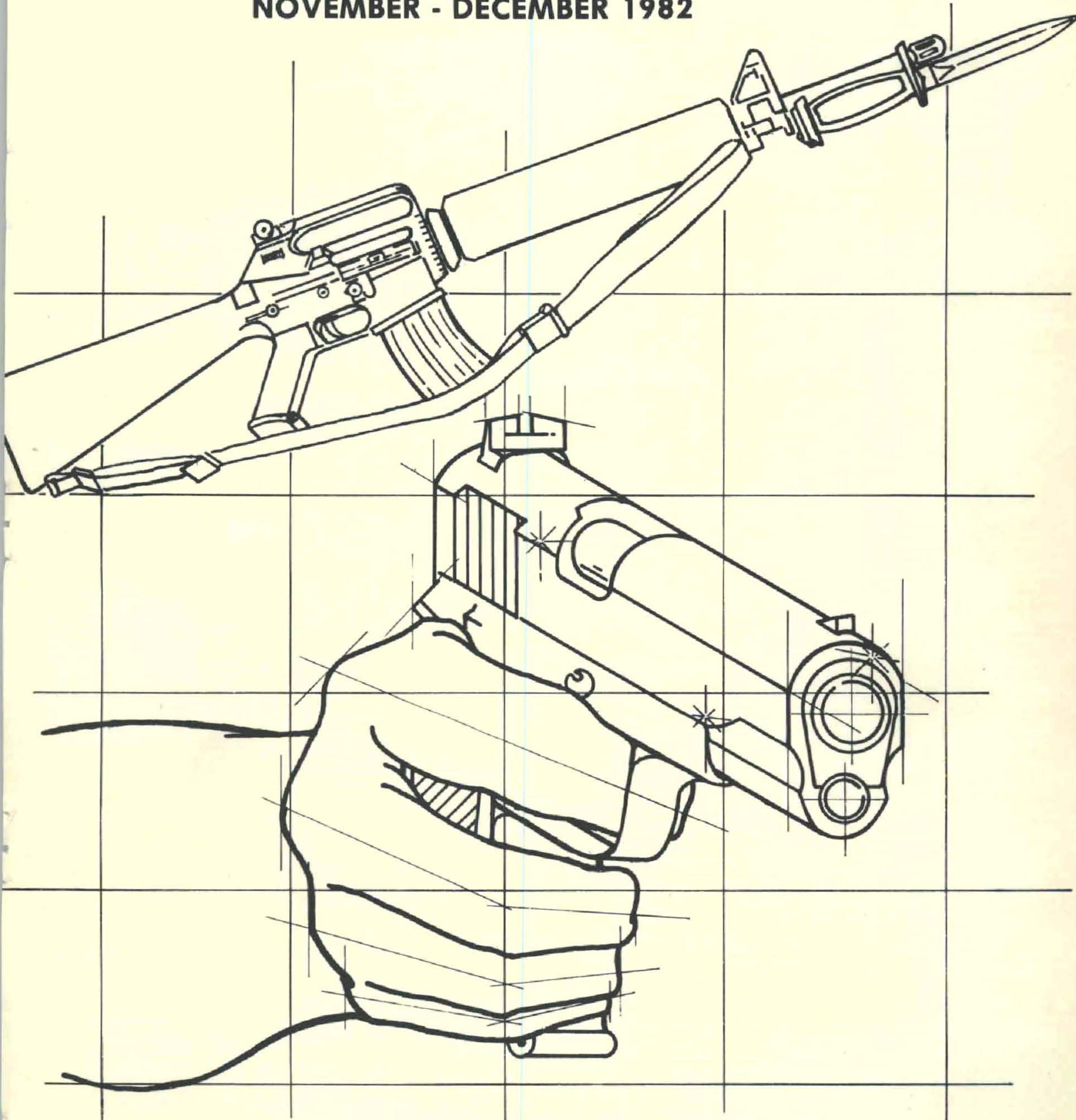
ARMY
R,D&A

- RESEARCH
- DEVELOPMENT
- ACQUISITION

NOVEMBER - DECEMBER 1982



FUTURE SMALL ARMS DISCUSSED AT SYMPOSIUM

ARMY R,D&A

Vol. 23 No. 6 NOVEMBER-DECEMBER 1982

OFFICIAL MAGAZINE OF THE RDA COMMUNITY, established 1959

FEATURES

DEPARTMENTS

ABOUT THE COVER:

Front cover portrays two main elements of the nation's small arms inventory—the rifle and the pistol. Replacement of the .45 caliber M1911A1 pistol and modification of the M16A1 rifle are under consideration. Back cover shows early small arms rounds (L. to R.) .58 Minie Ball, .50 Gallager, 11mm Chassepot, 12mm Pin Fire, .22 BBCap, .50 Maynard tape primer, .54 Burnside, .58 Musket (inside prime), .50 Crispin (short).

DISTRIBUTION is based on requirements submitted on DA Form 12-5. Army agency requirements must be mailed to the U.S. Army AG Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220.

Distribution on an individual basis is restricted to active and reserve officers who hold a specialty indicator of R&D (51), Procurement (97), Atomic Energy (52) and Project Management (6-T).

CHANGE OF ADDRESS. Individual addresses are provided by Officer Military Personnel Center, Alexandria, VA, and the USARPC, St. Louis, MO. Where active officer addresses are incorrect, individuals should contact their respective officer personnel office to ensure forwarding of correct address. Reservists should contact USARPC, ATTN: AGUZ-OEPMD, St. Louis, MO 63132.

OTHER GOVERNMENT AGENCIES requirements should be submitted directly to U.S. Army Materiel Development and Readiness Command, ATTN: DRCDE-OOM, 5001 Eisenhower Ave., Alexandria, VA 22333.

ALL NON-U.S. GOVERNMENT agencies, firms and organizations must obtain publication through the Superintendent of Documents. U.S. Government Printing Office, Washington, DC 20402. Single copies: domestic-$2.75, foreign-$3.45. Subscription rates (6 issues annually); domestic, APO and FPO address-$10.00, foreign mailing-$12.50.

(USPS-584-330)

Army R, D&A Magazine (ISSN 06162-7082) is an official Army periodical published bimonthly by the Development, Engineering and Acquisition Directorate (DRCDE), HQ U.S. Army Materiel Development and Readiness Command (DARCOM), Alexandria, VA 22333, under sponsorship of the Assistant Secretary of the Army (Research, Development & Acquisition); the Deputy Chief of Staff for Research, Development and Acquisition, Department of the Army; and the Commander, DARCOM.

Second class official mail postage paid by the United States Army at Alexandria, VA. Postmaster: Send address changes to Editor, *Army R, D&A* Magazine, HQ DARCOM, 5001 Eisenhower Ave., Alexandria VA 22333. Forward copies per Domestic Mail Manual part 159.225. Use of funds for printing of this publication has been approved by Department of Army, 23 Feb. 1979, in accordance with provisions of AR 310-1.

Purpose: To improve informal communication among all segments of the Army scientific community and other government R, D&A agencies; to further understanding of Army R, D&A progress, problem areas and program planning, to stimulate more closely integrated and coordinated effort among Army R, D&A activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

Picture Credits: Unless otherwise indicated, all photographs are from U.S. Army sources.

Submission of Material: All articles submitted for publication must be channeled through the technical liaison or Public Affairs Officer at installation or command level.

Bylined Articles: Primary responsibilty for opinions of bylined authors rests with them; their views do not necessarily reflect official policy or position of the Department of the Army.

Small Arms Meeting Draws More Than 150 Representatives

More than 150 industry and armed services representatives attended a 2-day meeting on small arms sponsored by the American Defense Preparedness Association, 14-15 September 1982, at the Presidio of San Francisco. The basically unclassified meeting was dedicated to the memory of the recently deceased Mr. Berge Thomasian, of SACO Defense Division, Maremont Corp. Mr. Thomasian had been an extremely active member of the ADPA and was Chairman Emeritus of its Small Arms Division. At a banquet during the meeting, Mr. Thomasian's widow accepted, to a standing ovation, an engraved medal and scroll, given by the ADPA, honoring her husband.

The keynote address by LTG John M. Brandenburg, commander, I Corps, Fort Lewis, WA, emphasized the title of the sponsoring ADPA to stress the need to *prepare*. The threat was real, emphasized Brandenburg. The Soviet Union can project its military power well beyond its borders, and has displayed a calloused indifference to world opinion when it has chosen to exercise those projections.

U.S. preparedness has been threatened by the deterioration of our technological lead, he contended, with the Soviets following a pattern of reducing technological risk by exploiting and improving upon proven U.S. designs.

While the U.S. is further ahead in preparedness today than was the case in the late 1930's and early 1940's, the clock is still running against us. While over the next five years, said Brandenburg, the Army will be acquiring a number of new systems, there will still be major shortcomings.

The Army must think, plan, and execute smartly, said the General. There is a need for improved heavy and light forces, and ways must be found to reduce the time from the approval of a ROC to the fielding of the system.

Brandenburg noted the important role of independent in-house R&D by industry in satisfying the Army's need for capabilities. But the Army's requirements had to be kept realistic.

The General noted that there is a segment of the population in America that advocates major reductions in defense spending in favor of increased social programs. He pointed out in conclusion that an eminent British statesman had once remarked to his countrymen that keeping his people free was one of the most important social services a nation's leadership could provide.

The meeting then went into a 4-session format, encompassing some 21 actual presentations, all but one of which were unclassified. The first session was devoted to operational concepts and requirements for small arms. The second covered machine guns, the third personal arms, and the fourth was devoted to ammunition.

Leading off the conceptual session was COL Robert B. Adair, director of Combat Doctrine, HQ TRADOC, who presented the Army's Airland Battle 2000 study findings, from which a number of future Army materiel requirements can be expected to emerge.

Following a classified presentation by LT Paul Evancoe, USN, on the Navy's special operations requirements, the audience received a presentation on Alternatives for Future Individual Weapons by Mr. Bernard J. Tullington, principal research scientist of Battelle Memorial Institute, Washington, DC.

The Battelle study, he stressed, looked at ultra-high technology for the period beyond the year 2000. Tullington pointed out that the progression in personal defense weapons over the centuries has often been revolutionary. Each advance, from the club to the spear, to bow, to gunpowder, provided a distinct military advantage initially to the fielder, and the fielding resulted in a changed way of doing battle. Once a new system is fielded its initial impact may be minimal, but it grows, and weapons then tend to stay in use for sizeable periods of time. But that span of time is now being drastically shortened by the leaps of technology.

However, stressed Tullington, small arms technology has progressed relatively slowly. Advances have been incremental and evolutionary. The U.S. must look ahead or someone else will, and confront us with a big battlefield advantage.

What is being sought for the future, he continued, is a 1-round-1-kill, hit-the-target-no-matter-where-it-is weapon. Effecting the design of such a weapon are the added factors of the growing need for physical security, the urban sprawl, and the need for anti-terrorist devices.

Two factors are always present in personal weapons, Tullington noted: the human operator and the effects mechanism. One has to examine the man-machine, the machine-work, and the man-work interfaces.

Tullington noted that a new advanced combat rifle could have high payoffs in such areas as logistic savings, RAM, configuration ease, human engineering, etc., and he cited a number of technological approaches believed to have a potentially high payoff for a future infantry rifle or weapon. When the technological risk is considered, stressed Tullington, be sure to keep in view the great advantage such a weapon could provide.

Lessons learned from U.S. Army participation in the "Bright Star" exercises was the subject of a presentation by Mr. Patrick Serao of ARRADCOM. Basically the lesson was that if U.S. small arms were kept well lubricated and extra preventative maintenance was given, the weapons would work satisfactorily in the Mid-East environment. But the necessary extra maintenance is a burden to the user.

COL John S. Ott then gave the group a run-down on the 9th Infantry Division High Technology Test Bed activities. He described the challenge given—to field by 1985 a new 16,000 man light division with the firepower of a heavy division, but air-liftable with today's available aircraft—predominantly C-141s. The division was to be capable of RDF and NATO use. Such a division will have sustainability through innovative logistics. Increased capability would be attained through exploiting technology and finding ways to expedite the progress from prototypes, to refinement and then fielding those deemed worthy. In the question period following there was discussion over sources of funding and the division's stated role as a tester of concept and doctrine rather than a tester-buyer of new materiel.

The conference then shifted into presentations concerning machine guns. The Hughes 7.62mm chain gun program was reviewed next by Mr. Richard H. Colby, project engineer of Hughes Helicopters. He noted that the United Kingdom has adopted the weapon and just recently had signed a letter of intent for production under license in the UK. The weapon will be used on UK MCV 80 vehicles—the counterpart to the U.S. Bradleys. The gun was also successfully used in Kenya on government helicopters in the recent internal disturbances. Of considerable note, Colby remarked, was the very low toxicity of the gun system when it was tested in a variety of combat vehicles by the British and by the Israelis.

An unveiling first look at GE's new .50 caliber was provided by Mr. Thomas W. Tremper of the General Electric Co., Burlington, VT. The gun was being designed for a variety of roles: general purpose, air defense, helicopter air to air and air to ground, a gun pod approach, and for conventional air to air.

It was GE's contention, said Tremper, that various missions require differing rates of fire, from 750-8,000 shots per minute. Their design featured the Gatling gun approach, in 3 and 6 barrel versions, self and externally powered. The weight for the 3-barrel gun was foreseen as 66 pounds, while the 6-barrel version would run 96 pounds.

There would be 95 percent commonality of parts, but reconfiguration would have to be done at depot or by the contractor. Reliability was foreseen at 200,000 MRBF. It would feature a no-tool concept for maintenance. Single or dual feed would be available along with a controlled burst capability.

The .50 caliber weapon, said Tremper, had distinct advantages in range and velocity over competitive calibers, resulting in their selection of the .50 caliber for a future machine gun.

A short summation of the Joint Services Small Arms Program status by Mr. James B. Ackley, chief of the JSSAP Program Office, ARRADCOM, was the next presentation. Ackley pointed out that the course of future small arms weapons would be in the direction of improved capabilities, i.e. range, firepower, armor-defeating, etc., taking into consideration also all possible tactical considerations, such as the Rapid Deployment Joint Task Force, airborne, boarding-at-sea, etc.

Ackley told the audience that there were several programs going to industry. In what he termed the limited issue category, would be a submachine gun and a close assault weapon. There were two anti-armor systems—a general purpose machine gun and an automatic grenade launcher machine gun, and under the category of general purpose infantry weapons are the squad automatic weapon, the improved M16A1 rifle, and the advanced combat rifle.

The audience was told to watch the *Commerce Daily* for RFP announcements on the submachine gun and the close assault weapon. The other programs were in various stages of contract award.

