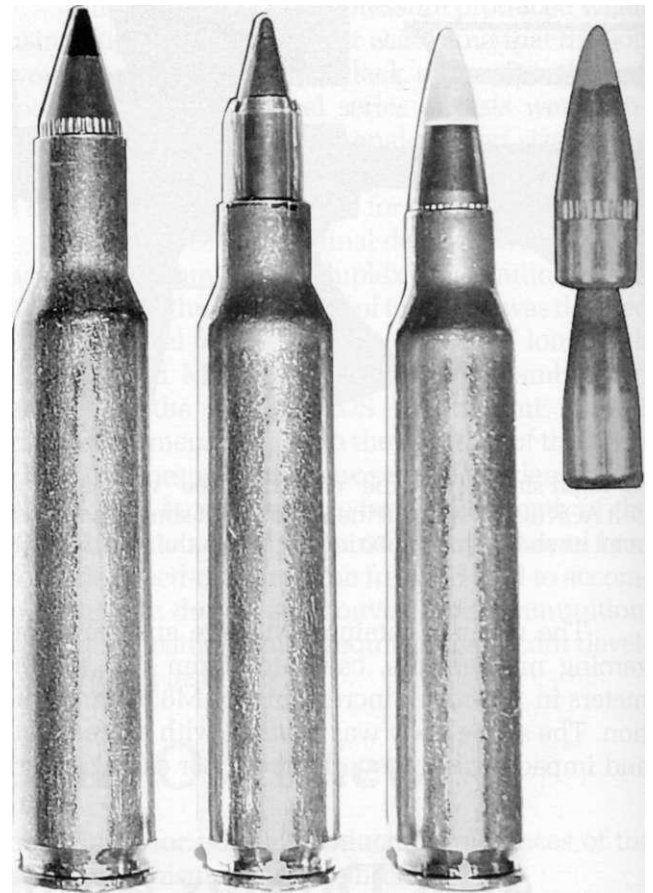
Final selection was a three-step process. First, the design requirements were listed and a determination was made as to the relative importance of each. Next, each design was ranked against each requirement in a compliance matrix, and the third step involved a multiplication of each design ranking by the relative weight of each requirement. Summing these products yielded the final overall ranking of each design, which revealed that the full-caliber duplex round met all the performance characteristics and was the clear winner.

Accordingly, in January, 1988 a decision was made to concentrate the total ammunition development effort on the finalization of the full-caliber duplex round.

The ammunition chosen by Colt for use in their ACR candidate included both M855 and M193 5.56x45mm ball ammunition, along with the compatible new duplex cartridge which had been developed in co-operation with Olin's Winchester Division. This final 5.56mm duplex round was similar in design to the 7.62mm NATO M198 duplex [TBR fig. 143), and comprised two projectiles, both with steel armor piercing cores, loaded one behind the other in the standard 5.56x45mm cartridge case.

During a range trial in the development phase, an M16A2 rifle had "blown up" when a trailing bullet stuck in the barrel, producing an estimated chamber pressure in excess of 100,000 psi when the subsequent round was fired. This type of failure was found to be primarily due to insufficient powder compression during the loading process, which in this case had allowed the trailer projectile to migrate downward almost to the primer flash hole, so that when the round was fired the lead bullet performed normally but the trailer barely made it past the gas port, where it remained as an obstruction when the gas pressure decayed. More rigorous quality control measures were instituted in the cartridge manufacturing process to prevent this problem from reoccurring.

In the final production version of the 5.56mm duplex cartridge the two bullets were configured slightly differently. The lead projectile, weighing 35 grains, had a cavity in its base and a yellow tip for

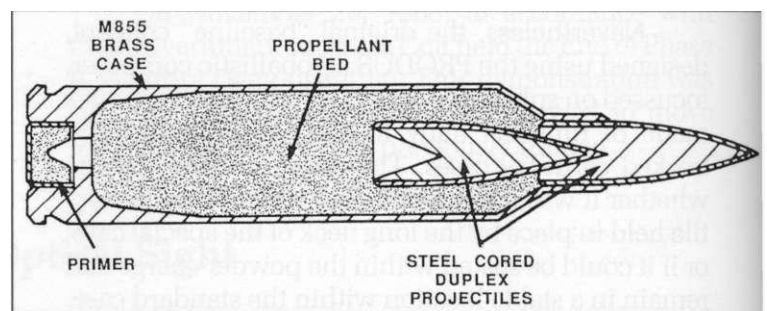


67. The three *types* of ammunition with which Colt experimented during the development of the ACR.

Left: the baseline subcaliber cartridge. Note the long neck of the special cartridge case.

Center: the subcaliber SLAP (Sabot Launched Armor Piercing) round.

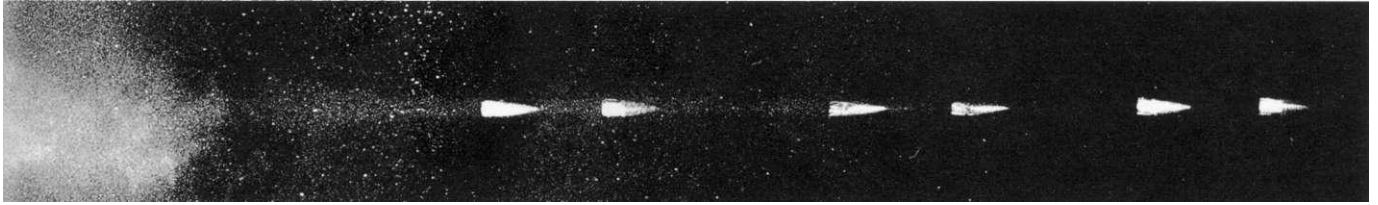
Right: the final selection, the 5.56x45mm duplex cartridge.



68. A line drawing showing a sectioned view of the final version of the Colt ACR duplex cartridge.

US Army drawing

identification purposes. The trailing projectile weighed 33 grains. By design the trailing projectile was supposed to disperse, so that if 100 duplex rounds were fired at the middle of a target, the



69. A high-speed photograph showing a three-round burst of Colt ACR duplex ammunition proceeding downrange in an exemplary fashion.

Results like this were only obtained after an immense amount of research and trial, and careful attention to quality control. courtesy Harold Waterman

"leaders" would produce 100 hits in a center group and the 100 "trailers" would impact in a random 360° circle at some distance around the center group. This would increase hit probability if aim was not precise. The trailing projectile had a step manufactured in the base to ensure that there was "built-in" dispersion.

Both bullets incorporated hardened steel cores surrounded by copper gilding jackets. This round produced a chamber pressure of approximately 55,000 psi, and both projectiles were launched at a muzzle velocity of approximately 2,900 fps.

The maximum effective range of the duplex ammunition was approximately 325 meters. For engaging targets at longer ranges, it was envisaged that the rifle would be loaded with standard M855 ball ammunition, which had an effective range out to 800 meters.

Without considering other factors such as wind velocity and direction, the 62-grain M855 ball bullet drops 19" in the first 300 meters, and the drop at 600

meters is 119". Not surprisingly the duplex bullets, each of which was approximately half the weight of the M855 ball projectile, were affected in a similar but more pronounced manner. Due to their lower mass and muzzle velocity, they drop 28" at 300 meters and 220" at 600 meters. For this reason, it was mandated that only targets under 325 meters away should be engaged with this cartridge.

While still considered acceptable, the finalized duplex cartridge also had a lesser penetration capability compared to the M855. During testing at Aberdeen Proving Grounds, the duplex ammunition penetrated Soviet body armor at 300+ yards.

The other problems encountered were with "flyers". The dispersions were noted in Colt's ACR Program Manager Richard Brown's final report, which stated that in Colt/Olin testing the leading projectile produced approximately 3" (+) dispersion, and the trailing projectile approximately 9.77" (+) dispersion as per specification.

**Drift Table (Inches)**

M855 Ball		Range (yards)	ACR Duplex	
Wind Speed			Wind Speed	
5(MPH)	10(MPH)		5(MPH)	10 (MFH)
4"	8"	300	10"	20"
8"	16"	400	21"	42"
14"	29"	500	37"	74"
21"	43"	600	57"	114"

## Phase III - Delivery of the Finalized Colt ACRs

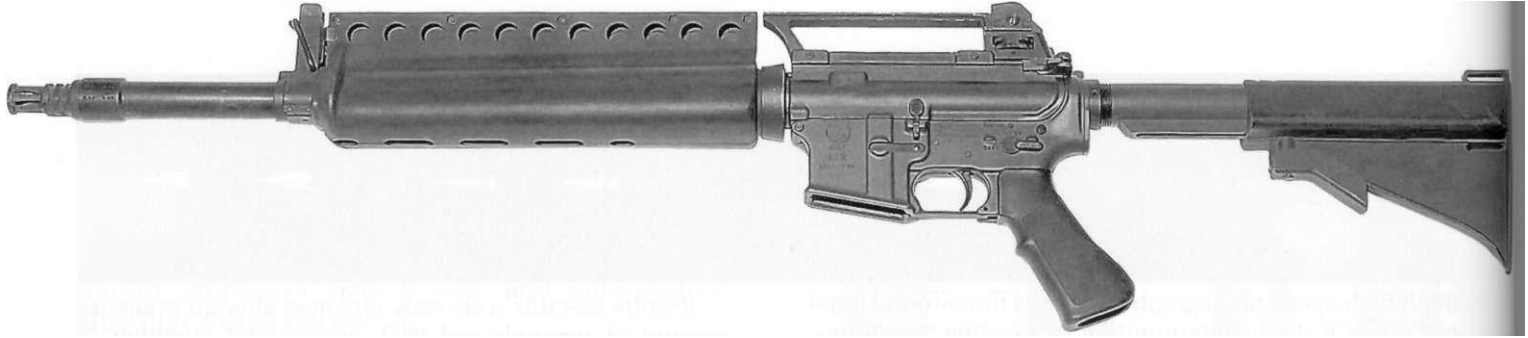
Final deliveries of the Colt ACR were slightly delayed due to lack of sufficient "Phase III duplex" ammunition. This caused no interruption in the Army's evaluations, however, and safety testing resumed. Colt's made additional hardware deliveries beyond the original scope of the contract.

The Phase III government test plan imposed a stringent limit on the use of training aids and devices. The program office plan was therefore reviewed,

with particular emphasis placed on the training required to support the testing.

Final Colt test firing at Blue Trail Range in Connecticut was conducted on May 9-12, 1989. The purpose of this test phase was to preview the training and firing techniques developed for the Phase III test program, which would include zeroing with both iron and optical sights, trigger pull discipline, and combat firing techniques.

60 Phase III - Delivery of the Finalized Colt ACRs



70. Left side view of Colt ACR serial no. CACR004, as submitted for military trial on March 9, 1989.  
official US Army photograph by Todd Mozes,  
Photographic Services, Picatinny Arsenal

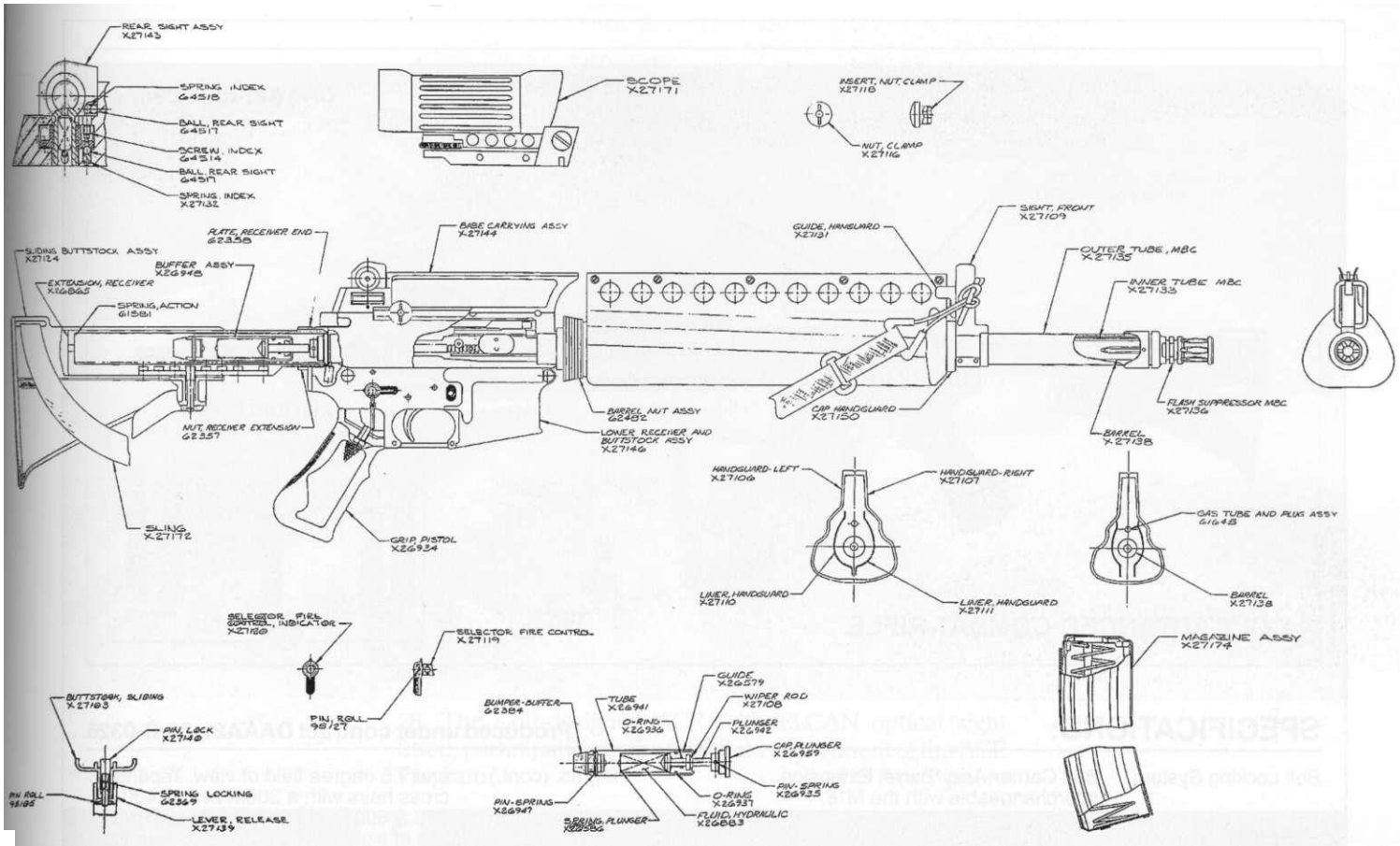


71. Left side closeup of Colt ACR serial no. CACR004, showing markings.  
official US Army photograph by Todd Mozes,  
Photographic Services, Picatinny Arsenal

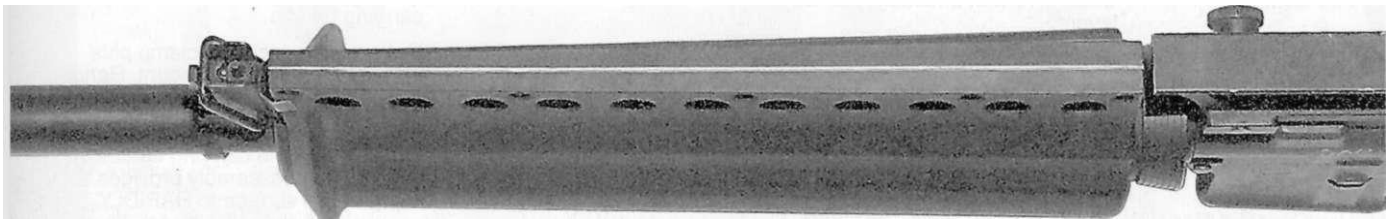
72. Left side closeup of the lower receiver extension of Colt ACR serial no. CACR004, showing multiple stock adjustment points.

official US Army photograph by Todd Mozes,  
Photographic Services, Picatinny Arsenal





73. A reduction of a large training chart produced by Colt, showing various features of the finalized Colt ACR as submitted for military trial. © 2003 by Colt Defense LLC. Used with permission, all rights reserved



74. Left side closeup of the finalized Colt ACR, with the rifle tilted slightly to show the white line running down the middle of the sight rib.

official US Army photograph by Todd Mozes,  
Photographic Services, Picatinny Arsenal

Colt provided technical support to the Army during the Phase III testing at Aberdeen. From July 17 - 28, 1989 the military trainers who supported Colt's Phase III field tests were themselves trained. This consisted of firing approximately 1,000 rounds from five ACR rifles. Throughout the training, no malfunctions occurred with either the firearms or ammunition. The duplex ammunition exhibited accuracy beyond the expectations based on previous

testing and system studies, resulting in an increase in maximum implementation range for offensive fire of from 300 to 400 meters, and possibly beyond, for defensive use, if lethality studies showed the round to be effective at these greater ranges.

An additional endurance test was conducted from December 12-16, 1989, during which a total of 6,000 rounds were fired (25% M855 and 75% duplex). The cyclic rate averaged 654.3 rounds per



DAAA21-C-86-0367

IRON SIGHT WITH CARRYING HANDLE

3.5X POWER OPTICAL SIGHT

**SIGHT GROUP**

**COLT ADVANCED COMBAT RIFLE**

**AMMUNITION**

M193-6      5.56 mm DUPLEX      M 855-6

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### SPECIFICATIONS:

Bolt Locking System.	Bolt Carrier Assy/Barrel Extension interchangeable with the M16.
Gas System.	Basic M16.
Feed System.	M16 design including Magazine.
Muzzle Brake Compensator.	1" dia. x 5.0" long. Reduces free recoil by 40 + %. Muzzle flash & blast levels equivalent to the M16.
Recoil Buffer.	Hydraulic-Reduces/eliminates peak recoil forces to the gunner.
Fire Control.	Basic M16 with ambidextrous safety levers.
Mode of Fire.	Selective: Safe; Semi(auto); Full(auto).
Rate of Fire.	Approximately 650 Rounds Per Min.
Weight w/o Magazine.	8 Pounds.
Length, Overall.	Stock fully closed - 37 inches. Stock fully extended - 41 inches.
Use/Cartridge/Mode.	Short range - Duplex - Iron/Auto. Mid range - Duplex - Scope/Semi. Long range - M855 - Scope/Semi.
Assembly/Takedown.	Basic M16.
Upper Receiver Assy.	Modified M16.
Lower Receiver Assy.	Modified M16.
Sights.	Iron aperture Zeroed at 300 M. (M855). Coincident at 225 M. (Duplex). Precision click adjustment to 600 M. range.  Optic Sight 3.5 power with 3" eye relief

**Produced under contract DAAA21-86-C-0326**

Sights. (cont.)	and 7.5 degree field of view. Tapered cross hairs with a 300M zero & 400, 500 & 600 M stadia lines. Has same line of sight as the iron sight. External zero adjustment. Optics include laser filter. Optional special purpose sights are accommodated by the dovetail design of the Upper Receiver. Upper Receiver incorporates mounting dovetail and locating cross grooves.
Sight Mount(s).	Iron sight system includes clamp and carrying handle.  Optic system includes clamp plus zeroable & adjustable mount. Range adjustment to 800 M.
Handguard.	Incorporates a sighting rib, which together with the carrying handle on the Iron Sight assembly provides a shotgun like surface to RAPIDLY acquire and engage a target. The gripping surfaces are specially designed for handling control and safety.
Pistol Grip.	Configured for maximum comfort and utility for all hand sizes with or without gloves.
Buttstock.	Sliding buttstock on Lower Receiver extension tube with positive stops provide a 4" range of adjustment in length of pull. (Trigger to Buttplate dimension). Incorporates cheekpiece for either left or right handed shooters.

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P.O. BOX 1868, HARTFORD, CT. 06144-1868



76. The Colt-designed ACR with ELCAN optical sight fitted, participating in the final field experiment of the ACR Program.  
US Army photo



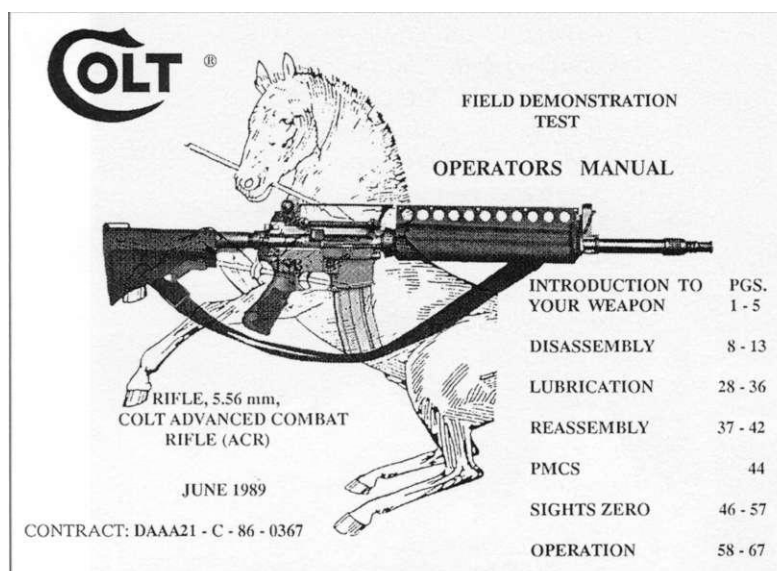
77. Colt's elated ACR design team in a photo dated May 17, 1989, one day before the last fifteen weapons were submitted for military tests.

Top row, left to right: George Podgorski, Dave Camera, Dave Ferris, Dave Dimauro, John Brunner, Bob Dudek,

Phil Hayes, Paul Kennedy and Frank Ciunel.

Bottom row, left to right: Ron Giddish, Richard Brown (Project Leader), and Harold Waterman.

Not shown: "Mac" McCoan, Greg Sperling, Henry Tatro, Ed Winter, Jim Taylor. courtesy Harold Waterman



78. The cover of the Colt ACR Operator's Manual, prepared and submitted as part of Colt's technical support to the Army during the Phase III testing at Aberdeen.

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minute. Accuracy was acceptable, and the bolts would consistently lock open on the last shot, even when the rifles were extremely fouled.

The assembly of the first six ACR rifles was completed by February 28, 1989. Acceptance testing began immediately, using a mix of M855 and duplex ammunition. The acceptance test criteria were identical to those for the M16A2 rifle, with one change and one addition. The change involved the acceptable cyclic rate of the ACR (650 +/- 50 rpm). The addition was the stipulation that the duplex ammunition projectile pair must shoot to within a 16" circle at 50 yards. Zeroing procedures were confirmed during this testing.

On March 9, 1989, one day earlier than stipulated in the contract, the first five Colt ACRs to be completed and acceptance tested for function and accuracy were delivered to Aberdeen Proving Grounds. There was an initial shortage of duplex ammunition, with only 11,200 out of the required 15,000 rounds in Army hands, but by March 19 the remaining quantity had been delivered. Final acceptance testing was completed in early May, and the final 15 Colt ACR rifles were delivered on May 18, 1989.

## On the Way to the MIL-STD-1913 Rail

On August 16, 1989, Richard Swan, president of ARMS, Inc., was sent a sample Colt ACR along with a purchase order from Colt's to improve the strength of the rails. This was approximately three months after all the ACR rifles were shipped.

As further discussed in Chapter Three, the standardized dimensions of the improved rail that Swan designed in response to Colt's request were eventually adopted as the MIL-STD-1913 rail.

## The End of the Road for the Duplex Cartridge - and the ACR Program

At first glance it might appear that the ACR program was a flop, in that in the end none of the ACR contenders emerged as a replacement for the existing arsenal of conventional rifles. However, the unprecedentedly sophisticated data collection systems developed for the program, which included the ability to not only record hits but to actually measure the

amount by which a shot missed the target as well, led to some highly encouraging conclusions regarding the ACR contenders, plus an upwardly revised opinion of both the M16A2 and the soldiers who participated in the program. The following are some final excerpts from the ACR Program Summary:

### Conclusions

*As a technology base program, the ACR program is considered to be a success. Although the desired hit probabilities were not achieved, significant advances in the state-of-the-art in rifle technology have been made. New gun mechanisms have been designed and proven, and the feasibility for reduced combat load through the use of lightweight plastic-case and caseless ammunition has been demonstrated. All rifle systems performed well in the stressed environment of the field experiment. The baseline performance of the M16A2 rifle was better than anticipated in terms of hit probability. This experiment for the first time has established a statistically valid data base on rifle performance in an operational environment . . .*

No rifles showed an increase in probability of hit over the M16A2 under the stressed conditions of the test. This is primarily because the soldiers performed better than expected; meaning aiming errors were smaller than anticipated. Therefore, the salvo burst sizes were too large to effectively increase the probability of at least one projectile hitting the target. Another contributing factor is that the burst size actually obtained from the weapons was somewhat greater than that originally requested . . . . The instrumentation on Buckner Range not only allowed for more accurate data to be collected in an operational setting, but for the first time allowed for aiming errors to be measured directly from the miss distance information.

The stressors used in this test to replicate aiming errors expected in combat were the task-induced stressors of target behavior and movement. Additional factors of physical exercise prior to firing a scenario also helped to further stress the shooter. Peer pressure and competition was used to motivate the troops during the extended duration of the test. It is unlikely that additional stressors, short of actual combat, could have been used in this test. The aiming errors generated in this test are considered to be an accurate reflection of current weapon system performance. This data base will remain the basis against which all individual weapons will be assessed well into the future.

The feasibility of caseless and lightweight plastic-cased ammunition has more than been demonstrated in this program. Few problems were experienced with the caseless rifles in the test. The past technical barriers of cook-off and vulnerability have now been overcome . . . .

The plastic-cased system had many problems of failing to obturate the gun chamber and venting gases into the buttstock early in the test . . . . However design solutions are known and had another weapon design iteration been possible it is likely that this problem would be effectively solved. Complete plastic cases cannot be used in conventional weapons like the M16A2, but with weapons specifically designed for it, complete plastic cases are feasible.

Many advances in high-performance rifle fl  chette technology have been made during this effort. New engineering plastics and sabot designs have solved previous launch reliability problems. Although significant advances were made in reducing fl  chette round-to-round dispersion, the dispersion of fl  chettes is still greater than that of bullets. This is the reason that the fl  chette rifles did not exhibit the hit performance of the bulleted rifles. It is unlikely that the round-to-round dispersion will be reduced further, which would likely preclude fl  chettes from further consideration as single shot rifle projectiles. Their high cross-sectional energy density and large length-to-diameter ratio make them very effective against all small arms targets. This, together with their flat trajectory and short time of flight, make them attractive for consideration in crew-served and area-fire applications.

Salvo rifles can be effective in increasing hit probability under conditions of large aiming errors. However, with the size of the aiming errors experienced in this test, a significantly smaller burst size would be required than those produced by the rifles in this program. It is unlikely that sufficiently small burst sizes could be obtained and controlled to effectively improve performance with the aiming errors now known to exist . . . .

The technology gains made under this program have opened the possibility of utilizing new weapon concepts to meet future needs and requirements. These technology gains as well as the development of a statistically sound data base have significantly advanced the state-of-the-art in rifle and individual weapon technology, which was the primary goal of this effort.

For Colt, while the performance of the M16A2 was upheld as "better than anticipated in terms of hit probability", neither the Colt ACR rifle nor the duplex round was ever type classified or put into production, although the experience gained with this initial "flat-top" receiver soon bore fruit in the successful M4 carbine, discussed in Chapter Three.

Interestingly, the Marine Corps later requested that Winchester/Olin produce duplex ammunition for use in street- and house-to-house fighting during Operation Desert Storm, but Winchester/Olin declined.

### Chapter Three

# The M4/M4A1 Carbine

## The "Shorty" Program Revisited

**A**s discussed in Chapter Fifteen of *The Black Rifle*, the XM177E2, the culmination of the original "shorty" program, had been discontinued for lack of financial resources during the latter days of the US military presence in Vietnam, and thus this project had never been entirely completed nor the weapon fully refined. However the benefits of a lightweight, easily-maneuvered carbine-type arm firing the standard 5.56mm cartridge remained quite evident, and Colt's had never completely given up on the development of a shorter, more compact version of what had meanwhile become the newly-adopted M16A2 service rifle. These early prototypes were basically the same as the 1965-vintage CAR-15 (Colt

Automatic Rifle-15) and XM177/XM177E2 carbines, but embodying the improvements Colt had introduced during the intervening years.

As early as mid-1982, the US government had expressed interest in a redesigned and upgraded carbine variation of the M16A2 weapon system. By 1984, the government was looking to procure their second general-purpose carbine of the 20th century which, like the M1, M2 and M3 carbines before it, was initially intended for the use of rear-echelon troops and others who needed more firepower than the pistol could provide, in a compact and easy-to-carry package.

## Origins of the XM4

After the adoption of the M855 5.56x45mm NATO cartridge, the primary focus was on the development of a carbine that would utilize this new ammunition. A meeting was held at Colt in September, 1984, to begin the development of the new carbine, which would become known as the XM4. At this meeting design features, upgrades and requirements were examined.

Additional meetings followed to clarify the new project, after which a procurement contract, no. DAAA21-85-C-0192, was signed on June 12, 1985. Under the terms of this contract, Colt was to furnish the US government with forty XM4 carbines for test and evaluation by February 7, 1986. Colt assigned Richard Brown, soon due to retire, as the initial XM4 Project Manager.

### The Major Features, as Defined by Contract DAAA21-85-C-0192

*. . . Design to utilize the newly adopted M855 Ball and M856 tracer cartridges. Also to be compatible with existing M193 Ball and M196 tracer ammunition as well as M200 blank cartridges.*

*The carbine will use the current M16A2 upper receiver and three-round limited burst control.*

*The carbine will use an improved handguard to enhance firing/handling under normal operation conditions.*

*The carbine shall have a collapsible/sliding stock.*

*Barrel should be 14 1/2 inches in length.*

*Mean Rounds Between Stoppages (MRBS) will equal or exceed 600 rounds when using issue M855 ammunition.*

*The carbine will be configured to accept MILES laser transmitter as well as the M203 grenade launcher.*

## The Emphasis Shifts from Parts Commonality to Performance

As noted, when the XM4 project was initiated in 1984 it was envisaged that carbines would be used mainly if not exclusively by support troops, and consequently the emphasis was on ensuring that the maximum number of components would be interchangeable with their counterparts in the M16A2 rifle. However, by the time the M4 and M4A1 carbines went into production a decade later in 1994, the end users had become frontline fighting units such as the SEALs, Special Forces and Airborne Divisions. This change had a significant influence on the Pre-Production Engineering (PPE) program, in that the primary emphasis had shifted from parts

commonality to performance. The Technical Data Package (TDP) was altered in response to this change in focus, to include all the performance-enhancing modifications Colt had developed for the M16A2.

Due to the different dynamic operating characteristics exhibited by the short-barrelled carbine the issue of commonality of parts was seen as restrictive, and as such this was of great concern to the designers. Parts commonality restrictions made good logistical sense, but the different operating characteristics of carbines versus rifles mandated many waivers to this restriction.

## Building and Testing the Initial Prototypes



79. Right side view of the XM4 carbine, the experimental version of the M4.

As originally designed, the carbine utilized the standard fixed carrying handle and M16A2 sights.

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To begin with, twenty-five carbines were built using the few XM4 components that were then available. The barrels used were standard Colt Model 723 chrome-lined 14 1/2 barrels, rifled with a 1 turn in 7" twist. The buffers first tested were a special Colt design, heavier than the standard carbine buffer. The gas port placement and the different bullet weights of the 55-grain M193 ball and 62-grain M855 ball loadings were found to affect the carbine's performance much more than the rifle's.

With the earlier AR-15/M16 series carbines (which included guns with 11 1/2" as well as 14 1/2" barrels), it had been found that cyclic rates could exceed 1,000 rounds per minute, depending on the type and manufacturer of the ammunition, and also the ambient temperature in which the weapon was fired. The gas port diameter was consequently tailored to fit the particular ammunition requirement, environmental extremes and after-port bore time.





80. The Colt M4 design team.

From left: Larry Robbins, "Mac" McCoan, Ahmed Ma-sood, Ken Maynard (M4 Project Manager), Kevin Kamin-ski, John Kyser, Jim Taylor, Chris Lynch and Derry Bailly.  
courtesy Jim Taylor

## Determining the Optimal Gas Port Size

In an effort to decrease the cyclic rate of fire, the gas ports on these carbines were initially bored to a reduced diameter of 0.062", so that they could be opened up if desired during further experimentation. During testing, it was found that M855 ammunition fired more reliably in the XM4, producing 20 malfunctions in 4,680 rounds, than did M193 ammunition, which produced the same total of 20 "failure to feed including bolt-over-base" malfunctions in only 600 rounds. These serious malfunctions were found

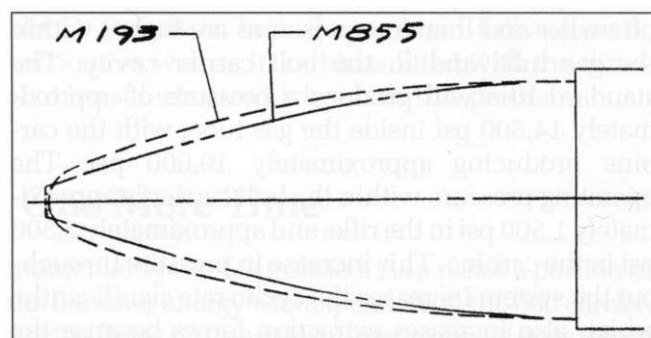
to occur regardless of whether the original .062" diameter or a larger .066" diameter gas port was used.

Further testing was conducted with a gas port diameter of 0.0625". Colt sent six XM4 carbines in this configuration to Fort Dix for hot weather (150°F) and cold weather (-50°F) testing, where it was determined that this gas port diameter performed well in cold temperatures, with no carbines failing due to "lack of power".

## Designing the New M4 Receiver

### Correcting Failures to Feed

Failures-to-feed had been noted in standard M16A2 rifles on occasion, but this condition was much more common in the carbine variations. The root of the problem was found in a combination of the higher cyclic rate (and hence bolt velocity), and the shape of the M855 projectile itself. Dimensionally, the 62-grain M855 ball projectile is longer and heavier than the 55-grain M193 projectile, so the centers of gravity differ. In addition, the M855 has a noticeably flatter secant ogive, and thus a sharper tip radius, than does the less-aerodynamic M193 with its "rounder" tangent ogive. It was suspected that these parameters were affecting the feeding process, which was already affected by variances in "magazine reaction", the time needed for the shot column to be moved up by the follower and spring. This takes longer with a full 30-round magazine and speeds up, as does the



81. Colt drawing showing the profile of the SS109/M855 Ball 5.56mm NATO projectile (solid line) compared to the then-standard M193 bullet (dotted line). This change in shape prompted a redesign of the feed ramps on the XM4/M4 carbine.

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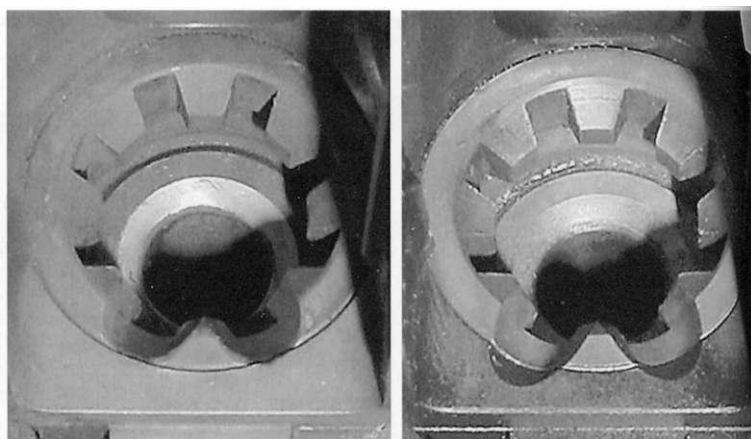


cyclic rate, as rounds are expended. Because of the higher bolt velocity and the resulting more rapid forward motion of the feeding cartridge, the nose of the heavier M855 bullet did not have time to rise high enough to enter one or other of the feed ramps on the barrel extension, and the bullet noses were stubbing on the upper receiver under the barrel extension, causing failures to feed. The exact, or specific, cause of this problem was never ascertained, but it was concluded that it was due to a combination of the higher cyclic rate, shorter buffer, the plastic collapsible stock, higher bolt velocities, and the different balance characteristics and the sharper bullet point of the new M855 ammunition.

To cope with this, the angle on the feed ramp cuts in the barrel extension was altered from 45° to 52°, and the two half-moon ramp cuts were themselves extended down into the vertical face of the upper receiver, below the barrel extension.

The initial XM4 design also exhibited some problems relating to resistance to feeding, where the first few cartridges from a full 30-round magazine would stall on the ramp, having been caught in the groove formed by the intersection of the barrel extension and upper receiver. These failures to feed were particularly apparent when firing from the shoulder.

The solution to this problem was found in a modification to the barrel extension, wherein the



82. Closeup comparison of the standard feed ramps on the M16A2 rifle, left, and the extended ramps on the XM4/M4 carbine (right), instituted as a result of the problem of failure to feed.

This new barrel extension and upper receiver would only be used for carbines, and eventually the Mk12/SPR rifles. The failures to feed were never a problem with the standard M16A2 rifle or any other full-sized rifle.

edges were broken on the locking splines. This, in combination with the modified feed ramp cutouts in the upper receiver, resulted in the development of a new upper receiver assembly specifically for the XM4/M4/M4A1 carbine. These new receivers are identified by the marking "M4", or sometimes just "4", on the front face above the gas tube hole (fig. 441).

### Remedying Failures to Extract

Failures to extract, a problem from the past, returned to dog the initial XM4 carbine development. It was to be expected that the physical characteristics of the carbine, which differ from those of the full-size rifle, would change the carbine's functioning parameters. Due to the gas port on the carbine being located much closer to the bolt carrier than on the rifle, gas is bled off earlier and therefore pressures are higher within the gas tube and in the bolt carrier cavity. The standard rifle will produce a pressure of approximately 14,500 psi inside the gas tube, with the carbine producing approximately 19,000 psi. The operating pressure within the bolt carrier is approximately 1,500 psi in the rifle, and approximately 2,500 psi in the carbine. This increase in pressure throughout the system increases the cyclic rate significantly, which also increases extraction forces because the residual pressure in the fired cartridge case is higher, since it is being extracted before the internal pressure has dropped to the level where extraction occurs in the rifle. This can lead to two basic problems: failure to extract, and premature bolt wear and breakage.

The higher cyclic rate of the carbine versions led to a *deja-vu* type of experience, not unlike the initial extraction problems experienced with early M16 and M16A1 rifles during the changeover from IMR to ball powder. The problem was largely solved by strengthening the extractor spring, in order to provide additional grip on the cartridge rim and prevent the extractor from slipping off the rim when unusually strong extraction forces were encountered. Colt's designed a specific extractor spring assembly for the carbines, which could also be used in standard rifles as well. This consisted of a stiffer extractor spring, identified by its gold color, fitted with a stiffer composite internal buffer within the spring to provide additional resistance to load on the spring. This special insert is identified by its black color.

Many experts in the field claim that Colt's specific extractor spring assembly is an essential modification which plays a critical role in the reliability of the M4 and M4A1 carbine. Nevertheless, the government initially rejected the use of the new spring, because they did not want to add a new part to the inventory. At one point they decided to install M231

port firing weapon extractor spring assemblies in carbines, due to the fact that the part number already existed, but this was later rescinded.

Colt installed this modified extractor spring assembly in all weapons they sold, with the excep-

tion of the M4 and M4A1 carbines sold to the US government, until the government accepted the new spring assembly in mid-2003.

### Coping with Faster Bolt Wear

The bolt used in the M4 carbine is exactly the same as the bolt designed for use in the rifle. In the rifle, due to the gas port being positioned farther toward the muzzle of the barrel and the resulting longer gas tube, the gas pressure is lower when it reaches the bolt carrier, and thus bolt velocity is slower, resulting in less impact wear on the bolt. In the carbine, due to the higher gas pressure in the bolt carrier cavity, the bolt carrier accelerates more rapidly during the unlocking phase. The carbine bolt is thus more prone to failure in the cam pin hole area, and also exhibits earlier cracking in the lug roots for reasons that are not completely understood.

The average life of the bolt in a standard rifle is approximately 25,000 rounds, which is considerably higher than the conservative 6,000-round life expectancy listed in the military specifications. Higher bolt velocities and impacting stresses on the bolt in the carbine result in substantially more battering, and the bolt life can decrease to approximately 20,000 rounds, even in normal use. With extreme conditions such as extended fully-automatic fire, this number will decrease substantially.

Most of the improvements in the durability of the bolt were achieved through process refinements such as more consistent surface finish in the cam pin

hole, improved control of the phosphating process, improved heat treatment, and precise control of stock removal after hardening. Colt engineers conducted a life test on an M4 carbine bolt which showed that small cracks detected in the bolt lug area did not produce unacceptable part life. The bolt was fired to failure, and lasted more than 24,000 rounds.

Nevertheless, Colt had designed a modified bolt and barrel extension for use in the carbines, to cope with the higher rates of fire and impact. When these were presented they were deemed unnecessary, due to the fact that DoD was fully satisfied with the life expectations of the standard bolt, which exceeded their specifications and requirements, and therefore they did not feel that these new components would offer a significant enough benefit to justify the cost.

As of this writing, however, Colt engineers are continuing to seek out new ways of increasing the durability of the bolt. As discussed in Chapter Four, with the M4/M4A1 carbines being used as front-line weapons by the United States Special Operations Command (USSOCOM), it has become evident that certain components need to be strengthened to meet significantly more demanding requirements than those for which the M4 carbine was originally intended.

### Improving the Semi-Automatic Disconnecter Spring

Experiences with commercial/law enforcement carbines after the XM4 program indicated that due to the more substantial bolt carrier closing force of the carbine, combined with the relatively lightweight platform, a failure of the hammer to be fully engaged by the disconnecter was causing a "doubling" mal-

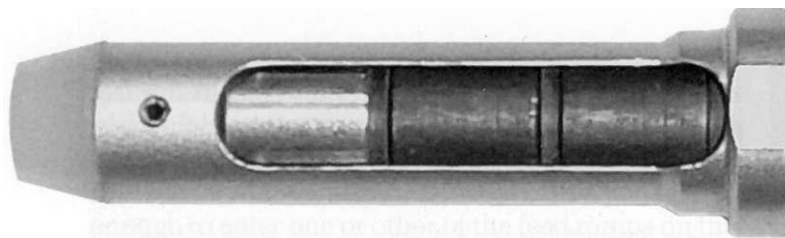
function. In the early 1990s Colt introduced a new heavier semi-automatic disconnecter spring (painted black), for use in both the standard full-automatic versions as well as in carbines fitted with the three-shot burst feature, which solved this problem.

## Saved By The Buffer, One More Time

During the XM4 development phases, the high cyclic rate during automatic or burst fire exacerbated a problem with light firing pin strikes, due to bolt carrier bounce as the bolt completes its cycle and goes into battery. Investigation showed that after the bolt initially rotated into the lock position and the sear trip released the hammer, the bolt carrier would bounce back off the barrel extension, so that when the hammer struck the firing pin the bolt carrier was

momentarily not fully closed. As a result a portion of the hammer energy was expended on the bolt carrier, not the firing pin, and the primer received only a light strike which did not fire the cartridge.

Colt experimented with several heavier solid buffers, which when tested produced bolt bounce so severe that it was hardly possible to get through a single three-shot burst without a malfunction. These buffers did decrease the cyclic rate, but functional



83. Cutaway view of the finalized M4 carbine buffer, developed to further dampen bolt carrier bounce and introduced in 1994. In this new "heavy" buffer a tungsten weight was substituted for one of the three standard steel weights, to more than double the weight of the standard buffer weight. cutaway by Ken Elmore

reliability was unacceptably compromised, and so no further testing was conducted with solid buffers.

Another new buffer was developed which functioned the same way as the standard carbine buffer, relying on the "cascading" weights and the neoprene bumpers to dampen bolt bounce, but utilizing a heavier-walled steel body. By increasing its mass, it was thought that the heavier buffer would deal with two major issues, both decreasing the high cyclic rate and further damping the bolt bounce to prevent light firing pin strikes.

During testing, ten carbines were equipped with the standard carbine buffer and fired in 120-round cycles. Each cycle consisted of firing four 30-round magazines, with the first two magazines (60 rounds) fired in three-shot bursts and the last two magazines

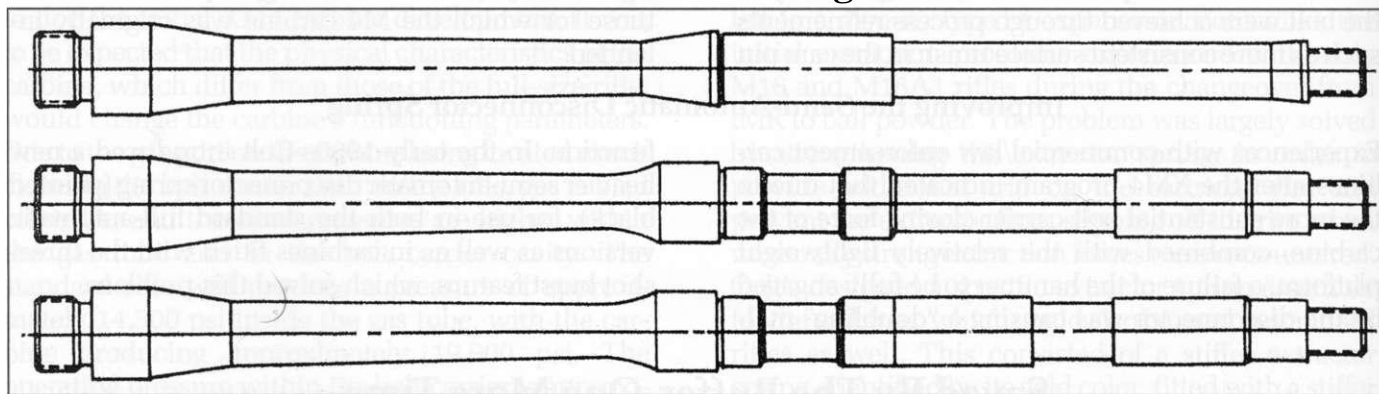
(the remaining 60 rounds) fired semi-automatically. Three firing positions were tested; a recoiling mechanical endurance mount; technician shoulder firing; and technician hip firing. A total of 7,200 rounds were fired during this test. A similar test was conducted using the heavier buffer, which resulted in a total of 40 malfunctions caused by bolt bounce.

Additional buffer designs were tested, one using lead-filled steel weights and one using tungsten carbide weights. Even though cyclic rate reduction was achieved, it was felt that these would be cost-prohibitive.

At length the decision was made to re-focus attention on testing different gas port diameters, and to stay with the standard Colt carbine buffer. This buffer remained in use until the final buffer design was implemented in 1994.

The new shorter buffer used in the finalized M4/M4A1 carbine is fitted with one heavy weight made of tungsten carbide, which weighs as much as two standard steel weights, plus two additional standard steel weights. When the bolt assembly and buffer are moving forward, the weights are held to the rear of the buffer assembly by inertia. Upon bolt carrier impact (following bolt impact) the buffer weights slide forward, impacting the front of the buffer just as the bolt carrier begins to bounce back, efficiently damping or "killing" the bounce.

## The XM4 Barrel Configuration



84. Colt engineers experimented with several different barrel profiles during the M4 development phase.

One requirement was that the barrel had to be able to

mount the M203 grenade launcher.

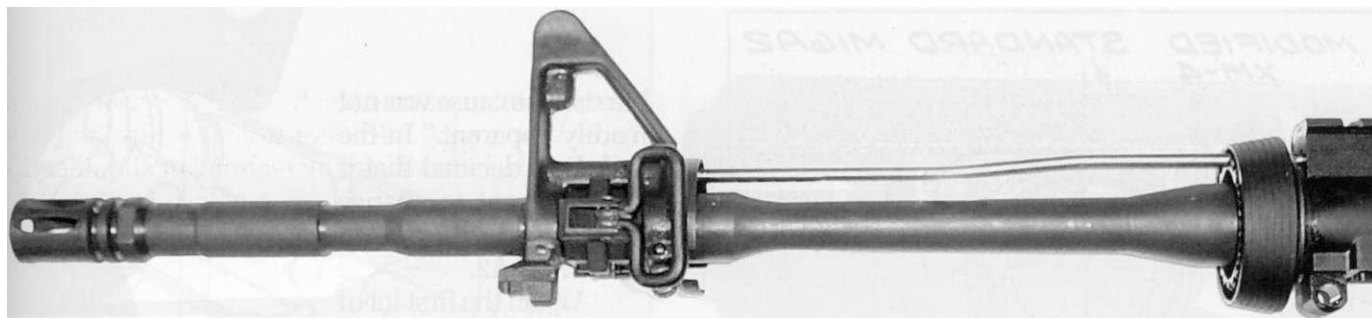
The third design shown (below) was chosen.

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In the initial carbine contract the government specified four major requirements for the XM4 barrel, as follows:

1. Utilize the government-specified 1 turn in 7" twist of the M16A2 rifle barrel, in order to stabilize the M855 ball and M856 tracer.
2. Barrel length will be 14 1/2 inches.
3. Must use the current M16A2 compensator.



85. Left side view of the government-specified, final production M4 barrel profile, just like the M16A2 in that the barrel is light under the handguards.

Note the sling swivel, which may be mounted on the left or right side of the front sight assembly, so a sling can be used with the M203 grenade launcher installed.

4. Must be adaptable for a top sling mount.

The XM4/M4 barrel configuration, as specified in the Technical Data Package (TDP), is as follows:

1. 14 1/2 inches in length.
2. Standard M16A2 5.56mm interior barrel bore and chamber configurations and dimensions, with a chrome-lined bore and chamber.
3. Standard M16A2 button-rifled barrel with six lands and grooves, 1 turn in 7-inch right-hand twist.
4. Use of standard gas port location for carbine barrels.
5. The gas port size will be .0625 inches in diameter.
6. Use of the standard M16A2 compensator.
7. Barrel will have the same exterior configuration from the barrel extension to the

handguard cap shoulder, just behind the after surface of the front sight assembly.

8. Use of standard carbine gas tube.

The exterior diameter of the barrel from the front sight forward is the same as the diameter of this portion of the M16A2 barrel, with the mounting groove being left the same diameter as the original M16/M16A1 barrel. This allows for the attachment of M203 grenade launcher mounting hardware, and also enables the attachment of an unaltered M16A2 MILES laser transmitter.

During the development phases the sustained rate of fire and "cook-off points of the XM4 were found to be comparable to those of the M16A2 service rifle. During testing it was found that after firing approximately 174 rounds at a rate 85 to 87 rounds per minute, including 10 seconds to reload, it took 55 seconds for the round in the chamber to ignite.

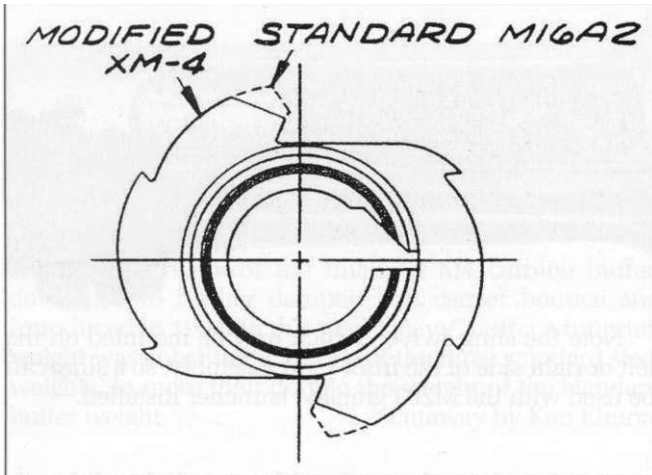
## Modifications to the Burst Cam

During endurance firing with the three-round burst mechanism engaged, a four-round burst was experienced. This phenomenon was easily detected by Colt's newly-acquired computer cyclic rate monitor, which showed a blip for each round fired. It was noted that, following the first four-round burst there were two complete three-round bursts and then another four-round burst. Analysis showed that these four-round bursts were in fact three-round bursts followed by a fourth shot which fired when the trigger was released. Investigation showed that this was caused by the upsetting of the rear capture hook of the disconnecter, the fourth shot occurring when the disconnecter hook lost engagement with the hammer disconnecter shelf before the primary trigger sear nose engaged the hammer.

This condition had been experienced during the development of the M16A2 rifle, fitted with the

original burst mechanism designed in the 1960s by Colt's senior product engineer Foster Sturtevant, when truncating the teeth on the cam had solved the problem of these non-conforming bursts. The teeth on the XM4 cam were experimentally even further truncated, but this did not solve the problem with the non-conforming bursts in the XM4.

The solution was found in basically returning to the original Sturtevant cam design, with removal of additional material from the top of the deep notch tooth on an approximate 45° angle, while defining the top of the tooth release point with a 90° angle on the inside of the leading edge. This enabled the deep notch tooth to rotate forward earlier in the cycle, and allowed the burst disconnecter to drop into the deeper notch and stabilize its motion prior to being struck by the rearward rotating hammer as it was being cocked.



86. The dynamics of the carbine, with its increase in cyclic rate, caused some problems when utilizing the burst cam designed for the full-size M16A2. This experimental cam allowed the disconnecter claw to engage sooner, preventing the failure. ©2003 by Colt Archive Properties LLC. Used with permission, all rights reserved

The reason this had been experienced in the carbine rather than the rifle was again due to the different firing dynamics of the carbine, with its higher bore pressure at the gas port tap-off location and the faster timing of the initial hammer/burst disconnecter impact.

The final M4 Carbine Production Engineering Report, produced in 1997, stated that the modified burst cam was tested in both Colt and FN M16A2 rifles, in order to investigate the possibility of its being utilized in the standard M16A2 as well. This new burst cam was found to be very sensitive to tolerances, and the conclusion was that while the Colt M16A2 rifles performed well, the FN rifles "fared poorly in exhibiting large numbers of nonconforming

bursts. The cause was not readily apparent." In the end, DoD decided that it did not want to change over to the new burst cam in the M16A2.

When the first lot of M4 carbines were submitted for qualification testing, they displayed a large number of nonconforming bursts which caused the entire lot to be rejected. Colt engineers investigated and found that all the cams were within specification, but that they would not perform properly in all tolerance conditions. This was partially due to minor process changes which caused enough of a shift in the part tolerances so that the burst disconnecter hook failed to engage the deep notch on the cam. This was confirmed by the use of high-speed motion pictures. The final modification to correct the problem was a full profile on the large tooth, the same as on the original Sturtevant cam. This permits the hammer to pull the cam backwards when the trigger is released and reposition it so the amount of hammer rotation is not critical.



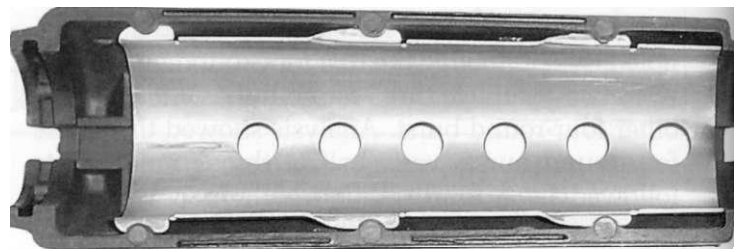
87. The final design of the M4 burst cam. This cam is nickel-plated to differentiate it from the standard rifle burst cam.

Like the prototype, the disconnecter claw engages sooner to catch the hammer.

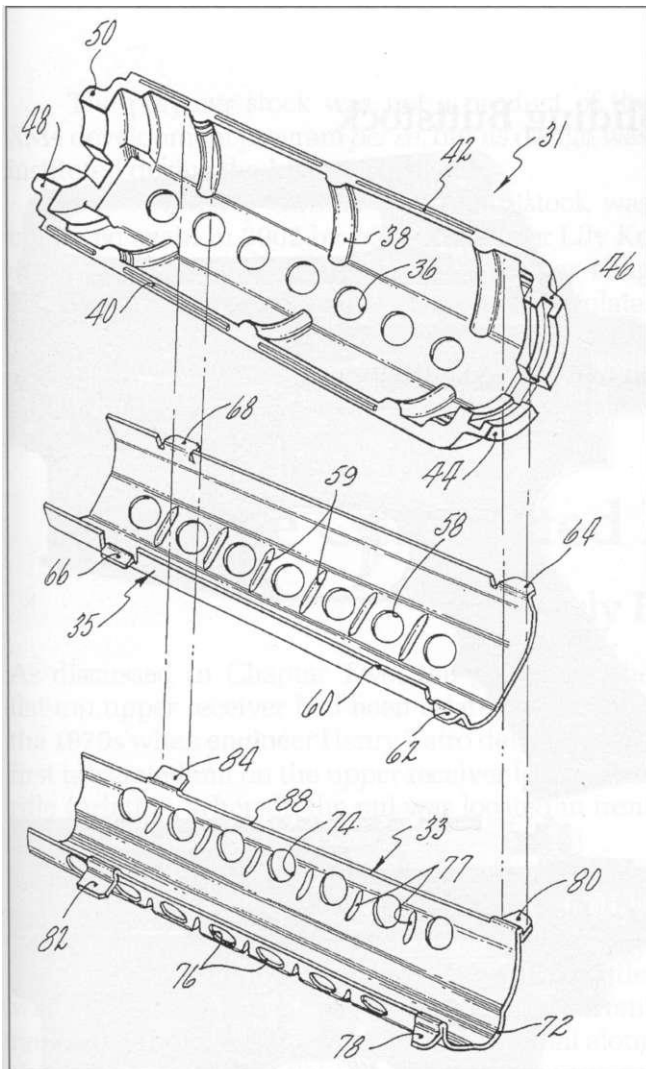
## The Improved XM4 Handguards

Three different handguard assemblies were tested for the XM4 carbine. The first variation was the standard M16A1 carbine interchangeable upper-and-lower round handguard assembly, with aluminum heat shields held in place in slots molded into the outer handguard shell. This is the same handguard used on all Colt carbines since the introduction of the XM177E2.

The second was a variation made from the improved M16A2 handguard assembly, modified by removing the forward wall, cutting the remaining length in half, and re-attaching the forward wall with epoxy cement. This modified shell was then fitted with a double aluminum liner. The vent hole pattern ensured that there was no straight path for radiant



88. The early carbine handguard, made from the modified M16A1 rifle handguard. The vent holes in the heat shield were in line with the holes in the handguard, which did little to protect the shooter when the barrel got extremely hot from consistent fire.

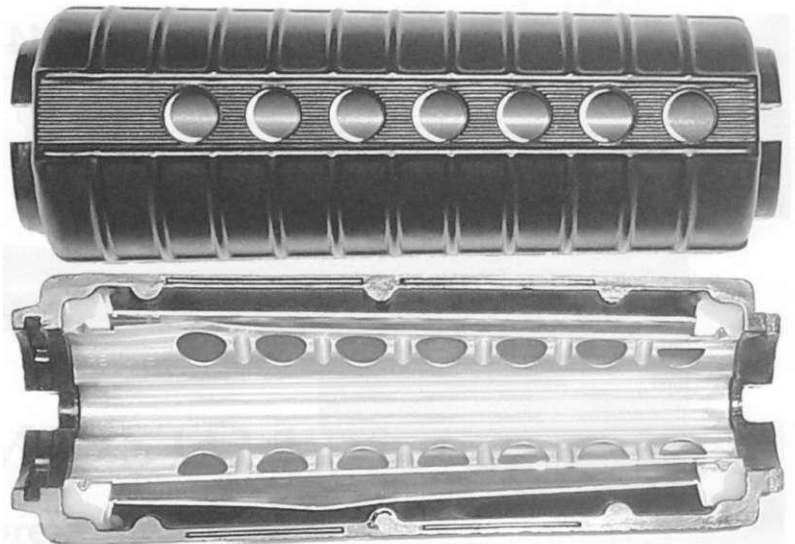


89. Drawings from US Patent no. 4,663,875, granted to Henry Tatro for the chosen XM4/M4 handguard design.

Note the two-piece heat shield, which increased protection for the shooter's hand from the heat of the barrel.  
US Patent Office

barrel heat to propagate through both liners and into the handguard shell. As noted in Chapter One, the standard M16A2 handguard, which utilizes a single heat shield, was developed so that the rear portion of the handguard vent holes were blocked by the liner, to allow the shooter's hand to remain gripped there as firing heat increased. Since the forward seven vent holes are open to allow hot air to escape, this forward portion becomes too hot to hold during sustained fire. All the vent holes were open on the original shortened carbine version of this handguard, which caused the handguard to heat up quickly during extended firing, making it difficult to hold in high-usage circumstances.

The third variation, and the one chosen for the XM4/M4/M4A1 carbines, was an improved double-



90. Two views of the final production M4 carbine handguard design.

Above: outside view. Note that the barrel is not exposed (top), due to the heat shield not allowing heat to escape directly through the vent holes.

Below: inside view. Note how the vent holes on the two heat shields do not line up.

heat-shielded handguard, larger in diameter and width, with heavier wall thickness. This handguard, developed by Colt's engineer Henry Tatro, was granted US Patent no. 4,663,875 on May 12, 1987.

This new handguard design offered two heat shields to protect the shooter's hand from the heat generated by prolonged firing. The inner liner has two upper and two lower rows of laterally opposed vent holes. The outer liner has upper and lower centrally disposed rows of vent holes, which are in line with the vent holes in the polymer handguards. The airflow through the lower row laterally opposes the vent holes in the inside shield. Heated air exits the first annular volume through the upper row of laterally opposed vent holes, and proceeds to the exterior of the handguard assembly through the second annular volume and the upper row of vent holes, and out the vent holes in the polymer handguard shell. Cooling air also circulates from the lower vent holes to the upper vent holes in the shell via the third annular volume.

The first XM4s, delivered in February, 1986, were fitted with standard (variation 1, above) handguards, and later that year in April, 1986, XM4s were equipped with the new double-shielded handguards (variation three, above). This pattern then became standard on all M4 and M4A1 carbines produced for the US government.

## The Improved XM4 Sliding Buttstock



91. Right side views of the two sliding four-position buttstock designs found on the M4-series carbine.

Above: an M4 carbine (with BURST feature) fitted with the polymer stock of the same design as the aluminum original.

Below: an M4A1 carbine (with AUTO feature) fitted with the longer, improved version designed by project engineer Lily Ko at Picatinny Arsenal in 2002, with extended checkered butt and a fixed sling swivel. As of this writing, all M4s being delivered to the US government come with this stock factory-installed at Colt.

In 1985, Colt replaced the older heavier (9.5 oz.) aluminum sliding buttstock with a super-tough nylon stock, weighing only 4.5 oz. (a 53% reduction in weight), made out of the same composite material as the M16A2 buttstock. This new stock, which together with an improved extension locking ring and wrench was designed by Colt's Horace "Mac" McCoan, had four adjustment positions rather than the two of the earlier carbines. This was intended to

make it more comfortable for soldiers to fire when wearing equipment such as flak vests and load-bearing equipment. "Mac" McCoan had also developed the "bird cage" flash suppressor during the Vietnam War era, as well as the storage compartment in the standard M16/M16A1 buttstock implemented during that period.



The polymer stock was not a product of the XM4 development program *per se*, but its design was instituted during the M4 program.

The M4/M4A1 carbine sliding buttstock was improved again in 2002 by project engineer Lily Ko at Picatinny Arsenal, to include a fixed rear sling swivel as well as an extended checkered buttplate. Although not designed by Colt, this version of the buttstock is currently fitted to all M4/M4A1 carbines being shipped from the factory, with the boxes labelled "Improved Buttstock".



92. Underside view of the receiver extension of the XM4/M4 carbine.

Note the four adjustment positions for the sliding stock.

## The Celebrated MIL-STD-1913 Rail

### Early Forerunners

As discussed in Chapter Two, the genesis of the flat-top upper receiver had been established during the 1970s when engineer Henry Tatro developed the first integrated rail on the upper receiver for a sniper rifle variation, whereon the rail was located in front of a built-in rear iron sight.

The next significant milestone in the development of the rail was Colt's Enhanced M16A2 Rifle project (the M16A2E1), funded by the US government in an attempt to improve the M16A2 rifle, which featured a rail closely resembling the current rail configuration. This concept involved a rail along the entire length of the flat-top receiver, and a removable carrying handle very similar to the current removable handle. Additionally, the Enhanced Rifle had a flip-up backup rear sight built into the upper receiver, which was folded forward under the removable carrying handle when not in use.

The next advancement was Colt's ACR (Advanced Combat Rifle), also discussed in Chapter Two, which featured a flat-top rail which could be fitted with either a removable carrying handle or a scope. Even though the ACR rail was not dimensionally compatible with the later rail configuration, the ACR was a significant step in the integration of this type of rail into the upper receiver.

While the idea for a flat-top upper receiver was clearly originated at Colt, the concept of the dovetail rail was derived from the commercial rail developed by W. R. Weaver during the early 1940s. As far as the military was concerned, however, there was a problem with the Weaver rail, in that no two were exactly the same, meaning that when an optical sight zeroed on a Weaver rail was removed and re-installed, it had to be re-zeroed.

### Modifying and Strengthening the Colt ACR Rail

A SOCOM requirement was established in 1987 - 1988 for a standardized means of mounting accessories to the M16 platform. In 1989, while the ACR program was still under way, Richard Swan, owner and founder of Atlantic Research Marketing Systems, Inc. (ARMS, Inc.), was called in to assist Colt with the development of a stronger "standardized" rail. As verified by Joe Unterkofler, then the Chief of the Light Weapons Development Team at Picatinny Arsenal, Swan later recalled how he analyzed the basic Weaver rail as used on the Colt ACR receiver and modified it in order to strengthen it and standardize its dimensions:

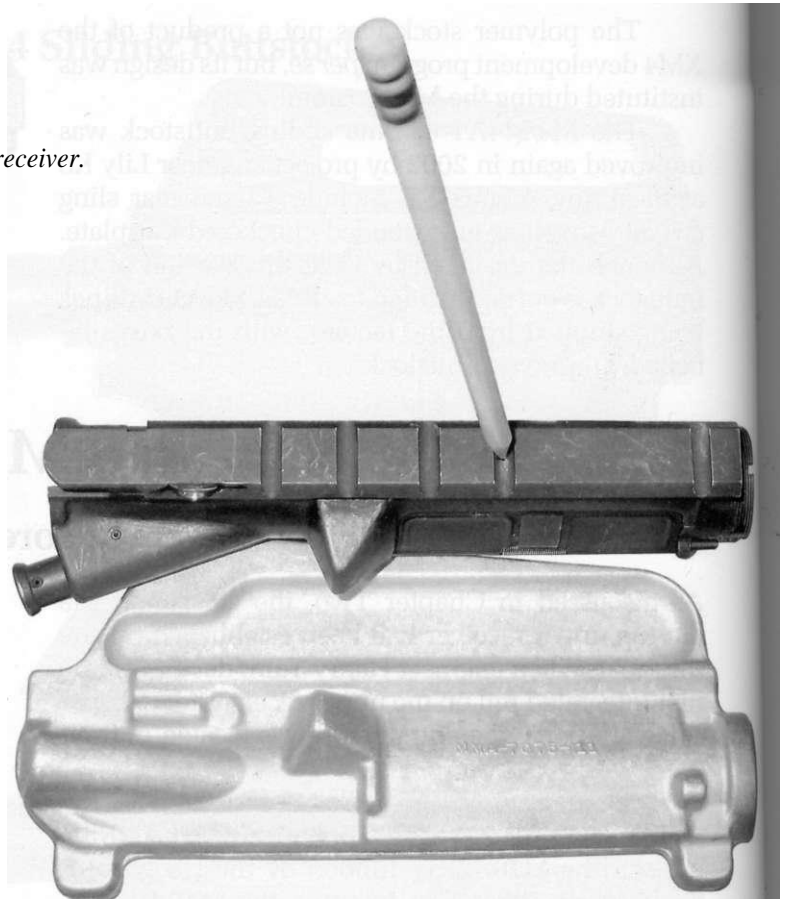
*. . . Picatinny's plan to standardize a common mounting interface on all small arms and crew-served weapons centered around two companies, ARMS, Inc., and Colt Firearms. ARMS was already manufacturing male and female dovetail rail attachments for delivery to the US military, some of which had already been issued NSN numbers for various other weapons besides the M16 and M16A1. The Colt ACR flat-top receiver, being differently dimensioned than the ARMS dovetail mounts and attachments then being issued, created a situation where interchangeability was not possible.*

*At the request of Picatinny's Joe Unterkofler, Robert Roy at Colt's provided me with a sample of the ACR receiver and its forging, so that I could*

analyze how best to incorporate the ARMS dovetail dimensions into a Colt flat-top receiver. In a notice dated March 8, 1989 [fig. 288], the Canadian military had already advised that they had adopted the ARMS dovetail dimensions for Canada's flat-top receiver.

Upon inspection of the ACR receiver and its forging by myself, working with Robert Roy, the following were noted:

1. The dovetail dimensions were much smaller than the ARMS dimensions that were already in service with the military.
2. The Colt ACR receiver utilized a Weaver-type half-round cross notch, vs. the standard ARMS rectangular notch. We were already providing square notches in the dovetail rail mounts for larger caliber weapons, and I pointed out that square notches would act as a more positive recoil stop on large-caliber weapons than would the half-round notches, as long as a rectangular crossbar in the mounting attachment, such as ARMS was using, was continued vs. a round rod which would batter any aluminum notch during firing. A common cross notch dimension would also have to be established in the dovetail rail of a new flat-top receiver to allow interchangeability, especially since the flat-top receiver of the M16 would be the most prolific and become the standard for interfacing.
3. The bottom of the half-round notches in the Colt ACR dovetail rail was the ACR receiver's thinnest point, so thin in fact that I was able to demonstrate to Rob Roy that a #2 lead pencil could be pushed right through the bottom of the half-round notch.
4. To provide a stronger dovetail rail/receiver and provide compatibility with the ARMS dovetail dimensions, the receiver of the Colt ACR would have to be raised .100". The ARMS standard .375"-wide and .110"-deep center channel was eliminated for use on the receiver, but retained in the mating Swan Sleeve attachment, as the concern was to retain as much strength in the receiver as possible.
5. ARMS had designed and patented a sleeving rail with built-in fold-down rear sight for the prototype #38 rail and receiver combination. Colt incorporated the ARMS dimensions of width and height below the 45° bottom angles of the forging, in order to allow clearance for items like the sleeve to be installed.



93. Top view of the Colt ACR flat-top receiver with its Weaver-type round cross-notched rail, above, and the modified forging from which this receiver was machined.

Compare with fig. 439: this forging did not contain enough metal to allow the production of a rail compatible with the ARMS male and female dimensions already in service with the military. It was also too thin: note the #2 lead pencil that Dick Swan demonstrated could be pushed right through the bottom of the half-round notch.

courtesy ARMS, Inc.

The dimensions below the lower dovetail 45° angles on the flat top were incorporated into a new forging by Colt [fig. 439], to replace the ACR forging. The vertical wall dimensions were specific to the forged upper receiver, as this was the only means to provide modular upgrades to raise or extend the small receiver, as specified in my 1989 patent application. The dovetails in the following rail attachments were to be the same as the flat top, but the vertical wall was dependent on the application in all devices other than the flat top, and later explained in Paragraph 6.3 of the MIL-STD-1913, finalized on February 3, 1995.

## Colt Adopts the Swan/NATO Rail


On August 8, 1990, the day after the ACR program field experiment had been concluded, a non-disclosure agreement regarding the "ARMS-modified M16 ACR receiver with modular sleeving system", for which the dimensions were provided by Swan and the drawing produced by Colt, was signed by Richard Swan and Richard Costello, Colt's Vice President of Engineering. At the meeting, Swan signed off on the drawing and on the rail dimensions. The drawing included the dimensions for the Canadian C7A1 rail, the standard Weaver rail, the Swan/NATO rail, and the ACR rail.

A close comparison of the dimensions of the Swan/NATO rail indicated on this 1990 drawing shows that they are the same as the dimensions on the MIL-STD-1913 rail, which was type classified in 1995. Depending on the drawing being looked at, this rail has been found to be dimensioned at least four different ways. There are four critical angle dimensions, two of which are exact and the other two are within tolerance.

The purpose of the MIL-STD-1913 rail was to standardize the dimensions in order to make the interface compatible with all current ancillary equipment. The other requirement for the standard rail was that it was not limited to accepting any particular optic or mount in any particular location, which was why a total of thirteen identical transverse slots were incorporated in the top of the rail.

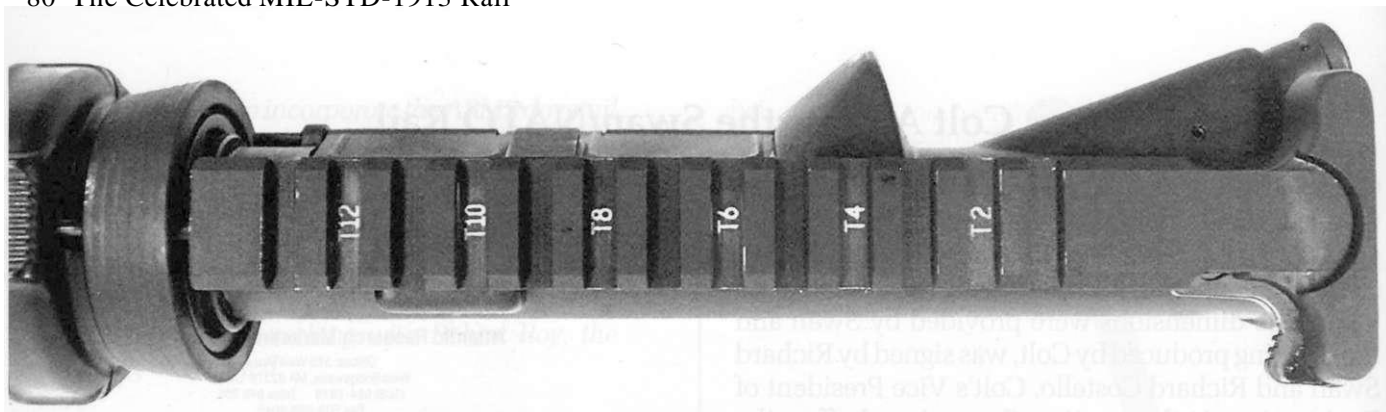
As noted, the MIL-STD-1913 rail was not destined to be type classified for a further five years, although Colt's was producing an identically dimensioned rail for at least three years prior to the design being finalized by the government as the new standard "MIL-STD-1913" rail in 1995. At that point, all future procurements of the M4/M4A1 carbine, as well as the later M16A4 rifle, would embody the new-style "flat-top" upper receiver, which incorporates the MIL-STD-1913 rail. This enables a scope, laser sight, holographic sight or any other compatible device, including a removable carrying handle, to be mounted right onto the receiver.

Many opinions have been heard during the preparation of this book concerning the source of the finalized MIL-STD-1913 rail dimensions, but the 1990 Colt/ARMS non-disclosure agreement and drawing, discussed above, have been the only documented evidence discovered, and no other written documentation has come to light.

<p>Specialists in Design and Manufacture of Military Mounting Brackets, Controls and Interfaces for Sighting Systems</p>	<p><b>A.R.M.S., INC.</b></p>  <p><b>A Subsidiary of Swan Industries</b> <b>Atlantic Research Marketing Systems, Inc.</b></p> <p>Offices: 375 West Street West Bridgewater, MA 02379 U.S.A. (508) 584-7816 Telex 948 205 Fax 508-588-8045</p>	<p>Weapon System Consultants Servicing The Free World</p>
<p>NON-DISCLOSURE AGREEMENT</p>		
<p>This agreement is made and entered into this 8th day of August, 1990 by and between Colt Manufacturing Company, Inc., 150 Hayslope Avenue, Hartford, Ct. 06106, and Atlantic Research Marketing Systems, Inc., having an office located at 375 West Street, West Bridgewater, MA. 02379.</p>		
<p>Whereas, both parties, for their mutual benefit, desire to disclose certain proprietary information related to the <u>A.R.M.S. modified M16 ACR receiver with modular sleeving system</u>, designed by and the sole property of A.R.M.S., Inc.</p>		
<p>Now therefore, in consideration of receipt of such information, the parties mutually agree as follows:</p>		
<p>1. All written information designated as proprietary, herein called "Proprietary information," disclosed by one party to the other shall be and remain the property of the originating party. The receiving party shall use the proprietary information for the purpose of the Agreement only and shall not disclose the proprietary information or any part thereof to any other person, firm or corporation without prior written consent of the disclosing party, and shall restrict to the same extent necessary to fulfill the purposes of this Agreement.</p>		
<p>2. Notwithstanding any other provisions hereof, neither party shall be liable for release or disclosure of any proprietary information that (a) is required by an order from a court of competent jurisdiction, (b) is or becomes part of the public domain, other than through breach of this Agreement, (c) is known to the receiving party prior to the disclosure by the other, (d) is subsequently rightfully obtained by the receiving party from a third party, or (e) is disclosed inadvertently, despite the exercise by the receiving party of the same degree of care which it normally uses to prevent unauthorized disclosure and use of its own proprietary information.</p>		
<p>3. Any written proprietary information must be identified as proprietary by an appropriate stamp or legend at the time of disclosure to the receiving party. Any proprietary information which is disclosed orally shall be concurrently identified as proprietary and such claim shall be confirmed in written form to the receiving party within twenty (20) calendar days.</p>		
<p>4. The proprietary information exchanged under this Agreement shall be returned to the originating party thereof promptly at its request, or in any event upon the termination or completion of this Agreement, together with all copies and/or negatives made thereof.</p>		
<p>5. The disclosure of proprietary information shall not constitute any grant, license, or option under any patent or other right now or hereafter held by the disclosing party.</p>		
<p>6. This agreement shall remain in force and effect for 36 months from the date set forth above.</p>		
<p>COLT MANUFACTURING CO., INC.</p>		<p>ATLANTIC RESEARCH MARKETING SYSTEMS, INC. (A.R.M.S., Inc.)</p>
<p>By: <u>Richard Costello</u></p>	<p>By: <u>Richard Swan</u></p>	
<p>Title: <u>V.P. Engr.</u></p>	<p>Title: <u>President</u></p>	
<p>Date: <u>8-8-90</u></p>	<p>Date: <u>8/8/90</u></p>	

94. A composite of the original two-page Non-Disclosure Agreement, signed by Richard Costello, Colt's Vice President of Engineering, and ARMS President Richard Swan on August 8, 1990.

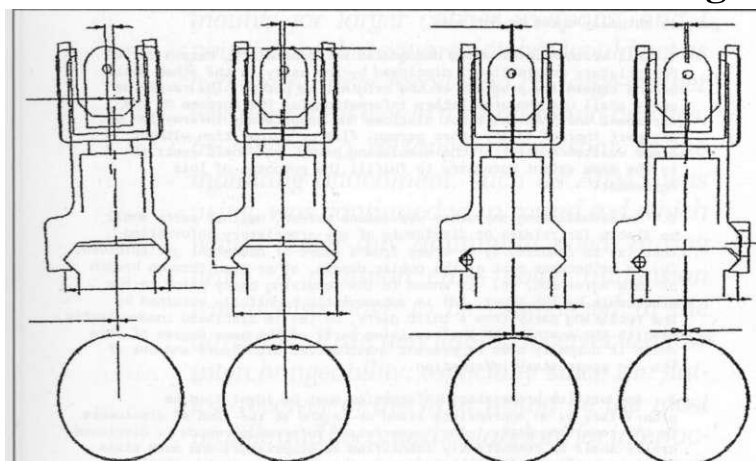
The dimensions of the Swan/NATO rail, which later became the MIL-STD-1913 rail, were included in the accompanying drawing. courtesy ARMS, Inc.



95. Top view of an M4 carbine, showing the integral MIL-STD-1913 rail.

Note the numbered slots (T2, T4, T6, T8, T10 and T12), which are intended to assist the operator in re-installing his optics in the same location in which they were zeroed.

## Tailoring the Iron Sights



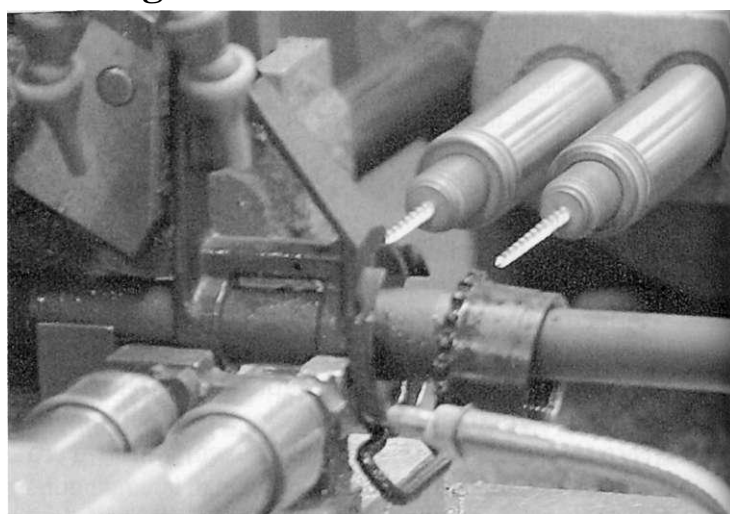
96. During the development of the rail and detachable carrying handle, it was found that the way the carrying handle attached affected the point of impact. If it did not sit properly, the center of the rear sight would not be in line with the center of the bore. The design was altered to ensure that the interface was correct.

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The rear iron sight provided in the removable carrying handle is adjustable for elevation from 300 to 600 meters, in comparison with the rear sight in the M16A2 fixed carrying handle, which is adjustable from 300 to 800 meters.

Compared to the standard rifle sight, the carbine rear sight sits higher relative to the bore centerline, in order to maintain enough wall thickness in the top of the upper receiver. These same upper receiver and sight dimensions are also used in the current M16A4 rifle.

Colt initiated a study of the interface relationship between the detachable carrying handle and the dovetail on the upper receiver, to determine how this



97. The front sight assembly is located in the proper position by a special drilling machine that drills and reams the two front sight taper pin holes. Then the front sight assembly will be secured on the barrel with two taper pins.

This is a very critical procedure: if the front sight assembly is not located properly, the gas port will not line up and the rifle/carbine will not function.

photo by Joe Hearon, ©2003 by Colt Defense LLC.  
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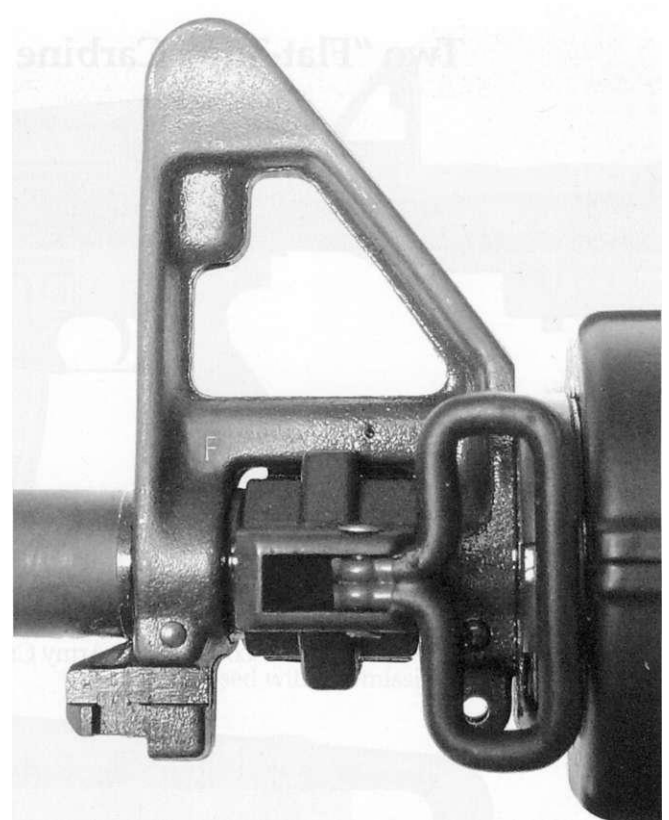
interface relates to the carbine's ability to accommodate the sight adjustment requirements for targeting. Research indicated that the maximum allowable tolerance was well beyond the allowable windage adjustment for the carbine, and accordingly, two modifications were made. First, the locating relationship between handle and the upper receiver dovetail was improved, which improved the consistency of the rear sight alignment with the bore centerline. The second modification was to increase the windage allowance.

It was soon discovered that some carbines failed to meet the targeting requirement because the front sight post could not be adjusted high enough. To correct this, the front sight assembly was raised up to bring it in line with the elevated rear sight. These higher front sight assemblies are marked 'F' (for Flat Top) on the left side. Both the flat-top rifle and carbine utilize the same front sight post,

98 (right). Left side closeup of the front sight assembly of a production M4 carbine.

Note the sling swivel assembly, which can be located on either side.

The "F" in the upper left corner of the sight base designates this higher assembly is for use with a flat-top upper receiver. This same front sight base is also used on the flat-top M16A4 rifle.



## A Hiatus after First Delivery

Colt delivered 40 prototype XM4s to Picatinny Arsenal (ARDEC) in February, 1986 for test and evaluation, along with a report of Colt's own test results. These prototype models still had the standard carbine handguards, as the final version of the double-heat-shield M4 handguard did not ship until April of that same year. Picatinny Arsenal reviewed the report, tested the weapons, and published their own findings.

At that point the entire M4 program lay dormant for several years until interest was expressed in a

Close Quarters Battle (CQB) carbine. Toward the end of the 1980s, the US Marine Corps expressed great interest in a carbine version of the M16A2 service rifle, the development of which they had also spearheaded during the early 1980s. Once again Colt provided prototypes. This time, however, the project was accepted for further development and entered an official developmental stage. This need was expressed by many US military special operations units and has since become the subject of a separate weapons program.

## Adopting the First General-Purpose Carbine Since WWII

As we have seen, significant development effort was required in order to turn the new carbine into a dependable and durable front-line weapon rather than merely a compact back-up for rear-echelon troops. The M4 and M4A1 were adopted on August 15, 1994 as the first general-purpose carbines to be issued to US military personnel since the M1 carbine of World War II. The M4, which was assigned NSN 1005-01-231-0973, was given this designation sim-

ply because it was next in numerical line to the nomenclatures of the M1, M2 and M3 carbines which it had superseded.

At that time the military still had some CAR-15s, as well as other variations of M16, M16A1 and M16A2 carbines with telescoping buttstocks and 10 1/2", 14 1/2" as well as 16" barrels, which were issued on a limited basis.

## Two "Flat-Top" Carbine Versions: the M4 and M4A1



99. Right side view of the final version of the M4 carbine, with stock extended.  
courtesy US Army Criminal Investigation Laboratory



100. Left side closeup of a US government-issue M4 carbine with the detachable carrying handle installed, showing markings.

Note the markings on the elevation knob, "6/3", which differ from the standard M16A2 rifle sight which is marked

"8/3". The rear sight operates exactly the same as its fixed-carrying-handle counterpart.

The knobs on the detachable carrying handle are hand-tightened, and optics may also be attached to the carrying handle.

courtesy US Army Criminal Investigation Laboratory

The upper receiver of the original XM4/M4 carbine was the fixed carrying handle type (fig. 79), fitted with the A2-style fully adjustable rear sight, the

built-in fired cartridge case deflector, and round forward assist plunger assembly. Only the XM4 prototypes and one lot of M4 carbines were produced in





101. Right side view of the M4A1 carbine. The M4A1 was developed to fit the requirement of a fully-automatic option to the M4 carbine. It is used primarily by US Special

Operations Command (SOCOM) operators.  
Note the new style sliding buttstock.

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102. Left side closeup of the Colt M4A1 carbine, showing markings.

Note the AUTO selector lever setting.

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the fixed carrying handle configuration. As mentioned, the XM4 upper receivers were specially produced with the feed ramps extended downward on the vertical face, in line with the cuts in the barrel extension (fig. 82).

Colt introduced their new "flat-top" upper receiver in 1992, and early carbines shipped with the flat-top upper receiver were called the Colt M4A1

carbine, even though this nomenclature predated the US government's assignation of the M4A1 designation. In 1994, when Colt began shipping two types of M4 carbines to the US government, the designations were officially altered to reflect the fact that while both carbines were built on flat-top upper receivers, the M4 retained the BURST control, while the M4A1 utilized the AUTO fire mode.

## Notes on Rifle/Carbine Component Commonality

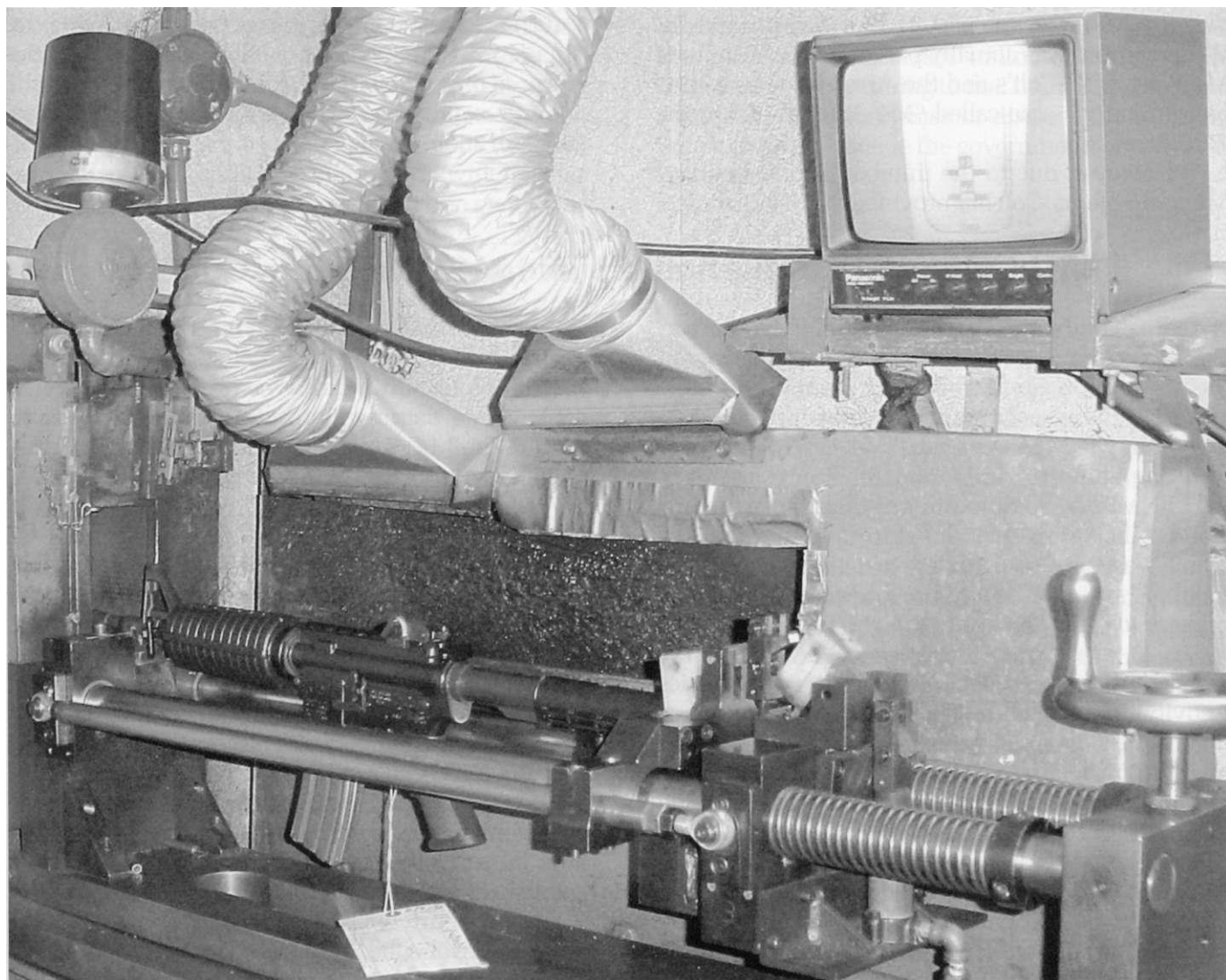


103. Right side view of the M4 carbine, shown partially disassembled.

Mechanically it looks identical to its full size counterpart, and it boasts a 75% parts commonality, but the numerous changes made to the M4 carbine have in fact made it a whole "new family" of weapons.

Approximately 25% of M4 components differ from those of the M16A1 and M16A2. The non-standard components are the upper receiver, barrel extension, buttstock assembly, buffer assembly, extractor spring

assembly, burst cam, barrel, handguards, rear sight base, front sight assembly, and gas tube. Thus, for all intents and purposes, the M4/M4A1 carbines constitute a "new family" of weapons.



104. After final assembly and inspection, all Colt-manufactured rifles and carbines are test-fired on Colt's 100 yard indoor range for function, cyclic rate and accuracy, the number of rounds fired depending on the contract require-

ment.

The monitor at upper right shows the target being fired on by this M4 carbine. ©2003 by Colt Defense LLC.

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## **Colt Gets Tough**

### **The "New Family of M4 Weapons": Round One to Colt's**

As of this writing, the M4 carbine is produced for the US government solely by Colt Defense LLC as an item proprietary to Colt. This sole-source award had resulted from an earlier dispute between Colt's and the US Army over whose technical data had been used to develop the M4. As discussed above, although the M4 shares a considerable parts commonality with the M16 and M16A2 rifle ("M16"), it also contains many critical and unique parts which were developed by Colt using its own private resources.

The government originally contended that the M4 was nothing but a variant of the M16, and that therefore it should fall under the 1967 Technical Data Sales and Patent License Agreement, Contract no. DAAF03-67-C-0108 (1967 Licence). Since the royalties under the 1967 Licence had already been paid in full, the Army argued that no royalties were payable on the M4, and that it could bid out the procurement of the M4 to third parties. Colt proved otherwise, and therefore the Army in settlement agreed to recognize

that the M4 was not part of the "Family of M16 Weapons" but was actually part of a new "Family of M4 Weapons". Colt's and the Army formalized this recognition via a so-called "M4 Addendum" to the 1967 Licence.

However, due to the number of non-standard M4 components, Colt has provided the M4 Technical

Data Package (TDP) to the government, with the stipulation that they are not allowed to use it for the purpose of solicitation for competitive bidding until the sole-source agreement with Colt is fulfilled on June 30, 2009.

## FNMI Challenges Colt's Sole-Source M4 Production Contract

Notwithstanding the above, FNMI (FN Manufacturing, Inc.) commenced an action against the government in the US Court of Federal Claims in 1998 to challenge the sole-source contract awarding production of the M4/M4A1 carbine ("M4") to Colt's Manufacturing Company, Inc.

FNMI had soon found out that the Army had granted the "M4 Addendum" to Colt, and that the Army was now recognizing that the "critical and unique" portion of the M4 technical data was proprietary to Colt. This came to light when, on March 19, 1998, the Army, through ACALA (US Army Armament and Chemical Acquisition and Logistics Activity), published an electronic CBD (Commerce Business Daily) announcement on the Internet of its intent to make a sole-source award to Colt's for the M4, and stating that the sole-source award was being made due to the government's "lack of data rights". A footnote to this announcement stated that "while this notice of intent is not a request for competitive proposals", a third party could submit a capability statement or a proposal within 45 days after publication of the CBD notice. Four days later, ACALA published the same announcement in a hard-copy CBD.

On May 5, 1998, the Army published another electronic notice to the effect that the award had been made to Colt's. The following day, FNMI delivered a proposal to the Army claiming that it was capable of producing the M4 for the Army. The Army rejected the FNMI proposal as untimely, since it had not been submitted until 47 days after the Internet posting, although only 43 days had elapsed since publication of the hard-copy notice. Thereupon, FNMI filed a protest with the US Court of Federal Claims, seeking to enjoin the government from awarding the sole-source contract to Colt's.

FNMI cited the following three grounds for its protest:

1. The Army had failed to consider FNMI's "timely expression of interest";

2. The sole-source award failed "to consider alternative competitive procedures";
3. The award to Colt's was based on "unenforceable data rights restrictions", and therefore the M4 Addendum was an improper "give-away" of the government's rights, and as such it was invalid.

In turn, Colt's entered the litigation as an intervenor and filed a motion to dismiss on the grounds that FNMI as the offeror lacked standing to protest, and that the protest was untimely. Both the government and Colt's argued that there was nothing improper in using the Internet date to calculate the 45-day submission period. The court disagreed, concluding that FNMI's bid had been received in a timely fashion, since there could only be one publication date applying to all offerors and the applicable date was properly the date that the paper version was published, not the date of the Internet posting.

The court next considered the adequacy of FNMI's unsolicited proposal. The government argued, and the court agreed, that FNMI did not supply the government with sufficient information to justify a decision to stop the sole-source procurement in favor of putting the M4 out for competitive bid. The court noted that, while FNMI has experience in the production of the M16A2 rifle, it had no experience in manufacturing the M4, and that its familiarity with the M4 carbine was confined to "technical information FNMI has been able to obtain through public documents (marketing brochures, data sheets, and field involvement)".

The most important issue raised and settled in this litigation concerned the technical data rights to the M4. The question was whether the government's agreement with Colt's to enter into the M4 Addendum was an improper attempt to "evade" the Competition in Contracting Act, 10 U.S.C § 2304, et seq. (CICA). FNMI sought a declaration from the court to void the award of the sole-source contract to Colt's, on the ground that the government had no authority

to agree to a contract which established a contractor's exclusive ownership of the technical data rights.

FNMI also contended that in relinquishing any technical data rights it might have negotiated for the M4, the government was in violation of the CICA, in particular 10 U.S.C.S. § 2320(a)(2)(A), which states that if an item or process is developed by a contractor

or subcontractor exclusively with federal funds, then the government possesses unlimited rights to use technical data pertaining to that item or process, and retains the right to release or disclose the technical data to persons outside the government, or permit its use by such persons.

## Vindication for Colt's M4 "Family"

The court allowed that if the M4 had indeed been developed using a mix of government and private funding, the government clearly would have the right to relinquish any rights it might have otherwise negotiated. FNMI contended that the M4 Addendum, which limits competition until July 1, 2009 at the earliest, ran afoul of the CICA and was therefore illegal. Under the M4 Addendum, if Colt's were to lose the sole-source contract, royalties would still have to be paid by the government on its M4 acquisitions until December 31, 2050, at which time such royalties would become paid up but its licensed rights to the M4 would continue.

However, the court found that there was compelling evidence to the effect that the M4 had been developed exclusively at Colt's expense. Moreover, it concluded that the development of the M4 technical data did not involve mixed funding, and therefore the M4 technical data was not an enhancement of the M16 data under the 1967 License. Consequently, the

court held that the proprietary rights to the M4 belonged to Colt's, and furthermore the court upheld Colt's contention that the M4 was not merely a derivative of the M16, but in fact an entirely new weapon system.

The court's final decision came in three parts, as follows:

1. The government had the right to recognize that the M4 technical data belonged to Colt's, outside of the 1967 License.
2. In settling its dispute with Colt's the government had properly entered into the M4 Addendum; and therefore,
3. The M4 Addendum did not violate the CICA, and was fully valid and enforceable.

Based on the foregoing, FNMI's action for injunctive relief was denied, and its complaint dismissed. FNMI did not appeal.

## M4/M4A1 Military Specifications

The M4 has an overall length of approximately 33" with the stock fully extended, and 29.8" with the stock fully retracted. The overall weight is alight 5.65 lbs. unloaded, or 6.65 lbs. with a full 30-round magazine. The M4 carbine has the standard government-issue SAFE, SEMI and BURST selector settings. Carbines equipped with the SAFE, SEMI and AUTO settings are also available under the nomenclature M4A1 (NSN 1005-01-382-0953). Due to the USSOCOM requirement for using the M4A1 under severe conditions which call for sustained full-automatic fire, Picatinny Arsenal has developed a special heavy barrel (fig. 117) with a flat for mounting the M203 grenade launcher, to be used in the SOCOM M4A1 carbine. As of 2003, all M4A1 carbines procured by the US government come standard with the heavy barrel fitted, although some units may still order their carbines equipped with the original light contoured M4 barrel.

The Military Specification (Mil Spec) for the M4 carbine is MIL-C-70599A, and for the M4A1 the Mil Spec is MIL-C-71186. This constitutes a major difference from all other carbines based on the AR15/M16 series of rifles which have been produced and sold to the Department of Defense, in that none of those carbines was officially adopted by the government, so no formal military specifications were issued for them. The Mil Specs are based on the Technical Data Package (TDP), which is furnished to the Department of Defense for every weapon accepted for US military issue.

The M4 and M4A1 carbines were officially adopted, and subjected to the same government qualification and inspections as the M16A2 rifle. The test weapons, four from each lot, (a "lot" normally consisting of 1,000 carbines or the number of carbines produced during the month in the factory), are

**Colt Manufacturing Range Data Collection System No 1**

File Ammo Endurance Previous Test ReTest Record Specs Rate of Fire Function Target To Excel Configure ROF Help About

**Auto**  
Burst

11:11 AM Fri, Aug 22

Model **R0977**  
Firing Mode **Auto**  
Windage Adj **12**  
Group Size **4.5**  
ROF Spec Low **700**  
ROF Spec High **970**

Rate of Fire, Rnds/min F4  
**851**

Guns Tested Today as of 07:08  
This Station **10** All Stations (Total) **10**

Total Rounds: **30**  
Rate Of Fire: **851**  
Max ROF:  
Min ROF:

Total Time: **6.103**  
Model: **R0920AF**  
Serial No:

**Passed**

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Serial No (F2) **W0977** Model (F3) **R0977** Lot No (F6) **UAE-2** Contract No **COLT DUM 0201-200** Sales Order **COLT 101** Test Type **Production** Gunner ID **Dennis Dumond, 1111**

Function & Rate Of Fire Test For R0977

Ammo Type	Ammo Lot No	Balance	As of	Total Rnds	Mount ID
M855 CLIP	Colt L03	1034567540	08:13 AM	<b>30</b>	Port 9

New/ReTest	Rnds Fired	R.O.F	Fault	ReFire Code	ReFire Rnds	Comment	Fault 2	Fault 3
New	30							

ROF  
Measure ROF (F1)  
List ROF's  
Print Reject Tag  
Save Results (F12)

ROF  
Function  
Target  
DataTest

105. Another critical test performed at Colt after the function test is the cyclic rate test. On AUTO- and BURST-fire carbines, the rate of fire must fall between a minimum of 700 and a maximum of 970 rounds per minute.

If the weapon has too low a cyclic rate, light strikes and

failures to extract and eject will occur, and if the rate is too high, light strikes and failures to extract and feed will occur.

The computer screen shows the results of the cyclic rate test of a USAF M4 carbine, which successfully met the requirement.

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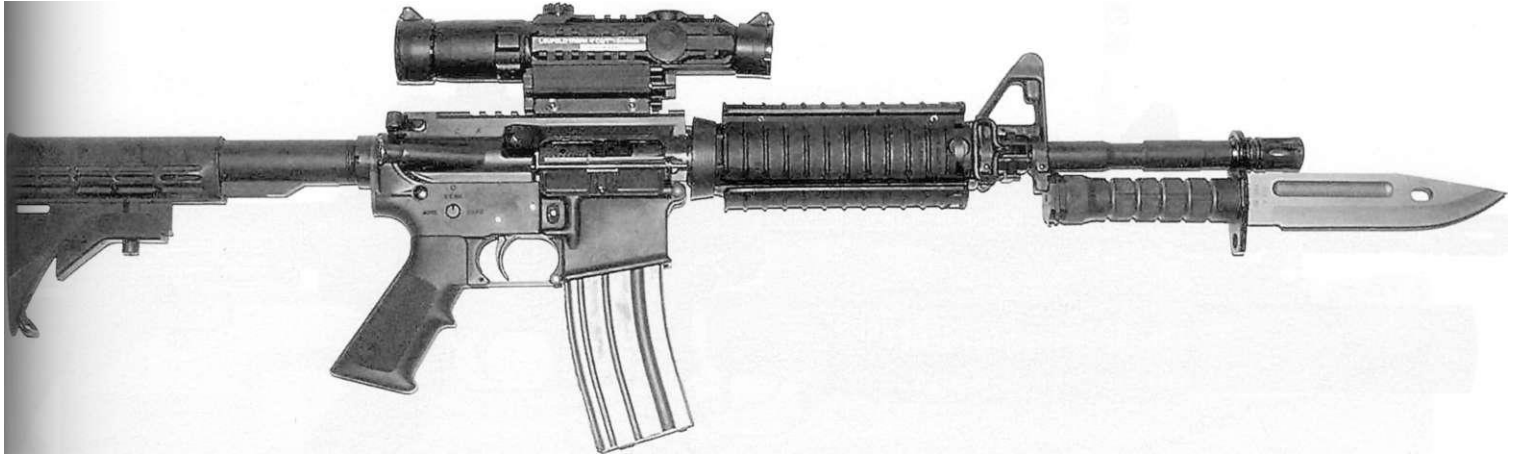
selected at random by government inspectors and are each subjected to a 6,000-round endurance test.

Government inspectors examine sample carbines very closely, visually as well as manually, to verify that they are within all the specifications as set forth in the TDP. Interchangeability is checked, and numerous go- no-go gauges are used to inspect the barrels, firing pins, front sight groups and headspace.

One of the most critical tests is for cyclic rate, which according to the Mil Specs during the function test must be between a minimum of 700 rpm and a maximum of 900 rpm for the M16A2, and between 700 and 970 rpm for the M4 carbine, using govern-

ment-issue M855 ball ammunition. For those rifles and carbines chosen to fire the 6,000-round endurance test, the cyclic rate at the end of the test must be within 700 and 940 rpm for the M16A2, and 700 to 1,025 for the M4 carbine.

Carbines are additionally tested for accuracy. Due to the different dynamics of the carbine, the percentages of allowed carbine malfunctions vary compared to the percentages allowed the standard M16A2 rifle (Chapter One). The functional criteria for the M4/M4A1, which state what type and number of malfunctions are permissible during the endurance test, are as follows:



106. Right side view of an M4A1 carbine fitted with the Leupold Mark 4 CQ/T scope, Knight's Armament RAS, both discussed in Chapter Thirteen, and M9 bayonet.

## Malfunctions and Unserviceable Parts Permitted in 6,000 Rounds

Malfunction	Single Carbine	Four Carbines
Failure of bolt to lock*	2	4
Failure to fire	2	4
Failure to feed (from magazine)	4	9
Failure to eject	2	4
Failure to chamber	3	7
Failure to extract	1	2
Bolt fails/hold rear	3	8
All other malfunctions**	0	0
Total Malfunctions combined	9	22

Unserviceable Parts	Minimum Life Rounds	Four Carbines Combined
Ejector Spring	3,000	2
Extractor Spring	2,000	1
Other Parts***	3,000	1
Total Unserviceable Parts Combined		3

\* In the event of a failure to lock malfunction, the forward assist will be used. Failure of forward assist to remain engaged with the bolt carrier will be considered an additional malfunction in the "other malfunctions" category.

\*\* Other malfunctions may include doubling (two rounds fired with single pull of trigger) during semi-auto firing. Failure for carbine to stop firing when trigger is released during auto or burst fire, etc.

\*\*\* Other parts shall be limited to trigger, disconnect, hammer springs and extractor and extractor pin.

According to Colt, the M4 retains the same degree of accuracy as the standard M16A2, except for the fact that the effective range of the M4 is 600 meters, compared to 800 meters for the M16A2. Obviously these ranges can be increased with the use of optic sights. Some operators claim the M4 is more accurate than the standard rifle, although the consensus is that it is not actually more accurate *per se*, but

that it is easier and economically more desirable to handle than the full-size M16A2 rifle. In Marine Corps tests, higher scores were achieved with the M4 carbine than with the standard rifle, and this was attributed to its superior ergonomics.

The M4/M4A1 carbine continues to evolve and become more versatile. With the introduction of such innovative rail systems as the Knight's Armament



107. Left side views of two Colt carbines, showing the two versions of the M203 grenade launcher offered by Colt.

Above: Enhanced M4 (with four-way fire control setting), fitted with the standard-length M203.

Below: M4A1 (with AUTO fire control setting), fitted with the shorter 9" carbine version of the M203.

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RAS (Rail Adapter System) and the ARMS, Inc SIR (Selective Integrated Rail) System (discussed in depth in Chapter Thirteen), the M4/M4A1 can utilize white light sources, scopes, reflex sights and laser sights, as well as thermal imaging and night vision

scopes. The possibilities are endless. The M4/M4A1 may indeed be the US military weapon of the future, and will certainly be in service for many more years to come.

## The M16's "Finest Hour" - Yet to Come?

When *The Black Rifle* was first published in 1987, the authors posited that the era of the then-newly-adopted M16A2 would become the M16's "finest hour". Today, more than sixteen years later, the M16 is still evolving, and as discussed in the following

chapters, the US military has recently adopted the M16A4 to replace the M16A2, indicating that perhaps, even today, the M16's "finest hour" has yet to arrive.





108. Left side closeup of an M4 carbine configured for the US Air Force. For some reason, the Air Force variation has the same NSN as the standard M4 carbine, even though they are packaged with different accessories, which causes great confusion when guns are shipped out, as the Army may get Air Force guns and vice versa.

The USAF does not utilize the standard removable carrying handle for iron sight use, but instead they provide

Colt with their own removable back-up rear sight, known as the BUIS (Back-Up Iron Sight), NSN 1005-01-484-8000, which is manufactured by the Matech Corporation under contract no. DAAE30-01-C-1081.

Elevation adjustments on the BUIS are accomplished by a lever on the left side, and windage by a drum on the right side.

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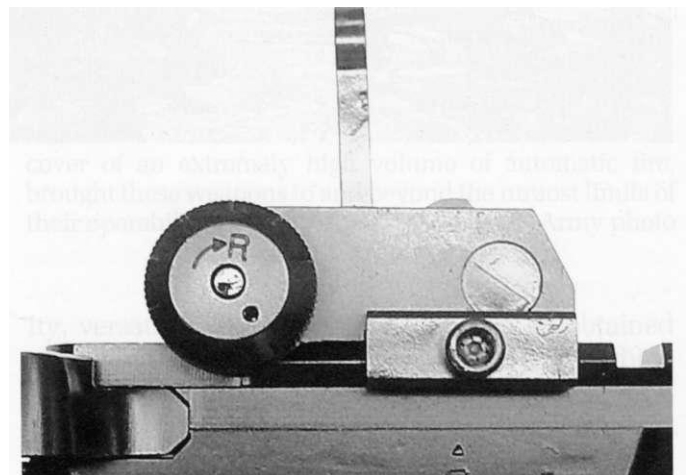
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109 (right). Right side view of the Matech, Corp. US Air Force BUIS.

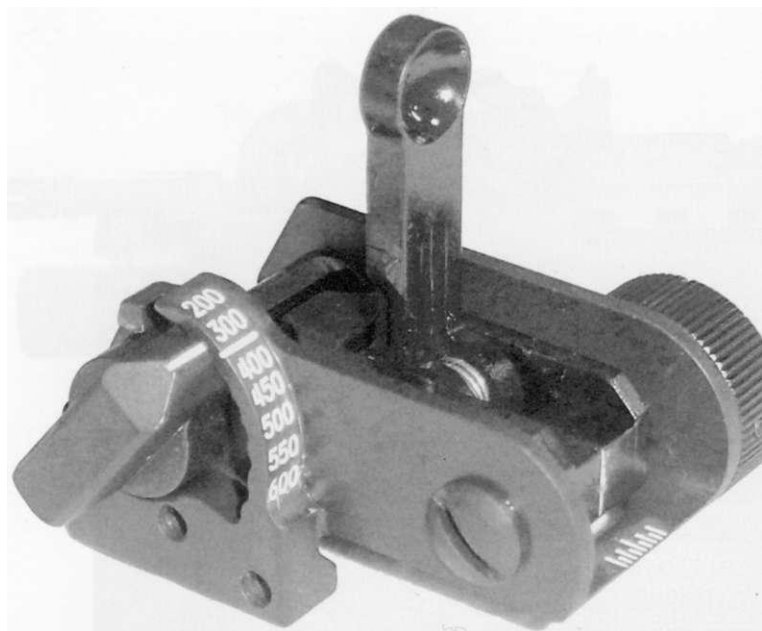
Note the A2-style windage drum.

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92 The M16's "Finest Hour" - Yet to Come?



110. Left rear three-quarter view of the BUIS (Back-Up Iron Sight), produced for use on USAF M4 carbines by the Matech Corp.

Note the elevation lever, and range graduations.

The sight aperture folds down to allow use of optical sights.



111. The M4 carbine on duty at an Air Base in Afghanistan.

Note the M68 reflex sight, KAC RAS and vertical pistol grip, and laser sight.

US Army photo

## *Chapter Four*

# Special Operations Command (SOCOM) Variations

## Pushing the Envelope



112. US Army Rangers on patrol. Note the KAC RAS system on the leading man's M4 carbine.

Certain SOCOM tactics, such as withdrawal under the

cover of an extremely high volume of automatic fire, brought these weapons to and beyond the utmost limits of their operability.

US Army photo

**T**he US Special Operations Command (SOCOM) is well known for making more stringent demands on its small arms than any other military unit in the world. In fact, SOCOM requires more reliabil-

ity, versatility and durability than can be obtained with almost any firearm, and the M4A1 carbine proved to be no exception.



113. In their operations in Afghanistan, SOCOM operators routinely carried M4A1 carbines in ambient temperatures of between 100° to 115°F before firing.

The one common thread in all the theories is that it is heat, excessive heat, which causes eventual barrel and bolt failures.

US Army photo

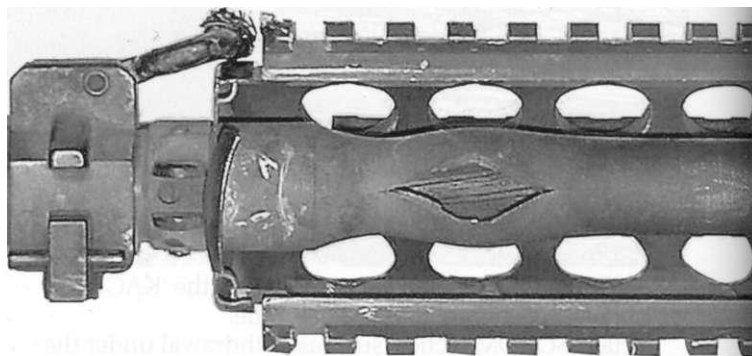
As discussed in the previous chapter, the M4 carbine was originally developed to fill a similar role as had the M1 carbine of World War II—that is, for troops who needed more firepower than a pistol or a submachine gun could provide, but who could not accommodate the weight and bulk of a standard rifle.

However the M4 had soon "leapfrogged" over its intended role as "secondary armament" to become the primary weapon of choice of the nation's most elite warriors, USSOCOM (United States Special Operations Command), who brought the M4A1 to and beyond the utmost limits of its operability.

## Pop Goes The Barrel

One problem, encountered during the period 1996 to 1998, was blown barrels. This could happen anywhere in the barrel, but most commonly occurred just behind the front sight assembly, or occasionally just in front of the front sight assembly.

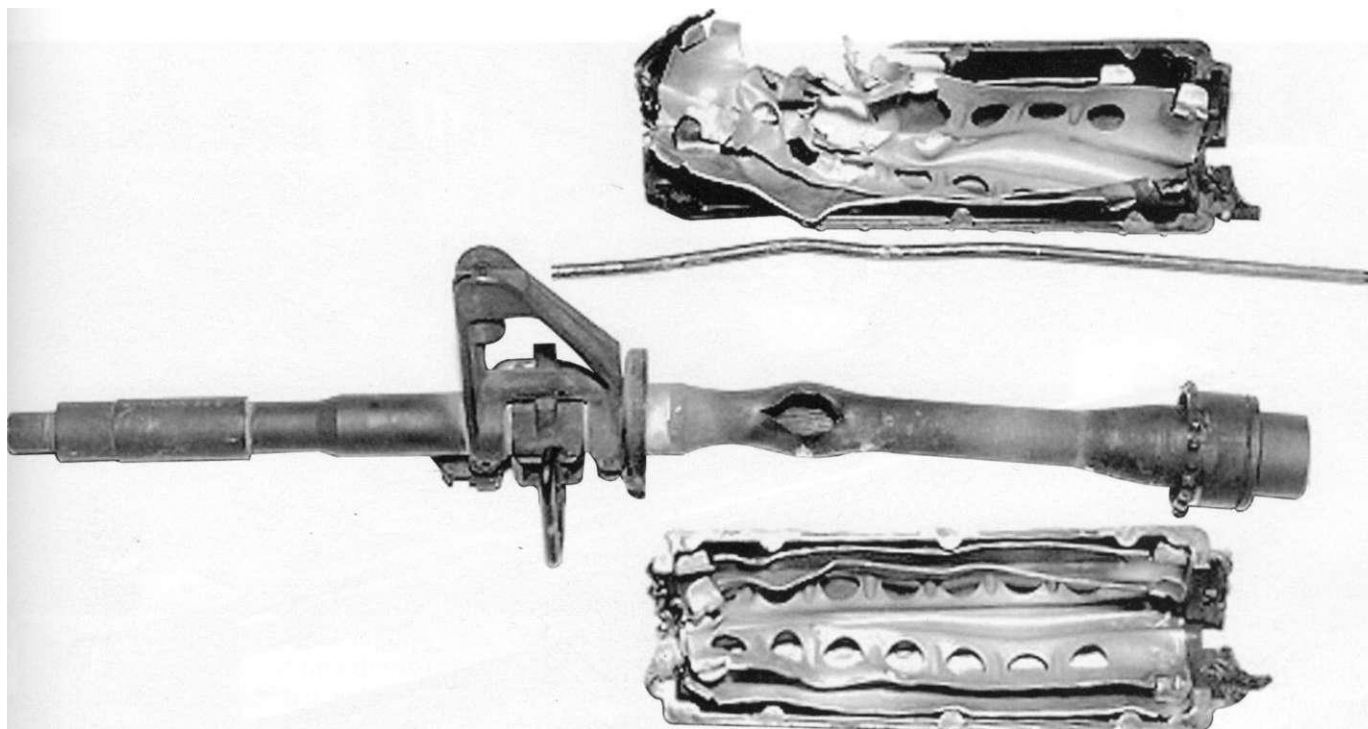
Several investigations were instigated as soon as these failures arose, and several theories were put forth. However, the only explanation substantiated by raw data was that the barrels were being used well beyond their design limits. It was found that, in order for a barrel to achieve a structural failure of this magnitude, it must be brought to its "transformation" temperature, which occurs when the barrel reaches between 1,100°F and 1,375°F. At this temperature the barrel will lose its structural integrity, and will fail. The exact number of rounds the barrel would fire before failure was not predictable, but once the barrel



114. Closeup of a blown carbine barrel, showing a typical catastrophic failure just behind the front sight.

courtesy United States Special Operations Command

had reached this temperature failure was inevitable, and the barrel would no longer be serviceable.



115. Another example of a barrel failure due to the barrel reaching its transformation temperature, which softens the metal.

courtesy United States Special Operations Command

How did the barrels get this hot? It should be noted that government testing has concluded that the cook-off temperature occurs after a consecutive 120 rounds of full-automatic fire, and that the M4A1 fires in the full-automatic mode. Studies at Rock Island Arsenal showed that in order for a barrel to reach its transformation temperature, where a catastrophic failure would inevitably occur, between 540 and 596 rounds had to be fired in 3 to 3 1/2 minutes, with cook-off's occurring constantly after 160 consecutive rounds.

It was found that certain operational conditions which occur in SOCOM training scenarios include withdrawal from an operation under the cover of an extremely high volume of automatic fire—in effect demanding that the M4A1 perform the role of a light machine gun rather than that of a lightweight carbine.

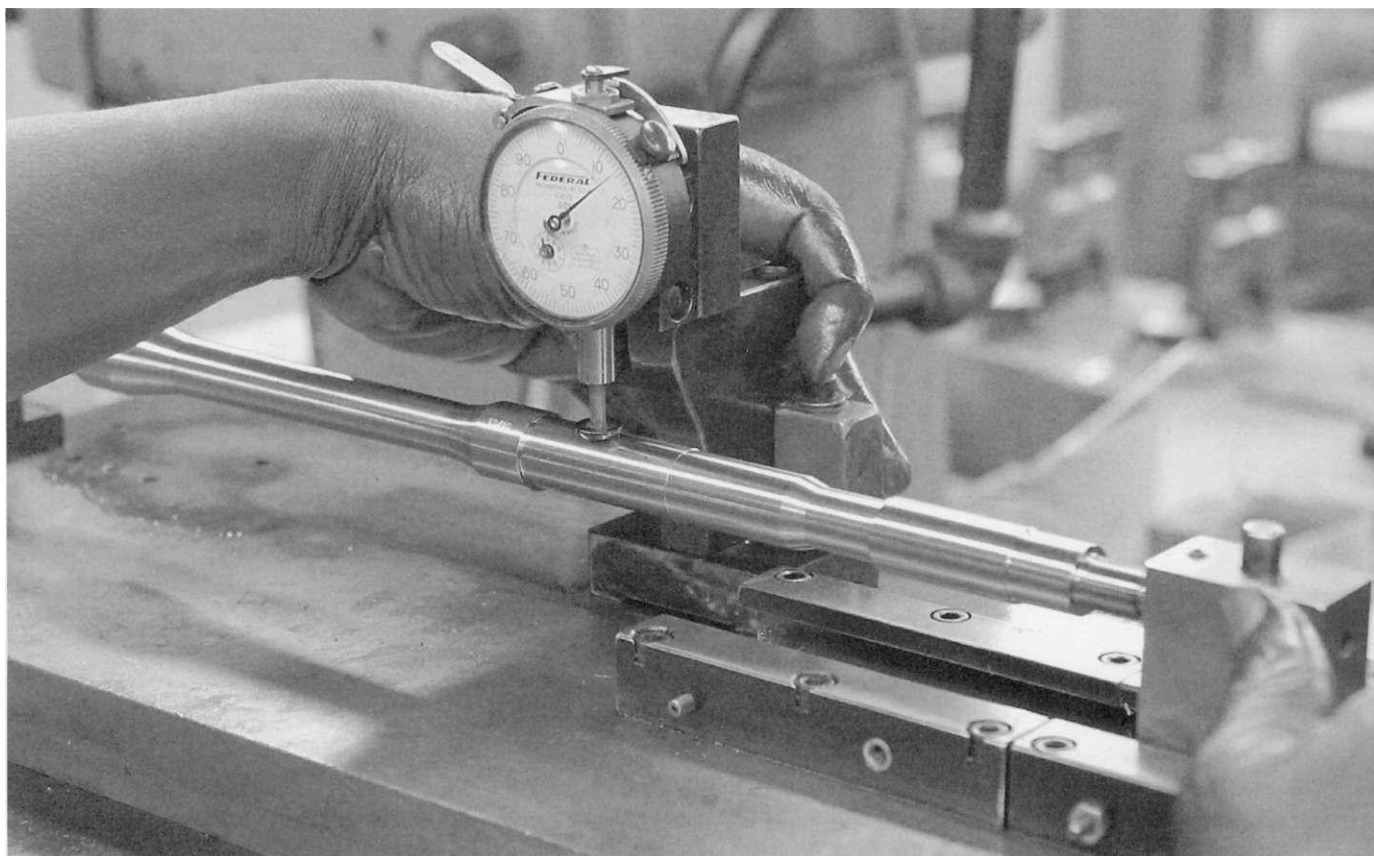
Nevertheless, the suspicion arose that the M4A1 barrels were failing due to poor quality materials and manufacturing processes. However, as per the Mil-Spec, Colt test-fires each barrel with a proof load which develops approximately 70,000 psi, compared to the average 52,000 psi of the standard 5.56x45mm cartridge, after which each barrel is Magnetic Particle Tested (Magnafluxed) to check for fractures or metal fatigue. Government inspectors monitor the materials as well, to be sure they are up to military standards.

Rock Island Arsenal was called in to investigate this problem, and tests were conducted which illustrated under just what conditions the barrels would fail. Their conclusions were that the catastrophic barrel failures resulted from excessive operation, and that it was unreasonable to expect a lightweight carbine to function under these conditions.

In their operations in Afghanistan, SOCOM operators routinely carry M4A1 carbines in ambient temperatures of between 100° to 115°F before firing. The one common thread in all the theories about the cause of the failures is that it is heat, excessive heat, which causes the eventual failure. However, what has not been agreed upon are the acceptable parameters for the use of these weapons. Therefore, whether the failures are caused by deliberate abuse or poor quality barrels is still in debate as of this writing.

In any event, a new heavy barrel was designed for the M4A1 to better cope with the excessive operational conditions which SOCOM demanded, by providing a larger bearing surface from which heat could dissipate. Additionally, a new heavier M4 buffer, designated the H2, was designed to enhance reliability by preventing any possible bolt bounce due to the extremely high cyclic rates of full-automatic fire. The H2 buffer is fitted with two tungsten weights and one steel weight, rather than the one tungsten weight and two steel weights of the standard M4 buffer.





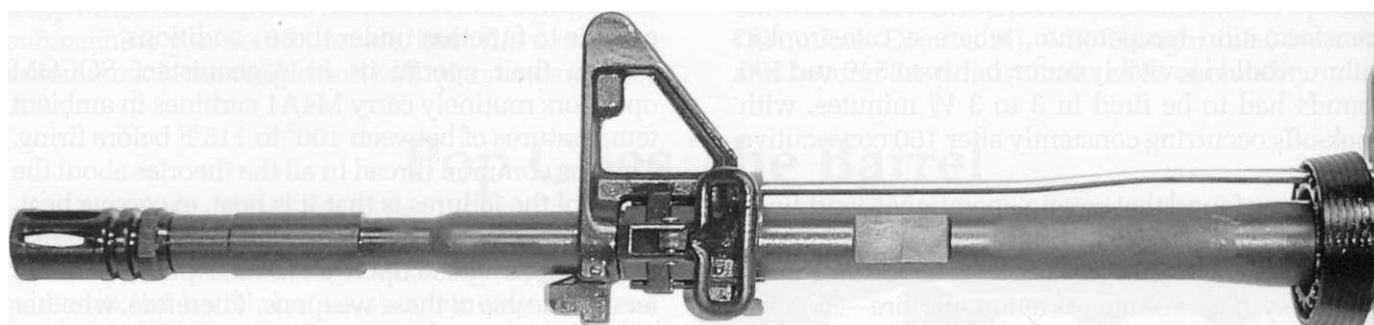
116. At Colt, the barrel starts out as a length of round bar stock, which is turned into a completely formed barrel in one pass through a Nakamura CNC lathe.

After the barrel is manufactured, it is inspected to be

sure it complies with the stringent military specifications. Only if it passes will it be sent out for chrome plating and external finish.

photo by Joe Hearon, ©2003 by Colt Defense LLC.

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117. Left side view of the heavy barrel designed as part of a reliability kit for the M4A1 carbine, in response to the needs of Special Operation Forces who required a more durable barrel for their extremely high firing schedule. This reliability kit also included the H2 buffer.

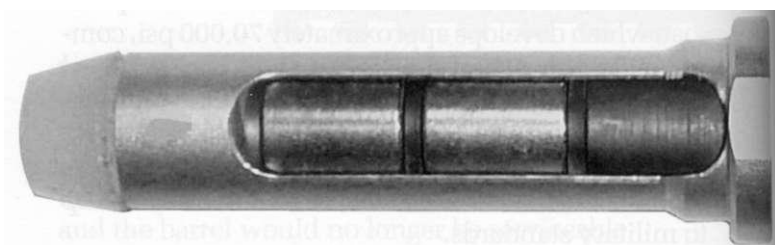
Note the heavier contour under the handguards, and the notch cut in the barrel approximately one inch behind the front sight assembly, to permit mounting the M203 grenade launcher.

©2003 by Colt Defense LLC.

