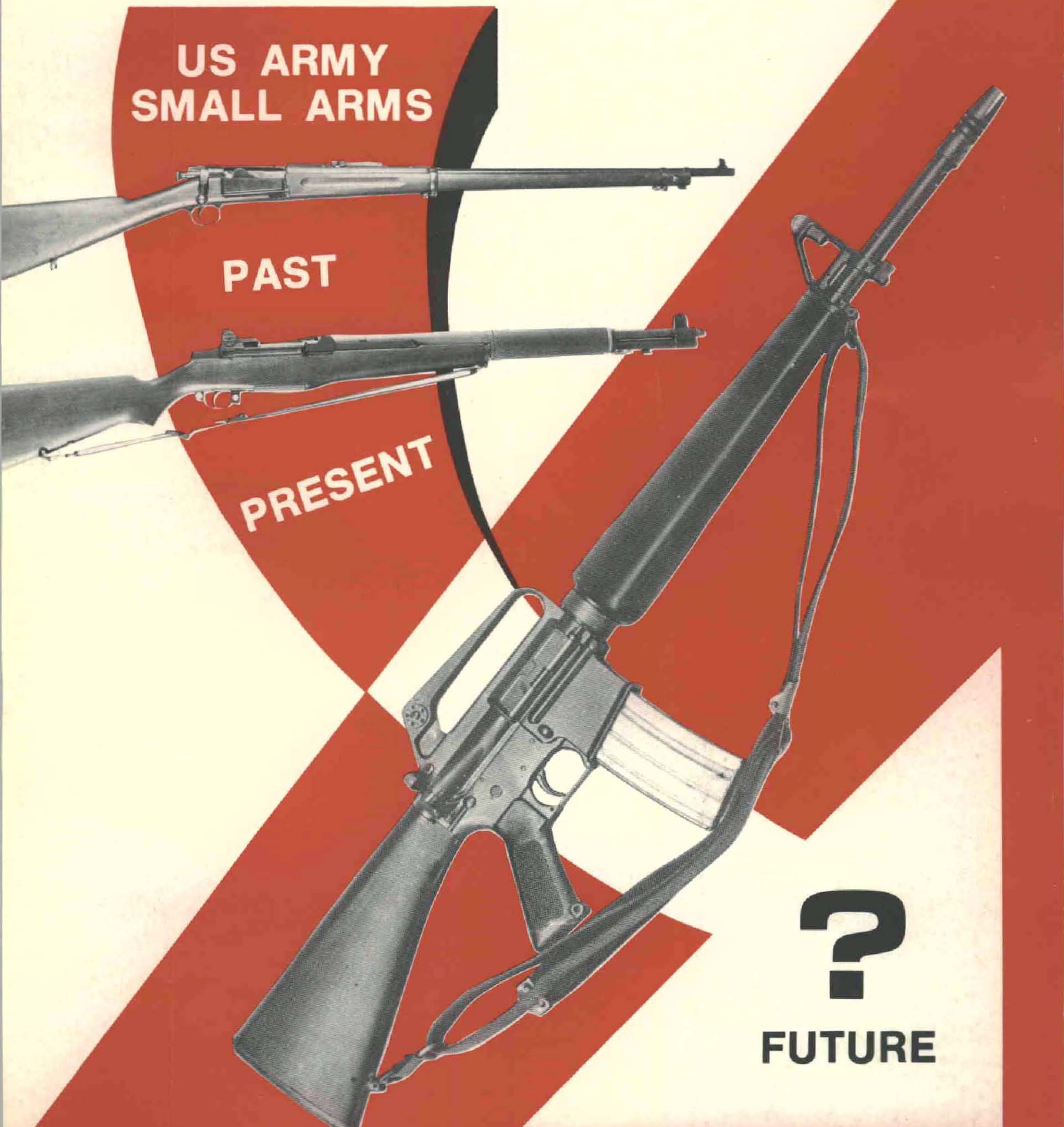
ARMY R,D&A

- RESEARCH
- DEVELOPMENT
- ACQUISITION

MAY-JUNE 1979



ABOUT THE COVER:

Shown on the front cover are three rifles that represent major technological changes in U.S. Army individual weapons. The M1898 Krag, at the top, is the first caliber .30 and the first bolt action rifle adopted for general use by the U.S. Army. Below it is the M1 rifle, the U.S. Army's first auto-loading infantryman's rifle. The M16, at the bottom, is the first U.S. Army 5.56mm lightweight rifle. Current testing of future systems continues to look at the smaller caliber.

The back cover shows the M1903 .30 caliber, bolt-action rifle that was the Army's mainstay in WWI and until adoption of the M1, and the M14 7.62mm rifle that succeeded the M1 and was the first attempt at a NATO standardized small arms caliber.

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FEATURES

DEPARTMENTS

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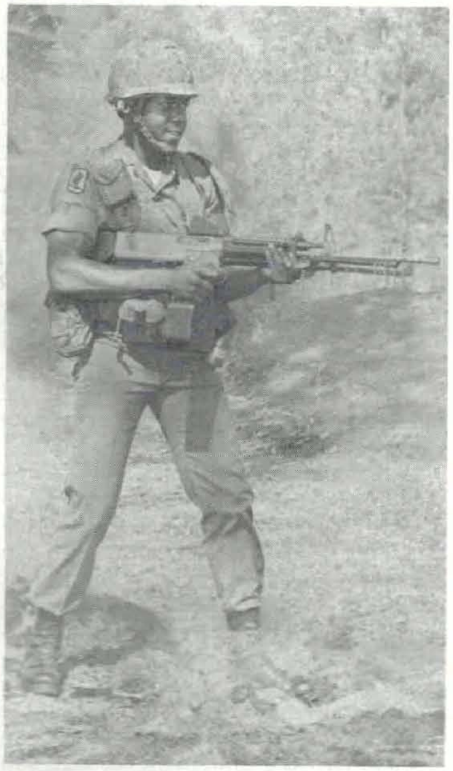
An Overview of Small Arms Technology

By COL Charles J. Garvey*

The glamorous and strategic aspects of our National Defense have received the preponderance of available assets in this era of high technology. Small arms development has become the forgotten wallflower. Available assets are no longer sufficient to meet the growing threat in an inflationary economy.

Cost effectiveness improvements are mandatory. Small arms technology has significant potential for improvement and must be exploited by placing renewed emphasis on production and research and development planning in this area.

The area of small arms is perceived by some as part of a hobby shop syndrome versus an area of real technological significance. When one reads the program summaries they read the same year after year. One question becomes evident, "What has the small arms community produced in the last decade?"



XM248 Squad Automatic Weapon will be evaluated with other contenders in 1979.

**COL Charles J. Garvey, a U.S. Military Academy graduate and infantry officer, is the military assistant to the Director of Land Warfare, Tactical Warfare Programs, in the Office of the Under Secretary of Defense for Research and Engineering. He has commanded the U.S. Army Honor Guard Company, an Airborne/Mechanized Battalion, and served two tours in Vietnam. A graduate of the Army War College, COL Garvey also possesses three master's degrees, the latest being a MBA from American University. His main area of interest in his present assignment is Close Combat.*

We have spent millions of dollars and—uncountable man-years and, to the best of my knowledge, the 30mm GAU 8 round is the only system produced in the recent past. However, I do realize that the 30mm ADEN/DEFA, the 25mm Bushmaster and the squad automatic weapon system are in the later stages of development. Need I even mention that an industrial firm with such a record would have filed for bankruptcy years ago.

Our challenge is to significantly advance small arms technology in the next decade. We simply must. Who is at fault? We are! Our traditional policy of each service determining its own requirements, running its own labs, and fighting for its own budget has led to inefficiencies, duplication, and parochialism in a number of instances.

Most development programs are long term and yet the leadership directing these projects has short-term responsibility and authority. It is not rare to see two or more program managers and at least two changes in OSD staffs during a developmental cycle.

Is there any wonder then that the "new kids on the block" perceive the program from different perspectives in different timeframes. These forces inevitably lead to requirement changes, extended schedules and ultimately cost increases.

There is always something new just around the corner that may be a better solution. Should we spend the time and money to pursue it if it means a delay in today's readiness or is it really true that a bird in the hand is worth two in the bush? It's a tough question but must be answered by decisive leadership.

Technology around the corner can be retrofitted later or be used on the follow-on system. We all get aggravated when we see people, time and money wasted. The thinking man sees past the glamorous laser, jet aircraft, and nuclear carriers. He realizes that in the last analysis wars are fought on the ground and it is the unglamorous systems, such as small arms, trucks, generators, and battlefield resupply that often make the difference.

One of our greatest small arms problems in this age of computerized modeling is how to show significance of an infantry soldier, his rifle or an automatic cannon both quantitatively and qualitatively. The Army just spent over six months and a million dollars studying this problem and we just don't have an answer.

We make advances in rifles and pistols but they are for competitive matches. Special stocks, special grips, intricately measured propellants may be okay for target shooting. However, we need reliability, accuracy, ease of maintenance and operation obtainable by any soldier, not just a skilled weapons technician, *and* those systems must be capable of being mass produced.

The Army recently completed a study of the Division in 1986. That study sets the theme of the future with a key statement by the late military affairs analyst, Mr. S. L. A. Marshall, from his classic work, *Men Against Fire:*

". . . We are at the opening of a new age in warfare when it appears certain that all operations will be accelerated greatly, that all ground formations must have greater dispersion for their own protection, and that therefore thought must be transmitted more swiftly and surely than ever. These things being true, it is an anachronism to place the emphasis in training and command primarily on weapons and ground rather than on the nature of man."

In the future we must insure that our technological advances can be made compatible with the average soldier. To do less is self defeating, regardless of the technical capability of the weapon system. The user community must be integrated throughout the concept and development phases.

Another *major issue* in weapon development is whether to initiate a new program, modify existing inventory, buy off-the-shelf, or fielded foreign systems. The answer is not always easy and depends on complex interrelated variables of time, money, significance of capability improvement and military judgment.

One point is clear. It is that a new development program must be the subject of intensive study and a clear decision by high-level leadership. We all should be placing our present small arms inventory under a microscope to see if a product improvement is warranted.

Economics in time and money dictate improvements to present systems and procurement of off-the-shelf or fielded foreign systems rather than new starts. The days of always replacing every item with a new development have passed.

Congress is sending us that message loud and clear. It's time we listened! But let's not have another M219 armor machinegun fiasco. During the early 1970s we product improved that weapon with 19 separate modifications. This resulted in very little change in performance. The fastest and least expensive method of impacting readiness today is to modify present inventory. This is the wave of the future.

We have all seen prices skyrocketing not only for defense weapons systems but for homes, food and transportation. Everything from inflation to government deficit spending to labor unions is blamed. A few areas which offer potential savings but that are not always fully appreciated are:

• *More competition* is necessary and Office of Management and Budget is looking closely at sole source contracts. They are difficult to justify in peacetime.

• *Testing*—Demanding unrealistic performance parameters cannot be tolerated. We must test for sensitivity to confidence limits and statistical probabilities. By varying one or five percent we may save millions of dollars and that most precious constraint "time."

For example, let us suppose a fuze is to operate at −65°F and that it functions well at −45°F but its reliability is severely degraded at lower temperatures. Are the extra 20° necessary? What's the cost in time and money to get there versus the penalty in performance? These questions demand answers.

We all must speak up and ask the dirty question. That's what we are being paid for. A program manager can request a requirement waiver if deemed appropriate. Requirements are dynamic and must be justified. Ammunition versus guns are as the blades to the razor or the cassettes to the recorder. Changes in ammunition testing, usage rates or reliability can have significant funding impact.

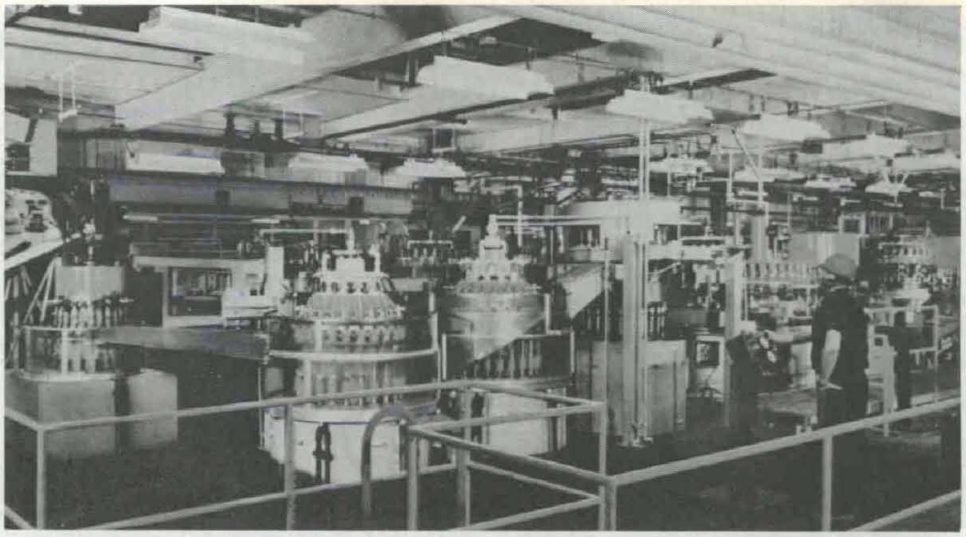
Another significant area for savings is reduction in prototypes required. We can no longer afford to provide dedicated systems for each test phase. Perhaps some correlation between a system's unit cost and test expenditures is warranted.

• *Facilities*—As labor becomes more expensive, programs must evaluate the relationship between automated tooling and labor. Significant savings are possible in this area when a system life cycle cost is analyzed.

• *Schedules*—Too often phases are sequential in nature rather than concurrent. Maximum concurrency shortens development times and saves resources. We require long-term dedicated management, initiatives, innovations, and a sense of urgency to do the job better. A classic example of schedule delay and indecision is the Bushmaster automatic cannon program for the Army's Infantry Fighting Vehicle.

Following side-by-side tests of three candidate guns, the decision was delayed for two years to permit a re-evaluation of the program. The result was increased time and money and the taxpayer was made to pay again for these decisions. The key point, although not fully measurable, is really the impact on field readiness and capability.

The history of small arms development is less than positive and important issues remain to be resolved. However, a number of initiatives are presently changing the "business as usual" approach which has been perceived by many critics.



COMPUTER CONTROLLED Cartridge Case Submodule at Lake City Army Ammunition Plant can produce 1200 cases per minute.

• *DOD Armaments/Munitions Requirements and Development Committee (AMRAD)*—Such organizations go back to 1949 when the Joint R&D Board was formed. It had no teeth and lasted only five years. In 1964 the Joint Technical Coordination Group was formed but due to service rivalries, it too met its master.

We cannot afford more duplication and waste! Deferment or elimination of funds is the answer. AMRAD, formed in 1969, is working! AMRAD's charter provides for AMRAD interest the moment a service establishes a requirement or a system enters advanced development and it continues through the life cycle of the material.

• *NATO Small Arms Test and Evaluation*—The tests are ongoing and the final report is due in June 1980. This was a major accomplishment in NATO cooperation and signals a trend for the future. These tests will recommend a second infantry small arms caliber, 7.62mm being the present NATO standard, and we are committed to abide by the outcome of these tests.

• *Joint Service Small Arms Program Plan (JSSAP)*—The Army, as executive agent, has chartered a JSSAP management committee composed of representatives from all services to develop and maintain a long-term small arms program. We have great expectations for this initiative.

• *Small Caliber Ammunition Modernization Plan*—Lake City has one module completed and in production. Four more modules will complete the system. The integrated manufacturing process includes automated in-process inspection. This small arms project has been a recent significant leap from the stone age.

• *The President's Quest for Rationalization, Standardization and Interoperability (RSI)*—The Secretary of Defense has even created a post for a NATO adviser. This position rates a vote in Defense Systems Acquisition Review Councils (DSARCs) and plays a key role in all ongoing programs. Action by top leadership is a must.

In the past, we couldn't get agreement on even the maximum effective range for rifles. Only a few weeks ago, a NATO report elaborated on the various Allied views and differences of opinion relative to the simple ammunition *link*.

In February 1978, the Joint Chiefs of Staff approved ammunition as the third highest priority for NATO standardization since it would increase operational flexibility, simplify logistics and reduce variety of new inventory.

In September 1978, the Under Secretary of Defense for Research and Engineering called the attention of the Military Departments to OSD efforts to gain NATO agreement to limit proliferation of 20-40mm ammunition since he considered guns and ammo critical operational interfaces on the tactical battlefield.

Today, any study that does not address all world alternatives is subject to failure from the outset. It would appear that we are well past the time when the U.S. can unilaterally introduce tactical munitions into the NATO structure without prior consultation and overwhelming justification.

• *Office of Management and Budget Circular A-109*—This document set off sparks a few years ago but the Mission Element Need Statement (MENS) is not going away. According to that concept, once OSD has approved a MENS, the program would be home free. That's not necessarily the case.

It's ironic, but—the first MENS approved was the Army's Advanced Heavy

Antitank Missile System (AHAMS) and it suffered a severe funding cut in the last budget. We will experience growing pains but more emphasis on the front end may save wasted effort. It does force the requirements community to get their act together early.

Too often we have been off and running on half thought-out concepts and then as development progresses, we begin to doubt the effort and we are off on the "study it again" syndrome. Just look at the B-1 or the Infantry Fighting Vehicle.

• *Increase in Congressional Staffs* —Growth in these staffs has had some positive effect on R&D programs. They have forced us to become more proficient. Answering their questions has taken more time from management.

Let's be honest, how many times have you heard an action officer state, "Man, that's a dirty question and it's going to be tough to answer." If our lockers were clean and our homework complete, we would be able to answer the question quickly and without heartburn. We cannot just spend money—we must have valid requirements, comprehensive evaluations of alternatives and be able to stand up and provide logical justification.

All the above forces form a framework within which we must operate. To say the least, the atmosphere gets cloudy now and then! Let's discuss the Under Secretary's mission in acquisition and focus on ammunition. The Under Secretary of Defense for Research and Engineering is responsible not only for R&D and acquisition but also production facilities.

Tactical Warfare Programs and more specifically, Land Warfare, in the Office of the Under Secretary of Defense for Research and Engineering has oversight responsibility for (1) 6.3 and 6.4 ammunition R&D programs, (2) ammo production facilities, (3) procurement of ammunition, and (4) Single Manager Conventional Ammunition DOD Directives and policies affecting management of the ammunition program.

Where is small arms procurement going in the next five years? Each budget year we must face reality and adjust our projected procurements so that they are within affordable limits. One of the difficult tasks performed by the Department of the Army and OSD is to determine how best to bring the budget in line with affordable levels. Quite often this has been achieved by merely stretching out procurement. Such procurement is usually inefficient.

In the future, we plan to conduct integrated R&D and production technical reviews to improve phasing of programs and to assure that the programs remaining are essential to our defense needs.

Why should the Single Manager for Conventional Ammunition be responsible for acquisition of all conventional ammunition? The Single Manager is in the best position to determine when existing capacity can be utilized, when it must be expanded and when to compete procurements between the ammunition producers or to direct procurements as needed to maintain active CORE producers. The latter is important if DOD is to be in a posture to activate the base should that be required.

Realities of where the DOD is headed is best reflected by recent budgetary action which limits funding for facilities to only those required to support peacetime procurement. This is rapidly resulting in an unbalanced production base from a mobilization viewpoint.

For example, propellant capability is not being balanced with projectile metal parts capability and resupply capability deviates from round to round. Our views are reinforced by an OUSDRE study on Ammunition Production Base and Stockpile Strategies being performed by the Institute for Defense Analyses (IDA).

We need a tech base both in-house and in industry. OMB Policy A-76 lays out the procedure for contracting. The bottom line is "Government's business is not to be in business." We need clear definitions of an identifiable small arms work area and a level funding profile. We need rewards to keep the best people in small arms. The incentives in the past have not been too great and erratic funding impacts on personnel security.

There is a need for OSD support of service programs. OSD is the last in-house devil's advocate prior to program presentation in the Congress. If you cannot justify it to OSD, chances are slim you will receive Congressional approval.

Parochialism must play second fiddle to joint programs. RSI should be reflected in every program. Requirements must be clearly stated within ranges to allow tradeoffs. Experienced leaders must be willing to take a stand when modeling capabilities are inadequate or lack the necessary sophistication to fully justify a program.

Military judgment is of paramount importance in a complete evaluation of a program. Too often this is not even mentioned because of our over zealous reliance on computerized data! Above all, our efforts must lead to products for the soldier and taxpayer.

Well, we have covered the waterfront and hopefully found some food for thought. I realize that we have weapons systems in R&D that are potentially better than the threat has in the field today, but let's look at some of our present weapons.

The 45 caliber pistol was originally made in 1905. Our *newer* version is vintage 1911. The 50 caliber M2 machineguns on our present M113 Armored Personnel Carriers commenced acceptability tests in 1933 and now we are procuring them again. It does the job and we have nothing better.

Even the firing port weapons on our new Infantry Fighting Vehicle will be modified M16 rifles. Many of our fielded systems such as tanks, aircraft, ships and small arms have been around for 20 years or more. Compare this to your household appliances and your own automobile.

How can we reduce failures, lighten the soldiers' load, decrease maintenance, simplify logistics and increase the lethality of all our weapons? It is a quest that is never ending, and like Don Quixote in the play, "The Man of LaMancha," he pursues his star regardless of how hopeless. However, let's not attack windmills.

CORRECTION

The *Army RDA Magazine* would like to express appreciation to the reader who brought to our attention the following error which was carried in our March-April edition. The caption under the picture on page 22 (article by Brigadier Joanathan Dent) incorrectly stated that the mortar has a 15 round per minute rate of fire with standard UK ammunition to ranges up to 100 meters. The maximum range for the mortar, as stated in UK pamphlet Number 24, Part 1, 1975, is 5600 meters, *not* 100 meters. Our apologies to Brigadier Dent.

MG Vinson Awarded DSM

MG Wilbur H. Vinson Jr., who died at Walter Reed Army Medical Center on Wednesday, 28 Mar. 1979 of leukemia, was awarded the Distinguished Service Medal on 2 Apr. 1979. The award, which had been approved prior to his death, and the approval known by MG Vinson, was in recognition of his exceptionally meritorious service from March 1973 to March 1979 while serving as commander, U.S. Army Southern European Task Force; Deputy Chief of Staff, Combat Developments, TRADOC; Director of Weapon Systems, ODCSRDA; and Assistant Deputy Chief of Staff for Research, Development, and Acquisition, HQDA.

Making the presentation on behalf of the Army was LTG Donald R. Keith, Deputy Chief of Staff for Research, Development, and Acquisition, HQDA, in the presence of his mother, father, wife, four children and son-in-law, GEN Frederick J. Kroesen Jr., Acting Chief of Staff; GEN John R. Guthrie, DARCOM commander; Senator Sam Nunn; and many friends and associates.

