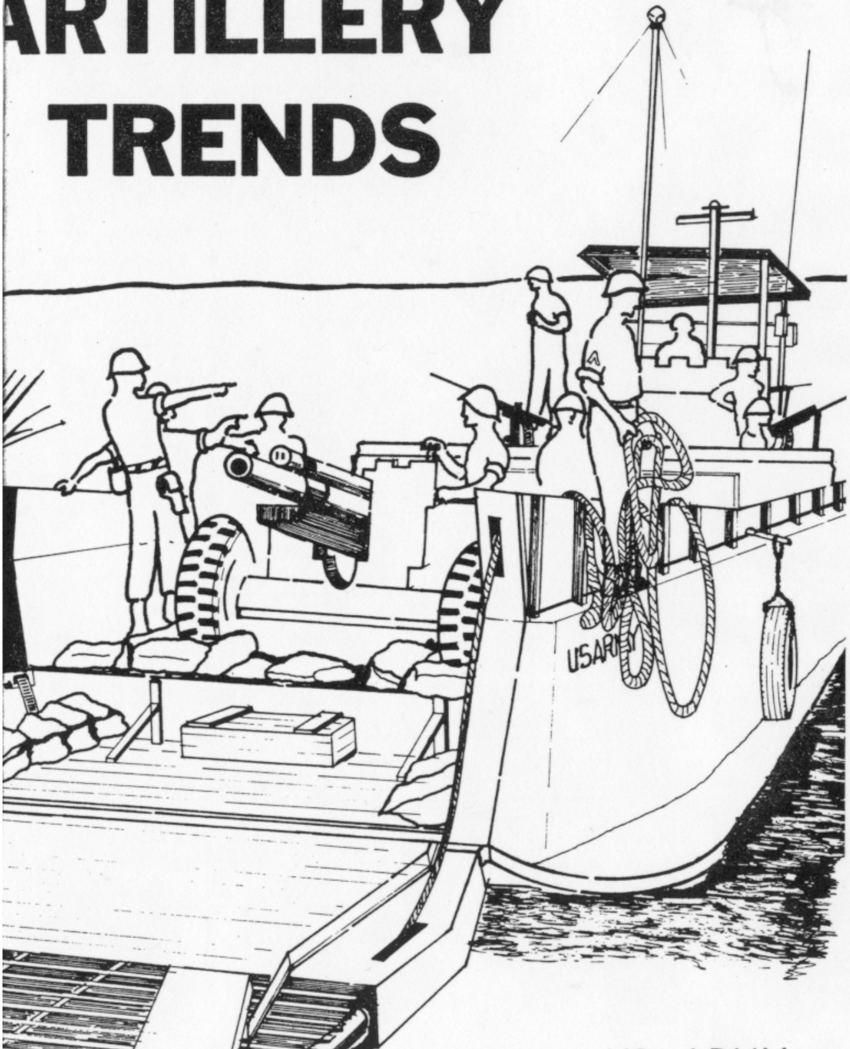
ARTILLERY TRENDS

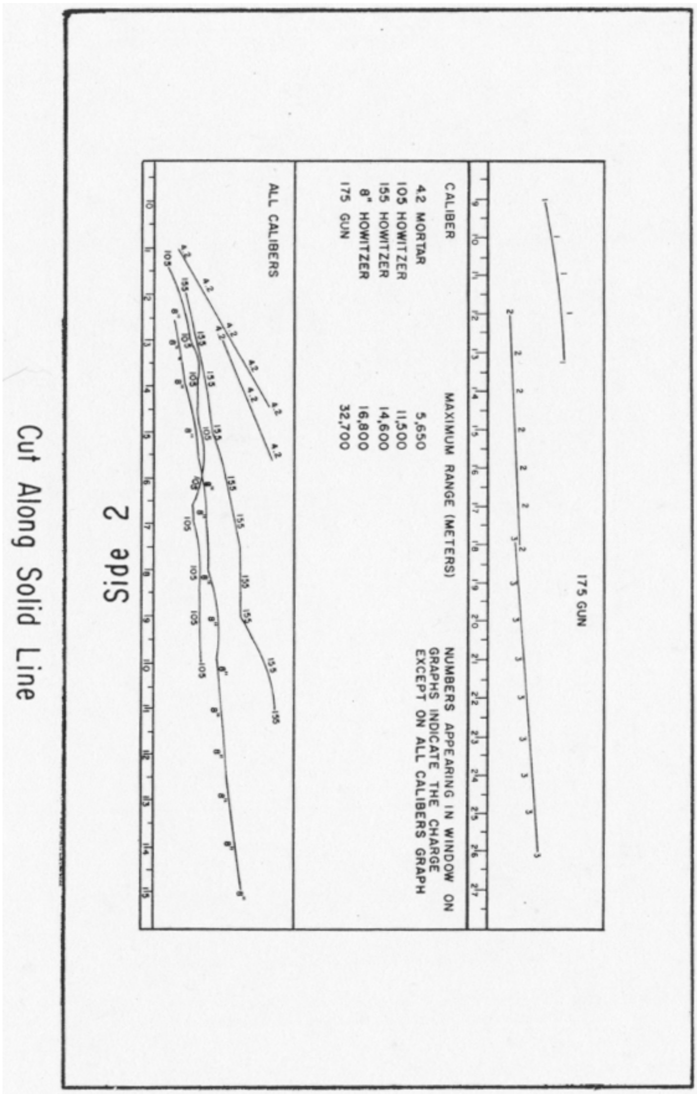


US ARMY

ARTILLERY AND

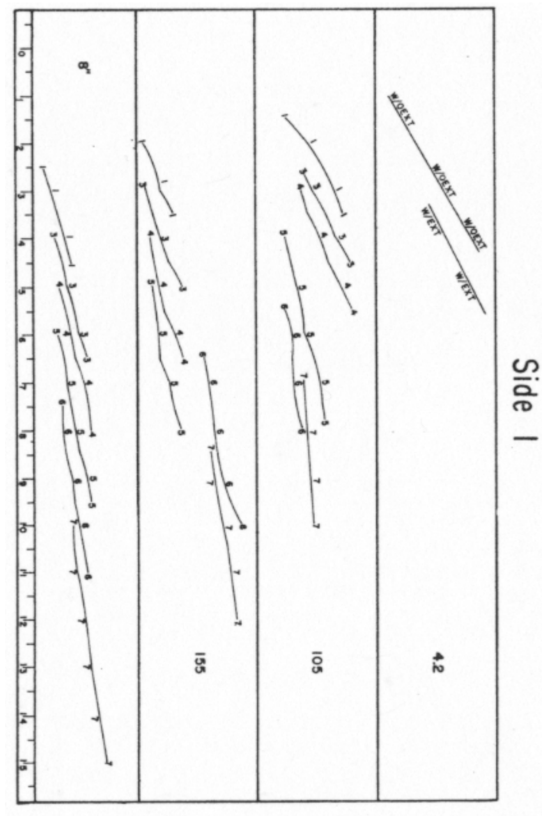
MISSILE SCHOOL

NUARY 1968



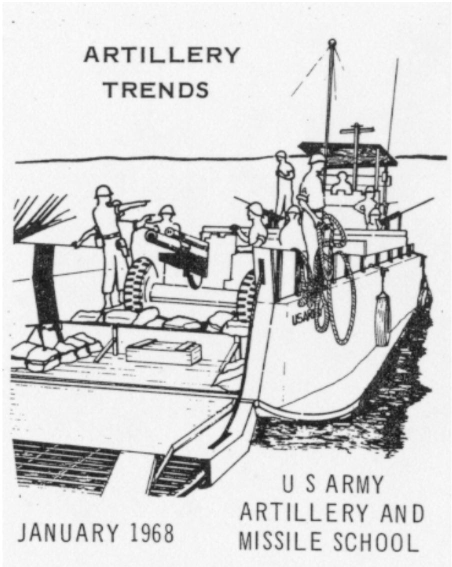
After Folding Main Portion. Hold The Card So That Side I Is Facing Up. Insert Slide Into Main Portion With Side I Facing Up.

REFER TO ARTICLE ON PAGE 96.



REFER TO ARTICLE ON PAGE 96.

Introduction



● COVER

In the last issue, ARTILLERY TRENDS' readers became acquainted with the preparation and movement of artillery in support of airmobile operations. But it has become evident that mobility of the artillery in a counterinsurgency role involves more than road convoys and airlifts by helicopter. Support of riverine operations dictates another means of employment—the use of waterborne artillery. In "Riverine Artillery," one unit's answer to this requirement is cited.

Whether the artillery is moved via land, air or water, the duties of the forward observer remain the same. In two articles, "First Round Smoke" and "Adjust by Sound," the authors discuss methods proved successful in adjusting rounds in terrain providing limited field of observation. The role of the forward observer is discussed further in "Aerial Artillery," "Tactical Air Support and the Forward Observer," and in "FO Found by Sound."

Also in this issue, readers may find refreshing "How to 'Prep' a Landing Zone," and "Defense of a Landing Zone"—articles on the preparation and defense of a battery position.

We invite readers to submit for publication their ideas which have proved workable in increasing the effectiveness of the Artillery. Dissemination of such information would be in keeping with the latest trends in the artillery. The material contained in this issue represents the best information available at time of publication. All readers and users of this handbook are encouraged to forward information concerning changes or suggestions for improvement of content and format to:

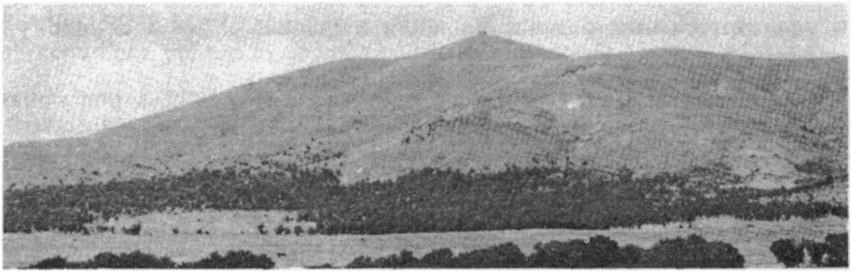
Commandant
U. S. Army Artillery and Missile School
Fort Sill, Oklahoma 73503

INSIDE THIS ISSUE

INSTRUCTIONAL AID NUMBER 39

ARTILLERY TRENDS is an instructional aid of the United States Army Artillery and Missile School published only when sufficient material of instructional nature can be gathered.

Instructional Department Notes



Artillery Transport Department

CHIEF OF SECTION COURSE

A new course, the 8-inch/175-mm cannon section chief course has been initiated at the U. S. Army Artillery and Missile School. This course is designed to fill the need for knowledgeable chiefs of sections for these weapons. It is intended for noncommissioned officers, grade E-5 or E-6, who are on orders to an 8-inch Howitzer or 175-mm gun unit. It is a one week course of 48 hours duration including processing and graduation. The first class began on 8 May 1967 and will run on a frequency of approximately one class per month. Planned input to the course is 20 students per class.

The Artillery Transport Department is teaching 16 hours of the 44 hours of instruction. This instruction consists of vehicle familiarization which includes a general description and the characteristics, capabilities and limitation of the two vehicles. The prospective 8-inch/175-mm cannon chiefs of section also receive instruction on the daily and quarterly maintenance services, automotive trouble-shooting procedures and actual operation of the vehicles, to include starting and stopping procedures, correct spade emplacement and towing and recovery operations. This portion is 14 hours of practical exercise and only 2 hours of conference instruction so that the chief of section actually learns by "doing" rather than by "hearing."

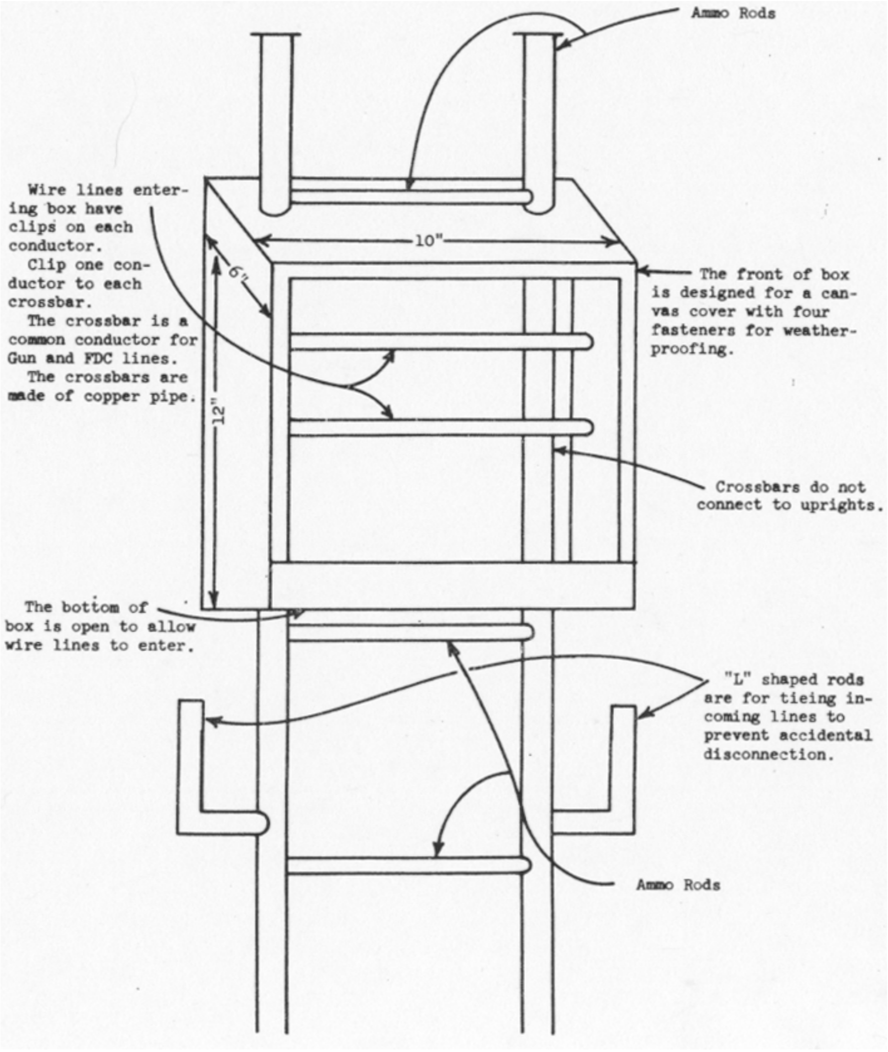
The Artillery Transport Department's portion of the 16 hour course, coupled with 28 hours of the Gunnery Department, produces noncommissioned officers with increased confidence and efficiency in their vital role as chiefs of section in 8-inch and 175-mm firing batteries. The course emphasizes "hardware" with theory held to a minimum.

Prerequisites for the course are: noncommissioned officers, grade E-5 or E-6, member of the active Army who is on orders to an 8-inch howitzer or 175-mm gun unit, qualified in MOS 13B. No security clearance required.

Communication/Electronics Department

To insure flexible and reliable communications in the field, there is a need for an alternate switching device for the MX-155 Switching Kit. A unit can construct a switching kit in a number of ways or modify a waterproof terminal strip.

Simply constructed, the device described below utilizes ammunition rods (105-mm howitzer), a wooden cover, and copper pipe.



Director of Instruction

COUNTERINSURGENCY ORIENTED TRAINING

The United States Army Artillery and Missile School is stressing the following portions of instruction designed to prepare graduates in coping with conditions unique to counterinsurgency operations.

OBSERVER TRAINING

Flash-Bang, as a technique of both target acquisition and fire adjustment, is presented in classes to students of the Field Artillery Officer Basic Course (FAOBC), the Field Artillery Officer Candidate Course (FAOCC), the Regular Army Officer Basic Course (RAOBC), the Artillery Officer Advanced Course (AOAC), and the Field Artillery Officer Orientations Course (FAOOC).

This technique is based on sound and the rate at which sound travels. In target acquisition, the time in seconds between the flash of the weapon and the sound of rounds leaving the tube is used in plotting counter-battery fire. In adjustment of fire, the time in seconds is used between the flash (detonation of the round) and the sound of the explosion as it reaches the forward observer.

ADJUSTMENT BY SOUND

Sound Adjustment is emphasized on night adjustment of fire exercises which includes the comparison of sound (105-155-8-inch), sound adjustment, illumination adjustment, and close-in fires (105-mm only). Night observation devices will also be used when they are received.

AERIAL OBSERVATION

The coordination between ground and air observers is stressed in RSOP's conducted by the School. Air observers are employed and taught to coordinate and cooperate with personnel on the ground. Combined adjustment is demonstrated to OBC, RAOBC, OCC, and FAOOC.

Aerial observation is used in OCS field exercises, the FAOOC course field exercise, as well as the field exercise for the Advanced Course. Coordination between the Forward Observer (FO) and Air Observer (AO) is also taught in the classroom. Plans are currently in progress to utilize T-41 type aircraft in an aerial navigation course of approximately four hours duration, which will be presented to the OCS and OBC students. Each student will be allowed, as a minimum, one air mission.

SMOKE ROUND

The use of smoke on the initial round is used on all RSOP firing exercises. Use of smoke for initial round when observation is difficult is taught in classes which are presented to OCS and OBC students. Students in OBC, RAOBC, and OCC receive two rounds of smoke and two rounds of white phosphorous per problem section in field exercises. Additionally, the students are handling, preparing, and firing shell smoke and white phosphorous on 105-mm firing exercises.

WALKING SHOOTS

The number of walking shoots has increased from 1 to 2 for OBC, RAOBC, and OCC students. FAOOC will continue to have one. **Reconnaissance by Artillery Fire** continues to be taught in classroom instruction.

REGISTRATION

Registration procedures as proposed by the school are generally well received by artillery units except for air adjustment of the height of burst. As now modified, the air observer adjusts the height of burst using the bracketing technique. He attempts to get two graze bursts and two air bursts by corrections in height in multiples of 20 meters. For example, if the first round is graze, the observer transmits UP 40. The UP 40 results in an air. The air observer transmits DOWN 20, 2 ROUNDS. These two rounds result in grazes. The observer transmits UP 20, 1 ROUND (this round verifies the previous air burst). The UP 20 results in an air. The mean height of burst is 10 meters (2 Grazes and 2 Airs at 20 above graze.) The air observer transmits "RECORD AS REGISTRATION POINT 1 AT DOWN 10, END OF MISSION."

FIRING BATTERY AREA

Construction of a 175-mm Gun Platform is beginning in the training area east of Fort Sill for use in instruction on battery positions. Construction is complete on a 6400*mils* dug-in **Artillery Battery Position** and is used in classes on the defense of the battery taught to OCS, OBC, and FAOOC students. In addition, the Officer Candidate Brigade plans to use the position for training during the new five-day field problems being given to the officer candidates beginning in March 1968.

BATTERY POSITION DEFENSE

Defense of the battery position is stressed in classes on counterguerrilla operations and is approached and discussed within the overall problem of position area security. **The use of listening posts** has always been included in the instruction, the Battery in the Defense, as a primary factor—**Early Warning.** Listening posts are also planned by student first sergeants on all field exercises conducted with OBC and OCS students.

The use of and planning for the **employment of Beehive ammunition** is taught through the use of actual combat examples. The use of the Beehive also is taught during all field instruction to include techniques devised for fuze setting. The instruction is given to OBC and OCS students who fire 4 rounds on the 105-mm field exercises.

6,400 MIL CAPABILITY

A two-hour practical exercise is given for classes on the firing battery in 6400-mil capabilities. The firing battery exercise will utilize two collimators, azimuth stakes, and speed jacks for towed weapons (if available). This will be taught to OBC, RAOBC, OCC, AOAC, and FAOOC.

SELF-PROPELLED WEAPONS

A demonstration of **tube changing** on the M107/M110 is given during the Self-Propelled Cannon Chief of Section Course.

Students in OBC, RAOBC, OCC, and FAOOC fire M108 and M109 howitzers on gunnery or tactics problems.

M102 HOWITZER

The trail on the M102 should be picked up and shifted instead of using the gears to traverse large shifts. This is stressed in the cannon classes which cover characteristics, nomenclature, function, sight test, and adjustment and maintenance of the self-propelled 8-inch howitzer, 175-mm gun, 105-mm howitzer, and M102 howitzer. The effects of sight mount cant and shock of firing are also stressed.

EXECUTIVE POST

The **battery executive post** is located wherever the executive is located. The roving executive is being used on all Reconnaissance Selection Occupation of a Position (RSOP) exercises. This training is conducted to teach students that the executive officer should avoid being a telephone operator at a permanent executive post.

FIRE DIRECTION AREA

Students spend two hours of practical exercises on 6400-mil procedures in the FDC/OP. Instruction covers charts, registrations, time transfer with normal transfer limits, transfer using wind cards outside of normal transfer limits, and multiple fire missions 3200 mils apart using different calibers.

TACTICS

Classes on **multiple missions,** both within the battery and concurrently with the Battalion FDC, continue to be presented on field exercises.

Clearance procedures to fire in regards to both ground and air safety are taught to OBC, OCS, and FAOOC students.

Instruction in the area of **orientation on Composite Batteries** is presented to AOAC and FAOOC, as well as to other senior officer courses.

LARGE NEGATIVE SITES

Large negative sites which exceed the firing table capabilities are being investigated. A new GST, which will improve the accuracy for large vertical intervals, will be constructed after completion of higher priority GFT's. The present method of determining extreme site is by the use of C and D scales of the GST to determine angle of site and table G of the firing table to determine the comp site factor. Multiply the comp site factor times the angle of site and add the result to the angle of site.

SITUATION OVERLAY

The display of either an overlay or underlay showing friendly locations, village locations, and other no fire areas on firing charts is used on all RSOP field exercises. A situation overlay is affixed to the VCO's chart in both battery and battalion FDC's. Instructors insure that their displays are understood and used prior to any fire command being computed. Additionally, a field grade supervisor inspects all problems to insure that instructors are teaching current doctrine and placing emphasis on recent changes such as sending commands direct to the guns, and use of situation overlay on VCO charts.

FDC PERSONNEL

The necessity for proper management of FDC personnel for "round the clock" operation is taught and stressed in field exercises as well as classroom instruction.

FIRE PLANNING

Fire planning for newly assigned FO's and LO's to battery and battalion level is covered in detail in classroom instruction. Major emphasis on fire planning at battery and infantry battalion level is stressed in classes as well as in practical exercises involving fire support in counterguerrilla operations.

LIAISON INSTRUCTION

A 30-minute class covers the duties of the liaison officer. Special emphasis is placed on the duties of the direct support battalion liaison officer, and specifically his responsibilities as the fire support coordinator. Special attention is given to the duties of the maneuver battalion liaison officer within the scheme of fire planning in basic fire planning classes. The class requires practical application of duties and responsibilities of a liaison officer at battalion and brigade level.

FO DUTIES

Instruction stresses the desirability of the FO to remain with the same infantry company regardless of the location of his parent unit. It is further emphasized that the artillery-infantry officers and personnel work as a team in accomplishing each mission.

H&I FIRES

We teach students, during the fire planning classes, to plan harassing and interdiction (H&I) fires based on **hard intelligence** rather that just terrain features.

FADAC

FADAC is enthusiastically accepted in most units as the primary firing data source. It has relieved some tension and pressure of the 24-hour operations. The present OBC program of instruction (POI) includes one hour on FADAC (AC-1). The new POI which starts with class 6-68 has 6 hours of FADAC training. The OCC POI includes 3 hours, and 9 additional hours will be requested. AOAC receives 8 hours, Field Artillery Operator and Intelligence Assistant Course (FAOIAC) 10 hours, Field Artillery Field Grade Officer Refresher Course (FAFGORC) 2 hours, and Senior Field Artillery Officer Course (SFAOC) 2 hours. The new Combat Field Artillery Operations and Intelligence NCO Candidate Course (MOS 13E40) that started 20 Nov 67 includes 14 hours of FADAC.

TACTICS INSTRUCTION

Airspace Control is emphasized in classes on tactics. The need for mobility and movement to support counterinsurgency operations is taught in all tactics classes. This teaching utilizes the full capability of all available artillery weapons.

The School teaches that the **outpost and perimeter defense** should be tied together with the Battery Command post on a hot-loop. The Battery FDC is tied to this hot-loop and can act as a command or control center. It is also taught that the FDO has responsibility for obtaining firing and airspace clearances.

AMMUNITION SUPPLY

The School teaches **Artillery Ammunition Supply and Resupply** to both AOAC and OCS students. Emphasis is on the ammunition supply system, how ammunition supply points are established, and how units maintain their basic loads and initiate requests for anticipated expenditures of ammunition. For OCS classes, the battery ammunition section and battalion ammunition trains are also discussed. In addition, emphasis is placed on the care and handling of ammunition at the gun position during all RSOP exercises.

PHOTOGRAMMETRY

Photogrammetry is used to establish survey control for both guns and targets to required artillery accuracies. The basic interpretation of aerial photos to include measurement of distances and determination of scale is taught by the School. The School is monitoring photogrammetry application and will provide artillery information to the Corps of Engineers which has proponency for these procedures.

AN/MPQ-4A

The School is preparing a report on the results of recent tests with AN/MPQ-4A for use in a countermortar/rocket role.

MISCELLANEOUS

In addition to the above, the School is presently teaching 81-mm and 4.2-inch FDC techniques, creeping fires, land navigation, construction of field expedient antennas, adjustment of illumination and searchlights, adjusting fires by the four cardinal directions, and the rigging of equipment for movement by helicopter.

COURSE CHANGES

Several changes have been effected in courses available to officers. The Field Artillery Officer Candidate Course has been increased from 9 to 12 weeks, and the Regular Army Field Artillery Officer Candidate Course has been increased from 6 to 9 weeks. In addition, a course has been initiated which provides instruction to officers assigned to duty in combat areas. The Field Artillery Officer Orientation Course lasts for four weeks with a maximum capacity of 45 per class. For information on all classes taught at the U.S. Army Artillery and Missile School, please see page 87.

Guided Missile Department

SERGEANT OFFICER COURSE REVISED

The program of instruction for the Sergeant Officer Course has been shortened one week. Now four weeks and four days in length, the course emphasizes need-to-know material with refresher training eliminated. Technical and field manuals are issued and used during the course to instill in the officer the proper use of manuals and the need for keeping abreast of current changes. The number of hours of theory within existing classes has been reduced to allow sufficient time for practical exercises and hands-on type instruction.

In addition to knowing the how's and why's of the system, graduates will be able to perform the various tasks necessary to launch a Sergeant missile to the desired target.

PERSHING COURSES REVISED

More practical exercises and instruction on troubleshooting techniques have been incorporated into the programs of instruction on the Pershing missile. The courses revised are the Pershing Officer, Pershing Missile, Pershing Battery, and Pershing System Maintenance Courses.

Television tapes are being prepared on the Pershing missile receipt inspection, missile assembly, and simulator-test adapter test.

Gunnery Department

COMPUTATION OF LARGE NEGATIVE SITES

Use of the GST to determine site is more accurate than the tabular solution, however when quadrant elevations exceed the limits on the back of each GST, the GST solution becomes less accurate. A new GST, which will improve the accuracy for large verticle intervals, will be constructed after completion of other higher priority GFT's.

In firing low angle, extreme site (vertical intervals less than minus 400 meters or greater than + 1,000 meters), is determined by taking the angle of site from the C and D scales of the GST and the complementary angle of site factor from Table G of the appropriate tabular firing table. The complementary angle of site factor is multiplied by the angle of site and then added to the angle of site.

The following example is provided as follows:

Known Data: Charge 3, Range 4,500, Altitude of the Battery 870 meters. Altitude of the target 230 meters. (FT 155 AH2)

VI = minus 640 meters

Angle of site (C & D scales) $= \frac{-640}{4{,}500} = -145$

Complementary angle of site (CAS) = —0.162
(Table G, column 12)

CAS = —.162 × 145 = —23

Site = angle of site plus complementary angle of site or
—145 + —23 = — 168

In firing high angle from mountain top positions, it is often necessary to select a charge lower than normal. When a large site is added to the elevation for the charge that would normally be used, the resultant quadrant elevation is higher than can be reached by the howitzer. Choosing the next lower charge presents another problem since the 10-mil site factor for the GFT solution cannot be read under the hairline for the lower charge. When a 10-mil site factor is required for the computation of site greater than is listed on current GFT's, the highest values listed should be used. In this case, the angle of site should be computed using the C and D scales of the GST. An alternate solution is to compute site by multiplying the complementary angle of site in Table G of the TFT by the angle of site in the manner illustrated in paragraph 2. Since complementary angle of site and site are large values when firing this type of mission, an error in drift is introduced. To compensate, use the drift corresponding to the quadrant elevation. New firing tables being constructed will contain extensions of high angle data with sufficient overlap to cover this problem.

ILLUMINATION DEBRIS

Units have complained of the debris ejected by the illuminating projectile as it functions over friendly troop positions. From firing tests conducted at Fort Sill, it was concluded that the carrier exceeds the range determined for a non-functioning round as listed in column 6 of appropriate illuminating firing tables. The functioning of the expelling charge in the projectile serves to accelerate the carrier while at the same time expelling the payload. Further tests are required to determine both the pattern of debris and the exact range of the carrier. Both personnel requesting illumination and the firing unit must take this problem into consideration when clearing illumination missions.

READING FROM GFT

Have you ever mistakenly read from your high angle graphical firing tables (GFT) the drift values for time of flight or vice versa? To facilitate the computer's use of the GFT, it is suggested that a "D" and a "TF" be penciled on the cursor and covered with cellophane tape. On future production models of the high angle GFT, the time of flight values will be printed in red.

