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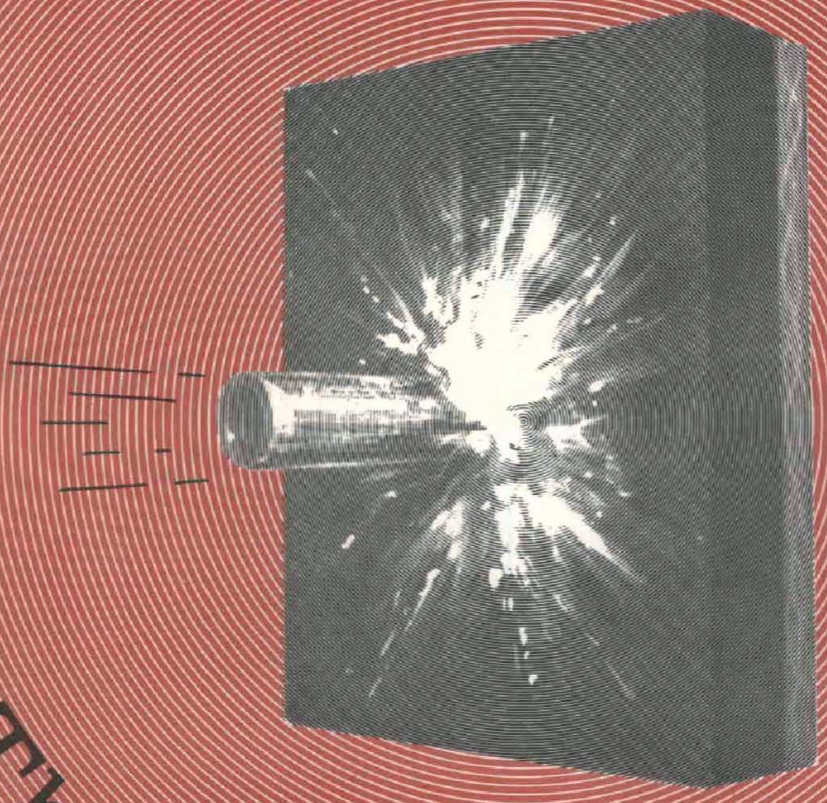
NOVEMBER - DECEMBER 1980

CERAMICS



for The Army of The Eighties

(See page 1)

ARMY R,D&A

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ABOUT THE COVER:

Front cover depicts a projectile striking a piece of ceramic armor. This illustration represents one of the many areas of ceramics research conducted at the U.S. Army Materials and Mechanics Research Center in Watertown, MA. Back cover shows a rotor of silicon nitrade ceramic that can withstand turbine inlet temperatures of 2,200° F. and speeds above 50,000 rpm without cooling.

FEATURES

DEPARTMENTS

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

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CERAMICS for the ARMY of the 80s

By Dr. R. Nathan Katz

Protection of aircrew personnel, survivability of equipment in the field, missile guidance, target acquisition, countermeasure technology, more efficient multifuel engine technology, and reduction of requirements for strategic materials are among the areas where modern, high technology ceramic materials are enhancing or will enhance the capabilities of the Army of the eighties.

Ceramic materials offer unique combinations of properties which are unavailable in other materials. For example, the combination of high hardness, high stiffness, and low density, required to create effective aircrew armor to counter the small arms threats encountered in Vietnam, were available only in certain ceramic materials. This article will discuss this and other applications for ceramics in more detail later.

Initially, it is desirable to define what we mean by ceramics, briefly discuss how they are made, what some of their properties are, and why they have been relatively little used in engineering structures until the past 15 years.

The classic definition of a ceramic as a product made by firing minerals at high temperatures (e.g., refractories, porcelain, brick, glass, enamels) comes to us from the Greek word, Keramos (burnt stuff). This definition is still largely accurate. However, today one usually considers ceramics as any inorganic, non-metallic material.

Thus, the families of materials, with some examples, shown in Figure 1 include carbons and salts. The high technology applications of ceramics listed in Figure 1 clearly illustrate the importance of this technology to many of the Army's mission areas.

Ceramic materials are generally processed at high temperatures, in some cases as high as 2500° C, but the processing may take several distinct routes. Melt formation of glass and glass-ceramic (e.g., pyroceram) materials are perhaps the most familiar.

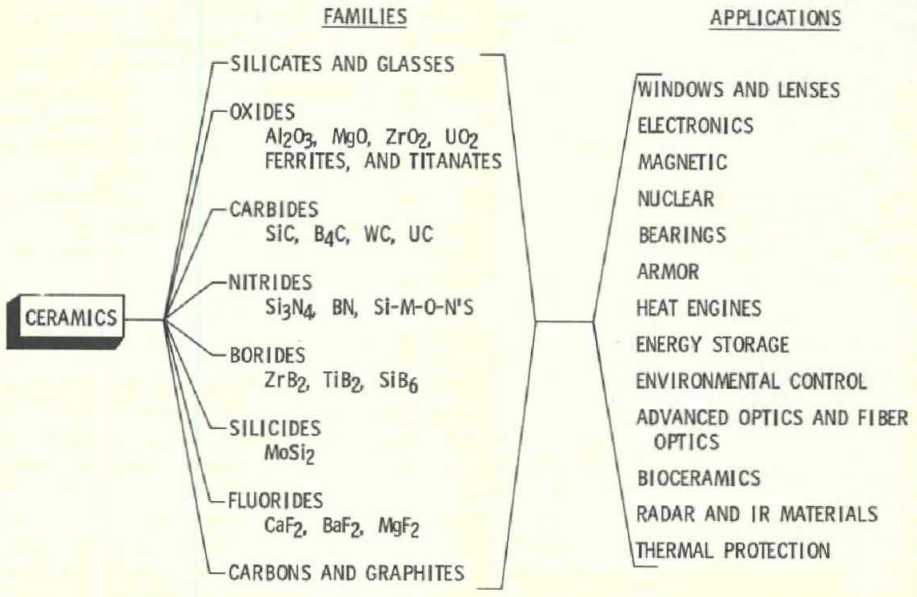


Fig. 1. Families and Applications of Ceramics

Solidification from the melt is also the basis for growth of ceramic single crystals, which are used in laser optics, lenses and windows in optical devices, acoustic delay lines, transducers, surface acoustic wave devices, photovoltaic cells and advanced transparent armor systems. Chemical vapor deposition has been used to produce both polycrystalline and single crystal ceramics. This technology is of particular importance in electronic and microelectronic circuit fabrication.

The bulk of engineering ceramics, however, are formed by the consolidation of powders. The application of heat, or the simultaneous application of heat and pressure will cause a ceramic powder to become a well-bonded polycrystalline body.

Readers familiar with metallurgy know the close relationship between ceramics and powder metallurgy (P/M). There is, however, one very important difference. Whereas, a P/M part can be heat treated or thermo-mechanically worked after fabrication to improve properties and remove defects, in general one cannot do this with ceramics.

Particular care must be exercised not to introduce any flaws, impurities or imperfections at any stage of the manufacturing process starting with the raw material powders. In fact, the production of reliable high-performance ceramics for virtually every Army application is critically dependent upon sophisticated powder characterization and quality assurance procedures.

The Army Materials and Mechanics Research Center, as the Army's lead laboratory for structural and optical ceramics, has developed an extensive in-house capability for the physical and chemical characterization of fine powders. While this has been essential to our ceramics and powder metallurgy development work, it has also enabled us to provide support to such widely divergent Army projects as preparing a new specification for zirconia powder for thermal battery manufacture, characterization of river silts for the Corps of Engineers, and assisting the Chemical Systems Laboratory in the development of advanced smokes and obscurants.

Properties of engineering ceramics are as diverse as the materials themselves. Rather than afflict the readers with tables or plots of seemingly random prop-

erties, I'd like to make a few general points. Ceramics usually can retain critical properties to high temperatures compared to metals or polymers. Ceramics are usually either insulators or semiconductors. Some electrically insulating ceramics exhibit only small changes in dielectric constant and loss over temperature excursions of up to 1000° C. Some ceramics can be very hard (i.e., diamond, aluminum oxide, boron carbide, silicon carbide and nitride, and cubic boron nitride), and thus, useful in wear resistant, erosion resistant applications. The current need for enhanced energy conservation has refocused attention on ceramics for thermal insulation, particularly at high temperatures. However, the truly important point, as we will see many times in the balance of this article, is the unique combinations of properties which ceramics can provide in certain applications, which literally make new technologies possible.

Ceramic materials have one fundamental limitation—they are brittle. Brittle does not necessarily mean weak; in fact, some ceramics can be much stronger than metals. Brittle means the materials have a limited strain tolerance and that if overstressed, ceramics cannot relieve stresses by local yielding as do metals and some polymers.

However, new design tools such as computer-based finite element stress analysis are enabling designers to more precisely define the actual local stresses which ceramic components will see in service.

Progress is also being made in fundamental re-evaluation of design philosophy. If the material cannot yield and relieve local overloads, then perhaps the structure can provide the yielding, by being compliant and allowing some articulation in the structure. This is not such a radical design concept—it is the way nature designs the human skeleton, which as an assembly of brittle materials, can take amazing overloads.

More to the point, in the Patriot missile exact stress analysis has led to the development of a compliant attachment system enabling the ceramic slip cast fused silica (SCFS) randome to mate to the missile body. This attachment scheme has performed flawlessly in the most demanding tests.

Thus, the brittleness of a ceramic component, if properly recognized and addressed in the design process, need not be a problem.

With the above background we are now in a better position to take a look at what ceramic technology is contributing to the Army today and where it is likely to contribute in the near future. Because AMMRC's role in developing ceramic technology has focused largely on the area of non-electronic ceramics, we will focus on this area. Equally interesting developments are taking place in ceramics for electronics and optical communications, and perhaps, a subsequent article can cover these.

Non-electronic ceramics in the Army can be divided into the main areas of protection and survivability, missile guidance, and propulsion and power generation applications. We shall look at each of these in turn.

Perhaps the most well known and dramatic Army application of structural ceramics is ceramic-faced composite lightweight aircrew armor. Early in our involvement in Vietnam an unacceptably high number of helicopters were being lost to hostile small arms fire.

Analysis of these losses indicated that armor protection for the air crews and critical components would significantly reduce the loss rates. However, the conventional armor materials available at that time were so heavy that armoring of certain helicopters would preclude their getting off the ground, let alone accomplishment of their mission.

Fig. 2. Boron Carbide/Kevlar Seat for Black Hawk

Analysis at AMMRC indicated that high elastic modulus, high hardness, low density armor materials could induce shatter of AP projectiles and thus might lead to lightweight armor systems. Several ceramics have such a combination of properties and around 1962, aluminum oxide faced composite armor meeting the minimal ballistic needs for helicopter armor, was developed by industry and put into almost immediate production.

Scientists at AMMRC in late 1964 first demonstrated a boron carbide faced composite armor system which was the most ballistically efficient, usable, lightweight armor system to be developed. AMMRC, working together with Natick Laboratories, and private industry developed a whole new industrial capability for fabricating large complex curvature boron carbide shapes for aircrew torso shields and seats.

This development went from laboratory demonstration, through industrial scale-up and process development, to fielding in about two years! It was one of the most rapid exploitations of a new technology on a large scale basis on record. As a result of the development of boron carbide faced aircrew body armor, hundreds of lives were saved and many missions completed.

During the ensuing years, boron carbide faced aircrew armor has been made more ballistically efficient by optimization of the ceramic composite system. In particular, new back up materials such as Kevlar have allowed the boron carbide faced armor to maintain its dominance for helicopter use.

Moreover, seats in current helicopters such as the UH-60A Black Hawk, not only have to be ballistically protective, they have to be crashworthy. To be specific, a boron carbide/Kevlar seat for the Black Hawk, such as shown in Figure 2, can defeat small arm projectiles at close range and it can also survive a crash where the dynamic loads reach 48G.

Again, the "trick" in having a brittle material survive in such a highly stressed situation is proper design of the shock attenua-

tion system and proper attachment of the ceramic.

The above discussion of ceramic armor has been limited to opaque armor. However, there are applications for improved transparent armor. Advances in the crystal growth of very large single crystals of hard oxide ceramics, led to the development, at AMMRC, of prototype transparent ceramic faced armor with about twice the ballistic efficiency of conventional laminated glass systems. This is currently being pursued for application in vision blocks for armored vehicles.

The benefits of transparent armor are clearly there, the drawback thus far has been cost. However, with advances in processing technology being pursued under a TARADCOM MM&T effort, the cost/benefit ratios may soon become favorable.

In today's battlefield environment, aircraft must be protected from threats potentially more deadly than small arms fire, namely heat-seeking missiles. Infrared countermeasures (IRCM) equipment now flies on both rotary and fixed wing aircraft. Whether these IRCM devices are electrically powered as in the AN/ALQ-144 (flown for example on the AH-1S) or are heated by combustion as in the AN/ALQ-147 (flown for example on the OV-1D), the IR sources are fabricated from advanced, high temperature ceramics. Figure 3 shows the ceramic IR source for the AN/ALQ-147 prior to assembly.

In the area of missile guidance, ceramics are contributing in several ways. The radome of the Patriot Missile and the IR domes on Chaparral, Stinger, and Redeye are ceramic. In the case of the Patriot radome, the material selection criteria included; low dielectric constant (stable with temperature), low dielectric loss (stable with temperature), low density, high thermal shock resistance, rain erosion resistance and fabricability in large sizes.

For the operational parameters of the Patriot, systems tradeoffs indicated that slip casted fused silica would be the optimum materials choice. Extensive proof testing and field testing of this missile have indicated that this choice has been fully successful.

In fact, the Patriot radome is the highest performance missile radome yet fielded. Nevertheless,

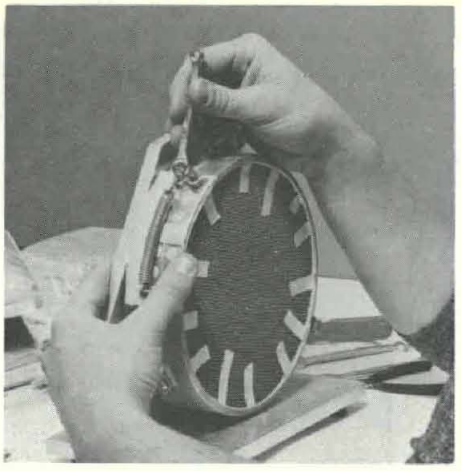


Fig. 3. Ceramic IR Source for AN/ALQ-147, IRCM System

increased performance and capability for future missile systems will shortly be required.

In particular, as missile velocities increase, it is clear that the current SCFS material will be rain erosion limited. Therefore, work on the development of advanced fused silica composite ceramics and silicon nitride based radome materials is being aggressively pursued at both MICOM and AMMRC. Figure 4 shows the improvement in rain erosion resistance which hot pressed silicon nitride can provide compared to SCFS at hypersonic conditions.

A new material, nitrogen-stabilized cubic aluminum oxide (A1ON, for aluminum oxynitride) has recently been developed by researchers at AMMRC. This material holds promise as a multimode (visible, near IR, radar and mm wave) dome material. Other advanced ceramics such as 3-D woven silica composites CVD Si_3N_4, and A1N are being evaluated for guidance windows in BMD applications.

Ceramics are also playing a key role in the phased array radar for the Patriot system. Each radar unit has over 5,000 phase shifters and each phase shifter contains a ceramic torroid as its core element. These phase shifter elements are now of a garnet composition, but work at MICOM is centered on developing an improved ferrite phase shifter. As the use of phased array radars spreads to other systems it is easy to envision the manufacture of ceramic phase shifter torroids becoming a truly mass production activity.

AMMRC is currently addressing a significant portion of its in-house ceramic research effort on the development of ceramic engine materials in support of DARCOM vehicular propulsion and mobile field power generation programs.

The significant potential of ceramics to help the Army's various heat engines attain their goals of enhanced fuel economy, multifuel

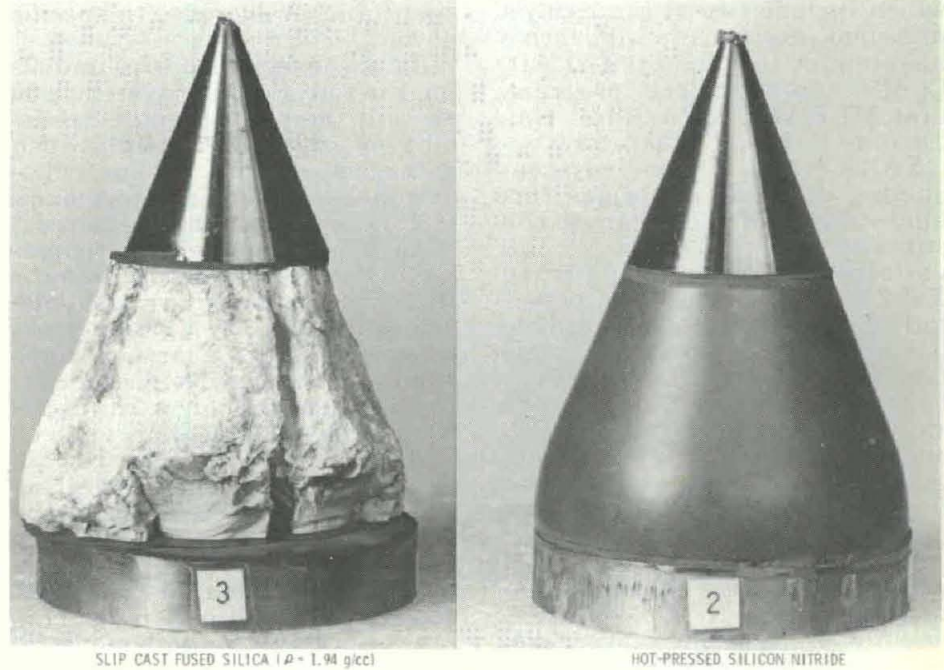


Fig. 4. Closeups of Ceramic Subscale Radomes After Exposure to 2,000 Feet Rain Field (1 + in./hr.) Mach 5 + (5,700 ft./sec.)

capability, higher specific power, reduced air flow (for gas turbines) as well as other benefits led to the initiation of research programs aimed at generating the technology base necessary for silicon nitride and silicon carbide-based ceramic materials to become "engine ready".

In the mid-seventies, AMMRC assessed the opportunities for utilization of ceramics in heat engines, and with inputs from the various commodity commands, obtained the roadmap shown in Figure 5. This roadmap proceeds through engines of ever more rigorous duty cycles from the standpoint of their tolerance for brittle materials design.

The solid lines in Figure 5 indicate where this "engine ready" technology has been transferred or is in the process of being transferred to the commodity commands. The dashed lines are anticipated future actions. This activity was accelerated by AMMRC's participation in the ARPA "Brittle Materials" program and various interagency activities with DOE.

Consistent with our assessment that small gas turbines for mobile field power would be the first Army area to utilize ceramics, MERADCOM personnel participated in monitoring the ARPA program with AMMRC. The technology base is now also being focused to support the TARADCOM and MERADCOM programs which include two of the Army's principal programs in innovative heat engine technology: TARADCOM's Adibatic Diesel program, and MERADCOM's Small Gas Turbine Powered Generator.

TARADCOM is currently conducting advanced cycle gas turbine studies for successors to the current AGT-1500 and for advanced diesel cycles for future XM-2/3-type vehicles. The potential of 2500° F uncooled ceramic hot flow path components in gas turbines results in up to 20 percent less fuel consumption per standard battlefield day (BFD) operation versus the diesel engine and 700 to 1000 lb/BFD less fuel than alternative advanced air-cooled metallic turbines.

Further, these ceramics will not require scarce imported materials such as Ni, Co, or Cr. A less fuel-efficient but nearer term ceramic based technology is the use of zirconia-based thermal barrier coatings (TBC's). TARADCOM is conducting R&D on these coatings and is currently using them in the AGT-1500 (XM-1) program.