Former CRD Dies

LTG (U.S. Army, Ret.) William C. Gribble Jr., former Chief of Research and Development, DA (1971-1973) and Chief of Army Engineers (1973-1976) died 2 June 1979 at DeWitt Army Hospital, Fort Belvoir, VA. Interment was at Fort Myer, VA, 6 June 1979.

Squad Automatic Weapon

By Thomas Cosgrove

Rifle, 5.56mm XM106

As part of its continuing effort to improve the American soldier's equipment, the U.S. Army Materiel Development and Readiness Command (DARCOM) will soon complete development of the Squad Automatic Weapon (SAW). A test program now underway at the U.S. Army Test and Evaluation Command and Fort Benning, GA, is expected to result in selection of a single design from among four contenders for eventual production.

One of the most interesting small arms developments in recent history has been (and is) the SAW. The development is interesting in its own right and it is interesting by comparison to the development history of its predecessors.

The M14 rifle of the 1950s, with its strong resemblance to the M1 (Garand) was developed in accordance with the guidelines and management techniques of that period. It was fielded after a long and intensive program and as part of a 2-weapon-1-cartridge plan to modernize the Army's infantry and to participate in NATO standardization.

The M16 rifle was fielded just a few years later—during a period of intense combat activity in Vietnam. Although it has no ancestry in U.S. military weaponry (because it was not the result of an evolutionary Army development program), the M16 rifle owes a large measure of its current good reputation to the full attention given it by many Army Ordnance/AMC/DARCOM professionals in an attempt to engineer the weapon for effective combat. In other words, the management and development were carried out *after* the decision to produce the M16 for Army use.

On the other hand, the SAW program has been both the victim and the beneficiary of modern management. On the plus side, the original SAW concept was the result of professional analysis of possible future combat scenarios in order to define the military need.

This need was then assessed by computer to determine the technical parameters within which the operational characteristics could be satisfied. Some of the concepts investigated new and novel ways to drive a gun mechanism or to feed it ammunition.

On the minus side, and this is a purely personal opinion, the computer study has "been for naught" because the caliber thus selected was abandoned, by directive, in favor of the artificial limit of a cartridge already in the system.

This re-orientation cost about 18 months in development time. The time delay generated questions in the minds of DA officials who were required to approve funds for succeeding years' effort. As a result, funding allocations to the project fluctuated which did little to encourage effective planning. The number and type of concepts to be tested has also been increased by direction. Whether this is good or bad remains to be seen.

Infantry weapons developments have always seemed to attract attention out of all proportion to their cost or caliber or almost any other scalar one might select. It has always been thus. President Lincoln, for example, is reported to have personally fired an experimental Whitney musket on the south lawn of the White House during the Civil War. GEN MacArthur, as Chief of Staff, personally made the decision that the U.S. Army would retain .30″ as its rifle caliber rather than change to .276″.

Also, debate on selection of a caliber for NATO troops was heard in the U.S. Congress and the halls of Canadian and British Parliament in the early 50s. The question being debated was resolved by the joint decision of Messrs. Churchill, Truman and Diefenbaker. President Kennedy was even photographed accepting a presentation model of the M14 rifle. Development of the M16 was conducted under the close supervision and direction of the then Secretary of Defense R. S. MacNamara, and the list goes on.

The original SAW program was designed to emphasize several points, namely, a conventional weapon, with conventional, but optimum ammunition and an early IOC (Initial Operational Capability) date. Because of program delays caused by fund shortages and program redirection, we won't achieve the last point.

Following the adoption of the M16 rifle, the Army initiated several studies to insure that future weapon

Machinegun, 5.56mm XM248

COMPARISON OF SAW CANDIDATES

	XM248	XM249	XM106	XM262
OVERALL LENGTH	1M	1M	1M	1M
WEIGHT (W/ACCESSORIES, W/O AMMUNITION)	6.5 KG	6.5 KG	4.8 KG	7.69 KG
BARREL LENGTH (INCLUDING FLASH SUPPRESSOR)	609 MM	523 MM	546 MM	482 MM
OPERATION/LOCKING	DUAL GAS SYSTEM; ROTATING BOLT W/3 LUGS	SINGLE GAS SYSTEM; ROTATING BOLT W/2 LUGS	SINGLE GAS SYSTEM; ROTATING BOLT W/8 LUGS	ROLLER LOCKED, RETARDED BLOWBACK SYSTEM
FEED	BELT FEED-ROTARY DRIVE	BOX MAGAZINE OR BOLT-OPERATED FEED LEVER	M16A1 RIFLE MAGAZINES SEPARATELY OR IN 3 BOX ASSEMBLIES (TRI-MAG)	BELT; DRIVEN BY SPROCKET
RATE OF FIRE (CYCLIC)	500 RPM	VARIABLE-700 1100 RPM	750 RPM	900 RPM
MANUFACTURER	FORD AEROSPACE & COMMUNICATIONS CORP., U.S.A.	FABRIQUE NATIONALE, BELGIUM	M16 RIFLE MODIFIED BY U.S. ARMY BALLISTICS RESEARCH LABORATORIES, ABERDEEN PROVING GROUND, MD.	HECKLER & KOCH, GERMANY

NOTES: ALL WEAPONS ARE CHAMBERED FOR THE U.S. 5.56 X 45MM M193/M196/XM777/XM778 CARTRIDGES.

ALL MACHINEGUNS CAN BE ADAPTED TO FEED FROM A RIFLE (BOX) MAGAZINE.

selection might be made on a more scientific basis. One of these, the Small Arms Weapons Study, carried the acronym "SAWS"—an abbreviation we find useful today.

The purpose of the 1966 SAWS effort was to evaluate, on the basis of test firing, weapons that were then commercially available to equip the rifle squad. By and large, these were 5.56mm weapons. They included the Stoner weapon family; cal. .223 weapons that were developed in Germany and marketed through American firms; and alternates to the M16, then the XM16, rifle.

Some cal. .30/7.62mm weapons were also considered. At the same time, TRADOC, or CONARC as it was called then, was conducting two significant tactical studies. One of these was IRUS-75 (Infantry Rifle Unit Study).

IRUS-75 was directed at the Infantry Rifleman and his organization for combat in the 1975 time frame. Shortly after this, a second operational study, ASARS (Army Small Arms Requirements Study) was initiated.

ASARS was an analytical evaluation of small arms characteristics to determine their relative importance in future development programs. Hence, it, too, had a bearing on organization. The results of these two TRADOC studies clearly indicated that each squad needed two automatic gunners (one per fire team).

Thus the need for the one-man machinegun was enunciated and defined. A Draft Material Need (MN) was circulated and staffed, massaged by Joint Working Groups, and was ultimately approved in March 1973.

Machinegun, 5.56mm XM249

Approval of the MN for a one-man machinegun was viewed as an interesting and useful challenge to the DARCOM community. Because the weapon was by definition intermediate to the rifle and to the machinegun, it was by no means certain that one caliber or the other would be preferred. The user had specified his need in terms of range of engagement and terminal effect against the battlefield target— truly a Required Operational Capability.

Picking up this challenge, the

Machinegun, 5.56mm XM262

laboratory at Rock Island Arsenal initiated a study, first of ammunition, and then of weapons. There was considerable overlap between these two phases of this study. This was because neither could be completely done in the absence of knowledge of its impact on the other.

Inasmuch as 7.62mm (the caliber of the company level M60 machinegun) and 5.56mm (the caliber of the shoulder rifle) were the natural limits to consider in a development of this type, the ammunition studies were grouped between these two caliber ranges.

Although some projectiles per se were smaller in diameter than 5.56mm, they were evaluated on the basis of their saboted size. The projectiles that were studied included flechettes, lead cored bullets, steel cored bullets, and multi-piece bullets. Except for the flechettes, they were all generally of conventional military construction.

The essential feature of this initial study was a computer conducted parameteric design analysis (PDA) looking at more than 1,000 conceptual designs. Terminal effects desired for each type of ammunition were those specified in the approved MN.

Because of the then relatively short period of time required for completion of the development and type classification of the system, Rock Island directed its effort at fairly conventional designs. Efforts were directed at those capable of being produced on conventional machinery.

Part of the effort undertook to study aluminum cartridge cases, although minimum funds were available for this. Design emphasis concentrated on steel cartridge cases rather than brass, looking ahead to the time when it would be necessary to conserve scarce copper and tin.

Weapon designs, in a variety of configurations, were assessed. Such factors as method of locking and unlocking, type of feeding, gas port location and diameter and barrel design were carefully considered in the PDA. As a result of this PDA, the development community selected 6.00mm as a preferred/optimum caliber for this intermediate weapon.

The precise caliber was not too far from some of the SALVO cartridges evaluated in the early 1950s. But 6mm ammunition could be made by industry on conventional bullet machinery and would not unduly introduce any delays to the program.

The pros and cons of a third caliber (in addition to 5.56mm and 7.62mm) in infantry units have been argued extensively. Small arms ammunition is made and used in such tremendous quantities that production is highly automated. The resulting cost per round is almost wholly for material since handling is virtually eliminated.

The supposed disadvantages of two rounds versus one round in the squad disappear unless both rounds are fed to their respective guns from the same magazine or link. In other words, a rifle (magazine fed) and a machinegun (link belt fed) require two different packs of ammunition so they might just as well each have an optimum cartridge. (It must be noted, however, that some of the SAW contenders now being tested will use either rifle magazine or metallic linked belts of ammunition.)

The weapon design, except for certain general restraints, was not firmly established. The Army elected to contract with industry for weapon design and from the proposals received, selected two for further investigation. Both of these were belt fed, gas operated mechanisms.

During the course of the development of these two weapons by industry, Rodman Laboratories, as part of their in-house technology program, conceived some novel feed mechanisms and other operating components for light weapons.

The design resulting from combining these was an unconventional dual rod, dual gas system mechanism with a rotary feed assembled on one of the rods. This mechanism eliminated the need for an expensive heavy receiver, and provided a very good non-surging belt-feed mechanism. The weapon showed great promise of being easy to manufacture, simple to maintain and reliable in operation.

At the same time that the three U.S. designs were being built for evaluation, the Army received a German design built by Heckler and Koch of Oberndorf, Germany, and the "MINIMI" developed and built by Fabrique Nationale in Belgium. Each of these weapons was in 5.56mm caliber.

Neither weapon was available in sufficient quantity for a full scale test, and both were dropped from consideration. Following the completion of DT-I/OT-I, ARRCOM prepared the required TOD (Trade-off Determination) as the basis for recommending an Engineering Development.

Although the TOD recommended continuation of the program, with a 6.00mm weapon combining the best features of all tested weapons into the Rodman Fixture, the program came under review in DA and OSD before this recommendation could be implemented.

On 14 Dec. 1974, DARCOM was directed to reconsider its design selection and evaluate weapon choices in either of the then two standard calibers — 5.56mm or 7.62mm.

For 18 months, the program for all intents and purposes, was at a standstill. During this period, Rock Island Arsenal renegotiated contracts, redesigned the Rodman test fixture, and prepared to conduct another evaluation in the new caliber.

The reoriented program centers on 5.56mm because an automatic weapon in 7.62mm has little, if any, hope of meeting the weight requirements of the user. Because 5.56mm showed potential problems in meeting the minimum operational requirements it was necessary for the user to reassess his military need and determine whether, on the basis of this reassessment, the 5.56mm round could be an effective machinegun cartridge.

Ultimately, it became necessary to redesign the bullet used in the M193 cartridge. The controlling factor in this redesign was that the new bullet must be compatible with the M16 rifle which was then and is now the standard U.S. Army rifle.

The new SAW program based on a 5.56mm cartridge was a whole new ball game for the world. Granted, the Army had to fall back and re-group just when it was thought to be in sight of its goal, but industry was ready to enter the contest.

Current candidate weapons are being supplied by the Ford Aerospace and Communications Corp. (XM248), Fabrique Nationale in Belgium (XM249 MINIMI), Heckler and Koch of Germany (XM262), and a heavy barrelled variant of the M16 fabricated under the supervision of the Army's Ballistic Research Laboratory (XM106).

All candidates are chambered for the U.S. 5.56mm cartridge. Rifling is 1 turn in 12 inches as is the M16 rifle. Machineguns are belt fed using the XM777 and XM778 cartridges in the 5.56mm version of the M13 (7.62mm) link.

The XM106 heavy barrelled rifle is fed from an assembly of three 30-round box magazines adapted for the purpose. Machineguns also can accept 30-round M16 box magazines with varying degrees of simplicity. A decision on whether this facility should be a permanent feature of the final design will be made after completion of the tests.

Tests are also expected to provide the basis for a rational decision as to whether the gun should be equipped with a 100 or a 200-round ammunition supply box. Based upon experience with the M60 machineguns, the other obvious question will also be addressed—should any box at all be provided with the gun?

Testing of this group of candidates for the SAW System has begun. By late 1979, all results are expected to be in and evaluated. Because the program uses the same cartridge which the U.S. nominated for the NATO tests, and because the MINIMI (XM249), in a slightly different form is also in the NATO tests, the SAW Project Office is anxious to reach a conclusion and make a selection compatible with NATO recommendation.

The concept of a Squad Automatic Weapon (or Light Support Weapon in Europe) is amenable to the tactics of our NATO allies. A compatible decision is essential.

THOMAS E. COSGROVE is a technical administrator assigned to the Armor-Infantry Team in the Systems Development Office, Directorate for Development and Engineering, HQ U.S. Army Materiel Development and Readiness Command. His initial association with infantry weapons developments began during earlier employment with the U.S. Army Ordnance Corps, and has continued during his employment with DARCOM. His academic credentials include a 1957 bachelor's degree in mechanical engineering from George Washington University, Washington, DC.

Energy R&D Policy Statement Encourages Synthetic Mobility Fuels

Emerging from a hard look at the past since the oil embargo of 1973, as well as a look at the present and the future, is a formal Army R&D policy that encourages R&D on synthetic "mobility fuels."

The paper titled "Army Policy Statement on Mobility Energy Research and Development" was approved and signed by Assistant Secretary of the Army (RDA) Percy A. Pierre on 22 Dec. 1978, and subsequently published to the field.

It has become increasingly evident that future shortages as well as the uncertainty of availability on conventional liquid petroleum fuels might well jeopardize the Army's ability to execute its assigned missions. To be able to carry out its missions then may necessitate use of synthetic fuels to meet its requirements for its aircraft and surface vehicles as well as power generation equipment.

Dr. Joseph H. Yang, Deputy Assistant Secretary of the Army (R&D) became concerned last fall that there was no Army policy on energy R&D—what areas the Army should be pursuing and why. After consultation with Secretary Pierre and members of the Army Staff, this policy statement resulted, providing guidelines to the field for the conduct of energy R&D, and the relationship of such work to the Department of Energy.

The full text of the policy statement follows:

The Army maintains the position that future shortages and uncertainty of availability of conventional liquid petroleum fuels for optimum execution of the Army mission will necessitate use of synthetic fuels to help satisfy mobility fuel requirements. "Mobility Fuels" as used herein refers to liquid fuels for Army vehicles and power generation equipment.

The term "synthetic fuels" refers to all liquid fuels, such as alcohol, not produced by conventional oil drilling and refining methods and to all blends of such fuels with conventional fuels. The Army mobility energy research and development policy objective is to increase the efficiency of use and reduce dependency on non-renewable energy resources through research, development, test, and evaluation while maintaining the highest levels of competence and effectiveness in Army training, readiness, and combat capability of strategic and tactical forces.

In accordance with national trends and Department of Energy and Department of Defense energy policy, the Army encourages research for massive production of synthetic mobility fuels for early type classification and use in existing Army vehicular engines and power generation equipment. The Army encourages research and development to improve the fuel efficiency of propulsion and power generation systems through design of new equipment and economic retrofit of old equipment and research and development of propulsion systems capable of using a broad range of conventional and synthetic fuels.

It will be Army policy to propose, support, and conduct research, development, tests, and evaluations to enable:

- Preparation of specifications for synthetic fuels suitable for test in Army mobility and power generation equipment.
- Procurement and testing of synthetic fuels for mobility and power generation equipment.
- Determination of required synthetic fuel characteristics for operation in Army mobility equipment.
- Determination of essential desirable modifications of Army engines required for more efficient use of liquid fuels.
- Determination of essential and desirable modifications of Army engines required to operate when fueled by synthetic fuels.
- Determination of cost of modifications and industry's capability to incorporate such modifications.
- Establishment of the characteristics and costs of DOD logistics system required to store and distribute synthetic fuels.
- Establishment of decision milestones to permit adjustments in the overall mobility energy Army research, development, test, and evaluation program.

This policy will take into account DOE responsibility for providing overall support for research and development for achievement of national energy objectives and DOD responsibility to cooperate when feasible with DOE and to conduct that mobility energy research and development necessary for effective execution of the Army mission.

This Army research and development policy is consistent with DOD energy policy and consideration will be given to its modification if and when necessary to maintain such compatibility.

REMBASS Given Go-Ahead

The Army is going to revitalize Project Manager (PM) Remotely Monitored Battlefield Sensors System (REMBASS). The program, which had come to a virtual standstill, took a new lease on life recently when the Department of the Army decided to continue development of the electronic sensor system which is used to detect and classify enemy movement on the battlefield using ground sensors.

An estimate of the first production buy indicates that it will be sufficient to outfit the Army's fighting divisions. Production funding could vary from $89 million to over $200 million, depending on the Army's decision to support just the basic units or to completely fill the pipeline. Nevertheless, the current plan foresees fielding of the unattended ground sensor system by the mid-80s.

According to Mr. William Carmody, operations research analyst, PM REMBASS, "the Army will consider early fielding of an abbreviated version, to be emplaced by hand, with air-dropped and artillery-emplaced ground sensors to follow."

RCA Corp., Camden, NJ, is the prime development contractor. Tests will be held later this year to demonstrate the ability of the classifying sensors to differentiate between wheeled and track vehicles and personnel.

The Joint Service Small Arms Program

By James B. Ackley & MAJ David E. Baskett

The military research and development community has realized a key breakthrough with the establishment of the Joint Service Small Arms Program (JSSAP). For the first time, a coordinated small arms weapons R&D approach, that includes all Services, has been implemented.

Basically, the program provides a unified effort for development of small arms weapons required by the Armed Services to meet their mission capability on the future battlefield.

The program is also designed to foster applicable technologies to permit rapid response to present and future small arms requirements. This joint approach in small arms is tied to those operational requirements which do not significantly differ and provides for development of solid, well oriented small arms systems.

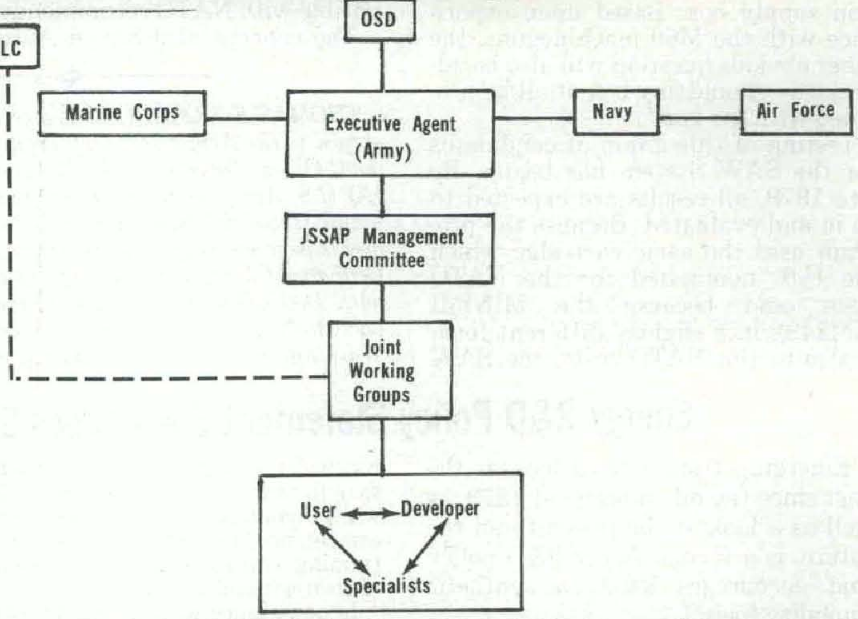


Figure 2. Joint Service Small Arms Program Management Structure

It is of historical interest to note that in December 1898 a joint Army-Navy board met and recommended the standardization of small arms and their ammunition throughout the U.S. Army, Navy, and Marine Corps. This recommendation was adopted and for the last 80 years there has been general acceptance of similar personal weapons and ammunition. This acceptance usually comes after fielding and in some cases only after extreme pressure is brought to bear.

In other instances, the Armed Services have embarked on expensive alternatives or modifications, citing special requirements or needs incompatible within the envelope of the available system. It is now recognized that the standardization process must begin prior to systems being issued to the field. In other words, reach agreement on unique and common needs during the early conceptual phase.

Eighty years, to the month, after the Joint Army-Navy Board agreed to standardize small arms and small arms ammunition, the signing of the Charter for the Joint Service Small Arms Program in December 1978 paved the way for reaching standardization agreement before on concepts—before a variety of procurements makes it difficult or impossible. The Army, Navy, Air Force, Marine Corps and Coast Guard, have joined in a mutual R&D pact to produce the highest quality individual and light crew-served weapons to lead the U.S. military into the 21st Century.

Extending well beyond the 1898 recommendations, the Joint Service Small Arms Program provides control yet flexible management of developmental small arms programs. Evolutionary improvements will be addressed while stimulating revolutionary developments to meet the challenges of the modern battlefield.

The Program Planning Model (Figure 1) clearly indicates the span and scope of coordination and review which will be the hallmarks of the JSSAP. It is important to note from the model that the program will be placing increased reliance on American industry directly and that NATO RSI considerations are an essential element in tasking to meet objectives of cost effective joint Service weaponry compatible with the RSI goal.

The JSSAP will include prototyping in specific technology areas. This will be determined from analyses of threat, state of technology, deficiencies of existing system(s), and areas where commonality can be exploited.

