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 6–634D) 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. Drills prescribed in this manual cover duties of individuals in preparing for action, during firing, and for march order.

e. 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, US 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 points.

(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 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 Missile Firing Battery

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

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 firing battery executive officer.
b. A guided missile material warrant officer.
c. A radiotelephone operator.

6. Firing Section

The firing section consists of section personnel, the air compressor truck, air servicer, missile test and fire control equipment, and auxiliary equipment. The 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 chief of firing section (CS).
b. An electronics chief.
c. A propulsion chief.
d. Two senior electronics specialists.
e. Five electronics specialists.
f. A propulsion specialist.
g. Three propulsion crewmen.
h. Two air compressor operators.
i. A power generator operator.

7. Servicing Section

The servicing section consists of section personnel, the launcher, the lightweight erection equipment, the missile and propellant transport vehicles, and the firefighting equipment. The 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 chief of servicing section.
b. A handling chief.
c. A propellant chief.

d. A firefighting crew chief.
e. A senior launcher crewman.
f. Two survey specialists.
g. Two firefighters.
h. Six heavy truck drivers.
i. Nine launcher crewmen.
j. An ordnance parts specialist.
k. A power generator operator.
l. Three 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 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 firing section and the chief of the 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 handling chief and the propulsion chief assist the chief of servicing section in performing the duties listed in *c* above.

e. The senior launcher crewman in the servicing section assists the chief of servicing section in performing the duties listed above. He also performs duties as prescribed by this manual.

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

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

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

i. The primary duties of the compressor operators, truck drivers, firefighters, power generator operators, and radiotelephone operator is operating and maintaining their equipment. They remain with their equipment unless other duties are designated by their chief of section.

CHAPTER 3

SECTION DRILL

Section I. GENERAL

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, only drills for the servicing section have been prescribed. With modification they can be adapted for use by the firing section.

10. Instructions

a. To develop maximum efficiency and to prevent injuries to personnel and damage to equipment, the drill procedure prescribed in this manual should be observed. Section drill is conducted in silence except for the commands and reports. A section must 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 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.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

11. To Form the Section

a. To Fall In. The chief of servicing section takes his post. On the command of execution, the servicing section forms in ranks at close interval, centered on and facing the chief of section at a distance of three paces (fig. 1). The chief of servicing section or the individual who gives the command may indicate in his preparatory command the place and direction most suitable to form

