CHAPTER 6
ORGANIZATION OF POSITION

42. (U) General

a. This chapter covers the composition and arrangement of elements of a group in position. For a discussion of other aspects of organization of position, such as security, communication, and survey, see chapters 7, 8, and 9.

b. The organization of a position includes those operations necessary for delivery of fire. Operations required to deliver fire as soon as possible after occupying position have first priority. These operations include assembly and checkout of missiles, preparation of ground handling equipment for action, and production of liquid oxygen and liquid nitrogen.

c. A new position should be prepared prior to occupation, as completely as time allows. All practicable measures are taken to avoid disclosing the position to the enemy. All personnel must be indoctrinated in the necessity for concealing the position from air observation. All units continue to organize and improve positions as long as the positions are occupied. Alternate firing positions should be prepared as soon as possible after completion of the primary positions.

43. (U) Group Headquarters and Headquarters Battery Area

a. The discussion in FM 6–140 on organization of command posts, and headquarters battery areas, generally is applicable to the headquarters and headquarters battery area of the Redstone group.

b. The headquarters battery position is organized to facilitate support of the command post.

c. The group fire direction center (FDC) should be located and organized where possible to permit operation with both firing batteries from a single location. The FDC has a capability of being split to operate simultaneously with the two firing batteries at widely separated locations. However, the group is authorized only one missile programing data computer Redstone.

44. (U) Firing Battery Position Areas

a. Each firing battery will normally occupy a position area and prepare firing positions in advance for occupation on receipt of a fire mission. The position area will be organized to take maximum advantage of natural camouflage and cover. The vehicles and equipment will be arranged to permit rapid movement out of the position area.

561443 O - 62 - 3

b. Firing positions may be prepared in the firing battery position area, adjacent to it, or sufficiently distant from it to minimize the danger of exposing the area to counterfire aimed at a firing position.

c. The firing position will be organized solely to facilitate the execution of the fire mission. A cleared area 65 by 12 meters must be available to permit maneuvering the necessary vehicles around the launcher. Within this area, the supporting media must be solid enough to support the launcher and the missile prepared for firing. The launcher with a loaded missile has approximately the same bearing pressure as an average person standing on his feet. The moisture content of the soil is important and its effects vary with different types of soils. It is extremely important that the soils supporting the launcher be homogeneous to prevent the launcher from settling unevenly under the weight of a fully loaded missile. In wet climates, due consideration must be given to an adequate drainage system around the launcher.

d. The location of the launcher, and the blast danger area determine the general arrangement of a firing position. The exact positioning of equipment depends on the mission, terrain, road nets, and unit standing operating procedure. A typical layout of equipment around a firing position is shown in figure 9. The danger area around the area is 45 meters for required ground support equipment, and a minimum of 180 meters for personnel protected by a revetment.

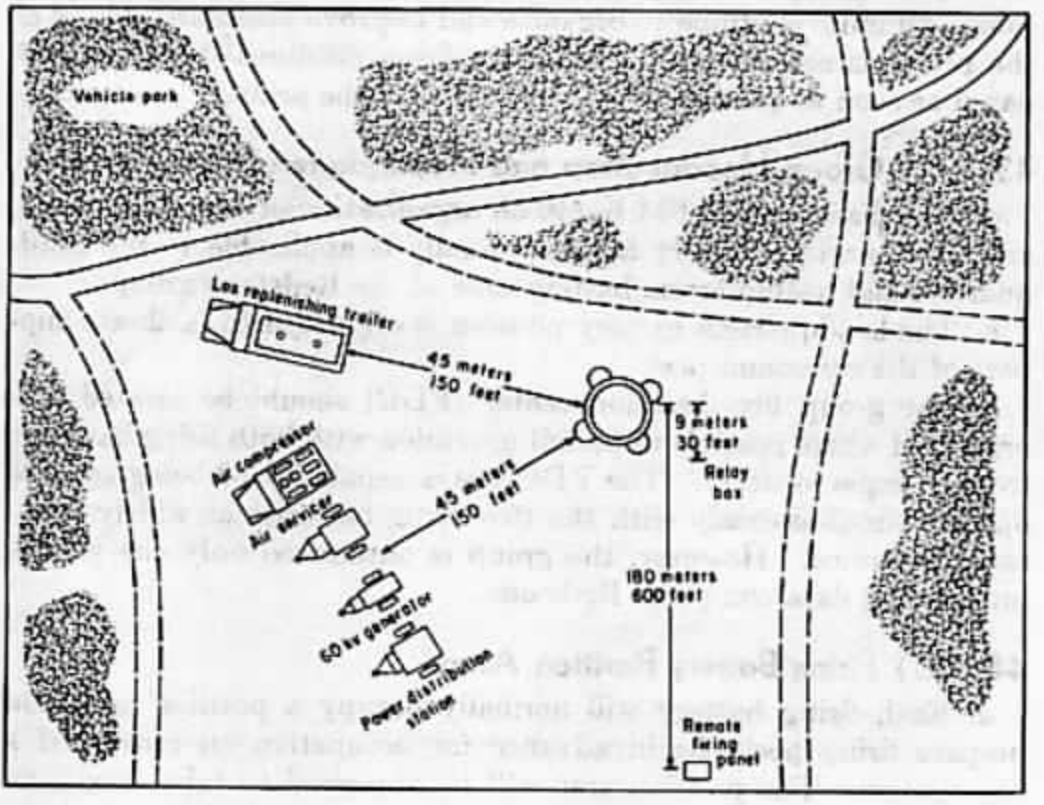

Figure 9. (U) *Typical final layout of equipment, firing position field artillery missile battery, Redstone.*

The following are the recommended placement practice distances for personnel and equipment during a firing.

Personnel and equipment	Distance from launcher	Additional protection required
Personnel	740 meters	None
	180 meters	Revetments
Firing support equipment	45 meters	None
	As near as 40 meters in blast area.	Revetments the height of the equipment.
Other support equipment	210 meters	None
Second missile	210 meters	Revetments

45. (U) Engineer Company Area

a. The engineer company organizes its area in accordance with the criteria for dispersion and protection prescribed by the group commander. Liquid oxygen-nitrogen generating plants and accessory equipment should be dispersed in such a manner that minimum loss or damage will result in event of a single attack. Figure 10 represents one possible layout of the engineer company.

b. Subordinate elements of the engineer company are organized under the following requirements.

(1) Company headquarters should be located centrally in order to provide administrative support to company elements.