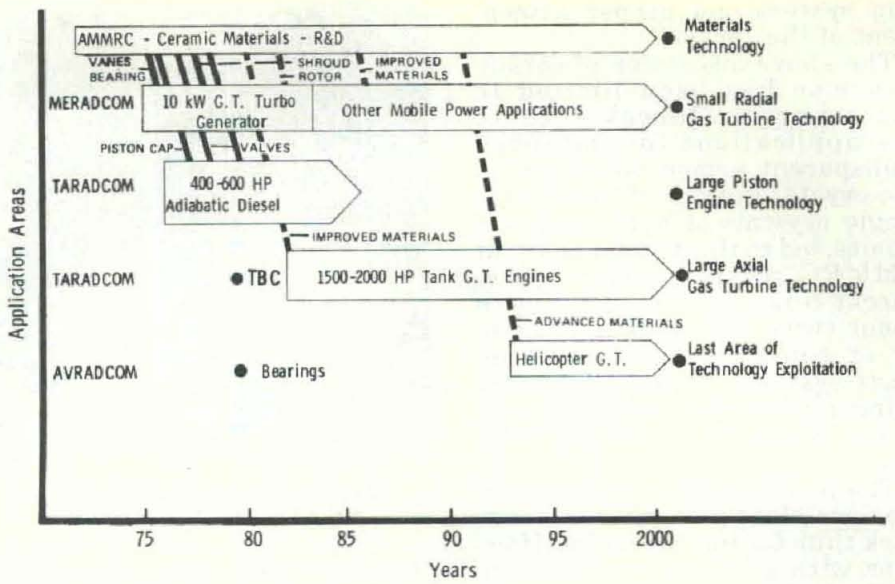


Fig. 5. AMMRC Roadmap for Introduction of Ceramic Materials Technology Into Army Heat Engine Development Programs

The diesel engine is also capable of considerable development via the turbo-compounded "Adiabatic Diesel," which runs hot, eliminates the water cooling system (and consequently the heat lost to the water cooling system), and extracts useful heat from the higher temperature exhaust gas via a turbine. Such an engine can reduce specific fuel consumption by 35 percent with a simultaneous increase in specific power.

As a consequence of eliminating the water cooling system, a 50 percent increase in engine reliability is projected. To obtain such gains, ceramic piston caps, cylinder liners, and exhaust gas manifolding and valves are required.

AMMRC is actively participating in the TARADCOM Adiabatic Diesel program. Our recently developed capability to hot press silicon nitride to near net shape enabled us to provide piston caps to TARADCOM on a rapid response basis. This has enabled TARADCOM's contractor to gain over 650 hours of early operating experience with ceramics in the engine.

The initial 250-hour full performance test goal for the single cylinder engine was met. This represents the first demonstration of a dynamic (as opposed to static) ceramic engine component to meet all initially established program objectives. TARADCOM is now proceeding to a multi-cylinder engine build and test. AMMRC is participating in producing prototype components for this engine, as well.

In the area of mobile field power, significant upgrading of the performance of gas turbine powered generator sets can be obtained even at temperatures below 2000° F. One problem in such units can be dust erosion. Hot-pressed silicon nitride (HPSN) significantly reduces this problem. Consequently, MERADCOM has pursued an engine development program to put ceramic trailing edges in the nozzle section of the 10-kw gas turbine. This work has met with considerable success.

Encouraged by the progress and analyzing the potential for both fuel consumption reduction and power growth for the current 10-kw unit, MERADCOM invited AMMRC to participate in a joint thrust program to update the 10-kw by stages to a 15-kw and then a 30-kw unit in the same engine frame. Concurrent reductions in specific fuel consumption (SFC) will also accure.

Full attainment of the program goals will require the development of a ceramic nozzle, rotor, bearings, combustor, and heat exchanger. Currently the 10-kw engine with a full ceramic nozzle is undergoing test and evaluation. The engine, producing its 10-kw rated power, has completed over

(Concluded on page 25)

10th Annual Army Project Managers Conference

The 10th annual Army Project Managers Conference was held in Orlando, FL, 6–8 October 1980, amid some spirited reaction and discussion. There were 125 attendees, including PMs and senior level DA and HQ DARCOM officials. The 2-1/2 days of presentations and discussions were designed to cover subjects and problem areas of mutual interest to the group.

LTG Robert J. Lunn, DARCOM, deputy commander for Materiel Development, representing GEN Guthrie, DARCOM commander, opened the conference by saying that he had reviewed GEN Guthrie's remarks and concerns mentioned in previous conferences, and that unfortunately, the concerns were still present in the areas of cost growth, ILS, use of letter contracts, and coordination by PMs with major commands. The problem of responsiveness without requirements documents was also discussed.

Turning to ILS, Lunn repeated GEN Guthrie's concern of previous years that ILS functions must receive top priority. Letter contracts and the appropriateness of their use was discussed at length.

The group was told by Lunn of the new instructions from HQDA involving sole source contracting for consulting services. The rationale for such a course of action must be thoroughly documented.

A PM serving as an integrator, said Lunn, is a common pitfall that must be avoided, as a PM simply does not have the people nor the expertise. Let the contractor do it.

In closing, Lunn stressed that PMs cannot stand alone and work in isolation. A PM cannot by-pass the various functional staffs, making commitments which the Army's limited resources will be unable to support.

LTG Lunn was followed by MG Robert L. Herriford, Sr., DARCOM director of Procurement & Production, who told the audience of the new system being instituted for program and cost control. Its origin, said Herriford, was GEN Guthrie's concern over cost growth. After reviewing an approach used by the Air Force Systems Command to this end, he described DARCOM's "still fluid" system.

Today, Herriford noted, there are many Army control documents but each covers a part of the program. The need is to put everything management needs into one document, though perhaps, he continued, an existing one could be modified to answer the need.

Minimal controls suggested, Herriford continued, include such things as having a single HQ DARCOM program monitor for each program, and more direct involvement by HQ DARCOM. A key feature of the system will be the establishment of a baseline for each program.

The concept for the new system was approved, Herriford said, on 5 August 1980, and four programs have been selected—IMAAWS, SOTAS, RPV, and FVS as the initial systems to fall under the new management approach.

COL Ray E. Frye, Jr., associate director for Cost Performance Reporting, HQ DARCOM, then discussed the subject of contractor performance measurement—a valuable tool for PMs, he said, to provide early warning of impending trouble. Timeliness, said Frye, was critical to the value of such a report, for a report two or three months late does not have the early warning value of one rendered on time. Further, these reports must be explanative, analytical, and corrective; they should contain the authority for any changes, and reasons for deviation from the approved baseline.

PMs must review these reports and get contractor high level involvement in the reports. Such actions will pay off for the PMs.

The first morning's presentations also included a discussion by MG Patrick M. Roddy, director, Programs Analysis and Evaluation, HQDA, on a programmer's perception of project management. Roddy expressed his concern that the Army was too often interested in an IOC date rather than a weapon system, that more front-loading is required in terms of verifying the availability of skills, force structure, etc., to ensure that a total useable system is fielded.

The morning wrap-up presentation was by BG James F. McCall, DARCOM comptroller, on financial management. He stressed his concern that R&D funds are sometimes used to pay charges more properly belonging to procurement accounts, an action that usually occurs during the transition phase.

Hon. Percy A. Pierre, Assistant Secretary of the Army (RD&A) was the luncheon speaker. The Secretary expressed confidence in the Army's materiel acquisition system overall, contending the Army's record was as good if not better than the other services. He did express concern that his office not be caught unaware when problems or changes arise. He further expressed his concern that the Army not lose out in exploiting available technology in high pay-off areas.

Following his address, Dr. Pierre then made the annual Project Manager of the Year awards. The 1980 selection saw two winners, COL Ronald E. Philipp, PM CAWS, and COL Harold E. Stubbs, PM CHAPARRAL/FAAR. (See separate article, page 6).

The afternoon session began with a review by Mr. John D. Blanchard, principal assistant deputy for Materiel Development, DARCOM, of the findings of the Defense Science Board 1980 Summer Study, the Army Science Board Fall Membership Meeting, and Pre-Planned Product Improvement. Following this, came presentations by COL Robert M. Balzhiser, DCSRDA HQDA, on new initiatives by DOD on DODD 5000.1 and 5000.2; Mr. Seymour Lorber, DRCQA, DARCOM on New RAM Thrusts—DODD 5000.39 and 5000.40; Mr. Edwin Greiner, as-

(Continued on page 7)

Philipp and Stubbs Win Annual PM Awards

Assistant Secretary of the Army (RD&A), Hon. Percy A. Pierre presents Secretary of the Army Awards for Project Management to COL Ronald E. Philipp and COL Harold E. Stubbs, at the 10th annual Army Managers Conference, Orlando, FL.

The prestigious annual award by the Secretary of the Army for outstanding performance by an Army Project Manager, for 1980, was a dual award. Hon. Percy A. Pierre, Assistant Secretary of the Army, (RD&A), made the presentations at a luncheon during the 10th annual Army Project Managers Conference in Orlando, FL, on 6 October.

The first award was to COL Ronald E. Philipp, PM, Cannon Artillery Weapons Systems/Joint Project Manager, Guided Projectile Program. In accepting the award COL Philipp noted the particularly valuable contribution made to his program by now retired LTC Robert Nulk and CPT J. D. Miceli.

The citation for COL Philipp reads as follows:

1980
Secretary of the Army Award
for
Project Management

COL Ronald E. Philipp

is cited for outstanding performance as Project Manager of the Cannon Artillery Weapons Systems/Joint Project Manager, Guided Projectile Program during the period of July 1979 through June 1980. Through his initiative, technical competence, excellent judgment and astute managerial ability, COL Philipp managed and coordinated the activities of a complex multilevel program interfacing the development and/or fielding of the single shot kill 155mm guided projectile (COPPERHEAD), the M198 155mm towed howitzer, the M549A1, rocket assisted projectile and the M203 propelling charge. His superb management has significantly reduced the lead time normally required to field a completely upgraded artillery weapon system and has resulted in a program that utilizes the most effective cost and schedule approach. COL Philipp's performance reflects great credit upon himself, the Cannon Artillery Weapons Systems/Joint Project Manager, Guided Projectile Program and the United States Army.

The second award was given to COL Harold E. Stubbs, PM, CHAPARRAL/FAAR Air Defense System. COL Stubbs also remarked to the audience on those he felt contributed so materially to the effort. COL Stubb's citation reads:

1980
Secretary of the Army Award
for
Project Management
COL Harold E. Stubbs

is cited for outstanding performance as Project Manager of the CHAPARRAL/FAAR Air Defense System during the period July 1979 through June 1980. Through his initiative, technical competence, excellent judgment and astute managerial ability, COL Stubbs managed and coordinated the activities of this complex program interfacing the development, acquisition, and readiness of the CHAPARRAL/FAAR. His superb management has resulted in the development of a forward looking infrared (FLIR) device that will provide the CHAPARRAL/FAAR with a night firing and adverse weather capability while doubling the operational time. COL Stubbs' performance reflects great credit upon himself, the CHAPARRAL/FAAR Air Defense System and the United States Army.

(Continued from page 5)
sistant deputy for Materiel Readiness, DARCOM, on A Perception—"Self-Inflicted Logistics Wounds;" and Mr. Frederick J. Michel, acting director of the Office of Manufacturing Technology, DARCOM, on Production Readiness Review and Its Importance to PMs.

The dinner speaker that evening was an old friend and former member of the Army RDA community, Dr. Ralph G. H. Siu. Always known as a delightful speaker with the ability to deliver a meaningful message encased in humor, Dr. Siu lived up to his reputation in his discussion of the qualities required to become a great project manager.

One essential quality, said Siu, was an ability to keep one's eye on the bases, not the ball, for he said the PM game is not unlike Chinese baseball when the rule is that anytime after the pitcher delivers the ball and the batter swings, that those in the field can move the bases anywhere they please!

As part of his presentation, Dr. Siu gave the following guidelines to the project managers, the first five to apply to their planning, and the second five to operational aspects:

- The shrike hunting the locust is unaware of the hawk hunting him.
- A mouse with but one hole is easily taken.
- In shallow water shrimps make fools of dragons.
- Do not try to catch two frogs with one hand.
- Give the bird room to fly.
- Do not insult the crocodile before you have crossed the river.
- It is better to struggle with a sick jackass than carry the wood yourself.
- Don't throw stones at the mouse and break the precious vase.
- It is not the last blow of the axe that fells the tree.
- The great project manager not only brings home the bacon but also the applesauce.

Much of the morning of the second day was devoted to the topic of force modernization. After an opening talk by BG(P) Benjamin T. Register, director for Materiel Management, DARCOM, on materiel management, COL R. E. Craven, DACS, HQDA, talked on the broad subject of Army force modernization. Craven told the group that it was an area far beyond the PMs ability, looking at the entire Army as a system. Modernization will continue, he said, out into the 1990s, with over 400 new systems of varying size, involving upwards of $38 billion. Great stresses will be exerted on the Army at all levels, involving some 40-50,000 manpower spaces as new systems are added on and the required spaces obtained from existing systems.

Craven was followed by COL Richard L. Nidever, associate director for Force Modernization, DARCOM, who expanded the subject by giving an introduction to the role of the DARCOM Force Modernization Office. COL John J. Tedesco, commander, DARCOM Materiel Readiness Support Activity, then described the current force modernization information system.

Following a presentation on Basis of Issue Plan/Qualitative & Quantitative Personnel Requirements Identification, by LTC Peter C. Boukalis, director, Equipment Authorization and Review Activity, the audience received a summary by Dr., Richard L. Haley, DARCOM deputy director for Development & Engineering, on the FY 81 R&D Program Execution.

At lunch the second day, the PMs were addressed by Hon. Robert H. Spiro, Jr., Under Secretary of the Army, who stressed the need for RSI. Noting that while RSI was political and economic in implementation, the payoffs were in military dividends to the Free World.

The afternoon session of the second day reconvened with a discussion by LTG George Sammet, Jr., (USA Retired), now with Martin Marietta, on an insight into the prime contractor-subcontractor relationships. Why should the government be interested in such relationships, Sammet asked. The answers he gave were that today's prime contractors—in a world of increasingly specialized technology, are becoming system integrators rather than fabricators. Second, contract overruns are mostly due to subcontractor problems.

Sammet noted that historically between the 15th and 35th month of a prime contract is the time when subs begin to reflect overrun problems if they weren't funded properly. The pitfalls, he noted, were poor communication between the prime and the sub, technical differences, eratic adherence to process control, inadequate supplier management, negotiating to meet the specified budget, and—most of all, a poor statement of work. A good PM, said Sammet, both in government and industry, must examine the list of potential pitfalls constantly and closely.

The remaining presentations of the day included a talk by Mr. H. James Spangler, ARRCOM, on plant utilization. He was followed by a discussion of personnel problems by BG Henry Doctor, Jr., director, Personnel Training & Force Development, DARCOM, that covered the Civil Service Reform Act implementation, the high-grade ceiling problem, and the future manpower status and the new system of ceilings by man-years of effort.

The final presentation was by COL Rudolph D. Descoteau, IG, DARCOM, who reviewed his areas of IG interest.

The final day began with a review by COL Donald M. Campbell, PM TRADE, on his responsibilities as the Army focal point for training devices and simulators. His work could be grouped into three categories: non-system devices—such as MILES; flight simulators, such as the one being developed for BLACK HAWK; and system devices as exampled by the XM1 trainer. Campbell told the audience that his workload included 77 non-systems, 5 flight simulators, 14 systems, 2 foreign military sales items, and 32 other miscellaneous programs, with a dollar value estimated to reach $300 million by FY 85.

Campbell was followed by Dr. John D. Weisz, Director, HEL,

who acquainted the audience with a new human factors engineering model. A discussion of health hazard technology management by BG Garrison Rapmund, commander, U.S. Army Medical R&D Command, was the next presentation. The general described the increasingly difficult problems arising from the potential hazards of vibration, vision, toxic fumes, noise, smokes, and emissions. There is an urgent need, he stressed, for the medical side to be brought into a system very early if later serious problems are to be avoided.

The presentation part of the conference concluded with the presentation of two awards for excellence in value engineering to MG Oliver D. Street, III, PM, Patriot, and COL William P. Farmer, PM, Nuclear Munitions.

Following an executive session conducted by LTGs Hardin and Lunn, the conference adjourned.

AMMRC Studies Prepreg Materials for Aerospace Applications

The U.S. Army Materials and Mechanics Research Center's Organic Materials Laboratory has been conducting considerable effort in the area of characterization and processing of prepreg materials (resin-impregnated reinforced broadgoods) used primarily for aerospace applications.

Prepregs produced commercially have yielded enough of a variation in properties to warrant study into these variations and the standardization of manufacturing techniques to be able to produce prepregs with predictable physical properties.

Roller-impregnation equipment from Ashton Engineering, Inc. will be used to help understand these processing factors in making prepregs. This equipment is capable of producing 6-inch tape widths continuously, using 24 rovings of glass, graphite, aramid, or other reinforcement and two component resin binders such as epoxy, with a viscosity range of 300 to 35,000 cps.

The roller impregnator system dispenses a metered ratio of resin and hardener using a fixed volume hydraulic gear pump linked to microprocessor/monitoring equipment. Ratios can be adjusted by changing gears in the pump. The two resin components meet in a static mixing chamber (resin manifold) and exit through individual oval holes on top of the manifold where there is direct contact with passing roving.

Resin flow is proportional to roving speed and is capable of accurately controlling fiber-to-resin ratio. Heat can be applied to the resin through use of independent resin and hardener cannister heaters, pump heaters, and line heaters to help make high viscosity resins more processable.

Quartz element heaters are used for preheating the rovings to remove moisture and improve wetting. The wetted rovings are worked through four rollers (two silicone rubbers, two stainless steel) to remove entrapped air.

A spacer bar collimates the rovings for delivery through chill rolls where prepreg is cooled if necessary, as well as flattened, and payoff wind-up equipment with release paper backing winds the final product on spools for immediate use or freezer storage in plastic bags.

Use of this roller-impregnator prepreg equipment will not only allow AMMRC to more closely evaluate the variables of processing but also provide the ability to economically produce hybrid prepregs not commercially available for specialty applications.

CSL Tests Training System for Chemical Defense

Researchers at the U.S. Army Armament R&D Command's Chemical Systems Laboratory are in the final stages of developmental testing of two integral items in the Army's training system for chemical defense.

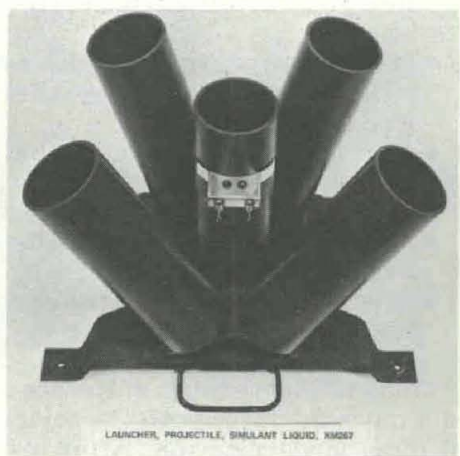
The XM11 liquid airburst projectile simulator (SPAL) that mocks an artillery airburst chemical agent attack and the XM267 projectile launcher from which the SPAL is delivered are both nearing developmental completion and will be fielded as chemical defense training devices.

According to Mary Ann Kraybill, CSL's project officer for the new items, the system must "simulate the action of a chemical agent so as to trigger detectors and provide a means for exercising protective and decontamination procedures.

The SPAL, which consists of a one liter polyethylene bottle filled with persistent chemical agent simulant, is loaded with a projection charge and a high explosive burster charge that is electrically actuated.

Used with the XM267 launcher, the SPAL simulates a liquid agent airburst attack. The launcher has five tubes for the SPAL bottles and is functioned upwind of the target. Training plans call for the two devices to simulate contamination on troops, vehicles or terrain with the liquid agent simulant.

With this system, American soldiers can be trained in simulated airburst or "toxic rain" attack during field exercises and learn the skills needed to survive and accomplish a mission in a chemical warfare environment.



