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WAR DEPARTMENT

U.S. Dept. of Army

TECHNICAL MANUAL

COAST ARTILLERY TARGET PRACTICE

February 27, 1941

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TECHNICAL MANUAL

COAST ARTILLERY TARGET PRACTICE

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON, June 16, 1941.

TM 4–235, February 27, 1941, is changed as follows:

39. Firing phase.—*a.* A group of 19 mines will be planted, including 6 **service** loaded and fused mines. Five No. 32 mine cases containing 150 pounds of trotol each and one case of the size provided in the local project containing 300 pounds of trotol will be used for the **service** loaded mines. The cases with 150-pound charges will be planted as Nos. 8 to 12, inclusive, and the other as No. 4. **In the absence of special instructions to the contrary, anchors, cast iron, 1,500-pound,** will be used with **the 6** service loaded mines. Each of the **remaining** 13 mines will be equipped with a firing device and with ½-ampere fuses in lieu of detonators, **and will be loaded with 300 pounds of either clean, dry sand or crushed rock as ballast.**

* * * * * * *

d. The electrical tests * * * as follows:

* * * * * * *

(2) Of the 13 **ballast loaded** mines, after firing has been completed.

(3) Of the 13 **ballast loaded** mines, 24 and 48 hours, respectively, after the test made under the provisions of (2) above.

* * * * * * *

g. On completion of firing at a towed target, mine No. 4 will be fired by selection. Thereafter, the remaining **service** loaded mines will be picked up, but the 13 **ballast loaded** mines will be permitted to remain planted for 48 hours. **A daily electrical test of each mine circuit will be made.** No repairs to the mine field will be made during this period. At the expiration of this period, the equipment will be taken up and disassembled for check purposes.

[A. G. 062.11 (5–29–41).] (C 1, June 16, 1941.)

51. Record service practice, firing phase.

* * * * * * *

c. Adjustment ***of fire.***—(1) **Adjustment of fire, except between courses where observation of results of firing on preceding courses indicates the desirability of such adjustment, is not prescribed.**

(2) For one of the **record** practices, no firings of any nature will be conducted by the battery concerned on the day of the practice prior to the record practice itself. **For this practice** preparation of fire

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corrections will be determined from a study of past firings conducted under similar conditions. No adjustment of fire will be permitted during courses of this practice. This does not prohibit the application, at the beginning of a course, of corrections based on observations of results on preceding courses.

d. Spotting.—Spotting for range * * * battery during firing.

* * * * * * *

[A. G. 062.11 (5–29–41).] (C 1, June 16, 1941.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

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TECHNICAL MANUAL

COAST ARTILLERY TARGET PRACTICE

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON, February 28, 1942.

TM 4–235, February 27, 1941, is changed as follows:

4. Service practice.—*a. Types.*

* * * * * * *

(2) *Record.*—A record service practice is a service practice conducted for the purpose of affording experience to and testing the efficiency of a single battery. Complete records will be kept and a target practice report rendered in accordance with the instructions contained herein. When local conditions require, **defense command,** army, or department commanders are authorized to modify any of the prescribed procedures for coast artillery target practices except those pertaining to safety precautions, **reports (including forms), and** methods of scoring. A copy of the authorization * * * in determining the annual classification of the organization.

* * * * * * *

[A. G. 062.11 (1–8–42).] (C 2, Feb. 28, 1942.)

5. Record service practice.

* * * * * * *

d. Classification.—**In his forwarding indorsement, the coast artillery district, brigade, or corresponding commander will recommend the classification to be awarded each practice. Commanders of defense commands,** army **commanders,** or department commanders will classify as "excellent," "very good," "good," "fair," or "poor" each record service practice conducted by an organization of their commands. The classification awarded will be stated in the forwarding indorsement.

[A. G. 062.11 (1–8–42).] (C 2, Feb. 28, 1942.)

6. Advanced service practice.

* * * * * * *

d. Classification.—**In his forwarding indorsement, the coast artillery district, brigade, or corresponding commander will recommend the classification to be awarded each practice.** Each advanced service practice will be classified as "excellent," "satisfactory," or "unsatisfactory" by the **commander of the defense command,** army **commander,** or department commander concerned. The classification of the practice will be stated in the forwarding indorsement.

[A. G. 062.11 (1–8–42).] (C 2, Feb. 28, 1942.)

*These changes supersede section II, Training Circular No. 51, War Department, 1941.

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12. Safety requirements.—Safety regulations which prescribe the general safety measures necessary in firing live ammunition by troops in time of peace will be found in AR 750–10, which is the basic War Department publication on this subject. Safety precautions pertaining to seacoast artillery and submarine mine firings are published in FM 4–20. Those pertaining to * * * and such assistants as may be required.

[A. G. 062.11 (8–14–41).] (C 2, Feb. 28, 1942.)

19. Record service practice.—*a. General.*

* * * * * * *

(6) If fire is by salvo, not more than two guns will be fired in any salvo. The shots of a salvo should be staggered approximately 2 seconds so as to permit officials of the practice to determine the range and lateral deviations of each impact. (See pars. 25*b* and 28*c*.) Organizations assigned * * * will be fired by each platoon.

* * * * * * *

b. Conduct of fire.

* * * * * * *

(3) *Calibration corrections.*—(*a*) All available records * * * before the commencement of record practice. No attempt should be made to calibrate a battery during trial or record firing. The calibration corrections applied and the data from which they were obtained will be entered in the emplacement book. The corrections will also be entered in the space provided on Form 25.

* * * * * * *

[A. G. 062.11 (1–8–42).] (C 2, Feb. 28, 1942.)

* * *	HITS, R. F.		TIME, R. F. PER SHOT PER GUN, SEC.	H. G. M. R. F.		* * *
	BROAD SIDE	BOW ON		BROAD SIDE	BOW ON	
* * *	3	5	68.3	0.41	0.68	* * *
*	*	*	*	*	*	*

Form 24. FIGURE 1.—Graphical analysis.

[A. G. 062.11 (1–8–42).] (C 2, Feb. 28, 1942.)

23. Service practice.

* * * * * * *

b. Graphical analysis.

* * * * * * *

(11) Dispersion ladders * * * as shown in figure 1. The values will be noted below their respective ladders. When the

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bracketing method of adjustment is used, a dispersion ladder for the assumed PE will also be drawn on the graph.

* * * * * * *

[A. G. 062.11 (1-8-42).] (C 2, Feb. 28, 1942.)

24. Time.

* * * * * * *

c. Time out.

* * * * * * *

(4) Determination of the sources of excessive lateral deviations for reasons of safety. The length of time to be deducted in such case will be that which, in the opinion of the harbor defense commander or his representative, was necessary for determining and remedying the source of error.

* * * * * * *

[A. G. 062.11 (1-8-42).] (C 2, Feb. 28, 1942.)

25. Determination of deviations.—*a. Theory.*

* * * * * * *

(3) In the above formula the value VT sin TVS is taken directly from the tug officer's report and is known as the camera (or range rake) deviation of the splash. TVS is also taken * * * is explained in paragraph 26.

* * * * * * *

[A. G. 062.11 (1-8-42).] (C 2, Feb. 28, 1942.)

FIGURE 4.—Transfer note to figure 5.

[A. G. 062.11 (1-8-42).] (C 2, Feb. 28, 1942.)

34. Lists and models.—* * *

a. Forms.

* * * * * * *

(2) *Models.*

* * * * * * *

RECORD OF RANGE DEVIATIONS

* * * * * * *

Instructions: Angles α and δ will be measured by estimation to the closest one-tenth of a degree using the film scale. If the target was towed from right to left, the signs of α and δ, respectively, are positive if to the left of M; negative if to the right. For target towed left to right, use opposite sign. If data in column 5 are not available, use data from column 7.

* * * * * * *

Form 20.

[A. G. 062.11 (1-8-42).] (C 2, Feb. 28, 1942.)

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TIMEKEEPER'S RECORD

* * * * * * *

Total corrected time R. F.=$\frac{7'07''+7'41''}{2}$=7'24''=444''. Time per shot per gun R. F.=427''+461''+13=68.3 sec.

* * * * * * *

Form 21.
[A. G. 062.11 (1–8–42).] (C 2, Feb. 28, 1942.)

* * * * * * *

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
E. S. ADAMS,
Major General,
The Adjutant General.

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TECHNICAL MANUAL

COAST ARTILLERY TARGET PRACTICE

CHANGES No. 3

WAR DEPARTMENT,
WASHINGTON, May 15, 1942.

TM 4–235, February 27, 1941, is changed as follows:

In all pertinent paragraphs of this manual and supplements thereto, wherever they appear therein, the words—

1. "The Adjutant General" are changed to read **Commanding General, Army Ground Forces.**

2. "Chief of Coast Artillery" are changed to read **Coast Artillery Board.**

3. "District commander" are changed to read **sector or subsector commander.**

[A. G. 062.11 (4–25–42).] (C 3, May 15, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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TECHNICAL MANUAL

COAST ARTILLERY TARGET PRACTICE

CHANGES No. 4

WAR DEPARTMENT,
WASHINGTON, July 27, 1942.

TM 4–235, February 27, 1941, is changed as follows:

4. Service practice.—*d. Types.*

* * * * * * *

(2) *Record.*—A record service practice is a service practice conducted for the purpose of affording experience to and testing the efficiency of a single battery. Records will be kept and a target practice report rendered in accordance with instructions contained herein. When local conditions require, **defense command,** army, **task force, base,** or department commanders are authorized to modify any of the prescribed procedures for coast artillery target practices except those pertaining to safety precautions, **narrative reports, and matériel and ammunition reports. The importance of target practice analyses as a means of determining the efficiency of the organization and matériel should be appreciated by all commanders; analyses should be made even in a modified form, whenever circumstances permit.** A copy of the authorization * * * in determining the annual classification of the organization.

* * * * * * *

[A. G. 062.11 (6–4–42).] (C 4, July 27, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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TECHNICAL MANUAL
COAST ARTILLERY TARGET PRACTICE

CHANGES No. 5

WAR DEPARTMENT,
WASHINGTON, December 1, 1942.

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TM 4–235, February 27, 1941, is changed as follows, *effective January 1, 1943:*

CHAPTER I (SUPERSEDED)
GENERAL

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Duties of harbor defense commander	10
Duties of group commander	11
Duties of battery commander	12
Safety requirements	13
Critique of service practice	14
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1. Scope.—This manual includes—

a. Instructions governing the conduct of all seacoast artillery target practices with seacoast cannon, mines, and automatic weapons used as substitute antimotor torpedo boat armament.

b. A description of the analysis of drill and target practice.

c. A description of the reports to be rendered by all unit commanders.

2. Antiaircraft target practices.—Seacoast artillery units manning antiaircraft weapons will conduct antiaircraft target practices in accordance with the provisions prescribed for antiaircraft units.

3. Application.—The provisions of this manual are applicable to both harbor defense and mobile seacoast artillery. The expressions "harbor defense," "groupment or group," and "sector or subsector," used throughout this manual, have a general meaning, and will be taken as applying to regiments, battalions, and brigades, or similar commands outside of harbor defenses.

4. Service practice.—*a. General.*—The types of service practice are record, special, and battle. The purpose of all service practices is to train the command for battle and to check the effectiveness of methods and functioning of matériel. The analysis of results is im-

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portant; no conclusions can be drawn as a result of any firing unless adequate records are kept during the firing for the purpose of making an analysis. General discussions of the various types of service practices appear in the following paragraphs. Detailed instructions pertaining to record service practices appear in the following chapters.

b. Preparation for firing.—Every care must be taken to insure that, before conducting a target practice, each organization shall have received the maximum amount of training in preparation therefor. Harbor defense commanders will not permit service practices to be conducted until the groupment or group commander has reported that he has personally inspected the organization in a simulated practice and has found that a satisfactory state of training exists.

c. Service conditions.—Within the limits of safety regulations and considering the state of training of a unit, defense command, army, task force, base, or department commanders will impose all reasonable service conditions during the conduct of a target practice provided the proper records can be obtained for use in compiling the required reports. The indorsements forwarding a target practice report will contain a description of the special conditions imposed, their effect on that particular practice, and the extent to which higher commanders participated in the supervision of the practice.

5. Record service practice.—*a. Purpose.*—A record service practice is conducted for the purpose of affording experience to and testing the efficiency of a single battery. Record service practices also provide a measure of the comparative efficiency and training of individual batteries.

b. Organization to fire.—Except when otherwise directed by the Secretary of War, each seacoast artillery organization assigned to fixed or mobile seacoast armament, including antimotor torpedo boat armament and submarine mines, will conduct annually at least one record service practice.

c. Conduct.—Record service practices will be conducted as prescribed in the following chapters.

d. Reports.—Complete records will be kept and reports submitted as prescribed in the following chapters for at least one record service practice annually.

6. Special service practice.—*a. Purpose.*—A special service practice may be conducted for purposes such as the following:

(1) To test the functioning of a battery under special conditions, not practicable for record service practices. The special conditions will be prescribed by the harbor defense commander and approved by the sector or corresponding commander.

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(2) To test the effectiveness of methods or to check the functioning of matériel.

(3) To provide preliminary training in preparation for a record service practice.

(4) To calibrate the guns of a battery.

b. Organizations to fire.—Any organization may fire special service practices provided that such practices are conducted in addition to at least one record service practice during the calendar year. Approval for special service practices will be obtained from defense command, army, task force, base, or department commanders.

c. Conduct.—A special service practice will be conducted in a manner which has been carefully planned with a view to accomplishing most effectively the purpose of the practice. The provisions for safety as prescribed herein will be observed.

d. Reports.—(1) No detailed instructions as to reports of special service practice are prescribed. All concerned should bear in mind that definite conclusions can be had only by thorough analysis of the practice. Appropriate reports submitted to higher authority will contain information which may be of value to the Coast Artillery Corps as a whole. Reports of special service practices will contain, as a minimum, the following:

(*a*) A narrative report, as prescribed for record service practices.

(*b*) A matériel and powder report.

(*c*) A record of range and lateral deviations obtained in the best manner available under the conditions of the practice.

(2) The reports will be submitted through channels to the Commanding General, Army Ground Forces.

7. Battle service practice.—*a. Purpose.*—A battle service practice is conducted by two or more batteries in accordance with a tactical program for the purpose of providing training for and testing the tactical efficiency of the higher command as well as of the individual batteries participating in the practice.

b. Conduct.—Battle service practices will be conducted in accordance with a well planned tactical problem which has been approved by the defense command, army, task force, base, or department commander. The provisions for safety as prescribed herein will be observed.

c. Reports.—Reports of battle service practice will be submitted as prescribed for special service practices.

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8. Period between practices.—*a.* A period of at least 3 months will elapse between consecutive service practices when conducted by an individual organization, except functional and calibration firings.

b. Functional and calibration firings and battle practices may be conducted without regard to dates of other firings except that they will not be conducted on the same day as service practices for training.

9. Ammunition allowances.—The annual allowance of ammunition for training purposes as prescribed in AR 775-10, is for subcaliber practices, record service practices, and special service practices conducted primarily for training. A special allowance of ammunition will be obtained through channels for each calibration and functional firing, and for each battle service practice. The number of rounds required for a record service practice is prescribed in the following chapters. In general, the same number should be used for each special service practice conducted for training.

10. Duties of harbor defense commander.—*a.* The harbor defense commander is responsible that all regulations governing target practice are complied with by organizations of his command.

b. He will prescribe the course or courses for the practice, arrange to have such courses provided at the proper time, and provide also for the control of the towing vessel. He should confer with the safety officer to insure that, if the target is ordered on its course, the battery will be able to fire without interruption.

c. He should be present at all service practices and act as umpire to decide any points of controversy that may arise, either as to the conduct of the practice, or the analysis thereof. In cases of unavoidable absence, he will appoint a qualified officer to act as his representative.

d. In his capacity as umpire he will, for record practices, check the timekeeper's report, giving special attention to a correct determination of "time out" and causes therefor, and will transmit the record to the battery commander concerned.

e. He will detail the necessary officials as hereinafter prescribed for the particular type of target practice involved. Prior to the commencement of the practice, he will assure himself that these officials are well instructed in their duties to the end that accurate records will be available for the analysis of the practice.

f. He will be responsible that a target practice once scheduled is expedited. In the preparation of schedules, such features as timetables of local shipping, hours of good visibility, and prevailing weather conditions should be given consideration.

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g. He will conduct the critique prescribed in paragraph 14*b*.

11. Duties of group commander.—The group commander will erform the duties prescribed below. In case the battery commander s also the group commander, these duties will be performed by the arbor defense commander or by a field officer specially detailed for he purpose.

a. He will supervise all preparations for the target practices of the atteries under his command and will determine the preparedness of ach to conduct a service practice.

b. He will supervise the preparation of target practice reports, erify the number of hits, recompute the score, and forward the re- ort of practice to the harbor defense commander. In his forwarding ndorsement, he will include the following certificate: "I certify that have recomputed the score and checked all records and reports per- aining to this practice."

c. He will conduct the critique prescribed in paragraph 14*a*.

d. For gun and mortar service practices, he will—

(1) Prescribe the methods to be used in determining the ranges r elevations at which the piece was actually laid when fired.

(2) Satisfy himself as to the accuracy of the measurement of the ength of the towline.

e. For mine service practice, he will—

(1) Supervise the officials detailed for the practice.

(2) Witness the conduct of the practice.

12. Duties of battery commander.—The battery commander will onduct the practice in accordance with prescribed regulations and nstructions from higher authority. He will, except as otherwise pecified, be responsible for the preparation and computation of all ecords and reports connected with the practice. All senior officers t the practice should consider his responsibilities and refrain from nterfering unless an emergency arises.

13. Safety requirements.—Safety regulations which prescribe he general safety measures necessary in firing live ammunition by roops for training will be found in AR 750–10. Safety precautions ertaining to seacoast artillery and submarine mine firings are pub- ished in FM 4–20. Safety precautions applicable solely to a particu- lar weapon are prescribed in the Field Manual covering service of the iece for that weapon. It is the responsibility of the harbor defense ommander that the pertinent safety requirements are strictly en- forced. He will detail a safety officer and such assistants as may be equired.

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14. Critique of service practice.—*a. Group.*—Each group commander will conduct a critique on each service practice held by the organizations of his command. This critique will be held as soon as practicable. No special report of the critique will be made, but any salient features brought out will be included in the forwarding indorsement of the group commander. The critique will be attended by as many officers on duty with the group as practicable.

b. Harbor defense.—Each harbor defense commander will hold a critique quarterly covering all service practices held within his command during the quarter.

15. Reports.—*a. Target practice.*—Reports of target practice will be submitted as prescribed in the following chapters for each kind of target practice.

(1) *Purpose.*—The purpose of these reports is to—

(*a*) Present to all concerned as complete a picture of the practice as possible.

(*b*) Permit the battery commander briefly to set forth circumstances that governed the practice, to discuss features that added to or detracted from the success of the practice, and to record any pertinent remarks of interest or value for the conduct of future practices.

(*c*) Permit all intermediate commanders to comment on the practices and to afford such commanders a partial standard for the measurement of the degree of training maintained in the battery.

(*d*) Provide the Commanding General, Army Ground Forces, with data for a study of performance of matériel and of methods for conduct of fire.

(*e*) Afford an opportunity to judge the state of training of the seacoast artillery units as a whole.

(2) *Submission and checking.*—(*a*) Record service practice reports will be completed and forwarded as prescribed herein at the earliest practicable date after the completion of the practice. Each harbor defense, sector, and subsector commander will examine target practice reports in sufficient detail to enable him to make pertinent comments in his forwarding indorsement.

(*b*) Each individual report as soon as checked and commented on will be forwarded promptly to the next higher commander.

b. Special matériel reports.—Minor failures of matériel will be reported on the matériel and powder forms included with each target practice report. If any unusual malfunctioning or failure of an important nature in matériel or ammunition occurs, the harbor defense commander will forward through channels to the Commanding

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eneral, Army Ground Forces, by separate communication a complete atement of the occurrence for the information of the Coast Artillery oard and chief of the interested service. This statement should inude a description of the defective matériel by which it can be identied, such as lot number, manufacturer's initials, names and numbers om standard nomenclature lists, or other distinctive marks on the atériel or the packing box, and should include a description of the rcumstances under which the defect became apparent.

[A. G. 062.11 (12–1–42).] (C 5, Dec. 12, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

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TECHNICAL MANUAL
No. 4-235

WAR DEPARTMENT,
WASHINGTON, *February 27, 1941.*

COAST ARTILLERY TARGET PRACTICE

Prepared under direction of the
Chief of Coast Artillery

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*This pamphlet supersedes TM 2160-35, December 1, 1938, and TR 435-56, May 2, 1925.

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CHAPTER 1

GENERAL

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1. Scope.—This manual includes—

a. Instructions governing the conduct of all coast artillery target practices other than small arms.

b. A description of the analysis of drill and target practice.

c. A description of the reports to be rendered by all unit commanders.

d. The method of classification of units for excellence in target practice.

2. Supplemental instructions.—Before the beginning of each calendar year a supplement to this manual, entitled "Instructions for Coast Artillery Target Practice," will be issued by the War Department. This supplement will include special instructions for the conduct and scoring of target practices to be held during that calendar year.

3. Definition of target practice.—The term "target practice" as used in this manual includes all coast artillery firings with seacoast cannon, mines, antiaircraft guns, antiaircraft automatic weapons, the test phase in mine practices, the detection phase of antiaircraft gun practices, and all searchlight practices. Target practices are classified as to kind, as subcaliber and service practices. The term "subcaliber" is used to refer to target practices conducted with subcaliber ammunition.

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4. Service practice.—*a. Types.*—The types of service practices are preliminary, record, advanced, special, and battle.

(1) *Preliminary.*—A preliminary service practice is a service practice conducted in preparation for record service practice. All battery and target practice officials, including recorders, will perform the duties during preliminary service practice that they will perform during record service practice. A careful analysis will be made of the results of preliminary service practices in the same manner as prescribed for record service practice.

(2) *Record.*—A record service practice is a service practice conducted for the purpose of affording experience to and testing the efficiency of a single battery. Complete records will be kept and a target practice report rendered in accordance with the instructions contained herein. When local conditions require, army or department commanders are authorized to modify any of the prescribed procedures for coast artillery target practices except those pertaining to safety precautions or to methods of scoring. A copy of the authorization for any such modifications will be included with reports of each practice concerned. Organizations are classified in accordance with the results of record service practice or practices conducted with the armament to which they are normally assigned. Target practices conducted with armament additionally assigned will be classified, but such classification will not be considered in determining the annual classification of the organization.

(3) *Advanced.*—An advanced service practice is a practice in which more difficult problems are presented for solution than generally obtain in the normal record service practice. It is conducted by an organization which previously has demonstrated its ability to conduct an excellent record service practice. Reports are submitted as hereinafter prescribed. A battery firing an advanced service practice will be classified in accordance with its success in handling the special features of the practice, and will be given the same consideration as batteries firing record service practices in the award of the Knox trophy.

(4) *Special.*—A special service practice is a practice fired primarily in order to test methods or matériel. The records to be kept in each case will be prescribed in the instructions authorizing the practice. Batteries will not be classified on the results of special service practices.

(5) *Battle.*—A battle service practice is a service practice conducted by two or more batteries in accordance with a tactical program. This type of practice affords training not only to individual batteries

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but also to the higher command. Batteries will not be classified on the results of battle practice.

b. Preparation for firing.—The limited allowances of ammunition and time available for target practices require that every care be taken to insure that, before conducting a target practice, each organization will have received the maximum amount of training in preparation therefor. Harbor defense or regimental commanders will not permit service practices to be conducted until the group or battalion commander has reported that he has personally inspected the organization in a simulated practice and has found that a satisfactory state of training exists.

c. Service conditions.—Within the limits of safety regulations and considering the state of training of a unit, army and department commanders will impose all possible service conditions during the conduct of a target practice, provided the proper records can be obtained for use in compiling the target practice report. The indorsements forwarding a target practice report will contain a description of the special conditions imposed, their effect on the score of that particular practice, and the extent to which brigade and higher commanders participated in the supervision of the practice.

5. Record service practice.—*a. Purpose.*—The purpose of all firing problems is the training of the command for battle. Record service practices serve the additional purpose of providing a comparative test of such training.

b. Organization to fire.—Except when otherwise directed by the Secretary of War, each coast artillery organization of the Regular Army and the National Guard assigned to fixed or mobile seacoast armament, submarine mines, antiaircraft armament, or antiaircraft searchlights will conduct annually one or more record or advanced service practices. Maintenance detachments of Coast Artillery and units of the Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camps will fire such record service practices as may be authorized by the Secretary of War.

c. Score.—The score of each record service practice will be computed as prescribed in the supplement to this manual issued annually by the War Department.

d. Classification.—Army or department commanders will classify as "excellent," "very good," "good," "fair," or "poor" each record service practice conducted by an organization of their commands. The classification awarded will be stated in the forwarding indorsement. Record service practices conducted by National Guard units not in the Federal service will be classified by the Chief of the National Guard Bureau.

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6. Advanced service practice.—Advanced service practices will be fired in lieu of record service practices.

a. Purpose.—Advanced service practices are intended to provide local commanders with the opportunity to test the firing of selected organizations under simulated war conditions. Each practice should be designed to solve a particular problem pertaining to the local situation. Care will be exercised in the planning and execution of advanced practices to insure that the results therefrom may have positive value of a tactical and technical nature.

b. Organization to fire.—(1) *Regular Army and National Guard in Federal service.*—(*a*) To be eligible to fire an advanced service practice, organizations of the Regular Army and National Guard in the Federal service shall—

1. Have been classified as "excellent" on the basis of record practices fired during the preceding year.

2. Not have fired an advanced practice during the preceding year.

(*b*) Selection of the Regular Army organizations and National Guard organizations in the Federal service to fire advanced service practices will be made by the army or department commander on recommendation of the regimental, harbor defense, and district commander concerned. In any harbor defense or in a regiment not stationed in a harbor defense, the number of organizations so selected will not be greater than one-fourth the number of organizations thereof conducting record service or advanced service practices. In computing the number to fire, a fractional value shall be considered as a unit. Advanced practices will be fired by eligible organizations within the limits prescribed above unless conditions in an eligible organization have so changed as to make an advanced practice either unsafe or uneconomical and unwise from a training viewpoint. Such cases will be decided by army and department commanders.

(2) *National Guard.*—National Guard batteries not in the Federal service, which have attained marked proficiency for two or more years in the conduct of record target practices, may be authorized by the Chief of the National Guard Bureau with the concurrence of the Chief of Coast Artillery to conduct advanced practices. Applications for authority to fire advanced practices will be submitted through channels.

c. Conduct.—(1) The provisions of this manual pertaining to conduct of practices, except as they affect safety precautions, are not mandatory for advanced service practices. However, they should be considered in formulating the special features of such practices.

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(2) A general plan for each advanced service practice will be submitted through channels to the army or department commander by the regimental or harbor defense commander concerned. This plan will include a statement of the problem, the assumed tactical situation, if pertinent, and the expected general outline of the practice. The army or department commander will furnish a copy of each plan approved by him to The Adjutant General for the information of the Chief of Coast Artillery.

(3) Interpretations and decisions that may be necessary in connection with advanced service practices will be made by the army or department commanders concerned.

(4) The district or brigade commander or an officer designated by him will personally witness the conduct of each advanced practice.

d. Classification.—Each advanced service practice conducted by an organization of the Regular Army or National Guard in the Federal service will be classified as "excellent," "satisfactory," or "unsatisfactory" by the army or department commander concerned. The classification of the practice will be stated in the forwarding indorsement. Advanced service practices conducted by National Guard organizations not in the Federal service will be classified by the Chief of the National Guard Bureau.

7. Use of chemical agents.—No record service practice will be held under gas or smoke concentrations unless specifically authorized in each case by the Secretary of War.

8. Ammunition allowances.—The annual allowances of ammunition for target practice are prescribed in AR 775–10.

9. Duties of harbor defense or regimental commander.—*a.* The harbor defense or regimental commander is responsible that all regulations governing target practice are complied with by organizations of his command.

b. He will prescribe the course or courses for the practice, arrange to have such courses provided at the proper time, and provide also for the control of the towing vessel or airplane.

c. He should be present at all record service practices and act as umpire to decide any points of controversy that may arise, either as to the conduct of the practice, the analysis thereof, or the computation of the score. In cases of unavoidable absence, he will appoint a qualified officer to act as his representative.

d. In his capacity as umpire he will, for seacoast record practices, check the timekeeper's report, special attention being given to a correct determination of "time out" and causes therefor, and will transmit the record to the battery commander concerned.

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e. He will detail the necessary officials as hereinafter prescribed for the particular type of target practice involved. Prior to the commencement of the practice, he will assure himself that these officials are well instructed in their duties to the end that accurate records will be available for the analysis of the practice and the computation of the score. On the completion of a target practice, he will arrange the duties of the officers involved so as to afford them time for analysis of practice and for completion of reports.

f. He will be responsible that a target practice once scheduled is expedited. In the preparation of schedules, such features as timetables of local shipping, hours of good visibility, and prevailing weather conditions should be given consideration. Personnel should not be ordered to posts of duty when there is little likelihood of firing for several hours. In carrying out these provisions, a battery commander should not be ordered to fire under conditions which will unduly handicap him in obtaining the best results.

g. He will provide for the furnishing of meteorological data to batteries conducting gun or mortar service practices at frequent intervals prior to and during the practice.

h. He will conduct the critique prescribed in paragraph 13*b*.

10. Duties of group or battalion commander.—The group or battalion commander will perform the duties prescribed below. In case the battery commander is also the group commander, these duties will be performed by the regimental or harbor defense commander or by a field officer specially detailed for the purpose.

a. He will supervise all preparations for the target practices of the batteries under his command and will determine the preparedness of each to conduct service target practice.

b. He will designate a place for authorized visitors and exclude all persons not connected with the firing from the vicinity of the gun position, plotting rooms, and observing stations.

c. He will arrange for commencement of the course when the battery is ready to fire. To avoid needless delays, he should confer with the safety officer to insure that, if the target is ordered on its course, the battery will be able to fire without interruption.

d. He will supervise the preparation of target practice reports, verify the number of hits, recompute the score, and forward the report of practice to the regimental or harbor defense commander. In his forwarding indorsement he will include the following certificate: "I certify that I have recomputed the score and checked all records and reports pertaining to this practice."

e. He will conduct the critique prescribed in paragraph 13*a*.

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f. For seacoast service practice, he will—

(1) Prescribe the methods to be used in determining the ranges or elevations at which the piece was actually laid when fired. (See par. 21*e*).

(2) Satisfy himself as to the accuracy of the measurement of the length of the towline.

(3) Designate firing positions for mobile artillery. In this connection, attention is directed to the requirements for safety pointing in azimuth as laid down in FM 4–20.

g. For mine service practice, he will—

(1) Supervise the officials detailed for the practice.

(2) Witness the conduct of the practice.

h. For antiaircraft service practice, he will—

(1) Determine the sequence in which the batteries will fire and inform all officials.

(2) Provide equipment for safety officers.

(3) For night firing, arrange for lights for illuminating the target, for barrier lights and, if requested by the Air Corps, provide such lights as are necessary for illuminating an emergency landing field.

(4) Observe projection of camera films and check computation of hits.

(5) In antiaircraft automatic weapon firings, verify the number of holes in the sleeve target.

11. Duties of battery commander.—The battery commander will conduct the practice in accordance with prescribed regulations and instructions from higher authority. He will, except as otherwise specified, be responsible for the preparation and computation of all records and reports connected with the practice. All senior officers at the practice should consider his responsibilities and refrain from interfering unless an emergency arises.

12. Safety requirements.—Safety regulations which prescribe the general safety measures necessary in firing live ammunition by troops in time of peace will be found in AR 750–10, which is the basic War Department publication on this subject. Safety precautions pertaining to seacoast artillery firings are published in FM 4–20. Those pertaining to antiaircraft artillery firings are published in FM 4–120. Safety precautions applicable solely to a particular weapon are prescribed in the Field Manual covering service of the piece for that weapon. It is the responsibility of the harbor defense or regimental commander that the pertinent safety requirements are strictly enforced. He will detail a safety officer and such assistants as may be required.

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13. Critique of service practice.—*a. Group or battalion.*—Each group or battalion commander will conduct a critique on each service practice held by the organizations of his command. This critique will be held as soon as practicable and in no case later than 10 days after the completion of the practice. No special report of the critique will be made, but any salient features brought out will be included in the forwarding indorsement of the group or battalion commander. The critique will be attended by all officers on duty with the group or battalion.

b. Harbor defense or regiment.—At the end of the service practice season and before the submission of his annual report, each harbor defense or regimental commander will hold a critique covering all service practices held within his command during the season. Points of interest brought out should be included in his annual report. No other report of this critique need be submitted.

14. Reports.—*a. Target practice.*—Reports of target practice will be submitted as prescribed in the following sections for each kind of target practice.

(1) *Purpose.*—The purpose of these reports is to—

(*a*) Present to all concerned as complete a picture of the practice as possible.

(*b*) Permit the battery commander briefly to set forth circumstances that governed the practice, to discuss features that added to or detracted from the success of the practice, and to record any pertinent remarks of interest or value for the conduct of future practices.

(*c*) Permit all intermediate commanders to comment on the practices and to afford such commanders a partial standard for the measurement of the degree of training maintained in the battery.

(*d*) Provide the Chief of Coast Artillery with data for a study of performance of matériel and of methods for conduct of fire.

(*e*) Afford an opportunity to judge the state of training of the Coast Artillery Corps as a whole.

(2) *Submission and checking.*—(*a*) Record service practice reports will be completed and forwarded as prescribed herein at the earliest practicable date after the completion of the practice. Each regimental, harbor defense, and district or brigade commander will examine target practice reports in sufficient detail to enable him to make pertinent comments in his forwarding indorsement.

(*b*) Each individual report as soon as checked and commented on will be forwarded promptly to the next higher commander.

b. Special matériel.—Minor failures of matériel will be reported on the powder and matériel forms included with each target practice

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report. If any unusual malfunctioning or failure of an important nature in matériel or ammunition occurs, the regimental or harbor defense commander will forward through channels to The Adjutant General by separate communication a complete statement of the occurrence for the information of the Chief of Coast Artillery and chief of the interested arm or service. This statement should include a description of the defective matériel by which it can be identified, such as lot number, manufacturer's initials, names and numbers from standard nomenclature lists, or other distinctive marks on the matériel or the packing box, and should include a description of the circumstances under which the defect became apparent.

c. Annual.—The following annual reports will be submitted:

(1) *By harbor defense and regimental commanders.*—(*a*) Schedules showing the organization firing, date, and caliber and type of armament of all service practices will be forwarded through channels to The Adjutant General for transmittal to the Chief of Coast Artillery as soon as approved.

(*b*) As soon as practicable after completion of the year's target practices, a comprehensive report covering the training and general results of the service practice season just completed will be submitted to the cost artillery district or brigade commander. If the harbor defense commander is also the regimental commander, only one report will be submitted. These reports should cover any items of interest and any comments or suggestions as to the improvement in artillery training and matériel.

(2) *By the coast artillery district or brigade commander.*—(*a*) On completion of the year's training, a comprehensive report covering the training, matériel, and general results of target practices will be submitted through channels to The Adjutant General. The report should include a discussion of and recommendations on matters pertaining to training and matériel. The harbor defense and regimental commanders' reports of training will be inclosed with and made a part of this report.

(*b*) Reports of training submitted by regimental commanders of National Guard organizations not in the Federal service will be forwarded separately with the comments and recommendations of the coast artillery district or brigade commanders thereon.

15. Classification of organizations.—*a.* Army and department commanders will classify annually as "excellent," "very good," "good," "fair," or "poor" each organization of the Regular Army and National Guard in the Federal service which during the preceding year has conducted a record or advanced service practice or,

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in the case of mine planter detachments, has participated in a mine service practice.

b. The classification of National Guard organizations not in the Federal service, insofar as pertains to target practice, will be made by the War Department, based on recommendations of the Chief of the National Guard Bureau and the Chief of Coast Artillery.

c. Artillery proficiency only will be the basis for determining these classifications. The score and also the efficiency and effectiveness of an organization in overcoming those obstacles imposed by the simulation of service conditions will be considered. Army and department commanders, if desired, may devise their own formulas to assist them in classifying the organizations concerned.

d. Past records indicate that in the long run not more than one-third of the units classified should be rated as "excellent." In order to maintain the present high standards, it is desired that this experience be used as a guide.

e. Classification will be made promptly and will be suitably announced in order that the personnel of an organization rated "excellent" who actually participated in the target practices may wear the badge for excellence prescribed in paragraph 42*i*, AR 600–40, before they are transferred or discharged.

f. The indorsement of the army or department commander forwarding the report of the last target practice conducted by an organization during an annual target practice season will include a statement of the classification awarded.

16. Knox trophy.—Each army and department commander will nominate to the War Department, by November 15 of each year, a candidate for the Knox trophy. The nomination will be based on artillery proficiency as shown in target practices conducted during the year commencing October 1 of the preceding year and terminating September 30. Any pertinent facts, exclusive of those appearing in the target practice report, should be included in the nomination. The War Department will determine the winner of the Knox trophy and of the United States Coast Artillery Association trophy.

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CHAPTER 2

SEACOAST ARTILLERY

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SECTION I

CONDUCT OF PRACTICE

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17. General.—This section includes provisions applicable to seacoast armament alone. The provisions of chapter 1 also apply to firings with seacoast armament. In addition, supplemental instructions covering certain phases of seacoast target practices, including scoring, will be issued annually by the War Department in a supplement to this manual. All service practices, except battle practices and special service practices, will be record or advanced service practices. Record and advanced service practices will be fired at towed water targets.

a. Pressure gages.—(1) For cannon equipped with fixed pressure gages, pressure measurements will be made in all practices with service or target practice ammunition. Copper cylinders may be changed either after each shot of trial fire or after completion of trial fire. Copper cylinders will not be changed between shots of record fire.

(2) For cannon using loose gages, pressure measurements will be limited to shots of trial fire. Extreme care will be taken after each round to insure that no gage remains in the bore.

(3) Should there be evidence that excessive pressures are being developed, the firing will be stopped and an investigation made to determine the cause.

b. Targets.—Fire is directed at a pyramidal target supplied by the Ordnance Department or at a suitable substitute therefor. This

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target marks the center of the danger space of the various hypothetical targets the dimensions of which are given in paragraph 28*a*. Special targets may be constructed locally or standard targets may be altered to increase visibility, to increase speed, to improve the accuracy of range finding with single station range finding instruments, or to facilitate spotting. To avoid unnecessary delay, in case of destruction of a target, the towing vessel should tow two targets separated by a distance of approximately 100 yards.

c. Training of observers and spotters.—Whenever a battery is fired, all available observers and spotters of other batteries will observe the firing. A comparison of all spotting results will be made.

d. Number of guns to be fired.—Unless there is but one gun in a battery, at least two guns will be used in target practice.

e. Settling shots.—Tractor-drawn and railway batteries occupying newly emplaced field positions from which no firing has been conducted previously may fire, subject to the approval of the district or brigade commander, one round per gun of the target practice allowance as settling shots.

f. Observing intervals.—In order to provide more accurate firing data under conditions which, though not obtaining in target practice, may be expected in actual service, the employment of observing intervals of 20 seconds or less in conjunction with the minimum practicable predicting interval is prescribed.

g. Replot of course.—When a vertical or self-contained base range finding system is employed by the firing battery, data for the replot will be obtained from a horizontal base track of the target made by a range section detailed for that purpose. This section should also measure the length of the towline as prescribed in paragraph 21*g*.

18. Subcaliber practice.—*a. General.*—Subcaliber practices will be conducted by all organizations prior to firing service practices. Subcaliber practices afford the battery commander opportunity to train the personnel of his organization, both as to individuals and as a team, and to test his plans for the conduct of service practice. Such practices also afford the group commander opportunity to ascertain whether the battery is ready to fire service practice. A sufficient number of these practices will be analyzed to insure that all officers and enlisted men of the organization concerned with the firing and preparation of records of service practices are fully competent to perform their duties. Subcaliber practices should be conducted as nearly as practicable according to the rules for conduct of service practice.

b. Targets.—Small improvised targets may be used for subcaliber practice.

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c. Responsibility for safety.—The battery commander will insure that adequate safety precautions are taken during subcaliber firings. For such firings he will detail safety pointing observers to perform the duties covered in FM 4–20.

19. Record service practice.—*a. General.*—(1) An organization having fired one service practice will not be permitted to fire another until the first has been completely analyzed and all reports pertaining thereto submitted to the harbor defense or regimental commander. An exception to this rule may be made in the case of mobile batteries conducting practices from simulated war positions where facilities for completing the records and reports are not available. In this case, however, the practice should be thoroughly analyzed before the battery is permitted to conduct another practice.

(2) Neither settling nor calibration shots will be fired on the same day as record practice.

(3) During record service practice, batteries will use only such installations and equipment as will be available during actual service except that, in view of the small size of the towed matériel target as compared to the targets to be expected in service, batteries required to adjust by the bracketing method and not provided with stations of sufficient height for effective axial or unilateral spotting may utilize more suitable stations or may employ horizontal base spotting systems. Sensings only will be reported to the personnel charged with the adjustment of fire, when the bracketing method is prescribed.

(4) In general, methods of drill, fire control and position finding, and the apparatus employed in record service practice will conform to those authorized in training publications. Tests of experimental methods or apparatus should be conducted in connection with subcaliber and special or advanced service practices.

(5) For record fire, the guns will not be loaded until the command ***Commence firing*** has been given.

(6) If fire is by salvo, not more than two guns will be fired in any salvo. The shots of a salvo should be staggered so as to permit officials of the practice to determine the range and lateral deviations of each impact. (See par. 25*b* and 28*c*.) Organizations assigned to tractor-drawn armament will employ two platoons of two gun crews each during a practice, the second platoon starting firing immediately on completion of firing by the first platoon. No time out will be allowed for the purpose of shifting platoons. If the second platoon mans different guns, such guns will not be loaded until after the last shot of the first platoon has been fired. Where two platoons are involved in any practice, approximately half the ammunition for that practice will be fired by each platoon.

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(7) Each mortar record service practice will be conducted in two zones with approximately the same number of shots in each zone.

(8) If ammunition allowances are sufficient for more than one service practice, organizations assigned to batteries of caliber 155-mm and below may fire one night practice each. The harbor defense commander will decide whether or not night practices are to be held.

b. Conduct of fire.—(1) *Adjustment of fire.*—Adjustment of fire should be based on sound gunnery principles. Thorough knowledge of the rules for adjustment of fire at moving targets as given in FM 4–10 is a prime requisite. From a gunnery standpoint, the most that a battery commander may accomplish is to eliminate all personnel errors, reduce systematic errors by a careful check of operation and adjustment of fire control equipment and matériel, reduce the dispersion of his guns to a minimum by careful loading and laying, and, with a minimum expenditure of time and ammunition, place the center of impact of his shots on the center of the danger space and keep it there.

(2) *Meteorological data.*—Meteorological observations should be taken immediately before firing and the data furnished promptly to the battery commander concerned. Every effort should be made to obtain the ballistic wind to the maximum ordinate of the trajectory.

(3) *Calibration corrections.*—(*a*) All available records of the past performance of the guns should be studied and, where necessary, calibration corrections made. Such corrections are generally applied at the guns by adjustment of the range drums or elevation scales. Calibration corrections should be applied before the commencement of record practice. No attempt should be made to calibrate a battery during record firing. The calibration corrections applied and the data from which they were obtained will be entered in the emplacement book. The corrections will also be entered in the space provided on Form 25.

(*b*) Should a calibration firing be authorized, it should be planned and conducted with extreme care. An anchored target will be used and at least four shots fired from each gun of the battery. The guns should be fired alternately to equalize as far as possible the effects of changes in meteorological conditions. Care should be exercised in the preparation of matériel, determination of the deviations of impacts, determination of personnel errors, and analysis of results. The resulting calibration corrections should be expressed in feet per second muzzle velocity so that the corresponding correction in yards at any range may be readily determined.

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(4) *Muzzle velocity.*—Prior to a target practice, every effort should be made to determine the most probable value of muzzle velocity to be expected, considering the calibration for the guns and the performance of the powder charges to be used. Ordinarily a study of the past records of the battery will give the most reliable information. If, however, the powder lot to be used in the target practice has not been fired previously, application should be made to the local ordnance officer for any information which he may have on the performance of the powder. When no records of previous firings are available, the muzzle velocity listed on the powder tag should be used. In cases where the powder is old and no weight adjustment in the charge has been made in recent years, or where for any other reason the accuracy of available information is doubted, application should be made through channels to the Chief of Ordnance for information as to what muzzle velocity may be expected.

(5) *Trial fire.*—(*a*) Trial fire should be conducted at the maximum rate consistent with the required accuracy of pointing and spotting.

(*b*) The number of shots allowed for trial fire will be as follows:

1. For guns of less than 8-inch caliber, not more than eight. Trial fire will be conducted by two-gun salvos. Any round of the maximum allowed for trial fire remaining after the trial correction has been determined will be used in record fire.

2. For guns of 8-inch or larger caliber, four.

3. For mortars, eight; four in each of two adjacent zones.

(6) *Record fire.*—Record fire should follow trial fire with the least practicable delay. Delay between trial and record fire in excess of a reasonable interval in which to determine and apply corrections will be commented upon in the battery commander's narrative report.

(7) *Adjustment methods.*—(*a*) For 3-inch, 6-inch and 155-mm guns, the bracketing method of adjustment will be used.

(*b*) For guns of 8-inch and larger caliber, the magnitude method of adjustment will be used. Trial fire will be conducted by the ranging shot method.

(*c*) For mortars, the magnitude method of adjustment will be used. Trial fire will be conducted by the trial shot method.

(8) *Spotting.*—For all practices with guns of 8-inch caliber and above, aerial spotting will be obtained whenever practicable. Unless otherwise directed, the battery commander will exercise his judgment as to the kind of spotting he uses in adjusting fire. For smaller calibers, aerial spotting will not be employed. The results of both methods of spotting will be tabulated on the reverse side of Form 24. When

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aerial spotting is employed, the pilot will be instructed to remain the maximum distance from the target at which spotting is feasible, considering the small size of the pyramidal target as compared to a service target. This distance need not exceed 10,000 yards. A statement of the pilot's estimate of his average slant range from the target during the firing will be included with the comparison of spotting results (Form 24).

(9) *Pointing rapid-fire guns.*—Three-inch, 6-inch, and 155-mm guns firing normal charge will employ case II pointing.

(10) *Maneuvering target.*—Target practice courses will include a maneuver of the target, such as a change of course of at least 5°.

c. National Guard not in Federal service.—(1) Except as otherwise provided for in this subparagraph and in the annual supplement to this manual, target practices by National Guard organizations not in the Federal service will be conducted as prescribed for Regular Army target practices.

(2) Army or department commanders may authorize such variations (except as to safety) in the rules for National Guard target practices as in their opinion are made necessary or advisable by the available time, limited personnel, state of training, or other similar conditions. Such authorized variations will be stated by the battery commander in his narrative report of the practice.

20. Battle service practice.—*a. Purpose.*—The purpose of battle service practice is to give the entire command the maximum training under conditions approximating those to be met in actual service.

b. Conduct.—Battle practice will be conducted under the regulations prescribed for record service practice in paragraph 19 where applicable. The maximum number of batteries and vessels available should be used; if two or more targets are towed by any one vessel, such targets will be separated from each other by at least 100 yards. The harbor defense commander will exercise control through the tactical chain of command. Changes of targets and concentration and distribution of fire will be undertaken if sufficient ammunition is available.

21. Officials and their duties.—A list of officials normally required for service practice, together with a statement of their duties, is given below. For all service practices, except where manifestly impracticable, these officials will be detailed from another regiment by the harbor defense or regimental commander. In case of battle practices and special firings, only such officials as are necessary for safety and the accomplishment of the purpose of the firing will be required.

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a. Safety officers.—One commissioned officer with the necessary qualified assistants. The duties of the safety officer and of his assistants are set forth in FM 4–20.

b. Timekeeper.—(1) *Personnel required.*—One officer as chief timekeeper and one enlisted assistant and in addition one qualified assistant for each gun firing.

(2) *Duties.*—(*a*) The chief timekeeper for the practice will take station at the battery firing. He will synchronize his watch with that of the tug officer.

(*b*) The chief timekeeper will take or cause to be taken by his assistants the time in hours, minutes, and seconds, of the following listed events:

1. Each shot of trial fire.
2. Each command ***Commence firing*** in record fire.
3. Each command ***Cease firing*** or ***Suspend firing.***
4. Each misfire or other matériel failure.
5. Each shot of record fire.

(*c*) The chief timekeeper will compute from the data obtained, as prescribed in (*b*) above, the time "in action" and "time out" for each gun, noting the cause of time out in each case.

(*d*) The chief timekeeper will complete the timekeeper's report (Form 21) promptly and submit it to the harbor defense or regimental commander for approval and transmittal to the battery commander concerned. (See par. 24.)

c. Observer of azimuth of target at instant of splash.—(1) *Personnel required.*—One officer and if necessary an enlisted assistant to act as a reader and recorder.

(2) *Duties.*—The observer will use an oriented azimuth instrument located as near as practicable to the directing point of the battery firing. The position selected should be such that the target will not be obscured from the observer because of smoke or dust incident to firing. When this instrument is not mounted on a pedestal, special care will be taken that the tripod is firmly set so that the instrument will not be thrown out of orientation during the firing. The azimuth of the target at the instant of each impact, or each group of impacts occurring simultaneously, will be observed and recorded. Parallax corrections need not be made unless the angle directing point-target-observer is more than 0.25°. Immediately after the practice the officer will enter the recorded data on Form 18 and submit it to the group commander.

d. Observers of lateral deviations.—(1) *Personnel required.*—One officer observer and a qualified enlisted observer as an assistant. Recorders may also be detailed if necessary.

