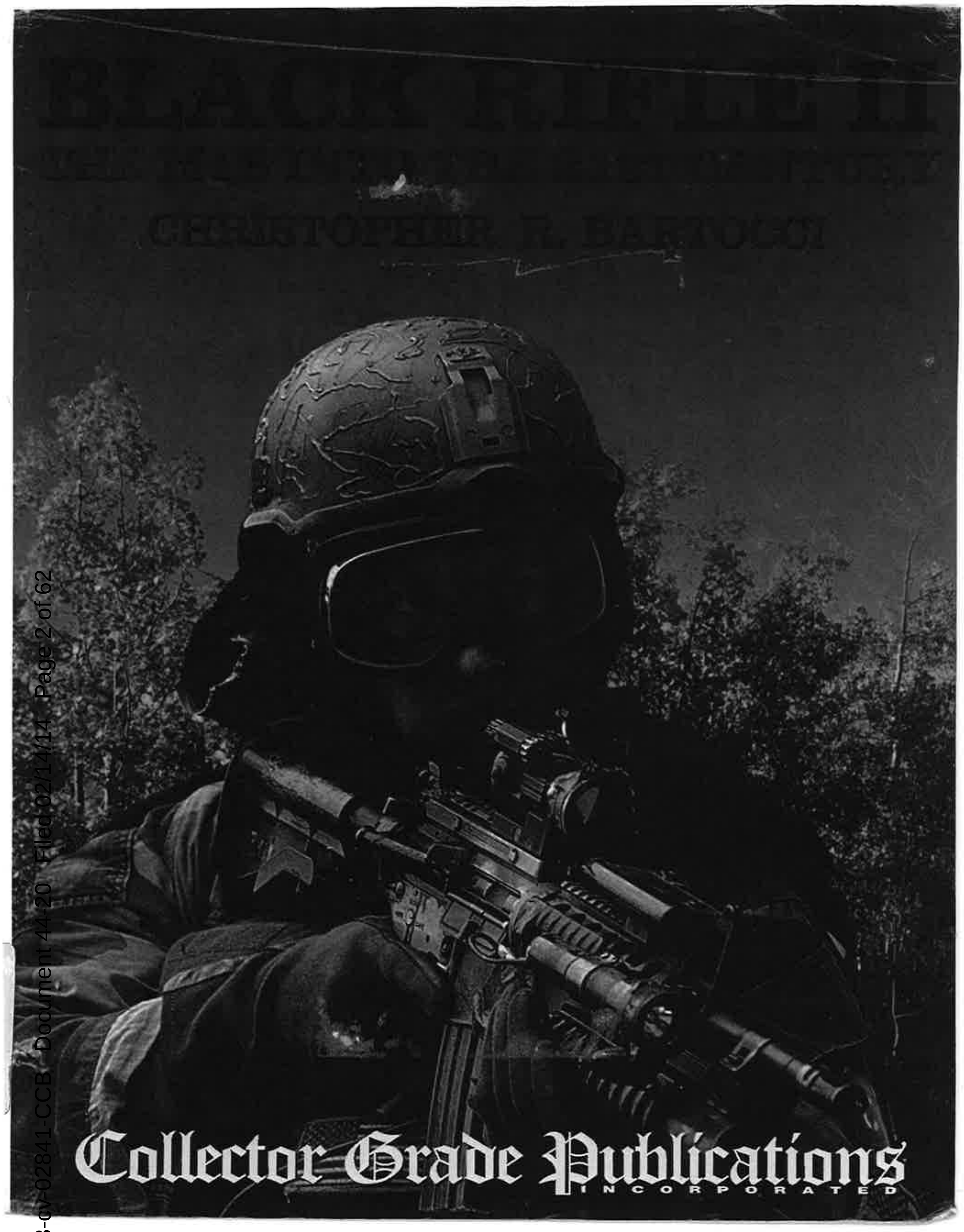
Exhibit 20

To Defendants' Memorandum in Support of Motion for Summary Judgment


BLACK RIFLE II
CHRISTOPHER R. BARTOCCI
Collector Grade Publications
INCORPORATED

SOPMOD M4 Accessory Kit

Special Operations Peculiar Modification to the M4 Carbine

Block I Accessory Kit

Reflex Sight
NSN: 1240-01-435-1916

4X Day Optical Scope
NSN: 1240-01-412-6608

Backup Iron Sight
NSN: 1005-01-449-6306

AN/PEQ-5 Carbine Visible Laser
NSN: 5860-01-439-5409

AN/PVS-17A Mini Night Vision Sight
NSN: 5855-01-474-8904

Visible Light Illuminator
NSN: 5855-01-448-5464

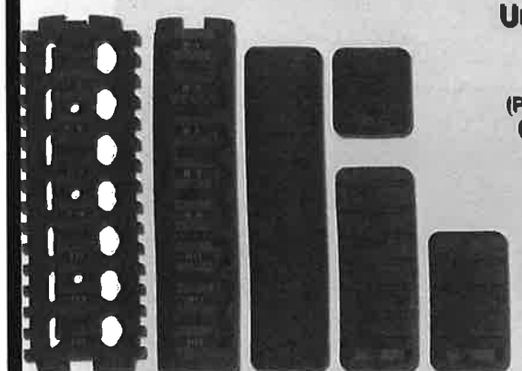
AN/PEQ-2 Infrared Illuminator
NSN: 5855-01-422-5253

Combat Sling Assembly
NSN: 1005-01-459-4390

M4A1 Carbine w/Carrying Handle
NSN: [illegible]-01-382-0953

Universal Pocketscope Mount (PVS14)
NSN: 5855-01-482-6164
(PVS18) NSN: 5855-01-485-7749
(M68) NSN: 5855-01-485-7755

Sound Suppressor Kit
NSN: 1005-01-437-0324



Rail Interface System
NSN: 1005-01-416-1089

Grenade Launcher Mount
NSN: 1005-01-416-1090

M203 9" Barrel Assembly
NSN: 1010-01-[illegible]0-7422

Grenade Launcher Leaf Sight
NSN: 1010-01-418-4588

Forward Handgrip
NSN: 1005-01-416-1091

NAVSEA
CRANE
Surface Warfare Center Division

SOPMOD M4 Block I Accessory Kit

Special Operations Peculiar Modification to the M4 Carbine Block I Accessory Kit

Program Mission: The SOPMOD Program Management Office at NSWC Crane, IN, will provide standardized, versatile weapons accesso to meet needs across SOF mission scenarios. These accessories will increase operator survivability and lethality by enhanced weapon performance, target acquisition, signature suppression, and fire control. SOPMOD PMO will provide these accessories when they are operation suitable, affordable, sustainable, and funded.

Program Sponsor: United States Special Operations Command

Program Manager: Naval Surface Warfare Center, Crane Divisio

Website: http://ssavie.socom.mil

BLACK RIFLE II

BLACK RIFLE II

THE M16 INTO THE 21st CENTURY

CHRISTOPHER R. BARTOCCI

PRODUCED AND EDITED BY R. BLAKE STEVENS

Collector Grade Publications
INCORPORATED

2004

The Collector Grade Library, 1979 - 2004

— our 25th year —

- *American Beauty: The Prewar Colt National Match Government Model Pistol* (1999) by Timothy J. Mullin
- *Backbone of the Wehrmacht—The German K98k Rifle, 1934 - 1945* (1991; 1993; 2001) by Richard D. Law
- *The Belgian Rattlesnake—The Lewis Automatic Machine Gun* (1998) by William M. Easterly
- *The Black Rifle—M16 Retrospective* (1987; 1992; 2004) by R. Blake Stevens and Edward C. Ezell
- *Black Rifle II—The M16 Into the 21st Century* (2004) by Christopher R. Bartocci
- *The Bren Gun Saga* (1986; Revised and Expanded Edition, 1999) by Thomas B. Dugelby
- *The Browning High Power Automatic Pistol* (1984; 1990) by R. Blake Stevens
- *Crown Jewels: The Mauser in Sweden - A Century of Accuracy and Precision* (2003) by Dana Jones
- *Death From Above—The German FG42 Paratroop Rifle* (1990) by Thomas B. Dugelby and R. Blake Stevens
- *The Devil's Paintbrush—Sir Hiram Maxim's Gun* (1989; 1993; Expanded Edition 2002) by Dolf L. Goldsmith
- *EM-2 Concept & Design—A Rifle Ahead of its Time* (1980) by Thomas B. Dugelby
- *The FAL Rifle* (1993 Classic Edition of the three-volume *FAL Series*) comprising:
  - *North American FALs* (1979; 1989) by R. Blake Stevens
  - *UK and Commonwealth FALs* (1980; 1989) by R. Blake Stevens
  - *The Metric FAL* (1981; 1989) by R. Blake Stevens and Jean E. Van Rutten
  - *The FAL Series Index* (1989) by Eino Sierpe and R. Blake Stevens
- *The Gas Trap Garand* (1999) by Billy Pyle
- *The Grand Old Lady of No Man's Land—The Vickers Machinegun* (1994) by Dolf L. Goldsmith
- *The Great Remington 8 and Model 81 Autoloading Rifles* (2003) by John Henwood
- *The Guns of Dagenham—Lanchester, Patchett, Sterling* (1995) by Peter Laidler and David Howroyd
- *Hitler's Garands—German Self-Loading Rifles of World War II* (2001) by W. Darrin Weaver
- *Honour Bound—The Chauchat Machine Rifle* (1995) by Gerard Demaison and Yves Buffetaut
- *Inglis Diamond: The Canadian High Power Pistol* (2001) by Clive M. Law
- *Kalashnikov: The Arms and the Man* (2001) a Revised and Expanded Edition of *The AK47 Story* by Edward C. Ezell
- *The Last Enfield—SA80: the Reluctant Rifle* (2003) by Steve Raw
- *Mauser: Original Oberndorf Sporting Rifles* (1997) by Jon Speed, Walter Schmid and Reiner Herrmann
- *Mauser Smallbores: Sporting, Target & Training Rifles* (1998) by Jon Speed
- *MG34 - MG42—German Universal Machineguns* (2002) by Folke Myrvang
- *Modern Military Bullpup Rifles—The EM-2 Concept Comes of Age* (1984) by Thomas B. Dugelby
- *The '03 Era—When Smokeless Revolutionized U.S. Riflery* (1994) by Clark S. Campbell
- *Proud Promise—French Autoloading Rifles, 1898 - 1979* (1995) by Jean Huon
- *Rock in a Hard Place—The Browning Automatic Rifle* (2000) by James L. Ballou
- *Sniper Variations of the German K98k Rifle* (1996) by Richard D. Law
- *The SPIW—The Deadliest Weapon that Never Was* (1984) by R. Blake Stevens and Edward C. Ezell
- *The Sten Machine Carbine* (2000) by Peter Laidler
- *Thompson: the American Legend—The First Submachine Gun* (1996) by Tracie L. Hill
- *US Rifle M14—From John Garand to the M21* (1983; 1988; 1991) by R. Blake Stevens
- *WAR BABY! The US Caliber .30 Carbine* (1992; 1998; 2001) by Larry L. Ruth
- *WAR BABY Comes Home—The US Carbine Volume II* (1993; 2001) by Larry L. Ruth

ISBN 0-88935-348-4

Published by Collector Grade Publications Incorporated
PO Box 1046 Cobourg, Ontario K9A 4W5 Canada
Printed and Bound in Canada

Acknowledgements

The 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.

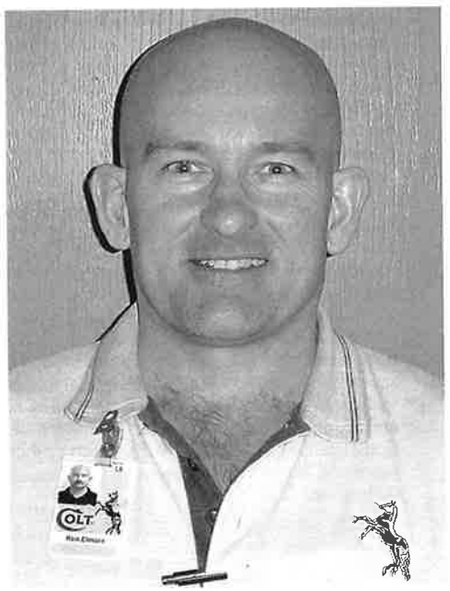
While I appreciate the co-operation from Colt and its associated people, the views, analyses, and conclusions made in this book are based on my own independent research and work and are not necessarily attributable to Colt, and Colt bears none of the responsibility for the accuracy, completeness or usefulness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

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.
Used with permission, all rights reserved

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.

