FM 6-35

DEPARTMENT OF THE ARMY FIELD MANUAL

FIELD ARTILLERY MISSILE

REDSTONE

HEADQUARTERS, DEPARTMENT OF THE ARMY

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CHAPTER 1

GENERAL

1. Purpose and Scope

a. This manual is a guide to assist commanders in developing the Redstone firing battery (TOE 6–637E) into an efficient, smooth-working disciplined team that will operate effectively in combat. This manual prescribes individual duties, section drills, methods of inspection and maintenance, methods of decontamination and destruction, safety precautions, training, and tests for qualification of missilemen.

b. FM 6–36 contains detailed technical firing procedures.

c. The material presented herein is applicable without modification to both nuclear and nonnuclear warfare.

d. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commandant, U. S. Army Artillery and Missile School, Fort Sill, Okla.

2. Definition of Terms

a. Front.

(1) When the launcher is being towed by the erector-servicer truck, the front of the section is the direction in which the truck is headed.

(2) With the launcher emplaced, the front of the section is as designated.

(3) For a missile in a horizontal position, the front is the direction in which the missile points.

b. Right (Left). The direction right (left) is the right (left) when standing to the rear and facing to the front.

3. References

Publications pertaining to the Redstone missile and associated equipment and covering related subjects not discussed in this manual are listed in the appendix.

CHAPTER 2

ORGANIZATION

4. Composition of the Redstone Missile Battery

The Redstone missile battery consists of a battery headquarters, a communications section and a firing battery.

a. The battery headquarters consists of personnel and equipment required for battery control and administration, to include the battery commander, the materiel warrant officer, and appropriate mess, supply, administrative, and maintenance personnel.

b. The communications section consists of personnel and equipment necessary for establishing and maintaining required radio and wire communications, to include a section chief, two radio teletypewriter operators, and senior wireman, a switchboard operator, an agent, and two wiremen.

c. The firing battery consists of a firing battery headquarters, a missile firing section, and a missile servicing section. These units are discussed in subsequent paragraphs.

5. Firing Battery Headquarters

The firing battery headquarters consists of personnel and equipment required for the command and control of the firing battery. The personnel of the firing battery headquarters are as follows:

a. A battery executive officer.

b. A chief of firing battery.

c. A radiotelephone operator.

6. Missile Firing Section

The missile firing section consists of section personnel, the air compressor truck, air servicer, missile test and fire control equipment, power distribution trailer, 60 KW generator, and auxiliary equipment. The missile firing section, in general, performs all operations pertaining to electrical cabling, pneumatic line installation, missile testing, and missile pressurization. The personnel of a firing section are as follows:

a. A section chief (SC).

b. A propulsion sergeant.

c. Three senior electronics specialists.

d. Five electronics specialists.

e. A propulsion specialist.

f. Three propulsion crewmen.

g. Two air compressor operators.

h. A generator operator.

7. Missile Servicing Section

The missile servicing section consists of section personnel, the launcher, the lightweight erection equipment, the missile and propellant transport vehicles, and the firefighting equipment. The missile servicing section, in general, performs all operations pertaining to missile and propellant transport, missile assembly other than intercabling, missile erection, and missile propellant loading. The personnel of a servicing section are as follows:

a. A section chief (SC).

b. A handling sergeant.

c. A fire crew chief.

d. Two senior launcher crewmen.

e. Two survey specialists.

f. Two firefighters.

g. Five heavy truck drivers.

h. Nine launcher crewmen.

i. An ordnance supply specialist.

j. A generator operator.

k. Four light truck drivers.

8. General Duties of Personnel

a. The duties of the battery executive officer are as prescribed in FM 6–140 and FM 6–25.

b. The guided missile materiel warrant officer is a technical adviser to the battery commander on matters pertaining to the operation and maintenance of the equipment in the Redstone missile system.

c. The chief of missile firing section and the chief of missile servicing section are responsible to the executive officer for—

(1) Training and efficiency of section personnel.

(2) Performance of duties in firing.

(3) Observance of safety and decontamination precautions.

(4) Inspection and maintenance of all section equipment.

(5) Preparation of field fortifications for protection of section equipment and personnel.

(6) Camouflage discipline; local security; and chemical, biological, and radiological warfare (CBR) security discipline.

d. The propulsion sergeant and senior electronics specialist No. 1 assist the chief of missile firing section in performing the duties listed in *c* above.

e. The handling sergeant and the senior launcher crewman No. 1 assist the chief of missile servicing section in performing the duties listed in *c* above.

f. The missile firing section crewmen perform duties on the missile test station, relay box, and launcher, as prescribed in this manual and FM 6–36.

g. The missile servicing section crewmen perform duties in missile assembly, erection, and propellant loading, as prescribed in this manual and FM 6–36.

h. The survey specialists perform duties in laying the missile.

i. The primary duties of the air compressor operators, truck drivers, firefighters, generator operators, and the radiotelephone operator are to operate and maintain their equipment. They remain with their equipment, unless they are assigned other duties by their chief of section.

CHAPTER 3

SECTION DRILL

9. Objective

The objective of section drill is to attain maximum efficiency with speed and precision. Due to the complex and technical operations required in the Redstone firing battery, no specific drills have been prescribed. However, drills should be conducted as prescribed by unit SOP's, and in consonance with FM 22–5.

10. Instructions

a. To develop maximum efficiency and to prevent injuries to personnel and damage to equipment, the drills prescribed by unit SOP's should be observed. Section drill is conducted in silence except for commands and reports. A section should be drilled until reactions to commands are automatic, rapid, and efficient.

b. Errors are corrected immediately. Each member of a section must be impressed with the importance of reporting promptly to the chief of section any errors discovered before or after firing. The chief of section will report errors immediately to the executive officer.

c. Battery officers and NCO's supervise the drills to insure that instructions are carried out and that maximum efficiency is attained.

d. Duties should be rotated among personnel during training so that each member of a section or portion of the section can perform all nonspecialized duties within the section. In addition, battery personnel not assigned specific duties during drill periods should be trained in the fundamentals of section drill so that they will be capable of functioning efficiently within a section, if required.

CHAPTER 4

OCCUPYING THE FIRING POSITION

11. General

The battery commander indicates the plan for the disposition of vehicles. Stakes may be driven into the ground to mark the exact location for these vehicles. The chiefs of sections direct their respective vehicles to the positions indicated in the most expeditious manner consistent with proper camouflage. Hand signals for guiding the drivers are contained in FM 21-60.

12. Occupying the Firing Position

a. The activities for preparing the firing position are directed by the battery commander. The area will be secured by establishing outposts or screening guards. The pioneer work necessary to clear the position, such as the removal of brush and tree stumps, is completed, and communications are established between the vehicle standby area and the firing position.

b. When the firing position is ready for occupation, the launcher is towed into position. The launcher is uncoupled from the prime mover and, by using either the hydraulic cart or the wrecker, its wheels are removed and it is emplaced and leveled. To facilitate laying the missile, the launcher should be emplaced so that the line from the center of the launcher to pad "I" will be in the direction of fire when the missile is erected.

c. Concurrent with leveling the launcher, the A-frame and all other equipment except the H-frame are removed from the erector-servicer truck. The truck is then turned around and positioned about 20 feet to the rear of the launcher. The H-frame components and support jacks are unloaded. The A-frame and H-frame are then assembled.

d. Concurrent with the assembly of the A-frame and H-frame, the air compressor truck towing the air servicer moves into position. The air servicer is emplaced and the air compressor is serviced, warmed up, and operated to pressurize the air bottles on the air-servicer trailer.

e. Upon arrival at the firing position, the generator trailer and power distribution station are emplaced. When all initial adjustments have been made and all external cabling has been checked, power is applied to the power distribution station on order of the chief of missile firing section.

f. While the ground handling equipment is being emplaced, the missile test station is brought into the firing position by the missile firing section. Ground electrical system cables are laid, and air lines are installed to the various items of equipment as they are positioned.

g. The remaining vehicles are brought into the firing position as directed by the section chiefs.

CHAPTER 5

DUTIES IN PREPARING, FIRING AND MARCH ORDER

Section I. GENERAL

13. General

a. The battery executive officer is responsible for overall supervision and coordination of the duties performed in preparing and firing the Redstone missile and march order of the Redstone equipment. Section chiefs must exercise close, direct supervision and coordination of their sections to insure that operations are performed properly in minimum time. Vehicular movement in the firing position must be restricted and controlled to avoid congestion and to protect personnel and equipment.

b. With the exception of duties related to missile laying procedures, which are described in chapter 7 of this manual, the sequence in which duties are performed by Redstone firing battery personnel in preparing and firing the missile and march order of equipment are outlined in tables I through XXII, FM 6–36.

14. Duties of Missile Firing Section Personnel

In general, the duties of individuals in the missile firing section during firing are as follows:

a. The chief of missile firing section supervises and commands his section. He is responsible that duties of his section are performed properly, that commands are executed promptly and that safety precautions are observed.

b. The senior electronics specialist No. 1 is in charge of the test station. He is responsible for the unloading of the cables and electrical equipment and for supervision of operation of the test equipment in the test station.

c. The propulsion sergeant is in charge of the auxiliary equipment on the launcher. He is responsible for the installation of air pressure lines and related equipment and the operation of propulsion equipment.

d. Electronics specialists No. 2 and No. 3 are responsible for the installation of all electrical equipment and cables and the operation of test equipment in the test station.

e. The propulsion specialist assists in installing the air pressure lines and related equipment. He also is responsible for the operation of the propulsion control panel in the test station.

f. The propulsion crewmen install the auxiliary equipment on the launcher, install the air pressure lines and related equipment, and operate the propulsion equipment during missile testing.

g. The air compressor operators drive the air compressor truck and operate the air compressor and the air servicer.

h. The generator operator is responsible for the proper functioning and maintenance of the generator.

15. Duties of Missile Servicing Section Personnel

In general, the duties of individuals in the missile servicing section during firing are as follows:

a. The chief of missile servicing section supervises and commands his section. He is responsible that duties of his section are performed properly, that commmands are executed promptly, and that safety precautions are observed.

b. The handling sergeant is responsible for unpacking the missile components, assembly of the erection equipment, missile assembly and erection, and installation of accessory items.

c. The senior launcher crewman No. 1 is responsible for preparation of the launcher for firing, and installation of propellants to the missile.

d. The fire crew chief is responsible for the positioning of firefighting equipment and for maintaining it in a state of readiness during firing operations.

e. The senior launcher crewman No. 2 supervises the majority of the work of the launcher crewmen. He is responsible for the preparation of the launcher for firing, missile assembly, and erection of the missile on the launcher.

f. Launcher crewmen numbers 1 through 9 work under the direct supervision of senior launcher crewmen in carrying out the duties specified in *c* and *e* above.

g. The truck drivers of the missile servicing section are responsible for driving and positioning their vehicles as directed.

h. The firefighters are responsible for maintaining their equipment in a state of readiness during firing operations.

i. The survey specialists are responsible for operating and maintaining the instruments and equipment which they use to lay the missile and for laying the missile on the firing azimuth. The survey specialists obtain the azimuth of the orienting line (OL) which is used to lay the missile and the firing azimuth (K) from the fire direction center.

j. The generator operator is responsible for the proper functioning and maintenance of the generator.

k. The ordnance supply specialist is responsible for the exchange and procurement of missile peculiar parts and supplies.

