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SPECIAL TEXT 44-160

ORGANIZATION, PROCEDURES, AND DRILL
FOR
NIKE I UNITS

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THE ARTILLERY SCHOOL
ANTIAIRCRAFT AND GUIDED MISSILES BRANCH
FORT BLISS, TEXAS

TAC AG CONTROL
No. 23889

[redacted]

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JANUARY 1954

ORGANIZATION, PROCEDURES, AND DRILL FOR NIKE I UNITS

This text is approved for resident and extension course instruction at The Artillery School, Antiaircraft and Guided Missiles Branch, only. It reflects the current thought of this school and conforms to printed Department of the Army doctrine as closely as possible.

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FOR THE ASSISTANT COMMANDANT:

S. L. HARDING
Lt Col, Arty
Secretary

[redacted]

CONTENTS

The material contained in this text will be used in the preparation of FM 44- ( ), Procedure and Drill for the Nike I System. The reader is encouraged to forward to The Artillery School, Antiaircraft and Guided Missiles Branch, any comments or added material that he believes would improve this text as to scope, coverage, and accuracy.

PART ONE

GENERAL

CHAPTER 1

INTRODUCTION

1. PURPOSE AND SCOPE. This special text is intended as a guide for the employment and service of the Nike I system in the continental United States. It covers the employment of Nike I, fire control and gunnery for Nike I, and procedure and drill for the fire unit. The tactical principles for the employment of Nike I will be published in a separate text. The technical details and adjustments of the system are not covered in this text.

a. While TO&E's 44-145, 146, and 147 (DA, 12 February 1953) provide for a launching battery of four sections with four launchers per section, units currently being formed in the CONUS are organized with three sections per battery and three launchers per section. The organization and personnel discussed herein are those approved in the above TO&E's. However, this text outlines position area requirements for units having fewer launchers and sections than specified in the TO&E's as well as for full TO&E organizations.

b. The nomenclature used in this special text is that currently used in the Antiaircraft and Guided Missiles Branch, The Artillery School, and not that in approved Ordnance Committee Meeting (OCM) reports. To facilitate the changeover to approved OCM nomenclature, appendix XIV shows the OCM nomenclature, the corresponding special text nomenclature, and that normally used by the contractor in his publications.

2. DEFINITIONS. Definitions of terms will be found in Glossary of Guided Missiles Terms, GM 51/8, prepared by the Committee on Guided Missiles, Department of Defense.

3. REFERENCES. Appendix I contains a list of publications pertaining to the Nike I system and allied subjects. Appendix II gives the contractor's recommended earth-compacting technique. Appendixes III and IV set forth safety requirements and first aid treatment. Appendix V shows the army radios organic to the Nike I battery. Appendixes VI through XIII are operational check lists. Appendix XIV is a nomenclature table.

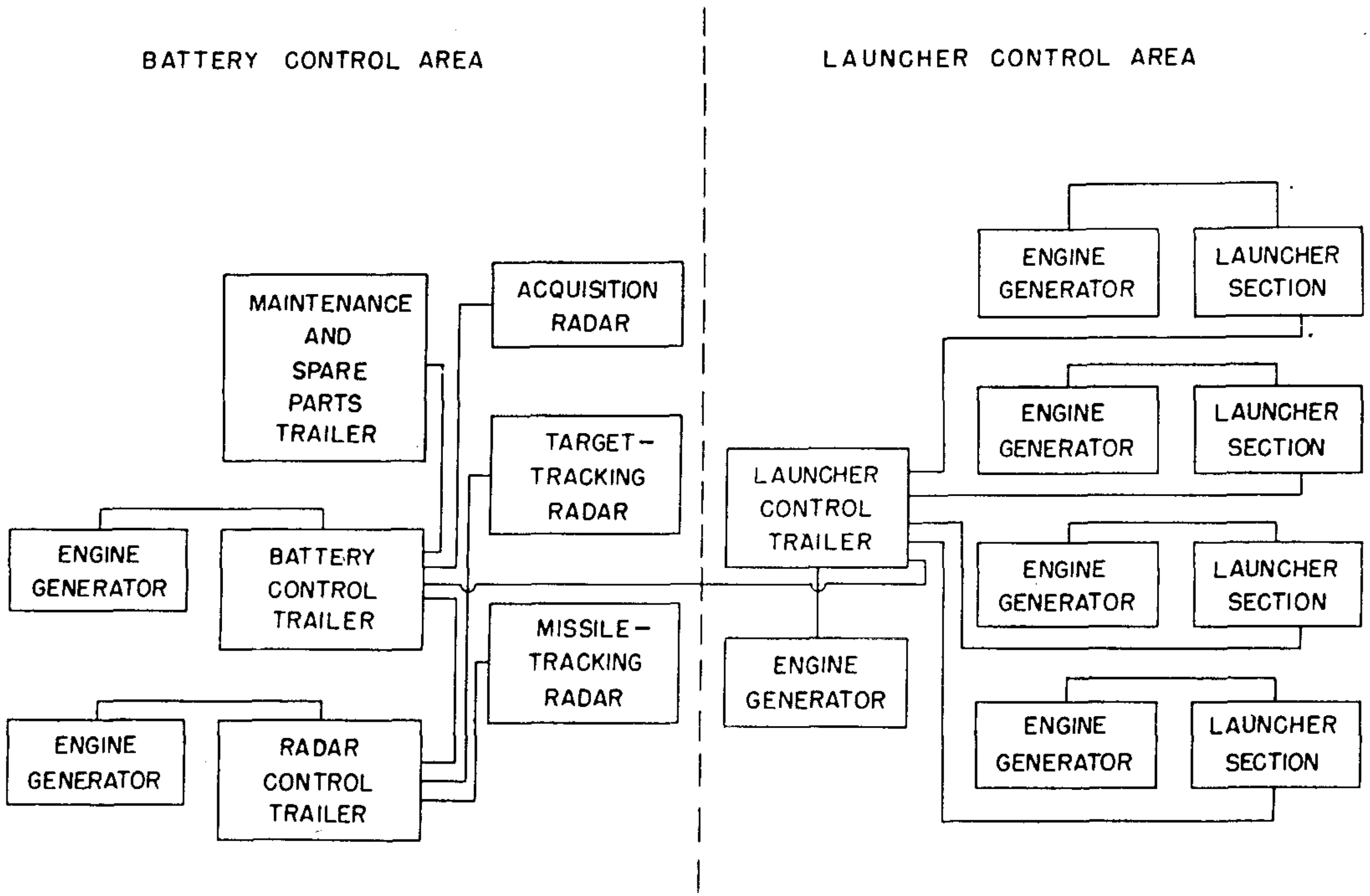


Figure 1. Block diagram of the Nike I system.

CHAPTER 2

DESCRIPTION OF NIKE I AND PERFORMANCE DATA

Section I. GENERAL

4. THE NIKE I SYSTEM. The Nike I system is of the command guidance type. The major components of the Nike I fire unit are shown in figure 1. Initially, a target located by an acquisition radar is transferred to a target-tracking radar. Data from the target-tracking radar are sent to a computer. The computer sends prelaunch data to the missile on the launcher. The missile-tracking radar beam, having been locked on this missile prior to launching, tracks the missile throughout its flight. Both the missile-tracking and target-tracking radars feed information to the computer which computes the steering commands to guide the missile to the predicted intercept point. These steering commands are sent to the missile during its flight via the missile-tracking radar beam. The flight path of the missile is altered by steering commands when necessary so as to cause it to intercept the target at a predicted point of intercept. When the missile is within killing distance of the target, the computer on the ground initiates a burst command to detonate the warhead. This command is sent via the missile-tracking radar beam.

5. THE NIKE I FIRE UNIT. The fire unit of the Nike I system is the battery. The firing battery is disposed in two areas, the battery control area and the launcher control area (fig. 2). These areas are located from 1,000 to 6,000 yards apart. The minimum distance is determined by the maximum elevation tracking rate of the missile-tracking radar, and the maximum distance is determined by the maximum length of cable available to connect the battery control trailer with the launcher control trailer.

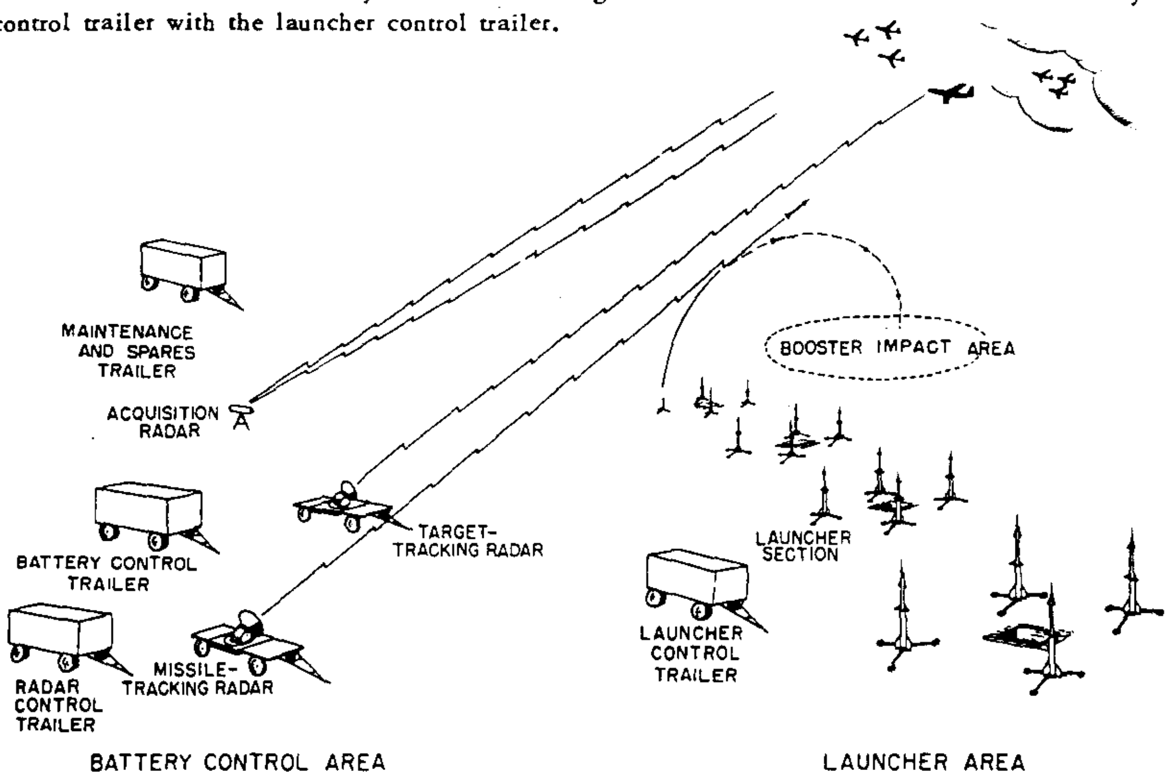
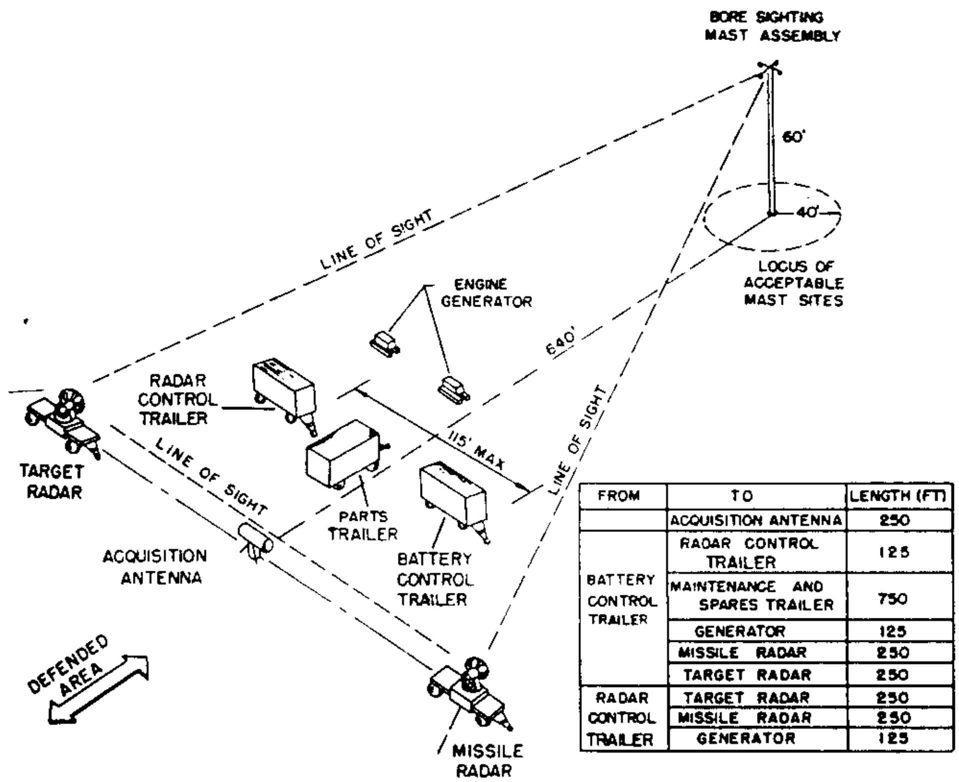


Figure 2. The Nike I fire unit.

6. BATTERY CONTROL AREA (fig. 3). The battery control area contains the acquisition radar, the target-tracking radar, the missile-tracking radar, the radar control trailer, the battery control trailer, and the maintenance and spare parts trailer.



FROM	TO	LENGTH (FT)
	ACQUISITION ANTENNA	250
BATTERY CONTROL TRAILER	RADAR CONTROL TRAILER	125
	MAINTENANCE AND SPARES TRAILER	750
	GENERATOR	125
	MISSILE RADAR	250
	TARGET RADAR	250
RADAR CONTROL TRAILER	TARGET RADAR	250
	MISSILE RADAR	250
	GENERATOR	125

Figure 3. Battery control area.

a. Acquisition radar (fig. 4). The acquisition radar provides continuous coverage of a sufficient range to permit transfer of the target to the target-tracking radar in time for the missile to be launched so it may intercept the target at maximum range. The antenna assembly is mounted on a tripod-supported drive unit. The r-f unit and modulator unit are mounted beneath the drive unit. The remainder of the set is located in the battery control trailer.

b. Target-tracking radar (fig. 5). The target-tracking radar tracks the target supplied to it by the acquisition radar and sends target present position data to the computer. The antenna assembly for this radar is mounted on a flat-bed trailer. When emplaced, the antenna is raised so that it is not supported by the trailer. The remaining equipment is mounted in the radar control trailer. The radar control trailer houses the control equipment for both the target-tracking radar and the missile-tracking radar. Both tracking radars have provisions for manual, aided-manual, and automatic tracking. However, manual and aided-manual tracking are employed in the missile-tracking radar only during test and adjustment.

c. Missile-tracking radar. The missile-tracking radar is similar to the target-tracking radar. The antenna assembly is mounted in a manner similar to that of the target-tracking radar assembly, and the remaining equipment is contained in the radar control trailer. This radar tracks a return signal transmitted by a beacon in the missile rather than a reflected signal. A communication link between the ground and the missile is provided by means of the radar beam

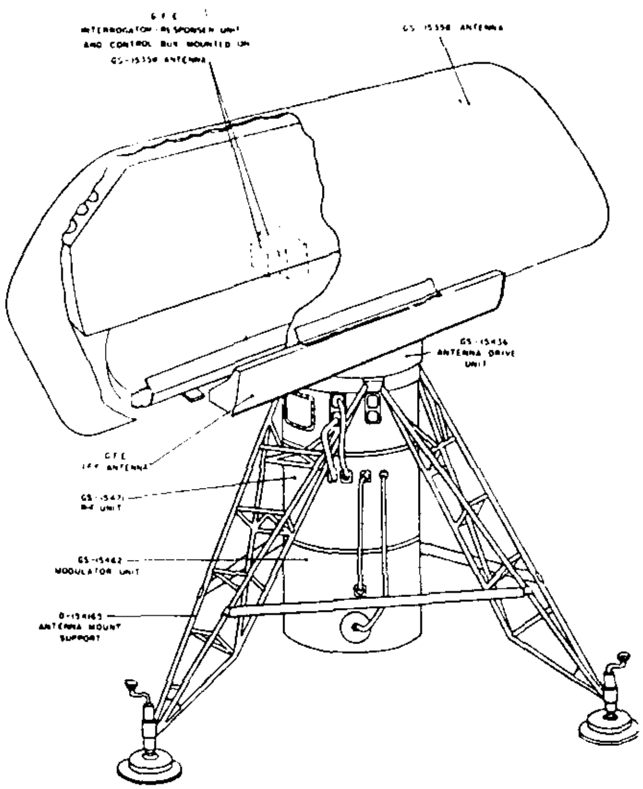


Figure 4. Acquisition antenna assembly.

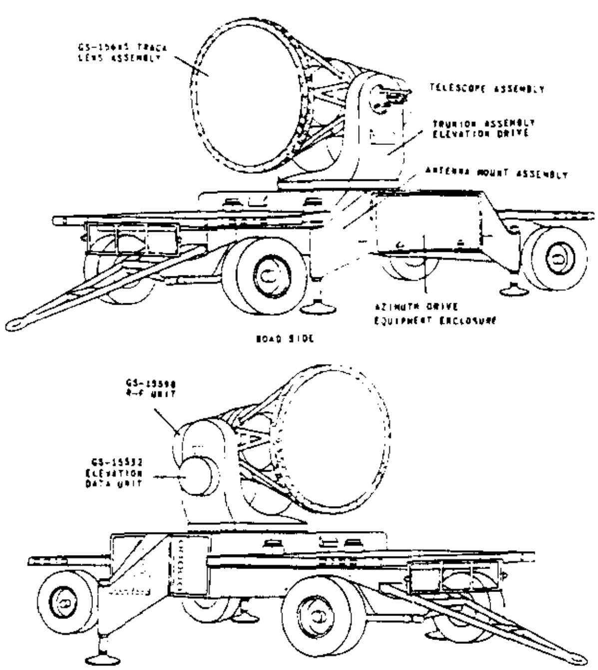


Figure 5. Tracking antenna assembly.

[redacted]

over which the steering and burst commands from the computer are transmitted. The missile-tracking radar also furnishes present position data to the computer. When tracking a missile, this radar is capable of only automatic operation. Manual control of the missile-tracking antenna is provided for test purposes only. Figure 6 shows the data flow in the fire unit.

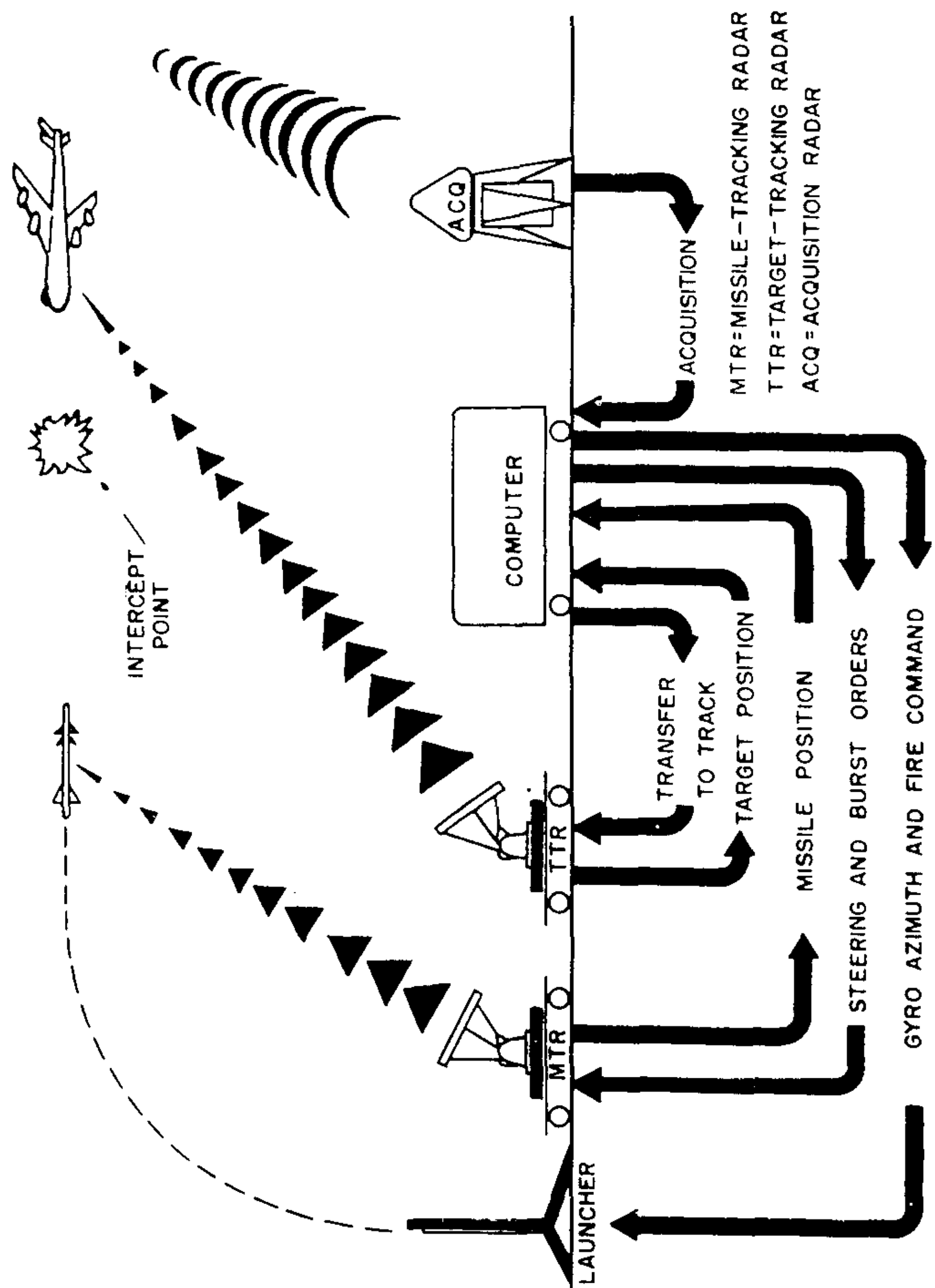


Figure 6. Data flow.

[redacted]

d. Radar control trailer (fig. 7). The radar control trailer houses the consoles which contain the controls and displays necessary for the operation of the missile-tracking and the target-tracking radars.

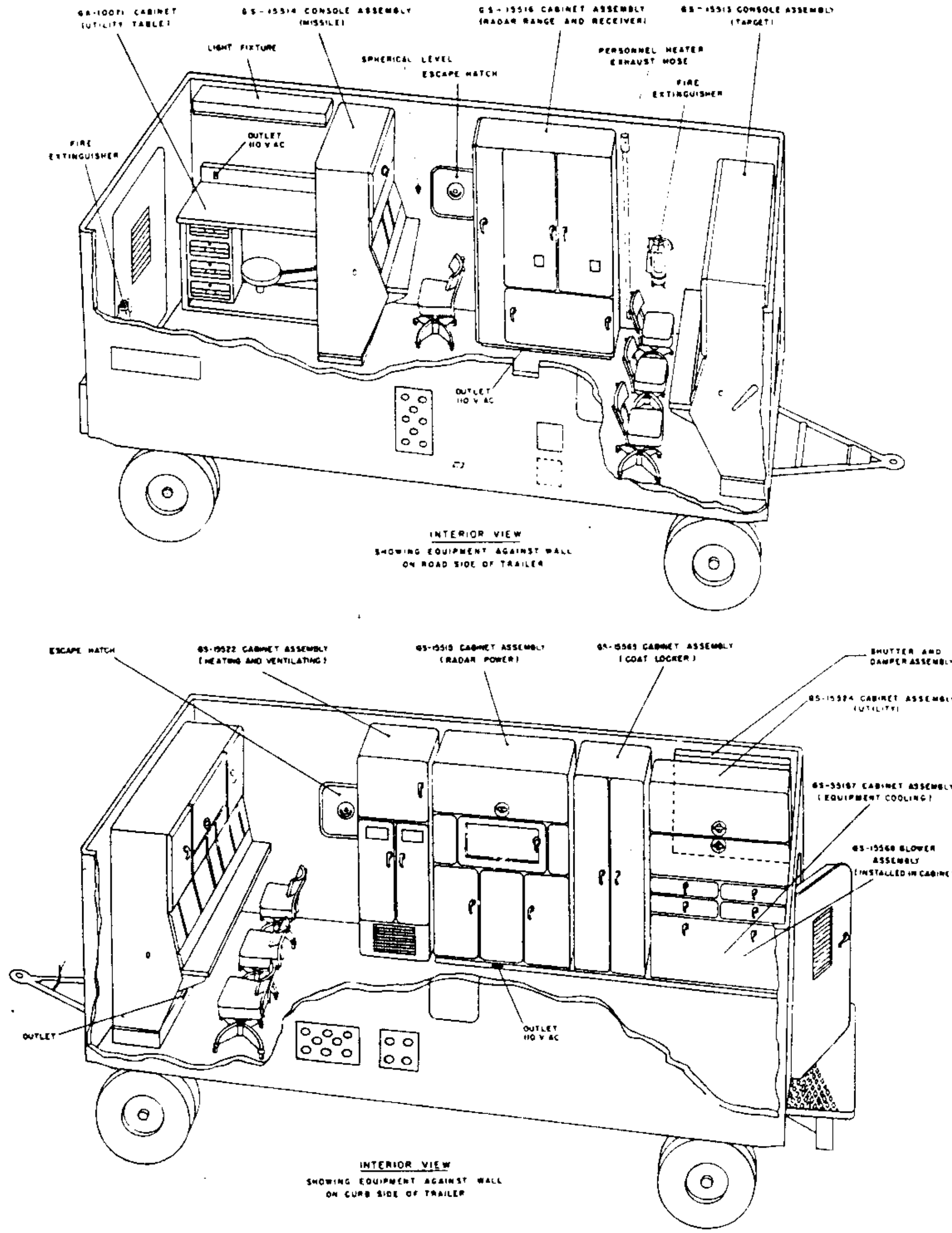


Figure 7. Radar control trailer.

e. Computer. The, computer is installed in the battery control trailer. The computer is divided according to its functional operation into three sections, the prelaunch, initial turn, and steering sections. At all times, the input information to the computer is continuous present position data obtained from the two tracking radars. The output information supplied during the prelaunch phase consists of a control order to orient the roll amount gyroscope in the missile to be fired and continuous position data to the automatic plotting boards. During the missile flight phase, steering commands are transmitted to the missile via the beam of the missile-tracking radar, and continuous information is supplied to the plotting boards. The missile burst command is automatically transmitted from the computer to the missile via the missile-tracking radar beam.

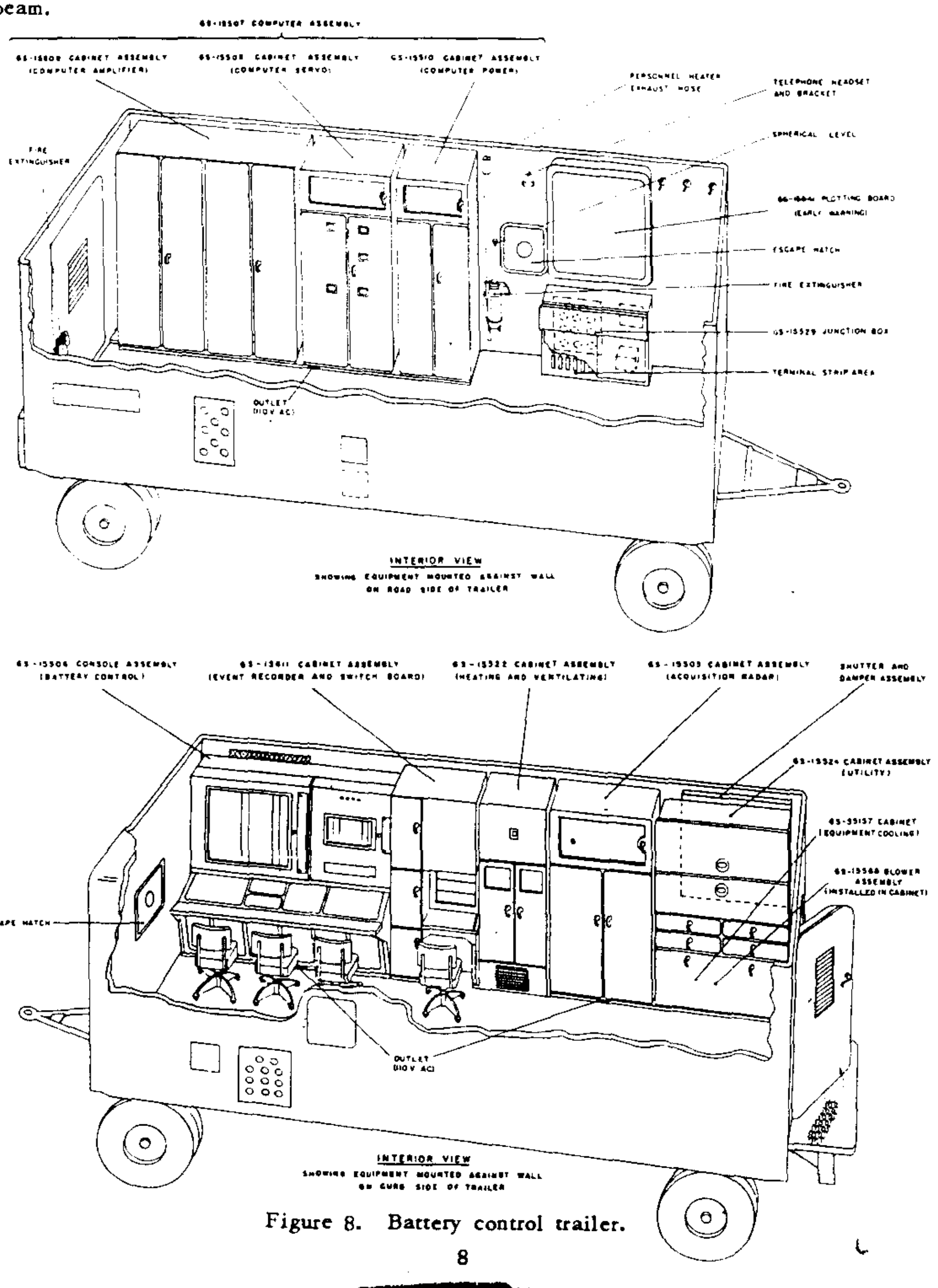


Figure 8. Battery control trailer.

[redacted]

f. Battery control trailer (fig. 8). The battery control trailer contains the acquisition radar control panel, the computer, the event recorder, an early warning plotting board, a switchboard, and the battery control console. The controls and displays necessary for the tactical operation of the battery are located in the battery control console (fig. 9). This console provides operating positions for the fire control officer, acquisition radar operator, and the computer

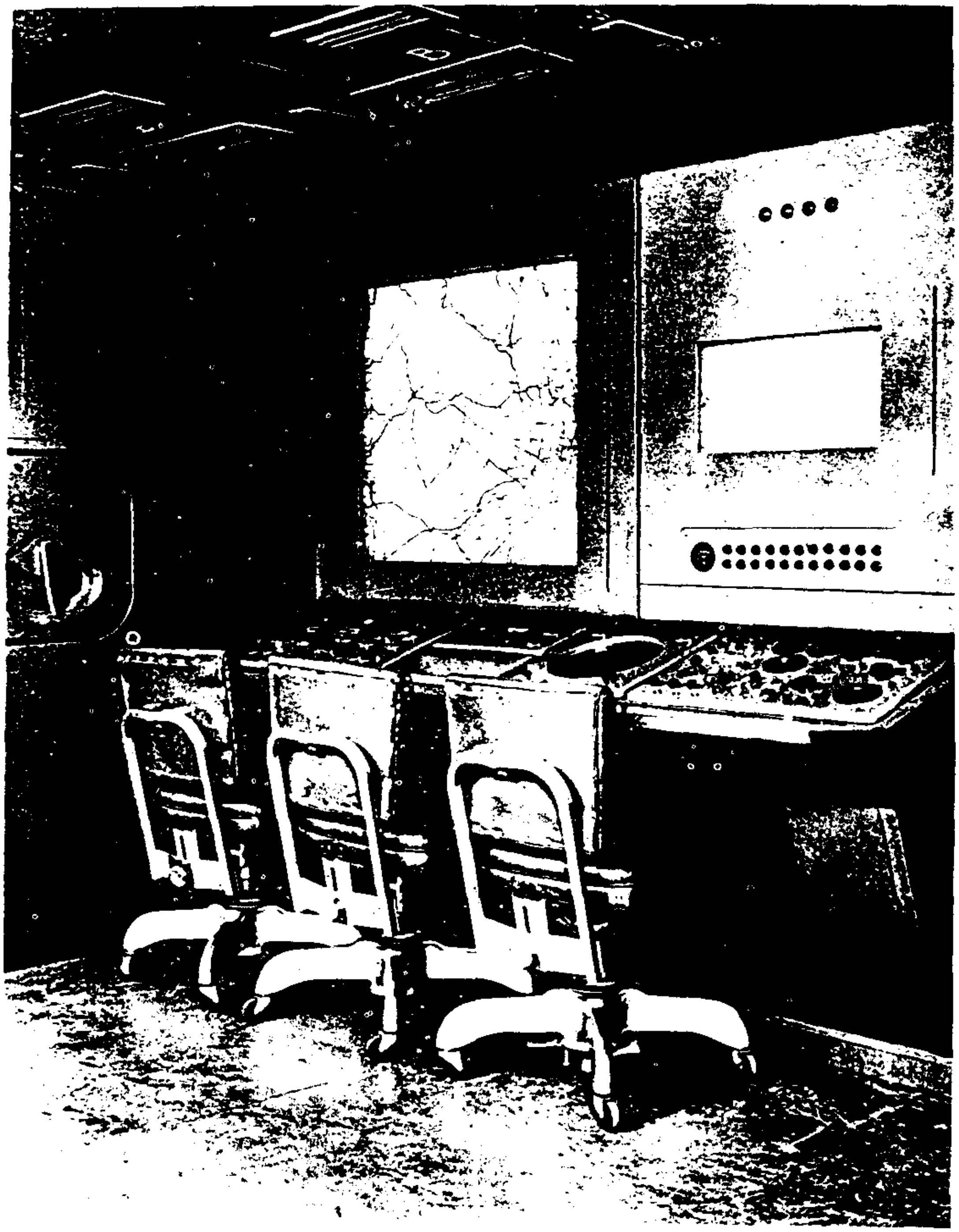


Figure 9. Battery control console panel.

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operat ... automat ... missi ... cent ... intercept plots the ... to launching the missile ... predicted time of fl...

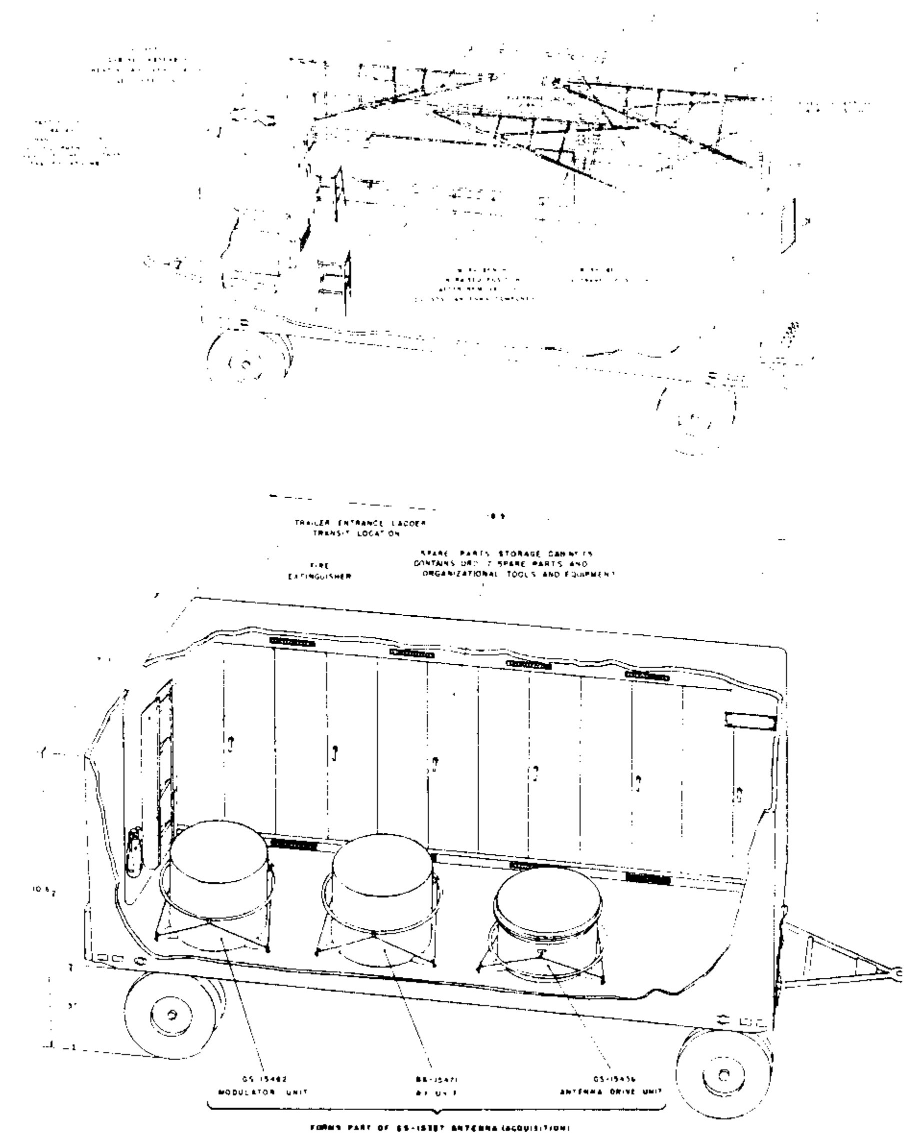

Figure 10. Maintenance and spare parts trailer.

[illegible] battery [illegible] assem[illegible]

[illegible] The launcher [illegible] area contains [illegible] and their associated equipment.

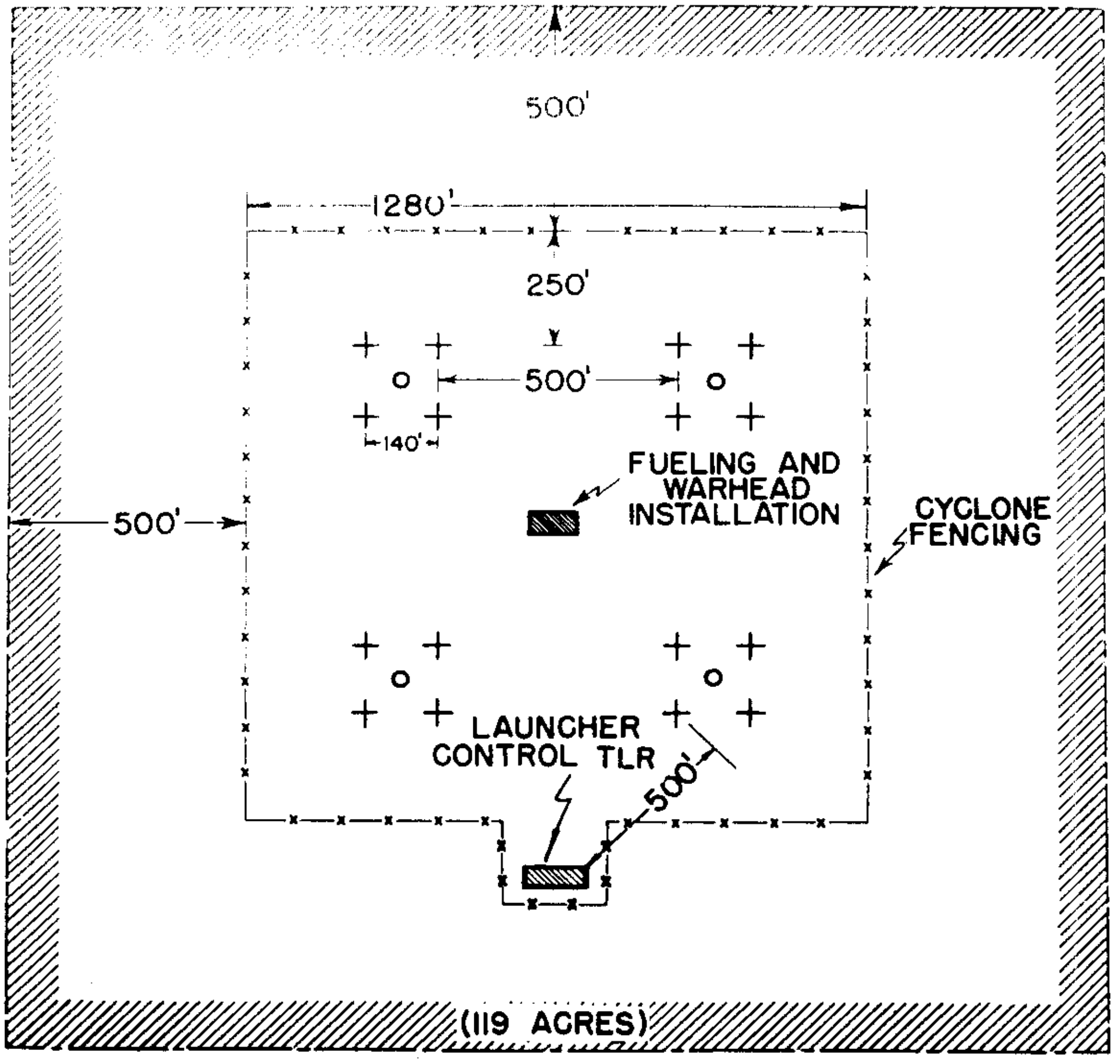

Figure 11. Launcher control area.

a. Launcher control trailer (fig. 12). The launcher control trailer functions as the control center for the four launcher sections. This trailer contains the launcher control console. The launcher control console provides the necessary switching and indicating circuits and electrical connections to the launcher section selected to fire and to the battery control console.