Safer Helicopters Through Advanced Structural Testing

By Drew Orlino

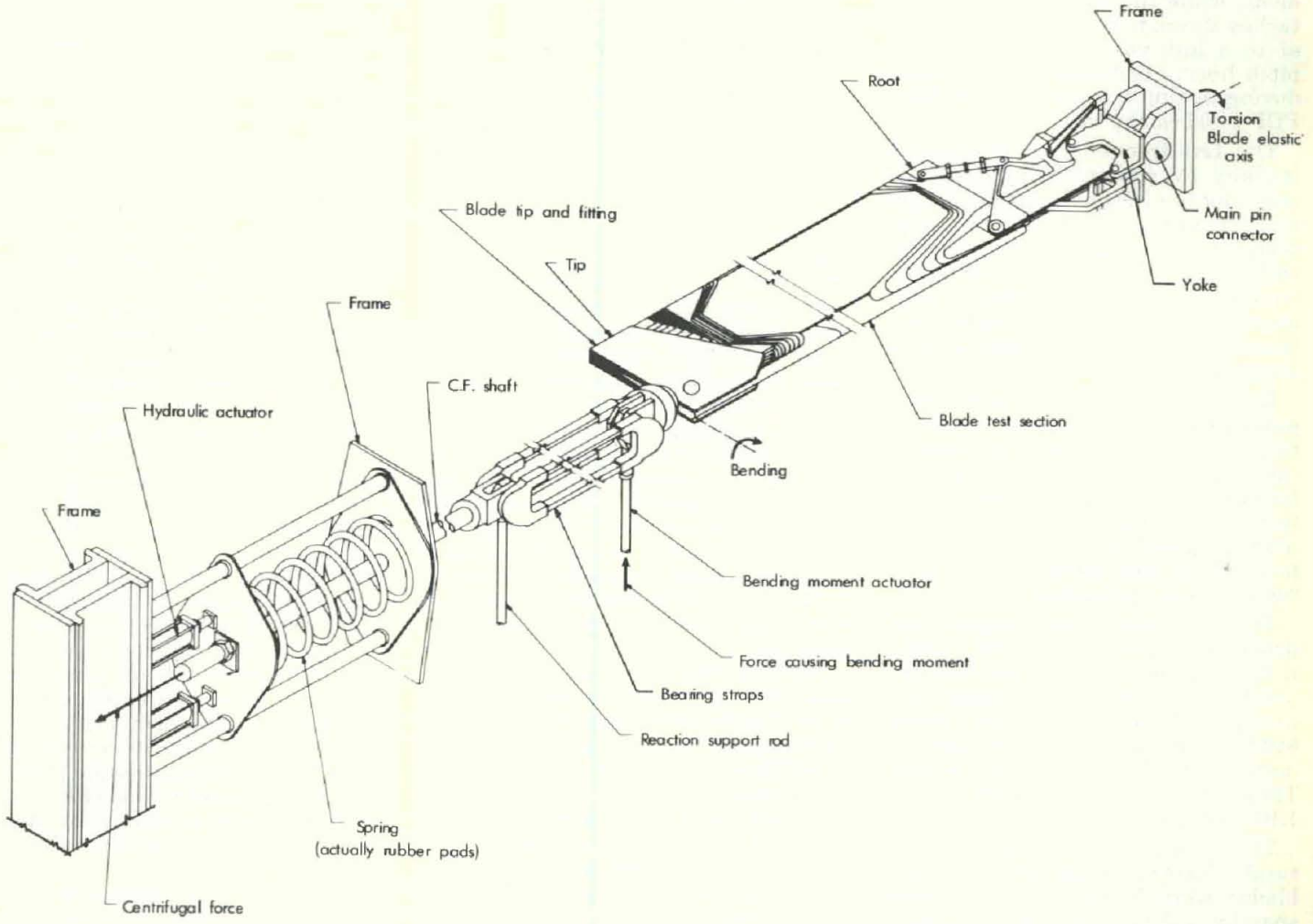


Fig. 1. Schematic of the Rotor Blade Resonant Fatigue Test Machine

New generation helicopters have come a long way since their military debut in Korea nearly 30 years ago. Military experts of that era saw the helicopter in a limited role. However, as the helicopter's performance characteristics improved, its role also broadened.

As a result of Vietnam, more focus was placed on aircraft survivability in a combat environment. For the first time, the helicopter was acquiring a multi-role capability in a different type of war and the application of the helicopter was expanded to include attack, scout, and observation as well as cargo and utility missions. These new missions placed increased emphasis on and fostered rapid evolution of rotary-wing technology.

Increased flight safety and the reduction of crash injury and fatalities became prime factors in the thrust of research and development on helicopter structures. More sophisticated structural testing techniques were needed to meet these new demands.

As late as 1974, the Applied Technology Laboratory (ATL), U.S. Army Research and Technology Laboratories (Aviation Research and Development Command), Fort Eustis, VA, had an extremely limited structural testing capability to support its R&D programs. Most structural testing at that time involved contractual efforts with rotary-wing companies.

Full-scale testing was possible under contract, but there was no accurate simulated flight load test capability available. This prompted ATL to obtain a test machine capable of accurately simulating flight loads on full-scale rotor blades.

This machine, delivered to ATL in May 1974 and called the Rotor Blade Resonant Fatigue Test Machine, is the only government-operated fatigue test machine capable of accurately simulating the tension, bending, and twisting that a rotor blade experiences during flight. The machine also has the capability of accelerating the accumulation of simulated rotor blade flight hours, by vibrating the rotor blade at its natural or "resonant" frequency.

With this new capability, ATL could conduct full-scale rotor blade fatigue tests in order to solve the kind of problems encountered in the field such as debonding, combat damage, cracking, and foreign object damage as well as trouble shooting problems that might arise through new designs.

The test device is approximately 44-feet long, 10-feet wide, 12-feet high, and can accept specimens up to 24-feet in length. The machine consists of a frame, a centrifugal loading system, hydraulic actuator sub-

systems, and blade attachment fittings (Figure 1).

A blade is mounted in the machine at the tip through a doubler arrangement, while the blade's root end attaches through its root fitting adapter to a hub yoke which contains a pitch horn. Loads applied to a blade during testing are stored in the DEC PDP 11/05 computer.

The test frequency is determined initially by manual adjustments in increments of .005 Hz, about a normal frequency, and is stored in the computer. Loading is then automatically applied by the computer through a controlled function generator which inputs a sine wave function to the two actuators operating in stroke control.

Limits are incorporated in the computer program to ensure the fatigue test will continually be conducted at the resonant frequency. If the test frequency drifts outside these limits, testing ceases automatically. In this manner testing continues for 24 hours a day with technicians making "spot checks" twice daily.

The first rotor blade fatigue test program occurred in July 1974 when a Risk Assessment Team was appointed to investigate the recent catastrophic failure of four Bell Model 540 main rotor blades after approximately 700 flight hours of service. These blades had an assigned life of 1,100 flight hours.

The team concluded that the structural failures experienced by the four blades were initiated in the blade spar by a debond between the spar and spar spacer (Figure 2), which caused local fretting, ultimately resulting in a fatigue crack.

After the team performed a statistical analysis to establish life for the blade, three blades were tested at ATL during the following 6 months to confirm a fatigue life of 550 hours in addition to determining the critical length of debonds for this blade model. The critical debond length established was 36-inches. Blades having debonds longer than this were designated as being unsafe for flight.

AVRADCOM then formed special inspection teams to determine the serviceability of these blades throughout the world on a one-time inspection basis. Remaining blades were designated as being safe for flight, but were restricted to a service life of 550 hours.

The next program to follow was the "Model 540 Rotor Blade Crack Propagation Investigation" undertaken as a portion of an overall effort to investigate the effect of ballistic damage on a variety of metal and composite rotor blades. The objective of this program was to investigate, through analysis and test, the rate of crack propagation in a metal blade spar from an induced defect.

When a rotor blade spar is subjected to ballistic impact, the resulting damage is generally an irregularly shaped hole with many sharp edges that produce stress concentrations. Normally one sharp edge will produce the most critical stress concentration. From this point a fatigue crack will initiate and propagate. Therefore, a 3/4-inch diameter hole with a saw cut was introduced into the top surface of the blade spar. The blade was fatigue tested at maximum level flight loads and crack growth was monitored.

This experimental data were then compared with analytical predictions to obtain a measure of the ability to predict crack growth characteristics. Based on the results of this program, ATL could predict crack growth behavior of a controlled defect in a metal blade spar if certain modifications were made to existing analytical techniques.

Another research effort completed was the "Metal Blade Repair Program," which evaluated the field repairable—expendable rotor blade (FREB) repair concept for metal rotor blades. This repair technique, originally consisting of nomex-honeycomb core and metal skins, proved favorable by withstanding high speed level flight loads during fatigue testing. Subsequently, this technique became available for field use and is presently the standard repair technique for the K-747 Composite Main Rotor Blade.

At the present time, an investigation is underway by ATL to study the propagation characteristics of typical manufacturing flaws as they appear in composite main rotor blades during fatigue loading. The objective here is to take one of the first sets of K-747 composite main rotor blades fabricated during the early R&D program and subject these blades to flight loads based on the Bell Helicopter Textron (BHT) flight spectrum encompassing 105 maneuvers encountered by an attack helicopter during a 2-hour mission.

Since production blades are fabricated with very few flaws, if any, it was important to fatigue test the early R&D blades because of their void content. After completing 1440 simulated flight hours of fatigue testing on one K-747 blade, it was concluded that voids in early R&D blades do not pose a problem for flight crews and can successfully withstand in-service usage.

Since 1974, ATL has installed a root end/midspan fatigue test machine. This fatigue test machine allows the testing of the root end midspan sections of a blade simultaneously—a new procedure that eliminates testing each section individually in two separate setups. ATL recently acquired a full-scale aircraft self-reacting load frame (Backstop) which is capable of conducting structural dynamic testing on full-scale helicopters.

The structural testing capability of ATL is continually increasing. The Laboratory already has a rotor blade fatigue testing capability that is

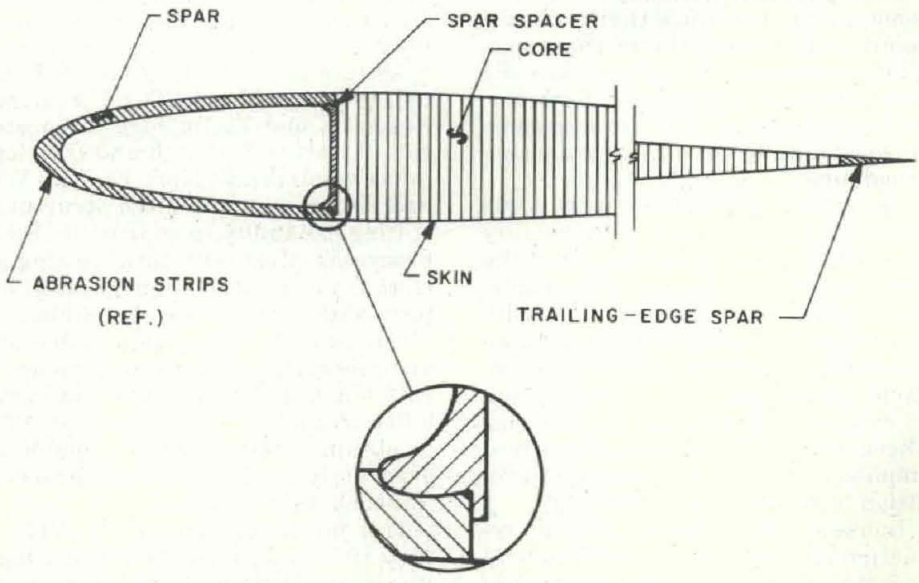
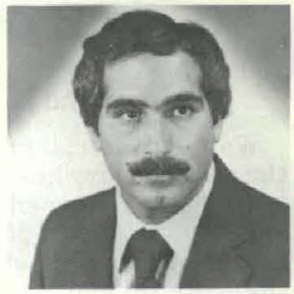


Fig. 2. Blade Spar With Debond Between Spar and Spacer

"second to none." The "backstop" will add a new dimension to the structural testing of helicopters.

As the role of the helicopter continues to broaden, ATL will continue its thrust for research and development of helicopter structures in order to meet its primary goal: to identify and solve potential problems before they arise.

DREW ORLINO is employed in the Structures Technical Area at the Applied Technology Laboratory, Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, VA. He is presently the project engineer of the K-747 Composit Main Rotor Blade Fatigue Test Program and is involved with the superplastic forming process of aluminum and titanium alloys. He holds a BS degree in aerospace and ocean engineering from Virginia Tech, and is currently studying for his MS in mechanical engineering at George Washington University.



Army-Industry Cooperation Improves M113 Ballistic Liners

Cooperation and active participation between a number of government agencies and industry has led to the development of ballistic liners for the M113 personnel carrier (see *Army RDA Magazine* July/August 1980).

Under the U.S. Army Materials and Mechanics Research Center's (AMMRC) coordination (Dr. Joseph J. Prifti and Mr. Eugenio DeLuca), the unique capabilities of participating Army laboratories and contractors were combined to generate a comprehensive data package to ballistically characterize an array of spall suppression liner materials and quantify the vulnerability reduction relevant to M113 installation.

FMC Corp., under AMMRC contract, and the Materiel Testing Directorate (MTD) collaborated in generating ballistic data and evaluating liner materials in conjunction with M113 armor versus weapon threats to M113 personnel. Utilizing the test results, the Ballistic Research Laboratory verified the reduction in vulnerability achieved with liners employing sophisticated computerized codes for the M113 system.

BRL also conducted a highly relevant investigation in which the favorable radiological protection afforded by liner materials was calculated and contrasted to current fielded M113s exposed to tactical nuclear weapons. The Chemical Systems Lab will be experimentally determining the effects of biological and chemical agents on optimal Kevlar liners.

Current efforts include the Army Materiel Systems Analysis Activity's computerized survivability assessments for the lined M113 versus typical battlefield scenarios. The Human Engineering Laboratory, MTD, and AMSAA will continue to provide guidance to AMMRC and FMC Corp. which is scheduled to install liners within M113 hulls and vehicles to be followed by test and evaluation.

This effort is being closely coordinated with the Tank and Automotive R&D Command, which is following-on with an MM&T program to implement liners for the M113.

Other contributing private contractors include, Mr. D. R. Kennedy, who e technical input and liaison have proven invaluable; and Honeywell, Inc. which expertly conducted novel GAU-8 ballistic testing on M113 aluminum.

Successful development of optimal liners for M113 vehicles is directly attributed to the highly cooperative efforts of the participating laboratories and contractors. Important contributions also came from other government agencies and industries. Continued cooperation will be required to complete the implementation of ballistic liners for the M113 and similar combat ground vehicles.

ETL To Develop Quick Response Multicolor Printer

COL Daniel L. Lycan, commander and director of the U.S. Army Engineer Tropographic Laboratories (ETL), Fort Belvoir, VA, has announced that development will begin on an advanced prototype xerographic color map reproduction system, the Quick Response Multicolor Printer (QRMP). Representatives from both Xerox Corp. and the Federal Government agreed on a $6.4 million contract calling for the development of this system.

Experts at ETL, originators of the QRMP, believe that by using color xerographic reproduction techniques, it will be possible to meet military requirements for the quick production of high quality, cost effective, multicolor reproductions of topographic maps, terrain intelligence information, overlays for existing maps and multicolor overprinting onto convertional maps.

Development of the QRMP is considered a significant breakthrough in mapping reproduction technology. The addition of a laser scanner has improved the "dry copying" process by making possible the high resolution necessary for map reproduction. New laser technology will provide greater reliability and simplification, making the QRMP easier to repair and maintain.

It is estimated that the QRMP will produce 24" by 30" maps at a speed greater than one map per minute with one run through the printer. A single-color press now in use in the field requires about eight hours to print 500 five-color maps. The QRMP will weigh significantly less than current presses, will be mobile enough to move from place to place, and requires less manpower and a lower skill level to operate and maintain.

Mr. Fred Myers, QRMP project engineer at ETL, estimates the prototype, which will be built by Electro-Optical Systems Division of Xerox, Pasadena, CA, will be completed by mid-1983.

Moving—Being Transferred?

To ensure continued receipt of the magazine, persons, both Active and Reserve, who are authorized individual copies, should give timely notice of their new address. Instructions on where to send address corrections are given on the inside of the front cover. DO NOT SEND CORRECTIONS to the magazine editorial office, as mailing labels are provided the magazine by the agencies mentioned in the instructions. Changes of address must be given to your duty station military personnel office. Regulations also require that you receive the magazine at your duty station address, not your home.

The U.S. Army's Mobility Energy R&D Plan

By Maryland D. Kemp

World industrial growth during the past century has been characterized and hastened by the widespread availability of inexpensive energy, primarily petroleum. But the Arab Oil embargo of 1973 and subsequent energy supply interruptions emphasized a number of points, key among them being that the world's principal oil-consuming countries are not the major oil producers. The Middle East and Africa have an estimated 67 percent of the world's petroleum reserves while Western Europe and the Western Hemisphere have only 16 percent. By most estimates, these reserves are expected to be exhausted within the next 70 years.

In the 1973–74 time frame, prices for petroleum rose threefold, signaling the end of inexpensive oil. Distribution of alternative sources of recoverable oil, such as tar sands and oil shale, favor the Western Hemisphere, but economical recovery techniques to exploit these resources have not been developed. Coal constitutes 81 percent of the U.S. energy reserves but supplies only 18 percent of the energy consumed.

The U.S., with 6 percent of the world's population, consumes more than 30 percent of the world's energy. It uses more energy per dollar of Gross National Product (GNP) than any other industrialized nation. Petroleum is used primarily for transportation, coal is used principally for electric utilities and industry, and natural gas is preferred for residential heating and some industrial uses.

Petroleum production in the U.S. peaked in 1970 and has slowed since then. As a result, in 1977 the U.S. imported approximately 50 percent of its crude oil requirements. Many analysts predict that the U.S. petroleum reserves will be exhausted before the year 2000, thereby creating a significant problem for the nation and the Department of Defense (DOD).

The national energy strategy is reflected in the following objectives established by the President on 29 April 1977 in the National Energy Plan I and reinforced in the National Energy Plan II, May 1979: in the near term, to reduce dependence on foreign oil and to limit vulnerability to supply disruptions; in the mid term, to keep U.S. oil imports sufficiently low to weather the eventual decline in the availability of world oil supplies caused by capacity limitations; and in the long term, to develop renewable and essentially inexhaustible sources of energy for sustained economic growth.

Some of the key specific national goals cited by the President, to be accomplished by 1985, are as follows: reduce energy usage growth to 2 percent per year, reduce gasoline consumption by 10 percent, increase coal production by 67 percent, use solar energy in 2½ million homes, and reduce energy consumption in federal buildings by 20 percent in existing buildings and 45 percent in new buildings.

While DOD consumes 1.8 percent of the nation's energy, it consumes over 3 percent of the total petroleum used by the U.S. DOD then, established energy conservation goals of attaining in FY74 a 7 percent savings over FY73, and in FY75, a 15 percent savings over FY73. And after that the goal was to hold to a zero percent growth over the FY75 level. All of these goals were achieved; some were exceeded.

The Army, for its part, operated through 1977 under the following energy management objectives: conserving energy while maintaining readiness; maintaining zero growth based on FY75 total energy consumption; and maintaining a supportive and cooperative role with designated national energy authorities in the development of new energy sources.

After reviewing the entire energy situation looking to the year 2000 and in consideration of the presidential goals, the Army Advisory Group on Energy (AGE), on 1 December 1977, established goals and objectives which were subsequently revised in August 1979.

The current goals are three in number. First, the Army aims to reduce energy consumption by 35 percent by the year 2000. Under this it seeks to reduce energy consumption in mobility operations by 10 percent by FY85 with zero growth to the year 2000 with no degradation to readiness; reduce energy consumption in facilities operations by 20 percent by FY85 and 40 percent by the year 2000; and to expand energy conservation education/information and incentive programs for all Army military and civilian personnel and their dependents.

The second major goal is to reduce dependence on nonrenewable and scarce fuels by the year 2000. Here the objectives are to develop capability to use synthetic/alternate fuels, and to increase systems efficiency by 15 percent. For facility oriented fuels the objective is to develop a capability to use synthetic gas to replace natural gas, and to reduce consumption of heating oil by 75 percent.

The third goal is to attain a position of leadership in the pursuit of national energy goals. Based on 1977 data, the Army's share of DOD energy consumption is 17 percent. Of that amount, 83 percent is consumed in installation or facilities operations and 17 percent in mobility operations.

Between FY73 and FY75, the Army reduced its consumption by 23.6 percent, exceeding the DOD goal by 8.6 percent. In FY75, the Army consumed 277 trillion Btu of energy at a cost of $545 million.

In FY78, despite reductions of approximately 6.8 percent in consumption compared with FY75, the costs rose above $780 million. If the Army were to maintain the FY75 level of energy consumption to the year 2000, the cost of energy for that year would be expected to exceed $3.1 billion.

On the other hand, if the Army meets its newly adopted goals,

the costs would be $1.8 billion in FY2000, resulting in a cost avoidance of $1.3 billion. The estimate for the total cost avoidance for the 20-year period between FY80 and FY2000 would be in excess of $11 billion. These energy-related savings do not take into account the Army's industrial support energy requirements.