- 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 Heines, 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 Théroux, 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.

Table of Contents

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

This 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 beaurocratic 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

The 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*

This 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

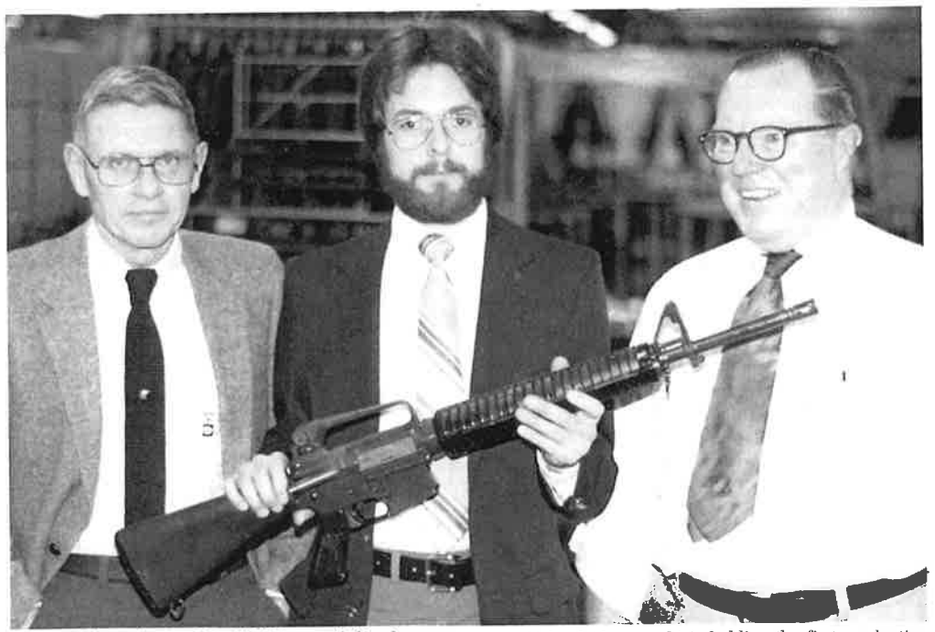
In the absence of any similar enthusiasm from the Army, whose inventory of M16A1s was still quite substantial, the Marines began unilateral negotiations with Colt's in January, 1980, contracting for the supply of three rifles modified in accordance with the USMC's primary requirements. Encouraged by 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 *TBR* 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

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.

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.

For more information, write Colt Firearms, P.O. Box 1868, Hartford, CT 06101; Telex 994421 Colt Fire Hfd, or call 203-236-6311.

COLT Firearms
Hartford, CT 06101

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.

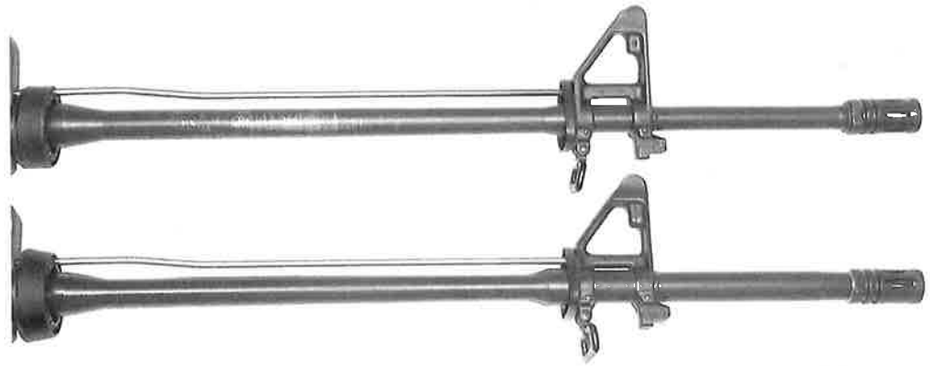
2. The Controversial "Heavy" Barrel

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.

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.

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 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 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!



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.

To answer this problem, the overall diameter of the barrel was increased, which made it 2½ 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.

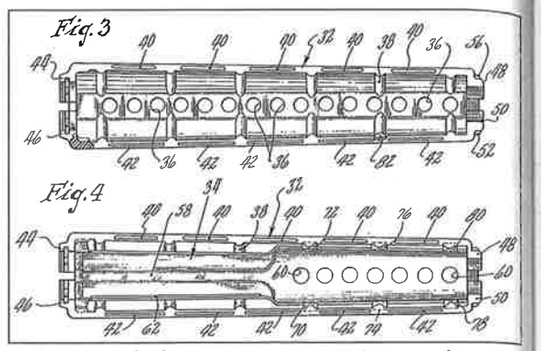
8. Top closeup of the new M16A2 four-position square front sight post.

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

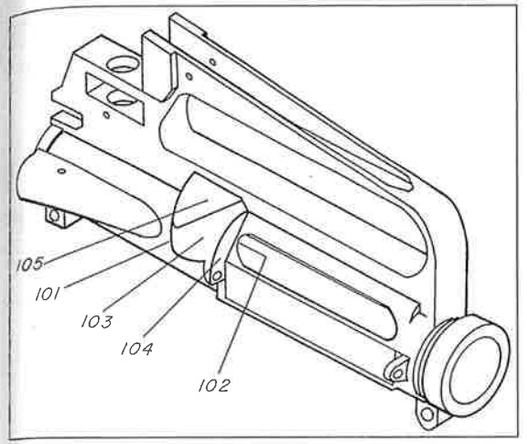
The new "Cylindrical Rifle Handguard Assembly" was developed by Colt engineers Harold Waterman and Seth Bredbury and patented under US Patent no. 4,536,982, dated August 27, 1985. This was an interchangeable half-round handguard that utilized snap-in heat shields instead of the riveted heat shields of 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.

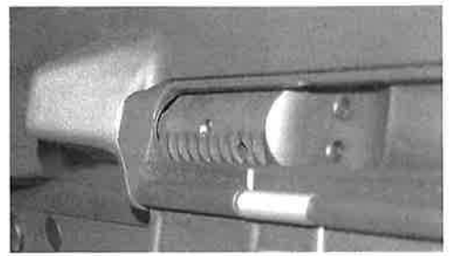
6. The Integral Fired Cartridge Case Deflector



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 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.



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.

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.

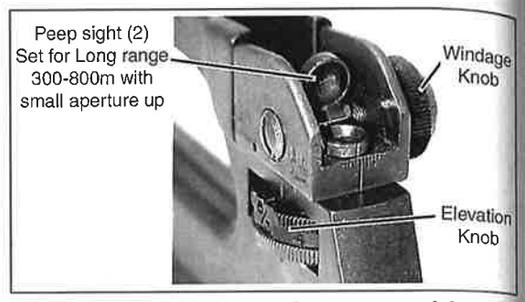
7. The Fully-Adjustable Rear Sight

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 protoytype version, depicted in fig. 375 on page 353 of *TBR*.

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 Wincentsen, 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.

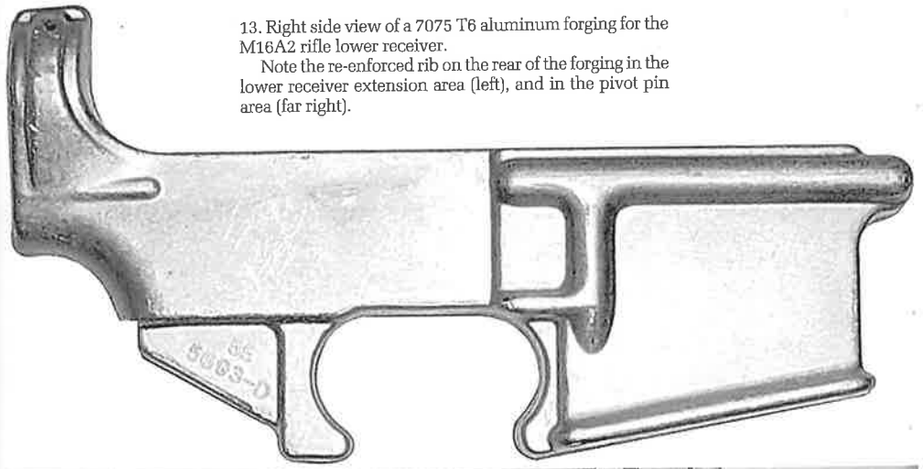
As of this writing, the Marine Corps is the only branch of the US Armed Forces which trains its troops in the use of the fully adjustable rear sight. The Army and Air Force train their people in battlesight-zero only. They zero the rifles at 25 meters at point of aim, after which the rifles will fire 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.

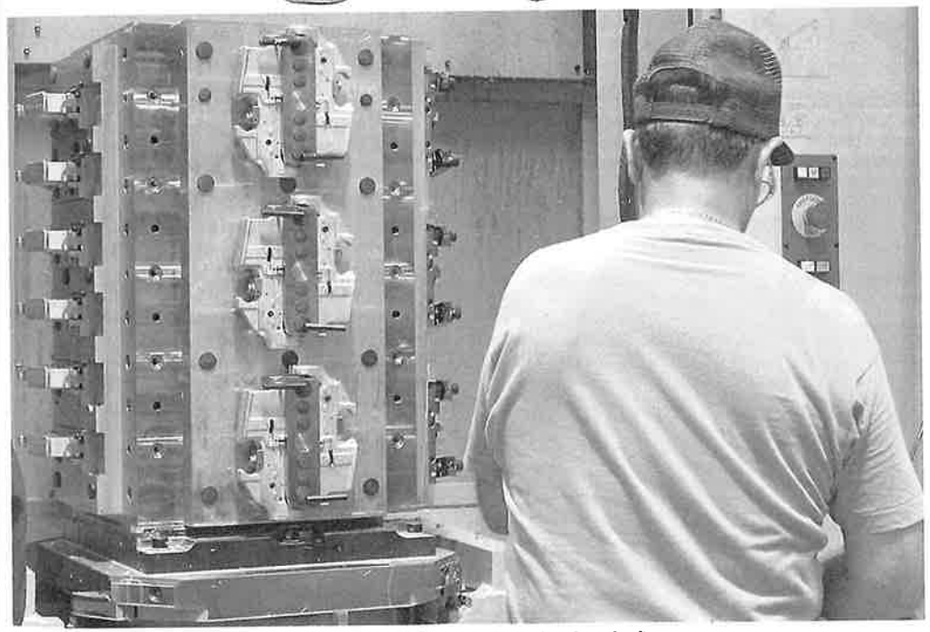
As shown in fig. 434, two different versions of the round button-style forward assist plungers exist. The early type was a large-diameter button with a flat edge on the inside, and the later (current) style features a smaller-diameter round button.

9. The Strengthened Lower Receiver



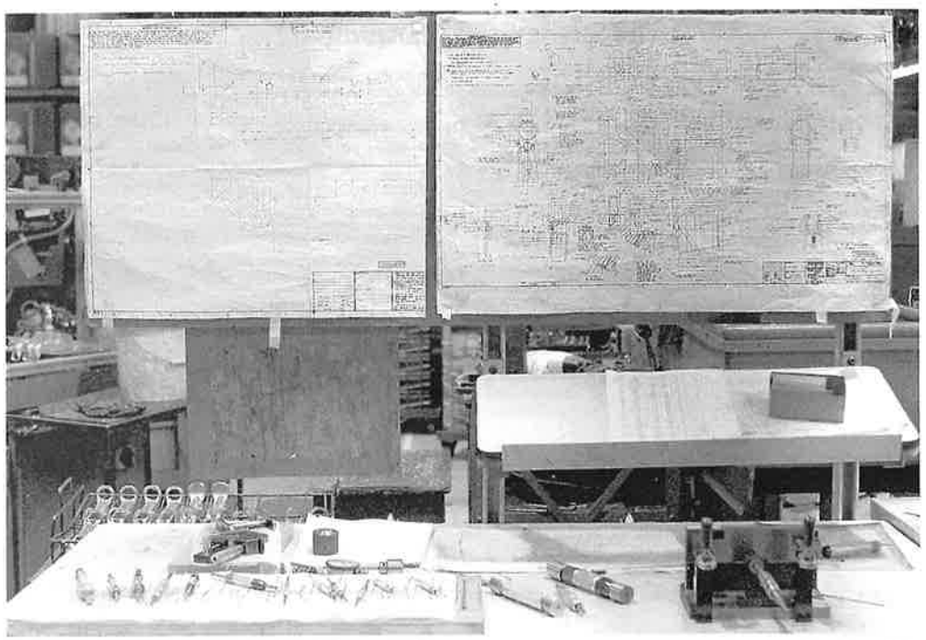
13. Right side view of a 7075 T6 aluminum forging for the M16A2 rifle lower receiver.