[redacted]

[redacted]

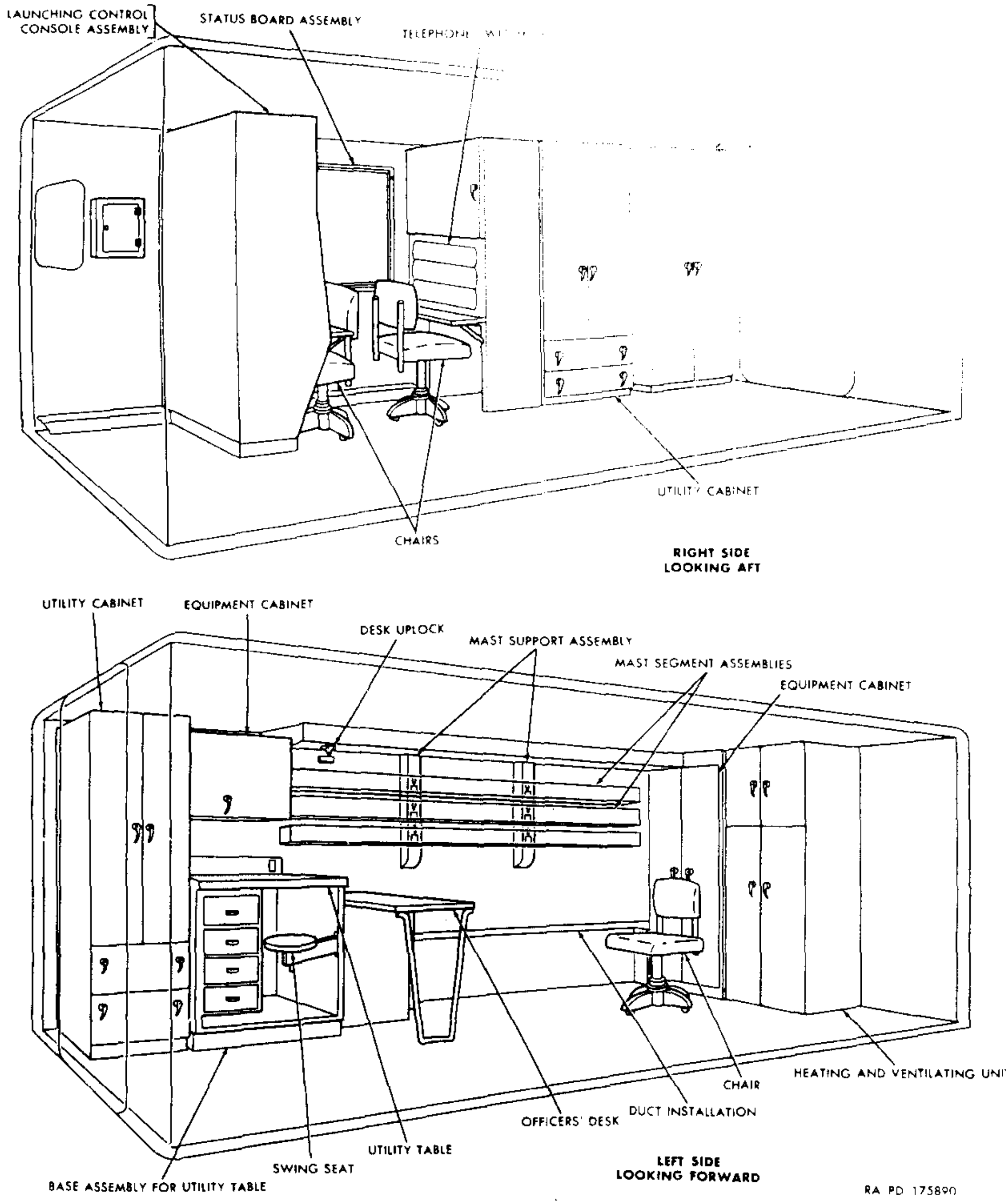

Figure 12. Launcher control trailer.

[redacted]

[redacted]

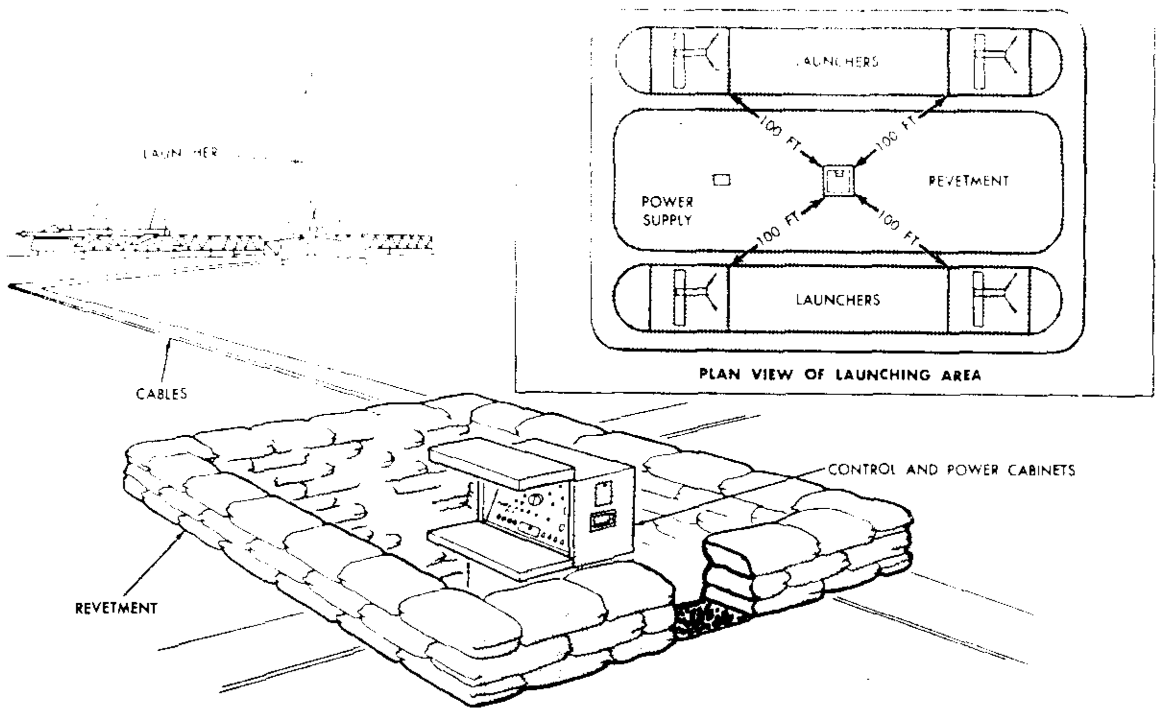

Figure 13. Launcher section, revetment top removed.

8. MISCELLANEOUS EQUIPMENT. There are a number of items of major equipment used throughout the firing battery which are not limited to use in either the battery control area or the launcher control area.

a. Transporter trailer (fig. 15). The missile and booster transporter trailer is a flat-bed trailer capable of transporting two missile-booster combinations mounted on their respective launching and transporting rails. The trailer body is mounted on coil springs that can be compressed by jacks to lower the trailer bed to the height of the loading and storage racks at the launcher.

b. Engine-driven generator. There are seven engine-driven generators in the firing battery. Two of the generators are used for power supply in the battery control area, and five are located in the launcher control area. All seven of these generators are identical. The generator set consists of a gasoline engine, an a-c generator, and the necessary controls. The power source, a watercooled gasoline engine which is directly connected to the generator by a flexible coupling, develops 69 hp at 1,714 rpm. The generator is a 30KW, 400-cycle, 3-phase alternator which produces a load voltage of 208 volts. The generator set is equipped with a gasoline heater for warming the engine and battery for cold weather starting.

[redacted]

[redacted]

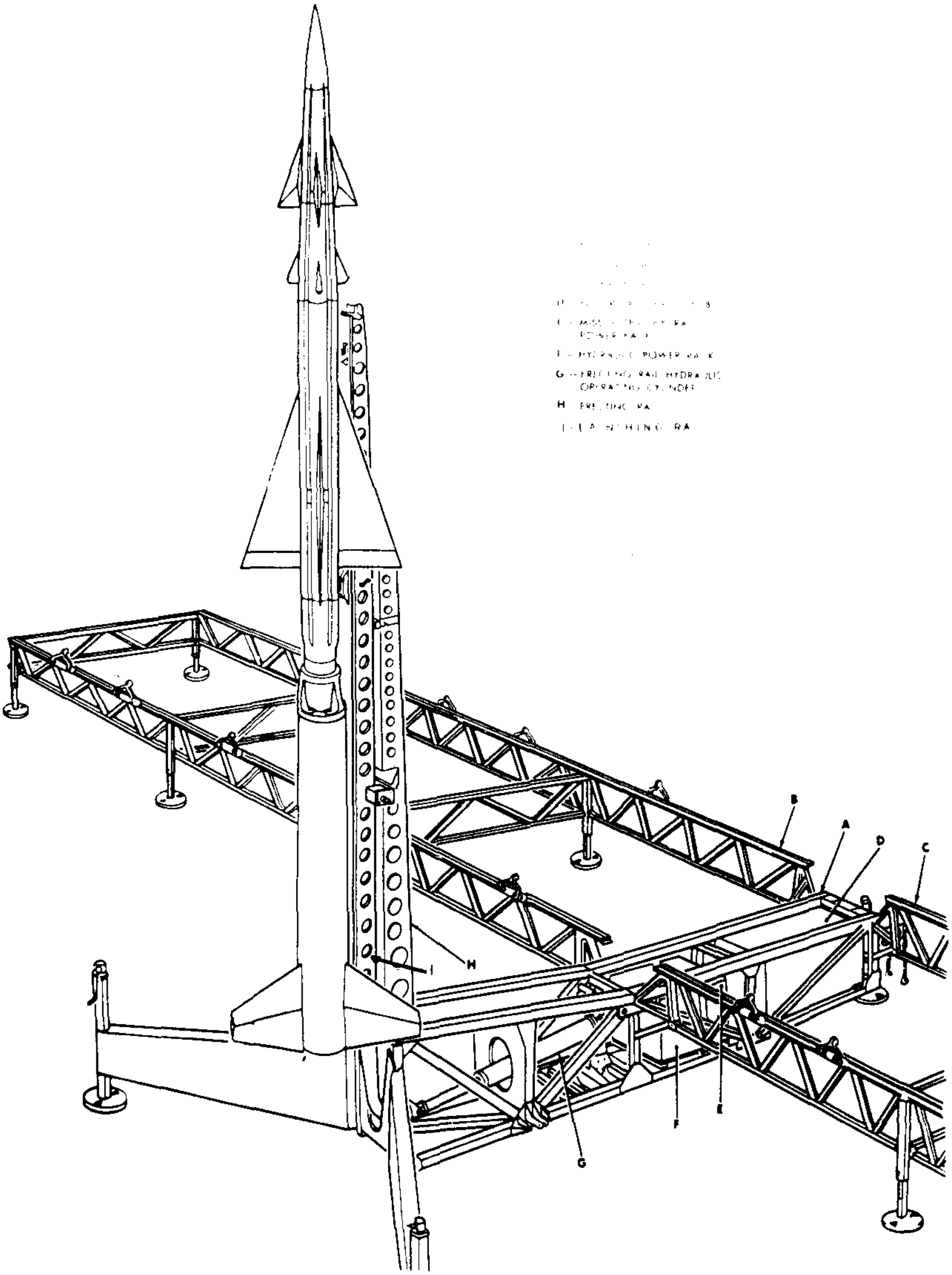

Figure 14. Nike I launcher and loading and storage racks.

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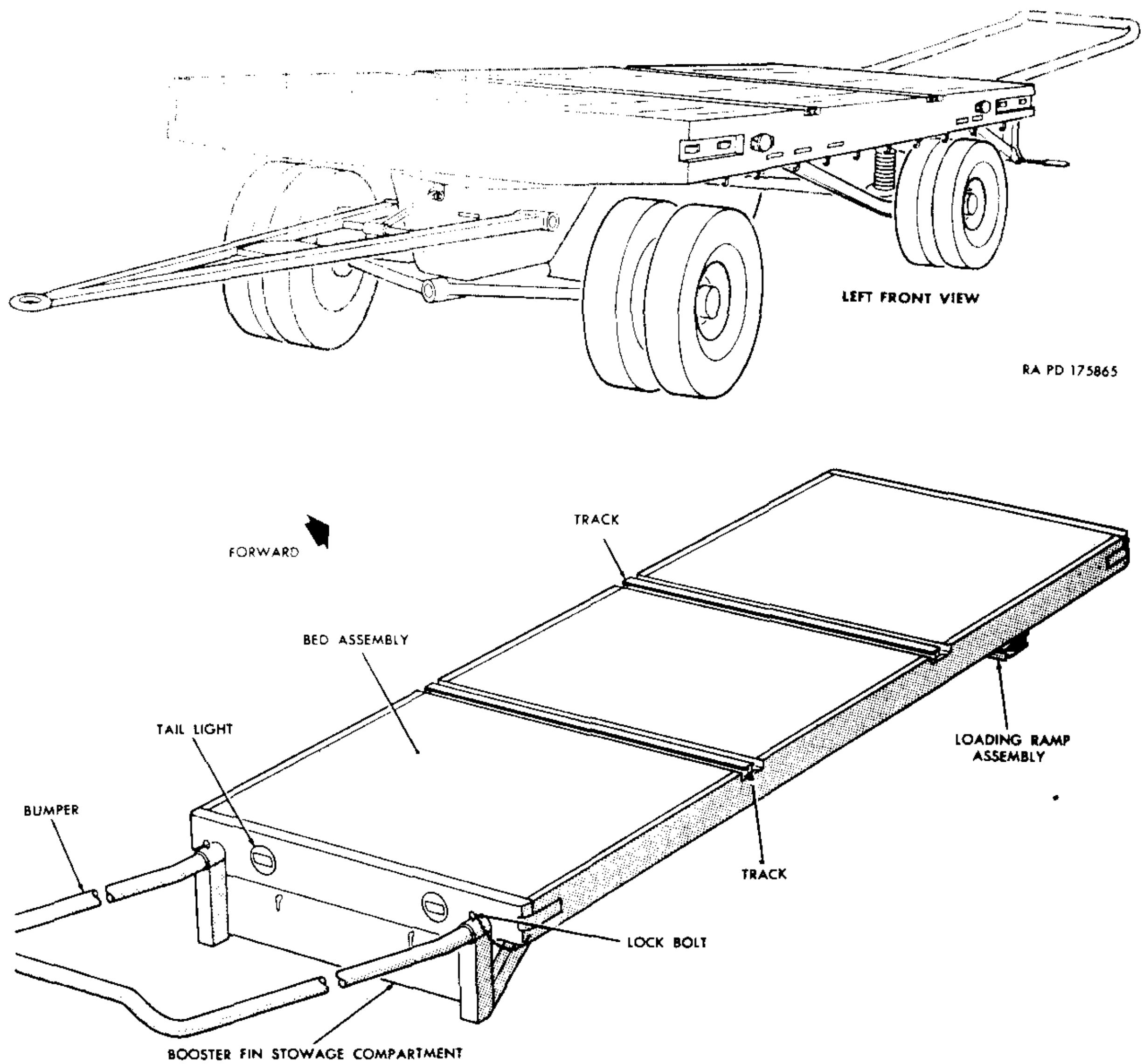

Figure 15. Transporter trailer.

[redacted]

system ... flexible ...
The ...
handling and installation.

9. GENERAL DESC... pencil-shaped body wh... tion. The body of the missile ... drical center body section ... in the extreme aft end of the body ... systems. These components are the propulsion system ... system, and the warhead system.

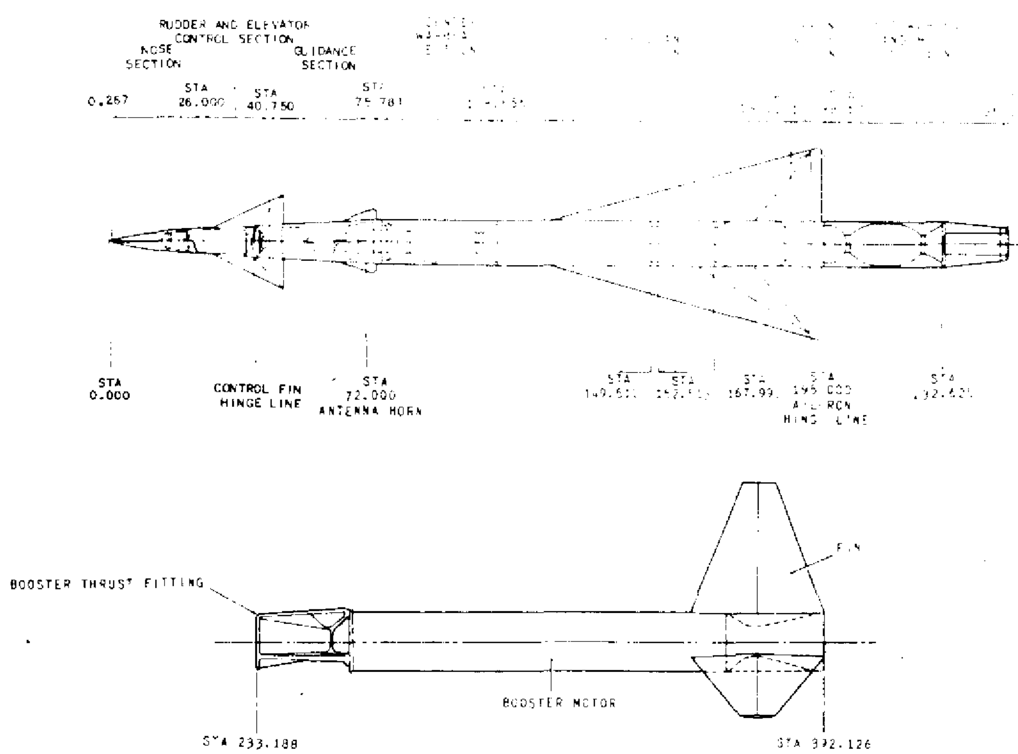

Figure 16. Missile-booster assembly.

[redacted]

[illegible] seconds

[illegible] the guida[illegible] with steering [illegible] of the missile ser[illegible] these comman[illegible] Secondly, it transmit[illegible] energy reflected from [illegible] tracking. The guidance section [illegible] phase of the missile's flight lasts approxi[illegible] essentially in free flight and receives no [illegible] equipment or attitude commands from the roll [illegible] connected to the control system, and [illegible] pointed toward the predicted point of inter[illegible] are allowed for the missile to roll stabilize. Approximately five [illegible] ground control equipment sends a 7g dive command to the missile. [illegible] the missile assumes an on-course trajectory toward the predicted point of intercept.

[illegible] *The hydraulic system.* The hydraulic system is used to amplify the commands produced by the guidance system and to furnish power to move the control surfaces. The major components of the hydraulic system are the hydraulic air tank, the air tank and power plug valve assembly, the accumulator, the air pressure regulator, the transfer valves, the steering control mechanism, and the aileron control mechanism. When the system is activated by pulling the the arming lanyard, air flows from the air tank through the hydraulic air tank and power plug valve assembly, through the pressure regulator valve, and into the accumulator. Oil is then forced out of the accumulator, through the transfer valves, to the hydraulic cylinders in the steering control and aileron control mechanism. By means of mechanical linkages, a linear deflection of these hydraulic cylinders is transformed into an angular deflection of the steering fins or ailerons. The transfer valves are controlled by outputs of the guidance unit. These valves control the direction and the amount of movement of the hydraulic cylinders which in turn control the operation of the control surfaces. The hydraulic system is an open system in which the used hydraulic oil is dumped overboard.

d. The warhead system. The warhead system is used to produce a destructive burst pattern. This system is divided into three parts, the nose, center, and aft warheads. The total weight of the warheads is 310 pounds, roughly one-quarter of the missile weight. The warheads are detonated on command from the ground control equipment, except when detonated by the fail-safe circuit. Detonation by the fail-safe circuit occurs when contact with the missile-tracking radar is lost for approximately 6 seconds. To detonate the warheads, a squib in the arming device is fired by an electrical impulse from the guidance unit. The squib then initiates a primacord harness which in turn detonates the warheads. The missile is armed only after booster acceleration initiates an arming sequence. A timing device which runs for approximately 4 seconds insures a minimum time of flight after reaching the required acceleration to complete the arming sequence. This insures that the warhead will remain unarmed until the missile safely clears the launching area.

10. THE NIKE I BOOSTER (fig. 16). The Nike I booster consists of a single jato unit which develops an average thrust of approximately 49,000 pounds for 3 seconds at 77° F. It is classed as an unrestricted-burning rocket since the powder grain is of such shape that it offers a large internal burning surface. This provides a high thrust of a short duration. The assembled booster weighs 1,198 pounds loaded, is approximately 11½ feet long, and 16 inches in diameter.

[redacted]

[redacted]

Section II. [illegible]

11. TARGET CHARACTERISTICS. [illegible] enemy aircraft and missiles traveling up to [illegible] and at slant ranges out to 50,000 yards.

12. FLIGHT CHARACTERISTICS. [illegible] 1.2 to 2.8. The missile is capable of executing a [illegible]

13. LIMITATIONS OF THE SYSTEM. *a. Operating* [illegible] limitations of the system is the surrounding air temperatures [illegible] will operate satisfactorily. This temperature range is from [illegible] motor of the missile and from 0° F to 120° F for the booster.

b. Limits of operation. The launcher-centered dead zone [illegible] in figure 17. This dead zone results from the requirements of initial boost, separation of booster and missile, missile roll stabilization, and the limiting 7g turn required to turn the missile's course toward the target.

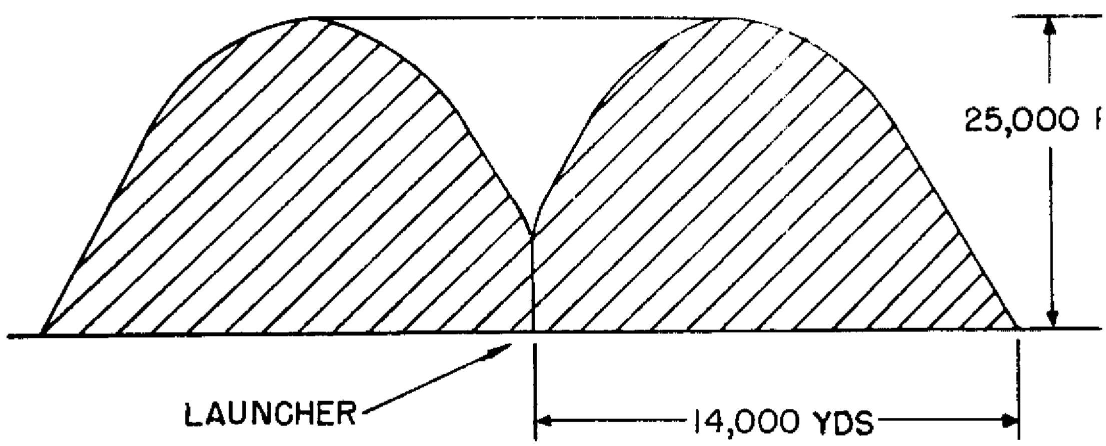

Figure 17. Nike I dead zone.

(1) Target-tracking radar. The target-tracking radar will track a jet bomber of t B-47 type at a maximum range of approximately 100,000 yards. The maxim tracking rates are 750 mils per second in azimuth, 750 mils per second elevation, and 1,000 yards per second in range. These tracking rates enal the tracking system to follow 1,100-knot targets flying a crossing course a minimum ground range of 1,000 yards. The slew rates are the same as maximum tracking rates except that the range slew rate is 12,000 yards second. The radar will operate throughout 360° in azimuth and from –90 +1,600 mils in elevation.

(2) Missile-tracking radar. The missile-tracking radar tracking the miss beacon signal will track the missile to a slant range of approximately 50,0 yards. The missile-tracking radar must be emplaced at least 1,000 yards fr the launcher so that the radar's vertical tracking rate will not be exceed during the boost phase.

(3) Computer. Table I shows the input capabilities of the Nike I comput

[redacted]

[illegible]	[illegible] yards [illegible] yards
[illegible]	Unlimited
TARGET RADAR ELEVATION	-90 to +1,600 mils
PARALLAX (in each rectangular coordinate) RADAR TO LAUNCHER RADAR TO RADAR	 0 to 6,000 yards -165 to +165 yards
VELOCITY (in each rectangular coordinate) TARGET CLOSING	 0 to 600 yards per second 0 to 1,400 yards per second
TIME TO INTERCEPT	0 to 100 seconds

d. Booster impact area. The booster impact problem limits the areas suitable for the Nike I fire unit emplacement. Development of a self-destroying booster will eliminate this problem. Figure 18 shows a diagram of a booster impact area in relation to the launcher section.

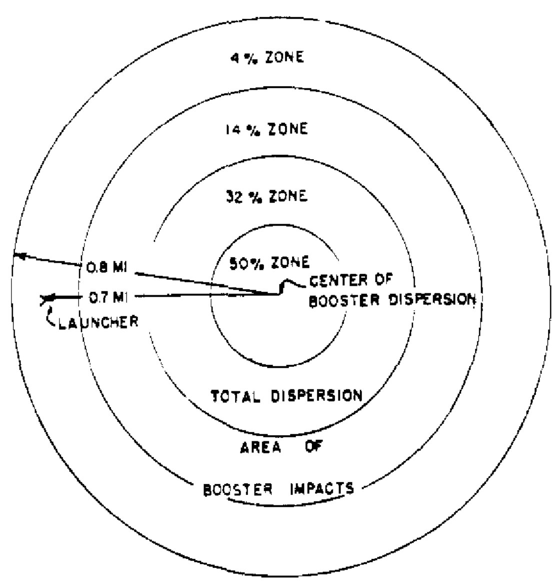

Figure 18. Booster impact area.

[redacted]

14. FIRE DIRECTION COMM[illegible] [illegible] tion will normally be the operationa[illegible] [illegible] AA defense commander controls op[illegible] [illegible] 19 shows the necessary elements in [illegible] [illegible] required in AAA may be found in FM [illegible]

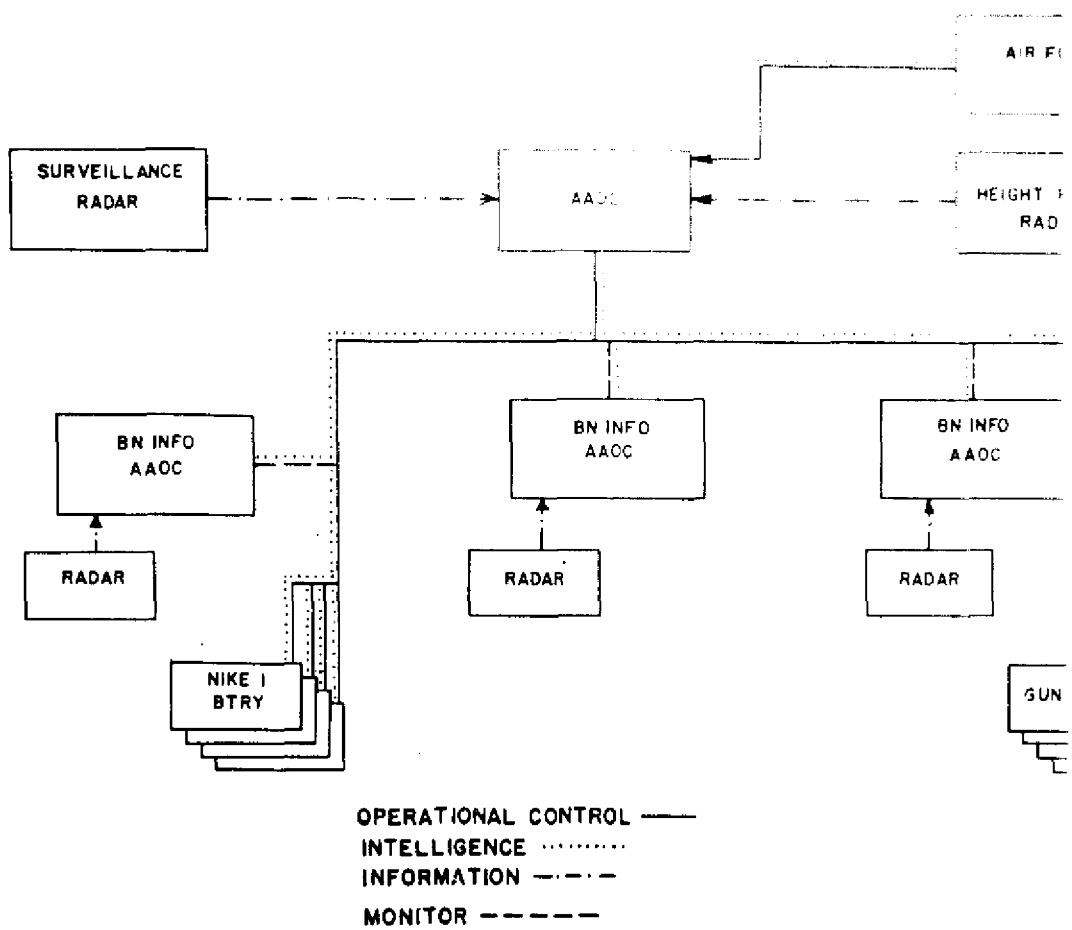

Figure 19. Organization for fire direction.

15. RADIOS USED IN A NIKE I BATTALION. Figure 20 shows the radio nets fo I battalion. Appendix V shows a list of the radios organic to the Nike I battalion characteristics.

Section II. BATTALION AND BATTERY COMMUNICATIONS

16. COMMUNICATIONS FOR THE BATTALION. *a. Wire.* Commercial wire com tion facilities will be used in the zone of the interior except for those facilities re the immediate local unit area. The following local lines are required (fig. 21).

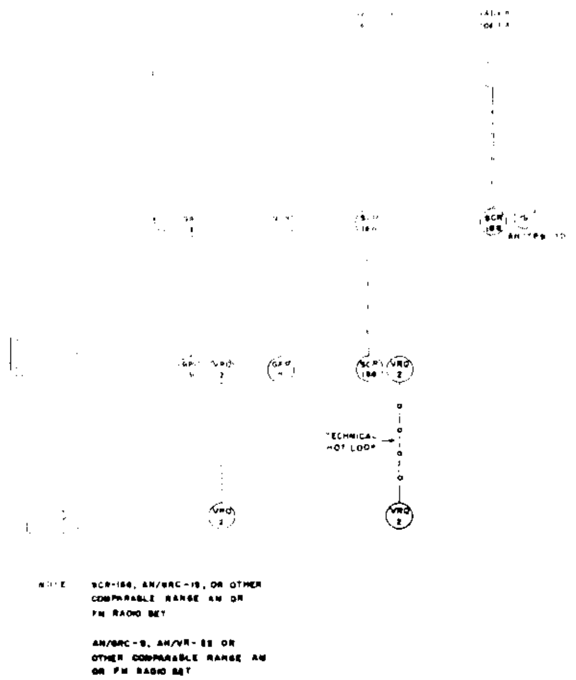

Figure 20. Battalion radio net.

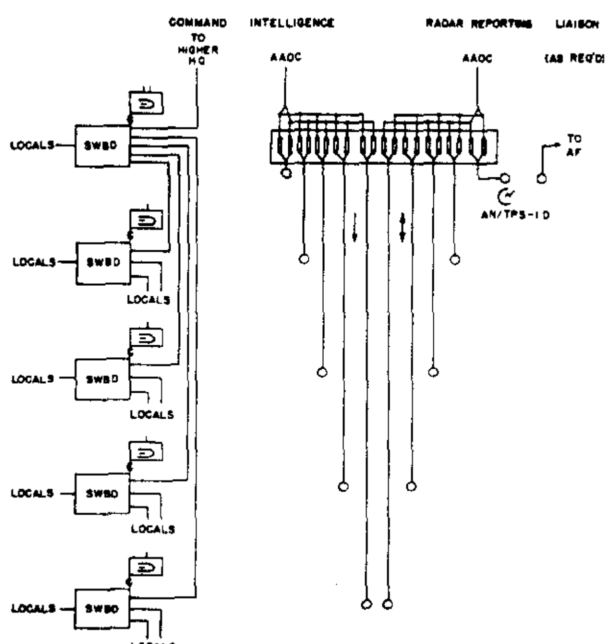

Figure 21. Battalion wire communication net.

(1) Two command and administration lines (commercial) from group to battalion.

(2) One command and administration line (commercial) from battalion to each battery in the battalion.

(3) A hot loop equipped with headsets at both ends is required from the battalion surveillance radar to AAOC for radar reporting. Depending on the number of battalions (and hence surveillance radars) in a given defense and the nature of the terrain, it may be necessary to run additional hot loops equipped with headsets from the AAOC to selected battery acquisition radars to insure adequate radar coverage and reporting 24 hours a day.

(4) Two hot loops, each equipped with a headset at each station, are required from the AAOC to the battalion CP and paralleled to each battery. One of these hot loops is used for intelligence broadcasts and the other for operational control.

(5) One loop is required from the battalion CP to the battalion missile assembly area. Since the battalion command post will likely be placed in an available building, while the assembly area must be remotely located for safety reasons, this probably will be a commercial line.

(6) One loop is required from the battalion CP to the battalion ready missile area. It is likely that the ready missile storage area will be separate from the assembly area due to both safety and space requirements.

(7) Land availability may restrict both the missile assembly and storage areas. Although assumed here that only one each will be used it is possible that a number of smaller areas will be employed. In such cases a separate loop to each is required.

b. Radio. Failure of the lengthy wire communications due to sabotage, bomb damage, accidents, or power failure must be expected, and radio must be supplied to insure continued operation when needed. The battalion radio net shown in figure 20 parallels the battalion wire net shown in figure 21 with the following exceptions:

(1) Only one command channel is provided between group and battalion.

(2) Since missile resupply is not contemplated during a raid and sufficient missiles are stored within each battery area, radio links are not provided from battalion to the missile assembly and storage areas.

17. COMMUNICATIONS FOR THE BATTERY (figs. 22 and 23). The communications plan for the Nike I battery consists of the following:

a. A telephone system using SB-22D switchboards in both the battery control trailer and the launcher control trailer.

b. Hot loops which are automatically established when the alert signal is given. These automatically provide a command hot loop and a technical hot loop without action by the switchboard operators.

c. Four local loudspeaker intercommunication systems, with five stations each, located at the launcher sections.

d. Two emergency radio channels which can be switched manually into the respective command and technical hot loops when both the field wire and cable voice channels fail.

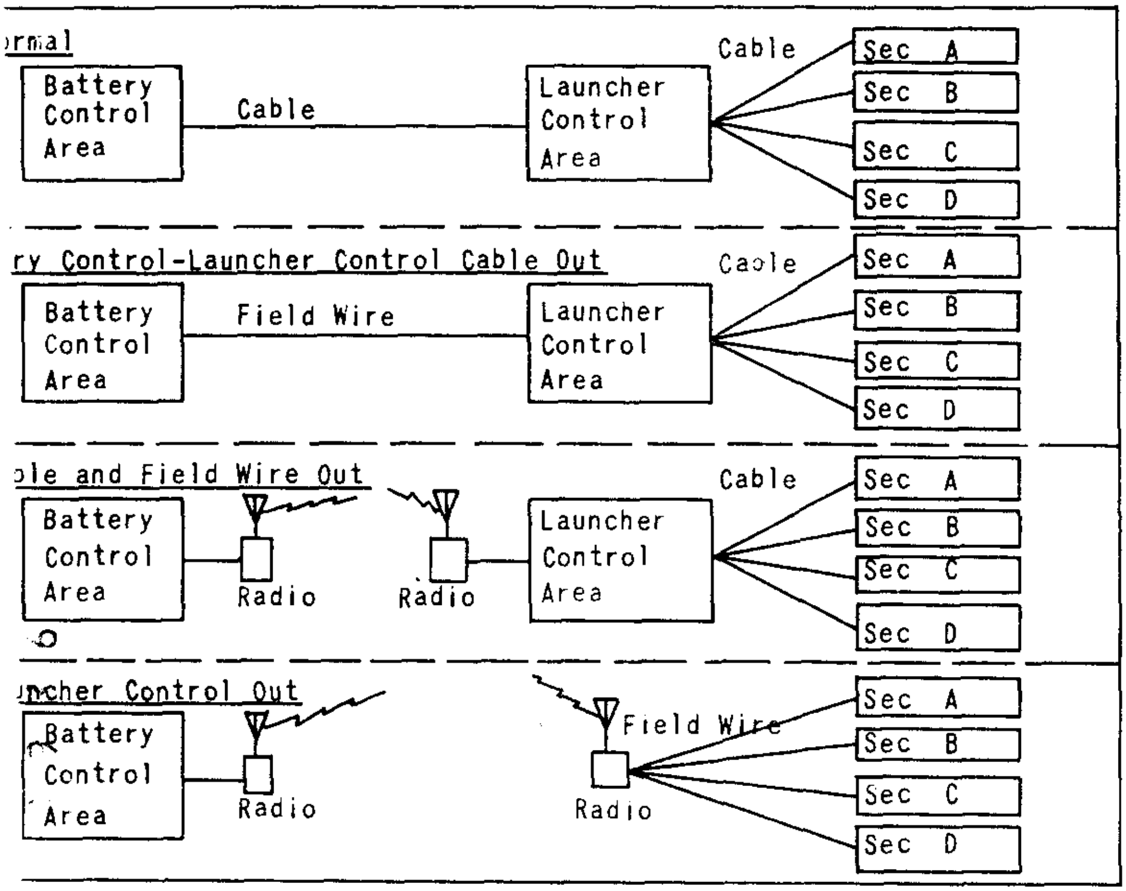

Figure 22. Hot loops under various conditions of operation.

18. BATTERY CONTROL SWITCHBOARD. The battery control switchboard is located battery control trailer (fig.8) and has provision for 29 lines.

a. Two groups of telephone trunks connect the battery control and launcher control . Two physicals and a phantom are located in a cable. Three pairs of field wires are laid a different route than that taken by the cable to form the other group.

b. Five lines go to stations from within the battery, normally unattended.

(1) The three antenna locations (3 lines).

(2) The maintenance and spare parts trailer (1 line).

(3) The two power units (1 line).

c. Four lines go to stations in the battery control trailer.

(1) Fire control officer.

(2) Computer operator.

(3) Early warning plotting board operator.

(4) Acquisition operator.

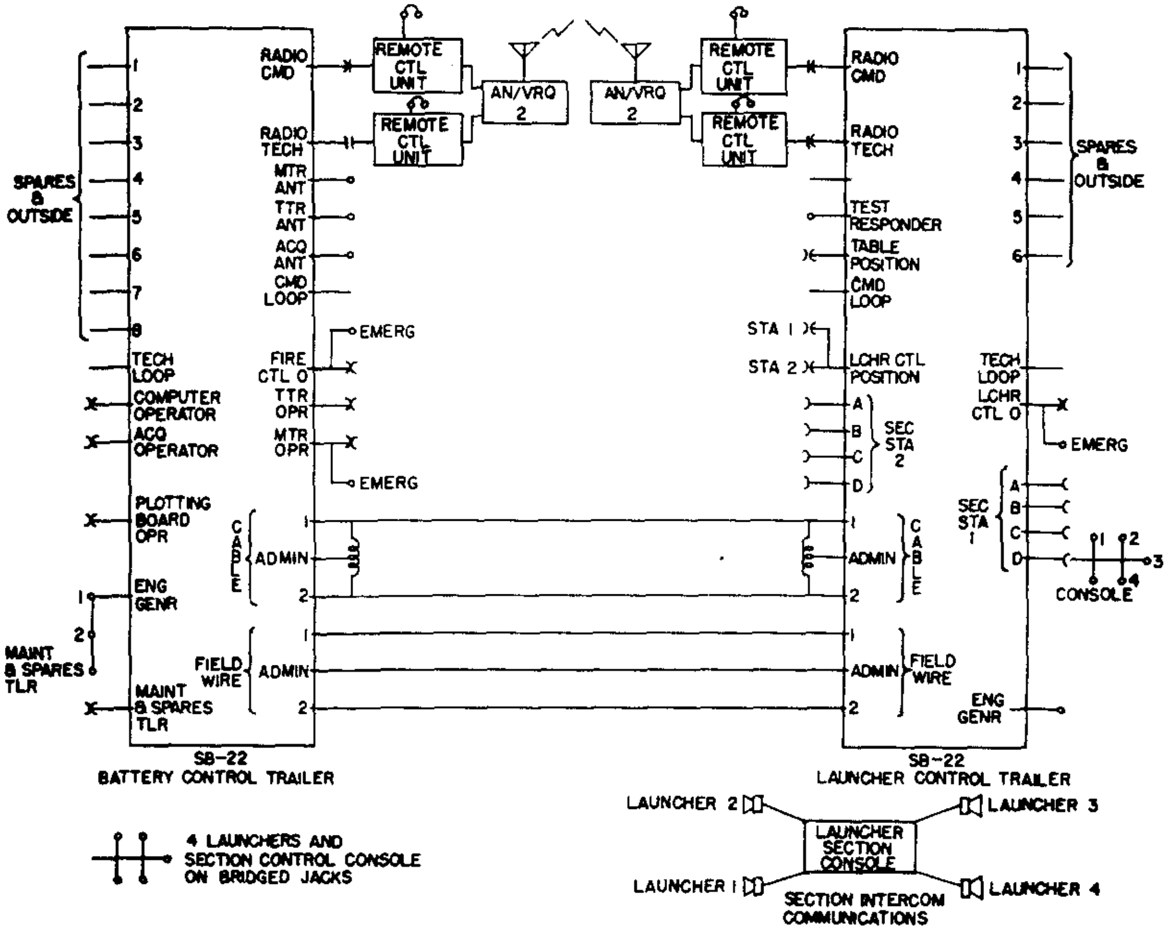

Figure 23. Nike I voice communication system.

d. Two lines go to stations in the radar control trailer.

(1) Missile-tracking radar operator.

(2) Target-tracking radar operators.

e. Two lines lead from hot loop jacks, one for the command and one for the technical hot loops.

f. Two lines make up the radio technical loop and radio command loop.

g. Eight lines are used for communications outside of the battery and spares.

(1) Intelligence (from AAOC).

(2) Operational control (from AAOC).

(3) Command and administration (from battalion).

(4) Five spares.

19. LAUNCHER CONTROL SWITCHBOARD. The launcher control area switchboard is located in the launcher control trailer (fig. 12) and has provision for 29 lines.

a. Six lines are used for interswitchboard trunks, the same as for the battery control switchboard.

b. Two lines go to unattended stations, the engine-driven generator set for the her control trailer and the test responder.

c. Eight lines serve two fixed EE-8 stations with headsets for each of four launcher ons. At each section, on one of the stations, jack multiples are provided to permit the use portable EE-8 set when necessary.

d. Three lines go to stations in the launcher control trailer.

(1) Launcher control officer.

(2) Two bridged launcher control console stations on one line.

(3) Utility table station.

e. Two lines form the radio technical loop and radio command loop.

f. Two lines lead from hot loop jacks, one for the command and one for the technical ops.

g. Six lines are use for communications outside of the battery as required and spares.

9. EMERGENCY JACKS. Emergency jacks to plug in EE-8 sets are provided in the y control, radar, and launcher control trailers. These jacks interconnect the fire control , missile-tracking radar operator, and launcher control officer.

I. HOT LOOPS (fig. 22). The hot loops are the command and technical hot loops. They tomatically activated when the yellow alert signal is given. Normally the hot loops func- n the two cable circuits, but two-way switching keys are provided at the battery and er control trailers for manually switching the hot loops from the cable to two of the field ircuits when the cable is disabled. These same keys can be used to switch the hot loops emergency radio channels.

a. Command hot loop (4 automatic and 3 by key or jack, a total of 7 stations).

(1) At the trailers of the battery control area, the stations provided for are:

(a) The fire control officer.

(b) The target-tracking radar operator.

(c) Missile-tracking radar operator under the control of a key (this station is normally on the technical hot loop).

(d) Switchboard jack for an emergency station, if required.

(2) At the launcher control area end of the hot loop the following stations are provided:

(a) Launcher control.

(b) Launcher section (A, B, C, or D depending on which section has been selected to fire).

(c) Switchboard jack for an emergency station when desired.

b. Technical hot loop (5 automatic and 5 by key or jack, a total of 10 stations). The technical hot loop is used to conduct tests involving the launching control section and a computer or radar operator.

(1) The stations on the technical hot loop in the trailers of the battery control are as follows:

(a) Computer operator.

(b) Acquisition operator (by operation of a key).

(c) Missile-tracking radar operator (when not connected to the command hot loop).

(d) Switchboard jack for emergency station.

(2) The following stations are on the technical hot loop in the launcher control area:

(a) Four stations, one each at launcher sections A, B, C, and D.

(b) Launcher control officer under control of a key (this officer is normally connected to a switchboard termination).

(c) Switchboard jack for emergency station.

22. LOUDSPEAKER INTERCOMMUNICATION SYSTEMS (fig. 23). Each of the four local loudspeaker intercommunication systems, one at each launcher section, provides five stations. There is one station at the section revetment and one at each of the four launchers. On the section control cabinet in the section revetment, a separate loudspeaker and microphone are furnished. There is one key for each of the launchers to permit two-way speech with each launcher individually. This key also makes it possible to exclude unusually noisy stations. The TALK-LISTEN switch in the NORMAL position allows listening to the preselected stations and in position 1 allows talking to all the stations. All stations are turned off during launch. Each of the launchers has a combination loudspeaker and microphone.