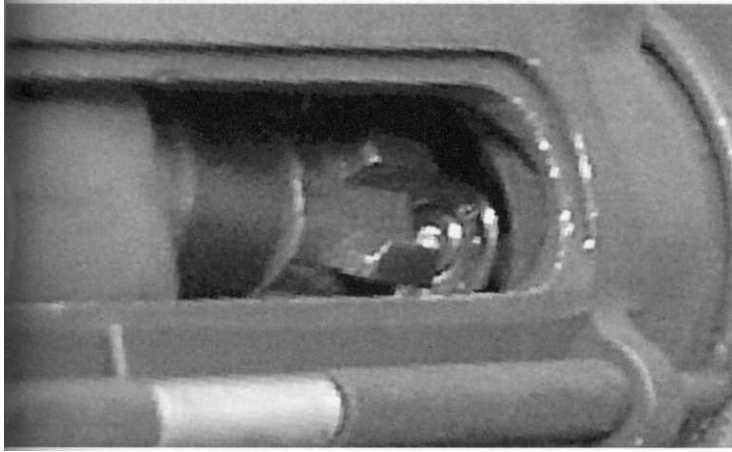
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118 (right). The new H2 buffer, cut away to show the two tungsten and one steel weights. This further dampened bolt carrier bounce, and also slightly lowered cyclic rate.

cutaway by Ken Elmore

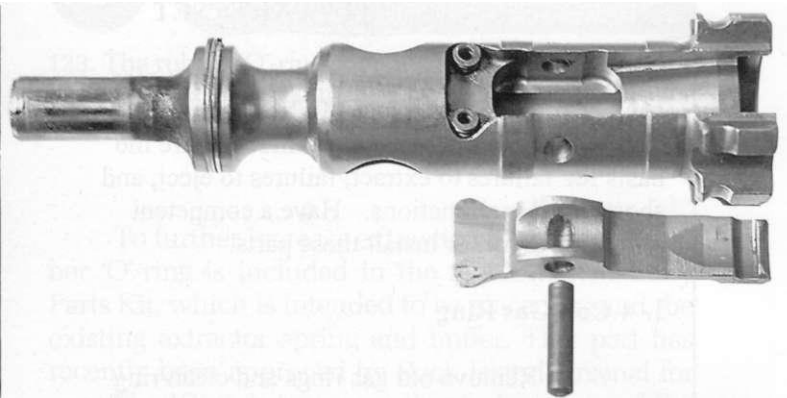


## Extending Bolt Life and Improving Extraction



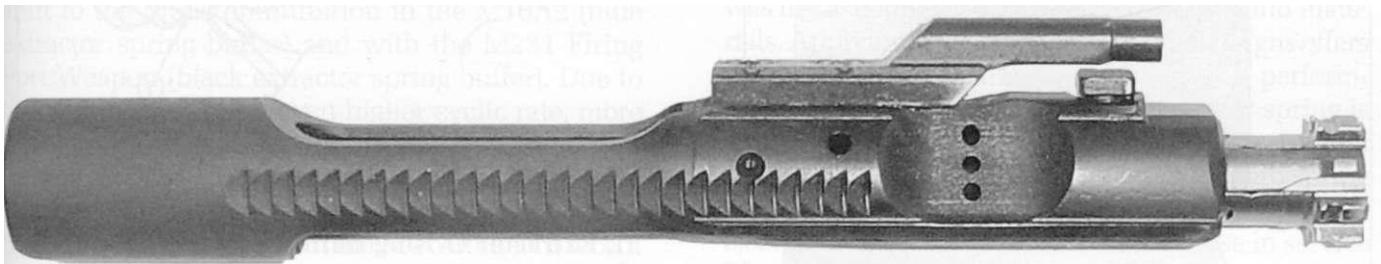
119. Closeup of a typical bolt failure, seen primarily on fully-automatic M4A1 carbines due to excessive operation and the bolt not being changed out at proper intervals. When the bolt wears out from extended use, it will crack in the cam pin area as shown here.

courtesy United States Special Operations Command



120. The improved bolt, designed and made of stronger material by Karl Lewis of the Lewis Machine & Tool Co.

Note the "lobster tail" extractor with its dual extractor spring to increase extraction reliability, as well as the stress-relief notches cut in the locking lugs to allow the lugs to "flex" so they will last longer.



121. The bolt and bolt carrier designed by Karl Lewis of the Lewis Machine & Tool Co.

Note the third gas port hole, and the stress-relief notches cut in the bolt lugs.

Additional SOCOM complaints concerned bolt failures and failures to extract. As discussed earlier, M16A2/M4 bolt life expectancy is already more than three times the service life called for in the military specifications. However, when they go, the bolts will fracture in or near the cam pin slot.

The use of M4A1 carbines by SOCOM operators, with their high round counts of fully-automatic fire, has resulted in more bolt failures than of any other component in the US military. Bolt failures are not common in the standard rifle, but, as discussed in Chapter Three, the carbine wears the bolt at a much more rapid pace due to its operating dynamics. The cyclic rate is also dramatically increased, causing further wear on the bolt. If the weapons are not

monitored and the bolt heads changed out at reasonable intervals, these failures are inevitable.

The best solution found so far has been to increase the strength of the bolt, as has been done in the modified bolt and bolt carrier designed and manufactured by Karl Lewis of the Lewis Machine & Tool Co. The Lewis bolt, which is much more expensive and difficult to produce than the current Mil-Spec bolt produced by Colt, is made from stronger material, and the locking lugs are stress-relieved by having transverse notches cut in them. Additionally, a much more durable "lobster tail" extractor is fitted, which is also made of stronger material and utilizes double extractor springs.



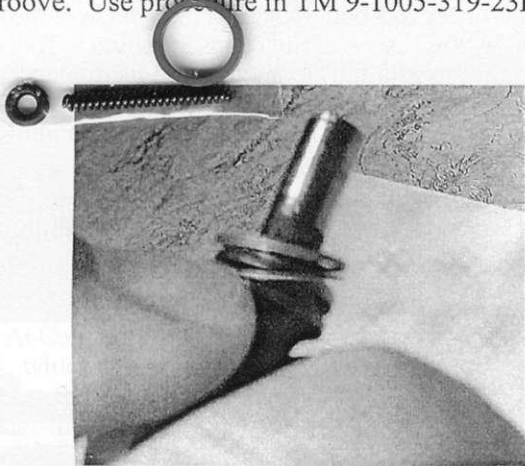
## The SOCOM Reliability Parts Kit

### M4 RELIABILITY PARTS SET

The M4 Reliability Parts Kit corrects the major sources of malfunctions in M4/M16 weapons. These are the parts to wear out first and are the basis for failures to extract, failures to eject, and short recoil malfunctions. Have a competent gunsmith or armor install these parts.

#### I. 4 Coil Gas Ring

1. Remove old gas rings and clean ring groove. Use procedure in TM 9-1005-319-23P



2. Insert the end of continuous ring in groove and hold in place with finger. Rotate bolt to wind the rest of the ring into the groove.

3. To assemble bolt into a used bolt carrier will require cleaning carbon and jacket residue from inside the bolt carrier. The 4 Coil Gas Ring will have a tight fit and scrap away remaining residue. Lubricate the ring area with CLP, insert until

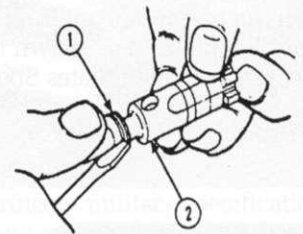
resistance is felt, and twist counter-clockwise while continuing to push in to fully seat the bolt. **DO NOT ATTEMPT TO FORCE IT STRAIGHT IN.** Reassemble rifle and work the bolt several times or fire a magazine to seat ring and clean carbon from ring seat.

4. Initially the bolt will be harder to open, but the rings will last the life of the bolt even at maximum rates of automatic firing and the improved seal will make the rifle more reliable in the cold.

#### NOTE

Do not remove bolt rings unless they require replacement and three new replacement bolt rings are on hand.

Using small flat tip jeweler's screwdriver, remove the three bolt rings (1) from the bolt (2).



#### II. Extractor O-Ring Buffer:

1. Remove the extractor from bolt. The rubber internal extractor spring buffer (blue or black may be left in place). Replace extractor spring if it has been broken or taken a set. Install O-ring around outside of extractor spring

2. Install the extractor into bolt and press against a hard surface to align bolt and extractor pin holes and replace extractor pin.

122. The components of the "M4 Reliability Parts Set" for the M4A1 carbine (in a small plastic bag, upper left), stapled to the installation instructions.

The kit contains a much stronger and more durable ejector spring, a more durable one-piece gas ring, and a rubber 'O'-ring which is installed around the extractor spring as shown in fig. 123. courtesy Michael Harris

The troubleshooting guide in the M16A2 and M4 Maintenance Manual traces most malfunctions to worn, broken, or missing extractor springs, ejector springs, and gas rings. Under a Navy Surface Warfare Center contract, Navy Engineer Dave Armstrong and Hugh McElroy of McElroy & Associates have developed and tested a Reliability Parts Kit for use by SOCOM, which enhances all three of these most problematic parts.

Initial research by spring engineers to see if a better extractor spring could be designed determined that, given the extremely small space between the rear of the extractor and the bolt, any spring would have a short life. This problem had been dealt with in the early 1970s as well by the Army, where, to increase reliability in extraction given the higher cyclic rates produced by the switch to ball powder, a polymer buffer, located within the coils of the extractor spring, was added to the extractor assembly. This proved to be a small but important modification, which increased extraction reliability.

Stronger buffer inserts were required with the shift to the M855 ammunition in the M16A2 (blue extractor spring buffer) and with the M231 Firing Port Weapon (black extractor spring buffer). Due to the carbine having an even higher cyclic rate, more extractor force is needed for use under extreme conditions. Colt has designed and implemented an even stronger polymer extractor spring buffer, identified by its black color, for use in the M4 carbine. In recent years, Rock Island has approved Colt's redesigned extractor spring and composite buffer, which augments the action of the extractor spring and increases its longevity. Standard rifle extractor spring buffers will be seen in various colors such as white and blue, which signify the use of different materials.



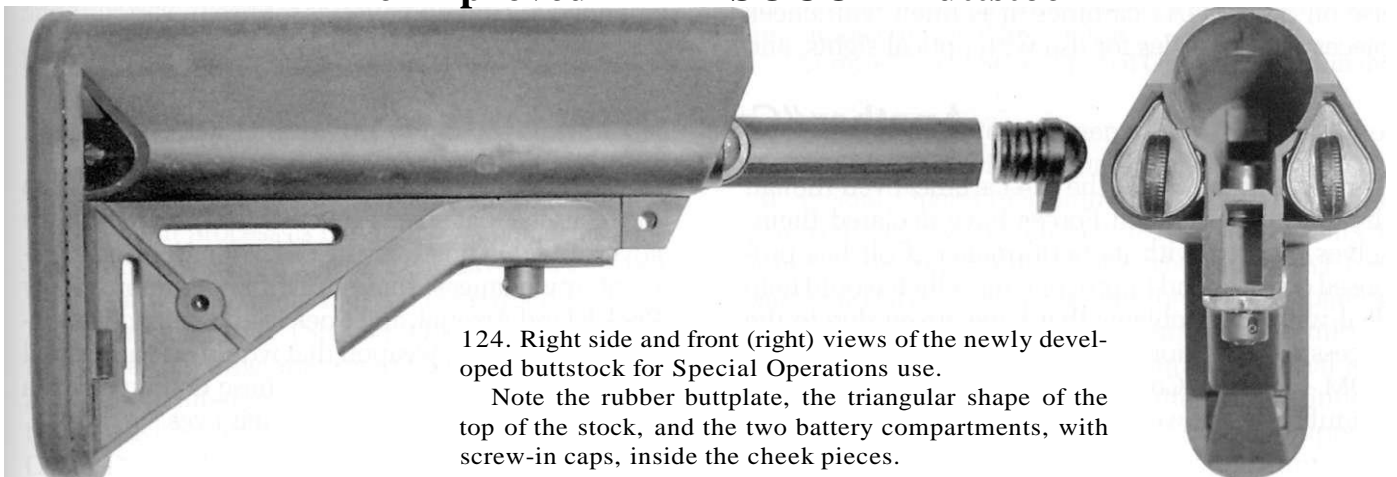
123. The rubber 'O'-ring contained in the "M4 Reliability Parts Set", left, and its method of installation around the extractor spring.

To further increase extraction reliability, a rubber 'O'-ring is included in the SOCOM Reliability Parts Kit, which is intended to be placed around the existing extractor spring and buffer. This part has recently been approved by Rock Island Arsenal for use. The 'O'-ring increases the spring force of the extractor by a factor of more than four, and has proven to be an excellent enhancement. All SOCOM M4A1 carbines and Mk12 MOD 0 & 1 rifles, as well as ArmaLite's AR-10 series rifles (discussed in Chapter Seven), use the rubber 'O'-ring.

The reliability kit also provides a new ejector spring. As recalled by Mike Harris, the original rifle was made using 1960s aircraft technology and materials. Applying space-age materials and designs offers the potential to further enhance weapon performance with minimal effort. The new ejector spring is made of high-temperature space-age spring material that will outlast the bolt. This higher-strength spring aids in ejection in two ways, by helping to speed up ejection and offering a significant increase in service life.

The final component of the kit is a one-piece gas ring, which replaces the current three-piece gas ring set. The new one-piece ring improves the gas seal to enhance cold-weather reliability, as well as offering an increase in service life over the original. The one-piece gas ring will last the life of the bolt as well.

## The Improved M4A1 SOCOM Buttstock



124. Right side and front (right) views of the newly developed buttstock for Special Operations use.

Note the rubber buttplate, the triangular shape of the top of the stock, and the two battery compartments, with screw-in caps, inside the cheek pieces.



125. Right side view of the newly developed buttstock for Special Operations use, shown installed on an M4A1 carbine.

This stock has two battery storage compartments to carry spare batteries for use with optics. The stock must

be removed so the battery compartments may be slid out. The profile of the cheek weld on the stock is very similar to that as the stock designed for Colt's ACR rifle (fig. 76), however this stock was neither designed nor produced by Colt.

A larger and even more durable buttstock, which bears a striking resemblance to the one used on the ACR fielded by Colt, was designed by SOCOM for use on their M4A1 carbines. It is fitted with cheek pieces on both sides for use with optical sights, and

two storage compartments, containing waterproof hollow plastic tubes, which are accessible once the stock is removed from the carbine. These tubes are intended to contain batteries for use in various optic and laser sights used in the SOPMOD kit.

## Another "Catch-22" at Colt's

Throughout the life of the M4 carbine, even though the rest of the Armed Forces have declared themselves pleased with its performance, Colt has proposed changes and improvements which would help deal with the problems that have arisen due to the excessive operational conditions employed by SOCOM. However Colt, as a defense contractor, must manufacture its weapons to conform with the mili-

tary specifications, which in turn are derived from the technical data package they have provided to the government. Therefore, in order for Colt to implement any changes, these must first be approved by Rock Island Arsenal, and Rock Island will not authorize changes to the weapon that would add additional parts to the inventory, unless these demonstrated a considerable improvement in their eyes.

# SOPMOD Block II and III Systems: a Summary of System Descriptions

## Introduction



126. The SOCOM poster used as the endpapers in this book, titled "Special Operations Peculiar Modification to the M4 Carbine - Block I Accessory Kit", showing the various enhancements issued by SOCOM.

The fine print at bottom right reads in part "The SOPMOD Program Management Office at NSWC, Crane, IN

will provide standardized, versatile weapons accessories to most needs across SOW mission scenarios. These accessories will increase operator survivability and lethality by enhanced weapon performance, target acquisition, signature suppression, and fire control."

courtesy United States Special Operations Command

Fortunately, SOCOM has the ability to seek out and purchase "mission-specific" equipment without having to go through the normal acceptance and procurement process as US military small arms, and thus many weapons in the SOCOM inventory are not used by any other branch of the US Armed Forces.

The SOPMOD (Special Operations Peculiar MODification) program was initiated by USSOCOM and implemented by the Naval Special Warfare Center (United States Special Operations Command), Crane Division, Crane, Indiana, in the mid-1990s.

SOPMOD set the requirements for a new family of weapons for SOCOM use that would be standard for all Special Operations branches. This was a two-pronged initiative which included enhancements to improve the operability of the M4 and M4A1 carbines and M16-series rifles and their rail adaptation systems, and also developed enhanced or additional accessory items and optics, including thermal and night vision devices, video modules, range finders, integrated pointer-illuminators, silencer/suppressors, muzzle brakes, bayonets, and shot counters.

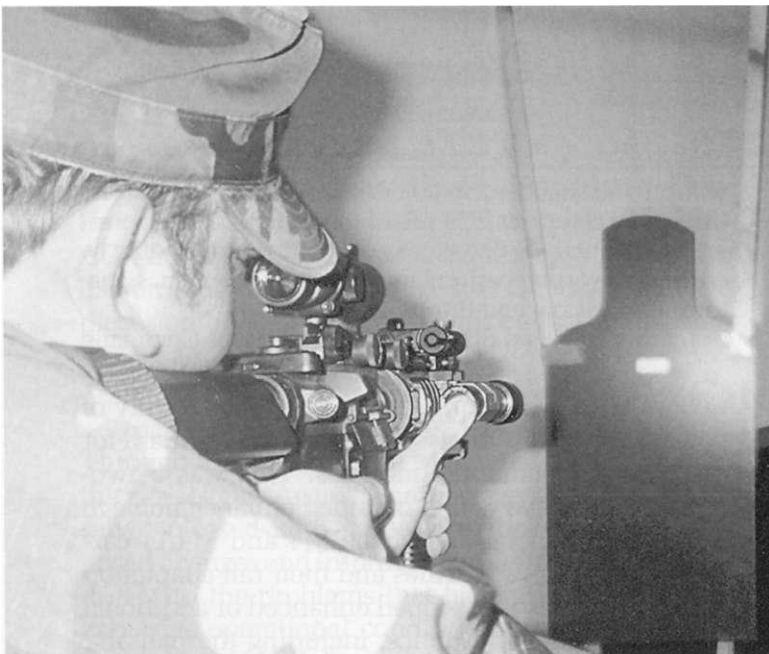
## The SOCOM Enhanced Carbine



127. An illustration from the SOCOM manual showing the SOPMOD Enhanced Carbine fitted with the Knight's Armament Company RAS system, vertical pistol grip and

back-up rear sight, and the Trijicon ACOG Reflex sight.

Note the KAC Front Sight Tower sling mount, installed around the gas block, which allows attachment of a front sling swivel on either side. courtesy Michael Harris



The criteria set forth for enhancing the M4A1 carbine resulted in a series of modifications and upgrades to the current M16A1 weapon which enhances its reliability, accuracy, zero retention, the ergonomic man/machine interface, and service life.

Reliability enhancements include a reduction in mean rounds between failure/stoppage, and barrel assemblies which are more accurate and will maintain their accuracy for longer periods of use, and are capable of mounting four-quadrant MIL-STD-1913 rails rigidly enough to retain zero within 1/2 MOA

128 (left). Another illustration from the SOCOM manual showing the M4A1 Enhanced Carbine utilizing the flash-light mounted on the Knight's Armament Company RAS, with the operator's thumb actuating the light.

This carbine is also equipped with the Knight's back-up sight and vertical pistol grip, and the Trijicon ACOG Day Optical sight and AN/PEQ-2 Infrared Laser Illuminator, mounted on the top rail. courtesy Michael Harris





129. This M4A1 Enhanced Carbine is equipped with the KAC RAS, vertical pistol grip, and back-up sight, with the AN/PEQ-2 Infrared Laser Illuminator sight mounted on the

top rail of the RAS, as well as the Trijicon Reflex sight on the receiver.  
courtesy Michael Harris



130. This SOCOM operator is firing his M4A1 Enhanced Carbine, fitted with the KAC Quick Attach/Detach Sound Suppressor, at night with the aid of the AN/PVS-17 A Mini Night Vision Sight and the Trijicon AGOG Reflex sight.

courtesy Michael Harris

objective/1 MOA threshold. Additionally, recoil management upgrades include a recoil attenuating buffer, a muzzle stabilizer, and a reduced cyclic rate to 500 rpm (650 rpm threshold) which reduces dispersion and increases acquisition speed in multi-tar-

get engagements. Overall durability and longevity of the weapon has been increased from 10,000 to 15,000 rounds as a threshold, with the objective being 30,000 rounds.

## The Carbine Reliability Parts Set (CRPS)

A Carbine Reliability Parts Set (CRPS; fig. 122, above) is being produced to accomplish the objectives of the Enhanced Carbine program.

Ergonomic upgrades provide ambidextrous controls, folding front and rear iron backup sights (to

accommodate top-quadrant-mounted optics), and the new sloping cheek-weld stock (fig. 124), with five adjustable lengths.

## Initiating the Special Forces Combat Assault Rifle (SCAR) Program: the M4A1 is Reclassified as an "Interim Weapon"

The enhanced carbine effort evolved into the Special Forces Combat Assault Rifle (SCAR) Program, initiated by SOCOM to develop a weapon which would meet their specific needs. With the SCAR program in

place, the M4A1 carbine was reclassified as basically an interim weapon, to fill a requirement until they could develop one specifically for their purposes.

## The Special Purpose Receiver (SPR)

A new upper receiver and barrel, plus accessories (bipod, sight, handguards, trigger, optics, suppressor, etc.), were developed for the M4A1 carbine/M16-series weapons to provide increased range, accuracy and terminal ballistics effects when combined with improved ammunition. The threshold was Ph.85 (a probable hit 85 % of the time) on the F-type target at

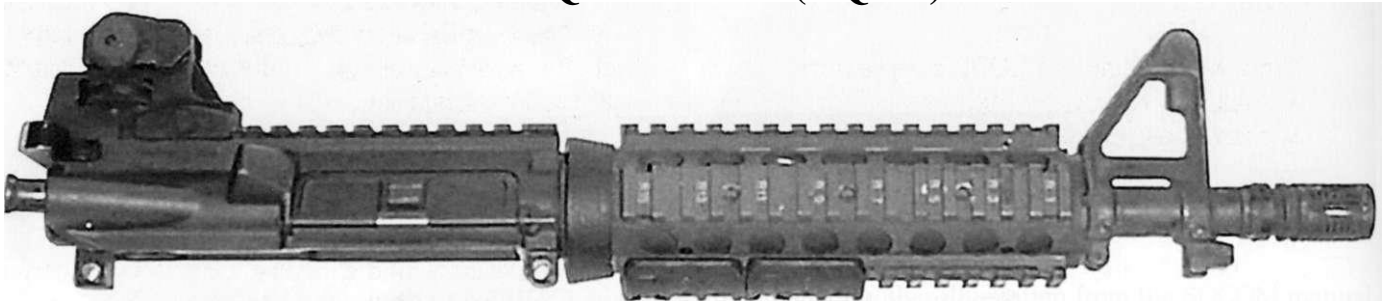
600 meters, with the Key Performance Parameter (KPP) objective being a Ph.85 at 800 meters. The SPR will rely on newly-developed ammunition, which remains compatible with current-issue M855 5.56x45mm NATO ammunition, to accomplish these objectives.

## The "Over The Beach" Receiver (OTBR)

The objective was to meet this need within the CRPS project, described above. If that objective failed, plans were in place to develop carbine and/or rifle parts and assemblies, compatible with the current carbine lower receivers, which would permit safe and effec-

tive firing under water and immediately upon exit of the water, without the delay of draining the weapon prior to firing. OTBR calibers sought, in order of priority, are 5.56x45mm, 7.62x39mm, .357 Magnum, and .45 ACP.

## The CQB Receiver (CQBR)



131. Right side view of the SOCOM CQB Upper Receiver, modified at the NSWC (Naval Surface Warfare Center),

Crane, Indiana. Note the RAS, and the Lewis Machine & Tool Co. detachable rear sight assembly.

courtesy United States Special Operations Command

Again, the objective was to meet this need within the CRPS project, described above. Should that objective fail, the required subsystem was described as the Short CQB Receiver (CQBR), consisting of an upper receiver, 10- to 12" barrel, and parts/accessories to

adapt the M4A1 Carbine/M16-series weapons to the role of a CQB (close-quarters battle) submachine gun, while maintaining compatibility with SOPMOD Kit accessories.



## The Sustained Fire Assembly (SFA)

Carbine and/or rifle parts and assemblies which are compatible with the current carbine lower receivers were required to permit safe and effective firing of the

weapon under heavy sustained rates of fire. Belt-fed capability was desired; increased magazine capacities were the threshold.

## Improved 5.56x45mm Ammunition

Improved ammunition loadings were desired to allow for more flexible use of the M4A1 carbine. Rounds which combine several or all of the following capabilities into a single round were of special interest:

- subsonic rounds for close-range engagements and for sentry suppression to ranges of from 100 meters (threshold) to 200 meters (objective).
- a highly accurate no-lead (green) projectile which can be used in place of M855 with

improved accuracy and terminal ballistics performance.

- an over-the-beach round which will allow the M4A1 carbine to be fired and function safely while flooded with water.
- an enhanced reduced-ricochet, low-penetration round for both training purposes and close-range engagements where ricochet and overpenetration are concerns.
- an enhanced armor-piercing round to achieve maximum performance against hard targets.

# Enhanced Accessories for the SOPMOD Kit

## The Enhanced Shotgun Module (ESM)

ESM will provide a 12-gauge shotgun for door breaching with less-than-lethal capabilities. It will operate both when attached to the carbine and when

configured in the stand-alone mode with pistol grip/buttstock.

## The Family of Muzzle Brake/Suppressors

Reductions in weapon flash and sound signatures are required for a variety of SOF weapons, including but not limited to:

1. a small, ergonomic CQBR suppressor;
2. a standard carbine suppressor;
3. a high-accuracy suppressor for SPR;

4. a machine gun suppressor.

While it was desired that one or two systems would accomplish all objectives, the user understood that this was technically unlikely, and that several variants might be required.

## Other Enhanced Accessories

Other planned developments include the following:

- Enhanced Combat Optical Sight (ECOS);
- Image Intensifier Module (IIM);
- Thermal Image Module (TIM);
- Digital Daylight Image Video Module (D2IVM);
- Rangefinder Module (RM);

- Integrated Pointer-Illuminator Module (IPIM);
- Heat Source Detection Module (HSDM);
- Battery Recharger/Blasting Machine (BRBM);
- Laser Protection and Protection from Optical (LAPPOA);
- Chamber Bore Sight (CBS);
- Enhanced Bayonet/Field Knife (EBFK);
- Shot Counter (SC).

## **Block III Summary System Descriptions**

### **The Integrated Carbine (IC)**

Integrated Carbine (IC) design, through integration of all the aspects of the enhanced M4A1 and its accessories mentioned above, will incorporate the improvements which technology is expected to provide by 2005. The IC will exploit emerging and advanced commercial technologies for miniaturized advanced aiming capabilities, which can be integrated into small arms as components rather than be attached as modules.

For example, the M4A1 carbine currently used by joint SOF utilizes a series of attachable modules for laser illuminating and aiming which are bulky, heavy, snag-prone, and sensitive to the heat of extended firing. The IC will re-package and integrate the capabilities found in current accessories into a single ergonomic, high-reliability carbine.

These advanced technologies would also provide an IR wide-beam illuminator compatible with night vision glasses for target identification and confirmation as well as optical and visible aiming points, combined in one instrument to include laser pointer/designator, modular component maintenance concept, sensor, and data fusion.

Other technological pursuits associated with the integrated carbine included the following:

- visible laser component for pointing/aiming, to include pulsed beam and pattern generation and/or visual light illumination.
- near infrared laser component for pointing/aiming, to include pulsed beam and pattern generation and/or visual light illumination.
- near infrared diode component for short-range illumination.
- range finder component to display/reticle.
- automatic range finder/ballistic solution.
- optic component which contains all of the capabilities of ECOS, plus range indication, weapon cant/inclination, barrel temperature, remaining shot count, video signal export, and a variety of call-up information in the visual field.
- ergonomic and simple switching of modalities.
- retro-compatibility with I2M, TIM, ESM, EBFK, and GLM is required.

These integrated and enhanced carbine requirements are basically the outline for the new SCAR program, which is being initiated at the time of this writing.

### **More on the CQBR (Close Quarter Battle Receiver)**

In response to the call for a CQBR, to be based on the standard M4/M4A1 carbine, it was determined that no barrel presently manufactured by Colt would fit the requirement.

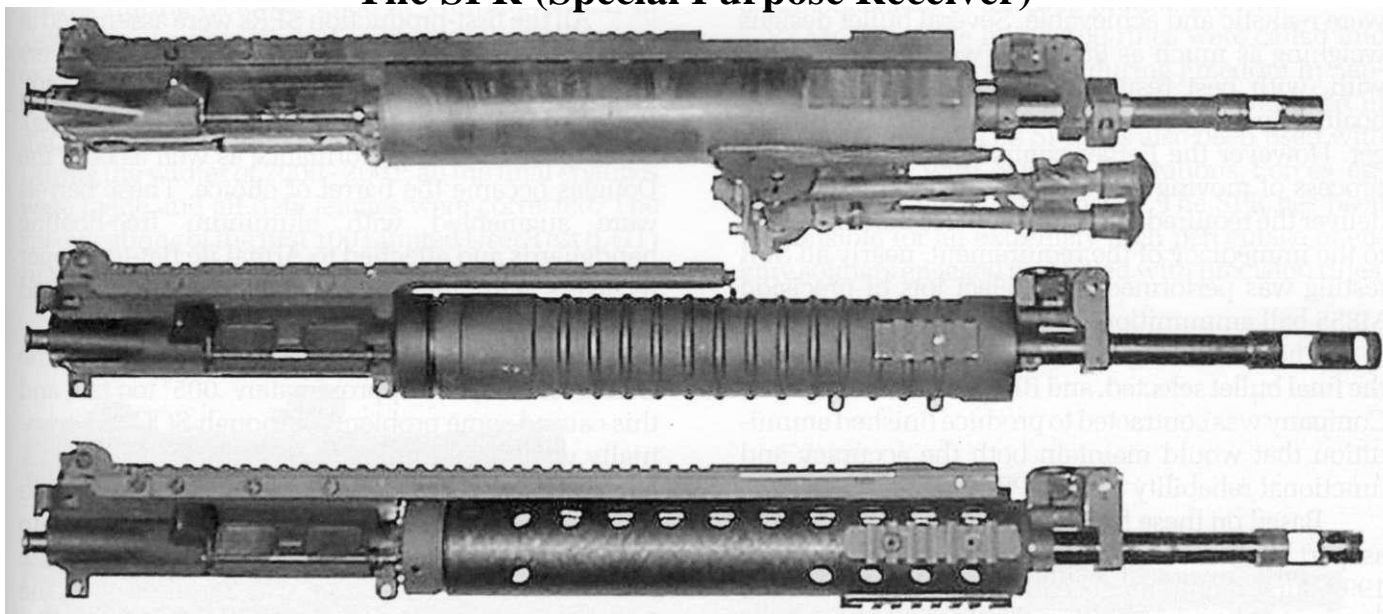
SOCOM custom-tailored several parameters to meet the requirement. First the barrel was cut down to 10", and the gas port modified so the carbine would function properly. This barrel is fitted with the Knight's Armament Company QD flash suppressor, to which the accompanying QD silencer/suppressor is affixed. Current variations also utilize the Knight's Armament RIS (Rail Interface System) with a backup rear sight (fig. 131) manufactured by Karl Lewis of the Lewis Machine & Tool Co.

The CQB is fitted with an 'O'-ring surrounding the extractor spring, which increases downward pressure on the extractor and assists in the extraction of cartridge cases containing higher residual pressure. The Sullivan 'D' ring, which accomplished the same objective, was also experimented with but was not adopted.

Muzzle velocities in excess of 2,400 fps are achieved even with this reduced barrel length, indicating that the majority of the powder charge is being burned, although when fired without the suppressor the flash and blast are quite impressive, to say the least.

# The Genesis of the Mk12 Rifle System

## The SPR (Special Purpose Receiver)



132. The concept for the SPR (Special Purpose Receiver) began as a drop-in upper receiver to be installed on the M4A1 carbine.

These three prototype SPR upper receivers were made by the US Army Marksmanship Unit in the summer of 1999, while they were experimenting with various barrel lengths (18, 20 and 22"). Numerous other options included finishes, various types of free-floating handguard tubes,

and lower receiver accessories.

Note these prototypes all have PRI carbon-fiber free-floating handguards and Swan sleeves (top and bottom) or receiver mount (middle), manufactured by ARMS, Inc.

Data collected by US Army Special Forces and Rangers in field trials in late 1999 were used for the final design decision, which eventually became the complete Mk12 MOD 0 rifle.

courtesy United States Special Operations Command

The SPR as initially designed was to be a drop-in upper receiver, adaptable to current M4/M4A1 carbines, which would fulfill two roles, acting as both as a light sniper rifle and, if the need arose, a light machine gun. There was no one rifle or carbine in production that would fit this particular role, so again, SOCOM had to build one themselves.

The concept of the SPR was the brainchild of Mark Westrom, president of ArmaLite, Inc. (Chapter Seven). As he originally conceived it, SPR stood for Special Purpose Rifle. Initial prototypes were produced with 18-, 20- and 22" barrels.

Westrom's concept sat dormant for some years until SOCOM revived it in the 1990s as an initiative of the 5th Special Forces Group. They envisioned the SPR as a Special Purpose Receiver, which would fit on a standard M4A1 carbine lower receiver. With

highly modified ammunition, the SOCOM SPR would provide a light, compact, long-range precision fire- and fire-support capability to the small Special Operations Forces groups who were not in a position to receive support from aircraft or artillery.

The SOPMOD Programs Office at the Naval Surface Warfare Center in Crane, Indiana produced the initial draft of the desired requirements, and went to work soliciting and testing the concept at hand. In late 1998 and throughout 1999, the 5th Special Forces Group collaborated with the US Army Marksmanship Unit (USAMU) at Fort Benning, Georgia, to develop initial prototypes to fill this new requirement. During the program, with SOPMOD funding, several prototypes were made and tested by the USAMU, working closely with the 5th Special Forces.

## Testing the Prototypes

Results of testing these first prototypes with hand-loaded ammunition revealed that the requirements were realistic and achievable. Several bullet designs weighing as much as 88 grains were experimented with, with best results obtained using a 73-grain boattail open-tip match bullet manufactured by Berger. However the Berger company was then in the process of moving to a new location and could not deliver the required quantities of these bullets, so due to the immediacy of the requirement, nearly all SPR testing was performed with select lots of precision M855 ball ammunition.

The Sierra 77-grain Boat Tail Match King was the final bullet selected, and Black Hills Ammunition Company was contracted to produce finished ammunition that would maintain both the accuracy and functional reliability of the SPR rifle.

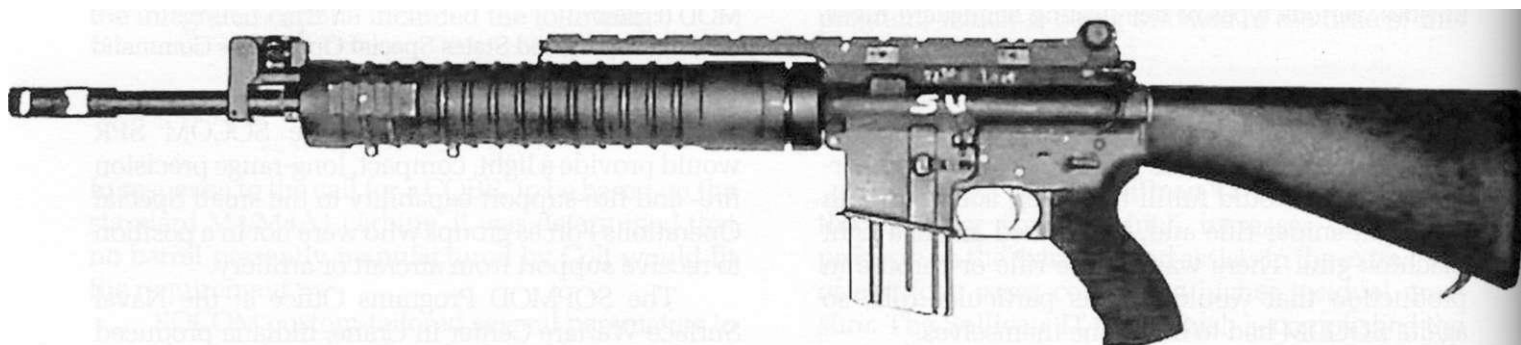
Based on these findings, the SPR was validated as part of the SOPMOD requirement in October, 1999. First requirements called for the drop-in SPR for the M4A1 carbine along with the Match-grade ammunition. Conceptually, this would result in a modified M4A1 carbine which would possess sniper-grade accuracy in a lightweight package that

could provide semi- or full-automatic firepower on demand.

All the first-production SPRs were assembled at NSWC in Crane, Indiana. The first 150 receivers utilized 18 1/2" barrels manufactured by Krieger (50), Douglas (50) and Snider (50, with polygonal rifling). Based primarily on performance as well as cost, the Douglas became the barrel of choice. These barrels were augmented with aluminum free-floating handguards and attached to ArmaLite flat-top upper receivers with integral MIL-STD-1913 rails, fitted with Swan # 3 8 sleeve rails.

SOCOM found that the ArmaLite as well as the Colt receivers were approximately .005" too tall, and this caused some problems, although SOCOM eventually went ahead utilizing as many Colt/stock system components as possible. There were two main triggers in use. Due to the fact the SPR would have to perform as both a sniper rifle and a light machine gun, a Match-grade trigger was required, but the full-automatic fire capability had to be retained. The first trigger implemented was the Knight's Armament Company two-stage selective-fire trigger, and the second was the Accuracy Speaks single-stage trigger.

## The Second-Generation SPR: Now the "Sof Precision Rifle"



133. Left side view of the second variation of the SPR upper receiver with a 22" barrel, on an M16/M16A1 lower receiver assembly. Note the Falcon Industries Ergo Grip pistol grip.

Selection of the Mk12 rifle was critical to ensure that SOCOM got the rifle they wanted, and not the rifle the government wanted to give them.

courtesy United States Special Operations Command

By the time this development was completed it had been found that, in order to achieve the full performance requirements, for example an improved Match-grade trigger to take full advantage of the quality of the barrel and upper receiver, more was needed than just a drop-in upper receiver. Consequently the term SPR took on yet another meaning, and now stood for "Sof Precision Rifle" (Special operations forces Pre-

cision Rifle). Within twelve months, Crane had taken all the knowledge they had gained in the initial prototype stage and used it to develop 24 second-generation SPR prototypes, which were more adaptable to production on a larger scale.

Due to the lack of availability of M4A1 carbines and the extremely large number of obsolete M16A1 rifles being turned into Crane by National Guard and

Reserve units for destruction, many of which were still in excellent condition, the host weapon was no longer the M4A1 carbine, but the older M16A1 rifle.

Formal testing of the first SPR rifles was conducted during October, 2000 at Thunder Ranch in Texas. The combination of operational and technical experimentation highlighted the few remaining weaknesses which required correction before production of the second generation SPR rifles began. During the winter of 2000 - 2001, all the final changes were made and all deficiencies were corrected. The specifications of the first 100 Limited User Test (LUT) rifles were set for large production runs, and the plan

called for these LUT rifles to be deployed with SOCOM operators overseas by the summer of 2001. These initial deployments allowed the users to evaluate and make suggestions for improvement before commencement of the final production run.

Most of these initial 100 rifles were called into service due to Operation Enduring Freedom in September, 2001. So the field trials were conducted in just that, the field. The SPR has also been used with great success with Special Operations Forces engaged in combat in Afghanistan. The SPR has been responsible for an extremely high percentage of enemy soldiers engaged and killed with precision rifles.

## The SPR Becomes the Mk12



134. Right side view of the two versions of the SPR which made the final selection: the Mk12 MOD 0 (above) and the Mk12 MOD 1 (center). Originally the SPR was to be an upper receiver only, but to meet all the requirements, it was necessary to have a lower receiver as well.

Both versions utilize the same surplus M16A1 lower receiver, shown below, equipped with a two-stage selec-

tive-fire Match-grade trigger. Most are fitted with an ambidextrous fire selector and the Falcon Industries Ergo-grip, although some retain the standard selector as shown here and the A2-style grip.

Only 20-round magazines are used, to better accommodate firing from the prone position.

After these initial combat successes, the SPR rifle was renamed the Mk12. Both the MOD 0 and MOD 1

versions of the Mk12, described further below, use the same lower receiver, which has been modified



138. Right side closeup of the muzzle end of the Mk12 MOD 0.

Note the folding front sight and gas block, designed and manufactured by Precision Reflex, Inc., with elevation drum above the hinge.

All SPR/Mk12 rifles utilize a barrel designed to take the OPS, Inc. silencer. The threads behind the muzzle brake are protected by a knurled nut, here shown removed, when the silencer is not used.



139. Top closeup of the muzzle end of the Mk12, MOD 0.

Note the unusual design of the muzzle brake, and the Precision Reflex, Inc. front sight, shown in the folded position on top of the PRI gas block.

block is made by PRI, and incorporates a folding front sight. The front sight post is adjustable for elevation by means of a dial on the front sight assembly.

The optics (plus light sources, bipod, etc.) are attached by ARMS, Inc. Throw Lever mounts which

allow for quick detachment if there is an immediate need to go to iron sights. Both Harris bipods as well as Versa-Pods are used.



140. All Mk12, MOD 0/1 rifles come in the same fitted carrying case with their accessories.  
courtesy United States Special Operations Command

### The Mk 12, MOD 1 (NSN 1005-01-504-3276)

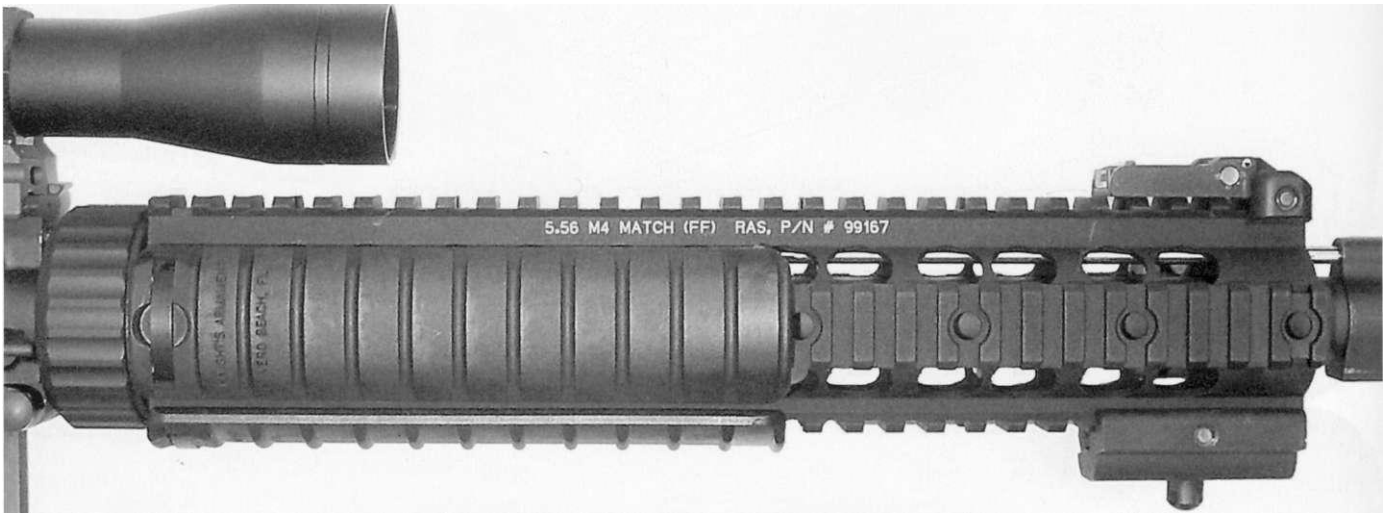


141. Right side view of the Mk12, MOD 1 rifle.  
Note the KAC Free-Floating RAS with built-in front sight assembly, and the Knight's back-up rear sight.

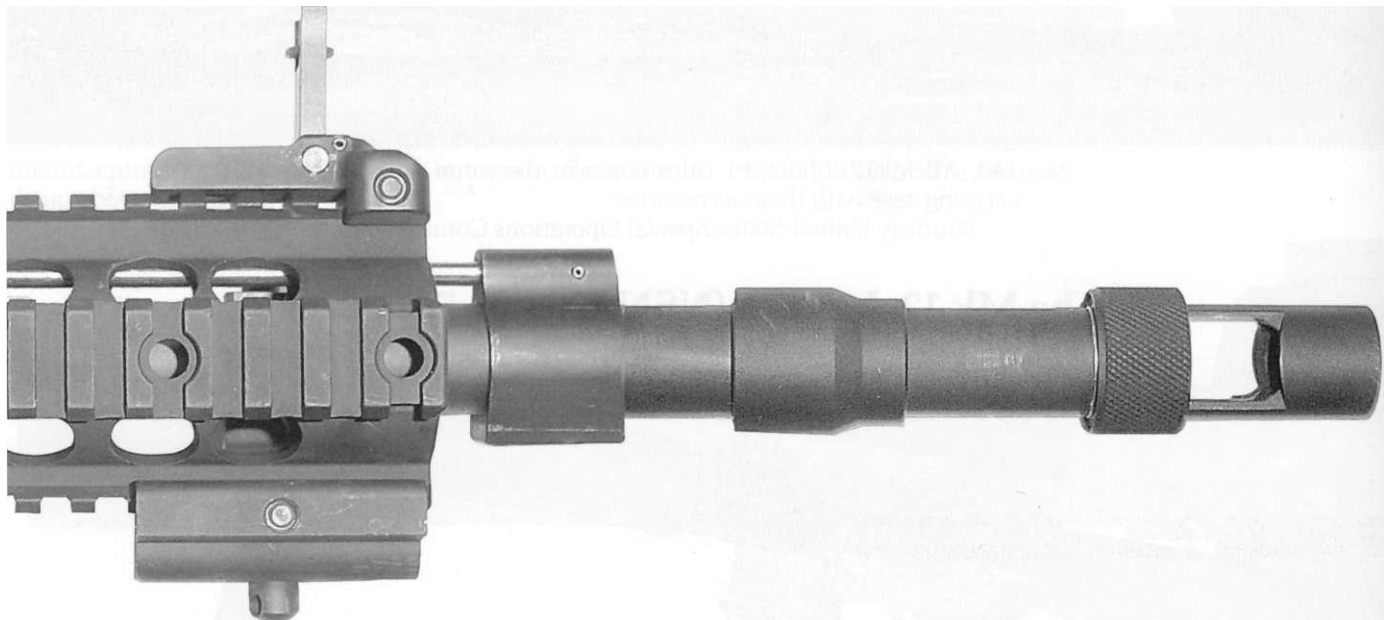
The Mk 12, MOD 1, weighing slightly less at 10.8 lbs., is carried by Army Rangers, Navy SEALs and Air Force Special Tactical Teams. It uses many compo-

nents manufactured by Knight's Armament Company including the Free Floating RAS (Rail Adapter System), which is fitted with full-length quad MIL-





142. Right side closeup of the Mk 12 MOD 1, showing the Knight's Armament Company Free-Floating RAS (Rail Adapter System) with folding front sight on top and the handguard adapter (below, right) for attaching the sling swivel and bipod.



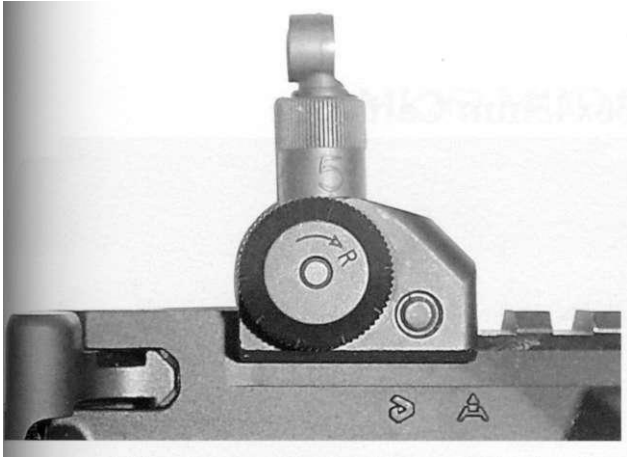
143. Right side closeup of the muzzle end of the Mk12, MOD 1.

Compare with fig. 138: note the different gas block, manufactured at the Naval Surface Warfare Center, Crane, Indiana.

The Knight's Armament Company folding front sight is shown in the open position.

STD-1913 rails. This rail system does not use a sleeve as does the MOD 0: optics are mounted directly on the upper receiver, or on the rails on the Free Floating RAS, using ARMS Inc. #22 high scope rings which

attach right to the rail. The KAC folding back-up sight is fitted on the rear of the upper receiver rail, and a folding front sight is used. The gas block is made at Crane.



144. Right side closeup of the Knight's Armament Company folding back-up rear sight on the Mk 12 MOD 1 rifle. This sight is both adjustable for windage and elevation.



145. Rear view of the KAC back-up rear sight, showing sight aperture and elevation adjustment knob.



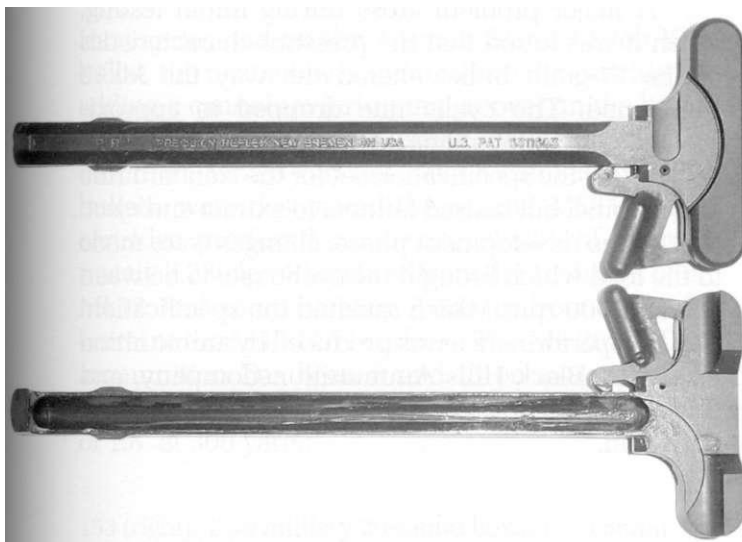
146. Right rear three-quarter view of the KAC folding front sight on the Mk12, MOD 1, which is adjustable for elevation.



147. Left side view of the Leupold TS-30 A2 variable telescopic sight, which is standard equipment on both the Mk12 MOD 0 and 1. The scope attaches to the rail with ARMS, Inc. #22 Throw Lever mounts on both versions of the rifle. The maximum power is 9X.

The early rifles utilized the TS-30 A1 scope, which is identical except it does not have the illuminated sight reticle of the TS-30 A2.

Note the top rear dial, which controls the intensity of the illumination of the reticle.

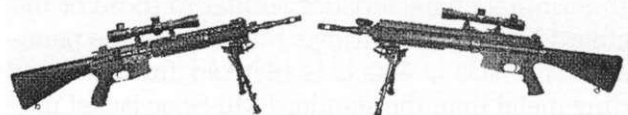


148. Top and bottom views of the Gas Buster charging handle, made by PRI of New Bremen, OH.

Note (below) how the rear edges of the charging handle extend downward, to prevent gas leakage toward the shooter's face.

SW370-BY-OPI-010

OPERATOR'S MANUAL  
for  
RIFLE, SPECIAL PURPOSE 5.56MM  
MK12 MOD 0/1  
NSN 1005-01-504-3275 (Mod 0)  
1005-01-504-3276 (Mod 1)



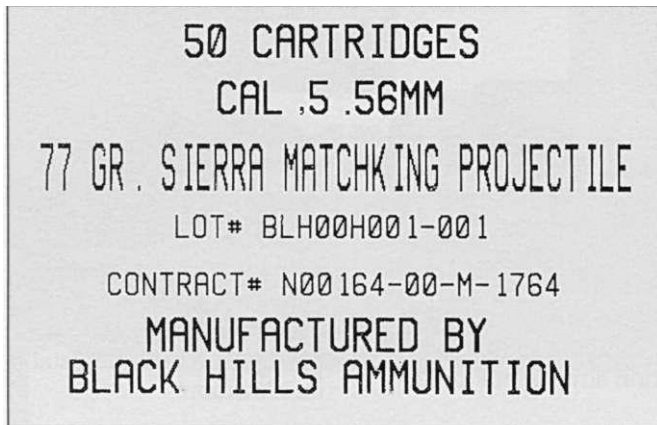
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149. The cover of the USSOCOM operator's manual for the special-purpose Mk12 MOD 0/1 rifles.

courtesy United States Special Operations Command

## The New Improved SOCOM 5.56x45mm Cartridge

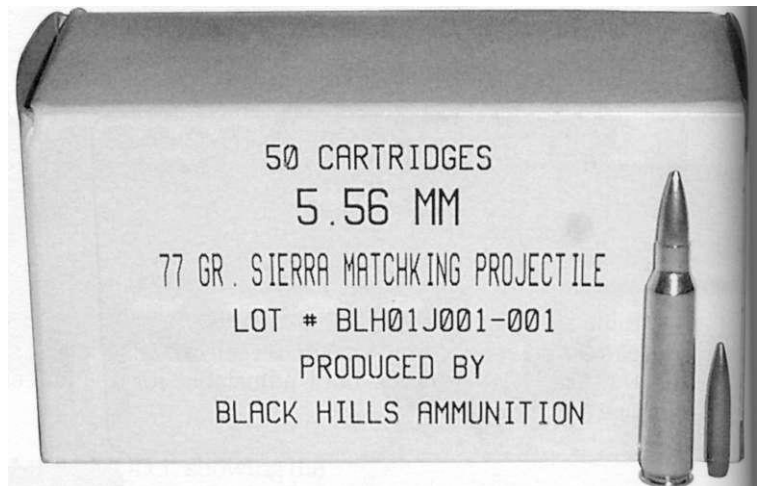


150. A box of 50 cartridges from one of the first production lots of SOCOM 5.56mm ammunition loaded with the 77-grain Sierra Match King bullet, manufactured by Black Hills Ammunition Company.

This was the box utilized until the bullet was type-classified as the Mk 262 MOD 0 cartridge.

As noted, part and parcel of the SOCOM requirements as set forth were improvements in the performance and versatility of existing 5.56mm ammunition, primarily to increase long-range performance and improve barrier penetration. It was found that the best way to accomplish these goals was to begin with the proven Match-grade ammunition utilized by the Army Marksmanship Unit and the Navy Marksmanship Team, which is loaded with the Sierra Match King 77-grain boat-tail open tip bullet, although the two marksmanship teams specify different powder types and charges. This is an open-tip bullet, not a hollow point, and is designed solely for accuracy, not expansion.

The process used in the manufacture of these Match-grade projectiles is much more exacting and expensive than that used for conventional military bullets, but yields vastly superior accuracy along with terminal characteristics similar to those of the standard M855 ball cartridge, but without the penetrator. The jacket, which is blanked from thinner gilding metal than the standard Mil-Spec jacket material for greater concentricity, is cupped, drawn, and trimmed from the base up, and then boattailed. The lead core is swaged from lead wire to the exact shape of the core, and then impacted into the jacket from



151. A slightly later box of 50 SOCOM cartridges, with a sample of the Mk 262 MOD 0 loaded cartridge and 77-grain Match King projectile.

The cartridge currently in production is loaded with the Mk 262 MOD 1, which is the same bullet with the addition of a cannelure.

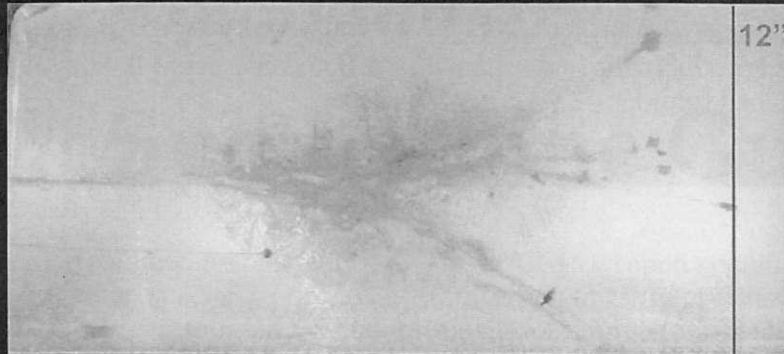
the top. The ogive is then formed, leaving a tiny hole in the tip of the bullet which will not expand on hitting a human target. The finished bullet is then sized.

Due to time constraints, the search for the optimal load came down to a choice among available Commercial-Off-The-Shelf (COTS) samples. More than twenty different loads and manufacturers were tested for suitability with the SPR.

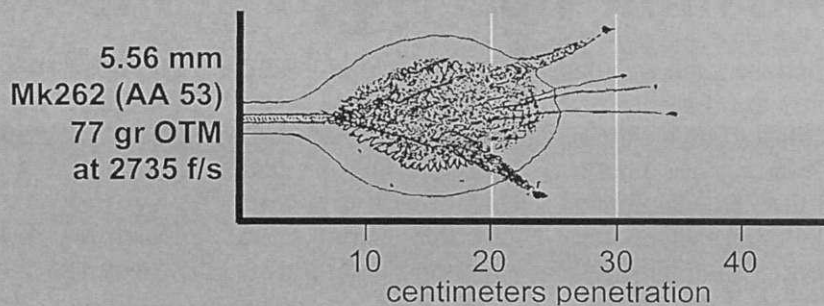
A major problem arose during initial testing, when it was found that the pressure characteristics of the 77-grain bullet altered the way the Mk12 functioned. The cyclic rate dropped to approximately 550 to 580 rounds per minute, which was not only below the specification set for the standard rifle and carbine, but caused failures to extract and eject. During the development phase, changes were made to the load which brought the cyclic rate to between 700 and 800 rpm, which satisfied the specification. The best performance was produced by ammunition loaded by Black Hills Ammunition Company, and this contractor was chosen for the next phase, militarization.

## Mk262 MOD 0 and MOD 1 Ammunition

### 5.56 mm Mk 262 77 gr OTM



Of the currently available 5.56 mm ammunition, the best overall choice for NSW use in carbines and rifles is the Mk 262, Mod 1 77 gr OTM, which offers both superior incapacitation potential, as well as greater accuracy than 62 gr M855 FMJ.



First documented U.S. military combat use of a 5.56 mm 77 gr bullet occurred in Viet Nam with NSW use in the Stoner 63

152. A chart illustrating the superior penetration characteristics of the Mk262 77-grain Open Tip Match (OTM) ammunition.

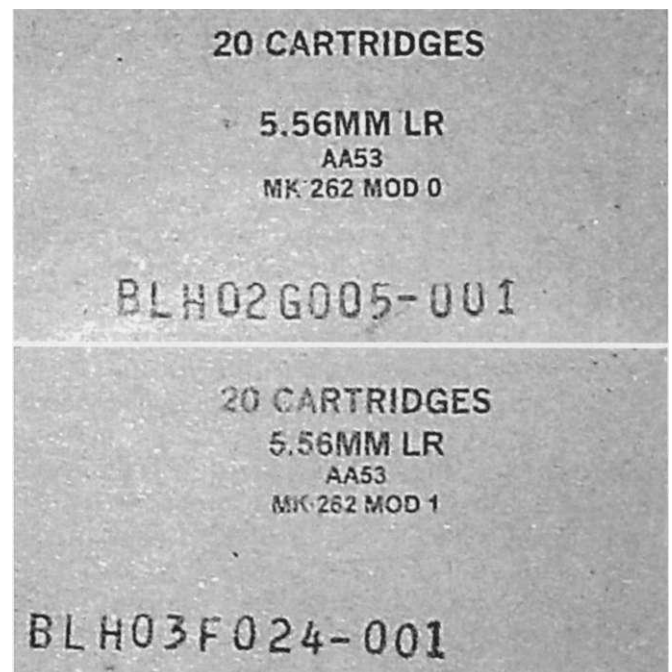
courtesy United States Special Operations Command

Having decided on the 77-grain Sierra Match King bullet, the next job was to militarize the cartridge by adding a cannelure (crimping groove) on the bullet. The first production lots loaded by Black Hills Ammunition, which did not have a cannelure on the bullets, were designated the Mk262 MOD 0. This cartridge produced a muzzle velocity of approximately 2,730 fps when fired from the 18" barrel of the Mk12, and approximately 2,680 fps from the 14 1/2" barrel of the M4/M4A1 carbine. The Mk 262 MOD 0 ammunition has been found to be extremely and consistently accurate, producing average group sizes of 1.8" at 300 yards.

153 (right). Two military 20-round boxes of "5.56mm LR" cartridges.

Above: the Mk 262 MOD 0.

Below: the Mk 262 MOD 1.



## 118 Describing the Mk12

As of this writing Sierra is producing a special version of the 77-grain Boat Tail Match open-tip bullet with a cannelure for use by SOCOM in cartridges designated the Mk 262, MOD 1. Other modifications include a primer sealant to protect the military-grade primer, and the use of heavy military brass. The militarized load produces the same chamber pressure as the M855 ball round.

Combat evaluations of this new cartridge in Afghanistan and Iraq have heralded the effectiveness of these cartridges. As of this writing a large percentage of the 5.56 ammunition being utilized by SOCOM in their M4/M4A1 carbines, CQB carbines as well as their Mk12 MOD 0 and MOD 1s in Afghanistan and Iraq consists of Mk 262 MOD 0 cartridges.

## *Chapter Five*

# Colt Submachine Guns

**W**ith the proliferation of law enforcement SWAT teams and other special response units during the 1980s, Colt's began to realize that they had been ignoring an entire marketplace for specialized weapons. Although the Colt 5.56mm

M16/AR-15 weapon system predominated in the law enforcement assault rifle and carbine arena, requirements for a limited-range urban submachine gun that would not overpenetrate were being served almost solely by the Heckler & Koch MP5 series.

## The Genesis of the Colt 9mm SMG Program

In the mid-1980s, with Colt's senior engineer Henry Tatro appointed as the SMG Project Leader, Colt's began development of a 9x19mm NATO caliber submachine gun based on their combat-proven M16/AR-15 weapon system. This approach was taken for several reasons. First, from a training standpoint, the law enforcement community contains large numbers of military veterans who have had prior training with the M16 service rifle, and by basing the SMG on the M16/AR-15, an easy transition from the assault rifle to the submachine gun and vice versa would be assured, as familiarity with either one would leave the operator right at home with the other. Furthermore, the AR-15/M16 weapon system has

always had the reputation as the finest human-engineered military rifle in the world. All operational controls are within hands' reach, meaning that the operator never has to remove his firing hand from the pistol grip, as both the selector lever and the magazine release can be actuated from that position. The opposite hand can remove/insert magazines, push in the bolt catch, or retract the charging handle.

All production Colt 9mm SMG serial numbers begin with the prefix "HT", the initials of Henry Tatro, the 9mm SMG project leader, while the serial numbers of the semi-auto-only commercial and law enforcement 9mm carbines begin with the prefix "TA", the first two letters of Mr. Tatro's last name.

## The 9mm SMG Prototypes

The initial SMG prototypes were based on the early XM177E1 carbine, which had been introduced during the Vietnam war. This carbine utilized the common telescoping buttstock as well as a short 10 1/2" barrel (11 1/2" overall with a 1" bird cage flash suppressor fitted).

With the basic parameters of the XM177E1 as the starting point, the first step was to redesign the operating system. An unlocked blowback system was sufficient to contain the much lower breech pressure of the 9mm NATO cartridge, meaning that both the gas system and the rotating bolt could be eliminated. The mass of the bolt assembly, as well as the weight of the hammer spring and the buffer/return spring, were calculated to keep the bolt closed

until pressures had dropped to a safe level before the empty cartridge was extracted and ejected, and a new round fed and chambered.

The original Colt 9mm SMG prototype fired from an open bolt, but since this arm could possibly fire due to the bolt carrier being released should the SMG be inadvertently dropped, a closed bolt, hammer-actuated system was designed. This both addressed the safety issue and increased the accuracy potential over that of the open-bolt prototype. Originally, the bolt utilized a standard 5.56mm extractor, but in later production a new extractor was designed expressly for the 9mm NATO cartridge.

The blowback system was found to produce an extremely high cyclic rate of fire. Colt installed a



154. Left side closeup of the prototype SMG showing markings indicating that this gun was based on a standard M16A1 lower receiver.

Note the numerous holes drilled into the magazine well, for use with various experimental types of magazine conversion inserts.



155. Left side closeup of an early 9mm SMG lower receiver, showing markings.

Note the "X"-prefixed serial number, indicating that this is a factory experimental model.

courtesy C. Reed Knight III

heavy steel insert in the rear of the bolt carrier assembly to increase the weight of the bolt and decrease the rate of fire from well over 1,200 rpm to 800 to 1,000 rpm, approximately the same as the SMG's 5.56mm counterpart.

Another design feature of the first prototype submachine gun was the addition of a grip safety, located right on the rear of the pistol grip where the web of the shooter's hand would come in contact

with it. This device worked in exactly the same manner as the grip safeties on Colt's old warhorse M1911/M1911A1 pistol and the UZI submachine gun, and was independent of the selector lever. However the grip safety mechanism added cost and complexity, and since it had never been needed or requested on the 5.56mm rifles or carbines, it was omitted in the production version of the submachine gun.

## Development of the 9mm SMG Magazine and Insert



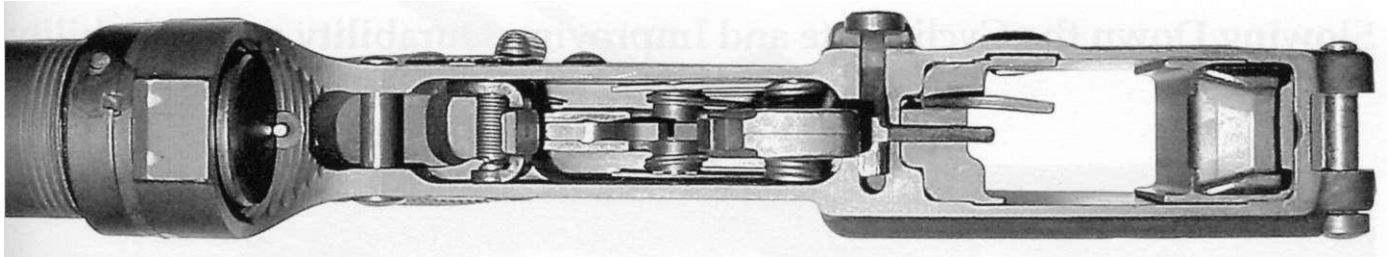
156. Right side view of an early production 9mm SMG.

Note the lack of gas/cartridge case deflector, and the converted UZI magazine.

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157. Top view of the inside of the 9mm SMG lower receiver, fitted with Colt's two-piece magazine adapter.

Note the feed ramp on the front adapter, and the ejector at the rear. Also note the extended arm on the bolt catch, which allows the SMG to hold open on the last shot.

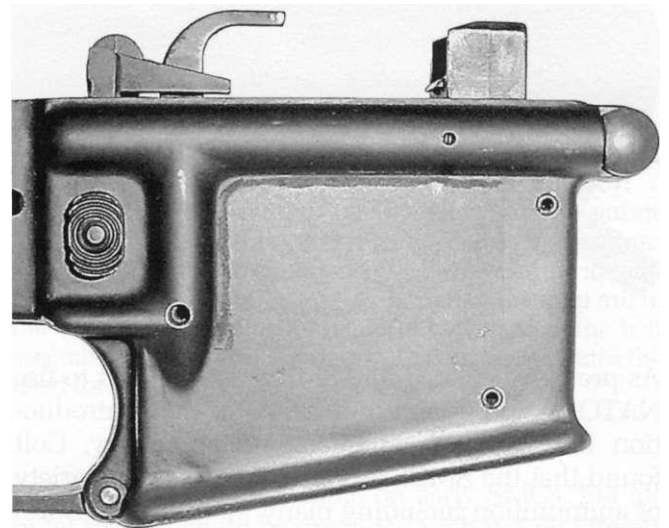
While Colt deliberately retained as much family resemblance as possible between the SMG and its 5.56mm counterparts, a special magazine obviously had to be developed to accommodate the 9mm NATO cartridge. Initially, Colt designed a removable one-piece magazine insert that accommodated a 9mm UZI magazine in the 5.56mm magazine well. The advantage of this was that by removing the insert and replacing the upper receiver with a 5.56mm assembly, the arm could be converted back to 5.56mm.

The one-piece insert was implemented only in the early prototypes, however, as tolerancing this part proved to be problematic due to slight dimensional differences which could be encountered in the magazine well, the magazine, and also the insert itself.

Production submachine guns initially utilized a two-piece (front and rear) insert, which was pinned in place, although in 2001 Colt switched to a new one-piece insert designed by Art Daigle, the Colt Model Shop Supervisor. This device, which was granted US Patent no. 6,072,352, was less expensive and easier to manufacture and assemble than the two-piece unit.

Due to the use of the magazine well insert, the magazine catch had to be made slightly longer so it would sit deeper in the catch notch on the magazine. This improved magazine retention and eliminated inadvertent magazine release. The rear portion of the insert has a fixed hook ejector, and the front is configured as a feed ramp, which sits directly in front of the magazine and guides each cartridge from the magazine to the chamber.

The original magazines used by Colt were the excellent, double-stack Israeli UZI magazines. Later versions used a modified UZI design which included a provision to actuate the bolt catch, so the bolt will lock to the rear after firing the last cartridge. Due to the increased distance from the bolt catch to the



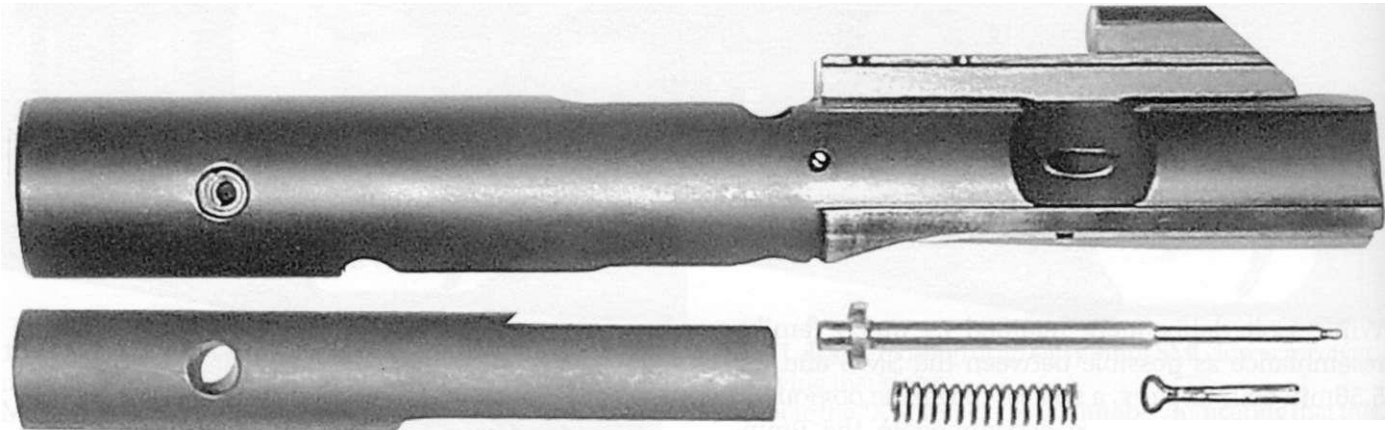
158. Right side closeup of the magazine well area on the lower receiver of the 9mm SMG.

Note the long hook ejector, the extended arm on the bolt catch at the rear of the magazine well, and the feed ramp at the front.

shorter (9mm vs. 5.56mm) magazine follower, the bolt catch was fitted with a longer actuation lever.

Originally, the SMG was designed to fire NATO-specification military ball ammunition. However for use by law enforcement personnel the requirement changed, and modifications were found necessary to accommodate law enforcement hollow-point ammunition. The early production magazines exhibited some problems in feeding various types of shorter hollow-point 9mm cartridges, and attempts to correct this affected both the magazine and feed ramp. Another problem encountered was that should the magazine be dropped, floorplate down, the ammunition would release from the magazine. Colt redesigned the magazine to correct these problems, thus putting the final finishing touches on an extremely durable and reliable submachine gun. Colt offers both 20- and 32-round magazines.

## Slowing Down the Cyclic Rate and Improving Durability and Reliability



159. Right side view of the bolt group for the 9mm SMG.

Note the one-piece bolt/bolt carrier, and the firing pin spring. Commercial handgun ammunition utilizes significantly softer primers than military and rifle cartridges, and this spring prevents firing pin inertia causing the cartridge to fire upon chambering.

Below, left: the steel weight, pinned into the rear of the bolt group to provide additional mass. This keeps the bolt closed longer until the pressure drops to a safe level before the fired cartridge case is extracted and ejected. In addition, the combination of the heavy bolt group and the 9mm SMG heavy buffer slows the cyclic rate.

As previously stated, the SMG was designed to fire NATO standard ammunition. After their introduction into the law enforcement community, Colt found that the SMGs were being fed a wide variety of ammunition including many +P (Plus Pressure) cartridges, which like 9mm NATO are loaded to a higher pressure than the 9mm Luger SAAMI specification, and +P+ (Plus Pressure Plus) cartridges, which are loaded even "hotter" and are generally intended for use only in SMGs. In the case of the Colt SMG, it was found that the use of such ammunition increased the cyclic rate and caused disconnecter and hammer/trigger pin breakages, as well as excessive wear on the lower receiver.

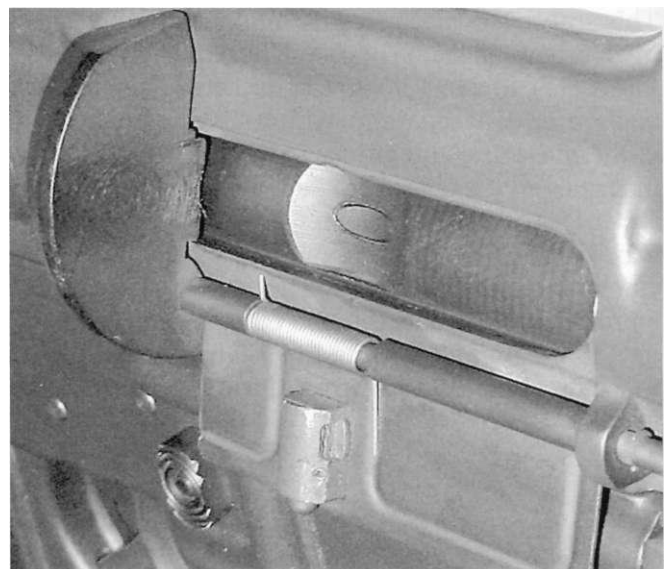
To cope with the issue of hammer/trigger pins breaking from the higher impact, Colt designed stronger hammer/trigger pins made from stainless steel. These stainless steel pins are only found in the selective-fire SMGs, with the semi-automatic only 9mm Carabines still using the standard hammer/trigger pins. Colt also designed a special heavier buffer to slow down the incredibly high rate of fire of the blowback SMG, and reduce bolt bounce. The new buffer body is made of solid steel with three internal steel weights to increase mass, as well as a neoprene bumper. Three rubber disks are also fitted, two between the steel weights and the third between the first steel weight and the front of the buffer body.

## Modifications for Production

Several modifications were made to the original prototype design to prepare the SMG for production. As discussed above, the one-piece magazine insert was initially replaced by the two-piece pinned-in insert. Also, a bird cage-style flash suppressor was added to the 10 1/2" barrel. In 1986, Colt added a spring-loaded polymer gas deflector to the rear of the ejection port, which was installed on the ejection port cover rod.

160 (right). Right side closeup of the Colt 9mm SMG showing the gas block/cartridge case deflector, added in 1986. Its primary purpose was to keep gas and unburnt powder away from the shooter's face.

Note the modified (shortened) ejection port cover.





161. Right side view of the Colt 9mm SMG, shown partially disassembled.

Stripping is performed in a very similar manner to any of the M16-series rifles, the main difference being due to

This shortened the overall length of the ejection port, and in turn meant that the ejection port dust cover had to be shortened approximately

the unlocked (blowback) system of operation of the bolt assembly. There is no separate bolt, which eliminates the need for a cam pin.

This was not available on early SMGs, but all older models could be upgraded with it. Colt offered a simple retrofit to customers who had purchased older versions of the submachine gun.

## The Colt 9mm SMG with the KAC Silencer

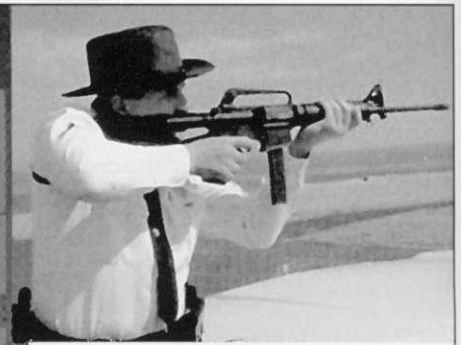


162. Left side view of a short-lived model of the Colt 9mm SMG equipped with a Knight's Armament Company silencer. The silencer worked very well, but was discontinued

due to a lack of interest in the marketplace.

Note the lower receiver began life as a semi-automatic-only lower, which was then converted to selective fire. courtesy C. Reed Knight III

The Future of Firearms



**Compact:** COLT® AR-15 lightweight .9mm law enforcement carbine R6450 weighs 5.8 lbs. Collapsible buttstock (32 inches closed) provides close-quarters versatility without compromising shooting capabilities.

**Accurate:** Provides law enforcement officers the performance and accuracy of a rifle platform when engaging targets outside the range of a handgun. Front sight square post adjustable for elevation; rear sight adjustable for windage, with two flip-type apertures for short range (0-50m) and long range (50-100m).

**Combat Ready System:** Semi-automatic, blow back operation. Fires from closed bolt (last round bolt hold open feature). Magazine capacity 20 rounds standard, 32 rounds optional.

**Colt Family of Weapons:**

The Colt .9mm has the same operational controls as the M16/AR-15 5.56 Family of Weapons. Many of the Colt .9mm carbine parts are interchangeable with the Colt Sporter Rifle and AR15 Carbine, thereby simplifying maintenance. Colt made the M16 the standard by which all others are judged. Quality makes the law enforcement .9mm carbine a COLT.

*For more information contact:*  
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Colt introduced a short-lived SMG model with a built-in silencer, developed by Knight's Armament in conjunction with Colt engineers, which was housed within a set of longer M16A2-style handguards. With this extremely well-designed silencer, the only noise apparent when firing subsonic 9mm ammunition was from the bolt "chatter".

Colt later discontinued all further development and production of silenced versions of their submachine gun due to lack of consumer interest, although many other silencer designs have been produced for the Colt SMG in the past.

## Variations of the Colt 9mm Carbine and SMG

### The Semi-Automatic AR-15 9mm Carbine (Model R6450)

Colt currently offers their submachine gun in several variations, each intended for a different purpose. The first version to be offered on the civilian market was the semi-automatic-only AR-15 9mm Carbine (Colt Model R6540), which was fitted with a 16" barrel and a telescoping buttstock and retained the M16A1-style rear sight, which is adjustable for windage only.

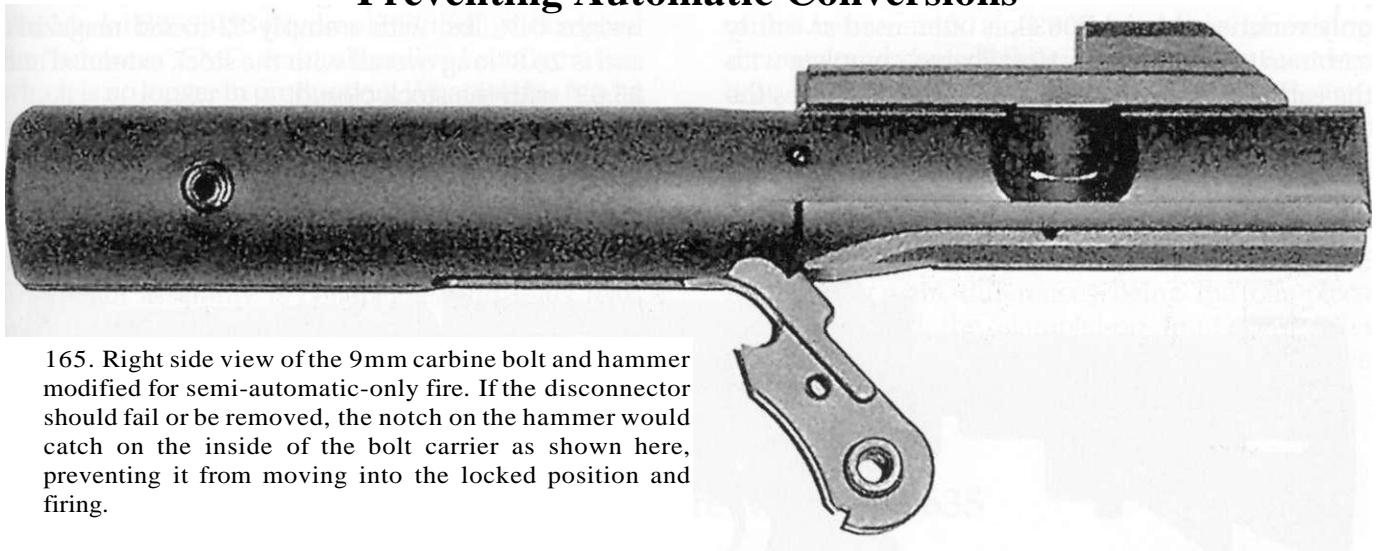
The carbine came with two 20-round magazines and a bayonet lug, although no bayonet could be mounted due to the fact the barrel length from the front sight assembly to the flash suppressor was too long. The AR-15 9mm carbine weighed a light 6.3 lbs. and measured 35" overall with the stock extended, and 32" with the stock telescoped.

In later production the AR-15 9mm Carbine was upgraded to include the gas deflector. The original AR-15 9mm Carbine is still available to law enforcement agencies.



164. Rear closeup of the 50m close-range rear sight aperture used on the Colt 9mm family of weapons.

### Preventing Automatic Conversions



165. Right side view of the 9mm carbine bolt and hammer modified for semi-automatic-only fire. If the disconnecter should fail or be removed, the notch on the hammer would catch on the inside of the bolt carrier as shown here, preventing it from moving into the locked position and firing.

163 (previous page). An early Colt advertisement for the semi-automatic Model R6450 9mm carbine, designed for the Law Enforcement community.

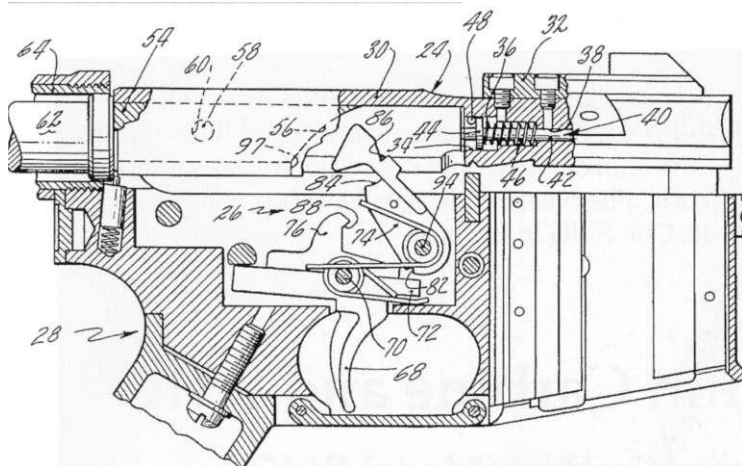
Note the caliber is stated as ".9mm".

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The selective-fire versions of the 9mm SMG retained the standard SAFE, SEMI and either AUTO or BURST fire control components. For the semi-automatic-only versions, however, a new safety/anti-conversion system had to be devised.





166. Henry Tatro's "Safety Device Preventing Conversion To Full Automatic Firing", granted US Patent no. 4,658,702 on April 21, 1987. US Patent Office

Colt assigned this task to Henry Tatro, the SMG Project Leader, who designed a firing mechanism wherein the selector, trigger and disconnecter were all standard—the only modified component was the hammer, which had a notch cut away on the front face. This works on the same principle as Colt's other semi-automatic only designs, and prevents full-automatic conversion by modification or removal of the disconnecter. The only difference on the 9mm carbine is that as the hammer falls the notch will engage the catch on the bolt assembly, rather than on the firing pin as in the standard .223 Rem., .222 Rem. (limited production) and 7.62x39mm caliber rifles and carbines, to prevent firing.

Henry Tatro's "Safety Device Preventing Conversion To Full Automatic Firing" was granted US Patent no. 4,658,702 on April 21, 1987.

## The Civilian Sporter and Match Target Lightweight Models

The AR-15 9mm Carbine was later replaced in the civilian catalog by the 9mm Sporter Lightweight (Model R6430), which was fitted with a fixed stock and no bayonet lug, the trigger group utilizing en-

larged (.170"-diameter) trigger and hammer pins (discussed in Chapter Ten).

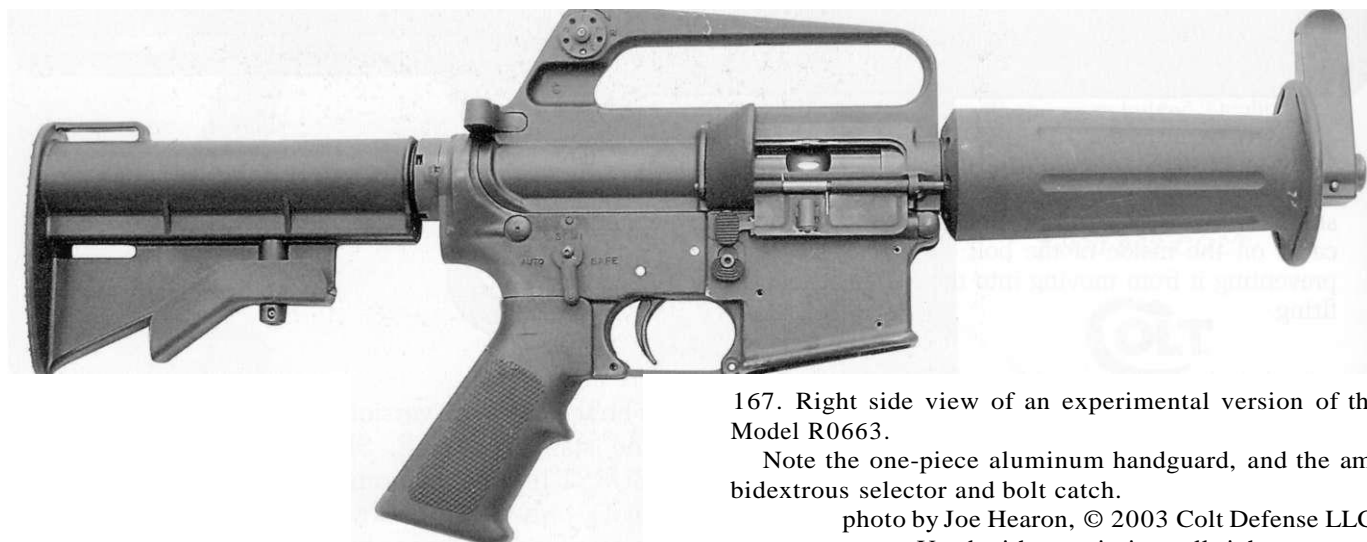
The current post-ban production Match Target Lightweight (Model MT6430) is the same basic rifle, minus the flash suppressor and bayonet lug.

## The Law Enforcement/Military Semi-Automatic Model R0634

The Law Enforcement/Military versions are the most popular of the Colt 9mm line. The semi-automatic-only variation, Model R0634, is often used as a duty carbine. It is fitted with a 10 1/2" barrel complete with the early bird cage flash suppressor, and utilizes the

M16A1-style rear sight, adjustable for windage only, as well as a telescoping buttstock. This version weighs 6 1/2 lbs. with a empty 32-round magazine, and is 28.8" long overall with the stock extended and 25.63" with the stock closed.

## The Discontinued "Brief case" SMG (Model R0633HB)



167. Right side view of an experimental version of the Model R0663.

Note the one-piece aluminum handguard, and the ambidextrous selector and bolt catch.

photo by Joe Hearon, © 2003 Colt Defense LLC.

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168. Right side view of the short-lived Colt 9mm SMG Model R0663, the "briefcase gun".

No longer in production, this was the smallest, most compact version of the Colt 9mm SMG family of weapons.

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The Model R0633HB (Hydraulic Buffer), nicknamed the "briefcase" SMG, was a short-lived configuration which is no longer in production. What set this model apart from the other versions was its extremely short 7" barrel, which utilizes the M231 handguard. The short barrel decreases the weight to a light 5.91 lbs., and shortens the overall length to 24 1/4" with the stock extended and 21" with the stock closed. The front sight assembly is collapsible, and folds rearward.

The most innovative feature of the R0633HB was the inclusion of a hydraulic recoil buffer, which both decreased felt recoil and lowered the cyclic rate

of fire between 100 and 200 rpm, thus increasing accuracy and controllability and aiding in recovery time. The Model R0633 was the same basic design, but produced without the hydraulic buffer.

The Model R0633HB features the same A1-style rear sight as all previous 9mm caliber submachine guns.

The Model 0633 was the earlier version of the R0630, the main differences being the one-piece handguard and the clamped-on front sight. The R0630, R0633 and R0633HB all featured selective semi- and full-automatic fire capability.

## The Selective-Fire Model R0635

The Model R0635 is in the same configuration as the semi-automatic-only Model R0634, but fitted for se-

lective fire. It is popular with SWAT teams, as well as military special operations units.





169. Left and right side views of the standard Colt selective-fire 9mm SMG Model R0635, shown with the sliding stock in the closed position.

Note the gas/cartridge case deflector, Colt magazine, and stainless steel hammer and trigger pins.



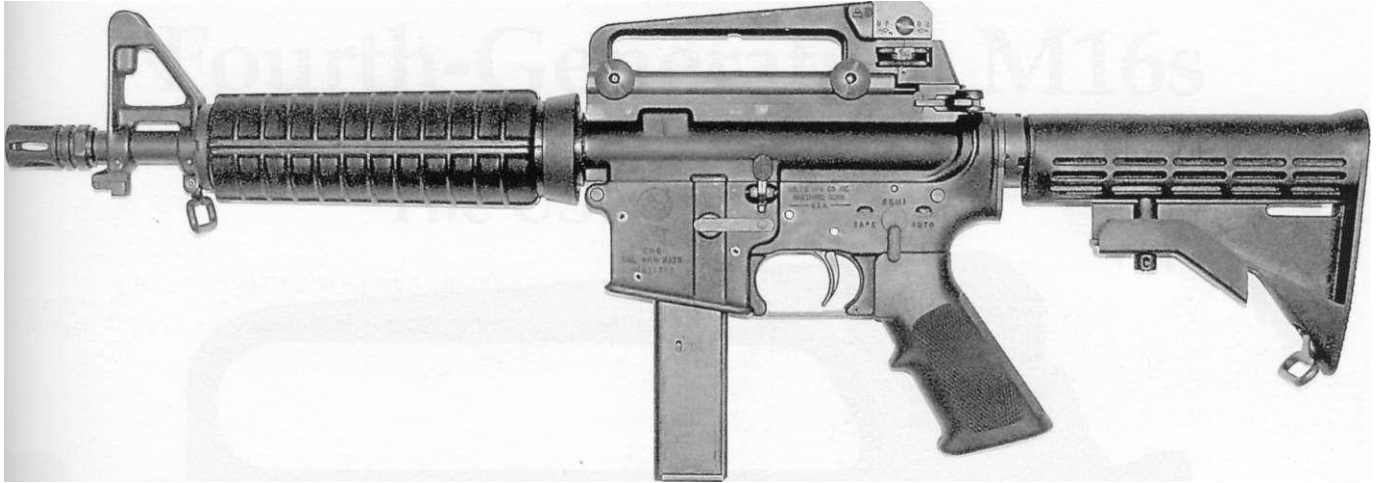
170. Left side closeup of the Colt 9mm SMG Model R0635, showing markings.

## The Model R0639, with Three-Shot Burst

The third Law Enforcement/Military version is the Model R0639, which is the same configuration as the

selective-fire Model R0635, but fitted with semi-automatic and three-shot burst fire control capability.

## Colt Special-Order "Flat-Top" SMGs



171. Left side view of the special-order flat-top Colt 9mm SMG.

Note the new improved version of the sliding buttstock.

Colt has filled some special orders for 9mm SMGs built on flat-top upper receivers. These were built on modified 5.56mm flat-top uppers which, unlike the

standard SMG upper, have the gas tube hole in the front of the receiver, and were equipped with the standard detachable carrying handle.

## Retrospective

Colt 9mm submachine guns have proven themselves in use with the US Secret Service, the Department of State, and the US Drug Enforcement Administration as well as with numerous police departments and SWAT teams all over the country. A large part of this success is the deliberate adaptability of the SMG to soldiers, police officers and shooters who have been trained, either by the military or a law enforcement agency, in the use of the M16/AR-15 series rifle. It has been found that training is easily carried over from the rifle to the submachine gun, and having both weapon systems as homogeneous as possible has proven to be a major benefit.

172 (right). Right side closeup of a 9mm SMG built on the custom flat-top upper receiver.

Note the removable carrying handle.



## *Chapter Six*

# Fourth-Generation M16s

## The US Navy M16A3



173. Left side closeup of the Colt M16A2E3, showing markings. The M16A2E3 was designed in response to the US Navy requirement for a fully-automatic option to the

burst-firing M16A2. This rifle was later adopted as the M16A3.

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**T**hroughout the years the Department of Defense and Colt have updated and made improvements to the original M16 rifle which have resulted in the current-issue M16A2, discussed in Chapter One, wherein were introduced and standardized the SAFE, SEMI, and controversial BURST fire control settings.

However there remained a need, set forth by the US Navy, for a version of the M16A2 which would fire in the full-automatic mode. Such a rifle

was first developed by Colt as the M16A2E3, and was later type-classified as the M16A3 (NSN 1005-01-357-5112; government drawing number 12012000; Colt Model R0646). This was a standard M16A2 with the sole difference being that the BURST setting had been replaced by an AUTO setting.

Relatively few—approximately 7,480—M16A3 rifles have been produced by FNMI, exclusively for the US Navy.



174. Left side closeup of an M16A3 rifle produced by FNMI, showing markings. FNMI is the only company to produce M16A3 rifles.

Note the AUTO selector position in place of the BURST setting of the M16A2. courtesy FN Manufacturing, Inc.

175 (below). Right side closeup of the M16A3.

Note the AUTO selector setting, and the standard M16A2-type fully adjustable rear sight.

courtesy FN Manufacturing, Inc.



## The New US Army and Marine Corps' General Purpose Rifle M16A4



176. Left and right side views of the M16A4 rifle, designed and produced by Colt.

Note the removable carrying handle on the flat-top upper receiver.

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Advancements in optics and the adoption of laser sights resulted in a plethora of new devices which posed ergonomic problems when mounted on the high fixed carrying handle of M16-series rifles, as craning up to look through them was awkward and exposed too much of the shooter's head and upper body. With the adoption of the "flat-top" M4 and M4A1 carbines, discussed in Chapter Three, it was seen as desirable to have a full-size battle rifle with the same versatility and adaptability to receiver-mounted optics.

The answer was the Colt-designed M16A2E4, type-classified as the M16A4 (NSN 1005-01-383-2872; government drawing number 12973001; Colt Model R0945). The upper receiver was changed to the new "flat-top" configuration with a built-in MIL-STD-1913 rail which enables the user to mount optics and other devices much lower relative to the centerline of the bore, which in turn allows the shooter to adopt a more natural shooting position.

In another carryover from the ACR and M4 programs, the M16A4 utilized the standard M4/M4A1 removable carrying handle, which if desired is mounted to the receiver rail. The fully-adjustable iron sights are calibrated to engage targets out to 600 meters, and are sighted in and used in the same manner as those on the standard M16A2 rifle. The M16A4 rifle fire control settings remain SAFE, SEMI and BURST.

The flat-top upper receiver has become standard on the US M16A4 and M4 and M4A1 carbines, as well as on all the Canadian-made Diemaco C7A1 rifles and C8A1 carbines and their variants. In fact, as discussed in Chapter Eight, the Canadian military has phased out their fixed-handle C7 rifles and C8 carbines in favor of flat-top C7A1s and C8A1s, and Diemaco currently does not produce fixed carrying handle versions at all.





177. Left side closeup of a Colt-manufactured M16A4 rifle, showing markings.

Note the removable carrying handle and the BURST

selector setting.

photo by Joe Hearon, ©2003 by Colt Defense LLC.

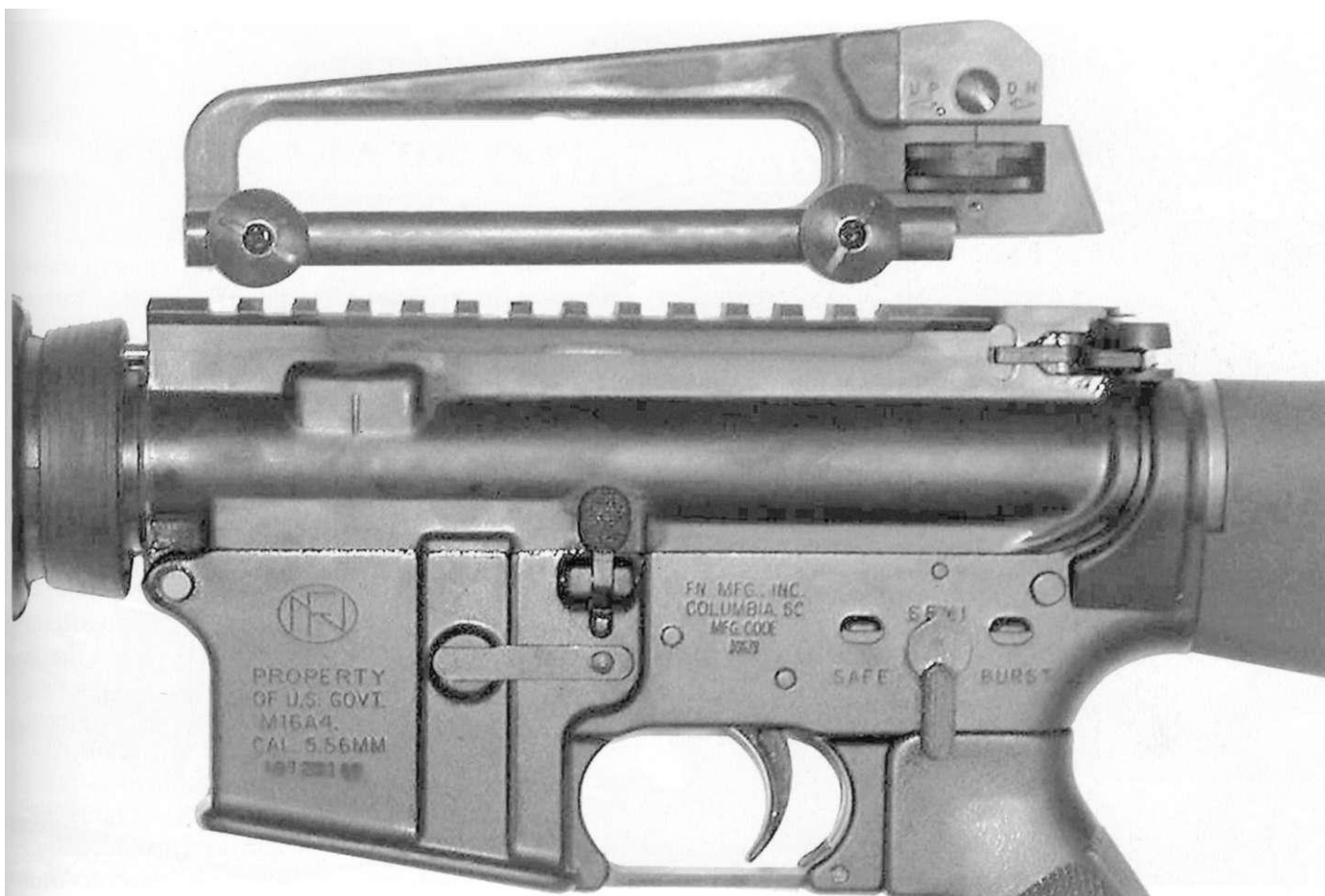
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178. Right side closeup of a Colt M16A4 rifle.

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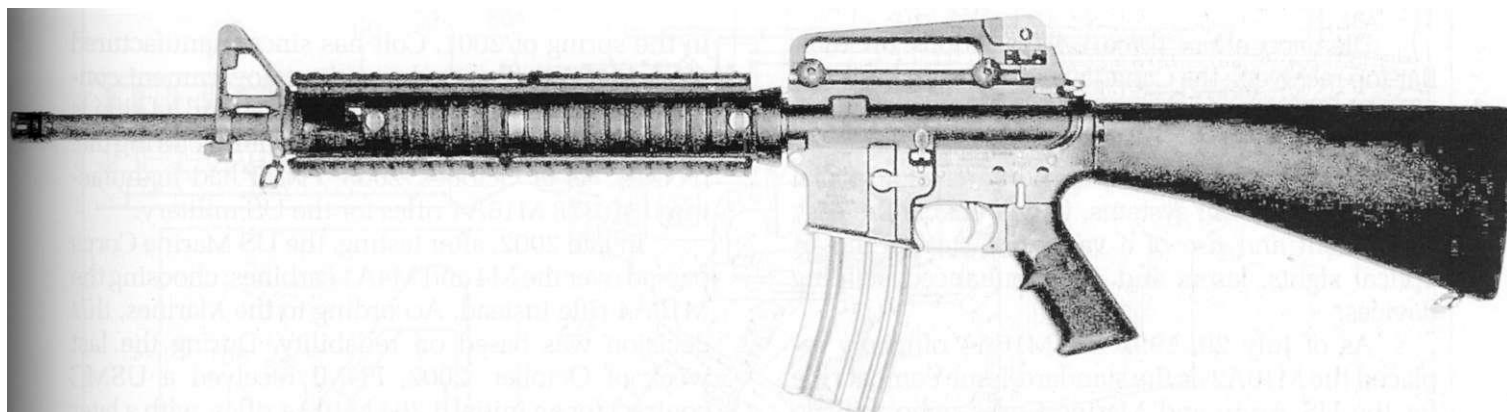


179. Left side closeup of an M16A4 manufactured by FNMI, showing markings.

Note the removable carrying handle and the integral

MIL-STD-1913 rail on the flat-top upper receiver.

courtesy FN Manufacturing, Inc.



180. Left side view of a current M16A4 rifle as procured by the US Marine Corps.

Note the Knight's Armament Company full-length M5 Rail Adapter System (RAS, discussed in Chapter Thirteen), which is supplied as standard equipment.





181. Basic Rifle Marksmanship training for a new recruit, shown here firing the M16A4 rifle with iron sights fitted.  
Note the M5 RAS, with plastic rail protectors installed.  
US Army photo

Diemaco offers three rail variations on their flat-top receivers: the Canadian specification rail, the US MIL-STD-1913 rail, or the British RARDE rail.

The general changeover to the flat-top upper receiver has opened up a whole new arena for special equipment and rail systems, which enable the easy attachment and use of a variety of state-of-the-art optical sights, lasers and other enhanced sighting devices.

As of July 29, 1997 the M16A4 officially replaced the M16A2 as the standard-issue combat rifle for the US Army and Marine Corps, who will no longer procure any M16A2 (fixed carrying handle) rifles.

Under contract no. DAAE20-98-C-0119 Colt's Manufacturing Company, Inc. agreed to supply the US government with just over 32,000 M16A4 rifles, at a total cost of \$6,371,568. The contract was completed and these initial M16A4 rifles were delivered

in the spring of 2001. Colt has since manufactured more M16A4 rifles under various government contracts, however as of this writing the M16A4 rifle is being manufactured solely by FN Manufacturing Inc. (FNMI). As of October, 2003, FNMI had manufactured 46,378 M16A4 rifles for the US military.

In late 2002, after testing, the US Marine Corps passed over the M4 and M4A1 carbines, choosing the M16A4 rifle instead. According to the Marines, this decision was based on reliability. During the last week of October, 2002, FNMI received a USMC contract for an initial 4,264 M16A4 rifles, with a later contract for an additional 27,000 rifles. All Marine Corps M16A4s are equipped with the Knight's Armament full-length M5 Rail Adapter System (RAS), to accommodate SOPMOD Kit components such as ACOG Reflex Sight as well as the ACOG Day Optical Sight (discussed in Chapter Thirteen).

# Further Advancements

## Colt's MARS (Mini Assault Rifle System)

Circa 1997, Colt's Manufacturing Company, Inc. went to work on a new project wherein they teamed up with Special Analytical Services (SAS) to develop an experimental mini-assault rifle, intended as a replacement for the 9mm pistol as well as numerous variations of submachine guns. The result was the Colt Mini Assault Rifle System (MARS), for which Colt engineer James Taylor and Michael Harris, the founder of SAS, were granted US Patent no. 5,827,992 on October 27, 1998.

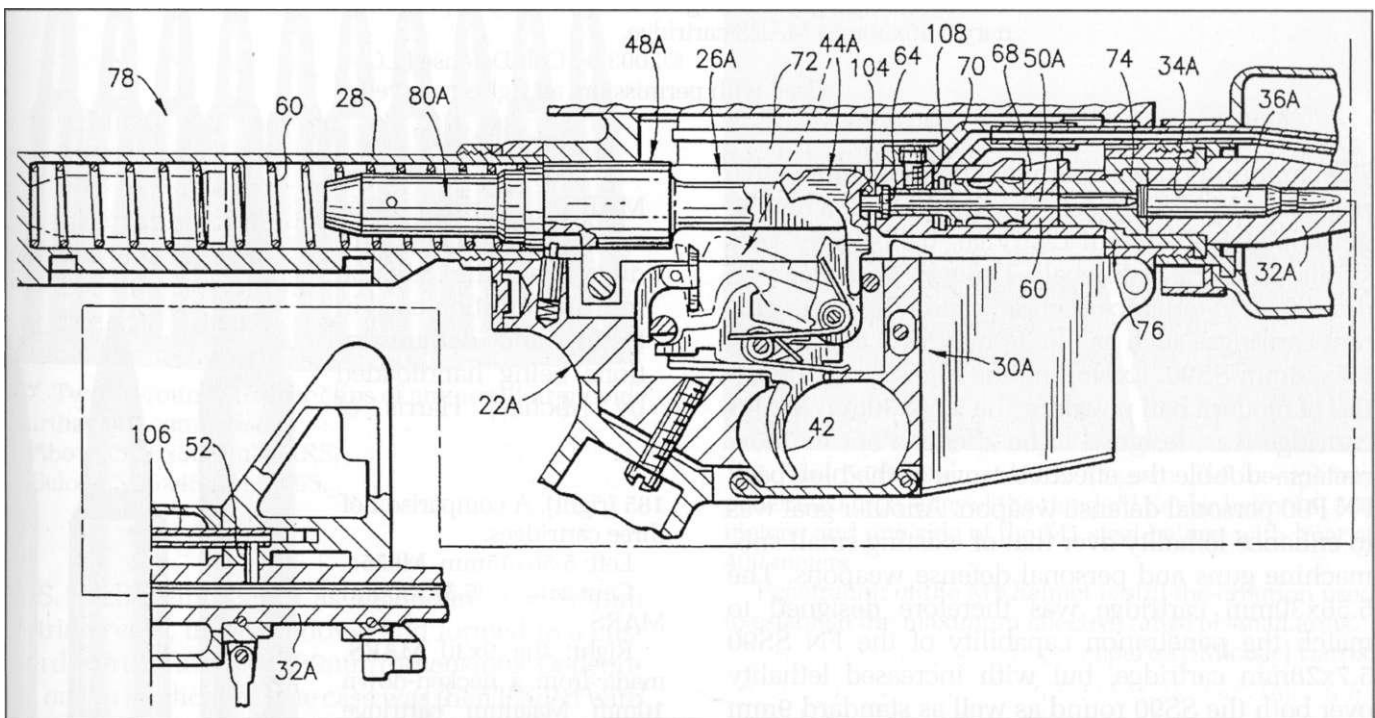
MARS was configured as a personal defense weapon for the military, which would also have law enforcement applications. The goal was to create a small, compact weapon which would be able to win a shootout against an AK47/AK74 or any other threat weapon, neither of which were practical or realistic opponents for someone armed with a 9mm caliber pistol or SMG. It was believed at the time by Colt and SAS that the MARS could replace 80% of all pistols and submachine guns, as well as up to 20% of rifles and carbines.



182. The Colt MARS design team.

Top row left to right: John Keyser, Ahmed Masood, Chris Lynch, Kevin Kaminski and Bob Dudek.

Bottom row left to right: Ron Giddish, Jim Taylor and Derry Bailey. courtesy Jim Taylor

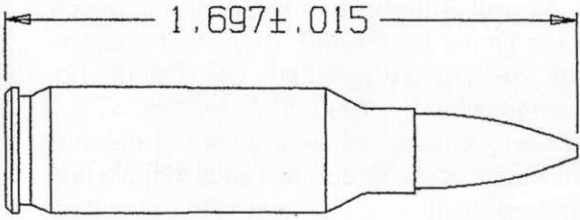


183. Drawing from US Patent no. 5,827,992 for features of the MARS rifle, granted to Colt's Jim Taylor and SAS'

Michael Harris, showing a right side sectioned view of the bolt, shortened receivers and gas system.

US Patent Office

## The 5.56x30mm Cartridge

PROPRIETARY INFORMATION			
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1. BULLET 55 GRAIN M193 2. VELOCITY 2600 FPS FROM 11 INCH BARREL 3. CASE CAPACITY 19.2 GRAINS OF WATER			
			
PRELIMINARY			
MATERIAL          HEAT TREAT          MARS FINISH NEXT ASSY USED ON APPLICATION		ANSI Y14.5M-1982 APPLIES THREADS PER FED-STD-H28 COLT SPEC CS1011 APPLIES  UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS-.0006 (±).005 .01 (±).01 ANGLES- ± 2° BREAK SHARP EDGES .005 TO .015 FILLET RADIUS .005 TO .015 125° ALL SURFACES	ORIG DATE OF DNG 4-30-98 DRAWN JET CHECK DTG APPD QUAL ENG APPD APPROVED-COLT COLT'S Manufacturing Company, Inc. Hartford, Ct. U.S.A. 5.56 MM MARS CARTRIDGE SIZE C CAGE CODE 13629 SCALE 4/1 EST VT ACTUAL SHEET 1 OF 1

184. Colt drawing describing some features of the preliminary 5.56x30mm MARS cartridge.

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The ammunition was perhaps the most innovative part of the MARS project. The MARS fired a newly-developed 5.56x30mm cartridge, ballistically very similar to the .221 Fireball. The new cartridge was developed to enhance accuracy and range over current cartridges such as the 9mm NATO and the FN 5.7x28mm SS90. Exploiting the high-energy densities of modern ball powders, the 5.56x30mm MARS cartridge was designed to be effective out to 300+ meters—double the effective range of the blowback FN P90 personal defense weapon. Another goal was to enhance lethality over that of existing small sub-machine guns and personal defense weapons. The 5.56x30mm cartridge was therefore designed to match the penetration capability of the FN SS90 5.7x28mm cartridge, but with increased lethality over both the SS90 round as well as standard 9mm NATO.

The short-lived MARS cartridge was never commercially produced, all the 5.56x30mm ammunition used in testing and demonstrations being handloaded by Michael Harris of

185 (right). A comparison of three cartridges.

Left: 5.56x45mm M855;  
 Center: 5.56x30mm MARS

Right: the 9x30 MARS, made from a necked-down 10mm Magnum cartridge case.





186. Various loadings of the MARS cartridge, shown among some of the rounds against which it was developed to compete.

From left to right: US 5.56x45mm M855 62-grain ball;

Russian 5.45x39mm M74 53-grain ball: MARS (62-grain SS109); MARS (55-grain ball); MARS (53-grain tracer); MARS (45-grain APDS); FN 5.7x28mm 31-grain P90; 9mm NATO (123-grain ball). courtesy Michael Harris

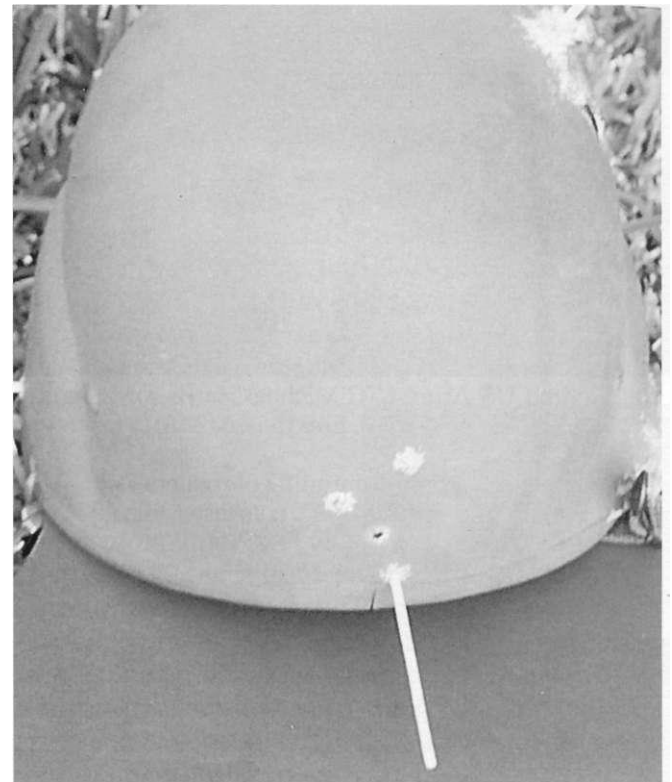


187. Two 10-round stripper clips of ammunition provide a further size comparison.

Above: 5.56x30mm MARS.

Below: 5.56x45mm M855.

SAS. Each round began as a standard 5.56x45mm cartridge case, trimmed down and formed in a custom die to the final 5.56x30mm dimensions. Depending on the application, the case was then loaded with either the 55-grain M193 ball bullet, the 62-grain M855/SS109 bullet with penetrator core, or a tracer bullet. The 55-grain M193 bullet produced a muzzle



188. The 5.56x30mm MARS 55-grain FMJ completely penetrated both sides of the standard Kevlar helmet at 300 meters, and one side of the M1 steel helmet with liner at 400 meters.

Penetration of the M1 helmet is still the criterion used to establish the maximum effective range of small arms.

courtesy Michael Harris.

velocity of 2,620 fps and a muzzle energy of 838 ft/lbs. when fired from the 10.5" barrel of the MARS.

The MARS cartridge could be loaded to any mission-specific configuration, which could include hollow- and soft-point bullets as well as ball and armor-piercing loads. It utilized Magnum pistol-type ball propellant, burned at rifle pressures to achieve higher velocities in its short barrel.

The MARS was battlesight zeroed at 200 meters, and the path of the bullet stays within approximately 3" of the line of sight. The 5.56x30mm bullet will penetrate a Kevlar helmet and vest at 300 meters.

The MARS was also experimentally chambered for the 9x30mm MARS cartridge, based on a necked-down 10mm Magnum cartridge case.

### A Comparison of Ammunition Parameters

Caliber	Bullet Weight	Muzzle Velocity	Barrel Length	Weapon Type
5.56x30mm	55 grains	2,620 fps	10.5"	Colt MARS
5.7x2 8mm	31 grains	2,346 fps	10.2"	FNP90
9mm NATO	124 grains	1,230 fps	8.85"	H&K MP5

### Describing the Three MARS Prototypes

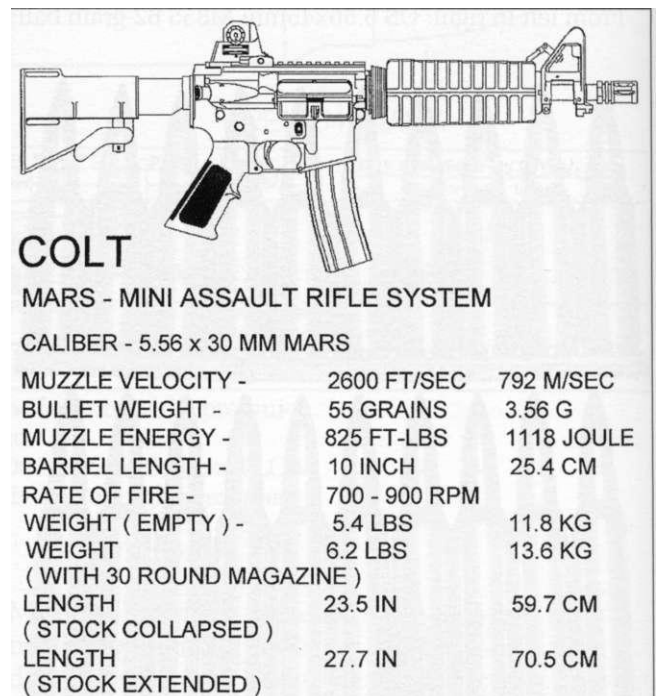


189. Retired US Army LTC Michael Harris, president of Special Analytical Services, fires the first MARS prototype at Colt.

Note the unfinished aluminum components.  
courtesy Michael Harris

Three MARS prototypes were made during the course of development. The upper and lower receivers, bolts and stock assemblies, all originally M4 carbine-type components, were shortened. A new magazine was designed to accommodate the shorter 5.56x30mm cartridge. This enabled the magazine well to be shortened, thus contributing to the shorter upper and lower receivers. The overall length of the collapsible stock was shorter than that of the standard carbine, and the buffer tube was shortened as well, necessitating a modified buffer, similar in design to the standard buffer, but shorter, containing two tungsten weights.

The MARS utilized a modified bolt and trigger group. The bolt carrier again was shorter, and fitted with a modified firing pin. All M16/AR-15-type rifles have a built-in safety mechanism which prevents them from firing out of battery. This mechanism

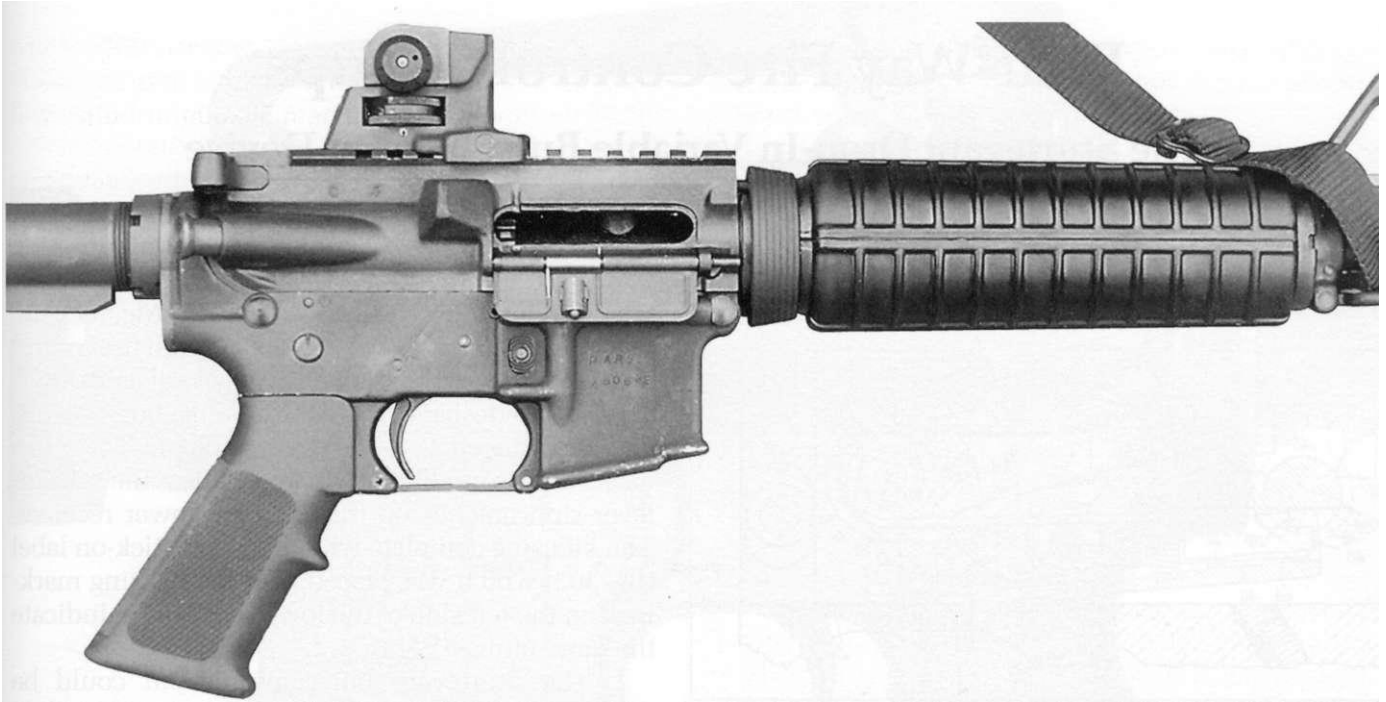


190. The specifications for the Colt MARS (Mini Assault Rifle System).  
courtesy Jim Taylor

involves three components: the hammer, firing pin, and bolt carrier assembly. If the disconnecter should fail on the standard rifles and carbines the hammer will ride the bolt carrier forward, the outer edge of the rear of the bottom of the bolt carrier keeping the hammer from striking the firing pin. Due to its overall length, the firing pin cannot protrude until the bolt is locked, by which time the hammer does not have sufficient energy to fire the cartridge.

Due to the shortened bolt carrier used in the MARS, modifications were made to the firing pin and the hammer to serve the same purpose. The firing pin





191. Right side close-up of the Colt MARS. Markings hand-stamped on the magazine well read "MARS X50692".

Note the shortened magazine well and ejection port, and the adjustable rear sight, made from a modified removable M4 carrying handle. courtesy Michael Harris

head was shortened, and a pocket was machined into the hammer where it strikes the firing pin, so if the disconnecter should fail, the firing pin could not protrude until the bolt was locked, by which time the hammer, riding the bolt carrier forward, would not retain sufficient energy to fire the cartridge.

The modified lower receiver necessitated some further changes. The locations of the hammer/trigger pins, automatic sear, and selector were moved slightly rearward. This enhanced the ability of a shooter with smaller hands to manipulate the selector lever without having to move his hand.

## An Evolutionary Dead End

Unfortunately, the MARS concept never found acceptance and thus never entered production. The Israelis showed the most interest in the MARS, as a possible replacement for their police UZI SMGs. This was exactly the type of market that MARS was designed for, and a production run of 2,000 guns per year for a term of ten years was discussed.

Colt took another look at the feasibility of the project in terms of these low numbers of units vs. the cost involved in tooling up for the MARS, and opted against going into production.

Thus the audacious MARS project represented an evolutionary dead end—the last attempt to adapt the M16-type weapon to a new cartridge expressly designed to fill any other than its intended roles as an assault rifle, carbine or submachine gun.

As of this writing, Colt has adapted the M16 weapon system to fire only 5.56x45mm NATO, .222

Remington, 9mm NATO and 7.62x39mm ammunition, although other manufacturers have adapted the system to additional calibers.

192 (right). Michael Harris demonstrating the lightweight, easy-to-carry MARS, designed for use by personnel who needed to have access to a weapon more lethal than a pistol-caliber SMG, but could not carry a full-size M16A2 or M4 carbine.

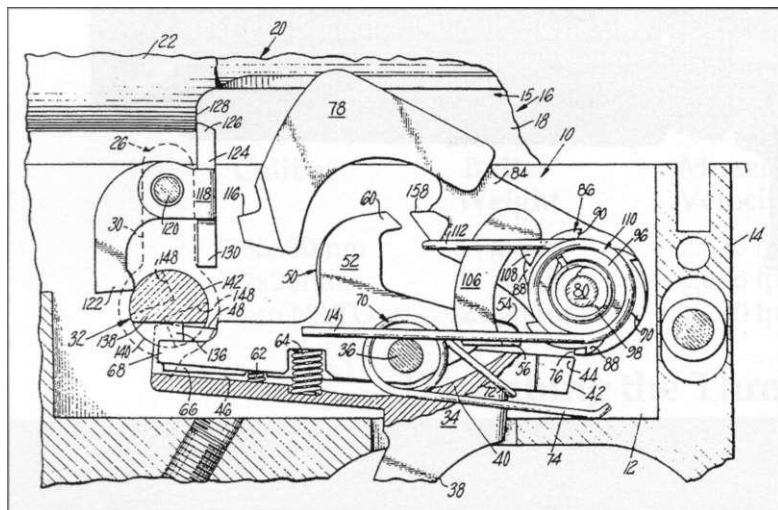
courtesy Michael Harris





## Four-Way Fire Control Groups

### The Sturtevant Drop-In Variable Burst Control Device



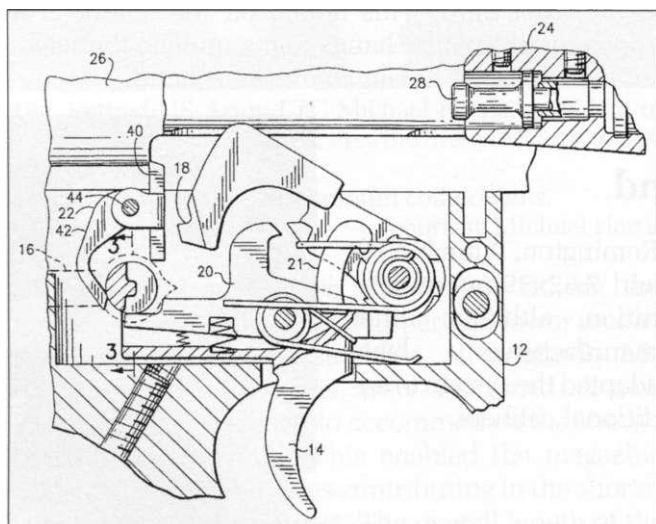
193. Drawing from US Patent no. 3,292,492, granted to Foster Sturtevant on December 20, 1966 for the Sturtevant Trigger Mechanism, the first four-way fire control group. The M16A2 burst device has lineage to this design.

US Patent Office

Colt's Foster Sturtevant had designed the first four-way fire control group for the AR15/M16 rifle in 1966. US Patent no. 3,292,492 was granted on December 20, 1966 for the Sturtevant Trigger Mechanism, which was a drop-in kit that would permit fire control settings for SAFE, AUTO, SEMI, as well as BURST. Sturtevant designed three different burst cams, which produced 2-, 3- and 6-round bursts. The selector itself was modified so it would clear the selector lever stop notches on the standard lower receiver. The kit came complete with a peel-off/stick-on label (fig. 503) which was placed over the existing markings on the left side of the lower receiver to indicate the new settings.

The Sturtevant burst mechanism could be dropped into any selective-fire rifle. It was installed in many different models by Colt, (the R0605B, R0606B, R0610B), as well as being sold as an upgrade kit. Only small quantities were ever produced.

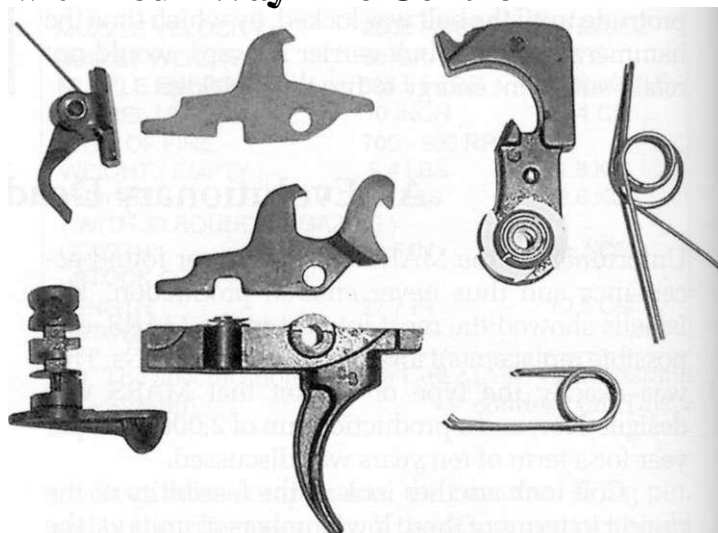
### The Colt "Enhanced Series" with Four-Way Fire Control



194. Drawing from US Patent no. 5,760,328, granted to Laurence Robbins on June 2, 1998 for the Robbins Four-Position Firearm Control Selector.

US Patent Office

In 1998, another patent was granted for a four-way fire control group, this one designed by Colt's Larry Robbins at the request of the Colt marketing department, who had received customer inquiries for a four-way rifle and carbine. US Patent no. 5,760,328



195. The components of the Robbins four-way fire control group.

Compare with the components of the Sturtevant group [TBR fig 170, p 172]: note the difference in the automatic sear as well as the burst disconnector. The Robbins group utilizes only two disconnector springs, with no third auxiliary spring as used in the Sturtevant group.

The trigger is the standard burst trigger, and the hammer is standard.