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(2) *Duties.*—The observers will place their azimuth instruments at points in the vicinity of the firing battery where the target will not be obscured from view by smoke or dust incident to firing. The points chosen will be so located that parallax corrections will be negligible. The angular deviation, right or left, of each impact with reference to the target will be observed and recorded. After the practice, these deviations will be reduced to yards, using the following formula:

$$D = d \times \frac{R}{100} \times 1.75$$

where

D = deviation in yards (take to the nearest yard).

d = deviation in degrees and hundredths.

R = actual range to target to the nearest hundred yards.

When the deviations are read in mils, the formula becomes—

$$D = d \times \frac{R}{100} \times 0.098$$

The actual range to the target for each shot will be obtained from the battery commander after the practice. The completed report will be submitted to the group commander who will verify the correctness of the computations and transmit the report to the battery commander concerned.

e. Elevation checkers.—(1) *Personnel required.*—One for each gun.

(2) *Duties.*—The duties of the elevation checkers are to determine and record the ranges or elevations at which the piece was actually laid when fired. The group commander will prescribe the method to be used in determining this information. The method to be used will be that which will give the greatest accuracy practicable considering the matériel and method of fire employed in the practice. Immediately after the practice, records will be completed, signed, and submitted to the battery commander.

f. Tug detail.—During a record service practice, no deviations obtained by the tug detail will be furnished the firing battery.

(1) *Personnel required.*—One officer and the necessary enlisted assistants to operate the cameras and three range rakes.

(2) *Duties.*—(*a*) *Tug officer.*

1. Prior to the departure of the tug the tug officer will synchronize his watch with that of the chief timekeeper. In order that all impacts may be identified with the serial number of the shots fired, he will cause to be noted the time of each impact during the firing.

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2. He will assure himself that the operators of the range rakes have a thorough understanding of their duties, and he will supervise the camera and range rake details during the practice.

3. During the practice he will act as an assistant to the safety officer (FM 4–20).

4. He will prepare the record of range deviations (Form 20), sign, and transmit it together with the camera films to the group commander as soon as practicable after the practice.

(*b*) *Camera detail.*

1. The camera detail will photograph each splash, marking carefully the film used for identification purposes.

2. Measurement of the films will be done under the supervision of the tug officer and in accordance with the provisions of paragraph 26.

(*c*) *Range rake detail.*—The range rake detail will, for each splash, record the time and deviation in mils, sighting on the edge of the splash nearest the battery.

g. Detail for measurement of towline length.—(1) *Personnel required.*—Two observers, two arm setters, and one plotter. If a special range section is detailed to make a horizontal base track as required by the provisions of paragraph 17*g*, it will perform the duty covered by this paragraph.

(2) *Duties.*—(*a*) Normally the length of the towline will be determined by horizontal base, as follows: The positions of the target and the towing vessel will be plotted alternately on successive bells for a sufficient number of positions of each to smooth out the courses. Each plotted point will be marked as a towing vessel position or a target position and will be numbered consecutively in the order plotted regardless of whether it represents the tug or target. The length of the towline will then be indicated by the distance between the plotted position of the towing vessel and the interpolated position of the target at the same instant. An average of three or four such measurements should be taken as the true length of the towline. Allowance will be made for the difference between the observing point on the towing vessel and the location of the camera on that vessel. The corrected length of the towline will be taken to the nearest 10 yards.

(*b*) The measurement of the towline as directed above may be done by the commanding officer of the firing battery immediately after the completion of the firing. If this procedure is followed, the tug officer should be cautioned to keep the tug under way and

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not allow the target to be pulled in until the measurement has been completed.

(*c*) If for any reason the length of the towline is not determined by the normal method described in (*a*) and (*b*) above, the following method will be used under the personal supervision of the group commander. The points of attachment of the towline to the target and the point of the towline at the position occupied by the observers on the towing vessel will be marked by tying cloth around the towline or by other suitable means. As soon as practicable after the practice, the towline will be detached from the tug and target, stretched, and measured accurately between the points marked. Allowance will be made for the length of the bridle so that the final measurement will indicate, to the nearest 10 yards, the actual distance which existed between the camera and range rakes on the tug and the center of the target during the record firing.

SECTION II

ANALYSIS

	Paragraph
Drill	22
Service practice	23
Time	24
Determination of deviations	25
Film scale	26
Comparison of spotting results	27
Score	28
Target practice, National Guard not in Federal service	29

22. Drill.—Prior to service practice and during the period of intensive training, battery commanders will analyze thoroughly drills, subcaliber practices, and simulated service practices, using the data corresponding to a number of selected times. (See *e* below.) The object of analysis of drill is to disclose the personal errors incident to the drill and the individuals responsible for each in order that corrective measures may be taken.

a. Types of records to be kept.—The example given in *j* below illustrates the records to be kept for a complete analysis of drill and analysis of practice. In the case selected for illustration, the records to be kept are those shown on Forms 1 to 13, inclusive. (See par. 34*a* for Forms 1 to 26, incl.) The forms used will vary slightly with the different classes of armament, fire control equipment, and method of firing.

b. Daily drill.—The keeping of records and the analysis of drill will be undertaken frequently in order to insure proficiency of the battery personnel.

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c. Commencement and duration of records.—Record keeping will begin at some convenient time after the commencement of tracking and for drill should be continued only for such time as firing would ordinarily be conducted on a single course of the target, that is, 10 or 20 minutes. To begin the record keeping, the battery commander or the range officer will designate the number of the course and announce, "Next bell is time 1." This will be repeated over the lines of signal communication from the plotting room to all concerned and will be a signal to begin all records on the next bell, and a note on the record sheets of the designated number of the course will be made.

d. Synchronism of records.—Every few minutes after the record keeping is begun some designated member of the range section will announce for general information and transmission the number of the next bell, as "Next bell is time 10." This is for the purpose of checking or correcting the synchronism throughout the system.

e. Numbering bells and courses.—Data for all shots or simulated shots and for the bells intervening between shots should be kept so that exactly what has happened can be reproduced. In the example cited, data for bells 1 to 24, inclusive, have been recorded. The observing interval was 20 seconds, and no data for intermediate bells have been recorded. If, for example, extrapolated data had been furnished to the emplacement at 10-second intervals, then the numbering of bells for records involved, such as the range percentage corrector's records, should have been 1, 1a, 2, 2a, . . ., the 10-second extrapolated data being recorded on the "a" bells.

f. Checking records.—In analysis of drill it is necessary to cross-check all records and to check the operation of all boards and computing devices. The former process will disclose the errors of transmission and application of data, while the latter will disclose the errors in operating the several boards and computing devices employed. To facilitate this work, a system of notation similar to that shown on the record forms should be employed. It will be noted that at the head of certain columns of each form there are numbers inclosed in parentheses which indicate the column and form number checked against; for instance, at the head of the second column, Form 3, appears a notation (2–4) indicating that this column (column 2 of Form 3) is to be checked against column 2 of Form 4. This method of notation will insure that no cross check is overlooked and will enable the checkers to complete their work in a minimum of time.

g. Battery commander's check sheet.—This form is arranged to disclose errors of the range section and to show the individuals

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responsible for the errors. Column 1 is the "time" corresponding to a particular bell, and opposite each time are three lines of data corresponding to this "time." Data in columns under "Errors in transmission and application" are determined by a cross check of records. Data in the first lines in these columns under "Errors in operation," corresponding to particular times, are copied from respective forms; the numbers in parentheses at the head of the columns indicate the forms from which these data are copied. The data on the second lines, corresponding to particular times, in columns 4 and 5, are the ranges and azimuths, respectively, of the set-forward points as determined by a replot of the course; in columns 6, 7, and 8, these data are determined from a reoperation of the equipment used, using the data that had been used by the operator. The third line is the difference between the first and second lines and shows the errors.

h. Replot of target course.—After the records are collected the first thing to be undertaken is a replot of the course of the target. To accomplish this when using horizontal base, the data on the arms setters' records, Forms 2 and 4, are used for the replot. When vertical base or self-contained base is used, the course is replotted using the recorded ranges and azimuths received from the single station instrument. After replotting the course of the target the battery commander next locates on the replot the position of each predicted point (if used) and of each set-forward point.

i. Check of auxiliary boards.—The battery commander or one of his assistants checks the operation of the several auxiliary boards or computing devices. In this he takes the arguments from record forms just as they are recorded thereon. His object is to see whether or not the operators have secured correct results with the arguments they used.

j. Example.—It is assumed that the battery consists of two 10-inch guns mounted on disappearing carriages, equipped with horizontal base system, using 20-second observing interval and firing by case II method of pointing. The records required are Forms 1 to 13, inclusive. In this example the data corresponding to "times 4, 7, 11, and 19" were selected for analysis. Forms will be examined in detail as follows:

(1) *Forms 1, 2, 3, and 4.*—Under "time 4" an error is found, the B′ reader's record being 258.70, while the arm setter's record is 258.07; otherwise the records agree. The error found is noted in column 3 on the battery commander's check sheet opposite "time 4," the numbers of the record sheets which indicate the error are entered in column 2, and the individual responsible in column 9. Ex-

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cept as noted, the forms are found to be correct. The columns of differences, column 3, Forms 1 and 3, should be carefully examined to see if the differences are reasonably uniform. This is the best means of checking the precision of the observations. The course is then replotted with the same readings as were used at drill.

(2) *Form 5.*—This form is examined and data are entered in the proper place (first line) on battery commander's check sheet, Form 13.

(3) *Form 6.*—Column 2 of this form is checked against Form 5 as indicated. No errors are found. The assumed muzzle velocity (2429 f/s) was determined from a study of previous firings. Reoperating the range correction board using the data recorded on Form 6, no errors are found.

(4) *Form 7.*—This form is checked and found substantially correct. It is to be noted that at "time 16" a BC correction of 2.94 (reference number) was applied.

(5) *Form 8.*—Using this form, the deflection board is checked and found substantially correct.

(6) *Forms 9, 10, 11, and 12.*—These forms are used by the emplacement officer to check the laying of the piece insofar as practicable. This can be done by relaying the pieces on the marks made on the racer, range drum, elevation rack, or other device, and noting readings. The data on the forms are later checked as indicated against Forms 7 and 8.

(7) *Form 13.*—This form is the battery commander's check sheet. The ranges and azimuths of replotted set-forward points and other data obtained from reoperation of plotting room equipment are entered on this form on the second line corresponding to the particular time, which then gives sufficient data for a determination of errors and the placing of responsibility therefor insofar as concerns members of the range section. The sheet is completed as indicated and in this case the B′ arm setter is charged with an error (+0.63°), "time 4," and the plotter is charged with an error (−30 yards), "time 11." Other errors are not material.

23. Service practice.—The object of analysis of target practice is to determine the proficiency of the firing unit and the performance of the matériel. These can only be studied after the collection and orderly arrangement of all data used during the practice. These data are used in the determination of the score, which in itself serves as a measure of the practice. For this analysis it is not necessary to determine individual errors, but the errors made by the firing unit as a whole are determined. The analysis is both tabular and graphical.

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a. Tabular analysis.—The example given in paragraph 22*j* was carried through the analysis of drill. This same example will serve to illustrate the analysis of practice.

(1) *Records required.*—In this example, Forms 1, 3, 5, 6, 7, 9, 11, 17, 18, 19, 20, 21, 23, 24, 25, and 26 will be required.

(2) *Form for tabular analysis* (*Form 23*).—To complete this form, the procedure given below should be followed.

NOTE.—Values to the nearest 10 yards only should be entered on lines 2 to 8, inclusive, otherwise as indicated.

(*a*) Replot the course using the B′ and B″ readers' forms (1 and 3), corrected where necessary for personnel errors and to give uniform values in the difference columns. When a vertical base or self-contained base system is used in the firing, data for the replot will be obtained from a horizontal base track of the target made by another range section under the supervision of the group or battalion commander (see par. 17*g*).

(*b*) Upon the replot of the course, determine the position of the target at each instant of impact by plotting the azimuth of the target (Form 18). Record the ranges to these points on line 2. Also measure the angle *VTG* for each shot or salvo and record their values on line 2, Form 26, for use in determining the range deviations of the splashes. The angle *VTG* should be recorded only to the nearest degree.

(*c*) Using the ranges from line 2, reoperate the range correction board to determine the ballistic correction that should have been applied in each case. Convert these values into yards and enter on line 3. In the example, a muzzle velocity of 2,429 f/s was assumed.

(*d*) From the battery commander's record (Form 17) and the range percentage correction board operator's record (Form 7) determine the BC correction which was actually ordered and the salvo to which applied. Enter these values, converted to yards, on line 5 under the shots to which they were applied. These values should be the corrections actually ordered and should not be confused with the corrections actually applied.

(*e*) Determine the ranges at which the pieces were actually laid from the elevation checker's record (Forms 9 and 11). If the guns were laid by angular elevation or if, because a non-standard projectile was used, a range-range conversion was necessary, the range or elevation shown must be converted to the actual range. Enter these values on line 7.

(*f*) Determine the actual deviation of each splash from the target as described in paragraph 25. Enter the values taken from line 14, Form 26, on line 9.

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(*g*) Enter on line 10 an exact repetition of data on line 5. This procedure is correct even though the exact amount of the correction actually ordered was not applied.

(*h*) Enter on line 16 the range deviations reported by the spotting section (from the battery commander's record, Form 17).

(*i*) The remaining lines on this form are filled in as indicated on the form itself.

(3) *Summary of depression position finder or range finder results (Form 23a).*—This form will be submitted when ranges for firing are obtained from a single station instrument and a horizontal base track is made for replotting purposes. In case the obtaining of a horizonital base track is impracticable, the reasons therefor will be stated in the group or battalion commander's indorsement.

b. Graphical analysis.—The graphical analysis is designed to present a picture of the more important aspects of the practice as a whole. The graph shows in chronological order what actually happened (plot of the actual deviations with respect to the target); the progress of the shoot (center of impact of actual deviations); what information was available to the battery commander as to the fall of the shots (plot of the spotted deviations); what action was taken (adjustment corrections applied). These items are all indicated on the graph by means of distinctive symbols. In addition, the graph shows the magnitude of the personnel errors, the developed and theoretical armament errors, the dimensions of the danger-space area and other pertinent data. While the graph is based on range deviations alone, the magnitude of the lateral deviation of each shot is indicated so that a complete picture of the fall of the shots with reference to the danger space is presented. The graphical analysis will be made on Form 24 (fig. 1). The symbols that appear on the top of this form will be used in preparing the graph. All blank spaces in the heading will be filled in by the battery commander. For mortars, the scores for the separate components will be indicated for each zone. The total score indicated for mortars will be that determined by combining the zone scores in the prescribed manner. The procedure in preparing the graphical analysis is as follows:

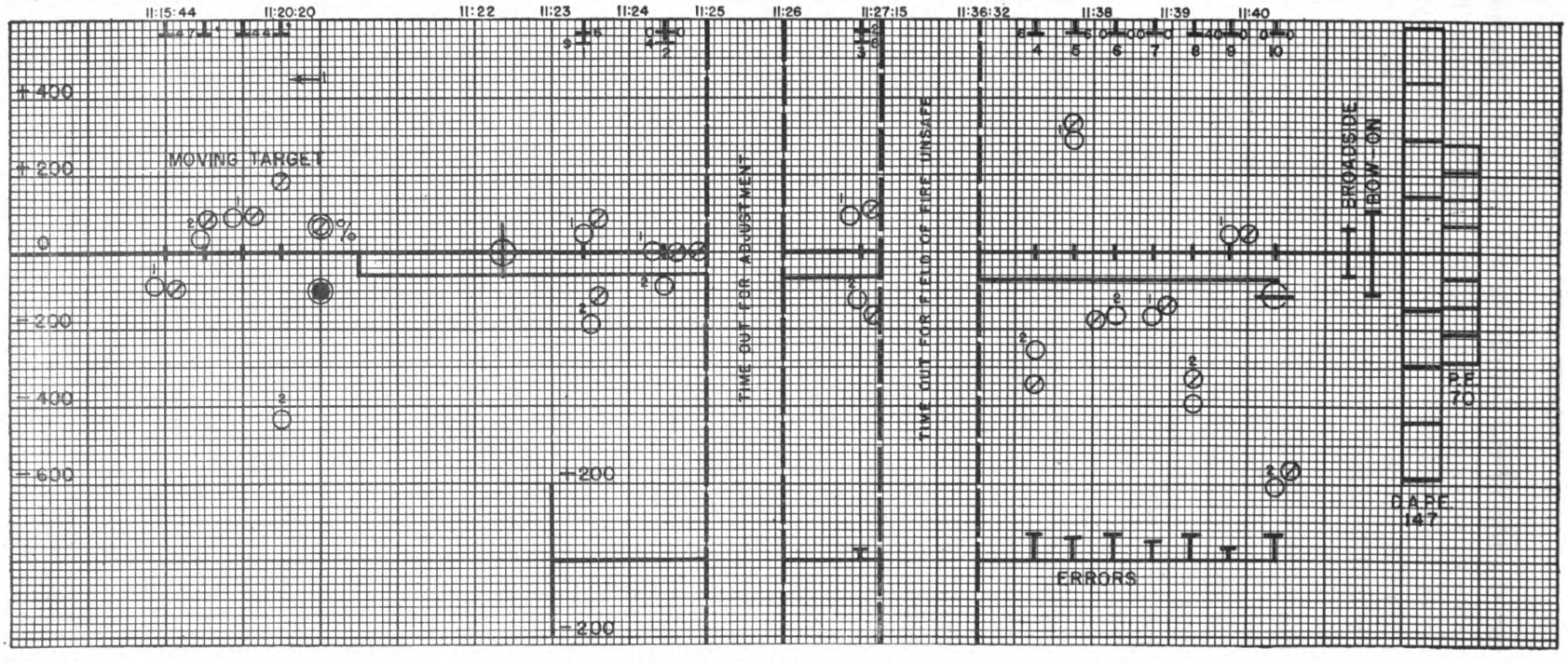
(1) The vertical scale is in yards, over or short, and the horizontal scale in time. A suitable scale will be chosen for each. Black ink *only* will be used in preparing this graph. A heavy horizontal line will be drawn, leaving 1½ inches at the left for binding. This line will be used throughout to represent the position of the target. A vertical line extending one-tenth inch above and below the target line will be drawn on the time line of each shot or salvo to represent the position of the pyramidal target. Directly above these vertical lines

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ORGANIZATION	PLACE	BATTERY	GUN, CAL. & MOD.	CARRIAGE MOD.	DATE	PRACTICE DAY OR NIGHT	BATTERY COMDR.	RANGE OFFICER	HITS, R.F. BROAD SIDE	HITS, R.F. BOW ON	TIME, R.F. PER SHOT PER GUN, SEC.	H.G.M. R.F. BROAD SIDE	H.G.M. R.F. BOW ON	AVERAGE ACTUAL RANGE, R.F.	CASE	LATERAL LIMITS (RT. OR LEFT) OF TARGET, (YDS.) BROAD SIDE	LATERAL LIMITS (RT. OR LEFT) OF TARGET, (YDS.) BOW ON	SCORE	RATING C. OF C.A.
F, 52nd CA	Ft. Monroe	Eustis	10", 1888	D.C., 1897	11-6-35	Day			3	5	34.1	0.41	0.68	10 207	II	80	16		

|, TARGET. ○, PLOTTED DEVIATIONS. ●, PLOTTED SALVO C.I. ⊘, SPOTTED DEVIATIONS. ◉, C.I. OF PLOTTED DEVIATIONS. ⊘, C.I. OF SPOTTED DEVIATIONS. ⊖, C.I. OF ALL RECORD SHOTS.
←5, SHOTS USED IN COMPUTING C.I. AND SHOT TO WHICH APPLIED. ←—6, SHOTS IGNORED IN COMPUTING C.I. $5\frac{+1}{2}4$, SALVO NUMBER WITH LATERAL DEVIATIONS IN YARDS. └, B.C. CORRECTION. ϕ, COMMENCE FIRING.



Form 24.

FIGURE 1.—Graphical analysis.

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and near the top of the graph the symbol ± will be used to indicate the number of shots in the salvo, the number of cross lines drawn in the symbol indicating the number of shots. These symbols will be drawn for all shots. Immediately below these symbols for record fire only will be placed the serial number of the salvo. The lateral deviation in yards to the right (left) of each impact, as determined from Form 19, will be indicated in small figures at the right (left) of the cross lines. The order, downward, in which these figures are placed is the same as that of the plotted impacts pertaining to the same time line. The figure on the uppermost cross line is the lateral deviation of the uppermost impact, and the figure on the next cross line is the lateral deviation of the next uppermost impact, etc. For example, the symbol $5\overset{\pm}{4}32$ indicates there were two shots fired on the fourth salvo, the shot plotted uppermost on the graph falling 5 yards to the left and the other 32 yards to the right of the target. Shots fired before record fire need not be plotted with respect to time, but the time of the first and last of such shots will be noted on the graph. The time of ***Commence firing*** will be plotted on the axis—symbol ∅ (0.15-inch radius).

(2) From the target line, plot—

(*a*) Each range deviation from the target (line 9, Form 23)—symbol ○ (0.10-inch radius).

(*b*) The range deviation of the center of impact of each salvo when spotting by salvos (line 9a, Form 23)—symbol ● (0.10-inch radius).

(*c*) Each range deviation as determined by the spotting section (line 16, Form 23)—symbol ⊘ (0.10-inch radius).

(3) It will be noted on the graph whether the trial fire was at a fixed or moving target as in figure 1.

(4) The center of impact of the spotted deviations upon which each correction was based will be plotted using the symbol ⊘ (outer circle 0.15-inch and inner circle 0.10-inch radius). The spotted center of impact will be determined as though all shots considered in determining the correction were fired with the same correction as the last shot of the group. Thus, if some of the shots were fired with corrections differing from that applied to the last shot, it will be necessary to compute, for those shots, what the spotted deviation would have been had they carried the correction actually applied to the last shot of the group. This is essentially the same process as that used in determining adjustment corrections by operation of the fire adjustment board. From the same vertical line on which this symbol is plotted and near the top of the graph a horizontal line will be

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drawn to the left one tenth inch for each shot considered in the computation of the center of impact in question—symbol ←. If any shots were disregarded in this computation, the symbol will be broken in the corresponding spaces—symbol ← —. The number of the salvo to which the correction was applied will be placed after the symbol; for example, ←—— 5.

(5) The means of applying the correction based upon trial fire will be noted on the graph to the right of the symbol ⊘ described in (4) above as "%" (range percentage corrector); or "flat."

(6) When it is possible to identify the shots from particular guns the impacts will be marked with the tactical number of the piece.

(7) The center of impact of the actual splashes of each series of shots upon which each correction was based will be plotted using the symbol ◉. This center of impact will be computed as for the symbol ⊘ described in (4) above (outer circle 0.15-inch and inner circle 0.10-inch radius).

(8) Draw a heavy solid line representing the adjustment correction which was actually applied (vertically, showing the amount and sense; horizontally, the shots to which applied). When the magnitude of the correction varies due to the correction having been applied as a percentage of a changing range, this variation will be shown by sloping the line from the horizontal so that the distance from the target line to the correction line will represent the amount of the correction in yards for that particular shot.

(9) At the right of the graph the center of impact of all actual splashes (record) will be plotted, using the symbol ⊖ (0.15-inch radius.) For mortars the center of impact will be shown for each zone, the symbol for the first zone being plotted at the end of that zone and that for the second zone being plotted as shown in figure 1.

(10) Vertical lines representing the range limits of the danger space of the broadside and bow-on targets will be laid off symmetrically with respect to the target line and marked as shown in figure 1.

(11) Dispersion ladders for the DAPE and the PE (table I) will be drawn on the right of the graph as shown in figure 1. (See par. 34*b* for tables I to VI, incl.) For mortars, lines representing the longitudinal limits of the danger space ((10) above) and the dispersion ladder, pertaining to the first zone, will be drawn between the last trial shot and the symbol for ***Commence firing;*** those for the second zone will be drawn as shown in figure 1. The values will be noted below their respective ladders. When the bracketing method of adjustment is used, the value of the assumed PE will also be noted on the graph.

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(12) When two or more symbols overlap, they will be offset horizontally a sufficient amount to clear each other.

(13) In a convenient position either above or below the target line draw a horizontal axis and construct a graph of errors as shown in figure 1. On the time line through each shot or salvo an ordinate will be drawn in the proper direction from the horizontal axis and equal in magnitude to the personnel error (from line 8, Form 23) occurring on such shot or salvo. When the splashes of the individual shots of a salvo can be identified, the personnel error on each shot will be plotted. Personnel errors less than 20 yards need not be shown on the graphical analysis.

(14) When time out is allowed all guns, a broken vertical line will be drawn at the beginning of time out and a similar line at the expiration of time out. The notation "Time out for _____

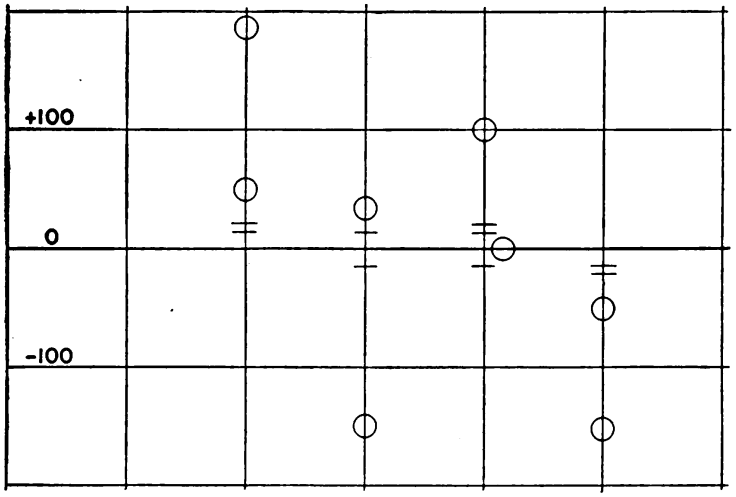


FIGURE 2.—Method of indicating spotting by sensing.

(giving reason)" will be made in the space between these lines. If necessary, the time scale may be broken. In all other cases when "time out" is allowed, a notation to that effect will be made; the time scale will not be broken.

(15) When the bracketing method of adjustment is employed, the method of indicating the sensing of the salvos will be as shown in figure 2 which is self-explanatory. *An impact sensed as a "hit" will be shown as both an "over" and a "short."*

24. Time.—For scoring purposes the time of practice includes record fire only and is the mean of the corrected times for the separate guns of the battery.

a. Total time for a gun.—The total time for a gun begins at the command ***Commence firing*** for the battery and ends when the gun fires

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its last shot, except when a gun goes out of action prior to the completion of the practice for some reason for which time out is not allowed, and does not resume firing. In this event, the total time for that gun will end when the last shot is fired by the battery.

b. Corrected time for a gun.—The corrected time for a gun is obtained by subtracting all allowed time out (*c*, *d*, and *e* below) from the total time as determined under *a* above.

c. Time out.—Time out during record fire will be allowed for the following conditions:

(1) Interference of vessels.

(2) Delays incident to movements of the towing tug.

(3) Defects in matériel which, in the opinion of the harbor defense commander or his representative, could not have been foreseen and remedied by the battery commander. When a matériel failure for which time out is allowed occurs in salvo fire, time out will be allowed only for the gun on which the failure occurred.

(4) Determination of the sources of excessive lateral deviations for reasons of safety, allowable only when case III pointing is being used. The length of time to be deducted in such case will be that which, in the opinion of the harbor defense commander or his representative, was necessary for determining and remedying the source of error.

(5) Obscuration of the target, except when caused by smoke or dust incident to firing.

d. Time out for adjustment.—(1) Time out for adjustment of fire will be allowed during record fire as follows: For 3-inch guns, not to exceed $4K$; for 6-inch and 155-mm guns, not to exceed $3K$; for all other armament, not to exceed K. K is the normal time per round for each gun. The value of K for each type of armament will be published annually in the War Department supplemental instructions.

(2) The allowance of time out under the provisions of (1) above will accrue to the battery under the following conditions:

(*a*) In no case will such time out be allowed unless the battery firing actually relays or suspends firing for the purpose of applying an adjustment correction.

(*b*) In any case where less time is lost than is permitted, only the time actually lost will be allowed as time out.

(*c*) Time out for adjustment purposes will be allowed when such time out does not run concurrently with time out allowed for any other purpose.

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(*d*) Time out for adjustment will be allowed during record fire only once for guns and once in each zone for mortars regardless of whether or not the entire period provided is used.

(*e*) If firing is suspended or if the battery relays for the purpose of applying an adjustment correction, time out may be allowed as provided above, even though no correction was actually applied.

(3) In training and in critiques the point should be stressed that suspension of fire for the purpose of applying an adjustment correction is allowed because of the extremely limited amount of ammunition available for target practice, and that suspension of fire for that purpose in battle, if the target is within the hitting area, would be improper.

e. Time out for changing zones, mortars.—Time out for changing zones of not to exceed $2K$ will be allowed mortar batteries conducting target practice in two zones. This allowance is subject to the same restriction as given for time out for adjustment in *d* (2) above.

f. Computation of time of practice.—The following illustrative examples of computation of corrected time are included to assist in clarifying the instructions contained in *a*, *b*, *c*, and *d* above.

(1) *Where time out occurs.*—In all cases where time out occurs, the battery matériel and personnel will have the same relative position upon the resumption of fire as existed when "time out" commenced in order that no material advantage or disadvantage will accrue to the battery firing.

Example: Assuming that the field of fire is unsafe and ***Cease firing*** is given immediately after a shot or salvo is fired or during the loading of the next shot, it may be that the battery will continue with the process of loading until the gun is ready to fire or will suspend loading at once. If the former happens, time will be counted against the battery until the loading operation is complete, but if the latter occurs, then time out will commence at the instant loading operations are suspended.

(2) *Determination of mean corrected time of practice.*

Example: In a four-gun 155-mm battery firing two-gun salvos, the time from ***Commence firing*** to the last shot fired by the battery is 9 minutes and 30 seconds. At the command ***Commence firing,*** guns Nos. 1 and 2 opened fire. Six minutes after the command ***Commence firing,*** the last shot was fired by the first platoon and simultaneously the second platoon commenced firing. During the time the first platoon was in action a time out for adjustment of 60 seconds ($3K$) was taken, and in addition gun No. 2 had a primer failure which caused a time delay of 20 seconds. Credit was allowed for both time outs, making the corrected times for guns Nos. 1 and 2, 5 min-

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utes, and 4 minutes and 40 seconds, respectively. For the second platoon, gun No. 3 fired its last shot 2 minutes after the last shot of the first platoon and then went out of action for a reason for which no time out is authorized in *c* or *d* above and remained out for the remainder of the practice. Gun No. 4 fired its last shot 3 minutes and 30 seconds after the last shot of the first platoon having no delays. The corrected time for guns Nos. 3 and 4 is therefore 3 minutes and 30 seconds. The corrected time for the battery equals—

$$\frac{5\text{m } 0\text{s}+4\text{m } 40\text{s}+3\text{m } 30\text{s}+3\text{m } 30\text{s}}{4}=\frac{16\text{m } 40\text{s}}{4}=4\text{m } 10\text{s}.$$

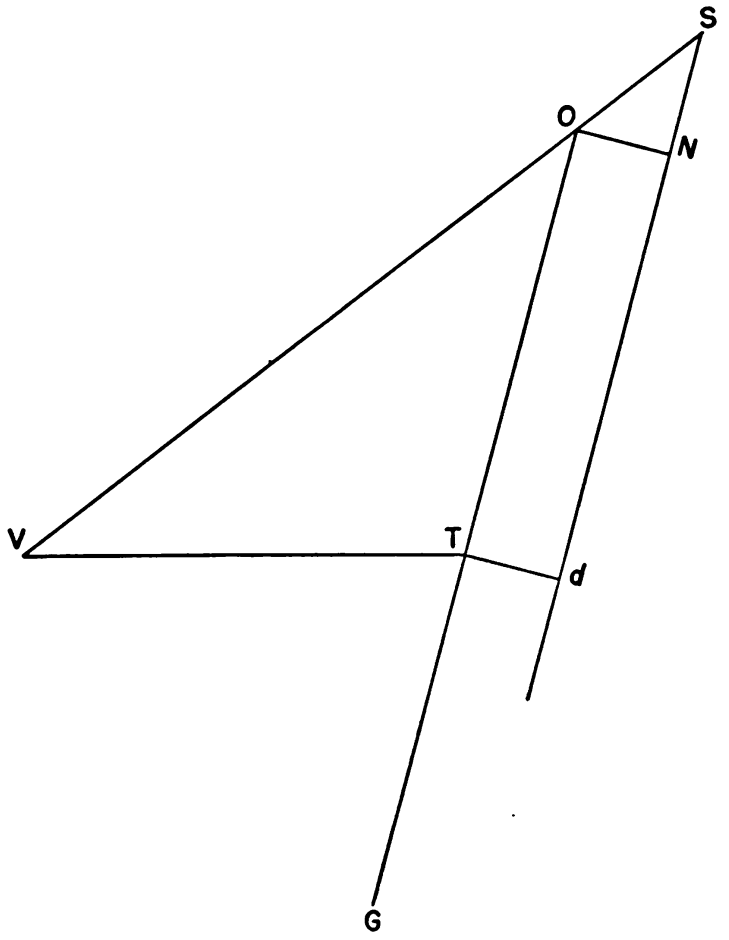


FIGURE 3.

25. Determination of deviations.—*a. Theory.*—Deviations of impacts from the target will be determined by the tabular method as explained below. Tables V and VI are furnished to reduce the amount of computations involved. A general explanation of the principles is as follows:

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(1) In figure 3, a type-sketch of the problem is indicated. In this sketch V is the towing vessel, T the target, G the gun, and S the splash.

(2) The range deviation of the splash from the target equals $Nd+NS$.

(a) In the triangle OVT—

$$\frac{OT}{\sin TVS}=\frac{VT}{\sin VOT}$$

$$OT=Nd=\frac{VT \sin TVS}{\sin VOT}$$

but angle VOT=angle VTG−angle TVS, therefore

$$Nd=\frac{VT \sin TVS}{\sin (VTG-TVS)}$$

(b) In the triangle OSN—

$$SN=ON \tan SON$$

but tan SON=cot OSN=cot VOT, and $ON=Td$, therefore

$$SN=\frac{Td \cos VOT}{\sin VOT}=\frac{Td \cos (VTG-TVS)}{\sin (VTG-TVS)}, \text{ and}$$

$$SN+Nd=\frac{VT \sin TVS+Td \cos (VTG—TVS)}{\sin (VTG-TVS)}$$

(3) In the above formula the value VT sin TVS is taken directly from the tug officer's report and is known as the camera deviation of the splash. TVS is also taken from the tug officer's report. Td is the lateral deviation in yards taken from the report of the observer of lateral deviations. VTG is obtained from the replot. The determination of the angle TVS from the camera film using a film scale is explained in paragraph 26.

b. Simultaneous impacts.—When two or more shots of a salvo fall at the same time, it will be impossible with present methods to determine which lateral deviation should be paired with a particular range deviation. In such situations the battery commander will match the least range deviation with the least lateral deviation; the next least range deviation with the next least lateral deviation, etc. Any advantage in hits obtained by this procedure is counteracted by the provisions of paragraph 28c(2).

c. Procedure.—Form 26 is supplied by the Coast Artillery Board or it may be prepared locally using the model in paragraph 34a. The work sheet contains instructions as to the method of obtaining the data for each line. In using tables V and VI, do not interpolate.

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Do not use fractions of yards or fractions of degrees in any part of the work.

26. Film scale.—*a. Purpose.*—The purpose of the film scale is to measure the longitudinal (range) deviation of the splash with respect to the target by measuring the distance between the images of the target and splash on a photographic film.

b. Theory.—(1) In figure 4, let T and S represent the actual target and splash; then the images of the target and splash will appear on the film at T' and S', respectively. M is the actual center of the film and V the position of the lens.

Then angle $T'VS'$=angle TVS

but angle $TVS=\tan^{-1}\frac{MS'}{VM}-\tan^{-1}\frac{MT'}{VM}=\beta-\alpha$

(2) The angles α and β are measured directly by use of a film scale graduated for tangent distances but having a scale marked in degrees. Distance VM is the focal distance of the camera lens (4½ inches in the standard camera). If the camera was tilted from the horizontal, the distances MT' and MS' will be increased proportionally to the reciprocal of the cosine of the angle of tilt; however, the film scale permits the proper values to be scaled directly.

c. Use.—(1) After developing the films, determine the geometric center of each by drawing diagonal lines from the corners of the exposed portion of the films. The point of intersection on each film will be marked M. The film will be marked as shown in figure 5. The angles α and β are measured by use of the film scale. The uppermost line of the film scale must pass through the center of the film M and be parallel to the horizon. If the camera has been tilted from the horizontal, the angular deviations are measured along the horizontal line under which the images appear. If the images of the target and splash are above the horizontal line through M, the film scale should be inverted.

(2) After completing the measurements, the proper sign is given to the angle TVS (over (+); short (−)), and the values of TVS and VT sin TVS are entered on Form 20, tug officer's report, for use by the battery commander in computing the actual range deviation of the splash.

d. Procurement.—Film scales may be obtained on request from the Coast Artillery Board.

27. Comparison of spotting results.—*a.* On the reverse side of the graphical analysis (Form 24) will be tabulated the spotting results to include the following:

(1) Actual deviations as determined by analysis.

(2) Deviations as reported by battery spotting section.

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(3) Deviations as reported by air observer.

b. The mean error (arithmetical) for each system of spotting will be indicated. The name of the aerial observer will appear on this form.

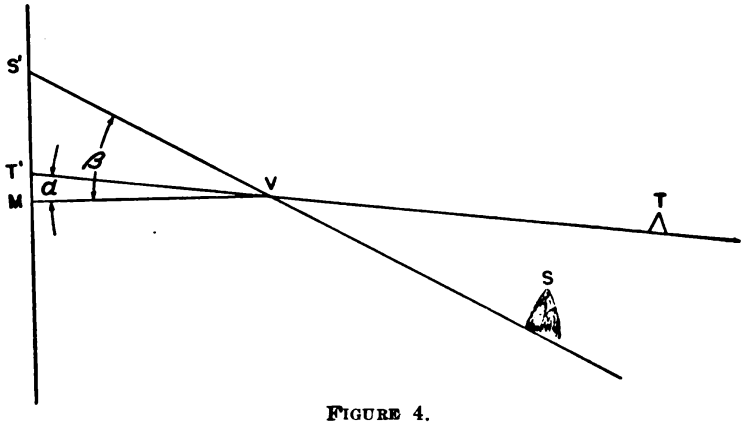


FIGURE 4.

NOTE.—If battery is *right*, put arrow in upper right corner; if *left*, place in upper left corner. Never put data on the horizon or in any place that will interfere with the measurement of *MT* or *MS*.

28. Score.—The scoring formula together with certain other pertinent elements of the score for all record service practices held during each calendar year will be published annually by the War Department in a supplement to this manual. In general, this score will be

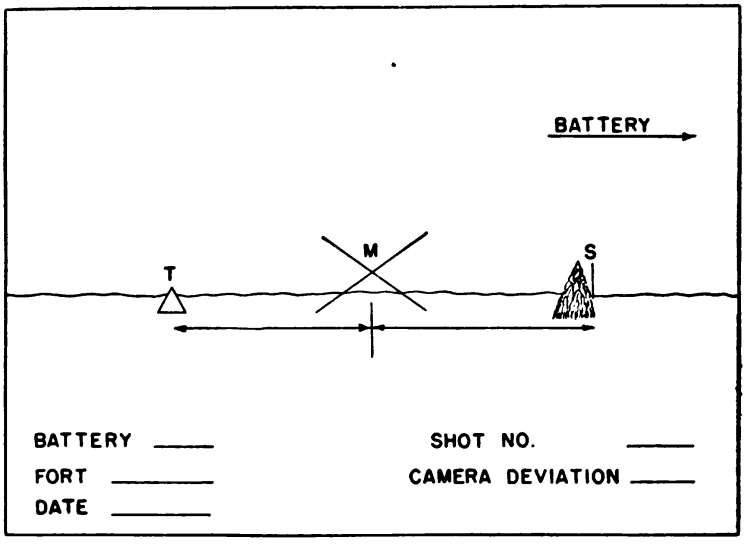


FIGURE 5.

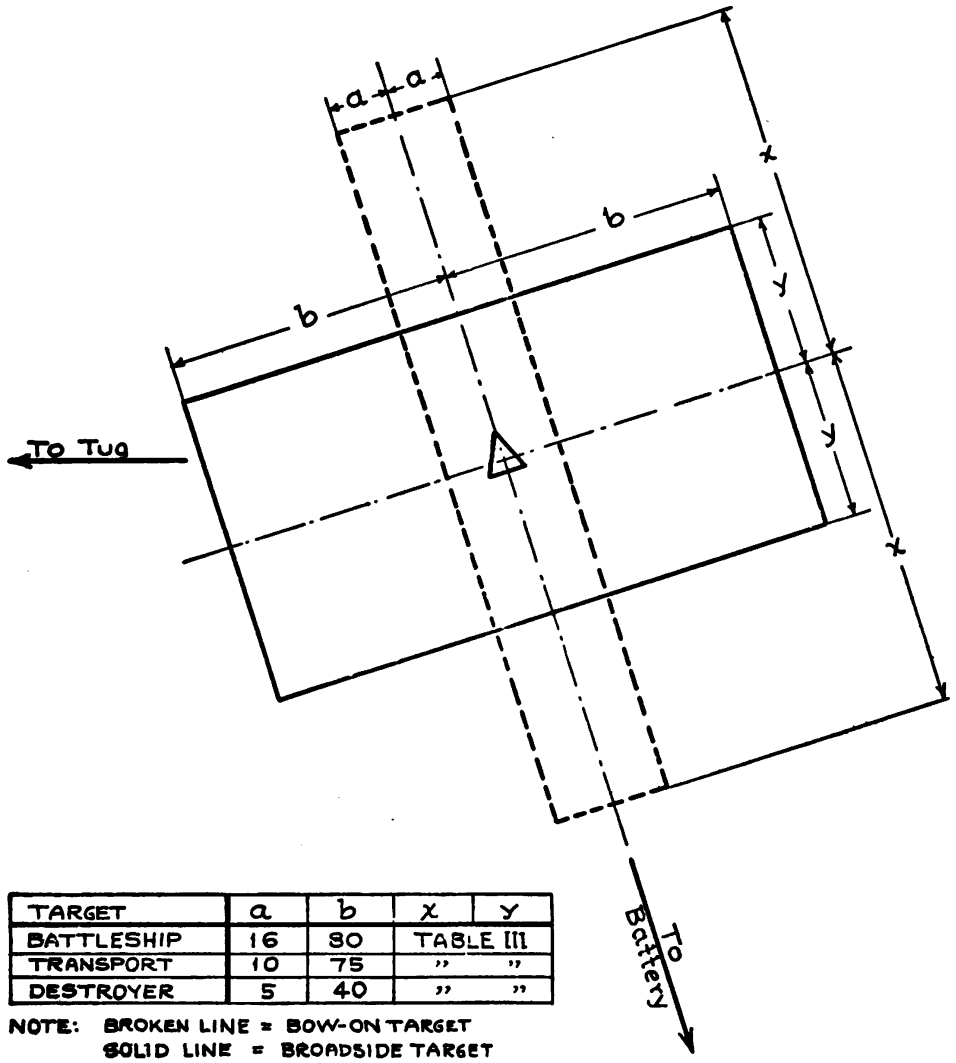
based on hitting, accuracy, time, and range at which the practice was conducted. The details of the formulas for the score are expected to change from year to year as experience adds to the general knowledge

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of the subject. There are, however, certain general elements that enter into the score which are of a relatively standard nature and which are therefore included in *a* to *f* below.

a. Hypothetical targets.—(1) For scoring purposes hypothetical targets are assumed. Such targets are rectangular parallelopipeds with dimensions approximating the vulnerable parts of—

(*a*) *Battleship.*—For mortars and for guns of 8-inch caliber and above, a battleship of the *California* class: Deck, 32 yards by 160 yards; hull above water, 10 yards; hull below water, 4 yards; sides and ends of target, vertical.



TARGET	a	b	x	y
BATTLESHIP	16	80	TABLE III	
TRANSPORT	10	75	"	"
DESTROYER	5	40	"	"

NOTE: BROKEN LINE = BOW-ON TARGET
SOLID LINE = BROADSIDE TARGET

FIGURE 6.—Dimensions of danger space in yards.

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(*b*) *Destroyer.*—For 3-inch and 6-inch guns, a United States destroyer: Deck, 10 yards by 80 yards; hull above water, 5 yards; hull below water, 2 yards; sides and ends of target, vertical.

(*c*) *Transport.*—For 155-mm guns, a transport of the *Henderson* type: Deck, 20 yards by 150 yards; hull above water, 10 yards; hull below water, 4 yards; sides and ends of target, vertical.

(2) For all record service practices by Regular Army organizations and for such other units as may be designated, the target for scoring purposes will consist of a bow-on and a broadside hypothetical target as follows (fig. 6):

(*a*) The bow-on target will have its longitudinal axis coincident with the gun-target line.

(*b*) The broadside target will have its longitudinal axis perpendicular to the gun-target line and crossing the center of the bow-on target.

(3) The danger space for the proper type of hypothetical target for the gun firing ((1) above) will be determined as indicated in *b* below, and the pyramidal target will be considered as being at the geometric center of this danger space.

b. Determination of danger space (*DS*).—(1) Table III gives the range limits of the danger space on each side of the center for various angles of fall for all types of targets. In entering this table, use the angle of fall corresponding to the nearest 100 yards of mean actual range for all record shots.

(2) The lateral limits of the danger space on each side of the center are given in table IV.

c. Determination of hits.—(1) (*a*) *Broadside.*—An impact is a hit on the broadside target when its range deviation does not exceed the value given in table III (one-half of the range danger space of the broadside target), and also its lateral deviation does not exceed the lateral limits of the broadside target as given in table IV.

(*b*) *Bow-on.*—An impact is a hit on the bow-on target when its range deviation does not exceed the range danger space of the bow-on target as given in table III, and also its lateral deviation does not exceed the lateral limits of the bow-on target as given in table IV.

(*c*) *Double.*—An impact may be counted as a broadside hit as well as a bow-on hit if its range deviation does not exceed the range limits of the danger space for the broadside target, and its lateral deviation does not exceed the lateral limits of the bow-on target.

(2) When hits result from the choice matching of deviations in a salvo as provided for in paragraph 25*b*, the probability that the method of matching may be in error must be considered in the score. The tabulation following will be used to determine the hits to be

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allowed when the proper matching of deviations in a two-shot salvo is not known. Column 1 is the number of shots of the salvo within the lateral limits of the target. Column 2 is the number of shots of the salvo within the range limits of the target. Column 3 is the number of hits to be allowed under the conditions of columns 1 and 2 for the target under consideration.

1 Number of deviations within lateral limits	2 Number of deviations within range limits	3 Number of hits allowed on target
1	1	½
2	1	1
1	2	1
2	2	2

This rule will be applied in determining the allowed hits on the bow-on target as well as on the broadside target.

d. Determination of wild shots.—A shot is defined as "wild" when the armament error of the shot is greater than four times the DAPE. This rule is to be applied as follows: Compute the data for lines 14, 15, and the DAPE (Form 23). Select that shot which has the greatest armament error (line 15) and apply the rule. If the shot is wild, recompute lines 14, 15, and the DAPE, excluding the wild shot. From the remaining shots, select the shot having the greatest armament error (line 15) and apply the rule again. This process is to be repeated until all wild shots are excluded. In no case will the shot be regarded as wild if the armament error of the shot is less than six times the probable error as given in table I.

e. Determination of lost shots.—A shot will be regarded as "lost" when its point of impact cannot be determined by the officials responsible for the range and lateral deviations.

f. Method of determining probability of hitting for use in scoring formulas.—The theory of this determination is covered in FM 4–10. The probability of hitting the danger spaces of the hypothetical targets is divided into two parts: the probability of hitting the broadside target, and the probability of hitting the bow-on target. The DAPE used in determining the probability of hitting as described below will be that obtained from Form 23 except that in no case will it be greater than 1.5 times, nor less than the PE as listed in table I.

The following symbols are used as indicated in (1) and (2) below:

F' =probability factor, broadside target.

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P' =probability of hitting broadside target.
F''_r=probability factor for range, bow-on target.
F''_d=probability factor for direction, bow-on target.
P''_r=probability of hitting bow-on target in range only.
P''_d=probability of hitting bow-on target in direction only.
P'' =probability of hitting bow-on target in both range and direction.
DS =danger space.

(1) *Broadside target.*—Since the lateral limits of this target are so wide, the probability of hitting it in direction is considered to be 1.00 or a certainty. Therefore, the probability of hitting this target in range is the probability of hitting it in both range and direction. In finding the probability of hitting in range, proceed as follows:

(*a*) Find the factor F' to three significant figures from the formula:

$$F' = \frac{\frac{1}{2}DS \text{ range (broadside target)}}{\text{DAPE (range)}}$$

where $\frac{1}{2}DS$ range is found as described in *b* above.

(*b*) Using F'' as an argument, enter table II and find P', the probability of hitting. Do not interpolate but use the value of F nearest the computed value of F'.

(2) *Bow-on target.*—The probability of hitting the bow-on target is the product of the probability of hitting that target in range and the probability of hitting it in direction. Proceed as follows:

(*a*) Compute F''_r from the formula:

$$F''_r = \frac{\frac{1}{2}DS \text{ range (bow-on target)}}{\text{DAPE (range)}}$$

(*b*) Use F''_r and table II as described in (1) (*b*) above and obtain P''_r, the probability of hitting the target in range.

(*c*) Compute F''_d from the formula:

$$F''_d = \frac{\frac{1}{2}DS \text{ lateral (bow-on target)}}{\text{PE direction}}$$

where $\frac{1}{2}$DS lateral is obtained from table IV and PE direction from table I.