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 forgings placed on the fixture.

photo by Joe Hearon, © 2003 Colt Defense LLC.
Used with permission, all rights reserved



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.

photo by Joe Hearon, © 2003 Colt Defense LLC. Used with permission, all rights reserved

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.

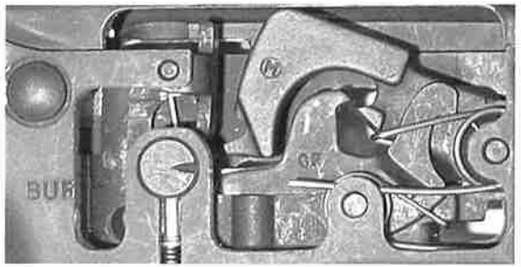
Note the integral fired cartridge case deflector, the selector lever markings on the lower receiver, and the redesigned pistol grip, as well as the new Colt "Delta Ring" (right). This modified slip-ring is canted to enable easier removal of the handguards.

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 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



18. Right side closeup of the M16A2 Burst mechanism as seen through a cutaway M16A2 rifle.
Note the second disconnector on the right, with its claw engaged on the burst cam of the hammer.

Accommodating the Burst Mechanism

The hammer had two modifications made to it for use with the burst mechanism. First, the disconnector hook was extended to the right, so that the pawl on the burst disconnector 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 disconnector so the burst mechanism could function. First, the width of the trigger was increased so both disconnectors would fit, along with the two disconnector 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 disconnector is identical to the standard M16A1 semi-automatic and automatic disconnector, 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 disconnector. The second, or burst disconnector, 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 disconnector 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 disconnector keeps it in place.

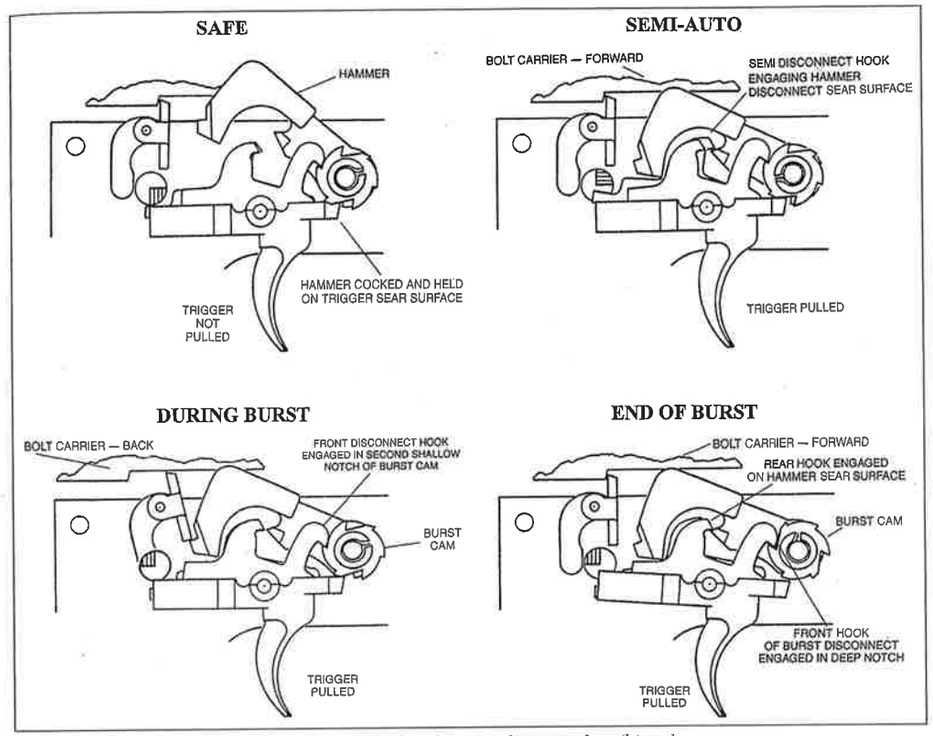
As the bolt assembly moves rearward, the clutch spring on the cam clutches the burst cam and causes it to rotate to the next notch as the hammer is forced rearward. When the bolt carrier assembly has made its full rearward movement, the hammer is caught and held by the auto sear.

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 disconnector is in the stop notch, which is much deeper than the other notches, so that the front hook of the disconnector is further forward than 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.



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 disconnector 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.

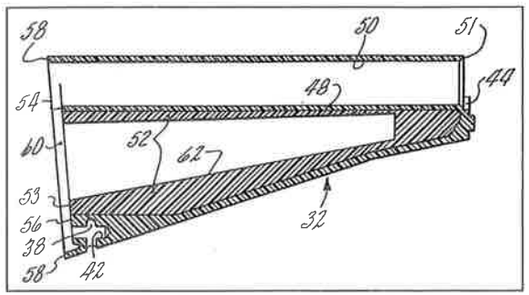
Since the burst cam is always engaged by the burst disconnector, there actually are three different semi-auto trigger pull weights. However, despite USMC Major R. N. Jepperson's carefully documented assertions (discussed on page 358 of *TBR*) that the trigger pull gets progressively *heavier*, the truth is that the first two pulls are quite similar, due to the burst disconnector claw engaging the two shallow notches on the burst cam, but the third pull is fractionally *lighter*, caused by the burst disconnector 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 5½ and 9½ 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.

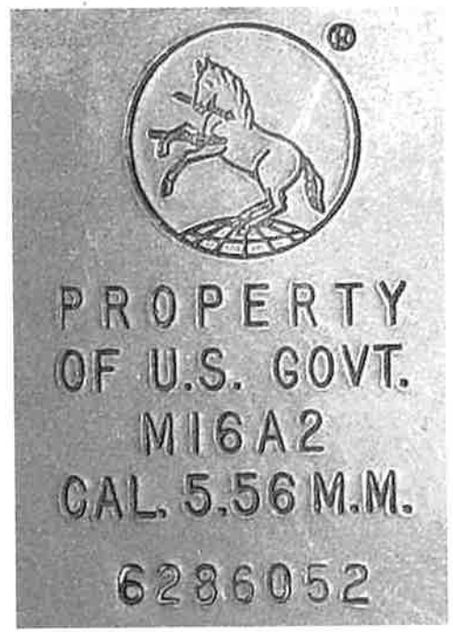
The trapdoor was also modified and improved. The latch was made easier to open by hand without the need for a cartridge or other tool to gain access to the cleaning kit storage cavity inside the stock. The face of the trap door was also fully checkered, in keeping with the rest of the buttplate.

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

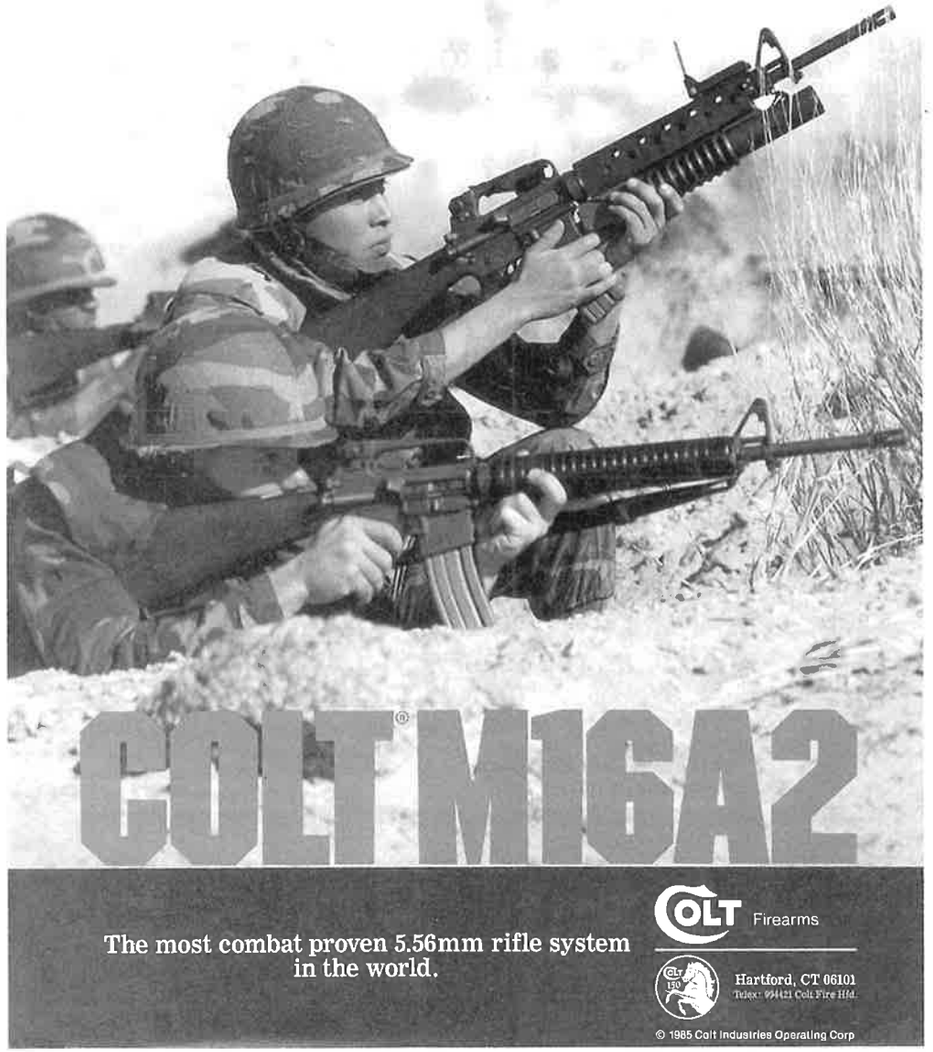
22. The cover of the Colt M16A2 Rifle Operator's Manual dated 1984.

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



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

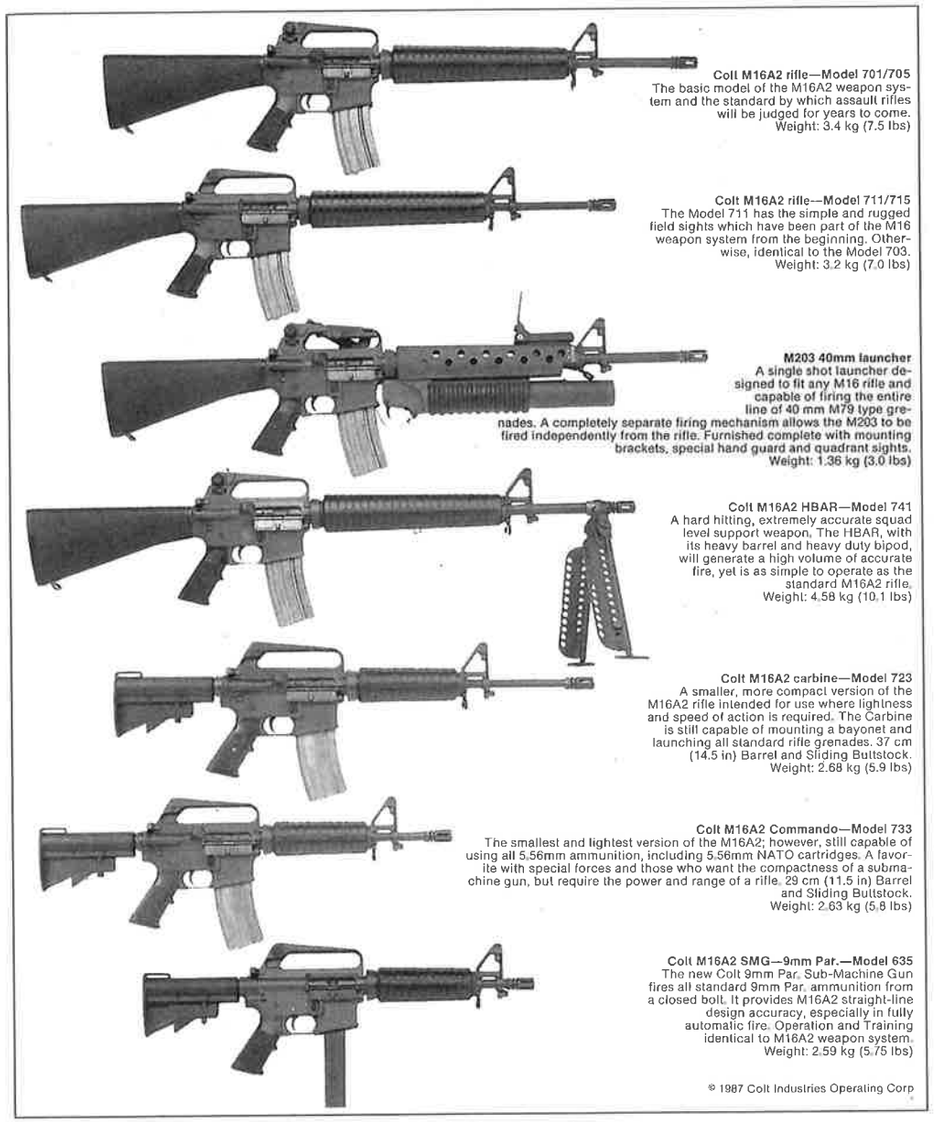
24. US Army Basic Rifle Marksmanship (BRM) training with the M16A2 rifle. US Army photo



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

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.