MINIMUM SAFE DISTANCE

The following tables describe the effects pattern of artillery rounds for the purpose of determining minimum safe distance. The probability that there will not be a casualty from a one battery volley at a distance 'D' from the mean point of burst[1] of the nearest projectile when firing high explosive is as follows:

POINT DETONATING ACTION

D (meters)	Probability (%) that there will not be a casualty								
	105-mm H2			155-mm H2			8″ H3		
	Standing	Prone	Foxhole	Standing	Prone	Foxhole	Standing	Prone	Foxhole
100	98.0	98.6	99.8	97.7	98.4	99.7	95.6	96.9	99.6
150	99.0	99.3	99.9	98.4	98.9	99.8	96.9	97.8	99.7
200	99.5	99.6	99.9	99.2	99.4	99.9	99.1	99.4	99.9
250	99.8	99.9	99.9	99.7	99.8	99.9	99.9	99.9	99.9
300	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9

AIR BURST ACTION

D (meters)	Probability (%) that there will not be a casualty								
	105-mm H2			155-mm H2			8″ H3		
	Standing	Prone	Foxhole	Standing	Prone	Foxhole	Standing	Prone	Foxhole
100	95.9	97.2	99.6	95.4	96.8	99.5	92.2	93.8	99.1
150	97.9	98.6	99.8	96.9	97.8	99.7	93.8	95.7	99.4
200	98.9	99.3	99.9	98.3	98.8	99.8	98.2	98.7	99.8
250	99.6	99.8	99.9	99.5	99.6	99.9	99.8	99.9	99.9
300	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9

1. The actual mean point of burst is unpredictable and compensating factors should be considered as follows:

   a. In observed fire, add 50 meters to distance 'D' for the uncertainty of the location of the target within the 50 meter bracket.

   b. In the Met plus VE technique at low angle, add 8 probable errors to distance 'D' to determine minimum safe distance.

2. 6 gun battery

3. 4 gun battery

155 SLANT SCALE GFT

The new slant scale graphical firing tables for the M109 155-mm howitzer will soon be made available to units. At that time they may be obtained through normal requisition channels using the following federal stock number:

How 155-mm 155AH2HEM107 FSN 1220-937-8282

Nonresident Department

NEW COURSES FOR RESERVE COMPONENT OFFICERS

The U. S. Army Artillery and Missile School is conducting two new courses of instruction for Reserve component officers, not on extended active duty. Both courses are a combination of nonresident (extension course) and resident instruction and designed so that completion of the nonresident phase is a prerequisite to attendance at the resident phase. The Field Artillery Officer Mobilization Basic Course replaces the current Basic Course 2-6-C20 in the School curriculum.

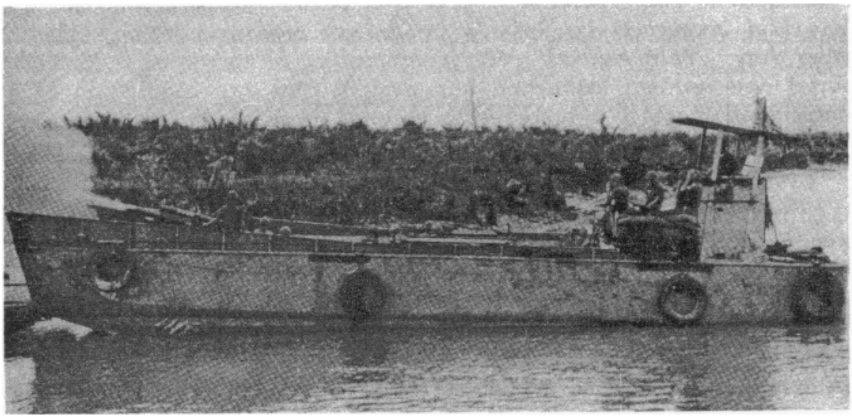
The Field Artillery Officer Mobilization Advanced Course consists of three phases—phase I, 160 credit hours of extension course instruction; phase II, 176 hours (4 weeks) of resident instruction; and phase III, 176 hours (4 weeks) of resident instruction. Phase I, the extension course phase, is divided into part A, 78 credit hours, and part B, 82 credit hours. The successful completion of part A of phase I is a prerequisite to attendance at the first resident phase. Resident phases II and III will be presented back-to-back. The student may take both resident phases in 1 year (8 weeks), or he may take phase II (4 weeks) in 1 year and phase III in the next succeeding year. Part B of phase I may be completed prior to attending resident phase II, in between resident phases II and III if these phases are taken in 4-week increments, or following the completion of resident phases II and III. All three phases of the course must be successfully completed in order to receive a diploma. This course may be completed by the student in 1 or 2 years. The Field Artillery Officer Mobilization Advanced Course replaces the resident Associate Career Course 2-6-C23 in the School curriculum.

The details of the two new courses appear in the 1967-1968 Extension Course Catalog, which was distributed to the field on or about 15 June 1967. DA Form 145, Army Extension Course Enrollment Application, is used to enroll in either of the courses. The dates of the resident phases will be announced later. Students now enrolled in the extension course program and the USAR School program are given credit for any work previously completed. Equivalent credit for basic or advanced level branch training, as appropriate, is granted for successfully completing either of these courses.

Target Acquisition Department

SURVEY

The procedures for transforming UTM grid azimuths from one zone to an adjacent zone have been simplified by the adoption of a tabular solution. The somewhat complex and time-consuming procedures involving the use of DA Form 6-34 will be superseded with the publication of the Army Ephemeris for 1968. This publication will contain the instructions and tables for the tabular solution. Computation of the data for the tables was performed at USAAMS on the gun direction computer M18.



Riverine Artillery

In the past the artillery was hard pressed when required to keep pace with the infantry in terrain not conducive to travel by land vehicles. Now, however, it is merely a process of hitching rides with CH-47 Chinook or CH-54 Skycrane helicopters.

But even with helicopters, the artillery is not as mobile as required. In swampy, marshy terrain, the helicopter can haul the howitzer into an area of operations; but where is the weapon emplaced? True, there will always be selected positions which can accomodate a battery of 105's, but this leaves much of the area an enemy haven free from artillery fire. The situation calls for waterborne artillery. Howitzers can't swim; they're just not water active. Thus, an expedient is sought.

Faced with the task of finding a suitable firing platform, one artillery unit considered both barges and the landing craft, medium (LCM-6). The latter was subsequently selected because it supplied its own power, resulting in greater speed and maneuverability in combating tidal variations. Although smaller than the barge, the LCM-6 could adequately accomodate the 105-mm howitzer.

In modifying the LCM-6, it was necessary to raise the howitzer sufficiently to allow the panoramic telescope sight to clear the side of the craft and to provide for a high-angle recoil pit. In addition, it was necessary to equalize the recoil shock across the rear bulkhead, construct a working platform for crewmembers, and provide storage space for ammunition. With dunnage supplied by ammunition ships, the required construction was completed in less than 2 days.

The firing platform was 10 feet 11 inches wide, which is the width of the LCM-6, and was 6 feet in length. Placed 6½ feet back from the ramp, the platform was raised 1 foot 4 inches at the front and 2 feet at the rear because of the deck's slope (fig 2).

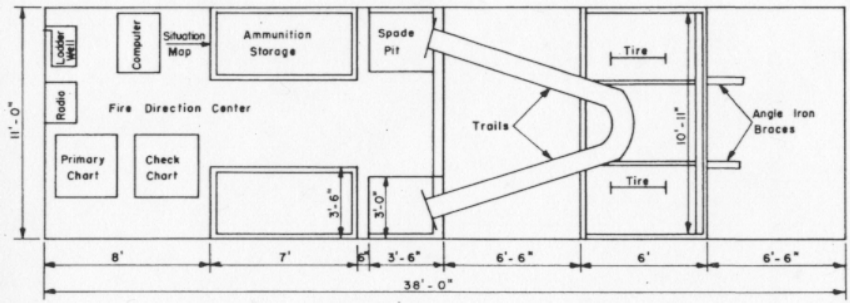


Figure 1. LCM-6 mounted 105-mm howitzer diagram drawn to scale.

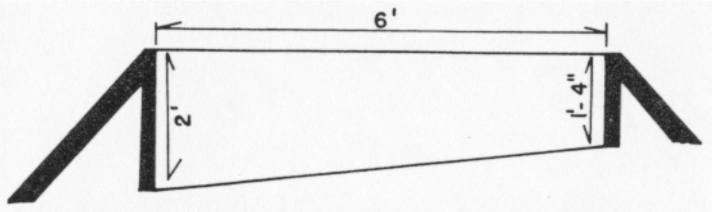


Figure 2. Side view of firing platform.

Angle iron braces were welded to the floor at the rear of the platform (fig 3 and 4).

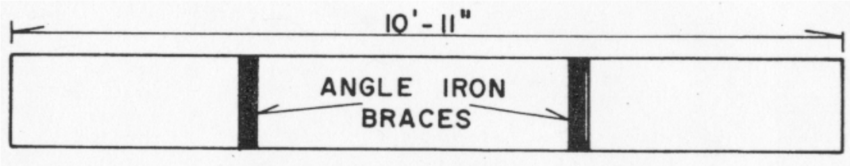


Figure 3. Front view of firing platform.

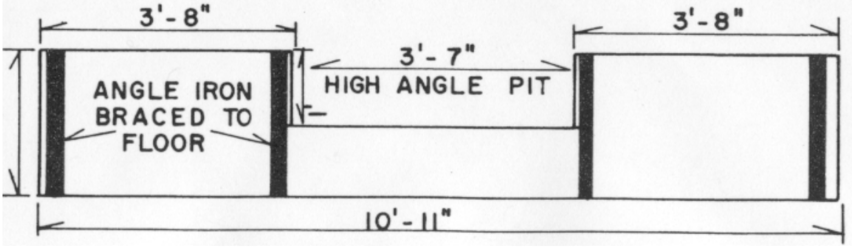


Figure 4. Rear view of firing platform.

With the exception of the high-angle pit, the interior of the platform was filled with sandbags (fig 5).

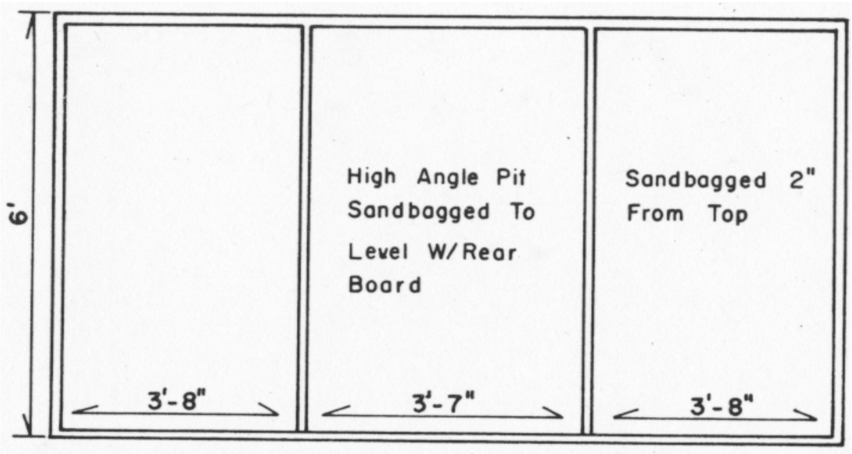


Figure 5. Top view of firing platform.

A plank was placed against the rear bulkhead to equalize the shock of recoil. Four braces were laid so that the ends of the braces were against the rear bulkhead block and to the rear of the trail spade pits (fig 6).

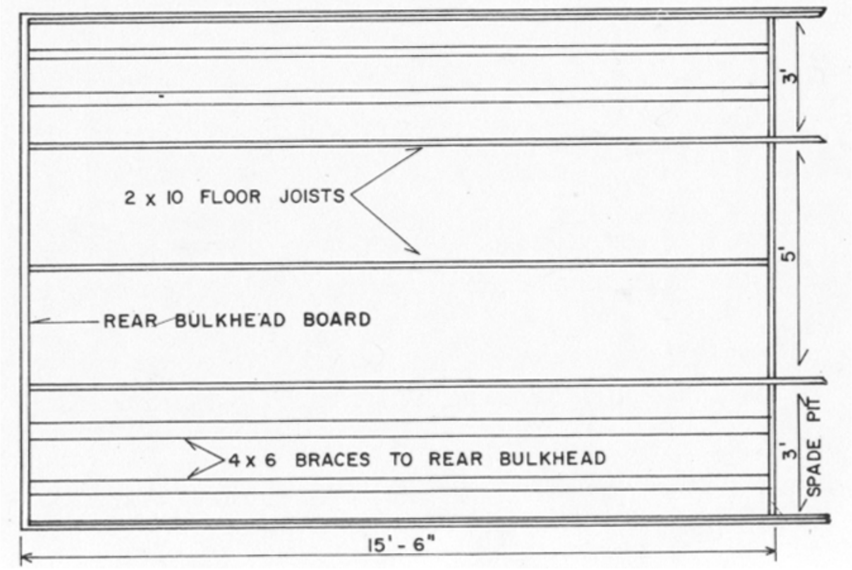


Figure 6. Floor joists and braces.

Seven 2″ by 10″ floor joists were placed on edge. All the joists, except the center joist, ran forward past the ends of the spade braces and formed the sides of the trail spade pits. The two outside joists were doubled to protect the side bulkheads from the spades (fig 6).

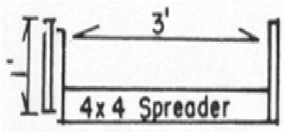


Figure 7. Front view of spade pit.

Spacers, 2″ by 10″, were placed every 3 feet between the floor joists, and flooring, 2″ × 8″ planks, was laid over the floor joists (fig 7). The trail spade pits were sandbagged to within 8 inches of where the spades would set, and trail logs were placed to form a buffer between the spades and the sandbags. A plank, 2 inches thick, formed the floor of the pits and protected the deck from damage.

An ammunition storage rack was constructed against each side bulkhead 8 feet forward of the rear bulkhead. From experience in firing, it was determined to be essential that the racks be emptied at the same rate to maintain an even keel (fig 1).

Since the ammunition load capability of the converted craft was 450 rounds, resupply was required for extended operations. It was decided that a landing craft, mechanized (LCM-8) would be used for this purpose because of its greater speed and load capability.

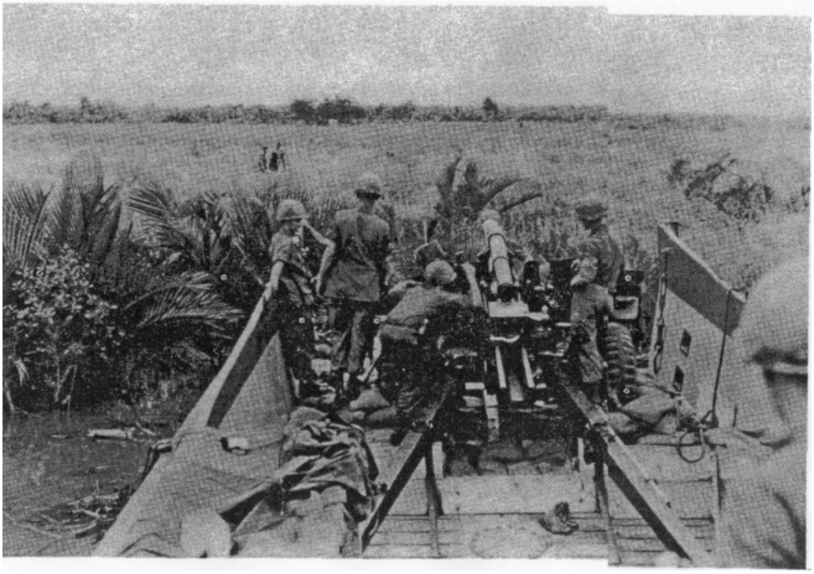


Figure 8. Laying for direction after craft was beached.

Because of the interior dimensions of the LCM-6, the howitzer trails could not be spread to the locking position. As a result, traverse capabilities were limited to 380 mils left and 375 mils right.

One problem was discovered when firing charge 7 at maximum left traverse. When a round was fired, the trigger arm rammed the trail, breaking the trigger shaft. A block was then attached to the right trail to prevent excessive traverse. Although traverse capabilities decreased, maximum and minimum elevations were retained.

Upon completion of the construction, the howitzer was placed aboard the craft and taken to a firing position on the edge of a marshy terrain. A position was selected on a gently sloping shore that was perpendicular to the line of fire. The shore was free from foliage and provided good visibility.

Beaching the craft proved to be the most critical phase of emplacement. The coxswain alined the craft on the azimuth of lay determined by the executive officer. The craft was then run as far up the shore as possible. Using the engines, the coxswain held the craft there while crewmen secured the bow. Trees and tree stumps served as anchors for mooring, although the craft contained six metal stakes for an alternate mooring capability. After the craft was secured, it was allowed to slide back against the mooring line.

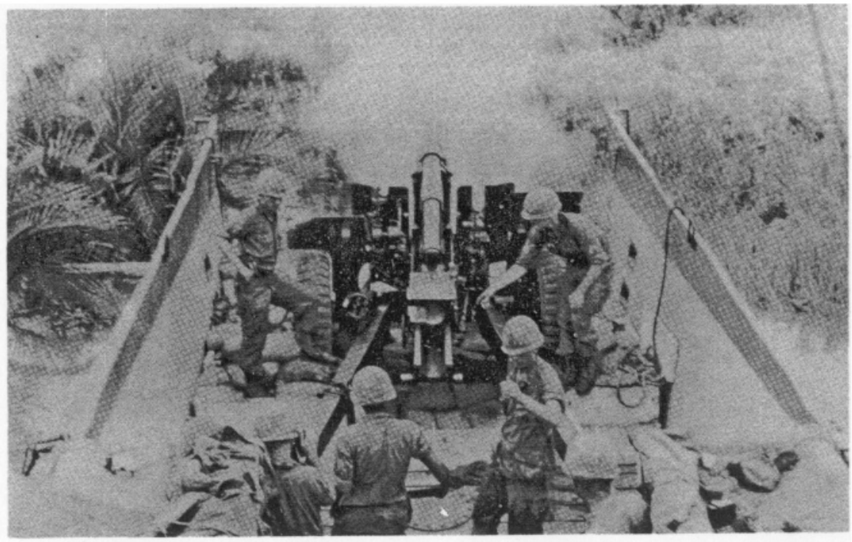


Figure 9. First round fired by converted LCM-6.

It was soon established that the craft, when beached as above, would be within 100 mils of the center of traverse. The craft, and not the howitzer, was laid as the coxswain maneuvered it in response to directions given by the gunner. The craft was then moored from the stern to maintain the lay.

Consideration of the time and level of the tide was vital for successful employment. The incoming tide could cause the craft to float off its mooring, and the outgoing tide could leave the craft aground. The craft was beached at high tide to obtain greatest stability.

In the first test firing, 40 rounds were fired by the howitzer in eight missions covering both low-and high-angle firing, extreme traversing, and relaying the craft when the target was outside on-carriage traverse limits. The greatest aiming post displacement between successive rounds was 8 mils, and accuracy of all fires was rated as good.

The test firing determined that—

- Stability must be maintained for acceptable results during firing.
- Accuracy of fires, both high and low angle, was comparable to that of fires of a ground-mounted howitzer.

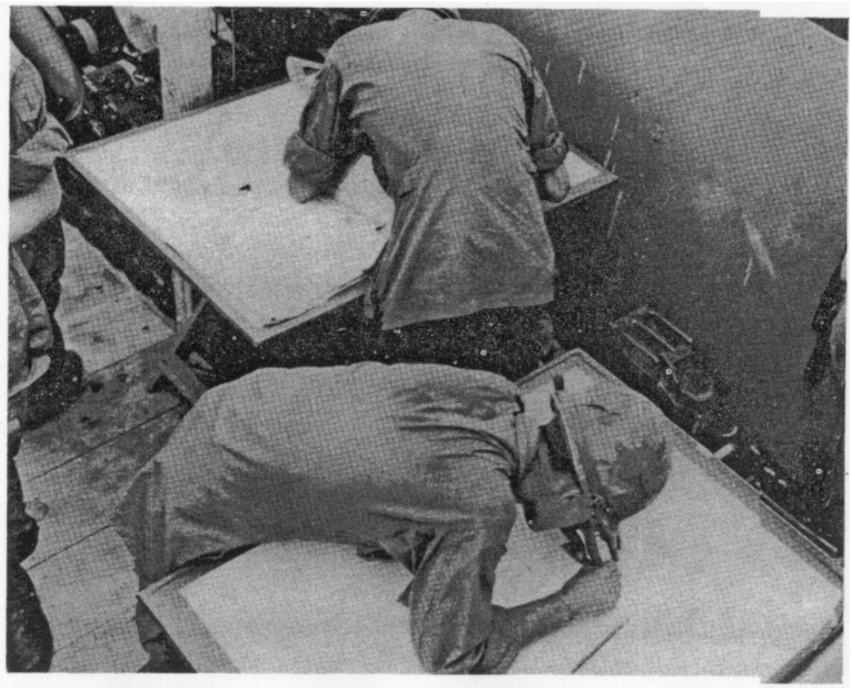


Figure 10. Fire direction center waterborne.

- Elapsed time required for firing the mission was comparable to that required for a ground-mounted piece. When the craft began to float off its beach site, it had to be reground and relaid for accuracy and safety.

- The construction on the landing craft performed its assigned function without modification.

After the first test firing, a second landing craft was modified, and a howitzer was placed aboard. Both howitzers then participated in a second test. After firing 85 rounds, the second test firing determined that—

- Each landing carft must be moored independently of the other. However, placing the craft close to each other had no adverse effect on the accuracy of the fires.

- All fire direction and gunnery techniques remained standard.

- Because of few identifying landmarks along the rivers, an aerial observer should be used to give the firing unit an accurate location.

- Accuracy and stability of the sheaf was comparable to that obtained by ground-mounted howitzers, providing the landing craft remained stable.

- Light rope (¾ or 1-inch thick) was more effective in mooring the landing craft than heavier rope because it was easier to handle, thus enabling the crewmen to moor the craft farther up on the beach.

- An AN/PRC-25 radio set positioned in the second landing craft provided the necessary control during movement and provided a backup means of communication.

- Telephone communications should be maintained between the landing craft upon occupation of the position.

Surveillance of fire from the crafts indicated that the accuracy and speed of the platoon compared favorably to the accuracy of a platoon in a normal ground position. The following determinations were obtained from the firing:

- Close coordination between the coxswain and the gunner was imperative.

- Charge 1, fuze quick, was highly effective in direct fire at a range of approximately 500 meters.

An intensive direct fire preparation should be fired on shorelines and inland approximately 200 meters before the craft occupies a firing site if the friendly situation permits.

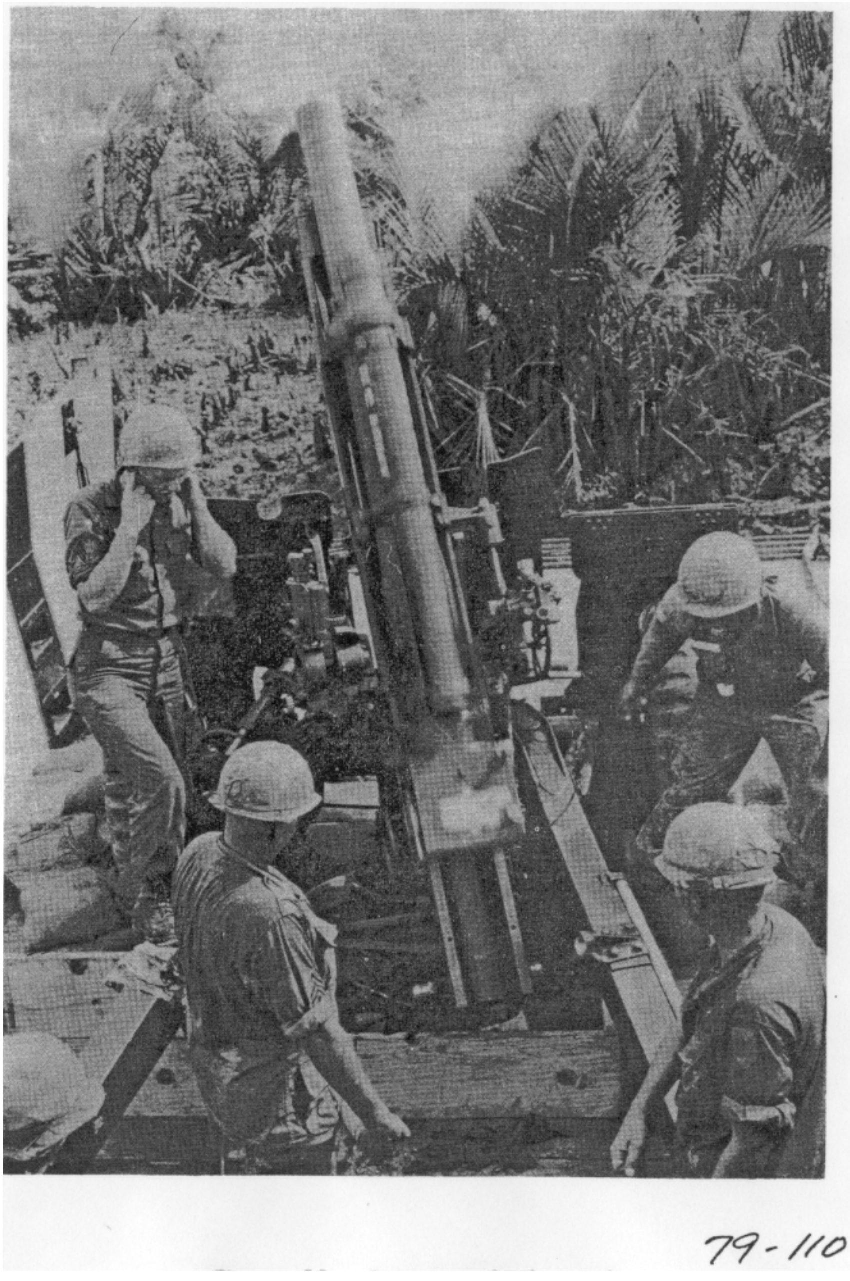


Figure 11. Firing at high angle.

PROPOSED PERSONNEL

With the successful employment of the two waterborne howitzers, the artillery gains ever greater mobility and maneuverability, which are valuable commodities in an unconventional environment. Although the conversion of a landing craft to an artillery firing platform may not be original, it posed a definite challenge to the unit involved in its construction. Their successful testing is indicative of how well that challenge was met.

Following is listed personnel proposed for the employment of a typical waterborne 105 unit:

Designation	Grade	MOS	Strength
Platoon headquarters			
Platoon commander	LT	1193	1
Fire direction officer	LT	1193	1
Platoon sergeant	E-7	13B40	1
Fire direction computer	E-5	13E20	1
Chart operator	E-4	13A10	2
Radiotelephone operator	E-3	13A10	1
Recorder	E-3	13A10	1
Howitzer section (two)			
Section chief	E-6	13B40	2
Gunner	E-5	13B40	2
Assistant gunner	E-4	13B40	2
Cannoneer	E-3	13A10	6
Ammunition section (one)			
Section chief	E-5	13B40	1
Ammunition handler	E-3	13A10	3
Medical aidman	E-4	91B20	1
Coxswain	E-4	61B20	2
Assistant coxswain	E-3	61B20	2
Engineer	E-4	61C20	2

M102'S TAKE TO THE WATER

Riverine artillery has taken even another form as two M102 howitzer batteries have been mounted on barges for greater mobility in marshy areas. Because of the shallow draft of the barges, this riverine artillery can be moved and emplaced along any waterway that has a depth of at least five feet and a width of approximately 50 meters.

The six weapons of each battery are mounted two on each barge. In addition to the howitzers which are bolted to the deck of the barge, two ammunition bunkers and a personnel bunker are constructed on the craft. Steel plating provides protection for crew members. In addition to three barges each battery has three LCM-8 landing craft which serve as prime movers. One LCM-8 is configured as the battery FDC.

The barges can best be positioned by utilizing the "far shore" concept. If possible, the barges are positioned on the bank away from the primary target area to allow the howitzers to fire away from the shoreline. This facilitates emplacement of a helipad on the shore next to the barges. To insure emplacement of barges along the shore in a minimum of time, they are tied alongside the LCM-8 prime movers so that the combination can maneuver against the current with the barge being placed closest to the side of the waterway on which it will be emplaced.

A steep bank with at least four feet of water at low tide is the ideal position for the artillery barge. This type of position allows the barge to remain level regardless of the tide. Although a shallow, sloping bank which allows the barge to become grounded during low tide provides

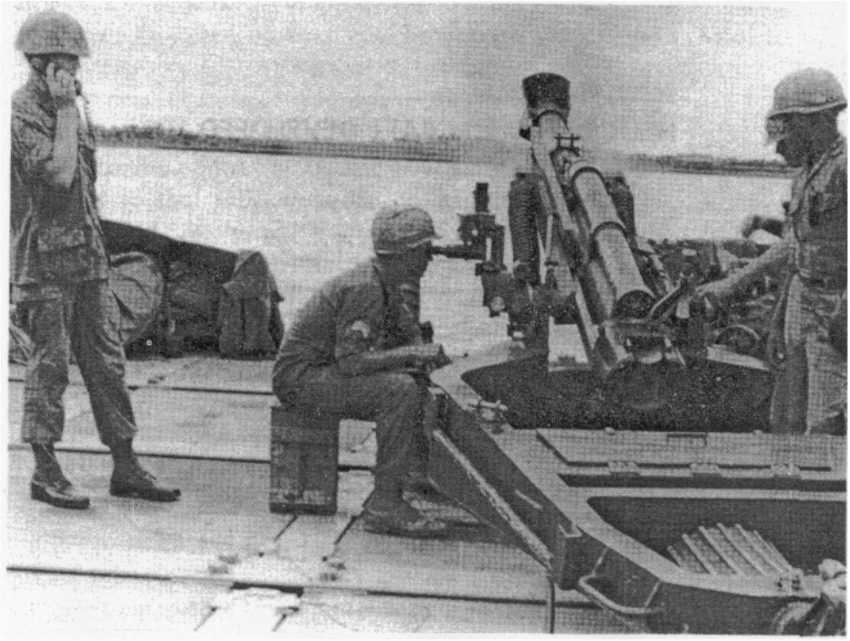


Figure 12. A section fires a round from their barge mounted M102 howitzer.

the most stable firing platform, some cant, depending on the slope of the bank, will develop as the barge becomes grounded. Best security is obtained by utilizing a bank with little or no foliage.