23. RADIO CHANNELS. Two radio channels (requiring four radios) provide radio communication between the launcher control area and the battery control area. The radios make possible continued operation of the battery in the event of the loss of all wire communication between the battery control and launcher control areas. The operation of the command and technical hot loops will be retained during radio operation. All hot loop stations will be manned during radio operation, and similar operating techniques can be used for both wire and radio operations.

24. RADIO NET. The radio net provides two radio channels (command and technical hot loops), retains all the hot loop stations during radio operation (one radio remote control unit telephone station at each radio will be added), and provides an emergency field-wire network from the launcher control area radios to the launcher sections for use in event the launcher control trailer is destroyed.

25. EMERGENCY FIELD WIRE NETWORK. If the launcher control trailer or its communication facilities are destroyed, a simple emergency field wire network provided between the radio sets in the launcher control area and the launcher sections may be used. In the launcher area, to transfer the radio system from the normal wire facilities to the emergency field-wire network, a keying arrangement (for both the command and technical hot loops) is provided at the radio location and at each of the four launcher sections. The regular built-in EE-8 telephone sets at the launcher sections will be used while operating on the emergency field-wire network.

CHAPTER 4

SITING REQUIREMENTS

Section I. THE LAUNCHING BATTERY SITE

26. GENERAL. From the nature of the Nike I system, the reconnaissance, selection, d occupation of position will be a deliberate undertaking. The difficulty of finding suitable es in populous areas, the large areas and engineering support required, the necessity for adequate road net, the line-of-site requirements, the need for suitable cable routes between fire unit control areas, the requirements for a booster impact area, and the tactical requirents of the site all contribute to the necessity for a well-planned and deliberate RSOP. Due to minimum distance required between the launcher and the missile-tracking radar (1,000 yards), firing battery will be divided into two areas, the battery control area and the launcher control a (fig. 2).

27. BATTERY CONTROL AREA. A minimum of eight acres is required for each battery ntrol area solely for the emplacement of the tactical equipment. This does not include the a required for personnel housing.

a. Technical requirements. The technical requirements for this area include: imum radar mask; accurate bore sighting and orienting; maintenance of the required level curacy; and a radar line of sight between the missile tracking radar, its test responder, and h launcher.

(1) The acquisition radar antenna and the target-tracking radar antennas must have no mask above one degree of elevation throughout the field of fire. The missile-tracking radar antenna must have a clear line of sight to all launchers and no mask above three degrees of elevation throughout the field of fire.

(2) For accurate bore sighting and orienting, the relative positioning of the target-tracking radar, the missile-tracking radar, and the bore sighting mast must be that shown in figure 3. There must be a line of sight from the missile-tracking radar to the target-tracking radar. The region between each tracking radar antenna and the bore sighting mast must be clear of obstructions within a ten-degree cone, the apex of which is located at the radar antenna and the center line of which is the line of sight between the antenna and the bore sighting target on top of the bore sighting mast. Obstructions appearing at greater range from the antennas than the bore sighting mast need not be considered.

(3) To maintain the required accuracy of leveling of the two tracking radar antennas requires that suitable foundations be provided for the three jack-pads of each antenna assembly. When the antennas are emplaced on earth, the foundations should be prepared by the contractor-recommended, earth-compacting techniques described in appendix II. When a site is for semi-permanent occupancy, concrete footings which extend well below the frost line and otherwise meet good construction practices should be provided. If the tracking antennas are to be emplaced on structures of any kind, the platform provided must be such as to insure no deviation in level greater than 0.07 mil during any 24-hour period.

b. Operational requirements. Operational requirements include those of limiting cable lengths, access roads, and digging in of trailers in the battery control area when necessary to avoid masking the tracking radars.

(1) The two engine generators, the battery control trailer, and the radar control trailer must be emplaced in the vicinity of the radar antennas and within the cable lengths provided (fig. 3).

(2) An all-weather access road will be required from the nearest public road to the battery control area.

(3) Within the battery control area, suitable connecting roads and footpaths will be required to all major items of equipment.

(4) Suitable hardstands will be required for emplacement of all van-type trailers, generators, and radar antenna flat-bed trailers in the battery control area.

(5) A 400-cycle converter of 60-kilowatt output capacity should be provided at the battery control area to furnish operating power during training, testing, and standby periods. Its use will reduce the wear and decrease maintenance required on the engine-driven generator sets.

(5) Fire control and communication cables used in the battery control area should either be buried or elevated for their protection. Elevation is preferable to facilitate repair and recovery.

c. General requirements. The following general requirements should be met in the battery control area.

(1) The most desirable location for the maintenance and spare parts trailer is at a point convenient to both the radar control trailer and the battery control trailer. When it is practicable, the maintenance and spare parts trailer may be emplaced within ten feet of the base of the bore-sighting mast so that the radar r-f test set can be operated from within the trailer. When the terrain does not allow siting the maintenance and spare parts trailer adjacent to the bore sighting mast, the radar r-f test set should be emplaced in the foot of the mast and such cover provided as is considered necessary for minimum operator comfort.

(2) Commercial electric power facilities are desired in the battery control area to provide for normal administrative operation in addition to the requirements stated in paragraph b(5) above.

(3) Housing for personnel should be provided in the vicinity of the battery control area to insure the maximum utilization of maintenance personnel and the ready availability of operating crews.

(4) The battery control area must be inclosed by a suitable fence so that a maximum of security is obtained with the minimum personnel.

28. LAUNCHER CONTROL AREA (fig. 11). A minimum of 119 acres is required for the TO&E launcher control area. This does not include the areas necessary for personnel housing or the booster impact areas.

a. Technical requirements. The requirements include those for radar line-of-sight and distance limitations. The radar line of sight must be clear from the missile-tracking radar the missile beacon antennas of all erected individual missiles when raised to the firing sition on the launchers. The radar lines of sight to the missile beacon antennas must not tail depression of the missile-tracking radar below minus 5°. The distance from the missile-ıcking radar to each launcher must equal or exceed 1,000 yards. This limitation is imposed the missile-tracking radar antenna elevation rate capabilities. The maximum limit of distance tween the missile-tracking radar and each launcher cannot exceed either the parallax limits the computer (6,000 yards in each rectangular coordinate) or that combined cable length ›rmally about 5,800 yards) which gives satisfactory impedance characteristics.

b. Operational requirements. Operational requirements are those that determine ıcement of the various elements of the launching section due to cable limitations, working ace, safety requirements, booster impact areas, administrative requirements, and those facili-s required by the operating personnel.

(1) The limitations imposed on the various elements of the battery due to cable lengths are: launcher section revetment to launcher, 125 feet; launcher control trailer to the near launcher sections, 1,000 feet; launcher control trailer to the far launcher section, 1,500 feet; launcher control trailer to generator, 125 feet; launcher control trailer to battery control trailer, 15,840 feet.

(2) A minimum distance of 140 feet between adjacent launchers of a single section will provide adequate space for missile ready racks, launchers, access for loading, unloading, servicing and maintenance, and will approximate the required safety limitations (fig. 11).

(3) The maximum distance between launchers and the launcher section control revetment will not exceed 125 feet due to the length of the cables.

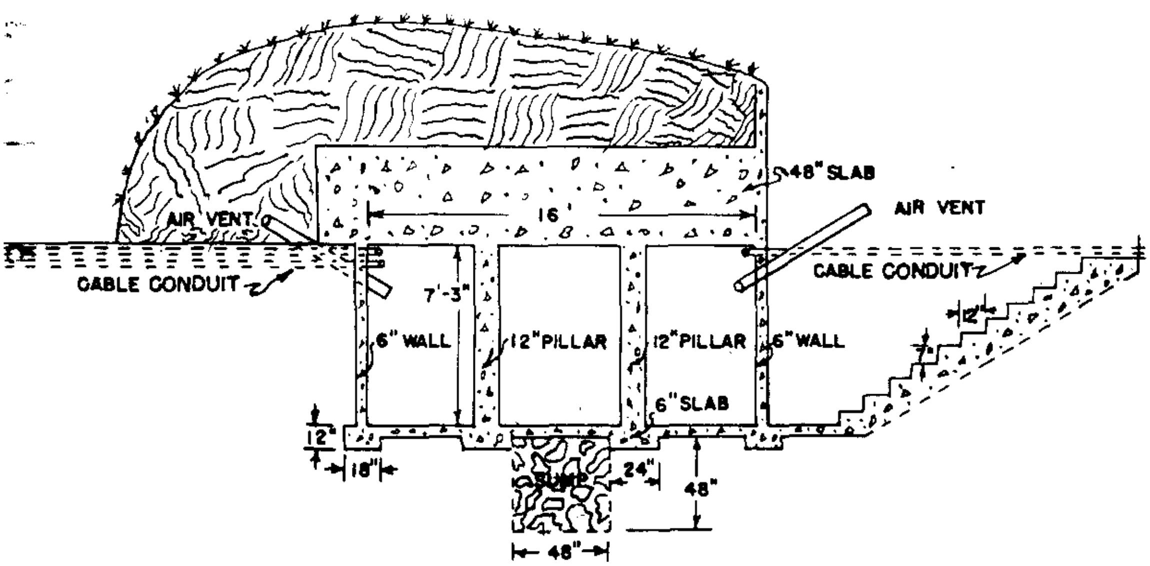

Figure 24. Launching section control revetment.

(4) A suitably heated, all-weather, reinforced-concrete revetment must be provided (fig. 24), for adequate blast protection for the panel and eight men. A separate barricade must be built for each of the four launching sections in the launching area (fig. 25).

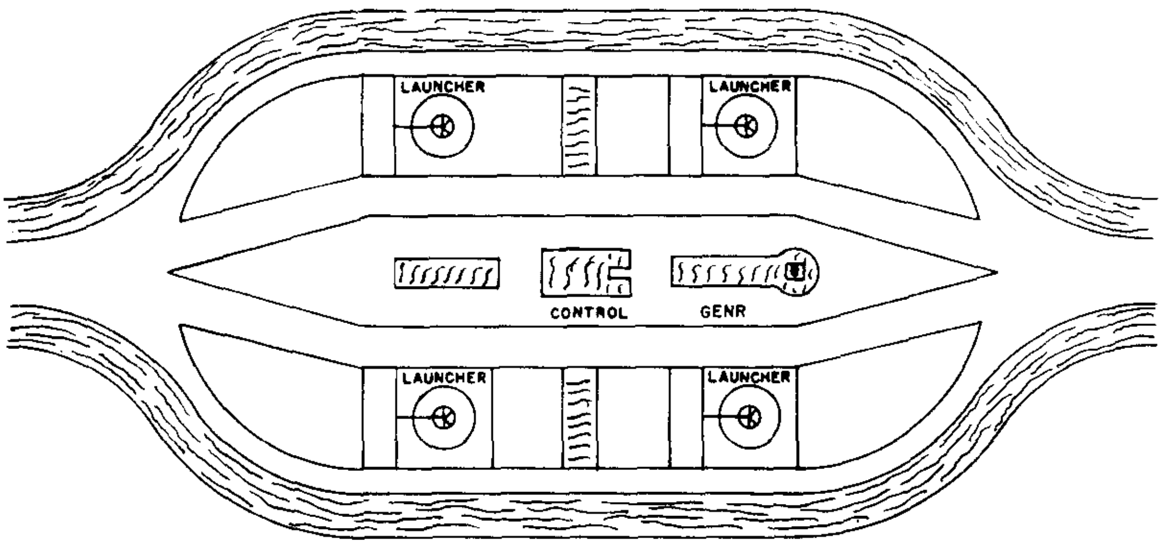

Figure 25. Launcher section barricade.

(5) The' recommended barricaded distance between launcher sections dictated by safety requirements is 640 feet. When real estate difficulties prevent attaining this distance, a 500-foot barricaded spacing between launcher sections is the minimum recommended considering psychological and operational requirements.

(6) Square and circular configurations in deployment of all launchers within sections and of sections within launching areas would generally minimize the over-all real estate and communication requirements but must be weighed against booster impact damage probabilities and the configuration of available land in each case.

(7) The launcher control trailer should be located to provide convenient access to roads and communications and not with the line-of-sight requirements from the missile-tracking radar to the erected missile beacons. Siting of this trailer at the edge of the launching section safety area nearest to the battery control area will maximize safety and tend to reduce communication distances. The minimum barricaded distance from the nearest launcher section should be 500 feet.

(8) The five engine generator units (one for each of four launching sections, and one for the launcher control trailer) should be dug in and revetted, preferably with overhead ventilated cover providing all-weather protection (fig. 26). Siting in a direction opposite the booster impact area is preferable.

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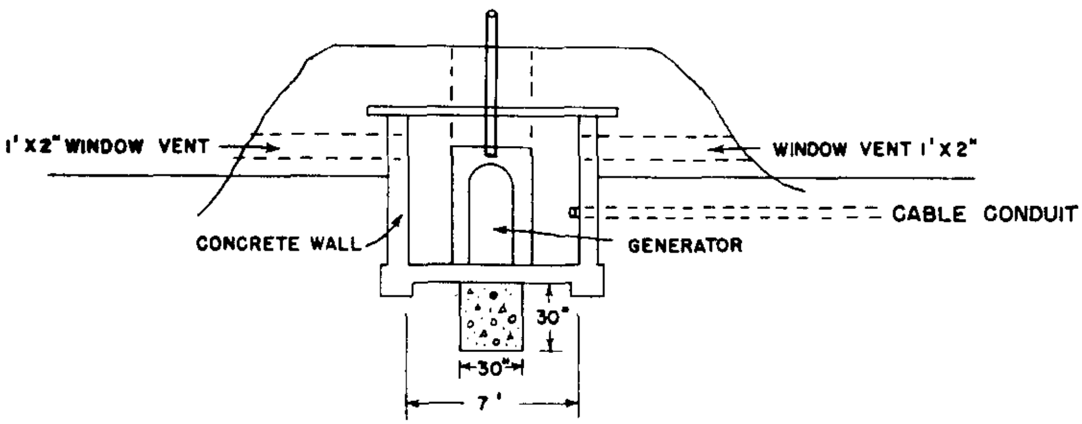

Figure 26. Engine generator revetment.

(9) One or more booster impact areas should be selected for each launcher section with due consideration for seasonal and prevailing wind effects and the configuration of the launching section. Acquisition, lease, or even easement or zoning of such impact areas is not considered a requirement.

(10) A perimeter zone about the launcher area, a minimum distance of 250 feet from the nearest launcher, fuel, missile, or explosive component area, should be acquired and fenced for security and safety (fig. 11).

(11) A lease (preventing construction but permitting farming, fishing, etc) should be obtained over an additional 500-foot perimeter, extending from the nearest launcher, fuel, missile, or explosive component area (fig. 11).

(12) Warheads, fuels, or other explosive components within the fire unit should be stored, assembled, and maintained in the launching area or its immediate vicinity to maximize safety and minimize real estate requirements.

(13) A missile-servicing shelter with a hard floor should be provided in each launching area. This all-weather shelter, 50 feet by 20 feet with a clear height of 15 feet (clearance for the missile transporter), should be suitable for fueling, defueling, installing or removing warheads, and for field surveillance-type maintenance on one missile at a time. This shelter should be revetted toward the nearest launchers and spaced a minimum of 150 feet from the nearest launcher and 650 feet from the nearest habitation. These distances are reduced when revetted (fig. 28) or underground (figs. 29 and 30) launching sites are used.

(14) A circular hard-surfaced slab 30 feet in radius is required at the base of each launcher. The center of this surface must be of concrete and have a

[redacted]

minimum radius of 12 feet. Concrete footings with hold-down bolts for all pads of the launcher and ready rack are required. Drainage and runways for cables are also required.

(15) Bogies or wheels should be removed from the launcher control trailer, launcher trailers, and generators. The launcher control trailer should be provided with a firm foundation and drainage as needed.

(16) All roads, footpaths, and action areas should be hard-surfaced to insure all-weather operation. All-weather access roads between the operational and administrative areas of the battery must be provided.

(17) Cables within and between areas should be buried or elevated to minimize damage through carelessness, accident, or sabotage. Elevation is preferable to facilitate repair and recovery.

(18) Warheads not installed in the battalion assembly area will be installed in the launcher areas. If detached warheads are to be stored in the launcher area, two suitable igloos for 16 warheads each must be provided. These igloos must be spaced at least 250 feet apart. In the launcher area, these igloos must be spaced a minimum distance of 500 feet from the nearest launcher section, trailer, or security fence and must be barricaded and 750 feet from the nearest habitation.

(19) A guard shelter suitable for all-weather use should be placed at the access road gate through the security fence surrounding the launcher area.

(20) A latrine should be provided for the launching area. Other personnel and administrative buildings may be located adjacent to either the battery control area or the launcher control area or convenient to the two areas.

(21) Because of hazards to personnel and equipment from acid, running water is required at each point where acid is handled or stored.

(22) Doubling of fire units on a site is a possibility to be considered when satisfactory sites are limited in number. Additional safety requirements would have to be complied with.

(23) All of the minimum distances stated are definite minimums. To increase operational safety, larger areas should be obtained if possible.

(24) Depressed and revetted acid storage with a light roof must be provided in each battery launching area 200 feet away from other facilities.

(25) Sandbags and sand-filled boxes are not sufficiently durable or substantial as revetment material for barricades at these sites.

(26) Commercial electric power is desired in the launcher control area.

Section II. HEADQUARTERS AND HEADQUARTERS BATTERY SITE

29. GENERAL. In general the location of the battalion command post will follow the procedure and include the criteria as outlined for medium and heavy AAA battalions in FM 44-4. The most difficult section of the Nike I battalion headquarters battery to locate is the battalion assembly and service area (fig. 27).

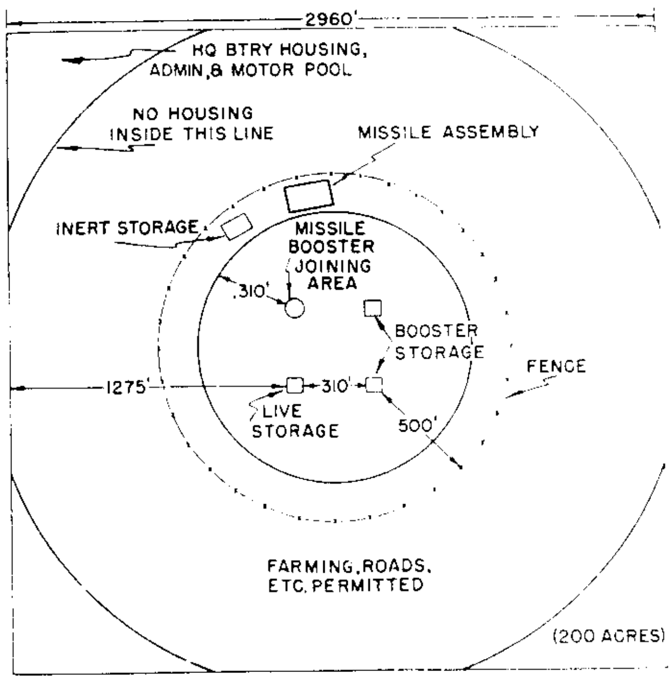

Figure 27. Battalion assembly and service area.

30. TECHNICAL REQUIREMENTS FOR THE ASSEMBLY AND SERVICE AREA. The nical requirements include those predicated upon the danger involved and the space requirets of the missiles to be assembled and stored in the area.

a. An explosives storage area capable of storing 96 crated booster (jato) units and eady missile-booster combinations must be provided. Because of the large safety distances iired from these areas to inhabited buildings (approximately 1,275 feet assuming barricaded age areas), it is desirable to put all explosive storage in the center of the area. Four sepa-structures should be provided in this storage area: two separate igloo-type buildings (apimately 20 feet x 30 feet), each capable of storing 48 crated boosters; one for ready storage 32 missile-booster combinations (approximately 50 feet x 60 feet); and one structure with a -surfaced floor (approximately 60 feet x 60 feet) for joining the missile to the booster. ice magazines should be separated by 310 feet. All other buildings or work areas should be east 310 feet from the service storage area. The necessary quantities of igniters and prima- can be stored in a separate building or in a separate portion of one of the storage buildings explosives. A magazine for storage of 32 warheads per launching battery must be provided uch a location that delivery over long distances will not be required on short notice. The iead should arrive at the launcher area simultaneously with the missile but preferably not ie same vehicle for safety reasons.

b. Areas, buildings, and facilities must be provided for missile assembly, test, pres-zation, and for storage of 32 inert missiles. One large building approximately 60 feet x 180 or several small buildings with approximately the same amount of total floor space can used. These buildings should have concrete floors, heat, and commercial electricity and be

[redacted]

a minimum of 310 feet from any building in the explosives storage area. They will be used to assemble and test a maximum of 16 missiles per 8-hour shift. The inert storage portion of the area requires approximately 5,400 square feet.

c. Suitable storage facilities for approximately 150 drums of acid are required although the acid filling can be done in the launching area. A total space of 300 feet x 300 feet, including a safety zone around the storage site, should be provided. This site should be located with respect to prevailing winds so as to minimize the possibility of acid fumes endangering the living or working areas. This storage site must be at least 310 feet from any of the explosive storage buildings.

31. OPERATIONAL REQUIREMENTS FOR THE ASSEMBLY AND SERVICE AREA. The operational requirements pertain to the connecting and access roads, convenient location of the various elements of the assembly section, and the location of the administrative facilities of the section and the headquarters battery.

a. Connecting roads are required between the various buildings in the assembly area and between sections of the explosive area since both the missiles and boosters are transported within these areas by hand dollies designed for operation on hard surfaces.

b. A good access road must be provided to the assembly area, the booster joining site, the ready storage area, and the acid storage sites.

c. The assembly area should be located as close as possible to the battery launching areas in order to minimize the distance that the assembled and tested missiles must be transported.

d. Provisions should be made in the launching area for the installation of warheads and the booster igniters, and for propellant servicing of the missile.

e. Administrative buildings, barracks, and vehicular maintenance facilities can be provided in this area. Such facilities should be located at the inhabitable-building distance from the explosives storage area (minimum distance 1,275 feet).

Section III. REDUCED POSITION AREA REQUIREMENTS.

32. GENERAL. While TO&E's 44-145, 146, and 147 (DA, 12 February 1953) provide for a launching battery of 4 sections with 4 launchers per section, units currently being formed in the continental United States are organized with 3 sections per battery and 3 launchers per section. Local conditions, availability and cost of sites, and availability of equipment may well reduce the number of launchers actually deployed to an even smaller number. In order to maintain an acceptable rate of fire under reduced area conditions, the launchers have been revetted or, in some cases, emplaced entirely underground. The missiles can be received, assembled, and tested in each battery, thus eliminating the battalion assembly and service area (fig. 30).

33. LAUNCHER CONTROL AREAS. The position area requirements will vary in accordance with the number of sections and the type of installation as shown in figures 28, 29, 30, 31, and 32.

34. BATTERY CONTROL AREA. By proper revetment and area layout, the acreage re-requirements for the battery control area can be reduced, as shown in figure 33.

35. COMBINATIONS. Another possibility for reducing the acreage requirements is to use a combination of underground and revetted launchers. With such a combination, each underground

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her can fire and immediately reload. If a higher rate of fire than the underground launchers eliver is required, the surface launchers can then be fired.

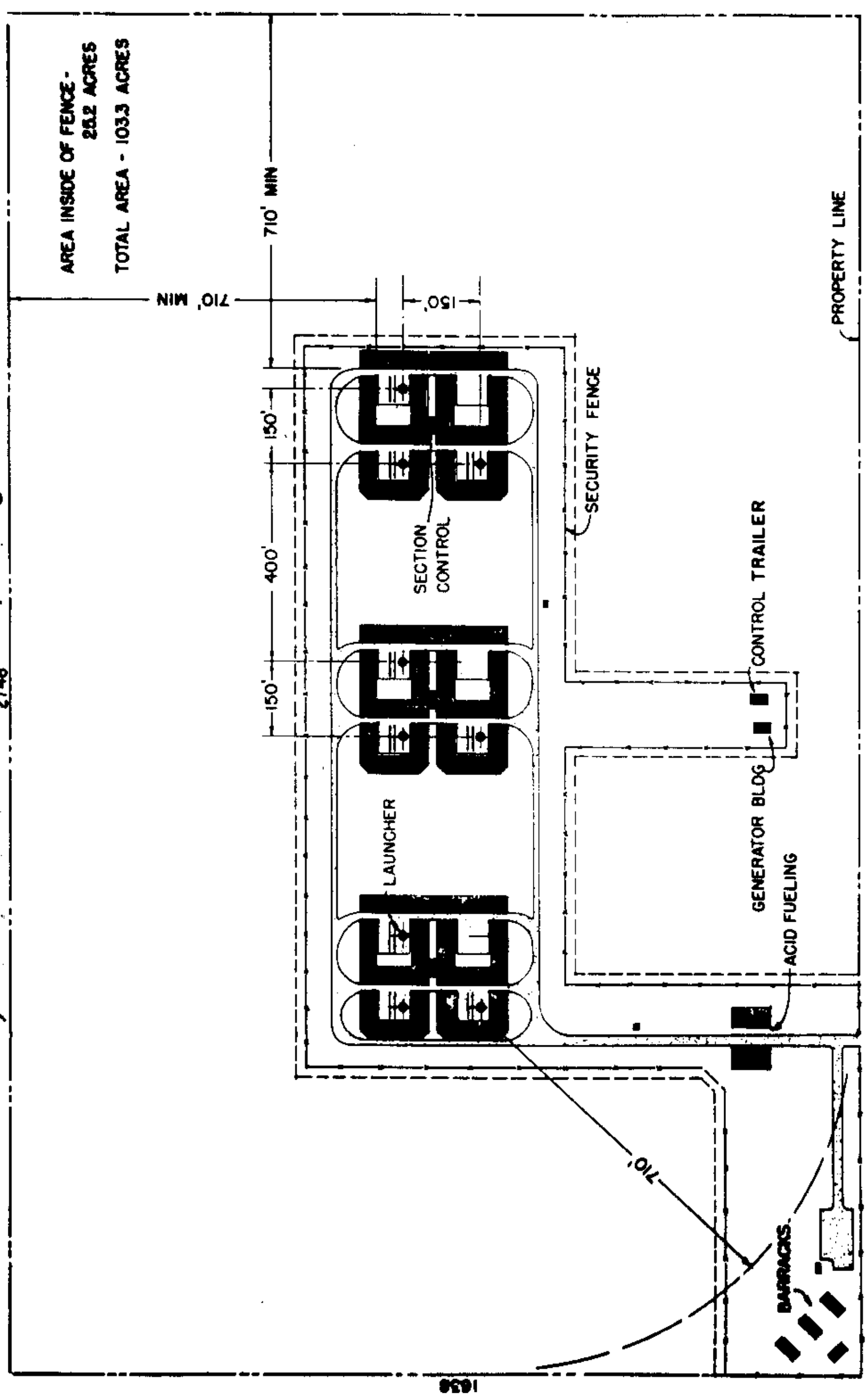

Figure 28. Launching area, 12 revetted launchers.

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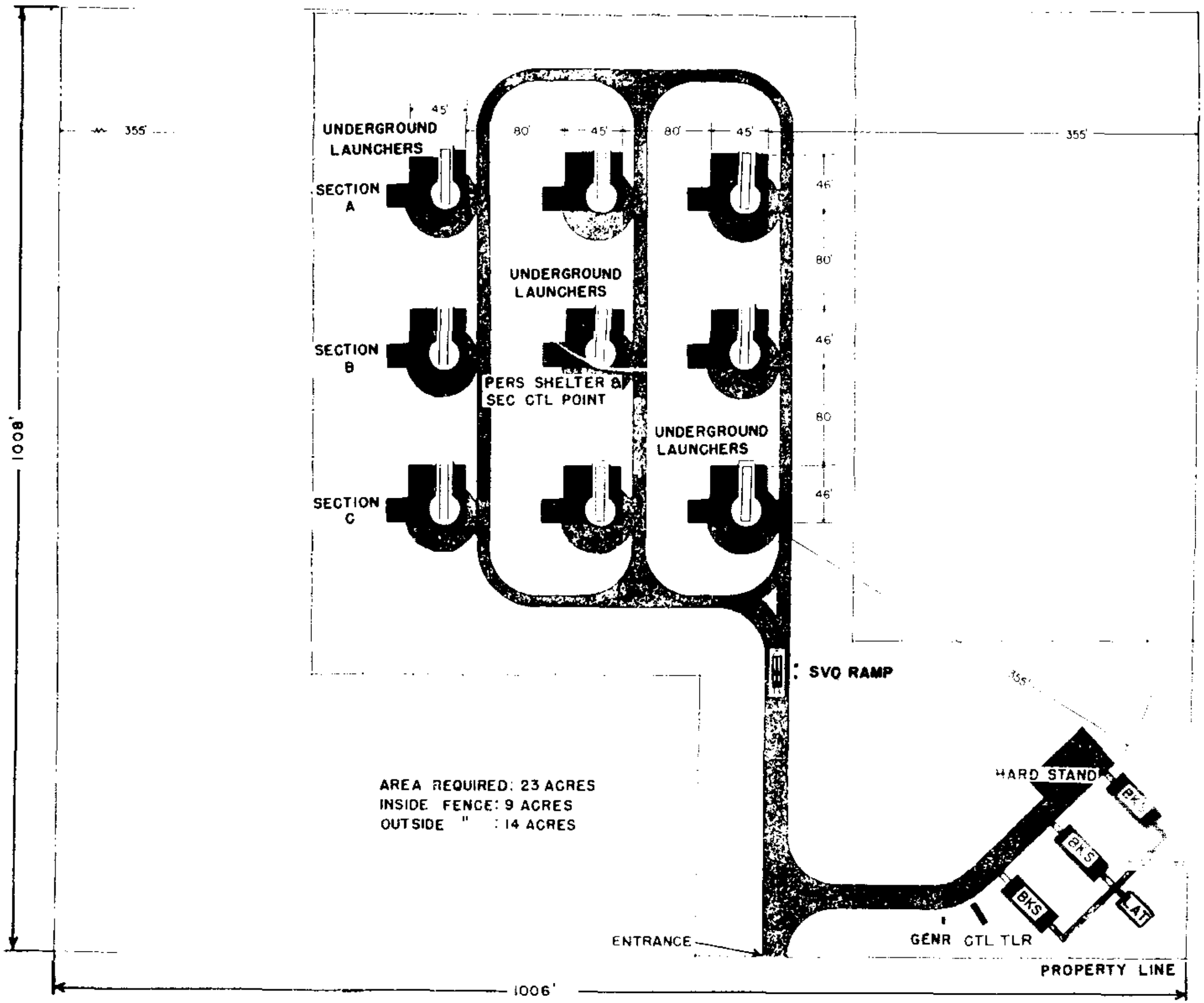

Figure 29. Launching area, 9 underground launchers.

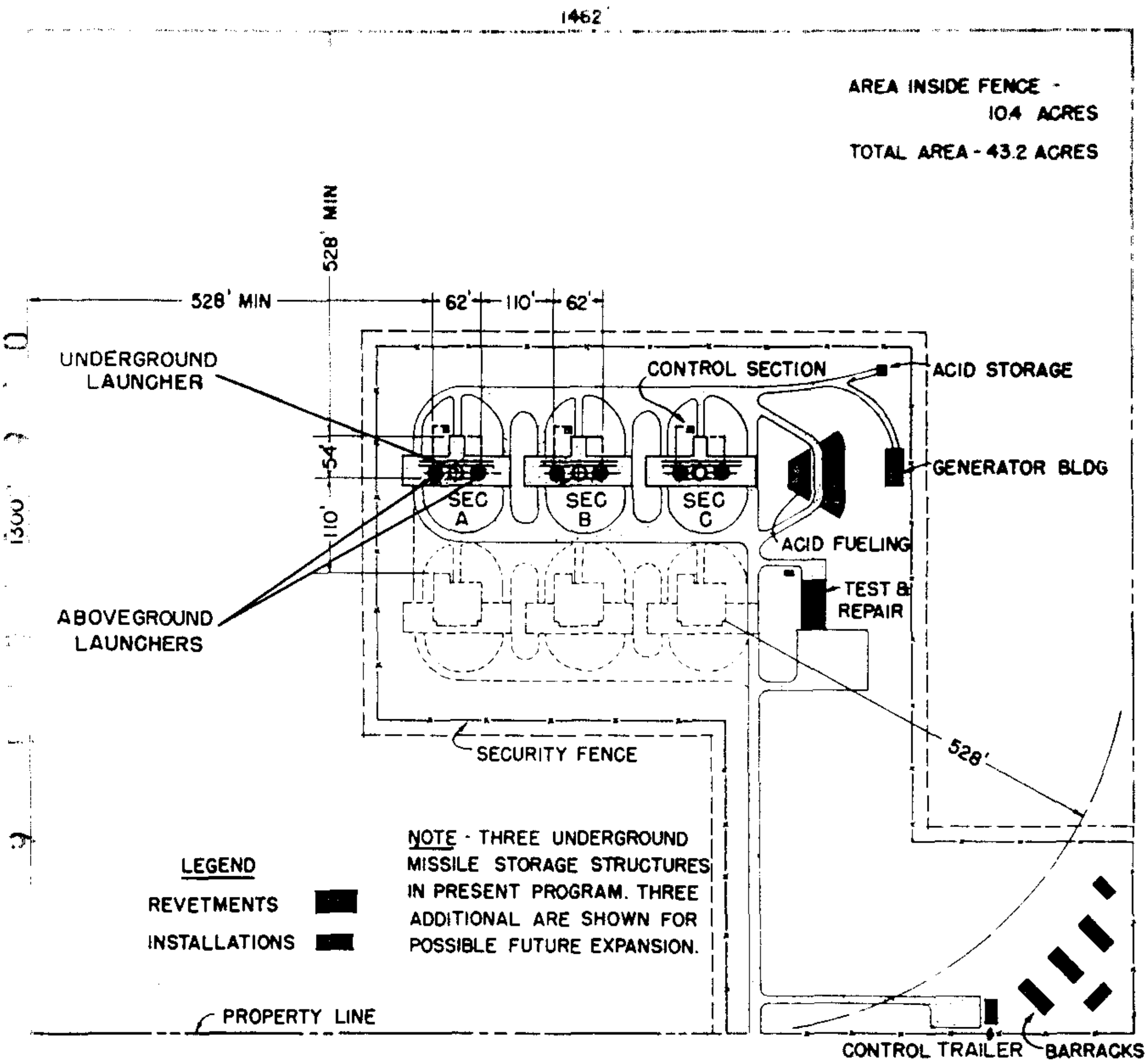

Figure 30. Launching area, underground-aboveground launchers.

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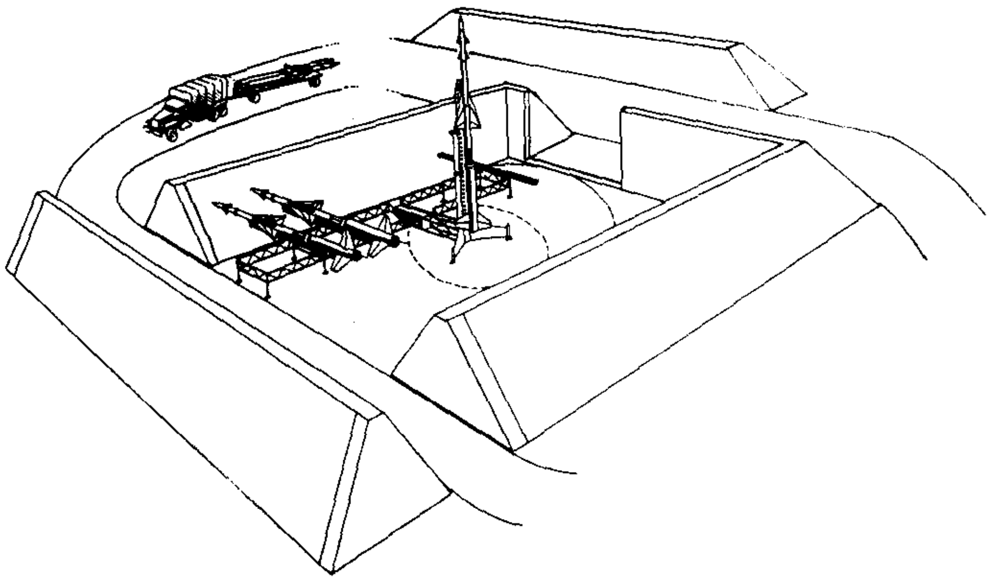

Figure 31. Revetted launcher.

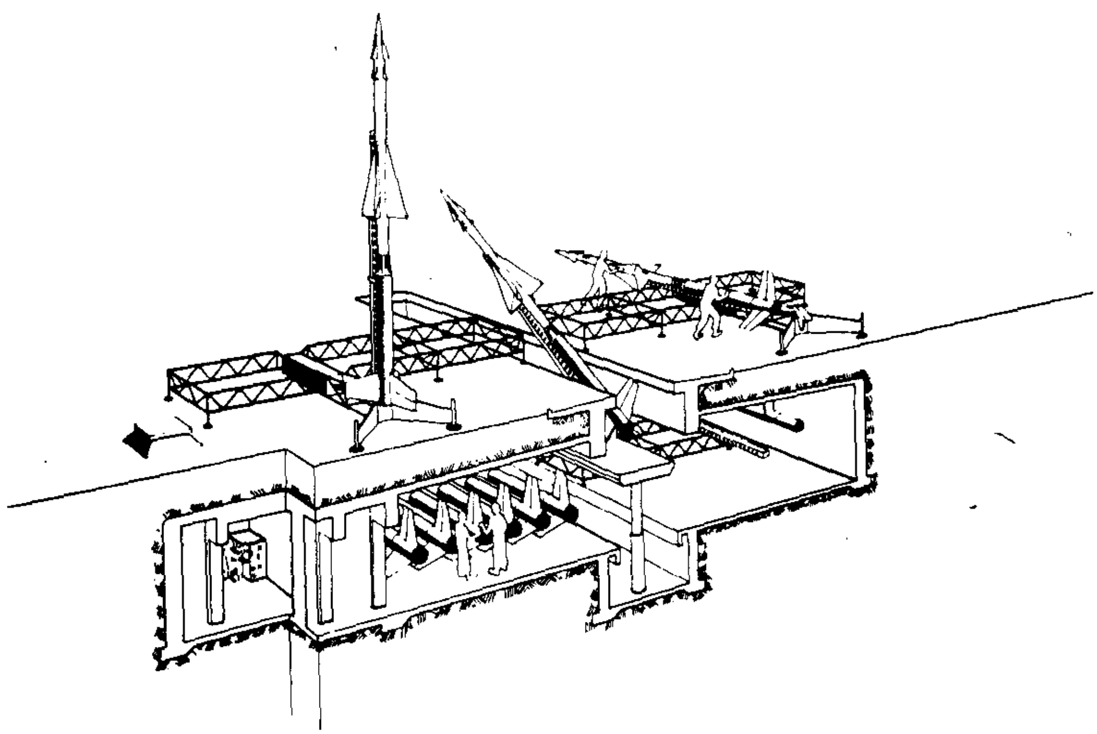

Figure 32. Underground-aboveground launcher.

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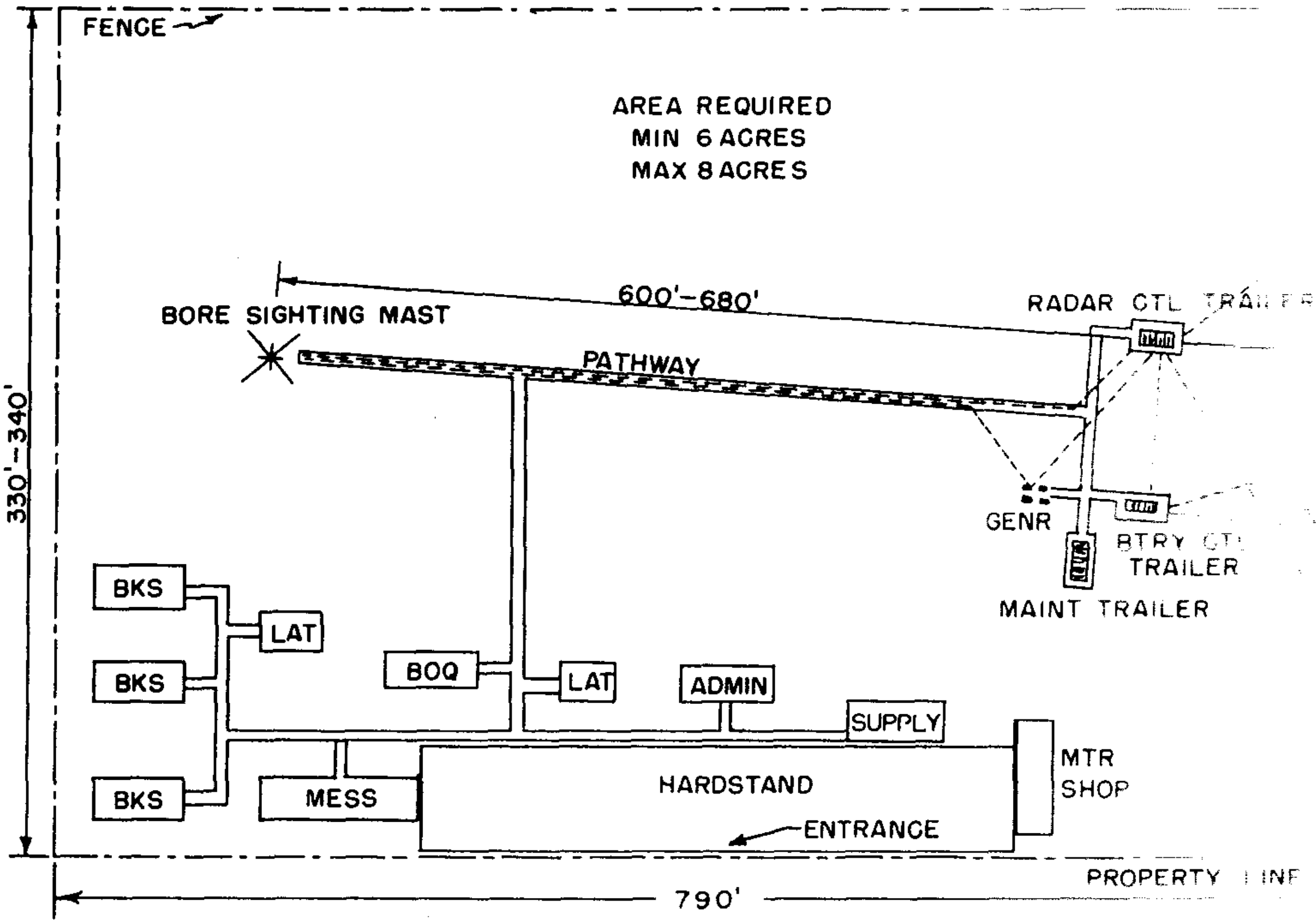


Figure 33. Battery control area, reduced.