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

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:

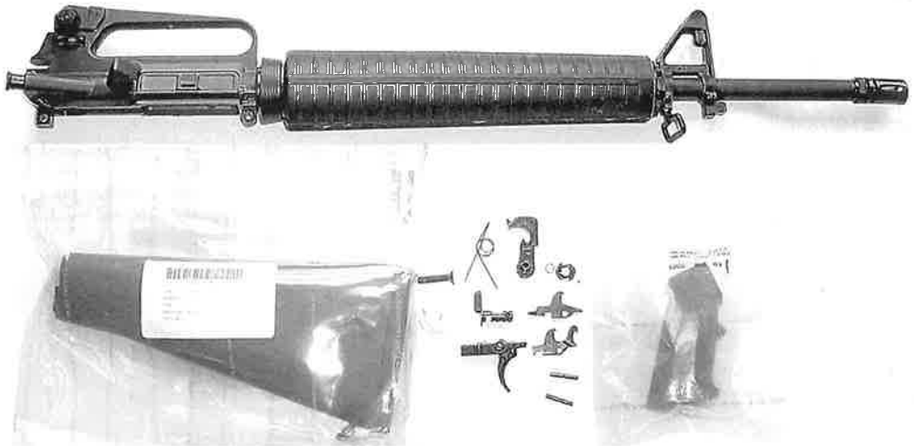
Malfunctions and Unserviceable Parts Permitted in 6,000 Rounds

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, disconnector, 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

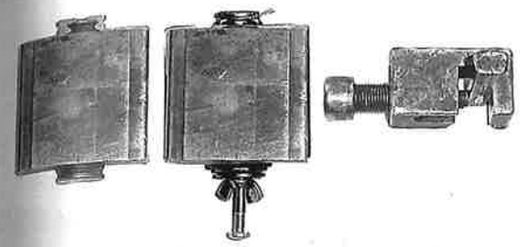
The refurbishment kit consists of:

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).

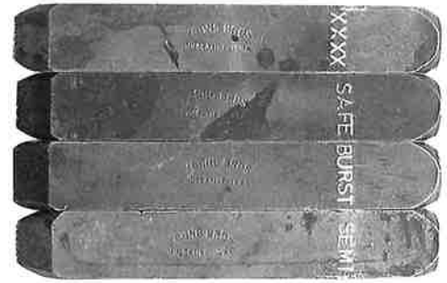
The refurbished A2 rifle keeps the original lower receiver and its extension, the charging handle, and bolt carrier group. The rest of the rifle is completely updated to the A2 configuration, with the exception of the benefits of the reinforced pivot pin and extension areas on the lower receiver.

Re-marking the Lower Receiver

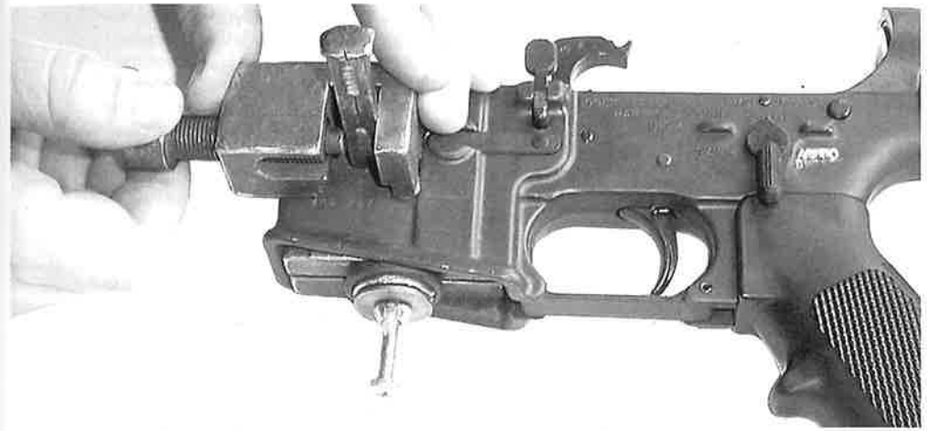
Two methods are employed to add the selector settings to the right side, change AUTO to BURST on the left, and add "A2" to the model designation on the left side of the lower receiver. The first method is by stamping. Five metal stamps are provided (SAFE, SEMI, BURST, A2 and XXXX), along with three steel fixtures. The first fixture is a protective brace, in two halves, which are put together and inserted in the



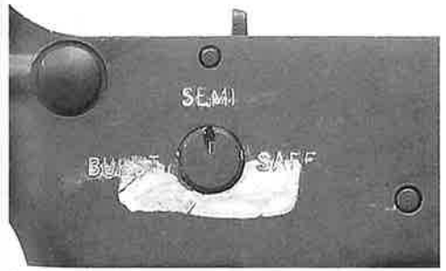
29. The two halves of the magazine well brace, left, and the "A2" punch and its positioning fixture.
courtesy Anthony Harvey



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 the 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	Group Extreme Spread (cm)	
		Start	3,600 rounds	6,000 rounds
M16A1	M193	19.03	18.73	17.73
M16A1E1	XM855	27.43	31.23	62.23

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:

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 Three

The M4/M4A1 Carbine

The "Shorty" Program Revisited

As 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.

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 ½" 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 ½" as well as 14 ½" 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 Masood, Ken Maynard (M4 Project Manager), Kevin Kaminski, John Kyser, Jim Taylor, Chris Lynch and Derry Baily.
courtesy Jim Taylor

Determining the Optimal Gas Port Size

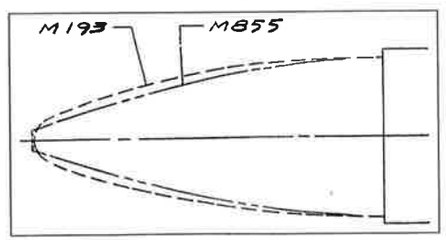
In an effort to decrease the cyclic rate of fire, the gas ports on these carbines were initially bored to a reduced diameter of 0.062", so that they could be opened up if desired during further experimentation. During testing, it was found that M855 ammunition fired more reliably in the XM4, producing 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



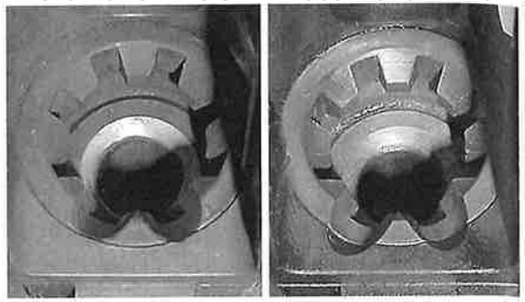
81. Colt drawing showing the profile of the SS109/M855 Ball 5.56mm NATO projectile (solid line) compared to the then-standard M193 bullet (dotted line). This change in shape prompted a redesign of the feed ramps on the XM4/M4 carbine.

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 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).



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.

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 exception 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 Disconnector 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 disconnector was causing a "doubling" malfunction. In the early 1990s Colt introduced a new heavier semi-automatic disconnector 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.

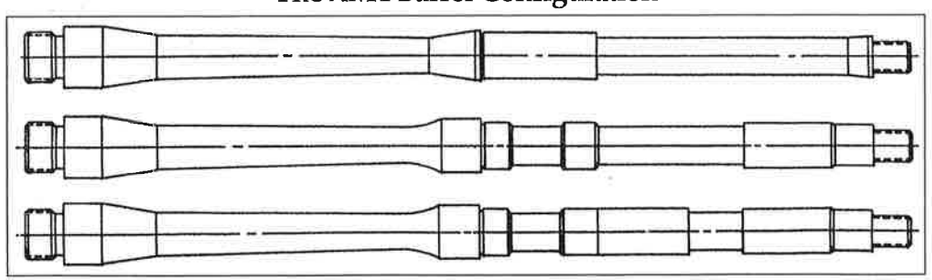
During testing, ten carbines were equipped with the standard carbine buffer and fired in 120-round cycles. Each cycle consisted of firing four 30-round magazines, with the first two magazines (60 rounds) fired in three-shot bursts and the last two magazines (the remaining 60 rounds) fired semi-automatically.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

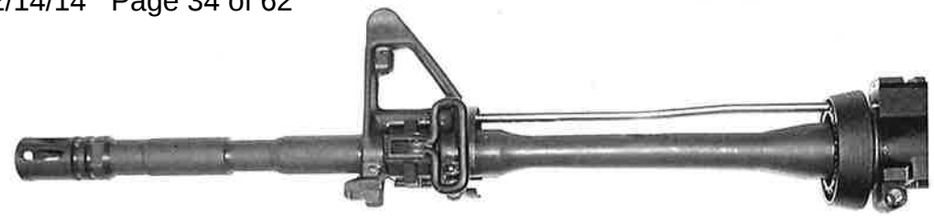
The third design shown (below) was chosen.

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 ½ inches.
3. Must use the current M16A2 compensator.
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 ½ 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.



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.

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.

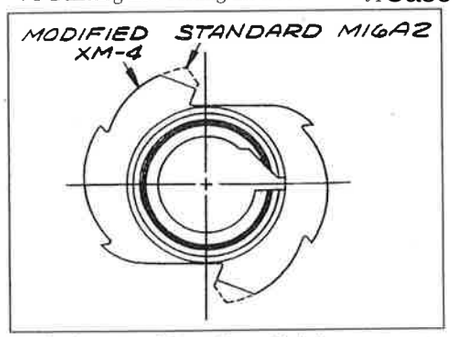
During the development phases the sustained rate of fire and "cook-off" points of the XM4 were found to be comparable to those of the M16A2 service rifle. During testing it was found that after firing approximately 174 rounds at a rate 85 to 87 rounds per minute, including 10 seconds to reload, it took 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 disconnector, the fourth shot occurring when the disconnector hook lost engagement with the hammer disconnector 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 disconnector 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 disconnector claw to engage sooner, preventing the failure.

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 disconnector 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 disconnector 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.

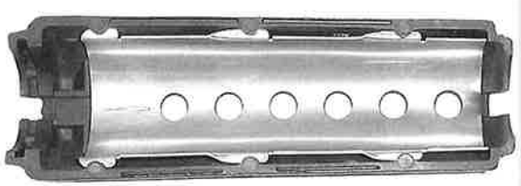
87. The final design of the M4 burst cam. This cam is nickel-plated to differentiate it from the standard rifle burst cam.