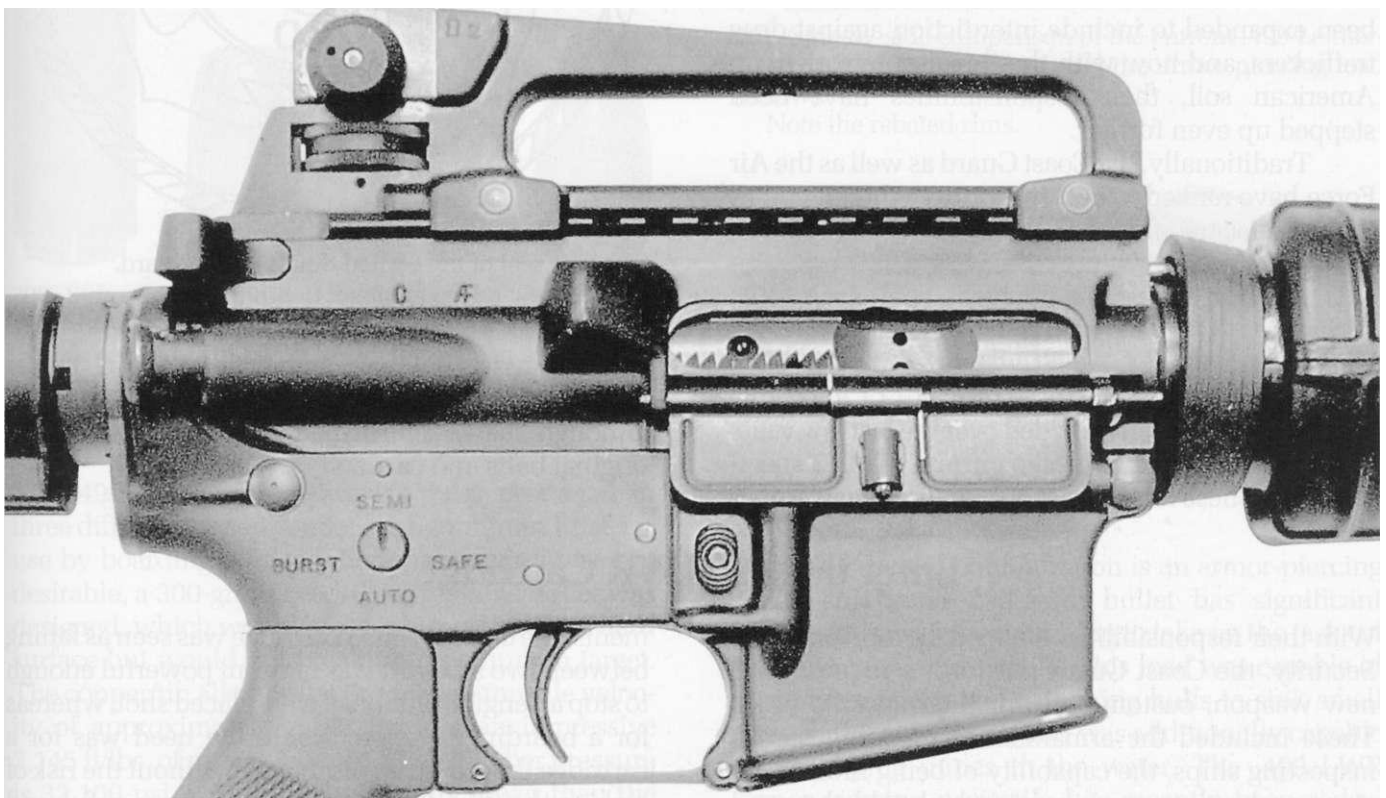


196. Left side closeup of a Colt M4 Enhanced Carbine, showing markings.

Note the shape of the selector lever, and the milled-off

selector stop notches.

The Robbins group is not a drop-in kit, but must be installed in a dedicated four-way lower receiver.



197. Right side closeup of a Colt M4 Enhanced Carbine, showing selector markings. These are the same on any of the models utilizing the Robbins four-way burst device.

was granted to Larry Robbins for his "Four Position Firearm Control Selector" on June 2, 1998.

This was a modified version of the Sturtevant system which required a specific lower receiver with no selector stop notches, and so this device could not be offered as a upgrade kit. The Robbins selector sat flush with the lower receiver, and the order of the fire controls was changed to SAFE, SEMI, BURST and AUTO.

The Robbins four-way selector was offered in a new series of rifles and carbines called the Colt Enhanced Series, which included the M4 Enhanced as well as the M16A2 Enhanced. This selector was also adapted to many existing models including the Commando and the M16A4 as well as HBAR rifles (Models CAR-703, R0708, R0738, R0748, R0778, R0908, R0938 and R0978). The only large quantities of the four-way trigger group ever produced by Colt were for a Greek Army contract.

## The US Coast Guard .499 LWR Conversion

The events of September 11, 2001 have forever changed the people of the United States, and both the country's military and its law enforcement agencies have gone on the offensive against the possibility of new terrorist threats targeting the US homeland. The United States Coast Guard, while not part of the Department of Defense, will play a major role in the new Homeland Security initiative put forward by the Bush Administration. While the entire ranks of the US Coast Guard number less than those of the New York City Police Department, they are responsible for the security of thousands of miles of coastline. Their traditional roles of Search and Rescue have already been expanded to include interdiction against drug traffickers, and now with the threat of terrorism on American soil, their responsibilities have been stepped up even further.

Traditionally, the Coast Guard as well as the Air Force have ranked lowest in priority when it comes to the replacement and updating of small arms. As a result, the majority of the rifles in Coast Guard arsenals belong in a museum, not in the field. As of 2003, many original Colt model 01 M16s and early M16A1s were still in service. As discussed in Chapter One, conversion kits manufactured by EMCO, Capco, Inc. and FNMI have been provided over the last few years to update these aging rifles to current M16A2 specifications. These kits consist of an entirely new upper



198. The seal of the United States Coast Guard.

receiver assembly and burst mechanism trigger group, as well as the updated pistol grip and stock, although many refurbished rifles still retain their original bolts and carriers.

## Enter the .499 LWR Cartridge

With their responsibilities stepped up for Homeland Security, the Coast Guard put forth a request for a new weapon, custom-built for their specific tasks. These included the armament of boarding parties inspecting ships, the capability of being fired at engines on boats to stop them and, should the need arise, to sink lightly armored or commercial boats that threatened them. In the light of these require-

ments, the current M855 cartridge was seen as falling between two stools. It was far from powerful enough to stop an engine without a well-placed shot, whereas for a boarding weapon, where the need was for a cartridge that could be discharged without the risk of sinking the ship, the 5.56mm was too powerful, and could penetrate most ships' hulls. It proved to be a difficult task to come up with one cartridge that

would both over- and under-penetrate as the situation required.

The answer to the problem was provided by Paul Leitner-Wise of the Leitner-Wise Rifle Company of Alexandria, Virginia, where development in response to this situation requirement began in 1994. The first question was the cartridge design. For anti-materiel use, clearly a large caliber was needed. It was also clear that at least two different bullet *types* were needed, one for penetration and one for anti-personnel use. Leitner-Wise created a new caliber, the .499 LWR (12.5x44mm), a .50 caliber bullet loaded in a proprietary rebated-rim cartridge case also manufactured by the Leitner-Wise Rifle Company.

The .499 LWR cartridge was designed to exploit to the fullest the concepts of less-than-lethal ammu-



199. The logo of the Leitner-Wise Rifle Company of Alexandria, Virginia. courtesy Paul Leitner-Wise

munition within the M16-type "envelope". The length of the cartridge case is 1.750", which is the trim length of the 5.56x45mm cartridge case. The overall length of the .499 LWR cartridge is 2.240", which is also equivalent to the overall length of the 5.56x45mm cartridge. These dimensions were chosen intentionally so the cartridge could be accommodated in a magazine that could be inserted into a standard M16-type lower receiver.

### Three Different "Green" Bullet Types



200. Side views of the two loadings of the .499 Leitner-Wise duty cartridge.

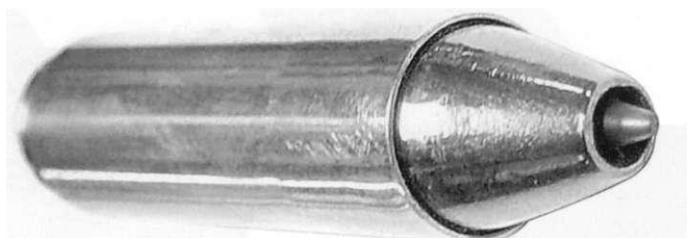
Left: early version, with heavy flat-topped solid bullet.  
Right: later version, with hollow-pointed bullet.

The .499LWR cartridge was initially produced in three different "green" bullet configurations. First, for use by boarding parties where penetration was not desirable, a 300-grain Lead-Free frangible bullet was designed, which would break up upon hitting a hard surface but would not break up on a human target. The copper/tin alloy bullet produces a muzzle velocity of approximately 2,182 fps and an impressive 3,145 ft/lbs. of muzzle energy. The chamber pressure is 32,100 psi, which is significantly lower than the standard 52,000 psi chamber pressure of the 5.56x45mm cartridge.



201. Side-by-side comparison of the current .499 Leitner-Wise duty cartridge, above, and the armor-piercing load (below).

Note the rebated rims.



202. Front three-quarter view of the .499 Leitner-Wise armor piercing load, showing hardened penetrator core.

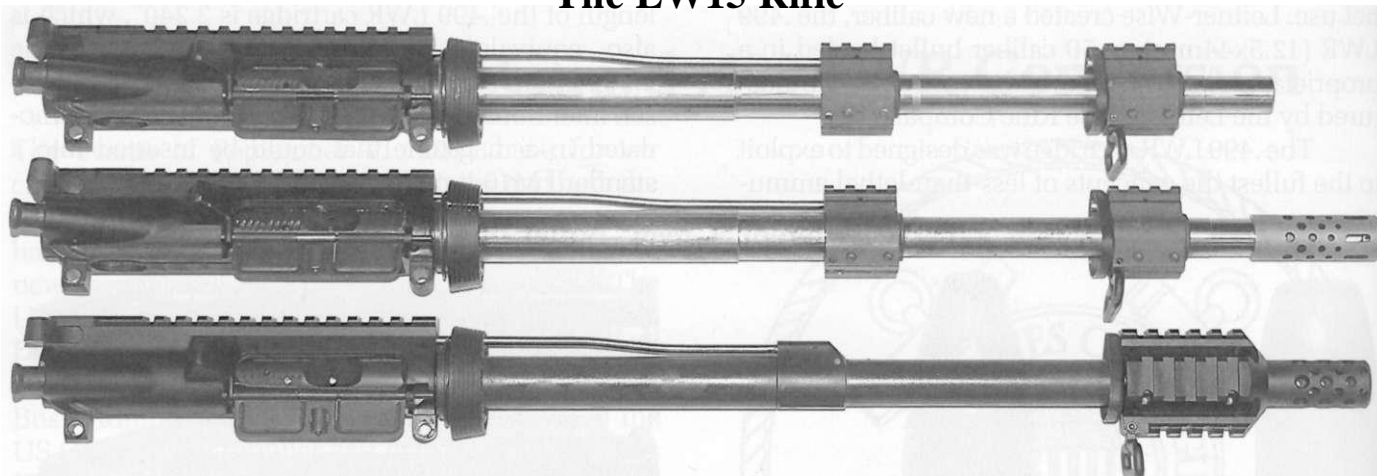
The second configuration is an armor-piercing load. This solid 290-grain bullet has significant power and enough penetration to take on the tasks of an anti-materiel projectile. This load was capable of stopping engines and breaching hulls to sink small ships if the need arose, and was additionally capable of destroying mines in the water. The .499 LWR armor-piercing projectile has recently been redesigned and fitted with an improved steel penetrator core that optimizes its potential for penetration.

The third loading is a practice cartridge, also featuring a 300-grain bullet which was originally made of a lead-free copper/tin alloy. The current training round is manufactured by AccuTec USA, and is made of a lead-free copper/polymer blend. This is used solely for training and on the range.

During the later course of development, the decision to offer frangible ammunition was dropped,

as the penetration requirements set forth by the Coast Guard for the duty round were not obtainable with a frangible projectile. So the frangible bullet loading in the duty round was replaced with a solid copper bullet manufactured by Barnes Bullets, which produces a muzzle velocity of approximately 2,206 fps.

## The LW15 Rifle



203. The LW15 was conceived as a drop-in upper receiver, capable of being adapted to any M16-type rifle. The three iterations shown here illustrate the developmental evolution of the design.

Above: prototype, with handguard cap made from a second (dummy) gas block, both gas blocks fitted with rails on top, and no muzzle device.

Center: second version with muzzle brake, but still utilizing two gas blocks.

Below: final version. Note the newly-developed gas block, located closer to the receiver, the new handguard cap, fitted with quad MIL-STD-1913 rails, and the final design of compensator.



204. Right side view of the LW15. This is the version being tested by the US Coast Guard.

Note the 12-round magazine, and Meprolight reflex sight.





205. Left side closeup of the LW15. The lower receiver shown is a commercial semi-automatic only variation manufactured by Leitner-Wise, serial no. LW500049.

Note the single-row "waffle"-pattern 12-round aluminum magazine, designed and manufactured by Precision Reflex, Inc. (PRI).

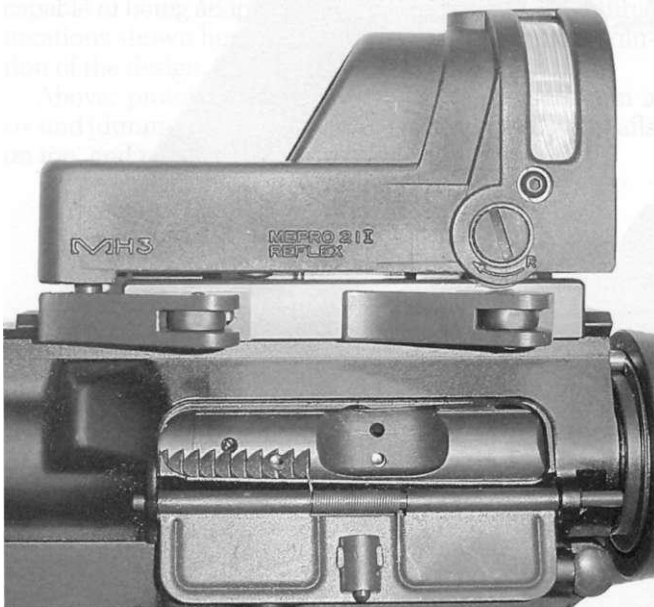




206. Right side partially disassembled view of the LW15, which is stripped and maintained the same way as any

other M16-type rifle.

Note the 7" gas tube, 1" shorter than M4 carbine length.



207. Right side closeup of the LW15 showing the chosen optic for the standard rifle, the Meprolight MH3 reflex sight. However, any optic can be mounted to the rail.

To maintain interchangeability and obviate the expense involved in designing an entirely new weapon system, the LW15 is configured as a modified upper receiver which can be "dropped" onto any standard M16-series lower receiver. The only modification to



208. Right side closeup showing the ejection port, which was widened to deal with the larger .50 caliber cartridge case.

Note the way the .499 LWR cartridge sits in the single-row magazine, ready to be fed into the chamber.

the upper receiver is that the ejection port has been widened at the front to accommodate the much larger cartridge case. The upper receiver is in the current flat top configuration (with MIL-STD-1913 rail), fitted with standard M16A2 round handguards.

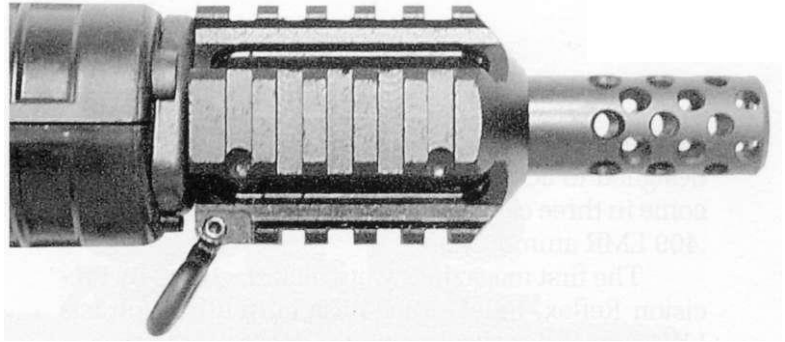
Small quad rails on the handguard cap accommodate light sources or any other accessory required.

The gas tube used on the LW15 rifle is 1" shorter than the standard M4 carbine gas tube.

The heavy .499LWR cartridge produces significantly more recoil than the standard 5.56mm NATO round, but not enough to cause even the smallest-statured shooters any difficulty in controlling it. In any case the barrel includes an integral muzzle brake/compensator, which dampens the perceived recoil.

The 18" barrel is offered in both stainless and alloy steel configurations, rifled with six lands and grooves with a one turn in 19" right-hand twist.

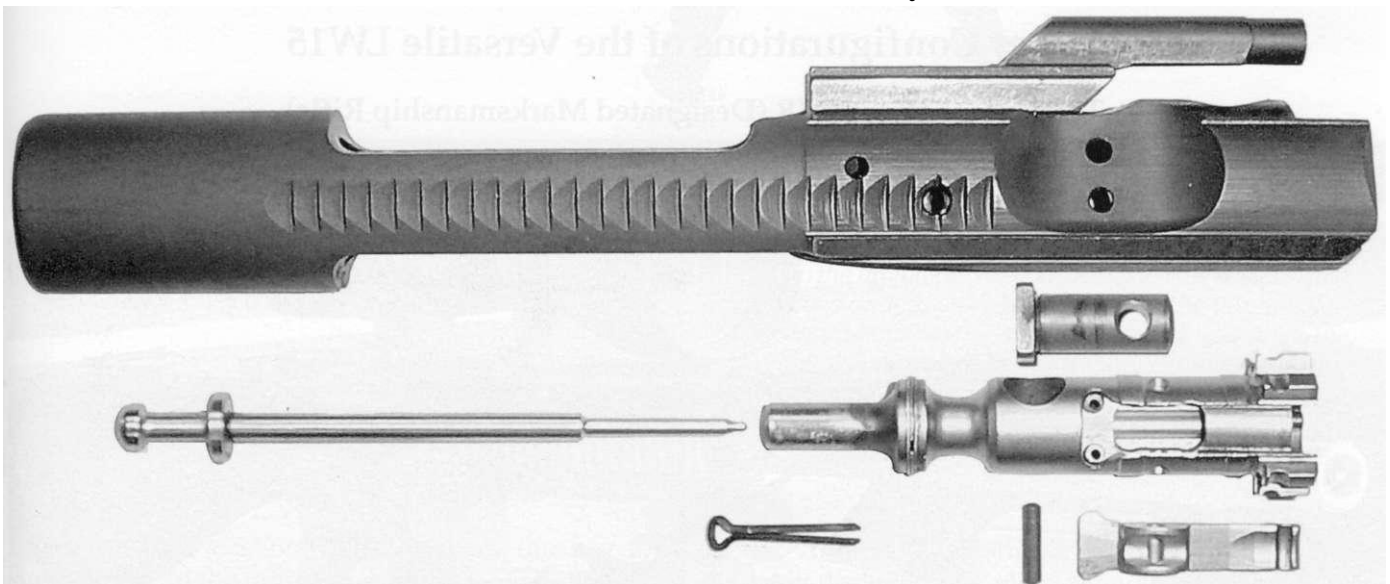
Depending on the configuration of the lower receiver, the rifle will fire either full-automatic or three-round bursts. Leitner-Wise also offers a complete semi-automatic-only version of the LW15 rifle for commercial sale.



209. Right side closeup of the handguard cap, with integral quad MIL-STD-1913 rails, and the integral muzzle brake/compensator.

The compensator does not do much to tame the muzzle blast, but it does decrease perceived recoil and muzzle jump.

### The LW15 Bolt Carrier Assembly



210. Right side view of the LW15 bolt assembly, stripped to show components. The automatic carrier shown is identical to the standard M16-type.

Note the nickel-plated bolt, initially developed by Karl

Lewis as a reliability upgrade for the M4/M4A1 carbines and carried over to the LW15. The two most significant changes are the use of a "lobster tail" extractor that utilizes two extractor springs, and the stress-relieved locking lugs.

The LW15 uses the standard M16-type bolt carrier. Leitner-Wise offers two versions of the bolt carrier, semi-automatic-only and automatic, the only difference being the length of the automatic sear trip area on the bottom rear portion.

Bolt carriers manufactured by the Lewis Machine & Tool Co. are interchangeable with, but heavier than, the standard mil-spec carriers, and are intended to induce a slight decrease in the cyclic rate of full-automatic fire.

The nickel-plated LW15 bolt, also manufactured by Karl Lewis, is patterned after the bolt de-

signed for the SOCOM Mk12. It is made of stronger metal than the standard 5.56mm bolt, and utilizes the improved "lobster tail" extractor fitted with two extractor springs to reduce spring fatigue and failure. Additionally the disconnecter claw is more aggressive than the standard extractor claw, which gives it a better "bite" on the extractor rim of the cartridge case. Notches are cut into the bolt locking lugs to stress-relieve them and allow the lugs to flex, which increases service life. The same bolt is used for both selective-fire and semi-automatic-only versions.

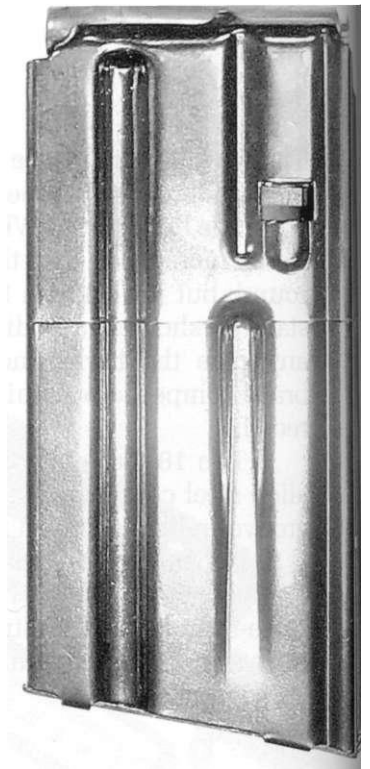
### The LW15 Magazine

Waffle-pattern, single-column steel magazines were designed to accommodate the new cartridge. These come in three capacities, holding 5, 7 or 12 rounds of .499 LMR ammunition.

The first magazines were manufactured by Precision Reflex, Inc. Leitner-Wise currently contracts LW15 magazine production to ProMag Industries.

As of this writing, Leitner-Wise is working on two additional magazines. The first is a double-column magazine that will hold 20 or 25 rounds, and the other is a Beta C-type drum that will hold 74 rounds.

211 (right). The newly developed (non-waffle) single-row seven-round LW15 magazine.



## Other Configurations of the Versatile LW15

### The Leitner-Wise DMR (Designated Marksmanship Rifle)



212. Left front three-quarter view of the prototype Leitner-Wise DMR (Dedicated Marksmanship Rifle), with the standard M16A2-type stock and pistol grip as originally fitted.

Note the Lewis Machine & Tool one-piece Monolithic Rail Platform (MRP), discussed in Chapter Thirteen, and the 25" free-floating barrel.



213. Left front three-quarter view of the improved current version of the specialist LW15 DMR, fitted with a specially-designed adaptation of the commercial AR-15 thumbhole stock manufactured by Bell & Carlson.

Paul Leitner-Wise comments on this new stock design as follows:

*. . . The .499 DMR version is made of better materials, has better quality control and more attention to fit and finish. We found with their original commercial design that we could break them in about 50 rounds.*

Like the LW15's 5.56mm counterpart, the key to survivability in the military market is versatility, and Leitner-Wise has added two additional "specialist" models. The first was christened the DMR (Designated Marksmanship Rifle). Utilizing a free-floating 25" heavy barrel, the DMR is designed to perform as a mid-range anti-materiel rifle as well as a machine gun. When used as a mid-range anti-materiel rifle, an optical sight will be installed on the rail. When firepower is required, the optic can be removed, back-up iron sights installed, and the DMR loaded with a 74-round Beta C-type mag can be fired in the full-automatic mode.

### **The Leitner-Wise CQB (Close Quarters Battle) Version**

Additionally, Leitner-Wise offers a CQB (Close Quarters Battle) version of the LW15, also built on the new Lewis Machine & Tool MRP. The CQB version (fig. 214) features a carbine stock and a short 10 1/2" barrel,

*As for the design and idea to use it over the standard stock, I can claim no responsibility for that; CW04 John Zimnoski of the USCG requested us to fit a thumbhole stock to the prototype weapon - we tested the weapon first with the standard stock and then with the thumbhole - the unanimous opinion of everybody was that the thumbhole allowed more control and stability and was the preferable option. Oh, yes, that and the fact that everybody's group sizes improved by a factor of two could be something to do with it!*

Another interesting feature of this rifle is the newly-designed one-piece Monolithic Rail Platform (MRP) developed by Karl Lewis of Lewis Machine & Tool Co., further discussed in Chapter Thirteen, which has an integral free-floating handguard built right in as part of the original upper receiver forging.

Currently Leitner-Wise is also experimenting with a new barrel with polygonal rifling with a one turn in 24" twist for use on their longer-range DMR weapon, which will be built on a Leitner-Wise lower receiver with a full-automatic capability and two-stage trigger.

which is dimensioned to accept a version of the M203 grenade launcher, also proprietary to Lewis Machine & Tool.



214 (left). The author firing the M203 grenade launcher mounted to the Leitner-Wise short barrelled CQB variation of the .499 LW15.

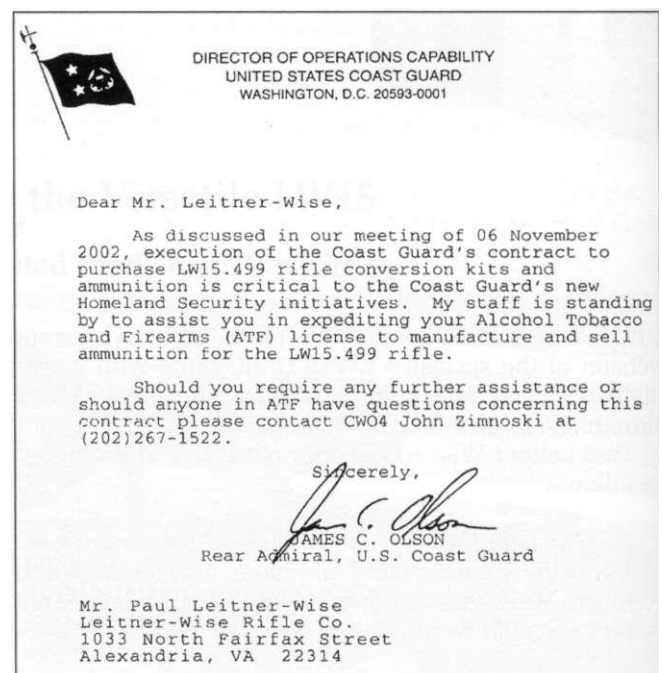
## The Future of the LW15/.499 LWR in the US Coast Guard

On September 30, 2002 Leitner-Wise entered into a contract for the new "Mini-.50" with Rear Admiral James Olson, the Director of Operations Capability of the US Coast Guard, whereby Leitner-Wise has agreed to supply upper receiver conversion kits, Meprolight tritium self-illuminated reflex sights, and ammunition to the Coast Guard.

As of this writing the LW15 and its .499 ammunition are still under test and evaluation by the Coast Guard, but it is expected that they will be adopted in the near future.

215 (right). Letter from USCG Rear Admiral James C. Olson to Paul Leitner-Wise, confirming their interest in the .499 LW15 as "critical to the Coast Guard's new Homeland Security initiatives".

courtesy Leitner-Wise Rifle Company



### LW15 Specifications

Overall Length:	36.25" (920.75mm)
Weight, without magazine:	6.275 lbs. (2.8kg)
Weight of empty magazine (10-rd):	.25 lb. (.11kg)
Weight of loaded magazine:	1.0 lb. (.45kg)
Caliber:	0.499 (12.5x44mm)
Effective range:	1,312.4' (400 meters)
Barrel construction:	stainless steel or alloy steel
Barrel length (with integral compensator):	18" (457.2mm)
Rifling twist:	.1 turn in 19"
Method of operation:	gas
Muzzle velocity:	2,200 ft/sec (670.6m/sec)
Rate of fire:	500-940 rpm
Type of fire:	semi-automatic/full automatic; 3-shot burst option available
Magazine capacity:	5/7/12; 74-rd drum

# The New 6.8mm Remington SPC Cartridge and the Modified M4/M16A4/Mk12

## Part 1 - The Special Purpose Cartridge (SPC)

During the SAW program of the early 1970s the US military investigated the possibility that 6mm (.243 caliber) might well be the best overall rifle caliber, with advantages over both the 5.56mm and 7.62mm NATO standard cartridges. However, in 1976 it was decided not to introduce a new caliber into the inventory, and the military abandoned the 6x45mm (6mm SAW) program in favor of the 5.56x45mm M16A1 battle rifle and the 7.62x51mm M60 general purpose machinegun.

The concept that 6mm was the "ideal" military caliber persisted, however, and in early 2002, soldiers of the 5th Special Forces Group (Abn), headed by MSG Steven Holland, received approval to initiate a Proof of Concept to develop a new capability that would increase incapacitation, lethality, and range over the existing 5.45x39mm, PRC 5.8x39mm, 7.62x39mm and 5.56x45mm NATO cartridges. This initiative was a grassroots effort aimed at providing better combat power for Special Operations Forces and soldiers of the Light Infantry, to include USMC MEU-SOC. This was the original programmatic evolution proposed for the SOPMOD Mk12 Special Purpose Rifle (SPR) system, the interim result of which was the fielding of the Mk262 77-grain ammunition, with a planned later transition to the Enhanced Rifle Cartridge (ERC) capability in a mid-bore 6.5mm, 6.8mm or 7mm caliber.

With the already proven combat success of the Mk12 SPR, the SPR concept-development team went to manufacturers in the US ammunition industry for assistance. To initiate the program, the companies involved in the development agreed to do so at their own expense, with the goal that the final product would provide US servicemen with a better capability and morale boost to combat the Global War on Terrorism (GWOT).

The assessment of the initial performance capabilities of the prototype cartridges, based on shortened commercial .30 Remington cases, was handed over to the USAMU Ammunition Section, headed by Troy Lawton. Industry involvement to consider this project at no cost to the government was championed by Sean Dwyer at Remington, who stated that Remington wanted to do their part on the Global War on Terrorism, and provide production capability for

the ammunition, which would be developed and manufactured by Remington using bullets provided by Sierra and Hornady.

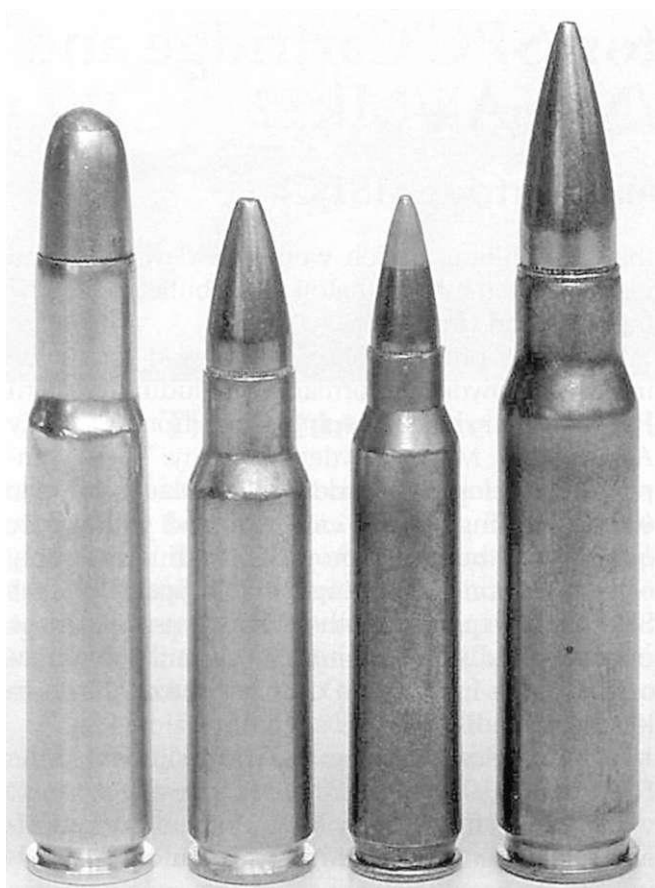
Several propellants were reviewed to provide improved powder performance, including Western Powder's Ramshot, and submissions from Accuracy Arms and St. Marks Powder Company. These companies developed powders particularly for the 6.8mm Remington SPC cartridge, and will supply quantities of the chosen propellant for final assembly of ammunition by Remington. The Special Forces SPC team require that the powder used is to be manufactured in the United States, and contain an organic flash inhibitor to decrease muzzle flash in low light conditions.

Remington began the final development of the SPC cartridge in the fall of 2001, using concept wildcat brass made up by MSG Holland from shortened .30 Remington cartridge cases. AutoCAD drawings of the prototype calibers in the same cartridge case were prepared by Cris Murray of the US Army Marksmanship Unit. Remington went to work to standardize the angle of the shoulder and length of the neck. Early experimental production of ammunition began at Remington in the first quarter of 2002, and went into full production in August, 2003.

During this time period several ballistic performance assessments, including accuracy and reliability-incapacitation tests, were conducted. Special Purpose Cartridges in 6.5mm, 6.8mm and 7mm calibers were reviewed to determine which bore size would best provide the capability needed by soldiers in combat. Once all the performance data were compiled the team briefed the Commander on the results, and recommended that the 6.8mm provided the best overall terminal, reliability and accuracy performance out to 450 meters. This recommendation was approved. The 6.8x43mm Remington SPC Terminal Performance results were independently confirmed by the Federal Bureau of Investigation's Firearms Training Unit as well as by USNR/Stanford University.

The 5th SFG (A) then submitted a request that a Legal Review be conducted of the 6.8mm SPC through USASFC(A) and USASOC(A) at Fort Bragg, NC. After extensive ballistic review on behalf of the





216. A comparison of four cartridges.

Left: the commercial .30 Remington cartridge.

Second from left: the 6.8x43mm Rem SPC cartridge, based on a necked-down .30 Remington case.

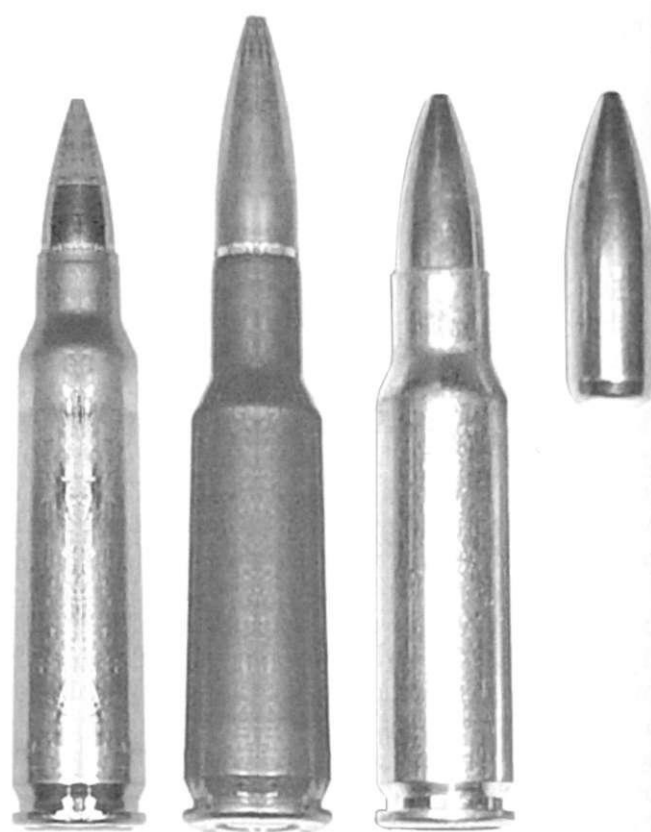
Second from right: 5.56x45mm M855 NATO.

Right: 7.62x51mm NATO.

courtesy Gary Paul Johnston

Department of the Army Judge Advocate General, conducted in January, 2003, approval was granted for further Operational/Combat review of the 6.8mm in the Recce Rifle and CQBR formats. Further, the DOA JAG ruled that the 6.8x43 Remington SPC cartridge, using the 110-115 grain Hornady and Sierra Match King OTM (Open Tip Match) bullets, was consistent with the international law obligations of the United States which include the Laws of War/Geneva Convention, and this ammunition was accordingly released for operational assessment in combat.

The finalized cartridge itself, known as the 6.8x43mm Remington Special Purpose Cartridge (SPC), is approximately 2mm shorter than the 6mm SAW cartridge of the 1970s. It utilizes a .277 caliber



217. A further cartridge comparison.

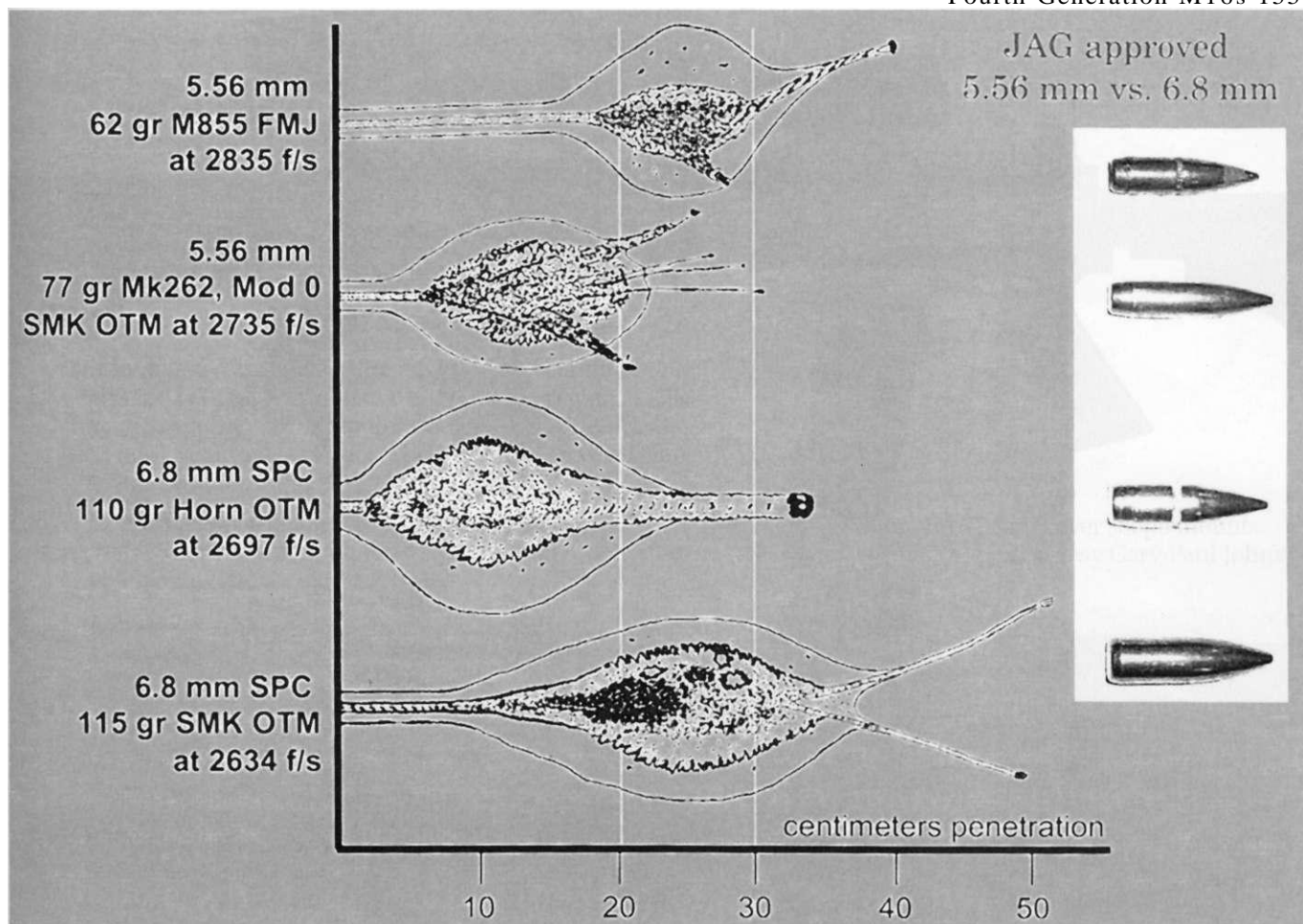
Left: 5.56x45mm M855 NATO.

Second from left: the Army-designed 6x45mm (6mm SAW) cartridge of the early 1970s.

Right: the new 6.8mm Remington SPC cartridge and bullet.

115-grain bullet fired at approximately 2,650 feet per second from an AR-15-type firearm with a 16 1/2" barrel.

At a meeting held during the winter of 2002 - 2003, chaired by project leader MSG Steven Holland, US Army Marksmanship Unit gun and ammunition technicians, NAVSPECWARCOM, the Federal Bureau of Investigation, Hornady Manufacturing, and Remington Arms, among others, the parameters were established for the provision of 6.8mm Remington SPC ammunition for further review by the involved units in a Limited User Assessment (LUA). Remington Arms received a commitment from Hornady to produce 7,000,000 6.8mm caliber bullets within the year 2003.



218. A ballistic comparison chart showing cavitation and penetration in gelatin of four cartridges.

From top: 5.56mm 62-gr. M855 ball; 5.56mm 77-gr.

Mk262 Mod 0; 6.8mm SPC 110-gr. Hornady OTM; 6.8mm SPC 115-gr. SMK OTM.

courtesy USSOCOM

## Part 2 - The Weapon System



219. Right side view of the PRI-manufactured Mk12 "drop-in" upper receiver modified to fire the **6.8mm** SPC cartridge. The barrel shown is the 16 1/2" "Recce" version.

Note the ARMS, Inc. #40 folding rear and front sights, and the EOTech holographic laser sight mounted on the free-floating handguard.

With the parameters of the ammunition decided upon, attention turned to developing the weapon system. The 6.8mm SPC was designed expressly to retrofit to any existing or future weapon system chambered for 5.56mm M855 ammunition, with a negligible conversion cost and a low impact on maintenance, so the next logical step was to develop an interim GWOT platform based on the M16 weapon

system, with the primary objective being to retain as much component compatibility as possible with the current Mk12, M16A4 and M4 carbines. M4 flat-top upper receivers with extended feed ramps were used on these prototype weapons, many manufactured by Lewis Machine and Tool Co.

The primary integration of the Mk12 rifle upper receiver to accommodate the Special Forces selected



220. Right side view of the 16 1/2" "Recce" version of the Mk12 converted to fire the 6.8x43mm Rem SPC cartridge, with M68 Reflex sight on top of ARMS SIR system, and sound suppressor installed, courtesy Gary Paul Johnston



221. ARMS president Richard "Dick" Swan in his element during the 2004 SHOT Show, firing the new Barrett M468 6.8mm rifle (fig. 226), configured with the Barrett mid-length barrel.

The rifle is fitted with the ARMS #40L folding rear sight, a Trijicon ACOG day scope, and an AN-PEQ-2 infrared laser illuminator, all mounted on an ARMS SIR system. photo by Chris Barrett

6.5 - 7mm Special Purpose Cartridges (SPC) was done by United States Army Marksmanship Unit (USAMU) Master Gunsmith, Cris E. Murray, at the USAMU Match Shop in Fort Benning, Georgia.

Initial Mk12 prototypes were based on the Navy WARCOM (SEAL) 16.5" Recce Rifle. Future systems for the 6.8mm could be the USSOCOM SCAR or PM Soldier/ARDEC XM8.

Commercial off-the-shelf barrel blanks from Rock Creek and PAC-NOR were procured and chambered for the 6.8mm Remington SPC cartridge for use in the initial Recce rifle and carbine variations. Prototype weapons have been made up with barrel lengths of 12 1/2, 14 1/2, 16 1/2 and 18 1/2", with the barrels fitted with the OPSINC, Mk12 SPR muzzle brake. The main barrel lengths under review are 16

1/2" Recce carbine variation (NAVSPECWARCOM) and a 12 1/2" CQBR configuration. The 6.8mm barrel utilizes an intermediate-length gas tube, with the gas port located in between the standard carbine and rifle locations. This increases reliability, by slightly decreasing the cyclic rate. Chamber pressures are around 50 - 51,000 psi, slightly lower than the 55,000 psi produced by the 5.56mm NATO cartridge.

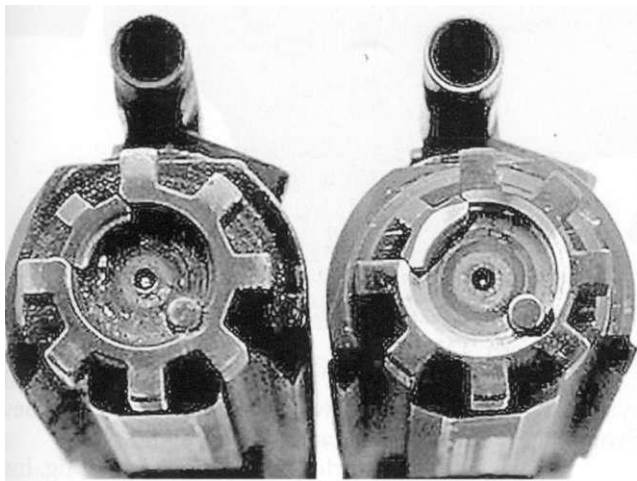
Standard Mil-Spec bolt carriers are manufactured by Colt, and Lewis Machine & Tool Co. also manufactures a heavier bolt carrier with three gas exhaust ports instead of two. The bolt itself is modified to accept the 6.8mm Remington SPC cartridge.

Precision Reflex, Inc. was asked to modify their existing 7.62x39mm AR-15 magazine to accommodate the new 6.8mm Rem cartridge. PRI was cleared



222. Right side view of a 6.8 SPR MK12 prototype variant.  
Note the PRI carbon fiber handguard, folding front sight/gas block and ARMS #38 SPR MOD Swan Sleeve,

#40 Back-Up sight and Throw Lever scope mounts.  
courtesy Gary Paul Johnston



223. A face-on comparison of two bolt heads.  
Left: standard 5.56x45mm.  
Right: bolt face opened out for the larger-diameter 6.8x43mm Rem SPC cartridge.  
courtesy Gary Paul Johnston

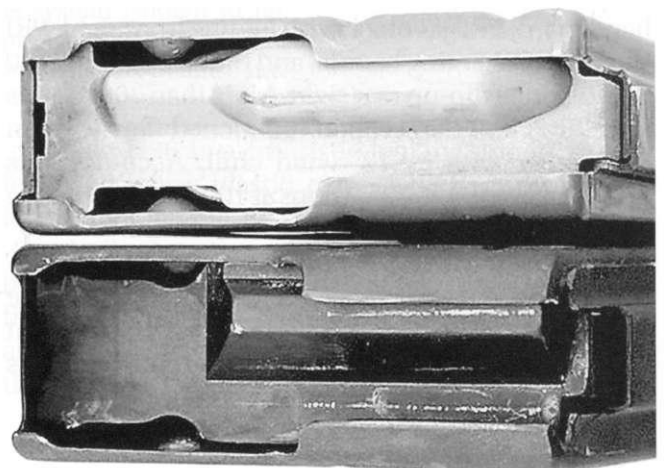
by Remington to use their (commercial variant) SPR uppers to proceed with the test of the new magazine.

The finalized magazines, made of steel rather than aluminum, are manufactured by Precision Reflex, Inc., in 28-, 18- and 10-round capacities. These are not standard 5.56mm magazines but the overall length is the same, so they will fit in standard load-bearing equipment. This magazine has numerous other features that were found to be advantageous by Special Forces operators. The follower is modified but in the configuration of the "green" Marine Corps follower, which increases reliability by stabilizing

225 (right). Top closeups of two magazines.  
Above: standard 5.56mm, with improved USMC "green" follower.  
Below: 6.8mm PRI magazine with redesigned follower.



224. A comparison of three magazines.  
Left: 28-round 6.8mm magazine.  
Center: 18-round 6.8mm magazine.  
Right: 30-round standard 5.56mm NATO magazine.





226. Left side closeup of the first Barrett M468, serial no. B15000, a purpose-built M16A2 clone in caliber 6.8SPC manufactured by Barrett Firearms Manufacturing Inc. of

Murfreesboro, TN.

Note the optic, attached to the upper rail of the SIR system with a Swan Throw-Lever mount, and the new Swan #40-L Stand-Alone back-up rear sight.

courtesy Barrett Firearms Mfg. Inc.

the follower with "legs" extending downward inside the magazine box at both front and rear.

Initial testing was limited due to the unavailability of large quantities of test ammunition. However, the test upper receiver and ammunition acquired from David Dunlap of Precision Reflex Inc. proved to live up to expectations. This upper receiver is equipped with a 16" barrel with the OPS, Inc. muzzle brake, PRI carbon-fiber free-floating handguard, PRI gas block with folding front sight, PRI Gas Buster charging handle, and the ARMS, Inc. #40 Stand-Alone flip-up rear sight. More than 200 rounds were fired and the weapon functioned flawlessly in 5° weather with a -12° wind chill. Accuracy was excellent, producing 2" groups at 100 meters utilizing the EOTech holographic sight.

Accuracy tests have produced groups approximately 1 1/2" in diameter at 100 meters which, while not impressive by competition standards, is excellent combat accuracy, especially since the SPC team has

made it clear that the gun platforms are purposely designed with less stringent tolerancing in order to ensure combat reliability.

As of this writing the Naval Surface Warfare Center has been authorized and funded by NAVSPECWARCOM to conduct reliability and function testing of the Mk12 Recce Variant weapon and ammunition. For their part, Army SOF combat developers, who provided the concept and initial development of the Mk12 rifle and ammunition system, are working diligently with USSOCOM to perfect this interim capability.

The first production 6.8SPC (6.8x43mm) upper receivers are manufactured by Precision Reflex Inc. and Barrett Firearms Manufacturing Inc. The Barrett variation has a 16.6" chrome-lined barrel, Barrett muzzle brake, Barrett S468 sound suppressor, modified bolt and extractor, Barrett folding front sight and gas block, ARMS SIR forend and ARMS, Inc. #40L folding rear sight.



## The Heckler & Koch HKM4

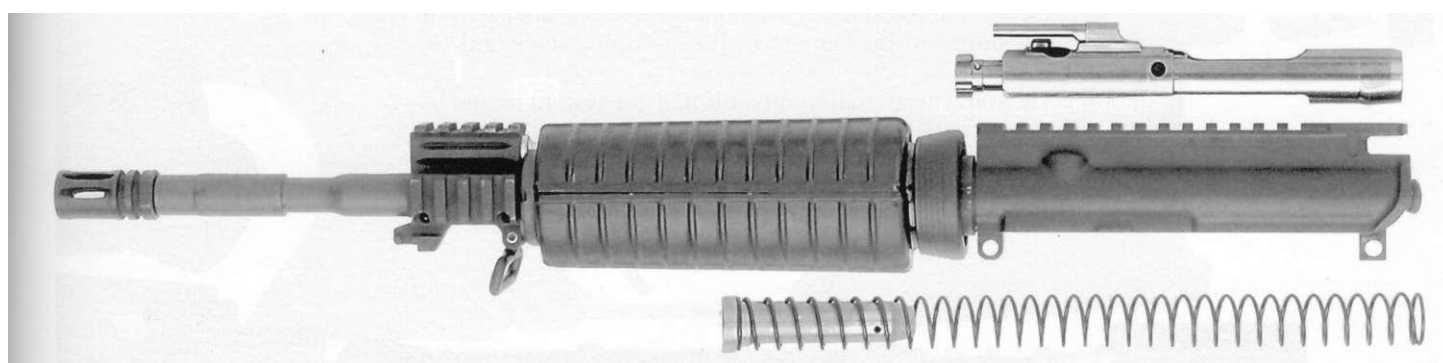


227. Left side views of two models of the 20" barrel rifle version of the HKM4.

Above: HK4MD selective-fire rifle.

Below: HK4MC semi-auto-only rifle with carbine-length handguard. Note the distinctive fluted barrel.

courtesy H&K Defense Inc.



228. Left side view of the HKM4 drop-in upper receiver with HK-specific pusher rod gas system (shown in fig. 230), bolt, bolt carrier with proprietary solid key, buffer and spring.

courtesy H&K Defense Inc.

Several years ago the famous armsmakers Heckler & Koch GmbH of Oberndorf, Germany, created quite a stir when they announced that they were abandoning the popular roller-locked G3 and HK33 rifle series, which had been the mainstay of the firm for half a century, in favor of a brand-new (for them) departure called the G36.

The G36 is a futuristic-looking, modular rifle featuring many plastic parts, largely encased in a tough, molded plastic shell.

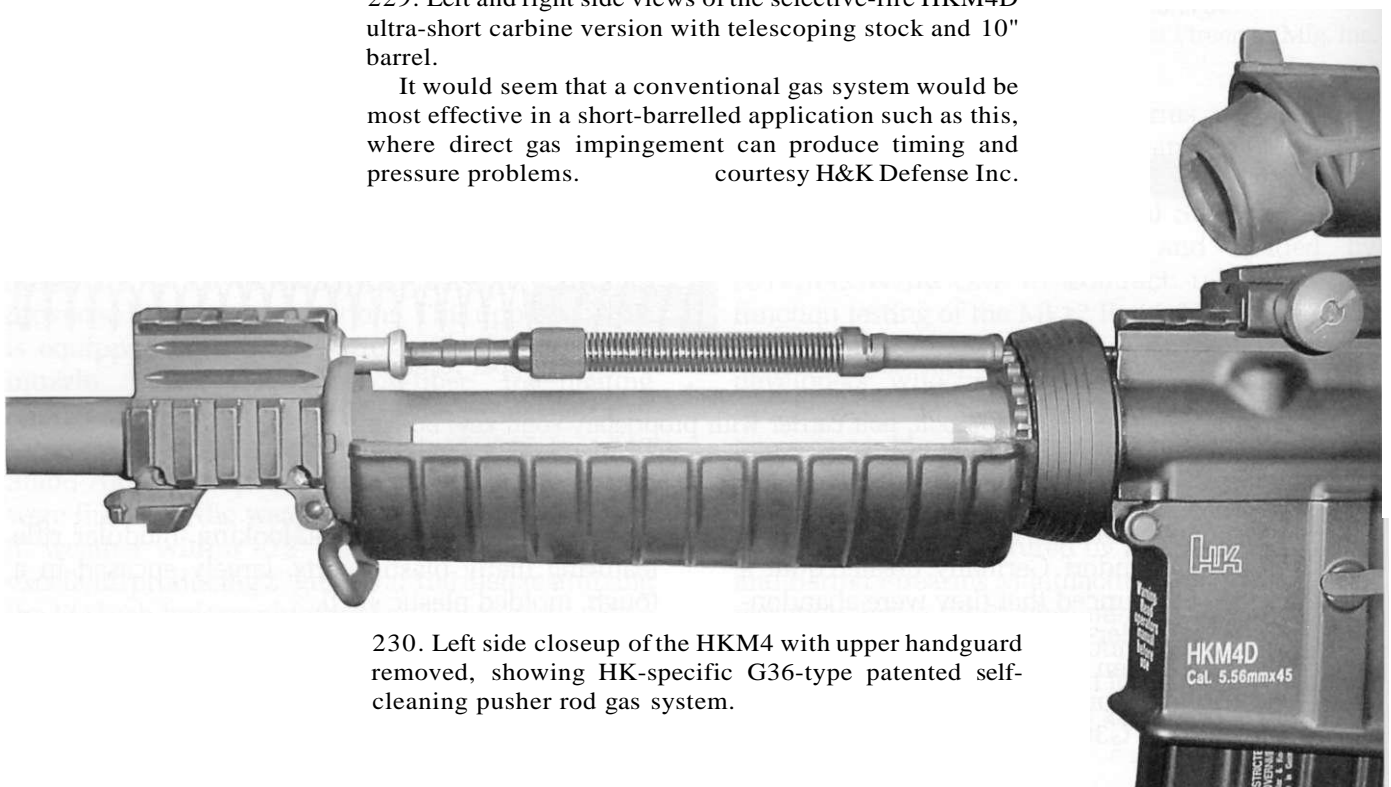
In its operating system, however, the G36 embodies some time-honored technology, resembling at first glance nothing so much as the gas-piston-operated ArmaLite AR-18 and its British bullpup clone, the deservedly unpopular SA80.





229. Left and right side views of the selective-fire HKM4D ultra-short carbine version with telescoping stock and 10" barrel.

It would seem that a conventional gas system would be most effective in a short-barrelled application such as this, where direct gas impingement can produce timing and pressure problems. courtesy H&K Defense Inc.



230. Left side closeup of the HKM4 with upper handguard removed, showing HK-specific G36-type patented self-cleaning pusher rod gas system.



231. Left side closeup of selective-fire HKM4D, showing markings.  
courtesy H&K Defense Inc.



232. Right side closeup of selective-fire HKM4D, showing markings.  
courtesy H&K Defense Inc.

A version of the G36 called the XM8 is currently being offered to the US military as a possible follow-on to the current M16 rifle series, and H&K Defense Inc., the US arm of the company, is in the process of constructing a new manufacturing facility in close proximity to Fort Benning, Georgia, where quantities of the new XM8s will be manufactured for US military trials.

Meanwhile, H&K Defense, Inc. has unveiled their HKM4 series, which is basically a drop-in upper receiver that will retrofit directly onto the vast major-

ity of M16/M4 rifles and carbines currently in service worldwide. Versions of the HKM4 have been made up in various barrel lengths including 20" rifle, 14.5" carbine, and an ultra-short 10" SMG.

When used in conjunction with the H&K-developed M16/SA80 magazine, the HKM4 with its proprietary G36-type pusher rod gas system and HK-specific bolt, bolt carrier, buffer and spring is said to offer dramatically improved reliability and component service life.



233. Right side closeup of the HKM4, showing the H&K diopter rear sight, originally developed for the G3 rifle, fitted to the receiver rail.

Note the "Staghorn" proofmark of the Ulm proof house.



234. A comparison of two magazines.

Left: H&K M16/SA80 magazine, originally developed by H&K as part of their upgrade of the British L85 (SA80) rifle system to the current L85A2/L86A2 standard. It is slightly longer, to allow proper seating of the full magazine in the receiver with the bolt closed above it. Note the magazine catch rebate, which is blanked but not cut through the side of the magazine to avoid ingress of dirt and fouling. According to H&K, this curved steel 30-round magazine with its redesigned polished stainless steel follower offers substantial improvement in reliability and durability over current-issue aluminum M16 magazines, and is currently in service with US and Allied units in Afghanistan and Iraq.

Right: standard aluminum 30-round Colt M16 magazine, courtesy H&K Defense Inc.

## Chapter Seven

# The AR-10 Renaissance

## The Stoner/Knight's Armament SR-25

**W**hen the alloy-and-plastic ArmaLite AR-10 rifle burst on the scene in the middle 1950s, it was considered the most advanced rifle in the world—"Tomorrow's Rifle Today", as the advertisements trumpeted. However, regardless of its merits, the AR-10 was doomed from the outset as far as serious consideration from US Army Ordnance was concerned. As described in the Collector Grade book *US Rifle M14*, Ordnance had a long-standing vested interest in their own home-grown T-series of rifles, notably the T44, which was then nearing the end of a tortuously long and underfunded development program at Springfield Armory. Sure enough, Secretary of the Army Wilbur H. Brucker announced the adoption of the finalized T44E4 as "US Rifle M14" on May 1, 1957.

The AR-10 did have its supporters, however. Its designer, Eugene Stoner, had always claimed in his ArmaLite days that his primary interest was in the development of .30 caliber (7.62x51mm) weapon systems, and the AR-10 as manufactured by *Artillerie-Inrichtingen* of Zaandam, Holland, did feature briefly in trials in several nations, and was actually adopted in limited numbers by Sudan and Portugal. However, with the acceptance of the AR-15 in the early 1960s and the revelatory combat effectiveness of the .223 (5.56x45mm) cartridge, the AR-10 was assigned to the scrap heap of small arms history, where it was to languish for nearly forty years until it was reincarnated—by its original designer—in the 1990s.

Gene Stoner joined forces with C. Reed Knight Jr. in the early 1990s at Mr. Knight's company,

Knight's Manufacturing Company (Knight's Armament Company) of Vero Beach, Florida. Gene Stoner came with a single goal, to resurrect his AR-10 design as nothing less than the most accurate 7.62x51mm semi-automatic rifle the world had ever known. At the same time, Stoner wanted to produce a Match-grade rifle that did not require the services of a full-time gunsmith to keep it in tune.

Although the concept remained the same, Stoner chose not to base his new rifle exactly on the old AR-10 design, as in order to build a rifle better than the original AR-10 he wanted to incorporate some of the refinements embodied in the then-current M16A2.

In keeping with their plan to develop a more advanced and refined rifle which would combine the best features of both the AR-10 and the latest AR-15 (the M16A2), Knight and Stoner decided to identify the new weapon with an "SR" prefix, standing for "Stoner Rifle". Taking a leaf from the history book, they took the number 10 (from the AR-10), and added 15 (from the AR-15), coming up with a completely new alphanumeric designation, the SR-25.

With SR-25 development geared toward military contracts but funded through commercial and law enforcement sales, the SR-25 Match Rifle made its world debut in 1993. During the refining stages, these rifles were carefully produced in limited numbers and sold into the high-end sniping/competition market. The SR-25 has never been mass-produced, and during the decade since its introduction in 1993, just over 4,050 have been produced.



235. An auspicious occasion: the introduction of the SR-25 at the Knight's Armament/Knight's Manufacturing Co. display at the 1995 SHOT Show.

Here Reed Knight, Jr. (left) holds a sample SR-25 with

handguard removed so that its designer, Gene Stoner, right foreground, can point out details of the gas system to an interested visitor, arms designer Uzi Gal.

courtesy Knight's Armament Co.

## Describing the SR-25

### The Flat-Top, Extruded Receiver

One significant departure from the original AR-10 and the AR-15/M16 series rifles is that the flat-top upper receivers of the SR-25 are produced from solid extrusions, rather than forgings, as, during initial development, it was found that tooling costs were considerably less for extrusions than they would have been had forgings been used.

According to KAC engineer Doug Olsen, problems can arise with the consistency of forged parts if they are not clamped very precisely in place for their initial cuts. The extrusions proved easier to fixture for the initial machining cut, and they then flowed

through the entire manufacturing process with fewer problems.

Another issue with forgings is that they tend to hold internal stresses, which have to be relieved prior to the final machining cuts. Knight's lower receivers are forged, and a process was developed whereby, after an initial series of roughing cuts, the semi-finished parts are left to set for a period of time prior to final machining.

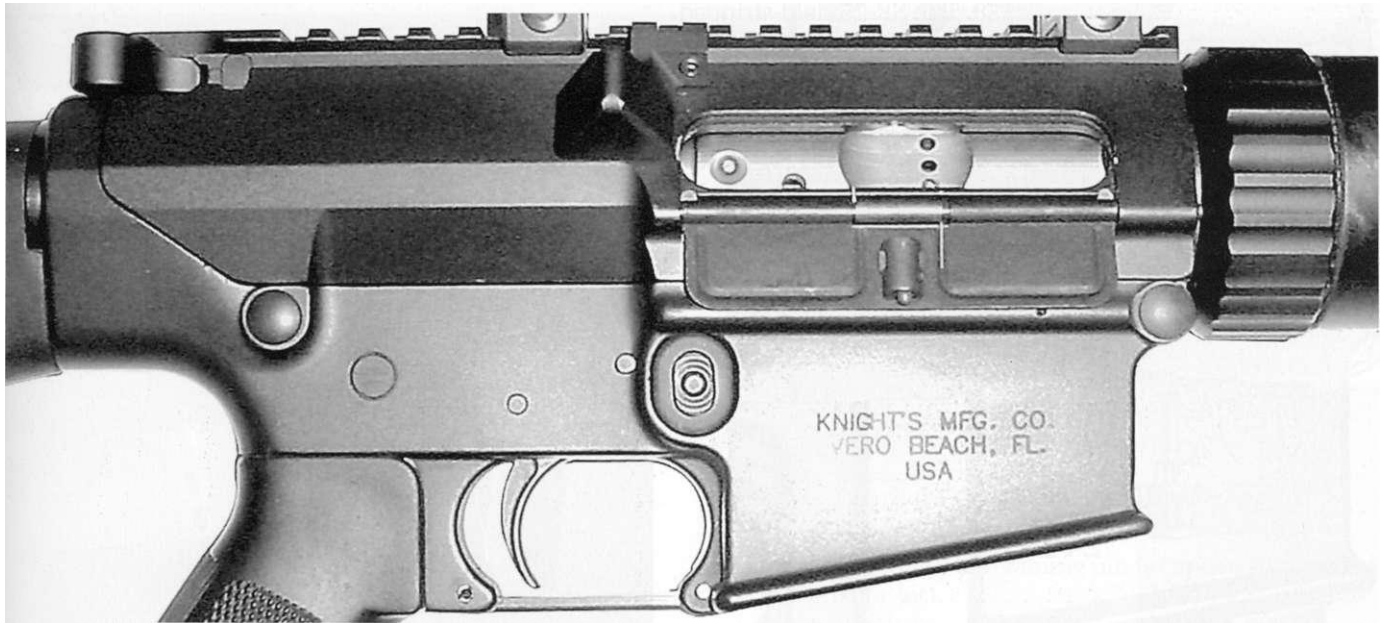
Unlike those rifles utilizing AR-15/M16 series upper and lower receivers, the SR-25 receivers were both brand new, and all-new tooling and processes



236. Left and right side views of the production SR-25 Match Rifle, Knight's most popular model. This rifle has, from the beginning, been guaranteed to shoot at least 1

MOA, right out of the box.

Anyone familiar with the M16 series rifle will be right at home with the SR-25.



237. Right side closeup of the SR-25 Match Rifle, showing markings.

Note the extruded upper receiver, and the chrome-plated bolt carrier group.

had to be created for the new designs. Knight's thus chose a different manufacturing process than had been used in the past, but the SR-25 still shares a 60% parts commonality with the current M16A2 service rifle.

The SR-25 Match Rifle weighs 10<sup>3</sup>/<sub>4</sub> lbs. empty, and is 43 1/2" long overall, with a 24" barrel. It utilizes the current production (5/8" longer) M16A2 stock and checkered buttplate.

Each lower receiver is mated to its upper receiver, the receivers being match-reamed at the pivot





238. The SR-25 field-stripped.

Disassembly and maintenance of the SR-25 is accomplished in the same manner as for the AR-15/M16 series.



239. Left side closeup of the receiver of the SR-25, showing markings.

Note the matching serial numbers on the upper and lower receivers. These are mated for a tight fit.



240. Right side closeup of the SR-25 showing the detachable fired cartridge case deflector, which attaches to the integral MIL-STD-1913 rail on the flat-top upper receiver.

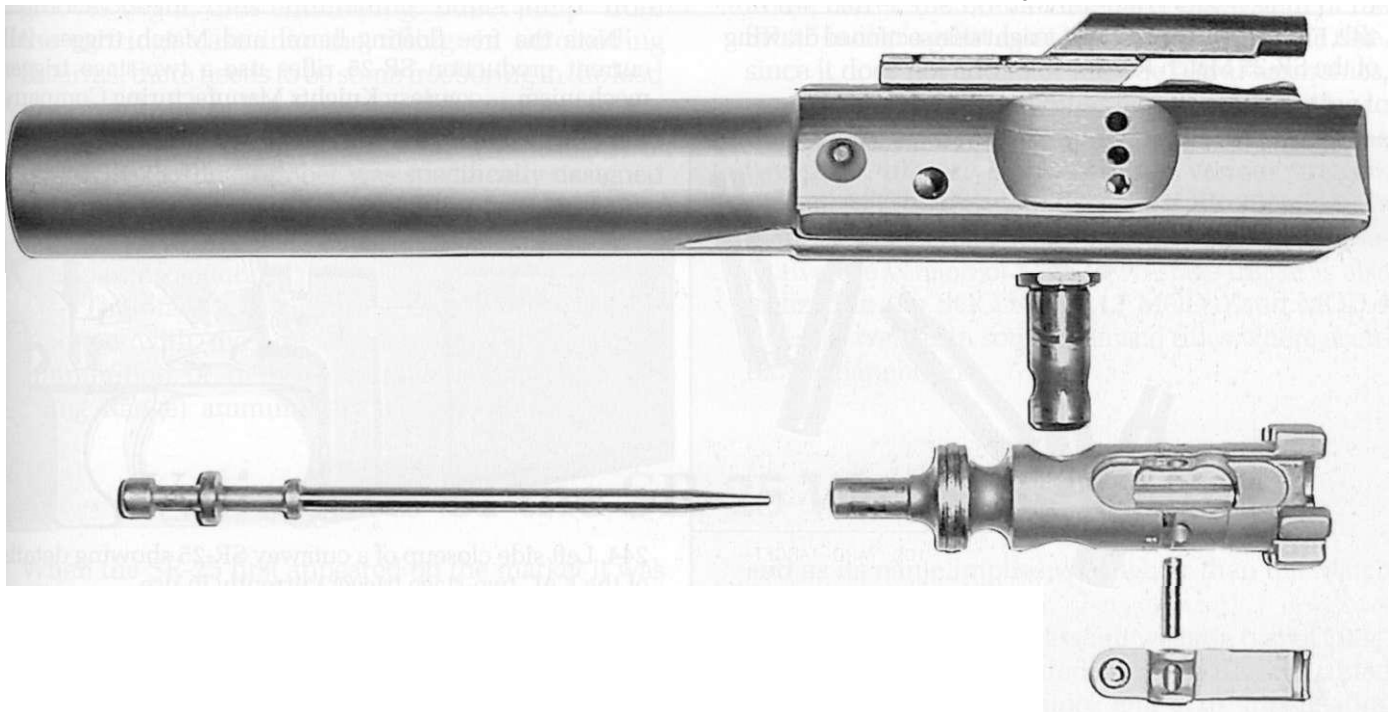
and takedown pin holes prior to coating achieve a good upper to lower receiver fit. Matching serial numbers are then applied to the left side of the lower and upper receivers. Both the rear take-down pin and the front pivot pin are captured, as they are not intended to be removed from the lower receiver for routine cleaning.

The SR-25 uses modified, drop-free AR-10 magazines, in versions holding 5, 10 and 20 rounds. The magazine catch is recessed into the right side of the receiver, to prevent accidental release. The bolt catch works identically to that of the AR-15/M16 series rifles. The buffer on the early models was configured as a solid one-piece nylon spring guide (fig. 519), but following later upgrades and enhancements, KAC now offers a standard buffer with weights similar to those in the standard M16-type rifles.

The SR-25 features an integral MIL-STD-1913 rail, machined into the extruded flat-top upper receiver. This enables scope rings to be mounted right to the upper receiver, thus aligning the shooter's face more comfortably with the scope. Knight's produces both 30mm steel, and 1" aluminum, scope rings. A removable carrying handle containing emergency iron sights is offered. Also available is a 600-meter flip-up rear sight assembly with a 30-click range-adjustable peep sight that is click-detented from 200 to 600 meters. The windage is adjustable in 1/2 MOA increments.

A detachable spent cartridge case deflector which mounts right to the SR-25 rail system does away with the problem of hot brass hitting a left-handed shooter in the face or rolling down his shirt.

## The SR-25 Bolt and Carrier Assembly



241. The chrome-plated SR-25 bolt carrier group is identical in design to that of the AR-15/M16, with one minor

change. The firing pin retaining pin is captive so it cannot be removed or lost.

The SR-25 retains the same gas system as the original AR-10, but incorporates specific components from the AR-15/M16 series rifles.

The bolt carrier assembly retains the external chrome plating of the original, and throughout the years of production various chroming methods have been experimented with and utilized.

The beefed-up bolt assembly, which looks like an AR-15/M16 bolt on steroids, utilizes the standard

seven-lug (with the extractor lug making a total of eight) rotating bolt, as well as standard M16-type gas rings. The bolts are individually headspaced and matched to the barrel and barrel extension.

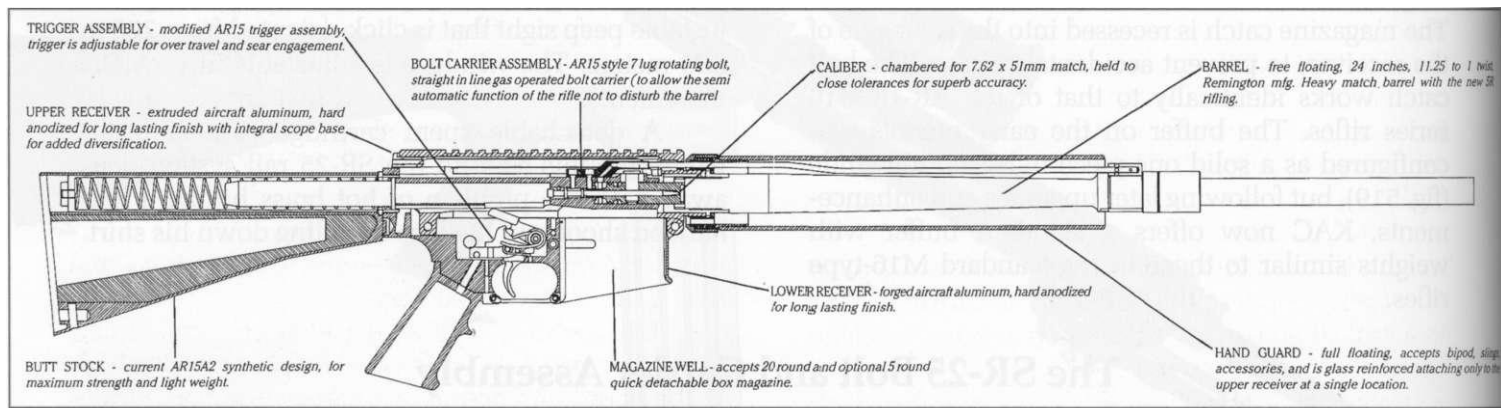
One change from the original design is the captive firing pin retaining pin, designed to prevent the possibility of its being lost.

## The SR-25 Magazine

The rifle originally used a slightly modified AR-10 magazine, made of aluminum. Once new magazine tooling was built, the rifles were delivered with heat-

treated, drop-free steel magazines. The magazines are available in capacities of 5, 10 and 20 rounds.

## The SR-25 Sniper Rifle



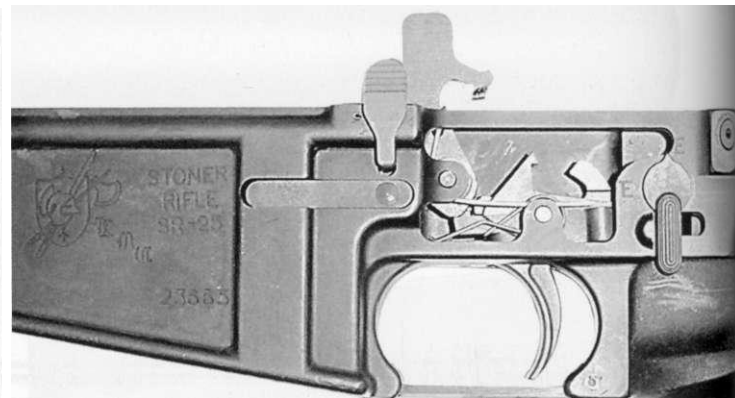
242. From an early brochure, a right side sectioned drawing of the SR-25 Match Rifle.

Note the free floating barrel and Match trigger. All current production SR-25 rifles use a two-stage trigger mechanism, courtesy Knights Manufacturing Company



243. A typical test target, accompanying any SR-25 Match Rifle, showing the rifle firing 1 MOA or less. Rifles firing over 1 MOA are rejected.

The primary role of the SR-25 was that of a sniper rifle, capable of precision accuracy. To assure this, Knight's maintains an extremely high standard in the manufacture of all the components of this rifle, and



244. Left side closeup of a cutaway SR-25 showing details of the KAC two-stage trigger currently in use.

This trigger comes in both semi-auto-only and selective-fire variations.

the firm guarantees maximum one-minute-of-angle groups right out of the box.

Every SR-25 Match Rifle comes from the factory accompanied by a test target showing the sub-MOA group. The truth of the matter is that the 1 MOA was the starting point, and if the test group was any larger than that, the rifle would be rejected. A well-broken-in SR-25 rifle, utilizing Match Grade commercial ammunition, will produce 1/2 MOA with little difficulty.

The key component in making this possible is the barrel. The original SR-25 rifle barrels were made from Remington 5R (five lands and grooves, right-hand twist) hammer-forged, carbon steel barrel blanks. These are the same barrels as those installed on the M24 bolt action rifles used by US Army and Marine snipers, and it should be noted that Knight's Manufacturing is the only company to whom Remington has ever sold these precision barrels. The one turn in 11 1/4" twist 5R rifling was designed to optimize the performance of 168-grain M118LR Match-grade bullets. In the last few years Knight's has switched from Remington barrels to Obermeyer 5R barrels, rifled with a slightly slower one turn in 11 1/2" twist.

The ammunition is all loaded with the same Sierra Match bullets, and tight tolerances are kept on the seating depth of the bullet in the cartridge case. In a typical bolt-action rifle, when a round is chambered, the bullet is seated right where the lands and grooves begin, thus eliminating "bullet jump" from the cartridge case into the rifling. In autoloading firearms, there needs to be some freeboring in the lead to prevent the bullet from possibly sticking in the rifling should a live round be extracted. In the case of the SR-25, the chamber was specifically designed to better control the diameter of the lead, and thus hold the bullet in better alignment with the bore, thus maintaining accuracy.

The one-MOA guarantee only applies in conjunction with the use of Match Grade 168-grain ammunition, or, in the case of the military, M118LR (Long Range) ammunition; as there is no way to

guarantee 1 MOA when firing bullets of alternate shapes and weights.

The gas blocks on the first production barrels were held onto the barrel with a threaded retaining nut, and came with a small section of rail, provided for the mounting of the emergency attachable front sight. In later versions the gas block was pinned onto the barrel.

The barrel was originally offered surrounded by a glass-reinforced fiberglass free-floating handguard, which is attached at a single location only on the upper receiver. Due to the fact that the handguard does not touch the barrel, slings and bipods can be attached to the handguard and utilized without any degradation of accuracy. However, while the standard fiberglass handguard is still available as an option, most customers have tended to prefer the KAC free-floating Barrel Rail System.

Unlike rifles such as the M14 and the Soviet Dragunov, where there is a piston assembly attached to the barrel, the no-moving-parts gas system of the SR-25 is also a great asset to the accuracy of the rifle, since it does not add to or impede barrel harmonics.

One of the several other factors contributing to the superb accuracy of the SR-25 rifle systems is the two-stage trigger. Knight's used various triggers throughout the development of the SR-25, and now manufactures their own proprietary design. The selective-fire version of KAC's two-stage trigger is also utilized in the SOCOM Mk12 MOD 0 and MOD 1 rifles, as well as in some Diemaco rifles where accuracy is paramount.

## Variations of the SR-25 Weapons Family

When the SR-25 first appeared on the market it was offered in two variants: the SR-25 Match Rifle, described above, and the SR-25 Standard Rifle, a much lighter assault rifle version fitted with a 20" standard barrel with a flash suppressor, and standard M16A2-style upper and lower round handguards. This rifle had a fixed front sight but retained the flat-top upper receiver with integral rail. As noted, Knight's also offered a removable carrying handle with fully adjustable rear sights. The Standard Rifle weighed approximately 8.8 lbs. unloaded, and measured 40 3/4" in overall length. Knight's guaranteed less than 2 MOA with this version of the rifle.

Later, the SR-25 Lightweight Match rifle replaced the Standard Rifle. The Lightweight Match utilized a 20" medium contour free-floating barrel

and as its name implies was lighter than the Match Rifle, weighing 9 1/2 lbs.

Prior to the federal assault weapon ban of 1994, Knight's also manufactured an SR-25 Carbine, fitted with a telescoping buttstock and a 16" free-floating barrel. The carbine came equipped with a removable front sight as well as the removable carrying handle with fully adjustable rear sight. After the ban, the telescoping stock was discontinued in favor of a fixed stock.

245 (following page). The three commercial SR-25 models available, circa 2003: the Match Rifle (above), Lightweight Match Rifle (center), and Carbine (below).

Note the option of the standard free-floating fiberglass handguard or the free-floating "Barrel Rail System".

courtesy Knight's Manufacturing Company

## 170 Variations of the SR-25 Weapons Family



**SR-25 Match Rifles.** The heart of these world class .308 precision target rifles is their 24-inch free-floating barrels. Their 11.25 to 1 barrel twist optimizes the performance of "out of the box" Remington Match grade 168 gr. boat tail ammunition. SR-25 Match Rifles are the only production rifles guaranteed to shoot less than one M.O.A. The 100 yd. factory qualification target fired with 5-rounds of match ammunition is shipped with each Match Rifle as testimony to its suburb accuracy.



**SR-25 Lightweight Match Rifles.** Offering 20-inch long "sporting weight" free floating barrels. These models are very possibly your best choice for general-purpose hunting or 3-Gun Matches when accurate, full caliber, semi-automatic .308 caliber is required. Two models: one with our original fiberglass handguard, and one available with an Army style Rail Adapter System (RAS) forend.



**SR-25 RAS Carbine.** A lighter and handier version of the Lightweight Match Rifle. The Stoner Carbine is an accurate, handy sporting arm for use in close cover and on backpack hunting trips. Available only with Free Floating Barrel Rail System (RAS) forend. SR-25 RAS Carbine...P/N: 98170

SR Rifle Part Numbers:	Fiberglass Handguard	Rail System Handguard	SR-25 Model Caliber .308 (7.62 mm NATO)	Match	Lightweight Match Rifle	Carbine
Match	98029	98168	Barrel Length	24" Hvy.	20" Std.	16" Std.
Lt. Wt. Match	98030	98169	Free Floating Barrel	Yes	Yes	Yes
Carbine	N/A	98170	Flat-Top Upper Receiver	Yes	Yes	Yes
			Two-Stage Match Trigger Available	Yes	Yes	Yes
			Chrome Bolt & Carrier	Yes	Yes	Yes
			One 10-Round Magazine w/ Rifle	Yes	Yes	Yes
			5-Round Magazines Available	Yes	Yes	Yes
			Overall Length	43.5"	39.5"	35.75"
			Unloaded Weight	10.75 lbs.	9.5 lbs.	7.75 lbs.

Note: Item is shown with optional accessories.



## The US Armed Forces Take a Second Look

After more than forty years, the US military took another look at the design they had shunned during the NATO trials of the late 1950s. This time, serious consideration came from the elite Navy SEALs. The SEALs, under USSOCOM (United States Special Operations Command), had for several years been looking for a sniper rifle better suited for MOUNT

(Military Operations Urban Terrain). They wanted a more maneuverable and easier-to-carry rifle, and were quickly convinced of the merits of the SR-25, which combined proven Match-grade accuracy with the rapid fire and high magazine capacity of a .308 caliber assault rifle.

### The Mk11, MOD 0



246. Right-side view of the SR-25 in the Mk11 MOD 0 version adopted by US Navy SEALs, shown here fitted with free-floating RAS handguard/rail system, Leupold

M3 variable optic sight, Harris bipod and Knight's Armament suppressor.



247. Left side closeup showing the KAC suppressor mounted on the Mk11 MOD 0.

Note the back-up front sight folded down on top of the

gas block, and the Quick Detach Suppressor lock latch holding the suppressor in place.

The US Navy SEALs adopted the SR-25, now type-classified as the "Rifle 7.62mm Mk11 MOD 0" (NSN 1005-01-475-7980) in May, 2000. The initial contract was for 300 Mk11 weapon systems, with follow-on contracts for the Mk11 or similar variants coming from US Army Rangers and other government agencies.

The Mk11 MOD 0 was configured as a complete weapon system, similar to the Heckler & Koch Mk23 MOD0 (NSN 1005-01-426-8951), and comprised an SR-25 rifle, Knight's Armament Company 7.62mm

Sound Suppressor, Leupold Long-Range Tactical 3.5-10x variable scope, and 600-meter back-up iron sights. The complete rifle system comes in a Pelican hard case with a fitted closed-cell foam liner.

The Mk11 was based on the SR-25 Lightweight Match rifle, utilizing the 20" Obermeyer barrel with a rifling twist of one turn in 11", optimized for the new M118LR (Long Range) 175-grain military Match ammunition. When fired in the Mk11 this cartridge produces a muzzle velocity of 2,571 fps. The ballistic cam on the Leupold Tactical scope is specifically



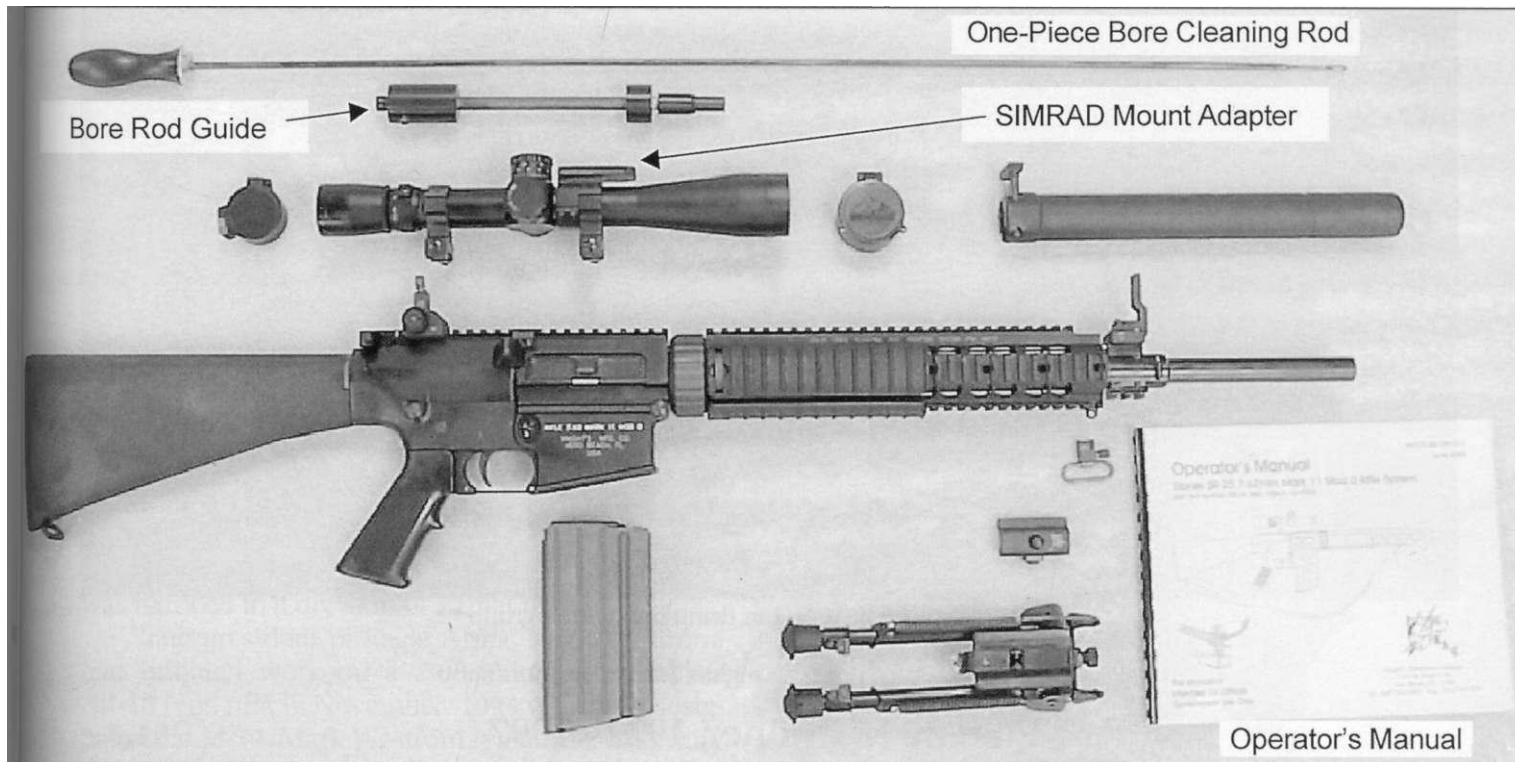


248. The US Navy Mk11 MOD 0 weapon system comes issued in a hard case which includes the weapon, scope, suppressor, back-up sights, cleaning rod, bore rod guide, cleaning kit, magazines, manual and sling.  
courtesy United States Special Operations Command

calibrated for M118LR ammunition, and the barrel configuration of the Mk11, in 100-meter increments from 100 to 1,000 meters.

Obviously, a decrease in barrel length from 24 to 20 inches could have had a dramatic affect on the

weapon's accuracy, and in order to retain the 1 MOA accuracy guarantee, Knight's had to make some additional modifications to the buffer, extractor, firing pin, and ejector.



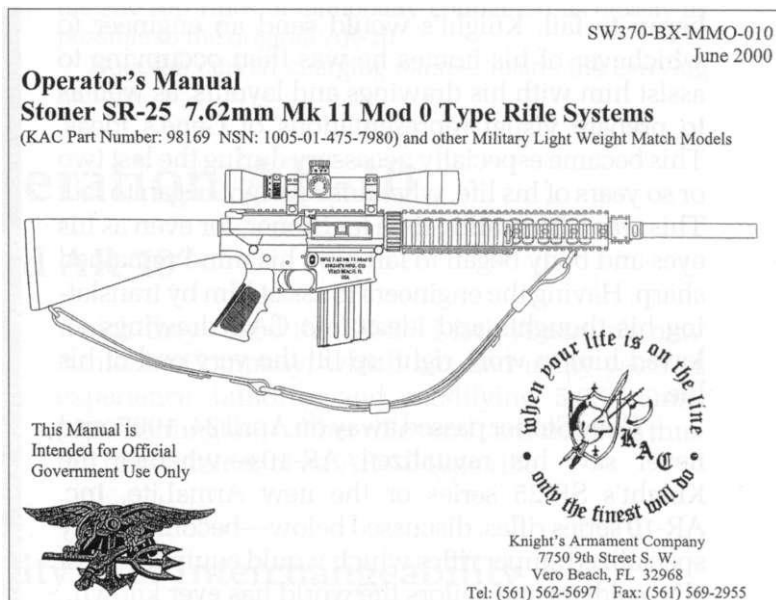
249. The components which make up the "Rifle 7.62 MK 11 MOD 0" system, including the optics, suppressor, cleaning rod and bore guide, and bipod.

Note the SIMRAD Mount Adapter, on the Leupold M3 optic sight. The KAC backup front and rear iron sights are shown raised.

The US Army has adopted a similar SR-25 system, courtesy United States Special Operations Command



250. Right side closeup of the lower receiver of the Mk11 MOD 0, showing markings under the ejection port.



251. The cover of the Operator's Manual for the Mk11 MOD 0 Rifle System.

courtesy United States Special Operations Command



252. The Mk11 MOD 0 on the firing line with a group of elite Navy SEALs.

courtesy Knight's Armament Company

## Eugene M. Stoner, 1922 -1997

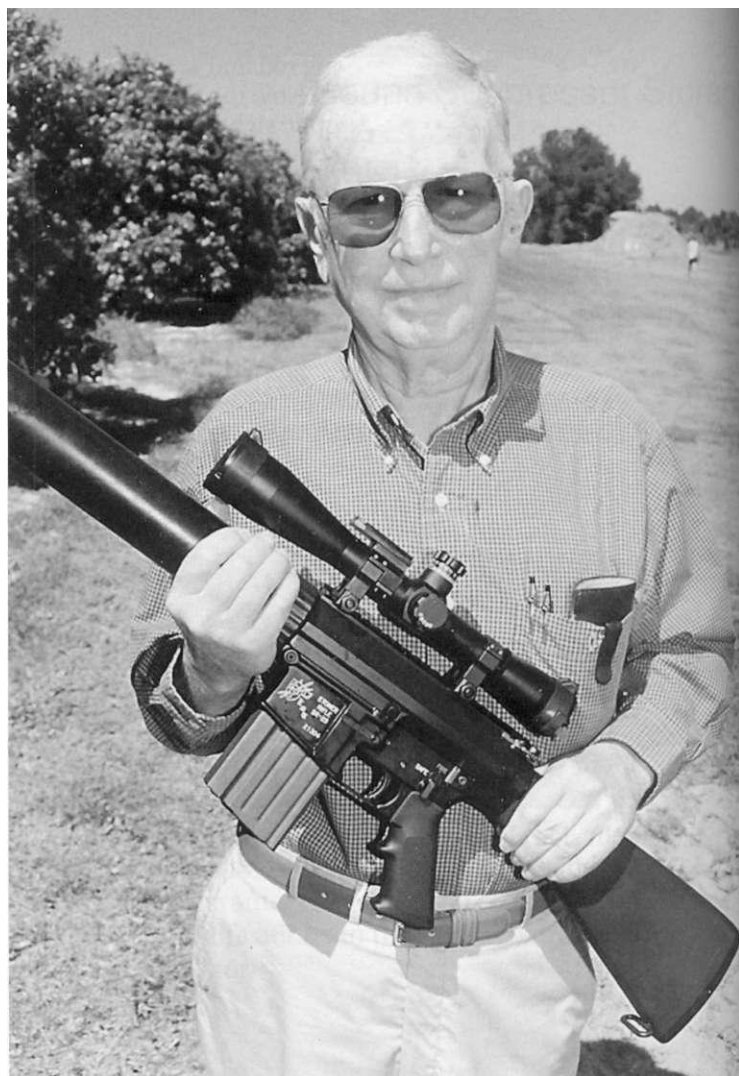
In his later years Gene Stoner owned a lakefront summer home in Michigan as well as a winter home in Palm City, Florida. He maintained offices in both homes, where he worked on his various designs. He never quite got used to the modern Computer Aided Design (CAD) systems, and preferred to work out his ideas with pencil and paper.

After Stoner developed cancer, and as his health began to fail, Knight's would send an engineer to whichever of his homes he was then occupying to assist him with his drawings and layouts, as well as to prepare visual representations of Gene's ideas. This became especially necessary during the last two or so years of his life, when his eyesight began to fail. This was a frustrating time for Stoner, for even as his eyes and body began to fail him, his mind remained sharp. Having the engineers to assist him by translating his thoughts and ideas into CAD drawings allowed him to work right up till the very end of his life.

Gene Stoner passed away on April 24, 1997, and never saw his revitalized AR-10s—whether the Knight's SR-25 series or the new ArmaLite, Inc. AR-10 series rifles, discussed below—become highly specialized sniper rifles which would equip the most elite soldiers and sailors the world has ever known.

253 (right). Gene Stoner in the spring of 1996, near his home in Palm City, Florida, displaying his SR-25 rifle.

courtesy Knight's Armament Company



Nevertheless, Stoner has most assuredly made his mark in small arms history. His basic rifle design has prevailed, and the M16 series has gone on to

become one of the most proven, most used and longest serving military weapons of all time.

## ArmaLite Must Go On!

Like most of the companies which comprise the American firearms industry, ArmaLite was not immune to changes of ownership, being bought and sold four times over the last half century. In early 1995 a fifth transition took place as Eagle Arms Inc. of Coal Valley, Illinois purchased the rights to the ArmaLite name, many technical drawings, and a small amount of hardware from the earlier ArmaLite company. The name of the corporation was changed from Eagle Arms to ArmaLite, and Eagle Arms itself was reduced to a division of ArmaLite.

The president of Eagle Arms, Mark Westrom, had initiated work on a .308 Winchester caliber AR-10 type rifle in November, 1994 which he designated the M-10. Mark Westrom is a former US Army Ordnance officer and civilian employee of the US Army's Armament Materials and Chemical Command (AMCCOM) at Rock Island Arsenal. With the re-establishment of ArmaLite, Westrom changed the name of his new rifle, and the new AR-10 was born.



254. ArmaLite president Mark Westrom, displaying one of his AR-10B rifles, intentionally configured as closely as possible to the original AR-10.

Note the curved charging handle, inside the carrying handle.

## The New-Generation AR-10

### The "Third AR-10"

As described in *US Rifle M14*, the original ArmaLite, then a division of Fairchild Engine & Airplane Corp., produced the first AR-10 during the 1950s. Forty years later, as discussed above, Knight's Manufacturing of Vero Beach, Florida oversaw the development of Gene Stoner's own second thoughts on the AR-10,

which they called the SR-25. Mark Westrom's new ArmaLite Company, which has had many years of experience building and modifying 5.56x45mm (.223 Remington) caliber rifles and carbines, was thus the third builder of an AR-10-type rifle.

### A Divergent View: Reliability over Interchangeability

It is interesting to note that, within the framework of a Match-grade sniper rifle, a conscious attempt was made by Gene Stoner to use as many AR-15/M16 parts as possible in the design of his SR-25. With

ArmaLite's new AR-10 series, Mark Westrom took a divergent view, preferring to concentrate on reliability and durability rather than interchangeability with the AR-15/M16.

Westrom had three choices when he took on the task of developing his AR-10. The first was to base the design on the original AR-10 drawings he had inherited when Eagle Arms purchased the assets of the original ArmaLite company. The second was to emulate, to a greater or lesser degree, Stoner's SR-25; and the third was to scale up his own version of the AR-15 to fire the 7.62x51mm cartridge.

A rifle based on the original AR-10 drawings would have looked somewhat strange to shooters used to the current M16A2 rifle, and would have

allowed only limited sales of spare parts to those who had already purchased SR-25s. Direct scaling-up of the AR-15 was technically the simplest approach, but this would have produced a totally unique design with no component sales potential to existing SR-25 owners. In the end, Westrom designed his new rifle to look much like the M16A2, but with interface surfaces that allowed his components to work in the SR-25, so that many components of his new rifle would immediately inherit an existing customer base.

## The "Clamshell" Lower Receiver: an Innovative Approach to Prototype Development



255. All magazine development and testing was done using the surrogate lower receiver shown here, made of two joined slabs of aluminum. The magazine well was adjusted to determine the ideal magazine location and feed angle.

This approach allowed Westrom to develop his rifle using SR-25 components as surrogates during testing. Nevertheless the processes of development, testing, and qualifying the AR-10 series were unusual, in that there were no prototype weapons *per se*. The lower receiver for the test rifle was made of two slabs of aluminum, machined to accept prototype parts.

This experimental "receiver" could be opened up, and then welded and re-machined to allow the magazine and other parts to be swapped out and shifted to find, for instance, the optimal angle for reliable feeding and chambering.

The next, and biggest, engineering problem was the magazine.

## The Biggest Hurdle: the New AR-10 Magazine

The most innovative feature of the new ArmaLite AR-10 rifle is the magazine. After the assault weapon ban of 1994, civilian magazines which held more than ten rounds could no longer be produced. The supply of original military AR-10 twenty-round magazines, as used in the early versions of the SR-25, was limited and thus expensive, so use of the same pool of magazines would limit the market for the

AR-10. In addition, the original AR-10 magazines were designed to be preloaded and disposable, and thus were not intended for extended use.

The need for an inexpensive, commonly available .308 caliber magazine led ArmaLite to consider both the M14 and the FN FAL magazines. Although the FAL magazines were less expensive, the M14 magazine, designed by John Garand, was found to be





256. Due to its wide availability, the magazine selected for the new ArmaLite AR-10 was the military M14 magazine. The five-round (left) and 20-round (right) versions are shown.

Note the M14 front lug has been removed (left), a new side mag catch slot added (center), and the bolt holdopen plunger has been incorporated in the follower (right).

better suited to the AR-10's action, so ArmaLite's new AR-10 uses a magazine based on the proven M14 design.

Once the selection of the basic M14 magazine design had been made, Westrom began the task of matching it to the AR-10. It was here that the whole project almost came unhinged.

To save time, Westrom initiated the design of the rifle and redesign of the magazine simultaneously. The initial assumption that ArmaLite only needed to identify the optimal location of the magazine in the rifle proved incorrect. While the rifle design advanced rapidly, the magazines stubbornly resisted progress. Ultimately, Westrom identified a relationship between the feed lips that affected the lowering of the cartridge base during feeding. Shortening the magazine's feed lips immediately produced



257. Top view of two ArmaLite AR-10 magazines.

Above: original black polymer follower.

Below: new forged and machined aluminum follower, designed for increased reliability of feeding in desert environments.

a magazine which functioned perfectly in his prototype AR-10, and the project was saved.

Unlike the M16 magazine, the M14 follower bears no rear protrusion to actuate the bolt catch. The second major change Westrom instituted allows the bolt catch to hold the bolt to the rear when the last round is fired. This was accomplished by adding a spring-loaded plunger to the rear of the polymer magazine follower to act as a bolt catch trip, to actuate the bolt catch when the magazine rises to its topmost position. When the magazine follower is down inside the body of the magazine, the plunger is compressed. As the follower rises, the plunger reaches a slot cut in the back of the magazine, and pops out into it. Continued upward movement of the follower carries the extended bolt catch trip into contact with the bolt catch, forcing it upward to contact and hold the bolt when the magazine is empty.

ArmaLite currently offers an improved aluminum magazine follower, which is a product of ArmaLite's Military Sales department.

## Building a 7.62x51mm Caliber Rifle, Not a 7.62mm M16

One of Westrom's goals was to design parts which would interface with the SR-25, but he began with a different design philosophy than that used on the SR-25. As noted, the SR-25 was designed to use many AR-15/M16 components as possible. For a version such as the Mk11 Mod 0, which is engaged in military service, there is a significant logistical advantage in a 60% parts commonality with the M16A2 rifle. Westrom, however, considered some of these parts insufficiently strong or otherwise unsatisfactory for use in the 7.62mm caliber AR-10, and felt that their

use would impose restrictive limits on the design of his rifle. He was therefore willing to build a rifle with specially designed parts. These changes included the use of a longer gas tube, a standard aluminum buffer with internal weights to dampen bolt carrier bounce, a spring-loaded firing pin, an improved extractor with rubber 'O'-ring and a stronger bolt catch, as well as a new recoil check.

Even with these innovations Westrom was able to retain a great degree of interchangeability between his rifle and the SR-25 at the higher assembly level.

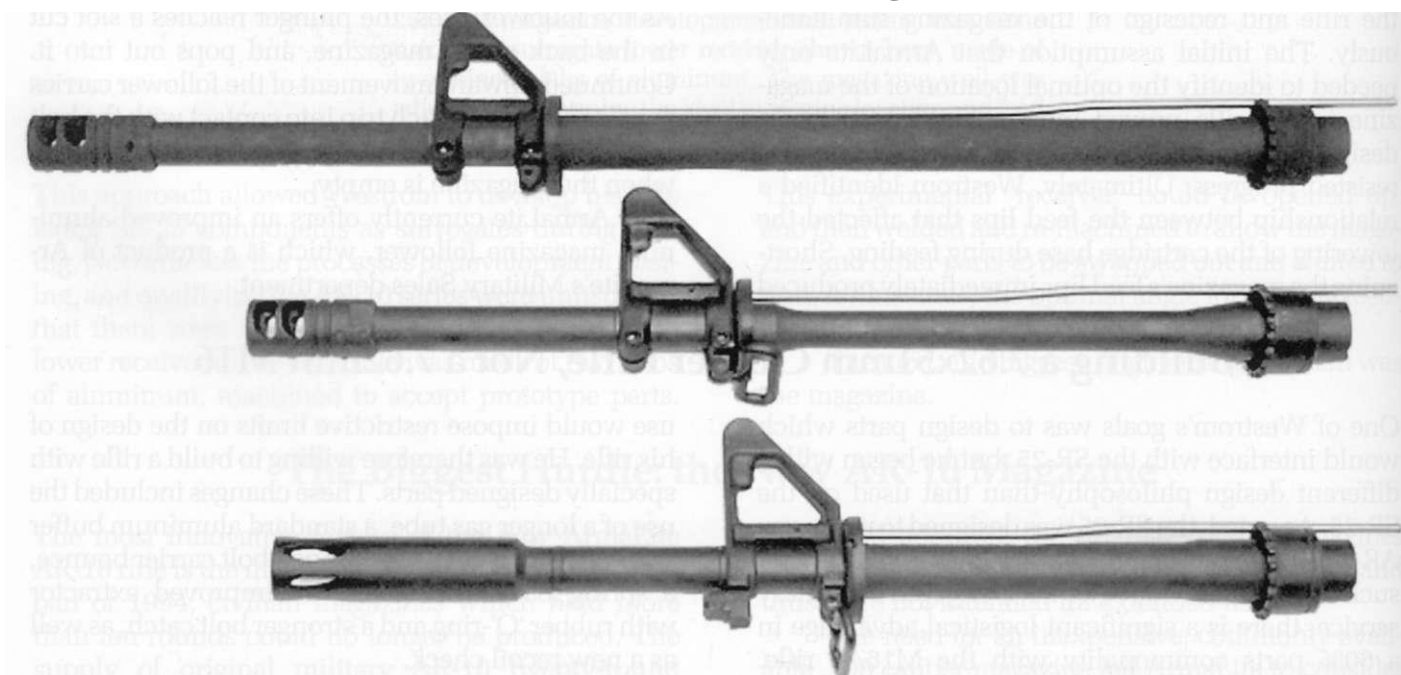




258. Right side view of the AR-10A2 "Infantry" model field-stripped, showing the strong similarities to the standard M16-type rifle.

Note the lack of forward assist, and the magazine release fence or "boss" to protect from accidental or unintentional release of the magazine.

## AR-10 Barrels and Handguards



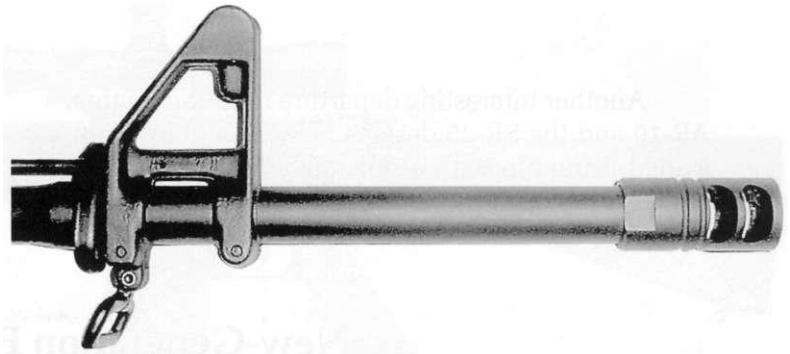
259. Three ArmaLite barrel and gas tube configurations.  
Above: standard AR-10A2 rifle.  
Center: mid-length AR-10A2 carbine.

Below: 5.56mm Law Enforcement-only short carbine.  
courtesy ArmaLite, Inc.

Barrels for the ArmaLite AR-10 are available in various configurations. The AR-10A2 and A4 rifles use a 20" chrome-lined barrel with four lands and grooves, rifled with a right-hand twist of one turn in 12". ArmaLite uses an adjustable front sight assembly which is held on with two set screws. This allows the rifle's front sight base to be shifted to zero the front sight for windage, while leaving the rear sight "mechanically zeroed," or perfectly centered in the rear sight base. This feature is unique to ArmaLite. The front sight assembly omits the bayonet lug in compliance with the federal assault weapon ban.

In addition, ArmaLite rifles feature a cylindrical multi-slot recoil check, which greatly reduces muzzle jump, on all but the AR-10(T) rifle barrel assemblies. The AR-10(T) (Target/Match) barrel is rifled with a right-hand twist of one turn in 10". All Match rifles utilize a free-floating handguard.

All ArmaLite carbines, whether 7.62mm or 5.56mm, utilize a special "mid-length" gas tube developed by Mark Westrom, approximately 2" longer than the standard carbine gas tube used on the early XM177 carbines and the current M4 family, which sits deeper into the carrier key. This assists reliability



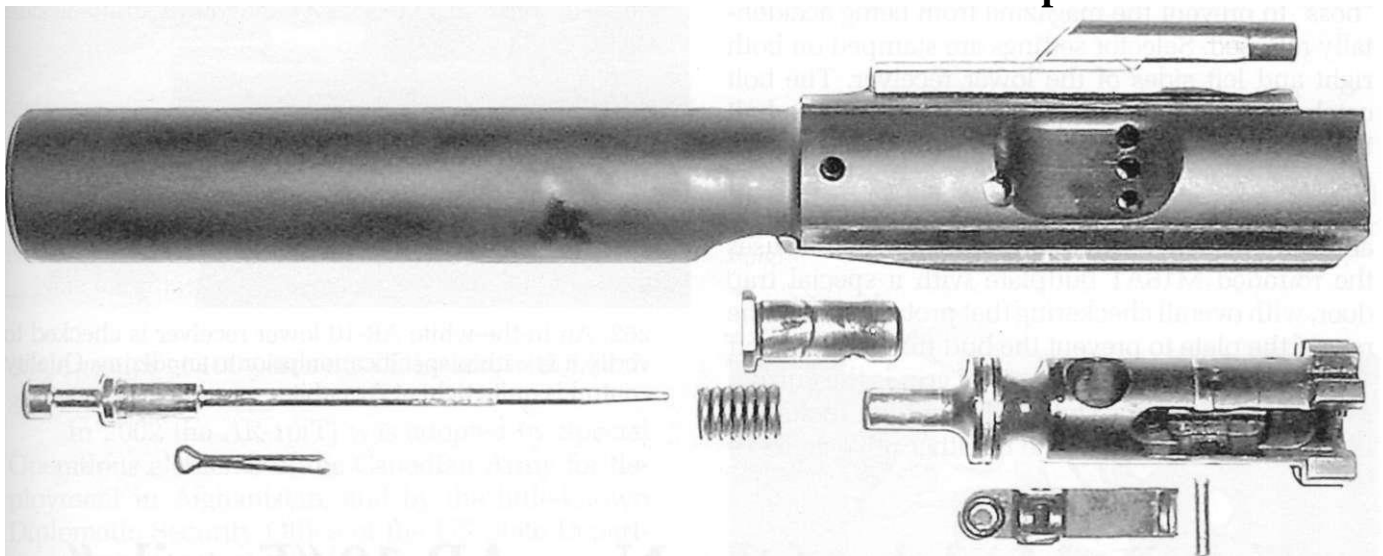
260. Right side closeup of the muzzle area of an AR-10A2 showing ArmaLite-designed muzzle check, which reduces recoil and muzzle climb.

In addition, the front sight assembly is held by two screws instead of taper pins. This enables the front sight to be adjusted if the rifle shoots off center.

by putting more distance between the bolt carrier and the gas port, so that less pressure enters the bolt carrier, which in turn lowers the cyclic rate.

All ArmaLite carbines also feature special handguards, which are 2" longer than those used on the XM177 and M4 and are more convenient and comfortable, and more attractive than the shorter, standard handguards.

## The ArmaLite AR-10 Bolt Carrier Group



261. AR-10 bolt carrier group, disassembled, showing similarities to the SR-25 bolt carrier group.

Note the firing pin spring, added to prevent slam-firing

The AR-10 bolt carrier is interchangeable with that of the SR-25. ArmaLite chose to stay with a black manganese phosphate finish on the outside of the bolt carrier assembly, to match the government process specified for the M16A2, although the inside

on the closing stroke due to firing pin inertia, especially when using non-military-spec ammunition with soft primers.

surfaces of the bolt carrier and carrier key are chromed. The bolt utilizes a one-piece McFarland Gas Ring instead of the standard three separate gas rings.

Another interesting departure from the original AR-10 and the SR-25 designs is the use of a spring-loaded firing pin with a separate spring, which sits between the front of the firing pin second head and the front of the bolt. This serves to retard the heavier

firing pin to prevent slam-fires. A standard firing pin retaining pin is used.

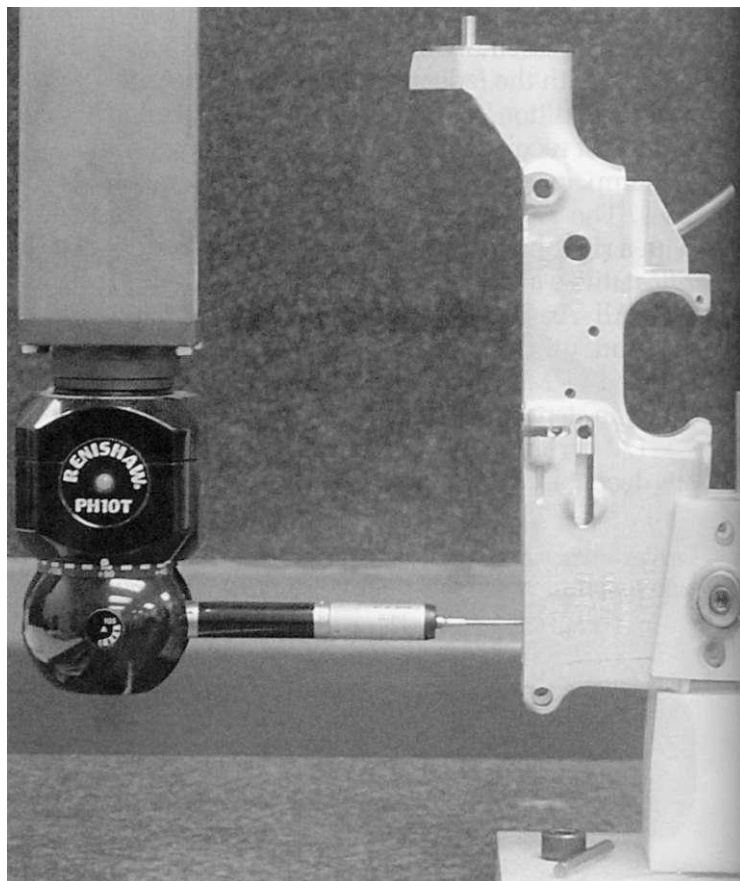
In addition the stronger extractor utilizes the rubber 'O'-ring around the extractor spring, which has been proven to significantly increase reliability and decrease the failure-to-extract malfunction.

## New-Generation Forged Receivers

ArmaLite produces two upper receiver variants for its line of AR-10 rifles. The AR-10A2 rifle and AR-10 A2 carbine receivers have a fixed carrying handle and adjustable iron sights almost identical to those of the M16A2. The AR-10(T) and AR-10A4 upper receivers are in the "flat-top" configuration, with top surfaces machined as MIL-STD-1913 rails. Both receivers are machined from 7175 T-74 aluminum alloy forgings to obtain better strength and a more sculptured look than found on an extruded receiver, and embody an integral "Brunton Bump" case deflector without the need for an additional part. The AR-10 does not have a forward assist.

The AR-10 lower receivers are made from aircraft-grade forgings, and look very similar to the M16A2 series receivers. They utilize the same style of push pins as well as the magazine release fence or "boss" to prevent the magazine from being accidentally released. Selector settings are stamped on both right and left sides of the lower receiver. The bolt catch is greatly beefed-up and strengthened to halt the larger AR-10 carrier group, and is not interchangeable with that of the M16A2.

The buttstock and pistol grip are interchangeable with the AR-15/M16 series rifles. ArmaLite uses the rounded M16A1 buttplate with a special trap door, with overall checkering that protrudes from the rear of the plate to prevent the butt from slipping off the shooter's shoulder. The pistol grip is the current M16A2 finger groove style. All furniture, including the handguards, is available in either olive-green or black.



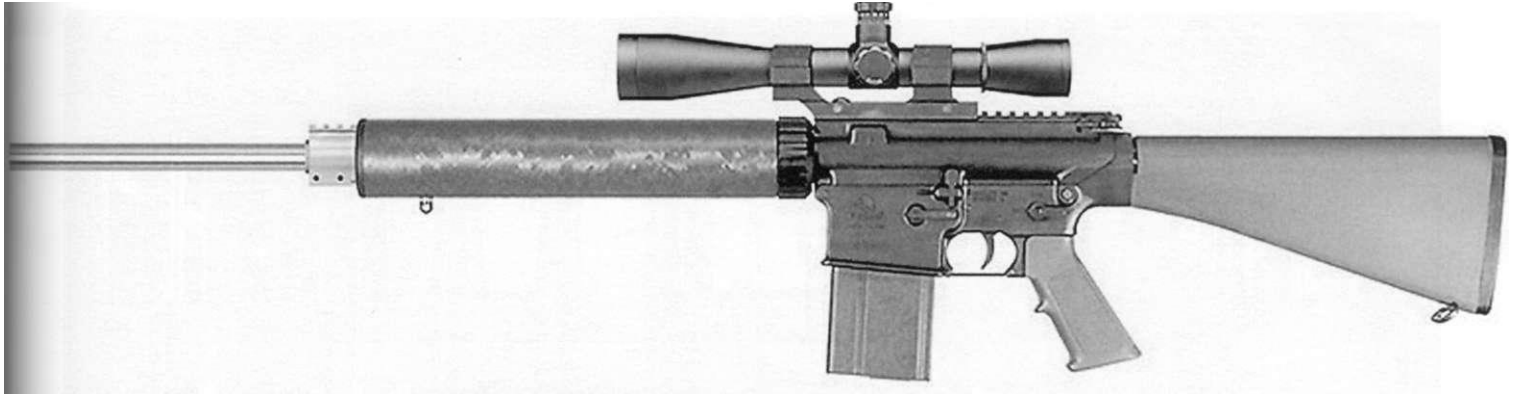
262. An in-the-white AR-10 lower receiver is checked to verify it is within specification prior to anodizing. Quality control is quite tight at ArmaLite.

# The Six Models of the New AR-10 "Family"

## The AR-10(T): the Canadian Forces Sniper Rifle

ArmaLite currently offers six versions of their AR-10 series. The top-of-the-line is the AR-10(T), which is a Match-grade rifle designed for tactical and competition use. It utilizes a 24" triple-lapped stainless steel barrel with a fiberglass free-floating handguard. The top of the flat-top upper receiver is configured as a

MIL-STD-1913 rail. Like the SR-25, the AR-10(T) has provisions to mount emergency iron sights on both the upper receiver and the gas block. The rifle comes with a two-stage National Match trigger. The overall weight of the AR-10(T) is approximately 10.8 lbs. Like the SR-25, ArmaLite guarantees one-minute-of-



263. Left side view of the ArmaLite AR-10(T) Match rifle, fitted with a stainless steel barrel and a free-floating handguard.

This rifle is guaranteed to fire 1 MOA out of the box with Match grade ammunition, courtesy ArmaLite, Inc



264. Left and right views of the version of the AR-10(T) which the Canadian Forces have adopted as their sniper rifle. The muzzle is threaded to accept a suppressor.

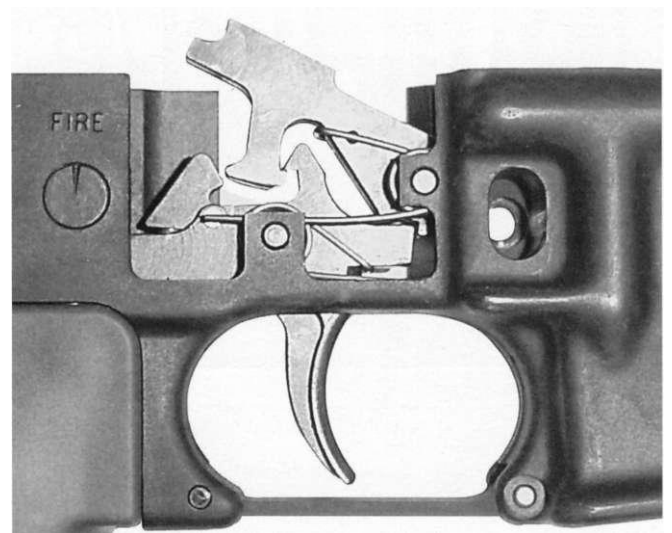
Note the adjustable cheekpiece on the stock, as well as

angle groups at 100 yards out of the box with Match grade ammunition.

In 2002 the AR-10(T) was adopted by Special Operations elements of the Canadian Army for deployment in Afghanistan, and by the little-known Diplomatic Security Office of the US State Department for use in the Middle East.

Based on problems experienced with M4 carbines in those theaters, ArmaLite carried out a series of investigations to identify problem areas and initiate trials of test changes to prevent similar occurrences with the AR-10. The tests resulted in production of a forged and machined aluminum follower for the AR-10 magazine, intended to improve tolerance for use in sand and dust.

the Badger Ordnance aluminum free-floating "Tactical Stabilizer Handguard" with full-length rail at receiver height.



265. The ArmaLite two-stage trigger, fitted as standard on all Match-grade rifles, optional with any configuration.





## ARMALITE® ~ A HISTORY OF INNOVATION .308 CALIBER AR-10™ SERIES RIFLES & CARBINES

### AR-10(T)™ .308 CALIBER

UPPER RECEIVER • FORGED FLATTOP  
 TRIGGER • NM TWO STAGE  
 BARREL • 24" SST T HEAVY  
 RIFLING TWIST • RH 1:11.25 INCH  
 FRONT SIGHT BASE • PICATINNY RAIL GAS BLOCK  
 MUZZLE DEVICE • NONE  
 OVERALL LENGTH • 43.5 INCHES  
 WEIGHT • 10.8 POUNDS  
 ACCURACY • 1" GROUPS AT 100 YARDS



### AR-10(T)™ CARBINE .308 CALIBER

UPPER RECEIVER • FORGED FLATTOP  
 TRIGGER • NM TWO STAGE  
 BARREL • 16" SST CARBINE  
 RIFLING TWIST • RH 1:11.25 INCH  
 FRONT SIGHT BASE • PICATINNY RAIL GAS BLOCK  
 MUZZLE DEVICE • RECOIL CHECK  
 OVERALL LENGTH • 37.0 INCHES  
 WEIGHT • 8.8 POUNDS  
 ACCURACY • 1.5"-2" GROUPS AT 100 YARDS

### AR-10A4™ .308 CALIBER

UPPER RECEIVER • FORGED FLATTOP  
 TRIGGER • STANDARD  
 BARREL • 20" CHROME LINED HBAR  
 RIFLING TWIST • RH 1:12 INCH  
 FRONT SIGHT BASE • PICATINNY RAIL GAS BLOCK  
 MUZZLE DEVICE • RECOIL CHECK  
 OVERALL LENGTH • 41 INCHES  
 WEIGHT • 9.0 POUNDS



### AR-10A4™ CARBINE .308 CALIBER

UPPER RECEIVER • FORGED FLATTOP  
 TRIGGER • STANDARD  
 BARREL • 16" CHROME LINED CARBINE  
 RIFLING TWIST • RH 1:12 INCH  
 FRONT SIGHT BASE • PICATINNY RAIL GAS BLOCK  
 MUZZLE DEVICE • RECOIL CHECK  
 OVERALL LENGTH • 37.0 INCHES  
 WEIGHT • 8.4 POUNDS

### AR-10A2™ .308 CALIBER

UPPER RECEIVER • FORGED A2  
 TRIGGER • STANDARD  
 BARREL • 20" CHROME LINED HBAR  
 RIFLING TWIST • RH 1:12 INCH  
 FRONT SIGHT BASE • M16 STYLE  
 MUZZLE DEVICE • RECOIL CHECK  
 OVERALL LENGTH • 41 INCHES  
 WEIGHT • 9.4 POUNDS



### AR-10A2™ CARBINE .308 CALIBER

UPPER RECEIVER • FORGED A2  
 TRIGGER • STANDARD  
 BARREL • 16" CHROME LINED CARBINE  
 RIFLING TWIST • RH 1:12 INCH  
 FRONT SIGHT BASE • M16 STYLE  
 MUZZLE DEVICE • RECOIL CHECK  
 OVERALL LENGTH • 37.0 INCHES  
 WEIGHT • 8.7 POUNDS



We offer a complete line of .223, .243 and .308 caliber rifles & carbines, plus the innovative AR-50™ .50 caliber rifle - All American made and backed by our lifetime warranty - and a great selection of options, upgrades, parts and accessories. Visit our website at [www.armalite.com](http://www.armalite.com), or send \$2.00 or your FFL for our complete catalog:

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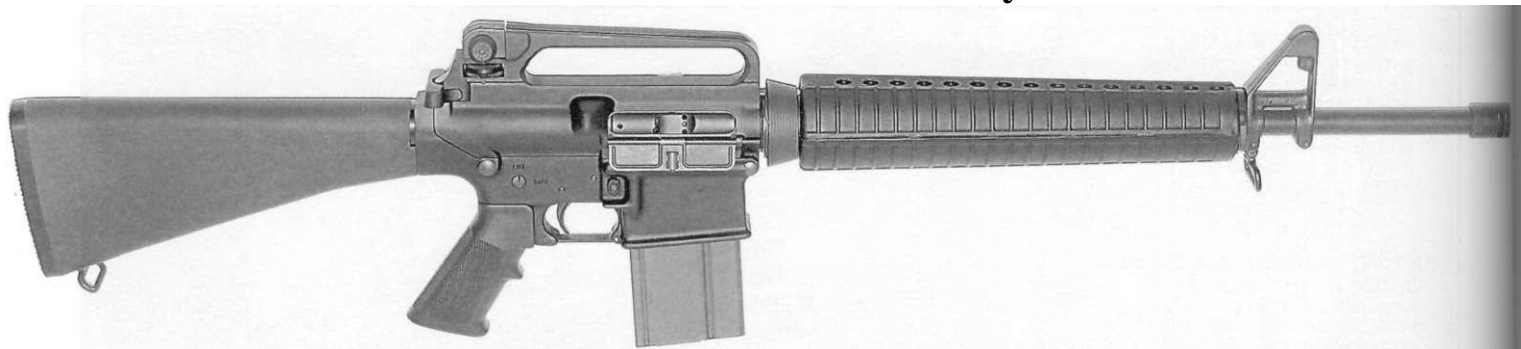
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266 (previous page). A rack of 20 AR-10(T) Canadian Sniper rifles ready for shipment to Canada.

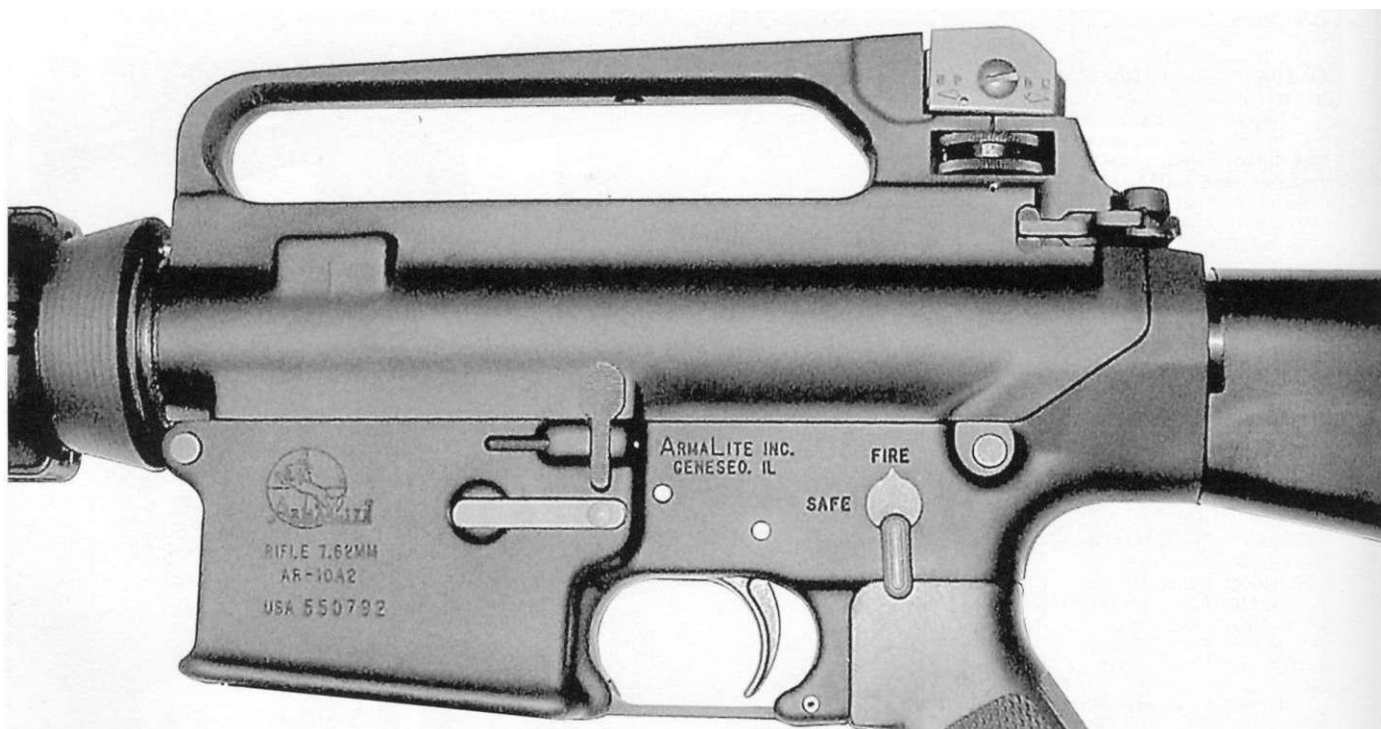
267. The complete line of AR-10 series rifles manufactured by ArmaLite, Inc. courtesy ArmaLite, Inc.