Section II. DETAILED DESCRIPTION OF CERTAIN DUTIES IN FIRING

16. Chief of Missile Firing Section

The chief of missile firing section—

a. Supervises and Controls Horizontal and Vertical Checkout. The chief of missile firing section supervises and controls both the horizontal and vertical tests.

b. Records Basic Data. The chief of missile firing section records data of a semipermanent nature. These data include results of tests, final fire commands, azimuth of orienting line, firing azimuth, serial number of missile fired, and date and hour of firing.

c. Reports Mistakes and Other Unusual Incidents to the Battery Executive Officer. If, for any reason, the missile cannot be fired, the chief of missile firing section promptly reports that fact to the battery executive officer and states the reasons therefor.

d. Observes and Checks Functioning of Materiel. The chief of missile firing section closely observes the functioning of all parts of the materiel during testing. He verifies that all cables are installed properly. He promptly reports to the battery executive officer any evidence of malfunctioning. A report is also furnished to the battalion fire direction center (FDC).

e. Indicates When the Missile is Ready to be Fired. The chief of missile firing section reports to the battery executive officer when ready to switch to remote operation. This report indicates that all tests have been successfully completed, control is ready to be switched to the remote firing panel, and the missile is ready to be fired.

17. Chief of Missile Servicing Section

The chief of missile servicing section—

a. Supervises and Controls Emplacement of the Launcher and Erection Equipment. The chief of missile servicing section supervises and controls the emplacement of the launcher and the assembly of the erection equipment. Particular attention is given to the condition of erecting cables and to the proper assembly of the A- and H-frame.

b. Supervises and Controls Missile Assembly and Erection. The chief of missile servicing section supervises and controls missile assembly and erection. This includes the positioning of missile trailers, missile body assembly, and missile assembly. During erection, he supervises the operation of the erector winch and the snubber unit.

c. Supervises and Controls Propellant Loading. The chief of the missile servicing section supervises and controls propellant loading operations. He reports to the test station when each phase of the propellant loading operation is completed.

CHAPTER 6

SITUATIONS REQUIRING SPECIAL ATTENTION

18. Missile Assembly

a. Care must be taken to insure that the necessary electrical and pneumatic connections between the warhead unit, aft unit, and thrust unit are made after the units are mated.

b. The ST–80 is located in its separate container when the missile is brought into the firing position. It is left in the shipping container until needed for installation. The ST–80 is handled only by the handling frame. Care must be exercised during removal from the container and placement in the missile to prevent any damage to the ST–80 dust cover.

19. Propellant Loading and Missile Servicing

a. Because of size, weight, and structural considerations of the missile, propellant loading is accomplished only when the missile is in the vertical position. Firefighting equipment must be in position before propellant loading is started.

b. Lithium chloride is used as an inert lead start fluid to prevent too rapid a buildup of thrust during ignition of the rocket engine.

c. Alcohol loading is performed as soon as the inert lead start has been loaded. Extreme care must be taken to prevent generation of sparks during alcohol loading. Any alcohol leak or spillage should be washed off thoroughly with water. All propellant handling and related equipment must be grounded and rubbing of surfaces must be prevented. At the completion of alcohol loading, the alcohol semitrailer is removed from the area.

d. Liquid oxygen is delivered to the firing position by two 9-ton liquid oxygen semitrailers. Personnel handling liquid oxygen must wear face shields and asbestos gloves. Prior to liquid oxygen loading, precooling of lines, pumps, and the missile liquid oxygen tank, must be accomplished. Precooling is normally accomplished in 4 to 8 minutes. When precooling has been accomplished, one semitrailer starts the pumping operation. After an interval of 3 to 5 minutes, the second semitrailer commences to pump. This procedure assures that a sufficient amount of liquid oxygen will be reserved in the second trailer for replenishing operation. Pumping is continued until liquid oxygen overflows through the liquid oxygen vent conduit. The empty trailer is removed from the area and the second trailer is positioned for liquid oxygen replenishing operations.

e. Hydrogen peroxide (H_2O_2) is delivered to the firing position in a special aluminum drum carried on the hydrogen peroxide servicer. The H_2O_2 temperature must be maintained within $\pm 10°$ of 175°F. This is accomplished by a temperature conditioning unit mounted on the H_2O_2 servicer truck. Personnel handling H_2O_2 are required to wear protective clothing and transparent face shields. During H_2O_2 loading, the firefighting crew must stand by to dilute any spillage with water. When the missile H_2O_2 tank overflows, the H_2O_2 servicer is removed from the area.

f. Liquid nitrogen (LN_2) is delivered to the firing position in 150-gallon, trailer-mounted containers and is used as a cooling agent in the heater-cooler drop tank. The truck used to transport the ST–80 to the firing position is normally dispatched for the LN_2 trailer. The LN_2 trailer is returned to the engineer company when it is no longer needed.

g. Individual duties for propellant loading and missile servicing are described in FM 6–36.

20. Propellant Unloading Operations

The missile section drains the propellants when ordered. Propellant unloading is performed in the following order: hydrogen peroxide draining, liquid oxygen draining, alcohol draining, and inert lead start draining. Detailed instructions on the procedures for propellant unloading are contained in FM 6–36.

21. Hold Procedure

a. The term "hold" is defined as the suspension of the firing operations at any time prior to firing the missile due to safety conditions, technical difficulties, or administrative reasons.

b. HOLD may be commanded by any individual in the unit. At this command, regardless of its source, hold procedures take effect immediately. When a hold is called, the individual commanding the hold will announce the reason and, if possible, the length of time required before operations can be resumed. The battery executive officer will investigate the condition that caused the command to be given. He will determine the length of time necessary for the hold and announce the point in the firing procedure at which operations will be resumed. A report will also be furnished to the fire direction center (FDC).

22. Hold Considerations

The following is a list of items or situations to be considered if a hold is called or a hold is anticipated:

a. Prior to disconnecting the test station:

(1) Minimum temperature of alcohol (varies with each missile).

(2) Temperature of H_2O_2 (65° to 85° F.).

(3) Availability of liquid oxygen (LOX) for replenishing.

(4) Possibility of valves freezing in the missile after LOX loading.

(5) Activated life of batteries.

(6) Range accelerometer precession rate.

(7) Lateral accelerometer precession rate.

(8) Temperature of ST-80 and availability of LN_2.

b. After disconnecting test station: Range accelerometer precession rate. (The test station must be reconnected to monitor the range accelerometer precession rate if the missile is not fired within 45 minuts.)

23. Emergency Cutoff

After the firing switch has been pressed, the propulsion system development can be stopped by activation of the CUTOFF COMMAND switch on the remote firing panel any time prior to electrical tailbreak. When ordered, emergency cutoff will normally be performed by the remote firing panel operator.

24. Failure to Fire

If the missile fails to fire, the procedure in *a* through *g* below will be followed.

a. Depress the FIRE switch again if the missile has not fired within 30 seconds.

b. If, after 1 minute, the missile has not fired, depress the EMERGENCY CUTOFF switch on the remote firing panel.

c. Turn EMERGENCY VENT switch on at the remote firing panel for 2 minutes.

d. Turn the 3,000 psi SOLENOID switch off at the air servicer.

e. Disconnect plug P–3219 from the relay box.

f. Disconnect plug P–4017 from the tail distributor.

g. Reset regulator to 2000 psi and turn 3000 psi SOLENOID switch to ON.

h. All necessary personnel may now return to the firing area and begin checking firing circuits to locate the source of malfunctioning.

25. Failure to Take Off

a. If firing switch is pressed and the firing sequence progresses satisfactorily through ignition but mainstage does not occur within 1.5 seconds, emergency cutoff should occur as follows:

(1) The automatic CUTOFF SIGNAL light should light at the remote firing panel.

(2) The cutoff signal will vent all tanks.

b. If the following conditions still exist, do not allow personnel to enter the immediate area of the launcher until actions in *c* below have been performed by firing section personnel.

(1) Air spheres remain still pressurized to 3,000 psi.

(2) Vent valve blown out. (Hydrogen peroxide is a fire hazard if it is blown out the vent valve.)

(3) Alcohol or liquid oxygen spillage. (Fire hazard.)

c. The chief of firing section should take the following actions:

(1) Insure that the cutoff signal has occurred. If so, the proper relays should be deactivated to render the missile in a safe condition.

(2) Vent spheres before allowing personnel to approach within 30 meters of the launcher.

(3) Flush the area around the missile with water from the fire truck.

(4) Consult the appropriate troubleshooting manual for further action. *No overall test is permissible with a fueled missile.*

26. Care, Use, and Adjustment of Laying Equipment

The laying equipment used by the Redstone firing battery consists of two Wild T2 theodolites with accessories, tripod-mounted precise targets, theodolite-mounted targets, steel tape, and a compass. For detailed information on the care, use, and adjustments of the theodolite, see FM 6–2.

CHAPTER 7

MISSILE LAYING PROCEDURES

27. General

a. The nature of the inertial guidance system and the range of the missile necessitates that the sensitive axes of the stabilized platform be precisely oriented before firing. The direction of th plane of the trajectory of the Redstone missile is established by properly orienting the lateral accelerometer. The objective in laying the Redstone missile is to aline the sensing axis of the lateral accelerometer on the lateral coordinate. After the missile is laid, the stabilized platform is correctly oriented to guide the missile along the aiming azimuth (K) computed for the mission.

b. The two phases of laying the missile, which are discussed in paragraphs 29 and 30, are as follows:

(1) A preliminary phase that orients the stabilized platform to within 1° of the firing azimuth.

(2) A final laying phase that orients the stabilized platform to within 2′ of the firing azimuth. This tolerance includes missile system and laying equipment error.

28. Definitions

a. Orienting Line (OL). The OL serves as a refreence for laying the missile. One terminal point of the line is established near the firing position and the line is extended in a known direction (azimuth) to a terminal point 100–300 meters away.

(1) The survey officer provides grid azimuth of the OL to an accuracy of ±20″.

(2) Criteria for establishing starting survey data or for taking astronomic observations for the OL direction are specified in FM 6-25.

