

S/S Feb 72

Reference

FM 6-125

6-125-

Reference

DEPARTMENT OF THE ARMY FIELD MANUAL

*Chap 9 - S/S 2M 6-162, Mar 69
Chap 8 - S/S 2M 6-161, June 69
& Fm 6-2, 19 June 70*

QUALIFICATION TESTS FOR SPECIALISTS FIELD ARTILLERY



**HEADQUARTERS, DEPARTMENT OF THE ARMY
APRIL 1963**

FIELD MANUAL
No. 6-125

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., 23 April 1963

QUALIFICATION TESTS FOR SPECIALISTS, FIELD ARTILLERY

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*This manual supersedes FM 6-125, 10 August 1950, including C 1, 22 October 1952.

CHAPTER 1

GENERAL

1. Purpose and Scope

a. This field manual prescribes tests to be used in determining the relative proficiency and qualifications of individual specialists assigned to the field artillery. They are designed primarily as a training aid to assist the battery commander in evaluating the relative proficiency of individuals and the professional fitness of sections to perform normal combat functions. The material presented herein is applicable without modification to both nuclear and nonnuclear warfare.

b. The tests are *qualification type tests* and are not to be used as a basis for examination for promotion or for determining the relative proficiency of batteries or higher units.

c. Qualification tests for field artillery personnel not contained in this manual can be found in publications appropriate to their career field. For example, Gunners and Missilemen qualification tests are found in the appropriate service-of-the-piece type manual.

d. The tests included in this manual may also be useful as a study reference for specialists who are preparing for an MOS Evaluation Test. Inasmuch as MOS Evaluation Tests are not available to Reserve and National Guard units, these tests may be used as a *guide* to verify the primary MOS of specialists in such units.

2. Definition of Terms

a. *Ability To*. This term is used to specify the performance of a duty, such as the *ability to splice field wire*. The test for *ability to* is practical.

b. *Candidate*. The individual being tested.

c. *Knowledge Of*. This term is used to specify an understanding of the subject and does not involve the actual performance of an act or duty. The test for *knowledge of* is written or oral.

d. *Minimum Standard*. A definite level of proficiency which is adequate for an individual, team, or unit.

e. *Time of Performance Standard*. The attainment of a standard of proficiency in an operation performed by an individual, team, or unit in a specified length of time.

3. Award of Qualification Badges

Successful completion of the tests in this manual, with the exception of the tests described in chapters 11 and 12, will form the basis for award of the appropriate qualification badge with the Field Artillery bar as described in AR 672-5-1 only upon approval from the Department of the Army.

a. Awards for drivers and mechanics are described in paragraph 110, AR 672-5-1.

b. Artillery mechanics will take the gunners qualification test appropriate for the unit to which they are assigned.

c. Radar mechanics will take the radar operator's qualification test appropriate for the unit to which they are assigned.

4. Performance Tests

a. *General Instructions.* The qualification tests for specialists contained herein are to be used as a *guide* in testing specialists in field artillery units. The nature of job classifications of certain specialists necessitate the inclusion of essay or oral type tests in this manual. Exact scoring of this type test is often difficult and is not always truly indicative of the individual's ability. In utilizing such tests that require essay type answers, the unit commander may, at his discretion, modify the subject material based on the educational level of the individual and his ability to express himself orally.

b. *Examiners.* An officer, warrant officer, or enlisted man who is fully qualified and experienced in the subject covered by the test will be detailed as "examiner" to administer the test.

c. *Assistance.* The candidate will receive no unauthorized assistance during the tests. Each candidate may select authorized assistants, as indicated in the tests. If a candidate fails any test because of the examiner or any assistant, the test will be disregarded, and the candidate will be given another test of the same nature.

d. *Time.* The time for any test will be the time from the last word of the command to the last word of the candidate's report. The candidate may, at his own discretion, begin any test after the first word of the first command.

e. *Scoring.* Scoring will be conducted in accordance with the two subparagraphs, "Penalties" and "Credit," under each subject. If a test is performed correctly within the minimum time limits, credit will be given in accordance with the subparagraph, "Credit," under each subject. Penalties will be assessed in accordance with the subparagraph, "Penalties," under each subject. The total penalties will not exceed the total credits allowed for any one test. *When the total penalties incurred equal the total credits allowed for a test, the candidate will be declared disqualified in that test and the examiner will proceed to the next test.*

f. Preparation for Tests. Prior to the examination, the examiner will familiarize himself with the tests, including penalties and credits. He will insure that all materials and equipment required for the tests are prepared, are readily accessible, and are in good operating condition. He will assure himself that the candidate understands the requirements of each test, and will require the candidate to report "I am ready" before each test. For those tests that require a detailed explanation by the candidate, checklists should be prepared based upon material contained in specific reference material. A detailed checklist will provide uniformity in scoring procedures which are influenced, not only by the performance of the candidate, but also by the difference in proficiency standards of various examiners.

g. Qualification Scores.

- (1) Minimum percentage scores required for qualification in the tests (except for survey specialists) are as follows:

<i>Individual classification</i>	<i>Percentage score</i>
Expert.....	90%
First-class specialist.....	80%
Second-class specialist.....	70%

- (2) The scoring for the survey specialists test is described in chapter 3.

5. References

See the appendix for list of references. Prior to the preparation of each qualification test, examiners should consult Department of the Army pamphlets of the 310-series for latest changes or revisions, and new publications of reference material.

6. Recommendations

Users of this manual are requested to submit recommendations for changes, corrections, additions, or modification of tests to the Commandant, United States Army Artillery and Missile School, Fort Sill, Okla. For format and guidance, see AR 310-3.

CHAPTER 2

OPERATIONS SPECIALISTS

7. Qualification Tests

a. The tests prescribed in this chapter provide for the qualification of operations specialists in the headquarters of all artillery echelons. Tests should be administered to operations personnel of the various echelons as follows:

- (1) Field artillery battery and battalion (pars. 9-21).
- (2) Division artillery, field artillery group or higher echelon (pars. 15, 18, 19, 21-23).

b. Operations personnel, regardless of the level of the artillery headquarters to which assigned, in order to be considered fully qualified as operations specialists must successfully complete the tests contained in paragraphs 9 through 21.

8. Outline of Tests

Par. No.	Subject	Num- ber of tests	Points each	Maximum credit	
				Battery and bat- talion	Higher echelons
9	Preparation of firing charts.....	1	5	5	-----
10	Determination of data from the firing chart..	3	4	12	-----
11	Determination of site.....	1	6	6	-----
12	Computation of fire commands.....	3	2	6	-----
13	Computation of corrections from meteorological data.....	2	-----	11	-----
	Test 1.....	(1)	7	(7)	-----
	Test 2.....	(1)	4	(4)	-----
14	Computation of corrections from a high burst (or center-of-impact) registration....	2	5	10	-----
15	Map reading.....	5	2	10	10
16	Replot of targets.....	1	5	5	-----
17	Preparation of deflection—correction scale....	1	2	2	-----
18	Computation of photo scale.....	3	-----	10	10
	Test 1.....	(1)	5	(5)	(5)
	Test 2.....	(1)	3	(3)	(3)
	Test 3.....	(1)	2	(2)	(2)
19	Restitution of points from a photograph....	1	10	10	10
20	Fire capabilities chart.....	1	6	6	-----

Par. No.	Subject	Num- ber of tests	Points each	Maximum credit	
				Battery and bat- talion	Higher echel- ons
21	Codes and authentication -----	3	-----	7	10
	Tests 1 and 3 -----	(2)	3	*(3)	(6)
	Test 2 -----	(1)	4	(4)	(4)
22	Fire direction procedures for higher artillery headquarters -----	4	-----	-----	45
	Tests 1 and 3 -----	(2)	15	-----	(30)
	Test 2 -----	(1)	5	-----	(5)
	Test 4 -----	(1)	10	-----	(10)
23	Evaluation of enemy artillery -----	1	15	-----	15
	Total -----	32	-----	100	100

*Battery and battalion operations personnel will not be required to take test 3 of paragraph 21.

9. Preparation of Firing Chart

a. Scope of Test. One test will be conducted to determine the candidate's ability to prepare a firing chart for use in the fire direction center.

b. Special Instructions.

- (1) The candidate will be furnished the coordinates and altitudes of the following locations:
 - (a) Battery centers of Batteries A, B, and C.
 - (b) Registration point.
 - (c) Observation post (01).
 - (d) Two concentrations within transfer limits of the registration point.
- (2) The following material and equipment will be provided:
 - (a) Grid sheet appropriately numbered for plotting.
 - (b) Target grid.
 - (c) Boxwood scale.
 - (d) GFT fan, or range deflection protractor, prepared with appropriate deflection markings.
 - (e) Plotting equipment, including appropriate type and color pencils.
- (3) The firing chart used for this test may be used for subsequent tests.

c. Outline of Test.

Examiner commands—	Action of candidate
THE SURVEY SECTION HAS JUST HANDED YOU, THE HORIZONTAL CONTROL OPERATOR, THE COORDINATES OF THE BATTERY CENTERS, REGISTRATION POINT 1, OBSERVATION POST (01), AND TWO TARGETS WITHIN TRANSFER LIMITS OF REGISTRATION POINT 1. THE AZIMUTH FROM 01 TO REGISTRATION POINT 1 IS 1230. ALL BATTERIES ARE LAID ON AN AZIMUTH WHICH PASSES THROUGH REGISTRATION POINT 1. PREPARE THIS CHART FOR USE IN THE FIRE DIRECTION CENTER.	Completes chart to include— a. Plotting of all coordinates received from survey section. b. Drawing and labeling deflection indexes. c. Drawing three azimuth indexes from 01.

d. Penalties. Penalties will be assessed as follows:

- (1) If the location of any surveyed position is plotted in error by more than 20 meters, 2 points each.
- (2) If a deflection index, or one of the azimuth indexes from 01, is in excess of 2 mils in error, 2 points.
- (3) No credit will be allowed if the time required exceeds 25 minutes.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

10. Determination of Data from the Firing Chart

a. Scope of Tests. Three tests will be conducted to determine the candidate's ability to determine data from the firing chart and to announce these data to the computers.

b. Special Instructions. The candidate will use the equipment and materials furnished for paragraph 9. Only those concentrations and targets previously plotted on the firing chart will be used.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	YOU ARE THE HORIZONTAL CONTROL OPERATOR. DETERMINE AND ANNOUNCE THE DATA TO CONC _____ (one of the concentrations previously plotted.) BASED ON THE FOLLOWING ORDER: BATTALION _____, CHARGE _____, FUZE _____, FIVE VOLLEYS, CONC _____.	Determines and announces all data normally announced by the horizontal control operator. (See FM 6-40.)

Test No.	Examiner commands—	Action of candidate
2	THE FOLLOWING INITIAL FIRE REQUEST HAS JUST BEEN RECEIVED: FIRE MISSION: FROM CONCENTRATION _____, AZIMUTH _____, RIGHT (LEFT) _____, ADD (DROP) _____: MACHINEGUNS: WILL ADJUST. (Examiner gives a target within 1,000 meters of plotted concentration.) DETERMINE AND ANNOUNCE THE DATA BASED ON THE FOLLOWING FIRE ORDER: BATTALION _____, SALVO RIGHT, USE REGISTRATION POINT 1, CHARGE _____, 3 VOLLEYS, CONC _____.	Plots location of target using target grid and draws target grid azimuth index. Determines and announces all data normally announced by the horizontal control operator of the adjusting battery.
3	THE FOLLOWING INITIAL FIRE REQUEST HAS JUST BEEN RECEIVED: FIRE MISSION: AZIMUTH _____, DISTANCE _____, INFANTRY IN OPEN, FUZE TIME, WILL ADJUST. DETERMINE DATA BASED ON THE FOLLOWING FIRE ORDER: BATTALION _____, CHARGE _____, 3 VOLLEYS, CONC _____.	Plots location of target and draws target grid azimuth index. Determines and announces all data normally announced by a horizontal control operator of the adjusting battery.

d. Penalties. Penalties will be assessed as follows:

(1) Test 1. For error in—

- (a) Failing to announce deflection correction (if using GFT fan), to the nearest mil, 1 point.
- (b) Deflection in excess of 3 mils, 2 points.
- (c) Elevation (if using GFT fan) in excess of 3 mils, 2 points; or in cases where range is announced, error in range in excess of 30 meters, 2 points.

(2) Test 2 and 3.

- (a) Error in location of target in excess of 20 meters, 2 points; 20 meters, 3 points; 40 meters, 4 points.
- (b) Error in target grid azimuth index in excess of 10 mils, 1 point.
- (c) Error in deflection in excess of 3 mils, 1 point.
- (d) Error in elevation in excess of 3 mils, 1 point; or in cases where range is announced, error in range in excess of 30 meters, 1 point.

(e) If time required exceeds 1 minute, no credit will be allowed.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

11. Determination of Site

a. Scope of Test. One test will be conducted to determine the candidate's ability to compute site by using a GST.

b. Special Instructions.

- (1) In addition to the materials listed in paragraph 9, the candidate will be furnished a graphical site table (GST).
- (2) The site will be determined for each concentration plotted on the firing chart.

c. Outline of Test.

Examiner commands—	Action of candidate
DETERMINE THE SITE TO THE FOLLOWING TARGETS. (Examiner gives previously prepared fire orders for both concentrations that are plotted on the firing chart.)	Determines and announces site for each designated battery. (Altitude of target and battery previously plotted on firing chart.)

d. Penalties.

- (1) A penalty of 1 point will be assessed for an error of 1 mil in any site computed. If the computed site is close to .5 (such as 3.5) both answers of 3 or 4 are correct.
- (2) Time in seconds, exactly or less than—60 45 30
Credit 1 2 3

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

12. Computation of Fire Commands

a. Scope of Tests. Three tests will be conducted to determine the candidate's ability to perform the duties of a battery computer.

b. Special Instructions.

- (1) The candidate will be furnished a GFT, a minimum of six FDC Computer's Records (DA Form 6-16) and a minimum of two Records of Precision Fire (DA Form 6-12).
- (2) Prior to the start of the tests, the examiner will prepare the data determined and announced during the missions by the horizontal control operator to the computer. In addition, the examiner will prepare the fire order required for each mission.
- (3) Test 1 will consist of a precision registration and a time registration. The candidate will complete the registration to include adjusted data, and GFT setting. The GFT setting is placed on the GFT or GFT fan by the candidate and (with the equipment marked correctly) is used in Test 2.

Test No.	Examiner commands—	Action of candidate
3	<p>THE FOLLOWING FIRE REQUEST HAS JUST BEEN RECEIVED: FIRE MISSION: COORDINATES _____, AZIMUTH _____, MACHINEGUNS, HIGH ANGLE, WILL ADJUST. FIRE ORDER: BATTALION _____, HIGH ANGLE INCLUDE SITE, FUZE VT, 2 VOLLEYS, CONC _____. (Examiner reads altitude of target and Btry B, and previously prepared horizontal control operator's data—deflection correction, chart deflection and range (elevation if using GFT fan). The examiner reads above data and observer correction for each round of mission.</p>	<p>Records fire mission and fire order. Records data announced by examiner and determines and records such data normally computed by the adjusting battery computer. If the unit is using a GFT fan, the candidate must determine drift and elevation in addition to other duties. (See FM 6-40.)</p>

d. Penalties. Penalties will be assessed as follows:

(1) *Test 1.* For error in—

- (a) Adjusted deflection, no credit allowed.
- (b) Adjusted elevation, no credit allowed.
- (c) Adjusted time, no credit allowed.
- (d) Announcement of GFT setting or marking of GFT setting of GFT fan (GFT), 1 point.
- (e) Procedure, 1 point.
- (f) Recording data, 1 point.
- (g) Deflection correction scale, 1 point.

(2) *Test 2.*

- (a) Error in recording data, 1 point.
- (b) Failure to use deflection correction scale or incorrect use of deflection correction scale, 1 point.
- (c) Error in 20/R factor, 1 point.
- (d) Failure to include 20/R, no credit allowed.
- (e) Error in computation or application of observers height of burst changes (UPs or DOWNs), 1 point.

(3) *Test 3.* For error in—

- (a) Recording data, 1 point.
- (b) The piece (QE fired) quadrant elevation, in excess of 3 mils, 1 point.
- (c) The piece (deflection fired) deflection, in excess of 1 mil, 1 point.

e. Subject to the penalties assessed in *d* above, 2 points will be awarded for each test.

13. Computation of Corrections from Meteorological Data

a. Scope of Tests. Two tests will be conducted to determine the candidate's ability to compute corrections from a metro message, to apply the corrections to the GFT or GFT fan, and to construct a deflection-correction scale.

b. Special Instructions.

- (1) The candidate will be furnished a GFT or GFT fan, a tabular firing table, and a metro message. He will be furnished the following information:
 - (a) Firing chart data to fire on the registration point.
 - (b) Necessary information from the battery.
 - (c) VE obtained from a registration and concurrent metro message.
 - (d) QE using last GFT setting and site.
- (2) Prior to the start of the tests, the candidate will be furnished a form for computation of the metro message or will be given an opportunity to prepare his own form, whichever he desires.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	COMPUTE THE METRO MESSAGE FROM THE DATA GIVEN, AND ANNOUNCE THE CORRECTIONS OBTAINED.	Determines metro corrections and announces all corrections.
2	PLACE THE CORRECTIONS OBTAINED IN TEST 1 ON THE GFT OR GFT FAN; CONSTRUCT AND MARK ON GFT FAN A DEFLECTION CORRECTION SCALE.	Sets up the GFT or GFT fan with GFT setting. Constructs a deflection correction scale and marks it on fan or makes card.

d. Penalties. Penalties will be assessed as follows:

- (1) Test 1. No credit will be allowed if—
 - (a) New range corrections are in error in excess of 10 meters.
 - (b) Metro deflection correction is in error by 1 mil.
 - (c) Metro message computed incorrectly. (Deduct 3 points for each mathematical error.)
- (2) Test 2. No credit will be allowed if the GFT setting is incorrectly marked on GFT or GFT fan or if deflection correction scale constructed is incorrect.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as follows:

- (1) Test 1.

Time in minutes, exactly or less than—	10	11	12
Credit	7	5	3

- (2) Test 2. Correct GFT setting, 2 points.
- (3) Test 2. Correct deflection scale, 2 points.

14. Computation of Correction from a High Burst Registration

a. Scope of test. Two tests will be conducted to determine the candidate's ability to compute corrections obtained from a high burst registration.

b. Special Instructions. The following will be furnished the candidate:

- (1) A firing chart with 01, 02 and battery center plotted; azimuth indices of 01 and 02 plotted; and a temporary deflection index constructed.
- (2) Six usable azimuth readings each from observers 01 and 02.
- (3) The data fired.
- (4) Azimuth and distance from 01 to 02 base.
- (5) Coordinates of 01.
- (6) TM 6-230.
- (7) DA Form 6-55.
- (8) Range deflection protractor or GFT fan.
- (9) Protractor.
- (10) GFT.
- (11) GST.
- (12) Boxwood scale.
- (13) Military slide rule (if desired by the candidate).
- (14) Plotting equipment.

c. Outline of Test.

Test No.	Examiner commands—	Action of candidate
1	THE HIGH BURST REGISTRATION WAS FIRED WITH CHARGE _____, DEFLECTION _____, RANGE _____, ELEVATION _____, AND SITE _____, THE FOLLOWING INFORMATION HAS BEEN REPORTED BY THE OBSERVERS. (Examiner reads 01's reported azimuths, 01's reported vertical angles, and 02's reported azimuths, and distance and azimuth 01 to 02.) COMPUTE ALTITUDE AND CHART LOCATION OF THE HIGH BURST. USE POLAR PLOT METHOD TO CHECK LOCATION. CONTINUE COMPUTATIONS ON DA FORM 6-55 AND COMPUTE COORDINATES AND ALTITUDE OF HIGH BURST.	The candidate records data fired and 01—02 reported data, as read by examiner, on DA Form 6-55. Averages azimuth and vertical angle readings. Computes coordinates and altitude of high burst location. Using polar plot method, check computed location and altitude of high burst.
2	DETERMINE DEFLECTION CORRECTIONS AND GFT SETTING FOR THE REGISTRATION.	Labels location correctly and determines registration corrections.

d. Penalties. Penalties will be assessed as follows:

(1) Test 1. For error in—

- (a) Averaging azimuths and vertical angle, 1 point per error.
- (b) Computing 01—HB distance, 2 points, if mathematical error only, and 5 points if procedural error.
- (c) Computing VI and altitude, 1 point.
- (d) Polar-plotted location in excess of 20 meters, no credit allowed.
- (e) Computing coordinates and altitude of HB, 2 points.

(2) Test 2. For error in—

- (a) Deflection correction, no credit allowed.
- (b) GFT setting determined, 1 point.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

15. Map Reading

a. Scope of Tests. Five tests will be conducted to determine the candidate's ability to read maps, to plot and read coordinates, and to use conventional signs and symbols.

b. Special Instructions.

(1) The following materials and equipment will be furnished the candidate:

- (a) Terrain map, 1:25,000 or 1:50,000 (declination diagram required).
- (b) Appropriate scale, map pins, and protractor.

(2) The signs and symbols used in Tests 1 and 2 should be those given in FM 21-30.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	IDENTIFY EACH OF THESE SIGNS OR SYMBOLS. (Examiner points out four military and four topographical symbols on terrain map.)	Identifies signs and symbols.
2	DRAW THE FOLLOWING SYMBOLS AS EACH IS NAMED. (Examiner names four military and four topographical points.)	Draws symbols as required.
3	GIVE THE GRID-AZIMUTH AND THE MAGNETIC AZIMUTH FOR 19____ FROM POINT A TO POINT B. (Examiner indicates points A and B on the map. They should be more than 4 inches apart.)	Measures and reports the grid-azimuth and the magnetic azimuth for the year designated by the examiner.
4	a. GIVE THE COORDINATES OF THIS POINT (Examiner indicates the point on map).	a. Measures and reports coordinates.

Test No.	Examiner commands—	Action of candidate
4	b. PLOT A POINT AT THE FOLLOWING COORDINATES: _____	b. Plots the point.
5	GIVE THE ALTITUDE OF THE POINT AT THE FOLLOWING COORDINATES: _____	Plots point. Determines and reports altitude.

d. Penalties.

(1) Tests 1 and 2.

- (a) For each sign or symbol named or drawn incorrectly, 0.5 point.
- (b) No credit will be awarded if the candidate fails to identify or draw correctly at least five symbols.

(2) Test 3.

- (a) If the grid-azimuth announced is in error in excess of 5 mils, 1.0 point.
- (b) If the magnetic azimuth announced is in error in excess of 1 mil, 1.0 point.
- (c) No credit will be allowed if the time required to determine both azimuths exceeds 2 minutes.

(3) Test 4

- (a) No credit will be allowed for part *a* if the reported coordinates are in error in excess of 25 meters or if the time required exceeds 30 seconds.
- (b) No credit will be allowed for part *b* if the point plotted is in error in excess of 25 meters or if the time required exceeds 30 seconds.

(4) Test 5. No credit will be allowed if the announced altitude is in error in excess of one-half of the contour interval or if the time required exceeds 2 minutes.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

16. Replot of Targets

a. Scope of Test. One test will be conducted to determine the candidate's ability to replot targets. This ability will include determination of altitude from a map, determination of data for replot, and plotting the data on a chart.

b. Special Instructions.

- (1) A mounted map of the target area will be furnished the candidate to determine replot altitude.

- (2) Prior to the start of the test, the examiner will prepare a complete record of fire for several targets on FDC Computer's Records (DA Form 6-16). At a minimum, the examiner should use FFE data which includes fuze quick, fuze time and fuze variable time. This record will be given to the candidate so that he can obtain the data announced in the fire order and the data fired in effect. Using this data, the candidate is directed to polar plot the final needle location of the target used for fire for effect. The test begins at the completion of the polar plot of fire for effect data.
- (3) The site fired, which is shown on the FDC Computer's Record, will be in error by not more than 10 mils.

c. Outline of Test.

Examiner commands—	Action of candidate
DETERMINE FINAL NEEDLE LOCATION OF TARGETS USING FIRE FOR EFFECT DATA AS SHOWN ON COMPUTER'S RECORD. DETERMINE AND ANNOUNCE FINAL REPLOT DATA. REPLOT TARGETS USING DATA DETERMINED. (Examiner uses target data which includes fuze quick, fuze time and fuze variable time in fire for effect.)	Polar plots fire for effect data and puts needle in proper location. Performs all procedures required by vertical control operator and horizontal control operator to determine final data for replot. (See FM 6-40.) Replots the targets.

d. Penalties. Penalties will be assessed as follows:

- (1) Error in altitude in excess of one-half of a contour interval, 1 point.
- (2) Error in final coordinates in excess of 10 meters, 1 point.
- (3) Error of 1 mil in site, used to determine plot location, 1 point.
- (4) Error in announcement of final replot data, 1 point.
- (5) Concentration not properly and completely identified, 1 point.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

17. Preparation of Deflection-Correction Scale

a. Scope of Test. One test will be conducted to determine the candidate's ability to determine and construct a deflection correction scale in card form or place it on the GFT or GFT fan.

b. Special Instructions. The examiner will give the candidate a deflection correction assumed to have been obtained by registration on the registration point at the given range and the adjusted elevation.

c. Outline of Test.

Examiner commands—	Action of candidate
RANGE TO THE REGISTRATION POINT IS_____. DEFLECTION CORRECTION FOR THE REGISTRATION POINT IS_____. ADJUSTED ELEVATION IS_____. CONSTRUCT A DEFLECTION CORRECTION SCALE IN CARD FORM OR ON THE GFT OR GFT FAN.	Constructs the deflection correction scale in card form or places the scale on the GFT or ballistic plate of the GFT fan. (See FM 6-40.)

d. Penalties. No credit will be allowed if—

- (1) The deflection correction scale is in error in excess of 1 mil at any point.
- (2) Incorrect elevation is used for setting up scale.
- (3) The time required exceeds 2.5 minutes.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

18. Computation of Photo Scale

a. Scope of Tests. Three tests will be conducted to determine the candidate's ability to compute the scale of a vertical photograph.

b. Special Instructions.

- (1) The following materials and equipment will be furnished the candidate:
 - (a) Terrain map, scale 1:25,000 or 1:50,000.
 - (b) Boxwood scale.
 - (c) One or more vertical photographs, scale between 1:10,000 and 1:15,000.
 - (d) Military slide rule.
- (2) Prior to the start of the tests, the examiner will select the points to be used and will mark them on the map and on the photograph.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	SET UP THE MILITARY SLIDE RULE FOR PHOTO-GROUND RELATIONSHIP AND DETERMINE PHOTO SCALE. (Examiner indicates to the candidate two points on the photo and tells him that the ground distance between them has been determined to be _____. Examiner should use odd figure between 1,000 and 2,000 meters.)	Measures the photo distance. Sets up the slide rule, computes and announces the photo scale.

Test No.	Examiner commands—	Action of candidate
2	COMPUTE THE SCALE OF THE PHOTOGRAPH FROM THESE TWO POINTS (indicated on photograph and map).	Computes and announces the photo scale.
3	COMPUTE THE SCALE OF THE PHOTOGRAPH. (Examiner tells the candidate that the information on the margin of the photograph indicates that the altitude of the aircraft was _____ above sea level and the focal length of the camera was _____.)	Computes and announces the photo scale.

d. Penalties. Penalties will be assessed as follows:

(1) Test 1.

(a) Error in computed scale in excess of 1 part in 200, 3 points.

(b) No credit will be allowed if the time required exceeds 3 minutes.

(2) Test 2. Error in computed scale in excess of 1 part in 200, 3 points.

(3) Test 3.

(a) Error in computed scale in excess of 1 part in 100, 2 points.

(b) No credit will be allowed if the time required exceeds 1 minute.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as follows:

(1) Test 1.

Time in minutes, exactly or less than—2 2. 5 3

Credit, 5 3 2

(2) Test 2.

Time in minutes, exactly or less than—2 2. 5 3

Credit 3 2 1

(3) Test 3. Maximum credit, 2 points.

19. Restitution

a. Scope of Test. One test will be conducted to determine the candidate's ability to reconstitute points from an air photograph.

b. Special Instructions. The following materials and equipment will be furnished the candidate:

(1) Map or chart, 1:25,000 or 1:50,000, with three restitution points plotted on it.

(2) Vertical photograph on which the three restitution points can be identified. One target will be marked on the photograph.

(3) Tracing paper and plotting equipment.

c. Outline of Test.

Examiner commands—	Action of candidate
FIND THE CHART LOCATION OF THE TARGET INDICATED ON THE PHOTOGRAPH. (Examiner explains that the three points marked on the photograph are plotted on the chart.)	Restitutes the target to the chart, using any method he desires.

d. Penalties. Penalties will be assessed as follows:

- (1) Error in location of more than 50 meters but less than 75 meters, 3 points.
- (2) Error in location of more than 75 meters but less than 100 meters, 5 points.
- (3) No credit will be given if the location of the target is in error in excess of 100 meters, or if the time required exceeds 10 minutes.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as follows:

Time in minutes, exactly or less than—	8	9	10
Credit	10	8	5

20. Fire Capabilities Chart

a. Scope of Test. One test will be conducted to determine the candidate's ability to prepare a battalion fire capabilities chart.

b. Special Instructions. The candidate will be furnished the following materials and equipment:

- (1) Firing chart with Batteries A, B, and C, and deflection indexes plotted thereon.
- (2) Plotting equipment.
- (3) Tracing paper.

c. Outline of Test.

Examiner commands—	Action of candidate						
<p>YOU ARE THE BATTALION OPERATION SERGEANT. THE BATTERY EXECUTIVES REPORT THE FOLLOWING FIRE CAPABILITIES:</p> <table><tr><td>RIGHT</td><td>LEFT</td><td>MINIMUM</td></tr><tr><td>DF</td><td>DF</td><td>RANGE</td></tr></table> <p>THE MAXIMUM RANGE FOR ALL BATTERIES IS _____. PREPARE AN OVERLAY OF BATTALION FIRE CAPABILITIES TO BE SENT TO THE HIGHER HEADQUARTERS AS AN OFFICIAL REPORT.</p>	RIGHT	LEFT	MINIMUM	DF	DF	RANGE	Prepares fire capabilities overlay.
RIGHT	LEFT	MINIMUM					
DF	DF	RANGE					

d. Penalties. Penalties will be assessed as follows:

- (1) Error in range of more than 30 meters, 3 points.
- (2) Error in deflection of more than 3 mils, 3 points.
- (3) Failure to include all essential parts of title, heading, and authentication, 1 point.
- (4) Failure to place identification marks on the overlay, 3 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as follows:

- (1) Accuracy of overlay, 3 points.
- (2) Neatness and legibility of overlay, 2 points.
- (3) Overlay title, heading, and authentication, 1 point.

21. Codes and Authentication

a. Scope of Tests. Three tests will be conducted to determine the candidate's ability to meet the security requirements of the operations section.

b. Special Instructions. The candidate will be furnished the following materials:

- (1) Authentication table prepared as it appears in signal operations instructions.
- (2) Prearranged message code (to include number section or (3) below).
- (3) Numeral code prepared as it appears in SOI.
- (4) Appropriate scale.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	YOU ANSWER THE TELEPHONE AND IDENTIFY YOURSELF. THE CALLING PARTY SAYS "THIS IS RAG 3. AUTHENTICATE HOTEL MIKE." ANSWER THE CHALLENGE.	Determines authentication from table and replies.
2	GIVE THE MAP LOCATIONS OF THESE POINTS: _____ IN CODE. (Examiner gives the coordinates of two points.)	Locates and reports map locations. (See FM 21-25.)
3	USING THE PREARRANGED MESSAGE CODE, ENCODE THE FOLLOWING MESSAGE: _____. (Examiner gives message in vocabulary of code, six code groups.)	Encodes message.

d. Penalties.

- (1) Test 1. No credit will be allowed if the candidate fails to give correct authentication.
- (2) Test 2. For each incorrect code group, 2 points.
- (3) Test 3. For each incorrect code group, 1 point.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

22. Fire Direction Procedures for Higher Artillery Headquarters

a. Scope of Tests. Four tests will be conducted to determine the candidate's ability to perform the operations involved in the processing and transmission of fire missions in the headquarters of field artillery groups, division artillery, and corps artillery.

b. Special Instructions.

- (1) It will be assumed that the headquarters concerned in these tests controls the following units:
 - (a) 1st Battalion, 20th Artillery (105-mm howitzer).
 - (b) 2d Battalion, 20th Artillery (105-mm howitzer).
 - (c) 1st Battalion, 26th Artillery (155-mm howitzer).
 - (d) 2d Battalion, 26th Artillery (155-mm howitzer).
- (2) Prior to the start of test 3, the troop list given in (1) above will be prepared and placed where it will be available readily for reference by the candidate.
- (3) The following materials and equipment will be furnished the candidate:
 - (a) Plotting equipment.
 - (b) Tracing paper.
 - (c) Chart or map, scale should be no smaller than 1:50,000.
 - (d) Fire capability templates should be furnished.
- (4) Prior to the start of the tests, battalion position areas and limits of fire should be selected so that complete fire capabilities overlay can be made from one chart.
- (5) Two targets will be plotted on the chart. Target 1 will be located so that it can be reached by only two or three battalions; target 2 will be located so that it can be reached by all battalions.
- (6) The examiner will use at least three methods of announcing battalion fire capabilities in test 1. (See FM 6-20-2.)

c. Outline of Tests.

Test No.	Examiner commands--	Action of candidate
1	PREPARE THE FIRE CAPABILITIES CHART FOR THIS HEADQUARTERS, AND AN OVERLAY FOR REPORTING OUR FIRE CAPABILITIES TO HIGHER HEADQUARTERS. (Examiner gives the candidate the location and fire capabilities of each battalion.)	Plots battalion locations and fire capabilities. Prepares overlay showing fire capabilities.
2	a. DEFINE AND GIVE THE PURPOSE OF A "NO FIRE LINE," b. PLOT THE "NO FIRE LINE," USING THESE COORDINATES:	a. Defines no fire line and states its purpose. b. Plots and labels no fire line.
3	a. THE FOLLOWING MESSAGE HAS JUST BEEN RECEIVED FROM THE 101ST FIELD ARTILLERY BATTALION: "THIS IS THE 101ST F. A. BATTALION, NOW ADJUSTING ON (nature of target); APPROXIMATE COORDINATES _____ ALTITUDE _____; CONCENTRATION NUMBER _____; REQUEST ADDITIONAL FIRE." YOU, AS CHIEF COMPUTER, RECEIVE THE FOLLOWING FIRE ORDER: FIRE THE 102D AND 104TH BATTALIONS: FIVE VOLLEYS; SHELL HE; FUZE QUICK; CENTER RANGE; AT MY COMMAND. SEND THE NECESSARY COMMANDS TO THE BATTALIONS CONCERNED. b. A SECOND MESSAGE FROM THE 101ST FIELD ARTILLERY BATTALION IS AS FOLLOWS: "CONCENTRATION NUMBER _____; ADJUSTED COORDINATES _____; ALTITUDE _____; NOW FIRING FOR EFFECT." GIVE YOUR COMMAND TO THE OTHER BATTALIONS.	a. Plots target and sends necessary commands to battalions. (See FM 6-40.) b. Plots adjusted locations of target, sends commands to fire the other two battalions.

Test No.	Examiner commands—	Action of candidate
3	<p>c. THE THIRD MESSAGE FROM THE 101ST FIELD ARTILLERY BATTALION IS AS FOLLOWS: "TARGET HAS MOVED _____ METERS WEST (EAST); REQUEST ADDITIONAL FIRE." S3 DIRECTS FIVE VOLLEYS WHEN READY. SEND THE NECESSARY COMMANDS.</p> <p>d. GIVE THE FIRE ORDER FOR FIVE VOLLEYS PER BATTALION ON TARGET 1 WITHOUT ADJUSTMENT.</p> <p>e. FIRE A "TIME ON TARGET" MISSION ON TARGET 2. USE FIVE VOLLEYS PER BATTALION, SHELL HE, FUZE VT.</p>	<p>c. Sends commands for additional fire on the target in its new location.</p> <p>d. Determines battalions to fire and gives the orders.</p> <p>e. Issues orders to the battalions.</p>
4	PREPARE A PROGRAM OF FIRES IN THE FORM OF AN OVERLAY ORDER FOR THE FOLLOWING MISSIONS: (gives coordinates of five concentrations). ALL CONCENTRATIONS ARE ON CALL FOR ALL BATTALIONS.	Plots concentrations. Prepares overlay including title, heading and authentication for signature.

d. *Penalties.* Penalties will be assessed as follows:

(1) Test 1.

- (a) For each battalion plot incorrectly labelled, 1 point.
- (b) For each essential part of the title or authentication omitted, 1 point.
- (c) For failure to include identity marks ("tick marks") on the overlay, 3 points.
- (d) Errors in the location of battalion fire capabilities on the fire capabilities chart, as follows:

Range error in meters, exactly or less than—	25	50	100
Penalty	0	2	5
Deflection error in mils, exactly or less than—	3	6	15
Penalty	0	2	5

(2) Test 2.

- (a) Error in location of the line in excess of 25 meters, at any point, 3 points.
- (b) For failure to label the line; 2 points.
- (c) For failure to properly define "no fire line," 1 point.

(3) Test 3.

- (a) Error in the location of any concentration, 3 points.
- (b) Failure to consider the "no fire line" restriction in any mission, 5 points.
- (c) Ordering fire which could not be accomplished because of fire capabilities, 5 points.
- (d) Deviation from the method of attack indicated, 3 points.
- (e) Failure to record a mission, 2 points.

(4) Test 4.

- (a) Error in the overlay location of any concentration in excess of 25 meters (each concentration), 2 points.
- (b) Omission of the title, heading, or authentication, 3 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as follows:

(1) Test 1.

- (a) Accuracy of overlay, 5 points.
- (b) Correctness of overlay title and authentication, 3 points.
- (c) Correct identification of battalions, 5 points.
- (d) Neatness and legibility, 2 points.

(2) Test 2.

- (a) Accuracy, 3 points.
- (b) Neatness and legibility, 2 points.

(3) Test 3. Maximum credit of 3 points will be awarded for each part of the test (*a*, *b*, *c*, *d*, and *e*).

(4) Test 4.

- (a) Accuracy, 5 points.
- (b) Completeness of overlay, 3 points.
- (c) Neatness and legibility, 2 points.

23. Counterbattery Activities

a. Scope of Test. One test will be conducted to determine the candidate's ability to perform operations required in counterbattery activities.

b. Special Instructions.

- (1) Prior to the start of the test, the examiner (FM 6-121) will prepare a series of Artillery Counterfire Information Forms (ACIF's) DA Form 2185-R which will allow the candidate to perform activities related to counterbattery operations. There should be a minimum of 10 completed forms which will lead to at least 4 confirmed weapons locations. The examiner should include information from radar, sound and flash sources, shelling reports, and air and ground observer reports.
- (2) The candidate will plot all the information on the ACIF's. These forms should be successively numbered and plotted.

- (3) The examiner will inform the candidate, prior to starting the test, what constitutes a confirmed target location.
- (4) The following materials will be furnished the candidate:
 - (a) Map, 1:50,000, suitable for use as a hostile battery chart.
 - (b) Overlay paper.
 - (c) Hostile Battery File cards (DA Form 2186-R).
 - (d) Prepared ACIF's.
 - (e) Plotting equipment.

c. Outline of Test.

Examiner commands—	Action of candidate
PERFORM COUNTERBATTERY OPERATIONS USING THE INFORMATION PROVIDED. PLOT INFORMATION AND FILL OUT HOSTILE BATTERY CARDS. (Examiner gives the candidate the completed ACIF's in numerical order. Candidate should properly plot and mark the appropriate chart and fill out the hostile battery file card. Candidate will be graded on his association of the information provided and actions taken during the plotting process.)	Plots information from ACIF's. Assigns proper symbols. Updates information as successive ACIF's are plotted.

d. Penalties.

- (1) Misplots from ACIF's in excess of 50 meters or 7 mils, 2 points.
- (2) Improper labeling of locations or rays, 2 points.
- (3) Improperly filled out hostile battery file card, 2 points.
- (4) Improper association of information from ACIF's, 5 points.
- (5) Procedural error (erasure of rays from shell reports, plotting suspect locations on hostile battery chart, etc.), 5 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 8.

CHAPTER 3

SURVEY SPECIALISTS, FIELD ARTILLERY

24. Qualification Tests

The tests prescribed in this chapter provide for the qualification of survey specialists at all echelons. Because of organizational differences and differences in equipment, some modification will be necessary for the administration of these tests to most units. The tests are designed where possible to facilitate this modification. Modifications other than those options presented in the test should be accompanied by a reevaluation of the weighting system.

25. Test Organization

The qualification test for survey is organized into three sections, with the sections designed to test and qualify the individual progressively as a second-class specialist, a first-class specialist, and as an expert in artillery survey. Section I is designed to evaluate the qualification of the individual in the basic skills of an artillery surveyor, and a score of 85 percent on this section qualifies the individual as a second-class specialist. Section II expands the skill coverage for evaluating the qualification of an individual, and a score of 85 percent on this section qualifies the individual as a first-class specialist. To be eligible to take this section of the test, the individual must achieve a score of at least 90 percent on section I. Individuals that achieve a score of at least 90 percent on section II are eligible to take section III of the test. Section III is designed as a comprehensive coverage of the skills required in all echelons of artillery survey, and personnel who score 90 percent or higher on this section are qualified as experts in artillery survey.

26. Outline of Tests

Par No.	Subject	Number of tests	Points each	Maximum credit
SECTION I				
27	Map Reading.....	4		6
	Test 1 and 2.....	(2)	2	(4)
	Test 3 and 4.....	(2)	1	(2)
28	Recording.....	2	11	22

Par No.	Subject	Number of tests	Points each	Maximum credit
SECTION I—Continued				
29	Computing.....	4		28
	Tests 1 and 4.....	(2)	5	(10)
	Test 2.....	(1)	8	(8)
	Test 3.....	(1)	10	(10)
30	Taping.....	1	20	20
31	Instrument Operation.....	2	12	24
Total.....				100
SECTION II				
Section I score $\times .40$				40
32	Recording.....	2	10	20
33	Computations.....	3		20
	Tests 1 and 2.....	(2)	7	(14)
	Test 3.....	(1)	6	(6)
34	Instrument Operation.....	3		20
	Test 1*.....	(1)	8	(8)
	Test 2.....	(1)	*8 (12)	*(8) (12)
	Test 3.....	(1)	*4 (8)	*(4) (8)
*When tellurometer is not issued to a unit Test 1 will be disregarded and point value of Test 1 will be redistributed as follows: Test 2, 12 points; Test 3, 8 points.				
Total.....				100
SECTION III				
Section II total $\times .50$				50
35	Map Reading.....	2		5
	Test 1.....	(1)	3	(3)
	Test 2.....	(1)	2	(2)
36	Grid Computations.....	3		10
	Tests 1 and 2.....	(2)	4	(8)
	Test 3.....	(1)	2	(2)
37	Survey Planning.....	1	15	15
38	Supervision and Operation.....	1	20	20
Total.....				100

Section I

27. Map Reading

a. *Scope of Tests.* Four tests will be conducted to determine the candidate's knowledge of map reading.

b. *Special Instructions.* Prior to the start of the test the examiner will provide the candidates with the following equipment:

- (1) Topographic map, scale 1:50,000 or larger.
- (2) Boxwood scale or coordinate scale, protractor and map pins.
- (3) Military slide rule (if desired by candidate).

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	IDENTIFY THESE SIGNS AND SYMBOLS. (Examiner points to 10 different commonly used military and topographic signs and symbols.)	Identifies signs and symbols as they are pointed out, orally or by writing answer.
2	COMPUTE THE SCALE OF THIS MAP (Examiner designates two points on the map at least four inches apart, and gives the candidate a false ground distance between them.)	Measures the map distance between the two points. Computes the scale using the map distance and the false ground distance. Announces or records the result.
3	MEASURE THE GRID AZIMUTH FROM _____ TO _____. (Examiner points out two prominent points on map at least four inches apart.)	Measures the grid azimuth with the protractor. Announces or records results.
4	DETERMINE COORDINATES AND HEIGHT OF _____. (Examiner points out or designates arbitrary feature on map. Advise candidate to read coordinates and height as accurately as possible.)	Read coordinates of designated point and determine height. Announces or records results.

d. Penalties.