## The AR-10A2 - the Basic Infantry Model



268. Right side view of the AR-10A2 "Infantry Rifle". This is the basic infantry rifle with fixed carrying handle, fully adjustable rear sight and standard front sight assembly.



269. Left side closeup of an ArmaLite AR-10A2 rifle, showing markings.

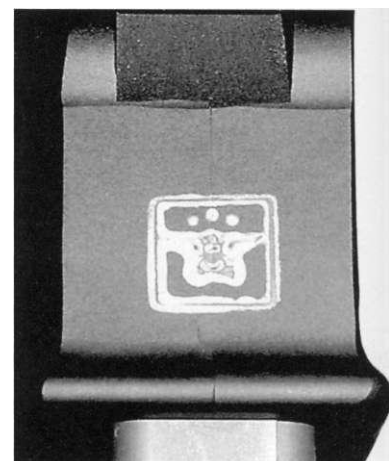
Note the similarities to the M16A2, including the rear

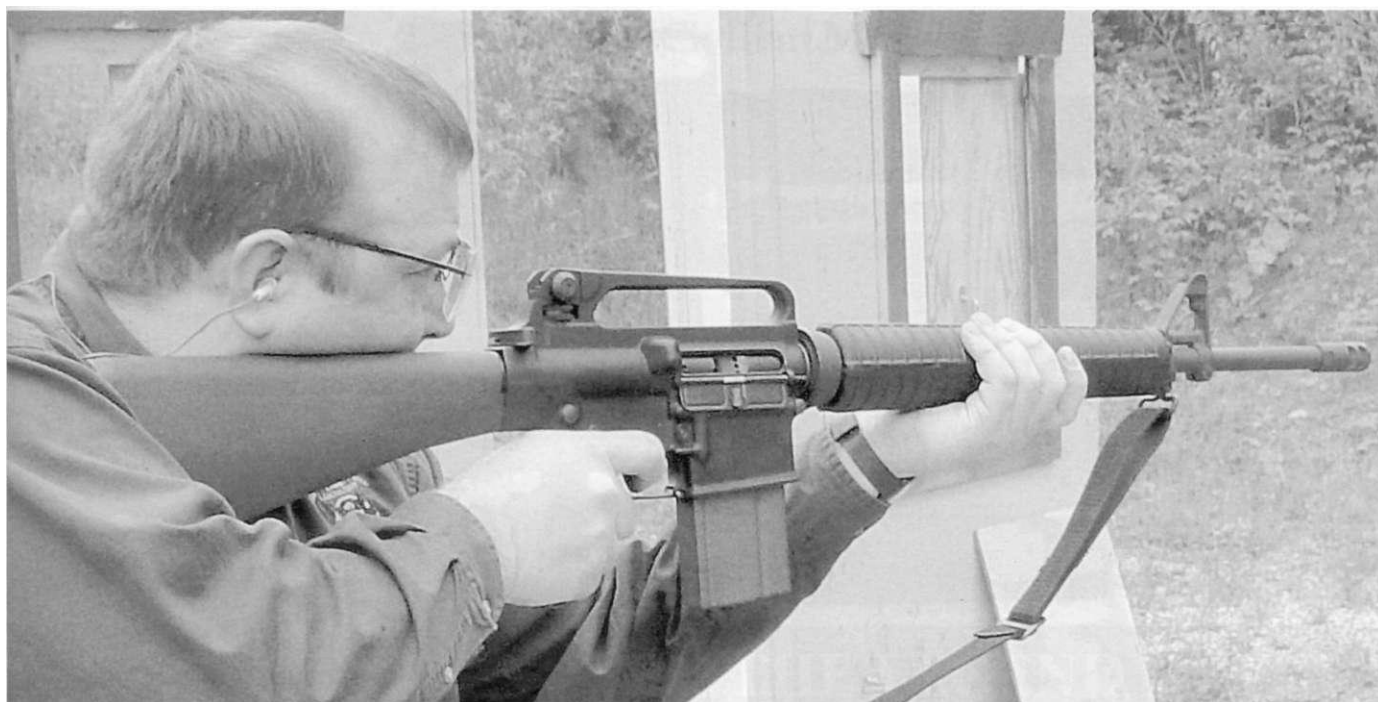
sight, although a much more durable bolt catch is used to cope with the impact of the much larger mass of the 7.62mm bolt carrier.

The basic Infantry model is the AR-10A2, a 7.62x51mm equivalent of the M16A2 rifle, capable of semi-automatic-only fire. The rifle incorporates a 20" chrome-lined barrel with recoil check, and fixed M16A2-style rear sights. The rifle weighs approxi-

mately 9.4 lbs. and has an overall length of approximately 41".

270 (right). After successfully completing proof and test firing, each ArmaLite rifle receives this military-style acceptance mark on the front of the magazine housing.





271. The author firing his AR-10A2. He finds it produces very mild recoil for a 7.62x51mm caliber rifle, and is extremely accurate.

### **The AR-10A4 SPR (Special Purpose Rifle)**



272. Left side view of the AR-10A4 Rifle, the most popular seller of the entire line. courtesy ArmaLite, Inc.

The AR-10A4 Special Purpose Rifle (SPR) is a combination of the AR-10(T) and the AR-10A2, and is the most popular version of the rifle. The 20" barrel begins as a double-lapped Match-grade barrel but is then chrome-lined, unlike the stainless barrel of the AR-10(T). The AR-10A4 weighs approximately 9 lbs.

The AR-10A4 bridges the gap between the Match-grade accuracy and reliability of the AR-10(T), while providing the corrosion resistance of the AR-10A2 in a special chrome-lined barrel. The AR-10A4 has standard handguards, as fitted to the AR-10A2 infantry rifle.

### **The Same Three Again, only Shorter**

Each of these three rifle models is matched by a similar carbine version mounting a 16" barrel, bringing the basic family to a total of six models. Options

concerning triggers, barrels, muzzle brakes, etc., are also available. All three carbines utilize Westrom's mid-length gas system (center, fig. 259).



273. Left side views of two carbine versions.

Above: the AR-10A2 Carbine.

Below: the AR-10A4 Carbine, with factory-installed  
optic sight.



274. Left and right side views of an instructional cutaway  
of an ArmaLite AR-10A4 carbine.

This flat-top upper receiver, with integral MIL-STD-1913 rail, is used on all ArmaLite AR-10 rifles except the AR-10A2 series and AR-10B.

## A Final Two Civilian Models

### The Collector's Choice: the AR-10B



275. Left side view of the AR-10B, with original-pattern charging handle inside the carrying handle.

courtesy ArmaLite, Inc.

ArmaLite offers a collector's model with a strong resemblance to the original AR-10, called the AR-10B. This retains some of the early features, such as the charging handle inside the carrying handle. It also features brown Sudanese-style furniture, and the window at the rear of the carrying handle through which the elevation setting may be viewed. Unlike any of the other current ArmaLite rifles, the AR-10B bears the original Pegasus emblem on the magazine well, instead of ArmaLite's trademark rampant lion.

ArmaLite offers the AR-10 series in two different calibers, and is preparing others. The standard is 7.62x51mm NATO (.308 Winchester), and the second is .243 Winchester. The only change required to make the conversion is a replacement of the barrel itself. The same bolt and magazine are used.

276 (right). An advertisement describing the collector's model, the AR-10B.

Note the use of the original "Pegasus" flying horse logo. This is the only ArmaLite model to be so marked - all others feature the ArmaLite "rampant lion".

# THE LEGEND RETURNS

## The ArmaLite® AR-10B™

*The latest addition to ArmaLite's family of AR-10™ rifles, the .308 caliber AR-10B™, represents ArmaLite's return to some of the early features that captured the imagination of millions.*

*The AR-10B™ features the unique charging handle in the carry handle of the first AR-10s, brown Sudanese style furniture, elevation scale window, and the famed ArmaLite® Pegasus logo.*

*The .308 caliber AR-10B™ is the perfect rifle for those collectors who could only wish for an ArmaLite® in it's early days.*

### The ArmaLite® AR-10B™

CALIBER • .308/7.62MM	RIFLING TWIST • RH 1:12 INCH TWIST
UPPER RECEIVER • FORGED AIRCRAFT ALLOY	MUZZLE DEVICE • CYLINDRICAL MULTI-SLOT RECOIL CHECK
BOLT • SIX LUG	FRONT SIGHT BASE • M16 STYLE
EJECTOR • SPRING LOADED PLUNGER, AUTOMATIC EJECTION	FINISH • MANGANESE PHOSPHATED STEEL, HARD ANODIZED ALUMINUM
TRIGGER • SINGLE STAGE, TWO-STAGE MATCH OPTIONAL	FURNITURE • BROWN
BARREL • 20" CHROME LINED MEDIUM	LENGTH • 41 INCHES
	WEIGHT • 9.4 LBS

*We offer a complete line of .223, .243 and .308 caliber rifles & carbines, plus the innovative AR-50™ .50 caliber rifle - All American made and backed by our lifetime warranty - and a great selection of options, upgrades, parts and accessories. Visit our website at [www.armalite.com](http://www.armalite.com), or send \$2.00 or your FFL for our complete catalog:*

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 502-532-0300 • Fax: 502-532-0775 • Email: [toppc@armalite.com](mailto:toppc@armalite.com)

**ARMALITE INC.**

### The Eagle Arms "No-Frills" AR-10

Finally, the Eagle Arms division of ArmaLite offers a "no frills" version of the AR-10. This is the basic AR-10 series rifle minus the chrome barrel and recoil check, and available only with black furniture. The Eagle version is manufactured with the same degree of workmanship and quality as its more expensive counterparts, but is priced closer to their line of 5.56x45mm rifles. It too is offered in several variants.

277 (right). An advertisement for the "no-frills" Eagle Arms AR-10 rifle.


The Eagle Arms variations are less expensive and do not offer chrome-plated barrels or muzzle checks. They are available only with black furniture.

courtesy ArmaLite, Inc.

# EAGLE ARMS AR-10™


## .308 CALIBER

Eagle Arms™ uses the latest in manufacturing technology to provide you with a quality rifle at a low price. First time shooters can now purchase a .308/7.62mm rifle for a price comparable to that of smaller caliber rifles.



**EAGLE ARMS AR10™ Flattop**

Model	Item #	Barrel	Front Sight	Rear Sight	Handguard
EAGLE ARMS AR10™ Service Rifle	E10A2BM	20" AR10 Moly	Adjustable A2	Std A2	Military Style
EAGLE ARMS AR10™ Flattop	E10A4BM	20" AR10 Moly	Adjustable Picatinny Rail	None	Military Style
EAGLE ARMS AR10™ Match Rifle	E10TBM	24" AR10T Moly	Adjustable Picatinny Rail	None	Alum Free Flat



**EAGLE ARMS™**  
**ALL AMERICAN MADE**

## Part II: The Canadian Contribution

### Chapter Eight

# Diemaco Rifles and Carbines

The following is a modified compendium of the material found in Chapter Twenty-four of *The Black Rifle*, updated with new material taken from the 2003 Collector Grade title *The Last Enfield* and

other new material resulting from the author's research at Diemaco, Incorporated of Kitchener, Ontario.

## Post-WWII Canadian Battle Rifles

The manufacturing rights to the FN FAL rifle were acquired by the Canadian government in 1954, and the (now defunct) Small Arms Division of Canadian Arsenals Limited (CAL) in Mississauga (Long Branch) Ontario was appointed as the design authority for the inch-measurement conversion of the FN FAL rifle for use by Australian, British and Canadian forces. Canada adopted the 7.62mm NATO caliber C1 rifle on June 1, 1955, and an initial 72,775 C1 rifles and 8,242 heavy-barrelled C2 auto rifles, basically the same as the C1 but fitted for selective fire and featuring a heavy barrel, 1,000-meter sights and a folding handguard/bipod, were manufactured at CAL during the late 1950s, with issue to Canadian forces beginning in 1956.

The C1 and C2 rifles were modified slightly in 1959, becoming the C1A1 and C2A1 models, and all

production contracts for rifles and spares were completed by the middle 1960s. (The entire development and production history of the C1/C1A1 rifle is described in detail in Collector Grade's *North American FALs*, Volume I of *The FAL Rifle*).

With the demise of the Small Arms Division of Canadian Arsenals Limited (CAL) on June 30, 1976, the Canadian government contracted with the private-sector firm Diemaco, Incorporated of Kitchener, Ontario to establish a facility to support the existing small arms inventory, described above, and to provide the necessary engineering backup and eventual production facilities if and when it was decided to replace these weapons with a new family of small arms.

## Canada and the "Weapons of the Eighties" NATO Trials

By the late 1960s the use of the 7.62mm NATO round had all but been abandoned in the "individual weapon" category, and by the late 1970s at least two NATO nations—Britain and West Germany—were actively pursuing individual design programs. In order that the commonality so painfully gained in the earlier 7.62mm NATO round should not be lost, it was decided that a second, smaller cartridge should be standardized within the NATO community. A Memorandum of Understanding was signed by eleven participating nations in 1976, which agreed

to a series of tests that would evaluate a number of weapon/ammunition systems and select a standard smaller caliber of ammunition.

While fielding no new weapons or ammunition of its own, Canada conducted the low-temperature climatic evaluation portion of the ensuing 1977-1979 NATO Ammunition Trials. This included complete responsibility for a major two-month Winter Trial of all competing weapons (average daily temperature -35° Celsius) during early 1979.



Additionally, and more importantly for Canada, 37 examples of each of the weapon types featured in the NATO trials (listed on page 342 of *The Black Rifle*) were provided to the Canadian government for study in a series of summer and winter military trials, plus endurance, precision and adverse condition tests. The Canadians made good use of this windfall, concluding that the 5.56mm entries they had tested were generally more accurate than their own existing 7.62mm weapons.

While the main stated purpose of the NATO Trials was to select a new second standard round of ammunition, the Canadians rightly considered the exposure they had been granted to the free world's most up-to-date rifle designs a fortuitous "wake-up

call" which would help them choose the right path when the inevitable decision was made to replace their aging 7.62mm C1A1/C2A1 inventory.

With the H&K G11 and its caseless cartridge withdrawn from the NATO trials due to cook-off problems, and the unperfected British "bullpup" 4.85x49mm Enfield Weapon System (EWS) losing points due to its non-standard caliber and poor performance, the Canadians narrowed their focus to a comparison between the new Belgian FNC and the control rifle, the US M16A1. While both the M16A1 and the FNC featured equivalent hit probability, the M16A1 proved significantly more reliable, and was the overall preference of the troops involved in the trials.

## The Small Arms Replacement Program (SARP)

The 5.56x45mm cartridge loaded with the longer, heavier Belgian SS109 projectile (or equivalent, such as in the American XM855) was officially accepted as the second standard NATO caliber by a conference of National Armament Directors in October, 1980, and this decision was then ratified by all NATO nations. In February, 1983 the Canadian government granted a \$1.7M contract to Diemaco, Inc. for a small arms replacement program (SARP) to replace Canada's aging arsenal of 7.62mm rifles and squad automatics with new weapons in 5.56mm caliber.

Having chosen the M16A1 as the basis of their future rifle, the Canadian government entered into a licensing agreement with Colt's Manufacturing Company, giving Canada the right to produce weapons in Canada for the use of Canadian and selected other NATO armies, and identifying Diemaco as the producing company. Colt's updated M16 Technical Data Package was provided to Diemaco to support this activity.

### Canada's New Small Arms Arsenal

In February, 1983 the Canadian government contracted for an initial 79,935 C7 rifles (the Canadian version of the Colt M16A2, with differences as described below), and 1,565 C8s, the carbine version of the C7. The C8 is fitted with an XM177E2-style collapsible buttstock and weighs .6kg (1.3 lbs.) less than the C7. With its stock telescoped, the C8 is 29cm (11.5") shorter overall. The C8 boasts 86% parts commonality with the C7 rifle. An additional 15,000 C7 rifles had been procured by the end of the SARP program.

The NATO guidelines for the 1980s had called for individual and light support weapons (IW and LSWs) in the same "second" caliber, backed up by medium weapons in 7.62mm NATO. This plan was fully supported by the results turned in by the FN SS109 version of the 5.56x45mm cartridge. Accordingly, the Canadians rounded out their new family of

small arms by purchasing 6,500 slightly modified examples of the FN Minimi [*mini-mitrailleuse*] light machine guns from Fabrique Nationale in Herstal, Belgium, which were designated the C9 in Canadian service. Interestingly, the C9's flash suppressor began as the same 5-slotted Canadian design already adopted in both the US M16A2 and the Canadian C7, but with the further omission of the topmost gas slot in order to minimize flash signature and consequent night vision degradation. These special flash suppressors were manufactured in Canada and shipped to FN Herstal for final assembly.

In addition to these new weapons, the Diemaco contract called for the supply of 470,570 nylon 30-round C7/C8/C9 magazines, 51,975 blank-firing adaptors and bayonets for the rifles, all to be produced in Canada.

## A Comparison Between the C7 and the M16A2



278. Left and right side views of the C7 assault rifle. Note the A1-style carrying handle.

Many critics felt that this was the ideal M16-type combat rifle.  
courtesy Diemaco, Inc.

As noted, the C7 is essentially a Colt M16A2 with some modifications and omissions. Beginning at the front end, the chief differences between the two weapons are as follows:

279 (right). Left side closeup of a Canadian Government C7 rifle, showing markings.

Note the structure of the serial number. The first two digits "90" indicate the year of production, and the following two letters "AA" indicate that this is a C7 rifle ("AB" would indicate a C8 carbine lower receiver).

courtesy Diemaco, Inc.



### The Barrel

The C7 barrel shares the controversial "heavy-in-the-wrong-place" profile of the M16A2 barrel, which is perhaps even more controversial in Canada than in the US, because at that time the Canadians did not use the M203 grenade launcher, and thus the official US reason for retaining the M16A1 dimensions under the handguards of the M16A2 did not apply. In fact, Canada actually proposed a more conventional

heavy barrel profile and applied for a design concession on the M16A2 barrel contour, which Colt's refused to grant. The C7's hammer-forged barrel shares the standard NATO 1 turn in 7" right-hand rifling twist, necessary to stabilize the Canadian version of the NATO-adopted SS110 tracer bullet, called the C78.



280. Right side view of an instructional cutaway C8 carbine.

Cutaway weapons are used extensively by Diemaco in

their logistical support to their customers. They are supplied to all customers as training aids and for troop familiarization as well as for armorer instruction.

courtesy Diemaco, Inc.



281. All Diemaco rifle barrels are made on government-supplied, state-of-the-art GFM hammer forges, the one shown being the second of two such machines now in use in the Diemaco plant.

This machine takes carefully honed, smoothbore "blanks" and exerts tons of pressure on the outside surface in a continuous and extremely rapid multi-hammering process, drawing the blank out to roughly one-and-a-half times its original length and cold-forging it around a

hardened mandrel, which is perfectly formed in the shape of the chamber, lead and the first few inches of rifling.

Concentrating initially on the rifling section, the blank is slowly rotated as it is hammered, the mandrel being simultaneously withdrawn until the end of the blank approaches, where upon the mandrel stops while the hammers continue, thus cold-forming the complete bore and chamber configurations in one pass.

courtesy Diemaco, Inc.

## Sights

Like its M16A2 counterpart, the C7 front sight is described as a "square prism on a threaded base", but in view of the 400-meter (600-meter maximum) Canadian range requirement, the M16A2's "complex"

fully-adjustable 800-meter rear sight was considered unnecessary. Consequently, the C7 features the standard 2mm-and 5mm-aperture M16A1-type flip-up rear sight, which is adjustable for windage only.

## Firing Modes

Canada's only other self-loading rifle, the C1/C1A1, was predominately issued as a semi-automatic during its thirty-odd years of service, and Canadian Forces doctrine stresses semi-auto fire only except under "special circumstances".

Full-auto fire discipline was considered to be "a function of training, and not to be accomplished by

some add-on device or gadget". Therefore the M16A2 three-round burst device, already viewed as more expensive and less reliable than the standard selective-fire mechanism, was deemed "not required". Consequently, the selector markings on Canadian-made C7s and C8s read S, R and AUTO.

## Magazines

Another outcome of the 1977-1979 NATO trials was the standardization of the interface of the M16A1 30-round magazine for all 5.56mm IWs and magazine-fed LSWs thenceforth to be adopted within the organization. Canada decided not to manufacture any 20-shot magazines, and from 1984 to 1991 standardized on a fifth-generation, Canadian-made nylon

30-round magazine, which will fit all such weapons: the C7, the C8 and the C9 (M249; Minimi); the British L85/L86 SA80 weapon system; the M16 family; and so on. These plastic magazines are still used by Dutch and Danish forces, but Canada has meanwhile switched to the production of a standard aluminum 30-round magazine.

## A Canadian Tradition: Variable-Sized Buttstocks

Another commendable tradition which has survived in the Canadian forces for many years, in an effort to "tailor" rifles to their variously-sized users, has been the availability of different buttstock lengths. Canadian bolt-action No. 4 rifle buttstocks were produced in Long (L), Normal (N), Short (S) and Bantam (B) lengths; and the C1A1 was available fitted with extra-long (XL), long (L), normal (N) or short (S) stocks.

Noting that the M16A2 featured a stock 5/8" longer than that of the old M16A1, Canada followed suit but stipulated that an optional 1/2" spacer be made available, so that the C7 will continue the tradition of user-variable buttstock lengths.

C7 buttstocks are fitted with a modified trapdoor developed by Colt's, which can be more readily opened than that of either the M16A1 or the M16A2.

## Terms of the Canadian Licensing Agreement

As per the terms of the licensing agreement between the Canadian government and Colt's Manufacturing Company, Diemaco is not allowed to sell its C7/C8 series in the United States, except as a subcontractor to Colt. As of the time of this writing, Diemaco is producing flat-top upper receivers for use on Colt M4/M4A1 carbines. Requirements for foreign sales are that the purchasing country must be either a NATO or Commonwealth member, and the sale must be approved by the Canadian Department of State.

Within these terms and conditions Diemaco has sold to a number of countries and has in fact made an enviable niche for the company in the Defense Industry in general, while completing Canadian contracts for in excess of 94,000 C7 rifles, C7A1 Optical Sighted Rifles (NSN 1005-21-909-7599), C8 Carbines, the critical parts of the C9A1 LMG (NSN 1005-21-897-0690; Canada's Minimi variant), and over 8,000 C9 barrel assemblies.

## GENERAL CHARACTERISTICS

The new Canadian 5.56 mm C7 rifle is a light-weight dependable and versatile weapon. It is a derivative of the well proven M16A2 design. The straight line construction which aligns the recoil forces with the bore axis and the shoulder, combined with the compensator, keeps muzzle climb during automatic fire to a minimum. The front locking bolt and direct self-regulating gas system eliminates the need for a heavy steel receiver, gas piston, and operating rod normally associated with gas operated weapons. Sights consist of an adjustable square post foresight and a windage adjustable flip type rear sight. A large battle aperture and a smaller long range aperture, permit easy target acquisition and high first round hit probability at combat and extended ranges.

## BARREL

Unique to the C7 rifle is the 1-7 inch twist Rotary Hammer Forged chrome-lined barrel, which offers increased strength, accuracy and longevity under adverse conditions. The barrel will accommodate the entire range of 5.56 x 45 NATO Standard ammunition as well as the U.S. M855 and M193 rounds. Barrel accuracy and endurance are outstanding. Precision testing by the Canadian Forces indicate virtually no change in barrel precision to 10,000 rounds and an ultimate life approaching 20,000 rounds.

## MAGAZINE

The reliable and maintenance free magazine is constructed of glass reinforced high strength nylon which resists fouling by cartridge brass, firing residue or dirt. The magazine will not dent nor will lips deform. Unserviceable nylon magazines are simply replaced because of the low cost.

## GRENADES

The C7 rifle can launch all standard U.S. and NATO rifle grenades without supplementary attachments. Installation of the M203 grenade launcher permits firing any of the standard 40 mm grenades.

## RELIABILITY

The C7 Rifle has demonstrated a mean time between failure of 6,480 rounds in Canadian Forces tests. Troop trials have included firing of weapons to 4,000 rounds without cleaning or malfunction.

## TECHNICAL DATA

Calibre	5.56 mm x 45 mm NATO
Operation	Gas, Expansion
Type of Fire	Semi and Automatic
Rate-of-Fire	700 - 900 SPM
Velocity at 24 M	Approximately 920 m/s (3020 fps)
Length W/short butt W/normal butt	101 cm (39.3 in) 101.6 cm (40 in)
Weight—Empty —W/30 Rd Magazine	3.34 kg (7.35 lb) 3.89 kg (8.5 lb)
Rifling—No. of Grooves —Direction of Twist —Rate	6 Right-Hand 1 turn in 7 inches
Locking Mechanism	Rotating Bolt
Sights—Front —Rear	Adjustable Square Post Windage Adjustable Flip Type Two Position Aperture

## DIEMACO PRODUCTION OF C7 RIFLES

Diemaco Inc., Canada's Centre of Excellence for Small Arms, is producing the C7 rifle, C8 carbine and related spares and accessories for the Canadian Forces Small Arms Replacement Project.

# Diemaco

1036 WILSON AVENUE, KITCHENER, ONTARIO, CANADA N2C 1J3  
TELEPHONE: (519) 893-6840  
TELEX: 069-55164  
FAX 519-893-3144



C7 Rifle is manufactured under license from Colt Industries.  
Magazine is manufactured under license from Thermold Inc.

## Production of the C7 Rifle and C8 Carbine

In order to commence manufacture of the C7, once all the details regarding the rifle's configuration and the production licence had been ironed out, a number of rifles and carbines were initially made up to the Canadian pattern by Colt's in Hartford, designated the models R0715 and R0725 respectively. Ironically, the Canadians found an extra item on the bill from Colt's: a fee to "re-engineer" the receiver back to the old A1 fixed-rear-sight configuration!

After the Colt-made R0715s and R0725s had passed Canadian acceptance trials, a five-phase plan was instituted which designated five stages of increasing Canadian content in the manufacturing process. During these phases, components of non-Canadian manufacture were supplied by Colt.

Diemaco delivered pre-production "Phase 1" rifles on schedule in August, 1985, which successfully passed acceptance. Production deliveries to selected units were scheduled to begin in March, 1986, against a continuing program designed to retire the last C1A1s in mid-1992.

The move to the fifth phase, 100% Canadian production, was completed in January, 1989. Diemaco manufactures 17 critical components in-house and sub-contracts (mostly in Canada) for the rest of the components for the C7 (NSN 1005-21-898-7044) and C8 (NSN 1005-21-898-7045) family of weapons. As of this writing, Diemaco also sources some sub-contracted parts from the United States.

## The C10 Training Rifle



283. Left and right side views of the C10 training rifle, developed by Diemaco as a realistic and inexpensive .22

Long Rifle caliber training weapon which simulates the feel and action of the standard C7 rifle.

Note the one-piece buttstock and lower receiver.

courtesy Diemaco, Inc.

In an effort to develop alternate methods of training soldiers which would both decrease costs yet still teach the soldiers and cadets the fundamentals of basic rifle marksmanship (BRM), Diemaco devel-

oped the C10 rifle in .22LR caliber, which features an unlocked, straight blowback operating mechanism. Weighing 3.4kg (7.6 lbs.) with a 15-round magazine capacity, the semi-automatic-only C10 exhibits all



# C10

## Cal .22 LR TRAINING RIFLE



### GENERAL CHARACTERISTICS

The C10 Training Rifle is a Cal .22 LR weapon developed to meet Military training requirements\*. It exhibits all function, handling and shooting characteristics of the C7/C8 and M16 family of small arms, with the exception of automatic fire. The C10 rifle features a barrel with a Cal .22 LR chamber and 1:16 inch twist rifling, a newly designed inertial bolt blowback mechanism. The sights have also been modified to improve accuracy at 30 m and 100 m ranges.

### TRAINING

The C10 Training Rifle permits realistic training of handling and shooting skills to Regular Force, Militia, and Cadet personnel, with direct training transfer to C7/C8 and M16 family weapons. Use of this rifle allows utilization of indoor or outdoor small bore range facilities which can not accommodate the higher powered 5.56 mm cartridge.

### AMMUNITION COST SAVINGS

Training costs are significantly reduced. The cost of one 5.56 mm C77 cartridge is equivalent to the cost of 20 Cal .22 LR cartridges. This ratio results in the training rifle paying for itself and the ammunition it has expended in less than 750 rounds fired.



### LIFE CYCLE COST SAVINGS

The C10 training rifle shares approximately 80% parts commonality with the C7 rifle. This commonality with the C7 rifle minimizes manufacturing, logistic, and fleet maintenance costs. No special tools are required for cleaning or maintenance purposes.

### SECURITY

The C10 Training Rifle fires in the semi-automatic mode only. This reduces considerably the logistic and security requirements for both transport and storage. Also, the entire breech mechanism may be removed from the weapon as a unit for separate storage if desired.

### AVAILABILITY

The C10 Training System is available as a complete rifle or an adaptor kit for M16-type rifles.

### SPECIFICATIONS

Principle of Operation	Blowback, firing from a closed breech.
Type of Fire	Semi-Automatic Only
Ammunition	Cal .22 LR
Magazine Capacity	15 rounds
Sights — Front	C7 post reduced to 0.052 in. width
— Rear	C7 aperture reduced to 0.050 in. dia.
Operational Safety	Fire Selector moved to "Safe" position.
Rifling — Number of Grooves	6
— Direction of Twist	Right Hand
— Rate of Twist	1 turn in 16 in.
Firing Pin Protrusion	0.027 to 0.038 in.
Muzzle Velocity	Approximately 1200 fps
Weight W/Magazine and Sling	7.6 lbs.
Barrel Length	20.4 in.



For more information contact:



**Diemaco**

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KITCHENER, ONTARIO  
CANADA, N2C 1J3

TELEPHONE: (519) 893-6840  
TELEX: 069-55164

\*C10 Training Rifle Development is  
Funded under contract to the Canadian  
Armed Forces.

284. A Diemaco sales brochure, listing the specifications of the C10 training rifle. As shown, practising with less-expensive .22 Long Rifle caliber ammunition yields impres-

sive results: 20 rounds of .22 Long Rifle ammunition can be fired for the cost of one C77 5.56mm cartridge.

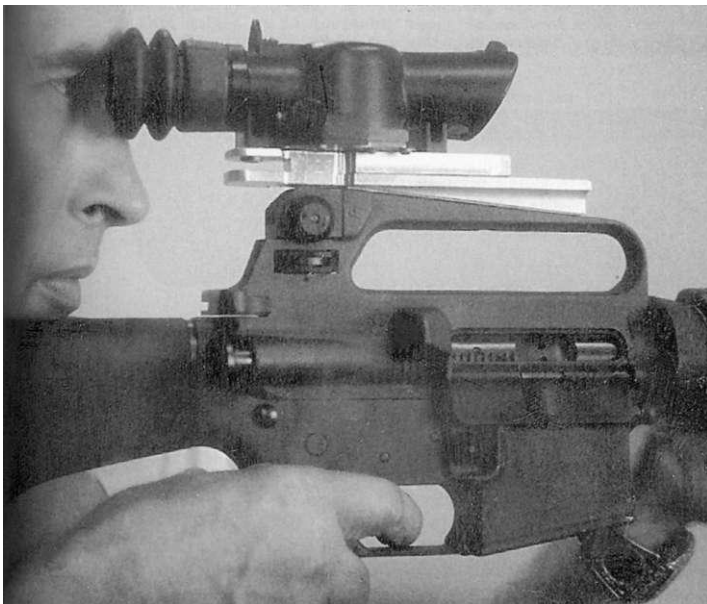
courtesy Diemaco, Inc.

the functioning, handling and firing characteristics of the C7/C8 rifle and carbine. The 20" C10 barrel, rifled with 1 turn in 16 inches, is designed exclusively for use with .22LR rimfire ammunition. The sights on the C10 have been altered to improve accuracy at 30 meters and 100 meters. Even with its dedicated one-piece molded lower receiver and buttstock, the C10 still shares approximately 80% parts commonality with the C7 rifle.

It was calculated that the use of the C10 would reduce the cost of training significantly, as it can fire 20 rounds of .22LR rimfire ammunition for the price of just one 5.56mm cartridge. On this basis, each C10 training rifle would pay for itself and the ammunition it has fired in less than 750 rounds.

Nevertheless, the C10 was not adopted by Canadian or other forces, and only a few examples of this innovative training rifle have been produced.

## The Canadian Flat-Top Upper Receiver



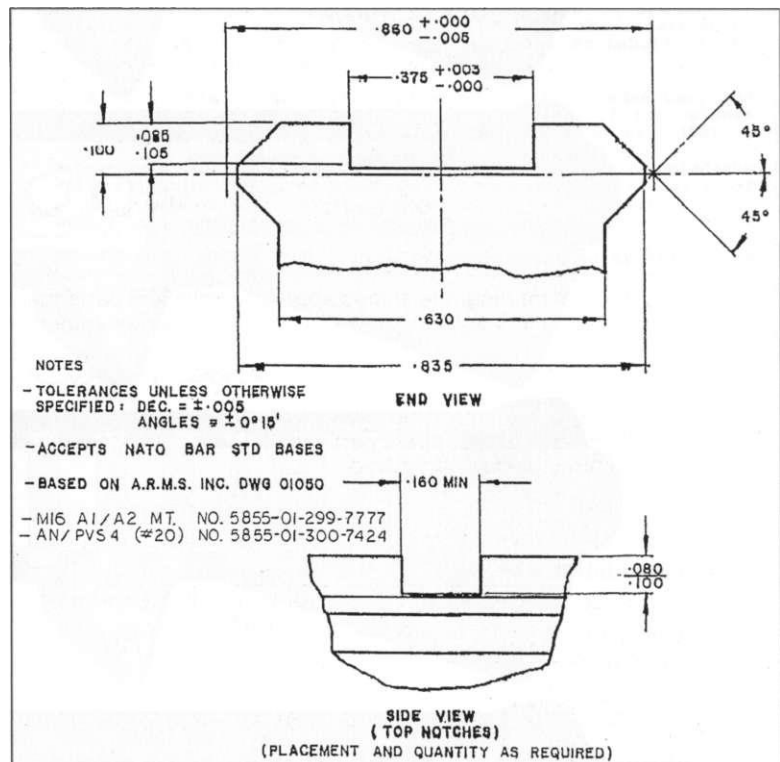
285. ARMS, Inc. founder and president Richard Swan, shown here in the early days of his involvement with scoped M16s.

Here Dick is demonstrating a prototype of his base and mount fitted into the carrying handle slot of an M16A2, which was granted US Patent no. 4,845,871 on July 11, 1989. The scope shown is a British SUSAT.

Editor's collection

The Canadians were true pioneers in the development and production of the flat-top upper receiver. This program began in the fall of 1986, four years before Colt released their integrated flat-top, and the Canadian flat-top rail went into production in 1988. Since the dimensions of the MIL-STD-1913 rail had not then been finalized, the Canadians designed their own rail configuration.

The Canadian government contracted with Richard Swan, founder and president of the successful American precision sight and mount firm ARMS Inc., to assist them with the final rail dimensions. The Canadian design was modified to incorporate several changes prior to the final drawing, which was dated

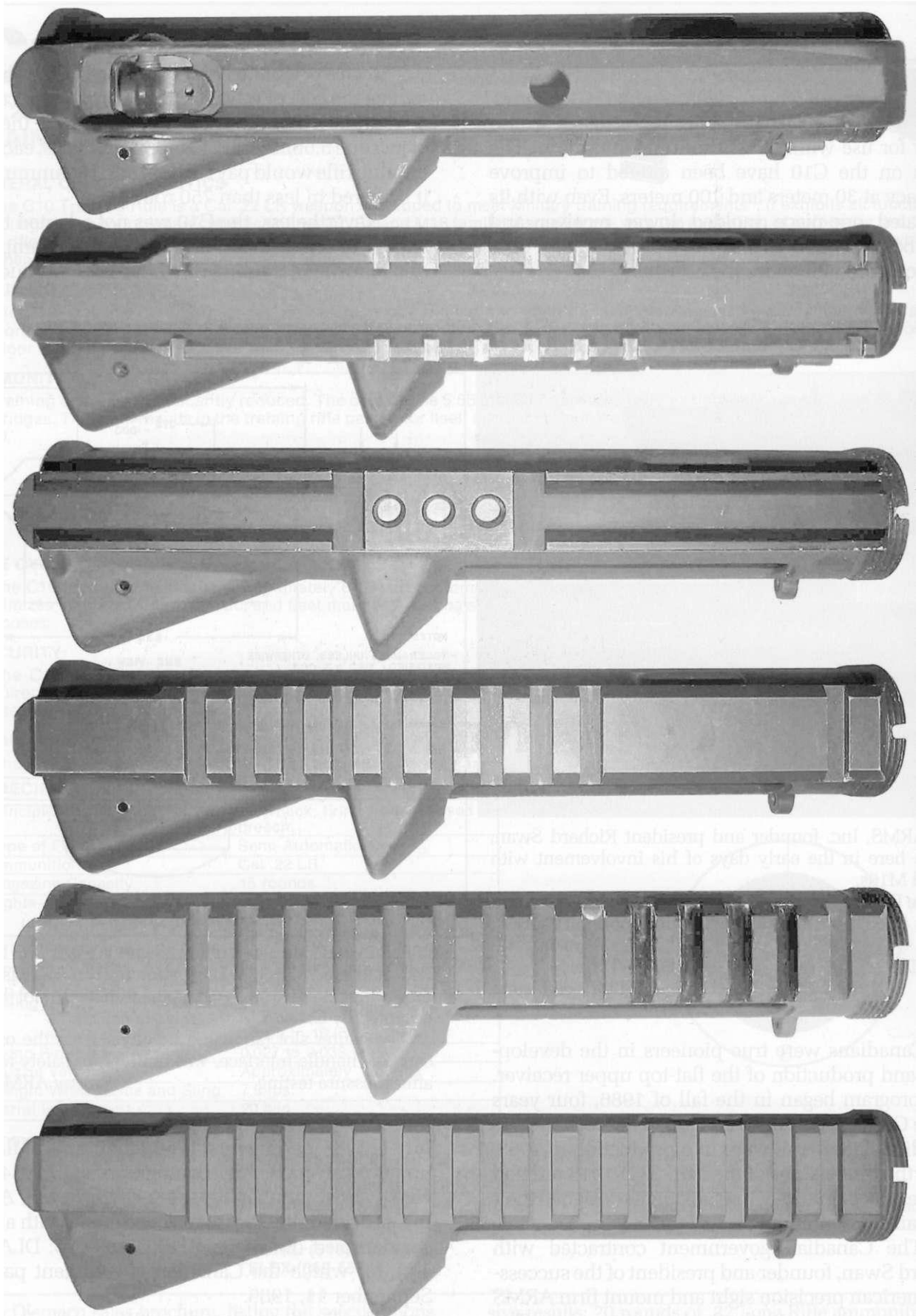


286. End and side views of the "Swan/Weaver Rail Master Pattern" dated March 8, 1989, showing dimensions of the mounting interface (above) and the transverse slot (below) accepted by Canada.

The center slot (above), a holdover from the original carrying handle interface, was omitted for safety reasons after pressure testing. courtesy ARMS, Inc.

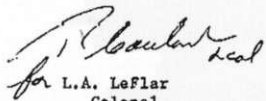
July 1, 1987, and the first production runs of flat-top upper receivers. Under contract no. 4QB W8464-9-HB11, serial number W8464-9-HB11/01-QB, ARMS Inc. provided the Canadian government with a set of standardized dimensions (10055-83-020; DLAEEEM 4-6), for which the Canadian government paid on September 11, 1989.

The finalized Canadian "Weaver" rail differs slightly from the MIL-STD-1913 rail. The dimensions of the dovetail are slightly different; the width of each



287. Top views of several Diemaco-built prototype upper receivers, beginning with the standard C7 carrying handle version, top, which were experi-

mented with in the course of the development of the adopted version of the integral flat-top rail (bottom).  
courtesy MWO Gary Crocker

<b>National Defence</b>	<b>Défense nationale</b>
National Defence Headquarters Ottawa, Canada K1A0K2	Quartier général de la Défense nationale Ottawa, Canada K1A0K2
10055-83-020 (DLAEM 4-6)	
March 1989	
<b>Distribution List</b>	
<b>WEAVER RAIL</b>	
<b>WEAPON INTERFACE</b>	
References: A. A.R.M.S. Inc FAX dated 03 Mar 89	
B. ARDEC FAX dated 07 Mar 89	
1. Thank you for your drawings with regard to the subject matter.	
2. The Canadian Forces Land Element intends to use this basic Swan/Weaver configuration, currently in use with various small arm weapons in Europe and the U.S.A., on our small arms and short range Anti-Armour Weapons for mounting day and night vision scopes. A copy of the rail pattern is enclosed.	
3. The Canadian Forces will also be using the "Swan Throw Lever" mounting system developed by A.R.M.S. Inc for mounting all our Night Vision Sights to this rail. It is currently being introduced with our AN/PVS 4 systems and will be used on our new light weight night sight planned for fielding in 1990/91.	
4. Any comments from the Joint Services Small Arms Program (JSSAP) and the Canadian Defence Liaison Office and other interested parties would be appreciated as early as possible due to planned production of our new small arms.	
 L.A. LeFlar Colonel Director Land Armament and Electronics Engineering and Maintenance	
ENCLOSURE: 1	
Canada	

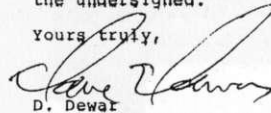
288. Letter from the director of DLAEM dated March 8, 1989, confirming that the Canadian military would be utilizing the Swan/Weaver rail dimensions provided by Swan, as well as the firm's proprietary "Swan Throw Lever Mounts".

slot is .178" min., narrower than the .207" min.-wide slots on the 1913 rail; and the Canadian rail has one more slot than the MIL-STD-1913 rail.

In addition, the height of the MIL-STD-1913 rail from the bottom of the upper receiver is 1.835" - 1.845", and thus the US-made M4/M4A1 and M16A4 flat-top rifles and carbines must use a separate front sight assembly (marked "F" on left side), which sits correspondingly higher than the standard M16-type rifle front sight assembly. The height of the Canadian sight rail is 1.842-1.856", which ensures that Die-

## The C7A1 Rifle and C8A1 Carbine

In Canadian service the C7 has been phased out in favor of the flat-top C7A1. Like the US M16A4, the C7A1 has a flat-top receiver, on which a variety of optics may be mounted. The C7A1 upper receiver normally comes fitted with the Canadian standard "Weaver" rail, but may be dimensioned as either the

<b>Supply and Services</b>	<b>Approvisionnement et Services</b>
Canada	Canada
Hull, Quebec K1A 0S5	Your file Votre référence
September 15, 1989	Our file Notre référence
SIDMB:DD.89-89	
ATLANTIC RESEARCH MARKETING SYSTEMS INC 375 WEST STREET WEST BRIDGEWATER MA 02379 USA	
Dear Sir/Madam:	
Re:	Contract Serial No, Value Date
	40B W8464-9-HB11 W8464-9-HB11/01-QB <del>W8464-9-HB11/01-QB</del> SEP11/89
U.S. Defense Priority Rating DO-D1 has been authorized by the United States Department of Commerce, Office of Industrial Resource Administration for application to the above referenced contract placed with you by this Department on behalf of the Canadian Department of National Defence.	
This is a rated order certified for national defense use, and you are required to follow all the provisions of the Defense Priorities and Allocations System regulation (15 CFR Part 350).	
Subcontracts issued by you to fulfill this contract should include the Priority Rating, required delivery date or dates, the signature of an individual authorized to sign rated orders, and the certification above.	
Should you require further information or Special Priorities Assistance with respect to the above referenced contract, contact the undersigned.	
Yours truly,	
 D. Dewar Chief, Priorities and Allocations Section Statistical Information and Data Management Branch (819) 956-3394	
Canada	

289. Letter from Supply and Services Canada dated September 15, 1989, confirming the Canadian government contract with ARMS, Inc. concerning the Swan/Weaver rail.

maco add-on sights and handles maintain the same sight axis as on the original C7 fixed-handle receiver version. This allows the use of the same front sight assembly on both the fixed sight and flat-top upper receivers, and permits Diemaco customers to upgrade their fleet of rifles to the newer flat-top version by means of a simple upper receiver switch, with no change in front sight or resulting iron sight axis.

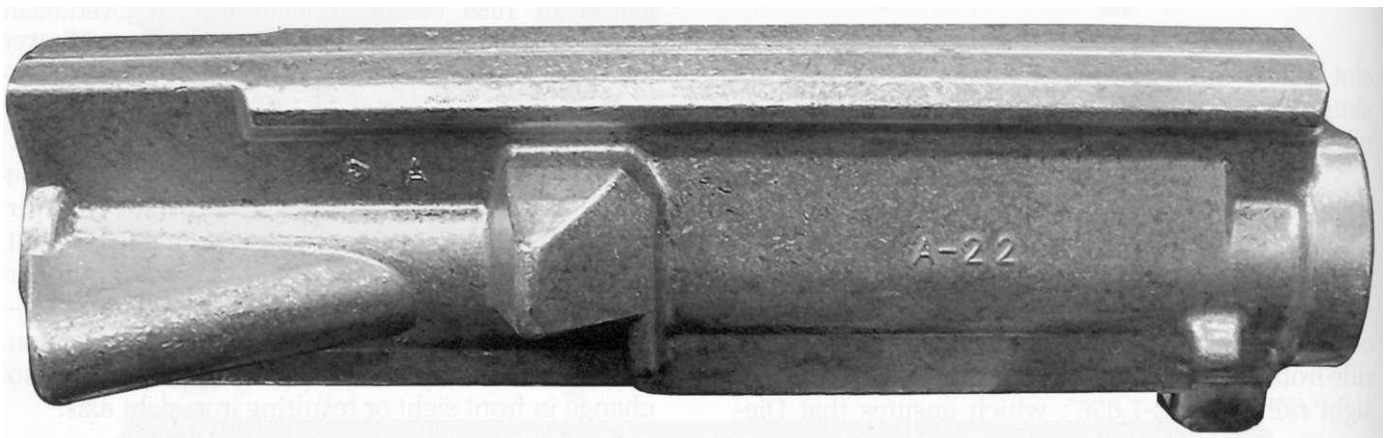
US MIL-STD-1913 or the British RARDE sight rail at the customer's request. The C7A1 may also be fitted with an emergency polymer back-up rear sight in case the optics fail or become damaged.

Diemaco is currently producing only flat-top weapons (C7A1, C8A1, C8A2 and other variations



290. Left and right side views of the Diemaco C7A1, or C7FT. Note the ELCAN optical sight with back-up iron sight attached to the receiver rail in front of the optic. The flat-top C7A1 has replaced the C7 rifle in the

Canadian Army. Many existing C7 rifles were retrofitted with the new flat-top upper receiver and converted into the C7A1 configuration. courtesy Diemaco, Inc.



291. Right side view of the rough forging blank provided for finishing into flat-top rifles and carbines at Diemaco. Compare with fig. 439: unlike Colt, Diemaco modified

their basic forging die to remove the carrying handle area as soon as the decision had been made to manufacture this type of receiver exclusively. courtesy Diemaco, Inc.

utilizing flat-top receivers), fitted with both Canadian standard "Weaver" and US MIL-STD-1913 profile sight rails.

The C7A1 remains the standard battle rifle of the Diemaco line, to which Diemaco has made modi-

fications and improvements over the years. One change has been the introduction of interlocking handguards, for increased durability during rough handling. Diemaco has also modified the front sight, keeping the four-position adjustment but with a

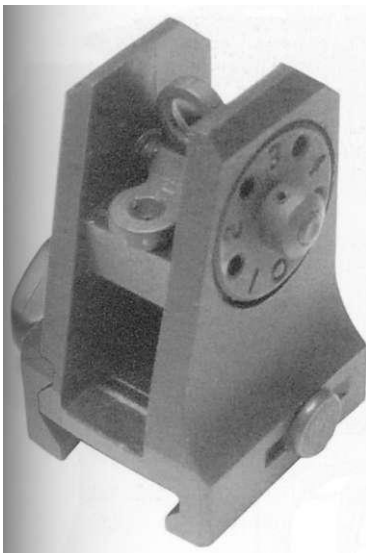




292. Left and right side views of the Diemaco flat-top C8A1, or C8FT carbine.

Note the rubber butt pad, developed at UK request for

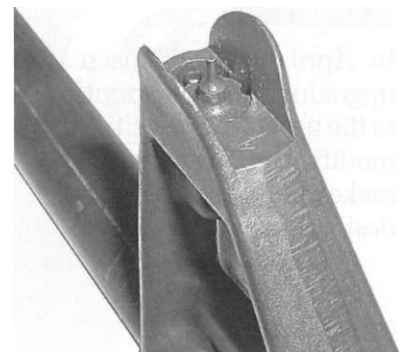
use when firing rifle-launched grenades, and the vertical front pistol grip, a Diemaco-designed accessory shown attached to the Diemaco TRI-AD I mount (discussed in Chapter Thirteen).  
courtesy Diemaco, Inc.



round-profile post instead of the original square type. They also decreased the diameter of the post to 0.050 inches, which, shooters claim, increases accuracy due to reduced target obstruction.

293 (left). The Diemaco polymer back-up rear sight, used on all variations of the flat top upper receiver regardless of model or barrel length, and normally attached to the receiver in front of the ELCAN optical sight.

The C8A1 (NSN 1005-21-921-2563), comparable to the US M4A1, provides the same features found on the C7A1 rifle in a carbine with a 14 1/2" barrel.



294. In response to requests for a front sight that would not cover the target, Diemaco introduced this narrower round-profile post, measuring only 0.050" in diameter, courtesy Diemaco, Inc.



## The C7A2 Rifle and C8A2 Carbine

### The Mid-Life Upgrade from the C7/C7A1/C7FT to the C7A2 Rifle



295. Left and right side views of the newly-developed C7A2 rifle, introduced as a mid-life upgrade from the C7/C7A1/C7FT.

This new rifle embodies many upgrades including the

four-position telescoping buttstock, green furniture, new C79A2 ELCAN optical sight, ambidextrous magazine catch and selector levers, and the TRI-AD I rail system.

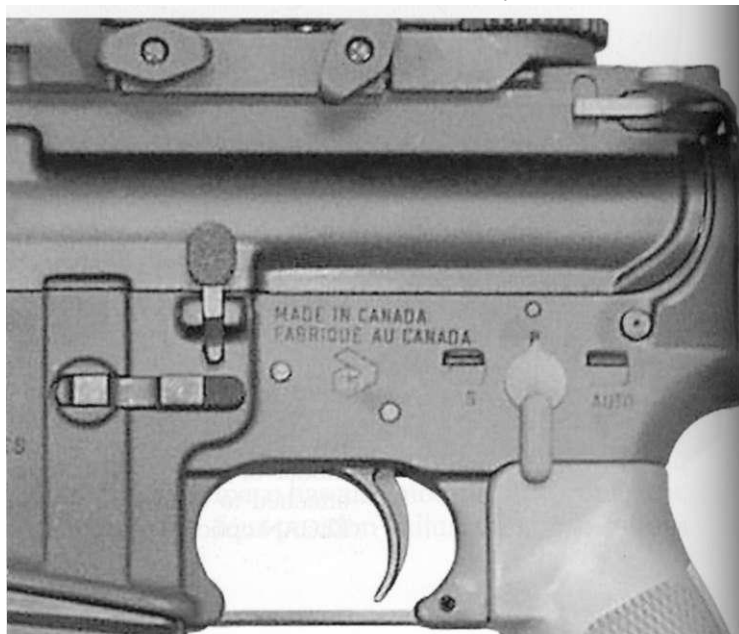
courtesy Diemaco, Inc.

In April, 2003 Diemaco undertook a program to upgrade the then-current-production C7/C7A1 rifles to the new C7A2 specifications. The C7A2 is a highly modified rifle designed to increase modularity and make the rifle more ambidextrous. Trials of this new design were conducted in the fall and winter of 2003.

The visual modifications to the C7A2 include:

296 (right). Left side closeup of the C7A2, showing markings.

Note the ambidextrous magazine catch on the left side.  
courtesy Diemaco, Inc.





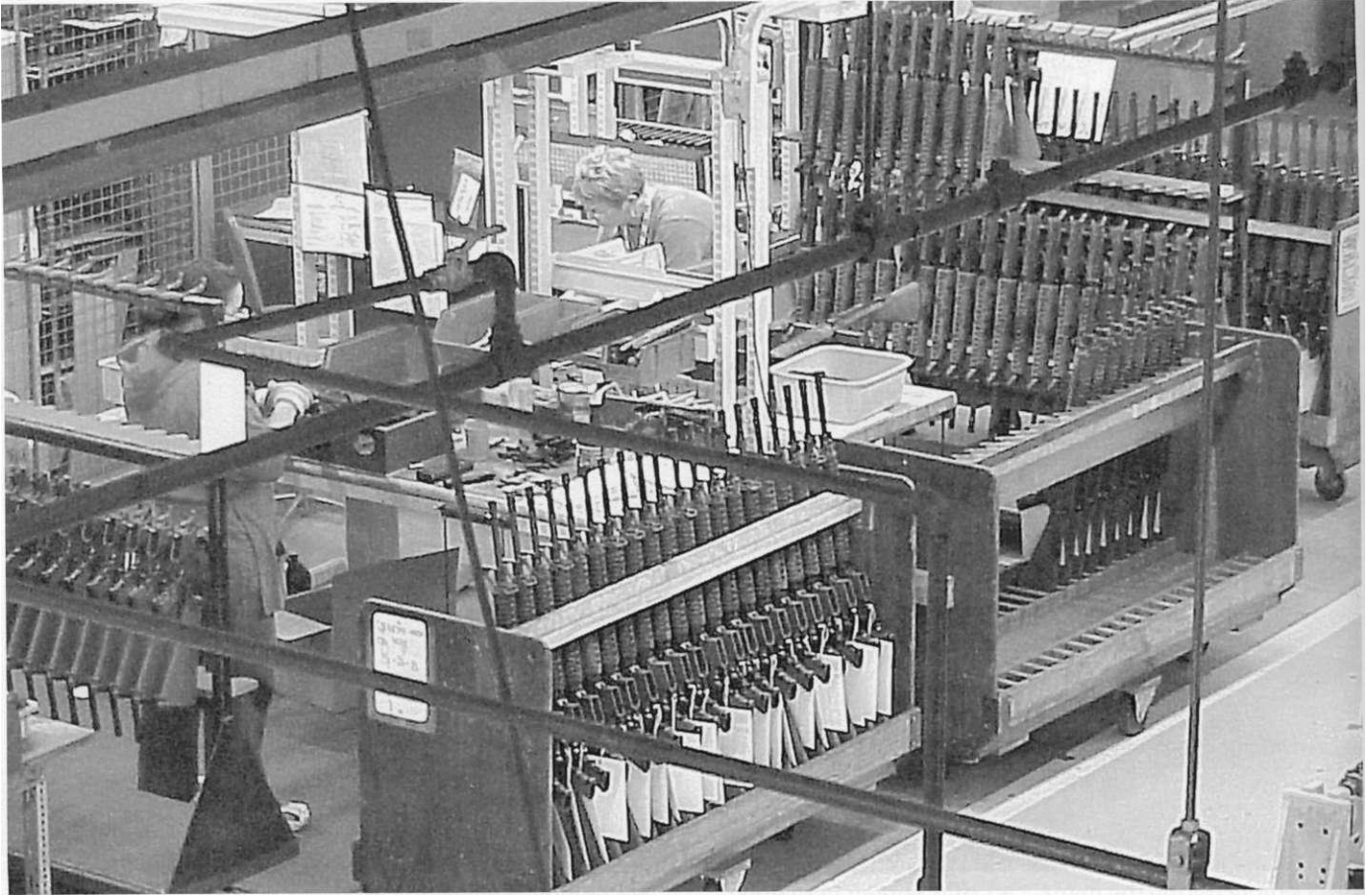
297. Demonstrating the new C7A2 rifle, shown here fitted with the TRI-ADI rail block attached around the front sight

assembly, and the new proposed "Bayonet 2000", now being produced for Canadian trials by Eickhorn of Solingen, Germany. courtesy Diemaco, Inc.

298. Left side closeup of the experimental wire-cutter "Bayonet 2000" and its scabbard, being produced for Canadian trials by Eickhorn of Solingen, Germany.

The velcro-fastened loop at center covers a sharpening stone. courtesy Diemaco, Inc.





299. A view of the Diemaco assembly pre-fire inspection area, showing components prior to final assembly, and assembled rifles awaiting acceptance firing.

courtesy Diemaco, Inc.



300. Left side view of the Diemaco C8A2, fitted with an Aimpoint M68 reflex sight.

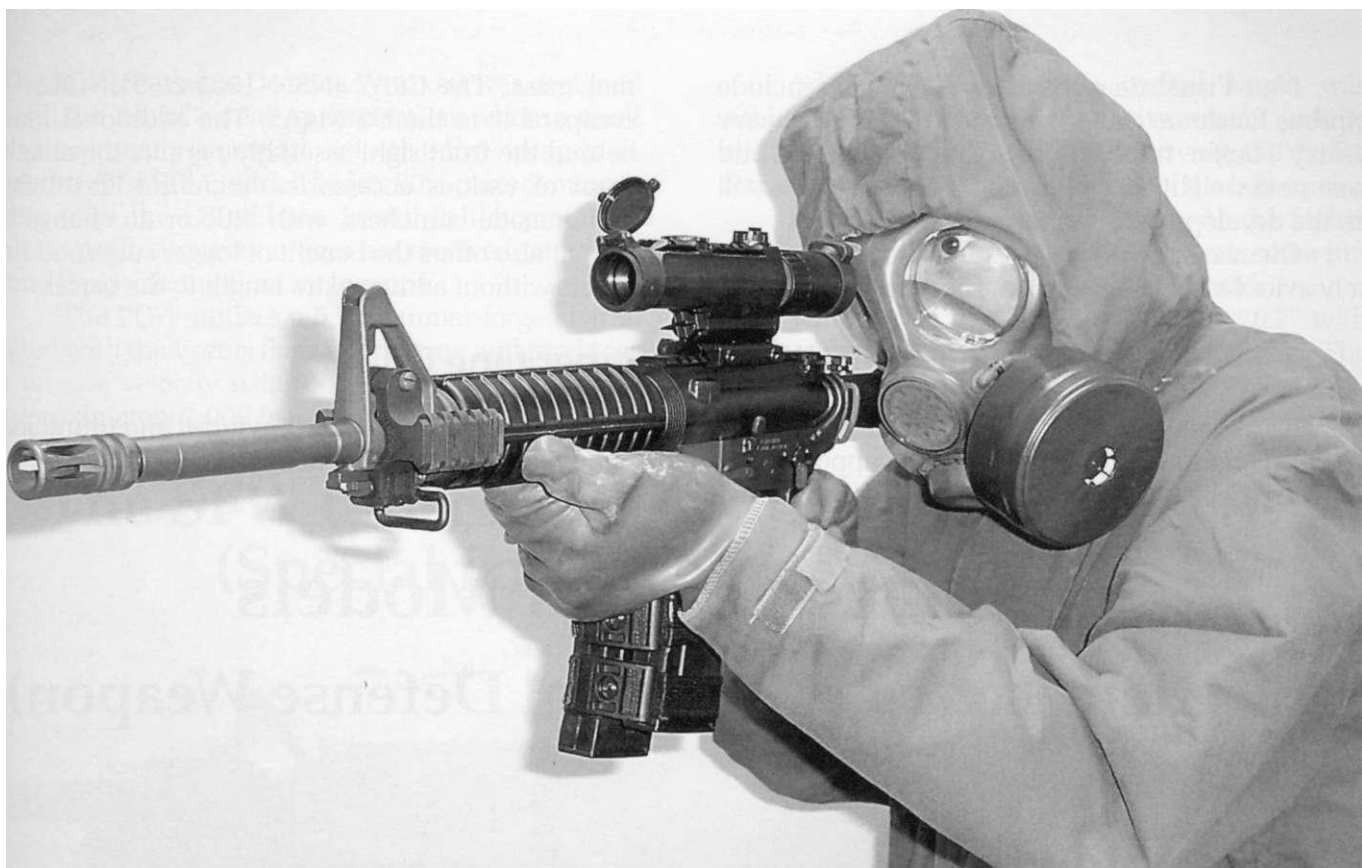
Note the contour of the M96 heavy barrel, developed in

response to a request from the Danish Army and now standard on many C8A2 carbines, and the aftermarket "mag cinch", shown holding two 30-round magazines.

courtesy Diemaco, Inc.

- colored furniture (greenish tan)
- a four-position telescoping butt
- the CANPAT Patrol Sling
- C79A2 Optical Sight (green) w/Gen 4 mount

- Diemaco TRI-AD I rail system
- ambidextrous magazine catch
- ambidextrous fire control selector
- tactical ambidextrous charging handle.



301. The C8A2 being experimentally fired by a Diemaco engineer while wearing a full chemical protection suit.

Note the Leupold CQ/T scope, and the TRI-AD I rail mounted on the front sight assembly.

courtesy Diemaco, Inc.

302 (below). Two views of the standard production Diemaco removable carrying handle, with windage adjustment only. This is seldom seen on Diemaco rifles due to

the fact they normally come issued with ELCAN optic sights and the much more compact polymer back-up iron sight (fig. 293).





Non-Visual Changes to the A2 version include Spring, Elastometric, Grip Kit, and the "HH" ("heavy heavy") buffer, fitted with two tungsten weights and one steel weight. As of this writing, the C7A2 is still in the developmental/prototype stages.

Diemaco also offers a C8A2 carbine, fitted with a heavier barrel to increase barrel strength and ther-

mal mass. The C8A2 (NSN 1005-20-913-4965) is comparable to the US M4A1. The additional mass behind the front sight assembly permits the attachment of various accessories, including flashlights and grenade launchers, with little or no change in zero. It also offers the benefit of longer sustained fire bursts without adding extra length to the barrel.

## Canada - Still the Number One Client

Canada remains Diemaco's number one client, and the firm continues to supply ongoing support to the Canadian arsenal of Diemaco small arms, at the

national level as well as to provincial and municipal police forces within Canada.

# Diemaco Special Models

## The Diemaco PDW (Personal Defense Weapon)



303. Left side view of the latest prototype of the Diemaco PDW (Personal Defence Weapon).

Note the Vortex flash suppressor on the short (5.7") hammer-forged barrel, and the aftermarket "mag pull" on the 30-round plastic magazine.

The collapsible stock and the buffer extension were shortened by 1.65", with the buffer relocated in the rear of the bolt carrier.

Note the enlarged hole in the plastic stock, designed to accept the thumb of the left hand to lock the butt to the wrist of the firer's right hand. courtesy Diemaco, Inc.

The PDW (Personal Defence Weapon) was designed to fill the role of a small entry weapon, where a small and extremely compact selective-fire weapon is needed. The PDW, which boasts 90% parts commonality with the C8 carbine, is still in the prototype phase until customer orders are received, at which time the project will move forward.

The PDW utilizes a 5.7" hammer-forged barrel fitted with the Vortex flash suppressor, and produces a muzzle velocity using M855 ball ammunition of approximately 2,000 feet per second.

Additional reduction in overall length was achieved by shortening the buffer extension and the sliding buttstock by 1.65", and moving the buffer forward and relocating it in the rear of the bolt carrier.

In order to ensure functioning with the higher cyclic rate and prevent failures to extract, some improvements were also made to the extractor.

The overall length of the PDW is 20.7" with stock collapsed and 24" with the stock extended. The overall weight unloaded is 2.2kg (4.9 lbs.)

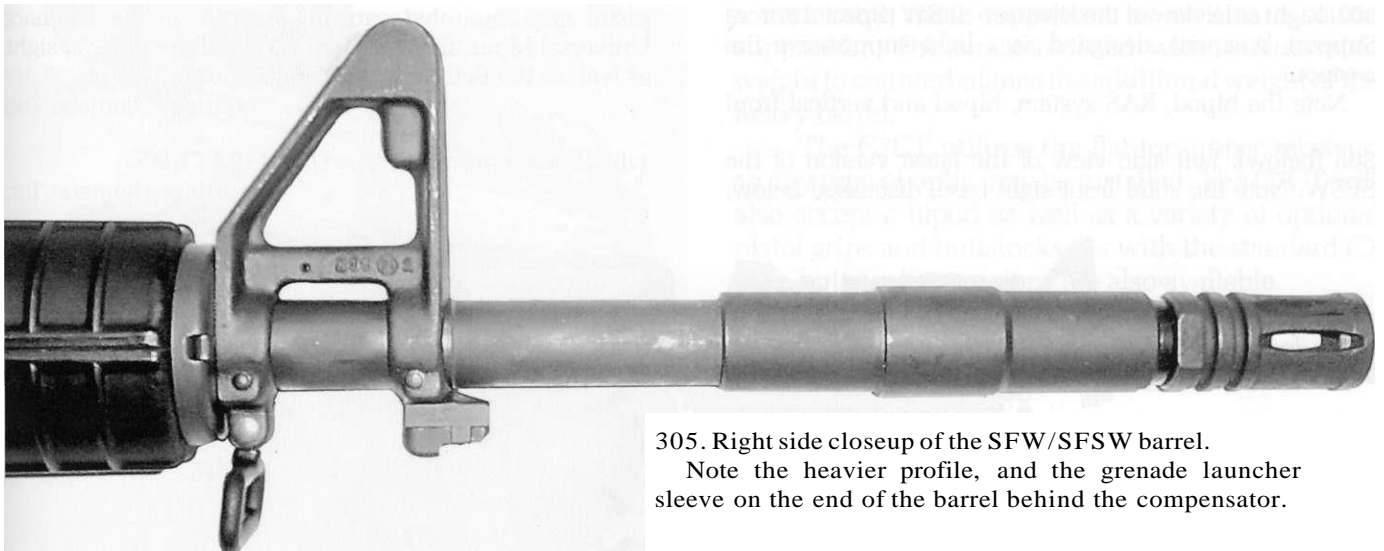
## The SFW (Special Forces Weapon) and SFSW (Special Forces Support Weapon)



304. Left side view of the Diemaco SFW (Special Forces Weapon). This carbine has a 16.1" heavy barrel designed for sustained automatic fire.

This was the baseline weapon which was entered into

the competition for the UK SFW, discussed below. After certain modifications were made to meet the British requirement, the Diemaco SFW was adopted as the L119A1 by UK Special Forces. courtesy Diemaco, Inc.



305. Right side closeup of the SFW/SFSW barrel.

Note the heavier profile, and the grenade launcher sleeve on the end of the barrel behind the compensator.



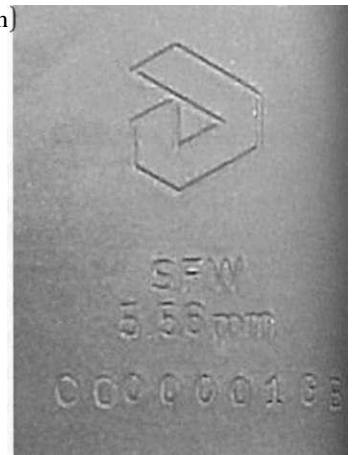
The Diemaco Special Forces Weapon (SFW), NSN 1005-21-921-1160, is a highly specialized carbine, utilizing a 16" barrel with a heavy cross section between the front sight and the flat-top receiver. Also mounted is the Diemaco-built M203A1 40mm grenade launcher. This versatile weapon was designed to meet the hit requirements specified in the British Statement of Requirements for a New 5.56mm Small Arms System ("NSSA"). The SFW carbine can be tailored to a particular mission, and yet maintain a high level of accuracy. The maximum effective range is from 500 to 600 meters with iron sights, and approximately 800 meters with optics.

The SFW utilizes a stow-away pistol grip as well as a three-position adjustable stock. An ambidextrous selector lever is standard, and the Knight's Armament RAS (Rail Adapter System) modular handguard is installed with rails to attach laser sights, illuminators, bipods, slings, secondary pistol grips as well as other tactical equipment.

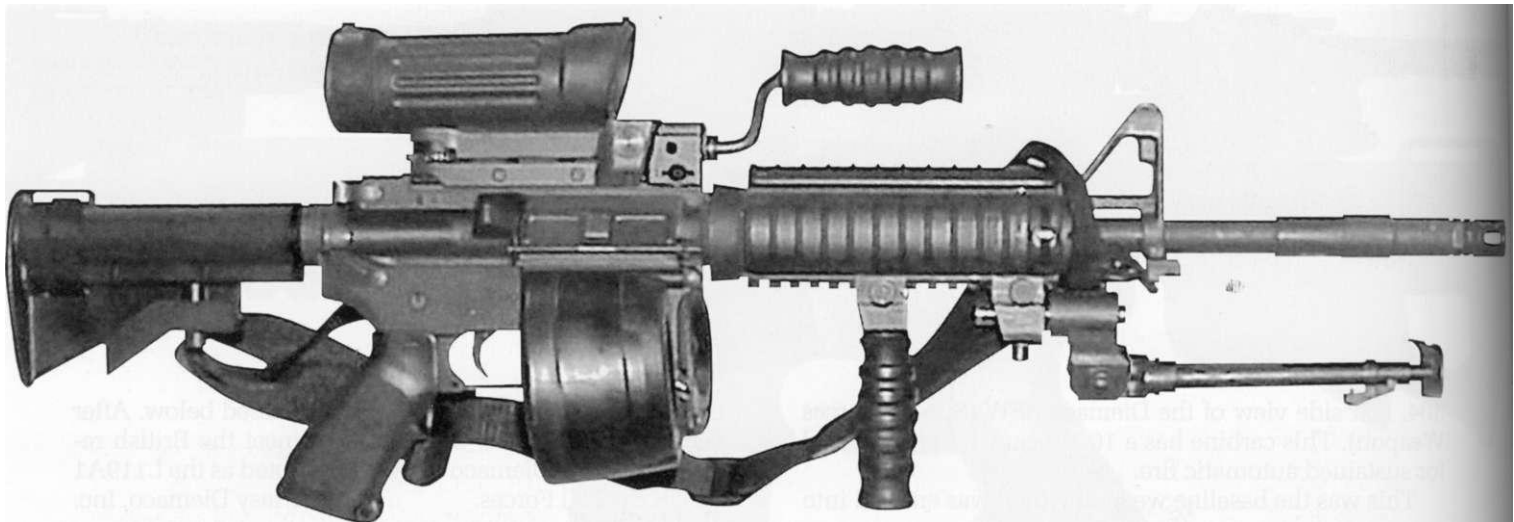
306 (right). Left side closeup of the receiver markings on the trials sample SFW shown above.

Note the "GB" serial number suffix.

courtesy Diemaco, Inc.



A companion to the Special Forces Weapon is the Special Forces Support Weapon, modified to take on the more demanding role of a light support weapon by the addition of a bipod, rate reducing buffer assembly, heavy barrel, carrying handle, and a high-capacity 100-round BETA "C" drum magazine, with a forward pistol grip added to enhance controllability.



307. Right side view of the Diemaco SFSW (Special Forces Support Weapon), designed as a light suppressive fire weapon.

Note the bipod, RAS system, bipod and vertical front

pistol grip, mounted carrying handle on the Diemaco Universal Mounting Adapter in front of the ELCAN sight, as well as the Beta "C" drum magazine.

courtesy Diemaco, Inc.

308 (below). Left side view of the latest version of the SFSW. Note the solid front sight base, discussed below,

which was a product of the UK L119A1 trials.

courtesy Diemaco, Inc.



## The C7CT and C8CT (Custom Tactical) and the CFCT (Canadian Forces Custom Tactical)



309. Left and right side views of the C7CT (Custom Tactical) sniper rifle.

Note the free-floating heavy barrel, the knurled cylin-

drical handguard, variable scope mounted over the flat-top receiver on the TRI-AD II rail, the folded detachable bipod, and KAC silencer.

courtesy Diemaco, Inc.



To fill the urban and short-range sniper role, Diemaco has produced an accurized C7 rifle called the C7CT (the C7 "Custom Tactical"). This rifle features an unchromed, hammer-forged, free-floating barrel capable of sub-minute-of-angle groups using NATO or heavy-bullet ammunition. The barrel will also accept a removable flash suppressor as well as a sound suppressor. The stock is fitted with a removable weight to counterbalance the additional weight of the heavy barrel.

The C7CT utilizes the flat-top upper receiver, so any type of optic may be installed. The C7CT will also accept a bipod as well as a variety of optional pistol grips and buttstocks. As with the standard C7 rifle, buttstock extensions are also available.

The CT rifle comes standard with a Match-grade, two-stage, trigger. To aid in faster lock time, the CT rifle is fitted with a titanium firing pin.

310 (left). A variation of the heavy-barrelled C7CT sniper rifle, fitted with the Trijicon ACOG scope on Badger Ordnance free-floating handguard (fig. 264) with full-length rail on the top of the handguard.

courtesy Diemaco, Inc.

## 210 The C8CQB (Close Quarter Battle) Carbine



311. Right side view of the C8CT (Custom Tactical) sniper carbine.

Note the adjustable buttplate, custom pistol grip with

adjustable rest, Leupold variable scope mounted on the TRI-AD II mount, free floating handguard, Harris bipod, and Diemaco folding front sight.

courtesy Diemaco, Inc.

Diemaco offers a carbine version of the CT known as the C8CT. Like its full-size counterpart, the C8CT has a free-floating Match-grade barrel. Additionally it utilizes a sliding buttstock with an adjustable buttplate. This carbine will deliver sub-MOA (i.e. less than 4") groups at ranges exceeding 400 meters.

At the request of the Canadian Armed Forces, Diemaco introduced an additional variation of the C7CT in the fall of 2002. The new Canadian Forces Custom Tactical (CFCT) has been custom-tailored to fill a requirement for use by the second man (Spotter) of a two-man sniping team. This version features the

flat-top upper receiver utilizing the Diemaco proprietary TRI-AD II rail assembly, to which the scope is mounted, and tan-colored stocks which include a free-floating handguard with built-in twin TRI-AD rails and a bipod, all of which leave the Match-grade 20" hammer-forged heavy barrel free of restriction. The CFCT rifle is fitted with a gas cutoff and the Knight's Armament Company compensator in place of a flash suppressor, which enables the attachment of a silencer.

Additional optional accessories include a brass catcher bag and Match-style pistol grip with palm rest.

## The C8CQB (Close Quarter Battle) Carbine



312. Left side view of the Diemaco C8CQB (C8 Close Quarters Battle) short-barrel carbine, designed for close-quarters engagement.

Note the "desert tan" furniture, and the EOTech holographic sight.

courtesy Diemaco, Inc.



313. The Diemaco C8CQB in operation with a member of a police SWAT team.

Note the KAC silencer and RAS with "desert tan" rail

protectors, EOTech holographic sight, and Diemaco vertical forward pistol grip. courtesy Diemaco, Inc.

One of the newest designs offered by Diemaco is the C8CQB (C8 Close Quarter Battle) carbine. This version offers a shorter 10" or 11 1/2" barrel fitted with the Vortex flash suppressor, which produces muzzle velocities for standard NATO 5.56mm cartridges of 2,590 feet per second from the 10" barrel and 2,650 feet per second from the 11 1/2 inch barrel, thus

making the power and lethality of the 5.56mm cartridge available in a package the size of an SMG

Utilizing a flat-top upper receiver capable of mounting reflex sights among many other sighting options, these models may also be fitted with a variety of sound suppressors and rail systems.

## The LSW (Light Support Weapon)

Diemaco also produces their Light Support Weapon (LSW), which is basically a 5.9kg (13-lb.) heavy-barrelled C7 rifle with some major modifications, and fitted with a bipod and forward pistol grip. The M16A2 Light Machine Gun project, discussed further in Chapter Nine, was a joint effort between Diemaco under contract with Colt wherein Diemaco designed many of the special features such as the handguards, carrying handle, forward grip, gas tube, and barrel. Colt's Henry Tatro designed the hydraulic buffer and the open-bolt operating system.

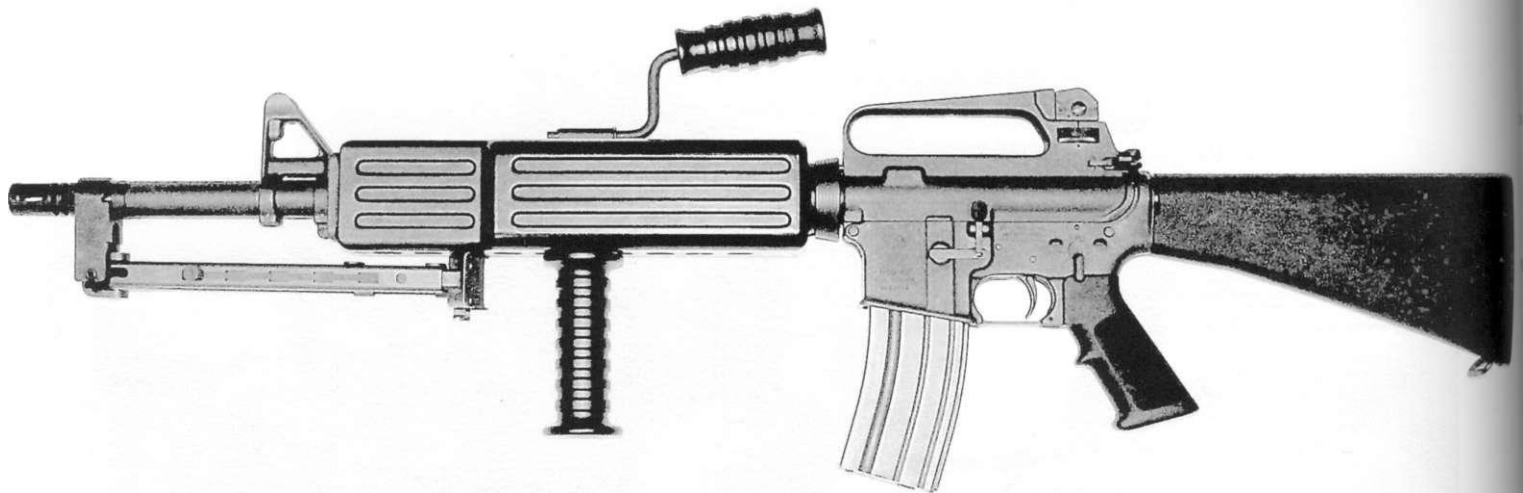
Like the C7 and C7A1, the LSW can be configured with a receiver with integral iron sights (NSN 1005-21-913-5019) or a flat-top receiver (NSN 1005-

22-126-9290). Diemaco has manufactured and delivered approximately 5,000 LSWs.

The main rationale behind this program was to design a special weapon capable of withstanding the severe and prolonged firing cycles to which a support weapon is subjected. To promote air circulation between bursts and prevent cook-off, the standard LSW fires from the open bolt position.

However, the choice of an open- or closed-bolt firing mechanism is optional, and the LSW can also be supplied in a closed-bolt version, such as the LSW-1 variation sold by Diemaco to the Royal Dutch Marines, and the LSW-2 sold to the Danish Armed Forces. The Dutch and Danish LSW-1 and LSW-2 both contain the standard rifle automatic firing

## 212 The LSW (Light Support Weapon)



314. Left side view of the fixed-carrying-handle LSW, embodying many features developed by Diemaco.



315. Right side view of the LSW in action, showing the Diemaco-developed early bipod in the open position. The LMG/LSW is adaptable to all environments and is easily

handled while wearing heavy winter clothing and mittens.

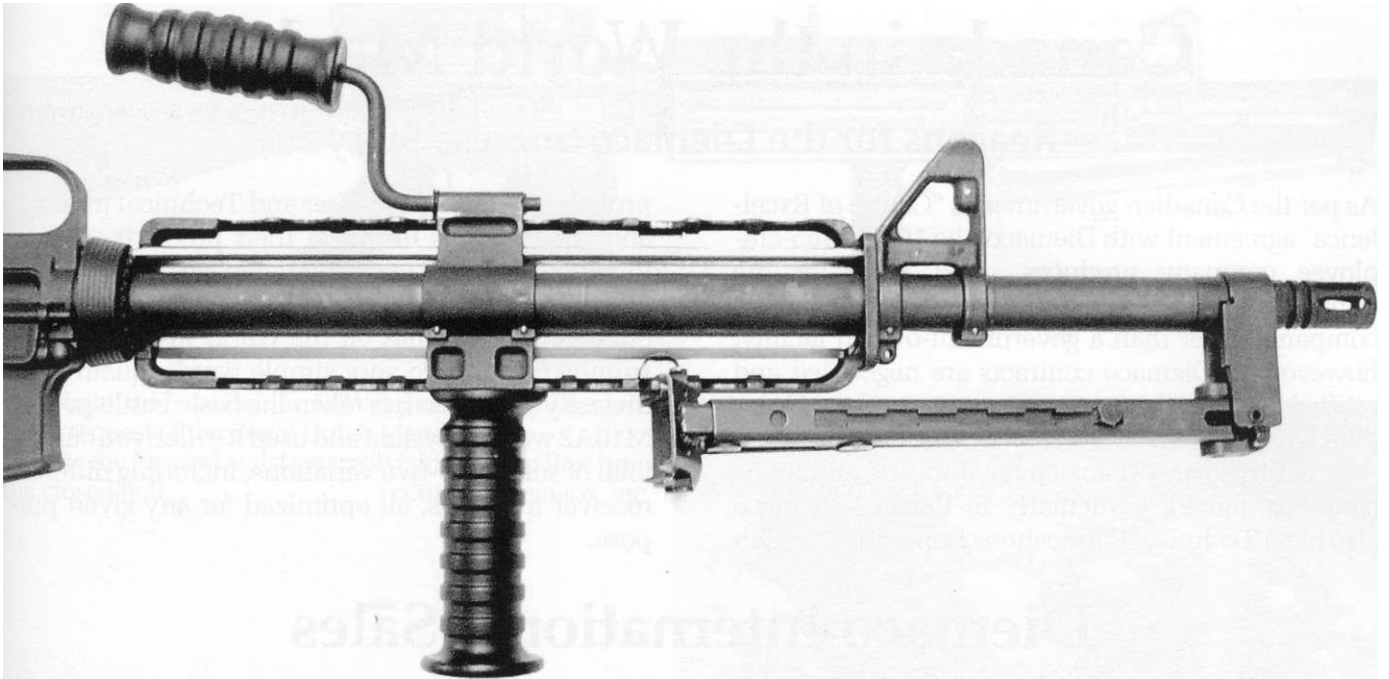
Note the absence of the forward assist on this open-bolt-firing model.  
courtesy Diemaco, Inc.

mechanism, fire from the closed bolt position, and are fitted with forward assists. The original LMG and the later Colt's Automatic Rifle (CAR) both fire from the open bolt position, and thus do not have forward assist assemblies.

A key component of its enhanced controllability is the addition of a cyclic rate reducer/hydraulic buffer, which lowers the cyclic rate of fire to

between 600 and 700 rounds per minute. Not only does this enhance controllability but it ensures reliable feeding and operation with both standard 30-round magazines as well as BETA "C" 100-round double-drum magazines.

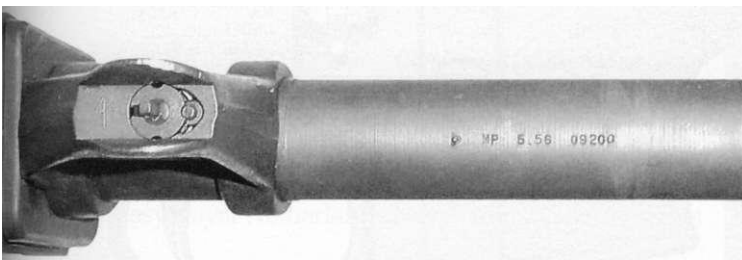
Early LMG/LSWs did not have a bayonet lug until the new bipod, depicted in fig. 347, was developed to permit the attachment of a bayonet.



316. Right side closeup of the LMG barrel and gas system. The handguards are interchangeable, with heavy pressed-in heat shields.

Note the extra-heavy barrel and significantly thicker

gas tube, adopted to better cope with high volumes of fire. The carrying handle and vertical pistol grip are attached to the yoke, which surrounds the middle of the barrel.



317. Top closeup of an LMG/LSW barrel, showing the Devtek/Diemaco "D", the quality control "MP", caliber "5.56" and the 5 digit batch code "09200".

All LMG/LSWs utilize hammer-forged, chrome-lined barrels manufactured by Diemaco, regardless of the markings on the receiver.

318 (right). The early Canadian-designed folding bipod had adjustable legs, and was mounted to the end of the barrel.

The early prototype LMGs used the standard M16-style front sight forging, after which this larger-diameter model was designed.

Note the Canadian-designed square handguard cap behind the front sight assembly, courtesy Diemaco, Inc.





# Canada in the World Market

## Reasons for the Diemaco Success Story

As per the Canadian government's "Centre of Excellence" agreement with Diemaco, the 100- to 185-employee company produces small arms for the Canadian and other friendly governments as a private company rather than a government-owned facility; however, all Diemaco contracts are negotiated and ratified between the customer country and the Canadian government.

On this basis Diemaco has fulfilled numerous contracts abroad, particularly in Europe. Diemaco also has a Technical Publications Department which

provides a full range of User and Technical manuals and training aids for all of their products, in customer-specified formats and languages.

The reason for the success of the Diemaco series of rifles and carbines on the world market may be summed up in two very simple words: quality and diversity. Diemaco has taken the basic battle-proven M16A2 weapon system and used it to derive a current total of some fifty-two variations, including different receiver markings, all optimized for any given purpose.

## Diemaco International Sales

### Equipping the Netherlands Armed Forces



319. Royal Netherlands forces equipped with Canadian-made Diemaco C7A1 rifles,  
courtesy Royal Netherlands Navy Audiovisual Services

A large contract for the Netherlands Armed Forces, consisting of 58,000 C7 rifles, C8 carbines, C7A1 flat-top optically-sighted rifles, C8A1 flat-top opti-

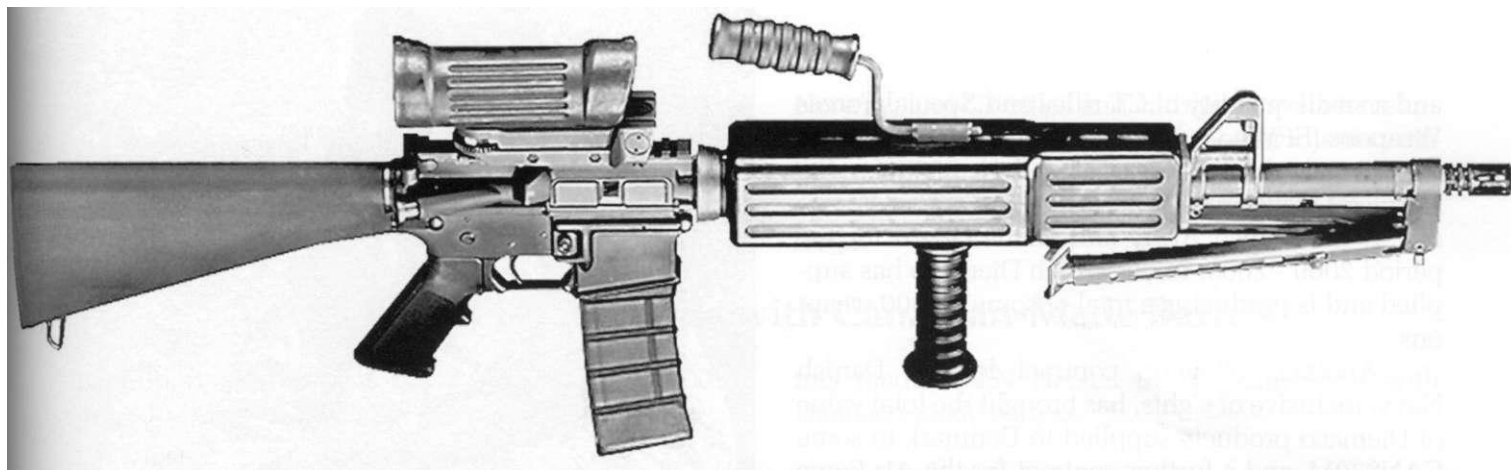


320. Left side closeup of the receiver markings for a C7A1 rifle manufactured for the Netherlands.

Note the identifying "NL" serial number suffix.  
courtesy Diemaco, Inc.

cally-sighted carbines, and Light Support Weapons, was signed in 1994 and completed in 1998. As part of this contract Diemaco provides logistic support to include spare parts, service, and training for armorers and instructors. In June, 2000 the Netherlands also contracted for 2,000 Optical EX48 Day Sights, manufactured by ELCAN in Midland, Ontario, for their new Light Machine Guns.

As noted, a closed-bolt-firing version of the Colt/Diemaco LSW, called the LSW-1, has also been purchased by the Royal Dutch Marines.



321. Right side view of the LSW-1 produced by Diemaco at the request of the Royal Dutch Marines.

Note the forward assist assembly: this version fires from the closed bolt. courtesy Diemaco, Inc.



322 (right). Royal Dutch Marines training in Belize with the Diemaco LSW-1 in the foreground, courtesy Royal Netherlands Navy Audiovisual Services

## Denmark

In 1995 Diemaco entered into an initial contract to supply the Danish International Brigade peacekeeping force with 7,772 M95 (C7) rifles and M96 (C8) carbines. This contract was completed in 1998, and Diemaco is providing the same support infrastructure to the Danish as they do in the Netherlands.

A new defense agreement was signed in December, 1999, and the decision was made to continue with Diemaco weapons. The firm was accordingly awarded an add-on contract to produce an additional 26,000 mixed fleet of rifles and carbines for general issue to the Danish Army, including the Home Guard. Along with that contract, Denmark has also been provided with the new closed-bolt-firing version of the Light Support Weapon called the LSW-2,



323. Left side closeup of the receiver markings on a C7A1 rifle manufactured for Denmark.

Note the identifying "DK" serial number suffix. courtesy Diemaco, Inc.

and a small quantity of CT rifles and Special Forces Weapons (SFW).

A new contract was signed in 2000 for the supply of Light Support and Combat Tactical Weapons to the Danish Army and Home Guard for the period 2000 - 2005, under which Diemaco has supplied and is producing a total of some 34,000 weapons.

Another follow-on contract for the Danish Navy, inclusive of sights, has brought the total value of Diemaco products supplied to Denmark to some CAN\$70M, and a further contract for the Air Force and the balance of production after 2005 will include 10,000 to 15,000 more weapons.

Denmark has also purchased ELCAN Optical Day and Night Sights for their light and heavy machine guns.

324 (right). A Danish soldier displaying his C7A1 rifle with the ELCAN optical sight mounted on the receiver rail.  
courtesy Gerhard Wirenfeldt HJV



## Norway



325. A Norwegian Special Forces soldier equipped with the Diemaco SFW in Norway green.

Note the M68 Reflex sight, the RAS with full rail protectors, and the Diemaco folding front sight.

courtesy Forsvarets Mediesenter



326. Left side closeup of the receiver markings on a SFW carbine manufactured for the Norwegian Special Forces.

Note the identifying "N" serial number suffix.

courtesy Diemaco, Inc.

The Norwegian Army still uses the 7.62mm NATO caliber G3, which they manufactured under license from H&K at Kongsberg Våpenfabrik as their *Gevaer Automatisk AG3*. The switch to general-issue 5.56mm weapons is planned to occur somewhere around 2007.

Meanwhile, in 2001 Diemaco entered into a contract with the Norwegian Special Forces, who were the first to field the Diemaco Special Forces Support Weapon (SFSW).

Further contracts were signed in 2002 and 2003 with the Norwegian National Police, Navy and Army Special Forces.

In addition, a small number of the CT (Custom Tactical) carbine versions are currently in service in

Norway, and CT rifles and carbines have been supplied in small numbers to several other client countries, where they have served with success in operations in Sierra Leone, Afghanistan, Iran, and Iraq.

### **New Zealand FN Minimis with Canadian-Made Barrels**

In addition, Diemaco has delivered more than 1,000 LMGs to the New Zealand Army. These were Mini-

mis made at FN Herstal in Belgium, fitted with Diemaco-made barrels.

### **Diemaco M203A1 Grenade Launchers in the Irish Republic**

The Canadian Forces adopted the Diemaco-manufactured M203 grenade launcher in 2000, and has also contracted with the Irish Republic to supply

M203A1 grenade launchers for their Steyr AUG assault rifles. Ireland has also purchased ELCAN Day Sights for their light machine guns.

### **The British L119A1 SFW (Special Forces Weapon)**



327. Men of 3 Commando Brigade Patrol Troop in a combat exercise at Bagram Air Base, Afghanistan, in early 2002. Both men are carrying Diemaco-made C7 rifles, the

one at right fitted with an M203 grenade launcher. Crown copyright, reproduced with permission of HMSO ([www.photos.mod.uk](http://www.photos.mod.uk))





328. Left side view of a typical Diemaco C8 carbine (this one actually part of the Netherlands contract), shown fitted with the UK-issue H&K side-opening double-action AG-C

40mm grenade launcher, which installs on the lower rail of the RAS and locks onto the bayonet lug.

courtesy H&K Defense Inc.

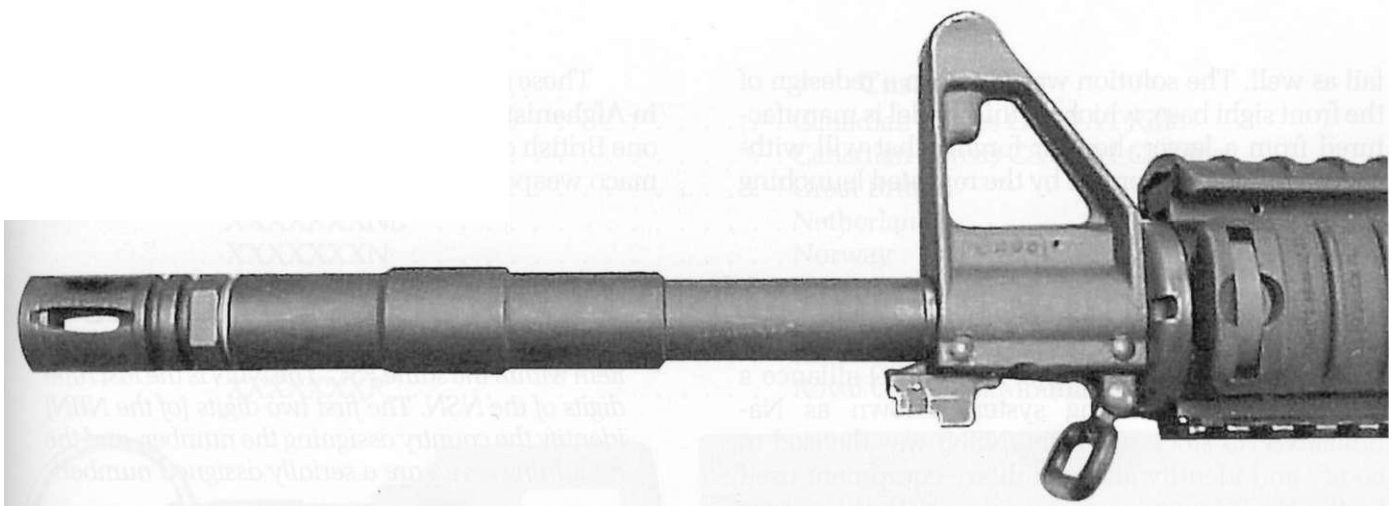


329. Left side closeup of the British-issue H&K AG-C grenade launcher, showing barrel swung to the side for loading. This versatile launcher is capable of accepting

longer grenades, such as some crowd-control loadings, than will fit into the pump-loading M203.

Note the mechanical grenade sight, as used by the British SAS.

courtesy H&K Defense Inc.



330. Left side closeup of the barrel of the UK L119A1 SFW carbine, showing the custom-manufactured solid-base

front sight assembly designed by Diemaco expressly for use with the H&K AG-C grenade launcher used by British Special Forces, which attaches to the bayonet lug.

courtesy Diemaco, Inc.



331. Left side closeup showing the receiver markings on the British Special Forces L119A1 SFW carbine.

Note the NSN marked on the receiver over the trigger, and the identifying "GB" serial number suffix.

courtesy Diemaco, Inc.

In 2000 Diemaco secured a contract to supply the UK with a quantity of SFWs (Special Forces Weapons). The SFW was designed in response to the British NSSA requirement published by the MoD, and designated by the British as the L119A1 Assault Rifle (NSN 1005-21-920-6546). This decision was taken after the C7 outperformed its competitors, which included the SIG 500 and Heckler & Koch G36, in a lengthy, expensive and exhaustively thorough series of trials conducted in Alaska (arctic testing), Kuwait (desert testing), and the jungles of Brunei (tropical testing). In fact, it was estimated that the British spent

more money on conducting these trials than they did on the weapons they purchased as a result of them!

Diemaco made a modification to the basic SFW carbine at the request of the British, who wanted an improved and strengthened front sight assembly. The British use the H&K AG-C 40mm grenade launcher, which is secured to the bayonet lug. It was discovered that as the violent recoil and torque produced by repeated grenade firings impacted the bayonet lug and front sight assembly, the taper pins securing it to the barrel began to fracture or loosen. Securing the pins only moved the problem up to the front sight ring on the barrel, which would eventually



fail as well. The solution was found in a redesign of the front sight base, which on this model is manufactured from a larger, heavier forging that will withstand the abuse generated by the repeated launching of grenades.

These rifles have been delivered, and were used in Afghanistan and Iraq by British Special Forces. As one British officer commented succinctly, these Diemaco weapons "functioned as advertised."

# Explaining National/NATO Stock Numbers

Shortly after the formation of the NATO alliance a standardized numbering system known as National/NATO stock numbers (NSN) was devised to codify and identify all the military equipment used by the NATO member countries as to type, country of origin, and a sequential serial number.

The Mil-Std definition of the NSN is as follows:

*The National/NATO stock number is a 13-digit number divided into two parts, the Federal Supply Class (FSC) number and National Item Identification Number (NIIN). The FSC is the first four digits of the NSN, and establishes its relationship to the*

*item within the same FSC. The NIIN is the last nine digits of the NSN. The first two digits [of the NIIN] identify the country assigning the number, and the remaining seven are a serially assigned number.*

The FSC number "1005" as the first four digits of the NSN signifies that the item so described is classified within the category of small arms.

The country identification codes (the first two digits of the NIIN) as assigned by the United States, Canada and Britain are: United States, 00 and 01; Canada, 20 and 21; UK 99.

## Canadian Government /Diemaco Model Numbers

Model	NSN
C7. . . . .	.1005-21-898-7044
C7A1. . . . .	.1005-21-909-7599
C7A1 (Semi-Auto Only). . . . .	.1005-21-884-6533
C7CT. . . . .	.1005-20-000-5067
CFCT. . . . .	not issued yet
C8. . . . .	.1005-21-898-7045
C8CT. . . . .	not issued yet
C8A1. . . . .	.1005-21-921-2563
C8A2. . . . .	.1005-20-913-4965
C8A2 with/ADIS. . . . .	.1005-21-000-2232
C8A2 with folding rear sight . . . . .	.1005-20-000-2236
C8A2 (M96) DK Carbine. . . . .	.1005-21-913-4965 & 4977
C8A2 (Navy) DK. . . . .	.1005-21-920-5278
LSW. . . . .	.1005-21-913-5019
LSW-2. . . . .	.1005-22-126-9290
SFW. . . . .	.1005-21-921-1160
SFWUK(L119A1). . . . .	.1005-21-920-6546
SFSW. . . . .	no NSN; Kit Item

## Diemaco Serial Number Coding

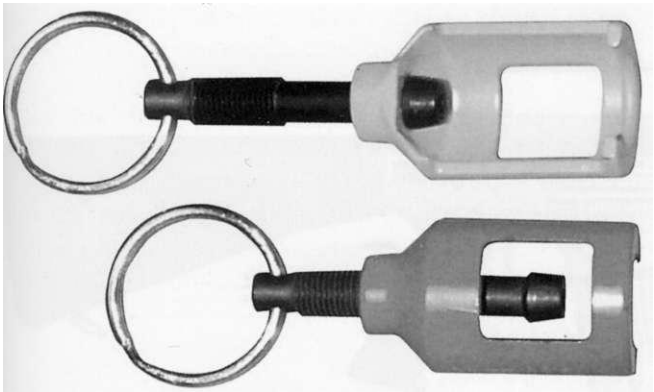
The first two digits in the serial numbers of Canadian Forces weapons indicate the year of production, followed by the rifle (AA) or carbine (AB) designation.

For offshore and other sales, the serial number system used by Diemaco includes an alphabetic

suffix which identifies the customer to whom the arm was sold.

The serial number codes being used on Diemaco rifles and carbines as of this writing are as follows:

Serial Number	Customer
XXAAXXXXXX . . . . .	Canadian Forces C7/C7A1 Rifle
XXABXXXXXX . . . . .	Canadian Forces C8/C8A1 Carbine
XXXXXXXXGB . . . . .	Great Britain
XXXXXXXXNL . . . . .	Netherlands
XXXXXXXXN . . . . .	Norway
XXXXXXXXNP . . . . .	Norwegian National Police
XXXXXXXXDK . . . . .	Denmark
XXXXXXXXDS . . . . .	Diemaco Sales
XXXXXXXXR . . . . .	Royal Canadian Mounted Police

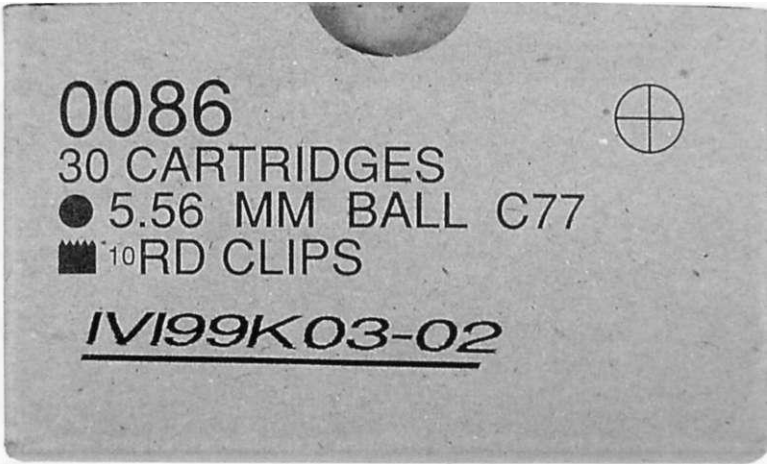


332. Two views of the Canadian-issue 5.56mm Blank Firing Attachment (BFA), developed by Diemaco for use with the C7 weapon family, M16A1/A2 rifles and carbines, and the M249 and C9 light machine guns. When installed this device will produce a realistic rate of fire at any ambient temperature, with any lot of blank ammunition.

Above: with threaded lock-rod open for installation.

Below: with threaded lock-rod in position to contact the internal diameter of the flash suppressor, to ensure that all powder gases are vented through the open sides of the BFA.

courtesy Diemaco, Inc.



333. A 30-round box of current-issue Canadian military 5.56mm C77 Ball ammunition, showing markings.

The cartridges are packaged on three 10-round plastic stripper clips inside this cardboard box.

courtesy MWO Gary Crocker

## Chapter Nine

# The Colt-Diemaco LMG



334. During the mid-1970s, as part of the Squad Automatic Weapon (SAW) program, Colt produced the XM106 open-bolt-firing light machine gun, also depicted in *TBR* figs. 319 - 320. Note the removable heavy barrel. The XM106 never left the prototype stage.

**I**n the early 1980s Rob Roy, then the head of Colt's military sales department, felt there would be a market for a heavy-barrelled light machine gun. Colt therefore initiated development of a brand-new member of the M16/AR-15 family—not an assault rifle or a carbine, but a 5.56mm light support weapon, designed to deliver heavy volumes of sustained fire

The only lineage to Henry Tatro's later 1980s design is the fact the hammer acts as the sear to stop and lock the bolt carrier group open to the rear. The rest of the operating mechanism of the XM106 was different, and Henry Tatro also abandoned the removable barrel feature in his later design.

while using as many standard M16 parts as possible. The LMG was originally developed prior to the inception of the M16A2 rifle program, although later-production LMGs were fitted with some of the updated and improved components developed for the M16A2.

## Adopting the Open-Bolt Firing System

The basic M16 operating mechanism was chosen as the starting point, although an open-bolt firing system was considered necessary to eliminate (or at least greatly reduce) the possibility of cook-off (a chambered cartridge discharging spontaneously due to the extreme heat buildup in the barrel/chamber generated by sustained full-automatic fire).

The open-bolt mechanism for the LMG, developed by Colt's senior engineer Henry Tatro, was

granted US Patent no. 4,433,610 on February 28, 1984. This was not a conventional open-bolt mechanism for two main reasons. First, the firing pin is not fixed. The bolt carrier assembly is nearly identical to that of the M16-series rifle, and the bolt locks up in exactly the same way as the standard rifle. Second, the hammer serves a dual purpose, working as a bolt carrier sear to keep the bolt in the open position when

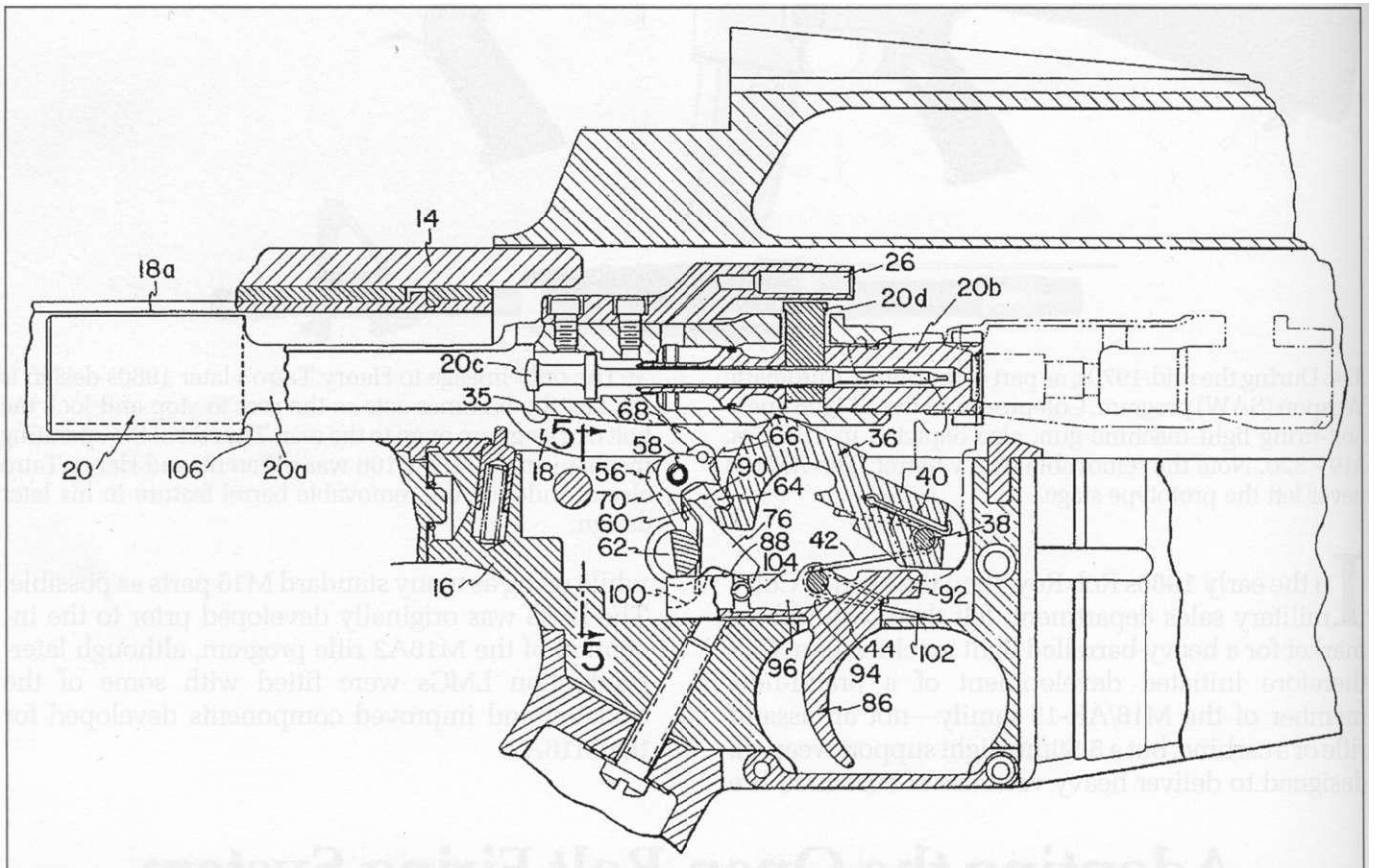


335. Right side view of Henry Tatro's original prototype open-bolt light machine gun.

Note the lack of forward assist, and the fully adjustable

rear sight, which later became standard on the M16A2 rifle.

Editor's collection,  
courtesy the late Dr. Edward C. Ezell



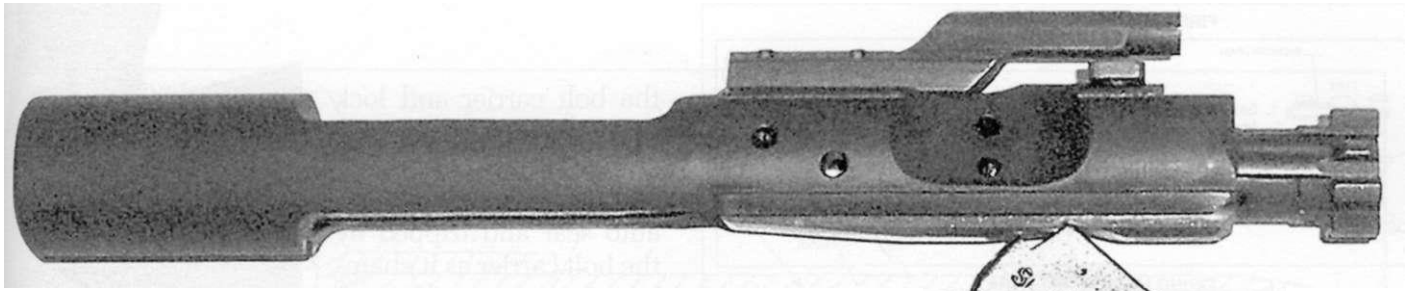
336. Fig. 2 from Henry Tatro's US Patent no. 4,433,610, titled "Open Bolt Mechanism For Automatic Firearm", issued on February 28, 1984.

This drawing illustrates the complex nature of the dual-purpose automatic sear.  
US Patent Office

not firing, as well as striking the firing pin to fire the chambered cartridge after the bolt has closed.

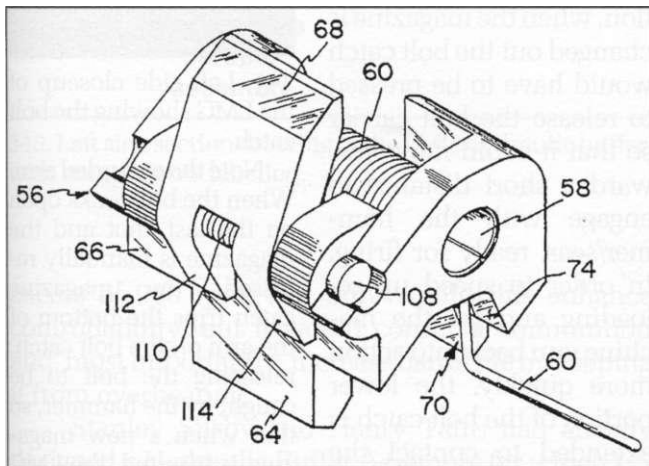
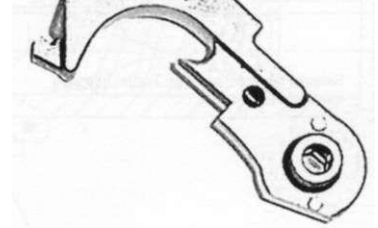
The fire control group is made up of five basic components: the hammer, trigger, bolt carrier assembly, connector, and auto sear assembly. The LMG fires only in the fully-automatic mode, so there was

no need for a disconnect. The dual-purpose hammer has a searing surface which engages a sear abutment on the bolt carrier, to hold it in the cocked position and prevent it from moving forward and firing until the trigger is pulled. The auto sear also performs a dual function, serving to pivot the ham-



337. Right side view of the bolt carrier of the LMG, with the hammer engaging and holding it "open".

The bolt carrier looks identical to the standard M16 selective-fire bolt carrier with the unnecessary forward assist notches omitted, and the hammer engagement notch cut on the front underside.



338. Drawing showing a left front three-quarter view of the LMG automatic sear assembly.

The top notch (68) is tripped by the bolt carrier to release the hammer to strike the firing pin. The notch (64) engages the hammer. The third notch (70) is engaged by the connector when the trigger is pulled, to lower the hammer and release the bolt carrier group to strip, lock and fire the cartridge.



339. Left side closeup of a cutaway early prototype LMG, showing the automatic sear and the connector.

When the trigger is pulled, the hammer will be lowered to release the bolt carrier to fire the cartridge.

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mer downward to release the bolt carrier assembly when the trigger is pulled, as well as performing as a traditional auto sear by releasing the hammer when

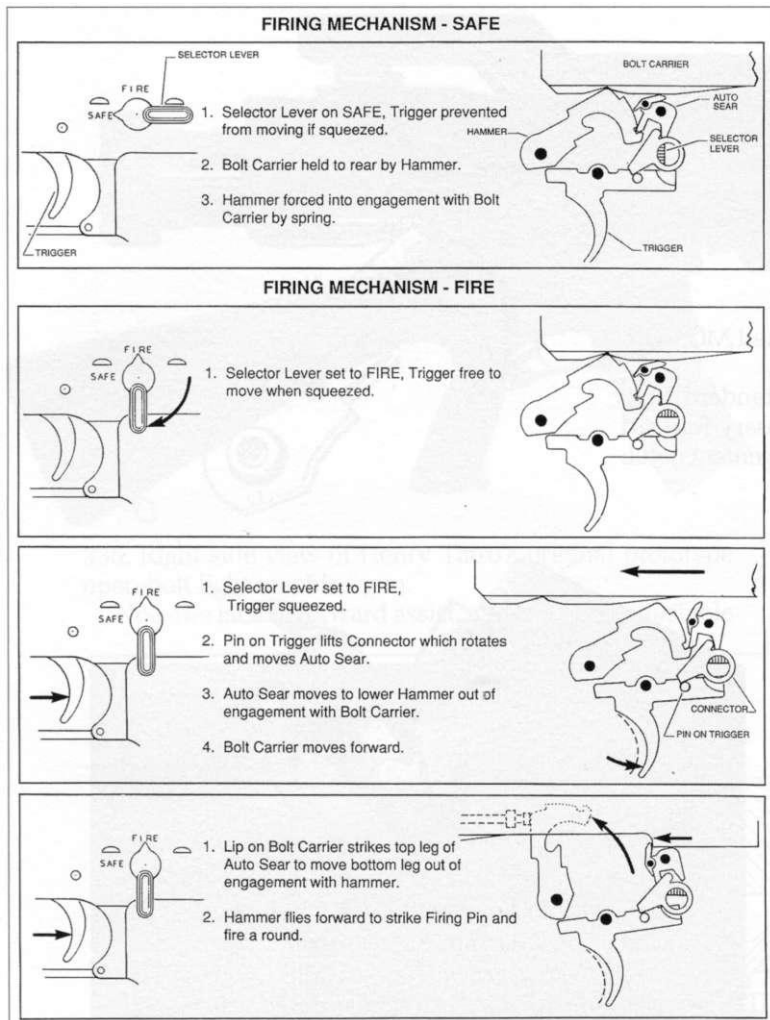
the bolt carrier assembly has moved into the locked position.

## The Open-Bolt Cycle of Operation

When the LMG is ready to fire, the bolt carrier is cocked and held to the rear by the hammer. When the trigger is pulled, the pin on the trigger (fig. 340) lifts the connector. This rotates the auto sear, which lowers the hammer out of engagement with the bolt carrier, releasing the bolt carrier but leaving the hammer held by the auto sear. As the bolt assembly moves forward, it strips a cartridge off the stack in the magazine and chambers it. As the bolt assembly

moves into the locked position, the auto sear trip on the bottom rear of the bolt carrier hits the auto sear, tripping it and releasing the hammer to strike the firing pin, firing the cartridge.

As the bullet travels down the bore it passes the gas port, located under the front sight assembly. A portion of the pressurized gas flows back through the gas tube and into the carrier key on the bolt carrier, imparting a hammer-like blow to the bolt carrier and



340. Diagrams illustrating the firing mechanism and sequence of the firing cycle of the open bolt Light Machine Gun.

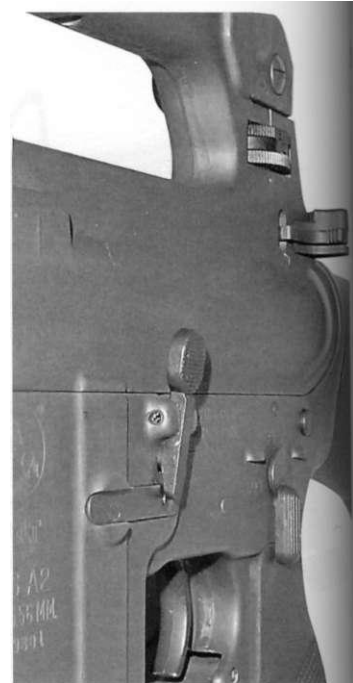
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pushing it rearward, which causes the bolt cam pin to rotate and unlock the eight-lug bolt from the barrel extension. The bolt and bolt carrier, continuing to move rearward, extract and eject the spent cartridge case. If the trigger is released, the hammer will catch

the bolt carrier and lock the bolt open. If the trigger remains pulled, the hammer will be caught by the auto sear and tripped by the bolt carrier as it chambers the next cartridge and moves into the locked position.

The bolt catch works similarly to that of the standard rifle, with one major exception. Due to the open bolt firing position, when the magazine is changed out the bolt catch would have to be pressed to release the bolt carrier so that it could move forward a short distance to engage with the hammer/sear, ready for firing. In order to speed up reloading and get the machine gun back into action more quickly, the lower portion of the bolt catch is extended to contact the left side of the magazine catch. When the magazine catch is pressed from right to left to release the empty magazine, the magazine catch pushes the bolt catch extension out, which levers the top of the bolt catch in, releasing the bolt carrier to move forward and engage on the hammer. So as soon as a loaded magazine is inserted and the trigger is pressed, the gun will resume firing without the operator having to deal with the bolt catch.



341. Left side closeup of the LMG showing the bolt catch.

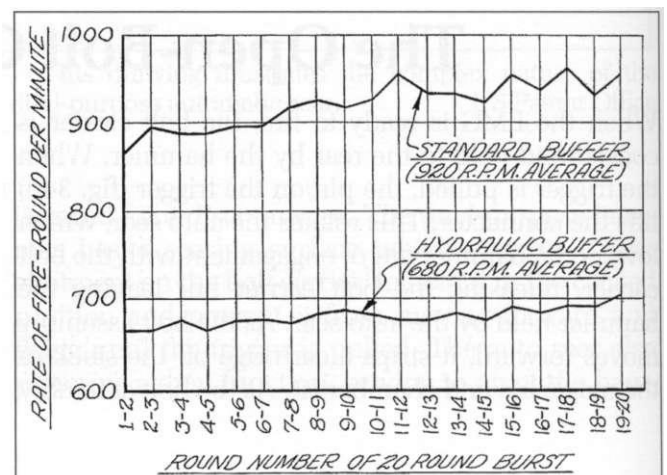
Note the extended arm. When the bolt locks open on the last shot and the magazine is manually released, the magazine catch trips the bottom of the arm on the bolt catch, releasing the bolt to be caught by the hammer, so that when a new magazine is inserted, the LMG is ready to fire.

## The Hydraulic Buffer: Decreasing the Rate of Fire

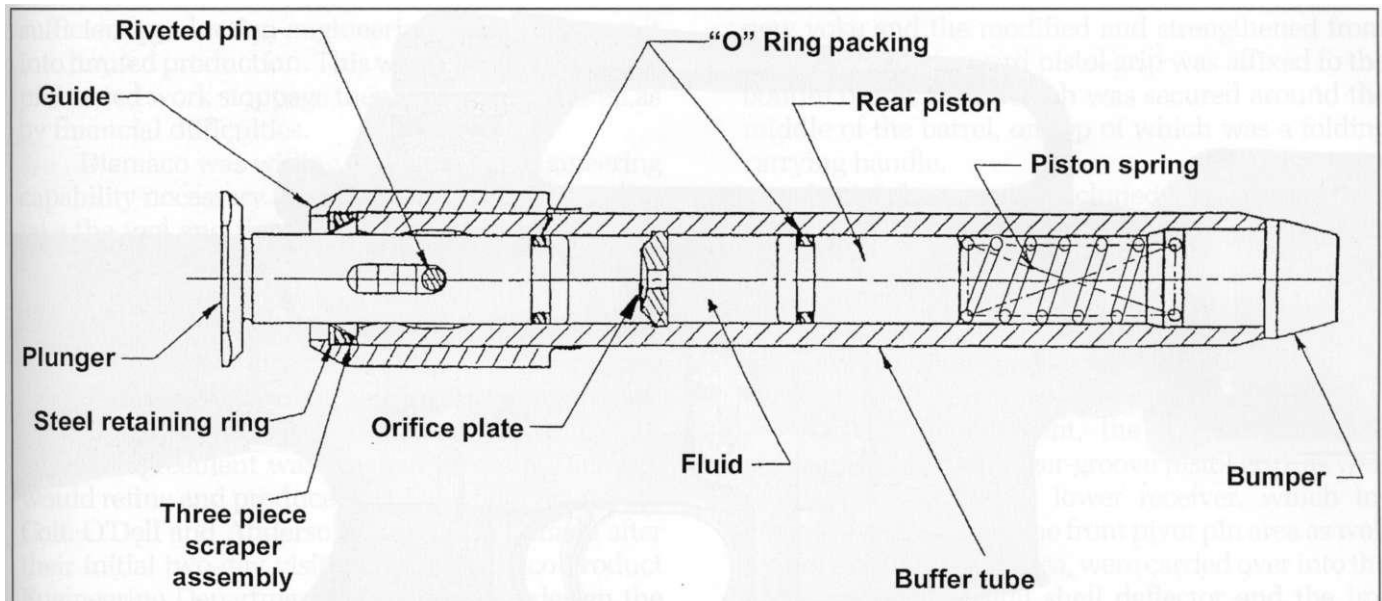
Thought was given to other preferable characteristics of a Light Support Weapon, in order to improve the reliability, durability and controllability of the LMG. With these goals in mind it was seen as desirable to decrease the high rate of fire of the particular gas operation mechanism used, which was running in

342 (right). Fig. 4 from US Patent no. 3,977,296, granted to Stanley Silsby and Henry Tatro in 1976, showing the slowdown effect on the rate of fire of the hydraulic buffer, from 920 rpm to 680 rpm.

US Patent Office







343. Left side section drawing of the LMG hydraulic buffer, with components labelled.

The LMG is the only member of the M16 family of weapons to ever have a hydraulic buffer installed as standard equipment. courtesy Diemaco, Inc.

excess of 950 rpm. Not only would this enhance controllability, but it would conserve ammunition and, most importantly, increase barrel life by keeping it from overheating.

Stanley Silsby and Henry Tatro had already designed a Hydraulic Buffer Assembly for which US Patent no. 3,977,296 had been granted on August 31, 1976. This buffer, originally designed as a rate reducer for the standard M16/M16A1 rifles, lay dormant until it was dusted off and utilized in the LMG, where it was found to decrease carrier rebound and provide more consistency between rounds on full-automatic fire.

The patent disclosure contains the following description of the function of the hydraulic buffer:

*. . . A recoil assembly of the invention includes a buffer having a tubular housing sealed at the rear end by a bumper adapted to engage the end of the receiver extension and by a piston at the front end adapted to engage the reciprocating bolt and carrier assembly. A spring, seated upon the bumper, urges a sliding seal in a forward direction. The*

*volume between the seal and the piston is filled with hydraulic fluid and contains an orifice, fixedly mounted in the housing, for furnishing hydraulic resistance to movement of the piston.*

*. . . the buffer travels with the end of the operating spring which is seated against the flange thereof. At the end of the recoil stroke, the momentum of the bolt and carrier assembly causes depression of the piston from its original extended position, thereby increasing the time interval of the recoil stroke. During the return stroke, the spring-loaded seal within the buffer pushes fluid through the orifice in the opposite direction, thereby to return the piston to its original position. Since the buffer of the invention has its interior volume between the seal and the piston filled with fluid, hydraulic resistance commences as soon as the piston is displaced.*

This buffer has been adapted to work in both 5.56mm rifles and 9mm SMGs and carbines. However, the only gun to feature the hydraulic buffer as standard equipment was the LMG.

## Further Design Features

### The Origin of the Fully-Adjustable Rear Sight

Henry Tatro designed the LMG expressly to be capable of putting out accurate, sustained fire at extended

ranges. The rear sight he developed for the LMG was therefore fully adjustable for windage and elevation,



344. Left side closeup of the LMG, showing markings and the fully adjustable rear sight.

This particular example has a Colt-marked lower receiver. Note the selector settings: SAFE and (full-automatic-only) FIRE.

with a dial to adjust the windage, which he felt would be much easier and faster than having to use a cartridge, adjustment tool, or a drift. Initial elevation adjustments went up to 500 meters, and eventually this range was extended to 800 meters.

As of this writing the LMG/LSW is only manufactured by Diemaco, so most of these guns have Canadian Diemaco markings.

The M16A1E1S (M16A2 early prototypes) were developed using the standard A1-style rear sight adjustable for windage only, but a slightly modified version of the LMG sight was found to fill the Marine Corps requirement for an improved M16 rear sight, and would later become standard on the new M16A2.

## The LMG Heavy Barrel and Other Features

To support its sustained fire mission the LMG utilized a heavy barrel, initially fitted with a standard flash suppressor and later with the M16A2 muzzle brake/compensator. Since the LMG fired from the open bolt, its upper receiver was not fitted with the forward assist assembly. The lower receiver, stock and pistol grip assemblies were standard M16A1 components. The early LMG had a much larger square-section handguard assembly for improved air

circulation, fitted with a forward pistol grip as well as an FN FAL-style carrying handle. An M60-style bipod was also fitted.

The LMG was originally issued with standard 20- and 30-round M16 magazines, but eventually the commercial BETAA-G 100-round dual-drum 'C' Mag was fitted. The selector lever had only two positions, SAFE and (full-automatic) FIRE.

## Second Thoughts from the Great White North

For various reasons, it fell to the Canadian firm Diemaco, Inc. of Kitchener, Ontario to complete the development of the Colt LMG. In the late summer of 1986, then-Project Leader Phil O'Dell and Ian Anderson, of Diemaco's Product Engineering Department, visited the Colt factory in order to examine the LMG

and determine how it could be readied for production in Canada.

During this period Colt's workforce was embroiled in a lengthy and contentious strike, and the Colt LMG had remained in the prototype stage for quite some time due to their not being able to free up

sufficient production-engineering resources to get it into limited production. This was complicated by the protracted work stoppage then under way, as well as by financial difficulties.

Diemaco was willing to devote the engineering capability necessary to complete the gun and undertake the tool and fixture designs necessary to move the LMG project forward. Colt never had a customer base large enough to make it worthwhile for them to go into full-scale LMG production, whereas at Diemaco, due to the modest size of their manufacturing operation and their small but loyal customer base, limited-quantity production was seen as ideal.

