AIR DEFENSE

TRENDS

US ARMY AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916
June 1973

AIR DEFENSE TRENDS
US ARMY AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916

IN THIS ISSUE

The way to achieve lasting peace is through hard, tough, meaningful negotiations. The way to negotiate successfully is to maintain adequate strength as the foundation for negotiations.

As a consequence of maintaining our strength and of hard bargaining, we have succeeded in reaching an agreement that applies the brakes to the momentum of the ongoing Soviet missile buildup.

The President, the Joint Chiefs, and I fully recognize that these agreements cannot protect us against grave risk if we fail to maintain the quality and the realism of our deterrent strength in the years ahead.

If we are to continue to make progress in negotiation to reduce threats to peace, we must remain strong. Only a strong nation can negotiate with confidence and with a minimum of risk.

— *Melvin R. Laird*
Former Secretary of Defense

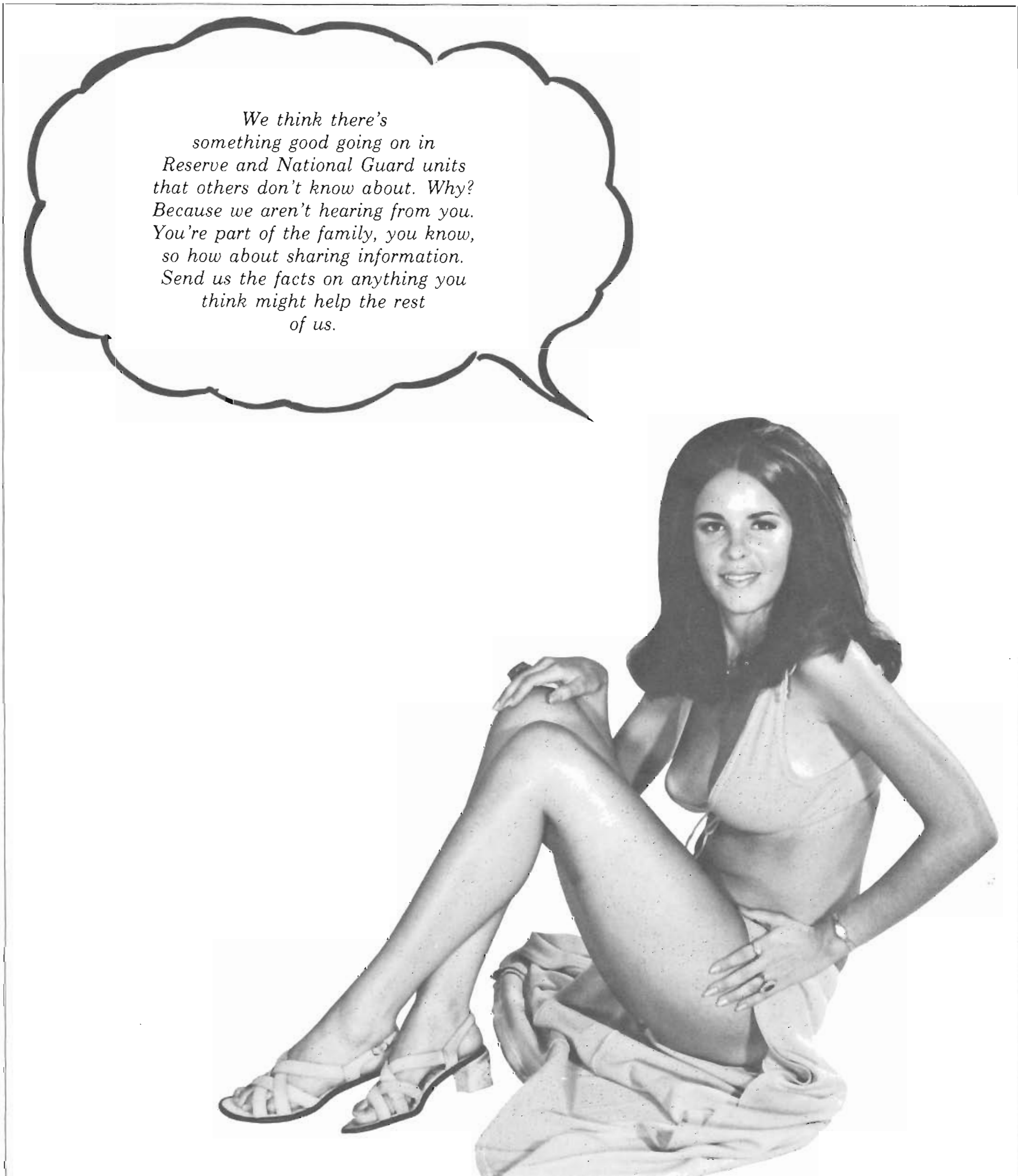
General Shoemaker Leaves Fort Bliss

Major General Raymond L. Shoemaker, after serving as Commanding General, US Army Air Defense Center and Fort Bliss, including the post of Commandant of the US Army Air Defense School, since 15 June 1971, has been reassigned as Commanding General, US Army Air Defense Command. Concurrently he was nominated by President Nixon for advancement to the rank of lieutenant general. A native of Washington, D.C., General Shoemaker graduated from West Point in the class of 1940 with a commission in the field artillery. In addition to attending the Command and General Staff College, Armed Forces Staff College, and National War College, he engaged in graduate studies at Stanford University where he received a master of art degree in journalism, and at George Washington University where he received a master of arts degree in internal affairs.

He was promoted to major general in August 1967. He served in Europe during World War II and with Headquarters, Far East Command, during the Korean Campaign.

General Shoemaker has been awarded the Distinguished Service Medal, Silver Star, Legion of Merit with Two Oak Leaf Clusters, Bronze Star Medal with Oak Leaf Cluster and "V" Device, Army Commendation Medal with Oak Leaf Cluster, and Purple Heart with Oak Leaf Cluster.

He has been replaced by Major General CJ LeVan, formerly Commanding General of the 32d Air Defense Command in Germany.


We think there's something good going on in Reserve and National Guard units that others don't know about. Why? Because we aren't hearing from you. You're part of the family, you know, so how about sharing information. Send us the facts on anything you think might help the rest of us.

COVER A Roland II System missile had just been fired and, according to recent tests, the odds are 7 to 1 it will destroy its target. An all-weather, command guided, low-altitude air defense system; with radar, optical, or combination operating modes, and a 10-missile complement; Roland can be installed on a single vehicle for highly mobile, forward area operation. The missile has a booster for fast blastoff and a sustainer motor to maintain high kill maneuverability out to ranges in excess of 6,000 meters. The operator can switch from radar to optical mode in real time.

Developed and perfected in joint effort by France and Germany, the system has come to the attention of the US Army for possible adoption into the US air defense arsenal. Testing of Roland in February, March, and April 1973 essentially completed recent US Army tests of Allied all-weather SHORAD systems. Compatability with the M55, M109, and MICV were considered. It was found that the weight of the system combined with the principal vehicle considered was 18 to 20 tons and it met phase II air transportability requirements. Adoption for US Army employment is credible. On page 44 is a comprehensive report on the Roland system.

US ARMY AIR DEFENSE SCHOOL

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AIR DEFENSE TRENDS

An instructional aid of the United States Army Air Defense School, Air Defense Trends is published on the basis of three issues annually. It is designed to keep air defense artillerymen informed of unclassified tactical, technical, and doctrinal developments because it is essential to national defense that all levels of air defense command be kept aware of these developments and their effect on the air defense posture.

Distribution of this publication will be made only within the School, except for distribution on a gratuitous basis to Army National Guard and USAR schools, Reserve component training and ROTC facilities, and as requested by other service schools. CONUS armies, US Army Air Defense Command, Active Army units, major oversea commands, and military assistance advisory groups and missions.

Qualified individuals may purchase copies of Air Defense Trends at 50 cents a copy from the Book Store, US Army Air Defense School, Fort Bliss, Texas 79916. The form below is printed for convenience in ordering.

When appropriate, names and organizations of authors are furnished to enable readers to contact authors directly when they have questions concerning an article.

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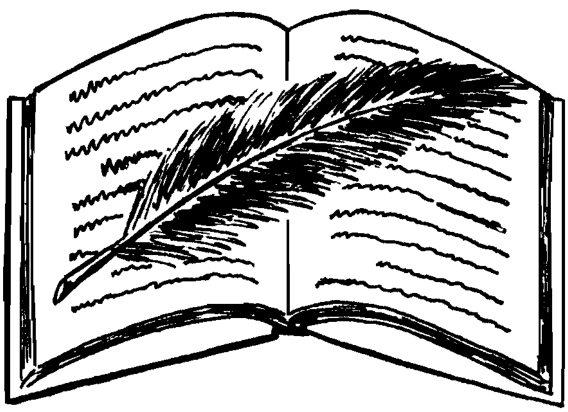


Air Defense Trends seeks your comments on any material published. A different viewpoint or a new line of reasoning may be published to stimulate the exchange of ideas. If you are an authority on a subject, we invite you to write an article and inform our other readers. If circumstances prevent you from writing an article, send in your idea and our editorial staff will assist in developing an acceptable article.

Readers are invited to submit for publication articles and informative notes that are of professional interest to the air defense artilleryman. Articles should be current and forthrightly stated and should relate to some aspect of what air defense units in the field are doing to accomplish their mission, particularly in the technical and tactical areas. Miscellaneous articles expressing either technical or nontechnical ideas that may be of value to air defense will also be considered for publication.

Direct communication to the editor is authorized:

Deputy Commandant for Combat and Training Development
US Army Air Defense School
P.O. Box 5600
Fort Bliss, Texas 79916
Telephone 915-568-5017
AUTOVON 978-1801

LETTERS *to the Editor*

• I was pleased to learn from "Army News Features," published by the US Army Command Information Unit, Washington, D.C., that Department of the Army has established more than 2,000 race relations and equal opportunity staff positions in units and organizations. I think this is timely action and may be a very effective measure toward rectifying situations that could become quite serious in the Army.

A general officer position heads the Office of Equal Opportunity Programs. The Army created this position to emphasize its commitment to race relations and equal opportunity.

Under the new set up, staff positions will be placed in the following units: brigade, division, corps, CONUS Army, small post, large post, small major command, large major command, and Headquarters, Department of the Army. Each race relations and equal opportunity staff office will be composed of two subordinate branches. The Race Relations Education and Training Branch will be responsible for developing, monitoring, and presenting the race relations education program. The Race Relations and Equal Opportunity Operations Branch will be responsible for all other actions associated with the maintenance of racial harmony and equal opportunity by developing affirmative action plans, analyzing lessons learned, identifying inequality of opportunity or treatment and recommending corrective actions, and instituting programs to insure involvement of service families and the community. Equal opportunity staff officers will have clear access to the commander.

I am wondering now whether similar provisions will be made for Reserve units. It would be a boon to the community relations and recruiting efforts of Reserve components, particularly in those areas where large minority groupings exist, to have similar recognized staff positions. I would welcome information concerning efforts to make these program positions a reality in Reserve component units.

DONALD W. BARTLETT
LTC, ADA — USAR
OIC, El Paso School Detachment
4166th US Army Reserve School
P.O. Box 9591
El Paso, Texas 79986

• The letter to the editor in the October 1972 issue of Air Defense Trends by LTC L. J. Coenen (concerning an alleged Communist plan for creating revolution) requires comment.

In reply to his closing question, (Is this coincidental, a reflection of changing values, a Communist plan, or a combination of all three?) the answer is most probably: none of these. Over 2 years ago this "document" began to appear in various publications. The Federal Bureau of Investigation made a thorough investigation, and Mr. Hoover himself reported that there was no evidence that the "document" ever existed. I think you should consider the possibility that letters such at LTC Coenen's have strong political overtones and investigate their fundamental accuracy — so far as possible. If Air Defense Trends is to be a sounding board for political or ethical/moral value judgments, then so be it. If not, a clarification of LTC Coenen's letter should be printed.

ROBERT W. UPTON
DAC
3344 Polk
El Paso, Tx

Thanks for your interest in Air Defense Trends and your comments. The basis for LTC Coenen's letter was a recent editorial by a prominent citizen of El Paso on his daily radio show. Colonel Coenen felt that the message deserved publication and we agree.

— Ed.

• I think many of us will agree that Air Defense Artillery is little understood in the Army today. What has created this phenomenon?

Since the first Nike Ajax became operational in 1953, some air defense artillerymen have taken the attitude that we are the elite branch of the Army. This attitude can be attributed to our association with expensive, complex, and intricate command, control and coordination, radar, and missile systems. Actually many of us need to broaden ourselves professionally, and one avenue is to become qualified in all ADA weapon systems and to seek more branch immaterial assignments.

Along with adjusting our own thinking, we need to enlighten other Army personnel regarding the facts of air defense. The Army, for the most part, has enjoyed the advantage of air superiority on every battlefield for over 25 years and consequently many of our senior officers have not fully acquired air defense expertise. A problem arising from this condition is complacency with regard to air attack. The solution is to reorient senior combat arms commanders and staff officers. The process was recently begun by the Chaparral/Vulcan battalion commander and his officers. But more needs to be done. Consequently, the US Army Air Defense School submitted a program of instruction (POI) for a 3-day Senior Non-Air Defense Officer Course to US Continental Army Command (CONARC) for approval in the summer of 1971. The POI was to provide general officers and non-air defense senior staff officers with a general knowledge of the materiel, doctrine, and deployment concepts of air defense in the field army. Unfortunately the POI was disapproved.

An opportunity to indoctrinate field grade officers in air defense is available to the US Army Command and General Staff College, Armed Forces Staff College, and senior service colleges. According to recent C&GSC graduates, in only one practical exercise did friendly forces not enjoy air superiority. With air superiority thus assumed, it becomes rather mechanical to task organize when preparing the operation orders.

In addition to our own attitudes and those of other Army officers, the ever-present question of economics has influenced decisions which may not have been in the best interests of national security. In the mid-1930's there was an unfulfilled need for the British air defenders to educate their comrades in arms, politicans, and the civilian population. This omission ultimately led to the failure of the British to have suitable antiaircraft defenses during September 1938. Because the British Army did not know how to use its antiaircraft, and did not realize the potential power, destructiveness, and threat posed by a "non-existent Luftwaffe," antiaircraft artillery (AAA) was treated as a special service tacked onto the Regular Army. Consequently, any money that was spent to build up AAA was felt to be money that should have gone to the Army proper for improvements. The British Army was busy trying to convert into a mechanized force to keep abreast of modern developments. It felt that home defense was not its primary concern and was an unproductive drain on its purse. The Army therefore paid little attention to building up antiaircraft artillery defense units. In fact, the task was given to the Territorials, who were regarded only as supplementary troops. It was to take the fear of Munich, 28 September 1938, to awaken the British to the danger of their position. As we not similarly weak in air defense today? General William C. Westmoreland has said. "We have permitted ourselves to go so long without adequate air defense we are headed for a potential battlefield disaster." Current economy moves have largely dismantled our air defense system. These tabulations show a comparison between NORAD weapons and radars in 1960 and 1971. Most of the cuts occurred in 1969:

NORAD Weapons

	1960	1971
Nike Hercules/Hawk batteries	270	63
Fighter squadrons (Regular)	65	14
Fighter squadrons (ANG)	38	15
Bomarc squadrons	9	7
	382	99

NORAD Radars

	1960	1971
Long-range radars	187	99
Gap filler radars	105	0
	292	99

In the same time period (1960-71), personnel assigned for air defense of CONUS were reduced 61.7 percent.

What tangible effect has this had on our capability to detect aircraft penetrating our airspace? Two recent instances reflect our weakness in this extremely sensitive area. On 5 October 1969 an armed Cuban Mig-17 flew undetected and unchallenged from Havana to Homestead AFB, Florida, and landed while the President's Air Force One was parked nearby. On 26 October 1971 a Cuban Anthonov AN-24 transport arrived at New Orleans Moisant International Airport without prior clearance. The aircraft crossed the US Aircraft Defense Identification Zone 200 miles out over the Gulf of Mexico but was undetected until within 25 miles of the airport when flying at 4,000 feet.

Admiral Thomas H. Moorer, Chairman of the Joint Chiefs of Staff, has recently testified that during the past 10 years the air defense of North America has been reduced approximately 60 percent. The decision to degrade US air defense, we are told, was based on the scarcity of money. As money became scarcer, the decision was made to deplete the southern defense ring in favor of the norther borders.

No doubt the decision to reduce our air defense posture in the south was made after all alternatives were carefully examined and analyzed. General McKee, Commander in Chief of the North American Air Defense Command, in testimony before the House Armed Services Intestigating Subcommittee, indicated that the master plan drawn up in 1967 was based on the premise that the savings achieved by phasing down the system would amortize the procurement of a more modern defense force. This is a valid argument, but I would hope that the savings achieved that could be applied elsewhere were weighted against the risks involved. We must never forget that the threat should dictate employment of these defensive weapon systems.

The validity of assumptions is critical to the decision-making process. But recommendations and subsequent decisions are sometimes based on uncertain situations. Admiral Moorer told the subcommittee that the decision to degrade the US air defense was based on projections of sharp reductions in the Soviet bomber threat; however, those projections have not fully materialized. Since then the Soviets completed development of the Back Fire bomber, a long-range aircraft similar to our B-1, and production of operational aircraft has begun. By November 1972 over 20 aircraft had been produced or were on the production line.

Although the big threat from Russia is her nuclear missile capability, her bombers could strike targets in the Southern States. And Cuba has Russian Mig-17 and Mig-21 aircraft, the latter with an operating radius that would permit attacks on any of our military installations in Florida. United States deterrent air power, along with restraints imposed by Russia on Cuba, should reduce the risk of such an attack, but we are nevertheless vulnerable to unchallenged flights entering the US through the 1,500-mile opening in our air defense on the southern perimeter between Florida and California.

In this letter I have pointed out several critical issues. I'm sure that many, like me, are eager to see some indication that action to effect equitable adjustments is under consideration.

JAMES V. SPROUSE, JR.
MAJ, ADA

USAADS REORGANIZATION — 1973

The United States Army has begun its most sweeping reorganization since 1962. The fundamental purposes of the action are to strengthen the Army by making it more efficient and to gear it more precisely to the challenges of the future. The changes primarily involve the Army's major commands within the Continental United States which are responsible for the readiness of STRAF and USAR units; operation of the training establishment and the development of concepts, doctrine, and materiel for land combat; and providing logistic support. The three major organizations established directly under Department of the Army to direct the initiatives essential to attainment of these goals are: Forces Command (FORSCOM), Training and Doctrine Command (TRADOC), and Army Materiel Command (AMC). All Service schools fall under Training and Doctrine Command.

The US Army Air Defense School (Prov) (USAADS) retains an office of budget and management, office of the secretary, an office for logistics, and the School Brigade. Effective March 1973, the 1st AIT Brigade became a part of the Air Defense School, thus bringing all teaching and training functions under the Commandant. The Safeguard Central Training Facility has been phased-down as a direct result of agreements reached between the United States and the Soviet Union concerning deployment of antiballistic missile systems. The phase-down was concurrent with Operation STEADFAST. Under the new organization, the Safeguard Central Training Facility became the Ballistic Missile Defense Department — one of the resident instruction departments. The major change structure relates to the establishment of two new Deputy Commandant positions — one for doctrine and one for instruction.

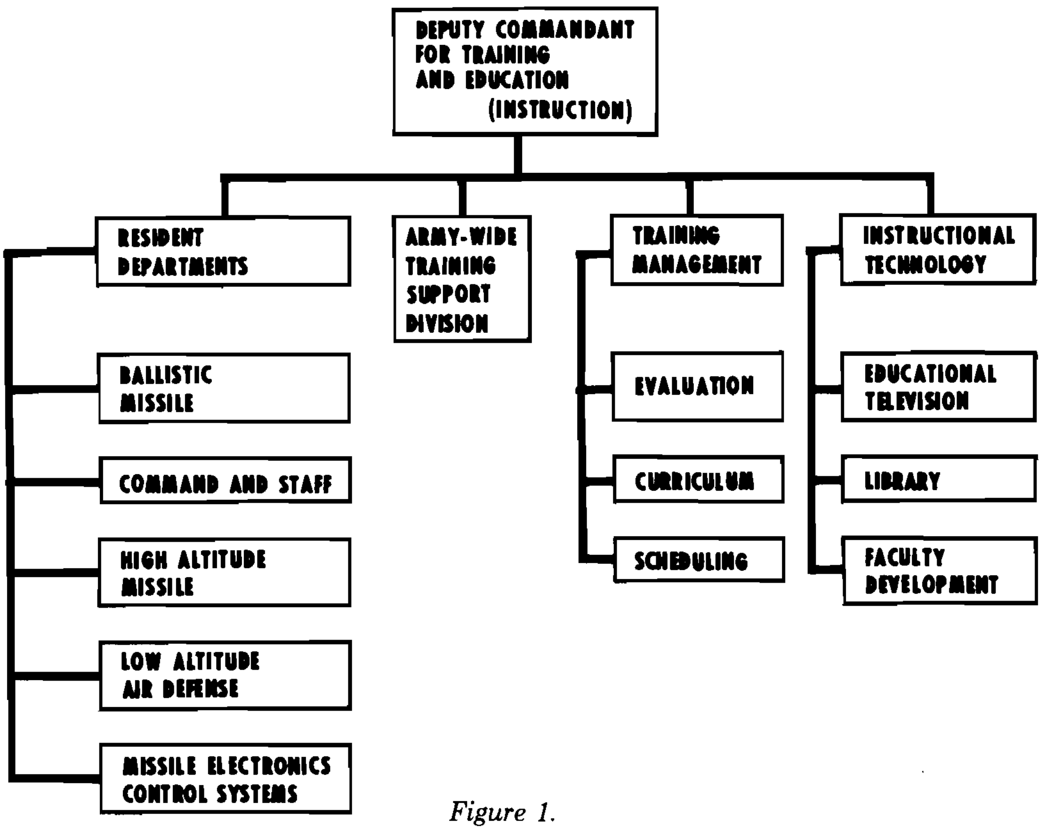


Figure 1.

The new proposed Organization for the Deputy Commandant for Training and Education (fig 1) incorporates two significant changes from the current Director of Instruction organization and changes the title of the Nonresident Instruction Department to the air defense's Army-Wide Training Support organization. Probably the most dramatic change, is the establishment of the Instructional Technology element which will include a library/learning center and a Training Aids Services Office (TASO). It is the aim of USAADS to provide a facility equipped to assist the individual in learning. When completed, the learning center will be a one-step facility which will include a library, GED MOS Library, study areas, faculty development area, TASO, automatic data processing systems and audio-visual instruction. It is envisioned that this facility will employ some of the latest techniques used to assist the individual in the learning process, and will be managed by educational technologists who will provide expert consultation on all aspects of education, including facilities, equipment, methods, techniques, and media (both hardware and software) from development through evaluation to complete application. The TASO will complement the learning center operation by providing a single point of contact for all aspects of instruction and effective, systematic management of all media functions at the US Army Air Defense Center and Fort Bliss and USAADS.

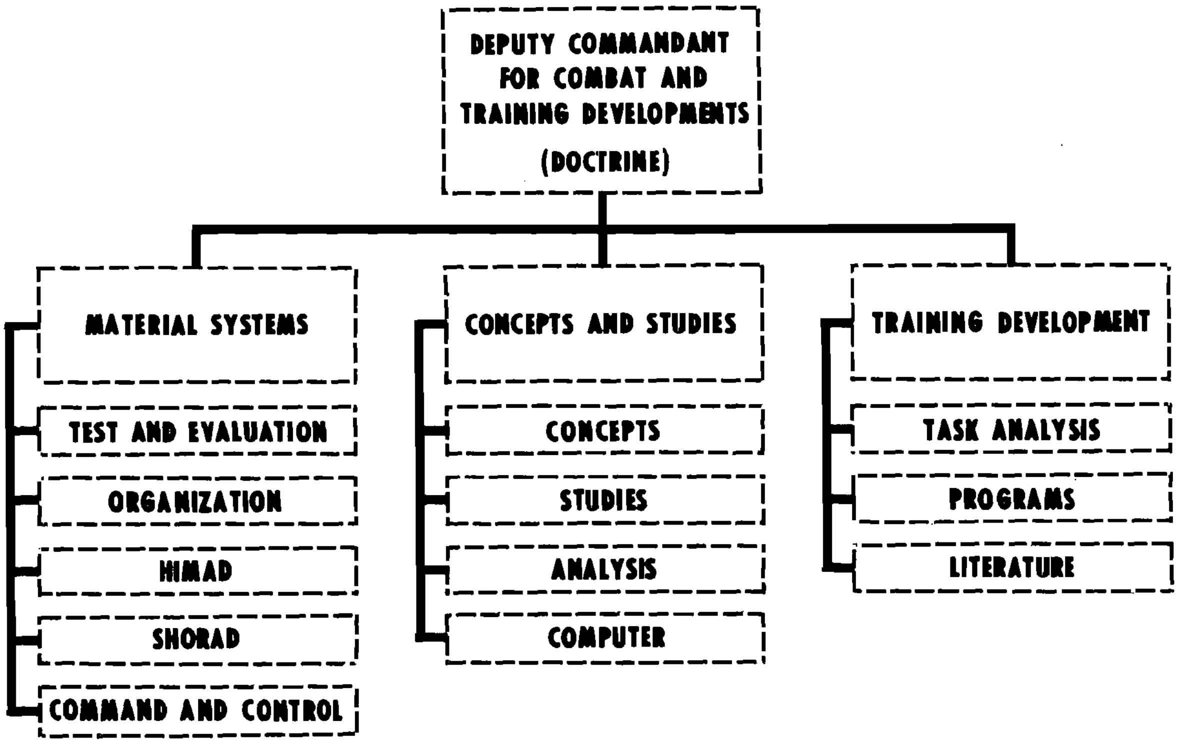


Figure 2.

The other newly established Deputy Commandant position is the Deputy Commandant for Doctrine (fig 2) — officially referred to as the Deputy Commandant for Combat and Training Development. This individual will be responsible for all School activities relating to combat developments to include proponent doctrine, organization, testing, concepts, studies, materiel developments, and training requirements, as well as development of the Army doctrinal and applicatory training literature. To accomplish these many and varied functions will require a personnel increase over the present organization which is now responsible for only a portion of the functions just mentioned. This increase will be satisfied primarily by combining what was the Air

Defense Agency of the Combat Developments Command and the Office of Doctrine Development, Literature, and Plans. All School functions pertaining to materiel, training, and literature development will be accomplished within this structure.

This new organization will enable the School to accomplish its resident and nonresident training responsibilities more effectively by permitting the academic side of the School to concentrate on instruction while providing greatly improved facilities for the learner. Also, the doctrine side of the School will enable the School to serve air defense world-wide and be more responsive to the needs and requests of the field.