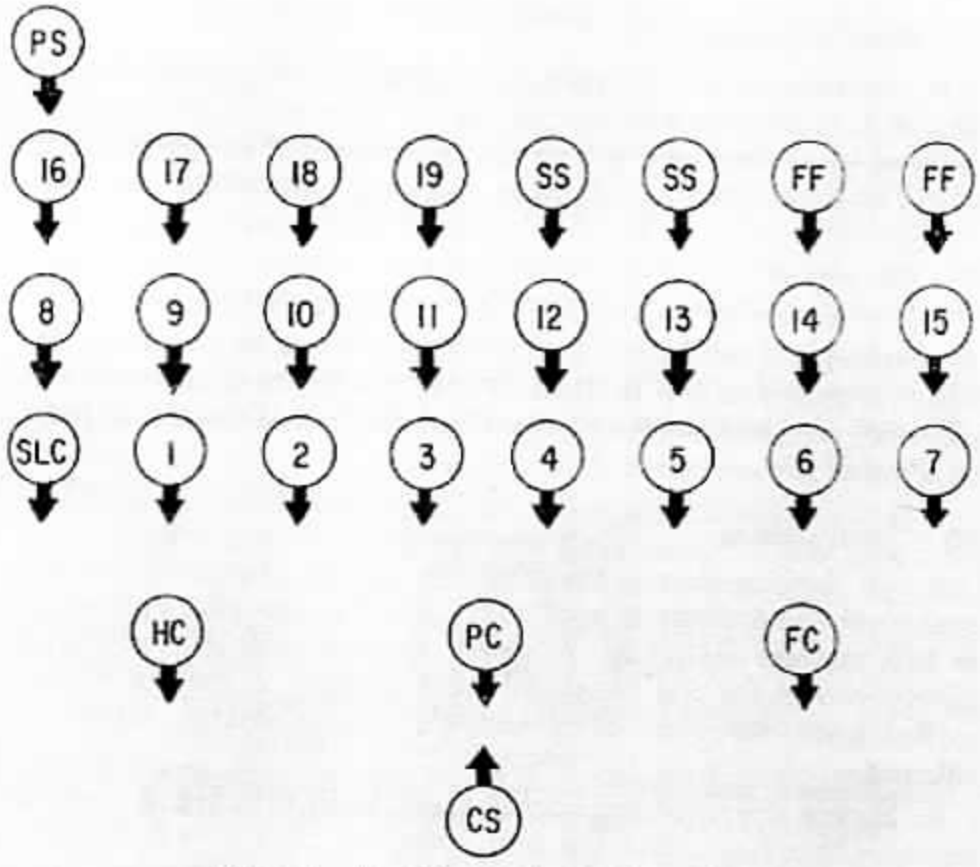

Figure 1. Servicing section in formation.

the section for a particular situation. At the first formation for a drill or exercise, the caution "as a servicing section" precedes the command. The commands are FALL IN; or 1. IN FRONT (REAR) OF YOUR LAUNCHER, 2. FALL IN; or 1. ON THE ROAD FACING THE PARK, 2. FALL IN. The members of the servicing section to whom the command applies move at double time and form at close interval, at attention, guiding on the senior individual in ranks.

b. To Call Off. With the section in formation, the command is CALL OFF. Execution is as follows:

(1) At the command, all personnel except the right flank men execute eyes right.

(2) The section then calls off in sequence, front rank, "senior launcher crewman," "1," "2," "3," "4," "5," "6," "7," "8," second rank, "9," "10," "11," "12," "13," "14," "15," "16," rear rank, "17," "18," "19," "survey," "survey," "firefighter," "firefighter," "parts specialist." As each man calls off, he turns his head smartly to the front.

12. Posts of Section

The command is 1. CREWMEN, 2. POSTS. The command is general and is applicable whether the section is in or out of ranks, at a halt, or marching. All movements are executed at double time and end at the position of attention. Only the posts of the launcher crewmen are shown, since the remainder of the servicing section generally perform specialized assignments. Duties of individuals using the lightweight erection equipment are given in table I.

a. Launcher Towed by Erector Truck. When the launcher is being towed by the erector truck, the section moves to posts shown in figure 2. All personnel face the front and are alined 2 feet outside the vehicles.