An agreement was reached whereby Diemaco would refine and produce the LMG under license for Colt. O'Dell and Anderson returned to Canada after their initial two-day visit, and the Diemaco Product Engineering Department proceeded to redesign the barrel and upper receiver assembly, beginning with the development of a new heavy barrel of increased diameter. Probably the most notable improvement was Diemaco's use of their trademark hammer-forged rifling in the barrel instead of the standard cold-formed button-rifling as used by Colt. The chamber and bore configurations were changed, and the exterior form was altered to accommodate the

new yoke and the modified and strengthened front sight. A sturdy forward pistol grip was affixed to the bottom of the yoke, which was secured around the middle of the barrel, on top of which was a folding carrying handle.

Initial changes also included a reworking of the handguards into an interchangeable (left and right instead of top and bottom) pair, with a snap-in heat shield instead of a riveted assembly, as well as a new handguard cap. Diemaco also developed a completely new folding bipod with adjustable legs for the LMG.

During development, the improved M16A2 stock assembly and finger-groove pistol grip, as well as the new reinforced lower receiver, which increases the strength of the front pivot pin area as well as the rear buffer tube area, were carried over into the LMG, and the integral shell deflector and the improved "Delta" ring were added to the upper receiver.

Diemaco increased both the inside and outside diameters of the gas tube, making it more durable to better deal with the additional heat produced by sustained full-automatic fire. The larger tube diameter in turn increased the internal volume of gas, which further lowered the temperature and operating pressure within the bolt carrier.

## The Proof of the (Canadian) Pudding

In December, 1986, before the LMG was put into production, Diemaco conducted a function and tolerance study of the firing mechanism, which resulted in several changes to the fire control parts. Some additional changes were also made to accommodate Diemaco's production capabilities and processes. On December 15, Colt sent up a prototype LMG, serial no. X24382, for reference purposes. Diemaco completed most of the design work in January, February and early March, 1987, and pre-production began on schedule after tool proving in early April, 1987.

During the week of April 1, 1987 a design review was held at Colt to freeze the design for the twelve pre-production units to be made at Diemaco in April.

Initial pre-production versions were sent to Colt for test and evaluation in the summer of 1987, followed by the beginning of series production in the fall and winter of 1987 and early 1988.

Production was a joint effort between Colt and Diemaco, with Diemaco producing the upper receivers and barrel assemblies, some fire control components, and the hydraulic buffer. Colt produced the lower receiver assemblies and performed all final assembly and test firing, other than barrel and bolt proof firing, which was performed at Diemaco.

Today, Diemaco is the only manufacturer in the world to produce an open-bolt light machine gun version of the M16 weapon system.

## Other Versions, Other Lands

The LSW-1, configured with a standard Auto firing (closed bolt) mechanism and a Canadian pattern flat-top upper receiver (fig. 321), has been in service with the Royal Dutch Marines since 1996 as their

section LSW. The Danish armed forces have purchased a similar model called the LSW-2.

Diemaco also produced a prototype LMG called the LSW99, which utilized a round plastic handguard, but this was never put into production.

## The Current-Production Diemaco LSW/LMG



345. Right side view of the Colt open-bolt-firing LMG (Light Machine Gun). Note the absence of the forward assist assembly.

Much of the final design work to get this LMG into production was carried out at Diemaco of Canada - the bipod, for example, was designed for US trials and adopted by the Royal Dutch Marines in their LSW-1.



346. Right side view of the LMG, shown partially stripped. With the exception of the more complex trigger group, the LMG disassembly process is identical to that of any other M16-type rifle.

Note (from rear) the hydraulic buffer, the extra-heavy barrel and longer, heavier gas tube; the yoke around the barrel that serves as an attachment point for the carrying handle and forward pistol grip; and the interchangeable handguards.

Current production versions of the Diemaco LMG/LSW are available in both open- and closed-bolt configurations.

The most recent changes have included the adoption of the standard Canadian pattern flat-top upper receiver, which can be supplied with or without a detachable carrying handle and/or Diemaco's proprietary TRI-AD I twin rail system, which clamps onto the front sight assembly for the attachment of accessories; an optional bayonet lug, and a new barrel yoke which includes a mounting post for a quick-detachable Parker Hale-style bipod which may be removed by the operator when not required.

### LMG/LSW Specifications

Overall length	39.6"
Barrel length	20"
Weights:	
Basic	11.8 lbs.
w/Adjustable Detachable Sight Handle (ADIS)	12.1 lbs.
with bipod and loaded 30-round magazine	13.9 lbs.
Max. effective range	875 yards
Rates of Fire:	
Cyclic	600 to 800 rpm
Automatic	150 to 200 rpm
Sustained	65 rpm

## The Colt CAR



347. Left side view of the Colt Automatic Rifle (CAR), produced for US military trials in 2001.

This version features the flat-top upper receiver, the newly-developed removable bipod and bayonet lug, and the Diemaco TRI-AD I twin rail attached to the front sight

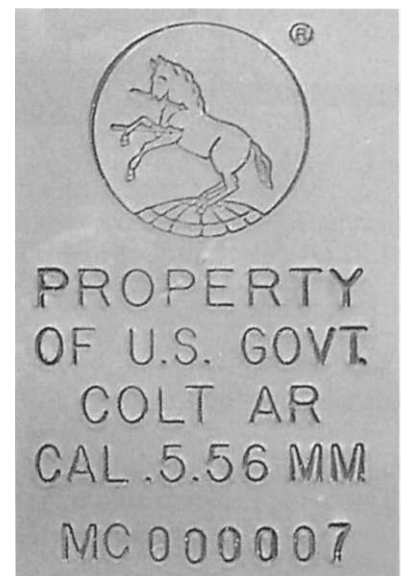
In 2001 Colt's requested that components for a number of selective-fire, heavy-barrelled rifles be produced by Diemaco in the LMG/LSW configuration with the open-bolt firing mechanism and no forward assist, and with MIL-STD-1913 rails on their flat-top receivers, for US military trials. These were assembled on Colt-manufactured lower receivers and given the designation "Colt Automatic Rifle" (CAR), with their lower receivers marked "Colt AR".

assembly. It is also fitted with a BETA A-G 100-round 'C' Mag.

Note the absence of the standard LMG/LSW carrying handle. courtesy Diemaco, Inc.

348 (right). Left side closeup of the CAR receiver, showing markings applied by Colt.

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# Part III: A Retrospective of Colt Commercial Developments

## *Chapter Ten*

# The Civilian AR-15

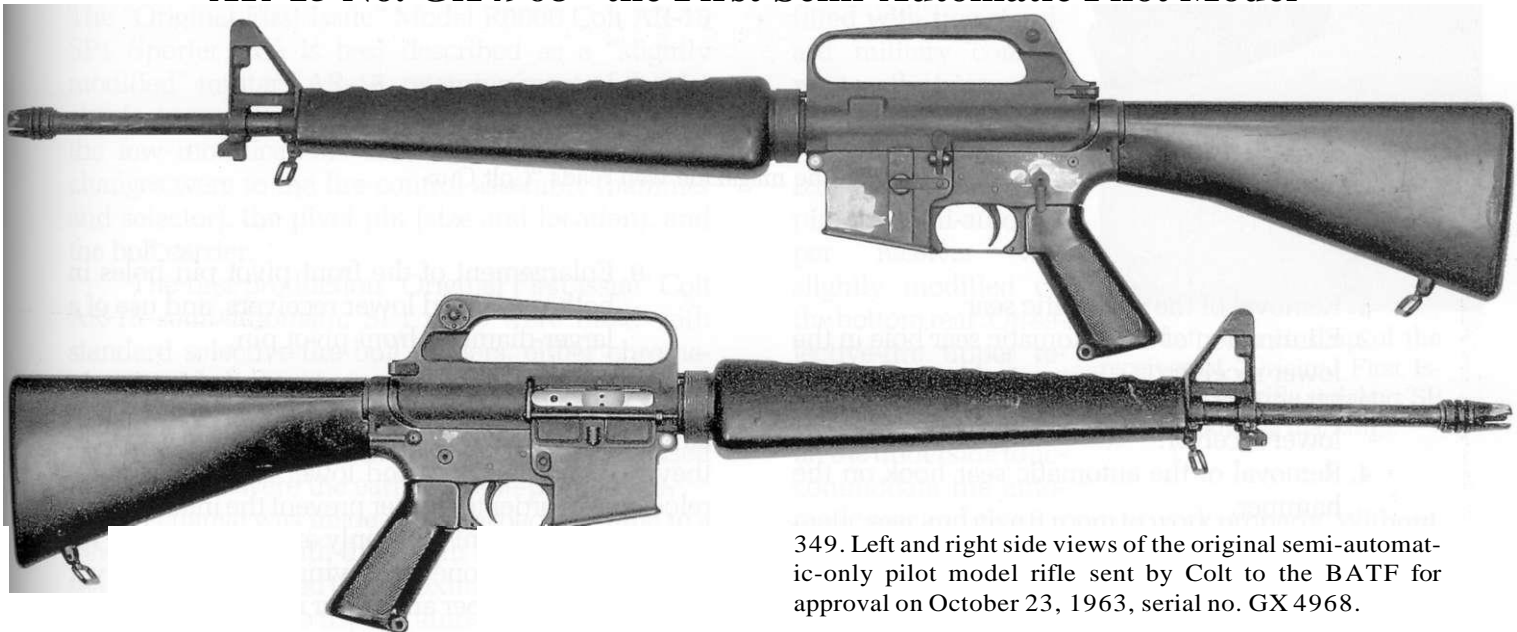
**I**n the early 1960s, while Colt's was struggling to sell the AR-15 to the US Armed Forces, they had realized that there might be some interest in a semi-automatic-only AR-15 on the civilian market. After all, it was and still is not uncommon in the firearms industry for civilian sales to help finance and sustain

a weapon system through the expensive "growing pains" of development and refinement.

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## The Initial Ten Changes to the Military AR-15

### AR-15 No. GX4968 - the First Semi-Automatic Pilot Model



349. Left and right side views of the original semi-automatic-only pilot model rifle sent by Colt to the BATF for approval on October 23, 1963, serial no. GX 4968.

Colt's began the process of seeking approval to produce a semi-automatic only variation of their AR-15 rifle for commercial sale by submitting a prototype semi-automatic only version, serial no. GX4968 (Gun Experimental no. 4968) to the Treasury Department

on October 23, 1963. A selective-fire rifle was also provided for comparison purposes.

Colt listed the following nine changes which they had made to the semi-auto version to prevent its re-conversion to full-automatic fire:





350. Right side closeup of the original semi-automatic-only pilot model, serial no GX 4968. The faint two-line hand-stamped marking on the magazine well reads "Colt Gun Room".

1. Removal of the automatic sear.
2. Elimination of the automatic sear hole in the lower receiver.
3. Elimination of the automatic sear well in the lower receiver.
4. Removal of the automatic sear hook on the hammer.
5. Removal of the automatic sear trip notch from the bottom rear portion of the bolt carrier.
6. Modification of the selector to eliminate the automatic setting.
7. Elimination of the "AUTO" position identification marking on the lower receiver.
8. Mechanical restriction of selector lever movement to two positions only: SAFE and FIRE.

9. Enlargement of the front pivot pin holes in both upper and lower receivers, and use of a larger-diameter front pivot pin.

On October 25, 1963, the Treasury Department advised Colt that in addition to these nine changes, they wanted the upper and lower receiver pin lugs relocated, in order to further prevent the interchangeability between semi-auto-only and selective-fire receivers. This was done by moving the enlarged pivot pin holes in the upper and lower receivers down and rearward.

Permission was granted on December 10, 1963 for Colt to commence production of the semi-automatic only AR-15, embodying the above ten changes. On January 2, 1964, the initial "Original First Issue" Colt AR-15 Sporter rifles were released for commercial sale.

## The "Original First Issue" Model R6000 Colt AR-15 SP1 Rifle



351. left and right side views of the "Original First Issue" SP1 Sporter rifle, introduced on January 2, 1964.

The "Original First Issue" Model R6000 Colt AR-15 SP1 Sporter rifle is best described as a "slightly modified" military AR-15, retaining most of the design features of the early military AR-15/M16 rifle. Of the few modifications made, the most significant changes were to the fire control assembly (hammer and selector), the pivot pin (size and location), and the bolt carrier.

The first production "Original First Issue" Colt AR-15 semi-automatic SP1 rifles were fitted with standard selective-fire bolt carriers, either chrome-plated or blackened by means of a manganese phosphate process. These were all "smooth-sided" (without the forward assist notches). The bolts used in these rifles were the early chrome-plated type.

A change was made at an unspecified time to a new bolt carrier, with the length from the rear to the sear trip area reduced to approximately 1.079", which was not sufficient to trip the auto sear. The insides of these bolt carriers were not chrome-lined, nor was the carrier key.

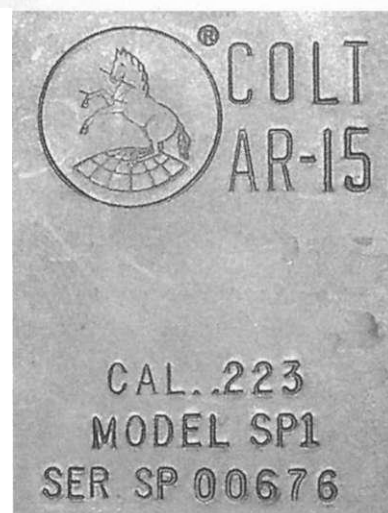
For reasons of component standardization, and the comparative innocence of the time frame in which these original Sporter models were released, it had been decided that these rifles would not be capable of re-conversion to selective-fire even when

fitted with two standard military components—the trigger and the disconnecter.

Aside from utilizing the larger pivot pin, the semi-auto upper receiver was slightly modified on the bottom rear. On selective-fire upper receivers, there is a small cutout (fig. 434) on the underside to accommodate the automatic sear and give it room to work properly. Without this cutout the receiver might not close on a selective-fire lower, and if forced it could damage the automatic sear.

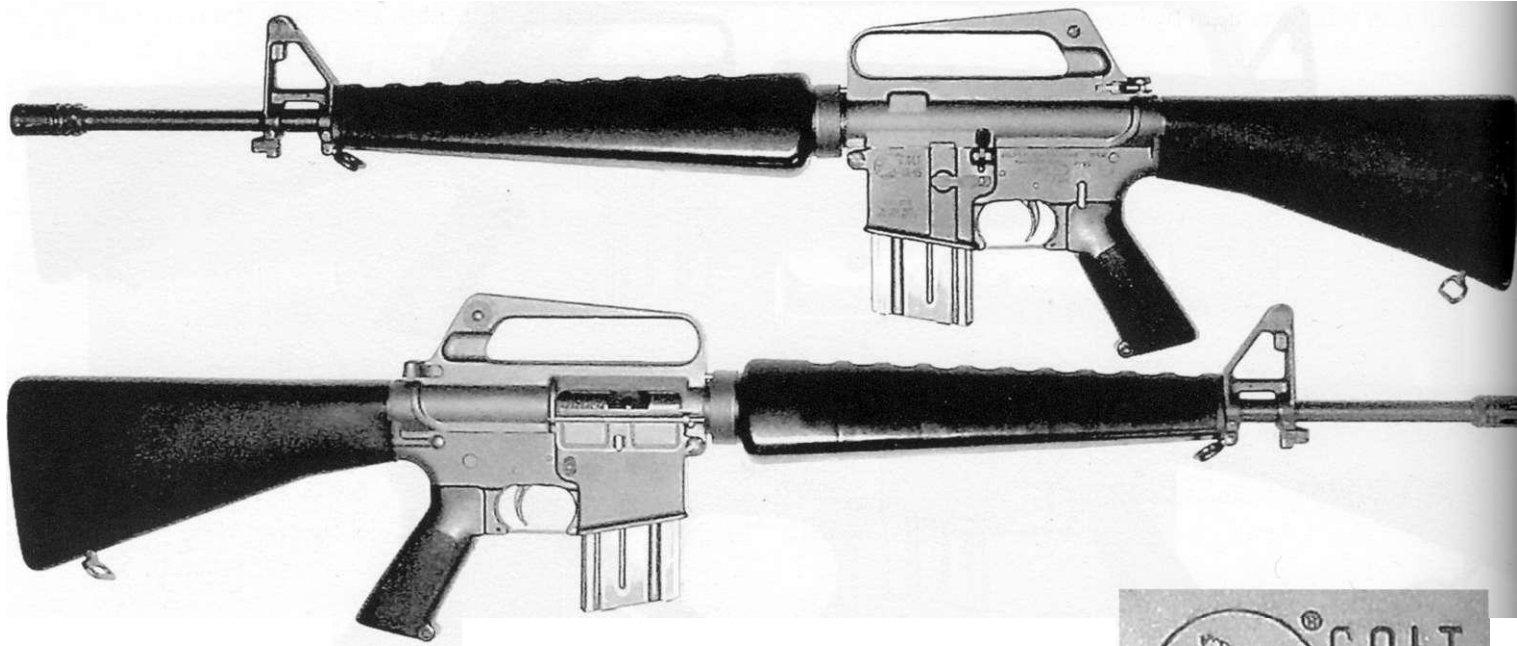
This rifle utilized the original Fibrite stock with the rubber buttplate and hinged rear sling swivel.

The barrels on the Original First Issue Colt AR-15 SP1 rifles were rifled with one turn in 12", as had by then been adopted on the M16/M16A1 rifles, and fitted with the early "three-prong" flash suppressors. The bore and chamber were not chrome-plated.



352. Left side closeup of the receiver of "Original First Issue" Colt SP1 rifle serial no. SP 00676, showing markings.

## The "Later Version" SP1 Rifle, with Redesigned Fire Control Group



With the growing popularity of the civilian AR-15 SP1 and the adoption of the M16/M16A1 rifles in 1967, Colt took some of those advances and incorporated them into their Later Version AR-15 SP1 rifle, which was still known as the Model R6000.

The Later Version Colt AR-15 SP1 bolt carrier was updated to the then-current M16A1 configuration, with a blackened exterior (utilizing the manganese phosphate process) and having the forward assist notches, with the inside of the bolt carrier and carrier key chrome-lined. The sear trip area was further cut back over that of the Original First Issue bolt carriers. The area around the rear of the firing pin was also removed, exposing the second head of the firing pin. This modification was implemented on April 14, 1969 for safety reasons, as discussed below.

Colt's also changed the entire fire control group to a new semi-automatic-only configuration, eliminating all fully-automatic components. The new components were made easy to identify, and designed to increase the safety of the rifle should anyone attempt to convert it to function as a "slam-fire" automatic, or if the disconnecter was to malfunction.

These and all future production AR-15 Sporter rifles were fitted with a slightly modified hammer, identified by the notch cut in the top front edge. The

purpose of this notch, in conjunction with the later version AR-15 bolt carrier with both heads of the firing pin exposed, was to prevent slam-fire whether by malfunction or deliberate attempt to convert the rifle by removing, damaging or disengaging the disconnecter to obtain full-automatic fire. When the rifle is fired in this manner, the theory is that after the first round is fired, the bolt carrier moves to the rear, riding over the hammer as usual. After the fired cartridge case is ejected and the bolt carrier and bolt move forward, the notch on the front of the hammer, no longer held back by the removed or damaged disconnecter, would engage the second or largest head on the firing pin, catching and stopping the bolt carrier, preventing the chambering of a new cartridge, and preventing the rifle from firing.

In addition, the tail was removed from the disconnecter, to prevent its acting during fully-auto-



354. Left side closeup of the receiver of a later Model R6000 SP1 rifle, serial no. SP 60232, showing markings.

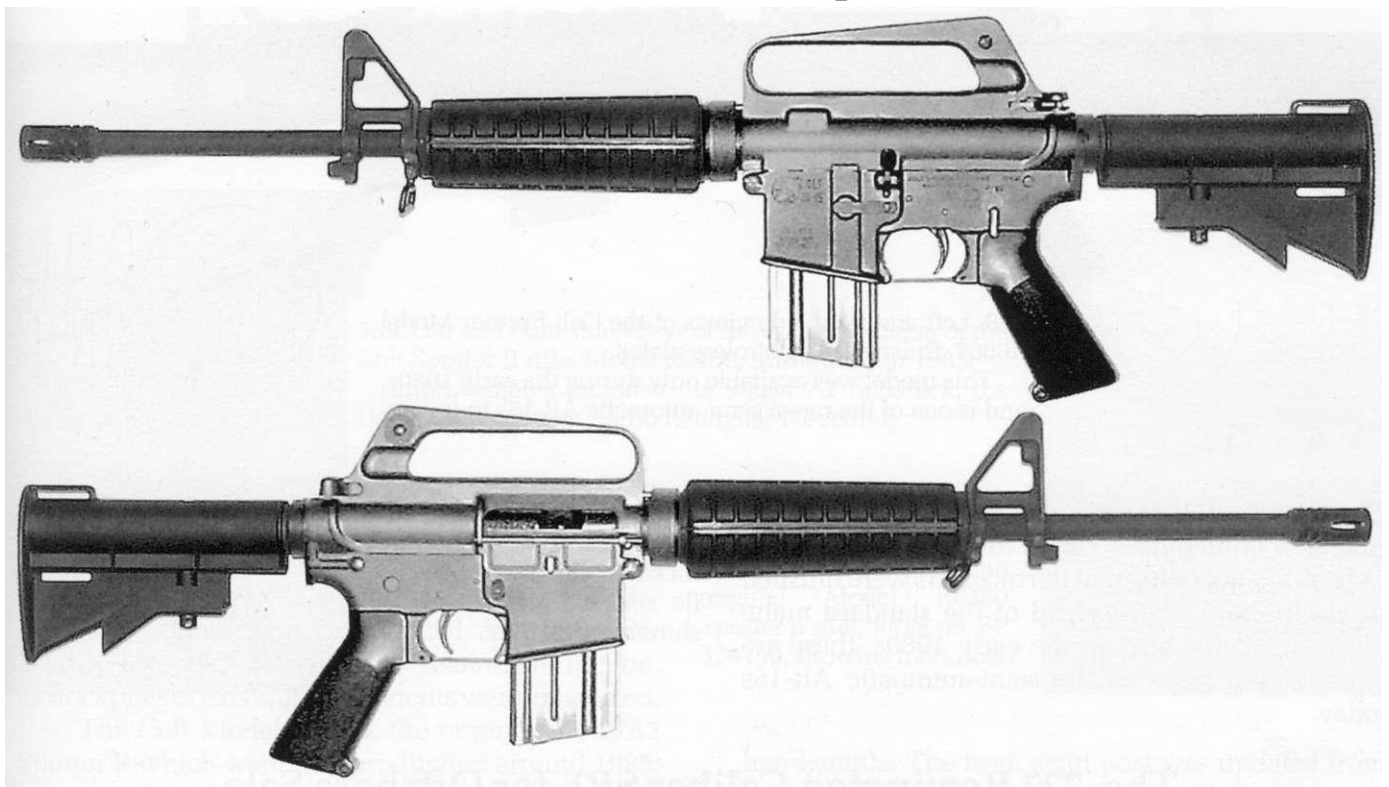
matic fire, when the selector lever pushes downward on the tail of the disconnecter, disengaging it so the hammer will be caught by the auto sear instead of the disconnecter.

The semi-auto trigger was modified so it would not accept the selective-fire disconnecter. This was accomplished by shortening the overall length and leaving the rear portion solid. The disconnecter spring location was moved forward, to accommodate the new disconnecter.

The later SP1 Sporter rifles were fitted with the newer stock, with the trap door in the buttplate for storage of cleaning supplies, as well as the new rear sling swivel, which was fixed and no longer movable.

The barrels on the Later Version Colt AR-15 SP1 rifles were still rifled with a twist of one turn in 12", and the bore and chamber were chrome-plated on the newer rifles. The more effective "three-prong" flash suppressor was replaced by the enclosed "bird cage" design.

## The Colt Model R6001 AR-15 Sporter 1 Carbine



355. Left and right side views of the Colt AR-15 Model R6001 SP1 Carbine, introduced on September 27, 1977.

The AR-15 SP1 Carbine (Model R6001) was introduced on September 27, 1977. The only two changes over the standard AR-15 SP1 rifle were the addition of the telescoping buttstock and the shortened 16" barrel.

As discussed in Chapter Twelve, additional modifications were made to the carbine a year later,

on September 20, 1978, when a newer disconnecter was designed with a longer back end to provide additional spring load, as well as a new trigger to accommodate it. This was to increase the reliability of the disconnecter, due to the higher bolt and carrier velocity of the carbine.

## Early Scoped Options

Colt offered the standard AR-15 Sporter 1 rifle fitted with the Colt 3X scope as the Model R6002, and the SP1 Carbine fitted with the Colt 3X scope as the

Model R6003. Another combination offered as the Model 6004 was the AR-15 SP1 rifle factory-fitted with the Tascorama scope.

## The Electroless Nickel AR-15 Sporter 1

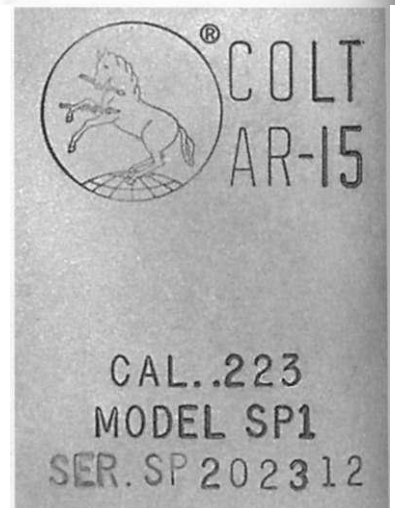


356. Left and right side views of the Colt Sporter Model R6007, finished in electroless nickel.

This model was available only during the early 1980s, and is one of the rarest semi-automatic AR-15s today.

Colt offered another version of their AR-15 Sporter 1 rifle on a limited basis called the Model R6007, the only difference being that the receivers were finished in electroless nickel instead of the standard matte black. Available only in the early 1980s, these are amongst the rarest of the semi-automatic AR-15s today.

357 (right). Left side closeup of the receiver of electroless nickel Model R6007 SP1 rifle serial no. SP 202312, showing markings.

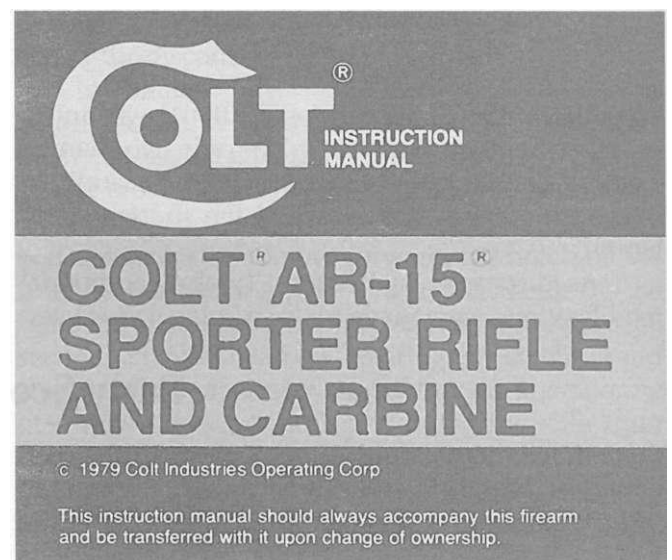


## The .222 Remington Caliber SP1, for Offshore Sale

Some countries throughout the world permit the private ownership of firearms, but have restrictions on civilians owning military caliber rifles. Colt developed their AR-15 SP1 rifle in the commercial .222 Remington caliber as the Model R6010, for export sales. These were not commercially available in the United States, and this caliber would not be offered domestically until the introduction of the AR-15A2 Government Model (Model R6510).

358 (right). The cover of the 1979 instruction manual for the Colt Sporter AR-15 rifle and carbine.

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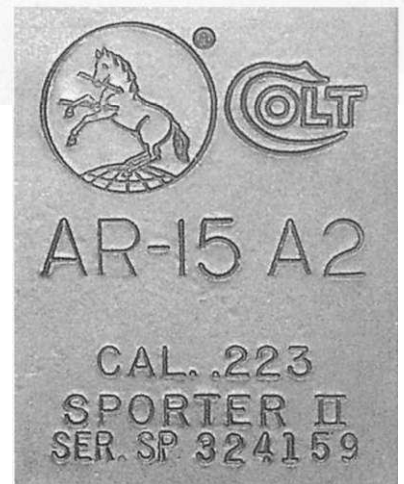


## The AR-15A2 "Sporter II" Series



359. Left and right side views of the original version of the Colt Sporter II rifle, Model R6400, introduced in 1985.

Improvements included the longer A2 buttstock, the Delta ring, and new round handguard assembly.



360 (right). Left side closeup of the receiver of an original Model R6400 Sporter II rifle, serial no. SP 324159, showing markings.

In 1985, shortly after the Department of Defense had adopted the M16A2, Colt initiated a program designed to update their commercial AR-15 Sporter rifle line throughout the next few years of production, as stockpiles of existing components were exhausted.

The Colt Model R6400, the original AR-15A2 Sporter II which went into production around 1985, was an update of the AR-15 SP1 rifle. The first examples utilized existing AR-15 SP1 upper receivers, without the forward assist assembly. This rifle had the new M16A2-profile fast (one turn in 7") rifling twist barrel, fitted with the new-style muzzle brake/compensator. The slip ring was replaced with the new canted "Delta" ring, for easier removal of the

handguards. The front sight post was updated from the round five-position front sight to the new square four-position front sight, and the rifle was fitted with the new half-round interchangeable handguards.

On the lower receiver the original Fibrite stock was replaced with the 5/8"-longer foam-filled nylon M16A2 stock assembly, as well as the new A2-style finger-groove pistol grip.

## The Sporter II Model 6401, with "Teardrop" Forward Assist

The next update, the Model R6401, followed within a year. The only change was the addition of the "Teardrop" forward assist assembly.



## Survival means different things to different people.

For a rancher in the high country of Wyoming, being self-sufficient can mean keeping varmints from his sheep. For a rugged individual in the wilderness, it means being prepared for any eventuality. For both these men, and thousands like them, there's only one gun. The Colt AR15A2.

The reasons are as simple as they are plentiful. First, it's the rifle they're already familiar with. The AR15A2 Sporter II is the civilian version of the

battle proven and recently improved U.S. military issue M16A1 for which ammo is readily available. Second, it's a lightweight, rugged, 223 caliber, high-powered rifle that's as accurate as it is dependable. Finally, it's a Colt.

If you already own an AR15 and you want to trade up to the new A2 Sporter II, or if you simply want to own the best 223 Rem. semi-automatic rifle on the market, see your Colt dealer today.

223 rifle standard with forward bolt assist. Collapsible stock carbine now available in 9mm and 223 caliber.

**COLT** A Heritage of Fine Craftsmanship  
Hartford, CT 06101

Be a safe shooter—never chamber a round until you are ready to shoot. Always read and follow the instruction manuals, which accompany each firearm. Free Colt catalogs and instruction manuals are also available from the factory on request.

361. One of the earliest advertisements for the new updated AR-15A2 Sporter II Model R6401 rifle with "tear-

drop" forward assist.

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## The AR-15A2 Carbine

The AR-15A2 Carbine, Model R6420, embodied four major changes over the earlier AR-15 SP1 Carbine. The first was the addition of the "teardrop" forward assist assembly, and the second was the addition of the new A2-style finger-groove pistol grip. The third was the change from the original one turn in 12" rifling to the new, faster one turn in 7" rifling. The

fourth change was replacing the A1-style bird cage flash suppressor with the new A2-style muzzle brake/compensator.

The AR-15A2 Carbine was also available with the A2-style fully adjustable rear sights as the Model R6421.

## The Heavy Barrel AR-15A2 HBAR Sporter



362. Left and right side views of the AR-15A2 HBAR Sporter, Model R6600, introduced in 1985.

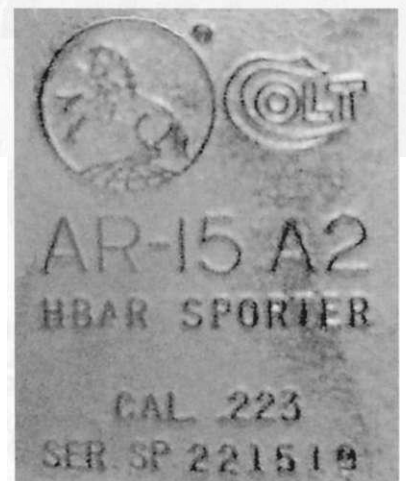
This rifle features the fully-adjustable A2 rear sight, the "teardrop" forward assist, and the case deflector on the upper receiver.

Colt introduced their new AR-15A2 Match HBAR (Heavy Barrel AR, Model R6600) in mid-1985, embodying three distinctive upgrades over the AR-15A2.

First, the AR-15A2 HBAR incorporated the new M16A2 style rear sight, which was adjustable by hand without the use of a tool or cartridge, for windage as well as elevation.

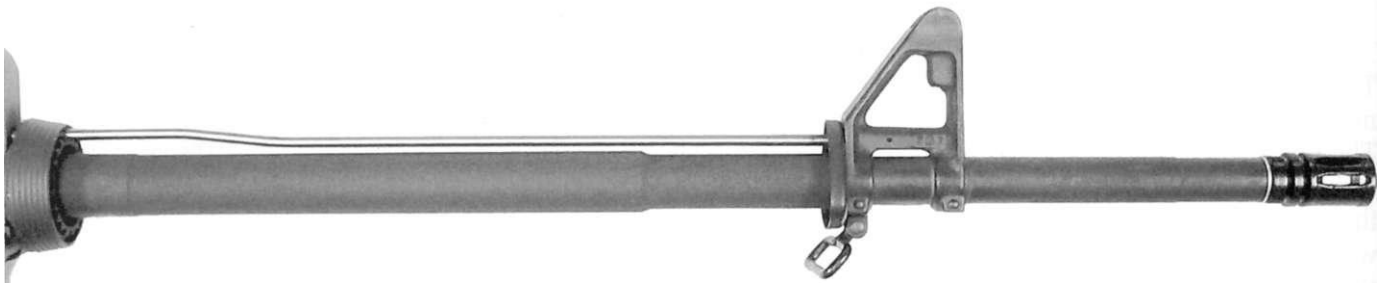
Secondly, the upper receiver was equipped with the integral M16A2 "Brunton Bump" shell deflector behind the ejection port, to deflect the fired cartridge case away from the face of a left-handed shooter.

363 (right). Left side closeup of the receiver of AR-15A2 HBAR Sporter rifle serial no. SP 221510, showing markings.



The third upgrade was Colt's new chrome-bore Heavy Barrel, which increased accuracy as well as weight.

Colt also sold the AR-15A2 Match HBAR with a .22 Long Rifle caliber conversion kit enclosed in the box, as their Model R6600K.



364. Right side view of the new AR-15A2 HBAR heavy barrel assembly.

Note that this barrel is heavy all the way through, rather

than just heavy from the rear of the front sight assembly forward as on the military M16A2.

### The Colt AR-15 9mm Carbine



# New from Colt

## Introducing the compact Colt AR-15 9mm Carbine.

Colt's new AR-15 9mm Carbine is the latest addition to the M16/AR-15 series used by law enforcement and military forces throughout the world. With the new AR-15 9mm Carbine, you'll eliminate

hours of training and familiarization that other 9mm systems require. Now police departments can expand their selection of calibers, while reducing the risk of confusion.

The Colt AR-15 9mm Carbine features collapsible buttstock, 20-round magazine, ribbed round handguard, and 16" barrel. For ordering information, contact your authorized Colt distributor.

365. An early Colt advertisement for their new AR-15 9mm Carbine. ©2002-2003 Colt Archive Properties LLC. Used with permission, all rights reserved.

In 1985 Colt introduced the newest member of the AR-15 Sporter "family": the Colt AR-15 9mm Carbine (Model R6450), based on their new submachine gun line and firing the 9mm NATO cartridge. Most Colt 9mm Carbines and SMGs utilize the M16-style upper

receiver without the forward assist assembly, the major difference being the 16" barrel with one turn in 10" rifling installed on the Carbine instead of the shorter barrel lengths offered on the military and law enforcement SMGs.

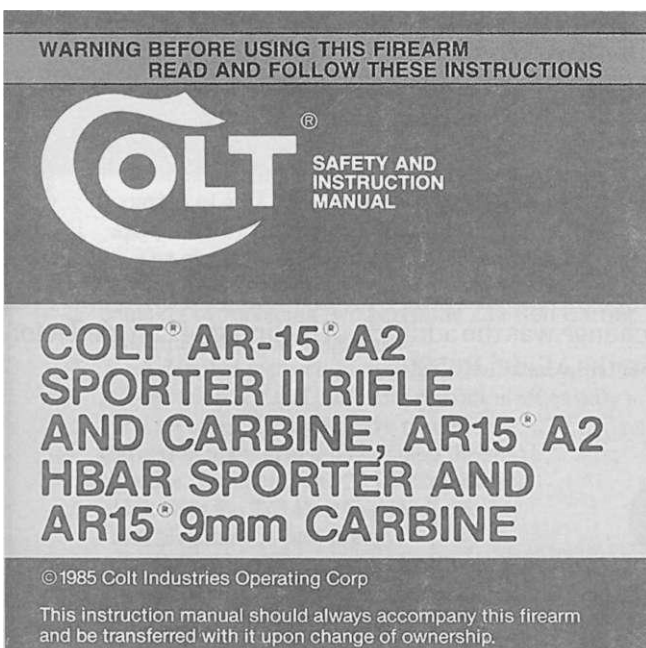


366. Left and right side views of the original version of the Colt AR-15 9mm Carbine, with 16" barrel.

Note the absence of plastic gas deflector on this early model.



367 (right). Left side closeup of the receiver of early AR-15 9mm Carbine serial no. TA 02352, showing markings.



368. The cover of the 1985 instruction manual for the Colt AR-15 A2 Sporter Rifle and Carbine, the HBAR Sporter and the 9mm Carbine.

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This new carbine utilized a blowback mechanism instead of the traditional locked-breech gas operation required for the more powerful 5.56x45mm NATO cartridge. In appearance the 9mm carbine looks identical to the AR-15 A2 Carbine, with the exception of the thin magazine which held 20 rounds of 9mm NATO ammunition. A 32-round magazine was also available.

The first production runs of 9mm Carbines and SMGs did not have the plastic gas deflector. Colt offered this feature as an upgrade to all customers who had purchased the early versions, and all future production carbines and SMGs came with the deflector factory-fitted.

## The Updated AR-15A2 Sporter II



369. Right side views of two versions of the AR-15 Sporter II rifle.

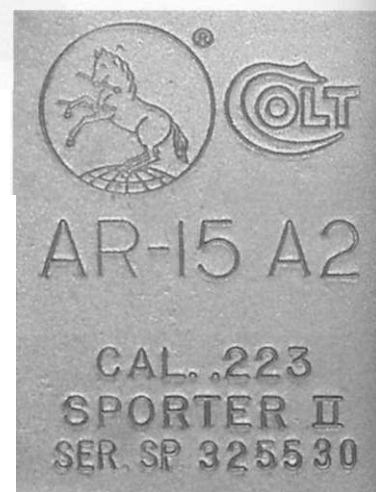
Above: the Model R6401, with forward assist but no case deflector.

Below; the Model R6500, with integral case deflector.

The new AR-15A2 Sporter II (Model R6500), an update of the original AR-15A2 Sporter II rifle, was first introduced in Colt's 1989 catalog. The only additions were the switch to the round forward assist button, and the addition of the integral spent shell deflector.

Over time, the AR-15A2 Sporter II was basically offered in three variations, which affected only the upper receivers. The receiver used on the original Sporter I (Model 6400) had no forward assist. As the remaining inventory of these early receivers was

370 (left). Left side closeup of the receiver of AR-15 Sporter II rifle serial no. SP 325530, showing markings.



depleted, Colt switched to the A1-style upper with forward assist in the Model 6401. The third and final change was the addition of the integral case deflector, in the Model R6500.

371 (facing page). A 1989 fact sheet describing the Colt AR-15 .22 Long Rifle conversion kit.

This was offered as an accessory or as part of a "package" right in the box with several Colt Sporter models.

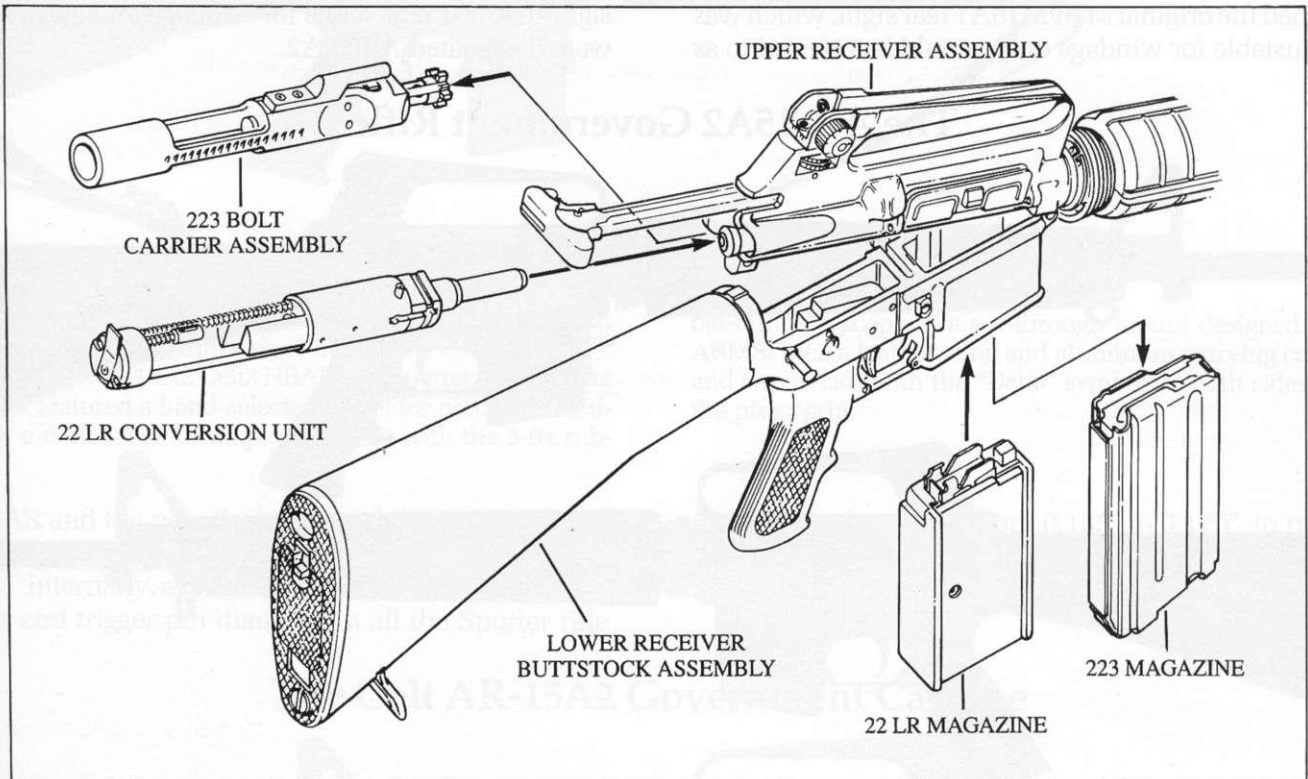
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# AR-15<sup>®</sup> CONVERSION KIT™

Caliber: 22 LONG RIFLE



## FACT SHEET

You can now convert your 223 caliber AR-15<sup>®</sup> sporting rifle so that it will accommodate 22 long rifle ammunition.

Colt is offering a 22 LR Conversion Kit™ which consists of a 22 LR Conversion Unit and a 22 LR Magazine with a capacity of 10 rounds.

The changeover from centerfire to rimfire capability is simple and easy to perform and can be accomplished quickly by replacing two parts, the 223 Bolt Carrier Assembly and the Magazine.

A detailed instruction manual is included with the Conversion Kit and the entire operation takes only a few seconds, once you have read the instruction manual and understand the sequence. Replacing the 22 LR Conversion Unit with the 223 Bolt Carrier Assembly and Magazine is just as easy.

All Colt manufactured 223 caliber AR-15 sporter models accommodate this new 22 LR Conversion Unit from Colt.

The kits will be sold through gun dealers across the country and will be available in mid-1989.

With the 22 LR Conversion Kit your AR-15 sporter becomes a more versatile rifle, capable of being chambered for the economical 22 long rifle cartridge which sells for about .04¢ per round, a fraction of what it would cost per round for the more expensive 223 cartridge.

The 22 long rifle cartridge offers a variety of short range training, plinking, target shooting, varmint, and hunting opportunities. You actually have two guns in one when you own a 22 Long Rifle Conversion Kit for your AR-15 sporter.

The AR-15 sporter is recognized by outdoorsmen everywhere as a superior rifle for the individual who wants a lightweight, rugged, sporting gun that has a reputation for accuracy and dependability. Now the AR-15 sporter can accommodate two of the most popular cartridges in the world.



Hartford, CT 06101

Warning: Be a safe shooter — never chamber a round until you are ready to shoot. Always read and follow the instruction manuals which accompany each firearm. Ask your area's law enforcement agency about gun ownership and defense laws. Free instruction manuals and Colt catalogs are also available from the factory on request.



## Changing the AR-15 Model Designations

At the beginning of the 1990s the AR-15 model designations were changed. All AR-15s which retained the original M16/M16A1 rear sight, which was adjustable for windage only, would be referred to as

"Sporters". The newer AR-15 rifles offered in the M16A2 configuration, which included the new rear sight that was adjustable for windage and elevation, were designated AR-15A2.

### The AR-15A2 Government Rifle



372. Left and right side views of the AR-15A2 Government Rifle, which was identical to the Match HBAR, minus the heavy barrel.

The AR-15A2 Government Rifle (Model R6550) is identical to the Match HBAR, minus the heavy barrel. The AR-15A2 Government Rifle incorporates the standard profile military issue 20" barrel, rifled with one turn in 7". Colt also sold some AR-15A2 Government models with .22 Long Rifle caliber conversion kits as the Model R6550K.

Colt's also introduced limited numbers of their AR-15A2 rifle chambered for the popular .222

Remington caliber cartridge as their Model R6510, which was identical to its .223 caliber counterpart except for the .222 caliber chambering.

One additional .222 caliber rifle was the Colt Sporter Target (Model Number R6511), which was offered for export only, fitted with the auto sear block (discussed below).

### The Colt Delta HBAR

In 1987, Colt introduced their new Delta HBAR (Model R6600DH). This was a finely-tuned AR-15A2 HBAR right out of the Colt Custom Shop. Delta HBAR features include hand-selected barrels for precision accuracy, and a removable cheek piece for use with the 3-9x rubber-armored scope with a see-through mount designed by ARMS, Inc. The rifle also came with a leather sling and aluminum carrying case, and

two decals with the "Delta" symbol on both left and right sides of the pistol grip.

In 1991, in keeping with the general change in model designations, the AR-15 nomenclature was dropped and the new "Sporter" line was introduced. Now the Delta HBAR was called the Sporter Match Delta HBAR, Model Number R6601DH. The only external difference between the AR-15A2 Delta



373. Right side view of the Colt Sporter Match Delta HBAR (Model R6601DH), introduced in 1987.

Both the AR-15A2 Delta HBAR and Sporter Match Delta HBAR featured a hand-selected barrel for precision accuracy, a removable cheek piece for use with the 3-9x rub-

ber-armored scope in a see-through mount designed by ARMS, Inc., a leather sling and aluminum carrying case, and two decals with the "Delta" symbol on both sides of the pistol grip.

HBAR and the new Sporter Match Delta HBAR was the removal of the bayonet lug.

Internally, as further discussed below, the hammer and trigger pin diameter in all the Sporter rifle

models was increased from 0.155" to 0.170", to prevent any full-automatic parts from being installed in these lower receivers.

## The Colt AR-15A2 Government Carbine



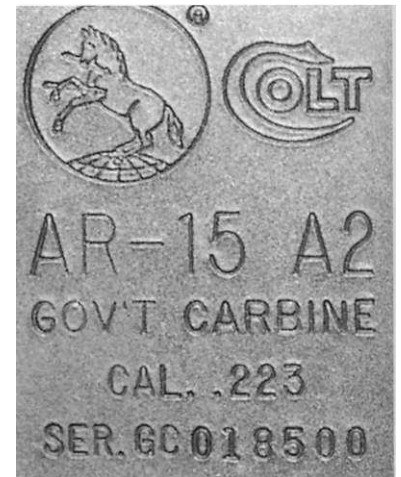
374. Left and right side views of the Colt AR-15A2 Government Carbine (Model R6520), fitted with the fully adjustable M16A2 rear sight and the integral spent cartridge case deflector.

## 248 Colt Curbs Civilian Sale of AR-15/Sporter Rifles

In 1988, Colt introduced an upgrade to their AR-15A2 Carbine. The new AR-15A2 Government Carbine (Model R6520) was fitted with the fully adjustable

M16A2 rear sight and the integral spent cartridge case deflector.

375 (right). Left side closeup of the receiver of AR-15A2 Government Carbine serial no. GC 018500, showing markings.



## Colt Curbs Civilian Sale of AR-15/Sporter Rifles

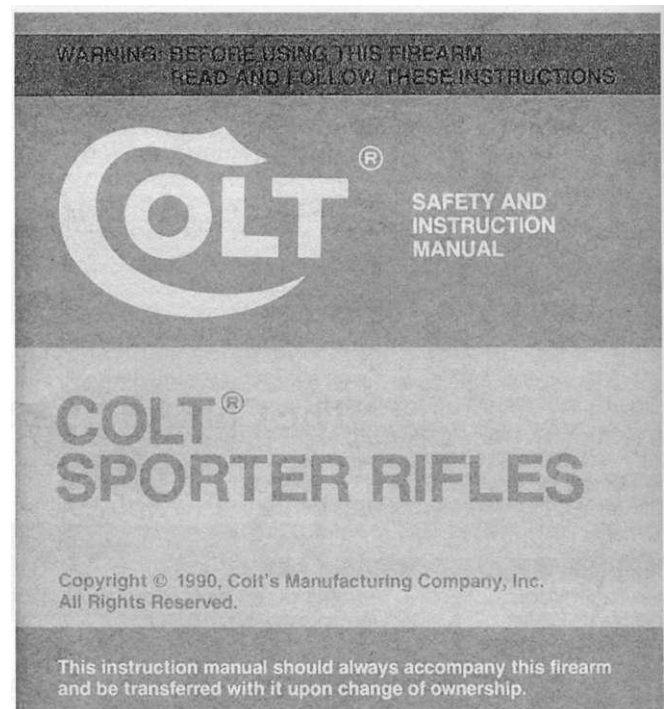
In early 1990, due to extreme pressure from the anti-gun coalition, Colt Industries/Colt Firearms Division made the decision to restrict all sales of AR-15 rifles, as well as the new Colt Sporter rifles, to law enforcement and military agencies only.

This was an extremely unpopular move in the eyes of the civilian gun owners of the United States who were fighting to keep the right of ownership of military-style semi-automatic-only rifles, and after the restructuring of the firm in 1991, Colt's Manufacturing Company resumed the commercial sale of Sporter series rifles and carbines, with the addition of a further modification intended to make these arms incapable of being converted to selective fire.

376 (right). The cover of the 1990 Safety and Instruction Manual for Colt Sporter Rifles.

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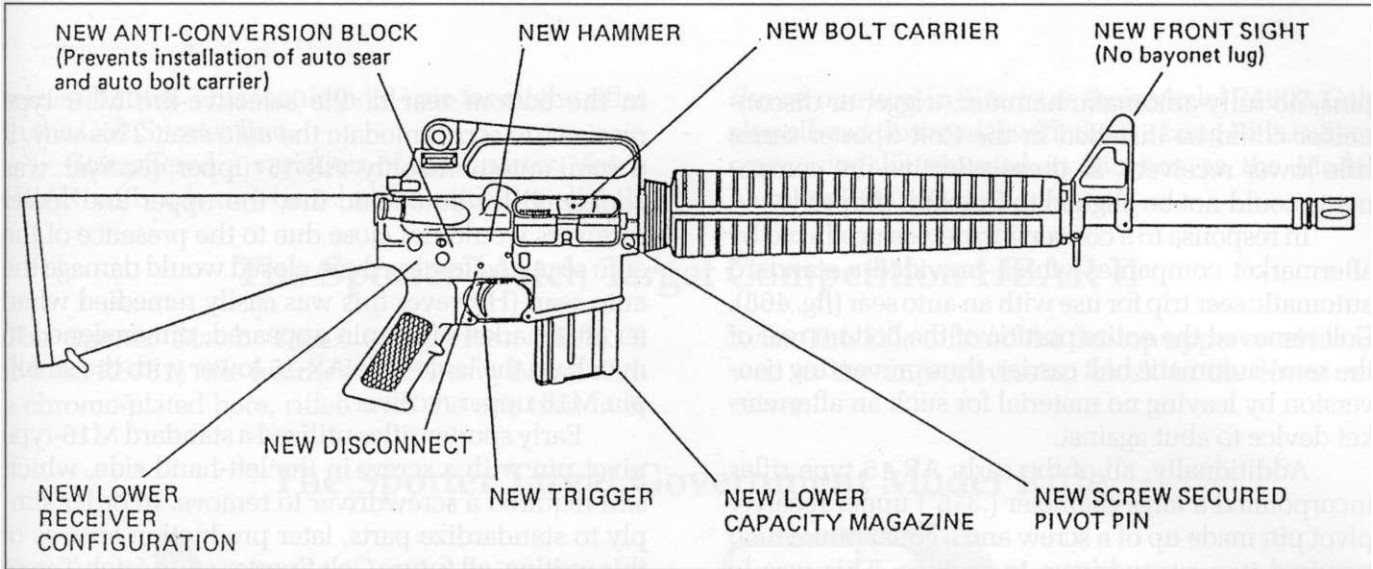
## The Anti-Conversion Auto Sear Block

Aside from omitting the bayonet lug, the most important change was the introduction of a permanent hardened steel auto sear/anti-conversion block, designed by Horace "Mac" McCoan and James Collier of Colt's Manufacturing Company, Inc. and granted US Patent no. 5,183,959. A larger-diameter hole was made above the selector where the auto sear would normally be located, and the auto sear block was installed and held in place with three hardened steel pins.

This block accomplished two things. First, it made it impossible to install an auto sear. Even if the sear block was removed, the auto sear could not be properly aligned due to the larger diameter of the hole in the auto sear area.

Secondly, if a fully-automatic bolt carrier was installed, the receivers would not close due to the height and location of the upper portion of the sear block. In some of the earlier Sporter rifles the receivers would close, however the bolt carrier would bind, making it extremely difficult to operate. An AR-15 bolt carrier must be used for the rifle to operate properly.

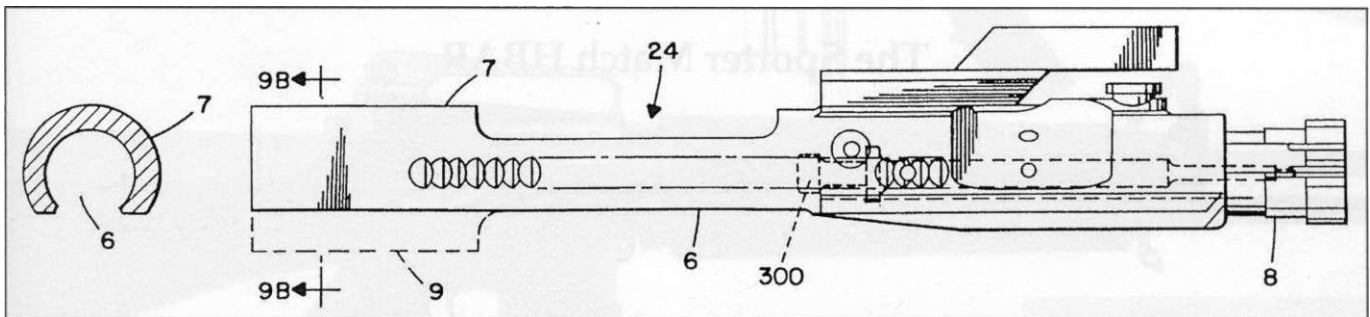
Colt omitted the auto sear block in the later production post-Assault Weapon Ban Match rifle line, due first to its high cost, second to the extreme difficulty it caused in production and assembly, and third and most important, it was not necessary. With the change from the standard diameter (0.155") to the new larger diameter (0.170") hammer and trigger



377. Line drawing showing a right side view of a Colt Sporter rifle circa 1990, with modifications designed to prevent conversion to selective or fully-automatic fire.

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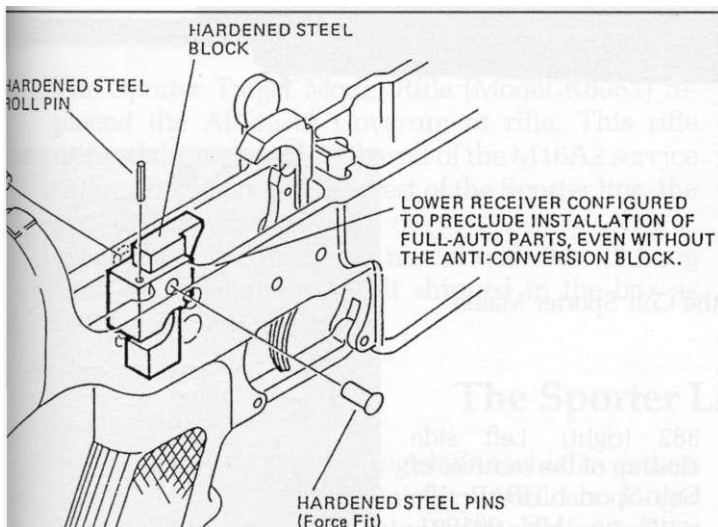
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378. Figs. 9B (left) and 9 from US Patent no. 5,183,959, granted on February 2, 1993 to Colts Horace "Mac" McCoan and James Collier for a "Semi-automatic firearm having a safety device preventing conversion to full auto-

matic firing", showing rear (left) and right side views of the bolt carrier with the entire auto sear trip area removed to prevent aftermarket conversion to automatic fire.

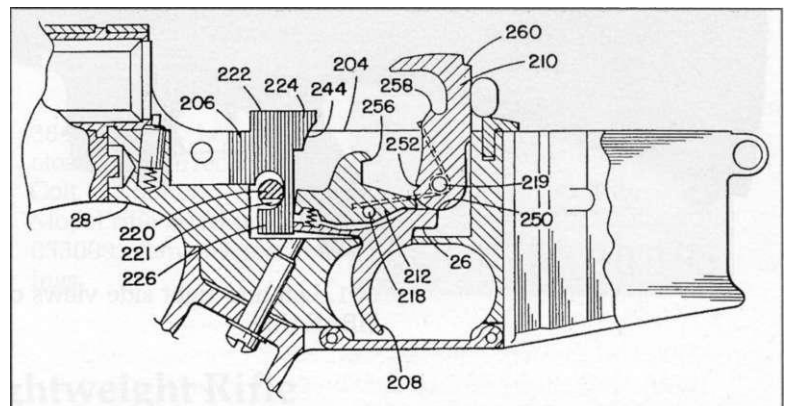
courtesy US Patent Office



379. Phantom drawing showing the location and components of the anti-conversion auto sear block.

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380. Fig. 4 from US Patent no. 5,183,959, showing a right side sectioned view of the lower receiver with anti-conversion auto sear block installed.

courtesy US Patent Office

pins, no fully-automatic hammer, trigger or disconnector could be installed in the Colt Sporter series rifle lower receivers, as these selective-fire components could not be aligned to function properly.

In response to a conversion device produced by aftermarket companies which provided a standard automatic sear trip for use with an auto sear (fig. 468), Colt removed the entire portion of the bottom rear of the semi-automatic bolt carrier, thus preventing conversion by leaving no material for such an aftermarket device to abut against.

Additionally, all of the early AR-15 type rifles incorporated a large-diameter (.315") upper receiver pivot pin made up of a screw and a collet pin, which required two screwdrivers to remove. This was to prevent M16/M16A1 and M16A2 upper receivers, which utilized the smaller Mil Spec .250" diameter pin, from being installed on AR-15 semi-auto-only lower receivers. The only difference between the AR-15 and the M16-type upper receiver is the cutout

in the bottom rear of the selective-fire M16 type receiver, to accommodate the auto sear. This way, if a semi-automatic-only AR-15 upper receiver was converted for automatic fire, the upper and lower receivers would not close due to the presence of the auto sear, and forcing them closed would damage the auto sear. (However this was easily remedied when an aftermarket offset pin appeared, dimensioned to match up the large-hole AR-15 lower with the small-pin M16 upper receiver.)

Early sporter rifles utilized a standard M16-type pivot pin with a screw in the left-hand side, which still required a screwdriver to remove. In order simply to standardize parts, later production and, as of this writing, all future Colt Sporter and Match Target rifles will be built on standard selective-fire upper receivers, bored with the small pivot pin (.250" diameter) hole and utilizing the standard pivot pin with the spring-loaded detent, the same as used on the M16 series military rifles.

## The Sporter Match HBAR



381. Left and right side views of the Colt Sporter Match HBAR rifle.

The Sporter Match HBAR (Model R6601) replaced the AR-15A2 HBAR rifle in commercial sales. Both utilized the 20" one turn in 7" twist heavy barrel. Early versions were built on the standard AR-15 style lower receiver, while later production rifles utilized the small-pin M16A2 upper and lower receivers which incorporated the raised area around the magazine

382 (right). Left side closeup of the receiver of Colt Sporter HBAR rifle serial no. MH 001001, showing markings.



release button. This would hold true for all the rifles in the Colt Sporter line.

Colt offered a variation of the Sporter Match HBAR with a heavy barrel rifled with the slightly

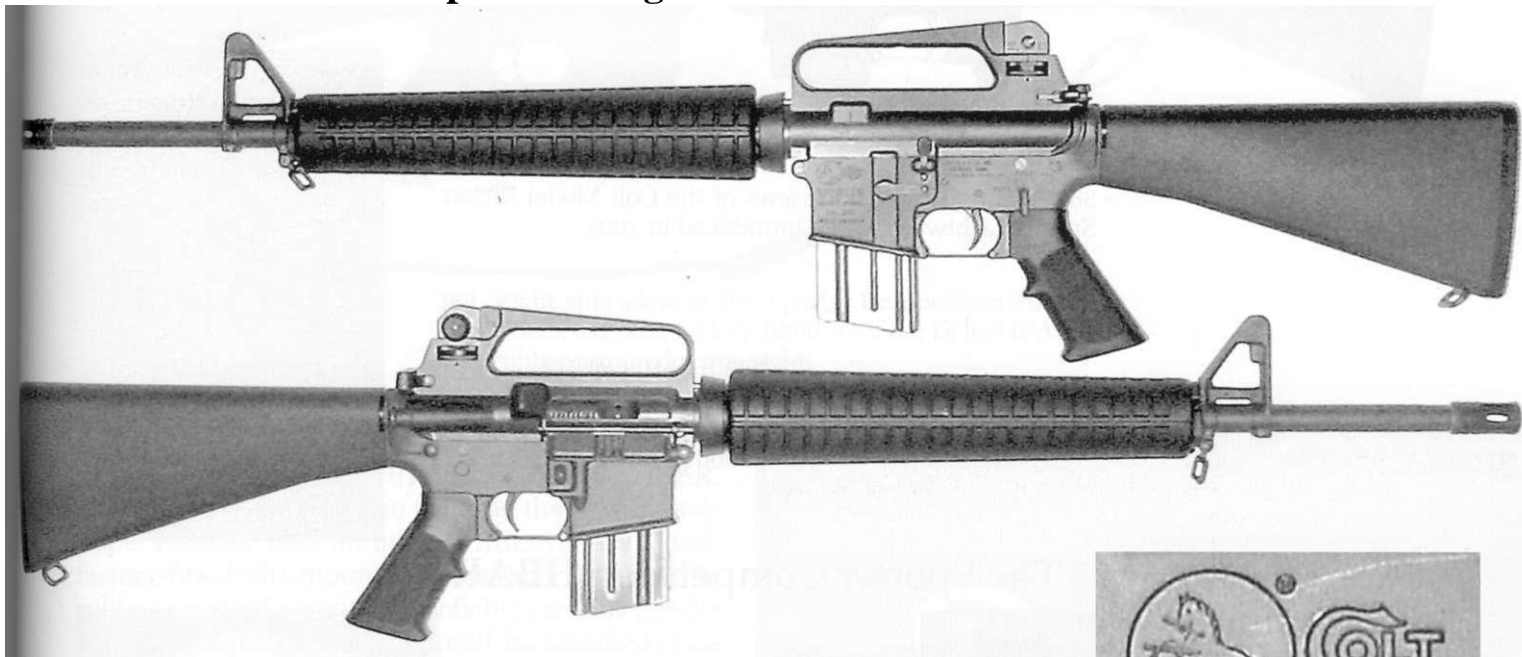
slower one turn in 9" twist as their Model R6602. Colt also offered this model with the .22 Long Rifle caliber conversion kit shipped in the box as the Model Number R6601K.

## The Sporter Match Target Competition HBAR II

The Sporter Match Target Competition HBAR II (Model R6731) rifle featured a 16" heavy barrel with a chrome-plated bore, rifled with the one turn in 9"

twist. This rifle utilized the flat-top upper receiver as well as the anti-conversion block in the lower receiver.

## The Sporter Target Government Model Rifle



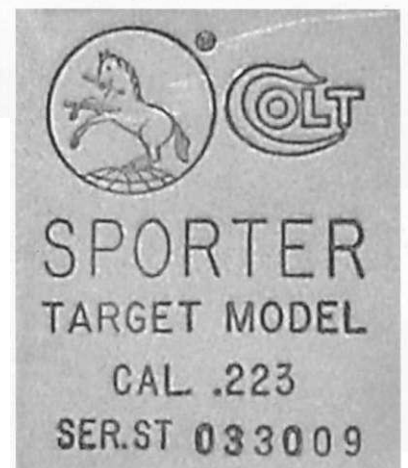
383. Left and right side views of the Colt Sporter Target Model rifle, Model R6551.

Note the absence of the bayonet lug.

The Sporter Target Model Rifle (Model R6551) replaced the AR-15A2 Government rifle. This rifle utilized the standard 20" barrel of the M16A2 service rifle, although as with the rest of the Sporter line, the bayonet lug was omitted.

Colt also offered this model with the .22 Long Rifle caliber conversion kit shipped in the box as Model R6551K.

384 (right). Left side closeup of the receiver of Colt Sporter Target Model rifle serial no. ST 033009, showing markings.



## The Sporter Lightweight Rifle

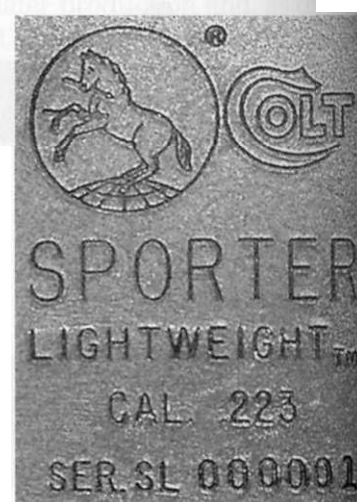
Due to the assault weapon legislation which was then pending, Colt's decided that they would no longer produce rifles with telescoping buttstocks for civilian sales. In 1991, to fill the resulting void in the marketplace for a lightweight and more compact rifle, Colt introduced the Sporter Lightweight Rifle (Model

R6530), fitted with a 16" carbine barrel complete with the M16A2-style muzzle brake/compensator. In place of the telescoping buttstock was the standard M16A2-style buttstock. This lightweight rifle weighed approximately 6.7 lbs.





385. Left and right side views of the Colt Model R6530 Sporter Lightweight rifle, introduced in 1991.



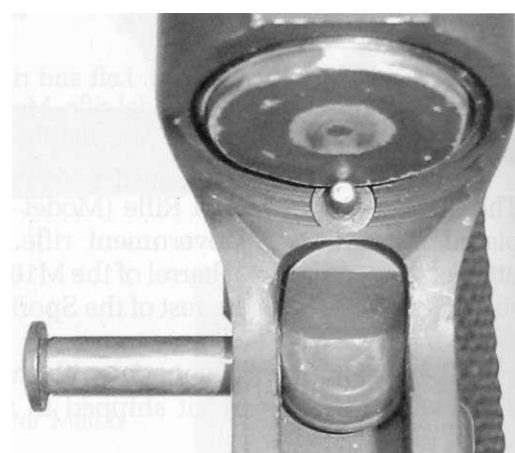
386 (right). Left side closeup of the receiver of Colt Sporter Lightweight rifle serial no. SL 000001, showing markings.

## The Sporter Competition HBAR



387. Three views of the aftermarket "Accu-wedge", which Colt's factory-installed in the Sporter Competition HBAR and some other Match-grade rifles to tighten the fit between the upper and lower receivers.

Left: Right side closeup of the upper receiver with



Accu-wedge in position.

Center: closeup of the molded red plastic Accu-wedge. The sloped end pushes forward and the base pushes upward on the upper receiver, producing a tight fit.

Right: Top closeup of lower receiver showing Accu-wedge properly installed.

The Sporter Competition HBAR (Model R6700) was an 8.5-lb. rifle featuring the newly introduced flat-top upper receiver with detachable carrying handle. The

barrel was rifled with a twist of one turn in 9", and fitted with a compensator. This rifle came with the aftermarket "Accu-wedge" factory-installed to

tighten up the fit between the upper and lower receivers.

Another version of the Sporter Competition HBAR, Model R6701, featured Millet scope rings and the ARMS, Inc. #5 scope mount base.

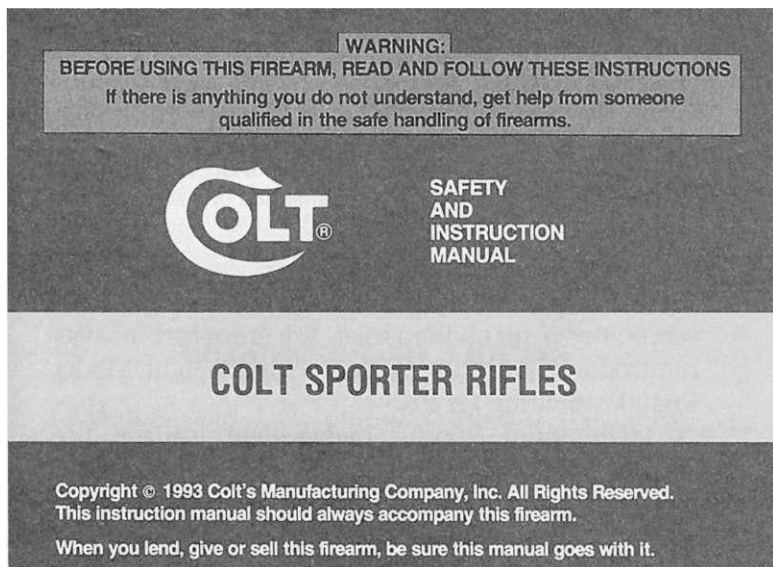
## Sporter Competition HBAR Range Selected



388. Right side view of the Sporter Competition HBAR Range Selected rifle, factory-fitted with the Delta HBAR's 3-9x rubber-armored scope sight.

The Sporter Competition HBAR Range Selected (Model Number R6700CH) replaced the Delta HBAR. This new 10.5-lb. rifle also featured the new flat-top upper receiver with an integral MIL-STD-1913 rail, factory-fitted with mounts and the Delta HBAR's 3-9x rubber-armored scope. A detachable carrying handle was also furnished, which could be installed once the scope was removed to give the rifle full iron sight capability.

As a step up from the standard Sporter Competition HBAR, this range-selected version features a hand-selected Match-grade barrel for precision accuracy. This barrel, with a rifling twist of one turn in 9", was not chrome-lined, due to the degradation this process can have on match-grade accuracy.



389. The cover of the 1993 Safety and Instruction Manual for Colt Sporter Rifles.

Compare with figs. 358, 368 and 376: Colt's message regarding the safe usage of firearms became more explicit and detailed as time went on.

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## The 9mm Sporter Lightweight



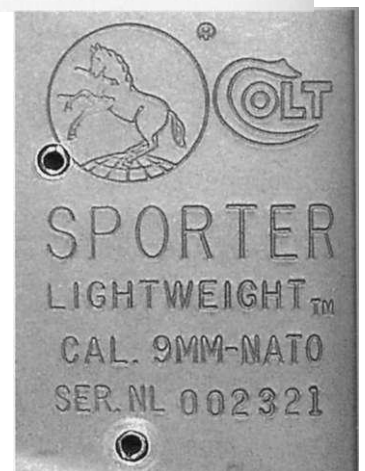
390. Left and right side views of the Colt 9mm Sporter Lightweight.

Note the factory-installed plastic gas deflector, and the absence of a bayonet lug.

With Colt's no longer producing carbines with telescopic stocks for civilian sales, the 9mm carbine was reintroduced as the 9mm Sporter Lightweight, Model R6430, weighing 7.1 lbs.

The 9mm Sporter Lightweight utilized the standard M16A2 stock assembly and the same 16" carbine barrel with A2-style muzzle brake/compensator. The plastic gas deflector was factory-installed over the rear of the ejection port.

391 (right). Left side closeup of the receiver of Colt 9mm Sporter Lightweight rifle serial no. NL002321, showing markings.



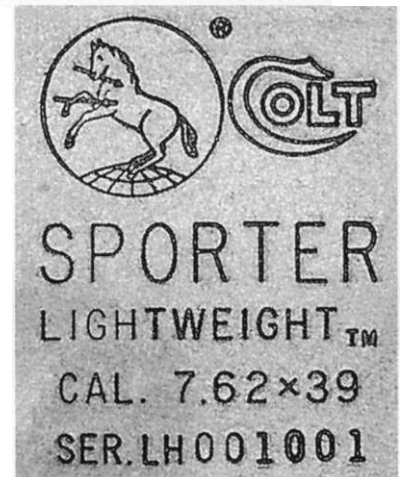
## The 7.62x39mm Sporter Lightweight Rifle

In 1993 Colt introduced yet another caliber into the sporter lineup with the new 7.3-lb. Lightweight Rifle (Model R6830), intended as a hunter's carbine and chambered for the 7.62x39mm cartridge, which is ballistically similar to the popular American .30-30 Winchester cartridge and suitable for medium-size game.

The Colt 7.62x39mm Lightweight Rifle had fixed iron sights and utilized a non-chrome-lined 16" barrel rifled with a one turn in 12" twist, fitted with the M16A2-style muzzle brake/compensator.



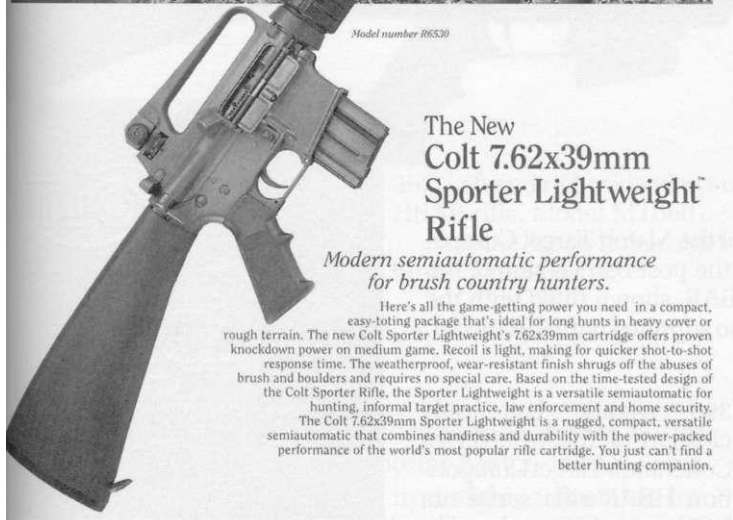
392. Left and right side views of the 7.62x39mm Sporter Lightweight rifle, introduced in 1993.



393 (right). Left side closeup of the receiver of Colt 7.62x39mm Sporter Lightweight rifle serial no. LH 001001, showing markings.



Model number R6530



394. A 1993 Colt advertisement introducing their new 7.62x39mm caliber Sporter Lightweight rifle.

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## Other Pre-Ban Models

Over the years Colt produced several special-run models which would never appear in any of their catalogs or brochures. One such was the Light Machine Gun Sporter (Model R6750), which featured the LMG upper receiver/barrel assembly as manufactured under license by Diemaco in Canada.

Two additional versions of the 7.62x39mm caliber Sporter included the Sporter HBAR Carbine (Model R6850), fitted with a 16" heavy barrel with a non-chromed bore, rifled with a one turn in 12", and a compensator. This rifle also has the flat-top upper receiver. The other 7.62x39mm version, the Sporter HBAR Rifle (Model R6851), offers the same specifications but is fitted with a 20" barrel.

# Post-1994 Assault Weapon Ban Production

## The New Colt Match Target ("MT Series" Prefix) Series

Compliance with the 1994 Assault Weapon Ban resulted in further changes to the model designations of all post-ban rifles, and introduced a new family of rifles called the Colt Match Target series. Along with the new name, the model prefix was changed to differentiate the post-assault weapon ban rifles and carbines from those produced prior to the ban. The new prefix chosen was "MT", instead of the standard "R", which was used for all other models.

According to the law, if the rifle could accept pre-ban high-capacity magazines, it could only have one of the following characteristics:

1. a separate pistol grip;
2. a flash suppressor;
3. a bayonet lug;
4. a threaded barrel muzzle.

Therefore, in order to remain within the legal requirements and keep producing Sporter rifles for commercial sale, Colt's had to omit the flash suppressing muzzle brake/compensator as well as the bayonet lug on all future production sporter rifles. Barrels on the Match Target series rifles were counterbored at the muzzle to protect the rifling.

## The Match Target Competition HBAR



395. Left and right side views of the Match Target Competition HBAR, Model MT6700, the post-ban version of the earlier Sporter Competition HBAR, shown fitted with the detachable carrying handle, also supplied with this model.

The Match Target Competition HBAR (Model MT6700) is the post-ban version of the earlier Sporter Competition HBAR. The Match Target Competition HBAR is built on the flat-top upper receiver with an integral MIL-STD-1913 rail, fitted with mounts. The detachable carrying handle was also supplied to provide full iron sight capability if desired. This rifle

396 (right). Left side closeup of the receiver of Colt Match Target Competition HBAR rifle serial no. CCH 001006, showing markings.



features a plain counterbored 20" barrel with a rifling twist of one turn in 9".

A later version, the Model MT6700C, incorporated a pinned-on 6-slot recoil compensator. Another later version, the Model MT6700T, came with a factory-installed competition hammer and trigger.

A small number of Match Target Competition HBAR rifles (Model MT6700CH) were fitted with the 6-slot pinned-on recoil compensators, Hogue pistol grips and handguards.

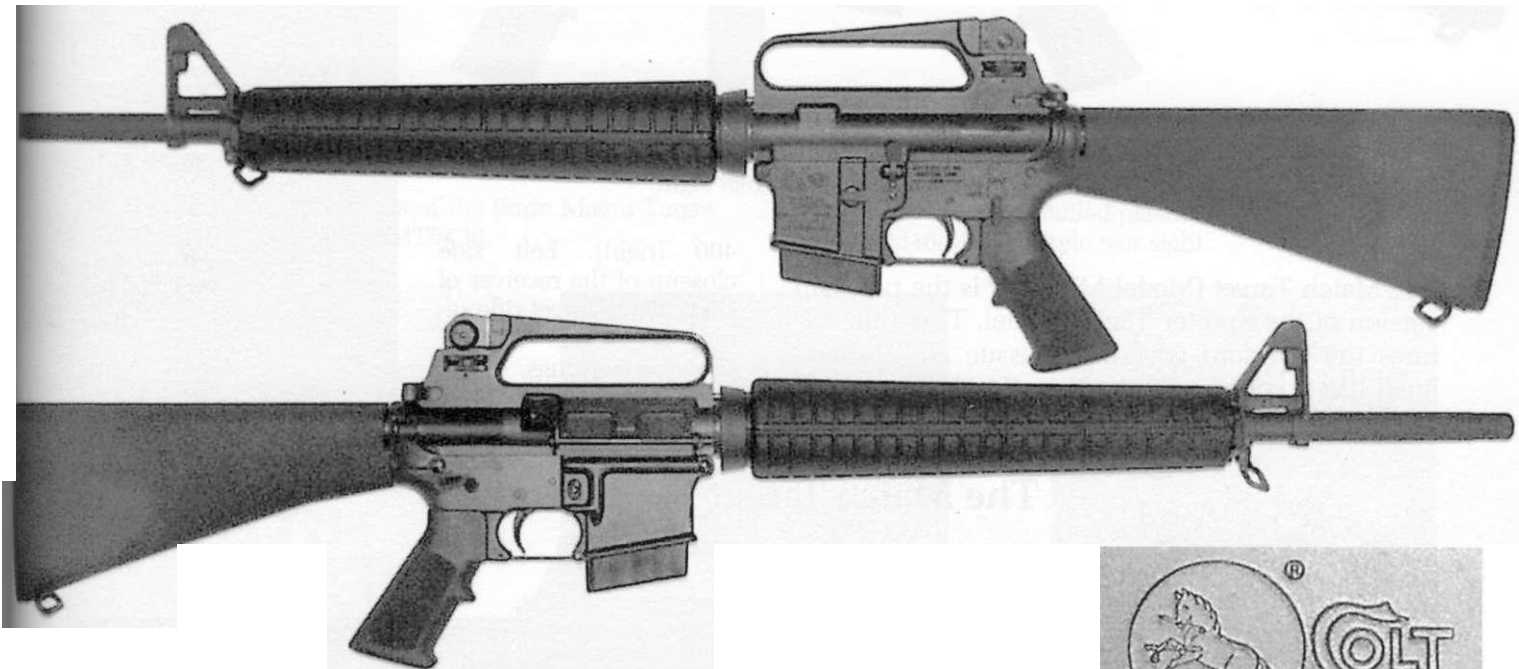
## The Match Target Competition HBAR II (Range Selected)

The features of the Match Target Competition HBAR II (Range Selected, Model MT6731) were similar to those of the Match Target Competition HBAR, above, but the HBAR II version came with a hand-selected, non-chrome-lined 16" Match-grade barrel for precision accuracy, counterbored and rifled with a twist of one turn in 9".

A later version of this rifle, the Model MT6731C, incorporated a pinned-on 6-slot compensator.

There was also a small run of Model MT6731HC Match Target Competition HBAR IIs, which came factory-fitted with Hogue pistol grips and Choate buttstocks.

## The Match Target HBAR



397. Left and right side views of the post-ban Match Target HBAR rifle, Model MT6601.

Note the A2-style rear sight, and the absence of a muzzle brake/compensator.

The Match Target HBAR (Model MT6601) is the post-ban version of the Sporter Match HBAR. This rifle has the A2-style rear iron sight, adjustable for windage and elevation, and utilizes a 20" barrel with a non-chromed bore, rifled with one turn in 7".

A later version, the Model MT6601C, incorporated a pinned-on 6-slot compensator. Another ver-

sion was available factory-fitted with a competition hammer and trigger, as the Model MT6601T.





## The Match Target



399. left and right side views of the post-ban Match Target rifle, Model MT6551, built on the M16A2-style upper receiver with fully-adjustable rear sight.

The Match Target (Model MT6551) is the post-ban version of the Sporter Target model. This rifle features the standard government-issue 20" chrome-lined barrel, rifled with one turn in 7". The Match Target weighs approximately 7.5 lbs.

400 (right). Left side closeup of the receiver of Colt Match Target rifle serial no. CST 001005, showing markings.



## The Match Target Lightweight



401. Left and right side views of the Match Target Lightweight rifle, as chambered for the .223 Remington and 7.62x39mm cartridges.



402. Left and right side views of the 9mm Match Target Lightweight rifle, the Model MT6430.

Note the factory-installed plastic gas deflector, and the original M16/M16A1-style rear sight.



403. left side closeups of the receivers of three versions of the Match Target Lightweight rifle, showing markings.

Left: .223 (5.56mm) caliber, serial no. CSL001006.  
Center: 7.62x39mm caliber, serial no. CLH001002.  
Right: 9mm caliber, serial no. CNL001010.

The Match Target Lightweight replaces the pre-ban Sporter Lightweight. This variation offers the lightweight and more compact 16" carbine barrel, in conjunction with the standard M16A2 buttstock.

The Match Target Lightweight comes in three caliber variations. The Model MT6530 is chambered in 5.56x45mm (.223 Remington); the Model MT6830

is chambered for the 7.62x39mm caliber. Both versions incorporate the M16A2-style fully-adjustable rear iron sight.

The third Match Target Lightweight is the Model MT6430, chambered in 9mm NATO (9x19; 9mm Luger; 9mm Parabellum). This version uses the original M16/M16A1 style rear sight.

## The Match Target M4 Carbine



404. Left side view of the Colt Match Target M4 Carbine, Model MT6400C.

Note the 16" M4-contour barrel and the new, improved

version of the telescoping buttstock, the same as used on the US military M4/M4A1 carbines except that it is permanently pinned in the open position.

The Match Target M4 Carbine (Model MT6400C) offers the famous M4 Carbine to civilian shooters in a legal post-ban package, fitted with a 16" M4-contour barrel with the pinned-on 6-slot compensator, rifled with a one turn in 7" twist. This carbine is built on the flat-top upper receiver, and comes with the detachable carrying handle as well as the M4 double-

heat-shielded handguards. The buttstock used is the new and improved version (taller and wider, with sling swivel), which is the same stock used on the US military M4/M4A1 carbines except that it is permanently pinned in the open position to comply with the Federal assault weapon ban.

## Colt Enters the Precision Market

Over the years, the AR-15/M16 weapon system has gained an impeccable reputation for precision accuracy in the semi-automatic mode. This trait was first noticed by testing personnel at Aberdeen Proving Rounds when firing the early AR-10 rifle.

Due to the fact the AR-15 does not use a conventional gas piston assembly, the barrel is subjected to a negligible bending moment when the rifle is fired, and the barrel vibrational harmonics are left

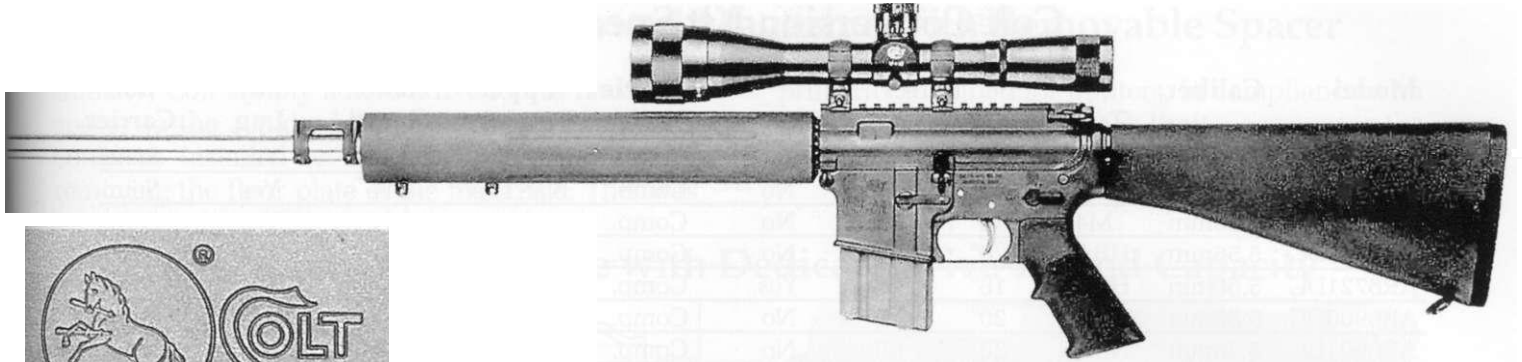
undisturbed. With the development of free-floating handguards, combined with a good trigger and barrel, the AR-15 was found to be capable of producing groups of one minute of angle and under at 100 yards with little difficulty. Many companies such as Quality Parts/Bushmaster, Les Baer, ArmaLite and Knight's Manufacturing have produced precision sniping-grade accurized rifles which take full advantage of the AR-15 design.

## The Precision-Grade Colt CAR-A3 HBAR Elite Target Rifle



405. Left side view of the Colt CAR-A3 HBAR Elite Target Rifle, Model CR6724.

Note the free-floating heavy brushed stainless steel barrel, the modified gas block, and tubular handguard.



406. Left side view of the Colt CAR-A3 HBAR Elite Target Rifle, Model CR6724, fitted with the Colt 3 - 9x variable scope sight.



407. Left side closeup of the receiver of Colt CAR-A3 HBAR Elite rifle serial no. BK 000006, showing markings.

In 1997, Colt's Manufacturing introduced their first-ever precision-grade target rifle called the Colt Accurized Rifle "CAR-A3" HBAR Elite (Model CR6724), which featured a flat-top upper receiver with an integral MIL-STD-1913

rail. This rifle incorporated a 24" heavy brushed stainless steel barrel rifled with a twist of one turn in 9", optimized for heavy Match-grade 5.56mm bullets. The free-floating barrel is surrounded by a tubular metal handguard. This rifle, which came with the Accu-wedge factory-installed to tighten the fit between the upper and lower receiver, weighs 9 1/4 pounds. Colt offers a variety of optics to fit the flat-top receiver of this rifle, and has produced the rifle with a factory-fitted Match-grade trigger.

## Colt's Enters the Component Business

Over the years, many aftermarket (non-Colt) rifles have been produced from spare parts kits. Colt never tapped into the component market by selling conversion upper or lower receivers, stripped or complete, and as a result it was difficult and extremely expensive to obtain genuine Colt components.

Colt introduced their own upper receiver conversion kits for the first time in 1994. These kits included a barrelled upper receiver, bolt assembly and offset pin, so the upper receiver could be installed on early AR-15 lower receivers as well as the new small-hole Colt Sporter lower receivers.

Colt offered four different pre- and post-ban versions of their conversion units. The original 1994 conversion barrelled upper receivers were fitted with the A2-style muzzle brake/compensators, and the caliber was stamped on the left side of the early conversion upper receivers. Starting in 1997 the muzzle brake/compensators were no longer installed.

The first version was the 5.56x45mm (.223 Remington) 20" HBAR with fixed A2-style sights, in

a pre-ban configuration with muzzle brake/compensator as the Model R6601DC, and the post-ban configuration, without the muzzle brake, as the Model MT6900DC.

The second was the 5.56x45mm (.223 Remington) 20" HBAR with flat-top receiver and removable carrying handle, in the pre-ban configuration (with muzzle brake) as the Model R6700DC and the post-ban configuration (without muzzle brake) as the Model MT6700DC.

The third version featured the flat-top upper receiver with the 7.62x39mm 16" barrel in the pre-ban configuration (with muzzle brake) as the Model R6830, and in the post-ban configuration (without the muzzle brake) as the Model MT6850DC.

The fourth version was the flat-top upper receiver with the 7.62x39mm 20" barrel, in the pre-ban configuration (with muzzle brake) as the Model R6851, and the post-ban configuration (without muzzle brake) as the Model MT6851DC.

## Colt Conversion Kit Specifications

Model	Caliber	Barrel				Muzzle Device	Upper Receiver	Hand-Guard	Bay Lug	Bolt Carrier
		Type	Length	Twist	Chrome					
AR6520DC	5.56mm	A1	16"	1/7	Yes	Comp.	A2	Carbine	Yes	Semi
AR6521DC	5.56mm	HBAR	16"	1/9	No	Comp.	Flat-Top	M4	Yes	Semi
AR6620DC	5.56mm	M4	16"	1/7	No	Comp.	A2	M4	Yes	Auto
AR6700DC	5.56mm	HBAR	20"	1/7	No	Comp.	Flat-Top	A2	Yes	Semi
AR6721DC	5.56mm	HBAR	16"	1/9	Yes	Comp.	Flat-Top	Carbine	Yes	Semi
AR6900DC	5.56mm	HBAR	20"	1/9	No	Comp.	A2	A2	Yes	Semi
AR6901DC	5.56mm	HBAR	20"	1/9	No	Comp.	A2	A2	Yes	None
AR6920DC	5.56mm	M4	16"	1/7	Yes	Comp.	Flat-Top	M4	Yes	Semi
AR6420DC	9mm	A1	10.5"	1/10	Yes	Comp.	Flat-Top	Carbine	Yes	Semi
CR6724DC	5.56mm	HBAR	24"	1/9	No	None	Flat-Top	Floating	No	Semi
M4A1RK	5.56mm	M4HBAR	14.5"	1/7	Yes	Comp.	Flat-Top	M4	Yes	Auto
MT6430DC	9mm	A1	16"	1/10	Yes	None	A1	Carbine	No	Semi
MT6431DC	9mm	A1	16"	1/10	Yes	None	Flat-Top	Carbine	No	Semi
MT6700DC	5.56mm	HBAR	20"	1/9	No	None	Flat-Top	A2	No	Semi
MT6731DC	5.56mm	HBAR	16"	1/7	No	None	Flat-Top	Carbine	No	Semi
MT6850DC	7.62mm	HBAR	16"	1/12	No	None	Flat-Top	Carbine	No	Semi
MT6851DC	7.62mm	HBAR	20"	1/12	No	None	Flat-Top	A2	No	Semi
MT6900DC	5.56mm	HBAR	20"	1/9	No	None	A2	A2	No	Semi
R0630DC	9mm	SMG	7"	1/10	Yes	None	A1	Floating	No	Auto
R0633DC	9mm	SMG	7"	1/10	Yes	None	A1	M231	No	Auto
R0708DC	5.56mm	A2	20"	1/7	Yes	Comp.	A2	A2	Yes	Auto
R0719DC	5.56mm	A2	20"	1/7	Yes	Comp.	A1	A2	Yes	Auto
R0723DC	5.56mm	M4	14.5"	1/7	Yes	Comp.	A1	Carbine	Yes	Auto
R0725DC	5.56mm	M4	14.5"	1/7	Yes	Comp.	A1	Carbine	Yes	Auto
R0733DC	5.56mm	A1	11.5"	1/7	Yes	Comp.	A1	Carbine	Yes	Auto
R0779DC	5.56mm	M4	14.5"	1/7	Yes	Comp.	A2	M4	Yes	Auto
R0920CK	5.56mm	M4	14.5"	1/7	Yes	Comp.	Flat-Top	M4	Yes	Auto
R0920DC	5.56mm	M4	14.5"	1/7	Yes	Comp.	Flat-Top	M4	Yes	Auto
R0921HBCK	5.56mm	M4HB	14.5"	1/7	Yes	Comp.	Flat-Top	M4	Yes	Auto
R0933CK	5.56mm	A1	11.5"	1/7	Yes	Comp.	Flat-Top	Carbine	No	Auto
R0933DC	5.56mm	A1	11.5"	1/7	Yes	Comp.	Flat-Top	Carbine	Yes	Auto
R0945CK	5.56mm	A2	20"	1/7	Yes	Comp.	Flat-Top	A2	Yes	None
R0990DC	9mm	SMG	7"	1/10	Yes	None	Flat-Top	M231	No	Auto
R6700DC	5.56mm	HBAR	20"	1/9	No	Comp.	Flat-Top	A2	No	Semi
R6850DC	7.62mm	HBAR	16"	1/12	No	Supp.	Carbine	Carbine	No	Semi
R6851DC	7.62mm	HBAR	20"	1/12	No	Supp.	Flat-Top	A2	No	Semi
R6900DC	5.56mm	HBAR	20"	1/9	Nos	Comp.	A2	A2	No	Semi
AR6520KIT	5.56mm	A1	16"	1/7	Yes	Comp.	A2	Carbine	Yes	Semi
AR6521KIT	5.56mm	HBAR	16"	1/7	Yes	Comp.	Flat-Top	M4	Yes	Semi
LE6920KIT	5.56mm	M4	16"	1/9	Yes	Comp.	Flat-Top	M4	Yes	Semi

All model numbers given above are for conversions being produced as of 1997.

## Colt Sporter and Match Target Series Magazines

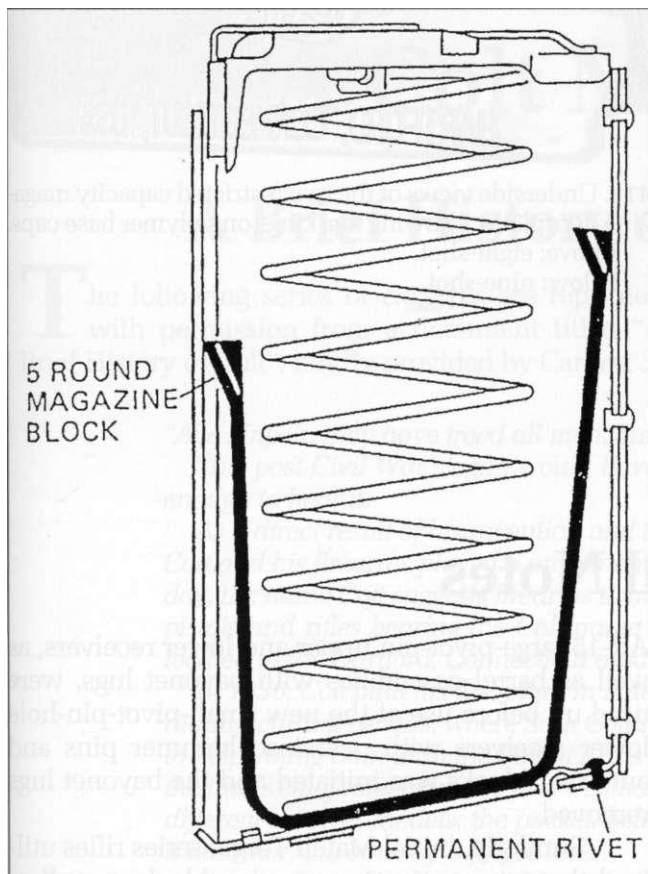
Throughout the years, Colt has provided several limited-capacity magazines for use with the civilian semi-auto-only versions of the AR-15 rifle.

## The Standard Twenty-Round Magazine with Removable Spacer

Initially, Colt simply added a five-round limitation spacer to the standard 20-round magazine, which could be installed or removed at will by simply removing the floor plate of the magazine. This was

primarily intended for hunters, in compliance with the laws in most states which limit magazines in the field to a five-round capacity for hunting.

## The Standard Magazine with Dedicated Five-Round Capacity



With the introduction of the Colt Sporter series, the configuration of this magazine was altered by the addition of a permanent rivet in the floorplate to



409. Underside views of two magazine floorplates.

Above: early commercial five-round magazine with no rivet in removable floorplate.

Below: later five-round magazine with permanent rivet in floorplate.

408 (right). Right side sectioned view of the standard Colt 20-round AR-15 magazine with five-round spacer installed and floorplate riveted.

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## Colt's Post-Assault Weapon Ban Eight- and Nine-Round Magazines

In compliance with the 1994 Assault Weapon Ban, which included a prohibition on the production of high-capacity magazines for commercial sale, Colt had to develop a magazine that could not be altered and could hold no more than ten rounds.

Colt has actually developed two such limited-capacity magazines. The first was an eight-round magazine with a flat-bottomed lower cap made of black polymer, with the vertical cartridge guides in

the aluminum magazine body carried into the polymer.

The second is Colt's new nine-round magazine, identified by its angled-bottomed polymer cap which is smooth with no vertical cartridge guides molded into it.

As of this writing, Colt is providing the nine-round magazines with all AR-15 rifles sold commercially.

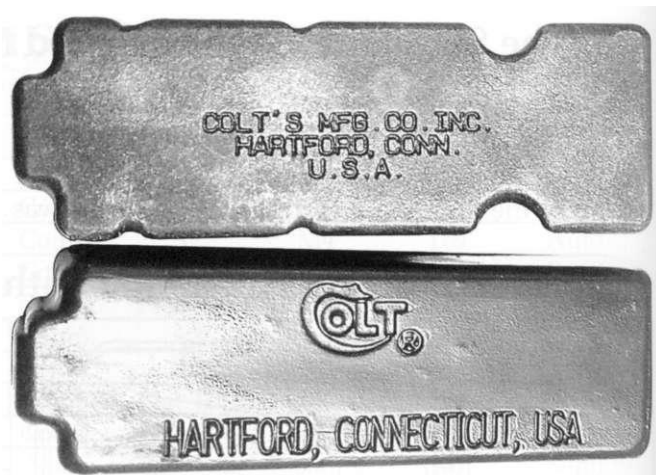




410. Left side views of the two post-assault weapon ban restricted capacity Colt AR-15 magazines.

Left: eight-shot, with grooved, flat-bottomed polymer base cap.

Right: nine-shot, with plain, angled-bottom polymer base cap.



411. Underside views of the two restricted capacity magazine floorplates, showing markings on polymer base caps.

Above: eight-shot.

Below: nine-shot.

## Some Final Notes

Throughout the years, Colt has produced many additional variations of their semi-automatic-only line, many involving only small changes which enabled these rifles to be sold in countries where civilian possession of military-caliber rifles is not allowed. Additional small runs of rifles were produced with various finishes and in special configurations. Due to the unavailability of examples of these small runs of rifles, they are not included in the chart of commercial model specifications (Chapter Eleven), which will be confined to the various models that have been made commercially available since 1963.

Other minor variations of the stated models may be found as a result of the normal factory practice of using up existing supplies of components before updates and product improvements are implemented. This will primarily be seen in the receiver changeover from the AR-15 series to the Colt Sporter series. Following the formation of Colt's Manufacturing Company, Inc. in 1990 and the subsequent introduction of the Colt Sporter series, existing stocks of

AR-15 large-pivot-pin upper and lower receivers, as well as barrel assemblies with bayonet lugs, were used up before use of the new small-pivot-pin-hole lower receivers with oversized hammer pins and auto sear blocks was initiated and the bayonet lugs removed.

Similarly, initial Match Target series rifles utilized the auto sear/anti-conversion block as well as large hammer and trigger pins. After Colt used up the existing auto sear blocks and receivers with them installed, they switched to the current Match Target lower receiver, without the block.

Eventually, when existing stocks of large hammer and trigger pins are exhausted, Colt will be going back to the .155" diameter hammer and trigger pins, in order to standardize on one single version of these parts. The new-style receiver will retain the same locations for the hammer and trigger pins in the lower receiver, but with restrictions in the width and depth machining so that full-auto parts will not fit.

# Part IV: A Reference Compendium

## Chapter Eleven

# A Colt Model Guide

## A Brief History of the Colt Company

**T**he following series of excerpts are reprinted with permission from a document titled "A Brief History of Colt", kindly provided by Carlton S.

Chen, Vice President, General Counsel and Secretary of Colt Defense LLC, and interspersed with the author's further notes:

*"Abe Lincoln may have freed all men, but Sam Colt made them equal. "*

*This post-Civil War slogan would have been music to Sam Colt's ears had he lived long enough to hear it*

*As a direct result of his invention and the marketing and sales success that followed, Sam Colt and his firearms played a prominent role in the history of a developing America. To this day, the name Colt suggests firearms to most Americans, and more than 30 million revolvers, pistols and rifles bearing the Colt name have been produced, almost all of them in plants located in the Hartford, Connecticut area.*

*In 1836, Colt built his first plant in Paterson, N.J., then one of this country's fastest-growing manufacturing centers, where Sam Colt's uncle, a successful local businessman, was willing to help young Sam form the Patent Arms Manufacturing Company. At age 22, Sam Colt was the firm's chief salesman and new-business promoter. He soon developed and produced three different revolver models: the pocket, belt, and holster; and two types of rifles, one cocked by a hammer, the other by a finger lever.*

*Despite the generally favorable performance of these products in the hands of early buyers, sales were sluggish. Even though the US government purchased small quantities of the Colt ring-lever rifle and the Colt 1839 carbine, quantities ordered appear never to have exceeded 100.*

*In 1842, the Patent Arms Manufacturing Co. closed. Sam Colt then turned his attention to selling the US government on his ideas for waterproof ammunition; underwater mines for harbor defense; and, in association with the inventor Samuel F. B. Morse, the telegraph.*

*During 1845, certain units of the US Dragoon forces and Texas Rangers, engaged infighting Native Americans in Texas, credited their use of Colt firearms for their great successes. US War Department officials reportedly were favorably impressed. When the Mexican War began in 1846, Capt. Samuel H. Walker, US Army, traveled East, looked up Sam Colt, and collaborated on the design of a new, more powerful revolver.*

*Within a week, the US Ordnance Department ordered a thousand of the newly designed revolvers, which Sam Colt called the "Walker". Suddenly, Colt was back in the firearms business but without a factory. He turned to Eli Whitney, Jr., son of the famous inventor of the cotton gin, who had a factory in Connecticut where the order was completed and shipped by mid-1847.*

*In 1851, two significant developments had a major effect on the future of the business. Sam Colt became the first American manufacturer to open a plant in England, thereby solidifying*

his reputation in international markets. And he began purchasing parcels of property in what was then called the South Meadows, an area of Hartford that fronted on the banks of the Connecticut River. The parcels, because they were often flooded, sold at remarkably low prices. A two-mile-long dike actually cost twice as much as the 250 acres; but the new plant, operational in 1855, was protected from the river's uncontrolled flow.

The factory was equipped with the most up-to-date metalworking machinery available, and was capable of turning out 5,000 finished handguns during its first year of operation. Knowledgeable of the latest achievements of New England's world-famous machine-tool industry, Colt lost no time in specifying interchangeable parts, some 80% of which were turned out on precision machinery.

At about this time, Mr. Colt, Hartford's unabashed sales promoter, raised the distinctive onion-shaped dome, topped with a cast-bronze rampant colt, over his factory, thereby assuring that every Hartford resident and visitor who saw the dome would ask about it and hear the Colt success story.

The firm was incorporated in 1855 in Connecticut as Colt's Patent Fire Arms Manufacturing Company, with an initial issuance of 10,000 shares of stock. Sam Colt retained ownership of 9,996 shares and gave one share to each of his business associates, including E. K. Root, his trusted factory superintendent and an inventor in his own right. By 1856 the company was producing 150 weapons a day; and the product's reputation for exceptional quality, workmanship and design had spread around the world, making Colonel Colt—the honorary title was awarded by the Governor of the State of Connecticut for Colt's political support—one of the ten wealthiest businessmen in the US.

Samuel Colt's health began to fail late in 1860 as the country moved toward Civil War. Prior to the actual declaration of war, Colt continued to ship his products to customers in southern states; but as soon as war was official, Colt supplied only the Union forces. The Armory was running at full capacity by year-end 1861, with more than 1,000 employees and an annual earnings level of about \$250,000. Samuel Colt died January 10, 1862, at the age of 47, having produced in his lifetime more than 400,000 weapons. His estate was reportedly worth \$15 million, an enormous sum for the time.

Some 19th century historians have gone so far as to say that Sam Colt's invention altered the course of world history. But when all was said and done, no man could deny that Sam Colt had achieved a level of both fame and fortune known to few other inventors.

Following Samuel Colt's death in 1862, control of the company remained in the hands of his widow and her family until 1901. During that 39-year period, a number of significant events and developments impacted the Colt product line.

In 1864, the Colt factory and adjacent office structure burned to the ground, suspending all but certain military production for almost three years. The factory was rebuilt and, according to Mrs. Colt's instructions, was constructed to be as fireproof as possible. In 1867, the company began producing Dr. R. J. Gatling's machine gun, a semiautomatic using a hand-operated crank to turn a cluster of six to ten barrels while feeding ammunition into the breech.

In 1872, Colt began the manufacture of its first breech-loaded revolver using self-contained metallic cartridges. The Single Action Army was an immediate sales success and became widely known as "the Gun that Won the West". Prior to 1941, Colt produced more than 350,000 Single Action Army models in various calibers, with almost 40,000 of the .45 caliber model being ordered by the US government.

Following the sale of the Colt Firearms Company to outside investors in 1901, only eight company presidents held office until 1955, when the company was purchased by the Penn-Texas Corporation, a new type of holding company which was one of the nation's first conglomerates. Colt Firearms became a wholly-owned subsidiary of the holding company, which was based in New York, and which also included the Pratt and Whitney Company of West Hartford.

A group of investors took control of the parent company in 1959 and changed the name of the conglomerate to Fairbanks Whitney, reflecting its acquisition of the Fairbanks Morse Company of Chicago.



412. A view of the front entrance and executive parking lot of the Colt's Firearms Division of Colt Industries, circa 1970.

Note the Colt dome, at center. photo by Ed Guinan, courtesy the late Edward C. Ezell, Ph.D.

*In 1960 another milestone in the history of Colt began with the introduction of the AR-15 semiautomatic rifle, followed by the M16 military full-automatic version. Involvement of the United States in Vietnam put heavy demands on Colt to supply arms for US troops.*

*Changes came again in 1964, when the parent company reorganized under the name Colt Industries, and the firearms subsidiary became Colt's Inc., Firearms Division.*

*On November 25, 1977, Colt Industries Operating Corp., Colt Firearms Division, was acquired from Colt's Patent Fire Arms Mfg. Co., and the M16 military rifle contract was transferred to Colt Industries Operating Corp.*

*In 1988 Colt suffered a blow with the loss of the government contract for M16 rifles. An agreement to sell the Colt Firearms Division to C. F. Holdings Corp. was announced in 1989, and in 1990 the company was sold to a coalition of private investors, the State of Connecticut, and the union employees, and renamed Colt's Manufacturing Company, Inc.*

#### **"Colt Industries, Coifs Firearms Division" Becomes "Colt's Manufacturing Company, Inc."**

On March 23, 1990, Colt Industries transferred their Firearms Division to what was newly referred to as Colt's Manufacturing Company, Inc. This was the result of a bitter and contentious four-year strike, which had proven devastating for the firm's management and employees alike. The lucrative military M16A2 contract had slipped away by default to

FNMI, and the company's commercial customer base had been alienated due to the previous decision by Colt Industries/Colt's Firearms Division to remove the AR-15 sporter series from the commercial marketplace. Within a year, the under-financed Colt's Manufacturing Company, Inc. had filed for Chapter 11 bankruptcy protection.

*. . . In May, 1994, the Company closed the Hartford Armory and relocated the entire company to its present day West Hartford facility. Additionally, Colt was awarded a sole source contract to supply nearly 19,000 of the new M4 carbines to the US Army and to joint Special Forces personnel. In September, a new group of investors purchased the company and Colt emerged from bankruptcy . . .*

Buoyed up by the new sole-source M4 carbine contract, Colt's Manufacturing Company, Inc. managed to come out of bankruptcy on September 28, 1994. As for the reinstated commercial rifle line, only

law enforcement rifles and carbines would retain the trademark AR-15 name. All future civilian semi-automatic-only rifles would be called the "Colt Sporter Series".

*. . . In 1998, Colt regained the US government contract for procurement of M16 rifles in excess of 32,000 units. Complementing this was a contract for updating 88,000 M16A1 rifles to the A2 configuration for the US Air Force. Additionally, Colt acquired Saco Defense, a Maine-based company specializing in automatic weapons for the military.*

*Colt began 1999 with a backlog of military rifle/carbine orders amounting to approximately 59,000 units. This included orders for exclusive production of the M4 carbine extending through the year 2010 . . .*

## Further Restructuring at Colt's

In September, 2002, Colt's Manufacturing Company, Inc. was split into two separate entities, and given the names under which Colt military and commercial products are made today: Colt Defense LLC, and Colt's Manufacturing Company LLC.

On November 4, 2002, Colt's entire defense business, including the machinery and equipment necessary to manufacture and assemble all Colt military and law enforcement small arms, was transferred to Colt Defense. The commercial assets remained with Colt's Manufacturing Company LLC.

Run separately but under the same roof in Colt's West Hartford, Connecticut manufacturing facility, each business is now able to focus on its separate operations, pursue business opportunities, and focus on its core customers. For Colt Defense, this means that it will be able to capitalize on its established market position and strong marketing relationships in the domestic and global firearm markets for military and law enforcement weapons.

## US Government/Colt Model Codes

Colt Model Number	Model	National/NATO Stock Number	Govt. Drawing Number
R0604 . . . . .	M16 . . . . .	1005-00-856-6885	. . . 8448600
R0603 . . . . .	M16A1 . . . . .	1005-00-073-9421	. . . 8448500
R0645 . . . . .	M16A2 . . . . .	1005-01-128-9936	. . . 9349000
R0646 . . . . .	M16A3 . . . . .	1005-01-357-5112	. . 12012000
R0945 . . . . .	M16A4 . . . . .	1005-01-383-2872	. . 12973001
R0920 . . . . .	M4 . . . . .	1005-01-231-0973	. . . 9390000
R0921 . . . . .	M4A1 . . . . .	1005-01-382-0953	. . 12972700
R0610 . . . . .	XM177 . . . . .	1005-00-933-7672	. . . 8448900
R0609 . . . . .	XM177E1 . . . . .	1005-00-930-5595	. . . . N/A
R0629 . . . . .	XM177E2 . . . . .	1005-00-021-2429	. . . 8448700
R0610 . . . . .	GAU-5/A . . . . .	1005-01-042-9820	. . . . N/A
R0649 . . . . .	GAU-5/A/A . . . . .	1005-00-973-5685	. . . . N/A
R0653 . . . . .	M16A1 Carbine . . . . .	1005-01-382-0953	. . . . N/A
none . . . . .	Port Firing Weapon . . . . .	1005-01-081-4582	. . . . N/A

## A Compendium of Colt Models

The following charts list, and describe numerous features of, the plethora of military and sporting models of the AR-15/M16 which have been manu-

factured by Colt since they acquired the rights to the design from Fairchild Stratos Corporation, the parent company of ArmaLite, back in 1958.

# Military and Law Enforcement Models

Model No.	Type	Barrel LengthType	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
R0601	AR-15 Rifle	20" A1	5.56mm	1/12	No	AUTO	M16	Fixed Early	A1	A1	3-Prong	Triangular	Yes
R0602	AR-15 Rifle - USAF	20" A1	5.56mm	1/12	No	AUTO	M16	Fixed Early	A1	A1	3-Prong	Triangular	Yes
R0603	M16A1 Rifle - US Army	20" A1	5.56mm	1/12	Yes	AUTO	A1	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0603	M16A1 Rifle - Korea	20" A1	5.56mm	1/12	Yes	AUTO	A1	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0603M	M16A1 Rifle - Malaysia	20" A1	5.56mm	1/12	Yes	AUTO	A1	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0604	M16 Rifle - USAF	20" A1	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0605A	M16A1 Carbine	14.5" A1	5.56mm	1/12	Yes	AUTO	A1	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0605B	M16A1 Carbine	14.5" A1	5.56mm	1/12	Yes	4-Way	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0606	M16 Rifle HBAR M1	20" HBAR	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0606A	M16A1 Rifle HBAR M1	20" HBAR	5.56mm	1/12	Yes	AUTO	A1	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0606B	M16A1 Rifle HBAR M1	20" HBAR	5.56mm	1/12	Yes	4-Way	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0607	SMG Tanker Model	10" A1	5.56mm	1/12	Yes	AUTO	M16	Sliding	A1	A1	3 1/2" Sound Supp.	Short Triangular	No
R0607A	SMG Tanker Model	10" A1	5.56mm	1/12	Yes	AUTO	A1	Sliding	A1	A1	3 1/2" Sound Supp.	Short Triangular	No
R0607B	SMG Tanker Model	10" A1	5.56mm	1/12	Yes	BURST	M16	Sliding	A1	A1	3 1/2" Sound Supp.	Short Triangular	No
R0608	Survival Rifle	10" A1	5.56mm	1/12	Yes	AUTO	M16	Short Fixed	A1	Folds	Cone-Shaped	Short Smooth Tubular	No
R0609	XM177E1 Commando - US Army	11.5" A1	5.56mm	1/12	Yes	AUTO	A1	Sliding	A1	A1	4 1/2" Sound Supp.	Carbine	No
R0610	GAU-5/A USAF	10" A1	5.56mm	1/12	Yes	AUTO	M16	Sliding	A1	A1	4 1/2" Sound Supp.	Carbine	No



Model No.	Type	Barrel Length Type	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
R0610B	SMG	10" A1	5.56mm	1/12	Yes	4-Way	M16	Sliding	A1	A1	4 1/2" Sound Supp.	Carbine	No
R0611	M16A1 HBAR Rifle	20" heavy untapered	5.56mm	1/12	Yes	AUTO	A1	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0611P	M16A1 HBAR Rifle - Philippines	20" HBAR	5.56mm	1/12	Yes	AUTO	A1	Fixed Later	A1	A1	Supp.	Triangular	Yes
R0613	M16A1 Rifle - Export	20" A1	5.56mm	1/12	Yes	AUTO	A1	Fixed Later	A1	A1	Supp.	Triangular	Yes
R0613P	M16A1 Rifle - Made in Philippines	20" A1	5.56mm	1/12	Yes	AUTO	A1	Fixed Later	A1	A1	Supp.	Triangular	Yes
R0614	Rifle Export	20" A1	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0614K	M16 Rifle - Korea	20" A1	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0614M	M16 Rifle - Malaysia	20" A1	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0614S	M16 Rifle - Singapore	20" A1	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0616	M16 HBAR Rifle M1	20" HBAR	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0619	XM177E1 Export Carbine	11.5" A1	5.56mm	1/12	Yes	AUTO	A1	Sliding	A1	A1	4 1/2" Sound Supp.	Carbine	No
R0620	XM177 Export Carbine	10" A1	5.56mm	1/12	Yes	AUTO	M16	Sliding	A1	A1	4 1/4" Sound Supp.	Carbine	No
R0621	M16A1 HBAR Rifle	20" HBAR	5.56mm	1/12	Yes	AUTO	A1	Fixed Early	A1	A1	Supp.	Triangular	Yes
R0629	XM177E2 SMG - US Army: mounts XM148 grenade launcher	11.5" A1	5.56mm	1/12	Yes	AUTO	A1	Sliding	A1	A1	4 1/2" Sound Supp.	Carbine	No
R0630	SMG	7" A1 light	9mm	1/10	Yes	AUTO	M16	Sliding	A1	Clamp-On	None	Floating 1-piece	No
R0633	SMG	7" A1 light	9mm	1/10	Yes	AUTO	M16	Sliding	A1	Fold Post	None	M231	No
R0633HB	SMG	7" A1 light	9mm	1/10	Yes	AUTO	M16 w/hydraulic buffer	Sliding	A1	Fold Post	None	M231	No
R0634	SMG	10.5" A1	9mm	1/10	Yes	SEMI	M16	Sliding	A1	A1	Supp.	Carbine	Yes
R0635	SMG	10.5" A1	9mm	1/10	Yes	AUTO	M16	Sliding	A1	A1	Supp.	Carbine	Yes
R0636	SMG	10.5" A1	9mm	1/10	Yes	AUTO	M16	Sliding	A1	A1	KAC Silencer	Special Long	No

Model No.	Type	Barrel LengthType	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
R0639	SMG	10.5" A1	9mm	1/10	Yes	BURST	M16	Sliding	A1	A1	Supp.	Carbine	Yes
R0639	XM177E2 Export Model	11.5" A1	5.56mm	1/12	Yes	AUTO	A1	Sliding	A1	A1	4 1/2" Sound Supp.	Carbine	No
R0640	M16 SMG	11.5" A1	5.56mm	1/12	Yes	AUTO	M16	Sliding	Flip-up	A1	4 1/2" Sound Supp.	Carbine	No
R0645	M16A1E1 (M16A2 prototype)	20" A2	5.56mm	1/7	Yes	BURST	A2	Fixed A2	A2	A2	Comp.	Rifle A2	Yes
R0645E	Enhanced Rifle	20" A2	5.56mm	1/7	Yes	BURST	Flat-Top Experimental	Fixed A2	A2 type & folding back-up	Flip-Up	Comp.	Rifle A2	Yes
R0645S	M16A2 Rifle	20" A2	5.56mm	1/7	Yes	SEMI	A2	Fixed A2	A2	A2	Comp.	Rifle A2	Yes
R0646	M16A2E3 (later M16A3)	20" A2	5.56mm	1/7	Yes	AUTO	A2	Fixed A2	A2	A2	Comp.	Rifle A2	Yes
R0649	GAU-5/A/A USAF	10" A1	5.56mm	1/12	Yes	AUTO	M16	Sliding	A1	A1	4 1/2" Sound Supp.	Carbine	No
R0651	M16A1 Carbine	14.5" A1	5.56mm	1/12	Yes	AUTO	A1	Fixed Later	A1	A1	Supp.	Carbine	Yes
R0652	M16 Carbine	14.5" A1	5.56mm	1/12	Yes	AUTO	M16	Fixed Early	A1	A1	Supp.	Carbine	Yes
R0653	M16A1 Carbine	14.5" A1	5.56mm	1/12	Yes	AUTO	A1	Sliding	A1	A1	Supp.	Carbine	Yes
R0653P	M16A1 Philippine Carbine	14.5" A1	5.56mm	1/12	Yes	AUTO	A1	Sliding	A1	A1	Supp.	Carbine	Yes
R0654	M16 Carbine	14.5" A1	5.56mm	1/12	Yes	AUTO	M16	Sliding	A1	A1	Supp.	Carbine	Yes
R0655	Sniper Rifle	20" A1	5.56mm	1/12	Yes	AUTO	A1 Special High Profile	Fixed Later	Match	Match	Silencer	Triangular	Yes
R0656	Sniper Rifle	20" A1	5.56mm	1/12	Yes	AUTO	A1 Special Low Profile	Fixed Later	Match	Match	Silencer	Triangular	Yes
R0701	M16A2 Rifle	20" A2	5.56mm	1/7	Yes	AUTO	A2	Fixed A2	A2	A2	Comp.	Rifle A2	Yes
R0702	M16A2 Rifle - UAE	20" A2	5.56mm	1/7	Yes	AUTO	A2	Fixed A2	Special (Tool to Adjust)	A2	Comp.	Rifle A2	Yes
R0703	M16A2 Rifle	20" A1	5.56mm	1/7	Yes	AUTO	A2	Fixed A2	A2	A1	Comp.	Rifle A2	Yes
CAR-703	M16A2 Experimental Rifle	20" semi-heavy	5.56mm	1/7	Yes	4-Way	Experimental w/gas piston	Fixed A2	Exp.	Exp.	Comp.	Rifle A2	Yes

Model No.	Type	Barrel Length/Type	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
R0704	M16A2 Rifle	20" A2	5.56mm	1/7	Yes	AUTO	A2	Fixed Later	A2	A2	Comp.	Rifle A2	Yes
R0705	M16A2 Rifle	20" A2	5.56mm	1/7	Yes	BURST	A2	Fixed A2	A2	A2	Comp.	Rifle A2	Yes
R0707	M16A2 Rifle	20" A1	5.56mm	1/7	Yes	BURST	A2	Fixed A2	A2	A1	Comp.	Rifle A2	Yes
R0708	M16A2 Rifle	20" A2	5.56mm	1/7	Yes	4-Way	A1M	Fixed A2	A1	A1	Comp.	Rifle A2	Yes
R0711	M16A2 Rifle	20" A1	5.56mm	1/7	Yes	AUTO	A1M	Fixed A2	A1	A1	Comp.	Rifle A2	Yes
R0713	M16A2 Rifle	20" A1	5.56mm	1/7	Yes	BURST	A1M	Fixed A2	A1	A1	Comp.	Rifle A2	Yes
R0715	M16A2 Rifle	20" A1	5.56mm	1/7	Yes	AUTO	A1M	Fixed A2	A1	A1	Comp.	Rifle A2	Yes
R0715X	M16A2 Rifle	20" A1	5.56mm	1/12	Yes	AUTO	A1M	Fixed A2	A1	A1	Comp.	Rifle A2	Yes
R0718	M16A2 Rifle - Holland	20" A2	5.56mm	1/7	Yes	BURST	A1M	Fixed A2	A1	A1	Comp.	Rifle A2	Yes
R0719H	M16A2 Rifle - Holland	20" A1	5.56mm	1/7	Yes	BURST	A1M	Fixed A2	A1	A1	Supp.	Rifle A2	Yes
R0720	M16A2 XM4 Carbine	14.5" A2	5.56mm	1/7	Yes	BURST	A2 with M203	Sliding	A2	A2	Comp.	M4	Yes
R0721	M16A2 XM4A1 Carbine	14.5" A2	5.56mm	1/7	Yes	AUTO	A2 with M203	Sliding	A2	A2	Comp.	M4	Yes
R0723	M16A2 Carbine	14.5" M4	5.56mm	1/7	Yes	AUTO	A1M	Sliding	A1	A2	Comp.	Carbine	Yes
R0723S	M16A2 Carbine	14.5" M4	5.56mm	1/7	Yes	SEMI	A1M	Sliding	A1	A2	Comp.	Carbine	Yes
R0723X	M16A2 Carbine	14.5" A1	5.56mm	1/7	Yes	AUTO	A1M	Sliding	A1	A1	Supp.	Carbine	Yes
R0725	M16A2 Carbine - UAE	14.5" A1	5.56mm	1/7	Yes	BURST	A1M	Sliding	A1	A1	Comp.	Carbine	Yes
R0725H	M16A2 Carbine - Holland	14.5" A1	5.56mm	1/7	Yes	BURST	A1M	Sliding	A1	A1	Comp.	Carbine	Yes
R0727	M16A2 Carbine - UAE	14.5" HBAR	5.56mm	1/7	Yes	AUTO	A1M	Sliding	Special (tool to adjust)	tapered post	Comp.	Carbine	Yes
R0727	M16A2 Carbine	14.5" M4	5.56mm	1/7	Yes	AUTO	A1M	Sliding	A1	A2	Comp.	M4 and Carbine	Yes

Model No.	Type	Barrel LengthType	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
R0728	M16A2 Carbine	14.5" M4 HBAR	5.56mm	1/7	Yes	AUTO	A1M	Sliding	A1	A2	Comp.	Carbine	Yes
R0729	M16A2 Carbine	14.5" M4 HBAR	5.56mm	1/7	Yes	BURST	A1M	Sliding	A1	A2	Comp.	Carbine	Yes
R0733	M16A2 Commando	11.5" A1	5.56mm	1/7	Yes	AUTO	A1M	Sliding	A1	A2	Supp.	Carbine	No
R0734A	M16A2 Commando	11.5" A1	5.56mm	1/7	Yes	BURST	A1M	Sliding	A1	A2	Supp.	Carbine	No
R0734	M16A2 Commando	11.5" A1	5.56mm	1/7	Yes	AUTO	A1M	Sliding	A1	A2	Supp.	Carbine	No
R0735	M16A2 Commando	11.5" A1	5.56mm	1/7	Yes	BURST	A1M	Sliding	A1	A2	Supp.	Carbine	No
R0735B	M16A2 Commando - Brazil	11.5" A1	5.56mm	1/7	Yes	BURST	A2	Sliding	A2	A2	Supp.	Carbine	No
R0737	M16A2 Commando	11.5" A1	5.56mm	1/7	Yes	AUTO	A1M	Sliding	A1	A2	Supp.	Carbine	No
R0738	Enhanced Carbine	11.5" A1	5.56mm	1/7	Yes	4-Way	A2	Sliding	A2	A2	Supp.	Carbine	No
R0741	M16A2 HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	AUTO	A2	Fixed A2	A2	A2	Comp. w/M60 Bipod	Rifle A2	Yes
R0741S	M16A2 HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	SEMI	A2	Fixed A2	A2	A2	Comp.	Rifle A2	Yes
R0742	M16A2 HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	AUTO	A2 w/scope mount	w/cheek piece	A2	A2	Comp.	Rifle A2	Yes
R0745	M16A2 HBAR Rifle	20" HBAR A2	5.56mm	1/7	Yes	BURST	A2	Fixed	A2	A2	Comp.	Rifle A2	Yes
R0746	M16A2 HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	BURST	A2 w/mount & 3x9 Scope	w/cheek piece	A2	A2	Comp.	Rifle A2	Yes
R0748	M16A2 HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	4-Way	A2	Fixed	A2	A2	Comp.	Rifle A2	Yes
R0750	LMG Open Bolt	20" HBAR+	5.56mm	1/7	Yes	AUTO	A2M	Fixed A2	A2	A2	Comp. w/Bipod	A2 Spl.	No
R0750MC	LMG USMC Open Bolt	20" HBAR+	5.56mm	1/7	Yes	AUTO	Flat-Top	Fixed A2	A4	A2	Comp. w/Bipod	A2 Spl.	Yes
R0755	M16A2 HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	AUTO	Flat-Top	Fixed	A4	A2	Comp.	Rifle A2	Yes
R0770	M16A3 Carbine	14.5" HBAR	5.56mm	1/7	Yes	AUTO	Flat-Top	Sliding	M4	M4	Comp.	Carbine	Yes



Model No.	Type	Barrel Length Type	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
R0777	M4	14.5"	M4	5.56mm	1/7	Yes	AUTO	A2	Sliding	A2	Comp.	M4	Yes
Carbine with extended feed ramps and heavy buffer													
R0778	M4	14.5"	M4	5.56mm	1/7	Yes	4-Way	A2	Sliding	A2	Comp.	M4	Yes
Carbine with extended feed ramps and heavy buffer													
R0779	M4	14.5"	M4	5.56mm	1/7	Yes	Burst	A2	Sliding	A2	Comp.	M4	Yes
Carbine with extended feed ramps and heavy buffer													
R0780	M16A3	11.5"	A1	5.56mm	1/7	Yes	BURST	Sliding	M4	M4	Supp.	Carbine	No
Command													
R0901	M16A4	20"	A2	5.56mm	1/7	Yes	AUTO	Fixed A2	A4	A2	Comp.	Rifle A2	Yes
Rifle													
R0901DOE	M16A4	20"	A2	5.56mm	1/7	Yes	AUTO	Fixed A2	A4	A2	Vortex	Rifle A2	Yes
DOE Rifle													
R0901CQB	M16A4	20"	A2	5.56mm	1/7	Yes	AUTO	Fixed A2	ARMS #40 Flip-Up	A4	Comp.	ARMS SIR Rail System	Yes
CQB Rifle													
R0901H	M16A3	20"	A2	5.56mm	1/7	Yes	AUTO	Adjustable	A4	A2	Comp.	Rifle A2	Yes
Rifle - Holland													
R0905	M16A4	20"	A2	5.56mm	1/7	Yes	BURST	Fixed A2	A4	A2	Comp.	Rifle A2	Yes
Rifle													
R0908	M16A4	20"	A2	5.56mm	1/7	Yes	4-Way	Fixed A2	A4	A2	Comp.	Rifle A2	Yes
Rifle													
R0911	M16A4	20"	A2	5.56mm	1/7	Yes	AUTO	Fixed	A4	A2	Comp.	Rifle A2	Yes
Rifle													
R0920	M4	14.5"	M4	5.56mm	1/7	Yes	BURST	Sliding w/ramps	M4	M4	Comp.	M4	Yes
Carbine													
R0920AF	M4	14.5"	M4	5.56mm	1/7	YES	BURST	Sliding w/ramps	Spl. Back-up Iron Sight	M4	Comp.	M4	Yes
Carbine - USAF													
R0920	M4	14.5"	M4	5.56mm	1/7	Yes	BURST	Sliding w/ramps	M4	M4	Comp.	RAS (Rail Adapter System)	Yes
Carbine													
R0921	M4A1	14.5"	M4	5.56mm	1/7	Yes	AUTO	Sliding w/ramps	M4	M4	Comp.	M4	Yes
Carbine													
R0921HB	M4A1	14.5"	M4	5.56mm	1/7	Yes	AUTO	Sliding w/ramps	M4	M4	Comp.	M4	Yes
Heavy Carbine													
R0921	M4A1	14.5"	M4	5.56mm	1/7	Yes	AUTO	Sliding w/ramps	M4	M4	Comp.	RAS (Rail Adapter System)	Yes
HBRAS													
R09211	M4A1	14.5"	M4	5.56mm	1/7	Yes	AUTO	Sliding w/ramps	none	M4	Comp.	M4	Yes
Carbine - Israel													
R0925	M4A1	14.5"	M4	5.56mm	1/7	Yes	BURST	Sliding w/ramps	M4	M4	Comp.	Carbine	Yes

Model No.	Type	Barrel Length/Type	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
R0927	M16A4 Carbine	14.5" M4 Heavy Carbine	5.56mm	1/7	Yes	AUTO	Flat-Top w/ramps	Sliding	M4	M4	Comp.	Carbine	Yes
R0933	M16A4 Commando	11.5" A1	5.56mm	1/7	Yes	AUTO	Flat-Top w/ramps	Sliding	M4	A1	Comp.	Carbine	No
R0933CQB	M4 Commando	11.5" A1	5.56mm	1/7	Yes	AUTO	Flat-Top	Sliding	ARMS #40 Flip-Up	M4	Supp.	ARMS SIR Rail System	No
R0935G	M16A4 Commando	11.5" A1	5.56mm	1/7	Yes	BURST	Flat-Top	Sliding	M4	A1	Supp.	M4	No
R0935	M16A4 Commando	11.5" A1	5.56mm	1/7	Yes	BURST	Flat-Top	Sliding	M4	A1	Supp.	Carbine	No
R0938	M4/M16A4 Commando HBAR	11.5" HBAR	5.56mm	1/7	Yes	4-Way	Flat-Top	Sliding	M4	A2	Comp.	M4	No
R0941	M16A4 HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	AUTO	Flat-Top	Fixed	A4	A2	Comp. w/M60 Bipod	Rifle A2	Yes
R0941H	M16A4 HBAR Rifle - Holland - w/ Bipod & Sling	20" HBAR	5.56mm	1/7	Yes	AUTO	Flat-Top	Fixed	A4	A2	Comp.	Rifle A2	Yes
R0941S	M16A4 BAR Rifle	20" HBAR	5.56mm	1/7	Yes	SEMI	Flat-Top	Fixed	A4	A2	Comp.	Rifle A2	Yes
R0941	M16A4 WOB HBAR Rifle	20" HBAR	5.56mm	1/7	Yes	AUTO	Flat-Top	Fixed	A4	A2	Comp	Rifle A2	Yes
R0942	M16A4 HBAR Rifle	20" HBAR	5.56mm	1/9	Yes	AUTO	Flat-Top	Fixed	A4	A2	Comp.	Rifle A2	Yes
R0943	M16A4 HBAR Rifle - Holland	20" HBAR	5.56mm	1/7	Yes	AUTO	Flat-Top	Fixed	A4	A2	Comp.	Rifle A2	Yes
R0945	M16A4 Rifle	20" A2	5.56mm	1/7	Yes	BURST	Flat-Top	Fixed A2	A4	A2	Comp.	A2 Special	Yes
R0950	M16A4 LMG	20" HBAR+	5.56mm	1/7	YES	AUTO Open Bolt	Flat-Top M	Fixed	A4	M4	Comp.	M4	Yes
R0977	M4 Carbine	14.5" M4	5.56mm	1/7	Yes	AUTO	Flat-Top w/ramps	Sliding	M4	M4	Comp.	M4	Yes
R0977CQB	M4 Carbine	14.5" M4	5.56mm	1/7	Yes	AUTO	Flat-Top w/ramps	Sliding	ARMS #40 Flip-Up	M4	Comp.	ARMS SIR Rail System	Yes
R0978	M4 Carbine	14.5" M4	5.56mm	1/7	Yes	4-Way	Flat-Top	Sliding	M4	A2	Comp.	M4	No
R0979	M4 Carbine	14.5" M4	5.56mm	1/7	Yes	BURST	Flat-Top	Sliding	M4	M4	Comp.	M4	Yes
R0979	M4 NYPD Carbine	14.5" M4	5.56mm	1/9	Yes	AUTO	Flat-Top	Sliding	M4	M4	Comp.	M4	Yes





Model No.	Type	Barrel Length Type	Caliber	Twist	Chrome	Fire Control	Upper Receiver	Stock	Rear Sight	Front Sight	Muzzle Device	Hand Guards	Bayonet Lug
AR6700	Law Enforcement Competition	20" HBAR	5.56mm	1/9	Yes	SEMI	Flat-Top	Fixed	A4	A2	Comp.	Rifle	Yes
AR6721	AR-15A3 Tactical Carbine	16" HBAR	5.56mm	1/9	Yes	SEMI	Flat-Top	Sliding	M4	A2	Comp.	Carbine	Yes
AR6731	Competition HBAR II Carbine	16.1" HBAR	5.56mm	1/9	Yes	SEMI	Flat-Top	Fixed	A4	A2	Comp.	Rifle	Yes
AR6830	Law Enforcement Light Weight Carbine	16" HBAR	7.62X39mm	1/12	No	SEMI	A2	Fixed	A2	A2	Supp.	Carbine	Yes
LE6920	Law Enforcement Carbine	16.1" M4	5.56mm	1/7	Yes	SEMI	Flat-Top	Sliding	M4	M4	Comp.	M4	Yes
LE6921	Law Enforcement HBAR Carbine	16.1" M4 Hvy	5.56mm	1/7	Yes	SEMI	Flat-Top	Sliding	M4	M4	Comp.	M4	Yes
LE6921	Law Enforcement Carbine	14.5" M4	5.56mm	1/7	Yes	SEMI	Flat-Top	Sliding	M4	M4	Comp.	M4	Yes
LE6922	Law Enforcement Carbine	16.1" M4	5.56mm	1/9	Yes	SEMI	Flat-Top	Sliding	M4	M4	Comp.	M4	Yes

\*\* The AR6320 was designed and named by Ken Elmore, Specialized Armament Warehouse/Colt Law Enforcement Training.