The Marine Corps, said Ackley, had decided to adopt the improved M16A1 rifle, which is being considered by the Army. Further, he continued, two concepts have been selected for the new advanced combat rifle, and that the advanced development work of the MK19 40mm grenade launcher was devoted primarily toward its ammunition.

The second session—that dealing with machine guns, was opened with a discussion by Mr. Eugene Ashley, Sr., staff engineer of the Advanced Armaments Systems Engineering Department, General Electric Co., Burlington, VT. Increased performance per man, said Ashley, was the payoff goal to be sought. Emerging from the GE study was the superiority of the 35mm over the 30mm caliber when used in a 3-barrel gatling version.

The DIVAD gun system status was presented by Mr. Dean S. Williams, manager of Ford Aerospace's Ammunition Engineering Department. The system has been adopted, said Williams, by 10 NATO nations and 47 nations worldwide. Some 5,000 weapons have been delivered to date.

A review of the 40mm automatic grenade launcher system was given by Mr. Dale Adams, chief, Armaments Division, Fire Control and Small Caliber Weapons Lab, ARRADCOM. Adams stressed that future improvements were being sought in ammunition in such areas as reduced time of flight and increased chamber volume. Also being sought was a training round for the 40mm system.

The problem of providing improved low friction wear surfaces for small arms components was reviewed by Dr. William T. Ebihara, chief of the Corrosion Protection Section, ARRADCOM. The bottom line of Ebihara's presentation was that current lubricants are adequate for current conditions but will not meet future needs. Several approaches are being investigated to include annodizing with solid particles of lubricant and porous nickel platings with infused lubricants.

The potential for the wider use of plastic parts in small arms was presented by Mr. Bruce Dawson, vice president, Gulf Stream Division, O'Sullivan Plastic Corp., Winchester, VA. Dawson stressed that seeking professional expertise in the plastics field was vital if the goal of using plastics to obtain increased cost effectiveness was really to be attained. He told the group to seek a full-service plastics company with access to full-product engineering and product processing. Demand quality of that company, and avoid relying solely on the lowest bid syndrome in selecting the company.

The third session, devoted to personal arms, began with a short update on the 9mm pistol program by LTC Anthony Bisantz, the project officer for that program at ARRCOM. The new revised Joint Services Operational Requirement, reflecting experience gained in the earlier effort, had just recently been signed, said Bisantz, and this would be the basis for future competition. The objective will be to buy, not develop, a new handgun. The RFP was being prepared and hopefully will be issued shortly. Bisantz expected the acquisition plan, essentially an update of the previous plan, would be approved. Watch the *Commerce Daily*, said Bisantz, for the RFP's announcement. Funding was in hand, he noted, to carry the program up to the point of contract award.

MAJ Bruce Wincentsen, USMC, test director for the Corp's improved M16 rifle program, run by the Marine Corps Development and Education Command, Quantico, VA, gave the audience a rundown on the Corps' findings. The Corps had determined in 1979, he noted, that there was a need for improvement in the rifle, and that a product improvement effort was in order. These improvements should include ruggedness, penetration, sighting, and certain human factor aspects.

The new version would differ in 9 basic ways over the current standard weapon, to include a 1 turn in 7 twist barrel, a new rear adjustable sight, a square front sight, new hand guard, new 5/8-inch longer plastic stock, and be capable of using the current standard 5.56 cartridge as well as the new SS109 round. The new version would be about one pound heavier.

A short status report on the Advanced Combat Rifle program was given by Mr. Richard Kwatnoski of ARRADCOM. The rifle program is in two parts—mid term and far term. For the mid term a significant improvement is the objective. Such things as caseless ammunition, salvo fire, and an improved day/night sight are being considered. This program has entered phase I, and an RFP has been issued to industry, looking for a technology demonstration in the October 83 - October 84 timeframe. The far term program is addressing a revolutionary improvement as discussed by Mr. Tullington of Battelle.

The session's final presentation was on improved small arms lubricants by Mr. Donald Yoder, director of developments of Break-Free Division, San/Bar Corp., Irvine, CA. The speaker noted that his company's lubricant, Break-Free, had been in existence since 1975, but was now in its 4th generation of improvement. The armed services had been using Break-Free, he noted. Tests, he said, show considerable improvement over standard oils and greases, and it has an inherent corrosion resistant quality built into it. There was a good exchange of information between the users and the manufacturer, which Yoder said was most beneficial.

The concluding session—that on ammunition, was led off by Mr. Angelo Mancini, deputy chief of the Joint Services Small Arms Program Office, ARRADCOM, on new developments in training ammunition. Costs and range space limitations were driving the efforts here, said Mancini. Improvements were being sought in full range, limited range, short range, and blank rounds, and the search was world-wide.

The General Electric Co. was again represented when Mr. Melvin J. Bulman of the company's Advanced Armaments System Engineering Department, Burlington, VT, described some of their work with liquid propellants. There had been some work done immediately after WWII, said Bulman, but then the rise of interest in missiles had cooled the extent of work. It was renewed by GE in the late 1960's using in-house R&D funds.

GE sees two potential avenues—a process using one single liquid and a second that envisions mixing two. GE chose in 1974 to exploit the single liquid approach, and are pleased with results to date. Such a technology, said Bulman, could provide a flatter projectile trajectory, reduced time of flight, improved terminal effects, and great money savings per round. There would be a common resupply source for all types of weapons with significant logistics benefits.

Wrapping up the meeting was Mr. E.J. Kirschke, director, R&D, Smokeless Powder Division, Olin Corp., St. Marks, FL. Kirschke briefly reviewed the history of the Olin Corp. and the development of ball powder, and gave a brief look at Olin's enhanced capability through its new plant at St. Marks, FL.

Army Announces PM Selection Board Meeting

MILPERCEN message R302300Z, September 1982, announced Army-wide that the PM selection board will convene 7 December 1982 to consider eligible colonels and lieutenant colonels promotable for assignment to designated PM position vacancies.

The board will consider all 0-6s and 0-5(P)s who are members of the PM development program, hold SC51 designators, or are currently serving PMs. Officers on the list will be automatically considered unless a written declination is submitted.

Officers not currently on the PM development program eligibility list may request consideration by the board if they believe they can qualify by virtue of training and experience. To be considered under this provision, an officer must forward a written request to MILPERCEN, Attention DAPC-OPC-PM, to reach that agency not later than 6 December.

Criteria to be used for consideration will include: be in 0-6 or 0-5(P) grade, not declined consideration by this board, not declined previous PM or command, and have 4 years or more of service remaining as of 1 January 1983. Serving commanders or district engineers are eligible for PM selection if they are projected to complete their normal tour by 1 January 1983.

Officers eligible for PM selection will not be permitted to appear in person before the board on his own behalf or in the interest of another eligible; however he may address a letter to the board inviting attention to any matter of record concerning himself that he believes important. Such a letter should be addressed to DAPC-MSB, 200 Stovall St., Alexandria, VA 22332.

As the announcing message was an Army-wide one, interested officers should contact their local message center for a copy.

A Developmental History of Small Arms Ammunition

By David J. Reap and John A. Resch

A developmental history of small arms ammunition must start with the origin of gunpowder which itself is a debate among historians and archaeologists alike. Some believe it was a Chinese invention of great antiquity because the ancient Chinese were known to employ various pyrotechnic mixtures similar to gunpowder. These were used primarily for the making of pyrotechnic or firework displays.

The earliest history of an explosive compound, composed of six parts saltpeter, two parts sulphur and two parts charcoal (almost the same as the current formula), is in an 846 A.D. manuscript, "Liber Ignium" by Marcus Graecus. However, most people believe that the true gunpowder which we now know as black powder was a European invention of the 13th century. In the essay, "De Mirabi Potestate Artes et Naturae", written in 1242 by Roger Bacon, an English philosopher, scientist and friar, the explosive properties of a mixture of saltpeter (potassium nitrate), sulphur and charcoal are expounded.

While Bacon made no inference to the use of this explosive as a propellant, in the early part of the 14th century (1313 A.D.) a German Franciscan monk, Berthold Schwartz, authored several manuscripts which described in detail the use of black powder as a propellant. Though some historians doubt the origin of these manuscripts, it is known that in 1314, guns and black powder existed in the city of Ghent, Flanders (now Belgium). The first use of gun powder as a propellant in military application occurred in 1331 at the siege of Licante, when the moors used the powder for propelling stone balls, and black powder and balls, first stone and later metal, were the ammunition of small arms for more than 500 years.

The preparation of saltpeter, sulphur and charcoal and the methods of granulating and mixing them to prepare black powder ostensibly evolved through the centuries by the slow and tedious process of trial and error.

Lead became the most common materiel for bullets, probably because it was easily cast by primitive means, its high density proved advantageous for exterior ballistic performance, and other materials such as stone were not readily available in the desired size or configuration.

CARTRIDGES (from left) .22 long-rifle; 5.56mm (M1983); 5.56mm (SS109); 7.62mm (M80); 5.56mm (Caseless); .30-40 (Krag).

Early ammunition did not provide its own means of ignition. Black powder carried in either a flask or horn, was poured into the muzzle of the weapon and packed down. A lead ball or a load of shot was then inserted into the muzzle with or without a wadding material, and rammed down on top of the black powder.

Ignition was accomplished at first by the gunner, who applied a live coal, heated wire, or slow burning cord or "match" to a pan of powder which was connected to the propellant charge at the breech of the weapon by a small hole through the barrel.

In later improvements, the gun provided the ignition, evolving through wheel locks where sparks were produced through the spinning of a steel wheel against pyrite, to the various actions which used the principle of flint striking against steel to produce sparks, i.e., snarphaunce, miquelet, and flintlock.

The first form of the cartridge as a unit of powder and ball is believed to have been developed during the matchlock period (circa 1550). It was essentially a unit formed by wrapping the ball and a charge of black powder in a roll of paper. The ends of the paper rolls were held in place either by tying or twisting them. The paper-wrapped, ball cartridge was then waterproofed by the application of a coating of grease and was used in much the same way as the powder flask and ball pouch. The exception was that the charge was premeasured and hence more uniform among shots.

In practice, the rifleman would remove a cartridge from his pouch, bite off the end opposite the ball, pour the powder down the barrel and ram the paper and ball down on top of the powder. The ignition was the same as previously described. American soldiers from the revolution through the Civil War used this paper cartridge method of loading and firing their weapons.

The first attempt to make the cartridge a single unit is attributed to M. Pauli during the early 19th century. A Swiss working in Paris, Pauli developed a breech loading gun which was chambered for an entirely new cartridge. It consisted of a ball and powder charge contained in a paper tube. It was inserted into a brass "rosette" configured head, which had a hole in its center. Placed in the center of the hole was a pellet of priming composition, containing fulminate of mercury invented by Reverend Alexander Forsythe (1807).

The complete cartridge was loaded into the breech of the weapon and was fired by the blow of the striker on the priming pellet. After firing, the rosette was removed from the weapon and used repeatedly, simply by inserting a new paper tube and priming pellet.

In 1814, almost concurrently with Pauli, Joshua Shaw, a Philadelphian, invented the percussion cap. While Pauli's cartridge required a new gun, Shaw's percussion caps facilitated the conversion of existing flintlocks to a more reliable method of ignition.

In 1827, Johan Nicholas Von Dreyse, who previously worked with Pauli, began work on a needle gun, possibly the forerunner of all modern bolt action rifles. Adopted by Prussia in December 1840, the needle gun used a self-contained, combustible cartridge. It consisted of a bullet that was seated on a paper-mache sabot, in the base of which was a priming pellet. Bullet, sabot and powder charge were wrapped in a paper container. This cartridge was fired by a drive needle that passed through the powder and struck the primer in the base of the sabot.

A similar cartridge and weapon were developed by the French. Their version, the "Chassepot" cartridge, moved the priming pellet from the base of the bullet to a wad at the base of the cartridge.

About 1836, another self-contained cartridge was introduced by M. Le Facheux. This cartridge, called the pin-fire cartridge, consisted of a paper tube and metal base. A percussion cap in the base of the cartridge was fired by the impact of a hammer on a pin resting inside the cap and projecting through the side of the cartridge case. These cartridges were rimless and were extracted from the weapon by hand, using the pin to pull them out of the breech. The design of these cases is somewhat similar to modern day shot shells.

In 1846, another Frenchman, M. Houllier, patented several versions of the pin-fire cartridge and weapon system as well as a variation of the present day rimfire system. Houllier's most notable achievement, however, was his use of copper or brass for the entire case of his cartridge, regardless of the priming system employed.

During the same period as the development of the needle fire and pin fire cartridges, another important small arms development was underway—the conical or cylindro-conoidal bullets.

It is generally agreed that development of the conical bullet began about 1825 and one of its better known examples is the "Minie" ball, invented by French Captain Minié, circa 1851. When fired in a gun with a rifled barrel, the conical bullet was superior to the ball or shot in many ways. By the spin imparted to the bullet by the rifling, greater gyroscopic stability was achieved, hence an improvement in accuracy and range.

It should be noted that, while balls used in rifled weapons also exhibit improved accuracy, the conical bullets, with greater surface area in contact with the rifling, demonstrated even greater improvements in accuracy.

At first, conical bullets were not readily accepted for military use. The increased surface area in contact with the rifling tended to make muzzleloading more difficult. Various systems, shapes and types were developed to ease loading. But, the conical bullet was not widely accepted until about 1850 when the breechloader was adopted as a military arm in Europe.

As conical bullets came into use in rifled, percussion-cap small arms, the general configuration of the cartridge remained unchanged. Instead of a round ball, paper cartridges were loaded with the new conoidal bullet.

In this country, a good example of this is the conical bullet, paper cartridge used in the caliber .58 Springfield Rifle musket, Model 1855. Another notable example is the previously cited French Chassepot cartridge.

When Houllier stipulated in 1846, the requirement to use copper or brass for the cartridge case, his rationale was not simply directed at ease in loading. With breechloading weapons and paper cartridges, it was virtually impossible to adequately seal the breech to prevent hot gases and particles from blowing rearward into the shooters' face. By using metal it was now possible, through obturation of the case, to impart an effective seal.

Two examples of early metallic case cartridges are the Maynard and Burnside cartridges, the former being possibly the most notable in that it was one of the first reloadable brass cartridges. It consisted of a brass tube to which a large disc was soldered, loaded with a black powder charge and a conical bullet. Ignition was through the small hole in the center of the head by either the Maynard tape primer or a percussion cap. Reloading was accomplished using tools and bullet molds provided with the weapon.

Another example of a metallic, cased cartridge was the "bulleted breech caps" developed by Flobert, a French gunsmith. His cartridge consisted of a small rimmed copper case loaded with a priming composition and into which was inserted a round ball. This was fired in the "saloon pistol" by compressing the priming composition in the rim of the case between the striker and breech of the gun. This, first shown at the London Exhibition of 1851, is the forerunner of today's rimfire cartridge.