USAADS Notes

Hinman Hall

DEPUTY COMMANDANT FOR COMBAT AND TRAINING DEVELOPMENT

TRAINING LITERATURE REPORT

Here is a list of Department of the Army training literature that is being produced at the US Army Air Defense School and should be printed and distributed late in FY 1973 or early in FY 1974.

FM44-1A US Army Air Defense Artillery Employment (U), Oct 69 (Revision — will be FM 44-1-1A when revised).

FM 44-1-1, US Army Air Defense Artillery Operations, Oct 69 (Change).

FM 44-4, Procedures and Drills for Chaparral Air Defense Guided Missile System, Sep 71 (Change).

FM 44-6, Procedures and Drills for Forward Area Alerting Radar (New).

FM 44-19-1, Air Defense Artillery Missileman Examinations (Nike Hercules) (New).

FM 44-19-4, Basic Air Defense Artillery Missileman Examinations (Hawk) (New).

FM 44-19-5, Advanced Air Defense Artillery Missileman Examinations (Hawk) (New).

FM 44-19-6, Expert Air Defense Artillery Missileman Examinations (Hawk) (New).

FM 44-19-7, Basic Air Defense Artillery Missileman Examinations (Chaparral) (New).

FM 44-20, Service Practice for ADA Missile Units, May 71 (Revision).

FM 44-30, Visual Aircraft Recognition, Aug 71 (Revision).

FM 44-82A (C), Procedures and Drills for Nike Hercules Missile Battery (U), Jun 70 (Revision).

FM 44-98A (C), ADA Engagement Simulator; GM System Radar Signal Simulator Station AN/TPQ-21 (Hawk) (U), May 67 (Revision) — New title when published: ADA Engagement Simulators, GM System Radar Signal Simulator Stations AN/TPQ-21 (Hawk) and AN/TPQ-29, (Improved Hawk) (U).

FM 44-( ), Procedures and Drills for Ballistic Aerial Target System (New).

FM 44-( ), Procedures and Drills for Hawk Missile Battery (Improved) (New).

FM 44-( ), Instructor's Manual, Training Set, Moving Target Simulator M87 (New).

FM 44-( ), ADA Engagement Simulator; GM System Radar Signal Simulator Station, AN/TPQ-29, Improved Hawk (New).

ATP 44-245, Air Defense Artillery Battalion, Hawk (Improved) (New).

ASubjScd 44-2, Visual Aircraft Recognition, May 71 (Revision).

ASubjScd 44-3, ADA Organization and Materiel, Jun 68 (Revision).

ASubjScd 44-4, FAAR Crewman Training (New).

ASubjScd 44-5, Reconnaissance, Selection, and Occupation of Position for Air Defense Artillery Units, Sep 69 (Revision).

ASubjScd 44-11, Tactical Air Control Center and Control and Reporting Center Sections, Jan 68 (Revision).

ASubjScd 44-21, ADA Operations and Intelligence Section, Jan 68 (Revision).

ASubjScd 44-44, Command and Acquisition Section (Improved Hawk) (New).

ASubjScd 44-43, Firing Section (Improved Hawk) (New).

ASubjScd 44-80, Air Defense Nuclear Operations Additional Skill Identifier, R2 (Nike Hercules) (New).

ASubjScd 44-16B10, AIT and Refresher Training of Hercules Missile Crewman, MOS 16B10, May 67 (Revision).

ASubjScd 44-16C10, AIT and Refresher Training of Hercules Fire Control Crewman, MOS 16C10, Jun 67 (Revision).

ASubjScd 44-16D10, AIT and Refresher Training of Hawk Missile Crewman, MOS 16D10, Feb 70 (Revision).

ASubjScd 44-16E10, AIT and Refresher Training of Hawk Missile Fire Control Crewman, MOS 16E10, Feb 70 (Revision).

ASubjScd 44-16F10, AIT and Refresher Training of Light Air Defense Artillery Crewman, MOS 16F10, Jun 69 (Revision).

ASubjScd 44-16H10, AIT and Refresher Training of ADA Operations and Intelligence Assistant, MOS 16H10, May 67 (Revision).

ASubjScd 44-16P10, AIT and Refresher Training of Chaparral Crewman, MOS 16P10 (New).

ASubjScd 44-16R10, AIT and Refresher Training of Vulcan/Chaparral Crewman, MOS 16R10, Apr 70 (Revision — TITLE CHANGE — AIT and Refresher Training of Vulcan Crewman, MOS 16R10).

ATT 44-3, Air Defense Section (Redeye), Sep 67 (Revision).

ATT 44-245, Air Defense Artillery Missile Units (Improved Hawk) (New).

ATT 44-535, ADA Missile Units (Nike Hercules), May 66; C1, Apr 67 (Revision).

In an effort to improve air defense artillery training literature, i.e., FM's, ATP's, ASubjScd's, and ATT's, the Deputy Commandant for Combat and Training Development is establishing a file of unit TAC SOP's. The TAC SOP's will be researched and analyzed for information to be used in improving training literature.

STINGER TRAINING

The US Army Air Defense School (USAADS) was designated by CONARC as the proponent school for the planning and execution of CONARC activities associated with the development and fielding of the Stinger system. USAADS participation in the Stinger development program is primarily training oriented and includes the generation of requirements for training devices, development and execution of the advance resident training plan, and preparation of Department of the Army applicatory training literature to support Stinger training and field operations.

At the present stage of Stinger development, planning for training to support the introduction of Stinger into the field army is necessarily based on a number of broad assumptions and will be defined and become specific with the development of the CONARC Advance Resident Training Plan in mid-1974. Basic assumptions for the planning of Stinger training are: First, that the Stinger will closely resemble the Redeye in physical configuration, handling and operational characteristics, tactics, employment techniques and doctrine, and in its organizational and MOS structure. Second, that the Stinger will replace the Redeye on a weapon-for-weapon and man-for-man basis and that replacement will take place as a gradual phase-in over a considerable period of time resulting in the necessity of supporting both systems in the field simultaneously. Third, that the Stinger Weapon will be fielded as a certified round of ammunition and will not require direct or general support maintenance in the field. And finally, that Stinger will be supported by an IFF system and that the IFF also will not require direct or general support maintenance in the field.

If the assumptions are (and remain) valid, then Stinger training will consist entirely of gunner and air defense section leader training and will be essentially the same as that now given Redeye personnel. There will be some modification and expansion of course content to account for the acquisition of a forward aspect engagement capability and to provide for instruction on the employment and organizational maintenance of the IFF equipment.

ORGANIZATION

Action was recently completed to implement the findings of the Tactical Vehicle Review Board (TVRB) and recommended vehicle adjustments (REVA) by the DA Wheels Study Group. All air defense artillery tables of organization and equipment were affected. It is expected that changes will be published prior to the end of FY 73. The following vehicle reductions, that apply to all TOE, are of particular interest:

All wheeled ambulances except one three-quarter ton were deleted from all air defense artillery battalions. The 3/4-ton ambulance remains in the medical section of the headquarters and headquarters battery.

The number of wire laying vehicles for each air defense artillery battalion were reduced to two. Vehicles remain in the communications section of the headquarters and headquarters battery.

Staff vehicles for the air defense brigades and groups were reduced on the basis of one vehicle per two staff sections plus one vehicle per authorized chaplain.

The command and control vehicles used by the battalion and battery executive officers were deleted from most air defense artillery battalions.

Although the reduction of vehicles from Redeye sections has no impact on air defense artillery organizations, it is of sufficient interest to the air defense community to mention. Vehicles were deleted from three Redeye teams of each Redeye section in the maneuver battalions. Vehicles were deleted from all Redeye teams in field artillery battalions, except airmobile division elements. Vehicles were deleted from three Redeye teams of separate brigade headquarters companies.

Scheduled for cyclic review during the latter part of FY 73 are two air defense artillery battalion TOE and their component tables as follows:

TOE 44-325H, ADA Battalion, Chaparral/Vulcan, SP

44-326H, HHB, ADA B, Chaparral/Vulcan, SP

44-327H, ADA Battery, Vulcan, SP

44-328H, ADA Battery, Chaparral, SP

TOE 44-235H, ADA Battalion, Hawk

44-236H, HHB, ADA Battalion, Hawk

44-237H, ADA Battery, Hawk

Comments and recommendations are solicited and may be forwarded to this Agency, ATTN: CDCAD-MO.

COMPUTERS

The Air Defense Agency uses an IBM 360/65 with over two million bytes of core (one million fast, one million slow) to run the computer models that are the foundation of analysis used to support most of the air defense related studies. We are continually conducting DA directed studies.

The primary model used is titled the Tactical Air Defense Computer Simulation and appropriately known here in the Southwest as TACOS. We think this model does almost everything but talk. The technical specifications of the model would fill more space than the last 12 issues of Air Defense Trends, it takes a large scale machine, a lot of experience, and approximately 3 months of preparation to conduct a study using this model. In return for all of this time and effort, we are capable of varying parameters not normally included in computer models. Some of these include varying combinations of guns and missiles; varying numbers and types of attacking aircraft; dynamic flexibility on the missile P_k varying with aircraft type, speed, altitude, and direction; number of aircraft in a group or cell; range of aircraft from site; benign or ECM environment; incoming or outgoing target; performance of any one of 15 aircraft maneuvers; or any combination of the above.

We have been using this model for about 8 years and improvements are being made each year. Although this model has always been used on an IBM 360 computer in the past, this is changing in FY 74. We will have a capability to use a Control Data 6500 computer in July 1973.

Our secondary computer model has a fast running time and a very quick start up time. This model is the Deterministic Mix Evaluation Worldwide or DMEW. As you may have deduced from the title, this is a deterministic model so no drawing of random numbers is conducted. We use this model to vary the mix of forces for the air defense systems under consideration. The greatest air defense effectiveness for the least expenditure is the goal we are seeking.

New equipment and increased capability is in our near future. Watch for future articles.

AIRSPACE CONTROL

The Agency and USAADS are participating in a program of evaluation of the Army airspace control system. The program is being conducted at Fort Hood, Texas, by representatives of CDC, CONARC, MASSTER, USAF, and tactical units. The main program objective is to define and refine the Army's current airspace control doctrine, procedures, organization, and materiel to the point that a workable system can be recommended to the Department of the Army. To date, efforts have included a 3-week CPX to further refine the tentative system. Considerable progress has been made. The program will impact significantly on ADA doctrine, procedures, and equipment requirements. FM 44-10 (Test), Army Airspace Control Doctrine, was published by USAADS March 1973.

DEPUTY COMMANDANT FOR TRAINING AND EDUCATION

CONTROL SYSTEMS TRAINING

A program of instruction combining the 25G20, Weapons Monitoring Center Repairman, and the 25H20, Radar Data Processing Center Repairman, courses has been designed for use at the US Army Air Defense School. The course is intended to provide needed repairmen for the MSG-4 system until it is replaced by the AN/TSQ-73, Missile Minder. The new course will be 42 weeks in length and provides comprehensive training on the WMC (25G20) and sufficient training to permit maintenance of the dissimilar and more complex parts of the RDPC (25H20).

MOS 222B QUALIFICATION COURSE

The US Army Air Defense School has developed a course to qualify enlisted personnel, MOS 24Q and 24P, for appointment as a Nike Hercules Warrant Officer, MOS 222B. The program of instruction will be offered by the High Altitude Missile Department.The course length is approximately 19 weeks. Personnel successfully completing this course will be appointed warrant officers and utilized as Nike Hercules organizational maintenance technicians and supervisors.

BIRDIE TRAINING

Department of the Army has directed the US Army Air Defense School to terminate formal maintenance training on the Fire Distribution Integration Systems, AN/GSG-5 (BIRDIE), course no. 4B-F8/150-25D20. The course will be deleted from the next edition of DA Pam 350-10, US Army Formal Schools Catalog.

AN/GSA-77 — AADCP INTEGRATION

During recent years the AN/GSA-77 Data Converter has replaced other types of battery terminal equipment used in an AD battery. Self-contained and using microminiaturized circuits, the Data Converter represents the most significant advance in command and control systems in AD batteries since the advent of automatic data processing.

Maintenance technicians in various courses at Fort Bliss are instructed in AN/GSA-77 theory and troubleshooting by the Missile Electronics and Control Systems Department. These same technicians receive instruction on their respective weapons system from the High Altitude Missile Department and/or the Low Altitude Air Defense Department. The missing link to tie the instruction together has now been provided by establishing communication links between Madison Park (MECS), Abernethy Park, building 60 Laboratories (HAM), and Schooley Park (LAAD). This link-up will enable future technician classes to receive instruction on a workable, complete command and control system similar to that which they will encounter in the field.

The four AN/GSA-77's in use by HAM will then be used in a multifaceted role:

Interface training with the Nike Hercules system to alleviate recent problems in the field with AN/GSA-77/Nike Hercules interface circuits.

Site-type training of maintenance technicians in problems occurring during "point-in-space" integrations with their respective AADCP's. Further, it will enable ADA battery organizational maintenance personnel to insure that all data converter and weapon system circuits within the ADA battery and used in command and control are functioning properly. This will isolate any problems encountered to either the AADCP or the communication circuits. Students in MECS courses will be able to operate and/or troubleshoot AADCP equipment while actually connected with a fire unit.

Site-type training of weapons system organizational maintenance personnel in use and troubleshooting of the AN/GSA-77 data converter in a round robin configuration (fire units interconnected but isolated from AADCP).

When incorporated into existing programs of instruction, this new USAADS capability will provide maintenance students with information previously gleaned from OJT in a fire unit.

COMMAND AND STAFF DEPARTMENT

ADA NCOES ADVANCED COURSE

USAADS has inaugurated an ADA NCOES Career Development Advanced Course. The 12-week course will be functional within the MOS and Career Management Field (CMF) context, and is oriented toward appropriate MOS qualification above the 40-skill level. Emphasis is placed on leadership and human relations skills and knowledge of subjects required to effectively perform as first sergeants, sergeants major, staff noncommissioned officers, or comparable unit noncommissioned officers. The program has two major divisions — CMF subjects and civilian education subjects. The civilian education subjects form an elective program that provides the student the opportunity to receive credits toward an associate degree.

The intent is, whenever possible, to provide the student with an expert instructor, regardless of rank or assignment.

The program of instruction (POI) includes several classes to be taught by civilians or officers; however, the majority of classes will be taught by the noncommissioned officers of the NCOES Division of the Command and Staff Department. The POI also includes NCO guest speakers from throughout CONUS.

Enlisted instructors for the Advanced course have been selected. Only instructors of the highest quality, E7 and E8, were selected. Personnel interested in becoming part of the development of the Noncommissioned officer Education System should make application through normal channels.

Personnel to attend the ADA Noncommissioned Officers Education System Advanced Course will be selected by a DA Selection Board. The following prerequisites have been established for the course:

Active Army or Reserve component in grade E-6 or E-7.

Not more than 17 years active service on scheduled report date for the course (may be waived for reserve component personnel).

MOS evaluation score of 100 or more as it appears on the enlisted evaluation data report, in the most recent primary MOS evaluation.

Eleven or more months active service remaining upon completion of the course.

Interim SECRET security clearance.

AIR DEFENSE ARTILLERY OFFICERS BASIC COURSE 6-73

DISTINGUISHED GRADUATE — 2LT Jonathan F. Gordon

HONOR GRADUATES — 2LT's Robert R. Brissette, Christopher K. Cooper, Clement C. Chinquist, and Phillip D. Patillo

COMMANDANT'S LIST — 1LT's John K. Hawley, Thomas E. Pratt, and John B. Wimbish; and 2LT's David A. Beaty, Gayle P. Chaffin, William H. Harrison, Steven S. Holsclaw, Terrell E. Kuhn, Joseph P. Lomio, Randolph W. Naber, John C. Orfe IV, and Raymond D. Weiss.

AIR DEFENSE ARTILLERY OFFICERS BASIC COURSE 7-73

DISTINGUISHED GRADUATE — 2LT Roger A. Boggs

HONOR GRADUATES — 2LT's Charles C. Seab, Chris T. Allen, Michael D. Reilly, and William E. DeLaney III.

COMMANDANT'S LIST — 1LT's Eugene T. Mitta, Joseph F. Staltz, James O. Lowney, Walter J. Lane, Louis R. Tramontozzi, John G. Adami, Jr., and George D. Gaski; and 2LT's Michael H. Little, David R. Webb, James C. Cornelius, Thomas E. Gillespie, and Frederick J. Worsley.

HIGH ALTITUDE MISSILE DEPARTMENT

DYNAMIC TRAINING

The High Altitude Missile Department recently perfected a new "mini-mock-up" battery control officers console. The mini-mock-up console, designed to complement the battery control officer training currently being given in the BCO lab, is an inexpensive, take-home replica of the actual control console used with the Nike Hercules system. Officer students will use several types of programmed lessons in conjunction with the mini-mock-up console to accomplish simulated engagements.

Three basic types programmed lessons are being developed to take full advantage of the potential for dynamic individualized instruction involving the console. Conventional written programs are being developed to instruct students in the function and relationship of Nike Hercules system components and the responsibilities of the battery control officer. Audio tape programs will force the student to make real time responses to the wide range of quasi-tactical situations that are likely to occur during an air defense exercise. The most stimulating concept is a gaming programed lesson that pits students against one another to effectively engage a series of enemy aircraft. This concept is being expanded into a game in which one student is given a hostile air force and several students form a Nike defense. Mistakes are translated into combat losses.

This original concept of dynamic training is one of several steps being taken to provide students with more vital and relevant training. The eventual goal of the High Altitude Missile Department is to provide a dynamic, individualized program that allows students to spend a major portion of their time preparing for their specific assignments. This concept is being explored by other departments within USAADS for application to operator training, maintenance training, nonresident courses, Reserve component training, and augmentation training.

MISSILE ELECTRONICS AND CONTROL SYSTEMS DEPARTMENT

AN/GSA-77 DATA CONVERTER

The AN/GSA-77 data converter or BTE (battery terminal equipment) replaced the coder-decoder group as the battery link in the command and control system. It embodies a new concept of organizational maintenance through the use of standardized solid-state circuit cards. The GSA-77 has self-contained replacement cards with printed procedures for operation and troubleshooting. This technique eliminates special-purpose field test equipment and requires less training and documentation than was necessary for the previous system. Front panel lights and alarms, automatic and manual loop tests, and built-in card tester are used to isolate faults. Manual troubleshooting techniques isolate those faults not located by loop tests and the card tester.

Using units should pay particular attention to DA Pam 310-4 and have current reference material on file. TM 9-1430-580-14 is the operator, organizational, direct support, and general support maintenance manual. TM 9-1430-580-25P is the organizational, direct support, general support, and depot maintenance repair parts list for the AN/GSA-77.

The AN/GSA-77 data converters are equipped with a replacement card for each type of card they use. These replacement cards are intended for troubleshooting as explained in TM 9-1430-580-14. An immediate request for resupply should be submitted each time a replacement card is used, and utmost care must be taken to insure that a defective card is not inadvertently placed in the data converter as an operational card.

Data converter operational floats are provided for direct exchange for those that cannot be repaired below depot level; storage location of operational floats is a local decision. Commanders should assure complete diagnostic checkout of the data converter prior to returning it to depot for direct exchange. Because of the logistical time lag to repair and return a data converter, the unit should not be sent to depot except as a last resort.

ARMY WIDE TRAINING SUPPORT DIVISION

CORRESPONDENCE COURSES

Recently the Department of Nonresident Instruction initiated a program to inform air defense artillerymen of the availability of correspondence courses to help them prepare for their MOS tests. In addition, commanders from brigade to battery level were informed of the value of the correspondence course program in helping them fulfill their MOS test program responsibilities as outlined in chapter 5 of AR 600-200. Reaction over a 3-month period was as high as 37 percent increase in enrollment in certain 16-series MOS courses. Overall, approximately 31 percent of the active Army Air Defense Artillery enlisted population is enrolled in correspondence courses. Our goal, with your assistance, is 70 percent. Commanders at all levels are urged to support the correspondence course program as outlined in AR 351-20 and DA Pam 351-20. It is a fact that correspondence course study is of benefit to the soldier as well as the Army.

SUPPLMENT TO 16-SERIES MOS CORRESPONDENCE COURSES

This Division is developing and instituting, on a trial basis, the addition of an OJT or "hands-on" supplement to certain 16-series MOS career development correspondence courses. OJT supplements for MOS 16R20 (Vulcan, towed and self-propelled) were ready in 1972. The supplement requires the soldier to physically perform those equipment duties required within his MOS and skill level. By using the OJT subcourse material and referenced technical manual and field manual duties, the student performs specified tasks under the observation of a unit administrator. Once the administrator and unit commander attest to the satisfactory performance of the individual, a certificate of completion for the supplement is issued. The OJT supplement, in which one may enroll separately from the related 16-series MOS correspondence course, provides the unit commander with a tool with which he can manage and conduct OJT. It will be particularly helpful for units charged with conducting advanced individual training (AIT). Applicants for enrollment must have access to the weapon system and must complete DA Form 145, Army Correspondence Course Enrollment Application, and forward through prescribed channels to Commandant, USAADS, ATTN: AWTS, P.O. Box 5300, Fort Bliss, Texas 79916. When enrolling for group study, forward the individual applications with a cover letter designating the group leader.

Notes From US Army Air Defense Center and Fort Bliss

REDEYE MISSILE ALLOWANCES FOR TRAINING

Redeye missile allowances to support Redeye training requirements have recently been changed by DA. The allocation for advanced individual training (gunner course) was changed from one missile per five students to two missiles per class. Maximum allocation for AIT is 100 missiles per year beginning in July 1973. The savings in missiles resulting from the reduction of the allocation for AIT have been used to increase the allocations for unit training. Each full division is now allocated 21 missiles and divisions having two brigades are allocated 14 missiles. Separate brigades and regiments are allocated seven missiles each. Non-divisional artillery battalions authorized Redeye are allocated one missile per Redeye section.

FAAR PERSONNEL CHANGES

Chaparral/Vulcan TOE's are being changed to reflect recent decisions affecting the FAAR platoon. ASI T8, FAAR Operations, is added to all 16P and 16R MOS in the FARR platoon. The MOS of the platoon sergeant is changed from 24M4 to 16R4 with ASI T8 since the responsibility of this man is as a platoon sergeant tactician instead of technician. He is responsible for deployment of the radars under the direction of the platoon leader and S3. The path is now open for a FAAR section chief, E6, to progress to platoon sergeant, E7, in MOS 16R/P with ASI T8.

SCAT

During December 1972, a reciprocal agreement was completed between the commandant, USAADS and the commandants of the USAIS, the USAARMS, and the USAFAS to provide the Air Defense Artillery Advanced Course graduate a unique opportunity to learn the complexities of the Infantry, Armor, and Field Artillery branches with which he must work closely. This opportunity is the Special Combat Army Training (SCAT) Program. It permits the graduate of a combat arms school advanced course to earn an additional advanced course diploma from any or all of the other schools through completion of special, reduced length, correspondence courses administered by the school concerned. The objective is improved training of combat arms officers at the advanced course level. The SCAT Program for the Infantry, Armor, and Field Artillery courses calls for 184, 225, and 157 credit hours of correspondence work, respectively. Completion of the courses is officially recorded on the officer's DA Form 66 and any diplomas earned carry equal value to those earned by resident students. Interested applicants may submit application under the SCAT Program, using DA Form 145, directly to the commandant of the school concerned. Applications should include evidence of successful completion of the ADA Officer Advanced Course within the past 6 years.

AN/MSQ-28 TECHNICAL MANUALS

This is a list of 46 TM's covering operations Central AN/MSQ-28 that have been declassified per Executive Order 11625 effective 31 December 1972.

TM NO.	DATE	CHANGES	GROUP
11-5840-271-30	3 Dec 62	None	4
11-5840-271-30/2	19 Mar 65	None	4
11-5840-271-30/3	1 Aug 63	1	4
11-5840-271-30/4	15 Apr 64	None	4
11-5840-271-30/5	1 Aug 63	1	4
11-5840-271-30/6	1 Aug 63	1	4
11-5840-271-30/7	1 Aug 63	1	4
11-5840-271-30/8	1 Aug 63	1	4
11-5840-271-30/9	1 Aug 63	None	4
11-5840-271-30/12	1 Aug 63	1	4
11-5840-271-30/13	1 Aug 63	1	4
11-5840-271-30/14	1 Aug 63	1	4
11-5840-271-30/15	1 Aug 63	None	4
11-5840-271-30/16	1 Aug 63	None	4
11-5840-271-30/19/2	1 Aug 63	1&2	4
11-5840-271-30/20/1	1 Aug 63	1	4
11-5840-271-30/20/3	1 Aug 63	1	4
11-5840-271-30/22	1 Aug 63	1	4
11-5840-272-30/2	1 Aug 63	1	4
11-5840-272-30-3	1 Aug 63	1	4
11-5840-272-30/4	5 Aug 63	1	4
11-5840-272-30/5	1 Aug 63	1	4
11-5840-272-30/6	24 Apr 63	None	4
11-5840-272-30/7	1 Aug 63	1	4
11-5840-272-30/8	1 Aug 63	1	4
11-5840-272-30/11	1 Aug 63	1	4
11-5840-272-30/12	1 Aug 63	1	4
11-5840-272-30/13	1 Aug 63	1	4
11-5840-272-30/14	1 Aug 63	1	4
11-5840-272-30/16	1 Aug 63	1	4
11-5840-272-30/18/1	1 Aug 63	1&2	4
11-5840-272-30/18/2	1 Aug 63	1	4
11-5840-272-30/19/1	1 Aug 63	1	4
11-5840-272-30/19/2	1 Aug 63	1	4
11-5840-272-30/22	3 Feb 65	None	4

CHAPARRAL/VULCAN TRACKING PRACTICE

Several locally fabricated devices have been used in the Fort Bliss area for Chaparral/Vulcan tracking practice. Two of these provide a means for training in some, but not all, of the tasks related to Chaparral/Vulcan target engagement.

The first is called the "ball" target (fig 1). It consists of a 1-foot diameter ball suspended by a trolley from a 3/16-inch cable which is suspended between two 40-foot high telephone poles spaced 350 feet apart. The ball is suspended 25 feet above ground level and is driven along the support wire by a reversible motor and pulley system which alternately pulls the ball between the two poles.