- (1) *Test 1.* Deduct 0.2 point for each symbol or sign identified incorrectly.
- (2) *Test 2.* Deduct 1 point if the denominator of the representative fraction is in error by more than 100 units and deduct all credit if in error by more than 200 units.
- (3) *Test 3.* Deduct 0.5 point if the azimuth is in error by more than 5 mils and 1 point if in error by over 10 mils.
- (4) *Test 4.*
 - (a) Deduct 0.6 point if either the easting or northing coordinate is in error by over 50 meters.
 - (b) Deduct 0.4 point if the height is in error by more than one-half of the contour interval of the map.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

28. Recording

a. Scope of Test. Two tests will be conducted to determine the candidate's knowledge of recording. The first test will check procedures used with the aiming circle and the second test will be on procedures for the basic survey instrument authorized by TOE.

b. Special Instructions. Prior to the start of the test the examiner will make the following preparations:

- (1) Provide equipment as listed below:
 - (a) Blank mimeographed sheets from recorder's notebook.
 - (b) 4H and 6H pencil.
 - (c) Straightedge.
- (2) Prepare the data so the examiner can read angles and distances, etc., in the same manner as a recorder would receive the data if he were accompanying a survey team in the field. Prepare a rough sketch of the area to permit the candidate to complete the remarks and sketch portion of the field notes.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	RECORD DATA FOR AIMING CIRCLE TRAVERSE. (Examiner reads data in same manner as normally available to recorder.)	Records data as prescribed by FM 6-2. Turns in field notes to examiner at completion of the test.
2	RECORD DATA FOR THEODOLITE TRAVERSE. (Examiner reads data in same manner as normally available to recorder. Include at least one multiple angle. Triangulation or astronomic observation are authorized substitutions.)	Records data as prescribed by FM 6-2. Turns in field notes to examiner at completion of the test.

d. Penalties. Penalties will be assessed as follows:

- (1) Failure to use proper procedure for recording horizontal or vertical angles, 3 points.
- (2) Failure to mean angles correctly, 3 points.
- (3) Incomplete or incorrect remarks section, 1 point.
- (4) Failure to record data in a neat and legible manner, 10 points.
- (5) Any other procedural error, 3 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

29. Computing

a. Scope of Tests. Four tests will be conducted to determine the candidate's knowledge and ability to solve various survey problems.

b. Special Instructions. Prior to the start of the tests the examiner will make the following preparations:

- (1) Provide the following equipment:
 - (a) One set of logarithmic tables (six- or seven-place as appropriate) for each candidate.
 - (b) DA Forms 6-1, 6-2, 6-8, 6-19.

- (2) Prepare simulated or actual field data for all tests in the format prescribed for the recorder's field notebook. Read or issue copy of data to the candidate.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	COMPUTE THE AZIMUTH AND DISTANCE FROM POINT A TO POINT B. (Furnish coordinates of each point.)	Compute azimuth and distance with DA Form 6-1.
2	COMPUTE THE FOLLOWING TRAVERSE; COMPUTE ACCURACY RATIO AND AZIMUTH ERROR OF CLOSURE. (Provide coordinates of starting point and azimuth to azimuth mark. Furnish angles and distance in the same manner in which a computer would normally receive this information. Provide coordinates of closing point and azimuth to azimuth mark if different than starting point.)	Computes coordinates of each station on DA Form 6-2. Computes accuracy ratio: azimuth error of closure.
3	COMPUTE THE FOLLOWING TRIANGLE CHAIN. (Provide starting data and simulated or actual field work to enable candidate to solve the triangulation problem. Data should be made available in the same sequence as normally provided to the computer by a survey party in the field.)	Uses field data provided and DA Form 6-8 to solve triangle chain.
4	COMPUTE THE FOLLOWING THREE-POINT RESECTION TO DETERMINE COORDINATES AND HEIGHT OF THE OCCUPIED STATION. (Provide candidate with necessary valid field data to perform the computation.)	Record field data on DA Form 6-19 and compute coordinates and height of occupied station.

d. Penalties.

- (1) *Test 1 and 3.* Deduct—

- (a) 0.5 point for each mathematical error.
- (b) 1.0 point for each logarithmic error.
- (c) 3.0 points for each procedural error.

- (2) *Test 2.* Deduct—

- (a) 0.5 point for each mathematical error.
- (b) 1.0 point for each logarithmic error.
- (c) 3.0 points for each procedural error.
- (d) 1.0 point if accuracy ratio is computed incorrectly and 0.5 point if the azimuth error of closure is computed incorrectly.

(3) *Test 4. Deduct—*

- (a) 0.5 point for each mathematical error.
- (b) 1.0 point for each logarithmic error.
- (c) 1.0 point for each procedural error.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

30. Taping

a. Scope of Test. One test will be conducted to determine the candidate's ability to function as a tapeman.

b. Special Instructions. Prior to the start of the test the examiner will make the following preparations:

- (1) Provide equipment as listed below:
 - (a) One 30-meter steel tape.
 - (b) Two plumb bobs.
 - (c) One set of eleven taping arrows.
 - (d) Two taping knuckles.
 - (e) One handle, steel tape, tension 30 lbs.
 - (f) Two ranging poles w/tripods.
- (2) Prepare a traverse course consisting of two stations, A and B. Determine the accurate distance between the two. Use terrain that will require breaking tape. Require candidate to tape both ways but change position from front tapeman to rear tapeman on the return run. Use a second candidate or assistant examiner for the second tapeman.

c. Outline of Test.

Examiner commands—	Action of candidate
TAPE TRAVERSE LEG FROM A TO B AND FROM B TO A TO A COMPARATIVE ACCURACY OF 1: 5000. COMPUTE COMPARATIVE ACCURACY THE TWO TAPED DISTANCES.	Tapes traverse leg as prescribed in FM 6-2. Compute comparative accuracy.

d. Penalties. A penalty of 3.0 points will be assessed for each of the following errors:

- (1) Failure to maintain correct tape tension.
- (2) Failure to maintain the tape in a horizontal position.
- (3) Improper handling of the plumb bob.
- (4) Failure to aline front tapeman.
- (5) Errors in breaking tape.
- (6) Errors in recording distance.
- (7) Incorrect computation of accuracy ratio.
- (8) Accuracy ratio below 1: 5000. Accuracy ratio below 1: 3000, cut 10 points.
- (9) Any other procedural error.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

31. Instrument Operation

a. Scope of Test. Two tests will be conducted to determine the candidate's ability to set up and operate an aiming circle and the theodolite.

b. Special Instructions. Prior to the start of the test the examiner will make the following preparations:

- (1) Provide equipment as listed below:
 - (a) Aiming circle w/tripod.
 - (b) Theodolite w/tripod.
- (2) Prepare stations as necessary and accurately determine angles, distances, azimuths, etc., to be used as a check on accuracy. Provide an assistant examiner as recorder for all tests.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	MEASURE THE HORIZONTAL AND VERTICAL ANGLES AZ-MK-Bn SCP—TS 1 WITH THE AIMING CIRCLE. (Designate the Bn SCP and identify the Az Mk and TS 1.)	Set up aiming circle and measure horizontal and vertical angles as prescribed in FM 6-2. Mean the angles and announce the results.
2	MEASURE THE HORIZONTAL AND VERTICAL ANGLES TS 1—TS 2—TS 3 WITH THE THEODOLITE. (Designate TS 2 as the occupied station of a traverse and identify the rear and forward stations.)	Set up the theodolite and measure horizontal and vertical angles as prescribed in FM 6-2. Mean the angles and announce the results.

d. Penalties.

- (1) *Test 1.* Deduct—
 - (a) 3.0 points for improper set up, leveling or handling of the instrument.
 - (b) 2.0 points for each procedural error in the angle measurement.
 - (c) 4.0 points if the horizontal or vertical angle is in error by more than 1.0 mil but less than 2.0 mils.
 - (d) 6.0 points if the horizontal or vertical angle is in error by more than 2.0 mils.
- (2) *Test 2.*
 - (a) Deduct 3.0 points for improper set up, leveling or handling of the instrument.

- (b) Deduct 2.0 points for each procedural error in the angle measurement.
- (c) For accuracy of measurement of horizontal and vertical angles, cut as indicated:

<i>T16</i>	<i>T2 (1 sec)</i>	<i>T2 (mils)</i>	<i>Cut</i>
Less than 0.1 mil.....	Less than 05''.....	Less than 0.02 mil....	0.0
0.1—0.2.....	05''—15''.....	0.02—0.08 mil.....	3.0
More than 0.2 mil.....	More than 15''.....	More than 0.08 mil...	6.0

e. Credits. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

Section II

(Consists of 40 percent of the earned score from section I plus the score earned in paragraphs 32–34.)

32. Recording

a. Scope of Tests. Two tests will be conducted to determine the candidate's ability to record triangulation field notes and an astro-nomic observation problem.

b. Special Instructions. Prior to the start of the test the examiner will make the following preparations:

- (1) Provide equipment as listed below:
 - (a) Field notebook or mimeographed pages.
 - (b) 4H and 6H pencil.
 - (c) Straightedge.
- (2) Prepare simulated or actual field data to present to candidate in the same manner as a recorder would normally receive this information.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	RECORD THE FOLLOWING TRIANGULATION SURVEY. (Present field data from triangulation problem in the same sequence a recorder would normally receive this data.)	Record survey field data as prescribed in FM 6–2.
2	RECORD THE FOLLOWING ASTRO-NOMIC OBSERVATION. (Present field data from the observation in the same sequence that a recorder would normally receive this data.)	Record field data from the astronomic observation as prescribed in FM 6–2.

d. Penalties. Deduct—

- (1) 2.0 points for each angle or time measured incorrectly.
- (2) 4.0 points for each procedural error.
- (3) 4.0 points if field notes are not neat and legible.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

33. Computing

a. Scope of Tests. Three tests will be conducted to determine the candidate's ability as a computer. The first test is solving a triangle by trilateration and the second is computing an azimuth from an astronomic observation. The third test is computing grid convergence for a specific area.

b. Special Instructions.

- (1) Provide equipment as listed below:
 - (a) Logarithmic tables (seven place).
 - (b) TM 6-300-(current year).
 - (c) DA Forms 6-7a, 6-10, 6-10a or 6-11, and 6-20.
- (2) Prepare actual or simulated field data for each test.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	<p>SOLVE THE FOLLOWING TRIANGLE BY TRILATERATION. THE KNOWN LENGTH OF THE SIDES ARE:</p> <p>a _____</p> <p>b _____</p> <p>c _____</p> <p>DETERMINE THE SIZE OF EACH ANGLE.</p>	Record given data on DA Form 6-7a and solve for interior angles.
2	<p>COMPUTE GRID AZIMUTH BY ASTRONOMIC OBSERVATION BY THE ALTITUDE (HOUR ANGLE) METHOD OF THE SUN (STAR). (Provide data from three sets of observations. Furnish grid convergence to permit candidate to determine grid azimuth.)</p>	Use field data provided and DA Forms 6-10, 6-10a or 6-11, and 6-20. Compute all three sets mean sets and reject any set that varies from the mean by more than the tolerance prescribed in FM 6-2. Apply grid convergence to mean of at least two sets to get grid azimuth.
3	<p>COMPUTE GRID CONVERGENCE GIVEN DATA:</p> <p>STATION: Bn SCP</p> <p>LATITUDE: _____N(S)</p> <p>LONGITUDE: _____E(W)</p> <p>COORDINATES: _____</p>	Compute grid convergence. Use DA Form 6-20 and TM 6-300-current year.

d. Penalties. Deduct 0.5 point for each mathematical error, 2.0 points for each logarithmic error and 4.0 points for each procedural error.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

34. Instrument Operation

a. Scope of Tests. Three tests will be conducted to determine the candidate's ability to operate the tellurometer and the surveying instrument azimuth gyro and one test will be conducted to determine the candidate's ability to perform theodolite adjustments. Units not issued the tellurometer will disregard Test 1.

b. Special Instructions. Prior to the start of the test the examiner will make the following preparations:

- (1) Provide equipment as listed below:
 - (a) One master and one remote tellurometer unit complete with cables, tripods and batteries.
 - (b) One Surveying Instrument Azimuth Gyro Artillery complete with control panel and power source.
 - (c) One theodolite with tripod.
 - (d) DA Form 5-139 (Field Record and Computations—Tellurometer).
 - (e) Logarithmic tables (seven place).
- (2) Provide an assistant examiner to operate the tellurometer remote unit.
- (3) Provide a recorder for tests 1 and 2.
- (4) Provide stations and azimuth marks as necessary to conduct tests 1 and 2.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	MEASURE THE DISTANCE TS 2—TS 3 WITH THE TELLUROMETER. (Stations must be at least 152 meters apart. Require the candidate to operate master station and instruct remote operator. Remote operator can be another candidate or an assistant examiner. <i>Delete this test for units not issued the tellurometer. Redistribute credit to other two tests.</i>)	Set up the master unit; instruct remote operator; measure distance. Resolve transit time and determine sea level distance in meters using DA Form 5-139.
2	DETERMINE AZIMUTH TO AZIMUTH MARK WITH THE SURVEYING INSTRUMENT AZIMUTH GYRO ARTILLERY. (Identify orienting station and azimuth mark. Provide grid convergence to candidate. Determination of azimuth by astronomic observation is an authorized substitution.)	Set up azimuth gyro and determine azimuth to azimuth mark. Apply grid convergence to attain grid azimuth.

Test No.	Examiner commands—	Action of candidate
3	<p>PERFORM THE FOLLOWING TESTS AND ADJUSTMENTS ON THE THEODOLITE:</p> <p>a. PLATE LEVEL.</p> <p>b. OPTICAL PLUMB.</p> <p>c. VERTICALITY (NOT APPLICABLE ON T-16).</p> <p>d. HORIZONTAL COLLIMATION.</p> <p>e. VERTICAL COLLIMATION.</p>	Perform tests and adjustments as prescribed in FM 6-2.

d. Penalties.

(1) *Test 1.* Deduct—

- (a) 2 points for improper setup or handling of the instrument.
- (b) 1 point if instructions by candidate to remote operator prior to beginning the measurement are inadequate.
- (c) 3 points for each procedural error in the measurement.
- (d) 2 points for each procedural error in the computation.
- (e) 0.5 point for each mathematical error in the computation.
- (f) 3 points if the accuracy is less than 1:7,000 but more than 1:5,000 when compared to the previously determined distance.
- (g) 6 points if the accuracy is less than 1:5,000 when compared to the previously determined distance.

(2) *Test 2.*

- (a) Deduct 2 (3) points for improper setup, leveling or handling of the instrument.
- (b) Deduct 3 (4) points for each procedural error in the azimuth measurement.
- (c) Deduct 1 (2) point for each computational error.
- (d) Deduct 6 (8) points if accuracy normally required by candidate's unit is not attained. (Specifications for accuracies are the same as listed in FM 6-2 for astronomic observations.)
- (e) The penalty points in parenthesis in (a) through (d) will be applied when Test Number 1 is not given.

(3) *Test 3.*

- (a) Deduct 1 (2) point for each test or adjustment that is not conducted as prescribed in FM 6-2.
- (b) Deduct 1 (2) point if test and adjustments are not conducted in the sequence specified in FM 6-2 for the instrument used.
- (c) The penalty points in parenthesis in (a) and (b) will be applied when Test 1 is not given.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

Section III

(Consists of 50 percent of the earned score from section II plus the score earned in paragraphs 35–38.)

35. Map Reading

a. Scope of Tests. Two tests will be conducted to determine the candidate's ability to scale geographic coordinates from a map and to restitute targets from a photograph.

b. Special Instructions. Prior to the start of the tests the examiner will make the following preparations:

(1) Provide equipment as listed below:

- (a) Map 1:50,000 or larger.
- (b) Tracing paper.
- (c) Protractor.
- (d) Straightedge.
- (e) Vertical photograph.
- (f) Military slide rule (if desired by candidate).

(2) Mark restitution points and target or point to be located on the photograph. Restitution points must also be located on the map.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DETERMINE THE GEOGRAPHIC COORDINATES OF _____ TO THE NEAREST 30 SECONDS.	Determine geographic coordinates of designated point.
2	DETERMINE THE MAP LOCATION OF TARGET NR _____ FROM THIS PHOTOGRAPH BY RESTITUTION.	Determine target location by one of the methods of restitution prescribed in FM 6-40.

d. Penalties.

(1) *Test 1.* Deduct—

- (a) 1 point if easting or northing is in error by more than 30 seconds but less than 60 seconds.
- (b) all credit if easting or northing is in error by more than 60 seconds.

(2) *Test 2.* Deduct—

- (a) 1 point for each procedural error.
- (b) 1 point if target location is in error by more than 50 meters in easting or northing.
- (c) all credit if target location is in error by more than 100 meters in easting or northing.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

36. Grid Computations

a. Scope of Tests. Three tests will be conducted to determine the candidate's knowledge and ability over detailed survey computations consisting of converting geographic coordinates to grid coordinates, zone to zone transformation, and conversion to common control.

b. Special Instructions. Prior to the start of the test the examiner will make the following preparations:

- (1) Provide equipment as listed below:
 - (a) TM 5-241-(3-7) (as appropriate depending on spheroid involved).
 - (b) DA Forms 6-1, 6-2, 6-23, 6-34, 6-36.
 - (c) Logarithmic tables (six- or seven-place).
 - (d) TM 5-241-2.
- (2) Prepare realistic requirements to issue as tests 1-3. Solve and check requirements.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	CONVERT THE FOLLOWING GEOGRAPHIC COORDINATES TO GRID COORDINATES: ____° ____' ____" N (S) ____° ____' ____" E (W)	Convert geographic coordinates to grid. Use DA Form 6-25 and TM 5-241-(3-7).
2	TRANSFORM THE FOLLOWING COORDINATES FROM ZONE ____ TO ZONE ____: E ____ N ____	Convert coordinates from one zone to the other. Use DA Form 6-36 and TM 5-241-2.
3	CONVERT THE FOLLOWING TRAVERSE TO THE COMMON GRID: ASSUMED DATA: COORDINATES BN SCP _____ _____ HEIGHT BN SCP _____ AZIMUTH TO AZIMUTH MARK _____ KNOWN DATA (COMMON GRID): COORDINATES BN SCP _____ _____ HEIGHT BN SCP _____ AZIMUTH TO AZIMUTH MARK _____ (Require candidate to convert all or selected points of the traverse run with assumed data to the common grid.)	Convert designated points of traverse to common grid. Use DA Forms 6-1 and 6-2.

d. Penalties.

- (1) Tests 1 and 2. Deduct 0.2 point for each mathematical error, 1 point for each logarithmic error and 2 points for each procedural error.
- (2) Test 3. Deduct 0.2 point for each mathematical error, 0.4 point each logarithmic error and 0.5 point for each procedural error.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

37. Survey Planning

a. Scope of Test. One practical test will be conducted to determine the candidate's ability to plan a survey. This test will include a briefing by the examiner, map reconnaissance, ground reconnaissance, and the survey order.

b. Special Instructions. Prior to the start of the test the examiner will make the following preparations:

- (1) Provide an area in which a survey can be conducted.
- (2) Provide a 1:50,000 map of the area.
- (3) Prepare a situation to include unit mission, time available, designation and general location of points to be surveyed and restrictions in use of routes, transportation and radios.
- (4) Provide a vehicle and driver for the candidate.

c. Outline of Test.

Examiner commands—	Action of candidate
PREPARE A SURVEY PLAN TO SUPPORT THE UNIT'S MISSION. THE MISSION ASSIGNED IS AS FOLLOWS: _____ EXTEND SURVEY CONTROL TO THE FOLLOWING POINTS: _____ THEIR APPROXIMATE LOCATIONS ARE: _____ YOU WILL HAVE _____ HOURS TO COMPLETE THE SURVEY. THE FOLLOWING RESTRICTIONS ARE IN FORCE: _____ _____ _____	Make a map reconnaissance to include plotting installations requiring control. Make a detailed ground reconnaissance and formulate a plan. Issue a survey order to the survey party (examiner).

d. Penalties. Deduct—

- (1) 2 points if the survey plan is not simple, timely or flexible.
- (2) 5 points if the plan is not adaptable or if it does not provide for checks.
- (3) 10 points if the plan cannot provide survey control to the required accuracy at all installations which require survey.

(4) 5 points if the survey order is not adequate to insure the mission is accomplished.

(5) 3 points if equipment is not utilized to best advantage.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

38. Supervision and Operation

a. Scope of Test. The test will determine the candidate's ability to organize and direct a survey party.

b. Special Instructions. Prior to the start of the test the examiner will provide a survey party complete with equipment and personnel authorized by applicable TOE.

c. Outline of Test.

Examiner commands—	Action of candidate
ORGANIZE THE SURVEY PARTY AND EXECUTE THE PLANNED SURVEY. (After the survey has started require the candidate to operate the instrument for at least one station.)	Brief members of the survey party. Direct and supervise operation until completion. Function as instrument operator when directed.

d. Penalties.

(1) Deduct 2 points for any failure to—

(a) Orient all personnel.

(b) Initiate the survey as soon as possible.

(c) Display an aggressive attitude in supervising the party while the survey is in progress.

(2) Deduct 3 points if the instrument is not set up, leveled and angles measured as prescribed in FM 6-2. (Applicable only when the candidate is functioning as instrument operator.)

(3) Deduct 3 points for each failure to—

(a) Provide computers with necessary data to begin computations.

(b) Properly select traverse (triangulation) stations.

(c) Supervise the work of the computers by spot checking their azimuths, bearing angles, distances and coordinates.

(d) Periodically verify the recorder's notes.

(e) Check taping procedures.

(f) Correct erratic procedures immediately on discovery.

(g) Check results by plotting surveyed points on a map.

(h) Supervise the instrument operator during theodolite, tellurometer, or surveying instrument azimuth gyro artillery operations.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 26.

CHAPTER 4

METEOROLOGICAL SPECIALISTS

39. Instructions

In order to conserve expensive radiosonde equipment, the following coordinating instructions will be followed in administering the tests outlined in paragraphs 50 through 59:

a. The tests referred to above will be conducted immediately before, during one radiosonde ascent, and directly thereafter, and will be based on data collected and recorded during this ascent.

b. A complete, well-trained, manning crew will be made available to operate the equipment, as needed, during the conduct of these tests.

c. The tests will be conducted in the sequence in which they are presented in the text.

d. Care will be taken to insure that the candidate and the assisting crew are familiar with the sequence and requirements of the tests.

e. All equipment required to produce a meteorological message by the radiosonde method will be made available for these tests.

40. Outline of Tests

Par. No.	Subject	Number of tests	Points each	Maximum credit
41	Theodolite ML-474/GM.....	3	1	3
42	Hydrogen Generator ML-303/TM and 30-gram pilot balloon.....	1	2	2
43	Tracking pilot balloon.....	1	4	4
44	Communication equipment.....	2	1.5	3
45	Psychrometer ML-224.....	2	1.5	3
46	Barometer ML-102.....	3	.5	1.5
47	Power unit 10KW.....	3	1	3
48	Plotting ballistic wind data from pibal observation.....	1	7	7
49	Plotting and computing weather data for sound ranging.....	3	-----	5
50	Assembly, orientation, nomenclature, and maintenance of the Rawin Set AN/GMD-1().....	4	1	4
51	Nomenclature and presetting procedures for Radiosonde Recorder, AN/TMQ-5().....	2	2	4
52	Preparation of the Radiosonde AN/AMT-4() for flight.....	3	-----	3.5
	Tests 1 and 2.....	(2)	1	(2)
	Test 3.....	(1)	1.5	(1.5)

Par. No.	Subject	Number of tests	Points each	Maximum credit
53	Preparation of train.....	1	1	1
54	Hydrogen Generator Set AN/TMQ-3 and sounding balloon.....	1	4	4
55	Baseline check.....	3	-----	4
	Tests 1 and 2.....	(2)	1	(2)
	Test 3.....	(1)	2	(2)
56	Operation of Rawin Set AN/GMD-1().....	1	4	4
57	Obtaining and evaluating the radiosonde record.....	1	9	9
58	Determining ballistic densities and temperature from radiosonde data.....	3	-----	7
	Test 1.....	(1)	3	(3)
	Tests 2 and 3.....	(2)	2	(4)
59	Determining zone winds from radiosonde data.....	3	-----	10
	Tests 1 and 2.....	(2)	1	(2)
	Test 3.....	(1)	8	(8)
60	General and artillery meteorology.....	1	18	18
	Total.....	42	-----	100

41. Theodolite ML-474/GM

a. *Scope of Tests.* Three tests will be conducted in which the candidate will be required to assemble, level, orient, check adjustment, and give the nomenclature of the theodolite ML-474/GM.

b. *Special Instructions.*

- (1) The following equipment will be made available to the candidate:
 - (a) One theodolite ML-474/GM in carrying case.
 - (b) One tripod ML-78.
- (2) One assistant will be furnished to help the candidate in checking the adjustment of the theodolite.
- (3) The examiner will furnish the candidate the local magnetic declination constant, and the location and angle of an established datum line.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	ASSEMBLE AND LEVEL THE THEODOLITE.	Removes the theodolite from the carrying case, assembles it on the tripod. Levels the instrument as prescribed in TM 11-6675-200-10.

Test No.	Examiner commands—	Action of candidate
2	ORIENT THE THEODOLITE BY THE MAGNETIC COMPASS AND ESTABLISHED DATUM LINE.	Orients the theodolite by the magnetic compass and by an established datum line as prescribed in TM 11-6675-200-10.
3	NAME PARTS DESIGNATED. (Examiner points to these parts: Compass, azimuth, calibration clamp, azimuth calibration adjust, leveling screws, azimuth scale, elevation scale, brightness control, bubble levels, azimuth tracking control, elevation tracking control.	Names the designated parts as prescribed in TM 11-6675-200-10.

d. Penalties.

(1) Test 1. A penalty of 0.5 point will be assessed for each of the following errors:

- (a) Any error made in assembling the instrument to the tripod.
- (b) Inability to level the instrument.

(2) Test 2. A penalty of 0.5 point will be assessed for an error of more than 0.5° in orienting the theodolite by the magnetic compass, or by an established datum line.

(3) Test 3. A penalty of 0.1 point will be assessed for each error in nomenclature.

e. Credit. If each test is performed correctly, a maximum credit of 1 point will be awarded for each of the three tests.

42. Hydrogen Generator ML-303/TM and 30-Gram Pilot Balloon

a. Scope of test. One test will be conducted in which the candidate will be required to generate the necessary hydrogen gas, and inflate and shelter a 30-gram balloon.

b. Special Instructions.

(1) The following equipment will be furnished the candidate:

- (a) One hydrogen generator ML-303/TM.
- (b) Ten balloons, 30-gram (two of each of the following colors: black, white, and red).
- (c) One balloon nozzle ML-373/GM.
- (d) Three calcium hydride charges ML-304A/TM.
- (e) One inflation shelter.
- (f) One ball of twine RP-15.
- (g) One pocket knife.
- (h) One can, corrugated, nesting, 24-gallon.
- (i) Twenty gallons of water.
- (j) Three calcium hydride charges ML-305A/TM.
- (k) Grounding equipment.

- (2) The candidate will be required to assemble the hydrogen generator as part of the test.
- (3) The balloons will be conditioned prior to the test, if required.
- (4) The inflated balloon will be tied down in a sheltered place for use in a subsequent test.
- (5) No penalty will be assessed for balloon breakage unless breakage is caused by carelessness on the part of the candidate.
- (6) Candidate will select and prepare the balloon for inflation before generating the hydrogen.

c. Outline of Test.

Examiner commands—	Action of candidate
GENERATE HYDROGEN AND INFLATE A 30-GRAM BALLOON.	Generates hydrogen. Chooses the proper colored balloon. Inflates and ties it down in the shelter as prescribed in TM 11-2405.

d. Penalties.

- (1) A penalty of 0.35 point will be assessed for each of the following errors:
 - (a) Use of an incorrect calcium charge.
 - (b) Failure to clean the generator properly after inflating the balloon.
 - (c) Failure to immerse the generator properly while generating the hydrogen.
 - (d) Use of the wrong colored balloon for current weather conditions.
 - (e) Failure to weigh off the balloon correctly.
 - (f) Failure to inspect the inflated balloon for defects.
 - (g) Failure to properly ground all inflation equipment.
- (2) Time penalties are as follows:

Time in minutes, exactly or less than—	15	20	25
Penalties	0	0.5	1.0

e. Credit. If the test is performed correctly within the minimum time limits, a maximum credit of 2 points will be awarded.

43. Tracking Pilot Balloon

a. Scope of test. One test will be conducted in which the candidate will be required to track a pilot balloon and read the scales of the theodolite.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One theodolite ML-474/GM.
 - (b) One tripod ML-78.

- (2) One assistant examiner, preferably a trained weather observer, will be made available to release the balloon and act as timer-recorder.
- (3) The following equipment will be furnished the assistant examiner:
 - (a) Two copies of DA Form 6-42 (Ballistic Winds from Observations of 30- or 100-Gram Balloons).
 - (b) One clip board.
 - (c) One timer PH-29 or FM-19.
 - (d) One pencil, 3H.
 - (e) One 30-gram or 100-gram balloon, properly inflated, and of the proper color.
- (4) The balloon should be tracked for at least 10 minutes and 24 seconds.
- (5) The examiner will check the tracking by observing the balloon through the open sight of the theodolite.

c. Outline of Test.

Examiner commands—	Action of candidate
TRACK PILOT BALLOON.....	Tracks the balloon and reads the scales of the theodolite at the command READ, as prescribed in FM 6-15, until directed to cease tracking.

d. Penalties. A penalty of 1 point will be assessed for each of the following errors:

- (1) Any appreciable inaccuracy in tracking.
- (2) Inability to operate the theodolite properly and without clumsiness.
- (3) Failure to announce the elevation and azimuth readings promptly, accurately, and in the prescribed sequence at the command READ.
- (4) Failure to stop tracking immediately at the command READ.

e. Credit. If the test is performed correctly, a maximum credit of 4 points will be awarded.

44. Communications Equipment

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to establish communication between a plotting central and the theodolite, test the operation of the sound powered telephones, and give the nomenclature of the communication equipment.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) Two head and chest sets HS-25.
 - (b) One spool DR-8 with $\frac{1}{4}$ mile of wire WD-1/TT.
 - (c) One tool equipment TE-33.
 - (d) Two jacks, JK-54.
 - (e) Sandpaper.
 - (f) One bristle brush, soft.
- (2) The examiner will designate the location of the plotting central and the observation point to the candidate.
- (3) One assistant examiner will be made available to assist the candidate in circuit checking.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	ESTABLISH COMMUNICATION AND TEST OPERATION.	Installs and assembles sound powered telephones. Checks for good connections.
2	NAME PARTS DESIGNATED. (Examiner points to five of these parts: Jack, plug, transmitter, receiver, spool DR-8, tool equipment TE-33.	Names each designated part as prescribed in FM 6-15.

d. Penalties.

- (1) Test 1. A penalty of 0.5 point will be assessed for each error in installing and assembling communications equipment.
- (2) Test 2. A penalty of 0.2 point will be assessed for each error in nomenclature.
- (3) Time penalties.
 - (a) Test 1.

Time in minutes, exactly or less than—	8	10	12	14
Penalties	0	0.5	1.0	1.5

- (b) **Test 2.** No time penalties are prescribed for test 2.

e. Credit. A maximum credit of 1.5 points will be awarded for each test performed correctly.

45. Psychrometer ML-224

a. *Scope of Tests.* Two tests will be conducted in which the candidate will be required to obtain a set of psychrometer readings and compute the relative humidity.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
(a) One psychrometer MI-224.

- (b) One wick (new) with sizing removed, and thread for wick.
- (c) One pocket knife.
- (d) One bottle of clean, pure water at ambient air temperature.
- (e) One copy FM 6-16.
- (2) One trained assistant examiner will be made available to take psychrometer reading simultaneously with the candidate.
- (3) One psychrometer ML-224 will be furnished the assistant examiner.
- (4) The examiner will insure that both psychrometers read within the required tolerances before the test.
- (5) Test 1 will be performed outdoors.
- (6) The examiner will compare the readings and computed relative humidity obtained by the assistant examiner in grading.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	OPERATE PSYCHROMETER.....	Installs the new wick. Operates and reads the psychrometer as prescribed in TM 11-2417.
2	COMPUTE RELATIVE HUMIDITY....	Computes the relative humidity as prescribed in FM 6-15.

d. Penalties.

- (1) Test 1.—A penalty of 0.5 point will be assessed for each of the following errors:
 - (a) Failure to install and wet the wick correctly.
 - (b) Failure to operate the psychrometer properly on the sling and handle.
 - (c) Failure to obtain psychrometer readings that agree within 0.5° C. with those taken by the assistant examiner.
- (2) Test 2.—Penalties will be assessed on inaccuracy in accordance with the following table:

Variance in percent	± 4	± 5
Penalties	0	1.5

e. Credit. If the tests are performed correctly, a maximum credit of 1.5 points will be awarded for each test.

46. Barometer ML-102

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to read the barometer, convert units of pressure, apply corrections, and demonstrate maintenance.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One barometer ML-102.
 - (b) One copy FM 6-16.
- (2) The barometric pressure in inches of mercury will be furnished the candidate.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	READ THE BAROMETER.....	Reads the barometer as prescribed in TM 11-427.
2	CONVERT INCHES OF MERCURY TO MILLIBARS.	Converts the pressure in inches furnished him, using the conversion chart in FM 6-16.
3	DEMONSTRATE OR DESCRIBE MAINTENANCE OF BAROMETER.	Demonstrates or describes handling, accuracy tolerances, maintenance, and method of calibration of the barometer as prescribed in TM 11-427.

d. Penalties.

- (1) Test 1—A penalty of 0.3 point will be assessed for an error or more than ± 0.1 millibar in reading the barometer.
- (2) Test 2—A penalty of 0.5 points will be assessed for an error in converting inches of mercury to millibars.
- (3) Test 4—A penalty of 0.2 point will be assessed for each error made in demonstrating or describing the maintenance required.

e. Credit. A maximum credit of 0.5 will be awarded for each test performed correctly.

47. Power Unit 10KW

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to operate, adjust frequency, and demonstrate maintenance of the power unit 10KW.

b. Special Instructions. The following equipment will be furnished the candidate:

- (1) One power unit 10KW.
- (2) Issued tools for power unit.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DEMONSTRATE MAINTENANCE-----	Demonstrates items 1 through 10 (as appropriate to model) of before-operation service as prescribed in TM 5-6115-204-10.
2	START THE POWER UNIT-----	Starts the power unit as prescribed in TM 5-6115-204-10.
3	ADJUST AND CHECK THE POWER UNIT.	Performs adjustment as prescribed in TM 5-6115-204-10.

d. Penalties.

- (1) Test 1—A penalty of 0.16 point will be assessed for each error in demonstrating the items of before-operation service.
- (2) Test 2—A penalty of 0.5 point will be assessed for each of the following errors:

- (a) Inability to start the power unit.
- (b) Incorrect procedure in starting the power unit.

- (3) Test 3—A penalty of 1 point will be assessed for inability to adjust the power unit as prescribed in TM 5-6115-204-10.

e. Credit. If the tests are performed correctly, a maximum credit of 1 point will be awarded for each test.

48. Plotting Ballistic Wind Data from Pibal Observations

a. Scope of Test. One test will be conducted in which the candidate will be required to weight and plot the weighted zone winds, and determine the ballistic winds.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One plotting board ML-122.
 - (b) One scale ML-577/UM.
 - (c) One copy of DA Form 6-57 (NATO Meteorological Message).
 - (d) One copy FM 6-16.
 - (e) Two pencils, 3H; art gum; sandboard.
- (2) A set of data for zone winds including zone number, wind direction, and wind speed for 10 zones will be furnished the candidate.

c. Outline of Test.

Examiner commands—	Action of candidate
DETERMINE THE BALLISTIC WINDS.	Weights and plots the zone winds. Determines the ballistic winds as prescribed in FM 6-15 for eight lines of message type 2 or type 3.

d. Penalties.

- (1) A penalty of 0.5 point will be assessed for exceeding the following tolerances of accuracy:
 - (a) No tolerance allowed for surface and the first zone.
 - (b) For the second, third, fourth, and fifth zones, ± 100 mils in wind direction and ± 1 knot in wind speed.
 - (c) For the sixth, seventh, and eighth zones, ± 100 mils in wind direction and ± 2 knots in wind speed.
- (2) Time penalties will be as follows:
 Time in minutes, exactly or less than—

25	27	28	29	30	31	32	33	
Penalties	0	1	2	3	4	5	6	7

e. Credit.

- (1) If the test is performed correctly within the minimum time limit, a maximum credit of 7 points will be awarded.
- (2) If the total penalties exceed 4 points, no credit will be awarded.

49. Plotting and Computing Weather Data for Sound Ranging

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to plot the readings on a 30-gram balloon, determine the effective wind, and determine the effective temperature.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One plotting board ML-122.
 - (b) One rule ML-126-A.
 - (c) One scale ML-577/UM.
 - (d) One copy of DA Form 6-48 (Weather Data for Sound Ranging).
 - (e) Two pencils, 3H, art gum; and sandboard.
 - (f) One copy FM 6-16.
- (2) The following data will be furnished the candidate:
 - (a) Time of sunrise and sunset, time of release, sky condition, dry bulb temperature, and wet bulb temperature.
 - (b) A set of readings on a 30-gram balloon through 3 minutes and 54 seconds of ascent to include time, elevation angle, and azimuth angle.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PLOT READINGS.....	Plots the readings as prescribed in FM 6-15.
2	DETERMINE THE EFFECTIVE WIND.	Scales and weights the winds. Determines the effective wind as prescribed in FM 6-15.
3	DETERMINE THE EFFECTIVE TEMPERATURE.	Determines the effective temperature as prescribed in FM 6-15.

d. Penalties.

- (1) Test 1—A penalty of 0.5 point will be assessed for each error made in plotting.
- (2) Test 2—A penalty of 1.5 points will be assessed for the following errors:
 - (a) Wind direction in error by more than ± 20 mils.
 - (b) Wind speed in error by more than ± 1 knot.
- (3) Test 3—A penalty of 1 point will be assessed if the effective temperature is in error by more than $\pm 0.2^{\circ}$ C.

(4) *Time penalties.*

(a) Test 1.

Time in minutes, exactly or less than—	5	6	7
Penalties.	0	0.5	1.0

(b) Test 2.

Time in minutes, exactly or less than—	7	9	11	13
Penalties	0	1	2	3

(c) Test 3.

Time in minutes, exactly or less than—	3	4	5
Penalties	0	0.5	1.0

e. Credit. A maximum credit of one point for tests 1 and 3; and three points for test 2 will be awarded if the tests are performed correctly.

50. Assembly, Orientation, Nomenclature, and Maintenance of the Rawin Set AN/GMD-1()

a. Scope of Tests. Four tests will be conducted in which the candidate will be required to assemble, orient, give the nomenclature, and demonstrate the preventive maintenance of the Rawin Set AN/GMD-1().

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One Rawin Set AN/GMD-1(), complete.

- (b) One power unit 10 KW; or commercial power supply.
 - (c) One radiosonde recorder AN/TMQ-5 ().
 - (d) One copy DA Form 11-238 (Petroleum Products Package Area Inventory).
- (2) The GMD will be emplaced in a good position for tracking, and the heavy components of the set will be assembled and leveled prior to starting the tests.
 - (3) All members of the meteorological section will be made available to assist during the test.
 - (4) The parts listed below will be laid near the set so that the candidate can complete the assembly without loss of time.
 - (a) Telescope.
 - (b) I-F and oscillator cables.
 - (c) Mixer assembly.
 - (d) Antenna scanner assembly.
 - (5) The examiner will furnish the candidate the azimuth and elevation angles to the orienting point.
 - (6) The candidate will be allowed to refer to DA Form 11-238 during test 4.
 - (7) When test 4 is completed, the GMD will remain emplaced and untouched until the candidate is ready to tune it during the ground check.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	COMPLETE GMD ASSEMBLY-----	Completes the assembly of the GMD so that it is prepared for operation as prescribed in TM 11-6660-206-10.
2	ORIENT THE GMD-----	Orients the GMD as prescribed in TM 11-6660-206-10.
3	NAME THE PARTS DESIGNATED. (Examiner points to 10 of these parts: elevation unit assembly, rawin receiver, antenna control, jack screws, azimuth unit, compression bars, jack plates, reflector, antenna scanner assembly, telescope assembly, elevation stow lock, azimuth stow lock, azimuth angle indicator, frequency tuning switch, spirit levels.)	Names the designated parts as prescribed in TM 11-6660-206-10.
4	PERFORM THE DAILY PREVENTIVE MAINTENANCE.	Performs the daily preventive maintenance as prescribed in TM 11-6660-206-10.

d. Penalties.

- (1) Test 1. A penalty of 0.25 point will be assessed for each error made in completing the assembly of the GMD.
- (2) Test 2. A penalty of 1 point will be assessed for an error of more than 0.5° in orienting the GMD in azimuth or elevation.
- (3) Test 3. A penalty of 0.1 point will be assessed for each error in nomenclature.
- (4) Test 4. A penalty of 0.25 point will be assessed if any item of preventive maintenance is not performed correctly.
- (5) *Time penalties.*

(a) Test 1.

Time in minutes, exactly or less than—	15	17	20
Penalties	0	0.5	1.0

(b) Test 2.

Time in minutes, exactly or less than—	10	12	14
Penalties	0	0.5	1.0

(c) Tests 3 and 4. No time limits are set for tests 3 and 4.

e. Credit. If the tests are performed correctly within the minimum time limits, a maximum credit of 1 point will be awarded for each test.

51. Nomenclature and Presetting Procedures or Radiosonde Recorder AN/TMQ-5()

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to give the nomenclature of the AN/TMQ-5 and check the alinement requisites.

b. Special Instructions.

- (1) The personnel equipment used in paragraph 50 will be furnished the candidate.
- (2) The AN/TMQ-5 will be alined and in good operating condition prior to starting the test.
- (3) When test 2 is completed, the AN/TMQ-5 will not be touched until the candidate is ready to use it during the ground check.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	NAME PARTS DESIGNATED. (Examiner points to five of the following parts: signal selector switch, reference adjust, control panel, frequency-time recorder, signal data converter, pen carriage, manual chart advance knob, pen heater, rawin time print switch.)	Names each part designated as prescribed in TM 11-2436.
2	PERFORM PRESETTING PROCEDURES (ten operations).	Perform presetting procedures prescribed in TM 11-2436.

d. Penalties.

- (1) Test 1. A penalty of 0.4 point will be assessed for each error in nomenclature.
- (2) Test 2. A penalty of 0.2 point will be assessed for each error made in performing the presetting procedures on the AN/TMQ-5().

e. Credit. A maximum credit of 2 points will be awarded for each test.

52. Preparation of the Radiosonde AN/AMT-4() for Flight

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to prepare the battery, assemble the radiosonde, perform the power check, and set the radiosonde frequency on the radiosonde transmitter.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One radiosonde AN/AMT-4() (disassembled).
 - (b) One battery pack BA-259/AM.
 - (c) One screw driver, small.
 - (d) Test set TS-538/U.
- (2) When test 3 is complete, the radiosonde will remain untouched until the candidate is ready to continue work on it during the ground check.
- (3) Additional radiosondes will be made available to the candidate in event the first one is defective.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PREPARE BATTERY	Prepares the battery for the flight as described on the battery cover.
2	ASSEMBLE THE RADIOSONDE.....	Assembles the radiosonde as prescribed in FM 6-15.
3	PERFORM POWER CHECK AND SET FREQUENCY.	Performs the power check and sets radiosonde frequency on radiosonde transmitter.

d. Penalties.

- (1) Test 1—A penalty of 1 point will be assessed for failure to activate the battery properly.
- (2) Test 2—A penalty of 0.5 point will be assessed for failure to insert the battery with the lid toward the top of the modulator.

- (3) Test 3—A penalty of 1 point will be assessed for each failure to—
- (a) Check the battery power properly.
 - (b) Set the radiosonde frequency on the transmitter properly.
- e. *Credit.* Maximum credit of one point each for tests 1 and 2; and 1.5 points for test 3 will be awarded if the tests are performed correctly.

53. Preparation of Train

- a. *Scope of Test.* One test will be conducted in which the candidate will be required to prepare the train for a radiosonde ascent.
- b. *Special Instructions.*
 - (1) The following equipment will be furnished the candidate:
 - (a) One ball twine RP-15.
 - (b) One parachute ML-132.
 - (c) One pocket knife.
 - (2) The balloon train will be prepared and laid out in preparation for the ascent which will be made as soon as the sounding balloon is inflated and the ground check is completed.
- c. *Outline of Test.*

Examiner commands—	Action of candidate
PREPARE TRAIN-----	Prepares the train as prescribed in FM 6-15.