The program is administered by a Joint Service Small Arms Program Management Committee that is

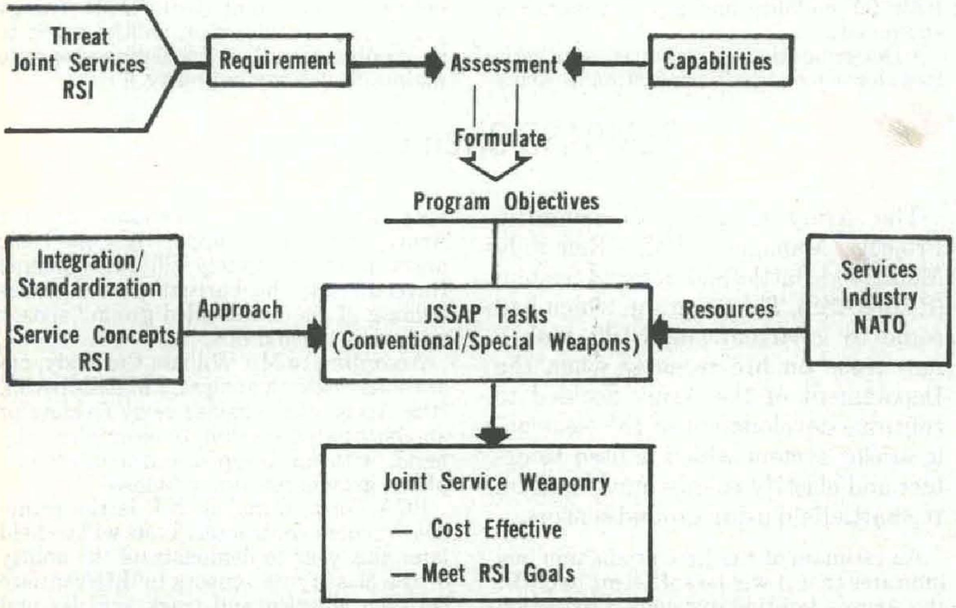


Figure 1. Joint Service Small Arms Program Planning Model

chaired by Army COL A. J. Larkins, commander/director of the Fire Control and Small Caliber Weapon System Laboratory of ARRADCOM. (See Figure 2.)

Designated principal committee members are: LTC William P. Carey, HQ, U.S. Army TRADOC; Mr. Ronald Henry, U.S. Naval Weapon Support Center; Mr. John Robbins, U.S. Air Force Armaments Laboratory; LTC Richard Maresco, U.S. Marine Corps Combat Development Center and CWO Lee Cearley, HQ, Coast Guard.

As the senior joint Service body for small arms development, the Management Committee will strive to harmonize the joint Service requirements, consolidate and coordinate development activity, reduce costs and improve the efficiency of the material acquisition process.

In its management capacity, the committee will make decisions and will coordinate program formulation planning, implementation, and, where needed, termination. The committee will also assure complete interservice awareness of the total research and development program in the area of small arms and related technology.

Objectives of the JSSAP are to provide the U.S. land forces with the small arms capability to effectively operate in an infantry, mechanized, airmobile, airborne, amphibious and counter-insurgency environment. Some special mission roles may include rear area protection, joint and combined task forces, and military operations in urban environment.

The program will give the American fighting man the small arms capability to effectively accomplish his assigned missions against threats to air base defense and security. Weapons for air crew survival and defense will be assured and provisions made to provide support for special missions capability (i.e., helicopter operations).

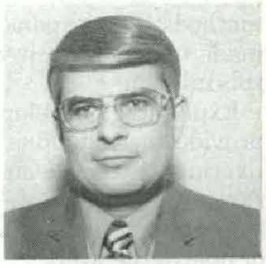
Finally, U.S. Naval and Coast Guard forces will be furnished with small arms that will meet the needs of special warfare, base security, and enforcement of laws and treaties.

Recognizing that innovation and advances in technology are not produced by the direct decree of new management organizations, the small arms program is intent on fostering a new environment in government, industry and among private individuals. This environment will encourage creativity and innovation focused on meeting current and projected needs of the Armed Forces.

Also on the planning list, is the establishment of strong ties with the NATO R&D community to allow the RSI process to begin while weapons are still in an early stage of development and testing.

There are bound to be growing pains in such a massive venture. However, the Joint Service Small Arms Program is off to a strong and promising start. It is led by dedicated members who want to place the finest small arms in the hands of tomorrow's users.

These individuals, with the support and cooperation of their Service, are providing expertise and zeal needed to spawn a new generation of small arms—one which will range from limited purpose weapons to high density systems capable of destroying the divergent targets expected in any future conflict.



JAMES B. ACKLEY is chief of the Joint Service Small Arms Program Office, U.S. Army Armament Research and Development Command (ARRADCOM), Dover, NJ. He began his career in small arms at Frankford Arsenal, following graduation with a mechanical engineering degree from Pennsylvania State University.

MAJ DAVID E. BASKETT is assigned to the Armament Concepts Office of ARRADCOM. He began his Army career as an enlisted man in 1964 and was commissioned in 1968 while serving in Vietnam. He holds a BS degree in aviation management (summa cum laude) from Metropolitan State College, and has completed the Infantry Officer Advanced Course.

Sheridan Assumes Duties as DARCOM D&E Director

Promotion to 2-star rank and assignment as director of HQ U.S. Army Materiel Development and Readiness Command's Development and Engineering Directorate came recently to MG Stan R. Sheridan, former DARCOM director of Battlefield Systems Integration, Office of the Deputy Commander for Materiel Development.

MG Sheridan succeeds MG Robert J. Lunn who was incumbent in that office until his recent reassignment as Assistant Deputy Chief of Staff for Research, Development and Acquisition, Department of the Army, Washington, DC.

Graduated from the U.S. Military Academy in 1951, MG Sheridan earned an MS degree in mechanical engineering from the University of Southern California in 1959. He has also completed course requirements of the Industrial College of the Armed Forces, the Command and General Staff College, and the Armor Officer Career Course.

MG Stan R. Sheridan

During 1975-78, MG Sheridan served as program manager of the Fighting Vehicle Systems in Warren, MI, following assignments from January-June 1975 as commander, Support Command, 2d Armored Division, Fort Hood, TX, and from March 1971-October 1974 as project manager for the M60 Series Tank family.

MG Sheridan also served for eight months as a strategic forces analyst, Studies Analysis and Gaming Agency, Office, Joint Chiefs of Staff. Included among his assignments in Vietnam were deputy brigade commander, 1st Brigade, 4th Infantry Division, and commander, 1st Battalion, 69th Armor.

In 1968, MG Sheridan was awarded the Secretary of the Army's Frank Pace Award in recognition of 1965-68 achievements as tank action officer, Office of the Army Chief of R&D. His areas of responsibility included the M551 General Sheridan, the M60A1E1/E2 Tank, the U.S./FRG Main Battle Tank; and associated equipment and tank components.

MG Sheridan's military honors include the Silver Star, Legion of Merit with two Oak Leaf Clusters (OLC), Distinguished Flying Cross, Bronze Star Medal with "V" device, Army Commendation Medal with OLC, Air Medal with 11 OLC, Purple Heart, Vietnamese Gallantry Cross with two gold stars, Combat Infantry Badge, and Vietnamese Combat Armor Badge.

Special Hard-Target Assault Weapon LAW

By William E. Zecher

The purpose of developing the Special Hard-Target Assault Weapon LAW (SHAWL) at the U.S. Army Missile Research and Development Command (MIRADCOM), Redstone Arsenal, AL, is to put an effective assault weapon into the hands of the individual infantryman.

During World War II, towns were taken by a group of GIs fighting from house-to-house or building-to-building using their rifles, hand grenades, and satchel charges. It is 35 years later and our soldiers will have to use the same methods and weapons to take over a city unless an effort is made to provide a weapon or weapons to assist the GI in this mission.

Exploratory development of the SHAWL is designed to provide the individual infantry with the capability of delivering a grenade inside of a room from cover up to a range of 200 meters. This is in lieu of running down the street and trying to throw the grenade through a window or hole in the wall.

SHAWL is being developed as an 8½-pound free-flight rocket system using two warheads in tandem on the front of an in-tube burning rocket motor. The weapon is one-manportable with throwaway launcher requiring no maintenance and no repair parts.

The SHAWL rocket is fired at a target wall (not window or opening) within 200 meters. The rocket impacts the target wall (Figure 1) where the dual-cone crush switch initiates the front warhead. The front warhead makes at least a 2-inch diameter hole in the target wall. This allows the follow-through warhead and spent motor case to pass through the hole into the target interior (Figure 2). The second (follow through) warhead is exploded inside the target by means of a time delay fuze, spraying lethal fragments throughout the room (Figure 3).

SHAWL is definitely not an antitank weapon. Tests to date show that a shaped charge warhead capable of defeating tank armor makes only a small hole in masonry walls. Unless the man in the room is directly behind the hole, he probably would not be hurt. With SHAWL, it would make no difference where he was in the room.

Initial feasibility of SHAWL was demonstrated in flight tests at Redstone Arsenal in May and June of 1977. The U.S. Army Infantry School, via a letter of interest, requested additional testing of SHAWL against masonry structures and bunkers. This was requested in order to measure lethality of the weapon and compare the lethality to other weapons tested against the same targets.

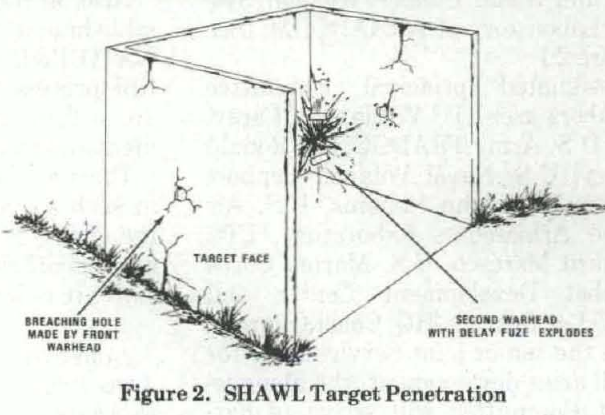


Figure 2. SHAWL Target Penetration

In November 1977, a total of 12 rockets were test fired against 8-inch reinforced concrete, 12-inch brick, and 4-inch brick facing 8-inch cinder block walled rooms at the Nevada Test Site in Mercury, NV.

In February 1978, a total of five rockets were test fired against earth and timber bunkers and an M49 Armored Personnel Carrier at Fort Benning, GA. As a result of these tests, a contract with Physics International was awarded to improve the performance of the front warhead.

Test results of the SHAWL against the masonry targets at Mercury, NV, have been analyzed by the U.S. Army Human Engineering Laboratory and the Army Materiel Systems Analysis Activity, both located at Aberdeen Proving Ground, MD.

Against certain targets, SHAWL is significantly more effective than the M72 LAW antitank round and is as effective as the 105mm tank round. The Army Materiel Systems Analysis Activity/Human Engineering Laboratory estimates that SHAWL—with the correct time delay in the follow-through warhead—could be more effective

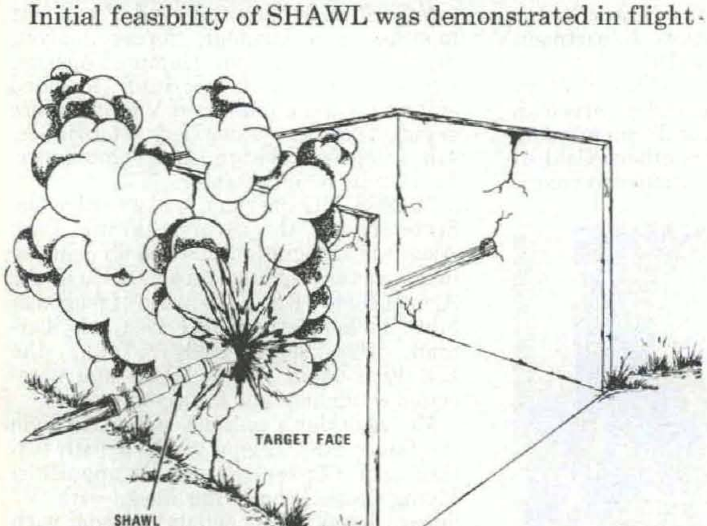


Figure 1. SHAWL Impact

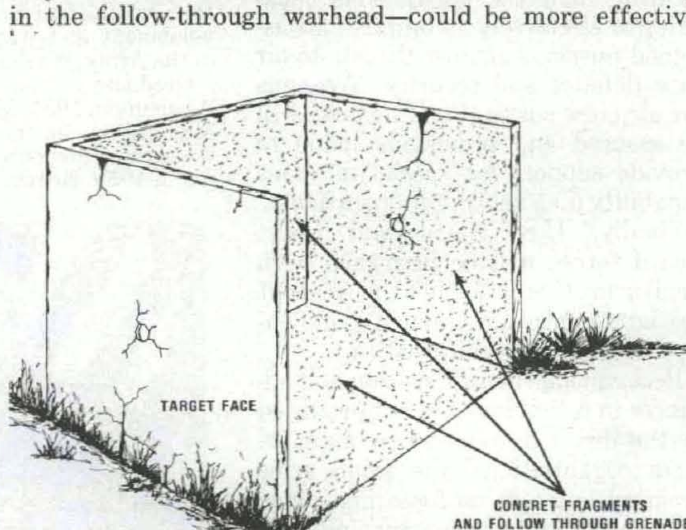


Figure 3. SHAWL Results

than the present design.

The individual soldier with the SHAWL on his back is definitely more maneuverable than a tank and can be more accurate than long range artillery. This weapon would allow a platoon of GIs flexibility and independence from support of artillery and tanks to assault many targets at the same time.

SHAWL would use much of the same parts, tooling and assembly lines that are now used on the Viper antitank rocket system. By utilizing almost all of Viper with very few additions and small changes, the soldier can be given a new weapon and capability that he does not have at present. Another very important advantage to SHAWL is that *no* additional training would be required. Anyone trained to fire Viper could fire SHAWL.

The experimental program is scheduled for completion within the next 16 months. It will include demonstration of the design using off-the-shelf Viper components. In late FY80 or early FY81, SHAWL is scheduled to enter a shoot-off competition against four other systems contending for the infantry assault role. Competition will not only show what is available to the infantry, but allow the Army to give the soldier the best possible weapon.

The Advanced Systems Concepts Office Armor/Infantry Weapons Concept Team was supported by the following MIRADCOM organizations: Propulsion Directorate, Test and Evaluation Directorate, and the Advanced Systems Development and Manufacturing Technology Directorate (Skunk Works). The Harry Diamond Laboratory is providing the fuzing for both warheads.

WILLIAM E. ZECHER has been employed since 1973 as a mechanical engineer in the Antitank Assault Concepts Team of the Advanced Systems Concepts Office at the U.S. Army Missile Research and Development Command, Redstone Arsenal, AL. He joined Redstone Arsenal in 1966 where he initially worked on missile test equipment. Previous to joining Redstone Arsenal, he was employed in 1960 by the U.S. Naval Missile Center, Point Mugu, CA, where he worked on BULLPUP, SHRIKE, and WALLEYE missile test evaluation programs. Academic credentials include a bachelor's degree in mechanical engineering from the University of Florida, and a master's in administrative science from the University of Alabama.

Benet Weapons Laboratory Creates New Magnetic Material

Creation of a new magnetic material—which reportedly represents an entirely new phenomena—has been announced by scientists at the U.S. Army Armament R&D Command's Benet Weapons Laboratory, Watervliet Arsenal, NY.

By using a process termed "pressure quenching," Benet scientists have converted the common mineral of greenockite (a form of cadmium sulfide which is normally non-magnetic) into a new glassy-like substance. Pressure quenching converts a material into an electrical conductor by subjecting it to more than a half-million pounds per square inch.

Pressure quenched cadmium sulfide displays a type of magnetic behavior which reportedly has never been seen in any other material. At room temperature it has a magnetization equal to the most advanced rare earth oxide magnet materials at the same magnetic fields.

This is the first time that magnetic behavior of this type has been seen in any material that does not contain an element which shows strong magnetic properties in its elemental form. The behavior cannot be explained by presently well-established theories.

Benet Lab's discovery was made as part of an extensive ultra-high pressure research effort. This effort was initiated several years ago at the suggestion of Mr. Norman L. Klein, recently retired U.S. Army assistant deputy for Science and Technology. It is under the overall direction of Dr. Thomas E. Davidson, director of Research at the Benet Laboratory.

The new material was discovered by Mr. Clarke G. Homan, physicist, and Mr. David P. Kendall, chief of the Materials Engineering Section. Measurements of the unique magnetic properties were made in cooperation with Prof. Robert MacCrone of Rensselaer Polytechnic Institute, NY.

There are two aspects of the unusual magnetic behavior of this new material that may lead to significant technological breakthroughs. At low magnetic fields, its behavior is similar to that found in materials known as "superconductors."

These superconductor materials, when cooled to extremely low temperature, conduct electricity with no resistance. All previously known superconductors show this behavior only at temperatures below about 250 degrees below zero, Celcius.

Pressure quenched cadmium sulfide shows the same type of magnetic behavior at temperatures approaching room temperature. This discovery could lead to development of a high temperature superconductor which would revolutionize electrical power distribution and generation.

At higher magnetic fields, the new material shows magnetic behavior which could lead to the development of new lightweight magnetic materials for use in electric motors, generators and other electrical devices. Combination of the two types of magnetic behavior may also lead to the development of new types of solid state electronic devices which have not been believed possible in the past.

Jet Exhaust Powers New Decontamination System Prototype

Completion of the first jet exhaust-powered decontamination system prototype, designed to provide rapid removal of contaminants from the surface of U.S. military tactical vehicles, has been announced by the U.S. Army Armament R&D Command's Chemical Systems Laboratory.

Built under contract by the Brunswick Corp., DeLand, FL, the apparatus features a J33-A-35 turbojet engine mounted on the rear of an M810 military truck. The operator's control cab and jet engine are mounted side-by-side on a hydraulically controlled turntable which allows rotation and elevation of the engine.

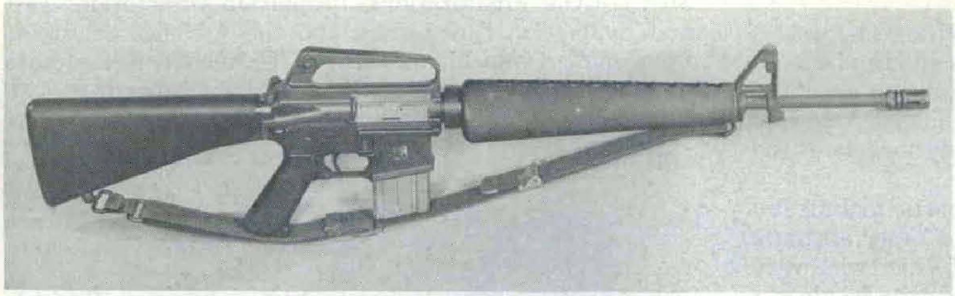
Mr. John Buddemeyer, a chemical engineer in CSL's Physical Protection Division and project officer for the contract, notes that the agility of the system permits the operator to direct exhaust blasts at the surface of a vehicle.

Buddemeyer added that four equally spaced nozzles are mounted at the exhaust end of the engine for injection of water or decontaminating solutions into the exhaust air stream. A 3-compartment fuel, water tank is mounted behind the driver's cab where heaters maintain proper water temperatures during the winter.

Development of the system reportedly provided a unique challenge to Brunswick engineers. This was because they had to solve problems associated with placing a jet engine in a non-aircraft environment and making it operational by a soldier in a remote field environment. Further development is planned, following tests.

Jet Exhaust-Powered Decontamination System

Photo by Brunswick Corp.



The M–16 Rifle
Decade of Evolution 1957-1967

By COL Henry R. Shelton

The following is an abbreviated version of the original study done by COL Shelton as his Army War College thesis in 1969. COL Shelton had excellent knowledge of the M-16 program, having served as the M-16 coordinator for a brigade that was given an initial issue of those rifles as it arrived in Vietnam, and then from July 1967 to July 1968 as a small arms action officer at CDC.

Adoption of the M-16 rifle by the U.S. Armed Services triggered much controversy in the late 1960s and early 1970s, a rifle that came into initial prominence under its commercially developed title as the AR-15.

There were many actions and decisions outside the Army concerning both the rifle and the ammunition that influenced the eventual Army decision. However, two of the most significant events were the Army Small Arms Weapons Study (SAWS) and the operational requirements generated by Vietnam.

Official U.S. Army interest in a lightweight rifle firing a small high velocity bullet dates back to the 1920s. In 1928 a board recommended to Chief of Staff MacArthur the development of a .276 caliber round. MacArthur backed the Ordnance Department position to continue development of weapons using the then standard .30 caliber cartridge.

World War II experience generated an official requirement for a lightweight automatic rifle, which resulted in the development and adoption of the M-14, though development of the M-14 was restricted by the U.S. adoption as standard of the NATO 7.62mm cartridge.

Nonetheless the Army Ordnance Corps continued investigations of a light rifle firing a small high velocity bullet. In 1957 the Army told industry it was interested in a rifle of not more than six pounds loaded, accuracy and trajectory equal to or better than the M-1 at ranges up to 500 yards, and capable of selective fire, along with certain penetration and lethality criteria.

In 1957 the Armalite Division of the Fairchild Corp. presented to the Army its prototype AR-15 rifle in response to this request. This rifle had been under company development since 1954, using technical advances in nonferrous metals and plastics to reduce weight, bulk, and cost of production. The cartridge of the AR-15 was the .223 caliber Remington.

Ten AR-15 were procured and delivered to the Infantry Board at Fort Benning in March 1958. These rifles were tested at Benning, at Fort Ord, and at Aberdeen against the M-14. Advantages were found to be weight, ease of handling, reliability, superior full automatic fire, and ease of disassembly and assembly. Disadvantages were given as high malfunction rate when using a 30-round magazine, excessive muzzle flash, poor accuracy, and inferior penetration. All tests recommended continued development.

However, simultaneous with these tests, a general officer board (Powell Board) met to review the rifle program, particularly to resolve the big bore versus the small bore, high velocity issue. The board recommended in 1959 retention of the M-14 for the automatic role and development of an AR-15 type rifle chambered for a .258 round to replace the M-14 in the standard rifle role. This decision was based largely on the earlier U.S. commitment to the NATO 7.62 round.

Fairchild in the meantime had divested itself from the small arms business, and rights of manufacture were obtained by Colt. The latter, despite the Army's decision, continued to refine the AR-15.

While Army interest seemed ended, the U.S. Air Force suddenly expressed interest in the weapon for use by their local security troops. Tests were then conducted by the Army Ordnance Corps in the fall of 1960 on upgraded AR-15s for the Air Force, and based on these the Air Force began a vigorous program to procure the weapon. Despite considerable DOD and Congressional resistance, purchase of 8,500 was approved in May 1962. Simultaneously, the Navy recommended adoption of the AR-15 for its SEAL teams.

Colt had also been industrious in their sales efforts by taking the weapon to Vietnam for demonstration. In 1961 the Military Assistance Advisory Group there requested 1,000 AR-15s be procured for full scale combat test there. The request was approved by the Secretary of Defense, and the Advanced Research Projects Agency (ARPA) was directed to conduct the evaluation.

The result was a recommendation that the AR-15 be adopted as the basic weapon to be provided the Armed Forces of the Republic of Vietnam.

As a result of the Air Force and MAAG actions, DOD decided to undertake a cost-effectiveness study of the M-14 versus the AR-15. The results, released in September 1962, concluded the AR-15 to be the better combat weapon, and based on data available, to be the less costly weapon.

At this point interest had reached not only high Army levels but White House as well. The Army was asked for its evaluation of the AR-15, the M-14, and the Soviet AK-47 rifles.