(3) The grid azimuth of the OL is corrected for convergence by fire direction personnel converting it to geodetic azimuth.

b. Orienting Angle. The orienting angle is the horizontal clockwise angle from the line of fire to the OL. It is determined by subtracting the geodetic azimuth of fire from the geodetic azimuth of the OL (adding 360° if necessary).

c. Orienting Station (OS). The OS is a point on the OL, established on the ground over which a wild T2 theodolite is set up to furnish known direction.

d. Reference Instrument (RI). The RI is a Wild T2 theodolite with target-mounted assembly, plumbed over the OS.

e. Orienting Line Target Mark (OLTM). The OLTM is a point on the OL established on the ground at a distance not less than 100 meters from the OS, over which an illuminated target, Wild, precise, will be mounted and plumbed. The OLTM is the other end of the OL.

f. Orienting Line Target (OLT). The OLT is an illuminated target, Wild, precise, which is tripod-mounted and plumbed over the OLTM. This target is used as a sighting point by the RI operator to orient the horizontal circle of his instrument.

g. Azimuth Control Instrument (ACI). The ACI is a Wild T2 theodolite which is used to transfer direction from the RI to the missile.

29. Preliminary Laying Phase

(Fig. 1)

a. The following steps are accomplished prior to erection of the missile.

(1) Set up the RI over the OS.

(*a*) For daylight and/or inclement weather operations, erect umbrella at the OS prior to setting up the RI.

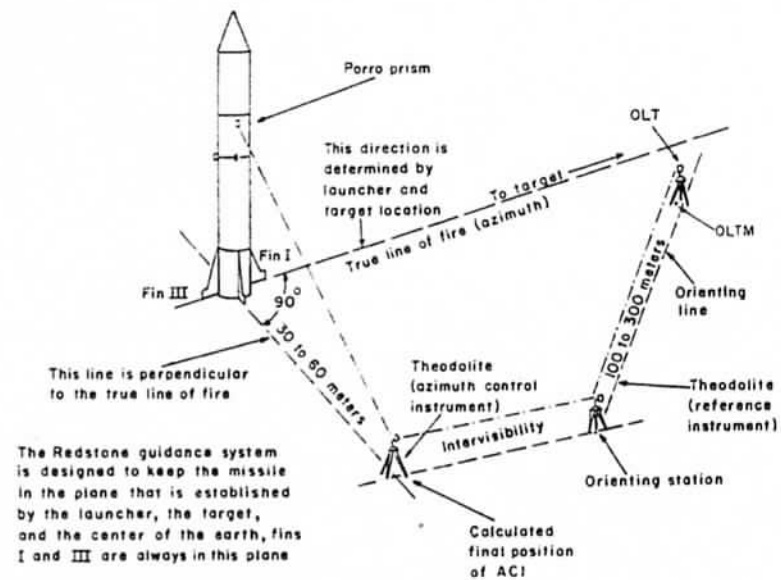

Figure 1. Laying the missile.

(*b*) Perform the prescribed plate level test to insure that the level bubble is in proper adjustment. The test and adjustment are described in paragraph 126, FM 6–2.

(*c*) Perform the prescribed horizontal collimation test for the instrument. The horizontal direct and reverse readings on an object should be exactly 180° apart; if the difference is more than 10", the instrument must be adjusted. The test and adjustment are described in paragraph 129, FM 6–2.

(*d*) Mark off an area 15 feet square around the RI. Only personnel operating the theodolite (to include checking or assistant operators) should be allowed inside this area.

(*e*) Level and plumb the RI.

(2) Compute orienting angle (Geodetic Azimuth of OL minus Geodetic Azimuth of fire).

(3) Set up, level, and plumb the OLT over the OLTM.

(4) Sight the telescope of the RI on the OLT.

(5) Using the coincidence knob and circle setting knob of the RI, set off on the horizontal circle the orienting angle minus 90° or plus 270°. Minus 90° is used if the orienting angle is greater than 90°; plus 270° is used if the orienting angle is less than 90°.

(6) Perform the prescribed plate level test and horizontal collimation test on the ACI as required in (1) (*b*) and (*c*) above.

(7) Place the ACI in position. Either one of two methods may be used.

(*a*) *First method.*

1. Set up, plumb and level the ACI over the middle of the blast deflector.

2. With the RI, lay the ACI.

a. Simultaneously sight the RI on the ACI and the ACI on the RI.

a. Without disturbing the alinement of either instrument, read the scale of the RI and set the reading into the scale of the ACI.

3. Turn ACI to a reading of 180°.

4. Establish the line of sight on the ground by—

a. Marking a line on the launcher ring in line with the vertical crossline.

b. Marking a position 30 to 60 meters from the launcher along the line of sight.

5. Mark a position 16.5 cm (6.4 in.) away from the position marked in *4* (b) above in the direction of fire.

6. Move the ACI to the position marked in *5* above and lay the ACI on the RI as in *2* above.

7. Mark off an area 15 feet square around the ACI. Only personnel operating the theodolite (to include checking or assistant operators) should be allowed inside this area.

(*b*) *Second method.*

1. At a distance from 30 to 60 meters from the launcher, sight on the center of the blast deflector with a compass. Move laterally until the compass reads the value of azimuth of fire minus 90° or plus 270°. (Minus 90° is used if the azimuth of fire is greater than 90°.) Mark point on the ground at this position.

2. Set up and level ACI over the point marked in *1* above.

3. Lay the ACI with the RI as in (*a*) *2* above.

4. Sight ACI on center of blast deflector. Read the angle, if the angle is 0°=20", proceed to *9* below. If not, determine the difference from zero and apply the appropriate sign. (If the angle falls in the first quadrant, the sign is plus: if it falls in the fourth quadrant, the sign is minus.)

5. Measure the distance from the ACI to the center of the blast deflector.

6. Convert the angular difference in *4* above to minutes and tenths of a minute. Multiply this value times 0.0003 times the distance measured in *5* above.

7. Move ACI in a direction perpendicular to the line from the ACI to the center of the blast deflector. The amount to be moved is computed in *6* above; the direction is determined as in *4* above (plus is right, minus is left).

8. Repeat steps in *3* thru *7* above.

9. Mark a line on the launcher ring in line with the vertical crossline.

10. Mark a position 16.5 cm (6.4 in.) away from the present location of the ACI in the direction of fire.

11. Set up the ACI at the position marked in *10* above, level and lay the ACI.

12. Mark off an area 15 feet square around the ACI. Only personnel operating the theodolite (to include checking or assistant operators) should be allowed inside this area.

b. After erection of the missile, direct the handling section to rotate the missile until the center of fin IV coincides with the line marked on the launcher ring. Sight the ACI on the Porro prism and direct missile rotation, if necessary, until an accurately centered reflection of the theodolite-mounted target is seen under the vertical crossline of the instrument. If the ACI reading is 0° ±59′ the missile is oriented within the accuracy requirement for preliminary laying. If not, relocate ACI using procedure in paragraph 30*c*(1) through (5) and repeat this step.

30. Final Laying

Note. Insure that precise leveling of the missile has been accomplished.

a. Recheck lay of the ACI.

b. Sight the ACI on the Porro prism and direct missile rotation, if necessary, until an accurately centered reflection of the theodolite-mounted target assembly is seen under the vertical crossline of the instrument.

c. If the ACI reading is 0° ±5″, the missile is oriented within the accuracy required for final laying, (proceed to *d* below). If not, perform the following steps:

(1) Determine the angular difference from zero. (If the angle is in the first quadrant, the sign is plus; if in the fourth quadrant, the sign is minus.)

(2) Measure the distance from the ACI to the launcher ring.

(3) Convert the angular difference determined in (1) above to minutes and tenths of minutes. Multiply the value times 0.0003, times the distance measured in (2) above.

(4) Move the ACI in a direction perpendicular to a line extending from the ACI to the center of the blast deflector. The amount to be moved is the distance computed in (3) above. The direction is determined in (1) above (plus is right, minus is left).

(5) Lay the ACI.

d. Repeat the steps in *b* and *c* above.

e. After the requirement in *c* above is met, perform the following check: (If the requirements of any of these checks cannot be met, the missile laying must be repeated.)

(1) Plunge the telescope of the RI and sight on the OLT.

(2) The reading from the RI must be 180° ±10″ from the angle originally set in the RI (par. 29*a*(5)).

(3) Plunge the telescope on the ACI and sight the ACI on the RI and the RI (telescope still plunged) on the ACI. The difference between readings from the two instruments must not exceed 20″.

f. Monitor continuously until X-5 minutes. During monitoring the reading from the ACI to the Porro prism must be within ±20″ of 0°. If the reading is between ±20° to ±30° from 0°, a command decision is required to fire. If the reading exceeds ±30″ from 0°, the final laying procedure must be repeated.

CHAPTER 8

MAINTENANCE AND INSPECTION

31. General

Maintenance and inspections are essential to insure that the battery is capable of carrying out its mission at all times. Systematic maintenance and inspection drills provide the best insurance against unexpected breakdown at a critical moment when maximum performance is essential. Maintenance and inspection procedures are prescribed in TM 9–1400–350–12.

32. Disassembly, Adjustment, and Assembly

Disassembly, adjustment, and assembly of the launcher and the test station are described in TM 9–1440–350–14 and TM 9–1430–350–14/1.

33. Records

a. The principal records pertaining to materiel are the guided missile record book and the unsatisfactory equipment report (DA Form 468). Information regarding the purpose and use of these forms is printed on the forms themselves.

b. The battery commander and the chiefs of sections also should keep semipermanent records of missile peculiar equipment for information and guidance.

34. Maintenance

Publications pertaining to maintenance of Redstone equipment are listed in the appendix.

35. Inspections

Regular inspections are required to insure that materiel is maintained in serviceable condition. TM 9–1400–350–12 and TM 9–1400–350–34/2 specify the schedule of technical inspections that must be followed. Operational life limitations preclude indiscriminate activation of components, and commanders at every echelon must insure that unauthorized adjustments are prohibited.

a. Each chief of section is responsible for the equipment within his section. He should inspect it thoroughly each day. If repairs or adjustments are required, he should take immediate corrective action. If the action required is beyond his capabilities, he should notify the battery executive officer, so the necessary action may be taken.

b. The firing battery commander, accompanied by the appropriate chief of section, should make a daily spot check inspection. He should inspect different parts of the materiel each day to insure complete coverage every few days. At least once a month, the firing battery commander should make a thorough mechanical inspection of the launcher, erector-servicer truck, missile test station, tools, and repair parts.

c. Battery and battalion commanders should make frequent command inspections to assure themselves that the equipment in their command is being maintained at prescribed standards of appearance, condition, and completeness.

d. For details on inspecting the launcher, the erector-servicer truck, and the missile test station, see TM 9–1440–350–14, TM 9–1430–350–14/1, and TM 9–1430–350–14/2. Deficiencies found during inspections should be corrected promptly.