- d. *Penalties.* A penalty of 0.5 point will be assessed if any error is made in preparing the train.
- e. *Credit.* If the test is performed correctly, a maximum credit of 1 point will be awarded.

54. Hydrogen Generator Set AN/TMQ-3 and Sounding Balloon

- a. *Scope of Test.* One test will be conducted in which the candidate will be required to generate the necessary hydrogen gas and inflate and shelter a sounding balloon.
- b. *Special Instructions.*
 - (1) The following equipment will be furnished the candidate:
 - (a) Eight calcium hydride charges, ML-304A/TM.
 - (b) One hydrogen generator AN/TMQ-3.
 - (c) Two sounding balloons.
 - (d) One balloon nozzle ML-196 and appropriate weights.
 - (e) Eight calcium hydride charges, ML-305A/TM.
 - (f) One inflation shelter.
 - (g) One ball twine RP-15.
 - (h) One pocket knife.
 - (i) One can corrugated, nesting, 24-gallon.

- (j) Twenty gallons water.
- (k) One FM 6-15.
- (l) Grounding equipment, properly installed.
- (2) The speed of the winds aloft will be furnished the candidate.
- (3) The candidate will be required to assemble the hydrogen generator as part of the test.
- (4) The balloons will be conditioned prior to the test, if required.
- (5) The inflated balloon will be tied down in a sheltered place for use in a subsequent test.
- (6) No penalty will be assessed for balloon breakage unless breakage is caused by carelessness on the part of the candidate. If a balloon is broken through no fault of candidate, time will be started anew on the second balloon.

c. Outline of Test.

Examiner commands—	Action of candidate
GENERATE HYDROGEN AND INFLATE SOUNDING BALLOON.	Assembles the generator and generates the hydrogen gas necessary to inflate a sounding balloon as prescribed in FM 6-15. Inflates the balloon and ties it down in the shelter as prescribed in TM 11-2405.

d. Penalties.

- (1) A penalty of 0.7 point will be assessed for each of the following errors:
 - (a) Inability to assemble the generator set AN/TMQ-3 properly.
 - (b) Use of an incorrect calcium charge.
 - (c) Failure to clean the generator properly after inflating the balloon.
 - (d) Failure to ground nozzle and generator set.
- (2) A penalty of 0.5 point will be assessed for each failure to—
 - (a) Clear a constriction in the neck of the balloon which occurs during inflation.
 - (b) Inspect the inflated balloon for defects.
 - (c) Weigh-off the balloon correctly.
 - (d) Tie the neck of the inflated balloon in such a manner that the balloon is sealed.
- (3) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—	45	50	55	60
Penalties	0	1	2	3

c. Credit. If the test is performed correctly within the minimum time limit, a maximum credit of 4 points will be awarded.

55. Baseline Check

a. *Scope of Tests.* Three tests will be conducted in which the candidate will be required to complete the assembly of the radiosonde AN/AMT-4(), tune the rawin set AN/GMD-1(), and perform and evaluate the baseline check at the radiosonde recorder (AN/TMQ-5()).

b. *Special Instructions.*

- (1) All equipment listed in previous 5 tests, plus a copy of TM 11-2440 and a computer, humidity-temperature CP 233B/UM, will be made available to the candidate.
- (2) All members of the meteorological section will be made available to assist during the test and will operate the rawin set, the TMQ-5, or the radiosonde, while the candidate is working on a specific piece of equipment.
- (3) Upon completion of test 3, the radiosonde and balloon will be attached to the balloon train in preparation for launching for the next test.
- (4) If the humidity element requires replacement, the time required for weathering will not be counted as performance time against the candidate.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	COMPLETE ASSEMBLY OF THE RADIOSONDE AN/AMT-4().	Completes the assembly of the radiosonde by installing the temperature and humidity elements.
2	TUNE RAWIN SET.....	Tunes the rawin set as prescribed in FM 6-15.
3	PERFORM BASELINE CHECK.....	Performs and evaluates the baseline check at the TMQ-5 as prescribed in FM 6-15.

d. *Penalties.*

- (1) Test 1—A penalty of 0.5 point will be assessed for each error made in completing the assembly of the radiosonde AN/AMT-4().
- (2) Test 2—A penalty of 1 point will be assessed if the candidate fails to tune the rawin set satisfactorily.
- (3) Test 3—A penalty of 0.5 point will be assessed for each error made in performing and evaluating the baseline check.
- (4) *Time penalties.*

Test 3.					
Time in minutes, exactly or less than—	20	23	26	29	32
Penalties	0	0.5	1.0	1.5	2.0

e. Credit. Maximum credit of one point each for tests 1 and 2 and 2 points for test 3 will be awarded if the tests are performed correctly.

56. Operation of Rawin Set AN/GMD-1

a. Scope of Test. One test will be conducted in which the candidate will be required to operate the rawin set and make the necessary adjustments during the first 5 minutes of a radiosonde ascent.

b. Special Instructions.

- (1) The equipment listed in previous 6 tests will be made available.
- (2) All members of the meteorological section will be made available to assist during the test.
- (3) The balloon with train and radiosonde will be launched when the examiner commands WARNING-RELEASE.
- (4) The candidate will be instructed to take position as operator of the rawin set to insure that the set is tracking automatically and that necessary adjustments are made.
- (5) The remaining members of the meteorological section will perform their normal duties during the ascent except that they will allow the candidate to take over their duties as required by the examiner.
- (6) The candidate will not be penalized for the following mishaps:
 - (a) Balloon burst at or after release.
 - (b) Signal failure 15 or more minutes after release.
- (7) A second radiosonde will be assembled, except for the humidity and temperature elements, for use in event the one prepared by candidate proves defective.

c. Outline of Test.

Examiner commands—	Action of candidate
WARNING-RELEASE-----	Positions GMD on radiosonde, switches to near-auto and far-auto, and performs necessary checks.

d. Penalties. A penalty of 1 point will be assessed for each failure to—

- (1) Have the AFC-manual switch in AFC position.
- (2) Properly set manual-near auto-far auto control.
- (3) Check that pin arm is placed in the ON position prior to release.
- (4) Perform optical-electrical bearing check.

e. Credit. If the test is performed correctly, a maximum credit of 4 points will be awarded.

57. Obtaining and Evaluating the Radiosonde Record

a. Scope of Test. One test will be conducted in which the candidate will be required to evaluate the radiosonde record and complete DA Form 6-43 (Radiosonde Data).

b. Special Instructions.

- (1) The equipment used in above test, with the addition of one FM 6-16, and one copy of DA Form 6-43, will be made available to the candidate.
- (2) The following information will be furnished the candidate:
 - (a) Baseline and surface observations at release.
 - (b) Pressure calibration chart.
 - (c) Radiosonde recorder calibration correction curve.
- (3) The candidate will move to the radiosonde recorder and start the test when notified by the examiner. He will operate the radiosonde recorder and perform the evaluating operations during the remainder of the ascent until the examiner gives the command CEASE TRACKING.
- (4) The remaining members of the meteorological section will continue to perform their normal duties during the ascent until the command CEASE TRACKING is given.
- (5) The candidate will be required to evaluate enough of the record to provide density and temperature data for an eight-line message. The candidate will be instructed to write the reason for putting in each particular level along the line drawn for each significant level.
- (6) During the ascent, the control recorder tape with elevation and azimuth angles and reference times will be kept intact so that the candidate can compute winds in a subsequent test.

c. Outline of Test.

Examiner commands—	Action of candidate
EVALUATE RADIOSONDE RECORD AND COMPLETE DA FORM 6-43 (RADIOSONDE DATA).	Obtains and evaluates the radiosonde record. Completes DA Form 6-43, as prescribed in FM 6-15.

d. Penalties.

- (1) A penalty of 1 point will be assessed if insufficient levels are chosen.

(2) A penalty of 0.3 point will be assessed for each of the following errors (total penalties will not exceed 5 points):

- (a) Omission on the radiosonde record, including data under title "Surface Observation at Release."
- (b) Level improperly placed.
- (c) Error in applying calibration or drift corrections in evaluating levels.
- (d) Error of more than ± 0.1 contact in determining contact numbers.

(3) A penalty of 0.2 point will be assessed for each of the following errors or omissions (total penalties will not exceed 2 points):

- (a) Error of ± 1 millibar in determination of pressure from contact numbers.
- (b) Error of more than $\pm 0.2^\circ$ C. in determination of temperature.
- (c) Error of more than ± 2 percent in determination of relative humidity.

e. Credit.

- (1) If the test is performed correctly, a maximum credit of 9 points will be awarded.
- (2) If total penalties exceed 6 points, no credit will be awarded.

58. Determining Ballistic Densities and Temperatures from Radiosonde Data

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to plot and determine data on the Chart ML-574/UM and compute ballistic densities and temperatures.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One FM 6-16.
 - (b) Two pencils, 3H.
 - (c) Eraser.
 - (d) Sandboard.
 - (e) Chart ML-574/UM.
 - (f) One scale ML-573/UM (Arty Zone Scale).
 - (g) Three copies of DA Form 6-44 (Ballistic Density or Temperature).
 - (h) One copy of DA Form 6-57 (NATO Meteorological Message).
- (2) The data from DA Form 6-43, obtained during the tests conducted under paragraphs 55 and 57 (including level number, pressure (mbs), temperature (degree C.), and relative humidity (percent)) will be furnished to the candidate.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PLOT AND DETERMINE DATA ON CHART ML-574/UM.	Plots the points and determines the data as prescribed in FM 6-15.
2	COMPUTE BALLISTIC DENSITIES FOR EIGHT LINES OF MESSAGE TYPE 3.	Computes the ballistic densities as prescribed in FM 6-15.
3	COMPUTE BALLISTIC TEMPERATURES FOR EIGHT LINES OF MESSAGE TYPE 3.	Computes the ballistic temperatures as prescribed in FM 6-15.

d. Penalties.

- (1) Test 1—A penalty of 0.3 point will be assessed for each of the following errors:

- (a) An error of more than ± 1 millibar in the initial plot of pressure.
- (b) An error of more than $\pm 0.2^{\circ}$ C. in the initial plot of temperature.
- (c) An error of more than ± 2 gram/m³ in density in the first through the sixth.
- (d) An error of more than ± 3 grams/m³ in density in the seventh and eighth zones.
- (e) An error of more than $\pm 0.5^{\circ}$ C. in temperatures.

- (2) Tests 2 and 3—A penalty of 0.23 point will be assessed if an error of more than ± 0.1 percent for surface and zones 1 through 8.

- (3) *Time penalties.*

- (a) Test 1.

Time in minutes, exactly or less than—	20	22	24	26
Penalties	0	1	2	3

- (b) Tests 2 and 3.

Time in minutes, exactly or less than—	15	18	21	24	28
Penalties	0	0.5	1.0	1.5	2.0

e. Credit.

- (1) If the tests are performed correctly within the minimum time limits, a maximum credit of 3 points for test; 1 and 2 points for tests 2 and 3 will be awarded.
- (2) If total penalties exceed 4.5 points, no credit will be allowed.

59. Determining Zone Winds from Rawin Data

a. *Scope of Tests.* Three tests will be given which require the candidate to plot a pressure-time curve, determine times at zones, and plot and determine the zone winds.

b. *Special Instructions.*

- (1) The following equipment will be furnished the candidate:
 - (a) One plotting board ML-122.
 - (b) One rule ML-126-A.
 - (c) One scale ML-577/UM.
 - (d) One slide rule ML-59.
 - (e) Two pencils, 3H.
 - (f) One art gum eraser.
 - (g) One sandboard.
 - (h) One copy DA Form 6-49 (Pressure-Time Chart).
 - (i) One straight edge.
 - (j) One copy DA Form 6-46 (Rawin Computation).
 - (k) One FM 6-16.
- (2) The following information will be furnished the candidate:
 - (a) Reference pressures from the modulator calibration chart.
 - (b) Control recorder tape from the beginning of the ascent.
 - (c) Release contact number and release pressure.
 - (d) Pressures (mb) at zone heights.
 - (e) Surface wind direction and speed.
- (3) The candidate will be required to determine the zone winds for an eight-line message.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	PLOT THE PRESSURE-TIME CURVE.	Plots the pressure-time curve as prescribed in FM 6-15.
2	DETERMINE THE TIME AT THE ZONE LIMITS.	Determines the time at the zone limits as prescribed in FM 6-15.
3	DETERMINE THE ZONE WINDS.	Determine the zone winds as prescribed in FM 6-15.

d. *Penalties.*

- (1) Test 1.—A penalty of 0.2 point will be assessed for each error of more than ± 1 millibar in plotting the time-height curve.
- (2) Test 2.—A penalty of 0.2 point will be assessed for each error of more than ± 0.2 minute in determining the time at the zone limits.
- (3) Test 3.—A penalty of 0.5 point will be assessed for any error in either direction or speed of the zone winds of more than ± 20 mils, or ± 1 knot.

(4) *Time penalties.*

(a) Test 1.

Time in minutes, exactly or less than—15 18 21
Penalties 0 0.5 1.0

(b) Test 3.

Time in minutes, exactly or less than—
25 27 30 33 37 39 42 45
Penalties 0 1 2 3 4 5 6 7

e. *Credit.*

- (1) If the tests are performed correctly within the minimum time limits, a maximum of 1 point for tests 1 and 2; and 8 points for test 3 will be awarded.
- (2) If total penalties exceed 6 points, no credit will be awarded.

60. General and Artillery Meteorology

a. *Scope of Test.* One test will be conducted in which the candidate will be required to answer orally 30 questions on meteorology.

b. *Special Instructions.*

- (1) The examining officer will read each question through slowly to the candidate two times.
- (2) The candidate will be allowed 2 minutes, if desired, to consider the question, prior to making his answer.

c. *Outline of Test.*

Examiner commands—	Action of candidate
ANSWER EACH QUESTION ASKED. (Examiner chooses 30 questions from list below.)	Candidate answers each question after due consideration as prescribed in any of the following official publications: FM 6-15; FM 6-16; TM 5-6115-204-10; TM 11-2405; TM 11-900; TM 11-2436; TM 11-2602B; TM 11-5014; TM 11-2440; TM 11-2432A; TM 11-2413; TM 11-6660-206-10; TM 11-6675-200-10; TM 11-2417; TM 11-427.

d. *Questions.*

- (1) What are the assumed standards of the meteorological factors on which tables are based?
- (2) How does the distance of the point of release from the rawin set (or theodolite) affect the computation of wind speeds?
- (3) What devices are used to transmit angular data from the main assembly to the control recorder?
- (4) What should the rawin set operator do if the overload indicator flashes on during operation?

- (5) Name 10 rules for evaluating a radiosonde record.
- (6) What type of release would you make in a high wind? Why?
- (7) What is the purpose of making a baseline check before sending aloft a radiosonde AN/AMT-4 ()?
- (8) What is the humidity tolerance allowed on baseline check for radiosonde AN/AMT-4 ()?
- (9) For what would you look on a radiosonde recorder record if you suspected a frequency shift?
- (10) Assuming no abrupt changes of weather (that is, front passages) during what hours of the day would you expect to have the highest relative humidity? The lowest relative humidity? Why?
- (11) Assuming no abrupt changes of weather (that is, frontal passages) during what hours of the day would you expect to have the highest temperature? The lowest temperature? Why?
- (12) What weather changes would you look for at a station to determine whether or not a cold front has passed?
- (13) What weather changes would you look for at a station to determine whether or not a warm front has passed?
- (14) What are the disadvantages of using a theodolite and a pilot balloon to determine winds aloft? What are the advantages?
- (15) Why are ballistic densities computed by the departure method often inaccurate?
- (16) A sound ranging message is computed at 0200 hours (sunrise 0600, sunset 1800). What is the correction for time of day if there is no rain, drizzle, or fog?
- (17) Why is humidity not evaluated on a radiosonde record when the radiosonde reaches 105 contacts?
- (18) On chart ML-574/UM you divide the virtual temperature sounding curve into artillery zones by balancing areas with your artillery zone scale. Why?
- (19) Give specific reasons why it is important to check leveling on a theodolite or rawin set before releasing a balloon?
- (20) How would you check the optical-electrical bearing on the rawin set?
- (21) For winds only, why are the surface and first line zone winds also considered ballistic winds?
- (22) Why are winds normally more constant in the upper air rather than at or near the surface?
- (23) What factors determine the thickness in meters of a layer of air 100 millibars thick?
- (24) Describe the two fundamental types of clouds and name at least one cloud from each of the three height classifications.
- (25) Where is the stratosphere located?

- (26) Density is computed from pressure, temperature, and humidity. How does variation of any one element, in turn, affect the density?
 - (27) List six elements of weather.
 - (28) What is the meaning of the term "sonic temperature"?
 - (29) What type of signal is transmitted by the radiosonde AN/AMT-4()?
 - (30) What are the component parts of the radiosonde AN/AMT-4()?
 - (31) Describe the operation of the recorder mechanism in a radiosonde recorder AN/TMQ-5().
 - (32) Explain how wind can affect a projectile during its trajectory.
 - (33) What is the purpose of the detector in the radiosonde recorder AN/TMQ-5()?
 - (34) Diagram a commutator bar from a radiosonde modulator between the fifty-fifth and sixty-fifth contacts, indicating what each segment represents.
 - (35) What are the condensation nuclei?
 - (36) Describe an occluded front.
 - (37) What is an isotherm, isobar, and millibar?
 - (38) Define ICAO.
 - (39) What is the standard condition for temperature, in percent, for artillery zone eight?
 - (40) What is the allowable tolerance for temperature (°C.) in performing the reference-temperature check?
 - (41) What is the proper name for the deflective force caused by the rotation of the earth and what effect does it have on the winds?
 - (42) What is the zone structure for radiological fallout computations?
 - (43) What is the zone structure for computer messages?
 - (44) In what units are wind direction, wind speed, temperature, and density reported on a Computer Metro Message?
 - (45) What meteorological data are required on a Fallout-Metro Message?
 - (46) What meteorological data are reported for significant levels when exchanging data with Air Weather Service?
 - (47) In what units and to what accuracy are wind data reported for Air Weather Service exchange?
- e. Penalties.* A penalty of 0.6 point will be assessed for each question that is not answered, or is answered incorrectly.
- f. Credit.*
- (1) If the test is performed correctly, a maximum credit of 18 points will be awarded.
 - (2) If total penalties exceed 12 points, no credit will be awarded.

CHAPTER 5

SOUND RANGING SPECIALISTS

61. General

This chapter is designed to test individuals in their ability to install, operate, test, and perform preventive maintenance on sound ranging equipment. In addition, it tests individuals in their ability to plot and compute data concerned with sound ranging.

62. Outline of Tests

Par. No.	Subject	Number of tests	Points each	Maximum credit
63	Installation of sound ranging set GR-8.....	1	4	4
64	Operation of sound ranging set GR-8.....	2	-----	7
	Test 1.....	(1)	2.5	(2.5)
	Test 2.....	(1)	4.5	(4.5)
65	Preventive maintenance of sound ranging equipment.....	2	-----	6
	Test 1.....	(1)	.5	(.5)
	Test 2.....	(1)	5.5	(5.5)
66	Installation of microphone T-23.....	1	3	3
67	Equipment testing.....	3	0.5	1.5
68	Electrical circuits.....	3	1	3
69	Adjustment of sound ranging set GR-8.....	1	5	5
70	Storage batteries—operation and maintenance.....	2	2.5	5
71	Outpost Operation.....	3	-----	3
	Tests 1 and 2.....	(2)	0.5	(1)
	Test 2.....	(1)	2	(2)
72	Computation of standard sound bases.....	2	5	10
73	Record reading.....	1	5	5
74	Computation of corrected time intervals.....	3	-----	16
	Tests 1 and 3.....	(2)	5	(10)
	Test 2.....	(1)	6	(6)
75	Preparation of final plotting chart (grid sheet).....	2	5	10
76	Plotting final time intervals on grid sheet.....	2	2.5	5
77	Special corrections and plotting.....	1	4.5	4.5
78	Sound-on-sound adjustment.....	1	7	7
79	Plotting and computing weather data for sound ranging.....	3	-----	5
	Tests 1 and 3.....	(2)	1	(2)
	Test 2.....	(1)	3	(3)
	Total.....	33	-----	100

63. Installation of Sound Ranging Set GR-8

a. Scope of Test. One test will be conducted in which the candidate will be required to connect properly all units listed below and prepare the set for preoperation tests.

b. Special Instructions.

(1) The following equipment will be available to the candidate:

- (a) One sound ranging set GR-8.
- (b) One telephone (tested).
- (c) One headset HS-30.
- (d) One chest set TD-1.
- (e) One ground rod MS-148/G.
- (f) A 12-volt dc source.
- (g) One roll recording paper.
- (h) One lineman's kit and wire.
- (i) One pickaxe, 4 pound.

(2) Two sets of outpost equipment with wire circuits will be installed prior to the test. Candidate will be required to connect wires to recorder as part of test.

(3) A wire line will be laid to a previously installed sound ranging microphone.

c. Outline of Test.

Examiner commands—	Action of candidate
INSTALL SOUND RANGING SET.....	Installs sound ranging set as prescribed in TM 11-2568.

d. Penalties.

(1) A penalty of $\frac{1}{2}$ point will be assessed for each of the following:

- (a) Plate supply timer not on shock mounting.
- (b) Recorder not on shock mounting.
- (c) High or low voltage cables are connected improperly.
- (d) 12-volt source is connected improperly.
- (e) Head and chest set and telephone are connected improperly.
- (f) Paper is loaded incorrectly.
- (g) Ground connection is made improperly.
- (h) Microphone and outpost unit wire lines are connected improperly.

(2) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—	5	6	7	8	9
Penalties	0	1	2	3	4

e. Credit. If the test is performed correctly within the minimum time limit, a maximum credit of 4 points will be awarded.

64. Operation of Sound Ranging Set GR-8

a. *Scope of Tests.* Two tests will be conducted in which the candidate will be required to test and operate the sound ranging equipment.

b. *Special Instructions.*

- (1) Prior to the test, a reduced scale 6 microphones, 2 outpost sound base will be installed.
- (2) The outposts will be manned.
- (3) The command post equipment will consist of the following:
 - (a) One plate supply and timer unit PE 244.
 - (b) One recorder BC 1337 ().
 - (c) Two 12-volt dc sources.
 - (d) One telephone with head and chest set.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	TEST SOUND RANGING SET-----	Places all controlling switches in operating position. Performs, identifies, and states results of preoperation tests as prescribed in TM 11-2568.
2	OPERATE SOUND RANGING SET----	Throws main switch off. Throws main switch on. Positions all controls for operation. Performs or explains the operations as prescribed in TM 11-2568.

d. *Penalties.*

(1) Test 1.

(a) A penalty of 0.5 point will be assessed for each of the following errors:

1. Any, but not each, meter reading incorrectly reported or not reported.
2. Failure to report necessary adjustments.
3. Reporting of unnecessary adjustments.
4. Failure to check telephone communication with the outpost operator.
5. Failure to instruct the outpost operator to start the sound ranging set.

(b) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—	10	12	14	16
Penalties	0	0.5	2.0	2.5

- (2) Test 2—A penalty of 0.5 point will be assessed for each of the following errors:
- (a) Any, but not each, control in incorrect position.
 - (b) Failure to correct or explain how to correct defects found during preoperation test.
 - (c) Failure to explain why a reserve storage battery must be kept nearby.
 - (d) Failure to inspect spare fuzes and vibrators.
 - (e) Failure to inform outpost operator that the set is ready to operate.
 - (f) Using improper procedure with outpost operator.
 - (g) Failure to adjust attenuators after recording sound when necessary.
 - (h) Cleaning galvanometer styluses improperly.
 - (i) Failure to explain how to check the frequency of the tuning fork.
- e. *Credit.*
- (1) Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 62.
 - (2) No credit will be awarded if total penalties exceed 4 points.

65. Preventive Maintenance of Sound Ranging Equipment

a. *Scope of Tests.* Two tests will be conducted in which the candidate will be required to identify maintenance material and tools and perform preventive maintenance.

b. *Special Instructions.*

- (1) The following equipment and materials will be made available to the candidate:
 - (a) One sound ranging set.
 - (b) One microphone.
 - (c) Maintenance materials and tools.
- (2) For test 2, the candidate will be furnished a copy of TM 11-2568 for his reference during the test. For maintenance tasks which require considerable time, such as tinning a soldering iron, the candidate will be required only to describe the preventive measures.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	IDENTIFY MAINTENANCE MATERIALS AND TOOLS.	Identifies the materials and tools prescribed in TM 11-2568.
2	PERFORM PREVENTIVE MAINTENANCE.	Performs the itemized preventive maintenance prescribed in TM 11-2568 and explains each step.

d. Penalties.

- (1) Test 1.—A penalty of 0.5 point will be assessed if the candidate fails to identify properly all the tools and materials required for maintenance, or if the candidate takes more than 3 minutes to complete the test.
- (2) Test 2.
 - (a) A penalty of 5.5 points will be assessed if it becomes evident that the candidate may damage the equipment. In this case, the examiner will stop the test.
 - (b) A penalty of 0.5 point will be assessed if any part of each item of preventive maintenance listed in TM 11-2568 is performed incorrectly. No more than 0.5 point will be assessed for each item.

e. Credit. Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 62.

66. Installation of Microphone T-23

a. Scope of Test. One test will be given in which the candidate will install a microphone T-23.

b. Special Instructions.

- (1) The equipment listed below will be furnished the candidate:
 - (a) One microphone T-23.
 - (b) One microphone shelter BE-66A.
 - (c) One shovel.
 - (d) One pick.
 - (e) One ground rod GP-16 with heavy wire.
 - (f) One lineman's kit with field wire.
 - (g) One telephone with test clips.
- (2) Ground selected for the test will be average soil. If it is extremely difficult to dig in the spot selected for the test the minimum time given under "time penalties" must be extended accordingly.

c. Outline of Test.

Examiner commands—	Action of candidate
INSTALL MICROPHONE-----	Installs microphone as prescribed in TM 11-2568.

d. Penalties.

- (1) A penalty of 0.5 point will be assessed for each of the following errors:
 - (a) Dimensions of the hole incorrect (tolerance, $\pm 2''$).
 - (b) Field wire connected incorrectly.
 - (c) Ground rod connected or installed incorrectly.
 - (d) Microphone suspended incorrectly.

- (e) Failure to pack dirt around the edge of the microphone shelter.
- (f) Failure to call CP and make the "hat wave" test.
- (2) Time penalties will be assessed as follows:
- | | | | |
|--|----|----|----|
| Time in minutes, exactly or less than— | 20 | 22 | 24 |
| Penalties | 0 | 1 | 3 |

e. *Credit.*

- (1) If the test is performed correctly within the minimum time limit, a maximum credit of 3 points will be awarded.
- (2) No credit will be awarded if total penalties exceed 2 points.

67. Equipment Testing

a. *Scope of Tests.* Three tests will be given in which the candidate will be required to test equipment.

b. *Special Instructions.*

- (1) The equipment listed below will be made available to the candidate.
- (a) One sound ranging set GR-8.
- (b) One microphone T-23.
- (c) One test set TS-26/TSM.
- (d) Pencil and paper.
- (2) Prior to administering the tests, the examiner will obtain, by actual measurement, the correct voltage and resistance measurements of the set to be used for the tests.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	MEASURE AND RECORD VOLTAGE AND RESISTANCE OF RECORDER TERMINALS NO 2 TO NO 5 AND NO 8 TO NO 12.	Measures and records the voltage and resistance as prescribed in TM 11-2568.
2	MEASURE AND RECORD THE VOLTAGE AND RESISTANCE OF TIMER TERMINALS NO 2 TO NO 8, NO 10, AND NO 11.	Measures and records the voltage and resistance as prescribed in TM 11-2568.
3	PRETEST MICROPHONE T-23-----	Pretests microphone T-23 as prescribed in TM 11-2568.

d. *Penalties.*

- (1) A penalty of 0.5 point will be assessed for each test or measurement performed incorrectly.
- (2) The total time for three tests must not exceed the time limits given in the following table:
- | | | | | |
|--|----|----|----|----|
| Time in minutes, exactly or less than— | 18 | 21 | 24 | 27 |
| Penalties | 0 | 1 | 2 | 3 |

e. Credit. Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 62.

68. Electrical Circuits

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to draw, trace, and explain electrical symbols and circuits.

b. Special Instructions. A sound ranging set GR-8, a microphone T-23, and pencil and paper will be made available to the candidate.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DRAW THE ELECTRICAL SYMBOLS FOR THE FOLLOWING: (Examiner selects eight symbols from the following list: Fixed resistor, voltmeter, battery, capacitor, single pole single throw switch, iron core transformer, variable resistor, ammeter, fuze, air core.)	Draws symbols.
2	DRAW AND EXPLAIN THIS CIRCUIT. (Examiner selects one circuit from the following list: Series, parallel, series-parallel.)	Draws and explains the circuit.
3	TRACE AND EXPLAIN THESE CIRCUITS. (Examiner selects one circuit from the following list: Time-motor and tuning fork circuit, microphone-voltage regulator circuit, microphone T-23 circuit.)	Traces in the equipment and explains the circuit. Reference to circuit diagrams on the equipment is authorized.

d. Penalties.

- (1) Test 1—A penalty of 0.125 point will be assessed for each symbol incorrectly drawn.
- (2) Test 2—A penalty of 1 point will be assessed if the circuit is drawn or explained incorrectly, or if the performance requires more than 4 minutes.
- (3) Test 3—A penalty of 1 point will be assessed for circuit incorrectly traced or explained.

e. Credit.

- (1) Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 62.
- (2) If total penalties exceed 2 points, no credit will be awarded.

69. Adjustment of Sound Ranging Set GR-8

a. *Scope of Test.* One test will be conducted in which the candidate will be required to make adjustments on the sound ranging set GR-8.

b. *Special Instructions.* A sound ranging set GR-8 will be installed ready to operate for use of the candidate.

c. *Outline of Test.*

Examiner commands—	Action of candidate
PERFORM FIVE ADJUSTMENTS ON THE SOUND RANGING SET. (Examiner selects five of the following adjustments: Adjusting the tuning fork contact screw; adjusting the tuning fork one-hundredth second contacts; stylus pressure adjustment; stylus zero position adjustment; time marking stylus alinement adjustment; printer latch adjustment; stylus time coordination adjustment.)	Performs the five adjustments as prescribed in TM 11-2568.

d. *Penalties.*

(1) A penalty of 1 point will be assessed for each adjustment incorrectly performed.

(2) Time penalties will be as follows:

Time in minutes, exactly or less than—	15	16	17	18
Penalties	0	2	4	5

e. *Credit.*

(1) If the test is performed correctly within the minimum time limit, a maximum credit of 5 points will be awarded.

(2) If total penalties exceed 4 points, no credit will be awarded.

70. Operation and Maintenance of PE-210 and Storage Batteries

a. *Scope of Tests.* Two tests will be conducted in which the candidate will be required to install and operate power unit PE-210 and demonstrate and explain the functioning and maintenance of storage batteries.

b. *Special Instructions.* The equipment listed below will be furnished the candidate:

- (1) One power unit PE-210 in good working order.
- (2) One 12-volt battery.
- (3) One hydrometer.
- (4) Two battery charging cables.
- (5) Battery test set.
- (6) Gasoline and oil.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	INSTALL AND OPERATE POWER UNIT PE-210. (Examiner directs candidate to—prepare fuel mixture and fill tank; start motor; connect and start charging the battery; check voltmeter and ammeter readings; increase and decrease the charging rate; stop the engine and disconnect the battery; demonstrate preventive maintenance procedures; explain corrective action when engine is flooded; explain corrective action when engine fails to start; describe safety precautions.)	Performs the operations directed as prescribed in TM 11-947.
2	DEMONSTRATE AND EXPLAIN THE FUNCTIONING AND MAINTENANCE OF STORAGE BATTERIES. (Examiner requires candidate to— (1) Explain the following: Preparation of a new battery for use; charging rate; variation of hydrometer reading with temperature changes; terminal voltage; ratings; effect of freezing; effect of impurities in electrolyte. (2) Describe the following: Storage cell; safety precautions. (3) Demonstrate how to mix and replenish electrolyte in a cell.)	Demonstrates operations and explains functions directed.

d. Penalties.

(1) Test 1.

(a) A penalty of 0.25 point will be assessed for each requirement incorrectly performed.

(b) If candidate shows obvious lack of knowledge of the PE-210 the test will be stopped by the examiner and no credit awarded.

(2) Test 2—A penalty of 0.25 point will be assessed for each requirement incorrectly performed.

e. Credit.

(1) Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 62.

(2) No credit will be allowed if total penalties exceed 3.5 points.

71. Outpost Operation

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to set up and operate the outpost.

b. Special Instructions.

(1) The equipment listed below will be made available to the candidate:

- (a) One telephone EE-8.
- (b) One outpost connecting box BE-71.
- (c) One outpost switch unit SA-45/G.
- (d) One reel unit RL-39 with wire WD-1.
- (e) One lineman's kit.
- (f) One terminal strip TM-184.

(2) The outpost will be located within 100 feet of the sound ranging set to save time in wire laying.

(3) A sound ranging set will be set up and made ready to operate.

(4) The outpost will be designated, and the equipment necessary for the test will be placed at the location.

(c) Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	LAY WIRE LINE FROM SOUND RANGING SET TO OUTPOST AND CONNECT OUTPOST UNIT.	Connects lines to sound ranging set and terminal strip, lays line to outpost, and connects outpost unit as prescribed in TM 11-2568.
2	PERFORM OUTPOST TEST.....	Performs outpost test prescribed in TM 11-2568.
3	DESCRIBE SELECTION OF OUTPOST POSITION AND DUTIES OF OUTPOST OBSERVER.	Describes as outlined in FM 6-122.

d. Penalties.

(1) Test 1—A penalty of 0.5 point will be assessed if the test is performed incorrectly.

(2) Test 2—A penalty of 0.5 point will be assessed if the test is performed incorrectly, or if the candidate requires longer than 1 minute to perform the test.

(3) Test 3—A penalty of 0.5 point will be assessed for each error in description.

e. Credit. Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 62.

72. Computation of Standard Sound Bases

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to compute one straight regular base and one irregular base.

b. Special Instructions.

- (1) The equipment listed below will be furnished the candidate:
 - (a) One book logarithms (7-place).
 - (b) Forms or blank paper for computations.
- (2) The data listed below will be supplied to the candidate by the examiner:
 - (a) Straight regular base.
 1. Type of base.
 2. Coordinates of one microphone.
 3. Azimuth of base.
 - (b) Irregular base.
 1. Type of base.
 2. Coordinates of six microphones.
- (3) In grading the candidate's computations, a penalty will be assessed only once for each mistake, even though the mistake causes subsequent computations to give incorrect results. If subsequent computations carry the error through using correct procedures, full credit will be awarded for computations made subsequent to the error.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	TYPE OF BASE: 6-MICROPHONE _____ METER STRAIGHT BASE; COORDINATES OF M3, _____, _____; AZIMUTH OF BASE, _____, MILS. COMPUTE THE SOUND BASE.	Computes sound base as prescribed in FM 6-122.
2	TYPE OF BASE: 6-MICROPHONE, IR- REGULAR BASE; COORDINATES OF MICROPHONES; M1 _____ M4 _____ M2 _____ M5 _____ M3 _____ M6 _____ COMPUTE AZIMUTH AND DIS- TANCE FOR EACH SUBBASE.	Computes azimuth and length of each subbase on DA Form 6-1. (This in- formation is used by the sound platoon to obtain wind and curvature cor- rections for the irregular sound base.)

d. Penalties.

- (1) Computation errors. A penalty of 1 point will be assessed for each error in computation made in either test.

(2) *Time penalties.*

(a) Test 1.

Time in minutes, exactly or less than—	20	25	30	35
Penalties	0	2	4	5

(b) Test 2.

Time in minutes, exactly or less than—	75	80	85	90	95
Penalties	0	1	2	4	5

e. *Credit.*

- (1) Subject to penalties imposed in *d* above, maximum credit will be awarded as indicated in paragraph 62.
- (2) No credit will be awarded if total penalties exceed 7 points.

73. Record Reading

a. *Scope of Test.* One test will be conducted in which the candidate will be required to read a record and compute the time intervals.

b. *Special Instructions.*

- (1) The equipment listed below will be made available to the candidate:
 - (a) One record from a six-microphone straight regular base.
 - (b) One record reader.
 - (c) Proper forms.
 - (d) Paper and pencil.
- (2) The pattern of breaks on the record furnished will be distinct and typical of the regular base used.

c. *Outline of Test.*

Examiner commands—	Action of candidate
READ, RECORD AND COMPUTE TIME INTERVALS.	Reads record. Computes and records time intervals.

d. *Penalties.*

- (1) A penalty of 5 points will be assessed for either of the following errors:
 - (a) Time arrivals not interpolated to the nearest 0.001 second.
 - (b) Time intervals not correct to the nearest 0.005 second.
- (2) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—	5	6	Over 6
Penalties	0	3	5

e. *Credit.* Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 62.

74. Computation of Corrected Time Intervals

a. Scope of Test. Three tests will be conducted in which the candidate will be required to compute final time intervals.

b. Special Instructions.

(1) The equipment listed below will be furnished the candidate:

- (a) Forms.
- (b) Pencil and paper.
- (c) Five recorded time intervals (uncorrected) from a straight regular base (such that the rough plot will form a polygon not greater than 200 meters in length) (to be used in tests 1 and 2 below).
- (d) Five recorded (uncorrected) time intervals from an irregular base (such that the rough plot will form a polygon not greater than 200 meters in length) (to be used in test 3 below).
- (e) One M1 wind corrector.
- (f) Temperature and asymptote correction charts.
- (g) One sound fan (4 seconds).
- (h) One irregular base fan.
- (i) All base wind and asymptote correction charts.
- (j) Two Monroe calculators.
- (k) Three improvised plotting boards.
- (l) FM 6-122.

(2) The following data will be furnished the candidate:

- (a) Meteorological sound ranging message.
- (b) Survey data for the following:
 - 1. Six microphone 4-second straight base. (To be used in test 1 and 2 below.)
 - 2. Five subbase azimuths and distances for a 6 microphone irregular base. (To be used in test 3 below.)

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	COMPUTE FINAL TIME INTERVALS USING STANDARD CORRECTION CHARTS.	Computes final time intervals as prescribed in FM 6-122.
2	COMPUTE FINAL TIME INTERVALS USING CALCULATORS.	Computes final time intervals as prescribed in FM 6-122.
3	COMPUTE FINAL TIME INTERVALS USING ALL-BASE CORRECTION CHARTS.	Computes final time intervals as prescribed in FM 6-122.

d. Penalties.

(1) Test 1.

- (a) A penalty of 1 point will be assessed for each time interval incorrectly computed. (Allowable tolerance of error is 0.005 seconds.)
- (b) Time penalties will be assessed as follows (time required to prepare the plotting charts will not be counted):
- | | | | | |
|--|---|---|---|--------|
| Time in minutes, exactly or less than— | 5 | 6 | 7 | over 8 |
| Penalties | 0 | 2 | 3 | 5 |

(2) Test 2.

- (a) A penalty of 1 point will be assessed for each time interval incorrectly computed (allowable tolerance of error is 0.002 seconds).
- (b) A penalty of 1 point will be assessed if either calculator is set up incorrectly.
- (c) Time penalties will be assessed as follows:
- | | | | | |
|--|---|---|---|---|
| Time in minutes, exactly or less than— | 6 | 7 | 8 | 9 |
| Penalties | 0 | 2 | 4 | 6 |

(3) Test 3.

- (a) A penalty of 1 point will be assessed for each time interval incorrectly computed. (Allowable tolerance of error is 0.005 seconds.)
- (b) Time penalties will be assessed as follows:
- | | | | | |
|--|----|----|----|----|
| Time in minutes, exactly or less than— | 15 | 16 | 17 | 18 |
| Penalties | 0 | 2 | 3 | 5 |

e. Credit.

- (1) Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 62.
- (2) No credit will be awarded if total penalties exceed 12 points.

75. Preparation of Final Plotting Chart (Grid Sheet)

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to construct a sound base on a grid sheet for plotting final time intervals.

b. Special instructions.

- (1) The candidate will be furnished the following data:
- (a) Coordinates of the microphones.
- (b) Azimuth of the base.
- (2) The equipment listed below will be furnished the candidate:
- (a) Drafting pencils.
- (b) Plotting scales.
- (c) Regular fan 4 second.
- (d) Irregular fan.
- (e) Two 1/25000 meter grid sheets.
- (f) Map pins, thumb tacks and map board.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	CONSTRUCT FINAL PLOTTING CHART FOR STRAIGHT REGULAR BASE.	Constructs grid as prescribed in FM 6-122.
2	CONSTRUCT FINAL PLOTTING CHART FOR IRREGULAR BASE.	Constructs grid as prescribed in FM 6-122.

d. Penalties.

(1) Test 1.

- (a) A penalty of 1 point will be assessed for each error of more than 20 meters in plotting a midpoint or normal point.
- (b) Time penalties will be as follows:
- | | | | | | |
|-----------------------|----|----|----|----|---------|
| Time in minutes, | | | | | |
| exactly or less than— | 30 | 32 | 34 | 36 | Over 36 |
| Penalties | 0 | 1 | 2 | 3 | 5 |

(2) Test 2.

- (a) A penalty of 1 point will be assessed for each error of more than 20 meters in plotting a midpoint or normal point.
- (b) Time penalties will be as follows:
- | | | | | | |
|-----------------------|----|----|----|----|---------|
| Time in minutes, | | | | | |
| exactly or less than— | 33 | 37 | 38 | 40 | Over 40 |
| Penalties | 0 | 1 | 2 | 3 | 5 |

e. Credit.

- (1) If the tests are performed correctly within the minimum time limit, a maximum credit of 5 points for each test will be awarded.
- (2) No credit will be awarded if total penalties exceed 7 points.

76. Plotting Final Time Intervals on Grid Sheet

a. *Scope of Test.* Two tests will be conducted in which the candidate will be required to plot the corrected time intervals supplied and record the corrected coordinates of the sound source.

b. *Special Instructions.* The equipment and data listed below will be furnished the candidate.

- (1) One grid sheet with straight, regular base prepared.
- (2) One grid sheet with irregular base prepared.
- (3) One sound plotting record with 5 corrected time intervals (which will result in a polygon not over 50 meters in length) from a 6-microphone straight base.
- (4) One sound plotting record with 5 corrected time intervals (which will result in a polygon not over 5 meters in length) from a 6-microphone irregular base.
- (5) One set of plotting fans.
- (6) One plotting scale, 1/25000 meters.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PLOT FINAL TIME INTERVALS FOR STRAIGHT BASE AND RECORD CORRECTED COORDINATES.	Performs operations as prescribed in FM 6-122.
2	PLOT FINAL TIME INTERVALS FOR IRREGULAR BASE AND RECORD CORRECTED COORDINATES.	Performs operations as prescribed in FM 6-122.

d. Penalties.

(1) Test 1.

(a) A penalty of 2.5 points will be assessed if the candidate fails to report the corrected coordinates within an accuracy of 30 meters of the true location.

(b) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—	3	4	5	6
Penalties	0	0.5	1.5	2.5

(2) Test 2.

(a) A penalty of 2.5 points will be assessed if the candidate fails to report the corrected coordinates within 30 meters of the true location.

(b) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—	4	5	6	7
Penalties	0	0.5	1.5	2.5

e. *Credit.* If the tests are performed correctly within the minimum time limit, a maximum credit of 2.5 points for each test will be awarded.

77. Special Corrections and Plotting

a. *Scope of Test.* One test will be conducted in which the candidate will be required to apply all corrections to a missing-string plot.

b. *Special Instructions.* The equipment and data listed below will be furnished the candidate:

- (1) One sound plotting record with 5 times of arrivals from a 6 microphone, $\frac{1}{2}$ second straight, regular base (with arrival time for microphone 3 missing).
- (2) Standard correction charts.
- (3) Regular base fan—4 seconds.
- (4) Prepared "rough plot" chart.

c. Outline of Test.

Examiner commands—	Action of candidate
DETERMINE ALL CORRECTIONS FOR MISSING-STRING PLOT.	Determines corrections as prescribed in FM 6-122.

d. *Penalties.*

(1) A penalty of 1.5 points each will be assessed the candidate if any 1 of the 3 corrections applied are in error greater than ± 0.003 .