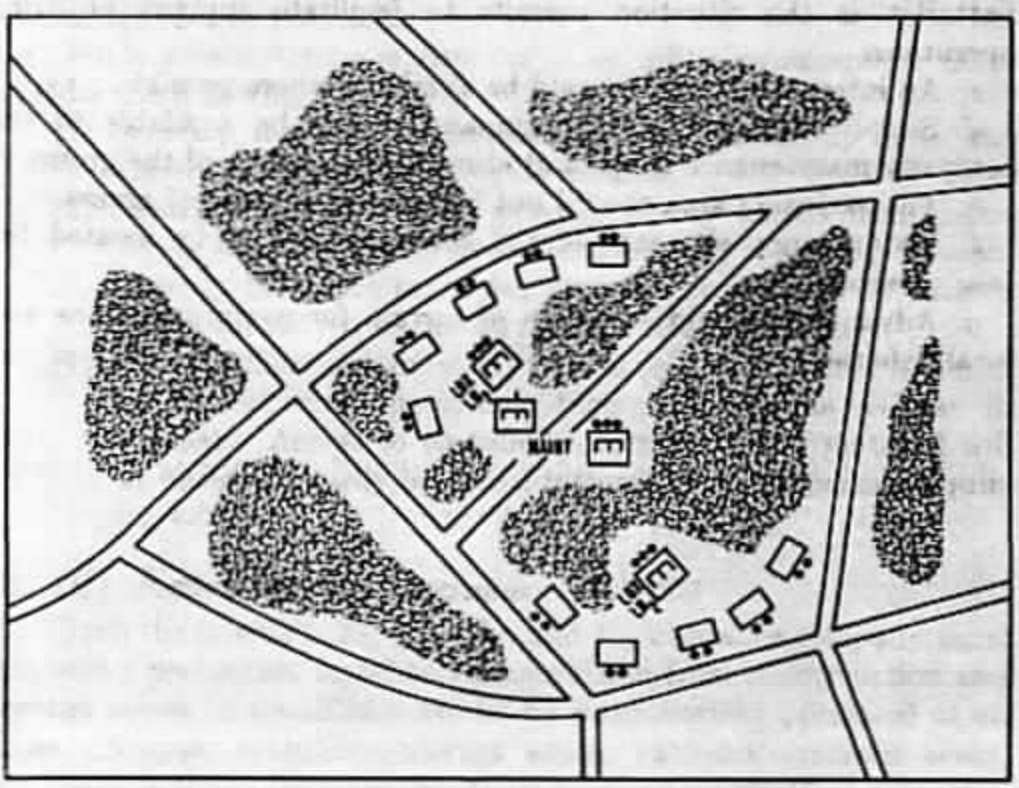

Figure 10. (U) *Typical engineer company position.*

(2) The location of the maintenance platoon must be selected with particular care. This location must serve as a working area for the platoon and provide access to the various sections of the engineer company and to other elements of the group. Consideration should also be given to supply routes to the supporting engineer repair parts company and field maintenance company.

(3) The generating sections and platoon headquarters can occupy a position in many patterns. Some factors which affect the layout are road nets, soil stability, existence of natural concealment, and space for LOX storage trailer exchange. However, one method of achieving maximum control without increasing the distance to supported units is to employ the pattern shown in figure 10.

46. (U) Ordnance Company Area

The ordnance company area should be organized with the following considerations:

a. The company headquarters and maintenance shop area should be located centrally to provide administrative support to all elements of the company. The shop office should be located near the entrance to the area, but also located so as to provide control and administrative support to the maintenance shops.

b. The ordnance company should be located as close to the firing batteries as the situation permits to facilitate support of firing operations.

c. An internal road net should be available where possible.

d. Supply elements of the company should be available to the company maintenance shops and also other elements of the group.

e. The exclusion area should not be located for ease of access.

f. Maintenance elements of the company should be located for ease of access.

g. Advantage should be taken of terrain for communications and local defense.

CHAPTER 7
SECURITY

47. (U) General

a. Personnel and equipment organic to the group are not adequate for ground and air defense. Higher commanders are responsible for providing ground and air defense.

b. Each unit of the group should organize its position for local security to include an adequate warning system, provisions for active and passive security measures, and marking areas swept for mines.

c. The nuclear capability of the Redstone missile makes each unit position of the group a high-priority target for attack by the enemy. The most effective way for an enemy to counteract the effectiveness of missile fire is to prevent the unit from firing its missiles. It can be expected that an enemy will focus his counterbattery intelligence efforts on locating unit positions of a field artillery missile group, Redstone. It can also be expected that the enemy will attack these unit positions with every means possible. Therefore, all active and passive security measures must be fully implemented. Particular attention must be given to passive air defense measures, especially camouflage of unit positions.

d. While establishing security for their units, commanders must consider the following principles:

(1) Security measures must *not* prevent this group from the timely accomplishment of its mission.

(2) Security measures must prevent enemy action from interfering with the timely accomplishment of the group mission.

(3) Security measures must not give a unit distinctive features which identify it as one having a nuclear capability.

(4) Security measures must prevent access to classified material by unauthorized personnel during training as well as in combat. Access to classified information and material will be based primarily on *visual recognition* of the person requiring access.

48. (U) Active Security Measures

a. Both the missile firing batteries and the ordnance company must take every precaution to protect ammunition from enemy action and prevent access to classified material by unauthorized personnel at all times. Nuclear munitions storage areas, warhead checkout areas, and the portions of the firing positions required for warhead operation are designated as exclusion areas as defined in AR 190–60 (classified).

b. Commanders concerned will take the following precautions to protect nuclear ammunition:

(1) Place an armed guard on each vehicle transporting ammunition during marches, and arrange the march column so that vehicles with mounted machineguns can cover by fire the vehicles transporting ammunition.

(2) Designate only a minimum number of authorized entrances and exits in the perimeter defense.

(3) Instruct guards to prohibit anyone who cannot properly identify himself from entering or leaving the perimeter defense of the unit.

(4) Organize a special reserve under the command of an officer with the specific mission of providing additional protection for ammunition. Members of this special reserve will be trained and equipped for hasty evacuation and destruction of ammunition. Reserve members will be designated by name and will have complete instructions as to the signal for and plan of assembly. Each member of this reserve should know those items of equipment he must have with him and be thoroughly rehearsed in his duties to insure rapid assembly and employment.

(5) Make plans for the disposition of ammunition to prevent capture. Preventing nuclear components from falling into enemy hands is of first importance. Instructions for disposition of ammunition to prevent its capture will normally be issued to the group by or through the army artillery headquarters. If capture is imminent and there is no communication with higher headquarters, the senior person eligible to exercise command in the unit will order evacuation, firing, or destruction of the ammunition in the following priority:

(a) Evacuation of all components of nuclear weapons and related sensitive items is preferred in all cases and will be given first consideration.

(b) If evacuation does not appear possible, he will next give consideration to the possibility of firing the ammunition ((6) below).

(c) If evacuation in the case of the ordnance company does not appear possible, he will order the destruction of the ammunition.

(6) Maintain current firing data in the missile group, for locations furnished by higher artillery headquarters for *safely* disposing of ammunition by firing. The senior officer present must be sufficiently familiar with the situation to insure that these fires will not endanger friendly troops.

(7) Maintain a standing operating procedure for the destruction of ammunition. Items will be destroyed only as a last resort or

when directed by higher authority. Destruction will be carried out only on order of the senior person eligible to exercise command, who is present in the unit. For instructions on procedures for destruction of ammunition, see FM 6–165, Warhead Section, XM18, XM30, XM31, and XM33 (Redstone) (U).

c. The security platoon of the headquarters and headquarters battery is designed to perform many of the functions described in *b* above.

d. The local security procedures discussed in *b* above will be the principal means of preventing personnel not organic to the unit from having access to classified materiel. In addition, the unit commander will take the following precautions to prevent access to classified materiel, including ammunition, by unauthorized personnel:

(1) Protect classified materiel at all times with a guard.

(2) Furnish unit officers, chiefs of section, and guards a list of the names of *organic* personnel who are authorized access to the materiel.

(3) Prohibit access to classified materiel by *nonorganic* personnel, unless the next higher headquarters clears them by name and specifies the type of information they are authorized to receive; these personnel will not be granted access to classified materiel, until they are *visually* recognized by the officer or noncommissioned officer from the unit visited who will accompany them while they are with the classified materiel.

(4) Instruct guards protecting classified materiel to allow those persons whom he visually recognizes as being on the list in (2) above to have access to the classified materiel. Instruct guards to allow other persons to have access to the classified materiel only when they are accompanied by an officer or noncommissioned officer whom the guard *visually recognizes* as on the list in (2) above.

(5) Arm guards with live ammunition at all times.

(6) Instruct guards as to what materiel or components of materiel are classified and what the classifications are.