Reconnaissance is usually made during low tide by a small party consisting at most of the battalion S-3, battery commanders and a security element. The low tide reconnaissance yields maximum information as to the nature of the bank and surrounding area. At a minimum, an aerial reconnaissance should be made.

A riverine convoy usually consists of one Command and Communication Boat or monitor with navigation radar, two naval Armored Troop Carriers for transporting infantry security elements, an LCM-8 configured as the battalion FDC, the barges and LCM's of the two batteries and additional LCM's as necessary. The artillery enhances the security of the convoy by having the howitzers pointing toward the banks of the river. Beehive, HE and white phosphorus ammunition are at each weapon, ready to fire. Fifty caliber machine guns and small arms are also ready within the convoy.

The infantry security element is landed prior to beaching the barges. The barges are positioned off shore during the landing to provide direct fire support if necessary.

This innovation of positioning M102 howitzers on barges once again points out that the requirement for the artillery to keep pace with the supported force, even if they be amphibious, can be met with the ingenuity and imagination of the competent artilleryman.

HELICOPTER-AIRCRAFT DEVELOPED

The vertical-rising and landing AH-56A U. S. Army aircraft, named the "Cheyenne", is being developed on schedule. The first of ten prototype combat AH-56A air vehiclese ordered by the Army, has begun a series of systems tests leading to the first flight test.

The AH-56A is an advanced aerial fire support system designed to fly at nearly twice the speed of combat helicopters now in Vietnam. It is one of the first major weapon systems originated under the Department of Defense's contract definition concept. Manufactured by Lockheed-California Company, the AH-56A aircraft is designed to escort troop-carrying helicopters in air mobile operations, and provide direct fire support in combat landing zones. It will be able to carry wired-guided antitank missiles, rockets, a grenade launcher, and a belly machine gun with a 360-degree field of fire.

Its two-man crew—pilot and co-pilot—will be protected from ground fire by armorplate.

Designed for quick turn-around capability, an AH-56A returning from a combat flight could be readied and rearmed for a new mission within ten minutes. A complete engine change could be accomplished in 30 minutes. The aircraft employed the Lockheed-developed rigid-rotar system in which the rotar blades are fixed rigidly to the mast, instead of being hinged or tethered as on most other helicopters.

FIRST ROUND SMOKE

Captain Dennis I. Walter

Many of the procedures used by close support artillery units in counterguerrilla operations vary from the sound artillery procedure we learned and practiced at Fort Sill. The title of this article epitomizes the caution which is necessary in firing artillery close to friendly troops or villages in heavy jungle. The terrain and the nature of fire support requried in these areas have led to the development of several special procedures. Explained here are a few of these procedures, the reasons for using them, and the experience gained from using them.

The accuracy of the first round in any fire mission depends on the accuracy of the target location, battery location, and GFT setting. The difficulties encountered in satisfying these three basic requirements best explain the need for firing an initial smoke round when the target is close to friendly troops.

The problems in target location experienced by a forward observer would hardly stretch one's imagination. Obviously, navigation in double-or triple-canopy jungle is a trying test of map reading and the observer can seldom locate himself or a target to an accuracy of less than 200 meters. Survey control is nonexistent in a great part of these areas; consequently, a battery location is generally determined by resection, map spot, or traverse from map spotted coordinates. Direction is usually determined by means of a sun shot; however, if the sun is hidden by cloudcover, direction may be no more accurate that the magnetic needle of an aiming circle for determining direction.

The basis for GFT settings is usually an unprecise registration, an experience range correction, or in most cases MET plus VE. The registration point is generally a stream junction visible from the air, and map spotted coordinates are used. Stream junctions shift and the map locations of some junctions may be inaccuate by as much as 50 to 100 meters. (This was established by firing transfers on nearby stream junctions after a registration had been fired). Although suitable flash base OP's are accasionally available, they are seldom accessible from the ground or secure from a tactical standpoint. Highburst registrations, therefore, are impractical. Mean-point-of-impact registrations are not feasible due to the absence of visible impact points.

Even when a battery has been properly registered in the primary direction of fire, many missions will be fired outside valid transfer limits. In this circumstance and before registration, an experience range correction GFT setting is used and has proven reliable. The range corrections vary with altitude and terrain in some areas.

The use of MET plus VE GFT settings is limited by a lack of both basic elements. The met stations are anchored to large base camps and generally their weather data is invalid for the tactical areas of operations due to hill masses and the plateaued terrain. The 105-mm howitzers under these circumstances should be calibrated at least monthly to maintain a curent velocity error. In the past, only semiannual calibrations have been accomplished.

To compensate for these difficulties, three special procedures are used by forward observers. These are: sending their direction after the first round; creeping during adjustment; and marking a location with artillery. The observer is seldom certain where the initial smoke round will land in relation to himself and the target. To facilitate his adjustment, he sends a direction to the FDC after he has observed the smoke and then devises a method of moving the round based on the terrain and troop dispositions. Creeping is a must when the observer is adjusting by sound. When the observer surrounds his unit with defensive targets, he starts a good distance from the perimeter and creeps 50 or 100 meters with each adjustment until properly located.

Marking rounds, either high smoke streamers or low bursting illumination rounds, are fired frequently to aid in navigation or location of a lost element. The trained observer usually requests the marking round over a point 300 to 800 meters from his location. This point in space must, of course, be visible through the canopy. If the round is observed, the unit can reorient or continue to move. If the round is unobserved, many more rounds may be required at different locations before the observer can locate his position. Illumination rounds are occasionally fired at night to mark the way home for aircraft or to mark a route for medivac ships.

We presently use the 6400-mil system proposed by the USAAMS Department of Gunnery for M102 and M108 howitzers. This system is simple and accurate and we recommend it highly.

Many position areas are merely holes chopped in the jungle, and minimum elevations of 500 mils are common. The gunnery procedures described in FM 6-40 for high-angle fire are satisfactory; however, it is often desirable to use high-angle fire in close support of an element operating within the 2,200-meter minimum range for charge 1. We have experimented successfully with the extrapolation of firing data from the TFT to a range of 1,750 meters; however we found the rounds to be eratic at shorter ranges. The 1,750-meter range was achieved at elevations close to 1,300 mils.

Our batteries have perfected the procedure of lighting their own perimeter with high-angle illumination. Several satisfactory solutions to this problem can be gleaned from the trajectory charts in the TFT; however, we have found that charge 4 will insure the most reliable results. Firing charge 4, elevation 1,000 mils, and time 4.5 seconds will place the illumination 700 meters to the front of the howitzers and not light up the position area.

On two occasions we have found it necessary to fire the M102 howitzer beyond the maximum TFT range. In each case the target was an area target and no friendly forces were in the vicinity. Theoretically, maximum range can be achieved at an elevation of 800 mils, and at this elevation we satisfactorily covered the targets with the mean point of impact 12,000 meters from battery center.

In general, the standard selections of fuze and projectile for type targets have proved valid. The one major exception is that neither light nor medium artillery rounds will penetrate the jungle canopy in sufficient quantity to successfully attack a bunker complex. The preponderance of rounds will detonate as airbursts even when fuze delay (M51A5) is used. Under these circumstances, we have had success in alternating shell WP and HE with fuze delay. The WP started numerous fires which caused panic and exiting of the bunker under the casualty-producing HE airburst. We also have employed the CVT fuze to great advantage for firing into rice paddies where HE with fuze quick detonates under the water with a greatly reduced lethal bursting radius.

When viewing the artillery procedures now utilized, we must conclude that they are far from the sophisticated gunnery which is our goal. More calibrations, met data, survey, and improved maps are necessary before the accuracy of unobserved fires and the first round of a mission can be refined. Until these areas are improved considerably, we will have to continue firing "First Round Smoke."

Adjust by Sound

Captain Charles W. Jackson, Jr.
Gunnery Department
USAAMS

The mission of the artillery and the forward observer is to provide timely and accurate fire. In many situations, an ambush for example, timely means immediately; even the time of flight is a long time to the ambushed force. The fire, to be effective, must neutralize or destroy the enemy, but it must not inflict casualties among the supported troops. Accurate target location (i.e., the location of the observer with the force) is paramount. All factors must be carefully weighed because the adjustment will be so close to the friendly force that even a minor error could be tragic. In a counterinsurgency environment, the forward observer with an infantry company faces situations that are seldom encountered in more conventional operations. Probably, the terrain will vary from flatland to broken or mountainous areas, the vegetation will vary from open hardwood forest with a single canopy to dense jungle with a 200-foot triple canopy, and all movement will be by foot. Generally, the observer's map will be accurate and to a scale of 1:50,000. The targets are generally within 300 meters of the forward observer and are at the limit of his field of observation.

Basic observed fire procedures apply in this environment, and the observer should be well trained in their use. However, he will have little experience in adjusting close artillery fires, and the conditions under which he must request and adjust them will be unfamiliar to him. The infantry company will need these close artillery fires and will be depending upon him to provide them. As unfamiliar as an observer will be with this environment, a little forethought, ingenuity, and mental rehearsal will enable him to overcome these obstacles and provide the needed fires.

TARGET LOCATION

Accurate target location is the most important element of a call for fire, and the determination of this element is the most time consuming. If the observer knows his map location, he should have little difficulty in locating a target that is no more than 300 meters from his position. Frequently, the observer, because of the terrain and the tactical situation, will encounter difficulty in ascertaining his location.

Presumably, the observer will travel from familiar terrain to unfamiliar terrain. As he does so, he should continually refer to his map and determine his position through association of map features with the ground features. In some areas, it may be difficult for the observer to associate map and terrain features. A member of the party can determine location by dead reckoning, the process by which one's present location is determined by plotting the course and distance from the last known location. All personnel should be familiar with this procedure, which is included in basic mapreading training. Often, an air observer, because of his more advantageous view of the terrain from the air, can determine the ground observer's location. Recognition signals and a means of communication are necessary for coordination between the two observers.

The observer can determine his location by resection from the location of two or more artillery rounds. The observer measures the azimuths to two or more white phosphorus bursts fired at map locations that will provide angles of resection between 400 and 2,800 mils. If he cannot see the white phosphorus shell, he should call for high-explosive shell with variable time fuze. The observer determines the direction by selecting a reference mark along the line to the sound of the burst and then measuring the azimuth to the reference mark. The observer uses the measured azimuths to the bursts for determining his location by the back-azimuth method of resection. The resection method may be used by the observer when it is undersirable to call fire near his position.

The observer may call for and adjust, if necessary, a marking round of colored smoke shell fuzed to burst in the air, or if the smoke shell cannot be observed, he may call for illuminating shell. If neither can be observed because of the canopy, high-explosive shell with variable time fuze, which can be heard for a considerable distance, should be fired. The replot data can be used to establish or confirm the map location of the round, which should then be replotted on the firing chart as a known point. Also, the observer can determine his location with relation to that of the marking round.

ADJUSTMENT BY SOUND

Usually, the observer has received some training in estimating the distance to a burst by timing the interval between the appearance of the flash and the arrival of the sound at his position. The interval can be timed with a watch or by counting; for example; "one 1,000, two 1,000," etc. The approximate distance to the burst can be determined by multiplying the interval in seconds by 350 meters per second, which is the speed of sound for practical use by the observer.

Since in much of the counterinsurgency area it will be difficult, if not impossible, for the observer to see the shell burst, the firing must be coordinated and the observer must be informed by the fire direction center when the round is to burst. A "splash and countdown" procedure is used by the FDC for informing the observer when the burst will occur. The standard warning SPLASH is given 5 seconds before burst and is followed by the countdown; for example, SPLASH-FOUR-THREE-TWO-ONE-BANG. The observer measures the time interval between the warning BANG and the arrival of the sound and calculates the distance to the burst. Since the warning BANG must be transmitted concurrently with the detonation of the round, accurate time-of-flight data are necessary for successfully accomplishing the splash and countdown. The FDC establishes a time-of-flight gageline on the graphical firing table after timing the flight of a projectile fuzed to burst above the piece mask. The following example illustrates the adjustment by sound and the use of a marking round for establishing the observer's location:

Forward observer:	FIRE MISSION—GRID 123456—DIRECTION 1600—MARKING ROUND—YELLOW SMOKE—200 METER HEIGHT OF BURST—ADJUST FIRE—OVER.
FDC:	FIRE MISSION GRID 123456—DIRECTION 1600—MARKING ROUND—YELLOW SMOKE—200 METER HEIGHT OF BURST—ADJUST FIRE—OUT.
FDC:	SHOT—OVER.
Forward observer:	SHOT—OUT.

The forward observer is unable to observe the round of yellow smoke; therefore, he decides to fire high-explosive shell with variable time fuze and, in addition, requests splash and countdown.

Forward observer:	HE—VT—REPEAT—SPLASH AND COUNTDOWN—OVER.
FDC:	HE—VT—REPEAT—SPLASH AND COUNTDOWN—OUT.
FDC:	SHOT—OVER.
Forward observer:	SHOT—OUT.
FDC:	SPLASH—FOUR—THREE—TWO—ONE—BANG—OVER.
Forward observer:	BANG—OUT.

The forward observer measures a time interval of 4 seconds between the bang and the sound of the burst. He selects as a reference mark a tree in line with the direction to the sound.

Forward observer:	END OF MISSION—OVER.
FDC:	END OF MISSION—OUT.

The forward observer measures an azimuth of 1,600 mils to the reference mark. He calculates the distance to the burst to be 1,400 meters (4 seconds X 350 meters per second). By plotting from coordinates 123456 a distance of 1,400 meters along a back-azimuth of 4,800 mils (1,600+3,200), he determines his location to be coordinates 109456.

COUDUCT OF MISSION

The ideal artillery mission is one which produces accurate fire for effect with the first rounds. The fastest and safest way to call fire on a target is by a shift from a previously fired target. Whenever the situation permits, an observer should maintain a recently fired target to his front—even if he cannot observe it. From this, target fire may be quickly adjusted into other targets as they appear. Defensive fires for the perimeter are planned and often are adjusted on potential target areas. If targets appear in or near these areas, fires can be rapidly and accurately brought to bear on them. Shifting fire from a known point should present little difficulty for the experienced observer.

However, when the target is to be located by coordinates, modification of **standard** techniques may be necessary, depending on the terrain and vegetation. The coordinates given in the call for fire should place the initial round in front of the observer and the supported force but close enough to the observer's position to permit adjustment by sound. Since the initial round will be close to the position, it should, for safety, be colored smoke shell fuzed to burst from 100 to 200 meters in the air to produce a streamer effect.

If the colored smoke round is spotted (the streamers are observed in the air, the smoke is observed near the ground, or the pop of the canisters being ejected is heard), the observer should change to high-explosive shell with fuze quick. He should be aware that high-explosive shell, because of ballistics differences, will impact at a greater range than that of the smoke canisters. The variation in range depends on the elevation fired and is greater for low elevations. The sound adjustment is initiated with the first round of high-explosive shell.

Accurate deviation spottings are difficult to make in a sound adjustment. Therefore, bold shifts and the establishment of a deviation bracket are desirable. When the deviation of the round from the OT line is great and the range (along the OT lines) is doubtful, a deviation correction without a range change could cause the round to impact on the observer's (and the supported force's) position. When the deviation is great and the range is doubtful, the observer should give a range correction to insure that the next round will impact a safe distance forward of the position. When the round is relatively close (within 1,000 meters), the observer should use one-half of the estimated range as the range correction.

The observer should request the battery in adjustment when his next corrections will cause the rounds to impact approximately 300 meters from the position. Thus, the observer can insure a safe sheaf in fire for effect and, perhaps, obtain early fire for effect. Also, the observer must consider the relationship of the trajectory to the location of the supported force. If tree bursts over the friendly force are possible, high-angle fire should be considered. Range dispersion becomes an important factor as the rounds are brought closer to the position. At the longer firing ranges, dispersion is greater and should be more carefully considered. The observer should remember that the tabular values of probable errors are based on firings of carefully selected ammunition under controlled conditions. The actual round-to-round errors experienced in the field normally will be larger than those listed in the firing tables.

If the initial smoke round is not spotted, there is a possibility that it may be a dud. If the observer is well oriented he should call REPEAT. If the initial smoke round bursts a considerable distance from the desired location, the observer should request high-explosive shell with variable time fuze, providing friendly forces in the area will not be endangered. If friendly forces will be endangered, he should request illuminating shell. If the high-explosive shell or illuminating shell bursts within 1,000 meters of the observer, he should call for high-explosive shell with fuze quick and begin the sound adjustment. If the initial round is more than 1,000 meters from the observer, he should change to colored smoke, make a large correction to bring the round close enough to be easily observed, and then begin the sound adjustment with high-explosive shell with fuze quick.

The following example illustrates the adjustment of fire by sound on a close-in target.

Forward observer: FIRE MISSION—GRID 246135—DIRECTION 1800—AUTOMATIC WEAPONS FIRING—YELLOW SMOKE—200 METER HEIGHT OF BURST—ADJUST FIRE—OVER.

FDC:	FIRE MISSION—GRID 246135—DIRECTION 1800—AUTOMATIC WEAPONS FIRING—YELLOW SMOKE—200 METER HEIGHT OF BURST—ADJUST FIRE—OUT.
FDC:	SHOT—OVER.
Forward Observer:	SHOT—OUT.

The observer estimates that the initial round burst at least 2,000 meters from his position. The only forces in this area are those which he is supporting; therefore, he decides to change to high-explosive shell with variable time fuze.

Forward observer:	HE—VT—SPLASH AND COUNTDOWN—OVER.
FDC:	HE—VT—SPLASH AND COUNTDOWN—OUT.
FDC:	SHOT—OVER.
Forward observer:	SHOT—OUT.
FDC:	SPLASH FOUR—THREE—TWO—ONE—BANG—OVER.
Forward observer:	BANG—OUT.

The observer measures an interval of 6½ seconds between the bang and the arival of the sound, and he selects as a reference mark a tree in line with the direction to the sound. He measures an azimuth of 1,400 mils to the tree and computes a distance of 2,275 meters (6 ½×350) to the burst. Since the round is more than 1,000 meters from his position he decides to change to colored smoke for the next round.

Forward observer:	DIRECTION 1400—YELLOW SMOKE—200 METER HEIGHT OF BURST—DROP 2200—CANCEL SPLASH AND COUNTDOWN—OVER.
FDC:	DIRECTION 1400—YELLOW SMOKE—200 METER HEIGHT OF BURST—DROP 2200—CANCEL SPLASH AND COUNTDOWN—OUT.
FDC:	SHOT—OVER.
Forward observer:	SHOT—OUT.

The observer spots the smoke round and decides to begin the adjustment by sound.

Forward observer:	DIRECTION 1800—HE—QUICK—ADD 300—OVER.
FDC:	DIRECTION 1800—HE—QUICK—ADD 300—OUT.
FDC:	SHOT—OVER.
Forward observer:	SHOT—OUT.

The observer estimates that his next corrections will cause the round to impact 300 meters from his position; therefore, he decides to adjust with the battery.

Forward observer:	BATTERY—RIGHT—100—DROP 100—OVER.
FDC:	BATTERY—RIGHT—100—DROP 100—OUT.
FDC:	SHOT—OVER.
Forward observer:	SHOT—OUT.
Forward observer:	LEFT 50—DROP 50—FIRE FOR EFFECT—OVER.
FDC:	LEFT 50—DROP 50—FIRE FOR EFFECT—OUT.
FDC:	SHOT—OVER.
Forward observer:	SHOT—OUT.
FDC:	ROUNDS COMPLETE—OVER.
Forward observer:	ROUNDS COMPLETE—OUT.
Forward observer:	STAND BY—AUTOMATIC WEAPONS SILENCED—TARGET AREA IS BEING CHECKED—OVER.
FDC:	STAND BY—AUTOMATIC WEAPONS SILENCED—TARGET AREA IS BEING CHECKED—OUT.
Forward observer:	END OF MISSION—SIX KILLED—TWO WOUNDED—OVER.
FDC:	END OF MISSION—SIX KILLED—TWO WOUNDED—OUT.

An air observer, if available, can provide considerable assistance in adjusting close fires. The forward observer either initiates the mission and then requests the air observer to conduct the adjustment, or, if the target is first identified from the air, the air observer may initiate the mission and conduct the adjustment. In either event, the forward observer is responsible for monitoring and maintaining control of the mission and for making corrections, if necessary. When the rounds are moved close to the friendly positions, normally the forward observer will take over the mission. The air observer will assist in the surveillance.

SAM-D MISSILE SYSTEM

Artist's drawings of the Surface-To-Air-Missile Development (SAM-D) have been released, revealing for the first time how the highly-mobile, all-weather system might look.

Aided by high-speed digital computers, SAM-D will be able simultaneously to acquire, identify, track, and destroy multiple air-supported targets. It now is in advanced development, for the purpose of advancing U. S. technology in this area.

FO Found By Sound

Colonel Salvo Rizza
Director, Gunnery Department
USAAMS

Normally when desiring to verify his position, a forward observer merely needs to request that two rounds be fired at different deflections in the same general area. After spotting the rounds, the forward observer measures the back-azimuths, which are plotted by the FDC. A fairly accurate position can be determined at the point where the two lines intersect. This method of resection is simple, adequately accurate, and requires only a compass which any FO is rarely without.

But in a situation where a thick jungle canopy restricts field of vision, an alternate method is required. One such method recently devised is based on sound and the rate at which sound travels. To use this method, the forward observer needs a compass and a watch with a sweep second hand. A simply constructed acetate template (fig 1), drawn to a 1:25,000 scale, is used in conjunction with the normal firing chart in the fire direction center. It is assumed that the general area in which the observer is located may be determined by knowledge of the tactical situation and the last known location of the observer. This general area is outlined on the template. Curves which represent the time interval between simultaneous burst are also displayed on the template.

Having determined the general area in which the observer is be-lived to be, the FDC places the template on the firing chart so that the zero line (centerline) is alined with the battery and the general observer

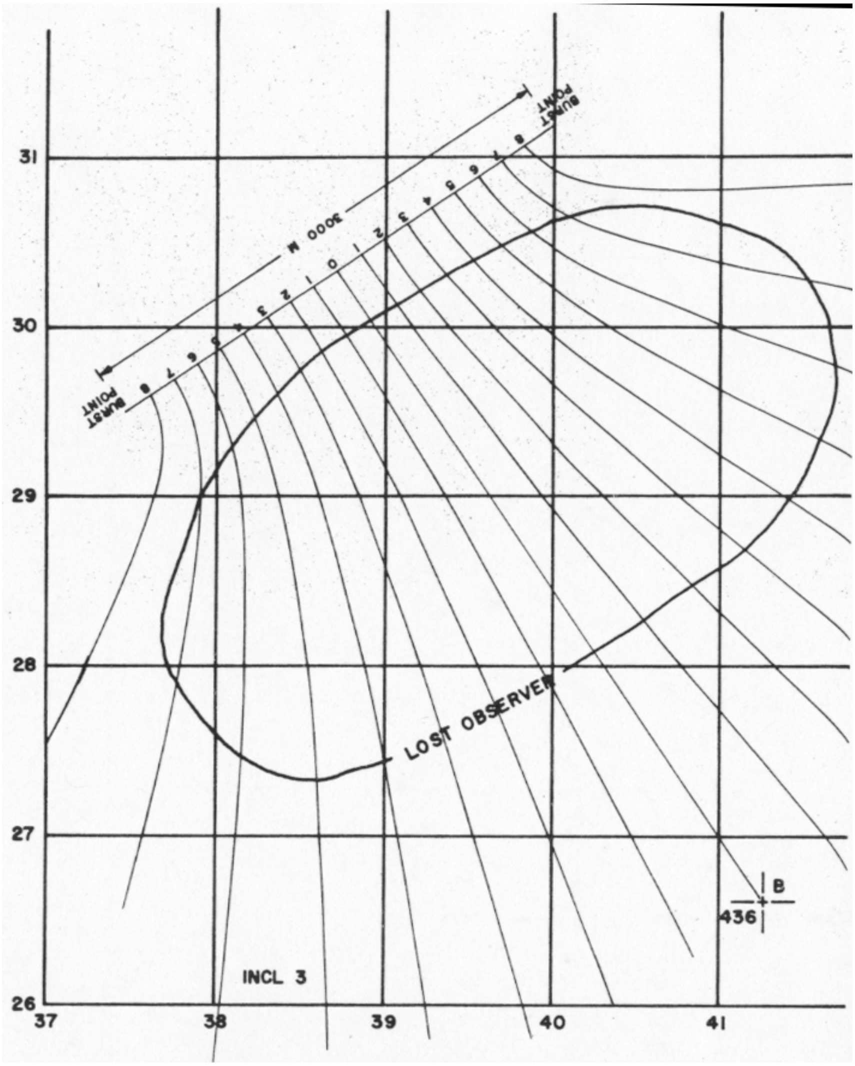


Figure 1. Template with time interval rays and general observer area.

area. The time interval rays may extend either toward or away from the firing unit's location. The quadrant and fuze setting are computed for the firing of two rounds which are to burst simultaneously at the burst points on the template. The rounds should have at least a 200-meter height of burst to minimize sound distortion and to preclude firing on friendly personnel. By selection of the proper height of burst, the bursts may be observed from the firing battery position or from an aircraft to

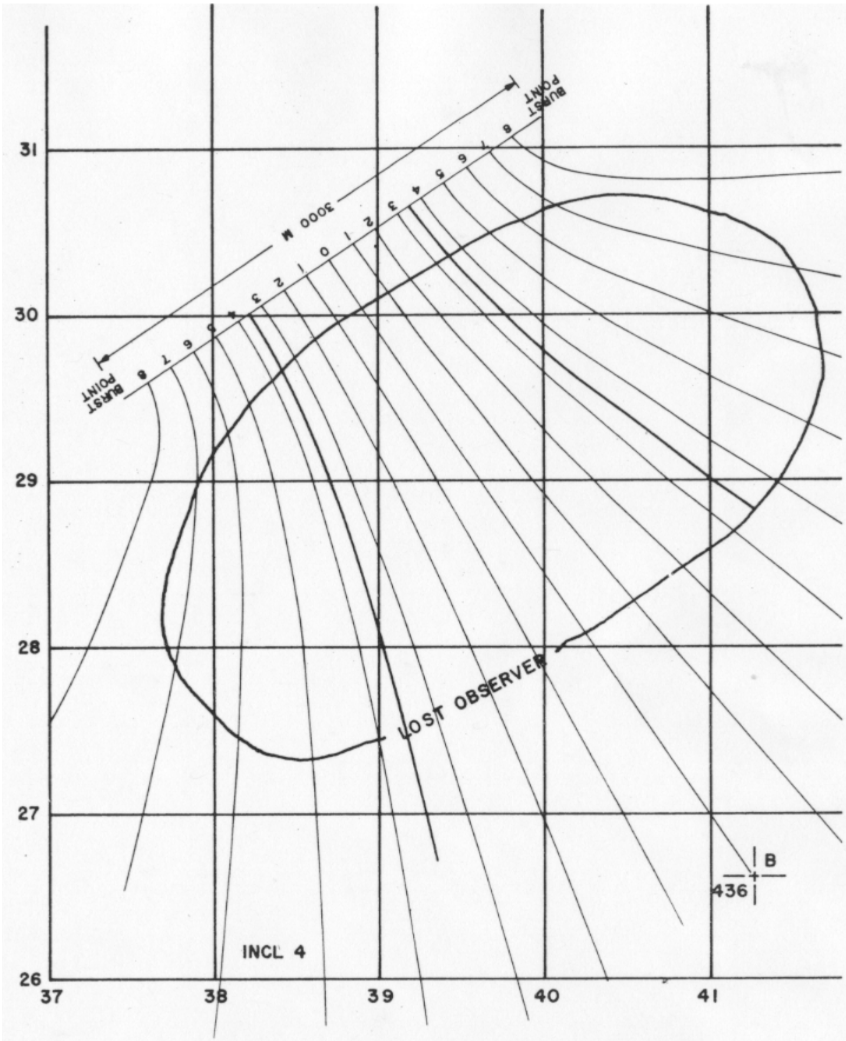


Figure 2. Time interval measured at 3.5.

insure that the rounds function at the same time. The rounds should burst at a deflection spread of 3,000 meters.

