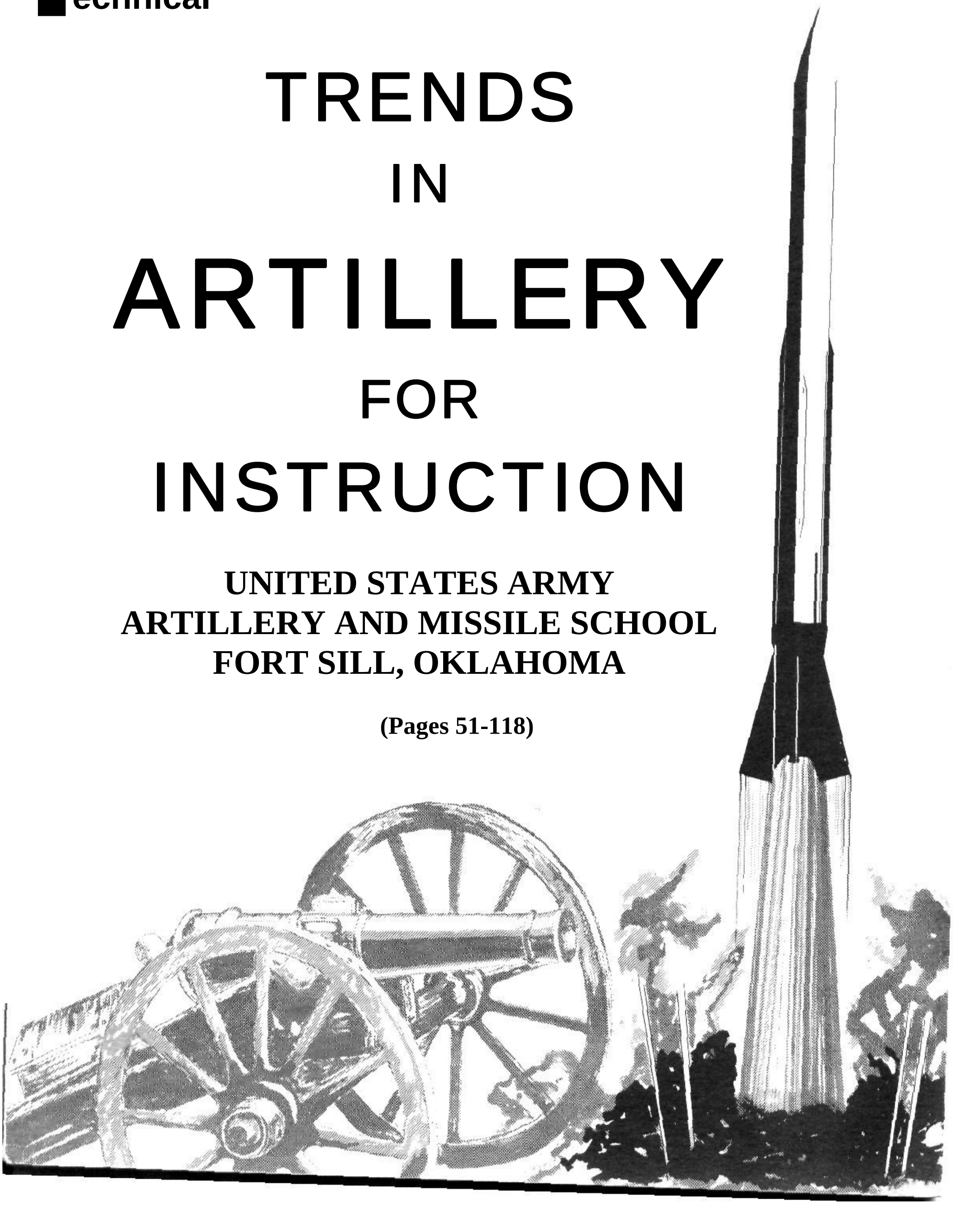
Tactical and **T**echnical

TRENDS IN ARTILLERY FOR INSTRUCTION

UNITED STATES ARMY
ARTILLERY AND MISSILE SCHOOL
FORT SILL, OKLAHOMA

(Pages 51-118)



UNITED STATES ARMY
ARTILLERY AND MISSILE SCHOOL

1 October 1957

This Nonresident Training Aid provides students of Artillery Extension Courses, Reserve Components and active Army Artillery staff training programs, ROTC programs, and Artillery USAR Schools with information on the most recent developments of an operational or functional nature on new weapons, new organizations, tactics, techniques, procedures, operations, and "tricks of the trade." Suggestions for additional material are invited. Forward them direct to the Assistant Commandant, U.S. Army Artillery and Missile School, Fort Sill, Oklahoma.

T.E. de SHAZO
Major General, USA
Commandant

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This training aid is for use by the Department of Publications and Nonresident Training, U.S. Army Artillery and Missile School, for Extension Courses, USAR Schools, Staff Training Programs of the Reserve and National Guard units, nonresident conferences, orientation, and other instructional purposes.

Edited and published by Department of Publications and Nonresident Training, U.S. Army Artillery and Missile School, Fort Sill, Oklahoma

U. S. ARMY
ARTILLERY AND MISSILE SCHOOL
OFFICE OF THE ASSISTANT COMMANDANT

1 October 1957

Tactical and Technical Trends in Artillery for Instruction is designed as a bridge between the School and each of you in keeping abreast of current developments. Artillerymen must be thoroughly and completely familiar with developments in tactics, techniques, and materiel.

No longer is it sufficient to know "how," but we must also know "why." This can only be determined by continuous and progressive study. I urge you to pursue such a course.

Originality of thinking is certainly not confined to this School. While we are constantly studying ways and means to better accomplish the Artillery mission, new ideas and suggestions from you are most welcome.

PHILIP C. WEHLE
Brigadier General, USA
Assistant Commandant

DEPARTMENT OF PUBLICATIONS AND NONRESIDENT TRAINING

COLONEL A. S. BRITT, JR., ARTILLERY, DIRECTOR

WHY THE INCREASED INTEREST OF USAR OFFICERS IN THE EXTENSION COURSE PROGRAM?

Enrollment in the Extension Course Program continues to increase. The number of lessons graded during the summer months has not shown the sharp decline of previous years. This reflects the interest being shown in extension course study by our students. Officers of all components have found our subcourses an excellent means of maintaining their professional qualifications.

Now, an additional factor has entered the picture which further increases the interest of USAR officers in our Extension Course Program. On 7 August 1957, Headquarters, United States Continental Army Command, issued Memorandum Nr 20, Subject: "Individual and Unit Personnel Standards for TOE and TD Units of the United States Army Reserve."

This memorandum emphasizes that all paid participants in TOE and TD units of the USAR must make a definite contribution to unit objectives and unit readiness. To this end, units have been directed to conduct a continuous qualitative screening designed to remove from paid participation those individuals who do not contribute to unit training and mobilization objectives. Officers who do not measure up to the required standards will be relieved of unit assignment.

Generally, officers in troop units will be required to be branch and MOS qualified. The authorization contained in subparagraph 14e, AR 140-140, to assign officers who are not branch qualified to units will generally be used only to the extent necessary to secure appropriate assignments for highly qualified individuals.

For officers now assigned to troop units, the provisions of subparagraph 16d, AR 140-140, with reference to attainment of branch and MOS qualifications, will be strictly enforced. This means that nonartillery officers assigned to artillery units will generally be required to attain branch qualification within 1 year of assignment. Even the allowable 12 months' extension is discouraged by Memorandum Nr 20.

This time limitation makes branch qualification difficult through the USAR schools and extension courses. Many nonartillerymen assigned to artillery units will probably choose to qualify by attending an associate resident course of instruction. To many, this may seem to be the fastest and best way to qualify. Without prior preparation, the nonartilleryman may experience some difficulty in the resident courses. For this reason, the School recommends that they prepare themselves by taking selected subcourses from our Extension Course Program. We have found that students with a limited artillery background are likely to have trouble with gunnery and special weapons instruction.

NEW SUBCOURSES

On or about 1 November 1957, the following new subcourses will be placed in administration:

Subcourse 6, Conduct of Observed Fire

Subcourse 9, The Field Artillery Firing Battery

Subcourse 18, Fire Direction I

Subcourse 19, Fire Direction II

Subcourse 74, Field Artillery Rockets and Guided Missiles

Subcourse 80, The Employment of Atomic Weapons

Subcourses 6, 9, 18, and 19 are based on FM 6-40, April 1957.

Anyone scheduled to attend one of the resident general courses at this School can profitably study these subcourses as a refresher.

You are reminded that any member of the armed forces, in any component, can enroll.

REVISED FM 6-40

Since the revised FM 6-40, dated April 1957, has been published and distributed by The Adjutant General during July, work is now underway to keep it current. This will include making changes which have become necessary due to new organizations or modifications in techniques since the cutoff date in the manual's preparation. It behooves all artillerymen to take part in creating these changes, thus helping to make this manual meet their needs and insure that it does not become obsolete. To fulfil this, we, at the School, would like to stress that direct comments are invited, in fact desired, on the contents of the manual. Is the manual deficient in any aspect? Are the explanations or illustrations vague, misleading, or not readily understandable? Is there any portion which should be revised? If so, where, why, and how should the additions or corrections be made?

We would also like to hear if you are pleased with the manual. If you have any comments, pro or con, or recommendations, let us hear from you so that future changes or corrections will give you the product you want.

Changes will be printed as page replacements which can easily be inserted in the manual. We hope that the changes will be timely and that the manual in the hands of the artilleryman will always reflect current thoughts and techniques.

EXTENSION COURSE COMPLETIONS

The following officers and enlisted men were issued certificates of completion for artillery extension courses during June, July, and August 1957.

ACTIVE ARMY

Name	Rank	Component	Course completed
Basanez, Edward S.	Capt	RA	FA Gunnery
Bidle, Paul J.	Lt Col	USAR-EAD	FA Gunnery
Hoenstine, Charles A.	1st Lt	RA	FA Gunnery
Ingham, Henry L.	Capt	USAR-EAD	FA Gunnery
Linck, Ralph E.	SFC	RA	Army Aviation
McGuire, Virgil P.	Capt	USAR-EAD	Army Aviation
Moseley, Lonnie L.	Capt	USAR-EAD	Army Aviation
Pallatin, John S.	MSgt	RA	FA Gunnery
Parsons, Robert B.	Capt	USAR-EAD	FA Gunnery
Pearson, Rey M.	MSgt	RA	AA Gunnery
Rollins, Orval W.	Capt	USAR-EAD	Army Aviation
Worthy, Leroy L.	Sgt	RA	FA Gunnery

NATIONAL GUARD

Name	Rank	State	Course completed
Adams, Daniel D.	1st Lt	Texas	FA Gunnery
Alexander, Howard C.	1st Lt	New York	FA Gunnery

NATIONAL GUARD (continued)

Name	Rank	State	Course completed
Graham, Burton T.	Sp3	Washington	FA Supply
Hitsman, Robert J.	1st Lt	Iowa	FA Gunnery
Link, Alfred E.	SFC	Kansas	Communication
Mayette, Paul M.	2d Lt	New Hampshire	FA Gunnery
Meagher, William E.	Capt	Connecticut	AAA Advanced
Perra, Andrew G.	MSgt	New Hampshire	FA Gunnery
Vanier, Gilson A.	Major	New Hampshire	FA Gunnery

USAR

Name	Rank	State	Course completed
Buskirk, Winfred C.	Lt Col	New Mexico	FA Gunnery
Ertelt, Henry R.	Capt	New Jersey	FA Gunnery
MacGregor, William E. Jr.	Capt	Minnesota	FA Gunnery
Morgan, John M.	1st Lt	Kentucky	FA Gunnery
Seymour, James D. Jr.	Capt	Texas	FA Gunnery
Wilcox, Millard W.	Lt Col	Utah	FA Gunnery

OTHERS

Name	Rank	Service	Course completed
Cavallo, Louis J.	1st Lt	USMC	FA Gunnery

RESERVE COMPONENTS STAFF TRAINING CATALOG

The Reserve Components Staff Training Catalog for FY 1959 was distributed during September 1957. A limited number of catalogs are on hand after completing the initial distribution. On request, we will send a copy to those units missed in the initial distribution.

Instructional material listed in this catalog is based primarily on the material listed in the programs of instruction (POI) for the 1958-59 USAR school year. The new catalog includes 16 classes which specifically cover delivery means, tactical employment, and nuclear effects of atomic weapons (unclassified). Distribution included field artillery units of the Active Army (to the battalion level) as well as units of the USAR and National Guard.

Beginning with this catalog (FY 1959 instructional material), a new procedure for ordering and shipping material is being implemented. Commanders may order instructional material at any time throughout the year, either in small increments or in one consolidated order as before. The first increment of this material will be available for shipment to using units on or about 1 May 1958.

Extension Course Exemptions for Participation in USAR Schools Program

--Lieutenant Colonel E. E. Cox, Artillery

An officer must complete his branch advanced course before he is eligible for higher level military schooling. Three methods for continuing his military education are available to the artillery officer not on extended active duty. Those methods are--

1. Attending (in residence) the Associate Artillery Battery Officer Course and Associate Artillery Officer Advanced Course, conducted by the U. S. Army Artillery and Missile School.

2. Attending a USAR Associate Artillery Battery Officer Course and USAR Associate Artillery Officer Advanced Course, conducted at various locations throughout the Zone of Interior.

3. Enrolling in the Field Artillery Battery Grade Extension Course and the Field Artillery Advanced Extension Course, conducted by the U. S. Army Artillery and Missile School.

A few students enrolled in USAR schools have not been able to complete the course of instruction because of a change in residence to a location in which a USAR school has not been established or because the USAR school or the artillery department has been discontinued. The U. S. Army Artillery and Missile School has recognized that some students, through no fault of their own, have lost credit for partially completed USAR school courses. After study, a method has been worked out to salvage some of this loss to the student.

As a result of this study, it is now possible for USAR school students to transfer to the Extension Course Program and receive credit for the instruction they have received in the USAR school. This can be done only when, through no fault of his own, the student cannot complete the USAR school course. Credit for USAR school instruction will be granted for each satisfactorily completed full year of USAR school instruction. Fractions of years cannot be credited.

In order to properly evaluate a request for "exemption in extension course study," the student must forward a certificate from the Commandant of the USAR school concerned indicating the specific USAR school years satisfactorily completed, the percentage of attendance during the reserve phases, the number of active duty phases attended, and a statement that the student has satisfactorily completed all examinations for the year or years of instruction concerned.

Correspondence should be addressed to:

Extension Courses Division
Fort Sill 10, Oklahoma

Extension course enrollment continues to rise. Join over 13,000 others by sending us your application for enrollment. NOW!

DEPARTMENT OF COMMUNICATIONS AND ELECTRONICS

COLONEL G. W. SEAWARD, ARTILLERY, DIRECTOR

LOW MAN ON THE TELEPHONE POLE

--LIEUTENANT COLONEL GEORGE V. GILLETTE, ARTILLERY

There is a jargon floating about in the sacrosanct halls of the U.S. Army Artillery and Missile School that is nearly as incomprehensible as the prattle of the teenage set. And it appears that we in the field artillery will be hearing more and more of such things as: "Run the command and FDC circuits through the carrier bay and multiplex two teletypes on them. Make the shot to battalion with the Yagi unless you are getting a bounce from army, in which case you will have to use the bedsprings."

What is behind this strange jargon? First, let us say it is a natural development sparked by the advancement in communication tactics and techniques imposed by the requirement to be prepared to fight an atomic war. Most of these terms are not actually new--they are new only in their application to field artillery communications. Whereas, in the past, field artillery communication was thought of in terms of the more simple circuits and nets, it is now necessary to consider complete systems.

To achieve maximum use of the all too few communication circuits available to the field artillery, a communication technique is being adopted which will permit four or more persons to talk over a circuit without one interfering with another. To do this, we use a method similar to that long used by the telephone companies. This method is known as carrier system or frequency division multiplexing. The strange nomenclature may make the idea sound complex but the principle is simple. Field artillery units will soon be using equipment based on the carrier system, so let's see what makes the thing tick.

The voice-frequency range for intelligible communications (we are not interested in Hi-Fi) can be considered to be between 200 cycles per second and 3,000 cycles per second. Suppose we let friend "A" talk directly on our circuit. His voice will take up the space to 3,000 cycles. Now friend "B" wants to talk too, so we move "B's" voice up by 4,000 cycles and he will be talking over the frequency band of 4,200 cycles to 7,000 cycles. Now comes friend "C" to get into the act. We must move his voice up by 8,000 cycles, so he uses the frequency band of 8,200 cycles to 11,000 cycles In this manner, we can keep stacking one voice on top of the other. In fact, commercial systems can stack 120 or more voices on 1 circuit. Now the question arises: how to unscramble this Tower of Babel at the other end? Simple! All we do is subtract the same number of cycles from each circuit that we added in the beginning and presto! we have the natural voice again. Take the example of friend "C." We left him talking in a frequency band of 8,200 cycles to 11,000 cycles. As stated, subtract 8,000 cycles and there he is again at 200 cycles to 3,000 cycles. Simple, ain't it?

So we have added two new phrases to our vocabulary--carrier systems and frequency division multiplexing.

Now let's carry our example a little further. We have assumed that, since we were talking in terms of telephones, the voices were going out over wire. This is true except for one small detail--with the carrier method we must provide a separate pair of wires for the voices going in one direction and another pair for the voices traveling in the other direction. You have heard of spiral 4 cable? This cable does the job; 2 pairs in one cover. More expensive? Not necessarily so. Remember, we are transmitting 4 conversations in 2 directions. Formerly that would have taken 4 pairs of wires; now we use only 2 pairs. Similarly, if we have 12 voice circuits, we do not increase the number of pairs. In other words, this is known as a 4-wire system in contrast to the common garden variety telephone which is a 2-wire system. Just to confuse the issue, let it be said that we can put up to 4 teletype circuits on each single voice circuit, since teletype is also based on a 4-wire system.