Results of the Army evaluation were divergent, again reflecting the existence of the "big bore" and "small bore" schools of thought. But the Chief of Staff recommended to the Secretary of the Army, in January 1963, to procure between 50-100,000 AR-15s to equip air assault, airborne, and Special Forces units; to procure a limited number of modified M-14s as automatic rifles; and to continue at an accelerated rate development of an ongoing technology program called the Special Purpose Individual Weapon (SPIW), a flechette firing weapon of radical design. The door was left open then, for a later decision as to the rifle for Army-wide adoption. These recommendations were approved by both the Secretary of the Army and the Secretary of Defense.

As a result the Army purchased from Colt, in November 1963, 104,000 rifles designated XM-16E1, of which 19,000 were for the U.S. Air Force. Distribution to Army troops began in March 1964.

But the issue was far from settled. During the 1963-64 period, the U.S. Marine Corps had become interested in the Stoner-63 system with its six configurations, its cartridge was also the .223 Remington. The Army had shown no interest, in the Stoner-63 system, which resulted in a blunt November 1964 memo from DOD to the Army Chief of Staff about the Army's "closed minds." The Army reply was a decision to restudy the entire small arms program, and establishment of the Army Small Arms Weapon System study (SAWS). The Combat Developments Command was assigned overall responsibility for the study.

Exhaustive tests of all types were conducted at a number of CONUS and overseas locations on the candidate systems. The XM-16E1, the M-14, and the Stoner were used in all phases; the AK-47 in part; and the SPIW was compared only by computer simulation.

In the meantime, the Army had begun re-equipping its units going to Vietnam with XM-16E1s, and MACV had come in with a request in December 1965 with an urgent requirement for 293,000 XM-16E1s for allocation to U.S., RVN, and ROK troops.

Also occurring at this time was a slippage in the SPIW program. Originally scheduled for type classification as Standard A in December 1965, technical problems caused the date to slip first to January 1967, and then again to June 1968. The SPIW program, for which a number of people had high hopes, was in serious technical trouble.

However, SAWS study findings that went to DA in August 1966 recommended no additional procurement of rifles or automatic rifles beyond the number of XM-16E1s currently on order until the SPIW became available in 1970. Recognition was given though, that conditions in Vietnam might force additional purchases. And, said the study, there was an indication "That the 5.56mm rifle [.223 Remington] offers the most promise for the money spent." The only detractor was TECOM who believed the system reliability to be poor, and improved quality control needed. CDC added a subjective conclusion to the findings by saying that analysis "determined that [the] 5.56mm . . .systems are more effective for low intensity conflicts and that 7.62mm systems are more effective for mid/high intensity conflicts."

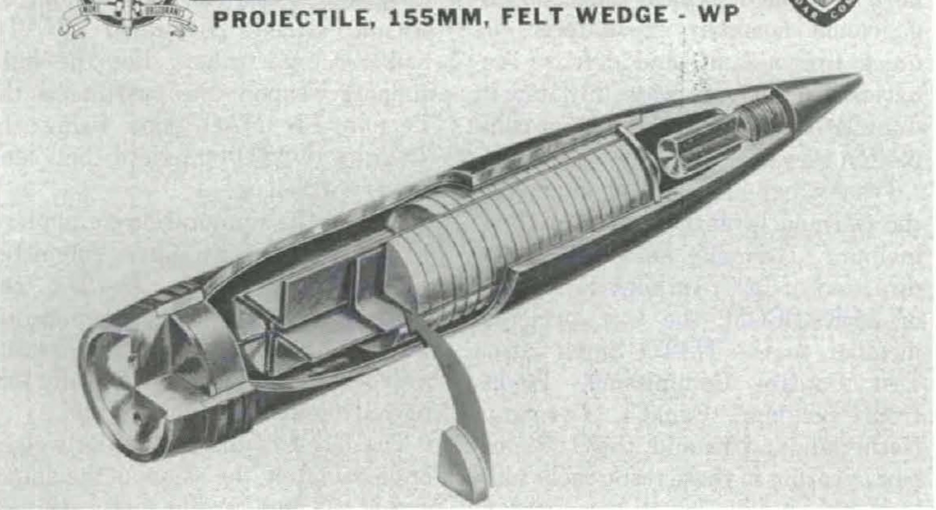
Meanwhile the buildup in Vietnam was absorbing XM-16E1s as fast as they were produced. NATO-oriented reserve stocks of M-14s were being used to support the training base. Procurement of new rifles had to be initiated.

The SAWS study results were being briefed and debated in the Army Staff, and no single course of action appeared as an obvious solution. A General Staff meeting resulted in two memoranda—one addressing the current rifle program, and the second, the future. The guts said adopt the XM-16E1 for the immediate needs. The Secretary of the Army forwarded to DOD in December 1966, his version which was essentially the same—rifle procurement for the foreseeable future would be the XM-16E1, though an active and broadened R&D effort should be continued to bring about further improvements in the Army's small arms. The Army then began taking steps to type classify the rifle as Standard A, a period of 36 years since the first recommendation to come up with such a rifle.

COL HENRY R. SHELTON has served as project manager of the Office of the PM-Smoke since he organized it in 1976. Commissioned in the infantry in 1951, he is a distinguished military graduate of Virginia Polytechnic Institute. He has served numerous troop command assignments including the 2d Battalion, 27th Infantry (Wolfhounds), Vietnam.

PROJECT MANAGER SMOKE / OBSCURANTS

PROJECTILE, 155MM, FELT WEDGE - WP



COL Henry R. Shelton, project manager, Smoke/Obscurants, in conjunction with COL Ronald E. Philipp, project manager, Cannon Artillery Weapons Systems, have announced successful completion of the advanced development project for an improved 155mm screening smoke projectile.

The U.S. Army Armament R&D Command's Chemical Systems Laboratory began engineering development of a prototype designated the XM825 in January 1979.

The XM825 utilizes a submunition concept to spread felt wedges saturated with white phosphorus (WP) over the target area. Submunitions were selected to overcome operational and logistical problems that exist with inventory smoke rounds.

The current WP round—the M110—is explosively disseminated with resulting heat causing the smoke to pillar rapidly and lose its screening effectiveness. The M116 hexachoroethane (HC) rounds have a relatively short burn time.

Capable of providing a quick and effective screen for 5 minutes, the XM825 is a member of the M483 ballistic family and it will have zone 8 charge range comparability. It will be fully interoperable with the U.S. M198 and Trilateral Nations (UK-GER-IT) FH70 howitzers.

Concept validation of the program involved fierce competition between white and red phosphorus prototypes developed respectively by ARRADCOM's Chemical Systems Laboratory and Large Caliber Weapons Systems Laboratory.

Test firing was conducted at Dugway Proving Ground, UT, from July to October 1978. The U.S. Army Field Artillery School considered the results in a cost operational effectiveness analysis.

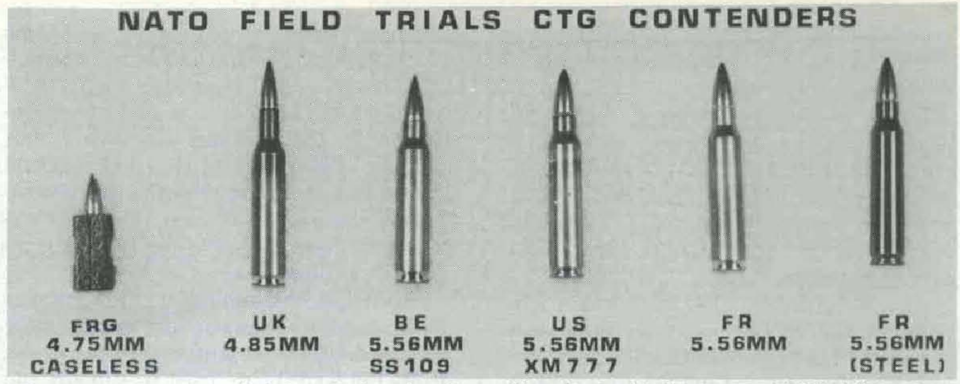
ARRADCOM Headquarters conducted an In-Process Review in December 1978. The XM825 was selected as the candidate after considering cost effectiveness, unit production, raw material availability and pollution abatement.

Following an engineering development program, type classification is planned for the fourth quarter of FY81. Initial fielding is projected for the second quarter of FY83. In the interim, the Army will rely on product improvement of the 155mm M116 HC round and the M110 WP projectile.

NATO

Field Trials

By Angelo N. Mancini Jr.



Certainly, an appropriate ongoing example of U.S. international involvement in Rationalization, Standardization and Interoperability is the current NATO Field Trials which are directed toward selection and standardization of a second caliber cartridge for the next family of NATO infantry small arms.

NATO military authorities have stated that standardization of their ammunition is essential and that standardization of infantry small arms is desirable for the post 1980 period.

NATO countries have all agreed, at the Conference of National Armaments Directors level, that only two calibers will be adopted for this next family of infantry small arms weapons. One will be the current NATO standardized 7.62mm cartridge. This family of weapons will consist of an individual weapon (rifle), a light support weapon (light machinegun) and a medium support weapon (medium machine gun).

In order to define the second caliber and standardize the ammunition (and, if possible, the weapons), a joint NATO test program was established. This program is presently being carried out to test and evaluate ammunition and weapon contenders which have been submitted by member countries.

By limiting the selection to only a second cartridge implies the following conclusions: the cartridge selected must fulfill the individual weapon (rifle) requirement as a minimum; and cartridge commonality with different weapons will be realized, i.e., individual weapon/light support weapon with same cartridge or light support weapon/medium support weapon with same cartridge.

The actual NATO test program is divided into two main parts. The first part is technical testing to evaluate performance parameters of all ammunition and weapons under laboratory and experimental type controls. These tests were initiated in April 1977, and were recently completed.

Tests are being conducted at Cold Meece, UK; Meppen, Germany; and Eglin AFB, U.S. The Eglin testing was conducted in May in the 78-meter McKinley Climatic Hanger over temperature ranges from +70°F to −65°F. The main purpose was to determine the environmental effect on bullet stability as measured by the increase in bullet dispersion and first maximum yaw.

The second part of testing is comprised of military user type trials. These tests are designed to evaluate ammunition/weapon system performance for individual and light support weapons at typical ranges of engagement normally encountered for quick fire, assault, and defense scenarios. These tests were initiated in June 1978 and are scheduled for completion very shortly.

Tests which are being conducted at the German Infantry School in Hammelburg, Germany, are under the direction of LTC Anthony E. Bisantz of ARRADCOM, the U.S. principal member to the NATO Small Arms Test Control Commission. Troops from Belgium, Canada, Germany, Netherlands, UK and the U.S. are participating in these tests. each country's troops will fire all weapon contenders.

In addition to the Hammelburg tests, low temperature climatic evaluation has been carried out for all weapons at Camp Shilo in Canada from 1 Jan. through 28 Feb. 1979. The average temperature was around −35°C (−31°F).

Perhaps the most significant milestone associated with the NATO Field Trials has been the requirement for a recommendation on cartridge selection by mid-January 1980. This date was highlighted in the Memorandum of Understanding (document AC/225-D/440, dated 2 June 1976), circulated by Under Secretary of the Army Dr. Walter B. LaBerge, then Assistant Secretary General for Defense Support at NATO.

The chart on page 15 shows the control and contender systems which are being tested in the NATO Field Trials. The principal reason for having control systems is to establish a baseline of data for ammunition and weapons currently in service.

For the individual weapon these are the U.S. 5.56mm M16A1 with M193/M196 ball and tracer cartridges, and the German 7.62mm G3 which fires standard NATO ball/tracer cartridges. For the light support weapon, the baseline is the Belgian FN MAG, also firing the 7.62mm NATO standard ball and tracer cartridges.

Among the ammunition contenders, UK and Germany have submitted experimental calibers. In fact, the FRG 4.75mm caseless ammunition was the only test cartridge reflecting a departure from conventionally employed ammunition technology.

The UK 4.85mm ball bullet weighs approximately the same as the standard M193 bullet, and has a conventional lead core with a gilding metal clad steel jacket. With the exception of the neck and shoulder area, the cartridge case is identical to the M193 case. It is a common cartridge for both the XL64-E4 individual weapon and the XL65-E4 light support weapon.

The weapons are bull pup designs with primary optical sights. The barrels are rifled at one turn in five inches of travel for bullet stability.

The 4.75mm caseless cartridge continues to be evaluated in the technical trials. However, it was withdrawn from the troop trials at the request of the German Government to permit continued development of the ammunition and weapon.

Remaining cartridge contenders are quite similar in overall envelope, caliber size, and cartridge case. The principal difference is bullet design. The Belgian 5.56mm ball cartridge uses the SS109 gilding metal jacketed bullet which weighs 62 grains and includes a steel penetrator in the core of the ogive for increased range of penetration.

This cartridge, with matching tracer, is common to the FNC individual weapon and the MINIMI light support weapon nominated by Belgium for these tests. The weapons employ standard iron sights and require a 1/7-inch rifle twist for bullet stability. It's no secret that the cartridge was developed against known U.S. requirements.

The U.S. 5.56mm XM777 ball cartridge also employs a gilding metal jacketed bullet with a small steel penetrator in the tip of the ogive. This results in improved penetration over the standard M193 bullet. Its design was constrained because it had to remain fully compatible with the M16A1 rifle while satisfying the U.S. requirements.

This bullet weighs 53.5 grains and is stable in the standard 1/12-inch rifle twist. The companion XM778 tracer provides improved daylight trace visibility and ballistic match to the ball cartridge as compared to the M193/M196 cartridges.

Of the two contenders shown for the French, the steel cased 5.56mm cartridge fired in the FAMAS Individual Rifle is the primary cartridge being evaluated. This bullet has a stannic steel jacket, weighs approximately 55 grains and also requires a 1/12-inch rifle twist for stabilization.

The weapon is also of the bull pup variety and, like most other contenders, uses iron sights for target acquisition. Based on U.S. experience with 5.56mm bullets, one could anticipate reduced barrel life with this system in comparison with systems using plain gilding metal jacketed bullets.

Ammunition/Weapons Submitted to NATO Field and Engineering Tests

Control		*Ammunition*	*Weapons Individual*	*Weapons LSW*	*Twist*
US	**5.56mm**	**M193/M196**	**M16A1**		**1/12**
GE	**7.62mm**	**Ball/Tracer**	**G3**		**1/12**
BE	**7.62mm**	**Ball/Tracer**		**MAG**	**1/12**
Candidates					
BE	**5.56mm**	**SS109 Ball/Tracer**	**FNC**		**1/7**
BE	**5.56mm**	**SS109 Ball/Tracer**		**MINIMI**	**1/7**
FR	**5.56mm (Steelcase)**	**Ball/Tracer**	**FAMAS**		**1/12**
GE	**4.75mm (Caseless)**	**Ball/Tracer**	**G11**		**1/12**
GE	**7.62mm**	**Ball/Tracer**		**MG3E**	**1/12**
UK	**4.85mm**	**Ball/Tracer**	**XL64**		**1/5**
UK	**4.85mm**	**Ball/Tracer**		**XL65**	**1/5**
Netherlands	**5.56mm**	**M193/M196**	**MN1**		**1/12**
US	**5.56mm**	**XM777/XM778**	**M16A1**		**1/12**

The Netherlands have not submitted a cartridge contender. However, they have entered the MN1 individual weapon with a conventional iron sight, firing the standard U.S. M193/M196 ball and tracer cartridges with a 1/12-inch rifle twist. Surely the most interesting point of this contender is the striking resemblance to the Israeli Galil.

Considering the cartridge contenders that have been entered, and acknowledging the inherent problems associated with evaluating experimental cartridge and weapon developments, one immediately recognizes a trend towards a smaller caliber than 7.62mm for future infantry weapons. This test program clearly shows the interest several nations have in 5.56mm caliber.

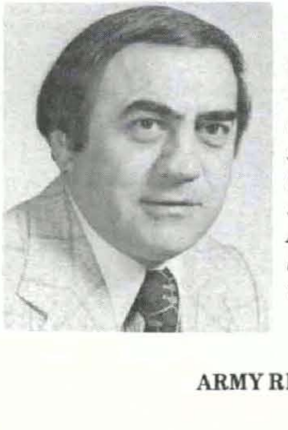
But the selection of a cartridge with its inherent bullet design, I anticipate, will present a real challenge. First, there is the consideration for the cartridge to meet NATO performance requirements for the useful ranges of individual weapons and light support weapons. The evaluation and weighting given to data obtained at these ranges will be critical to cartridge selection.

Second, the problem of satisfying national requirements will necessitate that data beyond the essential ranges be fully considered in the decision process.

Third, the possibility of selecting a cartridge to meet both individual weapon and light support weapon requirements of NATO, could adversely affect a country whose national requirements were to replace only the individual rifle.

Finally, because of the complexities associated with the 11 member nation decision making process for selection of the second caliber cartridge, it appears that the mid-January 1980 milestone might be more realistically postponed to the end of May 1980.

Ending on a positive note, it can be said that the NATO Field Trials for post 1980 small arms, involving 11 member nations, offer a magnificent study on the many lessons learned as a first major cooperative effort in RSI.

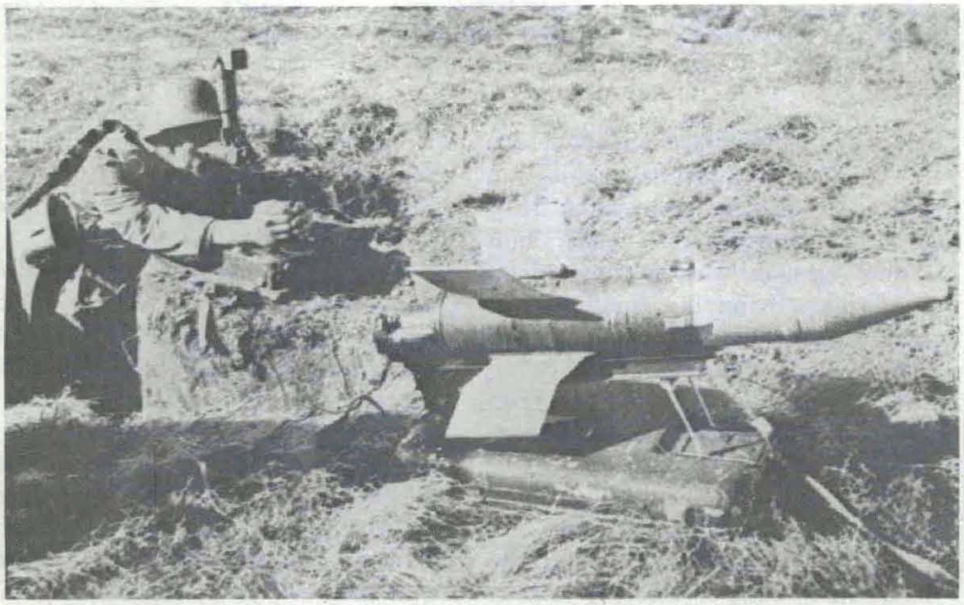


ANGELO N. MANCINI JR. is chief of the Light Weapons Team, Systems Division, Fire Control and Small Caliber Weapon Systems Laboratory, U.S. Army Armament R&D Command. From 1958-77, he conducted ammunition research and development on several advanced weapons systems while employed at Frankford Arsenal. He has also served since 1976 as a project officer for the NATO Small Arms Program. His academic credentials include a bachelor's degree in mechanical engineering from Villanova University.

Soviet Army In

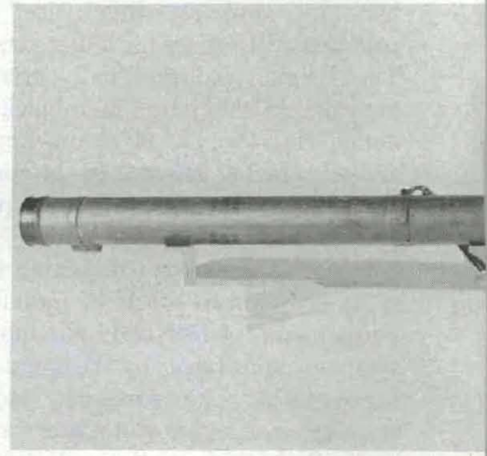
Fourth in a series of photospreads of the U.S review of foreign weapons and tactical vehi magazine pictured 14 foreign Infantry Figh showed some recent advances in foreign tra Square parade were featured in March-April Russian Infantryman's arsenal of weapons.

Makarov 9mm pistol

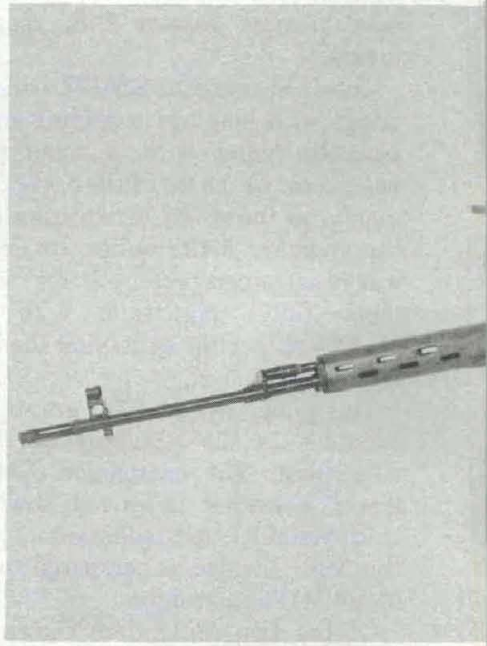


SAGGER, man-controlled, wire-guided antitank missile

SPG–9, 73mm recoilless gun used as battalion antitank weapon



SA–7, shoulder-fired aerial targe



Dragunov 7.62mm Sniper's Ri
semiautomatic weapon fitte

RPG–7 shoulder-fired anti

antry Weapons

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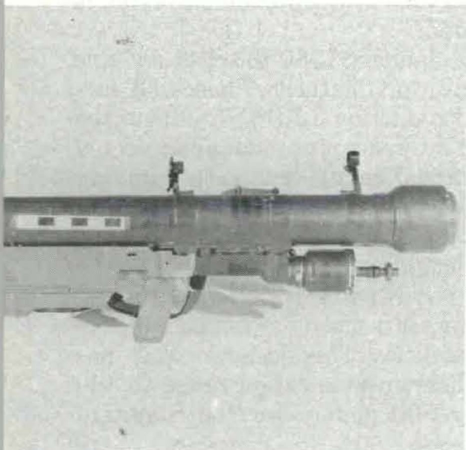
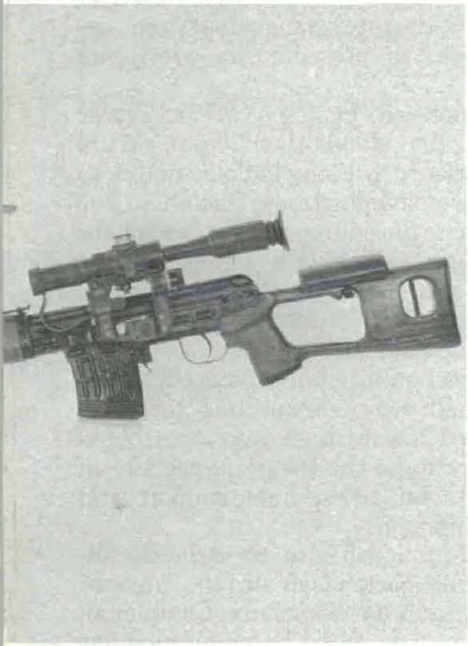
s. The March-April 1979 centerspread of this
Vehicles; the September-October 1978 issue
portation technology; photos of the 1977 Red
'78. Photos on this centerspread represent the

ERRATA. Centerspread, March-April 1979. Foreign Infantry Fighting Vehicles. Identifying legends for photos 7 and 8 were omitted and should read:

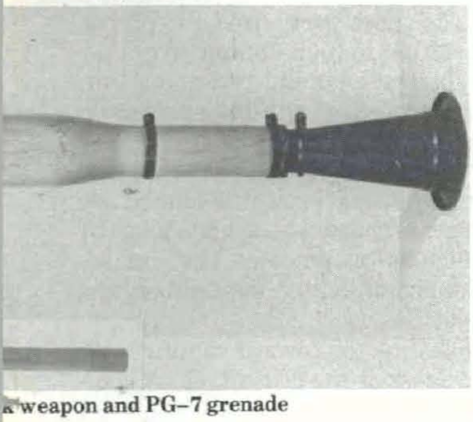
7—Interior of Tornado 2 fighting compartment.
8—French AMX–10P IFV, swimming (1973).