When the firing data is computed, the observer is instructed to prepare to time the sound interval between bursts. SPLASH is announced, and the observer reports the measured time interval. With an announced time of 3.5 seconds (fig 2), the observer could be along one of two possible time interval rays. He could be between the third and fourth rays on either side of the centerline. To determine on which side of the centerline

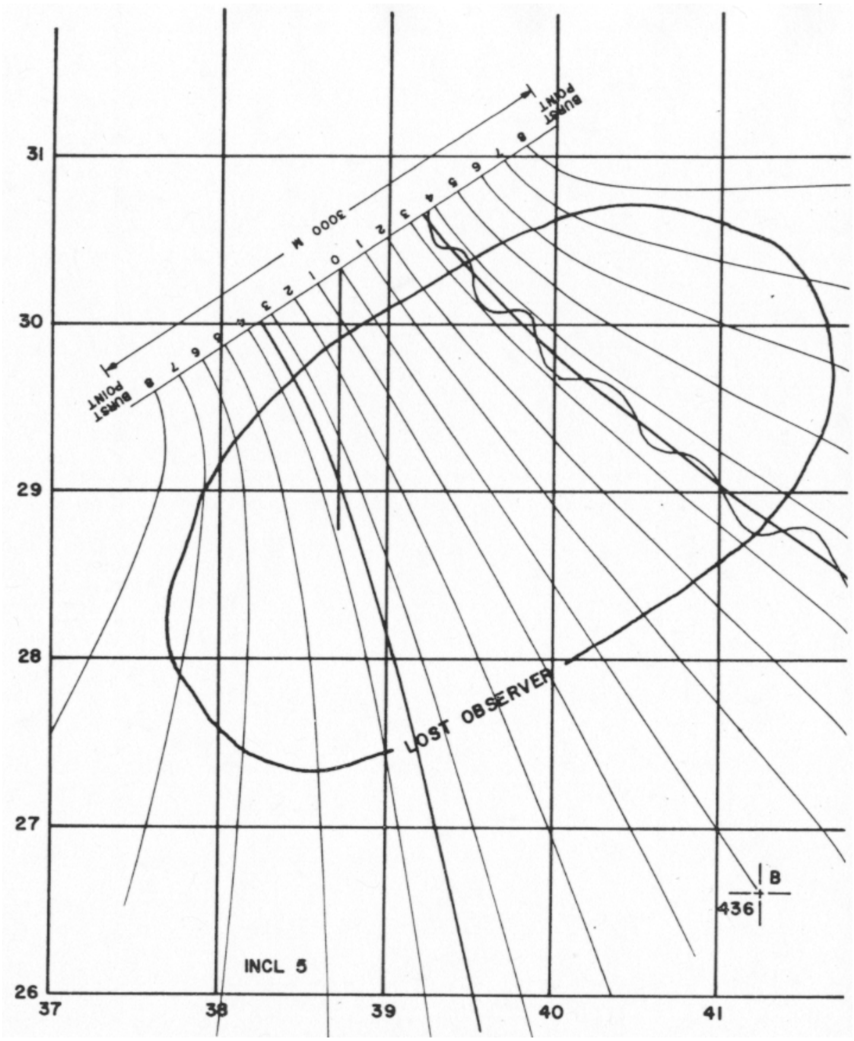


Figure 3. Back-azimuth eliminates one ray.

the observer is located, the FDC then has a single round fired at the center point between the two bursts and at a height of 200 meters. An azimuth is estimated to the sound of the burst by the forward observer. The fire direction center then constructs a back-azimuth from the point of burst plotted on the chart. This back-azimuth should intersect only one of the previously identified time interval rays. The observer's location is placed at the intersection (fig 3). Only under optimum conditions and with experienced observers can an accurate location be expected

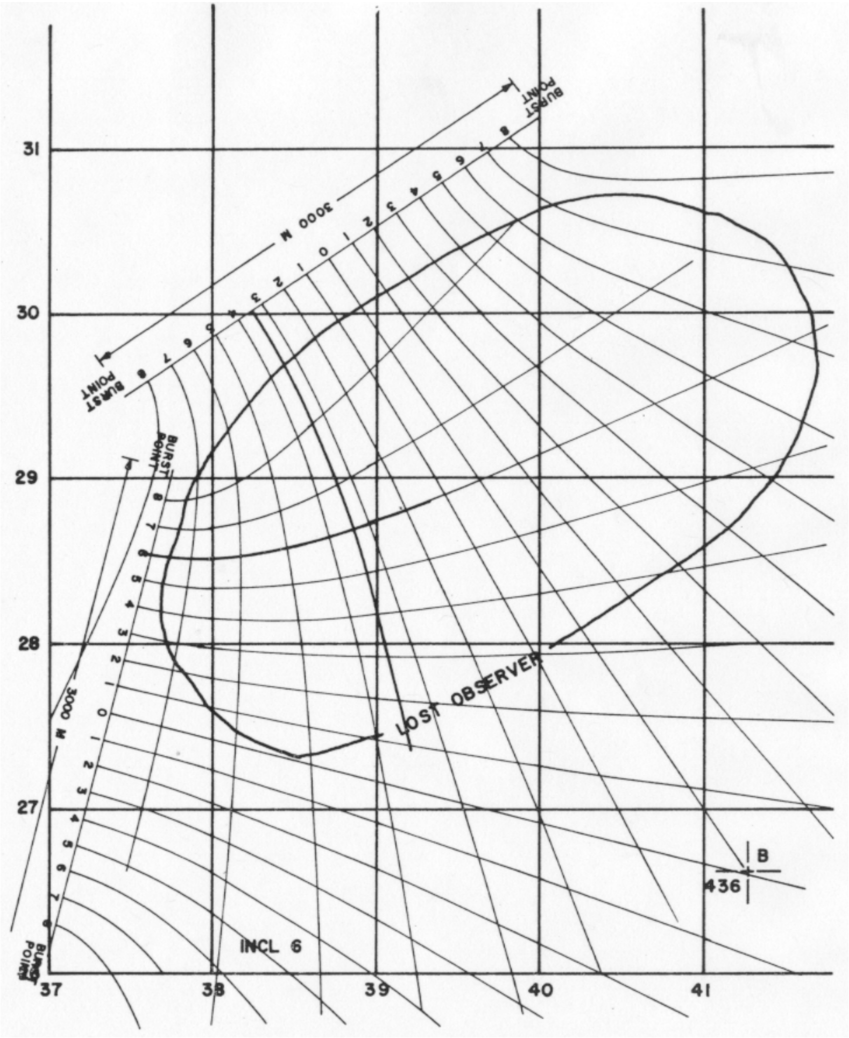


Figure 4. For a more accurate location.

with this intersection. However, in nearly every case, this back-azimuth will positively eliminate one of the two time interval rays. In some cases the terrain and tactical situation may eliminate the need for this single round to be fired.

For a more accurate location (fig 4), the two howitzers may be shifted 800 mils left or right, the template repositioned, and two more rounds fired before the single round is fired. The observer's location is placed at the intersection of the appropriate time interval ray and the previously determined ray.

If speed of location is critical or if artillery fire is desired by the observer, a second procedure is recommended. After the appropriate time interval ray has been determined, creeping rounds may be fired along the ray until a burst is located by the observer. At this point, the observer will control the adjustment by sound adjustment or visual techniques.

Many occupied unknown points can be located at the same time by use of this method. For any observer, the measured azimuth of the third burst becomes more critical as the time interval between simultaneous bursts lessens. If less than a second, the time interval may not provide the required assurance of discrimination for elimination of one of the azimuth rays. In this case, the template should be shifted and the rounds should be fired again to provide a larger time interval at the observer's location.

One of the most valid checks that can be performed is to compare data determined by the foregoing method with data measured by an observer in a known location. Accurate locations cannot be expected unless accurate corrections are available.

Several shortcuts will become obvious to the user of this technique as experience in its use is gained through practice. Careful map study and knowledge of the tactical situation are the most important factors in successful use of the time interval template.

Efforts are being made to locate or develop a small time interval measuring device which, upon activation, automatically measures time interval between successive sounds to 25 to 50 milliseconds. Such a device will increase accuracy considerably by eliminating the human reaction errors inherent in starting and stopping a stop watch. It is believed this device can be made extremely simple and the size of a package of cigarettes.

MALLARD SYSTEMS STUDIES NEGOTIATED

The U S Army has begun final negotiations with the Radio Corporation of America and Sylvania Electronics Systems, Inc., for each company to perform a major system study in the United States for the MALLARD Project.

A separate system study will be performed by an industry in the United Kingdom.

The MALLARD project is a cooperative international program for the development and production of a major tactical trunking and distribution communications system for use within the Field Armies of the United States, the United Kingdom, Canada and Australia.

How to "Prep" A Landing Zone

MAJ Edward J. Bunn

One of the primary tasks of the artillery in combat is the firing of preparations for a heliborne assault. The purpose of the "prep" is to destroy or neutralize the enemy and his defenses in the vicinity of the landing zone and to suppress antiaircraft fire.

The prep should be intense, cover the entire threat area, and be as brief as possible for accomplishment of the mission. The latter is a critical factor in achieving surprise and limiting the enemy reaction time. The prep must be continuous and must be shifted from the landing zone just before the initial assault elements touch down. A variety of procedures are followed in coordinating prepfires. One procedure that has proved to be very effective is discussed in the example below.

THE PROBLEM AND MISSION

The landing zone is typical—a clearing in the jungle containing rice paddies and overgrown cultivated fields (fig 1). The infantry commander desires a 20-minute artillery and air preparation with emphasis on the bunkers and trench system that have been reported to be in the tree line on the southwest side and the northwest corner of the landing zone. The prep also is designed to suppress possible antiaircraft fire. Due to prevailing winds and the landing zone orientation, the troopships will approach from the northwest and exit to the southeast.

FIRE SUPPORT

Two airstrikes are available. Each airstrike will consist of three sorties armed with conventional bombs, cluster bombs and napalm. Two 105-mm howitzer batteries, one 155-mm howitzer battery, and one 8-inch howitzer battery are within range. The artillery positions are to the south of the landing zone.

CONTROL

An air observer has been assigned by division artillery to adjust the fires and the artillery liaison officer will be airborne with the Infantry commander to provide a command and control link with the assaulting element. The air liaison officer (ALO) and the infantry S3 will also be in the command and control ship. In addition an observation helicopter has been made available for the direct support (DS) artillery battalion commander.

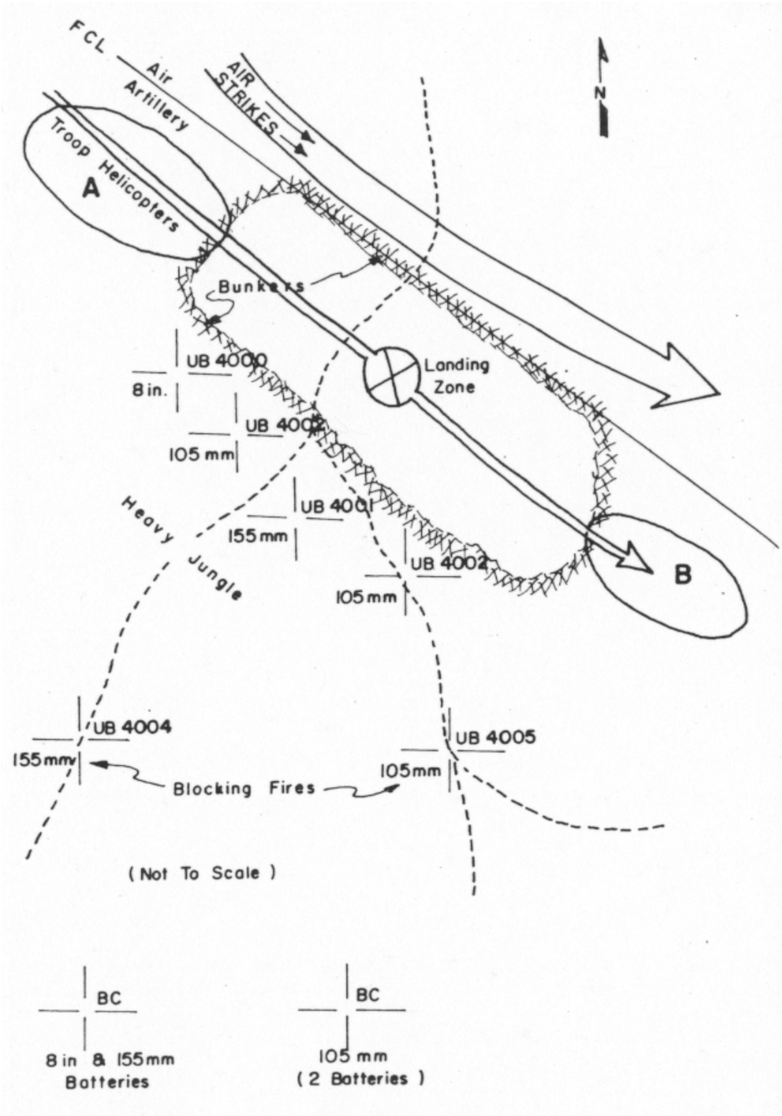


Figure 1. Landing zone.

PLANNING

The initial step in planning is an aerial reconnaissance of the landing zone by the artillery battalion commander or S3. If aerial reconnaissance is not possible, aerial photo or map reconnaissance should be made from the new series of pictomaps.

Coordination between the artillery liaison officer and the air liaison officer establishes the artillery-tactical air, fire coordination line along, and parallel to, the tree line on the northeast side of the landing zone. This will allow the artillery to fire to the southwest of this line without endangering the tactical bombers. The aircraft can make bombing runs along the northwest-to-southwest path without being endangered by artillery shells. The airstrikes will consist of bombing runs along the known northeastern bunker locations and runs along and inside the tree line bordering the landing zone. These airstrikes and the artillery prep discussed below will be occurring at the same time.

FIRE PLAN FOR THE ARTILLERY PREP

Unit	Target	Method of Fire
8-inch howitzer battery	UB4000	Battery 2 rounds
155-mm howitzer battery	UB4001	Battery 3 rounds
105-mm howitzer battery	UB4002	Battery 4 rounds
105-mm howitzer battery	UB4003	Battery 4 rounds

To provide better coverage of the hard targets and jungle area a fuze mix of 50 percent delay is normally used.

Before the mission the air observer and fire units are briefed on the following points.

(1) The fires of the 8-inch howitzer battery are to be shifted by using 50-meter and 100-meter shifts to thoroughly cover the area of suspected bunkers and trenches at the west end of the landing zone.

(2) The fires of the 155-mm howitzer battery are to be moved by using 50-meter and 100-meter shifts to saturate the heavier jungle west of the landing zone from the tree line to a depth of approximately 300 meters.

(3) The fires of the two 105-howitzer batteries are to be moved by using 50-meter shifts to saturate the tree line (overlapping the coverage of the 155-mm and 8-inch howitzers) to a depth of 150 meters. The 105-mm fires should be moved to the ends of the landing zone and then out to a depth of 400 meters along the troop helicopter approach and departure flight paths (in the vicinity of areas A and B, fig. 1). These areas should be receiving fire just prior to the helicopter assault to suppress antiaircraft fire.

(4) The air observer, DS battalion FDC, and all fire units will operate on one fire net with a minimum number of transmissions. Batteries will announce only the call sign and SPLASH for the initial rounds in each fire for effect (FFE). For example, assume that Battery A computes corrections and fires battery four rounds in fire for effect with the new data. The battery computes the time of flight and announces ALFA, SPLASH, 5 seconds prior to impact of the first of the four volleys. The observer's attention will be directed to the Battery A impact point by the announcement of ALFA, SPLASH. The observer will spot the first round and then announce the corrections to Battery A to move the fires to cover the

next desired area. Battery A will read back the corrections. If the Battery A read-back is correct, the next transmission between Battery A and the observer will be ALFA, SPLASH on the next fire for effect, and the observer will be free to direct his attention to the other fire units. A sample transmission is as follows:

Battery A: ALFA, SPLASH.
Observer: ALFA, LEFT 50, REPEAT, REPEAT.
Battery A: ALFA, LEFT 50, REPEAT, REPEAT, OUT.

It is imperative that this abbreviated radio procedure be utilized. It permits the necessary and accurate exchange of information between the observer and the fire units in the least possible time and with the least confusion. The first "REPEAT" requests the same range to be fired. The second "REPEAT" refers to fire for effect.

CONDUCT OF THE PREP

A thorough briefing and a competent air observer are the critical factors in the success of the prep. Once the firing starts, it is the observer who "moves" the artillery to provide the desired coverage. The DS battalion FDC controls the prep, but it relies on the observer to implement the plan. The artillery battalion commander and the infantry commander (through the artillery liaison officer) may request more thorough coverage of a particular area by contacting the DS battalion FDC on another communication net, such as the battalion command fire frequency. The DS battalion FDC controls and monitors the entire prep and aids the observer by passing on requests from the infantry commander and other observers.

The prep is started with a countdown from the DS artillery battalion for a time on target mission for all firing units. Before the countdown is initiated, a check is made with the artillery liaison officer to insure that the helicopters and airstrikes are on schedule. Once the firing has started, the observer adjusts the artillery in accordance with his briefing and advice from the infantry and artillery commanders.

While the helicopters are landing and the infantry is making initial deployments, the 155-mm howitzer battery and one 105-mm howitzer battery execute blocking fires (on targets UB404 and UB405) to prevent enemy reinforcements from reaching the LZ and to prevent wounded and disorganized enemy troops from escaping. The other 105-mm howitzer battery and the 8-inch howitzer battery are kept on call to provide support for the deploying infantry.

The shift to blocking fires is coordinated with the artillery liaison officer, the ALO, and the infantry commander so that the helicopters touch down less than 2 minutes after the battalion FDC gives the command to shift two batteries to blocking positions and announces END OF MISSION for the two "on call" batteries. All fire units immediately report "tubes clear" on LZ area to confirm that it is safe for the helicopters to approach.

CHARACTERISTICS OF THE PREP

The prep described above has the following characteristics:

(1) It is simple and therefore easy to control, and it can be planned in a very short time; in an emergency the observer can be briefed after he is airborne.

(2) It has maximum flexibility and therefore can be adjusted to fit many different situations. If fewer fire units are available the rate of fire can be increased up to a recommended maximum of battery six rounds for the 105-mm battery, battery four rounds for 155-mm battery, and battery three rounds for the 8-inch battery.

(3) It puts the maximum amount of "steel" in the target area. The ammunition expenditure for the prep described above would be approximately 760 rounds by the 105-mm weapons, 190 rounds by the 155-mm weapons, and 70 rounds by the 8-inch weapons.

(4) It has the advantage of surprise. Registration is not necessary (although it would be helpful); the observer adjusts the fire to cover the required area.

(5) It is intense and continuous, with fires shifted from the LZ less than 2 minutes before the troopships touch down.

(6) It is integrated with air and therefore does not require that the artillery cease fire for airstrikes.

SUMMARY

As previously stated, the key to the success of the entire operation is a thoroughly briefed and competent air observer. A good observer can control from four to six units firing into the same general area. The system has been successfully used with many variations, such as using three observers to control 12 firing units (on three separate nets) to saturate a large area with artillery in a short period of time. Another variation which has been employed is the use of three observers (on three nets) and nine fire units to concurrently prep six separate company size LZ's in 8 minutes. Application of the principles of simplicity, flexibility, and maximum firepower in the manner described above will result in a successful prep each time.

NEW CHINOOK DELIVERED

Delivery of the CH-47B Chinook helicopter is being made to the Army. The advanced Chinook, operating at sea level conditions with a full fuel load, is able to transport 15,800 pounds on a 115-mile radius mission. This represents more than 50 percent increase over the payload capability of the earlier model. Cruise speed of the new model is increased by 41 percent to 155 knots.

In a Counterinsurgency Environment

Defense of a Landing Zone

LTC Arthur L. Kelley

INTRODUCTION

Quick reaction to an attack on a landing zone is possible only by detailed planning for the defense of the position.

It is known that enemy attack plans are detailed and rehearsed; his execution is swift. His tactics are to close onto the position before being discovered.

A short mortar preparation precedes the enemy's assault. In blocking such tactics, the artilleryman occupying the landing zone must take an active part in the defense to prevent penetration of the position. Also, he must take passive measures to minimize casualties from the mortar attack.

PREPARATIONS

In a counterinsurgency type environment, infantry units will normally provide security for artillery units. However, the artillery must not be lulled into a false sense of security just because there is an infantry perimeter around its position. When the enemy masses for an attack, he might penetrate the perimeter rapidly unless the artillery makes a major contribution to the defense by using all its weapons.

The artillery pieces should be positioned carefully to provide the maximum direct fire capability without destroying the normal sheaf. Each howitzer section mans a machinegun. The machinegun is an integral part of the parapet and is located so that fire could be delivered in support of the infantry as soon as the enemy attack was apparent and before the infantry position was penetrated. Left and right limits for the machinegun are coordinated with the infantry commander and carefully staked to preclude inflicting friendly casualties.

Infantry defensive positions should be coordinated to permit maximum utilization of direct fire and to keep the enemy out of hand-grenade range of the artillery. The infantry elements also are positioned to permit the immediate employment of the howitzer section's machineguns. The machineguns could fire between the infantry defensive positions and cover the position in the event the position had to withdraw.

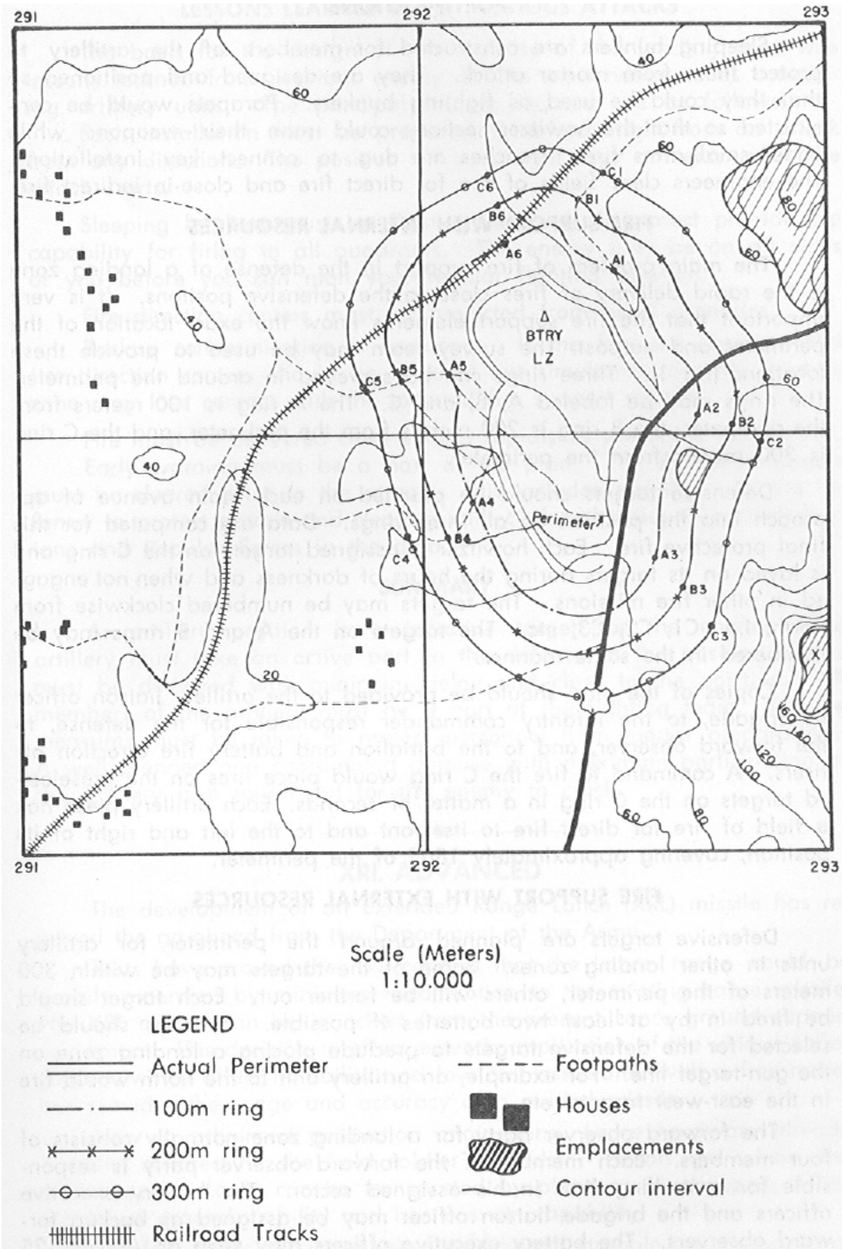


Figure 1. Landing zone

FORTIFICATIONS

Sleeping bunkers are constructed for members of the artillery to protect them from mortar attack. They are designed and positioned so that they could be used as fighting bunkers. Parapets would be constructed so that the howitzer sections could man their weapons while under small-arms fire. Trenches are dug to connect key installations. The engineers clear fields of fire for direct fire and close-in indirect fire.

FIRE SUPPORT WITH INTERNAL RESOURCES

The main problem of fire support in the defense of a landing zone is the rapid delivery of fires close to the defensive positons. It is very important that the fire support elements know the exact location of the perimeter and outpost. The survey team may be used to provide these locations (fig 1). Three rings can be surveyed in around the perimeter. The rings may be labeled A, B, and C. The A ring is 100 meters from the perimeter, the B ring is 200 meters from the perimeter, and the C ring is 300 meters from the perimeter.

Defensive targets should be planned on each main avenue of approach into the position on all three rings. Data are computed for this final protective fire. Each howitzer is assigned targets on the C ring and is layed on its targets during the hours of darkness and when not engaged in other fire missions. The targets may be numbered clockwise from north; i.e., C1, C2, C3, etc. The targets on the A and B rings may be numbered in the same manner.

Copies of the plan should be provided to the artillery liaison officer at brigade, to the infantry commander responsible for the defense, to the forward observer, and to the battalion and battery fire direction officers. A command to fire the C ring would place fires on the preselected targets on the C ring in a matter of seconds. Each artillery piece has a field of fire for direct fire to its front and to the left and right of its position, covering approximately 180° of the perimeter.

FIRE SUPPORT WITH EXTERNAL RESOURCES

Defensive targets are planned around the perimeter for artillery units in other landing zones. Some of the targets may be within 300 meters of the perimeter, others will be farther out. Each target should be fired in by at least two batteries if possible. Batteries should be selected for the defensive targets to preclude placing a landing zone on the gun-target line. For example, an artillery unit to the north would fire in the east-west targets, etc.

The forward observer party for a landing zone normally consists of four members. Each member of the forward observer party is responsible for controlling fires in his assigned sector. The battery executive officers and the brigade liaison officer may be assigned as backup forward observers. The battery executive officers may keep an AN/PRC-25 radio in their bunker to enable them to control fires in the event the forward observers are knocked out in the initial phase of the attack.

LESSONS LEARNED FROM PREVIOUS ATTACKS

The basis for the design of this defense of the landing zone was lessons learned from previous enemy attacks on landing zones containing artillery units. The principal lessons learned are as follows:

Each installation must be prepared to defend itself from an attack from any direction. The position on your right may not exist after the attack starts.

Sleeping bunkers must be fighting bunkers; they must provide the capability for firing in all quadrants. The enemy may be on all sides of you before you can man your regular fighting position.

Fire direction centers must be protected from hand grenades.

Backup communication is necessary. If the forward observer and fire direction centers should be knocked out simultaneously, the landing zone may lose contact with the external fire support means.

Fire must be delivered close in and rapidly to prevent a penetration.

Early warning must be a part of the plan. The defensive targets must be cleared prior to the attack. This includes clearing with the infantry to protect patrols and clearing with civil authorities to protect civilians and Popular Forces in the area.

SUMMARY

An artillery position is a lucrative target for the enemy. The artillery must take on active part in the defense of the position. Fires must be delivered with minimum delay and close to the position. All members of the artillery must be a part of the fighting team. Passive measures must be taken to protect personnel from mortar preparations. A well planned and coordinated defense with maximum participation of the artillery is a tough nut for the enemy to crack.

XRL ADVANCED

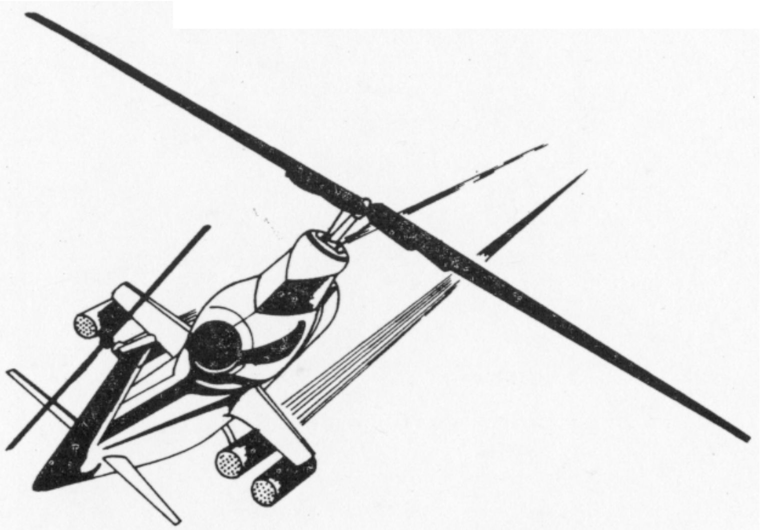
The development of an Extended Range Lance (XRL) missile has received the go-ahead from the Department of the Army.

Tests have proved the XRL concept that the Lance range could be greatly extended by minimum modification to the existing Lance missile. The XRL missile can be launched from the present Lance ground support equipment. This decision in effect extends application of the unique Lance concept which offers reliability and low cost associated with a free rocket but provides the range and accuracy of a guided missile.

Now in advanced production engineering, Lance hardware already is being tailored for the field soldier's needs - - it can go where the soldier goes. Lance can be transported by plane or air dropped; it has maximum ground mobility and has a swim capability.

The first Army missile to use pre-packaged storable liquid propellants Lance already has undergone a series of successful development test flights at White Sands Missile Range, New Mexico.

THE FIELD ARTILLERY BATTALION



Aerial Artillery

Major Wilbur R. Pierce, Jr.
Tactics/ Combined Arms Department
USAAMS

A new dimension has been added to the fire support capabilities of the artillery with the addition of aerial artillery to its arsenal.

The mission of the battalion is to provide aerial artillery direct fire support to assault units.

ORGANIZATION

The battalion is organized much like any other field artillery battalion in that it has a headquarters, headquarters and service battery and three firing batteries (fig 1). Tentatively, the battalion's Table of Organization and Equipment (6-725T) calls for 53 officers, 52 warrant officers, and 297 enlisted personnel. Major equipment is listed as follows:

TRANSPORT

Trucks ¼-ton	12
¾-ton	24
2 ½-ton	8
¼-ton ambulance	1
tank, fuel service 2 ½-ton	3

Drum fabric collapsible Liquid fuel 500 gallons	12
Water 250 gallons	3
Tank and pump unit 2 ½-ton truck	7

MATERIEL

Armament subsystem M3	36
Armament subsystem GM launcher ss-11B	12
Weapons subsystem XM16	3
Machinegun, light, flexible	23
.45 caliber pistol	34
.38 caliber revolver	114
5.56-mm rifle XM16E1	254

AVIATION

Helicopter utility UH-1B	39

COMMUNICATION

Radio set AN/GRC-125	3
PRC-25	10
PRC-47	4
URC-10	39
VRC-24	4
VRC-46	6
VRC-47	5
VRC-49	2
Radio teletypewriter set AN/VSC-2	1
Security equipment	
Cipher machine TSEC/KL-7	1
Electric teletype security equipment, KW-7	1
Switchboard SS-22/PT	5

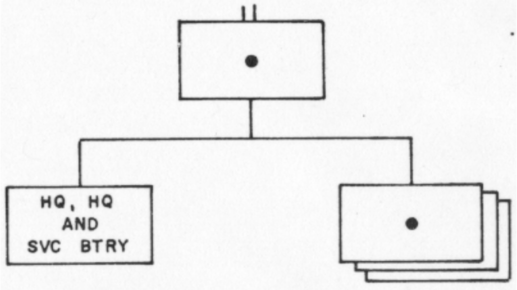


Figure 1. Field artillery battalion, aerial artillery.