Thus far, we have been talking only of transmissions over wire--sometimes called land lines. The technique of using 1 pair of wires for transmissions in 1 direction and another pair of wires for transmissions in the other direction is known as duplex operation and is compatible with radio. We can substitute a radio transmitter and a radio receiver for each pair of wires any place in the system and still have the capability of transmitting many conversations over the same channel. The only requirement is that the radio equipment be broadband (pass a greater number of frequencies). But then this capability has been used in TV for years, so it is no problem. In other words, if Lt "A", here at Fort Sill, is talking to a girl friend in another town down the road which we will call Chickasha, we put a transmitter at Fort Sill and a receiver at Chickasha to replace one pair of wires and a transmitter at Chickasha and a receiver at Fort Sill to replace the other pair. Now what do we have? A radio terminal at Fort Sill and a radio terminal at Chickasha. Those are the places where the radio terminates and the changeover to wire is made.

To conserve power and to keep interference down a bit, we try to concentrate the radio wave all in the direction of the receiving station. A scientist at the University of California by the name of Dr. Yagi discovered one day that by placing carefully cut pieces of antennas one in front of another, the radio waves could be focused like the beam from a flashlight. Oddly enough, this type of antenna was named after the developer and is known today as a Yagi. Look at the roof tops of the houses these days. A majority of the TV antennas are Yagis. Somebody else discovered that by putting a wire mesh behind the antenna it would help kill signals sneaking up from the rear. This device looked so much like bedsprings suspended in the air that "bedsprings" was adopted for the name. We now have antennas for military radio equipment which combine the best qualities of these two items.

So, now we have a tight beam lined up between here and Chickasha but, because of the curvature of the earth in that distance, our beams are shooting off into space. If we can't make it in one yump, we say, then let's make it in two. So we put in another receiver and transmitter in each beam down the road a piece and we're in business. And there we have a radio relay. What have we accomplished? We have now integrated wire and radio into one system.

IMPROVED LABORATORY INSTRUCTION

--MAJOR JOHN G. TAMALIS, ARTILLERY

The Radio Maintenance Branch of the Electronics Division, Department of Communications and Electronics will, in the near future, introduce an improved method of laboratory instruction. Design of required equipment has been completed, and new exercises incorporating appropriate material have been written. On completion of a new laboratory now under construction and the fabrication of certain laboratory equipment, the new system will be implemented to replace the present method of laboratory instruction for the 12-week Artillery Radio Maintenance Course.

The contemplated change is the result of studies made of many systems employed in service schools and civilian counterparts during past years and of a careful evaluation of the results of each system based on relative student improvement. Because of many factors, particularly the tremendous cost involved in procurement of electronic equipment required for mass laboratory type instruction and the requirements for conservation of instructor manpower while achieving maximum utilization of training time, improvement in instruction technique must be a continuing process. Since the problem is not unique to either this Department or this School, it is felt that a short review of our experiences might be of value to others faced with a similar problem.

At present, within the Electronics Division, two types of laboratory instruction are employed. In the Artillery Radio Maintenance Branch, a "production line" system is used, in which the student progresses from exercise to exercise, using large demonstration type boards for each step. The Basic Electronics Branch, on the other hand, is presently employing a "bread board" technique during the first half of the course and a demonstration board system for the remainder. Both systems have produced good results but both have inherent disadvantages.

Under the "production line" system, the student is given a preconstructed board. Thus, no time is lost in building the required circuit. However, the student does not receive the practical experience, early in the course, of handling components and constructing circuits from schematics. Also, the demonstration type boards are large in size and only one board is available for each exercise. Throughout the course of instruction, the students must work in pairs, and, since there is only 1 board for each exercise, only 1 pair can work on a particular assignment at a time. Since the purpose of laboratory exercises is to provide practical application of the instruction given during conference periods, steps must be progressive. This means that the students must proceed through the system in sequence. As a result, a lag exists between the head and tail of the class. This "lag" seriously complicates the scheduling of conference periods and examinations and otherwise reduces instructional effectiveness.

For example, in a class of 50 students, the last "lab pair" to enter the line are beginning the 1st exercise when the 1st pair are on the 25th exercise. This lag continues through the entire course and requires both a "starting" and "finishing" pool where students await entering the laboratory exercise phase or await completion of the laboratory exercises by the other students in the class. Even if the conference periods are directed at the middle pair, serious instructional difficulty can arise and students cannot be tested until the last pair have completed the laboratory work applicable to the examination.

The "bread board" method offers some improvement over the production line method. Here enough boards and test equipment are provided so that all students proceed through the laboratory exercises together. This eliminates the problem of complicated scheduling of conference periods and examinations. The difficulties with this system arise in the need for each pair of students to have one board for each exercise and in the method by which the components are attached to the board. Experience has shown that continual maintenance of the components and boards is necessary to keep the system operating. Further, the time required for the student to construct the circuit to be studied is in some cases excessive.

The new system to be employed for students of the radio maintenance course is the "plug-in" board system. This system eliminates the disadvantages of both laboratory procedures now in operation, chiefly by permitting simultaneous instruction of all students in a class. Three basic boards will be used by each lab pair, and all laboratory exercises during the first 6 weeks of basic instruction will be performed by using these boards. A template having the desired schematic is placed on the board as a guide for the student to insure that the components are properly placed and that excessive time is not lost in constructing the circuit. Laboratory periods utilizing this "plug-in" system will immediately follow conferences, and examinations can be given at the proper time. Likewise all students will proceed through the course together, thus allowing better supervision in the laboratory. Also, owing to the type of construction of the boards and components, minimum maintenance time will be required to keep the system operating. Successive steps in the fundamentals subcourse, which follows the "plug-in" phase, can be performed in small groups (10 to 12 students), and simultaneous instruction can be accomplished.

The equipment phase of the course (last 6 weeks) will be conducted by dividing the class into 2 groups and by alternating the sequence of instruction for various artillery radios. Sufficient equipment will be available to teach all members of each group simultaneously.

These improvements in laboratory instruction are in keeping with the U. S. Army Artillery and Missile School policy of continued refinement in teaching methods, designed to furnish better trained personnel for the artillery.

THE AN/GRC-46 RADIO SET

--BILLY J. GROVES, TECHNICAL CONSULTANT, DEPT OF C&E

A communication technique, long used by higher headquarters, is currently being considered for extension to lower echelon units. This technique, radioteletype, differs from most forms of communication in that distortion caused by overloading, or electrostatic interference does not degrade the signal quality until a certain critical point is passed. This feature, plus the desirability of having a printed message, will prove radioteletype to be a welcome addition to tactical communication systems. Information on the AN/GRC-46 radio set is presented in the following paragraphs:

This set, developed by U.S. Army Signal Engineering Laboratories (USASEL), is a mobile radioteletype station. Radio set AN/GRC-19 is the basic radio set. Additional components are a frequency modulator, a teletypewriter, an interconnection box, a rotary converter, and a shelter S-89/G. It is an assembly of standard equipment components into a set having military characteristics suitable for use in forward areas of the combat zone. When the AN/GRC-19 is combined with all of the components except the shelter, the set nomenclature is changed to AN/VRC-29. The AN/GRC-46 is normally mounted on a standard 3/4-ton cargo truck, but it also may be transported by cargo aircraft or helicopter. This set was declared standard 7 May 1956. First delivery to troop units is scheduled for December 1958 with a delivery rate of 30 sets per month.

The rated ground wave range of the AN/GRC-46 is 50 miles for voice operation and 75 miles for continuous wave (CW) operation. Sky wave coverage is listed as 150 to 1,500 miles, depending on the choice of frequency and antenna construction. Based on minimum signal strength required at the receiver, radioteletype ground wave range should approach the CW range. Sky wave coverage, as listed, is independent of the type of modulation. The AN/GRC-46, therefore, can be used for communication at 150 to 1,500 miles range, using sky wave propagation.

Field experience provides further indications of AN/GRC-46 performance. When the AN/GRC-46 is employed in a stationary installation, reliable communication can be maintained up to 30 miles by using whip antennas. The vertical whip has been used for distances up to 100 miles, but this range depends on frequency and terrain features; therefore, the antenna is not considered reliable for this distance. Horizontal half-wave doublet antennas, such as the AN/GRA-12, can be used to furnish short distance sky wave communication (0-250 miles).

A remote control device using the AN/GRA-6 as a basic unit has been developed for use with the AN/GRC-46 and the AN/VRC-29. By using field wire, it is possible to remotely operate the radioteletype set up to 1 mile from the vehicle. This School has recommended that the control device issued with the AN/GRC-46 include all teletype equipment necessary for remote operation.

The power requirement for operating the AN/GRC-46 is approximately 1,500 watts. This necessitates the use of a high capacity vehicle generator, such as the Leece-Neville system, when the AN/GRC-46 is operated in the vehicular installation. Recommendations are made for an auxiliary source of power independent of the vehicle for operating the AN/GRC-46 in a stationary installation. Production models of the AN/GRC-46 will permit ready connection to nonvehicular power supplies.

Indications are that tape perforating equipment will eventually be made a part of the AN/GRC-46 but early models are not likely to include such equipment. Tape perforating equipment will permit messages to be transmitted at high speed. Messages may be originated in tape form by means of a manually operated keyboard, proofread, and then transmitted at a convenient time at a speed of 60 or 100 words per minute. Another possible application is the recording of incoming messages on tape for retransmission purposes. Depending on the equipment available, the message may be retransmitted automatically and a tape copy retained at the retransmission station.

A cost reduction version of radio set AN/GRC-19, to be known as the AN/GRC-65, is being developed. This set will be similar to the AN/GRC-19 except that the automatic tuning features of the AN/GRC-19 will be replaced with manual tuning controls. The AN/GRC-65 will be capable of operating in conjunction with teletype equipment and, when available, will be issued for troop use in preference to the AN/GRC-19. The conventional double sideband method of modulation is used with the AN/GRC-19 and the AN/GRC-65. Even though they have not reached the field in quantity, replacements for these sets are under consideration. A study contract has been let which may lead to the development of a single sideband basic radio set to alleviate congestion in the present tactical AM frequency spectrum. This set would replace the AN/GRC-19 and AN/GRC-65 and likely would be used with teletype under a new nomenclature to replace the AN/GRC-46.

COMMUNICATION SYSTEMS

The "Reference Guide for Communication Systems," printed by the School for use in resident instruction, has been revised to include ROCID, ROCAD, and nondivisional units. Copies may be requested in accordance with paragraph 7h, AR 310-1, which permits gratuitous issue of one copy of instructional material to active Army units and instructional material to support USAR Schools, reserve component staff training, and ROTC programs. Correspondence or DA Form 17 (in duplicate) should be addressed to Commandant, U. S. Army Artillery and Missile School, ATTN: AKPSIDA-TP/MD. Individuals may purchase copies, over the counter or mail order, from the Book Department of the School, $2.70 postpaid.

DEPARTMENT OF GUNNERY

COLONEL W. E. SHOWALTER, ARTILLERY, DIRECTOR

POST-FIRING ANALYSIS--WHY!

--MAJOR ROBERT B. LEWIS, ARTILLERY

"Time on target is six zero seconds from NOW. . . five zero seconds, four zero seconds, three zero seconds, 29, 28, 27, 26, etc." The weapon crews are tense. Finally, the command FIRE is given by the Battery

Executive and the rounds are "on the way." The weapon crews begin to relax but the question foremost in their minds is, "Did we hit the target?" Maybe they will obtain a target hit or one very close, but the odds are there will be errors in range, deflection, and height. The weapon crews--and you--ask "Why?" A post-firing analysis will provide the answer.

Post-firing records can be a valuable source of information to units by providing an insight to the causes of these errors. The time required to properly fill out these records is negligible when you consider the wealth of information readily available and displayed in a logical sequence. A conscientious review of these records by gunnery officers and unit commanders can disclose those many computational and procedural errors that would otherwise go unnoticed. An analysis of these records will provide a sound basis on which to evaluate training weaknesses.

Only 280-mm gun, 8-inch howitzer, and 762-mm rocket (Honest John) units, as directed by USCONARC (United States Continental Army Command), are required to submit post-firing records for beyond-organizational review. These post-firing records receive evaluation and study at the U. S. Army Artillery and Missile School to determine the magnitude of errors and isolate the causes. A continuing evaluation of weapons systems, delivery techniques, and accuracies under all climatic and field conditions is made by the Research and Review Division, Department of Gunnery. The results of this analysis are then published in the form of training literature and are included in the program of instruction of the School. A knowledge of these accuracies will assist the gunnery officer in determining ammunition requirements and the special weapons officer in his analysis.

For each 280-mm gun round reported, the deviation from the intended target in terms of range, deflection, and height is extracted. The deviations are converted to average miss-distances as probable errors in range, deflection, and height. These data are segregated according to groups of rounds fired with or without known VE (velocity error); note is made of whether or not each round was fired within 2 hours of the most recent met (meteorological) message. Any trend in consistent deviation within groups fired with a given charge, or groups fired with or without known VE is then established. An attempt is made to isolate the sources of error. Those isolated become the subjects of additional study. For example, analysis of calibration data based on troop firings revealed a large discrepancy between MVV (measured velocity variation) and VE. This discrepancy may be attributed to a combination of errors in met data, firing tables, location of burst, and computations and to differences in ballistic characteristics of the projectile lots. Separate studies are being conducted to determine the magnitude of errors contributed by met and firing tables and by the differences in ballistic characteristics of projectile lots. From these studies, ammunition calibration data, changes in firing tables, and/or new types of met messages may be provided.

With the introduction of a new projectile (shell, HES, T347) and propellant for the 8-inch howitzer, a requirement for an evaluation of the firing records of the weapon similar to the evaluation of the 280-mm gun firing records became apparent. These post-firing reports are used to determine weapons systems accuracy and to verify accuracy of delivery techniques. They will also provide additional data based on a weapon of a different caliber than the 280-mm gun for the continuation of the studies of causes of inaccuracies.

After review of the Honest John reports by the Artillery Section at CONARC, one copy is furnished to Office, Chief of Ordnance, and one copy is sent to the U. S. Army Artillery and Missile School. All the firing report are checked by the Gunnery Research and Review Division to see if the fire direction computations are accurate. Then the miss-distance data are used to analyze the accuracy of the Honest John system. Every effort is made to isolate sources of error in the system. The analytical work performed includes recomputation of firing data with similar surface wind conditions, grouping rockets fired at similar ranges. One of the most valuable portions of the report is the part which gives the Honest John unit commander the opportunity to comment on any aspect of the 762-mm rocket equipment, organization, or procedure.

The validity of conclusions stemming from any study of unit firings depends directly on the accuracy, completeness, and legibility of the data reported. The reports are used to collect and analyze data to enable you to use more accurate and efficient techniques. Therefore, it is imperative that the utmost care be exercised in filling out firing records and that proper gunnery procedures be followed during firing. Incomplete reports must be discarded. Erroneous reports present a false picture, the effects of which may revert back to your unit. Without these reports, there can be no coordinated effort to use the experience of your unit to help other units of the same type. This is WHY we have post-firing analysis.

HONEST JOHN ACCURACY

--MAJOR HORACE A. MACINTIRE, ARTILLERY

Quite often the question arises, "What can be done in a unit to improve the accuracy of the Honest John?" Now that this heavy rocket is going to be used in even more organizations than in the past, this question assumes even greater significance.

A few individuals have dismissed the subject of accuracy of the Honest John with the statement that a rocket is inherently inaccurate and nothing can be done to improve this condition. In reality, nothing could be further from the truth. The probable error of the Honest John is considerably larger than that of an 8-inch howitzer. But it is certainly a more accurate weapon than many people believe.

Let's examine some of the areas that require particular care to achieve the best accuracy from the 762-mm rocket system.

The surface wind measuring set can be a cantankerous piece of equipment; and, since surface wind corrections are the largest single correction, this is a very important field. It is important to insure that the windsets have been properly laid and that the field-wire cable from windset to resolver is properly connected. It is easy to lay the windset 3,200 mils in error or to mix up the wires of the field-wire cable, which will, in either case, result in readings of the wrong sense. In addition, it is necessary to frequently calibrate windsets. This is done by signal field maintenance and should be requested before each service practice period. If the older model AN/MMQ-1 windset is being used, care must be taken that the operator averages the readings correctly. The average should be algebraic, and, if both plus and minus elevation corrections and left and right deflection corrections are obtained, errors may be made if the operator is not familiar with algebraic averages. The windsets should always be guyed, even if the surface wind is light. This should be done to maintain the mast as close to vertical as possible. Finally, to minimize the effects of surface wind vertical components, care should be used in selecting positions for firing points. The edge of a grove of trees, the edge of a gully, or the base of a hill should be avoided whenever the tactical situation permits.

Heating blankets are recommended for use even during mild weather. The closer that "standard" firing table propellant temperature can be approached, the less error will be introduced in making propellant temperature corrections. In addition, use of the blankets will assist in obtaining uniform temperature throughout the grains, also contributing to accuracy. Mention should be made of the powder temperature thermometers. The first thermometer issued was marked Dillon. Dillon thermometers were found to be unsatisfactory and should have been replaced. However, all powder temperature thermometers should be calibrated. It is recommended that the thermometers be read at 8 or 10 different temperatures over a period of several days and compared with a reliable meteorological thermometer such as is found in met section equipment. Calibration graphs can then be constructed.