## Legend

Although the "R0" designation may not be found in some early documentation and brochures, the "R0" prefix should always be implied when referring to Colt military/law enforcement model numbers.

### Upper Receivers

M16	Fixed carrying handle, rear sight adjustable for windage only, no forward assist
A1	Fixed carrying handle, rear sight adjustable for windage only, with forward assist
A1M	Fixed carrying handle, rear sight adjustable for windage only, with forward assist and shell deflector
A2	Fixed carrying handle with fully adjustable A2 rear sights and shell deflector as well as forward assist
A2M	Fixed carrying handle, A2 with fully adjustable rear sight and shell deflector, no forward assist
Flat-Top	Flat-top upper receiver both in M4 and A4 configurations
Flat-Top M	Flat-top upper receiver, no forward assist

### Caliber

5.56mm	5.56x45mm NATO (.223 Remington)
7.62x39mm	(7.62mm M43; 7.62mm Kalashnikov; 7.62mm Bloc)
9mm	9mm NATO (9x19mm; 9mm Parabellum; 9mm Luger)

**Barrel Types**

A1	early thin M16/M16A1 profile
A2	standard M16A2 profile, thin under handguard and thicker at muzzle
HBAR	Heavy Barrel/Heavy Barrel Automatic Rifle
Light	extremely light 9mm SMG barrel
M4	M4 carbine configuration: light under handguards and heavy at muzzle with groove for mounting M203 grenade launcher
HBAR+	very heavy LMG barrel for sustained fire
Heavy Carbine	found on some M4A1 (R0921HB) carbines

**Handguards**

Carbine	standard ribbed carbine handguard
M4	double-heat-shield M4 handguards
Triangular	early M16/M16A1 handguards
Rifle A2	standard round M16A2 handguards
Floating	free-floating tube
Rail Adapter	KAC RAS
SIR	ARMS Selective Integrated Rail
A2SPL	heavy-duty handguard for LMG

**Stocks**

Rifle	Early	early AR-15 stock without storage compartment/trap door
Rifle	Later	later M16A1-style with storage compartment/trap door
Rifle A2	M16A2	stock (5/8" longer and made of stronger material)
Sliding		any version of Colt's many sliding/telescoping stocks

**Muzzle Devices**

3-Prong	early open 3-prong flash hider
Supp.	later enclosed flash suppressor (birdcage)
Comp.	M16A2-style compensator/muzzle brake with closed bottom
Vortex	prong-style (in current use)
Sound Suppressor	suppressor for short-barrelled carbines and SMG to decrease muzzle blast

# Commercial Models

Model No.	Model	Barrel Length	Caliber	Twist	Forward Assist	Upper Receiver	Stock	Muzzle Device	Hand Guards	Bayonet Lug	Hammer/Trigger Pin Diameter
R6000	AR-15 SP1 Original First Issue	20" Std Not Chromed	5.56mm .223 Rem	1/12	No	M16	Fixed Early - no trap door	3-Prong	Triangular	Yes	0.155"
R6000	AR-15 SP1 Later Version	20" Std Chromed	5.56mm .223 Rem	1/12	No	M16	Fixed A1 stock with trap door	Supp.	Triangular	Yes	0.155"
R6001	AR-15 SP1 Carbine	16" Std Chromed	5.56mm .223 Rem	1/12	No	M16	Sliding	Supp.	Carbine	Yes	0.155"
R6002	AR-15 SP1 Carbine w/3X Scope	16" Std Chromed	5.56mm .223 Rem	1/12	No	M16	Sliding	Supp.	Carbine	Yes	0.155"
R6003	AR-15 SP1 Rifle w/3X Scope	20" Std Chromed	5.56mm .223 Rem	1/12	No	M16	Fixed	Supp.	Triangular	Yes	0.15"5
R6004	AR-15 SP1 Rifle w/Tascorama Red Dot	20" Std Chromed	5.56mm .223 Rem	1/12	No	M16	Fixed	Supp.	Triangular	Yes	0.155"
R6007	AR-15 SP1 Rifle - electroless nickel	20" Std Chromed	5.56mm .223 Rem	1/12	No	M16	Fixed	Supp.	Triangular	Yes	0.155"
R6010	AR-15 SP1 Later Version	20" Std Chromed	.222 Rem	1/12	No	M16 A1 stock with trap door	Fixed	Supp.	Triangular	Yes	0.155"
R6400	AR-15A2 Sporter II	20" A2 Chromed	5.56mm .223 Rem	1/7	No	M16	Fixed A2	Comp.	Rifle A2	Yes	0.155"
R6401	AR-15A2 Sporter II	20" A2 Chromed	5.56mm .223 Rem	1/7	Yes	A1	Fixed A2	Comp.	Rifle A2	Yes	0.155"
R6420	AR-15A2 Sporter Carbine	16" A1 Chromed	5.56mm .223 Rem	1/7	Yes	M16	Sliding Plastic	Comp.	Carbine	Yes	0.155"
R6420 CCC	Colt Camo Companion	16" A1 Chromed	5.56mm .223 Rem	1/7	Yes	A1	Sliding Plastic	Comp.	Carbine	Yes	0.155"
R6421	AR-15A2 Sporter Carbine	16" A1 Chromed	5.56mm .223 Rem	1/7	Yes	A2	Sliding Plastic	Comp.	Carbine	Yes	0.155"
R6425	AR-15A2 Sporter carbine	16" A1 Chromed	5.56mm .223 Rem	1/7	Yes	A1	Sliding Plastic	Comp.	Carbine	Yes	0.155"
R6430	9mm Sporter Light Weight	16" A1 Chromed	9mm Luger	1/10	No	M16	Fixed	Supp.	Carbine	No	0.170"
R6450	AR-15 Sporter Carbine	16" A1 Chromed	9mm Luger	1/10	No	M16	Sliding Plastic	Supp.	Carbine	No	0.155"
R6451	AR-15 Sporter SMG - Mexico	10.5" Light Chromed	9mm Luger	1/10	No	M16	Sliding Plastic	Supp.	Carbine	Yes	0.155"

Model No.	Model	Barrel Length	Barrel Type	Caliber	Twist	Forward Assist	Upper Receiver	Stock	Muzzle Device	Hand Guards	Bayonet Lug	Hammer/Trigger Pin Diameter
R6500	AR-15A2 Sporter II	20"	A2 Chromed	5.56mm .223 Rem	1/7	Yes	A1M	Fixed	Comp.	Rifle A2	Yes	0.155"
R6510	AR-15A2 Sporter Export	20"	A2 Chromed	.222 Rem	1/12	Yes	A1M	Fixed	Comp.	Rifle A2	No	0.155"
R6511	Sporter Export	20"	A2 Chromed	.222 Rem	1/12	Yes	A1M	Fixed	Comp.	Rifle A2	No	0.170"
R6512	Sporter Export	20"	A2 Chromed	.222 Rem	1/12	Yes	A2	Fixed	Comp.	Rifle A2	No	0.170"
R6520	AR-15A2 Gov't. Carbine	16"	A1 Chromed	5.56mm .223 Rem	1/7	Yes	A2	Sliding	Comp.	Carbine	Yes	0.155"
R6530	Sporter Light Weight	16"	A1 Chromed	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Carbine	No	0.170"
R6550	AR-15A2 Gov't. Model	20"	A2 Chromed	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	Yes	0.155"
R6550K	AR-15A2 Gov't.w/.22 Conversion Kit	20"	A2 Chromed	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	Yes	0.155"
R6551	Gov't. Sporter	20"	A2 Chromed	.223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	None	0.170"
R6551K	Gov't. Sport. w/.22 Conv. Kit	20"	A2 Chromed	5.56mm .223 Rem	1/7	Yes	A2	Fixed	None	Rifle A2	None	0.170"
R6552	AR-15A2 Gov't. Model	20"	A2 Chromed	5.56mm .223 Rem	1/9	Yes	A2	Fixed	None	Rifle A2	Yes	0.155"
R6552	AR-15A2 Sporter Match	20"	HBAR	5.56mm .223 Rem	1/9	Yes	A2	Fixed	Comp.	Rifle A2	Yes	0.155"
R6600	AR-15A2 Match HBAR	20"	HBAR	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	Yes	0.155"
R6600DH	AR-15A2 Delta w/3x9 Scope	20"	HBAR	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	Yes	0.155"
R6600K	AR-15A2 Match HBAR w/.22LR Conv. Kit	20"	HBAR	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	Yes	0.155"
R6601	Sporter Match HBAR	20"	HBAR Chromed	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	No	0.170"
R6601DH	Sporter Match Delta HBAR w/3x9 Scope	20"	HBAR	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	No	0.170"
R6602	Sporter Match HBAR	20"	HBAR	5.56mm .223 Rem	1/9	Yes	A2	Fixed	None	Rifle A2	No	0.170"
R6700	Sporter Comp. HBAR	20"	HBAR	5.56mm .223 Rem	1/7	Yes	Flat-Top	Fixed	Comp.	Rifle A2	No	0.170"



Model No.	Model	Barrel Length	Caliber	Twist	Forward Assist	Upper Receiver	Stock	Muzzle Device	Hand Guards	Bayonet Lug	Hammer/Trigger Pin Diameter
R6700CH Sporter	Range Select Flat-Top Comp.	20" HBAR w/3x9 Scope	5.56mm .223 Rem	1/7	Yes	Flat-Top	Fixed	Comp.	Rifle A2	No	0.170"
R6701 Sporter Comp.	HBAR	20" Chromed	5.56mm .223 Rem	1/7	Yes	Flat-Top w/ARMS Scope Mount	Fixed	Comp.	Rifle A2	No	0.170"
R6721 Tactical Carbine	AR-15A3	16" HBAR Chromed	5.56mm .223 Rem	1/7	Yes	Flat-Top	Sliding	Comp.	Carbine	Yes	0.170"
R6725 Flat-Top HBAR Sporter	AR-15A2	20" HBAR Chromed	5.56mm .223 Rem	1/7	Yes	Flat-Top	Fixed	Comp.	Rifle A2	Yes	0.155"
R6726 Flat-Top HBAR Sporter	AR-15A2	20" HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	Comp.	Rifle A2	Yes	0.155"
R6727 Flat-Top HBAR Sporter	AR-15A2	20" HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top w/Scope Base	Fixed	None	Rifle A2	No	0.170"
R6731 Sporter Match Target Comp.	HBAR HBAR II	16" HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	Comp.	Carbine	No	0.170"
R6750 Light Machine Gun Sporter	HBAR+ Chromed	20" HBAR+ Chromed	5.56mm .223 Rem	1/7	No	A2 w/No Forward Assist	Fixed	Comp.	A2 Special	Yes	0.155"
R6830 Sporter Match Target Light Weight - Chromed	A2	16" A2	7.62x39mm	1/12	Yes	A2	Fixed	Comp.	Carbine	No	0.170"
R6850 Sporter Flat-Top HBAR Carbine - Chromed	HBAR	16" HBAR	7.62x39mm	1/12	Yes	Flat-Top	Fixed	Comp.	Carbine	No	0.170"
R6851 Flat-Top Sporter Rifle	HBAR	20" HBAR	7.62x39mm	1/12	Yes	Flat-Top	Fixed	Comp.	A2 Rifle	No	0.170"
CR6724 Colt Accurized Rifle	CAR-A3 Brushed Stainless Steel	24" HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top w/Match Trigger Group	Fixed	None	Free Floating	No	0.170"
MT6400C Match Target M4 Carbine	M4	16" M4	5.56mm .223 Rem	1/7	Yes	Flat-Top	Fixed Sliding	Comp.	M4	No	0.170"
MT6430 Match Target Light Weight	A1	16.1" A1	9mm	1/10	No	M16	Fixed	None	Carbine	No	0.170"
MT6530 Match Target Light Weight	A1	16" A1	5.56mm .223 Rem	1/7	Yes	A2	Fixed	None	Carbine	No	0.170"
MT6551 Match Target	A2	20" A2	5.56mm .223 Rem	1/7	Yes	A2	Fixed	None	Rifle A2	No	0.170"
MT6601 Match Target HBAR	HBAR	20" HBAR	5.56mm .223 Rem	1/7	Yes	A2	Fixed	None	Rifle A2	No	
MT6601C Match Target HBAR	HBAR	20" HBAR	5.56mm .223 Rem	1/7	Yes	A2	Fixed	Comp.	Rifle A2	No	0.170"
MT6601T Match Target HBAR w/Match Trigger	HBAR	20" HBAR	5.56mm .223 Rem	1/7	Yes	Flat-Top	Fixed	None	Rifle A2	No	0.170"



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Model No.	Model	Barrel Length	Barrel Type	Caliber	Twist	Forward Assist	Upper Receiver	Stock	Muzzle Device	Hand Guards	Bayonet Lug	Hammer/Trigger Pin Diameter
MT6700	Match Target Comp. HBAR	20"	HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	None	Rifle A2	No	0.170"
MT6700C	Match Target Comp. HBAR	20"	HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	Comp.	Rifle A2	No	0.170"
MT6700M	Match Target Comp. HBAR - Mexico	20"	HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	None	Rifle A2	No	0.170"
MT6700 CH	Match Target Comp. HBAR	20"	HBAR	5.56mm .223 Rem	1/9	YES	Flat-Top	Choate Hogue Pistol Grip	Comp.	Rifle A2	No	0.170"
MT6700T	Match Target Comp. HBAR w/Match Trigger	20"	HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	None	Rifle A2	No	0.170"
MT6731	Match Target Comp. HBAR II	16"	HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	None	Carbine	No	0.170"
MT6731C	Match Target Comp. HBAR II	16"	HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Fixed	Comp.	Carbine	No	0.170"
MT6731 HC	Match Target Comp. HBAR II	16"	HBAR	5.56mm .223 Rem	1/9	Yes	Flat-Top	Choate Hogue Pistol Grip	Comp.	Carbine	No	0.170"
MT6830	Match Target Light Weight	16"	HBAR	7.62x39mm	1/12	Yes	A2	Fixed	None	Carbine	No	0.170"
TE6700	Tactical Elite Rifle	20"	HBAR	5.56mm .223 Rem	1/8	Yes	Flat-Top Scope & Rings	Choate	None	Tubular	No	0.170"
		1" diameter							Hogue Free-Floating			

# Serial Number Designations for Colt Semi-Automatic-Only Rifles

## Arms Produced Prior to the Assault Weapon Ban of 1994

SN and Prefix	Description
SP360200 and below. . . . .	Pre-Ban AR-15-marked rifles
CC001616 and below. . . . .	Pre-Ban Colt Carbine
CH019500 and below. . . . .	Pre-Ban Competition HBAR
GC018500 and below. . . . .	Pre-Ban Government Carbine
LH011326 and below. . . . .	Pre-Ban Sporter Lightweight 7.62x39mm
MH086025 and below. . . . .	Pre-Ban Sporter Match HBAR rifles
NL004800 and below. . . . .	Pre-Ban Sporter Lightweight 9mm
SL027264 and below. . . . .	Pre-Ban Sporter Lightweight .223 Rem
ST038100 and below. . . . .	Pre-Ban Sporter Target rifles with muzzle brake
TA10100 and below. . . . .	Pre-Ban 9mm Carbine
BD000134 and below. . . . .	Pre-Ban AR-15A3 Tactical Carbine

## Post-Ban Match Target Series Rifles

### Manufactured after September 13, 1994

SN Prefix	Description
MTM. . . . .	Match Target M4 Carbine
CCH. . . . .	Match Target Competition HBAR
CNL. . . . .	Match Target Lightweight
CST. . . . .	Colt Match Target, Target Model
CMH. . . . .	Match Target Match HBAR
CJC. . . . .	Match Target Competition HBAR II
BK. . . . .	CAR-A3 HBARElite
CSL. . . . .	Colt Match Lightweight .223 Rem
CLH. . . . .	Colt Match Lightweight 7.62x39mm

## Colt Law Enforcement Series

SN Prefix	Description
LSL. . . . .	Law Enforcement Lightweight Carbine
LGC. . . . .	Law Enforcement AR-15A2 Carbine
LTA. . . . .	Law Enforcement 9mm Carbine
LBD. . . . .	Law Enforcement AR-15A3 Tactical Carbine
LSL. . . . .	Law Enforcement Lightweight Carbine

## Serial Number Ranges For Colt AR-15 Sporter I Rifles

Year	SN Range	Year	SN Range
1963. . . . .	SP00001 - SP00023	1968. . . . .	SP10750
1964. . . . .	SP00101	1969. . . . .	SP14000 - SP14653
1965. . . . .	SP02501	1970. . . . .	SP15001 - SP15473
1966. . . . .	SP05600	1971. . . . .	SP16001
1967. . . . .	SP08250	1972. . . . .	SP19401

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<b>Year</b>	<b>SN Range</b>
1973. . . . .	SP24201
1974. . . . .	SP32601
1975. . . . .	SP43801
1976. . . . .	SP55301
1977. . . . .	SP67651

<b>Year</b>	<b>SN Range</b>
1978. . . . .	SP83400
1979. . . . .	SP96401
1980. . . . .	SP112801
1981. . . . .	SP134601
1982. . . . .	SP158201

## Chapter Twelve

# Component Reference Guide

## Barrel Group

### Military Barrel Identification

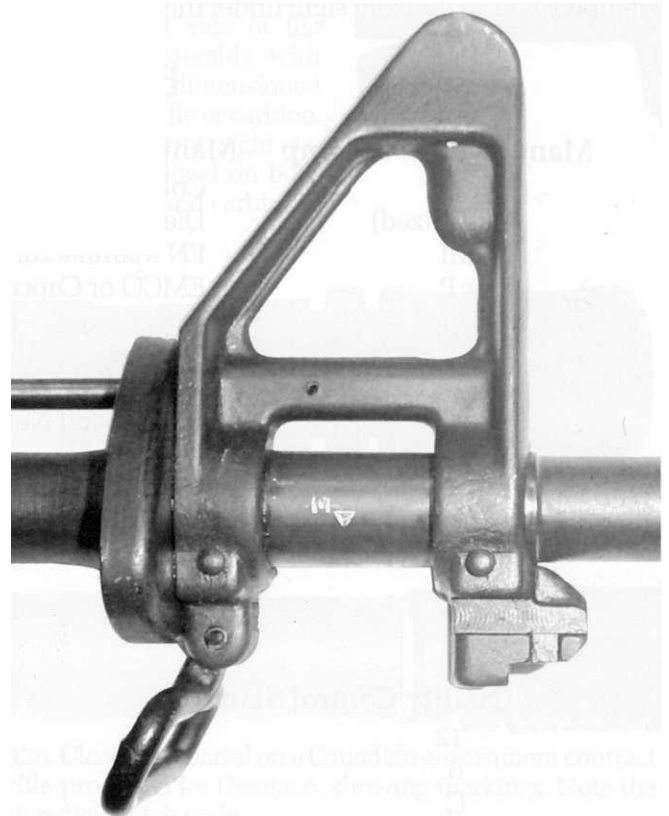


413. Underside closeup of an early M16 barrel, showing "12" marking indicating that the barrel is rifled with the 1-in-12 twist.

**T**he barrels used on the first production lots of AR-15 rifles, including the initial 18,000 broach-rifled barrels made for Colt by Winchester, utilized a one turn in 14" twist, were not chrome plated, and did not have any markings. When the rifling was changed from the original one-in-14" twist to the one turn in 12" twist in the summer of 1963, Colt began stamping the number "12" on the underside of the new barrels, right behind the flash suppressor, in order to differentiate the new faster-twist barrels from the older one-in-14" twist barrels. This "12" marking will often be seen with the prefix "CC" (chrome chamber) or "CB" (chrome bore and chamber). The prefix "S" has also been found, although its meaning has not been verified.

Additionally, Colt stamped the letter "M" on the right side of the barrel between the two front sight taper pins. This M, which can be found upside down, signified that the barrel had been Magnetic Particle Tested (Magnafluxed). These markings can be found on the barrels of early M16, XM16E1 and M16A1 rifles.

The chrome plated chamber was adopted on May 26, 1967, and the late-style M16A1 barrel with chrome plated bore and chamber was in production by 1971 or 1972. In lieu of the earlier "CC" or "CB"



414. Right side closeup of an M16 barrel showing "M" marking, signifying that the barrel had been Magnetic Particle Tested (Magnafluxed), and the early triangular Colt proof, later superseded by the "C MP" markings.

prefixes, Colt began to mark their barrels (ahead of an initial proprietary "C" for Colt) and the "MP" (Magnafluxed and Proofed), with an additional C" to indicate that the barrel had a chrome chamber only, or "CHROME BORE" or "B" to indicate chrome bore and chamber.

286 Military Barrel Identification



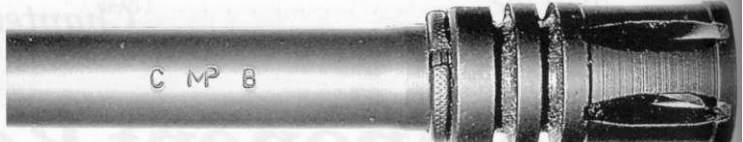
415. Closeup of Colt-manufactured 1-in-12 barrel, showing markings indicating chrome bore and chamber.



416. Closeup of Colt-manufactured 1-in-12 barrel, showing markings indicating chrome chamber only.



417. Closeup of a barrel manufactured by SAKO Defense, markings indicating chrome bore and chamber and 1-in-12 rifling. Only one such contract was awarded by the US government.



418. Closeup of Colt-manufactured 1-in-12 barrel, showing markings indicating chrome bore and chamber.

The formatting of the barrel information remained standard for all government contractors, although it should be noted that Colt also utilizes a date code on all of their barrels, in a month/year format stamped behind the front sight under the handguards

(fig. 421). For its part, Diemaco includes a work order number on the end of their marking, and does not mark barrel twist due to the fact they only produce barrels in the 1/7 twist configuration.

Barrel Marking Guide

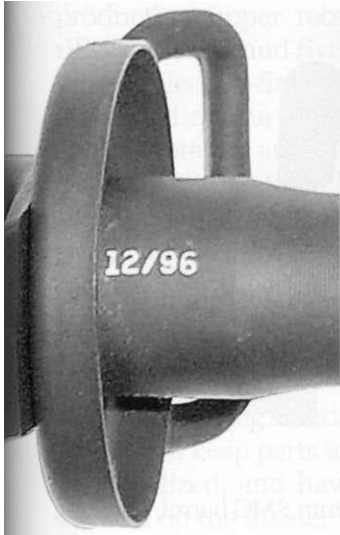
Manufacturer's Stamp	Manufacturer	Description
C	Colt	
D (stylized)	Diemaco	
FNMI	FN Manufacturing, Inc.	
E or P	EMCO or Capco, Inc.	(Modification Kits to convert M16A1 to M16A2 rifles, primarily for US Air Force and Coast Guard)
SAK	SAKO Defense	(one-time contract only)
RNC	Rock Island New Chrome Chamber.	The first new barrels modified by Rock Island Arsenal with chrome chambers. This program was begun in September, 1967.
RUC	Rock Island Used Chrome Chamber.	The first used barrels modified by Rock Island Arsenal with chrome chambers. This program was begun in September, 1967.
Quality Control Stamp		Description
12		1 turn in 12" twist (early rifles)
B		Chrome Bore and Chamber
C		Chrome Chamber Only
CB		Chrome Bore and Chamber (early Colt and GM Hydraulic Division barrel markings)
CC		Chrome Chamber (early rifles)
F		Flat-Top (left side of front sight assembly)
M		Magnetic Particle Inspection (Magnafluxed)
MP		Magnetic Particle Inspection and Proof Tested
HBAR		Heavy Barrel AR
O		Chrome vendor's mark placed on the outside of the barrel under the handguards to signify chrome bore and chamber. This is a US military requirement.



419. Closeup of Colt-manufactured M16A2/M16A4 barrel, showing markings.

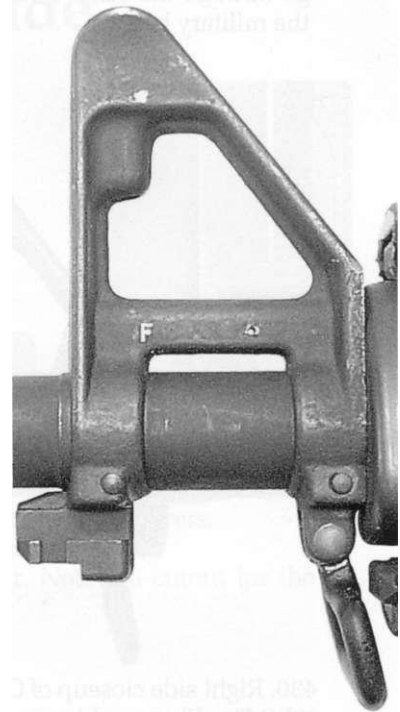


420. Closeup of M16A2/M16A4 barrel manufactured by FNMI, showing markings.



422. Closeup of Colt chrome vendor's mark.

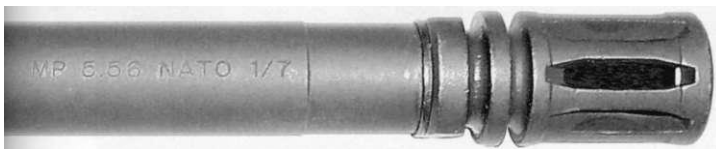
421 (left). Closeup of Colt month/year date code (for December, 1996), stamped on the barrel behind the front sight, under the handguards.



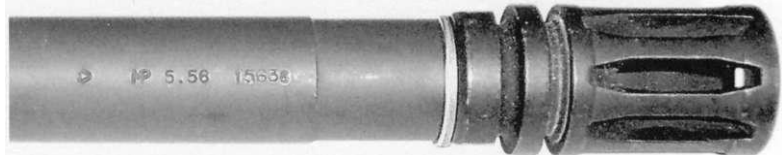
423 (right). Colt and FNMI mark the left side of the front sight assembly with an "F" if it is dimensioned for a flat-top rifle or carbine. This same front sight assembly is utilized on both flat-top rifles and carbines.



424. Closeup of the current M4 carbine barrel configuration, showing markings indicating manufacture by Colt.



425. Closeup of barrel produced by FNMI, showing markings. Note there is no manufacturer's code.



426. Closeup of barrel on a Canadian government contract rifle produced by Diemaco, showing markings. Note the five-digit batch code.



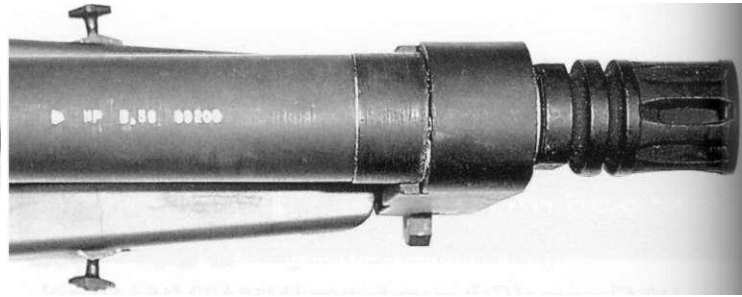
427. Closeup of heavy carbine barrel on a Diemaco Special Forces Support Weapon (SFSW), showing markings.



## 288 Military Barrel Identification

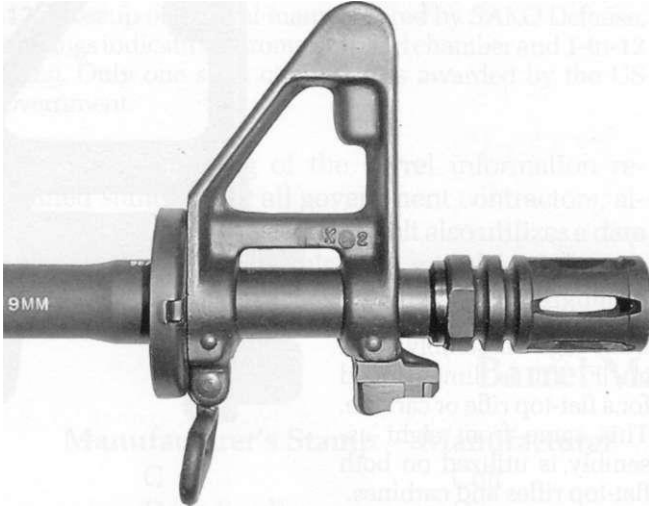


428. Closeup of Colt-manufactured commercial heavy barrel (Heavy Barrel AR), showing markings. These barrels go through the same testing and proofing procedures as the military barrels.

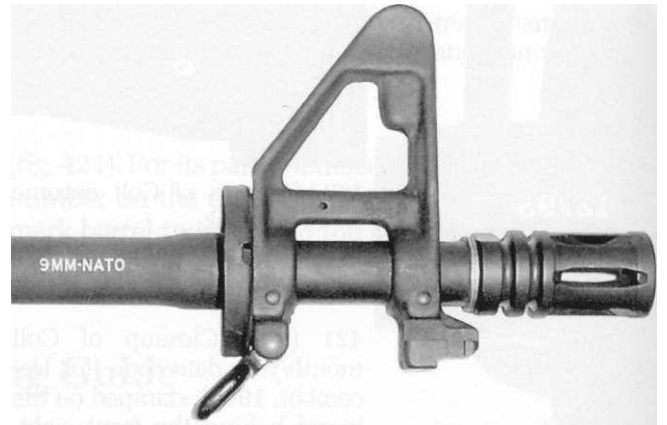


429. Closeup of Diemaco LMG/LSW barrel, showing markings. These will be found on Colt LMGs.

## Colt 9mm SMG Barrel Markings



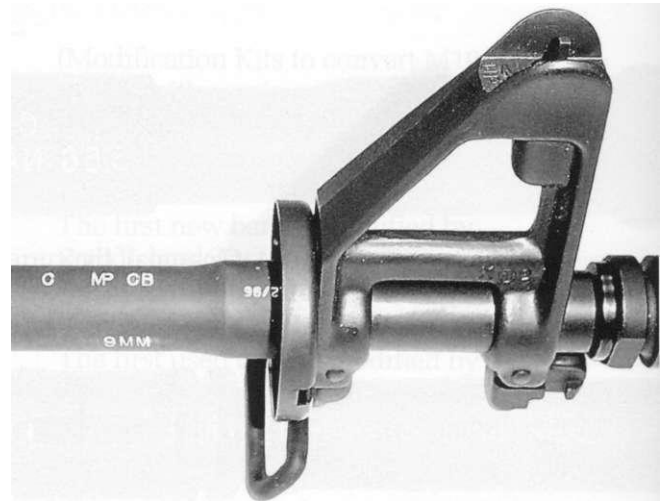
430. Right side closeup of Colt 9mm SMG barrel, showing "9MM" caliber marking.



431. Right side closeup of Colt 9mm SMG barrel, showing "9MM-NATO" caliber marking.

The barrels on Colt 9mm SMGs utilize the same quality control, factory, date and chrome vendor codes as their 5.56mm rifles. The only new code is the caliber signifier. Early barrels were marked "C MP CHROME BORE 9MM".

432 (right). Right side closeup of Colt 9mm SMG barrel showing factory, proof, chrome bore and chamber, date, and caliber codes.



433 (below). Right side closeup of Colt 9mm SMG barrel, showing markings. Since the SMG is blowback operated, there is no gas system.

Note the chrome vendor's mark (far left) as well as the factory, quality control, caliber, and barrel type codes.

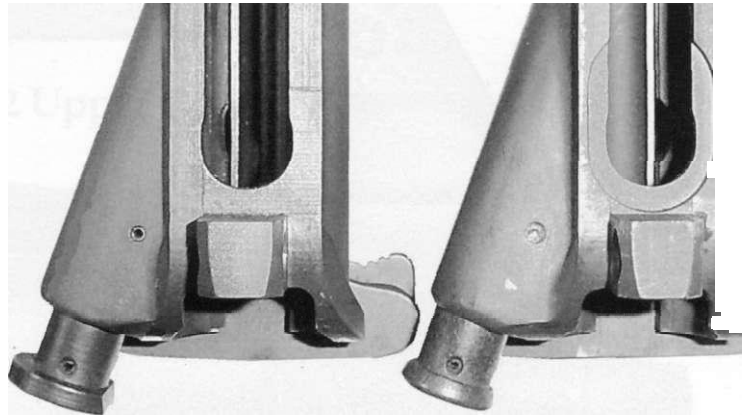


# Upper Receiver Group

## Upper Receiver Reference Guide

Throughout the years there have been basically five production upper receivers used for selective-fire rifles/carbines, and five for civilian sporter rifles/carbines. Selective-fire upper receivers have a relief cut machined on the bottom rear of the receiver to accommodate the auto sear, and they utilize the .250" diameter "Small Pivot Pin" captive push pin instead of the civilian Sporter .315" diameter "Large Pivot Pin", which is a screw and collet assembly. There is no auto sear relief cut on the semi-auto-only upper receivers.

As a cost-cutting measure, some time after Colt introduced their new Sporter series in 1990, they reverted to using standard small-pin upper receivers in order to keep parts interchangeable. The receivers are anodized, and have a dry film lubricant finish applied on the inside.

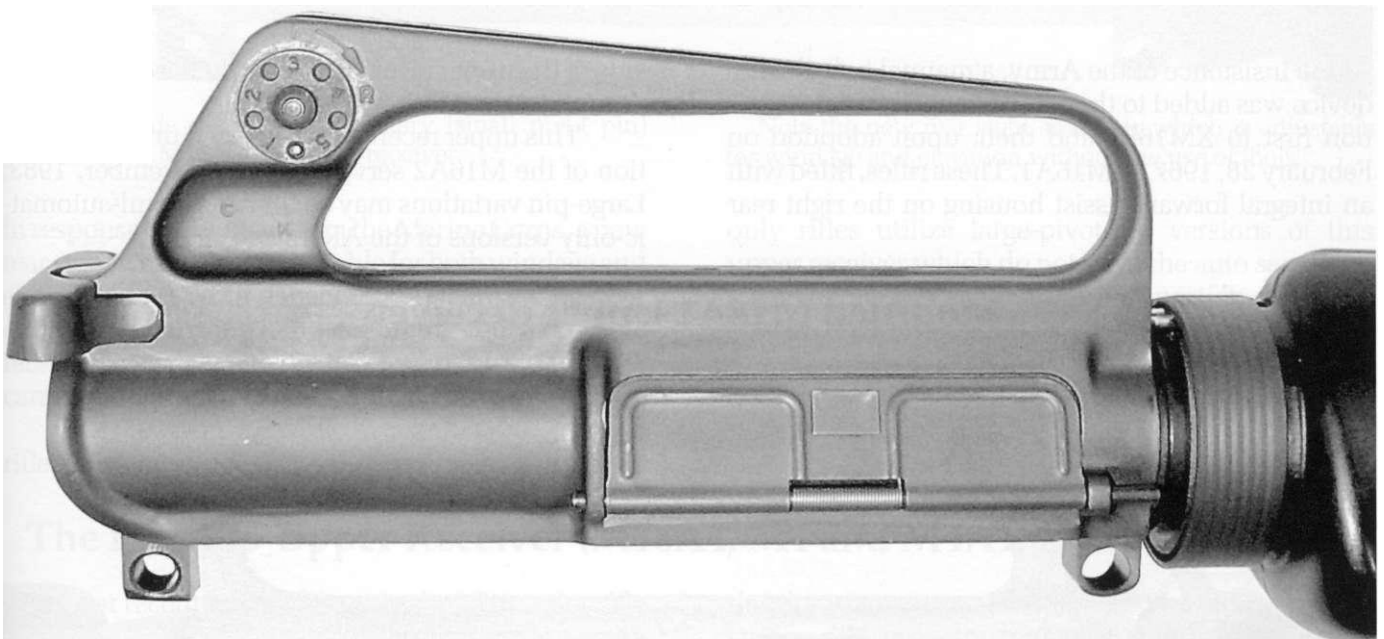


434. Underside closeups of two upper receivers.

Left: semi-auto-only receiver.

Right: selective-fire receiver. Note the cutout for the auto sear.

### The AR-15/M16 Upper Receiver



435. Right side view of AR-15/M16 receiver. This is the large pivot pin version, produced for civilian semi-auto-

matic-only versions of the AR-15 SP1 rifle and carbine, as well as early AR-15A2 Sporter II rifles and carbines.

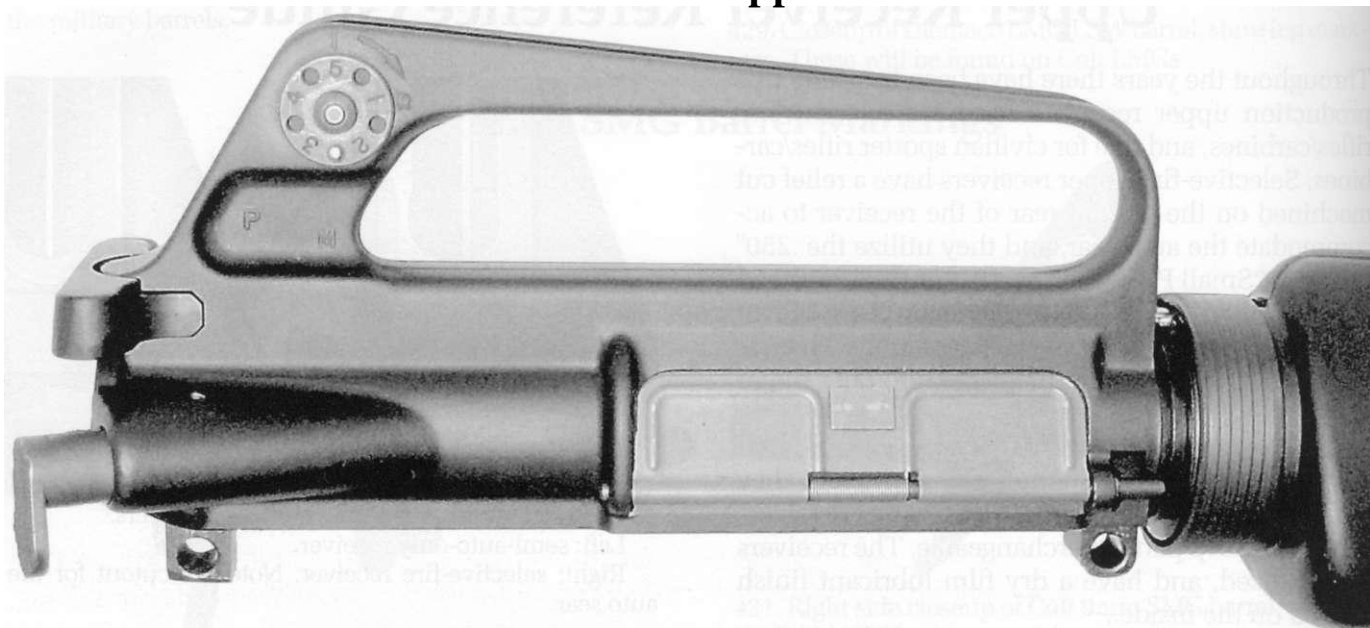
The first upper receiver had a fixed carrying handle with a rear sight that was adjustable for windage only. Initially there was no perceived need for an external mechanical link to force the bolt closed. Early upper receivers did not display forging codes. Later rifles

had forging codes on the recessed portion of the carrying handle beneath the rear sight windage drum. These receivers were utilized on the production M16 rifles purchased by the US Air Force, which remained in their inventories until they adopted the

M16A2 service rifle. This receiver with the large pivot pin was produced for civilian semi-automatic-

only versions of the AR-15 SP1 rifle and carbine, as well as early AR-15A2 Sporter II rifles and carbines.

### XM16E1/M16A1 Upper Receiver



436. Right side view of the military XM16E1/M16A1 upper receiver.

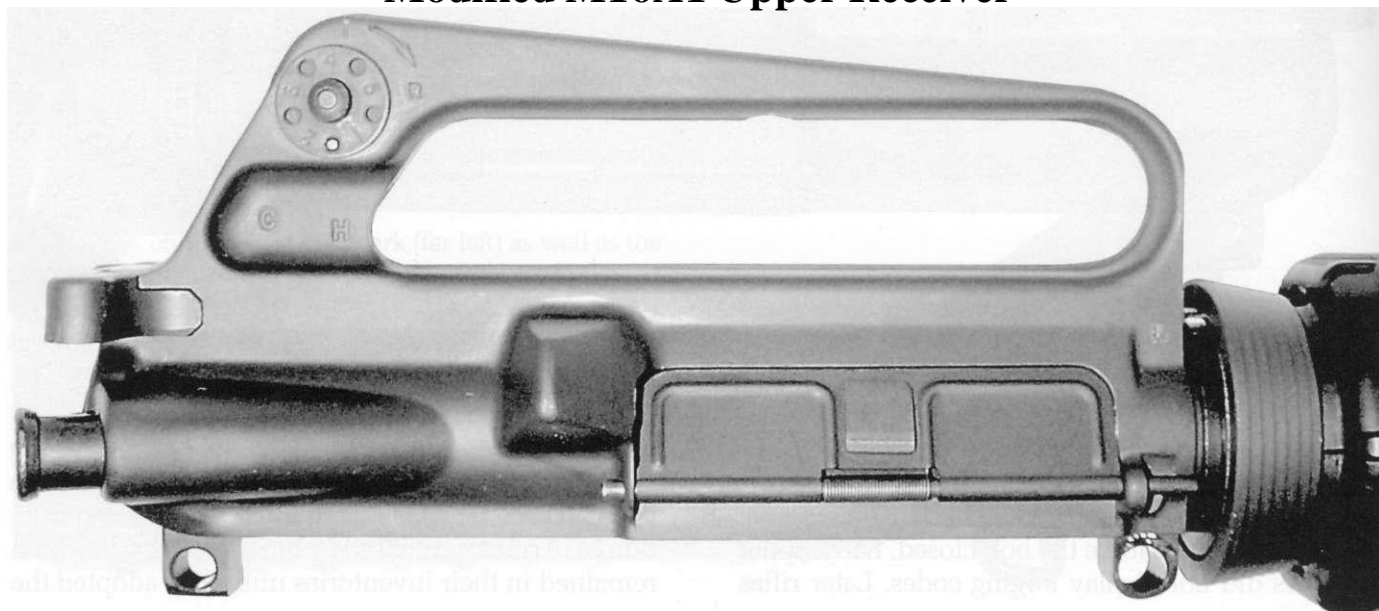
Note the "teardrop" forward assist assembly.

At the insistence of the Army, a manual bolt closure device was added to the M16, changing the designation first to XM16E1 and then, upon adoption on February 28, 1967, to M16A1. These rifles, fitted with an integral forward assist housing on the right rear

side of the upper receiver, were purchased by the US Army and the Marine Corps.

This upper receiver was utilized until the adoption of the M16A2 service rifle in November, 1983. Large-pin variations may be found on semi-automatic-only versions of the AR-15 carbines.

### Modified M16A1 Upper Receiver

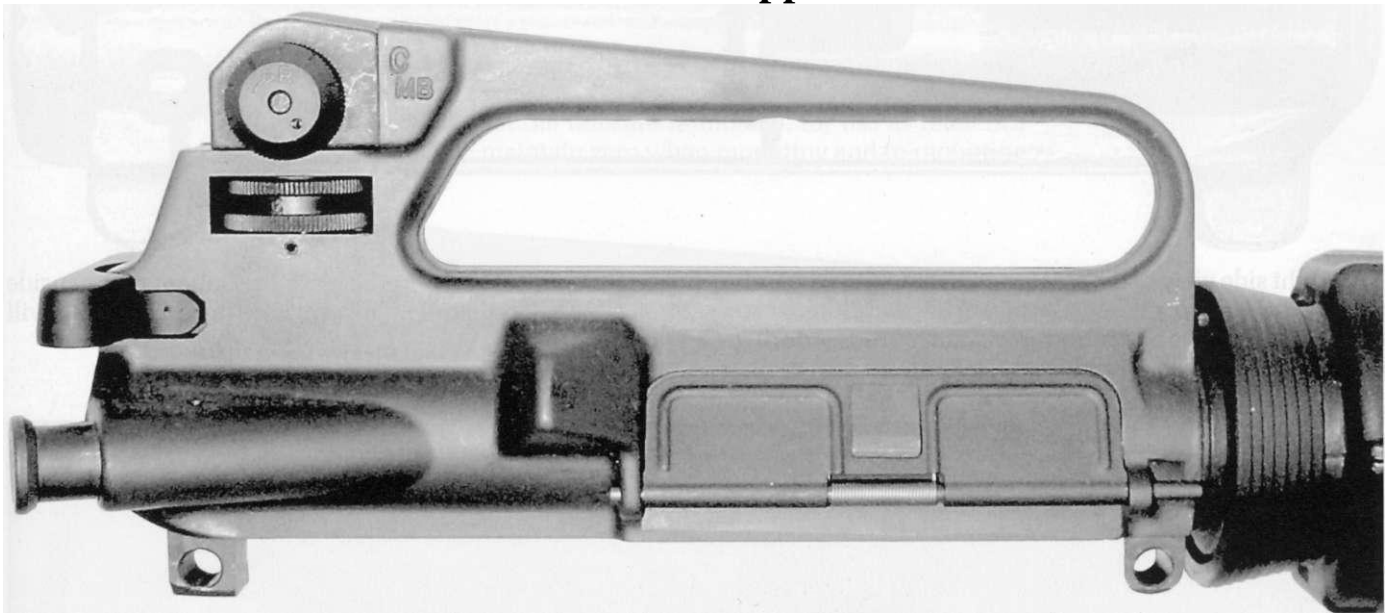


The only change from the original M16A1 upper receiver was the addition of the fired cartridge case deflector, a solid triangular block integral with the receiver forging, located at the rear of the ejection port to prevent fired cartridge cases from striking left-handed shooters in the face. The ejected cases will impact the deflector and either bounce forward or fly over the shooter's shoulder. The fired case deflector

will be found on the AR-15A2 Sporter II as well as on some carbines with large-pivot-pin receivers.

This receiver is still in production as of this writing for use on many law enforcement rifles and carbines with the small pivot pin. This configuration was adopted by the Canadian military for their C7 rifle and C8 carbine.

## M16A1E1/M16A2 Upper Receiver



438. Right side view of the military (small pivot pin) version of the M16A2/A3 upper receiver.

Note the new rear sight assembly, which is adjustable for windage and elevation without the use of tools.

In response to a request from the Marine Corps, a new rear sight was added, adjustable for both windage and elevation, located in a machined-out area at the rear of the fixed carrying handle. Forging codes on these receivers are located on the top right side of the carrying handle, in front of the rear sight assembly.

This receiver will also be found on the M16A3 rifle. Numerous AR-15A2 series semi-automatic-

only rifles utilize large-pivot-pin versions of this upper receiver which do not have the auto sear relief cut machined in the bottom rear portion of the receiver.

Current Colt Sporter and Match Target series rifles and carbines use the standard military small-pivot-pin version of this upper receiver.

## The Flat-Top Upper Receiver (M16A4, M4 and M4A1, C7A2 and C8A2)

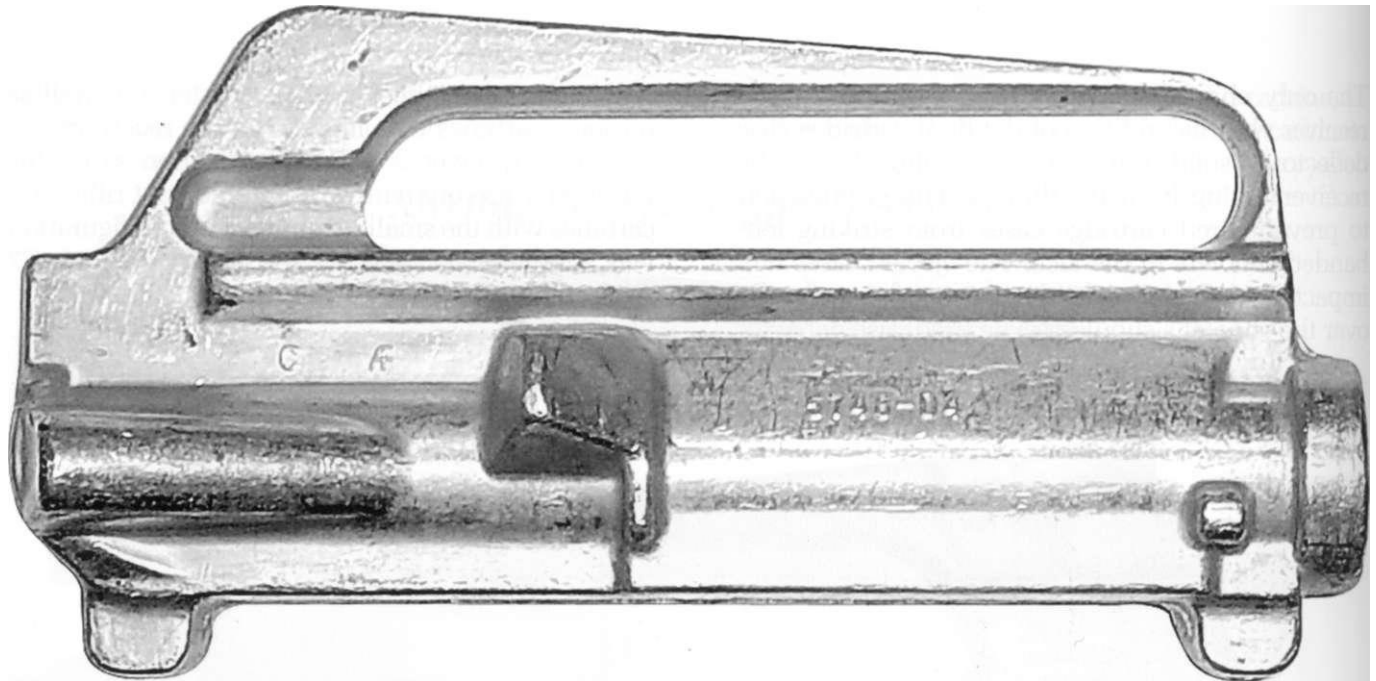
The most recent major change in the M16 series rifle has been the introduction of the flat-top upper receiver. As noted in earlier chapters, flat-top receiver

437 (previous page). Right side view of the modified M16A1 receiver with integral "Brunton Bump" fired case deflector.

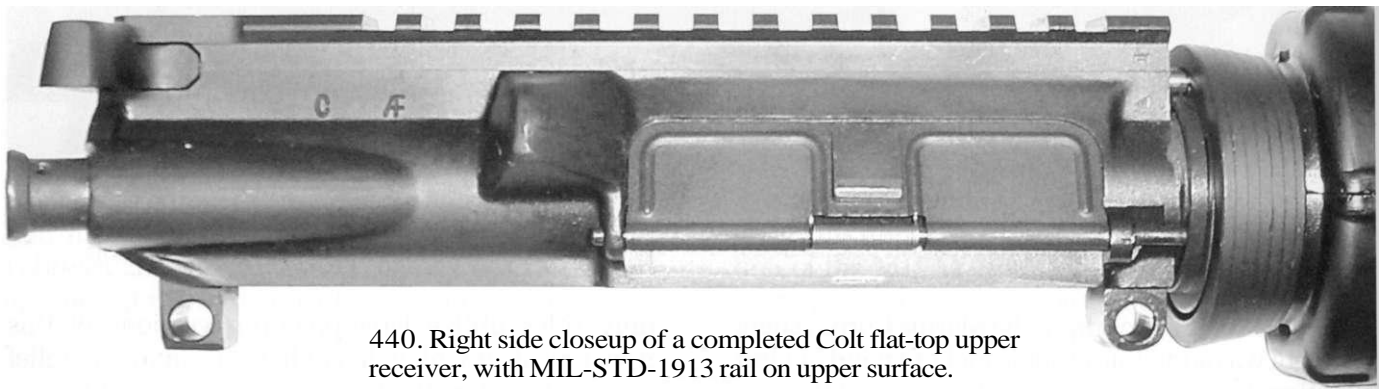
This is the commercial large pivot pin variation, as found on the AR-15A2 Sporter II as well as on some carbines.

developments were initiated as part of an ongoing sniper rifle program by Colt's Henry Tatro in the 1970s, and the M16A2E1 "Enhanced" Rifle of 1984—the forerunner of Colt's ACR candidate—was the first to feature a detachable carrying handle.

As discussed briefly in *The Black Rifle*, the Diemaco flat-top receiver program was initiated in 1986, using modified receivers with the handles cut off and a Canadian-designed scope base bonded to the resulting flat top [TBR fig. 397] to provide a



439. Right side view of the raw forging as procured by Colt. Note the enlarged rib beneath the bottom of the inside of the carrying handle. This is where the dovetail rail will be located, of the carrying handle. This is where the dovetail rail will be located,

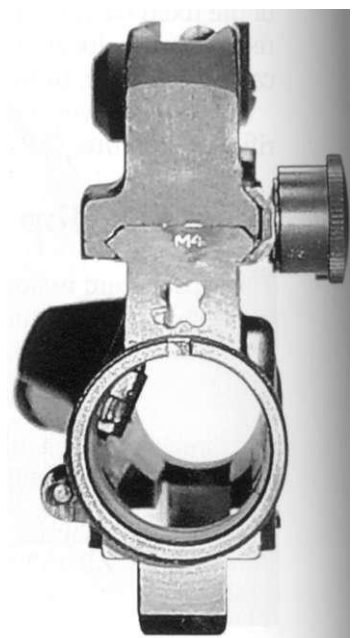


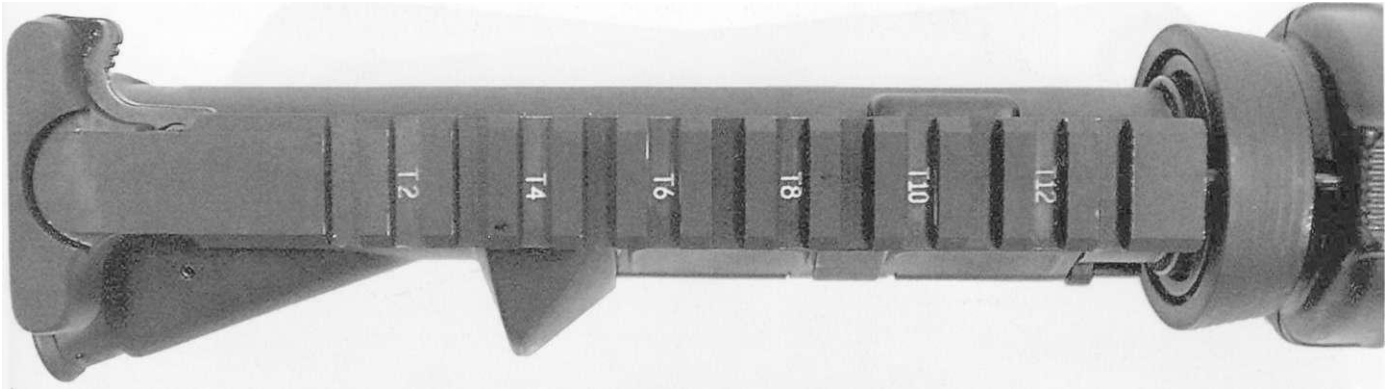
440. Right side closeup of a completed Colt flat-top upper receiver, with MIL-STD-1913 rail on upper surface.

"universal interface channel" for the attachment of optic sights. The redimensioned "flat-top" upper receiver was introduced on the Colt M4 and M4A1 carbines in 1994, and was later adapted to the new M16A4 service rifle. These rail dimensions were type-classified as the MIL-STD-1913 rail by Rock Island Arsenal in 1995. In Canada, the contract to begin the Diemaco C7A2 and C8A2 upgrade programs was signed in April, 2003.

The integral rail machined into the flat top of this receiver allows enhanced sighting systems such as scopes and reflex sights to be attached directly to the upper receiver of the rifle, thus providing the shooter with a much more comfortable sighting position than was possible with optics mounted above the fixed carrying handle.

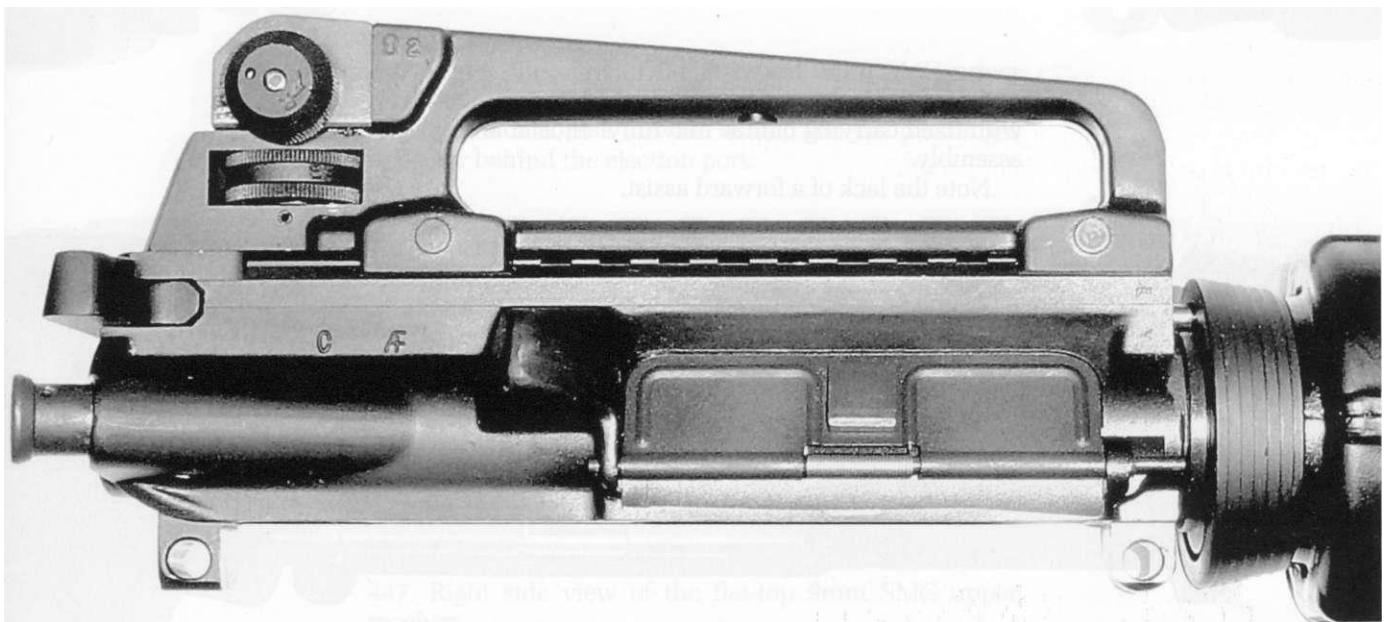
441 (right). Front closeup of flat-top upper receiver for an M4 or M4A1 carbine, marked either "M4" (or simply "4") above the gas tube hole to signify that the feed ramps in the receiver and barrel extension are modified and extended.





442. Top view of flat-top upper receiver showing MIL-STD-1913 rail.

Note that the rails are numbered, for use as reference points to maintain zero when mounting and re-mounting optics.



443. Right side view of Colt flat-top upper receiver with detachable carrying handle assembly fitted.

As discussed in Chapter Three, M4 and M4A1 upper receivers are marked either "M4" or simply "4" on the front of the receiver above the gas tube hole, signifying that the feed ramps in the receiver and barrel extension are modified and extended.

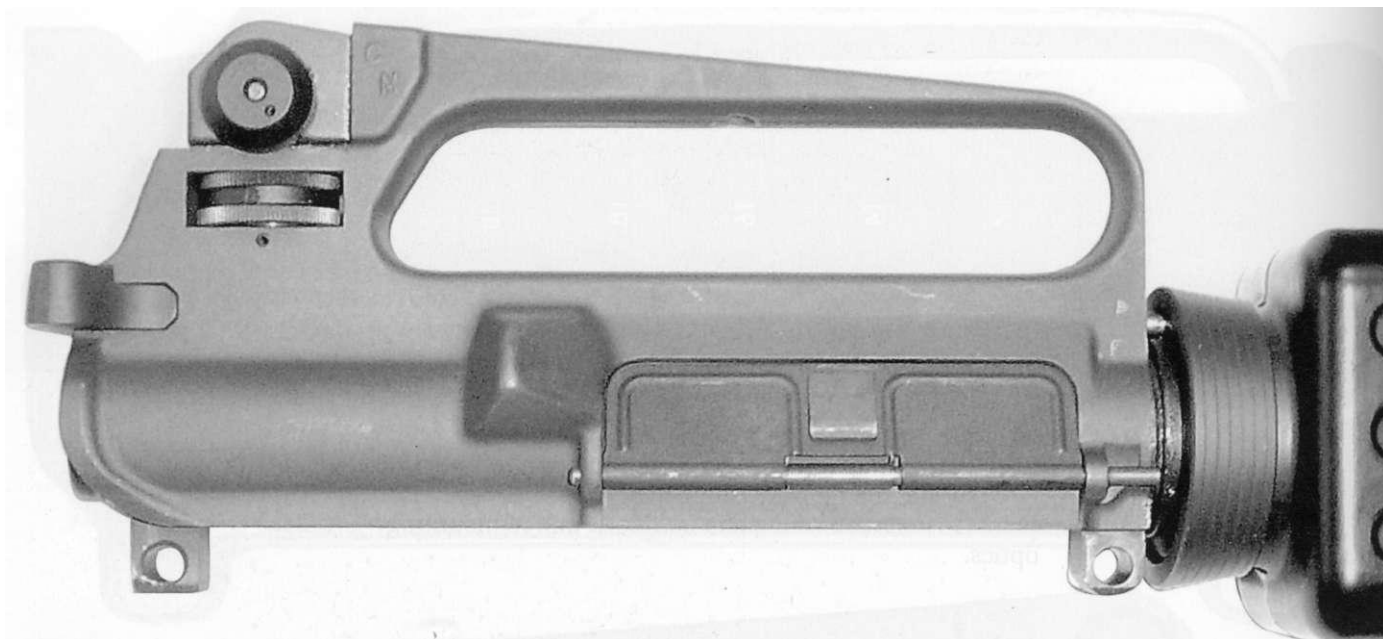
M16A4 upper receivers are not so marked, and utilize the standard barrel extension. Few of these receivers were manufactured in the large front pivot pin hole variation.

## The LMG/LSW Upper Receivers

Two upper receivers are used for the open bolt machine gun variations: the first has a fixed carrying handle and the M16A2-style fully adjustable rear

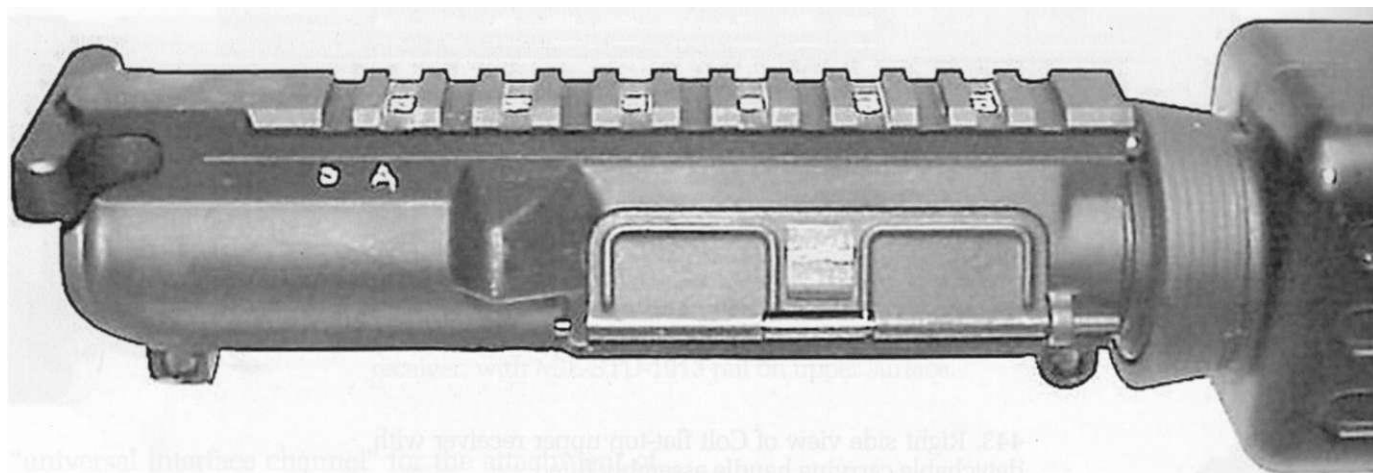
sight, while the second is a flat-top upper receiver. There is no forward assist on either receiver, due to fact that these weapons fire from an open bolt.





444. Right side view of the standard LMG upper receiver, with fixed carrying handle and fully-adjustable rear sight assembly.

Note the lack of a forward assist.



445. Right side view of a flat-top LSW/LMG upper receiver assembly produced by Diemaco.

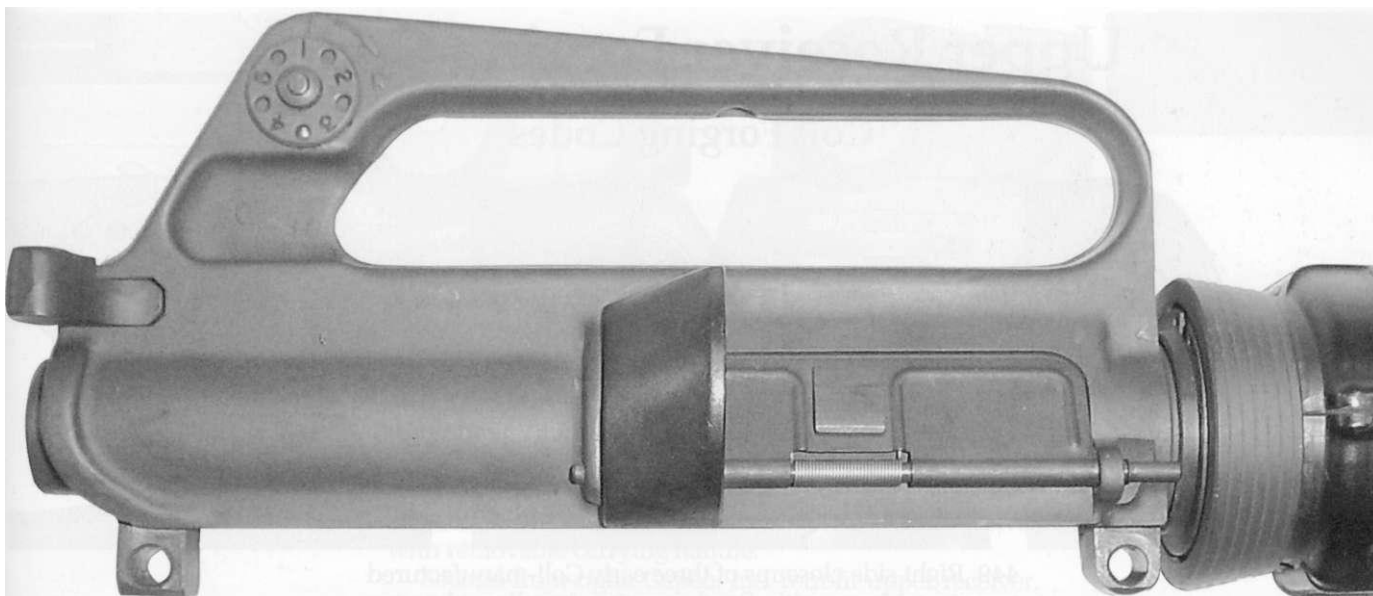
courtesy Ian Anderson and Ray Th  roux

## The Colt 9mm SMG/Semi-Automatic-Only Carbine Upper Receivers

The 9mm SMG utilizes an M16-style upper receiver, with the rear sight adjustable for windage only. The forward assist has been omitted, due to the SMG's blowback system of operation. Since there is no rotating bolt to lock, the cam notch in the upper receiver was not needed, and this has also been omitted. This receiver may also be found in the large pivot pin variation.

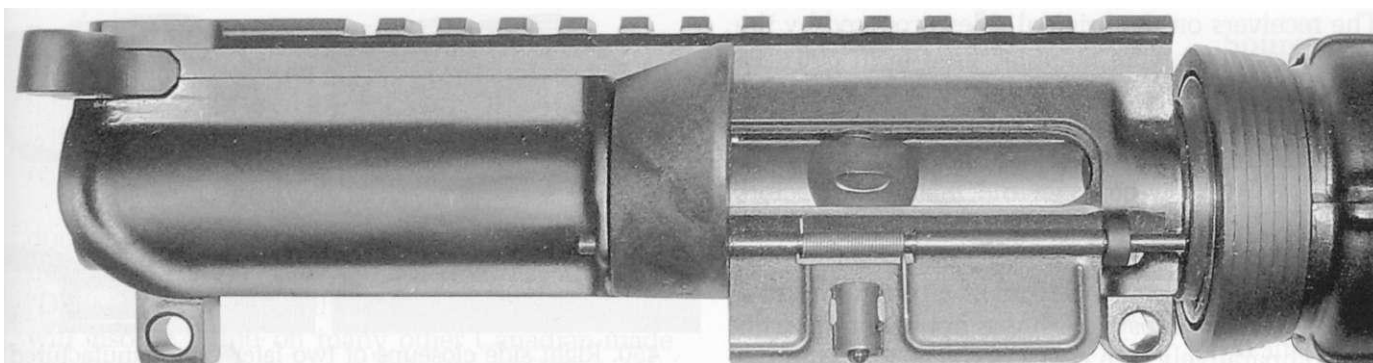
Colt has made some special runs of 9mm SMG upper receivers in the flat-top configuration, to provide a more ergonomic mounting position for optics.

Unlike the standard SMG upper receivers, on which the gas tube hole in the front of the upper receiver is omitted, the SMG flat-top retains the hole.



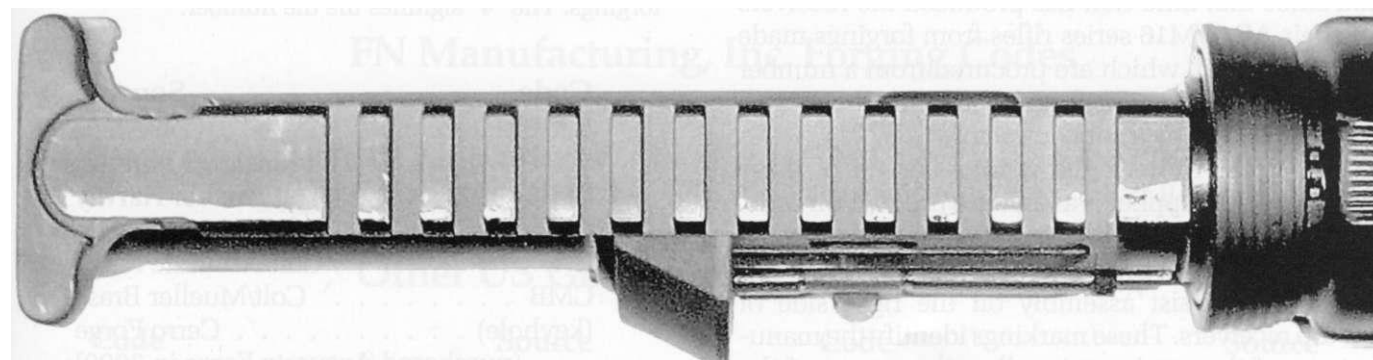
446. Right side view of the standard 9mm SMG upper receiver.

Note the lack of a forward assist, and the plastic gas deflector behind the ejection port.



447. Right side view of the flat-top 9mm SMG upper receiver.

Note the shortened ejection port cover, shown in the open position.



448. Top view of the flat-top SMG upper receiver, showing plain (unnumbered) rail.

# Upper Receiver Forging Codes

## Colt Forging Codes



449. Right side closeups of three early Colt-manufactured upper receivers with fixed carrying handles, showing manufacturer and forging codes.

Left: Colt/Anchor Harvey.

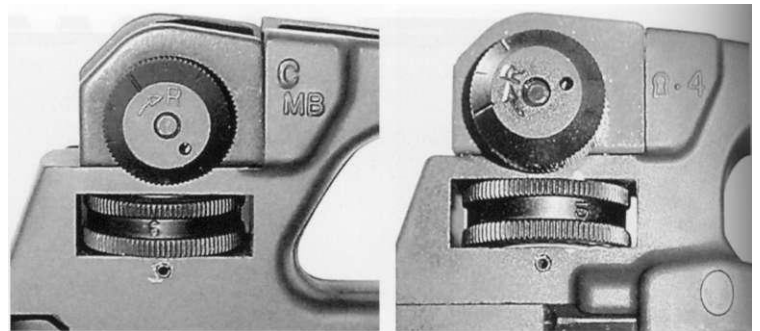
Center: Colt/Kaiser Aluminum.

Right: Colt/Martin Marietta.

The receivers on the original rifles procured by the US government were manufactured from 6061 T6 aluminum forgings. During the Vietnam war rifles with receivers made from this material were coming back destroyed by "Intergranular Exfoliation", a chemical reaction between the metal and factors such as humidity and body acids (perspiration), chemicals, etc., which caused the surface of the receivers to flake off in layers of aluminum and a white corrosive substance. It was not uncommon for the comparatively thin metal in the area around the front pivot pin to be completely eaten through in as little as three months' time.

After 1968 a changeover was made to 7075 T6 aluminum forgings, as Stoner himself had requested, and since that time Colt has produced the receivers for their AR15/M16 series rifles from forgings made of this material, which are procured from a number of outside vendors. The forgings are then machined, either at Colt or by a subcontractor.

In order to track the point of origin of these forgings, each supplier is assigned a production code. These appear as raised letters and symbols located on the right side of the carrying handle area, or above the forward assist assembly on the right side of flat-top receivers. These markings identify the manufacturer of the receiver as well as the source of the original forging, as follows:

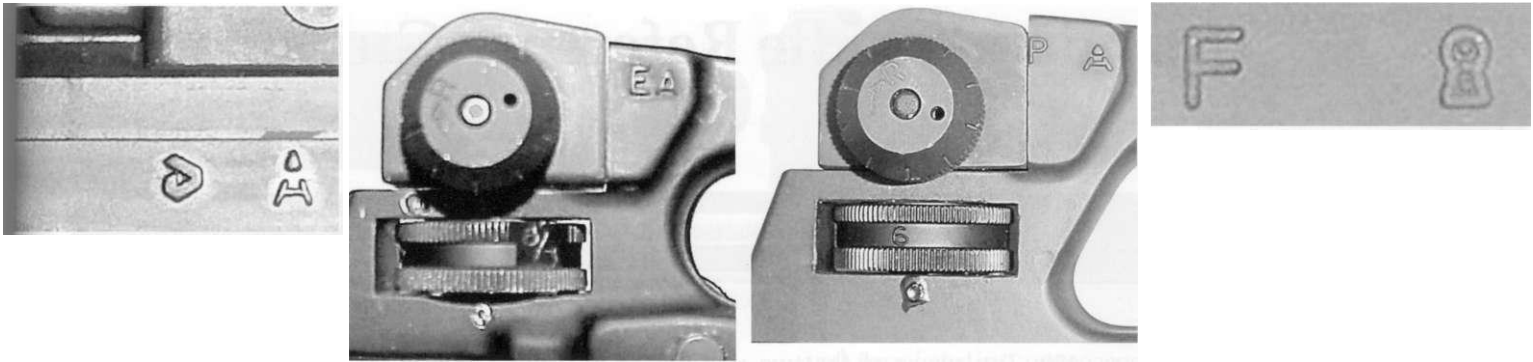


450. Right side closeups of two later Colt-manufactured upper receivers, showing forging codes.

Left: A2 (fixed handle) receiver by Colt/Mueller Brass.

Right: Detachable handle version with "keyhole" symbol of Cerro Forge, Inc., currently a supplier to Colt of upper, flat-top and lower receiver and charging handle forgings. The "4" signifies the die number.

Code	Source
CA . . . . .	Colt/Alcoa
CK . . . . .	Colt/Kaiser Aluminum
CH . . . . .	Colt/Anchor Harvey
CM . . . . .	Colt/Martin Marietta
CAF . . . . .	Colt/Accurate Forge
CMB . . . . .	Colt/Mueller Brass
(keyhole) . . . . .	Cerro Forge
. . . . .	(purchased Accurate Forge in 2000)



451. Closeups of four other upper receiver manufacturer/forging codes.  
Left: Devtek stylized "D" on a Diemaco flat-top upper receiver, made from an Anchor Harvey forging.  
Second from left: Eagle Arms manufactured receiver with removable carrying handle.  
Second from right: Capco, Inc. retrofit upper receiver, made from an Anchor Harvey forging.  
Right: "F" and stylized keyhole on FNMI receiver manufactured from a Cerro Forge forging.

Diemaco Forging Codes

Early production Diemaco receivers were made from forgings supplied from Colt and machined by Diemaco. These bear the CH (Colt/Anchor Harvey) code with an added Diemaco/Devtek stylized "D" in the recess under the rear sight position.  
Canadian-manufactured forgings may be produced by Waltech Company and marked with their nested triple W logo, as well as the Diemaco/Devtek "D". It should be noted that the stylized Diemaco "D" will also be found on many other Canadian-made components.

Code	Source
A . . . . .	Anchor Harvey
C . . . . .	Contour
DP. . . . .	Design Precision
D99. . . . .	Greystone
EA. . . . .	Eagle Arms
JS. . . . .	CFN
K . . . . .	Kaiser
SP. . . . .	Specialty Precision
nested triple W. . . . .	Waltech

Code	Source
(stylized) D. . . . .	Devtek/Diemaco

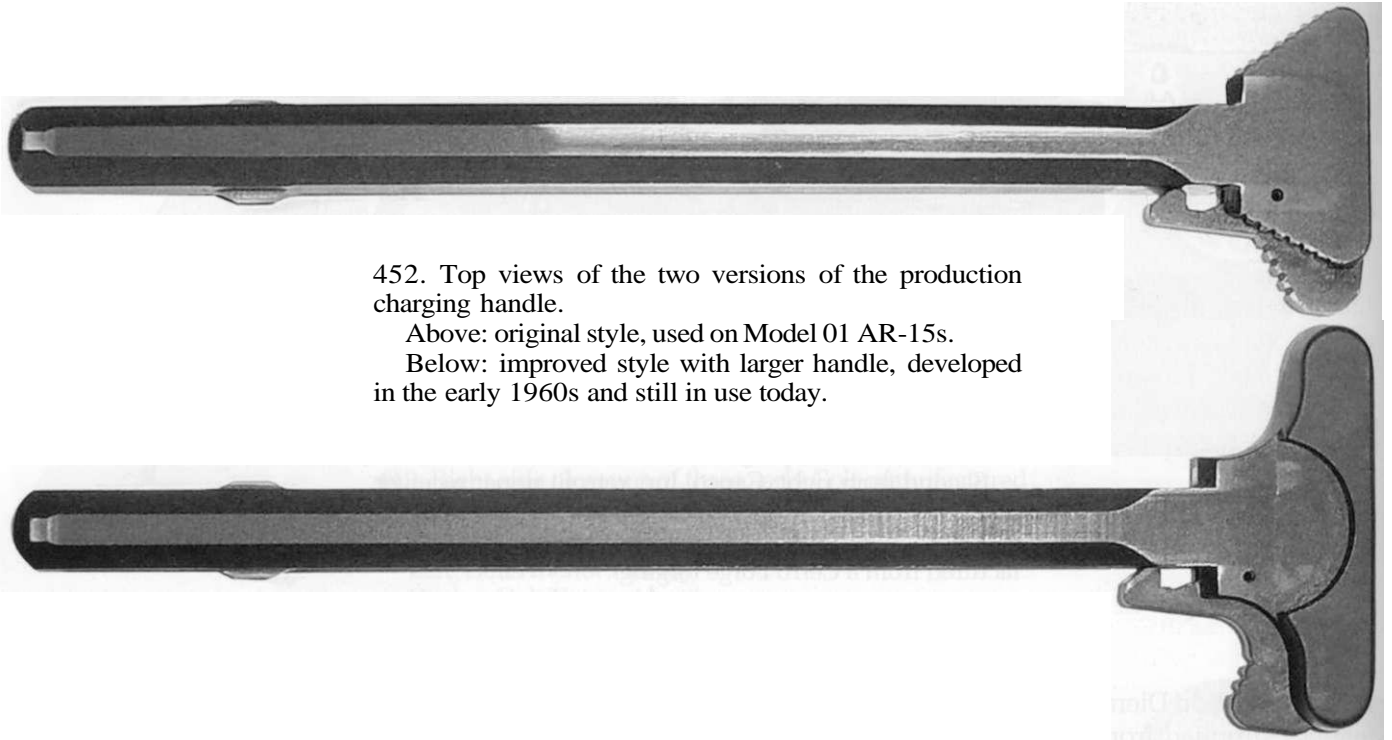
FN Manufacturing, Inc. Forging Codes

Code	Source	Code	Source
FA. . . . .	FNMI/Anchor Harvey	FMB. . . . .	FNMI/ Mueller Brass
FK. . . . .	FNMI /Kaiser Aluminum	F (keyhole). . . . .	FNMI/Cerro Forge

Other US Government Forging Codes

Code	Source	Code	Source
PA. . . . .	Capco, Inc./Anchor Harvey	L . . . . .	Lewis Machine & Tool Co.
E . . . . .	EMCO	LK. . . . .	LAR/Kaiser
		LM. . . . .	LAR/Martin Marietta

## Charging Handle Reference Guide



452. Top views of the two versions of the production charging handle.

Above: original style, used on Model 01 AR-15s.

Below: improved style with larger handle, developed in the early 1960s and still in use today.

There are two variations of the production charging handle. The distinctive "triangular" handle on the original type, installed in early Model 01 AR-15s, was soon found to be too small, and a second type with a larger handle was developed in the early 1960s. This type remains in use today.

As discussed in Chapter Four, SOCOM uses the commercial Gas Buster charging handle (fig. 148) manufactured by Precision Reflex Inc. (PRI) in their Mk12 series rifles, and Diemaco is utilizing this same charging handle, fitted with a modified ambidextrous latch assembly, in their new C7A2 rifle (Chapter Eight).

## Bolt Assembly

### Finish and Marking Variations



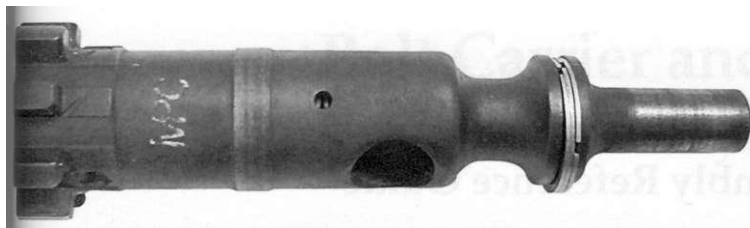
453. Closeup of early hard-chrome-plated bolt acid-etched with "M" and "P", signifying the bolt has been Magnetic particle inspected and Proof tested.

Early bolts manufactured by Colt were finished with their proprietary "hard chrome" plating process. It is unconfirmed when the process was changed from

chrome plating to manganese phosphating, and chrome bolts may be found in bolt carriers that are chrome plated or manganese phosphated. Early production chrome bolts will have "MP" (Magnetic particle inspected, Proof tested) acid-etched on them, in characters measuring 0.125" (1/8") high.

When Colt switched to the manganese phosphate finish, the "MP" characters were enlarged, to measure 0.140" in height.

Eventually, Colt bolts were marked with three characters, "MPC" (Magnetic particle inspected, Proof tested and manufactured by Colt), in the same fashion as the barrels. These characters can be 0.120", 0.125", 0.100" or 0.090" high.



454. Later phosphated bolt marked "MPC", signifying that it was Magnetic particle inspected, Proof tested and manufactured by Colt.

All current Colt bolts, regardless of whether they are to be installed in military, law enforcement or commercial rifles, are manganese phosphated, and all go through the same magnetic particle inspection

### Colt's Month and Year Date Coding System

From September, 1995 until November, 2001, Colt utilized a monthly coding system, whereby an additional letter was inserted between the "P" and the "C" to indicate the month and year of manufacture. The system began with the letter "A", so the markings on a bolt made in September, 1995 read "MP AC", in characters 0.090" high.

Colt initially cycled through the entire alphabet, ending with the use of "MPZC" for bolts made during the month of September, 1997. (In order to avoid confusion with the factory code, the letter "C" was not used in the monthly code system.)

Colt then cycled through the code sequence a second time, (again with the exception of C), differentiating the second cycle by underlining the month code letter. Cycle two thus began with "MPAC" in



455. Phosphated bolt manufactured by Colt during 2001, marked with a large "C" to indicate that it was intended for commercial sale.

and proof testing processes. However, during 2001, some Colt bolts were marked simply with a large "C", indicating that they were intended for commercial sale.



456. Phosphated Colt bolt marked "MPBC", indicating manufacture in January, 2000.

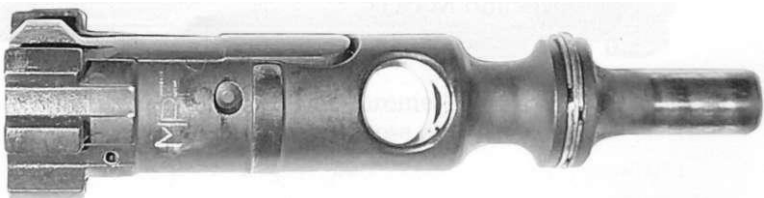
October, 1997, and ended with "MPZC" in November, 1999.

A third and final cycle was begun in December, 1999, once again starting over at "A" but this time putting a line over the month code letter, so the code for December, 1999 read "MPAC". The use of the month code system was discontinued in November, 2001 with "MPZC".

### US and Canadian Military Bolt Codes

Bolt Code	Quality Control	Manufacturer
MP	Magnetic Particle Inspected and Proof Tested	Colt
MPC	Magnetic Particle Inspected and Proof Tested	Colt
MPD	Magnetic Particle Inspected and Proof Tested	Diemaco*
MPF	Magnetic Particle Inspected and Proof Tested	FNMI
MPF	Magnetic Particle Inspected and Proof Tested	FNMI (subcontracted)
MPF	Magnetic Particle Inspected and Proof Tested	FNMI (subcontracted)
MPN	Magnetic Particle Inspected and Proof Tested	National Aerospace
MPR	Magnetic Particle Inspected and Proof Tested	Rock Island Arsenal

457 (right). Bolt marked "MPF", indicating manufacture by FNMI.





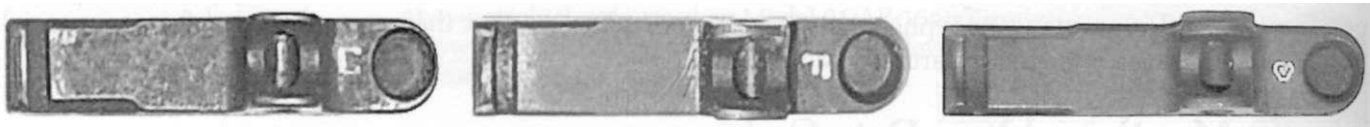
300 Bolt Assembly

\* It should be noted that Diemaco additionally marks a five-digit batch number on each bolt, underneath the "MPD" marking.

US Military Bolt Assembly Reference Guide

Description	NSN	Part No.	Bolt Assembly (M4 and M4A1)
Bolt Assembly (M16, M16A1, M16A2 and M16A4)	1005-00-992-72858448509		1005-01-422-377012972691

The M4/M4A1 bolt utilizes the stronger M4/M4A1 extractor assembly. This is the only difference between the two types of bolt assemblies.



458. Underside views of three military M16-series extractors, showing markings indicating manufacturer. From left: "C" (Colt); "F" (FNMI); stylized "D" (Diemaco).

tween the two types of bolt assemblies.

Identifying US and Canadian Military Extractors

In August, 1969, a Colt Engineering change was made which required that their proprietary "C" marking be placed on the extractor, with a note that on contract DAAF03-71-C-0003 this procedure had to be implemented by May, 1971. This was in order to differentiate Colt-made parts from ones made by the Hydramatic Division of General Motors and Harrington & Richardson. However this was only a requirement for military contract rifles and carbines, and commercial rifles and carbines can be found with both marked and unmarked extractors. From samples examined it appears that, starting in the early 1990s with the new Colt Sporter line of commercial rifles and carbines, all Colt extractors were marked regardless of whether they were destined for

installation in military, law enforcement or commercial firearms. This was to standardize parts.

In order to identify the manufacturer, current production extractors have a factory code marking placed on the inside of the extractor body, in front of the extractor spring assembly, as follows:

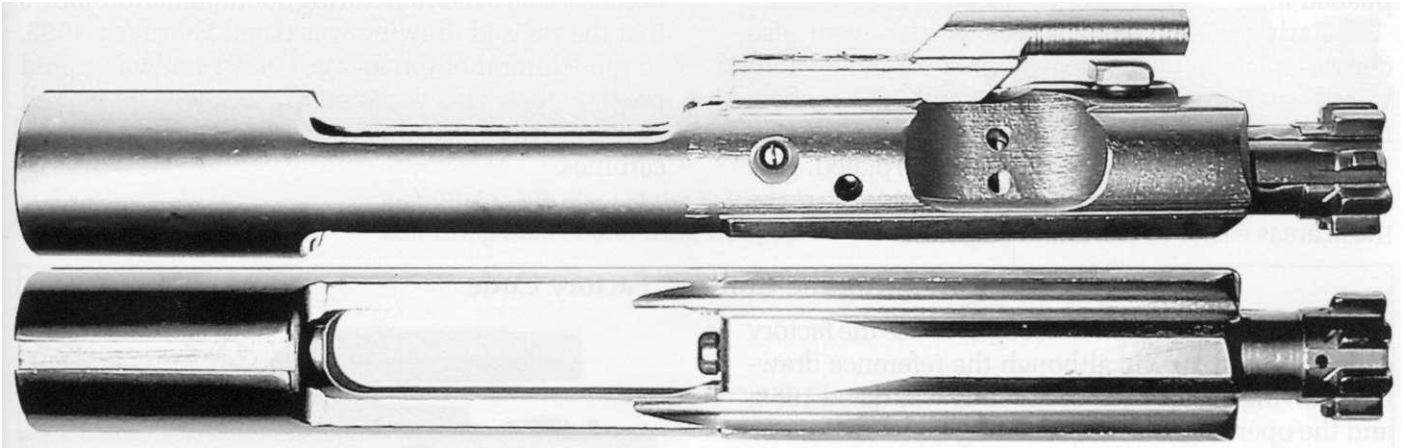
Manufacturer Code	Manufacturer
C . . . . .	Colt
D (stylized). . . . .	Diemaco
F . . . . .	FNMI
F . . . . .	FNMI (subcontracted)
S . . . . .	unknown

US Military Extractor Spring Assembly Reference Guide

Description	NSN	Part No.	Color
Spring, Assembly, Extractor (M16, M16A1, M16A2, M16A3 and M16A4)	1005-00-760-3768	8448755	n/a
Spring, Assembly, Extractor (M4 and M4A1)	1005-01-424-5899	12972692	gold spring, black buffer

# Bolt Carrier and Key Assembly

## The Early Bolt Carrier



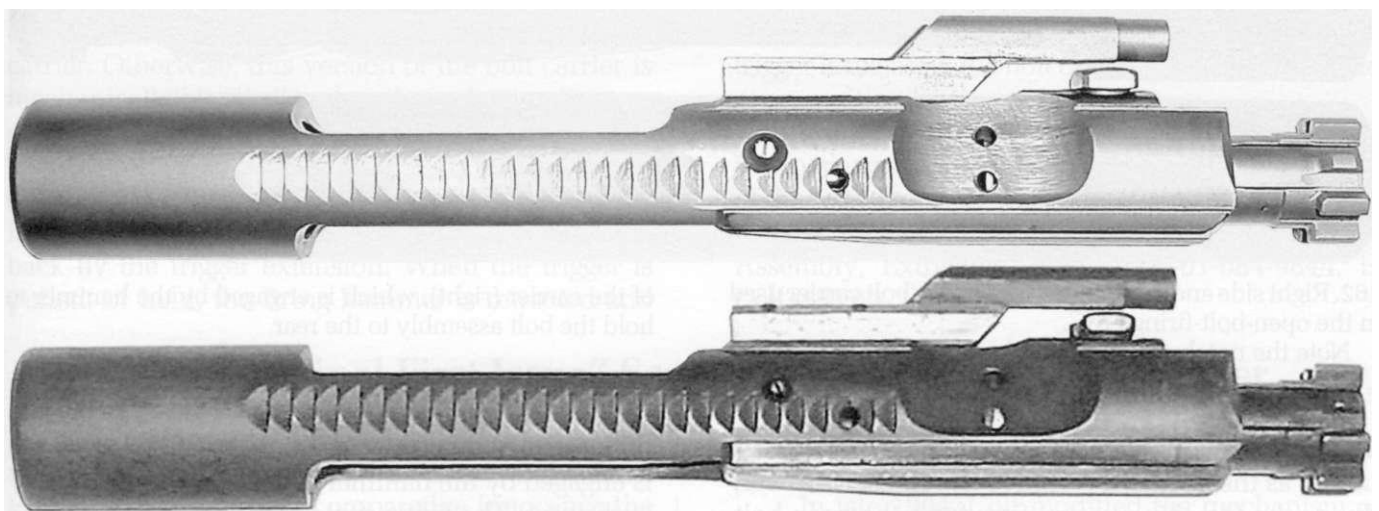
459. Right side and underside views of the early hard-chromed "smooth-sided" bolt carrier, produced for the Colt Model 01.

The first bolt carriers produced by Colt were for the AR-15 Model 01. As the rifle first appeared, the bolt carrier was without forward assist notches and finished with a proprietary industrial "hard" chrome plating. Early bolt carriers had no factory code stamped on the left side, due to the fact that no other manufacturer was then producing AR-15 rifles.

In later production these early bolt carriers were finished using the manganese phosphate process, as is still used in current production. The main reasons

for switching from chrome plating to manganese phosphate were to avoid problems with cracking caused by hydrogen embrittlement, and to address the issue of cost. Chrome plating is extremely expensive, and it was determined that it offered no advantage in corrosion resistance over the manganese phosphate finish. Colt's Horace "Mac" McCoan supervised this change from chrome plating to manganese phosphate finishing.

## The Standard Selective-Fire Bolt Carrier



460. Right side views of two standard selective-fire bolt carriers with forward assist notches.

Above: finished in hard chrome.

Below: finished in manganese phosphate.

With the introduction of the forward bolt assist assembly, a series of notches were machined into the right side of the bolt carrier, which are engaged by the forward assist pawl when the forward assist is pushed in.

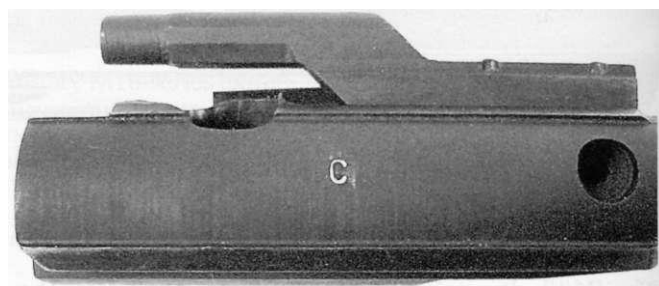
Early versions of this bolt carrier were also chrome plated, with later production being converted over to the current manganese phosphate finish, although the inside of the bolt carrier and inside of the carrier key were still chrome plated. This served to increase corrosion resistance and make these areas easier to clean and maintain.

### Adding the Colt "C" Factory Code

The exact date on which Colt began to use the factory code "C" is unknown, although the reference drawing showing the location of the code was dated 1968, and the operation sheet instructing the manufacturing department to place Colt's factory code on major components was issued in 1969. This was due to M16A1 production contracts being awarded to secondary sources (Harrington & Richardson and the Hydramatic Division of General Motors, Inc.) on April 19, 1969.

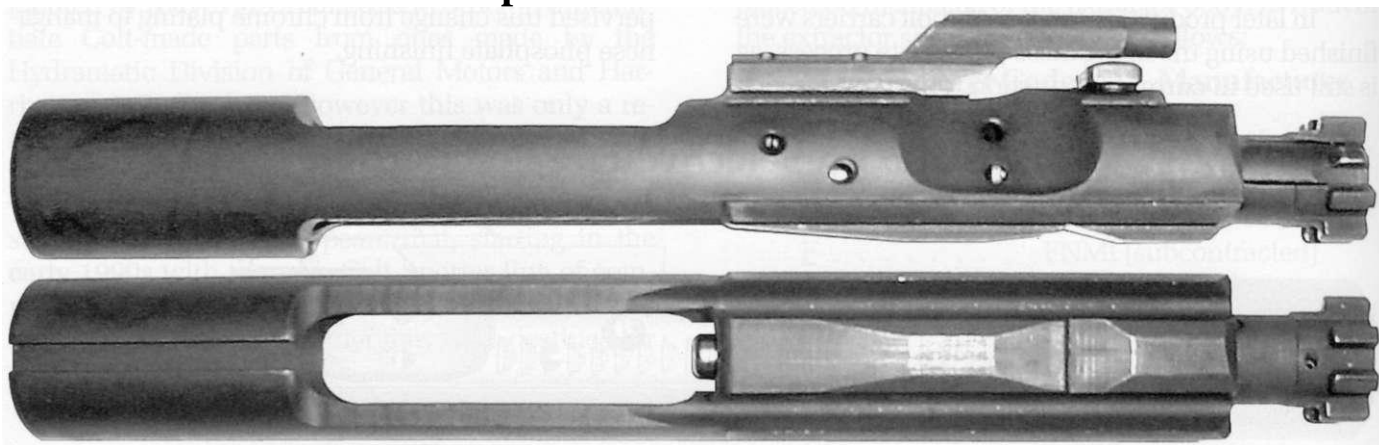
All current Colt bolt carriers have the Colt factory "C" code stamped on the left side.

In late 1966, in an effort to standardize the bolt carrier for use in both versions of the rifle, Colt stopped producing the smooth-sided bolt carriers in favor of utilizing only bolt carriers with forward assist notches. Colt's manufacturing documentation shows that the revised drawing was dated February, 1967, so the addition of the forward assist notches would pre-date that. This variation of the selective-fire bolt carrier is still in use today on selective-fire rifles and carbines.



461. Left side closeup of a phosphated bolt carrier showing Colt factory "C" manufacturer's mark.

### The Open-Bolt LMG Bolt Carrier



462. Right side and underside views of the bolt carrier used in the open-bolt-firing LMG.

Note the notch machined in the underside of the front

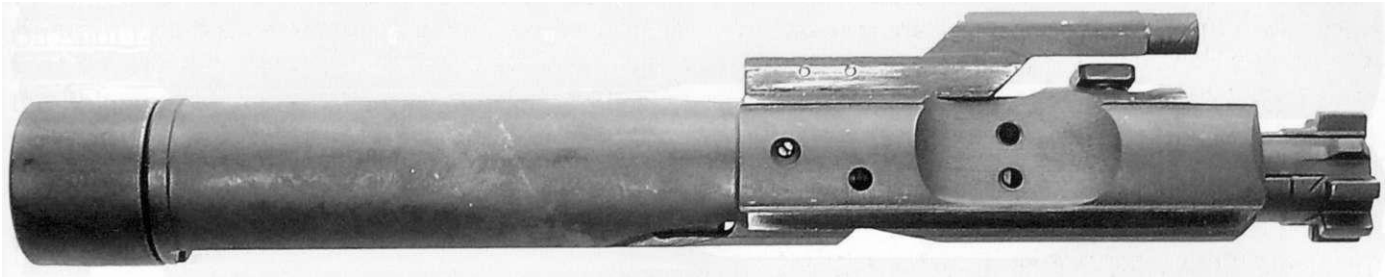
of the carrier (right), which is engaged by the hammer to hold the bolt assembly to the rear.

The open-bolt LMG uses basically the same bolt carrier as the standard selective-fire rifles. However, due to the fact this weapon fires from the open bolt position, the forward assist notches are omitted.

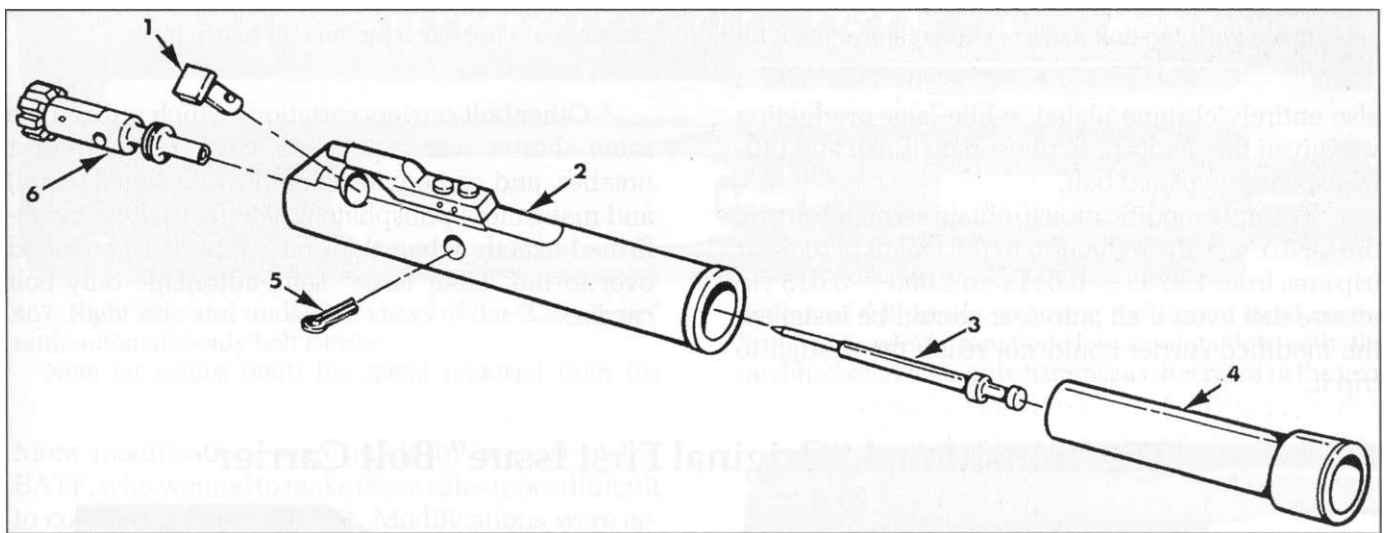
The one modification made to the bolt carrier for use in the open-bolt mode was a notch machined

in the underside of the front of the bolt carrier, which is engaged by the hammer to hold the bolt assembly to the rear. The firing cycle of the open-bolt LMG is described in Chapter Nine.

## The M231 Port Firing Weapon Bolt Carrier



463. Right side view of the bolt carrier used in the open-bolt-firing M231 Port Firing Weapon.



464. Exploded left side three-quarter view of the M231 bolt and carrier assembly. The labelled components are as follows:

1. Cam Pin

2. Bolt Carrier  
3. Firing Pin  
4. Firing Hammer  
5. Firing Pin Retaining Pin  
6. Bolt.

The M231 also fires from an open bolt position, so again there are no forward assist notches on the bolt carrier. Otherwise, this version of the bolt carrier is mechanically identical to the other selective-fire versions, with one major difference, as this gun does not fire by means of a conventional hammer, but rather utilizes a striker-like "firing hammer", which sits inside the rear portion of the bolt carrier and is drawn back by the trigger extension. When the trigger is pulled, or held, the firing hammer is retracted and

held until the bolt is locked and is then released to strike the firing pin to fire the cartridge. When the trigger is released, the bolt carrier group is held in the open position by the sear.

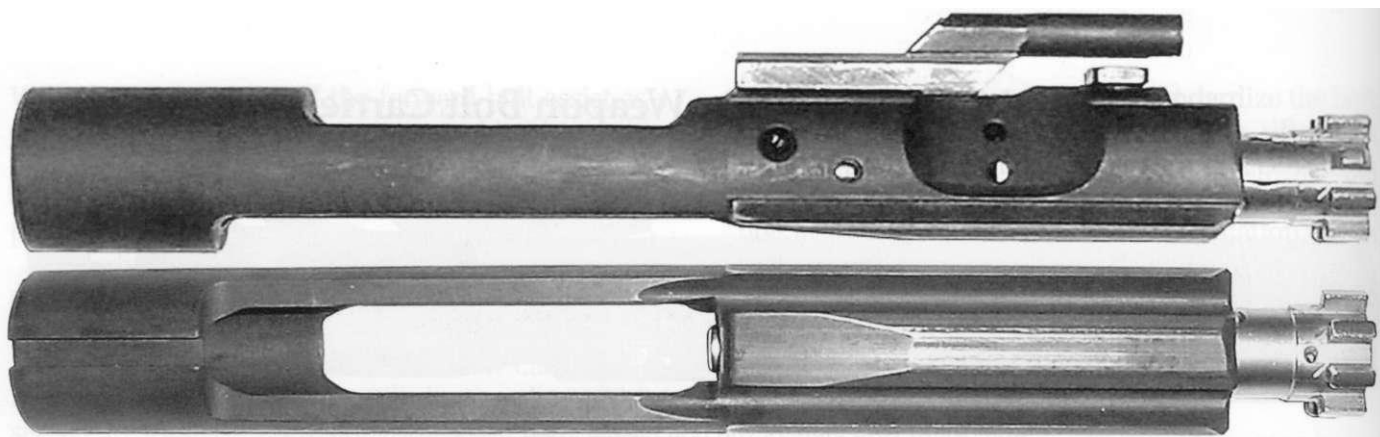
It should be noted that the M231 Port Firing Weapon uses a stronger extractor spring than the rest of the M16 family of weapons, in order to cope with the high cyclic rate of the M231. The M231 "Spring Assembly, Extractor", NSN 1005-01-084-9844, is Colt part no. 11828591.

## The "Original First Issue" Semi-Automatic-Only Bolt Carrier

In 1964 Colt introduced their first civilian semi-automatic-only rifle, the AR-15 SP1 Sporter, Colt Model R6000. In those days of comparative innocence the SP1 rifle was originally fitted with the early selective-fire bolt carrier, which as described above was en-

tirely chrome plated and without the forward assist notches.

In late 1964, Colt modified the mechanism of the Sporter rifle to include the first semi-automatic-only bolt carrier, as well as a modified hammer and selector. Early bolt carriers of this configuration were



465. Right side and underside views of the "Original First Issue" semi-automatic-only bolt carrier.

Compare with the bolt carriers shown above: note the

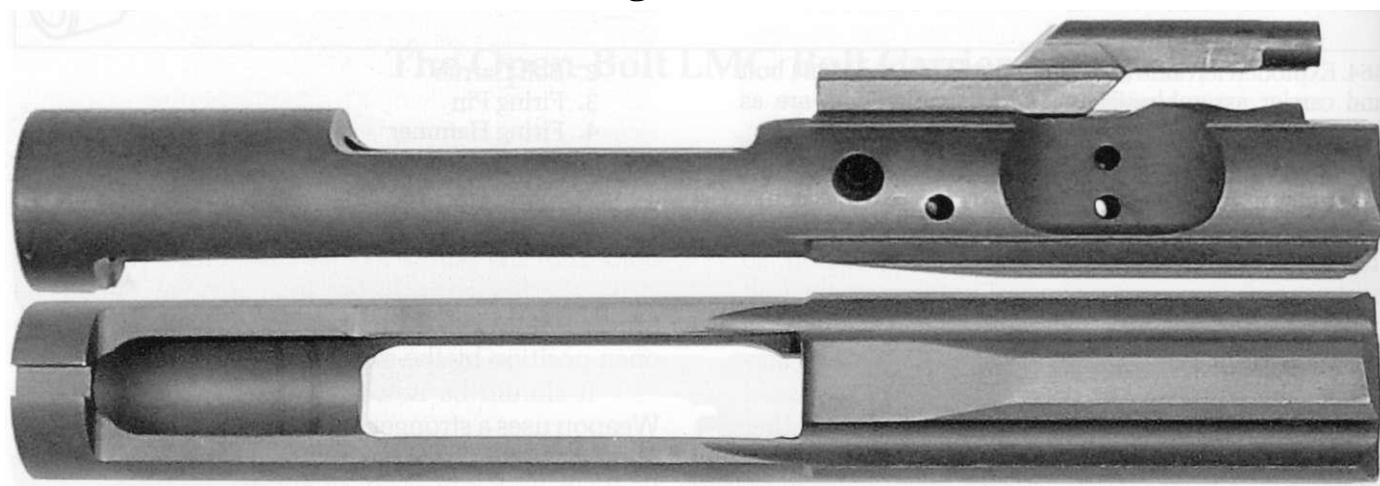
also entirely chrome plated, while later production was given the manganese phosphate finish and utilized a chrome plated bolt.

The only modification to obtain semi-automatic fire ONLY was the reduction in the length of the sear trip area from 1.5755+/-0.0115" to 1.060+/-0.015", to ensure that even if an auto sear should be installed, the modified carrier could not reach far enough to trip it.

reduction in the length of the sear trip area (left), to ensure that even if an auto sear should be installed, the modified carrier could not reach far enough to trip it.

Other bolt carriers variations which utilized the same shorter sear trip length have forward assist notches, and come with both chrome plated (early) and manganese phosphate finish (later). It is unconfirmed exactly when the Colt AR15 SP1 converted over to the "Later Issue" semi-automatic only bolt carrier.

### The Transitional "Original First Issue" Bolt Carrier



466. Right side and underside views of the transitional "Original First Issue" bolt carrier, finished in manganese phosphate.

The transitional version of the "Original First Issue" bolt carrier is identical to the original first issue bolt carrier, except that even more material has been removed from the auto sear trip area, reducing it to a length of 0.387+/-0.015". This bolt carrier sear trip length was utilized on all Colt semi-automatic-only rifles until the introduction of the Colt Sporter line.

Compare with fig. 465 : note that even more material has been removed from the sear trip area (left).

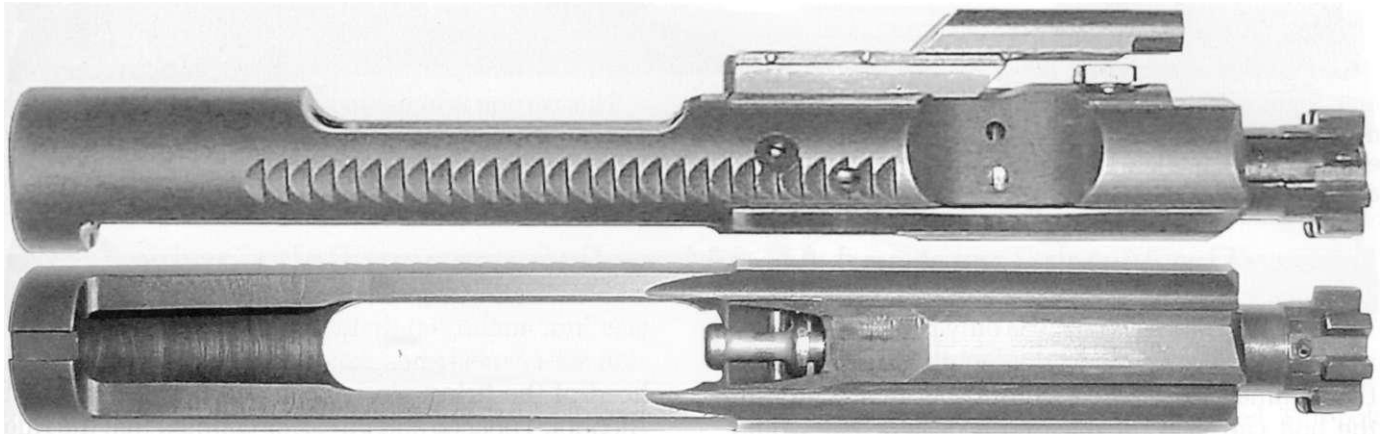
This version of the bolt carrier will also be found with forward assist notches. These were the last of the semi-automatic-only bolt carriers with the rear portion of the firing pin being covered by the bolt carrier.

## The "Later Issue" Semi-Automatic-Only Bolt Carrier

On April 14, 1969, Colt updated their semi-automatic-only bolt carrier to the M16A1 configuration. Both the bolts and bolt carriers were manganese phosphate finished, with the inside of the bolt carriers and

keys chrome plated. Even though the SP1 did not have a forward assist assembly, the "Later Issue" bolt carrier came with the forward assist notches.

### The BATF Requests More Modifications

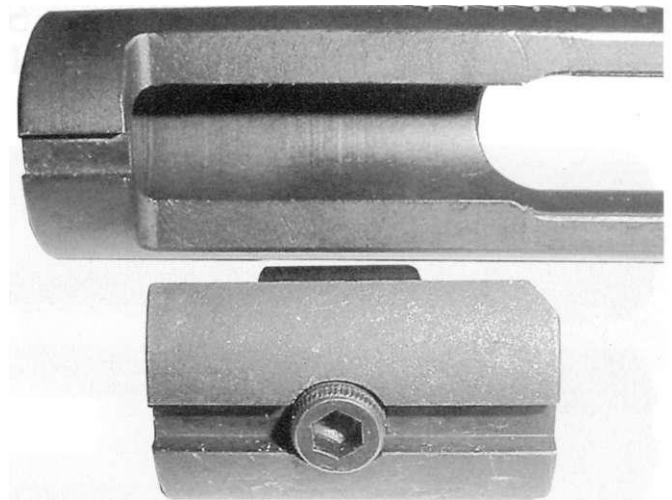


467. Right side and underside views of the "Later Issue" semi-automatic-only bolt carrier.

Note (at center right) the metal removed from the

bottom of the carrier, exposing the second head on the firing pin, which functioned in conjunction with the modified semi-auto-only hammer as described in the text.

More modifications were made by request of the BATF, who wanted to make these rifles more difficult to convert to full-automatic. Modifications were accordingly made to the bolt carrier, firing pin and hammer, to prevent the rifle from slam-firing should the disconnecter be removed or damaged, either by intent or through malfunction. In a safety mechanism package designed and patented by Colt's Ralph Kennedy, metal was removed from the bottom of the carrier, exposing the second head of the firing pin. This functioned in conjunction with the semi-auto-only hammer with the notch cut in the front. If the disconnecter should fail or be removed or disabled, the hammer would ride the bolt carrier forward, the notch in the hammer engaging the second (larger) head on the firing pin to catch the bolt carrier group and stop the rifle from firing the second shot.



468 (right). Underside closeup of the "Later Issue" semi-automatic-only bolt carrier, showing the bolt-on aftermarket filler which gave this carrier a selective-fire capability and led to the final design, depicted in fig. 469.

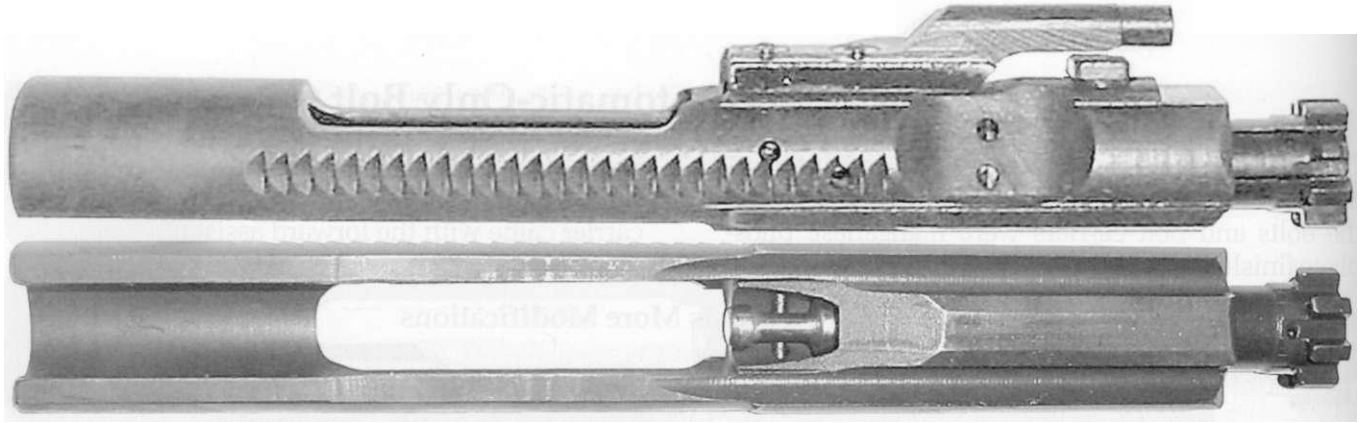
## The Colt Sporter Semi-Automatic-Only Bolt Carrier

This bolt carrier variation is identical to the "Later Issue" version with one final modification: metal in the sear trip area was removed entirely. This was in

response to aftermarket bolt-on devices designed to convert earlier versions of the semi-automatic-only bolt carrier into selective-fire carriers.



## 306 Bolt Carrier and Key Assembly



469. Right side and underside views of Colt's final word on the semi-auto-only bolt carrier, which embodied the exposed firing pin head safety modification (center right) and had the sear trip area (left) removed completely.

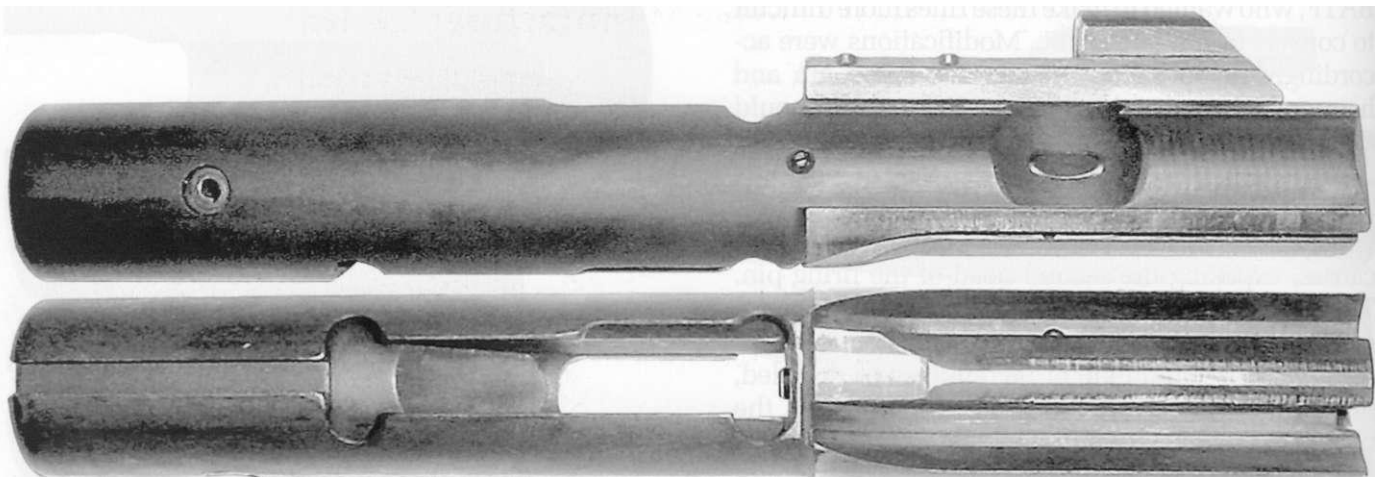
This version is in use today in all Colt semi-automatic Match series and semi-automatic Law Enforcement Only rifles.

## The Match Target and AR-15 Law Enforcement Bolt Carrier

This bolt carrier assembly was only in production for a very short time. Due to the fact that the notch on the hammer caused wear on the bottom rear edge of the bolt carrier, Colt released a design that would enclose the firing pin in the same way the selective fire bolt carriers did, and removed the entire sear trip area. This solved the bolt carrier wear problem; how-

ever, due to the fact that it rendered the anti-conversion/safety mechanism inoperable because the front head of the firing pin was enclosed, the Bureau of Alcohol, Tobacco and Firearms claimed that the rifle was now easily converted to fully-automatic fire by the slam-fire method, and they told Colt that they could not sell it.