There are several differences between the staff of this battalion and that of the standard 105-mm howitzer battalion. An aviation mainteance officer has been added to the staff to supervise the maintenance of the 39 aircraft organic to the battalion. An aviation safety officer advises the commander on matters pertaining to aviation safety. The battalion medical officer is now an aviation medical officer, or flight surgeon. The liaison capability has been reduced to one liaison officer who operates without a section and without equipment.

The headquarters and service battery is similar to that in other artillery headquarters units. It does, however, have an organic aviation section which is equipped with three UH-1B Iroquois helicopters. These aircraft are armed with the XM-16 armament system which mounts two modified M60, 7.62-mm machineguns and one pod of seven 2.75-inch rockets on each side. The three aircraft are used by the battalion commander and his staff to perform command, control, and reconnaissance missions.

Each of the three firing batteries has 12 UH-1B helicopters. Each battery is organized into three platoons, and each platoon has two sections with two aircraft each (fig 3). An operations section provides the battery's tactical fire direction capability and its communications. The service platoon performs second-echelon aircraft and vehicle maintenance and provides airfield service such as POL and ammunition resupply. Full-strength capabilities of the battery include providing aerial artillery fire support and antitank support and participating in semi-independent operations.

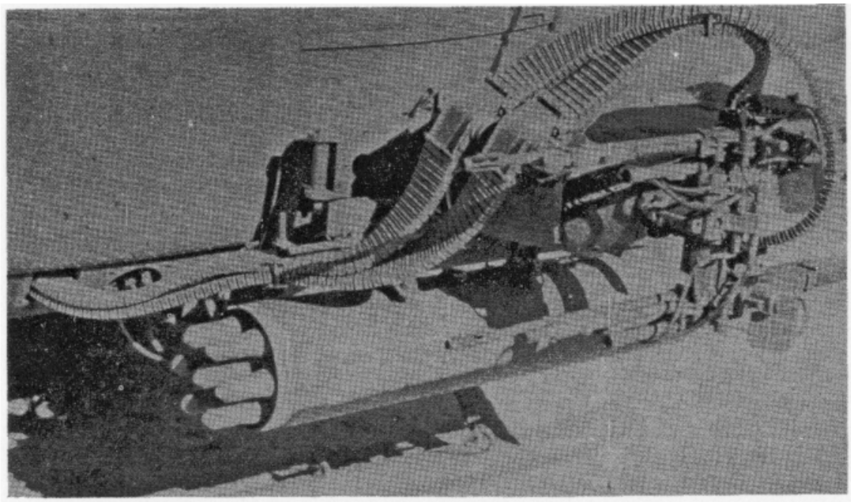


Figure 2. M16 system

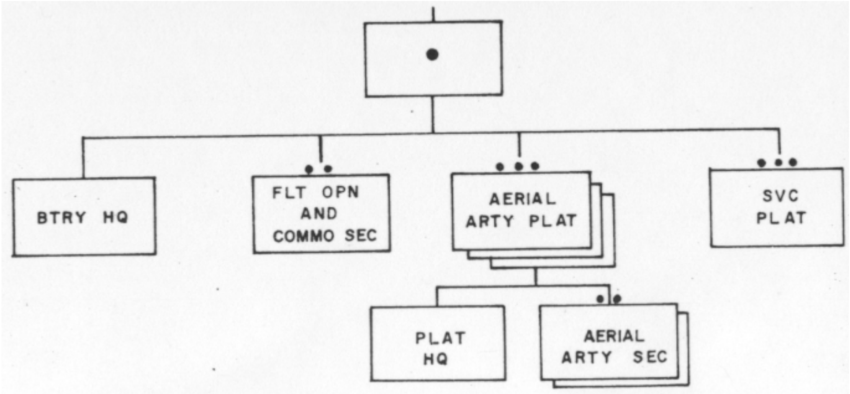


Figure 3. Field artillery battery, aerial artillery

WEAPON SYSTEM

The aerial artillery battery carries two types of aircraft armament systems. The M3 system is the firing battery's main armament (fib 4). The system is made up of eight 6-tube modules, with four modules mounted on each side which gives a characteristic rectangular shaped protuberance on the silhouette of the aircraft. The rocket used is the 2.75-inch folding fin aerial rocket, an old navy rocket which has been modified for firing from helicopters. The system has a maximum effective range of 2,500 meters and a minimum arming range of 100 meters.

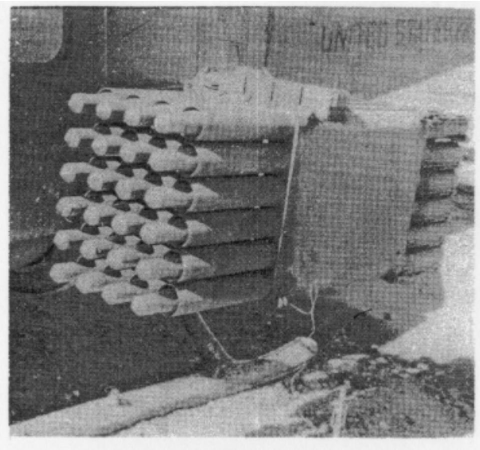


Figure 4. M3 System

The aircraft AH-IG HueyCobra, which will eventually replace the UH-1B aircraft, will be armed with 76 2.75-inch rockets.

Another weapon system available within the battery is the M22 system (fig 5) which mounts six SS-11 antitank wire guided missiles. The copitol-gunner operates the system electrically and guides the missile to the target through the wire which pays out from the aft end of the missile during flight. The system can be used on a limited scale in attacks on bunkers and cave entrances. Its use has been limited by the dense vegetation which makes it all but impossible for the gunners to maintain the required line of sight to the target. The systems are carried in the service platoon headquarters and are installed on the aircraft as the need arises.

SPRINT TESTED

The SPRINT, one of two interceptor missiles in the Chinese Communist oriented anti-ballistic missile defense system, has successfully under-gone a flight test at White Sands Missile Range, N.M. The test was designed to subject the missile to sharp maneuvers and high thermal effects.

Project officials said that during the flight the missile was given commands which caused it to maneuver sharply. These maneuvers also resulted in high thermal effects on the missile exterior through air friction heating.

One purpose of the flight was to demonstrate the ability of the SPRINT to execute these maneuvers successfully and withstand the high temperature involved.

Figure 5. M22 system

TACTICAL MISSIONS

The aerial artillery battalion can be assigned any of the standard artillery missions. The normal employment of the battalion is in the general support role with control retained at division artillery. The aerial artillery batteries are also given a general support mission when supporting the division base or during a division operation.

For brigade-size operations, one battery is usually given a mission of general support-reinforcing the fires of the direct support battalion supporting the brigade. On occasion a battery is assigned a modified reinforcing mission. On special operations, such as raids, for which there is no tube artillery support, the aerial artillery is given a direct support mission. This mission is highly modified, however, due to the lack of forward observers and liaison officers in aerial artillery organizations. These personnel are furnished by the direct support battalion which habitually supports the committed units.

If two brigades are committed, two batteries of aerial artillery normally will support the operation. In this situation the battalion sends out a forward command post to control the operations of the batteries and to provide increased flexibility of fire support. The batteries may still be given a general support-reinforcing mission and keep a quick-fire channel open to the direct support battalion.

EMPLOYMENT

A typical operation for an aerial artillery battery begins when it moves out with one of the brigades. Whenever practical, the battery operations section sets up in the vicinity of the direct support battalion headquarters with the aircraft laager area nearby. A direct wire line is usually laid between the battalion fire direction center and battery operation for receipt of missions.

Three different methods of operation are used to support airmobile assaults by airmobile units. Each of the basic methods calls for the firing of an aerial artillery preparation; however, if the method of operation is modified a preparation may not be fired.

The first method of operation calls for the aerial artillery support element to join the assault airlift in the pickup zone and to accompany the air column to the target area. The aerial artillery usually merely accompanies the lift but may act as an armed aerial escort during the flight. Its use in this role, however, detracts from its artillery support capability during later phases of the operation. As the air column nears the landing zone and begins to decelerate, the aerial artillery sprints ahead to fire its portion of the preparation. The standard preparation fired is one-half of an ordnance load for each aircraft in the flight.

The second method calls for the aerial artillery to join the air column at a designated point along the route and then to proceed with the air column to the target area as in the first method.

In the third method of operation, the aerial artillery orbits in the general vicinity of the landing zone. As the air column approaches, final coordination is effected and the aerial artillery takes spacing so as to fire its preparation approximately 30 seconds before the landing of the lead assault elements.

Whichever operational method is used, the supporting aerial artillery flight operates in the FM net being used by the direct support artillery. The artillery liaison officer with the force commander controls the timing and location of the aerial artillery preparation. The UHF (ultrahigh-frequency) radios of the aircraft are normally used to monitor the command net of the flight leader so that information as to changes in flight route, speed, or formation may be acquired without delay. The flight usually returns to the battery UHF channel as soon as the lift is completed.

STANDBY ON STATION

After firing their part of the preparation, the aircraft orbit nearby to answer calls for fire. If support is required, the forward observer calls the liaison officer who is normally circling the operational area in the command helicopter of the ground force commander. If the liaison officer decides to use aerial artillery, he calls the flight and gives them the mission.

The flight leader then contacts the forward observer on the observer's fire net in order to obtain detailed target information. The forward observer marks his position with smoke or panels during daylight and with flarepots or pyrotechnics at night. The flight leader also obtains from the forward observer the disposition of friendly troops. The aerial artillery gunner must know the location of all friendly elements before firing, especially when performing a close support mission which may entail firing within 30 meters of friendly troops. A desired direction of attack may be designated by the observer, or it may be determined by the flight leader.

Unless the target is visible to the aerial gunners, their fire is usually adjusted; standard artillery techniques are used. One pair of rockets per ripple is fired during this adjustment; longer ripples are fired in fire for effect. As the targets most frequently encountered are small, two ripples of three or four pairs are usually sufficient. If the target continues to resist, additional firing passes are made until the mission is completed.

At least one section of aerial artillery is habitually kept on air alert over the landing zone until the ground elements declare it secure. If the section on station expends its ordnance, it is relieved by another section.

GROUND ALERT

After the landing zone is secure, the aerial artillery flight is habitually released to return to the battery laager area. One section is kept on a 2-minute alert in the laager area for a mission both day and night. This "hot" section stands by its aircraft ready to be in the air within 2 minutes of receipt of a fire mission.

Another type of aerial artillery alert is called a mortar patrol. In this type of alert, one aircraft of the "hot" section remains airborne during the hours of darkness and patrols the base area. The other aircraft remains on ground alert and relieves the patrol aircraft for refueling. The mortar patrol aircraft frequently has the added mission of firing in the harassment and interdiction program and fires on as many as 15 targets a night, expending six to eight rockets on each target.

BIRD DOG

Another technique involves the use of an 0-1 Bird Dog flown by a member of the aerial artillery unit. The aircraft is flown over the operational area. The pilot maintains contact with the ground element on the two FM radios in the aircraft and with the aerial artillery battery on UHF. He keeps track of the location of all friendly elements as they move about the battle zone. He monitors calls for aerial artillery support, contacts the requesting forward observer for detailed target information, locates the target, confirms friendly positions, and briefs the flight as it is en route. When the aerial artillery flight arrives in the area, the Bird Dog pilot marks the target with smoke rockets or grenades and advises the flight as to the best direction of attack.

From his vantage point above the battle, the Bird Dog pilot is in an excellent position to acquire targets not visible from the ground. He can either adjust conventional tube artillery on these targets or call for attack of the targets by aerial artillery. This pilot has also been used frequently to adjust registrations for the direct support batteries when regular air observers were not available.

CALL FOR FIRE

The call for fire from aerial artillery is basically the same as the call for fire from conventional artillery as published in Department of the Army Training Circular 6-1, dated 1 September 1966. The call is processed through normal artillery or fire support channels. The fire support coordinator acting in the name of the force commander makes the final decision as to what type of fire support will be furnished.

The observer identification and warning order is standard except that the words "aerial artillery" may be added after the words "fire mission."

Target location may be by any method prescribed in TC 6-1; however, the aerial artillery flight leader requires either grid coordinates or a shift from a prominent terrain feature to locate the target area. An intermediate agency, such as the direct support battalion fire direction center, may be required to provide grid coordinates.

The description of the target should be as detailed as possible. Any adverse weather or other hazards to flight, including all known or suspect antiaircraft weapons in the area, should be included in this section.

The one major change to TC 6-1 techniques in the method of fire section involves the use of the term "danger very close." If the target is within 200 meters of friendly positions, the warning "danger very close" and the direction in degrees or inner cardinal bearing and the distance in meters from the target to the friendly troops must be included. An example would be DANGER VERY CLOSE, NORTHWEST 150 METERS or DANGER VERY CLOSE, 315 DEGREES, 150 METERS.

The method of fire is basically the same as in TC 6-1 except that the observer may specify the direction of attack so as to insure troop safety. The method of control remains unchanged.

ADJUSTMENT

Aerial artillery fire frequently must be adjusted onto the desired target, especially when the target is a small area target or a point that is not readily visible to the aircraft crews.

During the adjustment phase, either the observer-target line or the aircraft-target line may be used as an adjusting reference. The aircraft gunner must be informed of the method being used.

An abbreviated adjustment is generally used. Readback, as specified in TC 6-1, is an accepatble procedure. However, due to the rapidity of the action in an aerial artillery fire mission and the usual clearness of air-to-ground radio transmissions, readback should be held to a minimum. The terms "shot over" and "shot out" can normally be eliminated because the fact that the aircraft is firing will usually be obvious to both the pilot and the observer. Use of this shorter format allows the firing of two, or on occasion, three adjusting rounds during one firing run and greatly decreases the time needed to get fire for effect on the target.

The aerial artillery flight leader performs tactical fire direction by deciding on the amount of ammunition to expend, the method of fire (the number of pairs in each ripple and the number of ripples), the direction of the attack (if not specified by the forward observer), the number of firing passes to be made, the direction of break or departure after each pass, and a rendezvous point. He should confirm the identification of markers used to delineate the positions of ground units, announce the attack heading, and state whether or not he observes the target.

Upon completion of the mission, the flight leader gives the observer a report on any damage that he can see and receives a report of damage from the observer to round out his report. The flight leader is debriefed in the battery operations facility immediately upon his return from each mission so that any information he has gathered may go immediately into intelligence channels.

SUMMARY

The effectiveness of the aerial artllery has been established beyond question. It is very highly thought of by the units it is supporting. It allows our troops to operate under the protection of the artillery when they were beyond the range of conventional artillery weapons and has added the weight of its steel on the target to that of conventional artillery.

HYBRID ROCKET TESTED

The Army has successfully flight tested a hybrid rocket, employing a propulsion concept that holds promise of use for future missile and space applications.

The five-foot-long rocket—powered by both a solid propellant rocket motor and a hybrid rocket motor—was fired across one of the U. S. Army Missile Command's test ranges at Redstone Arsenal, Alabama, and impacted in the target area.

The rocket test-fired was composed of two stages. The boost stage was a solid propellant, ignited by an electrical squib and burned until a predetermined energy level was reached. Then, the hybrid stage ignited and burned for a period determined by the desired range.

The hybrid stage, which is critical in range control, has solid fuel and and a liquid oxidizer. In operation, the oxidizer is injected into the interior of the hollow fuel grain where the propellants burn. Thrust termination and therefore regulation is accomplished by shutting off the supply of liquid oxidizer.

Until now, selectable ranges have not been built into a solid propellant missile because of the problem of controlling burning of the solid fuel. Once ignited, solid fuels which contain the oxidizer as a part of the fuel block burn until expended.

MAJ J. Stallings
Tactics/Combined Arms Department
USAAMS

The artilleryman is expected by his infantry and armor counterpart to be a knowledgeable and competent coordinator of fire support. He must be prepared to live up to this expectation.

The forward observer has the vital job of providing coordination between target acquisition and the final accurate adjustment of artillery fires on the target.

In this capacity, he is there on the spot in close contact with the enemy. He is well-trained, and his ability to obtain deadly accurate artillery fires for the company commander is unquestionable.

What about the forward observer's ability to coordinate another fire support means—close air support? Specifically, what about his ability to provide the coordination necessary between the ground force in contact and the tactical fighter aircraft performing the close air support mission? This question brings up other questions: What are the circumstances that would require the FO to provide this coordination? How would he provide it?

First, let us discuss the background of this aspect of fire support and some of the terms involved.

Close air support is air action against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of the forces. Close air support is furnished by tactical fighter aircraft that deliver such fire support as gunfire, rockets, bombs, and incendijels (napalm) which, due to their deadly nature, require close control between the ground force and the pilot, if delivered close to friendly troops. This control is the normal duty of the forward air controller (FAC) assigned to the tactical air control party (TACP) with each maneuver battalion. The tactical air control party is an Air Force organization attached to each Army division, brigade, battalion, and cavalry squadron for the purpose of advising unit commanders on the use and control of tactical air support furnished to the Army forces. It is through the TACP radio facilities that immediate requests for tactical air support are transmitted to the direct air support center (DASC) which then scrambles aircraft to execute the approved requests (fig 1). The FAC assigned to the TACP at the maneuver battalion is a tactical fighter pilot (officer). From a forward ground or airborne position, he can control aircraft engaged in close air support to ground troops. The FAC is responsible for troop safety during the conduct of the mission as well as for destruction of the target.

Current FAC procedures, jointly approved by the Air Force and the Army, presuppose an orderly battle area, relatively identifiable enemy positions, and an adequate number of tactical air control parties. It is evident that in other warfare environments these assumptions may not remain valid. In an unconventional warfare environment there usually is no identifiable battleline. Positive identification of the enemy is difficult because of the enemy's use of concealment and because he frequently cannot be distinguished from the civilian populace or friendly paramilitary forces. Therefore, in unconventional warfare, the entire countryside may be potentially hostile. Numerous ground force units must probe this hostile environment in order to close with and destroy the enemy. For this reason, friendly ground forces usually operate not as complete organizational units but as subdivided elements of such units. For example, in some situations, a single battalion may be moving as a group of 10 or 20 widely separated and independent patrols. Under such conditions, it will not always be possible to provide a qualified Air Force FAC for each small unit. Similarly, in conventional warfare, Air Force FAC's may not be available to all units; therefore, the use of non-Air Force agencies may be necessary in either type of warfare.

Who then would be the logical person to take over this function in an emergency where close air support is needed and the forward air controller is not, or cannot be, available to control the mission? The most readily available indivdual and probably one of the best qualified individuals is the artillery forward observer. He is already present with the engaged company, and trained to adjust artillery fires. Acting as the forward air controller, he would be working with close support aircraft

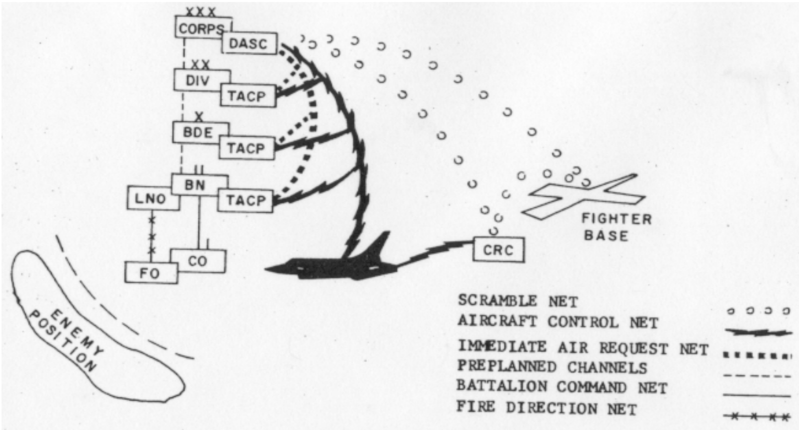


Figure 1. Close air support flow chart.

rather than with artillery. The forward observer is not as qualified to assist attacking aircraft as the trained fighter pilot working as the forward air controller; however, with an understanding of some of the basics involved, he would certainly have a good chance of success in an emergency situation where close air support is needed and available.

The use of the forward observer for assisting tactical aircraft in the absence of the forward air controller was proposed by Tactical Air Command in January 1965. It was Tactical Air Command's direction that no requirement for close air support by the Air Force go unsatisfied because of the absence of a qualified forward air controller. In such circumstances, the following procedures would be followed:

(1) When a close air support mission has been requested, approved, and scheduled by the direct air support center and it is known that no FAC will be available to direct the attack, an artillery or mortar forward observer may mark or otherwise identify the target for the attacking aircraft. This will require prior notification of the affected FO so that he can position himself for the impending mission. The fighter pilots should receive an air briefing on the target from either the DASC or a TACP and should be briefed to contact the FO for further assistance if the FO has access to ground-air communications. The FO, when contacted by the fighter pilots, should give the target description and coordinates and information as to the proximity of friendly forces as necessary. The FO will either point out the target through map or terrain references or will cause the target to be marked by use of appropriate artillery or mortar projectiles.

(2) If the FO has no ground-air communications, he should establish contact with the appropriate TACP via ground communications in order that the TACP may relay his information to the pilots.

It must be understood that appropriate ground force commanders must assume responsibility for troop safety when airstrikes are delivered in the absence of an Air Force forward air controller.

The U. S. Army Special Warfare School and the U. S. Air Force Special Air Warfare School recognized the importance of training individuals to assist aircraft in making close air support strikes because of the remoteness of special forces operations. These schools provide this training and have given the title of "forward air guide" to an individual trained in these procedures. By definition, the forward air guide (FAG) is a trained Army observer (usually an artillery forward observer) operating with ground or air operational units and who, in the absence of a forward air controller, assists aircraft in delivering ordnance on a target while the aircraft are engaged in close air support of ground troops.

What should the forward observer know if he is to act as a forward air guide? He is not expected to be as highly trained and knowledgeable as the forward air controller; however, he should be familiar with—

(1) Communications to be used.

(2) Target identification and methods of marking the target.

(3) Mission briefing and guidance techniques.

Before tactical aircraft are used for close air support there must be a need for the mission and a request made. Let us follow a situation and see how it might work. Suppose that Bravo Company, as part of a battalion on a search-and-destroy operation, makes contact with the enemy. During the course of the battle, artillery fires are called in by the forward observer, but the company commander determines that additional fires are needed on a certain portion of the enemy position. The company commander makes a request for close air support to the battalion on the battalion command net, or if necessary, the artillery FO could send the request to the artillery liaison officer at the battalion over his fire direction net (fig 1).

At the battalion, the request is approved and is sent by the TACP to the DASC as an immediate request. Data required in close air support requests must include, as a minimum, the following:

(1) Target description.

(2) Target location.

(3) Time on target (desired TOT and latest acceptable TOT).

(4) Results desired (destroy, neutralize, or harass).

The DASC receives the request and, if the request is approved by the Army staff at this level, the DASC will scramble the fighters to the target area. Let us assume for our situation that the FAC for the battalion is already engaged in directing fighter aircraft on a target for Alpha Company of the battalion and cannot assist Bravo Company. Also, there is not another FAC in the immediate area. Therefore, the forward observer will be required to provide coordination between the aircraft and the ground unit. How will he do this?

The primary means of communication between the FO and the strike aircraft is direct voice radio. The radio which most probably will be be available and which is mutually compatible is the UHF radio used in Army aircraft. If an Army aircraft is not immediately available to the FO, it may be necessary for him to relay strike guidance information to the strike pilot through other airborne units, through ground units, or through both. Radios which may be used for relaying such information are the AM(UHF)VRC-24 radios employed at the maneuver battalion fire support coordination center (FSCC) and the radios of the Air Force TACP located with the maneuver battalion. If time permits, the FO should try to obtain one of these radios to use at his location so that he can communicate directly with the strike aircraft.

Fighter aircraft establish radio communications with the FO on predetermined tactical frequencies. The strike flight commander affirms that he is in the orbit vicinity by reference to grid coordinates or by reference to the orbit point, using a predetermined code word. He may also require an authentication from the FO. The use of an authentication system in any hostile environment may be mandatory to prevent strike aircraft from responding to a fraudulent transmission. The authentication system used may be a published, worldwide system or a locally established system. The possibility of enemy use of radio to disrupt operations should always be considered, since the enemy might be able to net with the aircraft and thereby direct strikes against friendly troops or positions.

Targets may be identified by verbal description over the communications network, by visual means, or by a combination of these two methods. To assist the attack pilot in planning his delivery the FO should give target identification data to the pilot before his departure from the orbit point. If there is insufficient time or if all the required information is not available, the pilot should be given as much of the available information as possible.

The target description should include the following information:

(1) Type of target (personnel, structures, material, boats, vehicles, etc.).

(2) Direction of movement if the target is not stationary.

(3) Whether the target is dug-in, camouflaged, or exposed.

(4) Whether the target is a point or area target. If it is an area target, its configuration should be given.

(5) What the target is doing (attacking, withdrawing, dispersing).

Additional pertinent information may include any or all of the following:

(1) The locations of known, suspected or anticipated areas of enemy small-arms or antiaircraft fire, the heaviest concentration of such fires, and the types of weapons being employed.

(2) A descripition of obstacles such as powerlines, towers, trees, and hills to include the height of such obstacles.

(3) Pertinent weather information to include the estimated direction and velocity of surface winds (e.g., the wind is **from** 030° at 10 knots), an estimate of the visibility distance (in miles), an estimate of cloud height (e.g., the top of the hill is in the cloud), a description of rainfall (light or heavy), and any other available information concerning existing weather conditions.

Ground forces will sometimes be supported by airborne FAC's. The FAC may accompany strike aircraft or precede strike aircraft and call them in on a target as required. The airborne FAC and the FO are complementary. Each has certain advantages in locating, observing, and marking enemy (or friendly) positions, depending on the terrain or concealment of such positions. The FO relays through the airborne FAC the target information described above, and, when advantageous, the airborne FAC can control the strike.

During daylight hours any of the following methods which are appropriate may be used to mark or locate targets and friendly positions for close air support strikes.

(1) Identification panels can be used by all ground units. Strike aircraft may use these panels as reference points for locating the target. The use and color codes of such panels must be made clear to the pilot to avoid confusion and misdirected ordnance delivery. The use of the panel method for marking targets is explained in detail in STANAG 2114.

(2) Colored smoke fired from artillery weapons, mortars, or recoilless rifles can be used as reference points from which the strike aircraft can locate targets. When pyrotechnics or support fires are used to mark targets, the FO must coordinate closely with the strike pilots so that the aircraft will avoid the trajectory of the marking ordnance and be in a proper position to observe the burst of fire.

(3) White phosphorous can be used in the same manner as smoke for marking targets.

(4) Some other means that can be used for marking friendly positions as reference points include signaling mirrors, smoke grenades, flare guns, rocket/parachute flares, rifle grenade flares, colored balloons (floating over foliage), and signal fires.

(5) Prominent landmarks and terrain features can also be used as reference points; the direction and distance from such features to the target are given to the strike aircraft.

(6) When conditions of light permit, tracer ammunition may be fired to establish reference points or to pinpoint the target. For example, a point may be marked by the intersection of tracers.

(7) A pilot may also locate targets by map coordinates, since the pilot's map should have the same grid system as the map

used by the FO, even though the scales of the maps may differ. Normally, this method is most appropriate for locating area targets.

(8) As a last resort, the pilot may be guided on a dry run (simulated attack) of the target to confirm the location and furnish a basis for adjustment by the FO onto the exact target location.

Regardless of the method used for locating the target, the FO should immediately inform the strike aircraft of the accuracy of the drop after the first ordnance delivery pass, so that subsequent ordnance delivery passes may be concentrated at the point of the first pass or adjusted as necessary to insure target destruction.

During periods of darkness, the target may be pointed out to the close support aircraft by any of the visual means described above which are appropriate or by any of the following methods:

(1) Lighted arrows can be used to point out the direction of the enemy forces.

(2) Burning areas of incendijel (napalm) or other substances can be used as reference points from which the strike aircraft can be told the direction and distance to the target.

(4) The target area can be lighted by flares, searchlights, or small fires.

Flare aircraft may be used to illuminate enemy positions so that strike aircraft can attack and so that ground forces can maintain visual contact with the enemy. This type of air support can be especially effective in the defense of remote installations. The FO can guide the flare aircraft in positioning the flares in addition to guiding the strike aircraft in the close support attack.

Strike aircraft have a flare-dropping capability. For night operations, these aircraft are usually equipped with flares so that they can provide target illumination on a limited basis.

As a rule, no two strikes are conducted in exactly the same manner. The FO's initial requirement is to make as complete an analysis of the tactical situation as possible; he then must pass a descriptive picture of the situation to the strike flight supporting him. The success of the mission will depend on the degree of coordination attained between the FO and the pilot and on the good judgment exercised by the FO and the pilot.

The specific items of information to be provided the strike pilot by the FO are as follows:

(1) Target description and location (give target marking method, if used; mark your location only if necessary to establish a reference point from which target location can be identified for the pilot).

(2) Friendly location and marking, if necessary for safety.

(3) Terrain (type of terrain and hazards to flight, such as hills, box canyons, high trees).

(4) Enemy ground-to-air fire (small arms, flak).

(5) Alternate frequencies to use in event of lost radio contact.

(6) Target and friendly troop separation distance.

(7) Time to attack (ASAP, 5 minutes, NLT, etc.).

The pilot must have this information to obtain the maximum effect from delivered ordnance and to insure the safety of aircrews and friendly ground personnel.

In transmitting this information to the pilot, the FO must consider several points. First, the FO must consider that the pilot does not have the FO's view of the terrain. A 10-foot rise in the terrain looks flat from the air; therefore, such statements as "the other side of the hill" may mean nothing to the pilot. To the pilot "the tallest white tree in the bend of the river" looks like all other trees in the bend of the river. However, a statement such as "200 meters north of the red smoke" contains a means of measurement, has value, and can be understood by the pilot as can "the ditch east of the north-south road" or "the south edge of the canal, in the water."