The rimfire system soon expanded into larger calibers. Just before the Civil War, rimfire cartridges existed in calibers .22 through .58. Initially, these cartridges were somewhat unreliable and not widely adopted for military use. However, by the end of the war, they had attained wide usage with the Spencer Rifle.

There were problems in the tendency of the cartridge to misfire due to uneven distribution of priming mix in the rim and at the weakness at the head, caused by the formation of the rim. Nevertheless, rimfire cartridges offered an advantage over metallic cartridges which required a separate primer and were produced for sporting purposes in larger numbers. Production in the larger calibers lasted well into the 1870's with production in .22 caliber continuing today.

The center fire cartridge was the next evolutionary step in the development of the modern day cartridge. While center fire "type" cartridges had existed in the time of the needle gun cartridge—a fully contained metallic cased center fire cartridge did not exist until the close of the Civil War.

The earliest type of true center fire cartridge was the inside primed cartridge. From the outside, this cartridge looked like a rimfire cartridge but it is there that the similarity ceased. The inside primed cartridge consisted of a copper cartridge case with an interior metallic cup which was inserted from the mouth of the cartridge. The cup was positioned against the head of the cartridge cap and held in place by indentations in the case body.

In the center of this cup was a depression which contained priming compound. The cartridge was fired by the action of the weapon firing pin striking and crushing the case head against the depression containing the priming composition. This cartridge was adopted as the common U.S. military cartridge from approximately 1866 to 1886.

About 1866, the metallic center fire cartridge development took a quantum jump. This was occasioned by the invention of the drawn brass cartridge case. COL Berdan of the U.S. Army, found that it was possible to form a brass case by forcing a brass disc through a series of dies, the end of which was then a thin-walled, thick head case. With the thickened head it was now possible to form a pocket to contain a percussion primer in a one piece cartridge case.

Two types of primers were soon developed for use with these cartridge cases, the Berdan Primer and the Boxer Primer. The former consisted of a brass cap and pellet of priming composition. To allow for ignition, a raised center piece was formed in the cartridge case primer pocket. Two or three holes were also formed around this center piece to allow for spreading of the primer flame to the propellant.

The second type of primer, developed by COL E.M. Boxer of the British Army, differed from the Berdan because it had a self-contained anvil. Both types gained almost immediate acceptance and were used throughout the world; the Boxer being the most widely used in this country and the Berdan having favor in Europe.

The next and possibly most important development in small arms ammunition was the development of smokeless powder. The first such used with moderate success was invented by Schultze about 1864. It consisted of nitrated wood particles impregnated with nitrates of barium and potassium.

In 1885, the French Chemist Vielle developed the first satisfactory smokeless powder for military use. It was a single-base powder manufactured by colloiding nitrated cellulose with ether and alcohol; the end being nitrocellulose. In 1886, Alfred Nobel developed a double base, smokeless powder by colloiding nitrocellulose with nitroglycerin.

Smokeless powder was a great advance over black powder. The former produces two to three times the energy of an equivalent weight of blackpowder, its combustion products are almost entirely gaseous producing negligible residue as opposed to 60 percent for black powder and it greatly reduces fouling and does not generate the same amount of smoke.

After the development of satisfactory smokeless powder, almost every country began changing from weapons using black powder. France is generally credited with being the first country to adopt a rifle which used cartridges loaded with smokeless powder. This cartridge, used in the French Lebel rifle, Model 1886, consisted of a bottlenecked rimmed cartridge case, smokeless powder charge and bronze conical bullet.

The cartridge exhibited a muzzle velocity of about 2,380 feet per second, substantially greater than that which could be achieved with black powder. Concurrent with the change to smokeless powder was the change from all lead bullets to those that contained copper, cupronickel or copper-plated steel bullet jackets.

An early example of a U.S. military cartridge which used this is the .30 caliber for the Model 1892 Krag-Jorgensen cartridge rifle. The cartridge consisted of the then classical bottleneck configured rimmed case, a smokeless powder charge of 40 grains and a round-nosed bullet. Muzzle velocity was 2,000 fps.

The Krag was widely adopted by hunters and target shooters. Other U.S. cartridges then included some rimless varieties like the 6mm Lee Navy, caliber 30 Model 1903 and the caliber 30 Model 1906.

The latter was one with which the First World War was fought. It had a flat based, metal-jacketed lead core bullet and attained a muzzle velocity of about 2,770 fps. It was satisfactory for rifle use at short ranges, but did not exhibit a good long range accuracy as did the French boattail based bullets. It was not until 1925 that the U.S. Army adopted a boattailed bullet. The first such cartridge was the caliber 30 M1 for rifles and machine guns.

During the period just after World War I to just before World War II, no significant change in small arms ammunition occurred except for increase in caliber. Machine guns using large caliber cartridges (about caliber 50) and anti-tank rifles in the 12.7mm to 14.5mm range were developed and adopted by most countries. Several also experimented with large caliber cases necked down to accept standard rifle bullets to improve armor penetration. However, it was not until World War II, with changes in infantry tactics, that a significant development in small arms ammunition took place.

It was the Germans who, during the latter part of the war, first recognized and then developed an ammunition/weapon system based upon a change in battlefield tactics. They observed that rarely, if ever, was the infantry soldier required to engage and defeat targets beyond the 400 to 500 meter range and that even shorter ranges could be expected. No longer was it required to build heavy-weight, long-range rifles and a munition for them.

With this in mind, the Germans developed a new ammunition and rifle system that would fire a lighter bullet from a shorter cartridge. This new concept was first deployed in a system which was fielded during the retreat from Moscow. The MP 43 rifle (later MP44 assault rifle) fired a 7.92 × 33mm cartridge. The reduced cartridge size and hence reduced weight of the weapon system lessened the infantryman's carrying burden; enabling him to carry additional ammunition which gave reduced recoil enabling the rifle to be fired more effectively in the full, automatic mode. It was this system that would set future trends to infantry ammunition.

In the years following World War II, most countries began development of new intermediate power weapon systems using shorter ammunition similar to the German MP 44 assault rifle.

In the early 1950's, after extensive testing of the British 7mm, French 7.65mm and U.S. 7.62mm cartridges, the last was adopted as the NATO standard for rifles and machine guns. This cartridge, based on the light weight concept, consisted of a 150 grain bullet, 51mm case and a 48 grain propellant charge. It attained a muzzle velocity of 2,800 fps. The Warsaw Pact countries, on the other hand, adopted the 7.62 × 39mm cartridge used extensively in the AK 47 rifle.

Adoption by most of the world of these two cartridges was the start of a trend toward small caliber ammunition, ostensibly led by the U.S. After extensive review of war casualty reports and battlefield tactics, the Army concluded that hits on a target were often the result of unaimed fire and that for each bullet hitting a target, considerably more ammunition was expended.

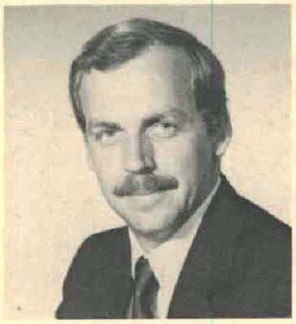
As a result of this study, the Army initiated several projects to increase the probability of hit by launching multiple projectiles with a single trigger pull, thus controlling the dispersion of the resulting pattern. These projects included "Salvo," "SPIW Flechette" and the "Salvo Squeeze Bore". Each was designed to increase hit probability.

"Salvo," in essence, looked at multiple-bullet cartridges and "SPIW Flechette" and was intended to fire multiple shots at a very high rate of fire with a single trigger pull. "Salvo Squeeze Bore" examined multiple-bulleted cartridges fired in weapon systems with tapered barrels. The 5.56mm cartridge was developed as an outgrowth of the "Salvo" project.

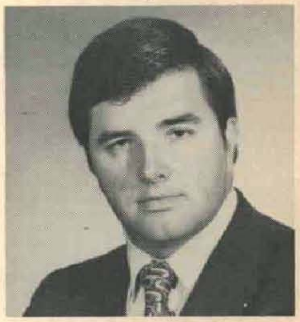
In retrospect, the advantage of the 5.56mm system over the 7.62mm system is weight. The M14 rifle, with 100 rounds of ammunition, in magazines, weighs about 17 pounds. At the same weight, the 5.56mm system includes the M16 or M16A1 rifle and 280 rounds of ammunition. In addition, the recoil of the M16 is considerably less than that of the M14 and generally means better marksmanship. One of the inferiorities, however, is its penetration capability.

With the continuing development of the Squad Automatic Weapon System, this inferiority was overcome. The addition of a steel tip to the projectile core and increasing the bullet weight substantially increased the down range penetration capability. After extensive ARRADCOM trials, the Belgium SS109 design has been standardized for use by NATO.

What is the future for rifle ammunition? Basically, ammunition consists of four components: case, primer, propellant and projectile. To reduce weight, the number of components will have to be reduced. Work is already underway to develop a caseless, fully combustible cartridge system.



DAVID J. REAP is a project engineer with the Fire Control and Small Caliber Weapon Systems Laboratory, U.S. Army Armament Research and Development Command. He earned a bachelor of engineering degree in mechanical engineering at Villanova University in 1966, then he began work at Frankford Arsenal, Philadelphia, and has continued at ARRADCOM since Frankford's closing.



JOHN A. RESCH is a product engineer with the Fire Control and Small Caliber Weapon Systems Laboratory, U.S. Army Armament Research and Development Command. He graduated from Pratt Institute, Brooklyn, NY, in 1974 with a bachelor of science degree in chemical engineering. He began working with the government at Frankford Arsenal, and came to ARRADCOM when Frankford closed.

The following also assisted in preparation of this article: Daniel Dietz of the ARRADCOM Support Activity, Louis Behling of the Technical Support Directorate, ARRADCOM, and William Davis, a retired federal employee who had worked at Frankford Arsenal.

MARDIS Coordinating Group Cites Gains in System Improvements

Numerous key improvements relative to the Modernized Army R&D Information System (MARDIS) were reviewed in San Antonio, TX, in October, during a meeting of the U.S. Army Materiel Development and Readiness Command's MARDIS Coordinating Group.

The meeting, chaired by Robert F. Chaillet, HQ DARCOM, was hosted by the Office of the Surgeon General, under the auspices of the U.S. Army Institute of Surgical Research, COL Basil A. Pruitt, commander of the Institute of Surgical Research, welcomed the group and provided an overview of the Institute's mission.

Conference presentations were provided by representatives from the U.S. Army Medical R&D Command; Computer Systems Command; U.S. Army Test and Evaluation Command; U.S. Army Electronics R&D Command; U.S. Army Logistics Systems Support Activity; Office, Deputy Chief of Staff for RD&A; HQ DARCOM; and the Atmospheric Sciences Laboratory.

The Modernized Army R&D Information System is the vehicle used to collect data required to support the formulation of the annual RDTE program and budget. When the system was initially activated in 1978 it was basically a punch-card, batch-processing operation.

One of the improvements being implemented is the replacement of the punch-card method with a direct computer terminal input for editing of the data. This improvement was established by the U.S. Army Armanent R&D Command, and has since been passed on to others.

Other system improvements resulting from DARCOM MARDIS Coordinating Group meetings have included simplification of reporting total program funding for Program Objective Memorandum building, improved identification of manpower resources, MARDIS manual improvements, and elimination of outdated reporting requirements. A total of 308 system change requests have been made to the MARDIS since its establishment.

There are also 80 additional change requests pending and of these only a fraction will be incorporated in the next system change package. A group has been established to prioritize these changes.

The next meeting of the DARCOM MARDIS Coordinating Group will be hosted by the Army Project Manager for Training Devices, 22-24 March, in Winter Park, FL.

Small Arms Training Ammunition for The 1980's

By Frank P. Puzycki

Intense interest in fielding improved small caliber training ammunition is evident in the formation of the Standards in Training Commission by the Chief of Staff Army and the recent formulation of numerous training device requirements and training device need statements by the user community.

The commission effort, for example, was directed at defining the training needs for Army weapon systems, considering all alternatives (e.g., live fire, simulation). The impetus behind these efforts can be attributed to current or forecast shortages of two key resources: dollars and firing range real estate.

From a financial standpoint, the effects of inflation during the past decade have been keenly felt throughout development, acquisition and operating costs. With respect to ammunition availability, this economic situation could force the user to choose between reduction of training activities or depletion of war reserve ammunition stockpiles.

The goal of providing more "bang for the buck" through fielding more economical small arms training systems is an attempt to stem those inflationary effects in the Army ammunition procurement budget.

From a different perspective, the inability to provide frequent live-fire training due to real estate restrictions at local training areas, e.g., U.S. Army Europe and National Guard, poses an equally important challenge. In this instance, the only alternative is more regular training at major training areas, incurring added costs in transporting the units to these facilities.

Fielding cost comparable, effective, short-range training ammunition alternatives to service rounds will permit more frequent opportunities for training, i.e., to let the soldiers do more soldiering.

TABLE 2

SHORT-RANGE TRAINING AMMUNITION PERFORMANCE

	Bullet wt (gm)	Muzzle vel (m/s)	Max range (m)	Max effective range (m)	Accuracy equiv-alence*	Weapon
M861 .22 Cal	2.57	330	1250	100	—	M16 rifle fitted with M261 rimfire adapter
XM862 5.56mm plastic training	0.2	1700	250	30	4X	M16 rifle fitted with special training bolt
XM858 Cal .50 plastic training	3.2	1335	500	150	4X	M2 machine-gun fitted with special recoil amplifier barrel assembly

***Accuracy of training ammunition at a given range X, equals accuracy of the service cartridge at the equivalent range, e.g., 4X**

Before discussing the specific programs that the Fire Control and Small Caliber Weapons Systems Laboratory of ARRADCOM, Dover, NJ, is pursuing to satisfy these emerging needs, it is important to define a few basic terms. Table 1 categorizes the three principal types of training ammunition in existence or under development in calibers .22 through .50 today.

Blank ammunition has and will be extensively used by the Army for numerous tasks including the MILES training regimen and weapon familiarization training. In such applications, blanks can provide collective training but fail to exhibit other key features of live fire including hit indication, realistic recoil and associated safety training.

TABLE 1

	TRAJECTORY	*MAXIMUM RANGE*
Blank	—	—
Short range	Scaled range, simulation, typically 4/1 ratio to service round to maximum effective range.*	10% or less of service grade equivalent
Limited range	Trajectory match to service ammunition to maximum effective range*	50% of service grade equivalent

***Maximum effective range: That range at which the training projectile simulates on a scaled range or point to point basis, the trajectory of the service cartridge.**

Short-range training ammunition addresses the need for providing frequent training in relatively confined areas sacrificing real-range trajectory matching and accuracy performance when compared to the service grade equivalent round for scaled-range simulation.