## The Colt 9mm SMG Bolt Assembly

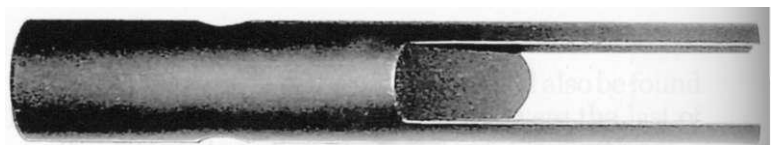


470. Right side and underside views of the Colt 9mm SMG blowback bolt assembly.

This bolt embodies a steel or tungsten weight pinned into the rear to increase overall mass.

The blowback mode of operation chosen for the Colt 9mm SMG entailed many modifications to the bolt group. The bolt and "carrier" are a single piece, with the breech face machined right into the front. No locking mechanism is utilized, and a weight was pinned into the rear to increase the overall mass.

Due to the softer primers used in pistol ammunition, the rear head of the firing pin was removed to lighten it and a firing pin spring was added, to prevent



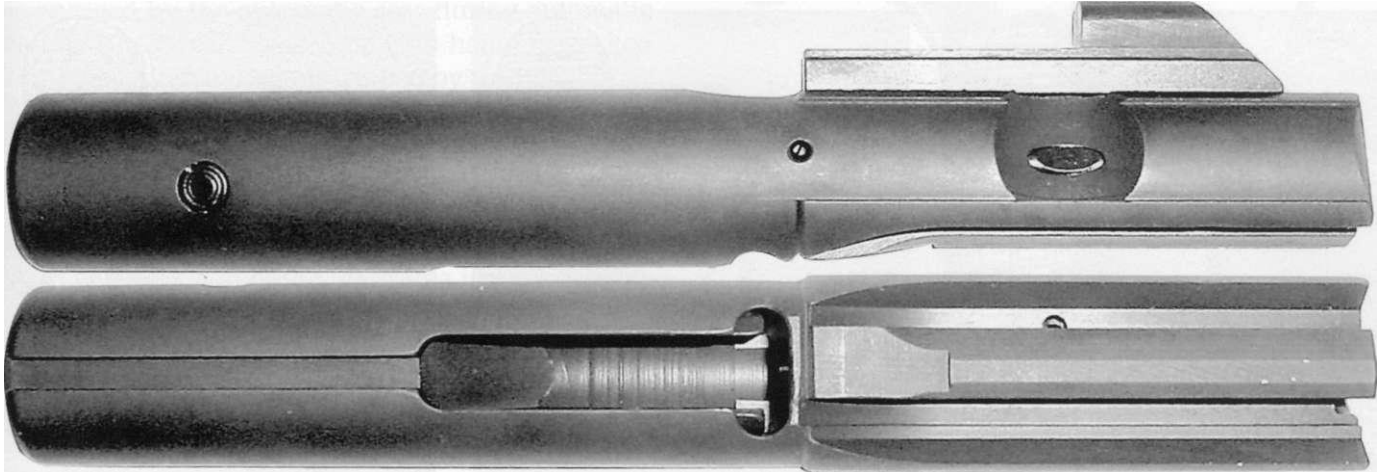
471. The 9mm SMG bolt weight, made in both steel and tungsten configurations.

the firing pin from discharging a cartridge by inertia when the bolt group chambers a cartridge.

The entire firing pin is enclosed, and a modified hammer is utilized in the semi-automatic only 9 mm Carbines, so instead of the hammer catching the

firing pin, it catches the bolt group itself. As of this writing, this is the only 9 mm bolt group produced by Colt.

## The Colt 9mm Carbine Semi-Automatic-Only Bolt Assembly



472. Right side and underside views of the Colt 9mm semi-automatic-only bolt assembly, redesigned to prevent

it from functioning with an auto sear installed. This bolt group is no longer in production.

This was functionally identical to the selective-fire version, described above. The only change was that the sear trip area on the bottom rear of the bolt group

was significantly extended to prevent the bolt group from functioning with an auto sear in the lower receiver. This bolt group is no longer in production.

## Military Bolt Carrier Manufacturer Codes

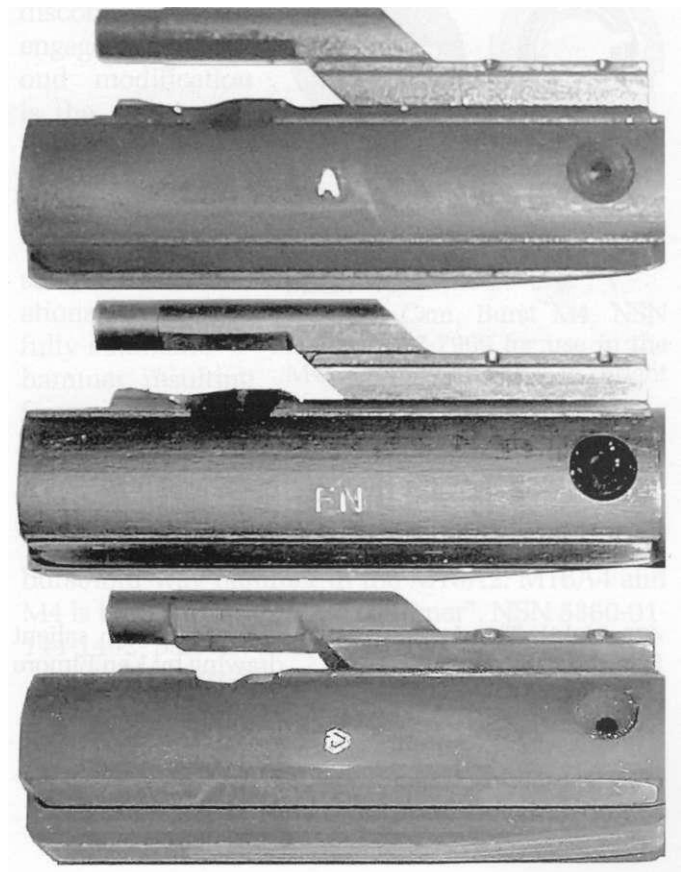
As noted earlier, Colt began stamping their bolt carriers and other components with their proprietary "C" code marking (fig. 461) in 1968 or 1969, signalling the fact that Colt was no longer the sole-source provider of M16 rifles and components to the US government.

In 1973 or 1974 it became a government requirement that each manufacturer imprint a distinctive code on the rifle components they produced, as follows:

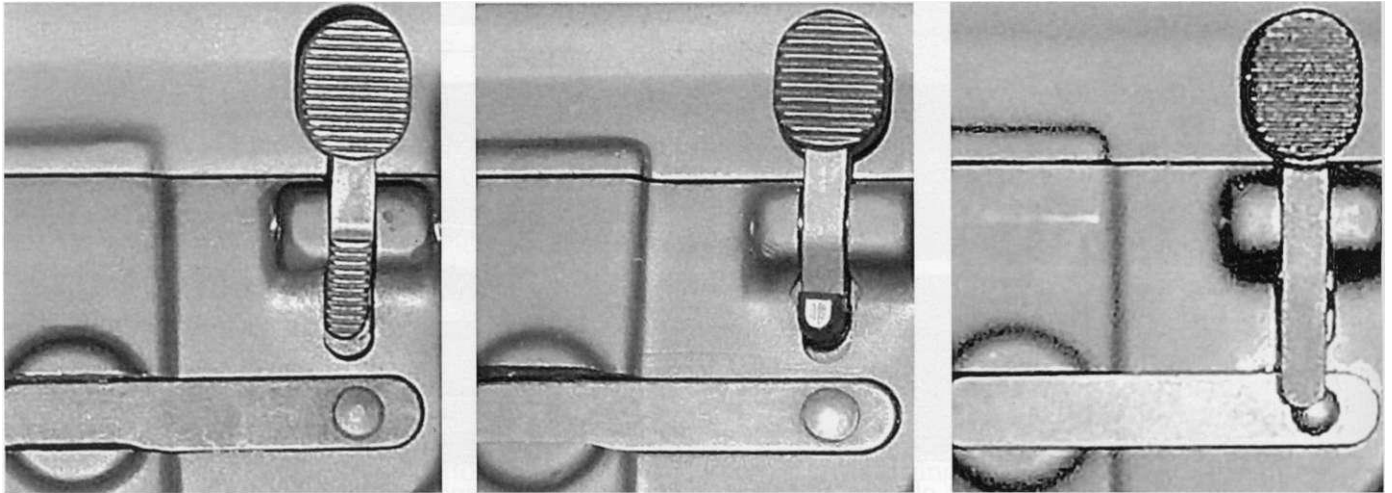
Manufacturer	Code
A . . . . .	Advanced Ordnance
C . . . . .	Colt
D (stylized) . . . . .	Diemaco
FN . . . . .	FNMI
J . . . . .	J. C. Manufacturing
CJ . . . . .	J. C. Manufacturing
M . . . . .	Unknown

473 (right). Left side closeups of three bolt carriers, showing manufacturer markings.

Above: Advanced Ordnance  
Center: FNMI  
Below: Diemaco.



## Lower Receiver Group Bolt Catch Reference Guide



474. Closeups of three versions of the bolt catch.

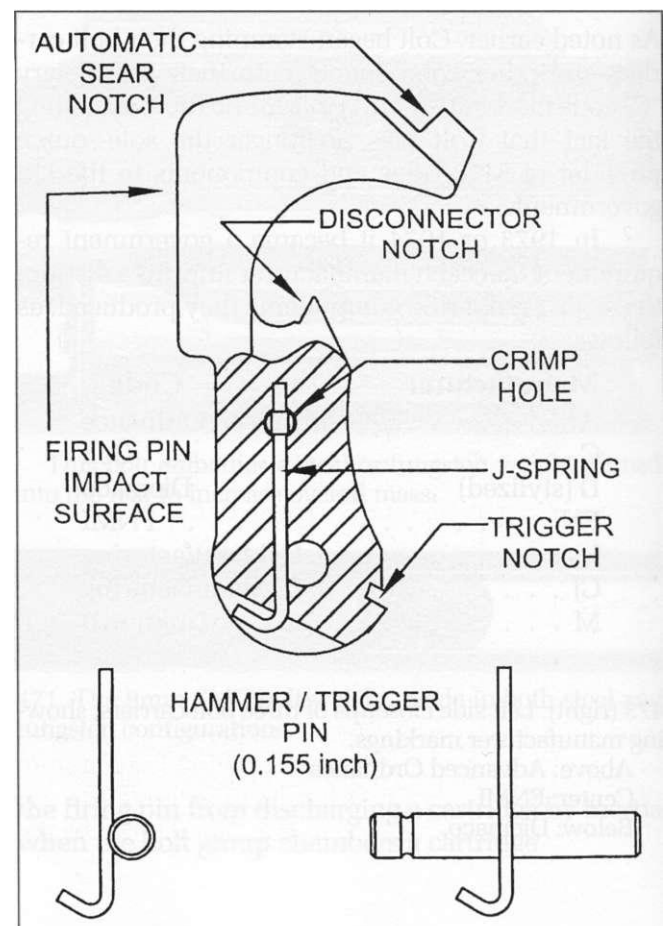
Left: early style, as used in first-production rifles.

Center: strengthened version, adopted in the early to mid 1960s to accommodate the higher cyclic rates caused by the switch to ball powder. This is the current standard

pattern.

Right: the LMG/LSW bolt catch. Note the extended arm which contacts the magazine catch to automatically release the bolt carrier group to the hammer/sear when the weapon is reloaded.

## Hammer Reference Guide



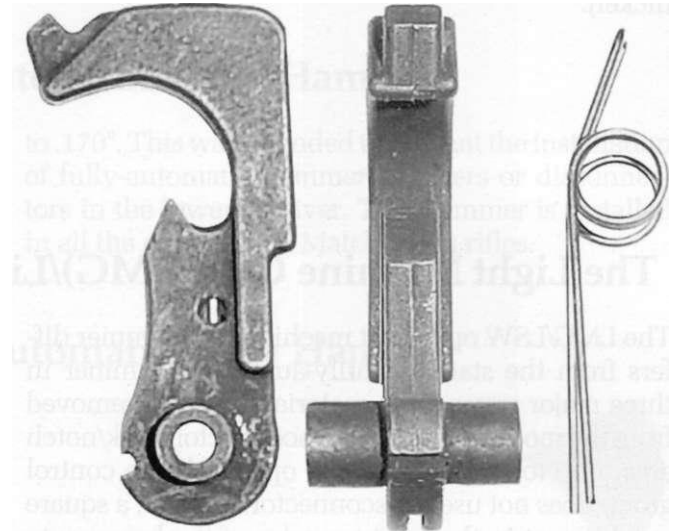
475 (right). The Anatomy of the Hammer, with salient features labelled.  
drawing by Ken Elmore

## The Fully-Automatic Hammer

The fully-automatic hammer is quite distinctive from the other hammers. It has a smooth front with an automatic sear hook/notch on the upper rear, which is engaged by the automatic sear during automatic fire. The automatic sear holds the hammer cocked until the automatic sear is tripped by the bolt carrier when the bolt is locked.

There are two variations, mainly concerning the configuration of the auto sear engagement hook/notch area, which came about as a result of a manufacturing change. Type 1 is shown at right, and the Type 2 version of the hook area is shown in fig. 477.

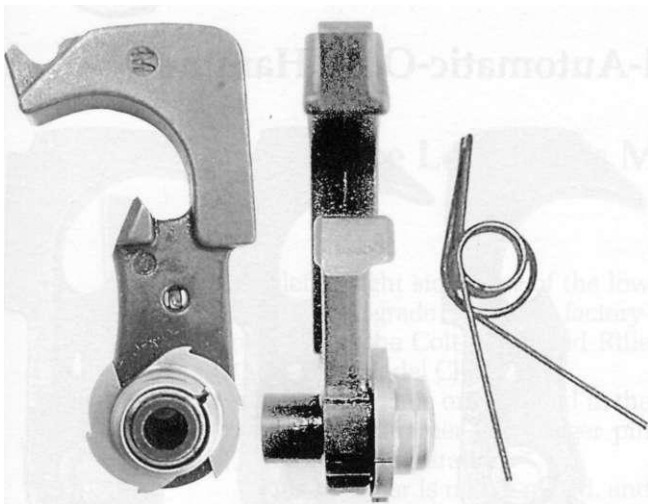
The same "Spring, Helical, Hammer" (NSN 5360-00-992-6648, Colt part no. 8448611), was used in the M16, M16A1, M16A3, and M4A1.



476. Right side and rear views of the fully-automatic hammer, and its "Spring, Helical, Hammer" (NSN 5360-00-992-6648), used in the M16, M16A1, M16A3, and M4A1.

Note the Type 1 auto sear hook/notch.

## The Three-Round Burst/Four-Way Hammer



477. Right side and rear views of the three-round burst/four-way hammer, and its "Spring, Helical, Hammer", (NSN 5360-01-144-1492), used in the M16A2, M16A4 and M4.

Note the Type 2 auto sear hook/notch.

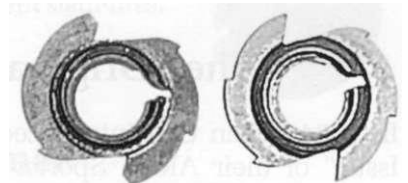
The burst hammer is similar to the fully-automatic hammer, with two modifications. First the hammer disconnector hook/notch has been extended to the right from 0.190+/-0.005" to 0.323+/-0.005", so the

second or burst disconnector can engage it. The second modification is the addition of the burst cam/cam clutch mechanism on the right side.

There are the same two variations as on the fully-automatic hammer, resulting from a manufacturing change in the auto sear engagement area on the top rear of the hammer.

The hammer spring used with the three-round burst/four-way hammer in the M16A2, M16A4 and M4 is the "Spring, Helical, Hammer", NSN 5360-01-144-1492, part no. 9349107.

As discussed in Chapter Three, the M4 carbine uses a modified burst cam. Accordingly, there are two separate burst cams in use, one for the M16A2/M16A4 rifles (Cam, Burst, NSN 1005-01-148-0172, part no. 9349108, colored black); and one

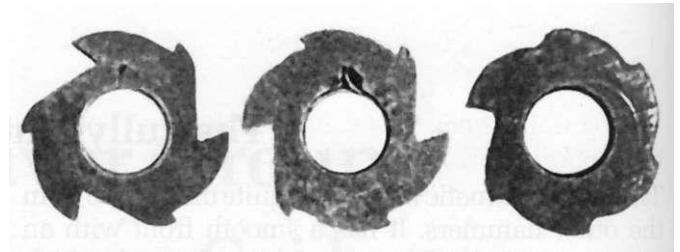


478. The two burst cams.

Left: Cam, Burst, NSN 1005-01-148-0172 for use in the M16A2/M16A4 rifles, colored black.

Right: Cam, Burst M4, NSN 3040-01-247-7969 for use in the M4 carbine, finished in bright nickel.

for the M4 Carbine (Cam, Burst M4, NSN 3040-01-247-7969, part no. 9390031, finished in bright nickel).



479. The three different but interchangeable burst cams developed by Foster Sturtevant in 1966 for his early four-way fire control group (US Patent no. 3,292,492).

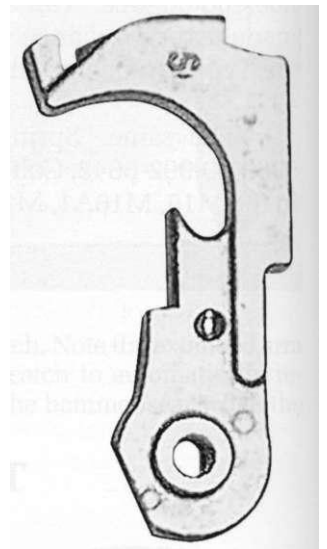
From left: two-shot burst, three-shot burst, six-shot burst.

## The Light Machine Gun (LMG)/Light Support Weapon (LSW) Hammer

The LMG/LSW open-bolt machine gun hammer differs from the standard fully-automatic hammer in three major ways. First, material has been removed from the modified hammer disconnecter hook/notch area, due to the fact that the open-bolt fire control group does not use a disconnecter. Second, a square notch is cut in the front top edge of the hammer to form the sear, which engages the notch on the bottom of the LMG/LSW bolt carrier group to hold the bolt carrier group to the rear. Third, the trigger engagement notch has been removed from the bottom rear. The LMG/LSW hammer is also nickel plated.

480 (right). Right side view of the nickel-plated LMG/LSW open-bolt machine gun hammer.

Note the modified disconnecter hook, the square notch cut in the front top edge of the hammer to form the sear, and the absence of the trigger engagement notch on the bottom rear.



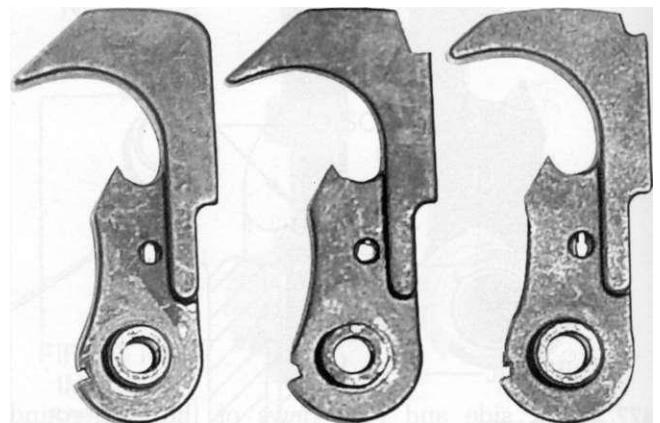
## The "Original First Issue" Semi-Automatic-Only Hammer

In 1964, when Colt introduced the "Original First Issue" of their AR-15 Sporter rifle to the civilian market, the hammer used was a slightly modified version of the fully-automatic hammer. The only difference was the removal of the automatic sear hook/notch from the top rear.

### The Later Version/Standard Semi-Automatic-Only Hammer

A modified hammer with a notch cut into the top edge of the front of the hammer was introduced on April 14, 1969, designed to prevent the rifle from firing in a slam-fire method either by malfunction or intent.

This hammer was designed for use in conjunction with the Later Version semi-automatic-only bolt carrier so that if the disconnecter was missing or defective, the notch on the front of the hammer would engage the front head of the firing pin, preventing the bolt from locking and thus preventing unsafe slam-fire conversions.



481. Right side comparison of the three different types of semi-automatic-only AR-15 hammers.

Left: the "Original First Issue" hammer, a modified version of the fully-automatic hammer with automatic sear hook/notch removed from the top rear.

Center: the later version/standard semi-automatic-only hammer, with a notch cut into the top front edge. Used in conjunction with the later version semi-automatic only bolt carrier to prevent slam-fires.

Right: the "Large Pin" version in current use, with hammer and trigger pins enlarged from .155" to .170".

This hammer was used in the Later Version Sporter I, the AR-15A2 series, and very early transitional Colt Sporter rifles.

## The Colt Sporter Semi-Automatic-Only Hammer

This was a slightly modified hammer which has only been utilized by Colt. As part of their effort to show good faith with lawmakers, Colt introduced their Colt Sporter series rifles with modified "Large Pin" hammer and trigger pins, enlarged in diameter from .155"

to .170". This was intended to prevent the installation of fully-automatic hammers, triggers or disconnectors in the lower receiver. This hammer is installed in all the current Colt Match series rifles.

## The 9mm Carbine Semi-Automatic-Only Hammer

For use with the different bolt group fitted to the 9mm Carbine, the top portion and hook/notch area of the hammer was removed, and a notch was cut into the face of the hammer to prevent slam-fires. Should the disconnector either malfunction or be removed, the notch on the face of the hammer will engage the bottom rear of the bolt group, preventing it from closing and firing. This hammer will be found in both .155 and .170 inch hammer/trigger pin configurations.

482 (right). Right side view of the 9mm Carbine semi-automatic-only hammer, with the top portion and hook/notch area of the hammer removed and a notch cut into the face of the hammer to prevent slam-fires.



## The Low Mass Match-Grade Hammer



483 (left). Right side view of the low mass Match-grade hammer, factory-installed in the Colt Accurized Rifle "CAR-A3" (Model CR6724).

This hammer is only offered in the "Large Pin" hammer and trigger pin (.170" dia.) configuration.

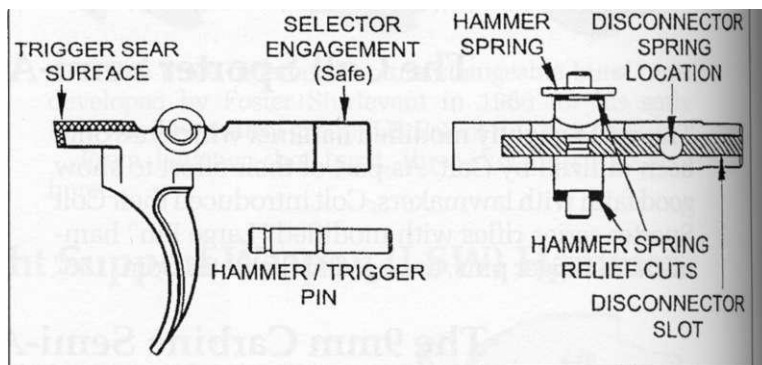
This hammer is nickel plated, and the CAR-A3 trigger and hammer pins are also nickel plated.

This hammer is utilized in the Colt Accurized Rifle "CAR-A3" (Model CR6724). This hammer is only offered in the "Large Pin" hammer and trigger pin (.170" dia.) configuration. This hammer is nickel plated, and the trigger and hammer pins are also nickel plated. The entire hammer hook has been removed to reduce weight and reduce "lock time". The anti-conversion/hammer safety notch in the top front of the hammer prevents the rifle from slam-firing.



## Trigger Reference Guide

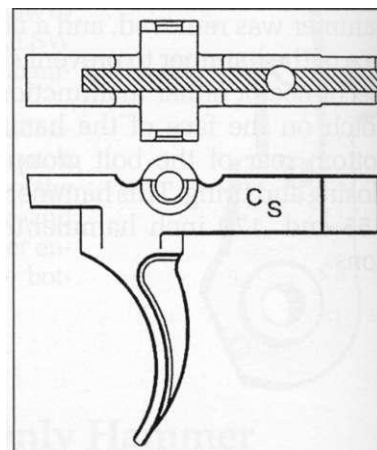
484 (right). The Anatomy of the Trigger, with salient areas labelled.



### The Selective Fire and the "Original First Issue" Semi-Auto-Only Trigger

The selective-fire trigger is identified by the open rear end, which accommodates the selective-fire disconnecter. The Original First Issue semi-automatic-only AR-15 Sporter I utilized this same trigger.

485 (right). Top and left side views of the open-ended selective-fire trigger.

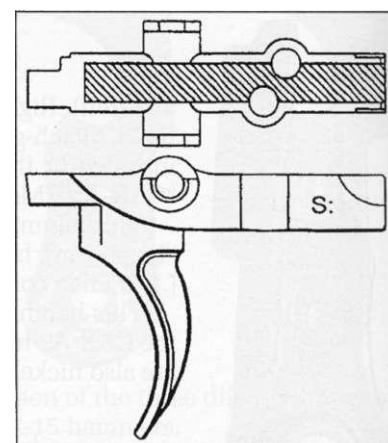


### The Burst and Four-Way Trigger

The current BURST/Robbins four-way trigger is identified by its thicker width and dual disconnecter spring locations, to accommodate the two disconnectors and their springs. In addition a notch has been taken out of the right side of the trigger nose, to allow the hammer with the burst cam installed to fit next to the trigger.

The early version of the four-way selector, designed by Foster Sturtevant and patented in 1966, used an entirely different trigger which utilized three disconnecter springs.

Two different disconnecter springs are used in the BURST trigger group. The "Spring, Helical, Disconnecter, NSN 5360-01-135-0353, part no. 9349116, is used with the burst disconnecter in the M16A2, M16A4 and M4. It is identified by its bright nickel finish. The "Spring, Helical, Disconnecter" NSN 5360-01-396-0256, part no. 12972695, is used with the M4 semi-auto disconnecter. It is identified by its black color.



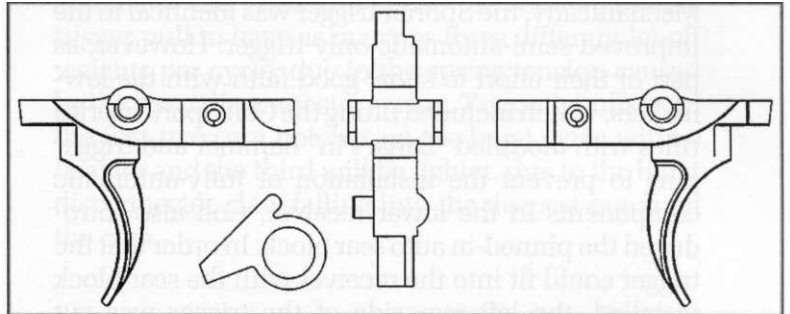
486. Top and left side views of the burst and four-way trigger.

Note the thicker width and dual disconnecter spring locations.  
drawing by Ken Elmore

## The Light Machine Gun (LMG)/Light Support Weapon (LSW) Trigger

This trigger is identified by the lack of a disconnecter slot, as no disconnecter or disconnecter spring are installed. There is a hole for the insertion of the trigger pin spring pin toward the rear of the trigger.

The left side of the trigger has a slight radius at the rear, while the right side is squared off to act as a contact point for the selector lever.



487. Left, top and right side views of the LMG/LSW trigger, with no disconnecter slot. The connector (center left) slides onto the selector and engages the pin on the trigger.

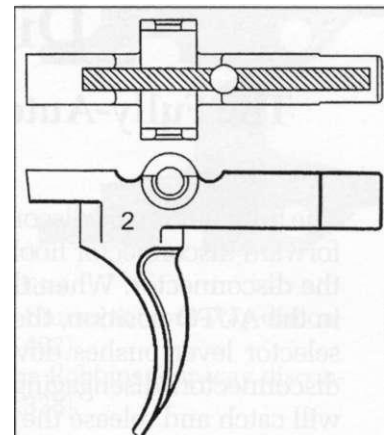
drawing by Ken Elmore

## The Later Version/Standard Semi-Automatic-Only Trigger

In 1965, when Colt first modified the fire control mechanism so that sporting AR-15s could fire only semi-automatically, the overall length of the trigger was reduced and the rear of the disconnecter slot was closed, so that a selective-fire disconnecter could not be installed. In addition the disconnecter spring location was moved forward to accept the newly designed semi-auto-only disconnecter. This trigger was used until the adoption of the Colt Sporter series.

488 (right). Top and left side views of the later version semi-auto-only trigger.

Note the closed end of the disconnecter slot,  
drawing by Ken Elmore



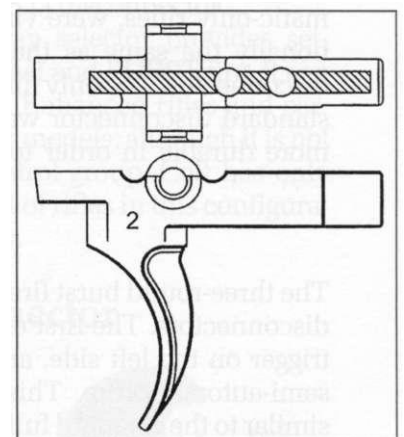
## The Colt Improved Semi-Automatic-Only Trigger

On September 20, 1978, due to the higher bolt carrier group velocities produced in carbines, Colt introduced a new trigger, modified to accommodate the new disconnecter. The notch which is engaged by the disconnecter spring was moved rearward from its previous position, thus increasing leverage and enhancing the longevity and reliability of the carbine disconnecter and spring.

To keep the trigger interchangeable with the rifle disconnecter, two disconnecter spring locations were provided, the first for the standard rifle disconnecter and the second for the carbine disconnecter.

489 (right). Top and left side views of the improved semi-auto-only trigger.

Note the dual disconnecter spring locations.  
drawing by Ken Elmore



## The Colt Sporter Semi-Automatic-Only Trigger

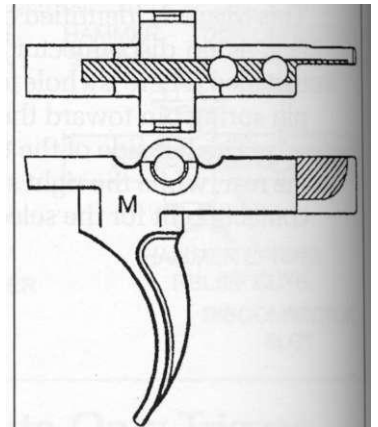
Mechanically, the Sporter trigger was identical to the improved semi-automatic-only trigger. However, as part of their effort to show good faith with the lawmakers, which included fitting the Colt Sporter series rifles with modified "Large Pin" hammer and trigger pins to prevent the installation of fully-automatic components in the lower receiver, Colt also introduced the pinned-in auto sear block. In order that the trigger could fit into the receiver with the sear block installed, the left rear side of the trigger was cut shorter than the right side.

This trigger is currently being used in the Colt Match rifle series and also in the Colt Accurized Rifle "CAR-A3" (Model CR6724). The trigger, hammer, and the trigger and hammer pins used in the Accurized CAR-A3 are all nickel plated.

490 (right). Top and left side views of the Colt Sporter semi-auto-only trigger.

Note the large pin hole diameter, and the cutaway rear end to accommodate the auto sear block.

drawing by Ken Elmore

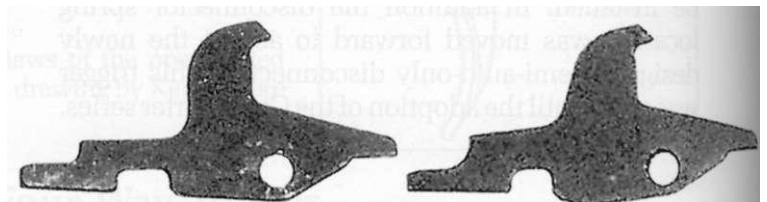


## Disconnecter Reference Guide

### The Fully-Automatic and Original First Issue Semi-Automatic-Only Sporter Disconnectors

The fully-automatic disconnecter is identified by the forward disconnecter hook and the tail at the rear of the disconnecter. When the selector lever is placed in the AUTO position, the disconnecter lobe on the selector lever pushes downward on the tail of the disconnecter, disengaging it so the automatic sear will catch and release the hammer without interference from the disconnecter. There are two variations.

The early disconnectors, found in the early selective-fire rifles and Original First Issue semi-automatic-only rifles, were virtually identical and functionally the same as the standard fully-automatic disconnecter. The only difference noted was that the standard disconnecter was strengthened and made more durable in order to handle the higher cyclic



491. Right side views of two fully-automatic and Original First Issue semi-automatic-only disconnectors.

Left: early pattern.

Right: standard pattern.

rates caused by the switch to ball powder. This was done by increasing the width of the hump behind the hook, from approximately .244" in the early pattern to approximately .302".

### The Three-Round Burst Disconnectors

The three-round burst fire control group utilizes two disconnectors. The first disconnecter sits inside the trigger on the left side, and is engaged only during semi-automatic fire. This disconnecter looks very similar to the standard fully-automatic disconnecter, except the tail has a slight bend inward.

When the selector lever is placed on BURST, the disconnecter lobe on the selector pushes downward on the tail of the semi-auto disconnecter, dis-

492 (right). The two disconnectors used in the three-round burst fire control group.



engaging it and allowing all operations to be performed by the burst disconnector, which sits inside the trigger on the right side. The burst disconnector is identified by its lack of a tail and a second forward claw, which engages the burst cam on the hammer.

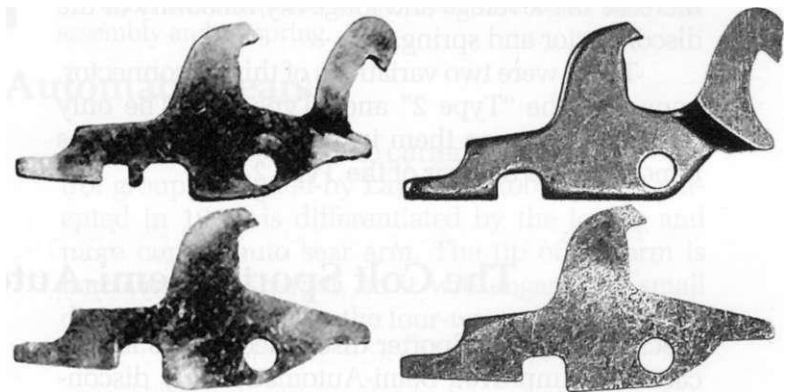
While the semi-automatic-only disconnector engages the hammer for each shot when the selector is set for SEMI, when the selector is set to BURST the burst disconnector only engages the hammer on every third shot, when the claw enters the deepest notch on the burst cam, causing the burst disconnector to engage the hammer to stop the cycle.

## The Four-Way Disconnectors

The earlier four-way disconnectors were designed and patented in 1966 by Colt's Foster Sturtevant (US Patent no. 3,292,492). These disconnectors were different from the current versions, and utilized three disconnector springs - two standard disconnector springs and a smaller auxiliary disconnector spring. An additional notch on the underside of the Sturtevant burst disconnector served to accommodate the additional auxiliary disconnector spring.

The current configuration of the four-way fire control group was designed and patented in 1998 by Colt's Laurence Robbins (US Patent no. 5,760,328). Like the standard burst fire control group, two disconnectors are needed. The semi-automatic disconnector is similar to the standard fully-automatic disconnector, with a tail on the rear. The major difference is in the four-way disconnector. Unlike the burst disconnector, the four-way disconnector also has a tail. When the four-way selector is placed on AUTO, the disconnector lobe on the selector pushes downward on both disconnector tails, disengaging them and allowing the automatic sear to engage the hammer. When the selector is placed on BURST, the disconnector lobe on the selector pushes downward on the left (semi-auto/auto) disconnector, disengaging it and allowing the claw on the right (BURST) disconnector to engage the cam, to allow the burst

The burst disconnector is never disengaged, and still goes through the burst cycle during semi-automatic fire. This can cause the semi-automatic trigger pull to have as many as three different let-off weights per cycle, due to the spring tension caused by the burst disconnector spring. Trigger let-offs from the first two cam notches on the burst cycle will be heavier and the third will be lighter, due to the burst disconnector claw falling into the deepest notch on the cam.



493. The four-way disconnectors.

Left (top and bottom): the Sturtevant four-way disconnectors (US Patent no. 3,292,492).

Right (top and bottom): the Robbins four-way disconnectors (US Patent no. 5,760,328).

cycle to operate. On semi-auto, the disconnector lobe disengages the right (BURST) disconnector.

The Robbins four-way selector provides settings for SAFE, AUTO, SEMI and BURST fire. It can be found in Colt's M16A2 Enhanced rifles and carbines, amongst many other models; although it is not a commonly-seen fire control group. Colt has only manufactured one large lot of rifles in this configuration, for the Greek military.

## The Standard Semi-Automatic-Only Disconnector

As an early part of the anti-conversion/safety modifications made to the later Sporter rifles, the first of the Colt-designed semi-automatic-only disconnectors appeared in 1965 and remained in use until the early 1990s. The entire rear tail was removed on the standard semi-automatic-only disconnector, and the area engaged by the disconnector spring was moved

494 (right). The standard semi-automatic-only disconnector, with tail entirely removed.



forward. As discussed in the Trigger Reference Guide in this chapter, a special semi-automatic-only trigger was also designed to accommodate this disconnecter, to ensure that the selective-fire disconnecter could not be installed in the trigger.

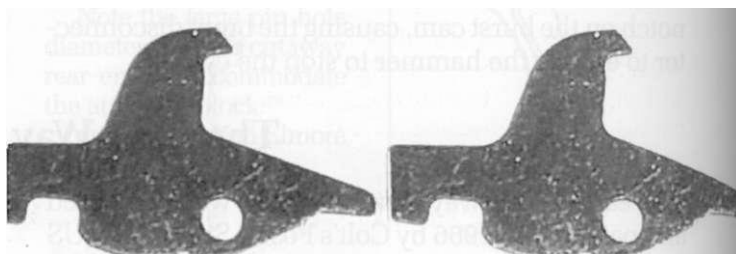
The mechanical downside to this modification was that less leverage was applied to the disconnecter,

as by moving the disconnecter spring forward, less spring tension was exerted on the disconnecter. This caused occasional failures when the disconnecter spring wore out, and Colt at one point issued a recall on a small number of rifles fitted with the standard semi-automatic-only disconnecter, in order to replace the disconnecter spring.

## The Improved Semi-Automatic-Only Disconnectors

On September 20, 1978 Colt introduced a modification to the disconnecter for the semi-automatic-only carbines. As a product improvement, the notch which is engaged by the disconnecter spring was moved rearward from its earlier position, in order to increase the leverage and longevity/reliability of the disconnecter and spring.

There were two variations of this disconnecter, known as the "Type 2" and "Type 2A". The only difference between them is that more material was removed from the rear of the Type 2.



495. Right side views of the two variations of the improved semi-auto-only disconnecter.

Left: the Type 2, with shorter rear end.

Right: the Type 2A.

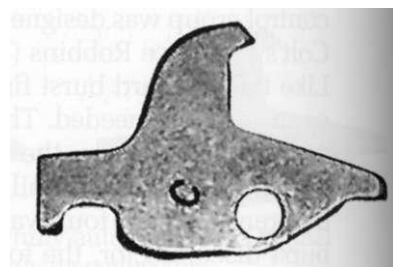
## The Colt Sporter Semi-Automatic-Only Disconnecter

Mechanically, the Sporter disconnecter was identical to the Improved Semi-Automatic-Only disconnecter. The only difference is the diameter of the pivot hole. In an effort to show good faith with the nation's lawmakers and prevent fully-automatic components from being installed in the lower receiver, Colt introduced their new Sporter series of rifles fitted with hammer and trigger pins enlarged from .155" to .170" in diameter.

Throughout the years, the disconnecter springs have been changed and improved. The current "Spring, Helical, Disconnecter" for the M16, M16A1 and M16A3, NSN 5360-00-992-7311 and part no. 8448594, is identified by its green or black color.

The current disconnecter spring for the M4A1 Carbine, "Spring, Helical, Disconnecter" NSN 5360-

496 (right). Right side view of the Colt Sporter semi-auto-only disconnecter. Note the large-diameter pin hole.



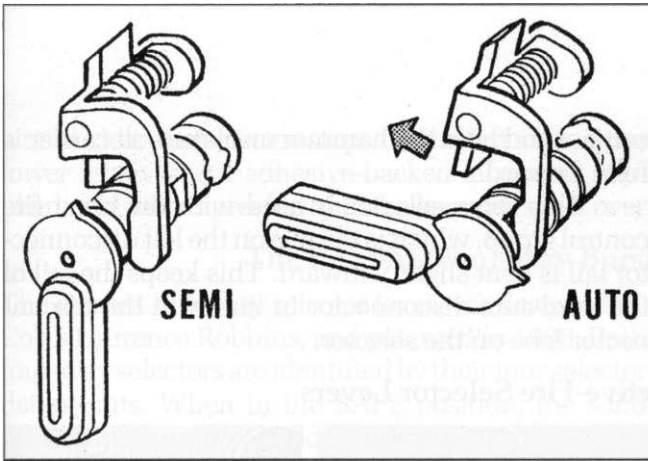
01-396-0256, part no. 12972695, has been further improved and stiffened for longer service life. It is identified by its gold color.

# Automatic Sear Reference Guide

## The Standard Automatic Sear (Fully-Automatic and Burst)

The automatic sear used for both automatic and burst fire is an assembly made up of the auto sear, bushing, spring, and pin. The arm on the auto sear is engaged by the selector lever to move the sear into position to contact the hammer (when AUTO or BURST are

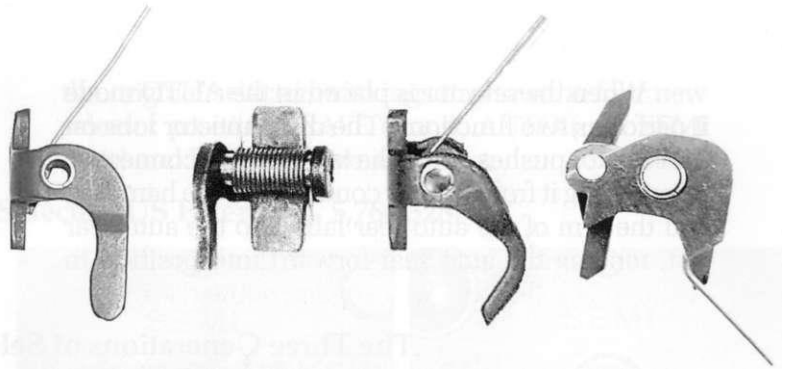
selected) or out of position (when SEMI is selected). When AUTO or BURST is selected, the sole purpose of the auto sear is to engage the hammer and hold it until the bolt carrier trips the rear of the auto sear, releasing the hammer to fire after the bolt is locked.



497. Diagram illustrating the function of the auto sear.

Left: with selector on SEMI, the auto sear is held upright so it will not catch the automatic sear notch of the hammer, nor be contacted by the bolt carrier.

Right: with selector on AUTO or BURST, the auto sear is positioned so it will catch the automatic sear notch of the hammer, and trip it when the bolt carrier closes.



498. Four auto sears.

Left: left side view of the standard automatic and burst auto sear and its spring.

Second from left: the Sturtevant four-way auto sear and spring.

Second from right: the Robbins four-way auto sear and spring.

Right: left side view of the open-bolt LMG auto sear assembly and its spring.

## The Four-Way Automatic Sears

The earlier four-way auto sear, designed by Foster Sturtevant and patented in 1966, utilized a shorter, thicker arm than the standard selective-fire automatic sear or the current Robbins four-way automatic sear. The two four-way selector levers are also quite different in the way they operate, including a different order of fire control.

The auto sear for the current four-way fire control group, designed by Laurence Robbins and patented in 1998, is differentiated by the longer and more curved auto sear arm. The tip of the arm is narrower and sharper, so it will engage the small disconnector lobes on the four-way selector.

## The LMG/LSW Automatic Sear (Open Bolt Fully-Automatic Only)

The open-bolt automatic sear is an assembly made up of the auto sear, pawl, pawl spring, pawl pin, automatic sear bushing, spring and pin. It is very much different from the standard automatic sear, and performs two functions. First, when the trigger is pulled, the auto sear pulls the hammer downward,

releasing the bolt carrier group to go forward to strip a cartridge off the magazine and chamber it. The auto sear then engages the notch on the hammer, so that when the bolt moves into the locked position, the bolt carrier trips the auto sear, releasing the hammer to fire the chambered cartridge.

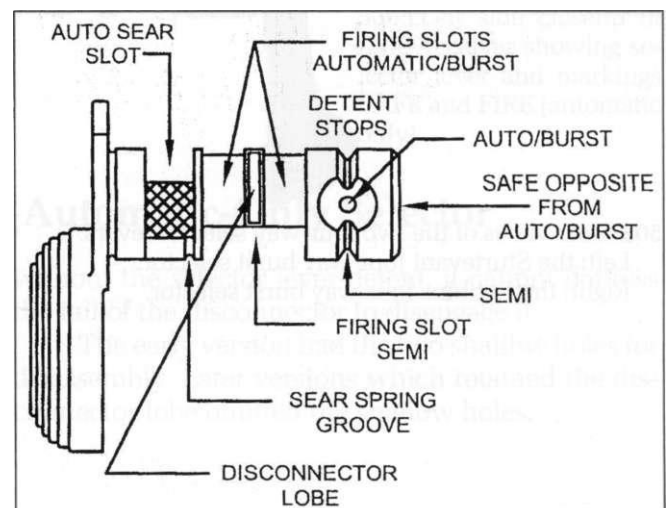
# Selector Lever Reference Guide

## The Selective Fire (Semi, Auto or Burst) Selector

The selective fire selector is identified by a few distinctive features. There are three detent cuts on the end of the right side of the selector, which are engaged by the fire control safety detent. The first notch is for SAFE, the second is for SEMI, and the third is for AUTO. There is also a deep notch on the left side of the selector, which engages or disengages the automatic sear.

499 (right). The Anatomy of the Selective Fire Selector Lever, with salient features labelled.

drawing by Ken Elmore



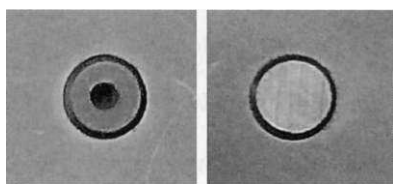


When the selector is placed in the AUTO mode it performs two functions. The disconnecter lobe on the selector pushes down the tail of the disconnecter, disengaging it from further contact with the hammer, and the arm of the auto sear falls into the auto sear slot, moving the auto sear forward into position to

contact and hold the hammer until the bolt carrier is fully forward.

This same selector is used with the burst fire control group, which is the reason the left disconnecter tail is bent slightly inward. This keeps the tail of the semi-auto disconnecter in line with the disconnecter lobe on the selector.

### The Three Generations of Selective-Fire Selector Levers



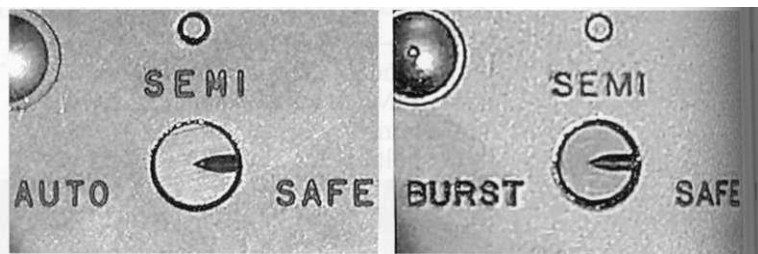
500. Right side closeups of two selective-fire selector levers.

Left: early type, with shallow recess for removal with a drift or the nose of a cartridge.

Right: standard type, introduced in the late 1960s.

There are three generations of selective-fire selector levers. The early version incorporated two shallow recesses, one on the right and one on the left side, which were used for the removal of the selector lever by inserting the nose

of a cartridge, the tip of the firing pin or a drift punch, into the shallow recess on the right side of the selector lever and pushing inward with a large amount of force. The new "standard" (second) version, introduced in the late 1960s, omitted the shallow recesses, and could only be removed by taking off the pistol grip and removing the fire control selector detent and spring.



501. Right side closeups of two types of receivers, showing markings and notches on the third-generation selector levers.

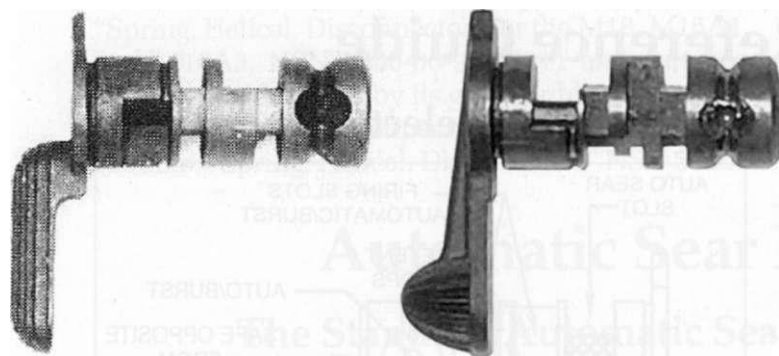
Left: markings on M16A3 rifle and M4A1 carbine.

Right: markings on M16A2 rifle and M4 carbine.

This version was used right up until the introduction of the M16A2 rifle, when the selector settings were also marked on the right side of the receiver to allow left-handed shooters to see what mode of fire was selected. A notch was cut on the perimeter of the right side of the third-generation selector lever, which points to the mode of fire selected. This version of the selector lever is used on all current selective-fire rifles and carbines.

## The Four-Way (Safe, Semi, Auto and Burst) Selectors

### The Sturtevant Four-Way Burst Selector (US Patent No. 3,292,492)

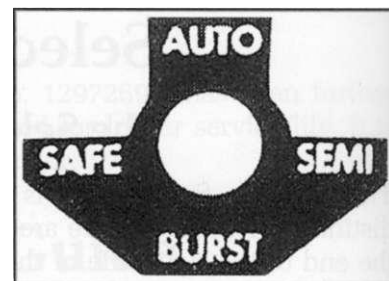


502. Rear views of the two four-way selector levers.

Left: the Sturtevant four-way burst selector.

Right: the Robbins four-way burst selector.

The first four-way trigger group was patented by Foster Sturtevant in December, 1966. This variation could utilize three interchangeable burst cams to deliver six-, three-, or two-shot bursts. This version uses the same selector lever style as the standard model, but with the lever undercut so it



503. The adhesive-backed label supplied with the Sturtevant four-way burst selector, indicating the four new selector positions, SAFE (front), AUTO (up), SEMI (rear) and BURST (down).

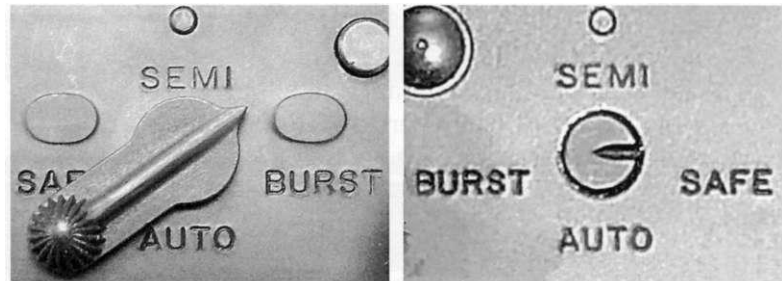
would clear the selector stops on the left side of the lower receiver. An adhesive-backed label was supplied, which was pressed onto the lower receiver over

the original selector markings to show the four new selector positions, SAFE (front), AUTO (up), SEMI (rear) and BURST (down).

### The Robbins Four-Way Burst Selector (US Patent No. 5,760,328)

The current four-way selector lever was designed by Colt's Laurence Robbins, and patented in 1998. Both four-way selectors are identified by their four selector detent cuts. When in the SAFE position, the solid portion of the selector body prevents trigger movement. When placed in the semi-automatic mode, an open square notch enables both disconnectors to function, allowing the left disconnector to engage the hammer 100% of the time. When placed in the BURST mode, the disconnector lobe depresses and disengages the left disconnector, allowing the right disconnector to control the hammer and engage the auto sear. When placed in the fully-automatic mode, both disconnectors are disengaged, leaving only the auto sear engaged.

The outward appearance of the Robbins selector has been altered to include a raised round "button-shaped" area on the rear of the lever, allowing it to be actuated 360° without having to remove the hand from the pistol grip. The selector settings on the Robbins four-way selector, which are differently po-



504. Left and right side closeups of a rifle with factory-installed Robbins four-way selector lever, showing markings indicating the new selector positions on both sides of the receiver, SAFE (front), SEMI (up), BURST (back), and AUTO (down).

Note (left) the selector stops have been milled off for use with this assembly.

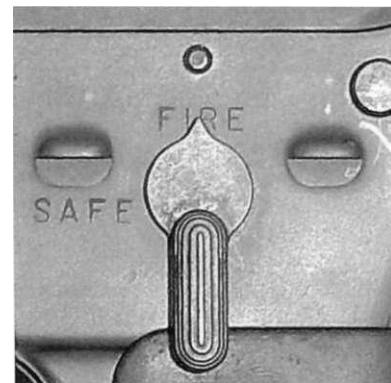
sitioned from the original Sturtevant design, are SAFE (front), SEMI (up), BURST (back), and AUTO (down). Rifles and carbines fitted with the current four-way selector have their selector stops milled off.

### The LMG/LSW Selector Lever

These variations fire full-automatic only, and this selector lever is differentiated by having an automatic sear spring groove and only two selector spring detent notches, one for SAFE and one for FIRE. The central notch

either frees or blocks trigger movement, while the second notch engages or disengages the automatic sear group.

The connector (fig. 487) slides onto the selector and engages the pin on the trigger.



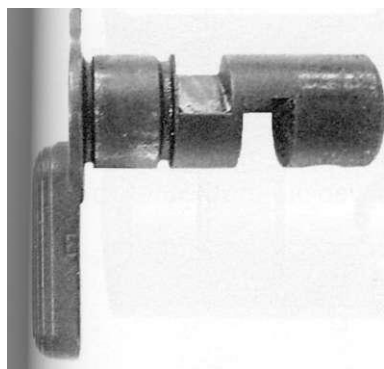
506. Left side closeup of LMG receiver showing selector lever and markings SAFE and FIRE (automatic only).

### The Original First Issue Semi-Automatic-Only Selector

The first semi-automatic-only selector was a modified automatic selector, with the third/AUTO selector detent and the notch which engages and disengages the auto sear omitted. The disconnector lobe which would disengage the disconnector is still present, but

without the selector lever detent, it cannot depress the tail of the disconnector to disengage it.

The early version had the two shallow holes for disassembly. Later versions which retained the disconnector lobe omitted the shallow holes.



505. Rear view of the LMG/LSW selector lever with only two detent notches, one for SAFE and one for FIRE (automatic only).

## The Standard Semi-Automatic-Only Selector

The standard semi-automatic-only selector lever was implemented in late 1978. The only modification was the removal of the disconnecter lobe, which was designed to depress the tail of the disconnecter on fully-automatic fire.

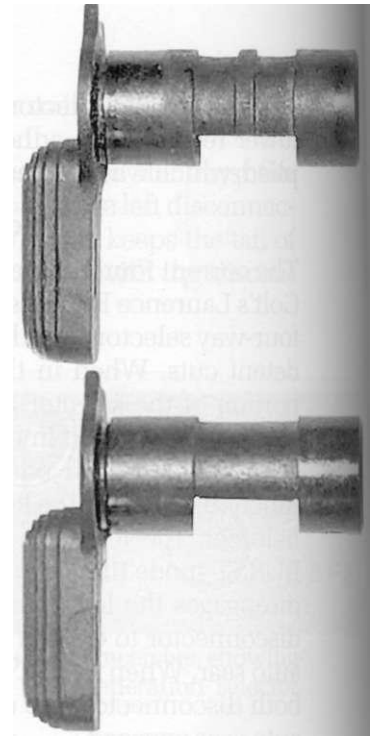
The standard semi-automatic-only selector was installed on all Later Version AR-15 Sporter I rifles and AR-15A2 series Colt Sporter rifles and carbines.

As of this writing, this component is still in use in all current production Colt Match Target series semi-automatic-only rifles and carbines, as well as Law Enforcement semi-automatic rifles and carbines.

507 (right). Rear view of two semi-auto-only selectors.

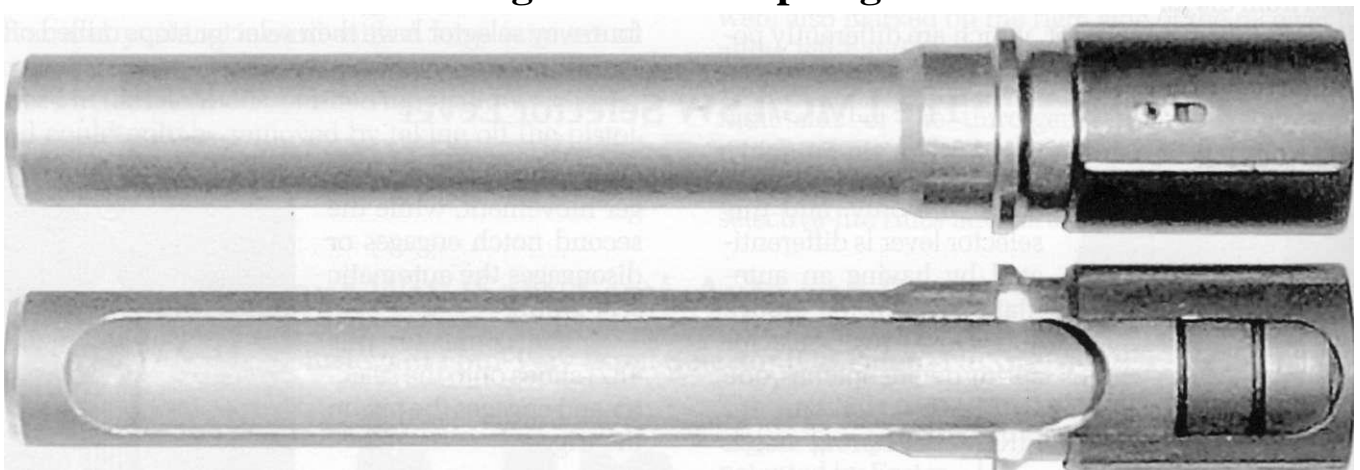
Above: original first-issue selector, with disconnecter lobe.

Below: standard semi-auto-only selector, with no disconnecter lobe. This version is in current use.



## Spring Guide/ Buffer Reference Guide

### The Original Action Spring Guide



508. The original AR-15 action spring guide. The complete component is shown above, and a cutaway, below, illustrates the hollow spring guide tube and the nested aluminum "Edgewater ring springs" in the forward buffer section at right.  
cutaway by Ken Elmore

The contents of the original action spring guide are shown in an exploded view in *TBR* fig. 200. The aluminum "Edgewater ring springs" employed in this initial design were found to be less than completely

effective in preventing bolt carrier rebound, which often caused light strikes when firing in the fully-automatic mode.

## The Standard Buffer and Spring Guide



509. The standard buffer and spring guide. The complete component is shown above, and the cutaway, below,

illustrates the internal series of five steel weights and rubber disks. cutaway by Ken Elmore

The original action spring guide was replaced during the Vietnam war era by a new buffer containing five steel weights, with small rubber disks between the weights, loosely contained within a tubular aluminum body with a polyurethane bumper on its rear end. When the bolt carrier group moved into the locked position, the "cascading" forward movement of these weights and rubber disks effectively damp-

ened the tendency of the bolt carrier group to bounce back. This new heavier buffer also slowed down the closing stroke to reduce the rate of fire, which had been heightened by the introduction of faster-burning ball powder.

This buffer is still in use today on the M16A3 and M16A4 as well as semi-automatic-only rifles.

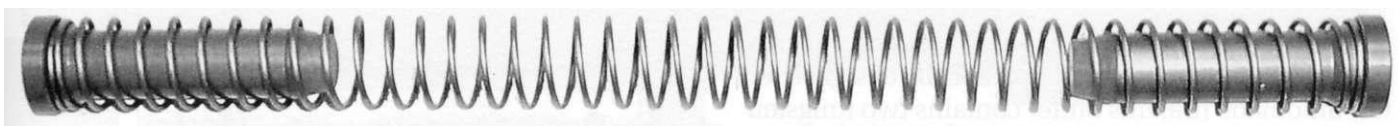
## The Carbine Buffer

This unit was patterned after the standard buffer, but shortened for use in conjunction with the telescoping buttstock. The carbine buffer contained three steel weights and rubber disks, and was utilized in all carbines until the development of the M4/M4A1.



510. The shortened carbine buffer, containing three steel weights and rubber disks.

## The Lightweight Spring Guide/Buffer



511. The lightweight buffer assembly, designed expressly in 1989 for use in AR-15 rifles chambered for the .222 Remington sporting cartridge.

This buffer has no internal weights and at 2.95" overall is slightly shorter than the standard carbine buffer, which is 3.25" overall. The weight of the standard carbine buffer is 2.97 oz., while the weight of the lightweight buffer is approximately 0.95 oz.

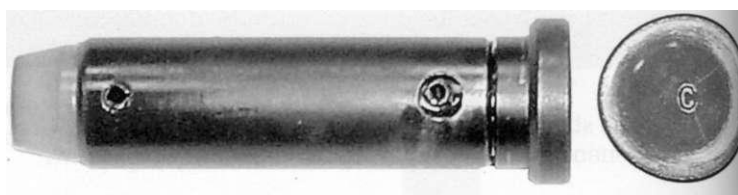
This buffer was designed for a specific purpose in 1989, when Colt was readying a significant order of .222 Remington caliber Sporter rifles for shipment to Italy. Due to the lower port pressure produced by the .222 Remington cartridge it was found that the

gas port had to be enlarged, and this redesigned lightweight buffer was installed to ensure that these rifles functioned reliably.

Two of these buffers are used, one located at each end of the return spring. The overall length of both buffers is equivalent to the length of a standard buffer. The stationary rear buffer acts as a stop for the forward buffer, so the bolt carrier will not overtravel into the buffer tube.

### The Three-Piece "Commando" Buffer

The Commando buffer is identified by its three-piece construction, and is marked with a "C" on the face of the buffer. These buffers are found in 5.56mm Colt "Commando" carbines fitted with 11 1/2" barrels, and may also be found in 9mm Colt carbines as well. The extra-heavy weight of this buffer is designed to prevent bolt carrier bounce off the barrel extension, thus eliminating light strikes on automatic and burst fire in carbines and SMGs with extremely high rates of fire. The rear piece of the buffer is solid steel, and acts as a counterweight.



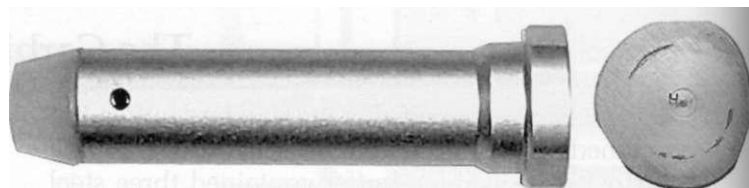
512. Right side and face-on views of the three-piece "Commando" buffer.

Note the identifying "C" marking on the face.

### The M4 Buffer

With the development of the M4 carbine, a new buffer was designed to further slow the rate of fire and to decrease the chance of a light strike, which are more common in carbines due to the faster bolt velocity. In addition to two standard steel weights a tungsten weight further increases the mass of the buffer.

The M4 buffer is identified by the "H" (for Heavy) marking on the front face of the buffer.

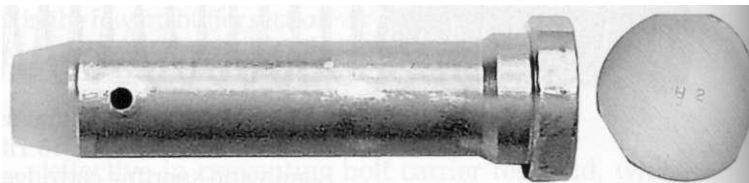


513. Right side and face-on views of the M4 buffer, which contains two steel weights and a tungsten weight for added mass. See fig. 83 for a cutaway view.

Note the identifying "H" marking on the face.

### The Heavy M4A1 Buffer

In late 2002, Colt developed a new buffer for use in US military M4A1 carbines. Specifically designed for full-automatic fire, this buffer contains two tungsten weights and one steel weight. The buffer is marked "H2", the "2" signifying the use of two tungsten weights. This was sold as part of a "Reliability Kit" which included the new heavy barrel for the M4A1 carbine for Special Operations use. As of this writing, Colt does not sell any carbines with this buffer installed.



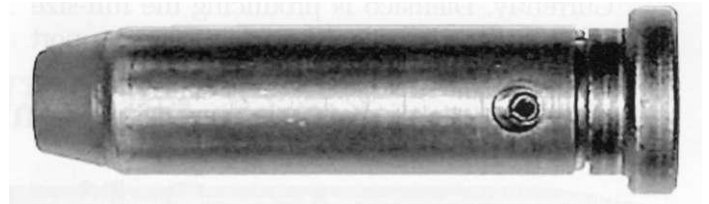
514. Right side and face-on views of the heavy M4A1 buffer, specially designed for full-automatic fire, containing two tungsten weights and one steel weight. See fig. 118 for a cutaway view.

Note the identifying "H2" marking on the face.

## The Two-Piece 9mm SMG Buffer

The body of the two-piece 9mm SMG buffer is made of steel, and utilizes three steel weights and three rubber disks, two between the steel weights and the third between the first steel weight and the front of the buffer body, as well as a neoprene bumper. The additional weight was added to slow down the incredibly high rate of fire of the blowback SMG. The mass of the buffer and bolt, assisted by the recoil and hammer springs, keeps the bolt from moving rearward until the pressures have dropped to safe levels before extracting and ejecting the fired cartridge case.

This buffer will also be found in the 9mm semi-automatic-only carbines.



515. The two-piece 9mm SMG buffer, containing three steel weights and three rubber disks.

## The Polymer Buffer

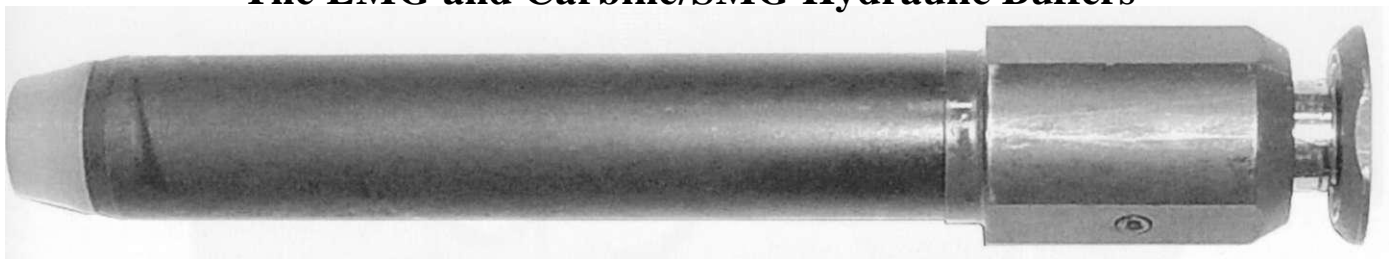


516. The polymer buffer, with two sets of weights molded in place during manufacture.

As part of a cost reduction measure implemented in December, 1999, current versions of the Match Rifle series utilize a new polymer buffer with two sets of weights molded into the center. During manufacture the weights are held in place in the center of the mold and the polymer is injected around them.

However, Colt's will be discontinuing the use of the plastic buffer and returning to the standard buffer when existing supplies are exhausted. This will be implemented as a product improvement, although the polymer buffer has been tested and qualified to the same standards as its predecessor.

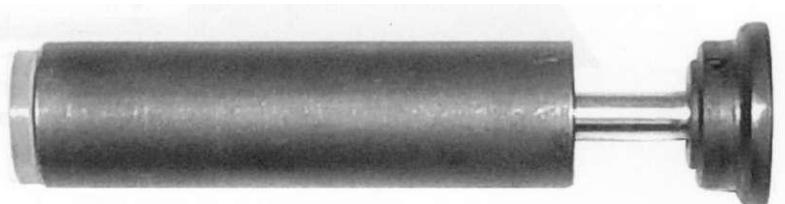
## The LMG and Carbine/SMG Hydraulic Buffers



517. The LMG hydraulic buffer, currently in production by Diemaco for use in their Light Support Weapon.

The hydraulic buffer was originally developed for use in the standard M16A1 back in the early 1970s, [TBR fig. 201), but it never found acceptance until the development of the LMG/LSW. Hydraulic buffers have been adapted for use in standard rifles and carbines as well as the 9mm SMG. A variation of this

518 (below). The carbine/SMG hydraulic buffer. This version was never sold in large quantities.



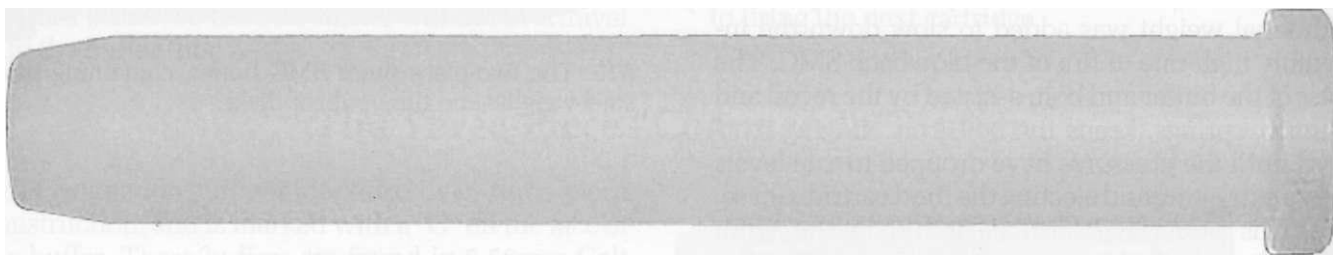


buffer was used in Colt's Advanced Combat Rifle (ACR) (fig. 60).

Currently, Diemaco is producing the full-size hydraulic buffer for use in their Light Support

Weapon. Colt does not offer this buffer as standard equipment on any of their models, but it will be supplied if requested.

### **Knight's Armament SR-25 Spring Guide**

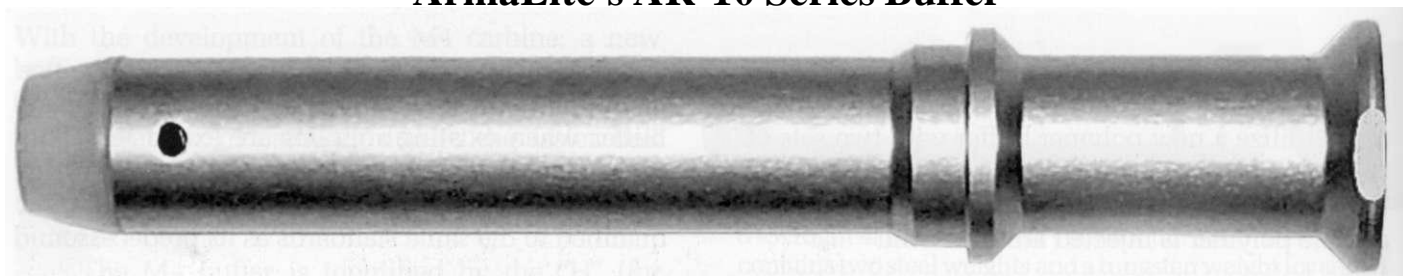


519. The original Knight's Armament solid polymer buffer, utilized in conjunction with an extremely heavy recoil spring in first-production SR-25 rifles.

The original AR-10 rifles utilized a plain spring guide without internal weights, and the first production SR-25 rifles utilized a one-piece polymer spring guide and an extremely heavy recoil spring. However, current productions SR-25 weapons, including

the Mk11 Mod 0, are fitted with a buffer with internal weights as well as a neoprene bumper. This was developed as part of the advanced Mk11 sniper rifle program, and was carried over to the rest of the production line.

### **ArmaLite's AR-10 Series Buffer**



520. The standard buffer utilized in the new ArmaLite 7.62mm NATO caliber AR-10 series of rifles.

The new ArmaLite AR-10 series rifles utilize a standard buffer with internal weights and external neoprene buffer. This buffer has been standard

equipment since Mark Westrom first put his AR-10s on the market.

*Chapter Thirteen*

# Sights and Rail Systems

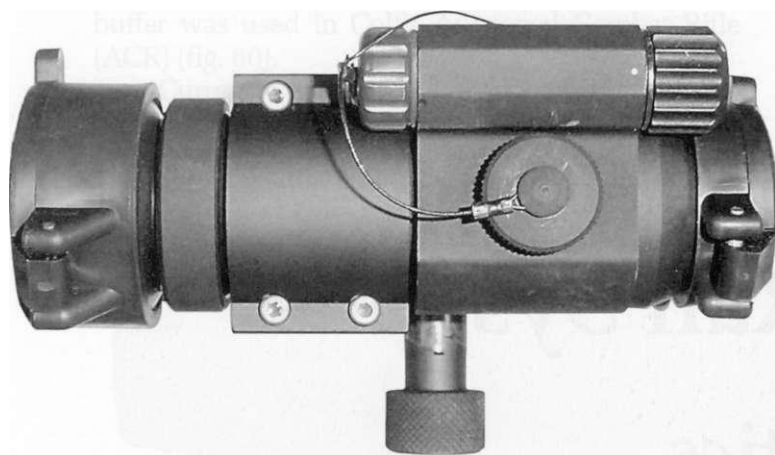
## Optics

### The General-Issue M68 Sight, Reflex, w/Quick Release and Mount

(NSN1240-01-411-1265)



521. Left side closeup of the Aimpoint M68 reflex sight mounted on an M16A2 retrofitted with an M16A4 flat-top upper receiver.



522. Top view of the M68 reflex sight.

Note the flip-up dust covers on the optics as well as the battery compartment and power switch.

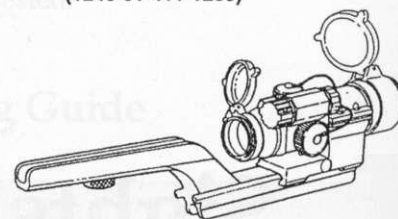
**D**uring the late 1980s, Picatinny Arsenal conducted a study to determine which sighting system to adopt as a replacement for conventional iron sights, in order to increase each soldier's accuracy and performance on the battlefield. Nearly twenty different optical sight manufacturers submitted products and participated in the testing. In 1997, following a three-year trial and evaluation period, the US Army awarded a contract to Aimpoint for 100,000 CompM2 reflex sights, to be called the M68. Aimpoint was awarded a second contract in 2001, for SOPMOD Block 2, to supply an undisclosed number of sights to USSOCOM. Aimpoint was awarded a third contract in 2002, for more than 20,000 M68 sights for the US Air Force.

Realizing that reflex sighting systems offer increased durability and reliability over conventional optical sights, the US Army adopted the M68 reflex sight for general issue rather than just for special operations forces. The Aimpoint-manufactured M68 reflex sight may be mounted on any standard M16, M16A1, M16A2 or M16A3 by means of a mount which attaches to the carrying handle with a screw and 'O'-ring, as well as directly on the MIL-STD-1913 rail on M16A4 rifles and M4 and M4A1 carbines.

The unit-power M68 features unlimited eye relief, which enables the shooter to sight with both eyes open. The clear aperture is 26mm in diameter, with a red dot reticle adjustable through ten settings of increasing intensity. The sight is battery-powered, using one 3-volt Lithium battery. The typical battery life of from 1,000 to 10,000 hours is determined by the length of time the unit is left switched on, and which dot strength setting is selected.

TM 9-1240-413-12&P

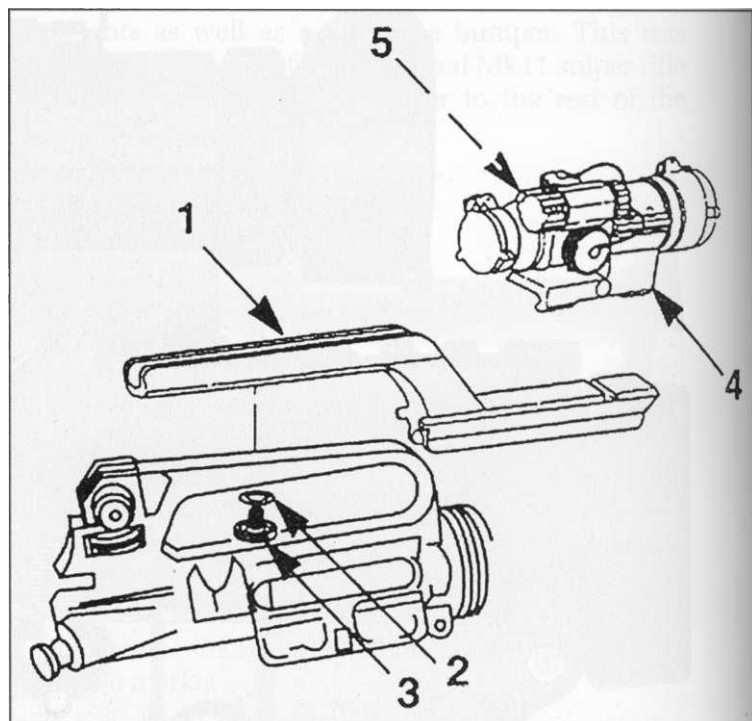
**OPERATOR AND UNIT MAINTENANCE MANUAL  
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST  
FOR  
M68 SIGHT, REFLEX, W/QUICK RELEASE AND MOUNT  
(1240-01-411-1265)**



**DISTRIBUTION STATEMENT C** - Distribution authorized to U.S. Government Agencies and their contractors for administration and operational purposes. This determination was made on 14 April 1993. Other requests for this document will be referred to: Director, Armament and Chemical Acquisition and Logistics Activity, ATTN: AMSTA-AC-NML, Rock Island, IL 61299-7630.

**HEADQUARTERS, DEPARTMENT OF THE ARMY  
OCTOBER 1997**

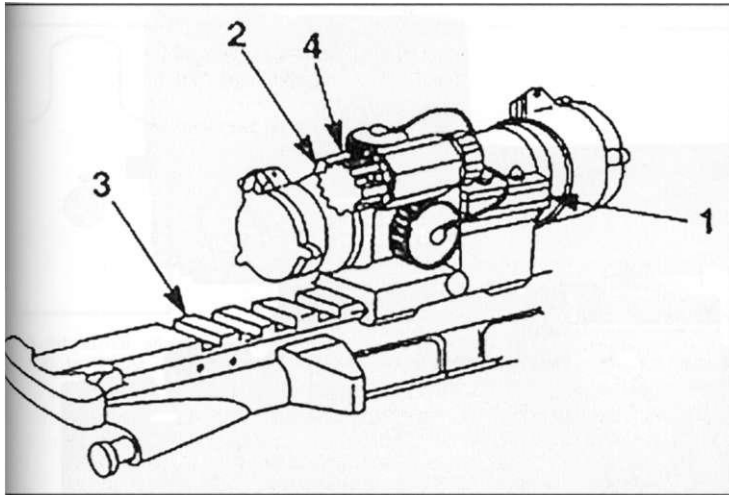
523. The cover of the US military manual for the M68 Reflex Sight, issued by the Department of the Army in October, 1997 showing the M68 in the adapter mount for use on the standard M16/M16A1/M16A2/M16A3 upper receiver.



524. Manual drawing of the M68 as configured for mounting on an M16, M16A1, M16A2 or M16A3 upper receiver with a fixed carrying handle.

The numbered components are as follows: 1: Mount; 2: 'O'-ring; 3: Mounting bolt; 4: M68 sight; 5: Power switch.

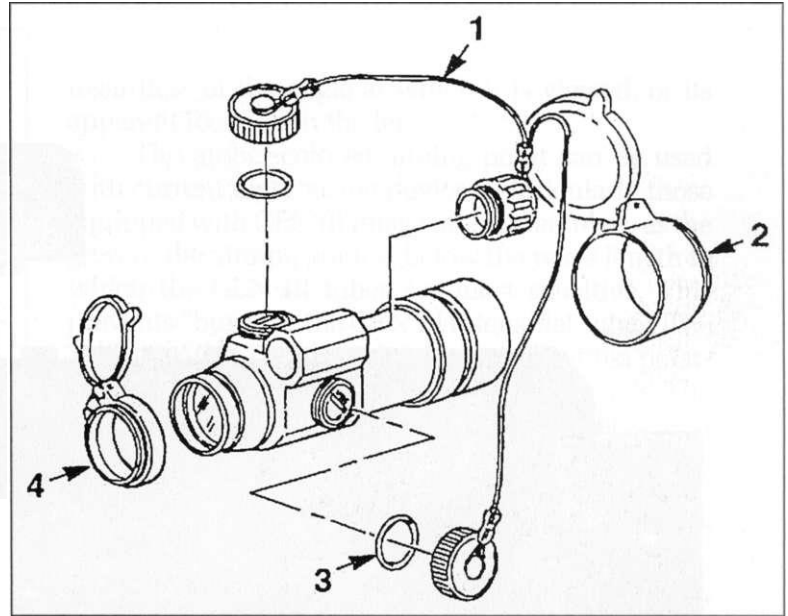
Each M68 is tested and guaranteed waterproof to a depth of 25 meters, although some practical testing indicates that this integrity will still be held at 100 meters. To meet operational requirements, the sights are tested to 160° and frozen to -50°. As part of



525. Manual drawing of the M68 as configured for mounting on an M16A4/M4/M4A1 flat-top upper receiver.

The numbered components are as follows: 1: Mount; 2: Sight assembly; 3: MIL-STD-1913 rail; 4: Power switch.

their "soldier-proofing" these sights have survived drops of twelve feet onto a hard surface.



526. Manual exploded view drawing of the M68.

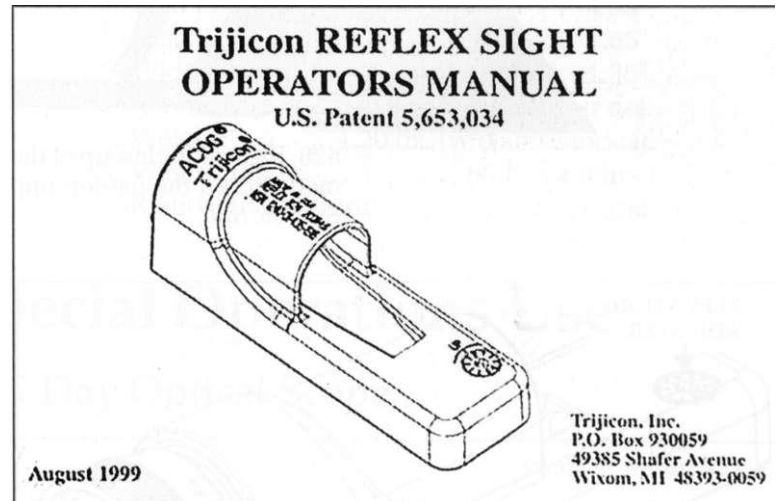
The numbered components are as follows: 1: Protective cap and wire assembly; 2: Objective lens cover; 3: 'O'-ring; 4: Ocular lens cover.

## The Trijicon ACOG Reflex Sight

As part of the SOPMOD package there was a requirement for a non-magnifying reflex sight for use in CQB (Close Quarter Battle) scenarios. It was envisaged that this sight would have a visible dot in the middle of the sight, not projected onto the target, to provide its operator with a quick sighting method with a single aiming point with which he would be able to engage targets without the need to align front and rear sights. This would save valuable time in a CQB, and the single aiming point would enable the operator to keep both eyes open to permit maximum use of his peripheral vision and enhance situation awareness. Optics with magnification were not considered desirable in CQB situations, as they would not hit to point of aim and the optics could blur due to the close proximity of the enemy.

Many "Red Dot" scopes have been developed over the last several years for use by hunters, IPSC shooters and in other combat shooting sports, nearly all of which have required the use of a battery. In a competition, when the battery dies you change it, but in close combat the operator denied the use of his primary sight is severely compromised and must quickly transition to an emergency back-up sight such as the Knight's Manufacturing Flip-Up Low-Profile 300 Meter Sight, or the ARMS #40 or #40L Stand-Alone Flip-Up Rear Sight.

The reflex sight chosen by SOCOM was the Trijicon ACOG (Advanced Combat Optical Gun-

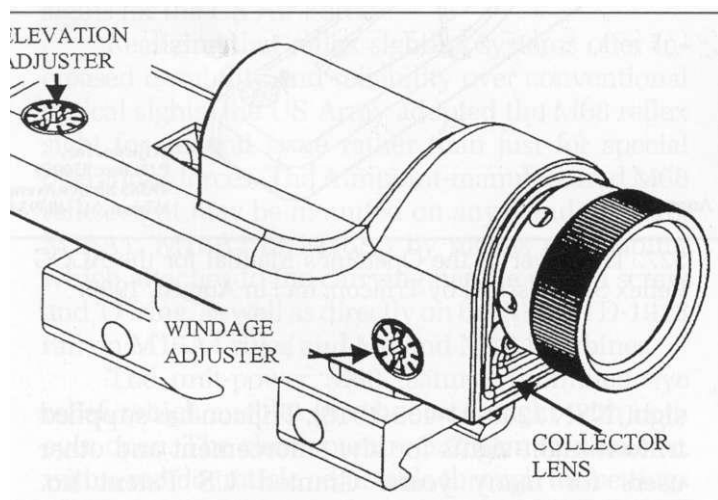


527. The cover of the Operator's Manual for the ACOG Reflex Sight, issued by Trijicon, Inc. in August, 1999.

sight, NSN 1240-01-435-1916). Trijicon has supplied tritium night sights for law enforcement and other users for many years. Granted US Patent no. 5,653,034, the Trijicon ACOG Reflex sight represents the state-of-the-art in "red dot" sights and has eliminated the need for a battery by utilizing a small amount of radioactive tritium (H<sup>3</sup>) contained in an aluminum cylinder to provide illumination, and advanced fiber optics to channel and enhance the light

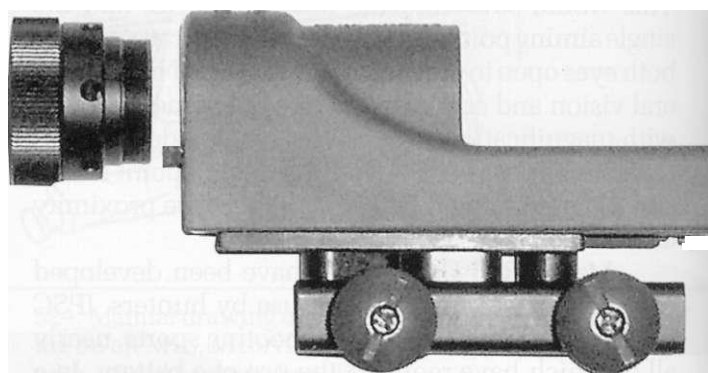


528. Right side closeup of the Trijicon ACOG Reflex Sight mounted on the flat-top upper receiver of a current Colt Sporter rifle.



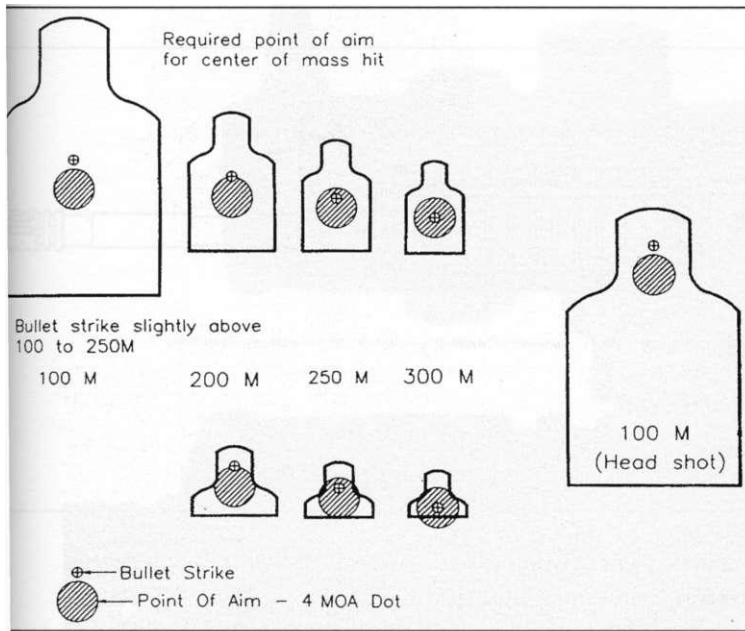
529. A right front three-quarter view of the Trijicon ACOG Reflex Sight, showing nomenclature. Note the optional polarizing filter (right). Windage and elevation adjustments are made with the rim of a 5.56mm cartridge.

line drawing courtesy  
United States Special Operations Command



530. Left side view of the Trijicon ACOG Reflex Sight. Note the optional polarizing filter (left).

source. Tritium illuminates even in total darkness, while the fiber-optic light collector automatically adjusts the aiming point brightness according to ambient day or night environmental conditions.



531. Diagram showing required points of aim for center of mass hits at various ranges when using the Trijicon ACOG Reflex Sight.

courtesy United States Special Operations Command

The sight utilizes a projected dot collimator which when zeroed creates an optical axis aligned with the bore and, by means of reflective coatings on the lens, generates an amber-colored aiming dot image that will appear to be on the target rather than inside the lens. The amber color was chosen because the human eye is more sensitive to amber than to red or orange. Due to the fact that the sight uses a collimator, the dot remains aligned on the target

regardless of the angle at which it is viewed, or its apparent location in the lens.

The amber-colored aiming point can be used with current night vision devices, particularly those equipped with GEN III image intensifier tubes, as the glow of the aiming point is below the wave length to which the GEN III tubes are most sensitive. This prevents "burn" in the GEN III intensifier tubes. The Trijicon ACOG reflex sight also comes with a polarizing filter which fits on their sunshaded models. The filter improves the aiming dot contrast when used with a flashlight, under varying lighting conditions, or when aiming at a light source.

To increase its durability, the sight body is manufactured from the same 7075-T6 aluminum, and then hard-anodized to the same Mil-Spec finish, as the receivers on M4A1 carbines. The sight is mounted either right to the MIL-STD-1913 upper receiver rail of the rifle/carbine, or to one of the various add-on rail systems (RIS, RAS, SIR, TRI-AD, etc.). The Trijicon Reflex sight is accurate out to 300 meters.

#### Characteristics

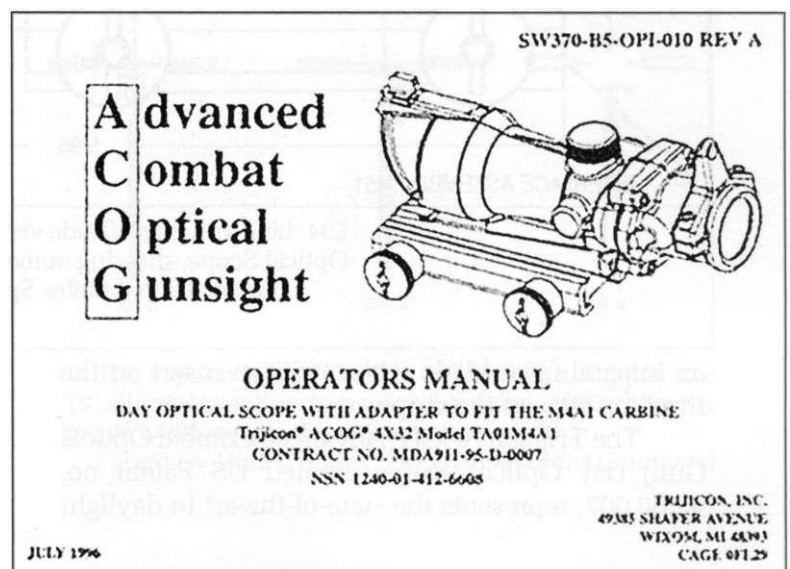
Length:	4.25"
with Polarizer:	4.99"
Height:	1.65"
Width:	1.35"
Reticle:	4.5 MOA amber dot
Weight:	4.20 oz. (w/o accessories)
Waterproof to:	66 ft. for 8 hrs.
Radioactive tritium:	.1 curie

## Optical Sights for Special Operations Use

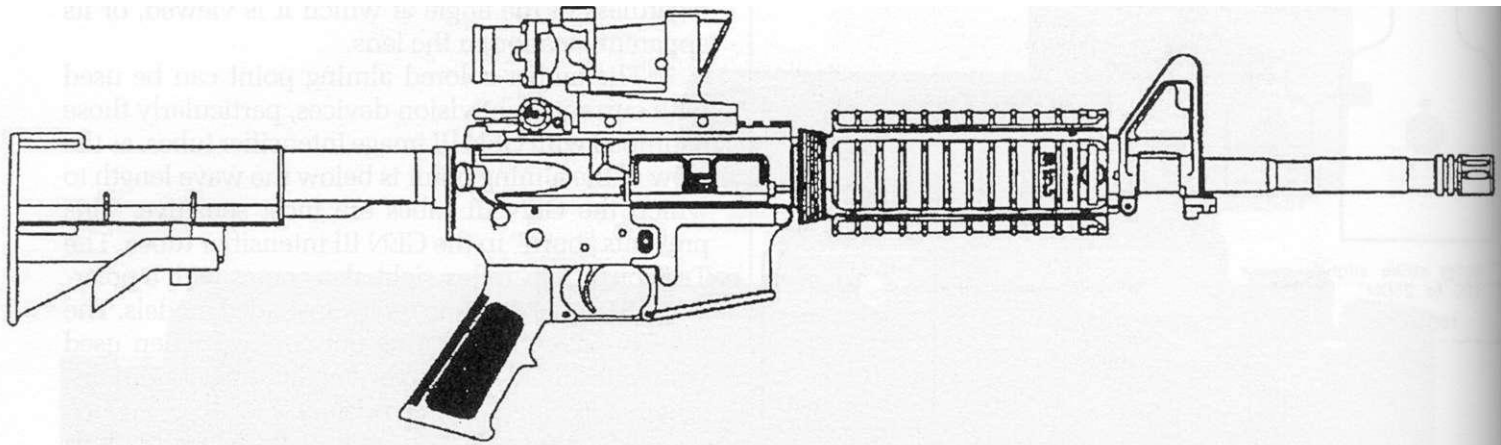
### The Trijicon ACOG Day Optical Scope

As with the Trijicon reflex sight, the Trijicon ACOG (Advanced Combat Optical Gun) Day Optical Scope (NSN 1240-01-412-6608, contract number MDA911-95-D-0007) was chosen by SOCOM as part of the SOPMOD kit. It was designed particularly to allow reliable and accurate engagement of targets out to 600 meters with the 14 1/2" barrel of the SOCOM-issue M4A1 carbine. The 4-power Day Optical Scope features a 32mm objective lens as well as emergency back-up iron sights consisting of a peep sight mounted on top of the rear portion of the scope and

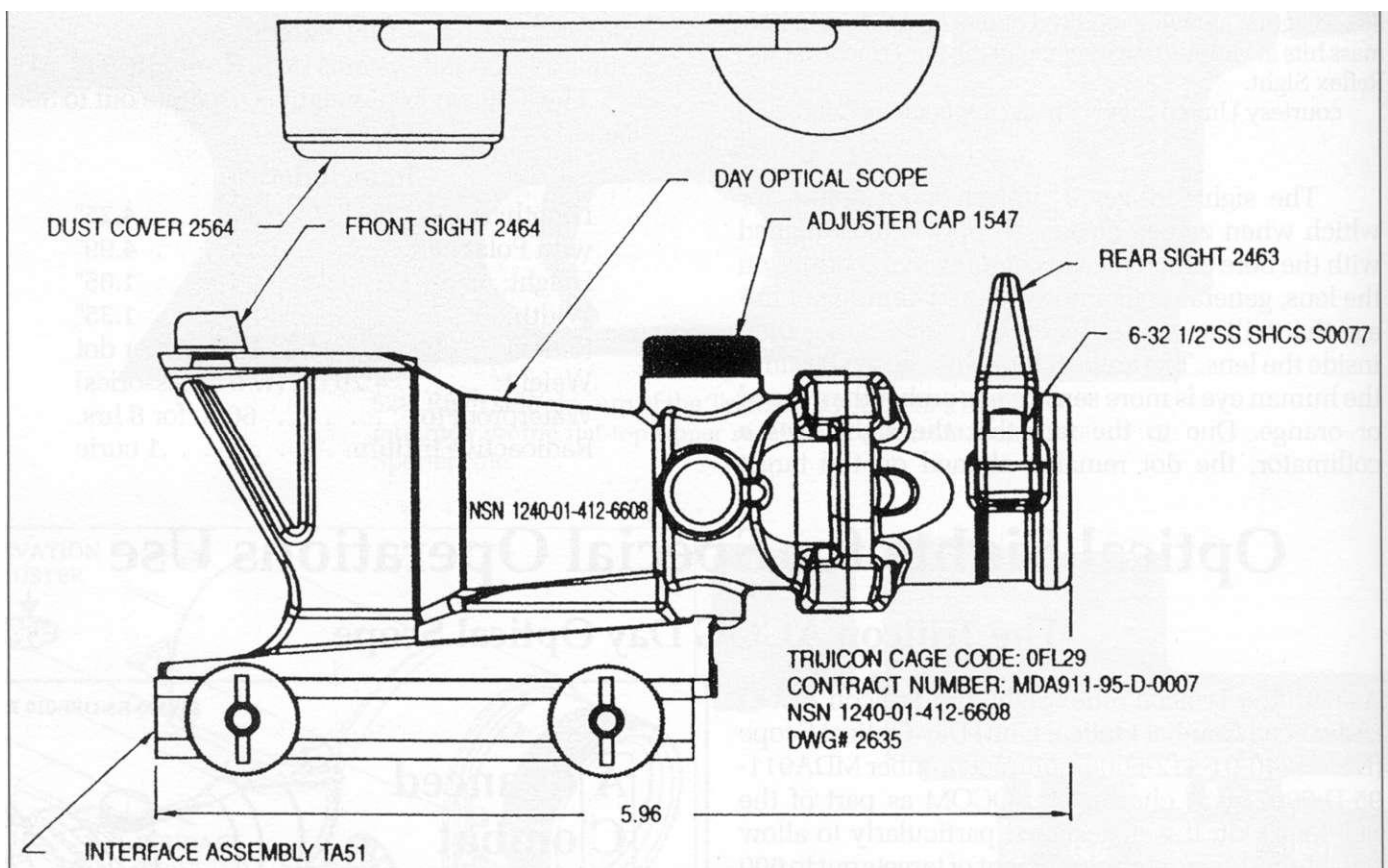
532 (right). The cover of the Operator's Manual for the ACOG Reflex Sight, issued by Trijicon, Inc. in July, 1996.







533. A line drawing right side view of the ACOG Day Optical Scope, installed on a SOCOM M4 carbine.  
courtesy United States Special Operations Command



534. Line drawing left side view of the Trijicon ACOG Day Optical Scope, showing nomenclature.  
courtesy United States Special Operations Command

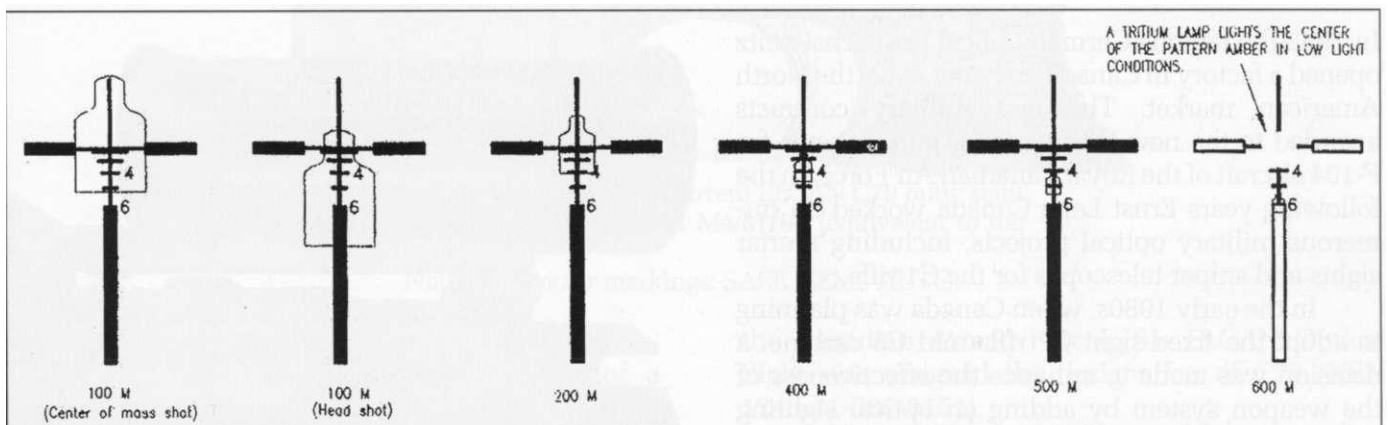
an integral front blade with a tritium insert on the front top edge of the scope.

The Trijicon ACOG (Advanced Combat Optical Gun) Day Optical scope, granted US Patent no. 4,806,007, represents the state-of-the-art in daylight

combat sights. It eliminates the need for a battery by utilizing a Pyrex vial of tritium (H3) to illuminate the scope's crosshair pattern in an amber color in low light or complete darkness, while leaving the crosshairs appearing black in daylight conditions.



535. Right side closeup of the Trijicon ACOG Day Optical scope mounted on the flat-top upper receiver of a current Colt Sporter rifle.



536. Line drawing showing use of the reticle pattern of the Trijicon ACOG Day Optical Scope at various ranges from 100 to 600 meters.

The caption reads "Outside of line width is equal to a 19" silhouette at the corresponding range. Aim where the man's width equals the reticle pattern width."

courtesy United States Special Operations Command



537. Rear closeup of the Trijicon ACOG Day Optical Scope showing the fixed rear peep and front blade back-up emergency sights, for use if the optics should become disabled.

Note the tritium dot inserted in the front sight, for use in low level light conditions.

To increase its durability, the body of the Trijicon Day Optical Scope is manufactured from the

same 7075-T6 aluminum as the receiver of the M4A1 carbine, and then hard anodized to the same Mil-Spec finish. The ACOG scope may be mounted on any MIL-STD-1913 rail, and secured by two hand-tightened knobs. Each scope comes provided with dust covers.

The scope is internally adjustable, so rough handling will not affect the zero. Adjustments to the elevation and windage knobs, which are protected by watertight seals, are made with a cartridge case rim. Each adjustment click changes the point of impact of the bullet 1/3" at 100 meters. The reticle is designed to be zeroed at 100 meters with the top crosshair being point of aim/point of impact. There are five additional crosshair lines which adjust the point of aim for the drop of the M855 cartridge at distances of 200, 300, 400, 500 and 600 meters. The length of the individual lines represents 19" at 100 yards, which is the width of an average man. The tritium lamp provides amber illumination of the primary, the 200- and the 300-meter crosshairs.

#### Characteristics 4x32mm Day Optical Scope

Objective Lens:	32mm
Magnification:	4 power
Eye Relief:	1.5"
Exit Pupil:	8mm
Field of View:	.7°
Field of View:	36.8 ft. @ 100 yards
Length:	5.8"
Weight:	9.9 oz.
Waterproof to:	200 ft.
Radioactive tritium:	.01 curies

## The Canadian ELCAN Optical Sight

In 1952 the famous German optical firm Ernst Leitz opened a factory in Canada, to better serve the North American market. The first military contracts awarded to the new firm were for gun cameras for F-104 aircraft of the Royal Canadian Air Force. In the following years Ernst Leitz Canada worked on numerous military optical projects, including mortar sights and sniper telescopes for the C1 rifle.

In the early 1980s, when Canada was planning to adopt the fixed-sight C7 rifle and C8 carbine, a decision was made to enhance the effectiveness of the weapon system by adding an optical sighting

538 (right). Right side closeup of an early version of the ELCAN optical sight and back-up iron sight (right), mounted on an experimental flat-top upper receiver.

Note the configuration of the early rail, which is bonded to the cut-down receiver. courtesy Diemaco, Inc.



system. In order to support the mounting of an optical sight, flat-top versions of the rifle and carbine were conceived, which would eventually be designated the C7A1 and C8A1. In the meantime, Ernst Leitz Canada was tasked to develop a suitable optical sight for use with the weapon system. DCIEM (Defence & Civil Institute of Environmental Medicine), a Canadian government establishment, had by that time determined that 3.5 power was the optimal magnification for a combat optic on the battlefield. In addition, the Canadian Forces set numerous other design criteria, including the ability to withstand a 5-foot

drop onto concrete while attached to a 16-lb. weapon, as well as immersion in ten meters of water.

The optical sight developed by Ernst Leitz Canada to meet these criteria became known commercially as the Leitz "Wildcat"—Leitz and the optical firm Wild having meanwhile amalgamated—and "CAT" being an acronym for "Combat Acquisition and Targeting". In the late 1980s preliminary testing began with the Canadian Armed Forces, and in 1990 the Leitz Wildcat scope was chosen for use with Colt's ACR (Advanced Combat Rifle) project.

### The Canadian C79 Optic Sight



539. Left side view of the current ELCAN C79 optic sight mounted on a flat-top Colt M4/M16E (equivalent to the M4A1).

Note the selector markings: SAFE, SEMI, AUTO.

In 1991 the Canadian government contracted to purchase approximately 65,000 optical sights of a slightly improved design, with 3.4x magnification and a 28mm objective lens. By this time Ernst Leitz Canada had been purchased by Hughes Aircraft, and had been renamed Hughes ELCAN Optical Technologies (ELCAN being an acronym of Ernst Leitz Canada), and thus the Wildcat scope became the ELCAN 3.4-power Optical Sight. Upon adoption by

the Canadian Armed Forces, the ELCAN Optical Sight was assigned the designation of C79 (NSN 1240-21-906-8151).

As discussed in Chapter Eight, after completing its weapons production contracts for the Canadian military, Diemaco developed and sold tailor-made versions of its rifles, carbines, LMGs and other products abroad to NATO countries such as Denmark, the Netherlands and Norway, with a special contract run

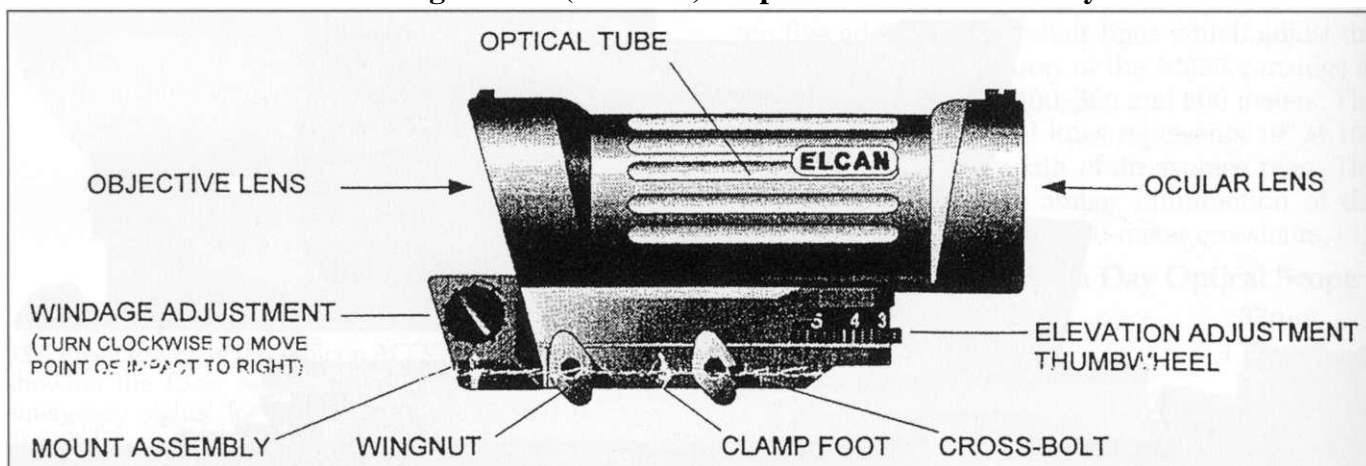
of L119A1 SFWs being produced for UK Special Forces. All of these countries adopted the ELCAN Optical Sight as well, and in recent years, ELCAN Optical Sights in various configurations have been placed in general military service all over the world.

540 (right). Right side closeup of the C79 (ELCAN) scope and mount assembly, plus back-up iron sight, on a flat-top upper receiver.

Note the "circled cross" logo on the receiver, indicating manufacture by ArmaLite, Inc. courtesy Diemaco, Inc.



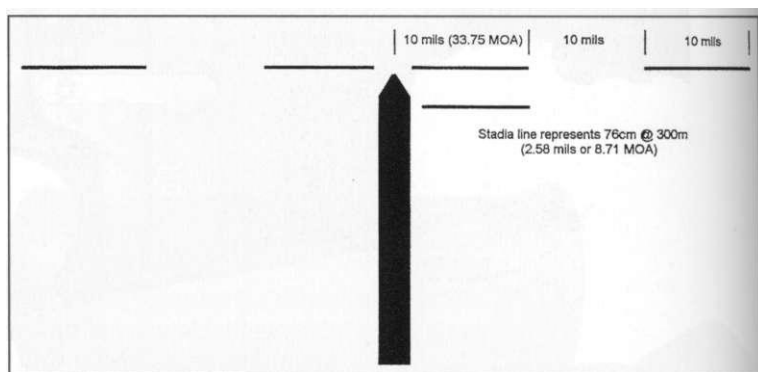
### Describing the C79 (ELCAN) Scope and Mount Assembly



541. Diagrammatic left side view of the C79 ELCAN scope and mount assembly, showing nomenclature.  
courtesy Armament Technology, Inc.



542. A view through the ocular lens of the C79 optic sight, showing the reticle pattern.  
courtesy Armament Technology, Inc.

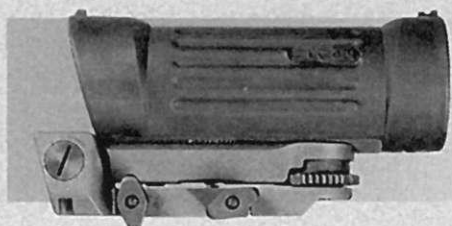


543. Diagram showing the shape and dimensions of the reticle pattern in the C79 scope sight.  
courtesy Diemaco, Inc.

544 (facing page). A one-page brochure describing the various features of the ELCAN Optical Sight and Mount assembly.  
courtesy Armament Technology, Inc.

The ELCAN Optical Sight is comprised of two major assemblies: a telescope assembly and a mount assembly. Unlike most optical sights, all zeroing and ballistic adjustment mechanisms on the ELCAN are





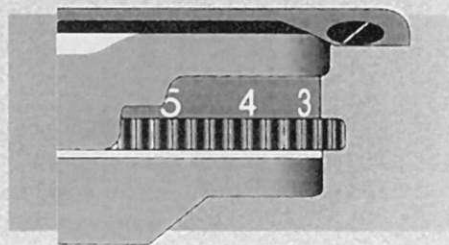
Large exit pupil with brilliant optical quality



Standard reticle with beta light illumination



External ballistic compensation dial (100 metre increments)



# ELCAN OPTICAL SIGHT

## SPECIFICATIONS:

## ELCAN 3.4X OPTICAL SIGHT

### DIMENSIONS:

length	165mm
width	57mm
height	86mm
weight	690g

### OPTICS:

Specification Definitions	As defined in MIL-STD-1241A
Magnification	3.4 x nominal
Field of View	8 degrees nominal (14.1m @ 100m)
Apparent Field of View	27.2 degrees
Entrance Pupil Diameter	28mm nominal
Exit Pupil Diameter	8.5mm nominal
Eye Relief	70mm nominal
Surface Quality	Meets MIL-O-13830-A

### GEN-4-SSL MOUNT:

Base Requirement	MIL-STD-1913 "Picatinny Rail".
Windage and Elevation	0.25 mil detent zeroing adjustments.
Attachment	Solid metal wing nuts.
Ballistic Compensation	Mount calibrated in 100m increments:
5.56 NATO	200m to 800m (62gr FMJ)
7.62 NATO	200m to 800m (147gr FMJ)
.50 BMG	300m-1900m S.L.A.P. (200m increments)

### RETICLE (STANDARD):

Vertical	Picket-type post with stadia line for basic range estimation.
Horizontal	Cant Indicators.
Range Estimation	Stadia line represents 76cm at 300m.
Illumination	Replaceable beta light source illuminates tips of post and horizontals.

Custom reticles are available for large Agency procurements

### HOUSING:

Surface Finish	Black anodized with chemical-resistant rubber outer casing.
Purging	Dry nitrogen purged.
Sealing	Waterproof (1 metre for two hours).
Durability	Designed to withstand a drop of 1.5 metres onto concrete while attached to an 8kg weapon.

  
**Armament  
Technology**  
INCORPORATED

3045 Robie Street, Suite 113 Halifax NS B3K 4P6 CANADA  
TEL: (902) 454 6384 FAX: (902) 454 4641  
[www.armament.com/elcan.htm](http://www.armament.com/elcan.htm)



contained in the mount. This decreases the number of penetrations to, and adds to the integrity of, the telescope assembly. Designed to clamp directly to the MIL-STD-1913 rail or to the Canadian "Weaver" rail of the C7A1, the ELCAN mount is provided with two wingnuts on the left side (versions for the Steyr AUG have wingnuts on the right) which are tightened to clamp the foot of the mount to the dovetail.

Windage adjustment is achieved by a calibrated adjustment screw located at the front of the mount. The left end of the windage screw is designed to be adjusted with a screwdriver or coin, while the right end can be adjusted with a bullet tip in an emergency. At the rear of the mount is the elevation adjustment thumb wheel. Once the telescope is zeroed for elevation, the thumb wheel will adjust the telescope quickly for ranges from 200 to 800 meters. The

standard configuration is calibrated for the 62-grain bullet of the 5.56mm NATO round, but 7.62mm NATO and .50 BMG versions are available as well. In the zeroing mode, each detent of the windage and elevation adjustments results in a one-quarter-mil change in point of impact (approximately 1" at 100 meters).

Rather than crosshairs, the ELCAN utilizes a picket-type reticle (a vertical post with a triangular tip) with horizontal stadia lines (fig. 543). The triangular tip is powered by a tritium lamp and will glow green in low-level light. An additional range-finding stadia line on the right side represents 76 centimeters at 300 meters, or roughly the distance between the top of a man's head and his belt buckle. The optical tube of the ELCAN Scope is protected by chemical-resistant black rubber armor.

### A Present-Day Upgrade

At the time of this writing in 2003, the Canadian Forces are conducting a mid-life refurbishment program for their C7 and C8 service rifles and carbines, which entails upgrading their current C79 optical sights to current standards. These refinements include installation of the GEN-4-SSL Mount and an

external color change from black to green (to match new uniforms and rifle/carbine furniture).

Currently the ELCAN line of optical, electro-optical and thermal weapon sights are marketed by Armament Technology Incorporated of Halifax, Nova Scotia.

### The US M145 ELCAN Scope



In 1999, the United States government contracted to procure nearly 30,000 M145 (NSN 1240-01-411-6350) modified versions of the ELCAN scope, for use on M240 and M249 machine guns. The M145 differs from the standard 3.4x model in that it incorporates the US Torque Knob attachment and utilizes a ballistically-compensated LED recticle. A smaller follow-on contract for M145 telescopes with crosshair recticles for the M4 carbine was issued by Picatinny Arsenal. This version has seen extensive combat service in Afghanistan and Iraq.

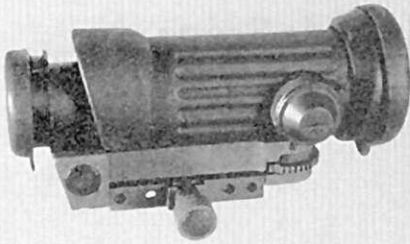
545 (left). A description and depiction of the ELCAN M145 Optical Sight and Mount assembly, which is in current use with US forces on their 5.56x45mm M249 and 7.62x51mm M240 belt-fed light machine guns.

Note the add-on "kill-flash" grid, bottom right, which attaches to the objective lens to stop lens reflections.

courtesy Armament Technology, Inc.

546 (facing page). A one-page brochure describing the various features of the ELCAN M145 Optical Sight and Mount assembly, as used by US forces.

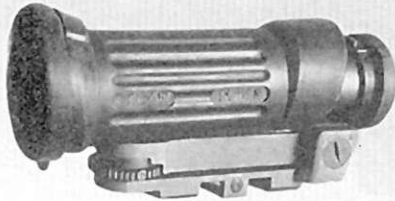
courtesy Armament Technology, Inc.



## ELCAN M145 OPTICAL SIGHT

### DIMENSIONS:

length	182mm
width	78mm
height	92mm
weight	660g



### OPTICS:

Magnification	3.4 x nominal
Field of View	8 degrees nominal (14.1m @100m)
Apparent Field of View	27.2 degrees
Entrance Pupil Diameter	28mm nominal
Exit Pupil Diameter	8.5mm nominal
Eye Relief	70mm nominal
Laser Protection	Available for Military production.

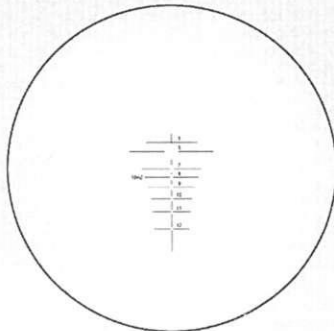
### RETICLE:

#### M240/M249:

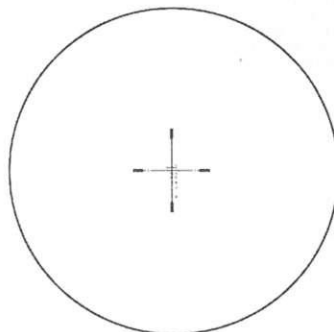
Calibrated cross-hair with range estimation.  
US Army Machine Gun ranging reticle,  
center-illuminated.  
Ballistic calibration 300-1200 metres.  
(blended 7.62/5.56 NATO)

#### M4:

Calibrated cross-hair with range estimation.  
US Army M4 Carbine Cross-hair ranging reticle,  
center-illuminated.  
Ballistic calibration 100-800 metres.  
(5.56 NATO 62gr FMJ)



M240/M249 reticle



M4 reticle

Custom reticles available for large Agency procurements.

### MOUNT:

Base Requirement  
Attachment  
Windage and Elevation  
Line of Sight

MIL-STD-1913 "Picatinny Rail".  
U.S.-style Torque Knob (wingnut mount available).  
0.25 mil detent zeroing adjustments.  
Identical to ELCAN Optical Sight,  
Approximating M16/AR15 iron sight.

### HOUSING:

Surface Finish

Black anodized with chemical-resistant  
rubber outer casing.

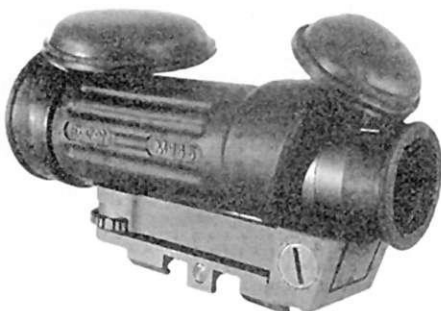
Purging  
Sealing  
Durability

Dry nitrogen purged.  
Waterproof (1 metre for two hours).  
Designed to withstand standardized NATO drop test.

### ELECTRICAL:

Reticle illumination  
Power Source

LED illumination of reticle center.  
DL1/3N 3V long life lithium battery.



**Armament  
Technology**  
INCORPORATED

3045 Robie Street, Suite 113 Halifax NS B3K 4P6 CANADA  
tel: (902) 454-6384 fax: (902) 454-4641  
[www.armament.com/elcan.htm](http://www.armament.com/elcan.htm)

## The Leupold Mark 4 CQ/T 1 - 3x14mm Variable Scope



547. Right side closeup of the Leupold Mark 4 CQ/T scope, mounted on a Colt M4A1 carbine.

Note the MIL-STD-1913 rail sections on the top and side of the scope.

With the increased use of optics among special operations forces as well as for general issue, new and improved optics are finding their way into the hands of the American soldier. One of the newest entries into the advanced optics market is the Leupold Mark 4CQ/T scope.

At the low end of its power variability range the Leupold Mark 4 CQ/T offers a true 1x setting, which supplies no additional magnification. This allows the sight to be used at short ranges with both eyes open, and without any distortion to the user's perception. The eleven-position illumination control dial allows the Circle Dot reticle to be used either without illumination or to be illuminated in an amber color, the intensity of which can be adjusted to meet any light condition, similar to the adjustments on the

ACOG Reflex or the Meprolight Mepro 21 reflex sights. However unlike the ACOG and Meprolight reflex sights, the CQ/T is powered by one AA battery. Leupold claims the battery life on a medium setting is 600+ hours, or seven hours of continuous use on the highest setting. The battery is inserted into a waterproof sealed tube, located under the scope.

With the increase of the power to 2x or 3x the sight acts as a standard combat scope for engaging targets at greater distances. The specialized eye relief is designed specifically for the M16/M4 cheek weld position, for maximum operator comfort. The windage and elevation adjustments are in 1/2 MOA increments. For Special Operations use, the CQ/T is available in a waterproof configuration with a proprietary DiamondCoat scratch-resistant lens coating



548. Right side view of the Leupold Mark 4 CQ/T scope showing the battery tube, battery, and cap.

<p><b>Weight:</b> 17.5 oz (w/o battery or mount)</p> <p><b>Length:</b> 8.75 in (at zero diopter)</p> <p><b>Finish:</b> Matte</p> <p><b>Circle Dot Reticle Size:</b> 9 MOA at 1x, 3 MOA at 3x</p> <p><b>Ocular Adjustment Range:</b> -2.0 to +0.5</p> <p><b>Parallax Adjustment:</b> Non-adjustable (factory set to 150 yards)</p> <p><b>Parallax Adjustment Range:</b> N/A</p> <p><b>Windage Dial Adjustment Increment:</b> 1/2-MOA</p> <p><b>Elevation Dial Adjustment Increment:</b> 1/2-MOA</p> <p><b>Total Windage Adjustment Travel:</b> 80-MOA minimum</p> <p><b>Total Elevation Adjustment Travel:</b> 80-MOA minimum</p> <p><b>Magnification:</b> 1x-3x</p> <p><b>Field of View at 100 yards:</b> 116.6 ft at 1x 84.3 ft at 3x</p> <p><b>Field of View at 100 meters:</b> 38.9 m at 1x 28.1 m at 3x</p> <p><b>Eye Relief:</b> 2.8 in (71mm) at 1x 2.0 in (51mm) at 3x</p>	<p>1. Ocular Lens 2. Diopter Adjustment Ring 3. Diopter Adjustment Lockring 4. Eyepiece Shell 5. Magnification Selector 6. Illumination Control Dial 7. Elevation Adjustment Dial 8. Windage Adjustment Dial 9. MIL-STD-1913 Accessory Rail 10. Objective Lens 11. Battery Pack (Battery Tube and Battery Cap) 12. MIL-STD-1913 Accessory Rail 13. Flat-Top Mounting Bracket (optional) 14. Mounting Foot 15. Mounting Foot Lug 16. Combination Eyepiece/Magnification Selector</p>
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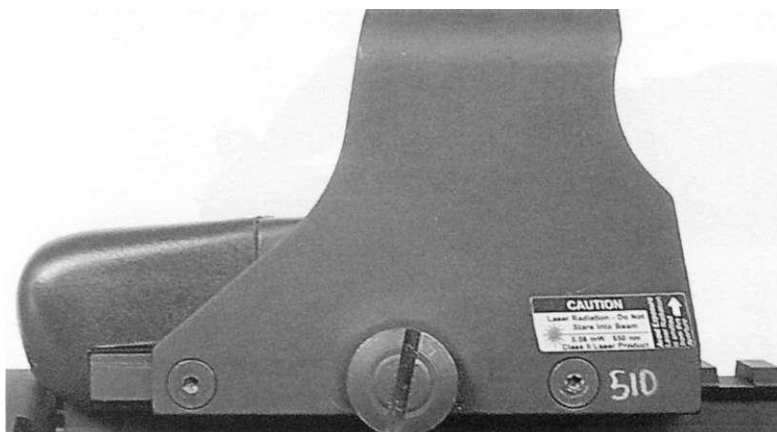
549. The nomenclature of the Leupold Mark 4, CQ/T scope.

on all exterior lens surfaces and a Multicoat 4 coating on all internal lens surfaces.

The CQ/T may be configured to fit any type of base. It comes with a MIL-STD-1913 mount, and it

may be attached to a Swan Throw-Lever mount as well. The scope body itself also has integral MIL-STD-1913 rails on the left, right and top, for use in mounting additional accessories.

## The EOTech 500 HDS Series Holographic Sights



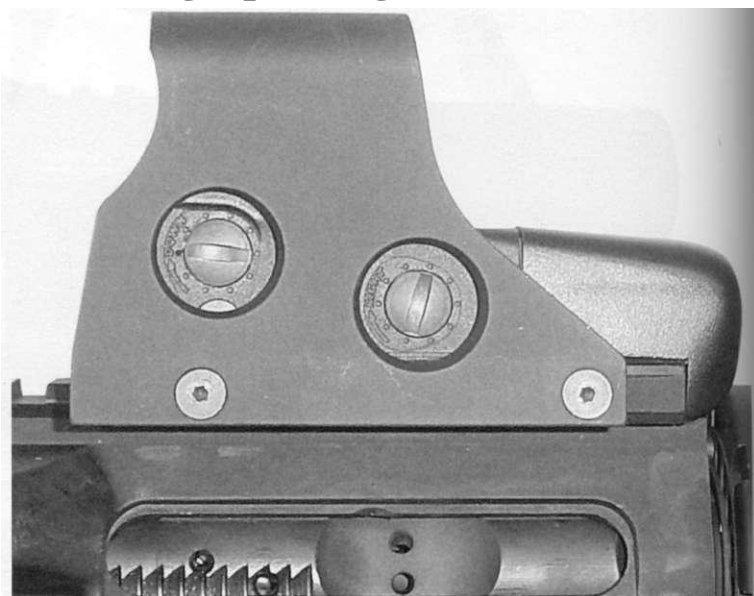
550. Left side view of the EOTech 500 series holographic sight, installed by means of its single mounting screw on a flat-top MIL-STD-1913 rail.

Note the decal (lower right), which reads in part "Caution - Laser Radiation - Do Not Stare into Beam".

In 1996, EOTech, Inc. introduced the EOTech Holographic Weapon Sight (HWS), the world's first holographic sight, utilizing similar technology as used in the targeting systems of military jet fighters. Designed to offer fast target acquisition in close quarter environments, what sets the HWS sight apart from any other optic available is that it can be ordered in optional reticle configurations to accommodate specific weapon platforms, such as less lethal launchers. The HWS offers a parallax-free sight design, implementing a two-dimensional reticle. The holographic technology enables the operator to be able to shoot with both eyes open, thus eliminating any "blind spots" associated with other scope-type optics, to maintain full situation awareness.

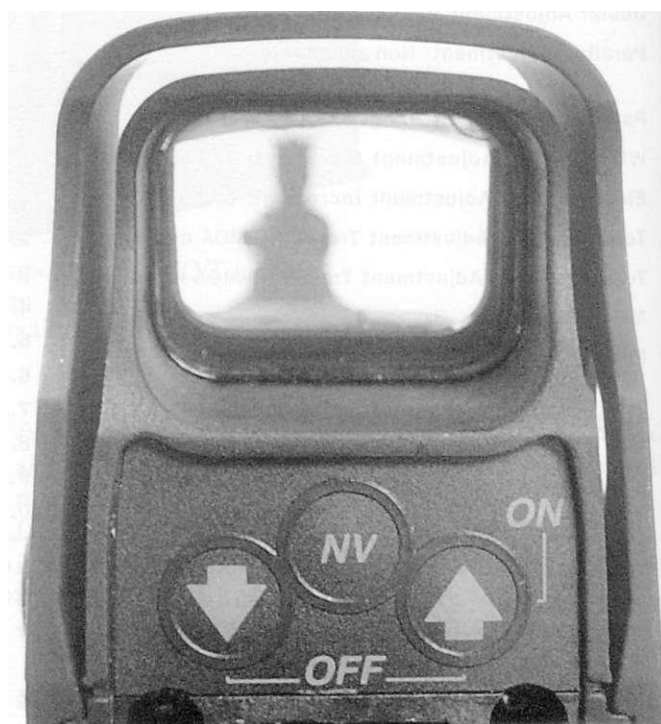
Perhaps the most fascinating aspect of this sight is that wherever the reticle appears in the sightscreen is where the bullet will go. The screen is made of a three-layer, shatterproof glass laminate, 3/16" thick for added durability. The sight remains fully operational even if a portion of the screen should be subjected to water, mud, or snow or sustain damage, as long as its zero is maintained.