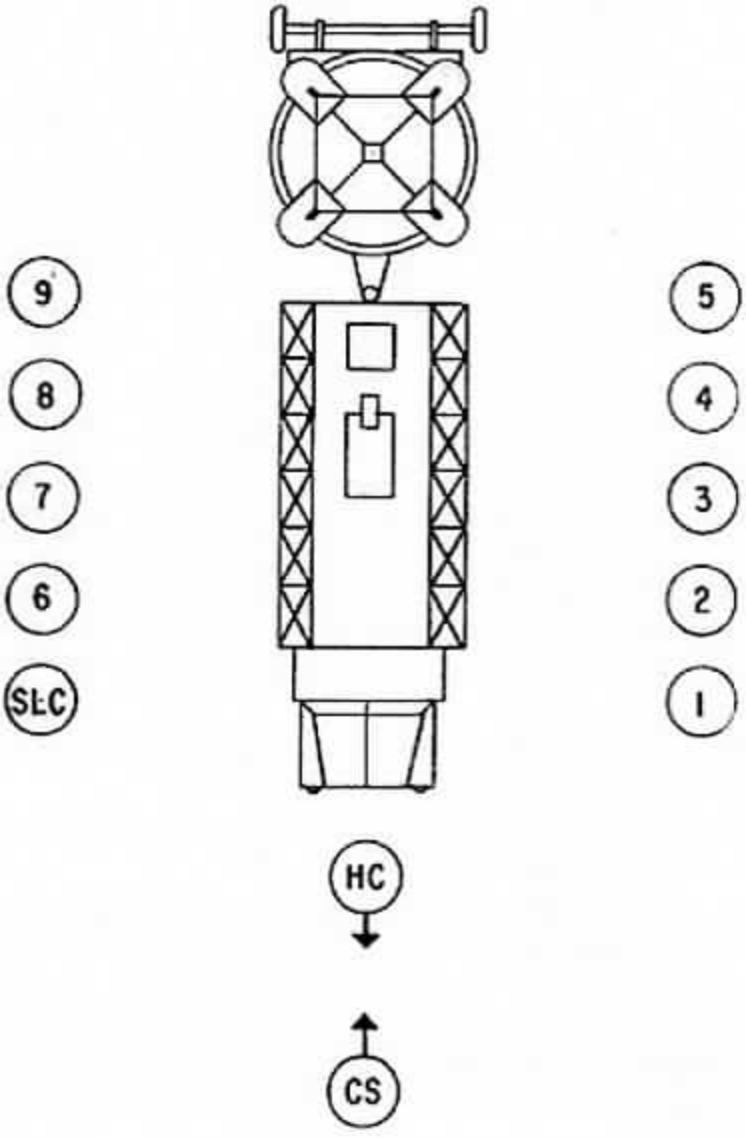

Figure 2. Posts, launcher towed by erector truck.

b. Launcher Uncoupled, Not Prepared for Action. When the launcher is uncoupled, not prepared for action, the section moves to posts shown in figure 3. All personnel face to the front and are alined 2 feet outside the launcher and vehicle.