PART TWO

FIRE CONTROL AND GUNNERY

CHAPTER 5

PREPARATION FOR FIRE

36. GENERAL. In the Nike I system, solution of the interception problem requires the analysis of two separate position determinations, one from the missile-tracking system and the other from the target-tracking system. Guiding the missile to the intercept point requires the target and missile coordinates supplied to the computer to be accurate in azimuth, angular height, and slant range. Orientation and collimation of the two tracking-antenna mounts must be carefully performed to insure that the required accuracy is obtained.

a. Collimation. The collimation of the two tracking-antenna mounts must be more accurate than that required in previous fire control systems. In the Nike I system the permissible total directional error is 0.33 mil. This corresponds to a linear distance of 14 yards at 40,000 yards range. The total error is the combination of the electrical and mechanical directional errors for both mounts.

b. Basic orientation problem. After emplacement, the first step in orienting the tracking radars is to level the target-tracking and missile-tracking antenna mounts. Since it is not possible to aline the radar axes directly with the mechanical axes of the antenna mount, an indirect approach is used. An optical set of axes is alined to the mechanical axes of the mount. The radar axes are then alined with the optical axes. Following this, the two tracking antennas are then oriented with respect to each other by optical means, and the radar antennas are considered to be collimated.

37. EMPLACEMENT. All of the procedures described, unless otherwise noted, are required in the initial alinement and bore sighting of the two tracking mounts during emplacement of the battery. Certain procedures, referred to as Group I, are required at every level and bore sighting check. Others, Group II, are to be performed periodically and at greater intervals. The various procedures, by paragraph number, will be divided as follows: Group I, paragraphs 41 and 48 through 53; Group II, paragraphs 38, 39, 42 through 47, and 54. Random effects that may cause inaccuracies in level and alinement between the two mounts, such as uneven heating by the sun, unequal wind effects, and soil settlement, must be given careful consideration. For these reasons, the following positioning of components is recommended:

a. The missile- and target-tracking antenna trailers should be emplaced parallel to each other to insure that external forces, such as wind and temperature effects due to heating by the sun, will cause the same magnitude and direction of change in level at the base of both antenna mounts.

b. Any sunshading of the two mounts by surrounding objects should be as nearly alike as possible.

c. The mounts should be emplaced to allow the wind-shielding of the mounts due to surrounding objects to be as nearly alike as possible. It is necessary that the tracking mounts be set up on their jacks as soon as possible in the system emplacement sequence and allowed to stand on the pads as long as possible prior to the alinement and bore sighting procedures to [illegible] of the mounts. [illegible] attempted immediately af[illegible] [illegible] level of the moun[illegible] [illegible]ted and adjusted frequently dur[illegible] [illegible] system accuracy [illegible] be necessary to check the le[illegible] [illegible] to 12 hours afte[illegible] has been emplaced. After th[illegible] [illegible] hours on the ant[illegible] [illegible] be sufficient, under normal c[illegible] [illegible] will be caused by [illegible] heavy rain, after which the level [illegible]

[illegible] The azimuth planes [illegible] rotation of the two antenna mounts must be [illegible] other. This is accomplished by leveling each mount with respect to the earth. [illegible] ation of the antenna 180° in azimuth and/or elevation and to direct it toward [illegible] during bore sighting operations, a track antenna control unit, which allows con[illegible] [illegible] of rotation at the antenna when connected into the servo control circuits, is [illegible] mount.

[illegible] LEVEL ASSEMBLY (fig 34). Two level assemblies mounted 90° apart are provided to level the tracking-radar antennas with an accuracy of about ±5 seconds of arc or about 0.025 mil. Each level assembly, inclosed in a housing on the turntable of the tracking-radar antennas, consists of a coarse spherical level for leveling the mounts to within the range of a precision level; a sensitive spirit level with a viewing device of the reflector-coincidence type; an associated counter which indicates the position of the sensitive level; and internal illumination for the precision level under the control of a momentary switch. The level housing assembly is sealed against dust and moisture and in addition has a silica gel cartridge to maintain a low internal relative humidity. The sensitive cylindrical level and viewing system are supported by the base through the pivot point and the actuating thread. The angle of the level vial with respect to the base is adjusted by the control knob. A counter, driven from a spur gear on the control knob shaft, gives an accurate indication of the position of the level. The viewing system of the level includes mirrors which split the image of the bubble longitudinally and transversely. This permits the operator to compare diagonally opposite quadrants of the bubble in parallel arrangement. The internal lighting is controlled by a pushbutton switch on the top of the level housing. This switch must be depressed for the operator to see the sensitive bubble. The accuracy of the leveling device is increased by the process of causing two similar lines to coincide. This operation may be performed to an accuracy of ±0.01 mil. The level position of the assembly is always determined by causing the split bubble images to be coincident. If the left section of the bubble image is visible but none or only a small portion of the right image is visible, the control knob is turned in a clockwise direction until the ends of the bubble are in coincidence. If more of the right hand image of the bubble is visible, the knob is turned in a counterclockwise direction until the ends of the bubble are coincident. A counter indicating the angle of the vial in relation to its base is used to enable the precision readings of the coincident level to be applied to the leveling of the antenna mount. This counter is geared to allow one digit to represent 0.02 mil. In the level assembly, backlash in the gear train between the position screw and the counter may cause an error of one digit between the counter reading and the level position. This source of error can be eliminated by always turning the knob in the same direction when approaching coincidence of the bubble images. The operating range of the counter is from a reading 3,125 to 6,875. Turning the control knob beyond these readings may damage the instrument. Special care should be exercised to avoid using the reading of one level with the 180° position of the other level. A table such as that shown in table II should be used to avoid this error. Several factors may combine to cause the counter readings at the 180° azimuth position of the antenna to disagree with the comparable reading at 0°. These factors include:

a. Level improperly oriented with respect to the rotating axis of the mount.

b. Tracking antenna mount not adequately leveled.

Table II. LEVEL RECORDING FORM

Operation	Level A	Lev
Initial Reading		
180° Reading		
Difference		
½ Difference		

c. Azimuth track irregularities in the antenna mount.

d. Backlash, if coincidence is not approached from the same direction at all times.

e. Coincidence of bubble images carelessly established.

Errors due to manufacturing tolerances are inherent to the rotating surfaces of the turntable and mount and cannot be corrected. The total error resulting from these track irregularities may be as high as 0.03 mil or 1½ digits on the counter. With care, the level can be set to within the range of ±0.01 mil which corresponds to one digit on the counter. Backlash may cause an error as high as one counter digit unless the precaution of always approaching coincidence from the same direction of rotation of the control knob is observed. If the counter readings at 180-degree positions differ by more than 2½ digits, the tracking unit should be releveled.

40. MAINTENANCE INFORMATION. Four 3-volt 323-type GE lamps used for illuminating the level are series-parallel connected to permit the use of a 6-volt supply. If one lamp burns out, the lamp connected in parallel with it will become very bright and the two in series with it will become very dim. These lights may be replaced from outside of the unit without breaking the seal.

41. DETAILED LEVELING PROCEDURE. To insure the azimuth rotational planes of each mount being parallel to the other, the following steps should be carefully performed simultaneously on each mount every day, preferably during a period of low temperature gradient (early morning). This is a Group II procedure, because complete leveling or releveling will not be necessary prior to each level and bore sighting check.

a. Rotate the turntable assembly until the level located on a radial line from the center of the mount (level A) is parallel to the long axis of the trailer. In this position the white stripes on the turntable will coincide with the white stripes on the equipment inclosure.

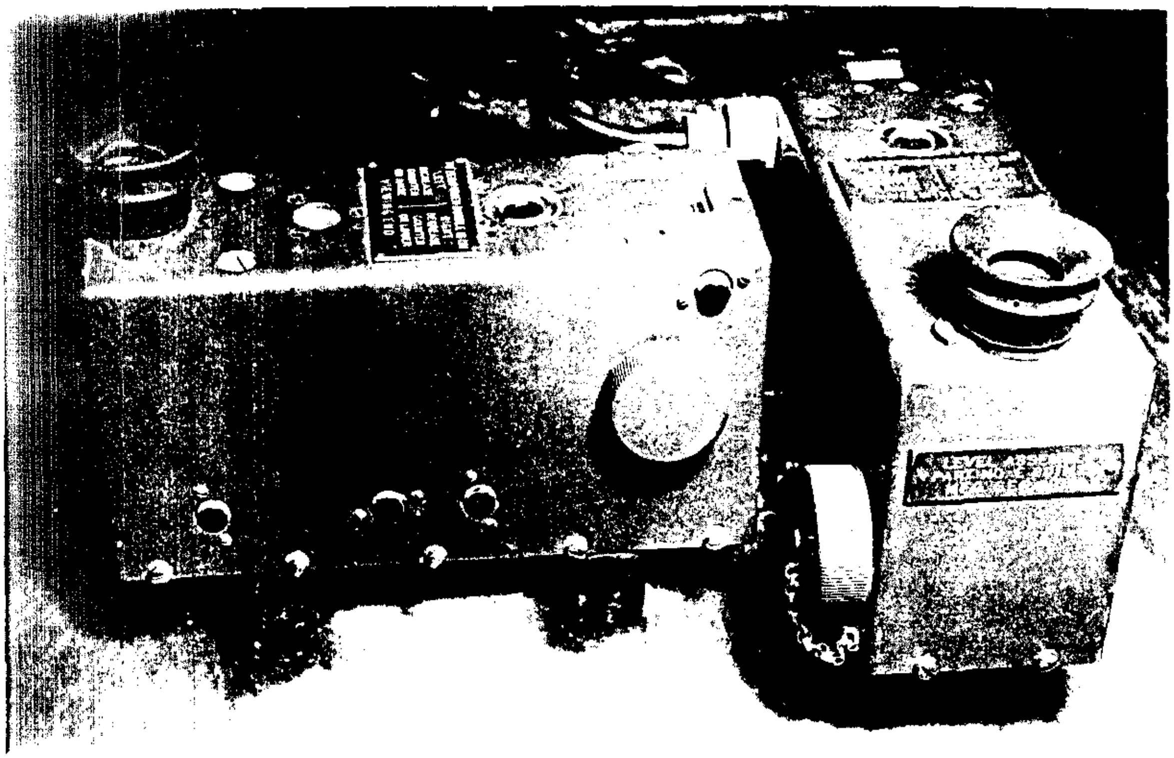


Figure 34. Level assembly.

...ing the coarse adjustment on the legs of the mount, adjust the leveling jacks, ... bring the level bubble into the center of the circular level, observing either

Rotate the knob on the side of level A until the ends of the bubble are in line on ... seen through the viewing glass on the level. Alinement should always be ac- ... while rotating the knob on the level box in the same direction. This practice will ... error due to backlash in the gearing system of the level box.

d. Read the counter on the level and record the reading.

e. Rotate the turntable assembly 180° and realine the white lines.

f. Using level A, again bring the ends of the vial bubble in line on the split image seen through the viewing glass.

g. Read the counter on the level and record.

h. Rotate the counter until it reads one-half the recorded readings of steps d and g.

i. Using the fine adjustment on level jack No. 2 (fig. 59), bring the ends of the vial bubble in line on the split image seen through the viewing glass on the level. Rotate the antenna 180° from the original position. Bring the ends of the split image (level A) into alinement, and note the counter reading. If it differs by more than 2½ digits from that which was obtained under paragraph h, repeat paragraphs c through i. The mount is now leveled along the axes parallel to the trailer axes. To obtain greatest accuracy from the leveling instrument, all readings on the counter should be approached from the same direction of rotation of the adjusting knob.

j. Retain the turntable in this position and rotate the kn[illegible]e side of level B until the ends of the vial bubble are alined.

k. Read the counter on the level and record.

l. Rotate the turntable assembly 180°. Using the knob on level B, once more aline the ends of the vial bubble. Read the counter on the level and record.

m. Rotate the counter until it reads one-half the difference between the recorded readings of steps k and l.

n. By adjustment of leveling jack No. 3, slowly aline the split image seen through the viewing glass on level B.

o. While at this position, check level A once more to determine whether the ends of the vial are still in line. If they are not, rotate the knob on level A to bring the vial bubble ends in line and record the counter reading.

p. As a final check, rotate the turntable assembly 180° and check level B. If the ends of the bubble are not in line, rotate the knob on level B to aline the vial bubble and record the counter reading.

q. Compare the two original zeroing numbers recorded from each level, steps h and m, and the readings recorded in steps o and p. The difference on one level between readings should not differ by more than 2½ divisions. This indicates that the azimuth rotational path is 5 seconds out of plane and/or off level, including the reading and backlash errors, if any, of the leveling instrument. Do not compare the readings of level A with those of level B.

Note: By performing the above steps on each mount at the same time and under the same conditions, any later major effect due to sun or wind will be the same on both mounts, thus tending to maintain parallelism of the rotational planes.

42. PERIODIC LEVEL CHECKS. After each mount is leveled, a simple method can be used to determine whether the mounts need releveling. The following procedures should be carried out on each mount simultaneously (this is a Group I procedure, to be performed during each level and bore sighting check):

a. Rotate the mount until the white lines on the turntable aline with the white lines on the equipment inclosure.

b. Rotate the knobs on level A and on level B until the ends of the vial bubble in each box are coincident.

c. Read the counter on each box and record.

d. Rotate the mount 180° and repeat steps b and c. Subtract reading b from reading d for each level and record (carry plus and minus signs on the difference). Algebraically subtract the difference obtained for level A on the missile-tracking mount from the difference for level A on the target-tracking mount. Do the same for level B. If either answer is larger than 10 divisions, the mounts must be releveled.

43. ADJUSTMENT OF ANTENNA OPTICS. The optical axis of the 32-power sighting scope, mounted on the tracking antenna mount, must be accurately alined with respect to the mechanical axes of the antenna mount. The later procedures to aline the radar system to the optical system and hence indirectly to the mechanical axes of the mount will seem accurate, but will be meaningless and misleading, unless the optical system has been first accurately alined.

[redacted]

The procedures to be described insure that the optical system will be satisfactorily alined. They should be performed on each antenna mount.

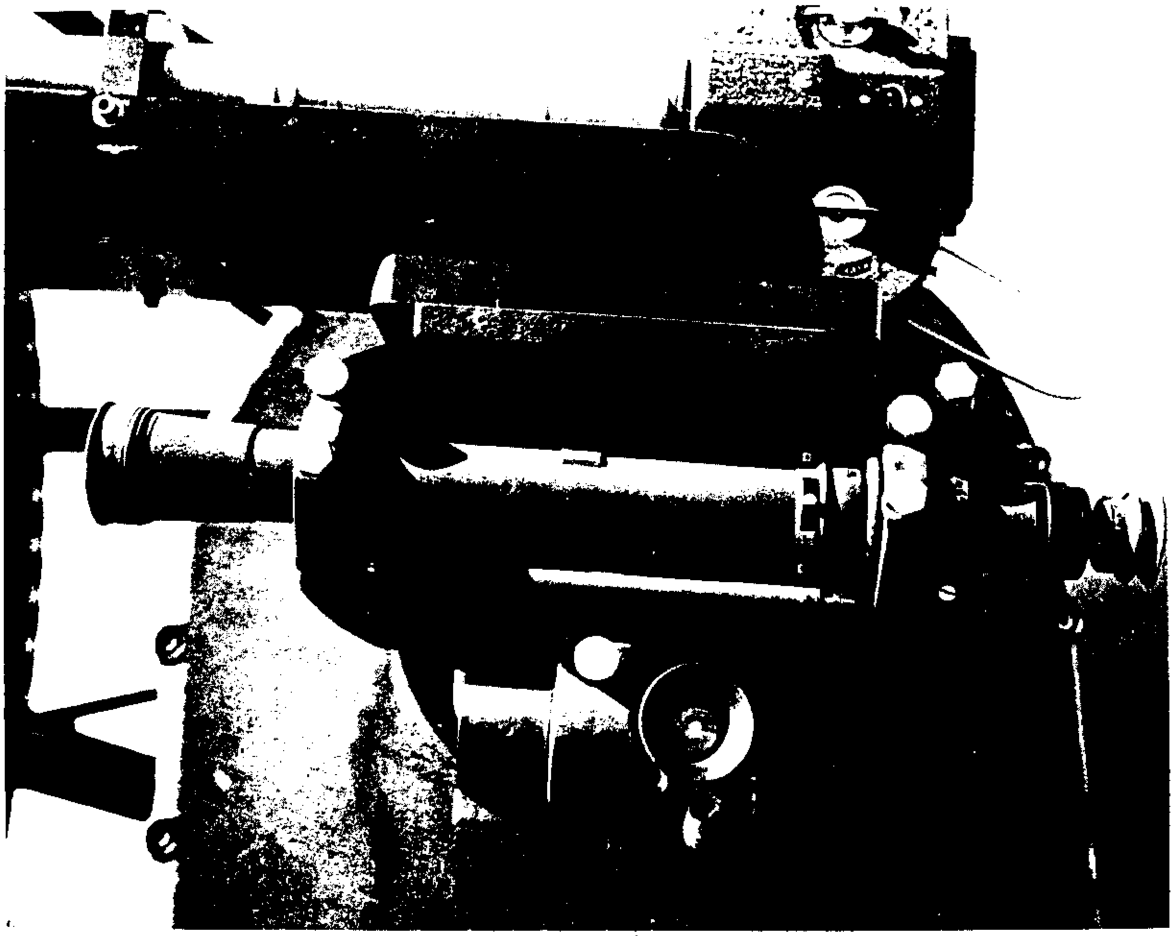


Figure 35. Sighting telescope.

44. SIGHTING TELESCOPE RETICLE ADJUSTMENT (fig. 35). Because the sighting telescope is often unclamped, reversed in its mount, and reclamped during the procedures which follow, it is of utmost importance that the optical axis of the telescope, denoted by the intersection of the reticle lines, be collinear with the mechanical axis of the telescope which is defined by the telescope positioning rings. Once adjusted at the factory, only severe shock or tampering should cause maladjustment of the telescope reticle. It will seldom be necessary to realine the reticle, but the check should be made regularly to insure correct adjustment.

a. With the sighting telescope clamped in the telescope mount in the reversed direction, adjust the antenna mount in elevation and/or azimuth until the reticle is centered on a well-defined target.

b. Leaving the antenna mount fixed in elevation and azimuth, loosen the telescope locking clamps and rotate the telescope a full 360° about the optical axis. While rotating the scope, it should be held tight against the V-blocks of the telescope mount. The cross of the reticle should stay centered on the optical target as the telescope is rotated. If it does not, the optical axis is not collinear with the mechanical axis. Care should be exercised when the sighting telescope is removed from the telescope mount not to damage the telescope collars or to allow dust to settle on the V-blocks or collars. A slight dimensional change in the collars of the telescope can have a serious effect on the system accuracy.

[redacted]

c. If the reticle does not remain centered with rotation, it n be adjuste zero deviation with rotation is obtained.

45. SIGHTING TELESCOPE WITH SPIRIT LEVEL ADJUSTMENT he spirit leve the sighting telescope on the target-tracking radar antenna may be used t fine the reference zero in elevation in later alinement procedures. The alinement requires t optical axis of the telescope to be parallel to the spirit level. This is accomplished as follows

a. With the sighting telescope clamped in the telescope mount, ate the antenna in elevation until the spirit level indicates level.

b. With the antenna fixed in elevation as above, remove the telescope from the mount, reverse it and relock it in the mount. When the spirit level and optics are parallel, the spirit level will again indicate level. If this second reading is not level, adjust the level to correct for half the difference in the level indications.

c. Readjust the antenna mount in elevation until the level indicates level. Reversing the telescope again should cause the level to indicate the antenna leveled in elevation. If not, repeat the above steps until, with the antenna fixed in elevation, the spirit level indicates level in either the normal or reversed position of the telescope. Care must be taken to avoid excess tightening of the clamp nuts which will cause the adjustment to drift.

d. Loosen the telescope locking clamps and rotate the telescope through a small angle about the optical axis while maintaining the telescope tight against the V-blocks of the telescope mount. As the telescope is rotated back and forth, the level bubble should remain fixed with respect to the graduations on the vial. If the level bubble moves with respect to the graduations, the level axis and the optical axis are not in the same plane, and the level must be adjusted until this test is satisfactory. This step and step c are interdependent, and, if an adjustment is needed here, steps a through c must be repeated.

46. M2A1 ELBOW TELESCOPE ALINEMENT. The M2A1 viewing telescope is clamped to the same mount as the sighting scope. It is a low-power, wide-field instrument used as a general target viewing scope. The alinement of this telescope to the mechanical axis of the antenna mount is not critical because it is not used in the antenna alinement procedures. It is advantageous to have the reticle of the M2A1 scope centered on the same point on a distant target as the reticle of the sighting scope. Once the alinement of the M2A1 has been completed, adjustments on the sighting scope in azimuth and/or elevation will carry along the M2A1 without disturbing the mutual alinement. The viewing telescope will be adjusted in azimuth and elevation at the factory, and it will seldom be necessary to correct these adjustments in the field. If misalinement occurs, readjustment can be carried out as follows:

a. Orient the antenna to center the sighting scope on a distant target.

b. Loosen the clamping screws that hold the M2A1 scope and adjust it in azimuth and elevation until the reticle of the M2A1 is centered on the same target as the sighting scope.

47. SIGHTING TELESCOPE PERPENDICULARITY ADJUSTMENT. The sighting telescope must be adjusted to insure that the optical axis will move in a plane perpendicular to the elevation axis when the antenna is elevated or depressed. This vertical plane will then be perpendicular to the azimuth plane of rotation. Accuracy in this adjustment is very important because the surface described by the radar beam in elevation must be in a plane perpendicular to the azimuth plane of rotation, and adjustment of the radar beam can only be made relative to the optical axis. The optical axis of the sighting scope is adjusted perpendicular to the mechanical elevation axis of the antenna in the following manner:

...evel of the antenna mo... as described in paragraph... and re-ev...

...the antenna in elevation until it is approximately level. Rotate the mount... vertical line target is centered in the sighting telescope.

...moving the mount in azimuth, plunge the antenna 180° in elevation until... again. Reverse the sighting scope in its mount and adjust the antenna... target is again sighted. The vertical reticle will be on the target if the... perpendicular to the mechanical elevation axis.

...the vertical reticle is not on the target, loosen the telescope mount azimuth locking screws and adjust the telescope mount in azimuth to correct for half of the error.

... Rotate the antenna mount in azimuth to place the vertical reticle of the sighting telescope on the target. Repeat the above two steps to check the adjustment and readjust, if necessary, until the optical sight is on the same vertical target with the antenna mount in the normal or in the plunged position.

48. SIGHTING TELESCOPE RETICLE LEVEL ADJUSTMENT. The horizontal reticle of the sighting telescope must be parallel to the azimuth plane of rotation if the adjustments for optical axis to the radar beam parallelism, described later in the bore sighting procedure, are to be accurate. The horizontal reticle can be rotated about the optical axis by appropriate adjustment on the telescope mount. The procedure is as follows:

a. Check the level of the antenna mount as previously described and, if necessary, relevel the mount.

b. Rotate the mount in azimuth until an edge of the horizontal reticle is positioned on a well-defined point.

c. Slowly rotate the antenna in azimuth, being careful not to move the antenna in elevation, and note whether the horizontal reticle deviates vertically from the target chosen in b. If a deviation is present, realine by use of the telescope reticle adjustment on the telescope mount until either end of the horizontal reticle remains on the same target while the optical target is scanned in azimuth.

49. RADAR BEAM ADJUSTMENT. As previously mentioned, the plane described by the radar beam in elevation must be perpendicular to the azimuth plane of rotation. In the foregoing adjustments, the sighting telescope was precisely adjusted to aline the optical axis perpendicular to the mechanical elevation axis. Now, the radar beam is to be alined parallel to the optical axis in azimuth to insure that the radar beam elevation plane is perpendicular to the azimuth plane of rotation. The optical axis will then be adjusted in elevation to make the radar beam and optical axis parallel. These procedures will be performed on each mount individually. At this point in the procedure, it is necessary to use the optical and r-f target assembly atop the 60-foot mast in the battery control area. Figure 36 shows the general appearance of the target assembly at the top of the mast. The procedure requires the radar systems to be capable of automatically tracking the r-f horn at the top of the 60-foot test mast. The radars must be accurately alined with respect to the zero setting of the servo system, zero setting of the angle detecting system, and phase balancing of the i-f amplifiers, prior to this calibration. The procedures will be performed at each level and boresight check.

50. AZIMUTH ADJUSTMENT OF THE RADAR BEAM. Before adjusting the radar beam in azimuth, the antenna mount turntable should be rechecked for level, and releveled if necessary.

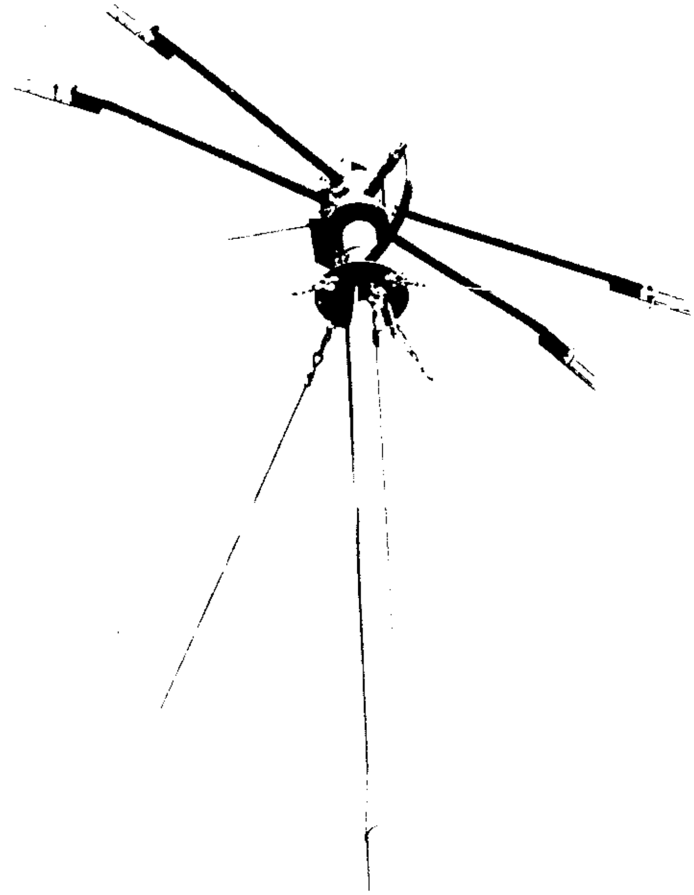


Figure 36. Optical and r-f target assembly (rear view).

The azimuth adjustment of the beam must be separately performed on each mount because this adjustment requires use of the r-f test set. However, the adjustment of one mount should closely follow the adjustment of the other mount. It will be necessary to disconnect the antenna control unit used in previous adjustments for local azimuth and elevation control, to allow tracking in automatic operation. The TEST-OPERATE switch in the radar control trailer must be in the TEST position to allow the antenna to be plunged to the back elevation quadrant, as required in these tests.

a. With the tracking antenna in the normal elevation quadrant, automatically track the r-f test target with the radar. The radar beam may not point directly at the r-f horn because of ground effects.

b. Observe the reading where the vertical reticle of the sighting telescope crosses the scale of the optical target located at the end of the target pole crossarm.

c. Plunge the antenna in elevation approximately 180° and rotate the mount 180° in azimuth. The radar antenna will again point at the r-f test target. Relock on the target assembly in automatic tracking (plunging of the antenna can be accomplished at the radar control trailer or at the antenna by use of the antenna control unit).

...ing on the r-f t[illegible] ... other optic[illegible] ... the vertical retic[illegible] ...

...cally add the targ[illegible] ... then divide the result by two ... the point, on either optic[illegible] target, where the optics should be centered ... and optical axis are paralle[illegible] This number may differ from zero, due to the ... mentioned in a above.

... step e does not show parallelism, physically move the r-f system in azimuth, relative to the antenna lens, to shift the radar beam in azimuth. Remain in automatic tracking while this adjustment is carried out. The antenna mount will rotate in azimuth as the r-f unit is moved, and the reticle of the sighting telescope will appear to move on the optical target. Shift the r-f unit until the telescope reticle moves to the reading determined in e.

g. Rotating the mount 180° in azimuth, plunging 180° in elevation, and relocking on the r-f test target should again put the vertical reticle of the sight telescope on the reading determined in step e.

h. Repeat the above steps, if necessary, with the mount in normal, or plunged and rotated position, until identical readings on the optical targets are produced.

51. ELEVATION ADJUSTMENT OF SIGHTING TELESCOPE. After the radar beam is alined to the optical axis of the sighting telescope in azimuth, the elevation planes of the optical axis and the radar beam are each perpendicular to the mechanical elevation axis of the antenna mount. To obtain complete parallelism between the optical axis and the radar beam, the sighting telescope is adjusted to aline the optical axis parallel to the radar beam because only the optical axis can be physically moved. Moving the telescope in elevation should not affect the precision azimuth adjustment previously performed. Prior to carrying out the following sequence, check the turntable for level. If necessary, relevel.

a. With the tracking antenna in its normal quadrant, automatically track the r-f test target with the radar. As before, the radar beam may not point directly at the r-f horn due to ground effects.

b. Observe the reading where the horizontal reticle of the sighting telescope crosses the scale of the vertical optical target near the r-f horn.

c. Rotate the antenna 180° in azimuth and plunge approximately 180° in elevation. Relock on the r-f test target in automatic tracking and note the new reading on the vertical optical target.

d. Algebraically add the target readings of b and c, then divide the sum by two. This number determines the point on the optical target where the optics should be centered when the optical axis is parallel to the radar beam. This number will probably differ from zero, due to ground effects mentioned in a.

e. If part d does not indicate parallelism, physically adjust the telescope mount in elevation until the sighting scope reticle rests on the target reading determined in d. Remain in automatic tracking throughout this adjustment.

f. Rotating the mount 180° in azimuth, plunging 180° in elevation, and relocking on the r-f test target should again place the horizontal reticle of the sighting telescope on the desired reading. If necessary, repeat the above steps until the readings made on the optical targets are exactly the same with the mount in the normal or plunged and rotated positions.

52. ORIENTATION OF THE TWO TRACKING RADARS. The previously described procedures have determined the mounts to be level, the radar beam of each mount parallel to the

optical axis of the associated sighting scope, and the radar beam and optical axis are perpendicular to the elevation axis of the particular antenna mount. The two radar systems must now be oriented, to insure that angular information fed to the computer from each mount is referenced to the same azimuth and elevation zero.

53. TARGET-TRACKING ANTENNA ORIENTATION. *a. Azimuth setting.* North in azimuth can be set into the target antenna data unit in several ways: with a compass, by local survey, by celestial or solar observation. While pointing in a direction of known azimuth the azimuth data unit dial is adjusted to indicate the correct azimuth. The adjustment is not critical where system accuracy is concerned but must reasonably correspond with the maps placed behind the plotting board at the battery control console to insure correct plotting of early warning information.

b. North. When target acquisition coordinates are received from a fire direction center (FDC), it is important that north on the azimuth data unit agree with north as used by the FDC. This can be accomplished by a careful determination using one of the methods of step a.

c. *Zero elevation.* Zero elevation can be set into the elevation data unit of the target-tracking antenna by either of the following methods:

(1) In the primary method, the target-tracking antenna is adjusted in elevation until the spirit level on the sighting telescope indicates level. The dial on the elevation data unit is then adjusted to zero.

(2) A secondary method is to sight on a target and note the elevation angle. Reverse the mount 180° in azimuth and again sight on the target. When the elevation data unit is properly adjusted the elevation angles will be the same in either case. The angle in the back quadrant will be 3,200 mils minus the angle in the front quadrant as read on the data unit dial.

54. MISSILE-TRACKING ANTENNA ORIENTATION. In the case of the target-tracking antenna, setting zero on the data unit does not affect system firing accuracy. However, orienting the data unit of the missile-tracking antenna with the data unit of the target-tracking antenna is necessary to insure the accuracy of the system. Each antenna mount must be carefully leveled before the following procedures are performed.

a. Reverse the sighting telescope (with the level vial down) in its mount on one of the two tracking antennas. Point the two antennas in the same general direction and adjust each mount until the telescope of either mount is centered on the target at the objective end of the other telescope. The two antennas are now pointing in the same radar direction.

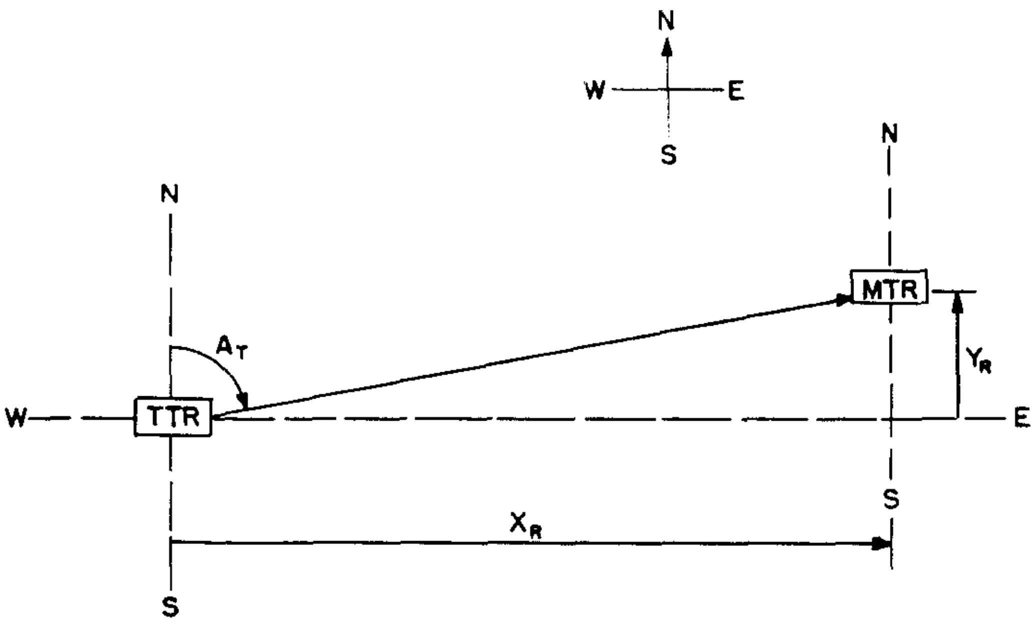
b. The elevation and azimuth data units on the missile-tracking antenna should be adjusted to register exactly the same elevation and azimuth angles indicated on the target-tracking antenna data units.

c. To determine the setting of the data units to be optimum from the computer standpoint, the ORIENT-CHECK-ENABLE button in the computer should be depressed. This places the same range voltage on the elevation and azimuth data units of each mount. The VELOCITY AND POSITION DIFFERENCE switch in the computer should be placed in the RADAR DATA DIFF-YDS missile from target position. The three velocity and position difference meters then indicate the differential voltages from the brushes of the azimuth and elevation data units. The YD/10 switch at the computer should be operated to obtain maximum sensitivity. The missile-tracking antenna elevation and azimuth data units must be adjusted to obtain a zero reading on all three meters. Elevation data unit rotation affects the H meter, and azimuth data unit rotation affects the X and Y meters.

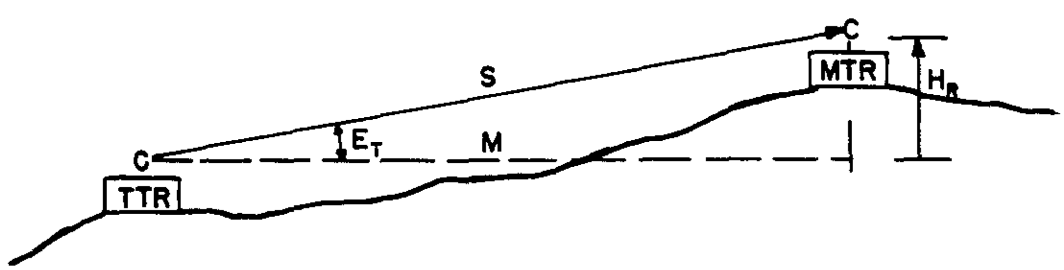
... [illegible] ... issile-tracking ... to ... per adjustment ... The ... of the azimuth ... used have the ... positive in the east ... north ... positive upward. ... as follows:

... measure the slope ... between the two radars, as ...

... With the target radar, measure the azimuth and elevation angles to the missile antenna. Refer to the elevation angle as E_T and the azimuth angle as A_T.



A. COMPUTER COMPUTATION DIAGRAM FOR RADAR TO RADAR PARALLAX SETTING (PLAN VIEW).



B. COMPUTER COMPUTATION DIAGRAM FOR RADAR TO RADAR PARALLAX SETTING (ELEVATION VIEW).

Figure 37. Parallax determination.

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c. Make the following calculations:

$H_R = S \sin E_T.$

$X_R = S \sin A_T \cos E_T.$

$Y_R = S \cos A_T \cos E_T.$

d. Set the parallax dials on the computer to the values found in paragraph c.

e. If the topography of the installation causes the measuring of the slope distance to be impractical, the horizontal distance, M, can be measured using the tapeline. The parallax corrections can then be found from the following expressions:

$X_R = M \sin A_T.$

$Y_R = M \cos A_T.$

$H_R = M \tan E_T.$

Note: $M = S \cos E_T.$

56. ADJUSTMENT OF THE LAUNCHER POSITIONING UNITS. The acquisition by the missile-tracking radar of the missile designated for firing is controlled by the operation of one switch. This is made possible by the use of launcher positioning units, LPU's, which supply control signals to the missile-tracking radar control circuits. These signals consist of synchro voltages proportional to the azimuth and elevation angles from the missile-tracking radar to the designated launcher of the selected section. A potentiometer is also provided in the LPU which is adjusted to produce an error voltage proportional to the range from the radar to the launcher. There are 17 launcher-positioning units located in the left side of the radar range and receiver cabinet in the radar control trailer. One LPU is provided for each of the 16 launchers in the battery and an additional unit is provided to slew the missile-tracking radar to the test responder in the launching area for test purposes or when launcher designation has not been completed. Use of the test responder as a 17th launcher reduces the time required for the acquisition of a new missile because the test responder represents the general location of all of the launchers in its launching area. Adjustment of the launcher-positioning units requires communication between the battery control area and the launcher control area. This is completed early in the battery emplacement sequence for administrative purposes during the installation of the battery. Communication is required between three positions, the missile-tracking radar antenna mount, the missile-tracking radar console, and the section chief of the section containing the launcher under consideration. One method of establishing the communications link is to simulate the yellow alert status of the battery by moving the ALERT STATUS switch on the battery control console to the YELLOW position. This will automatically set up the command and technical hot loops. By connecting the switchboard termination of the missile-tracking radar antenna into the switchboard emergency station of the command hot loop at the switchboard in the battery control trailer, communication is established between the desired stations. Due to the proximity of the missile-tracking radar console and the launcher-positioning units, the operator at the missile-tracking console will be responsible for the setting of the LPU's. He will direct the operation by use of the telephone.

a. The section will be selected and the launcher designated by using the appropriate control panel switches. If the interarea data cables have not been installed, it will then be

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pl ne. The sect ... will positively center ... ec launcher will be erected. The missile beac ...

...acking radar is then positioned toward the erected missile. By using ... unit, the vertical reticle of the sighting telescope is aimed on the ... missile, and the horizontal reticle of the sighting telescope is placed ... guidance unit antennas which project from the body about six feet below ... the missile. This point is above the tip of the erected launcher rail.

With the TEST switch on the control drawer of the missile-track console on TEST and the MAN-AID-AUTO switches on MAN, the missile radar operator turns the range handwheel until the beacon signal is centered in the range notch. He then makes the fine adjustments in azimuth and elevation by turning these handwheels until the azimuth and elevation error meters on the indicating panel of the console read zero. An alternate method for precisely training on the missile, once the beacon signal is the in range notch, is to throw the TEST switch to the OPERATE position and let the automatic tracking features take over. The servos then automatically reduce the positioning errors to zero. The TEST switch is then thrown back to TEST.

d. Azimuth, elevation, and range of the designated launcher are now obtained from the dials on the missile-tracking radar console and used to set the appropriate dials in the launcher-positioning unit. The track antenna control unit is disconnected at this time so that the LPU's outputs can be cut into the servo system.

e. To check the setting of the LPU, the tracking radar is slewed to a position which differs from the settings of the LPU in azimuth, elevation, and range. The TEST RESPONDER switch may be used for the purpose, if the 17th LPU is not the unit to be checked. It is immaterial at this point whether or not the launcher-positioning unit of the test responder has been properly adjusted.

f. With the REMOTE-LOCAL switch in the LOCAL position and the SECTION and LAUNCHER pushbuttons pressed on the missile indicating panel associated with the LPU being set up, the DISABLE and LAUNCHER ACQUIRE switches on the missile console are operated, causing the antenna of the missile-tracking radar to return to the position determined by the adjustments in d. The sighting telescope should again center on the designated launcher in both azimuth and elevation, and the azimuth and elevation error meters should once more read zero. The beacon should again be centered on the range notch.

g. If any of the conditions mentioned in f are not realized, the LPU must be readjusted.

h. The foregoing procedure, steps a through g, are carried out for all launchers in each of the four sections and the test responder. When setting the LPU for the test responder, the tracking radar is slewed to another attitude in azimuth, elevation, and range after the settings have been made. The 17th LPU is checked by operation of the TEST RESPONDER pushbutton on the missile-tracking radar console.

Note: Extreme caution should be observed during any movement of the tracking radar antenna. The personnel at the radar must be informed, through the voice communication system, prior to any movement of the antenna.

i. The foregoing is a detailed adjustment procedure of the launcher-positioning units. Generally, topographical maps of the installation site will be available in advance to the personnel responsible for the battery emplacement. After the battery has been emplaced, the approximate location of each launcher on the map is known. Azimuth, elevation, and range data required for the adjustment of each LPU can be determined from the map and recorded. This information can be set into the LPU's at any time after battery emplacement, which will greatly reduce the time required for the adjustment of these units. The procedure is the same using this method, except that only the checking and refinement of the adjustments will be necessary, as described under the detailed procedure. The setting of the launcher-positioning units will be necessary only once for any emplacement of the battery. If the tactical situation necessitates the relocation of any launcher section, the associated LPU must be reset to correspond to the new launcher positions.

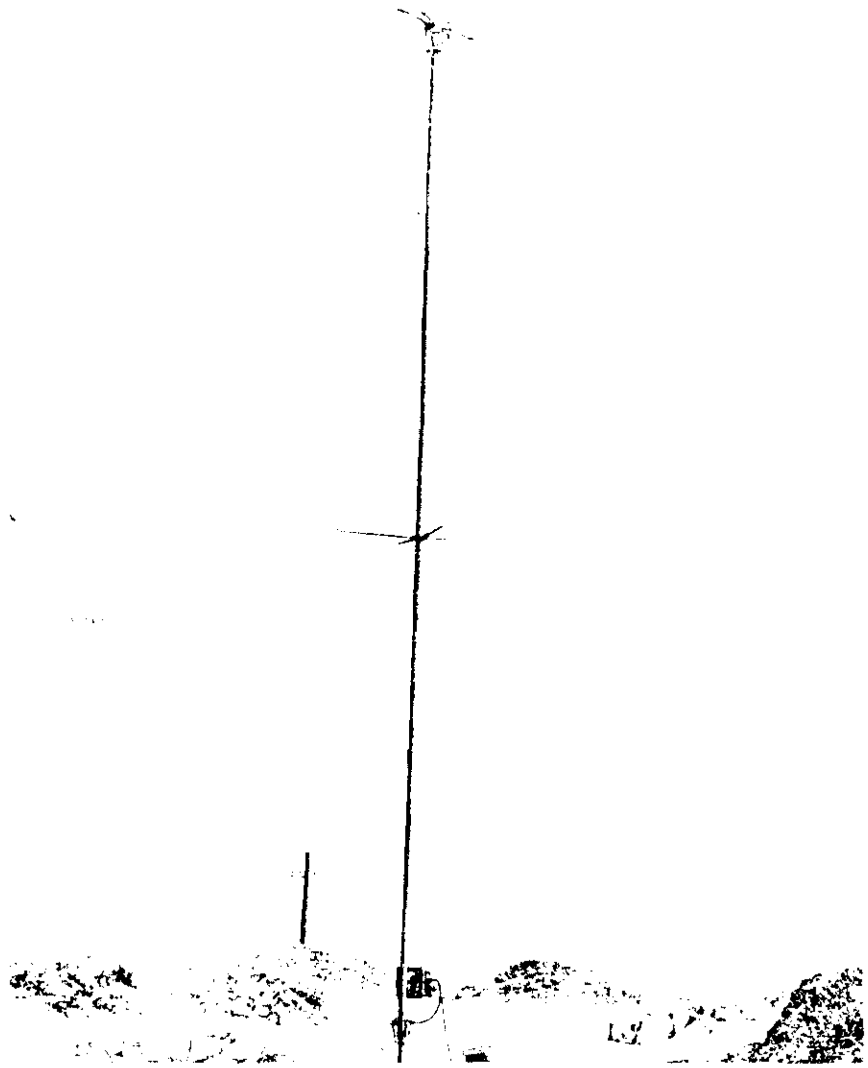


Figure 38. Bore sighting mast assembly.