36. Duties in Inspection Before Operation (March)

The inspection performed before movement is a final check on materiel before leaving the motor park for training, for combat, or for displacement. After inspection and correction of all deficiencies, the firing section and servicing section equipment is ready for action. The responsibilities and inspection duties of section personnel are as follows:

a. Chiefs of sections—

(1) Verify that trailers are properly coupled and brake lines connected.
(2) Verify that handbrakes are released.
(3) Verify the proper supply of gasoline, oil, water, and emergency rations.
(4) Verify the presence of technical manuals, lubrication orders, trip ticket, and driver's accident report forms.
(5) Verify that all section equipment and personnel are loaded on section vehicles.
(6) Report to the battery commander on completion of (1) through (5) above, "Sir, (so-and-so) section in order," or report any defects that the section cannot remedy without delay.

b. Driver—Performs before operation duties as prescribed in appropriate TM.

37. Duties in Inspection During Operation (March)

The inspections performed during movement are constant

checks on the functioning of the vehicles and the security of all loaded equipment. The responsibilities and duties of section personnel are as follows:

a. The chiefs of sections supervise the operation and assist the drivers in detecting obstacles that would cause injury to personnel or damage to the equipment.

b. The other crewmen inspect security of the loaded equipment.

c. The drivers operate the vehicles and inspect all instruments and controls.

38. Duties in Inspection During Halt

The inspections at the halt are made to insure that the vehicular equipment has remained in satisfactory operating condition. The halt provides the section personnel an opportunity to inspect the equipment for security.

39. Duties in Inspection and Maintenance After Operation

Immediately after movement, all section equipment is serviced and maintained in preparation for further sustained action and inspected to determine the need for maintenance by higher echelons. Individual duties of section personnel are designated by the chief of section.

40. Duties in Weekly Inspection and Maintenance

In garrison, inspection and maintenance duties are performed weekly. On maneuver or in combat, they are performed after each field operation or at weekly intervals, whichever occurs first. Depending on the status of training or on the tactical situation, more frequent inspections and maintenance may be scheduled at the discretion of the commander. The schedules and procedures for maintenance of the specialized missile materiel are contained in the appropriate technical manuals. Testing and operation will be performed only as directed in these publications since many assemblies in this equipment have a relatively short operational life.

a. Chiefs of sections—Supervise and direct section personnel in performance of inspections and maintenance of section equipment, vehicles, tools, and accessories.

b. Specialists, operators, and crewmen—Perform normal maintenance as directed by chiefs of sections.

c. Drivers—Perform first-echelon maintenance in accordance with the appropriate technical manual and lubrication order. The back of the driver's trip ticket (DD Form 110) is used as a checklist for maintenance service. The vehicle is inspected and serviced by the assigned operator or crew each day that it is operated.

CHAPTER 9

DECONTAMINATION

41. General

a. Equipment which has been contaminated by chemical, biological, or radiological agents constitutes a danger to personnel. *Contamination* is defined as the spreading of an injurious agent in any form and by any means. Persons, objects, or terrain may be contaminated. *Decontamination* is the process of making any contaminated place or object safe for unprotected personnel. This can be done by covering, removing, destroying, or changing into harmless substances the contaminating agent or agents. Generally, only equipment contaminated by persistent agents requires decontamination.

b. Although liquid oxygen, alcohol, and hydrogen peroxide are not persistent agents, decontamination procedures described in paragraph 44 will be followed.

42. Decontamination for Chemical Agents Other Than Propellants

a. Missiles. Wipe off visible contaminant from missiles with rags. Apply DANC (decontamination agent, noncorrosive, M4), wipe with solvent-soaked rag, then dry (FM 21–40). If DANC is not available, scrub with soap and cool water being careful that all motor parts are wiped dry. If a missile cannot be decontaminated at the position area it will be evacuated to an echelon where decontamination can be accomplished or the missile can be disposed of in accordance with local regulations.

b. Instruments and Fire Control Equipment. If instruments and fire control equipment are exposed to corrosive gases, clean as soon as possible with alcohol (or cleaning solvent, if alcohol is not available) and apply a thin coat of light machine oil. A rag dampened with DANC may be used for cleaning, followed by drying with a clean rag and applying a coat of machine oil. DANC injures plastic or hard rubber surfaces.

c. Weapons. Remove dirt, dust, grease, and oil from weapons. Do not apply "wet mix" (FM 21–40) but allow surfaces to air after oil and dirt have been removed. DANC can be used on all metal surfaces except the bore. Also effective on metal are hot water, cleaning solvent, or repeated applications of gasoline on

swabs. If this emergency use of gasoline-soaked swabs is made (FM 21–40), extreme care must be taken to insure that the gasoline does not spread the contaminant and does not remain present in liquid or vapor form. Also, excess gasoline will ignite when the weapon is fired. After decontamination, the weapons should be dried and oiled.

d. Automotive Equipment. Light contamination from spray can be neutralized by exposing automotive equipment to air. For heavy contamination, use DANC on interior or exterior surfaces which personnel are likely to touch. For decontamination of a large area, wash vehicles with water and scrub painted surfaces with soapy water.

43. Decontamination for Biological and Radiological Agents

a. General. After a contaminating attack, equipment may be recovered either by waiting to permit the decay of contaminants, or by active decontamination procedures to reduce the danger to a level at which it is no longer a significant hazard to operating personnel. Decontamination may be either hasty or detailed, depending on the urgency of the military situation. The procedure adopted is a command decision.

b. Hasty Decontamination. Hasty decontamination is performed when the situation is urgent. Its purpose is to reduce contamination sufficiently to permit personnel to work with, or close to, equipment for limited periods. Rough decontamination may be achieved by using water or steam, if available. Soap or detergent used with water or steam promotes decontamination.

c. Detailed Decontamination. Detailed decontamination, in which thoroughness is emphasized, is carried out in rear areas and at repair bases and includes procedures of surface decontamination, aging, sealing, and disposal.

44. Decontamination for Liquid Oxygen, Hydrogen Peroxide, and Alcohol

Decontamination of equipment or areas contaminated by liquid oxygen, alcohol, or hydrogen peroxide will be accomplished by drenching the contaminated surface with water.

Caution: **The use of rags or other reactive materials with hydrogen peroxide may cause fire or explosion (par. 59).**

CHAPTER 10

DESTRUCTION OF EQUIPMENT

45. General

a. Tactical situations may arise in which it becomes necessary to abandon equipment in the combat zone. In such a situation, all equipment to be abandoned must be destroyed to prevent its use by the enemy.

b. The headquarters of the force which a unit is supporting normally issues instructions for destruction of equipment to prevent capture. If capture is imminent and there is no communication with higher headquarters, the senior military person eligible to exercise command in the unit will order the destruction.

46. Plans

All batteries will prepare plans for destroying their equipment in order to reduce the amount of time required should destruction become necessary. The principles to be followed are as shown in *a* through *d* below:

a. Plans for destruction of equipment must be adequate, uniform, and capable of being easily carried out in the field.

b. Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires considerable time, *priorities* must be established so that the more essential parts will be destroyed first. Destruction of Redstone missile warheads is most important.

c. The same essential parts must be destroyed on all like units to prevent the enemy from constructing complete units from undamaged parts.

d. Spare parts and accessories must be given the same priorities as the parts installed on the equipment.

47. Methods

To destroy equipment adequately and uniformly, all personnel of the unit must know the plan and priority of destruction and be trained in the methods of destruction.

a. Warhead Destruction. Warhead evacuation, rather than destruction, will be given primary consideration. Only when warheads cannot be evacuated will destruction be ordered. Warhead

destruction will then have the highest priority. Classified components of the ammunition can be destroyed with the warhead by grouping them together at the time of destruction. The method of warhead destruction is described in FM 6–165, Warhead Section, XM18, XM30, XM31, and XM33, Redstone (U).

b. Missile Destruction. If a missile (less warhead) must be destroyed, place 10-pound blocks of TNT (or an equivalent amount of compound C3) on the liquid oxygen tank, the alcohol tank, and the guidance section. Electrical or nonelectrical fuses may be used to detonate. (For information pertaining to the use of blasting equipment and accessories for destruction, see FM 5–25, TM 9–1900, and TM 9–1946.)

48. Procedure

Equipment will be destroyed, in the following order of priority, in the manner indicated:

a. Destruction of the missile warhead will be accomplished as described in FM 6–165.

b. Classified publications pertaining to the materiel will be burned.

c. Classified components of the missile (other than the warhead) will be destroyed by smashing with a heavy tool, burning, blasting with demolition charges or by a combination of these methods as appropriate within the time available.

d. Destruction of the missile, launcher, vehicles, and other associated equipment will be accomplished in accordance with the appropriate technical manual issued with the equipment. Technical manuals are listed in the appendix.

Chapter 11

SAFETY PRECAUTIONS

Section I. GENERAL

49. References

Safety precautions to be observed are prescribed in SR 385–310–5.

50. Purpose and Scope

The purpose of this chapter is to outline the more important safety precautions to be observed by personnel in a Redstone unit. Emphasis is placed on precautionary measures required to prevent bodily injuries caused by liquid oxygen, liquid nitrogen, hydrogen peroxide, alcohol, compressed air, or electric shock. A summary of first aid treatment for these bodily injuries is included in this chapter.

51. Principles

The cardinal safety principle to be observed in operations involving explosives and fire hazards is to limit the exposure time of a minimum number of personnel to a minimum amount of hazardous materiel consistent with safe and efficient operation. This principle implies that hazardous working areas be separated from all other areas and that the minimum number of personnel needed for efficient operation be employed.

Section II. LIQUID OXYGEN

52. Characteristics

Liquid oxygen, generally referred to as LOX, is a light blue liquid. It is not combustible, but, being a strong oxidizing agent, it supports combustion of all flammable materials, particularly wood, asphalt, and other hydrocarbons to a very high and sometimes explosive degree. It is nontoxic and does not produce irritating fumes.

53. Storage

The 9-ton LOX trailer is sufficiently insulated to prevent a major increase in evaporation rate even when stored in direct

sunlight. Procedures for storing liquid oxygen do not present a major safety problem if the following rules are observed:

a. Maintain a distance of at least 60 meters between storage areas for liquid oxygen, alcohol, and hydrogen peroxide.

b. Equip each storage tank and portable container with pressure vents or relief valves.

c. Observe safety rules prescribed for the handling of liquid oxygen.

54. Handling Precautions

Although liquid oxygen is nontoxic and does not produce irritating fumes, personal contact will likely result in freezing of skin tissue. The effect is similar to a burn. To prevent contamination of personnel engaged in handling liquid oxygen, the following precautions must be observed:

a. Handle containers carefully to avoid damage resulting in leakage or spillage.

b. Instruct personnel on the characteristics of liquid oxygen, the precautions necessary to prevent contamination, and the methods of first aid treatment in the event of contamination.

c. Require personnel engaged in handling liquid oxygen to wear protective face masks and asbestos gloves.

d. Insure that firefighters with water-filled fire extinguishers are present in the handling area.

e. Provide safety showers, when available in handling areas, as a rapid means of treating personnel who have been covered with liquid oxygen. As an added precaution, provide an open container of water for flushing contaminated skin areas. The water provided by fire fighting equipment may be used by personnel as an alternate means of emergency decontamination.