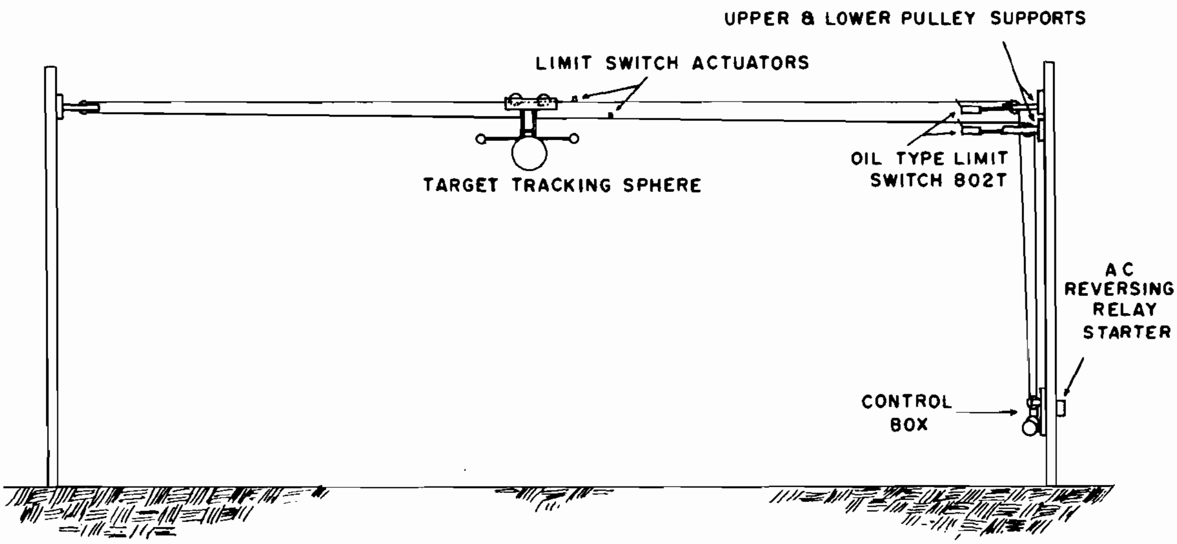


Figure 1. The ball target tracking device.

Equivalent speeds of 200, 400, and 600 knots can be attained by use of a selectable drive speed of 5, 10, or 15 feet per second, respectively. Emplacing the weapon approximately 50 feet from the perpendicular to the support wire is equivalent to a crossing target at a range of 1 kilometer. Using the scale, the equivalent length of a complete run approximates 7 kilometers.

The infrared (IR) source for Chaparral is a 6-watt, 6-volt lantern lamp which is powered by batteries within the ball. The lamp is mounted on a rod extending from the right side of the ball (as observed from the weapon) with the filament spaced 22 inches from ball center. This spacing partially compensates for the seeker/sight parallax error caused by the short tracking distance. If half the resulting boresight error is removed at the crossover point by sight adjustment, the resulting maximum parallax error should be approximately one-half degree.

Use of the ball target for Vulcan tracking requires operation in the manual or external mode because no radar information can be obtained at these scale distances. Evaluations of tracking performance can be made by use of the Vulcan dual-vision viewing device which was issued in early 1971 on the basis of one device per Vulcan platoon.

The second device (fig 2) has been successfully used to train Chaparral personnel in tracking procedures. It consists of a jeep, approximately 8 feet of pipe, some wire, a jeep stoplight lamp, and a 1/10-scale, locally fabricated, model jet aircraft 48 inches long with a wingspan of 40 inches.

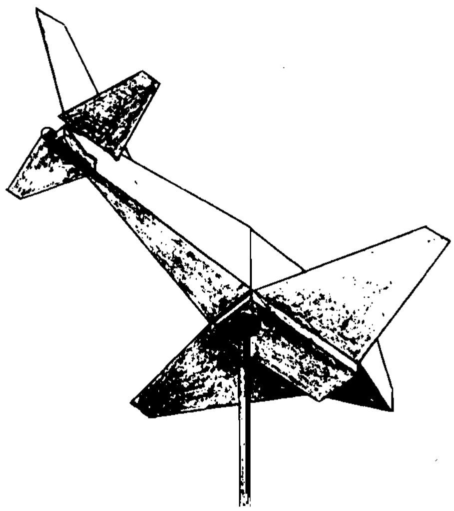


Figure 2. Aircraft model showing shielded lamp in tail.

The pipe was placed vertically in the jeep bed, guyed for stability, and the model plane mounted on top of the pipe. The lamp was placed on the model tail and wired to the jeep battery. To simulate a jet radiation pattern, the lamp was shielded so that only the rear one-third was visible from the side view. If a target run of approximately 3,000 feet is used and weapons are placed approximately 300 feet from and perpendicular to the midpoint, a jeep traveling at 25 mph or 40 mph is approximately equivalent to a target speed of 250 knots or 400 knots, respectively, at a distance of 1 kilometer. The scale course length represents approximately 10 kilometers. These speeds were selected to allow training in both the hold-fire and fire conditions. Evaluation of gunner performance was provided by the prototype Chaparral simulator evaluator which is expected to be fielded in late FY 73.

Additional information on either of these two devices will be furnished on request to the Editor.

Notes From the US Army Air Defense Board

VULCAN GUNNER TRACKING EVALUATOR

EXPANDED SERVICE TEST

An expanded service test of the Vulcan gunner tracking evaluator (VGTE) will be conducted at Fort Bliss. The VGTE was developed by Frankford Arsenal under the direction of US Army Weapons Command and the project manager for Chaparral/Vulcan in response to a requirement for a device that will provide a means for evaluating operator tracking proficiency. The equipment is presently at the US Army Air Defense Board. Twenty-three enlisted men from the 11th ADA Group and 1st Advanced Individual Training Brigade will be test subjects for the expanded service test. A check test (service phase) of armament organizational maintenance test set AN/MWM-3 will be conducted in conjunction with the expanded service test of the VGTE.

AN/TSQ-73

The AN/TSQ-73 command and control system is currently undergoing research and development acceptance testing (RDAT) at Litton Industries, Van Nuys, California facilities. An in-field RDAT is scheduled to be conducted at Fort Bliss Site Monitor test area. This effort will be followed by the engineering test/expanded service test, conducted jointly by White Sands Missile Range and US Army Air Defense Board.

RAPIER

The US Army Air Defense Board supported the US Army Missile Command in evaluating the British Short Range Air Defense Missile System. The Air Defense Board provided instrumentation, data reduction, range facilities, target coordination, administration, and logistics in this effort.

IMPROVED HAWK

The initial production test of the Improved Hawk missile system was completed during August 1972. In addition, the expanded service test of the improved platoon command post of the improved Hawk system was tested during the same time frame. The reliability verification test of the Improved Hawk missile was conducted later in the McGregor Range area. Five successful Improved Hawk missile firings culminated this test. The tropic phase of testing of the Improved Hawk missile system was initiated during January 1973 with shipment of a complete Improved Hawk battery to the Panama Canal Zone. Future testing will be conducted on the improved platoon command post for the Improved Hawk system in the tropic and arctic zones. A missile firing program will terminate testing in both of these environmental areas.

Notes From the Human Resources Research Organization

DIVISION NO. 5

HumRRO personnel at Fort Bliss have been working on a wide variety of problems in the areas of training, motivation, and leadership. HumRRO Division No. 5 has long been interested in the problems facing air defense artillery crewmen in the forward area. Numerous studies on the ability of the soldier to detect, identify, estimate the range to, and engage hostile aircraft have been completed. These research efforts have been conducted both in the laboratory and in the field, employing actual aircraft in the field. A summary of this entire series has been prepared and should be published before the end of FY 73.

HumRRO Division No. 5 and the US Army Air Defense Human Research Unit (US AADHRU) personnel have continued presentations of workshops in performance counseling. A number of Army officers have also been trained to give the workshops with HumRRO-developed materials, and have done so in their own units.

Work for the Combat Arms Training Board is continuing, as is work on the development of techniques for training and evaluating instructors, low-cost simulation techniques, and range estimation problems for the forward area crewman.

Research on techniques for systems engineering "soft-skill" portions of courses continues at a high rate. "Soft-skills" include such things as decision making, management, problem solving, and counseling. Two HumRRO scientists from Division No. 5 presented three papers at the Continental Army Command Soft-Skills Conference held at Fort Bliss in December 1972. Personnel from two other HumRRO Divisions also participated in the conference.

United States Army Sergeants Major Academy

The Noncommissioned Officer Education System (NCOES) was established in late 1971. This system consists of three progressive levels of instruction (basic, advanced, senior) which are designed to prepare noncommissioned officers to assume positions of increasing responsibility compatible with their career development and grade progression. The United States Army Sergeants Major Academy represents, in itself, the senior level of the NCOES, providing the pinnacle of formal military schooling for the career noncommissioned officer.

The Academy was activated by United States Continental Army Command (CONARC), General Order 98, 1 July 1972. In mid-July a task force of highly qualified instructors and command sergeants major, drawn from across the CONARC school system and several major Army commands, assembled at Fort Bliss to develop the Academy mission and curriculum. A second task force of highly dedicated CONARC school academicians was formed in October 1972 to assist the Academy staff and faculty in preparing specific lessons and related instructional materials. They evolved a viable educational program predicated on the principle of broadening and educating the student, as distinguished from MOS branch related skill training which is carried out at the basic and advanced levels of the NCOES.

Figure 1. The method of instruction is small group discussion — a departure from the Socratic method normally employed.

The mission of the Academy is to provide a comprehensive, professional educational environment within which selected noncommissioned officers may prepare to assume and fully discharge the total range of senior noncommissioned officer reaponsibilities, to include those of the command sergeant major.

The program of instruction provides advanced study for senior noncommissioned officers in four broad academic areas of human relations, military organization and operations, world affairs, and military management. A college level electives program rounds out the curriculum. The primary educational tactic employed at the Academy is the small group participative learning method. This instructional concept has been chosen in favor of the conventional and commonly known platform instructional technique.

Eligible for selection to attend the Academy are senior noncommissioned officers in the grade of first or master sergeant with 15-23 years service who have demonstrated the highest standards of professionalism and personal character, possess a GT score of 100 or higher, and a similar score on their latest primary military occupational specialty test. Selection of students is by Department of the Army board action.

Maintenance Supermen

Sergeant Lewis I. Hickman
Low Altitude Missile Department
US Army Air Defense School

Today the need for top-notch electronics maintenance men in air defense artillery is greater than ever before. We at the US Army Air Defense School have the responsibility for training these men, but the increasing complexity of new systems threatens our ability to graduate proficient maintenance men. Over the years we have made many changes in our programs and methods of instruction to cope with scientific advancement. We now systems engineer our courses, employ skill progression, improve training aids, and emphasize "hands on" training, yet we still have a problem. How can we be assured that every man graduated can function as well in the field as in the classroom? Obviously we can't, and many reasons why can be offered. The one heard most often is, "there are many differences between the field and classroom." Certainly there are differences, and perhaps the most significant is that in a classroom if a student commits an error a qualified instructor is nearby to help him. Confidence results from knowing someone is nearby to help you. But this immediate assistance is not always available in the field.

We try to instill confidence in new men by providing comprehensive training when possible in the use of equipment technical manuals. But consider this: most, if not all, of the technical manuals used in maintenance are developed by highly skilled engineers, maintenance technicians, and technical writing personnel from the contractor, developer, user, and trainer-user. Very often designer and engineer drawings, diagrams, and schematics, with little or no modification for benefit of user/student/trainee, are published in the equipment technical manual. To use these materials one must be proficient in related theory and its application. A man with such skill has little difficulty using the manuals. However, it takes a great amount of education and time to achieve that skill.

The question arises, "How, in 12 to 18 weeks, can we train students in maintenance courses to this high level of proficiency?" The answer is simple. We can't impart years of knowledge and experience in a few months. We do teach basic concepts, schematic diagram reading, terminology interpretation, basic electronics, and familiarization with specific equipment, but with the increasing complexity of weapon systems it is becoming apparent that students need more than we have been giving them.

The people who plan and write technical manuals have abilities, resulting from years of experience, we can never hope to teach in a classroom environment. And we can't wait 2 or 3 years for on-the-job training of students to provide this knowledge. The solution lies in how we gear classroom and equipment technical manual instruction understandably to the aptitudes and skills of the student/trainee.

Very few maintenance course students have vast experience and/or training in electricity or electronics. Some have difficulty understanding electronic symbols. So why show them, for example, this symbol () when you can just as easily say "this 3 AMP FUSE." A great deal of time is spent trying to teach the meanings of symbols and their interrelationships. Handing a technical manual containing mostly symbols to a man, we take him to the related equipment and expect him to locate all the parts from symbols in the book. How does one relate numerous block diagrams to corresponding equipment without months of experience?

Troubleshooting procedures in a particular technical manual state that there should be -28 volts at pin A. Once you find pin A on the schematic diagram you turn to the equipment and start looking again for pin A. Would it not be more practical to show a picture of the equipment with pin A clearly marked? In this way one could quickly locate the pin with little chance of error.

The Army, Air Force, and Navy have all done some research in this area. For example, an article in Government Executive, Dec 70, entitled, "Cookbook Approach to Air Force Training Is Cutting Costs," states, "The researchers . . . developed a method of simplifying the man's job and presenting instructions in a simplified form, something like a cookbook or the Heathkit instruction familiar to electronic bugs." With Heathkit instructions, any normal person who knows how to use a soldering iron and read simple instructions can build rather advanced equipment.

In the "cookbook" approach, the initial simplified instructions involved a rather complex item of equipment, the bomb-nav system of a B-52 bomber. To test their bomb-nav "cookbook," its authors asked male members of the senior class of a local high school to take the standard Air Force aptitude test and gave those who scored high and medium on the test 12 hours of instruction concerning the job performance aid and such fundamentals as how to use a soldering iron, oscilloscope, and voltmeter. They introduced malfunctions into the bomb-nav system and turned the students loose to troubleshoot, identify the defective part, and replace it. Then they compared student performance with that of fully-trained, 5th level, Air Force technicians (fully-skilled men with a minimum of 42 weeks of training and between 4 and 6 years of active duty and experience). The authors couldn't tell the difference between the performances of the two groups.

The fact that students of only medium aptitude were included in this experiment was significant, "because never in the history of Air Force maintenance have we taken a man with medium electronic aptitude and introduced him into electronic maintenance. Because he just hasn't got the capability to handle it."

Preparing to test their development on a broader scale, the researchers found that the System Program Office for the C-141 transport was developing a job performance aid called PIMO (presentation of information for maintenance and operation). They decided to watch PIMO before moving any further into the field.

PIMO is a maintenance index and composed of several different volumes which are subsystem associated. The interesting thing about each of these books is, first, the left page has instructions which have been carefully thought out. Each sentence starts with a verb — and standard verbs are used. The syntax is exactly the same in each sentence. There are not more than 12 to 14 words per sentence, and each line is, in a sense, a paragraph. Second, the opposite page lists necessary parts breakdowns, illustrations, and dependency charts telling the extent to which one part depends on another.

A man can follow the book through and end up doing very complex tasks without understanding why he does them. It is important that he does not have to go into a decision mode since it requires theory and application of principles which are costly and difficult to teach.

To check out the normal and emergency parking brake systems on a C-141, a technician using normal technical orders has to wade through about 2,000 pages to find the information he needs in 30 pages of four different orders, and he is in long-term memory because he has to go from one part to another with no index that tells him how.

Using PIMO, he looks up the task (check out the normal and emergency parking brakes) in the index and is referred to one of the system books which tells him in 35 continuous pages everything he needs to know (what equipment, how many people, and what parts are needed and what to do) in the checkout procedure. He goes from page one through page 35 and he has the checkout completed.

For the maintenance man in the field who is still working with design schematic diagrams and theory, this research is of little help. Now that new systems (Improved Hawk, SAM-D, Safeguard, etc.) are being developed or procured it is time our concept of maintenance instruction is revised. With the development of new systems, maintenance literature should be designed to facilitiate more effective training of maintenance men. Given the right materials, we can make every maintenance in the field a maintenance superman.

Often we have heard that new equipment will be easier to maintain becuase of modular components, where instead of troubleshooting to component level (a resistor, transistor, etc.) troubleshooting will be done to module level. However, the equipment will be comprised of thousands of modules. In some instances there will be more modules than there were components, hence the reason to modernize troubleshooting methods.

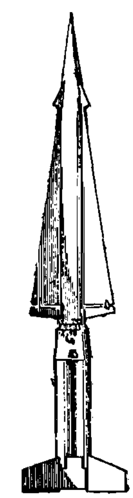
No one is willing to state that upon graduation a maintenance man will be fully capable of maintaining his assigned unit's equipment, the primary reason being a lack of requisite experience in schematic diagram terminology and theory. The question arises, "If a better maintenance manual is available, why should he have this problem?" The schematic diagram is a design tool and should continue to be used by the designers: the maintenance man needs something simpler. Take a picture of the item and show him where to put his test probes and what he's looking for. Give the maintenance man a reliable sequence of checks to be made for any malfunction. List the possible malfunction and list the logical solutions.

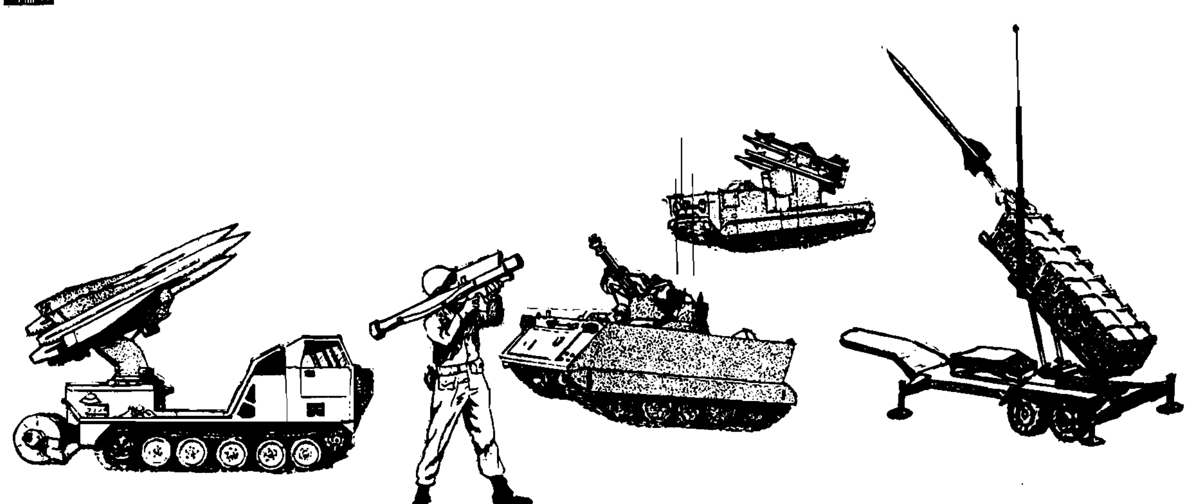
I am not advocating doing away with schematic diagrams because they do have a place — and that is with a man who has had years of experience in their interpretation.

In essence we need a manual designed to be functional in approach and predicated upon systems engineered job responsibilities and duties. The manual should be organized and written to enable the mechanic to locate quickly the source of trouble and replace the faulty item. Directions should be brief. Such instruction should incorporate minimal basic electronic knowledge and skill to recognize hazards, take preventive action, use test equipment, and follow directions that will locate the trouble. Theoretical interpretation, decision, and related action are left to the engineer and writer. The mechanic merely follows instruction and does what he is told.

AIR DEFENSE SYSTEM PROGRAM REVIEW

The 1973 air defense system program review was held at the US Army Air Defense Center and Fort Bliss, 7-8 February 1973. GEN Alexander M. Haig Jr., newly appointed Vice Chief of Staff of the Army, was the senior representative among an impressive list of high ranking military and civilian officials attending the 2-day meeting. Inspecting and reviewing US Army air defense systems and air defense capabilities of potential enemies along with General Haig were GEN Henry A. Miley Jr., Commanding General, US Army Materiel Command; LTG John Norton, Commanding General, US Army Combat Developments Command; LTG William C. Gribble Jr., Chief of Research and Development of the Army; LTG Richard T. Cassidy, Commanding General, US Army Air Defense Command; LTG Elmer H. Almquist Jr., Assistant Chief of Staff for Force Development; LTG Edward M. Flanagan Jr., Comptroller of the Army; Dr. Marvin E. Lasser, Chief Scientist of the Department of the Army; Abraham Golub, Scientific Advisor to the Assistant Chief of Staff for Force Development; and Richard J. Trainor, Director of Weapon Systems for the Assistant Chief of Staff of the Army. The review was hosted by MG R. L. Shoemaker, Commanding General, US Army Air Defense Center and Fort Bliss.





GEN Alexander M. Haig Jr., US Army Vice Chief of Staff; MG R. L. Shoemaker, Commanding General, US Army Air Defense Center and Fort Bliss; and COL D. E. Mulligan, Commander, 1st Advanced Individual Training Brigade, Fort Bliss, inspect static air defense weapon systems display.

The agenda for the review included this impressive list of topics.

- Foreign Air Defense Systems (characteristics, performance capabilities, technological trends, and research and development).

- Enemy threat to the field army and CONUS 1975-1990 (a projection of the threat foreign weapon systems pose to US forces; system capabilities including countermeasures and methods of system employment).

- Air Defense Systems Overview (the need for a family of weapons; operational deficiencies of US weapons and command and control systems; requirements for Nike Hercules and Hawk improvements; requirements for SAM-D, Stinger, Chaparral/Vulcan/FAAR, and Missile Minder AN/TSQ-73; requirements and status of documentation for tactical air control system/target alert data display set (TACS/TADDS), friend or foe (IFF), and high-energy laser to air defense (HELTADS).

- Air Defense Artillery Materiel Development Plan (materiel requirements for 1972-1986; priorities, rationale).

- Why SAM-D (review of why SAM-D is the solution to the Army's air defense problem after 1980; capabilities of Nike Hercules and Hawk to cope with the threat after 1980; characteristics and capabilities of SAM-D including countering the threat).

- SAM-D System and Program (system description and program).

- Modernized CONUS Air Defense Forces (study objectives, findings, and recommendations).

- SAM-D Nuclear and Antimissile Capability Study (report of study objectives, findings, and recommendations).

- Field Army Air Defense Study (report of study objectives, findings, and recommendations).

- Chaparral/Vulcan/FAAR (program status, improvement efforts, results of testing, problem areas requiring resolution, funding, gun air defense effectiveness study objectives and initial findings, gun prototyping).

- Stinger (status of developmental program).

- Foreign System Evaluation (objectives of Crotale, Roland II, and Rapier evaluation; findings related to the systems' potential to meet low altitude forward area air defense missile needs; results of evaluation).

- Improved Hawk (status or program).

- Missile Minder AN/TSQ-73 (status of development and procurement program; interface considerations).

- Tactical Air Control Systems/Tactical Air Defense Systems (status of program; technical interface design plan and its influence on future systems development; ground and amphibious operations interoperability program).

- IFF and Noncooperative IFF (examine the genesis of IFF and discuss equipment and its operational deficiencies; discuss requirements and rationale for development of a noncooperative IFF system; development progress).

- Safeguard (description and status of system development, testing, and deployment; personnel requirements and training programs; impact on Special Ammunition Load Agreement).

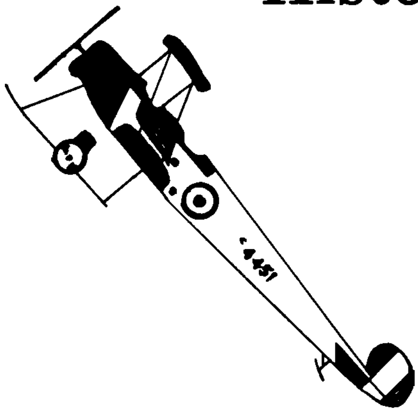
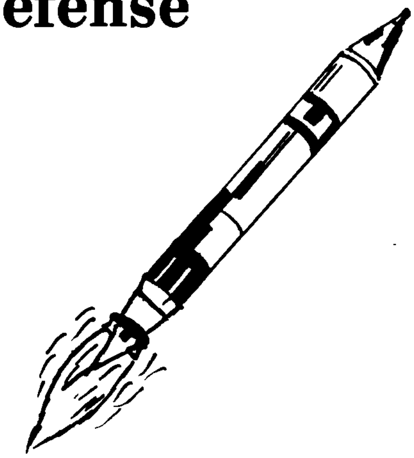
- Air Defense Funding (status and system priorities).

- Air Defense Personnel Situation (current and projected officer, warrant officer, and enlisted personnel posture; trends and problem areas).

The Air Defense System Program Review is a forum where the status of systems and subjects of high-level interest are discussed and appropriate guidance is provided. Final decisions and related directives are not formulated as part of the proceedings. These products of the Review require follow-on staff action. However, the Review is absolutely comprehensive and those in attendance who are high in the heirarchy of Army leadership, and represent a broad spectrum of high-level Army activities, depart with a better understanding of all aspects of the Air Defense Artillery role. Thus the groundwork is laid for future actions necessary to the effectiveness of the air defense mission.

In his closing remarks, General Haig emphasized an important aspect of the attitude of GEN Creighton W. Abrams, US Army Chief of Staff, toward the air defense artillery commander. He would seek to make the task of the commander at battalion and battery level — who in the final analysis has to do the job — easier to grasp and manage.

History of Air Defense

Editor's Note:

In this installment we see the United States air defense operations in the European theatre from D-day (6 June 1944) until the spring of 1945. Some interesting airspace control problems are discussed.

The Normandy invasion was initiated on 6 June 1944. Two US corps under the First US Army made assault landings, with V Corps elements landing on Omaha Beach and VII Corps elements landing on Utah Beach. Three task forces of reinforced division strength were landed, one on Utah Beach and two on Omaha Beach.

Antiaircraft units were attached to the assaulting corps for the landings but reverted to Army control on D + 3. One antiaircraft group was attached to each task force. A provisional machinegun battalion was added to the first two groups landed, and two balloon batteries were added to the Omaha group and one balloon battery to the Utah group. The Commanding General, 49th AAA Brigade, landed on D-day to establish permanent beach defenses in order that corps and divisional antiaircraft units could move forward with their organizations.

Early warning was obtained by listening to air force broadcasts from a headquarters ship until a combined fighter control-antiaircraft operations center could be established ashore. The Antiaircraft Artillery Intelligence Service (AAAIS) was established from the beginning, extending the system from local battery warnings using visual observers and SCR-584 radars, to the passing of information to the group gun operations room, and ultimately to inclusion in an area system centering in the brigade antiaircraft operations room. Antiaircraft smokescreens were planned to cover the two artificial ports, the POL port, and the major port of Cherbourg.

As the landings continued, units of the First, Third, and Ninth US Armies under the 12th US Army Group were moved ashore over US-occupied beaches. As American units moved forward, a United States communications zone was established to control, operate, and defend the beaches, ports, and rear areas. Air Force units, under the Ninth US Air Force, moved into France concurrently with the ground force units of 12th Army Group. The tactical air commands (TAC) provided both tactical air and fighter air defense effort generally within the Army areas. Following its landing on 15 August 1944, the XII TAC of the Twelfth Air Force came in through Southern France with the Seventh Army.