49. (U) Passive Security Measures

Existing doctrine for the passive defense of unit positions will be fully implemented. Passive security measures include:

a. Camouflage, cover, and concealment.

b. Dispersion of vehicles and equipment.

c. Field fortification (FM 5–15).

d. Communication security.

e. Adequate warning system to include communication listening posts and trip flares.

f. Obstacles (FM 5–31).

CHAPTER 8

COMMUNICATION

50. (U) General

a. All available means of communication must be utilized. No one means is considered primary or relied on exclusively. The field artillery missile group, Redstone, employs wire, radio (AM and FM), and messenger communication. Sound and visual means may also be employed when appropriate. In all communication systems, adequacy, reliability, and flexibility are prime considerations in their establishment and maintenance. These same considerations apply within this group. For a general discussion of communication, see FM 6–20. A detailed discussion of communication procedures and techniques is contained in field manuals of the 24-series and appropriate field and technical manuals of the 11-series.

b. The group headquarters and headquarters battery is responsible for establishing and maintaining communications to its subordinate elements (missile batteries, ordnance company, and engineer company). The subordinate elements are responsible for their internal communications. The wire laying capability of the ordnance and engineer companies is limited. When it will not interfere with the primary requirements, the group whould assist these companies in installing wire circuits.

51. (U) Wire Systems

a. Wire communication requirements are essentially the same for any employment of the group. A type wire system is shown in figure 11. When the firing batteries are widely dispersed, the command and operations circuits from the group to the batteries may be routed through the area communications system. The circuits from the group to the batteries must be sole-user circuits.

b. Since the group may be employed throughout the army area, communication with controlling headquarters (army artillery) may be difficult. When equipment and personnel are available from army signal units, the most satisfactory solution is a direct radio link between the army artillery command post and the missile group command post. A secondary solution is sole-user circuits through the army area communication system.

c. It is to be stressed that the criticality of the group fire support and the possible necessity to suspend a fire mission require direct

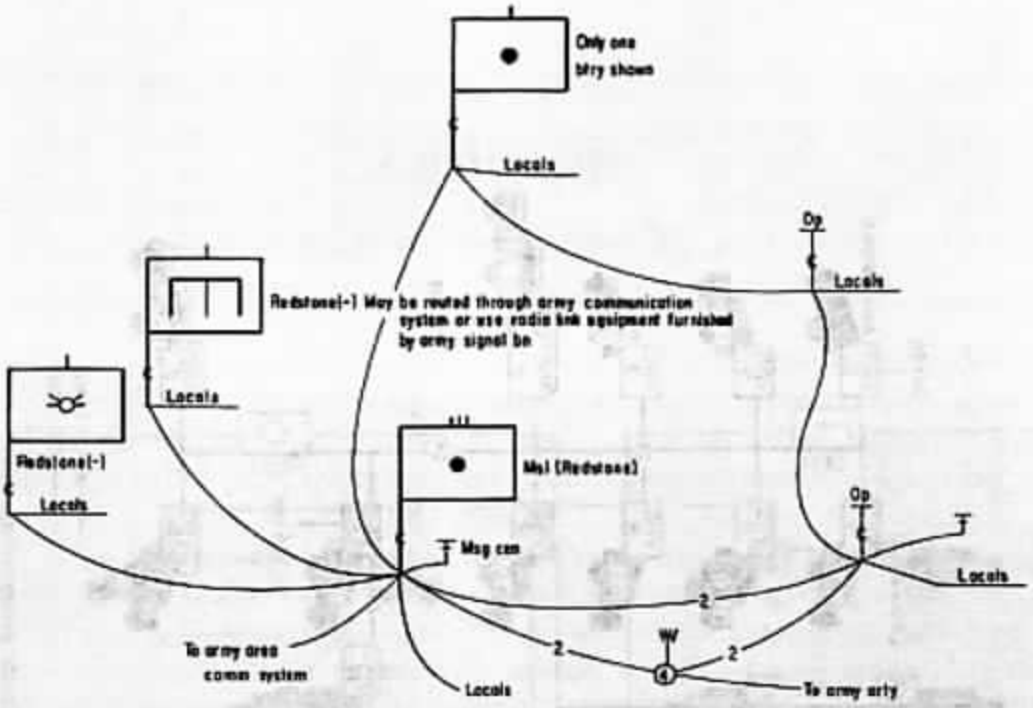

Figure 11. (U) *Type wire system for a field artillery missile group, Redstone.*

communication from the army artillery FSCS to the fire unit. Signal officers responsible for area communication systems over which sole-user circuits are routed must be cognizant of this requirement.

52. (U) Radio Systems

a. The missile group normally operates two command and fire direction nets, an AM and an FM. The AM net is used primarily for communication with subordinate units utilizing radioteletype. The FM net is used primarily for staff communication and communication with Army aircraft supporting the group. When distance permits, the FM net may be used for communication with subordinate units. The group operates in the army artillery command and fire direction net, AM, and monitors the appropriate warning net. A type radio system is shown in figure 12.

b. The missile battery FM radio equipment operates on the group command and fire direction net. The battery AM radio normally operates on the group command and fire direction net, AM, but may operate on the army artillery command and fire direction net, AM, while a fire mission is in progress.

c. In addition, the ordnance company and engineer company each operate an internal FM net. A type radio system is shown in figure 13.