(2) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—

	15	16	17	18	Over 18
Penalties	0	1.0	2.0	3.0	4.5

e. *Credit.* If the test is performed correctly within the minimum time limit, a maximum credit of 4.5 points will be awarded.

78. Sound-On-Sound Adjustment

a. *Scope of Test.* One test will be conducted in which the candidate will be required to conduct a sound-on-sound adjustment.

b. *Special Instructions.*

(1) The equipment listed below will be furnished the candidate:

- (a) Regular fan, 4-second.
- (b) Prepared "rough plot" chart.
- (c) Coordinate square, 1/25000 yards.
- (d) Map pins, thumb tacks, and map board.

(2) The following information will be furnished the candidate:

- (a) Azimuth of base 2500 mils.
- (b) Four microphone hasty base (approximately 4 sec in size).
- (c) Time intervals for hostile gun. (Produce polygon.)
- (d) Time intervals for registration point.

c. *Outline of Tests.*

Examiner commands—	Action of candidate
PLOT HOSTILE WEAPON.....	Plots hostile weapon on chart as prescribed in FM 6-122.
ADJUST CENTER NORMAL.....	Adjusts center normal as prescribed in FM 6-122.
SUBMIT INITIAL FIRE REQUEST.....	Candidate must submit initial fire request to fire direction center. (Examiner may act as computer in FDC.)
PLOT REGISTRATION POINT.....	Plots registration point as prescribed in FM 6-122.
CONDUCT ADJUSTMENT. (Examiner furnishes time intervals required to plot succeeding rounds. The adjustment should be completed with three adjusting rounds.)	Measures deflection and range shifts and sends corrections to FDC until adjustment is complete.

d. Penalties.

- (1) A penalty of 1 point will be assessed for one or more errors in each of the following:
 - (a) Plotting the hostile weapon.
 - (b) Adjusting center normal.
 - (c) Submitting the initial fire request.
 - (d) Plotting the registration point.
 - (e) Any one of the succeeding rounds, or errors in measurements in deflection and range shifts.
- (2) *Time Penalties.* The following table applies to total time it takes the candidate to complete the test.

Time in minutes, exactly or less than—	20	22	24	26
Penalties	0	3	5	7

e. Credit. If test is performed correctly within the minimum time limit, a maximum credit of 7 points will be awarded.

79. Plotting and Computing Weather Data for Sound Ranging

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to plot the readings on a 30-gram balloon, determine the effective wind, and determine the effective temperature.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One plotting board ML-122.
 - (b) One rule ML-126-A.
 - (c) One scale ML-577/UM.
 - (d) One weather data for sound ranging form.
 - (e) Two pencils, 3H; art gum; and sandboard.
 - (f) One copy FM 6-16.
- (2) The following data will be furnished the candidate:
 - (a) Time, dry bulb temperature, and wet bulb temperature.
 - (b) A set of readings on a 30-gram balloon through 3 minutes 54 seconds of ascent to include time, elevation angle, and azimuth angle.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PLOT READINGS.....	Plots the readings as prescribed in FM 6-15.
2	DETERMINE THE EFFECTIVE WIND..	Scales and weights the winds. Determines the effective wind as prescribed in FM 6-15.
3	DETERMINE THE EFFECTIVE TEMPERATURE.	Determines the effective temperature as prescribed in FM 6-15.

d. Penalties.

- (1) Test 1—A penalty of 0.5 point will be assessed for each error made in plotting.
- (2) Test 2—A penalty of 1.5 points will be assessed for the following errors:
 - (a) Wind direction in error by more than ± 20 mils.
 - (b) Wind speed in error by more than ± 1 knot.
- (3) Test 3—A penalty of 1 point will be assessed if the effective temperature is in error by more than $\pm 0.5^{\circ}$ C.
- (4) *Time penalties.*

(a) Test 1.

Time in minutes, exactly or less than—	5	6	7
Penalties	0	0.5	1.0

(b) Test 2.

Time in minutes, exactly or less than—	10	12	14	16
Penalties	0	1	2	3

(c) Test 3.

Time in minutes, exactly or less than—	3	4	5
Penalties	0	0.5	1.0

e. Credit. Subject to the penalties assessed in *d* above, maximum credit of 1 point each will be awarded for tests 1 and 3, and 3 points for test 2.

CHAPTER 6

FLASH RANGING SPECIALISTS

80. General

This chapter is designed to test individuals in their ability to install, operate, test, and perform preventive maintenance on equipment used for flash ranging. In addition, it tests individuals in their ability to compute information and perform the graphical solution to problems concerned with flash ranging.

81. Outline of Test

Par. No.	Subject	Number of tests	Points each	Maximum credit
82	Nomenclature assembly and leveling of the battery commander's telescope M-65.....	2	2	4
83	Care and maintenance of the battery commander's telescope M-65.....	1	2	2
84	Operation of BC telescope M-65.....	5	-----	24
	Test 1.....	(1)	3	(3)
	Test 2.....	(1)	4	(4)
	Test 3.....	(1)	5	(5)
	Tests 4 and 5.....	(2)	6	(12)
85	Reporting.....	1	2	2
86	Assembling, nomenclature, manning, and maintenance of plotting board M5.....	4	-----	6
	Tests 1 and 3.....	(2)	1	(2)
	Tests 2 and 4.....	(2)	2	(4)
87	Operation of plotting board M5.....	4	6	24
88	Computation of registration.....	1	6	6
89	Graphical solution of three-point resection.....	1	6	6
90	Graphical intersection.....	1	5	5
91	Computation of azimuth, distance, and vertical angle.....	1	7	7
92	Nomenclature of flash ranging set AN/GTC-1.....	1	1	1
93	Installation, testing, and operation of flash ranging set AN/GTC-1.....	3	2	6
94	Duties of switchboard operator.....	3	-----	4
	Tests 1 and 2.....	(2)	1	(2)
	Test 3.....	(1)	2	(2)
95	Maintenance of flash ranging set AN/GTC-1.....	1	3	3
	Total.....	29	-----	100

82. Nomenclature Assembly and Leveling of the Battery Commander's Telescope M-65.

a. Scope of Test. Two tests will be conducted during which the candidate will be required to name the parts, assemble and level the battery commanders telescope M-65.

b. Special Instructions. One battery commander's telescope M-65 with tripod, accessories, and carrying case will be furnished the candidate.

c. Outline of Test.

Test No.	Examiner commands—	Action of candidate
1	NAME PARTS DESIGNATED. (Examiner points to 10 of these parts: instrument light M-28, filter selector knob, interpupillary distance knob, elevating knob, head-window plug, telescope release knob, locating bushing, upper vertical spindle, level vial (circular) interpupillary scale, notation strip, azimuth scale, azimuth micrometer, azimuth knob, orienting knob, diopter scale, angle of site micrometer, angle of site scale index, angle of site scale, angle of site level vial.)	Announces the name of each part designated by the examiner as prescribed in TM 9-575.
2	ASSEMBLE AND LEVEL INSTRUMENT.	Sets up tripod over a point designated by the examiner. Removes the instrument from the carrying case and places the instrument on the tripod. Levels the instrument as prescribed in TM 9-575.

d. Penalties.

- (1) Test 1—A penalty of 0.2 point will be assessed for each error in naming the parts designated.
- (2) Test 2—A penalty of 0.5 point will be assessed for each of the following errors:
 - (a) Failure to seat the tripod legs firmly in the ground.
 - (b) Failure to center over designated point.
 - (c) Failure to level the instrument.
 - (d) Failure to check leveling by turning instrument through 3200 mils.
 - (e) Time in minutes, exactly or less than—

	1'40''	1'50''	over 1'50''
Penalties	0	1	2

e. Credit. If the test is performed correctly within the minimum time limit, a maximum credit of 2 points for each test will be awarded.

83. Care and Maintenance of the Battery Commander's Telescope M-65

a. Scope of Test. One test will be conducted in which the candidate will be required to demonstrate the care and maintenance of the battery commander's telescope M-65.

b. Special Instructions.

(1) The following equipment will be furnished the candidate:

- (a) Battery commander's telescope M-65 with accessories.
- (b) Small screwdriver.
- (c) Lens paper.
- (d) Lubricants.
- (e) Lens cleaning fluid.

(2) The horizontal micrometer scale of the instrument will be adjusted so that it does not read zero when the scale reading is zero.

c. Outline of Test.

Examiner commands—	Action of candidate
DEMONSTRATE CARE AND MAINTENANCE.	Demonstrates the care and maintenance as prescribed in the Preventive Maintenance Schedule TM 9-575.

d. Penalties. A penalty of 0.25 point will be assessed for each failure to—

- (1) Use proper method and materials in cleaning the lenses.
- (2) Use proper lubricating materials.
- (3) Check azimuth and orienting mechanisms.
- (4) Check elevation mechanism.
- (5) Check angle of site mechanism.
- (6) Check zero of scales and micrometers.
- (7) Adjust micrometer scale to read zero.
- (8) Check interpupillary distance knob.

e. Credit. If the test is performed correctly, a maximum credit of 2 points will be awarded.

84. Operation of the Battery Commander's Telescope M-65

a. Scope of Test. Five tests will be conducted in which the candidate will be required to operate the instrument.

b. Special Instructions.

- (1) A battery commander's telescope M-65, with accessories, will be set up and leveled for the candidates use.

(2) Tests 4 and 5.

- (a) The examiner will choose three targets, between 1 and 2 mils in diameter, and identify them to the candidate through the instrument.
- (b) The examiner then will position the instrument on each target successively so that the target is in the field of view but not in the center of the reticle. He will note the readings on the horizontal and vertical scales for each target setting.

c. Outline of Test.

Test No.	Examiner commands—	Action of candidates
1	READ AZIMUTH AND ANGLE OF SITE SCALES.	Reads three azimuths and three angles of site scales and micrometers placed on the instrument by the examiner.
2	ORIENT INSTRUMENT-----	Orients the instrument using three orienting points and three azimuths designated by the examiner as prescribed in TM 9-575.
3	MEASURE HORIZONTAL AND VERTICAL ANGLES.	Checks the level of the instrument.
4	READ RETICLE-----	Measures two horizontal and two vertical angles designated by the examiner.
5	ANNOUNCE HORIZONTAL AND VERTICAL READINGS.	Announces the reticle reading on each target as set up by the examiner.
		Applies the reticle reading mentally to the scale readings and announces the combined reticle and scale readings to the point.

d. Penalties.

- (1) Test 1. A penalty of .5 point will be assessed for each error of more than .1 mil in reading the azimuth and angle of site scales.
- (2) Test 2.
 - (a) A penalty of 1 point will be assessed for each of the following errors:
 1. Orientation in error more than 1 mil.
 2. Failure to take up lost motion in the same direction each time.

- (b) The following table of time penalties will be applied to each separate orientation trial:

Time, exactly or less than—

	1'	1'15''	1'30''	over 1'30''
Penalties	0	0.5	1.0	2.0

(3) Test 3.

- (a) A penalty of 1 point will be assessed for each of the following errors:

1. Failure to verify the level of the instrument before starting the measurements.
2. Each error of more than 1 mil in measuring the horizontal angles and 2 mils in measuring the vertical angles.
3. Failure to take up lost motion each time an angle is measured.

- (b) The following table of penalties will be applied to the measurement of each angle:

Time, exactly or less than—	1'30''	1'45''	over 1'45''
Penalties	0	5	1

- (4) Tests 4 and 5. A penalty of 1 point will be assessed for each error of more than 2 mils in—

- (a) Horizontal readings.

- (b) Vertical readings.

e. *Credit.*

- (1) If the tests are performed correctly, maximum credit will be awarded as indicated in paragraph 81.
- (2) No credit will be awarded if total penalties for all tests exceed 16 points.

85. Reporting

a. *Scope of Test.* One test will be conducted in which the candidate will be required to report a target to the switchboard operator.

b. *Special Instructions.*

- (1) One battery commander's telescope M-65 will be furnished the candidate.
- (2) The examiner will position the instrument and inform the candidate that the flash of a medium gun has been observed to an accuracy of 2 mils at this position. The switchboard operator has just called for a report on this observation.

c. *Outline of Test.*

Examiner commands—	Action of candidate
REPORT.....	Renders four item report as prescribed in FM 6-122.

d. *Penalties.* A penalty of 2 points will be assessed if the candidate fails to report exactly as prescribed in FM 6-122.

e. *Credit.* If the test is performed correctly, a maximum credit of 2 points will be awarded.

86. Assembling, Nomenclature, Manning, and Maintenance of Plotting Board M5

a. *Scope of Tests.* Four tests will be conducted in which the candidate will be required to assemble the plotting board, give its nomenclature, name and describe the duties of the members of the plotting team, and demonstrate maintenance and adjustment.

b. *Special Instructions.*

(1) The following equipment will be made available to the candidate:

(a) One plotting board M5, with accessories in the packing chest.

(b) One screwdriver.

(c) One wrench.

(d) Lubricant.

(2) One assistant will be made available to help the candidate assemble the plotting board.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	ASSEMBLE PLOTTING BOARD-----	Removes plotting board from the packing chest and assembles it as prescribed in TM 9-575.
2	NAME PARTS DESIGNATED. (Examiner points to these parts: drafting machine, plotting disk, table legs, vernier, azimuth scale, slow motion knob, brake lever, clamping thumbscrew, adjusting thumbscrew.)	Announces the name of each designated part as prescribed in TM 9-575.
3	NAME THE MEMBERS OF THE PLOTTING TEAM AND DESCRIBE THEIR DUTIES.	Names the three members of the plotting team. Describes briefly their duties as prescribed in FM 6-122.
4	DEMONSTRATE AND DESCRIBE CARE, MAINTENANCE, AND ADJUSTMENT.	Describes the proper methods of handling the plotting board and demonstrates the adjustments, precautions, lubrication, and storage as prescribed in TM 9-575.

d. Penalties.

- (1) *Test 1.* A penalty of 1 point will be assessed for improper handling of the parts of the plotting board, or inability to set up the plotting board properly.
- (2) *Test 2.* A penalty of 0.2 point will be assessed for each error in naming the parts of the plotting board.
- (3) *Test 3.* A penalty of 1 point will be assessed for failure to designate all members of the plotting team, or inability to briefly describe the duties of each.
- (4) *Test 4.* A penalty of 0.25 point will be assessed for each error or omission in performing the actions required of the candidate.
- (5) *Time penalties.* The following table of time penalties applies only to test 1 (no time penalties will be assessed for tests 2, 3, and 4):

(a) M5 board.

Time in minutes, exactly or less than—	3	4	over 4
Penalties	0	0.5	1.0

(b) M5A1 board.

Time in minutes, exactly or less than—	5	6	over 6
Penalties	0	0.5	1.0

e. Credit.

- (1) Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 81.
- (2) No credit will be awarded if total penalties exceed 4 points.

87. Operation of Plotting Board M5

a. Scope of Test. Four tests will be conducted in which the candidate will be required to operate the plotting board M5.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One plotting board M5.
 - (b) Two pencils, 2H or 3H.
 - (c) One eraser.
 - (d) One boxwood scale.
- (2) The examiner will furnish the candidate the coordinates of four observation posts and the direction of ranging.
- (3) The plotting board will be assembled prior to starting Test 1.
- (4) For Tests 2, 3, and 4 the candidate will be provided an assembled plotting board that has been gridded and grid numbered.
- (5) The following assistants will be provided the candidate:
 - (a) Draftsman for Test 3.
 - (b) Armsetter and recorder for Test 4.

c. Outline of Test.

Test No.	Examiner commands—	Action of candidate
1	NUMBER THE GRID.....	Numbers the grid and plots the observation posts as prescribed in FM 6-122.
2	PLOT OBSERVATION POSTS.....	Plots the four observation posts as prescribed in FM 6-122.
3	AS ARMSETTER OP 1 _____ OP 2 _____ OP 3 _____ OP 4 _____	Sets the arm after each command as prescribed in FM 6-122, and announces SET.
4	AS DRAFTSMAN OP 1 _____ OP 2 _____ OP 3 _____ OP 4 _____	Plots the target and announces its grid reference, accuracy, and distance as prescribed in FM 6-122.

d. Penalties.

(1) Test 1.

(a) A penalty of 3 points will be assessed for each of the following errors:

1. If any of the observation posts have not been placed so as to achieve maximum distance in ranging.
2. Any error in numbering the grid.

(b) Time penalties are as follows:

Time in minutes, exactly or less than—

	10	11	12	13	14	Over 14
Penalties	0	1	2	3	4	6

(2) Test 2.

(a) A penalty of 1 point will be assessed for each error of more than 10 meters in plotting an observation post.

(b) A penalty of 0.5 point will be assessed for each observation post incorrectly labeled.

(c) Time penalties will be assessed as follows:

Time in minutes, exactly or less than—

	10	11	12	13	14	Over 14
Penalties	0	1	2	3	4	6

(3) Test 3.

(a) A penalty of 1.5 points will be assessed for each error of more than 0.5 mil in setting the arm.

(b) Time penalties for each setting:

Time in seconds, exactly or less than—

	20	25	30	35	40	Over 40
Penalties	0	1	2	3	4	6

(4) Test 4.

(a) A penalty of 0.25 point will be assessed for each of the following errors:

1. Any case of plotting from the wrong observation posts.
2. Each failure to have the scale of the drafting machine within 10 meters of observation post when the ray is drawn
3. Failure to measure and announce the distances from two observation posts correctly.

(b) A penalty of 1 point will be assessed for failure to estimate accuracy of grid reference correctly.

(c) A penalty of 2 points will be assessed if the grid reference of the target announced by the draftsman are in error by more than 20 meters.

(d) The time limits given in the following table represent the total time required for plotting from the four observation posts.

Time in minutes, exactly or less than—

	3.0	3.5	4.0	4.5	5.0	Over 5.0
Penalties	0	1	2	3	4	6

e. *Credit.*

(1) If the test is performed correctly within the minimum time limit, a maximum credit of 6 points for each test will be awarded.

(2) If total penalties for all tests exceed 16 points, no credit will be awarded.

88. Computation of Registration

a. *Scope of Test.* One test will be conducted in which the candidate will be required to determine the grid reference and height to the center of burst of a high-burst registration. The candidate will be given the clamping azimuths and vertical angles from four observation posts and the horizontal and vertical deviations to six usable rounds, using the plotting board M5.

b. *Special Instructions.*

(1) The following equipment will be furnished the candidate:

(a) Plotting board M5, assembled and gridded, with four observation posts plotted.

(b) Pencil, 2H or 3H, paper.

(2) One armsetter will be available as an assistant.

(3) The examiner will furnish the candidate with the clamping azimuths and vertical angles from four observation posts and the horizontal and vertical deviations to six usable rounds.

c. Outline of Test.

Examiner commands—	Action of candidate
DETERMINE THE GRID REFERENCE AND HEIGHT OF THE HIGH BURST REGISTRATION.	Performs the necessary computations and plotting to determine the grid reference and height to the center of burst of the high burst registration, as prescribed in FM 6-122.

d. Penalties.

- (1) A penalty of 1 point will be assessed for each averaged azimuth or vertical angle from an observation post incorrectly computed.
- (2) A penalty of two points will be assessed if the grid reference of the center of burst of the high burst registration are not accurate to within 20 meters.
- (3) A penalty of two points will be assessed if the height of the center of burst of the high burst registration is not accurate within 1 meter.
- (4) Time penalties will be assessed as follows.

Time in minutes, exactly or less than—

	20	22	24	26	28	30	Over 30
Penalties	0	1	2	3	4	5	6

e. Credit.

- (1) If the test is performed correctly within the minimum time limit, a maximum credit of 6 points will be awarded.
- (2) No credit will be awarded if the total penalties exceed 4 points.

89. Graphical Solution of Three-Point Resection

a. Scope of Test. One test will be conducted in which the candidate will be required to solve a three-point resection problem, using the plotting board M5.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) Plotting board M5, assembled and gridded.
 - (b) Pencil, 2H or 3H; and paper.
- (2) One armsetter will be available as an assistant.
- (3) The examiner will furnish the candidate the coordinates of three known points, the angles turned from the unknown point to the three known points, and the vertical angles measured from the unknown point to the known points.
- (4) The candidate may make a freehand sketch of his work on scratch paper and may erase thereon; however, the time taken to make the sketch will be included in the test time.

c. Outline of Test.

Examiner commands—	Action of candidate
LOCATE UNKNOWN POINT-----	Performs the necessary plotting and announces the grid reference and height of the unknown point as prescribed in FM 6-122.

d. Penalties.

- (1) A penalty of 2 points will be assessed if the grid reference of the unknown point determined by the candidate is not accurate to within 30 meters of the correct grid reference.
- (2) A penalty of 2 points will be assessed if the height of the unknown point determined by the candidate is not accurate within one meter.
- (3) Time penalties will be assessed as follows:
Time in minutes, exactly or less than—

	20	22	24	26	28	Over 28
Penalties	0	1	2	3	4	6

e. Credit.

- (1) If the test is performed correctly within the minimum time limit, a maximum credit of 6 points will be awarded.
- (2) No credit will be awarded if total penalties exceed 4 points.

90. Graphical Intersection

a. Scope of Test. One test will be conducted in which the candidate will be required to locate an observation post given the location of another observation post, the location of a point in the target area, the azimuth from the known observation post to the unknown, and the azimuth from the unknown observation post to the known point in the target area, using the plotting board M5.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) Plotting board M5, assembled and gridded with one observation post and a point in the target area plotted.
 - (b) Pencil, 2H or 3H, paper.
- (2) One armsetter will be available as an assistant.
- (3) The examiner will furnish the candidate with the azimuth from the known observation post to the unknown observation post.
- (4) The examiner will then act as the observer at the unknown observation post. When the candidate gives the observer the orienting azimuth to the known observation post and instructs him to report the azimuth to the known point in

the target area the examiner (observer) will report the azimuth from the unknown observation post to the known point.

c. Outline of Test.

Examiner commands—	Action of candidate
LOCATE UNKNOWN OBSERVATION POST. (After giving command examiner will act as unknown observation post and when oriented by candidate, and upon request, report azimuth to known point in target area.)	Performs the necessary plotting and issues instructions to observer at unknown OP to determine the location of and announces the grid reference of the unknown observation post as prescribed in FM 6-122.

d. Penalties.

- (1) A penalty of 2 points will be assessed if the grid reference of the unknown OP determined by the candidate are not accurate to within 20 meters of the correct grid reference. A four point penalty will be assessed if not accurate within 40 meters, and no credit if in error more than 50 meters.
- (2) Time penalties will be assessed as follows:
Time in minutes, exactly or less than—

	5	6	7	8	9	Over 9
Penalties	0	1	2	3	4	5

e. Credit.

- (1) If the test is performed correctly within the minimum time limit, a maximum credit of 5 points will be awarded.
- (2) No credit will be awarded if total penalties exceed 3 points.

91. Computation of Azimuth, Distance, and Vertical Angle

a. Scope of Test. One test will be conducted in which the candidate will be required to compute azimuth, distance, and vertical angle from an observation post to a point of which the coordinates are known.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) Logarithm tables, six-place.
 - (b) DA Form 6-1, pencil and paper.
- (2) The following information will be furnished the candidate:
The coordinates and height of the observation post and the distant point.

c. Outline of Test.

Examiner commands—	Action of candidate
COMPUTE AZIMUTH, DISTANCE, AND VERTICAL ANGLE FROM THE OP TO THE DISTANT POINT.	Computes the azimuth, distance, and vertical angle from the observation post to the distant point as prescribed in TM 6-200.

d. Penalties.

- (1) A penalty of 1 point will be assessed for each error made in computing the azimuth, distance, and vertical angle. In grading the candidate's computations, a penalty will be assessed only once for each mistake, even though the mistake causes subsequent computations to give incorrect results. If subsequent computations carry the error through using correct procedures, full credit will be awarded for computations made subsequent to the error.
- (2) Time penalties will be assessed as follows:

Time in minutes, exactly or less than	10	12	14	Over 14
Penalties	0	2	4	6

e. Credit.

- (1) If the test is performed correctly within the minimum time limit, a maximum credit of 7 points will be awarded.
- (2) No credit will be awarded if total penalties exceed 5 points.

92. Nomenclature of Flash Ranging Set AN/GTC-1

a. Scope of Test. One test will be conducted in which the candidate will be required to name the parts of the flash ranging set AN/GTC-1 designated by the examiner.

b. Special Instructions. One flash ranging set AN/GTC-1, complete, will be furnished the candidate.

c. Outline of Test.

Examiner commands—	Action of candidate
NAME PARTS DESIGNATED. (Examiner points to 10 of these parts: line lamp, fuze holder, flash control toggle switch, ring-talk key, link keys, emergency telephone binding post, battery switch, power change-over switch, emergency operation key switch, indicating light and buzzer switch, incoming line binding post, control box C-100, ground rod GP-16, battery case CY-386.)	Names designated parts as prescribed in TM 11-5516.

d. Penalties. A penalty of 0.1 point will be assessed for each error in naming the designated parts.

e. Credit. If the test is performed correctly, a maximum credit of 1 point will be awarded.

93. Installation, Testing, and Operation of Flash Ranging Set AN/GTC-1

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to install, test, and demonstrate the operation of the flash ranging set AN/GTC-1.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One flash ranging set AN/GTC-1, complete.
 - (b) Thirty feet ground wire.
 - (c) One hundred feet field wire for observation lines.
- (2) Three trained assistants will be provided to assist during the tests and operations.
- (3) The location of the flash ranging set and the observation posts will be designated to the candidate.
- (4) Three additional observation posts will be connected to the switchboard for test 3.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	INSTALL FLASH RANGING SET WITH ONE OBSERVATION POST.	Installs the flash ranging set as prescribed in TM 11-5516.
2	TEST FLASH RANGING SET-----	Performs the six preoperation tests as prescribed in TM 11-5516. Announces the status of each part tested.
3	OPERATE FLASH RANGING SET-----	Operates the flash ranging set as prescribed in TM 11-5516.

d. Penalties.

- (1) Test 1—A penalty of 0.33 point will be assessed for each error made in installing the flash ranging set.
- (2) Test 2—A penalty of 0.33 point will be assessed for each incorrect performance of the six tests or failure to report correctly the status of each part tested.
- (3) Test 3—A penalty of 0.5 point will be assessed for each error in demonstrating the operation of the flash ranging set.

e. Credit. If the tests are performed correctly, a maximum credit of 2 points will be awarded for each test.

94. Duties of Switchboard Operator

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to test communication, orient observers, and receive and record a report on the flash target.

b. Special Instructions.

(1) The following equipment will be furnished the candidate:

(a) One flash ranging set AN/GTC-1, complete.

(b) Two DA Forms 6-3a.

(c) One pencil.

(2) The flash ranging set will be installed and four observation posts connected prior to starting the test.

(3) Four assistants will be provided to act as observers.

(4) Predetermined data will be prepared and furnished the four observers prior to starting the test.

(5) Orienting azimuths and vertical angles for the four observers will be provided the candidate.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	TEST COMMUNICATIONS.....	Tests communications as prescribed in FM 6-122.
2	ORIENT OBSERVERS.....	Orients observers as prescribed in FM 6-122.
3	RECEIVE AND RECORD REPORT ON A FLASH TARGET.	Receives reports, records them, and announces them as prescribed in FM 6-122.

d. Penalties.

(1) Test 1—A penalty of 0.25 point will be assessed for each error in procedure in testing communications.

(2) Test 2—A penalty of 0.25 point will be assessed for each error made in orienting the observation posts.

(3) Test 3—A penalty of 0.5 point will be assessed for each error made in recording and announcing reports.

e. Credit. Subject to the penalties imposed in *d* above, credit will be awarded as indicated in paragraph 81.

95. Maintenance of Flash Ranging Set AN/GTC-1

a. Scope of Test. One test will be conducted in which the candidate will be required to demonstrate the maintenance of flash ranging set AN/GTC-1.

b Special. Instructions. A flash ranging set AN/GTC-1 will be installed and connected with four observation posts for the use of the candidate during this test.

c. Outline of Test.

Examiner commands—	Action of candidate
DEMONSTRATE MAINTENANCE OF THE FLASH RANGING SET.	Performs the nine items of maintenance as prescribed in TM 11-5516.

d. Penalties. A penalty of 0.4 point will be assessed for each error in demonstrating maintenance of the flash ranging set.

e. Credit. If the test is performed correctly, a maximum credit of 3 points will be awarded.

CHAPTER 7

RADAR SPECIALISTS, RADAR SET AN/MPQ-10A

96. General

To save time and avoid unnecessary movement of the radar set, the following coordinating instructions will be followed in conducting the tests outlined in this chapter.

a. The tests should be conducted in the sequence in which they are presented in the text.

b. The tests follow a logical sequence of events. They start at the parking or rendezvous area, then move to the position area. Tests at the position area cover selection of site, emplacement of the radar, starting of the power unit, collimation, orientation, synchronization and calibration of the recorder RD-54, evaluation of site, weapons locations, and radar gunnery.

97. Outline of Tests

Par. No.	Subject	Number of tests	Points each	Maximum credit
98	Nomenclature of radar set AN/MPQ-10A and recorder RD-54.....	2	-----	5
	Test 1 (AN/MPQ-10A).....	(1)	3	(3)
	Test 2 (RD-54).....	(1)	2	(2)
99	Selection of site.....	1	8	8
100	Operation of power unit PU-26A/U.....	2	-----	5
	Test 1 (Nomenclature).....	(1)	2	(2)
	Test 2 (Starting procedure).....	(1)	3	(3)
101	Emplacement and starting procedure for radar set.....	1	10	10
102	Operation of the radar set.....	4	4	16
103	Operation of recorder RD-54.....	2	5	10
104	Evaluation of site.....	1	8	8
105	Map reading and use of plotting equipment.....	1	6	6
106	Weapons location.....	4	6	24
107	Radar gunnery.....	2	4	8
	Total.....	20	-----	100

98. Nomenclature of AN/MPQ-10A and Recorder RD-54

a. *Scope of Tests.* Two tests will be conducted in which the candidate will be required to locate, name, and/or state the purpose of various parts and units of the radar set AN/MPQ-10A and recorder RD-54.

b. *Special Instructions.*

(1) The following equipment will be made available to the candidate:

(a) Radar set AN/MPQ-10A.

(b) Recorder RD-54.

- (2) The nomenclature printed on the parts on which the candidate is to be questioned will be covered with masking tape or similar material.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	LOCATE, NAME AND/OR STATE THE PURPOSE OF THE PARTS DESIGNATED. (The examiner will select 20 of the following parts of the radar set.) Parabolic antenna, elbow telescope, main junction box, radar modulator, range computer, metallic rectifier, level assembly, spinner motor, outriggers, dipole, drawbar, compensating spring lock, switch and meter panel, emergency ON-OFF switch, trunnion, base unit, leveling jacks lowering bar, echo box, orienting clutch, azimuth lock plunger, main power switch, transmitter switch, receiver gain (variable) control, tuning (AFC-MFC) switch, rep-rate (1-2) switch, meter (AB-AC-BC) switch, range only auto (calibrate-normal) switch, target selector (aircraft-missile) switch, sector width mils (200-300-400-500-600-700-800) control, slant range handwheel, azimuth handwheel, B-scope, J-scope, sweep length switch, A-J (ON-OFF) switch, B-scope focus, range markers (ON-OFF) switch, elevation dial, cursor, and dial graduations.	Locates, names and/or states the purpose of the parts designated. Reference TM 11-1303; pars. 3-5, 7, 10-19, 31-39, 44-45.1, 47, 49-53, 64-73.
2	LOCATE, NAME AND/OR STATE THE PURPOSE OF THE PARTS DESIGNATED. (Examiner will select 10 of the following parts of the recorder RD-54.) Height servoamplifier, azimuth servoamplifier, power distribution panel, control panel, paper well clutch, 115-volt AC ON-OFF switch, paper drive auto off-local switch, height selector switch, range servo, azimuth servo, height servo, azimuth c-f switching, dimmer switch, slew switch, paper drive motor ON-OFF switch, range synchro data switch, baseline stylus, height stylus, paper well cover, panel light ON-OFF switch, and test cable.	Locates, names and/or states the purpose of each part designated. Reference TM 11-5534; pars. 8, 9, 14, 15, 17, 20-27, 47-50.

d. Penalties.

- (1) Test 1—cut 0.15 point for each error in nomenclature or statement of purpose and failure to locate a specified item.
- (2) Test 2—cut 0.2 point for each error in nomenclature or statement of purpose and failure to locate a specified item.
- (3) If total penalties on tests 1 and 2 exceed 3 points no credit will be awarded.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

99. Selection of Site

a. Scope of Test. A test will be conducted in which the candidate will be required to select a radar site.

b. Special Instructions.

- (1) The examiner will prepare a situation map of the area for the candidate's use showing the following elements of an assumed situation:
 - (a) Location of established survey control in the area.
 - (b) Location of friendly units adjacent to the area in which the radar set is to be sited.
 - (c) The general area designated for selecting a site.
 - (d) Suspected area of enemy activity.
- (2) The examiner must bear in mind when assessing penalties that any selected position is a compromise.
- (3) The following equipment should be furnished:
 - (a) Aiming circle.
 - (b) Binoculars.
 - (c) Map of area with all pertinent information.
 - (d) Plotting equipment.
 - (e) Compass M2.
- (4) A mission of either mortar location, artillery location, or both should be assigned to the candidate.

c. Outline of Test.

Examiner commands—	Action of candidate
SELECT A RADAR SITE	Selects a radar site within the designated area as prescribed in FM 6-160, pars. 56-62.

d. Penalties.

- (1) A maximum of 4 points will be cut for failure to select a position of which the terrain will provide electrical screening to minimize ground clutter but at the same time provide an acceptable screening angle of elevation (15-100 mils for weapons location and 15-40 mils for radar gunnery).

- (2) A maximum of 2 points will be cut for failure to select a position which provides ready access, cover, and concealment.
- (3) A maximum of 1 point will be cut for failure to consider the proximity of survey control.
- (4) A maximum of 1 point will be cut for failure to consider the proximity of friendly units.
- (5) All cuts will be made in proportion to the candidate's success.

e. Credit. If the test is performed correctly, a maximum credit of 8 points will be awarded.

100. Operation of Power Unit PU-26A/U

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to name and/or state the purpose of components of the power unit PU-26A/U, make preliminary checks and start the power unit.

b. Special Instructions.

- (1) The following equipment should be furnished the candidate:
 - (a) One power unit PU-26A/U.
 - (b) One 5-gallon can of gasoline.
 - (c) One adapter for the 5-gallon gasoline can.
 - (d) One power cable.
- (2) The examiner should check the battery before starting the test.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	NAME AND/OR STATE THE PURPOSE OF THE PARTS DESIGNATED. (The examiner will point out the following parts of the power unit: oil gage, coolant temperature gage, frequency meter, battery charge ammeter, voltmeter, running time meter, radiator drain valve, priming pump, manual throttle, hand crank, automatic voltage regulator (exciter voltage), manual voltage rheostat, emergency-normal switch, battery charge switch, line voltage circuit breaker, water temperature circuit breaker, voltmeter switch, ammeter switch, dc ammeter, reset button.)	Names and/or states purpose of each part designated. Reference TM 11-976A, pars. 5, 18-20.

Test No.	Examiner commands—	Action of candidate
2	START THE POWER UNIT. (The examiner will ascertain that the student checks the following: main line ON-OFF circuit breaker in OFF position, battery charge circuit breaker ON, emergency normal switch NORMAL, manual voltage regulator (maximum counterclockwise), automatic voltage regulator OFF, oil level, water level, fuel pump hand-primed, hand throttle at idle position, manual choke check. Examiner should be sure that he and the candidate are both using the same method.)	Completes checks and starts power unit as prescribed in TM 11-976A, pars. 21-25.

d. Penalties.

- (1) Test 1—cut 0.1 point for each error in nomenclature or statement of purpose.
- (2) Test 2—cut 0.3 point for each preliminary check the candidate fails to make.
- (3) If total penalties exceed 3.5 points, no credit will be awarded.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

101. Emplacement and Starting Procedures

a. Scope of Test. One test will be conducted in which the radar set is in position with the tracker mount rough-leveled only, and the candidate will be required to complete emplacement and start the radar set.

b. Special Instructions.

- (1) The following equipment will be made available to the candidate:
 - (a) One radar set AN/MPQ-10A in position with the tracker mount rough-leveled only.
 - (b) One recorder RD-54.
 - (c) One power unit PU-26A/U (operating with cable connected).
- (2) Assistants will be available to help the candidate (at discretion of examiner).
- (3) Assistants perform tasks only on specific instructions from candidate (at discretion of examiner).
- (4) Prior to starting tests, the examiner will prepare the radar as follows:
 - (a) Main line switch OFF.
 - (b) Servos switch OFF.

- (c) Receiver gain control knob, maximum counterclockwise position.
- (d) AFC-MFC switch to MFC.
- (e) Anti-jam ON.
- (f) Master AUTO-MANUAL switch to MANUAL.
- (g) Azimuth handwheel in.
- (h) Range AUTO-MANUAL switch to MANUAL.
- (i) At the recorder RD-54.
 - 1. AUTO-OFF-LOCAL switch ON.
 - 2. Paper drive motor switch ON.
 - 3. Height selector switch (MPQ-10) at 30,000 feet.
 - 4. 115 volt ON-OFF switch OFF.
 - 5. Cable connected to recorder but not to radar.
- (j) At the tracker mount.
 - 1. All blower vents closed.
 - 2. All intake vents closed.
 - 3. Antenna RELEASE-NORMAL switch, NORMAL.
 - 4. Azimuth lock plunger engaged.
 - 5. Orientation clutch engaged.

c. Outline of Test.

Examiner commands—	Action of candidate
COMPLETE EMPLACEMENT AND START THE RADAR SET AN/MPQ- 10A.	Completes emplacement and starts radar set AN/MPQ-10A as prescribed in TM 11-1303, pars. 45, 45.1, 50, 52, 53; FM 6-160, pars. 83-85, 88, 89.

d. Penalties.

- (1) Cut 0.4 point for each step of the procedure omitted.
- (2) Cut 0.7 point for each of the following errors:
 - (a) During emplacement, any violation of safety.
 - (b) Incorrect leveling procedure.
 - (c) Failure to rotate the tracker mount 180° after leveling, to insure proper level.
 - (d) Incorrect cabling procedure.
 - (e) Permitting the antenna release-normal switch to remain in the normal position.
 - (f) Attempting to turn on the transmitter before allowing the set to warm up.
 - (g) Failure to check control unit three-phase meter.
 - (h) Failure to have either 115 volts ON-OFF switch OFF or the paper drive AUTO-OFF-LOCAL switch in the OFF position on the recorder RD-54.

- (3) Time penalties will be assessed as follows (taken to nearest minute):

<i>20 minutes or less</i>	<i>21 to 30 minutes</i>	<i>Over 30 minutes</i>
0	3. 5	10

- (4) If total penalties exceed 6.5 points no credit will be awarded.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

102. Operation of the Radar Set

a. Scope of Test. Four tests will be conducted in which the candidate will system check, collimate, orient, and range calibrate the radar set AN/MPQ-10A.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One power unit PU-26A/U (operating).
 - (b) One radar set AN/MPQ-10A (emplaced, cabled, and voltage applied).
 - (c) One 100-gram balloon with reflector or one light Army aircraft.
 - (d) One preselected orienting point (at least 1,000 yards from the radar) with known azimuth and elevation.
 - (e) One preselected range calibration point with known azimuth and slant range.
- (2) Three assistants will be available to the candidate, but they will perform operations only on the candidate's instructions (at discretion of examiner).
- (3) The examiner will physically point out the orienting point to the candidate.
- (4) Mechanic's adjustment of orienting telescope, radar beam or tracking sensitivity of radar, should not be charged to the candidate in determining accuracy of collimation.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	TUNE RECEIVER AND DETERMINE TRANSMITTER EFFICIENCY BY THE ECHO-BOX METHOD.	Tunes receiver as prescribed in FM 6-160, par. 97.
2	COLLIMATE THE RADAR SET.....	Collimates the radar set as prescribed in FM 6-160, pars. 98-102.
3	ORIENT THE RADAR SET.....	Orients the radar set as prescribed in FM 6-160, pars. 103-105.
4	RANGE CALIBRATE THE RADAR SET.	Range calibrates the radar set as prescribed in FM 6-160, pars. 106-109.

d. Penalties.

- (1) Test 1—a penalty of 1 point will be assessed for each failure to—
 - (a) Tune echo box to the maximum deflection of indicator.
 - (b) Maximize the ring-time by adjustment of the gain and tuning controls.
 - (c) Check ringtime in the radar logbook.
 - (d) Correctly aline the range mark on the B-scope.
 - (e) Report to mechanic or chief of section any deficiencies noted.
- (2) Test 2—
 - (a) A penalty of 2 points will be assessed if the accuracy of collimation in elevation is not within ± 1 mil.
 - (b) A penalty of 2 points will be assessed if the accuracy of collimation in azimuth is not within ± 1 mil.
 - (c) All cuts should be made in proportion to the degree of accuracy of collimation.
- (3) Test 3—
 - (a) A penalty of 2 points will be assessed for failure to orient within ± 1 mil in azimuth.
 - (b) A penalty of 2 points will be assessed for failure to orient within ± 1 mil in elevation.
- (4) Test 4—a penalty of 1 point will be assessed for each failure to—
 - (a) Set off the correct slant range and azimuth to the range calibration point.
 - (b) Move the range only AUTO-MANUAL switch to the AUTO position.
 - (c) Check survey data with control unit data.
 - (d) Report all deviations.
- (5) No credit will be given if total penalties for the 4 tests exceed 11 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

103. Operation of the Recorder RD-54

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to synchronize and calibrate the recorder RD-54.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) One radar AN/MPQ-10A (operational and tuned).
 - (b) One recorder RD-54.
 - (c) One power unit PU-26A/U (operational).
 - (d) One plot reading scale.
 - (e) One stopwatch.
 - (f) One screwdriver.

- (2) Two assistants will be available to the candidate, but they will perform operations only on his instruction (at discretion of examiner).
- (3) The examiner will designate a center of sector.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	SYNCHRONIZE THE RECORDER RD-54.	Synchronizes the recorder RD-54 as prescribed in FM 6-160, pars. 110-118.
2	CALIBRATE THE RECORDER RD-54.	Calibrates the recorder RD-54 as prescribed in FM 6-160, pars. 119-126.

d. Penalties.

(1) Test 1—

(a) Cut 0.7 point for each of the following errors in synchronization of the recorder RD-54.

1. Incorrect adjustment of the gain, damping, or CF-switching controls on any of the amplifiers.
2. Failure to synchronize the range at the approximate expected range of operation. (Use 3,000 yards.)
3. Failure to synchronize the azimuth at the center of sector.
4. Incorrect positioning of the synchro data switch while adjusting the synchros.
5. Failure to displace the stylus carriage the appropriate amount while adjusting the CF switching.

(b) Time penalties (taken to nearest minute):

20 minutes or less	21-25 minutes	Over 25 minutes
0	1.5	3.0

(2) Test 2—

(a) Cut 0.7 point for each of the following errors in calibration.

1. Failure to calibrate height, range, or azimuth.
2. Failure to determine zero height or the corrections in range and azimuth and apply to the plot-reading scale.
3. Failure to report excessive deviations during successive steps in calibration.
4. Failure to calibrate at the correct intervals.
5. Each incorrect command given to the assistant at the tracker mount or control unit.

(b) Time penalties (taken to nearest minute):

25 minutes or less	26 to 30 minutes	Over 30 minutes
0	1.7	3.4

(3) No credit will be awarded if total penalties for the 2 tests exceed 6 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

104. Evaluation of Site

a. Scope of Test. One test will be conducted in which the candidate will be required to evaluate by means of clutter and coverage diagrams the radar site previously selected.

b. Special Instructions.

(1) The following equipment will be made available to the candidate:

(a) One radar set AN/MPQ-10A.

(b) One power unit PU-26A/U.

(c) Radar site evaluation chart.

(2) The examiner will insure that the radar set is adjusted correctly and operating properly.

(3) Two assistants will be available to operate the set.

c. Outline of Test.

Examiner commands—	Action by candidate
CONSTRUCT RADAR SITE EVALUATION CHART.	Constructs radar site evaluation chart as prescribed in FM 6-160, pars. 65-67.

d. Penalties. The candidate will be graded on the neatness, accuracy, and quality of his radar site evaluation chart. Cuts will be made accordingly.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

105. Map Reading and Use of Plotting Equipment

a. Scope of Test. One test will be conducted in which the candidate will be required to set up a grid sheet and plot known friendly and enemy positions.

b. Special Instructions.