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

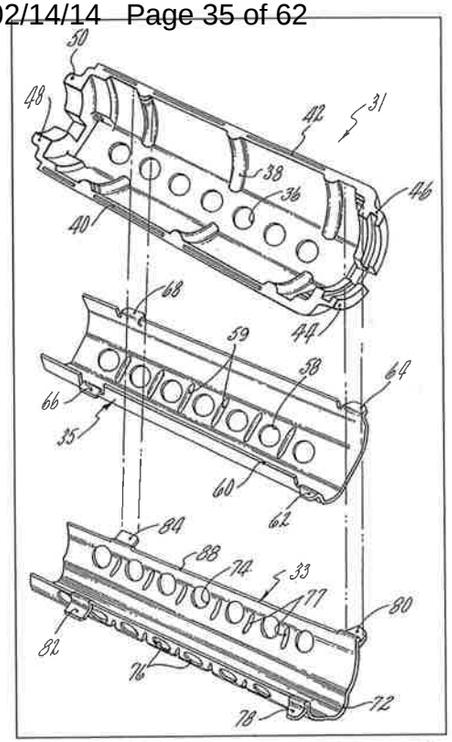
The Improved XM4 Handguards

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



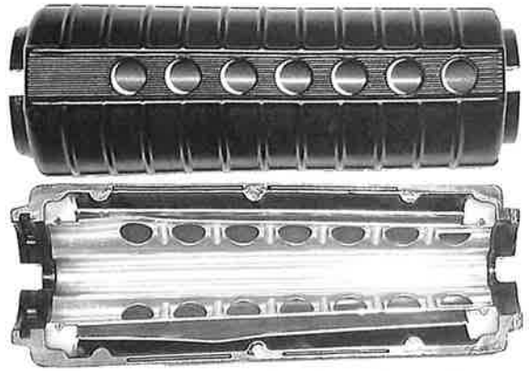
88. The early carbine handguard, made from the modified M16A1 rifle handguard. The vent holes in the heat shield were in line with the holes in the handguard, which did little to protect the shooter when the barrel got extremely hot from consistent fire.



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:

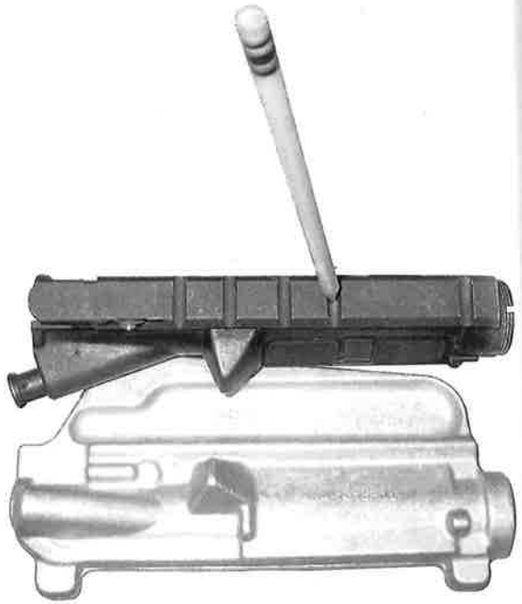
. . . Picatinny's plan to standardize a common mounting interface on all small arms and crew-served weapons centered around two companies, ARMS, Inc., and Colt Firearms. ARMS was already manufacturing male and female dovetail rail attachments for delivery to the US military, some of which had already 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

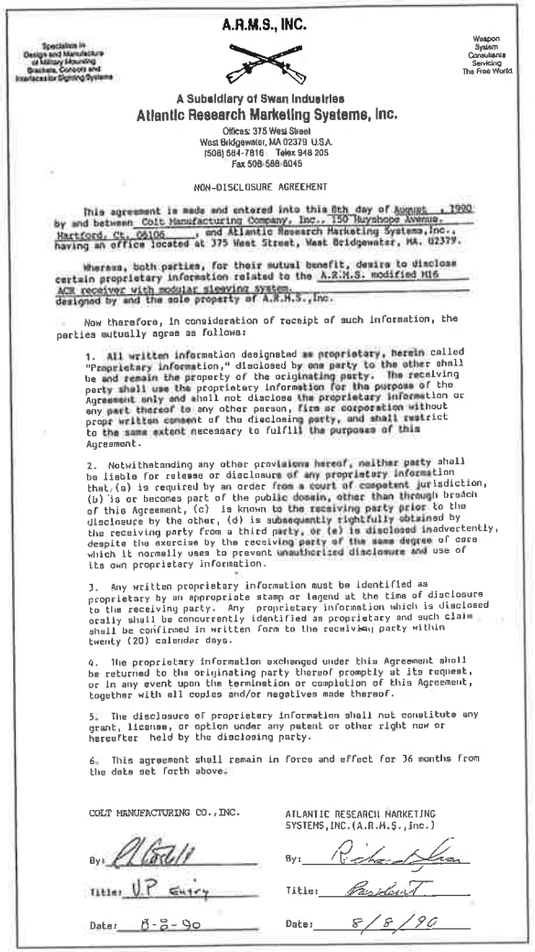
On August 8, 1990, the day after the ACR program field experiment had been concluded, a non-disclosure agreement regarding the "ARMS-modified M16 ACR receiver with modular sleeving system", for which the dimensions were provided by Swan and the drawing produced by Colt, was signed by Richard Swan and 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, athough 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.



A.R.M.S., INC.

Specialists in Design and Manufacture of Military Mounting Brackets, Conceptu and Interfaces for Sighting Systems

Weapon System Consultants Servicing The Free World

A Subsidiary of Swan Industries
Atlantic Research Marketing Systems, Inc.
Offices: 375 West Street
West Bridgewater, MA 02379 U.S.A.
(508) 584-7816 Telex 948 205
Fax 508-588-6045

NON-DISCLOSURE AGREEMENT

This agreement is made and entered into this 8th day of August, 1990 by and between Colt Manufacturing Company, Inc., 150 Huyshope Avenue, Hartford, Ct. 06106, and Atlantic Research Marketing Systems, Inc., having an office located at 375 West Street, West Bridgewater, MA. 02379.

Whereas, both parties, for their mutual benefit, desire to disclose certain proprietary information related to the A.R.M.S. modified M16 ACR receiver with modular sleeving system, designed by and the sole property of A.R.M.S., Inc.

Now therefore, in consideration of receipt of such information, the parties mutually agree as follows:

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.

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.

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.

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.

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.

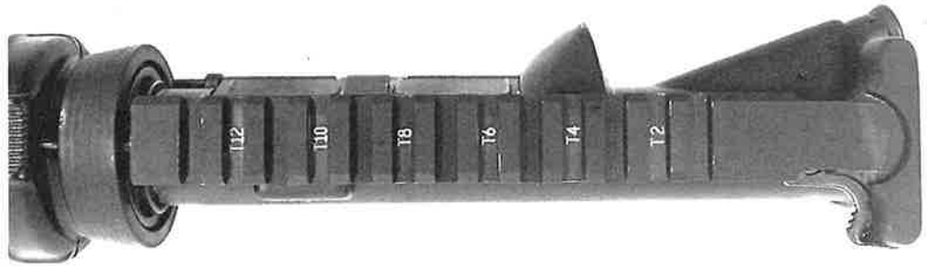
6. This agreement shall remain in force and effect for 36 months from the date set forth above.

COLT MANUFACTURING CO., INC. — By: [signature] Title: V.P. Engr. Date: 8-8-90

ATLANTIC RESEARCH MARKETING SYSTEMS, INC. (A.R.M.S., Inc.) — By: [signature] Title: President Date: 8/8/90

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.

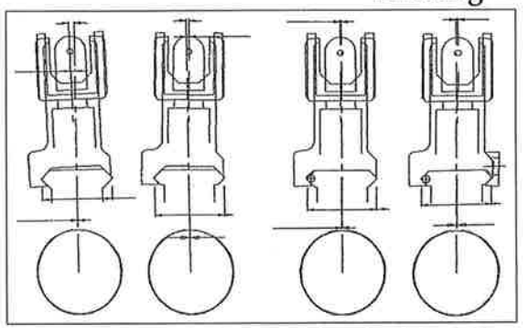
The dimensions of the Swan/NATO rail, which later became the MIL-STD-1913 rail, were included in the accompanying drawing. courtesy ARMS, Inc.



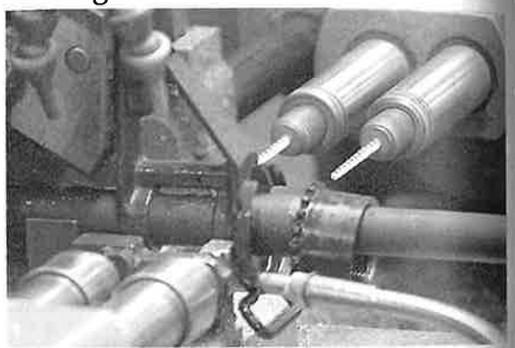
95. Top view of an M4 carbine, showing the integral MIL-STD-1913 rail.

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.



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.

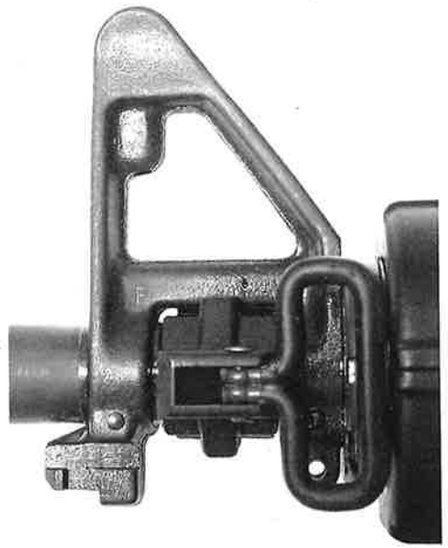
This is a very critical procedure: if the front sight assembly is not located properly, the gas port will not line up and the rifle/carbine will not function.

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 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 simply 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 ½", 14 ½" 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.

102. Left side closeup of the Colt M4A1 carbine, showing markings.
Note the AUTO selector lever setting.

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).

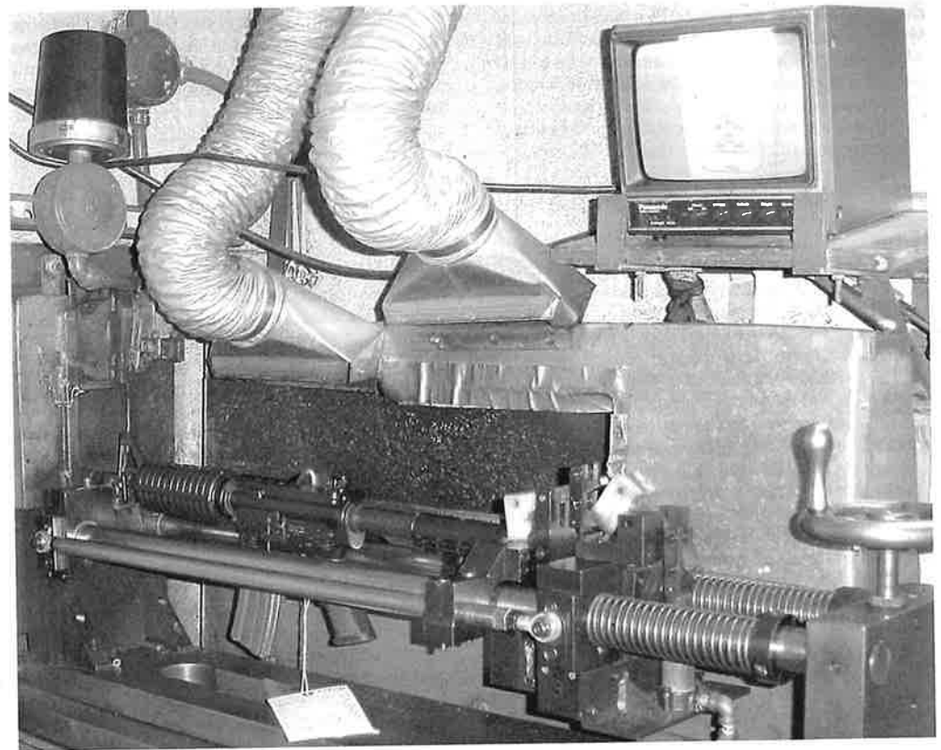
Colt introduced their new "flat-top" upper receiver in 1992, and early carbines shipped with the flat-top upper receiver were called the Colt M4A1 carbine, even though this nomenclature predated the US government's assignation of the M4A1 designation. In 1994, when Colt began shipping two types of M4 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 requirement.

The monitor at upper right shows the target being fired on by this M4 carbine.

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 "giveaway" 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.