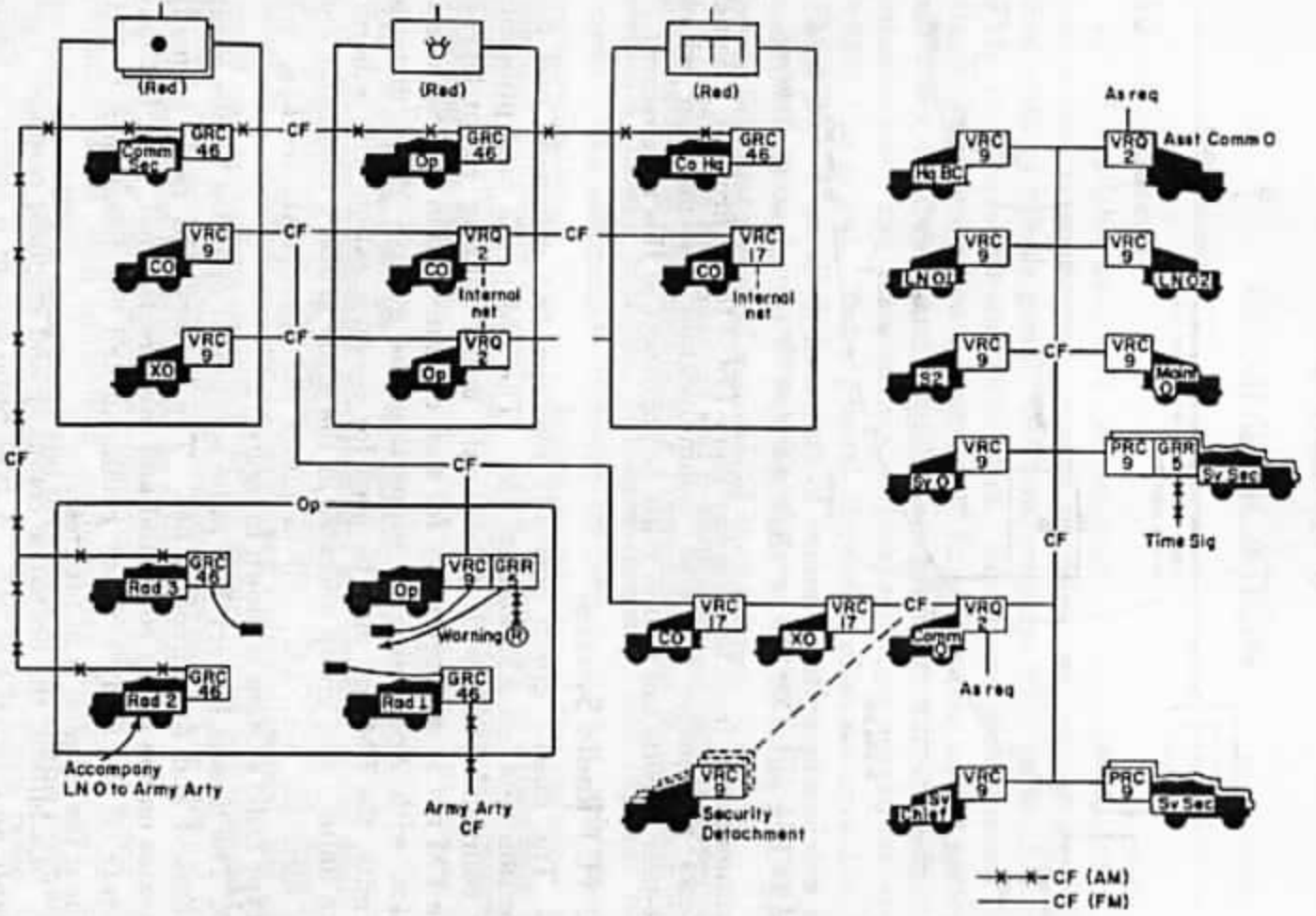

Figure 12. (U) *Type radio system, field artillery missile group, Redstone.*

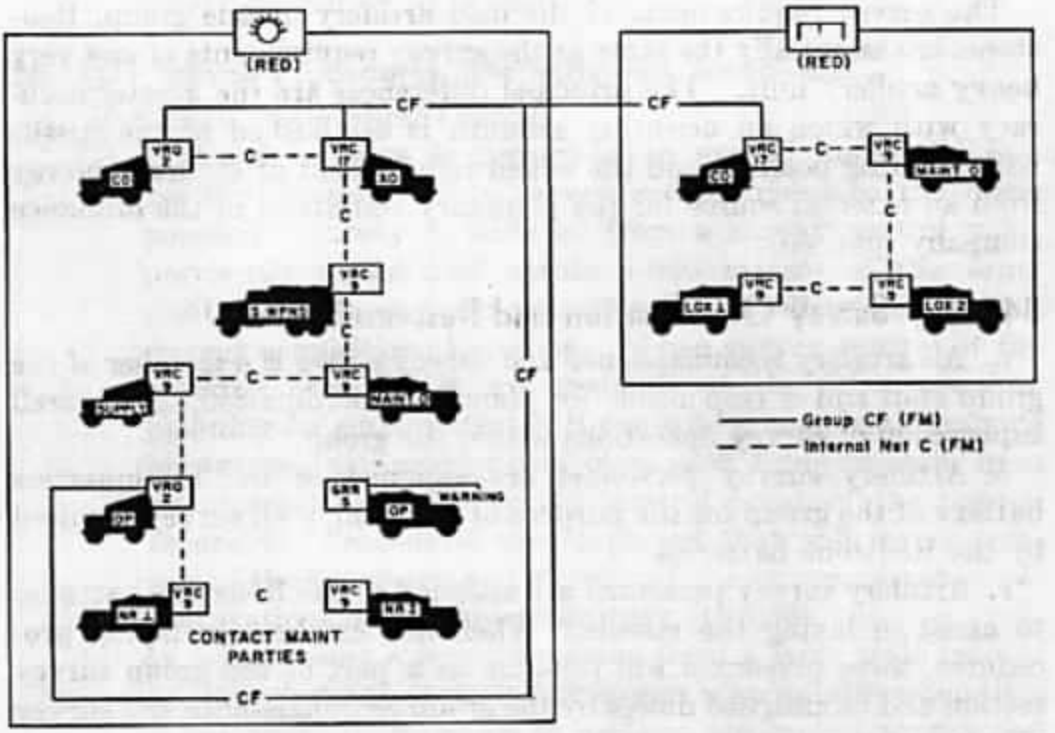

Figure 18. (U) *Type radio system, ordnance company and engineer company, field artillery missile group, Redstone.*

CHAPTER 9
SURVEY

53. (U) General

The survey requirements of the field artillery missile group, Redstone, are essentially the same as the survey requirements of any very heavy artillery unit. The principal differences are the greater accuracy with which an orienting azimuth is established at the missile battery firing position and the added requirement of accurate survey from an external source for the planetary test stand of the ordnance company (par. 55).

54. (U) Survey Organization and Responsibilities

a. An artillery reconnaissance and survey officer is a member of the group staff and is responsible for planning, coordination, and overall supervision of survey operations within the group.

b. Artillery survey personnel are assigned to the headquarters battery of the group for the purpose of performing all survey required by the Redstone batteries.

c. Artillery survey personnel are assigned to the Redstone batteries to assist in laying the missile. When not involved in laying procedures, these personnel will function as a part of the group survey section and be assigned duties by the group reconnaissance and survey officer.

55. (U) Survey Requirements and Accuracies

a. Survey requirements of the group performed by group survey personnel are as follows:

(1) *Grid coordinates and height of each launcher and alternate launcher position.* The grid coordinates and height of the launcher must be determined to an accuracy of 1:1000. These data are obtained by using 5th order (1:1000) survey procedures to extend control from a survey control point. The survey control point itself should be located to an accuracy of 1:3000 (4th order).

(2) *Grid azimuth of an orienting line for each launcher and alternate launcher position.* The azimuth provided the orienting line should be accurate to ±20 seconds. If the urgency of the situation demands, commanders may accept lesser accuracies up to ±60 seconds.

b. Survey requirements of the group performed on request by engineer topographic units at Army are as follows:

(1) Positioning the planetary test stand of the ordnance company. The astronomic position accuracy requirement for the planetary test stand is a probable error of ±1 second (this approximates 1 second of arc or 30 meters) and is ±5 meters in height.

(2) *Astronomic azimuth (uncorrected for the deflection of the vertical) for orienting the planetary test stand of the ordnance company.* The azimuth provided the planetary test stand must be accurate to ±7 seconds.

56. (U) Survey Procedures, Methods and Techniques

a. Horizontal and Vertical Control.

(1) A closed traverse is performed to extend horizontal and vertical control from a survey control point to the firing position. Survey is initiated from a survey control point previously established within 1,000 meters of the firing position by an engineer unit or a field artillery observation (target acquisition) battalion. When survey control of the required accuracy is not available at the firing position, planning for employment of the missile group should provide for extension of survey control to each firing position from the nearest available survey control point of the desired accuracy. Procedures are employed that will insure location of the launchers, and if required, the astronomic observation stations, to 5th order accuracy (1:1000).

(2) As a last resort a map inspection from a large scale map of known reliability (1:50,000 or larger) is acceptable when time is not available in which to perform a complete survey and the situation is such that the commander considers immediate firing necessary for the successful accomplishment of the mission.

b. Directional Control.

(1) Whenever possible, direction for orientation of the missile will be obtained by astronomic observations. These observations should be performed at the orienting station; however, if two launchers are located in the same vicinity, it may be desirable to perform the observations at a point that will permit extension of azimuth to both launchers by directional traverse. In making the astronomic observation, the final azimuth determined should result from the mean of four usable sets. All four sets should agree within ±20 seconds of the mean. If any one of the four sets fails to meet this criteria, it should be rejected and another observation made.