Improper computation of empty weight can contribute to errors. Change 3 to FTR 762-A-1 explains in detail how empty weight is to be computed. Supervision is often required to insure that the right stenciled component weights are obtained from the rockets to be fired.

Particular care is required in handling rockets during assembly, checkout, and firing. The firing tables assume a standard rocket in every respect, and this requires care on the part of the rocket assembly and launcher crews. The fins must be handled as if they were breakable after removal from the case. Bending the fins or changing their shape in any manner will drastically change the trajectory. The launcher shoes on top of the motor body must <u>not</u> be removed. They serve no purpose as far as guiding the rocket but are essential for balance and weight. Repainting a live rocket for appearance should be avoided. If it is necessary to paint identifying marks on a rocket, they should be painted with as little paint as possible and without exposure to blowing dirt or sand. Otherwise, the aerodynamic characteristics of the rocket may be affected.

A launcher should be carefully moved into position so that the launcher sight mount is directly over the survey stake for the proper firing point. It is not generally recognized how important this is. Computation of range and azimuth is based on the assumption that the launcher is correctly positioned over the stake. Placing the launcher 25 meters to the flank of the stake will introduce a 25-meter error into the system at all ranges.

Normal artillery standards of accuracy are just as essential with this weapon as with cannons. Such standards as leveling bubbles, proper sight picture, proper adjustment of sighting and laying equipment, and boresighting before each rocket is fired should be adhered to strictly. Cross-leveling of the launcher prior to a fire mission is another "must" and should be emphasized.

Meticulous attention to these details is paying off in significant improvement of accuracy, and only through such attention will we reduce those "inherent inaccuracies" of the Honest John system.

FORWARD OBSERVER-EXECUTIVE EMERGENCY PROCEDURES

GENERAL

The organization of a fire direction center (FDC) is designed to permit efficient division of duties among personnel so that fire missions can be processed rapidly and accurately on a 24-hour basis. Normally, operation of the FDC is conducted in such a manner. However, in combat, conditions may exist in which emergency measures are necessary to deliver effective fire. Field artillery doctrine demands timely delivery of fire regardless of the availability of FDC's, target grids, and graphical firing table (GFT) fans! An emergency system may be needed because of the loss of certain equipment and/or personnel. If this happens, training and SOP within the battery will undergo a real test.

There are numerous solutions to this situation depending on the experience, imagination, and equipment available. The forward observer can send commands or make his corrections in relation to (1) the gun-target line, (2) the observer-target line, or (3) a known point on the map, e.g., FROM HICKORY SCHOOL, WEST 400, SOUTH 600.

The executive also has various alternatives. If maps are not available or his map is destroyed, from his general knowledge of the situation (location of friendly troops, observer, and enemy) he can estimate the necessary range and deflection to fire a round or two which will surely be safe and within the observer's view. White phosphorus is excellent for this purpose. Thereafter he may use the mil relation to determine deflection shifts and the "C" from the tabular firing tables for range changes; or if a GFT is available, he may use the 100 over R factor for deflection shifts and read the elevation direct.

Another alternative exists when the executive has a map. Let's assume that he knows the location of the forward observer. He can actually make a rapid plot of the weapons, observation post, and target location regardless of the method used by the forward observer in identifying the target. If the forward observer makes his corrections with regard to the observer-target line, the executive can actually plot these corrections and then rapidly determine a range and deflection for the weapons. Even without any kind of range measuring equipment, the executive can still quickly determine the range--by counting grid squares and interpolating bwtween grid squares, or, better yet, by using a simple strip of paper for this purpose. To determine deflection he can estimate or measure the offset in yards from the gun-target line and apply the mil relation to determine the deflection shift.

The above methods do not begin to exhaust all possibilities. The important point is to remember that in most situations artillery fire must be delivered promptly. A shortcut solution may often be required for a temporary period until a more complete fire direction system is set up and organized.

This article describes three systems by which effective fire may be delivered promptly. One system requires the executive to use only the tabular firing table (or GFT); the second requires the use of a map and the tabular firing table (or GFT); the third system is based on the use of the M10 plotting board and the appropriate firing table. Each has its own advantages and disadvantages and each requires only a minimum of training.

Let's suppose a situation exists in which the battery executive's vehicle is leading the battery column (105-mm howitzer battery) and just as it rounds a bend in the road, a concentration is dropped in the vicinity. One round hits the truck carrying the FDC equipment and destroys the truck and equipment. Let's make it more interesting and say the forward observer radios back that he is in a rough spot and needs immediate help. He requests _______ COORDINATES 46358974, AZIMUTH 6370, ROADBLOCK, WILL ADJUST. The big question is how long will it be before the battery is delivering effective fire.

TABULAR FIRING TABLE ONLY

The tabular firing table only system, which may be used to get successful results, is one in which only the tabular firing tables (or GFT) are available. The data contained in the tabular firing tables and the mil relation formula can be utilized to bring effective fire on targets of opportunity within a reasonable length of time and with a reasonable expenditure of ammunition.

The observer has designated a target location by coordinates. You, as the battery executive, are without a map or chart. Therefore, based on your knowledge of the situation, you estimate the direction to the center of the zone of action of the supported troops to be azimuth 6,000. You select a range of 5,000 yards for the initial volley and decide to use white phosphorus to assist the observer in locating the first volley. The observer must be notified of the situation at the battery; i.e., emergency FDC, no target grids, make corrections in relation to gun-target line. In order that the observer can visualize the gun-target line, 2 rounds are fired at 400 yards difference in range and at the same deflection. Once the observer locates the first volley, his initial correction should be made from the round fired with the lower of the two elevations. Observer corrections are sent as left or right so many yards in relation to the gun-target line and add or drop so many yards in relation to the target. The executive computes each deflection change by using either the mil relation (W over RM) established initially or by computing a 100 over R factor for use in determining subsequent deflections. Elevation can be obtained from the tabular firing tables for each range or the executive may use the value of "C" as obtained from the firing tables for determining subsequent elevations. The value of C and the W over RM factor may require changing if a large range change occurs in the adjustment.

The first volley is fired with shell WP, charge 5, deflection 2,800 (azimuth 6,000), elevations 287 and 319. For this range, C = 7.3, use 8 and 100 over R = 20 (100 ÷ 5).

Observer correction:	RIGHT 800, REPEAT RANGE
Command to weapons:	SHELL HE, FUZE QUICK, DEFLECTION 2640 (8 × 20; 2800 - 160 = 2640), ELEVATION 287
Observer correction:	LEFT 100, ADD 400
Command to weapons:	DEFLECTION 2660 (2640 + 20), ELEVATION 319 (287 + 32)
Observer correction:	RIGHT 50, DROP 200
Command to weapons:	DEFLECTION 2650 (2660 - 10), ELEVATION 303 (319 - 16)
Observer correction:	ADD 100
Command to weapons:	ELEVATION 311 (303 + 8)
Observer correction:	RIGHT 50, DROP 50, FIRE FOR EFFECT
Command to weapons:	BATTERY 2 ROUNDS, DEFLECTION 2640 (2650 - 10), ELEVATION 307 (311 - 4)
Observer:	END OF MISSION, ROADBLOCK NEUTRALIZED, ESTIMATE SIX CASUALTIES

The advantage of this emergency FDC is that it is fast and accurate. Commands can readily be computed and sent to the weapons with a minimum of lost time. Fuze time can be read directly from the tabular firing tables. Shifts from a known point, i.e., concentrations fired in, can be made quickly The disadvantage of this FDC is that the observer must base his adjustment on the gun-target line. If the angle T is large, this becomes more difficult for the inexperienced observer.

TABULAR FIRING TABLE AND MAP (SCALE 1:25,000)

In this situation with the tabular firing tables and a battle map available, the forward observer can report his location by code to the battery executive. Positions of the battery, forward observer, and target must be plotted on the map. A convenient range scale may be constructed quickly using the yard scale given on the map.

The weapons are laid on azimuth 6,000 (the direction of fire) and aiming posts are positioned at deflection 2,800. Construct a line on the map from the weapon position at an azimuth of 6,000 mils.

Note. Draw a line on the map from the battery position north parallel to a grid line for a distance of 5,000 yards. From this point, swing an are left whose chord is 2,000 yards, vertex at the battery position. The azimuth of this point from the battery position is 6,000 mils.

Draw and measure a perpendicular line from the plotted location of the target to this line (target is left of line of fire). By using the mil relation (W over RM) determine the deflection shift necessary to point the weapons at the target. In this case, the length of the perpendicular line from the target (plotted from the forward observer's initial fire request) to the line of fire (azimuth 6,000) is measured as approximately 1,100 yards; measured range from the weapons to the target is 5,500 yards. Applying W over RM, the deflection change necessary is 200 mils or deflection 3,000 (2,800 + 200). Initial commands to the weapons include: SHELL WP, CHARGE 5, DEFLECTION 3000, ELEVATION 324. (See figure 1.)

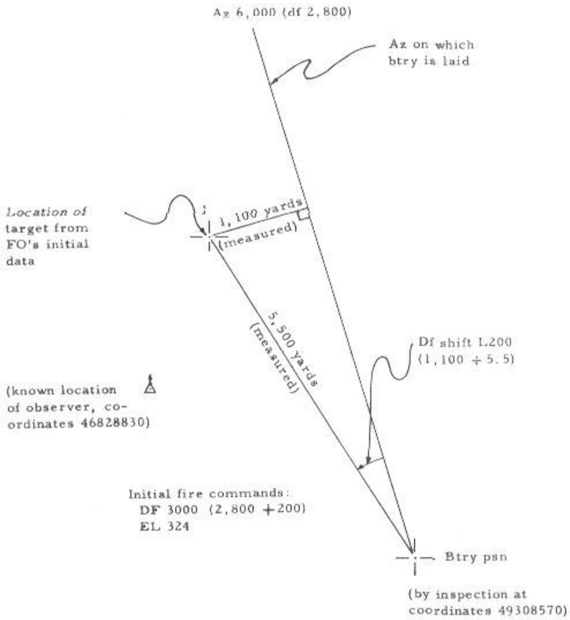


Figure 1. Computing initial fire commands.

Observer correction: RIGHT 600, REPEAT RANGE.

To allow the observer to correct along the observer-target line, plot (fig 2) the correction 600 yards right and perpendicular to a line between the observer and the plotted target. Now, to obtain deflection and range for the weapons, measure the perpendicular distance of this plotted correction from an imaginary line running from the weapons through the plotted target. In this case the measured distance is approximately 520 yards. Range from the weapons to the plotted correction is approximately 5,300 yards.

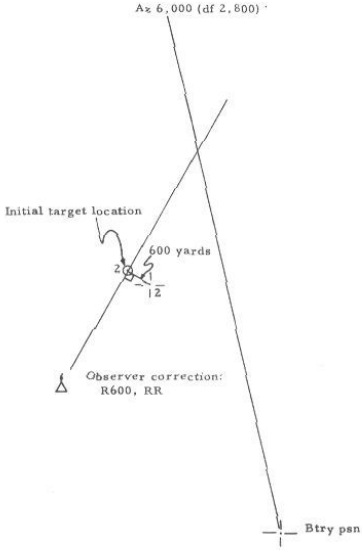


Figure 2. Plotting observer correction.

Applying the mil relation (520 ÷ 5.3) = 98㎖. (Figure 3.)

Commands to weapons: DEFLECTION 2902 (3000 - 98)
ELEVATION 309 (RANGE 5300)

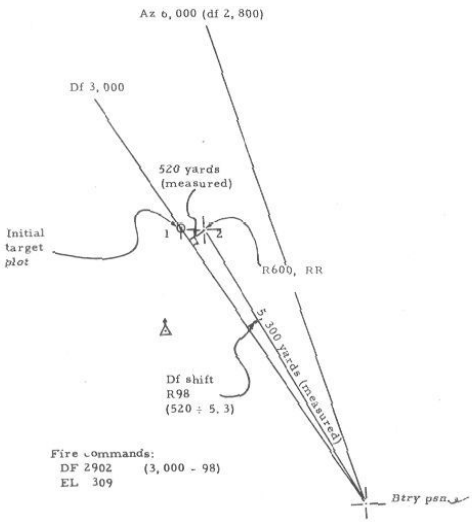


Figure 3. Computing fire commands for subsequent corrections.

Considering now this last plotted location as the target plot, the mission is continued in this manner until END OF MISSION is received from the observer, at which time the concentration is labeled and used as a reference point from which other targets can be polar plotted.

The advantages of this system are first, that it allows the observer to make corrections from the observer-target line, and second, the initial data should be quite accurate thereby expediting the mission.

TABULAR FIRING TABLE AND M10 PLOTTING BOARD

In the tabular firing table and M10 plotting board system, the executive uses an M10 plotting board, which permits the observer to sense on the observer-target line. Relative positions of battery and targets are plotted on the board; accuracy of data produced depends on the exactness of the operator. Observer corrections are plotted just as on the target grid, permitting the observer to shoot the observer-target line (no change from current observed fire procedure). If each small square on the plotting board is assigned a value of 100 yards, then the maximum range which can be plotted is 8,000 yards. Accuracy of ranges read will decrease slightly when a value greater than 100 yards is assigned to each square.

You, as the battery executive, estimate the direction to the center of the zone of action of the supported troops to be azimuth 6,000 and you lay the weapons on this azimuth. To prepare the board, set the 6,000-mil graduation opposite the 0 index (fig 4). Conveniently under the 6,000-mil graduation, write in the deflection at which the aiming posts are positioned (use 2,800). Deflection graduations to the right decrease in 100-mil increments, so write in 27, 26, 25, 24, 23, etc.; deflection graduations to the left increase--29, 30, 31, 0, 1. Now plot on the disc the battery 3,000 yards from the board center along the index line in the opposite direction from the 0 index; each square equals 100 yards (the 0-3200 line on the plastic disc is disregarded). Make sure azimuth 6,000 (deflection 2,800) is set at 0 index.

You select a range of 5,000 yards for the initial volley and decide to use white phosphorus for this volley to assist the observer in locating the rounds. The target is plotted 5,000 yards from the plotted battery position along the index line. Piece deflection is read opposite the 0 index at top, deflection 2,800 mils in this case.

You now have the deflection and range for the weapons. Convert the range to elevation and fire the first volley.

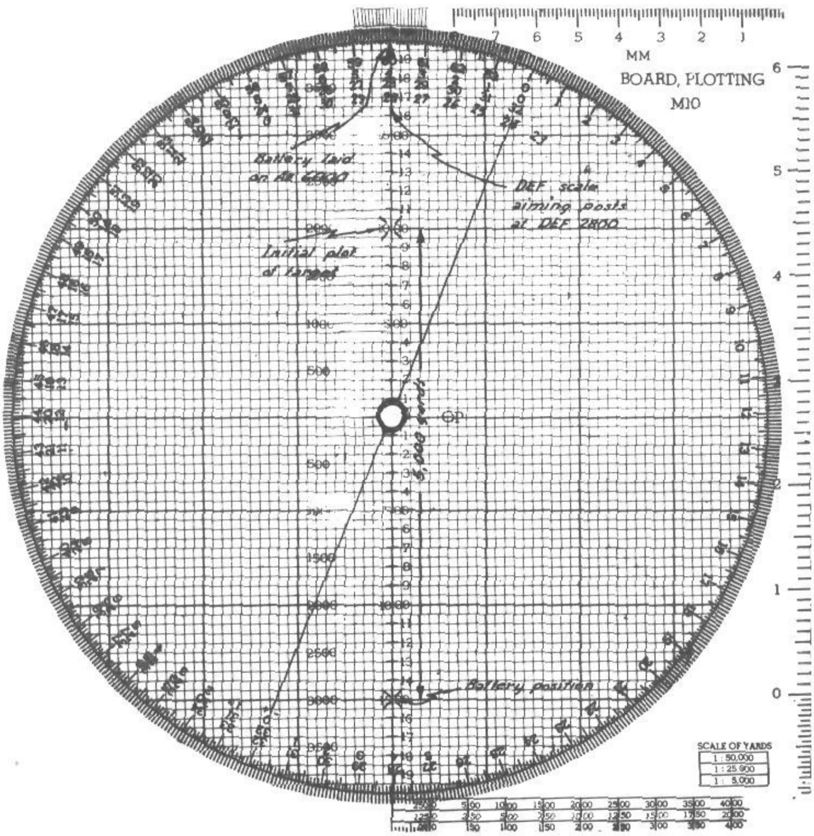


Figure 4. M10 plotting board with 6,000 mil graduation opposite 0 index.

Before any correction reported by an observer can be plotted, the disc must be oriented on the observer-target azimuth. Mark a reference index on the azimuth graduation reported by the observer to the target (azimuth 6,370 for this target). This reference index is used to facilitate orientation and is erased on completion of the mission. Now rotate the disc so that the observer azimuth (6,370) is opposite the 0 index. (The disc is now oriented on the observer-target azimuth (fig 5).)