The DOD, in response to the consideration of assured supply of energy, particularly mobility fuels; and in support of DOD's primary aim of maintaining the operational readiness of our strategic and tactical forces, has established the following general energy objectives:

- Broaden the range of mobility fuels which can be used in military systems, with primary emphasis on domestically produced synthetic fuels.
- Promote energy conservation with primary emphasis on the development of more efficient propulsion and power generation equipment. Reduce the dependence of military installations, particularly remote bases, on petroleum derived fuels, by promoting the use of more abundant or renewable energy sources where liquid hydrocarbon fuels and natural gas are now used.

To support these objectives, specific R&D efforts are underway to:

Develop for propulsion systems, testing and evaluation procedures and broad range specifications compatible with newer emerging funds from a variety of sources.

Limit the level of energy usage by increasing the efficiency of mobile equipment used in operation and training.

Increase the use of simulators in bridging artillery and air drop modeling of equipment to reduce fuel consumption.

Develop alternate/synthetic fuels derivable from domestic/renewable supplies.

MERADCOM has been designated as the DARCOM Lead Command to develop an Army Mobility Energy R&D Plan. The overall objective of the Plan will insure a cohesive, coordinated program. This will lead towards a stronger more efficient Mobility Energy R&D Program.

National security objectives can be achieved only if we are prepared to meet essential Military energy requirements. The ability of the U.S. to deter armed conflict, to respond to Military aggression, to field modern and effective weapons, to meet our worldwide commitments, even to exist as a nation, depends upon the availability of an adequate supply of energy. At the same time, the Military must also be aware and account for the needs of the economy.

Management of any project or program in the Army Mobility Energy R&D Plan will remain the responsibility of the appropriate R&D Command. MERADCOM will continue to update the Army Mobility Energy section, coordinate and monitor responses to DARCOM/DA/DOD inquiries and assure compatibility and non-duplication with other services, DOE, and other Government agencies. MERADCOM will also develop and apply an "assessment" methodology to define system performance and evaluation using an up to date data base, insure technology transfer (of a general nature) and provide user assistance.

Responsibility for the preparation, implementation and coordination of the Plan is in the Energy and Water Resources Laboratory, Fuels and Lubricants Division. The Point of Contact is Maryland D. Kemp, AV 354-4594; Commercial (703) 664-4594.

MARYLAND D. KEMP is a chemist and senior staff scientist with the Energy and Water Resources Laboratory, Fuels and Lubricants Division, MERADCOM. He holds a BS degree in chemistry from Johnson C. Smith and an MS degree in chemistry from Howard University. As the recipient of a Secretary of Army Research and Study Fellowship, he has done advanced study in the Kinetics of Crystal Growth at the University of Briston, England, and has been a frequent contributor to professional literature.

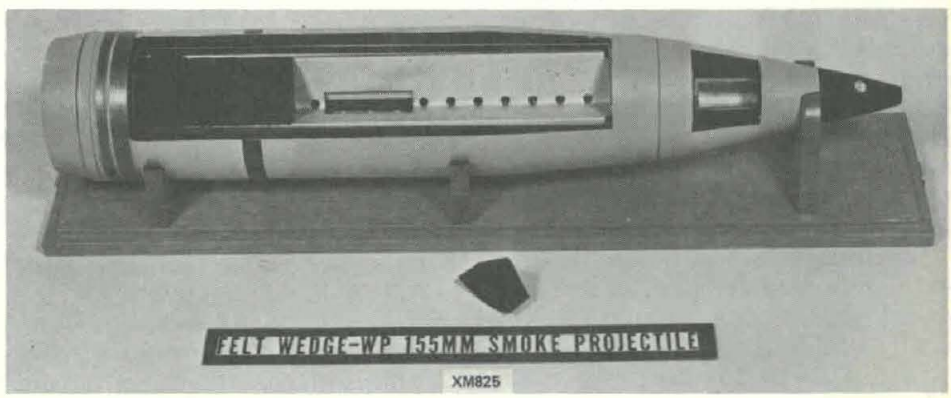
XM825 Development Nears Completion at CSL

Engineering development of the XM825 155mm improved screening smoke projectile is nearing completion at the U.S. Army Armament R&D Command's Chemical System Laboratory. It will reportedly provide a significant improvement in visual ground screening effectiveness over the Army's current standard projectiles.

According to Mr. James L. McKivrigan, CSL's project officer, "The XM825 is an artillery-delivered projectile that ejects white-phosphorus (WP) saturated felt wedges above the target area. The wedges fall to the ground producing a dense obscuring cloud up to 250 meters long.

"There are a total of 116 felt wedges in all, capable of producing improved dispersion and persistence of a WP smoke screen for up to 10 minutes," said McKivrigan, who is assigned to the Munitions Division of CSL.

The projectile, which is designed for use with the M109A1 and the M198 howitzer weapon systems, is expected to be adopted for Army use within two years.

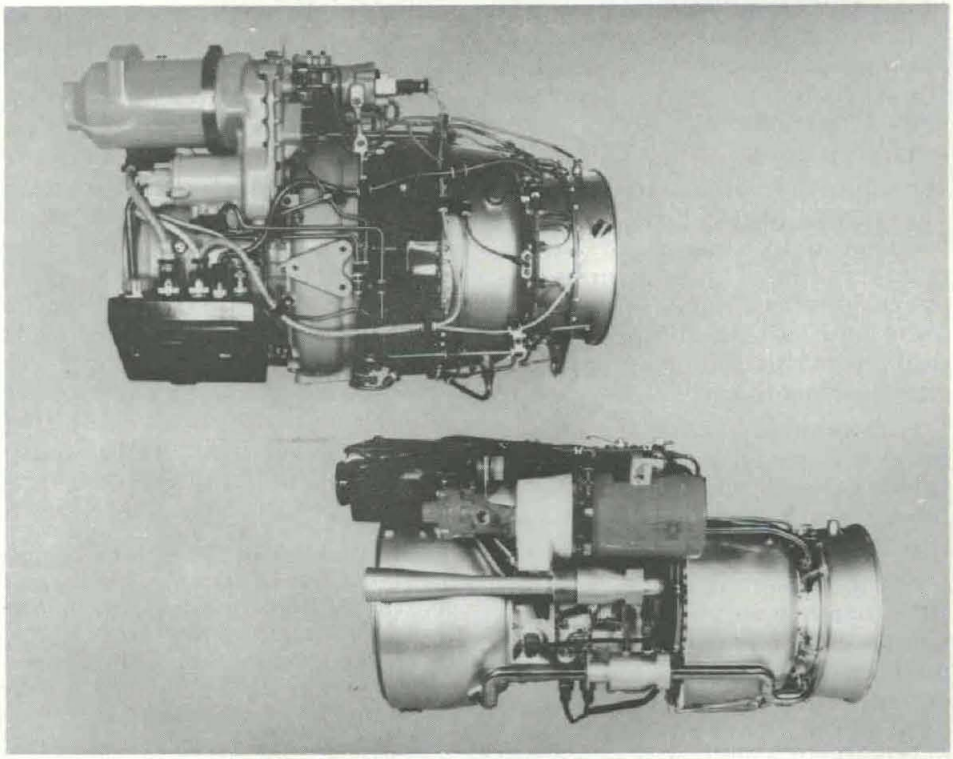


800 h.p. Demonstrator Engine Exceeds Fuel Consumption Goal

By Roger G. Furgurson

The Applied Technology Laboratory (ATL), U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, VA, has announced the achievement of one of the most significant goals in its 800 Horsepower Advanced Technology Demonstrator Engine (ATDE) program.

During recent engine testing, the fuel consumption characteristics of the ATDE were determined to be better than the goal established at the beginning of the program. The ATDE has lower fuel consumption, i.e., the amount of fuel burned per hour for each horsepower being developed, than any known turboshaft engine in the world under 1,000 horsepower.



TWO CANDIDATES in the 800 h.p. Advanced Technology Demonstrator Engine (ATDE) Program being conducted by the Applied Technology Laboratory, U.S. Army Research and Technology Laboratories, U.S. Army Aviation R&D Command, Fort Eustis, VA. Top: Detroit Diesel Allison ATDE mockup. Bottom: Avco Lycoming ATDE mockup.

Fuel consumption—You can strike up a conversation on this subject in any group at any time. Since the embargo in 1974 and particularly since the gas lines of 1979 and the $1.25 and up per gallon prices of 1980, everyone is tuned into the need to conserve energy.

Engineers and others dealing with the design of most combat vehicles have always been concerned about fuel consumption, but sensitivity to this aspect of performance is greatest in aircraft design. A combat helicopter can carry more payload or operate over a wider mission radius if it is equipped with more efficient engines.

In addition to the obvious operational improvements that are brought about by lower fuel consumption, very significant lifecycle cost benefits are realized because of the high cost of fuel. But how does an engine with significantly better fuel consumption find its way into a new Army aircraft?

Turbine engines have historically required considerably more development time than the aircraft which they power. Unless the engine development is started earlier than the aircraft development program, the two schedules will not be compatible. This has frequently been a problem for senior level DOD managers due to the difficulty of obtaining approval for a high level of funding for engine development prior to the complete aircraft system having been approved. The concept of a demonstrator program was conceived to fill this gap.

For a fraction of the cost of full-scale development, the demonstrator program can determine the potential level of performance for a particular engine configuration. Since more than one developer participates in the demonstrator phase, some options exist prior to committment to full-scale development.

However, in order for the demonstrator phase to produce truly meaningful results the program must consider all requirements of an Army helicopter engine. Due to the very nature of helicopter operations, the engines are required to cope with a severe environment.

Landings are routinely made in unprepared areas, creating a large quantity of flying dust, leaves, sticks, hay, grass or any other material that may become airborne when whipped by the hurricane force winds of the rotor down wash. An inlet protection system must be incorporated to protect the engine from this debris. The demonstrator engine incorporates this protective system in its basic design so that the demonstration performance includes any losses associated with such a system.

An Army helicopter must be maintained by Army personnel sometimes under adverse conditions with a minimum of tools and

equipment. The engine design must consider the method of disassembly, location of removable items, available access to bolts, screws, etc. Sometimes these considerations adversely impact performance. Trade-offs have to be made.

The eventual cost of producing an engine must be reasonable. Many factors can affect engine production cost—type of materials, methods of fabrication, and the basic component design. Some of these can, in turn, affect performance. All of these factors are considered during the demonstrator program so that the performance attained is realistic.

When the complete aircraft system development nears and detailed planning is initiated, the aircraft systems manager has realistic engine performance and cost information available to him. The subsequent full-scale engineering development will be at less risk and the engine and aircraft schedules will be compatible.

Planning for the 800 Horsepower ATDE program began early in 1975. Its content and structure were based upon the Army's previous 1,500 Horsepower Demonstrator Engine Program. This earlier demonstrator program provided the technical foundation for the T700 engine which now powers the new Blackhawk and Advanced Attack Helicopter. A slightly modified version of the T700 also powers the Navy's new Seahawk Helicopter.

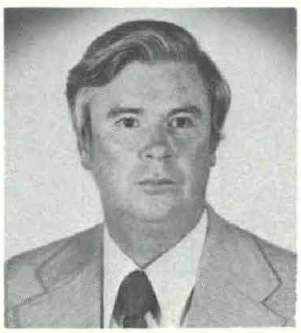
The ATDE program consists of two separate efforts being undertaken by AVCO Lycoming and Detroit Diesel Allison. Approximately 500 hours of engine testing will be accomplished by each contractor, to include environmental tests to determine the effects of sand and dust, low temperature operation, and temperature distortion at the engine's inlet.

Performance determination and durability testing will also be conducted. At the end of June 1980, approximately half of the testing was completed. During this testing the fuel consumption characteristics were determined to be better than the original program goal.

Although testing to date has to be considered preliminary, it does show that the aerothermodynamic efficiency of the components is close to the design goal. Further development will almost surely improve the performance attained so far.

An 800 horsepower turboshaft engine could power a variety of current and future aircraft in either single- or twin-engine configurations. Light utility and attack aircraft will be needed in the future Army fleet to supplement recently developed larger aircraft filling these roles.

The current UH-1 and Cobra aircraft will be phased out in future years. A need also exists for a new scout type aircraft. A new advanced engine could greatly enhance the capabilities of these aircraft while at the same time expend far less fuel and result in a lower life-cycle cost.



ROGER G. FURGURSON has been with the Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM) at Fort Eustis, VA, since 1965. He is now one of the two project engineers for the Advanced Technology Demonstrator Engine (ATDE) program. He received a BS degree in mechanical engineering from Virginia Polytechnic Institute in 1959.

ADCC Project Office Rejoins MICOM

The Huntsville-based office that is developing computer-driven command and control systems for Army air defense weapons has rejoined the Army Missile Command family.

The Air Defense Command and Control (ADCC) Project Office, formerly assigned to the Army Communications Research and Development Command but located in Huntsville Research Park, was transferred to MICOM effective Oct. 1.

The office initially joined MICOM in 1964 but left in 1971 when it was transferred to the then Electronics Command.

"Most of the weapon systems we interface with are MICOM systems," said COL David Wyatt, ADCC project manager and Mr. William Fondren, his civilian deputy. "For this reason we believe the air defense command and control mission can be accomplished more effectively under MICOM."

The project office, with approximately 65 people, is developing new command and control systems for several short-range Army weapons, including Stinger, Chaparral, Roland, Vulcan and the Divad gun.

"In operation, the equipment will receive and process information from radars and provide directional information for acquiring targets to the various gunners," Wyatt and Fondren said. "We anticipate fielding the equipment in the mid to late eighties."

The ADCC project office also manages Missile Minder, a computerized command and fire control system currently deployed with the Army's Hawk and Nike Hercules missiles and will support Patriot when that system is deployed.

Missile Minder not only controls surface to air missile batteries but coordinates air defense operations with the Navy, Air Force and Marines.

Missile Minder receives, processes, displays target information, evaluates the threat, and assigns the appropriate Hawk or Hercules fire sections to the hostile threat. In addition to showing the battlefield scenario, both friendly and enemy forces, and directing anti-aircraft weapons, Missile Minder can coordinate with interceptor control centers and show the unit engaging the enemy.

DARCOM Program

Shown on these pages are 52 of the Army's program/project managers. This listing is correct as of 1 November 1980. Additional information regarding the Program/Project Manager Program may be obtained from the Office of Project Management, ATTN: DRCPM, HQ DARCOM, 5001 Eisenhower Ave., Alexandria, VA 22333. Phone: Autovon 284-9572, or Commercial (202) 274-9572.

GLOSSARY OF ACRONYMS:

AAH-Advanced Attack Helicopter
ACVT-Armored Combat Vehicle Technology
ADCCS-Air Defense Command Control System
ADTDS-Air Defense Tactical Data Systems
ASE-Aircraft Survivability Equipment
ASH-Advanced Scout Helicopter
ATACS-Army Tactical Communications Systems
ATD-Armor Training Devices
CAC-Control & Analysis Centers
CAWS-Cannon Artillery Weapons Systems
CE-Commercial Construction & Selected Material Handling Equipment
CHAP/FAAR-Chaparral/Forward Area Alert Radar

AAH

MG Edward M. Browne

TADS/PNVS

PHOTO NOT AVAILABLE

COL Donald P. Wray

ASE

COL Daniel J. DeLany

CAC

COL Kenneth M. Irish

ACVT

LTC James B. Welch

ATACS

COL Glen L. Rhodes

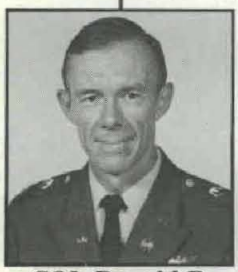
ADCCS

COL David L. Wyatt

TOS/OITDS

COL Alan B. Salisbury

COBRA



COL Donald R. Williamson

CE

LTC Raymond F. Vachon

DCSCS

MG Donald R. Lasher

DIVAD

COL Charles C. Adsit

FAMECE/UET

COL Richard H. Benfer

FVS

PHOTO NOT AVAILABLE

BG Donald P. Whalen

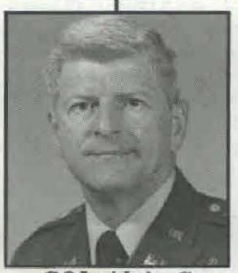
M60 TANKS

COL Paul C. Bayruns

M113

LTC James A. Logan

MEP



COL Alvin G. Rowe

MLRS

COL Monte J. Hatchett

MSCS

COL Donald J. Callahan

NAVCON

COL LeRoy White

SMOKE

COL Samuel L. Eure

SEMA

COL Sylvester C. Berdux

SOTAS

COL Wayne B. Davis

STINGER

COL James E. Rambo

TMDS

LTC Joseph C. Marangola

RPV

COL George F. Christensen

Project Managers

DCSCS-DCS-(Army) Communications Systems
DIVAD-Division Air Defense Gun
FAMECE/UET-Family of Military Engineer Construction Equipment/Universal Engineer Tractor
FIREFINDER/REMBASS-Firefinder/Remotely Monitored Battlefield Sensor Systems
FVA-Fighting Vehicle Armament
FVS-Fighting Vehicle Systems
HELLFIRE/GLD-Heliborne Laser Fire & Forget Missile System/Ground Laser Designators
HET-Heavy Equipment Transporter
ITV-Improved TOW Vehicle
MEP-Mobile Electric Power
MLRS-Multiple Launch Rocket System
MSCS-Multi-Service Communications Systems
NAVCON-Navigation Control Systems
NUCMUN-Nuclear Munitions
PLRS/TIDS-Position Location Reporting System/Tactical Information Distribution Systems
RPV-Remotely Piloted Vehicle
SANG-Saudi Arabian National Modernization Program
SEMA-Special Electronic Mission Aircraft
SINCGARS-Single Channel Ground & Airborne Radio Subsystem
SOTAS-Stand-Off Target Acquisition/Attack System
TACFIRD/FATDS-Tactical Fire Direction System/Tactical Information Distribution Systems
TADS/PNVS-Target Acquisition Designation System/Pilot Night Vision System
TMAS-Tank Main Armament Systems
TMDS-Test Measurement & Diagnostics Systems
TOS/OITDS-Tactical Operations System/Operations & Intelligence Tactical Data Systems
TRADE-Training Devices

30MM

LTC David W. Logan

ASH

COL Ivar W. Rundgren

TACFIRE/FATDS

COL Harold E. Luck

PLRS/TIDS

COL Robert D. Morgan

BLACKHAWK

COL Donald K. Andreson

CAWS

COL Robert W. Pointer

CH-47M

COL Terry L. Gordy

CHAP/FAAR

COL Harold E. Stubbs

FVA

COL William R. Sowers

FIREFINDER/ REMBASS

COL John S. Chesbro

HAWK

COL Lynn H. Stevens

HET

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LTC Ronald J. Charbonneau

HELLFIRE/GLD

COL Stanley D. Cass

ITV

COL James A. Chernault

NUCMUN

COL William P. Farmer

PATRIOT

MG Oliver D. Street

PERSHING

COL William J. Fiorentino

SATCOM

COL Charles F. Lindberg

SANG

BG Gerald T. Bartlett

SINCGARS

COL Aaron E. Wilkins

TOW/DRAGON

COL Neil S. Williamson III

TRADE

COL Donald M. Campbell

ATD

LTC Harry Meeth III

VIPER

COL Caron J. Larkins

XM1 TANK

MG Duard D. Ball

TMAS

COL David A. Appling

Wire Strike Protection for Helicopters

By LeRoy T. Burrows

Wire strike protection for Army helicopters and their crews is on the way. Unfortunately, too late for some; but fortunately, in time for many. To the uninitiated, this may not seem like a very big deal. The average citizen views communications and power cables as an unobtrusive necessity but to the helicopter pilot these wires are a dangerous obstacle to the completion of a mission.

In-flight wire strikes are a serious threat during all-weather daytime and nighttime helicopter operations such as terrain flight (NOE, low level, contour), inclosed area takeoff/landing, and confined area maneuver. The U.S. Army's growing emphasis on these operations is a major reason for the recent increase in wire strikes experienced.

In the 19 March 1980 *Flightfax*, the U.S. Army Safety Center reported that in the first four months of FY81, four lives were lost in wire strike mishaps and four helicopters were destroyed.

Despite peacetime training emphasis on avoiding wire strikes, the Army Safety Center reports that during the period 1 January 1974 to 1 January 1980, wire strikes accounted for: 8 percent of total Army aircraft damage; 6 percent of total Army aircraft injuries; and 16 percent of total Army aircraft fatalities.