57. ADJUSTMENT OF THE BORE SIGHTING MAST ASSEMBLY (fig. 38). The radar test antenna is also referred to as the bore sighting mast assembly. This unit consists of the 60-foot mast and an r-f horn and optical targets attached at the top of the mast. This assembly is used in bore sighting the tracking radar antenna mounts. The mast is divided into sections, approximately 10 feet long and the entire assembly is supported by guy wires to insure sufficient rigidity of the structure. Bore sighting tolerances require the mast to be exceedingly stable. A ½-inch lateral deflection of the mast and a twisting of the antenna horn of 2° is the maximum allowable

[redacted]

... the target assembly should be level within 3° after the mast has been assembled and erected. The mast assembly will not be damaged by winds up to 60 mph. A definite relationship must be established between the two tracking radar antenna mounts and the mast position when placing the mast assembly in the battery control area. This relationship is determined by three principal factors:

a. Radiation pattern of the r-f horn antenna atop the bore sighting mast. Both antenna mounts must remain well within the radiation pattern from the horn, about 65° in azimuth and 9.5° in elevation.

b. Maximum distances between the missile- and target-tracking radar trailers and the mast are determined by the length of cable supplied for the required interconnections.

c. The minimum distances between the three components are determined by the ¾° field of vision of the 32X sighting telescope on the tracking antenna mounts and dimensions of the optical targets atop the bore sighting mast. Consideration of the above factors has determined the best configuration of the components to be triangular (fig 3). The bore sighting mast is placed along the perpendicular bisector of the line between the tracking radar antennas at a distance of 640 feet with a tolerance of 40 feet. The locus of acceptable mast sites is a rectangle 80 x 160 feet centered on the mid-distance line between mounts, and is established by the additional condition that the shorter line of sight from one mount to the mast must be at least 89 percent of the distance from the other mount to the mast. This maintains the difference in path loss for the tracking radars at a maximum of 2.8 db. The radar test antenna is shown in figure 36. The antenna support is clamped to the top of the mast by two bolts and serves as a base for the r-f horn and optical target arm assemblies. The horn antenna is fed by a waveguide from the radar r-f test set. The r-f test set may be located in the maintenance and spare parts trailer or on the mounting provided at the base of the mast. The horn dimensions are 17 x 7[illegible] x 1 inches. The throat of the horn is encompassed by the antenna orientation indicator or elevation optical targets. These are calibrated for use in aligning the optical axes of the tracking radars and the r-f beam. The antenna horn is flanked by four other optical targets placed on the arm assemblies which are perpendicular to the antenna mast. These targets are used in pairs, one for each tracking radar. The critical dimensions of these arm assemblies is established in manufacture. For this reason, care must be exercised in assembling the optical targets prior to adjustment and attachment to the mast. The angle between the arm assemblies can be adjusted through a range of 16° to 32°. Perpendicularity between the optical target and tracking radar antenna optical axes is brought about by the use of sighting bars placed on two of the arm assemblies and the vertical optical target surrounding the horn antenna. These bars are fixed at a 45° angle, and appear to be canted when viewed through the sighting telescope if the line of sight is not perpendicular to the target. To insure adequate coverage of both tracking radar antenna mounts by the r-f beam of the antenna horn, three adjustments must be completed. Careful calculation and adjustment of the settings for the assemblies prior to erection of the mast will insure the required accuracy of these adjustments. The target arms and the r-f horn are adjusted after the bore sighting mast has been assembled and before it is raised. They are adjusted in the following manner:

(1) Using the telescope on each tracking antenna mount, sight each mount on the other's telescope. After reading the azimuth data dial on each mount, rotate the mounts so that each is sighted on the point that the mast will occupy. Read the azimuth dial on each mount. Determine the angle from the opposite tracking radar antenna to the position of the bore sighting mast for each radar mount. Subtract the sum of these angles from 3,200 mils. The answer will be the inclined angle made by the two arms of the target assembly. This angle is set by use of the azimuth scale on the target assembly.

[redacted]

(2) As a first approximation for the elevation setting of the mount at a point in space approximately 10 man heights, ing mast "jim pole" heights above the intended mast elevation angle from the elevation dial on each mount. Al two elevation angles and divide by two. The result will b to set the horn on the bore sight pole so that it will vertical plane between the tracking mounts when the mast is set to this angle, using the elevation scale on the targ

(3) After the mast and the target assembly have been raise r-f horn must be pointed properly with respect to the tracking mounts.

58. AZIMUTH ADJUSTMENT. Sight the optics of either tracking mount on the target assembly so that the vertical reticle line of the telescope is on the zero mark of the left-hand target for the mount being used. Note the position of the ball on the end of the sighting rod projecting from the target arm. Physically rotate the mast until the ball and the zero mark on the target fall on the vertical reticle line of the telescope. Check for a similar ball and zero coincidence on the left-hand target for the other tracking mount. If the procedures have been followed carefully, the ball and zero should be on the vertical reticle.

59. ELEVATION ADJUSTMENT. Sight the optics of each tracking mount on the target assembly so that the horizontal reticle is lined up on the two ball ends of the sighting rods projecting from the elevation scale at the r-f horn. If both tracking mounts are on the same elevation and if the r-f horn is properly pointed in elevation, the horizontal reticle of each telescope should cross the elevation scale at the zero mark. If the balls, target, and reticle appear as in figure 39, the mast assembly may be tilted forward or backward slightly to obtain the appearance of figure 40. If the mast must be moved an excessive amount, it should be lowered and the horn readjusted to minimize the difference previously noted. If the tracking mounts are at different elevations, the horizontal reticle of each telescope should cross the elevation scale at the same number but of opposite sign (plus for the lower tracking mount, minus for the higher).

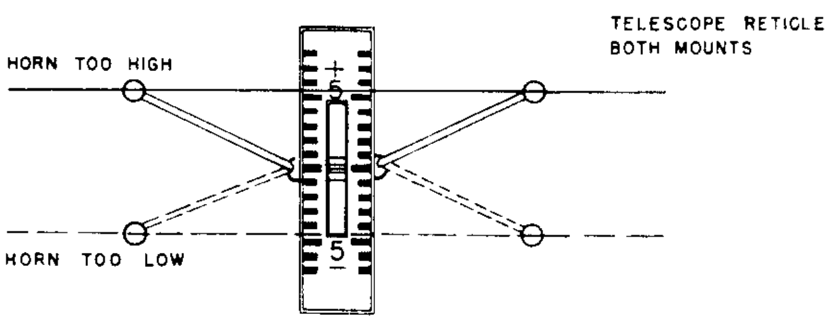


Figure 39. Target assembly (before elevation adjustment).

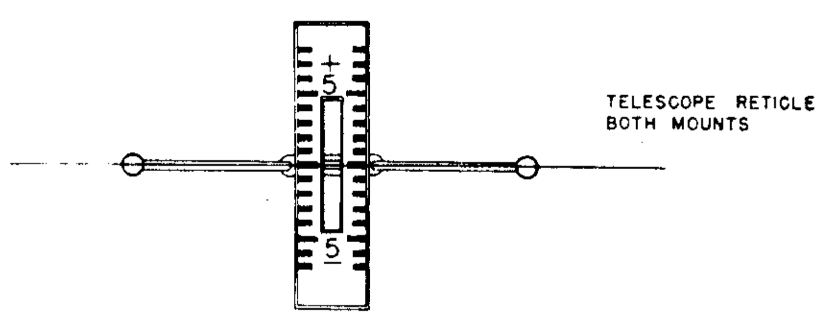


Figure 40. Target assembly (after elevation adjustment).

[redacted]

CHAPTER 5

CONDUCT OF FIRE

THE ANTIAIRCRAFT OPERATIONS CENTER (AAOC)

[illegible] The tactical headquarters of an antiaircraft defense commander (AADC) [illegible] operations center (AAOC). It is the agency provided to collect and evaluate information and disseminate it as intelligence for the antiaircraft defense. It is the agency through which operational control over subordinate units is exercised.

61. RESPONSIBILITIES AND FUNCTIONS. For this agency to accomplish its mission effectively it must receive certain information from an Air Force agency. It will be the responsibility of the Air Force agency to furnish the AAOC early warning information, final target identification, and the flight status of all friendly aircraft in the vicinity of the defense (see FM 44-1 for air defense organization). The AAOC must perform the functions listed below:

a. Collection and evaluation of target information and dissemination of intelligence.

b. Target designation to appropriate fire units.

c. Method of engagement to be used by fire units.

62. THE BATTALION INFORMATION AAOC. The battalion information AAOC is a subordinate AAOC established by each battalion commander to monitor the activities of the senior AAOC exercising operational control over all the defense fire units. Under emergency conditions defined by the AA commander, a battalion information AAOC may exercise operational control of the battalion fire units. When designated by the AA commander, it will function as the senior AAOC.

Section II. THE NIKE I BATTERY

63. GENERAL. The purpose of this section is to delineate a sequence of events which will enable a Nike I fire control officer to engage the designated target. The success of the whole defense pattern depends upon the ability of each fire control officer to exercise proper fire control over his unit.

64. PRELAUNCH PHASE. After the battery has been alerted and the designated target has been acquired by the acquisition radar, the following sequence of events take place:

a. A launcher section is designated. At the time of the STAND BY order, the number of missiles prepared for action will be indicated on the battery control console. The particular launcher which is to fire first will be designated at the section. The launchers at the designated section will be erected, which will indicate to the fire control officer that the launching section is ready. The missile radar will slew to the designated missile automatically. When the missile-tracking radar receives a signal return of sufficient strength from the missile beacon, the radar will be switched to operate in automatic track.

b. The target-tracking radar is placed on target. The fire control officer, by means of manual controls, places electronic markers over the target indicated on the acquisition radar PPI scope. These controls also position similar electronic markers on the target-tracking radar scope, indicating to the radar operators the particular target that is to be tracked.

[redacted]

[redacted]

c. The time to fire is then determined from the course of the as predicted on the plotting boards. Time to fire will be computed for opening fire at max range unless the specified methods of engagement dictate otherwise.

d. The launcher section status is checked prior to firing. This be indicated on the battery control console.

65. ENGAGEMENT PHASE. a. The missile is fired. This is accomplished by the fire control officer at the tactical control panel. In an emergency, the firing may accomplished at the launcher section, provided communication facilities are operative. The mber of missiles fired depends upon the method of engagement.

b. To insure that the engagement is progressing satisfactorily, the FCO checks the progress of the engagement by means of the plan and elevation plotting boards on which the paths of the missile and the target are followed to the burst point. If the missile plot indicates an erratic round, the FCO can determine when to fire the next round to meet the specified method of engagement. The FCO should depend on firing only three out of the four missiles available in each launching section due to possible missile failure. A fourth missile will then be available in each launching section if one of the designated missiles should fail.

c. The FCO determines when each missile has reached the target and prepares to launch the next missile as dictated by the method of engagement. The plotting boards previously mentioned will provide this information The time of detonation can also be determined on the target-tracking radar scope.

d. A report is made to the AACC or battalion information AAOC, as required by SOP, upon completion of each target engagement. The report will include an estimation as to the success of the engagement.

Section III. SEQUENCE OF OPERATIONS

66. GENERAL. For the firing unit to accomplish its mission with minimum confusion, maximum efficiency, and the best possible utilization of all available personnel, a series of specific operating procedures have been set up. All personnel should be made thoroughly familiar with the sequence of operations to be performed. Because of the varied duties to be performed by assigned personnel as well as the distances involved, the operational procedures to be performed at the battery have been separated into two areas, the battery control area and the launcher control area. These areas are further subdivided.

a. Battery control area.

(1) Radar control trailer.

(2) Battery control trailer.

b. Launcher control area.

(1) Launcher.

(2) Launcher section.

(3) Launcher control trailer.

67. SEQUENCE OF NIKE I ALERTS. The procedures involved in maintaining and operating the battery so that personnel involved will each carry out his duties at the required moment are symbolized by four intrabattery colored light signals activated in the following sequence:

[redacted]

[redacted]

[illegible] The appearance of each of these lights acts as a signal for the [illegible] certain specific operations. The 4-color alert status is peculiar [illegible] should not be confused with the AAOC conditions of readiness.

[illegible] ERT STATUS AND AAOC CONDITION OF READINESS. The conditions [illegible] disseminated by the AAOC for surface-to-air guided missiles will be the [illegible] units, that is, all clear (secure), standby, and battle stations. See FM 44-4 [illegible] explanation of these conditions of readiness. The times at which these conditions of readiness will be disseminated are a decision of the antiaircraft defense commander. They are related to the air raid warning which has been received in the AAOC from the ADCC. All clear (secure) will be the normal condition of readiness when no attack is probable or imminent. Upon receipt of all clear (secure), the Nike I battery will go into its white alert status. Standby will be the condition of readiness when an attack is probable. It should be disseminated by the AAOC to the Nike I battery as soon as warning yellow is received from the ADCC and preferrably not later than 15 minutes prior to the time the Nike I battery is expected to fire. Upon receipt of standby, the Nike I battery should immediately go into its yellow alert status. Battle stations will be the condition of readiness disseminated when an attack is imminent. It must be given approximately one minute prior to the time the Nike I battery is expected to fire. It should not be given more than five minutes prior to the time the Nike I battery is expected to fire to avoid needless wearing out of the missiles by repeated warm-up. It is not necessarily disseminated when air raid warning red is received from the ADCC. Condition of readiness battle stations will require the Nike I battery to go through both its intrabattery blue and red alert status. The times indicated above, i.e., 15 minutes for warm-up during standby and 1 minute for missile warm-up during battle stations, must be more accurately determined during service tests. The times given are based upon estimates of the times required to warm up the equipment and the missiles. Recommended operational procedures to be followed under each condition of readiness and its corresponding Nike I intrabattery alert status are listed in paragraphs 69 through 72. Table III shows the Nike I intrabattery alert status for each corresponding AAOC condition of readiness.

Table III. NIKE I ALERT STATUS.

AAOC CONDITION OF READINESS	NIKE I INTRABATTERY ALERT STATUS
All clear (secure)	White alert
Standby	Yellow alert
Battle stations	Blue alert: When missile ready signal is received on the battery control console, go into Nike I red alert status.

69. NIKE I ALERT STATUS WHITE. The white alert status is the normal condition of readiness for the battery during the all clear (secure) condition of readiness from AAOC. All personnel not on duty must remain within a specified time-distance from their specific action stations. Routine reports pertaining to the tactical condition of the battery will be furnished to the fire control officer at specified intervals. All equipment will be periodically checked to insure its readiness for use within ten minutes after an alert. Surveillance equipment will be continually manned, and security stations will be maintained. Alert lights and alarm circuits will remain energized. Normal training and continued maintenance in the general battery area will be carried on.

[redacted]

70. NIKE I ALERT STATUS YELLOW. The yellow alert is given ... notification by AAOC of condition of readiness standby. When the yellow alert status is g... 1, all alarm systems within the surrounding areas will be automatically sounded. Each l... ching crew will prepare its missiles. Personnel will warm up the engine generators and ch... the power supplies and control equipment. After an appropriate interval, the alarms wil... e deactivated at each location. Table IV lists operational procedures for yellow alert.

Table IV. YELLOW ALERT OPERATIONAL PROCEDUR...

LAUNCHERS

(1) Camouflage is removed.
(2) Main power switch is turned on.
(3) Booster conditioning equipment is removed.
(4) Missile air pressure is checked.
(5) Internal battery condition is checked.
(6) Additional checks required by SOP are made.
(7) Report is made to the launcher section control, LAUNCHER No. ______ PREPARED.

SECTION CONTROL (fig. 42)

(1) Main power plant and switch are turned on.
(2) Hydraulic and launcher power switches are turned on.
(3) Report is made to launcher control, as each launcher and missile is reported prepared, by depressing the PREPARED push-button switch.
(4) Report is made to the launcher control, SECTION No. ________ IN ORDER.

LAUNCHER CONTROL TRAILER (fig. 43)

(1) Relay power switch is turned on.
(2) IN ORDER reports are received from sections.
(3) LAUNCHING DETAILS IN ORDER is reported by voice to the fire control officer.
(4) The responder will be tested. Verification of the responder response indications will be made by telephone.

BATTERY CONTROL TRAILER

(1) On the tactical control panel (fig. 44), the ALERT STATUS rotary switch is placed on YELLOW.
(2) The NO PREPARED meter on the battery control signal panel is checked to determine the number of available missiles.
(3) The TRACK TRANSMITTER FILAMENTS toggle switch on the acquisition power control panel is placed in the ON position.
(4) The COMPUTER POWER toggle switch on the computer power control panel is placed in the ON position.
(5) The PLATE VOLTS toggle switch on the computer power control panel is placed in the ON position.
(6) The SERVO DC toggle switch on the computer power control panel is placed in the ON position.

RADAR CONTROL TRAILER

Radar power control panel:

(1) PHASE rotary switch is placed in the C position.
(2) The ADJUST PHASE C control knob is rotated until the line volts meter reads 120V.
(3) The MAIN POWER switch is placed in the ON position.

... OWER switch is pl... in ... ON position.
... ATE VOLTS toggle ... placed in the ON pos...

... ntrol panel (fig. 45):

... PLY control knob is rotated counterclockwise to the START position.
... PLY ON pushbutton is depressed.
... PPLY control knob is rotated until the proper meter reading is obtained ... amperes magnetron current).
... toggle switch is placed in the ON position.

... NSITY CONTROL knob is rotated clockwise until barely a trace is visible.
... AIN control knob is rotated until a satisfactory noise level is achieved.

Precision indicator:

(1) The INTENSITY control knob is rotated clockwise until barely a trace is visible.
(2) The GAIN control knob is rotated until a satisfactory noise level is achieved.

Track azimuth indicator:

(1) The INTENSITY control knob is rotated clockwise until barely a trace is visible.
(2) The FOCUS CONTROL knob is rotated to obtain a clearly defined trace.

Track range indicator:

(1) The INTENSITY control knob is rotated clockwise until barely a trace is visible.
(2) The FOCUS control knob is rotated until a clearly defined trace is obtained.

Track elevation indicator:

(1) The INTENSITY control knob is rotated clockwise until barely a trace is visible.
(2) The FOCUS control knob is rotated until a clearly defined trace is obtained.

Radar power control panel:

(1) The MISSILE POWER toggle switch is placed in the ON position.
(2) After a 30-second delay, the MISSILE PLATE VOLTS toggle switch is placed in the ON position.

Missile tracking control panel (fig. 46):

(1) The HV SUPPLY control knob is rotated counterclockwise to the start position.
(2) The HV SUPPLY ON pushbutton is depressed.
(3) The HV SUPPLY control knob is rotated until the magnetron current is 13 miliamperes.
(4) The IND HV toggle switch is placed in the ON position.

Track range indicator:

(1) The INTENSITY control knob is rotated clockwise until barely a trace is visible.
(2) The FOCUS control knob is rotated until a clearly defined trace is obtained.

71. NIKE I ALERT STATUS BLUE OR RED. a. The blue alert status is directed when the AAOC directs condition of readiness battle stations. The launcher section chief insures that personnel are in the revetment, the launchers are raised, and the heaters and gyros of the selected missile are turned on. The ON DECK order originates in the launcher control trailer. This signal should be given approximately seven minutes prior to launching. To insure the availability of a sufficient number of missiles it may be necessary to place more than one section ON DECK. Under normal conditions the remaining sections are placed ON DECK during the red alert. Table V lists operational procedures for blue alert.

Table V. BLUE ALERT OPERATIONAL PROCEDURE

LAUNCHERS

(1) The rail support yoke safety lock, the air regulator pin, the shorting plug from the new booster squib, and the booster cap from the old booster squib connection will be removed and kept. On a service practice missile it is also necessary to pull and keep the spotting charge pin.

(2) The booster electrical lead to the booster squib electrical disconnect at the base of the launcher will be connected.

(3) Upon completion of (1) and (2), the launcher crew chief will verify that all pins have been removed and that all personnel have returned to the section revetment.

(4) Report is made to launcher section, LAUNCHER No. ________ READY.

LAUNCHER SECTION

(1) The senior crewman will send all personnel from the ON DECK section to the revetment.

(2) The launcher crew chief, after ascertaining that all of his crew are within the revetment, will actuate the LAUNCHER READY light by inserting his key in the launcher ready switch on the left side of the launcher section control cabinet (fig. 41).

Figure 41. Launcher ready switches.

(3) When the LAUNCHER READY signal is activated the senior launching crewman will erect the launcher.

(4) For the missile about to be launched:

(a) The HEATER AND GYROS switch is turned on.

(b) The MISSILE HYDRAULIC switch is turned on (red alert).

(5) When the green READY TO FIRE light appears at the section, the chief of section will designate the launcher.

(6) The status switch will be turned to the SECTION READY TO FIRE position.

LAUNCHER C... TROL

...N READY lights are lighted, the section which will launch first will

...ADY is sent to the battery control trailer by placing the ready to fire ... READY TO FIRE position.

...Y CONTROL TRAILER (TACTICAL CONTROL PANEL)

... board CONDITION switch is placed in the REF MARK position.

... board CONDITION switch is placed in the OPERATE position.

RADAR CONTROL TRAILER

Missile track indicating panel. The elevation and azimuth dials are monitored to check if the missile track antenna has been slewed to the coordinates of the test responder.

... Track range indicator. The range dial is monitored to check if the missile track antenna has been slewed to the coordinates of the test responder.

b. The red alert status is initiated as soon as the missile ready signal is received from the launcher area. No particular response will be required at the launchers upon notification of a red alert status. The ON DECK and SECTION SELECTED crews will remain in the revetment. The other sections will continue with their prescribed duties. The actions taken on entering the red alert status are listed in table VI.

Table VI. RED ALERT OPERATIONAL PROCEDURE

LAUNCHER SECTION

(1) The power for the external HEATERS AND GYROS on all erected missiles will be turned ON.

(2) The section control operator will hold the command test CYCLE switch closed for 25 seconds for the designated missile.

(3) The gyro preset system is checked to see that it presets to the new heading prescribed by the computer.

(4) The crew prepares to select another missile in the event of a misfire or a reject from the missile tracking radar operator.

(5) All stand by for an emergency launching.

LAUNCHER CONTROL TRAILER

(1) To insure a constant flow of missiles, another section is ordered on deck at the appropriate time.

(2) After the section presently launching has expended its missile, a new section is selected.

BATTERY CONTROL TRAILER

PPI indicator:

The target is observed and located on the indicator.

Acquisition control panel:

The CHALLENGE pushbutton is depressed. If the proper response is not received, the FOE pushbutton is depressed,or other action prescribed by SOP procedures is taken.

Target designate control panel:

(1) The range handwheel is rotated until the range circle is positioned on the target.

Table VI (contd).

(2) The flashing azimuth line is placed on the target by rotating control knob and depressing the outer ring of the azimuth control.

(3) The range circle is kept on the target by rotating the range handw l.

(4) The flashing azimuth line is kept on the target by rotating the az uth control knob.

(5) When the acquisition operator has superimposed the range circle a flashing azimuth line on the target, the DESIGNATE-ABANDON switch is held the DESIGNATE position.

Tactical control panel:

(1) The plotting board condition switch is placed in the PLOT positio

(2) The computer condition switch is placed in the ACTION positio

(3) At the proper time, the FIRE toggle switch is operated to fire the missile.

RADAR CONTROL TRAILER

Target tracking control drawer:

(1) When the designate buzzer sounds, the acquire switch is held to the left until the target-tracking antenna slews to the azimuth and range coordinates of the target.

(2) The designated target is maintained on the azimuth line of the precision indicator automatically, since the MAN-AID-AUTO switch is in the AUTO position.

(3) The designated target is maintained on the range line of the precision indicator automatically, since the MAN-AID-AUTO switch is in the AUTO position.

Missile track control drawer:

If the missile is to be rejected, the reject button is depressed.

Target track control drawer:

(1) The elevation operator searches for the target in elevation by operating the slew switch. As soon as he is approximately on the target, he rotates the elevation handwheel until the two pips on the track elevation indicator are equal in amplitude. He verbally signals the other radar operator by the report TARGET, to begin tracking the target by means of their tracking indicators.

(2) When the coast lamp on the control drawer is extinguished, indicating that the tracking radar is on target, the elevation operator places his man-aid-auto-elev aid switch in the AUTO position. The tracking radar then tracks the target automatically in all coordinates.

(3) The azimuth operator then depresses the tracked push button, which signals the fire control officer that the target tracking radar is locked on the target.

72. AFTER-LAUNCHING OPERATIONS. After the supply of prepared missiles in a section is exhausted, the section control operator positions the launcher section switch to NONE and lowers the launchers individually, approximately 5 seconds after the missile is fired. This will expedite reloading operations. The launching section chiefs will turn off their key switches prior to the return of the launcher crews to the launchers.

Section IV. ANALYSIS OF FIRE

·ERAL. To properly evaluate and analyze the operating efficiency of his per- ·quipment, the unit commander must keep a permanent record of all battery activities ·cal engagement or target practice.

·ENT RECORDER. The event recorder is a photographic recording devise used ·permanent record of equipment operation and battery activity during red alert from ·gnal to the burst order. It is located in the same cabinet as the switchboard in the ·rol trailer.

Film. The film is a sensitized photographic paper 200 feet long and 12 inches ·astened on a drum roll and is drum fed. It travels at the rate of 6 inches per minute.

Channels. There are 24 channels capable of recording missile data. Eleven of the· ·els are used in recording equipment operation and battery activity during a red alert, · ·he remaining thirteen are spares. A channel is used to record each of the following actions:

(1) The time missile track signal occurs, if and when missile reject signal occurs, and when the plus or minus gimbal limit stops are reached in the com- ter.

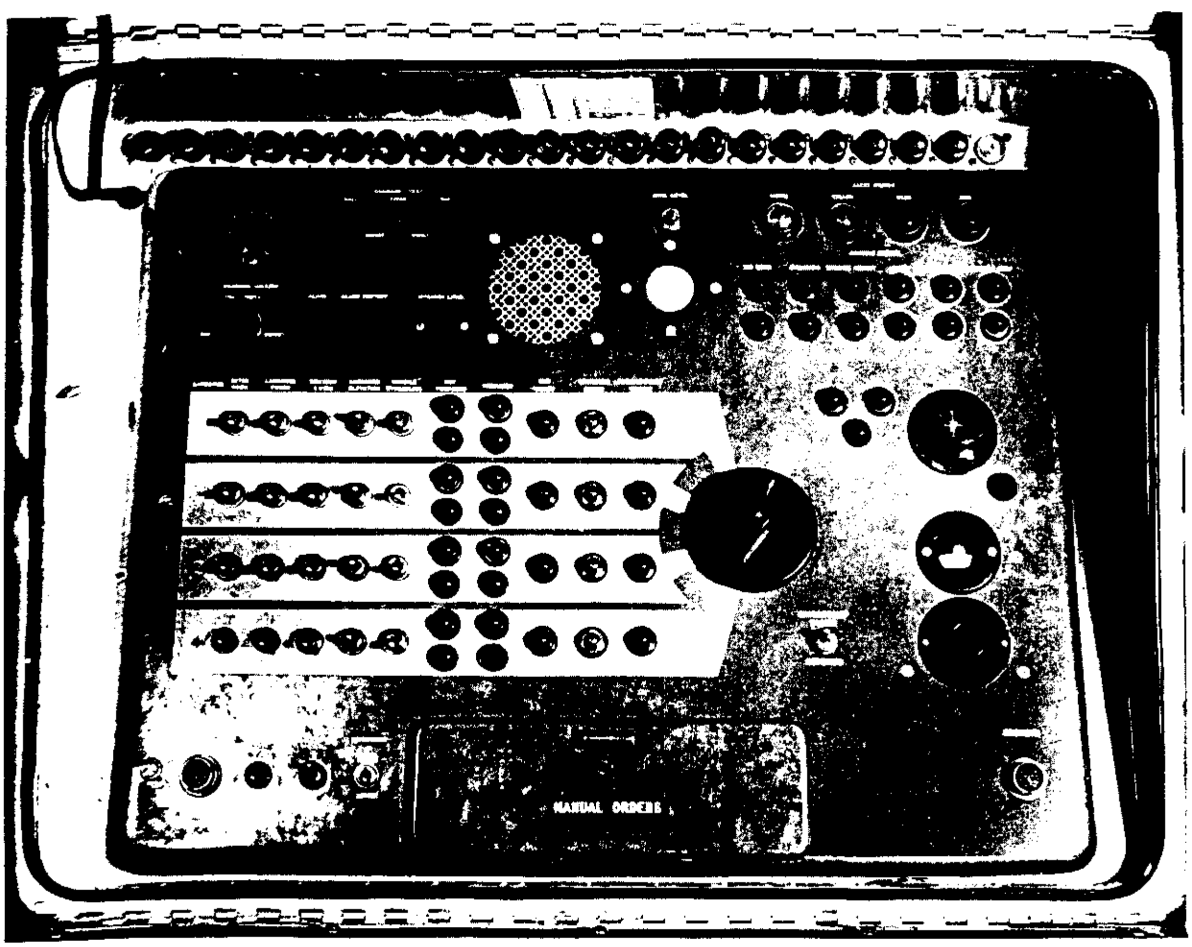
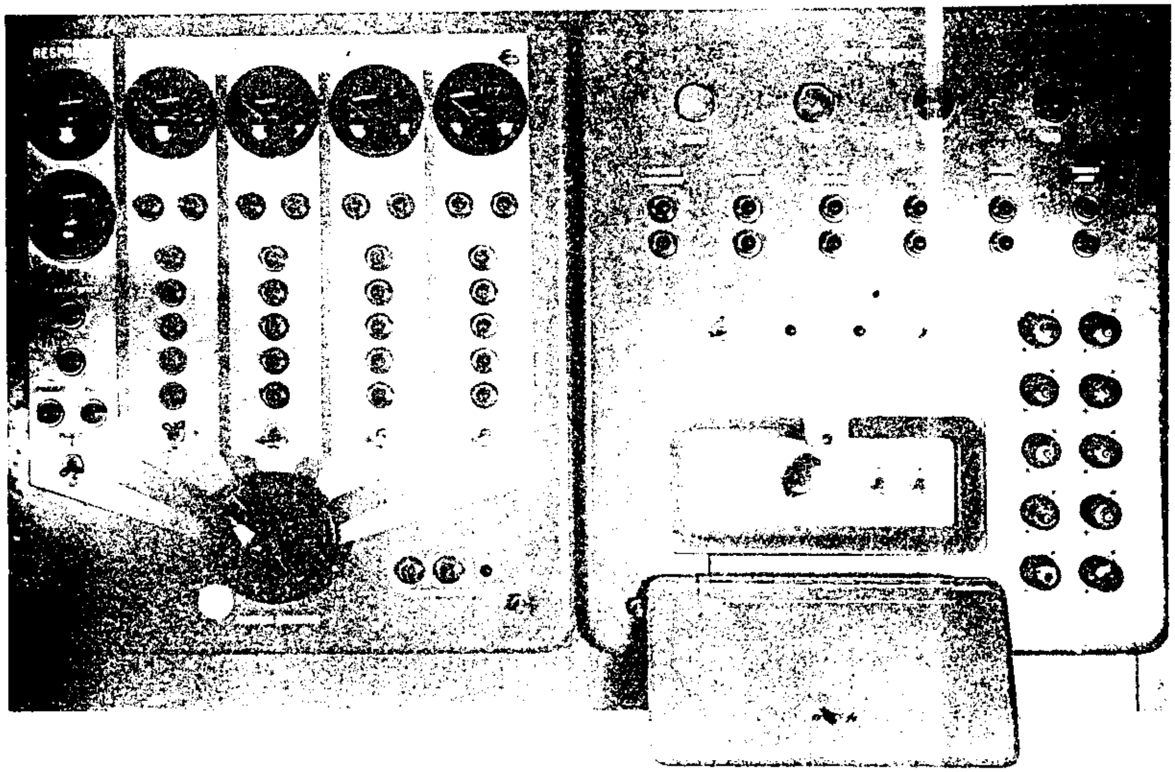


Figure 42. Launcher section control panel.



[illegible] marker console.

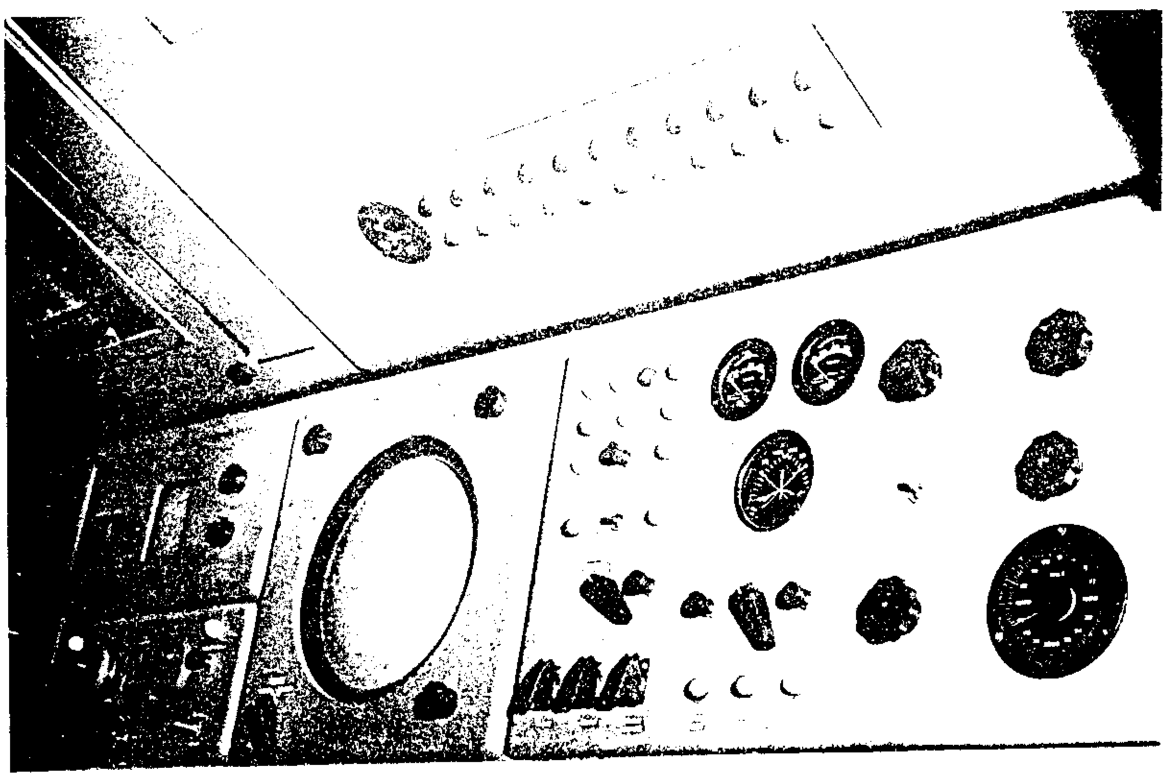


Figure 44. Tactical control panel.

[redacted]

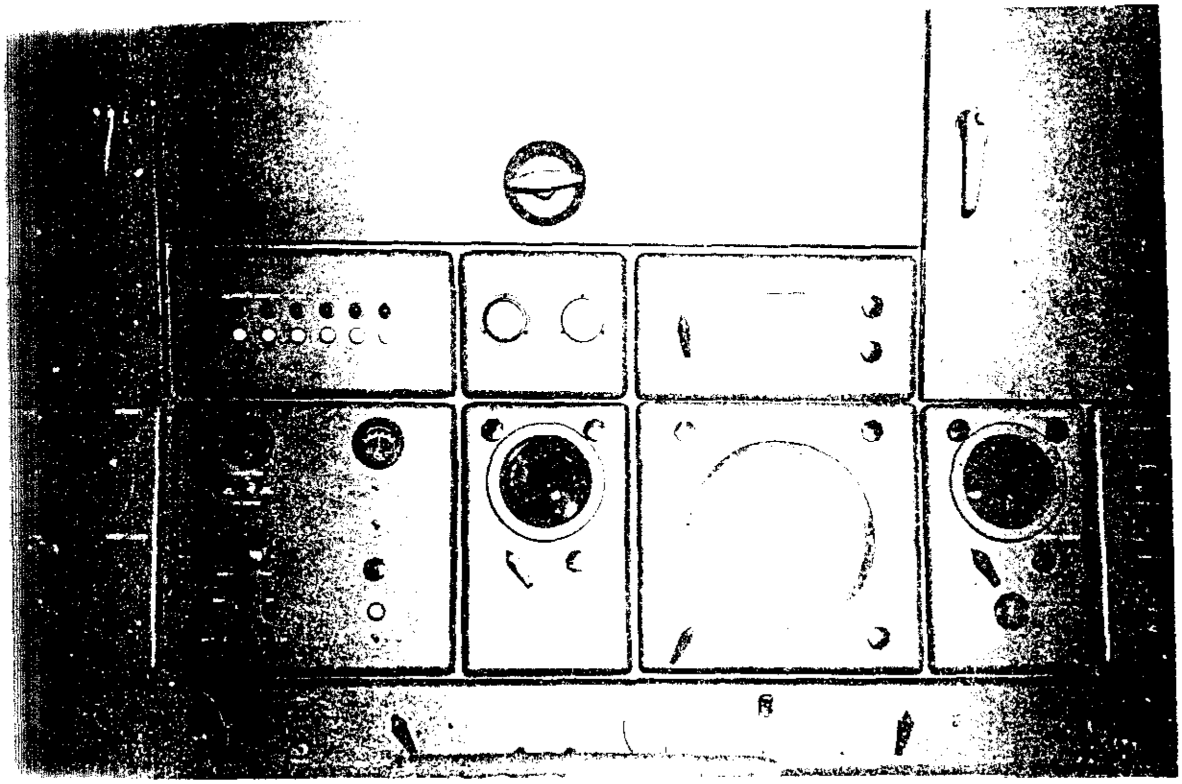


Figure 45. Target-tracking radar control panel.

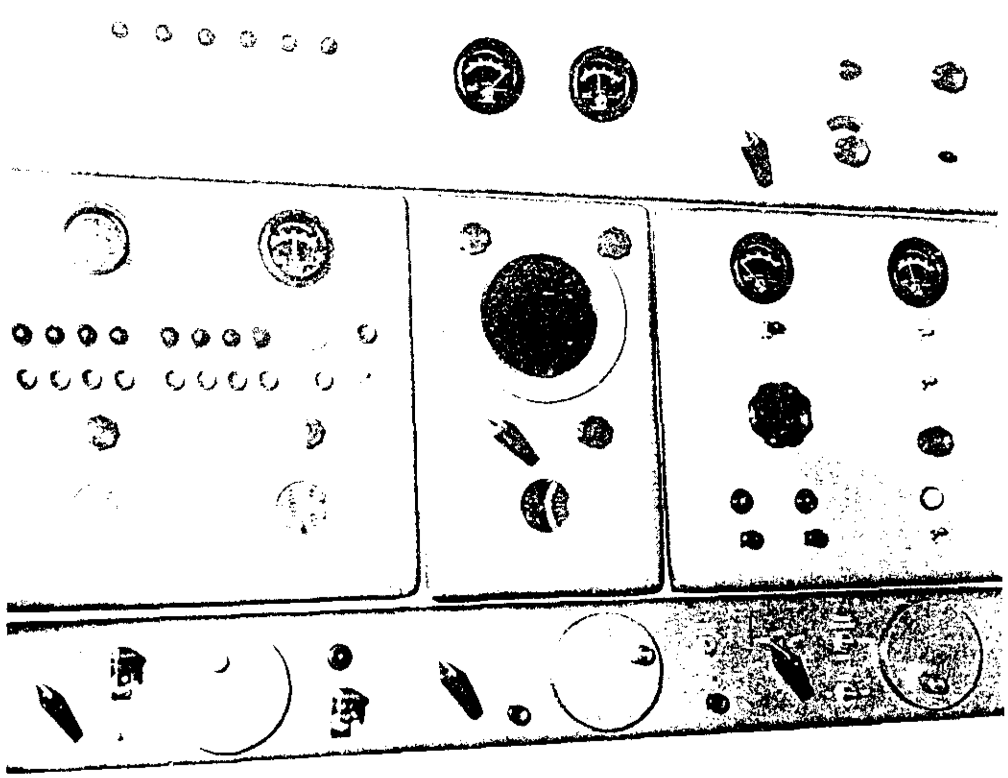


Figure 46. Missile-tracking radar control panel.

[redacted]

(2) To indicate when the target is designated and tracked and when the computer becomes ready. This channel also indicates when the missile is fired, when missile away occurs, and when the burst occurs.

(3) The continuous G_p order sent from the computer to the missile-tracking radar.

(4) The continuous G_y order sent from the computer to the missile-tracking radar.

(5) The three component velocities of the target. At burst, these channels are switched over so that they record the apparent miss distance at time zero in each of the three coordinates.

(6) The AGC voltage (operation of the radar).

(7) Which section has been designated to fire.

(8) Which launcher in the above section has been designated to fire.

(9) The number of missiles ready at any given time.

[redacted]

PART THREE

PROCEDURE AND DRILL

CHAPTER 7

THE LAUNCHING PLATOON

Section I. ORGANIZATION OF THE LAUNCHING PLATOON

75. GENERAL. The launching platoon receives the assembled missiles from the assembly and service section (ch. 9) and prepares the designated missiles for launching by the fire control officer. The AAA missile battery is made up of a headquarters section, a communication section, and two platoons, the fire control platoon and the launching platoon (fig. 47). The launching platoon consists of a platoon headquarters and four launching sections. The platoon headquarters consists of 1 officer, 1 warrant officer, and 12 enlisted men. Each of the 4 launching sections consists of 8 enlisted men.

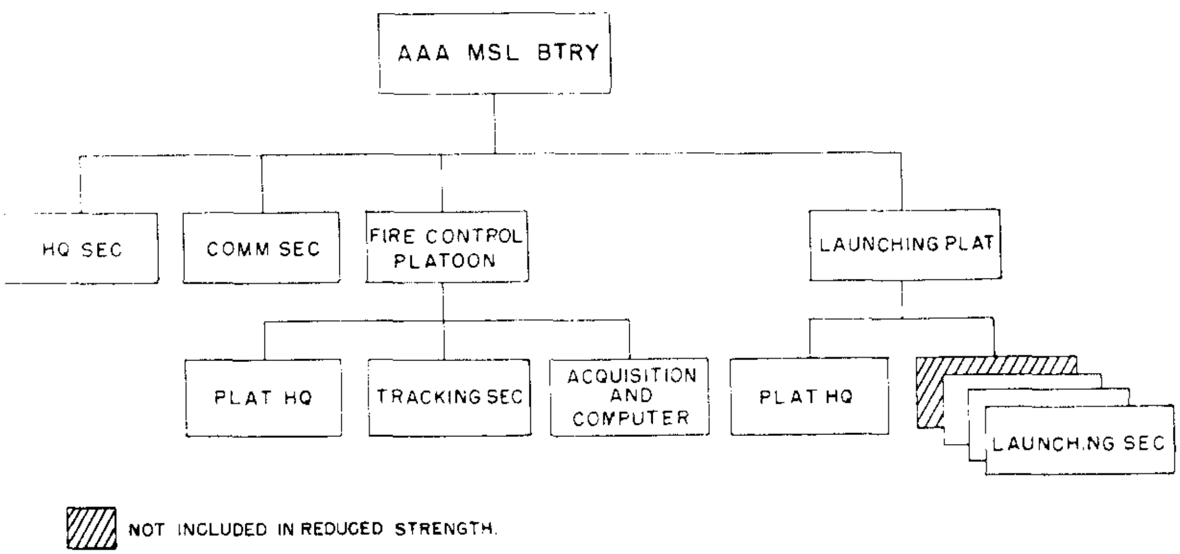


Figure 47. AAA missile battery.