(*d*) Use F''_d and table II as described under (1) (*b*) above and obtain P''_d, the probability of hitting the target in direction.

(*e*) The probability of hitting the bow-on target P'' in both range and direction is as follows:

$$P'' = P''_r \times P''_d$$

29. Target practice, National Guard not in Federal service.—*a. Analysis.*—Only so much of the prescribed procedure for

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analyzing a practice as may be essential for the completion of the special reports for the National Guard not in the Federal service (par. 31) will be required.

b. Score.—Due to the shorter time available to National Guard units not in the Federal service, for training and for analysis, a simplified score will be used. The formulas for the score, together with other pertinent instructions, will be published annually in the supplement to this manual. In general, practices conducted by National Guard units not in the Federal service will be scored on accuracy, time, and range.

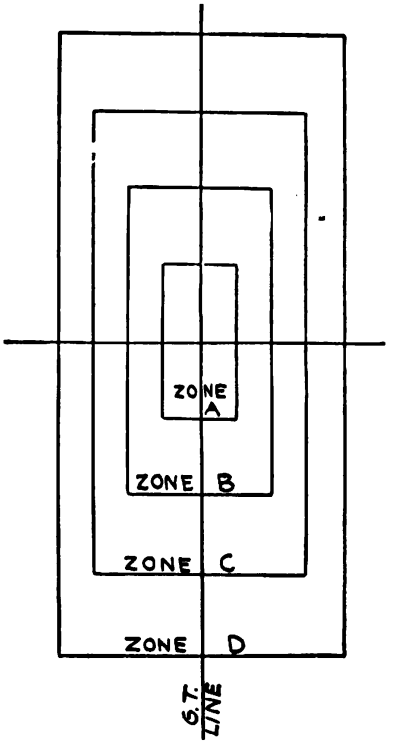


FIGURE 7.

c. Hypothetical targets.—The hypothetical target for National Guard target practices conducted by units of the National Guard not in the Federal service will consist of a series of four concentric rectangles with their longer axes coincident with the gun-target line. The center of these rectangles will be represented by the actual pyramidal target being towed (see fig. 7). The various sections of the target will be marked as zones A, B, C, and D. The dimensions of the various rectangles as well as the scoring value of an impact in each zone will be included in the annual supplement to this manual.

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SECTION III

REPORTS

Paragraph
Record service practice and advanced practice, Regular Army and National Guard in Federal service 30
Target practice, National Guard not in Federal service 31
Firings other than record service practice and advanced practice, Regular Army and National Guard 32
Target practice, Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camp 33

30. Record service practice and advanced practice, Regular Army and National Guard in Federal service.—*a. Record service practice.*—On the completion of each record service practice by organizations of the Regular Army and National Guard in the Federal service, reports will be prepared and submitted as follows:

(1) *Preparation.*—Four sets will be prepared.

(*a*) Sets 1 and 2, except as noted, will consist of—

One graphical analysis (Form 24) (fig. 1) (omit from set 2).

One tabular analysis (Form 23).

One summary of depression position or range finder results, where required (Form 23a).

One matériel and powder report (Form 25).

One score sheet (Form 27).

One battery commander's narrative report. This report will contain—

A brief description of methods of drill, fire control, or position finding, and of apparatus employed which differed materially from those authorized in training publications. If axial or unilateral spotting was not used when spotting was by sensing, reasons for adoption of the system used.

A statement as to cause of any delay between trial and record fire beyond that reasonably necessary to compute and apply an adjustment correction.

If the battery was allowed time out, a brief discussion of the cause.

A brief explanation of any occurrence not otherwise covered which is essential to an understanding of the results attained.

Recommendations for the improvement of methods of drill, fire control, or position finding.

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(*b*) Set 3 may be in pencil or draft form. It will consist of—
One copy of each form listed in paragraph 34*a* used in preparing the reports of the practices.
One copy of the battery commander's narrative report.
One set of photographic records of impact.

(*c*) Set 4 will consist of two copies of the matériel and powder report (Form 25).

(2) *Binding.*—Each set of reports, except set 4, will be arranged in the order given in (1) (*a*) above, and securely bound at the left side with suitable fasteners such as "Acco." Each set will have a flexible front and back cover 8½ by 11 inches in dimensions. The front cover will contain the following information:

COAST ARTILLERY

SERVICE PRACTICE REPORT

Kind of service practice_____
(Day or night)
Harbor defenses of_____
Fort_____
Organization, Battery_____ Coast Artillery
Date of firing_____
Battery _____
Caliber and model of guns_____
Type and model of carriage_____
Score_____ Score_____ Rating_____
(Group commander) (By C. of C. A.)
This copy for_____

(3) *Distribution.*—(*a*) *Sets.*

1. Set 1 will be forwarded through channels to The Adjutant General for file by the Chief of Coast Artillery.

2. Set 2 will be forwarded through channels to the coast artillery district commander for his comment and return to the organization for file as a permanent record. When returned for file this set should include a copy of all indorsements made on the set forwarded to The Adjutant General.

3. Set 3 will be retained by the firing organization for a period of 1 year after which time it may be destroyed.

4. Set 4 will be forwarded to the local ordnance officer who will extract one copy for file with the historical record of the powder and will forward the remaining copy through ordnance channels to the Chief of Ordnance.

(*b*) *Indorsement.*—In his forwarding indorsement on sets 1 and 2, the group or battalion commander will include a concise statement

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of any difficulties encountered in the practice as well as any points of general interest. His indorsement will include the certificate called for in paragraph 10*d*.

b. Advanced practice.—(1) On completion of an advanced service practice, the battery commander will forward through channels a detailed narrative report. This report will be sufficiently comprehensive to enable higher authority to determine the actual merits of the practice and will include, where pertinent, a statement of the number of hits, percentage of hits, and hits per gun per minute. Insofar as practicable, other reports will conform to those required for record service practices. In forwarding indorsements, each higher commander in the proper channel of communication will set forth his views as to the conduct and value of the practice. The computation of the score is not required. District or brigade commanders will recommend a classification of each advanced service practice.

(2) Three copies of the matériel and powder report (Form 25) will be prepared and submitted as follows:

One copy with the narrative report.

Two copies to the local ordnance officer who will extract one copy for file and forward the remaining copy through ordnance channels to the Chief of Ordnance.

31. Target practice, National Guard not in Federal service.—*a. Preparation.*—The preparation and submission of reports of service practice are responsibilities of the National Guard unit commanders. The following reports will be prepared and submitted as indicated:

(1) Sets 1 and 2 will consist of the following:

One score sheet for National Guard practice (Form NG–1).

One plot of impacts on rectangular target.

One record of spotting and adjustment (Form NG–2).

One abbreviated matériel and powder report (Form 25). (For preparation of this report see note on form.)

One battery commander's narrative report. This report will contain—

A brief description of any points of interest or value.

A report of any variations from regulations authorized by the army commander.

(2) Set 3 will consist of the following, in draft form, if desired:

One copy of each form listed for sets 1 and 2.

One timekeeper's record (Form 21).

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One record of—

Azimuth of target at instant of impact (Form 18).
Lateral deviations (Form 19).
Range deviations (Form 20).
Elevation checker (Form 9).
Azimuth checker (Form 10).

(3) Set 4 will consist of two copies of an abbreviated matériel and powder report (Form 25).

b. Binding.—Sets 1, 2, and 3 will be bound as provided in paragraph 30*a*(2); set 4 will be transmitted without binding.

c. Distribution.—(1) Sets 1 and 2 will be transmitted through the State adjutant general and the coast artillery district commander to the corps area commander. Such remarks as may be pertinent will be indorsed on both sets by each office through which they pass. Set 1 will then be forwarded to The Adjutant General for file by the Chief of Coast Artillery; set 2 will be returned through the coast artillery district commander and State adjutant general to the organization which conducted the practice, for file as a permanent record.

(2) Set 3 will be retained by the firing organization for a period of 1 year after which it may be destroyed.

(3) Set 4 will be forwarded to the local ordnance officer who will file one copy for his own records and will forward the remaining copy through ordnance channels to the Chief of Ordnance. Set 4 will be prepared and submitted prior to completion of the camp period of the firing organization.

(4) One extra copy of Form 25 will be prepared for file with the permanent records of the organization charged with the maintenance of the battery fired.

d. Report of defects.—If defects of matériel are found, the senior National Guard officer present, assisted by the unit instructor, will make the investigation and report called for by paragraph 14*b* and will submit report direct to the post commander if serving on a post or, if not on a post, through National Guard channels to the corps area commander.

32. Firings other than record service practice and advanced practice, Regular Army and National Guard.—*a. Battle service practice.*—The report of battle service practice will be submitted through channels to The Adjutant General and will consist of—

(1) One abbreviated matériel and powder report (Form 25 (see note on form)) for each battery firing.

(2) A narrative report by the officer in charge, containing such information as he considers of interest or value.

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(3) In addition to the above, one copy of each abbreviated matériel and powder report will be forwarded through ordnance channels to the Chief of Ordnance, and one copy will be filed with the emplacement or gun book of the armament fired.

b. Calibration practice and other firings with service ammunition not covered by a above.—Three copies of the matériel and powder report (Form 25) will be prepared and submitted as follows:

(1) One copy to The Adjutant General.

(2) Two copies to the local ordnance officer, one to be retained, the other forwarded through ordnance channels to the Chief of Ordnance.

c. Subcaliber practices.—The battery commander will submit the following reports of subcaliber firings:

(1) A report of the number of subcaliber practices conducted prior to each service practice will be tabulated in the space provided on Form 25 of the report pertaining to that service practice.

(2) At the conclusion of the target practice season, a report on Form 22 will be submitted through ordnance channels to the Chief of Ordnance covering all subcaliber firings since the submission of the last report.

(3) A record of the subcaliber firings will be entered in the emplacement or gun book.

33. Target practice, Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camp.—Service practices of units of the Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camps will be conducted in the manner prescribed for Regular Army target practices except as otherwise provided for in this paragraph and in the annual instructions for coast artillery target practice.

a. Variations.—An army or department commander may authorize such variations (except as to safety) in the rules for target practices conducted by the Organized Reserves, Reserve Officers' Training Corps, or Citizens' Military Training Camps as in his opinion are made necessary or advisable by the available time, limited personnel, state of training, or other similar condition.

b. Records and reports.—It is the responsibility of the camp commander that four copies of the abbreviated matériel and powder report are prepared for each practice conducted by units of the Organized Reserves, Reserve Officers' Training Corps, or Citizens' Military Training Camps. In addition, the reports mentioned in paragraph 14*b*, when required, will be submitted by the camp commander. No other reports will be required. These records will be

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submitted to the regimental or harbor defense commander who will dispose of them as follows:

(1) One copy will be forwarded to The Adjutant General.

(2) One copy will be transmitted to the custodian of the gun book or emplacement book.

(3) Two copies will be transmitted to the local ordnance officer who will extract one copy for file with the historical record of the powder and will forward the remaining copy through ordnance channels to the Chief of Ordnance.

SECTION IV

FORMS AND TABLES

Paragraph
Lists and models 34

34. Lists and models.—The following forms and tables will be necessary for recording the data to complete the analysis of drill and the analysis of practice. The computation of score will be made on Form 27, which is self-explanatory. All of these forms will be prepared locally with the exception of Forms 21, 23, 23a, 24, 25, 26, 27, and cover sheet, which will be furnished by the Coast Artillery Board on request. The request will show what forms and how many of each are desired. Forms 1 to 17, inclusive, are given as guides only and may be modified or additional forms used to conform to the equipment employed.

a. Forms.—(1) *List.*

	Form
B′ reader's record	1
B′ arm setter's record	2
B″ reader's record	3
B″ arm setter's record	4
Plotter's record	5
Range correction board operator's record	6
Range percentage correction board operator's record	7
Deflection board operator's record	8
Display board (elevation-azimuth checker) record	9, 10, 11, 12
Battery commander's check sheet	13
Spotting observer's record	14, 15
Spotting board record	16
Battery commander's record	17

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(Form)

Azimuth of target at instant of impact 18
Record of lateral deviations 19
Record of range deviations 20
Timekeeper's record 21
Report of subcaliber firing 22
Tabular analysis 23
Summary of depression position or range finder results 23a
Graphical analysis (see fig. 1) 24
Matériel and powder report (seacoast guns) 25
Work sheet for determination of range deviations 26
Score sheet (not shown) 27

(2) *Models.*

B′ READERS RECORD

1 Time	2 Azimuth (2–2)	3 Dif.
1	260. 17	
2	259. 69	0. 48
3	259. 19	. 50
4	258. 70	. 49
5	258. 18	. 52
6	257. 70	. 48
7	257. 19	. 51
8	256. 69	. 50
9	256. 15	. 54
10	255. 66	. 49
11	255. 14	. 52
12	254. 65	. 49
13	254. 12	. 53
14	253. 63	. 49
15	253. 14	. 49
16	252. 65	. 49
17	252. 15	. 50
18	251. 66	. 49
19	251. 14	. 52
20	250. 65	. 49
21	250. 14	. 51
22	249. 65	. 49
23	248. 45	1. 20 [1]
24	247. 98	. 47
xx	xxxxx	xxx

[1] Changed to No. 1 target.

Form 1.

B′ ARM SETTER'S RECORD

1 Time	2 Azimuth (2–1)	3 Dif.
1	260. 17	
2	259. 69	
3	259. 19	
4	258. 07	
5	258. 18	
6	257. 70	
7	257. 19	
8	256. 69	
9	256. 15	
10	255. 66	
11	255. 14	
12	254. 65	
13	254. 12	
14	253. 63	
15	253. 14	
16	252. 65	
17	252. 15	
18	251. 66	
19	251. 14	
20	250. 65	
21	250. 14	
22	249. 65	
23	248. 45	
24	247. 98	
xx	xxxxx	xxx

Form 2.

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B'' READER'S RECORD

1 Time	2 Azimuth (2–4)	3 Dif.
1	277. 08	
2	276. 55	0. 53
3	276. 00	. 55
4	275. 47	. 53
5	274. 92	. 55
6	274. 40	. 52
7	273. 83	. 57
8	273. 28	. 55
9	272. 69	. 59
10	272. 16	. 53
11	271. 58	. 58
12	271. 04	. 54
13	270. 46	. 58
14	269. 92	. 54
15	269. 34	. 58
16	268. 79	. 55
17	268. 21	. 58
18	267. 65	. 56
19	267. 06	. 59
20	266. 50	. 56
21	265. 90	. 60
22	265. 33	. 57
23	263. 89	1. 44 [1]
24	263. 32	. 57
xx	xxxxx	xxx

[1] Changed to No. 1 target.

Form 3.

B'' ARM SETTER'S RECORD

1 Time	2 Azimuth (2–3)	3 Dif.
1	277. 08	
2	276. 55	
3	276. 00	
4	275. 47	
5	274. 92	
6	274. 40	
7	273. 83	
8	273. 28	
9	272. 69	
10	272. 16	
11	271. 58	
12	271. 04	
13	270. 46	
14	269. 92	
15	269. 34	
16	268. 79	
17	268. 21	
18	267. 65	
19	267. 06	
20	266. 50	
21	265. 90	
22	265. 33	
23	263. 89	
24	263. 32	
xx	xxxxx	xxx

Form 4.

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PLOTTER'S RECORD

1 Time	2 Range to S. F. point (2–6)	3 Azimuth of S. F. point (2–8)
1	10, 640	260. 17
2	10, 640	259. 69
3	10, 640	259. 19
4	10, 650	258. 70
5	10, 660	258. 18
6	10, 670	257. 70
7	10, 680	257. 19
8	10, 700	256. 69
9	10, 680	256. 15
10	10, 680	255. 66
11	10, 650	255. 14
12	10, 620	254. 65
13	10, 620	254. 12
14	10, 620	253. 63
15	10, 650	253. 14
16	10, 650	252. 65
17	10, 650	252. 15
18	10, 650	251. 66
19	10, 650	251. 14
20	10, 670	250. 65
21	10, 690	250. 14
22	10, 700	249. 65
23	10, 740	248. 45
24	10, 760	247. 98
xx	xxxxx	xxxxx

Form 5.

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RANGE CORRECTION BOARD OPERATOR'S RECORD

1	2	3							4
		Pointer settings							
Time	Range to S. F. point (2–5)	Muzzle velocity	Atmospheric density	Tide	Wind	Weight	Elasticity	Rotation	Correction reference No. (2–7)
1	10, 640	2, 429	102	0	45	510	59	270	290
2	10, 640	2, 429	102	0	45	510	59	270	290
3	10, 640	2, 429	102	0	45	510	59	270	290
4	10, 650	2, 429	102	0	45	510	59	270	290
5	10, 660	2, 429	102	0	45	510	59	270	290
6	10, 670	2, 429	102	0	45	510	59	270	290
7	10, 680	2, 429	102	0	45	510	59	270	290
8	10, 700	2, 429	102	0	45	510	59	270	290
9	16, 680	2, 429	102	0	45	510	59	270	290
10	10, 680	2, 429	102	0	45	510	59	270	290
11	10, 650	2, 429	102	0	45	510	59	270	290
12	10, 620	2, 429	102	0	45	510	59	270	290
13	10, 620	2, 429	102	0	45	510	59	270	290
14	10, 620	2, 429	102	0	45	510	59	270	290
15	10, 650	2, 429	102	0	45	510	59	270	290
16	10, 650	2, 429	102	0	45	510	59	270	290
17	10, 650	2, 429	102	0	45	510	59	270	290
18	10, 650	2, 429	102	0	45	510	59	270	290
19	10, 650	2, 429	102	0	45	510	59	270	290
20	10, 670	2, 429	102	0	45	510	59	270	290
21	10, 690	2, 429	102	0	45	510	59	270	290
22	10, 700	2, 429	102	0	45	510	59	270	290
23	10, 740	2, 429	102	0	45	510	59	270	290
24	10, 760	2, 429	102	0	45	510	59	270	290
xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

Form 6.

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RANGE PERCENTAGE CORRECTION BOARD OPERATOR'S RECORD

1 Time	2 Ballistic correction (total) (4–6) reference No.	3 B. C. correction (4–17) reference No.	4 Range S. F. point (2–5)	5 Corrected range [1] (2–9) (2–11)
1	2. 90	3. 00	10, 640	9, 940
2	2. 90	3. 00	10, 640	9, 940
3	2. 90	3. 00	10, 640	9, 940
4	2. 09	3. 00	10, 650	9, 940
5	2. 90	3 00	10, 670	9, 950
6	2. 90	3. 00	10, 670	9, 960
7	2. 90	3. 00	10, 680	9, 970
8	2. 90	3. 00	10, 700	9, 990
9	2. 90	3. 00	10, 680	9, 970
10	2. 90	3. 00	10, 680	9, 970
11	2. 90	3. 00	10, 650	9, 940
12	2. 90	3. 00	10, 620	9, 900
13	2. 90	3. 00	10, 620	9, 900
14	2. 90	3. 00	10, 620	9, 900
15	2. 90	3. 00	10, 650	9, 940
16	2. 90	2. 94	10, 650	9, 870
17	2. 90	2. 94	10, 650	9, 870
18	2. 90	2. 94	10, 650	9, 870
19	2. 90	2. 94	10, 650	9, 870
20	2. 90	2. 94	10, 670	9, 900
21	2. 90	2. 94	10, 690	9, 920
22	2. 90	2. 94	10, 700	9, 930
23	2. 90	2. 94	10, 740	9, 970
24	2. 90	2. 94	10, 760	9, 980
xxx	xxx	xxx	xxx	xxx

[1] The values shown in this column have been corrected for the range-range relationship existing between the standard projectile (617 pounds) and the nonstandard projectile (510 pounds).

Form 7.

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DEFLECTION BOARD OPERATOR'S RECORD

1 Time	2 Azimuth (3–5)	3 Range (2–5)	4 Wind deflection component	5 Deflection case II (2–10) (2–12)
1	260. 17	10, 640	35	
2	259. 69	10, 640	35	229
3	259. 19	10, 640	35	229
4	258. 70	10, 650	35	229
5	258. 18	10, 670	35	229
6	257. 70	10, 670	35	228
7	257. 19	10, 680	36	227
8	256. 69	10, 700	36	226
9	256. 15	10, 680	36	225
10	255. 66	10, 680	36	227
11	255. 14	10, 650	36	228
12	254. 65	10, 620	36	229
13	254. 12	10, 620	36	227
14	253. 63	10, 620	36	228
15	253. 14	10, 650	36	229
16	252. 65	10, 650	36	227
17	252. 15	10, 650	36	228
18	251. 66	10, 650	37	227
19	251. 14	10, 650	37	229
20	250. 65	10, 670	37	230
21	250. 14	10, 690	37	230
22	249. 65	10, 700	37	231
23	248. 45	10, 740	37	(1)
24	247. 98	10, 760	37	230
xxx	xxx	xxx	xxx	xxx

[1] Change to No. 1 target.

Form 8.

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DISPLAY BOARD (ELEVATION CHECKER) RECORD

Gun No. 1

Range

1 (Time) (Shot)	2 Range (5–7)
1	9, 940
2	9, 940
3	9, 940
4	9, 940 √
5	9, 950
6	9, 960
7	9, 970
8	9, 990
9	9, 970
10	9, 970
11	9, 940
12	9, 900 √
13	9, 900
14	9, 900
15	9, 940
16	9, 870
17	9, 870
18	9, 870
19	9, 870
20	9, 900 √
21	9, 920
22	9, 930 √
23	9, 970
24	9, 980
xxx	xxx

(*a*) Display board recorder makes check mark opposite data at which piece was fired.

(*b*) Elevation checker records data at which piece was actually laid.

Form 9.

DISPLAY BOARD (AZIMUTH CHECKER) RECORD

Gun No. 1

Deflection

1 (Time) (Shot)	2 Deflection (5–8)
1	227
2	229
3	229
4	229 √
5	229
6	228
7	227
8	226
9	225
10	227
11	228
12	229 √
13	227
14	229
15	227
16	228
17	227
18	229
19	230
20	230 √
21	231
22	190 √
23	230
24	230
xxx	xxx

(*a*) Display board recorder makes check mark opposite data at which piece was fired.

(*b*) Azimuth checker records data at which piece was actually laid.

Form 10.

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DISPLAY BOARD
(ELEVATION CHECKER)
RECORD

Gun No. 2

Range

1 (Time) (Shot)	2 Range (5-7)
1	9, 940
2	9, 940
3	9, 940
4	9, 940
5	9, 950
6	9, 960
7	9, 970
8	9, 990 √
9	9, 970
10	9, 970
11	9, 940
12	9, 900
13	9, 900
14	9, 900 √
15	9, 940
16	9, 870
17	9, 870
18	9, 870
19	9, 870
20	9, 900 √
21	9, 920
22	9, 930 √
23	9, 970
24	9, 980
xxx	xxx

(*a*) Display board recorder makes check mark opposite data at which piece was fired.
(*b*) Elevation checker records data at which piece was actually laid.

Form 11.

DISPLAY BOARD
(AZIMUTH CHECKER)
RECORD

Gun No. 2

Deflection

1 (Time) (Shot)	2 Deflection (5-8)
1	2. 27
2	2. 29
3	2. 29
4	2. 29
5	2. 29
6	2. 28
7	2. 27
8	2. 26 √
9	2. 25
10	2. 27
11	2. 28
12	2. 29
13	2. 27
14	2. 28 √
15	2. 29
16	2. 27
17	2. 28
18	2. 27
19	2. 29
20	2. 30 √
21	2. 30
22	2. 31 √
23	1. 90
24	2. 30
xxx	xxxx

(*a*) Display board recorder makes check mark opposite data at which piece was fired.
(*b*) Azimuth checker records data at which piece was actually laid.

Form 12.

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POINTING CHECKER'S RECORD

Gun No. 1

1 Shot No.	2 Deflection used
T–1	2. 29
T–3	2. 25
1	2. 21
2	2. 16
3	2. 16
4	2. 10
5	2. 15
6	2. 16

Form 10a.

POINTING CHECKER'S RECORD

Gun No. 2

1 Shot No.	2 Deflection used
T–2	2. 25
T–4	2. 29
1	2. 31
2	2. 36
3	2. 36
4	2. 32
5	2. 35
6	2. 35
7	2. 35
8	2. 35

Form 12a.

BATTERY COMMANDER'S CHECK SHEET

Errors in transmission and application			Errors in operation					Individual responsible
1	2	3	4	5	6	7	8	9
Time	Record sheets No.	Amount of error	Range S. F. point (5)	Azimuth S. F. point (5)	Range correction board (6)	Range percentage corrector (7)	Deflection board (8)	
4	1–2	+. 63	10, 650 10, 650 0	258. 70 258. 68 +. 02	2. 90 2. 90 0	9, 940 9, 940 0	2. 29 2. 29 0	B′ arm setter (+0. 63)
7	------	------	10, 680 10, 670 +10	257. 19 257. 17 +. 02	2. 90 2. 90 0	9, 970 9, 960 +10	2. 27 2. 28 −. 01	
11	------	------	10, 650 10, 680 −30	255. 14 255. 16 −. 02	2. 90 2. 90 0	9, 940 9, 950 −10	2. 28 2. 29 −. 01	Plotter −30 yards
19	------	------	10, 650 10, 660 −20	251. 14 251. 14 0	2. 90 2. 90 0	9, 870 9, 860 +10	2. 29 2. 29 0	

Form 13.

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SPOTTING OBSERVER'S RECORD

S′

1 Shot No.	2 Deviation (2–16)
T–1	2. 95
T–2	3. 10
T–3	2. 95
T–4	3. 10
1	2. 90
2	3. 20
3	3. 00
4	3. 05
5	2. 95
6	2 85
7	2. 95
8	3. 05
9	3. 00
10	3. 00
11	3. 00
12	3. 00
13	3. 05

Form 14.

SPOTTING OBSERVER'S RECORD

S′

1 Shot No.	2 Deviation (2–16)
T–1	2. 80
T–2	3. 25
T–3	3. 10
T–4	2. 40
1	3. 00
2	3. 00
3	3. 00
4	3. 00
5	3. 10
6	2. 60
7	2. 55
8	3. 45
9	2. 80
10	2. 85
11	2. 55
12	3. 05
13	2. 40

Form 15.

SPOTTING BOARD RECORD

1 Shot No.	2 S′ deviation (2–14)	3 S″ deviation (2–15)	4 Range deviation (3–17) reference No.
T–1	2. 95	2. 80	2. 91
T–2	3. 10	3. 25	3. 08
T–3	2. 95	3. 10	3. 09
T–4	3. 10	2. 40	3. 17
1	2. 90	3. 00	3. 08
2	3. 20	3. 00	2. 89
3	3. 00	3. 00	3. 00
4	3. 05	3. 00	3. 00
5	2. 95	3. 10	3. 10
6	2. 85	2. 60	2. 85
7	2. 95	2. 55	2. 70
8	3. 05	3. 45	3. 29
9	3. 00	2. 80	2. 85
10	3. 00	2. 85	2. 88
11	3. 00	2. 55	2. 66
12	3. 00	3. 05	3. 04
13	3. 05	2. 40	2. 52

Form 16.

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BATTERY COMMANDER'S ADJUSTMENT RECORD

1 Shot No.	2 Piece fired	3 Range deviation (4–16) reference No.	4 Range correction ordered (3–7) reference No.
T–1	1	2. 91	
T–2	2	3. 08	
T–3	1	3. 09	
T–4	2	3. 17	2. 94
1	1	3. 08	
2	2	2. 89	
3	1	3. 00	
4	2	3. 00	
5	1	3. 10	
6	2	2. 85	
7	2	2. 70	
8	1	3. 29	
9	2	2. 85	
10	1	2. 88	
11	2	2. 66	
12	1	3. 04	
13	2	2. 52	

Form 17.

AZIMUTH OF TARGET AT INSTANT OF IMPACT

1 Shot No.	2 Azimuth
T–1	259. 95
T–2	258. 41
T–3	256. 32
T–4	255. 22
1	252. 97
2	252. 97
3	251. 16
4	251. 16
5	247. 81
6	247. 81
7	238. 42
8	238. 98
9	237. 59
10	237. 15
11	236. 70
12	236. 25
13	235. 85

----------,
(Grade and organization)
Observer.

Form 18.

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RECORD OF LATERAL DEVIATIONS

Shot No.	Deviation, hundredths of degree		Observer to target	Deviation (yards)		Remarks
	Left	Right	Range	Left	Right	
T–1		0. 02	10, 640		3. 7	
T–2	0. 04		10, 640	7. 4		
T–3		. 02	10, 640		3. 7	
T–4	. 02		10, 650	3. 7		
1		. 03	10, 680		5. 6	
2	. 05		10, 680	9. 4		
3	Line		10, 700			Target destroyed.
4	. 02		10, 700	3. 7		
5		. 01	10, 790		1. 9	On new target; no loss of time.
6		. 04	10, 790		7. 5	
7	. 03		11, 480	6. 0		
8		. 03	11, 530		6. 0	
9	Line		11, 580			
10	Line		11, 620			
11		. 02	11, 660		4. 1	
12	Line		11, 720			
13	Line		11, 760			

----------, ----------,
(Grade and organization)
Observer.

Approved:

----------,
Group commander.

NOTE.—If lateral observations are in degrees and hundredths, compute the deviations in yards by the following formula:

$$D=d\times\frac{R}{100}\times 1.75$$

where

D=deviation in yards.

d=deviation in degrees and hundredths.

R=actual range to the nearest hundred yards.

If lateral observations are in mils, the formula becomes—

$$D=d\times\frac{R}{100}\times 0.098.$$

Form 19.

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RECORD OF RANGE DEVIATIONS

Battery _____ Fort _____ Date _____

Shot No.	Time			From camera			Camera deviation of splash towline length (VT) times sine of (5) (over +; short −)	From range rake—average of observer's readings TVS
(1)	(2)			(3)	(4)	(5)	(6)	(7)
	H.	M.	S.	MT′ α	MS′ δ	(4) − (3) TVS		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Length of towline _____ yards.

Instructions: Angles α and δ will be measured by estimation to the closest one-tenth of a degree using the film scale. If the target was towed from right to left, the signs of α and δ, respectively, are positive if to the left of M; negative if to the right. For target towed right to left, use opposite sign.

_____,
Tug officer.

Approved:

_____,
Group commander.

Form 20.

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TIMEKEEPER'S RECORD

Shot No.	Time — Piece number 1 H.	1 M.	1 S.	2 H.	2 M.	2 S.	3 H.	3 M.	3 S.	4 H.	4 M.	4 S.
Trial:												
1	11	15	44									
2				11	17	15						
3	11	19	18									
4				11	20	20						
Record:												
Commence firing	11	22	22	11	22	22						
1–2	11	23	23	11	23	27						
3–4	11	24	24	11	24	33						
5–6	11	26	59	11	27	03						
Cease firing	11	28	00	11	28	00						
7				11	37	17						
8	11	37	45									
9				11	38	18						
10	11	38	45									
11				11	39	17						
12	11	39	46									
13				11	40	20						
In action R. F		17	24		17	58						
Less time out		10	17		10	17						
Cor. time R. F												

Cause of delay	Time out allowed — Piece number 1 H.	1 M.	1 S.	2 H.	2 M.	2 S.	3 H.	3 M.	3 S.	4 H.	4 M.	4 S.
Adjustment of fire	0	1	00	0	1	00						
Field of fire unsafe	0	9	17	0	9	17						
Relay	0	0	0									
Total R. F	0	10	17	0	10	17						

Total corrected time R. F. $= \frac{7'07'' + 7'41''}{2} = 7'24'' = 444''$. Time per shot per gun R. F. $= 427'' + 461'' = 68.3$ sec.

AM ~~PM~~

Examined and approved:

----------,
(Grade and organization)

----------,
(Grade and organization)
Timekeeper.

Form 21.

Original from UNIVERSITY OF CALIFORNIA

REPORT OF SUBCALIBER FIRING

Harbor defenses of_____, Fort_____. Organization_____. Date_____

Battery	Number of pieces equipped with subcaliber guns	Subcaliber gun used—				
		1-pounder, caliber .30, 2.95, 75-mm, M1916	Registered number	Number of times previously fired	Number of shots fired in this practice	Serial number of the last shot this practice

Give any information of interest concerning the action of the ammunition_____

_____

_____

_____,

_____,
(Grade and organization)

Battery commander.

_____,

_____,
(Grade and organization)

Commanding harbor defenses.

NOTE.—This form will be submitted through ordnance channels to the Chief of Ordnance at the conclusion of subcaliber practice.

Form 22.

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TABULAR ANALYSIS

Battery *Eustis;* **Organization** *Battery F, 52d C. A. (Ry.);* **Place** *Fort Monroe, Va.;* **Date** *November 6, 1940.*
Length of base line *3,235.6 yards;* **Distance and azimuth from primary station to battery** *DP____O* (*B′ and DP are coincident*).

Graphical analysis	Line No.	Shot No.	T-1	T-2	T-3	T-4	1	2	3	4	5	6	7	8	9	10	11	12	13
		Gun No.	1	2	1	2	1	2	1	2	1	2	2	1	2	1	2	1	2
	1	Zone																	
	2	Actual range to target at instant of splash (from replot).	10,640	10,640	10,640	10,650	10,680	10,680	10,700	10,700	10,790	10,790	11,480	11,530	11,580	11,620	11,660	11,720	11,760
	3	Ballistic correction which should have been applied (reoperation of range correction board).	−160	−160	−160	−160	−160	−160	−140	−140	−130	−130	−140	−140	−140	−140	−140	−130	−130
	4	Line 2+line 3	10,480	10,480	10,480	10,490	10,520	10,520	10,560	10,560	10,660	10,660	11,340	11,390	11,440	11,480	11,520	11,590	11,630
	5	B. C. correction actually ordered (B. C. record).	0	0	0	0	−60	−60	−60	−60	−70	−70	−70	−70	−70	−70	−70	−70	−70
	6	Range at which piece should have been laid (4+5).	10,480	10,480	10,480	10,490	10,460	10,460	10,500	10,500	10,590	10,590	11,270	11,320	11,370	11,410	11,450	11,520	11,560
	7	Range at which piece was actually laid (elevation checker's record).	10,530	10,560	10,530	10,490	10,460	10,460	10,510	10,510	10,620	10,620	11,340	11,380	11,440	11,460	11,520	11,550	11,630
Graph of errors	8	Personnel errors exclusive of spotting errors and errors made in ordering B. C. correction (7−6).	+50	+80	+50	0	0	0	+10	+10	+30	+30	+70	+60	+70	+50	+70	+30	+70
○	9	Range deviation of splash (form 26).	−88	+38	+88	−435	+42	−190	0	−89	+94	−122	−258	+288	−164	−166	−329	+46	−604
●	9a	Deviation of salvo center of impact (when spotting is by salvo) (from line 9).																	
	10	Repeat line 5	0	0	0	0	−60	−60	−60	−60	−70	−70	−70	−70	−70	−70	−70	−70	−70
	11	Deviation stripped of B. C. corrections (9−10).	−88	+38	+88	−435	+102	−130	+60	−29	+164	−52	−188	+358	−94	−96	−259	+116	−534
	12	Repeat line 8	+50	+80	+50	0	0	0	+10	+10	+30	+30	+70	+60	+70	+50	+70	+30	+70

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TABULAR ANALYSIS—Continued

Graphical analysis	Line No.	Shot No.	T-1	T-2	T-3	T-4	1	2	3	4	5	6	7	8	9	10	11	12	13
		Gun No.	1	2	1	2	1	2	1	2	1	2	2	1	2	1	2	1	2
	13	Deviation stripped of B. C. correction and personnel errors (11-12).	−138	−42	+38	−435	+102	−130	+50	−39	+134	−82	−258	+298	−164	−146	−329	+86	−604
	14	Center of impact under conditions of line 13, excluding wild shots.	−144	−144	−144	−144	−83	−83	−83	−83	−83	−83	−83	−83	−83	−83	−83	−83	−83
	15	Armament error (13-14)	+6	+102	+182	−291	+185	−47	+133	+44	+217	+1	−175	+381	−81	−63	−246	+169	−521
⊘	16	Deviation reported by spotting section (B. C. record).	−96	+85	+96	+181	+85	−117	0	0	+108	−162	−344	+334	−174	−139	−396	+47	−564

	Trial	Record
Average armament error (arithmetical mean of entries in line 15, excluding wild shots)	145	174
DAPE (0.845×average armament error)	123	147
Average actual range (arithmetical mean of entries in line 2)	10,643	11,207

NOTE.—If range or depression position finder was used in the target practice, Form 23a will be submitted.
Form 23.

----------,
Battery commander.

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SUMMARY OF DEPRESSION POSITION FINDER OR RANGE FINDER RESULTS

Battery_____, _____Coast Artillery.
Fort_____
Name of battery_____
Depression position finder:
Type_____
Height of instrument_____
Height of tide_____
Harbor defenses of_____
Date_____
Kind of practice_____
Self-contained range finder:
Type_____
Correction setting (correction wedge dial)_____
_____
Azimuth, from depression position or range finder to battery directing point_____
Range, from depression position or range finder to battery directing point_____

1 Shot or salvo No.	2 D. P. F. or S. C. R. F. range	3 Uncorrected range used [1]	4 True range (horizontal base)	5 Observing error, D. P. F. or S. C. R. F. (col. 2-col. 4)

[1] Column 3 will be filled in when the single station ranges were adjusted (smoothed) by use of a plotting or time-range board.

_____,
C. A., Battery commander.

Form 23a.

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MATÉRIEL AND POWDER REPORT (SEACOAST GUNS)

Fort *Monroe, Va.*
Organization *Battery F, 52d* Coast Artillery.
Caliber and model of gun *10-inch M1888.*
Date of practice *November 6, 1940.*

Harbor Defenses *Chesapeake Bay.*
Name of Battery *Eustis.*
Kind and model of carriage *DC M1896.*
Kind of practice *Service* (Day) (Night).

Tactical number of piece	1	2		
Zone				
Number of shots	8	9		
Average actual range	10,400	11,045		
Assumed MV, 70° (1)	2,429	2,426		
Deviation of CI (2) (yards)	+53	−231		
Deviation in f/s MV	+8	−33		
Developed MV, 70°	2,437	2,393		

(1) The assumed MV for each gun is determined by subtracting the calibration correction from the assumed MV of the reference piece.
(2) The algebraic mean of the entries on line 13, Form 23, for each gun separately.
Actual range—maximum *11,760;* minimum *10,640.*
Average azimuth (zero south)—T. S. *2,550;* R. S. *2,470.*
Developed armament probable error: T. S. *123;* R. S. *147.*
Average lateral deviation (yards): T. S. *5;* R. S. *3.*

METEOROLOGICAL DATA (indicate zone(s) used)		
	MFM MFM	
	30059	
	0011602	
	1022402	
	2042302	
	3021602x	
Time taken	10:45 A. M	
Time used	11:15 A. M	
Tide	+2 feet	
Air temperature	72°	

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POWDER

Lot *X551*. Year *1917*. Mfr. initials *DP–P*.
Weight of charge:
Zone *158*, pounds *11* ounces.
Zone ___, pounds __ ounces.
Type of charge *Base Increment*. Normal pressure *55,000 lbs.*
Temperature of powder *64*. Normal MV, 70° *2,400 f/s*.

PROJECTILE

Lot No. *7345*. Rotating band *Broad*.
Weight *510*.

PRIMERS

Lot No. *Unknown*. Mfr. initials *ASMP*.
Kind *Friction*. How fired *Lanyard*.
Number of failures *None*.

RECAPITULATION OF PRESSURES

Tactical No. of piece	Number of shots	First gage	Second gage	Average
1	2 T. S.	35,800	25,600	35,800
1	2 T. S.	34,400	33,600	34,000

CARRIAGE

Valve settings—Disappearing carriages

	Gun No. 1	Gun No. 2
Throttling	0.25	1.60
Buffer		

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Tactical No. of piece	Reg. No. of piece	Initials of manufacturer	Reg. No. of carriage	Initials of manufacturer	Serial number of shots	
					Before practice	After practice
1	24	Beth. S. Co	48	N. T. W. Co	405	413
2	1	Beth. S. Co	63	S. F. and M. Co	382	391

RECORD OF SUBCALIBER PRACTICES

Date	10-26-35	10-28-35	10-29-35	10-31-35					Total shots
Shots fired	20	20	30	40					110

NOTE.—When abbreviated report only is required, the developed armament probable error and the developed muzzle velocity may be omitted.

Form 25.

----------,
C. A., Battery commander.

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WORK SHEET FOR DETERMINATION OF RANGE DEVIATIONS

Line											
1	Shot number	1	2	3	4	5	6	7	8	9	10
2	Angle *VTG* from replot. Sign always plus	+	+	+	+	+	+	+	+	+	+
3	Angle *TVS* from tug officer's report (over +; short−)										
4	Line (2) minus line (3)	+	+	+	+	+	+	+	+	+	+
5	Obtain from table V using the values of line (4) as arguments. Plus if line (4) is less than 90°; otherwise minus										
6	Lateral deviation (yards). If target was towed right to left a right deviation is plus; left deviation minus. Use opposite signs if target was towed left-to right										
7	Algebraic product of values on lines (5) and (6)										
8	Camera deviation of splash from column 6, tug officer's report (over +; short −)										
9	Algebraic sum of values on lines (7) and (8)										
10	Obtain from table VI using the values of line (4) as arguments. Always plus	+	+	+	+	+	+	+	+	+	+
11	Range deviation of splash. Line (9) divided by line (10)										

Instructions: First fill in the data on lines (2), (3), (6), and (8); then complete lines (4), (5), and (10); finally accomplishing the computations on lines (7), (9), and (11). Values only to the closest yard and whole degree will be used on this form.

Form 26.

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b. Tables.—(1) *List.*

	Table
Probable errors (range and direction) seacoast armament	I
Probability factors	II
Range limits of danger space	III
Lateral limits of danger space	IV
Values of cos (*VTG-TVS*) for computation of range deviations (line 5, Form 26)	V
Values of sin (*VTG-TVS*) for computation of range deviations (line 10, Form 26)	VI

(2) *Models.*

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TABLE I

[Probable errors in yards]

3-inch to 12-inch guns

Range [1]	3-inch 15-lb.		6-inch M1900-03-05 90- and 108-lb.		6-inch M1897-1908 90- and 108-lb.		155-mm 95-lb. normal charge		155-mm 95-lb. supercharge		8-inch 200- and 260-lb.		10-inch 510- and 617-lb.		12-inch 870-lb. stacked		12-inch 900-, 975-, 1,070-lb. nonstacked charges		12-inch 900-, 975-, 1,070-lb. stacked charges	
	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction
3,000	26	2	23	2	23	2	23	-----	-----	-----	24	3	25	1	25	1	32	1	27	1
4,000	30	3	25	3	26	3	25	-----	-----	-----	25	3	28	2	28	1	36	1	30	1
5,000	36	5	28	3	30	3	27	3	-----	-----	29	4	32	3	31	2	41	2	33	2
6,000	45	6	31	4	37	4	30	3	-----	-----	34	5	37	3	34	2	46	2	36	2
7,000	56	8	35	4	43	4	34	4	-----	-----	39	6	44	4	38	3	51	3	40	3
8,000	66	10	39	5	53	5	38	5	-----	-----	45	7	51	5	41	4	57	4	43	4
9,000	77	12	43	6	62	6	43	6	-----	-----	52	9	58	6	45	5	62	5	47	5
10,000	89	14	48	7	72	7	49	7	41	9	59	12	67	8	49	6	68	6	51	6
11,000	104	17	54	8	84	8	55	8	45	9	67	14	77	9	54	7	74	7	56	7
12,000	121	22	60	9	97	9	62	9	50	10	76	15	87	11	59	8	80	8	60	8
13,000	-----	-----	67	10	112	10	69	10	55	10	86	17	99	12	65	9	87	9	65	9
14,000	-----	-----	74	11	127	11	76	11	60	11	97	19	111	14	70	11	94	11	70	11
15,000	-----	-----	82	12	143	12	85	11	66	11	108	22	124	17	76	12	101	12	75	12
16,000	-----	-----	90	14	160	14	-----	12	72	12	121	25	138	20	82	14	108	14	80	14
17,000	-----	-----	-----	-----	-----	-----	-----	13	80	13	133	28	153	23	89	15	116	15	86	15
18,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	14	146	32	-----	-----	96	17	124	17	92	17
19,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	16	161	36	-----	-----	103	19	132	19	98	19
20,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	18	176	40	-----	-----	111	21	141	21	104	21
21,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	192	44	-----	-----	119	24	150	24	110	24
22,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	208	49	-----	-----	128	27	159	27	117	27
23,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	225	54	-----	-----	136	30	168	30	125	30
24,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	145	32	177	32	132	32
25,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	154	35	187	35	140	35
26,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	164	38	197	38	147	38
27,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	207	41	155	41
28,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	218	44	163	44
29,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	228	47	172	47
30,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	239	51	181	51

[1] The range used in entering this table is the mean actual range to the nearest 100 yards.

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14- and 16-inch guns and 16-inch howitzers

Range [1]	14-inch						16-inch		16-inch howitzers	
	M1909–M1910		M1907		14-inch railway M1920		2,100-, 2,340-lb., all charges		Range	Direction
	1,400-, 1,500-, 1,660-lb.		1,400-, 1,560-, 1,660-lb.		1,215-, 1,400-, 1,560-, 1,660-lb.					
	Range	Direction	Range	Direction	Range	Direction	Range	Direction		
10,000	51	5	34	5	46	11	36	4	35	9
11,000	56	6	36	6	50	11	38	5	37	9
12,000	62	6	38	6	55	11	40	5	38	10
13,000	69	6	40	6	60	11	43	6	39	11
14,000	76	7	42	7	65	12	46	6	40	12
15,000	84	8	44	8	70	12	49	7	40	12
16,000	92	9	47	9	76	12	52	7	41	13
17,000	101	9	49	9	82	13	55	8	41	13
18,000	110	9	52	9	89	13	58	8	41	14
19,000	119	10	55	10	96	13	62	9	41	15
20,000	129	10	58	10	103	13	66	9	42	15
21,000	139	11	61	11	110	14	70	10	42	16
22,000	150	11	64	11	118	14	74	10	42	16
23,000	161	12	67	12	126	14	78	11	43	17
24,000					134	15	82	11	43	17
25,000					143	15	86	12	44	18
26,000					151	15	91	12		
27,000					160	16	96	13		
28,000					170	16	100	14		
29,000					180	17	105	15		
30,000					190	18	110	16		
31,000					201	20	116	17		
32,000					212	22	121	18		
33,000					223	24	127	20		
34,000					234	26	132	21		
35,000					246	28	138	23		

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36,000					258	30	144	24		
37,000					270	33	150	26		
38,000					282	36	156	28		
39,000					295	39	163	30		
40,000					308	43	169	32		

[1] The range used in entering this table is the mean actual range to the nearest 100 yards.

12-inch mortars

Zone	Aliquot part charge						Base increment charge					
	700-lb.		824-lb.		1,046-lb.		700-lb.		824-lb.		1,046-lb.	
	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction	Range	Direction
III	24	10			28	10					39	10
IV	30	10			30	10					41	10
V	36	10			32	10					43	11
VI	42	11			34	10					45	11
VII	48	11			36	11					47	12
VIII	52	12	52	12					61	12		
VIII–A											55	13
VIII–B							60	13				
IX							66	14				
X	56	14					80	15				
X–A	86	26										

NOTE.—As shown in the above table, the same probable error will be used throughout the entire zone regardless of the elevations used. This procedure is adopted for purposes of simplification.

TABLE I is published for scoring purposes only. The range probable error values listed were based on a study of the results of 10 years' target practices.

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TABLE II.—*Probability factors*

Table II is divided into two parts as follows:

a. When F is less than 2.00.

b. When F is greater than 2.00.

In using this table do not interpolate. For values of F less than 2.00, enter the table with the nearest even value of F to two decimal places and obtain the probability of hitting. For values of F 2.00 or greater, enter the table with the nearest even value of F to one decimal place.

Example: F=0.085, use F=0.08; F=2,034, use F=2.0.