Each Tactical Air Command was organized to include one or more fighter wings, each with a fighter control squadron, an aircraft warning battalion, and a signal construction company. The headquarters normally was located with or near the army headquarters with which it operated. Each TAC established a fighter control center which controlled and directed the assigned fighter groups on both tactical and air defense operations. Each such center included an information center in which air movements were identified and tracked, based upon radar plots, pilot reports, and reports from other operating units. An antiaircraft liaison officer from the associated antiaircraft brigade was located at the fighter control center to coordinate antiaircraft operations and to exchange intelligence and operational instructions with the antiaircraft artillery units.

An antiaircraft artillery brigade was assigned to each army. The brigade commanded all assigned units not allocated to corps or divisions and maintained close liaison with the fighter wing through its liaison section at the fighter control center. Antiaircraft command and control remained under the Army chain of command through brigade to units, with close coordination being exercised with the fighter wing at the fighter control center. Air Force requests for hold fire invariably were honored.

Figure 1. Operations center of the 70th Fighter Wing of IX Tactical Air Command. Two such centers were maintained so that, by leapfrogging, one center could keep up with the armies' advance. The antiaircraft liaison position is at the lower left of the photo.

The relationship between IX Air Defense Command and the communications zone differed from that which existed between the tactical air commands and the armies. On 2 August 1944, General Eisenhower directed that antiaircraft artillery employed in defense of the communications zone be attached to IX Air Defense Command to centralize responsibility for the air defense of rear areas under one commander and to authorize him to deploy all available air defense elements in accordance with an integrated plan. Antiaircraft units were assigned to the communications zone, except for units temporarily on loan to 12th Army Group. All antiaircraft brigades assigned operated directly under IX Air Defense Command whose deputy commander was an antiaircraft officer and whose staff included antiaircraft officers.

The basic air defense unit in the IX Air Defense Command was the provisional air defense wing, which had attached for operations one fighter control squadron, one night-fighter squadron, and one aircraft warning battalion. Day fighter aircraft normally remained assigned to the tactical air commands, but would be attached and then allocated to the air defense wings for operations as required. Each wing operated a fighter control center which filtered air movements, passed out air raid warnings and notifications of friendly aircraft movements, directed fighter interceptions, and, when communications permitted, exercised operational control over antiaircraft artillery units through an antiaircraft artillery operations room.

Before D-day, Supreme Headquarters Allied Expeditionary Forces (SHAEF) had prescribed rules for the establishment of certain antiaircraft zones — the Inner Artillery Zone (IAZ), the Unrestricted Area, and the Gun Defended Area. In the Inner Artillery Zone, aircraft were forbidden to fly and antiaircraft was free to fire at all aircraft not recognized as friendly. In Unrestricted Areas, aircraft had freedom of movement and guns were restricted to fire only against aircraft definitely identified as hostile, or aircraft committing a hostile act. The Gun Defended Areas were somewhat a compromise, with precedence sometimes given to aircraft and sometimes to guns, but in which all aircraft other than fighters were prohibited. Originally, 96 hours were required for notification of all concerned prior to the establishment of an Inner Artillery Zone, but, after the breakout of Third Army and the need to protect bottlenecks through which it passed, restriction was reduced to a 1-day notice. Third Army continued to establish Inner Artillery Zones for river-crossing areas and bottlenecks, and other armies did the same. Twelfth Army Group and Ninth Air Force mutually agreed on the necessity for the Innter Artillery Zones and, although Allied Expeditionary Air Forces raised objections from time to time, SHAEF ruled in favor of the Inner Artillery Zones.

Before the end of August, a difficult situation was reached because an almost continuous chain of Inner Artillery Zones had been established from Avranches to Paris, forcing (UK) Bomber Command formations to fly increased distances around the Inner Artillery Zone chain or to fly over 10,000 feet in crossing it. A solution was found by abolishing some of the more westerly Inner Artillery Zones. By 7 September, the Bomber Command again objected to the almost continuous chain of Inner Artillery Zones between Paris and Antwerp, and SHAEF directed the abolishment of some Inner Artillery Zones to provide a corridor through which the bombers could operate. This solution was not entirely satisfactory to Bomber Command, who claimed that German fighters could concentrate on striking bombers as they exited from the corridors.

Another solution tried was for information on friendly aircraft movements to be broadcast from the United Kingdom in a special code. The fighter control centers receiving this information would pass it to antiaircraft defenses and request them to hold fire as required to protect the planes. This system also was not entirely satisfactory, especially for plans not on schedule, either in time or location. Problems of saturation by IFF responses also complicated the identification of planes crossing vital areas within the battle zone.

Responsibility for obtaining long-range early warning was vested in the aircraft warning battalions. These units used radars and visual observer reports to plot the movements of all friendly and enemy planes. Because of the lack of communications and frequent movements required, antiaircraft employed its own radio nets, using organic radars and observers, to provide local early warning as a supplement to (or in the absence of) early warning provided by the fighter control center. Identification in the forward combat area at lower altitudes usually could not be furnished by the fighter control center.

The antiaircraft liaison officer in the fighter control center would broadcast information on all known hostile and unidentified flights in the area for all antiaircraft units and any others who cared to listen. Forward directing posts, equipped with radar and employing visual observers, passed early warning on aircraft movements to the fighter control center. These posts usually operated a net control station at the corps antiaircraft group headquarters and used plots received over the group radio to supplement their own information.

Movement messages of friendly bomber activity received at the fighter control center were filtered by a movement liaison officer and passed to the antiaircraft liaison officer who subsequently sent out orders to hold fire or release fire as appropriate. Warnings were received by units as far down as the automatic weapons sections, although only antiaircraft groups and gun batteries were required to receive the warnings. The group would rebroadcast these warnings and those originated by its own sources to all automatic weapons battalion, battery, and platoon headquarters. In addition to the warnings received from the control center by gun battalions, and from group by the automatic weapons battalions, each gun battalion always operated one SCR-584 radar for independent warning, and each automatic weapons battalion, battery, and platoon kept a visual observer on duty to broadcast warnings.

The defenses established against flying (buzz) bomb attacks on Antwerp constituted the only major exception in the United States air defense organization normally employed in Europe. Because the British did not have sufficient resources to defend both Antwerp and Brussels, the Antwerp defense was assigned to the United States.

As the strength of German airpower declined, it lacked the ability to launch sorties against the invasion forces at the rate estimated. Reductions were then made in antiaircraft units scheduled for shipment from the United States to the theater, thus reducing antiaircraft authorizations by some 25 percent. As German airpower continued to decline, increasing use was made of antiaircraft units in a ground-support role whenever the air situation permitted. When one compares this turn of events with the magnitude of German aircraft production, the effectiveness of Allied air defense is readily discernible.

The situation in mid-1944 is illustrated by remarks made by Adolf Galland, General of the Fighters, at an armament conference. He noted that German planes were outnumbered, and that the loss of pilots at the rate of some 250 per month was the biggest problem.

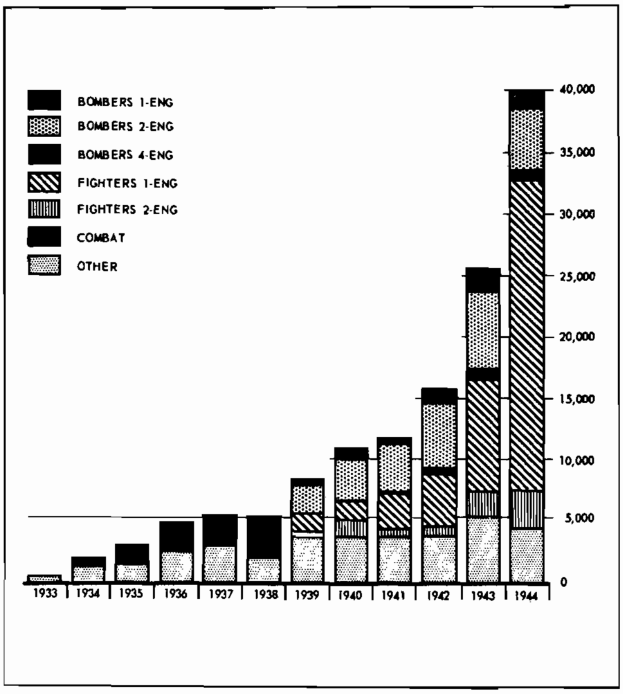


Figure 2. German aircraft production.

In a last desperate effort to stem the tide of Allied aircraft, a plan was developed to use a pilot force of boys in the Hitler Youth 16 to 18 years old, to fly small jet aircraft in great masses against the enemy forces — a plan which was never used. The aircraft, the He-162, was to be mass-produced as economically as possible. Construction of the first models was completed in 2½ months, and the first flight was on 6 December 1944. Until the war's end only about 200 were produced.

By 1945, the German fighter force was powerless to stop the Allied attack. Heavy-bomber strikes continued against the aircraft industry, airbases, fuel supplies, and transportation. American daylight bomber raids by now exceeded 1,000 bombers on many missions. On 18 March 1945, Berlin was struck with 1,200 American bombers escorted by 14 squadrons of P-51's. Propeller-driver German fighters were of little effect; however, Me-262 jet fighters were able to break through the escort cover and shoot down some of the bombers. Fortunately, only a few such fighters were available.

ROLAND
WEAPON SYSTEM

Roland is a low-altitude surface-to-air weapon system developed jointly by the Aerospatiale at Chatillion-sous-Bagneux, France, and the Messerschmitt-Bolkow-Blohm, G.m.b.H. at Ottobrun-Munich, Germany, to meet operational and technical requirements laid down by the general staffs of the French and German armed forces. The system, comprising two versions — clear weather and all weather — was developed for installation in a single, all-terrain, armored vehicle, thus being able to accompany frontline mobile units, providing them with protection against attack by low- and very low-flying aircraft. The Roland system can be split up into various parts to allow its installation in other types of vehicles (wheeled or tracked), on temporary or permanent ground installations, or in ships (including low-tonnage vessels).

OPERATIONAL CRITERIA

NATURE OF THE AIR THREAT

In spite of the ever-increasing use of surface-to-surface missiles, aircraft, because of their operational flexibility and the variety of their armaments, will continue for many years to play an important role in land warfare. Hence, there will be a continuing air threat to field units and combat installations.

Progress during the last 20 years against medium- and high-flying aircraft, both in detection and means of active defense (Nike Hercules and Hawk), has greatly increased the effectiveness of air defense. The result has been to force attacking aircraft to fly as low as possible to avoid, at least partially, radar cover and to reduce the warning time available to surface units. Modern electronic aids make it possible for aircraft to fly at speeds up to mach 0.9 at altitudes below 300 feet.

Attacks on targets whose location is known in advance can be made even in bad weather by means of electronic sensors and navigational aids. On the other hand, attacks on moving and scattered targets, such as will be found in the forward areas of the combat zone, can be effective only if the pilot is able to see the target; i.e., in clear weather.

In both cases, after approaching at very low altitude, the aircraft will attack in a flat 5° to 10° dive after as short a climb as possible to a height which will depend on the hardware to be released (bomb, short-range air-to-surface missile, rocket, gun, or machinegun). This height will not exceed 1,000 meters. Normally, the attacking range will vary between 1,000 and 5,000 meters.

After attacking, the aircraft will make its escape at very low altitude. When using dragbombs, clusters, or napalm, the attack may be made at very low, level flight.

INADEQUACIES OF NIKE HERCULES AND HAWK

Figure 1 illustrates the low-altitude limitations of the Nike Hercules and Hawk missile systems, and shows the airspace which Roland was designed to cover.

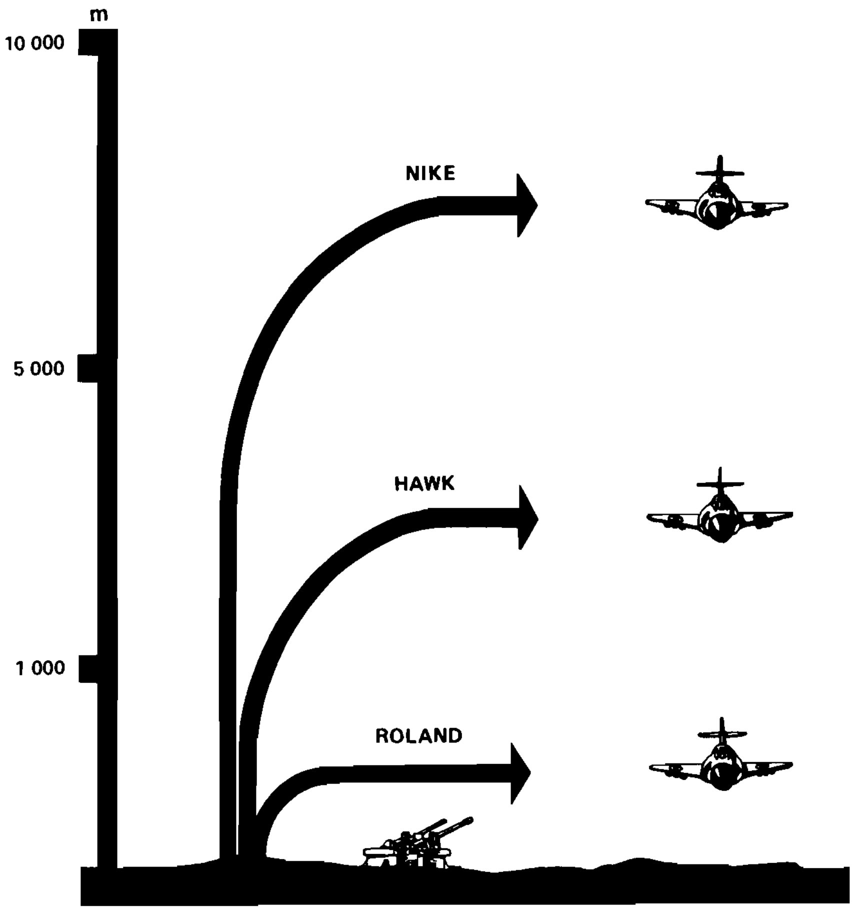


Figure 1. Roland is designed to defend against attacks at altitudes too low for Nike Hercules or Hawk intercept.

Small caliber, quick-firing air defense weapons of the 20-mm to 40-mm variety which are designed to defend this area have such limitations as an effective range of less than 2,000 meters, low-hit probability, and high ammunition consumption. They provide only a limited degree of protection for units, thus a gap in air defense does exist.

TARGETS TO BE PROTECTED

There will be other targets needing protection but the following are the more important ones and must therefore by given priority:

- Forward mobile units that are unable to take advantage of radar cover of the whole battlefield and are thus especially vulnerable to surprise attack, particularly under conditions of good visibility.

- Surface-to-surface launch ramps, command posts, depots, and various frontline installations, both in clear weather and, to a certain extent, in poor visibility.

- Fixed and semifixed installations in the rear area (command and logistics installations, air bases, etc.) in all weather. In this case it is a question of supplementing by a low-altitude air defense system the medium- and high-altitude defenses provided by missiles of the Hawk and Nike Hercules types.

REQUIREMENTS OF A LOW-ALTITUDE AIR DEFENSE SYSTEM

An air defense system intended to operate against aircraft attacking at low altitudes must have clear- and all-weather capabilities for use according to the mission and prevailing conditions. The all-weather capability must supplement the clear-weather capability, not replace it. In fact, optical guidance will, in certain circumstances, be preferable to radar guidance; e.g., when a target is flying at very low altitude, multiple targets are in close formation, or intense electronic countermeasures (ECM) are employed. The system must also incorporate the following characteristics:

- High hit probability providing for an aircraft to be brought down with one missile (two at the most).

- A minimum effective range so that aircraft can be engaged, even in the case of late acquisition.

- A maximum effective range sufficient to insure destruction of an attacking aircraft before it releases its weapons.

- Short reaction time on the order of a few seconds.

- Automation, to reduce the reaction time, still keeping the possibility of human intervention for target selection and defense against ECM.

- High resistance to ECM.

- Continuous readiness, thus avoiding the necessity for previous deployment and preparation for action which involves serious delays.

- Mobility and protection comparable to that of the units it must protect.

- Simplicity combined with sturdiness and high reliability, avoiding solutions that are too sophisticated.

- Ease of operation and maintenance.

- Reasonable cost so that adequate numbers can be provided on the battlefield.

- Flexibility of use, if only for reasons of training, logistics, and economy. the clear- and all-weather systems must use the maximum number of standard components. Basic units of the system must be capable of installation on various types of vehicles to suit the intended use.

GENERAL CHARACTERISTICS OF ROLAND SYSTEM

Figure 2. Roland I. (Can be converted to Roland II at depot in two days.)

Based on entirely new concepts and the most modern techniques, the Roland system (figs 2 and 3) represents a reasonable compromise between requirements which are often contradictory. The general characteristics are:

- Continuous readiness because the complete installation is fitted in a <u>single</u> armored vehicle and thus constitutes a self-contained firing unit capable of acquiring targets while on the move.

- Reaction time is 8 to 12 seconds for initial engagement and 3 to 9 seconds to fire.

- Hit probability ranges from 50 to 85 percent according to the speed and flight path of the attacking aircraft. This effectiveness is attributable to guidance accuracy and the use of a special warhead whose effects, created by multiple hollow charges, add to the normal blast and fragmentation effects of the proximity fuze and impact fuze.

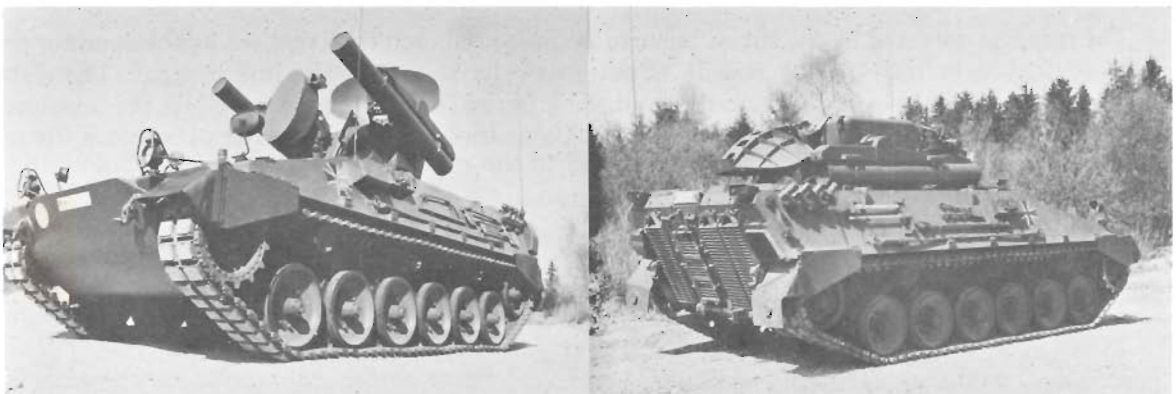


Figure 3. Roland II.

- The zone of action ranges from 500 to more than 6,000 meters with a rodal range of 5,500 meters when the target reaches a speed of mach 0.9. This zone of action is possible because of the excellent maneuverability of the missile at all ranges, a constant mach 1.5 speed reached in 2 seconds, and flight control by jet deflectors.

- Ease of loading is an important feature. Reloading of the two launchers is controlled from inside the vehicle and requires only a few seconds. Ten rounds are immediately available for firing.

● The semiautomatic firing sequence, by providing a very short reaction time, allows the fire control officer to identify and select the target, arm the proximity fuze, and decide on measures to take in case of excessive electronic countermeasures (ECM), thus minimizing the chances of an abortive launch.

● Mobility and protection of the crew, when Roland is installed in a tank, is the same as that provided the armored units it accompanies.

● Flexibility of use is characteristic because Roland I (clear weather) and Roland II (all-weather) are compatible. Developed concurrently and using standard components common to both, one system can be converted to the other without difficulty. The various units of the system can be installed in different types of vehicles (tracked or wheeled), in fixed firing posts, or in ships (large or small).

● The cost effectiveness factor is very favorable because of the reasonable price and high destructive power of the system.

● The use of proven techniques has been exploited. The successful development of Roland results from the valuable experience previously acquired by its manufacturers, both prime contractors and subcontractors, in the development of many other tactical missiles. Techniques previously used in first and second generation antitank missiles were adapted and extrapolated; e.g., infrared automatic command guidance, two-stange propulsion motor (booster and sustainer).

DESCRIPTION OF ROLAND I

PRINCIPLES OF OPERATION

The target is detected by the surveillance radar, acquired, and then tracked by the operator using an optical sight (fig 4). The missile is automatically slaved to the line of sight. The sight measures the angular velocity of the target and the infrared (IR) localizer determines the misalinement of the missile in relation to the line of sight. Using these data, a computer determines the required guidance commands which are transmitted to the missile by radio command link.

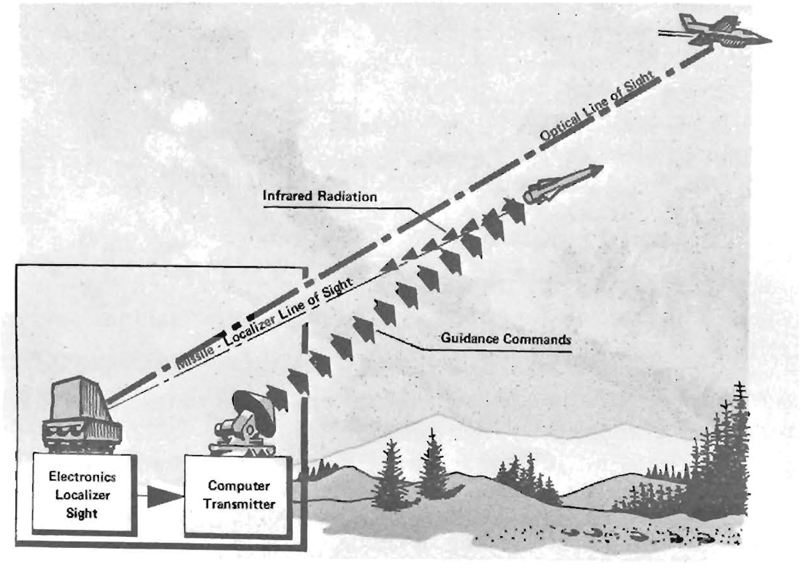
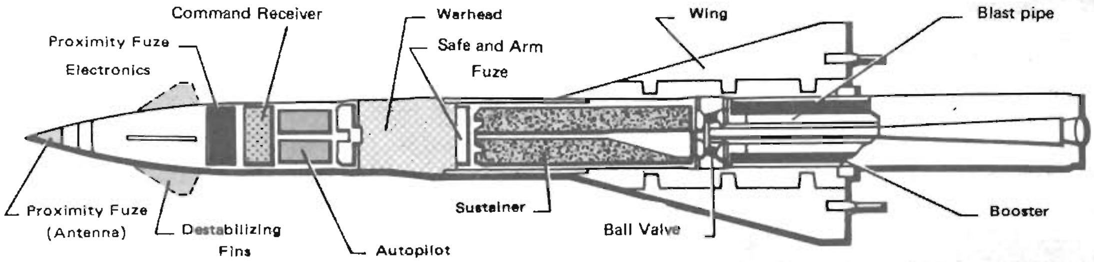


Figure 4. Artist's concept of the Roland I target detection, acquisition, and tracking method.

The signals received by the missile are then converted into jet deflector orders. The missile carries a warhead initiated either by impact or proximity fuze. The proximity fuze is set to operate at a distance compatible with the warhead lethality radius.



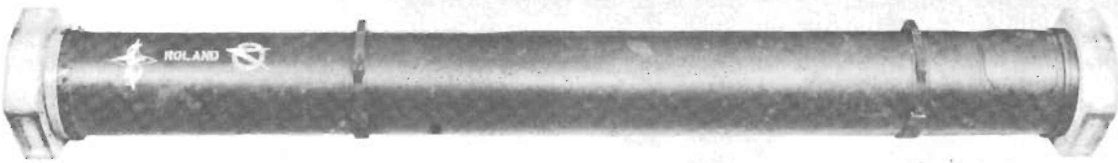


Figure 5. Diagram of the Roland missile.

The round of ammunition comprises a missile, with folding cruciform wings, sealed inside a tubular container. The characteristics are as follows:

Launch weight	62.5 kg approx	(138 lb)
Warhead weight	6.5 kg approx	(14 lb)
Warhead explosive	3.5 kg approx	(7.5 lb)
Length	2.400 m	
Wing span	0.500 m	
Body diameter	0.160 m	

The missile is delivered in its container which also serves as launch-tube (tactical package). The rounds of ammunition are normally grouped in logistic transport packages.

Following are the characteristics of the round ready for firing (missile in its container):

length	2.600 m
diameter	0.270 m
weight	85 kg (185 lb)

The missile has a cylindrical body terminating in a pointed nose-cap, and four wings which unfold at launch. The wings are set at a certain angle of incidence to the longitudinal axis to rotate the missile about its roll axis.

The propulsion unit consists of two stages: the boost motor at the rear of the missile has two exhaust nozzles and boosts the missile to a speed of approximately 500 meters per second in about 2 seconds; the sustainer motor, located in front of the boost motor, has a single exhaust nozzle mounted at the end of a tube, which passes through the boost motor compartment. The sustainer motor is able to maintain the missile at a constant speed for 13 seconds. The all-burnt range is greater than 6,000 meters.

If the target being tracked maneuvers at a very low altitude, the fire control officer can cut out the proximity fuze function to avoid its being triggered by ground effect (the missile has an impact fuze). Moreover, the arming of the proximity fuze can be remote controlled during the flight of the missile. As a safety measure, the safety and arming unit of the warhead's pyrotechnic fuze arms the fuze only after a certain time of powered flight.

No system of self-destruction has been fitted into the missile as such a system could introduce dangers for friendly troops when the missile is flying at very low altitude — a normal condition of use. Instead, the missile has been provided with a device for neutralizing the "armed" condition during flight. This prevents warhead initiation by restoring the existing safety devices to their "safe" position. This occurs automatically at the end of propulsion (if the missile misses the target). It also occurs if the missile flies out of the radio-link beam, or by command of the fire control officer. In this case, the loss of the command guidance signals initiates small explosive charges which bring about a fall in pressure due to the rupturing of the rocket motor.

FIRE CONTROL

The fire control installation comprises the surveillance radar, aiming device, IR localizer, command computer, command transmitter, launchers, and ammunition racks. These units are installed in a fixed compartment and an upper rotating turret. The compartment serves as the fire control officer's station.

The surveillance radar has an antenna rotating constantly at about one revoluntion per second. Detection of a target in the radar beam sets off an acoustic signal, thus avoiding the necessity to maintain continuous watch on the radar display. Stationary return is eliminated by a special device. The surveillance radar's range for the detection of an aircraft or helicopter depends on the ground relief and the speed and height of the target. Normally this is about 17 kilometers. On the radar's panoramic display, the targets are shown in synthetic video according to established codes. This is made possible by integrated data processing of radar information. Only those targets which are of concern at a given moment are represented. Thus the fire control officer has at all times at his disposition the means to select the most dangerous target and to give the order to fire at the optimum moment.