The loss of men and materiel in peacetime due to wire strikes is a serious problem that may be greatly amplified in a combat situation, adversely affecting mission effectiveness. Typically, in a hostile environment, we can expect the enemy to string wires as an intrusion countermeasure.

Since the emphasized operations require flight close to the ground during varying degrees of visibility, the hazards presented by wires cannot be eliminated. However, the effects of these hazards can be effectively reduced by configuring the helicopter system to withstand wire strikes.

Increasing helicopter survivability to the wire strike threat will result in fewer mishaps, and therefore, increased aircraft availability, decreased maintenance, reduced casualties, and improved mission effectiveness.

The Applied Technology Laboratory (ATL) of the U.S. Army Research and Technology Laboratories (AVRADCOM), located at Fort Eustis, VA, has been active in analyzing the wire strike problem and defining concepts that will make a helicopter more tolerant to this threat.

In 1978 this author visited the Canadian National Defence Headquarters (NDHQ) to review the design of a Wire Strike Protection Concept conceived by Bristol Aerospace Ltd (BAL) under NDHQ sponsorship. Ironically, their concept was almost identical to one for which ATL was formulating a development effort, except the ATL concept included skid gear protection.

It was pointed out that U.S. Army wire strike mishap statistics strongly supported the need for skid gear protection from wire snags and that this would be a worthwhile addition to the Canadian design.

BAL redesigned their concept to include skid gear protection and named it the Wire Strike Protection System (WSPS). It resulted in a design that is consistent with U.S. Army goals of simplicity, light weight, retrofit suitability, low cost and high effectiveness for any wire strike protection concept.

The WSPS is a cutter/deflector system with a lower cutter (Figure 1) to protect the skid gear; an upper cutter (Figure 2) to protect the main rotor controls; and a windscreen center post deflector with a serated cutting edge insert to deflect wires to upper cutter, to cut copper and aluminum wires, and to enhance counterpost structure.

The WSPS is a passive system, having no moving parts. Upon wire impact, the helicopter momentum deflects the wire/cable into the upper or lower wedge shaped cutter where it is notched to the extent required for easy breakage in tension. The total OH-58A WSPS weight is 16.3 pounds, including all supporting structures and the mounting plates.

In May 1979, the Canadian WSPS was qualified for Canadian Kiowa helicopter (OH-58A) application. BAL conducted at a Gimbli, Manitoba, Canada site, a series of 52 wire cutting tests. A deflector and upper cutter were mounted on a wrecked Kiowa fuselage and rigidly secured to the flatbed of a truck. The truck was driven into various wires.

Test variables included speed (15 to 60 mph), yaw angle (0 to 45°), and strike location (nose to top of cutter). This author arranged for a DARCOM/TRADOC/Safety Center team to witness part of this test series.

Concurrently, the Canadian Aerospace Engineering Test Establishment conducted a flying qualities qualification of the OH-58A with the WSPS installed. (No wires were cut in these tests.) All tests were successful and no significant effects upon aircraft performance were noted.

The wire cutting test method employed by BAL validated upper cutter and deflector design objectives. However, they did not test the lower cutter and, because the aircraft was rigidly fixed to the truck bed, did not answer questions regarding aircraft pitch and yaw changes and deceleration loads during the wire impact and cutting sequence. Potential effects upon aircraft control, crew, and blade flapping were also not addressed.

To answer these questions, and thereby determine suitability of a WSPS for U.S. Army aircraft application, ATL acquired WSPS com-

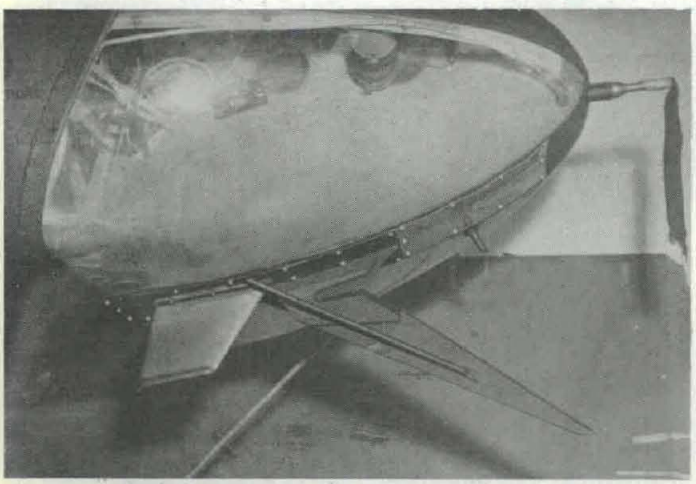


Fig. 1. LOWER CUTTER of Wire Strike Protection System (WSPS) protects skid gear of helicopter.

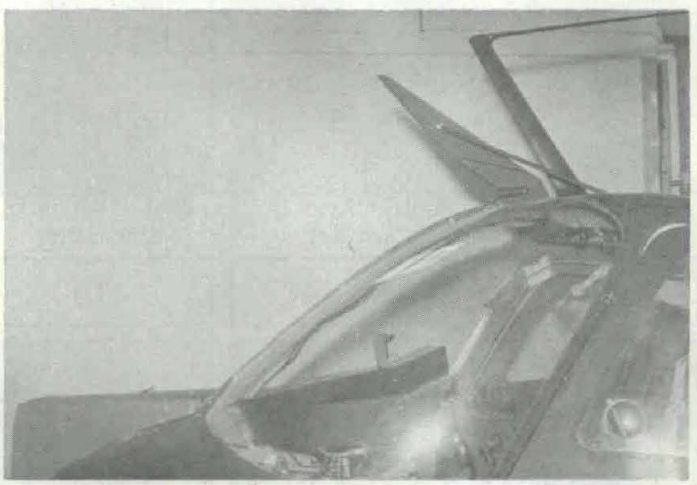


Fig. 2. UPPER CUTTER of Wire Strike Protection System protects main rotor controls of helicopter.

ponents from Canada under a standardization loan agreement to conduct a series of tests in the U.S.

Inasmuch as a manned flight through wires posed an unacceptable risk, a test approach was selected that would nearly duplicate the free flight condition.

The tests were performed at the NASA Langley Research Center's Crash Impact Dynamics Research Facility, Hampton, VA, which uniquely permits helicopter pendulum swing tests (Figure 3). In these tests the aircraft was supported only by the rotor mast, as it would be in normal flight.

The Army's test specimen was an OH-58A helicopter that had been retired from service and was being used for maintenance training. It was fully equipped less avionic equipment. The aircraft was prepared for testing at ATL, to include installation of the Canadian OH-58A Helicopter Wire Strike Protection System.

Successful cuts of a 10M steel 3/8-inch-diameter cable carrying a 50-pair communications cable were made, each with the upper and lower cutter. This was the first test of the lower cutter.

As a final test, two .419-inch-diameter copper high voltage power transmission cables were strung above a 10M messenger and a 50-pair commo cable. These multiple wires were cut with ease, deflecting into the upper and lower cutter simultaneously.

In these tests the aircraft velocity at impact was 40 knots and the yaw angle was 15 degrees. The attitude changes and aircraft loads recorded were analyzed and found to be insignificant for all tests.

In addition, ATL fabricated an adapter kit to fit the OH-58A WSPS on an OH-58C. This hardware was shipped to the U.S. Army Aviation Engineering Flight Activity, Edwards AFB, CA. They installed it on an OH-58C and conducted flying qualities tests. No adverse effects on the lateral stability of this aircraft were noted (no wire cutting attempted).

Additionally, ATL arranged for the Canadians to loan to the U.S. Army the second WSPS production unit so that it could be installed on an OH-58A at Fort Rucker to serve as a display and to permit operational evaluation (not to include wire cutting). The U.S. Army Aviation Development Test Activity at Fort Rucker performed this installation.

The Canadians initiated retrofit of their Kiowa's in April 1980. In this country, Product Improvement Programs (PIPs) have now been submitted for the OH-58, UH-1 and AH-1 series helicopters. Plans for retrofitting all Army helicopters have also been formulated by HQ AVRADCOM and HQ TSARCOM.

As a result of the ATL and Canadian tests and the alarming wire strike mishap statistics disseminated by the Army Safety Center, the major "users" took a supporting stand for the WSPS. USAREUR stated an urgent requirement for a WSPS and requested that action be initiated to obtain WSPS equipment in Europe at the earliest possible time frame.

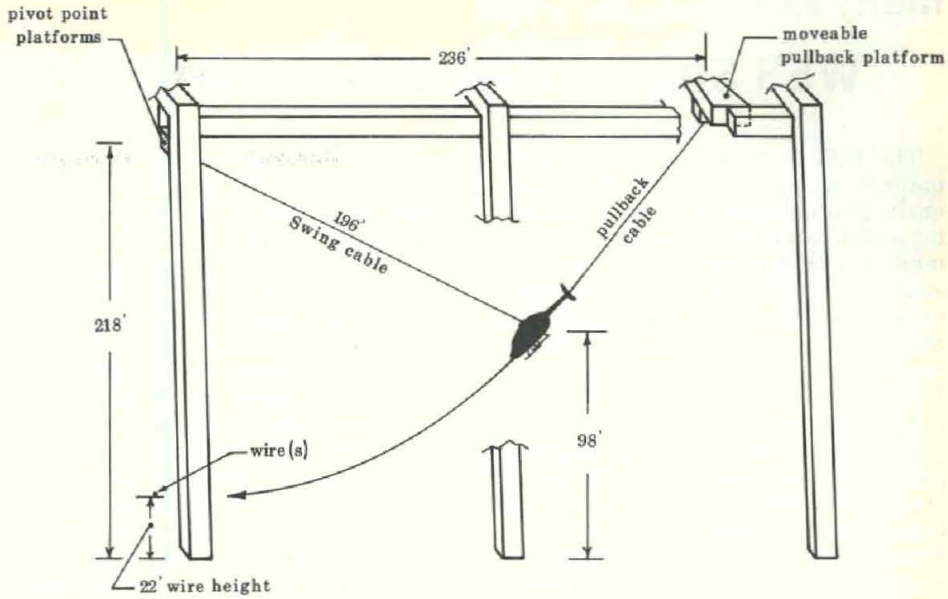


Fig. 3. Wire Strike Protection System (WSPS) pendulum swing tests performed at NASA Langley Research Center's Crash Impact Dynamics Research Facility, Hampton, VA.

The Eighth U.S. Army stated that the WSPS is considered to be of critical importance to aviation safety. They asked that assistance be provided to insure early initiation of the OH-58, UH-1 and AH-1 PIPs. FORSCOM stated there is an urgent requirement now for wire strike protection for Army helicopters and urges that WSPS PIPs receive high priority.

No further development is required for the OH-58A. However, for all other systems the basic WSPS concept will require configuration adaptation and basic handling quantities evaluation. BAL has designed a UH-1 WSPS configuration under contract to the Canadian NDHQ. It will also be available to the U.S. Army for retrofit initiation for this aircraft in FY-81.

The AH-1S will require developmental efforts to adapt the basic WSPS concept to this more complex weapons system. It is important to point out that during the competitive procurement process another wire protection system, other than the one described herein, could be selected. This would more than likely affect the retrofit schedules stated above.

Although it is not a panacea, the Wire Strike Protection System is considered to be critical survivability equipment for Army helicopters. The WSPS has been qualified in Canada and by the U.S. Army and is ready for OH-58A retrofit now.

Based upon mishap data one can deduce that the WSPS will be at least 70 percent effective in preventing wire strike accidents. Therefore, it can be postulated that for peacetime operations the WSPS will reduce Army aviation damage by 5.6 percent, aviation injuries by 4.2 percent, and aviation fatalities by 11 percent.

In a combat situation, the WSPS can be expected to be even more prolific in preventing accidents and casualties because of the increased threat.

The approval and funding of the wire strike protection PIPs is another indication that flight safety is high on the list of Army aviation priorities.

LEROY T. BURROWS is an aerospace engineer assigned to the Aeronautical Systems Division, Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, VA. Burrows holds a BS degree from the Virginia Polytechnic Institute, and a graduate diploma in fluid dynamics from the Von Karman Institute, Brussels, Belgium. He is a major in the U.S. Army Reserves and a graduate of the Army Command and General Staff College.

Many Advantages Cited. . .

WES Studies Pavement Recycling Under RDTE Program

The U.S. Army Waterways Experiment Station, Vicksburg, MS, is presently conducting a study to evaluate materials and mix designs for pavement recycling under the Army research, development, test and evaluation program and is preparing a Standard Practice Manual and Guide Specification on the subject for the U.S. Air Force Engineering Services Center, Tyndall AFB, FL.

A number of processes for recycling pavements are being used. These recycling processes can be classified under three broad categories: surface recycling, cold recycling, and hot recycling. Surface recycling includes heater planing-scarifying, grinding, and rejuvenating.

Heater-planing involves heating the surface of a bituminous concrete pavement and removing the surface to the desired depth.

There are a number of reasons for removing some of the pavement surface prior to resurfacing. They include keeping the dead load on a bridge below some fixed level and the tieing to curbs, manholes, and other structures, or otherwise providing the desired grade. Clearances in tunnels and underpasses can also be maintained by heater-planing.

There are a number of reasons for scarifying the pavement surface. Often, the pavement surface has become glazed from the action of traffic. To promote good bond between this existing glazed surface and an overlay, it is often desirable to scarify the surface, thus encouraging better layer interlock between the old and new pavement layers.

Scarification also breaks up the crack pattern and reduces the amount of reflective cracking that will appear in the overlay. Scarification of the top 3/4 to one inch allows additional asphalt binder or rejuvenating agent to be added to this scarified material.

Reasons for removal of material by grinding a pavement surface are to maintain a preset grade in a case where an overlay is planned (as in heater-planing) or to temporarily improve the skid resistance.

Occasionally, when a pavement surface has been planed with a grinder to give it a rough surface texture, the surface is used as the riding surface until sufficient funds are available to overlay or otherwise treat it.

Material removed by grinder operations can be used in pavement construction. Usually some additional binder material such as asphalt emulsion or a proprietary rejuvenator is added to the asphalt to improve its binding qualities. The material can be mixed in place with additional asphalt or removed and plant-mixed to produce a satisfactory mix.

Rejuvenators have been used extensively in surface recycling and may be sprayed directly on the surface of a bituminous pavement to retard the loss of surface fines and reduce cracking, or used in conjunction with the other two surface recycling processes (heater- planer-scarifier or grinder).

In-place processing involves breaking up the in-place pavement, adding binding agent or lubricating agent, mixing, laying, and compacting. One method of processing bituminous pavement in place is planing the pavement to the desired depth with a grinder. A binding and/or lubricating agent is then mixed with the planed material and compacted. Materials normally added include water, cement, proprietary rejuvenators, or asphalt.

Another method of breaking up the old pavement consists of ripping the pavement into chunks with a plow-like device attached to a grader or bulldozer, followed by additional crushing with traveling hammermill. After the old pavement is broken up and mixed in place with binding and/or lubricating agent, the mix is spread with a grader or laydown machine and rolled.

In the fixed-plant process, the material is removed from the pavement area for processing. An old bituminous pavement may be broken up with the grinder or with a plow. When the grinder is used, the planed material is hauled to the plant and stockpiled for further processing.

Recovered material is then processed through the plant with water, asphalt, rejuvenator, or cement being added. After mixing, the material is hauled back to the pavement site, placed, and compacted. If the material is removed with a plow, it is necessary to crush the material prior to processing through the plant.

Often the fixed plant is used to process material obtained from portland cement concrete (PCC) pavements. Slabs of concrete are first broken up with a headache ball. If the concrete is reinforced, the steel is cut with torches prior to loading and hauling to the crusher. PCC can be broken up and crushed to produce aggregate for base course, econocrete (lean concrete), high-quality concrete, or asphaltic concrete.

Hot recycling consists of taking up old pavements; crushing the old mix; mixing the crushed mix with virgin aggregate, virgin asphalt, and/or recycling agent; and laying the recycled mix using the same procedures as those for conventional hot mix. Hot recycling produces an asphaltic concrete mix having quality approaching that of conventional asphaltic concrete mix.

One of the types of plants used to produce hot recycled asphaltic concrete is the heat exchanger. In it the flame does not come in contact with the aggregate or recycled mix and, therefore, the asphalt is not damaged excessively and pollution is minimized.

A drum mixer can also be used for recycling asphalt concrete. The desired procedure is to feed the virgin aggregate at the end near the flame and to add the old asphalt mix about midway of the mixer. New asphalt is added immediately past the location where the old asphalt mix is added.

Virgin aggregate is heated to a higher temperature than the old mix and this additional heat transfers by conduction to the old mix. The virgin aggregate also acts as a shield and prevents the flame from excessively damaging the old asphalt binder and minimizes the air pollution that is produced.

Conventional plants can be modified to produce recycled asphalt concrete. When a conventional plant is used, the virgin aggregate is superheated in the dryer and sized in the hot bins.

The old asphalt mix is added directly to the pugmill where the superheated aggregate and new asphalt binder are added and mixed. Since the old asphalt mix does not travel through the dryer, pollution is minimized.

Use of the recycling processes described above has resulted in better pavements being built at lower cost while minimizing the use of natural resources and eliminating unsightly waste stockpiles of old broken-up pavement.

Report on Army Statistical Expertise

By Dr. Theodore Trybul

The state-of-the-art of U.S. Army statistical expertise and its availability to the Army's testing community was the subject of an Army Science Board Summer Study conducted earlier this year at the Armed Forces Staff College, Norfolk, VA.

Initiated at the request of Assistant Secretary of the Army for Research, Development and Acquisition Dr. Percy Pierre, the study was designed to examine the Army's statistical expertise relative to the number, distribution and quality of statistical personnel; the adequacy of educational opportunities and dissemination of current technical information; and quality control.

The ASB found that the Operational Test and Evaluation and Development Test and Evaluation commands account for about 80 percent of the Army's statisticians. Also, the number of scientists in allied disciplines employed in statistics is more than five times as great as the number of pure statisticians.

Generally, it was felt that both the numbers and the distribution of statistically trained personnel are adequate, with the possible exception that some Product Assurance Directorates (PADs) and Test Boards have no statisticians. However, at these levels, contractor support is available.

Relative to the overall quality of statisticians, it was found to be adequate and, in some cases, excellent. The ASB also indicated that the Army sponsors a wide variety of activities and information courses related to statistics.

The final aspect of expertise that was examined was that of quality control. The ASB found that quality control in terms of management and peer review appeared to be adequate and, at some of the major centers of statistical expertise, is very good.

One of the key areas of concern to the study group was an apparent lack of early coordination and interchange of information and needs between the Program Management Office (PMO), the test designers, and the contractor, and a resulting impact on the quality of development and operational testing.

The ASB learned of several incidents in which late changes in the schedules and analysis requirements have severely affected the quality of both the testing and analysis. Some of these incidents might have been avoided with better communication.

Finally, in the area of communication, several conflicts were identified in reported results that may have been due to the use of different data sets, or to the same data set being used in an attempt to answer different questions, but which were interpreted as conflicts in analysis. More care in explaining statistical results to decision-makers is essential.

The final area of concern, in terms of the quality of testing, was the lack of a well-documented audit trail throughout the development and testing processes. First quantitative parameters in requirements documents were stated without supporting rationale. Then, test designs were made and presented without accompanying rationale.

Finally, after most equipment is fielded, there is no effective collection of reliability, maintainability, or performance data to help improve the fielded system, assist in the development of future systems requirements, develop better future test plans for similar systems, or to validate and improve predictive models.

The Board concluded that:

- The Army possesses enough statisticians well qualified to conduct the design and analysis required by the Army testing activities.
- As a result of the review of the cases presented by the Army testing agencies, it is believed that the Army agencies are doing a generally adequate—and often very good—job in their statistical activities.
- The ASB was very favorably impressed by the continuing efforts of the Army statistical community to improve and keep current with the state-of-the-art through such vehicles as workshops and courses.

The following recommendations of the panel were intended to permit the Army to more fully exploit the capabilities described above:

- The Army has several "Centers of Excellence" in statistical techniques, tests, and analyses involved in testing (e.g., AMSAA, BRL, CDEC, OTEA, TECOM). However, a portion of surveillance testing, acceptance testing, and DT and OT of minor systems being conducted by the PADs and the Test Boards needs to be improved. This constitutes tremendous testing expenditures.

The panel finds that the statistical expertise just described is not always available to these latter types of organizations, and therefore recommended that the Army task its Centers of Excellence to immediately structure a program to help upgrade the quality of these statistical activities by making periodic visits and reviews, and by encouraging consultations.