$F<2.00$

Factor	0.00	0.02	0.04	0.06	0.08
0.0	0.00	0.01	0.02	0.03	0.04
.1	.05	.06	.07	.09	.10
.2	.11	.12	.13	.14	.15
.3	.16	.17	.18	.19	.20
.4	.21	.22	.23	.24	.25
.5	.26	.27	.28	.29	.30
.6	.31	.32	.33	.34	.35
.7	.36	.37	.38	.39	.40
.8	.41	.42	.43	.44	.45
.9	.46	.47	.48	.49	.49
1.0	.50	.51	.52	.53	.54
1.1	.54	.55	.56	.57	.58
1.2	.58	.59	.60	.61	.62
1.3	.62	.63	.64	.65	.66
1.4	.66	.67	.68	.68	.69
1.5	.69	.70	.71	.71	.72
1.6	.72	.73	.74	.74	.75
1.7	.75	.76	.77	.77	.78
1.8	.78	.79	.79	.80	.80
1.9	.80	.81	.81	.82	.82

$F>2.00$

Factor	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
2	0.82	0.84	0.86	0.88	0.90	0.91	0.92	0.93	0.94	0.95
3	.96	.96	.97	.97	.98	.98	.99	.99	.99	.99
4	.99	.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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TABLE III.—*Range limits of danger space in yards, over or short, from pyramidal target*

Angle of fall		Destroyer target		Transport target		Battleship target		Angle of fall		Destroyer target		Transport target		Battleship target	
		Broadside	Bow-on	Broadside	Bow-on	Broadside	Bow-on			Broadside	Bow-on	Broadside	Bow-on	Broadside	Bow-on
°	′							°	′						
4	00	55	76	110	146	116	151	10	00	25	54	50	103	56	108
4	10	53	74	106	144	112	149	10	20	24	54	48	102	54	107
4	20	51	73	102	141	108	146	10	40	24	53	47	102	53	107
4	30	49	72	99	138	105	143	11	00	23	53	46	101	52	106
4	40	48	71	96	136	102	141	11	20	22	52	45	100	51	105
4	50	46	70	93	134	99	139	11	40	22	52	44	99	50	104
5	00	45	69	90	132	96	137	12	00	21	52	43	99	49	104
5	10	44	68	87	130	93	135	13	00	20	51	40	97	46	102
5	20	43	67	85	129	91	134	14	00	19	50	38	95	44	100
5	30	41	66	83	127	89	132	15	00	18	49	36	94	42	99
5	40	40	65	81	125	86	130	16	00	17	49	34	92	40	97
5	50	39	64	79	124	84	129	17	00	16	48	33	91	39	96
6	00	38	64	77	123	83	127	18	00	16	48	32	90	38	95
6	10	37	63	75	121	81	126	19	00	15	47	30	90	36	95
6	20	37	63	73	120	79	125	20	00	15	47	29	89	35	94
6	30	36	62	71	119	77	124	22	00	14	46	27	87	33	92
6	40	35	61	70	118	76	123	24	00	13	46	26	86	32	91
6	50	34	61	69	117	74	122	26	00	12	45	24	85	30	90
7	00	34	60	67	116	73	121	28	00	12	45	23	84	29	89
7	10	33	60	66	115	72	120	30	00	11	44	22	84	28	89
7	20	32	59	64	114	70	119	35	00	10	44	20	82	26	87
7	30	32	59	63	113	69	118	40	00	9	43	18	81	24	86
7	40	31	59	62	112	68	117	45	00	8	42	17	80	23	85
7	50	30	58	61	111	67	116	50	00	8	42	16	79	22	84
8	00	30	58	60	111	66	116	55	00	7	42	15	79	21	84
8	20	29	57	58	109	64	114	60	00	7	41	14	78	20	83
8	40	28	56	56	108	62	113	65	00	7	41	13	77	19	82
9	00	27	56	54	107	60	112	70	00	6	41	13	77	19	82
9	20	26	55	53	105	59	110								
9	40	26	55	51	104	57	109	Formula		$5+3.5 \cot \omega.$	$40+2.5 \cot \omega.$	$10+7 \cot \omega.$	$75+5 \cot \omega.$	$16+7 \cot \omega.$	$80+5 \cot \omega.$
10	00	25	54	50	103	56	108								

NOTE.—Since each value in this table is one half the corresponding danger space, the table will be used in computing the probability factor. (See fig. 6.) In using the above table *do not interpolate*. First find the angle of fall for the nearest hundred yards of mean actual range for all record shots. Enter the table with the argument nearest the angle of fall as thus determined and obtain one half of the range danger space for the particular target considered.

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TABLE IV.—*Lateral limits of danger space, in yards, right or left from pyramidal target*

Kind	Bow-on (yds.)	Broadside (yds.)
Battleship	16	80
Transport	10	75
Destroyer	5	40

TABLE V.—*Values of cos (VTG–TVS) for computation of range deviations* (line 6, Form 26)

Line 4, Form 26 (read down)	0	1	2	3	4	5	6	7	8	9	10	Line 4, Form 26 (read up)
0	1.00	1. 00	1. 00	1. 00	1. 00	1. 00	0. 99	0. 99	0. 99	0. 99	0. 98	170
10	.98	. 98	. 98	. 97	. 97	. 97	. 96	. 96	. 95	. 95	. 94	160
20	.94	. 93	. 93	. 92	. 91	. 91	. 90	. 89	. 88	. 87	. 87	150
30	.87	. 86	. 85	. 84	. 83	. 82	. 81	. 80	. 79	. 78	. 77	140
40	.77	. 75	. 74	. 73	. 72	. 71	. 69	. 68	. 67	. 66	. 64	130
50	.64	. 63	. 62	. 60	. 59	. 57	. 56	. 54	. 53	. 52	. 50	120
60	.50	. 48	. 47	. 45	. 44	. 42	. 41	. 39	. 37	. 36	. 34	110
70	.34	. 33	. 31	. 29	. 28	. 26	. 24	. 23	. 21	. 19	. 17	100
80	.17	. 16	. 14	. 12	. 10	. 09	. 07	. 05	. 03	. 02	0	90
	10	9	8	7	6	5	4	3	2	1	0	

NOTE.—In using the above table *do not interpolate.*

TABLE VI.—*Values of sin (VTG–TVS) for computation of range deviations* (line 10, Form 26)

Line 4, Form 26 (read down)	0	1	2	3	4	5	6	7	8	9	10	Line 4, Form 26 (read up)
0	0	0. 02	0. 03	0. 05	0. 07	0. 09	0. 10	0. 12	0. 14	0. 16	0. 17	170
10	.17	. 19	. 21	. 23	. 24	. 26	. 28	. 29	. 31	. 33	. 34	160
20	.34	. 36	. 37	. 39	. 41	. 42	. 44	. 45	. 47	. 48	. 50	150
30	.50	. 52	. 53	. 54	. 56	. 57	. 59	. 60	. 62	. 63	. 64	140
40	.64	. 66	. 67	. 68	. 69	. 71	. 72	. 73	. 74	. 75	. 77	130
50	.77	. 78	. 79	. 80	. 81	. 82	. 83	. 84	. 85	. 86	. 87	120
60	.87	. 87	. 88	. 89	. 90	. 91	. 91	. 92	. 93	. 93	. 94	110
70	.94	. 95	. 95	. 96	. 96	. 97	. 97	. 97	. 98	. 98	. 98	100
80	.98	. 99	. 99	. 99	. 99	1. 00	1. 00	1. 00	1. 00	1. 00	1. 00	90
	10	9	8	7	6	5	4	3	2	1	0	

NOTE.—In using the above table *do not interpolate.*

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CHAPTER 3

SUBMARINE MINES

Paragraphs
SECTION I. Conduct of practice 35–43
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SECTION I

CONDUCT OF PRACTICE

General 35
Preliminary practice 36
Mine service practice 37
Test phase 38
Firing phase 39
Time of planting 40
Determination of hits 41
Special safety precautions 42
Officials and their duties 43

35. General.—This section contains provisions applying to submarine mine practices only; the provisions of chapter 1 also apply. In addition, supplemental instructions covering scoring and other phases of submarine mine practices will be issued annually by the War Department before the beginning of each mine practice season.

36. Preliminary practice.—Two or more preliminary practices, including the firing of submines by observation, will be conducted under the same general procedure as for service practices. In the absence of special instructions to the contrary, No. 32 mine cases with at least 1,000-pound anchors will be used as control units for all submines.

37. Mine service practice.—*a. Scope.*—The mine service practice will consist of two phases: test and firing. The test phase will include the planting of two groups of mines and the testing of these groups over an extended period of time. The firing phase will include the following:

(1) The planting of a group of mines.

(2) The firing of two mines of this group by observation at a target towed across the line of mines.

(3) The firing of a third mine of this group by selection as a test of the ability of the mine battery personnel to assemble and plant

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mines which will withstand the shock of detonation of an adjacent mine fired with a service charge.

b. Mine and shore cables.—(1) Class B one-conductor cable will be used for mine cables as far as practicable. If the armor of the class B cable on hand is not in a fair condition or better, or if the insulation resistance of the cable when wet does not exceed 2½ megohms per 1,000 feet, the oldest class A one-conductor cable may be cut and used for mine cable figures of eight.

(2) The shore cable will consist of the oldest single conductor cable on hand which is not exempted by the requirement for rotation of equipment due to recent use.

c. Rotation of equipment.—(1) In order to insure the serviceability of all equipment for a mine project, a program will be inaugurated for the rotation in use of all submarine mine equipment except that which is specifically exempted below. The equipment used during the firing phase will be different from that used during the test phase, and both sets will be different from any used in previous years until the complete stock on hand for a given item has been used in rotation, after which units longest out of service will be used. Mine swivels will be employed in planting both the test and firing phase groups in the same proportion as the percentage of the project for which swivels have been supplied.

(2) In order to avoid the unnecessary expenditure of equipment, mine cables, mooring ropes, raising ropes, buoy ropes, measuring lines, and heaving lines are exempted from the foregoing requirement for rotation of equipment.

d. Operation of power-generating equipment.—During the submarine mine practice, all power for the operation of the mine control system and casemate equipment will be generated by the gasoline or Diesel electric power equipment supplied for use with the submarine mine system. In case, for any reason, it is impracticable to comply with this provision, a complete statement of the reasons therefor will be included in the narrative report.

e. Control buoys.—For each group planted, three control buoys will be planted prior to the commencement of planting, as follows:

One to mark the intended position of No. 10 mine.
One to define the line of mines to the left of No. 10 mine.
One to define the line of mines to the right of No. 10 mine.

Of these three marking buoys, the last two may be at any desired distance to the left and right, respectively, of the marking buoy for No. 10 mine. and it is not essential that the three buoys be exactly in a straight line.

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f. Target and towline.—For firing, any suitable target will be used. The length of towline between towing vessel and target will be not less than 300 yards.

g. Intervals between mines.—The planting intervals between mines will be 100 feet.

h. Replanting of mines.—During planting operations and before the distribution box has been lowered, mines which have been planted may be moved or replanted, providing the time allowed for planting is not exceeded.

i. State of tide.—The mine planter commander will be allowed to choose the state of tide at which to begin planting the mine practice groups.

j. Plotting of mines.—As each mine is planted it will be plotted, and as soon as the plot is verified by the plotting room official the mine position will be entered in ink.

k. Submergence.—The submergence of each mine will be taken as prescribed in TM 4–220 (now published as TM 2160–20). After taking the submergence, and during or immediately after marking the mine for plotting, the mine yawl crews will take and report the sounding of the mine. The submergence as read will be referred to mean low water, and the submergence which would exist at mean low water will be recorded.

l. Responsibility for conduct of practice.—The responsibility for the conduct of the submarine mine practice rests with the battery commander, except for those operations specifically delegated to the mine planter commander in accordance with the provisions of TM 4–220 (now published as TM 2160–20).

m. Records.—A record will be kept of the following occurrences in both the test and firing phases:

(1) Each time the distribution box is raised after it has been planted initially.

(2) Each time the shore cable is repaired except when such repairs are made at the distribution box.

(3) Each time a mine is raised after the distribution box has been planted initially.

38. Test phase.—*a.* The test phase will be conducted as follows: Two complete groups of 19 unloaded mines each will be planted near the planned location for the wartime field. The two groups will be planted approximately on a line with an interval of about 100 feet between mine No. 1 of group II and mine No. 19 of group I.

b. Each mine will be completely equipped with a firing device, but with a ½-ampere electric fuze connected across the detonator leads in lieu of detonators.

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c. Supervisory equipment will be operated for a period of 10 hours each day during a 14-day period. The 2-week test period will commence at the time the distribution box for the second group is planted initially. In case failures of matériel occur which render the group as a whole inoperative to the extent that the prescribed daily tests cannot be made, the test phase will be extended to provide a total of 14 days of tests and operation.

d. Each mine of the group will be tested electrically once daily.

e. The maintenance of synchronism of the casemate and distribution box selectors (M2A1 and M2A2 systems only) will be tested during a period of 1 hour each day.

f. A submergence of 6 feet at mean low water is prescribed for the test phase.

g. Five mines of each of the test groups will be bumped by a boat to simulate contact firing at any time between the eighth and twelfth days of the test period. The operation of bumping a given mine will not be repeated if on the first attempt the vessel actually strikes or comes in contact with the mine. The number of the mine bumped and the time of bumping will be recorded on the bumping vessel. The number of the mine signaling and the time of signaling will be recorded in the casemate. A comparison of the two records will be made to determine whether the correct mine responded to the bump and whether there was any excessive delay. Firing power will not be applied to the system.

h. At the end of the prescribed period the equipment will be taken up and disassembled for check purposes. Special note will be made of the electric fuses in the detonator circuits to determine whether any are blown.

i. Operations during the test phase will include the picking up of any two mines numbered 2 to 6 or 14 to 18, inclusive, of the test groups that are not adjacent to one another and replacing them by two other mines. The picking up and replanting will be accomplished at any time between the eighth and twelfth days, inclusive, of the phase. The positions of the replanted mines will be shown on the plot of the mine field. This operation is in addition to the replacing of any mines because of electrical faults and for which a penalty is assessed. Mine buoys and buoy ropes will not be used in picking up the mines.

39. Firing phase.—*a.* A group of 19 mines will be planted, including 6 loaded and fused mines. Five No. 32 mine cases containing 150 pounds of trotol each and one case of the size provided in the local project containing 300 pounds of trotol will be used for the

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loaded mines. The cases with 150-pound charges will be planted as Nos. 8 to 12, inclusive, and the other as No. 4. If available, old automatic anchors planted as dead weight anchors will be used with all service loaded mines. Each of the 13 unloaded mines will be equipped with a firing device and with ½-ampere fuses in lieu of detonators.

b. For the firing phase, the normal submergence in feet at mean low water will be determined by subtracting from 20 the mean value of the rise and fall of the tide, except that in no case will a normal submergence of less than 10 feet be used.

c. After plotting the mines and recording the submergences, the mine buoys will be removed.

d. The electrical tests in the firing phase will consist of taking the milliammeter readings of the mine circuits as follows:

(1) Of the 19 mines initially planted, 1 hour after the distribution box has been lowered.

(2) Of the 13 unloaded mines, after firing has been completed.

(3) Of the 13 unloaded mines, 24 and 48 hours, respectively, after the test made under the provisions of (2) above.

e. Firing by observation, using machine operation for M–2 systems, will be conducted on each of two courses of a target towed at random across the line of mines. If any course as actually towed does not intersect the line of mines at an angle greater than 60°, or pass within 20 yards of the plotted position of a loaded and unfired mine, the course will be considered "not a firing course" and firing will be withheld without penalty to the organization. Towing will continue until two firing courses have been run. Failure to fire a mine on a firing course will be counted as a miss.

f. Observations of splashes will be made from the towing vessel and from a vessel anchored in prolongation of the line of mines. Immediately after each mine is fired, the positions of both vessels will be plotted to determine the distance from the observers to the mine. Observation from both vessels will be by camera, but two range rakes on each vessel will also be used so that in case of failure of the camera record the mean of the range rake observations may be used. The position of the material target at the instant of fire will be marked on the plot of the mine field, referring camera or range rake deviations to the plotted position of the mine fired.

g. On completion of firing at a towed target, mine No. 4 will be fired by selection. Thereafter, the remaining loaded mines will be picked up, but the 13 unloaded mines will be permitted to remain planted for 48 hours. No repairs to the mine field will be made

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during this period. At the expiration of this period, the equipment will be taken up and disassembled for check purposes.

40. Time of planting.—*a. Total.*—The total elapsed time of planting will be the time from the throwing of the first heaving line, as the planter passes the distribution box boat to plant No. 10 mine, until the planting officer signifies that the planting has been completed. Normally the completion of planting will coincide with the planting of the last mine; however, the full time allowance may be utilized if desired in moving or replanting mines.

b. Net.—The net planting time is the total elapsed planting time less all authorized deductions for interruptions and delays. Authorized deductions are limited to the following causes:

(1) Man overboard or other accidents to personnel.

(2) Breakdown of mine planter, distribution box boat, or mine yawl.

(3) Delay occasioned by the intention to avoid imperiling life or vessel. Delay caused by entangling a cable or a line of any kind in the propeller of any vessel, however, is not an authorized deduction.

41. Determination of hits.—*a.* The hypothetical target, representing the vulnerable area on the bottom of a capital ship, is a rectangle 50 by 30 yards, with its center at the target and its longer axis coincident with the track of the target.

b. A hit will be scored when a mine is fired if, at the instant of firing, the position of the mine is covered by the area of the hypothetical target, or if the position of the mine is not more than 10 yards distant from the nearest point on the perimeter of the hypothetical target. It is immaterial whether or not the mine fired is the one nearest the target.

c. If any mine other than the one ordered is fired, or if two or more mines are fired on the command, no credit for a hit will be allowed.

42. Special safety precautions.—The following special safety precautions apply during the firing phase:

a. The towing vessel will commence towing the target at a prearranged signal, and as soon as it has passed at a safe distance beyond the loaded mines a red streamer will be hoisted. This will be answered by the hoisting of a red streamer on the shore when directed by the safety officer. No mine will be fired unless both streamers are hoisted.

b. Under no circumstances will any power be applied to the group panel in the casemate until after the distribution box has been planted and word has been received from the safety officer that the field of fire has been cleared of all vessels and is safe. If already

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turned on, power will be turned off the group panel in the casemate promptly on receipt of word that the field of fire is not safe. After firing a mine, a short period will be allowed for the purpose of checking the mine circuits, after which the power will be turned off promptly.

c. The electrical tests prescribed in paragraph 177*h* (testing of assembled compound plugs) and paragraph 208 (testing loaded and assembled mine cases), TM 2160–20, are prohibited. This test will be omitted from the manual when published as TM 4–220.

43. Officials and their duties.—A list of officials of mine service practices together with their duties is given below. These officials will be detailed from another regiment except where manifestly impracticable and assigned by the harbor defense or regimental commander as official observers and assistants to the group commander.

a. Safety officer.—The safety officer has no duties during the test phase. During the firing phase he is responsible for the safety of the field of fire and the towing vessel. When the battery is ready to fire and the field of fire is safe, he will cause a red flag to be displayed at or near the battery commander's station. He will be assisted in his duties by the casemate and planting officials.

b. Plotting room official.—He will witness all plotting and verify and record the data pertaining to the score. After planting is completed he will—

(1) Determine the longitudinal displacement for the positions component of the score, as follows:

(*a*) From the plotted position of the control buoy marking, the intended position of No. 10 mine, draw straight lines to the plotted positions of the other two control buoys.

(*b*) Measure to the scale of the plotting board and record the perpendicular distances from each of the 19 mines in the group to the control lines of mines as established in (*a*) above.

(2) Determine the lateral displacement for the positions component by measuring to the scale of the plotting board the linear distance along the control lines of mines between perpendiculars to the control line drawn through each mine.

c. Casemate official.—The casemate official will witness and record all casemate tests including the inspection of fuses at the end of each phase. During the firing phase he will act as assistant safety officer for the casemate. As such, he will be connected to the safety officer by telephone and will see that no power is applied to the group operating panel or the interrupter panel until word is received from the safety officer that the field of fire is clear. He will be responsible for the strict compliance with the safety precautions listed in paragraph

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42*b*. During bumping operations, he will synchronize his watch with that of the planting official and will record the time that the operating panel signals that a mine has been struck, together with the number of the mine.

d. Planting official.—The planting official will witness all work on the water and record all data pertaining to the score, including the time of planting. In addition to the above, during the firing phase he will act as tug officer. As such, he will supervise the camera and range rake details and act as assistant to the safety officer. During the bumping operations he will synchronize his watch with that of the casemate official and will take station on the bumping or tilting vessel. He will record the time that each mine is first bumped or tilted and the number of the mine.

e. Camera and range rake details.—Camera and range rake details will obtain the deviation of the splash with reference to the material target as for seacoast firings.

SECTION II

SCORE AND REPORTS

	Paragraph
Score	44
Reports of practice	45

44. Score.—The scoring formula together with pertinent elements of the score will be published annually by the War Department for all mine service practices held during each calendar year. In general, the score will be based on—

a. Accuracy of planting with reference to the predetermined line of mines (longitudinal displacement, positions component).

b. Accuracy of planting with reference to distance between mines (lateral displacement, positions component).

c. Accuracy of planting with reference to depth (submergence component).

d. Time required for planting (time component).

e. Functioning of the mine system (test component).

f. Hits on the hypothetical target (hitting component).

45. Reports of practice.—*a. Preparation.*—(1) The following sets of reports will be prepared for submission as indicated:

Set 1 for The Adjutant General.

Set 2 for the battery records.

(2) Each of the above sets will consist of—

One summary of mine service practice (Form M–1).

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One each of the following for each service group planted:
Planter's record (Form M-2).
Casemate record (Form M-3).
Loading room record (Form M-4).
Plotting room record (Form M-5).
The plot, or tracing of the plot, of each mine field planted in service practice.
The battery commander's narrative report. (In the set for The Adjutant General this report will be submitted in duplicate.)

(3) The plot of each mine field will include the following data, entered in ink ((*c*), (*d*), (*e*), and (*f*) below apply to firing phase only):

(*a*) Position of each control buoy.

(*b*) Position of each of the 19 mines.

(*c*) Position of each of the tracks of the two courses used in record fire.

(*d*) Position of the flank observation vessel.

(*e*) Position of the material target at the instant of firing.

(*f*) An outline of the hypothetical target to the scale of the plotting board for each position of the material target required in (*e*) above.

(*g*) Orienting lines from M′ and M″ properly marked.

(*h*) Position of the distribution box.

(*i*) A graphical scale in yards.

(*j*) Legend showing organization and date of planting.

(4) The battery commander's narrative report will contain—

(*a*) A brief description of methods of drill, fire control, or position finding differing from those outlined in Field or Technical Manuals.

(*b*) A brief description of new articles of equipment utilized which have not been previously described.

(*c*) A full account of any malfunctioning, abnormal result, or penalty incurred in the preliminary practices or in either of the two phases of the mine service practice.

(*d*) Reference to any leakage or condensation found in the mine cases after being picked up.

(*e*) A statement that test and firing groups were planted in project mine field areas or an explanation as to the reasons for planting mines in other locations.

b. Binding.—Each set will be supplied with front and back covers and will be bound at the top with suitable fasteners, such as "Acco."

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c. Distribution.—(1) Set 1 will be forwarded through channels to The Adjutant General for file in the office of the Chief of Coast Artillery.

(2) Set 2 will be forwarded through channels to the coast artillery district commander for his comment and returned to the organization for file with the battery records. When returned for file, this set should include a copy of all indorsements made on the set forwarded to the corps area commander.

(3) In his forwarding indorsement on sets 1 and 2, the group commander will comment on any difficulties encountered in the practice, as well as any points of general interest not fully covered in the narrative report. His indorsement will include the certificate called for in paragraph 10*d*. (In the set for The Adjutant General this indorsement will be submitted in duplicate.)

Section III

FORMS

Paragraph
List and models 46

46. List and models.—*a. List.*—The following forms will be necessary for recording the data required for mine service practice reports. All of these forms including cover sheets will be supplied by the Coast Artillery Board on request. Requisitions for forms will specify the number of each desired.

	Form
Summary of mine service practice	M–1
Planter record	M–2
Casemate record	M–3
Loading room record	M–4
Plotting room record	M–5

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b. Models.

SUMMARY OF MINE SERVICE PRACTICE

Battery_____, _____*Coast Artillery.* Harbor defenses of _____
Fort_____ Date_____
Total number of days mine planter was available for mine training and mine practice_____
Total number of mines planted in training prior to submine practices _____
Number of submine practices held _____. Number of mines planted in submine practices _____.

Participating in mine service practices	Number	Percent of strength present for duty
Officers		
Enlisted men		

Equipment:
Circuit closer, model _____
Firing device, model _____
Mine system, model _____

Score:

Components	Test phase	Firing phase	Total
Positions:			
Longitudinal			
Lateral			
Submergence			
Time			
Test:			
Mine test			
Bump or tilt test			
Miscellaneous			
Firing			
Totals			

Penalties (state whether test or firing phase)_____
Electric fuse in detonator circuit blown in mines Nos. _____
Dates and nature of repairs to mine field, including shore cable_____
Dates on which selectors failed to remain in synchronism during 1 hour daily checks_____

_____, _____,
Group commander. *Battery commander.*

Form M-1.

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PLANTER RECORD

(Test) (Firing) Phase

Battery_____, _____ *Coast Artillery.* Harbor defenses of_____

Fort_____. Date_____

Mine No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Submergence, feet (referred to mean low water)																			
Depth of water, feet, at time of planting																			

Average depth of water at time of planting, feet_____

State of tide at time of planting, referred to mean low water_____ feet {plus / minus}

Current velocity, measured or estimated in miles per hour_____

Direction of current in reference to line of mines_____

Average depth, referred to mean low water, feet_____

Time first heaving line passed_____

Time nineteenth mine let go_____

Total elapsed time of planting, minutes_____

Time out allowed (explain below), minutes_____

Additional time, if any, used in moving or replanting mines. minutes_____

Net time of practice_____

BUMP OR TILT TEST (DATE_____)

Mine No.					
Time mine was bumped or tilted					

United States Army Mine Planter_____

Mine planter commander_____

Master of mine planter_____

Difficulties, including delays in planting, repairs to shore cable or distribution box selector after planting_____

_____

_____,

_____*C. A., Planting official.*

Approved:

_____,

_____*C. A., Group commander.*

Form M–2.

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CASEMATE RECORD

(Test) (Firing) Phase

Battery_____, _____*Coast Artillery.* Harbor defenses of_____
Fort_____ Date_____
Mine system model_____
Group panel number_____used. Type of D. B. selector_____

	Date	Time	Mine No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	No. 20 contact (M2); testing voltage (M1)
Test reading, milliamperes																						

First reading taken (1 hour after planting distribution box)_____APM_____
(Date)

SYNCHRONIZATION TEST

Date																
O. K. or fail																

I certify that all tests prescribed for the mine system in use were made, with the following exceptions_____

_____,

_____*C. A., Casemate official.*

Approved:_____,

_____*C. A., Group commander.*

Form M–3.

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LOADING ROOM RECORD

(Test) (Firing) Phase

Battery_____, _____*Coast Artillery.* Harbor defenses of_____
Fort_____ Date_____

Mine No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Mine size (number)																			
Compound plug (model)																			
Fuse can (model)																			
Firing device (type or model)																			
Circuit closer (type, spring plate or M1926)																			
Voltmeter reading prior to assembly between (for M–3 firing device):																			
Red (ground) and case																			
Black and ball seat																			
Black and red (ground)																			
Black and red																			
Anchor (model)																			
Mooring rope, length (for C. I. anchor) (feet)																			
Mine cables:																			
Type																			
Class																			
Reel number																			
Check in column for mines fired																			

Shore cable, type, length, and reel number_____
Trotol: Manufacturer_____ Lot_____ Year_____ Date Received_____
Fuses: Type, regular, waterproof, submarine. Manufacturer_____
Year of manufacture_____ Lot number_____

_____,
_____*C. A., Loading officer.*

Form M–4.

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PLOTTING ROOM RECORD

(Test) (Firing) Phase

Battery_____, _____*Coast Artillery.* Harbor defenses of_____
Fort_____ Date_____
Type of position finding system and length of base line or height of DPF_____
From measurements on plotting board.
Perpendicular distances in feet between plotted mine positions and plotted control line (longitudinal displacement):

Mine No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Distance (feet)																			

Distance in feet between perpendiculars from mines to control line (lateral displacement):

Mines Nos.	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19
Distance (feet)																		

Record of observation for determination of deviations:
Towing vessel: Method of observation____ Length of towline_____yards
Flank vessel: Method of observation____ Distance to 1st mine_____yards
Distance to 2nd mine_____yards
Deviation of center of splash as viewed from towing vessel, R. or L. (yards):
1st mine_____; 2nd mine_____.
Deviation of center of splash as viewed from flank vessel, R. or L. (yards):
1st mine_____; 2nd mine_____.

_____,
_____*C. A., Plotting room official.*

Approved:_____,
_____*C. A., Group commander.*

Form M–5.

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CHAPTER 4

ANTIAIRCRAFT GUNS

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SECTION I.	Conduct of practice	47–55
II.	Records	56–61
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SECTION I

CONDUCT OF PRACTICE

	Paragraph
General	47
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Preliminary service practice	49
Record service practice, detection phase	50
Record service practice, firing phase	51
Additional assignment practices	52
National Guard not in Federal service	53
Officials and their duties, detection phase	54
Officials and their duties, firing phase	55

47. General.—This section includes provisions applicable only to antiaircraft guns. The provisions of chapter 1 also apply to firings with antiaircraft guns. In addition, supplemental instructions covering certain phases of antiaircraft target practices, including scoring, will be issued annually by the War Department in a supplement to this manual.

a. Scope of annual target practice.—The annual target practice of each gun battery will consist of a detection phase and a firing phase. Both phases will be considered in arriving at the annual classification of batteries.

b. Matériel and personnel.—(1) Insofar as practicable each battery will conduct its record service practice with the major standard items of equipment with which it is normally equipped. Should local conditions make necessary the shifting or borrowing of matérial, the regimental commander will give reasons therefor in his forwarding indorsement on the target practice report covering the record service practice concerned.

(2) Should a battery not possess sufficient personnel to man the normal number of guns to be used during a record service practice, it may borrow personnel from other batteries.

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(3) These instructions may be waived for batteries firing anti-aircraft armament as additional assignment, and for units of the Reserve Officers' Training Corps, Citizens' Military Training Camps, and Organized Reserves. These units may use whatever matériel is available but key men should be members of the firing battery.

(4) A record service practice once begun will be completed with the same matériel and personnel with which it was started.

c. Duration of gun service practices.—(1) A record service practice will be completed on the same day on which it is begun, except that the regimental commander may postpone the completion of a practice when—

(*a*) No sleeve target is available with which to continue the practice.

(*b*) Firing cannot be resumed because of an unsafe field of fire.

(2) When the completion of a record service practice has been postponed for the reasons given above, a detailed explanation will be submitted by the regimental commander in his indorsement on the report of practice.

d. Firing time.—The time of firing on each course is the elapsed time from the command ***Commence firing*** to the last discharge decreased by any time out. Time out will be allowed only when ***Cease firing*** is ordered for reasons of safety which are not due to personnel errors or failures of matériel of the battery firing. Only the time actually lost under this provision will be allowed.

e. Information to be furnished airplane director.—(1) The regimental commander will decide on the type of courses, in conformity with the instructions appearing in the following paragraphs, which will be towed for a particular service practice or series of practices, and will furnish the airplane director with the following information prior to the day of the service practice or practices:

(*a*) Type (rectilinear, maneuvering, diving).

(*b*) Altitude.

(*c*) Direction.

(*d*) Minimum horizontal range.

(2) Information concerning the type, altitude, direction, or range of courses to be flown will not be furnished the battery commander.

(3) In planning the courses which will constitute a service practice, every effort will be made to simulate attacks which might be expected under service conditions.

f. Records section.—A records section will be organized in each regiment or in each battalion for the purpose of obtaining accurate synchronized records for use in analysis of service practices. The decision as to whether the records section is organized in the regiment

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or battalion depends on local conditions and is left to the discretion of the regimental commander. The section will be brought to a high state of training before any service practice. Complete records will be made for all preliminary service practices as nearly as practicable in the same manner as for record service practices.

48. Preparation of fire.—*a. General.*—Careful and thorough preparation of fire is essential for a successful target practice. This includes training of personnel, careful test and adjustment of matériel, and preparatory fire.

b. Preparation of matériel.—The necessary steps for the preparation of matériel for firing are listed in FM 4–120. For methods of making the tests and adjustments to fire control equipment and orientation and synchronization see FM 4–110.

c. Determination of muzzle velocity and fuze error.—Prior to a target practice, every effort should be made to determine the most probable value of muzzle velocity and fuze error to be expected. (See FM 4–110.)

d. Calibration firings.—Calibration firing should be conducted when new guns are received or when it has been demonstrated that the guns of the battery are not shooting together. Firings for this purpose should be conducted with extreme care. (See FM 4–110.)

e. Trial fire.—(1) The purpose of trial fire is to determine the magnitude of errors due to unknown causes and apply the proper corrections to firing data. Ballistic corrections for known nonstandard conditions should be applied before firing trial shots. (See FM 4–110.)

(2) Complete records, including the meteorological message and ballistic corrections applied, for all trial shot problems should be kept for future study.

(3) Under service conditions the tactical situation may not permit the conduct of trial fire. In order to determine corrections which may be applied in target practices fired under such simulated service conditions, the records mentioned in (2) above are essential.

f. Meteorological data.—Meteorological observations should be taken immediately before firing and the data furnished promptly to the battery commander concerned. Every effort should be made to obtain the ballistic data to the maximum altitude at which fire is expected.

49. Preliminary service practice.—At least one preliminary service practice will be conducted and completely analyzed before proceeding to a record service practice. Preliminary practices will be conducted under the regulations prescribed for record service practices. The score will be computed as for record practice, but such

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score will not be taken into consideration in the classification of the organization.

50. Record service practice, detection phase.—*a. Purpose.*—This phase is designed to afford training in daytime surveillance of the normal zone of a gun battery and to test the ability of a gun battery to detect targets in sufficient time so that they may be met with fire as soon as they come within the maximum range of the guns. No actual firing will be done in this phase.

b. Conduct.—(1) This phase will be conducted once annually.

(2) The battery may use any or all of the intelligence agencies which would be available to it if it were part of a normal area defense. Such agencies include—

(*a*) Observers in the antiaircraft artillery intelligence service or at searchlight listening posts.

(*b*) Observers at searchlight positions. Sound locators may be used.

(3) An objective will be selected and a 60° defensive sector will be laid out about this objective. Figure 8 shows the objective, the defended sector, the location of the gun battery, and the approximate locations of the outer intelligence agencies which may be used in this phase.

(4) It need not be conducted in conjunction with the firing phase nor from the battery positions occupied during the firing phase.

(5) The following provisions will govern the conduct of this phase:

(*a*) The battery commander will report to the battalion commander when the battery is ready.

(*b*) After such report the battalion commander will request the airplane director to begin the phase. No information concerning the movements of the airplane, other than information furnished by the agencies referred to in (2) above, will be given to the battery except that it may be informed that the target airplane has taken off.

(*c*) Twelve separate daylight attacks will constitute the detection phase.

(*d*) Each attack will start beyond sight or hearing of the outer line of antiaircraft artillery intelligence observers and will end when the attacking airplane reaches the bomb release line.

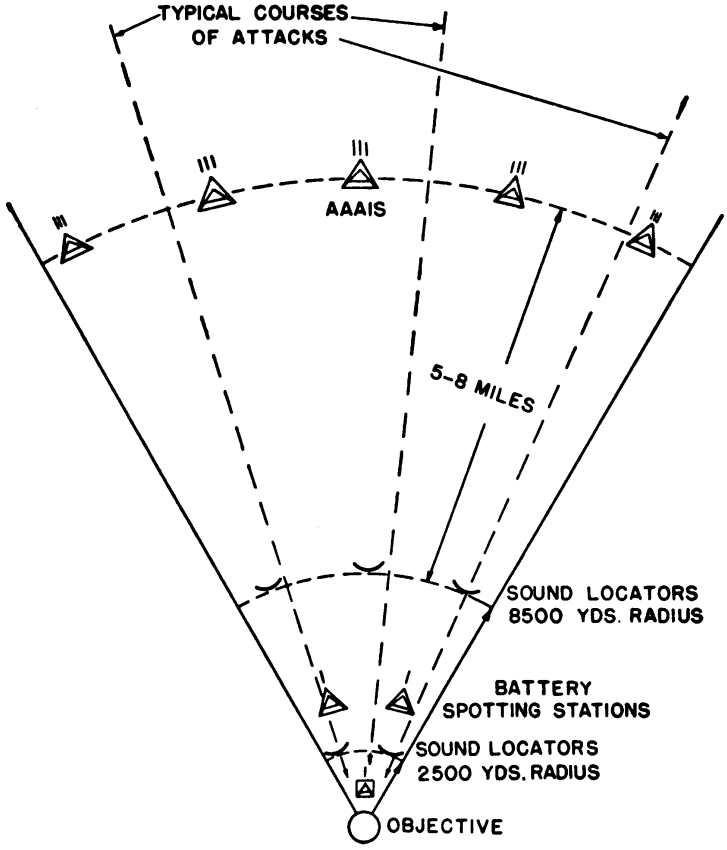
(*e*) Three attacks each will be made at altitudes approximately 9,000, 12,000, 15,000 and 18,000 feet, respectively.

(*f*) No restriction will be placed upon the movements of the attacking airplane other than that attacks will be made within the defended sector at the altitudes prescribed above. However, attacks will conform, as to type, to those which might be expected from a loaded bomber.

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(*g*) The range officer will endeavor to pick up the target with director and height finder in sufficient time to permit opening fire at the maximum range of the guns. Umpires at the director and height finder will determine when the battery is "on target."

51. Record service practice, firing phase.—*a. Purpose.*—This phase is designed to afford training in the preparation and conduct of fire at aerial targets and to test the ability of a gun battery to deliver effective fire against such targets.



NOTE.—Distances indicated are approximate and are intended as a guide only.

FIGURE 8.

b. Number of practices.—(1) Three record service practices will be fired at towed sleeve targets.

(*a*) Two of the three record service practices will be day practices and one will be a night practice.

(*b*) One of the three record service practices will be fired with high explosive shell.

(2) Not more than one service practice, preliminary or record, will be fired by a battery in any one day.

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c. Methods of adjustment.—(1) For one practice the angular unit method will be used. Trial shots will be fired immediately preceding the practice.

(2) For the two other practices the method of range adjustment employed will be at the discretion of the battery commander.

(3) For one of the two practices prescribed in (2) above, no firings of any nature will be conducted by the battery concerned on the day of the practice prior to the record practice itself. Preparation of fire corrections will be determined from a study of past firings conducted under similar conditions. The corrections used will be shown on Form AA-3. No adjustment of fire will be permitted during courses of this practice. This does not prohibit the application, at the beginning of a course, of corrections based on observation of results on preceding courses.

(4) For the other practice fired as prescribed in (2) above, trial shots may be fired immediately preceding the practice.

(5) For those practices in which one or more flank spotting stations are employed, no restrictions are imposed on the lengths of the spotting base line or lines used.

d. Spotting.—Spotting for range and lateral and vertical corrections will be conducted with personnel from the battery firing. The deviations, as reported by the records section, deviations detail, visual, will not be used nor will such be made available to the battery during firing.

e. Courses to be fired on.—After the battery commander has announced that he is ready to begin the practice, each course on which the safety officer gives clearance will be counted as one course. After a practice is once begun, fire will be conducted on each successive course unless safety considerations makes such procedure impossible. When fire is not conducted on successive courses, the battalion commander in his indorsement will give the reason why such course was not fired on. If no firing takes place on a safe course, the score for that course will be zero.

f. Number and types of courses.—(1) A record service practice will consist of four courses, as follows:

(*a*) At least one course will be towed directly toward the battery.

(*b*) At least one course will be towed across the front of the battery.

(*c*) At least two courses will be diving on a slope not less than 1 to 5, that is, losing 1 yard altitude for each 5 yards forward motion.

(2) On all courses the target will, so far as consistent with safety, simulate such maneuvers as might be expected from a loaded bomber

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during the last 2 minutes of flight before the bomb release line is reached.

g. Ranges and altitudes.—(1) The initial altitude of each of the four courses of a record practice will differ from the initial altitude of each of the other courses of that practice by not less than 300 yards.

(2) No minimum altitude for record practices is prescribed.

(3) The average slant range on each course except incoming courses will be not less than 3,000 yards.

(4) Altitudes will be determined by stereoscopic height finder for all practices.

h. Number of guns.—(1) Three or four guns, dependent on the number issued to the organization, will be manned completely, each by a detachment.

(2) Not less than two guns will be fired on any course of service practices in which the angular unit and the modified bracketing methods of adjustment are used.

(3) Not less than three guns will be fired on any course of the practice in which the fuze range pattern method of adjustment is used.

(4) Effort will be made to see that on the completion of the target practice season all guns will have fired approximately the same number of rounds.

i. Rate of fire.—The following will be taken as the normal rate of fire for each model of gun:

Model of gun	Method of pointing	Rate
3-inch M1917, 1917M1, 1917MII, 1918	Case 1½	12
3-inch M1918	Case III	18
3-inch M1917M1, 1917M11, M1, M2, M3, M4	Case III	25
90-mm	Case III	20
105-mm	Case III	12

52. Additional assignment practices.—Regular Army batteries firing antiaircraft guns as an additional assignment will proceed as follows:

a. Additional assignment service practices will comprise a firing phase only.

b. This phase will consist of one or more preliminary service practices and one record service practice.

c. The record service practice may be either a day or night practice.

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d. A record service practice will consist of not less than two nor more than four courses. Types of courses will be as follows for each practice:

(1) At least one course will be towed directly toward the battery.

(2) At least one course will be towed across the front of the battery.

(3) On all courses, the target will, so far as consistent with safety, simulate such maneuvers as might be expected from a loaded bomber during the last 2 minutes of flight before the bomb release line is reached.

e. The average slant range on each course, except on incoming courses, will be not less than 3,000 yards.

f. Not less than two guns will be fired on any course of the practice.

53. National Guard not in Federal service.—*a.* Target practices of National Guard batteries not in Federal service will comprise a firing phase only.

b. This phase will consist of one or more preliminary service practices and one record service practice.

c. The record service practice may be either a day or night practice.

d. A record service practice will consist of not less than two nor more than four courses. Types of courses will be as follows for each practice:

(1) At least one course will be towed directly toward the battery.

(2) At least one course will be towed across the front of the battery.

(3) On all courses the target will, so far as consistent with safety, simulate such maneuvers as might be expected from a loaded bomber during the last 2 minutes of flight before the bomb release line is reached.

e. The average slant range on each course, except on incoming courses, will be not less than 3,000 yards.

f. Not less that two guns will be fired on any course of the practice.

54. Officials and their duties, detection phase.—*a. Umpires.*—(1) *Personnel.*—Two disinterested officers will be designated as umpires, the senior being chief umpire.

(2) *Duties.*—(*a*) The chief umpire will observe through the spotting telescope of the director. When he determines that the director is on the target and after the assistant umpire has reported to him that the height finder is on the target, he will report "On target" to the officer in charge of records.

(*b*) When the height finder detail has picked up the target, the assistant umpire will verify that fact by looking through the stereoscopic observer's eyepiece and will then report the height finder on target to the chief umpire.

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b. Officer in charge of records.—(1) *Personnel.*—Officer in charge of records section.

(2) *Duties.*—As described in paragraph 60*a*. (Also acts as chief timekeeper.)

c. Airplane director.—(1) *Personnel.*—An officer of the Air Corps, if possible, otherwise a Coast Artillery Corps officer.

(2) *Duties.*—As described in paragraph 55*b*.

55. Officials and their duties, firing phase.—A list of officials for service practice together with a statement of their duties is given below. These officials will be detailed from other regiments unless such action is manifestly impracticable. The officials will be assigned by the regimental commander. In the case of special service practices, only such officials as are necessary for safety and the accomplishment of the purpose of the firing will be required.

a. Safety officers.—(1) *Personnel required.*—One commissioned officer with necessary qualified officer assistants.

(2) *Duties.*—The duties of the safety officer and his assistants are prescribed in FM 4–120.

b. Airplane director.—(1) *Personnel required.*—An officer of the Air Corps, if possible, otherwise a Coast Artillery Corps officer.

(2) *Duties.*—He will serve as liaison officer between the Coast Artillery Corps and the Air Corps. He will be present at all service practices and will transmit all instructions to the pilot of the towing airplane.

c. Officer in charge of records.—(1) *Personnel.*—Officer in charge of records section.

(2) *Duties.*—As described in paragraph 61*a*.

d. Chief timekeeper.—(1) *Personnel.*—One officer.

(2) *Duties.*—Obtains and records the elapsed time to nearest second from ***Commence firing*** to the last discharge. Obtains the data required to complete Form AA–10 from the assistant timekeepers and the officer in charge of records.

e. Assistant timekeepers.—(1) *Personnel.*—Officers acting as safety pointing observers.

(2) *Duties.*—Act as assistants to the safety officer as safety pointing observers and obtain and record the elapsed time to the nearest second from ***Commence firing*** to the last discharge of the gun to which assigned.

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SECTION II

RECORDS

	Paragraph
General	56
Records to be taken during detection phase	57
Records to be taken during firing phase	58
Records section	59
Duties of records section, detection phase	60
Duties of records section, firing phase	61

56. General.—Accurate information on the results of target practice depends in a large measure on the thoroughness, completeness, and accuracy of the records taken during the practice. The target practice analysis is meaningless unless the records are accurate and complete. Due to the time factor and the nature of the data required, coordinated training of the personnel involved in record taking is of great importance.

57. Records to be taken during detection phase.—The following records will be taken during the detection phase. Records specified in *a* and *b* below will be made by the records section. All other records will be made by the battery commander.

a. Target position records, visual (Form AA-8).—(1) Angular height in mils of the target from the battery (0_1).

(2) Azimuth in mils of the target from the battery (0_1).

(3) Angular height in mils of the target from the flank (0_2).

(4) Azimuth in mils of the target from the flank (0_2).

b. Chief timekeeper's record (Form AA-10).—This is a record of the pick-up time and other data necessary for the synchronization of records. Times will be taken to the nearest second.

c. Altitude from height finder (Form AA-8).—The basic altitude as determined by the height finder in use, recorded each 5 seconds from the command ***Stand by for time zero, ready, take.***

58. Records to be taken during firing phase.—The following records will be taken during the firing phase. Records specified in *a* to *e*, inclusive, below will be made by the records section. All other records will be made by the battery commander.

a. Target position records, visual (Form AA-8).—(1) Angular height in mils of the target from the battery (0_1).

(2) Azimuth in mils of the target from the battery (0_1).

(3) Angular height in mils of the target from the flank (0_2).

(4) Azimuth in mils of the target from the flank (0_2).

b. Target position records, camera (Form AA-18).—The same records as required in *a* above but made upon projection of the camera

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films. "Camera time" of the readings will be converted to "records time" by the officer in charge of records.

c. Deviations records, visual (Form AA–9).—(1) (*a*) *Lateral deviations, battery.*—The lateral deviations in mils of the bursts projected onto the slant plane.

(*b*) *Vertical deviations, battery.*—The vertical deviations in mils of the bursts projected onto the vertical plane of position.

(*c*) *Range deviations, flank.*—The lateral deviations in mils of the bursts projected onto the slant plane passing through the position of the flank observer.

(2) These readings are recorded against the time elapsed since the first burst. This time will be converted to "records time" by the officer in charge of records before turning the records over to the battery commander.

(3) (*a*) The slant plane is defined as the plane which includes the line observer-target and which is perpendicular to the vertical plane through the same line. It is the plane of readings taken on the horizontal reticule of a BC telescope properly leveled.

(*b*) The vertical plane of position is defined as the vertical plane containing the line observer-target. It is the plane of readings taken on the vertical reticule of a BC telescope properly leveled.

d. Deviations records, camera (Form AA–18).—These records are the same as in *c* above but made upon projection of the camera films. "Camera time" will be converted to "records time" by the officer in charge of records before turning the records over to the battery commander.

e. Chief timekeeper's record (Form AA–10).—This is a record of the corrected time of action and other data necessary for the synchronization of the records. Times will be taken to the nearest second. For authorized time out see paragraph 47*d*.

f. Miscellaneous records.—(1) *Altitude from height finder (Form AA–8).*—The basic altitude as determined by the height finder in use, recorded every 5 seconds from the command ***Stand by for time zero, ready, take,*** to include one reading after the last burst occurred.

(2) *Altitude set into director (Form AA–8).*—This is the corrected altitude set into the director. If it is impracticable to read the altitude set into the director, this record may be filled in by adding algebraically the *net* altitude correction to each of the altitudes as recorded in (1) above.

(3) *Adjustment records (Form AA–8).*—These records consist of the lateral adjustment record, vertical adjustment record, and altitude adjustment record. At the beginning of each course, record

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will be made of the adjustment correction with which fire is opened. Thereafter, as adjustment corrections are applied, record will be made of the *net* adjustment correction and the time such is applied.

(4) *Range spotter's records (Form AA–9).*—(*a*) *Modified bracketing method.*—The record of the stereoscopic observer's sensings of the range deviations of the bursts will be recorded against elapsed time since the first burst. The officer in charge of records will convert this time to "records time."

(*b*) *Angular unit method.*—The record of the flank range spotter's reports of the mil deviations of the bursts will be recorded against elapsed time since the first burst. The officer in charge of records will convert this time to "records time."

(*c*) *Fuze range pattern method.*—The record of the flank range spotter's reports of the deviations of the center of the fuze range pattern, in terms of the "spread" of the pattern, will be recorded against elapsed time since the first burst. The officer in charge of records will convert this time to "records time."

59. Records section.—The organization and training of a records section will be placed on a basis which will insure continuity of training and supervision. A typical organization is outlined in FM 4–110. The training of the records section will be concurrent with the training of the firing batteries. Each section will be brought to a high state of training prior to service practice by units of the regiment.

60. Duties of records section, detection phase.—*a. Officer in charge of records.*—(1) Supervises the functioning of the records section and synchronizes the records.

(2) Gives the command ***Stand by for time zero, ready, take,*** as soon as the observers at 0_1 and 0_2 are on the target. Should the observer at 0_1 pick up the target and the observer at 0_2 fail to pick up the target in time to insure that sufficient records will be obtained for analysis purposes, the officer in charge of records will give the command ***Stand by for time zero, ready, take,*** despite the fact that 0_2 is not on, and will have the target position report (Form AA–4a) prepared from angular heights measured at 0_1 and altitudes measured at the height finder.

(3) Gives the command ***Cease tracking*** as soon as sufficient data have been taken to insure a determination of the course and speed of the target airplane. Normally at least six readings should be taken at 5-second intervals.

(4) Takes and records the pick-up time. Pick-up time is defined as follows:

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(*a*) If the chief umpire reports the battery "on target" before the command ***Stand by for time zero, ready, take,*** has been given, pick-up time will be the elapsed time to the nearest second between the command ***On target*** and records time zero.

(*b*) If the chief umpire reports the battery "on target" after the command ***Stand by for time zero, ready, take,*** has been given, pick-up time will be the records time at which the report "on target" was made.

(5) Collects and verifies all records immediately after the practice and checks them before releasing the recorders.

(6) Prepares Form AA–4a.

b. Target position details, visual.—(1) Adjust, set up, and orient the observing instruments on the ends of a suitable base line at least 3,000 yards long.

(2) Pick up and track the target as soon as it is located.