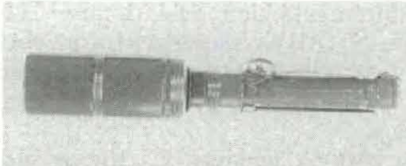
issile, counterpart to U.S. Redeye



a gas-operated, magazine-fed,
vith a PSO–1 telescopic sight

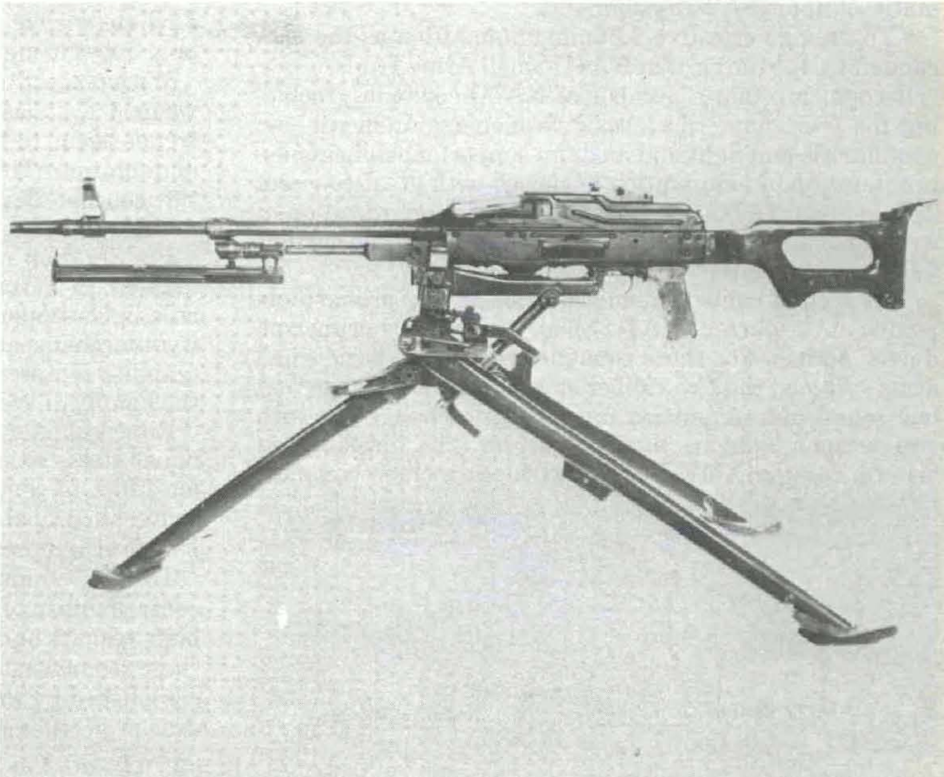


weapon and PG–7 grenade



RKG3 HEAT grenade used against light armored vehicles or tanks

AKM, 7.62 (wooden stock) and AKMS (folding stock) assault rifle



PKM, 7.62 general purpose machinegun can be used in antiaircraft role

Developments and Trends in Small Arms Ammunition

By Robert J. McHugh

An assessment of the current and projected military threat, coupled with U.S. advanced tactics, dictates the need for new and improved small arms weapon systems. The recent User Requirements and Science and Technology Objectives Guide (STOG) characterizes future small arms systems as being extremely portable, versatile and capable of engaging, suppressing and defeating the enemy threat at extended ranges.

These objectives can best be achieved via the development of small arms ammunition incorporating the following physical and performance characteristics: Reduced weight, volume and cost; Low and/or controlled muzzle impulse; Improved aerodynamics; and Improved hard and soft target effects.

The primary thrust in technology and exploratory development is directed toward advancing the engineering feasibility of saboted, sub-caliber ammunition. The Army's technology base and small arms developments are being integrated with joint Services' requirements in the formulation of the Joint Service Small Arms Program (JSSAP).

Technological advances and exploratory development programs should establish a sound engineering base for more effective mid- to long-range systems. With respect to urgent user needs of today, an aggressive program is underway for rapid insertion of the most recent technologies into existing and/or advanced developed systems.

One key example of ammunition technology insertion is the development of the 5.56mm, XM777 Ball and XM778 Tracer Cartridges (see Figure 1). The thrust of these developments is 2-fold:

• To provide improved 5.56mm ammunition in support of a User's Requirement for a lightweight Squad Automatic Weapon (SAW) System.

• To provide effective 5.56mm ammunition as the U.S. candidates for the current NATO Small Arms Trials.

Recognizing that a number of NATO countries, including the U.S., have three basic weapon requirements—an assault rifle and light and medium support machineguns—proliferation of ammunition is viewed with great concern. This led to a NATO agreement that the standardization of a second caliber of ammunition, in addition to the current 7.62mm, is essential.

This second caliber standardization is the primary objective of the current NATO Small Arms Trials being conducted abroad. For those countries with three basic small arms systems, the two caliber standardization means that one round of ammunition must be interchangeable with two weapon systems. In this respect, the development criteria for the XM777/778 Cartridges include complete interchangeability with the M16A1 Rifle and the proposed SAW System.

Fig. 1. 5.56mm Improved Ammunition

The SAW System is currently in the DT1a/OT1a testing phase with four weapons in contention. Two of the weapon candidates are foreign systems, namely the XM249 and XM262. The third contender, XM248, has been developed by a U.S. commercial firm. The last contender, XM106, is an in-house developed system.

An IPR is scheduled for January 1980 to select a single weapon design to proceed into a Maturity Phase and subsequent Low Rate Initial Production (LRIP). Results of the NATO Trials will have an influence on caliber and selected cartridge for SAW. Additional details and background on the SAW development are contained in a related article on page 4.

The XM777 Ball Cartridge is almost identical to the Standard M193 used in the M16A1 Rifle, with the exception of a steel conical insert in the ogive of the bullet to enhance penetration capabilities. This design change has resulted in an increased helmet penetration range to 850 meters compared to only 500 meters for the Standard M193.

Design studies have indicated that penetration performance could be further enhanced by inclusion of longer steel penetrators. However, the interchangeability requirement in the M16A1 (stability) represented the overriding design constraint.

Design changes incorporated in the XM778 Tracer Cartridge, compared to the standard 5.56mm, M196 Cartridge were those necessary to assure ballistic match to the XM777 and to enhance daylight tracer visibility. The length of the lead slug was reduced to provide for a longer tracer column. This change, coupled with the insertion of improved pyrotechnics, has resulted in extending the daylight visible tracer range to 725 meters compared to only 300-400 meters for the Standard M196.

With respect to the projection for more advanced, future weapon systems, the small arms ammunition technical trends seem to be directed toward high velocity saboted ammunition. This appears to be the thrust, especially in the concept developments for rifles, light support and multi-purpose heavy machineguns.

Proliferation of ammunition will also be seriously addressed in future systems, particularly in the area of rifle/light support machinegun developments. Commonality/interchangeability of weapon parts, based on modular designs, represents a future engineering goal leading to the Family of Weapons Concept.

Rifle systems are, for the most part, fired in combat under stress situations resulting in high aiming errors. In an effort to compensate for these aiming errors and improve hit probabilities, the concept of multiple projectile launch still represents an effective trend.

The key ammunition design parameters for effective controllability of sequential multiple projectile launch are high velocity and low muzzle impulse. The achievement of these somewhat contradictory parameters can be accomplished by the sabot launch of lighter, sub-caliber, low drag projectiles at high velocities.

These concept approaches directed toward significantly increasing combat effectiveness at the critical, short com-

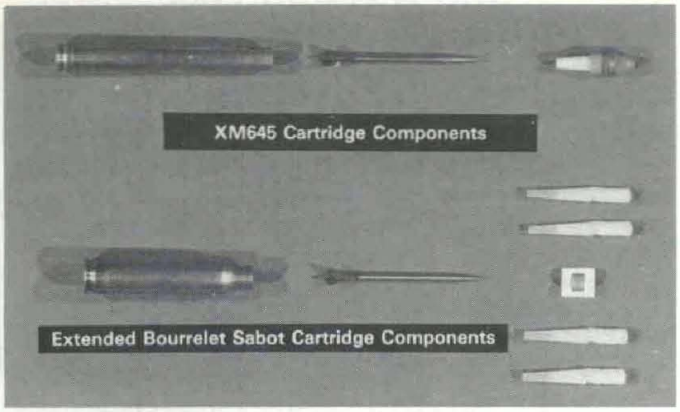


Fig. 2. Flechette Cartridge Development

bat ranges, will be designed without resultant trade-offs at the longer suppressive ranges.

Flechette ammunition is currently being considered as an effective and viable approach for a common round in the rifle/light support machinegun roles. Flechette ammunition offers the key parameters of low impulse and high velocity. Also, inherent in its design are the characteristics of low drag and enhanced terminal effects against both hard and soft targets.

Previous small arms flechette developments were plagued with the problems of sabot ingestion by the firer and excessive projectile dispersions. The earlier design (XM645) and the current ongoing exploratory development approach are shown in Figure 2.

The XM645 Cartridge utilized a one piece fiberglass sabot design which was launched from a smooth bore barrel with a stripper at the muzzle. The stripper, which shredded the sabot into numerous particles, contributed to both the ingestion and accuracy problems. More recent design studies have led to an extended bourrelet, four piece, segmented sabot design.

The flechette/sabot assembly is now fired from slow twist rifled barrels so as to impart spin to the flechette as it goes through resonance. These design changes, culminating from a recent technology base program, have eliminated the key technical barriers.

Also, studies on the advancement of tracer flechette technology have led to an external tracer design exhibiting visibility to 600 meters. It is felt that this performance can be further enhanced within the next few years.

The extensive engineering effort required to develop a flechette system is readily recognized. However, the potential superior effectiveness of the ammunition concept as a common round approach for rifle/light support machinegun roles certainly justifies its pursuit.

Multiple launch of small caliber bullets also represents a viable approach for significant effectiveness increases in the rifle role. A 4.32mm Serial Bulleted Rifle system was assessed in the exploratory development phase. From this system, an extremely lethal 4.32mm bullet was launched at high velocity in the 3-round burst mode. This system demonstrated significant effectiveness increases over the M16A1 between 0-500 meters.

In an effort to capitalize on the merits of high velocity, small caliber bullet effectiveness, concept studies were undertaken that resulted in a Dual Cartridge Approach for combined rifle/light support machinegun roles (Figure 3).

The feasibility of saboting the lethal 4.32mm bullet to 5.56mm was pursued as an approach to eliminating the previous small bore (4.32mm) erosion problem. The current design incorporating a four piece, segmented-interlocking sabot has been effective in accurately launching the 4.32mm lethal bullet from a 5.56mm bore at high velocities.

Transfer of this saboting technology to high velocity bulleted systems provides a concept approach which eliminates the erosion barrier while still offering significant anti-personnel effectiveness improvements over the M16A1 Rifle between 0-500 meters.

With respect to the longer range suppressive and penetrating effectiveness, an optimum, full bore 5.56mm bullet has been designed. This 5.56mm bullet design incorporates an improved drag configuration and would be capable of penetrating a helmet at ranges approaching 1500 meters.

Both the 4.32/5.56mm sabot ammunition and the optimum 5.56mm full bore round are compatible with a one in eight inch twist rifling. This Dual Cartridge offers interchangeability of ammunition in the rifle and light support

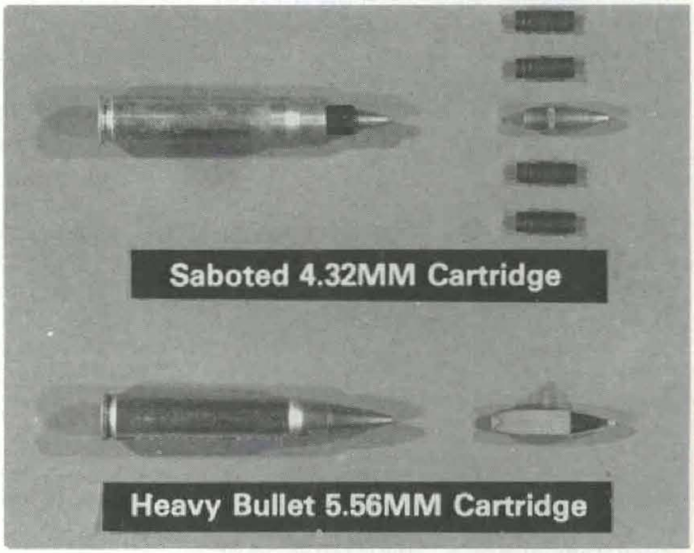


Fig. 3. Dual Cartridge Concept

machinegun and represents another approach for a family of weapons.

In the heavy machinegun area there is a serious need for new and improved weapon systems. Current Cal .50 ammunition was type classified over three decades ago. Product improvement programs have certainly extended the performance service life of these munitions, but current and projected military threat dictates development of more effective ammunition.

For many years now, the M2 and M85 weapons, firing current Cal .50 ammunition, have been the mainstay as primary armament for U.S. lightly armored vehicles such as the M113A1 APC. Recent studies have shown that our class of Cal .50 weapon systems have virtually no effect against current and projected enemy armored vehicles.

There have been some state-of-the-art advances made and evaluated. A number of domestic and foreign cartridges have been assessed, but still lack the performance required to defeat projected targets at the desired extended ranges.

Assessment of these state-of-the-art munitions has certainly defined the trends for future ammunition developments in this area. High velocity, low drag, saboted ammunition typifies this trend. Current concepting studies are being pursued for a dual purpose:

• Determining the feasibility of developing high performance ammunition compatible with the M2 and M85 weapons.

• Providing a data/technology base for defining the optimum caliber for a new Multi-Purpose Armor Machinegun.

One concept, under exploration, is a long rod, dense metal penetrator sabot—launched from a smooth bore at high velocities. Since this penetrator is fin-stabilized, studies will be expanded to assess potential design changes that might enhance the feasibility of effectively launching the projectile in current Cal .50 rifled barrels.

The second concept employs a more conventionally designed heavy metal penetrator which will also be saboted, but spin stabilized. Penetrator design versus twist rate trade-offs will be assessed to again determine the feasibility of ammunition compatibility with the M2 and M85 weapons. Current studies on a similar ammunition concept in the medium caliber area could provide an effective data base for scaling within this effort.

The current 40mm, M203 Grenade Launcher, attached to the M16A1 Rifle, has provided the user with an effective added dimension within the combat environment. The grenade launcher is a single shot, breech-loaded pump action weapon which fires a variety of ammunition.

The M203 provides a means of both suppressing and neutralizing targets that are in dead spaces of grazing fire weapons. Grenadiers can suppress and/or disable enemy armored vehicles until other antitank weapons such as TOW or Dragon can be employed.

More sophisticated battlefield tactics will include scenarios which depend heavily upon the effective employment of grenade systems. Toward this end, the user has indicated an interest in a multi-shot, semi-automatic capability.

Since the weight and bulk of current 40mm grenades severely restricts the design options for a multi-shot launcher, the Army has embarked on the exploratory development of a new 30mm High Explosive Dual Purpose (HEDP) Cartridge. Figure 4 illustrates a side by side comparison of the new 30mm HEDP Cartridge compared to the current 40mm, M433 HEDP.

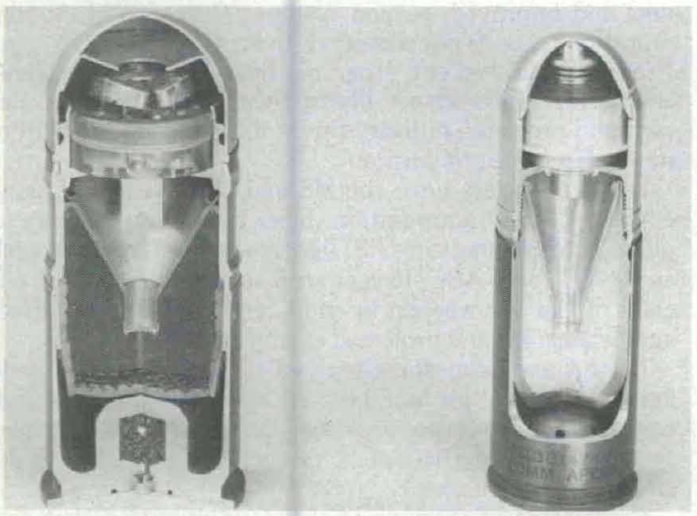


Fig. 4. Left: HEDP, 40mm M433. Right: HEDP, 30mm XM

40MM, M433/30MM, HEDP CARTRIDGE COMPARISON

PERFORMANCE CHARACTERISTICS

	40MM	30MM
MUZZLE VELOCITY (FPS)	247	275
MAXIMUM RANGE (M)	400	515
MUZZLE IMPULSE (#-SEC)	3.0	3.0
ARMOR PENETRATION (IN.)	2.0 MIN	2.0 MIN

PHYSICAL CHARACTERISTICS

	40MM	30MM
CARTRIDGE WEIGHT (GMS)	230	179
CARTRIDGE LENGTH (IN.)	4.02	3.75
CARTRIDGE VOLUME (CU IN.)	5.25	4.00

Figure 5

The dual purpose capability of the 30mm HEDP includes a high explosive antipersonnel fragmentation mechanism plus an armor defeating shaped charge component. Fuzing for the new cartridge is a point initiating, base detonating type which is armed by setback and spin. The escapement mechanism provides safe arming to a range of 50 to 90 feet from the muzzle.

A comparison of the physical and performance characteristics of the 30mm versus 40mm is shown in Figure 5. The thrust of this development, as depicted in the figure, is to provide effectiveness comparable to the 40mm with significant reductions in weight and volume. These are the primary physical characteristics that enhance the feasibility of developing lightweight and portable multi-shot launcher attachments.

Weapon designers are currently capitalizing on this ammo development by prototyping a four shot, semi-automatic launcher using the M16A1 Rifle as a test bed. The conceptual hardware is being explored to establish feasibility and effectiveness of this approach as a candidate for a new future rifle with both a point and area fire capability.

The multi-shot, semi-automatic capability will provide an increased volume of fire and is expected to be especially effective against moving enemy targets. Multi-Shot Grenade Launcher (MSGL) conceptual hardware will be delivered to Fort Benning for "hands-on" evaluation to solicit user input for the next generation design.

In the area of sidearms, the Air Force is currently generating background data for the near term replacement of their current air crew survival and defense weapon—M15, Cal .38 Special Revolver. The ongoing program will evaluate the suitability of several domestic and foreign 9mm semi-automatic handguns.

The Army will continue to monitor the Air Force activities. Results of these assessments will be evaluated by the JSSAP Management Committee to determine whether a Joint Services' requirement for a new handgun is needed.

The relatively high muzzle impulse/recoil of M1911A1, Cal .45 Pistol has long been recognized as the primary contributor to high combat aiming errors resulting in low hit capabilities. Within a limited scope, the Army's ammunition conceptual studies are directed toward compensating for this deficiency via the exploration of lower impulse cartridges and the launch of multiple projectiles.

New concepts to include the launch of "ring projectiles" are being assessed. Parallel to these studies, initial concepting is underway for the generation of ammunition concepts for the submachinegun role.

Up to this point, small arms ammunition developments and trends, supportive of new weapon systems through RDT&E channels, have been summarized. Execution of a comprehensive small arms ammunition program encompasses utilization of numerous other viable channels to include Product Improvement, Military Adaptation of Commercial Items (MACI), and International Materiel Evaluation (IME) Programs. Most significant of these— product improvement—represents cost effect alternatives to new developments.

These programs provide opportunities for the application of technologies that were not available during the R&D phase and precludes premature obsolescence of existing systems. One of the more recent key thrusts in these areas has been directed toward satisfying the user's more urgent needs in providing ammunition for simulated field training.

One of the most recent programs in the training area is the product improvement of Cal .50 blank ammunition for the M2, HB Machinegun. The WWII vintage M1 Blank Cartridge and the Air Force developed Blank Firing Attachment (BFA) for the M3 HB Machinegun was determined unsuitable for application in the more technically advanced training systems, such as the Multiple Integrated Laser Equipment Systems (MILES).

The MILES requirement dictated the need for product improved blank ammunition concurrent with the development of a new BFA. Through this product improvement program, a number of blank deficiencies were corrected. The problem of propellant deterioration was eased by redesigning the cartridge to a rosette-type crimp configuration and the inclusion of new and more effective propellant enhanced the reliability of ballistic performance.

A significant number of improved blank cartridges have been manufactured. These rounds have been tested and proven effective for employment in simulated training systems. Quantities have been delivered to the U.S. Army Test and Evaluation Command for product improvement tests concurrent with DTII Testing of the BFA.

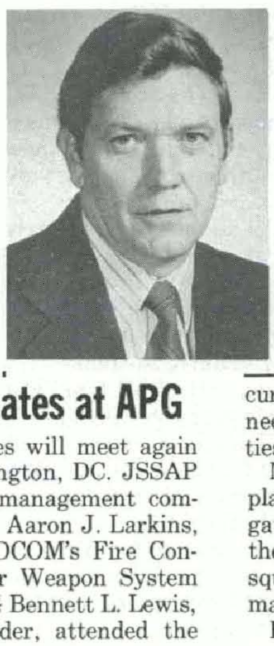
Results of these tests are expected to culminate in effective simulated machinegun firings in more realistic training environments with the M2 series of weapons. In addition to functioning the M2, feasibility studies have demonstrated that the M85 can also be functioned with minor weapon modifications.

The U.S. Army Armor School has identified a need for a Cal .22 Rim-Fire Tracer Cartridge for use in the FM 17-12, Tank Gunnery Training System. In current scaled-range firing exercises, commercial ball cartridges are being used. The ball cartridge does not offer the visual display required for adjustments of fire by the burst-on-target method given a first round miss.