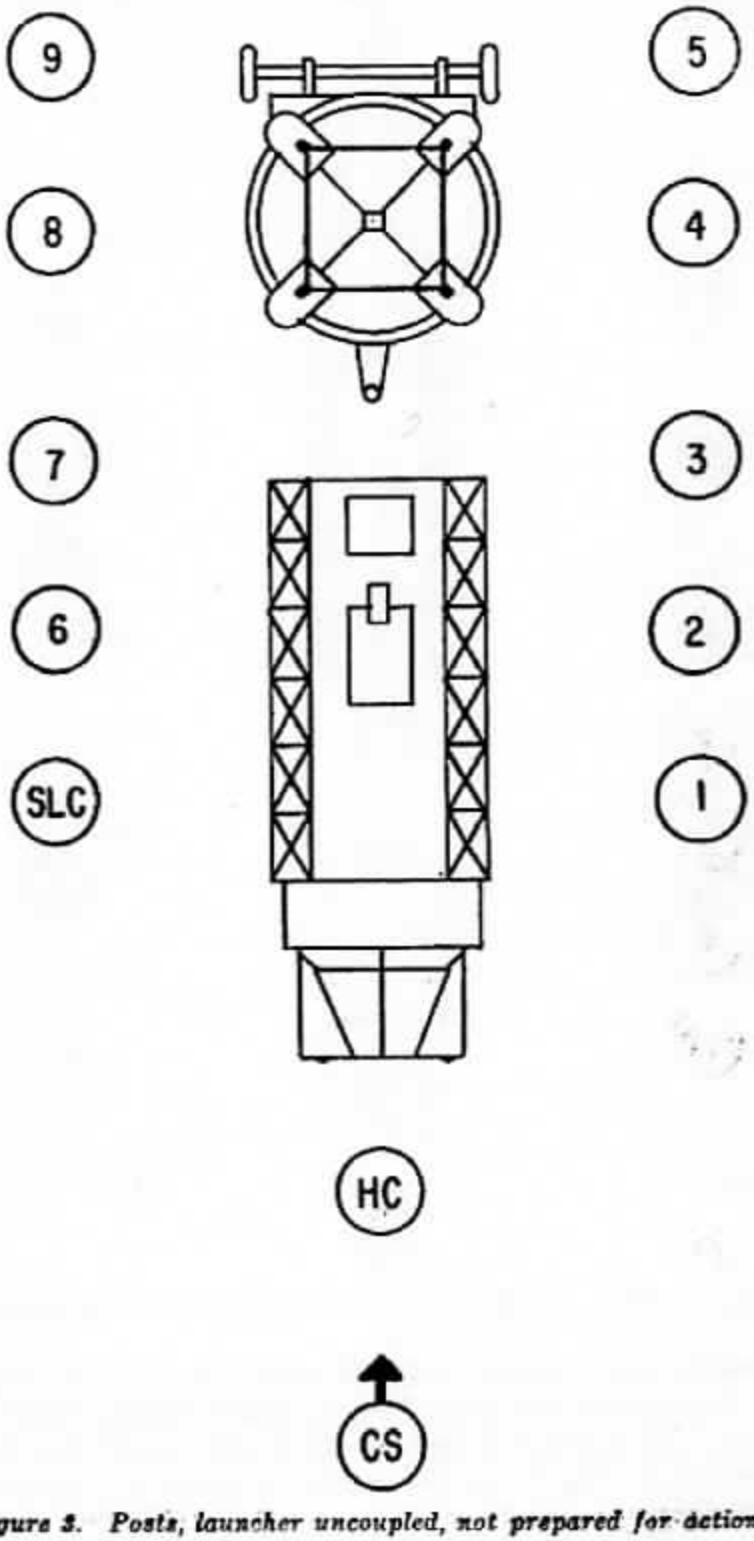

Figure 3. Posts, launcher uncoupled, not prepared for action.

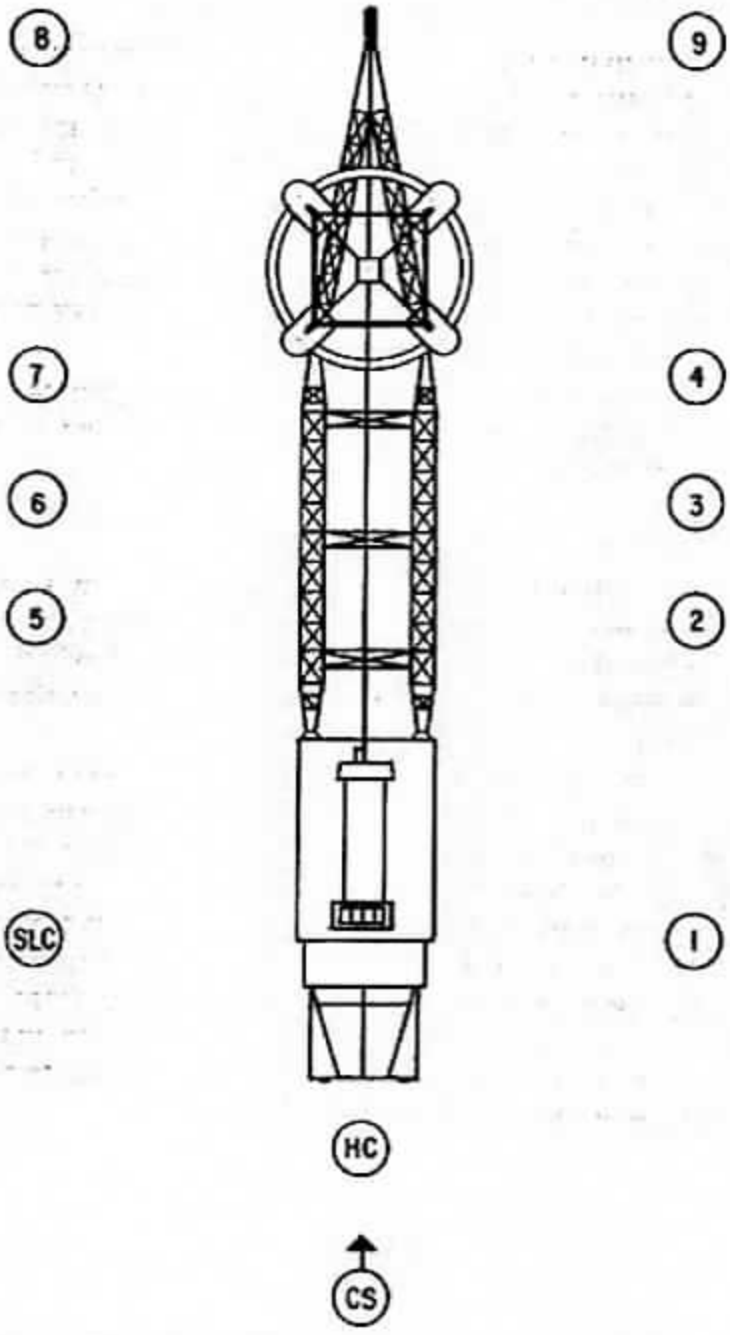

Figure 4. Posts, launcher and erector truck prepared for action.

c. Launcher and Erector Truck Prepared for Action. When the launcher is prepared for action, the section moves to posts shown in figure 4. All personnel face to the front except the chief of servicing section, who faces the battery commander unless otherwise instructed.