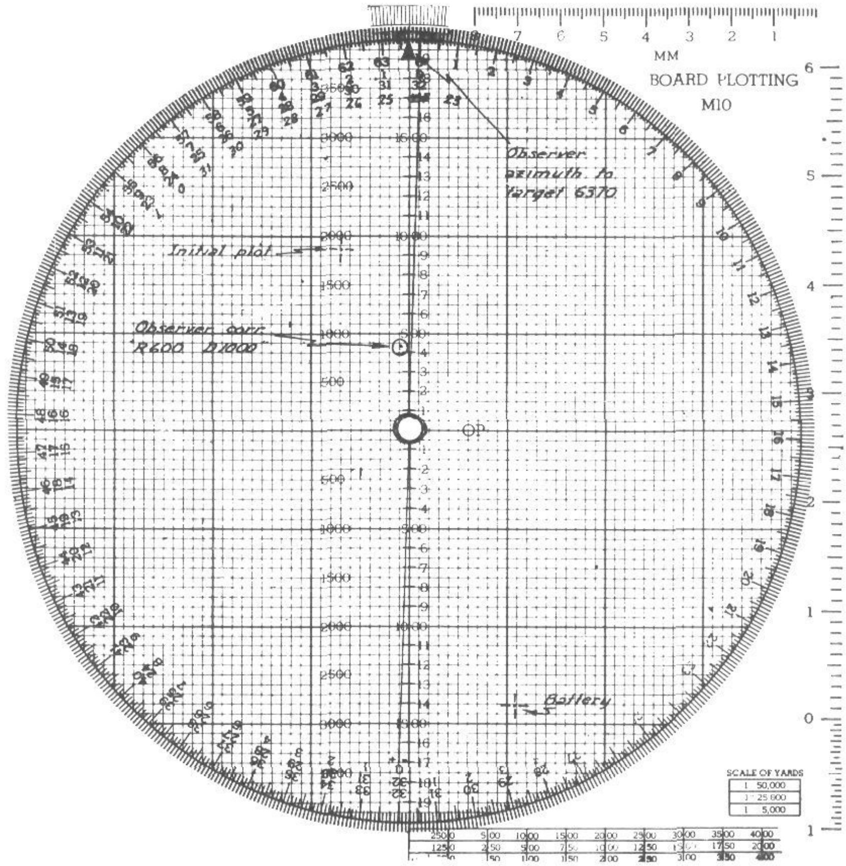


Figure 5. M10 plotting board with disc oriented.

After the first volley is fired, using charge 5, deflection 2,800, elevation 287 (C = 7.3; use 8), the observer reports, RIGHT 600, DROP 1000. With the observer azimuth (6,370) still at 0 index, plot the correction just as you would on the target grid. Now rotate the disc until an imaginary line containing the plotted observer's correction and the plotted battery position is parallel to the index line of the gridded base (fig 6). Since the deflection (or azimuth) opposite the 0 index is the same for any line parallel to the index line, the deflection is read on the deflection scale opposite the 0 index. When the index mark does not fall exactly on one of the 10-mil graduations of the mil scale, the reading to the nearest mil may be determined by using the left side of the vernier on the base. Deflection in this case should read approximately 2,746 mils. The gun-target range is determined by counting the squares between the weapons and the target or from the range scale along the index line. The range in this case is approximately 3,850 yards. As soon as deflection and range are determined, the disc should be rotated so that the reference index (observer-target azimuth 6,370) is opposite the 0 index and the board is prepared for the next observer correction.

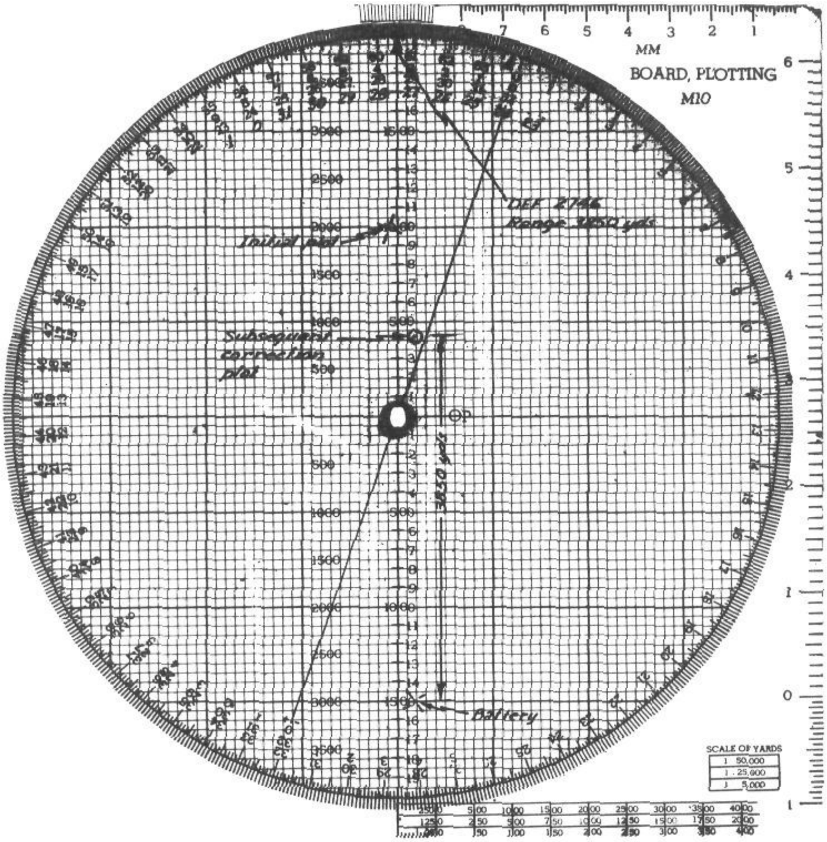


Figure 6. M10 plotting board with disc rotated.

The commands to the weapons after the first volley would be DEFLECTION 2746, ELEVATION 207.

Observer correction:	LEFT 100. ADD 200
From M10 board:	DEFLECTION 2756, RANGE 4080
Command to weapons:	DEFLECTION 2756, ELEVATION 223
Observer correction:	RIGHT 50, DROP 100

From M10 board:	DEFLECTION 2747, RANGE 3960
Command to weapons:	DEFLECTION 2747, ELEVATION 215
Observer correction:	ADD 50, FIRE FOR EFFECT
From M10 board:	DEFLECTION 2744, RANGE 4020
Command to weapons:	DEFLECTION 2744, ELEVATION 219

At END OF MISSION, this concentration is plotted and labeled on the disc and the observer azimuth index is erased. Future targets may be polar-plotted from labeled concentrations by setting off the announced azimuth for the fire mission, i.e., the observer now sends a fire request as follows: ________ FROM CONCENTRATION 1, AZIMUTH 5780, LEFT 600, UP 40, ADD 600, 2 MACHINE GUNS, WILL ADJUST. The computer places a reference index at azimuth 5,780 mils and rotates the disc until this index (5,780 mils) is opposite the 0 index on the board base. The shift requested by the observer is plotted on the disc. The procedure for determining deflection and range is the same as explained above. Corrections for difference in altitude must be applied by using the 100 over R scale. Initial data for this mission would include DEFLECTION 2917, SITE PLUS 9, (RANGE 4500) ELEVATION 251.

The advantages of this type of emergency FDC are:

a. No change in forward observer procedure of adjusting fire to the observer-target line.

b. Deflection is read direct from the board.

c. New targets are plotted quickly from plotted concentrations or known points on the board.

The disadvantages of this type of emergency FDC are as follows:

a. Elevation and fuze time are read from the tabular firing table.

b. When each small square on the board is assigned a value of 100 yards, the gun-target range is limited to 8,000 yards. For ranges greater than 8,000 yards, a value of 200 yards must be given. When a value greater than 100 yards is assigned each square, i.e., 200 yards, accuracy of the reading is reduced.

In ROCID, ROTAD, or ROCAD, the delivery of artillery fire quickly as well as accurately may be crucial. The battery commander, forward observer, or executive cannot hide behind a flimsy excuse that his FDC is "not yet set up" or has been knocked out. What will your battery do under these conditions?

The Extension Course Program.

The battery grade and advanced extension course parallel as closely as possible the respective associate resident courses of this School.

DEPARTMENT OF MATERIEL

COLONEL HORACE L. SANDERS, ARTILLERY, DIRECTOR

AMMUNITION PERFORMANCE

--CAPTAIN THOMAS E. OBERLEY, ARTILLERY

Tactical concepts of the atomic battlefield with its highly mobile forces and increased distances have created a requirement for improved accuracy in both present and future field artillery weapons. Office, Chief of Ordnance, has supplied the School with interesting information relative to improving the propelling charge for the 155-mm gun. These improvements may be extended to other standard and future weapons for field artillery use.

The Office, Chief of Ordnance, report points out that significant improvements in muzzle velocity and pressure uniformity have been obtained with three modifications of the M19 propelling charge. Firings took place at Jefferson Proving Ground in April 1956 (reference JPG Firing Record A22275). Two types of central tube ignition and a stacked charge design were tested against the present design at high, low, and normal temperatures. (See tabulated results.)

The two central tube ignition designs both have cardboard tubes through the center of the charge, full length, and so designed to make the charge almost concentric with the chamber diameter. The so-called "center core" design has the main black powder charge in a silk segmented bag, which is placed in the base section tube, and a small igniter pad at the exposed base end of the propelling charge. This "central tube" design is similar to the center core except that the main black powder charge is contained between two concentric cardboard tubes in the base section, with a single tube in the forward section. Both designs leave a fairly large amount of free space through the center of the charge.

It will be noted from the tabulation below that the maximum dispersion in muzzle velocity at 70° F was reduced to less than 0.6 percent by the 2 central tube ignition designs and 1.0 percent for the stacked charge design as compared to 1.5 percent for the standard M19 design. Although the improvement at 140° was not as great, the maximum dispersions for the modified charges were all under 0.65 percent. The low temperature results were exceptionally good. The maximum dispersions for the modified charges were all under 0.8 percent at -65° while the standard M19 charge design gave 2.6 percent at -25° F. The low temperature firings demonstrate more than any others how much the interior ballistic performance has been improved, particularly when the pressure-time (P-T) relationships are compared. An examination of the P-T records for these firings reveals a dramatic improvement in the smoothness of the curves.

The following tabulation summarizes the results of a special ballistic test of modified M19 propelling charges in 155-mm gun, M2:

	Temp	Rounds	Muzzle velocity, fps		Pressure, psi/100	
Charge	°F	considered	Mean	Max dispersion	Mean	Max dispersion
*M19 std	70	7	2773	18	381	11
M19 test	70	6	2800	42	408	61
Center core	70	7	2769	16	392	18
Central tube	70	7	2763	12	389	16
Stacked	70	7	2765	28	379	20
M19 test	140	7	2846	19	428	31
Center core	140	7	2818	8	424	23
Central tube	140	7	2816	12	422	15
Stacked	140	7	2814	17	415	10
M19 test	-25	7	2724	73	364	118
Center core	-65	7	2639	22	306	22
Central tube	-65	7	2634	9	305	9
Stacked	-65	7	2630	6	300	11

*Standard calibration propellant--all other rounds loaded with propellant from one production lot.

Commensurate with efforts of the Office, Chief of Ordnance, there are certain basic rules which must be adhered to by user personnel in attaining improved accuracies. These basic requirements are common everyday procedures in the care, maintenance, and handling of both weapon and ammunition. Some of the most common violations of the requirements for improved accuracy and weapon performance are--

a. Improper ramming.

b. Misplacement of propellant charge in the separate-loading ammunition.

c. Improper selection of lot number.

d. Not protecting propellants.

e. Improper care and cleaning of projectiles.

f. Improper care and maintenance of tubes.

Improper seating of the projectile is a result of malfunctioning rammer mechanisms or a lack of crew training in the case of weapons which have no power features. The improperly seated projectile produces variations in muzzle velocities, reduces accuracy, and increases tube wear.

Improving weapon accuracy, increasing tube life through a hard uniform ram, and seating the projectile in the lands and grooves should be emphasized in training.

Careful attention to placing the propellants of separate-loading ammunition produces a more uniform burning effect and gives improved round-to-round uniformity in muzzle velocities. Propellants should be positioned in the chamber so that the igniter pad will contact the mushroom head at the primer vent.

Quality and quantity controls have resulted in ballistically improved projectiles and reduced lot numbers; however, in some cases, several lots and weights of projectiles may be available to the battalion S3 or battery executive officer. In cases where several small lots are available, this ammunition should be expended on will adjust missions. Indiscriminate mixing of lot numbers increases the dispersion pattern and reduces effects on the target.

Protecting and conditioning propellants to control temperature and moisture content will assist in stabilizing propellant reaction and give uniform burning, thereby increasing the uniformity of chamber pressures. Ammunition should be kept off the ground (at least 6 inches) and away from the direct rays of the sun and should be well ventilated. Ammunition (particularly propellant, primers, and igniters) should be unpacked only when needed for immediate use (immediately prior to loading).

Foreign material, such as dirt and sand accumulations, on the projectile creates excessive friction, heat, and wear in the forcing cone and in the lands and grooves of the tube. As this wear progresses, pits and gas washes appear in the bore. The end result is reduced tube life and extreme variations in muzzle velocities.

In conjunction with cleaning and maintaining the projectiles, the tubes must be properly maintained. Foreign materials in the tube have basically the same effect as dirty projectiles. Artillery tubes should be clean and dry prior to firing.

Although the requirements enumerated above are basic and well known to the artillery officer and experienced chief of section, they are consistently violated in field training exercises. The violation of a single requirement may appear small and insignificant; however, an accumulation of these errors results in unpredictable impacts and unsatisfactory field performance.

To attain the required standards of performance, careful attention must be directed toward eliminating the common day-to-day errors over which the artillery officer does have control.

THE BATTERY OFFICER

--MAJOR ARTHUR V. CORLEY, ARTILLERY

When artillerymen gather in groups of two or more, the talk soon centers on the relative merits of cannon vs rocket artillery. Although the debate almost always ends in a draw, it will continue to be a favorite subject for many years to come. But the conviction that even though the previous decade has produced many revolutionary weapons techniques, the basic requirement for an effective artillery unit--leadership--remains unchanged is growing among artillerymen of both teams in this debating society. Whether the agent of destruction is delivered to the enemy by the energy of animal fibers in a catapult or by lowering grid bias in a vacuum tube in a guided missile, the elements of leadership necessary to coordinate the efforts of the crewmen are still the most important factors, and this leadership must be most obvious in battery officers.

The art of command, so much discussed, so little understood, can become lost in the headlong rush toward bigger and better "bangs," unless we remain alert to the fact that men must assemble, load, lay, and fire every weapon now available to us, including those promised for the future. The push-button and the vacuum tube, although marvelous devices in their own right, are not thinkers or leaders. Rather than lessening the requirements for leadership in the battery, they have increased it manyfold.

The traditions, esprit, and efficient techniques for employment built by generations of artillerymen serving cannon can hardly be dismissed lightly. On the other hand, it would be equally foolish to ignore the capabilities provided by technological advancement in the rocket and missile field. In the final analysis, the artilleryman must always return to his reason for existence--fire support of ground-gaining arms. If this purpose is applied against weapons systems, it becomes apparent that cannon, rockets, and missiles all have their mission to perform, each complementing the other. This implies that as long as ground arms require fire support and as long as the artillery officer builds and retains proficiency as an artilleryman, he need have no fear of his professional future, for artillery is a function, not a weapon.

WEAPONS CHARACTERISTICS CHART (CANNONS)

The weapons characteristics chart published herein includes data on all of the standard field artillery cannons and small arms. It is believed that the information provided in this chart will be of great benefit and interest to artillerymen everywhere.

This chart was prepared by the Department of Materiel, United States Army Artillery and Missile School, in instructional note size, and is issued to basic officer students attending courses in the Department of Materiel. It is available to advance students who request it.

Preparation of a similar chart for rockets, missiles, and associated handling equipment is contemplated by the Department of Materiel, and unclassified portions will be published in future issues.

FOOTNOTES

(1) Standard (S), limited procurement (LP), substandard (SS), limited standard (LS), test (T).

(2) Ranges listed are maximum obtainable from gun or howitzer. Range for self propelled or tank weapons is that which can be reached with vehicle on level terrain. Effective maximum ranges can be obtained by comparison of probable errors. Ranges of AA Weapons when using time fuze or tracer fuze (shell destroying) are dependent on time of fuze functioning or tracer burn-out.

(3) Sliding wedge breechblock (SW), vertical sliding wedge breechblock (VWB), horizontal sliding wedge breechblock (HSW), interrupted screw breechblock (IS), interrupted lug (IL), continuous pull firing mechanism (CP), solenoid and inertia firing mechanism (SI), percussion hammer firing mechanism (PH), (IT) interrupted thread breechblock.

(4) Telescopes: Straight (S), panoramic (P), elbow (E).

(5) Cyclic—fastest rate of fire that gun is mechanically capable of developing.

Maximum—rate of fire which can be obtained for short periods of time without changing barrels or resting the gun.

Prolonged—rate of fire possible without changing barrels or resting the gun.

(6) Dimensions given are those of weapon prepared for towing.

(7) M2A2 carriage has respirator, larger shields, and screw type traversing mechanism.

(8) M1A1 carriage had electric brakes replaced by air brakes, M1A2 has rack and pinion jack replaced by screw type jack.

(9) Limber is equipped with combat type 11.00 × 20 tires inflated to 65 pounds pressure.

(10) Includes weight of heavy carriage limber M5, 2,200 pounds.

(11) Barrel and recoil mechanism carried on Transport Wagon M1A1, carriage on Transport Wagon M3A1. Gun emplaced with Truck Mounted Crane M2, or by winch on prime mover.

M60 —Truck-Tractor, 4-5 T, 4×4

(12) Barrel and recoil mechanism carried on Transport Wagon M2A1, carriage on Transport Wagon M3A1.

Howitzer emplaced with Truck Mounted Crane M2 or by winch on prime mover.