Section III. LIQUID NITROGEN

55. Characteristics

Liquid nitrogen, generally referred to as LN_2, is a colorless liquid. It does not support combustion. It is nontoxic and does not produce irritating fumes.

56. Storage

Liquid nitrogen is stored in 150-gallon trailer mounted containers. Procedures for storing liquid nitrogen do not present a major safety problem when the following rules are observed:

a. Equip each storage tank with pressure vents or relief valves.

b. Observe safety rules prescribed for the handling of liquid nitrogen.

57. Handling Precautions

Although liquid nitrogen is nontoxic and does not produce irritating fumes, personal contact will likely result in freezing of skin tissues. To prevent contamination of personnel engaged in handling liquid nitrogen, the precautions for handling liquid oxygen must be observed (par. 54).

58. First Aid Treatment for Liquid Oxygen and Liquid Nitrogen Contamination

Although liquid oxygen or liquid nitrogen do not wet or adhere to the skin, persons working with these solutions who have had the liquid spilled on any part of the body will immediately apply cold wet compresses to the affected area. A container kept stocked with clean rags or sponges will be set aside for first aid use only. If blisters develop, these should be opened with a sterile blade. If symptoms of irritation remain after treatment with compresses, the patient should receive medical treatment. *Do not apply petroleum jelly, tannic acid paste, or other greasy medicants.*

Section IV. HYDROGEN PEROXIDE

59. Characteristics

The highly concentrated hydrogen peroxide used in the Redstone system is not to be confused with the weak solution of this compound used as an antiseptic. In the highly concentrated pure state, it is a colorless liquid that is neither flammable nor explosive; but, when contaminated with grease, oil, or some metals and salts, it will explode. Although it is nontoxic, the solution is very irritating to the skin, nose, throat, and lungs and is extremely dangerous to the eyes.

60. Storage

a. Hydrogen peroxide should be kept in the aluminum drum in which it is received. The following rules must be observed in storing hydrogen peroxide:

(1) The drums must be stored in a cool place, out of the direct rays of the sun, and away from areas of fire hazard.

(2) Storage areas must be free of combustible materials and stored metals. The site should be properly drained or diked to prevent damage in the event of drum rupture.

(3) In garrison, drums should be stored in noncombustible buildings.

(4) Minimum quantity distances for locating full drums of hydrogen peroxide are as follows:

Quantity	Distance in Meters				
	Inhabited buildings	Public highway	Public railway	Magazine distance	Personnel operations
1 drum	300	90	180	50	50
2 drums	365	110	220	70	50
3 drums	400	120	240	80	50

(5) Safety rules prescribed for the handling of hydrogen peroxide must be observed.

(6) When measuring the temperatures of hydrogen peroxide, do not use a mercury thermometer; use a passivated, aluminum-jacketed thermometer.

b. During transport of hydrogen peroxide, the container must be continuously checked for contamination of the hydrogen peroxide. Procedures described in (1) through (5) below should be followed:

(1) Position the every-angle thermometer used to measure the hydrogen peroxide temperature so that it can be easily seen. An air thermometer should be placed close by to record the ambient (air) temperature.

(2) Check the thermometers at frequent intervals.

(3) If the temperature of the hydrogen peroxide rises 20° F. or more above the ambient temperature, it must be disposed of as soon as possible. Detailed procedures are described in TM 9–1450–350–14/1.

(4) If contamination in its early stages is discovered during transport, there will be sufficient time to use the chain hoist to transfer the drum from the truck to the ground. Remove the caps from the overflow and suction connections and overturn the drum to allow the liquid to drain. Care must be exercised that the concentrated hydrogen peroxide is not drained into a confined area containing organic materiel as an explosion might occur. Keep personnel and equipment clear of the area, because there is danger of fire.

(5) If the contamination appears to have reached the critical stage, dump the drum from the truck and drain by riddling it with small arms fire from a safe distance. Since this method may produce an explosion, it can be used only in remote areas where the safety of others is not endangered.

61. Handling Precautions

Since clothing is likely to ignite and burn vigorously on contact with hydrogen peroxide, the chief danger to personnel from hydrogen peroxide is from burns. Fires which result from hydrogen peroxide cannot be put out with carbon dioxide or foam-type extinguishers. Drenching with large amounts of water is recommended. The following precautions must be observed:

a. Handle containers carefully to avoid damage resulting in leakage or spillage.

b. Instruct personnel in the characteristics of hydrogen peroxide and in the methods of first aid treatment in the event of contamination. See paragraph 62.

c. Require personnel engaged in handling hydrogen peroxide to wear protective clothing.

d. Insure that firefighters with water-filled extinguishers are present in the handling area.

e. Provide safety showers, when available in handling areas as a rapid means of treating personnel who have been covered with hydrogen peroxide. A container of clean cloths and/or sponges for use in treatment of burns and a small container of 3 percent *boric acid* solution for washing out the eyes must also be available. The water provided by firefighting equipment may be used as an alternate means of emergency decontamination of personnel.

f. On conclusion of handling operations, if spillage has occurred, decontaminate all clothing by soaking in water.

g. If possible, require personnel engaged in handling operations to bathe thoroughly on completion of their duties.

62. First Aid Treatment for Hydrogen Peroxide Contamination and Burns

a. Any area of the body which comes in contact with hydrogen peroxide should be drenched with water for at least 15 minutes. Cold compresses should be applied on affected areas. If blisters form, they should be opened with a sterile blade. *Do not apply ointments.* If hydrogen peroxide comes in contact with the eyes, they should be irrigated with water, then with a 3 percent boric acid solution. If symptoms of irritation remain, send the patient for medical treatment.

b. In the event of burns received from fire, administer first aid prescribed above and follow instructions outlined in FM 21–11.

Section V. ALCOHOL

63. Characteristics

The alcohol used in the Redstone system is an ethyl alcohol-water solution containing a small amount of methyl alcohol. For

safety purposes purple dye (aniline) is also added for leak detection and to indicate that methyl alcohol has been added. *The presence of methyl alcohol causes the solution to become a poison when taken internally.* Its effect on the skin is negligible unless contamination exists over a long period of time. The solution is highly flammable, but as a liquid it is not explosive. The vapors formed by the liquid, however, when mixed with air to the proper concentration, are explosive.

64. Storage

Procedures for storing alcohol are as follows:

a. Keep in a place with adequate ventilation and away from areas of fire hazard.

b. Maintain a distance of at least 60 meters between storage areas for liquid oxygen, hydrogen peroxide, and alcohol.

c. Segregate empty and full containers.

d. Observe safety rules prescribed for the handling of alcohol.

e. Periodically test the alcohol-water mixture to assure that proper mix is maintained. This procedure is described in TM 9-1400-350-12.

65. Handling Precautions

a. When alcohol is handled in the open, concentrations of the vapor are not likely to build up and the following precautions can be taken:

(1) Instruct personnel in the characteristics of the alcohol.
(2) Although protective clothing is not required, personnel should wear shoes that are nonspark-producing.
(3) Although showers are not essential, they are considered desirable in case of severe contamination.
(4) Keep an open container of water in the area for flushing contaminated skin areas.
(5) Remove contaminated clothing and bathe the skin with water.
(6) Prohibit all spark-producing equipment from use in the handling area.
(7) During handling, position firefighters equipped with water-filled fire extinguishers in the area.

b. In addition to the precautions listed in *a* above, when alcohol is handled in a closed area and the vapor concentration is high enough to cause irritation, a self-contained breathing apparatus should be worn.

66. First Aid Treatment for Alcohol Contamination

Alcohol that contacts the skin should be washed off with water.

If the eyes are contacted with alcohol, they should immediately be washed with large amounts of cool, clean water. Under certain conditions, exposure to high concentrations of alcohol vapors may result in slight intoxication. Personnel so affected should be removed to a vapor-free area. If this liquid is accidentally swallowed, medical attention should be obtained immediately. If medical attention is not available, the patient should be dosed with a solution containing 3 tablespoons of Epsom salts for each quart of water. The patient should drink as much of the solution as he can hold. Epsom salts should be kept on hand and readily available at all times.

Section VI. COMPRESSED AIR

67. General

The high air pressures required in Redstone operations are extremely dangerous. When improperly handled, containers and lines of compressed air are subject to leakage and occasionally to explosive rupture with consequent damage. High pressure streams of air and whipping of ruptured air lines may inflict serious injury to personnel and equipment. However, the intelligent use of compressed air systems and frequent inspections reduce the potential hazard.

68. Pressure Systems

a. Inspections. Complete and regular tests and inspections of the pressure systems are essential to insure safety and efficient functioning. Systems should be inspected for leaks, defective piping, improperly adjusted valves, malfunctioning of regulators, and presence of foreign material in the system. The air receivers and lines which trap moisture must be drained at frequent intervals to lessen corrosion. The working area around a pressure system must be free of flammable substances and unnecessary equipment. During pressurization of the systems, all personnel except those required for the pressurization operation should be cleared from the area. Newly assigned personnel must be closely supervised until they perform their duties in compliance with current safety regulations.

b. Adjustment of Valves, Regulators, and Fittings. The adjustment of valves and regulators is the critical operation in controlling a pressure system The following precautions must be taken in operating and adjusting the valves and regulators:

(1) Close valves when system is not in use.
(2) Always open and close valves slowly and stand to one side while doing so.

(3) Adjust valves in the intake and pressure lines prior to starting the compressor.
(4) Do not operate the compressor in excess of rated capacity.
(5) Never permit the compressed air to enter the regulator suddenly.
(6) Release pressure through *bleeder* valves only, never by loosening a fitting or part of a line connection.
(7) Do not permit oil or grease to contact the valves, regulators, or gages.
(8) Never use a wrench or hammer to open or close a valve equipped with a handwheel. For valves difficult to open, point the valve opening away from the body and exert greater force on the handwheel or key provided. Tighten the hand-operated valves only moderately.
(9) Release pressure from the regulator when the cylinder is not in use.
(10) Before the fittings are connected, clear the cylinder valve of foreign material by opening the valve slightly for an instant.

c. Flexible High-Pressure Lines. Lines should be periodically tested as components of the high-pressure system in accordance with the instructions contained in TM 9–1400–350–12. The installation of these lines should always be inspected before pressurization of the systems. They should be securely tied down or sandbagged at prescribed intervals to prevent whipping in case of rupture. Tying down is essential at couplings and connections. An uncontrolled high-pressure line can cause serious injury or death.