Limited-range training ammunition is directed at the majority of the training exercises, providing realistic point to point trajectory match to the corresponding service grade round, when real estate restrictions are not a factor. This limited-range round, however, will satisfy that other critical requirement mentioned above, by providing a cost saving alternative to the firing of service grade ammunition.

Even in those instances, where it is desirable or necessary to provide live-fire training with service grade ammunition, efforts have been proposed to effect cost savings, for example, by developing alternative low-cost packaging techniques for standard ammunition.

An endeavor concluded in FY81 qualified a new less hazardous propellant for the M200 5.56mm blank cartridge offering the dual advantages of improved safety and reduced ammunition costs.

The ARRADCOM effort is directed at upgrading the Army's total small arms training capability by filling in these existing ammunition gaps (i.e., limited and short-range training cartridge) while reducing costs in presently available blank and service grade ammunition through a 3-prong program.

The first short-term ARRADCOM effort involves introduction of the short-range plastic training ammunition to units stationed in U.S. Army Europe and the National Guard in calibers 5.56mm and .50.

Under the TECOM International Materiel Evaluation Program, commercially available short-range cartridges have been identified which meet the U.S. Army Europe and National Guard needs and are pesently being evaluated for potential type classification action against approved training device requirements.

The use of this International program permits a relatively short-term program to be concluded without the dollar/time expenditure normally associated with life cycle developed items. Table 2 lists the technical characteristics of the International short-range cartridges presently under evaluation.

The M861 .22 caliber rimfire tracer cartridge was type classified at ARRADCOM in December 1981. This round replaces the more familiar .22 caliber long rifle ball cartridge presently in use in scaled-range tank gunnery training.

Fired from the M16 rifle, which is mounted co-axial to main gun tank armament, the M861 tracer will provide the tank crew with a visual means of sensing the flight and aim point of the projectile facilitating easier and more rapid adjustment of the weapon on these scaled ranges. It is easy to see cost savings inherent in this form of training when compared to the per round cost of a 105mm service tank round!

The XM862 and XM858 short-range plastic training rounds are presently in the international test and evaluation program. These rounds consist of a plastic bullet which is molded integral to the plastic cartridge case neck. Under the action of the burning propellant gases, this bullet tears away from the case neck and accelerates down the bore and on to the target.

The remainder of the cartridge case consists of a combination of either plastic/aluminum (cal .50) or plastic/brass (5.56mm). These short-range cartridges require the use of a special recoil amplifying weapon adapter to effect automatic function of the rifle/machinegun.

In this short-term program, the key emphasis is in providing increased training opportunities in these range restricted theaters while effecting cost savings by reducing the frequency of transporting troops to major training areas.

The second gap in the small caliber training ammunition inventory will be answered by the full-scale development of limited-range training ammunition. Since the majority of exercises in rifle

TABLE 3

LIMITED-RANGE TRAINING AMMUNITION

PERFORMANCE GOALS

Cost effective versus service round.

Accuracy and zero equivalence to service round at desired maximum effective ranges.

Capable of activating standard targets/mechanisms.

Minimum ricochet.

Brass casing.

Realistic recoil.

Companion tracer capability.

Compatibility/function with standard weapon bolts.

Range profile:

Cal	Max effective	Maximum
5.56mm	300	1500
7.62mm	300	1500
Cal .50	600	2500

TABLE 4

TRAINING AMMUNITION PRODUCT IMPROVEMENT PROGRAMS

Program	Scope	Initiation	Completion
7.62mm M82 blank cartridge	Improve function and reliability of the current blank cartridge	FY82	FY84
Cal .50 M1A1 blank cartridge	Provide cost savings over existing blank through material substitution	FY83	FY85
XM858 Cal .50 plastic training cartridge	Provide improved performance and cost savings over the present commercially procured round	FY83	FY85
XM862 5.56mm plastic training cartridge	Provide improved performance and cost savings over the present commercially procured round	FY84	FY85
Cal .50 blank M1A1 cartridge alternate propellant	Provide new, less hazardous propellant which increases ammo production capacity and reduced ammunition production costs	FY82	FY84
Packaging	Economical packaging alternative to current metal boxes (M2A1/M19A1)	FY85	FY87
Packaging	Elimination of current wire-bound crate	FY85	FY87

marksmanship and machinegun training will eventually use such a round, cost savings are a paramount concern. Table 3 summarizes the desired performance characteristics identified by the user for the limited range role.

A review of these requirements surfaces one underlying issue that the user has emphasized throughout training ammunition programs; i.e., training transfer.

Ideally, a good small arms training ammunition system masks its identity to the firer during use. It looks, functions and performs like the service grade cartridge. It does not require the user to alter his weapon or training techniques by having to employ special bolts, magazines or other ancillary devices which can produce a negative training experience. From the Army's perspective, there should be only two areas in which this ammunition should provide departures from the norm: range fans and acquisition cost economies.

The initial limited-range development effort, sponsored by the Joint Services Small Arms Program, will be conducted in FY83 in caliber .50. This contractural effort will identify potential ammunition concepts meeting all or some of these user performance needs and will produce prototype hardware for evaluation at the year's end.

It is anticipated that the technology developed during this program will be spun off to the 7.62mm and 5.56mm rounds, eventually providing the Army with a family of low cost, service round-matched training cartridges meeting the majority of the users' training needs in the small caliber area.

The third effort in small caliber training ammunition relies on the use of product improvement programs to provide cost savings and/or enhanced performance in existing ammunition types. Table 4 summarizes these current or future improvements. By way of example, the 7.62mm M82 blank cartridge design effort will result in improved function and reliability for this item.

Borrowing from a successful effort in 5.56mm blank ammunition, a current effort is directed at providing a new and less hazardous propellant for the Cal. 50 M1A1 blank cartridge to increase production capacity for this round while reducing its production cost.

A future improvement program will explore the cost savings potential of a caliber .50 M1A1 plastic blank cartridge to replace the existing conventional brass case design.

As mentioned previously, low cost alternative packaging for service grade ammunition is being proposed as a further means of providing training economies. Finally, as noted in Table 4, product improvement efforts are planned to provide improved versions of the short-range training cartridges presently under international evaluation to provide cost savings, rather than the present cost comparability envisioned for these rounds in the near term.

In summary, the development and rapid fielding of improved small caliber training ammunition systems is a critical element in assuring that the Army maintains soldier proficiency in the decade of the 80s, because those key resources of money and available real estate are likely to continue to contract in the future. The user and developer communities are addressing this challenge using the totality of the life cycle development and acquisition process, tailored to the short or long term nature of the specific Army need.

FRANK PUZYCKI serves as a senior project engineer with the Fire Control and Small Caliber Weapon Systems Laboratory, U.S. Army Armament Research and Development Command. He earned a bachelor of science degree in engineering physics at St. Joseph's College in 1969 and a master of engineering degree in engineering science from Penn State University in 1972.

Mine Detection Division Establishes a New Test Site

By Marisa McCarthy

The Mine Detection Division, a part of the U.S. Army Mobility Equipment R&D Command's Countermine Laboratory, will be using land on West Virginia University's Reymann Memorial Farm at Wardensville, WV, as a test site to conduct mine detection experiments. A variety of airborne, vehicular and hand-held sensors will be investigated.

West Virginia University has agreed to allow the Mine Detection Division to use two acres as a base of operations and for full-time experimentation. An additional 35 acres will be available on a noninterfering basis.

The additional 35 acres will be used to conduct minefield detection experiments which will coexist with the operations of the research farm. The Reymann Memorial Farm is only 96 miles from MERADCOM and carries out agricultural and animal husbandry experiments.

Specifically, the University carries out studies in animal nutrition as well as many horticultural experiments with special vegetation. The experiments are implemented and managed by the farm's knowledgable full-time staff of students assisted by other students and daily hired workers.

The farm consists of 1,500 acres of land covered with dense woods, grazing land, hay fields and vegetation test fields. The Capon river flows through the farm. This assortment of nature is ideal for Mine Detection's need for a variety of soil types and terrain similar to rural areas in Germany. The entire region can be used to collect realistic background data.

Indeed, the test site was designated ERGATS standing for Eastern Region German Analog Test Site, because its physical landscape is analogous to the foothills of the mountains of Central Europe. It has similarities to the river valleys of Germany where the cultivated lands provide routes for armored units to avoid urban terrain where momentum would be lost.

Detection of surface and buried minefields using reconnaissance assets and airborne minefield detection systems are the primary programs that the Mine Detection Division will be studying on the acreage.

A program called Minefield Detection Using Reconnaissance Assets is the first such project to utilize the two acre test site. The overall goal of this program is to establish the utility of reconnaissance assets in a minefield detection role.

Black and white, and infrared photos will be taken of minefields placed on the test site grounds. These photos will be studied by professional photointerpreters to see if this imagery can be used for detection of mines. Environmental parameters which affect the photograph's quality for use in mine detectability will be determined and recorded.

Such things as the type of background, time of day, percentage of cloud cover, sensor visual access and available contrast will be studied to see how these factors affect successful detection of mines using pictures taken in an aircraft.

Peter Pecori, project engineer for the program states that, "the results of this project should help in the determination of what effects the environment has on the ability of existing tactical reconnaissance assets to detect minefields.

A photointerpreter's guide providing keys on the factors which affect the airborne minefield detection ability and a mission commander's guide detailing conditions necessary for a successful mine detection overflight will be prepared."

New concepts for enhancing this capability through modification of the films used, and new concepts for automated image analysis to reduce the need for photointerpreters, will also be evaluated and tested on the site as research projects are identified and executed.

Similar to the program just described is one called Airborne Minefield Detection System project. This project is expected to deliver instantaneous, high resolution minefield imagery from a remotely piloted vehicle to a mobile unit stationed at the rear of a combined forces assault team. These images will give detailed high resolution information about the chosen route of advance, minefields which may block it, and the disposition of enemy covering forces.

Basic conditions require that the targets be optically accessible to the overhead sensor and have adequate contrast so as to be distinguishable from the surrounding area. George Maksymonko, project engineer for the program, states that it "is a recommended approach to minefield detection for use by armored assault units to counter the threats of mines during a flank attack.

Since a threat such as this gives only a short time for the armored unit to detect the mines, the instant availability of these images to the mobile unit to detect the mines is necessary."

The program concept is to use a remotely piloted vehicle, essentially a small robotic aircraft, to transport an electro-optical scanner over the battlefield and take images of the ground, send these images in real time to a ground station processor and display unit, and provide for immediate detection and location of minefields. A major thrust of this effort will be to develop automatic data screening methods to pull minefields out of the background.

Another program using the test site is the Visual Detection program. This human factors project will utilize an aircraft and human observers to detect minefields with only the unaided eye and available night vision enhancement devices.

Persons of different sex, age, as well as individuals having differences in background and level of experience with mines, will be used to see if they can correctly identify mined areas. They will be tested to see whether their background in knowledge of nature and agricultural environments will help to distinguish something that looks out of the ordinary, like mines, from the normal environment.

The question to be answered is, can the crew of an attack helicopter, which reconnoiters at very low altitude, provide any capability for minefields detection?

Mari-Catherine Fischer, project scientist for this program, gives her view of the significance of this program to minefield detection. "Often times the innate or learned abilities of our soldiers are overlooked. This is why a human factors approach is of necessary importance when a subject such as remote minefield detection is investigated. From past experiences, there are some unique soldiers who seem to exhibit an amazing ability to discern anomalies in the environment. These are the type of individuals which we hope to employ in minefield detection."

The soldiers will be flown over the test site and asked to pick out mined areas. Their answers will be recorded to see if they were correct, even though some parts of the field will have no mines to be detected. Low-level flights over the test site will be carried out at all hours during the day and different times throughout the year.

One of the great advantages of the test site commented on by Dr. Raymond Nolan, chief of the Research Branch is, "the ability to fly at any odd hour of the day or night without disturbing a large population in the surrounding area."

A mobile, electromagnetic test facility, used by the Mine Detection Division, will be placed on the site to conduct experiments in support of a variety of applied research programs. This equipment is capable of very precise measurements of electromagnetic scattering, over a wide frequency range. It will be used in programs to gain a better understanding of the response of targets and natural backgrounds to electromagnetic excitation.

Improved portable, vehicular, and airborne sensors may result from this work. The test site will also be used to collect data on natural agricultural odorants and vapor transport mechanisms, and to support development of new concepts in biosensor explosive detection.

The staff of the university and of the research farm have been very cooperative and have even expressed interest in the possible use of minefield sensors in support of their agricultural programs. A fellowship program to employ graduate students in support of the minefield detection program is under consideration.

The most important aspect of this test site is the realistic nature of the land use and surface conditions, both of which are critical to the development of effective remote minefield sensors for use in Europe.

MARISA MCCARTHY is a senior majoring in business administration at James Madison University. She was employed this past summer in the Mine Detection Division of the Countermine Laboratory, U.S. Army Mobility Equipment R&D Command, Fort Belvoir, VA.

BRL Range Becomes National Landmark

Following four decades of service to the nation, the U.S. Army Ballistic Research Laboratory's Aerodynamics Range has been designated a national historic mechanical engineering landmark.

Recognized as the world's first large-scale, fully instrumented ballistic facility for producing data on the aerodynamic characteristics of missiles in free flight, the historic ballistic landmark was dedicated recently by the American Society of Mechanical Engineers during ceremonies at Aberdeen Proving Ground, MD.

The Aerodynamics Range is a fully enclosed facility equipped to launch a missile in free flight and record its motion over a 285-foot trajectory. The range consists of a firing room containing a launcher, a blast chamber to protect instrumentation, and a photo gallery for recording the flight of the missile.

Activated in 1943, the range provided, for the first time, the capability to accurately measure histories of projectile motion as well as detailed, transient flow structure of bodies in high-speed flight. Since 1973, the American Society of Mechanical Engineers has designated 79 state, national and international landmarks.

Shown on these pages are 56 of the Army's program/project/product managers. This listing is correct as of 1 October 1982. Additional information regarding the Program/Project/Product Manager Program may be obtained from the Project Management Division, DEA, ATTN: DRCDE-M, HQ, DARCOM, 5001 Eisenhower Ave., Alexandria, VA 22333. Phone Autovon 284-9570, or Commercial (202) 274-9570.

AAH

MG Edward M. Browne

ASH

Photo Not Available

COL William H. Forster

ADCCS

COL David L. Wyatt

ASE

COL Edward C. Robinson

BLACK HAWK

COL Ronald K. Andreson

BFVA

COL Thomas K. Seybold

BFVS

BG Donald P. Whalen

CAWS

COL John Kronkitis

CH-47

COL Dewitt T. Irby, Jr.