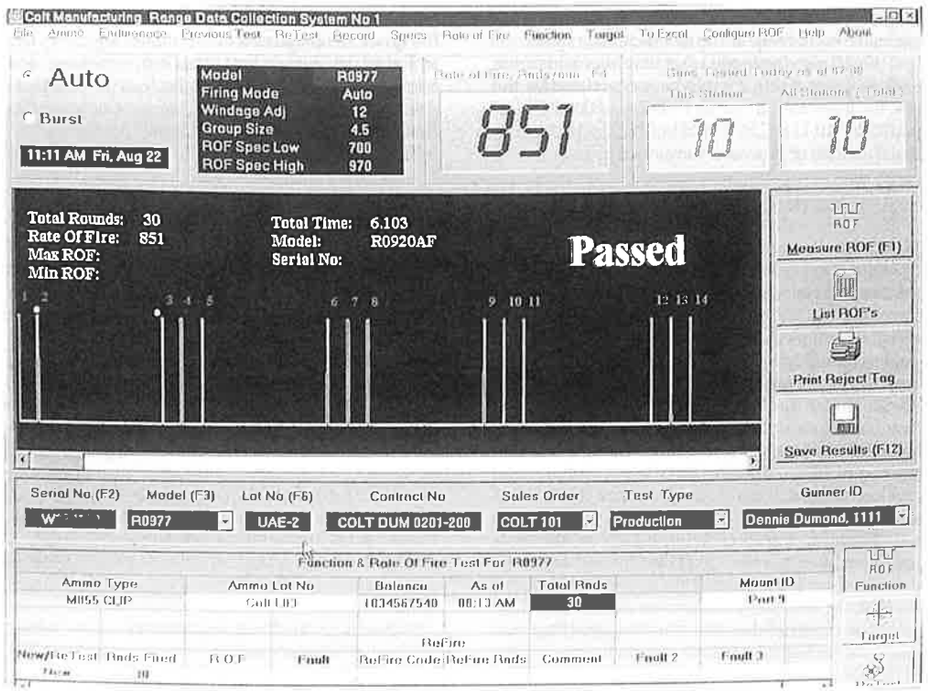
Based on the foregoing, FNMI's action for injunctive relief was denied, and its complaint dismissed. FNMI did not appeal.

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 a light 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



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.

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 government-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, disconnector, 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 ergonomically 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.

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.

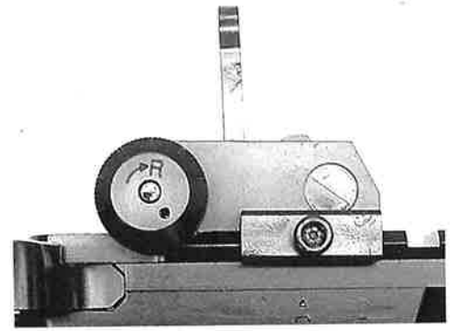
The USAF does not utilize the standard removable carrying handle for iron sight use, but instead they provide Colt with their own removable back-up rear sight, known as the BUIS (Back-Up Iron Sight), NSN 1005-01-484-8000, which is manufactured by the Matech Corporation under contract no. DAAE30-01-C-1081.

Elevation adjustments on the BUIS are accomplished by a lever on the left side, and windage by a drum on the right side.

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.

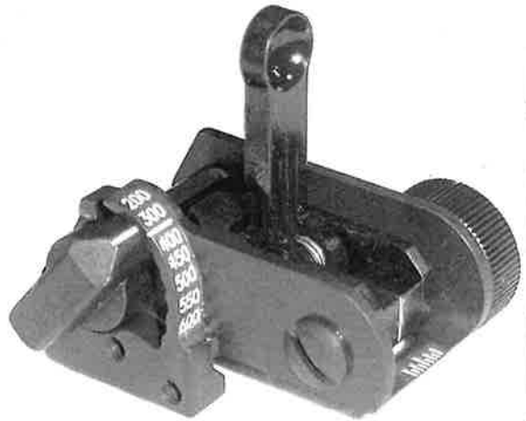
The M16's "Finest Hour" - Yet to Come?

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.



109 (right). Right side view of the Matech, Corp. US Air Force BUIS.

Note the A2-style windage drum.



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

Part III: A Retrospective of Colt Commercial Developments

Chapter Ten

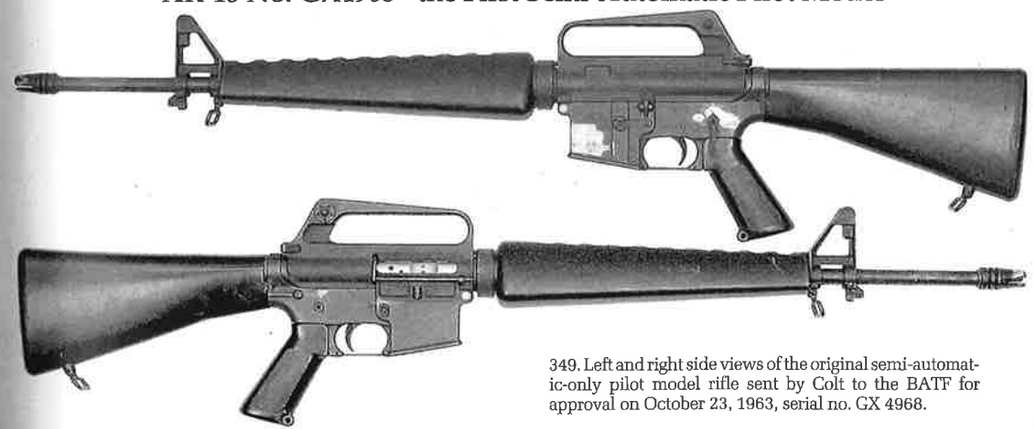
The Civilian AR-15

In 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.

Unless noted otherwise, all the photos in this chapter were taken by Terri McSweeney, and are copyright ©2003 by Colt Defense LLC. They are used with permission, with all rights reserved.

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.

352. Left side closeup of the receiver of "Original First Issue" Colt SP1 rifle serial no. SP 00676, showing markings.

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.

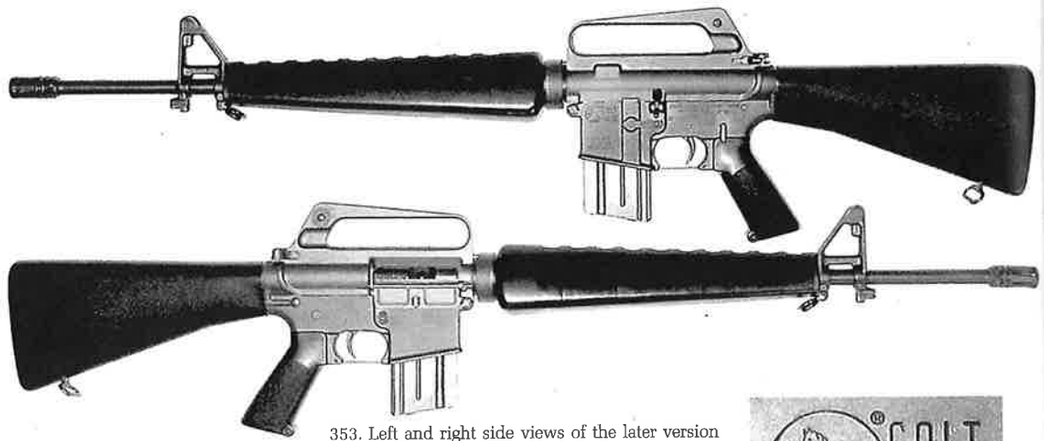
For reasons of component standardization, and the comparative innocence of the time frame in which these original Sporter models were released, it had been decided that these rifles would not be capable of re-conversion to selective-fire even when fitted with two standard military components—the trigger and the disconnector.

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.

The "Later Version" SP1 Rifle, with Redesigned Fire Control Group



353. Left and right side views of the later version Model R6000 SP1 rifle, with redesigned fire control group, introduced circa 1976.
Note the change from the early prong-type flash hider to the new "bird cage" version.

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 disconnector 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 disconnector 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 disconnector, 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.

354. Left side closeup of the receiver of a later Model R6000 SP1 rifle, serial no. SP 60232, showing markings.

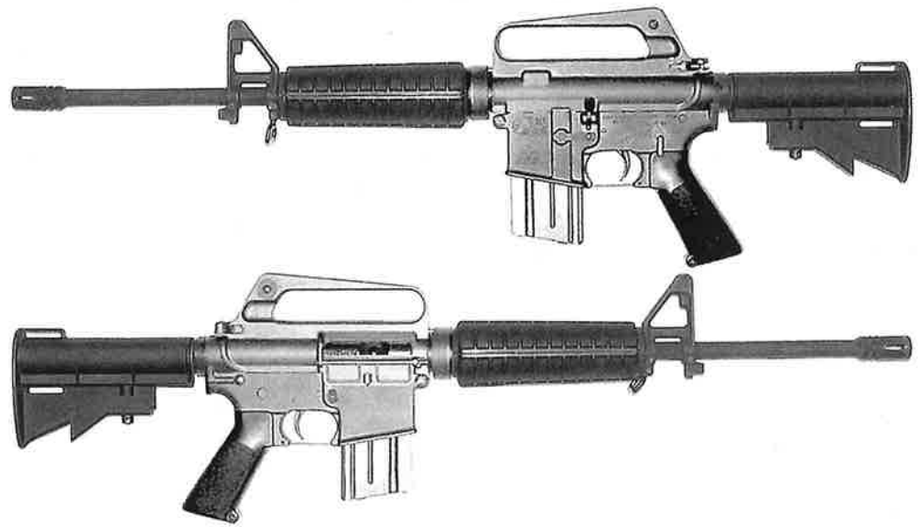
In addition, the tail was removed from the disconnector, to prevent its acting during fully-automatic fire, when the selector lever pushes downward on the tail of the disconnector, disengaging it so the hammer will be caught by the auto sear instead of the disconnector.

The semi-auto trigger was modified so it would not accept the selective-fire disconnector. This was accomplished by shortening the overall length and leaving the rear portion solid. The disconnector spring location was moved forward, to accommodate the new disconnector.

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 disconnector 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 disconnector, 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

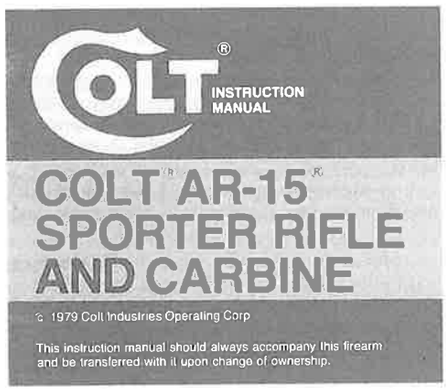
356. Left and right side views of the Colt Sporter Model R6007, finished in electroless nickel.
This model was available only during the early 1980s, and is one of the rarest semi-automatic AR-15s today.

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.

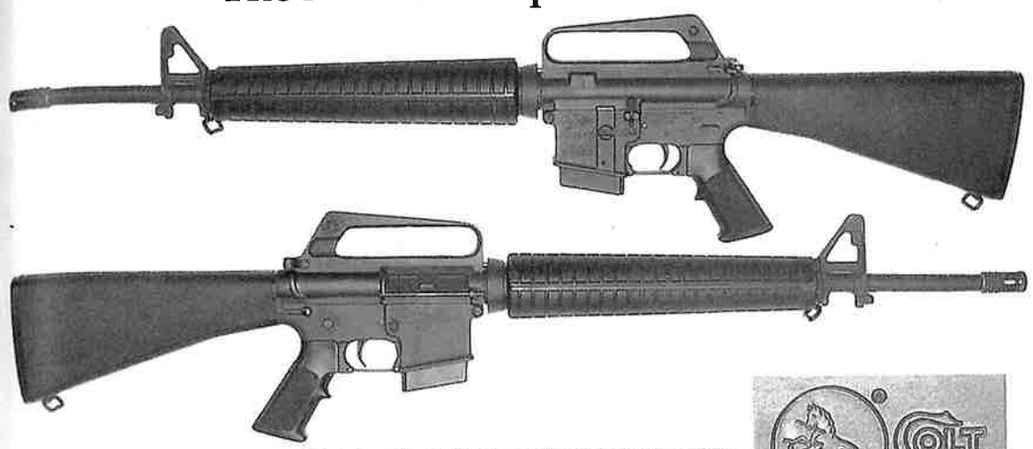
The .222 Remington Caliber SP1, for Offshore Sale

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.

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.

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.