WEAPON	WEIGHT LESS AMMUNITION	METHOD OF OPERATION	TYPE OF FEED	MAX RATE OF FIRE (RPM)	SUSTAINED RATE OF FIRE (RPM)	MAX RANGE IN YARDS (NEAREST 50)	MAX EFFECTIVE RN IN YDS	EFF BURSTING AREA IN YDS	WT COMPLETE RD (LBS)
Pistol, Auto. Cal .45 M1911A1	2.44	Short-recoil semi-automatic	7 rd magazine	21-28	10	1650	50		
Submachine Gun Cal .45 M3A1	8.7	Blowback automatic	30 rd magazine	450	40-60	1750	100		
US Carbine Cal .30 M2	5.53	Gas operated semi-auto & auto	30 rd magazine	750-775	40-60	2200	300		
US Rifle Cal .30 M1	9.5	Gas operated semi-automatic	8 rd clip	16-24	16	3500	500		
US Rifle Cal .30 M1C&M1D(Snipers)	12.31	Gas operated semi-automatic	8 rd clip	10-15	10	3500	800-1000		
US Rifle Cal .30 M1 w/Rifle Grenade Launcher M7 & Rifle Grenade M9A1	12.34	Manual single shot	Manual	4	4	250 350 with M7 cartridge	Point target 75 Area target 365	10(a)	Rifle Grenade M9A1 1.31
Browning Auto Rifle Cal .30 M1918A2	19.4	Gas operated automatic	20 rd magazine	350-550	40-60	3500	500		
Hvy M. G. Cal .30 M1917A1	94.2(c)(d)	Recoil automatic	Belt, metallic link	450-600	125	3500	700 AA 2000 Grd		
Lt M. G. Cal .30 M1919A6	32.5 Bipod 49.5 Tripod	Recoil automatic	Belt, metallic link	400-550	60	3500	700 AA 2000 Grd		
Hvy M. G. Cal .50 HB,M2 on Grd Mt M3	128 Ground 86(b) Ring 168 Pedestal	Recoil semi-auto & automatic	Belt, metallic link	400-600	40	7400	1000 AA 2000 Grd		
2.36" Rocket Launcher M9A1	15.87	Manual single shot	Breech loading by hand	8	4	700	Area targets 700, Point targets 300	Rkt WP M10A3 20(a); Rkt HEAT M6A5: 15(a)	Rkt WP M10A3 3.4; Rkt HEAT M6A5 3.4
2.36" Rocket Launcher, M18	10.3	Manual single shot	Breech loading by hand	8	4	700	Area targets 700; Point targets 300	Rkt WP M10A3 20(a); Rkt HEAT M6A5: 15(a)	Rkt WP M10A3 3.4; Rkt HEAT M6A5 3.4
3.5" Rocket Launcher, M20	14.35	Manual single shot	Breech loading by hand	8	4	900	Area targets 900; Point targets 200	20	Rkt HEAT M28A1 9; Rkt Practice M29A1 9

(a) Radius of bursting area.
(b) Does not include weight of ring mount M32.
(c) Includes 7 pints of water weighing 8.4 lbs.
(d) Does not include ammunition belt, chest of ammunition, steam condensing device or water chest.

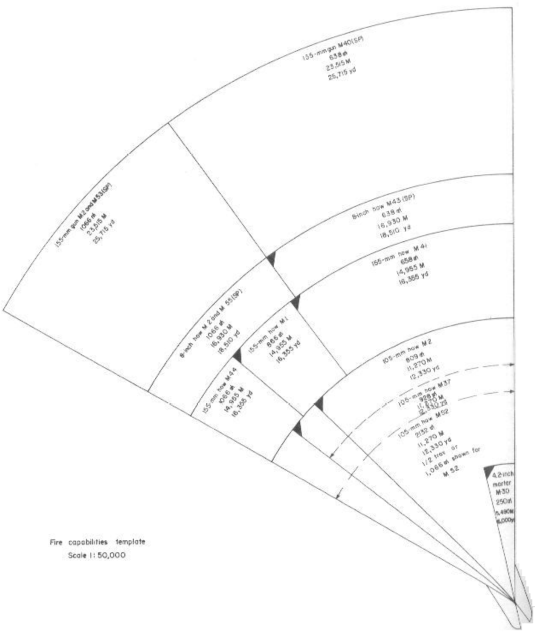
HSW--Horizontal sliding wedge
VSW--Vertical
STIS--Stepped thread interupted screw
ELEC--Electric
INER--Inertia
PH--Percussion hammer
CP--Continuous pull
SIP--Spring actuated inertia pull
HPC--Hydro pneumatic constant
CHSP--Concentric hydro spring
HPV--Hydro pneumatic variable
HP--Hydro pneumatic
HS--Hydro spring

WEAPON-- Caliber type, and carriage model	Max muzzle velocity F S	Max range (yards)	Model number	Length (gun or how) overall (inches)	Life in full service (rd)	Type breechblock	Type firing mech	Recoil mech model number	Type recoil mech	Min recoil	Max recoil	Gas pressure at 70°	Min elev (mils)	Max elev (mils)	Mils per turn handwheel	Type traverse	Max right (m	
75-MM how, M1A1, carriage M8	1,270	9,620	M1A1	59.3	20,000	HSW	CPM13	M1A4	HPC	25	32	1,250	-89	800	24	Axle	53	5
105-MM how, M2A2, carriage M2A2	1,550	12,205	M2A2	101.3	20,000	HSW	CPM13	M2A1	HPC	39	42	1,100	-89	1,156	10	Pintle	409	4
105-MM how, T96E1, mtr carriage M52	1,550	12,205	T96E1	99.8	20,000	VSW	SIP	T77E1	CHSP	12	13¼	None	-179	1,156	21	Ring and Race	1,066	1,
155-MM how, M1A1, carriage M1A2	1,850	16,355	M1A1	149.2	15,000	STIS	PHM1	M6	HPV	41	60	1,500	-0	1,156	14.8	Pintle	448	4
155-MM how, M45, mtr carriage M44	1,850	16,355	M45	156.6	Est. 15,000	STIS	T95 T108	M80	HS	19¼	19 3/8	None	-89	1,156	F 16.16 S 2	Ring and Race	533	5
155-MM gun, M2, carriage M1	2,800	25,715	M2	277.3	1,800	STIS	PHMI	M3A1	HPV	29	70	1,820	-36	1,156	13.1	Pintle	533	5
155-MM gun, T80, mtr carriage M53	2,800	25,715	T80	291.7	1,800	STIS	Elec Iner		HS	18	20	None	-89	1,156		Ring and Race	533	5
8-inch how, M2, carriage M1	1,950	18,510	M2	202.5	5,600	STIS	PHMI	M4	HPV	29	70	2,000	-36	1,156	13.1	Pintle	533	5
8-inch how, T89, mtr carriage M55	1,950	18,510	T89	216.7	6,000	STIS	Elec		HS	18	20	None	-89	1,156		Ring and Race	533	5
240-MM how, M1, carriage M1	2,300	25,255	M1	331	2,000	STIS	PHMI	M8	HPC	60	60	1,400	+267	1,156	10.5	Pintle	400	4
280-MM gun, T131, carriage T72	2,500	31,200	T131	512.5	NA	STIS	PH Elec	T80 T81	HP	P 32 S 40	42 95	700 990	0	978		Ball Socket	6,400 133	1
4.2-inch mortar, M30, mount 24		6,000	M30										800	1,045			6,40 125	1
4.5-inch multiple RL, M21		9,000	M21	36			Elec						0	1,333	10	Axle	64	

Type Traverse	Max Right (Mils)	Max Left (Mils)	Mils per Turn Handwheel	Type Trails	Equilibrators	Brake Action	Tire Pressure	Panoramic Telescope	Telescope Mount	Instrument Lights	Range or Elev Quad	Wt. Firing	Wt. Traveling	Length Traveling	Width Traveling	Height Traveling	Time to Emplace (Min)	Max Rate of Fire (Rd/Min)	Prime Mover	SNL	FM	TM
de	53	53	4.1	Mod Box	Spring	None	20	M1	M3A1	M13		1,440	1,440	126	50	33	3	6	MP Par ¼-Ton	C 20	6-110	9-319
ntle	409	400	19	Split	Spring	Hand	40	M12A70	M21A1	M19	M4A1	4,980	4,980	236	84	60	3	4	2½-Ton M5	C 21	6-75	9-325
ng nd ace	1,066	1,066	21	None	None	Veh	Track	149E1	179		M1	54,100	54,100	226	126	133	1	4		C 86	6-77	9-717A
ntle	448	418	10.3	Split	Spring	Air Hand	55	M12A7C	M25	M34	M1	12,700	12,700	288	96	71	5	3	M5 5-Ton	C 39	6-81	9-331
ing nd ace	533	533	12	Veh Spade	Torsion Bar	Veh	Track	M12A7E4	190	M34	M1	62,500	62,500	240	128	122	5	3		D 63	6-92	9-7004
ntle	533	533	10	Split	Pneu	Air	Bog 45 Lim 65	M12A7C	M18A1	M12 M19 M38	M1	27,700	30,100	442	98.9	107	½-6 hrs	2	M4 7½-Ton	D 24	6-90	9-350
ng nd ace	533	533		Veh Spade	Hydraulic Gas	Veh	Track	149E1	179E2		M1	96,000	96,000	379	140	140	1	2		D 49	6-	9-7212
ntle	533	533	10	Split	Pneu	Mech Air	45 65	M12A7C	M18A1	M19-33-36	M1	29,700	32,000	432	98.9	108	½-6 hrs	1	M4 7½-Ton	D 29	6-91	9-335
ng nd ace	533	533		Veh Spade	Hydraulic Gas	Veh	Track	149E1	179E2	M33	M1	96,000	96,000	325	140	140	1	1½		D 49	6-	9-7220
ntle	400	400	8.1	Split	HP	Air	25	M12A7C	M30	M22-35	M1	98,220	64,700	H 439 C 429	118 118	84 128.3	1-6 hrs	1	M 6	D 31	6-95	9-341
ll cket	6,400 133	133			HP	Air		M12A7C	M30	M22-35	M1	166,638	94,000	1,010	124	146	12	1	T10	D 57	6-96	9-338-1
	6,400 125	125						M34A2	M79	M42	M1	650	645				1-3	15-20		A 85	6-50 23-92	9-2008
de	64	57	5	Wish bone		Hand	25-40	M62	M79	M42	M1	1,530	1,530	179	79.5	57	5	25	¼-Ton 2½-Ton	C 90	6-55	9-3036

MP -
PAR
1 4-T
2 1 2
M5-
M4 -
7 1 2
T10 -
5-ton
M6-3

MP - Mule pack
PAR - Parachute
I 4-Ton - Jeep
2 I 2-Ton - Truck
M 5-Tractor
M4 - Tractor
7 I 2 - ton - Truck
T10 - Transporter
5-ton - Truck
M6-38 - ton high speed tractor



Fire capabilities template
Scale 1: 50,000

DO YOU HAVE TECHNICAL PROBLEMS?

The U.S. Army Artillery and Missile School is concerned about the delay in obtaining first-hand information on technical problems involving materiel. The best information on technical problems normally is obtained by the user in the field. However, because of the time required to move correspondence through appropriate channels, such information is delayed in reaching this School.

This problem has been brought to the attention of the United States Continental Army Command and authority received for field artillery units in continental United States to communicate directly with the School on these matters. It is hoped that users of materiel will take this opportunity to let the School (ATTN: Director, Department of Materiel) know of technical problems involving materiel. Your letters will be acknowledged and you will be informed of final action taken.

Extension Course Students. Let us know your needs for individual subcourses. We will be glad to send them to you.

DEPARTMENT OF MOTORS

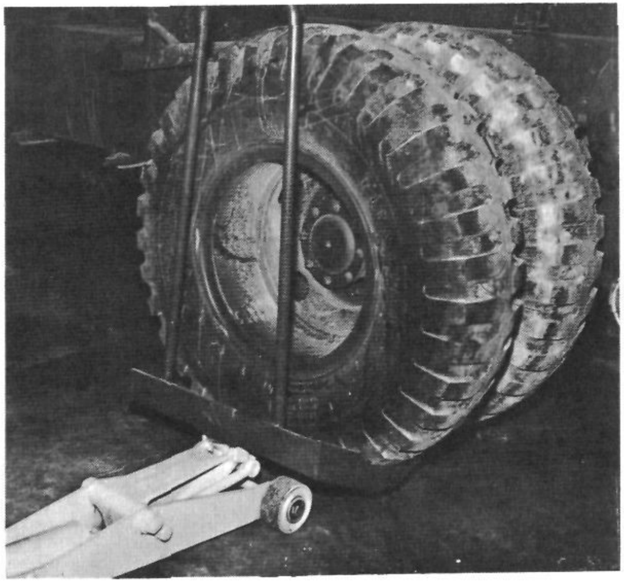
COLONEL WILLIAM W. BEVERLY, ARTILLERY, DIRECTOR

MOBILITY WITH MAINTENANCE

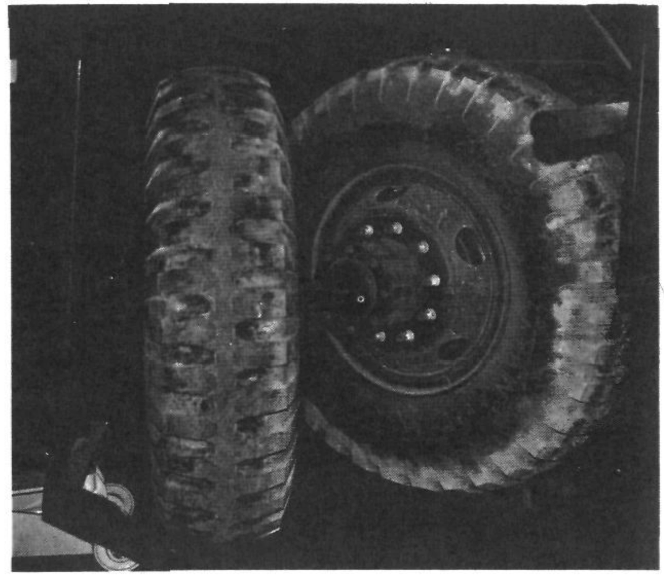
--CHIEF WARRANT OFFICER DONALD C. SHOTT, DEPT OF MOTORS

Mobility, the keyword in tactics and employment of the Army today and for many tomorrows, was and will continue to be a challenge. Hannibal met the challenge with elephants. How have we met the challenge? How will we meet this challenge in the future? Each of us is involved, in one way or another, and each of us must endeavor to meet this challenge with resourcefulness, ingenuity, and constant effort. We must continually strive to reduce the time and effort involved in accomplishing those maintenance tasks which are arduous and time consuming.

Along these lines, the back-breaking, time-consuming labor involved in lifting and handling the wheel and drum assembly for heavy wheeled vehicles, especially the truck, cargo, 10-ton, 6×6, M125, has been reduced by the development of the adapters shown in figures 7 and 8. These devices were especially designed for handling the very heavy tire, wheel, and drum assembly of the 10-ton, 6×6 cargo truck. However, with little alteration they can be used, in conjunction with the shop jack, to handle any or all heavy wheel assemblies.

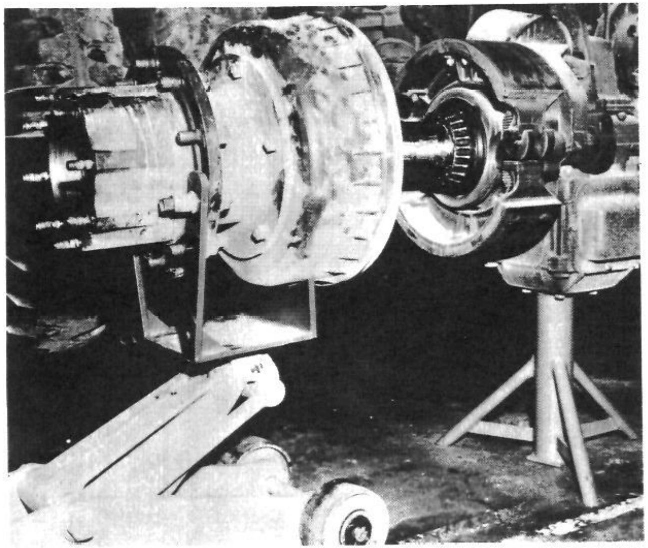


① Puller in place.

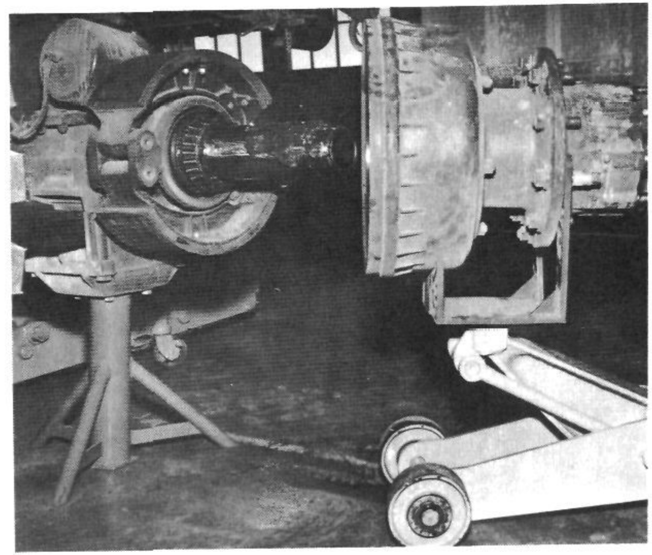


② Wheel and tire removed.

Figure 7. Wheel puller.



① Puller in place.



② Hub and drum removed.

Figure 8. Hub puller.