CHAP/FAAR

COL William S. Chen

FISTV

COL James A. Chernault

HAWK

COL John S. Drosdeck

HET

COL Howard W. Roth

HELLFIRE/GLD

COL Stanley D. Cass

JTFP

COL Thomas P. Kehoe

JVX

Photo Not Available

COL James A. Creech (USMC)

MPG

COL James B. Welsh

MICNS

LTC James A. Love

MLRS

COL August M. Cianciolo

MSCS

COL Donald J. Callahan

NUC MUN

COL William P. Farmer

OPTADS

COL Philip S. Threefoot

SINCGARS

COL Edward R. Baldwin

SMOKE

COL Samuel L. Eure

SEMA

COL William D. Taylor

STINGER

COL Richard C. Dean

RPV

COL Robert D. Evans

TADS/PNVS

COL Donald P. Wray

ACRONYMS:

AAH—Advanced Attack Helicopter
ASH—Advanced Scout Helicopter
ADCCS—Air Defense Command/Control System
ASE—Aircraft Survivability Equipment
ARD—Armor Training Devices
ATACS—Army Tactical Communications Systems
ATM—Army TMDE Modernization
ATSS—Automatic Test Support Systems
BFVA—Bradley Fighting Vehicle Armament
BFVS—Bradley Fighting Vehicle Systems
CAWS—Cannon Artillery Weapons System

(Continued on page 22)

ARD

LTC John A. Longhouser

ATACS

COL Glen L. Rhoades

TMOD

PM Not Selected

ATSS

LTC Joseph C. Marangola

COBRA

COL Donald R. Williamson

CCE/SMHE

LTC Leroy W. Paul

DCS(ARMY)

BG T.D. Rodgers

DIVAD

COL(P) Charles C. Adsit

FATDS

COL Harold E. Luck

FIREFINDER/ REMBASS

COL John S. Chesbro

LAV

COL Joseph J. O'Brien (USMC)

M1

MG Duard D. Ball

M9/ACE

LTC Robert F. Huttner

M60

COl Claude B. Donovan

M113

LTC James A. Logan

MEP

COL Michael S. Higgins

PATRIOT

MG Jerry M. Bunyard

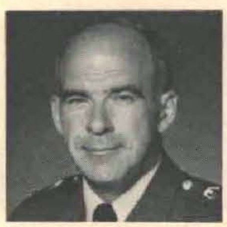
PERSHING

COL William J. Fiorentino

PSE

COL Robert K. Cornell

PLRS/TIDS



COL Richard G. Saunders

SATCOM

COL Charles F. Lindberg

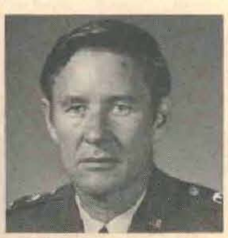
SANG

BG John J. Yeosock

TMAS

COL David A. Appling

TMDE

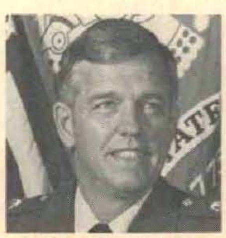


COL Walter J. Gabrysiak

TOW

COL Bryon L. Powers

TRADE



COL Donald M. Campbell

US ROLAND

Mr. John Robins

VIPER

COL Robert T. Walker

Cost Discipline

By LTG Richard H. Thompson

The unanticipated and seemingly uncontrollable growth in the cost of weapons systems has placed in jeopardy the Army's ability to finance future efforts to equip the force. The concomitant effect of this growth is the impact it has had upon the public perception of the Army and industry's ability to manage the materiel acquisition system.

If future Army readiness and sustainability goals are to be achieved and maintained, the Army, working with industry, must make every effort to control cost growth and keep the total cost of Army systems within the realm of affordability.

To confront this challenge effectively, it is essential to recognize that the predominant cost in any system is the cost to support it. As an example, the anticipated cost breakdown on the M1 Abrams tank is 1.2 percent for research and development, 23.8 percent for acquisition and 75 percent operation and support. Clearly, it is necessary to control the cost of that support, i.e., manpower, materiel and time required to support the system if we are to control the actual life-cycle cost of that system.

The first step is the identification of logistical support requirements early in the life cycle. The logistician's truism is that it is never too early to consider integrated logistics support (ILS) in the materiel acquisition process; it must be done commensurate with concept development and continued throughout the life of the system. To accomplish this, two things must happen. First, we, the Army must know what we want and state those requirements in specific terms. We must also have the courage to freeze design well before the production decision; and that design must be based on operational peacetime readiness and wartime effectiveness objectives.

Secondly, industry must give us what we want and need; nothing less. This means that the first production contract cannot include the first of several change proposals designed to make the system work. These actions should have been accomplished before production.

Experience has demonstrated that decisions made early in the concept and development stages will determine production cost as well as the total operational and support costs of a system. It is, therefore, mandatory that we infuse "thinking logistics" as early as possible in the acquisition process.

One of the more difficult things for industry to do is to begin logistics engineering during concept development. Current Army contracting procedures should require industry to consider ILS as a separate contractual requirement on research and development contracts. This necessitates the integration by industry of all ILS elements including supply and maintenance support, test equipment and transportability into system design and program management.

Industry must also assess the effect of a hardware system on the manpower needs essential to its support. This is the cornerstone in any logistic support concept, the product of which is an industry cost proposal for ILS that is based on the most likely rather than the most optimistic costs. The reality, however, is that industry, for many reasons, does not perform well in this area. Innovative actions on the part of the government can change this.

Positive and innovative initiatives by industry to integrate realistic ILS earlier into the development process must be recognized and rewarded by the government to accrue long-term benefits for the Army. Techniques such as this will provide the impetus to Army budgeteers to fund based on a more realistic system cost. The outcome is the long-term funding for the total ILS package and the commitment of resources earlier for acquisition of that support package. An acquisition procedure such as this tends to be stabilizing on the industrial base, especially 2nd, 3rd, and 4th tier subcontractors who are dependent on a steady, predictable demand for their specialized production capability.

The inclination to accept reliability, availability, and maintainability characteristics that provide the lowest system acquisition cost must be reversed, since these acquisition policies virtually ignore the ultimate support cost.

Incentives that create a favorable atmosphere allow for the integration of ILS into the early phases of the life-cycle and should result in life-cycle cost becoming a pivotal element in source selection.

By providing the opportunity to industry to consider various alternatives in supporting a given system and permitting such efforts to be rewarded, we create the atmosphere in which sufficient competition is induced permitting the evaluation of prototype systems to include their ILS packages.

Life-cycle cost procedures provide us with an avenue through which we can influence system characteristics that minimize the expenditure of other scarce logistic resources, i.e., people, time, and materiel, during the life of the system and allow the latitude to trade-off or adjust their variables over which we have some control. This will provide the backdrop for reasoned production decisions and with some assurance, a realistically negotiated design-to-unit-production cost. Of course, this means industry must do a better job in tracking, reporting, managing and controlling costs. However, with this comes increased confidence, not only within DOD, but also with Congress and the American public.

A firm resolve to implement this policy accrues significant dividends; infant mortality experienced during low rate initial production allows preplanned product improvements to be developed. This enhances the decision maker's ability to select what he wants during the evolution of the system over its lifetime, in a thoughtful, logical, systematic way. If this were made common practice, our ability to support a system would be significantly increased.

In the past, this has tended to destroy DOD's credibility with Congress, because of our never-ending need for more dollars to "fix" the system. The result has been the proliferation of single-year contracts which have a destabilizing effect on the industrial base, as well as discouraging industry participation in defense preparedness programs.

The corollary to a stable design configuration and the consideration of ILS during the development of a system is the development of an environment in which the award of multi-year contracts is encouraged, with the Army having some degree of assurance that we will get what we want, when we want it, for the cost we expect.

This process should go a long way to strengthen the industrial base and control the acquisition cost of the system. It will mean better logistical support for the Army, since fewer variations of the same piece of equipment will be in the field at any one time. As an example, the initial contract for the UH-60A Blackhawk helicopter froze the design for the initial 3-year production run, resulting in the fielding of only one configuration during that period.

Not until the award of the second multi-year contract will all the engineering change proposals collected over the initial contract term be applied. The logistic implications are obvious. However, it is critical that industry not use this emerging movement to multi-year acquisition as an invitation to buy-in or to proliferate engineering change proposals as a wedge to increase profits.

Ideas which have been presented here may not result in the least expensive production cost, however, they should result in decisions being made which will give the Army systems that have the lowest life-cycle cost among competing systems. They will also provide the Army with the ability to find the most effective mix of available resources to support any system in support of its readiness objectives.

Distinct challenges exist for both the Army and industry. First, the Army must establish firm design decisions and look at the true cost of a system before making acquisition decisions. We must have the corporate courage to eliminate unaffordable risky programs.

Second, the Army is a good customer. Industry must not take advantage of the inherent limitations imposed on the Army by statute and regulations, but rather deal within these limitations. Industry must find ways to control costs. This requires dialogue and mutual trust between industry and the Army which encourages necessary private efforts to refocus economic objectives from short term to long range.

The outcome should be a line of communication that allows industry to tell the Army when programs are unaffordable or that the state-of-the-art being sought can't be achieved within the design-to-unit-production-cost.

Finally, we all must insure logistics support is fully considered and integrated in system concept, design, and development if we are going to control cost growth and get the most capability possible for each defense dollar spent.

LTG RICHARD H. THOMPSON is Deputy Chief of Staff for Logistics Department of the Army. He holds a bachelor's degree in social science from the College of the Ozarks and master's degree in public administration from George Washington University.

Multipurpose Vehicle Tests Near Completion at APG

The High Mobility Multipurpose Wheeled Vehicles that arrived at Aberdeen Proving Ground, MD, at the end of April are nearing the end of their testing program.

The high mobility vehicle is an outgrowth of two earlier programs to find a replacement for the M151A2 jeep and the M561 Gamma Goat. Some of the vehicle's features include a diesel engine, power steering, automatic transmission, power brakes, and a common chassis upon which several different bodies could be built, such as troop carrier/utility vehicle, ambulance and weapons carrier.

Three corporations, AM General, General Dynamics, and Teledyne, have produced the candidate vehicles and each candidate is currently being put through a series of rugged endurance and performance tests at APG and other test sites.

The vehicles at APG have been running reliability, availability, maintainability, and durability or endurance testing, over several different types of road surfaces at the Churchville, Perryman, and Munson test courses.

"They have to run 20,000 miles on paved, dirt, and gravel surfaces, Belgium blocks, hills and grades," explained Mr. Bill Sulak, assistant test director for the Materiel Testing Directorate (MTD). "We basically will see what will last and what won't on each vehicle as it goes through the testing."

There are 40 different main events, plus sub-events. Some of the tests include tire-performance tests where the vehicle is run at certain speeds and distances on flat tires, fording tests where the vehicle is forded at water depths of 30 and 60 inches, and environmental tests where the vehicle is exposed to extreme cold temperatures.

Steering performance tests are also conducted where the vehicle's steering and handling are measured. The steering tests are the most recent performance test conducted on the vehicles. A new type of tracking system, the point-angle measurement system, was employed for the steering test. It has been used before for tracking high-speed aircraft but this is the first time it was used for automotive testing.

While testing is going on at APG, other testing is also being conducted at other test sites across the country. Desert testing is being conducted at Yuma Proving Ground AZ; operational training with the troops is going on at Fort Ord, CA; ocean fording tests are underway in another location in California; and air mobility tests are being conducted at Fort Bragg, NC.

What's the outlook for the vehicles? A contract is tentatively scheduled to be awarded to one of the competing corporations in December of this year. Fielding of the vehicles is expected to begin in March 1983.

High-mobility vehicles by (from left) Teledyne, AM General, General Dynamics.

Exclusive Interview. . .

BRL Director Cites Importance of Ballistics Programs

Director of the U.S. Army Ballistic Research Laboratory Dr. Robert J. Eichelberger provided some very enlightening responses to a series of broad-ranging questions during a recent interview at Aberdeen Proving Ground, MD. The questions posed to him and his responses follow:

Q. What role does fundamental research play in the development of ballistics technology?

A. Fundamental research plays a very profound role and, in a field such as ballistics, it is a role that the Service labs must really support. This is because there are areas of science in ballistics technology that do not attract a great deal of interest for purposes other than ballistics.

The BRL has, for many years, been at the forefront of research in high pressure physics, deformation of materials at very high strain rates, and studies of very rapid chemical reactions. There is very little interest in industry or at universities in doing this type of independent research. They are not interested in these fields unless supported by the Army. Consequently, the internal work in these fields is still very important to the BRL.

Although I emphasize the importance of in-house ressearch, I should note that work supported by the Army Research Office is a very critical adjunct to our in-house work. Without their help, we would be isolated and become ingrown.

Fundamentally, we at the BRL consider 6.1 research to be the very foundation of our entire program. We are very proud of our performance in the field, and of the contributions to the development and engineering technologies. Our laboratory work has achieved global recognition.

Q. Could you discuss the relationship between BRL and the development and user community?

A. The BRL, as a matter of policy, is not institutionally funded. Mission funding supports about 50 to 60 percent of the BRL's total effort. The remainder is essentially customer service to developers and to users, as represented by TRADOC. We serve a great diversity of both developers and users. We take great pride in the services we have provided to such activities as the M1 Project Manager's Office and to the Tank Main Armament Systems Project Office, and to the various DARCOM major commands.

We are also in constant communication with the commands and schools at TRADOC in order to get information regarding their future requirements and to discuss some of the concepts we have developed which may be of some use to them. Specifically, we are now working with people at Fort Sill in exploiting the artillery command and control system. Additionally, we have worked closely with Fort Knox in evaluating armament weapon systems.

Our people are very frequently called upon to serve on source selection evaluation boards and cost operational effectiveness studies. Therefore, I think our relationship with both developers and users has become very close, and the feedback we get is critical in planning our own mission program.

Q. Weight and ease of handling of ammunition have always been major concerns for the soldier in the field. What specifically, is BRL doing to address these concerns?

A. For a very long time attention has been given to improving efficiency of the systems. For example, in the area of infantry anti-tank systems much of the effort has gone into reducing the weight of the warhead, which also allows a reduction in the weight of the propulsion system and the launcher. The LAW system is an example of this.

All of the improvements in efficiency of systems can be used to reduce weight. Unfortunately however, we are on a treadmill that is traveling very fast and the threat is increasing as rapidly as we can improve the efficiency of our systems.

It is an inescapable fact of life that the performance of a weapon increases linearly with the dimension of a weapon whereas the weight increases as a cube of the dimension. With the increases in threat that have been perceived recently, it is surprising that the increases in weight of our systems have been kept as low as they have.