(1) The following equipment will be made available to the candidate:

(a) One map board.

(b) One grid sheet.

(c) One aluminum range deflection protractor.

(d) One coordinate scale.

(e) One plotting scale.

(f) One protractor.

(g) One each 4H and 6H pencil.

- (h) Red, blue, and green hard lead pencils.
- (i) Two map pins and two plotting needles.
- (j) One contour map of the area.
- (2) The examiner will provide the candidate with known friendly and enemy positions. The candidate should be given grid coordinates and polar coordinates to plot. In at least one case, height should be determined from a contour map. Radar azimuth indices should be constructed.

c. Outline of Test.

Examiner commands—	Action of candidate
PLOT ALL KNOWN LOCATIONS ON GRID SHEET. (The locations and designations of adjacent units will be given to the candidate. Information may be in the form of polar coordinates or grid references. Candidate will have a map of the area to determine all additional information such as height of locations, labeling of lower left hand corner of grid sheet, etc.)	Constructs grid sheet as prescribed in FM 6-2, ch. 2, and FM 6-40, ch. 2.

d. Penalties.

- (1) A penalty of 0.6 point will be assessed for the incorrect—

- (a) Labeling of the grid sheet.
- (b) Establishment of the indices.
- (c) Labeling of a known location.
- (d) Use or reading of the range-deflection protractor.
- (e) Use or reading of the coordinate scale.
- (f) Use or reading of the plotting scale.
- (g) Use of map pins or plotting needles.
- (h) Use of 4H or 6H pencils.
- (i) Use of colors.
- (j) Use of height from the contour map.

- (2) No credit will be allowed if penalties exceed 6 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

106. Weapons Locations

a. Scope of Tests. Four tests will be conducted in which the candidate will be required to act as control unit operator, recorder operator, plot reader, and plotter during the detection, tracking, and location phases.

b. Special Instructions.

- (1) A radar set AN/MPQ-10A with recorder RD-54 and power unit PU-26A/U will be emplaced in a favorable position for detecting and tracking projectiles fires from a mortar

or artillery weapon, preferably the site previously selected by the candidate.

- (2) A qualified operator will be made available to assist in operating the set.
- (3) The examiner will make necessary arrangements to provide mortar or an artillery piece with sufficient ammunition to represent the enemy. He will also establish communication between the weapon and the radar site.
- (4) When sending fire commands to the weapon, the examiner will insure that the commands are audible to the candidate.
- (5) If an artillery weapon is used, it should be located so that the radar set will be observing the projectile from the flank.
- (6) A plot-reading scale, parabolic template (7,500 feet) grid sheet and contour map of the area should be available.
- (7) If the center of sector is different from the one for which the candidate synchronized the recorder initially, he should be notified of the new center of sector.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	SECTOR SCAN AND DETERMINE PICK-UP DATA FOR WEAPONS LOCATION. (Examiner will have a maximum of five rounds fired at approximately one minute intervals.)	Performs duties of control unit operator as prescribed in FM 6-160, pars. 144-147.
2	TRACK PROJECTILES AND CORRECT PICK-UP DATA. (Five rounds will be fired to provide for locking on and tracking automatically; then five more rounds will be fired with the candidate at the recorder RD-54 and an assistant at the control unit. The candidate is then instructed to improve pick-up data.)	Tracks projectiles and improves pick-up data as prescribed in FM 6-160, pars. 148-152.
3	INTERPRET THE PLOT. (After completion of test 2 and a plot has been obtained from the recorder RD-54, the candidate is to draw a diagram of the weapon and burst with respect to the radar position. Grid north is to be indicated on the diagram and positions drawn accordingly.)	Interprets the plot and draws diagrams as prescribed in FM 6-160, pars. 129-143.
4	EXTRAPOLATE THE PLOT. (The plot will be extrapolated to determine both the weapon and burst location. The polar plot data obtained will be plotted on the grid sheet used in paragraph 105b(2). Coordinates and height of weapon and burst are to be determined. An assistant should be available to aid in obtaining the difference in height.)	Extrapolates the plot as prescribed in FM 6-160, pars. 136-142.

d. Penalties.

- (1) Test 1—a penalty of 2 points will be assessed for each failure to—
 - (a) Adjust the radar so that it scans the proper sector in azimuth.
 - (b) Set elevation about 20 mils above the highest point of the screening crest in the sector.
 - (c) Detect the projectile echo on the upward portion of the trajectory (assessed for each undetected echo).
- (2) Test 2—a penalty of 2 points will be assessed for each failure to—
 - (a) Gate the echo on the J-scope with the slant range hand-wheel and track the projectile automatically (assessed for each echo missed).
 - (b) Return the master AUTO-MANUAL switch to MANUAL when the projectile reaches the screening crest elevation on the downward leg of its flight path.
 - (c) Improve pick-up data (while acting as recorder operator) and eliminate most of the pick-up jump on the height, range, and azimuth curve.
- (3) Test 3—A penalty of 1.5 points will be assessed for each failure to—
 - (a) Determine whether the weapon is firing from right to left or left to right.
 - (b) Represent accurately range changes.
 - (c) Locate accurately the weapon with respect to the radar.
 - (d) Locate accurately the burst with respect to the radar.
- (4) Test 4—A penalty of 1 point will be assessed for each incorrect—
 - (a) Extension of the curves.
 - (b) Use of the parabolic template.
 - (c) Reading of the range and azimuth curves.
 - (d) Compensation for difference in height.
 - (e) Polar plotting of the weapon.
 - (f) Determination of the coordinates.
- (5) No credit will be allowed if total penalties for the 4 tests exceed 14 points.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 97.

107. Radar Gunnery

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to determine the grid reference of a high-burst and center-of-impact registration.

b. Special Instructions.

- (1) The following equipment will be furnished for the candidate:
 - (a) One plot-reading scale.
 - (b) One parabolic template.
 - (c) One grid sheet and necessary plotting equipment.
 - (d) One DA Form 6-39 (radar-observed high-burst registration).
 - (e) Six scaled sketches of the J-scope representing the range to each burst.
 - (f) Six center-of-impact plots.
 - (g) One sketch of the telescope reticle with six rounds representing high burst placed at random around the center.
 - (h) One DA Form 6-40 (radar-observed center-of-impact registration).
 - (i) One set of trajectory charts.
- (2) During the test on high-burst registration, the candidate will utilize DA Form 6-39. He will determine and record pointing data, deviations indicated on the sketch of the telescope reticle, and range deviations indicated on sketches of the J-scope. He will then compute the average range, elevation, and azimuth to the center of burst and determine the grid reference and altitude of the high-burst registration point.
- (3) During the test on center-of-impact registration, the candidate will utilize DA Form 6-40. He will determine and record pick-up data and the deviations in range and azimuth derived from the six plots. He will then compute the average range and azimuth to the center of burst and determine the grid reference and altitude of the selected datum plane to the center-of-impact registration point.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	OBSERVE HIGH-BURST REGISTRATION, RADAR VISUAL METHOD. COORDINATES OF RADAR _____ ALTITUDE OF RADAR _____ COORDINATES OF HB _____ RADAR TO SCREENING CREST ANGLE _____ REPORT WHEN READY TO OBSERVE.	Conducts radar observed high-burst registration as outlined in FM 6-160.

Test No.	Examiner commands—	Action of candidate
2	OBSERVE CENTER-OF-IMPACT REGISTRATION AT SELECTED DATUM PLANE. COORDINATES OF RADAR _____ ALTITUDE OF RADAR _____ ALTITUDE OF REGISTERING PIECE _____ CHARGE _____ CALIBER _____ QE _____ COORDINATES OF REGISTERING PIECE _____ COORDINATES OF CI _____ REPORT WHEN READY TO OBSERVE.	Conducts radar observed center-of-impact registration as outlined in FM 6-160.

d. Penalties.

(1) *Test 1.* A penalty of 0.4 point will be assessed for each of the following errors:

- (a) Each mistake made in determining pointing data.
- (b) Each mistake made in filling in the form.
- (c) The candidate should be asked what data would he send to FDC for the registration and cut according to his answer.

(2) *Test 2.* A penalty of 0.4 point will be assessed for each of the following errors:

- (a) Each mistake made in determining pick-up data.
- (b) Any procedure error made in reading of plots.
- (c) Each mistake in filling in the form.
- (d) The candidate should be asked what data would he send to FDC for the registration and cut according to his answer.

e. Credit. Subject to the penalties assessed in paragraph *d* above, credit will be awarded as indicated in paragraph 97.

CHAPTER 8

RADAR SPECIALISTS, RADAR SET AN/MPQ-4A

108. General

To save time and avoid unnecessary movement of the radar set, the tests should be conducted in the sequence in which they are presented in this chapter.

109. Outline of Test

Par. No.	Subject	Number of tests	Points each	Maximum credit
110	Nomenclature of radar set AN/MPQ-4A.....	1	5	5
111	Selection of site and emplacement.....	1	8	8
112	Operation of radar set AN/MPQ-4A.....	11	-----	36
	Test 1.....	(1)	5	(5)
	Tests 2 and 8.....	(2)	7	(14)
	Tests 3, 5, 6, and 9.....	(4)	2	(8)
	Test 4.....	(1)	4	(4)
	Test 7.....	(1)	3	(3)
	Tests 10 and 11.....	(2)	1	(2)
113	Evaluation of site.....	1	7	7
114	Map reading and use of plotting equipment.....	1	6	6
115	Weapon and impact location.....	3	8	24
116	Radar gunnery.....	2	7	14
	Total.....	20	-----	100

110. Nomenclature of Radar Set AN/MPQ-4A

a. Scope of Test. One test will be conducted in which the candidate will be required to locate, name, and/or state the purpose of various parts of the radar set AN/MPQ-4A.

b. Special Instructions. The nomenclature printed on the parts on which the candidate is to be questioned will be covered with masking tape or similar material.

c. Outline of Test.

Examiner commands—	Action of candidate
<p>LOCATE, NAME, AND/OR STATE THE PURPOSE OF THE PARTS NAMED. (The examiner will select 20 items from the parts listed below.)</p> <p>Antenna Group OA-1258/MPQ-4A and all its components.</p> <p>Telescope M62A1 and mount, telescope Control-Indicator Group and all its components.</p> <p>Dehydrator.</p> <p>Receiver-Transmitter Group and all its components.</p> <p>Power cable reel.</p> <p>Remote cable reel.</p> <p>Electrical Equipment Shelter and components.</p> <p>Control-Indicator Stand.</p> <p>Power cable.</p> <p>Remote Control Cable.</p> <p>Pedestal Control Cable.</p>	<p>Locates, names, and/or states the purpose of the parts designated.</p>

d. Penalties.

- (1) Cut 0.25 point for each error in nomenclature or statement of purpose; and for each failure to locate the specified part.
- (2) If total penalties exceed 3 points no credit will be awarded.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 109.

111. Selection of Site and Emplacement

a. Scope of Test. A test will be conducted in which the candidate will be required to select a radar site and explain how he would emplace the set.

b. Special Instructions.

- (1) The examiner will prepare a situation map of the area for the candidate's use showing the following elements of an assumed situation:
 - (a) Location of established survey control in the area.
 - (b) Location of friendly units adjacent to the area in which the radar set is to be sited.
 - (c) The general area designated for selecting a site.
 - (d) Suspected area of enemy activity.
- (2) The examiner must bear in mind when assessing penalties that any selected position is a compromise.

(3) The following equipment should be furnished:

- (a) Aiming circle.
- (b) Binoculars.
- (c) Map of area with all pertinent information.
- (d) Plotting equipment.
- (e) Compass, M-2

(4) A mission of a mortar location, should be assigned to the candidate.

c. Outline of Test.

Examiner commands—	Action of candidate
SELECT A RADAR SITE AND EXPLAIN HOW YOU WOULD EMPLACE THE RADAR SET.	Selects a radar site within the designated area as prescribed in FM 6-161, pars. 8-11, and explains how he would emplace the set.

d. Penalties. A maximum of—

- (1) Four points will be cut for failure to select a position for which the terrain will provide electrical screening to minimize ground clutter but at the same time provide an acceptable screening angle of elevation (15-40 mils for radar gunnery).
- (2) Two points will be cut for failure to select a position which provides ready access, cover, and concealment.
- (3) One point will be cut for failure to consider the proximity of survey control.
- (4) One point will be cut for failure to consider the proximity of friendly units.
- (5) Four points will be cut for improper explanation of emplacement.

e. Credit. Subject to the penalties assessed in *d* above, maximum credit of 8 points will be awarded.

112. Operation of Radar Set AN/MPQ-4A

a. Scope of Tests. Eleven tests will be conducted in which the candidate will be required to operate the radar set AN/MPQ-4A.

b. Special Instructions. The examiner must ascertain that the radar set to be used by the candidate is in good working order prior to the start of the test and that the computer has been correctly aligned.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PERFORM PRELIMINARY ADJUSTMENTS.	Performs preliminary adjustments on following equipment as described in FM 6-161, par. 19. a. Receiver-transmitter group. b. Control-indicator group. c. Antenna group. d. Interlock circuits. e. Vents.
2	PLACE THIS SET IN OPERATION -----	Puts set in operation using the starting procedure as outlined in FM 6-161, par. 20.
3	RANGE CALIBRATE THIS SET BY USING RANGE MARKERS.	Follows procedure for range calibration as outlined in FM 6-161, par. 21.
4	PERFORM THE FOLLOWING CHECKS AND ENTER RESULTS IN RADAR LOG: a. Ringtime check. b. AFC operation check. (The local oscillator must be properly tuned before the AFC and ringtime checks are performed.)	Performs ringtime check and AFC check as outlined in FM 6-161, par. 22.
5	ORIENT THE ANTENNA IN AZIMUTH USING THE ELECTRICAL METHOD AND PERFORM THE AZIMUTH COLLIMATION CHECK. (The examiner will furnish the candidate a good electrical target at a known azimuth.)	Performs required procedures as described in FM 6-161, par. 25.
6	ORIENT THE ANTENNA USING THE OPTICAL METHOD.	Performs required action outlined in FM 6-161, par. 25.
7	CHECK THE ALINEMENT OF THE ORIENTING TELESCOPE WITH THE ELEVATION DIALS.	Performs elevation orientation check as outlined in FM 6-161, par. 26.
8	PERFORM COMPUTER ALINEMENT CHECK. (The computer must be properly alined prior to this test.)	Performs computer alinement check as described in FM 6-161, par. 27.
9	SET THE TRUE RADAR LOCATION INTO THE COMPUTER.	Performs required action as outlined in FM 6-161, par. 28.
10	PLACE THIS RADAR SET OUT OF OPERATION BY USING NORMAL STOPPING PROCEDURE.	Performs normal stopping procedures as described in FM 6-161, par. 23.
11	EXPLAIN PROCEDURES FOLLOWED FOR EMERGENCY STOPPING PROCEDURES.	Describes the two steps outlined in FM 6-161, par. 24.

d. Penalties.

(1) *Test 1.* Cut 1 point for failure to—

- (a) Set AFC-MANUAL switch on Control-Monitor to AFC position.
- (b) Set 3 control-power supply controls to proper position. (1 point for each of the 3 settings.)
- (c) Set azimuth and range indicator controls to proper position. (1 point for each of the 9 settings.)
- (d) Check to make sure that azimuth stow lock is out, azimuth handwheel is all the way, and fenders are down (no partial credit).
- (e) Close all interlocks and open all vents (no partial credit).

(2) *Test 2.* Cut 1 point for failure to—

- (a) Check power unit for proper voltage and frequency.
- (b) Check operation of the system blowers. (1 point for failure to check each of the 3 system blowers.)
- (c) Rotate Test Meter Selector switch and check readings on both the control-power supply and the control-monitor.
- (d) Verify proper movement of the antenna in azimuth and elevation.
- (e) Check the dehydrator for proper air pressure and dry air.
- (f) Adjust magnetron current to 22 ma after the transmitter is turned on.
- (g) Tune the local oscillator properly if necessary.

(3) *Test 3.* Cut 0.5 point for failure to—

- (a) Turn the Range Shift switch to the OFF position.
- (b) Set range at 2000M using Lower Beam range handwheel.
- (c) Set Range Selector switch to 2500M position and Expanded Sweep Delay switch to position 1.
- (d) Properly adjust and check Range Zero and Range Slope.

(4) *Test 4.* Cut 2 points for failure to—

- (a) Perform ringtime check properly.
- (b) Perform AFC Check properly.

(5) *Test 5.* Cut 1 point for the following:

- (a) Failure to use Lower Beam control to place azimuth strobe over the target.
- (b) Failure to adjust IF GAIN to reduce the size of the echo so that it may be easily bisected.
- (c) Each error in collimation.

(6) *Test 6.* Cut 1 point for each error or failure to follow the proper procedure.

(7) *Test 7.* Cut 1 point for each failure to—

- (a) Check level of set before centering the reticle on the checkpoint.

- (b) Record errors greater than one mil.
- (c) Know why the elevation orientation check is useful.
- (8) *Test 8.* Cut 1 point for each failure to—
 - (a) Check linearity between antenna elevation counter and the computer lower beam elevation counter at 7 elevations from -100 to $+200$ mils.
 - (b) Check azimuth controls with azimuth counter and azimuth strobe.
 - (c) Check range controls with range counter and range strobes.
 - (d) Check both the Radar Height counter and the Weapon Height counter for proper operation.
 - (e) Check Radar Location and Weapon Location counters using the Radar Location Easting and Northing switch.
 - (f) Check linearity between the computer azimuth counter and the movement of the azimuth strobe.
 - (g) Check Delta T counter for proper operation.
 - ~~(h) Know where the four computer accuracy check problems are located (in computer compartment and in log book).~~
 - (i) Know the tolerances for the check results (not greater than 20 meters in Easting or Northing, with the sum of the errors not greater than 36 meters).
 - (j) Perform the required steps in sequence.
- (9) *Test 9.* Cut 2 points for failure to know how to set the radar location into the computer.
- (10) *Test 10.* Cut 1 point for failure to perform Normal stopping procedure.
- (11) *Test 11.* Cut 1 point for failure to know Emergency stopping procedure.
- e. *Credit.* Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 109.

113. Evaluation of Site

- a. *Scope of Test.* One test will be conducted in which the candidate will be required to evaluate by means of clutter and coverage diagrams the radar site previously selected.
- b. *Special Instructions.*
 - (1) The following equipment will be made available to the candidate:
 - (a) One radar set AN/MPQ-4A.
 - (b) Radar site evaluation chart.
 - (2) The examiner will insure that the radar set is adjusted correctly and operating properly.
 - (3) Two assistants will be available to operate the set.

c. Outline of Test.

Examiner commands—	Action of candidate
CONSTRUCT RADAR SITE EVALUATION CHART.	Constructs radar site evaluation chart as prescribed in FM 6-160, pars. 65-67.

d. Penalties. The candidate will be graded on the neatness, accuracy, and quality of his radar site evaluation chart. Cuts will be made accordingly.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 109.

114. Map Reading and Use of Plotting Equipment

The test contained in paragraph 105 will be used in testing candidate under this paragraph. Some modification may be required.

115. Weapon and Impact Location

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to act as radar operator and chart operator during detection and location.

b. Special Instructions.

- (1) A radar set AN/MPQ-4A with necessary equipment will be emplaced in a favorable position for detecting projectiles fired from a mortar and locating the weapon and impact location.
- (2) A qualified operator will be made available to assist in operating the set.
- (3) The examiner will make necessary arrangements to provide the mortar with sufficient ammunition to conduct the tests. He will establish communication between the weapon and the radar site.

c. Outline of Test.

Test No.	Examiner commands—	Action of candidate
1	SCAN ASSIGNED SECTOR FOR PROJECTILES. (Examiner will have a maximum of five rounds fired at approximately one minute intervals.)	Scans assigned sector, detects projectile, and performs procedures outlined in FM 6-161, pars. 32-35.
2	COMPUTE THE WEAPON POSITION.	Computes weapon position as prescribed in FM 6-161, par. 36.
3	COMPUTE THE IMPACT AREA OF THIS ROUND.	Computes impact area as prescribed in FM 6-161, pars. 37 and 38.

d. Penalties.

(1) *Test 1.* Failure to—

- (a) Adjust the radar so that it scans the proper sector in azimuth, 4 points.
- (b) Set elevation about 10 mils above the highest point of the screening crest in the sector, 2 points.
- (c) Detect the projectile echo on ascending leg of trajectory, 1 point for each projectile echo missed.

(2) *Test 2.* Failure to—

- (a) Strobe echoes in proper sequence, 1 point.
- (b) Place detent switch in detent release position, 2 points.
- (c) Use the timer properly, 1 point.
- (d) Set delta time into the computer, 3 points.
- (e) Plot location on map to determine altitude, 2 points.
- (f) Insert difference of altitude into the computer if difference exceeded 10 meters, 3 points.
- (g) Improve weapon location until successive readings in difference in altitude differ by less than 10 meters, 4 points.
- (h) Return delta controls to detent position after final location, 1 point.

(3) *Test 3.* Failure to—

- (a) Aline antenna on proper azimuth for impact location, 4 points.
- (b) Strobe lower beam echo return prior to upper beam echo, 4 points.
- (c) Use delta time, 2 points.
- (d) Plot location on map and determine difference in altitude, 2 points.
- (e) Return delta controls to detent position after final location is made, 1 point.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 109.

116. Radar Gunnery

a. Scope of Tests. Two tests will be conducted in which the candidate will be required to determine the grid reference of a high-burst and center-of-impact registrations.

b. Special Instructions.

(1) The following equipment will be furnished for the candidate:

- (a) One DA Form 6-39, modified for use with the AN/MPQ-4A radar set.
- (b) One sketch of the reticle on the orienting telescope with six rounds representing high bursts placed at random around the center. The range deviation for each round will be listed adjacent to the reticle sketch.

- (c) One DA Form 6-40, modified for use with the AN/MPQ-4A radar set.
- (d) One grid sheet and the necessary plotting equipment.
- (2) During the test on high burst registration, the candidate will utilize modified DA Form 6-39. He will determine and record pointing data and deviations indicated on the sketch of the telescope reticle. He will then compute the average range, elevation, and azimuth to the center of burst and determine the grid reference and altitude of the high-burst registration point.
- (3) During the test on center-of-impact registration, the candidate will utilize modified DA Form 6-40. He will determine and record the pointing data. The deviations in range and azimuth for each round will be given to the candidate and he will enter this information on the form. He will then compute the average range and azimuth to the center of burst and determine the grid reference and altitude to the center-of-impact registration point.

c. Outline of Test.

Test No.	Examiner commands—	Action of candidate
1	<p>a. CONDUCT RADAR OBSERVED HIGH-BURST REGISTRATION. (The following information will be furnished to the candidate: location of HB registration point, location of radar, screening crest angle, and field correction.) REPORT WHEN READY.</p> <p>b. DETERMINE RANGE AND AZIMUTH TO REGISTRATION POINT AND DATA FOR FDC.</p>	Conducts radar observed high-burst registration as outlined in FM 6-161, pars. 39-46.
2	<p>CONDUCT RADAR OBSERVED CENTER-OF-IMPACT REGISTRATION. REPORT WHEN READY. (The following information will be furnished the candidate: location of CI registration point, location of radar, and screening crest angle.)</p>	Conducts radar observed center-of-impact registration as outlined in FM 6-161, pars. 47-57.

d. Penalties. Tests 1 and 2.

- (1) Each mistake in determining pointing data, 2 points.
- (2) Each mistake in filling in the form, 1 point.
- (3) For inability to determine the range and azimuth to the registration point or knowledge of data to be sent to the FDC, proportional cuts up to 7 points may be made, commensurate with the candidate's knowledge.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 109.

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CHAPTER 9

RADAR SPECIALISTS, RADAR SET AN/TPS-25

117. General

To save time and avoid unnecessary movement of the radar set, the tests should be conducted in the sequence in which they are presented in this chapter.

118. Outline of Test

Par. No.	Subject	Number of tests	Points each	Maximum credit
119	Nomenclature of radar set AN/TPS-25.....	1	5	5
120	Selection of site and emplacement.....	1	8	8
121	Operation of radar set AN/TPS-25.....	6	-----	68
	Test 1.....	(1)	12	(12)
	Tests 2 and 3.....	(2)	14	(28)
	Test 4.....	(1)	18	(18)
	Tests 5 and 6.....	(2)	5	(10)
122	Map reading and use of plotting equipment.....	1	6	6
123	Battlefield surveillance and moving target location.....	1	13	13
	Total.....	10	-----	100

119. Nomenclature of Radar Set AN/TPS-25

a. Scope of Test. One test will be conducted that will require the candidate to locate, name, and/or state the purpose of various parts of the radar set AN/TPS-25.

b. Special Instructions. The nomenclature printed on the parts on which the candidate is to be questioned will be covered with masking tape or similar material.

c. Outline of Test.

Examiner commands—	Action of candidate
LOCATE, NAME, AND/OR STATE THE PURPOSE OF THE PARTS NAMED. (The examiner will select 20 of the parts listed in TM 11-5840-217-10, figs. 2-12 and 14-16.)	Locates, names, and/or states the purpose of the designated parts.

d. Penalties.

- (1) Cut 0.25 points for each error in nomenclature or statement of purpose; and for each failure to locate the specified part.
- (2) If total penalties exceed 3 points no credit will be awarded.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 118.

120. Selection of Site and Emplacement

a. Scope of Test. One test will be conducted in which the candidate will be required to select a radar site and explain how he would emplace the set.

b. Special Instructions.

- (1) The examiner will prepare a situation map of the area for the candidate's use showing the following elements of an assumed situation.
 - (a) Location of established survey control in the area.
 - (b) Location of friendly units adjacent to the area in which the radar set will be sited.
 - (c) The general area designated for selecting a site.
 - (d) Suspected area of enemy activity.
- (2) The examiner must bear in mind when assessing penalties that any selected position is a compromise.
- (3) The following equipment should be furnished:
 - (a) Aiming circle.
 - (b) Binoculars.
 - (c) Map of area with all pertinent information.
 - (d) Plotting equipment.
- (4) A mission of battlefield surveillance to include the detection of both personnel and vehicles will be assigned to the candidate.

c. Outline of Test.

Examiner commands—	Action of candidate
SELECT A RADAR SITE AND EXPLAIN HOW YOU WOULD EMPLACE THE RADAR SET.	Selects a radar site within the designated area and explains how he would emplace the set.

d. Penalties.

- (1) A maximum of 2 points will be cut for failure to select a position which provides ready access, cover, and concealment.
- (2) A maximum of 1 point will be cut for failure to consider the proximity of survey control.
- (3) A maximum of 1 point will be cut for failure to consider the proximity of friendly units.

- (4) A maximum of 4 points will be cut for failure to locate the set within 4,500 meters of the area of interest.
 - (5) A maximum of 2 points will be cut if candidate selects an unsuitable location for the shelter and power unit.
 - (6) A maximum of 4 points will be cut for improper explanation of emplacement.
 - (7) The full cut will be assessed if candidate fails to obtain line-of-sight.
- e. *Credit.* Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 118.

121. Operation of Radar Set AN/TPS-25

a. *Scope of Tests.* Six tests will be conducted that will require the candidate to operate the radar set.

b. *Special Instructions.* Prior to the test the examiner will have the radar set emplaced and the antenna leveled. He will also ascertain that the set is in good working order. After these duties have been performed and checks completed, the examiner will change all the operating controls so that the set is out of adjustment.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	CHECK THE SETTINGS OF THE OPERATING CONTROLS AND RESET THE CONTROLS AS NECESSARY	Performs preliminary control settings as outlined in TM 11-5840-217-10, par. 80.
2	PLACE THIS SET IN OPERATION AND PERFORM OPERATIONAL CHECKS. (Examiner will check all the preliminary control settings and make the necessary corrections before allowing the candidate to start this test.)	Starts set and performs checks as prescribed in TM 11-5840-217-10, par. 81.
3	ORIENT THE ANTENNA.....	Orients the antenna as prescribed in TM 11-5840-217-10, par. 66.
4	ORIENT MAP ON PLOTTING BOARD	Orients maps as prescribed in TM 11-5840-217-10, par. 67.
5	ORIENT THE X, Y COUNTERS TO INDICATE THE COORDINATES BY_____.	Orients the X, Y counters as prescribed in FM 6-162, par. 25.
<p>Note. The examiner may require the candidate to set the counters to indicate grid reference of the target, or to indicate cartesian coordinates from either the radar set or from an adjacent position.</p>		

Test No.	Examiner commands—	Action of candidate
6	<p>CALIBRATE THE X, Y COUNTERS AND CHECK THE OPERATION OF THE PLOTTING COMPONENTS. (Reference FM 6-162, par. 26.)</p>	<p>a. Sets the elevation counter to 0, and the range to 18,000 meters. Set the azimuth to either 0 or 3200 mils, whichever shows on the map on the plotting board. The Y counter should read 18,000 meters (plus or minus 140 meters) <i>more</i> than the radar coordinates if the azimuth set-in was 0 mils, and <i>less</i> if the azimuth was 3200 mils. The X counter should read the radar coordinates (plus or minus 140 meters). Turn the azimuth to either 1600 or 4800 mils, whichever shows on the plotting board. The X counter should indicate 18,000 meters (plus or minus 140 meters) <i>more</i> than the radar coordinates if the azimuth was 1600 mils, and <i>less</i> if the azimuth was 4800 mils. The Y counter should read the radar coordinates (plus or minus 140 meters).</p> <p>b. After the X and Y counters are calibrated, a problem is set into the radar to check the plotting components. Set the azimuth to either 800 or 4000 mils. Check the elevation counter for a reading of zero mils and set the range to 14, 140 meters. The reading on both the X and Y counters should be 10,000 meters (plus or minus 75 meters) <i>more</i> than the radar coordinates if the azimuth was 800 mils, and <i>less</i> than the radar coordinates if the azimuth was 4000 mils. The elevation counter is then set to +143 mils and the range counter is checked for a reading of 14,000 meters (plus or minus 75 meters).</p>

d. Penalties.

(1) Test 1—Cut 3 points for each of the following:

(a) Each control on the radar set control omitted or improperly set.

- (b) If the power supply switch is not set in OFF position.
- (c) If the VOLTS switch and the PHASE switch on the power unit are not set properly.

Note to Examiner: Do not let the candidate proceed to Test 2 if either of the switches is improperly set.

- (d) For each air intake port and exhaust port that is not opened, and for each switch on the shelter power distribution box not set to OFF.
- (2) Test 2—cut 3 points for each of the following:
- (a) If the candidate does not know that the RADIATE switch must be OFF during refueling operations at the power unit.
 - (b) If the power unit is not properly started and line voltage properly adjusted.
 - (c) For each switch on the shelter power distribution box that is not set to proper position.
 - (d) If candidate does not check readings at the RCVR XMTR after the transmitter has been turned on.
 - (e) If candidate fails to adjust scope for proper presentation and the VOLUME control and RCVR GAIN control for noise output from the headphones or loudspeaker.
- (3) Test 3—
- (a) For failure to declutch the plotting board arm before searching in azimuth, 5 points.
 - (b) Failure to locate the orienting point, 10 points.
 - (c) For any procedural error in setting the known azimuth into the set, 5 points.
- (4) Test 4—failure to—
- (a) Prepare map properly, 4 points.
 - (b) Move the plotting board indicator light to the origin of the plotting board by using the MAP ZERO switch and the range coupling, 8 points.
 - (c) Set MAP SCALE switch to proper scale, 8 points.
 - (d) Properly aline the indicator light with the azimuth reference line, 4 points.
 - (e) Complete orientation, 20 points.
- (5) Test 5—cut 5 points for the following:
- (a) For any procedural error in orienting the X and Y counters.
 - (b) Failure to complete orientation.
- (6) Test 6—cut 5 points for the following:
- (a) Failure to complete calibration.
 - (b) Failure to check operation of the plotting components by using *both* of the test problems set forth in FM 6-162, paragraph 26.
- (7) If penalties for any one test exceed 50 percent of the total

credits that can be awarded, no credit will be awarded for that test.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 118.

122. Map Reading and Use of Plotting Equipment

The test contained in paragraph 105 will be used in testing candidates under this paragraph. Some modification may be required.

123. Battlefield Surveillance and Moving Ground Target Location

a. Scope of Test. One test will be conducted requiring the candidate to conduct battlefield surveillance and to detect targets.

b. Special Instructions.

- (1) The examiner will prepare a situation map of the area for the candidate's use, showing the following elements of an assumed operation:
 - (a) Enemy and friendly frontlines.
 - (b) The road to be placed under surveillance by the radar section.
- (2) An assistant will be made available to assist in operating the radar.
- (3) The examiner will arrange for vehicle to move up and down target road on his command.
- (4) The examiner will have the set emplaced, and oriented at a suitable location for the test.
- (5) Necessary communication to provide control of the vehicle will be provided by the examiner.

c. Outline of Test.

Examiner commands—	Action of candidate
SCAN THE AREA OF INTEREST FOR TARGETS AND DETERMINE LOCATION OF TARGET(S) DETECTED.	Scans specified area and determines location of target(s) as prescribed in TM 11-5840-217-10, pars. 82 and 83, FM 6-162, pars. 29-32.

d. Penalties. Failure to—

- (1) Properly align antenna on center of area of interest, 6 points.
- (2) Use the Auto Search (Mode 1) properly, 3 points.
- (3) Determine proper elevation angle for search of assigned sector, 5 points.
- (4) Use Mode 4 (Man-Track Audio) to refine location of detected target, 4 points.
- (5) Note direction of movement of target vehicle, 3 points.
- (6) Detect assigned target, full cut.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 118.

CHAPTER 10

COMMUNICATION SPECIALISTS

Section I. GENERAL

124. General

a. The tests for qualification of communication personnel are grouped as follows:

- (1) Communication Personnel, General.
- (2) Message Center Personnel.
- (3) Wire Personnel.
- (4) Radio Personnel.

b. All candidates for qualification as communication specialists are required to complete satisfactorily two of the following in addition to a(1) above.

- (1) Message Center Personnel.
- (2) Wire Personnel.
- (3) Radio Personnel.

Section II. COMMUNICATIONS, PERSONNEL, GENERAL

125. Outline of Tests

Par. No.	Subject	Number of tests	Maximum credit
126	Phonetic Alphabet.....	1	2
127	Authentication.....	2	4
128	Message Writing.....	1	5
129	Operations Code.....	2	4
130	Map Reference and Numeral Cryptosystems.....	2	4
131	Radiotelephone Procedure.....	4	10
132	Test, Operation, and Maintenance of Remote Control Unit.....	4	6
133	Map Reading.....	6	6
134	Panel Code.....	5	5
135	Pyrotechnics.....	2	4
	Total.....	29	50

126. Phonetic Alphabet

a. *Scope of Test.* One test will be conducted to test the candidate's knowledge of the phonetic alphabet.

b. Special Instructions. The candidate will be furnished a printed message containing at least 20 characters.

c. Outline of Test.

Examiner commands—	Action of candidate
READ THIS MESSAGE USING THE PHONETIC ALPHABET.	Candidate reads the message using the phonetic alphabet.

d. Penalties. A penalty of 0.5 point will be assessed for each phonetic equivalent given erroneously. Repetitions of errors will not be considered as additional errors.

e. Credit. Two points will be allowed if all characters are read correctly.

127. Authentication

a. Scope of Tests. Two tests will be conducted to determine the proficiency of the candidate in the use of authentication systems.

b. Special Instructions. The candidate will be furnished an SOI.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	LOCATE IN THE SOI THE PROPER AUTHENTICATION TABLE FOR THIS DATE.	Locates the table in the SOI.
2	AUTHENTICATE. (Examiner will give the challenge consisting of two letters.)	The candidate will reply as determined in the SOI.

d. Penalties. Penalties will be assessed as follows:

- (1) Two points for failure to locate the authentication table in the SOI.
- (2) One point for failure to use the authentication table of the proper date.
- (3) Two points for improper authentication from the table.

e. Credit. Four points will be allowed if the candidate finds the proper authentication table in the SOI and correctly replies to the challenge.

128. Message Writing

a. Scope of Test. The candidate will be tested in the use of the message book.

b. Special Instructions.

- (1) The candidate will be furnished a message book.
- (2) The examiner will create a situation requiring a message to be sent in the clear to another unit.

c. Outline of Test.

Examiner commands—	Action of candidate
SEND THIS MESSAGE TO _____ (Examiner gives the unit designation, precedence, classification, and contents of the message orally.)	Writes message on the forms furnished.

d. Penalties. Penalties will be assessed as follows:

- (1) Two points if message is not printed.
- (2) Three points if message is not legible.
- (3) One point for each of following which are in error.
 - (a) Date and time signed.
 - (b) Classification.
 - (c) Precedence.
 - (d) Signature authorizing message sent in the clear.
 - (e) Addressee.
 - (f) Text.
 - (g) Originator.
 - (h) Grade and title of writer.

e. Credit. Five points will be allowed if all elements of the message are correct.

129. Operations Code

a. Scope of Tests. Two tests will be conducted to determine the proficiency of the candidate in the use of the operations code.

b. Special Instructions. The candidate will be furnished a copy of an operations code, a message book, an encoded message, and a clear text message.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	ENCODE THIS CLEAR TEXT MESSAGE	Encodes the message using the operations code.
2	DECODE THIS MESSAGE.....	Decodes the encoded message.

d. Penalties. Penalties will be assessed as follows:

- (1) One point for each error in encoding or decoding.
- (2) Two points for each message not printed legibly.

e. Credit. Four points will be allowed if the candidate completes both operations correctly.

130. Map Reference and Numeral Cryptosystems

a. Scope of Tests. Two tests will be conducted to determine the proficiency of the candidate in the use of the map reference and numeral cryptosystems.

b. Special Instructions. The candidate will be furnished a copy of a map reference or numeral cryptosystem, a message book, a message containing encoded map coordinates, and a message containing map coordinates in the clear.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	ENCODE THESE MAP COORDINATES.	Encodes the map coordinates using the map reference or numeral cryptosystem.
2	DECODE THIS MESSAGE-----	Decodes the message using the map reference or numeral cryptosystem.

d. Penalties. Penalties will be assessed as follows:

- (1) One point for each error in encoding or decoding.
- (2) Two points for each message not printed legibly.

e. Credits. Four points will be allowed if the candidate completes both operations correctly.

131. Radiotelephone Procedure

a. Scope of Tests. Four tests will be conducted to determine the candidate's knowledge of radiotelephone procedure.

b. Special Instructions.

- (1) Only one candidate should be tested at one time. The instructor will operate as all other stations in the net.
- (2) Each candidate will be furnished—
 - (a) A call sign.
 - (b) A list of call signs in the net.
 - (c) Authentication table.
 - (d) The designation of each station in the net.
 - (e) A serviceable FM radio.
 - (f) An encoded message.
 - (g) A clear text message.
 - (h) A message book.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	OPEN THE NET.....	Opens net using procedure as given in ACP 125(B) and KAG 24/TSEC.
2	TRANSMIT THIS ENCODED MESSAGE.	Transmits message using procedure as given in ACP 125(B) and KAG 24/TSEC.
3	TRANSMIT THIS CLEAR TEXT MESSAGE.	As above.
4	CLOSE THE NET.....	Closes the net using procedure as given in ACP 125(B).

d. Penalties. Penalties will be assessed as follows:

- (1) Three points for failure to open or close net properly.
- (2) Two points for failure to authenticate when necessary.
- (3) One point for each repetition of authenticator.
- (4) 0.5 point for each unnecessary repetition of a call.
- (5) 0.5 point for each error in transmission.

e. Credit.

- (1) Tests 1 and 4, 3 points each.
- (2) Tests 2 and 3, 2 points each.

132. Test, Operation, and Maintenance of Remote Control Unit

a. Scope of Tests. Four tests will be conducted to determine the candidate's knowledge of the duties of a radiotelephone operator when using a remote control unit.

b. Special Instructions.

- (1) The candidate will be furnished—
 - (a) Remote Control Unit C-433/GRC.
 - (b) Handset H-33/PT.
 - (c) 2 batteries BA-30.
 - (d) 1 battery BA-414/U.
 - (e) Field lineman's toolkit.
 - (f) 10 feet of field wire.
- (2) The examiner will have radio set AN/VRQ-2 with local control C-434/GRC connected. A radio operator will be available at the local control.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PREPARE REMOTE CONTROL EQUIPMENT FOR OPERATION WITH VISUAL SIGNALING.	<p>Installs two BA-30 batteries, one BA-414/U battery, connects battery cable, and replaces battery compartment cover.</p> <p>Sets the BELL-LAMP switch in the LAMP positions.</p> <p>Checks to see that the pilot lamp is installed in its holder.</p> <p>Restores the unit to its case and fastens the snap catches.</p>
2	DEMONSTRATE AND EXPLAIN THE FUNCTION OF THE REMOTE CONTROL EQUIPMENT WHEN THE SELECTOR SWITCH IS IN EACH OF THE THREE POSITIONS.	<p>Sets selector switch to each of the three positions and explains the operation. (Ref. TM 11-5038.)</p>
3	INSTALL THE REMOTE CONTROL UNIT FOR USE WITH RADIO PROVIDED, AND WITH AUDIBLE SIGNALING.	<p>Opens the case to set the BELL-LAMP switch to BELL position. Replaces the unit in its case and fastens the snap catches.</p>
4	<p>USING THE EQUIPMENT PROVIDED PERFORM THE FOLLOWING OPERATIONS:</p> <p>a. DEMONSTRATE THE USE OF THE REMOTE CONTROL AS A TELEPHONE.</p>	<p>a. Sets selector switch to TEL position and signals the local operator. Operates handset PUSH-TO-TALK switch to talk.</p>
		(In the following demonstrations the candidate must establish the desired mode of operation by telephone conversation with the operator at the local control unit.)

Test No.	Examiner commands—	Action of candidate
4	<p>USING THE EQUIPMENT PROVIDED PERFORM THE FOLLOWING OPERATIONS—Continued</p> <p>b. DEMONSTRATE PUSH-TO-TALK OPERATION OF EITHER SET 1 OR SET 2 WITH LOCAL CONTROL OF RADIO SET POWER AND RETURN THE EQUIPMENT TO STANDBY.</p> <p>c. DEMONSTRATE PUSH-TO-TALK OPERATION OF SET 2 AND REMOTE CONTROL OF RADIO SET POWER.</p> <p>d. CONTACT THE BASE SET WITH YOUR SET NUMBER 2. BASE SET CALL SIGN IS _____. YOUR CALL SIGN IS _____.</p> <p>e. SIGNAL THE LOCAL OPERATOR AND RETURN THE EQUIPMENT TO STANDBY.</p>	<p>b. Turns the selector switch to the left-hand write-in position.</p> <p>Operates handset PUSH-TO-TALK switch to transmit over Set 1.</p> <p>Releases handset PUSH-TO-TALK switch to listen to either or both set 1 or set 2.</p> <p>Turns the selector switch to right-hand write-in position for set 2 operations.</p> <p>Operates handset PUSH-TO-TALK switch to transmit over Set 2.</p> <p>Releases handset PUSH-TO-TALK switch to listen to either or both Set 1 or Set 2.</p> <p>Returns selector switch to TEL position at end of demonstration.</p> <p>c. Turns the selector switch to the left-hand write-in position.</p> <p>Momentarily presses the handset PUSH-TO-TALK switch.</p> <p>Turns the selector switch to the right-hand write-in position and momentarily operates the PUSH-TO-TALK switch.</p> <p>d. Turns the selector switch to the left-hand write-in position.</p> <p>Contacts the base set using procedure as given in ACP 125(B).</p> <p>e. Turns selector switch to telephone position.</p> <p>Intermittently operates generator to signal local operator.</p>

Note. Functions of the write-in positions may be reversed if the line connections are reversed at either the local or remote unit.

d. Penalties. 0.2 point will be assessed for failure to perform properly any operation in each test.

e. Credit. Six points will be allowed if all operations in all tests are performed properly.

133. Map Reading

a. Scope of Tests. Six tests will be conducted to determine the candidate's ability to read maps, to plot and read coordinates, and to use conventional signs and symbols.

b. Special Instructions.

(1) The following materials and equipment will be furnished the candidate:

(a) Terrain map, 1:50,000 (marginal data required).

(b) Scale 1:50,000.

(2) In test 3 (c below), the naming of any four items of marginal information will satisfy requirements; but, if the student fails to name the scale and the declination diagrams, the examiner should ask leading questions to bring about their inclusion. Graphical scale and representative fraction are considered as two separate items.