76. PLATOON HEADQUARTERS. The platoon headquarters consists of a platoon leader, missile warrant officer, platoon sergeant, guided missile mechanic, SAM electronics materiel specialist, air compressor operator, five SAM assembly crewmen, SAM firing panel operator, portable generator operator, and a switchboard operator.

a. Platoon leader. Coordinates, plans, directs, and supervises the operation of the equipment and personnel assigned to the platoon. He assumes full command and responsibility for the actions of the platoon.

b. Missile warrant officer. Supervises and coordinates activities of personnel engaged in the assembling, testing, adjusting, and repair of Nike I guided missiles.

[redacted]

c. Platoon sergeant. Supervises and coordinates activities of t... nching platoon.

d. Guided missile mechanic. Exercises technical supervision of ssile assembly and performs the more complex duties involved in the mechanical aspects of embly, such as uncrating and assembly of the hydraulic and propulsion system, testing for lfunctions, replacement of defective components, and fueling. He also supervises and perfo s duties in connection with the supply and storage of warheads and propellants.

e. SAM electronics materiel specialist. Assist in the technic supervision of assembly and performs the more complex duties involved in the uncrating, a sembly, testing, adjusting, and replacing of defective components of internal electronic gu nce equipment.

f. Air compressor operator. Operates and performs operator ma tenance on air-compressing machines.

g. SAM assembly crewman. Assists in the assembly, testing, and preventive maintenance of Nike I missiles, including airframes, internal guidance equipment, warheads, propulsion systems, and other major components.

h. SAM firing panel operator. The firing panel operator sets up, orients, synchronizes, checks functioning of, performs preventive maintenance on, and operates Nike I missile integrated fire control equipment. This includes firing panels, automatic data transmission systems, and associated equipment.

i. Portable generator operator. Operates and performs operator maintenance on engine generators.

j. Switchboard operator. Operates and maintains field telephone switchboards.

77. LAUNCHING SECTION. A launching section consists of a launching section chief (LSC), a senior launcher crewman, a launcher crewman, three assembly helpers, a firing panel operator (FPO), and a portable generator operator.

a. Launching section chief. The LSC is in charge of the entire launching section and is responsible to the launching platoon leader for the emplacement, orientation, operation, and maintenance of Nike I launchers, missiles, and associated materiel under his charge. He is also responsible for the training and the performance of duties of the members of his section.

b. Senior launcher crewman. The senior launcher crewman assists in emplacing, displacing, transporting, and performing preventive and organizational maintenance on the launchers and associated equipment. He also assists in transporting and loading missiles and boosters onto launchers; installing warheads; and fueling, when done at the launching site.

c. Launcher crewman. The launcher crewman assists in emplacing, displacing, and transporting launchers and associated equipment and performing preventive and organizational maintenance. He also assists in transporting and loading missiles and boosters onto launchers; installing warheads; fueling, when done at the launching site; and operating the firing panel.

d. Assembly helpers. The assembly helpers assist in the assembly, testing, and preventive maintenance of Nike I missiles. This includes work on airframes, internal guidance equipment, warheads, propulsion systems, and other major components. They also assist in emplacement and displacement of the launcher and launcher section equipment.

e. Firing panel operator. The FPO sets up, orients, synchronizes, checks functioning of, performs preventive maintenance on, and operates Nike I missile integrated fire control equipment. This includes firing panels, automatic data transmission systems, and associated equipment.

generator operator. Operates and performs operator maintenance on engine

Section II. DRILL AND PROCEDURES

Safety requirements dictate that no launcher be reloaded while another [illegible] section is in the process of firing. Thus, reloading of launchers will take [illegible] Since any specific rate of fire must be predicated on the time involved in re- [illegible] launchers in a section, it is imperative that a set procedure be followed by each member of the launching crew. Constant repetition or drill by each crewman in the performance of his duties will increase the efficiency of the section and permit a higher rate of fire.

[illegible]. EMPLACEMENT OF THE LAUNCHER CONTROL TRAILER. The trailer is towed into position by its prime mover. The position area should be as level as possible to reduce the amount of jacking required to level the trailer. This will in turn keep the stresses on the trailer body to a minimum. When the trailer is in position, the parking brakes are set (fig. 51), the wheels are chocked (fig. 52), and the prime mover is unhooked. The trailer is then leveled by means of the four leveling jacks incorporated in the trailer's undercarriage (fig. 55). Most of the equipment carried in the launcher control trailer in transit is held in position by tie-down cables. These cables, after emplacement, are stored in the general purpose locker. Personnel perform the steps listed below after the trailer is leveled:

a. Lower the rear platform to a horizontal position and attach the rear steps (fig. 56).

b. Remove the launcher-section operating cabinets and power cabinets and transport them to the section revetments.

c. Release the launcher control trailer furniture from the traveling tie-downs and position them in the proper places in the trailer (fig. 12).

d. Remove the alarm siren from the cabinet on the roadside wall at the rear of the trailer and install it on the siren bracket.

e. Assemble the three sections of the responder-mast assembly.

f. Position the bottom section of the mast assembly on the bracket provided on the front of the trailer. Install the rope and pulley assembly and the mast platform on the mast.

g. Position the responder unit on the mast platform. Connect the responder cable to the top of the mast (fig. 48).

h. Drive the ground rod into the ground a short distance from the forward section of the curbside wall of the trailer. Connect the wire assembly from the ground rod to the terminal in the trailer junction box.

i. Connect handsets and headsets to the jacks at the launcher control officer's desk, the utility table, the test responder station, the generator station, and to two jacks at the control console stations.

j. Install external cables.

(1) Connect the three cables from the battery control trailer to the proper receptacles in the launcher control trailer junction box.

(2) Connect the four cables from the launcher sections to the proper receptacles in the launcher control trailer junction box.

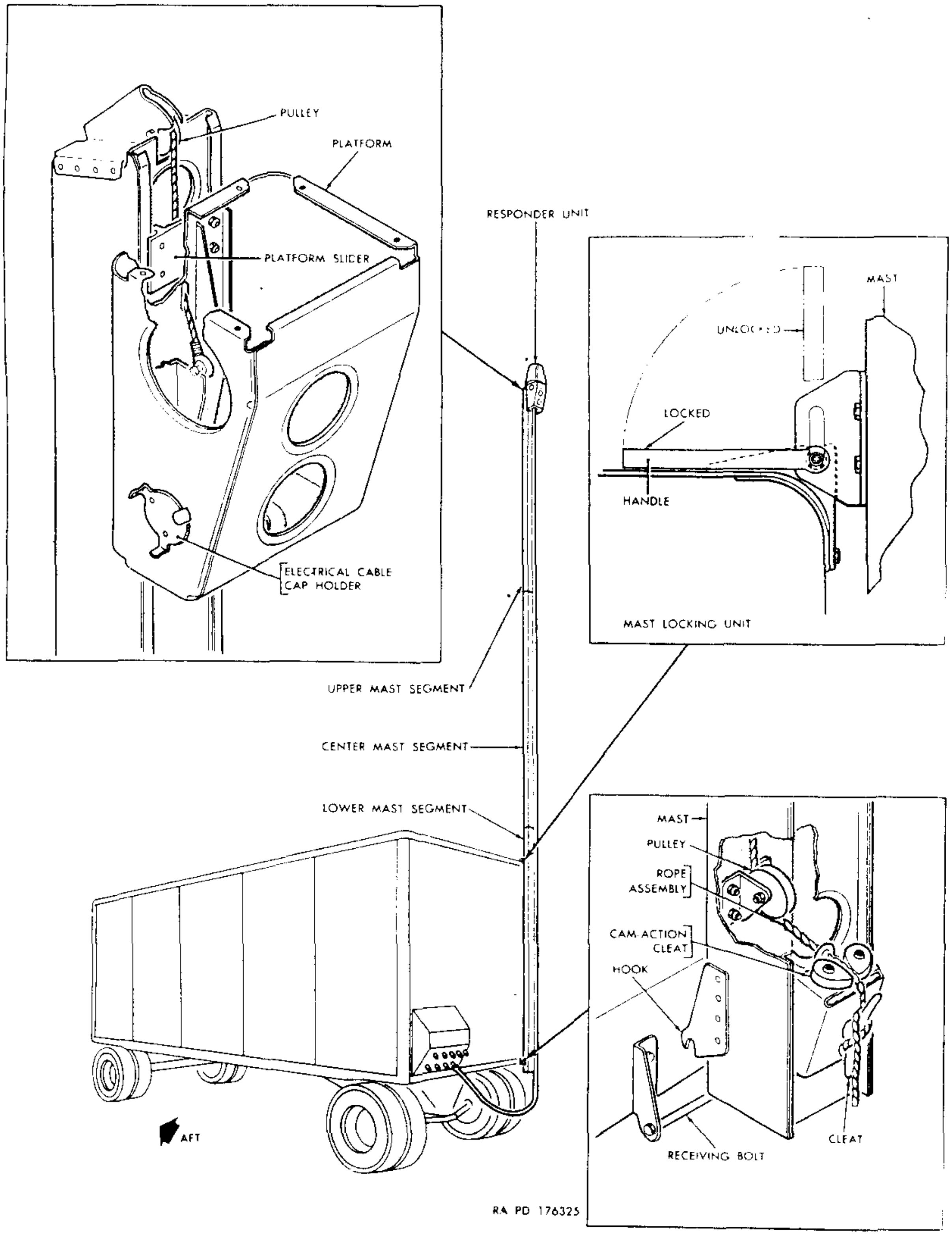


Figure 48. Installation of responder.

the power cable from the generator to the proper receptacle in the control trailer junction box

the test responder cable to the launcher trailer junction box.

...E OF THE LAUNCHER CONTROL TRAILER. Personnel perform the ... preparing the launcher control trailer for traveling:

... the following switches to the OFF position.

(1) Control trailer main power.

(2) Console main power.

(3) Heat and vent main power.

b. Turn off the engine generator.

c. Disconnect the power cable connecting the launcher control trailer with the generator.

d. Disconnect the following cables from the launcher control trailer junction box, first making sure that the launcher section generators are turned off:

(1) Three cables from the battery control trailer.

(2) Cable from the responder unit.

(3) Four cables to the launcher sections (one to each section).

e. Disconnect the field telephone wires from the trailer junction box.

f. Disconnect the ground-rod wire assembly from the trailer junction box and remove the ground rod from the ground.

g. Lower the test responder to the trailer platform. Disconnect the cable from the test responder unit. Store the test responder in the storage cabinet.

h. Disconnect the test responder mast assembly from the launcher control trailer.

i. Disassemble the test responder mast assembly and store in the supports provided.

j. Detach the alarm siren from its bracket and store in the storage cabinet.

k. Secure the furniture within the trailer.

l. Transport the launcher section operating and power cabinets to the launcher control trailer. Secure these in the trailer with the turnbuckles provided.

m. Detach and secure the steps to the radar platform.

n. Close and lock the trailer main entrance door.

o. Raise the rear platform to a vertical position and secure it with the latches provided.

p. Retract the leveling jacks until the trailer is resting on its own undercarriage.

q. Connect the prime mover to the trailer.

81. EMPLACEMENT OF LAUNCHER AND THE LOADING AND STO GE RACKS. A prime mover will tow the launcher assembly into position on the launchin site. This prime mover will also transport the loading and storage racks and other equipme associated with the launcher. The launcher-section operating cabinet and power cabinet wil e transported to the launching site in the launcher control trailer. Personnel perform the o ations listed in table VII.

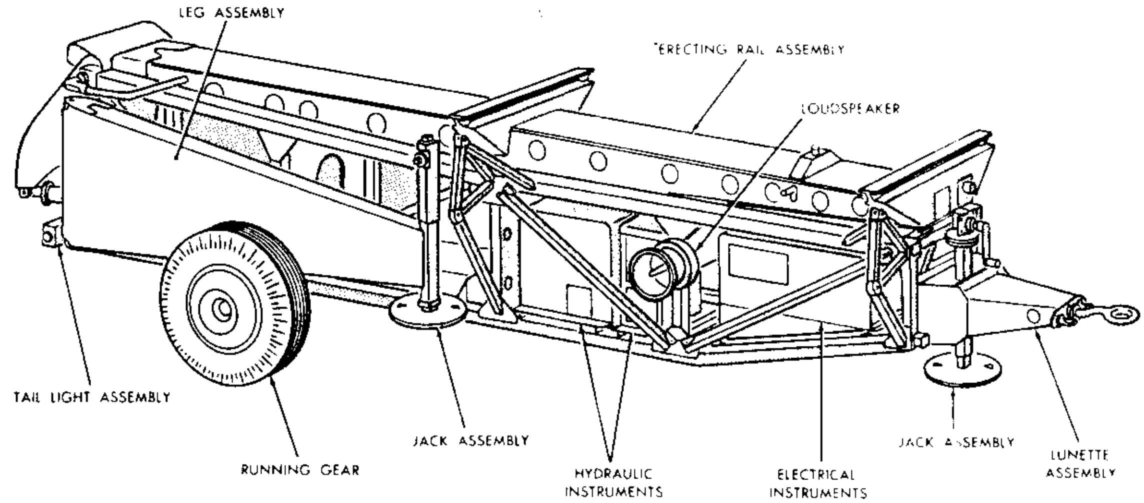


Figure 49. Launcher in traveling position.

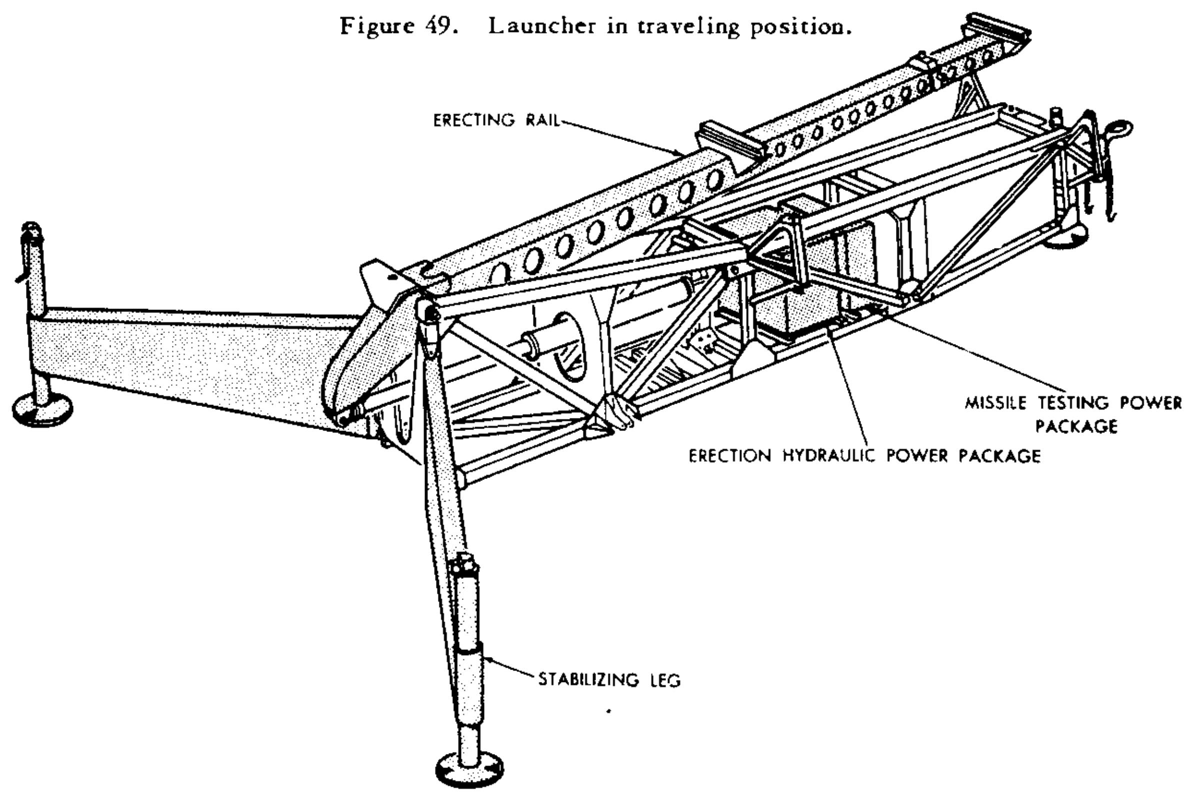


Figure 50. Launcher emplaced.

[redacted]

VII. LAUNCHER EMPLACEMENT PROCEDURE

LAUNCHER (figs. 49 and 50)

[illegible] prime mover from launcher.

[illegible] forward jack, extend the leg jacks, and disengage the launcher axle and [illegible] from the launcher.

[illegible] bumper and running light assembly from the launcher.

[illegible] the stabilizing leg jacks and unfold the stabilizing legs until they reach [illegible] stops.

[illegible] the launcher at a height of 42 inches by extending the forward launcher jack and the stabilizing leg jacks.

(6) Check the level of the launcher by placing a level on the erecting-rail leveling pads.

(7) Tie down launcher to the previously prepared concrete slab or substitute.

LOADING AND STORAGE RACKS (fig. 14)

(1) Unload the truss units from the prime mover.
(2) Place three end-truss and six side-truss units to the left of the launcher and place two end-truss and four side-truss units to the right of the launcher.
(3) Assemble truss units by means of the slip pins provided. There will be three sections of the rack to the left of the launcher and two units to the right of the launcher.
(4) Secure the open end of the side-truss units to the base structure of the launcher.
(5) Level the loading and storage racks by adjusting the supporting legs.
(6) Attach the storage box to the left end of the loading and storage rack.
(7) Remove the launcher operating panel from the base of the launcher and clamp it on the forward side truss on the left side of the launcher.
(8) Remove the loudspeaker from the base of the launcher and install it next to the launcher operating panel on the forward side of the left truss.
(9) Starting 20 inches from the left end, install a clamp assembly for each of the three missile test stations 80 inches apart on the forward side-truss units.
(10) At each missile test station, connect a manual shutoff valve and the hydraulic pressure and return lines.
(11) Mount the clamp assembly and the four-way hydraulic selector valve on the left side of the launcher on the forward side truss approximately 12 inches from the launcher attach point.
(12) Connect necessary hydraulic pressure and return lines from the four-way hydraulic selector valve to the missile test stations, the missile testing hydraulic power unit, and the launcher.
(13) Connect the electrical cable assemblies from the junction box for each missile testing station to the disconnects on the left end of the launcher operating panel.
(14) Remove the hold-down trunnion slip pins that hold the erecting rail in the cradle.

LAUNCHER SECTION REVETMENT

(1) Emplace the portable engine-driven generator not less than 50 feet from the section revetment.
(2) Transport the launcher section operating cabinet and power cabinet from the launcher control trailer to the launcher section revetment.
(3) Place the power cabinet on firm footing in the bottom of the revetment and install the operating cabinet on top of the power cabinet.
(4) Connect the necessary cables from the operating and power cabinets to the launcher junction box.
(5) Connect the cable from the power cabinet to the engine-driven generator. Make sure that the main power generator switch is in the OFF position.

[redacted]

(6) Connect the cable between the section operating cabinet and launcher control trailer.
(7) Make the necessary telephone connections.

82. MARCH ORDER.

a. Turn off the generator.

b. Disconnect the cables leading from the launcher section.

c. Disconnect the cables from the launcher to the test stations. Remove and stow the launcher operating panel in its traveling position on the launcher.

d. Disconnect, remove, and store in the equipment storage box the clamp assemblies, manual shutoff valve, hydraulic pressure and return lines, and the 4-way selector valves.

e. Disconnect the loading and storage racks from the launcher.

f. Disassemble the loading and storage racks and load on the prime mover.

g. Attach the light assembly to the launcher and install demountable running gear.

83. TWO-MAN LAUNCHER LOADING PROCEDURE. The launcher erecting arm will be in the lowered or down position (par. 72). No member of the launcher loading team will leave the revetment until directed to do so by his section chief. The two-man crew will then perform the steps listed in table VIII.

Table VIII. TWO-MAN LAUNCHER LOADING PROCEDURE

Number 1	Number 2
1. Goes to the front of the empty transport rail on the lowered erecting arm.	1. Goes to the left side of the launcher between the loading racks.
2. Disconnects the hydraulic and electrical connections from the old transport rail.	2. Unlocks the front and rear transport rail locking assemblies on old rail.
3. Assists No. 2 to push the old rail to the right until it strikes the bumper assembly.	3. Assists No. 1 to push the old rail to the right until it strikes the bumper assembly.
4. Goes to the next missile to be fired and disconnects the electric and hydraulic connections at the test station.	4. Goes to the next missile to be fired and unlocks the two transport rail locking assemblies.
5. Assists No. 2 to push the new missile onto the erecting arm.	5. Assists No. 1 to push the new missile onto the erecting arm.
6. Makes the electric and hydraulic connections between the new missile and the erecting arm; removes and keeps the yoke pin assembly.	6. Locks the new missile transport rail to the erecting arm; pulls and keeps the air regulator safety pin; removes and keeps the booster cap from the old booster squib connection; connects the booster squib on the new booster, retaining the shorting plug in his possession.

...er 1	Number 2
...ching power. Turns on	7. Locks the rear locking assembly on the old rail.
...ard hydraulic connections	8. Checks the ground power plug for leaks.
Reports over the intercomm system: LAUNCHER ________ READY TO FIRE.	9. Prepares to return to revetment.
10. When ordered by section chief, returns to section revetment. Otherwise, continues maintenance on missile.	10. When ordered by section chief, returns to section revetment. Otherwise, continues maintenance on missile.
11. Gives the yoke pin assembly to the section chief.	11. Gives the air regulator pin, the shorting plug from the new booster, and the booster cap from the old booster squib connection to the section chief.
12. Inserts crew safety key into launcher ready switch on side of control cabinet and turns to ON when directed to do so by his section chief.	12. Remains in revetment.

[redacted]

CHAPTER 8

THE FIRE CONTROL PLATOON

Section I. ORGANIZATION OF THE FIRE CONTROL PLATOON

84. GENERAL. The fire control platoon (fig. 47) is responsible for the operation and maintenance of the acquisition radar, computer, missile-tracking radar, and target-tracking radar. It is composed of a platoon headquarters consisting of one officer, two warrant officers, and three enlisted men; a tracking section consisting of nine enlisted men; and an acquisition and computer section consisting of nine enlisted men.

85. PLATOON HEADQUARTERS. *a. Platoon leader.* Coordinates, plans, directs, and supervises the operation of the equipment and personnel assigned to the platoon. He has full command and responsibility for the actions of the platoon.

b. Guided missile integrated fire controller (warrant officer). Supervises and coordinates activities of fire control personnel engaged in transportation, installation, orientation, synchronization, operation, and organizational maintenance of integrated fire control equipment used for tracking aerial targets and external guidance of Nike I missiles. He tests, adjusts, replaces major components of, and performs organizational maintenance on integrated fire control equipment.

c. Portable generator operator. Operates and performs operator maintenance on engine generators.

d. Switchboard operator. Operates and maintains field telephone switchboards.

86. TRACKING SECTION. *a. Section sergeant (one per section).* Supervises and coordinates the activities of fire control personnel in transportation, installation, orientation, synchronization, operation, and organizational maintenance of integrated fire control equipment used for tracking aerial targets and external guidance of the Nike I missile. Tests, adjusts, and performs organizational maintenance on integrated fire control equipment.

b. Chief radar operator (two per section). Same as a above.

c. Radar operator (six per section). Sets up, orients, synchronizes, checks functioning of, performs preventive maintenance on, and operates Nike I integrated fire control equipment.

87. ACQUISITION AND COMPUTER SECTION. *a. Section chief (one per section).* Same as in paragraph 85a.

b. Assistant section chief (one per section). Same as a above.

c. Chief computer operator (one per section). Same as a above.

d. Radar operator (three per section). Same as in paragraph 85c.

e. Computer operator (three per section). Same as d above.

Section II. DRILL AND PROCEDURES

88. GENERAL. A suitable site is selected for emplacing the battery control elements, keeping in mind maximum and minimum distances between the elements of the battery, radar lines of sight, parallax limitations, and suitability of the terrain.

[redacted]

ENT FOR THE FIRE CONTROL PLATOON. The battery control trailer, ...er, and the maintenance and spare parts trailer are emplaced on as firm ...und as possible. See appendix II for recommended earth-compacting tech... are leveled by means of the leveling jacks incorporated in their under... ...l perform the emplacement procedures listed in table IX.

...ble IX. FIRE CONTROL EMPLACEMENT PROCEDURE

BATTERY CONTROL TRAILER

... trailer has been pulled into the selected position, set the trailer brake (fig. ...lace a wheel chock at each wheel (fig. 52), disconnect the brake and light cable, ... the prime mover away.

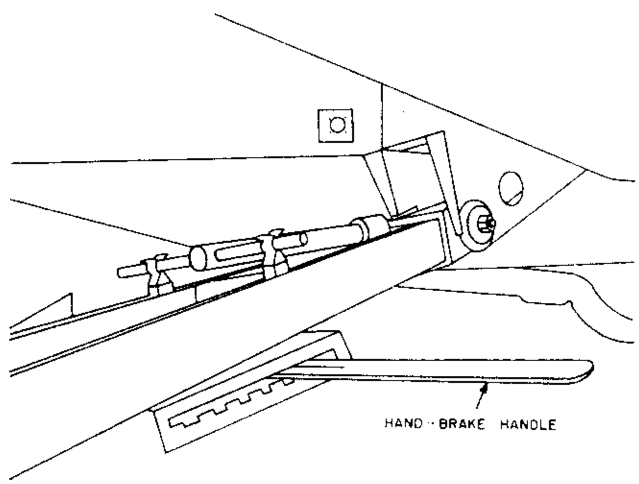


Figure 51. Trailer brake.

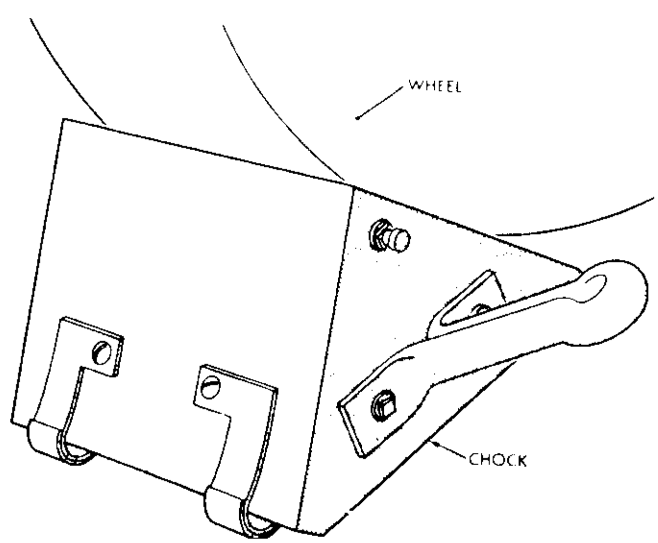


Figure 52. Wheel chock emplaced.

Table IX (Contd)

(2) Place the front and rear tie rods in the installed position (figs. [illegible] 54).

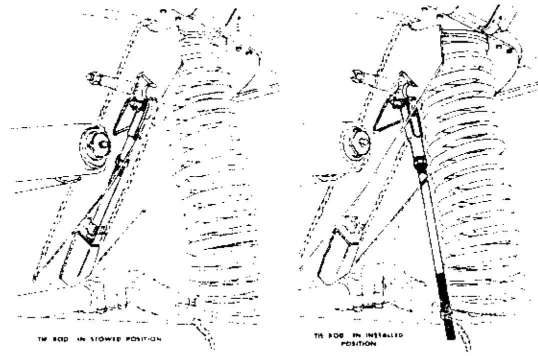


Figure 53. Front tie rods.

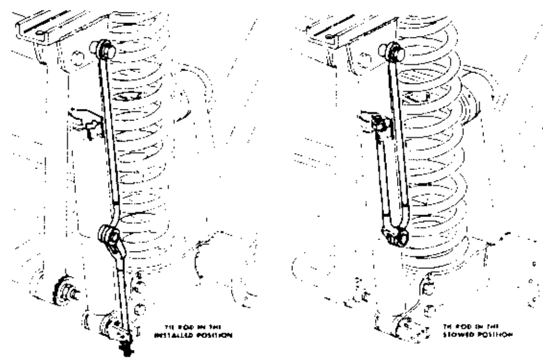


Figure 54. Rear tie rods.

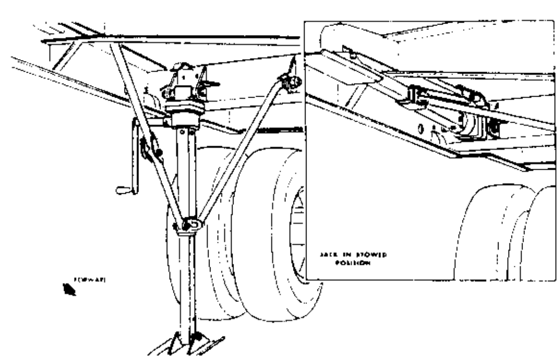


Figure 55. Leveling jack emplaced.

(3) Drop and lock the leveling jacks into position (fig. 55).

(4) Extend the jacks until they rest firmly on the ground.

and secure the rear platform; remove the rear steps from inside the asten securely to the rear platform (fig. 56).

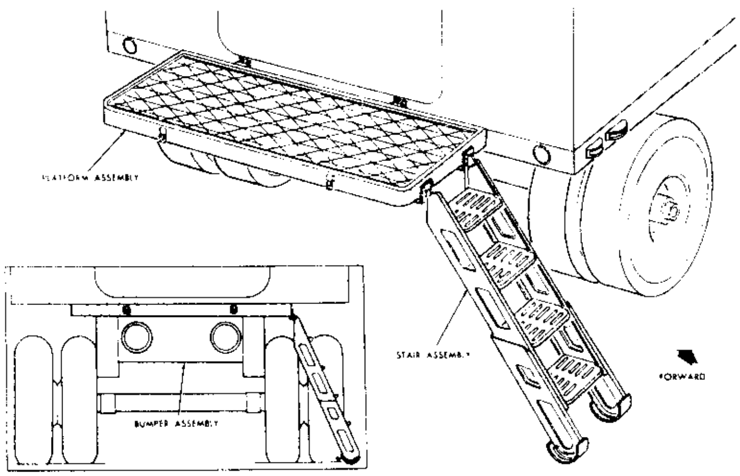


Figure 56. Steps and platform emplaced.

(6) Open all the air vents.

(7) Release all chairs and other movable equipment from the traveling position and put into the operating position (fig. 8).

(8) Release the plotting board pen carriages and install the plotting pens.

(9) Level the trailer.

(10) Connect the external cables when ready.

RADAR CONTROL TRAILER

The procedure for the emplacement of the radar control trailer is the same as for the battery control trailer above except for step No. 8 which is omitted and figure 8 which is not applicable; see figure 7 instead of figure 8.

TARGET-TRACKING RADAR TRAILER AND ANTENNA

(1) After the trailer has been pulled into the selected position, set the trailer brake (fig. 51), place a wheel chock at each wheel (fig. 52), disconnect the brake and light cable, and drive the prime mover away.

(2) Install the steps.

(3) Release the spring snubber assemblies on the front and rear undercarriages from their traveling position and place in the installed position (fig. 57).

(4) Remove and store the shields from the leg assembly mounting surfaces and the protective covers from the equipment inclosure vents.

Table IX (Contd).

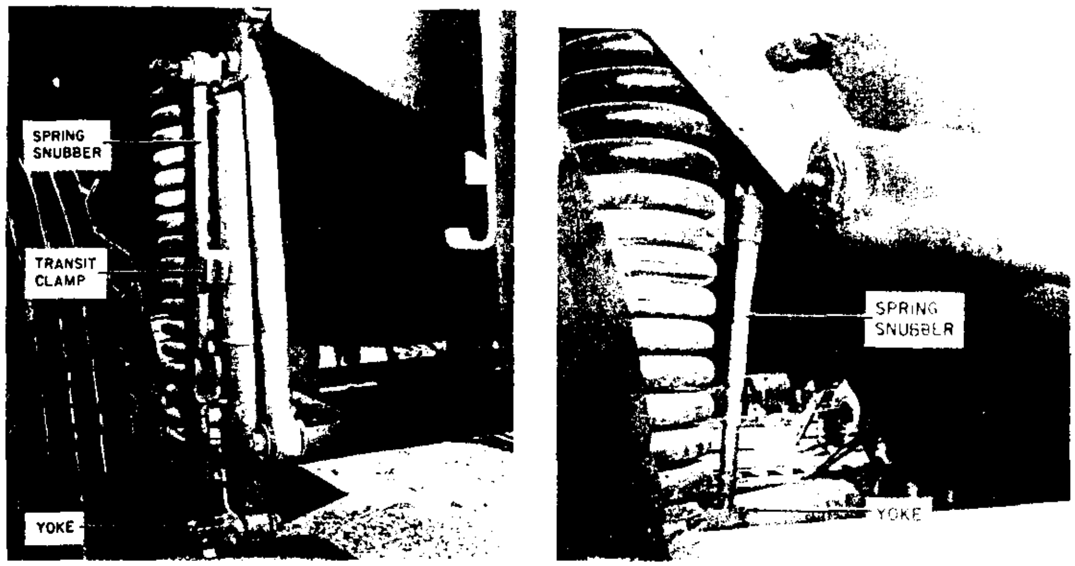


Figure 57. Snubber assemblies.

(5) Attach the three leg assemblies (figs. 58 and 59).

(6) Extend the three leveling jacks until the antenna mount is raised approximately 1½ inches.

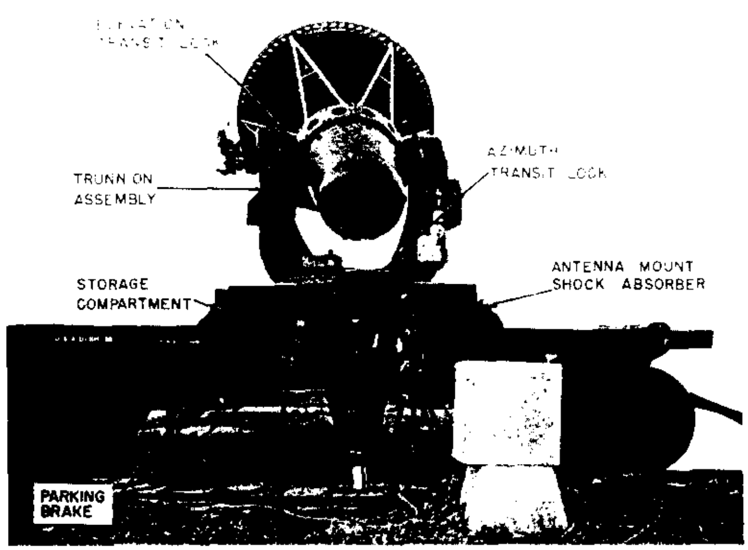


Figure 58. Track antenna assembly, curbside.

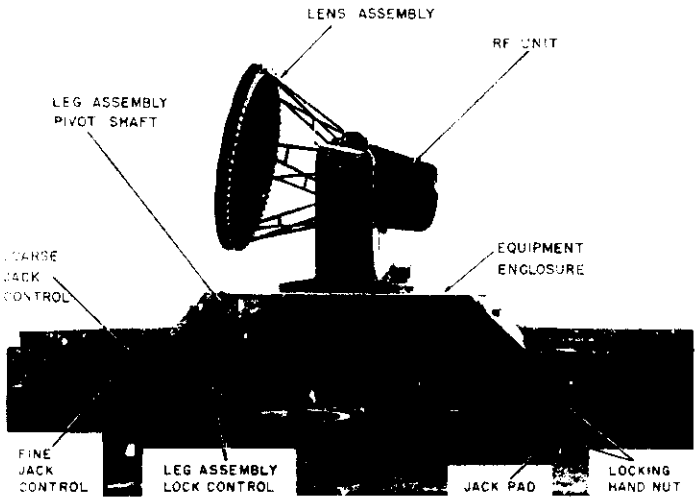


Figure 59. Track antenna assembly, roadside.

(7) Raise the antenna mount from the shock absorbers (fig. 58).

(8) Remove the canvas covers from the trunnion assembly and store in the equipment storage compartment (fig. 58).

(9) Release the lens assembly from the trailer deck and install.

(10) Unlock the r-f unit in elevation (fig. 58).

(11) Unlock the trunnion assembly in azimuth (fig. 58).

(12) Procure the sighting and viewing telescopes from the storage com[illegible]ent (fig. 58) and install on the trunnion assembly.

(13) Place the antenna disable switch in the NORMAL (up) pos[illegible].

(14) Connect the external cables when ready.

(15) Level as explained in chapter 5.

MISSILE-TRACKING RADAR TRAILER AND ANTENNA

The procedure for emplacement of the missile-tracking radar trailer and antenna is the same as for the target-tracking radar trailer and antenna, except that it is performed at the site selected for the missile-tracking radar.

ACQUISITION ANTENNA

The emplacement of the acquisition antenna in the Nike I system is the same as that used in the emplacement of the acquisition antenna in the AA fire control system M33, except for the external cable connections. Appropriate Department of the Army publications should be consulted for more detailed instructions than listed below.

(1) Remove the modulator from the maintenance and spare parts trailer and set it on the site selected for the acquisition radar.

(2) Remove the r-f coupler and the antenna drive unit from the maintenance and spare parts trailer, and set them on the top of the modulator in that order (fig. 60).

(3) Install the three mounting legs by inserting the ball joints at the top of each leg into the receiving sockets on the antenna drive unit (fig. 61).

(4) Attach a jack assembly to each leg and tighten the swing bolts (fig. 62).

Table IX (Contd).

Figure 60. Emplacing acquisition radar assembly components.

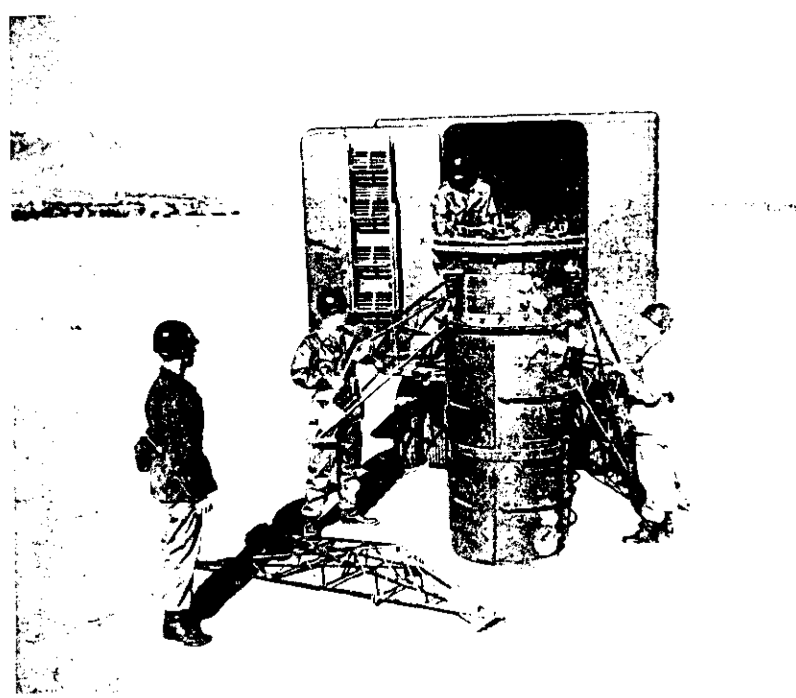


Figure 61. Installing mounting legs.

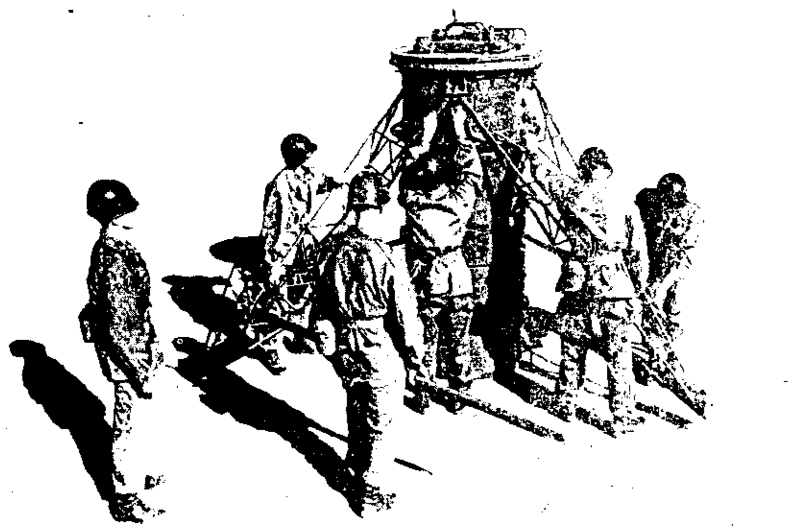


Figure 62. Attaching jack assembly to leg.

(5) **Attach the leg braces** to the mounting legs (figure 63).

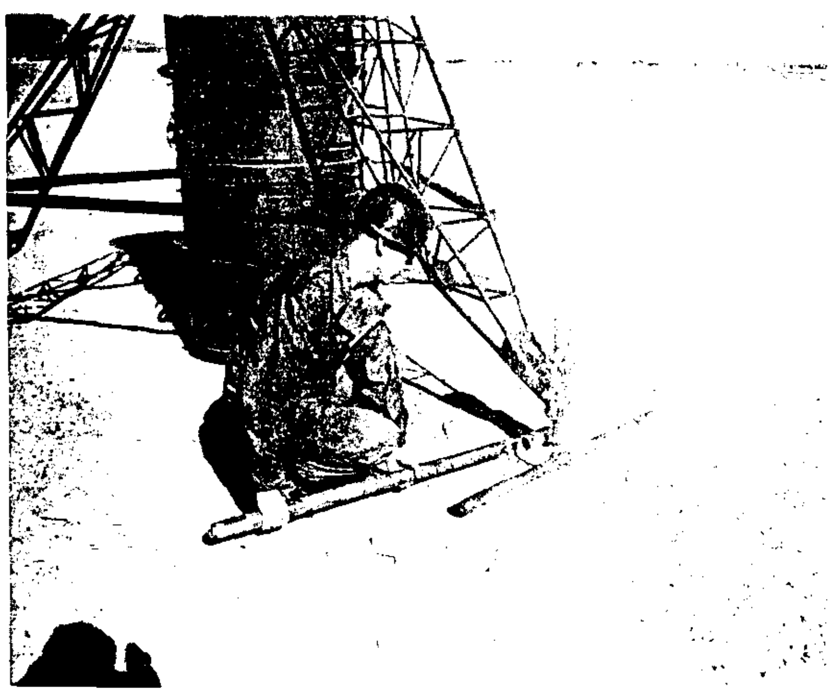


Figure 63. Attaching leg braces

Table IX (Contd).