(3) Read and record against record time the azimuth and angular height of the target from each station from the word "take" of the command ***Stand by for time zero, ready, take,*** and each 5 seconds thereafter to and including the command ***Cease recording.***

(4) Complete the proper forms (Form AA–8) and turn them in to the officer in charge of records.

c. Altitude recorder (member of height finder detail).—(1) Reads and records against record time the altitude of the target as measured by the height finder from the word "take" of the command ***Stand by for time zero, ready, take,*** and each 5 seconds thereafter to and including the command ***Cease recording.***

(2) Completes the proper forms (Form AA–8) and turns them in to the officer in charge of records.

61. Duties of records section, firing phase.—*a. Officer in charge of records.*—(1) Supervises the functioning of the records section and synchronizes the records.

(2) Gives the command ***Commence tracking*** sufficiently in advance of firing to insure that the target is picked up by the observers before the first shot is fired.

(3) Gives the command ***Stand by for time zero, ready, take.*** This will be given in sufficient time to insure that the section is operating smoothly when the first shot is fired.

(4) Takes and records the record time to nearest second of the occurrence of the following events:

(*a*) Commence firing.

(*b*) First burst.

(*c*) Last burst.

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(5) Just before the first burst, gives the command ***Camera action.***

(6) After the last burst, gives the command ***Cease recording.***

(7) Collects and verifies all records immediately after the practice and checks them before releasing the recorders.

(8) Supervises the projection of the camera films and prepares Forms AA–4a and AA–11.

b. Camera detail.—(1) Adjust, set up, and orient the cameras on the ends of a suitable base line at least 3,000 yards long.

(2) Photograph a terrestrial datum point before and after each record service practice. Counters will be illuminated for this purpose.

(3) At the command ***Commence tracking,*** pick up and track the target and report "Ready."

(4) The battery (0_1) theodolite is the control theodolite. At the command ***Stand by for time zero, ready, take,*** the 0_1 theodolite operator, having recorded the counter reading, starts the time counters in both theodolites by throwing the signal switch on his theodolite.

(5) At the command ***Camera action,*** the 0_1 and 0_2 theodolite operators begin photographing by turning on camera motors and counter lamps.

(6) Continue to track and photograph.

(7) At the command ***Cease recording,*** turn off the motor, lamp, and signal switches.

(8) Develop and project the films and fill in the required forms (Form AA–18).

c. Target position detail, visual.—(1) Adjust, set up, and orient the observing instruments on the ends of a suitable base line at least 3,000 yards long.

(2) At the command ***Commence tracking,*** pick up and track the target.

(3) Read and record against record time the azimuth and angular height of the target from each station from the word "take" of the command ***Stand by for time zero, ready, take,*** and each 5 seconds thereafter to and including the command ***Cease recording.***

(4) Complete the proper forms (Form AA–8) and turn them in to the officer in charge of records.

d. Deviations details, visual.—(1) Obtain and record on Form AA–9 the lateral and vertical deviations of the bursts from the target as observed from the battery and the horizontal lateral deviations of the bursts from the target as observed from the flank. These records are synchronized by starting a stop watch at the occurrence of the first burst and recording the deviations against

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the elapsed time since that event. Enter the readings on appropriate lines and strike out the entry in column 1, if necessary, and write in the proper time in seconds.

(2) Turn in completed records to officer in charge of records.

SECTION III

ANALYSIS

	Paragraph
General	62
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Firing phase	64

62. General.—The object of analysis of antiaircraft gun target practice is to determine the proficiency of the firing unit and the performance of the matériel. Antiaircraft gun target practices will be analyzed in accordance with the provisions of this section.

63. Detection phase.—*a. General.*—The purpose of this analysis is to determine the battery's efficiency in picking up targets in sufficient time to permit opening fire at the maximum range of the guns.

b. Forms used.—The data necessary for analysis of this phase are obtained from or placed on the following forms:

Target position record (Form AA–8 from 0_1, 0_2, and height finder).
Target position report (Form AA–4a).
Chief timekeeper's record (Form AA–10).
Graphical analysis (Form AA–6a).
Summary of practice (Form AA–2a).

c. Preparation of target position report (Form AA–4a).—(1) Each course requires a separate form.

(2) (*a*) Make entries in columns 2 and 7. If a plotting board is used, each entry equals the azimuth of the target (source, Form AA–8). If Lewis charts or Crichlow slide rule are used:

1. If 0_2 is on the left when facing the field of fire from the battery, each entry equals the azimuth of the target (source, Form AA–8) minus the azimuth of the base line (0_1–0_2).

2. If 0_2 is on the right, each entry equals the azimuth of the target minus the *back azimuth* of the base line (0_1–0_2).

(*b*) Line out inappropriate phrase in column heading.

(3) Make entries in columns 3 and 8 (source, Form AA–8).

(4) Make entries in colums 4 and 9. These values may be found by plotting or may be computed by means of Lewis charts or Crichlow slide rule. Entries will be obtained to the nearest 10 yards.

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(5) Make entries in columns 6 and 11 using entries in columns 3 and 4, 8 and 9, respectively. These values may be found by plotting or may be computed by Lewis charts or Crichlow slide rule. Entries will be obtained to the nearest 10 yards.

(6) Make entries in column 12. These entries are the means of columns 6 and 11. If, however, it is obvious that data from one station are in error, use altitude computed from data of the other station and make an explanatory note on the form.

(7) Entries in columns 5, 10, 13, and 14 will not be made. The line entitled "averages" need not be filled in.

(8) In case the target is not picked up from 0_2, the distant station, Form AA–4a, will be prepared from the angular heights measured at 0_1 and the altitudes measured at the height finder.

d. Definitions.—The symbols used in preparing the graphical analysis (Form AA–6a) and summary of practice (Form AA–2a) are defined as follows:

T_0=position of target at "time zero."
T_P=position of target at time of pick-up (when chief umpire reports "on target").
T_M=position of target when crossing the 30-second fuze range curve.
T_F=position of target when fire is opened.
T=position of target when met by the initial bursts.
R=horizontal range to T.
R_M=horizontal range to T_M.

e. Preparation of graphical analysis (Form AA–6a), figure 9.—(1) A separate form need not be used for each course, two or more courses being plotted on a form where the altitudes of these courses are sufficiently separated to distinguish clearly the plot of each course.

(2) Plot vertical projection of each course from the data in columns 3 or 4, and 12, Form AA-4a. Label plotted points T_0, T_5, T_{10} . . . etc., in accordance with the record times to which they correspond.

(3) Draw a representative straight line course through the plotted points and label it with the course number, C_1, C_2, C_3, etc.

(4) Determine ground speed of target, in yards per second, by scaling the straight line distance between the first and last plotted points and dividing by the elapsed time in seconds.

(5) Plot T_P, the point of pick-up, by measuring in the proper direction along the plotted course (extended if necessary) a distance from T_0 equal to the ground speed times pick-up time.

(6) Plot T_F, the point at which fire is opened, by measuring along the plotted course (extended if necessary) a distance from T_P equal to the ground speed times 15 seconds. T_F is always between T_P and the battery.

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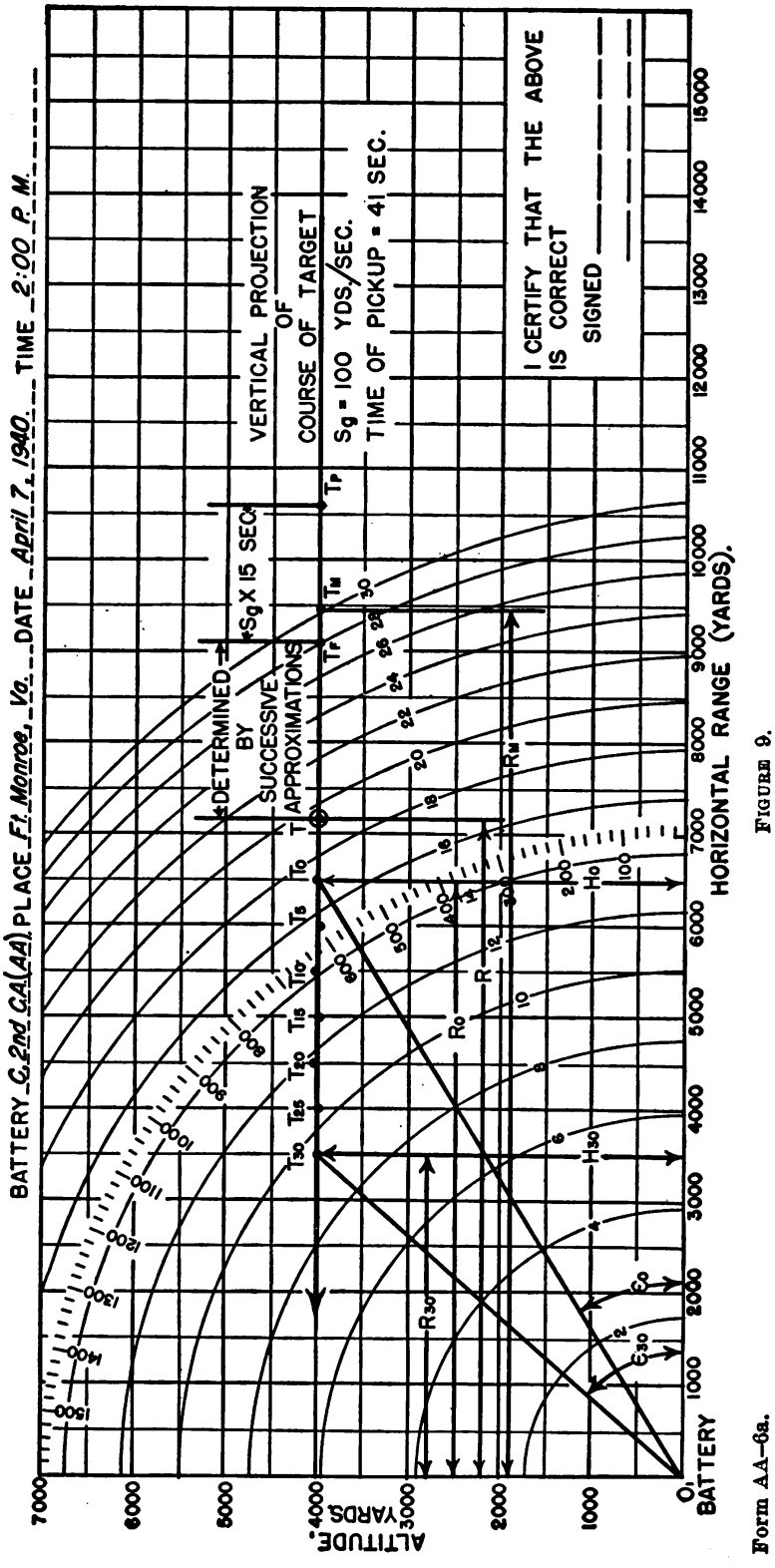


FIGURE 9.

Form AA-6a.

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(7) Determine and plot T by a series of successive approximations as follows:

(*a*) Assuming that the curves of fuze range (Form AA–6a) also represent time of flight, determine time of flight to T_F.

(*b*) Multiply this time of flight by the ground speed to determine the first approximation of the travel during time of flight.

(*c*) Subtract this travel from the horizontal range to T_F. The result represents the first approximation of the horizontal range to T and determines the first approximation (T') of the position to T on the plotted course.

(*d*) Using the time of flight to this point (T'), determine a new approximation (T'') of the position of T on the course in the same manner.

(*e*) Continue this process until the position of T is determined. The points (T', T'' . . . etc.) representing the successive approximations need not be plotted.

(8) Enter the horizontal range to T (R) in column 3, Form AA–2a.

(9) Plot T_M, the point at which the plotted course (extended if necessary) intersects the 30-second fuze curve.

(10) Enter horizontal range to T_M (R_M) in column 4, Form AA–2a.

f. Preparation of summary of practice (Form AA–2a).—(1) Enter data in columns 2, 3, and 4 from Form AA–6a. Entry in column 2 will be the altitude at the point of pick-up.

(2) Complete column 5. Entry equals entry in column 3 divided by entry in column 4.

(3) Complete column 6. Entry equals entry in column 5 multiplied by the proper K factor as prescribed in a War Department supplement to this manual. Entry is computed to two decimal places.

(4) Enter total score, detection phase, at the bottom of column 6.

64. Firing phase.—*a. Target position data.*—In order to locate the target in space, simultaneous readings of azimuth and angular height are taken from the ends of a known base line. These data are automatically recorded on the camera film. They are also taken and recorded by a visual detail every 5 seconds. From these basic data, the following are computed:

(1) Horizontal range, slant range from the battery (0_1), and altitude.

(2) Horizontal range, slant range from the flank (0_2), and altitude.

b. Location of burst in space.—In order to locate each burst in space the lateral and vertical deviation of each burst from the battery (0_1), and a horizontal lateral deviation from the flank (0_2), all in mils, are obtained from the camera records and also by a visual detail.

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The time of each burst is determined, and all bursts which occur within 2½ seconds of any time for which the position of the target is computed are grouped and considered to have been fired with the target in that one position. The mil deviations are converted to yard deviations. These deviations are then combined with certain factors on Form AA–11 to obtain the true range deviation along the line of position.

c. Forms used.—The data necessary for analysis of this phase are obtained from or placed on the following forms:

Camera report (Form AA–18).
Target position record (Form AA–8 from 0_1, 0_2, and height finder).
Adjustment record (Form AA–8).
Target position report (Form AA–4a).
Deviations of spotter's record (Form AA–9).
Computation of impacts (Form AA–11).
Tabular analysis (Form AA–5).
Graphical analysis, firing phase (Form AA–6b).
Chief timekeeper's record (Form AA–10).
Summary of practice, firing phase (Form AA–2b).
Trial shot and calibration report (Form AA–3).
Matériel and powder report (Form AA–7).
Summary of height finder results (Form AA–4b).

Models of these forms are shown in chapter 7. It will be noted that some of the forms must be improvised locally while others may be obtained from the Coast Artillery Board.

d. Preparation of target position report (Form AAX4a).—(1) Each course requires a separate form.

(2) Make entries in columns 2 and 7. If a plotting board is used, entry equals the azimuth of the target (source, Form AA–18, if available, otherwise Form AA–8). If Lewis charts or the Crichlow slide rule are used, the entries will be determined as follows:

(*a*) If 0_2 is on the left when facing the field of fire from the battery, each entry equals the azimuth of the target minus the azimuth of the base line (0_1–0_2).

(*b*) If 0_2 is on the right, each entry equals the azimuth of the target minus the *back azimuth* of the base line (0_1–0_2).

(*c*) The entries will be the proper angles to use in computing columns 4 and 9. Line out inappropriate phrase in the column heading.

(3) Make entries in columns 3 and 8 (source, Form AA–18, if available, otherwise Form AA–8).

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(4) Compute entries for columns 4 and 9. The accuracy desired is three significant figures, that is, to nearest 10 yards.

(5) Compute entries for columns 6 and 11 using entries in columns 3 and 4, 8 and 9, respectively. Desired accuracy is three significant figures, that is, to nearest 10 yards.

(6) Compute entries for columns 5 and 10, using entries in columns 3 and 4, 8 and 9, respectively, to nearest 10 yards.

(7) Compute entries in column 12 by taking the mean value of entries in columns 6 and 11. If, however, it is obvious that one camera is in error, use altitude computed from data of the other camera and make an explanatory note on the form.

(8) Compute entries in column 13:

$$\text{Entry}=\frac{(\text{height finder altitude}-\text{camera altitude})}{\text{camera altitude}}\times 100$$

(Source of height finder altitude, Form AA–8)

Retain proper sign and one decimal figure, that is, to nearest tenth of 1 percent.

(9) Compute entries in column 14:

Entry=entry column 5×entry column 13

Retain sign and express to nearest 10 yards.

(10) Circle entry in column 1 nearest in time to occurrence of first burst. Circle entry in column 1 nearest in time to occurrence of last burst. Compute and fill in entries for averages for position data in columns 2, 3, 4, 5, and 12 between and including these two times.

(11) Fill in data at bottom of form.

(*a*) Obtain average time of flight by entering a trajectory chart with average values of horizontal range and altitude as arguments. The average values of horizontal range and altitude are those computed as described in (10) above.

(*b*) The ground speed may be obtained by dividing the length of the course measured on the horizontal plot by the elapsed time or computed by the method described below.

e. Computation of ground speed.—The following method may be used for determining the ground speed of the target when a horizontal plot of the target course has not been made. Referring to figure 10, GA and GC are horizontal ranges to successive points along the target's course which may be obtained from Form AA–4a.

$$AG=R_1,\ GC=R_2$$

By constructing $GA=GB$, triangle AGB is isosceles.

$$\text{Angle } GAB=\text{angle } GBA=1{,}600 \text{ mils}-\text{angle } \frac{AGB}{2}$$

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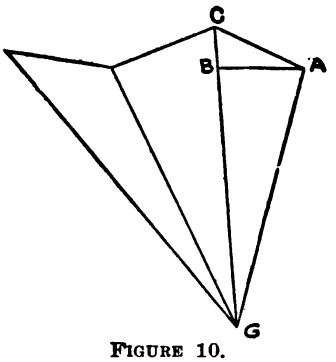


FIGURE 10.

Where angle AGB (=angle AGC) is small, angle ABC may be assumed equal to a right angle.

$$BC=GC-GA=R_2-R_1 \quad (1)$$

$$AB=2R_1 \sin \frac{AGC}{2}$$

$$=R_1 \sin AGC, \text{ approximately} \quad (2)$$

The hypotenuse AC may then be obtained by laying off to any convenient scale the side BC perpendicular to side AB, the values of BC and AB being obtained by formulas (1) and (2). The distance AC may be computed by slide rule or by trigonometric methods if desired. The accompanying example demonstrates the method of computation. In practice, the computations should be made by using the data of the station from which the azimuth of the course changes the least.

GROUND SPEED COMPUTATION

Time	Range	Azimuth	$<AGB$	AB	BC	AC
Sec.	*Yd.*	*Mils*	*Mils*	*Yd.*	*Yd.*	*Yd.*
0	4, 350	1, 355	----	---	---	---
5	4, 480	1, 310	45	192	130	234
10	4, 580	1, 265	45	198	100	223
15	4, 735	1, 225	40	180	155	238
20	4, 910	1, 190	35	163	175	240
25	5, 025	1, 150	40	193	115	227
30	5, 145	1, 120	30	148	120	192
35	5, 300	1, 085	35	177	155	236
40	5, 470	1, 055	30	157	170	233
45	5, 640	1, 025	30	162	170	236

Average=228.8÷5=45.8 yards per second.

f. Antiaircraft gun target.—(1) The antiaircraft gun target is a point represented by the forward end of the towed sleeve target. The hitting volume for the purposes of scoring is shown in figure 11, with the antiaircraft target shown in the proper relation. It is based on the bursting volume of high explosive shell. In designing the hitting volume, the density of fragmentation and penetrating

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power of the fragments were considered. The shape of this volume is not determined by the shape of an airplane.

(2) Dimensions of the antiaircraft gun hitting volume are as follows:

	a	b	c	d
Dimension in yards:				
3-inch guns	80	20	80	22
90-mm guns	94	22	80	22
105-mm guns	110	24	80	22

g. Explanation of Form AA-11, computation of impacts.—(1) Figure 12 represents a horizontal projection of the situation at the

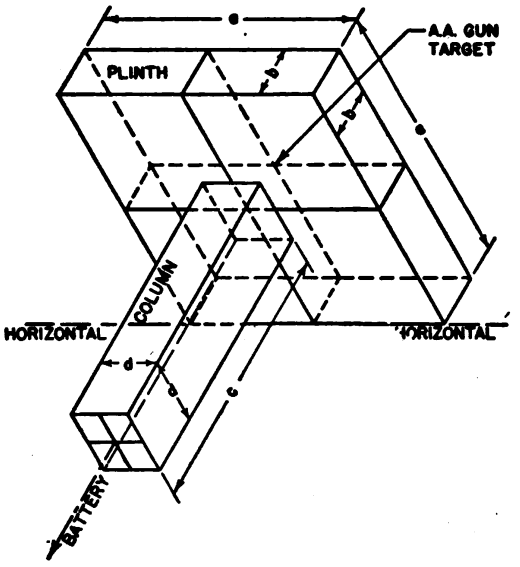


FIGURE 11.—Antiaircraft gun hitting volume.

target. The target is at T, the burst at B. The problem is to solve for the horizontal range deviation, TD. The following quantities are known:

Lateral deviation $TR=DB$.

Flank deviation TA.

Gun-target-flank angle GTF=angle TCA=angle BCD.

In right triangle TAC, $TC=TA$ csc $TCA=TA$ csc 0_1T0_2.

Table VII contains values of F_1 which are natural cosecants, hence the product of F_1 and the flank deviation TA gives the distance TC (column 13, Form AA-11).

In right triangle BDC, $DC=DB$ cot $DCB=DB$ cot 0_1T0_2.

Table VIII contains values of F_2 which are natural cotangents, hence the product of F_2 and the lateral deviation DB gives the distance CD (column 15).

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The horizontal range deviation $TD=TC+CD$ (column 16).

(2) Figure 13 represents the situation at the target projected into the vertical plane of position. The problem is to solve for the slant range deviation TK. The following quantities are known:

Horizontal range deviation TD.

Vertical deviation $TI=KB$.

Angular height=angle HTD=angle HBK.

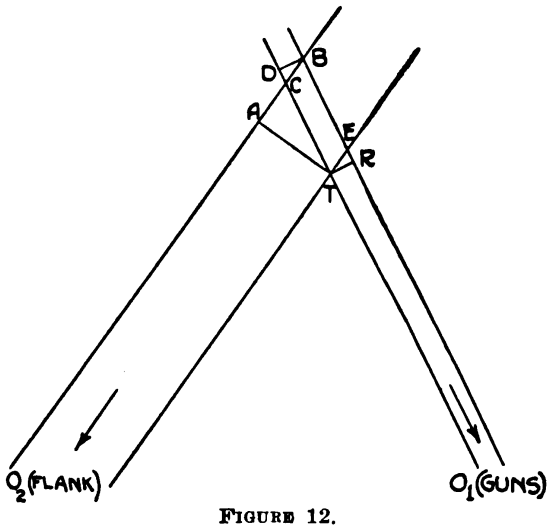


FIGURE 12.

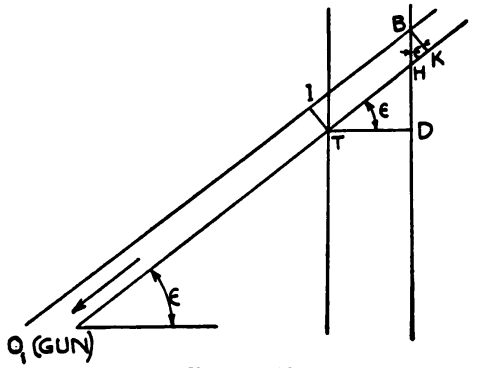


FIGURE 13.

In right triangle TDH, $TH=TD$ sec ϵ.

Table VII contains values of F_3 which are natural secants, hence the product of F_3 and the horizontal range deviation TD gives the distance TH (column 17).

In right triangle BKH, $HK=KB$ tan ϵ.

Table VIII contains values of F_4 which are natural tangents, hence the product of F_4 and the vertical deviation KB gives the distance HK (column 19).

The slant range deviation $TK=TH+HK$ (column 20).

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(3) The lateral deviation (column 14), vertical deviation (column 18), and true slant range deviation (column 20), of the burst have now been obtained, and a comparison of these deviations with the corresponding dimension of the hitting volume indicates immediately whether or not the shot was a hit.

h. Preparation of Form AA–11, computation of impacts.—(1) Divide the bursts into groups as follows: All bursts which occurred within 2½ seconds of a 5-second interval for which the position of the target was computed (see Form AA–4a) will be grouped and given a group designation corresponding to that interval. Separate the groups from each other by horizontal lines and enter the proper group designation in columns 1 and 10 (such as "30," "35," "40," etc.).

(2) In columns 2, 3, and 5 enter the appropriate data from Form AA–4a for the particular positions of the target to which the bursts were referred as groups.

(3) Column 4 is the horizontal angle gun-target-flank for the appropriate target position and is obtained by taking the difference between the entries in columns 2 and 7 of Form AA–4a.

(4) Complete entries in columns 6, 7, 8, and 9 by extraction of proper values from tables VII and VIII.

TABLE VII.—*Factors F_1 and F_2*

Argument for F_1	0	10	20	30	40	50	60	70	80	90			
100	10.20	9.28	8.51	7.86	7.30	6.82	6.39	6.02	5.69	5.39	5.13	3,000	1,400
200	5.18	4.89	4.67	4.47	4.48	4.12	3.96	3.82	3.68	3.55	3.44	2,900	1,300
300	3.44	3.34	3.24	3.14	3.05	2.97	2.89	2.81	2.74	2.68	2.61	2,800	1,200
400	2.61	2.55	2.50	2.44	2.39	2.34	2.29	2.25	2.20	2.16	2.12	2,700	1,100
500	2.12	2.08	2.05	2.01	1.98	1.95	1.91	1.88	1.85	1.83	1.80	2,600	1,000
600	1.80	1.77	1.75	1.72	1.70	1.68	1.66	1.64	1.62	1.60	1.58	2,500	900
700	1.58	1.56	1.54	1.52	1.51	1.49	1.47	1.46	1.44	1.43	1.41	2,400	800
800	1.41	1.40	1.39	1.37	1.36	1.35	1.34	1.33	1.32	1.30	1.29	2,300	700
900	1.29	1.28	1.27	1.26	1.25	1.25	1.24	1.23	1.22	1.21	1.20	2,200	600
1,000	1.20	1.19	1.19	1.18	1.17	1.17	1.16	1.15	1.15	1.14	1.13	2,100	500
1,100	1.13	1.13	1.12	1.12	1.11	1.11	1.10	1.10	1.09	1.09	1.08	2,000	400
1,200	1.08	1.08	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1,900	300
1,300	1.05	1.04	1.04	1.04	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1,800	200
1,400	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1,700	100
1,500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1,600	0
		90	80	70	60	50	40	30	20	10	0	Argument for F_1	Argument for F_2

NOTE 1.—To obtain F_1, enter the table with the horizontal angle gun-target-flank to the nearest 10 mils. Extract the tabular value without interpolation.

Examples: *GTF* angle=639 *mils*, F_1=1.70.
GTF angle=1935 *mils*, F_1=1.06.

NOTE 2.—To obtain F_2, enter the table with angular height of the target from the battery to the nearest 10 mils. Extract the tabular value without interpolation.

Examples: Angular height=581 *mils*, F_2=1.19.
Angular height=946 *mils*, F_2=1.68.

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TABLE VIII.—*Factors F_2 and F_4*

Argument for F_2	0	10	20	30	40	50	60	70	80	90			
100	10.15	9.22	8.45	7.79	7.23	6.74	6.31	5.94	5.60	5.30	5.03	3,000	1,400
200	5.03	4.78	4.56	4.35	4.17	3.99	3.83	3.68	3.55	3.42	3.30	2,900	1,300
300	3.30	3.18	3.08	2.98	2.88	2.79	2.71	2.63	2.56	2.48	2.41	2,800	1,200
400	2.41	2.35	2.29	2.23	2.17	2.11	2.06	2.01	1.96	1.92	1.87	2,700	1,100
500	1.87	1.83	1.79	1.75	1.71	1.67	1.63	1.60	1.56	1.53	1.50	2,600	1,000
600	1.50	1.47	1.43	1.41	1.38	1.35	1.32	1.29	1.27	1.24	1.22	2,500	900
700	1.22	1.19	1.17	1.15	1.13	1.10	1.08	1.06	1.04	1.02	1.00	2,400	800
800	1.00	.98	.96	.94	.92	.91	.89	.87	.85	.84	.82	2,300	700
900	.82	.80	.79	.77	.76	.74	.73	.71	.70	.68	.67	2,200	600
1,000	.67	.65	.64	.63	.61	.60	.59	.57	.56	.55	.53	2,100	500
1,100	.53	.52	.51	.50	.49	.48	.46	.45	.44	.43	.41	2,000	400
1,200	.41	.40	.39	.38	.37	.36	.35	.34	.32	.31	.30	1,900	300
1,300	.30	.29	.28	.27	.26	.25	.24	.23	.22	21	.20	1,800	200
1,400	.20	.19	.18	.17	.16	.15	.14	.13	.12	.11	.10	1,700	100
1,500	.10	.09	.08	.07	.06	.05	.04	.03	.02	.01	.00	1,600	0
		90	80	70	60	50	40	30	20	10	0	Argument for F_2	Argument for F_4

NOTE 1.—To obtain F_2, enter the table with the horizontal angle gun-target-flank to the nearest 10 mils. Extract the tabular value without interpolation.

Examples: GTF angle=1033 mils, F_2=0.63.
GTF angle=2359 mils, F_2=0.92.

NOTE 2.—To obtain F_4, enter the table with the angular height of the target from the battery to the nearest 10 mils. Extract the tabular value without interpolation.

Examples: Angular height=536 mils, F_4=0.59.
Angular height=882 mils, F_4=1.17.

(5) Column 12. Entry = (mil deviation of burst in slant plane from flank) times (slant range from 0_2 to target for that group) divided by 1,000. Express to nearest yard. "Overs" will be given a + sign and "shorts" a − sign.

(6) Column 14. Entry = (lateral deviation of burst in mils in slant plane from battery) times (slant range to target from 0_1 for that group) divided by 1,000. Express to nearest yard and give a sign in accordance with the following table:

TABLE IX

	Angle GTF from 0 mils to 1,600 mils		Angle GTF from 1,600 mils to 3,200 mils	
	Observed deviations		Observed deviations	
	Left	Right	Left	Right
When facing field of fire and—				
0_2 is on left	−	+	+	−
0_2 is on right	+	−	−	+

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(7) Column 18. Entry equals (vertical deviation of burst in mils from battery) times (slant range to target from battery for that group) divided by 1,000. Express to nearest yard. "Aboves" will be given a + sign and "belows" a − sign.

(8) Column 13. Entry equals entry column 12 times F_1 for that group. Retain sign and express to nearest yard.

(9) Column 15. Entry equals entry column 14 times F_2 for that group. Retain sign and express to nearest yard.

(10) Column 16. Entry equals algebraic sum of entries in columns 13 and 15.

(11) Column 17. Entry equals entry column 16 times F_3 for that group. Retain sign and express to nearest yard.

(12) Column 19. Entry equals entry column 18 times F_4 for that group. Retain sign and express to nearest yard.

(13) Column 20. Entry equals algebraic sum of entries in columns 17 and 19. This column gives the slant range deviation of the bursts in yards, + indicating "over" and − indicating "short."

(14) Column 21, determination of hits:

(*a*) *3-inch antiaircraft guns.*

1. In column 20, circle each deviation which lies between the limits 0 and −20 yards, inclusive. For each deviation so circled examine corresponding entries in columns 14 and 18. If both of these are between the limits +40 and −40 yards, the burst is a hit in the *plinth.* Mark hits in column 21.

2. In column 20, circle each deviation which lies between the limits −20 and −100 yards, both inclusive. For each deviation so circled examine corresponding entries in columns 14 and 18. If both deviations are between the limits +11 and −11 yards, the burst is a hit in the *column.* Mark hits in column 21.

3. A burst whose range deviation is exactly −20 yards and whose lateral and vertical deviations are smaller than +11 or −11 yards may be counted as a hit in either the *plinth* or the *column* but not in both.

(*b*) *90-mm antiaircraft guns.*

1. In column 20, circle each deviation which lies between the limits 0 and −22 yards, inclusive. For each deviation so circled examine entries in columns 14 and 18. If both of these are between the limits +47 and −47 yards, the burst is a hit in the *plinth.* Mark hits in column 21.

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2. In column 20, circle each deviation which lies between the limits −22 and −102 yards, both inclusive. For each deviation so circled examine corresponding entries in columns 14 and 18. If both deviations are between the limits +11 and −11 yards, the burst is a hit in the *column*. Mark hits in column 21.

3. A burst whose range deviation is exactly −22 yards and whose lateral and vertical deviations are less than +11 or −11 yards may be counted as a hit in either the *plinth* or the *column* but not in both.

(*c*) *105-mm antiaircraft guns.*

1. In column 20, circle each deviation which lies between the limits 0 and −24 yards, inclusive. For each deviation so circled examine entries in columns 14 and 18. If both of these are between the limits +55 and −55 yards, the burst is a hit in the *plinth*. Mark hits in column 21.

2. In column 20, circle each deviation which lies between the limits −24 and −104 yards, both inclusive. For each deviation so circled examine corresponding entries in columns 14 and 18. If both deviations are between the limits +11 and −11 yards, the burst is a hit in the *column*. Mark hits in column 21.

3. A burst whose range deviation is exactly −24 yards and whose lateral and vertical deviations are less than +11 or −11 yards may be counted as a hit in either the *plinth* or the *column* but not in both.

i. Preparation of tabular analysis (*Form AA–5*).—(1) Enter in column 2 the "records time" of the occurrence of each burst.

(2) Obtain from proper trajectory chart the time of flight to nearest second for target position associated with each group of bursts. Enter these values in column 3 opposite burst which occurred closest in time to the time for which position data were computed.

(3) Make entries in columns 4, 8, and 12 from Form AA–18 when available, otherwise from Form AA–9. Designate direction by L, R, A, B, O, and S.

(4) Extract from Form AA–11 the entries in columns 14, 18, and 20 and record in columns 5, 9, and 13, respectively. Designate direction by L, R, A, B, O, and S.

(5) Make entries in columns 6 and 10. Entry equals adjustment correction in mils stripped of the trial shot correction. Opposite burst No. 1 enter net adjustment correction with which the first round was fired. Enter other corrections (net values) opposite burst

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which occurred closest in time to the time at which correction was applied. Designate direction by L, R, A, and B.

(6) Compute entries for columns 7 and 11. Entry equals effect in yards of the correction ordered. In computing, use slant range to the group containing the first burst which carried the correction. Obtain this burst by adding the time of flight to the record time of the shot at the time the correction was applied. The result will give the "records time" of the first burst which carried the correction. Opposite this burst enter result to nearest yard.

(7) Enter values of spotted deviations in column 14. Circle each group of bursts which was considered in making a range adjustment correction.

(8) In column 15 enter percent altitude correction which should have been applied. Entry equals (average of entries in column 13 for the same bursts which were considered in making the range adjustment correction) times 100, divided by (appropriate slant range for that group of bursts). Enter opposite corresponding entry in column 16. Express to nearest tenth of 1 percent and designate direction by plus or minus.

(9) Entry in column 16 equals percent altitude correction which was applied, stripped of the trial shot correction. Enter opposite burst which occurred nearest in time to the time the correction was applied. Opposite burst No. 1 enter percent altitude correction stripped of the trial shot correction which was effective at the time the first round was fired. Use plus or minus to designate direction.

(10) Compute entries in column 17. Entry equals effect in yards of slant range caused by the correction ordered in column 16. Use slant range to the target for that position associated with the group of bursts containing the first round to carry the correction. Express to nearest yard and record opposite the first burst which carried the correction. (See (6) above.)

j. Preparation of graphical analysis (Form AA–6b).—(1) Ordinarily, use a scale such that the distance between heavy lines equals 100 yards. However, if 75 percent of the shots do not plot within the respective spaces allotted to range deviations, lateral deviations, or vertical deviations, use a scale such that the distance between heavy lines equals 200 yards for such deviations. Mark the scale plainly.

(2) Plot each shot in three dimensions, using entries in columns 5, 9, and 13 of Form AA–5. Mark with a small circle about ⅛ inch in diameter. Connect each plotted point with the next with a straight line.

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(3) Fill in solidly with black ink the circles which represent hits.

(4) Plot each entry which affected the location of the bursts from column 14, Form AA–4a. Each entry should appear on the vertical numbered line upon which is plotted the first shot affected by the error. To determine the entry from column 14, Form AA–4a, to plot opposite bursts No. 1, for example, subtract time of flight (Form AA–5) from "records time" of that burst and use entry opposite "records time" nearest in value to the result obtained. Mark each of plotted points with a cross (X) and connect each cross with the next by a straight line.

(5) Plot each entry from column 17, Form AA–5, on the shot line corresponding. Mark each point with a square (□). From each such square draw a line parallel to the axis to the shot line containing the next square. From this point draw a perpendicular line to the next square.

(6) Plot entries from columns 7 and 11, Form AA–5. Mark each with a square (□) and proceed as in (5) above.

k. Preparation of matériel and powder report (Form AA–7).—The form is self-explanatory. If no malfunctioning or breakages occurred, make a negative report under "malfunctioning and breakage of matériel." When a malfunctioning occurs, report name of part in question. When designating an item, its name and number obtained from a standard nomenclature list will be used.

l. Trial shot and calibration report (Form AA–3).—This form is self-explanatory.

m. Summary of practice (Form AA–2b).—(1) Data on items for each course have already been calculated.

(2) The scoring formula will be prescribed annually in the War Department supplement to this manual.

n. Preparation of summary of height finder results (Form AA–4b).—(1) This form is completed only when a stereoscopic height finder is used. A separate form will accompany each Form AA–4a.

(2) Enter records times in column 1. The first entry is the first circled records time and the last entry is the last circled records time in column 1, Form AA–4a.

(3) In column 2 enter angular height from the 0_1 station. Entry equals corresponding entry in column 3, Form AA–4a.

(4) In column 3 enter altitudes computed from camera records (visual records if cameras are not used). Entry equals corresponding entry in column 12, Form AA–4a.

(5) In column 4 enter altitude as actually read from height finder. Entry equals corresponding entry, Form AA–8.

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(6) Make entries in column 5. Entry equals entry in column 4 minus entry in column 3.

(7) Compute averages of columns 2, 3, and 5.

(8) Compute average height finder error, in units of error, from formula printed on Form AA–4b.

(9) Determine range corrector setting which would have given the correct altitude. This value equals the range corrector setting used plus or minus the average error expressed in units of error.

(*a*) For T9E1 and M1 height finders, the value of the error expressed in units of error is added if the height finder altitudes are greater than the true altitudes and subtracted if the height finder altitudes are less than the true altitudes.

(*b*) For M2 height finders, the value of the error expressed in units of error is subtracted if the height finder altitudes are greater than the true altitudes and added if the height finder altitudes are less than the true altitudes.

o. Cover sheet (Form AA–1).—This form is self-explanatory.

Section IV

REPORTS

	Paragraph
Preliminary service practice	65
Record service practice	66
Advanced service practice	67
Distribution of reports	68

65. Preliminary service practice.—Three copies of Form AA–7 will be completed and distributed as follows:

a. One copy retained by the battery after notation by the battalion commander.

b. One copy through ordnance channels to the Chief of Ordnance.

c. One copy of The Adjutant General for file in the office of the Chief of Coast Artillery.

66. Record service practice.—*a. Composition.*—(1) *Sets.*—The following sets of reports of target practice will be prepared for each record practice:

(*a*) Sets 1 and 2 will consist of the following forms bound in the order given:

1. Detection phase.

(a) Cover sheet (Form AA–1).
(b) Summary of practice (Form AA–2a).
(c) Graphical analysis (Form AA–6a).
(d) Target position report (Form AA–4a).

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(e) Battery commander's narrative report.
(f) Battalion commander's indorsement.
(g) Regimental commander's indorsement.
(h) Succeeding indorsements from progress through military channels.

2. Firing phase.

(a) Cover sheet (Form AA–1).
(b) Summary of practice (Form AA–2b, Guns).
(c) Trial shot and calibration report (Form AA–3).
(d) Tabular analysis (Form AA–5), one per course.
(e) Graphical analysis (Form AA–6b), one per course.
(f) Target position report (Form AA–4a), one per course.
(g) Summary of height finder results (Form AA–4b), one per course.
(h) Matériel and powder report (Form AA–7).
(i) Battery commander's narrative report.
(j) Battalion commander's indorsement.
(k) Regimental commander's indorsement.
(l) Succeeding indorsements from progress through military channels.

(*b*) Set 3 will consist of the following in draft form if desired:

1. One copy of each form listed for sets 1 and 2.
2. Target position or adjustment records (Form AA–8).
3. Deviations or spotter's records (Form AA–9) (firing phase only).
4. Chief timekeeper's record (Form AA–10).
5. Computation of impacts (Form AA–11) (firing phase only).

(*c*) Set 4 (firing phase only) will consist of one copy of the matériel and powder report (Form AA–7).

(2) *Binding.*—After arranging the reports in the order indicated above, each set, except set 4, will be provided with flexible back and front (Form AA–1) covers and securely bound at the top with an "Acco" or similar fastener.

b. Forms.—The preparation of the forms listed above is described in section III.

c. Battery commander's narrative report.—This report will be submitted for all record service practices and will include—

(1) Comments on training which are of general interest.

(2) Detailed description of new methods used in the conduct of training or in the service practice.

(3) An analysis of the results of stereoscopic spotting in the practice in which that method is used.

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(4) A statement of the number of lights used for illuminating the target for night practices and whether or not adequate illumination was obtained.

(5) A discussion of the difficulties experienced during the current training season in the operation or maintenance of the matériel and equipment assigned. This discussion will include a full description of each difficulty which occurred, an account of the measures taken to overcome it, and suitable suggestions or recommendations for preventing a recurrence of the same difficulty in the future. Particular attention will be paid to troubles which may have developed in fire control equipment.

(6) Any recommendations the battery commander may desire to make as to changes or improvements in matériel, methods of training or gunnery, or in the scoring formula.

d. Battalion commander's indorsement.—This will include—

(1) Comments on the practice and on any recommendations of the battery commander.

(2) Salient features brought out in the critique.

(3) The certificate called for in paragraph 10*d*.

e. Regimental commander's indorsement.—This will include—

(1) Comments on the practice and on any recommendations of the battery or battalion commanders.

(2) Statement of any failure to comply with provisions of this manual or of the annual training memorandum.

f. Forwarding reports.—Each regimental, harbor defense, and brigade, district, or corresponding tactical commander will examine target practice reports in sufficient detail to enable him to make pertinent comments in his forwarding indorsement. Each report, as soon as checked and commented on, will be forwarded promptly to the next higher commander.

g. Additional assignment and National Guard not in Federal service.—Units of the Regular Army firing antiaircraft guns as additional assignment and National Guard units not in Federal service will submit reports similar to those of regular gun batteries.

h. Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camps.—Those units firing antiaircraft guns will submit Form AA–7 only.

67. Advanced service practice.—*a.* On completion of an advanced practice the battery commander will prepare a detailed narrative report. This narrative report will be sufficiently comprehensive to enable higher authority to determine the actual merits of the practice.

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b. Insofar as practicable the reports will conform to those required for record service practices. The computation of the score is not required for advanced practices.

c. In forwarding indorsements, each higher commander in the proper channel of communication will set forth his views as to the conduct and value of the practice.

68. Distribution of reports.—*a. Regular Army and National Guard in Federal service.*—(1) Set 1 will be forwarded to The Adjutant General through channels.

(2) Set 2 will be forwarded to the coast artillery brigade, district, or corresponding commander through channels. This set, with a copy of the indorsement made on the set forwarded to the army commander, will be returned to the organization for file.

(3) Set 3 and the original records used in the preparation of the target practice report, including camera films, will be retained by the organization for a period of 1 year following the date of the practice, after which time they may be destroyed.

(4) Set 4 will be forwarded through ordnance channels to the Chief of Ordnance.

b. National Guard not in Federal service.—(1) (*a*) Sets 1 and 2 will be forwarded through the State adjutant general and the coast artillery district commander to the army commander.

(*b*) After being indorsed by the district commander and the army commander, set 1 will be forwarded to The Adjutant General, and set 2 will be returned through the coast artillery district commander and the State adjutant general to the organization for permanent file.

(2) Set 3 and the original records used in the preparation of the target practice report will be retained by the organization for a period of 1 year following the date of the practice, after which time they may be destroyed.

(3) Set 4 will be forwarded through ordnance channels to the Chief of Ordnance.

c. Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camps.—Three copies of the matériel and powder report (Form AA–7) will be distributed as follows:

(1) One copy to the organization charged with the maintenance of the battery fired.

(2) One copy through channels to the Chief of Ordnance.

(3) One copy to The Adjutant General for file in the office of the Chief of Coast Artillery.

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CHAPTER 5

ANTIAIRCRAFT AUTOMATIC WEAPONS

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SECTION I

CONDUCT OF PRACTICE

	Paragraph
General	69
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Number of practices, machine-gun battery	72
Procedure	73
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Officials and their duties	76

69. General.—This section includes provisions applicable only to antiaircraft automatic weapons. The provisions of chapter 1 also apply to firing with antiaircraft automatic weapons. In addition, supplemental instructions covering certain phases of antiaircraft target practices, including scoring, will be issued annually by the War Department in a supplement to this manual.

a. Training.—FM 4–112 will be used as a guide for the training of battery personnel.

b. Matériel and personnel.—(1) Insofar as practicable, each platoon will conduct its record service practice using the major standard items of equipment with which it is normally supplied. Should local conditions make necessary the shifting or borrowing of matériel, the regimental commander will give reasons therefor in his forwarding indorsement on the target practice report covering the record service practice concerned.

(2) Should a platoon not possess sufficient personnel to man the normal number of weapons to be used during a record service practice, it may borrow personnel from other platoons.

(3) A record service practice once begun will be completed with the same matériel and personnel with which it was started.

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(4) The above instructions may be waived for batteries firing antiaircraft automatic weapons as additional assignment, and for units of the Reserve Officers' Training Corps, Citizens' Military Training Camps, and Organized Reserves. These units may use whatever matériel is available but key men should be members of the firing battery.

(5) The use of special bolts, springs, or other nonstandard machine gun parts to obtain a rate of fire higher than that obtainable with the caliber .30 and caliber .50 machine guns as issued is prohibited.

c. Information to be furnished airplane director.—(1) The regimental commander will decide on the type of courses, in conformity with the instructions appearing in the following paragraphs, which will be towed for a particular service practice or series of practices, and will furnish the airplane director with the following information prior to the day of the service practice or practices:

(*a*) Type (rectilinear, maneuvering, diving).

(*b*) Altitude.

(*c*) Direction.

(*d*) Minimum horizontal range.

(2) Information concerning the type, altitude, direction, or range of courses to be flown will not be furnished the battery commander.

(3) In planning the courses which will constitute a service practice, every effort will be made to simulate attacks which might be expected under service conditions.

d. Records section.—A records section will be organized in each regiment or in each battalion for the purpose of obtaining accurate synchronized records for use in analysis of service practices. The decision as to whether the records section is organized in the regiment or battalion depends on local conditions and is left to the discretion of the regimental commander. The section will be brought to a high state of training before any service practice. Complete records will be made for all preliminary service practices as nearly as practicable in the same manner as for record service practices.

70. Preliminary service practice.—At least one preliminary service practice will be conducted and completely analyzed before proceeding to a record service practice. Preliminary practices will be conducted under the regulations prescribed for record service practice, but such score will not be taken into consideration in the classification of the organization.

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71. Number of practices, 37-mm gun battery.—Each platoon of 37-mm gun batteries of antiaircraft regiments will fire the following day practices:

a. One or more preliminary and one record service practice with caliber .30 or caliber .50 machine guns mounted on adapters on 37-mm guns.

b. One or more preliminary and one record service practice with 37-mm guns.

72. Number of practices, machine-gun battery.—Each platoon of machine-gun batteries of antiaircraft regiments will fire the following day practices:

a. One or more preliminary and one record service practice with caliber .30 machine guns.

b. One or more preliminary and one record service practice with caliber .50 machine guns.

c. In addition, where practicable, either a caliber .30 or a caliber .50 night practice, consisting of four courses divided between the platoons firing the practices listed in *a* and *b* above, will be fired under the following conditions:

(1) No searchlight illumination will be used on the towing airplane, towline, or target during the actual firing.

(2) On all courses of this practice the target will be towed directly toward the platoon position, and no firing will be allowed until the towing airplane has passed the vertical plane through the right to left axis of the platoon position. The provisions of paragraph 73*a* will not apply to this practice.

(3) Complete records as required for a record service practice will be submitted, but the score of the practice will not be considered in the determination of the classification of the battery for the year.

(4) The narrative report for the night practice will prescribe the manner in which the practice was conducted and will state the time of sunset, amount and source of natural illumination, color of target, and percentage of tracers used.

73. Procedure.—*a. Courses and maneuvers.*—(1) After the battery commander has announced that he is ready to begin the practice, each course on which the safety officer gives clearance will be counted as one course.

(2) If no firing takes place on a safe course, the score for that course will be zero.

(3) Each service practice will consist of five courses.

(*a*) The target will be towed directly toward the platoon for at least one course of each record practice.

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(*b*) The target will be towed directly across the platoon front for at least one course of each record practice.

(*c*) During all courses the towing airplane will execute such maneuvers as are consistent with service conditions and safety.

(*d*) The five courses of a record service practice will be varied as to direction, altitude, slant range, and speed.

b. Ranges and altitudes.—(1) Two of the five courses of each practice will be fired at a target whose altitude is less than 350 yards. On at least two of the remaining courses the target altitude will be greater than 350 yards.

(2) On at least one course of each practice the average slant range will be less than 700 yards. On at least two courses of each practice the average slant range will be between 500 and 1,000 yards.

(3) For 37-mm practices only, on at least one course of each practice the average slant range will be greater than 1,500 yards.

(4) In any record practice in which the provisions of (1), (2), and (3) above have not been fully complied with, the battalion commander will state the reasons therefor in his forwarding indorsement.

c. Determining holes in sleeve on each course.—For record service practices the target will, when practicable, be dropped after each course. When it is impracticable to change the target for each course, bullets marked with printer's ink may be used. When colored bullets are used all bullets should be colored, using different and contrasting colors, one color being used for each course. When the holes are counted, any whose edges are not tinted, either on the outside or inside of the sleeve with one of the colors used during the firing, will be divided equally among the courses of the practice. When colored bullets are used, the holes in the sleeve should be counted as soon after the firing as possible, since colors fade quickly upon exposure.

d. Duration of service practice.—(1) A record service practice will be completed on the same day on which it is begun except that the regimental commander may postpone the completion of a practice when—

(*a*) No sleeve target is available with which to continue the practice.