Section VII. ELECTRIC SHOCK

69. Rescue

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from the live conductor as promptly as possible. To avoid direct contact with either the live conductor or the victim's body, use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high voltage wire; use extreme caution to avoid the resulting electric flash.

70. First Aid Treatment for Electric Shock

The treatment for electric shock is artificial respiration (FM 21–11).

Section VIII. NUCLEAR SAFETY REQUIREMENTS

71. Precautions

a. Radiation tolerances will not be exceeded under normal operating conditions.

b. Safety precautions required in the handling and storage of the Redstone warhead are contained in FM 6–165.

CHAPTER 12

TRAINING

72. Purpose and Scope

The purpose of this chapter is to present general information for training the personnel of a firing battery in the performance of their duties.

73. Objective

The objective of this chapter is to train crewmen to perform their individual duties rapidly and, through drill, to coordinate them into an effective combat team.

74. Conduct of Training

a. Training will be conducted in accordance with the principles set forth in FM 21–5. The training goal is outlined in Army Training Program for Field Artillery Missile Battalion, Redstone (ATP 6–635E), and AR 611–201.

b. In general, individual training is conducted by noncommissioned officers as far as practicable. Officers are responsible for preparing training plans, for conducting unit training, and for supervising and testing individual training.

c. Throughout training, the application of prior instruction to current training must be emphasized.

d. The firing battery must be able to perform the operations prescribed in this manual equally well during daylight and at nighttime under blackout conditions. Night training under blackout conditions must be stressed.

e. The Redstone trainer is the training missile for the Redstone unit. Some components of the tactical missile have a short operational life, and continuous use would result in damage to the missile. Since most operations required to prepare a tactical missile for firing can be performed on the trainer missile, it will provide the realistic training required for a missile unit. Simulating essential operations because of safety, labor involved, or the complex nature of the equipment must be avoided. Maximum use should be made of mock firings of training missiles to include crew drills on—

(1) Missile assembly.

(2) Installation of cables.
(3) Missile testing.
(4) Missile erection and propellant loading.

*f. **Caution:*** **Tactical basic load missiles should not be used for fueling operations except in preparation for an actual firing.**

75. Standards To Be Attained

The qualifications established by AR 611–201 should be used as a guide for standards to be attained by individuals. The qualifications established by Army Training Test 6–635E should be used as a guide for standards to be achieved by units.

CHAPTER 13

TESTS FOR QUALIFICATION OF MISSILEMEN

Section I. GENERAL

76. Purpose and Scope

This chapter prescribes the tests to be given in the qualification of missilemen. The tests are designed to measure a soldier's knowledge of the equipment in a Redstone firing battery; these tests do not require a technical background or school training. The purposes of the tests are—

a. To provide a means of determining the relative proficiency of the individual artillery soldier in the performance of duties required of members of the Redstone firing battery. The tests will not be a basis for determining the relative proficiency of batteries or higher units.

b. To serve as an incentive for individuals within the Redstone firing battery to expand their knowledge of the complete Redstone system, thereby increasing their value to the unit.

c. To serve as an adjunct to training.

77. Standards

The candidate will be required to perform the tests in accordance with the procedures listed in this manual and the appropriate technical references. In those tests in which a candidate is required to direct assistants, he will do so in the manner of a noncommissioned officer, regardless of his actual rank. Although time limits have not been imposed for these tests, an obvious lack of knowledge or trial and error solutions will be cause for halting a test and failing the candidate on that particular test.

78. Administration of Tests

The battery commander will be responsible for the testing of personnel within his battery. Individuals should be allowed to apply for qualification on a voluntary basis. Generally, tests will be administered as follows:

a. Ten areas within the Redstone system have been selected for test purposes. Within each area several tests are available. A candidate must be prepared for all the tests within an area, but only one will be administered. When the candidate reports for a

test, the test to be administered will be selected on the basis of a drawing or by some other form of chance.

b. A single test, once started, will be conducted from start to finish without interruption.

c. The series of tests may be administered over any period of time established by the battery commander.

d. Tests may be administered in any sequence, subject to the decision of the battery commander.

e. All tests entail the performance of duties normally assigned to specific individuals within the firing battery. These assigned personnel will be appointed as examiners to conduct and grade the tests involving their duties.

f. All tests will include the duties that are performed in the course of a normal firing sequence. Therefore, special arrangements for time and equipment for testing are not required. Tests may be conducted during the normal training periods for firing sequence procedures, with the candidate performing the duties and being graded by the examiner.

g. Candidates will be allowed to use all checksheets and related materials that are available to assigned personnel in their normal performance of duties.

h. Candidates will not be required to troubleshoot or repair equipment.

79. Assistance

The candidate will receive no unauthorized assistance. Assistants will be furnished to the candidate as required for each test. The assistants will perform duties as they are assigned by the candidate. Assistants will volunteer no information but will execute the candidate's commands to the best of their ability. When erroneous commands are given, the assistants should so inform the examiner prior to acting on the command. If a candidate fails a test because of the fault of the examiner or an assistant, the test will be disregarded, and the candidate will be given another test in the same area.

80. Conduct of Tests

At the start of a test, equipment will be in the same condition that it would be in during the normal firing sequence. The examiner will explain to the candidate the scope of the test and indicate the men who will act as assistants. He will also furnish the candidate with any checksheets or related materials available. During the test, the examiner will prevent the candidate from making any mistakes that would be harmful to personnel or equipment. At the

completion of the test, the examiner will critique the candidate's performance, tell him the score he has been awarded on the test, and turn in the score to the battery commander.

81. Scoring

A maximum score of 10 points is possible for each test. A candidate who successfully performs duties required by a test will be given at least 7 points. Additional points will be awarded as determined by the manner of performance. Errors will be weighted and the candidate will be penalized a proportional number of points.

82. Qualification Scores

Minimum scores required for qualification of missilemen are as follows:

Individual classification	*Minimum score*
Expert missileman	90
First-class missileman	80
Second-class missileman	70

83. Outline of Tests

Area	Subject	Maximum credit
I	Auxiliary power equipment	10
II	Cable and pneumatic line layout	10
III	Missile assembly	10
IV	Horizontal testing procedures	10
V	Erector-servicer truck and launcher	10
VI	Missile erection	10
VII	Vertical testing procedures	10
VIII	Propellant loading	10
IX	Missile laying	10
X	Candidate evaluation	10
	Total credit	100

Section II. AUXILIARY POWER EQUIPMENT

84. Scope of Tests

Two tests are available for testing a candidate on the operation of auxiliary power equipment. Only one test will be administered.

85. Special Instructions

a. The air compressor and air servicer will be emplaced with necessary pneumatic connections made prior to conducting test 1.

b. The power generator and the power distribution trailer will be emplaced and necessary cabling connections made prior to conducting test 2.

86. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	Prepare for action.	Performs all the before operation preventive maintenance, starts the air compressor, goes through the warmup cycle and checks out all engine gages. As soon as the engine warmup cycle is completed, performs the warmup cycle for the compressor and makes all the adjustments necesary to put the compressor in service.
	Pressurize air servicer.	Pressurizes the air servicer.
2	Prepare for action.	Performs all the before-operation preventive maintenance on the generator set, and starts the diesel engine. After warmup period and checkout of engine gages, turns generator switch to ON and checks voltage and cycle rate of generator.
	Adjust networks voltage.	Turns on networks BUS output switch on power distribution station. Adjusts voltage to proper value.
	Adjust inverter BUS power.	Turns on inverter BUS output switch, adjusts voltage to proper value.
	Monitor 60 cps voltage.	Turns circuit breakers on. Continues to monitor the power distribution station (PDS) during horizontal power check, making adjustments as required.

87. Penalties

a. No credit will be given if proper warmup procedures for the air compressor are not followed in test 1.

b. No credit will be allowed in test 2 if the voltages are not maintained within the proper limits.

Section III. CABLE AND PNEUMATIC LINE LAYOUT

88. Scope of Test

Three tests are available for measuring a candidate's knowledge of the cable and pneumatic line layout required in the Redstone system. Only one test will be administered. The cable and air pressure line connections to be made are those required in preparation for horizontal checkout.

89. Special Instructions

The missile test station, launcher, and accessory truck will be positioned before the test is started. The candidate will be assisted as required to perform the test selected.

90. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	Prepare for action.	Unloads, lays, and connects all cables and air lines between the missile test station and the relay box.
2	Prepare for action.	Unloads lays, and connects all cables and lines between the launcher and the missile.
3	Prepare for action.	Installs valve box on the launcher. Unloads, lays, and connects all cables and lines between the launcher and the relay box.

Section IV. MISSILE ASSEMBLY

91. Scope of Test

Two tests are available for measuring a candidate's knowledge of missile assembly procedures. Only one test will be administered.

92. Special Instructions

The erector-servicer, the A-frame, the H-frame, and the launcher will be emplaced prior to beginning the test. The trailer cover lifting jacks will also be installed on the trailer covers. The candidate will be assisted as required by personnel from the servicing section in performing the test selected.

93. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	Prepare for action.	Removes the trailer covers from the aft and warhead unit trailers; using the A-frame or wrecker method, mates the warhead unit and the aft unit. Insures that the mating bolts are torqued to the correct value.
2	Prepare for action.	Removes the thrust unit trailer cover. Supervise positioning of thrust unit trailer near launcher. Connects rotating frame assembly to thrust unit and attaches thrust unit slings. Supervises placement of missile body and performs missile mating operations. Insures that dummy explosives bolts are torqued to the correct value.

Section V. HORIZONTAL TESTING PROCEDURES

94. Scope of Test

Four tests are available for measuring a candidate's knowledge of horizontal testing procedures. Only one of these tests will be administered.

95. Special Instructions

All preparations for horizontal checkout will be completed before beginning the test. The candidate will be assisted as required by firing section personnel in performing the test selected.

96. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	(Examiner will command candidate to perform appropriate tests as they occur during the horizontal checkout procedure.)	Performs duties of stabilizer control panel operator during horizontal checkout.

Test number	Examiner commands (for example)	Action of candidate
2	(Examiner will command candidate to perform appropriate tests as they occur during the horizontal checkout procedure.)	Performs duties of range control panel operator during horizontal checkout.
3	(Examiner will command candidate to perform appropriate tests as they occur during the horizontal checkout procedure.)	Performs duties of lateral control panel operator during horizontal checkout.
4	(Examiner will command candidate to perform appropriate tests as they occur during the horizontal checkout procedure.)	Performs duties of propulsion control panel operator during horizontal checkout.

97. Penalties

No credit will be given if proper procedures are not followed during the tests. Any action that would create an unsafe condition or endanger personnel will be immediately stopped.

Section VI. ERECTOR-SERVICER TRUCK AND LAUNCHER

98. Scope of Test

Two tests are available for measuring a candidate's knowledge of the erector-servicer and the launcher. Only one test will be administered.