Since no known U.S. sources for commercial Cal .22 Rim-Fire Tracer Ammunition have been identified, it has been proposed, through the IME Program, that foreign candidate ammunition be evaluated for this purpose.

In conclusion, the current thrust of the Army's Small Arms Ammunition Program stresses those developments and technical trends required to provide the user with effective weapon systems and essential training devices to combat the current and projected serious enemy threats.

Special Note: The author would like to express his gratitude to the personnel within the Fire Control and Small Caliber Weapon Systems Laboratory at the U.S. Army Armament R&D Command who supported this article and especially the staff within the Small Caliber Ammunition Development Team.



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Conferees Review Small Arms Weapons Candidates at APG

Approximately 50 representatives from the U.S. Army, Air Force, Navy, Marine Corps, and Coast Guard recently attended a 3-day series of meetings at Aberdeen Proving Ground, MD, as part of the Joint Service Small Arms Program (JSSAP).

During their stay they witnessed demonstrations of Squad Automatic Weapon Systems, being tested by APG's Materiel Testing Directorate (MTD), and candidates in the Air Force 9mm Handgun Program. They also saw demonstrations of the XM231 Firing Port Weapon and the 30mm Multi-Shot Grenade Launcher.

The Ballistic Research Laboratory (BRL), one of four major U.S. Army Armament Research and Development Command laboratories, developed the concept and first models of the Firing Port Weapon and the XM106 rifle, one of four candidates for the SAWS Program.

This was only the third JSSAP meeting since it was officially chartered in December 1978. Delegates will meet again this summer in Washington, DC. JSSAP is administered by a management committee chaired by COL Aaron J. Larkins, commander of ARRADCOM's Fire Control and Small Caliber Weapon System Laboratory. He and MG Bennett L. Lewis, ARRADCOM commander, attended the APG demonstration.

As the senior joint service body for small arms development, the management committee attempts to harmonize joint requirements, consolidate and coordinate development activity, reduce costs, and improve efficiency of acquisition.

JSSAP is a unified effort for development of small arms systems required by all services and for advancement of technology to permit rapid response to present and future small arms requirements.

Its general goals are to foster creativity and innovation among government, industry and private individuals to meet current and projected Armed Forces needs. It aims also at establishing strong ties with the NATO R&D communities.

MTD personnel demonstrated and displayed the SAWS candidates for the delegates. The selected weapon will replace the two M16A1 rifles in the infantry squad and may replace one or more M60 machineguns in selected platoons.

Four SAW candidates are: the XM262 machinegun manufactured by Heckler and Koch of Oberndorf, Germany; the XM248 machinegun manufactured by the Ford Aerospace and Communications Corp.; the XM249 machinegun manufactured by Fabrique Nationale of Herstal, Belgium; and, XM106 developed by BRL.

The SAWS and Air Force handgun candidates as well as the Grenade Launcher and Firing Port Weapon were fired against a target array ranging from 29 to 400 meters on APG's Main Front. A representative from Eglin Air Force Base, FL, demonstrated candidates in the Air Force Handgun Program.

RDTE/Procurement Budget Requests Call for $10 Billion

Approximately $10 billion is called for in the FY 1980 Army RDTE and procurement budget requests submitted recently to the Congress in a joint statement by Assistant Secretary of the Army (Research, Development and Acquisition) Dr. Percy A. Pierre, and Deputy Chief of Staff for Research, Development and Acquisition LTG Donald R. Keith. The total RDTE request is $2.927 billion, and the procurement request is $7123.4 billion. A summary of funds requested for major areas of effort is shown on Table 1.

Fiscal Year 1980, according to the statement, will be a milestone year for the Army. This is because FY 1980 will mark the beginning of the return on investment made by the American people for the past decade in R&D funds.

However, the report states quite candidly that at the present the U.S. Army is—from an equipment standpoint—second rate. It notes, on the other hand, that within a period of three to four years the U.S. can become more competitive with the armies of our potential enemies.

Several factors have accounted for the Army's present distressful situation regarding equipment. Vietnam, for example, diverted substantial resources that would have otherwise been applied to equipment modernization.

The statement also notes that during the same period the Army development process, itself, left much to be desired, and the Soviets began an armaments development program so purposeful and intense as to border on mobilization. Since 1960, the report contends, the Soviets have introduced 60 major systems into their ground forces.

The pace of Soviet equipment modernization, states the report, is such that it would be presumptuous for the U.S. to assume equipment we field in two or three years is vastly superior to future Soviet developments of which we know little or nothing.

Tanks are discussed in the statement as a good example of Soviet progress. The Soviets now have thousands of T-62s which are a good match for our M-60. Joining this force are the new Soviet T-64s and T-72s of which several thousand have already been produced.

The T-64s and T-72s, notes the budget statement, are clearly superior to the M-60. The Soviets are also continuing development, at an accelerated rate, on the new T-80 tank. In order to at least be competitive with these developments, the budget request calls for $31.6 million to conduct DT/OT III and complete remaining development tasks on the XM1 main battle tank.

FY 1979 was the first year of production of the XM1 tank. The target delivery date for the first vehicle is February 1980. In FY 1980, the statement requests $576.9 million for procurement of 352 XM1s and $890.9 million in FY 1981 for procurement of 591 XM1s. The statement stresses that the prime offensive instrument of the U.S. Army in the 1980s will be the XM1.

Overall, the FY 1980 request of $1,888.9 million for Weapons and Tracked Combat Vehicles represents a $377.8 million increase over FY 1979. The Tracked Combat Vehicle portion of the request, $1,692.5 million, is intended to improve combat effectiveness and readiness of armored and mechanized forces, and includes tanks, infantry vehicles, the carrier family of vehicles, and self-propelled howitzers.

Air defense is described in the FY 1980 statement as another area of concern. The Soviets and the Warsaw Pact have over 3,000 combat aircraft in the Central Europe area. Many of these aircraft, such as some versions of the MIG-23, are designed specifically for ground attack.

Of all the air defense systems in the Army's inventory, only the Improved Hawk is a first-rate, all-weather system with some electronic countermeasures resistance. Relative to procurement, the statement requests $1250.5 million for missiles in FY 1980, an increase of $485.8 million over the FY 1979 program. Specifically, the program continues procurement of Chaparral, Improved Hawk, U.S. Roland, Patriot, and Stinger air defense systems.

There is overwhelming evidence that the Soviet Union, with the largest lethal chemical warfighting capability in the world, will routinely employ it against our forces if it is to their advantage, according to the budget statement. For this reason, the Congress is asked to support a request for $53.1 million CB RDTE.

These funds will be used to continue work on the Remote Sensing Chemical Agent Alarm, the new XM29 mask, and type classify XM9 detector paper. Efforts will also proceed on decontamination materials and equipment, and collective protection for armored vehicles.

Another area in which the budget statement says the U.S. has been preempted is in a combat field it pioneered: heliborne fire power. The Soviet HIND-D assault helicopter can deliver considerably more ordnance than the U.S. Cobra TOW, and is a more sophisticated aircraft in several other aspects.

The FY 1980 requests for Aircraft Procurement totals $946.4 million and is distributed over four activities: Aircraft ($355.8 million), Modification of Aircraft ($442.2 million), spares and repair parts ($71.5 million), and support equipment and facilities ($76.9 million).

Using 1965 as a departure point, the statement notes that the Soviets have produced the following items which have put them in a superior position relative to equipment (some items previously mentioned have been deleted).

- The ZSU-23-4 air defense gun. The statement terms this the best in the world when fielded, certainly one of the best now.
- Surface-to-air missiles: the SA-7 shoulder-fired, SA-6 and SA-8 radar guided, SA-9 infrared, and a follow-on SAM. Since 1954 they have deployed nine SAM systems.
- Artillery systems. Two beautifully designed self-propelled howitzers have appeared within the last five years.
- Two generations of antitank guided missiles.
- The BMP, the finest infantry fighting vehicle in the world. Several variants have already appeared.
- Several nuclear capable surface-to-surface missile systems and a new free-flight tactical rocket system.
- A wide variety of ordnance items, bridging equipment, electronic warfare devices, engineer vehicles, small arms, radars, and transport vehicles.

The budget statement stresses that the Soviets unquestionably have the best equipped Army in the world. One reason for this is an apparent willingness on their part to spend whatever is necessary to achieve superiority.

Soviet society, states the report, is profoundly militaristic and regimented. As much as 13 percent of their gross national product is diverted to military expenditures. That compares to roughly seven percent of our own.

During the past 10 years, the Soviets have increased their defense expenditures at the rate of about three percent per year, and since 1973, they have spent a full 50 percent more on general purpose forces than has the U.S.

Equally important, according to the statement, is where the Soviets place their priorities in spending. They spend more than twice what the U.S. does in procurement of weapons and equipment, more than twice what we spend on R&D, but only half what we spend on personnel, and less than a third on operations and maintenance.

Finally, the report notes that the Soviets have twice as many men under arms as the U.S. does, and yet they pay them only half. A Soviet recruit, for instance, gets only about $3-$5 a month in salary. Concludes the report: "Savings thus squeezed from the hides of the Soviet conscripts are poured into investments in firepower, mobility, and more force structure."

TABLE 1

FY 80 Planned Program: Selected RDTE Systems

System	Budget Request ($ in Millions)	Capsule Summary of Work to be Performed
XM1 Tank	31.6	Conduct DT/OT III; complete remaining development tasks.
Tank Gun Development	51.9	Validate testing of 120mm gun and ammo family. Test two 120mm gun equipped XM1s.
Infantry Fighting Vehicle/Cavalry Fighting Vehicle	33.3	Completion of testing and PEP effort. Develop trainers and simulators, nuclear hardening and integration of ventilated face mask. Production decision.
High Mobility Weapons Carrier	2.5	Procure six vehicles each from two contractors for competitive testing.
Armored Combat Vehicle Technology Program	14.4	Complete testing on HIMAG and HSTV-L. Begin in depth test data analysis.
Forward Observer Vehicle	6.0	Initiate full scale ED to include prototype hardware for testing.
COPPERHEAD	7.1	Complete development testing (DT II) of over 200 projectiles.
Advanced Attack Helicopter	176.2	Flight test of five YAH-64s. Flight evaluation of competing TADS/PNVS systems.
HELLFIRE	58.0	Flight testing of 36 missiles; OT testing.
Advanced Scout Helicopter	12.5	ED contracts awarded based on FY 79 analyses.
AH-1S COBRA/TOW	1.0	Complete all developmental and operational testing.
CH-47 Modernization	23.1	DT/OT II begins with 400 hours by two aircraft.
Flight Simulators	2.4	UH-60 simulator will complete testing and be type classified.
Aircraft Electronic Warfare Self-Protection Equipment	9.9	Continue development of radar jammer, missile detector; begin DT/OT test of laser warning receiver and CW radar jammer. Begin AD on optical warning/location system.
Basic Airdrop Technology Advanced Development of Airdrop Equipment/Techniques Airdrop Equipment Development	3.5	Continue efforts in a variety of cargo and personnel drop techniques and equipment.
CHAPARRAL	6.1	Begin development work on night firing capability.
DIVAD GUN	25.7	Complete ED effort in preparation for competitive test.
General Support Rocket System	72.3	Complete validation phase. Fire 100 rockets and award contracts for design maturation and LRIP.
High Energy Laser Components	19.0	Continue technology work.
Improved HAWK	10.1	Continue to develop anti-ARM and anti-ECM PIPs. Improve reliability, availability and maintainability.
PERSHING II	144.8	Missile and GSE design will continue. Fabricate ED models of RV equipment. Static fire developmental engine. Initiate joint DOD/DOE ED on warheads.
US ROLAND	11.3	Complete testing; begin trainer development; complete design and list of major ECCM improvement.
TOW	26.2	Work on improved warhead and guidance for potential retrofit to existing TOWs.
Battalion Mortar System	3.0	Tech data package prepared; PEP begins to evaluate requirements for U.S. production. ED work on HE, illuminating and training ammo.
Squad Automatic Weapon	.5	Complete DT/OT I and evaluate test data to support IPR.
CB Defense	53.1	Continue work on Remote Sensing Chemical Agent Alarm, new XM 29 mask, and type classify XM 9 detector paper. Continue efforts on decon materials and equipment, and collective protection for armored vehicles.
Terminally Guided Warhead (for GSRS)	3.0	Initiate a concept definition.
Nuclear Munitions	25.9	ED of fuze and rocket motor for 155 projectile. Complete DT/OT II for Improved 8-inch projectile. Work on Emergency Disablement System.
Firefinder Radars	4.3	Complete DT/OT tests and items needed to support system when fielded.
SOTAS	66.5	Continue ED contract.
TRI-TAC	54.8	Continue work on switches, Mobile Subscriber Equipment, and Net Radio Interface System.
White Sands Missile Range	109.8	Support major test programs of Army, Navy and Air Force. Procure instruments for High Energy Laser testing. Perform critical maintenance and repair.
PATRIOT	128.7	Complete ED and PEP; expand production facility, procure five tactical fire units and 155 missiles.

A detailed description of these and all other Army RDTE programs is contained in the Congressional Descriptive Summaries.

Total RDTE FY 80 Budget Request: $2.927 Billion

R&D's Responsibility for Integrated Logistic Support

By Gerald Malakoff

Integrated Logistic Support is a catchy phrase. We refer to it as ILS and it has so much visibility that just about every organization involved with materiel acquisition has that term somewhere in its organization chart.

One common definition of ILS is that "It is a composite of the support considerations necessary to insure the effective and economical support of an item/system during its life cycle." ILS, then, is a cradle to grave concept.

The ILS objective is to enhance operational readiness and logistic support management and to minimize the cost of ownership. But this objective can only be accomplished by placing the emphasis on ILS early in the acquisition process to influence the design and *develop* the logistic support package.

The front end is where these efforts should be going on. It is this same front end where the R&D community is spending its money. The author intends to present the case that the bulk of *ILS performance* can best be accomplished within the Army by the Development Commands.

With implementation of the Army Materiel Acquisition Review Committee (AMARC), the Commodity Commands were divided into separate Development and Readiness Commands. The Readiness Command, whose principal responsibility is support of fielded equipment, absorbed the National Maintenance Point (NMP) and National Inventory Control Point (NICP), the logistical elements of the predecessor commodity command.

During the initial assignment of responsibilities, the planners recognized that effective ILS required emphasis during equipment development. However, they also concluded that ILS, being composed of logistical elements, should be performed by the logistical-oriented Major Subordinate Commands, the Readiness Commands.

Therefore, the original Letter of Instructions (LOIs) implementing the AMARC reorganization, assigned the management of ILS to the Research and Development Commands. The doing of the functional elements became the responsibility of the Readiness Commands.

Prior to the AMARC reorganization, ILS was not very effective. It was mostly a buzz word without organizational strength. With the AMARC implementation, ILS has become significantly more effective, but is still far short of the desired goal. The following are some of the reasons for the shortfall:

• *Misunderstanding of the Purpose of ILS*. ILS is the composite of all support considerations in a system's life cycle. It can also be looked upon as a bridge between the development of hardware and its support in the field.

The large bulk of ILS is performed during the acquisition phase. Emphasis is on logistic influence of design and "development" of the support package. Both are integral to the design and development of the hardware with traditional logistics elements such as final tech manuals and provisioning being only the tail end of the ILS effort.

Put another way, the bulk of ILS is an R&D effort, most of which is performed by the R&D contractor. Thus, the principle role of the DARCOM ILS team is to perform Logistic Support Analysis (LSA) and support design during the entire acquisition cycle, assure adequate contract definition, and review, coordinate, verify, validate and test.

These are really the government's "doing" of ILS and are so tied into the hardware development, that it is only logical for the Development Command to have the responsibility through the development and operational testing phase.

• *Management Responsibility is Separate From Functional Responsibility.* The doing of ILS as implied by various loosely worded guidance and regulations is predominately the responsibility of the Readiness Command, with the developer providing the management. The practical result is management without corresponding authority, an unfeasible approach to good management.

The situation is made worse because the division of responsibility is assigned to organizations with different sets of priorities. The developer's priority is concerned with the system in development and initial fielding.

The Readiness Command, however, is oriented to support of fielded equipment. A Readiness Command with a workforce of thousands almost totally devoted to the field support mission finds the weight of that role as a natural barrier to practical acceptance of an R&D support role.

• *Mission and Functions.* Prior to AMARC, the predeccessor commodity command had its logistic workforce in the NICP and NMP. These field-oriented activities did a poor job of supporting the R&D effort, just as the R&D elements did a poor job in designing in the support.

The AMARC implementers viewed ILS as logistic functions and naturally should be performed by a logistic activity. Since the AMARC reorganization placed the logistic elements in the Readiness Command, the doing function of ILS was assigned there.

Unfortunately, the originally poor R&D support effort is compounded because not only is the new organization still field oriented, but now reports to a separate command and, subsequently, has different priorities.

The AMARC reorganization was really a missed opportunity. It provided the chance to establish a logistic element at the Development Command that would be free from the overwhelming weight of the fielded support mission of the Readiness Command.

Such an R&D oriented logistics activity working in a development (and consequently innovative) environment, not only would assure necessary inputs from the Readiness Command as well as all the other relevant activities, but more importantly, combine both responsibilty and authority for performance of ILS under one management.

• *Too Small an ILS Staff at the Development Command.* The Development Command LOI specifies that a small organic ILS management staff will discharge their ILS responsibilities for overall planning and schedules. The word "small" resulted in exactly that: a small ILS office. Its insufficiency is a result of two factors:

The first is misunderstanding the extent of ILS management by a Development Command. The support requirements portion of a development program is invariably understated. The nine traditional functions of ILS not only consume a high proportion of R&D dollars but are labor intensive.

Development of the software package requires as much change as the hardware itself. Managing a dynamic, intensive, multifaceted conglomerate of logistic product "developments" requires more than a small staff to perform the functions of coordinating, analysis, contract definition, review, verification, validation, etc.

Second, there is inadequate external support. For all the previous reasons, external support is inadequate. If the developer wants to see that ILS is performed properly, he must do it himself. The project engineer has ultimate responsibility, but his primary concern is overcoming technical problems. From a practical point he is dependent on the ILS staff for the actual performance of ILS. This workload by the developer remains until testing is completed.

The ILS function requires more logistic manpower than currently assigned to Development Commands. A relatively small increase in the ILS TDA of the Development Command would easily handle that mission.

A transfer of a small number of positions from the Readiness to the Development side of the house would hardly be felt by the Readiness Command because it would be minuscule compared to a typical workforce of thousands in a Readiness Command with its fielded systems support mission.

In essence, ILS should be looked upon not solely as logistics, but as a function in itself as much related to design and development as it is to logistics. This function is performed throughout the life cycle but the emphasis is at the front end.

The author suggests that Army policy be changed and regulations revised accordingly to delegate greater authority for ILS performance to the Development Commands. Appropriate resources should be reassigned to insure policy implementation.

Development Commands in general would not require a large infusion, MERADCOM, for example, with an ILS TDA of 13, could probably perform the necessary ILS effectively with a staff of 30. The author further proposes the following Development Command LOI to delineate the expanded ILS function:

PROPOSED DEVELOPMENT COMMAND LETTER OF INSTRUCTION (ILS PORTION).

ILS Emphasis. ILS is a composite of all the support considerations necessary to insure the effective and economical support of an item/system during its life cycle. The objective is to enhance operational readiness and logistics support management and to minimize the cost of ownership.

This objective can only be accomplished by placing the emphasis on ILS early in the acquisition process by: Influencing the design and acquisition of materiel systems to insure that these systems are reliable and maintainable; and by the timely planning, development, acquisition, testing, and deployment of required logistic resources as an integral part of the materiel acquisition process.

Principle elements of ILS are related to the overall system life cycle include maintenance plan, support and test equipment, supply support, transportation and handling, technical data, facilities, personnel and training, logistic support resource funds, and logistic support management information.

Most benefits from ILS realized through influencing the design and "developing" the support package. Both of these efforts are front end efforts and are integral to the hardware development/acquisition.

ILS can also be looked upon as a bridge between the development of the hardware and its support after fielding. Consequently, the Development Command and Materiel Readiness Command perform vital roles in ILS.

The development of the logistic support package cannot be performed separately from the development of the hardware. Furthermore, influencing the design vis-a-vis logistic considerations can best be performed by an R&D element with logistical expertise. Consequently, the Development Command will have an organic ILS staff, large enough to meet these two objectives.

Development Command Responsibilities. The Development Command will perform the following:

- Overall managing, planning and scheduling of ILS to insure that all ILS events are integrated into item/system development. Effective management is not possible without commensurate authority. To insure that corrective actions are taken on individual programs, the developer as the ILS Manager is authorized to abrogate traditional assignment of tasks when necessary, to accomplish the ILS objective.
- Preparation and review of logistic input to requirements documents, contract packages, planning and scheduling documents.
- Logistic Support Analysis (LSA), develop the Logistic Support Analysis Record (LSAR), identify logistic issues for testing, and prepare the test support package.
- Monitor contractor performance; verify, validate and accept deliverable logistic products; assure proper interface with Readiness Commands and other appropriate activities in "development" of data for the support package.

Readiness Command Responsibilities. The Materiel Readiness Command will perform the following:

- Insure that the ILS concept is compatible with the logistics structure of the Army. This requires continuous coordination with the Development Command on an individual ILS event basis providing input/comments on data calls; requirement, planning and scheduling documents; and review of development support products through participation in contract postaward conferences; and assessment of contractor performance and products through in-process reviews, validation and acceptance reviews, and LSA/LSAR reviews and the conducting of Physical Teardown and Evaluation Reviews.
- Concurrent with first time buy, utilize the logistic data provided by the Development Command as part of the hardware development to perform provisioning, prepare the final logistics support products and assure that their availability is concurrent with the availability of the hardware.
- Designate an ILS manager for each project/product managed system and grouping of nonproject/product managed developmental materiel to coordinate ILS events within the Materiel Readiness Command and to serve as the focal point for assigned item/system ILS matters. Special interface relationships will be established between the Developer and the Materiel Readiness Command as part of the transition planning and tracking process. In this relationship the Materiel Readiness Command has primary interest in how ILS planning/scheduling documentation, development of logistic data, and task execution is progressing from engineering development to the point of transition.

Additional ILS Responsibilities. The additional responsibilities will be performed as follows:

- *New Equipment Training (NET).* The Development Command is responsible for NET planning, scheduling, and conduct of the NET program until the decision is made for the first production buy. A critical interface must be maintained between the Development Command and the Materiel Readiness Command to be sure that the Materiel Readiness Command technicians and field representatives are thoroughly familiar with the item, and to effect the accomplishment of an effective NET Program.
- *Provisioning.* The Development Command is responsible for managing, planning and scheduling of initial provisioning and procurring the initial provisioning data through LSAR. The Materiel Readiness Command is responsible for carrying out the functions of the Initial Materiel Support Office (IMSO). The IMSO, utilizing the LSAR, will execute all initial provisioning actions for items/systems, and implement the DA Provisioning Manual (TM 38-715-1) for all initial provisioning processes.