The aming device consists of an optical sight incorporating an IR localizer. Optical tracking is achieved by operation of a joystick controlling a mirror, gyro stabilized in two axes. The mirror reflects the target and missile images into the aimer's eyepiece and into the IR localizer. Detectors on the two axes determine the speeds of movement of the line of sight in elevation and bearing for computation of the command guidance signals. The localizer is mounted in such a way that it is permanently harmonized with the optical sight axis. It measures the misalinement of the IR sighting axis (tracers-localizer) from the optical sighting axis in elevation and bearing. These misalinements are used to compute guidance commands for transmission to the missile. The sight head slaves the turret in bearing, and the missile support arms and command transmitter antenna in elevation.

The command computer computes the necessary guidance commands from the angular rate of the line of sight measured in elevation and bearing, and the missile's misalinement from the line of sight. The command comprises two terms: a K1 term which depends on the linear displacement between the missile and the line of sight. (It is obtained by multiplying the angular misalinement detected by the IR localizer by a function of range/t.o.f.) and a K2 term which is computed from target kinematic date (angular rate of the line of sight). The resulting command is modified by a coordinate changer (to take account of missile position) and transmitted to the missile by radio link.

The guidance commands are sent to the missile by a microwave transmitter. The transmission is highly directional and selective, and is strongly protected against both intentional and accidental electronic interference. The directional design of the missile's receiver antenna provides supplementary protection against ECM coming from ahead. The radio command transmitter antenna is slaved in elevation to the combined optical/IR sight and is constantly pointing at the missile.

FIRING SEQUENCE

When one or several targets appear on the radar display, first indicated by an acoustic signal, the fire control officer interrogates the target(s) by IFF. This interrogation can be carried out by one of three methods:

- Automatic.
- Manual.
- Automatic within a given sector.

Next, he strobes the selected target, which has the effect of training the turret on the azimuth of the target. The aimer searches for the target in elevation using the aiming sight (integral with the turret as to the azimuth). He is provided with an automatic indication of the required search amplitude. When the target appears in the sight, the aimer aims the sight so as to maintain the target at the center of his sighting reticule. As soon as the fire control officer sees on the radar display that the target is within range, he authorizes "open fire" by pressing the button marked "OPEN FIRE." This action energizes the missile firing circuits and the signal "open fire" appears in the aimer's sight. During firing, the air control officer can select a second target on his display. As soon as the aimer sees that the warhead has exploded, he reverts to the "stand-by" position and his sight is put on the azimuth of the second target. The subsequent firing sequence is similar to that already described.

ROLAND II SYSTEM

PRINCIPLES OF OPERATION

The acquisition and tracking of the target by the optical aiming sight and the measurement of missile misalinement by infrared goniometer limit the use of the Roland I to clear daylight conditions. This limitation led to consideration of an all-weather system which is being developed concurrently with the clear-weather system. The two systems are compatible and use the maximum number of common components. Roland II (all-weather) differs mainly from Roland I (clear-weather) in the addition of a tracking radar which takes over the functions of the optical sight and infrared localizer in the all-weather mode (fig 6).

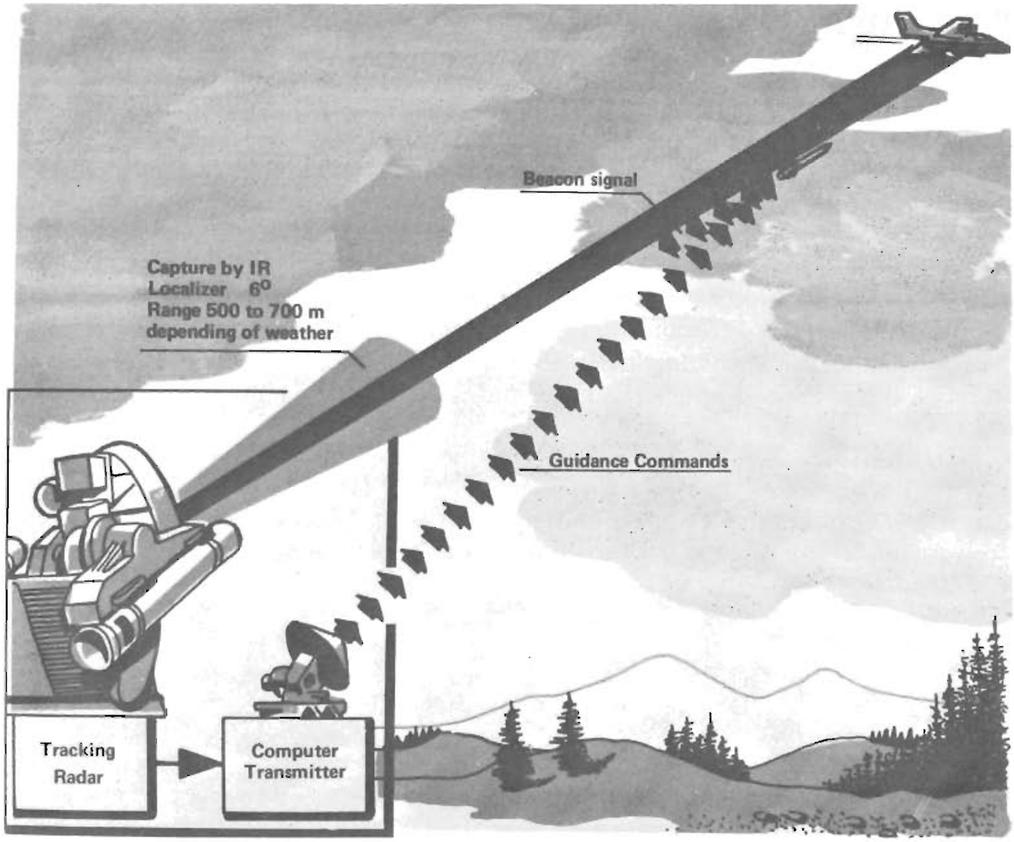


Figure 6. Artist's concept of the Roland II detection, acquisition, and tracking method.

In the tracking stage the radar beam is slaved to follow the target by means of misalinement voltage signals originating from the radar target tracking channel. After launch, an infrared localizer (of the same type as the "large field" unit of the Roland I infrared localizer), installed on the antenna of the tracking radar, controls the missile up to a range of 500 to 700 meters, at which range the missile enters the pencil beam of the tracking radar. A second tracking channel follows the missile by means of a beacon carried by it. Missile misalinement is calculated from the angular misalinement between target/antenna and antenna/missile. This misalinement information is supplied to the computer and from then on the operation of guidance command is the same as for the clear weather system.

Three methods of operation are possible: optical only, radar only, and both optical and radar. It is possible to shift from optical mode to the radar mode, or vice versa, even after missile launch. Because the optical method is more accurate, it will be used whenever atmospheric conditions permit, particularly with targets flying at very low altitudes (especially in the case of operation at sea) or in conditions of strong electronic countermeasures. The change from one method to the other is made by a switch. In the case of jamming by the target, the radar is equipped with passive tracking facilities (track-on-jam).

TRACKING RADAR

The tracking radar is a monopulse, microwave radar with short pulse and low recurring frequencies. It has a magnetron transmitter and a Doppler filtering device to eliminate static return. The parabolic antenna of the Cassegrain type, with circular polarization and fine pencil beam, makes it possible to track targets at low altitudes and to discriminate between two targets close to each other in bearing. The antenna is gyro stabilized in elevation and bearing. The two-channel radar can deal simultaneously with misalinement of missile and target. Missile position in relation to the radar beam is established by continuous-wave transmission from the missile beacon.

Tracking is controlled on a type "A" display with three traces showing elevation of the target, simple video or the signal from the beacon over a range of 16 kilometers, and video in a range gate of 1 kilometer. For the third trace it is possible to choose either simple video or filtered video. The missile position in the radar beam is established from the continuous signal transmitted by the missile beacon. The signal is transmitted by two antennas fixed to the rear of the missile on two opposite fins.

INSTALLATIONS

The Roland system has been developed especially to provide antiaircraft protection for armored and mechanized units. The carrying vehicle must therefore be similar in its range of mobility and form of protection to the units it accompanies. Accordingly, the Federal German Army selected the SPZ 25-ton tank and France the AMX 30-ton tank. Roland can be installed without major difficulty on other types of armored vehicles provided they have sufficient space and can support a mass of about 6 tons. Other types of installations can be considered for the defense of fixed or semifixed objectives at the rear, such as airfields and important depots. They can be on lorries, trailers, or platforms. Roland II will normally be used to defend this type of objective.

SOME OPERATIONAL CHARACTERISTICS

REACTION TIME

The reaction time is the time elapsing between the acoustic alert and missile launch. This includes the time necessary for radar acquisition, interrogation and target selection, optical or tracking radar capture, and firing sequence. For the first firing, the reaction time is between 8 and 12 seconds. For subsequent firings, between 3 and 9 seconds according to whether the target is the same or one already located in the sight's field, or one that has to be optically or radar acquired. The rate of fire depends on the number of targets to be engaged, their ranges (missile flight time), and reloading times, but always exceeds two missiles per minute.

MISSILE SPEED

The missile reaches its cruising speed 2 seconds after launch. This speed is about 500 meters per second and is maintained more or less constant throught the flight.

OPERATING VOLUME

The general shape is that of a semiellipsoid whose half major axis is 6.3 kilometers, and whose half minor axis is 5.5 kilometers. The minimum effective range is about 500 meters.

POSSIBILITY OF INTERCEPTION AND HIT PROBABILITY

Roland will intercept all targets flying at speeds up to mach 1.2. For the most part, this range includes fighter-bombers, reconnaissance aircraft, and attack helicopters. In certain favorable cases (e.g. frontal attacks at low level) the system can intercept targets flying at mach 2.

Hit probability varies from 50 to 85 percent according to the target's speed, approach angle, and type.

RELIABILITY

Probability of successful operation of the missile is 95 percent. Mean time between failure of the fire control unit is 150 hours. Simple maintenance provisions results in a high rate of system availability.

NOTE: The requirements of a low-altitude air defense system appearing in this article are the opinion of the author and do not necessarily reflect the opinion of the US Army Air Defense School or the Department of the Army.

AIR DEFENSE IN THE SOVIET UNION

Part I

Major Tyrus W. Cobb

The bulk of information contained in this article requires that it be published in two parts. Part II will be published in the next issue of Air Defense Trends.

Material in this paper is the sole responsibility of the author and does not necessarily reflect the views of the United States Government. The data has been drawn from the open press, both Soviet and Western, and is unclassified. Please address all correspondence to the author, 840 W. 12th Street, Reno, Nevada 89503 (Ph: 702-747-2341).

— Editor

"Our military means of air defense are capable of reliably destroying the enemy's rockets as well as his airplanes, regardless of the height or speed of the flight, at long distances from defended objects."

—Soviet Minister of Defense, Marshal A. A. Grechko

Beginning roughly with the fall of Krushchev from power in 1964 the Soviet Union embarked on a military-technological revolution designed to eradicate the overwhelming superiority of the United States in both offensive and defensive weaponry. In possibly no other area, save that of naval capabilities, has this buildup been so apparent as it has been with respect to the strategic defense forces. While the air defense effort in the United States has stagnated, and the system is, in the words of Defense Secretary Melvin Laird, "vulnerable and marked by reduced effectiveness" in many areas,[2] the Soviets have devoted considerable effort toward providing a viable shield against aircraft attack and a partial antiballistic missile (ABM) defense for the Moscow-Leningrad region.

A capsule summary of air defense efforts in the USA and the Soviet Union reveals the following comparisons:[3]

	SOVIET (PVO STRANY)	AMERICAN (CONAD)
Interceptor Aircraft	3,200	593 (14 Regular and 15 ANG Squadrons)
Surface-to-Air Missile Launchers	Over 10,000	895 (5 Bomarc-B Squadrons 27 Nike Hercules Batteries)
Antiballistic Missile Launchers	67	None Deployed
Troops Assigned	500,000 (Divided roughly 50-50 between air and ground forces)	85,000 (To a great extent National Guard)

The figures reveal the tremendous numerical superiority of the Soviet Union in this area, but cannot be interpreted correctly without a fuller understanding of concepts of strategic air defense and the particular role assigned to these weapon systems.

— Soviet Conceptions of Strategic Air Defense —

When discussing strategic air defense, Soviet writers generally refer to two types of measures which might be employed. The first is the passive means of defense — blast protection, fall-out shelters, population dispersal — all of which might be considered under the general area of civil defense (grazhdanskaya oborona in the Russian), and those physical protection and camouflage measures taken to shield aircraft and missiles on the ground. A second general area concerns the active means of defense, including antiaircraft artillery (AAA), interceptor aircraft, surface-to-air (SAM) and antiballistic missiles (ABM), and antisatellite devices.

The Soviet air defense effort is under control of the National Air Defense system, referred to as the PVO Strany. In turn, Soviet military strategists have conditionally partitioned the air defense effort into three general subareas: antiaircraft defense (PSO); Antimissile defense (PRO), which includes but is not limited to ABM; and Antisatellite defense (PKO).

While Soviet thinking regarding tactical employment of air defense weapons differs little from that of the United States, there is a wide divergence in stragetic importance assigned to these commands. Marshal Sokolovskii, former chief of the Soviet General Staff, defines the mission of the PVO Strany (National Air Defense Command) as preventing ". . . enemy air weapons from penetrating the country's air space and to prevent nuclear attacks on the country's most important regions and targets, including concentrations of armed forces; missile, air and naval bases; strategic reserves; storage areas; control points; and communications."[5] While this employment is similar to that assigned to the North American Air Defense Command (NORAD), Sokolovskii makes an important distinction: "If missile troops in a future war will play the main role in dealing nuclear blows to targets all over the enemy's territory, the National PVO will play the principal role in protecting our territory from such blows and repel enemy nuclear assaults."[6] Thus, while the United States relies principally on the threat of an offensive composed of its intercontinental ballistic and submarine-launched intermediate range missiles and manned bombers to deter the enemy from launching a strike, the Soviets place greater emphasis on maintaining a balanced offensive-defensive mix.

If a viable defense against missile and aircraft incursions can be constructed, important strategic advantages are immediately conferred upon the Soviet Union. First, this defense will mitigate the threat of an offensive action against the USSR and quite possibly war from within its national boundaries. Secondly, it would partially negate the deterrent effect of the threat of a United States retaliatory attack because of the certainty that the latter's reactive force would be attrited. Obviously a viable air defense system would give the Soviets much more flexibility in pursuing their ambitious foreign policies.[7] If the defensive system is only partially successful, that is, it cannot assure complete security from attack but still provides extensive damage, this would still have the advantage of providing a significant residual military retaliatory force and, in conjunction with an effective civil defense program, lower civilian casualties.

The Soviet political-military leadership has pursued this ambitious air defense effort in the face of some very formidable geographical, tactical, and technological obstacles. Even a cursory look at the map will reveal the difficulty of protecting the Soviet Union, the largest national land mass in the world. Stretching over 11 time zones, the USSR yields air approaches along a frontier running over 20,000 miles. In addition, it faces a powerful enemy who possesses the capability to launch a nuclear attack from any direction. The United States has over 1,000 ICBM, 656 submarine-launched ballistic missiles, and 475 heavy bombers, and may soon maintain satellite-based nuclear weapons. According to former Secretary of Defense Laird, the US is still "confident of the ability of (its) Poseidon and Minuteman III to penetrate all known Soviet ABM defenses."[8] Finally, there is considerable concern over the technical feasibility of constructing a viable air defense system, an almost Sisyphean task in that as soon as an effective defense is deployed against one weapon system, another more formidable one appears.

Despite these tremendous obstacles, the Soviets have persisted in their attempts to construct a pervasive air defense shield. Recognizing the limitations of their weapons, they have followed a historical and peculiarly Russian solution to these problems — the emphasis on overinsurance through large numbers. If a weapon system is only 25 percent effective, then the reply is simply to quadruple the number deployed.[9] This, along with the tremendous size of the land mass to be defended, accounts to a great extent for the numerically impressive air defense armada they have assembled. Yet the impracticality of defending the whole country from air attack and the necessity of concentrating on selected areas of primary importance is acknowledged by one Soviet expert, V.T. Surikov, who notes:

> PVO weapons are not disposed uniformly over the country's entire territory, but are employed to create a zone-objective defense of the most important areas and objectives.[10]

— The PVO Strany in Historical Perspective —

The rejuvenation of the National Air Defense Command is fairly recent because the PVO did not fare well under Josef Stalin and Nikita Khrushchev. At the beginning of World War II the Soviets were clearly unprepared to repulse the German Luftwaffe. What passed for the PVO at that time possessed only 300 medium and 200 light AA batteries and AA machinegun batteries along with a small interceptor force. This unpreparedness was one of the important shortcomings for which former Communist Party First Secretary Khrushchev attacked Stalin in his 1956 "Secret Speech" to the Central Committee.[11] Early warning, based on a visual warning service, was virtually nonexistent. One peculiarity of the Soviet air defense effort at this time was the extensive dependence on women in the ranks. Marshal Chuikov, former commander of the 62nd Army in the defense of Stalingrad, commended the outstanding performance of the distaff service manning AA guns.[12] One whole fighter-aviation regiment, flying principally the vintage YAK-9, was composed entirely of women (though commanded by a male).

But the core of the German air offense had been depleted during the Battle of Britain and never was a serious threat to the heart of the Soviet Union. After the termination of hostilities and the onset of the Cold War the Russians faced a much more impressive adversary. The United States assembled a powerful bombing force under the Strategic Air Command equipped with nuclear weapons. Units of fighter aviation were deployed around the world, and by the mid-1950's a virtual ring of missile units was stationed along the borders of the USSR. The Soviet response was unimpressive and slow. They remained unable to cope with night and all-weather operations, because most of the fighters were designed for operation during good visibility only.[13]

Tactically and organizationally the PVO effort also lagged behind. For the most part there was little coordination within the air defense system which was oriented to a point defense concept (punktovy printsip), concentrated around industrial and population complexes with each defense acting for the most part as an independent unit.[14] The organization of the PVO frequently changed as the Russians sought to solve the complex problem of coordinating air defense. During the war a number of PVO "zones" were initially created, but were soon replaced by a series of "regions." The regions gave way to PVO Fronts with zones of responsibility that ran roughly east to west extending from the reconquered heart of the country into the East European theater of operations.

Soon after the war the then existing four Fronts were reorganized into PVO Districts in which the strip of land along the border constituted a separate zone in itself. The confusion inherent in this unwieldy concept was compounded by subordinating the PVO troops to other commands, either the Commander of the Artillery of the Red Army or to the military territorial (non-PVO) districts in which the air defense troops were physically located.[15] Finally the staffs and commands were permeated with political appointees of doubtful technical ability but of unquestionable political loyalty. The command of the important Moscow Air Defense District, for example, was in the hands of Vasily Stalin, son of the late dictator.[16]

Recognizing the inadequacies of their air defense network, the Soviets in the mid-50's embarked on a crash program to improve the system. The PVO was equipped with more advanced interceptor aircraft possessing all-weather, day-night, and supersonic capabilities. Another significant development was the deployment near Moscow of the Soviet first generation surface-to-air missile, the SA-1 (obsolete now, but still in service in the same locale). The SA-1 was replaced a few years later by the more advanced SA-2, and deployed more extensively.[17] Considerable improvements were made in radar technology and the AA guns gradually eclipsed into obscurity.

Possibly more important was the major reorganization of the air defense system in 1954. Reflecting the need for a greater degree of centralization, the PVO Strany was created as a separate, independent service of the Soviet Armed Forces under the leadership of its Commander-in-Chief (Glavnokomanduiushii), Marshal L.A. Govorov. Following his death in 1955 the command of the PVO Strany fell to Marshal of the Soviet Union C.C. Biriuzov. In 1962 Biriuzov was promoted to Chief of the General Staff of the Soviet Armed Forces, his duties with the PVO being assumed by Marshal of Aviation V.A. Sudets. Since 1966 the post of Commander-in-Chief has been held by Marshal P.F. Batitskii.[18]

— Contemporary Organization of the PVO Strany —

The PVO Strany became an independent command in 1954 and is now one of the five services (Vidy) that constitute the Armed Forces of the Soviet Union.* It is a truly unified command in the sense that all components which relate to the air defense effort have been subordinated to this one headquarters.Four main branches (roda voisk) of the services are under the command of the PVO:[19]

Antiaircraft artillery troops	(Zenitnaya Artilleriya)
Antiaircraft missile troops	(Zenitno-raketnye voiska)
Radar troops	(Radioteknicheskie voiska)
Fighter command of the air force	(Istrebitel'naya aviatsiya)

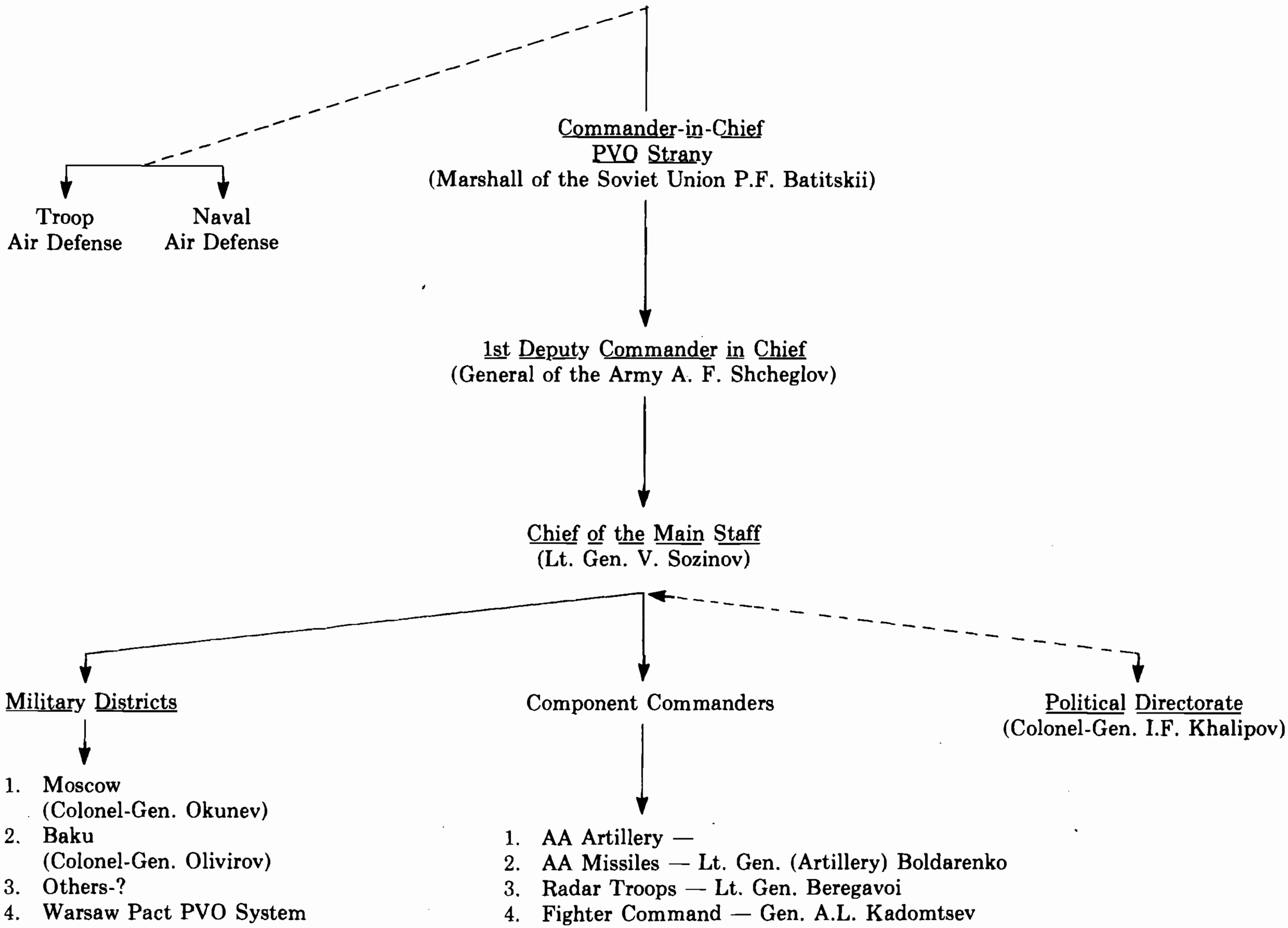
This last command may be the source of some confusion. The Air Force is also one of the five major services in the Soviet Armed Forces, and it has five branches subordinate to it, including the Fighter Aviation Command (IA-PVO). However, the Air Force CINC exercises only logistical support, research and development, and other administrative functions. The IA-PVO has been detached from the Air Force and attached to the National Air Defense Command which exercises operational control over it.

The PVO Strany is commanded by a Commander-in-Chief (glavnokomanduishii), alternately an Air Force then an Artillery officer, and the four main branches by comanders (komanduishii) who are assisted by two important organs. First, the Main Staff (Glavnyi shtab) performs operational control of the subordinate units. Secondly a military Council (Voennyi Sovet), under the chairmanship of the Commander-in-Chief of the PVO, is the highest collective organ in the command and acts as an advisory council to the CINC PVO Strany.* A powerful political directorate, omnipresent in the Soviet Armed Forces, acts as the eyes and ears of the Communist Party and conducts political work in the ranks on the basis of directives and instructions received from Party headquarters. An organizational schematic of the PVO Strany follows.

*The five services are the Air Forces, the Ground Forces, the Strategic Rocket Forces, and the National Air Defense Command, which constitute the abstract entity known as the Soviet Army, and the Naval Forces.

*The composition of the Military Council, as noted in 1969, was Chairman and CINC Batitskii, his deputy Shcheglov, the head of the political agency, Khalipov, Kadomtsev from the Aviation Command, Col-Generals Tsyganov and Baidukov, and Maj. General Gichko. (From Voiska Protivovozdushnoi Oborony Strany, p. 367).

NATIONAL AIR DEFENSE COMMAND



The National Air Defense Command works in close cooperation with but does not command two other air defense systems in the Soviet Armed Forces. The Troop Air Defense (PVO Voisk) is subordinate to the Ground Forces and is charged with providing antiaircraft defense of troops in combat, forward supply areas, weapons positions, and selected objects in the operational area. The Naval Air Defense (PVO Sil' Flota) has the mission of providing defense for ships against air attack (by on-board missiles) and is under the control of the Soviet Navy. However, the Naval Air arm is not subordinate to the Navy but is an operational element of the PVO's Air Defense Fighter Command (IA-PVO)!