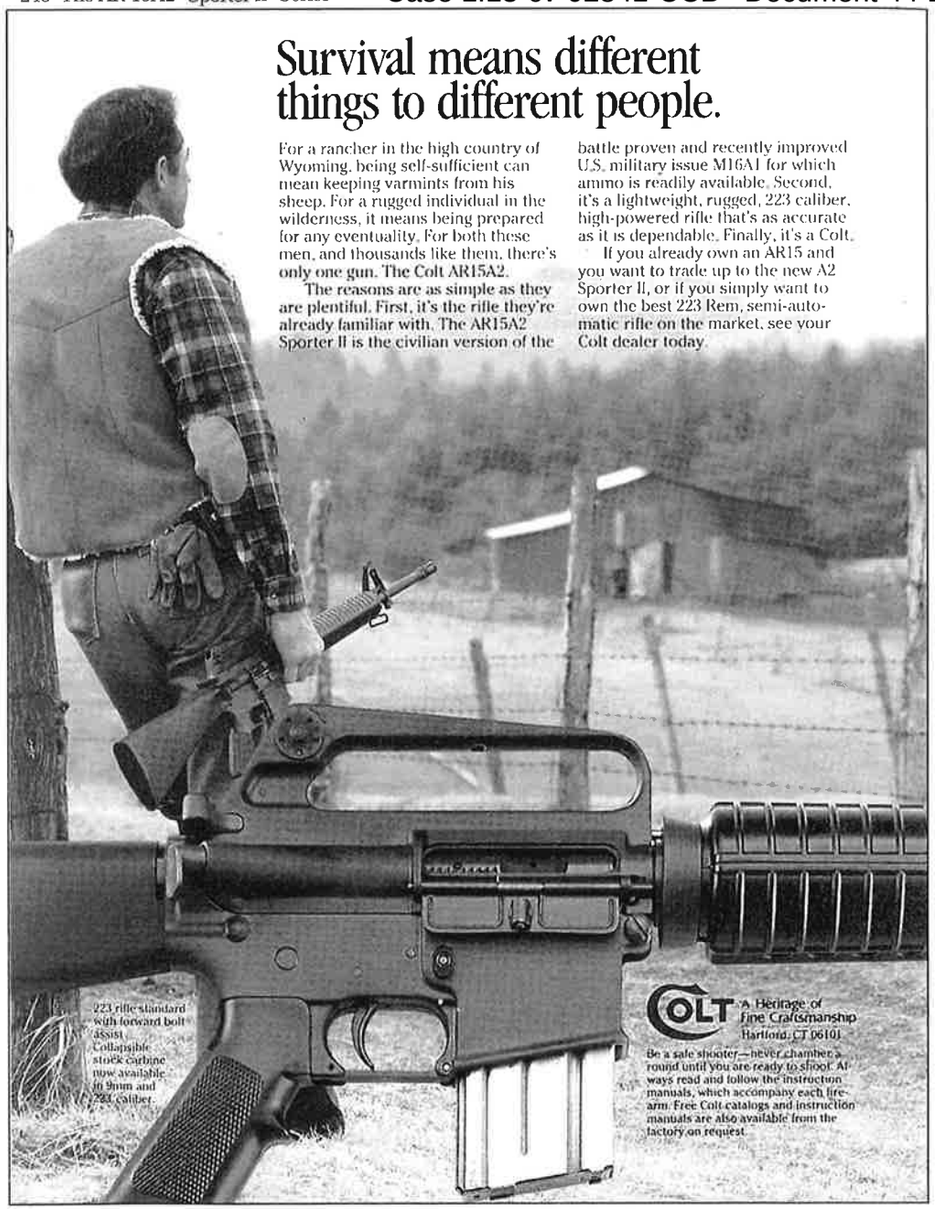
The Colt Model R6400, the original AR-15A2 Sporter II which went into production around 1985, was an update of the AR-15 SP1 rifle. The first examples utilized existing AR-15 SP1 upper receivers, without the forward assist assembly. This rifle had the new M16A2-profile fast (one turn in 7") rifling twist 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.

360 (right). Left side closeup of the receiver of an original Model R6400 Sporter II rifle, serial no. SP 324159, showing markings.

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.



361. One of the earliest advertisements for the new updated AR-15A2 Sporter II Model R6401 rifle with "teardrop" forward assist.

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.

363 (right). Left side closeup of the receiver of AR-15A2 HBAR Sporter rifle serial no. SP 221510, showing markings.

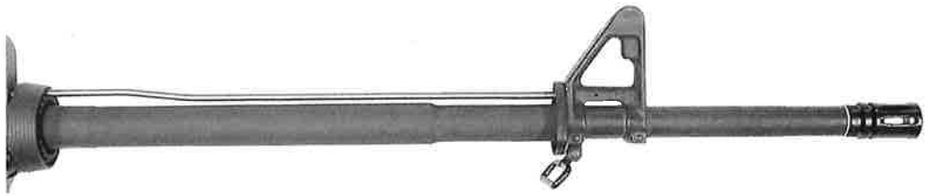
Colt introduced their new AR-15A2 Match HBAR (Heavy Barrel AR, Model R6600) in mid-1985, embodying three distinctive upgrades over the AR-15A2.

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.

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.

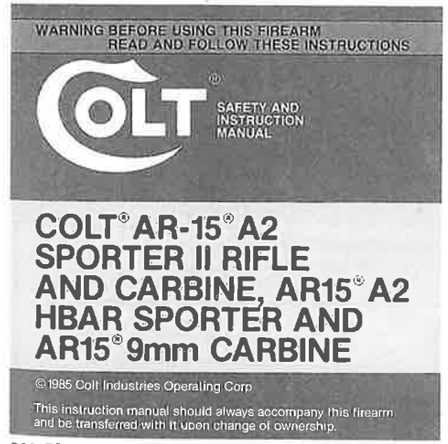
The Colt AR-15 9mm Carbine

365. An early Colt advertisement for their new AR-15 9mm Carbine.

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.



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.

367 (right). Left side closeup of the receiver of early AR-15 9mm Carbine serial no. TA 02352, showing markings.

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-15A2 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.

370 (left). Left side closeup of the receiver of AR-15 Sporter II rifle serial no. SP 325530, showing markings.

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.

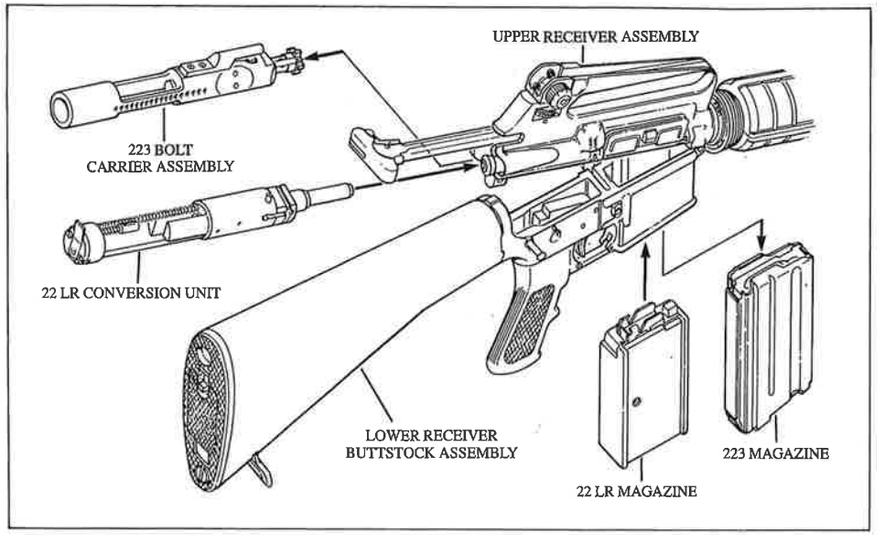
Over time, the AR-15A2 Sporter II was basically offered in three variations, which affected only the upper receivers. The receiver used on the original Sporter 1 (Model 6400) had no forward assist. As the remaining inventory of these early receivers was depleted, Colt switched to the A1-style upper with 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.

COLT®

AR-15® CONVERSION KIT™

Caliber: 22 LONG RIFLE



FACT SHEET

You can now convert your 223 caliber AR-15® 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.

COLT®
MADE ONLY IN THE USA
Hartford, CT 06101

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.

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 rubber-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.

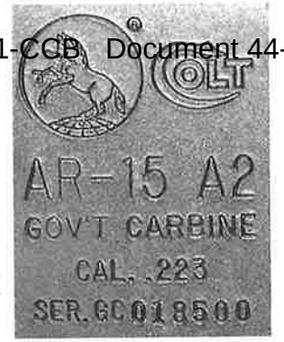
HBAR and the new Sporter Match Delta HBAR was the removal of the bayonet lug.

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.

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.

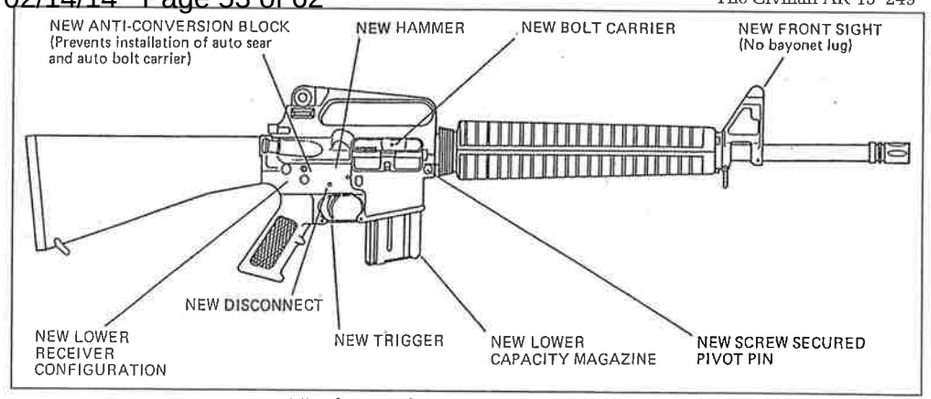
The Anti-Conversion Auto Sear Block

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.

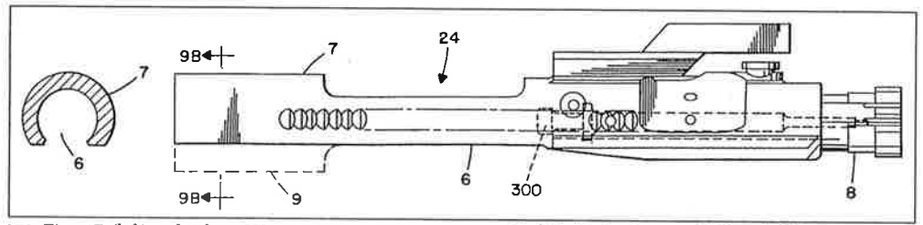
This block accomplished two things. First, it made it impossible to install an auto sear. Even if the sear block was removed, the auto sear could not be properly aligned due to the larger diameter of the hole in the auto sear area.

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.

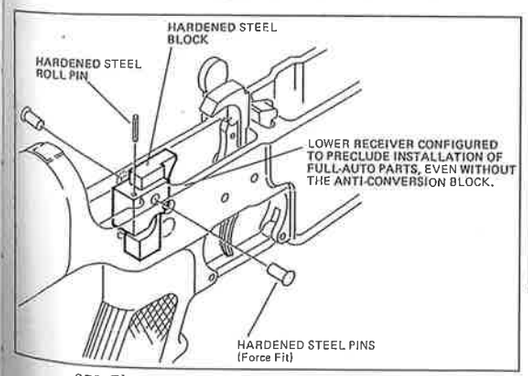
Colt omitted the auto sear block in the later production post-Assault Weapon Ban Match rifle line, due first to its high cost, second to the extreme difficulty it caused in production and assembly, and third and most important, it was not necessary. With the change from the standard diameter (0.155") to the new larger diameter (0.170") hammer and trigger



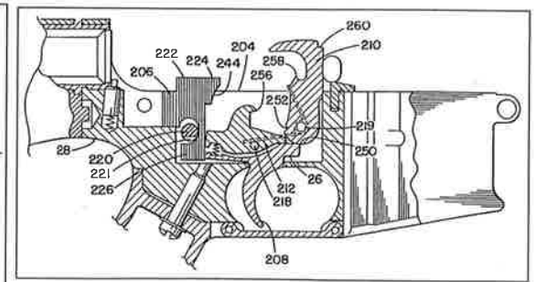
377. Line drawing showing a right side view of a Colt Sporter rifle circa 1990, with modifications designed to prevent conversion to selective or fully-automatic fire.



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 automatic 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.



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.