The Development Command and the Materiel Readiness Command will maintain a continuous provisioning interface to insure that all items (end, integrated, and support) essential to a gaining command's mission are available on a timely, scheduled, and uniform basis.

- *Publications.* The Development Command is responsible for planning and scheduling technical manuals and publications to include repair parts lists, maintenance allocation charts, instructional manuals, lubrication orders, operational manuals, etc. The developer will prepare draft technical manuals and, publications through testing. Materiel Readiness Command, utilizing the post-testing draft equipment publications, will be responsible for preparation, acquiring, and maintaining current equipment operational and technical publications throughout the remainder of the life cycle. The Development Command and the Materiel Readiness Command will maintain a continuous publications interface during the materiel acquisition phase to insure that equipment publications are developed, published, and distributed for each item introduced into the operational inventory.

• *Maintainability Engineering.* The development Command is responsible for maintainability engineering to insure design, test and production of equipment that is operable and maintainable by individuals possessing common skills, aptitudes and educational levels.

• *Logistics Support Analysis (LSA), and Logistic Support Analysis Record (LSAR).* Logistic Support Analysis is a generic term describing the entire analytic logistic effort conducted within the system engineering framework. It is an integral part of the design and development process and like the hardware development, is subject to frequent review and revisions.

The LSAR, as the file for the logistic support information derived from the LSA, is subject to continuing change as the LSA is performed and also provides the data for use by the developer to perform testing, etc. Consequently, the developer must perform the LSA and maintain the LSAR with support from the appropriate Readiness Command and other activities. These responsibilities will be performed as follows:

• The Development Command will have a capability sufficient to perform LSA, to include logistic modeling, and maintain and utilize the LSAR. This will assure appropriate analysis of logistics for use in designing the hardware and developing a logistic support capability responsive to operational requirement of the system or equipment.

• The Materiel Readiness Command will be responsible for Maintenance Engineering function on fielded equipment. He will maintain a continuous interface in all phases of the acquisition process for new weapons and equipment, inputting experience data for inclusion in the LSA.

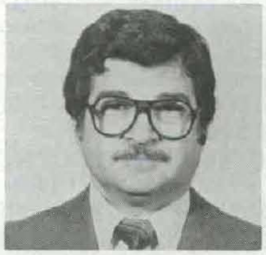
• *Test, Measurement and Diagnostic Equipment (TMDE).*

• The Development Command is responsible for managing the RDTE portion of the TMDE Program and for planning and scheduling TMDE requirements.

• The Materiel Readiness Command is responsible for TMDE Program coordination, centralized management effort, and program execution to include registration of TMDE and updating the DA TMDE Preferred Item List (PIL).

• The Development Command and Materiel Readiness Command will maintain a continuous TMDE interface to insure the availability of TMDE to provide the capability of performing timely and accurate equipment malfunction identification, isolation, diagnosis, and failure prediction; and reduce the Army's TMDE inventory by eliminating unnecessary proliferation and duplication.

GERALD MALAKOFF is chief of the Integrated Logistics Support Division, Integrated Logistics Support and Engineering Directorate, U.S. Army Mobility Equipment R&D Command, Fort Belvoir, VA. He holds a BS degree in electrical engineering from the University of Arizona and is a member of the Society of Logistic Engineers.



ARRADCOM Approves Field Use of M549A1 Projectile, M198 Howitzer

The rocket-assisted projectile, M549A1, for use in the M114A2, M198, and M109 155mm howitzers, will soon begin reaching artillery units in the field. MG Bennett L. Lewis, commander U.S. Army Armament R&D Command (USARRADCOM) has approved release of the projectiles for issue.

The new "RAP" will provide the 155mm howitzer with a significantly increased range capability as well as improved fragmentation qualities.

The projectile has two distinctive preassembled components: the high explosive warhead made of new high fragmentation steel, and the rocket motor. The motor is made from high strength steel alloy and employs a solid propellant. A pyrotechnic delay assembly in the rocket nozzle provides ignition for the motor.

A new lifting plug has been fitted also, to protect the warhead nose in rough handling.

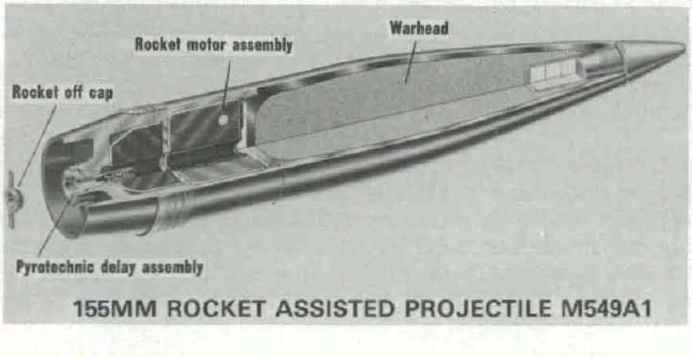
Additionally, another major milestone in artillery development has been reached with release by ARRADCOM of the new M198 155mm towed howitzer and accompanying M203 propelling charge to soldiers in the field.

The howitzer system, the first major system to be released by ARRADCOM since its establishment two years ago, is the Army's first new towed 155mm howitzer since World War II.

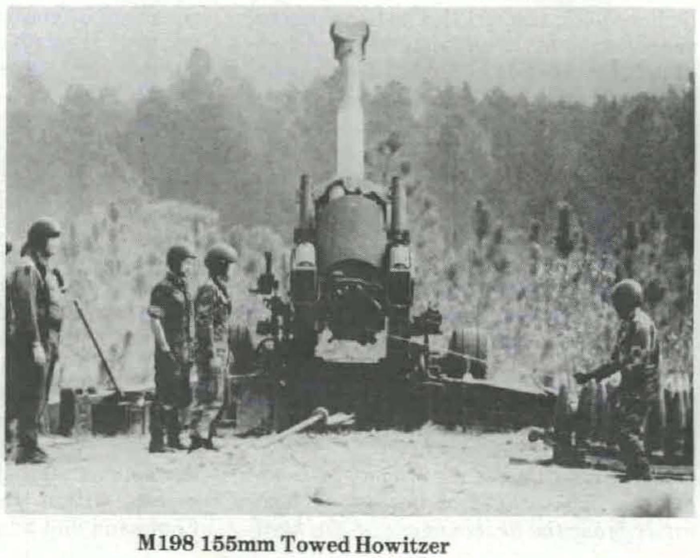
In addition to firing all stockpiled ammunition items, the weapon is specifically designed to use new ammunition being developed by the United States and its NATO allies. It will give the U.S. artillery improved range, reliability, maintainability, and lethality. The system's development and production have been managed throughout by the Army's Project Manager's Office for Cannon Artillery Weapons System (CAWS).

The first production models, manufactured by Rock Island and Watervliet Arsenals, were delivered last July. Participating in production of fire control is Numax Electronics, Inc., of Hauppauge, Long Island. Remaining carriages for the M198 will be manufactured by Consolidated Diesel Electronic Co. of Old Greenwich, CT.

The initial production howitzers were tested at Aberdeen Proving Ground, MD, and operational testing was completed in February at Fort Bragg, NC. The howitzers will be produced through 1984.



155MM ROCKET ASSISTED PROJECTILE M549A1



M198 155mm Towed Howitzer

DARCOM Active in U.S./German Staff Talks

A significant Army avenue for progress in achieving the goals of RSI is that of the U.S./GE Army Staff Talks. These formal talks are held twice yearly between high-level U.S. and German Army officials, on a rotational basis between countries.

The origin of the formal program was a suggestion in 1974 by the German Army Vice Chief of Staff to GEN Frederick C. Weyand, then U.S. Army Chief of Staff, that regular bilateral discussions be held as a means to better configure U.S. and German Armies for maximum cooperative combat power.

The suggestion was adopted, and the commanding general, TRADOC, was designated the responsible U.S. Army official, and the Vice Chief of Staff of the German Army appointed their representative.

It was agreed that initial discussions should cover the areas of antitank guided missiles, battlefield smoke, battlefield reconnaissance, and battlefield identification friend-or-foe.

The first talks were held in Bonn in October 1975, at which time the basic operational field manuals of each Army were compared for similarities and differences prior to moving to full cooperation on equipment. Further, agreement was reached to prepare joint concept papers on tactical areas.

Among the 11 tactical areas selected were those of the threat, antiarmor, airmobile operations, night operations, air defense, and fire support.

Since then talks have been held twice yearly, the latest having been at Fort Sill, OK, in February 1979. The seventh meeting is planned for September 1979 in Munich.

Since the 1975 meeting, 19 topics have been identified in joint concept papers, nine of which have been ratified by the respective armies and signed by the Chiefs of Staff. In the words of the DARCOM Office of International R&D, "This phase of cooperation is well established . . . . Emphasis is now shifting to other phases of cooperation . . . ."

To assist and prepare for Staff Talks, a joint Steering Committee has been created. Here, national representatives review proposed concept papers and prepare the formal agendas for the Staff Talks. At the conclusion of the talks, heads of the delegations determine, by consensus, what has been accomplished, and compile and distribute minutes along with an outline of future tasks.

High-level DARCOM participation in this activity is provided by membership in both the Steering Committee and the Staff Talks official delegation of LTG Robert J. Baer, Mr. Bryant Dunetz, and MG Stan Sheridan. Staff support from DARCOM is provided by the Bilateral Army Staff Talks Division of the Office of International R&D.

Close cooperation with TRADOC is assured by direct coordination between DARCOM and TRADOC's International Army Staff Talks Office.

Four phases of cooperation have been specified as part of these Staff Talks. These are: harmonized concepts, definition of requirements, evaluation, and cooperative fulfillment of requirements. The joint tactical concept papers previously mentioned are representative of the work being done under the first of these.

Under definition of requirements, the Military Equipment Characteristics Document (MECD) has been adopted to serve as a requirements document. It is designed to insure a joint position on the requirement for a system, to insure agreement on nature and characteristics of a system, to promote interoperability and standardization, and to harmonize operational and organizational concepts.

The document can also be used to assist in the formalizing of Memoranda of Understanding and Data Exchange Agreements.

The third phase—evaluation, has the goal of developing joint scenarios and models to develop a common ground for evaluation of operational concepts, organizations, and materiel.

The fourth phase is product-oriented, with gains being sought in standardization and interoperability. Joint identification of candidates is the first step in this phase, and they may be in the categories of materiel, training, or logistics.

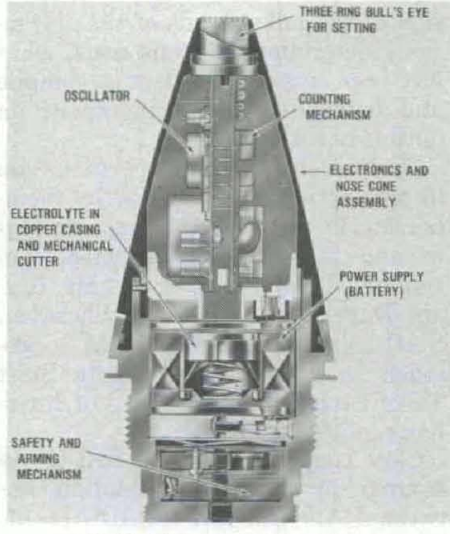
Each of these categories is further subdivided into those where cooperation is already underway, those where good possibility exists, and those where more information is needed. Examples here are night vision under the first, MANPADS (Stinger) under the second, and Copperhead for the third.

Mr. Dunetz noted recently that perhaps equally important to progress in this arena, was the attention now being given to non-major items.

While individually many items may have a relatively low individual cost, their contribution may be great in terms of the large quantities procured by the respective armies. Therefore, attention to what are called NMIs—non-major items, is coming to the fore as a part of the Staff Talks. Among those now being looked at are chemical defense items.

ARRADCOM's Second Annual Product Assurance Forum drew more than 200 government/industry representatives to discuss technologies related to reliability, maintainability, testing, quality assurance, cost effectiveness and data systems. Participants, shown above, included MG Robert J. Lunn, Assistant Deputy Chief of Staff for RD&A, flanked by (left) Mr. Seymour J. Lorber, DARCOM director of Quality Assurance; (right) Mr. Dale Adams, ARRADCOM director of Product Assurance; and Mr. Edward Causin, Rockwell International director of Product Assurance. Sponsored by American Defense Preparedness Association, the meeting was held 30 April, at Downington, PA.

HDL Continues Electronic Time Fuze Development



M724 Electronic Time Fuze

"A great departure from anything that has been done up to now in the field." These are the words used to describe the new M587/724/36 electronic time fuze that was recently type classified. It was developed at the U.S. Army Electronics R&D Command's Harry Diamond Labs, Adelphi, MD.

Scheduled for delivery to U.S. troops by the early 1980s, the fuze system will reportedly provide greater safety and accuracy in the firing of projectiles at distant targets. It is considered moderately priced and permits a soldier to use either the M587 fuze (high explosive rounds) or the M724 fuze (submunitions and canister rounds). Both fuzes are set by the M36 electronic fuze setter by touching it to the nose of the fuze.

This is the first all-electronic artillery time fuze system accepted into the Army inventory.

To set the fuze, the operator simply indicates the desired time on the setter box dials and inserts the box over the nose end of the fuze for less than a second.

Setting is reportedly not only rapid and exact, but also includes an automatic internal check of the electronics in both the fuze and the setter.

Where mechanical time fuzes count down the time to detonation with a clockwork balance wheel, the time base in the new ET fuze is a very precise electronic oscillator. A counting mechanism keeps track of how many oscillator pulses have occurred.

In addition to the mechanical safety and arming mechanism common to all time fuzes, the electronic portions of the M587/724 are built to avoid hazardous errors.

For example, the firing circuit cannot be powered until 3.4 seconds before target time. This helps insure detonation will not occur while in flight over friendly troops. Also, any interruption in electric current causes the oscillator and counter to restart the countdown. This assures that the fuze will "fail-long" or fire on impact.

Reliability tests show that the fuze is very rugged and at least 98 percent effective, an unusually high performance record. More than 2,000 fuzes were test-fired at Yuma Proving Ground, AZ, and Fort Sill, OK.

The M587/724/36 is compatible with a wide variety of projectiles and cannons. Its rapid setting process permits less time delay between receiving setting instructions and actual firing. It may be set for any time from 0.2 seconds to 199.9 seconds.

One of the most important assets of the new fuze is that it can be manufactured by the U.S. electronics industry, and won't rely on the vanishing clockworks industry for its production base. Finally, the fuze is immune to electronic countermeasures.

Under development for eight years, the ET fuze is the fifth designed by HDL to be type classified in five years. All previous HDL fuzes operate by detecting proximity to target, rather than time elapsed after firing.

It is no wonder that Mr. Norman Doctor, M587/724/36 fuze program director, has termed the new fuze "a great departure from anything that has been done up to now in the field."

Foreign Tech Data Package Successfully Converted

Today's defense community is stressing, wherever possible, the use of RSI—or international cooperative efforts in acquiring new materiel in the interests of economy and increased military efficiency and operability. One aspect of RSI involves the use by the U.S. of foreign technical data packages and vice versa.

In simple terms, a technical data package is all of the necessary information needed for a new manufacturer to set up a production line and produce a final product. The package will contain such things as drawings, specifications, plans, standards, performance requirements, etc.

Based on earlier experience with the European-developed Roland air defense system, U.S. designers learned there were vast differences in the way U.S. and European industry does its engineering and production details. The same held true for the Belgian M.A.G. 58 machinegun purchased by the U.S. and type classified as the M240 machinegun.

The gun was purchased, along with manufacturing data used by the Fabrique Nationale of Belgium, and the problem presented U.S. experts was then of converting and transferring the nearly 15,000 drawings into a more manageable number.

Also involved was translating the information into English and rewriting the data so that it would conform to American engineering drafting convention and qualify the new technical data package for U.S. competitive procurement bids.

Complicating the task was the fact that the drawings were written by many persons in many styles. This necessitated five trips by ARRADCOM personnel to the contractor's plant to learn how they did things.

Fabrique Nationale, although a large corporation, is still operated like a big family business. Many modifications have been made to the process since the gun was first manufactured in 1958, and some of these have been passed on by word-of-mouth. This allows the designers to pass on information on their drawings with general notes like "be very careful here" or "don't make this hole too big."

Therefore, determining the precise meaning of such notes could only be accomplished by talking directly to the Belgian engineers and machinists, and examining the process closely.

After more than a year spent verifying accuracy and suitability of the U.S. translations, which involved command personnel from such diverse elements as systems and weapons engineering, product assurance, design drafting, manufacturing technology, materials engineering and packaging, the job was completed in December.

Now the 7.62mm machinegun is described in just 240 drawings, rather than the 15,000 drawings and associated documents used by the Belgians. After bidding, the contract is expected to be awarded 30 June.

TARADCOM Expands Emphasis on Foreign Materiel

The U.S. Army Tank-Automotive Research and Development Command (TARADCOM), which is responsible for the Army's R&D for wheeled and tracked vehicles, has placed increased emphasis on foreign intelligence in recent years.

Within the TARADCOM organization is the Foreign Intelligence Office (FIO), which provides support both to TARADCOM and the U.S. Army Tank-Automotive Materiel Readiness Command (TARCOM), which share the buildings and equipment at the Warren-based Detroit Arsenal.

One of the primary functions of the FIO is implementation of the Foreign Materiel Exploitation (FME) Program. The FME Program provides engineers in the tank-automotive community with the opportunity to acquire, test and evaluate select foreign materiel which is in direct support to R&D programs.

Within the past few years, the FME Program at TARADCOM has been steadily expanding. One primary factor which led to this expansion has been the increasing need to know and understand capabilities of foreign countries in various tank-automotive technology areas.

Other important factors include the possibility of more equipment being made available for exploitation and evaluation, and perhaps the advent of the Rationalization, Standardization and Interoperability (RSI) and International Materiel Evaluation (IME) programs.

One of the current acquisitions and impressive items being evaluated under the FME Program, according to Mr. Robert Kaczmarek, foreign materiel program manager at TARADCOM, is the Czechoslovakian TATRA-813, 8x8, 8-ton high mobility tactical truck (Figure 1). This vehicle recently completed engineering performance tests at Aberdeen Proving Ground, MD, and was compared extensively with the 10-ton German MAN, 10-ton Lockheed "Dragon Wagon" and the 10-ton PACCAR.

The TATRA vehicle will be shipped to TARADCOM to undergo an extensive nuclear-biological-chemical and signature evauation. An advanced engineering performance test will also be conducted.

The SAAB-SCANIA, 6-ton, 6x6 tactical truck (Figure 2) was recently acquired in support of the 5-ton Product Improvement Program. The SAAB-SCANIA vehicle incorporates a unique 3-speed automatic transmission with a synchronized 2-speed transfer case. This vehicle will be examined at TARADCOM and shipped to the contractor's site to undergo an engineering performance test.

The VCL ½-ton Italian amphibious jeep is scheduled to arrive at TARADCOM for engineering performance and amphibious capabilities evaluation. This vehicle will be on loan from the Italian Government.

Other programs which are under way include the tentative acquisition and evaluation of the French hyperbar diesel engine and a Reliability, Availability and Maintainability (RAM) Program on the Soviet UAZ-469 jeep.

If the past couple of years are any indication of what the future holds for the TARADCOM FME Program, it is reportedly very encouraging. It is very evident, says Kaczmarek, that the engineers and scientists at TARADCOM and TARCOM realize the benefit and potential of such a program in assisting them in performing their mission.

Congressional Subcommittee Questions RSI Concept

A special subcommittee of the House Armed Services Committee has found many aspects of the Defense Department's Rationalization, Standardization, and Interoperability program subject to criticism.

Its findings and conclusions began by stating that DOD "is unable to define clearly many of the terms it uses. . . ." The term rationalization for example, the report says is an incomprehensible one.

The subcommittee found that there was evidence to contradict the rationale for RSI that says it will reduce duplication and increase efficiency of defense expenditures. Rather, said the report, "It is unlikely there will be significant cost savings realized from arms cooperation. . . . The potential savings are purely theoretical."

The Culver-Nunn Amendment, it admitted, was subject to confusing interpretation. "Arms cooperation as a concept does not necessarily imply that the policy of standardization and interoperability as passed in the Culver-Nunn amendment would be most effectively implemented."

Noting the growth of European defense industry, and their governmental investments in various aspects, the subcommittee noted that the "only conceivably efficient and equitable mechanism to provide the best defense will be to select. . .competitively. This approach is. . .supported in principle but. . .nearly. . .ignored in practice."

The report took note that Memoranda of Understanding (MOUs) were being used to document understandings between defense officials, but such agreements lacked Congressional approval and were therefore limited in scope.

The subcommittee then went into the overall economic aspects, stating that DOD "does not have a single definition of the '2-way street.' " It is often, the report said, construed as a political device to secure economic benefits for Europe and often had "little or nothing to do with enhancing military effectiveness."

The Family of Weapons concept, the report said, "is formless and undefined." Major segments of U.S. industry and labor are confused, states the report, about this concept.

And, such international arms cooperation involves considerations beyond DOD, and yet the responsible Office of Federal Procurement Policy knows little about such programs.

It is significant that the subcommittee's report is titled "NATO Standardization, Interoperability and Readiness." On the readiness side, the findings were not comforting regarding NATO's ability to sustain itself. It found the NATO goal of three percent annual growth in defense spending a compromise, and the U.S. has not honored its commitment since President Carter agreed to it.

The NATO Long Term Defense Plan, the report continued, will have little impact on NATO readiness until the 1990s. The Short Term Initiatives represent a positive, if not wholly adequate, step toward correcting specific deficiencies in the near to mid-term.

The report concluded with nine recommendations to correct the alleged weakness set forth by the subcommittee.

The full text is found in HASC No. 95-101, Ninety Fifth Congress, Second Session.

Fig. 1. TATRA-813 8-ton Tactical Truck

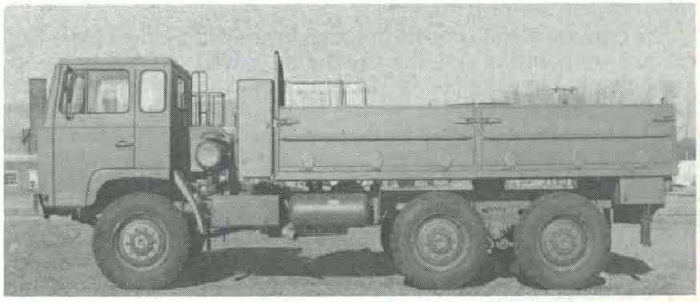


Fig. 2. SAAB-SCANIA 6-ton Tactical Truck

Capsules...

19 Personnel Chosen for Future PM Assignments

Names of 19 colonels and promotable lieutenant colonels—chosen for future assignment to project manager vacancies—were announced recently by the Department of the Army Project Manager Selection Board. The announcement indicated that any officer who declines a PM assignment followng selection by the Board will not be eligible for future PM consideration or OPMS command consideration.