(2) If a starting azimuth of 3d order astronomic accuracy (probable error ±5 seconds) or higher is available at the survey control point, azimuth may be extended to the orienting line as part of the position area survey. A separate directional traverse may be necessary if the azimuth must be carried to the orienting station from a point other than that from which position area survey operations are initiated. Using either procedure, all angles are measured two positions with a theodolite. The angles must be remeasured if the values determined from each position vary by more than 5 seconds from the mean; i.e., if the spread exceeds 10 seconds. By using this procedure and by limiting the number of directional traverse legs to two, a high assurance is provided that the azimuth placed on the orienting line will be accurate within ±20 seconds.

(3) When it is not possible to make an astronomic observation for the determination of azimuth, the direction of the orienting line should be determined with the surveying instrument, azimuth, gyro, and artillery.

(4) An azimuth determined by astronomic observation should be checked as soon as possible with the surveying instrument azimuth gyro artillery, or by closing a directional traverse as described in the previous paragraph, based on existing survey control of equal or higher accuracy. An azimuth determined by the surveying instrument azimuth gyro artillery should also be checked. All directional traverses must be closed.

c. Methods and Techniques. The survey methods and techniques discussed in TM 5–234 and TM 6–200 are utilized in survey operations performed by the missile group.

CHAPTER 10
ADMINISTRATION AND LOGISTICS

Section I. GENERAL

57. (U) General

The group headquarters is considered both tactical and administrative; however, administrative functions of the group headquarters are not limited to coordination, supervision, and control. Normal administrative functions prescribed for batteries and companies are discussed in applicable Department of the Army publications. This chapter covers additional administrative, supply, and maintenance procedures which are peculiar to, or which must be emphasized for, this type of organization.

58. (U) Group Organization and Logistic Responsibilities

The command, policy, and maintenance and supply channels of the field artillery missile group, Redstone, are shown in figure 14. The logistic mission of the group is to establish, supervise, and coordinate logistic policies that are compatible with operational and technical requirements established by higher headquarters and firing or using elements.

a. The headquarters and headquarters battery logistic mission is the implementation of logistic procedures that will insure compliance with the group logistic policy and the supply of all items for which responsibility has not been delegated to the ordnance and engineer support companies.

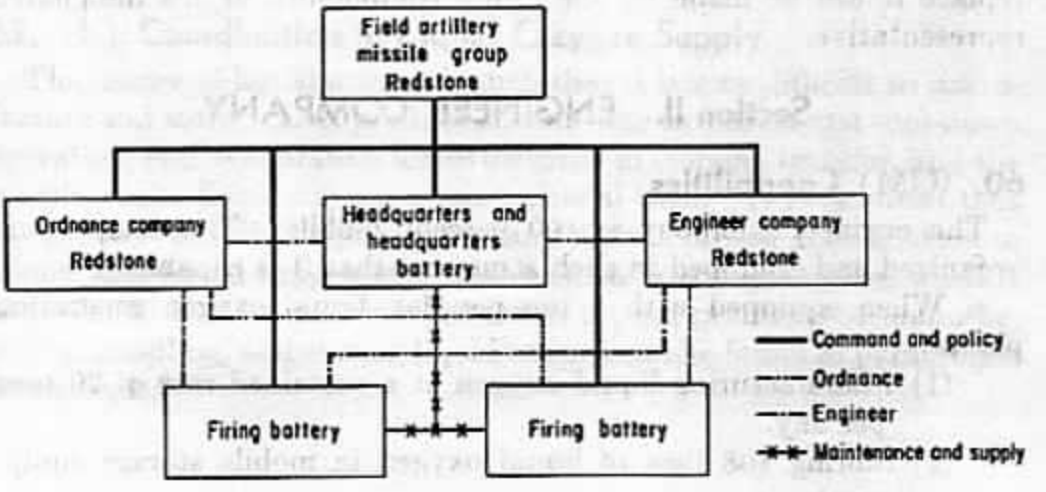

Figure 14. (U) *Maintenance and supply channels, field artillery missile group, Redstone.*

b. The Redstone firing battery logistic mission is the implementation of group logistic procedures.

c. The logistic mission of the ordnance company, Redstone, is to—

(1) Provide supply and maintenance service for ordnance and signal equipment within the group.

(2) Provide technical assistance to the artillery commanders on maintenance and supply matters concerning the Redstone missile system.

(3) Assist in gathering and forwarding field engineering data on materiel failure.

(4) Supply hydrogen peroxide (H_2O_2) and mixed alcohol.

d. The logistic mission of the engineer company, Redstone, is to—

(1) Provide field maintenance for all engineer mechanical equipment within the group.

(2) Manufacture and supply liquid oxygen (LOX) and liquid nitrogen (LN_2).

(3) Provide technical assistance to artillery commanders on maintenance and supply matters.

(4) Assist in gathering and forwarding field engineering data on materiel failures.

59. (U) General Support Policies

a. Technical support must be provided in a manner which precludes cancellation or delay of a firing mission because of failure to have serviceable materiel or supplies at the point of employment.

b. Continuous communication between the support units and elements of the group will be maintained.

c. On receipt of a fire mission by a firing battery, the support companies will replenish the basic load of the firing battery.

d. If a missile in the firing position should fail to pass firing readiness checks, the decision as to whether to repair the missile or to replace it will be made by the group commander or his designated representative.

Section II. ENGINEER COMPANY

60. (CM) Capabilities

The engineer company is 100 percent mobile. The company is organized and equipped in such a manner that it is capable of—

a. When equipped with 5 ton per day liquid oxygen generating plants:

(1) Manufacturing liquid oxygen at a sustained rate of 20 tons per day.

(2) Storing 108 tons of liquid oxygen in mobile storage equipment.

(3) Manufacturing liquid nitrogen at a rate of 800 pounds per day while producing liquid oxygen at a sustained rate of 20 tons per day.

b. Storing 9 tons of liquid nitrogen on mobile storage equipment.

c. Providing field maintenance and repair parts support for all group engineering mechanical equipment.

d. Transporting and transferring liquid oxygen and liquid nitrogen.

e. Providing all necessary mess, supply, and administrative functions except that required for personnel management.

f. With adequate warning, supporting a maximum rate of fire of 4 missiles in a single 24-hour period.

g. Supporting a sustained rate of fire of one missile every 48 hours.

61. (U) Functions

The engineer company is organized as shown in figure 6. The functions of the elements of the engineer company are as follows:

a. Company Headquarters. The company headquarters is the command and administrative element of the company. It provides mess, unit supply, and all administrative facilities for the personnel of the unit. The unit commander, in addition to his normal command functions in the company, is the special staff adviser to the group commander for all engineer matters.

b. Maintenance Platoon. The maintenance platoon is responsible for field maintenance of mechanical engineer equipment in the group, and it provides all engineer repair parts for the group. It provides engineer maintenance contact teams for repair at the firing position and on a standby basis during fire missions. It also provides second echelon maintenance on its organic ordnance and engineer equipment.

c. Liquid Oxygen Generating Platoons. Each of the liquid oxygen generating platoons generates, stores, and transports liquid oxygen. In addition these platoons perform preventive maintenance on all their operating equipment and produce liquid nitrogen as required.

62. (U) Coordination in Liquid Oxygen Supply

The nature of liquid oxygen is such that it is very difficult to manufacture and store. Lost production time due to defrost and cool-down operation, and evaporation losses incurred in storage, transfer, and the missile, make liquid oxygen a most critical item. It is essential that the fire unit and the engineer company maintain close coordination to insure that liquid oxygen is available in sufficient quantities, when it is needed. A more detailed discussion on the problems of manufacturing, handling, and storing liquid oxygen can be found in paragraphs 68 through 76.