Secondly the FO must consider that the enemy, when he is hidden, is extremely difficult to spot from the air. A good method that can be used for pointing the pilot's attention in the right direction to see the target is the clock method. In this method various points of the aircraft represent positions of the hands of a clock with the nose of the aircraft representing the 12 o'clock position (fig 2.) The 11 o'clock position is 30° to the left of the aircraft nose; 3 o'clock position is 90° to the right of the nose or directly off the right wing. If the pilot receives the message HE IS IN YOUR 2 O'CLOCK POSITION, the pilot should look to the right and forward of the wing. The 12 o'clock or 6 o'clock positions mean that the pilot cannot see the target well and that he may need to turn his aircraft to see targets that were under these positions.

If facilities are available, radio is the best means for transmitting airstrike guidance information to the strike pilot. The pilot, hears and comprehends best those messages transmitted in terminology to which he is accustomed and in a sequence which he anticipates. For this reason, the use of radio transmission techniques described here will increase the probability of mission success.

When making radio contact with the strike aircraft, the originator (FO) uses the pilot's call sign to initiate the call, then identifies himself. After he completes this callup procedure, the FO transmits the message to the pilot. To insure that the pilot understands his message, the FO should make the message as brief and comprehensive as possible. In transmitting the message, the FO must speak slowly and clearly. In the excitement of combat he may have a tendency to speak rapidly and at great length, making it difficult for the pilot to hear and comprehend

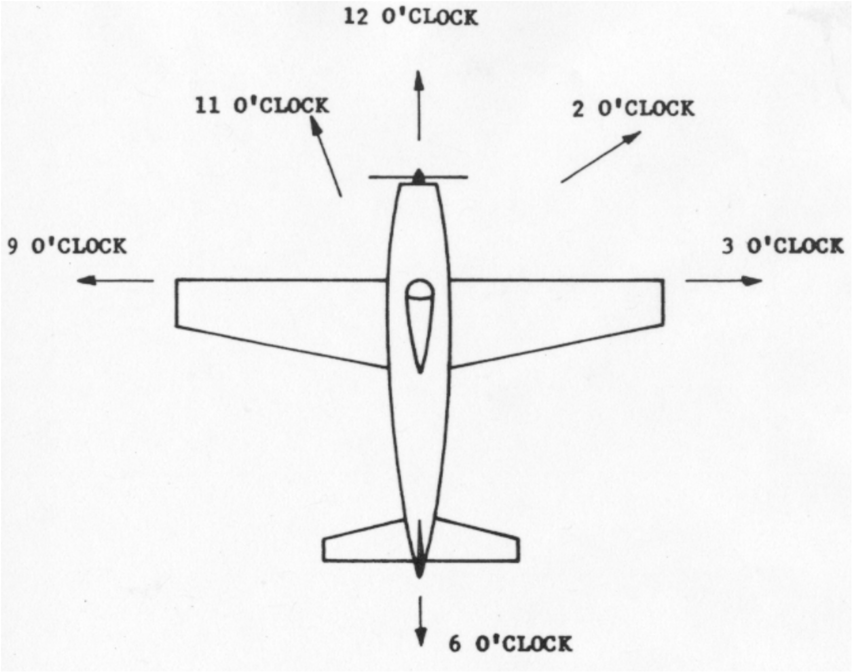


Figure 2. Clock system of direction.

the message. For the situation illustrated in figure 3, the appropriate message to be transmitted by the FO is as follows:

> 501 LEADER, THIS IS LITTLE JOHN 31, I HAVE A MISSION BRIEFING FOR YOU, OVER.
> ROGER, LITTLE JOHN, SEND YOUR BRIEFING, OVER.
> 501 LEADER, WE ARE PINNED DOWN 100 METERS NORTH OF AN ENEMY POSITION ON A CANAL BANK. THE ENEMY IS DUG IN ALONG A TREE LINE SOUTH OF THE CANAL, OVER.

If too many items of information are included in a transmission, the pilot will not be able to readily comprehend all of the information and will be forced to ask for retransmission. As a general rule, no more than two items of information should be given in a single transmission.

The discussion just presented gives some of the more important details that the forward observer must know to be a qualified forward air guide in an emergency situation. The Artillery School provides a reference note on the forward air guide to each of its resident students.

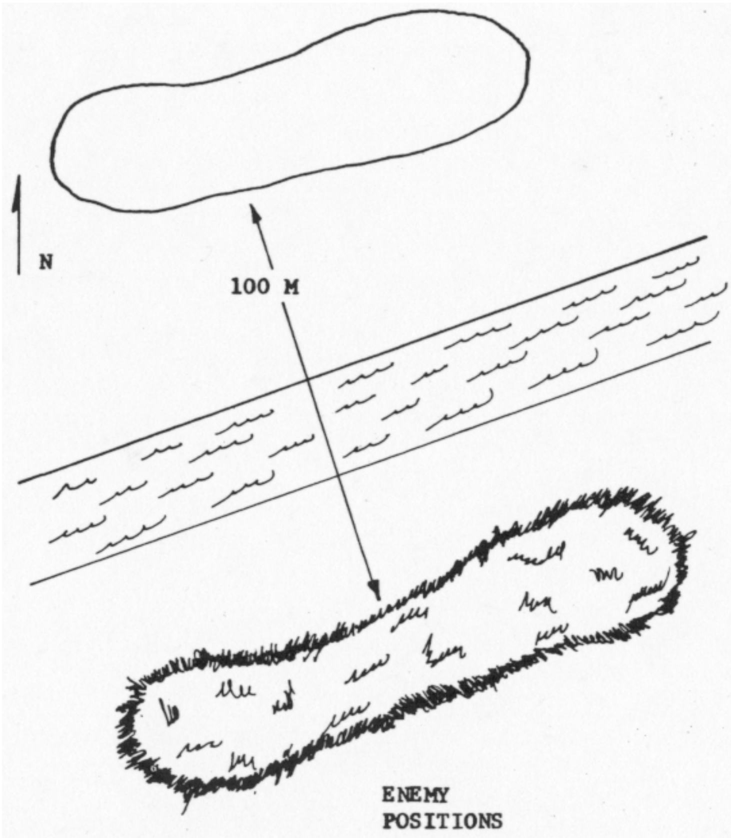


Figure 3. Situation requiring air support.

This reference note gives many more details with examples on this subject.

Every forward observer in the field today, especially those in Vietnam, must be ready to coordinate close air support for the company. This will become more important as ground operations become more dispersed with numerous and simultaneous actions.

When friendly lives are at stake, the forward observer may influence the outcome of events by having this limited but essential bit of knowledge.

Why not the forward observer?
Why not you?

Intercomunication Set For M108 And M109

Major Richard M. Young
Communication/Electronics Department
USAAMS

The intercommunication set AN/VIC-1 is now being issued with the M108 and M109 self-propelled howitzers to replace intercommunication set AN/UIC-1. Some units, issued the equipment, have experienced difficulty in both the installation and operation of the set when they desired to connect an external telephone line; i.e., to the executive officer's post.

Two separate problems actually exist. One concerns proper installation and the other concerns operational procedures.

When the tracked vehicle is manufactured, the telephone wires connected to the external line binding posts mounted on the right rear of the vehicle are passed through the power-communications turret ring to an electrical connector located on the inside rear bulkhead. The telephone wires exit the connector at that point; the ends are taped and then tucked into a convenient out-of-the-way place behind the bracket for the amplifier AM-1780/VRC.

To connect the external line into the interphone system, it is necessary to locate the wire lines and remove the tape. Each line has a slender pin-type connector on the end and is tagged with lugs marked "L1" and "L2" (see figure 1). A separate grounding lead is also taped to the bundle. The two pins marked "L1 and "L2" are inserted into the binding posts marked "LINE" on the front panel of the AM-1780/VRC. The grounding lug is connected to the bracket for the AM-1780/VRC.

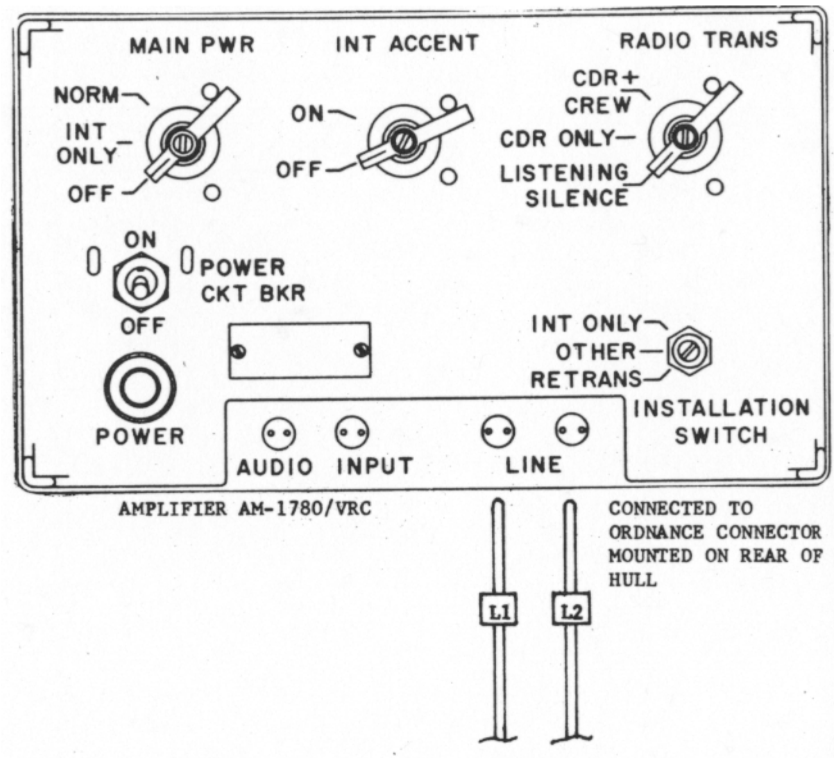


Figure 1. Amplifier AM-1780/VRC and wire lines with pin-type connectors tagged "L1 and "L2."

This completes proper installation of the equipment; however, two-way communication between the external telephone and the howitzer section is still not possible unless two operational procedures are observed.

First, the function switches of both C-2298/VRC control boxes connected to the amplifier AM-1780/VRC must be operated in the ALL position only (see figure 2). If operated in any other position, including the INT position, the incoming call on the telephone circuit cannot be heard through the headset-handset H-161 or the CVC helmet, whichever is used.

Second, the toggle switch on the H-161 or the CVC helmet has three positions: a spring-loaded radio transmit (RAD) position, a center (off) position, and the interphone (ICS) position. **All toggle switches** of all **headsets** connected to the control boxes must be in the center, or off, position to receive an incoming telephone signal. If any one toggle switch is in the ICS position, neither C-2298 control box can pass the telephone signal. Before a voice signal can be transmitted out to the telephone line, the user's toggle switch must be placed to the ICS position. In other words, telephone communication through the AN/VIC-1

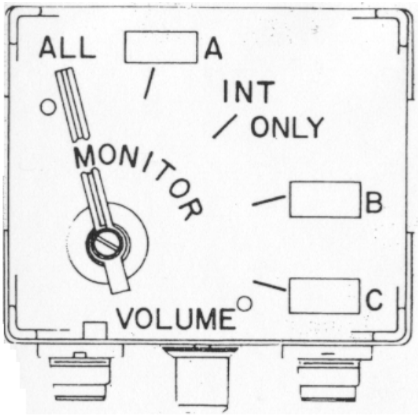


Figure 2. C-2298/VRC control boxes must be operated in the ALL Position

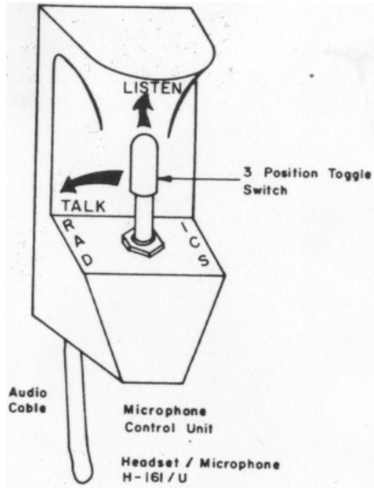


Figure 3. Togle switch for headset/microphone.

is strictly on a push-to-talk basis. Duplex operation to an external telephone is not possible.

If maximum efficient use of the AN/VIC-1 is to be realized, the equipment must be installed properly and all section chiefs and crewmembers must be thoroughly familiar with the operation of the equipment. Knowing the peculiarities of the system will prevent many headaches later which could be critical in a combat situation.

The recommended procedural changes as stated above have been submitted for inclusion in change 2 to TM 11-5830-340-12 scheduled for publication by 1 October 1967.

Testing of the AN/VIC-1 intercommunication set was completed in February 1967 by the United States Army Artillery Board with the recommendation that a third control (gunnery's) box, C-2298/VRC be added to facilitate direct firing. This third box has been installed in an M109 and currently is undergoing tests by the Board.

TANKERS USE LASER

Laser "guns" that simulate heavy tank cannons are helping the Army train better tank gunners in less time.

These lasers fire brief, brilliant beams of light along the path a 105-mm tank shell would take. They permit highly efficient target practice even inside Reserve and National Guard Armories.

The Army estimates that laser cannon simulators may cut training time as much as 20 per cent and at the same time improve the accuracy of gunners. They replace less accurate 30 caliber and 7.62 machine-gun trainers commonly used to simulate cannon fire on M-48 and M-60 tanks.

"SHOOT FROM THE HIP"

Fire
Direction
Center

Lieutenant Colonel Merlyn H. Smith (Retired)
Gunnery Department,
USSAMS

Lieutenant McLeod, battery exec, had been in combat almost 6 months. His 105-mm battery had gone into position the night before, and an ambush had destroyed his FDC truck, including the equipment. Three FDC key personnel were casualties and had just been evacuated by helicopter. Now six howitzer sections stood poised for fire missions; ammunition in full supply lay ready for use. McLeod's recorder gestured frantically with his receiver-transmitter—a call for fire was coming over the radio. Just one lucky enemy action and his battery would be useless if observer data could not be converted to commands for the guns!

BLUE FOX 18, THIS IS BLUE FOX 26. FIRE MISSION, OVER.
BLUE FOX 26, THIS IS BLUE FOX 18. FIRE MISSION, OUT.
BATTERY ADJUST, SHELL HE, CHARGE 5, FUZE QUICK, CENTER 1 ROUND, 3 ROUNDS VT IN EFFECT, **DEFECTION 2675,** QUADRANT 330, OUT.

These gun commands were coming from a forward observer, not from a fire direction center!

THIS IS BLUE FOX 18. SHOT, OVER.

The observer looked through his fieldglasses and observed the initial rounds 100 mils right of the observer-target line and short of his intended adjusting point. He looked at a small board, stuck a pin into it, and commanded DEFLECTION 2782, QUADRANT 348, OVER. He was soon in fire for effect. How was it done?

Let's take a look at this unique emergency fire direction center. It uses a "jeep board" and a miniature simplified graphical firing table fan. The observer assumes his location to be at the center of the jeep board (fig 1) and determines the azimuth (to the nearest 100 mils) for the center of his target area (in this example, 1700 mils). He marks the

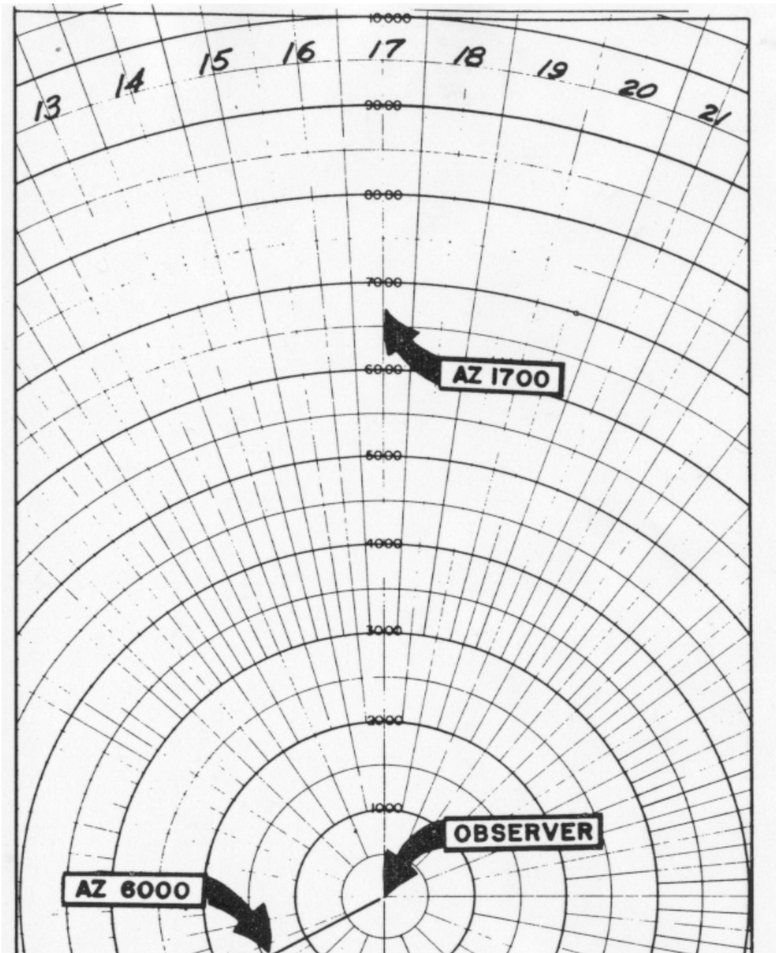


Figure 1. Jeep board oriented toward center of target area.

top center of his jeep board with that azimuth and labels the other direction lines with their appropriate azimuths at 100-mil intervals. (The 50-mil lines need not be labeled). Using his knowledge of the location of his firing battery, he estimates the azimuth and distance to the battery position and plots the battery on the jeep board, using the azimuth and distance rings. In this example, an azimuth of 6,000 mils and a distance of 2,500 mils are shown. A map may be used to assist in estimating these data.

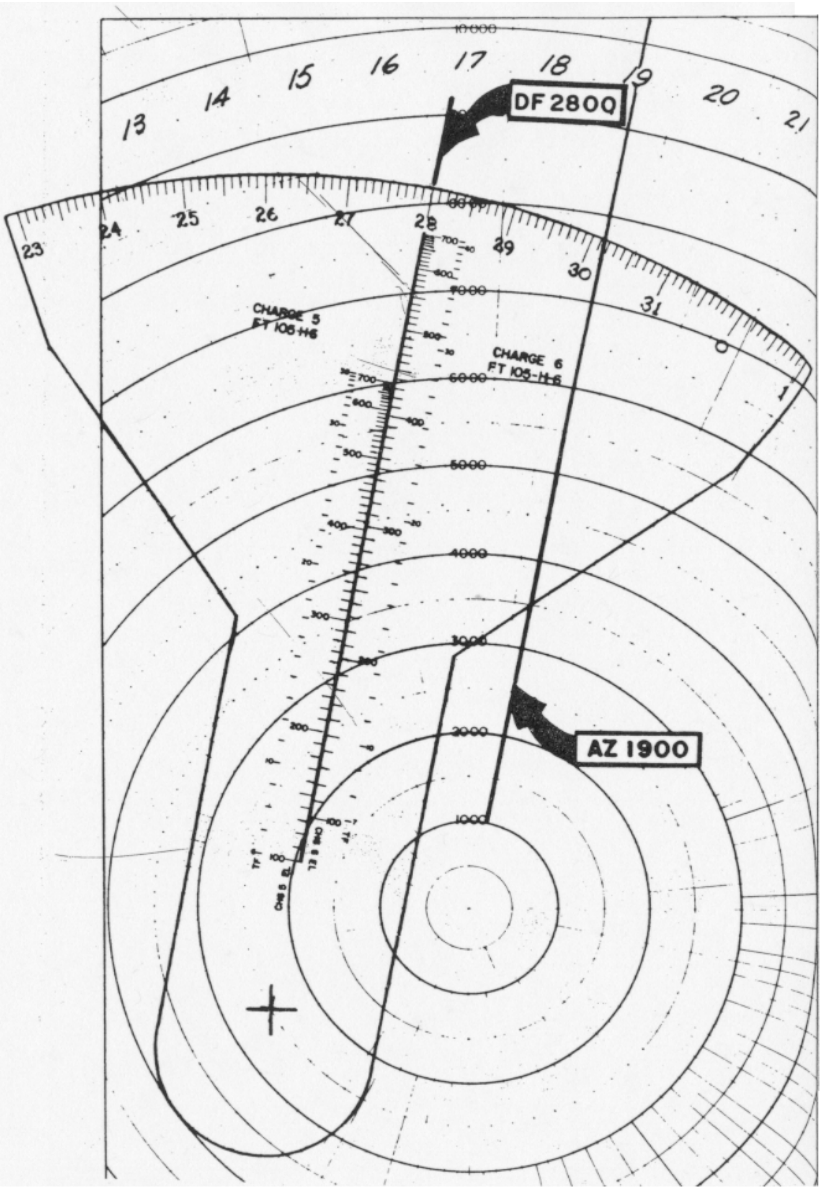


Figure 2. Deflection index constructed with guns laid on azimuth 1900.

He knows that the battery was laid on azimuth 1900 and that the referred deflection to the aiming posts is 2800; therefore, he places the vertex of his "jeep board fan" at the battery position (fig 2) and alines the centerline parallel to the 1900 azimuth line on the jeep board. He then marks a deflection index at the center of the arc and labels the deflection arc on the fan every 100 mils, starting at the center with 2,800 mils. Now he is ready to go.

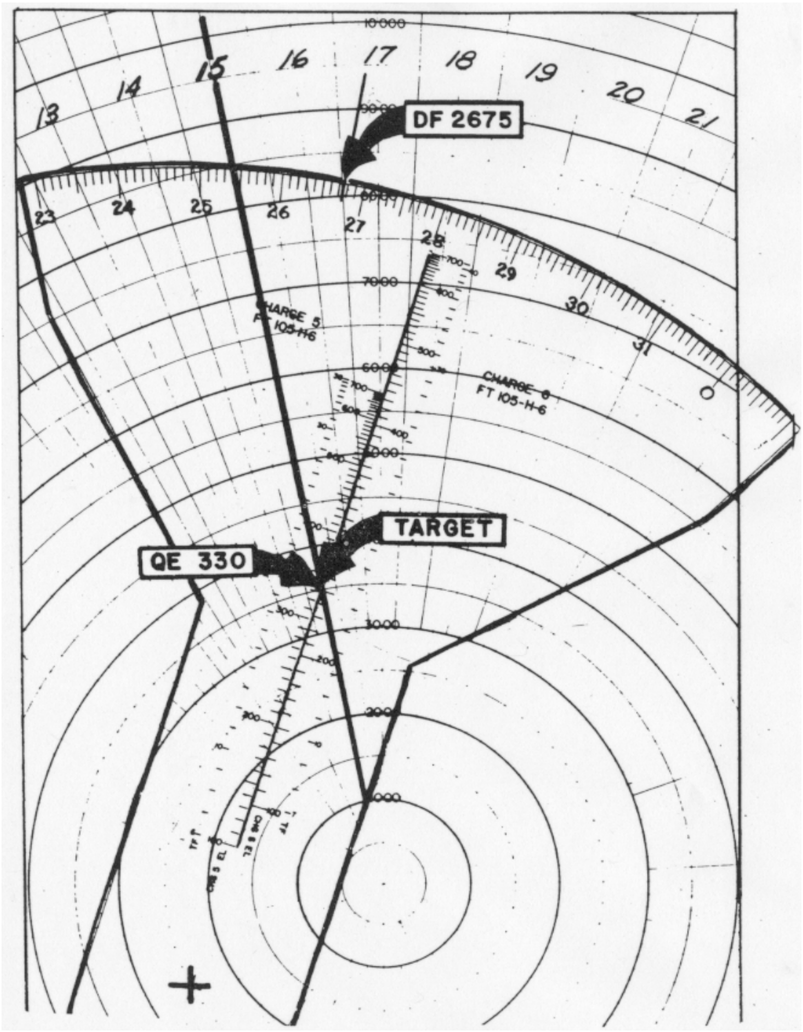


Figure 3. Initial firing data.

A target appears at azimuth 1500. He estimates the distance as 3,500 meters and sticks a pin in his jeep board where the 1,500-mil azimuth line intersects the 3,500-meter distance circle. By orienting the centerline of his jeep fan over this point, he reads his initial firing data (fig 3). When his first rounds appear 100 mils right and short for range, he simply moves the pin left 100 mils to azimuth 1400 and along that line increases the range 400 meters. Moving the centerline of his jeep fan he reads the new firing data.

Succeeding rounds are on the observer-target line and he is able to continue the adjustment and quickly enter into fire for effect. Deflections and elevations are read to the nearest mil until a 100-meter bracket in range is obtained. Fire for effect is started by splitting the elevation bracket in mils.

Ignoring the site on the initial rounds poses no significant problem unless operations are in mountainous terrain. In such cases, a good estimate of site would be necessary to get the initial rounds on or near the observer-target line. In any event, site is "shot in."

Another method of locating the battery is similar to constructing the percussion plot observed fire chart. The battery fires a round into the center of the sector and the observer estimates the distance to this round. He plots it on the azimuth line from his positon; then, using the jeep fan with its vertex at this position, he back plots the battery at the quadrant elevation fired with the centerline of the fan laid parallel to the azimuth line in the direction of fire. In this situation, the forward observer uses standard fire request procedures, except that he gives the lateral shift in mils instead of in meters.

The jeep board system may also be employed by fire direction personnel at the firing battery as a "shoot from the hip" fire direction to rapidly adjust fire in a fast-moving situation. This system may even be used for massing more than one battery. As the observer obtains information, he can improve the system by taking advantage of his experience with weather and velocity error effects to better estimate an initial quadrant elevation. The advantage of the system lies in its simplicity and speed. Bear in mind, however, that it is only an emergency system for special situations.

METRO SOLUTION FOR LARGE DIFFERENCES IN ΔH AND MDP

CW4 Garland C. Goodman,
Target Acquisition Department
USAAMS

Artillery units have, on occasion, encountered a situation where the firing battery position is more than 390 meters above or below the Meteorological Datum Plane. Table "D" in the Tabular Firing Tables makes no provision for this situation. Since it is not always feasible to position the metro station in the vicinity of the firing positions, the following method, based upon the best available information, may be used to correct the temperature and density portion of the metro message.

The portion of Table "D" in the Tabular Firing Table dealing with density may be extrapolated to meet the needs of unique situations. Specifically, a correction of one-tenth of one percent is applied for each change of 10 meters in altitude from the Metro Datum Plane (MDP). If the firing unit is above the MDP, a negative one-tenth of one percent is applied algebraically for each 10-meter increment. Similarly, if the firing unit is below the MDP, a positive one-tenth of one percent is applied algebraically for each 10-meter increment.

The portion of Table "D" dealing with temperature may also be extrapolated, however the correction factor differs. If the firing unit is above the MDP a negative 2.26 × 10—2 is algebraically applied for each 10-meter increment. Logically, if the firing unit is below the MDP, the sign of the correction factor is positive.

Examples are shown below:

(1) ΔH = 500 M above the MDP.

(2) Density correction:

$$\frac{500}{10} \times -.1\% = -5.0\% \text{ of Standard}$$

(3) Temperature correction:

$$\frac{500}{10} \times -2.26 \times 10^{-2} = -1.1\% \text{ of standard}$$

Utilizing this technique there is no method for correcting wind data for a significant difference in height between the MDP and the firing battery. However the Atmospheric Sciences Laboratory, ECOM and the Ballstics Research Laboratory are conducting a joint study in this area.

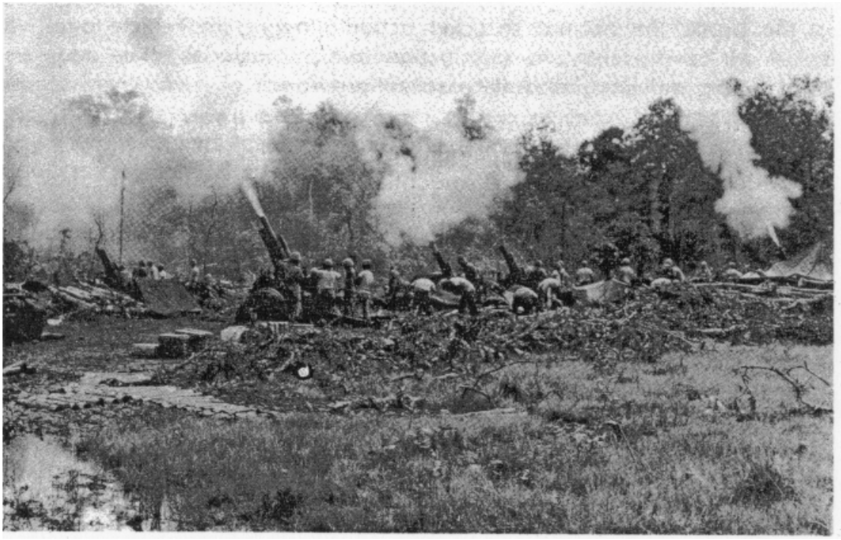
Another solution to this problem is to produce a special meteorological message (Mountain Met). This special metro message can be provided by the artillery metro section utilzing the latest electronic Radiosonde Flight. In the previous example where the battery was 500 meters above the Meteorological Datum Plane (MDP), the metro section can compensate for this difference in height between the guns and the MDP by placing a level on the Artillery - Pressure - Density - Chart (ML-574) chart at 500 meters. This level then becomes the **new** surface level for the computation of wind, temperature and density. Zones one, two, three, etc. of the "Mountain" Metro Message are computed/plotted from this **new** surface plot. From a meteorological standpoint we have moved the MDP to the height of the gun position. This method is of course, possible only when the metro section is **below** the gun position. Recognizing the heterogeneous nature of the lower atmosphere, no known method of "mountain met" has been proven to be completely acceptable. In fact, in certain cases, particularly with respect to ballistic wind data, the "mountain met" method may introduce even greater errors than the standard method. (For this reason, extra caution must be exercised when firing in close support of friendly troops in situations of this kind.)