Where the Rapid Deployment Force is concerned, attention is being given to reductions in weight. This has led to smaller caliber, rapid fire antiarmor systems and lightweight infantry antiarmor systems. Improvements have also been made in the structural design and use of more advanced materials.

"Fundamentally, we at the BRL consider 6.1 research to be the very foundation of our entire program. We are very proud of our performance in the field, and of the contributions to the development and engineering technologies."

Q. What areas of ballistics do you feel offer the greatest potential for a "breakthrough" during the next decade?

A. I think that despite the very rapid advances made in armor and antiarmor during the past decade we will continue to see dramatic improvements in these areas. However, the most dramatic breakthrough will probably occur in the propulsion area. I think there will be very substantial improvements in the efficiency of gun propulsion. I also expect that liquid propellant technology will bear fruit in the next decade. I think that electromagnetic propulsion will become an important addition to our propulsion techniques in the longer term.

I suspect though that the most important advances won't come from a single technology, but from what I term "systems engineering". This is the application of all the technologies in an integrated and coherent fashion. At the BRL we have developed, during recent years, a special methodology for handling the integrated engineering evaluation of concepts before any hardware is even built. The object of this is to find out how to best combine current or future advances in all phases of ballistics and to combine advances in ballistics with the peripheral advances such as guidance and control and target acquisition into a complete weapon system. It is sometimes surprising how great an improvement in overall systems performance can be achieved simply by using off-the-shelf technology and combining it in optimal fashion. Examples of this can be found in air defense technology.

A systems engineering approach as a solution to air defense problems has clearly indicated to us that reduction in time of flight of projectiles will provide the greatest increase in performance of air defense gun systems. This has caused us to alter our programs considerably and to emphasize increases in muzzle velocity and reductions in drag. This has also led us into areas of warhead design in order to be able to develop warheads that can withstand greater acceleration.

Another example is in the artillery area. We have gotten heavily involved in studying the command and control facets of artillery applications as a means of finding which types of ammunition would be most effective in the field. We have essentially decided that we cannot determine the best mix of ammunition for use by the artillery without addressing the command and control problem. This is also providing a lot of spinoffs for the artillery community by way of alternate means of handling their communications, command and control and also their training systems.

Q. Are the Ballistic Research Lab's facilities and services available for use by other government agencies and industry and how is technological information exchanged and monitored between Army labs and industry labs?

A. My response to the first part of the question is technically yes—the BRL facilities are available for use by other agencies and industry. However, practically speaking, I must say that our facilities are so highly specialized and safety is such a major factor that it is very rare for either industry or other laboratories to use our facilities. Very frequently however, we do work on behalf of other laboratories and for industrial firms.

Monitoring and the transfer of technology to industry is carried out in a number of ways. One of the most consistent and major ways is the active participation of BRL personnel in the American Defense Preparedness Association. The BRL has been extremely active in presenting papers at ADPA meetings and in helping the ADPA arrange meetings and select papers. We also consult with any industry that has a bonafide government contract and a need-to-know status. We do feel that one of our major jobs is the development of the technological base for ballistics and the transfer of that technology to industry and to other government agencies.

Q. How would you compare the resources and capabilities of BRL with similar facilities in the Soviet Union?

A. The answer to that question is difficult because we actually know of no facilities in the Soviet Union that are comparable to those of the BRL. Ballistics work in the Soviet Union, similar to that of the BRL, is done primarily by a number of large institutions. For example, explosives work or high-pressure physics efforts are divided among several large institutions. Therefore, it is very difficult to see how the Soviets integrate their fundamental research into what we call ballistics technology and the application of ballistics technology.

At the fundamental level, we share the uncomfortable feeling with a lot of the U.S. scientific community that the Russians are putting much more personnel resources and money into relevant sciences than we are.

Q. What do you believe are the major problems, unique to the Army RD&A process, which inhibit greater progress in ballistics technology?

A. I think that the major problems are not really technical, but are management oriented. Ballistics technology is very commonly considered to be a mature technology and it suffers in the competition for funds. There are a number of new exotic technologies that ballistics must compete against and these newer technologies attract a lot of interest at the higher levels within the Department of Defense. Therefore, it has become difficult to keep programs in the general ballistic area in ballistics technology funded at an adequate level to bring them to fruition. We consequently waste a lot of money because we have to terminate projects short of completion. Sometimes we are also forced to prematurely remove projects from the exploratory development stage and try to exploit them because we don't have enough funds in 6.2 to build large-scale hardware in sufficient quantities to demonstrate the new technology.

Q. What impact have BRL programs had on the civilian community?

A. The subject of ballistics really doesn't impact the civilian community in as dramatic a fashion as electronics or optics. However, we have had beneficial impacts entirely aside from the electronic computer. I guess its been so long ago that people tend to forget that the first electronic computer was built by and for the Ballistic Research Laboratory. More recently, the BRL has provided a lot of advice on fire arms and other weaponry to the nation's civilian peacekeeping agencies.

I believe the most significant impact that BRL has had recently has been the result of some work we did for the U.S. Department of Transportation. This work, which involved improving the safety of propane tank railroad cars, was described in a relatively recent article in the *Army RD&A Magazine*. The DOT has documented cases where hundreds of millions of dollars have been saved as a result of the modification of tank cars developed by the BRL.

We are really very proud that BRL has become a sort of intermediary in the triumvirate of the railroad management, the unions, and the DOT. Fortunately, we have credibility with all three of these sectors and our advice is acceptable to all three.

Q. What impact is laser technology having on BRL programs?

A. Many years ago, the BRL was involved in determining the feasibility of laser weapons. That role was ultimately turned over to the Missile Command which is now responsible for development of laser weapons. Currently, BRL's involvement with lasers is limited mainly to evaluating the lethality of laser weapons, as a customer service to MICOM and its project managers. BRL also develops techniques to help reduce the vulnerability of Army equipment from enemy laser weapons.

Apart from the weapon aspects, BRL's program has been very dramatically impacted by laser technology, mostly in instrumentation. Laser systems are being used to get precise measurements of the motion of projectiles inside a gun tube; many types of laser spectroscopy are also being used to analyze combustion and detonation phenomena. The laser has become a significant part of our arsenal of measurement tools.

Q. The cost of producing projectiles is continually mounting. What specifically is being done to reduce projectile costs?

A. First, aside from inflation, the major reason for the increasing costs of projectiles has been increasing sophistication. The change from "dumb" projectiles (simple ballistic projectiles) to guided or "smart" projectiles has led to greater costs, particularly the costs of the sensors and the decision making componentry associated with the guided projectile. Attempts to cope with the increased costs and the advances in technology are directed at greater use of advances in electronics and optics to help reduce the costs of sensors and guidance and control systems.

"In a sense, I guess the name of the game these days is data base management in both the scientific and the business arenas. It is really a different way of life to be able to turn to your computer terminal, rap a few keys and have your entire program displayed before you. . ."

There has also been a great deal of effort put into the development of new classes of both propellants and explosives. These are substantially less expensive than those presently in use. Incidentally, this is one of the main objectives of the Joint Technical Coordinating Group on Munitions Survivability. For example, the cost of liquid propellant appears to be potentially a small fraction of the cost of current solid propellants.

As I stated, we expect to go into advanced development on a liquid propellant system for artillery in the next decade. The fielding will of course depend on the timing of new artillery systems or the decision to undertake some drastic product improvement program.

The new class of explosives that are called intermolecular explosives are also showing promise of providing performance requirements, improving safety, and substantially reducing costs. These explosives also don't require the government to build and maintain dedicated plants.

Q. Some advancements are being made in using plastics in the production of some small arms ammunition. Has any consideration been given to similar applications for larger projectiles?

A. A great deal of consideration has been given to the use of plastics, but there have been very few successful applications. Part of the problem is that the environment of large caliber systems is very different from that of small arms. Consequently, in order for plastics to survive the large caliber environment they would almost have to be a composite. There have been efforts to make plastic rotating bands for artillery shells and there are ongoing efforts to use composite materials with a plastic base in tank ammunition. However, these applications are all in the future.

Q. What impact are computers having on BRL programs?

A. This is a very timely question because we feel we are currently undergoing a second or perhaps a third revolution in computer technology. Presently we think we are at the forefront of the new technology of distributive computing.

We are in the final stages of installing a complete distributive system in which every professional and many support personnel will have computer terminals on their desks to aid in their work. These terminals will be supported by a number of small computers that constitute nodes in the distributive system. All of this will be joined in a network, and tied to our main computer which is a Cyber 76. Consequently, this system will increase our capacity to solve larger problems. Finally, this whole network is tied into the DARPA network which allows us to communicate with the rest of the nation and overseas.

Through an agreement with the ARO, we have also arranged for contractors to use our computers. This is a very efficient use of our computers and a good way of augmenting the capability of ARO contractors.

In summary, I think, as I stated earlier, that we are in the final stages of what we consider to be another revolution. Both our scientific work and our management will be conducted on a single massive net. In a sense, I guess the name of the game these days is data base management in both the scientific and in the business arenas. It is really a different way of life to be able to turn to your computer terminal, tap a few keys and have your entire program displayed before you and be able to make realtime programming changes. I might add that we helped HQ DARCOM in establishing a similar system.

Army-Europe Receives 2 Mobile Imagery Interpretation Centers

Army image interpretation came into sharp focus recently with the fielding of two Mobile Army Ground Imagery Interpretation Centers. The Combat Surveillance and Target Acquisition Laboratory, an element of the U.S. Army Electronics R&D Command, turned over two operational systems to U.S. Army-Europe.

One system was installed at Zweibruecken Air Force Base in Germany, where it will be operated by the 581st Military Intelligence Detachment. The second was installed at the Royal Air Force-Alconbury in the United Kingdom, where it will be operated by the 582d Military Intelligence Detachment.

The mobile imagery center is a two-shelter, computer-assisted intelligence dissemination facility. Its minicomputers, large intelligence data base, and automated aerial photographic exploitation stations provide state-of-the-art tools for rapid exploitation of aerial photography.

Intelligence reports can be sent over the automatic digital network, tactical teletype, and digital data link communication subsystems organic to each imagery center shelter.

The Mobile Army Ground Imagery Interpretation Center is the first tactical system certified by the Defense Communications Agency for direct tie-in with the automatic digital network.

The fielding of the first two systems does not complete the work of the imagery center team. Four more systems will be fielded next year in Korea and the U.S.

2 Fighting Vehicle Concept Designs

By Mr. DeWitt R. Hoeltzel, Mr. Steven Sawka and Mr. Paul Cag

Though the Army has received only about 350 of some 7,000 M1-series tanks it will buy over the next decade, the Army Tank-Automotive Command's R&D Center's Concepts Laboratory is already planning for the next generation of tanks that will be needed to meet battlefield threats beyond the mid-1990's. This planning defines the research necessary to generate a series of system development options for mid-term (1990) and far-term (2000) production.

A program underway at TACOM to develop a Tank Test Bed is part of the mid-term effort to define innovative approaches to a lighter, more survivable, fightable tank design.

On June 22, TACOM awarded a 3-year, $12.9-million contract to General Dynamics to design and fabricate such a test bed. This vehicle will use the major automotive components of the M1 and a modified version of the XM256 120mm gun that will be used in the M1E1 tank planned for 1985.

The test bed will incorporate new automatic loader and surveillance technology while utilizing a modified M1 chassis, thereby reducing the cost and long lead time that would otherwise be needed to develop such a test bed from scratch.

The testing will represent a radical departure from the traditional U.S. tank design, in which three members of a four-man crew—a commander, gunner, and loader—are stationed in the turret along with the primary weapon, and the driver is in the hull.

In this concept, a three-man crew—a commander, gunner, and driver—will be stationed in the front of the hull for improved protection. In a separate compartment behind the crew will be an ammunition basket and automatic loader with an externally mounted main gun above the turret ring.

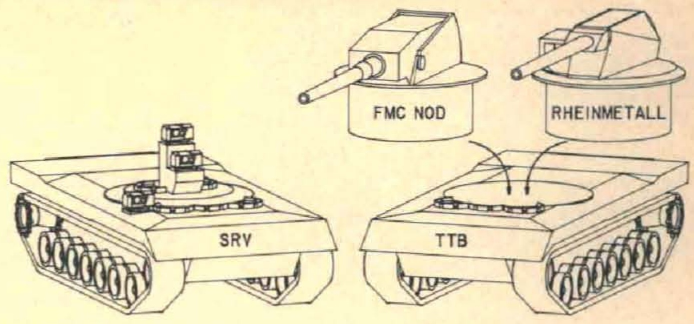
With this configuration, the TTB will have a lower silhouette and weigh approximately 15 percent less than current tank designs. The weight reduction will be achieved by eliminating the heavy, bulky armor currently required above the turret ring for crew protection and by reducing the size of the space allotted for the crew and ammunition.

An additional benefit would be that, since the M1 automotive component base has a load capacity of more than 60 tons, this tank design would have unprecedented armor growth potential to meet the threat of advanced weapons systems in future years. Moreover, the automatic loading capability, with a full complement of ready rounds, would enhance overall combat effectiveness.

In the past, such a tank design was not practical because the commander and gunner always had to be in the turret for a direct view of targets through optical sights. However, with the advent in recent years of electro-optical sights, in which cameras are used to convert optical images into TV images, it now appears possible to be able to line up targets using a TV monitor inside the hull.

During the first year of the test bed development program, TACOM and General Dynamics will take a close look at two critical issues which must be resolved before the test vehicle is actually built: first, do we have the technology to provide a safe, reliable automatic loader for a main tank gun? and second, can the commander and gunner adequately see the battlefield from within the hull?

All of the authors are employed in the Exploratory Development Division of the Concepts Laboratory of the U.S. Army Tank-Automotive Command's R&D Center, Warren, MI. DeWitt R. Hoeltzel is the project engineer for the Tank Test Bed project; Steven Sawka is the assistant project engineer for the Tank Test Bed; and Paul Cag is the assistant project engineer for the surrogate research vehicle.



Tank Test Bed Program

Under terms of the development contract, two General Dynamics subcontractors—Rheinmetall of West Germany and FMC Corp.—will each build a trial model of an alternative automatic loader proposed by each firm. These will undergo laboratory tests at the companies' facilities, and the results will be monitored by TACOM engineers. If all goes well, a winning concept will be selected next June for full-up fabrication.

Meanwhile, in an effort to find and correct any possible crew function problems, TACOM will simulate the test bed concept at Fort Knox next Spring with a surrogate research vehicle now being prepared jointly by TACOM and Litton Systems, Inc. (The Pietzsch Co. of West Germany is the major subcontractor.)

Scheduled for completion in November, the surrogate vehicle will be used during the next several years to evaluate not only the test bed concept but also other possible future close combat vehicle configurations.