- Test designers and analysts from the OT and DT communities and the contractor must be required to meet at the earliest possible date and periodically thereafter to coordinate their objectives and data needs. The PM must be responsible for such coordination.
- The quantitative portion of the requirement documents must be accompanied by a rationale with supporting justification. That rationale must be made available to the appropriate test communities.
- The test designs and plans for analysis developed by the test organizations must also be accompanied by supporting rationale. Among other things, this rationale will help reduce the confusion in interpreting test results and will indicate the risks implied by the test plans.
- Schedule changes (time as well as content) in development programs that affect test designs and analyses must immediately be made known to all concerned. This recommendation is intended to emphasize the importance the Army places on the testing component of the development cycle and the need to provide sufficient time for analysis.

The board recommended that post-IOC field data be collected for all new major systems and selected fielded systems for the purposes of: making product improvements more effective; making efforts to determine future requirements more meaningful; validating and improving predictive models; and developing more efficient future test plans.

DR. THEODORE TRYBUL is director of the Analysis Directorate at the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, MD. He holds a PhD in engineering and applied science from George Washington University, an MS in engineering from the University of New Mexico, and a BS in mechanical and industrial engineering from the University of Illinois. He has authored more than 200 articles and has taught engineering at George Washington University and California State College.

CORADCOM Awards $190 Million for Communications Switches

Production of electronic telecommunications switches for the tri-service tactical communications program is called for under a $190 million contract awarded recently by the U.S. Army Communications R&D Command, Fort Monmouth, NJ.

GTE Products Corp., Communication Systems Division, will supply 300-line and 600-line circuit switches, known as AN/TTC-39, and 50-line message switches, designated AN/TYC-39. They will also provide related spare parts and support equipment.

This TRI-TAC program family of communications switches is designed to ease the transition from the present, largely analog system to the future digital military communications network.

Described as "versatile units", the circuit switches interconnect analog and digital subscriber instruments and trunks. They also interface with the wide variety of existing and planned military and commercial telephone equipment including AUTOVON, NATO, commercial offices and other automatic switches such as the Army's AN/TTC-38 analog switch.

The message switch will work with AUTOVON, NATO and other current military communications equipment. The circuit and message switches allow for secure communications in the U.S. tactical switched network and interconnection with the NATO allies networks.

The AN/TYC-39 message switch reportedly provides all levels of security plus the store and forward capability of receiving and delivering record traffic for dedicated and switched subscribers in tactical and strategic environments.

Production and delivery of both switches are scheduled for completion in 1984. COL Donald J. Callahan, project manager for Multi-Service Communications Systems (MSCS), CORADCOM, has project responsibility for the AN/TTC-39 switch family.

Army Awards Patriot Production Contract

The U.S. Army Missile Command recently announced award of a $123.1 million contract to Raytheon Co., under FY 1980 funds, for production of the Patriot, the Army's newest air defense system.

The initial buy of the plane killer consists of five fire units and 155 missiles with the work to be performed at Raytheon's Andover, MA facility; Martin Marietta Aerospace's plant at Orlando, FL and at Thiokol Co., at Redstone Arsenal, AL.

This brings the Patriot FY80 production contract to approximately $228.4 million. The Army previously awarded $105 million for long lead time materials. Defense Department approval for limited production of Patriot was announced last September. DOD said that full-scale production will depend on test results with the first production hardware and other tests planned during the next two years.

"This is what the Patriot team has worked for . . . to get Patriot through development and into production so we can get the system into the soldiers' hands as soon as possible," said MG Oliver D. Street III, Patriot project manager.

The computer-assisted Patriot is so sophisticated and smart it reportedly can diagnose its own problems and tell how to solve them. Featuring a new guidance scheme, along with the digital computer, Patriot can simultaneously destroy a number of planes over a wide range of altitudes, maneuvers and countermeasures, and operate under all weather conditions.

The highly mobile Patriot will replace both the Nike Hercules and Hawk weapon systems. Negotiating the contract for the Army was the Army Missile Command's Procurement and Production Directorate.

CSL Team Reduces Costs of XM30 Mask

A 7-member team of technicians and engineers at the Army Armament R&D Command's Chemical Systems Laboratory has been credited with saving millions of dollars as a result of proposals related to the XM30 protective mask.

Following a value engineering task team study of the new XM30 chemical-biological protective mask, the team's proposals to reduce the life cycle costs, validated for the first full year at $5,448,000, were accepted and incorporated into the mask technical data package.

Total program savings for the mask, developed at the Chemical Systems Lab, is estimated to be at least 10 times the first year amount.

According to Mr. Warren Miller, chief of the Value Engineering Division, this is the largest savings ever validated at CSL for the Army's chemical research and development.

The purpose of the study was to value engineer the mask's components to reduce the life cycle costs, particularly the procurement cost per item. Eleven value engineering proposals were submitted and accepted.

The study team, credited with savings of $6,443,500 to date, includes Mr. Howard MacIver, Developmental Support Division; Mr. Robert Wagner, Physical Protection Division; and Mr. Ronnie Eckstein and Mr. Curtis Bauer, both employed in ARRADCOM's Technical Support Division. All are engineering technicians.

Also recognized in the team effort were Mr. Frank Martin, industrial engineer; John Scavnicky, a mechanical engineer, and Charles Galton, a tool and die maker.

CSL Researchers Develop Chemical Agent Detector

Researchers at the U.S. Army Armament R&D Command's Chemical System Laboratory, Aberdeen (MD) Proving Ground, have reportedly developed a very sensitive liquid chemical agent detector.

Capable of detecting a single droplet of chemical agent less than one-thousandth of an inch in diameter, or about the width of an average human hair, the automatic liquid chemical agent detector, designated ALAD, can alert soldiers in the field of the presence of an aerosol chemical agent cloud.

According to Mr. David Tanenbaum, ALAD's project engineer in CSL's Chemical-Biological Detection and Alarms Division, ALAD can detect agents such as thickened GD, VK, mustard and Lewisite. It can also relay the cloud characteristics such as location, course, velocity, and dimensions.

"ALAD would provide a significant role in reducing personnel casualties from liquid aerosol chemical agent attacks," says Tanenbaum. "Since plans call for a network of detectors on the battlefield, which a central receiver continuously monitors, large area surveillance is possible."

When the detection mechanism determines the existence of a chemical cloud, an alarm is activated and coded information is transmitted to the control unit. Testing of the unit, which weighs approximately 20 pounds, is continuing at CSL.

USAETL Physicists Devise Low-Cost Interferometer

Two physicists at the U.S. Army Engineer Topographic Laboratories have reportedly devised an inexpensive interferometer for use in testing mechanical, optical and electronic parts and detecting surface irregularities as small as a fraction of a light wavelength.

Interferometers, which are precise measuring instruments, are normally too expensive for schools and small businesses to use. However, ETL employees Mr. Mike McDonnell and Mr. Tice DeYoung built their own in less than a week.

McDonnell notes that the materials can be purchased for under $20.00, not including a low-power laser. The low-cost interferometer, says McDonnell, is just as accurate as a "perfect" interferometer costing over a thousand dollars.

An interferometer can split two or more beams of light from one course and reunite them after they have traveled over different paths. When the light waves meet again, an interference pattern of fringes or bands is generated at the interface.

Interferometry is the indirect measurement of wavelengths or extremely small movements or dimensions using these fringe patterns. When optical components are tested, minute accuracy discrepancies will show up as easy-to-see deviations from the correct fringe pattern.

The greatest expense in producing an interferometer is the necessity to use very flat, high quality glass for all of the components, particularly the beam-splitter. This takes hours of skilled labor to produce. Cheaper, low quality, glass that is not as flat produces distorted measurements.

McDonnell and DeYoung found a way to use ordinary glass to construct a unique wedge-shaped beam-splitter. Instead of using a fine, optically engineered solid beam-splitter, they glued together some photographic plates from which they had removed the light-sensitive coating. They then filled the hollow wedge with ordinary mineral oil. "A 69-cent bottle was more than enough," says McDonnell.

While the device has a more limited range of application than a perfect interferometer, it is still very flexible and useful, the two developers say. It can put high-precision measurement within the reach of anyone who needs to make use of this precision.

Army Tests Optics/Radar in ICBM Launch

The Army has successfully demonstrated the latest in both optical and radar missile-tracking capabilities during a single test in the central Pacific, according to a recent announcement from the Ballistic Missile Defense (BMD) Program headquarters, Huntsville, AL.

Both an advanced optical sensor and a proven ground-based radar successfully monitored the descent of an intercontinental ballistic missile (ICBM) target complex over the Kwajalein Missile Range in the Marshall Islands. The mission began with the launch of an ICBM-type reentry vehicle on a Minuteman I booster from Vandenberg Air Force Base, CA.

Several minutes after the Vandenberg launch, a telescope, known as the Designating Optical Tracker (DOT), was carried aloft by a rocket fired from Roi-Namur Island in the Kwajalein Atoll. While above the atmosphere, the telescope recorded the incoming target's trajectory and obtained a significant amount of scientific data. The telescope was then parachuted into the ocean and recovered.

After the target reentered the earth's atmosphere, it was tracked to its spashdown in the lagoon by the integrated radar and data processing systems of BMD Systems Technology Test Facility on Meck Island.

This was the third in a series of tests for the BMC Advanced Technology Center's DOT experiment which is designed to demonstrate the utility of optical sensors to BMD. The Center is responsible for developing new technolgies to improve U.S. BMD capabilities.

The test was also the 48th and final mission for the Test Facility established by the Systems Technology Project Office of the BMD Systems Command. The Project Office is responsible for integrating and testing promising technological advances within a system framework.

The facility was designed to validate the next generation of radar and data processing technology beyond the SAFEGUARD system. After compiling a very high success rate in more than three years of testing, the capabilities represented by the facility are now considered "on the shelf" technology that has fully demonstrated its BMD utility.

CSL Developing Decontamination Apparatus

One of the principal efforts currently under development at the Army Armament R&D Command's Chemical Systems Laboratory is a portable decontamination apparatus that will be mounted on wheeled and tracked vehicles, towed artillery, or aircraft for easy cleansing of the equipment.

According to Mr. James Gailbrois, CSL's project officer for the apparatus, "This manually-operated device dispenses chemical agent decontaminating solution through a brush, allowing soldiers to quickly and efficiently clean the contaminated vehicles' entry and exit paths as well as areas needed for their operation and maintenance.

"The idea is to stop after a chemical agent attack, remove the decon device, scrub and decontaminate the vehicle and then pack up and be on your way," says Gailbrois.

Weighing less than 60 pounds when filled, the apparatus is mounted on a vehicle and consists of a decontamination agent container, a manual pump, hoses, and an attachable brush.

The accelerated development program, underway in CSL's Physical Protection Division, calls for the decon apparatus to be adopted for Army use next year.

Patriot Air Defense System Approved for Limited Production

Secretary of Defense Harold Brown has approved the recommendation of the U.S. Army to enter into limited production of the Patriot Air Defense System. A decision on full-scale production will await results of tests on the first production units and other tests planned in the next two years.

Patriot, designed to engage and destroy the bomber and fighter aircraft threat through the 1990s, has recently completed engineering development, development tests, and operational tests.

It is termed the nation's most advanced ground air defense system and is capable of engaging and destroying multiple aircraft simultaneously over a wide range of altitudes, maneuvers, and countermeasures, and in all weather conditions. It employs a phased array radar, a new and highly effective missile guidance scheme together with a digital computer to achieve an unequaled level of air defense capability.

Patriot is expected to replace the capability of the Nike Hercules to engage high altitude aircraft and much of the medium and low-flying aircraft mission of the Improved Hawk system.

The decision to start limited production of Patriot was based on results of tests by independent Army development and user agencies as well as plans for further growth and capability demonstrations. The limited production decision implements the Army's plan which is focused toward additional system maturity prior to the European deployment.

The recommended program will lead to confirmation of the system design capability using production hardware in user tests in 1982. Initial production equipment will be tested for reliability and system capabilities. Planned increases in the production rate will be based on increased performance as demonstrated.

The Patriot program is managed by Project Manager MG Oliver D. Street, III. The prime contractor on the program is Raytheon Co., Lexington, MA. The Martin Marietta Aerospace Corp., Orlando Division, Orlando, FL, is principal subcontractor.

CSL Completes M243 Launcher Development

Development of one of the Army's newest smoke grenade launchers has been completed at the Army Armament R&D Command's Chemical Systems Laboratory (CSL), and an $860,000 contract awarded for the first production of the launcher system designed for armored vehicle protection.

According to Mr. Frank Stewart, CSL's project officer, the launcher, obtained under a standardization loan agreement with the United Kingdom, was tested in CSL's Munitions Division, for the Army's Project Manager for Smoke/Obscurants.

The grenade launcher, designated the M243, features a pair of four-tube aluminum dischargers mounted on the vehicle from which red phosphorus grenades are electrically fired using the arming/firing control box onboard the armored vehicle or truck.

"The launcher will provide a visual smoke screen from eight UK-L8A1 grenades within two to six seconds when fired in salvo. The resulting smoke screen is established from about 65 to 170 feet forward of the vehicle and will last from one to three minutes, depending on the wind condition," Stewart said.

When no wind exists, the smoke screen forms in no more than three seconds. Two grenade stowage boxes on the vehicle provide onboard reloading capability.

The M243 launcher system, currently in production at Ronal Industries, Port Chester, NY, has been adapted to the Improved TOW Vehicle.

CERAMICS for the ARMY of the 80s

(Continued from page 4)

200 hours of continuous operation with no distress to the ceramic components.

As AMMRC has interacted with the engine development community, feedback on materials or materials-related problems has been obtained. One major problem which has surfaced is the lack of even preliminary data for the engine designer in the critical area of mechanical properties after materials exposure to turbine (or at least oxidizing) environments for meaningful (several hundreds of hours minimum) times. Therefore, AMMRC is focusing on the evaluation of mechanical properties of engine ceramics after environmental exposure. AMMRC is closely coordinating this effort with design engineers at MERADCOM, TARADCOM, and AVRADCOM.

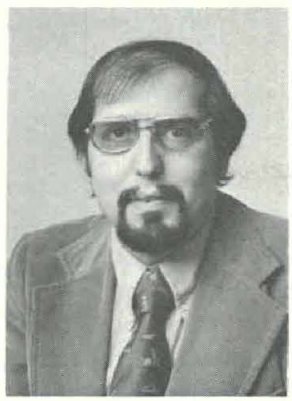
Additionally, AMMRC is expanding the technology base for near net shape fabrication of silicon nitride and silicon carbide ceramics. Advanced processes such as the fabrication of SiC from organic precursors, and net shape sintering of silicon nitride are currently under investigation with financial support from both DARPA and DOE respectively. Success in these projects will go far to assure reliable and affordable engine components for the Army and for civilian use.

One very important reason why structural ceramics will become more widely applied in the Army, as well as society in general, is that they are abundant, domestically available, and potentially low price materials. Thus, substitution of ceramics based on silicon, aluminum, oxygen, nitrogen and carbon, for alloys based on cobalt, chromium, nickel and other scarce, expensive, imported materials will occur where feasible.

One example of where such materials substitution might be beneficial is in small caliber machine gun barrel liners. Currently, these have erosion resistant liners made of a high cobalt alloy. If one could substitute a high performance silicon based ceramic for the cobalt alloy, cost would be significantly reduced and weight slightly reduced.

The Army's Advanced Concepts Team (ACT) has funded ARRADCOM to conduct an initial feasibility study in this area, with AMMRC participating as a materials consultant. Once a method of properly fitting the liner in the gun barrel was achieved (the importance of proper attachment, again) successful single shot tests of up to 1000 rounds per liner with no distress to the ceramic were demonstrated. While the early results are encouraging, much further testing and development needs to be performed before such a substitution can be seriously implemented.

Structural ceramics offer the Army opportunities to increase capabilities, exploit new technologies, and reduce dependence on strategic imported fuels and metals. With such powerful incentives, the use of ceramic materials is sure to increase within the Army during the decade of the eighties. AMMRC looks forward to working together with the other commodity commands within the DARCOM family to bring many of these opportunities from the laboratory into systems application.



DR. R. NATHAN KATZ joined the Army Materials and Mechanics Research Center in Watertown, MA as a research metallurgist in 1962. He is currently chief of the Ceramics Research Division in the Metals and Ceramics Laboratory at AMMRC. Dr. Katz received a BS in metallurgy from MIT, an MS in metallurgical engineering from the University of Michigan, and a PhD in materials science from MIT. He is a fellow of the American Ceramic Society.

AVRADCOM Awards $103M for CH-47 Remanufacture

A $103 million contract for the immediate remanufacture of nine CH-47A Model Chinook helicopters to the D-Model configuration was awarded to the Boeing-Vertol Co., Ridley Park, PA, by the U.S. Army Aviation Research and Development Command.

Remanufacturing of the A-B-C Model Chinook's was considered the most cost effective concept to increase the flexibility of the current medium lift helicopter fleet. Besides lowering the operating costs and extending the fleet's life, the modernization program increases the helicopter's operational capabilities.

At the official signing of the contractual agreement, COL Terry L. Gordy, CH-47 Modernization PM said, "The signing of this initial production contract marks a significant milestone in the CH-47 Modernization Program. After four years of development and testing, we are entering production to send the modernized CH-47 to the soldier in the field."

Current Army plans are for the remanufacture of 436 of its existing fleet of Chinooks to the CH-47D Model configuration. Estimated cost of remanufacturing the fleet over the next 10 to 12 years is $3.1 billion. Initial deliveries are scheduled to begin in May, 1982. The first three Chinook A-Models scheduled to be remanufactured are currently at Boeing-Vertol.

Capsules . . .

Construction Units To Get Water Systems

Engineer construction units throughout the Army will soon receive the 6,000 Gallon Semitrailer Mounted Water Distributor System recently type classified as a standard item of U.S. Army equipment.

The semitrailer mounted system will replace the truck mounted water distributor system presently in the Army inventory and provides a six fold increase in water capacity. This increased water capacity will provide the Army with an optimally balanced compaction capability at a level compatible with haul and compaction capabilities.

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, type classified the system as a "First Time Buy" and is procuring 226 units from the Macleod Co. of Cincinnati, OH.

The distributor will be employed worldwide with the initial fielding due to be completed by April 1981. Construction units will use the system to supply water for soil compaction and dust control, but it also offers a limited fire fighting capability.

A liquid-cooled Perkins diesel engine mounted at the rear of the distributor directly drives its 600-gallon-per-minute centifugal pump. The spray system is made up of two nozzles that can produce a fan type spray pattern covering a swath up to 70 feet wide.

The semitrailer mounted distributor is towed by a standard military truck tractor. A remote control panel is used to operate the system from the tractor's cab.

Uses of Binocular Radio Evaluated

The U.S. Army Electronics Research and Development Command (ERADCOM) and U.S. Army Communications Research and Development Command (CORADCOM) are evaluating expanded uses for the binocular radio.

Recently tested, the 70-gigahertz (GHz) binocular radio provides fast deployable, line-of-sight, secure tank-to-tank voice communications through a 2-mile range—even in bad weather or on a "dirty" battlefield. CORADCOM is demonstrating the radio's uses to the Training and Doctrine Command.

ERADCOM hopes to use the binocular with hand-held portable radar devices for communicating between ranges of 2 to 7 miles. It was developed by the Electronics Technology and Devices Laboratory (ETDL) according to CORADCOM specifications. Four "test-bed" prototypes were produced by the TRW Defense and Space Systems Group.

The process involves modifying a conventional pair of binoculars. The optics on one side of the binoculars are replaced by an antenna and transmit/receive electronics. The remaining binocular optics provide line-of-sight alignment between two radio units. As long as you can see a person, you can talk to him or her.

According to ETDL scientists at Fort Monmouth, the radio binocular opens up new vistas in advanced millimeter wave technology.

$24.4 Million Contract Let for AN/TSC-99

The Project Manager for Army Tactical Communications Systems and the Center for Communication Systems, U.S. Army Communications Research and Development Command, Fort Monmouth, NJ recently awarded a $24.4 million contract to Rockwell International Corp., Richardson, TX for the engineering and manufacture of 22 AN/TSC-99 transportable communication systems.

The AN/TSC-99 will provide the U.S. Army Special Forces with an advanced HF and satellite radio system designed for long range, high speed message traffic using burst communications to minimize air time.