Whether or not the adapters will be accepted and produced as a special tool Army wide, their simple design and the ease with which they can be constructed from scrap metal will invite local procurement.

You probably have a labor saving device, developed through your own ingenuity and which you alone know how to make. Send it, or a picture and description, to this School and let others profit by your example.

TRACTOR AND SELF-PROPELLED ARTILLERY ENGINES

--MAJOR STEPHEN O. BROWN. ARTILLERY

"Wow, listen to the roar of that Diesel engine--sure do wish my prime mover put out power like that!" Is Joe right? Would a Diesel engine give him more power and performance? To answer this question properly, a discussion of compression ignition and spark ignition engines is in order.

The two principal types of internal combustion engines now in use are compression ignition engines and spark ignition engines. In a compression ignition engine, the power is produced by the combustion of fuel and air in a combustion chamber. The fuel is sprayed into hot compressed air which has been heated by the act of compressing it into about one-fifteenth of its original volume. The heat in the air ignites the fuel spontaneously. This type of engine is often called a Diesel engine after the inventor, Rudolph Diesel. In a spark ignition engine, the power is produced by the combustion of air and fuel in a combustion chamber, just as in the compression ignition engine. The difference between the two types occurs in the method of inducing combustion. In the spark ignition engine, a mixture of fuel and air is compressed to about one-eighth of its original volume. This compression does not provide sufficient heat to ignite the mixture spontaneously, so the mixture is ignited by an electric spark. This type of engine is also known as an Otto cycle engine and is the type found in all American produced automobiles.

Theoretically, the fuel required for a compression ignition engine will be more readily available than the fuel for a spark ignition engine because the compression ignition engine will burn many fuels, including vegetable oils, animal oils, and most types of petroleum products. However, in the United States, gasoline is much more readily available in wartime than Diesel fuels. The reason is the tremendous peacetime production of gasoline for civilian use. Since Diesel fuel is used primarily by industry, it is as necessary in war as in peace and, thus, is not sufficiently available to divert to military use. Conversely, tremendous stocks of gasoline become available for military use when civilian consumption is curtailed. If both types of fuels were available, other factors must be considered in determining which type of engine is best for use in artillery vehicles.

Based on the World War II shortage of Diesel fuel, the Navy was given first priority on all middle distillate (Diesel) fuels. The Army was then forced to use gasoline as the primary fuel for its vehicles. The advent of nuclear power for ships has reduced the Navy's need for Diesel fuels, and recently the Army adopted a new petroleum fuel policy which allows the development of compression ignition engines burning Diesel fuels for self-propelled artillery pieces, armored personnel carriers, and cargo tractors.

Until quite recently, it was considered impossible to burn gasoline in a compression ignition engine because of the high pressures developed, but a new compression ignition engine which burns both Diesel fuel and gasoline has been developed by the MAN Company of Germany (Maschinenfabrik Augsburg-Nurenburg) and is being tested for military use. At present, the engine has not been adopted for military use.

If fuels for compression ignition engines can reasonably be expected to be available, other factors must be considered in choosing between compression and spark ignition engines. Basically, the foremost factor is the tactical doctrine of the Army and thus the size, weight, and expected use of the artillery piece. The United States Army has always supported the theory that extreme piece flexibility, sufficient mobility, and light armor is the best combination. This requirement of sufficient mobility demands that the overall size be held down, that power steering and automatic shift devices be provided, and that there be a high ratio of horsepower to overall weight.

The weight of an engine is relatively unimportant, because of the fact that a few hundred pounds more or less is small compared with the total weight of most artillery vehicles. However, the space available is extremely critical. In addition to the personnel and combat equipment, a large storage space for fuel is required, and much space is required for power transmission and steering equipment. The overall size of an engine can be greatly influenced by the general compactness of the design, and efficient designs are possible in both the compression and spark ignition engines.

A real advantage of greater fuel economy would come in the fuel resupply problem. Engineering tests have shown that a self-propelled artillery piece equipped with a compression ignition engine would consume only about three-fourths of the fuel required by the same piece equipped with a spark ignition engine. Based on these tests, it would require 3 fewer 2 1/2-ton truckloads of fuel to refuel a battalion of compression ignition engine equipped self-propelled howitzers after a 100-mile march. This is a very significant saving in fuel and transportation.

A complicating feature with compression ignition engines burning Diesel fuel is that an additional type of fuel must be supplied. As long as civilian automobiles in the United States are powered by gasoline engines, the smaller vehicles in Army units will continue to use gasoline engines of commercial types. However, this problem could be easily solved if the MAN (Maschinen-fabrik Augsburg-Nurenburg) compression ignition combustion system is perfected for use in Army vehicles. This is a compression ignition engine which burns gasoline as well as regular Diesel fuel.

It is generally considered that compression ignition engines are harder to start than spark ignition engines, and this is a very serious deficiency for a combat vehicle. When the compression ignition engine is cold, it is difficult to attain high enough temperature to ignite the fuel because of slower cranking speeds. The slower cranking speed is caused partially by increased oil viscosity. This difficulty may have been partially overcome by the development of multiviscosity oils. Another cause of slow cranking speeds is the loss of battery efficiency because of the cold. These factors affect the cranking speeds of spark ignition engines as well as compression ignition engines, but the problem is not as serious. Compression ignition engines also require slightly higher starter torque because of the greater compression ratio.

Many starting techniques have been developed for compression ignition engines, but most of them require time-consuming preparation and are not suitable for a combat vehicle. However, some of the techniques would appear to be acceptable for increasing ease of starting. The very heavy duty electrical equipment necessary on self-propelled artillery plus a separate auxiliary gasoline engine for battery charging, would indicate that a starter heavy enough to start the engine at almost any temperature could be installed. An alternate method might be to adapt the auxiliary spark ignition engine so it could be used to turn over the compression ignition engine, although this might require a larger auxiliary engine than is now used. Another possibility of insuring positive starting in any weather would be the use of air starting. In an air-starting system, compressed air is introduced into the cylinders in turn. The air expands and rotates the engine. The air storage cylinder would take room, but space could probably be found or the air storage cylinder could be mounted on the outside of the vehicle. The air compressor and distributor would be very small. Air starting could be provided as an auxiliary starting system or as the only starting system. In spite of the many starting techniques which may be employed, the greatest obstacle to the adoption of compression ignition engines is the military requirement of positive starting in temperatures from -25° F to +125° F without external assistance.

A problem of great importance to the crew of a tank is the relative inflammability of the engine fuel, both under ordinary operating conditions and when the vehicle suffers a hit. Under normal operating conditions, a gasoline-driven vehicle is probably more susceptible to an accidental fire or explosion than a Diesel-driven vehicle because the vaporization point of gasoline is around 0° F, but the vaporization point of Diesel fuels is above 100° F. This means that under normal conditions, if any leaks occur, gasoline is already vaporized and requires only a spark to set it off. This hazard does not occur with Diesel fuel until the temperature of the engine compartment gets above the vaporization point of the fuel. The importance of fuel fires becomes most important in a vehicle carrying high explosive ammunition because even if the ammunition is not hit, a fuel fire could set off the ammunition. The relative inflammability of gasoline and Diesel fuels is the subject of much controversy between the proponents of the two types of engines.

It appears that the spark ignition engine has a slight advantage over the compression ignition engine at present. However, since a compression ignition engine can be produced which would match the performance capabilities of a similar spark ignition engine, the acceptance of compression ignition engines in artillery vehicles depends only on the assurance of sufficient supplies of compression ignition fuel and the development of positive cold weather starting without external aids.

Have you submitted an extension course lesson this month? If not, why not sit down tonight and work one? When we receive your lesson we will grade it and have it on its way back to you within 24 hours.

DEPARTMENT OF OBSERVATION

COLONEL E. G. HAHNEY, ARTILLERY, DIRECTOR

ARTILLERY BALLISTIC METEOROLOGY

--MAJOR FORREST B. TILSON, ARTILLERY

The artillery has now replaced all its visual type meteorological (met) sections with electronic type meteorological sections. Meteorological sections equipped with the latest electronic weather-measuring instruments are now authorized on the TOE's of the following units:

Headquarters Battery, Field Artillery Observation Battalion

Headquarters Battery, Division Artillery (all types of divisions)

Headquarters Battery, Antiaircraft Artillery Group

Headquarters Battery, Antiaircraft Artillery Brigade (2 sections)

This means that in a type field army there are 26 electronic meteorological sections. Thus, an artillery unit will rarely be unable to obtain a met message from a nearby electronic section. The visual type met instruments are still retained by the met sections, and the old visual method of preparing the met message can still be used as an alternate method, if necessary.

There are important advantages to having artillery met sections equipped with the electronic instruments. These advantages are--

a. Met data can be obtained in any type of weather. During World War II, when visual equipment was used, there were many occasions when wind data could not be obtained because of the presence of low cloud cover or fog.

b. Actual temperatures, pressures, and humidities of the upper atmosphere can be measured by an instrument (radiosonde) carried aloft by a balloon. The radiosonde transmits to the met station these data, from which atmospheric densities are computed. Formerly, in the visual sections, this information could be measured accurately only at the ground, and the data aloft had to be estimated, based on experience factors.

c. Met data can be obtained at higher altitudes by using the electronic equipment.

The techniques used by the artillery met sections in measuring weather data and preparing met messages are covered in detail in TM 6-242, Meteorology for Artillery, and TM 6-241, Meteorological Tables for Artillery. Both of these manuals were published in the latter part of 1956 and are the most up to date and most complete references available on the subject of artillery ballistic meteorology.

SIMULTANEOUS OBSERVATION OF A CELESTIAL BODY FOR DIRECTION

--1ST LIEUTENANT R. M. SINGLETARY, ARTILLERY

The wider fronts and mobile operations envisioned in future tactical situations place increased emphasis on survey at all levels. To assist in meeting the demands for survey in areas where dependable maps are available, a method of survey known as simultaneous observation may be used to transmit direction rapidly and accurately.

Simultaneous observation has been taught at the U.S. Army Artillery and Missile School for some time, but the method is not being fully exploited by units in the field.

With adequate communications, common direction can be distributed throughout a division or corps sector in 5 minutes by using the simultaneous observation method. The method obviates the need for individual astronomic observations throughout the sector and decreases the time required for obtaining a starting azimuth from 1 hour to approximately 5 minutes.

Direction can be distributed on a time schedule or on call. If a time schedule is used, the headquarters responsible for distribution of the azimuth must make the following information known to all using units:

a. The location of the master station (station of known azimuth).

b. The radio frequency to be used by the master station.

c. The schedule of observations.

Simultaneous observation is based on the principle that lines from any two points to a point at infinite distance are parallel. For practical survey purposes, the sun and stars are at infinity (for 2 points 300 miles or less apart, the sun can be used; there is no limitation if a star is used).

A simultaneous observation of the sun or the same star is coordinated by radio from a master station; thus, all observing instruments are sighted on a common direction (the M1 aiming circle is not suitable for this work).

Each flank station (station desiring an azimuth) receives the azimuth of the heavenly body measured by the master station. The flank station corrects this azimuth for curvature of the earth. If the perpendicular distance of the flank station right or left of a line connecting the master station and the heavenly body and the vertical angle to the body measured by the master station is known, the correction for curvature of the earth can be determined from the nomograph (page 199, TM 6-200). If, when facing the heavenly body, the flank station is left of the line connecting the master station and the body, the correction is added; if the flank station is right of the line, the correction is subtracted (fig 9).

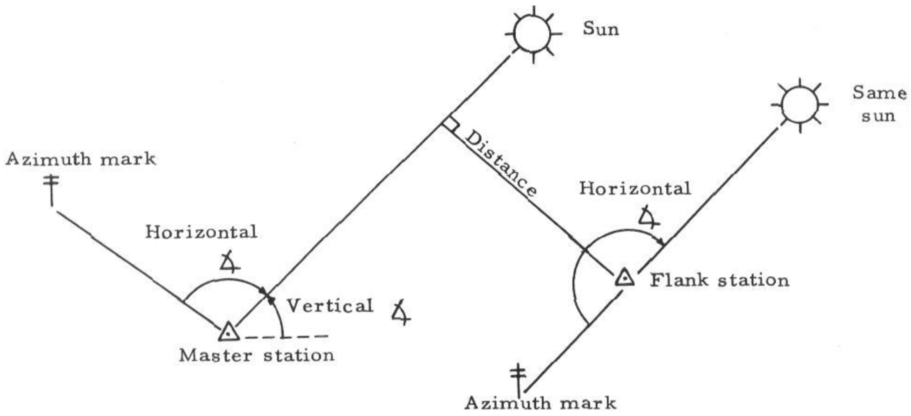


Figure 9. Simultaneous observation of the sun.

The accuracies obtained by the use of this method are as follows:

Theodolites (T2)--Azimuth correct to within 30 seconds.

Transits--Azimuth correct to within 1 minute.

Aiming Circle M2--Estimated accuracy 2 mils.

The limitations are communication, weather, and availability of maps.

T16 THEODOLITE

--1ST LIEUTENANT LOMA O. ALLEN, JR., ARTILLERY

The T16, 1-minute, theodolite (fig 10), manufactured by Wild Heerbrugg Ltd, has recently undergone a series of tests and evaluations by the Army Engineer Research and Development Laboratories at Fort Belvoir, Virginia. The results of these tests indicate that the T16 can be used as a suitable replacement instrument for the 20-second and 1-minute transits. The instrument is currently undergoing further tests at the U.S. Army Artillery Board at Fort Sill to determine its suitability for artillery purposes.

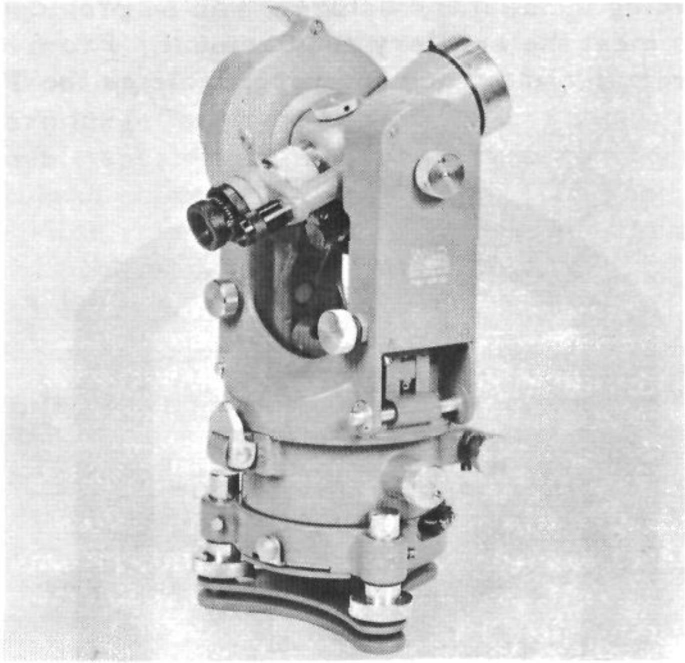


Figure 10. T16 theodolite, 1-minute.

The T16 theodolite is a sturdy, compact, well-constructed instrument weighing 10 pounds. It is equipped with glass circles, repeating clamp, inverting telescope, electric illumination, plate level, vertical circle level, telescope level, circular level, detachable tribrach, optical plummet, horizontal and vertical clamps, and tangent screws. A metal dome-shaped carrying case and a wooden pyramidal-shaped shipping case are also furnished. Either a stiff leg or an extension leg tripod can be provided with the instrument. A leather pouch, containing a plumb bob, key for tripod, screw driver, dust brush, two adjusting pins, and a metal battery box, is provided with the instrument and can be attached to the tripod leg.

The technical features of the T16 are diameter of objective, 1.58 inches; magnifying power, 28X; shortest focusing distance, $4\frac{1}{2}$ feet; 2-screw collimation adjustment; and circles read to 1 minute of are and accurately estimated to 1/10 of a minute (fig 11). One of the more interesting features of this instrument is that it can be used as either a repeating or a directional instrument. This is made possible by the repeating clamp which, when engaged, secures the circle socket and horizontal circle to the alidade. The repeating clamp is also used for setting the desired initial reading on the horizontal circle. Another interesting and convenient feature is the erecting optical plummet, which facilitates optical plumbing considerably.

The T16, according to the manufacturer, can be provided with mil-graduated circles to meet the artillery requirement. From all indications, the instrument is every bit as strong and dependable as the T2 which is now in common use.

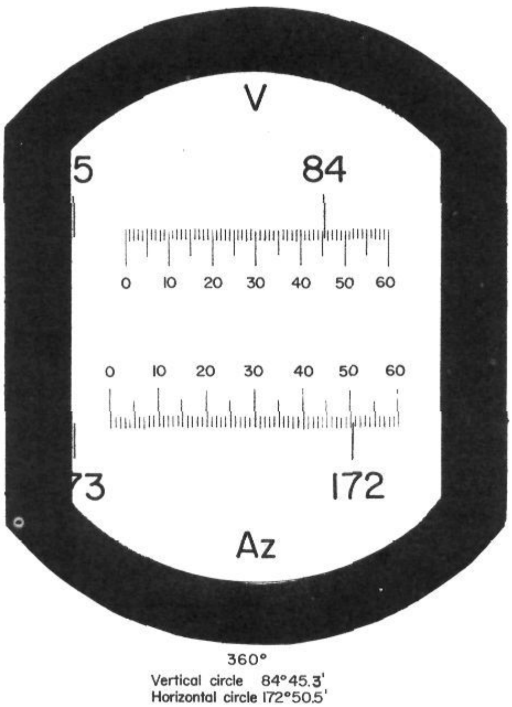


Figure 11. Segment of T16 theodolite azimuth scale.