Section III. ORDNANCE COMPANY

63. (CM) Capabilities

The ordnance company is a 100 percent mobile unit capable of direct ordnance and signal maintenance and supply support for ordnance equipment peculiar to the Redstone system of the group, including the supply of alcohol and hydrogen peroxide. However, additional transportation must be acquired or organic transportation shuttled to move the complete load of missiles and warheads in the supply point. The organization of the company is such that it is capable of—

a. Providing support such that a missile may be fired within 6½ hours after arrival of the firing battery at a prepared firing position. If firing is delayed, support can be rendered to maintain the missile for 24 hours in condition to fire within 1 hour or less.

b. Supporting a maximum rate of fire of 4 missiles in a single 24-hour period with adequate warning and supply of additional missiles.

c. Supporting a sustained rate of fire of one missile per 48-hour period.

d. Furnishing organic field maintenance support for major items of ordnance and signal equipment peculiar to the Redstone system and field maintenance support for those common items directly associated with equipment within workload capabilities.

e. Providing contact teams and repair at the firing position as required.

f. Providing all necessary mess, supply, and administration functions for assigned and attached personnel.

64. (U) Functions

The ordnance company is organized as shown in figure 7. The functions of the elements of the ordnance company are as follows:

a. Company Headquarters. The company headquarters is the command and administrative element for the company. It provides mess, unit supply, and all administrative facilities for the personnel of the unit except that required for personnel management. The unit commander, in addition to his normal command functions in the company, is the special staff adviser to the group commander for all ordnance matters.

b. Operations Section. The operations section is the focal point for all mission activities performed by the unit. The operations officer is the coordinator for all maintenance and supply activities. The master control records for maintenance and supply functions are maintained by this section and requests for special contact teams are coordinated.

c. Missile Maintenance Platoon. The missile maintenance platoon provides all missile system maintenance. It must supply the contact

teams to work outside the physical confines of the unit shop. This will include the firing batteries and the ordnance unit storage points. The main functions include pre-issue inspections, component repair, in-storage inspections, and other tasks as directed.

d. Supply Platoon. The supply platoon will handle all supply functions within the unit with the exception of unit supply. This supply function will include the supply of major Redstone items and missile fuel as well as all repair parts to both of the operating sections of the ordnance company and the firing batteries of the group. Present technical and safety considerations indicate that one or more missile and fuel supply points should be established at some distance from the unit proper with the control remaining centrally located in the supply platoon headquarters. The special weapons section of the supply platoon maintains and prepares for issue items peculiar to nuclear weapons and makes instorage periodic technical surveillance inspections of all nuclear warheads within the group. The supply platoon is responsive to the needs of the operations section for personnel to augment the contact teams.

e. Automotive Maintenance Platoon. The automotive maintenance platoon is responsible for all supporting functions to the unit, such as machine shop facilities, welding facilities, wrecker service, and field maintenance for automotive equipment. The platoon will provide special personnel and equipment to the contact teams as deemed necessary for the performance of a particular task.

f. Signal Maintenance Section. The signal maintenance section provides signal maintenance and repair parts for the organic signal equipment of the group. The section will provide special equipment and personnel to the contact teams as deemed necessary for the performance of a particular task.

g. Redstone Trainer Section. The Redstone trainer section operates and maintains the Redstone trainer and furnishes training support to the firing batteries. This support will be coordinated by the S3.

Section IV. AMMUNITION HANDLING PROCEDURES

65. (U) General

The ammunition supply procedures for the group are generally the same as those prescribed for other field artillery units with a nuclear capability. For ordnance procedures see FM 9–5 and TM 9–1903.

66. (U) Complete Round

A complete round is considered to be 3 missile sections (thrust unit, aft unit, and warhead unit), guidance components, missile batteries, explosive bolts, igniter squib, fuels (alcohol and hydrogen peroxide), and sufficient perishable items (liquid oxygen and liquid nitrogen) to insure that a suitable firing level is maintained over a minimum period of 8 hours without replenishment.

67. (CM) Missile Handling Procedures

a. Capability. The group is capable of transporting four missiles (complete rounds). Of the 4 missiles, 2 are in ready storage at the ordnance company and 1 at each firing battery.

b. Drawing. The ordnance company will draw missiles from a designated supply point. Missiles are packaged in 4 packages consisting of the thrust unit, aft unit, warhead unit, and the stabilized platform (ST–80). A fifth container is used for transporting expendable group support equipment.

c. Checkout.

(1) The ST–80, missile and warhead will be checked out by the ordnance company, prior to issue to the firing battery, as prescribed in TM 39W39–16.1 and volume II–A, Notes on Development Type Material, Ordnance Inspection Procedures.

(2) The winterization kits are used as required.

d. Transport.

(1) The ST–80 is transported to the firing position on an M35, 2½-ton truck, cargo, 6 x 6.

(2) The ST–80 container temperature must be maintained between 32° F. and 105° F. The container has heating facilities for temperature control when needed. This heating device utilizes a 24-volt d.c. power source for use during motor marches and a 110-volt a.c. power source for storage purposes. (For detailed instructions see Notes on Development Type Material, volume III–1, Ballistic Guided Missile XM8; Shipment, Handling, and Storage.)

e. Storage.

(1) There will be a missile and fuel storage area for each missile in the group basic load. Of the 4 storage areas, 2 will be manned by ordnance and 1 by each of the 2 firing batteries. These areas will be dispersed for tactical reasons as determined by the group commander.

(2) Each missile component will be stored in its own shipping container.

(3) The missile packages and fuels should be stored in an area affording good hardstand, road nets, and camouflage. The storage areas should allow entry and exit of servicing vehicles with a minimum of movement of the missile components.

(4) The explosive components, explosive bolts, and igniters will be stored in accordance with like items listed in FM 9–5 and TM 9–1903, and current regulations.

(5) The special weapons section of the ordnance company will perform in-storage periodic technical surveillance inspections on all nuclear warheads within the group as prescribed in

appropriate publications. Storage monitoring will be accomplished by the ordnance company.

(6) Periodic tests must be made by the ordnance company on the ST–80 to measure the drift rates. ST–80's in possession of the firing batteries will be returned to the ordnance company for periodic tests. When the drift rates exceed the tolerance specified, the ST–80 must be evacuated to a higher support echelon.

(7) Periodic tests must be made by the ordnance company to requalify guidance and control missile components.

f. Issue.

(1) During tactical operations, group headquarters will alert the ordnance company as early as possible when a fire mission has been received.

(2) The ordnance company will immediately notify the backup support echelon to ship a replacement missile to the ordnance company.

(3) The replacement missiles for the firing batteries will be delivered by the ordnance company to a specified location or may be picked up by organic transportation of the firing batteries.

Section V. PROPELLANT HANDLING PROCEDURES

68. (U) Liquid Oxygen-Nitrogen Production

The engineer company is equipped with eight 5-ton per day liquid oxygen-nitrogen mobile generator units. The 5-ton generator unit is mounted in 2 semitrailers; 1 trailer contains the air supply unit and the other an air separator unit.

a. The 5-ton per day air supply unit contains four diesel engine driven air compressors. The compressors connected in parallel, compress atmospheric air to 3,000 psi.

b. The air separator semitrailer assembly contains the equipment for separating the compressed air into liquid oxygen and liquid nitrogen. The compressed air is first dried, then cooled and passing through an expansion valve is liquified. The liquid air is then filtered to remove carbon dioxide and hydrocarbons before flowing to the distillation columns for separation into liquid oxygen and nitrogen. The actual separation of oxygen/liquid nitrogen takes place within the distillation columns. The liquid oxygen/liquid nitrogen is then subcooled and passed to storage.