The AN/TSC-99 will combine existing commercial systems and Army equipment into two air transportable dolly-mounted assemblages. The assemblages will form the base station component of the U.S. Army's Special Forces Burst Communications Systems (SFBCS).

Outstation equipment includes manpack radios and an advanced Digital Message Terminal which will permit Special Forces personnel in the field to quickly send and receive messages when engaged in unconventional warfare or special operations deep in hostile territories.

The new system will eliminate the use of slow, manual Morse Code transmission. The new Burst Communications System is scheduled to be fielded early in 1982.

Army To Buy U.K. Combat Support Boats

Production of 102 United Kingdom Combat Support Boats is called for in a $16.9 million contract, announced recently by the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.

Selected on the basis of its compatibility with the MERADCOM-developed floating ribbon bridge now deployed in Europe, the boat will be produced by Fairey Allday Marine, Ltd. It is expected to be delivered to U.S. Army units in November 1981.

The Combat Support Boat is constructed of welded aluminum and powered by two diesel engine driven water-jets. Its shaft is only 22 inches compared to 41 inches for the current U.S. standard 27-foot bridge erection boat.

Additionally, the boat is 27 feet long, has a top speed of 25 MPH, and is unsinkable. Like the current U.S. boat, the new one can be carried and launched by the ribbon bridge transporter fitted with a cradle.

Adoption of the British boat followed 10 months of intensive test and evaluation under the International Materiel Evaluation (IME) program by MERADCOM. Two boats used for tests were obtained on loan from the United Kingdom Ministry of Defense as part of the U.S. Army Rationalization, Standardization, and Interoperability program.

Provisions of the new contract also include a full supply of spare parts for two years, a one-year warranty, parts manuals, provisioning software, operations of a depot facility, and services of a technical field services representative on an as-required basis.

CSL Develops Biological Detection Alarm

A biological agent detection and warning system under development at the Army Armament R&D Command's Chemical Systems Laboratory (CSL) will soon become a valuable tool for soldiers in battlefield environments.

The two-part detection and warning system, which is being developed in CSL's Chemical-Biological Detection and Alarms Division, consists of an automatic biological agent alarm and a biological agent sampler.

The alarm signals the presence of biological agent aerosols by monitoring chemiluminescence reactions, defined by CSL researchers as the emission of light as a product of a chemical reaction with biological materials.

According to Mr. William Keane, CSL's project officer for the system, "The alarm senses airborne biological material and gives an alarm when the quantity as well as the characteristics of the material satisfy the predermined criteria.

"The collector continuously samples 1,000 liters of air per minute and selects particles of the desired size range for introduction into the chemical reaction. The sampler, which is automatically activated when the alarm sounds, collects samples of the suspect aerosols that will be later identified at designated medical laboratories," Keane said.

Scheduled for type classification next year, the biological detection and warning system will be assigned to command and control centers down to brigade level.

Personnel Actions . . .

GENERAL OFFICER ASSIGNMENTS:

BG Jerry M. Bunyard, deputy director, Defense Test & Evaluation, Office of the Under Secretary of Defense for Research and Engineering, has been assigned as Project Manager for Patriot.

BG Eugene Fox, executive to Assistant Secretary of the Army (RDA), is assigned as Deputy Director, Defense Test & Evaluation, Office of the Under Secretary of Defense for Research and Engineering.

Lang Follows Lasher as CSA Commander

BG V. O. Lang

BG V. O. Lang, former deputy commander of the U.S. Army Communications and Electronics Materiel Readiness Command, Fort Monmouth, NJ, has succeeded MG Donald R. Lasher as commander of the U.S. Army Communications Systems Agency/Project Manager DCS (Army).

Prior to his arrival at Fort Monmouth in 1978, BG Lang served at the Pentagon as assistant deputy director for Operations (Telecommunications), Office of the Joint Chiefs of Staff. From 1974–76, he served in Korea as commander, 1st Signal Brigade and J-6 UNC/COMUSK/EUSA.

Other key assignments have included assistant deputy for Materiel Acquisition, Office of the Assistant Secretary of the Army (Installations and Logistics); commander, 39th Signal Battalion, U.S. Army Strategic Communications Command, Vietnam; and director of Materiel Acquisition, Office of the Deputy Chief of Staff for Logistics.

Graduated with a BA degree in accounting and auditing from Pennsylvania State University, BG Lang holds a master's degree in business administration from the University of Arizona. He also completed the Command and General Staff College, Industrial College of the Armed Forces, and the Army Signal School basic and advanced courses.

BG Lang's military awards and decorations include the Defense Superior Service Medal, Legion of Merit (two awards), Bronze Star Medal, Meritorious Service Medal, Army Commendation Medal (three awards), and the Parachutist Badge.

Spence Heads Toxic Materials Agency

COL John D. Spence

Commander of the Army Toxic and Hazardous Materials Agency, Aberdeen (MD) Proving Ground, is the new title of COL John D. Spence, following completion of an assignment as commander/director of the Army Chemical Systems Laboratory.

Preceding his tour at CSL, COL Spence was assigned as HQ DARCOM associate director of Plans, Doctrine and Systems. He has served also as a plans officer on the Army Staff, as commander of an advanced individual training unit at Redstone Arsenal, AL, and as an assistant professor of military science at the University of California (Los Angeles).

COL Spence holds a BS degree in business from Roosevelt University, an MS in business management from Central Michigan University, and has completed course requirements at the Command and General Staff College, and the Army War College.

He is a recipient of the Bronze Star Medal with Oak Leaf Cluster (OLC), the Meritorious Service Medal with two OLC, and the Army Commendation Medal with OLC.

Whittaker Named Armament Command DC

COL Howard C. Whittaker

COL(P) Howard C. Whittaker has been named deputy commander of the U.S. Army Armament Research and Development Command (ARRADCOM). He succeeds MG David W. Einsel, Jr. who has taken a dual assignment as deputy assistant to the Secretary of Defense (Atomic Energy) (Military Applications) and executive secretary, Military Liaison Committee to the Department of Energy.

COL Whittaker was formerly Hawk project manager at the U.S. Army Missile Command (MICOM), Redstone Arsenal, AL. Before that he was project manager of the Chaparral/FAAR Missile and Radar System, also at MICOM.

Whittaker graduated in 1955 from the United States Military Academy, and earned a master's degree in education at Boston University. Additionally, he is a graduate of the Command and General Staff College, and the Army War College.

Another key assignment was as Kuwait project manager at Redstone. He has also served overseas in Korea, Vietnam and Europe.

His awards include the Legion of Merit, the Meritorious Service Medal and the Joint Services Commendation Medal.

COL Walton Assumes Duties as OPM Chief

COL Warren J. Walton

COL Warren J. Walton has assumed new duties as chief, Office of Project Management, HQ DARCOM. He formerly was the armor systems director in the Battlefield Systems Directorate of DARCOM.

He was commissioned from ROTC at Auburn in 1958 with a degree in business and has subsequently earned a master's degree in business management. An Army Command and General Staff College graduate, he also attended the Armor School's advanced and basic courses and the fixed and rotary wing Aviation Schools.

His key assignments include tours as chief, Armor Branch, Combat Arms Division, OPMD, MILPERCEN: branch chief in ODCSPER, HQDA; commander, 2nd Battalion, 69th Armor, 197th Infantry Brigade; assignment officer, Armor Branch, Office of Personnel Operations; company commander and S-3 in the 229 Aviation Battalion; and the normal combat arms company grade assignments.

COL Walton is the recipient of the Distinguished Flying Cross, Bronze Star Medal, Meritorious Service Medal, Air Medal with 22 OLC, and the Army Commendation Medal.

Awards . . .

2 DARCOM Senior Executives Receive New Presidential Award

President Carter, at a ceremony in the White House Rose Garden on 9 September, presented Distinguished Executive Rank Awards to Mr. John D. Blanchard and Dr. Robert S. Wiseman. The two DARCOM RDA executives were among 50 senior executives chosen to receive this new government award.

The Distinguished Executive Rank Award is the highest recognition given to senior executives of the government. Of the 7,000 such executives not more than one percent of those in the Senior Executive Service may receive this award given for sustained extraordinary accomplishments. It may be received only once in five years. In addition to a certificate presented by the President, a monetary award of $20,000 accompanies the recognition.

Mr. Blanchard holds the position in DARCOM Headquarters as Principal Assistant Deputy for Materiel Development, and has been with the Department of the Army since 1972.

Blanchard was recognized for initiating the annual "Atlanta" conferences which bring high officials from the Department of the Army together with presidents and high officers of industry for mutual cooperation in the weapons system acquisition business. Additionally, his contribution as author of the Acquisition Management Guide used by DOD and private industry, and his successful negotiations with foreign firms were singled out in his citation.

Dr. Wiseman, who now serves in DARCOM Headquarters as the Assistant Deputy for Science and Technology, was recognized for his outstanding management of the Army's electronics program and laboratories while serving as Technical Director, ERADCOM, and for his current management of the Army's DARCOM science and technology program and its R&D laboratories.

Singled out for specific mention was Wiseman's excellent management qualities and leadership in the technical innovation of night vision equipment, and his effectiveness in implementing Project REFLEX.

Another Army recipient of the Distinguished Executive Rank Award is Mr. James J. Leonard, Deputy Comptroller of the Army, Office of the Comptroller of the Army.

DA Civilian Executives Attain Meritorious Executive Rank

Mr. William A. Davis Jr., U.S. Army Ballistic Missile Defense Organization, Mr. Henry B. Simmons, U.S. Army Waterways Experiment Station and Mr. Richard B. Lewis, II of the Aviation R&D Command, are among recent recipients of the new Presidential Award for the Rank of Meritorious Executive.

Authorized by the Civil Service Reform Act of 1978, the award is accompanied by a $10,000 cash bonus and a certificate signed by the President of the United States. Ten other Army civilian executives also received Presidential Awards this year. Some of these awards carried $20,000 cash bonuses.

Davis, who is deputy program manager and highest ranking civilian in the Army's Ballistic Missile Defense Organization, shares responsibility for directing an annual third-of-a-billion dollar effort to develop technology to defend the U.S. against an ICBM attack.

He was credited specifically with assisting in the development of more cost-effective BMD systems to counter the growing Soviet threat. Recently, he has helped lead the evolution of Low Altitude Defense (LOAD), which promises to double the survivability of landbased ICBM forces for a modest investment cost.

A graduate of Vanderbilt University, Davis earned an MS degree in management from the Massachusetts Institute of Technology in 1967. He is a member of the Association of the U.S. Army and the American Institute of Aeronautics and Astronautics.

Simmons, who is chief of the Waterways Hydraulics Laboratory, is responsible for direction of programs in the areas of hydraulics, hydrodynamics, hydraulic structure dynamics, and sedimentation. These programs are annually valued at about $17 million.

Considered one of the foremost authorities on tidal hydraulics he is credited with initiating a program to study the physical aspects (particularly temperature) of water quality in reservoirs. This led to the establishment of the Environmental and Water Quality Operational Studies R&D Program.

Simmons is a registered professional engineer in Mississippi, and a charter member of the Senior Executive Service. He also serves on the Corps of Engineers Committee on Tidal Hydraulics which correlates Corps research on tidal hydraulics and related phenomena.

Lewis is technical director of the Aviation R&D Command and is responsible for management of the Army Aviation research, development, test and evaluation program. This encompasses activities in St. Louis, MO; Moffett Field, CA; Cleveland, OH; Fort Eustis and Langley, VA; and Fort Monmouth, NJ.

An honor graduate (aeronautical engineering) of Princeton University, he holds a master's degree in aerospace engineering from Rensselaer Polytechnic Institute. In addition to government employment, he serves in private industry with Sikorsky Aircraft.

The award certificate presented to Lewis praised his extraordinary capabilities and his demonstrated exceptional managerial competence and top technical leadership in the aerospace research, development and engineering fields.

Other Department of the Army recipients of the Rank of Meritorious Executive are Mr. Richard Armstrong, chief, Engineering Division, U.S. Army Engineer Division, Ohio River, Cincinnati, OH; Dr. William R. Beisel, deputy for Science, Army Medical Research Institute of Infectious Diseases; Mr. Kisuk Cheung, civil engineering supervisor, Army Engineering Division, Pacific Ocean, Fort Shafter, HI; Mr. Lloyd A. Duscha, chief, Engineering Division, Directorate of Civil Works, Office, Chief of Engineers; and Mr. Henry B. Jones, director of Procurement & Production, Army Tank-Automotive Materiel Readiness Command, Warren, MI; Mr. William J. Lindberg, director for Advanced Sensors, U.S. Army Missile Command, Redstone Arsenal, AL; Mr. Leonard J. Mabius, senior technical director/chief engineer, U.S. Army Communications Command, Fort Huachuca, AZ; Mr. James C. Steinhoff, civilian personnel director, HQ, U.S. Army Forces Command, Fort McPherson, GA; and Mr. Martin B. Zimmerman, deputy assistant chief of staff for automation and communications, Office of the Assistant Chief of Staff for Automation and Communications, Washington, DC.

MERADCOM Presents CO's Awards

Winners of the 1980 Commander's Awards for Science, Technology, Leadership, Administrative/Technical Support and Outstanding Laboratory were announced recently at the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.

BG William H. Schneider, DARCOM chief of staff, was principal speaker at the presentation ceremony, the 23rd in the history of the prestigious awards. Linking the pioneering spirit of the winners to that of Columbus, he congratulated the group on their discovery of new worlds of achievement in varied fields of endeavor represented by the medals.

Following his remarks, the General presented three of five awards. The medal for scientific achievement went to

Dr. Alayne A. Adams and Mr. Amos J. Coleman, research chemists in the MERADCOM Electrical Power Laboratory. The team furthered the state-of-the-art of fuel cells for silent electric power through development of advanced electrolytes and electrocatalysts.

The technological achievement medal was shared by MAJ Harry N. Hambric, Mr. Carlos A. Piad and Mr. Dan Causey, Jr., Marine and Bridge Laboratory. They were cited for contributions to the success of a high visibility test and evaluation program to determine revised vehicle load ratings for bridge and raft configurations on ribbon bridge production equipment.

The leadership medal was won by Mr. John Hotler, Programs and Analysis Directorate, for development and implementation of classic life cycle management models for both R&D and non-development programs.

Mrs. Walter C. Gelini, another special guest at the ceremony, presented the administrative/technical support medal named in honor of her husband who died in 1970 during his tour as MERADCOM commander. The award went to the team of Mary E. Thodos and Mr. Larry Kearns, Services and Support Directorate, for expert and expeditious handling of travel arrangements.

The fifth award, recognizing the outstanding MERADCOM laboratory for 1980, was presented by COL Albert F. Dorris, MERADCOM commander, to Mr. Stuart A. Kilpatrick, chief of the Counter Intrusion Laboratory. The selection was based on a comparative evaluation of the command's eight laboratories.

Presentation of certificates and $50.00 cash awards to 30 nominees preceded the announcement of the winners.

BRL Team Gets Systems Analysis Award

A 5-man aircraft systems research team at the Ballistics Research Laboratory (BRL) has been awarded the Systems Analysis Award presented annually by the Army Armament R&D Command (ARRADCOM) for noteworthy achievements in operations research.

Led by Dr. Donald F. Haskell, a mechanical engineer, the team included Dr. Mark Kregel and Mr. George W. Hartwig, two BRL research physicists; Mr. Thomas F. Erline, a BRL mathematician, and Mr. Robert R. Schnick, a technician assigned to an ARRADCOM support element at the Aberdeen Proving Ground.

The team was cited for the accomplishment of a comprehensive, innovative systems analysis of the Army's Precision Aim Technique Heliborne Anti-Tank (PATHAT) gun system concept.

The citation noted that the group's efforts demonstrated that the PATHAT concept was feasible and provides a very good cost effective heliborne tank destruction capability at an extended range without the need of adding a complicated gun stabilization system.

In addition, the citation pointed out that the system analysis could lead to a substantial improvement in the effectiveness of the Army attack helicopter systems.

The ARRADCOM System Analysis Award was established to supplement a similar award presented annually by the Army Materiel Development and Readiness Command (DARCOM), ARRADCOM's parent command, in recognition of a notable achievement.

Singley Receives Meritorious Decoration

Mr. George T. Singley Jr., former deputy director, Applied Technology Laboratories (AVRADCOM), Fort Eustis, VA, received the Decoration for Meritorious Civilian Service, the Department of the Army's second highest honorary award for civilian employees.

Singley, who retired recently following more than 37 years of civilian and military service, was cited for significant contributions which are expected to impact on the Army's air mobility systems needs in the 1990s.

During his tenure at ATL, Singley served as chief, Applied Aeronautics Division; acting director, Systems, Office of the Technical Director; chief, Systems Support Division; technical advisor to the Director; and chief, Military Operations Division.

He is listed in the 1946 edition of *Who's Who in American Colleges and Universities*, has authored numerous aviation reports, and is a rated pilot in rotary and fixed-wing aircraft.

Conferences & Symposia . . .

Smoke Symposium V Calls for Papers

A call for papers proposed for presentation at Smoke Symposium V, 28–30 April 1981 at the U.S. Army Harry Diamond Laboratories, Adelphi, MD, has been issued by COL Samuel L. Eure, PM for Smoke/Obscurants.

Papers from DOD, industrial, academic and allied nations personnel are acceptable and may be classified up to and including Secret. Major symposium topics are obscurant testing, instrumentation, methodology, modeling, toxicology, electro-optical, and training and doctrine.

All abstracts, which must be received by 15 January 1981, should include the title, paper length (20 minutes maximum), security classification, and audio-visual requirements. Abstracts review and notifications of acceptance or non-acceptance will be mailed by 2 February 1981.

Papers not selected for presentation at the symposium may be chosen for inclusion in the published proceedings. A final, photo-reproducible copy of the paper must be submitted for publication in the proceedings by 10 April 1981.

Abstracts should be mailed to: PM Smoke/Obscurants, ATTN: DRCPM-SMK-T/Mr. Klimek, Aberdeen Proving Ground, MD 21005. Autovon: 283-5411/5605, commercial: (301) 278-5411/5605.

Food Researchers Meet at NLABS

More than 250 military and civilian scientists and technologists engaged in food service and food packaging research, attended the 2-day Fall meeting of the R&D Associates for Military Food and Packaging Systems at the U.S. Army Natick (MA) Research and Development Labs.

Although ADM Elmo R. Zumwalt, USN (Ret), former Chief of Naval Operations was a last minute cancellation, his prepared keynote address, "The Shifting Military Balance and Consequences for the 1980s," was presented by Mr. Herbert M. Ames, Pack and Process, Inc.

ADM Zumwalt indicated in his statement how the United States, under President Kennedy, was able to checkmate the Soviet Union at the time of the Cuban crisis in 1962. "In the aftermath of that crisis, the Soviet Union embarked upon an impressive program and has since proceeded with the largest strategic nuclear construction program in history; it continues unchecked up to this hour."

"As a result of what they have been able to achieve in SALT I and now in SALT II, the Soviet momentum has accelerated at an amazing pace," he added and urged that SALT II be amended to make it more equitable.

Mr. Harrell B. Altizer, director for Supply Management Policy, Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics), reviewed the many outstanding contributions of Natick Laboratories to the DOD Food Service Program. They included, he said, the Long Range Patrol Ration; the new Meal, Ready to Eat; Dehydrated, Compressed Foods; Formed Meat Cuts and numerous other efforts that provide and maintain the best military feeding system in the world.

Five major discussion sessions under the theme, "Readiness Through Research," included New Combat Feeding Systems—Can we Win the First Battle?; New Food Processes and Products—the Role of Compressed Foods; New Concepts in Tactical Food Service and Sanitation Equipment; Industry Trends and Forecasts in Food Packaging in the '80s and Prediction of the Shelf Life of Military Rations.

Career Programs . . .

ISEF Winner Visits Aeromechanics Lab

Mr. James A. Zigan, a recent high school graduate, spent a week with the Aeromechanics Lab, U.S. Army Research & Technology Laboratories (AVRADCOM), as a result of his being named a superior winner in the 31st International Science & Engineering Fair held in St. Paul, MN. His winning science fair entry "Environmental Aeronautics" was based on airplane propeller research ... which tied in with Army helicopter rotor blade research.

Jim Zigan explained his own research propeller project this way: "The purpose of my experiment was to test an idea I had for improving propeller efficiency through the use of a special tip fence. The idea of the propeller tip fence was developed from study of super critical airfoils which utilized winglets to disturb the air vortices.