New Field Manual on Artillery Sound Ranging and Flash Ranging

--Major Jacob H. Church, Artillery

Artillery sound ranging and flash ranging are the subjects of a new field manual, FM 6-122, recently published by the Department of the Army. Sound ranging is one of the most prolific means of locating hostile artillery batteries. Flash ranging, on the other hand, can be used not only to locate hostile artillery but also to locate other battlefield targets and to register friendly artillery units rapidly, accurately, and economically. Sound ranging and flash ranging were described briefly in FM 6-120, The Field Artillery Observation Battalion and Batteries, whereas the new manual describes the techniques in greater detail and in simple language. FM 6-122 should be of great assistance to units in the field in training sound ranging and flash ranging platoons and in maintaining a high level of proficiency.

One of the techniques described in the new manual is flash ranging by using the standard target area short base. Short base flash ranging procedures have been standardized, and a new form has been developed to speed up the computation of coordinates. This form, DA Form 6-2b, is designed for use with the slide rule. Any unit can obtain this form by requisitioning it through normal publication supply channels.

DEPARTMENT OF TACTICS AND COMBINED ARMS

Colonel B. E. Powell, Artillery, Director

USAR Special Weapons Instruction

Commencing with the 1957-58 USAR school year, the U.S. Army Artillery and Missile School will effect a considerable increase in the amount of USAR special weapons instruction. This action is being taken as a part of the overall program to emphasize atomic warfare conditions in all phases of instruction.

The following are the special weapons subjects which have been added to the 1957-58 USAR program of instruction:

Subject	Title	Hours	Type	Year, course, and phase
T 5240	Casualty and Damage Estimation, Target Analysis, Numerical.	4	C, PE	2-A-R
T 5242	Target Analysis Using Atomic Damage Template Method.	2	C, PE	3-A-R
T 5252	Introduction to Special Weapons Calculation.	3	C, PE	1-A-R
T 5270	Troop Safety and Protective Measures.	1	C, PE	1-A-R

Note. The "C, PE" under Type indicates that the subject is presented in a conference and practical exercise. The designation "2-A-R" indicates that the subject is given in the second year, advanced course, reserve phase.

Department of the Army Pamphlet 39-1, Atomic Weapons Employment, dated June 1956, is used as a reference text for these subjects. Each USAR school received five copies of this pamphlet at the time of its publication. The pamphlet is unclassified but is marked "For Official Use Only."

These new subjects will provide considerable background instruction in special weapons for a large number of reserve officers of the field artillery.

Present plans call for the inclusion of 18 additional hours of special weapons in struction in the USAR program commencing with the 1958-59 USAR school year.

ATOMIC TARGETS OF OPPORTUNITY--DEFINITION AND BRIEF DISCUSSION

--MAJOR BURRIS C. DALE, ARTILLERY

What is a suitable target of opportunity for an atomic weapon? This question has created a great deal of discussion in recent months at the U.S. Army Artillery and Missile School. After considerable thought and study, the information below was made available to instructional divisions to provide a common basis for teaching resident and nonresident students. Your comments concerning the definition and discussion are welcome and will be appreciated.

DEFINITION

a. Atomic targets may be considered as preplanned or opportunity targets as presently taught for nonatomic targets. An atomic target is a target or target complex of such size, density, composition, or tactical importance that the use of atomic weapons is necessary to achieve the desired results, and the tactical advantage to be gained by its destruction will insure or materially assist in the accomplishment of the commander's mission.

b. Preplanned atomic targets are atomic targets on which sufficient intelligence has been obtained to warrant their analysis and subsequent inclusion in fire support plans.

c. Atomic targets of opportunity have the following characteristics:

(1) They have been observed in the course of an operation and have not been previously considered or analyzed.

(2) They have the capability of altering their characteristics within a period of time to such an extent as to be no longer an atomic target. There must be some indication that the target will retain its characteristics for the period of time necessary to deliver an atomic weapon.

DISCUSSION

Targets of opportunity suitable for attack by atomic weapons must be thought of by the present artilleryman as being quite different from targets of opportunity for nonatomic field artillery weapons. The following points are discussed in an effort to delineate between the atomic and nonatomic targets of opportunity:

a. Time Requirements. The time required to deliver atomic weapons, after the target information is available, depends on three primary factors. The first factor is the time required to process the information into a specific recommendation by the staff and to permit the commander to arrive at his decision. If authority to employ atomic weapons is retained at higher echelons, this time element becomes significant. The second factor is the time required after the decision has been reached and the fire mission assigned to the artillery element. This factor includes the time required to compute data and prepare the atomic weapon for firing, which can be partially concurrent with obtaining the commander's approval by the use of timely warning orders. The third factor is the time required to warn troops and aircraft within effects radius of the weapon.

b. Reaction Time. The reaction time required varies with the atomic delivery system employed; a target suitable for the 280-mm gun or the 8-inch howitzer may not be appropriate for other systems requiring longer periods of preparation. If they are to be valid targets, atomic targets of opportunity must persist for periods greater than the reaction time for the specific atomic delivery capability available. With our present atomic delivery systems and our present procedures for processing a target, a target availability time of at least 30 minutes is considered necessary for our simplest and most responsive systems with correspondingly longer times for the more complex systems.

c. Target Size. Consideration must be given to the extreme radius of effect of atomic weapons and the area of terrain affected by these weapons. In this connection, nonatomic artillery has the flexibility necessary to attack targets occupying very small areas as well as those occupying larger areas; the larger areas require multiple units and a heavy expenditure of ammunition with a comparatively low order of "target kill." Conversely, atomic weapons used to attack small area targets risk an expensive overkill. With this in mind, we can say that the amount of terrain or area occupied by the target becomes an important consideration in using atomic weapons.

d. Target Density. The target should be populated with enough enemy military personnel and materiel so that the destructiveness of the atomic capability will be realized to the desired maximum. The density of a target may downgrade the importance of target size in considering its suitability for use as an atomic target. Although density within a target increases the effect of nonatomic artillery, it becomes a critical factor in evaluating atomic targets when the objective is to destroy personnel or materiel.

e. Tactical Importance. Certain targets may possess tactical importance sufficient to warrant attack by atomic weapons without regard for the size or density of the target. For example, an enemy atomic delivery means may pose such a threat to the opposing commander that it becomes an immediate target of opportunity. Other examples are readily apparent--an attacking force in process of a breakthrough that will jeopardize an entire operation, a denial operation concerned with contamination or barriers rather than personnel, and a beachhead or bridgehead situation threatened with certain disaster by an identifiable force.

f. Target Information. Information concerning targets of opportunity suitable for atomic weapons will originate from the standard artillery intelligence sources, augmented by general staff sources for the longer range weapons. In contrast to targets of opportunity for nonatomic artillery, visual identification of an atomic target of opportunity will be more difficult and will usually require corroborating information. The artillery forward observer and the aerial observer are located to provide early information of observed enemy activity which may indicate personnel concentrations or installations suitable for attack by divisional atomic means. A single observer may be incapable of providing all of the information required by the commander in making his decision to employ atomic weapons; however, his reports constitute a primary source of information to the commander and, at times, as in the case of an enemy breakthrough, may be the only reliable source of information available.

REVISION OF RESIDENT INSTRUCTION

--LIEUTENANT COLONEL KENNETH B. STARK, ARTILLERY

That old cliche "There'll be some changes made" has taken on new meaning in recent months at the U. S. Army Artillery and Missile School as work proceeds swiftly on the most comprehensive revision of resident instruction in modern times. It's all a part of the period of evolution in tactical organizations, doctrine, and technique by which the Army is preparing itself for atomic war or for nonatomic war under the threat of atomics. This period of evolution, particularly the part played by the new ROCID Infantry and ROTAD Airborne Pentomic Divisions, seems destined to give new importance to the figure "5"--that is, 5 battle groups, 5 mortar batteries, five 105-mm howitzer batteries, and so on--and woe unto the unwary student who may still feel that 2 regiments forward and 1 in reserve will always approximate the School solution. It just doesn't work that way anymore. Even the old standby, the direct support battalion, has disappeared from the infantry and airborne divisions. Only in the armored division is there enough of a link with the past to provide the instructor and the student a nostalgic common denominator.

This evolution at the School has been twofold: first, in the manner in which the instructional material is prepared; and, second, in the material itself. There was a time when the student was exposed to infantry, armor, artillery, and engineer instruction that used a technique which, for want of a better description, might be referred to as the "one combat arm at a time" method. There were exceptions, of course, but the instruction in general was not of a combined arms nature. Today, that system is largely a thing of the past. In its place, the School has completely integrated instruction on those subjects which are of interest to two or more of the combat arms. The change is apparent at a glance if one notices the "ear" in the upper right hand corner of all instructional material issued by the School. Today, the designation "T3225/7680" is in the upper right hand corner. This designation is the number assigned to the subject "Division Artillery in Support of an Armored Division in Offense," with the "T" replacing the "CA" on previous instructional material.

In T3225/7680, the emphasis is on artillery, with the armor personnel at the School providing the fill-in necessary for a complete presentation. If the numbers were reversed, i.e., T7680/3225, the emphasis would be on armor operations, with artillery tactics personnel providing the fill-in to make a complete presentation.

The evolutionary change in the instructional material itself, particularly that pertaining to the division level and below, is apparent at a glance. Striking changes in military symbolism and terminology, coupled with major organizational changes and the development of completely new types of artillery units, produce a situation wherein the student finds himself confronted with a new world of military facts, ideas, and techniques. His experiences are still his most valuable asset, but the tempering process which they undergo at the School is perhaps more complete than ever before. The instructor, too, is faced with a difficult problem in that he must now go into considerable detail in presenting all material, even that which in the past several years required only a refresher type of presentation.

The change in instructional material pertaining to corps artillery and army artillery is equally remarkable and impressive, and it may seem particularly so to the student struggling with a fire capabilities or situation overlay somewhat larger than any envisaged in his wildest imagination. Atomic artillery fire planning and detailed instruction in atomic weapons effects, with the accompanying mysteries of the log-log slide rule, add new dimensions to instruction in career courses at the School.

Just where does the School stand today in this period of evolution? How much remains of the old instructional material in comparison with the new? These questions are not easily answered, but it can be stated safely that the halfway mark in the preparation of resident instruction has been passed. This does not mean that everything is firmed up nicely in the completed half or that changes will not be forthcoming. It does mean that the material has been presented to a "guinea pig" class or will be presented to one in the immediate future. It means that material covering the major subjects has been written, reviewed, and undergone a series of tests. It means that the big writing job in resident instruction has been conquered.

Newly completed resident material covers all phases of the offense and defense at corps, division, battle group-combat command, and rifle company levels. A representative cross section of the material is shown below:

T3325/7275	Division Artillery in a Defensive Action.
T3100/7270	Division Artillery Fire Support Planning.
T3225/7680	Division Artillery in Support of an Armored Division in Offense.
T3340/7670	Armored Division Artillery in Support of Delaying Action.
T2400	Division Artillery Organization for Combat.
T7100/2411	Organization of the Infantry Division (ROCID).
T3355	Corps Artillery Operations in a Corps Defense.
T3255	Artillery Support of Corps Operations.
T3125	Corps Artillery Fire Planning for the Corps in the Attack.
T3111	Corps Artillery Fire Planning.
T7105/2410	Organization of the ROTAD Airborne Division.
T7235/2552	Considerations of Defensive Combat.
T7205/2551	Considerations and Fundamentals of Infantry and Artillery Offensive Combat.
T7211/3070	Infantry Division Battle Group in a Penetration.
T7260/3311	Reinforced Infantry Division Battle Group in a Delaying Action.
T7245/3310	Infantry Division Battle Group in Position Defense.
T7650/3336	Combat Command in Mobile Defense.
T7635/3201	Combat Command, Armored Division, Offense.
T7080/3314	Rifle Company in the Defense.
T7041/3210	Rifle Company in the Attack.

T5252 (U) Introduction to Special Weapons Calculations.

T 5240 (U) Casualty and Damage Estimation, Target Analysis, Numerical.

T5242 (U) Target Analysis, Atomic Damage Template Method.

T5270 (U) Troop Safety and Protective Measures.

The listed material is for resident instruction and does not have instructor's manuscripts and training aids. The instructor's manuscripts and training aids when prepared will be included in the nonresident version of each subject.

Copies of the resident version of each subject are available. Active Army units should submit requests as set forth in the Monthly List of Instructional Material furnished by this School. Individuals may purchase copies from the Book Department.

Need training in special weapons effects? Subcourse 80, The Employment of Atomic Weapons, will go into administration on or about 1 November 1957.

OFFICER CANDIDATE SCHOOL

COLONEL WILLIAM J. GALLAGHER, ARTILLERY, COMMANDANT

ACTIVE DUTY OBLIGATIONS OF OCS GRADUATES

--LIEUTENANT ROBERT W. KINDT, ARTILLERY

Selective Service inductees, a potential source of officer candidates previously untapped, now have a choice on their length of active duty after graduation from Officer Candidate School (OCS). Many of them have not wished to commit themselves to an additional 2 years of service by completing OCS and accepting a commission.

This has been remedied recently by changes 7 and 8 to AR 350-50. These changes bring the OCS program in line with the Reserve Forces Act, under which officers commissioned from the ROTC program may be called to active duty for short tours of only 6 months.

An officer candidate who was serving in an inducted status at the time of selection for OCS may now serve either 6 months or the remainder of his 2-year obligated tour, whichever is greater; or he may elect to serve 2 years of active duty after graduation. Regular Army candidates may choose either 6 months or 2 years. The choice will be made before graduation from OCS.

One advantage of the new OCS program may be a material increase in the number of personnel applying for Officer Candidate School Training. A Human Resources Research Office report states that only 10 percent of those eligible for Officer Candidate School apply. The shorter tours will provide a good source for augmenting the Army Reserve and the National Guard with Officer Candidate School trained officers. These officers would have an advantage over Reserve Forces Act officers in that they will have at least 6 months of active duty unbroken by basic course attendance. The shorter tour will tend to increase the number of applicants with higher educational background who apply for OCS. The experience of the School has been that the non-Regular Army candidate as opposed to the Regular Army candidate has a higher educational level. Also, the higher the educational level of a candidate, the better chance he has for successful completion of the course.

A disadvantage would be the number of officers who might request the short tour. This would be offset by a greater number of graduates and the probability that those who now enter are career-minded and would continue to request long tours.

At present, the Officer Candidate School trains National Guard and Army Reserve classes for 11 weeks during the summer. Also, National Guardsmen and Army Reservists may attend the regular 22-week course. Although many of these men are subsequently commissioned, they are under no active duty obligation like that imposed on the man who enters OCS from active duty.

It is urged that unit commanders give this new policy wide publicity.

Upon initial extension course enrollment, students are now receiving two subcourses. An additional subcourse is sent to them with each subcourse certificate of completion. This procedure insures that the student will always have a subcourse in his possession which he can be working on while he is waiting for a certificate of completion.

SECRETARY

COLONEL JOHN W. DEAN, JR., ARTILLERY

NEW EXTENSION SUBCOURSE 80

The problem of resident course failure in the special weapons phase of the Tactics and Combined Arms subcourse is of concern to the School. This instruction has been included in the regular Advanced Course and the Associate Advanced Course. The number of failures in the latter course is excessively high. A new extension subcourse 80, Employment of Atomic Weapons, is being written and will be available about 1 November 1957. It is recommended that officers who are to attend the Associate Advanced Course apply for and successfully complete this extension subcourse. This should reduce the number of failures and will result in a higher level of academic attainment in this vital field.

For those officers who cannot attend resident instruction, extension subcourse 80 will serve as a valuable source of information in this vital area for all artillerymen.

NEW FM 6-40

The new FM 6-40, Field Artillery Gunnery, dated April 1957, is now available at the Book Department to those who desire a personal copy for $2.60 each, prepaid.

New to the artillery?

Subcourse 2, Artillery Organizations--Battery and Battalion, is now in administration.

COMBAT DEVELOPMENT DEPARTMENT

COLONEL GEORGE C. CASSADAY, ARTILLERY, DIRECTOR

TARGET ACQUISITION AND COMBAT SURVEILLANCE

--CAPTAIN JOHN T. PRICE JR., ARTILLERY

What are the meanings of the terms "target acquisition" and "combat surveillance"? Are they synonymous or merely related terms?

Combat surveillance is defined in the Army as the continuous surveillance of the combat area to provide information directly influencing sustained ground combat. The information includes friendly as well as enemy information that is obtained by both technical and nontechnical means. A combat surveillance system includes the overall equipment to acquire the basic information. It also includes the techniques required to correlate and apply rapidly and effectively the information gained.

"Target acquisition" is a widely used term. Generally, it is referred to as being a part of combat surveillance; yet, there are numerous instances when the terms are used interchangeably. Also, there are some cases when the term is considered to denote an entire chain of events from target detection to delivery of fire on the target. As far as can be determined, there is no universally accepted or authoritative definition of target acquisition.

Here at the U. S. Army Artillery and Missile School we recognize that target acquisition and combat surveillance are interrelated and, to a degree, mutually contributing to one another. However, we feel that target acquisition is an inclusive, but more demanding, intelligence process in regard to speed and accuracy requirements. Also, we feel that the term embodies three separate elements: the detection, identification, and location (three dimensions) of the target.