How air defense operations are conducted in the Soviet Union must remain the subject of speculation since this subject is not discussed in their open press. We do know that the Commander-in-Chief exercises operational control through his main staff and from there through Air Defense Districts. However, only two Districts are ever mentioned in Soviet writings on the subject, Moscow and Baku. Whether other Air Defense Districts (PVO Okrugi) exist or whether the rest of the country is subordinate to these two regions is not known. Some veteran observers have speculated that at least 20 such PVO districts are in existence, scattered over the USSR land mass.[20] Quite possibly the Soviets have continued the concept which existed in 1954 by which the territory was divided into zones running east-west. In this case Moscow and Baku Districts would have several PVO regions under their sponsorship. Incidentally, while the Soviet Union is divided into several military districts for command purposes (much as the USA is subdivided into Army areas), the PVO troops are not operationally subordinate to these districts — a distinction it shares only with the political police and long-range aviation.

— Soviet Air Defense Weapon Systems —

The PVO Strany is a complex organization possessing a wide range of weapons ranging from traditional antiaircraft artillery through surface-to-air missiles to modern, advanced-model fighter-interceptors. In this section let's look at the weaponry employed in the antiaircraft role, leaving the ABM and antisatellite means to a later chapter.

Antiaircraft Artillery:

As mentioned earlier, the Soviets were extremely weak in terms of AA artillery at the beginning of the war and, in view of the absence of large scale strategic bombing on the part of the Germans, did not appreciably improve. After the war the USSR directed more attention to producing advanced weapons for the PVO role, but soon became infatuated with the prospects offered by unguided surface-to-air rockets. However, evidence now indicates that a reappraisal regarding the effectiveness of traditional AA artillery has been made which indicates that the guns may be coming back into favor. The experience of the war in Viet-Nam, in which the SAM's have not fared too well, has contributed to this thinking, but so has the appearance of rapid, low-flying aircraft. A Soviet text, Sovremennaya Artilleriya (Contemporary Artillery), notes that the appearance of armed helicopters, with their on-board guided antitank rockets and unguided jet projectiles, have created a renewed need for the AA guns. In particular, these weapons will be employed in defense of armored and mechanized infantry units, not only from attack by fighter-bombers, but also from armed choppers flying at low altitudes.[21] Other AAA weapons still serve the PVO in a gap-filler role.

The Soviet Union has produced a number of AAA Weapons ranging in size from 14.5-mm to 130-mm. Most of the 85-, 100-, and 130-mm nonautomatic guns have been withdrawn and replaced by SAM units, although they are still found in the countries of the Warsaw Pact. The 14.5-mm heavy machinegun, identified as the "ZPU", is produced with one, two, and four barrels, the latter two guns being towed weapons. They are being phased out in favor of the "ZU-23," a towed 23-mm double-barreled AA gun. A 57-mm towed gun, the "S-60," is a highly regarded weapon, especially suited for use against armored vehicles as well as low-flying aircraft. The Soviets have produced the 100-mm "KS-19" and the 130-mm "KS-30" big guns, both of which have been phased out in favor of surface-to-air missiles.

More important in the air defense role are the self-propelled automatic AA guns, in which some of the weapons mentioned above have been mounted on either a truck or track chassis. The "ZSU-23-4," a four-barreled version of the 23-mm gun on a light truck chassis is now widely deployed, as is the "ZSU-57-2." The latter is a twin version of the 57-mm AA automatic gun mounted on a redesigned T-54 tank chassis, and is the most commonly found SP AA gun in the Soviet Union today.[22]

Surface-to-Air Missiles:

For years the PVO Strany and the PVO Voisk have been in the process of replacing part of their conventional artillery with surface-to-air missiles. Over 10,000 have been deployed to date in seven different forms. The SA-1, SA-2, SA-4, and SA-5 are primarily employed in the high-altitude defense role, while the SA-3, SA-6, and SA-7 are designed to counter the low- and medium-altitude flying threat.

The first of the Soviet SAM missiles to appear was the SA-1, code named (by NATO) the Guild, which was deployed around Moscow in 1956 in limited numbers. Although the weapon is somewhat obsolete, it is still found in the Moscow defense today. The Guild is a one-stage, radioguided, liquid-fueled missile with a slant range of 22 miles and a top speed of Mach 2.5. The SA-1 is somewhat similar to our Nike Ajax, both nonmobile and firing a high-explosive warhead.

The heart of the Russian antiaircraft system is the SA-2 Guideline missile, about 8,000 of which are now deployed throughout the USSR. The Guideline is a second-generation SAM which made its initial appearance in 1958. Possessing a slant range of approximately 25 miles, the SA-2 performs with an effective altitude of from 3,000 to 80,000 feet. The Guideline is a two-stage rocket, the missile booster being solid fuel propelled and the sustainer motor using liquid fuel. The SA-2 travels at speeds between Mach 3 and Mach 3.5 and does not carry a nuclear warhead, at least in the original version. Those SA-2's produced after 1967, however, could carry an atomic charge. The system is somewhat mobile, a factor which explains its extensive deployment with the field armies. The SA-2 missile battery is deployed in a star-like cluster, six launchers surrounding a central fire-control unit, and is fired with a launch angle of 80 . Unlike the Nike Hercules, which first gains altitude and then dives to intercept its target, the SA-2 chases its prey. Consequently the weapon lacks maneuverability, especially at lower altitudes. For this reason the older-version Guideline has not fared too well in North Viet-Nam against US pilots. Recent modifications, in particular in radar technology, should improve the performance of the SA-2. This weapon is deployed not only in the Soviet Union and Vietnam, but also in Egypt, Cuba, and Warsaw Pact countries, and other members of the Socialist Commonwealth.

The most advanced high-altitude air defense system the Soviets possess revolves around the SA-5 Griffon*, a two-stage missile used in the long-range role. Traveling at speeds between Mach 3 and Mach 5 the Griffon has a slant range of up to 112 miles. Over 900 SA-5's have been positioned in the Soviet Union. Variously described as an unmanned long-range interceptor, antiaircraft rocket, and antimissile missile, the Griffon may possibly have a role in the Soviet ABM system. This is probable if the radars associated with the Tallin System, which is the defense against long-range aircraft attacking from the West and Northwest, are upgraded. If this were done, the SA-5 could play a point defense or terminal role in the ABM defense.

The first of the Soviet missiles to be employed in the low-altitude role was the SA-3 Goa, a two-stage boosted missile not unlike our Hawk. The SA-3 is employed against low-flying aircraft at short ranges, and thus is intended to supplement the SA-2 Guideline. The Goa has a slant range of 15 miles, travels at Mach 2.5, and is twin-mounted on a truck chassis. A modified version of the SA-3 is mounted on warships and (along with the SA-2) provides air defense for the Soviet Navy. Several SA-3 batteries have been positioned in Egypt.

Two SAM missiles are assigned to the field army for defense against attacking aircraft. The SA-4 Ganef is twin-mounted on tracked carriers and is air-transportable. It is effective in the medium-altitude to high-altitude range, and may have a surface-to-surface role. The SA-6 Gainful is a new triple-mounted missile (on a tracked vehicle) designed to counter the low-flying threat, and is not unlike our mobile Hawk system. The SA-6 has a slant range of 16 miles and will supplement the SA-4 in its battlefield defense role.[23]

The newest missile in the air defense role is designated the SA-7*. Dubbed the Russian Redeye (the Soviets call it Strela, meaning arrow), the SA-7 is shoulder-fired and uses passive infrared homing for guidance. It is about 4 feet long, and carries a high-explosive warhead. The Strela has an effective maximum range of about 2 miles and can down targets at altitudes from 150 to 4,800 feet. The weapon has appeared in Vietnam recently and scored several kills of U.S. helicopters during the massive North Vietnamese invasion of the South in 1972. It is expected that the Russian Redeye will be deployed in the rifle companies of the Warsaw Pact armed forces soon.[24]

Interceptor Aviation:

Tremendous strides have been made in producing an advanced generation of fighter aircraft in the Soviet Union for the IA-PVO (Air Defense Fighter Command). In the last 15 years the Russians have unveiled over 20 new fighter-interceptors, while the United States prior to 1971 had produced only one, the controversial, multipurpose F-111.[25] Since 1964 alone, four new interceptors have been added to the Soviet inventory, and these models will constitute over half the fighter force by mid-1973.[26] The greater portion of the new aircraft have all-weather and improved range characteristics along with other advanced avionic capabilities. Over 3,000 interceptors are presently assigned to the IA-PVO.

The workhorse of the Soviet fighter aviation is the venerable MiG-21* series of planes, code-named the Fishbed. The original MiG-21 made its appearance in 1956, and is a short-range, delta-winged, clear-weather fighter. The improved versions, principally the Fishbed-J, travel at Mach 2 with a combat radius of 348 miles and carry two Atoll air-to-air missiles similar to our Sidewinder.

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*Some writers refer to the SA-5 as the "Gammon."

*Some confusion exists in terminology, since many writers have erroneously referred to the ABM "Galosh" missile as the SA-7.

*Airplanes in the Soviet Union are identified by the constructor-group which produces the plan. In this case both the Mikoyan and Gurevich firms combined to produce the MiG series.

An advanced product of the Mikoyan-Gurevich consortium, the MiG-23 Foxbat*, has been referred to as the finest combat aircraft in the world. The Foxbat is a Mach 3.5 aircraft (in a non-combat configuration) possibly equipped with down-looking (50-mile range) radar that would give it an important look-down-shoot-down capability. Equipped with four semiactive homing A-A-2-2 air-to-air missiles with 35-mile ranges, the MiG-23 is a twin-engined, all-weather fighter with a combat radius of over 700 miles. It can fly at 80,000 feet altitude, even with the air-to-air missiles on board, well out of the range of US tactical aircraft. While the Foxbat may additionally play a ground attack role, it is principally a strategic interceptor, probably designed to counter the US's projected B-1 bomber. Both the MiG-21 and MiG-23 have been observed flying over Egypt.

Another product of the MiG group, tentatively labeled the Flogger, is expected to become the Soviet's number one fighter in the near future. The Flogger is a Mach 2.3 variable-geometry fighter with a combat radius of 600 miles. In appearance it is not unlike the American F-111.

The Sukhoi firm has produced a family of planes for the IA-PVO. The SU-7B Fitter is a Mach 1.6 close support fighter-bomber, but has not yet been deployed extensively. Modified versions of this plane have been viewed, notably a variable-geometry and another with a STOL (short takeoff and landing) capability. The SU-9 delta-winged Fishpot flies at Mach 1.8 and is used primarily in the short-range role. The SU-9 carries two Anab semiactive homing missiles, one with an infrared homing head and the other with a radar homing dome to give it flexibility. The SU-11 Flagon-A is a delta-winged fighter with a Mach 2.5 maximum speed and is now replacing the MiG-21. It, too, has seen service over Egypt.

Two other members of the air defense command deserve mention. The TU-29P Fiddler is a very long-range strategic interceptor which is used mainly in the Arctic and Baltic regions in conjunction with the Soviet airborne early warning aircraft. The TU-29P flies at Mach 1.1 with a combat radius of 1,000 miles. Its two-man crew closely monitors the Strategic Air Command's B-52's. The Fiddler has no counterpart in the West since no other country has the Soviet Union's formidable problem of defending vast land areas against the B-52. The YAK-29P medium-range all-weather interceptor, code-named the Firebar, is a Mach 1.7 aircraft claiming a combat radius of 575 miles.[27]

The Radar Command:

Personnel working with radars in the Soviet air defense command belong to a separate branch of the service, the radar troops (radioteknicheskie voiska), unlike the USA where they are integrated into other branches. The mission of the radar troops is to give early warning of approaching aircraft, identify them as friend or foe (svoi-chuzhoi), track the target, and guide missiles, aircraft, or projectiles to their destination.[28]

In recent years the Soviet Union has made tremendous gains in trying to close the gap that existed between the USA and Russia in the field of radar technology. Yet in many respects the USSR still lags behind the Americans, and this must be considered one of her weaker links in the air defense system. However, extensive progress has been made in one field, that of an overland airborne early-warning system (AWACS). Using modified TU-114 Cleats aircraft, the Moss system provides early-warning, and in the case of actual combat, would make target priority selections for

*Some experts have expressed doubt that the Foxbat is actually the MiG-23.

the fighter aircraft.[29] The basic TU-114 has been modified to accommodate the large crew and extensive electronic data needed for this mission. However, few Moss planes are actually flying today[30] and, although the USA currently trails in this field, it is expected to field a far superior system in the near future.

The employment of the radar network in the antiaircraft role is best understood by simulating an actual engagement. The target is first detected by early warning search and acquisition radars, usually the Tall King. As the target comes closer, the range and azimuth are assimilated with data from a separate height-finder radar (incorporated on newer models). A command and control center will make the decision as to whether or not the target will be engaged by interceptor aircraft at longer distances or by the SAM missiles closer in. In the latter case the data are fed to a Fan-Song radar at the SA-2 missile site, which combines target tracking and missile guidance in one unit. So as not to alert the targeted aircraft, the Fan Song is not activated until the last possible moment.[31] The SA-4 and SA-6 use the Long-Track acquisition radars, and are controlled and directed by a truck-transportable group called the Pat Hand (which can track one target while searching for others). The Low-Blow is used with the SA-3 system.

FOOTNOTES

1. "Krepnet Boyevoye sodruzhestvo voisk PVO stran Varshavskovo Dogovora" (Strengthening the military co-operation of the air defense troops of the Warsaw Pact Countries), in Vestnik Protivovozdushnoi Oboronoi, #11, 1971, p. 16.

2. Secretary of Defense Melvin R. Laird, National Security Strategy of Realistic Deterrence, Annual Defense Department Report, FY 1973, p. 74.

3. This table was compiled from several sources, primarily Laird, op. cit., p. 40, and The Military Balance, 1970-1971, (International Institute of Strategic Studies, London, 1971), and "Fresh Worry Over Soviet Arms Build-Up," US News and World Report, 28 Feb 1972, p. 25.

4. I. I. Anureev, Oruzhie Protivoraketnoi i Protivokosmicheskoi Oborony (Weapons of Antimissile and Anticosmic Defense), Moscow, Voenizdat, 1971, p. 5.

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8. Laird, op. cit., pp. 40-44.

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10. V. T. Surikov, Combat Employment of Missiles (Boevoe Primenenie Raket), Moscow, 1965. (JPRS translation TT 65-33191), p. 125.

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15. Discussed more fully in Voiska Protivovzdushnoi Oborony Strany (Troops of the National Air Defense Command), Voenizdat, Moscow, 1968, pp. 67-365. Hereafter referred to as Voiska PVO.

16. Malcolm Mackintosh, Juggernaut: A History of the Soviet Armed Forces (Secker and Warbug, 1970), p. 286.

17. The Military — Balance, op. cit., p. 6.

18. Voiska PVO, op. cit., p. 367.

19. 50 Let Vooruzhennykh Cil' SSSR (Fifty Years of the Soviet Armed Forces), Voenizdat, Moscow, 1968, p. 510.

20. Asher Lee, The Soviet Air Force (Gerald Duckworth & Co., Ltd., London, 1961), p. 121-122 and Mackintosh, op. cit., p. 316.

21. A. N. Latukhin, Sovremennaya Artilleriya (Modern Artillery), Voenizdat, 1970, p. 215.

22. Information contained in this section is a compilation from above cited text; Artilleriya i Rakety (Artillery and Missiles), Voenizdat, 1968; and especially from USAREUR Pamplet #30-60-1, Identification Guide, 31 July 1968, pp. 245-288 and 463-470.

23. Data pertaining to SAM missiles has been compiled primarily from The Military Balance, op. cit.; "USSR-Air Defense Missile Development," Military Review, March, 1966, pp. 104-5; and Jane's All the World's Aircraft, 1971-72 (Sampson Low, Marston & Co., Ltd., London), pp. 566-569.

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25. "Soviets Push Advances in Fighters," Aviation Week & Space Technology, 18 Oct. 1971, p. 34.

26. Laird, op. cit., p. 42.

27. Information relating to Soviet aircraft has been extracted from Jane's All the World's Aircraft, op. cit., pp. 427-470; John Taylor, "Soviet Airpower," Military Review, November, 1969, 1969, pp. 89-96; and "Soviets Push Advances in Fighters," op. cit.

28. Voiska PVO, op. cit., p. 47.

29. Jane's All the World's Aircraft, op. cit., p. 460.

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Potpourri of Information

LIGHTWEIGHT RADAR

A new lightweight "dogfighting" radar designed for use in tactical aircraft is being built by a specially-selected team at Hughes Aircraft Company. The objective is to build a radar that is in accord with the current philosophy of making military equipment that is simple, reliable, and inexpensive. The radar will incorporate all the latest state-of-the-art technology and provide all the capability required by the new family of lightweight tactical fighters.

It will have heads-up, auto-acquisition modes for dogfight encounters, a look-down and look-up capability, clutter suppression, and digital scan converter display equipment for bright fade-free target data presentation. It will be capable of directing the firing of all current armament, including guns, radar-guided missiles, and infrared missiles. The design of the radar is directed toward a system that requires a minimum of maintenance. No external flight line equipment or unit adjustments will be required at the flight line. All line-replaceable units can be reapired at the intermediate level, resulting in a minimum dependence on the depot. One prototype system is to be built and installed in a test aircraft. Flight tests are scheduled to begin in late 1973.

DOUBLE PHOENIX LAUNCH

Two US Navy aviators in an F-14A Tomcat became the first military crew in history to attack multiple targets simultaneously with multiple missiles from a single fighter aircraft when they launched two AIM-54A Phoenix missiles against two widely-separated QT-33 drones off Pt. Mugu, California, recently. The "double whammy" launch was a test of the multiple launch and guidance capability of the AWG-9 Weapon Control System which can fire up to six Phoenix missiles at six separate targets and keep them on course simultaneously.

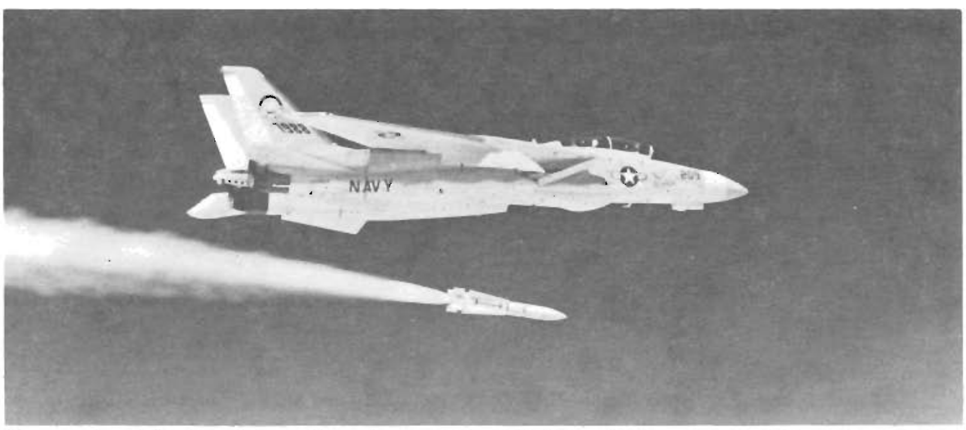


Figure 1. Flight of the Phoenix — The US Navy's long range Phoenix missile, developed and built by Hughes Aircraft Company, trails white plume in the first photo to be released of a guided launch of the missile from the new Grumman F-14A Tomcat fighter. In this test the missile scored a hit on a tiny drone simulating a supersonic jet fighter flying at extremely high altitude. In another test the Phoenix destroyed a jet fighter drone at a record distance of 76 miles. The Navy activated two F-14 Tomcat squadrons last October at the Miramar Naval Air Station, San Diego, California. They will be the first squadrons to fly the new fighters, scheduled to begin arriving soon.

In the test, the F-14 was vectored out in a "look-down, shoot-down" attack against the two QT-33's, each of which was approaching at a different altitude and different range, on courses crossing the F-14 track. The AWG-9 acquired track on both targets, while continuing to scan for other targets as part of the test. Both Phoenix missiles were launched and guided successfully.

COOLING IT

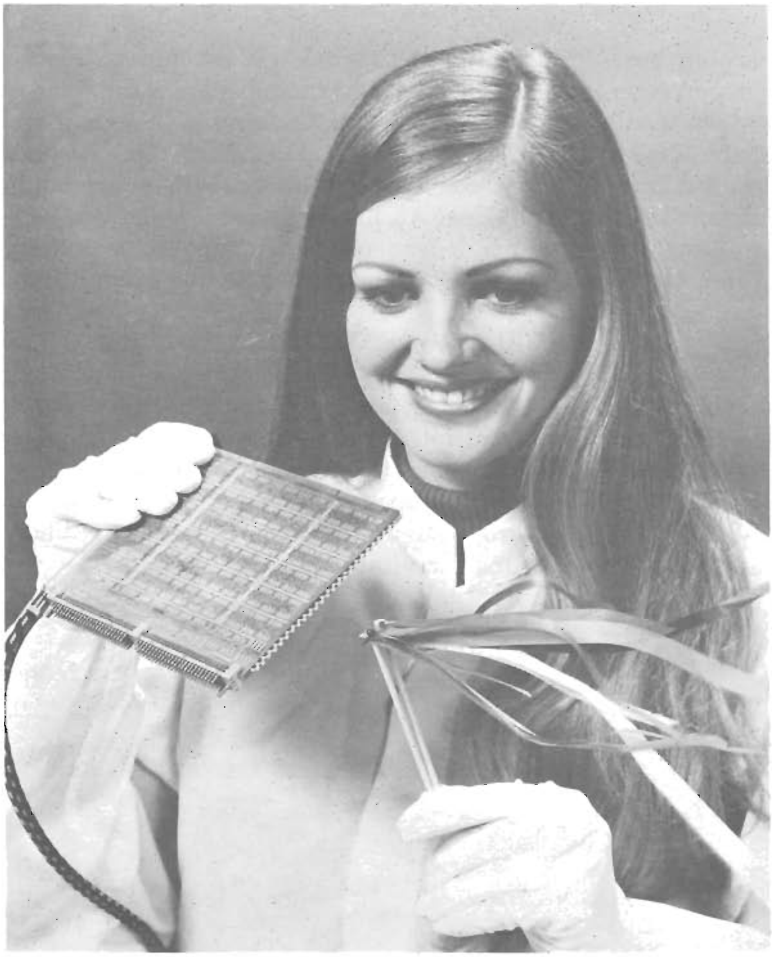


Figure 2. Air blowing through the waffle-like inner core of an electronic plug-in module ruffles a pompon held by a Hughes Aircraft Company employee. She is demonstrating a new technique developed for cooling electronics in the lightweight radar Hughes builds for the US Air Force's new F-15 fighter under contract to McDonnell Douglas. The "sandwich" construction was one of several new weight-reducing techniques that cut the radar system's weight by 50 pounds. The efficient cooling permits the massing of electronic components close together without causing heat problems.

MAVERICK MISSILES

The US Air Force has ordered an additional 3,000 TV-guided Maverick missiles under a $47.7-million contract awarded Hughes Aircraft Company. Under the new contract deliveries of missiles, launchers, and ground support equipment are to begin in October 1973. They will be built at the Hughes Tucson, Arizona, manufacturing facility, where work is currently underway on a 2,000-missile order placed by the Air Force last year. The Maverick, which is guided by a tiny television camera in its nose, has demonstrated high accuracy against ground targets such as tanks, vehicles, buildings, and field fortifications. In operation, the pilot focuses the camera on a target and launches the missile. He is then free to veer away while the missile continues toward the target under its own guidance.

'SEES' AT NIGHT

Twelve long-range night viewing devices that could be used by ground observers to scan large battle areas in total darkness are being built for service testing under simulated combat conditions by the Army. The infrared device, called NODLR (for Night Observation Device, Long Range) forms a TV-like image from thermal radiation of objects in view, and operates equally well in either light or darkness. The portable, battery-powered NODLR can be mounted on a ground tripod or installed on vehicles, and can "see" such objects as troops, vehicles, and bunkers. Because it is a thermal device, the NODLR operates passively without producing radiation that could be detected by an enemy.

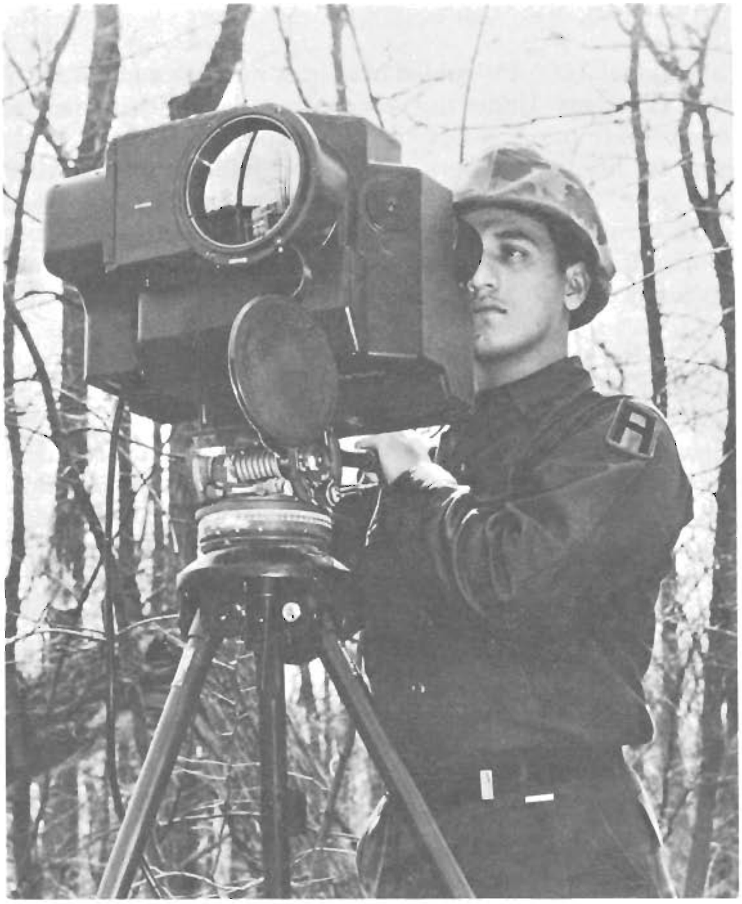


Figure 3. Night observation devices similar to this early model, which can be used to scan large battle areas in total darkness, will be built by Hughes Aircraft Company under a contract with the US Army Night Vision Laboratory. Called NODLR (for Night Observation Device, Long Range), the infrared device forms a TV-like image from thermal radiation of objects in view.

The Army recently completed successful trials with developmental models. The next stage will be full-scale service testing under operational conditions by the Army Test and Evaluation Command, including tests in arctic and tropical climates. Hughes will build the 12 service-test models and will provide space parts and field support services under a contract from the Army Electronics Command's Night Vision Laboratory, Fort Belvoir, Virginia. The new models will have improved capability and lower power consumption, and will be smaller, lighter, and easier to manufacture. Following the service tests, it is expected that NODLR will be the first high-performance thermal night observation device to go into production.