(3) The signs and symbols used in these tests will be those given in FM 21-30 and FM 21-31.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	IDENTIFY EACH OF THESE SIGNS OR SYMBOLS. (Pointing out ten signs and symbols on terrain map.)	Identifies each as pointed out.
2	DRAW THE FOLLOWING SYMBOLS AS EACH IS NAMED. (Names five units, military activities, boundaries, or weapons.)	Draws symbols as required.
3	NAME FOUR ITEMS OF INFORMATION FOUND IN THE MARGINAL DATA OF A MAP.	Without reference to a map the candidate names four items. (See b(2) above.)
4	a. LOCATE THIS POINT ON THE TERRAIN MAP, COORDINATES: _____ b. FIND THE COORDINATES OF THIS POINT (indicating point on map).	a. Locates the point at the designated coordinates using an appropriate scale. b. Measures and reports coordinates.
5	GIVE THE ELEVATION OF: _____ _____ (any prominent point).	Determines and reports the elevation as determined from the contour lines on the terrain map.
6	INDICATE THE BEST ROUTE BETWEEN _____ AND _____ _____ (any two points).	Traces the best route on the terrain map.

d. Penalties. Penalties will be assessed as follows:

(1) *Test 1.*

(a) 0.1 point for each sign or symbol named incorrectly.

(b) No credit will be allowed if the candidate fails to identify six or more signs or symbols correctly.

(2) *Test 2.*

(a) 0.2 point for each sign or symbol drawn incorrectly.

(b) No credit will be awarded if the candidate fails to draw three or more signs or symbols correctly. Symbols which are not drawn neatly and legibly will be considered as drawn incorrectly.

(3) *Test 3.* No penalties are provided for this test. 1 point maximum credit will be allowed if the candidate names four items correctly.

(4) *Test 4.*

(a) No credit will be allowed for part *a* if the point is located in error in excess of 50 meters, or if the time required is in excess of 30 seconds.

(b) No credit will be allowed for part *b* if the reported coordinates are in error in excess of 50 meters, or if the time required exceeds 30 seconds.

(c) 0.5 point credit will be allowed for each part completed satisfactorily.

(5) *Test 5.* No credit will be allowed if the reported elevation is in error in excess of one-half the contour interval, or if the time required exceeds 2 minutes. 1 point maximum credit is allowed.

(6) *Test 6.* No penalties are provided for this test. 1 point maximum credit is allowed.

e. Credit. Subject to the penalties listed in *d* above, a maximum of 1 point will be awarded for each test.

134. Panel Code

a. Scope of Tests. Five tests will be conducted to test the candidate in the use of panels, and to determine his familiarity with the combined panel system.

b. Special Instructions. The candidate will be furnished a copy of the SOI and thirteen miniature panels, 2 by 6 inches in size, cut from paper or cloth.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	LOCATE THE PANEL RECOGNITION CODE IN THE SOI.	Locates the correct item in the SOI.
2	DISPLAY THE FLASH INDEX, LETTER INDICATOR, AND NUMERAL INDICATOR.	Displays indicators as given in SOI.
3	DISPLAY NUMERALS 1 THROUGH 9.	As above.
4	DISPLAY THIS NUMBER OF THREE DIGITS.	As above.
5	DISPLAY SIX DIFFERENT LETTERS OF THE ALPHABET.	As above.

d. Penalties. One point will be assessed for each display made incorrectly.

e. Credit. Five points will be allowed if all displays are made correctly.

135. Pyrotechnics

a. Scope of Tests. Two tests will be conducted. The first tests the candidate's ability to locate an item on pyrotechnics in the SOI. The second tests his knowledge of firing pyrotechnics.

b. Special Instructions. The candidate will be furnished a copy of the SOI, and appropriate equipment for firing pyrotechnics.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	LOCATE IN THE SOI AN ITEM WHICH REFERS TO THE USES OF PYROTECHNICS.	Locates the item in the SOI.
2	DEMONSTRATE THE PROPER METHOD OF FIRING PYROTECHNICS.	Demonstrates the proper handling and proper method of firing.

d. Penalties. Penalties will be assessed as follows:

- (1) Two points for failure to locate the specified item in the SOI.
- (2) One point if the candidate does not handle properly and/or properly assemble the pyrotechnic device.
- (3) One point if the candidate does not demonstrate the proper firing of the pyrotechnic.

e. Credit. Four points will be allowed if the candidate proves himself familiar with the SOI and the proper use of pyrotechnics.

Section III. MESSAGE CENTER PERSONNEL

136. Outline of Test

Par. No.	Subject	Number of tests	Maximum credit
137	Message Center Procedure.....	2	10
138	Cipher Machines.....	3	20
139	Teletypewriter Procedure.....	1	20
	Total.....	6	50

137. Message Center Procedure

a. Scope of Tests. Two tests will be conducted to determine the proficiency of the candidate in the following:

- (1) Maintaining the message center log.
- (2) Processing of messages.
- (3) Use of route delivery list.

b. Special Instructions.

- (1) The candidate will be furnished the following materials:
 - (a) Message center log.
 - (b) Route delivery list.
 - (c) Message book.
 - (d) Pencil.
- (2) The candidate will be given information as to the means of communication available and time each was established. (Assume communication with three units.)
- (3) The candidate will be given a list of message center numbers of 10 outgoing messages—five will be receipted, and five not.
- (4) One message will be prepared for the next higher headquarters and one for a lower headquarters. These messages will be handed to the candidate after the tests have been explained to him.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	FROM THE INFORMATION AVAILABLE COMPLETE THE MESSAGE CENTER LOG.	Completes message center log from information given.
2	PROCESS THESE MESSAGES. (Examiner will create a situation requiring one message to be sent by radio.)	Process the two messages.

d. Penalties. Two points will be assessed for each incorrect entry or operation.

e. Credit. Ten points will be allowed if all entries and operations are performed correctly.

138. Cipher Machine TSEC/KL-7

a. Scope of Tests. Three tests will be conducted to determine the candidate's proficiency in the use of the cipher machine TSEC/KL-7.

b. Special Instructions.

- (1) The candidate will be furnished a cipher machine and the appropriate key list. He will be required to extract the necessary information from the key list to set up the machine for operation.
- (2) The candidate will be given a clear text message of at least 10 words and an enciphered message of at least 10 groups.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PREPARE THIS MACHINE FOR OPERATION.	Prepares the machine for operation following the procedure outlined in the appropriate technical manual.
2	DECIPHER THIS MESSAGE.....	Deciphers the message.
3	ENCIPHER THIS MESSAGE.....	Enciphers message.

d. Penalties. Penalties will be assessed as follows:

- (1) Five points if machine is not properly prepared for operation within 15 minutes.
- (2) Two points for each error in enciphering or deciphering.
- (3) Two points for each minute or fraction thereof in excess of 5 minutes required to encipher or decipher each message.

e. Credit. Twenty points will be allowed if all operations are performed correctly.

139. Teletypewriter Procedure

a. Scope of Tests. One test will be given to determine the candidate's proficiency in preparing messages for transmission by teletypewriter.

b. Special Instructions. Candidate will be furnished a clear text message in field messageform.

c. Outline of Test.

Examiner commands—	Action of candidate
REWRITE THIS MESSAGE IN THE PROPER FORMAT FOR TRANSMISSION BY TELETYPE.	Candidate rewrites message in form prescribed in ACP 126. Special notice will be taken of the proper sequence of the format line numbers.

d. Penalties. Three points will be assessed for each format line which is in error or in the wrong sequence.

e. Credit. Twenty points will be allowed if all the message is written correctly.

Section IV. WIRE PERSONNEL

140. Outline of Test

Par. No.	Subject	Number of tests	Maximum credit
141	Test of Field Telephones.....	1	6
142	Maintenance of Field Telephones.....	2	2
143	Installation of Field Switchboard.....	3	7
144	Maintenance of Field Switchboard.....	3	4
145	Operation of Field Switchboard.....	6	7
146	Line Route Maps.....	1	6
147	Installation of Wire Circuits.....	1	18
	Total.....	17	50

141. Test of Field Telephones

a. Scope of Tests. One test will be conducted to determine the candidate's proficiency in testing field telephones.

b. Special Instructions.

- (1) The candidate will be furnished a test telephone, serviceable batteries, field wire, a lineman's kit, and four telephones (same type as the test telephone) which are known to contain faults.
- (2) Three minutes will be allowed to test each of the four telephones that have known faults. Before testing each telephone, other than the test telephone, the candidate will indicate that he is ready. Three minutes after the candidate indicates he is ready, the examiner will command STOP and require the candidate to announce the fault in that telephone.

c. Outline of Test.

Examiner commands—	Action of candidate
TEST THE TELEPHONES PROVIDED AND ANNOUNCE THE FAULT FOUND IN EACH.	Tests the test telephone. Connects test telephone to the first telephone to be tested. Indicates that he is ready. Tests and announces the fault in the telephone. Tests each of the other telephones in turn, following the above procedure in each case.

d. Penalties. Penalties will be assessed as follows:

- (1) Two points for failure to test the test telephone.
- (2) One point for failure to determine the fault in each telephone within 3 minutes, or the announcement of a fault other than that which exists for each telephone.

e. Credit. Six points will be allowed if each telephone is tested correctly within the prescribed 3 minutes per telephone.

142. Maintenance of Field Telephone

a. Scope of Tests. Two tests will be conducted to determine the candidate's proficiency in the maintenance of the field telephone.

b. Special Instructions. The candidate will be furnished a field telephone and a lingman's kit.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	EXPLAIN THE PRECAUTIONS TO BE TAKEN WHEN THE TELEPHONE IS REMOVED FROM SERVICE.	Demonstrates and explains the inspection of the telephone and removal of batteries.
2	PERFORM THE FIRST ECHELON MAINTENANCE ON THE FIELD TELEPHONE.	Performs first echelon maintenance as prescribed on DA Form 11-240.

d. Penalties. No penalties are provided for these tests.

e. Credit. One point will be allowed for each test completed satisfactorily.

143. Installation of Field Switchboard

a. Scope of Tests. Three tests will be conducted to determine the candidate's ability to install a field switchboard of the type with which his unit is equipped.

b. Special Instructions. The candidate will be furnished two switchboards, batteries, two operator's headsets, three field telephones, field wire, a wireman's toolkit, and two ground rods.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	INSTALL BOTH SWITCHBOARDS WITH TWO TRUNK CIRCUITS AND ONE LOCAL CIRCUIT EACH.	Sets up and tests switch- as prescribed in appropri- ate technical manual.
2	ASSUMING THE OPERATORS TELEPHONE CIRCUIT IS OUT, CONNECT A FIELD TELEPHONE FOR EMERGENCY OPERATION.	Connects field telephone as prescribed in appropriate technical manual.
3	CONNECT TWO SWITCHBOARDS FOR PARALLEL OPERATION.	Installs switchboards as pre- scribed in appropriate technical manual.

d. Penalties. Two points will be assessed for each test performed incorrectly.

e. Credit. Seven points will be allowed if all tests are completed satisfactorily.

144. Maintenance of the Field Switchboard

a. Scope of Tests. Three tests will be conducted to determine the candidate's proficiency in performing maintenance on the field switchboard.

b. Special Instructions. The candidate will be furnished a field switchboard and a lineman's kit.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	EXPLAIN THE PREPARATION OF THE SWITCHBOARD FOR TRANSPORTATION OR STORAGE.	Explains, and demonstrates where necessary, the preparation of the switchboard for transportation or storage.
2	REMOVE AND REPLACE A LINE PACK.	Removes unit and replaces as prescribed in appropriate technical manual.
3	DEMONSTRATE CLEANING OF CORDS, PLUGS, JACKS, AND TERMINALS.	Cleans items requested as prescribed in appropriate technical manual.

d. Penalties. Cut 1 point for each error or omission.

e. Credit. Four points will be allowed if all tests are completed satisfactorily.

145. Operation of Field Switchboard

a. Scope of Tests. Six tests will be conducted to determine the proficiency of the candidate in switchboard operation.

b. Special Instructions.

- (1) Several candidates may be tested at one time. Each is scored on his individual performance.
- (2) Each candidate will be furnished a copy of the SOI.
- (3) A minimum of three switchboards, each having three locals, will be installed ready to operate prior to the beginning of the tests.
- (4) Each switchboard and phone will be given a unit designation corresponding with the SOI.
- (5) The examiner will provide operators for the local telephones.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	MAKE A TRAFFIC DIAGRAM FOR THE BOARD YOU ARE NOW OPERATING.	Finds directory names using SOI and makes traffic diagram.
2	PLACE A LOCAL CALL-----	Performs operation using procedure prescribed in ACP 134(A).
3	PLACE A TRUNK CALL-----	As above.
4	PLACE A CONFERENCE CALL-----	As above.
5	FIRE MISSION ON A CIRCUIT NOW IN USE.	As above.
6	PLACE AN URGENT CALL OVER A CIRCUIT ALREADY IN USE.	As above.

d. Penalties. One point will be assessed for any operation or phase performed incorrectly.

e. Credit. Seven points will be allowed if all operations are performed correctly.

146. Line Route Maps

a. Scope of Tests. One test will be conducted in which the candidate will be required to answer questions concerning the use and construction of line route maps.

b. Special Instructions. The candidate will be furnished a line route map on a photomap, map, or a sheet of overlay paper, with the locations of various installations between which circuits are assumed to be installed.

c. Outline of Test.

Examiner commands—	Action of candidate
EXPLAIN THE LINE ROUTE MAP. (Examiner asks candidate at least four questions pertaining to a line route map.)	Answers questions, using, when necessary, the line route map furnished by examiner.

d. Penalties. Two points will be assessed for each question answered incorrectly.

e. Credit. Six points will be allowed if all questions are answered correctly.

147. Installation of Wire Circuits

a. Scope of Test. One test will be conducted to determine the candidate's knowledge and ability of laying, servicing, and picking up wire circuits. The candidate will be tested in the duties of all members of a wire crew (excluding wire team chief and driver).

b. Special Instructions.

- (1) A wire truck will be provided with at least one of each type of wire laying device authorized for the candidate's unit, each type of wire, telephones, tags, tape, seizing wire, stakes (wooden), pike poles, lance poles, and lineman's kits (one per candidate).
- (2) Several candidates (not more than six) will be assigned to the truck as a wire crew. Each candidate will perform all the duties (*a* above) involved in laying, servicing, and picking up wire circuits. Each type of crossing will be installed.
- (3) At appropriate intervals, the examiner will stop the test and cause the candidates to change posts. The test will continue until each candidate is tested in all operations.

c. Outline of Test.

Examiner commands—	Action of candidate
INSTALL THE WIRE NET----- (Examiner designates the type of wire net to be laid, giving the location of unit switchboards.) (Examiner rotates candidates in the various jobs during installation of the wire net so that each candidate will perform all duties in each phase of the installation.)	Performs his assigned duty as team of candidates installs the designated wire net.

d. Penalties. Two points will be assessed for each of the following:

- (1) Failure to leave sufficient slack.
- (2) Improper operation of reel units.

- (3) Faulty splices, tying, or tagging.
- (4) Failure to test wire before using.
- (5) Failure to test wire at end of each reel.
- (6) Failure to tie, tag, test, and turn over wire to switchboard operator at location.
- (7) Failure to use proper type of crossing.
- (8) Excessive time in performing duties.

e. Credit. Eighteen points will be allowed each candidate if all operations and duties are performed correctly.

Section V. RADIO PERSONNEL

148. Outline of Test

Par. No.	Subject	Number of tests	Maximum credit
149	Sending and Receiving Code Groups-----	2	7
150	FM Radio Sets-----	5	8
151	AM Radio Sets-----	2	6
152	Radio-Telegraph Procedures-----	7	12
153	Radio-Teletype Operation-----	5	12
154	Cipher Machine TSEC/KW-9-----	1	5
	Total-----	22	50

149. Sending and Receiving Code Groups

a. Scope of Tests. Two tests will be conducted to test the candidate's rate of speed in transmitting and in receiving radio-telegraph (CW) under field conditions.

b. Special Instructions.

- (1) Examiner will provide the candidate with a typewritten page containing at least 54 five-letter code groups.
- (2) Examiner will provide a qualified operator and two AM radio sets of the type used in the candidate's unit.
- (3) Each test will be of 3 minute's duration.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	TRANSMIT CODE GROUPS. (Examiner requires candidate to transmit for 3 minutes.)	Transmits code groups provided by examiner.
2	RECEIVE CODE GROUPS-----	Receives and copies code groups.

d. Penalties and Credit. No penalties are provided for these tests. Credit will be given as follows:

Transmission:

Number of correct five-letter code groups *per minute*, exactly or more than----- 8 13 18
Credit----- 1 2 3

Receiving:

Number of correct five-letter code groups *per minute*, exactly or more than----- 8 13 18
Credit----- 2 3 4

150. FM Radio Sets

a. Scope of Tests. Five tests will be given to determine the candidate's proficiency in the installation, testing and adjusting of FM radio sets.

b. Special Instructions.

- (1) The candidate will be furnished the components and ancillary equipment of radio sets AN/VRC-17 and AN/VRQ-2 not assembled.
- (2) Two radios AN/PRC-9 will be furnished for test five
- (3) The examiner will provide an additional radio set with a qualified operator to act as the base set.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	USING THE COMPONENTS PROVIDED, ASSEMBLE RADIO SET AN/VRQ-2.	Assembles radio set AN/VRQ-2 as prescribed in TM 11-287.
2	USING THE COMPONENTS PROVIDED, ASSEMBLE RADIO SET AN/VRC-17.	Assembles radio set AN/VRC-17 as prescribed in TM 11-611.
3	PERFORM THE FOLLOWING OPERATIONS WITH RADIO SET AN/VRC-17: a. PROVIDE POWER TO ENTIRE RADIO SET. b. CHECK CIRCUITS ON RECEIVER TRANSMITTER RT-67 USING THE METER SWITCH.	a. Turns the OPERATE switch on the power supply to TRANS & RECEIVE position and turns on the auxiliary receiver POWER SWITCH. b. Rotates meter switch through 12 positions and determines the condition of the circuit elements checked on the meter.

Test No.	Examiner commands—	Action of candidate
3	<p>PERFORM THE FOLLOWING OPERATIONS WITH RADIO SET AN/VRC-17—Continued</p> <p>c. PRESET THESE THREE FREQUENCIES ON RECEIVER R-109: YOUR ASSIGNED FREQUENCY IS _____, YOUR ALTERNATE FREQUENCY _____, AND SPARE FREQUENCY _____. LEAVE THE RECEIVER R-109 TUNED TO YOUR ALTERNATE FREQUENCY.</p> <p>d. PRESET THESE TWO FREQUENCIES ON THE RT-67: YOUR ASSIGNED FREQUENCY IS _____, AND YOUR ALTERNATE FREQUENCY IS _____.</p> <p>e. CONTACT BASE SET ON YOUR ASSIGNED FREQUENCY. HAVE THE BASE SET CALL YOU ON YOUR ALTERNATE FREQUENCY _____. PRESET ON YOUR RECEIVER R-109 AND ANSWER CALL.</p>	<p>c. Presets the frequencies following procedure prescribed in TM 11-611. Leaves receiver R-109 tuned to alternate frequency.</p> <p>d. As above.</p> <p>e. Calls base set and requests them to call back on the frequency given. Tunes RT-67 to alternate frequency and answers call using procedure prescribed in ACP 125-(B).</p>
4	<p>PERFORM THE FOLLOWING OPERATIONS WITH RADIO SET AN/VRQ-2:</p> <p>a. MAKE SQUELCH AND VOLUME LEVEL ADJUSTMENT.</p> <p>b. CONNECT AND OPERATE AS A RETRANSMISSION STATION USING THESE TWO FREQUENCIES _____ AND _____.</p>	<p>a. Turns on radio set AN/VRQ-2 and makes adjustment as prescribed in TM 11-287.</p> <p>b. Connects and operates radio set as a retransmission station following the procedure given in TM 11-287.</p>
5	<p>PERFORM THE FOLLOWING OPERATIONS WITH RADIO SET AN/PRC-9:</p> <p>a. CALIBRATE THE RADIO TO FREQUENCY _____.</p> <p>b. CONNECT FOR REMOTE OPERATION.</p>	<p>a. Calibrates the radio set using the procedure given in TM 11-5820-292-10.</p> <p>b. Connects the radio set to the remote control unit.</p>

d. *Penalties.* Penalties will be assessed as follows:

(1) *Tests 1 and 2.* One point each.

(2) *Tests 3, 4, and 5.* 0.5 points for each sub-test.

e. *Credit.* Eight points will be allowed if all operations are performed correctly.

151. AM Radio Sets

a. Scope of Tests. Two tests will be conducted to determine the candidate's proficiency in installing and adjusting AM radios.

b. Special Instructions.

- (1) Candidate will be furnished the components of AN/GRR-5, 2 batteries BA-419/U, and 1 battery BA-405/U.
- (2) For test 2 a radio-teletype set AN/GRC-46 will be furnished the candidate. Any AM radio set issued to the candidates organization may be used if the AN/GRC-46 is not available.
- (3) Another compatible AM radio set will be used as the base set and manned by a competent operator.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	<p>USING THE COMPONENTS OF THE AN/GRR-5 PERFORM THE FOLLOWING OPERATIONS:</p> <ol style="list-style-type: none"> a. INSTALL ALL COMPONENTS OF THE AN/GRR-5 FOR DRY BATTERY OPERATION. b. PRESET THE AN/GRR-5 ON FREQUENCIES _____ AND _____. 	<ol style="list-style-type: none"> a. Installs components and connects dry batteries. b. Presets the frequencies using the procedure prescribed in TM 11-295.
2	<p>USING THE COMPONENTS FURNISHED PERFORM THE FOLLOWING OPERATIONS:</p> <ol style="list-style-type: none"> a. INTERCONNECT COMPONENTS OF RADIO TELETYPEWRITER SET AN/GRC-46 FOR CW OPERATION. b. CALIBRATE RECEIVER AND TUNE TO YOUR ASSIGNED FREQUENCY, WHICH IS _____. c. TUNE TRANSMITTER TO ASSIGNED FREQUENCY AND LOAD ANTENNA. d. ESTABLISH COMMUNICATION WITH BASE SET. 	<ol style="list-style-type: none"> a. Installs and interconnects all components. Makes appropriate settings for CW operation. b. Follows procedure given in appropriate technical manual. c. As above. d. Calls base set and establishes communication by CW.

d. Penalties. One point will be assessed for each part of each test not performed satisfactorily.

e. Credit. Six points will be allowed if all operations are completed in a satisfactory manner.

152. Radio-Telegraph Procedures

a. Scope of Tests. Seven tests will be conducted to determine the candidate's knowledge of radio-telegraph procedure.

b. Special Instructions.

- (1) Several candidates should be tested at one time, each being scored as his transmissions are made.
- (2) Each candidate will be furnished an AM radio set of the type used in his unit. All sets must be capable of operating on the same net.
- (3) Each candidate will be designated as a radio operator at a particular station. He will be furnished a list indicating the units in the net, an SOI, and authentication system, and a call sign.
- (4) The examiner will provide each candidate with a prepared cryptographed message of not less than 15 five-letter groups, and a clear text message of approximately 15 words. No two candidates will be furnished the same message.
- (5) In test 5, the examiner should be provided with a qualified operator, who will call each station in the net in turn. In calling he will blur the call sign of the calling station.
- (6) "Jamming," as used in test 6 will be simulated and the candidate will be questioned as to his knowledge of antijamming techniques.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	EXPLAIN THE DUTIES OF THE NET CONTROL STATION OPERATOR.	Explains duties of net control station operator.
2	YOU ARE NET CONTROL STATION OPERATOR. ORGANIZE THE NET.	Organizes net following procedure in ACP 124(B).
3	SEND THIS CRYPTOGRAPHIC MESSAGE.	As above.
4	SEND THIS CLEAR TEXT MESSAGE.	As above.
5	ANSWER A STATION WHOSE CALL SIGN YOU DID NOT RECEIVE.	As above.
6	ASSUME THAT OPERATION IS BEING JAMMED. EXPLAIN HOW YOU WOULD CONTINUE OPERATION.	
7	CLOSE THE NET-----	Uses procedure as prescribed in ACP 124(B).

d. Penalties. One point will be assessed for each of the following:

- (1) For failure to know the duties of the net control station operator.
- (2) Failure to open net properly.
- (3) Unnecessary repetition of calls.
- (4) Transmitting faster than slowest operator in the net.
- (5) Failure to keep a proper log.

- (6) Errors in transmission.
- (7) Improper procedure.
- (8) Failure to authenticate when necessary.
- (9) Repetition of authentication groups.
- (10) Failure to close net properly.

e. Credit. Twelve points will be allowed if all operations are performed correctly.

153. Radio-Teletype Operation

a. Scope of Tests. Five tests will be given to determine the candidate's proficiency in the operation of radio teletype equipment.

b. Special Instructions.

- (1) These tests will only be given to candidate's in units which are issued the radio teletype set AN/GRC-46 or comparable equipment.
- (2) The examiner will provide another radio teletype set with a competent operator to net with the candidate's set.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	INTERCONNECT ALL COMPONENTS OF RADIO TELETYPE SET AN/GRC-46.	Installs all power, control, and interconnecting cables.
2	YOUR ASSIGNED FREQUENCY IS _____ AND YOUR STATION CALL IS _____. TURN ON THE RADIO SET AND TUNE TO YOUR ASSIGNED FREQUENCY USING DOUBLET ANTENNA.	Follows the starting and tuning procedure prescribed in the appropriate technical manual.
3	PREPARE THE RADIO TELETYPE SET FOR FREQUENCY SHIFT KEYING ONE-WAY REVERSIBLE OPERATION.	Follows procedure prescribed in appropriate technical manual.
4	TRANSMIT THIS MESSAGE BY RADIO TELETYPE.	Transmits message using procedures given in ACP 126.
5	SHUT DOWN THE STATION-----	Follows procedure prescribed in appropriate technical manual.

d. Penalties. Penalties will be assessed as follows:

- (1) *Tests 1, 2, 3, and 5.* 0.1 point for each operation incorrectly performed.
- (2) *Test 4.* 0.5 point for each procedural error.

e. Credit. Maximum credit will be allowed for each test as follows:

- (1) *Tests 1, 2, and 3.* Three points each.
- (2) *Test 4.* Two points.
- (3) *Test 5.* One point.

154. Cipher Machine TSEC/KW-9

- a. *Scope of Test.* One test will be conducted to determine the candidate's proficiency in the use of the cipher machine TSEC/KW-9.
- b. *Special Instruction.* The candidate will be furnished a cipher machine TSEC/KW-9 and the appropriate key list. He will be required to extract the necessary information from the appropriate key list to set up the machine for operation.
- c. *Outline of Test.*

Examiner commands—	Action of candidate
PREPARE THIS MACHINE FOR OPERATION.	Prepares machine for operation following the procedure outline in the appropriate technical manual.

- d. *Penalties.* A penalty of 0.3 point will be assessed for each operation incorrectly performed.
- e. *Credit.* Maximum credit allowed will be 5 points.

CHAPTER 11

FIELD ARTILLERY MECHANIC AND ARMORER

Section I. GENERAL

155. General

a. Tests for qualification of artillery mechanics and armorers are grouped in twelve separate tests as follows:

- (1) 105-mm howitzer, towed.
- (2) 105-mm howitzer, self-propelled.
- (3) 155-mm howitzer, towed.
- (4) 155-mm howitzer, self-propelled.
- (5) 8-inch howitzer, towed.
- (6) 8-inch howitzer, self-propelled.
- (7) 175-mm gun, M107 and 8-inch howitzer, M110, self-propelled.
- (8) 280-mm gun.
- (9) Boresighting, periodic tests, and on-carriage fire control equipment.
- (10) Small arms.
- (11) Ammunition.
- (12) Publications, forms, and records.

b. The tests in this chapter will not be used as a basis for award of the field artillery qualification badge. Field artillery mechanics and armorers desiring to compete for the field artillery qualification badge will take the gunner's or missile men tests appropriate for the unit to which they are assigned.

156. Use of Technical Manuals

The technical manual appropriate to the particular weapon will be available to the candidate for reference. The examiner will authorize its use only for those tests in which adjustments to given specifications are required.

Section II. PRIMARY WEAPONS

157. 105-MM Howitzer, Towed

a. *Scope of Tests.* Six tests will be conducted to determine the candidate's knowledge of functioning, nomenclature, and maintenance of the towed 105-mm howitzer, to include—

- (1) Barrel and breech.
- (2) Recoil.

- (3) Cradle lock strut and traveling lock bracket.
- (4) Equilibrators and elevating mechanism.
- (5) Brakes.
- (6) Wheel bearings.

b. Special Instructions. Unit will furnish candidate with a towed 105-mm howitzer with cradle lock strut, traveling lock brackets and wheel bearings improperly adjusted, and sufficient tools to enable candidate to establish reserve oil, adjust cradle lock strut, traveling lock brackets, and wheel bearings.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	EXPLAIN REMOVAL OF BARREL GROUP.	Candidate explains the correct procedures as outlined in TM 9-325.
2	ESTABLISH PROPER RECOIL OIL RESERVE.	Candidate explains the correct procedure as outlined in TM 9-325.
3	DISASSEMBLE AND ASSEMBLE THE BREECH MECHANISM AND FIRING LOCK.	Candidate will disassemble and assemble the breech mechanism and firing lock as outlined in TM 9-325.
4	a. EXPLAIN PROPER ADJUSTMENT OF EQUILIBRATORS.	a. Candidate explains proper adjustment as outlined in TM 9-325.
	b. TRACE POWER TRAIN OF ELEVATING MECHANISM FROM THE HANDWHEEL TO ELEVATING ARC.	b. Candidate traces power train from handwheel to elevating arc.
5	EXPLAIN ADJUSTMENT AND MAINTENANCE OF BRAKE MECHANISM.	Candidate explains proper adjustment and maintenance as outlined in TM 9-325.
6	ADJUST WHEEL BEARINGS-----	Candidate adjusts wheel bearings as outlined in TM 9-325.

d. Penalties. Penalties will be assessed as follows:

- (1) *Tests 1, 4, and 5.* If candidate fails to explain functioning and procedures as outlined in references, examiner will award a grade commensurate with the knowledge of the candidate.
- (2) *Test 2.* No credit will be allowed if candidate does not know the correct oil reserve that is to be established.
- (3) *Test 3.* If candidate fails to disassemble or assemble the breech mechanism and firing lock properly, 7 points.
- (4) *Test 6.* No credit will be allowed if candidate fails to adjust wheel bearings properly.

e. Credits. Subject to penalties assessed in *d* above, maximum credit for tests 1 and 5, 6 points each; tests 2, 3, 4, and 6, 7 points each.

158. 105-MM Howitzer, Self-Propelled

a. Scope of Tests. Five tests will be conducted to determine the candidate's knowledge of functioning, nomenclature, and maintenance of the self-propelled 105-mm howitzer, to include—

- (1) Barrel and evacuator chamber.
- (2) Recoil mechanism.
- (3) Elevating mechanism.
- (4) Traversing mechanism.
- (5) Breech.

b. Special Instructions. Unit will furnish candidate with a self-propelled 105-mm howitzer and necessary tools. Weapon will have low oil reserve.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	a. EXPLAIN FUNCTIONING OF BARREL AND EVACUATOR CHAMBER.	Candidate explains the correct procedure as outlined in TM 9-7204.
	b. REMOVE LOCK RING AND EVACUATOR CHAMBER AND REASSEMBLE.	Candidate will use the procedures as outlined in TM 9-7204.
2	DISASSEMBLE AND ASSEMBLE THE BREECH MECHANISM AND FIRING LOCK.	Candidate will disassemble and assemble the breech mechanism and firing lock as outlined in TM 9-717A.
3	ESTABLISH PROPER RECOIL OIL RESERVE AND ADJUST THE BUFFER REGULATOR.	Candidate establishes the correct oil reserve and adjusts recoil regulator as outlined in TM 9-7204.
4	TRACE THE POWER TRAIN OF THE TRAVERSING MECHANISM FROM THE HANDWHEEL TO THE BASE RING AND RACE.	Candidate traces the power train from the handwheel to the base ring and race.
5	TRACE THE POWER TRAIN OF THE ELEVATING MECHANISM FROM THE HANDWHEEL TO THE ELEVATING ARC.	Candidate traces the power train from the handwheel to the elevating arc as outlined in TM 9-7204.

d. Penalties. Penalties will be assessed as follows:

- (1) *Test 1.* If candidate fails to explain functioning or use the proper procedures as outlined in references, examiner will award a grade commensurate with the knowledge of the candidate. Four points may be cut for each portion.
- (2) *Test 2.* If candidate fails to disassemble or assemble the breech mechanism and firing lock properly, 8 points.
- (3) *Test 3.* No credit will be allowed if candidate does not know the correct oil reserve that is to be established.
- (4) *Tests 4 and 5.* If candidate fails to trace the complete power train, the examiner will award a grade commensurate with the knowledge of the individual.

e. Credits. Subject to penalties assessed in *d* above, maximum credit of 8 points will be awarded for each test.

159. 155-MM Howitzer, Towed

a. Scope of Tests. Six tests will be conducted to determine the candidate's knowledge of functioning, nomenclature, and maintenance of the towed 155-mm howitzer, to include—

- (1) Barrel and breech.
- (2) Recoil.
- (3) Howitzer, general.
- (4) Equilibrators, elevating and traversing mechanism.
- (5) Brakes.
- (6) Wheel bearings.

b. Special Instructions. Unit to furnish candidate with a towed 155-mm howitzer and necessary tools.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DISASSEMBLE AND ASSEMBLE THE BREECH MECHANISM AND DEMONSTRATE PROPER USE OF HEADSPACE GAGE. EXPLAIN PROPER MAINTENANCE OF TUBE BEFORE AND AFTER FIRING.	Candidate disassembles and assembles breech mechanisms as in TM 9-331A, and demonstrates use of headspace gage as outlined in TM 9-331A.
2	ESTABLISH REPLENISHER OIL RESERVE AND EXPLAIN PROPER PROCEDURE FOR OIL RESERVE.	Candidate establishes replenisher oil reserve and explains procedure for establishing recuperator oil reserve as outlined in TM 9-331A.
3	DESCRIBE AND GIVE THE FUNCTIONING OF THE MAJOR COMPONENTS OF THE HOWITZER.	Candidate describes and explains the functioning of the major components as outlined in TM 9-331A.
4	EXPLAIN THE PROPER CHECK FOR BACKLASH IN THE ELEVATING AND TRAVERSING MECHANISM.	Candidate explains the proper check for backlash as outlined in TM 9-331A.
5	PERFORM TESTS OF AIRBRAKES, TO INCLUDE: a. TEST FOR AIR LEAKAGE. b. DRAIN WATER FROM EMERGENCY TANK AND AIR FILTERS. c. CLEANING OF AIR FILTERS. d. TESTING OF AUTOMATIC EMERGENCY BRAKING FEATURE. e. ADJUST PUSH ROD TRAVEL.	Candidate performs tests as outlined in TM 9-331A.
6	ADJUST WHEEL BEARINGS-----	Candidate adjusts wheel bearings as outlined in TM 9-331A.

d. Penalties. Penalties will be assessed as follows:

- (1) *Test 1.* If candidate fails to disassemble or assemble the breech mechanism properly, 8 points; use the headspace gage properly, 4 points; explain the proper maintenance, 4 points.
- (2) *Test 2.* If candidate fails to establish replenisher oil reserve, 6 points; explain proper procedure, 3 points.
- (3) *Tests 3 and 4.* If candidate fails to explain functioning and procedures as outlined in references, examiner will award a grade commensurate with the knowledge of the candidate.
- (4) *Test 5.* For each part of the test performed incorrectly, full cut.
- (5) *Test 6.* No credit will be allowed if candidate fails to adjust wheel bearings properly.

e. Credits. Subject to penalties assessed in *d* above, full credit will be given the candidate as indicated below:

- (1) Test 1; 8 points.
- (2) Tests 2, 3, 4, and 6; 6 points each.
- (3) Test 5. Parts a and b, 1 point each. Parts c, d, and e, 2 points each.

160. 155-MM Howitzer, Self-Propelled

a. Scope of Tests. Six tests will be conducted to determine the candidate's knowledge of functioning, nomenclature, and maintenance of the self-propelled 155-mm howitzer, to include:

- (1) Barrel and breech.
- (2) Recoil.
- (3) Elevating and traversing mechanism (manual).
- (4) Elevating and traversing mechanism (power).
- (5) Equilibrator.
- (6) Power rammer.

b. Special Instructions. Unit will furnish candidate with one self-propelled 155-mm howitzer and the necessary tools. Weapon will have improperly adjusted equilibrator and low oil reserve.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DISASSEMBLE AND ASSEMBLE THE BREECH MECHANISM AND FIRING LOCK. EXPLAIN PROPER MAINTENANCE OF THE TUBE AND BREECH MECHANISM BEFORE AND AFTER FIRING.	Candidate disassembles and assembles breech mechanism to include firing lock as outlined in TM 9-7004.
2	ESTABLISH OIL RESERVE IN THE REPLENISHER.	Candidate establishes oil reserve in the replenishers as outlined in TM 9-7004.

Test No.	Examiner commands—	Action of candidate
3	EXPLAIN THE PROPER CHECK FOR BACKLASH IN THE TRAVERSING AND ELEVATING MECHANISM (MANUAL).	Candidate explains proper method of checking backlash in the elevating and traversing mechanisms.
4	TRACE THE POWER TRAIN OF THE ELEVATING AND TRAVERSING MECHANISM FROM THE HAND-WHEELS TO THE BASE RING AND RACE AND THE ELEVATING ARC (POWER).	Candidate traces the flow of power of the power elevating and traversing mechanisms as outlined in TM 9-7004.
5	ADJUST THE EQUILIBRATOR-----	Candidate adjusts equilibrator as outlined in TM 9-7004.
6	CHECK THE POWER RAMMER-----	Checks the power rammer for operation as outlined in TM 9-7004.

d. Penalties. Penalties will be assessed as follows:

- (1) *Test 1.* If candidate fails to disassemble or assemble the breech mechanism and firing lock properly, 7 points; explain the proper maintenance, 4 points.
- (2) *Test 2.* If candidate fails to establish proper replenisher oil reserve, 7 points.
- (3) *Tests 3, 4, and 6.* If candidate fails to explain functioning and procedures as outlined in references, examiner will award a grade commensurate with the knowledge of the candidate.
- (4) *Test 5.* No credit will be allowed if candidate fails to adjust equilibrator properly.

e. Credits. Subject to penalties assessed in *d* above, maximum credit for tests 1 through 5, 7 points each; test 6, 5 points.

161. 8-Inch Howitzer, Towed

a. Scope of Tests. Six tests will be conducted to determine the candidate's knowledge of functioning, nomenclature, and maintenance of the towed 8-inch howitzer, to include—

- (1) Barrel and breech.
- (2) Recoil.
- (3) Equilibrators.
- (4) Elevating and traversing mechanisms.
- (5) Brakes.
- (6) Wheel bearings.

b. Special Instructions. Unit will furnish candidate with one towed 8-inch howitzer and the necessary tools. Weapon will have improperly adjusted equilibrators and low oil reserve.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DISASSEMBLE AND ASSEMBLE THE BREECH MECHANISM AND DEMONSTRATE USE OF HEADSPACE GAGE. EXPLAIN MAINTENANCE OF TUBE BEFORE AND AFTER FIRING.	Candidate disassembles and assembles breech mechanism and demonstrates use of headspace gage as outlined in TM 9-3004.
2	ESTABLISH OIL RESERVE IN REPLENISHER AND EXPLAIN OIL RESERVE IN RECUPERATOR.	Candidate establishes oil reserve in replenisher and explains oil reserve in recuperator as outlined in TM 9-3004.
3	ADJUST EQUILIBRATORS-----	Candidate adjusts equilibrators as outlined in TM 9-3004.
4	EXPLAIN THE PROPER CHECK FOR BACKLASH IN ELEVATING AND TRAVERSING MECHANISM.	Explains proper check for backlash. See TM 9-3004.
5	PERFORM TESTS OF AIRBRAKES TO INCLUDE: a. TEST FOR AIR LEAKAGE. b. DRAIN WATER FROM EMERGENCY TANK AND AIR FILTERS. c. CLEANING OF AIR FILTERS. d. TESTING OF AUTOMATIC EMERGENCY BRAKING FEATURE. e. ADJUST PUSH ROD TRAVEL.	Candidate performs tests as outlined in TM 9-3004.
6	REMOVE AND REPLACE WHEELS AND HUBS.	Candidate performs tests as outlined in TM 9-3004.

d. Penalties. Penalties will be assessed as follows:

- (1) *Test 1.* If candidate fails to disassemble or assemble the breech mechanism properly, 8 points; use the headspace gage properly, 4 points; explain the proper maintenance, 4 points.
- (2) *Test 2.* If candidate fails to establish proper replenisher oil reserve, 6 points; explain oil reserve, 3 points.
- (3) *Test 3.* No credit will be allowed if candidate fails to adjust equilibrators properly.
- (4) *Tests 4 and 6.* If candidate fails to explain functioning and procedure as outlined in references, examiner will award a grade commensurate with the knowledge of the candidate.
- (5) *Test 5.* For each part of the test performed incorrectly, full cut.

e. Credits. Subject to penalties assessed in *d* above, full credit will be given the candidate as indicated below:

- (1) Test 1; 8 points.
- (2) Tests 2, 3, 4, and 6; 6 points each.
- (3) Test 5, parts a and b; 1 point each. Parts c, d, and e; 2 points each.

162. 8-Inch Howitzer, Self-Propelled

a. Scope of Tests. Seven tests will be conducted to determine candidate's knowledge of functioning, nomenclature, and maintenance of the self-propelled, 8-inch howitzer to include—

- (1) Barrel and breech.
- (2) Recoil.
- (3) Elevating and traversing mechanism (manual).
- (4) Elevating and traversing mechanism (power).
- (5) Equilibrators (manual and power).
- (6) Scavenger system.
- (7) Power rammer and ammunition hoist.

b. Special Instructions. Unit will furnish candidate with one self-propelled 8-inch howitzer and the necessary tools.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DISASSEMBLE AND ASSEMBLE THE BREECH MECHANISM TO INCLUDE THE FIRING LOCK. EXPLAIN PROPER MAINTENANCE OF THE TUBE AND BREECH MECHANISM BEFORE AND AFTER FIRING.	Candidate disassembles and assembles the breech mechanism including the firing lock as outlined in TM 9-2350-210-12.
2	ESTABLISH OIL RESERVE IN REPLENISHER.	Candidate establishes correct oil reserve in the replenisher as outlined in TM 9-2350-210-12.
3	EXPLAIN THE PROPER CHECK FOR BACKLASH IN THE ELEVATING AND TRAVERSING MECHANISMS (MANUAL).	Candidate explains proper method of checking backlash in elevating and traversing mechanisms, as outlined in TM 9-2350-210-12.
4	TRACE THE POWER TRAIN OF THE ELEVATING AND TRAVERSING MECHANISMS FROM THE HAND WHEELS TO THE BASE RING AND RACE AND THE ELEVATING ARC (POWER).	Candidate traces the flow of power of the power elevating and traversing mechanisms as outlined in TM 9-2350-210-12.

Test No.	Examiner commands—	Action of candidate
5	ADJUST EQUILIBRATORS-----	Candidate adjusts equilibrators as outlined in TM 9-2350-210-12.
6	CHECK THE SCAVENGER SYSTEM--	Candidate checks the scavenger system as outlined in TM 9-2350-210-12.
7	CHECK THE POWER RAMMER AND AMMUNITION HOIST.	Candidate checks the power rammer and ammunition hoist as outlined in TM 9-2350-210-12.

d. Penalties. Penalties will be assessed as follows:

- (1) *Test 1.* If candidate fails to disassemble or assemble the breech mechanism and firing lock properly, 6 points; explain the proper maintenance, 3 points.
- (2) *Test 2.* If candidate fails to establish proper replenisher oil reserve, 6 points.
- (3) *Tests 3, 4, 6, and 7.* If candidate fails to explain functions and procedures as outlined in given references, examiner will evaluate a grade commensurate with the knowledge of the candidate.
- (4) *Test 5.* No credit will be given if candidate fails to adjust equilibrators properly.

e. Credits. Subject to penalties assessed in *d* above, maximum credit for tests 1 through 5, 6 points each; tests 6 and 7, 5 points each.