99. Special Instructions

The candidate will be assisted by servicing section personnel as required in performing the test selected.

100. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	Prepare for action.	Performs necessary operation in unloading, positioning, and assembly of the lightweight erection equipment.
2	Prepare for action.	Positions the launcher, and removes the wheels using the hydraulic cart or wrecker method. Levels launcher and lowers outrigger pads to stabilize the launcher.

Section VII. MISSILE ERECTION

101. Scope of Test

Three tests are available for measuring a candidate's knowledge of missile erection procedures. Only one test will be administered.

102. Special Instructions

The launcher and erection equipment will be emplaced and all cabling completed prior to beginning the test. The candidate will be assisted by servicing section personnel as required in performing the test selected.

103. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	(Examiner will command candidate to perform appropriate missile erection duties).	Performs necessary operations in rigging the missile for erection and deerection.
2	(Examiner will command candidate to perform appropriate missile erection duties.)	Positions the hydraulic cart and performs warmup procedures. Operates hydraulic cart during missile erection and deerection.
3	(Examiner will command candidate to perform appropriate missile erection duties.)	Operates the erector-servicer winch during missile erection and deerection.

104. Penalties

No credit will be allowed if the proper procedures are not followed in missile rigging, erection, and deerection.

Section VIII. VERTICAL TESTING PROCEDURES

105. Scope of Test

Four tests are available for measuring a candidate's knowledge of vertical testing procedures. Only one test will be administered.

106. Special Instructions

All preparations for vertical checkout will be completed before beginning the test. The candidate will be assisted as required by firing section personnel in the performance of the test selected.

107. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	(Examiner will command candidate to perform appropriate tests as they occur during the vertical checkout procedure.)	Performs duties of the stabilizer control panel operator during vertical checkout.
2	(Examiner will command candidate to perform appropriate tests as they occur during the vertical checkout procedure.)	Performs duties of the range control panel operator during vertical checkout.
3	(Examiner will command candidate to perform appropriate tests as they occur during the vertical checkout procedure.)	Performs duties of the lateral control panel operator during vertical checkout.
4	(Examiner will command candidate to perform appropriate tests as they occur during the vertical checkout procedure.)	Performs duties of the propulsion control panel operator during vertical checkout.

108. Penalties

No credit will be given if proper procedures are not followed during the tests. Any action that would create an unsafe condition or endanger personnel will immediately be stopped.

Section IX. PROPELLANT LOADING

109. Scope of Test

Three tests are available for measuring a candidate's knowledge of propellant loading procedures. Only one test will be administered.

110. Special Instructions

Firefighting equipment must be available in the area before these tests are conducted. All safety procedures must be observed and protective clothing will be worn as required. The candidate will be assisted as required in performing the test selected.

111. Conduct of Tests

Test number	Examiner commands (for example)	Action of candidate
1	(Examiner will command candidate to perform appropriate propellant loading operation.)	Positions the alcohol semitrailer and makes necessary hose connections. Computes alcohol load and performs alcohol loading duties.
2	(Examiner will command candidate to perform appropriate propellant loading operation.)	Positions the liquid oxygen (LOX) trailers and makes necessary hose connections. Performs LOX loading duties.
3	(Examiner will command candidate to perform appropriate propellant loading operation.)	Positions the hydrogen-peroxide (H_2O_2) servicer and makes necessary hose connections. Performs H_2O_2 loading duties.

Section X. MISSILE LAYING

112. Scope of Test

There are three tests available for measuring a candidate's knowledge of laying procedures. Only one test will be administered.

113. Special Instructions

All required missile laying equipment will be present in the firing area. Survey requirements will have been completed and the orienting line will be marked prior to the test. The candidate will be assisted by the survey specialists in performing this test.

114. Conduct of Test

Test number	Examiner commands (for example)	Action of candidate
1	Place the ACI in position.	The candidate may use either of two methods as directed by examiner: *First Method:* The candidate sets up the ACI over the middle of the blast deflector. He lays the ACI with the RI and turns the ACI to a reading of 180°. He marks a line on the launcher ring and a position on

Test number	Examiner commands (for example)	Action of candidate
		the ground, 30 to 60 meters from the launcher, in line with the vertical crossline of the ACI. He marks a position 16.5 cm away from the position marked on the ground, in the direction of fire. He moves the ACI to this position and lays the ACI with the RI. *Second Method:* At a distance of 30 to 60 meters from the launcher, he sights on the center of the blast deflector with a compass. He moves laterally until the compass reads the value of azimuth of fire minus 90° or plus 270° (minus 90° if the azimuth of fire is greater than 90°). He marks a point on the ground at this position. He sets up the ACI over this point and lays the ACI with the RI. He sights the ACI on the center of the blast deflector and reads the angle from the ACI. If the reading is 0°, ± 20″, he marks a line on the launcher ring in line with the vertical cross line of the ACI and marks a position 16.5 cm away from the present location of the ACI in the direction of fire. He sets up the ACI at the new position and lays it with the RI. If the reading to the blast deflector is not within ±20″ of 0°, he must compute a new location for the ACI (par. 29*a*). After setting up and laying the ACI at the computed position, he must check to see if the angle to the blast deflector

Test number	Examiner commands (for example)	Action of candidate
		is within ±20″ of 0°. If it is not, he again determines a new location for the ACI. After verifying an angle of 0°±20″ he must move the ACI 16.5 cm in the manner described above and lay it with the RI.
2	(Examiner will command the candidate to lay the missile within the tolerance required for preliminary laying.)	The candidate directs rotation of the missile until the center of fin IV coincides with line he marked on the launcher ring. He sights the ACI on the Porro prism and directs missile rotation, if necessary, until an accurately centered reflection of the theodolite-mounted target is seen under the vertical crossline of the instrument. If the ACI reading is 0° ± 59′, the requirement for preliminary lay is satisfied. If not, he must compute a new location for the ACI (par. 29*a*). He moves the ACI to the computed position, lays the ACI with the RI and repeats the above step. He continues repositioning and laying the ACI until the reading to the target is within ±59′ of 0°.
3	(Examiner will command the candidate to perform final laying of the missile.)	The candidate will insure that precise leveling of the missile has been accomplished. He checks the lay of the ACI and then sights on the Porro prism and directs missile rotation, if necessary, until an accurately centered reflection of the theodolite-mounted target is seen under the vertical crossline of the ACI. If the ACI reading is 0° ±5″, the missile is laid within the accuracy re-

Test number	Examiner commands (for example)	Action of candidate
		quirement for final laying. If not, he must compute a new location for the ACI (par. 29*a*). He moves the ACI to the computed position, lays the ACI with the RI and repeats the above step. He continues repositioning and laying the ACI until the reading to the target is within ±5″ of 0°.

115. Penalties

No credit will be allowed if—

a. The ACI is not located within 1 meter of the correct position for test 1.

b. The missile is not laid within ± 59′ of 0° for test 2.

c. The missile is not laid within ± 5″ of 0° for test 3.

Section XI. CANDIDATE EVALUATION

116. Candidate Evaluation

The candidate evaluation score is the last score awarded to the candidate. It is awarded by the battery commander based on his opinion of the candidate's value to the unit. It is not based solely on technical proficiency but should take into consideration the candidate's character, efficiency, leadership, ability, appearance, and performance of routine duties.

APPENDIX

REFERENCES

1. Miscellaneous Publications

AR 190–60	Physical Security of Atomic Weapons (U).
AR 220–70	Companies; General Provisions.
AR 320–5	Dictionary of United States Army Terms.
AR 320–50	Authorized Abbreviations and Brevity Codes.
AR 380–5	Safeguarding Defense Information.
AR 525–30	Army Missiles.
AR 611–201	Manual of Enlisted Military Occupational Specialties.
AR 750–5	Maintenance of Supplies and Equipment.
SR 385–310–5	Launching Guided Missiles and Heavy Rockets.
ATT 6–635E	Army Training Test for Field Artillery Missile Battalion, Redstone.
ATP 6–635E	Army Training Program for Field Artillery Missile Battalion, Redstone.
DA Pam 108–1	Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings.
DA Pam 310–series	Military Publications Indexes (as applicable).
DA Pam 750–1	Preventive Maintenance Guide for Commanders.
TOE 6–635E	Field Artillery Missile Battalion, Redstone.
TOE 6–C37E	Field Artillery Missile Battery, Redstone.

2. Field Manuals

FM 5–15	Field Fortifications.
FM 5–20	Camouflage, Basic Principles and Field Camouflage.
FM 5–25	Explosives and Demolitions.
FM 6–2	Artillery Survey.
FM 6–20–1	Field Artillery Tactics.
FM 6–20–2	Field Artillery Techniques.
FM 6–21	Division Artillery.
FM 6–25	Field Artillery Missile Battalion (Redstone) (U).

FM 6–36	Field Artillery Missile Redstone; Firing Procedures.
FM 6–140	The Field Artillery Battery.
FM 6–165	Warhead Section, XM18, XM30, XM31, and XM33, Redstone, (U).
FM 21–5	Military Training.
FM 21–6	Techniques of Military Instruction.
FM 21–10	Military Sanitation.
FM 21–11	First Aid for Soldiers.
FM 21–26	Map Reading.
FM 21–30	Military Symbols.
FM 21–40	Small Unit Procedures in Nuclear, Biological, and Chemical Warfare.
FM 21–41	Soldier's Handbook for Nuclear, Biological, and Chemical Warfare.
FM 21–48	Training Exercises, and Integrated Training in Chemical, Biological, and Nuclear Warfare.
FM 21–60	Visual Signals.
FM 22–5	Drill and Ceremonies.
FM 24–18	Field Radio and Field Cable Techniques.
FM 24–20	Field Wire Techniques.
FM 25–10	Motor Transportation Operations.
FM 30–5	Combat Intelligence.
FM 30–30	Aircraft Recognition Manual.
FM 31–15	Operations Against Airborne Attack, Guerrilla Action and Infiltration.
FM 31–50	Combat in Fortified Areas and Towns.

3. Technical Manuals

TM 3–220	Decontamination.
TM 5–9139	Container, Oxygen, Vacuum Shell, Skid Mounted, 1500 lbs Liquid, 150 Gallon (Hofman Model 600V–LO–1).
TM 9–575	Auxiliary Sighting and Fire Control Equipment.
TM 9–1900	Ammunition, General.
TM 9–1903	Care, Handling, Preservation, and Destruction of Ammunition.
TM 9–1946	Demolition Materials.