My objective, said Zigan, was to show that similar construction on propellers (since propellers are also airfoils) would decrease noise since the vortex is a major contributor of noise and at the same time increase propeller efficiency.

"I designed a test stand to spin model airplane propellers at the same relative tip speed as that of a light airplane's propeller. I also built an electronic tachometer to measure RPM to calculate tip speed.

Three ground rules were followed: the propellers are tested at the same RPM; each propeller had a 6-inch pitch, and the same relative thrust level was maintained. Noise levels were recorded with a Dba meter and on magnetic tape, and thrust was monitored with a spring scale.

Using the tip fence reduced noise and increased thrust significantly. This research confirmed my original proposition that the standard propeller driven light aircraft can be made quieter and more efficient through optimized propeller tip design.

"I would like to see industry test my idea for possible application for commercial propeller driven aircraft." And if it works for propeller aircraft, it might also work for helicopter rotor blades. Jim planned to enter Purdue University this fall to study engineering.

Sarver Begins 6 Months Executive Training

Dr. E. William Sarver, a research chemist who started his Federal career as a military officer at Edgewood Arsenal in 1969, has begun six months of executive training at the Army Armament R&D Command's Chemical Systems Laboratory (CSL).

He was assigned to CSL's Research Division before his selection as the 37th trainee to participate in the program, established in 1970 by CSL's deputy director, Dr. B. L. Harris.

Sarver served as a military researcher until 1970 and then served overseas in Korea with the 7th Infantry Divison until 1971, the year he returned to Edgewood and was appointed to Federal civil service.

He received a bachelor's degree in chemistry from West Virginia University in 1964 and a master's degree in the same discipline from Marshall University in 1966. Lehigh University awarded him a doctorate in 1969 before he entered military service.

CSL Deputy Director Named AICE Fellow

Dr. Benjamin L. Harris, deputy director of the Army Chemical Systems Laboratory (CSL), Aberdeen Proving Ground, MD, has been named a Fellow of the American Institute of Chemical Engineers, a 50,000-member national technical organization.

Dr. Harris was elected by his fellow members for his work in Army chemical and biological research particularly in defense and retaliation systems in pollution abatement and environmental control.

Listed in "American Men and Women of Science," "Chemical Who's Who" and "Who's Who in the East," he was for many years an assistant professor of chemistry at the Johns Hopkins University, where he was awarded a BS degree and a doctorate in chemical engineering.

Dr. Harris entered Federal service in 1952 in the Army Chemical Corps Research and Development Command. He has also served in the Office of the Secretary of Defense as Deputy Assistant Director for Chemical Technology.

He returned to the Army in 1970 as technical director of Edgewood Arsenal and was designated deputy director of CSL with the establishment of the Army Armament Research and Development Command in 1977.

LTC Pedersen Elected as Fellow in AAM

LTC C. E. Pedersen Jr.

LTC Carl E. Pedersen, Jr., executive officer, U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), Fort Detrick, Frederick, MD, was recently elected a Fellow in the American Academy of Microbiology. This Academy serves as the professional services arm of the American Society of Microbiologists. Members are elected to the Academy on the basis of excellence and originality in their discipline.

LTC Pedersen, a research microbiologist, was assigned to the U.S. Army Medical R&D Command (USAMRDC) as the manager of Military Disease Hazards and later as director of Research Programs (1977–1980). Prior to this assignment he served as chief of the Rickettsiology Division and as assistant chief of the Virology Division, USAMRIID from 1971–1977 where he performed research in Venezuelan equine encephalomyeltis, Q Fever and Rocky Mountain Spotted Fever vaccines.

He has authored more than 60 technical articles principally on the structure immunology and physiology of the Rickettsial organisms and several tropical viruses. He is considered one of the nation's authorities on the Rickettsial organisms and vaccines.

He is listed in the reference volume of American Men and Women in Science and has served on several committees of the American Society of Microbiologists. He is a graduate of University of Texas (PhD), the AMEDD Advanced Officer Course, the Command and General Staff College and the R&D Management Course.

LTC Pedersen is an active member of the American Society of Microbiologists, Association of Military Surgeons of the U.S.; the American Society for Tropical Medicine and Hygiene and the Society for General Microbiology.

Dr. Honig To Head Academy of Sciences

Dr. John G. Honig, chief of the Aircraft, Missiles and Electronics Division, Office of the Comptroller of the Army, has been chosen as president-elect of the Washington Academy of Sciences. He has been a Fellow of the Academy since 1964 and has served on its Board of Managers and as treasurer.

Associated with the Department of the Army since 1967, Dr. Honig has held a senior staff position in the Office of Assistant Vice Chief of Staff of the Army, and has served in the Office of the Deputy Chief of Staff for Research, Development and Acquisition.

He was a founding member and a former president of the Military Operations Research Society, a founding member and a president of the Washington Operations Research Council, and a former chairman of the Military Applications Section of the Operations Research Society of America.

BRL Library Provides Unique Information Repository

Fifty years ago scientists and technical personnel were aware of nearly everything being done in their respective fields, so says Ms. Rosalie Forst, chief of the Army Armament R&D Command's Scientific and Technical Information Branch.

However, today "the magnitude and extent of research and development for defense has increased the need for technical information and the necessity for deep indexing of research reports and other technical reference material."

According to Forst, veteran librarian, more thorough cross-referencing techniques now make it easier to serve the special needs of more than 1,000 scientific and technical personnel at the ARRADCOM Ballistic Research Laboratory as well as personnel assigned to the Army Materiel Systems Analysis Activity and the Materiel Testing Directorate at Aberdeen Proving Ground who regularly use BRL's technical library's services.

"We're unique, a sort of one-of-a-kind in the world. The library's collections include some military documents nearly 100 years old in addition to a repository of ballistic firing records, probably unparralleled sources of information," says Forst.

The library was first organized in 1917, from part of the Army Ordnance School holdings of some 3,000 volumes collected during World War I. Later, through the purchase of the library of Prof. Maxim Bocher, of Harvard University, many volumes printed in French and German, as well as many reprints of papers on mathematics were acquired.

According to Ms. Ida Johnson, the library's chief of open literature, BRL scientists, engineers and technicians have access to more than 26,000 books, nearly 2,000 cartridges of microfilm, and thousands of miscellaneous pamphlets, specifications and catalogs.

Rosalie Forst

"The library regularly subscribes to about 740 periodicals," says Johnson, "We have extensive information retrival systems, including the Lockheed Retrival System (DIALOG) which has access to more than 100 data bases, as well as the Ohio College Library Center (OCLC) on-line computer system for searching references and cataloging information," Johnson notes.

"Furthermore, we have Selected Dissemination of Information (SDI) services tailor-made to the needs of our users, including bibliographies of in-house information and those purchased in the library.

"In addition, through arrangements with the Johns Hopkins University, our library patrons have the use of the university's library in Baltimore," she said.

Mr. Paul Ryan, the library's chief of closed literature, says his section has data from more than a million scientific tests from Department of Defense-sponsored research, development, test and evaluations (RDT&E) with a heavy concentration in ordnance.

"We have more than 300,000 technical reports and 600,000 firing records," said Ryan, "including a most unique collection of documents dating back to the beginning of APG in 1917.

"The library's firing records, accumulated from a cross-section of the Army's test ranges, provides us with the most complete collection of its type within the Department of Defense," said Ryan, who also has the responsibility for the Defense RDT&E online computerized system, the Defense Technical Information Center (DTIC).

The three BRL librarians are justly proud of such a unique repository of information and source of valuable specialized services.

"We have a good, solid library, enhanced by on-line services and data bases that put information at the scientist's fingertips and we're studying faster and more automated methods of bringing information to the researchers to serve them better," Forst concludes.

TURN-OF-THE-CENTURY soldiers performing field tests on an Ehrhardt Carriage in a 1902 photo, one of the many photos included in the ARRADCOM Library at Aberdeen Proving Ground, dating back to the 1890s.

MENS Status

The following is a listing of the status of DOD Mission Element Need Statements (MENS), as of the end of 6 October 1980. The MENS is the newest of the requirement documents, and approval by the Secretary of Defense of a MENS is necessary before a "go" decision is given to a program designed to answer a need. (see *Army RDA Magazine*, May/June 1978, p. 1):

MENS APPROVED	Service
Close Combat Anti-Armor Weapon System (AMPM)	Army
Tactical Warfare Combat Logistics Support (VCXCOD)	Navy
Amphibious Warfare Surface Assault (LVA)	Marines
Naval Mines (IWD)	Navy
Beyond Visual Range Air-to-Air Combat (AMRAAM)	Air Force
Undergraduate Jet Flight Training System (VTXTS)	Navy
Primary Undergraduate Pilot Training System	Air Force
Continues Battlefield Stand-Off Surveillance (TR-1)	Air Force
Combat Rescue System (HX)	Air Force
Improved Wide Area Anti-Armor Capability (WHAM)	Air Force
Satellite Operations Capability	Air Force
DOD Shuttle Operation Capability	Air Force
Submarine Launched ASW Stand-Off Weapon	Navy
Mobile Subscriber Equipment (MSE)	Army
Improved Missile Warning and Attack Assessment	Air Force
C-5A Wing MOD	Air Force
High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)	Joint
Advanced Lightweight Torpedo	Navy
Anti-Suawacs (ASALM)	Air Force

FOR COMMENT MENS CURRENTLY IN OSD	
Self Protection Weapon	Air Force
Survivable Military Launch System	Air Force
Air Refueling Modernization (KC 135 Re-Engine)	Air Force
Advanced Tactical Reconn. System (ATARS)	Air Force
Tacfire Modular Improvement Program	Army
Short Range Air Defense Command and Control	Army
Multi-Purpose Surface Combatant (DDGX)	Navy

MENS CURRENTLY IN OSD FOR APPROVAL	
Improved Identification Capability	Joint
FAC-X	Air Force
C-X	Air Force
Amphibious Assault Surface Delivery Mobility (LCAC)	Navy
Distributed Stand-Off Anti-Air Capability (SOJS)	Navy
Heavy Brigade Division Field Artillery	Army
Submarine Advanced Combat System	Navy

MENS PREVIOUSLY REVIEWED BY OSD	
V/HXM	Marines
Long-Range Airborne ASW (LORAAS)	Navy
Fleet Attack Submarine	Navy
Defense Against Stand-Off Jammer Threat	Army
Corps Support Weapon System	Army
Armored Combat Logistics Support Vehicle Family	Army
Direct Fire Support for Amphibious Warfare	Marines
Strategic Bomber Modernization (CMCA)	Air Force
Improved RSTA Helicopter	Army
Space Defense	Air Force
Force Level and Maneuver Control	Army
Tacamo (ECX)	Navy
Tactical Surveillance System	Navy

MENS EXPECTED	
Operational Support Aircraft	Air Force
Common Multi-Mode Radar (CMMR)	Air Force
B-52 Companion Trainer (CTA)	Air Force
Space Surveillance	Air Force
Advanced Military Landing System (AMLS)	Air Force
Advanced Air Superiority Fighter	Air Force
Enhanced Tactical Warning of Atmospheric Attack	Air Force
Multi-Role Bomber	Air Force
Countering Tactical Ballistic Missile	Army
All Source Analysis System	Army
Patriot ECCM	Army
Precision Guided Munitions (SADARM)	Army
Automatic Test Support System (ATSS)	Army
EHF Advance Satellite Comm. Program	Navy
Advanced V/STOL	Navy

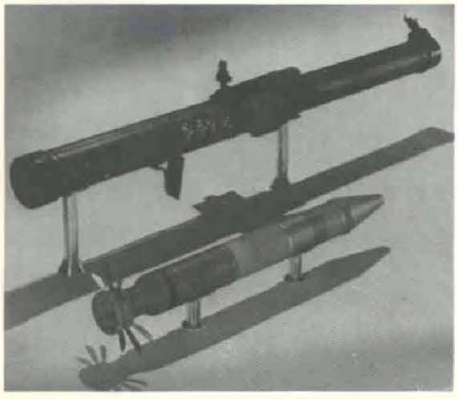
Index of 1980 Major Articles in Army RDA Magazine

The following is a headline list of key articles published during the past year in the Army Research, Development and Acquisition Magazine.

JANUARY—FEBRUARY—

R,D&A ARMY • RESEARCH • DEVELOPMENT • ACQUISITION

JANUARY - FEBRUARY 1980



COMPOSITE MATERIALS FOR ARMY APPLICATIONS

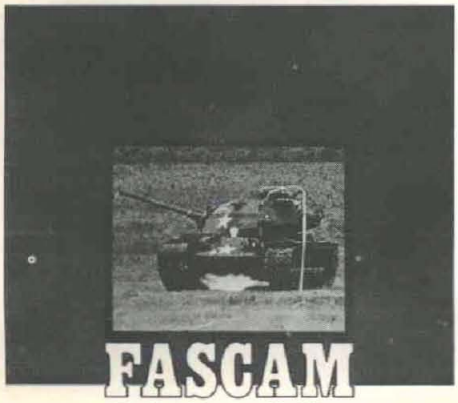
(See page 1)

- Army Applications Of Composite Materials.
- Army Mobility Fuels In The 21st Century.
- Interview With Former ASA (R&D) Norman Augustine.
- Foreign Armored Reconnaissance Vehicles (Photos).
- Armament Concepts Office Stresses 'New Ideas'.
- WES Continues Work In Sensor Technology Research
- Generation Of Weapons Requirements For Soviet Ground Forces.
- Sensor Development And Application.
- AORS Participants Review Priority Problems.
- Army Studies Copter Wire Strike Protection System.
- Battelle Forecasts $61.8 Billion for CY 1980 R&D.

MARCH—APRIL—

R,D&A ARMY • RESEARCH • DEVELOPMENT • ACQUISITION

MARCH-APRIL 1980



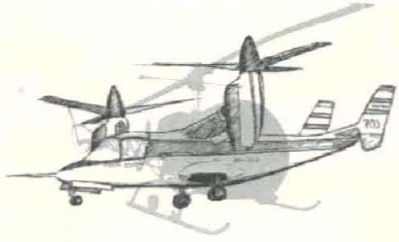
Family of Scatterable Mines

- Atlanta VI: A New Sense of Urgency.
- Improving The M113A1 Armored Personnel Carrier.
- Scatterable Mines: A Unique New Capability.
- Tank Crew Turbulence.
- The Case For An Automated Acquisition Handbook.
- Improving Railroad Safety Through Insulation Technology.
- ADPA Sponsors Seminar On Army Requirements.
- ETL Developing Quick Response Multicolor Printer.
- Evolution And Status Of The Advanced Planning Briefing.
- Natick Evaluating New Emergency Assault Food Packet.
- CSL Developing New Chemical Protective Mask.
- ETL Announces Production Of 99 PAD Systems.
- White House Conference Aids Information Availability.

MAY—JUNE—

R,D&A ARMY • RESEARCH • DEVELOPMENT • ACQUISITION

MAY - JUNE 1980



Focus on Army Aviation Technology

- Tilt Rotor Aircraft.
- Rotor Systems Research Aircraft.
- Advancing Blade Concept Flight Research Program.
- Evolution Of The Cobra Helicopter.
- The CH-47 Chinook Modernization Program.
- A Pictorial Photospread Of Soviet Helicopters.
- The Radar Threat Trainer And U.S. Army Aviation.
- BRL Research Provides Survivability For Aircraft Engines.
- A Report On The History Of U.S. Army Aviation.
- USAISR Honored By U.S. Marine Corps Meritorious Unit Citation.
- TRADOC's Role In The Aviation R,D&A Process.
- WES Developing SACON For Training Purposes.
- Programable Handheld Calculators Aid Field Artillery Units.

JULY—AUGUST—

R,D&A ARMY • RESEARCH • DEVELOPMENT • ACQUISITION

JULY - AUGUST 1980

ARMY OUT - OF - COUNTRY

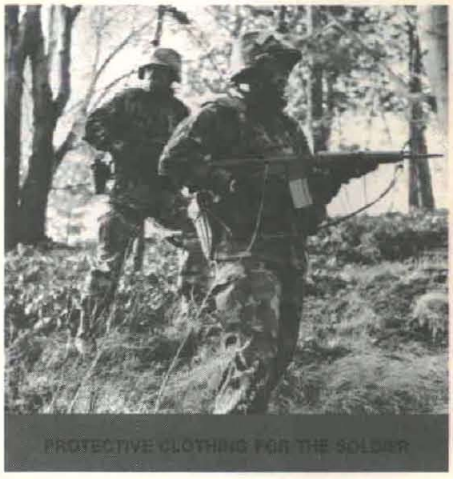
Research, Development & Standardization Agencies

- Army Overseas Activities In Support of R&D And Standardization.
- Responses From Army Vice Chief Of Staff GEN John W. Vessey Jr.
- HQ DARCOM Office Of International R&D And Standardization.
- Army Research, Development & Standardization Group—Germany.
- Research, Development & Standardization Down Under.
- Standardization And The NATO-MAS U.S. Army Interface.
- Role Of The U.S. Mission To NATO In Armaments Cooperation.

SEPTEMBER—OCTOBER—

R,D&A ARMY • RESEARCH • DEVELOPMENT • ACQUISITION

SEPTEMBER - OCTOBER 1980



PROTECTIVE CLOTHING FOR THE SOLDIER

- Interview With NARADCOM Commander COL Robert Cuthbertson.
- New Concepts In Chemical Protective Clothing
- RSI And Combat Clothing For The 1980s.
- A History Of The Combat Boot.
- The Environment, The Soldier, And His Equipment.
- Warsaw Pact Military Clothing Pictorial Review.
- Research, Development & Standardization Group—Canada.
- R&D Within The Soviet Ministry Of Defense.

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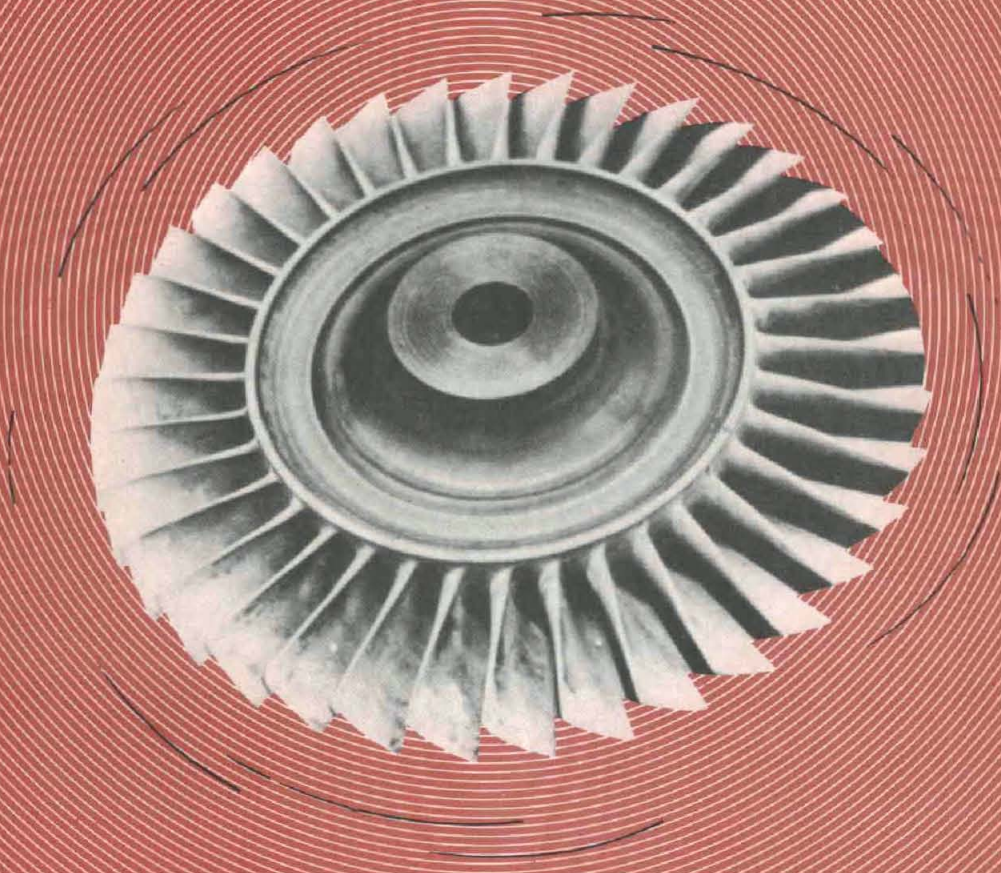

TRI-DENSITY WHEEL COLD SPIN TESTED TO 55,700 RPM