The optimum solution is to move the metro section to the battery position, but if this is not feasible, then an alternate solution would be to send a "Pibal Team" to the battery position.

CAUGHT IN FLIGHT

Photographing one projectile in flight is difficult enough, but when two are stopped, one starts looking for a second weapon. Such was the case when a member of B Battery, 2D Battalion, 157TH Artillery, a unit of the Colorado Army National Guard, photographed this firing sequence during his unit's annual field training. The projectile at the left was fired by the second weapon in the platoon positioned to the left rear of the weapon shown in the picture.

Counterinsurgency Lessons Learned



The following material finds its origin in information extracted by the U. S. Army Artillery and Missile School from correspondence which has passed between U. S. artillery units and USAAMS, efforts by departments of the School to solve problems experienced by units in counterinsurgency operations, and after action reports distributed by the Department of the Army.

VEHICLE RECOVERY AND CANAL-CROSSING TECHNIQUES

Field experience has demonstrated the need for developing means for expediting canal crossings, especially for the M113 armored personnel carrier and the M114 command and reconnaissance vehicle.

Several effective techniques of expediting vehicle recovery and canal crossings have been developed.

The capstan-anchor method of vehicle recovery is a successful self-recovery method of exiting steep-banked canals. This expedient features steel adapters permanently bolted to the vehicle drive sprockets and aluminum capstans fastened to the adapters by "T" lugs. A 4¾-inch arc must be cut from the vehicle shroud and end cover in order to mount the adapter; however, this does not reduce the vehicle's swimming capability. Auger-type ground anchors are used as "deadmen." Augers of either 6-or 8-inch diameter and auger eyes or holes are permanently affixed to both ends of steel pipes 6 feet in length. Timbers are buried at ground level directly in front of the ground anchor eye to distribute the pull weight over a large area in order to decrease ground pressure and also to avoid the possibility of bending the anchor shafts. Nylon rope, 1 inch in diameter, is fastened to the capstans and passed through the eyes of the imbedded anchors, and all slack is removed. The vehicle is then placed in low range and slowly proceeds out of the mired area or up the bank, the normal sprocket action allowing the vehicle to recover itself. A kit is presently in production which includes the adapters, capstans, rope, anchors, and necessary hardware.

A fabricated push bar has been developed to facilitate M113 crossings of small canals. This method was developed to replace the log-pushing method that required dismounted troops to position the log between the pushed and pushing vehicles. The push bar consists of two oblong steel adapters mounted on the M113 tow eyes into which 4- by 4-inch mahogany timbers are fitted. The other ends of the timbers are inserted into two oblong steel adapters, which, in turn, are fastened to the "push foot." The push foot itself is composed of a rectangular steel plate mounted with serrated track pads, which provide cushioning and nonslip qualities to the foot. A cable connected to the push foot and the top of the vehicle chassis is used to position the push bar. When an M113 vehicle is mired in, or cannot exit unassisted from, a canal, an M113 equipped with the push bar is used to push the vehicle from the canal. The push bar is carried atop the vehicle until needed. One or more M113 carriers equipped with push bars have been used to push a mired carrier across paddies, bogs, and narrow canals.

Balk aluminum bridge sections, 8 and 15 feet in length, are being used to span short gaps, thereby enabling vehicles to cross them. They are also used to construct corduroy rods to assist vehicles in exiting canals.

Demolitions are also being used as an aid in exiting canals. Demolitions are used to breach an exit bank of a river or canal that is too steep for a vehicle to climb. An exit site prepared by use of demolitions, however, is not necessarily suited for self-exit and may often require a push or pull expedient.

The use of logs or timbers placed atop an M113 when it is necessary to lift or pull another vehicle is another field expedient. The tow cable, attached to the mired vehicle, is run over the logs on top of the M113 which is located at the edge of the bank. The cable is then attached to another M113, which accomplishes the towing.

The methods of vehicle recovery and canal-crossing are many and are limited only by the resourcefulness of the individuals involved.

FUZE CAN OPENER

During recent months several reports indicate that cannoneers have suffered lacerations when opening M513 CVT (controlled variable time) fuze cans. Upon investigation, it became apparent that the opening key provided with each can is too small to maintain a straight rolling tear when torque is applied. Also, in many cases, the tapered end of the opening strip is too brittle and snaps off when the key is attached.

Subsequent tearing of the canisters with pliers or screwdrivers in an effort to remove the lids resulted in the lacerations. These cuts were usually incurred during the heat of combat, resulting in loss of time if first aid was applied or possible infection if the individual continued to work.

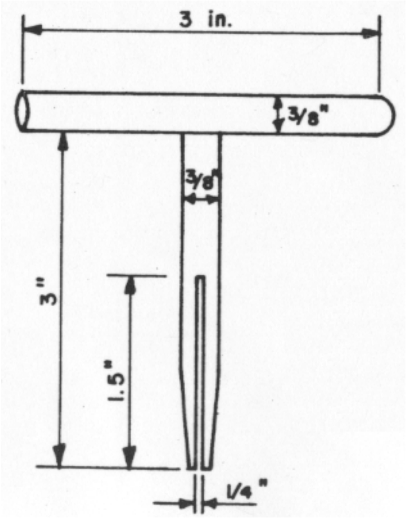
In an effort to correct the situation, this unit has devised the reusable opening key shown in the figure below. The desirable features of the key are its large size and ease of use. The top of the "T" is wide enough to provide increased leverage, and the leg is long enough to roll evenly around the side of the can.

Since using this key, personnel of the unit have suffered no lacerations. In addition, the opened cans are reusable. Formerly, the majority of the fuze cans were so mutilated after being opened that they were unfit for repackaging any CVT fuzes that were not used. Now the fuzes can be put back in their containers and sealed with tape.

The question may be asked, "How does one remove the roll of metal from the key?" Our simple solution is to insert the leg of the key into the slot of an engineer stake and pull the key from the roll. As we utilize engineer stakes to support our ammo tarpaulins in the howitzer section parapets, the removal procedure is accomplished in the immediate area with minimum effort.

Our current program calls for two such keys per howitzer section. The keys are made of ⅜-inch-diameter steel rod, and the two pieces are easily cut and welded together. Tapering the leg facilitates removal of the roll of metal.

Finally, an equipment improvement recommendation has been forwarded through channels requesting that a more functional key be provided with the canisters.



1. Cut two 3-inch pieces of ⅜-inch-diameter steel rod.
2. Weld to form a "T".
3. Cut leg of "T" down center with hacksaw.
4. Taper leg with file to ¼-inch-diameter.

Figure 1. Diagram of "T" key.

M107/M110 ELEVATING SLIP CLUTCH ADJUSTMENT

Some artillery units have experienced problems with the traversing drive assembly slip clutch and the elevating drive assembly slip clutch for the M107/M110. It was found that some of the torque settings were greater or less than the torque settings stated in TM 9-2300-216-35/2, paragraphs 23 and 59.

The U. S. Army Tank Automotive Command (ATAC) has authorized weekly instead of bi-monthly inspections of weapons in Southeast Asia by Field Maintenance. During these inspections, Field Maintenance should test the torque on both the traversing and elevating slip clutches. Tests by Field Maintenance must be made with a torque wrench before applying any adjustment as authorized and described in figures 15 and 19, pages 31 and 35, of TM 9-2300-216-35/2.

ATAC has verified the slip clutch settings listed in the manual and no changes are required.

CHAPARRAL ROAD TESTED

The U. S. Army's Chaparral air defense guided missile system has completed a rugged 100-mile series of road tests aimed at determining the effects of shock and vibration.

The system tested was the first production configuration model produced by Aeronutronic. Testing was conducted at the Naval Ordnance Test Station, China Lake, Calif.

Chaparral fire units produced by Aeronutronic and the experimental XM-730 tracked vehicle produced by the FMC Corporation, San Jose, Calif., were driven over rugged terrain to determine the effects of shock and vibration on the entire system. Army gunners occupied the inclosed, Aeronutronic-constructed firing turrent mount in several of the tests. The panel shown on the side of the vehicle recorded test data.

The missile system, selected recently by the Army as one of two major weapon systems to provide field commanders with low altitude air defense in forward battle areas, has been successfully test fired at White Sands Missile Range, N. M.

Chaparral is an infrared, heat-seeking missile system consisting of a missile launcher and mount and fires modified air-to-air missiles in a ground-to-air configuration. The fire unit is self-contained and can be mounted on any of several types of vehicles including the self-propelled XM-730, railroad flat cars, flat bed trucks or trailers or can be ground mounted.

Gunners in the Chaparral turret mount aim the missile to fire. The missile automatically guides on the target's heat source after launch.

Status of Training Literature and Films

Training Literature

The following training literature is under preparation by the U. S. Army Artillery and Missile School. The completion dates listed is that time at which the publications are scheduled to be submitted to the Adjutant General for publication.

FIELD MANUALS (FM)		Estimated Date FY	QTR
FM 6-123	Visual Airborne Target Locating System	69	1
FM 6-( )	Field Artillery Missile, Lance	69	1
FM 6-( )	Field Artillery Missile, Pershing	69	3
TRAINING CIRCULAR (TC)			
TC 6-( )	The Laser Rangefinder XM-23 (data on new material)	68	2
ARTILLERY TRAINING PROGRAM (ATP)			
ATP 6-195T	Field Artillery Battalion, Lance	69	2
ATP 6-700	Field Artillery Airmobile Units	to be determined	
ARMY SUBJECT SCHEDULES (ASubjScd)			
ASubjScd 6-23	Field Artillery Sound Ranging	68	3
ASubjScd 6-26	Field Artillery Flash Ranging	68	2
ASubjScd 6-27	Field Artillery Searchlights	68	1
ASubjScd 6-15D10	MOS Technical Training and Refresher Training of Field Artillery Missile Crewman, Lance	69	2

		Estimated Date FY	QTR
ASubjScd 6-17A10	MOS Technical Training and Refresher of Field Artillery Combat Surveillance and Target Acquisition Crewman	68	2
ARMY TRAINING TEST			
ATT 6-705	Airmobile Field Artillery Battalion, 105-mm	to be determined	
ATT 6-707	Airmobile Field Artillery Battery, 105-mm	to be determined	
ATT 6-715	Airmobile Field Artillery Battalion, LJ	to be determined	
ATT 6-717	Airmobile Field Artillery Battery, LJ (tests for new units)	to be determined	

ATT 6-725	Airmobile Field Artillery Battalion, Aerial Rocket	to be determined	
ATT 6-727	Airmobile Field Artillery Battery, Aerial Rocket	to be determined	
ATT 6-195T	Field Artillery Missile Battalion, Lance	69	1

The following training literature is either being revised (R) or supplemented with a change (C) by the U. S. Army Artillery and Missile School:

			Estimated FY	**Date QTR**
FIELD MANUALS				
FM 6-2	(R)	Artillery Survey	68	3
FM 6-3-1	(C)	Gun Direction Computer, M18, Cannon Application	68	4
FM 6-15	(R)	Artillery Meteorology	68	4
FM 6-20-2	(R)	Field Artillery Techniques	68	3
FM 6-40	(R)	Field Artillery Cannon Gunnery	68	1
FM 6-40-1	(R)	Field Artillery Honest John/Little John Rocket Gunnery	68	4
FM 6-40-1A	(C)	Field Artillery Honest John/Little John Rocket Gunnery (U) (classified secret restricted data)	68	4
FM 6-10	(R)	Field Artillery Communications	69	1
FM 6-20-2	(C)	Field Artillery Techniques	69	3
FM 6-40	(C)	Field Artillery Cannon Gunnery	69	3
FM 6-40-2	(R)	Field Artillery Missile Gunnery (U) (classified)	69	1
FM 6-70	(R)	105-mm Howitzer, M102	69	4
FM 6-75	(C)	105-mm Howitzer, M101 Series, Towed	69	3
FM 6-88	(R)	155-mm Howitzer, M109, Self-Propelled	69	4
FM 6-94	(R)	175-mm Gun, M107, Self-Propelled, and 8-Inch Howitzer, M110, Self-Propelled	68	2

			Estimated FY	**Date QTR**
(S) FM 6-99	(R)	Employment of Selected Ammunition with Cannon Artillery (U) (Classified)	69	3
FM 6-40-3	(C)	Gun Direction Computer M18, Gunnery	68	4
FM 6-57	(C)	Field Artillery Rocket Little John with Launcher M34	68	4
FM 6-59	(C)	Field Artillery Rocket Honest John with Launcher M386	68	4

FM 6-70	(R)	105-mm Howitzer M102	68	2
FM 6-73	(R)	Graphical Scales for 105-mm, 155-mm, 8-Inch Howitzers, 175-mm Gun, 762-mm Rocket, M31 Series	68	4
FM 6-75	(C)	105-mm Howitzer, M101 Series, Towed	68	1
FM 6-79	(C)	105-mm Howitzer, M108, Self-Propelled	68	1
FM 6-81	(C)	155-mm Howitzer, M114, Towed	68	3
FM 6-88	(C)	155-mm Howitzer, M109, Self-Propelled	68	1
FM 6-92	(C)	155-mm Howitzer, M44, Self-Propelled	68	4
FM 6-94	(C)	175-mm Gun, M107, Self-Propelled and 8-Inch Howitzer, M110, Self-Propelled	68	2

			Estimated FY	Date QTR
FM 6-122	(R)	Artillery Sound Ranging and Flash Ranging	68	3
FM 6-135	(R)	Adjustment of Artillery Fire by the Combat Soldier	68	3
FM 6-160	(R)	Radar Set AN/MPQ-10A	68	4
FM 6-161	(R)	Radar Set AN/MPQ-4A	68	4
FM 6-162	(R)	Radar Set AN/MPQ-25A	68	4

TECHNICAL MANUALS (TM)

TM 6-300-68	(R)	The Army Ephemeris To update data	68	1
TM 6-300-69	(R)	The Army Ephemeris	69	1

ARTILLERY TRAINING PROGRAM (ATP)

ATP 6-100	(R)	Field Artillery Units	68	2
ATP 6-175	(R)	Field Artillery Missile Units HJ/LJ	68	3
ATP 6-555	(R)	Field Artillery Missile Battalion, Sergeant	69	2
ATP 6-558	(R)	Field Artillery Searchlight Battery	69	3
ATP 6-575	(R)	Field Artillery Target Acquisition Battalion	68	4
ATP 6-615	(R)	Field Artillery Battalion, Pershing	69	1

			Estimated FY	Date QTR

ARMY SUBJECT SCHEDULES (ASubjScb)

ASubjScd 6-4	(R)	Field Artillery Combat Intelligence	67	4
ASubjScd 6-10	(R)	Field Artillery Radar Operations	68	4
ASubjScd 6-22	(R)	Conduct of Observed Fires	68	3

ASubjScd 6-24	(R)	Organization and Duties of the Operations Section and Processing Section of Field Artillery Target Acquisition Battalion	68	2
ASubjScd 6-25	(R)	Construction of Sound Ranging Plotting Chart To update	68	1
ASubjScd 6-30	(R)	Umpiring and Aggressor Forces	69	3
ASubjScd 6-31	(R)	Visibility Diagrams To update	68	1
ASubjScd 6-41	(R)	Organization/Mission-Infantry, Airborne, Armored, and Mechanized Division	67	4
ASubjScd 6-42	(R)	Difficult Traction & Field Expedients	69	3
ASubjScd 6-15E10	(R)	Pershing Missile Crewman	69	1
ASubjScd 6-154	(R)	Flash Ranging Crewman	68	3
ASubjScd 6-155	(R)	Sound Ranging Crewman	68	3

			Estimated FY	Date QTR
ASubjScd 6-156	(R)	Artillery Radar Crewman	68	3

ARMY TRAINING TEST (ATT)

ATT 6-157	(R)	Field Artillery Battery, Lt/Med, Towed/SP	67	2
ATT 6-350	(C)	Field Artillery Gun/Howitzer Battery, Heavy, Towed/SP	68	1
ATT 6-558 (old 6-6)	(R)	Field Artillery Searchlight Battery	68	2
ATT 6-615		Field Artillery Missile Battalion Pershing la	69	3

The following training literature is under preparation (N), revision (R), or change (C) by the U. S. Army Combat Developments Command Artillery Agency, Fort Sill.

FIELD MANUALS (FM)

			Estimated FY	Date QTR
FM 6-102	(N)	Field Artillery Battalion Aerial Artillery	68	2
FM 6-120	(R)	Field Artillery Target Acquisition Battalion and Batteries	68	1
FM 6-121	(R)	Field Artillery Target Acquisition	68	1
FM 6-39	(R)	Field Artillery Battalion, Pershing	68	1

Changes to the following publications have been submitted by the U. S. Army Combat Developments Command Artillery Agency to the U. S. Army Combat Developments Command Combined Arms Group for processing to the Adjutant General.

FM 6-20-1	(R)	Field Artillery Tactics		
FM 6-140	(R)	Field Artillery Cannon Battalions and Batteries	68	1

RESIDENT COURSES

U. S. Army Artillery and Missile School

Listed are resident courses scheduled by the United States Army Artillery and Missile School for both officer and enlisted personnel. Courses listed are those scheduled to begin during fiscal year 1968.

OFFICER COURSES

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
2-6-C8	1-68	13 Aug 67	14 Aug 67	25 Aug 67	61
FA Field Grade	2-68	1 Oct 67	2 Oct 67	13 Oct 67	61
Off Refresher (2 Weeks)	3-68	17 Mar 68	18 Mar 68	29 Mar 68	62
(Max Cap: 62)	4-68	12 May 68	13 May 68	24 May 68	62
					246
2-6-C20	1-68	11 Jul 67	17 Jul 67	15 Sep 67	119
FA Officer	2-68	1 Aug 67	7 Aug 67	6 Oct 67	119
Basic	3-68	22 Aug 67	28 Aug 67	27 Oct 67	119
(12 Weeks	4-68	12 Sep 67	18 Sep 67	17 Nov 67	119
(Max Cap: 120)	5-68	26 Sep 67	2 Oct 67	1 Dec 67	119
	6-68	6 Nov 67	13 Nov 67	20 Feb 68	118
	7-68	28 Nov 67	4 Dec 67	8 Mar 68	118
	8-68	30 Jan 68	5 Feb 68	26 Apr 68	119
	9-68	13 Feb 68	19 Feb 68	10 May 68	118
	10-68	27 Feb 68	4 Mar 68	24 May 68	117
	11-68	26 Mar 68	1 Apr 68	21 Jun 68	117
	12-68	7 May 68	13 May 68	2 Aug 68	90
	13-68	14 May 68	20 May 68	9 Aug 68	88
	14-68	28 May 68	3 Jun 68	23 Aug 68	88
					1568
2-6-C20-RA	1-68	3 Jul 67	10 Jul 67	18 Aug 67	118
RA FA Officer	*2-68	8 Aug 67	14 Aug 67	22 Sep 67	126
Basic	3-68	31 Oct 67	6 Nov 67	24 Jan 68	81
(9 Weeks)	4-68	23 Jan 68	29 Jan 68	29 Mar 68	74
(Max Cap: 120)	5-68	30 Apr 68	6 May 68	8 Jul 68	74
***USMA Class**					
					473
2-6-C21	1-68	23 Jul 67	24 Jul 67	18 Aug 67	43
FA Officer	2-68	21 Aug 67	22 Aug 67	19 Sep 67	43
Orientation	3-68	24 Sep 67	25 Sep 67	20 Oct 67	43
(4 Weeks)	4-68	22 Oct 67	23 Oct 67	21 Nov 67	18
(Max Cap: 45)	5-68	19 Nov 67	20 Nov 67	16 Dec 67	18
	6-68	7 Jan 68	8 Jan 68	2 Feb 68	18
	7-68	5 Feb 68	6 Feb 68	5 Mar 68	18
	8-68	10 Mar 68	11 Mar 68	5 Apr 68	18
	9-68	7 Apr 68	8 Apr 68	3 May 68	18
	10-68	6 May 68	7 May 68	4 Jun 68	19
	11-68	10 Jun 68	11 Jun 68	9 Jul 68	19
					275
2-6-C22	1-68	2 Jul 67	6 Jul 67	5 Apr 68	144
Artillery Officer Advanced	*2-68	28 Aug 67	31 Aug 67	31 May 68	144
(27 Weeks)	3-68	23 Oct 67	26 Oct 67	30 Jul 68	144
(Max Cap: 145)	*4-68	8 Jan 68	11 Jan 68	27 Sep 68	141
	5-68	18 Mar 68	21 Mar 68	10 Dec 68	141
	*6-68	20 May 68	23 May 68	21 Feb 69	140
* Includes 31, 31, and 32 allied officers respectively					854

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
		PHASE II			
2-6-C23	1-68	25 Feb 68	26 Feb 68	22 Mar 68	54
FA Officer Mobilization Advanced	2-68	21 Apr 68	22 Apr 68	17 May 68	54
					108
		PHASE III			
(Ph II: 4 Wks)	1-68	24 Mar 68	25 Mar 68	19 Apr 68	30
(Max Cap: 120)					30
2E-F4	1-68	9 Jul 67	10 Jul 67	21 Jul 67	42
Senior FA Officer	2-68	21 Jan 68	22 Jan 68	2 Feb 68	42
(1 Wk, 5 Da)	3-68	16 Jun 68	17 Jun 68	28 Jun 68	43
(Max Cap: 50)					127
2E-F12	1-68	17 Aug 67	18 Aug 67	7 Sep 67	33
Nuclear, Biological and Chemical Weapons Employment (3 Weeks) (Max Cap: 35)	**(The above class for 2E-F12 Course is conducted for selected graduates of Class 4-67, AFAOCC)**				
2E-F13	1-68	24 Sep 67	25 Sep 67	27 Oct 67	23
Nuclear, Biological and Chemical Weapons Employment	2-68	18 Feb 68	19 Feb 68	22 Mar 68	22
(5 Weeks) (Max Cap: 35)					45
2E-F14	1-68	8 Oct 67	9 Oct 67	20 Oct 67	27
Nuclear, Biological and	2-68	3 Mar 68	4 Mar 68	15 Mar 68	27
Chemical Weapons Employment	3-68	16 Jun 68	17 Jun 68	28 Jun 68	28
(Res Comp) (2 Weeks) (Max Cap: 35)					82
2G-F1	1-68	12 Nov 67	13 Nov 67	18 Nov 67	90
Division Artillery Staff Officer	2-68	7 Jan 68	8 Jan 68	13 Jan 68	89
Refresher (1 Week) (Max Cap: 116)					179
2E-1154	1-68	12 Jul 67	13 Jul 67	22 Sep 67	21
Artillery Target Acquisition	2-68	27 Sep 67	28 Sep 67	11 Dec 67	20
Officer (10 Weeks, 1 Da)	3-68	17 Jan 68	18 Jan 68	29 Mar 68	20
(Max Cap: 20)	4-68	10 Apr 68	11 Apr 68	21 Jun 68	20
					81
2F-1190-D	1-68	20 Aug 67	21 Aug 67	22 Sep 67	31
Sergeant Off (4 Wks, 4 Da)	2-68	25 Sep 68	26 Sep 67	27 Oct 67	30
(Max Cap: 25)	3-68	18 Feb 68	19 Feb 68	22 Mar 68	30
					91
2F-1190-E	1-68	23 Jul 67	24 Jul 67	12 Sep 67	28
	501-68	30 Jul 67	31 Jul 67	14 Sep 67	20
Pershing Off	2-68	10 Sep 67	11 Sep 67	30 Oct 67	28
(7 Wks, 1 Da)	3-68	10 Jan 68	11 Jan 68	1 Mar 68	28
(Max Cap: 30)					104
2G-1183	1-68	20 Sep 67	21 Sep 67	9 Nov 67	39
Artillery Survey Officer	2-68	3 Jan 68	4 Jan 68	23 Feb 68	40
(7 Wks, 1 Da)	3-68	28 Mar 68	29 Mar 68	17 May 68	40
(Max Cap: 40)					119
4C-0200	1-68	6 Jul 67	7 Jul 67	21 Sep 67	43
Communications Officer	2-68	17 Aug 67	18 Aug 67	2 Nov 67	43
(10 Wks, 4 Da)	3-68	7 Sep 67	8 Sep 67	22 Nov 67	43
(Max Cap: 40)	4-68	28 Sep 67	29 Sep 67	15 Dec 67	43
	5-68	26 Oct 67	27 Oct 67	30 Jan 68	43
	6-68	4 Jan 68	5 Jan 68	21 Mar 68	43
	7-68	25 Jan 68	26 Jan 68	11 Apr 68	43

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
	8-68	15 Feb 68	16 Feb 68	2 May 68	43
	9-68	7 Mar 68	8 Mar 68	22 May 68	43
	10-68	18 Apr 68	19 Apr 68	5 Jul 68	43
	11-68	9 May 68	10 May 68	26 Jul 68	43
	12-68	6 Jun 68	7 Jun 68	22 Aug 68	44
					517
WO-F1	1-68	9 Jul 67	10 Jul 67	28 Jul 67	202
Warrant Officer Orientation	2-68	13 Aug 67	14 Aug 67	1 Sep 67	202
(3 Weeks)	3-68	17 Sep 67	18 Sep 67	6 Oct 67	202
(Max Cap: 202)	4-68	15 Oct 67	16 Oct 67	3 Nov 67	202
	5-68	26 Nov 67	27 Nov 67	15 Dec 67	202
	6-68	14 Jan 68	15 Jan 68	2 Feb 68	197
	7-68	3 Mar 68	4 Mar 68	22 Mar 68	197
	8-68	14 Apr 68	15 Apr 68	3 May 68	198
	9-68	2 Jun 68	3 Jun 68	21 Jun 68	198
					1800
5B-F2	1-68	7 Jul 67	10 Jul 67	14 Jul 67	5
Ballistic Meteorology	2-68	1 Dec 67	4 Dec 67	8 Dec 67	5
Technician Refresher	3-68	19 Apr 68	22 Apr 68	26 Apr 68	5
(5 Days) (Max Cap: 10)					
					15
Refresher Training in the Tactical	1-68	9 Jul 67	10 Jul 67	15 Jul 67	30
Employment of Nuclear,	2-68	13 Aug 67	14 Aug 67	19 Aug 67	30
Biological and Chemical	3-68	22 Oct 67	23 Oct 67	28 Oct 67	30
Weapons (1 Week)	4-68	10 Dec 67	11 Dec 67	16 Dec 67	30
(Max Cap: 30)	5-68	7 Jan 68	8 Jan 68	13 Jan 68	30
	6-68	25 Feb 68	26 Feb 68	2 Mar 68	30
	7-68	10 Mar 68	11 Mar 68	16 Mar 68	30
	8-68	28 Apr 68	29 Apr 68	4 May 68	30
	9-68	19 May 68	20 May 68	25 May 68	30
					270
	OFFICER/ENLISTED COURSES				
2F-F1/121-F1	1-68	9 Jul 67	10 Jul 67	14 Jul 67	20
FADAC Operators	2-68	8 Oct 67	9 Oct 67	13 Oct 67	19
(1 Week)	3-68	21 Jan 68	22 Jan 68	26 Jan 68	20
(Max Cap: 20)	4-68	28 Apr 68	29 Apr 68	3 May 68	20
					79
4F-F5/041-13A1N	1-68	7 Jul 67	10 Jul 67	14 Jul 67	10
8-Inch Nuclear Projectile	2-68	14 Jul 67	17 Jul 67	21 Jul 67	10
Assembly	3-68	28 Jul 67	31 Jul 67	4 Aug 67	10
(1 Week)	4-68	4 Aug 67	7 Aug 67	11 Aug 67	10
(Max Cap: 30)	5-68	11 Aug 67	14 Aug 67	18 Aug 67	10
	7-68	8 Sep 67	11 Sep 67	15 Sep 67	10
	8-68	15 Sep 67	18 Sep 67	22 Sep 67	10
	9-68	22 Sep 67	25 Sep 67	29 Sep 67	10
	10-68	6 Oct 67	9 Oct 67	13 Oct 67	10
	11-68	13 Oct 67	16 Oct 67	20 Oct 67	10
	12-68	27 Oct 67	30 Oct 67	3 Nov 67	10
	13-68	10 Nov 67	13 Nov 67	17 Nov 67	10
	14-68	24 Nov 67	27 Nov 67	1 Dec 67	10
	15-68	1 Dec 67	4 Dec 67	8 Dec 67	10
	16-68	8 Dec 67	11 Dec 67	15 Dec 67	10
	17-68	5 Jan 68	8 Jan 68	12 Jan 68	10
	18-68	12 Jan 68	15 Jan 68	19 Jan 68	10
	19-68	19 Jan 68	22 Jan 68	26 Jan 68	10
	20-68	2 Feb 68	5 Feb 68	9 Feb 68	10
	21-68	9 Feb 68	12 Feb 68	16 Feb 68	10
	22-68	23 Feb 68	26 Feb 68	1 Mar 68	10