(*b*) Firing cannot be resumed because of an unsafe field of fire.

(2) When the completion of a record service practice has been postponed for the reasons given above, a detailed explanation will be submitted by the regimental commander in his indorsement on the report of practice.

e. Firing time.—The time of firing on each course is the elapsed time from the command ***Commence firing*** to the last discharge decreased by any time out. Time out will be allowed only when ***Cease firing*** is ordered for reasons of safety which are not due to personnel

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errors or failures of matériel of the battery firing. Only the time actually lost under this provision will be allowed.

f. Number of service practices.—Not more than one service practice, preliminary or record, will be fired by a platoon in any one day.

74. Additional assignment practices.—Batteries firing antiaircraft automatic weapons as additional assignment will be governed by the provisions of this section except as follows:

a. Number of practices.—Each battery will fire one or more preliminary service practices and one record practice.

b. Ranges and altitudes.—(1) Slant range will be less than 700 yards for machine guns and less than 1,000 yards for 37-mm guns when fire is opened on each course except on incoming courses.

(2) Altitudes will be less than 400 yards for each course.

75. National Guard not in Federal service.—Each National Guard automatic weapons battery not in Federal service will be governed by the provisions of this section except as follows:

a. Number of practices.—Each battery will fire one or more preliminary and one or more record service practices.

b. Ranges and altitudes.—Regimental commanders will prescribe ranges and altitudes at which practices will be fired.

76. Officials and their duties.—A list of officials for service practice, together with a statement of their duties, is given below. These officials will be detailed from other regiments unless such action is manifestly impracticable. The officials will be assigned by the regimental commander. In the case of special service practices, only such officials as are necessary for safety and the accomplishment of the purpose of the firing will be required.

a. Safety officers.—(1) *Personnel required.*—One commissioned officer with necessary qualified assistants.

(2) *Duties.*—The duties of the safety officer and his assistants are set forth in FM 4–120.

b. Airplane director.—(1) *Personnel required.*—An officer of the Air Corps, if possible, otherwise a Coast Artillery Corps officer.

(2) *Duties.*—He will serve as liaison officer between the Coast Artillery Corps and the Air Corps. He will transmit all instructions to the pilot of the towing airplane.

c. Officer in charge of records.—(1) *Personnel required.*—Officer in charge of records section.

(2) *Duties.*—As described in paragraph 79*a*.

d. Chief timekeeper.—(1) *Personnel required.*—One officer.

(2) *Duties.*—Obtains and records the elapsed time from ***Commence firing*** to the last discharge of the battery or ***Cease firing.*** Ob-

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tains the data from the assistant timekeepers and the officer in charge of records to complete Form AA–10. No entry is required for lines 8 or 9. The guns may be loaded prior to ***Commence firing.***

e. Assistant timekeepers.—(1) *Personnel required.*—Officers or noncommissioned officers acting as safety pointing observers.

(2) *Duties.*—Act as assistants to the safety officer as safety pointing observers and obtain and record the elapsed time from ***Commence firing*** to the last discharge of the gun to which assigned. They will also record the number of rounds fired on each course and the number and kind of stoppages which occurred on the gun to which assigned.

Section II

RECORDS

	Paragraph
General	77
Records to be taken during service practice	78
Records section	79

77. General.—Accurate information on the results of target practice depends in a large measure on the thoroughness, completeness, and accuracy of the records taken during the practice. The target practice analysis is meaningless unless the records are accurate and complete. Due to the time factor and the nature of the data required, coordinated training of the personnel involved in record taking is of great importance.

78. Records to be taken during service practice.—*a. Target position records, visual (Form AA–8).*—(1) Angular height in mils of the target from the battery (0_1).

(2) Azimuth in mils of the target from the battery (0_1).

(3) Angular height in mils of the target from the flank (0_2).

(4) Azimuth in mils of the target from the flank (0_2).

b. Target position records, camera (Form AA–18).—The same records as required in *a* above, but made upon projection of the camera films. "Camera time" of the readings will be converted to "records time" by the officer in charge of records.

c. Record of lateral and vertical leads (Form AA–8).—This record is required only when the central control equipment set M–1 is used. It is taken from the dials on the control box and recorded opposite records time.

d. Chief timekeeper's record (Form AA–10).—This is a record of the corrected time of action and other data necessary for the synchronization of the records. Times will be taken to the nearest second. For authorized time out see paragraph 73*e*.

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e. Record of number of rounds fired.—This record is kept on each course by the safety pointing observers. There is no special form for this record.

79. Records section.—The organization and training of the records section will be placed on a basis which will insure continuity of training and supervision. A typical organization is outlined in FM 4–110. Its training will be concurrent with the training of the firing batteries. The section will be brought to a high state of training prior to service practice by units of the regiment. The composition and duties of the records section are as follows:

a. Officer in charge of records.—(1) Supervises the functioning of the records section and synchronizes the records.

(2) Gives the command ***Commence tracking*** sufficiently in advance to insure that the target is picked up by the observers.

(3) Gives the command ***Stand by for time zero, ready, take.*** It will be given about 10 or 15 seconds prior to the command ***Commence firing.***

(4) Obtains and records the "records time" of—

(*a*) Commence firing.

(*b*) Cease firing.

(*c*) Last discharge.

(5) Gives the command ***Cease recording*** on a 5-second record time interval after the last discharge.

(6) Collects and verifies all records immediately after the practice and checks them before releasing the recorders.

(7) Computes Form AA–4a.

(8) Counts the holes in the target and reports to the battery commander the number of holes obtained on each course. Paragraph 10*h* requires the battalion commander to verify this count.

(9) Computes the multiplying factor when nonstandard targets are used.

b. Camera detail.—The duties of the camera detail are the same as prescribed for guns in chapter 4, section II, except that the base line will be at least 500 yards long instead of 3,000 yards long.

c. Target position detail, visual.—The duties of the target position detail are the same as prescribed for guns in chapter 4, section II, except that the base line will be at least 500 yards long instead of 3,000 yards long.

d. Lateral and vertical lead recorders.—The lateral and vertical leads actually set are obtained by recording the reading of the outer (mechanical) pointer of the lateral and vertical dials on the control box. The time of recording must be synchronized with that

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of the records section. There are two methods of obtaining these data:

(1) When the leads are not changing rapidly (long range and slow speed), one man reads the dial every 5 seconds, commencing with ***Time zero*** and ending with ***Cease tracking.*** A recorder records the readings on Form AA–8.

(2) When the leads are changing rapidly, a record of leads may be obtained by placing a piece of paper around the outer edge of the lead scale and marking thereon the position of the pointer at the end of each time interval. When the paper is placed around the scale, an orienting mark should be made on the paper opposite the zero of the scale. During a course, the recorder takes position opposite the adjuster. He marks the position of the pointer every 5 seconds commencing with ***Time zero*** and ending with ***Cease tracking.*** After each course the readings are transferred to a Form AA–8, each reading being placed opposite the proper records time.

e. Target detail.—Retrieves the target and turns it over to the officer in charge of records. Assists the officer in charge of records in counting the holes in the target.

SECTION III

ANALYSIS

	Paragraph
General	80
Scoring target	81
Analysis procedure	82

80. General.—The object of analysis of antiaircraft automatic weapons target practice is to determine the proficiency of the firing unit and the performance of the matériel. Antiaircraft automatic weapons target practices will be analyzed in accordance with the provisions of this section.

81. Scoring target.—*a. Definition.*—The standard antiaircraft automatic weapons scoring target is a target in the form of a truncated cone of such dimensions that the area of a longitudinal section through its axis is 85 square feet. Each hole in such a target is scored as a hit.

b. Method of scoring hits.—The following procedure will govern the scoring of hits on the various types of targets:

(1) *B–9 or B–9A.*—This target is of such dimensions that the hits equal the number of holes multiplied by 0.8.

(2) *B–12.*—When this target is used, a hole made in the bridle section will be counted as a hit, a hole made in the small sleeve

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section will be counted as one-half hit, and a hole made in the large sleeve section will be counted as a hit. No multiplying factor other than that given in the tabulation below will be used since the longitudinal cross-sectional area of the B–12 target is substantially the same as that of the standard scoring target as given in *a* above.

Section	Holes made	Multiplying factors	Hits
Bridle	4	1	4
Small sleeve	10	½	5
Large sleeve	6	1	6
Total hits			15

(3) When the A–5 tow target is used, the holes in each section (bridle, small sleeve, and large sleeve) will be counted separately. One half the number of holes in the small sleeve section will be added to the number of holes in the large sleeve section and the bridle section. The total so obtained is then multiplied by 2.5 to get the number of hits.

Section	Holes	Multiplying factor	Net number of holes
Bridle	4	1	4
Small sleeve	10	½	5
Large sleeve	6	1	6
Total			15

15×2.5=37.5 hits.

(4) Where either the A–5 or B–12 target is used, the number of holes counted in each section of the target will be shown separately on Form AA–2b, the form being modified locally.

(5) When necessary to use a sleeve target other than those listed above, the presented area of one of the targets of the type in use should be measured, preferably before the firing, and the proper multiplying factor determined. Measure the length of the target and one half the circumference at each end. Obtain the presented area. Compare this with the presented area of the standard scoring target (85 square feet) and obtain the multiplier to be used. Carry to one decimal place.

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Example: Target used is 16 feet long. One half the circumference at the mouth is 5.5 feet; at the tail, 1.6 feet.

$$\text{Presented area}=\frac{1}{2}\left(\frac{11}{3.14}+\frac{3.2}{3.14}\right)\times 16=36.0 \text{ square feet.}$$

$$\text{Multiplier}=\frac{85}{36}=2.4$$

The number of hits equals 2.4 times the number of holes.

c. Score.—(1) The score for a record service practice consists of the sum of the scores for the individual courses.

(2) The scoring formula for antiaircraft automatic weapons practices will be published annually in a War Department supplement to this manual.

(3) If the target is shot down on any course and lost, or lost from any other cause not chargeable to the battery personnel, the score for that course will be taken as the average of the scores for the other courses of that practice. Every precaution will be taken to prevent the loss of targets.

82. Analysis procedure.—*a. Forms used.*—The data necessary for analysis of automatic weapons practices are obtained from or placed on the following forms:

(1) Target position record (Form AA–8 from 0_1 and 0_2).
(2) Lateral and vertical lead record (Form AA–8).
(3) Target position report (Form AA–4a).
(4) Chief timekeeper's record, automatic weapons (Form AA–10).
(5) Tabular analysis (Form AA–19).
(6) Graphical analysis (Form AA–20).
(7) Summary of practice, automatic weapons (Form AA–2b).

Models of these forms are shown in chapter 7. It will be noted that some of the forms must be improvised locally while others may be obtained from the Coast Artillery Board.

b. Preparation of target position report (Form AA–4a).—(1) Each course requires a separate form.

(2) The target position report will be prepared in a manner similar to that prescribed for antiaircraft gun reports. (See par. 64*d*.) Entries and computations will be from and including the record time interval before ***Commence firing*** to and including the record time interval after the last discharge. No entries are required in columns 10, 13, and 14.

(3) The horizontal plot of courses will be furnished by the records section to the battery commander.

c. Preparation of tabular analysis (Form AA–19).—(1) To complete the tabular analysis the following records are required: Form

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AA–4a, a horizontal plot of the course, and a record of the leads actually set at the control box.

(2) The method of calculation used for this analysis is optional, but the use of the Crichlow slide rule is recommended. The procedure for its use is prescribed in (3) to (20), inclusive, below.

(3) Complete the data called for at the top of Form AA–19. To determine R_m, extend a straight average line through the plotted points on the horizontal plot of the course. The measured length of the perpendicular to the course and passing through the plotted gun position will be the R_m for that course.

(4) The records times for which data are available are copied from Form AA–4a to line 1. Points for which data are available are taken as points of future position for lead computation. Points on the lead curve will be computed for each 5-second interval from ***Time zero*** to ***Cease tracking.***

(5) Determine L_p (line 2) by measuring the distance along the course on the horizontal plot from the midpoint of the course to the point of future position.

(6) α_p (line 3) may be determined by measuring the angle on the horizontal plot with a mil protractor. When using the Crichlow slide rule, hold arm S on the element of lower value (R_m or L_p); set L on the element of greater value (R_m or L_p). Move L until S is on index and read α_p under L on scale C.

NOTE.—α_p is greater than 800 if L_p is greater than R_m, and α_p is less than 800 if L_p is less than R_m.

(7) R_p (line 4). This value may also be determined by measuring the distance from the battery position to the point of future position on the horizontal plot. When using the Crichlow slide rule, hold arm S on the index and set L on α_p on scale D. Move L until S is on R_m, scale E. Read R_p under L on scale E.

(8) Compute ϵ_p and D_p, following the steps for the solution of right triangles printed on the face of the rule.

(9) t_p. Enter the 37-mm firing tables with ϵ_p and D_p. Enter the machine gun firing tables with R_p and H. Interpolate t_p to the nearest one-hundredth of a second.

(10) Line 8 of Form AA–19 is self-explanatory.

(11) L_o (line 9). L_o will be greater than L_p on the approaching leg of a course and less than L_p on the receding leg.

(12) $S_g t_p \sin \alpha_p$. Using the Crichlow slide rule, hold S on index; set L at α_p on scale D. Move L to $S_g t_p$ (line 8) on scale E and read the answer under S on scale E.

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(13) D_o (line 11). When the gun is pointing at the future position with the correct lead, the sight is directed at the present position. The formulas for leads require this one element of present position. To determine D_o, plot range as the ordinate (vertical scale) of a graph and L as the abscissa. Plot D_p opposite values of L_p. Join these points by a smooth curve. Read D_o from this curve opposite the values of L_o. The value of L_o for the first point of a course will be greater or less than the first value of L_p. It is therefore necessary either to extend the range curve by estimation or, the better method, obtain data from the records section for two points before the time of the command ***Commence firing.*** Then the calculation for the first point need be carried only as far as line 6. This gives a point on the range curve ahead of the first L_o and D_o reading required.

(14) δ_L (line 12) and σ_1 (line 17). The angle whose sine is x/y is obtained on the Crichlow slide rule as follows: Hold arm S on x (the numerator) on scale E; set arm L on y (the denominator) on scale E. Without changing the angular displacement between the arms, move L until S is on the index. Read the value of the angle under L on scale D.

(15) The lateral and vertical leads actually set (lines 13 and 20) on the control box are obtained from Form AA–8. Since the normal of each lead dial is 300 for machine guns and 500 for 37-mm guns, these values are subtracted from the readings on Form AA–8 before entering the readings on lines 13 and 20 of Form AA–19. Note that lines 12 and 13 and lines 19 and 20 of Form AA–19 cannot be compared on this form. The lateral and vertical leads actually set on the control box are recorded on this form as a convenient record from which Form AA–20 can be completed.

(16) $S_g t_p \cos \alpha_p$ (line 14). Hold arm S on the index; set arm L on α_p on scale B. Move L to $S_g t_p$ (line 8), scale E, and read the answer under S on scale E.

(17) Sin ϵ_p times line 14 (line 15). Hold arm S on the index; set arm L at ϵ_p on scale D. Move L to the value entered in line 14 and read the answer under S on scale E.

(18) Cos δ_L times line 11 (line 16). Solve in a manner similar to line 14, substituting the proper values for δ_L and D_o.

(19) ϕ_s (line 18). Enter the proper firing table with H and R_p and determine the superelevation to the nearest mil.

(20) σ_L (line 19). The form is self-explanatory. Remember that the sign of σ_L, line 17, is positive as long as the angular height is increasing and negative when the angular height of the target is decreasing. The sign of ϕ_s is always positive.

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d. Preparation of graphical analysis (Form AA–20).—The graphical analysis is designed to present in graphical form the data shown on Form AA–19. The graph shows a curve of computed lateral and vertical leads and a separate curve of the lateral and vertical leads that were actually set on the gun.

(1) The vertical scale is in mils. When the maximum and minimum values of the computed and set leads will permit, the scale will be 1 inch=10 mils. The two lateral lead curves are plotted on the upper half of the sheet, and the two curves of vertical deflection are plotted in the lower half of the sheet.

(2) The horizontal scale is in yards (L) of distance along the horizontal projection of the target's course, measured from the midpoint of a crossing course. L is positive when measured in the direction of flight (on the receding leg of the course). When the time between ***Commence firing*** and the last discharge of a gun is 20 seconds or less, the horizontal scale will be 1 inch=200 yards. For longer courses or high ground speeds the scale will be decreased as necessary.

(3) A vertical solid line will be drawn on the graphical analysis at points representing the present position (L_o) of the target at the command ***Commence firing*** and at the time of last discharge. Label the first line *OF* and the second line *LS*

e. Preparation of matériel and ammunition report (Form AA–13).—(1) Under *f*, Form AA–13, list each different kind of stoppage which occurred and the number of times each kind occurred.

(2) Under *g*, Form AA–13, report all breakages or malfunctioning. In listing malfunctionings, the name and number of the part will be taken from a standard nomenclature list. If no breakages or malfunctioning occurred, so state.

f. Summary of practice (Form AA 2b).—This form is self-explanatory. The averages will not be weighted.

Section IV

REPORTS

	Paragraph
Preliminary service practice	82
Record service practice	84
Advanced service practice	85
Distribution of reports	86

83. Preliminary service practice.—Three copies of Form AA–13 will be completed and distributed as follows:

a. One copy retained by the battery after notation by the battalion commander.

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b. One copy through ordnance channels to the Chief of Ordnance.

c. One copy to The Adjutant General for file in the office of the Chief of Coast Artillery.

84. Record service practice.—*a. Composition.*—(1) *Sets.*—The following sets of reports of target practice will be prepared for each record service practice:

(*a*) Sets 1 and 2 will consist of the following reports bound in the order given:

1. Cover sheet (Form AA–12).
2. Summary of practice (Form AA–2b, automatic weapons).
3. Target position report (Form AA–4a), one per course.
4. Matériel and ammunition report (Form AA–13).
5. Tabular analysis (Form AA–19), one per course.
6. Graphical anaylsis (Form AA–20), one per course.
7. Battery commander's narrative report.
8. Battalion commander's indorsement.
9. Regimental commander's indorsement.
10. Succeeding indorsements from progress through military channels.

(*b*) Set 3 will consist of the following reports in draft form if desired:

1. One copy of each form listed for sets 1 and 2.
2. Target position record (Form AA–8).
3. Chief timekeeper's record (Form AA–10).

(*c*) Set 4 will consist of one copy of the matériel and ammunition report (Form AA–13).

(2) *Binding.*—After arranging the reports in the order indicated above, each set, except set 4, will be provided with flexible back and front (Form AA–12) covers and securely bound at the top with an "Acco" or similar fastener.

b. Forms.—The preparation of the forms listed above is described in section III.

c. Battery commander's narrative report.—This report will be submitted for all record service practices and will include—

(1) Comments on training which are of general interest.

(2) Detailed description of new methods used in the conduct of training or in the service practice.

(3) A discussion of the difficulties experienced during the current training season in the operation or maintenance of the matériel and equipment assigned. This discussion will include a full description of each difficulty which occurred, an account of the measures to overcome it, and suitable suggestions or recommendations for preventing a recurrence of the same difficulty in the future.

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(4) Any recommendations the battery commander may desire to make as to changes or improvement in matériel, methods of training or gunnery, or in the scoring formula.

d. Battalion commander's indorsement.—This will include—

(1) Comments on the practice and on any recommendations of the battery commander.

(2) Salient features brought out in the critique.

(3) The certificate called for in paragraph 10*d*.

e. Regimental commander's indorsement.—This will include—

(1) Comments on the practice and on any recommendations of the battery or battalion commanders.

(2) Statement of any failure to comply with provisions of this manual or of the annual supplement to this manual (par. 2).

f. Forwarding reports.—Each regimental, harbor defense, and district commander will examine target practice reports in sufficient detail to enable him to make pertinent comments in his forwarding indorsement. Each report, as soon as checked and commented on, will be forwarded promptly to the next higher commander.

g. Additional assignment and National Guard not in Federal service.—Units of the Regular Army firing automatic weapons as additional assignment and National Guard units not in Federal service will submit reports similar to those of regular automatic weapon batteries.

h. Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camps.—Those units firing automatic weapons will submit Form AA–13 only.

85. Advanced service practice.—*a.* On completion of an advanced service practice the battery commander will prepare a detailed narrative report. This narrative report will be sufficiently comprehensive to enable higher authority to determine the actual merits of the practice.

b. Insofar as practicable the reports will conform to those required for record service practices. The computation of the score is not required for advanced practices.

c. In forwarding indorsements, each higher commander in the proper channel of communication will set forth his views as to the conduct and value of the practice.

86. Distribution of reports.—*a. Regular Army and National Guard in Federal service.*

(1) Set 1 will be forwarded to The Adjutant General through channels.

(2) Set 2 will be forwarded to the coast artillery brigade district, or corresponding commander through channels. This set, with a

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copy of the indorsement made on the set forwarded to the army commander, will be returned to the organization for file.

(3) Set 3 and the original records used in the preparation of the target practice report will be retained by the organization for a period of 1 year following the date of the practice, after which time they may be destroyed.

(4) Set 4 will be forwarded through ordnance channels to the Chief of Ordnance.

b. National Guard not in Federal service.—(1) (*a*) Sets 1 and 2 will be forwarded through the State adjutant general and the coast artillery district commander to the army commander.

(*b*) After being indorsed by the district commander and the army commander, set 1 will be forwarded to The Adjutant General, and set 2 will be returned through the coast artillery district commander and the State adjutant general to the organization for permanent file.

(2) Set 3 and the original records used in the preparation of the target practice report will be retained by the organization for a period of 1 year following the date of the practice, after which time they may be destroyed.

(3) Set 4 will be forwarded through ordnance channels to the Chief of Ordnance.

c. Organized Reserves, Reserve Officers' Training Corps, and Citizen's Military Training Camps.—Three copies of the matériel and ammunition report (Form AA–13) will be distributed as follows:

(1) One copy to the organization charged with the maintenance of the battery fired.

(2) One copy through channels to the Chief of Ordnance.

(3) One copy to The Adjutant General for file in the office of the Chief of Coast Artillery.

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CHAPTER 6

ANTIAIRCRAFT SEARCHLIGHTS

		Paragraphs
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SECTION I

CONDUCT OF PRACTICE

	Paragraph
General	87
Conditions of practice	88
Preliminary service practice	89
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National Guard not in Federal service	92
Officials and their duties	93

87. General.—This section includes provisions applicable only to antiaircraft searchlights. The provisions of chapter 1 also apply to antiaircraft searchlights. In addition, supplemental instructions covering certain phases of antiaircraft target practices, including scoring, will be issued annually by the War Department in a supplement to this manual.

a. Object of record service practice.—The object of record service practice for antiaircraft searchlight units is to test their efficiency in detecting and illuminating aerial targets early enough to permit gun batteries to take them under fire at maximum range.

b. Matériel and personnel.—(1) Insofar as practicable, each battery will conduct record service practice with the major standard items of equipment with which it is normally supplied. Should local conditions make necessary the shifting or borrowing of matériel, the regimental commander will give reasons therefor in his forwarding indorsement on the target practice report covering the record service practice concerned.

(2) A record service practice once begun will be completed with the same matériel and personnel with which it was started.

(3) These instructions may be waived for batteries manning antiaircraft searchlights as additional assignment, and for units of the

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Reserve Officers' Training Corps, Citizens' Military Training Camps, and Organized Reserves. These units may use whatever matériel is available.

c. Duration of service practice.—A record service practice will be completed on the same night on which it is begun except that the regimental commander may postpone the completion of a practice when—

(1) No airplane is available with which to continue the practice.

(2) A sudden change in atmospheric conditions prevents continuance of the practice at prescribed altitudes.

d. Information to be furnished airplane director.—(1) The regimental commander will decide on the type of courses which will be flown for a particular service practice or series of practices, and will furnish the airplane director with the following information prior to the day of the service practice or practices:

(*a*) Type of each course (rectilinear, maneuvering, diving).

(*b*) Altitude of each course.

(*c*) Direction of each course.

(*d*) Minimum horizontal range of each course.

(2) Information concerning the type, altitude, direction, or range of courses to be flown will not be furnished the battery commander.

(3) In planning the courses which will constitute a service practice, every effort will be made to simulate attacks which might be expected under service conditions.

e. Records section.—A records section will be organized in each regiment or in each battalion for the purpose of obtaining accurate synchronized records for use in analysis of service practices. The decision as to whether the records section is organized in the regiment or battalion depends on local conditions and is left to the discretion of the regimental commander. The section will be brought to a high state of training before any service practice. Complete records will be made for all preliminary service practices as nearly as practicable in the same manner as for record service practices. The duties of the records section are discussed in section II.

88. Conditions of practice.—*a. Objective and searchlight positions.*—Service practices will be conducted from war positions as far as practicable. The objective defended and the defensive sectors will, insofar as possible, be those assigned for actual defense under war conditions. Where a wartime mission has not been assigned to the searchlight battery, the objective to be defended in service practices will be assigned by the harbor defense or regimental commander subject to approval by the coast artillery district or brigade commander.

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The principles set forth in section III, chapter 5, FM 4–105, will be followed in locating the elements of the battery to solve the tactical problem involved in the defense of the objective.

b. Listening posts.—Listening posts will be located far enough (5 to 8 miles) in advance of the forward light positions to allow time for the transmission of warnings and a search of the threatened area with the sound locators prior to the time the target airplane comes within range of the searchlights.

c. Size of defensive sector.—Each record service practice will consist of setting up and defending a sector appropriate in size to the number of searchlights employed. A battery of fifteen searchlights is the minimum required for a 360° coordinated defense. This minimum is suitable only when the objective is 1,000 yards or less in diameter. Objectives larger than 1,000 yards in diameter require more than fifteen searchlights for a reasonable defense. The size of the sector defended will be governed by the matériel and personnel available and by peacetime limitations on the number of suitable searchlight positions that can be occupied.

(1) When matériel and personnel are available for the operation of fifteen or more searchlight units, each record service practice will provide for a 360° searchlight defense, except as noted in *e* below.

(2) When the number of searchlight units available and manned is less than fifteen, the following provisions will govern the size of the defensive sector.

(*a*) The size of the sector in degrees that a given number of lights (less than fifteen) is expected to defend may be expressed as follows:

$$\frac{360°}{15 \text{ lights}} \times \text{number of lights available.}$$

(*b*) To compensate for the assistance that each neighboring light on the flank would provide in a 360° defense, the size of the service practice defensive sector as determined in (*a*) above will be reduced by 15° on each flank of the sector.

(*c*) Therefore, the size of the defensive sector to be used for service practice may be expressed as follows:

$$\text{Size of sector in degrees} = (24 \times \text{number of lights}) - 30°$$

d. Local conditions.—Should local conditions make it necessary to deviate from the provisions of *c* above, the regimental commander will give reasons therefor in his forwarding indorsement on the target practice report covering the record service practice concerned.

e. Defense by more than one battery.—When more than one battery is assigned to the defense of the same objective, battery sectors will

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be prescribed and the number and types of courses prescribed for a record service practice will be provided for each battery.

f. Marking defensive sector.—(1) The objective will be marked by the emplacement of a suitable light which may be located easily by the attacking airplane. The light used for this purpose may be any searchlight, beacon, or other suitable marker.

(2) When the sector is less than 360°, the sector boundaries will be marked by beacons or other suitable markers.

89. Preliminary service practice.—At least one preliminary service practice will be conducted and analyzed completely before proceeding to a record service practice. Preliminary practices will be conducted under the regulations prescribed for record service practice, but such score will not be taken into consideration in the classification of the organization.

90. Procedure.—*a. Number of record service practices.*—Each searchlight battery will conduct three record service practices.

b. Courses.—Four courses will constitute a record practice. One course of each record practice will be a gliding course simulating a high altitude gliding bombing attack. On this course the plane will start its glide before it crosses the line of listening posts. Each course will be started beyond the range of the listening posts and will terminate when the airplane passes the objective or is lost.

c. Target maneuvers.—On each of the four courses of a record service practice not more than three searchlights will be employed at any one time in searching for the target, and not more than two searchlights will be employed to carry the target after it is picked up. The pilot of the airplane will attempt to escape the illuminating lights by employing any maneuvers consistent with safety, provided he continues in the general direction of the objective.

d. Altitude.—On all courses of the record service practices conducted by antiaircraft searchlight batteries of Regular Army and National Guard in Federal service, the minimum altitude of each course, except the gliding course, will be 10,000 feet. On the gliding course the glide will be started at an altitude of not less than 10,000 feet.

e. Type of target.—A modern bombardment airplane will be used as a target. Airplanes whose exhaust is visible from the ground will not be used.

f. Camouflage.—The propellers and the under side of the fuselage, the tail surfaces, and the wings of airplanes used as targets in service practices will be entirely covered with a dull black wash or paint, the specification of which will be prescribed by the Chief of the

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Air Corps. Each target practice report will specifically state whether or not a blackened airplane was used.

g. Visibility.—Searchlight record service practices will not be conducted on nights when conditions, as moonlight or cloud background, are such that the target may be seen with the unaided eye from ground stations.

h. Tracking.—Control stations will not be manned during the time the target is going out preparatory to making a new attack. Regimental commanders will take positive steps to insure that targets are not tracked out by means of the binoculars on the control station.

91. Additional assignment practices.—Regular Army organizations manning antiaircraft searchlights as additional assignment will conduct at least one preliminary and one record service practice.

92. National Guard not in Federal service.—National Guard searchlight batteries not in Federal service will conduct at least one preliminary and one record practice.

93. Officials and their duties.—A list of officials for service practices together with a statement of their duties is given below. These officials will be detailed from other regiments unless such action is manifestly impracticable. The officials will be assigned by the regimental commander. In the case of special service practices only such officials as are necessary for the accomplishment of the purpose of the practice will be detailed.

a. Airplane director.—(1) *Personnel.*—An officer of the Air Corps, if possible, otherwise a Coast Artillery Corps officer.

(2) *Duties.*—He will serve as liaison officer between the Coast Artillery Corps and the Air Corps. He will transmit all instructions to the pilot of the towing airplane.

b. Officer in charge of records.—(1) *Personnel.*—Officer in charge of records section. He has a number of assistants, the number depending on the size of the defensive sector.

(2) *Duties.*—As described in paragraph 96*a*.

c. Assistants to officer in charge of records.—(1) *Personnel.*—One officer or qualified noncommissioned officer in charge of each target position detail.

(2) *Duties.*—Supervises the work of the target position detail.

d. Chief timekeeper.—(1) *Personnel.*—The officer in charge of records also acts as chief timekeeper.

(2) *Duties.*—(*a*) Obtains and records for each course—

1. Clock time of the following:

(a) First light in action.

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(b) Pick-up.
(c) End of course.

2. Elapsed time to the nearest second:
(a) First light in action to pick-up.
(b) Total carry time.

(*b*) Obtains the data required to complete Form AA–14 from assistant timekeepers and from his own records.

e. Assistant timekeepers.—(1) *Personnel.*—The assistants to the officer in charge of records also act as assistant timekeepers. In addition, timekeepers will be stationed near the outer ring of lights to insure that all parts of the defensive sector are under observation by the timekeeper's detail.

(2) *Duties.*—(*a*) Obtains and records for each course—

1. Clock time of the following:
(a) First light in action.
(b) Pick-up.
(c) End of course.

2. Elapsed time to the nearest second:
(a) First light in action to pick-up.
(b) Total carry time.

(*b*) Turns records in to chief timekeeper.

f. Instructions for timekeepers.—(1) Each timekeeper will be equipped with a time interval recorder (stop watch) which has two recording hands.

(2) Each timekeeper starts both hands of his watch as soon as the first light goes into action.

(3) At the instant of the first illumination of the airplane, the secondary hand is stopped and the primary hand allowed to continue.

(4) If the plane is continuously illuminated and the moving primary hand leads the secondary hand by 10 seconds or more, a pick-up has been made. The secondary hand indicates the time from the time the first light went in action to pick-up, and this value is recorded.

(5) The secondary hand is then brought into coincidence with the moving primary hand.

(6) If the plane is not continuously illuminated for 10 seconds ((4) above), the secondary hand is brought into coincidence with the primary hand at the instant the plane is uncovered. This procedure with the secondary hand is repeated for each succeeding illumination of the airplane until a pick-up has been made on the course.

(7) After a pick-up has been made and recorded and the secondary hand brought into coincidence with the primary hand, the secondary hand is then used to determine when the airplane has been lost and

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when the course is ended. This is done by stopping the secondary hand at the instant the airplane is uncovered. If 10 seconds or less have elapsed before the airplane is again illuminated, the airplane is not considered lost, and the secondary hand is again brought into coincidence with the primary hand without recording the data. However, if more than 10 seconds have elapsed since the airplane was uncovered, the airplane is considered lost and the course ended. The secondary hand then indicates the elapsed time from the instant the first light went into action to the end of the course.

(8) It will be noted that the primary hand is not stopped at any time until the course is completed.

(9) Timekeepers with target position details will also synchronize the readings by announcing to the recorders the 10-second intervals as indicated by the primary hand.

SECTION II

RECORDS

Paragraph
General 94
Records to be taken during service practice 95
Records section 96

94. General.—Accurate information on the results of target practice depends in a large measure on the thoroughness, completeness, and accuracy of the records taken during the practice. The analysis is misleading unless the records are accurate and complete. Due to the time factor and the nature of the data required, coordinated training of the personnel involved in record taking is of great importance.

95. Records to be taken during service practice.—The following records will be taken during each searchlight service practice:

a. Target position records, visual (Form AA–8).—(1) Angular height in mils of the target from the data station.

(2) Azimuth in mils of the target from the data station.

(3) Altitude in yards of the target from the data station.

b. Chief timekeeper's record (Form AA–14).—This is a record of the clock time of the first light in action, pick-up, and end of course, and the elapsed time from first light in action to pick-up and total carry time.

96. Records section.—The organization and training of the records section will be placed on a basis which will insure continuity of training and supervision. The section will be brought to a high state of training prior to any service practice. The composition

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and duties of the records section during searchlight service practices are as follows:

a. Officer in charge of records.—(1) Supervises the functioning of the records sections.

(2) Stations target position details and timekeepers in locations which will insure that all parts of the defensive sector are under observation.

(3) Performs duties of chief timekeeper (par. 93*d*).

(4) Collects and verifies all records immediately after the practice.

(5) Computes Form AA-4a.

b. Assistants to officer in charge of records.—(1) Supervises functioning of target position detail; coordinates and synchronizes readings of altitude, angular height, and azimuth by height finder and BC telescope details. Readings are made at 10-second intervals.

(2) Performs duties of assistant timekeeper (par. 93*e*).

(3) Collects and verifies all records of target position detail and turns records over to officer in charge of records.

c. Target position detail, visual.—(1) Set up, orient, and adjust BC telescope and height finder at position designated.

(2) Pick up and track the target as soon as it is illuminated.

(3) Record readings of azimuth and angular height on 10-second intervals as announced by the timekeeper.

(4) Record readings of altitude opposite the nearest 10-second reading time as frequently as practicable during the time the target is illuminated.

(5) A dash will be entered in the space opposite each time on which a reading was not obtained.

(6) Complete proper forms (Form AA-8) and turn them in to the assistant officer in charge of records.

d. Number of target position details.—The target position details should be located well forward of the objective but in rear of the outer ring of lights. The number of details should be sufficient to insure that all parts of the sector are under observation. This number will vary with the size of the sector and local conditions of terrain and visibility.

SECTION III

ANALYSIS

	Paragraph
General	97
Analysis procedure	98

97. General.—The object of analysis of antiaircraft searchlight target practice is to determine the proficiency of the searchlight bat-

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tery and the performance of the matériel. Antiaircraft searchlight target practices will be analyzed in accordance with the provisions of this section.

98. Analysis procedure.—*a. Forms used.*—The data necessary for analysis of antiaircraft searchlight practices are obtained from or placed on the following forms:

(1) Target position record (for azimuth, angular height, and altitude) (Form AA–8).

(2) Target position report (Form AA–4a).

(3) Defended area plan.

(4) Chief timekeeper's record (searchlights) (Form AA–14).

(5) Summary of practice (searchlights) (Form AA–16).

Models of these forms are shown in chapter 7. It will be noted that some of the forms must be improvised locally while others may be obtained from the Coast Artillery Board.

b. Preparation of target position report (Form AA–4a).—(1) Column 1, enter time from Form AA–8.

(2) Column 2, enter azimuth of target from Form AA–8.

(3) Column 3, enter angular height from Form AA–8.

(4) Column 6, enter altitude from Form AA–8.

(5) Column 4, enter horizontal range, determined by use of Lewis chart, graphically or by computation from angular height and altitude with Crichlow slide rule.

(6) Fill in data in heading except "direction."

(7) Fill in data for "ground speed of target" and "type of airplane."

(8) Compute averages for altitude only.

(9) Do not enter any other data except those specified.

c. Defended area plan.—A chart drawn to scale (fig. 14) will be prepared, showing—

(1) Listening posts.

(2) Searchlights and sound locators.

(3) Data stations (*G*).

(4) Communication lines.

(5) Sector boundaries.

(6) Objective.

(7) Horizontal projection of each course of the airplane, plotted by means of azimuths and horizontal ranges from the data station (*G*) (Form AA–4a), showing—

(*a*) Plotted position each 10 seconds.

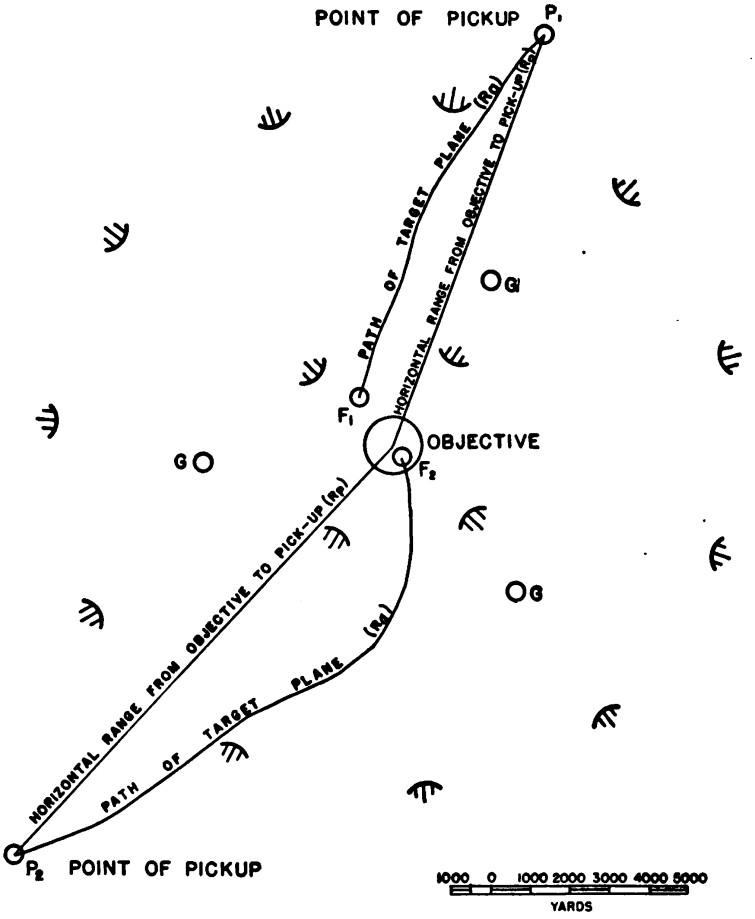
(*b*) Point of pick-up (point *P*). This point is obtained by extending the course back from the first plotted point. For example, if the first position reading on the airplane was made at 30 seconds

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and the pick-up was made at 17 seconds, the course will be extended back from the first reading by an amount equal to the average observed ground speed in yards per second multiplied by 13 seconds.

(*c*) End of course (point *F*).

(8) Scale of chart in graphical form.



NOTE.—Listening posts and communication lines are not shown in this figure.

FIGURE 14.—Defended area plan.

d. Summary of practice (*Form AA–16*).—(1) This form is self-explanatory. The data on items for each course are obtained from the target position report (Form AA–4a), chief timekeeper's record, and the defended area plan.

(2) R_L is the average distance from the three searchlights in the outer ring which are closest to the course under consideration.

(3) The scoring formula will be prescribed annually in the War Department supplement to this manual.

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SECTION IV

REPORTS

Paragraph
Preliminary service practice 99
Record service practice 100
Advanced service practice 101
Distribution of reports 102

99. Preliminary service practice.—Three copies of Form AA–15 (Matériel reports (AA Searchlights)) will be completed and distributed as follows:

a. One copy retained by the battery after notation by the battalion commander.

b. One copy through engineer channels to the Chief of Engineers.

c. One copy to The Adjutant General for file in the office of the Chief of Coast Artillery.

100. Record service practice.—*a. Composition.*—(1) *Sets.*—The following sets of reports of target practice will be prepared for each record service practice:

(*a*) Sets 1 and 2 will consist of the following reports bound in the order given:

1. Cover sheet (Form AA–17).
2. Summary of practice (Form AA–16).
3. Defended area plan. This form will be folded to the same size as that of the cover sheet (8½×13 inches).
4. Target position report (Form AA–4a).
5. Matériel report (Form AA–15).
6. Battery commander's narrative report.
7. Battalion commander's indorsement.
8. Regimental commander's indorsement.
9. Succeeding indorsements from progress through military channels.

(*b*) Set 3 will consist of the following in draft form if desired:

1. One copy of each form listed for sets 1 and 2.
2. Target position record (Form AA–8).
3. Chief timekeeper's record (Form AA–14).

(*c*) Set 4 will consist of one copy of the matériel report (Form AA–15).

(*2*) *Binding.*—After arranging the reports in the order indicated above, each set, except set 4, will be provided with flexible back and front (Form AA–17) covers and securely bound at the top with an "Acco" or similar fastener.

b. Forms.—The preparation of the forms listed above is described in section III.

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c. Battery commander's narrative report.—This report will be submitted for all record service practices and will include—

(1) Comments on training which are of general interest, including a brief description of the methods used in the selection and training of listeners, the number tested, and the percentage found satisfactory.

(2) A discussion of the difficulties experienced during the current training season in the operation or maintenance of the matériel and equipment assigned. This discussion will include a full description of each difficulty which occurred, an account of the measures to overcome it, and suitable suggestions or recommendations for preventing a recurrence of the same difficulty in the future.

(3) Any recommendations the battery commander may desire to make as to changes or improvement in matériel, methods of training or gunnery, or in the scoring formula.

d. Battalion commander's indorsement.—This will include—

(1) Comments on the practice and on any recommendations submitted by the battery commander.

(2) Salient features brought out in the critique.

(3) The certificate called for in paragraph 10*d*.

e. Regimental commander's indorsement.—This will include—

(1) Comments on the practice and on any recommendations of the battery or battalion commanders.

(2) Statement of any failure to comply with provisions of this manual or of the annual supplement and reason therefor.

f. Forwarding reports.—Each regimental, harbor defense, and brigade or district commander will examine target practice reports in sufficient detail to enable him to make pertinent comments in his forwarding indorsement. Each report, as soon as checked and commented on, will be forwarded promptly to the next higher commander.

g. Additional assignment and National Guard not in Federal service.—Units of the Regular Army conducting searchlight practices as additional assignment and National Guard searchlight batteries not in Federal service will submit reports similar to those of regular searchlight batteries.

h. Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camps.—Those units conducting searchlight practices will submit Form AA–15 only.

101. Advanced service practice.—*a.* On completion of an advanced practice the battery commander will prepare a detailed narrative report. This narrative report will be sufficiently comprehensive to enable higher authority to determine the actual merits of the practice.

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b. Insofar as practicable the reports will conform to those required for record service practices. The computation of the score is not required for advanced practices.

c. In forwarding indorsements, each higher commander in the proper channel of communication will set forth his views as to the conduct and value of the practice.

102. Distribution of reports.—*a. Regular Army and National Guard in Federal Service.*—(1) Set 1 will be forwarded to The Adjutant General through channels.

(2) Set 2 will be forwarded to the coast artillery brigade, district or corresponding commander through channels. This set, with a copy of the indorsement made on the set forwarded to the army commander, will be returned to the organization for file.

(3) Set 3 and the original records used in the preparation of the target practice report will be retained by the organization for a period of 1 year following the date of the practice, after which time they may be destroyed.

(4) Set 4 will be forwarded through channels to the Chief of Engineers.

b. National Guard not in Federal service.—(1) (*a*) Sets 1 and 2 will be forwarded through the State adjutant general and the coast artillery district commander to the army commander.

(*b*) After being indorsed by the district commander and the army commander, set 1 will be forwarded to The Adjutant General, and set 2 will be returned through the coast artillery district commander and the State adjutant general to the organization for permanent file.

(2) Set 3 and the original records used in the preparation of the target practice report will be retained by the organization for a period of 1 year following the date of the practice, after which time they may be destroyed.

(3) Set 4 will be forwarded through channels to the Chief of Engineers.

c. Organized Reserves, Reserve Officers' Training Corps, and Citizens' Military Training Camps.—Three copies of the matériel report (Form AA–15) will be distributed as follows:

(1) One copy to the organization charged with the maintenance of the matériel.

(2) One copy through channels to the Chief of Engineers.

(3) One copy to The Adjutant General for file in the office of the Chief of Coast Artillery.

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SUMMARY OF PRACTICE

DETECTION PHASE

BATTERY_____, *Coast Artillery (AA)*. **PLACE**_____

DATE_____ **TIME**_____

1	2	3	4	5	6
Course number	Altitude H	R	R_m	$\frac{R}{R_m}$	Score $\frac{R}{R_m} \times K$
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Total score, detection phase					

I certify that the above computations are correct.

(Signed)_____,

_____,
Battery commander.

One copy each:
AGO
CG, Brig or CA Dist
Btry

Form AA-2a.

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SUMMARY OF PRACTICE

FIRING PHASE

Guns

BATTERY_____, _____ *Coast Artillery (AA).* PLACE_____
DATE_____ TIME_____

Course number	1	2	3	4	5	Summary
Direction of course						
Average slant range (yards)						
Average horizontal range (yards)						
Average altitude (yards)						
Average angular height (mils)						
Ground speed of plane (m. p. h.)						
Number of guns						
Number of shots						
Number of hits						
Percent of hits						
Hits per gun per minute						
Shots per gun per minute						
Time of action (seconds)						
Average time of flight						
Number of holes						
_____						
_____						
Type of target						
Score						**Total**
$Sg/25$						
$15+Sg/25$						
$H'G'M'$						
HGM						
$\frac{H'G'M'}{\left(15+Sg/25\right)\left(\frac{HGM}{H'G'M'}\right)}$						

I certify that the above computations are correct.

(Signed) _____,
_____,
Battery commander.

1 copy each:
AGO
CG, Brig or CA Dist
Btry

Form AA-2b.

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SUMMARY OF PRACTICE

Firing Phase

37-mm Guns or Machine Guns

BATTERY ------, ------ *Coast Artillery (AA).* PLACE ----------
DATE ---------- TIME ----------

Course number	1	2	3	4	5	Summary
Direction of course						
Average slant range (yards)						
Average horizontal range (yards)						
Average altitude (yards)						
Average angular height (mils)						
Ground speed of plane (m. p. h.)						
Number of guns						
Number of shots						
Number of hits						
Percent of hits						
Hits per gun per minute						
Shots per gun per minute						
Time of action (seconds)						
Type of target						
Number of holes						

Score						Total

$Sg/25$						
$15+Sg/25$						
H′G′M′						
$\frac{HGM}{H'G'M'}$						
$\left(15+Sg/25\right)\left(\frac{HGM}{H'G'M'}\right)$						

I certify that the above computations are correct.

(Signed) ----------,
----------,
Battery commander.

One copy each:
AGO
CG, Brig or CA Dist
Btry

Form AA-2b.

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TRIAL SHOT AND CALIBRATION REPORT

BATTERY _____, _____ *Coast Artillery (AA)*. PLACE _____
DATE _____ TIME _____

TRIAL SHOT POINT

	Azimuth (mils)	Horizontal range (yards)	Altitude (yards)	Angular height (mils)
0_1 to T. S. P				
0_2 T. S. P				
0_1 to 0_2				

Firing data were corrected for the following nonstandard conditions:
Muzzle velocity of cams used _____
Muzzle velocity (previously determined) _____ (from section b, Form AA–7).
Fuze error (previously determined) _____ (from section b, Form AA–7).
Meteorological message used. First group _____ Altitude group _____
Powder temperature _____
Ballistic corrections (see FM 4–110).
dH% (due to ΔMV) _____ *dφ* (due to Δ MV) _____
dF (due to Δ density) (Mk. III fuze only) _____
Gun data on which trial shots were fired (gun No. _____)
Quadrant elevation _____. Azimuth _____. Fuze _____.

Shot No.	Observed deviations in mils of trial shots						Center of burst and T. S. corrections	Calibration corrections			
	Horizontal or slant plane [1] (battery 0_1)				Horizontal or slant plane [1] (flank 0_2)			Gun No.	*φ*	*F.*	Az. cor.
	R	L	A	B	O	S					
1							Hor. range to CB				
2							T. S. corrections:				
3							M. V. cor.	1			
4								2			
5							% alt. cor	3			
							φ cor	4			
Average							Az. cor				

[1] Line out inappropriate phrase.

(Signed) _____,
_____.

One copy each:
AGO
CG, Brig or CA Dist
Btry

Form AA–3.

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TARGET POSITION REPORT

BATTERY _____, _____ *Coast Artillery (AA)*. **PLACE** _____
DATE _____. **TIME** _____
Course No. _____. Direction of course _____.