The surrogate vehicle will consist of a modified M1 tank hull featuring a low-profile turret module with an externally mounted laser main gun simulator and modular crew stations and surveillance sights which can be moved to various locations throughout the vehicle to evaluate different concepts. The hull modifications are being made at TACOM, and Pietzsch is fabricating the turret and electronic equipment.

The surrogate unit is scheduled to arrive at Fort Knox in January 1983, and following a two-month shakedown test, the test bed simulation exercise will get underway; it is scheduled to be completed by June. If no problems are encountered, it is expected that General Dynamics will then get the green light to build the tank test bed which would be ready for testing in 1985.

Mock-up Model of the Tank Test Bed

Composite Helicopter Airframes on the Horizon

By Danny E. Good

To perform effectively on the battlefield of the future, the helicopter will need increased performance capabilities and the ability to carry larger payloads. Furthermore, reduced unit production and operational costs will enable the military to field more helicopters for the dollar.

The application of fibrous composite material construction for helicopter structures provides the opportunity to field a lower cost helicopter with a lower empty weight and improved performance characteristics. To demonstrate these potential improvements through the application of composites to the helicopter airframe, the Army is conducting an ambitious research and development program which will have helicopters flying with an airframe constructed of fibrous composite by late 1984.

The U.S. Army Aviation R&D Command's Applied Technology Laboratory at Fort Eustis, VA, has undertaken the Advanced Composite Airframe Program to develop the design data, fabrication knowhow and test experience necessary to reduce the technical risk associated with the introduction of composite airframe construction into aircraft production.

The technology developed and the benefits demonstrated will enable earlier commitment to the production of composite airframes by the helicopter manufacturers and acceptance by the Army and other operators than would otherwise be possible.

Government and industry alike have expanded considerable funds and effort in support of programs to develop composite materials and design concepts for rotary wing aircraft applications. During the past 10-15 years the potential for improved performance and lower weight and cost through the application of fibrous composites to aircraft structures has been demonstrated in a variety of advanced development programs.

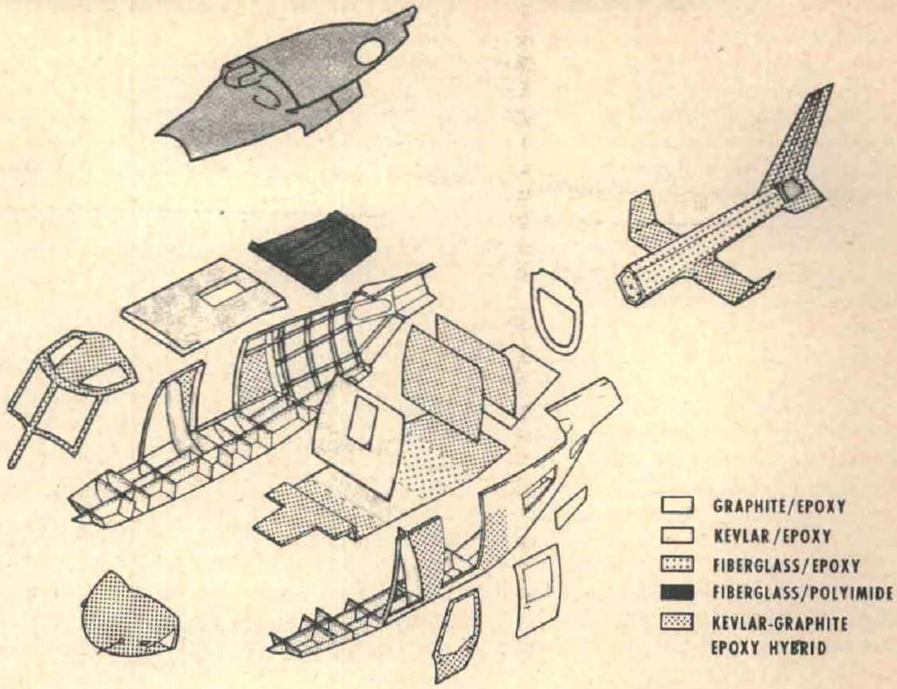


Fig. 1. Bell Material Breakdown

As a result of these efforts, the application of composites to production rotor blades has come to fruition. The inherent nature of the fibrous composite yields a rotor blade which is more damage tolerant, more fatigue resistant, and less costly to produce than its metal counterpart.

By the mid-1970's, the application of fibrous composite construction to selective fuselage structures, such as the AH-1G tail section, had been successfully demonstrated through design, fabrication, and flight tests. However, the technical risk associated with the engineering development of an entire helicopter fuselage constructed with composites had not been reduced to an acceptable level. As such, the Army's UH-60 and AH-64 utilize composites only in secondary non-flight critical airframe components.

The unknown which has inhibited the helicopter manufacturers and the military community from fully committing to the production of complete airframes fabricated of fibrous composites can only be eliminated through a development program such as the composite airframe program.

The program provides the opportunity for a convincing demonstration of the practicality of applying fibrous composites to the complex airframe structures. Program goals are to demonstrate compliance with the MIL-STD-1290 crashworthiness requirements and improvements in reliability, vulnerability, safety and survivability while achieving a 17 percent reduction in airframe production costs and a 22 percent reduction in airframe weight when compared to a baseline metal airframe.

In 1979, multiple contracts were awarded to five helicopter manufacturers to conduct the advanced composite program preliminary design. In the preliminary design phase each contractor developed a metal baseline design and three separate composite design configurations. Trade-off analyses were conducted by each contractor to arrive at a final structurally efficient, low cost, low weight design configuration which incorporated significant improvements in the military characteristics as well.

In a follow-on competitive procurement, contracts were awarded to Bell Helicopter Textron and Sikorsky Aircraft to develop a detail design, conduct design support testing, and develop manufacturing plans for the fabrication of their selected composite helicopter detail design configuration.

Each contractor has completed the detail design of their respective composite airframe helicopter. The dynamic systems and subsystems are those of an existing commercial helicopter with only minor modifications being required for compatibility with the composite airframe design.

The Bell composite helicopter, using components from their Model 222, has a design gross weight of 7,525 lbs. The Sikorsky composite helicopter, using components from their S-76, has a design gross weight of 8,470 lbs.

Numerous trade-offs have been made to select the most effective materials and structural configurations for the various airframe components in order to provide airframe designs that are structurally and environmentally sound and are at the same time light-weight, low in cost and producible.

A breakout of the major structural components and representative materials used in the Bell and Sikorsky designs are shown in Figures 1 and 2. In general, graphite is used where high strength and stiffness are required such as in longerons, beams and frames. Kevlar is predominate in the airframe skins of both the primary and secondary structure, while fiberglass is used in areas subject to high wear such as floors and lower fuselage skins.

Computer-aided design and manufacturing has and continues to play a significant role in the development of the composite airframe detail designs. It is estimated that the number of design hours has been reduced 50 percent below what would have been required to develop the designs on the conventional drawing board.

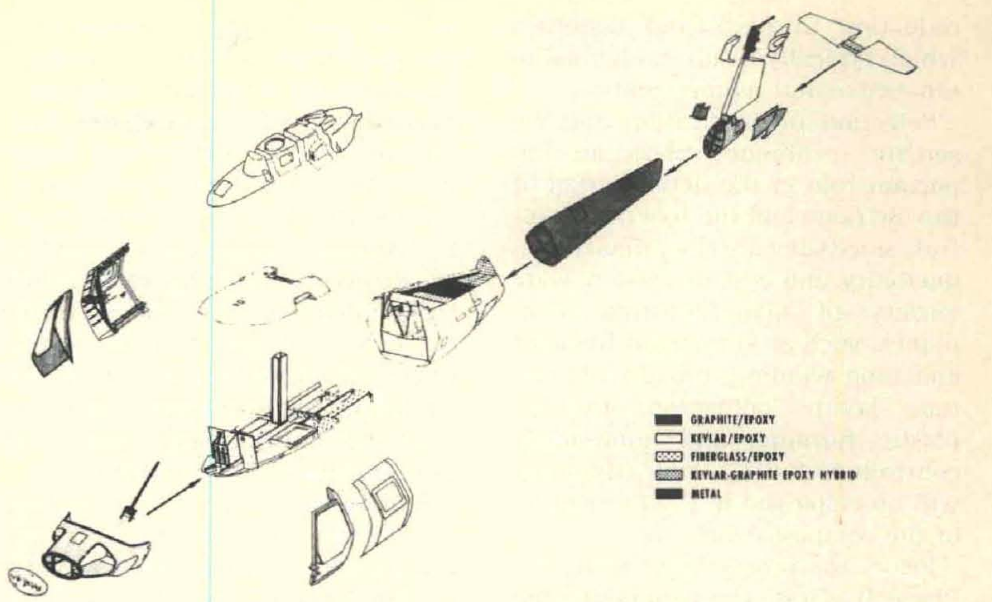


Fig. 2. Sikorsky Material Breakdown

The computer-aided design system provides a common data base for engineering design and manufacturing tool design. This system is also used to develop numerical control machine tapes for controlling ply cutting, tape layup, and inspection equipment, as well as defining tracking paths for automated inspection techniques.

Design configurations have been verified through an extensive design support test program. Early in the program, wind tunnel testing of a one-fifth scale model was conducted to verify the drag and static stability characteristics of the airframe.

Ballistic impact, radar reflectivity, laser effects, and lightning strike tests have been conducted on coupons, panels, and components to substantiate the design from a military characteristics viewpoint. Structures and materials design support testing was conducted which ranged all the way from coupon testing to verify material allowables for specific laminate configurations to static and fatigue testing of a full-size cabin roof structure.

Crashworthiness requirements of MIL-STD-1290 are a primary design driver with respect to structural integrity. Retention of high mass items, such as the transmission, controlled failure of airframe/landing gear joints and controlled crushing of the fuselage structure, all require special design considerations.

In addition to the airframe, a new landing gear is being designed and developed since the entire energy management system (airframe, landing gear, and seats) must be considered in order to effectively design and demonstrate the crashworthiness characteristics. A partial airframe section with one main landing gear attached will be tested to substantiate the crashworthy characteristics of the landing gear and airframe interface structure.

Large co-cured and bonded airframe sections and assemblies substantially reduce the number of parts and fasteners which, in turn, reduce fabrication labor-hour requirements and thus reflect a lower recurring production cost. These design configurations reduce operational costs through substantial reduction in parts and fasteners which typically result in high maintenance action requirements.

Selection of fabrication and assembly techniques plays an important role in the detail design of the airframe and the tool design effort, since they are the primary producibility and cost drivers. A wide variety of manufacturing techniques, such as automated filament and tape winding, broadgoods and tape layup, pultrusion, thermoplastic forming, and numerically controlled cutting and trimming, will be employed in the fabrication of the composite airframe.

Prior to proceeding with the Phase II effort, the results of each contractor's detail design, design support test, tooling design and manufacturing plan was assessed in early September 1982 during the government's in-process reviews of the two advanced composite airframe contracts. Phase II efforts will consist of the fabrication of three full-scale airframes, extensive laboratory testing, and ground and flight demonstration of the composite airframe flight vehicles.

Inasmuch as the primary goals of the composite airframe program are weight and cost reductions, as compared to conventional metal aircraft structures, the fabrication of three airframe assemblies provides the opportunity to track the weight and cost of the composite airframes.

Actual weights, man-hours, and material costs will be accumulated and compared to airframe weight and cost predictions as well as to available cost and weight data for conventional metallic airframes. In addition, the fabrication and assembly of complete airframe structures provides the most reliable means of identifying and resolving problems associated with the fabrication of a complete airframe using composites.

To ensure that all the interface issues associated with systems integration and flightworthiness have been identified and resolved, the assembly and flight evaluation of a complete flight vehicle is necessary. Furthermore, a full-size airframe is needed in order to provide valid detection, vulnerability, and cashworthiness verification test data.

Prior to flight demonstration of the composite airframe helicopters, the structural integrity of the full-scale airframe will be verified through static and dynamic shake testing of the full-scale airframe. In addition, ballistic tests, electromagnetic compatibility tests and drop testing will be conducted.

Fifteen hours of ground testing will be conducted to ensure functional and operational compatibility of the aircraft systems and subsystems with the Advanced Composite Airframe Program. By late 1984, the program flight vehicle will be ready for flight test.

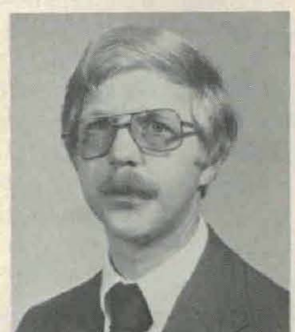
The flight test program will include 50 productive hours of testing to assess the aircraft performance, flying quality, and vibration characteristics through an orderly and progressive expansion of the flight envelope.

With the completion of the flight test program, composite technology will have been demonstrated such that the technical risk associated with the introduction of composite airframes into production will be at a level acceptable to both the manufacturer and the military.

With the Advanced Composite Airframe Program on the horizon in 1984, the aviator can expect to see the composite technology developed, emerge in the late '80s as product improvements for the UH-60 and AH-64 and in the early '90s in new production aircraft such as the LHX and JVX.

With the fielding of composite airframe technology, the aviator can expect to have an aircraft that is safer, more damage tolerant, more easily repaired, and at the same time, will carry increased payload or provide increased range, or both.

DANNY E. GOOD is an aerospace engineer assigned to the Aeronautical Technology Division, Applied Technology Laboratory of the U.S. Army Research and Technology Laboratories (AVRADCOM). He graduated with a BS degree in aerospace engineering from Iowa State University in 1970 and has attended George Washington University for graduate studies in structures and materials.



PM ACRONYMS

(Continued from p. 13)

CHAP/FAAR—Chaparral/FAAR
CCE/SMHE—Commercial Construction/ Selected Material Handling Equipment
DCS(Army)—Defense Communications Systems
DIVAD—Division Air Defense Gun
FATDS—Field Artillery Tactical Data Systems
FISTV—Fire Support Team Vehicle
HET—Heavy Equipment Transporter Systems
HELLFIRE/GLD—Hellfire/Ground Laser Designators
JTFP—Joint Tactical Fusion Program
JVX—Joint Vertical Lift Aircraft
LAV—Light Armor Vehicles
M9—Armored Combat Earthmover (ACE)
MEP—Mobile Electric Power
MPG—Mobile Protected Gun
MICNS—Modular Integrated Communications and Navigation Systems
MLRS—Multiple Launch Rocket System
MSCS—Multi-Service Communication Systems
NUCMUN—Nuclear Munitions
OPTADS—Operations Tactical Data Systems
PSE—Physical Security Equipment
PLRS/TIDS—Position Location Reporting System/Tactical Information Distribution Systems
SATCOM—Satellite Communications
SANG—Saudi Arabian National Guard (SANG) Modernization Program
SINCGARS—Single Channel Ground and Airborne Radio Subsystem
SEMA—Special Electronic Mission Aircraft
RPV—Tactical Airborne Remotely Piloted Vehicle/Drone System
TADS/PNVS—Target Acquisition Designation System/Pilot Night Vision System
TMAS—Tank Main Armament System
TMDE—Test Measurement and Diagnostic Equipment
TMOD-TMDE Modernization
TRADE—Training Devices

Capsules . . .