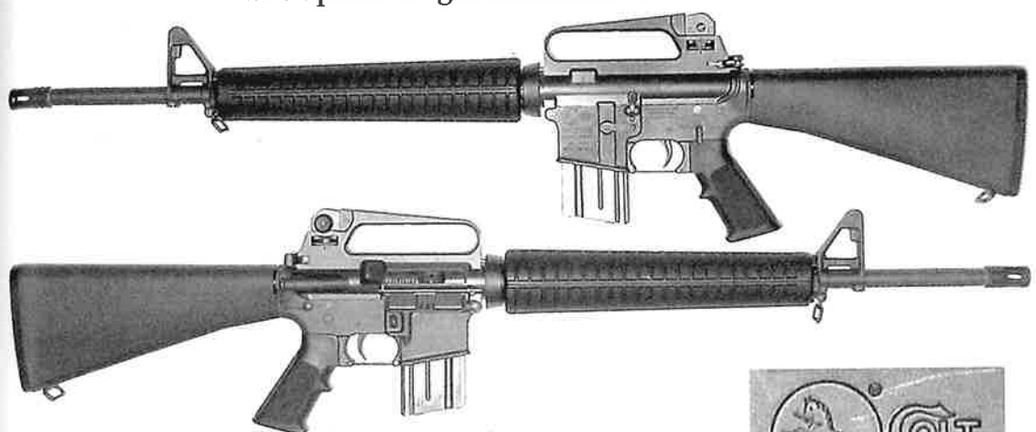
release button. This would hold true for all the rifles in the Colt Sporter line.

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.

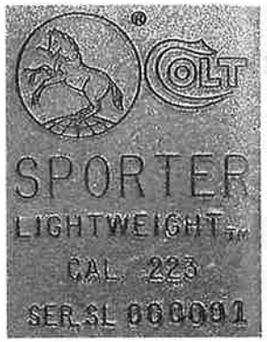
Colt also offered this model with the .22 Long Rifle caliber conversion kit shipped in the box as Model R6551K.

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.

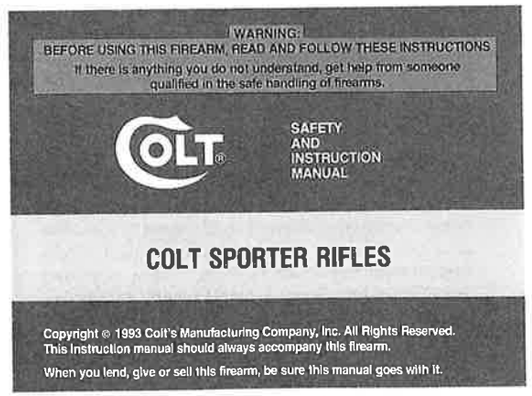
Another version of the Sporter Competition HBAR, Model R6701, featured Millet scope rings and the ARMS, Inc. #5 scope mount base.

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 useage of firearms became more explicit and detailed as time went on.

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.

391 (right). Left side closeup of the receiver of Colt 9mm Sporter Lightweight rifle serial no. NL 002321, showing markings.

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.

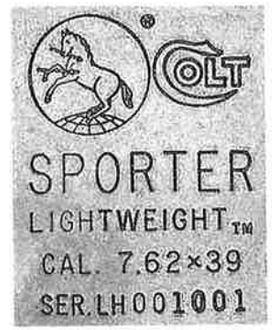
The 7.62x39mm Sporter Lightweight Rifle

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.

394. A 1993 Colt advertisement introducing their new 7.62x39mm caliber Sporter Lightweight rifle.



393 (right). Left side closeup of the receiver of Colt 7.62x39mm Sporter Lightweight rifle serial no. LH 001001, showing markings.

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 features a plain counterbored 20" barrel with a rifling twist of one turn in 9".

396 (right). Left side closeup of the receiver of Colt Match Target Competition HBAR rifle serial no. CCH 001006, showing markings.

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".

398 (right). Left side closeup of the receiver of Colt Match Target HBAR rifle serial no. CMH 001002, showing markings.

A later version, the Model MT6601C, incorporated a pinned-on 6-slot compensator. Another version 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. CSL 001006. Center: 7.62x39mm caliber, serial no. CLH 001002. Right: 9mm caliber, serial no. CNL 001010.

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.

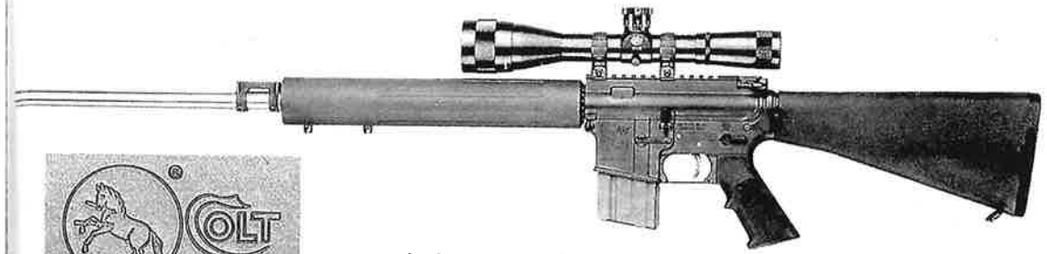
Colt Enters the Precision Market

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.

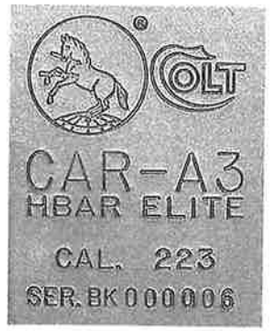
Due to the fact the AR-15 does not use a conventional gas piston assembly, the barrel is subjected to a negligible bending moment when the rifle is fired, and the barrel vibrational harmonics are left undisturbed. With the development of free-floating handguards, combined with a good trigger and barrel, 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 ¼ 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 Type	Barrel Length	Barrel Twist	Chrome	Muzzle Device	Upper Receiver	Hand-Guard	Bay Lug	Bolt Carrier
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.

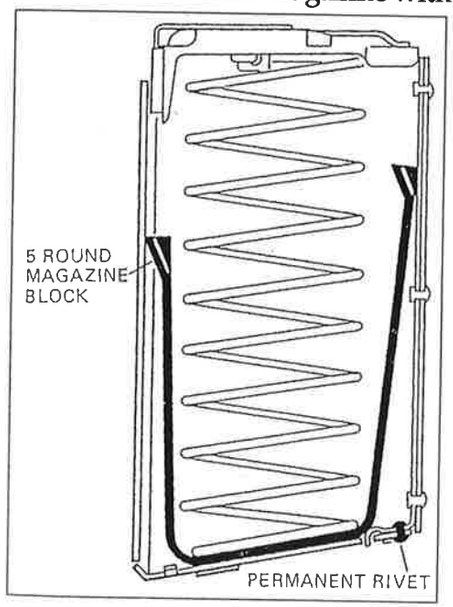
Colt Sporter and Match Target Series Magazines

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



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.

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 prevent the removal of the spacer, thus making this a magazine of dedicated five-round capacity for hunting applications.

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.

Collector Grade Publications, 1979 - 2004:

The Black Rifle – M16 Retrospective by R Blake Stevens and Edward C Ezell. Fourth Printing, 2004. 416 pages, 441 illustrations.
ISBN 0-88935-115-5

The most thorough study of all facets concerning the background and evolution, both political and developmental, of the 5.56 x45mm M16. The standard reference source for anyone interested in researching the complex history of this weapon system—where it came from; what it is; what it is not; and why.

US Rifle M14: From John Garand to the M21 by R Blake Stevens. Revised Second Edition, 1991. 352 pages, 246 illustrations.
ISBN 0-88935-110-4

The complete saga of the last true "lock, stock and barrel" rifle ever fielded by US Army Ordnance. Covers all the US "lightweight" rifle and ammunition developments from 1943 to 1982, with updated information on the latest USAMTU modifications which turn the M14 into the gilt-edge M21.

The Last Enfield: SA80—The Reluctant Rifle by Steve Raw. Deluxe First Edition, 2003, 360 pages, 382 illustrations.
ISBN 0-88935-303-4

A former Royal Marine Armourer tells the *in-depth* story of the last weapon system to be developed and produced at RSAF Enfield, the controversial British bullpup SA80, adopted as the L85A1 (IW) and L86A1 (LSW) in 1985, and dogged with problems, ever since. The SA80 is currently being upgraded to a new A2 version by Heckler & Koch.

All titles feature deluxe hardcover binding, colourful laminated dustjackets, and *sewn-in* pages

Crown Jewels: The Mauser in Sweden - A Century of Accuracy and Precision by Dana Jones. Deluxe First Edition, 2003. 312 pages, 691 illustrations.
ISBN 0-88935-283-6

The *in-depth* story of all models of the military Swedish Mauser—the m/94 carbine; m/96 long rifle; m/38 short rifle; m/39 and m/40 K96ks; wartime and postwar m/41 sniper rifles—then the CG63 competition rifle and its offshoots; ammunition, accessories, and sights.

MG34 - MG42: German Universal Machineguns by Folke Myrvang. Deluxe First Edition, 2002. 496 pages, 646 illustrations.
ISBN 0-88935-278-X

The MG34; the most advanced MG in the world at the outbreak of World War II, combined the advantages of both light and heavy MGs and was able to perform the functions of both. The later MG42, the world's first "stamped" MG, fired at the incredible rate of 25 rds/sec.

Hitler's Garands - German Self-Loading Rifles of World War II by W Darrin Weaver. Deluxe First Edition, 2001. 392 pages, 590 illustrations.
ISBN 0-88935-275-5

Beginning with the Mauser G41(M) and Walther G41(W), this is the *in-depth* story of the G/K43, including many expert tips on how to avoid paying large sums for "reproductions"—or outright fakes—of the many G43 accessories and accoutrements being offered today.

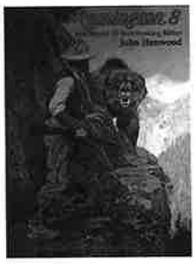
A Quarter-Century of Quality Classics

Backbone of the Wehrmacht – the German K98k Rifle, 1934-45 by Richard D Law. Author's Revised Edition, 1993. 384 pages, 8 illustra-tions.
ISBN 0-88935-139-2

Making, and mark-the 100+ contrac-l-year variations of the 4 million bolt-action K98k rifles produced in Nazi Germany before d during World War II.

Sniper Variations of the German K98k Rifle by Richard D Law. Volume II of ***Backbone of the Wehrmacht*** Deluxe First Edition, 1996. 240 pages, 291 illustrations.
ISBN 0-88935-222-4

The sequel to our most popular title: the *in-depth* study of the scoped rifle of choice for German snipers during World War II.



The Great Remington 8 and Model 81 Autoloading Rifles by John Henwood. Deluxe First Edition, 2003. 304 pages, 291 illustrations (31 in color).
ISBN 0-88935-291-7

The *in-depth* story of the world's first practical autoloading centerfire sporting rifle, designed by John M. Browning and manufactured by the Remington Arms Co. and Fabrique Nationale (FN).

Much Remington history and memorabilia, plus *all* the models: deluxe grades, experimentals, military, police and FBI variants.

Accurate, critically-acclaimed *in-depth* information for advanced collectors and military historians

The FAL Rifle Classic Edition, 1993, 2002. 848 pages, 844 illustrations.
ISBN 0-88935-168-6

All the material from the original three-volume *FAL Series: North American FALs, UK & Commonwealth FALs* and *The Metric FAL*, plus *The FAL Series Index*, now printed on fine matte coated paper and bound in one deluxe, library-quality volume.

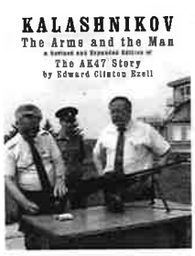
The Browning High Power Automatic Pistol by R Blake Stevens. Expanded Second Edition, 1990. 306 pages, 313 illustrations.
ISBN 0-88935-089-2

The classic, *in-depth* study of the development, and over 50 years of production history, of the world-famous FN High Power pistol.

Includes a chapter on the Canadian High Power of WWII, plus experimentals, copies and clones from around the world.

KALASHNIKOV: The Arms and the Man - a Revised and Expanded Edition of *The AK47 Story* by Edward Clinton Ezell. Deluxe First Edition, 2001. 312 pages, 356 illustrations.
ISBN 0-88935-267-4

Kalashnikov small arms are the most widely used and best known in the world today, with estimates as high as 100 million manufactured since the introduction of the *Avtomat Kalashnikova* (AK47).



Thirty Titles Now In Print

US & Canadian Retail Orders shipped *POSTPAID!*