Time	Battery camera visual					Flank camera visual					Altitude (yards) (mean of columns 6 and 11)	Altitude errors	
	Az. target, minus— 1. Az. 0_1—0_2 2. Back az. 0_1—0_2	Angular height (mils)	Hor. range (yards): Guns (computed from columns 2 and 7); S. L.'s (computed from columns 3 and 6)	Slant range (yards) (computed from columns 3 and 4)	Altitude (yards): Guns (computed from columns 3 and 4); S. L.'s (read by altimeter)	Az. target, minus— 1. Az. 0_1—0_2 2. Back az. 0_1—0_2	Anglar height (mils)	Hor. range (yards) (computed from columns 2 and 7)	Slant range (yards) (computed from columns 8 and 9)	Altitude (yards) (computed from columns 8 and 9)		Percent (computed)	Effect on slant range (yards)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Average													

Length of base line _____ yards
Azimuth of base line (0_1–0_2)_____.
Ground speed of target_____{m. p. h. / y. p. s.
Pilot's average air speed_____ m. p. h.

Type of towing plane_____
Average time of flight_____seconds
Time of {commence firing (MG)_____ / first burst (guns)_____
Time of {cease firing (MG)_____ / last burst (guns)_____

(Signed) _____,
_____.

One copy each:
AGO
CG, Brig or CA Dist
Btry
Form AA–4a.

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SUMMARY OF HEIGHT FINDER RESULTS

(Complete only when stereoscopic height finder is used)

BATTERY ——, —— *Coast Artillery (AA)*. PLACE ——————

DATE —————— TIME ——————

Course No. —————— Direction of course ——————

a. Name of observer ——————

——————

Has he attended CA School observer's course? ————

Year? ————

Has he attended any other observers' school? ————

Where? ——————

Year? ————

b. Height finder ——————
(Type and model)

c. Serial number ——————

d. Magnification used ——— (M)

e. Range corrector setting used ——

——————

f. How was setting determined:

(Internal adjuster and calibration curve)

(Internal adjuster)

(Infinity adjustment)

(Known datum point)

(Adjusting lath)

1	2	3	4	5
Time	Angular height θ_1 (column 3, Form AA–4a)	Camera altitude (same as column 12, Form AA–4a)	Height finder altitude (Form AA-8)	Error of height finder (column 4–3)
Averages	(ϵ)	(H)		(h)

NOTE.—The purpose of this form is to obtain samples of the performance of stereoscopic observers and height finders. It is not intended for use in the determination of the altitude error at the time the gun was fired. The entries in column 4 should be the actual altitudes determined by the height finder, regardless of whether or not such altitudes were set into the director.

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g. Average altitude ----------(*H*) (from column 3)

h. Average altitude error ----------(*h*) (from column 5).

i. Average angular height ---------- (ϵ) (from column 2).

j. Average height finder error in units of error---------- $\left(M=12,\ \text{units of error}=\frac{0.9 \sin \epsilon\ h\ (\text{yards})}{(H \text{ in thousands of yards})^2}\right)$ $\left(M=24,\ \text{units of error}=\frac{1.8 \sin \epsilon\ h\ (\text{yards})}{(H \text{ in thousands of yards})^2}\right)$

k. Adjuster setting which would have given correct average altitude ----------

---

One copy each:
AGO
CG, Brig or CA Dist
Btry

(Signed) ----------,

----------,
Battery Commander.

Form AA–4b.

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TABULAR ANALYSIS

BATTERY ------, ------ *Coast Artillery (AA).* PLACE ----------
DATE ---------- TIME ----------
Guns Nos. ------, ------, ------, ------ Number of rounds fired------.
Time from "Commence firing" to last discharge -------- seconds (Form AA–10). Course No. -------- Direction of course --------

Burst number	Time	Time of flight	Lateral				Vertical				Range					
			Deviations (camera) (visual)		Adjustment corrections		Deviations (camera) (visual)		Adjustment corrections		Deviations (camera) (visual)		Spotted deviations	Adjustment corrections		
			Mils (Form AA–18)	Yards (FormAA–11)	Mils (Form AA–8)	Yards (computed)	Mils (Form AA–18)	Yards (FormAA–11)	Mils (Form AA–8)	Yards (computed)	Mils (Form AA–18)	Yards (Form AA–11)	Mils (Form AA–9)	Percent altitude correction needed	Percent altitude correction applied	Effect in yards slant range (computed)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1																
2																
3																
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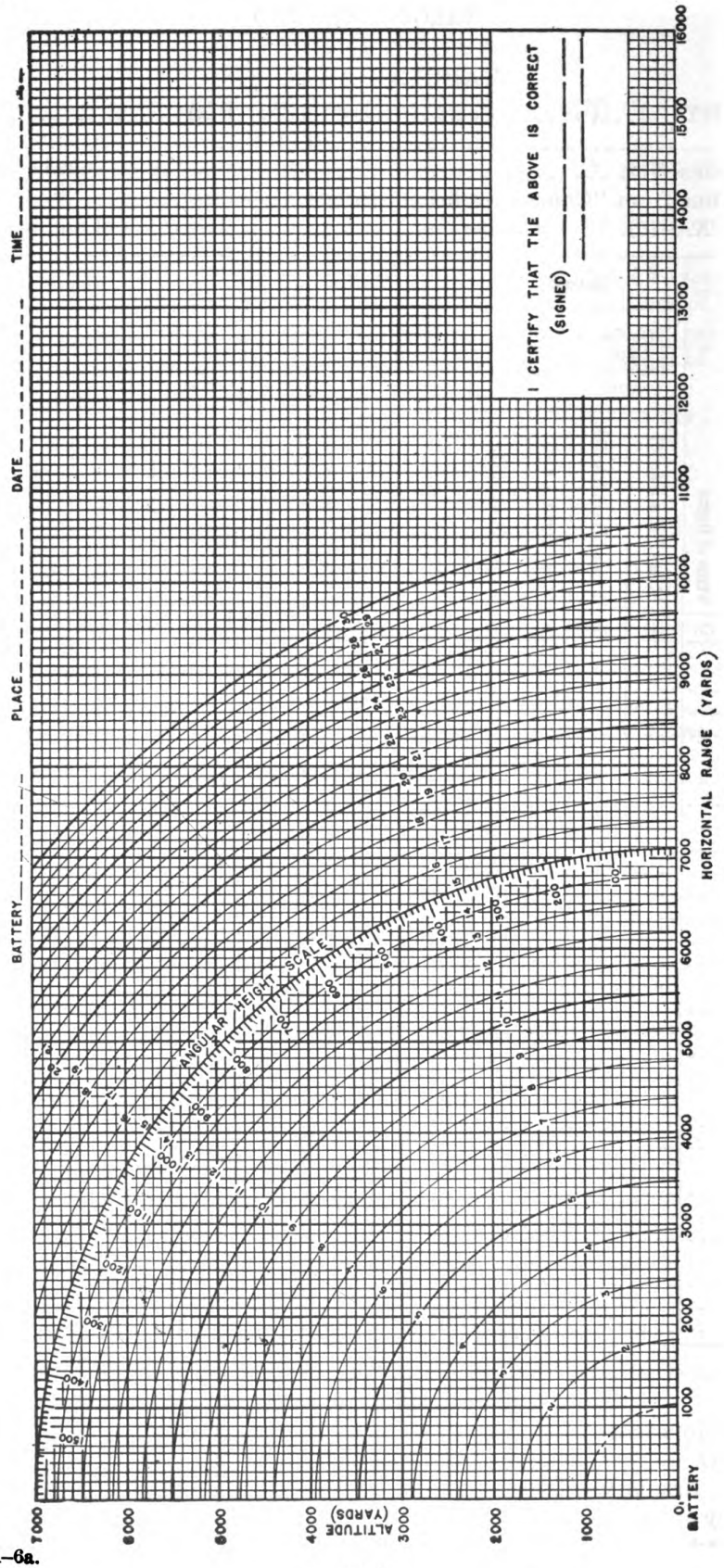
Method of adjustment used ----------.

(Signed) ----------,
----------.

One copy each:
AGO
CG, Brig or CA Dist
Btry

Form AA–5.

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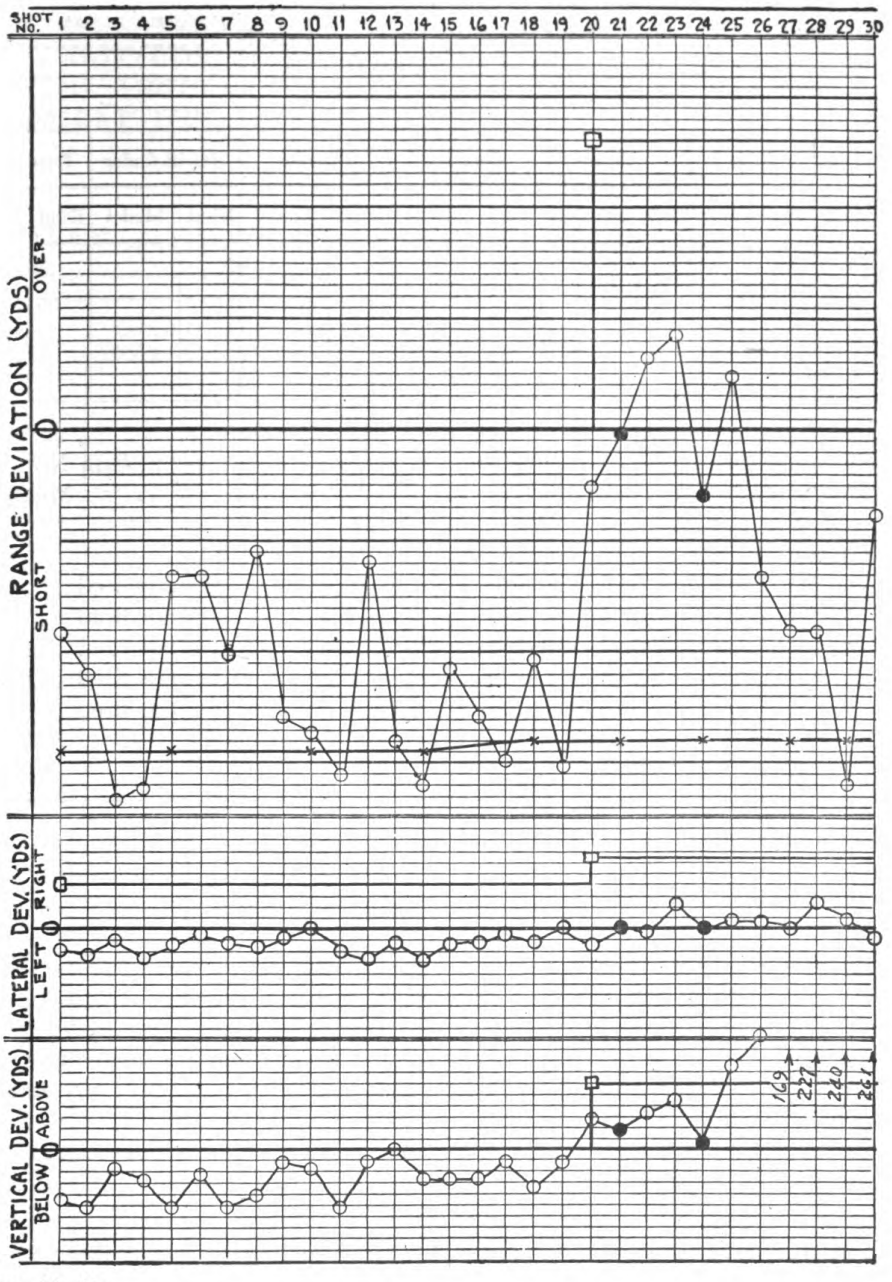


Form AA–6a.

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GRAPHICAL ANALYSIS

COURSE No. *1* DIRECTION *L–R*



Form **AA–6b.**

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MATÉRIEL AND POWDER REPORT

AA Guns

BATTERY_____, _____*Coast Artillery (AA)*. PLACE_____
DATE_____ TIME_____

a.

Ammunition		Fuze		Gun		Carriage		Director		Height finder		Fuze setter	
Kind	Lot	Kind	Lot	Caliber	Model	Kind	Model	Kind	Model	Kind	Model	Kind	Model

b. Last muzzle velocity measured by chronograph. Date_____
Chronograph_____. Number rounds fired_____. Gun No._____
Total rounds previously fired by Gun No. _____, _____. Measured M. V._____f/s.
Muzzle velocity and fuze error determination (FM 4–110).
(1) Trial shot problem, date_____, rounds fired_____.
(2) Trial shot problem, date_____, rounds fired_____.
(3) Trial shot problem, date_____, rounds fired_____.
(4) Trial shot problem, date_____, rounds fired_____.
(5) Trial shot problem, date_____, rounds fired_____.
Developed muzzle velocity_____f/s. Fuze error_____.

c.

Tactical number of piece				
Register number of piece				
Manufacturer's initials				
Rounds previously fired (present liner)				
Rounds fired this practice				
Total rounds fired to date (present liner)				

d. Malfunctioning and breakage of matériel (ammunition, guns, carriages, fuze setters, director, and height finder). (Give register number of any matériel listed below):

_____
_____
_____

(Signed)_____,
_____

One copy each:
AGO
C of Ord
CG, Brig or CA Dist
Btry

Form AA-7.

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TARGET POSITION, ADJUSTMENT OR LEAD RECORD

a. (1) LATERAL; (2) VERTICAL; (3) RANGE ADJUSTMENT.
b. ALTITUDE: (1) FROM HEIGHT FINDER; (2) SET ON DIRECTOR.
c. (1) ANGULAR HEIGHT; (2) AZIMUTH OF TARGET FROM; (3) BATTERY; (4) FLANK.

VISUAL OBSERVATION

BATTERY_____, _____*Coast Artillery (AA)*. PLACE_____
DATE _____ TIME _____

Time	Course 1, direction L–R	Course 2, direction—	Course 3, direction—	Course 4, direction—	Course 5, direction—	Course 6, direction—
0						
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						
55						
60						
65						
70						
75						

NOTE.—Circle appropriate words for heading.

One copy:
Btry

(Signed) _____,
_____.

Form AA-8.

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DEVIATIONS OR SPOTTER'S RECORD VISUAL, IN MILS

a. (1) LATERAL; (2) VERTICAL; (3) FLANK DEVIATIONS RECORD.
b. RANGE SPOTTER'S RECORD: (1) FLANK; (2) STEREOSCOPIC; (3) FUZE RANGE PATTERN.

BATTERY_____, _____*Coast Artillery (AA)*. PLACE_____

DATE_____ TIME_____

Time	Burst No.	Course 1		Course 2		Course 3		Course 4		Course 5	
		L A O	R B S	L A O	R B S	L A O	R B S	L A O	R B S	L A O	R B S
_____	1										
_____	2										
_____	3										
_____	4										
_____	5										
_____	6										
_____	7										
_____	8										
_____	9										
_____	10										
_____	11										
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_____	24										
_____	25										
_____	26										
_____	27										
_____	28										
_____	29										
_____	30										

NOTE.—Circle appropriate words for heading.

One copy:
Btry

(Signed)_____,

_____

Form AA-9.

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CHIEF TIMEKEEPER'S RECORD

Guns or Automatic Weapons

BATTERY ____, ___*Coast Artillery (AA)*. PLACE _____

DATE_____ TIME _____

FIRING PHASE

	Course 1	Course 2	Course 3	Course 4	Course 5
1. "Commence firing" to last discharge					
2. From assistant timekeeper's Gun No. 1					
3. From assistant timekeeper's Gun No. 2					
4. From assistant timekeeper's Gun No. 3					
5. From assistant timekeeper's Gun No. 4					
6. Corrected time of action					
7. Record time of "Commence firing"					
8. Record time of first burst					
9. Record time of last burst					
10. Record time of "Cease recording"					

NOTES

1. All times recorded on this form are to the nearest second.
2. If no time out is allowed, the correct time of action will be the time from "Commence firing" to "last discharge" as determined by the chief timekeeper.
3. If time out is allowed, find the average corrected time for ALL guns firing and use as the corrected time of action.
4. Data for lines 7, 8, 9, and 10 will be obtained from the officer in charge of records.
5. Data for lines 8 and 9 are not required for machine guns.

DETECTION PHASE

	Course 1	Course 2	Course 3	Course 4	Course 5	Course 6
11. Time of pick-up						

	Course 7	Course 8	Course 9	Course 10	Course 11	Course 12
12. Time of pick-up						

One copy:
Btry

(Signed) _____,

_____.
Chief timekeeper.

Form AA-10.

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COMPUTATION OF IMPACTS

BATTERY_____, _____*Coast Artillery (AA)*. PLACE_____

DATE_____ TIME_____

Course No. _____

Group	Slant range from 0_1 (yd.)	Slant range from 0_2 (yd.)	Angle G. T. F. (mils)	Angular height 0_1	F_1	F_2	F_3	F_4
1	2	3	4	5	6	7	8	9
25	5, 660	7, 040	623	608	1. 75	1. 43	1. 21	. 68
30	5, 680	7, 180	603	601	1. 80	1. 50	1. 20	. 67
35	5, 750	7, 320	579	587	1. 85	1. 56	1. 19	. 65
40	5, 820	7, 490	556	569	1. 91	1. 63	1. 18	. 63
45	5, 930	7, 640	533	548	2. 01	1. 75	1. 17	. 60

Group No.	Burst No.	Flank deviations (yd.)	Column 12×F_1 (col. 6)	Lateral deviation (yd.)	Column 14×F_2 (col. 7)	Column 13+column 15	Column 16×F_3 (col. 8)	Vertical deviation (yd.)	Column 18×F_4 (col. 9)	Column 17+column 19	Hits, *P.*=Plinth, *C.*=column
10	11	12	13	14	15	16	17	18	19	20	21
25	1	−77	−135	−11	−16	−151	−183	−34	−23	−206	_____
	2	−140	−245	0	0	−245	−297	−11	−7	−304	_____
	3	−21	−37	−17	−24	−61	−74	+28	+19	−55	_____
30	4	−7	−13	0	0	−13	−16	+17	+11	−5	P
	5	+22	+40	−6	−9	+31	+37	+34	+23	+60	_____
	6	+7	+13	+23	+35	+48	+58	+45	+30	+88	_____
35	7	−29	−54	0	0	−54	−64	+6	+4	−60	C
	8	−7	−13	+6	+9	−4	−5	+75	+49	+44	_____
	9	−95	−176	+6	+9	−167	−199	+103	+67	−132	_____
40	10	−127	−241	0	0	−241	−284	+169	+106	−178	_____
	11	−165	−315	+23	+38	−277	−327	+227	+143	−184	_____
45	12	−206	−413	+12	+21	−392	−458	+249	+149	−307	_____
	13	−92	−185	−12	−21	−206	−241	+261	+157	−84	_____

One copy:

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Signed_____,

_____

Officer in charge of records.

Form AA–11.

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COAST ARTILLERY

TARGET PRACTICE REPORT

37-mm Guns or Machine Guns

PRIMARY
ADDITIONAL } ASSIGNMENT

BATTERY _____, _____ *Coast Artillery (AA)*
PLACE _____
DATE _____

Machine guns, caliber _____
Mount _____
Fire control _____
Visual records
Day
Night } practice
Score _____
Rating _____

This copy for _____

Form AA–12.

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MATÉRIEL AND AMMUNITION REPORT

37-mm Guns or Machine Guns

BATTERY _____, _____ *Coast Artillery (AA).* PLACE _____
DATE _____ TIME _____

a. Matériel used:

Ammunition				Weapon		Mount		Flash hider	Shoulder stock	Sight
Ball		Tracer								
Caliber	Lot	Caliber	Lot	Caliber	Model	Kind	Model			

b. Ammunition record, _____ Platoon:

Tactical number of weapon				
Register number of weapon				
Rounds previously fired (present barrel)				
Total rounds fired to date (present barrel)				
Rounds of ball ammunition fired this practice				
Rounds of tracer ammunition fired this practice				
Totals for platoon, this practice				

c. Number and sequence of loading of ball and tracer _____
d. Burn-out point of tracer ammunition used _____
e. Burn-out point determined by _____
f. List of stoppages and causes _____

g. Breakages or malfunctioning of matériel (see appropriate Standard Nomenclature List for standard nomenclature and number of part) _____

(Signed) _____

One copy each:
AGO
CG, Brig or CA Dist
Btry

Form AA-13.

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CHIEF TIMEKEEPER'S RECORD

Searchlights

BATTERY ——, —— *Coast Artillery (AA)*. PLACE ——

DATE —— TIME ——

Clock time	Course 1	Course 2	Course 3	Course 4
First light in action				
Pick-up				
End of course				
Time to nearest second				
First light in action to pick-up				
Pick-up to end of course				

One copy:
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(Signed) ——,

——,
Chief timekeeper.

Form AA-14.

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MATÉRIEL REPORT

AA Searchlights

BATTERY____, ____*Coast Artillery (AA)*. PLACE_____ DATE_____

Light No. (tactical)	Searchlights				Power plants				Control station		Sound locator	
	Model		Serial No.	Total hours operation to date [1]	Model		Serial No.	Total hours operation to date [2]	Model	Serial No.	Model	Serial No.
	Year	Manufacturing			Year	Manufacturing						
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

[1] To be estimated if accurate record is not available.
[2] Obtained from W. D., Q. M. C. Form No. 248.

Malfunctioning and failures of and repairs on the above matériel since last report. (State date of occurrence and name plate data in each case.) Use reverse side if necessary.

(Signed)_____,

_____,

Battery commander.

One copy each:
AGO
CE
CG, Brig or CA Dist
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Form AA-15.

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BATTERY COMMANDER'S SUMMARY OF PRACTICE

Searchlights

BATTERY____, ____*Coast Artillery (AA)*. PLACE_____ DATE_____

Type and number of searchlights_____
Type and number of sound locators____
Type of acoustic correctors_____
Number of listening posts_____
Type of data transmission_____
Type of D. E. C_____
Corrections as result of trial shot_____

Type of plane_____
Camouflaged?_____
Acoustic wind:
Altitude_____yards
Velocity_____m. p. h.
Azimuth_____mils
Weather conditions_____

Line	Quantity	Source	Course 1	2	3	4	Average	Nearest
1	R_a	Defended area plan						100 yards.
2	t_a	Form AA–14						Second.
3	S_g	R_a/t_a=line 1÷line 2						Yds/sec.
4	t_p	Form AA–14						Second.
5	$S_g/20$	Line 3÷20						0.1.
6	$10/t_p$	10÷line 4						0.1.
7	Plus 20		20	20	20	20		
8	$20+\frac{S_g}{20}+\frac{10}{t_p}$	Line 5+line 6+line 7						0.1.
9	R_p	Defended area plan						0.1.
10	R_L	Defended area plan						0.1.
11	R_p-R_L	Line 9—line 10						0.1.
12	Plus 12		12	12	12	12		
13	R_p-R_L+12	Line 11+line 12						0.1.
14	H_p	Form AA–4a						0.1.
15	R_N	Enter scoring curve with H_p.						0.1.
16	$\frac{R_p-R_L+12}{R_N}$	Line 13÷line 15						0.1.
17	C	Line 8×line 16						0.1.
18	Total score	$C_1+C_2+C_3+C_4$						0.1.
19	R_c	Defended area plan						0.1.
20	Number of lights used to pick up plane							
21	Number of lights used to carry plane							

(Signed) _____,
_____,
Battery commander.

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CG, Brig or CA Dist
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Form AA-16.

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COAST ARTILLERY

TARGET PRACTICE REPORT

Antiaircraft Searchlights

PRIMARY
ADDITIONAL } ASSIGNMENT

BATTERY _____, _____*Coast Artillery (AA)*

_____*Platoon.* PLACE_____

DATE_____

Searchlight model _____

Type of control_____
(Hand or D. E. C.)

Sound locator model_____

Acoustic corrector model_____

Score_____

Rating _____

This copy for_____

Form AA–17.

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BATTERY / ~~FLANK~~ } CAMERA REPORT

BATTERY *C, 2d C.A. (AA).* PLACE: *Fort Monroe, Va.* DATE: *April 7, 1938*

Course No. 1

Counter time of "Cease recording"---------- 0110+8.
Counter time of "Records time 0"---------- 0072+8.
Elapsed counter time---------- 38.
Number of times counter failed to turn over---------- 0.
(This occurred at times --------, --------, --------):
Elapsed camera time---------- 38.
Records time of "Cease recording"---------- 38.
Rate of counter change---------- 1 per second.
Average number of frames per each counter number----- 10.

ORIENTATION CHECK

	Correct data for datum point	Camera reading at beginning of practice	Camera reading at end of practice
Azimuth	2, 485	2, 485	2, 485
Angular height	0	0	0

Camera time	Records time	Target position: Azimuth (mils)	Target position: Angular height (mils)	Burst No.	Deviations: Mils L ~~O~~	Deviations: Mils R ~~S~~	Deviations: Mils A	Deviations: Mils B	Remarks
0072+8	0	2, 169	575						
0077+8	5	2, 209	582						
0082+8	10	2, 249	588						
0087+8	15	2, 291	594						
0092+8	20	2, 333	599						
0097+8	25	2, 376	603						
0100+6	28			1	3			8	
0101+5	29			2	4			9	
0102+8	30	2, 420	606						
0103+7	31			3	2			3	
0104+8	32			4	5			5	
0106+2	33			5	3			9	
0106+5	34			6	1			4	
0107+8	35	2, 464	608						
0108+6	36			7	2			9	
0108+7	36			8	3			7	
0110+1	37			9	2			2	
0110+4	38			10	0			3	

One copy:
Btry

(Signed) ----------,
----------,
Officer in charge of records.

Form AA-18.

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BATTERY ____, ____ *Coast Artillery.* DATE _____ Course No. 2

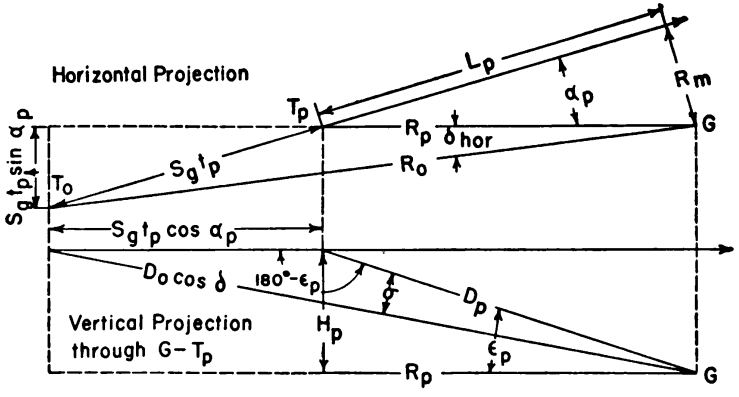
From plot of course _____ R_m=705 Yds. F/T 37-AA-N-1

From Form AA-4a (average) _____ H=435 Yds. Gun 37-mm

From Form AA-4a _____ S_g=65 Yds./sec. M. V. 2700 f/s

$$\delta_{hor}=\sin^{-1}\frac{S_g t_p \sin \alpha_p}{R_o} \qquad \frac{S_g t_p \cos \alpha_p}{\sin \sigma_1}=\frac{D_o \cos \delta}{\sin (180-\epsilon_p)}$$

$$\delta_L=\sin^{-1}\frac{S_g t_p \sin \alpha_p}{D_o} \qquad \sigma_1=\sin^{-1}\frac{S_g t_p \cos \alpha_p \sin \epsilon_p}{D_o \cos \delta}$$



1	Time (Form AA-4a)	0	5	10	15	20	25
2	L_p (from horizontal plot)	−825	−500	−175	+155	+480	+800
3	$\alpha_p=\tan^{-1}\frac{R_m}{L_p}$	721	972	1352	1379	991	737
4	$R_p=\frac{R_m}{\sin \alpha_p}$	1085	868	727	723	856	1065
5	$\epsilon_p=\tan^{-1}\frac{H}{R_p}$	388	473	550	552	480	394
6	$D_p=\frac{H}{\sin \epsilon_p}$	1170	972	849	846	960	1152
7	t_p (Firing table)	1. 59	1. 28	1. 09	1. 09	1. 26	1. 56
8	$S_g t_p$	103. 5	83. 4	71. 0	71. 0	82. 1	101. 5
9	L_o=line 2±line 8	−929	−583	−246	+84	+398	+699
10	$S_g t_p \sin \alpha_p$	67. 1	67. 7	68. 8	69. 3	67. 6	67. 1
11	D_o (graph)	1240	1018	866	833	921	1089

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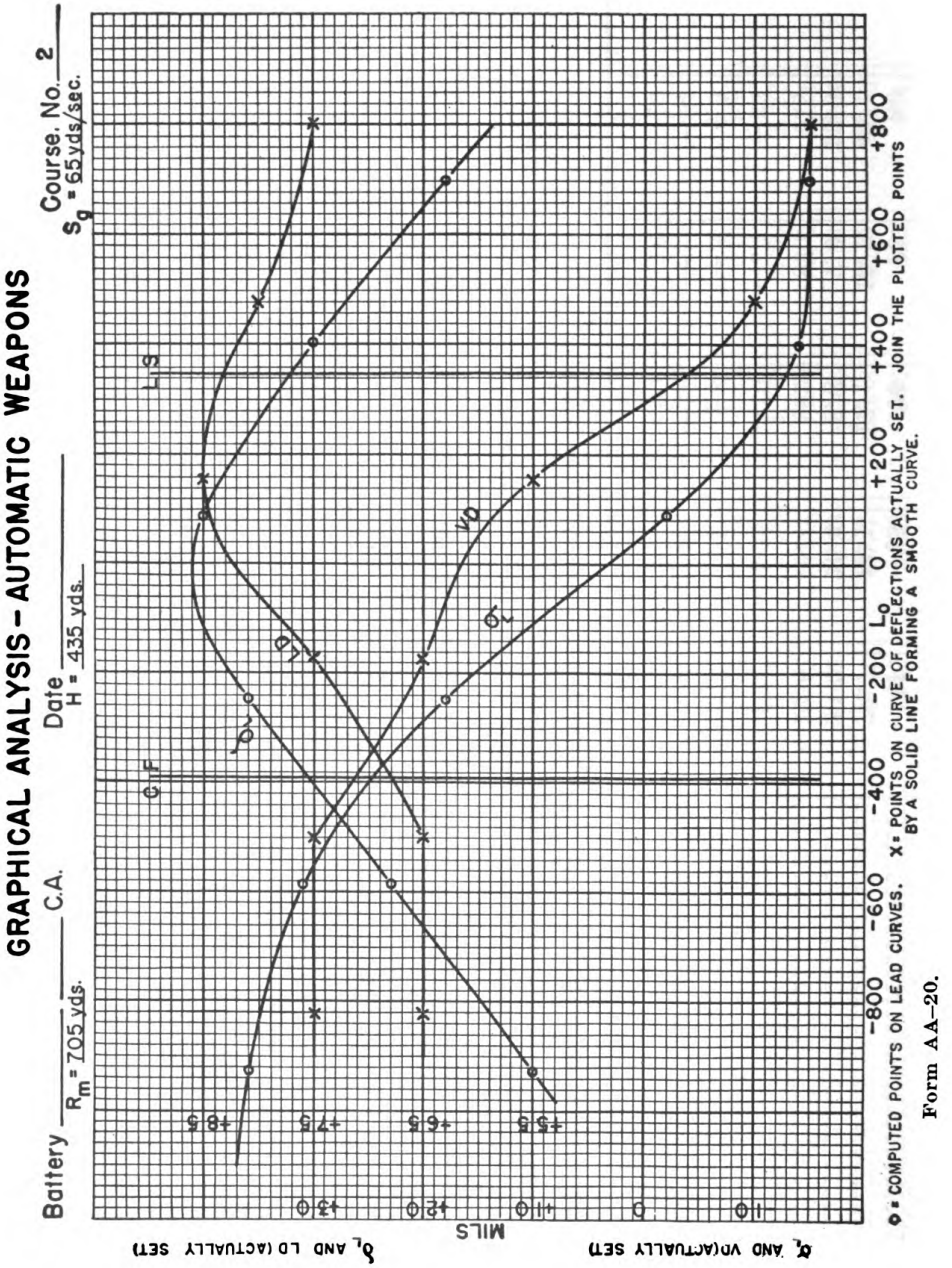
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12	$\delta_L = \sin^{-1} \frac{\text{line 10}}{\text{line 11}}$	55	68	81	85	75	63
13	*LD* (actually set)	65	65	75	85	80	75
14	$S_g t_p \cos \alpha_p$	78.7	48.1	17.1	15.2	46.1	76.0
15	Sin $\epsilon_p \times$ line 14	29.2	21.6	8.8	7.9	20.9	28.6
16	Cos $\delta_L \times$ line 11	1236	1014	862	830	918	1085
17	$\sigma_l = \sin^{-1} \frac{\text{line 15}}{\text{line 16}}$	+24	+22	+10	−10	−23	−27
18	ϕ_s (Firing table)	+12	+9	+8	+8	+9	+12
19	$\sigma_L =$ line 18 ± line 17	+36	+31	+18	−2	−14	−15
20	VD (actually set)	+30	+30	+20	+10	−10	−15

On Form AA–20 plot lines 12 and 19 against line 9 (L_s). Plot lines 13 and 20 against line 2 (L_p).

Form AA-19.

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Form AA-20.

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[A. G. 062.11 (1–3–41).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

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INSTRUCTIONS FOR COAST ARTILLERY TARGET PRACTICE—1942

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON, April 30, 1942.

1942 Supplement to TM 4–235, November 25, 1941, is changed as follows:

11. Score.

* * * * * * *

a. Firing phase.—(1) The score for each course is:

* * * * * * *

H'G'M' is taken to one decimal place from figure 1 **for 3-inch antiaircraft guns, or figure 1½ for 90-mm antiaircraft guns,** using as arguments the normal rate of fire (as prescribed in **par. 51*i***, TM 4–235) and the average slant range in yards of the course taken to the nearest hundred yards.

* * * * * * *

[A. G. 062.11 (3–14–42).] (C 1, Apr. 30, 1942.)

445868°—42

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ADDENDA TO 1942 SUPPLEMENT TO TM 4-235

WAR DEPARTMENT,
WASHINGTON, December 26, 1941

INSTRUCTIONS FOR ANTIMECHANIZED TRAINING AND FIRING BY ANTIAIRCRAFT UNITS

	Paragraphs
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III. Firing	6-8

SECTION I

GENERAL

	Paragraph
General	1
Reports	2

1. **General.**—*a.* All firing units of antiaircraft artillery will receive annual training in the technique and tactics of antimechanized defense, to include actual firings at suitable targets within the allowances authorized by AR 775-10.

b. In conducting the program of training in antimechanized defense, the instructions outlined herein will be followed.

c. The instructions contained in letters A. G. 353 (8-14-40) M-C, (7-8-41) MT-C, August 16, 1940, and July 14, 1941, subject "Training of Antiaircraft Regiments in Antimechanized Defense," are rescinded.

2. **Reports.**—On completion of the firing phase of antimechanized training, the organization commander concerned will submit through channels to the War Department a brief narrative report of such firing. The report will include—

a. Complete description of training methods used preliminary to firing.

b. Description of the target, firing range, and how the firing problem was conducted.

c. Number of rounds fired and the result of firing, where obtainable.

d. Sketch of the firing range, showing the course of the target, firing point, and position of target at beginning and end of firing on each course.

e. Recommendations, where appropriate.

433349°—42

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SECTION II

PRELIMINARY TRAINING

	Paragraph
General	3
Tactics	4
Technique	5

3. General.—*a.* All training in antimechanized defense will be in accordance with the provisions of Training Circular No. 3, War Department, 1940; Training Circular No. 8 and section I, Training Circular No. 41, War Department, 1941; Training Films 5–146 to 5–149, inclusive; and pertinent paragraphs of FM 100–5 and FM 5–30; and will include the subject of defense against landing boats or motor torpedo boats.

b. Training must be conducted in the technique of bringing accurate fire to bear on small, fast-moving ground or water-borne targets. Training should also include extensive practice in the use of other defensive measures, such as barriers, camouflage, and land mines, to be taken against mechanized forces. The use of cover and concealment, to include protection of personnel from ground and aerial attack, should be emphasized.

4. Tactics.—*a.* Tactical training of all units will be conducted to include practical exercises in—

(1) Selection and occupation of positions suitable for antimechanized defense.

(2) Construction of barriers.

(3) Operations against surprise mass mechanized attacks wherein vehicles are actually used to represent armored elements.

b. Troops will be given a general understanding of the fundamentals of beach defense.

5. Technique.—*a.* All firing will be done by the use of sights, assisted in the case of automatic weapons by tracers. Extensive practice will be given in the estimation of target speeds, ranges, and leads to be used in firing.

b. Preliminary practice with the caliber .30 machine gun, where the guns and ammunition are available, will be of tremendous benefit in the training of automatic weapons units.

c. Due to smoke and dust as a result of firing, observation of impacts often will be impracticable for the gun pointers on the 3-inch and 90-mm guns. In most cases it may be necessary for a spotter somewhat removed from the mount to observe the impacts and report them to the men on the sights.

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d. When firing at tanks with 37-mm or larger guns, gunners should be trained to aim at the tracks and suspension mechanisms of the tank.

e. Firing at mechanized targets normally will not be commenced until the target is within a range that will allow effective and accurate fire. Gunners will be instructed not to disclose the position of the gun by firing until the target is at such a range.

SECTION III

FIRING

	Paragraph
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Courses	7
Rates of fire	8

6. General.—*a.* Firing will be conducted within the ammunition allowances as authorized by AR 775–10. The present allowances provide ammunition for antimechanized firing as follows:

	Rounds
Each caliber .50 machine gun	500 [1]
Each 37-mm gun	25 [1]
Each 3-inch antiaircraft gun battery, antiaircraft regiment or separate battalion	40
Each 90-mm antiaircraft gun battery, antiaircraft regiment or separate battalion	40

NOTE.—Although no allowances of caliber .30 ammunition are set up specifically for antimechanized firing, such portions of the allowances authorized by paragraph 47*b*, AR 775–10, for antiaircraft artillery firing as are not used for this purpose may be used for antimechanized training.

b. The type of range on which firing will be conducted is dependent on the local situation. A firing range on land, where a degree of surprise and a course varying in elevation can be obtained, is considered preferable to a firing range over water. The type of target to be used will depend on materials available and the range on which it is to be used. The guiding rule to be followed in the design of the range, the courses, and the target is to make the situation as realistic as possible. It is desired to deviate as far as possible from a fixed situation wherein the gun crews know beforehand the exact range and course on which the target will appear.

[1] Where temporary reductions have been imposed, reduction factor should be applied.

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7. Courses.—*a.* (1) Firing will be conducted on *at least* two courses, one of which will be an incoming course; that is, the general direction of the target will be toward the gun position to the extent permitted by safety features.

(2) Where range facilities permit, it is desired that the courses be maneuvering, having at least two changes in direction, each amounting to about 30°. (On land ranges, courses moving up and down low hills as well as having changes in direction are particularly desired.)

b. Ranges at which firing will be conducted are as follows:

	Yards
Machine gun	150 to 500
37-mm gun	250 to 1,000
3-inch and 90-mm guns	500 to 1,000

c. Targets will be towed at speeds from 15 to 25 miles per hour.

8. Rates of fire.—Fire will be conducted with the various weapons as follows:

a. Machine gun.—Firing will be conducted with one gun at a time firing in short bursts.

b. 37-mm gun.—One gun will operate at a time, by single shot, as rapidly as is consistent with accurate laying.

c. 3-inch or 90-mm guns.—One gun will operate at a time as rapidly as is consistent with accurate laying.

[A. G. 353 (11-5-41).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1942

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ADDENDA No. 2 to 1942 SUPPLEMENT to TM 4–235

WAR DEPARTMENT,
WASHINGTON, May 16, 1942.

INSTRUCTIONS FOR SUBMARINE MINE TARGET PRACTICE

The instructions pertaining to submarine mine target practices appearing in chapter 3, TM 4–235, and section III of the 1942 Supplement to TM 4–235 are suspended until further notice and the following substituted therefor:

1. **General.**—The provisions of chapter 1, TM 4–235, which apply to mine target practices remain in effect and will be strictly observed.

2. **Special instructions.**—*a. Phases.*—The mine service practice will consist of two phases, a day firing phase and a night firing phase.

(1) *Day phase.*—The target will be fired on as it passes over the *seaward* line of mines. If the target is not fired on during this first course, it will constitute a "miss" unless the safety officer rules that the field of fire is unsafe. If the field is declared unsafe, the day phase will be repeated after the expiration of at least 24 hours.

(2) *Night phase.*—The target will be fired on as it passes over the *inshore* line of mines. If the target is not fired on during this course, it will constitute a "miss" unless the field of fire is declared unsafe. If the field of fire is declared unsafe, the night phase will be repeated after the expiration of at least 24 hours.

b. Time allowed for practice.—The day and night phases will be concluded within 1 week from the time that the record target practice begins, unless safety precautions delay firing. The harbor defense commander will notify the mine group commander and the mine battery commander at the beginning of the target practice period. Subsequently, the harbor defense commander will notify the mine group commander and the mine battery commander when the target is on course.

c. Fire by observation.—All firing will be by observation only.

d. Plotting of mines.—The mine field will not be replotted just prior to the test nor will any mines be moved from their positions for purposes of this practice. For the observation fire which is contemplated, the current plot of the mine field will be used.

e. Selection of courses.—One vessel will tow a target for each phase. Target practices will be fired on courses selected by the harbor defense

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commander and will not previously be made known to any of the mine command.

(1) *Type of course to be towed.*—The towed target will simulate the approach of a hostile naval vessel in direction. Straight courses at constant speed are not considered suitable for purposes of this target practice until after the vessel has received word that the mine will be fired on that course, as provided for in (5) below.

(2) *Control buoys.*—No control buoys will be used anywhere in the field.

(3) *Angle of approach to field.*—The vessels will approach the line of mines so that the acute angle between the line of mines and the course of the towing vessel, extended, will not be less than 50°.

(4) *Flank groups not used.*—The flank groups of the designated lines will not be considered as suitable groups for purposes of this practice.

(5) *Signals to towing vessel.*—The safety officer will cause a red streamer to be displayed on shore when the towing vessel has cleared the line of mines by 200 yards, provided that the mine will be fired on that course. The towing vessel will acknowledge receipt of the message by raising a red streamer.

f. Target and towline.—Any suitable target will be used. The length of towline between towing vessel and target will not be less than 500 yards.

g. Safety requirements.—The harbor defense commander will see that all pertinent safety requirements are strictly enforced.

(1) Under no circumstances will firing power be applied to any mines which are not in either the seaward or the inshore lines of mines. The seaward line of mines only will have firing power applied during the day phase. The inshore line of mines only will have firing power applied during the night phase.

(2) After firing a mine, a short period will be allowed for the purpose of checking the mine circuit, after which the power will be turned off.

h. Determining position of target and deviation of splash.

(1) The course of the target will be determined by plotting on the plot of the mine field the positions of the target, using bilateral observation.

(2) The observation stations will be instructed to track the towing vessel as soon as the plotter has determined the last plotted point of the target necessary for the prediction. At the instant the mine is fired both observers will cease tracking, and thus establish

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the position of the towing vessel at the moment of firing the mine. The azimuth from each station will be recorded.

(3) At either base-end observation station used by the mine battery, preferably the one from which the deviations of the splash with respect to the mine can be better observed, a second observing instrument will be set up for the purpose of measuring the azimuth of the target at the time that the mine is fired, and the deviation of the splash with respect to the target.

(4) The deviation of the splash with respect to the target will also be measured from the tug. For the day phase, both a camera and range rake will be used to measure the deviation. For the night phase, the range rake only will be used.

(5) To determine the position of the target at the instant the mine is fired, replot the course of the target on the plot of the mine field. Then draw a ray at the measured azimuth of the target from the observation station, as determined in (3) above. The intersection of the ray and the course of the target, prolonged if necessary, will establish the position of the target.

(6) To determine the location of the splash, the following procedure will be used: Draw a straight line between the established position of the target and the position of the towing vessel. Then construct a ray which will indicate the angular deviation of the splash with respect to the target as measured from the towing vessel. Construct a ray from the observation station which will also indicate the deviation of the splash with respect to the target. The intersection of the two deviation rays will establish the position of the splash and the actual position of the fired mine.

i. Replanting of mines.—Each mine which is fired will be replaced. Any of the six adjacent mines which within 24 hours develop faults will also be replaced as part of the target practice. Time will be kept for the replanting and repairing operations from the time the mine is fired until the distribution box is lowered at the conclusion of repairs for that phase. Exceptions to this are given in $m(1)(c)$ below. If mines in more than one group are affected, time will continue until the last distribution box involved is planted. A complete record will be kept of the repairs required and the malfunctioning of any matériel.

j. Officials and their duties.—The officials required will be detailed from another regiment, except where manifestly impracticable, and assigned by the harbor defense or regimental commander as official observers and assistants to the mine group commander.

(1) *Safety officer.*—During both phases, the safety officer will be responsible for the safety of the field of fire and the towing

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vessels. He will be assisted in his duties by the casemate and planting officials.

(2) *Plotting room official.*—He will witness all plotting and verify and record the data pertaining to the location of the mine the position of the target when the mine is fired, and the location of the splash.

(3) *Planting official.*—The planting official will witness all work on the water. He will record the time necessary to repair the field In addition to the above, during the firing phase he will act as tug officer. As such, he will supervise the camera and range rake details and act as assistant to the safety officer.

(4) *Casemate official.*—The casemate official will act as assistant safety officer for the casemate. As such, he will be connected by telephone to the safety officer and will see that no firing power is applied until after word is received from the safety officer that the field of fire is clear.

(5) *Observer of deviations.*—One officer observer will determine the azimuth of the target at the instant of firing and the deviation of the splash with respect to the target by means of an observing instrument located in one of the base-end stations.

k. Operation of power generating equipment.—During the submarine mine practice, all power for the operation of the system will be generated by the gasoline or Diesel electric power equipment supplied for use with the submarine mine system.

l. Responsibility for practice.—The responsibility for the conduct of the submarine mine practice rests with the mine battery commander.

m. Score, records, and reports.

(1) *Score.*—The score will consist of a hitting component and a miscellaneous component.

(*a*) Fifty points will be allowed for each hit on the hypothetical target.

(*b*) *Determination of hits.*

1. The hypothetical target representing the vulnerable area of a destroyer will be a rectangle 40 yards long and 10 yards wide with its center at the target and its longer axis coincident with the track of the target.

2. A hit will be scored when a mine is fired if, at the instant of firing, the position of the splash is covered by the area of the hypothetical target, or if the perimeter of the hypothetical target on the plot is not more than 15 yards from the splash.

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(*c*) The miscellaneous component will be negative in effect. Its magnitude for each phase will be equal to the interval, in hours, less 24, between the firing of the mine and the replacing of the fired mine, together with the complete repair of damage to the six mines nearest to the fired mine. If the weather is such as to render repair work dangerous, the harbor defense commander will so certify. For such instances, the time for the miscellaneous component will begin when conditions become safe. These times will be certified by the harbor defense commander. If conditions become unsafe while work in the field is in progress, time out will be allowed, provided that the times and conditions are certified by the harbor defense commander.

(*d*) No hit will be allowed for any mine other than the one ordered fired.

(2) *Records.*—For each phase, a record will be kept of the following:

(*a*) The group number and the mine number of the mine ordered fired and the time.

(*b*) The group number and the mine number of the mine or mines which fired and the times.

(*c*) The time required to replace the fired mines and repair any other damage to the field, including the replacing of damaged mines. A narrative report should cover the operations.

(*d*) Accurate plots of the position of the target with particular emphasis on the location of the target when the mine fires, the location of the splash, and the plotted position of the fired mine.

(3) *Reports of practice.*

(*a*) The following sets of reports will be prepared for submission as indicated:

1. Set 1 for the Commanding General, Army Ground Forces.

2. Set 2 for the battery records.

(*b*) Each of the above reports will consist of—

1. A plot of the course of the target for each phase. The four mines on each side of the course will be shown on the plot and will be obtained from the plot in common use for showing the location of mines in the field. The position of the material target at the instant of firing the mine and the position of the splash will be

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plotted as accurately as possible. The hypothetical target will be plotted to scale with its center at the center of the material target. The scale of the plot will be indicated. The legend should show the organization, day or night phase, and the date.

2. The battery commander's narrative report will contain a full account of any malfunctioning, abnormal operations, conditions peculiar to the project, the time required to restore the field to its original conditions, and any difficulties due to the night practice.

(*c*) *Binding.*—Each set will be supplied with front and back covers, and will be bound at the top with suitable fasteners such as Acco.

(*d*) *Distribution.*

1. Set 1 will be forwarded through channels to the Commanding General, Army Ground Forces, for file in the office of the Coast Artillery Board.

2. Set 2 will be forwarded through channels to the coast artillery subsector commander for his comment and returned to the organization for file with the battery records. When returned for file, this set should include a copy of all indorsements made on set 1.

3. In his forwarding indorsement on sets 1 and 2, the mine group commander will comment on any difficulties encountered in the practice, as well as any points of general interest not fully covered in the narrative report. His indorsement will include the certificate called for in paragraph 10*d*, TM 4–235. (In the set for the Commanding General, Army Ground Forces, this indorsement will be submitted in duplicate.)

[A. G. 062.11 (4–25–42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1942

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ADDENDA NO. 3 TO 1942 SUPPLEMENT TO TM 4-235

WAR DEPARTMENT,
WASHINGTON, September 29, 1942.

INSTRUCTIONS FOR ANTIMOTOR TORPEDO BOAT TARGET PRACTICES

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	Paragraph
General	1
Training	2
Safety precautions	3
Number of practices	4
Number of courses	5
Records	6
Procedure for scoring	7
Reports	8

1. General.—These instructions cover the conduct and analysis of target practices for 37-mm and 40-mm antimotor torpedo boat batteries. These instructions are applicable for the remainder of the year 1942.

2. Training.—The harbor defense commander will prescribe the training procedure. Appropriate publications on matériel will be used as a guide for the care and operation of the armament.