In holography, all the information required to reconstruct the reticle image is recorded everywhere on the Heads-Up screen, so that as long as the reticle is visible somewhere on the screen, the sight is fully operable. This sight also offers unlimited eye relief as well as off-axis aiming. There is no "improper" sight picture: as long as the reticle is seen, it will hit the target. The brightness of the reticle may be adjusted by the "up" and "down" arrow buttons.



551. Right side view of the EOTech 500 series sight installed on a flat-top MIL-STD-1913 rail.

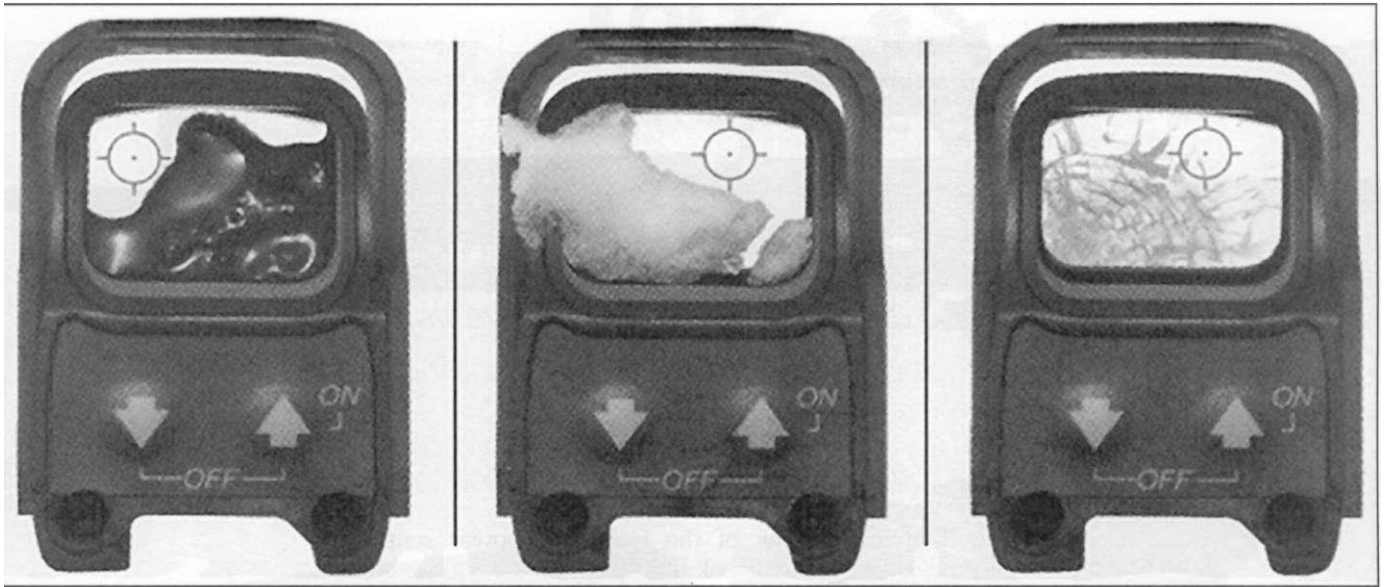
Note the windage and elevation adjustment dials, which can be adjusted with a coin or cartridge case rim.



552. Rear closeup of the EOTech 500 series sight screen and control buttons. The sight is turned on by pushing the "Up" arrow button. When on, the arrow buttons adjust the intensity of the reticle. Pushing the button marked "NV" puts the sight in the night vision mode.

Note the front backup sight, visible through the viewing window.





553. Three rear views of the 550 series sight, from an EOTech brochure, showing the sight window partially obscured by mud (left), snow (center), and broken glass (right).

Due to holographic technology, regardless of the position of the reticle in the sight screen, the bullet will always strike where the center dot of the reticle is located.

courtesy EOTech Inc.

Also, the 550 military series includes an additional ten brightness settings, which allow an operator to use the sight in conjunction with a night vision device.

The EOTech units are powered by two batteries, offering both an "AA" or "N" cell option. The lithium AA battery life at optimal performance can last up to 500 hours. Built into the sight is an automatic eight-hour internal shut-off, or it can be programmed to shut off after four hours. Upon turning on the sight, the reticle will blink when the battery is in need of replacement. It is suggested that the batteries be replaced before any mission.

Adjustments are made with a coin or cartridge rim on the right side of the sight. Each click changes the point of impact 1/2 inch at 100 yards. The reticle

is a 65 MOA ring with alignment ticks and a 1 MOA aiming dot.

Due to the size of the screen on the sight, if the back-up front and rear sights are engaged, they are visible right through the screen. This also assists when bore sighting the optic.

Recognized by many as the best close-quarter battle optic in the industry, the dot can also be used for precision aiming at distances out to 500 yards. The sight is designed to mount directly to a MIL-STD-1913 rail to complement an M4/M4A1 or M16A4 rifle. Additional mounting solutions are available to incorporate an HWS onto other weapon platforms.

EOTech sights have seen service with US armed forces as well as Australian, British, German, Greek, Hungarian, Italian, and Korean military and police units.

## Colt AR-15 Rifle Scopes

Right from the outset, Colt offered a practical-range compact scope sight as an accessory to the AR-15 rifle. The first models produced were 3x scopes with a 20mm objective lens, and later a more powerful 4x scope was introduced.

Adjustments for elevation and windage could be made with the rim of a 5.56x45mm (.223 Remington) cartridge. Each click of the elevation/windage adjustment knobs changes the point of impact one inch at 100 yards. Both knobs feature

screw-on protective caps. A range selection knob is also included, adjustable from 100 through 200, 300, 400, and 500 yards, which adjusts for bullet drop at the given ranges. The scope features an adjustable eye piece that allows the scope to be focused to suit the individual shooter's eye.

The Colt scope was designed to mount to either the A1- or A2-style fixed carrying handle by means of a see-through mount which enabled the use of the iron sights with the scope mounted. The scope and

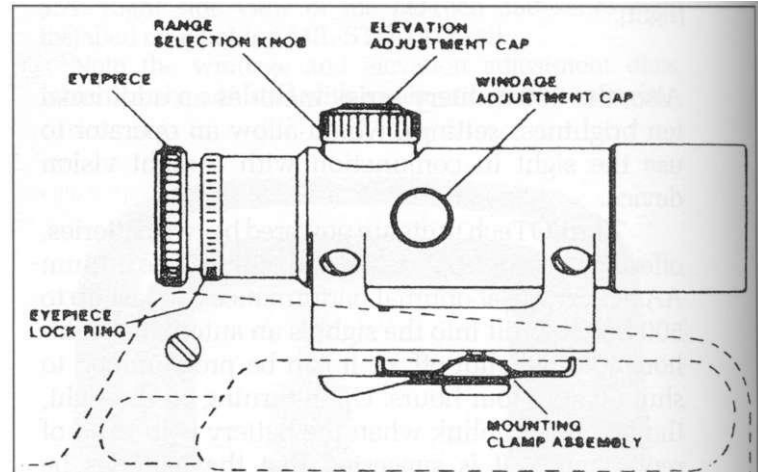




554. Right side view of the Colt 4x20-power scope, equipped with Butler Creek flip-up scope caps, mounted on an M16A2 rifle by means of the Colt see-through mount, so the iron sights may still be used when the scope is mounted.



555. Right side view of the Colt 4x20 scope and mount.  
Note the bullet drop compensator on the top of the scope, and the spring-steel locking bar, which fastens onto the threaded post from the underside, through the hole in the rifle's carrying handle.



556. A line drawing right side view of the Colt 3x20 and 4x20 scope, showing nomenclature.

The sight adjustments may be made with the rim of a 5.56mm cartridge.

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mount were inserted down into the carrying handle groove with the threaded post fitting through the hole in the center of the handle, and held in place by a

clamp assembly with a leaf-type spring which was screwed onto the post from the underside.



LAW ENFORCEMENT

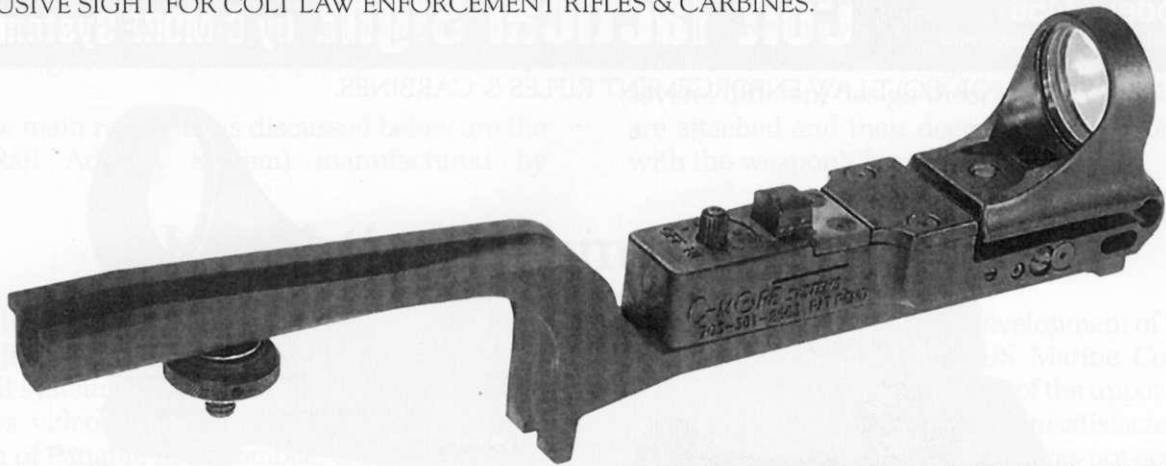
LEADERS IN LAW ENFORCEMENT

**Model 63457**

Fits Colt A-1 &amp; A-2 Rifles and Carbines

**Colt Scout Sight by C-MORE Systems**

EXCLUSIVE SIGHT FOR COLT LAW ENFORCEMENT RIFLES &amp; CARBINES.



Colt has teamed with C-MORE Systems to bring American Law Enforcement a revolutionary red dot sighting system designed exclusively for the Colt® M-16, AR-15 and Match Target Rifles and Carbines.

Developed for tactical units, special operations and S.W. A.T. teams, Colt delivers a heads up display for Rapid Target acquisition without obstructing the field of view. The Colt Scout Sight is ideal for low light conditions.

**COLT SCOUT SIGHT FEATURES:****Wide Field of View**

**Patented Lens Technology:** Laminated Lens- 29 mm diameter beam splitter, double anti-reflective; hard coated; parallax free, non magnifying with unlimited eye relief

**Integral Scope & Mounting System:** Fits All A-1, A-2 Rifle & Carbine Receivers

**Dot Size:** 6 MOA Standard. Ghost Free Dots

**Long Life Battery:** 2-3 Months

**Battery Options:** 1/3 Duracell or 2L76 Energizer; 3 Volt Lithium

**100% Waterproof & Fogproof**

**Positive Locks Windage & Elevation**

**800 MOA Windage & Elevation Adjustment**

**Scout Sight can be zeroed to iron sight setting without firing weapon**

**Electronic sight confirmation**  
of zero where one witnesses the other

**Total Weight:** 7 Ounces - Sight & Mount

**Retains complete aperture sight capability**

**Versatile:** Sight is rapidly attached and detached for weapon configuration versatility

**Contact Colt's Law Enforcement Sales  
1-800-962-COLT**

557. A Colt brochure describing the various features of the Colt/C-MORE Law Enforcement Scout reflex sight, as configured for Colt A1 and A2 rifles and carbines with fixed carrying handles.

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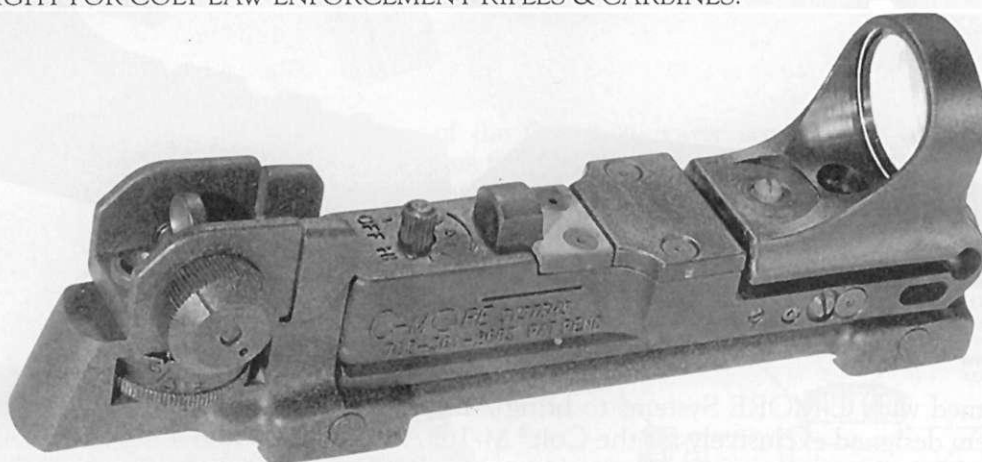
LAW ENFORCEMENT

LEADERS IN LAW ENFORCEMENT

**Model 63456**  
Fits All Colt Flattop Receivers

## Colt Tactical Sight by C-MORE Systems

EXCLUSIVE SIGHT FOR COLT LAW ENFORCEMENT RIFLES & CARBINES.



Colt has teamed with C-MORE Systems to bring American Law Enforcement a revolutionary red dot sighting system designed exclusively for the Colt® M-16, AR-15 and Match Target Rifles and Carbines.

Developed for tactical units, special operations and S.W.A.T. teams, Colt delivers a heads up display for Rapid Target acquisition without obstructing the field of view. The Colt Tactical Sight is ideal for low light conditions.

### COLT TACTICAL SIGHT FEATURES:

#### **Wide Field of View**

**Patented Lens Technology:** Laminated Lens-29 mm diameter beam splitter, double anti-reflective; hard coated; parallax free, non magnifying with unlimited eye relief

**Integral Scope & Mounting System:** Fits All Flat Top Receivers

**Dot Size:** 6 MOA Standard; Ghost Free Dots

**Long Life Battery:** 2-3 Months

**Battery Options:** 1/3 Duracell or 2L76 Energizer; 3 Volt Lithium

**100% Waterproof & Fogproof**

**Positive Locks Windage & Elevation**

**800 MOA Windage & Elevation Adjustment**

**Tactical Sight can be zeroed to iron sight setting without firing weapon**

**Electronic sight confirmation** of zero where one witnesses the other

**Total Weight:** 12 Ounces

**Retains Complete aperture sight capability**

**Versatile:** Sight is rapidly attached and detached for weapon configuration versatility

558. A Colt brochure describing the various features of the Colt/C-MORE Law Enforcement Tactical reflex sight, with back-up iron sight, as configured for flat-top upper receivers.

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# Rail Systems

The decision to adapt specialized modules to M4/M4A1 carbines involved first the redesign of the handguard. Initial requirements were for a rigid mounting of quad-MIL-STD-1913 rails, which would provide a top mount for any necessary optic sight, two side mounts for the attachment of laser, white light, IR sight or light source, as well as a bottom rail for mounting a forward pistol grip or grenade launcher.

The main rail systems discussed below are the RAS (Rail Adapter System) manufactured by

Knight's Armament Inc., the SIR (Selective Integrated Rail) manufactured by ARMS, Inc., the TRI-AD system manufactured by Diemaco, Inc., the FIRM (Floating Integrated Rail Mount) produced by FNMI, and the MRP (Monolithic Rail Platform), manufactured by the Lewis Machine & Tool Co.

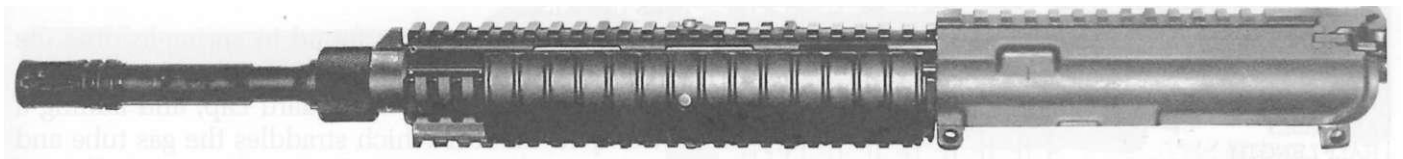
Interestingly, while these various systems perform essentially the same function, they are based on several different design theories regarding how they are attached and their degree of interaction, if any, with the weapon's barrel.

## Knight's Armament Company

As recalled by KAC engineer Doug Olsen, Reed Knight, Jr. said that the idea for the Knight's Armament rail systems came to him while he was watching news videos of Operation Just Cause, the US invasion of Panama in December, 1989, wherein he noticed Special Forces troops with flashlights taped to their weapons. He felt that there had to be a better way to provide a safe, secure and reliable means of attaching accessories to US military M16-series rifles and carbines.

Research aimed at the development of just such a project, initiated by the US Marine Corps, had resulted in a complete redesign of the upper receiver. Tests of this new receiver were unsatisfactory, however, proving that this approach was not acceptable, and attention was then focussed on ways to attach accessories for particular missions without any permanent modifications to the rifle or carbine.

### The RIS (Rail Interface System)



559. Left side view of an early prototype of the Knight's Armament rail system. courtesy C. Reed Knight III

Early examples of the original "Rail Interface System" (RIS) were manufactured from aluminum round bar stock. Subsequent RIS systems were produced, first from aluminum investment castings, and finally from the current-production aluminum extrusions.

The RIS is held in place by two pins in the rear of the system that sit upon two of the "scallop" (teeth) on the barrel nut. The handguard slip ring or

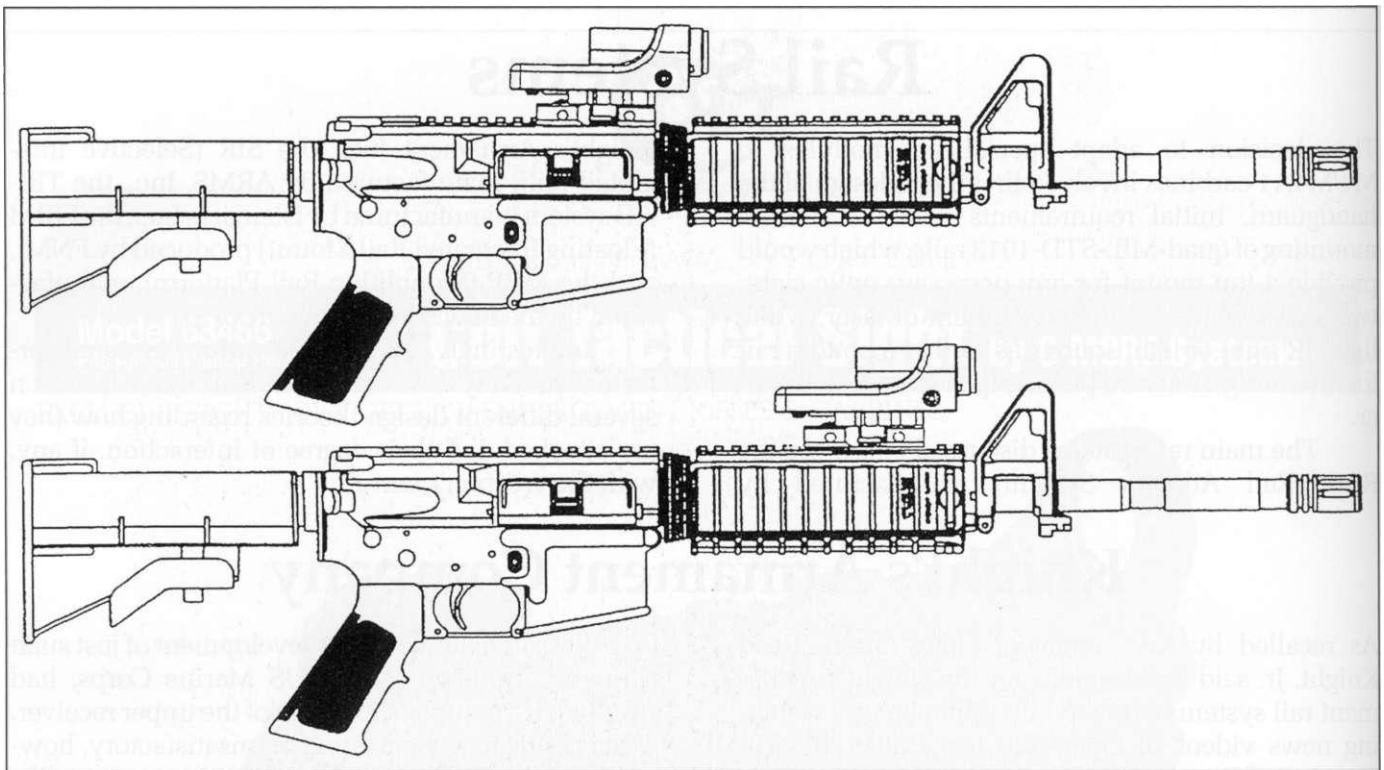
newer Delta ring holds the rear of the RIS in place. There is a clamp at the front which clamps and holds the front of the RIS in place.

The US Navy became interested in this project and put out a solicitation, for which Knight's Armament Company was awarded the contract. The US Navy adopted the RIS for use by its SEALs, and as of this writing is still procuring it today.

### The RAS (Rail Adapter System)

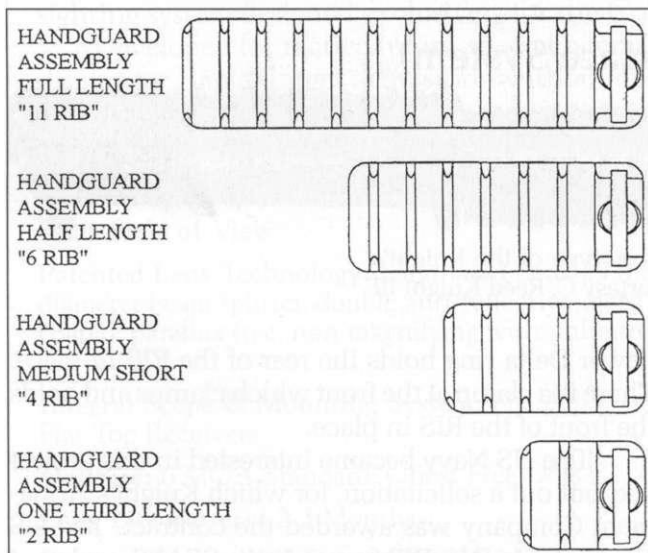
Soon after the Navy contract for the RIS, the US Army put out a solicitation for a "Rail Adapter System" or RAS. The total solicitation, test and evaluation process of the RAS took approximately two years, after

which the Army concluded that the RAS as submitted did not adequately hold zero throughout their testing phases, and that further development was necessary to solve the zeroing problem. The rear of



560. Line drawing right side views of the Trijicon reflex sight attached by means of the Knight's Armament RIS/RAS (Rail Interface System/Rail Adapter System) to two M4A1 carbines.

Above: sight mounted on receiver.  
Below: sight mounted further forward than the rifle's receiver would allow.  
courtesy United States Special Operations Command



561. Line drawing showing some of the various lengths of slip-on polymer handguard assemblies offered by KAC as accessories to the RAS.

Designed to protect the rails and give the operator something to hold when the handguard begins to heat up from firing, these modular rail protectors are a very popular accessory and may be seen in numerous views throughout this book.

courtesy United States Special Operations Command

the RAS was held in place by two pins which sit upon two of the scallops (teeth) on the barrel nut, the same as the RIS.

The solution was found in spring-loading the front of the RAS where it sits on the barrel underneath the lip of the handguard cap, and adding a clamp at the rear which straddles the gas tube and holds the rear pins onto the barrel nut, regardless of the pressure applied by the Delta/slip ring. With this modification, the RAS would maintain alignment with the barrel throughout a 10,000-round endurance test to within 1/2 MOA.

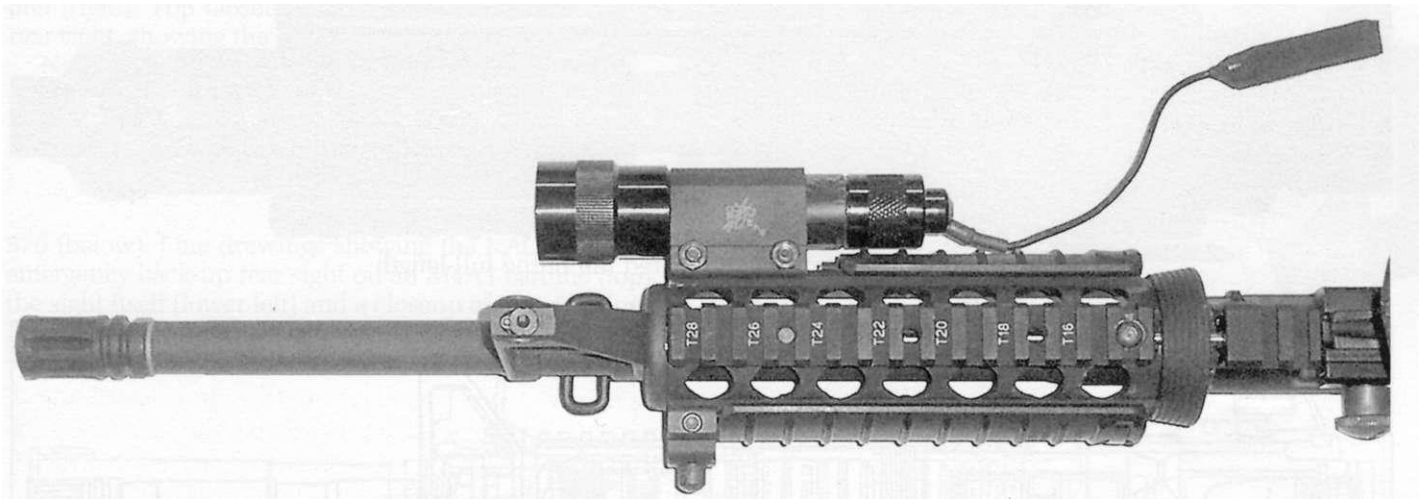
The Knight's Armament Rail Adapter System (RAS), US Patent no. 5,826,363, is configured as quad-mounted MIL-STD-1913 rails. Both the RIS and RAS have removable lower rail panels which allow for the attachment of the M203 grenade launcher by means of a Quick-Detach (QD) Mounting Bracket. The QD latch has been adopted by both the Army and Navy (USSOCOM).

The RAS comes with varying lengths of sliding polymer covers which can be slid over rails that are not being utilized. These both protect the rail and give the operator something to hold when the handguard begins to heat up from firing. These handguard pan-



562. Right side view of an M4A1 carbine equipped with the KAS RAS mounting a Leupold Mark 4 CQ/T scope.

Note the rails of the RAS are fitted with KAC rail protectors.



563. Top closeup of a carbine fitted with the KAC RAS, mounting a flashlight on the right side ahead of the 6-rib rail protector.

Note that the top rail positions are numbered to allow optics or other devices to be removed and replaced in the same location as when zeroed.

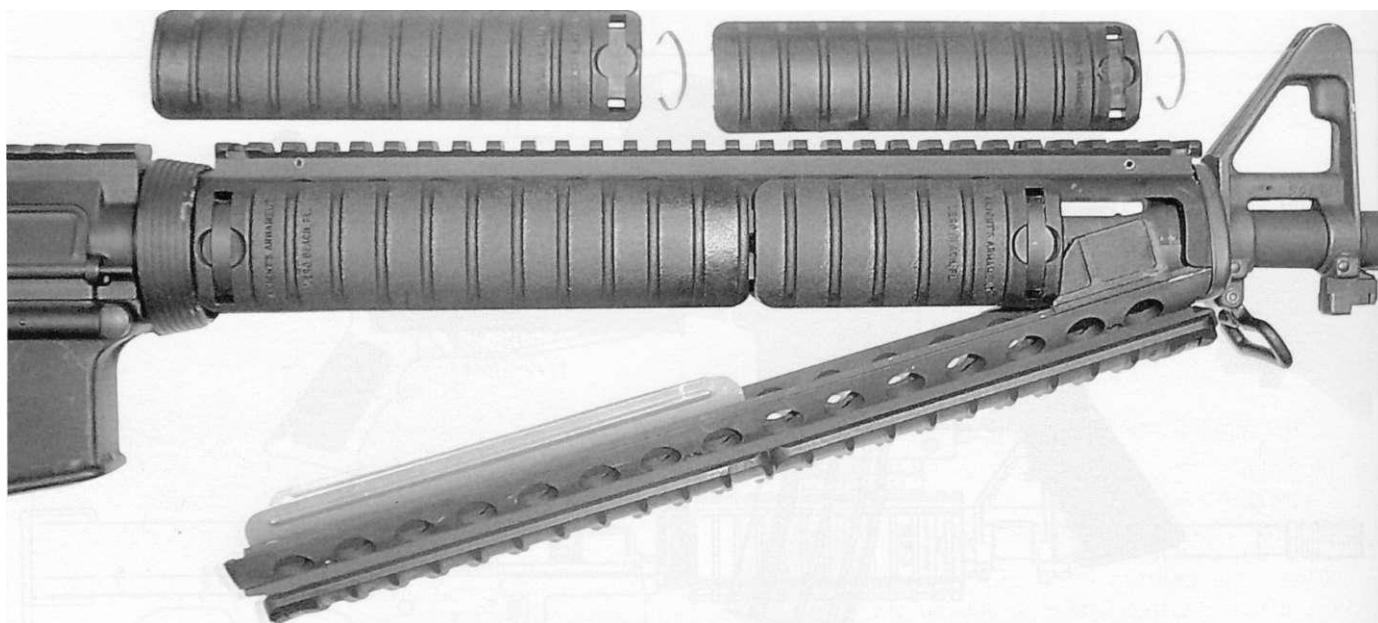
els come in 11, 9, 6, 5, 4 and 2-rib versions, and each is secured by a metal spring clamp.

As additional accessories KAC produces a Front Sight Tower sling mount (fig. 127) which attaches through the front sight assembly, as well as a vertical pistol grip (VPG) (fig. 566), which some instructors at Fort Benning say substantially increases hit probability. KAC also produces flip-up emergency front and rear sights which can be used in the event the optics become damaged or rendered inoperable. KAC

also produces white light sources to be attached to the RAS.

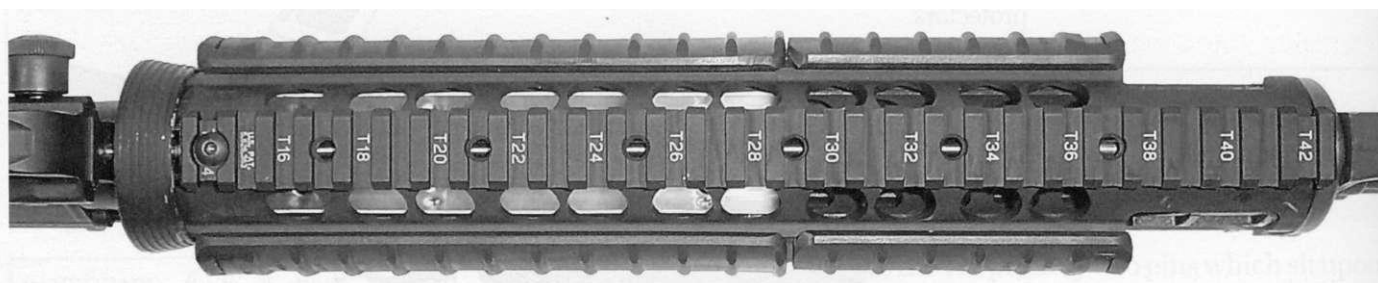
The RAS system is in current use with the US Department of Defense as well as USSOCOM. The Army adopted the RAS in both carbine (M4) and rifle (M5) lengths. RAS systems have also been sold to companies such as Colt and Diemaco for use as standard equipment on some of their variations, although Diemaco has since discontinued the use of the RAS in favor of their own TRI-AD system, due mainly to a lack of availability of the RAS.



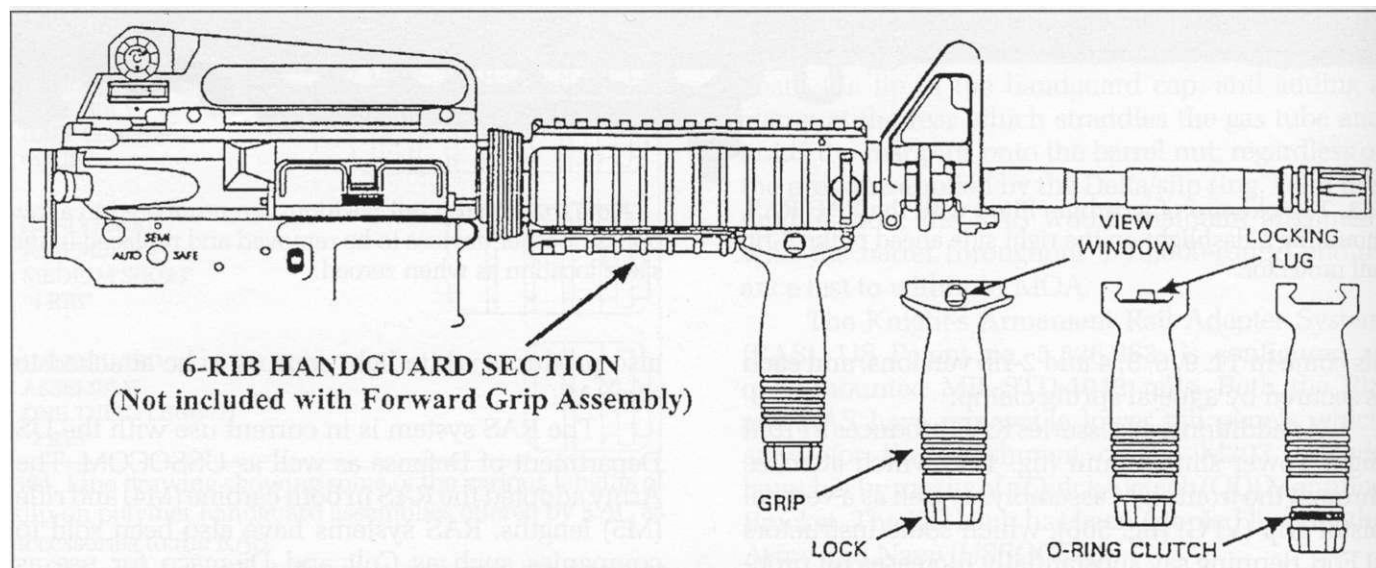


564. Right side closeup of the full-length M5 RAS, an extended version of the standard carbine RAS giving the same modularity to the rifle.

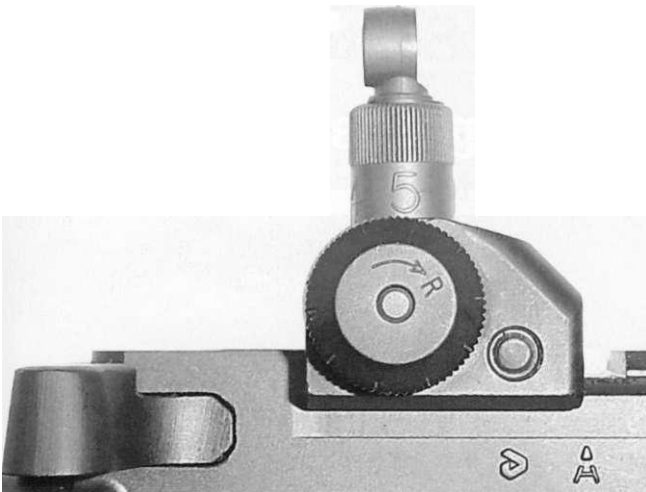
As of this writing the US Marine Corps is procuring all their current production M16A4 rifles with the M5 RAS as standard equipment.



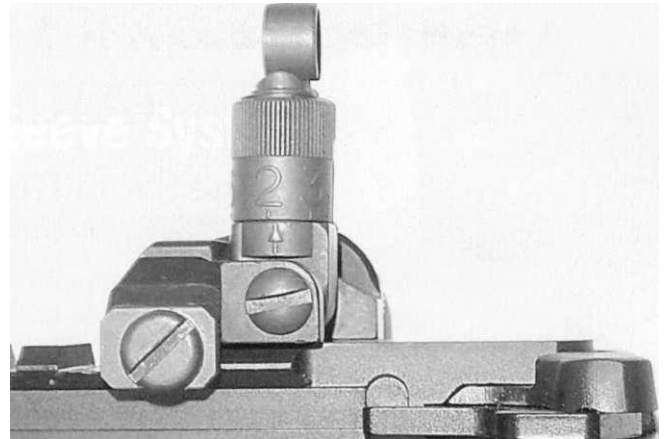
565. Top closeup of the numbered rail of the full-length M5 RAS.



566. Line drawing right side views of an M4A1 carbine fitted with the RAS, various handguard sections, and the KAC-produced vertical pistol grip, showing method of attachment to the bottom rail. This forward grip is one of the most popular RIS/RAS accessories,  
courtesy United States Special Operations Command



567. Right side closeup of the KAC-produced folding back-up iron sight, installed on a flat-top upper receiver manufactured by Diemaco.

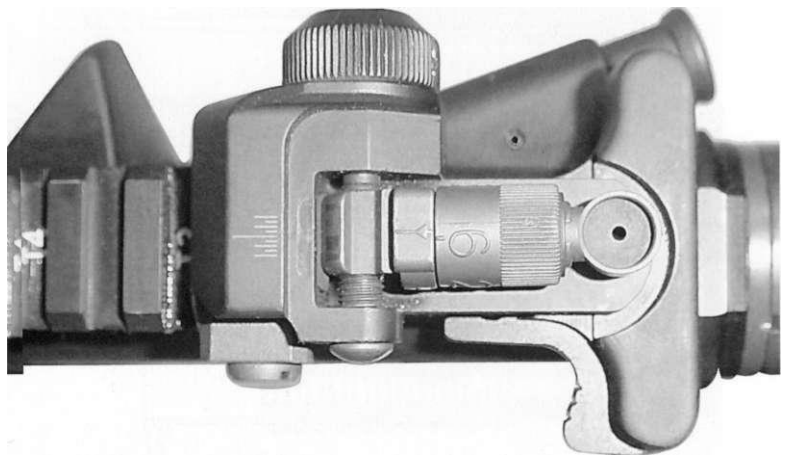


568. Left side closeup of the KAC-produced folding back-up iron sight, installed on a flat-top upper receiver.

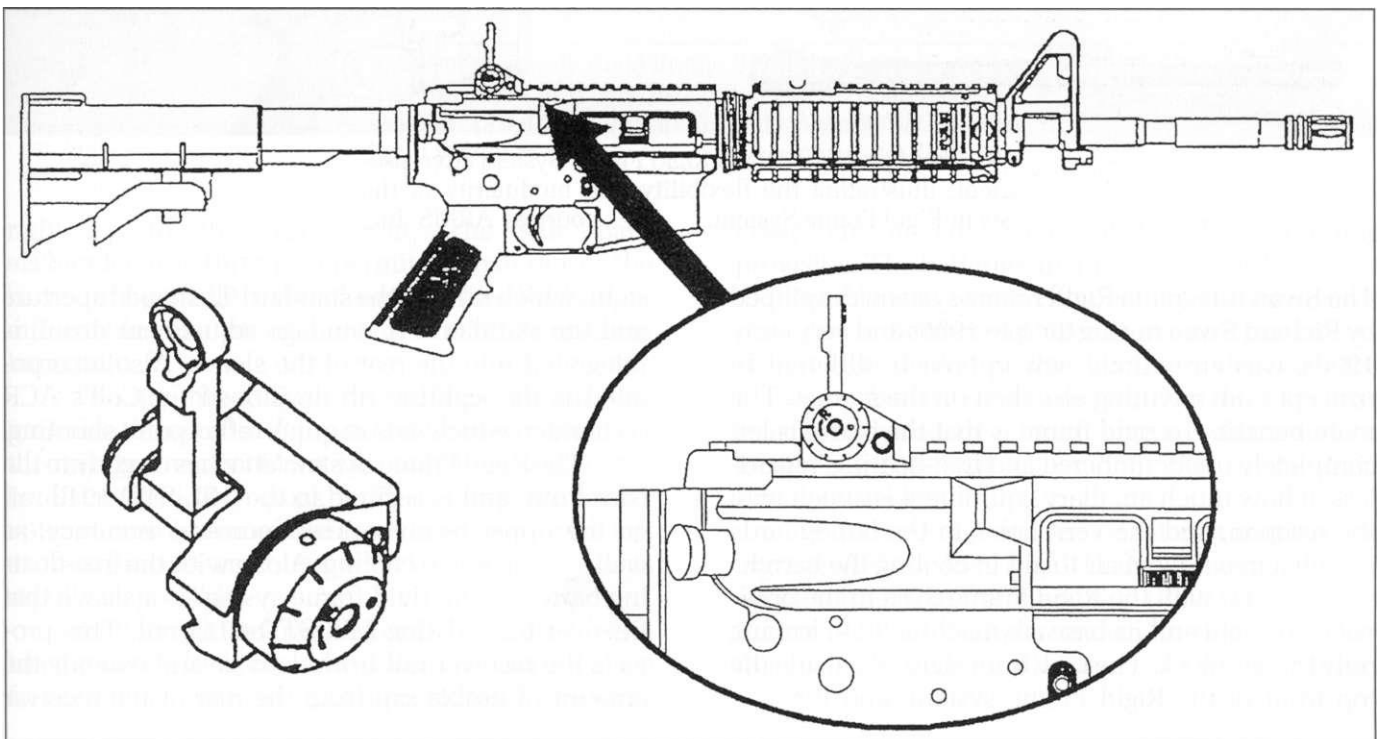
This sight is also standard on the Mk12 MOD 1 rifle used by USSOCOM.

569 (right). Top closeup of the KAC-produced back-up rear sight, showing the sight folded.

Note the windage drum (top).

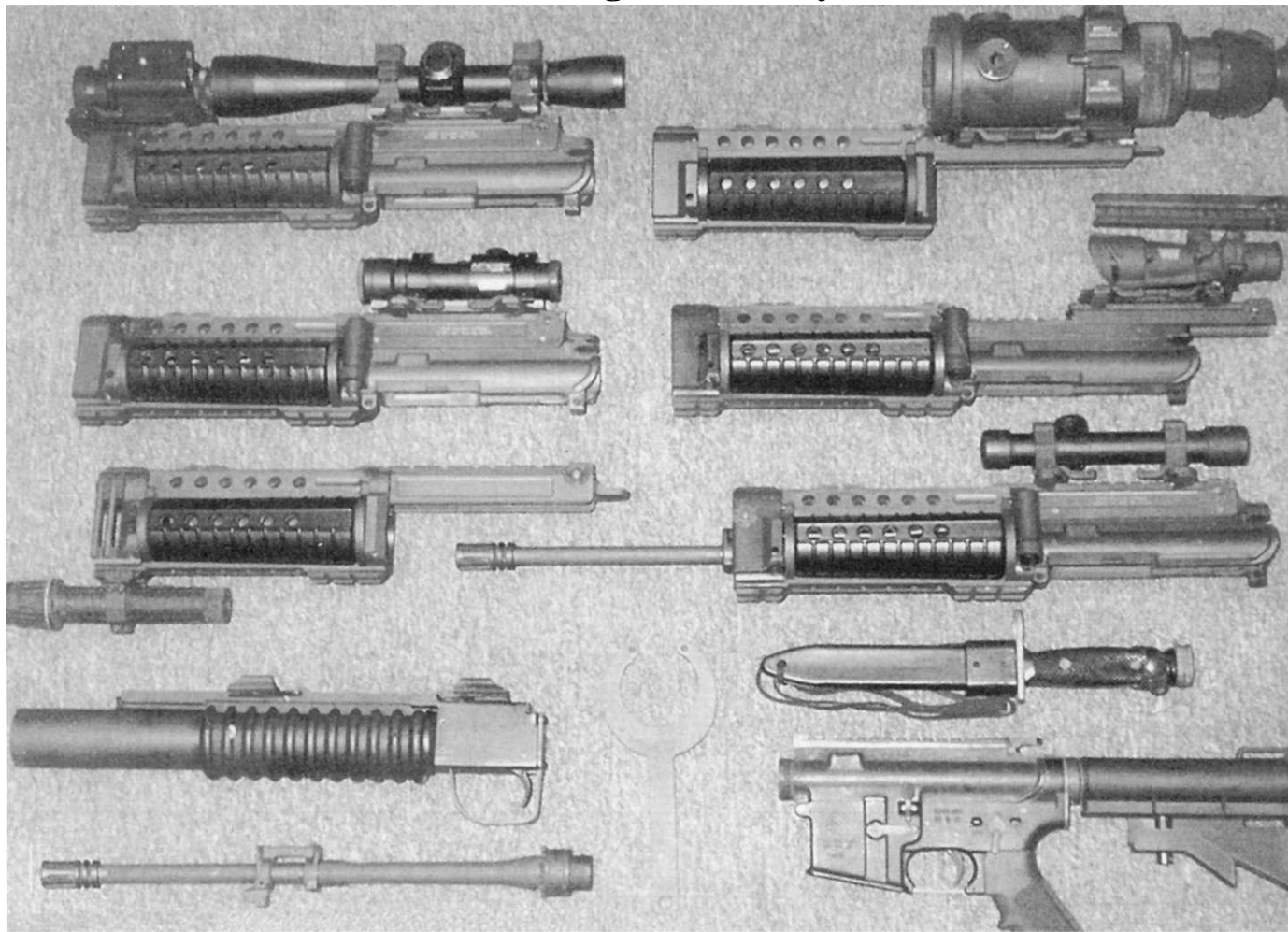


570 (below). Line drawings showing the KAC-produced emergency back-up rear sight on an M4A1 carbine (top), the sight itself (lower left) and a closeup of it in position, courtesy United States Special Operations Command



# Atlantic Research Marketing Systems, Inc. (ARMS, Inc.)

## The Swan Rigid Frame System



571. From an early ARMS Rigid Frame System advertisement, illustrating the flexibility and modularity of the Swan Rigid Frame System. courtesy ARMS, Inc.

The Swan Integrated Rigid Frame system, developed by Richard Swan during the late 1980s and very early 1990s, was an entirely new approach, different in concept from anything else then on the market. The main benefit to a rigid frame is that the barrel is left completely unencumbered and free-floating, regardless of how much ancillary equipment is attached to the weapon, and the vent holes in the handguards permit a free flow of air to aid in cooling the barrel.

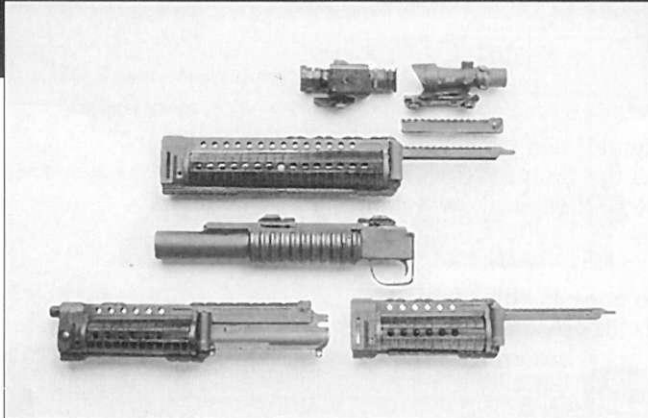
For use with the Rigid Frame System the original front sight and its base are machined off, leaving only the gas block. The new front sight sits inside the top front of the Rigid Frame system, and the rear

sight, which utilizes the standard 'L'-shaped aperture and the standard A1 windage adjustment drum, is integrated into the rear of the sleeve. Also incorporated is the sighting rib developed for Colt's ACR contender, which aids in quick reflex point shooting.

The Rigid Frame System attaches directly to the barrel nut, and is secured to the MIL-STD-1913 rail on the upper receiver. This increases accuracy, as well as assisting in cooling. Along with the free-floating barrel on the rigid frame system is a sleeve that fits over the existing MIL-STD-1913 rail. This protects the receiver rail from damage and extends the amount of usable rail from the rear of the receiver

# SERFSS

## Swan Extended Rigid Frame Sleeve System



Rifle SERFSS with accessories: MANTIS image intensifier night sight, Trijicon day optic, Multi-level rear sleeve, Extended rigid interface frame, Quick attach/detach M203 Grenade Launcher.

Bottom left: Carbine SERFSS (shown integrated to the upper receiver) with the AN/PAQ-4C integrated laser aiming device.

Bottom right: Carbine SERFSS without the AN/PAQ-4C integrated laser aiming device.



**Weapon Modularity** — Gives the soldier employment flexibility and system growth.



**Saco Defense**  
i n c o r p o r a t e d

### SYSTEM DESCRIPTION

The Swan Extended Rigid Frame Sleeve System consists of four major assemblies.

- An extended rigid interface frame with upper and lower Swan/Picatinny rails, to which accessories are attached. Includes:
  - A yoke to attach the frame to the forward portion of the rifle upper receiver
  - Protective spring-loaded hand guards
  - Retractable pistol grip
- A floating front sight housing to which the front portion of the upper and lower rails attach above and below the barrel. Contains:
  - Advance laser and sensor components
  - A standard front sight bead to replace the existing iron front sight frame
- A free floating barrel. It does not touch the extended rigid frame sleeve in any way.
- A multi-level rear sleeve that changes the height of the rearward end of the upper rail.

572. Another early Rigid Frame System advertisement for the "SERFSS", as it was distributed by Saco Defense, Inc., including a detailed description of the benefits of the Swan Rigid Frame System. courtesy ARMS, Inc.

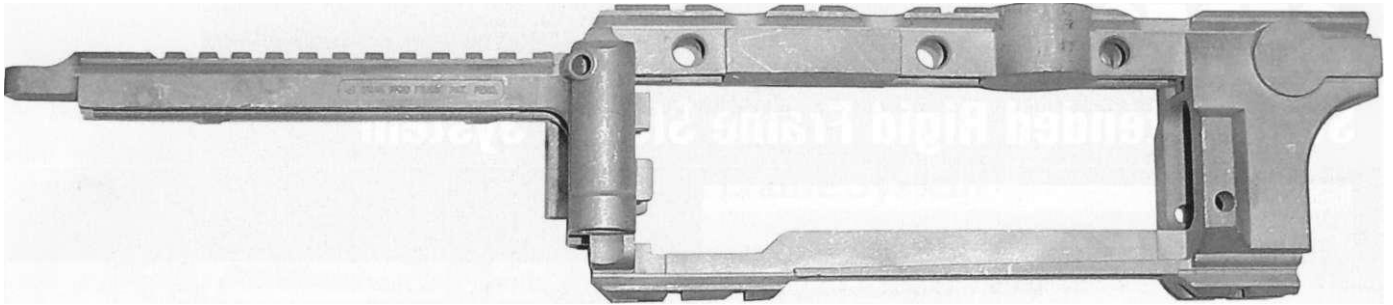
right up to the front sight. The side panels/handguards flip up to permit the exterior of the barrel and gas tube to be cleaned, while the bottom rail enables the attachment of an M203 grenade launcher.

The mounts utilized by the Rigid Frame System, also designed and produced by Swan, attach to the rails by means of two Throw Levers, which can be disengaged very quickly. This is important if an optic should become damaged and the shooter has to transition to emergency back-up iron sights as rapidly as possible.

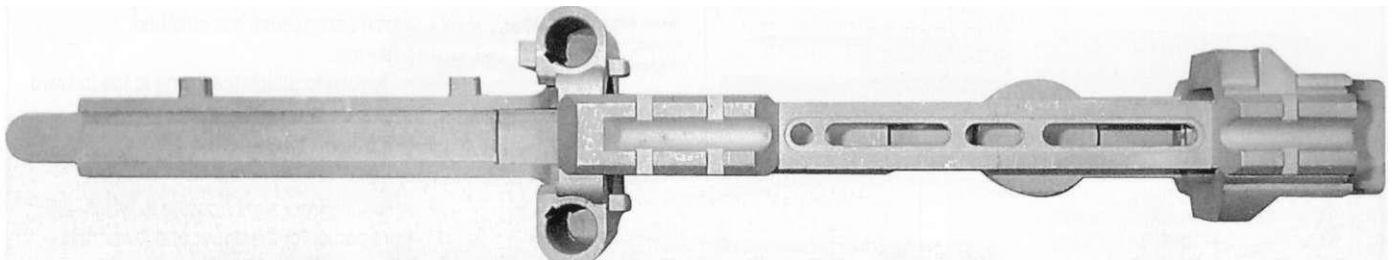
Built in right below the front sight is an integral laser socket which provides automatic boresighting for optics, an automatic aiming point for IR or visible

lasers, and an advanced realistic MILES training provision. The batteries are installed in the bottom of the Rigid Frame System, the battery compartments providing a redundant power source so if one battery is damaged or one of the circuits is disabled, the remaining battery continues to power the laser. The laser is activated by a touch button, which may be located on the front left or right side of the Rigid Frame System.

In 1992, Colt professed an interest in distributing the ARMS, Inc. Rigid Frame System, and requested the exclusive marketing rights. However, at that time SACO had also shown an interest in producing the Rigid Frame System. ARMS, Inc. wanted



573. Right side view of an original casting for the Swan Rigid Frame System. This was the first free-floating rail system to be adapted to the AR-15/M16 weapon system.



574. Underside view of the original casting for the Swan Rigid Frame System.

Note the two hollow battery compartments (left center), just ahead of the receiver mounting rail at left.



575. Right side view of an AR-15 equipped with the Swan Rigid Frame System. Note the laser protruding from the front of the top face.

The Rigid Frame System featured a sighting rib similar to that used on the Colt ACR candidate, which enabled

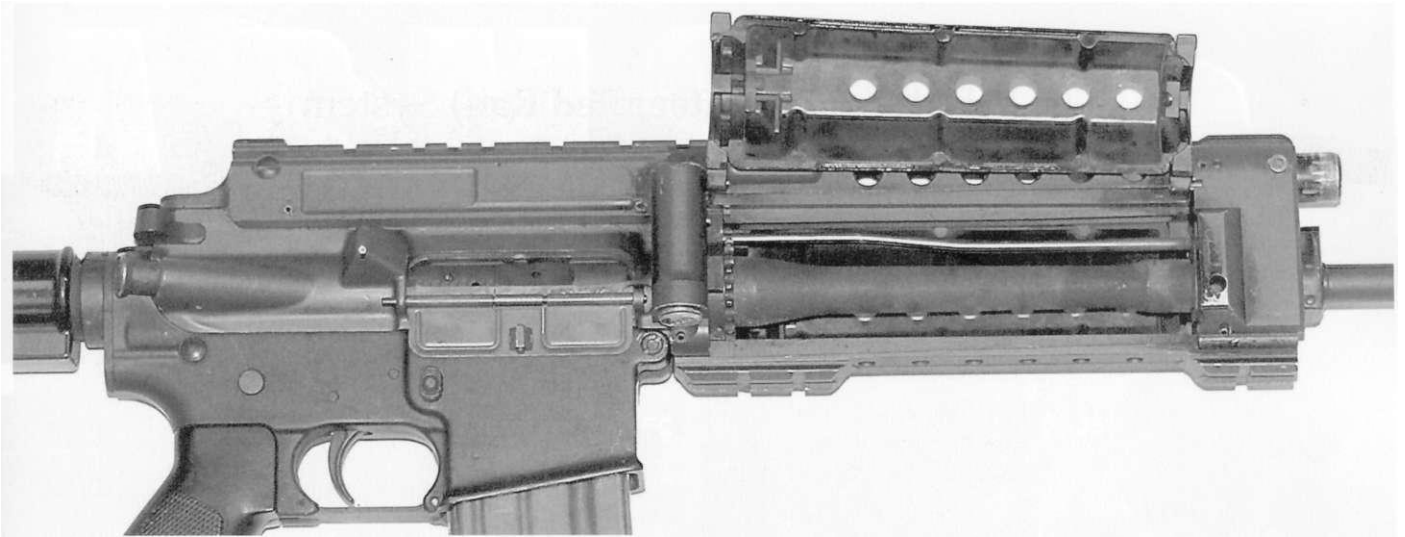
quick reflex shooting similar to the technique used with a shotgun. This design feature was highly encouraged during the ACR trials, and Swan incorporated it into his design.

both firms to produce it, but Colt's were not interested if they could not secure the exclusive rights.

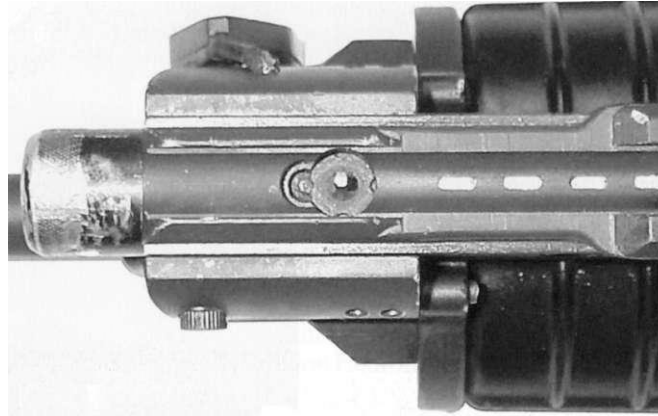
Due to these and other complications, the Rigid Frame System was never produced in large quanti-

ties, and it lay dormant until the advent of the SIR system, which would incorporate numerous improvements over all the rail systems then in existence.





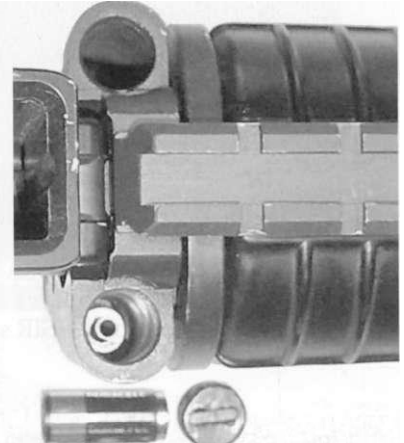
576. Right side closeup of the Swan Rigid Frame System mounted on an AR-15, showing the handguard open for cleaning purposes.



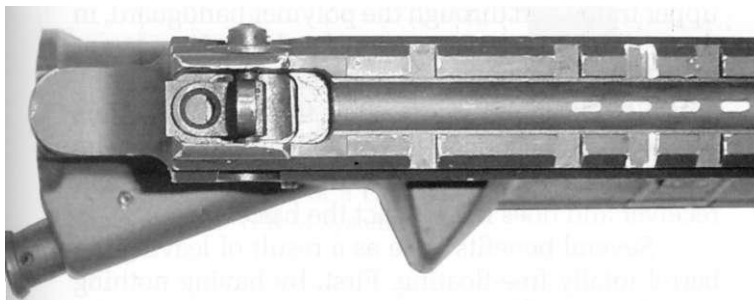
578. Top closeup of the Rigid Frame System showing the front post back-up sight.

The laser (left) is utilized for both sighting as well as an easy way to bore sight optics.

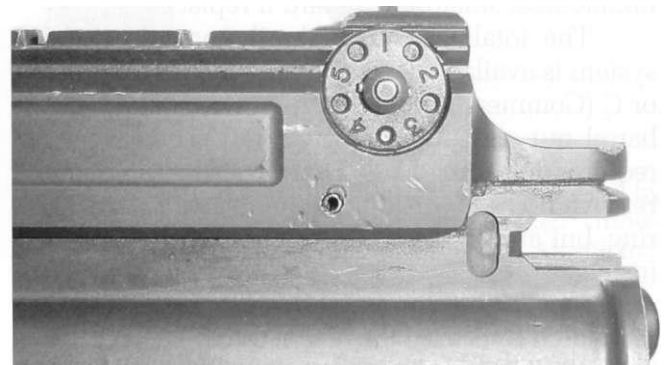
577 (left). Front closeup of the Rigid Frame System, showing the machined-down gas block/front sight assembly. The barrel is completely free-floating.



579. Underside closeup of the bottom rail of the Rigid Frame System, showing the two battery compartments, one of the batteries and its battery cap.



580. Top closeup of the back-up rear iron sight, showing the dual aperture of the standard M16 rifle sight.



581. Left side closeup of the Rigid Frame System, showing the M16-style windage adjustment on the back-up rear iron sight.



## The SIR (Selective Integrated Rail) System



582. Inventor Richard Swan gazes fondly at two of his many creations: the Rigid Frame System, left, and one of the latest versions of the SIR system, right.

courtesy ARMS, Inc.

The Selective Integrated Rail System (SIR) was developed by Richard Swan in late 1999, and prototypes first appeared in 2000. In concept, the SIR system was an updated descendant of the Swan Rigid Frame System of the late 1980s and very early 1990s.

The SIR system is probably the most advanced accessory available today for any rifle or carbine variation of the M16 family of weapons. The SIR weighs approximately four ounces more than the double-heat shield handguard it replaces.

The totally rigid quad-rail frame of the SIR system is available in two versions, the M (Military) or C (Commercial), and both versions attach to the barrel nut and upper receiver rail. The M version requires the spring-loaded handguard assembly to be removed. The C version attaches by way of the Delta ring, but also to the barrel nut, and may be factory-installed.

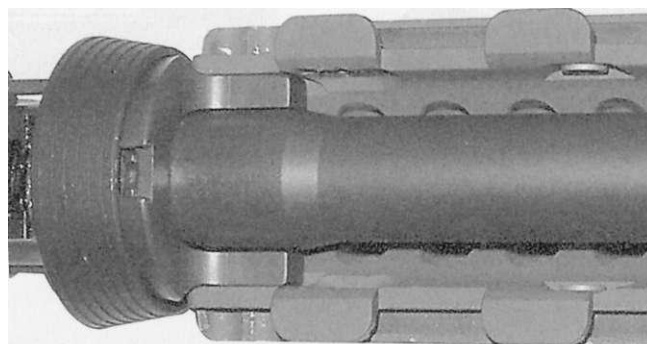
The SIR has its own full-length MIL-STD-1913 rail which runs from the rear of the upper receiver to the front sight assembly, and sits approximately 4/10" higher than the rail on the upper receiver, to locate the mounted optic slightly higher than if attached



583. A comparison of two versions of the carbine-length SIR system.

Above: commercial drop-on (C) version.

Below: military (M) version, installed with only the barrel nut.  
courtesy ARMS, Inc.



584. Underside closeup of an M16 with lower handguard removed, showing how the SIR C system attaches to the Delta ring and barrel nut.

directly to the receiver rail. A selection of various accessory rails may be attached, via a channel in the upper frame and through the polymer handguard, in the 3, 6 and 9 o'clock positions as desired.

Unlike the Knight's Armament RAS, but like the ARMS, Inc. Rigid Frame System, the SIR sleeve offers the decided advantage of a free-floating barrel. The SIR attaches to the MIL-STD-1913 rail on the upper receiver and does not contact the barrel.

Several benefits arise as a result of leaving the barrel totally free-floating. First, by having nothing impeding barrel harmonics, the accuracy potential is unaffected. The second major benefit is a reduction in heat buildup in the barrel, as heat is not conducted back through the aluminum sleeve into the handguards. There are numerous "air" holes in the

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ATLANTIC RESEARCH MARKETING SYSTEMS, INC.

M-4 Civilian Version Carbine S.I.R.®  
#45C

Slim Carbine Bi-Level S.I.R.®  
#50SC

M-4 Military Version Carbine S.I.R.®  
#45M

Carry Handle Carbine S.I.R.®  
#51A1/A2

Slim Carbine S.I.R.®  
#46SC

Bi-Level Mid Length S.I.R.®  
#58SM

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585. Various versions of the SIR system offered by ARMS, Inc.  
photo by Joe Hearon, courtesy ARMS, Inc.

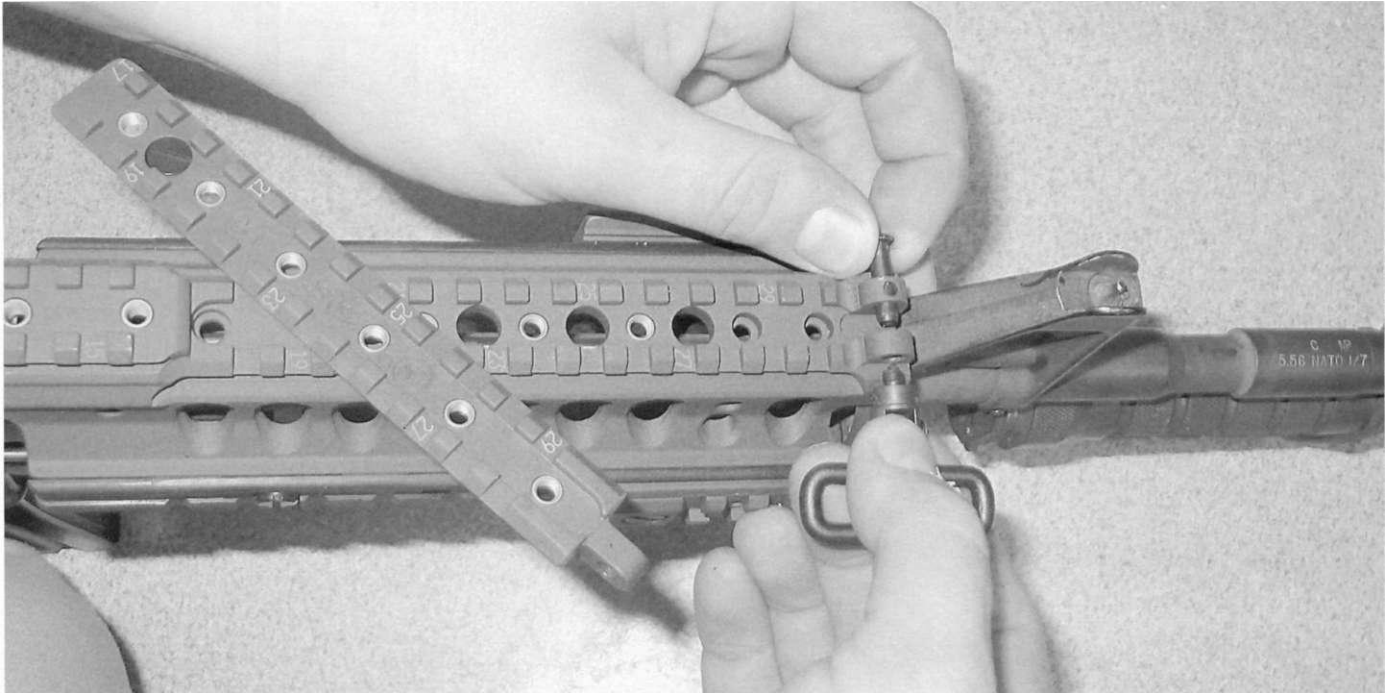


586. Left side view of a Colt Law Enforcement Carbine fitted with the SIR M system.

Note the vertical foregrip, attached to the lower rail by means of mount fitted with the Swan patented Throw-Lever, courtesy ARMS, Inc.

SIR which are too small for a finger to go through but large enough to greatly increase to flow of cool air. This is a main factor in increasing reliability and longevity of both the barrel and upper receiver.

Also, when accessories are attached to the rails of the SIR system, they do not weigh the barrel down. One problem that has been encountered with rails, particularly ones with pistol grips attached to them, is that pulling downward on the front pistol grip



587. Closeup of the top rail of the SIR system on a Colt Law Enforcement Carbine, showing the accessory top rail sec-

tion being fitted. This is dimensioned to bring the forward rail extension to the same height as the rail on the receiver. courtesy ARMS, Inc.

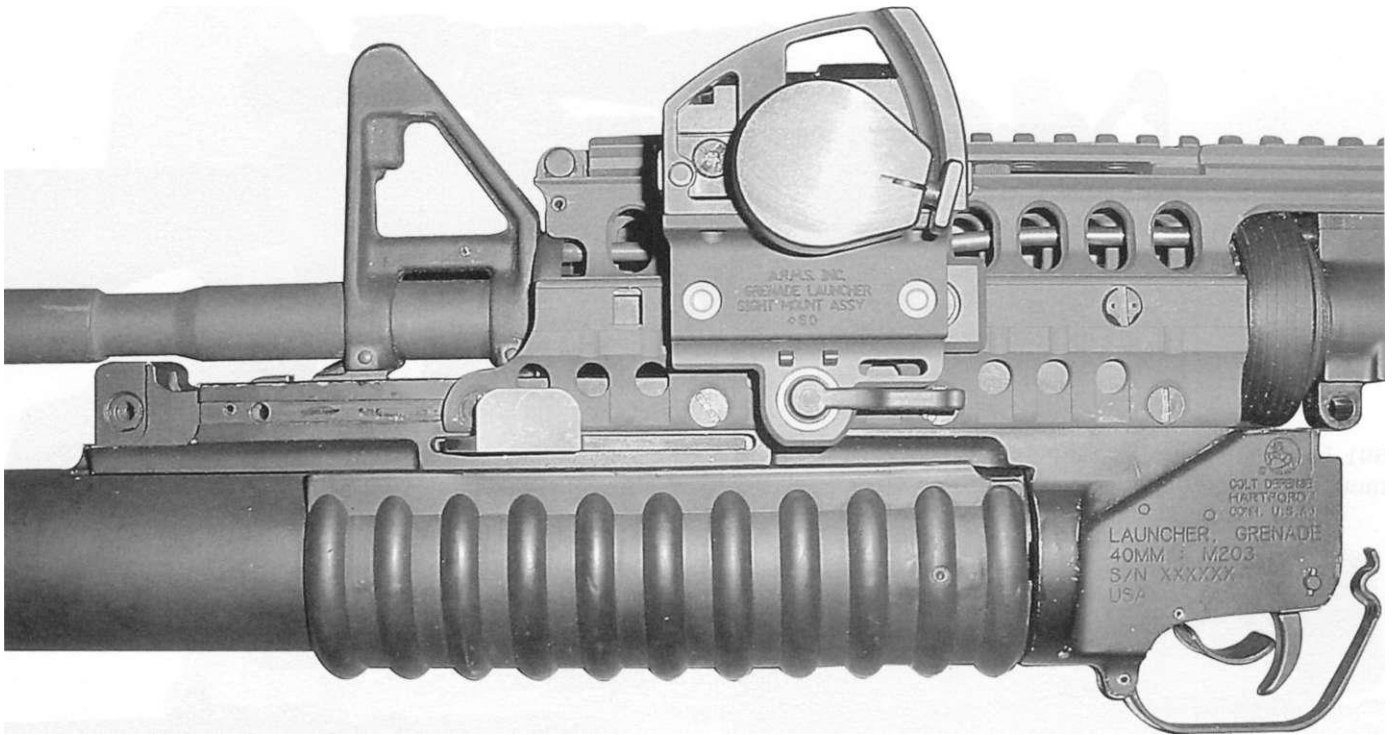


588. Right side view of a Colt Law Enforcement Carbine with SIR C system mounting an M203 grenade launcher on the lower rail.

Note the #40L flip-up rear iron sight, the M68 Reflex optic sight, and the AN-PEQ-2 infrared laser illuminator mounted on the forward rail. courtesy ARMS, Inc.

when the barrel is hot will actually cause the barrel to droop, due to the downward force acting on the soft hot metal. This is eliminated by design in the SIR System, as the forward pistol grip attaches to the lower rail of the SIR, not the barrel. This is the same for any modular attachments, for whether it be a light

Aim-Point sight or a heavy Night Vision scope, the weight has no effect on the barrel. The lower handguard on the SIR is made of high-impact polymer, and has the two side rails and bottom rail attached. All the rails on the lower handguard can be removed if desired—for instance, if a lower pistol grip is not required the lower rail can



589. Left side closeup of the M203 and Swan-developed ARMS grenade launcher sight system mounted on a SIR C on a Colt carbine. courtesy ARMS, Inc.

be removed so the operator can grip the handguard comfortably. Also, by removing the synthetic lower handguard, the M203 grenade launcher can be attached directly to the SIR. The SIR will also accept a grenade launcher sight.

Swan introduced his new line of advanced SIR systems, including his first full-length SIR system, the #59, designed for use on the M16A4 rifle, at the 2003 SHOT Show. The new system has all the same specifications and options as the carbine version. Additionally Swan has developed a new slimline version of the SIR for both carbine and rifle variations, along with a special SIR system, the #53 MVR, for use with AR-10 series rifles.

Dick Swan has also developed two very durable pop-up rear sight assemblies, the #40 and #40L, both of which secure to the rear of the rail on the upper receiver so that when a SIR system is installed, the entire rail on the upper receiver is protected. The standard #40 version of this sight is also used on the USSOCOM Mk12 MOD 0 rifle.

Both sights are similar in design, and are secured in the downward position by a spring-loaded lever. To engage the sight, the operator merely has to

590 (right). The SIR M system in use, mounted on an M4 carbine and fitted with the short 9" M203 grenade launcher, laser aiming sight, optic, and flashlight.

photo by Joe Hearon, courtesy ARMS, Inc.





## 358 The SIR (Selective Integrated Rail) System



591. Left side view of the new full-length SIR #59 system mounted on an M16A4 rifle, with folded Harris bipod.

Both bipod and optic are attached by means of Swan Throw-Lever mounts. courtesy ARMS, Inc.



592. Left side view of the new full-length SIR #59 system mounted on an ArmaLite AR-15 rifle.

Note the Swan #22 Swan Tactical Ring Caps (TRC) and Tactical Ring Rail (TRR) sections above the Leupold Ultra 10X M3A optic sight, and the Harris bipod.

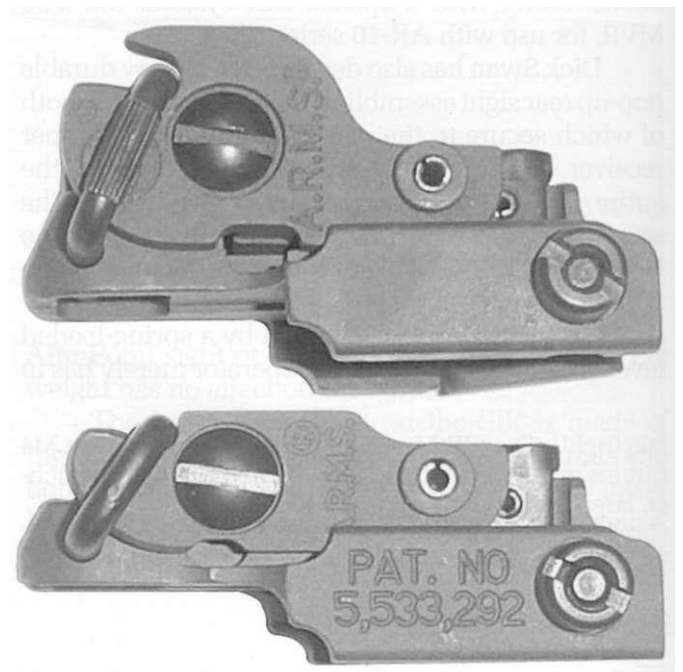
Both bipod and optic are attached by means of Swan Throw-Lever mounts. courtesy ARMS, Inc.

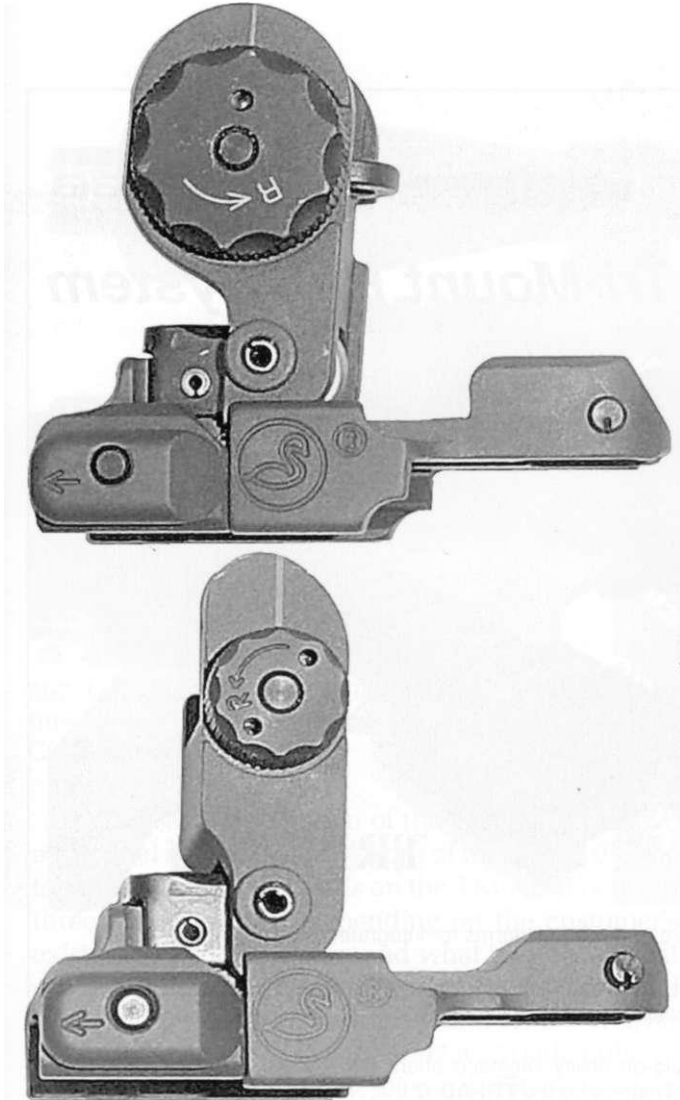
pull outward on the catch lever. The #40 is the standard sight. It has two apertures, identical to the standard A2 (0-2) short- and long-range apertures. The #40L (US Patent no. 5,533,292) is a more compact version, the L standing for Low. This sight was redesigned to make it more compatible with lower-riding optics. The major difference is in the aperture itself. When the #40L sight is raised, the long-range aperture is engaged. For close range, the long-range

593 (right). Right side views of the two Swan Stand-Alone flip-up rear iron sights.

Above: the original #40.

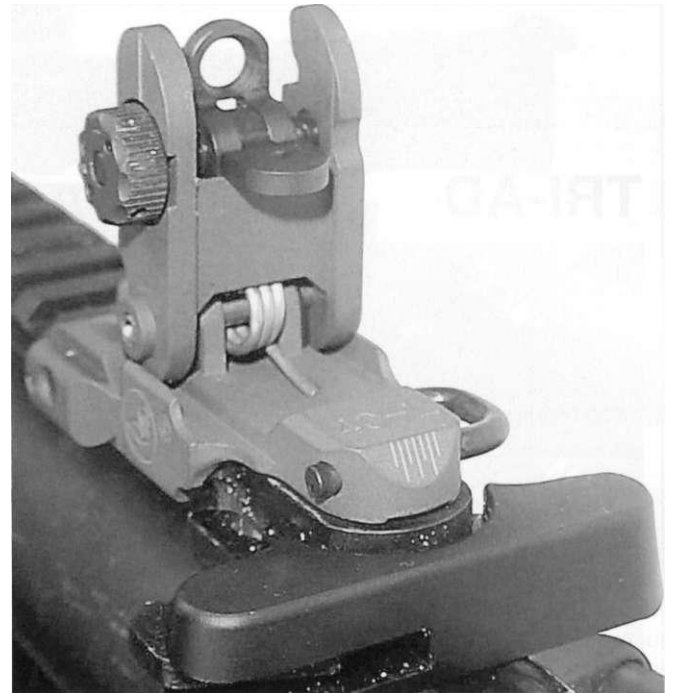
Below: the new patented low-profile #40L.





aperture is pulled rearward and down, exposing the larger short range aperture.

Both Swan iron sights are zeroed in the same manner as the standard rifle sights, with the windage



595. Left rear three-quarter closeup of the Swan Stand-Alone #40L rear sight, showing long-range aperture pulled rearward and down, exposing the larger short-range aperture.

594 (left). Left side views of the two Swan Stand-Alone flip-up rear iron sights, with sights raised. Note the windage dials.

Above: the original #40.

Below: the new #40L.

dial, very similar to that of the standard M4 detachable carrying handle and M16A2 rifle dials, located on the left of the sight body.

## Diemaco, Inc.

### The Diemaco TRI-AD System

Diemaco has produced numerous rifle and carbine variations to order for various customers, fitted with the Knight's Armament RAS system as standard equipment. However, due to the heavy demand for the RAS system, there can be a long waiting period, and the US military is at the front of the line. For this reason Diemaco decided to design their own proprietary TRI-AD rail system, in order to be able to make deliveries of complete weapon systems in a timely fashion rather than holding up deliveries until RAS systems could be acquired.

The Diemaco TRI-AD System is made up of two components. The larger is the TRI-AD II, basically a sleeve rail which sits on top of the rail of the flat-top upper receiver and is attached by the same type of lock nut assembly as used with the detachable carrying handle.

The TRI-AD II rail itself comes in two variations. The first is the 10"-long Extended Sight Rail Assembly, a single top rail which comes in two configurations, either MIL-STD-1913 (09127C-1), or Weaver (09127C-2).





Diemaco's C7 Flat Top Rifles and C8 Flat Top Carbines represent reliable and solid platforms for integrated weapon systems.

The integrated rail on the receiver accepts a multitude of accessories. For some users or in specific operations there is a need or desire to add several accessories simultaneously onto the Diemaco Flat Top weapon.

In order to maintain the modular concept, and to have maximum build-on ability Diemaco offers the **TRI-AD Mounting System**. It consists of two Adapters, the **TRI-AD I** which clamps around the front sight, and the **TRI-AD II** that mounts onto the existing upper receiver rail like any other accessory.

The **TRI-AD Mounting System** has been developed by Diemaco for adaptation onto any C7, C8 or M16 type Flat Top weapon with "Weaver" or "Picatinny" flat top upper receiver, and the adapter rail itself can be configured similarly.

Diemaco produces the **TRI-AD Mounting System** as per military specifications. The components are machined from solid aluminum and anodized black.

#### **TRI-AD I**

The **TRI-AD I** is the front TRI-Mount Adapter. It consists of two linked halves that are permanently joined by a steel pin. The adapter mounts to the barrel of any C7 Rifle or C8 Carbine at and under the front sight. When mounted, it provides three parallel mounting rails for up to three auxiliary products on the sides and/or below the front sight.

#### **TRI-AD II**

The **TRI-AD II** is the rear TRI-Mount Adapter. It mounts on the upper receiver of the C7 Flat Top Rifle or C8 Flat Top Carbine. It has two side rails and one upper rail surface for mounting of auxiliary items. The mount adds height that is required when mounting many optical sights or telescopes.

596. The Diemaco specification sheet for their proprietary TRI-AD (Tri-Mount Rail System), featuring the TRI-AD I, left, which clamps around the front sight with no need to remove or change handguards, and the TRI-AD II extended sight rail assembly, right and in the background, which mounts to the receiver rail, does not contact the barrel and extends the useable rail area on top and at 3:00 and 9:00 on the sides.  
courtesy Diemaco, Inc.



597. Left side closeup of a Bausch & Lomb optical sight fitted to the TRI-AD II, mounted on the receiver rail of a C8CT sniper rifle.

Note the forward rail sections, which extend over but do not touch the tubular handguard, which itself does not touch the free-floating barrel. courtesy Diemaco, Inc.

The second variation of the TRI-AD II has two additional side rails on the front of the basic 10"-long top rail assembly. The rails on the TRI-AD II come in three configurations, depending on the customer's existing rail configuration and what they want to fit on the rail: either all MIL-STD-1913 (10973C-1); all Weaver (10973C-2); or a third option with a Weaver top rail and MIL-STD-1913 (10973C-3) side rails.

Another benefit of the Diemaco TRI-AD system is that it sits somewhat higher, so various configurations of scopes and other aiming devices may be used with no mounting difficulties because they will clear both the handguards and front sights.

The second component of the TRI-AD system, called the TRI-AD I, attaches directly to the front sight assembly by means of a transverse bolt and offers three additional rails (left, right and bottom), without the need to change handguards. Both of the MIL-STD-1913 side rails are 2.125" long, and enable the attachment of flashlights, laser pointers or whatever other accessory device may be required. Diemaco offers fixed or folding forward pistol grips, which may be attached to the bottom rail.

Diemaco also manufactures an additional Twin Rail assembly, which attaches to the front sight assembly in a manner similar to the TRI-AD I. The main differences between the TRI-AD I and the Twin Rail Assembly are that the MIL-STD-1913 side rails of the Twin Rail Assembly are 3.3" long, there is no bottom rail, and there are sling swivel mounts on the top of both sides. Another difference is that the Twin Rail is made of steel instead of anodized aluminum.



598. Left front three-quarter view of the TRI-AD I twin rail kit.

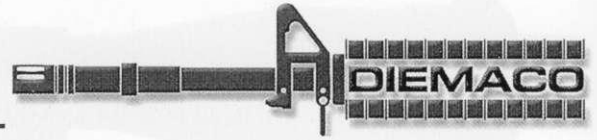
This attaches around the front sight assembly, with no need to remove or change handguards, to enable the attachment of accessory sights or aiming devices at 3:00 and 9:00 as well as a bipod or a vertical pistol grip at the 6:00 position. courtesy Diemaco, Inc.

The TRI-AD System can be attached to any flat-top receiver, and the TRI-AD I or Twin Rail Assembly will mount on any M16-type rifle or carbine which utilizes a standard front sight assembly.

At approximately 1/5 the cost of the Knight's Armament RAS, the TRI-AD System has become a popular alternative for Diemaco's customers.

# DIEMACO

## WEAPONS ACCESSORIES



### U.M.A - Diemaco Universal Mounting Adapter



#### U.M.A - Diemaco Universal Mounting Adapter

The **Diemaco Universal Mounting Adapter** is optionally configured with a carrying handle and or a solid post and a stud for slings and bipod.

The adapter has been engineered to perform several functions. It clamps solidly to any Canadian weaver, Mil. Spec. 1913/ and Picatinny Rail systems. This Aircraft quality aluminum hard anodized unit is

machined from a solid bar and has knurled thumbnuts to allow quick installation and removal in any application. It includes a crossbar to assure repeatable positioning and a positive stop.

The **Universal Mounting Adapter** is used for multiple combinations of attachments such as carrying handle, sling swivels, lightweight and heavy duty bipods.

599. A Diemaco brochure describing an additional accessory - the Diemaco-developed Universal Mounting Adapter (UMA), which enables installation of an auxiliary carrying handle, bipod or vertical pistol grip.

courtesy Diemaco, Inc.

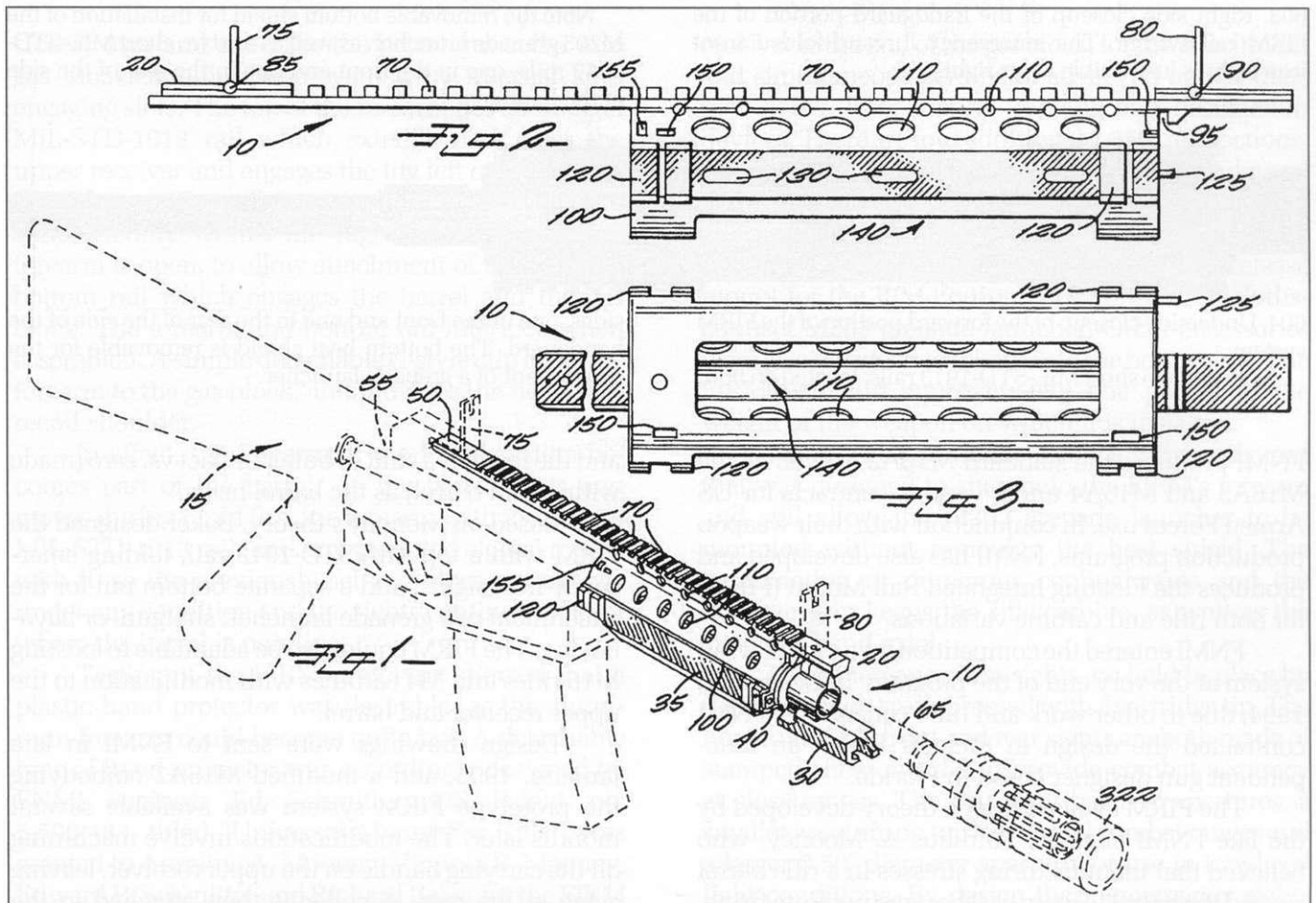
# FNMI

## The FIRM (Floating Integrated Rail Mount)



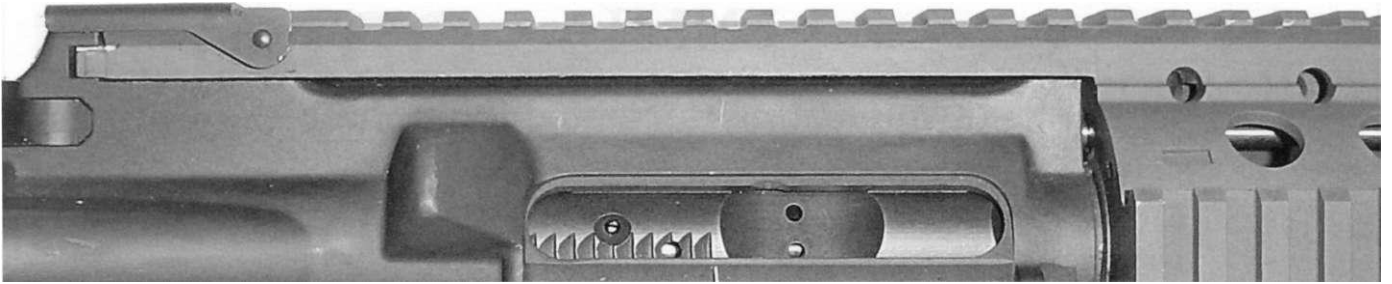
600. Right side view of the FIRM rail system mounted on a modified M16A2 rifle.

Note the new gas block and the ELCAN optical sight, installed on the upper rail.



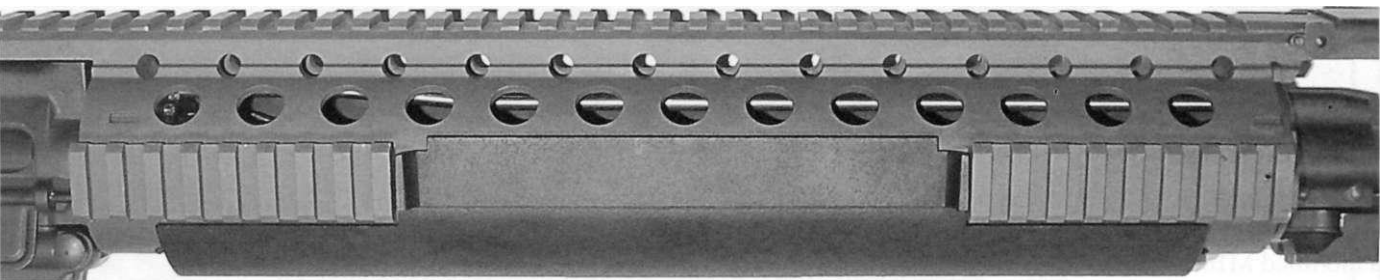
601. Drawings from US Patent no. 5,590,484, titled "Universal Mount For Rifle", granted to Aurelius Mooney, Edward Schmitter and Richard Baker, showing right side

and underside views of the FIRM rail, and a view of the modified rifle with FIRM attached. US Patent Office



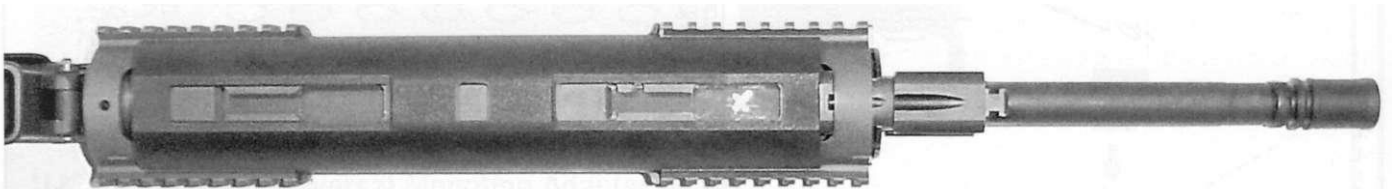
602. Right side closeup of the receiver portion of the FIRM rail system. The curves of the receiver under the rail are all that is left of the original carrying handle.

The rearward-folded rear emergency iron sight, left, is held by a detent pin.



603. Right side closeup of the handguard portion of the FIRM rail system. The emergency forward-folded front iron sight is just visible at far right.

Note the removable bottom shield for installation of the M203 grenade launcher, as well as the two short MIL-STD-1913 rails, one in the front and one in the rear of the side of the handguard.



604. Underside closeup of the forward portion of the FIRM system.

Note the two short MIL-STD-1913 rails, located on both

sides, one in the front and one in the rear of the side of the handguard. The bottom heat shield is removable for the attachment of a grenade launcher.

FNMI produces the standard M16A2 as well as the M16A3 and M16A4 under various contracts for US Armed Forces use. In conjunction with their weapon production programs, FNMI has also developed and produces the Floating Integrated Rail Mount (FIRM) for both rifle and carbine variations.

FNMI entered the competition for a modular rail system at the very end of the program. In December, 1994, due to other work and time constraints, FNMI contracted the design to Richard Baker, an independent gun designer based in Florida.

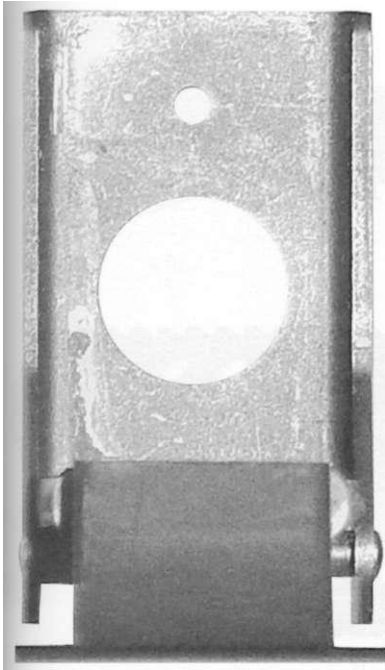
The FIRM evolved from a theory developed by the late FNMI engineer Aurelius A. Mooney, who believed that manufacturing stresses in a rifle barrel caused the barrel to warp as it became hot from firing. With the M16 series, he reasoned that since the front sight is mounted on the barrel and the rear sight is on the upper receiver, they cannot move together,

and the result is a shift in bullet impact vs. zero (made with a cold barrel) as the barrel heats.

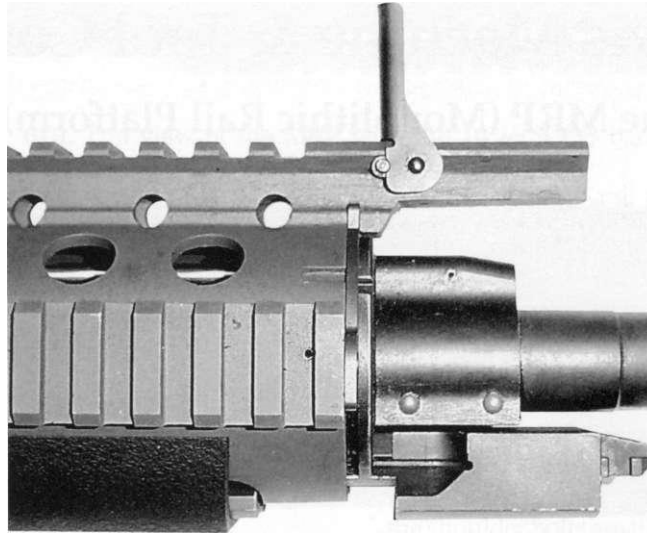
Based on Mooney's theory, Baker designed the FIRM with a top MIL-STD-1913 rail, folding emergency iron sights, and a separate bottom rail for the attachment of a grenade launcher, shotgun, or bayonet lug. The FIRM could also be adaptable to existing M16 rifles and M4 carbines with modification to the upper receiver and barrel.

Design drawings were sent to FNMI in late January, 1995, and a modified M16A2 embodying the prototype FIRM system was available several months later. The modifications involve machining off the carrying handle on the upper receiver, leaving a lug at the rear. A collar is then attached to the outside of the barrel nut, and a new circular gas block replaces the existing front sight assembly. A new one-piece aluminum forearm (handguard) fits



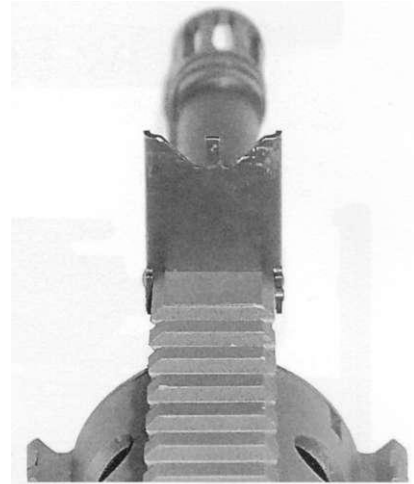


605. View through the non-adjustable back-up rear sight, showing the two apertures.



606. Right side view of the emergency folding front sight assembly, also held by a detent.

Like the rear sight, this is non-adjustable.



607. A view from the rear of the emergency front iron sight, showing the non-adjustable post.

closely over and straddles the barrel nut collar and gas block. Rotation is prevented by internal keys engaging slots. The top of the forearm has an integral MIL-STD-1913 rail which extends back over the upper receiver and engages the lug left on the rear of the receiver. The rail is not solidly locked, but can slide laterally within the lug. The bottom of the forearm is open, to allow attachment of the separate bottom rail which engages the barrel and the gas block. The forearm and bottom rail interlock when assembled. A simple detachable C-style clip locks the forearm to the gas block, and provides the necessary recoil shoulder.

In effect, the forearm of the FIRM system becomes part of the barrel. As the barrel heats and moves during rapid fire, the forearm with its integral MIL-STD-1913 rail (and any mounted sights) moves with it, so the previously set zero does not change under any condition and the sights continue to point where the barrel is pointing.

Testing of the FIRM prototype showed that a plastic hand protector was desirable, as the aluminum forearm could become quite hot. A detachable type of hand protector was accordingly designed by FNMI engineer Ed Schmitter. US Patent no. 5,590,484, titled "Universal Mount For Rifle", was granted to Aurelius A. Mooney, Virginia R. Mooney, Edward P. Schmitter and Richard Baker for the FIRM system on January 7, 1997.

The FIRM system provides a full-length MIL-STD-1913 rail which runs from the rear of the upper

receiver to the end of the gas block, for the attachment and simultaneous zeroing of advanced optics, thermal sights, laser aiming, ranging and designation devices. There are four additional 3.350" rail sections, one each on the left and right sides of the handguard at the rear and front, which enable the attachment of all current SOPMOD accessories. The bottom rail was designed to accept a shotgun or a quick-release mount for the R/M Equipment improved/quick-disconnect M203 grenade launcher. Other accessories were also designed to "snap" into the bottom rail. The FIRM will add approximately one pound to the weight of the weapon on which it is installed.

There is an additional plastic lower handguard that was designed to snap onto the FIRM's forearm and still allow the M203 grenade launcher to be mounted without removing the heat shield. The combination of numerous cooling vents and the polymer grip keeps the rifle/carbine, as well as the shooter's hand, cool.

Two emergency iron sights are held in place by detents, which are depressed with a cartridge tip. The non-adjustable front and rear sights are both made of stamped sheet metal and provide combat accuracy at close ranges. The rear sight has two apertures, a smaller aperture on top for normal combat ranges and a larger 0.50" diameter aperture for use in low-level light conditions. By design these emergency sights are not adjustable, the theory being that they would be used primarily at close range, and that adjustments would not be necessary.



## The Lewis Machine & Tool Company

### The MRP (Monolithic Rail Platform)



608. The components of the Lewis Machine & Tool Company Monolithic Rail Platform (MRP) system.

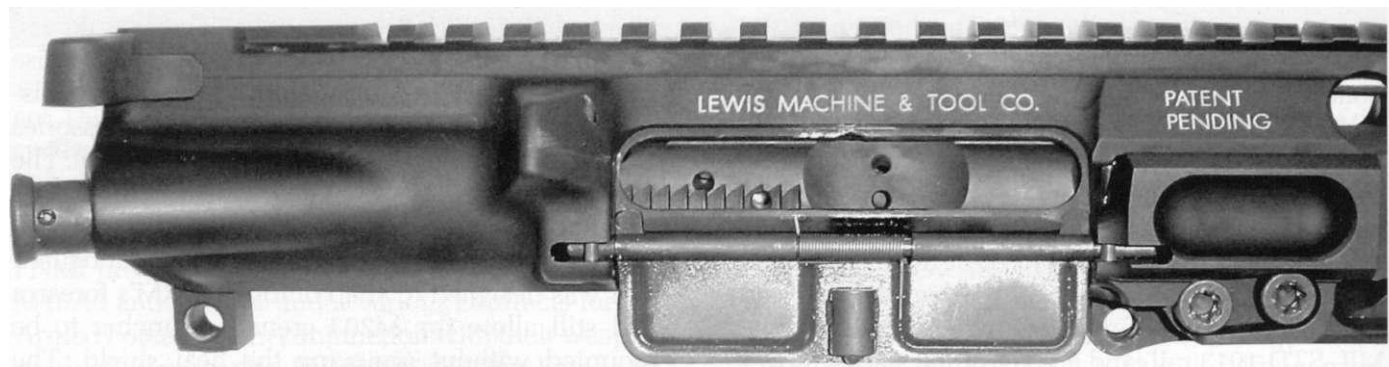
At left is the charging handle and the Lewis Machine & Tool Co. Enhanced Bolt.

Beside these is the full-length MRP (top), with the two transverse shoulder bolts.

Below these is the MRP CQB 10 1/2" barrel, and a 14

1/2" barrel (below). Any length of barrel may be installed in the MRP, in any of the available calibers.

Note the two holes in the receiver for the shoulder bolts. One aligns the barrel in the receiver, and the other tightens the receiver around the circumference of the barrel extension, to eliminate any gaps between the barrel and the receiver.



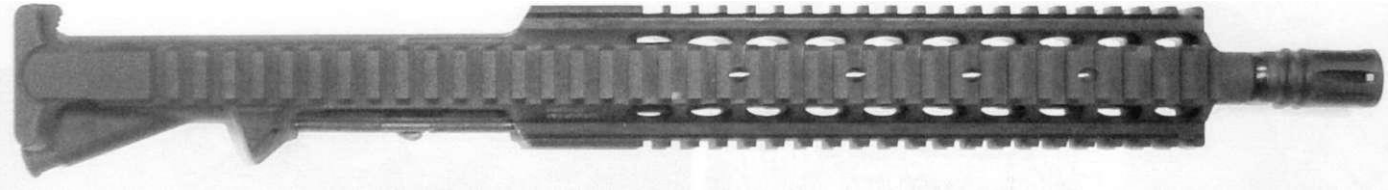
609. Right side closeup of the MRP, showing markings.

Note the two transverse bolts, at lower right, which align and retain the barrel.

The newest addition to the family of rail adapter systems is the MRP (Monolithic Rail Platform). Easily the most radical variation of all current integrated rail systems, the MRP was designed by Karl Lewis and is produced by the Lewis Machine & Tool Company.

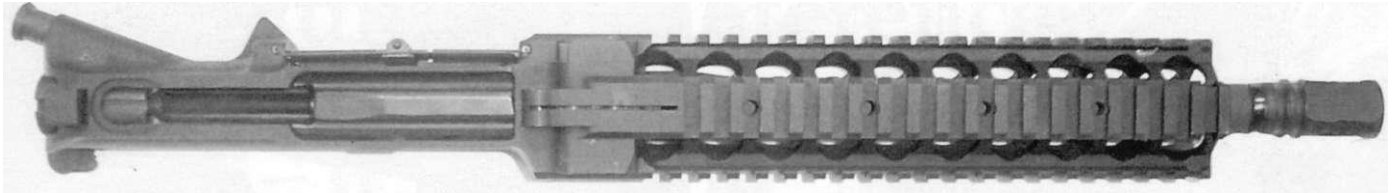
While all the other current rail systems utilize existing M4/M16A4 (or, in the case of the FIRM, modified M16-type) flat-top upper receiver assemblies and/or the standard barrel nut/slip ring and handguard cap for installation, the MRP completely

replaces the upper receiver with a whole new one-piece receiver/free-floating handguard/rail system with quad MIL-STD-1913 rails, and a new, proprietary barrel. The top surface of the MRP, which extends as one constant rail from the rear of the "upper receiver" portion to the front, will accept any SOP-MOD accessory, and standard KAC rail protector covers may be used to protect portions of rails that are not in use.



610. Top view of the MRP with the 10 1/2" CQB barrel installed.

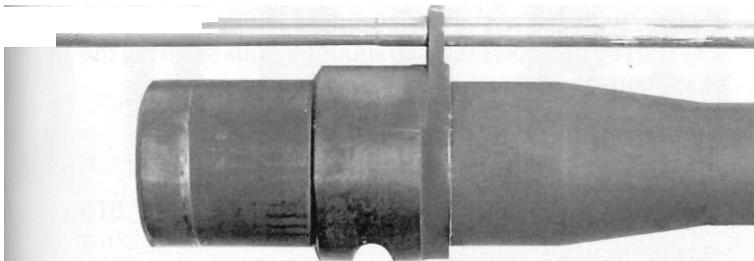
Note the unbroken full-length MIL-STD-1913 rail on top, as well as the side rails at 3:00 and 9:00.



611. Underside view of the MRP with the 10 1/2" CQB barrel installed, showing the bottom rail.

Note the slot cut in the bottom of the upper receiver,

which allows the receiver to clamp around the barrel as the shoulder bolts are tightened. This system provides 360° retention of the barrel in the MRP receiver.



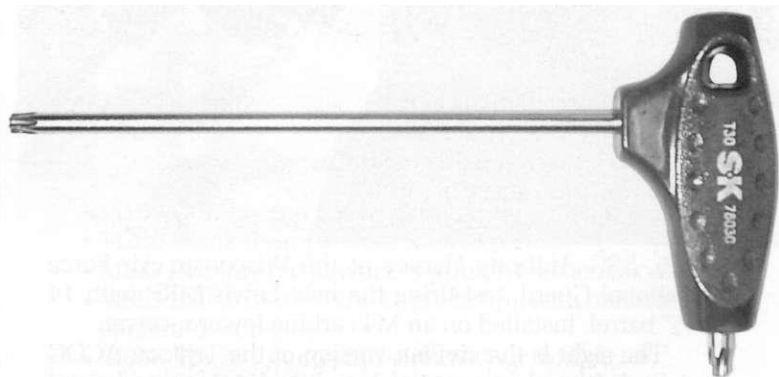
612. Right side closeup of the barrel extension and rear portion of the gas tube.

Note the alignment brace which aligns the gas tube with the bolt carrier key, as well as the semicircular notch cut in the bottom rear portion of the barrel through which one of the shoulder bolts passes to retain the barrel in the receiver.

The barrel assembly consists of a barrel with a modified exterior at the breech, and a gas tube. The gas tube is installed in the gas block and held in place by a bracket at the rear of the barrel, which properly aligns the gas tube with the bolt carrier key. The barrels can be configured as Match-grade bull barrels or lightweight combat barrels, and are free-floating to improve accuracy and promote cooling.

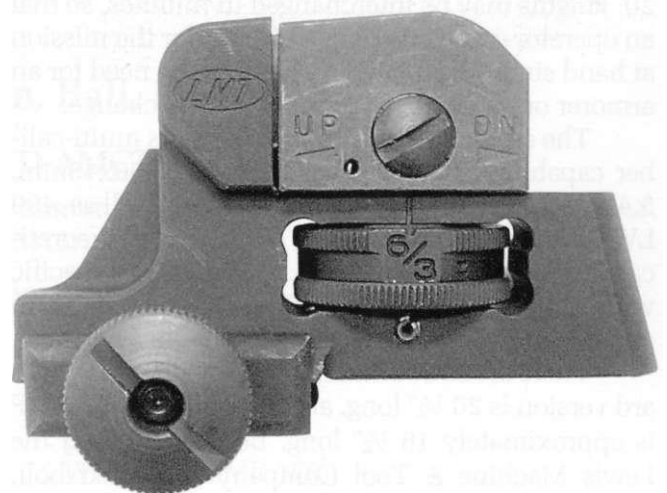
There is a transverse semicircular notch cut into the bottom of the barrel, which is located by one of the pair of shoulder bolts. When the two bolts are tightened, the circumference of the MRP locks all the way around the barrel, so no threads are needed to hold the barrel into the upper receiver.

From a logistical standpoint, this revolutionary approach has two main advantages. First, once the MRP is installed on the rifle, the barrel may be easily replaced with another barrel configuration by removing the two shoulder bolts with the proprietary in-



613. The special wrench, used to tighten/loosen the shoulder bolts.

As of this writing a new wrench is being developed with a fixed torque setting.



614. Left side view of the back-up rear sight manufactured by the Lewis Machine & Tool Company for use with the MRP.

This sight is utilized on the SOCOM CQB carbine.

### 368 The MRP (Monolithic Rail Platform)



615. SSG Anthony Harvey of the Wisconsin Air Force National Guard, test-firing the new Lewis MRP with 14 1/2" barrel, installed on an M4 carbine lower receiver.

The sight is the civilian version of the Trijicon ACOG sight, (with red arrow reticle), and the KAC forward pistol grip is installed on the RAS.

stallation wrench. Barrels of 10 1/2, 14 1/2, 18 1/2 or 20" lengths may be interchanged in minutes, so that an operator could customize his rifle for the mission at hand simply and quickly, without the need for an armorer or gunsmith to make the barrel change.

The second benefit of the MRP is its multi-caliber capability. Barrels chambered for 5.56x45mm, 5.45x39mm, 6.8x43mm, 7.62x39mm as well as .499 LWR may be installed in the MRP so that, theoretically, it could be configured to be mission-specific with any one of the four available barrel lengths in any one of five calibers.

There are two variations of the MRP. The standard version is 20 1/2" long, and the shorter CQB MRP is approximately 16 1/2" long. Both come with the Lewis Machine & Tool Company enhanced bolt, which is made of stronger material than standard Mil-Spec bolts, has dual extractor springs, and a more aggressive extractor claw.



616. Changing barrels on the Lewis MRP is simplicity itself.

Here, with the aid of the supplied wrench (fig. 613), SSG Harvey unscrews the two shoulder bolts securing the 14 1/2" barrel.

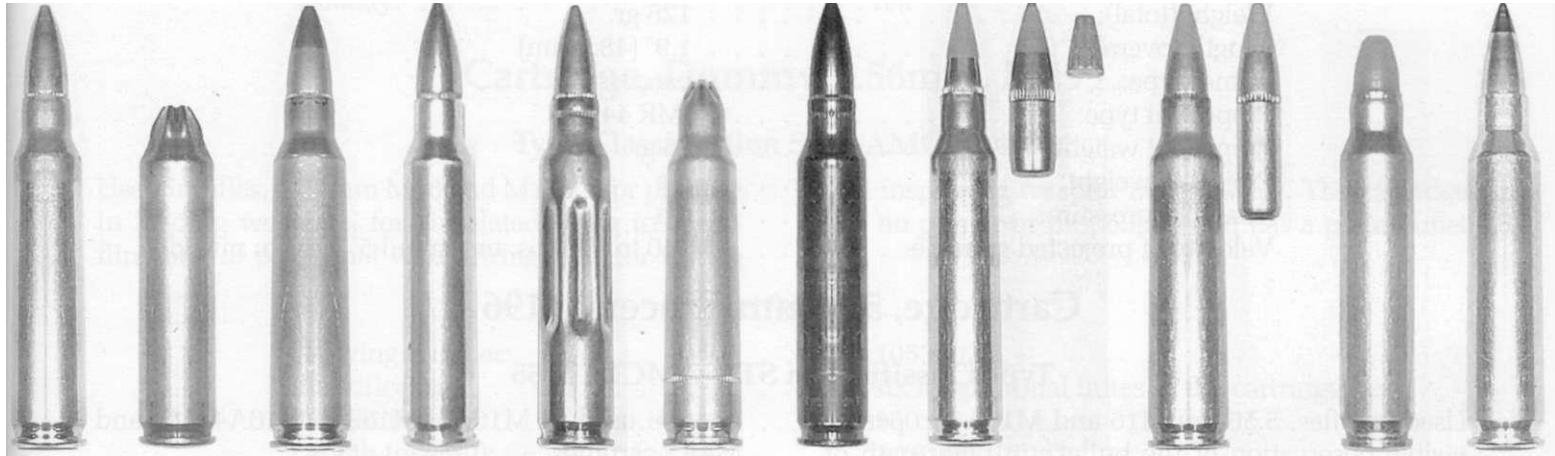


617. With the 14 1/2" barrel removed, the 10 1/2" barrel is inserted into the MRP receiver, after which the two shoulder bolts are replaced and tightened.

The entire process takes only a few minutes.

*Chapter Fourteen*

# Ammunition Reference Guide



618. Standard US military loadings of the 5.56x45mm cartridge. From left:

- M193 Ball;
- M195 Grenade (rosette crimp);
- M196 Tracer (red tip);
- M197 High Pressure Test (silver-colored case);
- M199 Dummy (no powder or primer, fluted case);
- M200 Blank (crimped and knurled case);
- M232 Dummy (no powder or primer, blackened case);
- M855 Ball (5.56mm NATO, green tip), with bullet and penetrator core;
- M856 Tracer (orange tip) with 63.7-gr. bullet;
- M862 Plastic (reduced load, blue plastic bullet);
- M995AP (black tip).

**T**his chapter is a brief compendium of the standard loadings of 5.56x45mm ammunition as issued by the US military and described in TM

43-0001-27. The various types are discussed in order of their assigned "M" designations, as follows:

## Cartridge, 5.56mm, Ball, M193

### Type Classification STD-AMCTC 5143

Intended for use in rifles, 5.56mm M16 and M16A1, against personnel and light armored vehicles. This

ammunition may be used in M16A2, M16A3, M16A4, M4 and M4A1 carbines.

### Specifications

Identification:	plain bullet tip
Weight (total):	.182 gr.
Length (overall):	2.26" (57.4mm)
Primer type:	percussion
Propellant type:	WC 844 or CMR 170
Propellant weight:	28.5 or 26.5 gr.
Projectile weight:	55 gr. (TM 43-0001-27 states 56 gr.)
Chamber pressure:	52,000 psi
V <sup>15</sup> (measured 15 feet from muzzle):	3,250 fps

Cartridge, 5.56mm, Grenade, M195

Type Classification STD-AMCTC 6919

Used in rifles, 5.56mm M16 and M16A1 to provide pressure, on functioning, to project grenades to a desired target using a grenade projection adapter.

Specifications

Identification:	rose-petal (rosette-crimp) closure of the cartridge case mouth, sealed with red lacquer
Weight (total):	.126 gr.
Length (overall):	.19" (48.3mm)
Primer type:	percussion
Propellant type:	IMR4475
Propellant weight:	25 gr.
Projectile weight:	n/a
Chamber pressure:	n/a
Velocity of projected grenade:	.140 to 165 fps, measured 5' 6" from muzzle

Cartridge, 5.56mm, Tracer, M196

Type Classification STD-AMCTC 5055

Used in rifles, 5.56mm M16 and M16A1 to permit visible observation of the bullet's in-flight path or trajectory to the point of impact. This ammunition may be used in M16A2, M16A3, M16A4, M4 and M4A1 carbines,

Specifications

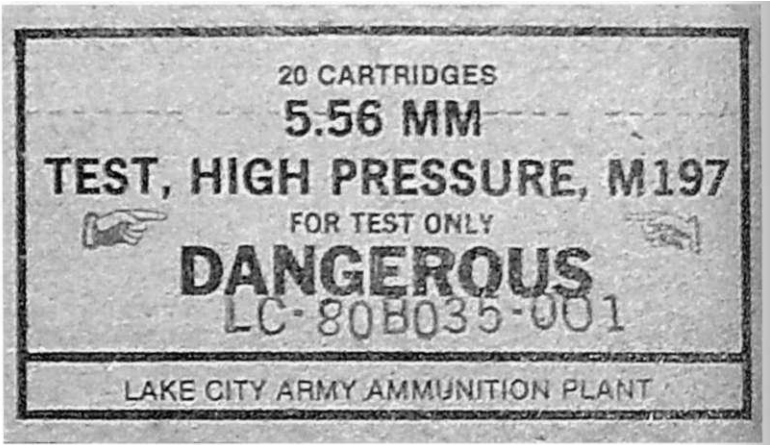
Drawing number	.10534193
Identification:	red bullet tip
Weight (total):	.177 gr.
Length (overall):	2.26" (57.4mm)
Tracer compound:	R284
Primer type:	percussion
Propellant type:	WC 844 or IMR 8208M
Propellant weight:	28.5 or 25.3 gr.
Projectile Weight	.54 gr.
Chamber pressure.	52,000 psi
V <sup>15</sup>	3,200 fps

Cartridge, 5.56mm, High Pressure Test, M197

Type Classification STD-AMCTC 4484

This cartridge is loaded with a particular propellant that produces pressures substantially higher than the service rounds. It is used in rifles, 5.56mm M16 and M16A1 for proof test of weapons during manufacture, test or repair. This ammunition may also be used for proof testing M16A2, M16A3, M16A4 rifles, and M4 and M4A1 carbines.

619 (right). The front of a 20-round box of M197 High Pressure Test cartridges as loaded by the Lake City Army Ammunition plant in 1980.



**Specifications**

Identification:	. . . . .	stannic-stained (silvered) or nickel plated cartridge case
Weight (total):	. . . . .	.174 gr.
Length (overall):	. . . . .	2.26" (57.4mm)
Primer type:	. . . . .	percussion
Propellant type:	. . . . .	SR 7641
Propellant weight:	. . . . .	.16.7 gr.
Projectile weight:	. . . . .	.56 gr.
Chamber pressure:	. . . . .	.70,000 psi
Velocity:	. . . . .	n/a

**Cartridge, Dummy, 5.56mm, M199**

**Type Classification STD-AMCTC 4662**

Used in rifles, 5.56mm M16 and M16A1 for practice in loading weapons, for simulated firing to detect flinching of personnel when firing, and for testing	and inspecting weapon mechanisms. The cartridge has no primer or propellant, and has a plain bullet tip.
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**Specifications**

Drawing number:	. . . . .	.10534021
Identification:	. . . . .	six longitudinal flutes in the cartridge case
Weight (total):	. . . . .	.150 gr.
Length (overall):	. . . . .	2.26" (57.4mm)
Primer type:	. . . . .	n/a
Propellant type:	. . . . .	n/a
Propellant weight:	. . . . .	n/a
Projectile weight:	. . . . .	.55 gr.
Chamber pressure:	. . . . .	n/a
Velocity:	. . . . .	n/a

**Cartridge, 5.56mm, Blank, M200**

**Type Classification STD-AMCTC 5942**

Used in rifles, 5.56mm M16, M16A1, M16A2, M16A3 and M16A4 and in carbines M4 and M4A1 for simulated firing in training exercises and saluting	purposes. An engraved knurl is located 1/2 inch from the head of the cartridge case.
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**Specifications**

Drawing number:	. . . . .	.10542379
Identification:	. . . . .	rose-petal (rosette-crimp) closure of the cartridge case mouth, sealed with lacquer.
Weight (total):	. . . . .	.107 gr.
Length (overall):	. . . . .	.1.9" (48.3mm)
Primer type:	. . . . .	percussion
Propellant type:	. . . . .	HPC 13
Propellant weight:	. . . . .	.7 gr.
Projectile weight:	. . . . .	n/a
Chamber pressure:	. . . . .	n/a
Velocity:	. . . . .	n/a



## Cartridge, Dummy, 5.56mm, M232

### Type Classification STD-AMCTC 4485

Used in rifles, 5.56mm M16 and M16A1 for practice in loading weapons, for simulated firing to detect flinching of personnel when firing, and for testing

and inspecting weapon mechanisms. The cartridge has no primer or propellant.

### Specifications

Drawing number:	. . . . .	.10534146
Identification:	. . . . .	black chemical finish over the entire round
Weight (total):	. . . . .	.161 gr.
Length (overall):	. . . . .	2.26" (57.4mm)
Primer type:	. . . . .	n/a
Propellant type:	. . . . .	n/a
Propellant weight:	. . . . .	n/a
Projectile weight:	. . . . .	n/a
Chamber pressure:	. . . . .	n/a
Velocity:	. . . . .	n/a

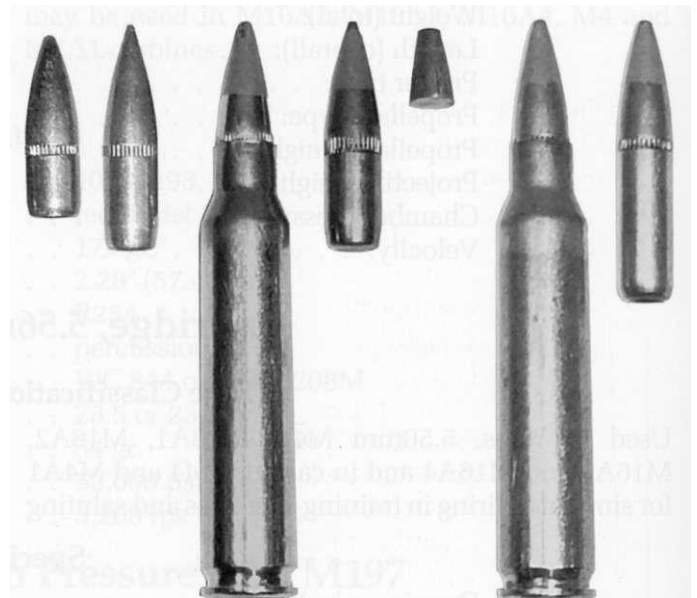
## Cartridge, 5.56mm, Ball, M855

### Type Classification STD-MSR 05826003

Used in rifles, 5.56mm M16A2, M16A3 and M16A4, in carbines M4 and M4A1, and also used in M249 machine guns against personnel and light armored vehicles. The bullet has a steel "penetrator" core inside the copper jacket.

### Specifications

Drawing number:	. . . . .	9342862
Identification:	. . . . .	green bullet tip
Weight (total):	. . . . .	.190 gr.
Length (overall):	. . . . .	2.26" (57.4mm)
Primer type:	. . . . .	percussion
Propellant type:	. . . . .	WC 844
Propellant weight:	. . . . .	26.1 gr.
Projectile weight:	. . . . .	.62 gr.
Chamber pressure:	. . . . .	55,000 psi
V <sup>78</sup> :	. . . . .	.3,025 fps



620. A comparison of 5.56mm projectiles. From left:

- 55-gr. M193 Ball bullet;
- 54-gr. M196 Tracer bullet (red tip);
- M855 Ball cartridge (green tip);
- 62-gr. M855 bullet;
- M855 penetrator core;
- M856 Tracer cartridge (orange tip);
- 63.7-gr. M196 tracer bullet).

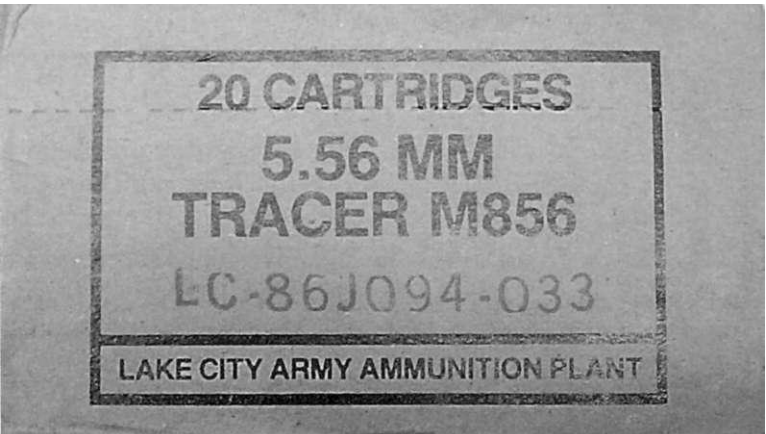
**Cartridge, 5.56mm, Tracer, M856**

**Type Classification STD-MSR 05826002**

Used in rifles, 5.56mm M16A2, M16A3 and M16A4, in carbines M4 and M4A1, and also used in M249 machine guns to permit visible observation of the bullet's in-flight path or trajectory to the point of impact.

**Specifications**

- Drawing number: . . . . . 9342863
- Identification: . . . . . orange bullet tip
- Weight (total): . . . . . 191 gr.
- Length (overall): . . . . . 2.26" (57.4mm)
- Tracer compound: . . . . . not available
- Primer type: . . . . . percussion
- Propellant type: . . . . . WC 844
- Propellant weight: . . . . . 24.7 gr.
- Projectile weight: . . . . . 63.7 gr.
- Chamber pressure: . . . . . 55,000 psi
- V<sup>78</sup>: . . . . . 2,870 fps



621. The front of a 20-round box of M856 Tracer cartridges as loaded by the Lake City Army Ammunition plant in 1986.

**Cartridge, 5.56mm, Plastic, M862**

**Type Classification STD- not assigned yet**

Used in rifles, 5.56mm M16, M16A1, M16A3 and M16A4, in conjunction with M2 Practice Bolt, for training in local and urban training areas where range

restrictions preclude use of standard service ammunition.

**Specifications**

- Drawing number: . . . . . 12598589
- Identification: . . . . . blue plastic bullet
- Weight (total): . . . . . 108 gr.
- Length (overall): . . . . . 2.03" (51.6mm)
- Primer type: . . . . . percussion
- Propellant type: . . . . . WPR 260
- Propellant weight: . . . . . 8.7 gr.
- Projectile weight: . . . . . 3.6 gr.
- Chamber pressure: . . . . . 15,750 psi
- V<sup>15</sup>: . . . . . 4,525 fps

**Cartridge, 5.56mm, Armor Piercing (AP), M995**

**Type Classification STD- 29 March, 1996**

Used in rifles, 5.56mm M16A2, M16A3 and M16A4, in carbines M4 and M4A1, and also authorized for use in M249 machine guns to provide improved

penetration performance against various targets as compared to standard ball ammunition.

**Specifications**

- Drawing number: . . . . . 12956131
- Identification: . . . . . black bullet tip
- Weight (total): . . . . . 180 gr.

374 Cartridge, 5.56mm, Armor Piercing (AP), M995

Length (overall): . . . . . 2.25" (57.15mm)  
Primer type: . . . . . 4.5mm Berdan  
Propellant type: . . . . . WCR845  
Propellant weight: . . . . . 27.5 gr.  
Projectile weight: . . . . . 52 gr.  
Chamber pressure: . . . . . 50,250 psi  
 $V^{78}$ : . . . . . 3,324 fps