Electronics Group Aids in Information Exchange

An Electronics Coordinating Group was formed in 1977 by the Army Research Office (ARO) Electronics Division, and consists of a group of senior-level scientists and managers from ARO and Army laboratories having significant electronics-related R&D programs.

This group provides a mechanism for exchanging information and for coordination of electronics research activities among Army laboratories and ARO. It seeks to identify the state-of-the-art of electronics technology and direction for future research, and assisted actively in the electronics research review of DARCOM laboratories.

This past spring, members of the Group visited the Combat Developments Experimentation Command (CDEC) at Fort Ord and Fort Hunter-Liggett, where they were given presentations and demonstrations to familiarize them with the operations and methodology used to conduct tests and with the scientific technology utilized.

Electronics technology utilized during tests at CDEC is at the forefront of the state-of-the-art. Large quantities of data concerning position location and status of players and targets must be communicated and processed by computer.

Determining position of multiple fast-moving targets in real-time is an extremely difficult computational problem. Issues were discussed relating to the fact that laser designators currently utilized do not penetrate dirty battlefield atmospheres. These problems are also common to the development of tactical systems.

An understanding of the conduct of Army operations provided members of the Group valuable information which can be used to evaluate the merits of the application of electronics R&D with which they are concerned. Cooperative demonstrations of this nature establish a direct coupling between the user and the research community within the Army. As a result, research programs may be focussed upon research areas of maximum benefit to the Army.

Personnel Actions . . .

Zahn Chosen as CSL Deputy Commander

COL Kenneth C. Zahn has been named deputy commander of the Chemical System Laboratory (CSL), a major research activity of the Army Armament Research and Development Command at Aberdeen Proving Ground, MD.

COL Kenneth C. Zahn

COL Zahn has served at APG since 1980 as director of the Plans and Programs Directorate for the Army Test and Evaluation Command. Before his assignment to TECOM he completed a year of study at the Army War College, Carlisle, PA.

He studied at the University of Arizona where he was awarded a bachelor of science degree in education in 1959, and both a bachelor of science degree in liberal arts, and a master's degree in chemistry in 1960. The University of Ilinois awarded him a doctorate degree in organic chemistry in 1967.

For three years (1969-1972) he served on the faculty at the U.S. Military Academy at West Point as an instructor and an assistant professor of chemistry.

He was also a test director and staff officer in the Experimental Systems Division at the Deseret Test Center study in 1974 at the Army Command and General Staff College.

COL Zahn served as a Department of Defense liaison officer for Field Command of the Defense Nuclear Agency at the Lawrence Livermore Laboratories in California from 1975 to 1977. He then served until 1979 as commander of the Army Criminal Investigation Laboratory at Fort Gordon, GA.

His military decorations include the Bronze Star Medal, the Meritorious Service Medal, the Army Commendation Medal with Oak Leaf Cluster, and the Air Medal.

Ramsden Joins DCSRDA Programs/Budget Office

COL John J. Ramsden has been assigned as chief of the RDTE Programs and Budget Division Office, Deputy Chief of Staff for Research, Development, and Acquisition, DA. He succeeds COL Benjamin A. Huggin.

COL Ramsden is a 1957 graduate of the U.S. Military Academy and has an MS degree in engineering science from Purdue University. He is also a graduate of the Artillery Basic Course, the Ordnance Advanced Course, the Army Command and General Staff College, and the Industrial College of the Armed Forces.

His military assignments have included R&D coordinator and product manager at Picatinny Arsenal; executive officer, 27th Maintenance Battalion, Vietnam; associate professor, Department of Electrical Engineering, USMA; commander, 801st Maintenance Battalion, Ft. Campbell, KY; commander, Harry Diamond Laboratories; chief, Materiel Management Division, ODCSLOG; and commander, Ordnance Program Division, Saudi Arabia.

COL Ramsden is a recipient of the Legion of Merit, the Bronze Star, the Meritorious Service Medal with two Oak Leaf Clusters, and the Air Medal.

Career Programs . . .

Epstein Chosen for CSL Executive Training

The U.S. Army Armament R&D Command's Chemical Systems Laboratory (CSL) has announced that Mr. Bob Epstein, an engineer, has been selected as the 45th civilian employee to participate in CLS's technical executive training program.

Starting in 1971 in the Office of Edgewood Arsenal's Technical Director, the program is designed to give participants a practical experience in the essentials of staff work relating to management decisions. In addition, it is intended to provide a meaningful experience for personnel expected to assume high technical and administrative positions at the Edgewood chemical R&D center.

A registered engineer in Maryland and Delaware, Epstein is employed in the Smoke Branch in CSL's Munitions Division. He started his federal career in Edgewood in 1973, working in demilitarization/disposal and transferred to munitions research in 1978.

Epstein attended Cornell University where, in 1949, he was awarded a bachelor of science degree in mechanical engineering. Drexel University, Philadelphia, awarded him a master's degree in the same discipline in 1959.

The executive training program includes a 3-month assignment in the Office of the CSL Commanding General. The trainee also participates in a similar period of training in the Office of the Deputy Chief of Staff for Research, Development and Acquisition (DCSRDA) in the Pentagon.

Awards . . .

Outstanding Achievements Cited. . .

7 Personnel Win Materiel Acquisition Awards

DARCOM Deputy Commander for RD&A LTG Robert J. Lunn presents materiel acquisition award to Roy D. Greene; other team members who received the award are Dr. James J. McLeskey, James A. Hess, Curtis W. Barbee Jr., and CPT William D. Carraway.





Two individuals and a five-man team have been selected as recipients of the 1981 Secretary of the Army Award for Outstanding Achievement in Materiel Acquisition. A maximum of 10 winners are selected annually from among nominees serving in support of the materiel acquisition process.

The award is presented in recognition of high-level efforts in project, materiel and special-item management activities; procurement and production achievements; and scientific research. Consideration is based on the complexity of the problem and the degree of originality in solving it; significance of the accomplishment; and improvement in program management.

Civilian or military individuals or teams receive a silver medallion and a miniaturized lapel pin depicting the first U.S. Secretary of War Henry Knox.

All of the winners of the 1981 team award were recognized for their contributions in designing, developing, and implementing a new system for program and cost control of major weapons systems. Their new system, according to the award citation, will significantly improve the materiel acquisition process, strengthen program management, and control cost growth of major acquisition programs. Winners of the team award are:

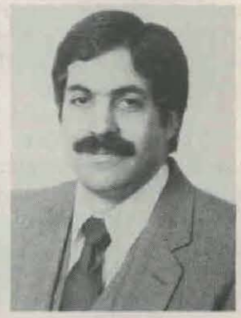
Mr. Roy D. Greene, acting deputy director for Program Management and associate director for Programs and Budget, Development, Engineering and Acquisition Directorate, HQ DARCOM, is responsible for the development, review, and administration of RDTE programs and budgets. He holds a BS degree from Western Kentucky University, a master's degree from American University, and is a graduate of the Industrial College of the Armed Forces.

Dr. James J. McLeskey is a general engineer in the Munitions Systems Division, Development, Engineering and Acquisition Directorate, HQ DARCOM. His academic credentials include a BA degree in chemistry from Rice University and a PhD in physical chemistry from Duke University. Prior to joining HQ DARCOM, he was a physical scientist at the U.S. Army Mobility Equipment R&D Command, Fort Belvoir, VA.

Mr. James A. Hess is an electronics engineer, Battlefield Automation Management Division, Development, Engineering and Acquisition Directorate, HQ DARCOM. He received a BS degree from Newark College of Engineering and a master's degree in engineering from Texas A&M University. He has also authored numerous technical presentations.

Mr. Curtis W. Barbee Jr., formally with the Programs and Budget Office, Development, Engineering and Acquisition Directorate, HQ DARCOM, is now employed in the Office of the Deputy Chief of Staff for Research, Development and Acquisition, DA. He holds a BS in business administration from Upper Iowa University. He is responsible for submission of the Army's procurement portion of the President's budget.

Individual materiel acquisition awards went to Aulton B. Pennington and Kenneth S. Solinsky.

CPT William D. Carraway, now serving in Korea, was assigned formerly as an operations research systems analysis officer in the Cost Analysis Division, Comptroller Directorate, HQ DARCOM. A 1971 graduate of the U.S. Military Academy, he was a consultant on the materiel acquisition process and on cost growth in weapon systems development.

One of two individual awards for materiel acquisition was presented to *Mr. Aulton B. Pennington*, a supervisory quality assurance specialist in the Directorate for Quality Assurance, Anniston Army Depot, Anniston, AL. He was cited for his design and implementation of the "Counseling of Contractors" program for materiel found to be nonconforming and impacting on overhaul schedules at DESCOM depots.

Mr. Kenneth S. Solinsky, former director, Product Assurance Division, U.S. Army Night Vision and Electro-Optics Laboratory, also is a winner of the award for materiel acquisition. Graduated with a BS degree from Clarkson College of Technology and an MS degree from Texas A&M University, he was recognized for development and implementation of an innovative acquisition strategy which provides greater competition and cost benefits for the government.

Conferences & Symposia . . .

ETDL Plans Frequency Control Symposium

The U.S. Army Electronics Technology and Devices Laboratory, Fort Monmouth, NJ, has announced that the 37th Annual Frequency Control Symposium will be held 1-3 June 1983 in Philadelphia, PA.

An international gathering devoted to frequency control and precision timekeeping, the Frequency Control Symposium normally draws more than 700 people from industry, universities, and government laboratories. Symposium chairman is Mr. John R. Vig.

"VuPoints" . . .

The following remarks are a representative sampling of the letters received in response to the editorial which appeared in the September-October 1982 issue of the Army RD&A Magazine. The subject of that editorial was the unnecessary use of acronyms in the printed media.

Dear Sir:

Let me congratulate you for your stand against clap-trap acronyms and stilted style—I felt like underscoring every sentence. Continue your firm stand to edit out such bilge. Please pay particular attention to the doubly insidious habit of irrational use of numerical superscripts—the C^3I, P^3I, R^2N construction. They are nonsense both syntactically and mathematically (N^3 means all N's are identical). If we don't stand firm someone is going to call the New Testament M^2LJ!

John T. Newman
Deputy Director
Systems Management
HQ DARCOM

Dear Sir:

I do not know you, but you must be most astute and knowledgeable far beyond your youthful years to have written the editorial which appeared in your magazine. Acronyms have been the bane of my military employment dating back to 1954 when I started working for the Quartermaster Corps R&D Command in Natick, Massachusetts. It is so ridiculous now that acronyms are repeating themselves and one never knows for sure which one is being discussed. I equate the mentality of those who derive and use acronyms to those who put For Official Use Only and Confidential classifications on subjects which are discussed openly in such magazines as *TIME*. In spite of your well worded plea, I think you are bucking a tidal wave of tremendous force. I once made up a list of acronyms which were pertinent to the Air Weather Service, and I came up with 15 pages without really digging out anything obscured. The time lost, which supposedly translate into dollars spent, on figuring out acronyms must far exceed any and all benefits attached. There must have been a time in ancient history, preceding xerox, when acronyms never existed and our government functioned. I suppose that any movement to curtail or reduce the use of acronyms has to come from the bench level, as I have not noted any ground swell from bureaucrats themselves in easing up. Competency to them is measured in the number of acronyms which they can throw at an audience. I wonder if you could get any White House support for this, as it seems like something which Ed Meese might buy. But I presume it would take a flood of letters into his office to even get his attention. You are to be congratulated on your editorial.

Paul C. Dalrymple
Geographer
Army Engineer Topographic Labs

Editors Note: 63 is scarcely youthful, but we enjoy the compliment.

Dear Sir:

Your editorial on the use of acronyms was long overdue. I can't agree with you more. If it's becoming distasteful in the written form, imagine being exposed to it daily in the oral form. Communicating with industry people in particular is becoming near impossible. Lets begin a campaign to change the trend. You, with your magazine, we, with our training and supervision of military personnel and civilian employees.

D.E. Luppino
Chief, Document Preparation Division
Natick R&D Labs

Dear Sir:

Congratulations on your editorial. It needed to be said, but I doubt if the perpetrators are listening. You showed restraint in not commenting on the Howard Cosellish obfuscation common to those who would display erudition. About 15 years ago a friend attended a duty-hour class in *Effective Army Writing*. To add reality he brought to class a draft of correspondence he was preparing. The whole class participated and their product was sent forward for signature, with pride. It was rejected and returned with the comment: The writer should attend an Effective Army Writing course. The instructor wept.

Murray Combs
Quality Assurance Specialist
Fort Meade, Maryland

Dear Sir:

I share your concern about the explosive growth of the use of acronyms (and abbreviations) in military writing. The phenomenon has become so widespread that I'm convinced it should be classified as a mania as in Acronymania (ACNI). ACNI is a state of being (SOB) wherein one exhibits a compulsion to form acronyms when writing technical documents (TEDS), such as a computer software manual (COMSOM), an Army regulation (ARG), et cetera (etc.) A person who has ACNI is an Acronymaniac (ACNIAC) and should be encouraged to join Acronymaniacs Anonymous (ACNIACANY).

F. Robert Morris
Computer Systems Analyst
Natick R&D Labs

Dear Sir:

I may find myself in a minority, but I firmly disagree with your editorial on acronyms. I personally find acronyms to be quite a useful tool—particularly because of their ability to convince, confuse, and conceal the real meaning of what an individual is trying to say. For example, it is obvious that the Soviets read a great deal of our government documents in an attempt to find out secrets. Acronyms do not lend aid to their sinister intentions, and therefore provide a great public service. I believe so strongly in the positive value of acronyms that I would like to propose that an annual award be established in order to recognize the *G*reatest *A*chievement *R*esulting in *B*etter *A*cronyms for *G*overnment *E*xecutives (GARBAGE). I would personally be very proud to display the GARBAGE plaque on the mantel in my home, along with my bowling trophies. Too often we condemn things before evaluating them fully. I do hope that consideration will be given to my suggestion. Thank you.

Anonymous Reader

DEPARTMENT OF THE ARMY

Headquarters
U.S. Army Materiel Development & Readiness Command
5001 Eisenhower Avenue
Alexandria, VA 22333