13. To Mount

The commands are 1. PREPARE TO MOUNT, 2. MOUNT; or MOUNT.

a. At the preparatory command, the section moves at double time to their positions. Before the commanders of the vehicles and drivers mount, they verify that the trailer loads are properly coupled, that personnel and equipment are aboard, and that the tailgate and safety straps are secure. If any member(s) of the section is to remain dismounted, his designation is announced, with the caution "stand fast," between the preparatory command and the command of execution; for example: 1. PREPARE TO MOUNT, NUMBER 3, STAND FAST, 2. MOUNT.

b. If the command is MOUNT, the section executes, without pausing, all that has been prescribed for the command 1. PREPARE TO MOUNT, 2. MOUNT.

14. To Fall Out

a. At Drill. When it is desired to give the section a rest from drill or to relieve them temporarily from a *formation* or *post*, the command FALL OUT is given. This command which may be given at any time requires that the section remain in the vicinity of the drill area.

b. During Firing. When firing duties have been suspended temporarily, but it is desired to have the section remain in the vicinity of the launcher, the command FALL OUT is given. The command may be limited to certain individuals; for example: NUMBERS 1 THROUGH 9, FALL OUT or ALL EXCEPT NUMBER 1, FALL OUT. Men stand clear of the launcher to insure that the settings and laying remain undisturbed. During these periods, the chief of servicing section or the senior crewman may direct his men to improve the position, to replenish supplies, or to do any other necessary work.

CHAPTER 4

PREPARING FOR FIRING AND TRAVELING

15. 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.

16. Occupying the Firing Position

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

b. When the firing position is ready for occupation, the erector-servicer truck, towing the launcher, is moved into position. The launcher is uncoupled from the erector-servicer 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 fin number one 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 is 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 the position. The air servicer is emplaced and the air compressor is serviced, warmed up, and put into operation 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 section.

f. When the battery servicing shop arrives at the firing position, it is emplaced in the vicinity of the generator trailer.

g. While the ground handling equipment is being emplaced, the firing section brings the missile test station into the position and systematically begins to lay the ground electrical system, to install air lines, and connect the various pieces of equipment as they are positioned.

17. To Prepare for Firing

a. With the compressor truck, erector-servicer truck, launcher, and test station in position, the command to prepare for firing is PREPARE FOR ACTION. Duties of individuals are given in tables I and II.

b. Prepare for action is normally initiated without command immediately after the vehicles are in position.

c. If prepare for action is not desired, the command DO NOT PREPARE FOR ACTION must be given.

d. The launcher will be prepared for action as prescribed in FM 6–36. For details on warmup procedures for the compressor, see TM 5–4310–205–10.

e. Complete technical operating procedures are contained in FM 6–36.

18. To Prepare for Traveling

a. To prepare to travel after firing, the command is MARCH ORDER. Duties of individuals are given in tables I and II.

b. If travel must be resumed before the missile is fired, step-by-step control will be exercised by the executive officer. Propellant unloading procedures are listed in chapter 6. The duties listed in tables I and II should be reversed in sequence, and only those steps that are applicable should be performed.

Table I. Duties of the Servicing Section.
(Located at back of manual)

Table II. Duties of the Firing Section.
(Located at back of manual)

CHAPTER 5

DUTIES IN FIRING

Section I. GENERAL

19. General

The entire sequence of duties performed by the Redstone firing battery personnel in firing a missile are shown in tables I and II. To minimize time and to make maximum use of equipment, firing section and servicing section personnel must coordinate their work at the firing position. One section cannot operate independently of the other. It is the duty of the battery executive officer to supervise and coordinate these duties. He must restrict vehicular movement within the firing position for protection of cables and insure that all procedures are followed in the proper sequence. To show all duties that are being performed simultaneously within the battery, the sequence steps in tables I and II have been keyed together; i.e., sequence step 3 in both tables I and II represents the same time interval. The general instructions for conducting section drill apply equally to duties in firing.

20. Duties of Firing Section Personnel

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

a. The chief of 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 electronics chief is in charge of the test station. He is responsible for the unloading of the cables and electrical equipment and the operation of the test equipment in the test station.

c. The propulsion chief 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. The electronic specialists 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 senior air compressor operator drives the air compressor truck and operates the air compressor.