Reporting dates of the selectees will be coordinated in each case between the losing command, Colonels Division, the Military Personnel Center, and the U.S. Army Materiel Development and Readiness Command Office of Project Management. The new Project Manager designees and their projects are as follows:

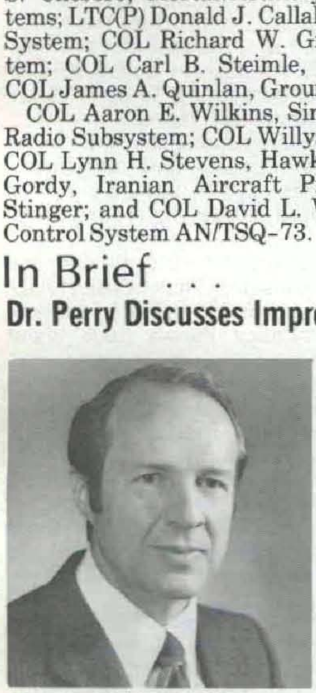
COL Glen L. Rhoades, Army Tactical Communications Systems; COL Daniel Delaney, Hellfire Guided Missile System; COL Robert S. Borer, Navigation/Control Systems; COL Alan B. Salisbury, Tactical Operations Systems; COL Samuel L. Eure, Army Smoke/Obscurants; COL Wayne B. Davis, Standoff Target Acquisition System;

LTC(P) Kenneth M. Irish, Control and Analysis Centers; COL William Fiorentino, Pershing Guided Missile System; COL John S. Chesbro, Mortar/Artillery Locating Radars-Firefinder Systems; LTC(P) Donald J. Callahan, Multi-Service Communications System; COL Richard W. Griffin, Tactical Fire Direction System; COL Carl B. Steimle, General Support Rocket Systems; COL James A. Quinlan, Ground Laser Designators;

COL Aaron E. Wilkins, Single Channel Ground and Airborne Radio Subsystem; COL Willys E. Davis, Improved TOW Vehicle; COL Lynn H. Stevens, Hawk Missile Systems; LTC(P) Terry L. Gordy, Iranian Aircraft Program; COL Phillip H. Mason, Stinger; and COL David L. Wyatt, Air Defense Command and Control System AN/TSQ-73.

In Brief . . .

Dr. Perry Discusses Improved NATO Cooperation



Dr. William J. Perry

U.S. Department of Defense plans for improved cooperation in development and procurement of armaments in NATO were discussed in a recent "Fact Sheet" issued by Under Secretary of Defense for Research and Engineering Dr. William J. Perry. A synopsis of that report, which was based on earlier testimony before a Subcommittee of the House Armed Services Committee, follows:

Under Secretary Perry stressed in his opening remarks that he is aware of industry concern that improved NATO cooperation may mean a U.S. loss of markets, jobs and technological know- how. This concern, he said, results from either a lack of information or misunderstanding of U.S. plans, objectives and the current alliance environment.

Three questions, noted Perry, are at the core of the U.S. program for improved armament cooperation: Why is armament cooperation important? What is our proposed framework to improve cooperation? What criteria should be applied as we consider cooperative programs?

The importance of cooperation was expressed by the Under Secretary by pointing out the expanding Soviet expenditures on armaments. For example, in 1977 estimated Soviet defense costs exceeded corresponding U.S. costs by 25 to 40 percent. In investment, Soviet expenditures were estimated at 75 percent greater.

These expenditures, said the Under Secretary, are being translated by the Soviets into a significant production advantage, and it is worrisome in two respects: It indicates that the present numerical imbalance will get worse; and it raises concerns about maintaining our present qualitative advantage.

Perry noted that there are two potential solutions to the imbalance problem. One is to increase defense expenditures, and the other is to improve efficiency. The most significant and realistic approach is to improve efficiency on an alliance-wide basis.

The proposed framework for improving NATO cooperation includes a triad of actions comprised of General Memoranda of Understanding (MOUs) in reciprocal purchasing, dual production, and the "Family of Weapons."

Under Secretary Perry stated that the purpose of the MOUs is to open up the defense market of each country to fair competition by NATO's defense industry. "Buy National" restrictions will be waived on a reciprocal basis.

Dual production, the second leg of the triad, implies that when one nation completes production of a system, that system should be made available for production by other countries. The Family of Weapons concept entails greater efficiency by reducing duplication in development. Trans-Atlantic industrial teaming will be encouraged.

Some of the Family of Weapons presently being explored include antitank guided missiles, air-to-surface weapons, ship-to-ship missiles, and air-to-air missiles. The Under Secretary noted that the U.S. has proposed that the U.S. Advanced Medium-Range Air-to-Air Missile (a joint U.S. Air Force/Navy program) become the NATO standard for the medium range missile.

The preceding triad of cooperative actions can be effective in the long term, said Perry, only if cooperation begins very early in the acquisition process. The process should begin at the requirements definition stage.

Several criteria are essential, said Perry, if improvements in NATO readiness and force effectiveness are to be realized:

• **Effectiveness and Efficiency.** The first test of a candidate program is whether or not that program will improve effectiveness of the alliance forces. Relative to efficiency, a cooperative program should be expected to improve allocation of alliance defense resources.

• **Competition.** Competition will be a key criterion in consideration of future cooperative programs. It will be a central element in the triad of actions to improve cooperation. Proposals which unnecessarily restrict competition will not be supported.

• **Technology Transfer.** Prudent transfer of technology is a key to future cooperative programs. A balance must be struck between sharing technology and protection of other U.S. interests.

• **Jobs.** Cooperative programs which are recommended will not result in the net loss of jobs for U.S. industry. The U.S. must cooperate with its allies. If we go it alone, there will be no benefit in U.S. jobs, and there will be incredible waste.

Under Secretary Perry concluded his remarks by stressing that the principal obstacle in allied cooperation is the cumulative inertia of 30 years of failure with the many tales of why it will not work. Said he: "This can be overcome by leadership, commitment, and proper attention to economic incentives."

Dr. Davis Discusses Personnel Technology

Deputy Under Secretary of Defense for Research and Advanced Technology Dr. Ruth M. Davis recently presented a U.S. Department of Defense Statement on Training and Personnel Technology before a Congressional Subcommittee on Research and Development. A summary of her address follows:

Dr. Davis began her remarks by stating that training and personnel technology (people related programs) covers a broad range of interests and problems. Manpower is important, she said, because it is needed to operate modern weapon systems.

She stressed that manpower accounts annually for a larger share of the defense budget than does the procurement of weapon systems. "Our program in Training and Personnel Technology," she continued, "accounts for about four percent of the total DOD Science and Technology Program."

Objectives of the DOD Training and Personnel Technology Program, she continued, are:

• To improve the ability to design weapons and support systems so they can be operated and maintained effectively by people with minimum required amounts of training.

• To develop training devices and procedures that will improve our ability to train military personnel.

• To train military personnel so that they will be effective in performing job assignments throughout their careers.

• To improve the ability to forecast requirements for manpower and to recruit and retain those needed by the DOD.

Dr. Davis noted that the major purpose of the 6.1 and 6.2 Technology Base Program is to improve military capabilities. This will be achieved, she said, by improving operational activities; increasing the user-technologist interaction; and by providing a more responsive management and coordination capability.

Research, development, test and evaluation requests for the Fiscal Year 1980 Training and Technology Program are contained in Table 1 and Table 2.

TABLE I

Training and Personnel Technology Program (6.1–6.3)

($M)	FY 78	FY 79	FY 80
Human Factors	24.5	25.5	33.1
Simulation & Training Devices	23.6	24.1	36.6
Education & Training	23.4	26.7	24.1
Manpower & Personnel	19.4	17.6	23.9
Total	90.9	93.9	117.7

TABLE II

Training and Personnel Technology Program (6.1–6.4)

($M)	FY 78	FY 79	FY 80
Human Factors	24.5	25.5	33.1
Simulation & Training Devices	55.3	65.1	96.2
Education & Training	23.5	26.7	24.1
Manpower & Personnel	19.4	18.3	25.5
Total	122.7	135.6	178.9

Research and development, said the Deputy Under Secretary, has improved operational activities in a number of ways. For example, computer based instruction can save 25 percent of the time required by students to complete the same courses given by conventional means.

Another improvement is a result of efforts in engagement simulation. The new Multiple Integrated Laser Engagement system, for instance, shows an increase of about 50 percent in detection of hostile targets, 25 percent increase in enemy kills, and about 50 percent reduction in casualties due to the enemy.

The Night Carrier Landing Trainer, another new aid, also provides a 40 percent improvement in qualifying new pilots to land at night on aircraft carriers.

Dr. Davis stated that R&D efforts must also be directed at areas where users have problems related to their use of personnel. The first action in this area, she said, was establishment of a fully coordinated R&D program for computer adaptive testing. This, she noted, is a promising approach for improving DOD recruit selection and classification.

Various program managers are also being assisted to help them solve various manning and training problems related to systems such as the F-18, VTX-TS, XM1, B-52, F-111, and others. Efforts have also been increased to support manpower policies set by the Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics).

Dr. Davis explained that one of her most recent efforts at improving the technology program was her sponsorship, during the past year, of a tri-Service meeting of all Training and Personnel Technology Laboratories and Centers' commanding officers and their technical directors.

She noted that this meeting, to the best of her knowledge, was the first time that all training and personnel laboratory decision makers met for cooperative discussions. Twelve laboratories were represented.

The Deputy Under Secretary closed her remarks by calling on her audience to provide continued support for the Department of Defense Technology Program.

Awards . . .

ISEF Winners Attend Japan Awards Ceremony

From the computer integrated video delivery of health care throughout Japan to the more ancient technology of the singing floors of the Shogun Palace in Kyoto, students representing the United States at the Japanese Student Science Awards (JSSA) Ceremony received an instructive 8-day overview of ancient and modern Japan.

Mr. Paul J. Hoehner of Rochester, MI; Miss Mary E. Kroening of San Diego, CA; and their escort, LTC Millard L. Pedersen, executive officer at the U.S. Army Research Office, Research Triangle Park, NC, comprised the American delegation invited to participate in the JSSA Ceremony.

Mr. Hoehner was selected by Army judges at the 29th International Science and Engineering Fair (ISEF), Aneheim, CA; Miss Kroening was chosen by a separate screening process by the Navy as their representative at Operation Cherry Blossom (OCB).

At the JSSA Ceremony, 7 Jan. 1979, Prince and Princess Hitachi personally extended the welcome of the Japanese people and discussed the scientific work of Miss Kroening and Mr. Hoehner at the conclusion of the awards ceremony.

The intensive schedule in Japan was coordinated with the Public Affairs Office, U.S. Army Japan, and the Office of Naval Research, Japan. As a result of the joint Army-Navy efforts, the OCB group was granted access to such premiere Japanese research installations as the Tokyo Medical Information System Development Center, the Tokyo Dai-Ichi Kokuritsu Iryo Center, the Tokyo Metropolitan Komagome Hospital, the Tokyo University Large Scale Computer Center, the Primate Research Institute of Kyoto University, and the General Control Center for the Superexpress Bullet Train. Interspersed with on-site visits to high-technology installations were visits to cultural and historic points in Kyoto, Nagoya and Tokyo.

OCB is part of the ongoing effort of the United States Army to stimulate, encourage and reward exceptionally talented high school students in the field of the physical and life sciences.

In addition to participation in the ISEF and the regional and state science fairs, the Army sponsors the Junior Science and Humanities Symposium and American participation in the International Mathematical Olympiad.

DARCOM Deputy Commanding General for Materiel Development LTG Robert J. Baer with Operation Cherry Blossom representatives Paul J. Hoehner and Mary E. Kroening, and U.S. Army Research Office Commander COL Anthony P. Simkus.

Mittenthal Receives Legion of Merit First OLC

LEGION OF MERIT, first Oak Leaf Cluster, is presented to COL Lothrop Mittenthal (right) by Bryant R. Dunetz.

COL Lothrop Mittenthal, commander/senior standardization representative of the U.S. Army Research and Standardization Group (Europe), London, England, since 1976, was presented the first Oak Leaf Cluster to the Legion of Merit during recent retirement ceremonies in London.

The citation accompanying the award, which was presented by DARCOM Assistant Deputy for International R&D Mr. Bryant R. Dunetz, recognized COL Mittenthal for meritorious service, and outstanding leadership which significantly increased the standardization and interoperability of materiel and nonmateriel items between the U.S., the United Kingdom, and Republic of Germany.

COL Mittenthal was also cited for improving scientific information and research support to U.S. Army laboratories. "COL Mittenthal's effectiveness in the enhancement of Rationalization, Standardization and Interoperability," noted the citation, has been exemplary and reflects great credit upon himself, DARCOM, and the U.S. Army."

Personnel Actions . . .

Patton Chosen as DARCOM Readiness Director

MG George S. Patton

MG George S. Patton, a veteran of more than 32 years of active Army service and former commander, VII Corps, U.S. Army, Europe, recently assumed new duties as director of Readiness, HQ U.S. Army Materiel Development and Readiness Command.

A graduate of the U.S. Military Academy, MG Patton has an MS degree in international affairs from George Washington University. He has completed requirements of the Infantry School (basic course), Armored School (advanced course), Command and General Staff College, Armed Forces Staff College, and the Army War College.

From 1975-77, MG Patton commanded the 2d Armored Division at Fort Hood, TX, following tours with the Office, Chief of Staff, U.S. Army; as director, Security Assistance Directorate, J-7, U.S. European Command; and as assistant commandant, U.S. Army Armor School, Fort Knox, KY.

Listed among his other key assignments are assistant division commander, 4th Armored Division, U.S. Army, Europe; commander, 11th Armored Cavalry Regiment, U.S. Army, Vietnam; and chief, Force Developments Branch, Office, Assistant Chief of Staff, G-3, Vietnam.

MG Patton's military honors include the Distinguished Service Cross with Oak Leaf Cluster (OLC), Silver Star with OLC, Legion of Merit with two OLC, Distinguished Flying Cross, Bronze Star Medal with "V" device and OLC, Air Medal with 27 OLC, Army Commendation Medal with three OLC, and the Purple Heart.

Ball Succeeds Tobiason as WSMR Commander

BG Duard D. Ball, former commander of the U.S. Army Ordnance and Chemical Center and School, Aberdeen Proving Ground, MD, has assumed new duties as commander of White Sands (NM) Missile Range. BG Ball, who has almost 26 years of military service succeeds MG Orville L. Tobiason.

BG Duard D. Ball

A 1953 graduate of Oklahoma A&M College, BG Ball was commissioned in the Ordnance Corps upon graduation. He served with the 35th Infantry Regiment in Korea and eventually was assigned to the 25th Infantry Division before it returned to Hawaii in 1954.

In 1961 he received a master's degree in industrial management from Babson Institute. In 1962 he became senior ordnance supply adviser in Taiwan, and later he commanded the 704th Maintenance Battalion of the 4th Infantry Division in Vietnam. BG Ball went to Europe in 1970 and alternatively commanded the Miesau Army Depot and the 60th Ordnance Group.

In the U.S., BG Ball served with the Redstone Missile Project at WSMR, from 1958-60. Fifteen years later, he returned to the Directorate of National Range Operations, and before his assignment to the school at APG, he was deputy commander of the U.S. Army Tank-Automotive R&D Command, Warren, MI.

BG Ball holds the Legion of Merit, Soldier's Medal, Bronze Star Medal and several other decorations, including the Vietnam Cross of Gallantry, twice.

Bishop Directs Engineering Research Center

COL Ted E. Bishop is the new director of the U.S. Army Coastal Engineering Research Center, Fort Belvoir, VA, following a tour of duty as assistant chief of Planning Division, Directorate of Civil Works, Office, Chief of Engineers, Washington, DC.

A 1955 graduate of the U.S. Military Academy, West Point, NY, COL Bishop received a master's degree in civil engineering from the University of Illinois in 1961, and has completed course requirements of the Army War College.

As director of the Coastal Engineering Research Center, COL Bishop will be responsible for the Corps of Engineers' laboratory and field research related to shoreline protection and construction and maintenance of coastal structures. He will serve also as executive secretary for the Corps' Coastal Engineering Research Board.

A registered professional engineer in Virginia and Maryland, COL Bishop is a recipient of the Bronze Star Medal with Oak Leaf Cluster, the Legion of Merit, and the Air Medal.

Harvey Takes Over as Deputy ASA (Acquisition)

Mr. Thomas E. Harvey has been appointed as the new Deputy Assistant Secretary of the Army (Acquisition). He had served, since 1 Nov. 1978, as a consultant to the Assistant Secretary of the Army for Research, Development and Acquisition.

Thomas E. Harvey

In 1977, he was selected by President Carter to be a White House Fellow and, in that capacity, served during 1977-78 as special assistant to ADM Stansfield Turner, director of the Central Intelligence Agency.

Prior to his selection as a White House Fellow, he practiced law for five years in New York City with the firm of Milbank, Tweed, Hadley and McCloy. Mr. Harvey holds a BA degree from the University of Notre Dame and a Juris Doctor degree from the Notre Dame Law School.

Holtom Takes Over as R&S Group Commander

COL Stanley E. Holtom

COL Stanley E. Holtom, former director for Program Management, Security Assistance Center, HQ U.S. Army Materiel Development and Readiness Command, has assumed new duties as commander of the U.S. Army Research and Standardization Group (Europe).

Included among his earlier tours of duty was service as an infantry officer with command and staff experience in Europe, the Far East, Vietnam, Cambodia, and the Dominican Republic. He has also served assignments in the operations, intelligence and logistics fields with various DOD agencies and the Office of the Joint Chiefs of Staff.

COL Holtom holds an MSC degree from George Washington University, is a distinguished graduate of the Industrial College of the Armed Forces, and is a recipient of the Legion of Merit, Bronze Star, Meritorious Service medal, Air Medal, Joint Service Commendation Medal, Army Commendation Medal, and the Combat Infantryman's Badge.

60 Years of Soviet Small Arms

"... the one who succeeds is the one who has the greatest technology, organization, discipline and the best machines . . ."

V.I. Lenin

By David Latt

When the Bolsheviks rose to power in October 1918, they faced the task of creating an armed force and providing it with the necessary weapons and ammunition, primarily small arms and artillery. The need for small arms was particularly critical.

Initially, the Red Army depended upon models inherited from the old Russian Army. These included domestically manufactured Model 1891 Mosin rifles and carbines, heavy 1910 Model Maxim-type machineguns and 1895 Nagant revolvers. Also available were very limited quantities of foreign models of weapons purchased by the Czarist government during the first World War.

Inasmuch as Czarist Russia's technical and economic base had been barely adequate to supply even a third of the old regime's wartime weapons requirements, the new government marshaled its resources for the purpose of developing a self-sufficient arms industry. By dint of a concentrated organizational effort, which was spurred on by fears that counter- revolutionary military attack was imminent, considerable success was achieved, particularly in the development and production of small arms.

Thus, in the two decades following the October revolution, the combined efforts of scientists, designers, and technical workers assembled at centers in Izhevsk, Kovrov, Saratov, and Tula enabled the Soviets to build an industry that was capable of outstripping the enemy in small arms production during World War II (Figure 1).

	USSR	Germany
Rifles & carbines	12,000,000	7,500,000
Submachine-guns	6,103,000	1,247,000
Light & mounted machineguns	954,500	617,000

Figure 1. Production of Small Arms (1941-1945)

Soviet small arms development was profoundly influenced by F. G. Fedorov, inventor of the assault rifle and founder of the first Soviet design bureau for automatic weapons; N. M. Filatov, a leader in the production and testing of automatic rifles; and A. A. Blagonravov, who provided administrative leadership in small arms research and expedited the development of new systems. Under the guidance of these men, many designers evolved, including such notables as V. A. Degtyarev, P. M. Goryunov, G. S. Shpagin, S. G. Simonov, A. I. Sudayev, and F. V. Tokarev.

The use of automatic weapons grew steadily during World War II as their superiority for close combat purposes became obvious. Wartime infantry unit holdings included 7.62mm PPD (Degtyarev) submachineguns, PPsh (Shpagin) and PPs (Sudayev) submachineguns, SVT semiautomatic rifles (Tokarev) and, near the end, SKS-45 semiautomatic carbines (Simonov), DP (Degtyarev) light machineguns, and SGM (Goryunov) mounted machineguns.

The PPD, which entered service in 1940, combined the qualities of both a pistol (low weight and portability) and a machinegun (high rate of fire). The PPsh, supplied to the front at the end of 1941, retained the performance characteristics of the PPD, but was of simpler design, thus making it easier to manufacture.

The PPS submachinegun was the most compact (623mm long), light (3.04 kg) and simple in design. It was noted for its folding-type metal stock and a 2-row box magazine with 35 cartridges and was convenient for use on reconnaissance missions. The air-cooled SGM mounted machinegun, weighing 36.9 kg, replaced heavier (66 kg) water-cooled Maxim machineguns whose water jackets were vulnerable to bullets and shell splinters.

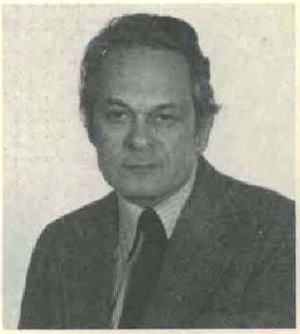
In an effort to provide Soviet infantry units with tactical independence when engaging highly mechanized enemy troops, each infantry regiment had a company equipped with 14.5mm antitank rifles. Two models, the single loading AT rifle designed by Degtyarev, and the 5-shot magazine-fed self-loading AT rifle designed by Simonov, were put into service. The armor-piercing capability of the antitank rifles (not less than 20mm at a distance of 500 m) made them effective against enemy armored vehicles, machineguns, and armored emplacements.

Among the current designers, the most prolific is M. T. Kalashnikov, a former World War II tank sergeant, who is responsible for the AK-47 AKM and AK-74 assault rifles; the RPK and RPKS light machinegun; and the PK, PKB, PKS, PKM, and PKT general-purpose machineguns.

These weapons have been uniquely successful in satisfying Soviet requirements for small arms capable of providing infantry units with increased automatic firing power and greater effective ranges. Kalashnikov's gas-operated mechanism was the start of a new weapons family featuring light weight, reliable operation, a high cyclic rate and a relatively low dispersion shot pattern.

The basic Soviet criteria for developing infantry weapons are reliability, simplicity of design, ruggedness, ease of operation and ease of maintenance under field conditions. Above all, however, weapons must be easy to mass-produce. Within the constraints imposed by these criteria weapons design and modification continues, although future research and development will probably concentrate on ballistic and metallurgical improvements.

DAVID LATT is serving as a specialist and adviser on foreign Army R&D management and facilities at the Foreign Science and Technology Center in Charlottesville, VA. Formerly, he was an historian with the Office, Chief of Engineers. His academic credentials include an AB degree from University College, New York University and an MA from Columbia University.



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