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
	23-68	1 Mar 68	4 Mar 68	8 Mar 68	10
	24-68	15 Mar 68	18 Mar 68	22 Mar 68	10
	25-68	22 Mar 68	25 Mar 68	29 Mar 68	10
	26-68	5 Apr 68	8 Apr 68	12 Apr 68	10
	27-68	19 Apr 68	22 Apr 68	26 Apr 68	10
	28-68	3 May 68	6 May 68	10 May 68	10
	29-68	10 May 68	13 May 68	17 May 68	10
	30-68	17 May 68	20 May 68	24 May 68	10
	31-68	7 Jun 68	10 Jun 68	14 Jun 68	10
	32-68	14 Jun 68	17 Jun 68	21 Jun 68	7
					317
4F-F4/121-15B30	1-68	3 Jul 67	5 Jul 67	17 Aug 67	32
Sergeant Missile Battery	2-68	30 Oct 67	31 Oct 67	15 Dec 67	32
(6 Wks, 2 Da)	3-68	8 Jan 68	9 Jan 68	21 Feb 68	32
(Max Cap: 32)	4-68	1 Apr 68	2 Apr 68	15 May 68	31
					127
121-15E20 Enlisted	1-68	10 Jul 67	11 Jul 67	25 Aug 67	35
Pershing Missile Battery	2-68	14 Aug 67	15 Aug 67	2 Oct 67	35
(6 Wks, 4 Days)	3-68	2 Oct 67	3 Oct 67	20 Nov 67	35
(Max Cap: 35)	4-68	16 Oct 67	17 Oct 67	5 Dec 67	35
	501-68	30 Oct 67	31 Oct 67	15 Dec 67	23
	5-68	13 Nov 67	14 Nov 67	17 Jan 68	35
	6-68	4 Dec 67	5 Dec 67	6 Feb 68	35
	7-68	2 Jan 68	3 Jan 68	19 Feb 68	35
	8-68	22 Jan 68	23 Jan 68	11 Mar 68	35
	9-68	19 Feb 68	20 Feb 68	8 Apr 68	35
	10-68	11 Mar 68	12 Mar 68	26 Apr 68	35
	502-68	25 Mar 68	26 Mar 68	10 May 68	23
	11-68	1 Apr 68	2 Apr 68	17 May 68	35
	12-68	29 Apr 68	30 Apr 68	17 Jun 68	35
	13-68	27 May 68	28 May 68	16 Jul 68	35
	14-68	17 Jun 68	18 Jun 68	5 Aug 68	35
					536
2E-F19/030-F2	1-68	7 Aug 67	8 Aug 67	11 Aug 67	13
FA Searchlight	2-68	9 Oct 67	10 Oct 67	13 Oct 67	13
(5 Days)	3-68	4 Dec 67	5 Dec 67	8 Dec 67	13
(Max Cap: 30)	4-68	29 Jan 68	30 Jan 68	2 Feb 68	12
	5-68	1 Apr 68	2 Apr 68	5 Apr 68	12
	6-68	20 May 68	21 May 68	24 May 68	12
					75
4F-214E/121-21G20	1-68	7 Jul 67	10 Jul 67	28 Nov 67	21
Pershing System Maintenance	2-68	21 Jul 67	24 Jul 67	12 Dec 67	21
(19 Wks, 4 Da)	3-68	8 Sep 67	11 Sep 67	14 Feb 68	21
(Max Cap: 21)	4-68	27 Oct 67	30 Oct 67	4 Apr 68	21
	5-68	24 Nov 67	27 Nov 67	29 Apr 68	21
	6-68	2 Jan 68	3 Jan 68	21 May 68	21
	7-68	26 Jan 68	29 Jan 68	17 Jun 68	21
	8-68	16 Feb 68	19 Feb 68	9 Jul 68	14
	9-68	24 May 68	28 May 68	15 Oct 68	15
					176
		Phase I Report	**Phase II Report**	**Close**	
4C-211A/104-26B20	1-68	14 Jul 67	9 Oct 67	7 Feb 68	26
Weapons Support	2-68	25 Aug 67	21 Nov 67	21 Mar 68	26
Radar Maintenance	3-68	6 Oct 67	18 Jan 68	1 May 68	26
(Ph I: 12 Wks)	4-68	17 Nov 67	29 Feb 68	12 Jun 68	26
(1 Da)	5-68	12 Jan 68	8 Apr 68	22 Jul 68	26

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
(Ph II: 14 Wks)	6-68	23 Feb 68	17 May 68	30 Aug 68	26
(2 Da)	7-68	5 Apr 68	1 Jul 68	14 Oct 68	26
(Total: 26 Wks)	8-68	17 May 68	13 Aug 68	26 Nov 68	26
(3 Da)	9-68	28 Jun 68	24 Sep 68	21 Jan 69	26
(Max Cap: 24)					
					234
4B-F1/101-31B30	2-68	20 Oct 67	23 Oct 67	3 Nov 67	19
FADAC Maintenance	3-68	17 Nov 67	20 Nov 67	4 Dec 67	19
(1 Wk, 5 Da)	4-68	2 Feb 68	5 Feb 68	16 Feb 68	20
(Max Cap: 24)	5-68	8 Mar 68	11 Mar 68	22 Mar 68	20
	6-68	5 Apr 68	8 Apr 68	19 Apr 68	19
	7-68	10 May 68	13 May 68	24 May 68	19
	8-68	7 Jun 68	10 Jun 68	21 Jun 68	19
					154
5B-F1/420-93F20	1-68	10 Jul 67	11 Jul 67	18 Sep 67	39
Artillery Ballistic Meteorology	2-68	31 Jul 67	1 Aug 67	9 Oct 67	39
(9 Wks, 4 Days)	3-68	21 Aug 67	22 Aug 67	30 Oct 67	39
(Max Cap: 40)	4-68	11 Sep 67	12 Sep 67	20 Nov 67	38
	5-68	2 Oct 67	3 Oct 67	12 Dec 67	38
	6-68	23 Oct 67	24 Oct 67	18 Jan 68	40
	7-68	13 Nov 67	14 Nov 67	7 Feb 68	40
	8-68	4 Dec 67	5 Dec 67	28 Feb 68	40
	9-68	8 Jan 68	9 Jan 68	18 Mar 68	40
	10-68	29 Jan 68	30 Jan 68	8 Apr 68	40
	11-68	19 Feb 68	20 Feb 68	29 Apr 68	40
	12-68	11 Mar 68	12 Mar 68	17 May 68	40
	13-68	1 Apr 68	2 Apr 68	10 Jun 68	40
	14-68	22 Apr 68	23 Apr 68	1 Jul 68	40
	15-68	13 May 68	14 May 68	23 Jul 68	40
	16-68	3 Jun 68	4 Jun 68	12 Aug 68	40
	17-68	24 Jun 68	25 Jun 68	3 Sep 68	41
					674
198-35D30 (Enlisted)	1-68	20 Oct 67	25 Oct 67	28 Mar 68	18
Meteorological Equipment	2-68	23 Feb 68	26 Feb 68	15 Jun 68	18
Repairman (19 Wks, 4 Da)	3-68	7 Jun 68	10 Jun 68	28 Oct 68	18
(Max Cap: 18)					
					54
	ENLISTED COURSES				
2-6-F1	1-68	2 Jul 67	11 Jul 67	12 Dec 67	245
FA Officer Candidate	2-68	9 Jul 67	17 Jul 67	17 Dec 67	245
(23 Weeks)	3-68	23 Jul 67	31 Jul 67	16 Jan 68	245
(Max Cap: 252)	4-68	30 Jul 67	7 Aug 67	23 Jan 68	245
	6-68	13 Aug 67	21 Aug 67	6 Feb 68	245
	505-68	10 Sep 67	18 Sep 67	5 Mar 68	128
	501-68	24 Sep 67	2 Oct 67	19 Mar 68	252
	502-68	29 Oct 67	6 Nov 67	23 Apr 68	252
	503-68	26 Nov 67	4 Dec 67	21 May 68	252
	504-68	14 Jan 68	22 Jan 68	25 Jun 68	126
	506-68	28 Jan 68	5 Feb 68	9 Jul 68	126
	507-68	11 Feb 68	19 Feb 68	23 Jul 68	126
	508-68	25 Feb 68	4 Mar 68	6 Aug 68	126
	509-68	10 Mar 68	18 Mar 68	20 Aug 68	126
	510-68	24 Mar 68	1 Apr 68	3 Sep 68	126
	511-68	14 Apr 68	22 Apr 68	24 Sep 68	126
	512-68	28 Apr 68	6 May 68	8 Oct 68	126
	513-68	12 May 68	20 May 68	22 Oct 68	126
	514-68	26 May 68	3 Jun 68	5 Nov 68	126
	515-68	9 Jun 68	17 Jun 68	19 Nov 68	126
	516-68	23 Jun 68	1 Jul 68	3 Dec 68	126
					3866

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
2-6-F2	1-68	8 Mar 68	11 Mar 68	25 May 68	107
FA Officer Candidate	2-68	14 Jun 68	17 Jun 68	31 Aug 68	107
(Res Comp) (11 Weeks)					
(Max Cap: 120)					214
101-F2					
AN/TRC-80 Operations	2-68	31 Aug 67	5 Sep 67	3 Nov 67	9
(Pershing) (9 Weeks)	3-68	12 Jan 68	15 Jan 68	18 Mar 68	15
(Max Cap: 15)	4-68	5 Apr 68	8 Apr 68	10 Jun 68	13
					47
101-F4	1-68	27 Jul 67	28 Jul 67	11 Oct 67	45
Communications Chief	2-68	16 Nov 67	17 Nov 67	16 Feb 68	45
(10 Wks, 3 Days)	3-68	28 Mar 68	29 Mar 68	12 Jun 68	45
(Max Cap: 40)					
					135
250-F1	1-68	9 Jul 67	10 Jul 67	26 Sep 67	42
FA Operations and	2-68	24 Sep 67	25 Sep 67	13 Dec 67	42
Intelligence Assistant	3-68	7 Jan 68	8 Jan 68	26 Mar 68	40
(11 Wks, 1 Day)	4-68	7 Apr 68	8 Apr 68	25 Jun 68	40
(Max Cap: 65)					
					164
412-F1	1-68	28 Jul 67	31 Jul 67	25 Aug 67	28
Artillery Survey NCO	2-68	16 Nov 67	17 Nov 67	15 Dec 67	28
(4 Weeks)	3-68	13 Jun 68	14 Jun 68	12 Jul 68	29
(Max Cap: 80)					
					85
610/611-F1	1-68	10 Jul 67	12 Jul 67	8 Sep 67	22
Master Mechanic	2-68	28 Aug 67	30 Aug 67	27 Oct 67	22
(9 Weeks)	3-68	16 Oct 67	18 Oct 67	15 Dec 67	22
(Max Cap: 40)	4-68	8 Jan 68	10 Jan 68	8 Mar 68	22
	5-68	26 Feb 68	28 Feb 68	26 Apr 68	22
	6-68	8 Apr 68	10 Apr 68	7 Jun 68	22
	7-68	20 May 68	22 May 68	19 Jul 68	22
					154
221-17B20	1-68	17 Jul 67	18 Jul 67	12 Sep 67	70
FA Radar Operation	2-68	14 Aug 67	15 Aug 67	10 Oct 67	70
(8 Wks, 2 Days)	3-68	11 Sep 67	12 Sep 67	6 Nov 67	70
(Max Cap: 35)	4-68	9 Oct 67	10 Oct 67	7 Dec 67	54
	5-68	6 Nov 67	7 Nov 67	22 Jan 68	60
	6-68	8 Jan 68	9 Jan 68	5 Mar 68	60
	7-68	5 Feb 68	6 Feb 68	2 Apr 68	31
	8-68	4 Mar 68	5 Mar 68	29 Apr 68	31
	9-68	1 Apr 68	2 Apr 68	27 May 68	31
	10-68	29 Apr 68	30 Apr 68	25 Jun 68	31
	11-68	27 May 68	28 May 68	24 Jul 68	31
					568
412-17C20	1-68	3 Jul 67	5 Jul 67	24 Aug 67	19
Artillery Sound Ranging	2-68	11 Sep 67	12 Sep 67	1 Nov 67	19
(7 Wks, 2 Days)	3-68	4 Mar 68	5 Mar 68	24 Apr 68	19
(Max Cap: 28)	4-68	13 May 68	14 May 68	5 Jul 68	18
					75
198-35D20	1-68	7 Jul 67	10 Jul 67	16 Oct 67	12
Meteorological Equipment	2-68	20 Oct 67	23 Oct 67	15 Feb 68	11
Mechanic (14 Weeks)	3-68	23 Feb 68	26 Feb 68	3 Jun 68	10
(Max Cap: 14)	4-68	7 Jun 68	10 Jun 68	17 Sep 68	10
					43

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
611-63C20	1-68	10 Jul 67	12 Jul 67	25 Aug 67	41
Tracked Vehicle Mechanic	2-68	17 Jul 67	19 Jul 67	1 Sep 67	41
(7 Weeks)	3-68	24 Jul 67	26 Jul 67	8 Sep 67	41
(Max Cap: 40)	4-68	31 Jul 67	2 Aug 67	15 Sep 67	41
	5-68	7 Aug 67	9 Aug 67	22 Sep 67	41
	6-68	14 Aug 67	16 Aug 67	29 Sep 67	41
	7-68	21 Aug 67	23 Aug 67	6 Oct 67	41
	8-68	28 Aug 67	30 Aug 67	13 Oct 67	41
	9-68	11 Sep 67	13 Sep 67	27 Oct 67	41
	10-68	18 Sep 67	20 Sep 67	3 Nov 67	41
	11-68	25 Sep 67	27 Sep 67	9 Nov 67	41
	12-68	1 Oct 67	3 Oct 67	17 Nov 67	50
	13-68	8 Oct 67	10 Oct 67	22 Nov 67	50
	14-68	15 Oct 67	17 Oct 67	1 Dec 67	50
	15-68	22 Oct 67	24 Oct 67	8 Dec 67	50
	501-68	5 Nov 67	7 Nov 67	15 Dec 67	50
	16-68	29 Oct 67	31 Oct 67	15 Dec 67	50
	17-68	12 Nov 68	14 Nov 67	12 Jan 68	50
	18-68	19 Nov 67	21 Nov 67	19 Jan 68	50
	19-68	26 Nov 67	28 Nov 67	26 Jan 68	50
	20-68	3 Dec 67	5 Dec 67	2 Feb 68	50
	502-68	2 Jan 68	4 Jan 68	16 Feb 68	50
	21-68	7 Jan 68	9 Jan 68	21 Feb 68	50
	22-68	14 Jan 68	16 Jan 68	1 Mar 68	50
	23-68	21 Jan 68	23 Jan 68	8 Mar 68	50
	24-68	28 Jan 68	30 Jan 68	15 Mar 68	50
	25-68	4 Feb 68	6 Feb 68	22 Mar 68	50
	26-68	11 Feb 68	13 Feb 68	29 Mar 68	50
	27-68	18 Feb 68	20 Feb 68	5 Apr 68	50
	28-68	25 Feb 68	27 Feb 68	12 Apr 68	50
	29-68	3 Mar 68	5 Mar 68	19 Apr 68	50
	30-68	10 Mar 68	12 Mar 68	26 Apr 68	50
	31-68	17 Mar 68	19 Mar 68	3 May 68	50
	32-68	24 Mar 68	26 Mar 68	10 May 68	50
	33-68	31 Mar 68	2 Apr 68	17 May 68	50
	34-68	7 Apr 68	9 Apr 68	24 May 68	50
	35-68	14 Apr 68	16 Apr 68	29 May 68	50
	36-68	21 Apr 68	23 Apr 68	7 Jun 68	50
	37-68	28 Apr 68	30 Apr 68	14 Jun 68	50
	38-68	5 May 68	7 May 68	21 Jun 68	50
	39-68	12 May 68	14 May 68	28 Jun 68	50
	40-68	19 May 68	21 May 68	3 Jul 68	50
	41-68	26 May 68	28 May 68	12 Jul 68	50
	42-68	2 Jun 68	4 Jun 68	19 Jul 68	50
	43-68	9 Jun 68	11 Jun 68	26 Jul 68	50
	44-68	16 Jun 68	18 Jun 68	2 Aug 68	50
	45-68	23 Jun 68	25 Jun 68	9 Aug 68	49
					2250
412-82C20	1-68	10 Jul 67	11 Jul 67	7 Sep 67	90
Artillery Survey Specialist	2-68	17 Jul 67	18 Jul 67	14 Sep 67	90
(8 Wks, 2 Days)	3-68	31 Jul 67	1 Aug 67	28 Sep 67	90
(Max Cap: 90)	4-68	21 Aug 67	22 Aug 67	19 Oct 67	90
	5-68	28 Aug 67	29 Aug 67	26 Oct 67	90
	6-68	4 Sep 67	5 Sep 67	1 Nov 67	90
	7-68	11 Sep 67	12 Sep 67	8 Nov 67	90
	8-68	25 Sep 67	26 Sep 67	24 Nov 67	90
	9-68	16 Oct 67	17 Oct 67	15 Dec 67	79
	10-68	30 Oct 67	31 Oct 67	16 Jan 68	79
	11-68	6 Nov 67	7 Nov 67	23 Jan 68	79
	12-68	20 Nov 67	21 Nov 67	5 Feb 68	79
	13-68	8 Jan 68	9 Jan 68	7 Mar 68	79
	14-68	15 Jan 68	16 Jan 68	14 Mar 68	79

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
	15-68	22 Jan 68	23 Jan 68	21 Mar 68	79
	16-68	29 Jan 68	30 Jan 68	28 Mar 68	79
	17-68	5 Feb 68	6 Feb 68	4 Apr 68	79
	18-68	4 Mar 68	5 Mar 68	1 May 68	78
	19-68	11 Mar 68	12 Mar 68	8 May 68	78
	20-68	18 Mar 68	19 Mar 68	15 May 68	78
	21-68	25 Mar 68	26 Mar 68	22 May 68	78
	22-68	1 Apr 68	2 Apr 68	29 May 68	78
	23-68	29 Apr 68	30 Apr 68	27 Jun 68	78
	24-68	6 May 68	7 May 68	5 Jul 68	78
	25-68	13 May 68	14 May 68	12 Jul 68	78
	26-68	20 May 68	21 May 68	19 Jul 68	78
	27-68	27 May 68	28 May 68	26 Jul 68	78
	28-68	24 Jun 68	25 Jun 68	22 Aug 68	78
					2289
8″/175mm Cannon	1-68	9 Jul 67	10 Jul 67	15 Jul 67	20
Chief of Section	2-68	13 Aug 67	14 Aug 67	19 Aug 67	20
(2 Weeks)	3-68	10 Sep 67	11 Sep 67	16 Sep 67	20
(Max Cap: 20)	4-68	15 Oct 67	16 Oct 67	21 Oct 67	20
	5-68	12 Nov 67	13 Nov 67	25 Nov 67	20
	501-68	26 Nov 67	27 Nov 67	9 Dec 67	20
	502-68	7 Jan 68	8 Jan 68	20 Jan 68	20
	503-68	21 Jan 68	22 Jan 68	3 Feb 68	20
	504-68	4 Feb 68	5 Feb 68	17 Feb 68	18
	505-68	18 Feb 68	19 Feb 68	2 Mar 68	18
	506-68	3 Mar 68	4 Mar 68	16 Mar 68	18
	507-68	17 Mar 68	18 Mar 68	30 Mar 68	18
	508-68	31 Mar 68	1 Apr 68	13 Apr 68	18
	509-68	14 Apr 68	15 Apr 68	27 Apr 68	18
	510-68	28 Apr 68	29 Apr 68	11 May 68	18
	511-68	12 May 68	13 May 68	25 May 68	18
	512-68	27 May 68	28 May 68	8 Jun 68	18
	513-68	9 Jun 68	10 Jun 68	22 Jun 68	18
	514-68	23 Jun 68	24 Jun 68	6 Jul 68	18
					360

ATC COURSE CONDUCTED USING USAAMS FACILITIES

COURSE	CLASS NO	REPORT	START	CLOSE	INPUT
ASubScd 11-31B20	2-68	17 Jul 67	18 Jul 67	15 Sep 67	40
Field Radio Mechanic	4-68	31 Jul 67	1 Aug 67	29 Sep 67	40
(9 Weeks)	6-68	14 Aug 67	15 Aug 67	13 Oct 67	40
(Max Cap: 40)	7-68	21 Aug 67	22 Aug 67	20 Oct 67	40
	8-68	28 Aug 67	29 Aug 67	27 Oct 67	40
	9-68	5 Sep 67	6 Sep 67	3 Nov 67	40
	10-68	11 Sep 67	12 Sep 67	9 Nov 67	40
	11-68	18 Sep 67	19 Sep 67	17 Nov 67	40
	12-68	25 Sep 67	26 Sep 67	27 Nov 67	40
	13-68	2 Oct 67	3 Oct 67	4 Dec 67	40
	14-68	9 Oct 67	10 Oct 67	11 Dec 67	40
	15-68	23 Oct 67	31 Oct 67	17 Jan 68	40
	16-68	6 Nov 67	14 Nov 67	30 Jan 68	40
	17-68	20 Nov 67	21 Nov 67	6 Feb 68	40
	18-68	27 Nov 67	28 Nov 67	12 Feb 68	40
	19-68	4 Dec 67	5 Dec 67	19 Feb 68	40
	20-68	3 Jan 68	9 Jan 68	8 Mar 68	40
	21-68	15 Jan 68	16 Jan 68	15 Mar 68	40
	22-68	22 Jan 68	23 Jan 68	22 Mar 68	40
	23-68	29 Jan 68	30 Jan 68	29 Mar 68	40
	24-68	5 Feb 68	6 Feb 68	3 Apr 68	40
	25-68	12 Feb 68	13 Feb 68	12 Apr 68	40
	26-68	19 Feb 68	20 Feb 68	19 Apr 68	40
	27-68	26 Feb 68	5 Mar 68	2 May 68	40

COURSE	CLAS S NO	REPORT	START	CLOSE	INPUT
	28-68	11 Mar 68	12 Mar 68	9 May 68	40
	29-68	18 Mar 68	19 Mar 68	16 May 68	40
	30-68	25 Mar 68	26 Mar 68	23 May 68	40
	31-68	1 Apr 68	2 Apr 68	31 May 68	40
	32-68	8 Apr 68	9 Apr 68	7 Jun 68	40
	33-68	15 Apr 68	16 Apr 68	14 Jun 68	40
	34-68	22 Apr 68	23 Apr 68	21 Jun 68	40
	35-68	29 Apr 68	30 Apr 68	28 Jun 68	40
	36-68	6 May 68	7 May 68	8 Jul 68	40
	37-68	13 May 68	14 May 68	15 Jul 68	40
	38-68	20 May 68	21 May 68	22 Jul 68	40
	39-68	27 May 68	28 May 68	29 Jul 68	40
	40-68	3 Jun 68	4 Jun 68	2 Aug 68	40
	41-68	17 Jun 68	18 Jun 68	16 Aug 68	40
	42-68	24 Jun 68	25 Jun 68	23 Aug 68	40
					1680

HAWK DESIGN TESTS COMPLETED

Engineering design tests of the SP (Self-Propelled) Hawk, the newest version of the Hawk solid-propellant surface-to-air defense missile system have been completed.

SP Hawk will provide additional mobility and ease of emplacement for the Hawk system currently deployed with Army and Marine Corps units in the United States and overseas.

The heart of the SP Hawk battalion is the indepenedent firing section of the Self-Propelled Platoon. The key to this mobile firing section is the new Self-Propelled Launcher (SPL), basically a tracked vehicle with a Hawk launcher mounted on its bed.

RADAR AERIAL MAPPING

Employing radar, the U.S. Army Corps of Engineers has obtained the first suitable aerial photography for mapping a continuous cloud covered area that has defied conventional methods since 1947.

The area selected for this experimental research and development program was a portion of Darien Province in southeast Panama and the border area of northwest Columbia. Because of continuous heavy cloud cover, efforts over the years to obtain the photographic coverage needed for mapping were unsuccessful.

Radar mapping of the Darien began January 19, 1967, utilizing the Army AN/APO-97 radar system developed by Westinghouse Electric Corporation for the Army Electronics Command. Data acquisition was completed February 10, 1967. Total radar photographic coverage obtained was approximately 6,600 square miles. Aviation support was provided by a contractor.

End products of the project are radar masaics and 1 to 250,000 scale topographic maps. They will be available by late 1967.

Probable Error Slide Rule

Gunnery Department
USAAMS

The range probable error slide rule, as shown on the following pages, was developed for use as an aid to determine what range probable error could be expected with a particular caliber and charge at a specific range. This device, presently employed in the Gunnery Department as an instructional aid, graphically includes the following:

a. Range probable errors plotted against the optimum ranges of each charge for the 4.2-inch mortar, 105-mm Howitzer (SP), 155-mm Howitzer (SP), 8 inch Howitzer (SP), and the 175-mm Gun.

b. A composite graph including all of the above calibers except the 175-mm Gun.

c. The average area covered by the burst of one round for each caliber.

d. The average area covered by the bursts of a battery one round for each caliber.

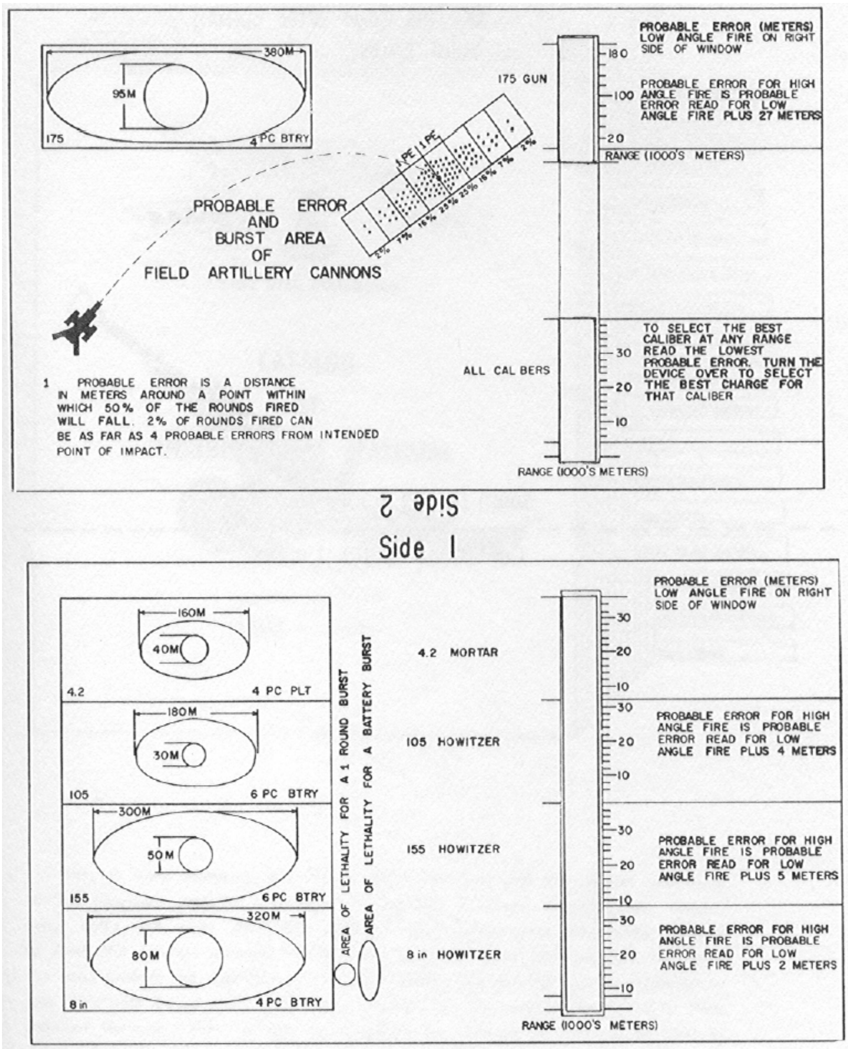
e. A definition of probable error.

This card is virtually self explanatory with respect to operation. For example, to select the particular weapon and charge that has the least range probable error at 7,000 meters, move the slide of the composite graph so that 7,000 meters appears at the right hand side of the lower window; then determine the caliber to use by reading the lowest probable error line that intersects the right edge of the window. In this case the 105-mm Howitzer is the selection that is made. Without moving the slide turn the card over and determine the charge that expresses the least probable error at 7,000 meters for the 105-mm Howitzer. The card shows that charge 6 has a low-angle probable error (shown to the right side of the window) of 11 meters; charge 7, 13 meters; and charge 5, 18 meters. On this basis charge 6 would be the preferred charge to use.

The low-angle probable error can then be used to determine the probable error for high-angle fire. By taking the low-angle probable error and adding it to the figure noted in the instructions, the summed value will then be the range probable error for high-angle fire for that caliber and charge.

For your convenience, the slide components, as illustrated on the following pages, may be detached and assembled into a usable rule.

L1136 Army–Ft. Sill, Okla.



380M
95M
175
4 PC BTRY
175 GUN
PROBABLE ERROR (METERS) LOW ANGLE FIRE ON RIGHT SIDE OF WINDOW
PROBABLE ERROR FOR HIGH ANGLE FIRE IS PROBABLE ERROR READ FOR LOW ANGLE FIRE PLUS 27 METERS
180
100
20
RANGE (1000'S METERS)
1 PE
1 PE
2% 7% 16% 25% 25% 16% 7% 2%
PROBABLE ERROR AND BURST AREA OF FIELD ARTILLERY CANNONS
ALL CALIBERS
30
20
10
TO SELECT THE BEST CALIBER AT ANY RANGE READ THE LOWEST PROBABLE ERROR. TURN THE DEVICE OVER TO SELECT THE BEST CHARGE FOR THAT CALIBER
1 PROBABLE ERROR IS A DISTANCE IN METERS AROUND A POINT WITHIN WHICH 50% OF THE ROUNDS FIRED WILL FALL. 2% OF ROUNDS FIRED CAN BE AS FAR AS 4 PROBABLE ERRORS FROM INTENDED POINT OF IMPACT.
RANGE (1000'S METERS)
Side 2
Side 1
160M
40M
4.2
4 PC PLT
180M
30M
105
6 PC BTRY
300M
50M
155
6 PC BTRY
320M
80M
8 in
4 PC BTRY
AREA OF LETHALITY FOR A 1 ROUND BURST
AREA OF LETHALITY FOR A BATTERY BURST
4.2 MORTAR
105 HOWITZER
155 HOWITZER
8 in HOWITZER
PROBABLE ERROR (METERS) LOW ANGLE FIRE ON RIGHT SIDE OF WINDOW
30
20
10
PROBABLE ERROR FOR HIGH ANGLE FIRE IS PROBABLE ERROR READ FOR LOW ANGLE FIRE PLUS 4 METERS
PROBABLE ERROR FOR HIGH ANGLE FIRE IS PROBABLE ERROR READ FOR LOW ANGLE FIRE PLUS 5 METERS
PROBABLE ERROR FOR HIGH ANGLE FIRE IS PROBABLE ERROR READ FOR LOW ANGLE FIRE PLUS 2 METERS
RANGE (1000'S METERS)