FLIR SYSTEM FOR A-7E CORSAIR II

An advanced forward-looking infrared (FLIR) system that will enable pilots to locate and attact targets at night will be developed for the US Navy's A-7E Corsair II by Hughes Aircraft Company. Under a $1-million letter contract from LTV Aerospace Corporation's Vought Aeronautics Company, Hughes will begin a program to design, build, and flight-test five FLIR sensors for the Navy's TRAM (Target Recognition and Attack Multisensor) program. The advanced FLIR has higher resolution and longer range than earlier systems, and as a result can be used by tactical aircraft to locate a target on a single pass. The A-7E FLIR will be the first operational system to project an infrared image on the aircraft's head-up display where it will be combined with existing symbology used for weapon delivery. FLIR will extend the aircraft's combat capability to 24 hours and will assist in night flying.

The new FLIR is an outgrowth of the technology developed on forward-looking infrared systems built earlier for the B-52 bomber, Cheyenne helicopter, P-3 Orion patrol aircraft, and OV-10 attack aircraft.

LIGHTER MANPACK RADIO FOR MARINE CORPS

A new lgihtweight Manpack radio — about the size and weight of a box of laundry detergent — has been delivered by Hughes for US Marine Corps test and evaluation. Providing 280,000 channels, the new radio — officially known as the AN/PRC-104 — employs advanced circuit design and microminiaturized solid state devices to achieve high performance and ruggedness in an extremely small package. Each unit weighs only 10 pounds, including its battery pack. It is designed to lighten the burden of a combat radioman and to offer him far greater flexibility in obtaining desired communications. It has so many automatic features it's almost a 'hands-off' radio. All the operator has to do is go into the transmit/receive mode, select a frequency, and hit the press-to-talk switch. The antenna is tuned, the set is alined, and the transmitter comes to full power, all automatically. The PRC-104 is a high-frequency transceiver that uses ground and atmospheric propagation to send its signals a few thousand yards or bounce them several thousand miles. Normal use would range from 50 to 300 miles when employed by Marine Corps surveillance crews whose missions often take them some distance from their bases. The radio with its battery forms a package only 12 inches wide, 10 inches high, and 2½ inches thick. The silver-zinc battery provides at least 16 hours of service before recharging is necessary.

ARMY'S MANPACK RADIO

Production of the Army's standard Manpack radios has been resumed by Hughes Aircraft Company's ground systems group under a 13-month contract from the Army's Electronics Command valued at more than $2 million. A total of 341 sets will be built, along wity 591 battery packs and accessories. The radio, known officially as the AN/PRC-74 (C), is a lightweight, man-portable, high-frequency, transistorized, single-sideband transceiver. The present procurement is to provide Manpacks to satisfy the requirements of several countries under international logistic agreements.

Developed in 1965, more than 5,000 of the 74's in various configurations were built for the US Armed Forces.

The 16,000 channel C-model radio, with electrical power supply, is housed in a metal cannister 12 inches high, 3¾ inches deep, and 12 inches wide, and weighs only 14½ pounds.

The set operates on one of two battery packs — wet or dry — that become a part of the unit when clamped to the bottom of the radio cannister.

The radio has proved particularly effective under adverse terrain and environment conditions.

FIRST NUCLEAR 'REFRIGERATOR'

The first nuclear-power cryogenic refrigerator was demonstrated recently by the Atomic Energy Commission and Hughes Aircraft Company at the Mound Laboratories in Miamsburg, Ohio. The refrigerator was developed for supercooling infrared and other sensors to greatly increase their sensitivity. The device is a Vuilleumier-cycle cryogenic refrigerator which has application in a variety of infrared, microwave, laser, and radiation detection systems. The refrigerator has been successfully used in space, air, and ground systems such as the Air Force's spaceborne celestial mapper program, the Air Force's airborne MAFLER (Modified Advanced Forward-Looking Infrared) program, and on the Army's ground-mobile night vision device called NODLR. In each of these applications electricity was used as the heat source for the refrigerator. The demonstration was the first time radioisotopes were used to provide the heat energy required. Three capsules of plutonium 238 developed by the Atomic Energy Commission were inserted in the refrigerator, which weighs approximately 9 pounds and can provide spot cooling down to -320° Fahrenheit (77° Kelvin).

Figure 4. The first cryogenic refrigerator to use nuclear energy as a source was demonstrated 25 October 1972 by the Atomic Energy Commission and Hughes Aircraft Company. This Vuilleumier-cycle cryogenic device can be used to supercool infrared and other sensors down to -320°F., thus greatly increasing their sensitivity. An employee of the Hughes cryogenic department, where the refrigerator was developed, demonstrates how three vials containing plutonium 238 would be inserted into insulated chamber of the device to provide the heat source.

Vuilleumier-cycle refrigerators are somewhat similar in concept to home gas refrigerators since refrigeration is produced from a heat source; however, the VM refrigerator cools to temperatures more than 400° F. lower than conventional home freezers. The use of heat power source is significant since vehicles such as spacecraft are frequently so limited in available electrical power that an electrically-driven cryogenic cooler cannot be used, thereby sacrificing system performance and mission flexibility. The Vuilleumier-cycle device has gained rapid acceptance in system applications because it has achieved substantially lower loads on internal pistons and bearings. This inherent feature increases the reliability and life of cryogenic refrigerators an order of magnitude over current standards for operational military type refrigerators.

CANADAIR LTD AN/USD 501 AIRBORNE SURVEILLANCE DRONE SYSTEM

To fulfill a need for rapid information system, the Governments of Western Germany, Canada, and United Kingdom contracted with Canadair Ltd (a General Dynamics subsidiary) of Montreal, Canada, to develop an airborne surveillance system. The CL-89 or AN/USD 501 system is the result of a 10-year effort and was designed to rapidly provide a division commander with data from 40 kilometers beyond the FEBA.

The AN/USD drone is 12 inches in diameter, 104 inches long, turbine powered, and booster launched with a preset flight profile. The normal flight altitudes are between 200 and 1,000 meters above ground level. The available sensors carried by the 100-kilogram drone are a choice of either Zeiss, Itek, or Hycon high-speed cameras with a 140° field of view, or a Hawker Siddey Ltd, infrared line scanner, augmented with a dispenser of flares. These scanners can provide high resolution information for both the clear day and clear night environment and lesser quality data in inclement weather.

The drone wing is organic to the FRG Army Division Artillery and is self-sustaining in the missions of mission planning, flight programing, launch, recovery, photo processing, and photo interpretation. The mission equipment is all mounted on wheeled carriers and capable of high battlefield mobility. Each of the drone wings will house two mobile launchers with checkout equipment and two recovery sections to allow simultaneous launch and recovery from two areas.

HQ MASSTER has been chartered by HQ DA to perform essentially a military performance test at Fort Bliss and Fort Huachuca to answer three related questions.

a. Can the drone be detected by ground units including air defense elements?

b. Can the drone survive in flight through an area with known air defense systems?

c. Are the navigational and sensor systems accurate, and do they provide timely and usable data to the field commander?

The drone test group at Fort Bliss consisted of US Army and Federal Republic of Germany Army personnel. The test was scheduled for August 1973.

AUTOMATICALLY RECONFIGURABLE MODULAR MULTIPROCESSOR SYSTEM

National Aeronautics and Spcae Administration (NASA) believes the need for in-flight computer capability may increase to levels comparable to demands placed on computer systems at large commercial installations. Consequently, a computer that can stay healthy and on the job in outer space for 5 years is the object of a design study now underway at Hughes Aircraft Company's ground systems group at Fullerton, California. The Hughes design team expects to provide the 5-year life span for the computer by designing highly reliable switches that would bring redundant modules into action when normal operating modules fail.

The spaceborne computer, called ARMMS — for Automatically Reconfigurable Modular Multiprocessor System — must be adaptable to missions ranging from manned launch vehicles to unmanned interplanetary spacecraft and large manned earth or lunar orbital stations.

Computer operations which ARMMS may be called upon to perform include guidance, control, navigation, and station keeping, as well as data management, control and evaluation of experiments, environmental control, and display operation. ARMMS must be technically adaptable to perform its tasks through launch, boost, and orbit or coast.

Manned launch vehicles and unmanned interplanetary vehicles need high reliability but low computation capability. Large manned earth or lunar orbiting stations require relatively low reliability but very high computation rates. Consequently, ARMMS must trade-off reliability and computation capacity. It must be capable of operating in three basic modes:

Internally redundant, providing low computational capability but high reliability.

Parallel processing, so parallel units can handle different tasks, providing high computational capacity with relatively low reliability.

Operations when only one module of each kind is functioning.

The study will be in three phases, beginning with selection and definition of the configuration satisfying the 5-year requirement. Next, the necessary redundancy will be designed into the system. Finally, the design team will develop a more refined design and detailed analysis of the system for NASA.

A computational model of switching mechanisms in long life modular computers has been developed by Hughes under an earlier NASA contract. This model will be augmented for use on ARMMS. The design team will also call on experience gained in the development of Hughes' H4400 computer, a highly modular system incorporating many of the aspects of hardware and software fault detection and recovery which will characterize ARMMS.

The 18-month project will be accomplished under the direction of the Astrionics Laboratory of the National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Alabama.

LICENSE LET TO BUILD ROLAND

Hughes Aircraft Company and the Boeing Company have been licensed by the combined French and German manufacturers to produce the Roland II all-weather ground-to-air missile system for the US Army. It has yet to be decided, however, whether Roland II or any other similar system will be adopted by the Army.

The Need for Quiet Military Equipment

Major Frederick P. Weichel, Jr.

The United States Army is not only well-trained and well-equipped, but is extremely noisy! Five minutes in a motor pool while the 2½-ton trucks are warming up, or in tank park when the tankers turn over those big engines, or in a sleepy Bavarian town when a US Army convoy roars through will clearly convince you that the Army is almost synonymous with noise. Civilian vehicles and other equipment are expected to be quiet. Quiet is not necessary, however, for Army equipment — or is it?

The US Army in Vietnam always had difficulty obtaining good results from its reconnaissance flights. The Viet Cong were excellent at camouflage techniques and very wise. When they heard an airplane approaching, they ran for cover and didn't move. Observers had difficulty seeing them and electronic sensors found it difficult to detect them.

Ground reconnaissance elements moving forward are often motorized. Both tracked and wheeled vehicles venture out into enemy territory, trying to find the enemy. With the noise made by the vehicles, contact is assured — if the enemy wants it that way.

Bumper markers are covered during tactical moves to conceal the identity of a convoy, while the exhaust notes of a hundred trucks call upon every local citizen to satisfy his curiosity by coming out and taking a good, long look. If such a tactical move were in the vicinity of the FEBA, eyes other than sleepy ones would be alerted.

Infrared searchlights are often used in perimeter defense to covertly observe the perimeter for movement. These searchlights are usually powered by nearby vehicles with engines racing to furnish sufficient voltage.

In ambush or counterambush operations, as soon as a gunner opens fire on a column the enemy reacts effectively by "hitting the deck," then there are no targets in the kill zone. The surprise is gone. The ambush is over. Now it's just another fire fight.

Reconnaissance aircraft used in Vietnam ran the gauntlet from the lightest helicopters to the heaviest cargo planes. Any airplane enabling its crew to see or otherwise detect the enemy is performing in the reconnaissance role. Much of the noise from helicopters emanates from the whirling main rotor blade. This source of noise may be uncontrollable; however, one source of noise — the engine — is common to all aircraft.

The internal combustion engine lends itself rather well to noise abatement projects. This is true of turbine devices and spark-ignition systems. The installation of an effective and efficient muffling system for exhaust gases seems to provide excellent possibilities. Elimination of engine noise would render a fixed-wing airplane about as noisy as a glider and decrease detection distances considerably.

What about the ground reconnaissance elements? Mufflers could certainly reduce engine noise drastically, but the tracked vehicles that often are deployed for reconnaissance present additional problems. Tankers agree that although the noise from a tank engine can almost rupture your eardrums when the engine is under load, tanks can be fairly quiet when idling. In fact, one armor officer relates a story of almost being run over by a tank that was slowly rolling up behind him. "If it weren't for the sound from the tracks," he said, "it would have rolled right over me."

The tracks themselves make quite a racket, especially when the vehicle is moving rapidly. Why not redesign the tracks to remove the clanking metal parts? They could be replaced, perhaps, by hard rubber shoes with plastic inserts. Maybe that scheme would not work, but isn't it worthy of investigation?

Generators are probably the noisiest element in any missile site or base camp. Since they provide all of the electrical power, they are really the heart of any tactical location and as such are vital to the operation of tactical equipment. The generators themselves do not make much noise but the engines that drive them do. These engines, being of internal combustion type, are subject to muffling. Whether the generator is a jeep ignition system providing power for a searchlight or a large diesel engine located in the engineering building on site, an effective muffling system could be installed to silence its operation.

In Bamberg, Germany, an air defense artillery battery employed most of its weekend manning crew from Firday to Monday filling 7,000 sandbags to cover the generator building. Generator exhaust pipes were routed underground where baffling was installed in them. All of this work was done to shield the German residents nearby from the noise of the battery's generators.

Small arms, too, can be muffled. Sometime ago, an enterprising Special Forces noncommissioned officer in Tan Rai, II Corps, Republic of Vietnam, put together a section of 2-inch pipe, some spun glass, and some washers to make a silencer for his Sten gun. So effective was this device that witnesses report that the only sound to be heard was the bolt ramming home. An instance was also reported in which this weapon was used against a squad of Viet Cong soldiers. The only alert they had to the action was the sound of their comrades falling to the ground.

Air conditioners for missile trailers and blowers for other parts of missile systems are common in that the noise they produce is caused by rushing air rather than by an internal explosion. However, it would seem that noise abatement could be accomplished for these items in much the same manner as for engines. A muffling system on air intakes and exhausts might result in reduction of noise to levels approaching that of a small household fan. Such a reduction in air conditioner and blower noise would provide a measure of security of location and make necessary talking easier.

Some work is being done in noise abatement with regard to personnel comfort and safety. Site generator building personnel are required to wear ear protectors in the building when generators are running. In this environment, it is virtually impossible to converse and special provisions must be made to alert personnel to incoming telephone calls or tactical alerts.

The problem is clear. Something should be done about noise in many areas of the military. As we have seen, some of these areas, though certainly not all, are air and ground reconnaissance, convoy security, movement to contact, perimeter security, and weapons security. What can be done? Let's have the planners, the engineers, and even the dreamers examine the problem to see what can be done.

Reviewing Field Manuals

Roy Rogers

How many times have you heard people gripe and complain about the content of certain field manuals; for example, incorrect or outdated information, insufficient data, poorly written material, etc?

In this same respect, how often have you seen a person do anything about it? Individuals may actually make written comments on field manuals any time they desire. AR 310-3, Preparation, Coordination, and Approval of Department of the Army Publications, makes this provision in that it directs that all manuscripts have the following statement included in the preface, or in an introductory paragraph: "Users of this publication are encouraged to submit changes and comments to improve the publication." AR 310-3 also directs the field manual writer to send his publication out for a field review. This provides selected reviewers a privileged opportunity to make comment before the manuscript is published.

A field manual writer may spend anywhere from 6 to 12 months developing a new manual or revising an old one. Although the writer is normally an expert in his particular field, he may:

- Overlook an important item of known doctrine.
- Be unaware of a new practice, method, or procedure being used in the field which, if proven sound, could become Army doctrine.
- Include fragmented material of a subject in which he has a working knowledge, but which is not his specialty.

For these very reasons the writer is required to send the draft manual out to all interested agencies, usually to the command or battalion level, in the continental United States and overseas for a field review. He expects the publication to be reviewed at these levels of command, and hopes it will get down to the company level.

The writer expects to receive comments, and if he does not receive some comments he may feel the manual has only been rubber-stamped, and not reviewed. Whereas the writer tries to write in the area of his expertise when developing the manual, he also expects reviewers to comment primarily in their field of expertise.

The US Army Combat Developments Command recently initiated a program to update and modernize Army field manuals. Although many fine, worthwhile comments were received, an in-house review of field manuals prepared by the Transportation Agency to date and forwarded for field review indicates:

- A very small return of comments on draft manuals sent to field units overseas.
- A large number of comments were editorial in nature.

Other comments were based on minor differences of opinion or wording, and were not in the field of expertise of the activity making comment.

In many instances, the specific comment was not submitted in the form of a recommended change as outlined in paragraph 1-8, AR 310-3.

Dwelling on the first point, small return of comments from field units, the writer solicits and wants these comments. These comments should come from the operating units in the field as it is these units for whom the manual is written. It is understandable that these units probably have less time for the review and little help available to prepare the comments. Recognizing this, the reviewing activities are given a specific period of time after date of receipt in which to complete the comments. The number of days for review is based on the size and nature of the draft manuscript as prescribed by AR 310-3.

On the remaining points, these basic precepts should be observed by the reviewer when reviewing and submitting comments on field manuals:

- Carefully read the purpose and scope paragraphs of the manual. This will help in evaluating the manuscript content and in formulating effective, constructive comments.

- Do not be an edit clerk. If the meaning of the material is clear and correct, do not become concerned with punctuation, paragraph numbering, spelling, and the like, unless such errors obviously change the intended meaning. An editorial review of the manual is conducted prior to final printing.

- Base comments on fact — not on minor differences of opinion of wording. Opinions are debatable, but facts are accepted. Provide the source of the stated fact by a concise reference so that it may be easily verified. Commenting in your own area of experitse should reduce opinion-type comments.

- Do not indicate errors without correcting them. A worthwhile comment takes the form of a recommended change. It should show exactly what is meant and avoid allegation of fault. A brief explanation of the recommended change should always be included.

- Reasons such as accuracy, clarity, correctness, and completeness are unsatisfactory explanations. These reasons fail to tell the writer why the suggested change is more accurate, more clear, more complete, or whatever.

Finally, submit comments on a DA Form 2028, Recommended Changes to Publications. Chapter 1, AR 310-3, provides guidance for the use of the DA Form 2028 in commenting on manuscripts. Some administrative points that should be observed in preparing comments are:

- General and specific comments are numbered consecutively.

- Deleted material is shown inclosed in quotation marks when it is a part of a paragraph or subparagraph.

- Added material is underlined.

- The date, subject, and agency preparing the comments will be shown at the top of each page of comments.

If the above administrative procedures are followed, with comments factually supported, the reviewer can be sure his comments will be given the utmost consideration, regardless of the wrtier's point of view. Should the writer disagree, the comment must be forwarded to his nect higher command for resolution as an unresolved comment.

— Reprinted from Arrowhead
September 1972

Did You Know?

Watch this space in each issue of Air Defense Trends for information emanating from the Air Defense Artillery Branch, Military Personnel Center, Department of the Army. Questions may be directed to the appropriate action officer where names and telephone numbers appear at the end of the related topic.

The information herein is the Air Defense Artillery Branch interpretation of current policies and programs. It is not an official Department of the Army publication.

OFFICER PERSONNEL

ASSIGNMENTS

Changes In The Prerequisites For Flight Training. A new edition of AR 611-110, "Selection and Training of Army Aviation Officers," has been published and distributed to the field with an effective date of 1 August 1972. The significant changes in the prerequisites for flight training area:

Applicants need only be high school graduates or the equivalent, preferably with two or more years of college.

Graduates of the AROTC Flight Training Program may be entered into flight training under Class 2 medical fitness standards ONLY if applying prior to completing 36 months of active federal commissioned service. Later applicants must meet class la standards.

(MAJ Jernigan/31052)

Preference Statement. Yes, the assignment officers at Branch do look at Preference Statements. In fact I was looking at a yellow one the other day dated 27 April 1963. The officer wanted to be assigned to the Dallas-Fort Worth Defense. That one was not helpful at all, but you can help us by keeping a current preference statement on file.

(LTC Lambert/31052)

Changing Times for Lieutenants. That unaccompanied tour that you have been looking forward to may not be available in the near future. In the past few years, career-oriented lieutenants who initially received CONUS assignments could expect an unaccompanied tour for their first oversea assignment. As Vietnam phases down and we bring our units in Europe up to strength, we find that many of our lieutenants will be receiving accompanied tours following their initial CONUS assignment. The determination as to which type of tour you will receive depends upon the validation of world-wide requirements and officer availability in the desired time frame.

(LTC House/31370)

Redeye Section Leader Qualifications. In response to a Department of the Army requirement to fill Redeye section leader positions throughout the world with qualified air defense officers, the Air Defense School has included a block of instruction on the Redeye missile system for officers attending the basic course. This block of instruction qualifies a lieutenant as a Redeye section leader. Since November 1971 approximately 400 Reserve and National Guard lieutenants in active duty for training status have also received this instruction. The Air Defense School strongly recommends that these OBC graduates be used to fill the training and manpower requirements of the United States Army Reserve and National Guard units equipped with Redeye. The Air Defense School will continue to assist personnel in the field with their Redeye training requirements; however, this information is designed to assure you that our graduating lieutenants are ready to assume Redeye responsibilities if needed.

(LTC House/31370)

New and Challenging Assignments For C/V Officers. Maneuver and firepower are two primary elements of combat power with a line division. For years the division was devoid of air defense firepower, but the recent deployments of C/V battalions have placed the youngest combat arm on center stage with the divisional organization.

An assignment to one of these battalions directly involves the air defender in the complexities of integrated fire support within the division. Normal battalion staff and battery duties entail the exciting interplay of ground tactics and air defense support.

As the quality of air defense officers has been recognized within the division, a wide variety of assignments are opening for our officers. Air defenders are currently serving as primary general staff officers and in numerous general staff positions.

As we gain experience with the divisions, our competence and professionalism will soon place the Air Defense Artillery Branch in a position of demand as a combat arm with the field army.

(MAJ Arnold/31177)

EDUCATION

Order of Merit Lists. During the past few months the Branch has been engrossed in the preparation of a number of order of merit lists, better known as OML's. As of press time we had completed three — the senior service college, the CGSC, and the OML for promotion to lieutenant colonel. Still in development is the OML for promotion to colonel. As announced in our most recent newsletter, officers eligible for senior service college or CGSC may contact the Branch Education Officer for information concerning their standing (in thirds) on the respective lists. Similar information is also available for those majors in the primary zone for promotion to lieutenant colonel, and will be available by the end of October for lieutenant colonels in the primary zone for promotion to colonel. The next order of merit list to be prepared by the Branch will most likely be the command OML. This list is to be furnished to the initial DA Command Selection Board (lieutenant colonel level) as a first step in the implementation of the officer personnel management system.

(LTC McCrea/31390)

Advanced Degree Program For ROTC Instructor Duty (ADPRID). There is still a need for qualified applicants for the advanced degree program for ROTC instructor duty. The program is outlined in AR 621-101, 8 March 1972. The program provides a splendid opportunity for the qualified officer to gain his advanced degree and to bring those credentials to full use in the development of our primary source of officer personnel. We have had a great deal of success in placing our applicants in one of their preferred schools; there is still great freedom of choice of schools in the future. Reserving of spaces for FY 1976 has begun, so if you are interested please review the regulation and by all means . . . apply.

(LTC McCrea/31390)

Instructors For The United States Military Academy. The Branch Education Officer has solicited applications for USMA instructor duty in accordance with AR 614-130. These applications have not been forthcoming and are still needed. The Branch has the opportunity to nominate officers for a number of branch immaterial slots at the Academy, in nearly every department, yet we do not have on file a sufficient indication of interest on the part of our officers. The current nomination drill for those not specifically requested by name was completed on 3 September. If you feel you are qualified and are interested in this assignment, please let me know by applying under regulation cited above or by dealing directly with the Academy. We are most interested in providing our high quality officers for an assignment to USMA.

(LTC McCrea/31390)

Warrant Officer Advanced Course (Test). On a trial basis, selected senior warrant officers in various MOS's controlled by several OPD career branches will attend an advanced course in January 1973. The test course will be conducted at Fort Rucker, Alabama.

The test program evolved from discussion at the first annual DA world-wide personnel conference (the current Chief of Staff directed review of the Warrant Officer Program) and coordination with CONARC. If the results prove to be successful, the course could become a springboard for a branch/MOS immaterial advanced course for senior warrant officers.

The objective of the course is to equip the senior warrant officer to maximize his contribution to the Army and his personal career satisfaction. The planned curriculum of general professional development subjects, including electives from a university cooperative program, is designed to complement the warrant officer's military knowledge and expertise.

(CW4 Vaughn/31177)

PERSONNEL ACTIONS

Timely Submission of OER's. The preparation of officer efficiency reports is one of our most important duties as commissioned officers. In addition to being accurate and fair in preparing OER's, it is of utmost importance that you prepare them promptly. Our commands are provided adequate notice concerning the convening of selection boards for promotion and are able to submit special OER's when appropriate. However, announcements are not made far in advance of convening Command and General Staff College and Senior Service College Selection Boards. In addition, there is a great deal of administrative work by the Branch prior to the convening of the boards. We strongly recommend that OER's be submitted as timely as possible to insure consideration by these boards. The Chief of Staff approved 1 January 1973 as the effective date of implementation for the new OER, DA Form 67-7.

(LTC Forte/31375)

Year Groups Open For Approval of Competitive Voluntary Indefinite Agreements. As most of you are probably aware, HQDA manages the Army officer personnel strength by fiscal year groups; i.e., in general, officers who entered active duty in FY 71 are in the 1971 year group. Each branch is limited in the number of officers who may be retained on active duty from a particular year group. This is significant in that applications for voluntary indefinite extensions must be disapproved for officers falling in year groups where the Branch ceiling has already been met. At the present time, ADA Branch has met this ceiling for year groups 1968, 1969, and 1970; however, there are still vacancies for 1971, 1972, and 1973. Information on earlier year groups may be obtained by contacting the Branch. Be sure to check AR 135-215 before submitting an application for VI status. Those who entered active duty after 1 July 1970 must submit for a Competitive VI under paragraph 5c of AR 135-215. Officers who submit their applications after completion of the basic course should wait until approximately their 18th month of service in order to have an established record of performance for evaluation of their application.

(MAJ Alexander/31375)

Warrant Officer Procurement. DA Message AGUZ-RCP-ORM, 071721Z August 1972, announced a program for procurement of warrant officers to fill current and projected Army vacancies. Qualified individuals may apply for appointment as a warrant officer, USAR, under the provisions of AR 135-100 and request concurrent active duty under the provisions of the cited message and AR 135-210. Quotas are available for the immediate appointment of qualified applicants in the following ADA MOSs.

MOS	TITLE
221B	AD Missile Assembly Technician, Nike
222B	AD Missile Fire Control Technician, Nike
223C	AD Missile System Technician, Hawk
223D	AD Missile System Technician, Improved Hawk

(CW4 Vaughn/31177)

FROM THE DIRECTOR OF ENLISTED PERSONNEL

Phase out of Army Aircraft. Some Army aircraft are being "retired from active duty" and transferred to the Reserves and National Guard. Those active duty aircraft maintenance personnel who hold MOS for these aircraft may soon find themselves out of a job.