3. Safety precautions.—Safety precautions will be the same as those required to be observed for seacoast subcaliber firing with the additional precaution that no firing will be conducted when the angle target-gun-towing vessel is less than 9° (160 mils). The length of the towline and the direction of the course will be governed by the above precaution.

4. Number of practices.—All practices will be day practices. Each 37-mm and 40-mm antimotor torpedo boat battery will fire one or more preliminary service practices and one record service practice. At least one preliminary service practice will be fired and completely analyzed before the record practice is fired. No preliminary practice will be conducted on the day of the record practice.

5. Number of courses.—Each practice will consist of four courses. Such changes in range and the direction of the course as are consistent with safety requirements will be made during each course. No firing will be conducted at ranges beyond 2,500 yards or at ranges less than 500 yards. The harbor defense commander or his representative will prescribe the courses to be towed and will impose such service conditions as may be practicable. One course will be limited to a maximum range of 900 yards, and one course will be limited to a minimum range of 1,500 yards.

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6. Records.—*a.* The following records will be required to compu the score of the practice:

Average speed of the target on each course.
Average range to the target on each course.
Firing time in seconds for each course.
Number of shots fired on each course.
Total number of hits on the four courses combined.

The average speed and range for each course will be determine from horizontal baseline data, if practicable. Sufficient data will b taken to insure reliable results. The necessary computations ma be made graphically or analytically. The firing time in seconds o each course is the elapsed time from the command COMMENCE FIRIN to the last discharge decreased by any time out. Time out will b allowed only when CEASE FIRING is ordered for reasons of safet which are not due to personnel errors or failures of matériel of th firing battery. The number of shots fired from each gun will b recorded and added to obtain the number of shots for the course. Th scoring of hits will be as prescribed in paragraph 7*d*.

b. In addition to the records prescribed in *a* above, sufficien records will be made to prepare a narrative report and a matérie and ammunition report. For the purpose of the latter report Form AA-13, Matériel and Ammunition Report, now prescribed fo antiaircraft 37-mm guns and machine guns, will be used. Appro priate changes will be made on the form where required. A complet description of all breakages and malfunctioning of matériel and am munition will be entered on the reverse side of the form.

7. Procedure for scoring.—One score for the four courses com bined will be computed. This score will be based on certain weighted average data and total data from the records prescribed in paragraph 6*a*. The score for each practice will be computed to one decimal place from the following formula:

$$\text{Score}=\left(80+20\left(\frac{S}{15}\right)\right)\left(\frac{HGM}{H'G'M'}\right)$$

where

S=weighted average speed of the target in miles per hour for the four courses taken to the nearest mile per hour (see *b* below). The expression $\frac{S}{15}$ will be taken to one decimal place.

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HGM=hits per gun per minute taken to the nearest half hit per minute from the formula:

$$HGM=\frac{60h}{gt}$$

where

h=number of target practice hits to the nearest unit.

g=maximum number of guns firing at one time during the practice.

t=total firing time in seconds for the four courses to the nearest second.

H'G'M' is taken from the curve in figure 1 to the nearest half hit per minute, using as an argument the weighted average range for the practice (see *a* below).

The method of converting the basic data of the records for use in scoring is described below.

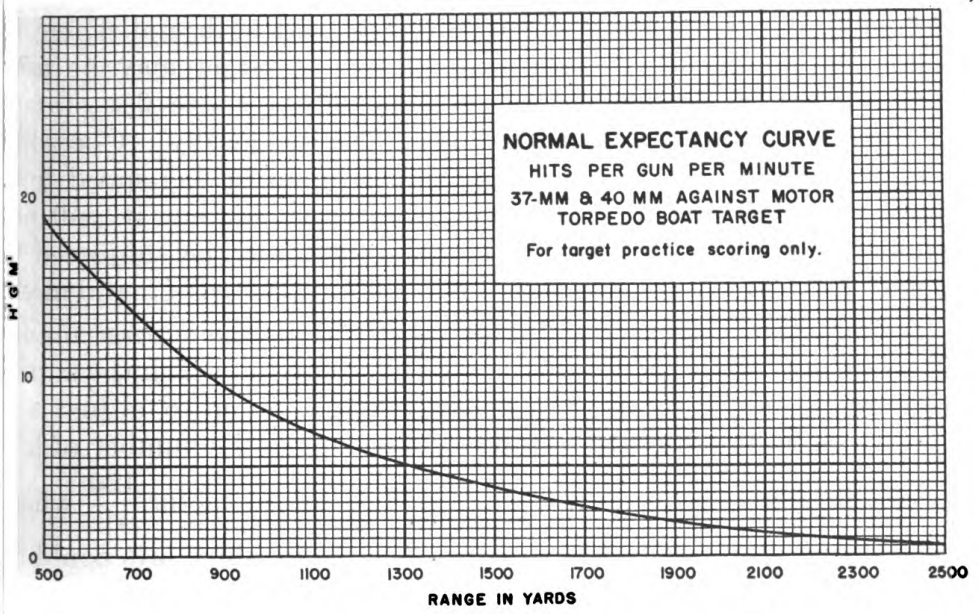


FIGURE 1.

a. Weighted average range for practice.—The weighted average range for the practice will be obtained by weighting the average range for each course in accordance with the number of rounds fired on the course, by means of the following formula:

$$\text{Weighted average range for the practice}=\frac{S_1R_1+S_2R_2+S_3R_3+S_4R_4}{S_1+S_2+S_3+S_4}$$

where S_1, S_2, etc., are the number of shots fired on courses 1, 2, etc., and R_1, R_2, etc., are the average ranges for courses 1, 2,etc. The

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average range for each course will be computed to the nearest 10 yard and the average weighted range for the practice will be computed the nearest 20 yards.

b. Weighted average speed of target for practice.—The weighted average speed of the target for the practice (S) will be obtained by weighting the average speed for each course in the manner prescribed for weighting average ranges in *a* above. The average speed of the target for each course will be computed to the nearest half-mile per hour and the weighted average speed for the practice will be computed to the nearest mile per hour.

c. Total firing time.—The total firing time in seconds (t) will be the total of the firing times of each of the four courses taken to the nearest second. For record practice, t will not be taken as less than 100 seconds.

d. Target and scoring hits.—(1) Only hits on the material target will be scored. For the purpose of scoring, the standard target will be considered a vertical plane which is 20 feet in length and 6 feet in height (120 square feet). Any type or size of target may be used provided that its superstructure presents only a single flat surface as a hitting area. Such targets will be improvised locally. Consideration should be given to obtaining the maximum towing speed from vessels available, and to constructing the target so that it will not be destroyed easily. For example, if the target is to be subjected to high explosive fire, the hitting area should be constructed of metal mesh.

(2) Only hits in the vertical plane which forms the superstructure will be scored. Hits in the raft or other structures on which the superstructure is mounted will not be scored. In order to adjust the number of hits to a basis of a standard size target, the number of hits scored on the actual target will be multiplied by the factor $\frac{120}{A}$ when A is the area in square feet of the plane surface in which hits could be scored. This area will be determined to the nearest square foot prior to the practice. The factor $\frac{120}{A}$ will be computed to one decimal place, and in no case will be taken greater than 10.0 The number of target practice hits (h) will be determined to the nearest whole number.

(3) When nonexplosive ammunition is fired, the number of hits will be determined by counting the number of holes in the plane surface in which hits are allowed. Nonexplosive ammunition will be fired if available.

(4) When explosive ammunition is fired, the number of hits will be determined by counting the number of impact bursts against the

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plane surface, and by counting the number of holes which are evidently the result of duds. Care must be exercised not to credit as hits impact bursts which occur on the water and not against the target. For this purpose, observation from the towing vessel may prove more feasible than observation from the shore.

(5) The scoring of hits will be done carefully in accordance with the the above instructions by an officer not assigned to the firing battery.

8. **Reports.**—On the completion of each record service practice, reports will be prepared and submitted as follows:

a. Four sets will be prepared.

b. Sets 1, 2, and 3 will consist of a—

(1) Tabulation of all data and records prescribed to be taken in the above paragraphs.

(2) Computation of the score.

(3) Matériel and ammunition report (Form AA–13).

(4) Battery commander's narrative report which will contain a brief description of the following:

(*a*) Methods of drill, fire control, and fire adjustment.

(*b*) Method of firing; that is, single shots, bursts, or continuous.

(*c*) Reasons for a time out that may have been allowed.

(*d*) Target and towing vessel used.

(*e*) Courses fired on.

(*f*) Recommendations.

c. If an estimate can be given of the number of hits obtained on each course, these data should be included in the narrative report with a statement as to the basis of the estimate.

d. Set 4 will consist of two copies of the matériel and ammunition report.

e. Distribution and forwarding indorsements will be as prescribed for seacoast artillery target practices in TM 4–235 as amended by Changes No. 3.

[A. G. 062.11 (9–9–42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1941

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1942
SUPPLEMENT TO
TM 4–235

WAR DEPARTMENT,
WASHINGTON, November 25, 1941.

INSTRUCTIONS FOR COAST ARTILLERY TARGET PRACTICE—1942

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SECTION I

GENERAL

	Paragraph
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Duties of commanders	3

1. Scope.—*a.* This supplement is published for the information and guidance of all concerned in the conduct of coast artillery target practices.

b. As provided in paragraph 2, TM 4–235, the special instructions appearing herein will govern the conduct and scoring of coast artillery target practices during the calendar year 1942.

c. For the year 1942 only, organizations of the National Guard performing extended active military service will be governed by the provisions of TM 4–235 (as amended by this supplement) that are prescribed for the Regular Army.

2. Advanced service practice.—For the year 1942 only, the provisions of paragraph 6*b*, TM 4–235, are suspended for antiaircraft units. In lieu thereof the following will govern:

b. Organization to fire.—Any coast artillery battery manning antiaircraft weapons as a primary assignment that, in the opinion of the army or department commander, has attained a satisfactory degree of basic training, may be designated by the respective army or department commander to fire an advanced service practice.

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3. Duties of commanders.—For the year 1942 only, paragraph 9, TM 4–235, is changed by adding the following subparagraph:

i. In antiaircraft brigades and antiaircraft training centers, the brigade commanders and training center commanders will exercise control over courses, detail of officials, and schedules as prescribed above for harbor defense and regimental commanders.

SECTION II

SEACOAST ARTILLERY

	Paragraph
Special instructions	4
Score	5

4. Special instructions.—*a. Batteries to be fired.*—For the year 1942 only, organizations, if practicable, will fire the batteries assigned to them, included in present harbor defense projects. Harbor defense mobile batteries normally will fire from assigned war positions.

b. Number of practices.—(1) For 3-inch batteries, two record service practices will be fired. These practices will be separated by a minimum of 4 months.

(2) For other calibers, one record service practice will be fired.

c. Lateral adjustment.—For the year 1942 only, lateral adjustment of fire by methods other than the gun pointer jumping splashes will be used.

5. Score.—*a. Form to be used.*—The computation of the score will be entered on score sheets, Form 27.

b. Guns.—(1) The score components, except the E component, will be based only on the shots of record fire. The score for each practice is the algebraic sum of five components, each expressed to one decimal place.

$$\text{Score} = A + B + C + E + R.$$

(2) *A component (hitting).*—(Standard value 30.)

$$A = 15\left[\frac{H'}{P'S} + \frac{H''}{P''S}\right]$$

in which

S = number of record shots.
H' = number of hits on the broadside target during record fire.
H'' = number of hits on the bow-on target during record fire.
P' = probability of hitting broadside target.
P'' = probability of hitting bow-on target.

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In computing the *A* component, the value of the developed armament probable error will be taken as not less than 1 nor greater than 1½ times the probable error given in table I, paragraph 34, TM 4–235. For determination of hits and probability of hitting, see paragraph 28*c* and *f*, TM 4–235.

(3) *B component* (*accuracy*) —(Standard value about 50.)

$$B=36\left[\frac{PE+\text{DA E}}{d}\right]-10$$

in which

PE=value taken from table I, paragraph 34, TM 4–235.

DAPE=range DAPE (stripped of wild shots) from Form 23.

d=mean of the actual range deviations, record fire, including wild shots (arithmetical mean of the entries in line 9, Form 23). In case shots are lost so that all record shots are not used in determining *d*, the term $36\left[\frac{PE+\text{DAPE}}{d}\right]$ of the *B* component will be multiplied by the fraction,

$$\frac{\text{Number of shots used in determining } d}{\text{Number of record shots}}$$

(4) *C component* (*time*).—(Standard value 20.)

(*a*) Determine the value of $\frac{gt}{KS}$ to two decimal places:

in which

g=number of guns.

t=total corrected time of record fire in seconds.

S=number of record shots.

K=number of seconds prescribed as normal time for firing one shot per gun (see table of *K* factors below).

Table of K factors

Guns	*K* in seconds
3-inch	5
6-inch DC	20
6-inch BC	15
155-mm, case II	15
155-mm, case III	20
8-inch railway, 8-inch BC, and 10-inch DC	50
12-inch guns and mortars, all types, and 14-inch DC	60
14-inch railway, and 16-inch BC, DC, and howitzer	80
14-inch turret	90

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(*b*) With the value of $\frac{gt}{KS}$ as determined in (*a*) above, enter the time component *C* table below and obtain the value of *C*. The maximum score component obtainable is 25.0, and the minimum score component obtainable is −55.0.

Time component C table

$\frac{gt}{KS}$	C	$\frac{gt}{KS}$	C	$\frac{gt}{KS}$	C
		1.00	20.0		
0.70	25.0	1.01	19.8	1.30	0.0
0.71	24.8	1.02	19.5	1.31	−1.0
0.72	24.6	1.03	19.3	1.32	−2.2
0.73	24.5	1.04	19.0	1.33	−3.5
0.74	24.3	1.05	18.7	1.34	−4.7
0.75	24.2	1.06	18.5	1.35	−6.0
0.76	24.1	1.07	18.2	1.36	−7.2
0.77	23.9	1.08	17.8	1.37	−8.5
0.78	23.7	1.09	17.4	1.38	−10.0
0.79	23.6	1.10	17.0	1.39	−11.5
0.80	23.5	1.11	16.4	1.40	−13.0
0.81	23.3	1.12	15.8	1.41	−14.5
0.82	23.1	1.13	15.2	1.42	−16.0
0.83	23.0	1.14	14.6	1.43	−17.5
0.84	22.8	1.15	14.0	1.44	−19.0
0.85	22.7	1.16	13.2	1.45	−20.6
0.86	22.5	1.17	12.5	1.46	−22.3
0.87	22.4	1.18	11.7	1.47	−24.0
0.88	22.2	1.19	11.0	1.48	−25.8
0.89	22.0	1.20	10.1	1.49	−27.8
0.90	21.8	1.21	9.2	1.50	−29.8
0.91	21.7	1.22	8.4	1.51	−31.9
0.92	21.5	1.23	7.5	1.52	−34.0
0.93	21.3	1.24	6.5	1.53	−36.5
0.94	21.1	1.25	5.5	1.54	−39.0
0.95	20.9	1.26	4.5	1.55	−41.5
0.96	20.7	1.27	3.5	1.56	−44.0
0.97	20.5	1.28	2.4	1.57	−46.5
0.98	20.4	1.29	1.2	1.58	−49.0
0.99	20.2			1.59	−52.0
				1.60	−55.0

NOTE.—When $\frac{gt}{KS}$ is less than 0.70, take *C*=25.0. When $\frac{gt}{KS}$ is greater than 1.60, take *C*=−55.0.

(5) *R component.*

$$R=B\left[\frac{\text{Actual range} - \text{normal range}}{\text{Normal range}}+\frac{\sqrt{M}}{50}\right]$$

in which

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B=value of the B component of the score.

Actual range=arithmetical mean of the entries in line 2, Form 23.

Normal range=value listed in the table of normal ranges below.

M=average rate of change of range in yards per minute during record fire. The rate of change of range will be obtained as follows: Take range differences between consecutive record shots from line 2, Form 23. Add these range differences, irrespective of sign, and divide their sum by the total elapsed time in minutes to the nearest tenth between the first and last record shots. If for any reason it becomes impracticable to complete the practice on one course, the rate of change of range will be obtained, as described above, for each course. A weighted average based on the number of shots on each course will be obtained.

The value of R, as computed above, will be given the proper algebraic sign in determining the score.

Table of normal ranges

Armament	Normal range day firing [1] (yards)
3-inch	6,000
6-inch and 155-mm normal charge (when using coincidence range finder)	7,000
6-inch and 155-mm normal charge (except when using coincidence range finder)	10,000
155-mm supercharge	13,000
8-inch railway	13,000
8-inch BC, normal charge	16,000
8-inch BC, supercharge	20,000
10-inch DC	12,000
12-inch mortar (1,046-pound projectile):	
Firing in Zones VI and VII	6,000
Firing in Zones VII and VIII	7,500
12-inch mortar (700-pound projectile)	10,000
12-inch DC	14,000
12-inch BC	20,000
14-inch turret	14,000
14-inch DC	16,000
14-inch railway	24,000
16-inch howitzer:	
Firing in Zone II	15,000
Firing in Zone III	17,000
16-inch BC and DC, 2/3 charge	17,000
16-inch BC and DC	26,000

[1] For night firing, the normal range will be taken as 50 percent of the foregoing values, except that no value less than 5,000 or greater than 8,000 yards will be used.

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(6) *E component (preparation of fire).*—The purpose of the *E* component is to provide a bonus for careful and accurate preparation of fire. The value of the *E* component will be determined as follows: The center of impact of all trial or ranging shots, stripped of adjustment corrections made during trial fire, will be determined by taking the algebraic mean of the trial shot deviations from line 11, Form 23. Camera records, if available (otherwise spotting records, carefully rechecked), will be used in this determination. Using as arguments the range and lateral deviation of the center of impact as thus determined, enter the appropriate one of the two tables in (*a*) and (*b*) below to find the value of *E*. The probable error used in these computations will be that listed in table I, paragraph 34, TM 4–235.

(a) Table of values of *E*, when lateral deviation is not more than four direction probable errors:

Range deviation	*Value of E*
Not more than 2 *PE's*	+8
More than 2 but not more than 4 *PE's*	+4
More than 4 *PE's*	0

(b) Table of values of *E*, when lateral deviation is more than four but not more than six direction probable errors:

Range deviation	*Value of E*
Not more than 2 *PE's*	+4
More than 2 *PE's*	0

(*c*) When the lateral deviation is more than six probable errors, the value of *E* will be zero regardless of the magnitude of the range deviation.

c. Mortar batteries.—The score for each zone will be computed, as prescribed for guns in *b* above, as though the firing in each zone constituted a complete practice. For the purpose of computing the zone score, the time for the first zone will end and the time for the second zone will commence at the time of firing the last shot or salvo in the first zone. A separate score sheet for each zone will be included with the target practice records. The score for the practice will be determined by combining the zone scores on a proportion basis according to the number of record shots in each zone. The following example indicates the method to be used.

Example.—If the total score for $A+B+C+E+R$ for the first zone (twelve record shots) is 120, and the total score for $A+B+$

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$C+E+R$ for the second zone (eight record shots) is 90, then the score for the practice is:

$$\frac{12\times120}{20}+\frac{8\times90}{20}=108.$$

SECTION III

SUBMARINE MINES

Paragraph
Special instructions 6
Score 7

6. Special instructions.—For the year 1942 only, the following paragraphs of TM 4-235, including Changes No. 1, are modified as follows:

37. *Mine service practice.—a. Scope.—* * * *

(1) The replacing of five ballast-loaded mines of the project depth test group by five service-loaded mines.

* * * * * * *

(3) Delete entire subparagraph.

* * * * * * *

38. *Test phase.—a.* The test phase will be conducted as follows: Two complete groups of 19 mines, each loaded with 300 pounds of clean, dry sand or crushed rock, will be planted near the planned location for the wartime field. The two groups will be planted approximately on a line with an interval of about 100 feet between mine No. 1 of group II and mine No. 19 of group I.

* * * * * * *

e. Delete entire subparagraph.

f. The submergence of one group designated as the bump test group will be 6 feet at mean low water. The submergence of the other group designated as the project depth group will be that required for the majority of the groups included in the harbor defense mine project. After submergence has been taken on this project depth group all mine buoys will be removed therefrom.

g. All mines of the bump test group will be bumped by a boat to simulate contact firing at any time between the eighth and fourteenth day of the test period. The operation of

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bumping a given mine will not be repeated if on the first attempt the vessel actually strikes or comes in contact with the mine. The number of the mine bumped and the time of bumping will be recorded on the bumping vessel. The number of the mine signaling and the time of signaling will be recorded in the casemate. A comparison of the two records will be made to determine whether the correct mine responded to the bump and whether there was any excessive delay. Firing power will not be applied to the system.

h. At the end of the prescribed period the equipment of the bump test group will be taken up and disassembled for check purposes. Special note will be made of the electric fuses in the detonator circuits to determine whether any are blown. Five ballast-loaded mines, Nos. 8, 9, 10, 11, and 12, in the project depth group will be picked up and disassembled for check purposes when they are replaced with service-loaded mines for the firing phase. The electric fuses of the other 14 mines of this group will be tested when they are picked up after the firing phase is completed.

i. Delete entire subparagraph.

39. *Firing phase.—a.* The firing phase will consist of picking up ballast-loaded mines Nos. 8, 9, 10, 11, and 12 of the project depth group and replacing these with five mines, each loaded with 300 pounds of TNT. If available, old automatic anchors planted as dead-weight anchors will be used with the five service-loaded mines. The firing phase will start at the conclusion of the test phase.

b. Mine buoys and buoy ropes will not be used for picking up the five ballast-loaded mines. The five service-loaded mines will be planted with the submergence required by the harbor defense project, but in no case will this submergence be less than 10 feet.

* * * * * * *

d. The electrical tests in the firing phase will consist of taking the milliammeter readings of the mine circuit as follows:

(1) Of all 19 mines of the group 1 hour after the five service-loaded mines are planted.

(2) Of the 14 ballast-loaded mines, immediately, 24 hours and 48 hours after firing has been completed.

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(3) Delete entire subparagraph.

e. Delete phrase "using machine operation for M-2 systems."

* * * * * * *

g. On completion of firing at a towed target, all unfired service-loaded mines will be picked up. The 14 ballast-loaded mines will remain planted for 48 hours. At the expiration of this period, the equipment will be taken up and disassembled for check purposes.

40. *Time of planting.—a. Total.*—* * *

Add to this subparagraph the following: The total elapsed time of planting in the firing phase will be the time from the raising of the distribution box for picking up mines Nos. 8, 9, 10, 11, and 12 until the distribution box is planted at the completion of the planting of the five service-loaded mines.

* * * * * * *

42. *Special safety precautions.*

* * * * * * *

b. Under no circumstances will firing or clearing power be applied to the group panel in the casemate until after the distribution box has been planted and word has been received from the safety officer that the field of fire has been cleared of all vessels and is safe. If already turned on, all power will be turned off the group panel in the casemate promptly on receipt of word that the field of fire is not safe. After firing a mine, a short period will be allowed for the purpose of checking the mine circuits, after which the power will be turned off promptly.

* * * * * * *

Add the following subparagraph:

d. Operating power may be used to check the condition of circuits in planted mines before the distribution box is closed and planted. The test with operating power will not be made until the safety officer advises the casemate officer that the field of fire is cleared of all vessels except the distribution box boat.

7. **Score.**—The score for submarine mine practice is the sum of the points attained in the test phase and in the firing phase, as outlined below:

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a. Test phase.—(1) *General.*—The two groups planted for the test phase will be scored separately, giving full weight to each component and element. The final score for the test phase of the submarine mine target practice will be the sum of the points attained during the test phase for both groups divided by two.

(2) *Positions component.*—The positions component is divided into two elements: the longitudinal element and the lateral element.

(*a*) The points attained for the longitudinal element will be determined as follows: A value of 0.25 point will be allowed for each mine where the distance measured as prescribed in paragraph 43*b*(1), TM 4–235, is not greater than 30 feet. For each of the distances which is greater than 30 feet and less than 100 feet, the value will be as shown in column 2 of the table given in (5) below.

(*b*) The points attained for the lateral element will be determined as follows: A value of 0.30 point will be allowed for each interval where the distance measured as prescribed in paragraph 43*b*(2), TM 4–235, is not less than 75 feet nor greater than 125 feet. For each of the distances which is less than 75 feet or greater than 125 feet, the value will be as shown in column 3 of the table given in (5) below, but no credit will be allowed for any distance which is less than 50 feet or greater than 150 feet.

(*c*) The value of the positions component will be the sum of the points attained in the longitudinal element and the lateral element.

(3) *Submergence component.*—For each mine whose submergence when referred to mean low water does not differ from the prescribed value of 6 feet in the bump test group and from the project submergence in the project depth group, by more than 10 percent of the depth of the water at the time of planting, a value of 0.30 point will be allowed. For each mine whose submergence is outside the limits prescribed above or which floats, no credit will be taken, except that in case the depth of water at the time of planting exceeds 60 feet the mine may be picked up and replanted once without loss of credit. All floaters will be picked up and replanted, for which operation time out is authorized.

(4) *Time component.*—The points attained for the time component will be 4.65, provided that the net time is equal to or less than the number of minutes allowed in column 4 of the table given in (5) below. For every minute or fraction thereof that the net elapsed time exceeds the above time, one-half point will be deducted, provided that the maximum number of points thus deducted will not be greater than 4.65.

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(5) *Table.*

1	2	3	4
Average depth of water (feet) (mean low water)	Value of longitudinal element for each mine	Value of lateral element for each mine	Time allowed (minutes)
25–50	0	0	170
51–75	.05	.05	180
76–125	.10	.10	190
Over 125	.15	.15	200

(6) *Test component.*—The test component consists of three elements: the mine-test element, the bump-test element, and the miscellaneous element.

(*a*) The points attained for the mine-test element will be determined as follows: A credit of 2.5 points will be given for each of the mines planted. Milliammeter readings of each mine circuit will be taken once daily. The following deductions will be made for faults in mine circuits:

M–3 system.—For each mine whose milliammeter reading differs from that of a normal mine circuit by more than 10 percent but not more than 20 percent, deduct one point multiplied by the number of days on which such reading was obtained. For each mine where the difference is more than 20 percent, deduct two points multipled by the number of days on which such reading was obtained.

(*b*) For the year 1942 only, a credit of one point will be added for each mine of the bump-test group which signals properly in the casemate when bumped. A credit of 19 points will be added for the project depth group planted at project submergence whether or not a vessel of sufficient draft is available to make a bump test of these mines and regardless of whether the system operates when the mines are bumped. A full report of the bumping operations will be included in the narrative report.

(*c*) The value of the miscellaneous element is always negative and will be determined as follows:

1. For any mine system, one point will be deducted from the test component for each electric fuse in the detonator circuit which, on completion of the test phase and the firing phase, is found to have been blown.

2. For any mine system, one point will be deducted from the test component each time the distribution box is raised

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after it has been planted initially, except when such action is taken to repair a fault which has already resulted in penalty.

3. An additional two points will be deducted from the test component each time the shore cable is repaired, except when such repairs are made at the distribution box.

4. An additional two points will be deducted from the test component each time a mine is raised after the distribution box has been planted initially.

5. One point will be deducted from the test component for each mine of the bump test group which is bumped and fails to signal.

(*d*) The value of the test component in the test phase will be the algebraic sum of the points attained or penalties incurred according to (*a*), (*b*), and (*c*) above.

b. Firing phase.—(1) *Positions and submergence components.*—The values of the positions and submergence components will be determined as for the test phase in *a*(2) and (3) above, except that position and submergence components will be computed only for the five service-loaded mines.

(2) *Time component.*—The time allowed for the firing phase will be 300 minutes. The points attained for the time component will be 3.75, provided that the net time is equal to or less than 300 minutes. For every 5 minutes or fraction thereof that the net elapsed time exceeds the above time, one-half point will be deducted, provided that the maximum number of points thus deducted will not be greater than 3.75.

(3) *Test component.*—The test component in the firing phase consists of two elements: the mine-test element and the miscellaneous element.

(*a*) The method of determining the points attained in the mine-test element will be as follows: A credit of five points will be given for each of the mines planted. One hour after the distribution box has been planted, one test reading will be taken on each mine. Deductions as follows will be made for faults in mine circuits:

M–3 system.—For each mine whose milliammeter reading differs from that of a normal mine circuit by more than 10 percent, but not more than 20 percent, deduct 0.5 point. For each mine where the difference is more than 20 percent, deduct one point.

(*b*) The miscellaneous element will be as prescribed in *a*(6)(*c*) *1*, *2*, *3*, and *4* above. In addition, for each mine which fails to test

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within the limits set forth in (*a*) above during the period of the electrical tests made subsequent to the firing, one point will be added to the miscellaneous element.

(*c*) The value of the test component in the firing phase will be the algebraic sum of the foregoing mine-test values and the penalties incurred under the miscellaneous element.

(4) *Firing component.*—Firing will be conducted by the observation method. The value of each hit in the firing component will be 15 points, provided that if any mine other than the one ordered is fired, or if two or more mines are fired simultaneously, no credit for a hit will be allowed.

c. Tabulation of maximum points attainable.

Component	Test phase		Firing phase
	Group I	Group II	
Positions:			
Longitudinal	4. 75	4. 75	1. 25
Lateral	5. 40	5. 40	1. 50
Submergence	5. 70	5. 70	1. 50
Time	4. 65	4. 65	3. 75
Test:			
Mine test	47. 50	47. 50	25. 00
Bump test	19. 00	19. 00	----------
Miscellaneous	----------	----------	----------
Firing	----------	----------	30. 00
Subtotal	87. 00	87. 00	63. 00
Total each phase	87.00		63. 00
Grand total	150. 00		

SECTION IV

ANTIAIRCRAFT GUNS

	Paragraph
General	8
Number of practices	9
Number of guns	10
Score	11

8. General.—*a.* For the year 1942 only, firings will be distributed as far as practicable throughout the year in order to maintain a high state of artillery proficiency.

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b. Reports from abroad indicate that opportunities for effective fire on long courses are extremely rare because the target normally maneuvers immediately after the first bursts. The procedure in current use abroad consists of careful preparation of fire, tracking until steady data are obtained, and then firing a few rounds from all guns. Batteries should receive training in this method of fire.

9. Number of practices.—For the year 1942 only, the provisions of paragraph 51*b*, TM 4–235, are suspended. In lieu thereof the following will govern:

b. Number of practices.—(1) Two record service practices will be fired at towed sleeve targets.

(*a*) One of the two record service practices will be a day practice and the other will be a night practice.

(*b*) One of the two record service practices will be fired with high explosive shell.

(2) Not more than one service practice, preliminary or record, will be fired by a battery in any one day.

(3) Other firings within ammunition allowances will be prescribed by antiaircraft training center or brigade commanders (or regimental commander when no higher antiaircraft commander is present). For such firings, target practice regulations will be used as a guide where applicable except for safety regulations which are mandatory. A description of all firings not covered by target practice reports will be included in annual reports of training.

10. Number of guns.—For the year 1942 only, the provisions of paragraph 51*h*(1), TM 4–235, are suspended. In lieu thereof the following will govern:

h. Number of guns.—(1) Mobile gun batteries where possible will fire four guns on each course of record service practices. Where necessary, matériel will be shifted from one battery to another in order to obtain four guns. Fixed antiaircraft gun batteries will fire on each course all guns assigned to the battery.

11. Score.—The score for each record service practice conducted under either the firing phase or the detection phase consists of the sum of the scores obtained on each of the separate courses; for example, score equals C_1+C_2, etc., where C_1, C_2, etc., are expressed to one decimal place.

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a. Firing phase.—(1) The score for each course is:

$$C=\left[15+H+\frac{S_g}{25}\right]\left[\frac{HGM}{H'G'M'}\right]$$

where

H=average altitude of the course in thousands of yards taken to one decimal place.

S_g=average ground speed of the target in miles per hour taken to the nearest mile per hour. The expressions $\frac{S_g}{25}$ will be taken to one decimal place.

$HGM=\frac{60h}{gt_a}$ where

h=number of hits.

g=maximum number of guns used during the course.

t_a=corrected time of action in seconds (Form AA–10); t_a will not be taken as less than 5 except as provided in (2) below.

$H'G'M'$ is taken to one decimal place from figure 1, using as arguments the normal rate of fire (as prescribed in TM 4–235) and the average slant range in yards of the course taken to the nearest hundred yards.

(2) If the target is shot down during record fire, an adjusted value of t_a will be used in the formula for determining HGM. This adjusted value will be determined as follows:

$$\text{Adjusted value}=t_a\left[\frac{S-S'}{S}\right]$$

where

S=total number of shots during course.

S'=total number of bursts occurring after target was shot down.

t_a=corrected time of action as in (1) above. In this case only, the restriction that t_a will not be taken as less than 5 will not apply.

(3) For all practices fired with high explosive shell the officer in charge of the records will, at the end of each practice, count the number of holes in the sleeve target and report this information to the battery commander. The battery commander will record on Form AA–2b, Summary of Practice, Firing Phase, Guns, the number of holes in the sleeve resulting from each practice. This does not change existing instructions for determining hits from camera records.

(4) For the year 1942 only, no scores will be computed for 105-mm gun practices. Such firings will be classed as advanced practices.

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b. Detection phase.—The score for each course is:

$$C=\frac{R}{R_M}\times K$$

where

R=horizontal range in yards from the battery to the target at the time the first burst would have occurred (horizontal range to point T) taken to the nearest hundred yards.

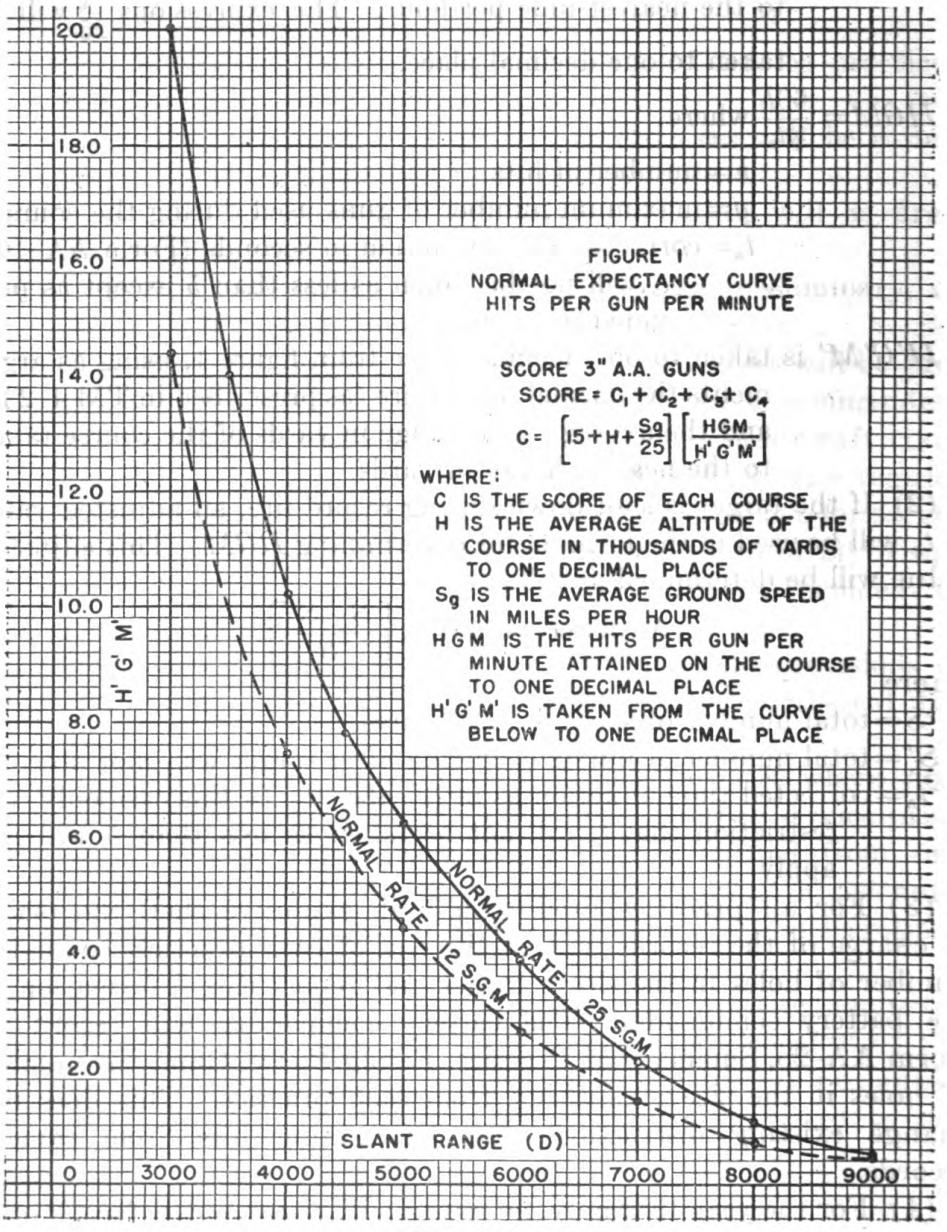


FIGURE 1.

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R_M=horizontal range in yards from the battery to the point where the plotted course of the target intersects the 30-second fuze curve (horizontal range to point T_M) taken to the nearest hundred yards.

K=10.

SECTION V

AUTOMATIC WEAPONS

	Paragraph
General	12
Number of practices	13
Score	14
Change in paragraph 82, TM 4–235	15

12. General.—For the year 1942 only, firings will be distributed as far as practicable throughout the year in order to maintain a high state of artillery proficiency.

13. Number of practices.—*a.* For the year 1942 only, the provisions of paragraph 71, TM 4–235, are suspended. In lieu thereof the following will govern:

71. *Number of practices, 37-mm gun battery.—a.* Each platoon of 37-mm gun batteries will fire—

(1) One or more preliminary practices with caliber .30 or caliber .50 machine guns.

(2) One or more preliminary and one record service practice with 37-mm guns.

b. At least one platoon of each 37-mm gun battery will conduct its record service practice at night using searchlight illumination of the target.

b. For the year 1942 only, the provisions of paragraph 72, TM 4–235, are suspended. In lieu thereof the following will govern:

72. *Number of practices, machine-gun battery.—a.* Each platoon of machine-gun batteries of antiaircraft regiments will fire—

(1) One or more preliminary practices with caliber .30 machine guns.

(2) One or more preliminary and one record service practice with caliber .50 machine guns.

b. At least one platoon of each machine-gun battery will conduct its record service practice at night using searchlight illumination of the target.

14. Score.—*a.* The score for an automatic weapons record service practice consists of the sum of the scores obtained on each of the

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separate courses; for example, score $=C_1+C_2$, etc., where C_1, C_2 etc., are expressed to one decimal place.

b. The score for each course is:

$$C=\left[15+\frac{S_g}{25}\right]\left[\frac{HGM}{H'G'M'}\right]$$

where

S_g=the average ground speed of the target in miles per hour taken to the nearest mile per hour. The expression $\frac{S_g}{25}$ will be taken to one decimal place.

HGM=hits per gun per minute, attained on the course taken to the nearest hit per gun per minute, from the formula:

$$HGM=\frac{60h}{gt_a}$$

where

h=number of hits.

g=maximum number of guns used during the course.

t_a=firing time in seconds. Except for the night practice, and when the average slant range is less than 500 yards, t_a will not be taken as less than 10 seconds.

$H'G'M'$ is taken to the nearest unit from figure 2, using as an argument the average slant range in yards of the course taken to the nearest 10 yards.

c. The standard types of antiaircraft machine-gun targets and the standard antiaircraft machine-gun scoring target will be used for 37-mm guns when fired by the method of central tracer control. It is expected, however, that 37-mm remote controlled guns using the M5 director shortly will be issued to troops. The method of fire adjustment employed with the M5 director requires that a tracer round be silhouetted in front of the target or obscured behind the target. The small vertical dimension of the B–12 sleeve target is a decided handicap when this method of fire control is used. The flag target A–6A, size 6 by 29 feet, has been adopted as standard for 37-mm guns when fired with director control. Flag targets must be flown with their transverse axis vertical on crossing courses and with their transverse axis horizontal on directly incoming courses. When this target is used, a hole made in any part of the flag will be counted as a hit. When available, this target should be used in

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target practice with the 37-mm gun and carriage M3A1 (remote controlled) and director M5.

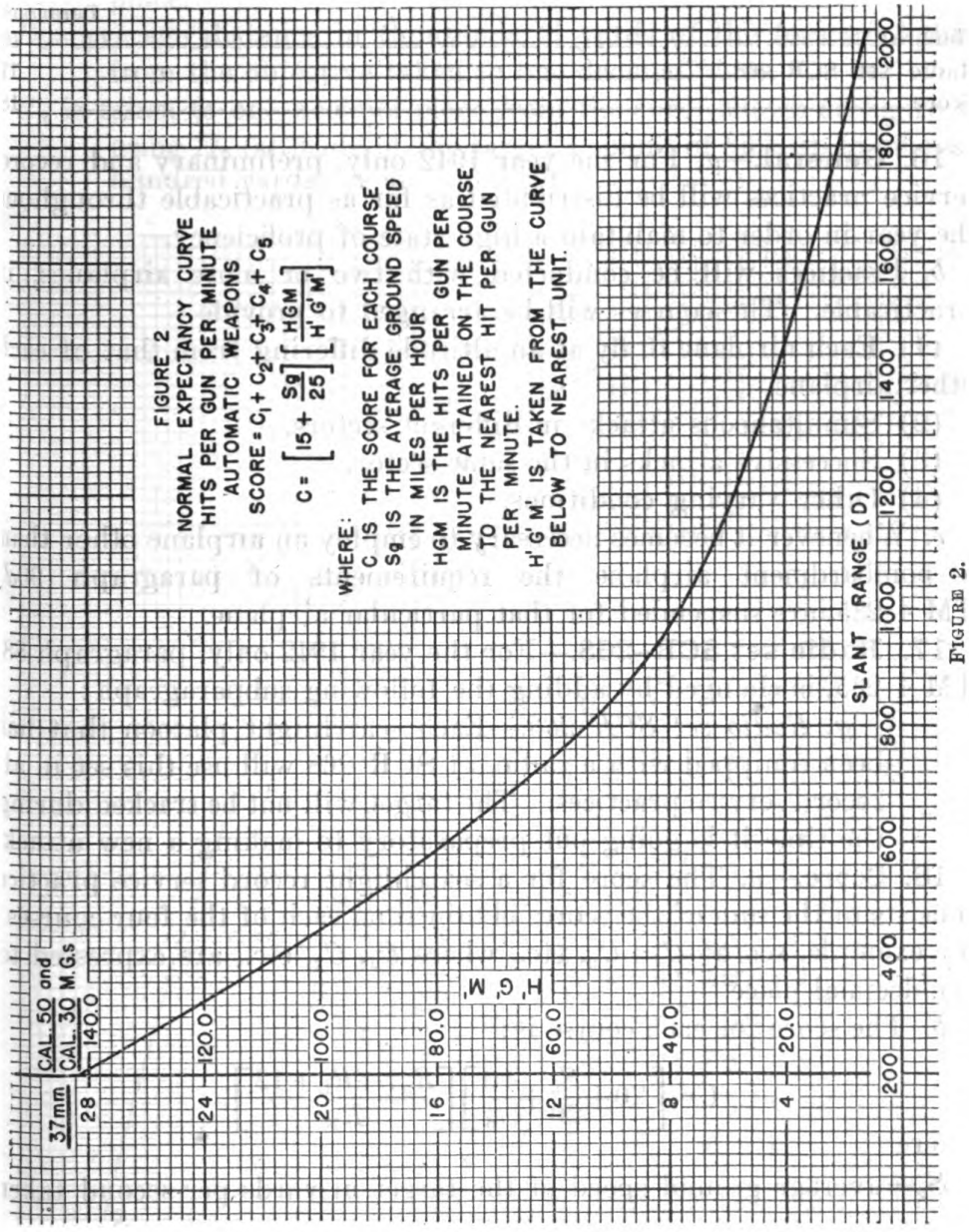


FIGURE 2.

15. Change in paragraph 82, TM 4–235.—The note in paragraph 82*c*(6) is changed to read as follows:

NOTE.—a_p is less than 800 if L_p is greater than R_m, and a_p is greater than 800 if L_p is less than R_m.

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SECTION VI

ANTIAIRCRAFT SEARCHLIGHTS

	Paragraph
General	16
Radio set SCR–268	17
Score	18

16. General.—*a.* For the year 1942 only, preliminary and record service practices will be distributed as far as practicable throughout the year in order to maintain a high state of proficiency.

b. Practices will be conducted with two or more airplanes, if practicable. The courses will be arranged to provide—

(1) Each airplane to fly at an altitude differing from that of each other airplane.

(2) Simultaneous attacks in different sectors.

(3) Successive attacks in the same sector.

(4) Other varying conditions.

c. Whenever it becomes necessary to employ an airplane other than a bombardment airplane the requirements of paragraph 90*d*, TM 4–235, are suspended for that particular airplane.

17. Radio set SCR–268.—For the year 1942 only, paragraph 88, TM 4–235, is changed by adding the following subparagraph:

g. Radio set SCR–268.—Each searchlight platoon that has been equipped with a radio set SCR–268 will use this set in all record service practices. The target will not be tracked during the time it is going out preparatory to making a new attack.

18. Score.—*a.* The score for a searchlight record service practice consists of the sum of the scores obtained on each of the four courses; for example, score $= C_1 + C_2$, etc., where C_1, C_2, etc., are expressed to one decimal place.

b. The score for each course is:

$$C = \left[20 + \frac{S_g}{20} + \frac{10}{t_p}\right]\left[\frac{R_p - R_L + 12}{R_N}\right]$$

where

S_g = average ground speed of the target in yards per second taken to the nearest yard per second. The expression $\frac{S_g}{20}$ will be taken to one decimal place.

t_p = time from "in action" to pick-up taken to one decimal place; t_p will not be taken as less than 1.0 second.

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R_p=actual horizontal range in thousands of yards of the point of pick-up measured from the objective and taken to one decimal place.

R_L=average distance in thousands of yards of the forward lights from the objective taken to one decimal place.

R_N is taken to one decimal place from the curve shown on figure 3, using H_p (altitude of the target at point of pick-up to nearest hundred yards) as an argument.

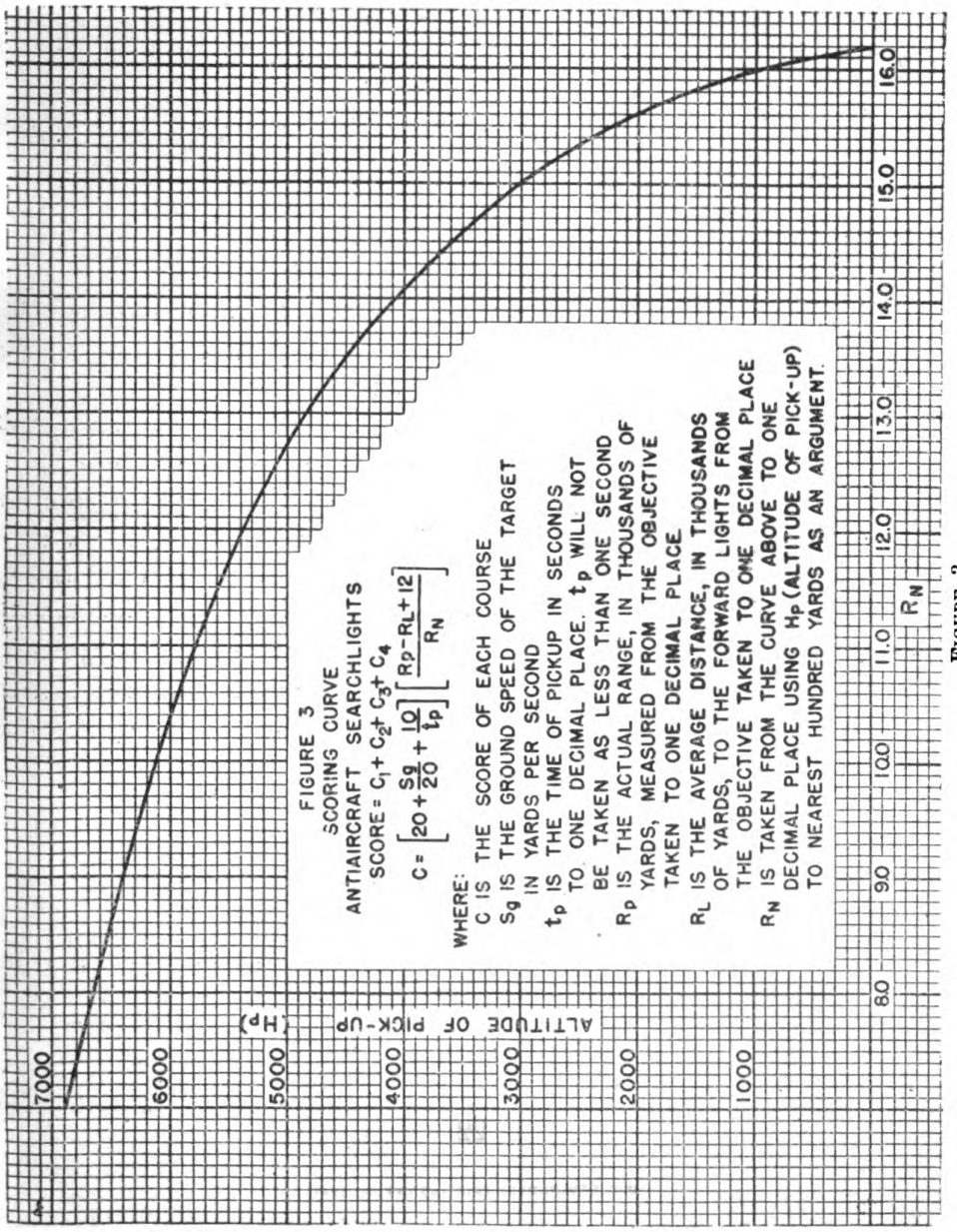


FIGURE 3.

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[A. G. 062.11 (10-15-41).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

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