(6) Position the r-f coupler under the antenna drive unit so that the key positions line up, insert the locking pins, and lock the two units together.

(7) Position the modulator under the r-f coupler so that the key positions line up, insert the locking pins, and lock the two units together.

(8) Adjust the leg assemblies until the assembled units are approximately level (fig. 64).

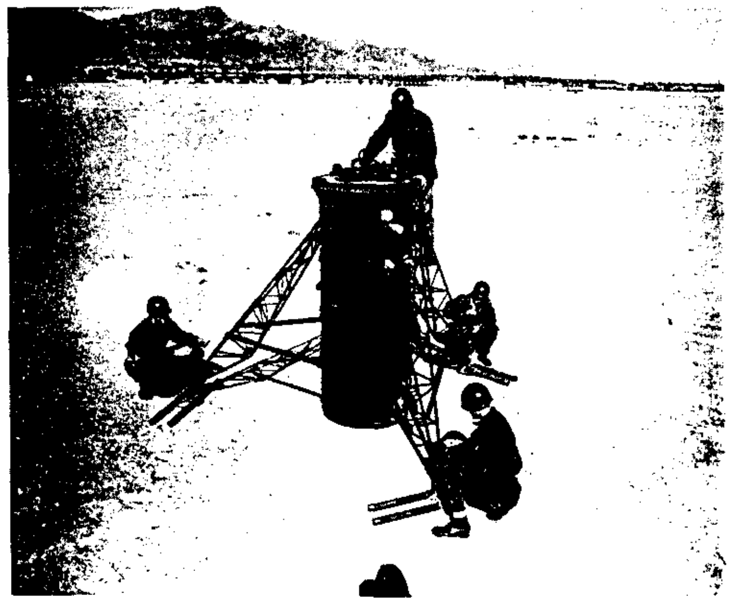


Figure 64. Leveling assembled components.

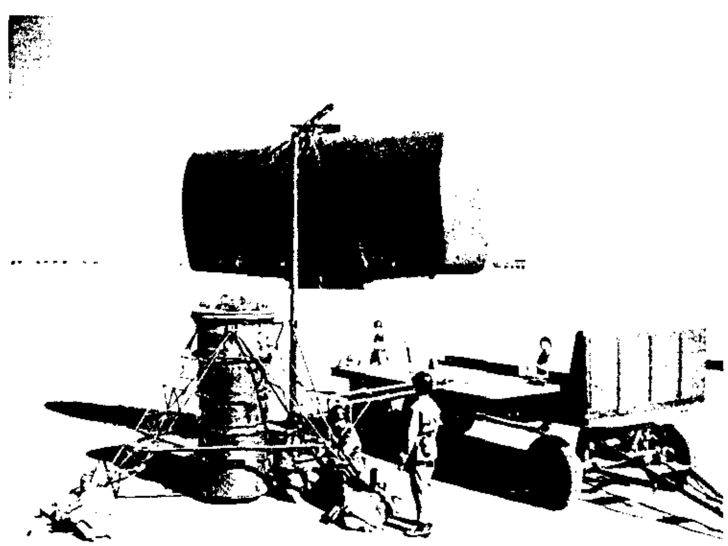


Figure 65. Removing antenna from trailer.

na trailer to the emplacement site, set up the derrick, and lift the an-
trailer (fig. 65).

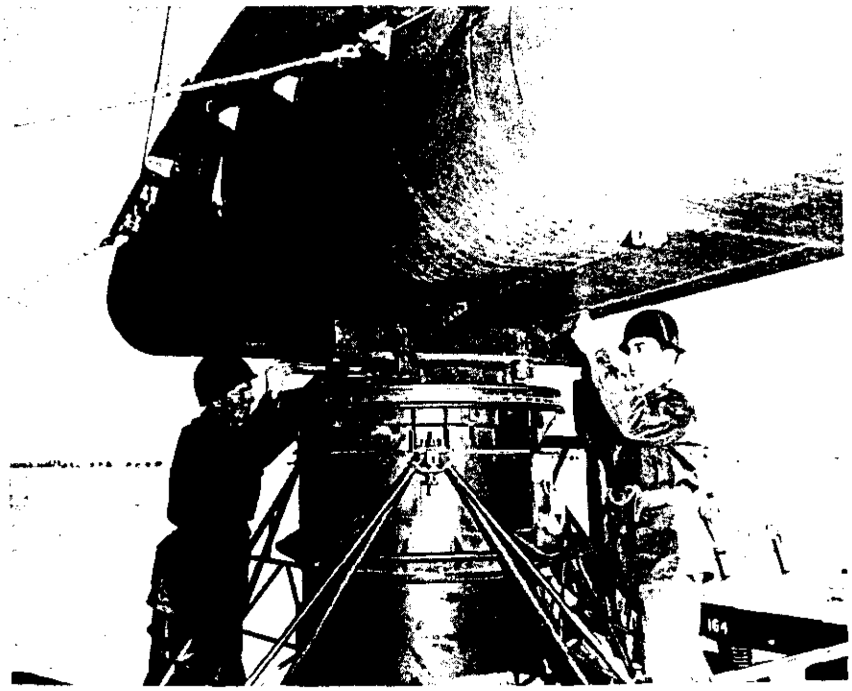


Figure 66. Fastening antenna to antenna drive unit.

(10) Fasten the antenna to the top of the antenna drive unit (fig. 66).

(11) Remove the derrick, stow it on the acquisition antenna trailer, and pull the trailer away.

(12) Connect the waveguide (fig. 67).

(13) Connect the external cables when ready.

MAINTENANCE AND SPARE PARTS TRAILER

(1) After the trailer has been pulled into the selected position, set the trailer brake (fig. 51), place a wheel chock at each wheel (fig. 52), disconnect the brake and light cable, and drive the prime mover away. NOTE: *The maintenance and spare parts trailer should not be emplaced until after the acquisition radar modulator, r-f unit, and antenna drive unit have been removed at the acquisition radar site.*

(2) Place the front and rear tie rods in the installed position (figs. 53 and 54).

(3) Drop and lock the leveling jacks into position (fig. 55).

(4) Unlatch, drop, and secure the rear platform; remove the rear steps from the inside of the trailer and fasten securely to the rear platform (fig. 56).

(5) Open all the air vents.

(6) Remove the r-f test set and bore sighting mast assembly from the trailer (fig. 10).

Table IX (Contd).

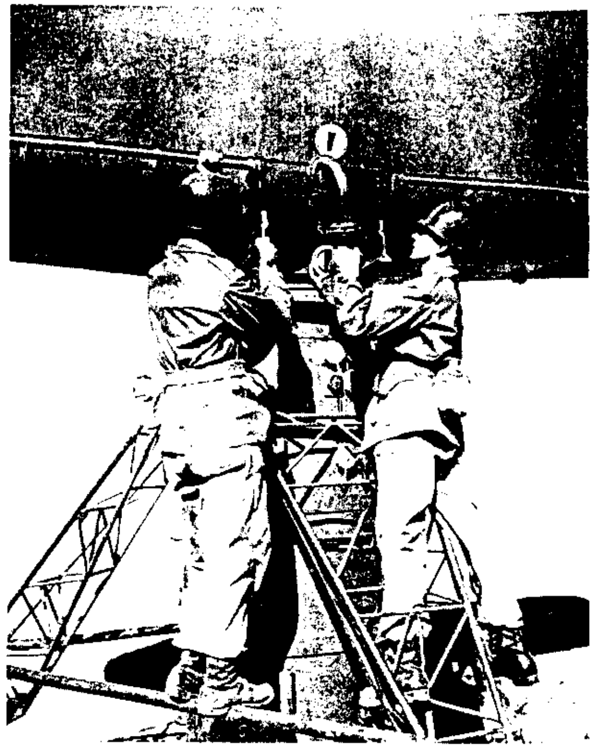


Figure 67. Connecting waveguide.

(7) Unfasten and place all other equipment in its proper operating position in the trailer.

(8) Connect the external cables when ready.

90. MARCH ORDER. The components in the battery control area that must be prepared for march order are the battery control trailer, the radar control trailer, the maintenance and spare parts trailer, the two power units, the acquisition radar antenna assembly and trailer, and the two track antenna trailers. Personnel perform the operations listed in table X.

Table X. MARCH ORDER PROCEDURE

BATTERY CONTROL TRAILER

(1) All cables are disconnected and cable receptacle covers are placed on receptacles and checked for tightness.

(2) All air vents are closed and fastened.

(3) Chairs and other movable equipment within the trailer are secured.

(4) The four plotting board pen carriages are locked, the pens removed and drained, and placed in the pen storage box.

(5) The door is closed and fastened.

(6) The rear platform and steps are folded and fastened in place.

(7) The leveling jacks are pulled into position and locked in place.

(8) The trailer hitch, brake and light connections, and lights and reflectors are checked to insure that the trailer is roadworthy.

ACQUISITION RADAR ANTENNA

acle covers are placed on receptacles and checked for tightness.

ismounted and secured in its proper place on the trailer.

s are retracted and locked into position.

bles are secured.

brake connections, and lights and reflectors are checked to insure the trailer is roadworthy.

BATTERY CONTROL POWER UNITS

(1) able receptacle covers are placed on the receptacles and checked for tightness.

(2) The leveling jacks are retracted and locked into position.

(3) Trailers are checked for the proper towing connection, brake and light connections, and lights and reflectors.

RADAR CONTROL TRAILER

The march order procedure on this trailer is similar to that for the battery control trailer.

TARGET-TRACKING RADAR TRAILER AND ANTENNA

(1) The antenna disable switch is placed in the ANTENNA DISABLE (down) position.

(2) The sighting and viewing telescope is removed from the mount on the trunnion assembly, placed in its carrying case, and stored in the storage compartment.

(3) The trunnion assembly is locked in azimuth.

(4) The r-f unit is locked in elevation.

(5) The lens assembly is removed and secured to the trailer deck.

(6) The protective canvas cover is placed on the trunnion assembly.

(7) The three jacks are retracted and the antenna mount is secured to the shock absorbers.

(8) The leg assemblies are detached from the equipment inclosure.

(9) Shields for the leg assembly mounting surfaces and protective covers for the equipment inclosure vents are installed.

(10) The spring snubbers on the front and rear undercarriages are disengaged and put into traveling position.

(11) The folding step is raised and secured.

(12) The trailer is connected to the prime mover and wheel chocks are stored on the trailer.

(13) The rear wheel parking brake is released.

MISSILE-TRACKING RADAR TRAILER AND ANTENNA

March order procedure for this piece of equipment is similar to that for the target-tracking radar antenna.

MAINTENANCE AND SPARE PARTS TRAILER

(1) All cable receptacles must be covered.

(2) The radar r-f test set is disassembled and secured in the trailer.

(3) All equipment in the trailer must be secured.

(4) All ventilators on the roof and sides are closed and fastened.

(5) The door of the trailer is closed and locked.

[redacted]

Table X (Contd).

(6) The rear platform is lifted and secured.

(7) Steps are put in place and secured.

(8) Towing connections, brake and light connections, and lights and reflectors are checked to insure that the trailer is roadworthy.

CABLING

All cables are placed on reels.

91. FIRE CONTROL SYSTEM DRILL. See chapter 6, Conduct of Fire, for suggested fire control system drill.

92. CARE AND ADJUSTMENT OF MATERIEL. The principles for the care and adjustment of the fire control equipment are similar to those for the AA fire control system M33, and those principles should be used as a guide pending additional instructions.

[redacted]

[redacted]

CHAPTER 9

ASSEMBLY AND SERVICE OF THE MISSILE

ORGANIZATION OF THE ASSEMBLY AND SERVICE SECTION

The assembly and service section is organic to the headquarters battery of the AAA battalion (figs. 68 and 69). As specified in TO&E 44-146 there will be 14 men assigned to this section. It will be their duty to supervise, plan, and maintain the operations of the battalion assembly and service area. The 14 men composing this section are listed below along with their rank and duties.

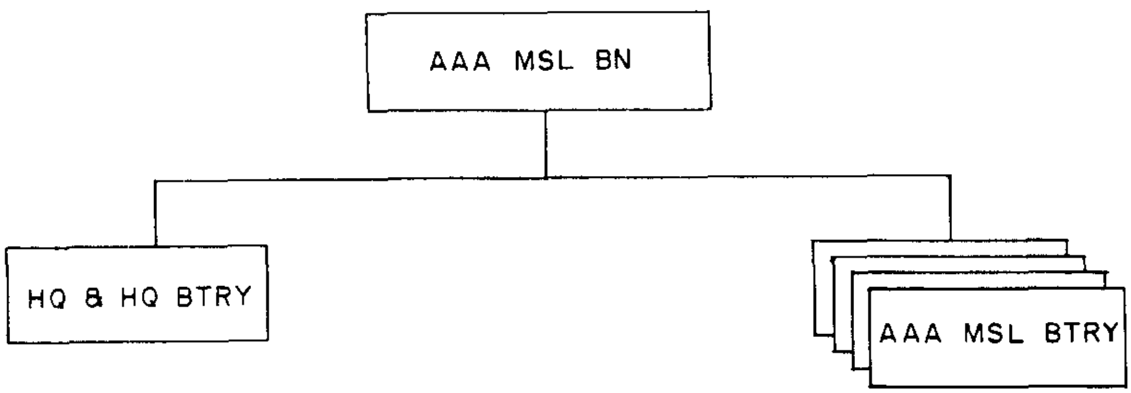


Figure 68. AAA missile battalion.

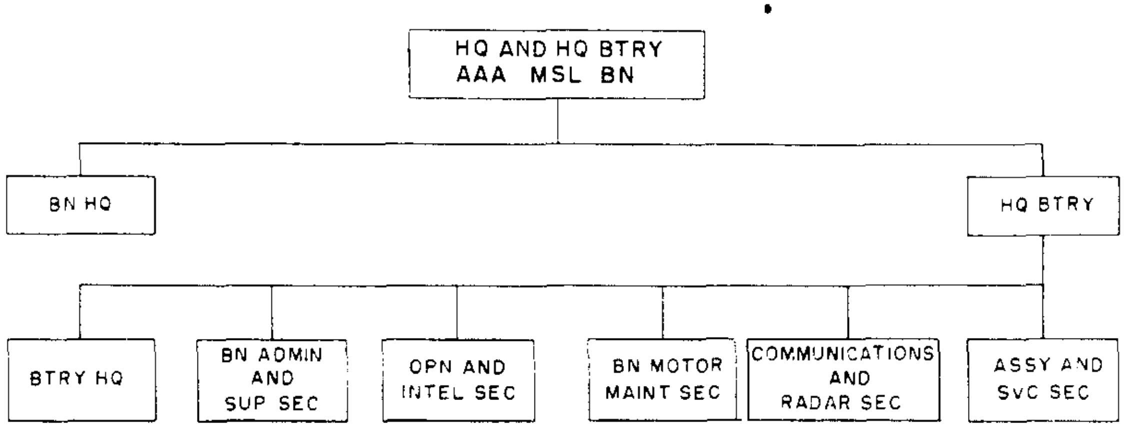


Figure 69. Headquarters and headquarters battery, AAA missile battalion.

a. Section chief (one per section). Coordinates, plans, directs, and supervises the assembly, organizational maintenance, testing, storage, and transportation of Nike I missiles and related equipment.

b. Missile mechanic (one per section). Exercises technical supervision of missile assembly and performs the more complex duties involved in mechanical aspects of assembly, such as uncrating and assembly of the hydraulic and propulsion system, testing for malfunctions, replacement of defective components, and fueling. He also supervises and performs duties in connection with the supply and storage of warheads and propellants.

[redacted]

[redacted]

c. *Electronics materiel specialist (one per section).* Assists echnical supervision of assembly, and performs the more complex duties involved in the ting, assembly, testing, adjusting, and replacing defective components of internal electroni lance equipment in Nike I missiles.

d. *Air compressor operator (one per section).* Operates and perf operator maintenance on air-compressing machines.

e. *Crane operator (two per section).* Operates and performs operat maintenance on hoists and stationary and truck- and crawler-mounted cranes.

f. *Materiel crewman (two per section).* Assists in assembly, testing, and preventive maintenance of Nike I missiles, including airframes, internal guidance equipment, warheads, propulsion systems, and other major components.

g. *Materiel handler (one per section).* Same as *f* above.

h. *Light truck driver (four per section).* Drives military wheeled vehicles up to and including 4½-ton rated capacity to transport personnel, supplies, and equipment and performs preventive maintenance and minor roadside repairs on assigned vehicles. When not working at his designated job he will act as a materiel handler.

i. *Portable generator operator (one per section).* Operates and performs operator maintenance on portable generators.

94. PERSONNEL. Because of the numerous operations which must be performed in the assembly and service areas, the assembly and service section may be supplemented by personnel drawn from other elements of the battalion when their services are required. Personnel designated to work with this section should be given specific duties so that they can accomplish their tasks with maximum efficiency.

Section II. ASSEMBLY PROCEDURES

95. GENERAL. The Nike I battalion will organize, operate, and maintain a field assembly area to supply the launching units with ready serviced missiles. This area will be equipped and staffed to receive, assemble, test, and store completed missiles as well as warheads and propellants. The battalion assembly section will prepare and deliver to fire units only that number of missiles to be expended during an engagement. This section will be responsible for the delivery of the missiles to the unit since the missile transports are maintained under battalion control at all times. Some of the procedures which are detailed as if occuring in a centralized battalion assembly area may be performed in the launcher area if safety requirements prevent transporting fully assembled missiles with warheads and fuel through populated areas. Such items as acid filling, starting mixture injection, and assembly of the booster (jato) igniter and warhead detonators will probably be performed in the decentralized areas. See chapter 11 for restrictions on the transportation of propellants.

96. SUPPLY. Conventional vehicles are satisfactory for the transportation of packaged missiles, propellants, and warheads from the factory as far down as the battalion assembly areas. However, loading and unloading procedures require careful guarding against shock and rough handling with consequent damage to missile components. Because of the diverse manufacturing origins or supply depots that will distribute the numerous components and fuels, the battalion assembly area has been divided into four separate receiving sections. Under certain conditions, some of these sections could conceivably be located within the same building or fenced area. Under other conditions some of the sections will be located at the launching area. They have been divided into separate areas in this text primarily to illustrate the numerous functions which

[redacted]

...ections are equipped to uncrate the item as it is received and provide ...mporary stockpile. When the missile is received by the using organiza- ...fficer in charge to determine if the materiel has been properly prepared ...ng organization and to be sure it is in condition to perform its assigned ... service. After removal from the shipping containers, a check should be ...booster and missile components are present. A visual inspection should ...or evidence of loose or missing screws, bolts, nuts, pins, and rivets. ...ances, the appearance of the missile and booster will indicate their con- ... the type of treatment they have received. All mechanical parts should operate smoothly without binding or rough motion. Parts must be free of any foreign matter which might affect their operation. An inspection should be made for bare spots or a damaged finish which exposes bare metal and may lead to corrosion. A rigid inspection should be made of all missile and booster components for cracks, paying particular attention to the nose section, rudder and elevator control section, guidance section, aileron control section, control fins, ailerons, and motor sections. If cracks are found, these components must be replaced. A block diagram of the flow of materiel from the time it is received at these stations until it is forwarded to a launching unit is shown in figure 70. The operations performed at these stations and the steps the materiel must pass through are described in the following paragraphs. Figure 71 shows a suggested assembly area layout and work diagram.

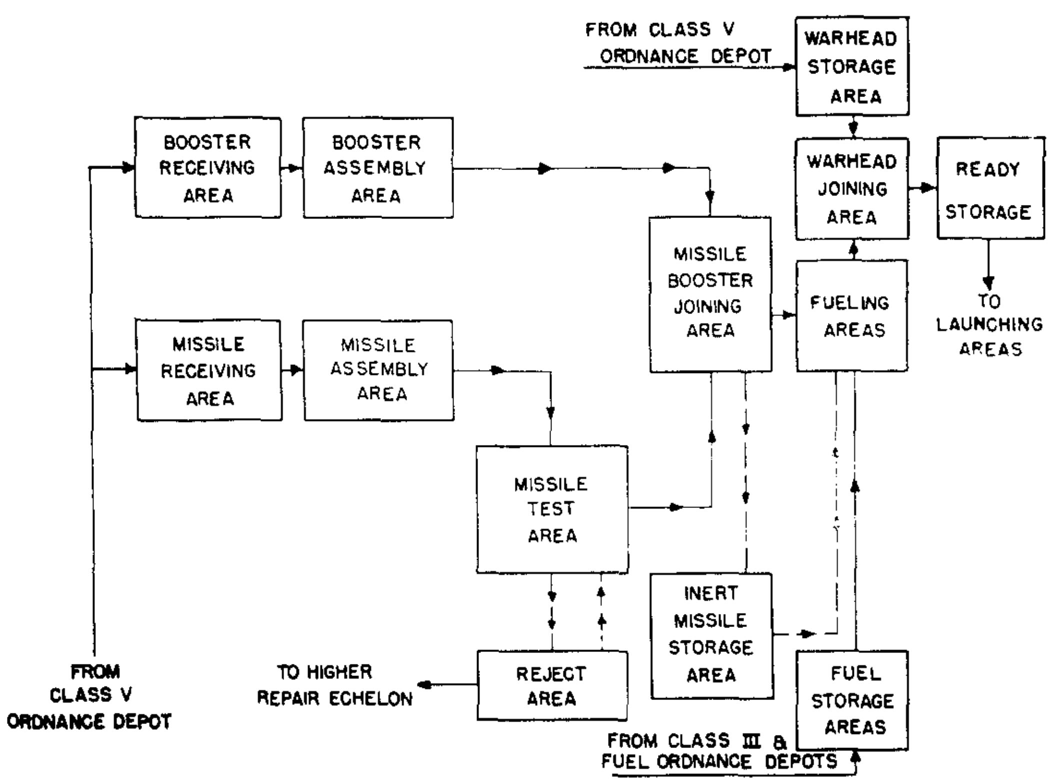


Figure 70. Flow diagram for missile assembly area.

9 1 9 7

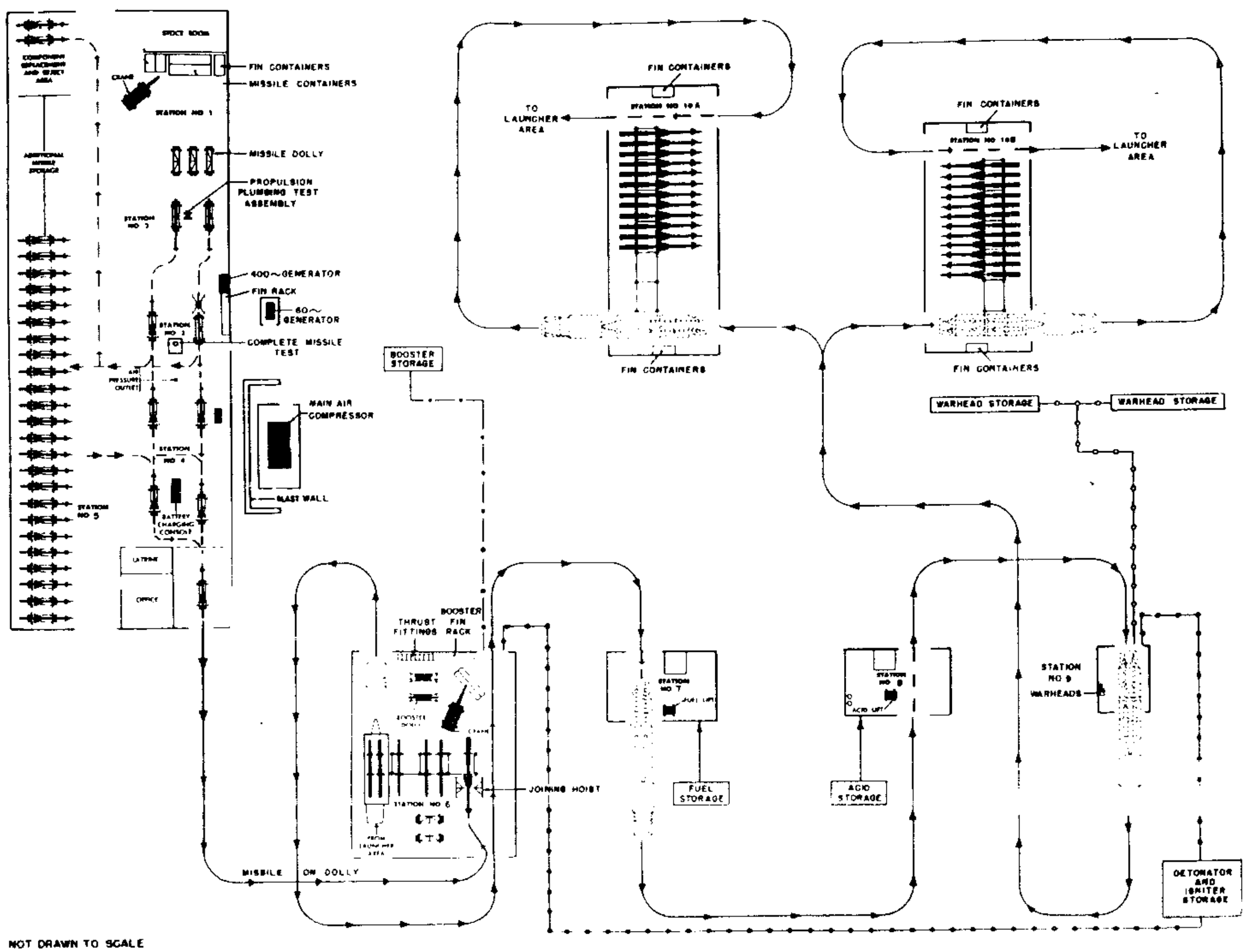


Figure 71. Suggested assembly area and work flow diagram.

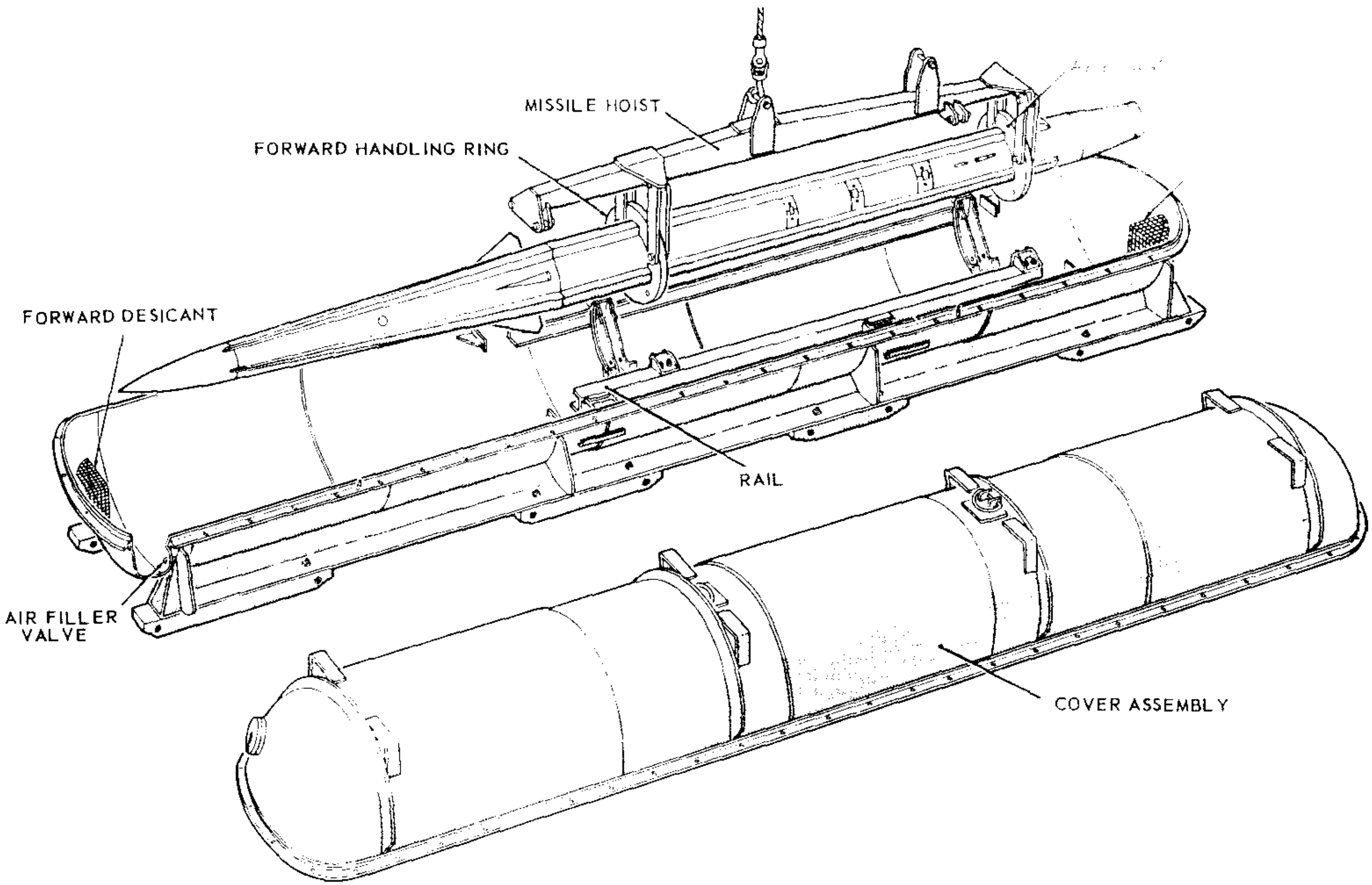


Figure 72. One-piece missile container.

97. WARHEAD STORAGE AREA. Warheads will be supplied to this site in containers which will stand normal handling. This storage area will be a magazine area and the warheads may be transported to the loading position on bomb trailers or on the bed of a bomb-service truck or similar vehicle.

98. FUEL STORAGE AREA. Liquid propellants will be drawn from ordnance fuel depots or class III supply points. These fuels will be delivered in two general types of containers, bulk containers such as tank trucks or trailers and standard size small drums containing the correct amount for fueling a single missile. Special handling is required for the propellants and the starting mixture. These items will be separated from each other at all times during warehousing and transport. Specified quantities of these propellants will be furnished to the fueling area for complete fueling of those missiles designated for ready service storage or dispatch to a launching area.

99. MISSILE RECEIVING AREA. In the receiving area, the main body section and the fins and ailerons are received for temporary storage and uncrated. The missile will be shipped in a one-piece container (fig. 72) which contains the complete missile minus the control fins, main fins, and ailerons. The control fins, main fins, and ailerons are shipped in a one-piece container (fig. 73). The missile containers must be completely depressurized before they are opened to prevent injury to personnel. If any component is found damaged when received, it should be replaced with a new component, and the damaged component should be returned to the appropriate maintenance depot for repair or salvage.

100. UNCRATING PROCEDURE FOR THE ONE-PIECE MISSILE CONTAINER. The following directions are given to personnel assigned to uncrate the materiel and must be carefully followed when opening these containers:

a. Remove the valve core from the pressurizing valve assembly and allow the container to depressurize. *CAUTION: Do not attempt to open the container until all of the air has escaped and the container is completely depressurized.*

b. Remove the hex-head steel bolts, nuts, and lock washers from the parting surfaces of the container.

c. Remove the top half of the container by securing a hoist and sling assembly to the lifting eyes on top of the container and operating the hand winch on the hoist assembly.

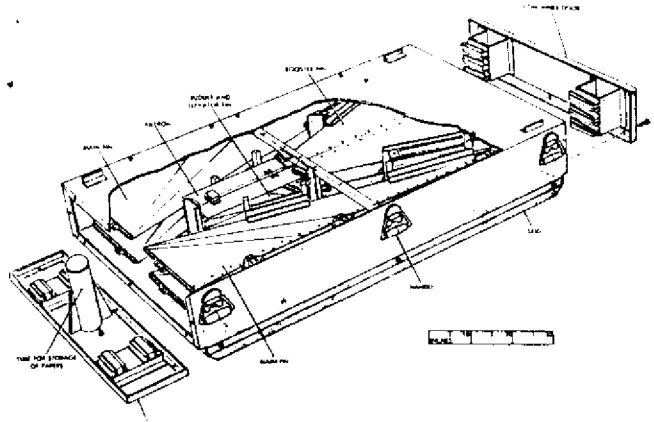


Figure 73. Fin storage container.

[redacted]

...ETE MISSILE. The following procedures should be carefully ... from their containers:

... rings from the shock mounting brackets.

...sile-hoist assembly as near the container as practicable and ... to the missile handling rings, using four steel bolts, and four ... *hoist must lift the missile at the lifting point on the hoist cor- ... ravity of the load. If lifted at the wrong point, the missile will ... with possible injury to personnel or damage to the missile.*

... the missile from the shipping container, by operating the hand winch on the ... and place it on a missile dolly (fig. 74). *NOTE: Exercise extreme care during the lifting operation to avoid damage to the missile.*

d. Remove the hoist assembly from the missile by removing the four steel bolts and four safety nuts from the missile handling rings.

102. REMOVING FINS (fig. 73). a. The fins may be removed from the container by hand. Due to their mounting arrangement, each component may be removed independently. However, extreme care must be exercised during the removal of these components.

b. Do not drop or handle the fins and components in any manner that might result in damage to the units.

103. MISSILE ASSEMBLY AREA. In the assembly area the fins and ailerons are attached to the missile. Assembly personnel will perform the following operations:

a. Attach the four main fins to the missile structure with the six bolts provided for each fin.

b. Mount ailerons on pins in the missile structure and secure them to the main fins.

c. Aline ailerons with the scribe marks on the missile. Center potentiometers by connecting the potentiometer centering bridge and rotating the ailerons until the bridge meter reads ZERO.

104. BOOSTER RECEIVING AREA. In the booster receiving area the booster and its component parts are received for temporary storages and uncrated. *WARNING: The absorbtion of nitroglycerin fumes by the silica gel bags used to absorb moisture in the booster container will make them potential explosives. These bags should be rendered harmless by dropping them into a pail of water immediately upon removal from the booster container. The component parts uncrated at this point and moved to the booster assembly area are:*

a. Thrust structure.

b. Booster launching lugs and plates.

c. Booster fin attach ring.

d. Shroud.

e. Booster fins (may arrive in container with missile fins).

105. BOOSTER ASSEMBLY AREA. In the booster assembly area the booster is completely assembled except for the fins, igniter, launching lugs, and plates. The booster is placed on a booster dolly (fig. 25) by means of a tractor crane. This dolly is used as both a work stand and

[redacted]

a means of transport between the assembly area and the final assembly and joining area. Personnel perform the following operations at this station:

a. *Attach sling to booster.*

b. *Attach thrust structure.*

c. *Attach fin fittings.*

d. *Attach shroud.*

e. *Check booster case.*

f. *Check propellant.*

g. *Transport to joining area.*

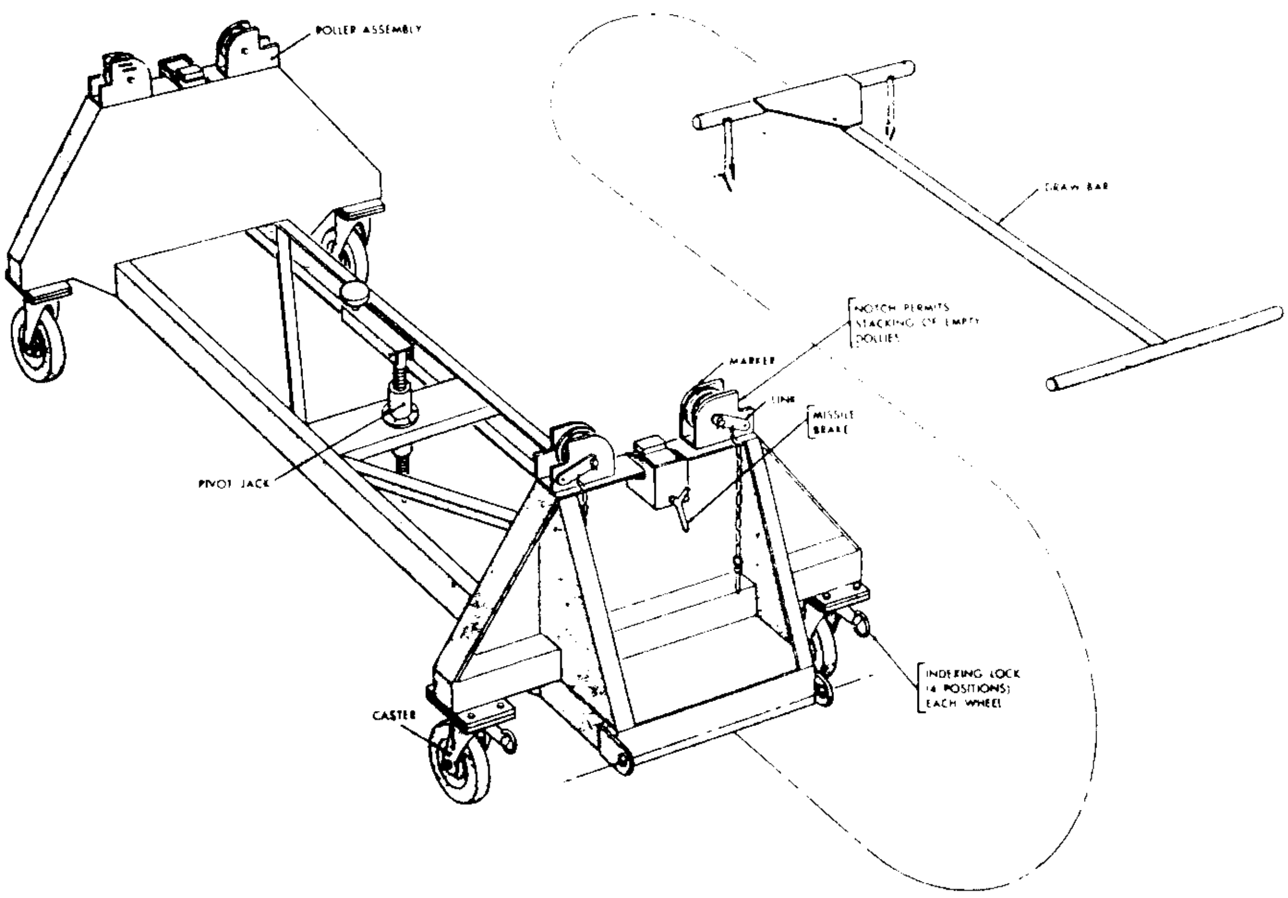


Figure 74. Missile dolly.

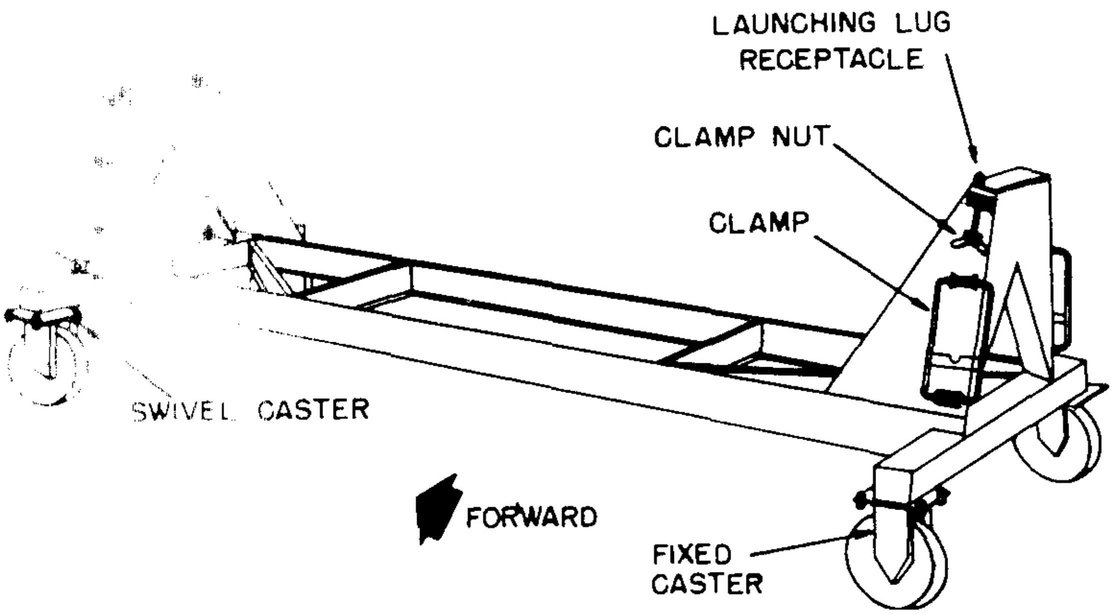


Figure 75. Booster dolly.

106. MISSILE TEST AREA (fig. 76). In the test area the external connections are made between the test panel and the missile. The hydraulic system is filled and the entire system is checked on a go-no-go basis. The following specific checks will be made.

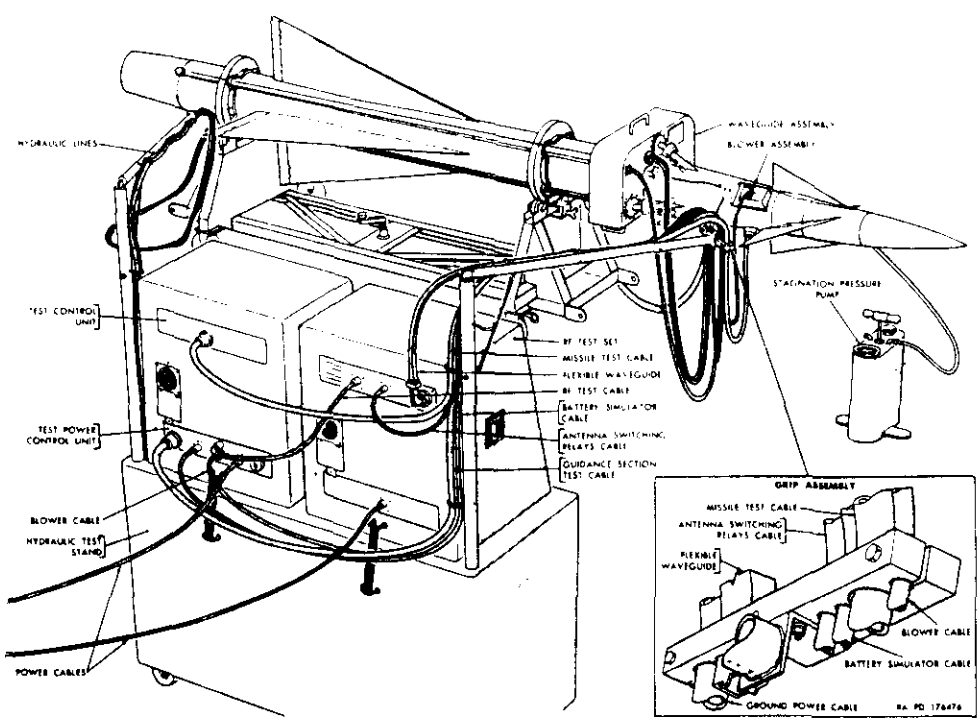


Figure 76. Missile test set.

a. *Connect hydraulic oil supply line.*

b. *Fill hydraulic system.*

c. *Connect electric cables.*

d. *Warm up system.*

e. *Calibrate electrical check-out equipment.*

f. *Check out servo inputs and flight control systems.*

g. *Check voltages and currents.*

h. *Check gyro preset system.*

i. *Check balance of control signals and steering plate signals.*

j. *Check hydraulics operation.*

k. *Check command system from external beacon signal.*

l. *Check detonation signal.*

m. *Remove external connections.*

n. *Install missile batteries.*

o. *Connect air lines from missile to air compressor.*

p. *Pressurize missile to operating pressure.*

q. *Transport to missile-booster joining area.*

107. REJECT AREA. Missiles failing to pass the go-no-go test will be evacuated to this area for repairs. If faults are found that are beyond the scope of organizational maintenance, the missile will be forwarded to an appropriate higher echelon for repair. The reject area will maintain a limited supply of spare parts for those missile components which need most frequent replacement and can be replaced without elaborate tools. Some components in this category are batteries, fins, booster igniters, tubes, receivers, antennas, amplifiers, beacons, inverters, resistors, switches, and fairing strips. To facilitate operations of the personnel in the repair zone, a series of performance checks and troubleshooting charts have been developed and are described in appropriate contractor's manuals. Personnel are advised to refer to these charts as often as necessary. If the required missile repairs are beyond the scope of organizational maintenance, the missile will be evacuated to the proper higher repair echelon.