This phase out of equipment systems affects the following MOS:

67B (O-1/U-6 Airplane Repairman)
67C (U-1A Airplane Repairman)
67M (OH-13/H-23 Helicopter Repairman)
67P (CH-34 Helicopter Repairman)

MOS 67T (CH-37 Helicopter Repairman) is being dropped from the enlisted MOS structure. Formal announcement and reclassification guidance will be disseminated in a forthcoming change to AR 611-201. Other aviation maintenance MOS now overstrength because of the decrease in aviation units resulting from the phasedown in RVN include:

67F (Airplane Technical Inspector)
67N (UH-1 Helicopter Repairman)
67W (Helicopter Technical Inspector)

People who have skills which are becoming obsolete or are overstrength have two options available to them:

1. There are a limited number of school quotas available for courses in the following aviation maintenance MOS:

67G (U-8/U-21 Airplane Repairman)
67V2T (OH-58 Helicopter Repairman)
67X (CH-54 Helicopter Repairman)
67Y (AH-IG Helicopter Repairman)

If you desire to stay in the aviation maintenance career field and can qualify for one of these schools, you should see your personnel officer to request a quota. Chapter 11, AR 614-200, outlines the procedures for requesting MOS training courses. Installations are authorized to request by telephone.

2. If you desire to work in another career field, DA will soon publish reclassification guidance listing those fields, by MOS, which are open to reclassification. There will be no reclassification into the aviation maintenance career field in the foreseeable future.

Don't hesitate; school quotas are limited.

Missile Minder
A Giant Step Forward

The Missile Minder AN/TSQ-73 is a forthcoming system for the command and control of Army surface-to-air missile system air defense which provides extensive improvements over previous similar systems. Missile Minder is riding on the leading edge of a technological wave and is being implemented with other candidate Army tactical data system programs in mind, while undergoing design for its primary air defense role.

Need for Command and Control in Army Air Defense

Command and control of Army air defense began in a small way in World War I and continued into the era of radar in World War II, a voice telephone network, it operated with long reaction times and very low precision. The advent of nuclear weapons and jet aircraft with high speed and high payload forced the adoption of air defense weapons with a higher probability of single-shot kill, such as Nike Hercules and surface-to-air guided missile systems. Because of their costs, there was a corresponding need for reduction in rounds fired and, therefore, an increase in command and control capability over these systems.

These factors demand both economy of fires and assurance that all targets are engaged, beginning with those of highest threat. Furthermore, a demand for assured protection for friendly aircraft was added to the air defense equation. It is to attain these goals that air defense command control systems, such as the Missile Minder, have been devised. These goals are achieved in Missile Minder by collecting, processing, displaying, and communicating coordinated real-time information about the air situation to the Nike Hercules and Hawk missile battery commanders.

Meetin the User's Needs

The Missile Minder, illustrated in figure 1, is the culmination of more than 20 years of continuous effort by the Army in perfecting the design of air defense command and control systems for Army air defense.

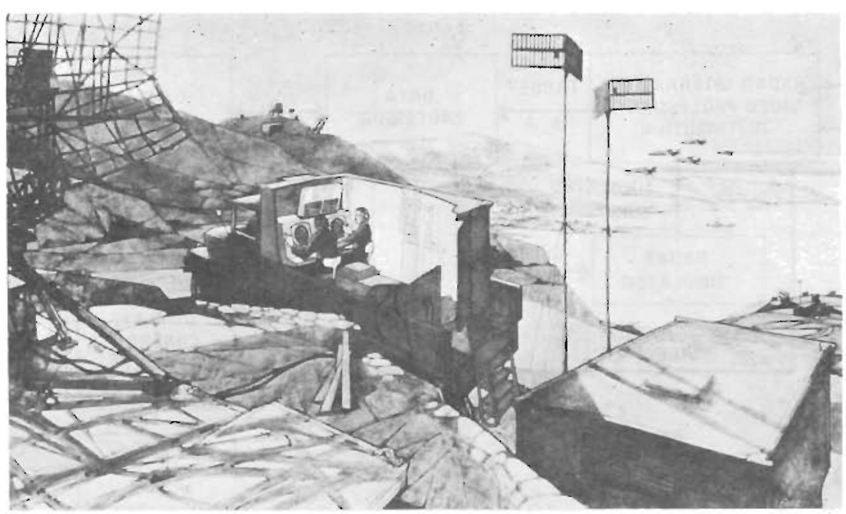


Figure 1. Missile-Minder AN/TSQ-73.

For the first time this system approaches the user's full operational requirements, the maintenance community's reparability desires, and the logistician's support requirements. Each element of system design and each subsystem are demonstrations of a concerted effort by the Army and contractor to achieve goals that were unattainable in earlier systems.

System Description

Missile Minder is used at both the battalion and group levels. Located at the battalion Army air defense command post (AADCP), the Missile Minder coordinates the activities of a number of surface-to-air missile batteries. As a group level device, the system coordinates the activities of a number of battalions, thereby adding cohesion to the air defense across a broad front. The Missile Minder AN/TSQ-73 is enclosed within a single air transportable shelter as shown in figure. 2. Included within this single shelter are not only the operating electronics with two operator control and display consoles, but also a workbench with storage for classified and other documents, spare parts, and tools and test equipment sufficient for maintenance. The system includes in the same shelter the maintenance and repair facility that occupies an additional van in some of the previous systems. Prime power, communications equipment, and radars are separately provided.

The Missile Minder performs the functions of track correlation, identification, threat evaluation, weapon assignment, data exchange with other systems, and simulations for training. It is also capable of displaying target information from a collocated radar. Figure 3 is a block diagram illustrating the subsystems which perform the chief functions of the AN/TSQ-73.

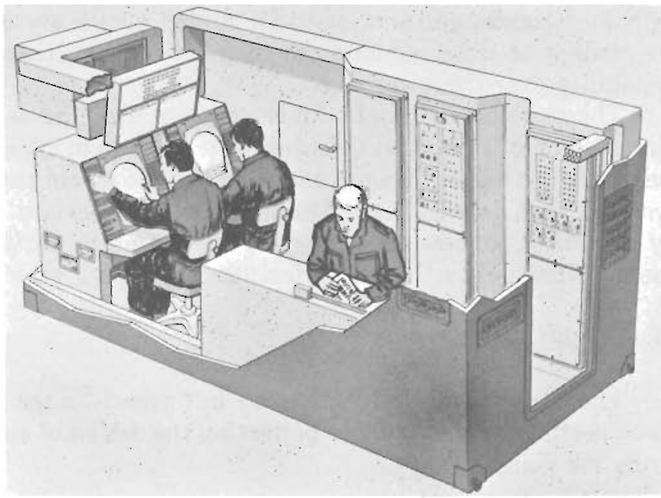


Figure 2. AN/TSQ-73 crew positions.

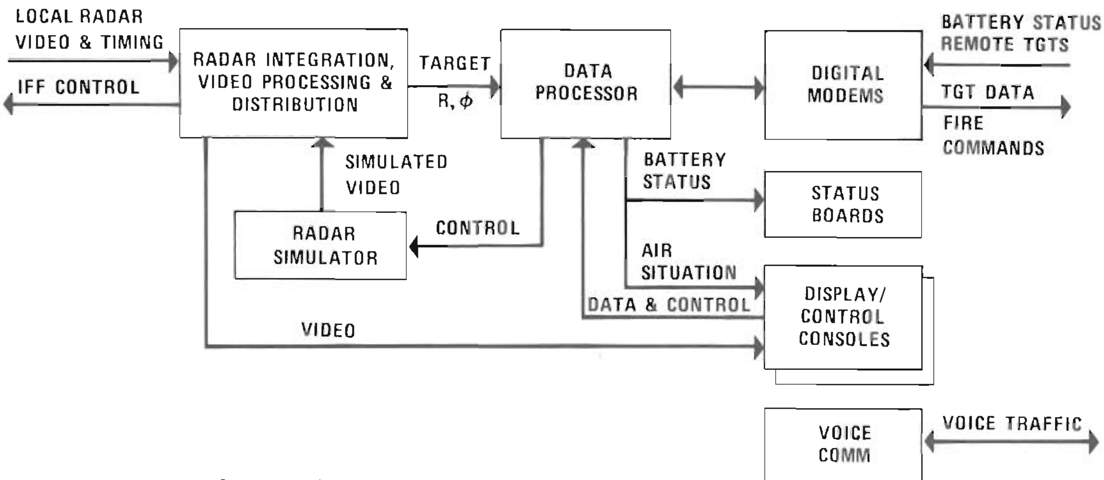


Figure 3. System block diagram.

Information Exchange Features

Data sources include local radar and an extensive digital data link network. Missile Minder is designed for compatibility with any of a large number of current or proposed military radars, including 3-D, which could be used locally with the AN/TSQ-73. Video received from the radars is processed in a dual channel video processor designed for both reliability and processing two different kinds of video simultaneously, thus assuring the best possible track quality. Radar data processing includes fully automatic acquisition and tracking of both radar and beacon returns from aircraft. In addition, digital data from remote gap-filler radars can be accepted by the system.

Track data is exchanged via digital data link with associated fire units, adjacent Missile Minders, and systems of other services such as the Marine Tactical Data System or the AN/TSQ-91 portion of the 485-L of the Air Force. Additional information will be exchanged with the Army air traffic management automated centers (ATMAC) and the tactical operations system (TOS), when deployed. Figure 4 illustrates the typical interfaces for the battalion system. Interfaces with the other services, TOS, and ATMAC are normally accomplished with the group system as shown by the broken line. The battalion system can interoperate with those systems, when it does not operate with a group system. Information received in exchange of data, combined with the local radar/beacon information, provides the Missile Minder operators with a picture of the air defense situation extending over the entire battlefield.

The individual two-way data links with each subordinate fire unit provide the necessary near-real-time data exchange between the battalion and battery commander for proper conduct of the air defense battle. First, the battery commander must be made aware of the general situation or state-or-alert; second, he must be given the early warning information about targets penetrating his defended airspace; and third, he must be made aware of the activities and assignments of adjacent batteries having field of fire overlapping his own.

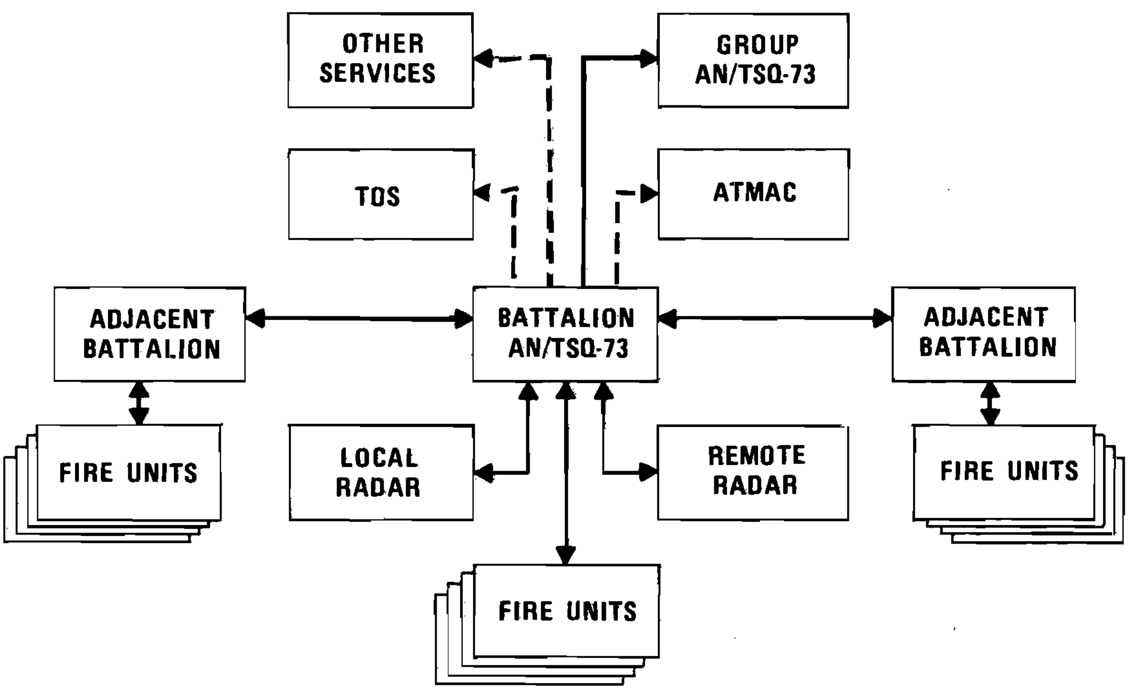


Figure 4. Battalion system interfaces.

This basic data allows him to fulfill his mission in the most effective manner.

Conversely, the battalion commander is kept informed of the present intentions and actions of each battery commander. Thus, the battalion commander is prepared to resolve conflicts, prevent overkill or underkill, and forward battle action summaries in near-real-time to other headquarters.

A single universal design of terminal equipment handles all of the several variations of data link parameters required in Army air defense. The system can also detect open or noisy data links to allow reconfiguration of communications, if needed.

The data received from the many sources described above are analyzed by the computer to eliminate redundant tracks. The resulting file of unique track information is available for display on the operator's situation displays.

Operator Display Features

The principal operator display is the cathode-ray tube (CRT) forming the central part of the control console. The CRT displays a very large number of operator selectable tracks, track velocity vectors, alpha-numerica descriptors, fire unit-target pairing lines, computer generated maps, and safe corridors simultaneously with a full radar video display. The operator uses console switches to control the display of data, to initiate actions with regard to targets or assigned fire units, and to interrogate the computer for any additional data that may be needed.

The console displays data on a rectangular CRT mounted with its long axis vertical. This provides the air situation display with an auxiliary readout at the bottom of the tube for clear text amplification of information shown on the situation display. Figure 5 illustrates the current display. It is seen as viewed by the operator at the top, and with sections extended for maintenance in the bottom two views.

Supplementing the console display is the fire unit status display panel which is located over the consoles. Intended primarily for the local air defense commander, the status display shows the current defense readiness of each fire unit, primary and secondary track assignments, and missile supply status. The status display is updated automatically by the computer each time a change of status is received from any fire unit.

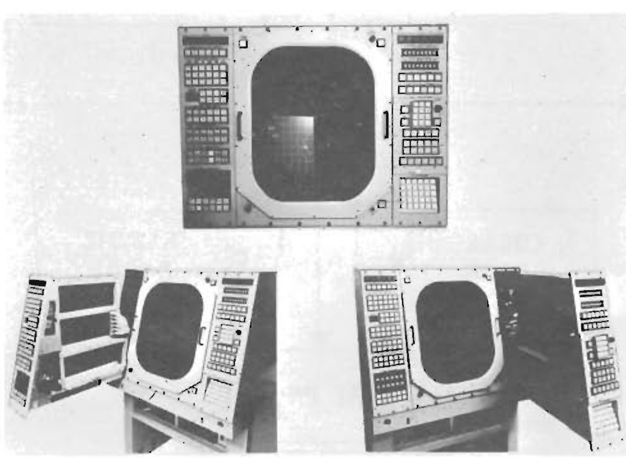


Figure 5. AN/TSQ-73 principal operator display. The two bottom views show sections extended for maintenance.

Data Processing Features

The dual-processor, militarized computer was designed specifically to meet the requirements of fast-reaction tactical systems. Although functionally identical to the TACFIRE AN/GYK-12 computer, the AN/TSQ-73 computer is packaged differently. In addition to controlling the overall system operation, the computer performs the calculations and data manipulation required for automatic acquisition and tracking of local tracks, correlation of local tracks with tracks received from various locations, threat evaluation, weapon selection, and automatic data link message processing. The computer also assists in friendly aircraft protection, and interprets and responds to operator requests for data display and transmission of action messages. During what would otherwise be idle time, the computer tests each of the subsystems and alerts the operator if trouble is detected. The operator then initiates a diagnostic program to isolate the problem to a replaceable circuit card or module.

Logistics Simplification Features

Logistics simplification is a design concern equal to that of obtaining significant increases in technical capability over older systems. The AN/TSQ-73 system incorporates a reliability/maintainability approach that sharply decreases system downtime and expensive support requirements.

The need for direct support unit and general support unit maintenance has been designed out by the use of effective built-in, computer-driven, diagnostic programs, and by the ease of accessibility to circuit cards, which allows the maintenance technician at the system to quickly isolate and replace faulty modules. Because of the small number of highly reliable types of circuit cards and modules, a full complement of field spares can be contained with the operational shelter, easily accessible for quick replacement.

This approach requires no external test equipment and allows a high degree of pull-out/plug-in maintenance. This, in turn, allows the use of simpler maintenance manuals, with concurrent simplification of training. The design allows a high degree of economical throwaway of faulty parts, and stresses maximum commonality. By careful design, 10 card types constitute over 60 percent of the AN/TSQ-73 digital circuitry. Less than 1,000 peculiar line items will enter the supply system when the system is fielded. This represents about 15 percent of the quantity currently stocked for the system being replaced by the AN/TSQ-73. Power requirements for the Missile Minder are approximately 10 percent of that of the system being replaced. Although reliability, availability, and maintenance times are classified, they will be improved over the older system by an astonishing amount.

Use for Other Army Tactical Data Systems

The Missile Minder is designed so that each of the subsystems is as general purpose as the function allows. For this reason, the Missile Minder may be applicable to other Army tactical command and control functions. Certain roles have already been identified and if the Missile Minder can be used, a substantial saving in future investment costs can be realized.

Regardless of its possible future applications to other systems, the primary benefit of the AN/TSQ-73 is its importance to the successful accomplishment of the Army's assigned air defense role. This system will provide a significant increase in technical capability, reliability, and maintainability, with concurrent operating cost savings, over the system it will replace.

MAGNETISM

Across

1. Iron is a ferromagnetic material with high ______________.

7. One maxwell equals __________ magnetic field line.

9. __________ has practically no effect on magnetic flux.

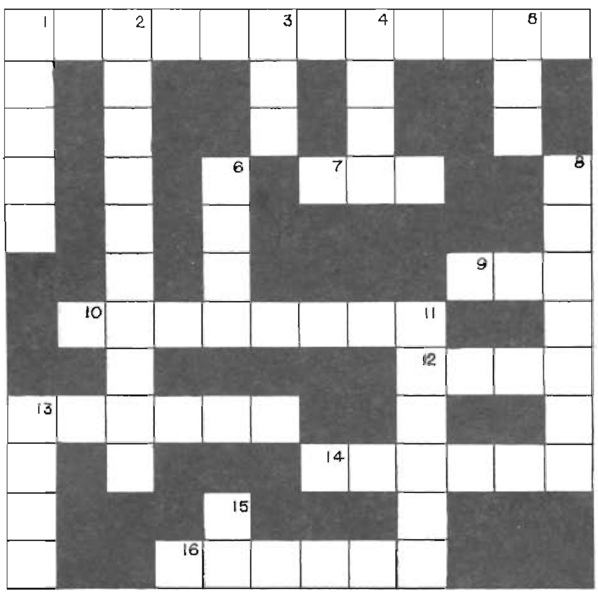
10. __________ poles exist on opposite sides of an air gap.

12. A magnetic field __________ does not cross others.

13. A ______________ has practically no effect on magnetic flux.

14. Such materials as wood and glass do not ____________ magnetic lines of force.

16. Magnetic material with high mu is best for a ______________ against a steady field.



Down

1. Inducted ____________ are always opposite from the original field poles.

2. Ferrites are magnetic but have high ______________.

3. Ohms law for magnetic circuits involves flux, ____________-turns, and reluctance.

4. Soft ____________ concentrates magnetic flux by means of induction.

5. A current of 4 amp through __________ turns provides a magnetomotive force of 40 amp-turns.

6. Each ampere-____________ of a coil produces magnetic flux throughout the magnetic path.

8. Without ____________, an electromagnet has practically no magnetic field.

11. A ______________ magnetic ring has no poles and no air gap.

13. In Ohms law for magnetic circuits, the ampere-turn unit corresponds to the ______________.

15. The __________ curve is used to show how much flux density results from increasing the amount of field intensity.

Solution on page 92.

Reader's Corner

CURRENT BOOKS AND ARTICLES OF MILITARY INTEREST

This list is published to draw attention to worthwhile and informative books and articles in other publications. We realize that not all items will be available to all readers. Our motive is to be helpful to as many readers as possible.

The content of these publications does not necessarily represent the opinion of the US Army Air Defense School.

— *Editor*

BOOKS

The Military and American Society: Essays and Readings, edited by Stephen E. Ambrose and James A. Barber, Jr. The Free Press, New York.

The Modern Military in American Society: A Study in the Nature of Military Power, by Charles Walton Ackley. The Westminister Press, Philadelphia.

To the Yalu: From the Chinese Invasion of Korea to MacArthur's Dismissal, by James McGovern. William Morrow, New York.
". . . an interesting, compact, and relatively unbiased narrative of the Truman vs. MacArthur controversy set against the backdrop of the Chinese intervention in Korea."

The Road to Yalta: Soviet Foreign Relations, 1941-1945, by Louis Fischer, Harper and Row, New York.
"An expert on the Soviet Union, Fischer writes very readable history. Each chapter is enriched by the addition of personal reminiscences, anecdotes, and private interviews."

Participation Training for Adult Education by Paul Bergevin. The Bethany Press, St. Louis.
"The purpose of this book is to describe a program of learning which develops a favorable climate for learning through coming to understand one's relationship and responsibility to other persons in the learning process."

Lieutenant Calley: His Own Story by William L. Calley. The Viking Press, New York.
"Now his supporters and detractors can hear from him. For those who read this book, Lieutenant

Calley's words will be surprising, threatening, or sorrowful; maddening, outrageous, or sincere. It is unlikely that America's image of itself and its soldiers will survive the publication of his own account."

How to Read Electronic Circuit Diagrams by Robert M. Brown. TAB Books, Blue Ridge Summit, PA.
"In this book you learn the significance of each type of diagram . . . Thus you learn to recognize each diagram for its intended purpose, and develop the ability to derive the correct information from the maze of weird looking symbols and lines."

Peace and Counterpeace; from Wilson to Hitler by Hamilton F. Armstrong. Harper and Row, New York.
"With enthusiasm, humor and dignity, Hamilton Fish Armstrong moves easily through a world of infinite variety — a night in Madrid with Ernest Hemingway, lunch at Hyde Park with the newly elected FDR, a lively afternoon with Queen Marie of Rumania."

The Great Guns by Harold L. Peterson. Crosset and Dunlap, New York.
The author describes and pictures 18 historical guns which he believes best tell the history of the various types.

Hess, the Man and His Mission by J. Bernard Hutton. MacMillan Co., New York.
"The book has the excitement and suspense of an adventure story. It probes with balance and intelligence the justice of the Nuremberg Tribunal's decision against Hess."

Inividualizing Instruction in Science and Mathematics by Virgil M. Howes. MacMillan Co, New York.
"This volume focuses on programs, guidelines, and practices in individualization of instruction in relation to mathematics, science, and uses of technology."

Israel, a Regional Geography by Yehuda Karmon. Wiley-Interscience, New York.
"This book tries to describe and to explain to the interested general public and to students of geography the process of evolution of new geographical patterns and regional structures."

ARTICLES

"Now Is the Time," Richard T. Knowles, Ordnance (September-October 1972), pp 120-123.
"Now is the time for all concerned Americans to study what is happening to the balance of power that we have maintained so long, and what threat exists to the possibility of peace and the preservation of freedom."

"How to Brief People," Clark C. Abt, Training in Business and Industry (September 1972), pp 50-54.
"Clark Abt's own briefings are as clear as a jewelry store window . . . Here he tells how to organize and deliver the kind of good briefing that . . . can launch a project, mobilize entire groups, inspire the intellect, accelerate the heartbeat, and make everyone's day feel like a major event."

"Mainland China, 1972," Current History (September 1972), entire issue.
"What are the strengths and weaknesses of the People's Republic of China as a new era of diplomacy opens? In this issue, China's current situation is evaluated by seven specialists."

"Paramilitary Case Study — The Bay of Pigs," Lyman B. Kirkpatrick, Naval War College Review (November-December 1972), pp 32-42.
"Rather than shunning the possibility of using covert operations in the future to gain policy objectives, experiences like the Bay of Pigs merely underline the fact that policymakers must be educated as to what is possible, and the responsibility for this lies with the career intelligence community."

"The Bad News about the Federal Budget," Juan Cameron, FORTUNE (November 1972), pp 93-95.
"FORTUNE foresees continuing large deficits over the next several years including a $24-billion deficit in 1977. Deficits of this magnitude would unsettle money markets, foster inflation, and increase international economic difficulties."

"Government Workers: Joint Study Shows Productivity Gains," Thomas D. Morris, Defense Management Journal (October 1972), pp 16-20.
"It should be heartening news to 2½ million members of Uncle Sam's work force to learn that they are not a liability in the national income accounts, and that we have reached a point of being able to prove this with a sample of over 50 percent of the Federal civilian population."

"The Coming Hydrogen Economy," Lawrence Lessing, Fortune (November 1972), pp 139-146.
"The fuel of the future will be relatively cheap, marvelously abundant and entirely clean. We may be using it within a decade."

"Military Considerations in the Indian Ocean," Edmund Joseph Gannon, Current History (November 1972), pp 218-221.
"It is difficult, if not impossible, to predict with accuracy the likely course of military events over the next decade or so in the Indian Ocean . . . However, the chance of an outbreak of armed conflict in the Indian Ocean area remains unpleasantly high."

"Industrial Preparedness," Christopher S. Maggio, Parameters (Summer 1972), pp 52-59.
"How well, from an industrial point of view, have we done in the past to insure that our country was ready for war? What are some inadequacies in our present system of industrial preparedness? What can be done to improve our condition?"

"Microcircuits by Electron Beam," A. N. Broers and M. Hatzakis, Scientific American (November 1972), pp 34-44.
"By using an electron beam to trace the patterns of electronic circuits it should soon be possible to put 100,000 transistors and similar devices on a silicon chip a few millimeters square."

"Rocketry in the 50's," Astronautics & Aeronautics (October 1972), pp 38-65.
Here is a history of rocketry in the 1950s through the eyes of the people who led in the early development. Articles by outstanding authorities recall the early beginnings, establishing our presence in space, the political bugs involved, liquid fuel development, and other aspects.

"The Strategy of Resolve," David K. Pansius, Air University Review (September-October 1972), pp 66-73.
"Pulled between our desire to avoid potential costs and our need to defend our allies, we have sought a solution through avoiding the issue. We respond according to reflex, not reason. The prolonged use of such a strategy can only lead to eventual failure."