163. 175-MM Gun M107 and 8-Inch Howitzer M110, Self-Propelled

a. Scope of Tests. Six tests will be conducted to determine candidate's knowledge of functioning, nomenclature, and maintenance of the 175-mm gun and 8-inch howitzer M110 to include—

- (1) Barrel and breech.
- (2) Recoil.
- (3) Elevating and traversing mechanism (power).
- (4) Equilibrators.
- (5) Power rammer and ammunition hoist.
- (6) Traveling lock.

b. Special Instructions. Unit will furnish candidate with one 175-mm gun and the necessary tools. Weapon will have improperly adjusted equilibrators.

c. Outline of Test.

Test No.	Examiner commands--	Action of candidate
1	DISASSEMBLE AND ASSEMBLE THE OBTURATOR SPINDLE ASSEMBLY TO INCLUDE THE FIRING LOCK. EXPLAIN PROPER MAINTENANCE OF THE TUBE AND BREECH MECHANISM BEFORE AND AFTER FIRING.	Candidate disassembles and assembles the obturator spindle assembly to include firing lock as outlined in TM 9-2300-216-10.
2	EXPLAIN PURPOSE OF REPLENISHER AND OIL RESERVE IN RECUPERATOR.	Candidate explains purpose of replenisher and oil reserve in recuperator as outlined in TM 9-2300-216-10.
3	TRACE THE POWER TRAIN OF THE ELEVATING AND TRAVERSING MECHANISMS FROM THE HANDWHEELS TO THE BASE RING AND RACE AND THE ELEVATING ARC.	Candidate traces the flow of power of the power elevating and traversing mechanisms as outlined in TM 9-2300-216-10.
4	ADJUST EQUILIBRATORS.-----	Candidate adjusts equilibrators as outlined in TM 9-2300-216-10.
5	CHECK POWER RAMMER AND AMMUNITION HOIST.	Candidate checks the power rammer and ammunition hoist as outlined in TM 9-2300-216-10.
6	EXPLAIN PURPOSE AND ADJUSTMENT OF TRAVELING LOCK.	Candidate explains purpose and adjustment of traveling lock as outlined in TM 9-2300-216-20.

d. Penalties. Penalties will be assessed as follows:

- (1) *Test 1.* If candidate fails to disassemble or assemble the obturator spindle assembly or the firing lock properly, 7 points; explain the proper maintenance, 3.5 points.
- (2) *Tests 2, 3, 5, and 6.* If candidate fails to explain functions and procedures as outlined in the references, examiner will award a grade commensurate with the knowledge of the candidate.
- (3) *Test 4.* No credit will be given if candidate fails to adjust equilibrators properly.

e. Credits. Subject to penalties assessed in *d* above, full credit will be given to the candidate, as indicated below:

- (1) Tests 1, 2, 4 and 5; 7 points each.
- (2) Tests 3 and 6; 6 points each.

164. 280-MM Gun

a. *Scope of Tests.* Six tests will be conducted to determine the candidate's knowledge of functioning, nomenclature, and maintenance of the 280-mm gun, to include—

- (1) Barrel and breech.
- (2) Recoil (primary).
- (3) Recoil (secondary).
- (4) Elevating and traversing mechanisms.
- (5) Equilibrators.
- (6) Power elevation and power rammer.

b. *Special Instructions.* Unit will furnish candidate with the weapon and necessary tools.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	DISASSEMBLE AND ASSEMBLE THE BREECH MECHANISM. EXPLAIN MAINTENANCE OF TUBE BEFORE AND AFTER FIRING. (Prior to the test the breech mechanism must be removed from the carrier and placed on a tarp.)	Candidate disassembles and assembles breech mechanism as outlined in TM 9-338-1 for the 280-mm gun.
2	DRAIN AND ESTABLISH THE OIL RESERVE IN THE PRIMARY RECOIL MECHANISM. CHECK NITROGEN PRESSURE AND DECREASE OR INCREASE PRESSURE AS REQUIRED.	Candidate drains and establishes the oil reserve. Checks and decreases or increases nitrogen pressure as outlined in TM 9-338-1 for the 280-mm gun.
3	DRAIN AND ESTABLISH OIL RESERVE IN THE SECONDARY RECOIL SYSTEM. CHECK NITROGEN PRESSURE AND DECREASE OR INCREASE PRESSURE AS REQUIRED.	Candidate drains and establishes the oil reserve. Checks and decreases or increases the nitrogen pressure as outlined in TM 9-338-1 for the 280-mm gun.
4	EXPLAIN THE PROPER CHECK FOR BACKLASH IN THE ELEVATING AND TRAVERSING MECHANISMS.	Candidate explains proper check for backlash. See TM 9-338-1.
5	ADJUST EQUILIBRATORS.-----	Candidate adjusts equilibrators as outlined in TM 9-338-1.
6	CHECK THE POWER SYSTEM FOR THE POWER RAMMER AND POWER ELEVATION.	Candidate checks the power system for operation as outlined in TM 9-3019.

d. Penalties. Penalties will be assessed as follows:

- (1) *Test 1.* If candidate fails to disassemble or assemble the breech mechanism properly, 7 points; explain the proper maintenance, 4 points.
- (2) *Tests 2 and 3.* If candidate fails to establish proper oil reserve and nitrogen pressure, 4 points each.
- (3) *Tests 4, and 6.* If candidate fails to explain functioning and procedures as outlined in references, examiner will award a grade commensurate with the knowledge of the candidate.
- (4) *Test 5.* No credit will be given if candidate fails to adjust equilibrators properly.

e. Credits. Subject to penalties assessed in *d* above, maximum credit for tests 1, 2, 3, and 5, 7 points each; tests 4 and 6, 6 points each.

Section III. BORESIGHTING, PERIODIC TESTS AND ON-CARRIAGE FIRE CONTROL EQUIPMENT

165. Boresighting, Periodic Tests, and On-Carriage Fire Control Equipment

a. Scope of Tests. Three tests will be conducted to determine the candidate's knowledge of boresighting, periodic tests, and unit maintenance of on-carriage fire control equipment.

b. Special Instructions. The candidate will be furnished an artillery piece assigned the unit, boresighting equipment, and on-carriage fire control equipment.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	BORESIGHT USING TWO METHODS APPLICABLE TO UNITS' PRIMARY WEAPON.	Candidate boresights weapon.
2	PERFORM BASIC PERIODIC TESTS...	Candidate levels trunnions.* Makes end-for-end test on gunner's quadrant. Tests sight mount and panoramic telescope. Tests elbow telescope and range quadrant.*
3	DEMONSTRATE THE PROPER METHOD OF CLEANING ON-CARRIAGE FIRE CONTROL EQUIPMENT AND EXPLAIN CARE EXERCISED WHEN UNUSUAL WEATHER CONDITIONS PREVAIL.	Candidate demonstrates proper method for cleaning fire control equipment as outlined in TM 9-575.

*On applicable weapons.

d. Penalties. Penalties will be assessed as follows:

- (1) *Tests 1 and 2.* No credit will be allowed if candidate fails to boresight or perform basic periodic tests in the proper manner.
- (2) *Test 3.* If candidate fails to explain functioning and procedures as outlined in references, examiner will award a grade commensurate with the knowledge of the candidate.

e. Credits. Subject to the penalties assessed in *d* above, credit will be awarded as indicated below:

- (1) *Test 1.* For each method of boresighting performed correctly, 5 points; maximum credit, 10 points.
- (2) *Test 2.* Maximum credit, 6 points.
- (3) *Test 3.* Maximum credit, 4 points.

Section IV. SMALL ARMS

166. General

In cannon artillery units, the artillery mechanic is normally responsible for organizational maintenance of small arms as well as the primary weapons of the unit. In missile batteries and all headquarters and service batteries, however, the armorer has the responsibility for organizational maintenance of small arms. Unit commanders should delete paragraphs 157 through 165 when testing individuals whose primary duty is as the unit armorer. Artillery mechanics should be capable of completing the test for paragraphs 157 through 170.

167. Scoring

The scoring for this section is not shown numerically since the types of small arms issued field artillery units vary and the point scores would not be valid. A commander should review the types of small arms weapons issued to his unit and make his own evaluation as to the points to be awarded for each test. As a guide, the following weapons are listed in order of difficulty in detailed stripping with the first weapons listed being the most difficult.

- a.* Machineguns, caliber .30 and caliber .50.
- b.* Rifle, M1 and M14.
- c.* Carbine, M2 or M3; pistol, caliber .45.
- d.* Machinegun, M60; grenade launcher, M79.
- e.* Rocket launcher, 3.5-inch.

168. Small Arms

a. Scope of Tests. Seventeen tests will be conducted to determine the candidate's knowledge of—

- (1) Detail stripping and assembly of small arms.
- (2) Nomenclature.
- (3) Causes of malfunctions and corrective actions.
- (4) Proper care and maintenance.

b. Special Instructions. Each candidate will be furnished the weapons listed below. Tests for weapons not issued the unit may be omitted.

- .30 cal rifle, M1.
- .30 cal carbine, M2 or M3.
- .45 cal pistol.
- Grenade launcher, M79.
- .30 cal machinegun.
- .50 cal machinegun.
- 7.62-mm rifle.
- 7.62-mm machinegun.
- 3.5-inch rocket launcher.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS OF .30 CAL RIFLE, M1.	Candidate detail strips and names all parts. FM 23-5.
2	CLIP JUMPS OUT ON SEVENTH ROUND WHEN FIRING .30 CAL RIFLE, M1. GIVE CAUSE AND CORRECTIVE ACTION.	Bent follower rod. Replace follower rod.
3	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS OF .30 CAL CARBINE, M2 (M3).	Candidate detail strips and names all parts. FM 23-7.
4	.30 CAL CARBINE, M2 (M3) FIRES IN BURST OF TWO OR THREE ROUNDS WHEN SELECTOR IS TO REAR OR IN SEMIAUTOMATIC POSITION. GIVE CAUSES AND CORRECTIVE ACTION.	Causes: Sear broken or worn. Correction: Replace sear.
5	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS OF .45 CAL PISTOL.	Candidate detail strips and names all parts. FM 23-35.
6	GIVE CAUSES AND CORRECTIVE ACTION FOR THE FOLLOWING MALFUNCTIONS, .45 CAL PISTOL: a. FAILURE OF RIGHT SEAR SPRING LEAF TO HOLD GRIP SAFETY OUT. b. FAILURE TO EXTRACT-----	a. Cause: Sear weak or broken. Correction: Replace sear spring. b. Cause: Broken extractor claw, weak spring action of extractor. Correction: Replace claw or spring.
7	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS OF THE GRENADE LAUNCHER, M79.	Candidate detail strips and names all parts. TM 9-1010-205-12.

Test No.	Examiner commands—	Action of candidate
8	EXPLAIN THE PROPER PROCEDURE FOR CLEANING AND LUBRICATING THE GRENADE LAUNCHER, M79.	Explains procedure as described in TM 9-1010-205-12.
9	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS FOR .30 CAL MACHINEGUN.	Candidate detail strips and names all parts. FM 23-55.
10	AFTER .30 CAL MACHINEGUN HAS BEEN FIRED EXPLAIN THE PROPER PROCEDURE FOR CLEANING AND LUBRICATING.	Clean daily for 3 or more days after firing, using one of the following: <ul style="list-style-type: none"> a. Bore cleaner. b. GI soap and hot water. c. Water. Lubricate with one of the following: <ul style="list-style-type: none"> a. Oil, lubricating, preservative, special. b. Oil, lubricating, preservative, light. c. Oil, lubricating, preservative, medium. d. Aircraft, instrument, machinegun oil (A.I.M.O.). e. SAE No. 10 or 30.
11	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS OF .50 CAL MACHINEGUN.	Candidate detail strips and names all parts. FM 23-65.
12	MAKE ADJUSTMENT WITH HEADSPACE GAGE	Candidate makes adjustment using headspace gage.
13	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS OF 7.62-MM RIFLE.	Candidate detail strips and names all parts. FM 23-8.
14	RIFLE FAILS TO EJECT. GIVE CAUSE AND CORRECTIVE ACTION.	Broken ejector or weak ejector spring. Replace faulty part.
15	DETAIL STRIP, NAME AND REASSEMBLE ALL THE PARTS OF 7.62-MM MACHINEGUN.	Candidate detail strips and names all parts. FM 23-67.
16	AFTER 7.62-MM MACHINEGUN HAS BEEN FIRED EXPLAIN THE PROPER PROCEDURE FOR CLEANING AND LUBRICATING.	Candidate explains procedures as outlined in FM 23-67.
17	EXPLAIN THE CARE AND MAINTENANCE OF THE 3.5-INCH ROCKET LAUNCHER.	Explains procedures as described in FM 23-32.

d. Penalties. Penalties will be assessed as follows:

- (1) The full cut will be assessed for each test where the candidate fails to do properly any of the following:
 - (a) Detail strip or reassemble the weapon correctly. (Stripping and reassembling should always be included as part of the same test.)
 - (b) Give the proper cause(s) for a malfunction or indicate the proper corrective action.
 - (c) Explain the proper maintenance for the weapon involved.
- (2) For each major component part the candidate fails to name, or names incorrectly, cut 10 percent of the points assigned to that test.
- (3) If candidate fails to name correctly 8 or more component parts, cut 25 percent of the points assigned to that test.

e. Credits. Subject to penalties assessed in *d* above, full credit will be given the candidate if he satisfactorily performs tests as outlined.

Section V. AMMUNITION

169. Ammunition

a. Scope of Test. Seven tests will be conducted to determine candidate's knowledge of storage, marking and nomenclature of ammunition.

- (1) Storage of artillery ammunition.
- (2) Deep cavitized projectile.
- (3) Classification of artillery ammunition.
- (4) Complete round.
- (5) Projectile.
- (6) Small arms ammunition.
- (7) 3.5-inch rocket ammunition.

b. Special Instructions. Unit will furnish candidate with a marked projectile and one round of 3.5-inch rocket ammunition.

c. Outline of Test.

Test No.	Examiner commands—	Action of candidate
1	EXPLAIN HOW THE PROJECTILES ARE STORED IN BATTERY: a. NUMBER OF ROUNDS IN A STACK. b. NUMBER OF LAYERS IN A STACK. c. DISTANCE BETWEEN STACKS.	Candidate explains proper storage of projectiles as outlined in appropriate FM's.
2	EXPLAIN THE PURPOSE OF THE DEEP CAVITIZED PROJECTILE AND HOW IT CAN BE IDENTIFIED.	Candidate explains the purpose and identifying mark of the deep cavitized projectile as outlined in appropriate weapon TM.

Test No.	Examiner commands--	Action of candidate
3	DEFINE THE FOUR CLASSIFICATIONS OF AMMUNITION ACCORDING TO USE.	Candidate defines the four classifications of ammunition as outlined in TM 9-1300-203.
4	NAME THE COMPONENTS OF A COMPLETE ROUND OF AMMUNITION.	Candidate names the components of a complete round of ammunition as outlined in TM 9-1300-203.
5	IDENTIFY THE FOLLOWING PROJECTILES FROM THE COLOR DESCRIPTION: a. OLIVE-DRAB b. GREY c. BLUE d. BLACK	Candidate identifies the type of projectile from color description as outlined in TM 9-1300-203.
6	IDENTIFY THE FOLLOWING TYPE ROUNDS OF SMALL ARMS AMMUNITION FROM THE COLOR OF THE TIPS OF THE BULLETS: a. NO COLOR b. BLACK c. BLUE d. RED	Candidate names the four types of bullets as outlined in TM 9-1900.
7	NAME AND IDENTIFY THE COMPONENTS OF A COMPLETE ROUND OF 3.5-INCH ROCKET LAUNCHER AMMUNITION.	Candidate identifies and names the four component parts of a complete round of 3.5-inch rocket launcher ammunition as outlined in FM 23-32.

d. Penalties. Penalties will be assessed for *all tests* as follows—if candidate fails to explain, define, or otherwise show a sufficient knowledge of the subject, examiner will award a grade commensurate with the knowledge of the candidate.

e. Credits. Subject to penalties assessed in *d* above, full credit will be given to the candidate, as indicated below:

- (1) Tests 1, 3, 4 and 6—3 points each.
- (2) Tests 2 and 7—2 points each.
- (3) Test 5—4 points.

Section VI. PUBLICATIONS, FORMS, AND RECORDS

170. Publications, Forms, and Records

a. Scope of Tests. Two tests will be conducted to determine the candidate's knowledge of publications, forms and records and their use.

b. Special Instructions.

- (1) The examining officer will read each question through slowly to the candidate two times.
- (2) The candidate will be allowed 2 minutes, if desired, to consider the question, prior to making his answer.
- (3) Candidate will be furnished a copy of the applicable ORD 7.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	<p>ANSWER EACH QUESTION ASKED. (Examiner chooses 8 questions from the list below.)</p> <ol style="list-style-type: none"> 1. What DA publications prescribed training for the individual soldier? 2. Name the DA publication used to record the history of an artillery weapon. 3. To what publication would you refer for the listing of available standard nomenclature lists? 4. Repairs or changes to an item of equipment to build in safety features or to improve its working quality would be printed under what title? 5. What number ORD SNL is used by the using organization (battery or company) to determine its authorization of spare parts and equipment? 6. What number series of field manuals pertain to Field Artillery? 7. What letter groups of ORD publications lists all types of ammunition? 8. What letter group in the ORD publications lists standard hardware items? 9. What DA publication lists the prescribed lubricants and the interval of use? 10. ORD 9 SNL (list of all parts) is used for what purpose? 11. What ORD publication is a stock guide for ordnance units? 12. What DA publications describe organizational maintenance on materiel? 	<p>FM's.</p> <p>Equipment Log.</p> <p>ORD 1.</p> <p>Modification work order (MWO).</p> <p>ORD 7.</p> <p>Series 6.</p> <p>PRS&T.</p> <p>H.</p> <p>Lubrication Order (LO).</p> <p>Identification and storage.</p> <p>ORD 8.</p> <p>TM's.</p>
2	<p>USING AN ORD 7, GIVE FOLLOWING INFORMATION: STOCK NUMBER AND AUTHORIZATION OF FOLLOWING SPARE PARTS OR ITEMS OF EQUIPMENT.</p> <p>(Examiner selects 4 items from the ORD 7 and gives the names of the items to the candidate.)</p>	<p>Candidate will determine the information from the ORD 7 provided by the examiner.</p>

d. Penalties. A one point penalty will be assessed for each incorrect or incomplete answer.

e. Credits. Subject to penalties assessed in *d* above, credit will be given the candidate as indicated below:

- (1) *Test 1.* 0.75 point for each correct answer; maximum credit, 6 points.
- (2) *Test 2.* One point for each correct answer; maximum credit, 4 points.

CHAPTER 12

MOTORS PERSONNEL

Section I. GENERAL

171. Qualification Tests

The tests for qualification of motors personnel are grouped in five separate tests, as follows:

- a. Drivers, general.
- b. Drivers, wheeled vehicles.
- c. Drivers, track vehicle.
- d. Mechanics, wheeled vehicles.
- e. Mechanics, track vehicle.

172. Drivers

Before taking the tests prescribed in paragraphs 175 through 185, driver candidates must qualify as drivers under the provisions of TM 21-300 or TM 21-301. All driver candidates will be required to complete satisfactorily the test for drivers, general, as prescribed in paragraphs 175 through 177. In addition, candidates will be required to complete satisfactorily the tests prescribed in paragraphs 178 through 181 or 182 through 185, depending on the type of vehicle for which they are to qualify. An additional reference for driver selection is AR 600-55.

173. Vehicles

a. *Drivers.* Each candidate for driver qualification will be tested on the vehicle used as a prime mover in his particular unit. Candidates of headquarters batteries, service batteries, and other units not having towed weapons will be tested on the largest wheeled vehicle with which their particular units are equipped, and which is used for towed loads.

b. *Mechanics.* Each candidate for mechanic qualification, wheeled vehicles, will be tested on all types of wheeled vehicles in his unit. The track vehicle mechanic will be tested on all types of track vehicles in his unit.

174. Use of Technical Manuals

The technical manual appropriate to the particular vehicle will be available to the candidate for reference. The examiner will authorize its use only for those tests in which adjustments to given specifications are required; for example, test 5 and test 8 of paragraph 188.

Section II. DRIVERS, GENERAL

175. Outline of Test

Par. No.	Subject	Number of tests	Points each	Maximum credit
176	Driver information.....	3	-----	15
	Test 1.....	(1)	4	(4)
	Test 2.....	(1)	8	(8)
	Test 3.....	(1)	3	(3)
177	Map reading.....	6	-----	20
	Tests, 1, 2, 4, 5, and 6.....	(5)	3	(15)
	Test 3.....	(1)	5	(5)
	Total.....	9	-----	35

176. Driver Information

a. Scope of Tests. Three tests will be conducted to determine the candidate's—

- (1) Knowledge of the rules of the road.
- (2) Ability to give and understand hand signals.
- (3) Ability to make out the required driver's forms.

b. Special Instructions.

- (1) *Tests 1 and 2.* A street diagram and a number of model vehicles will be provided for these tests.

- (2) *Test 3.*

(a) The candidate will be furnished the following forms:

1. Vehicle and equipment operational record with Equipment Log Book and DA Form 2404 and/or DA Form 2400 and DA Form 2404.

2. Accident Report—Standard Form 91.

3. Accident Report—DD Form 518.

- (b) A wheeled vehicle and/or a track vehicle of any type will be available to the candidate.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	GIVE TWELVE RULES OF THE ROAD. (When possible the examiner sets up a situation for each rule, using model vehicles.) (See TM 21-305 and/or TM 21-306.)	Moves model vehicles to demonstrate rules, or answers questions orally.
2	a. DEMONSTRATE EIGHT HAND SIGNALS. (Examiner calls off signals to be given.) b. EXPLAIN THE MEANING OF THESE HAND SIGNALS. (Examiner gives eight hand signals.) (See TM 21-305 or TM 21-306.)	a. Demonstrates signals as called off by examiner. b. Explains meaning of signals given by examiner.
3	a. MAKE OUT THIS VEHICLE AND EQUIPMENT OPERATIONAL RECORD. (Examiner gives candidate a mission, indicates vehicle, and gives him a vehicle and equipment operational record.) (See TM 38-750.) b. COMPLETE THIS ACCIDENT REPORT, AND EXPLAIN WHAT YOU DO WITH IT AFTER COMPLETING THE REPORT. (Examiner sets up assumed accident, using street diagram and model vehicles.) (See TM 21-305 or TM 21-306.)	a. Accomplishes vehicle and equipment operational record, taking actual data from vehicle. b. Completes accident report and explains disposition.

d. Penalties. No penalties are provided for these tests.

e. Credit.

- (1) *Test 1.* A credit of one-third point will be allowed for each rule of the road correctly demonstrated or explained.
- (2) *Test 2.* A credit of 0.5 point will be allowed for each hand signal correctly demonstrated or explained.
- (3) *Test 3.* A credit of 1.5 points will be allowed for each form correctly accomplished.

177. Map Reading

a. Scope of Tests. Six tests will be conducted to determine the candidate's ability to read road maps and military maps.

b. Special Instructions.

- (1) The candidate will be furnished a road map and a military map of a scale not smaller than 1:50,000.

- (2) In tests involving direction or distance, considerable latitude will be allowed. Directions will be given by points of the compass rather than as azimuths; for example, northeast, southwest. Distances will be given in miles and tenths of a mile, coordinates to the nearest 100 meters.
- (3) In test 3, the selected conventional signs will be those of particular interest to a driver, such as various types of roads, railroads, and bridges.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	a. LOCATE THIS POINT ON THE MAP (giving reference numbers and letters). b. GIVE THE APPROXIMATE COORDINATES OF THIS POINT (indicating point on military map)	a. Indicates point on road map. b. Estimates coordinates and reports.
2	DETERMINE THE DISTANCE BETWEEN THESE TWO POINTS (indicating on either map).	Estimates distance to nearest 0.2 mile.
3	GIVE THE MEANING OF THESE TEN CONVENTIONAL SIGNS (pointing to either map).	Identifies signs as examiner points them out.
4	YOU ARE AT POINT A (indicating on map). STATE THE DIRECTION OF POINT B FROM POINT A (second point on map).	Estimates direction and reports it.
5	DETERMINE, BY INSPECTION OF THE MAP, THE BEST ROUTE BETWEEN THESE TWO POINTS (indicating two widely spaced points).	Traces the best route on the map.
6	DEFINE A STRIP MAP, AND EXPLAIN ITS PURPOSE (TM 21-305).	Describes strip map.

d. Penalties and Credit. No penalties are provided for these tests. Credit will be awarded as follows:

- (1) *Test 1.* For each part of the test correctly performed or answered, 1.5 points.
- (2) *Tests 2, 4, 5, and 6.* Each, 3.0 points.
- (3) *Test 3.* For each conventional sign correctly identified, 0.5 point.

Section III. DRIVERS, WHEELED VEHICLES

178. Outline of Test

Par. No.	Subject	Number of tests	Points each	Maximum credit
179	Nomenclature.....	6	-----	20
	Tests 1 and 2.....	(2)	5	(10)
	Tests 3 and 5.....	(2)	3	(6)
	Tests 4 and 6.....	(2)	2	(4)
180	Maintenance.....	4	5	20
181	Driving.....	5	5	25
	Total.....	15	-----	65

179. Nomenclature

a. Scope of Tests. Six tests will be conducted to determine the candidate's knowledge of the nomenclature of the vehicles of his unit, and of the tools and equipment of each vehicle.

b. Special Instructions. A prime mover will be furnished the driver for these tests. Where possible, a stripped chassis is desirable. The vehicle will be at the place where the tests are to be conducted.

c. Outline of Tests.

Test No.	Examiner commands--	Action of candidate
1	TRACE THE POWER TRAIN, POINTING OUT THE PRINCIPAL ELEMENTS.	Traces the power train through the clutch, transmission, propeller shafts and universal joints, transfer case, differential, and axles.
2	TRACE THE IGNITION SYSTEM FROM THE SOURCE OF POWER TO THE SPARK PLUGS, POINTING OUT THE PRINCIPAL ELEMENTS.	Traces ignition system through the battery, ignition switch, ignition coil, condenser, and distributor.
3	POINT OUT THE PRINCIPAL PARTS OF THE FUEL SYSTEM, AND SHOW HOW THE FUEL GETS FROM THE TANK TO THE ENGINE.	Traces fuel system from the fuel tank through the fuel pump and carburetor to the engine.
4	POINT OUT THE WATER PUMP AND THE FAN, AND EXPLAIN THE FUNCTION OF EACH.	Points out parts named and explains their functions.

Test No.	Examiner commands—	Action of candidate
5	POINT OUT THE OIL FILLER PIPE, BREATHER, OIL GAGE, (DIPSTICK) AND OIL PRESSURE GAGE, STATE WHAT OIL LEVEL SHOULD BE MAINTAINED AND HOW MUCH OIL PRESSURE SHOULD REGISTER ON THE GAGE.	Points out parts named, and states oil level and oil pressure.
6	NAME THESE PARTS. (Examiner points, in turn, to the steering gear, pitman arm, drag link, and tie rod and requires the candidate to name each part.)	Names parts indicated.

d. *Penalties.* Penalties in tests 4 and 5 will be assessed as follows:

- (1) *Test 4.* No credit will be allowed if candidate does not know the correct water level to be maintained in the radiator.
- (2) *Test 5.* No credit will be allowed if the candidate does not know the correct oil level to be maintained.

e. *Credit.* Credit will be awarded as follows:

Test No.	Maximum credit	Number of major elements correctly named						Additional credits
		6	5	4	3	2	1	
1	5	5	4	3	2	1	0	Correct explanation of functions—1 point.
2	5	5	4	3	2	1	0	
3	3	-----	-----	-----	3	2	1	
4	2	-----	-----	-----	-----	1	0	
5	3	-----	-----	3	2	1	0	
6	2	-----	-----	2	1.5	1	0	

180. Maintenance

a. *Scope of Tests.* Four tests will be conducted to determine the candidate's knowledge of maintenance and his ability to care for his vehicle and tools.

b. *Special Instructions.*

- (1) A prime mover will be furnished the driver for this test. The tools and equipment which normally accompany the vehicle will be laid out prior to the start of the tests. The driver will be furnished a vehicle and the Equipment Log Book, and DA Form 2404.
- (2) In test 4, the examiner will note the manner in which the candidate uses his tools.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PERFORM THE BEFORE-OPERATION SERVICE.	Performs before-operation service as prescribed in the appropriate vehicle TM. Reports when service is completed, and remains seated in vehicle, engine running.
2	PERFORM THE DURING-OPERATION SERVICE. (Examiner requires candidate to drive the vehicle over a short course.)	Performs during-operation service as prescribed in the appropriate vehicle TM.
3	PERFORM THE AFTER-OPERATION SERVICE. (Examiner requires the candidate to return to the park before directing him to perform this operation.)	Performs after-operation service as prescribed in the appropriate vehicle TM, and explains use of DA Form 2404.
4	DEMONSTRATE THE USE OF EACH TOOL IN THE VEHICLE TOOLKIT.	Demonstrates use of tools.

d. Penalties.

- (1) *Test 1.* No credit will be allowed if the candidate fails to inspect the fuel, oil, and water.
- (2) *Test 4.* No credit will be allowed if the candidate uses pliers in tightening nuts.

e. Credit. A credit of 5 points will be allowed for each test. The examiner will determine the credit to be allowed for each operation required by the Equipment Log Book and DA Form 2404, according to their application.

181. Driving

a. Scope of Tests. Five tests will be conducted to determine the candidate's ability to drive a vehicle towing an artillery piece or other towed load, and to employ a limited number of field expedients.

b. Special Instructions.

- (1) The following equipment will be furnished the candidate:
 - (a) Prime mover, with piece or loaded trailer coupled.
 - (b) A snatch block of the size issued to the candidate's unit.
 - (c) Tow rope or tow chain, and material suitable for use as a spreader bar.
 - (d) Log or other material suitable for a deadman.
 - (e) Pioneer tools.
 - (f) A second vehicle of any type to be used in test 5.
- (2) The candidate will be furnished one assistant to aid him in

backing, in handling the cable, and in constructing the deadman.

- (3) If it is impracticable to use a deadman in test 3, the examiner may direct the use of another vehicle, a tree, or other suitable anchor. The candidate should be able, however, to explain the use and construction of a deadman.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DRIVE AND BACK THIS VEHICLE. (Examiner requires candidate to drive and back the vehicle with a towed load.)	Drives and backs vehicle as directed.
2	CONSTRUCT A DEADMAN. (Examiner selects favorable location.)	Constructs deadman as directed, using assistant as necessary.
3	USE THE WINCH TO ASSIST IN MOVING THE VEHICLE	Makes the winch cable fast to the deadman installed for test 2. Moves vehicle by means of the winch.
4	RIG THE SNATCH BLOCK TO INCREASE THE PULLING POWER OF THE WINCH.	Makes the snatch block fast to the deadman. Rigs the cable through the block. Moves the vehicle by means of the winch. (See TM 21-305.)
5	DEMONSTRATE THE PRESCRIBED METHOD OF TOWING THIS VEHICLE (indicating). (See b(1)(f) above.)	Attaches tow rope or chain and spreader bar. Takes up the slack, and prepares to tow the vehicle.

d. Penalties. Penalties will be assessed as follows:

(1) *Test 1.*

(a) If vehicle and towed load "jackknife" in backing, 1 point.

(b) If candidate turns the wheels in the wrong direction, 1 point.

(c) If candidate fails to request guidance in backing, 3 points.

(2) *Test 2.* If the deadman pulls out when used in test 3, no credit will be allowed.

(3) *Test 3.* If the winch shearpin breaks, no credit will be allowed.

(4) *Test 4.* Same as test 3.

(5) *Test 5.* No credit will be allowed if the candidate fails to use a spreader bar.

e. Credit. Subject to the penalties assessed in *d* above, the candidate will be awarded a maximum credit of 5 points for each test successfully completed.

Section IV. DRIVERS, TRACK VEHICLES

182. Outline of Test

Par. No.	Subject	Number of tests	Points each	Maximum credit
183	Nomenclature.....	6	-----	20
	Tests 1, 2, and 3.....	(3)	2	(6)
	Tests 4 and 5.....	(2)	5	(10)
	Test 6.....	(1)	4	(4)
184	Maintenance.....	4	5	20
185	Driving and field expedients.....	5	-----	25
	Test 1.....	(1)	7	(7)
	Tests 2 and 3.....	(2)	4	(8)
	Tests 4 and 5.....	(2)	5	(10)
	Total.....	15	-----	65

183. Nomenclature

a. Scope of Tests. Six tests will be conducted to determine the candidate's knowledge of the nomenclature of the track vehicles of his unit.

b. Special Instructions.

- (1) The candidate will be required to name only principal parts or assemblies. For example, the principal elements of the power train, self-propelled, 155-mm howitzer, M44, are the engine, transmission universal joints, and drive sprockets. (See technical manual appropriate to the particular vehicle.)
- (2) The candidate will be furnished a track vehicle of the type for which he is to qualify.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	GIVE THE NAME OF THE TRACK VEHICLE AND ITS GENERAL CHARACTERISTICS, INCLUDING: HEIGHT, WIDTH, WEIGHT, FORDING DEPTH, AND NUMBER OF SPEEDS.	Names track vehicle and gives its characteristics as set forth in appropriate technical manual.

Test No.	Examiner commands—	Action of candidate
2	TRACE THE FLOW OF FUEL, AND EXPLAIN THE FUNCTIONING OF THE ENGINE FROM THE START OF THE INTAKE STROKE UNTIL THE POWER IS DELIVERED TO THE TRANSMISSION.	Points out and names the fuel tank, pump, filter, and lines. Explains what happens within the engine during each of the four strokes of operation, using correct nomenclature for major parts such as cylinders, pistons, and crank shaft.
3	TRACE THE ELECTRICAL SYSTEM FROM THE SOURCE OF VOLTAGE TO THE SPARK PLUGS, NAMING THE PRINCIPAL ELEMENTS OF THE SYSTEM.	Traces the electrical system from the storage battery to the sparkplugs or from the magneto to the spark plugs, pointing out the principal elements:
4	POINT OUT AND NAME THE PRINCIPAL ELEMENTS OF THE POWER TRAIN, AND EXPLAIN HOW POWER IS TRANSMITTED FROM THE ENGINE TO THE TRACKS.	Traces the power train from the engine to the tracks, pointing out and naming the principal elements.
5	a. NAME THE TYPES OF BRAKES WITH WHICH THIS VEHICLE IS EQUIPPED, AND TELL HOW THEY ARE APPLIED. b. POINT OUT THE TRACKS, IDLERS, TRACK SUPPORT ROLLERS, AND SPROCKETS.	a. Names types of brakes (air, electric, mechanical), and indicates method of applying them. b. Indicates required parts.
6	NAME THE TYPE OF STEERING SYSTEM THIS TRACK VEHICLE HAS, AND EXPLAIN HOW IT FUNCTIONS.	Explains steering system in general terms.

d. Penalties and Credit. No penalties are provided for these tests. Credit is based on the percentage of correct answers to questions asked. The maximum credit for these tests is given in paragraph 182.

184. Maintenance

a. Scope of Tests. Four tests will be conducted to determine the candidate's knowledge of maintenance and his ability to care for his vehicle and tools.

b. Special Instructions.

- (1) A track vehicle will be furnished the candidate. The tools and equipment which normally accompany the vehicle will be in place on the vehicle.

(2) The candidate will be furnished a vehicle and Equipment Log Book and DA Form 2404.

(3) Prior to the start of the tests, the examiner will map out a short driving course.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	PERFORM THE BEFORE-OPERATION SERVICE.	Performs before-operation service as prescribed in the appropriate technical manual. (Reports when service is completed and leaves engine running.)
2	PERFORM THE DURING-OPERATION SERVICE. (Examiner requires candidate to drive the vehicle over a short course.) (See b(3) above.)	Performs the required service as prescribed in appropriate technical manual.
3	RETURN TO PARK AND PERFORM THE AFTER-OPERATION SERVICE.	Performs the prescribed service and explains use of DA Form 2404.
4	DEMONSTRATE THE USE AND MAINTENANCE OF EACH TOOL IN THE VEHICLE TOOLKIT.	Demonstrates use of tools and maintenance required in each case.

d. Penalties. In test 1, penalties will be assessed as follows:

(1) Failure to inspect fuel, oil, and cooling system, 5 points.

(2) Failure to inspect tracks for proper tension, 2 points.

e. Credit. Maximum credit allowed for each test is given in paragraph 182. The examiner will determine the credit to be allowed for each operation required by the Equipment Log Book and DA Form 2404 appropriate technical manual on a percentage basis, according to their application to the particular vehicle.

185. Driving and Field Expedients

a. Scope of Test. Five tests will be conducted to determine the candidate's ability to drive a track vehicle towing an artillery piece or other towed load, and to employ a limited number of field expedients.

b. Special Instructions. The following equipment and personnel will be furnished the candidate:

(1) Track vehicle with piece or loaded trailer coupled.

(2) Tow cable.

(3) Pioneer tools.

(4) One assistant to aid the candidate in backing and in handling the cable.

(5) A second vehicle of any type for use in test 2.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DRIVE AND BACK THIS VEHICLE. (Examiner requires the candidate to drive the track vehicle over a short course, and to back into a designated position with a towed load.)	Drives and backs track vehicle and towed load as directed.
2	DEMONSTRATE THE PRESCRIBED METHOD OF TOWING THIS VEHICLE (indicating second vehicle). (See <i>b(5)</i> above.)	Attaches tow cable. Demonstrates towing the vehicle.
3	USE THE WINCH TO ASSIST IN MOVING THE TRACK VEHICLE.	Makes the winch cable fast to a tree or other anchor. Moves track vehicle with assistance of winch.
4	THIS ROAD WHEEL (pointing) IS BROKEN. USE A FIELD EXPEDIENT TO PERMIT THIS TRACK VEHICLE TO CONTINUE IN OPERATION UNTIL REPAIRS CAN BE MADE.	Removes road wheels and secures support arm.
5	DEMONSTRATE A METHOD OF ASSISTING THE TRACK VEHICLE TO CLIMB THIS HILL WITHOUT USING THE WINCH.	Makes one end of cable fast to a suitable anchor, the other end to a track. Demonstrates method of moving track vehicle by braking one track. (See TM 21-306.)

d. Penalties. Penalties will be assessed as follows:

(1) *Test 1.*

- (a) If vehicle and towed load "jackknife" in backing, 1 point.
- (b) If candidate brakes wrong track in steering, 1 point.

(2) *Test 2.* If the candidate fails to use cables correctly, no credit will be allowed.

(3) *Test 3.* No credit will be allowed if—

- (a) Candidate tries to move track vehicles with winch alone.
- (b) Winch shear pin breaks under stress.

e. Credit. Subject to the penalties assessed in *d* above, maximum credit for each test successfully completed is shown in paragraph 182.

Section V. MECHANICS, WHEELED VEHICLES

186. Outline of Test

Par. No.	Subject	Number of tests	Points each	Maximum credit
187	Maintenance.....	3	-----	5
	Test 1.....	(1)	1	(1)
	Tests 2 and 3.....	(2)	2	(4)
188	Engine.....	9	-----	20
	Tests 1, 3, 4, 7 and 9.....	(5)	2	(10)
	Test 6.....	(1)	1	(1)
	Tests 2, 5, and 8.....	(3)	3	(9)
189	Electrical system.....	15 or 16	-----	31
	Test 1.....	(1)	2	(2)
	Test 2.....	(3)	2	(6)
	Test 3a or b.....	(1)	2	(2)
	Test 3c.....	(1)	2	(2)
	Test 4a.....	(1)	2	(2)
	Test 4b.....	(1)	1	(1)
	Test 4c, d, e, or f (one test only).....	(1)	2	(2)
	Test 4g or h (one test only).....	(1)	2	(2)
	Test 4i ¹	(1)	3	
	Test 5a-d.....	(4)	2	(8)
	Test 5e or f.....	(1)	2	(2)
	Test 6.....	(1)	2	(2)
190	Power train.....	12 or 13	-----	24
	Test 1.....	(1)	2. 5	(2. 5)
	Test 2a.....	(1)	2	(2)
	Test 2b-e.....	(4)	1. 5	(6)
	Test 3 ²	(1)	3	
	Tests 4 and 5.....	(2)	2	(4)
	Test 6a.....	(1)	3	(3)
	Test 6b.....	(1)	2	(2)
	Test 6c ³	(1)	1	
	Test 6d ³	(1)	4	
	Test 7a-e (three tests only).....	(3)	1. 5	(4. 5)
191	Chassis.....	7	-----	20
	Test 1a.....	(1)	4	(4)
	Test 1b or c.....	(1)	3	(3)
	Test 2a.....	(1)	3	(3)
	Test 2b.....	(1)	1	(1)
	Test 2c.....	(1)	2	(2)
	Test 2d or e.....	(1)	2	(2)
	Test 3.....	(1)	5	(5)
	Total.....	-----	-----	100

¹ On ac charging systems, use test 4i in place of 4b, and 4c, d, e, or f.

² May be given in place of any two of the following tests: 2b, c, d, or e.

³ Test 6c and 6d can be given in place of 6a and 6b. Note change in value of tests.

187. Maintenance

a. *Scope of Tests.* Three tests will be conducted to determine the candidate's general knowledge of the organization for maintenance, forms and records, and the common terms used in maintenance work.

b. *Special Instructions.* The candidate will be furnished DA Form 2404.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	NAME THE THREE CATEGORIES AND THE FIVE ECHELONS OF MOTOR MAINTENANCE AND EXPLAIN WHERE AND BY WHOM EACH IS PERFORMED.	Outlines, in his own words, the general maintenance organization. (See AR 750-5.)
2	Complete DA Form 2404. (Examiner selects five items from the Preventive Maintenance Service outlined in the appropriate TM and indicates the result of inspection and corrective measures taken on each item.)	Fills in DA Form 2404 as prescribed in the vehicle TM 38-750.
3	a. DEFINE THE FOLLOWING TERMS USED IN MOTOR MAINTENANCE RECORDS: ADJUST, CLEAN, SPECIAL LUBRICATION, SERVICE, TIGHTEN. b. DEFINE THE FOLLOWING TERMS: TOP DEAD CENTER, FIRING ORDER, VALVE CLEARANCE, TIMING, FREE TRAVEL.	a. Define terms. b. Define terms.

d. *Penalties and Credit.*

- (1) No penalties are provided for these tests. Maximum credit will be awarded as indicated in paragraph 186.
- (2) *Test 2.* A credit of 1 point will be allowed for each form correctly accomplished.
- (3) *Test 3.* A credit of 0.2 point will be given for each term correctly defined.

188. Engine

a. *Scope of Tests.* Nine tests will be conducted to determine the candidate's knowledge of the operation of liquid cooled engines and his ability to perform engine maintenance properly.

b. *Special Instructions.*

- (1) To administer this test, there must be one wheeled vehicle furnished, preferably a 5-ton or smaller. In addition, when the situation permits, it is desirable to have some training

- aids (cutaway engine, engine mockup, or engine schematics and charts).
- (2) Prior to the start of all tests requiring adjustment of an item, the item will be adjusted improperly.
 - (3) The candidate will be furnished the following:
 - (a) A wheeled vehicle (5-ton or smaller) with TM.
 - (b) TM 9-8000.
 - (c) Training aids (if possible).
 - (d) A complete set of general mechanics tools as prescribed in the TOE appropriate to his unit.
 - (e) Seasonal grade lubricating oil (1 quart minimum).
 - (f) Solvent (1 quart minimum).
 - (g) Rag or waste.
 - (h) One assistant to be used as the candidate desires.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	DEMONSTRATE AND EXPLAIN THEORY OF ENGINE OPERATION (use training aid).	Points out and explains 4-stroke cycle engine operation.
2	PERFORM COMPRESSION CHECK.	Tests compression as outlined in appropriate vehicle TM, making wet compression test if necessary, and reports the results. Recommends proper corrective action to be taken.
3	SERVICE AIR CLEANER.....	Performs the required operation as outlined in appropriate vehicle TM.
4	SERVICE OIL FILTER.....	Performs required operation as outlined in appropriate vehicle TM.
5	CHECK AND ADJUST VALVE CLEARANCE.	Performs required operation as outlined in appropriate vehicle TM.
6	EXPLAIN HOW COOLING SYSTEM FUNCTIONS (use trainer).	Explains function of components.
7	ADJUST FAN BELT.....	Performs the required operation as outlined in appropriate vehicle TM.
8	CHECK AND ADJUST CARBURETOR IDLE SPEED AND IDLE MIXTURE.	Performs the required operation as outlined in the appropriate TM, using authorized testing equipment.
9	PERFORM FUEL PUMP CHECKS.	Performs checks as outlined in appropriate TM, using authorized testing equipment and recommends necessary corrective action.

d. Penalties. Where specific penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.