Information obtained during recent conferences and liaison visits indicates that these differences between combat surveillance, as defined, and target acquisition, as commonly used, are not generally recognized by some personnel in the developmental field. To clarify this situation and to provide a descriptive and authoritative meaning for target acquisition, the U. S. Army Artillery and Missile School has recommended to Headquarters, U. S. Continental Army Command that the following definition be approved and disseminated:

"Target acquisition--the technique of acquiring a target through intelligence procedures to include detection, location, and identification of the target. Detection determines the existence or presence of a target. Location consists of the three-dimensional positioning of the target by coordinates; by azimuth, distance, and difference in altitude from a known point; or by similar means. Identification is the recognition of a target; determination of the nature of the target; and information on the size, distribution, etc., which will assist in making a proper target analysis. This process cannot be considered complete unless information is available on each of the three elements: detection, location, and identification."

Prepare for the future. Enroll in the Artillery Extension Course Program today.

READY FOR RECHECK

Views expressed in these letters are those of the authors and are not necessarily those of the U.S. Army Artillery and Missile School.

Field Modification in Mounting the AN/MPQ-10 Radar

TO: Assistant Commandant, USAA&MS, Fort Sill, Oklahoma

Considerable difficulty has been experienced in the 2d Armored Division Artillery with the radar equipment trailer V-62/MPQ-10. The major problems have been the failure of the frame and the tow bar assembly to withstand normal use. A little over a year ago, a radar set AN/MPQ-10 unit was mounted on the generator trailer M7 (fig 12 and 13). It has been in constant use since then under field conditions. Results have been so satisfactory that a program to replace all V-62/MPQ-10 mounts in USAREUR has been approved by Department of the Army, Ordnance. The test has shown the following:

a. Carriage breakdown has been eliminated.

b. M7 mounted radar can be emplaced and march ordered in 30 percent less time than a V-62 mounted radar.

c. There have been no electronic failures contributable to the M7 mount.

d. The M7 trailer can be handled with greater ease and speed and with much less training and maintenance than the V-62/MPQ-10 trailer.

Comparison of trailers

V-62/MPQ-10		M7
10 ft 6 in	Wheelbase	3 ft 4 in
4 ft 7 3/8 in	Track	7 ft 6 in
18 ft 9 1/2 in	Length	15 ft 8 in
6 ft	Width	8 ft
14 1/8 in	Road clearance	9 1/4 in
6.00-20	Tires	7.50-20
13 ft	Width with outriggers emplaced	8 ft
5°	Maximum slope for emplacement	10°
4,000 lbs (aprx)	Weight	4,150 lbs

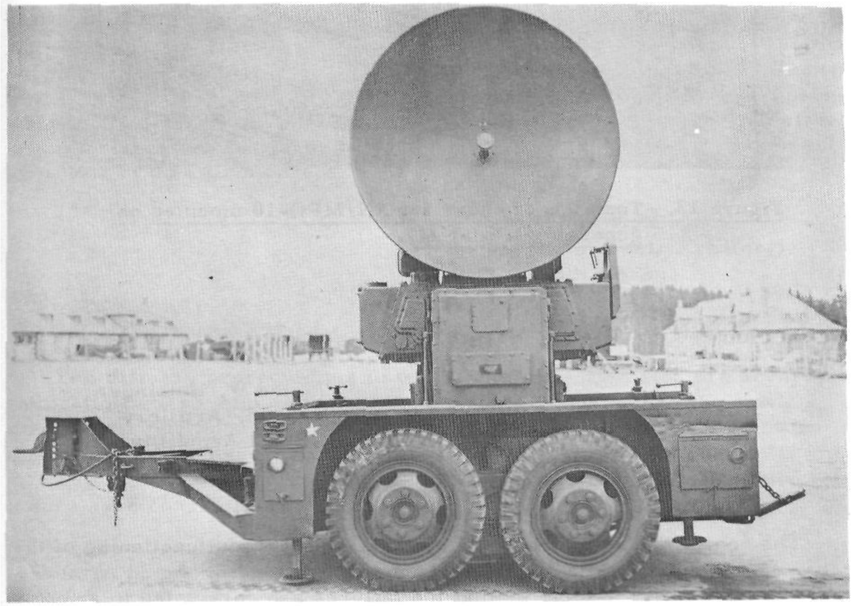


Figure 12. Side view of radar set AN/MPQ-10 mounted on generator trailer M7.

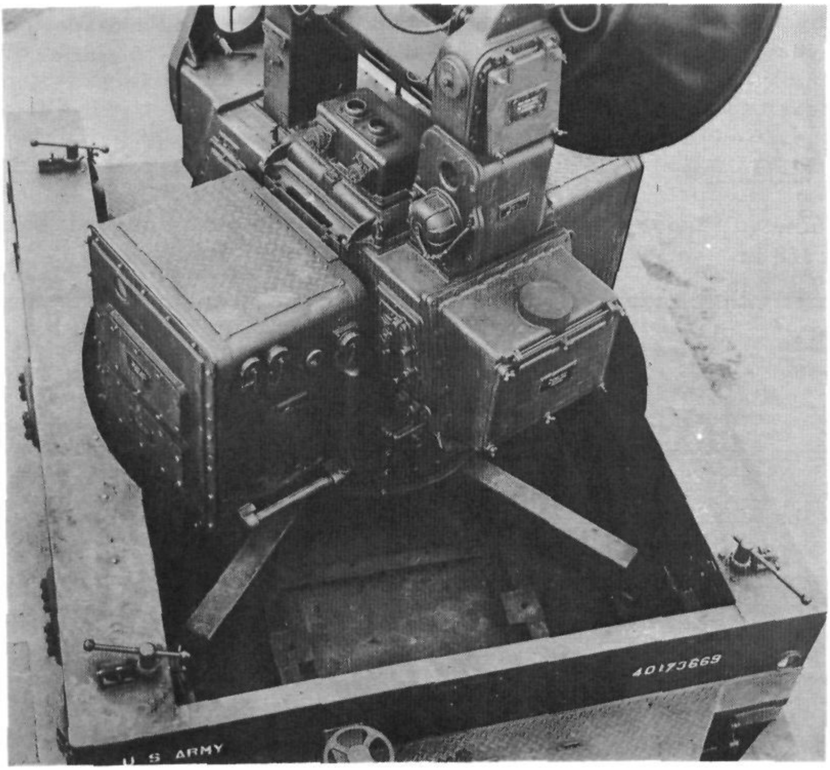


Figure 13. Top view of radar set AN/MPQ-10 mounted on generator trailer M7.

James W. Holsinger
Colonel, Artillery
CO, 2d Armd Div Arty

* * *

The School had not been aware of any persistent malfunctioning of the radar equipment trailer V-62/MPQ-10 as experienced by the 2d Armored Division Artillery. It could be that the failures are correlated to armor usage and environment. Any information concerning similar experience would be appreciated.

MORE ON USE OF FUZE SETTER M26

Sir:

I am writing this letter in regard to the article on use of the fuze setter M26 (Trends, 19 June 1957). While my comments are not in regard to the safety precautions, they have to do with a method of using the setter which will save an average of at least 5 seconds per setting and on occasions more than 35 seconds have been saved. When using the fuze setter, inexperienced persons have the greatest trouble in mounting the setter on the fuze correctly after the time has been set on the fuze setter. This is the result of trying to go too fast and becoming a little nervous. With the method I have used, the fuze setter is placed on the fuze before the announced time is set on the setter. Any time but safe may be put on the setter when putting the fuze setter on the fuze. The fuze itself is not touched in any way other than having the setter placed over it. The fuze setter is mounted on the fuze when the command Fz Ti (FUZE TIME) is announced in the case of the first round, or as soon as the round before is fired in the case of the second and following rounds. When the time is given, all the person cutting the fuze has to do is turn the outer ring to the correct time, lock the winged nut, and cut the fuze. By using the above method, the time to put the fuze setter on the round is not spent after the time is commanded but during the otherwise wasted time while other rounds are in flight or other commands are being given. The above system will not affect the accuracy to any disadvantage; it might help, however, in that while the time is being set on the fuze setter, the setter is on a firm base. * * *

Arthur A. Connell
(Lieutenant, Artillery)
765th FA Bn

*　　　*　　　*

The primary prerequisites in using the fuze setter M26 are accurate calibration and careful setting of the announced time before the movable time ring is positioned. Placing the fuze setter on the fuzed projectile before setting the announced time is an excellent method of stabilizing the fuze setter while setting the time. This method is used in many units, and it does save considerable time.

One Solution to the All Around Problem (Trends, 19 June 1957)

TO: Assistant Commandant, USAA&MS, Fort Sill, Oklahoma

1. The following conclusions and assumptions are basic to the ensuing discussion:

a. Existing materiel and organization, with their inherent limitations, are accepted.

b. Present doctrine, expressly including present transfer limits, is accepted as controlling.

c. Adjustment of fire must be possible without delay throughout the battery's normal zone of action.

d. Fire for effect must be delivered without delay at the conclusion of adjustment.

e. Not fewer than three pieces can be profitably employed in volley fire.

f. From the foregoing, effective fire (which meets all conditions stated) is impossible for a single battery throughout a 6400-mil zone of action.

2. The questions sought to be answered are:

a. By what tactics and organization can a single battery deliver effective fire through the widest possible normal zone of action?

b. What is the minimum artillery force, under present TOE's, capable of effective fire throughout a 6400-mil zone of action?

3. One special situation might exist, worthy of comment: When "islands of resistance" are located within the range of attached artillery from each other, conventional artillery operations are possible by an interchange of direct support missions between the artillery batteries attached to adjacent battle groups. A fire capabilities chart for this situation would resemble figure 14.

4. In more dispersed positions, the normal zone of action of the attached battery must be limited to avenues of probable enemy approach, to compensate for its inability to cover 6400 mils. Battle group position areas must be selected with this limitation in mind, and maximum advantage derived from terrain obstacles, supplemented by minefields, wire, etc.

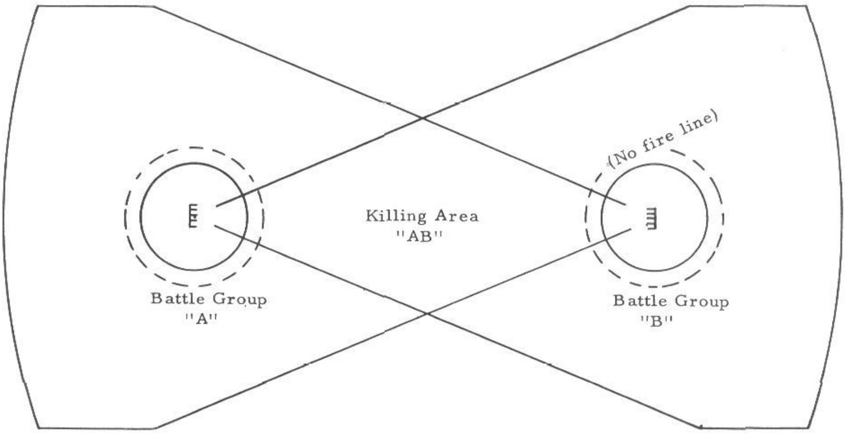


Figure 14. Proposed fire capabilities chart.

5. In terrain devoid of obstacles, the direct support battery must be prepared to engage the enemy with effective fire throughout the widest possible normal zone of action, with contingent zones covering the remainder of the battle group's perimeter. A 6-piece 105-mm howitzer battery can cover 800 mils per piece, for a total of 4800 mils; but no concentration of fire is possible without re-laying pieces adjacent to the adjusting piece, with the concommittent loss of coverage of the adjacent sectors of fire, and risk of "losing" the adjustment because the target is located (or moves) outside the sector of the adjusting piece. It is submitted that the best compromise of these difficulties is to register 4 pieces covering a continuous 3200-mil zone, reserving 2 pieces as a reinforcing platoon. Adjustment could thus commence immediately with 1 piece on any target discovered in the entire normal zone and the reinforcing platoon simultaneously laid on a compass corresponding to initial deflection for the problem and prepared, with application of individual corrections, to fire in effect with the adjusting piece, giving 3 pieces in effect. If additional fire is required, pieces flanking the adjusting piece may be shifted and brought in, bringing the total of weapons engaged to five. To facilitate use of the "reinforcing platoon" and minimize individual corrections, the formation shown in figure 15 is suggested (which eliminates corrections for lateral displacement and

provides a uniform range correction, applicable to fires reinforcing any adjusting piece).

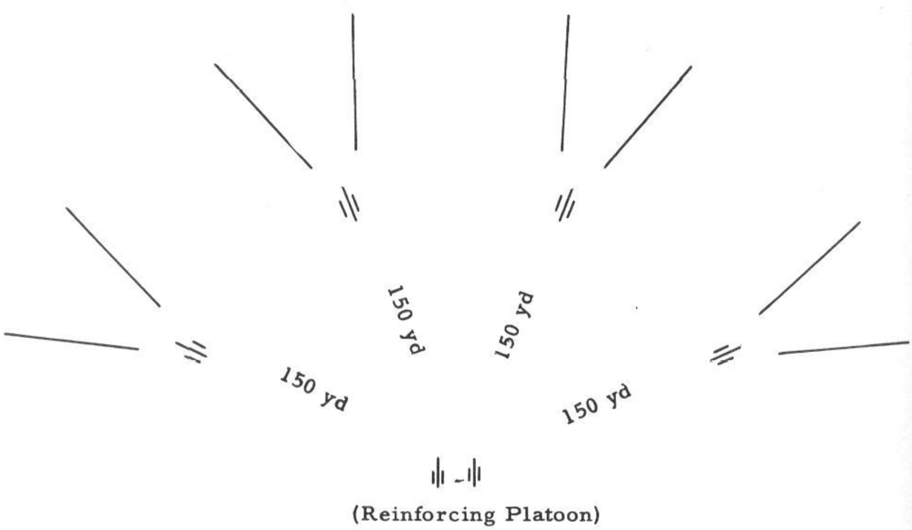


Figure 15. Suggested 3200-mil coverage formation.

6. It is anticipated that, combining principles discussed in paragraphs 4 and 5, adequate artillery support could be provided in most situations by 1 battery; however, on the occasions when true all around artillery support is needed, 2 batteries (or better, 1 battalion less a battery), are required for effective coverage of a 6400-mil normal zone of fire.

Marshall B. Hardy
Lt Col, FA, USAR
CO, 373d FA Bn

* * *

The concept presented by Colonel Hardy is interesting in light of studies being conducted on employment of artillery under the new organizations. This concept has not been tested or evaluated by the School.

Field Expedient Support for Switchboards

TO: Communications Department (USAA&MS, Fort Sill, Oklahoma)

While out in the field last summer we were confronted with (the) problem of using effectively the newly acquired switchboard (SB-22).

Since no base to keep the switchboard off the ground in foul weather has been issued, I was persistent that there must be something around that I could use. After looking over my equipment in the wire truck I finally came up with the idea of using the wire reel stand (reel unit RL-31).

John Noga
(Master Sergeant, USAR)

*   *   *

The switchboard SB-22 will fit on the braces between the legs of the reel unit RL-31 and the frame will keep the switchboard off the ground. However, this field expedient is not recommended as a general practice. Most field artillery batteries have only 2 or 3 reel units, and they are usually in constant use by the wire teams in laying, recovering, and servicing field wire. If the wire teams are deprived of the use of even one of these reel units, sooner or later their primary activity is going to be curtailed, to the detriment of the unit as a whole. If the stand is used as a switchboard mount only when it is not required by the wire teams, the operator may have to relocate his switchboard at a critical time when the wire teams have to put the reel unit back in use in its primary function. Also, the switchboard mounted on the reel unit frame isn't at the optimum height for ease of operation.

The School recommends the following methods for emplacing switchboards:

a. Digging the switchboard in, particularly when the unit may be subject to attack or is in training for that type of situation.

b. Setting the switchboard on packing boxes or empty wire reels RL-159.

c. Tying the switchboard to a tree, stump, post, or any other convenient fixed object, by using scrap field wire.

"The essence of field artillery is the maneuver of fires."

Major General John A. Crane
"Full Use of Field Artillery" in
The Field Artillery Journal
June 1945

79-10257 ARMY-FT. SILL, OKLA. 21, 5M

YARD-METER TABLE

(conversion factor -- 9144)

Yards	Meters	Yards	Meters
100	91	6,000	5,486
200	183	7,000	6,401
300	274	8,000	7,315
400	366	9,000	8,230
500	457	10,000	9,144
600	549	20,000	18,288
700	640	30,000	27,432
800	732	40,000	36,576
900	823	50,000	45,720
1,000	914	60,000	54,864
2,000	1,829	70,000	64,008
3,000	2,743	80,000	73,152
4,000	3,658	90,000	82,296
5,000	4,572	100,000	91,440

PHONETIC ALPHABET

Letter	Word	Pronunciation*
A	ALFA	AL FAH
B	BRAVO	BRAH VOH
C	CHARLIE	CHAR LEE
D	DELTA	DELL TAH
E	ECHO	ECK OH
F	FOXTROT	FOKS TROT
G	GOLF	GOLF
H	HOTEL	HOH TELL
I	INDIA	IN DEE AH
J	JULIETT	JEW LEE ETT
K	KILO	KEY LOH
L	LIMA	LEE MAH
M	MIKE	MIKE
N	NOVEMBER	NO VEM BER
O	OSCAR	OSS CAH
P	PAPA	PAH PAH
Q	QUEREC	KEH BECK
R	ROMEO	ROW ME OH
S	SIERRA	SEE AIR RAH
T	TANGO	TANG GO
U	UNIFORM	YOU NEE FORM
V	VICTOR	VIK TAH
W	WHISKEY	WISS KEY
X	XRAY	ECKS RAY
Y	YANKEE	YANG KEY
Z	ZULU	ZOO LOO

*Note: Blackface portion denotes the accented syllable(s).