69. (U) Liquid Oxygen-Nitrogen Production Losses

Liquid oxygen-nitrogen production rates will vary with the losses due to changes in the ambient temperature, the local barometric pressure, and the plant cooldown time. Because compressor performance decreases in direct proportion to the decrease in atmospheric

pressure, the output of a generator will decrease at an estimated rate of 4 percent per inch of mercury drop in barometric pressure (equivalent to an increase in altitude of 1,000 feet). Production of liquid oxygen-nitrogen also drops as the ambient temperature increases. Assuming a normal ambient temperature of 85° F., the output of the generator will decrease at a rate of 2 percent per 10° F. rise in ambient temperature. Shutdown time of the 5-ton-per-day plant for maintenance, repair, and defrosting will result in an approximate loss of 30 percent of rated production. The support of the normal sustained fire rate precludes frequent shutdown of the generators because of attendant losses in production due to defrost, disassembly, movement assembly, and cooldown time. Time lost in movement cannot exceed 1 day per 5 days of full production, if the sustained fire rate is to be maintained.

70. (U) Handling Liquid Oxygen and Liquid Nitrogen

The presence of dirt and impurities in liquid oxygen and liquid nitrogen is one of the most probable sources of equipment malfunction. Care must be taken to avoid contaminating lines and fittings with oil and dirt. Purity standards for handling and testing should be in accordance with Federal Specification BB–0–925. Personnel handling liquid oxygen and liquid nitrogen should be properly protected from the extremely low temperature. The safety requirements in TB 5–351–1. Liquid Oxygen and Nitrogen, should be rigidly adhered to. The principal safety precautions are as follows:

a. Wear asbestos gloves.

b. Wear face shield.

c. Clear away combustible materials from a liquid oxygen handling area.

d. Use only materials and lubricants specified for use with liquid oxygen.

e. Use only water, chemical (powder) foam, carbon dioxide, or inert gases in fighting fires involving liquid oxygen.

f. Clean all metallic fittings with triachlorathene or a hot solution of soda ash and water.

g. All generating and storage equipment should be grounded when operating.

h. Do not smoke or allow open flames within 100 feet of a liquid oxygen container.

i. When cleaning equipment, make sure that the cleaning area is well ventilated.

71. (U) Storage and Transportation of Liquid Oxygen and Liquid Nitrogen

In addition to manufacturing liquid oxygen and liquid nitrogen, the engineer company is charged with transportation and storage

to the supply point designated by the group commander. To accomplish this mission, the company has transport and storage containers. The firing batteries of the Redstone group also have the capability of transporting liquid oxygen and liquid nitrogen from the engineer company to the firing position.

a. Each platoon is provided with five 9-ton capacity, semitrailer-mounted, liquid oxygen transport containers. The transport containers have an estimated loss rate of 2 to 3 percent per day when the product is in transit and 1 percent per day when in storage.

b. Each generating plant has receiving tanks capable of storing 1½ tons of liquid oxygen and 200 pounds of liquid nitrogen while plant is in operation. Normally, accumulated storage is transferred to the mobile containers every 8 hours.

c. The engineer company has one 9-ton capacity, semitrailer-mounted, liquid nitrogen transport container. This container has an estimated loss rate of 2 to 3 percent per day in transit and 1 percent in storage. Liquid nitrogen is transported from the engineer company to the firing batteries in four 150-gallon, trailer-mounted containers.

72. (U) Transfer Rates

In order to estimate the time required to manufacture, transfer, and load liquid oxygen and liquid nitrogen for any mission, it is essential to know the transfer rates of all components within the system. Before a delivery schedule can be established, pumping rates must be known. Although transfer time can be decreased by skilled personnel through experience, the overall time requirement is determined by equipment capability.

a. The estimated transfer rates are listed below:

(1) From on-plant storage to the 9-ton container is 60 to 100 pounds per minute using pressure transfer.

(2) From on-plant storage to the 9-ton container is 140 gallons per minute using pump transfer.

b. The loading rate of the missile from one 9-ton trailer is 150 gallons per minute. With 2 trailers and manifolded the maximum rate is approximately 250 gallons per minute.

c. The replenishing rate from the 9-ton container to the missile is 35 gallons per minute.

d. When the missile is being unloaded into a 9-ton container, the rate is approximately 80 gallons per minute.

e. Liquid nitrogen is automatically transferred to the missile cooling system as needed. Approximately 70 gallons per hour are used.

Note. The rate in *b* above is based on use of electrical pumping equipment. All other rates are applicable using pressure transfer means at reduced rates.

73. (U) Liquid Oxygen and Liquid Nitrogen Storage, Transfer, Transport and Cooldown Losses.

Losses in liquid oxygen and liquid nitrogen during the various phases of handling and utilization vary with insulation, pumping rates, turbulence, ambient conditions of pressure and temperature, wind velocity, and the specific heat of containers. The following estimates of loss rates are based on limited experience and are not intended to reflect ambient conditions or pumping rates:

a. Nine-Ton Semitrailer Liquid Oxygen Container Losses.

(1) Loss of liquid oxygen in 10-foot hose used in transferring 9 tons of liquid oxygen from liquid oxygen generating plant into trailer (filling time is approximately 45 minutes)—0.2 ton.

(2) Loss associated with container (cold—containing some residual liquid oxygen)—0.2 ton.

(3) Liquid oxygen loss associated with container (warm—75 tons).

(4) Evaporation loss per day (full container) in static storage—0.09 ton.

(5) Evaporation loss per day in transit—0.27 ton.

(6) Residual loss in 9-ton containers:

(*a*) When pumping against 75 psig head at 150 gallons per minute—0.3 ton.

(*b*) When pumping against 30 psig head at 150 gallons per minute—0.4 ton.

(*c*) When transferring by pressurization only at approximately 30 to 50 gallons per minute—0.02 ton.

b. Missile Losses.

(1) Initial cooldown losses and boil-off replacement during filling—2.5 tons.

(2) Boiloff from filled missile—0.9 ton per hour. (Rates may vary between 15 and 45 pounds per minute, depending on the ambient conditions of pressure and temperature.)

(3) Hose loss per hour during transfer of liquid oxygen from 9-ton container to missile to replace boiloff—0.5 ton.

74. (U) Alcohol

a. Receipt. The ordnance company obtains alcohol from the next higher supply echelon. Alcohol is supplied in 55-gallon drums or by exchange of alcohol trailers. The method of supply depends on the local supply requirements.

b. Mixing. The mixing of alcohol and water is accomplished by the ordnance company. The 3,000-gallon alcohol trailer is filled with a basic load of fuel (75.5 percent alcohol and 24.5 percent water ± 1 percent by weight) from the 55-gallon drums and engineer-processed water.

c. Issue. Each firing battery is authorized 1 alcohol trailer, and the ordnance company is authorized 3 alcohol trailers. Each firing battery obtains a trailer load of mixed alcohol from the ordnance company and stores the loaded trailer at the battery. The ordnance company stores two of its trailers loaded with mixed alcohol in a ready-for-use condition. Resupply of alcohol may be made by exchanging an empty trailer for a loaded trailer or by refilling the empty firing battery trailers. The method of resupply used within the group will be prescribed by the group commander.

d. Storage. Filled alcohol trailers will normally be stored within the same area as the missile. The storage of these trailers is subject to quantity and distance requirements for flammable fuels.

e. Inspection. Inspection of mixed alcohol in trailers will be performed by a fuel specialist team from the ordnance company. The fuel specialist team will conduct a mixture concentration test on all filled trailers in the group as directed. This team will carry sufficient alcohol in 55-gallon drums to restore the fuel mixture to the required concentration.

f. Special Precautions. The mixed alcohol must be at least the required minimum temperature before loading. The minimum alcohol is furnished as fire mission data. The minimum required alcohol temperature graph is used as a guide in maintaining the approximate alcohol temperature until the fire mission command sheet is received. After the alcohol has been loaded in the missile, the temperature is periodically monitored to insure it does not drop below the minimum required temperature. The efficiency of the rocket engine varies with alcohol temperature, and is controlled by adjusting the fuel ratio mixture control valve shortly before firing. During standby conditions, electric heaters in the alcohol trailer may be used to maintain the required alcohol temperature.

g. Operating Instructions. See chapter 2, volume VI, Notes on Development Type Materiel, Alcohol Tank Semitrailer, Description, Operation, and Maintenance.

h. Maintenance Instructions. See chapter 3, volume VI, Notes on Development Type Materiel, Alcohol Tank Semitrailer, Description, Operation, and Maintenance.