(1) *Tests 2 and 9.* Deduct 0.5 point if candidate does not correctly state what action should be taken.

(2) *Test 6.* No credit will be allowed unless candidate covers at least 4 components.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 186.

189. Electrical System

a. Scope of Tests. Fifteen or sixteen tests will be given (depending on the vehicle used) to determine the candidate's knowledge of automotive electrical systems, and his ability to perform organizational maintenance on the electrical systems of the wheeled vehicles of his unit.

b. Special Instructions.

(1) To facilitate the candidate's explanation of the functions of the various items of electrical equipment, enlarged charts and schematics will be provided whenever possible.

(2) A wheeled vehicle, preferably 5-ton or smaller, will be furnished for these tests.

(3) In tests 4c, d, e, and f, select only one test.

(4) On vehicles with ac charging systems, Test 4i will be used in place of test 4b and test 4c, d, e, or f.

(5) Either test 4g or 4h may be used.

(6) Either test 5e or 5f may be used.

(7) Test 6—use any three of the following eight situations:

(a) Starter turns too slowly or not at all. Trouble in battery, connections, or starter.

(b) Engine cranks but will not start. Trouble in the ignition system.

(c) Engine runs roughly. Trouble is bad spark plugs.

(d) Engine sluggish. Trouble in ignition timing.

(e) No generator charge rate shown. Trouble is faulty regulator or faulty cutout relay.

(f) Excessive generator charge rate. Trouble is faulty regulator.

(g) Low charge rate on ac charging system. Trouble is regulator out of adjustment.

(h) Low generator (ac or dc) output. Trouble is loose fan belt.

Note. Troubles will be introduced singly, the candidate being required to locate one before the next one is placed in the system.

(8) An assistant will be furnished to be used as the candidate sees fit.

(9) The candidate will be furnished the following:

- (a) A complete set of general mechanics tools as prescribed in the TOE appropriate to his unit.
- (b) One low voltage circuit tester.
- (c) One battery hydrometer.
- (d) One multimeter.
- (e) One TM 9-8030.
- (f) One wheeled vehicle (5-ton or smaller) with TM.

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	DEFINE THE FOLLOWING TERMS: VOLT, AMPERE, OHM, CURRENT, NEGATIVE, POSITIVE, DC, AC, OPEN CIRCUIT, GROUNDED CIRCUIT.	Defines terms.
2	BATTERIES----- a. TEST THE SPECIFIC GRAVITY OF THE STORAGE BATTERIES. b. DETERMINE THE ABILITY OF THE BATTERY TO FURNISH CURRENT. c. REMOVE AND REPLACE THE BATTERIES.	Using authorized testing equipment, performs the required operation as outlined in the appropriate vehicle TM and/or TM 9-8030. Tests the specific gravity of the electrolyte, reports results, and states whether or not the battery should be recharged. Tests battery voltage under load (either LVCT load bank or cranking motor). Remove the batteries, cleans terminals and connections, and replaces the batteries.
3	(CRANKING SYSTEM.) (Examiner will test candidate on a or b but not both. Test c will always be given.) a. CHECK BATTERY-TO-STARTER CABLE. b. CHECK STARTING SYSTEM GROUND. c. REMOVE AND REPLACE THE STARTER.	Using the authorized testing equipment, performs the required operation as outlined in the appropriate vehicle TM and/or TM 9-8030. Checks for excessive resistance (voltage drop), reports results, and recommends action to be taken. Checks for excessive resistance (voltage drop), reports results, and recommends action to be taken. Performs the required operation.

Test No.	Examiner commands—	Action of candidate
4	<p data-bbox="232 204 654 257">(CHARGING SYSTEM.) (See b(3), (4), and (5) above.)</p> <p data-bbox="239 336 654 469">a. POINT OUT AND EXPLAIN THE FUNCTION OF THE COMPONENTS OF THE DC OR AC CHARGING SYSTEM (depends on vehicle used).</p> <p data-bbox="239 472 654 495">b. POLARIZE A DC GENERATOR.</p> <p data-bbox="250 552 654 592"><i>Note.</i> Only one of the following four tests will be used: c, d, e, or f.</p> <p data-bbox="239 610 654 663">c. CHECK DC GENERATOR VOLTAGE (generator check).</p> <p data-bbox="239 666 654 719">d. CHECK DC GENERATOR MAXIMUM CHARGE RATE.</p> <p data-bbox="239 795 654 848">e. CHECK VOLTAGE REGULATOR SETTING.</p> <p data-bbox="239 927 654 980">f. CHECK CIRCUIT BREAKER CLOSING VOLTAGE.</p> <p data-bbox="250 1010 654 1051"><i>Note.</i> Only one of the following two tests will be given: g or h.</p> <p data-bbox="239 1068 654 1121">g. CHECK CHARGING SYSTEM GROUND CIRCUIT.</p> <p data-bbox="239 1148 654 1227">h. CHECK AND ADJUST THE VOLTAGE OUTPUT OF THE AC CHARGING SYSTEM.</p> <p data-bbox="239 1231 654 1464">i. CHECK THE RESISTANCE OF THE FIELD CIRCUIT THROUGH THE RECTIFIER OF THE AC CHARGING SYSTEM, AND RECOMMEND THE PROPER CORRECTIVE ACTION. (This test is a substitute for tests b and c, d, e, or f above.)</p>	<p data-bbox="684 204 1048 336">Using authorized testing equipment, performs the required operation as outlined in the appropriate vehicle TM and/or TM 9-8030.</p> <p data-bbox="684 340 1048 442">Points out the components and explains the operation of the components of the charging system.</p> <p data-bbox="684 472 1048 548">Uses vehicle battery to establish desired polarity of the dc generator.</p> <p data-bbox="684 610 1048 663">Checks for generator output voltage at idle speed.</p> <p data-bbox="684 666 1048 795">Checks the maximum charge to determine if the current regulator is functioning properly, and recommends action to be taken.</p> <p data-bbox="684 799 1048 927">Checks voltage output to determine if voltage regulator is functioning properly, and recommends action to be taken.</p> <p data-bbox="684 931 1048 1007">Checks closing voltage of cut-out relay and recommends action to be taken.</p> <p data-bbox="684 1068 1048 1148">Checks for excessive resistance (voltage drop) and recommends action to be taken.</p> <p data-bbox="684 1151 1048 1204">Performs the required operation.</p> <p data-bbox="684 1231 1048 1333">Performs the required operation, reports results, and recommends the proper action to be taken.</p>

Test No.	Examiner commands—	Action of candidate
5	<p>(IGNITION SYSTEM) (See b(6) above.)</p> <p>a. EXPLAIN THE FUNCTION OF THE COMPONENTS OF THE BATTERY IGNITION SYSTEM.</p> <p>b. REMOVE AND REPLACE THE DISTRIBUTOR.</p> <p>c. CHECK AND ADJUST THE ENGINE TIMING.</p> <p>d. CLEAN AND ADJUST THE SPARK PLUGS.</p> <p><i>Note.</i> Only one of the following two tests will be given: e or f.</p> <p>e. CHECK THE PRIMARY CIRCUIT RESISTANCE (continuity check).</p> <p>f. CHECK BREAKER POINT RESISTANCE (breaker point condition).</p>	<p>Using authorized testing equipment, performs the required operation as outlined in the appropriate vehicle TM and/or TM 9-8030.</p> <p>Traces the primary and secondary circuits, explaining the function of components, to include at least 4 components of the primary and 3 components of the secondary.</p> <p>Performs the required operation.</p> <p>Performs the required operation.</p> <p>Performs required operation.</p>
6	<p>TROUBLESHOOT THREE TROUBLES IN THE ELECTRICAL SYSTEMS.</p>	<p>Checks the primary ignition circuit for continuity and recommends action to be taken.</p> <p>Checks the breaker points for excessive resistance and recommends action to be taken.</p> <p>Troubleshoots the system using authorized testing equipment, reports results, and recommends action to be taken.</p>

d. Penalties. Where specific penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.

- (1) *Test 2.* Deduct 0.5 point if candidate does not correctly state if battery needs recharging or not.
- (2) *Test 3 a and b.* Deduct 0.5 point if candidate fails to recommend proper corrective action.
- (3) *Test 4a and 4d through i.* No credit will be allowed unless all components are covered.
- (4) *Test 5 a, c, and f.* No credit will be allowed unless at least 4 components of the primary circuit and 3 components of the secondary circuit are covered.
- (5) *Test 6.* Deduct 0.5 point for each trouble that the candidate does not recommend the proper corrective action.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 186.

190. Power Train

a. Scope of Tests. Six or seven (depending on type of vehicle) tests will be given to determine the candidate's knowledge of the power train system and his ability to perform the required maintenance operations on the system.

b. Special Instructions.

- (1) In all tests which require a demonstration of a method, the candidate will be required to point out and name the parts involved, point out the tools to be used, and indicate the proper operation.
- (2) Prior to the start of all tests which involve adjustment of an item, the item will be adjusted improperly.
- (3) A wheeled vehicle (with technical manual) preferably a 5-ton or smaller, will be available for these tests.
- (4) An assistant will be furnished to be used as the candidate sees fit.
- (5) If the examiner desires, test 3 may be given in place of two of the following tests: 2 b, c, d, or e. If the examiner does *not* desire to give test 3, all portions of test 2 (a-e) must be given.
- (6) Test 6 is in two parts. Give only 6 a and b or 6 c and d.
- (7) Give any three of the following for test 7: 7 a, b, c, d, or e.
- (8) A toolkit, general mechanics will be furnished each candidate as well as an equipment lubrication order.
- (9) Special tools and/or equipment necessary for the performance of these tests will be furnished the candidate.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	TRACE THE FLOW OF TORQUE FROM THE ENGINE TO THE WHEELS, GIVING PRIMARY PURPOSE OF EACH MAJOR ASSEMBLY.	Explains how torque is transmitted from the engine, through the power train, to the wheels, naming the major assemblies and explaining primary purpose of each. (Major assemblies include clutch, transmission, transfer, propeller shaft assembly, and axle assemblies.)

Test No.	Examiner commands—	Action of candidate
2	<p>a. INSPECT THE LUBRICANT IN THE TRANSMISSION, AND INDICATE THE PROPER LUBRICANT AND LEVEL.</p> <p>b. PERFORMS TRANSMISSION OIL PRESSURE CHECKS.</p> <p>c. PERFORMS TRANSMISSION FRONT BAND CHECK AND ADJUSTMENT.</p> <p>d. PERFORMS TRANSMISSION THROTTLE LEVEL AND THROTTLE LINKAGE CHECK AND ADJUSTMENT.</p> <p>e. PERFORMS TRANSMISSION MANUAL SHIFT LINKAGE CHECKS AND ADJUSTMENTS.</p>	<p>Inspects lubricant, announces proper lubricant, and indicates lubricant level.</p> <p>Demonstrates operation as described in appropriate technical manual and announces correct pressure for transmission settings.</p> <p>Demonstrates operation as prescribed in appropriate technical manual.</p> <p>Demonstrates operation as prescribed in appropriate technical manual.</p>
3	CHECK AND ADJUST THE CLUTCH PEDAL FREE TRAVEL. (See par. 189b(5).)	Demonstrates operation as prescribed in appropriate technical manual.
4	EXPLAIN THE FUNCTION OF TRANSFER ASSEMBLY AND INDICATES THE PROPER LUBRICANT LEVEL.	Checks and adjusts free travel as prescribed in appropriate technical manual and announces correct amount of free travel.
5	DEMONSTRATE PROCEDURE OF PROPER LUBRICATION OF PROPELLER SHAFT UNIVERSAL JOINTS.	Explains purpose of transfer assembly and indicates lubricant level.
	<i>Note.</i> Only tests <i>a</i> and <i>b</i> or <i>c</i> and <i>d</i> below will be given.	
6	<p>a. NAME THE COMPONENTS OF REAR AXLE ASSEMBLY AND EXPLAIN FUNCTION OF EACH.</p> <p>b. INSPECT THE DIFFERENTIAL FOR PROPER LUBRICATION AND STATE WHAT THE LUBRICANT LEVEL SHOULD BE.</p> <p>c. EXPLAIN THE FUNCTION OF CONSTANT VELOCITY UNIVERSAL JOINTS.</p> <p>d. DEMONSTRATE PROCEDURE FOR CLEANING, INSPECTING, REPACKING, INSTALLING, AND ADJUSTING WHEEL BEARINGS.</p>	<p>Names the components of rear axle assembly and explains primary purpose of each.</p> <p>Inspects differential and announces proper lubricant level.</p> <p>Explains purpose of constant velocity universal joints.</p> <p>Demonstrates operation as prescribed in appropriate technical manual (will be performed on one wheel only).</p>
	<i>Note.</i> Only three of the following five tests will be given.	

Test No.	Examiner commands—	Action of candidate
7	<p>a. TEST AND ADJUST THE WINCH DRAG BRAKE.</p> <p>b. DEMONSTRATE THE PRESCRIBED METHOD OF ADJUSTING THE WINCH AUTOMATIC SAFETY BRAKE.</p> <p>c. DEMONSTRATE THE PRESCRIBED METHOD OF ADJUSTING THE WINCH STOP COLLAR.</p> <p>d. UNWIND THE WINCH CABLE, CLEAN, INSPECT, LUBRICATE, AND REWIND.</p> <p>e. EXPLAIN THE PURPOSE OF THE SHEARPIN AND DEMONSTRATE ITS REPLACEMENT.</p>	<p>Performs required operation as prescribed in appropriate technical manual.</p> <p>Performs required operation as prescribed in appropriate technical manual.</p> <p>Performs required operation as prescribed in appropriate technical manual.</p> <p>Performs required operation as prescribed in appropriate technical manual.</p> <p>Explains the purpose, demonstrates operation.</p>

d. Penalties. Where penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.

(1) *Test 1.* No credit will be allowed if the candidate fails to—

(a) Trace the torque through the power train correctly.

(b) Explain the primary purpose of at least three of the major assemblies.

(2) *Test 2e.* No credit will be allowed if the candidate fails to perform all the checks and adjustments.

(3) *Test 6a.* No credit will be allowed if the candidate fails to name and explain primary purpose of at least two components.

e. Credits.

(1) *Test 1.*

(a) For correct tracing of power train, 1.5 points.

(b) For each correct primary purpose of a major assembly, 0.2 point.

(2) *Test 2.*

(a) Test 2a—2 points.

(b) Test 2 b, c, d, and e—1.5 points each.

(3) *Test 3*—3 points.

(4) *Tests 4 and 5*—2 points each.

(5) *Test 6.*

(a) Test 6a—3 points.

(b) Test 6b—2 points.

(c) Test 6c—1 point.

(d) Test 6d—4 points.

(6) *Test 7.* For the 3 tests given; 1.5 points each.

191. Chassis

a. Scope of Test. Three tests will be given to determine the candidate's knowledge of the chassis system and his ability to perform the required maintenance operations on the system.

b. Special Instructions.

- (1) In all tests which require a demonstration of a method, the candidate will be required to point out and name the parts involved, point out the tools to be used, and indicate the proper operation.
- (2) Prior to the start of tests which involve adjustments of an item, the item will be adjusted improperly.
- (3) A wheeled vehicle (with technical manual) preferably a 5-ton or smaller, will be made available for these tests.
- (4) A toolkit, general mechanics will be furnished each candidate.
- (5) Special tools and/or equipment necessary for the performance of these tests will be furnished the candidate.
- (6) An assistant will be furnished to be used as the candidate sees fit.
- (7) Administer test 1a and 1b to candidate if $\frac{1}{4}$ -ton, $\frac{3}{4}$ -ton, or $2\frac{1}{2}$ -ton vehicles are used. If 5-ton vehicle is used, administer test 1a and 1c.
- (8) Administer test 2e in place of test 2d if vehicle used is $2\frac{1}{2}$ -ton or larger.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	<p>a. CHECK THE FRONT WHEELS FOR TOE-IN AND DEMONSTRATE THE ADJUSTMENT OF TOE-IN.</p> <p>b. PERFORM CHECK AND ADJUSTMENT OF STEERING GEAR.</p> <p>c. NAME THE COMPONENTS OF HYDRA-POWER STEERING SYSTEM AND EXPLAIN FUNCTION OF EACH.</p>	<p>Checks the front wheels for toe-in and demonstrates toe-in adjustment operation as prescribed in appropriate technical manual.</p> <p>Performs required operations as prescribed in appropriate technical manual.</p> <p>Points out and announces the components, giving the primary purpose of each.</p>

Test No.	Examiner commands—	Action of candidate
2	<p>a. PERFORM CHECK AND ADJUSTMENT OF THE SERVICE BRAKE.</p> <p>b. TEST AND ADJUST PARKING BRAKE.</p> <p>c. DEMONSTRATE THE PRESCRIBED METHOD OF BLEEDING THE BRAKE SYSTEM.</p> <p>d. PERFORM CHECK AND ADJUSTMENT OF BRAKE PEDAL FREE TRAVEL.</p> <p>e. DEMONSTRATE THE PRESCRIBED METHOD OF MAKING AIR COMPRESSOR GOVERNOR CHECK AND ADJUSTMENT.</p>	<p>Performs required operations as prescribed in appropriate technical manual (check and adjustment will be performed on one wheel only).</p> <p>Performs required operations as prescribed in appropriate technical manual.</p> <p>Performs required operations as prescribed in appropriate technical manual. (Demonstrate either the manual method or pressure method.)</p> <p>Performs required operations as prescribed in appropriate technical manual.</p> <p>Performs required operations as prescribed in appropriate technical manual.</p>
3	NAME THE COMPONENTS OF THE SUSPENSION SYSTEM AND EXPLAIN FUNCTION OF EACH.	Point out the components, giving their name and the primary purpose of each. (Components include spring, spring shackles, rebound clips, center bolt, U-bolts, shock absorbers, and torque rods.)

d. Penalties.

- (1) Where specific penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.
- (2) In Test 3, no credit will be allowed if the candidate fails to—
 - (a) Point out at least five of the suspension components.
 - (b) Explain the primary purpose of at least three of the major components of the system.

e. Credits. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 186.

Section VI. MECHANICS, TRACK VEHICLE

192. Outline of Examination

Par. No.	Subject	Number of tests	Points each	Maximum credit
193	Maintenance.....	3	-----	5
	Test 1.....	(1)	1	(1)
	Tests 2 and 3.....	(2)	2	(4)
194	Engine.....	11	-----	25
	Test 1.....	(1)	2	(2)
	Tests 2, 4, 5, and 9.....	(4)	3	(12)
	Tests 3, 7, and 8.....	(3)	3	(9)
	Tests 6 and 11.....	(2)	1	(2)
	Test 10a through e (only <i>three</i> will be given).....	(3)	3	-----
195	Electrical system.....	15 to 17	-----	31
	Tests 1, 15, 16, and 17.....	(4)	2	(8)
	Tests 2, 3, and 4.....	(3)	1	(3)
	Tests 5 through 14.....	(10)	2	(20)
196	Power train.....	7	-----	17
	Tests 1 and 5.....	(2)	2	(4)
	Tests 2, 3, 4, and 7.....	(4)	3	(12)
	Test 6.....	(1)	1	(1)
197	Winch.....	4	-----	7
	Tests 1, 2, and 3.....	(3)	2	(6)
	Test 4.....	(1)	1	(1)
198	Tracks and suspension system.....	7	-----	10
	Tests 1, 2, 5, and 6.....	(4)	1	(4)
	Tests 3, 4, and 7.....	(3)	2	(6)
199	Hull: fire extinguishers.....	3	-----	5
	Tests 1 and 3.....	(2)	1	(2)
	Test 2.....	(1)	3	(3)
	Total.....	50	-----	100

193. Maintenance

a. Scope of Tests. Three tests will be conducted to determine the candidate's general knowledge of the organization for maintenance, forms and records, and the common terms used in maintenance work.

b. Special Instructions. The candidate will be furnished the following forms:

(1) DA Form 2403, with left-hand page completed for six vehicles.

(2) DA Form 2404.

c. Outline of Tests. See paragraph 187c.

d. Penalties and Credit. See paragraph 187d.

194. Engine

a. *Scope of Test.* Eleven tests will be conducted to determine the candidate's knowledge of engines and his ability to perform engine maintenance properly.

b. *Special Instructions.*

- (1) The administration of these tests depends upon the type of vehicle used and the number of vehicles available. A track-laying vehicle must be provided. In addition, the engine must be removed from the vehicle (except the M59 and M113) and an extension kit connected to perform tests 2, 5, 10, and 11.
- (2) The order in which the tests are performed depends on the type of vehicle used and will be prescribed by the examiner. Since the engine has to be removed to complete all tests, it is recommended that all tests be performed while the engine is removed from the vehicle.
- (3) Omit tests 3, 7, and 8 when testing candidate on engines having fuel injection.
- (4) Test 10 will be used for a candidate whose unit is issued vehicles with engines having fuel injection. Examiner will require the candidate to take only *three* of the tests shown.
- (5) The candidate will be furnished—
 - (a) A track-laying vehicle.
 - (b) A complete set of tools as prescribed in the TOE appropriate to his unit.
 - (c) Light lubricating oil (1 quart minimum).
 - (d) Dry cleaning solvent (1 quart minimum).
 - (e) Waste or rags.
 - (f) One assistant to be employed as the candidate desires.
- (6) Prior to starting the tests, the examiner will have the engine removed from the vehicle. He then will effect an improper adjustment of the following:
 - (a) Valves on at least two cylinders.
 - (b) Carburetor(s). (Naturally aspirated engines.)
 - (c) Sliding vane fuel pump (engine employing fuel injection).
 - (d) Booster pump (engine employing fuel injection).

c. *Outline of Tests.*

Test No.	Examiner commands—	Action of candidate
1	DEMONSTRATE AND EXPLAIN THE THEORY OF ENGINE OPERATION (Use training aid).	Points out and explains the 4-stroke cycle and valve actions.
2	TEST THE COMPRESSION AND REPORT THE RESULTS OF THE TEST. STATE WHAT CORRECTIVE MEASURES, IF ANY, SHOULD BE TAKEN.	Tests compression as prescribed in appropriate technical manual, reports results. Recommends the corrective measures required.

Test No.	Examiner commands—	Action of candidate
3	REMOVE, CLEAN, AND REPLACE THE AIR CLEANER(S). (This test is omitted for engines having fuel injection.)	Performs the required operation as prescribed in appropriate vehicle technical manual.
4	SERVICE OIL FILTER.....	Performs the required operation as outlined in the appropriate vehicle technical manual.
5	CHECK AND ADJUST VALVE CLEARANCE.	Performs the required operation as outlined in the appropriate vehicle technical manual.
6	EXPLAIN HOW COOLING SYSTEM FUNCTIONS (Liquid or air).	Explains functions of at least four components in either system.
7	ADJUST DRIVE BELTS. (Omit on engines having—(a) No drive belts; (b) Fuel injection.)	Performs the required operation as outlined in the appropriate technical manual (on one drive belt to be designated by the examiner).
8	CHECK AND ADJUST CARBURETOR(S) AND LINKAGE. (Omit on engines having fuel injection.)	Performs the required operation as outlined in the appropriate technical manual, using only authorized testing equipment.
9	PERFORM FUEL PUMP CHECKS. (Diaphragm or electric.)	Performs the required operation as outlined in the appropriate technical manual, using authorized testing equipment.
10	FUEL INJECTION SYSTEM. (Use only <i>three</i> of the following tests. See b (3) and (4) above.)	
	a. ADJUST SLIDING VANE PUMP PRESSURE.	Performs the required operation as outlined in the appropriate technical manual, using authorized testing equipment.
	b. ADJUST BOOSTER PUMP.....	Performs the required operation as outlined in the appropriate technical manual.
	c. TIME INJECTOR PUMP TO THE ENGINE.	Performs the required operation as outlined in the appropriate technical manual.
	d. CHECK AND/OR ADJUST FUEL FLOW.	Performs the required operation as outlined in the appropriate technical manual, using authorized testing equipment. Recommends the corrective measures required.
	e. PERFORM INJECTOR NOZZLE STATIC TEST.	Performs the required operation as outlined in the appropriate technical manual, using authorized testing equipment. Recommends the corrective measures required.
11	INSPECT THE MANIFOLDS AND RECOMMEND ANY CORRECTIVE ACTION REQUIRED.	Performs the required operation as outlined in the appropriate technical manual.

d. Penalties. Where specific penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.

- (1) *Test 1.* No credit will be allowed unless the candidate covered all four strokes and the opening and closing of each valve.
- (2) *Test 2.* If the candidate does not know the corrective action to be taken, a penalty of 1 point will be assessed.
- (3) *Test 5.* No credit will be allowed if candidate adjusts the valve clearance on the wrong stroke, or on the wrong part of a stroke.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 192.

195. Electrical System

a. Scope of Tests. Fifteen to seventeen tests will be conducted to determine the candidate's knowledge of track vehicle electrical systems and his ability to perform organizational maintenance on the electrical system of unit vehicles.

b. Special Instructions.

- (1) A track-laying vehicle will be available.
- (2) For test 2, the candidate will be furnished a hydrometer.
- (3) For tests 3, 6, 15, 16, and 17, the candidate will be furnished a low voltage circuit tester (LVCT).
- (4) For tests 8 and 10, the candidate will be furnished a timing light.
- (5) For tests 6, 7, 12, 14, 15, 16, and 17, it is recommended that the engine be removed from the vehicle (air cooled engines only) and connected to the vehicle with an extension kit.
- (6) The examiner may choose between tests 6a or 6b. Do not use both.
- (7) For test 17, at least two troubles will be introduced into the electrical system. Troubles will be introduced singly, the candidate being required to locate one before another is placed in the system. Suggested troubles—
 - (a) Batteries installed in reverse. (Use this test cautiously. Candidate error can cause equipment damage.)
 - (b) No residual magnetism in generator field circuit.
 - (c) Bad control box.
 - (d) High resistance in cranking (starter) circuit.
 - (e) Defective master relay.
 - (f) Grounded magneto.
 - (g) Bad spark plugs.
 - (h) Defective neutral safety switch.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate.
1	EXPLAIN, IN YOUR OWN WORDS, THE MEANING OF THE FOLLOWING: VOLTAGE, AMPERE, OHM, HIGH TENSION, LOW TENSION, OPEN CIRCUIT, GROUNDED CIRCUIT, CIRCUIT BREAKER, RELAY, AND CONTROL CIRCUIT.	Defines each term.
2	TEST THE SPECIFIC GRAVITY OF THE ELECTROLYTE IN THE STORAGE BATTERY.	Tests the specific gravity with the hydrometer, reports results, and states whether or not the battery should be recharged.
3	DETERMINE THE ABILITY OF THE BATTERY TO FURNISH CURRENT.	Tests battery voltage under load, using authorized testing equipment.
4	REMOVE AND REPLACE THE BATTERIES.	Removes batteries and cleans terminals. Cleans and paints battery box and correctly replaces batteries.
5	EXPLAIN THE FUNCTION OF THE COMPONENTS OF THE CRANKING MOTOR (STARTER) CIRCUIT.	Traces the control and power circuits, explaining function of the components in each circuit.
6	a. PERFORM A LINE LOSS CHECK OF THE CRANKING MOTOR (STARTER) CIRCUIT. (Engine removed.) b. PERFORM A GROUND LOSS CHECK OF THE CRANKING MOTOR (STARTER). (Engine removed.) <i>Note.</i> (Candidate will be required to perform either 6a or b above, but not both.)	Performs a line loss check between the batteries and the cranking motor, using authorized testing equipment. Performs a ground loss check between the grounded side of the cranking motor and the negative post of the batteries, using authorized testing equipment.
7	REMOVE AND REPLACE THE CRANKING MOTOR (STARTER). (Engine removed.)	Performs the required operation as outlined in the appropriate vehicle technical manual.
8	REMOVE MAGNETOS AND ADJUST THE BREAKER POINTS.	Performs the required operation as outlined in the appropriate vehicle technical manual, using authorized testing equipment.
9	EXPLAIN THE FUNCTION OF THE IGNITION SYSTEM (BATTERY OR MAGNETO).	Traces the primary and secondary circuits, explaining the function of the components, to include at least three components of the primary and two components of the secondary circuits.

Test No.	Examiner commands—	Action of candidate
10	INSTALL AND SYNCHRONIZE THE MAGNETOS.	Performs the required operation as outlined in the appropriate vehicle technical manual, using authorized testing equipment.
11	REMOVE AND REPLACE DISTRIBUTOR.	Performs the required operation as outlined in the appropriate vehicle technical manual.
12	CLEAN AND ADJUST THE SPARK PLUGS. (Engine removed.)	Performs the required operation as outlined in the appropriate vehicle technical manual.
13	POINT OUT AND EXPLAIN THE FUNCTION OF THE COMPONENTS OF THE DC OR AC CHARGING SYSTEM (depends on vehicle used).	Points out and explains the operation of the components of the charging system.
14	DEMONSTRATE THE PRESCRIBED METHOD OF POLARIZING THE GENERATOR. (Engine removed.)	Polarizes the generator using a jumper wire from the positive battery terminal to the generator field circuit. The generator has an external ground, therefore, the generator ground must be connected.
15	PERFORM A LINE LOSS CHECK OF THE CHARGING SYSTEM. (Engine removed.)	Performs the required operation as outlined in the appropriate vehicle technical manual, using authorized testing equipment.
16	PERFORM AN UNCONTROLLED VOLTAGE CHECK OF THE GENERATOR. (Engine removed.)	Performs the required operation as outlined in the appropriate vehicle technical manual, using authorized testing equipment.
17	TROUBLESHOOT TWO TROUBLES IN THE ELECTRICAL SYSTEM. (Engine removed.)	Troubleshoots the system, using authorized testing equipment. Reports results and recommends proper corrective action.

d. Penalties. Where specific penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.

- (1) *Test 1.* Failure to explain satisfactorily the function of the terms in the test—0.3 point for each term.
- (2) *Test 2.* Deduct .5 point if candidate does not state what action should be taken.
- (3) *Test 5.* No credit will be allowed unless all components are covered.
- (4) *Test 6a or b.* Same as test 2.
- (5) *Test 9.* No credit will be allowed unless at least three components of the primary and two components of the secondary circuits are covered.

(6) *Test 13.* Same as test 5.

(7) *Test 17.* Deduct 1 point for each trouble the candidate fails to locate and recommend corrective action to be taken.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 192.

196. Power Train

a. Scope of Tests. Seven tests will be conducted to determine the candidate's knowledge of a track-laying vehicle power train and his ability to perform power train maintenance properly.

b. Special Instructions.

- (1) The administration of these tests depends upon the type of vehicle used and the number of vehicles available. A track-laying vehicle must be provided utilizing a CD-500 transmission or a similar type.
- (2) The candidate will be furnished—
 - (a) A track-laying vehicle.
 - (b) A complete set of tools as prescribed in the TOE appropriate to his unit.
 - (c) Required lubricants.
 - (d) Drycleaning solvent.
 - (e) Waste or rags.
 - (f) One assistant to be employed as the candidate desires.
- (3) Prior to starting the tests, the examiner will have the vehicle in the shop. He will then effect an improper adjustment of the following:
 - (a) Transmission shift control linkage.
 - (b) Transmission steer control linkage.
 - (c) Brakes.
 - (d) Cut safety wire on universal joints.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	CHECK TRANSMISSION OIL LEVEL.	Performs the required service as outlined in appropriate vehicle technical manual. Indicates the proper level.
2	ADJUST TRANSMISSION SHIFT CONTROL LINKAGE.	Performs the required adjustment as outlined in appropriate vehicle technical manual. Announces correct position of shift lever and transmission shift control valve.

Test No.	Examiner commands—	Action of candidate
3	ADJUST TRANSMISSION STEER CONTROL LINKAGE.	Performs the required adjustment as outlined in the appropriate vehicle technical manual. Announces correct position of steer bar, shift lever, and transmission steer control valve.
4	ADJUST BRAKES.....	Performs the required brake adjustment as outlined in the appropriate vehicle technical manual.
5	SERVICE OIL FILTERS.....	Performs the required service as outlined in the appropriate vehicle technical manual.
6	CHECK OIL IN FINAL DRIVE ASSEMBLIES.	Performs the required service as outlined in appropriate technical manual. Indicates the level.
7	CHECK UNIVERSAL JOINTS.....	Performs the required service as outlined in the appropriate technical manual.

d. Penalties. Where specific penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.

- (1) *Test 1.* No credit will be allowed if candidate does not check for presence of oil then warm up transmission and check for proper level.
- (2) *Test 7.* No credit will be allowed if candidate does not properly check the lubrication and safety wires on the universal joints.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 192.

197. Winch

a. Scope of Tests. Four tests will be conducted to determine the candidate's knowledge of the winch.

b. Special Instructions. One assistant should be provided to aid the candidates in test 4. In test 4, the cable should be unwound only to the extent necessary to determine the candidate's ability to perform the maintenance operations required.

c. Outline of Tests.

Test No.	Examiner commands--	Action of candidate
1	TEST AND ADJUST THE DRAG BRAKE.	Performs required operations as prescribed in appropriate technical manual.
2	DEMONSTRATE THE PRESCRIBED METHOD OF ADJUSTING THE BRAKE BAND.	Demonstrates as prescribed in appropriate technical manual.
3	EXPLAIN THE PURPOSE OF THE SHEAR PIN AND DEMONSTRATE ITS REPLACEMENT.	Explains purpose; demonstrates operation.
4	UNWIND THE CABLE, CLEAN, INSPECT, LUBRICATE, AND REWIND (b above).	Same as test 1 above.

d. Penalties.

- (1) Where specific penalties are not indicated below, proportional cuts will be made based on the knowledge of the candidate.
- (2) In test 3, no credit will be allowed if the candidate is unable to explain the purpose of the shearpin.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 192.

198. Tracks and Suspension System

a. Scope of Tests. Seven tests will be conducted to determine the candidate's knowledge of the components of the suspension system and his ability to perform maintenance.

b. Special Instructions.

- (1) The tests included are to be used as a guide in the testing of mechanics on all types of track-laying vehicles used by field artillery units.
- (2) The candidate will be furnished—
 - (a) A track-laying vehicle.
 - (b) A complete set of tools as prescribed in the TOE appropriate to his unit.
 - (c) Required lubricants.
 - (d) Drycleaning solvent.
 - (e) Waste or rags.
- (3) Prior to starting the testing, the examiner will have the vehicle in the shop and all equipment available.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	INSPECT AND SERVICE THE TRACKS. EXPLAIN PROCEDURES.	Performs inspections and operations as prescribed in the appropriate technical manual. Announces each inspection as it is made and recommends corrective action. (Inspections will include worn track pads, worn center guides, and dead blocks.)
2	a. EXPLAIN THE PURPOSE OF THE SPROCKETS. b. INSPECT AND SERVICE THE SPROCKETS.	Explains function of the sprockets. Performs inspections and operations as prescribed in appropriate technical manual. Announces each inspection as it is made and recommends corrective action. (Inspection should include tightness of mounting bolts, measurement of sprocket wear and recommendation as to reversal or replacement.)
3	REMOVE AND REPLACE ROAD WHEEL AND BEARING.	Performs required inspections and checks bearing torque as outlined in appropriate TM.
4	EXPLAIN THE PURPOSE AND OPERATION OF THE COMPENSATOR (IDLER WHEEL).	Explains purpose and operation. Performs inspections as outlined in appropriate technical manual. (Inspections should include tests for adjustment and lubrication.)
5	INSPECT SHOCK ABSORBERS AND STATE CORRECTIVE ACTION REQUIRED.	Inspects shock absorbers as outlined in appropriate technical manual. States the proper installation of shock absorbers.
6	CHECK FOR BROKEN TORSION BAR.	Checks torsion bar as outlined in the appropriate technical manual.
7	INSPECT AND ADJUST THE TRACK TENSION.	Performs required inspections and adjustments as prescribed in the appropriate technical manual.

d. Penalties and Credit. No specific penalties are provided for these tests. Proportional cuts will be made based on the knowledge of the candidate.

e. Credit. Subject to the penalties assessed, credit will be awarded as indicated in paragraph 192.

199. Hull—Fire Extinguishers

a. Scope of Tests. Three tests will be conducted to determine the candidate's knowledge of methods of reaching various units for inspection and servicing and his ability to operate and service fire extinguishers.

b. The examiner will provide a track-laying vehicle which employs a fixed fire extinguisher system.

c. Outline of Tests.

Test No.	Examiner commands—	Action of candidate
1	EXPLAIN TYPE OF FIRE EXTINGUISHERS USED.	Explains type used.
2	INSPECT AND SERVICE THE FIRE EXTINGUISHER.	Performs required inspection and service as prescribed in appropriate technical manual (points out nozzles, lines, and cylinders).
3	POINT OUT THE HULL DRAIN VALVES.	Points out drain valves and indicates required maintenance as indicated in the appropriate technical manual.

d. Penalties. No specific penalties are provided for these tests. Proportional cuts will be made based on the knowledge of the candidate.

e. Credit. Subject to the penalties assessed in *d* above, credit will be awarded as indicated in paragraph 192.

APPENDIX

REFERENCES

AR 310-3	Military Publications
AR 600-55	Motor Vehicle Driver-Selection, Testing and Licensing.
AR 672-5-1	Awards
AR 746-2300-1	Color and Marking of Vehicles and Equipment.
AR 750-5	Maintenance Responsibilities and Shop Operations
DA Pam 310-series	Military Publications Indexes
Field Manuals:	
6-2	Artillery Survey
6-10	Field Artillery Communication
6-15	Artillery Meteorology
6-16	Tables for Artillery Meteorology
6-20-2	Field Artillery Techniques
6-40	Field Artillery Cannon Gunnery
6-121	Field Artillery Target Acquisition
6-122	Artillery Sound Ranging and Flash Ranging.
6-140	The Field Artillery Battery
6-160	Radar Set AN/MPQ-10
6-161	Radar Set AN/MPQ-4A
6-162	Radar Set AN/TPS-25
21-26	Map Reading
21-30	Military Symbols
21-31	Topographic Symbols
23-series	Utilize the manuals appropriate for the small arms issued the unit.
24-16	Signal Orders, Records and Reports
24-17	Tactical Communications Center Operations
24-18	Field Radio Techniques
24-20	Field Wire and Field Cable Techniques

Technical Manuals:

5-241-1	Grids and Grid References
5-241-2	Universal Transverse Mercator Grid, Zone to Zone Transformation Tables.
6-230	Logarithmic and Mathematical Tables
6-240	Slide Rule, Military, Field Artillery, with Case, 10-inch.
6-300 (Current Year)	Army Ephemeris
9-series	Utilize the manuals appropriate for the vehicles issued the unit.
9-575	Auxiliary Sighting and Fire Control Equipment.
9-1300-203	Ammunition for Antiaircraft, Tank, Anti- tank, and Field Artillery Weapons.
9-1305-200	Small Arms Ammunition
9-1900	Ammunition, General
9-1903	Care, Handling, Preservation, and De- struction of Ammunition.
9-6140-200-15	Operation and Organizational, Field and Depot Maintenance: Storage Batteries, Lead-Acid Type.
9-8000	Principles of Automotive Vehicles
10-500-10A-6	Air Delivery of Supplies and Equipment: Rigging RL 172/6 Reeling Machine with M38A1 ¼-ton Utility Truck.
11-287	Radio Sets AN/VRQ-1, -2, and -3
11-289	Receiver-Transmitter RT-66/GRC, RT- 67/GRC, and RT-68/GRC.
11-295	Radio Receiving Set AN/GRR-5
11-297	Radio Sets AN/VRC-19, -19X, -19Y, -19XX, and -19YY.
11-333	Telephones EE-8, EE-8-A, EE-8-B
11-362	Reel Units RL-31, RL-31-B, RL-31-C, RL-31-D, and RL-31-E.
11-427	Barometer ML-102-series and ML-316/ TM.
11-611	Radio Sets AN/VRC-16, -17, and -18
11-806	Radio Transmitters T-195/GRC-19, T- 195A/GRC-19, and T-195B/GRC-19.
11-900	Power Units PE-75-series
11-947	Power Units PE-210, PE-210-A, -B, and -C.
11-1303	Radar Sets AN/MPQ-10 and -10A; In- stallation and Operation.
11-2134	Manual Telephone Switchboard SB- 86/P; Installation and Operation.

Technical Manuals—Continued

11-2155	Telephone Set TA-312/PT
11-2225	Teletypewriter Sets AN/GGC-3, -3A and Teletypewriter Reperforator-Transmitters TT-76/GGC, TT-76A/GGC, and TT-76B/GGC.
11-2240	Wire Dispenser MX-306 A/G
11-2405	Meteorological Ballons and Inflation and Launching Accessories.
11-2413	Hydrogen Generator ML-303/TM and Hydrogen Generator Set AN/TMQ-3.
11-2417	Thermometers ML-4 and ML-5, Psychrometers ML-24 and ML-224, Shelters ML-41, ML-41-A, and ML-41-B, and Instrument Shelter, Meteorological 5-101/UM.
<u>11-2432A</u>	Radiosondes AN/AMT-4A, -4B, -4C and Radiosonde Set AN/AMT-4D.
11-2436	Radiosonde Recorders AN/TMQ-5, -5A, -5B, and -5C.
11-2440	Radiosonde Baseline Check Sets AN/MGG-1, and -1A.
11-2546	Connecting and Switching Kit MX-155/GT.
11-2568	Sound Ranging Set GR-8
11-2602B	Frequency Standard TS-65C/FMQ-1 and TS-65D/FMQ-1.
11-5014	Test Sets TS-538/U, 538A/U, 538B/U, and -538C/U.
11-5038	Control Group AN/GRA-6
11-5516	Flash Ranging Set AN/GTC-1
11-5534	Azimuth-Elevation Range Recorder RD-54/TP and Azimuth-Elevation Range Recorder RO-3/MPQ.
11-5805-210-10	Operator's Manual: Frequency Shift Converter CV-278/GR.
11-5805-262-12	Operator's and Organizational Maintenance Manual: Switchboards, Telephone, Manual SB-22/PT and SB-22A/PT.
11-5815-204-10	Operator's Manual: Radio Teletypewriter Sets AN/GRC-46, -46A, -46B, and AN/VRC-29.
11-5820-205-10	Operator's Manual: Radio Transmitter Modulator MD-203/GR.

Technical Manuals—Continued

11-5820-292-10	Radio Sets AN/PRC-8, -8A, -9, -9A, -10, -10A, and -28.
11-5820-334-10	Operator's Manual: Radio Receiver R-392/URR.
11-5840-208-10	Operator's Manual: Radar Set AN/MPQ-4A.
11-5840-217-10	Operator's Manual: Radar Set AN/TPS-25.
11-6115-204-10	Operator's Manual: Gasoline Engine Generator Sets PU-286A/G, and -286B/G.
11-6660-206-10	Operator's Manual: Rawin Sets AN/GMD-1A and -1B.
11-6675-200-10	Operator's Manual: Theodolites ML-47-C through ML-47-R, ML-247 and ML-247-A and Double Center Theodolite ML-474/GM.
21-300	Driver Selection and Training (Wheeled Vehicles).
21-301	Driver Selection, Training, and Supervision; Tracked Vehicles.
21-305	Manual for the Wheeled Vehicle Driver
21-306	Manual for the Tracked Vehicle Driver
38-750	The Army Equipment Record System and Procedures.

Miscellaneous:

(CM) ACP 124(B)	Communications Instructions-Radiotelegraph Procedures (U).
(CM) ACP 125(B)	Communications Instructions-Radiotelephone Procedures (U).
(CM) ACP 126	Communications Instructions-Teletypewriter (Teleprinter) Procedure (U).
ACP 131(A)	Communications Instructions-Operating Signals.
KAG-21A/TSEC	Operations Code and Prearranged Message Code.
KAG-24/TSEC	Authentication
KAO-11/TSEC	KL-7 Operation
KOA-49/TSEC	KW-9 Operation
TB ENG 23	Use of Tellurometer in Military Surveying.
ORD-7	Appropriate for the unit
SNL's	Appropriate for the unit

By Order of the Secretary of the Army:

EARLE G. WHEELER,
*General, United States Army,
Chief of Staff.*

Official:

J. C. LAMBERT,
*Major General, United States Army,
The Adjutant General.*

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NG: State AG (3); units—same as active Army except allowance is two (2) copies to each unit.

USAR: Same as active Army.

For explanation of abbreviations used, see AR 320-50.

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