TM 9–2810	Tactical Motor Vehicle Preventive Maintenance, Supply, Inspections, and Training Procedures.
TM 21–300	Driver Selection and Training (Wheeled Vehicles).
TM 21–305	Manual for the Wheeled Vehicle Driver.
TM 5–4310–205–10	Operator's Manual: Compressor, Air, Reciprocating (Clark Model HO–6–5C1).
TM 5–6115–208–10	Operator's Manual: Generator Set, Diesel Engines 60 KW (Cummins Model JS–6–G).
TM 5–8120201–12	Operator and Organizational Maintenance Manual: Tank, Storage, Liquid, Aragon-Nitrogen-Oxygen, Semi-Trailer Mounted, 18,000 lbs.
TM 9–1400–350–10	Weapons System: Introduction and Description (U).
TM 9–1400–350–12	Maintenance Operational Readiness Procedures: Artillery Operations.
TM 9–1400–350–34/1	Ordnance Inspections Procedures.
TM 9–1400–350–34/2	Maintenance Operational Readiness Procedures: Ordnance Operations.
TM 9–1410–350–14/1	Ballistic Guided Missile XM8; Shipment, Handling, and Storage.
TM 9–1410–350–14/2	Ballistic Guided Missile XM8: Ballistic Shell.
TM 9–1410–350–14/3	Ballistic Guided Missile XM8; Propulsion System.
TM 9–1410–350–14/4	Ballistic Guided Missile XM8: Guidance and Control System; Description (U).
TM 9–1410–350–14/5	Ballistic Guided Missile XM8: Guidance and Control and Electrical Systems; Maintenance.
TM 9–1410–350–14/6	Ballistic Guided Missile XM8: Guidance and Control and Electrical Systems; Component Replacement and Cable Repair.

TM 9–1410–350–14/7	Ballistic Guided Missile XM8: Guidance and Control and Electrical Systems; Schematics and Wiring Diagrams.
TM 9–1410–350–24P/1	Organizational and Field Maintenance Repair Parts and Special Tools List for Guided Missiles, Ballistic, XM8.
TM 9–1410–350–34/1	Ballistic Guided Missile XM8: Guidance and Control System; Stabilized Platform (ST–80) Maintenance (U).
TM 9–1410–350–34P/1	Repair Parts and Special Tools List for Stabilized Platform ST–80, Ballistic Guided Missile, M8, (U).
TM 9–1410–350–34/2	Field Maintenance Manual—Ballistic Guided Missile XM8: Guidance and Control System; Range Guidance Computer (U).
TM 9–1410–350–34P/2	Repair Parts and Special Tools List for Range Guidance Computer: Ballistic Guided Missile, M8.
TM 9–1410–350–34/3	Field Maintenance Manual: Ballistic Guided Missile XM8: Guidance and Control System; Lateral Guidance Computer, (U).
TM 9–1410–350–34P/3	Repair Parts and Special Tools List for Lateral Guidance Computer: Ballistic Guided Missile XM8.
TM 9–1410–350–34/4	Ballistic Guided Missile XM8: Guidance and Control System; Control Computer.
TM 9–1410–350–34P/4	Repair Parts and Special Tools List for Control Computer: Ballistic Guided Missile XM8.
TM 9–1410–350–34/5	Ballistic Guided Missile XM8: Guidance and Control System; Control Relay Box.
TM 9–1410–350–34P/5	Repair Parts and Special Tool Lists for Control Relay Box: Ballistic Guided Missile M8.
TM 9–1410–350–34/6	Field Maintenance Manual: Ballistic Guided Missile XM8: Guidance and Control System; Program Device.

TM 9–1410–350–34P/6	Repair Parts and Special Tools List for Program Device: Ballistic Guided Missile XM8.
TM 9–1410–350–34/7	Field Maintenance Manual: Ballistic Guided Missile XM8: Guidance and Control System; Inverter.
TM 9–1410–350–34P/7	Repair Parts and Special Tool Lists for Inverter, Ballistic Guided Missile M8.
TM 9–1410–350–34/8	Ballistic Guided Missile XM8: Guidance and Control System; Actuator.
TM 9–1410–350–34P/8	Field Maintenance: Repair Parts and Special Tools List for Actuator, Electro-Mechanical, Rotary, Mod 0; Ballistic Guided Missile XM8.
TM 9–1430–350–14/1	Truck Mounted Guided Missile Programer-Test Station AN/MSM–38: Description and Operation.
TM 9–1430–350–14/2	Truck Mounted Guided Missile Programer-Test Station, AN/MSM–38, Operator, Organizational, and Field Maintenance.
TM 9–1430–350–14/3	Truck Mounted Guided Missile Programing Data Computer AN/MJQ–1: Description and Operation (U).
TM 9–1430–350–14/4	Truck Mounted Guided Missile Programing Data Computer AN/MJQ–1: Maintenance.
TM 9–1430–350–14/5	Truck Mounted Guided Missile Programing Data Computer AN/MJQ–1, Adjustments and Checks.
TM 9–1430–350–14/6	Truck Mounted Guided Missile Programing Data Computer AN/MJQ–1, Wire Lists.
TM 9–1430–350–24P/2	Organizational and Field Maintenance Repair Parts and Special Tools List for Programer-Test Station, Guided Missile, Truck Mounted, AN/MSM–38.
TM 9–1430–350–34P/5	Missile Programing Data Computer AN/MJQ–1: Lists of Equipment, Repair Parts, and Tools (APP. III).

TM 9–1440–350–14	Guided Missile Platform: Launcher M74 and Truck Mounted Guided Missile Erector-Servicer M478.
TM 9–1440–350–24P	Organization and Field Maintenance Repair Parts and Special Tools List for Launcher, Platform; Guided Missile XM74 and Erector-Servicer Guided Missile, Truck Mounted, XM478.
TM 9–1450–350–14/1	Operator, Organizational and Field Maintenance Manual: Truck Mounted Hydrogen Peroxide Servicer XM506.
TM 9–1450–350–14/2	Repairs Parts Vehicles: Semi-Trailer Mounted Guided Missile System Supply Office, M484, Truck-Mounted Preservation and Storage Shop M485, Guided Missile Bulk Material Repair Parts Truck M486, Guided Missile Repair Parts Trailer M487, and Guided Missile Repair Parts Truck M488.
TM 9–1450–350–14/3	Trailer Mounted Guided Missile System Power Distribution Station AN/MSQ–32.
TM 9–1450–350–14/4	Trailer Mounted Guided Missile Battery Servicing Shop M479.
TM 9–1450–350–14/5	Accessories Transportation Trucks.
TM 9–1450–350–14/6	Trailer Mounted Guided Missile Air Servicer M483.
TM 9–1450–350–24P/1	Organizational and Field Maintenance Repair Parts and Special Tools List for Hydrogen Peroxide Servicer Guided Missile, Truck Mounted, ¾ Ton, 4x4, XM506.

TM 9–1450–350–24P/2	Organizational and Field Maintenance Repair Parts and Special Tools List for Repair Parts Vehicle, Guided Missile System Supply Office, Semi-Trailer Mounted M484, Preservation and Storage Shop, Truck Mounted, M485, Truck, Guided Missile Repair Parts Bulk Material, M486, Trailer, Guided Missile Repair Parts M487, Truck Guided Missile Repair Parts M488.
TM 9–1450–350–24P/3	Repair Parts and Special Tools List for Trailer Mounted Guided Missile System, Power Distribution Station, AN/MSQ–32.
TM 9–1450–350–24P/4	Organizational and Field Maintenance Repair Parts and Special Tools List for Guided Missile Battery Servicing Shop, Trailer Mounted, M479.
TM 9–1450–350–24P/5	Organizational and Field Maintenance Repair Parts and Special Tools List for Truck, Accessories, Transportation.
TM 9–1450–350–24P/6	Repair Parts and Special Tool Lists for Air Servicer, Guided Missile Trailer Mounted, M483.
TM 9–2330–350–14	Alcohol Tank Semitrailer XM388.
TM 9–2330–350–24P	Repair Parts and Special Tool Lists: for Semitrailer, Tank, Alcohol, M388.
TM 9–4935–350–14/1	Operator, Organizational, and Field Maintenance Manual: Semitrailer-Mounted Guided Missile Test Station AN/MSM–33 Control Components and Semitrailer-Mounted Guided Missile Test Station AN/MSM–41 Guidance Components.
TM 9–4935–350–14/2	Operator, Organizational and Field Maintenance Manual: Actuator Test Fixture.
TM 9–4935–350–14/3	Operator, Organizational and Field Maintenance Manual: Control Computer Test Fixture.

TM 9–4935–350–14/4	Operator, Organizational, and Field Maintenance Manual: Control Relay Box Test Fixture.
TM 9–4935–350–14/5	Operator, Organizational and Field Maintenance Manual: Program Device Test Fixture.
TM 9–4935–350–14/6	Operator, Organizational, and Field Maintenance Manual; Inverter Test Fixture.
TM 9–4935–350–14/8	Operator, Organizational, and Field Maintenance Manual; Stabilized Platform ST–80 Test Fixture.
TM 9–4935–350–14/9	Operator, Organizational, and Field Maintenance Manual Semi-Trailer-Mounted Stabilized Platform Test Station AN/MJM–3, Description and Operation (U).
TM 9–4935–350–14/10	Operator, Organizational, and Field Maintenance Manual: Semi-Trailer-Mounted Stabilized Platform Test Station AN/MJM–3, Maintenance.
TM 9–4935–350–14/11	Operator, Organizational, and Field Maintenance Manual: Truck-Mounted Guided Missile System Pneumatic Shop M477.
TM 9–4935–350–14/12	Operator, Organizational, and Field Maintenance Manual: Missile System Test Equipment Calibrator Set; Description, Operation, and Field Maintenance.
TM 9–4935–350–14/13	Operator, Organizational, and Field Maintenance Manual: Missile System Test Equipment, Calibrator Set.
TM 9–4935–350–34P/2	Field Maintenance Repair Parts and Special Tools List: Actuator Test Fixture.
TM 9–4935–350–34P/3	Field Maintenance Repair Parts and Special Tools List: Control Computer Test Fixture.
TM 9–4935–350–34P/4	Field Maintenance Repair Parts and Special Tools List: Control Relay Box Test Fixture.

TM 9–4935–350–34P/5	Field Maintenance Repair Parts and Special Tools List: Program Device Test Fixture.
TM 9–4935–350–34P/6 w c/1	Field Maintenance Repair Parts and Special Tools List: Inverter Test Fixture.
TM 9–4935–350–34P/7	Field Maintenance Repair Parts and Special Tools List for Guidance Computer Test Fixture.
TM 9–4935–350–34P/8	Field Maintenance Repair Parts and Special Tool Lists: Stabilized Platform ST–80 Test Fixture.
TM 9–4935–350–34P/10	Field Maintenance Repair Parts and Special Tool Lists: Test Station, Stabilized Platform, Semi-Trailer Mounted, AN/MJM–3.
TM 9–4935–350–34P/11	Field Maintenance Repair Parts and Special Tools List for Truck Mounted Guided Missile System Pneumatic Shop F477.

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BY ORDER OF THE SECRETARY OF THE ARMY:

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Chief of Staff.

Official:

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