75. (U) Hydrogen Peroxide

a. Receipt. The ordnance company receives the hydrogen peroxide (H_3O_2) from the next higher support echelon. Premixed hydrogen peroxide is received in vented seal type containers.

b. Storage. Although no temperature conditioning is required for hydrogen peroxide during storage, its temperature must be checked upon receipt to determine that drum temperature and ambient temperature do not indicate an abnormal temperature difference. After temperature check on receipt the drums must be checked once

each day for five days for heat generation, which indicates decomposition. Place hand on outside of drums to perform temperature checks. If the temperature in any drum indicates higher than the ambient temperature, but not excessively high, the drum must be isolated and placed under close surveillance. If the temperature continues to rise, the contents must be dumped. For detailed instructions, see volume VII, Notes on Development Type Materiel, Guided Missile Hydrogen Peroxide Servicer XM506, Description, Operation, and Maintenance.

c. Issue. The firing batteries will use specially designed organic transportation to pick up hydrogen peroxide at the ordnance company and transport it to the firing position. The ordnance company does not have the special H_2O_2 trucks required for this purpose.

d. Inspection. The hydrogen peroxide in sealed containers will be inspected and tested every three months by ordnance technicians. If the mix is not within tolerance, the ordnance fuel specialists will take corrective action as described in volume VII, Notes on Development Type Materiel, Guided Missile Hydrogen Peroxide Servicer XM506; Description, Operation, and Maintenance.

e. Operating Instructions. See chapter 2, volume VII, Notes on Development Type Materiel, Guided Missile Hydrogen Peroxide Servicer XM506; Description, Operation, and Maintenance.

f. Special Precautions. During firing operations, heating and cooling facilities in the hydrogen peroxide servicer must be used to condition the hydrogen peroxide to a temperature between 65° F. and 85° F. If the temperature falls outside the limits the hydrogen peroxide must be drained back into its containers to be either heated or cooled.

76. (U) Safety Precautions

a. General. A group SOP should be prepared to provide procedures for fighting different types of fires.

b. Alcohol.

(1) Fire fighting equipment will always be available during mixing and loading. A fog nozzle is most effective for extinguishing an alcohol fire.

(2) No smoking or unnecessary vehicle movement should be allowed within the immediate vicinity of propellant loading operations.

(3) Excessive exposure to fumes should not be allowed.

c. Liquid Oxygen (LOX).

(1) Fire fighting equipment will always be available during liquid oxygen loading. Liquid oxygen alone does not burn but it actively supports combustion when associated with certain combustible material.

(2) No smoking or unnecessary vehicle movement should be allowed in the immediate vicinity of propellant loading operations. Combustibles usually ignite at much lower temperatures in an oxygen-enriched atmosphere, thereby creating a fire hazard.

(3) Fires are of greater intensity in an atmosphere enriched with oxygen than air.

d. Hydrogen Peroxide (H_2O_2).

(1) Fire fighting equipment will always be available during testing and loading. The principal objective in extinguishing an H_2O_2 fire is to dilute the H_2O_2 with water; therefore, a stream of water is usually used.

(2) Cleanliness of equipment is mandatory. H_2O_2 is extremely sensitive to impurities. Should dirt, grease, or other extraneous material come into contact with the H_2O_2, an explosion is likely to occur.

(3) Protective clothing and face masks must be worn for H_2O_2 operation.

(4) Leaking H_2O_2 or spillage must be washed away with water.

(5) Containers found to be leaking in storage should be washed down with water. The ordnance company should be notified immediately in order that the ordnance fuel specialist may dispose of the container. Washing of the leaking container must be continuous from the time of discovery to disposal by the fuel specialist.

Section VI. MAINTENANCE AND SUPPLY

77. (U) General

a. A concentrated effort is required to maintain the large amount of complex materiel in the Redstone group. Command supervision of maintenance, a rigorous preventive maintenance program, and other unit maintenance principles must be aggressively applied in this group.

b. The artillery group commander, based on the recommendations of the technical support unit commanders, may, within the limits of prescribed technical procedures, alter the performance of maintenance operations to suit the capabilities and requirements of the individual units. The principal governing factors are the level of skill, equipment, and time required. Normally, maintenance by the user will be limited to replacement of major assemblies and components, and the engineer and ordnance unit will, within their capabilities, repair components and subassemblies within the major assemblies and components.

c. The group commander will establish priorities for evacuating items requiring maintenance beyond the workload capabilities of the support units.

d. The general procedures set forth in FM 9–1 and FM 9–3 will be used for establishing shop SOP's and production control within the

ordnance company. TM 5–505, Maintenance of Engineer Equipment, will be used as a guide for the proper maintenance of engineer equipment.

78. (U) Operational Procedures

a. Work Order Procedures. The work order procedures prescribed in FM 9–1 and FM 9–3 will be followed when material is delivered to support company shops by using personnel.

b. Contact Teams. Work to be accomplished at the firing position by contact teams will be handled by a similar work order procedure.

c. Repair Parts Supply. The support companies will be responsible for requisitions from depots and for storage and issue of repair parts for equipment peculiar to the Redstone system within the group.

d. Supply Liaison. The following liaison procedures will apply:

(1) Support companies will furnish contact parties to assist firing batteries with maintenance and technical supply problems and procedures.

(2) Contact party personnel will be alert for problem areas and report them to their respective company commanders.

(3) Company commanders, acting as group technical staff officers, will recommend solutions to the group commander for approval.

e. Technical Inspection Procedures.

(1) Each support company will inspect the materiel for which it has maintenance and supply responsibility as required by appropriate technical publications or at least once annually.

(2) Technical inspections will be made to determine the condition of materiel, adequacy of maintenance and supply procedures, and training requirements. These inspections will be for the specific purpose of improving the condition of materiel. Personnel to conduct the inspections will be drawn from the appropriate sections of the support companies with personnel of the firing batteries assisting as required.

(3) The support company inspection personnel will assist the group commander in conducting command inspections.

f. Reporting Failures.

(1) A failure reporting system will be made part of the group logistic system.

(2) The support companies will forward the failure report forms each week to a designated agency for evaluation and processing. Field engineers attached to the support company will review these reports and make necessary comments.

g. Field Engineers.

(1) Field engineers will be attached to the engineer and ordnance companies.

(2) The duties of the field engineers will be directed by the support company commanders within the scope of the contract, to include but not to be limited to the following:

(*a*) Supplement the technical capabilities of the support companies by analyzing difficulties, evaluating deficiencies, and reporting deficiencies with analyses and evaluations.

(*b*) Evaluate prescribed and improvised maintenance procedures, tools, and equipment.

(*c*) Evaluate the adequacy of repair parts provided and of packaging and packing.

(*d*) Assist in technical training.

(*e*) Assist in the application of modifications and in retraining in the use of modified equipment.

(*f*) Conduct specific engineering investigations.

(*g*) Review and comment on failure reports.

Go to Page 62