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

21. Duties of Servicing Section Personnel

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

a. The chief of servicing 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 handling chief is responsible for unpacking the missile components, assembly of the erection equipment, missile assembly and erection, and installation of accessory items.

c. The propellant chief is responsible for installing the propellant loading equipment and transferring propellants to the missile.

d. The firefighting 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 supervises 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. The launcher crewmen, numbers 1 through 9, work under the direct supervision of the senior launcher crewman in carrying out the duties specified in *b* above.

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

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

Section II. DETAILED DESCRIPTION OF CERTAIN DUTIES IN FIRING

22. Chief of Firing Section

The chief of firing section—

a. Supervises and Controls Horizontal and Vertical Checkout. The chief of firing section will supervise and control both the horizontal and vertical tests.

b. Records Basic Data. The chief of firing section will record data of a semipermanent nature. This data includes 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 Commander. If, for any reason, the missile cannot be fired, the chief of firing section will promptly report that fact to the battery executive officer with the reasons therefor.

d. Observes and Checks Functioning of Materiel. The chief of 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 will also be furnished to the group fire direction center (FDC).

e. Indicates When the Missile is Ready to be Fired. The chief of 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.

23. Chief of Servicing Section

The chief of servicing section—

a. Supervises and Controls Emplacement of the Launcher and Erection Equipment. The chief of servicing section will supervise and control the emplacement of the launcher and the assembly of the erection equipment. Particular attention will be paid 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 servicing section will supervise and control missile assembly and erection. This includes the positioning of missile trailers, missile body assembly, and missile assembly. During erection, he will supervise the operation of the erector winch and the snubber unit.

c. Supervises and Controls Propellant Loading. The chief of the servicing section will supervise and control propellant loading operations. He will report to the test station when each phase of the propellant loading operation is completed.

CHAPTER 6

SITUATIONS REQUIRING SPECIAL ATTENTION

24. 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 will be left in the shipping container until needed for installation. Insure that the ST–80 is handled only by the handling frame. Care should be exercised during removal from the container and placement in the missile to prevent any damage to the ST–80 dust cover.

25. 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. The inert lead start fluid is used to prevent too rapid a build-up of thrust during ignition of the rocket engine. Lithium chloride will be used as the inert lead start fluid when the temperature is 35° F. or below. If the temperature is above 35° F., water may be used. If the temperature is dropping at a rate that indicates that lithium chloride will be required at the time of firing, it will be left to the battery commander's discretion, as to which method to employ.

c. Alcohol loading is performed as soon as the inert lead start has been loaded. Before alcohol loading is started, the temperature of the alcohol should be checked to insure that it is above the required minimum in order to eliminate the need for reheating. Extreme care will be taken to prevent generation of sparks during alcohol loading. 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 will be 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 2 to 4 minutes. When precooling has been accomplished, one semi-

trailer 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 at 75° ± 10° 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 fire fighting 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. Individual duties for propellant loading and missile servicing are described in tables I and II.

26. Propellant Unloading

The servicing section is required to drain 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. Individual duties during propellant unloading are contained in tables I and II. Detailed instructions on the procedures for propellant unloading are contained in FM 6–36.

27. 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, and 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 commander 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).

28. 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.

b. After disconnecting test station:

(1) Range accelerometer precession rate.

(2) Range computer presettings. (The test station must be reconnected to monitor the range accelerometer precession rate and the presettings in the range computer if the missile is not fired within 45 minutes.)

29. 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.

30. Failure To Fire

If the missile fails to fire, the procedure in *a* through *f* 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. All necessary personnel may now return to the firing area and begin checking firing circuits to locate the source of malfunctioning.

31. 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:

(1) The automatic cutoff signal light should light at the remote firing panel.

(2) The cutoff signal will vent all tanks.

(3) If the following conditions still exist, do not allow personnel to enter the immediate area of the launcher until *b* below has been performed by firing section personnel.

(*a*) The air spheres are still pressurized to 3,000 psi.

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

(*c*) Alcohol and liquid oxygen create a fire hazard if they are present on the ground.

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

32. Care, Use, and Adjustment of Laying Equipment

The laying equipment used by the Redstone firing battery consists of three Wild T2 theodolites with accessories, tripod-mounted precise targets, theodolite-mounted targets, steel tape, compass, and launcher orienting instrument bracket. For detailed information on the care, use, and adjustments of the theodolite, see TM 6–200.

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