108. MISSILE-BOOSTER JOINING AREA. In the joining area the final assembly operations for both the missile and booster are completed, and the two are joined together on the launching and transporting rail. The launching and transporting rails (fig. 77) are returned to this point from the launching site on the transporter trailer. The transporter trailer is positioned at one end of the launcher loading and storage rack section which serves as a workstand. The returned launching and transporting rails are transferred to this rack. The used electrical lead for the missile is removed and a new one installed, after which the launching and transporting rail is ready for loading the booster. The booster is lifted off the booster dolly with a tractor crane and lowered onto the launching and transporting rail. Positioning of the booster over the rail is accomplished manually. After the booster is in place, the hold-down plates are attached to the launcher lugs. The booster is then secured to the rail by a support bracket. To join the missile and booster on the launching and transporting rail, the following operations are performed.

[redacted]

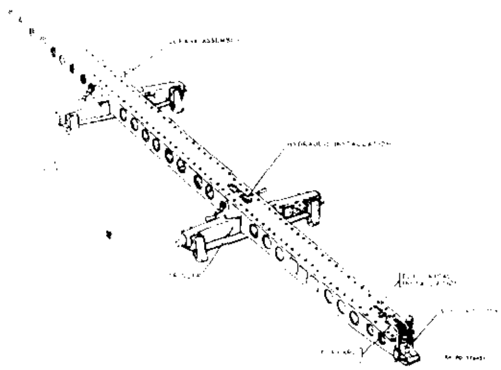


Figure 77. Launching and transporting rail.

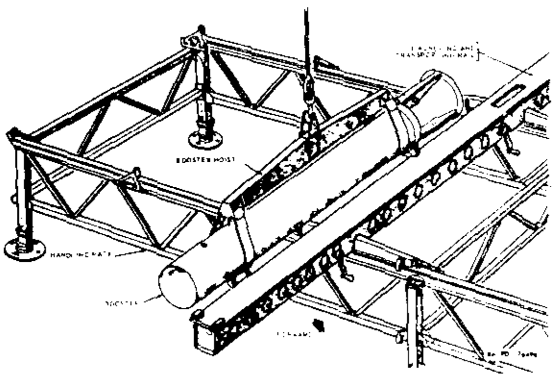


Figure 78. Installing booster on rail.

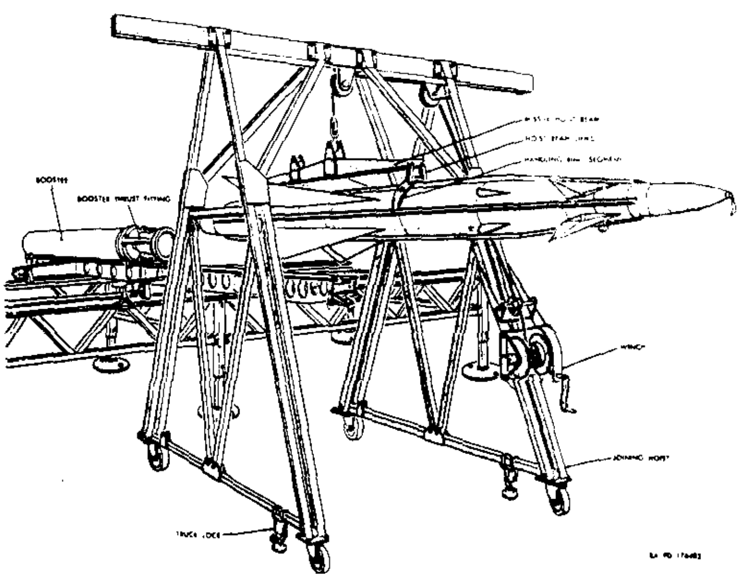


Figure 79. Preparing to join the missile to the booster.

[redacted]

a. Attachment of hoist assembly to booster.

(1) Attach the swivel hook on the missile-booster joining hoist to the lifting point on the booster-hoist assembly beam marked LIFT POINT FOR BOOSTER.

(2) Position the booster hoist so the lifting sling marked BOOSTER TAIL is over the booster housing just forward of the shroud.

(3) Fasten the forward lifting sling around the booster, immediately aft of the thrust fitting, and attach the sling to the hoist-beam-sling attach bracket, using the two sling-attach pins attached to the ends of the sling. *NOTE: Install the two safety keys in the sling-attach pins in both the forward and aft lifting slings to prevent damage to the booster and handling equipment (fig. 78).*

(4) Fasten the aft lifting sling around the booster, forward of the shroud, and attach the sling to the hoist-beam-sling attach bracket, using the two sling-attach pins attached to the end of the sling.

b. Installation of booster on launching rail.

(1) Remove the plates from the booster launching lugs by removing two bolts from each plate.

(2) Raise the booster with the hoist to a height adequate to clear the rail assembly and position the hoist so it straddles the rail assembly. *NOTE: Position the booster so it is alined with the rail.*

(3) Slowly lower the booster, on the aft end of the rail, by operating the hand winch on the hoist until the booster launching lugs are seated on the rail and extend over the edges on both sides. *NOTE: Be sure that the aft end of the booster is positioned against the stops at the aft of the rail and that the aft firing-indicator lever has been operated and has closed the lift-off switch.*

(4) Install the launching-lug plates using the two bolts provided for each plate.

(5) Remove the safety and the sling-attach pins from the hoist-beam-sling attach brackets and remove the forward and aft lifting slings.

(6) Remove the hoist assembly from the immediate working area.

c. Attachment of hoist assembly to missile (fig. 79).

(1) Install the two segments of the aft missile handling ring by installing the bolt which is attached to each ring segment in the holes provided at the forward end of the motor section at missile station 232. Install the forward ring segments, in the same manner, in the holes provided at the forward end of the oxidizer tank at missile station 108.65.

(2) Attach the swivel hook on the missile-booster joining hoist to the lifting point on the missile-hoist beam. *CAUTION: The swivel hook must lift the complete missile at the lifting point on the hoist corresponding to the center of gravity of the load. If lifted at the wrong point, the missile will swing downward at one end with possible injury to personnel or damage to the missile.*

Position the joining hoist so it straddles the missile and attach the hoist link assemblies to the missile handling rings, using the four steel bolts and four safety nuts provided.

ing the missile to booster (fig. 80).

Prepare the rail to receive the missile by latching the forward support and the electric plug in the retracted position (fig. 77). *NOTE: Store the loading-rack pin in the rear, aft of the forward launching-rail support.*

With the hoist raise the missile to a height adequate to clear the rail assembly and position the hoist so it straddles the rail assembly. Position the missile so it is alined with the rail.

Slowly lower the missile on the forward end of the rail by operating the hand winch on the joining hoist until the missile is within four inches of the rail and is alined with the rail.

Move the missile aft by hand until the motor section is almost fully seated in the booster thrust fitting.

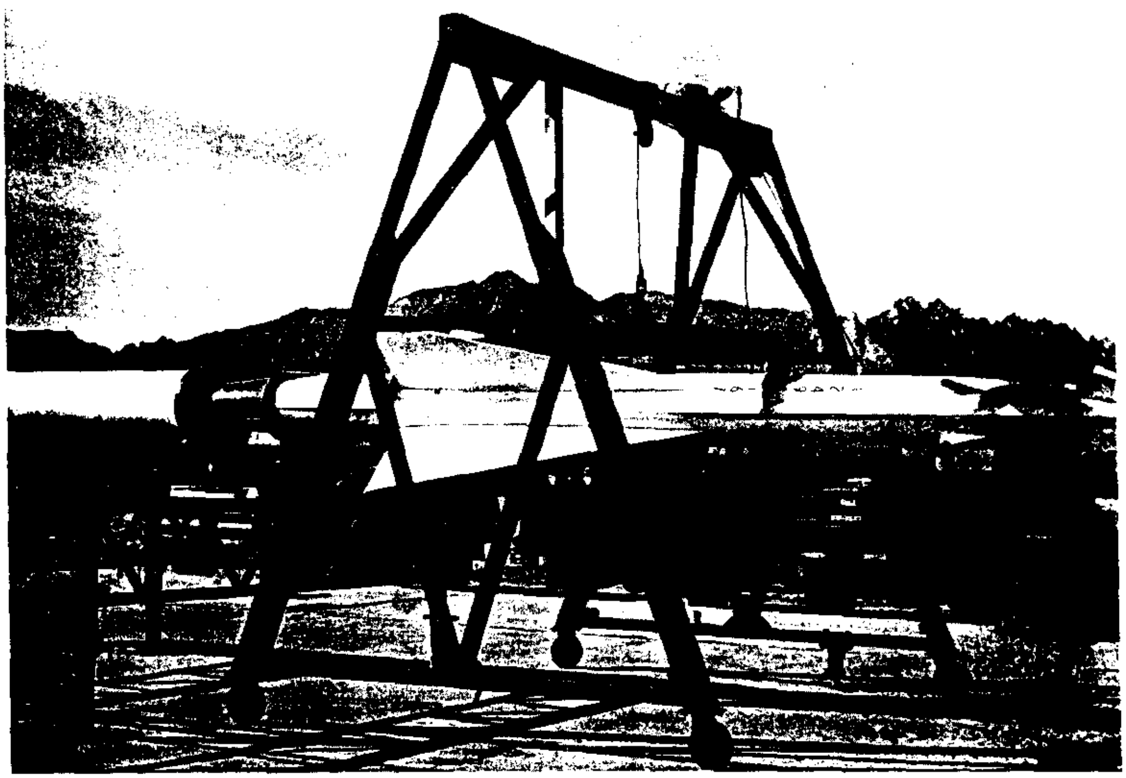


Figure 80. Joining missile to booster.

(5) Begin installation of the hydraulic plug in the air tank and power-plug valve (fig. 81). *NOTE: Gain access through the large elliptical hole in tunnel No. 3 at the motor section of the missile.*

(6) Install the propellant-system arming lanyard to the attaching lugs provided on the hydraulic plug. Use the spring steel pin provided (fig. 81).

(7) Hold the electric-plug contact screw in position so the pl... will seat in the receptacle in tunnel No. 3 of the missile propellant section as the missile is installed on the rail.

(8) The launching-rail forward latch, located on the forward support, must be in the extreme aft position, and the forward support must be ...ed slightly forward of the vertical position, in order to receive the missile.

(9) With all preparations complete, lower the missile slowly until it seats on the rail. As the missile seats, guide it aft by hand so the index pin in the booster thrust fitting seats in the indexing hole in the aft end of the missile. *NOTE: The hydraulic plug must seat in the air tank and power-plug valve, the electric plug must seat in the receptacle in tunnel No. 3, and the forward hook and latch must seat in the fitting in tunnel No. 3 between the center and propellant sections at missile station 108.65.*

(10) With full seating of the missile, the impulse must move the forward support back to the vertical position. *NOTE: Due to the build-up of tolerances in the missile and booster, the booster thrust fitting, forward hook and latch, and electric and hydraulic plugs may not seat in their respective positions. In this case, lift the missile slightly up and forward, removing it from the ground-power plug and forward-end supports, and adjust the bolts and check nuts equally on the two booster stops at the aft end of the rail. The adjusted position of the booster may cause incorrect adjustment of the aft firing-indicator lever (fig. 83). If so it will be necessary to readjust the striking bolt so that the lift-off switch will be closed when the booster is positioned against the stops. In extreme cases, install the firing-indicator lever in the alternate position before readjusting the striking bolt.*

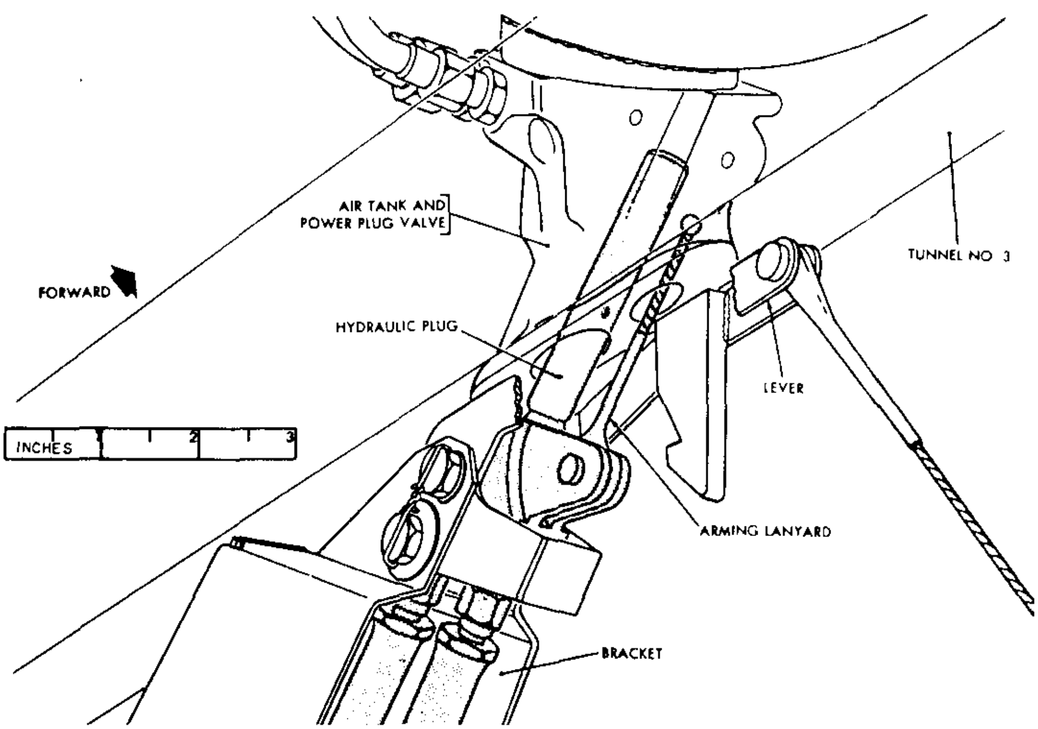


Figure 81. Hydraulic plug installed in missile.

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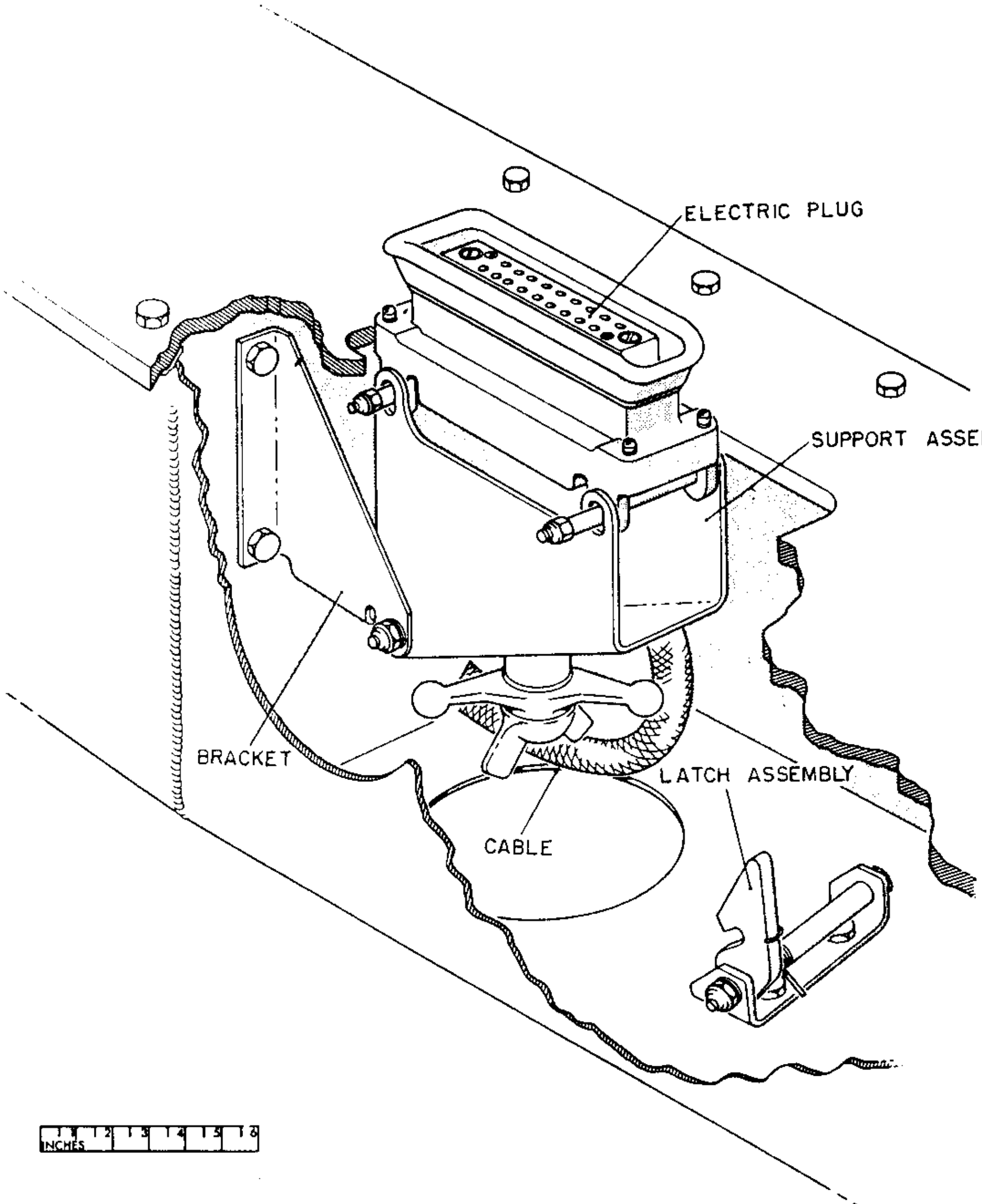

Figure 82. Electric plug installation.

[redacted]

(11) Adjust the launching-rail forward-support clamp nut and the forward hold-down lower wing nut so the forward hook is properly positioned in the fitting in tunnel No. 3 at missile station 108.65.

(12) Install the loading-rack pin in the forward support to prevent forward movement of the missile.

(13) Remove the hoist-link assemblies from the missile handling rings by removing the four steel bolts and four safety nuts. Remove the hoist assembly from the immediate working area.

(14) Remove the handling rings from the missile by removing the two segment attach bolts.

e. The launching rail assembly together with the missile and booster is then transferred to the transporter.

f. The missile is then transported to the fueling area.

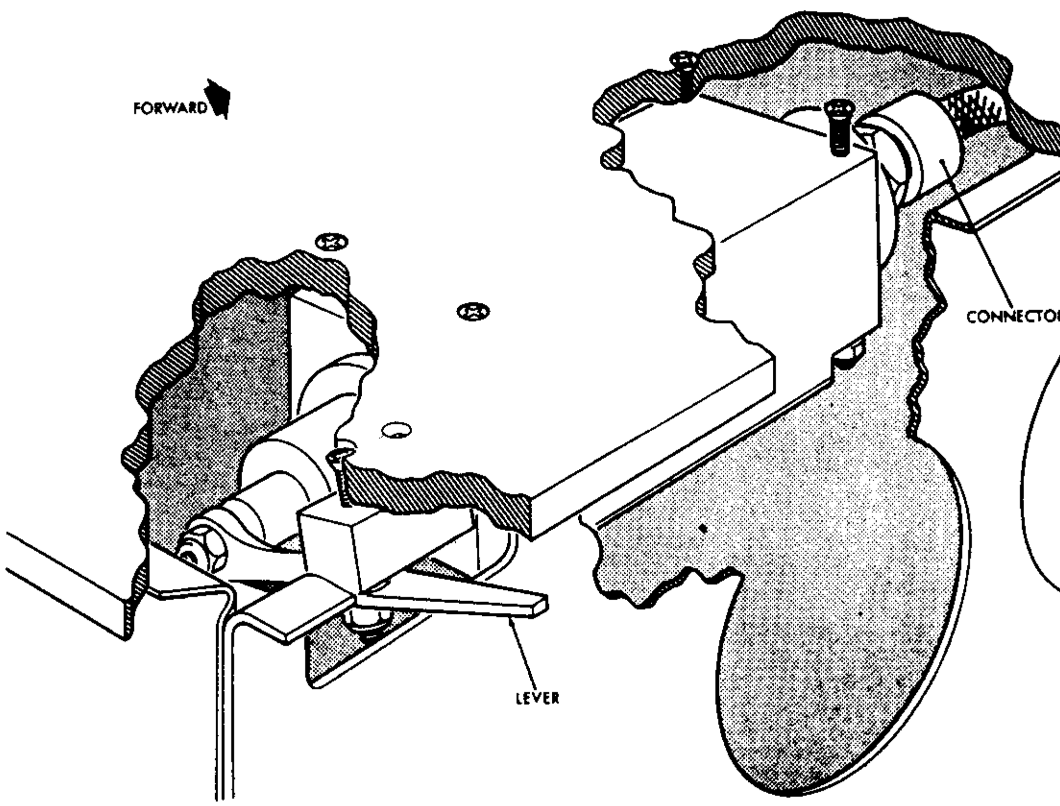

Figure 83. Firing indicator lever.

109. INERT MISSILE STORAGE AREA. In this area, those missiles (less boosters) that have been tested for operating condition (par. 106) but lack warheads and propellants are stored until such time as they are required. Shelter must be provided to protect the missiles from the weather. Periodic maintenance checks and inspections will be performed. When these missiles are needed by the launching units they will be taken to the joining area and then transported to the fueling area.

[redacted]

SERVICING AREAS. In these areas the propellant filling operations ... lant tanks will be filled with the assembled missile on the transporter. ... positioned on the ramp to give the proper inclination (5°) to the missile. ... ly and an oxidizer-servicing assembly are used. The fuel-servicing ... ts of a fuel measuring can, a filler-hose assembly, and a hoist assem- ... measuring can to the desired height. The oxidizer-servicing assembly ... oxidizer drum, a filler-hose assembly, a vent-line adapter, a vinylite ... sembly for raising the oxidizer drum to the desired height. A syringe is ... tarting mixture (fig. 88). The missile is fueled by following the procedures ... sonnel must wear protective clothing during these operations.

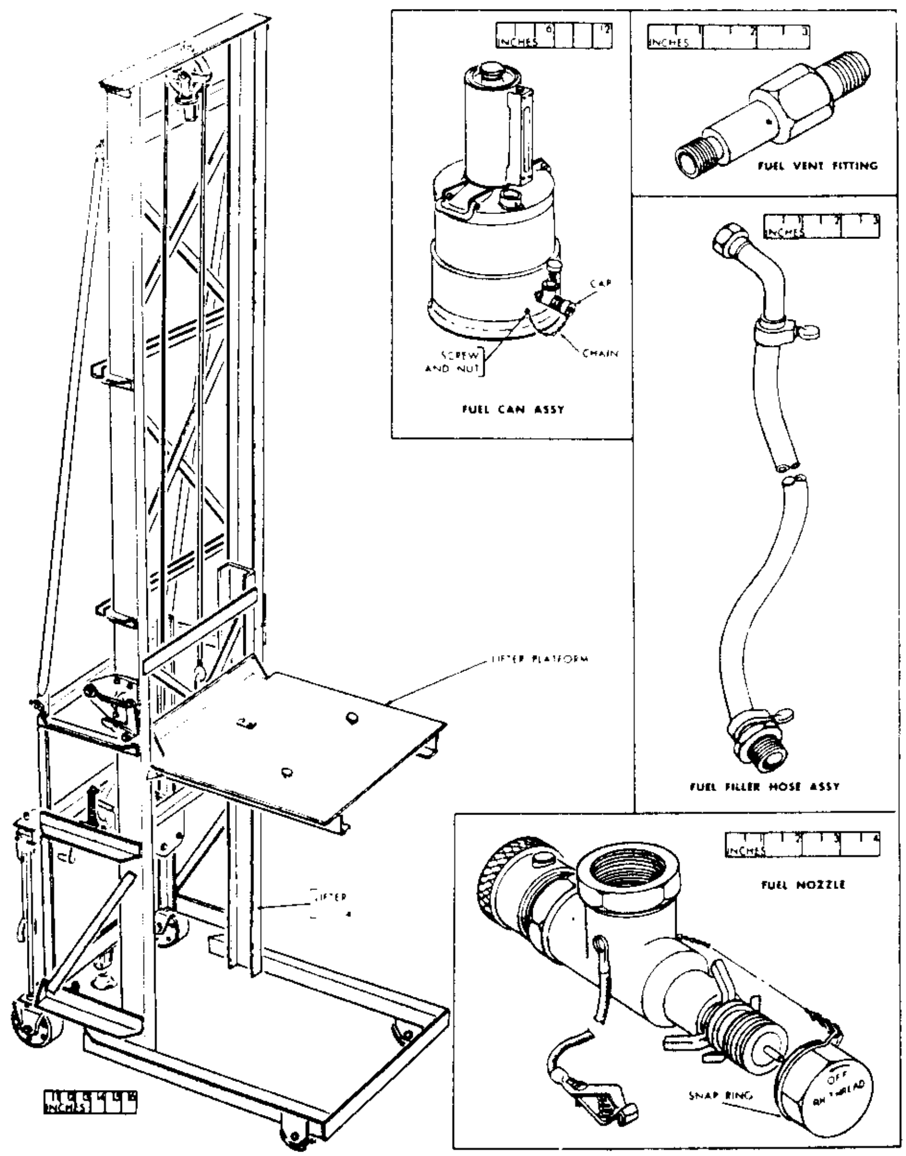

Figure 84. Fuel-servicing assembly.

[redacted]

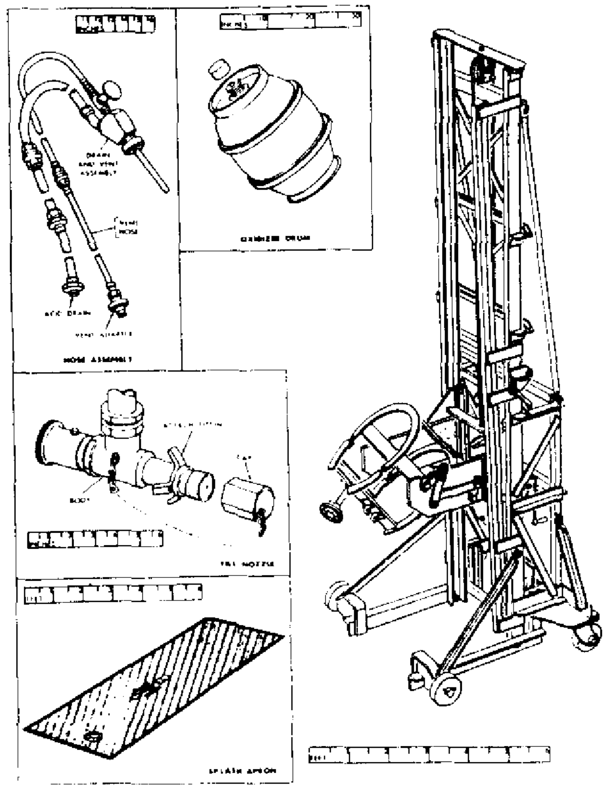

Figure 85. Oxidizer-servicing assembly.

Table XI. FUELING PROCEDURE

FUEL TANK (figs. 84 and 86)	
(1)	Refer to appendix III for handling procedures.
(2)	Elevate the missile to approximately 5°, nose-up position by positioning the transporter trailer on an incline.
(3)	Remove the plug from the tank filler fitting at missile station 171. Be sure to replace the plastic washer in the tank filler fitting.
(4)	Push the teflon stopper onto the end of the filler nozzle. Install the filler-nozzle assembly by screwing the nozzle adapter into the filler fitting (fig. 86). NOTE: *The nozzle valve must be in the CLOSED position.*
(5)	Connect the other end of the filler hose to the fuel measuring can.
(6)	Remove the fuel-tank vent plug at missile station 151, and install the vent assembly.
(7)	Remove the cap from the fuel measuring can, open the gate valve, and raise the can so the base of the can is 54 inches above the tank filler fitting. NOTE: *Do not kink the filler hose.*
(8)	Open the nozzle valve by unscrewing and pulling the knob out.
(9)	Watch the flow of fuel through the filler hose and close the nozzle valve when the fuel lever in the hose drops to within 1 inch of the nozzle. CAUTION: *If air bubbles*

[redacted]

, *close the nozzle valve immediately. Allow the fuel to clear up*
nozzle valve again.

ssembly and install the vent plug at missile station 151.

e assembly by unscrewing the adapter from the filler fitting. Install
e at missile station 171.

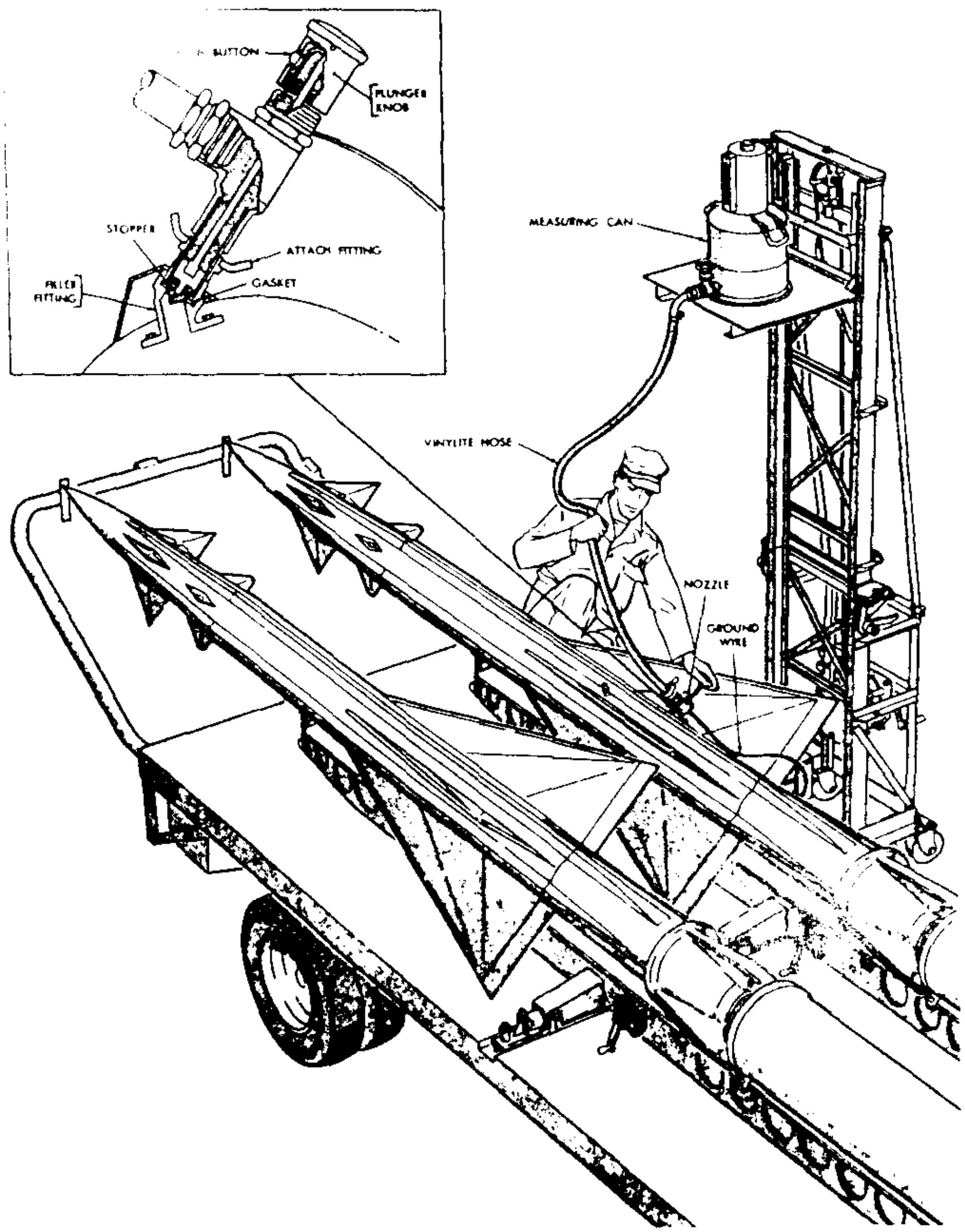

Figure 86. Filling the fuel tank.

[redacted]

[redacted]

Table XI (Contd).

OXIDIZER TANK (figs. 85 and 87).

(1) Refer to appendix III for the safe handling procedures.

(2) Elevate the missile to a 5^{o}, nose-up position on the transporter trailer by positioning the transporter trailer on an incline.

(3) Install the vinylite apron, using the two corrosion-resisting steel bolts provided.

(4) Remove the tank vent plug at missile station 107.9. Install the vent-line-adapter assembly. *CAUTION: Make sure the O-ring seal is installed on the adapter assembly before the adapter is installed on the missile.*

(5) Push the teflon stopper onto the end of the filler nozzle.

(6) Connect the vent-line hose assembly to the vent-line adapter.

(7) Remove the plug from the tank filler fitting at missile station 151, and install the filler-nozzle assembly by screwing the nozzle adapter into the filler fitting. *NOTE: The nozzle valve must be in the CLOSED position.*

(8) Place the oxidizer drum on the hoist and secure it with the filler plug up.

(9) Place the drum hoist as near the missile as practicable.

(10) Remove the filler plug from the oxidizer drum being careful not to loosen the drum bushing. *CAUTION: Make sure the seat remains in the bottom of the drum bushing when the filler-hose assembly is installed in the bushing.*

(11) Install the filler-hose assembly in the oxidizer drum by tightening the adapter nut. *CAUTION: Check all connections on the filler-hose assembly, oxidizer drum, and missile. No leaks are allowed.*

(12) Open the vent-line valve and raise the drum with the hoist so the drum filler bushing is 60 inches above the tank filler fitting.

(13) Open the nozzle valve by unscrewing and pulling the knob out.

(14) Watch the vinylite window in the oxidizer filler line and close the nozzle valve when the oxidizer level is within 1 inch of the lower end of the window. *CAUTION: If air bubbles appear in the window, close the nozzle valve immediately. Allow the oxidizer to clear up before opening the valve again.*

(15) Disconnect the vent line, remove the vent adapter, and install the tank vent plug.

(16) Disconnect the filler rozzle by unscrewing the nozzle adapter and install the oxidizer-tank filler plug. *CAUTION: Neutralize any oxidizer spilled on the apron or missile with a sponge soaked in a bicarbonate-of-soda solution and wash the affected area with water.*

(17) Remove the vinylite apron by removing the two corrosion-resisting steel bolts which were installed previously.

(18) Remove the filler-hose assembly from the drum by unscrewing the adapter nut from the drum bushing and install the drum filler plug.

(19) Wash the hose assembly with running water for 15 minutes and hang it in a vertical position to drain and dry.

[redacted]

[redacted]

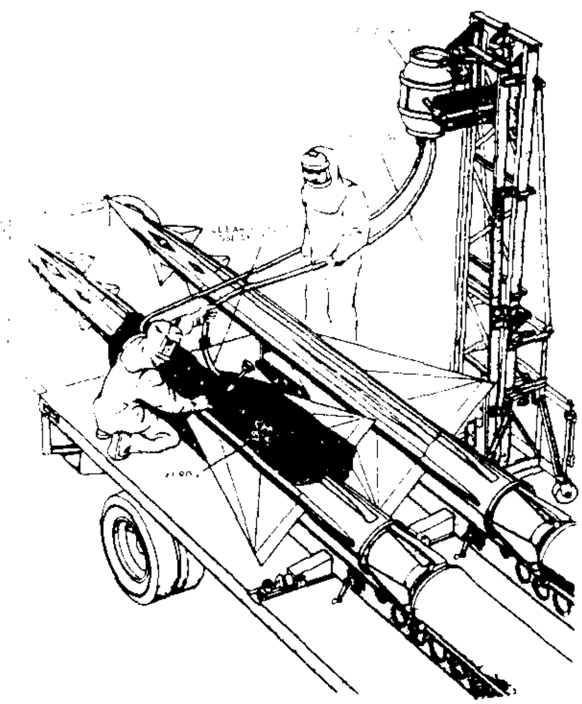

Figure 87. Filling the oxidizer tank.

STARTING MIXTURE (fig. 88)

(1) Refer to appendix III for safe handling procedures.

(2) Remove the plug and seal from the starting-fluid-line vent fitting at missile station 160 in tunnel No. 4.

(3) Remove the filler plug from the starting-fluid-line filler fitting at missile station 227, between tunnels No. 3 and No. 4.

(4) Fill the syringe-tube assembly with starting mixture.

(5) Insert the syringe-tube assembly into the fitting marked STARTING-FLUID FILLER at missile station 227. Holding the syringe in the full in position, apply a steady force on the piston knob until the starting mixture is forced from the vent hole. *NOTE: The fluid should be injected as rapidly as possible to eliminate air pockets.*

(6) Remove the syringe-tube assembly from the filler. Install the filler plug, vent seal, and vent plug.

(7) Neutralize any spillage.

111. WARHEAD INSTALLATION AREA. The warheads are installed in the missile in the installation area. Under normal circumstances, the warheads can be lifted into the missile by manpower. Personnel perform the following operations:

a. Place a support under the guidance section of the missile.

b. Remove tunnel No. 4 and the warhead section covers.

[redacted]

d. Install and clamp the center and aft warheads.

e. Remove the nose cone, withdraw the retaining ring.

f. Install the nose warhead.

g. Insert and connect the primacord leads to the warheads and the ve-way con (fig. 89). *CAUTION: Do not connect the primacord to the arming mechan ms at this*

h. Replace and fasten the nose cone, warhead covers, and tunnel No. 4.

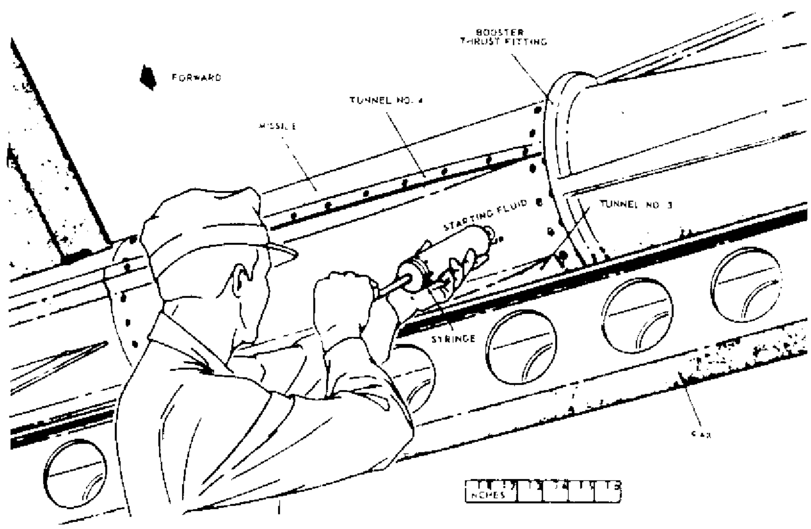

Figure 88. Inserting the starting mixture.

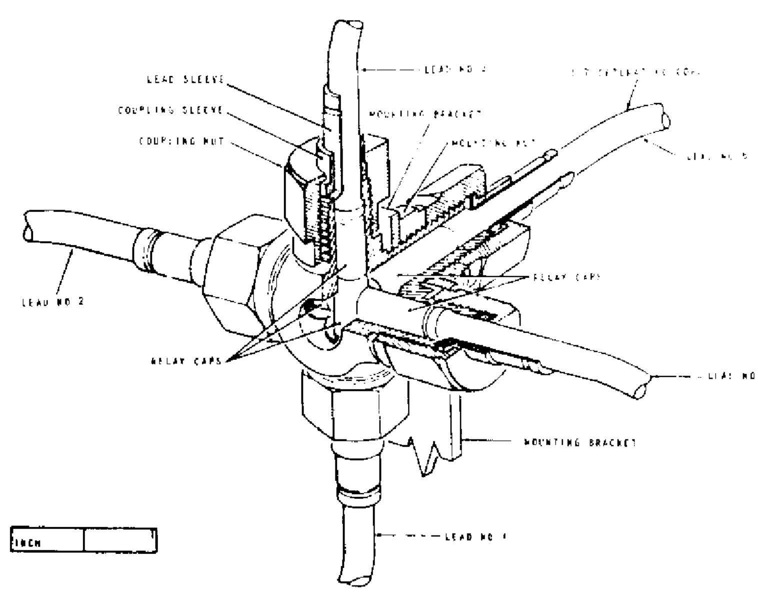

Figure 89. Five-way connector.

[redacted]

CHAPTER 10

ORGANIZATIONAL MAINTENANCE OF EQUIPMENT

[illegible] LUBRICATION AND PAINTING. *a. Lubrication orders for equipment.* Lubrication orders prescribe cleaning and lubrication procedures and indicate locations, intervals, and proper materials for servicing the missile-handling equipment. Lubrication orders are issued with the handling equipment and must be carried with it at all times. In the event the ground handling equipment or individual units thereof are received without the lubrication order(s), the using organization must requisition them immediately.

b. General lubrication instructions for equipment. Service intervals, specified on the lubrication orders, are for operation where moderate temperatures, humidity, and atmospheric conditions prevail. Under extremely corrosive conditions or when an excess of foreign material is present, it may be necessary to decrease the designed lubrication intervals. Any indication of excessive friction such as squeaks, binding, or traces of rust or corrosion should be remedied promptly regardless of the normal lubrication period.

c. Lubrication equipment. Each piece of materiel is supplied with lubrication equipment adequate to maintain the materiel. This equipment will be cleaned both before and after use. Lubrication guns will be operated carefully and in such a manner as to insure proper distribution of the lubricant.

d. Points of application. Lubricating fittings, grease cups, oil holes, and the surrounding surfaces should be wiped clean before the lubricant is applied. A ¾-inch red circle should be painted around all lubricating fittings and oil holes.

e. Reports and records. Unsatisfactery performance or defects in the application or effect of prescribed petroleum, lubricants, and preservative materials will be reported on DA AGO Form 468, Unsatisfactory Equipment Report. A record of lubrication of the equipment is maintained on DA AGO Form 460.

f. Ball bearings. In the annual lubrication of ball bearings, the equipment is not disassembled to add recommended quantities of oil. Where it is specified that a few drops of oil be applied to ball bearings, it is principally for the purpose of preventing corrosion. No more oil than is necessary to provide a thin film should be applied.

g. Lubrication of equipment under unusual conditions. It is necessary to lubricate more frequently to compensate for abnormal or extreme conditions such as high or low temperatures, prolonged periods of operation, continued operation in sand or dust, immersion in water, or exposure to moisture. Any of these operations or conditions may cause contamination and quickly destroy the protective qualities of the lubricants. Intervals may be extended during inactive periods commensurate with adequate preservation.

b. Grade of lubricant. Lubricants are prescribed in the key in accordance with three temperature ranges: above +32°F (0.0°C), +40°F to -10°F (4.4°C to -23.3°C), and from 0°F to -65°F (-17.8°C to -55.4°C). The grade of lubricants should be changed whenever weather forecast data indicate that air temperatures will be consistently in the next higher or lower temperature range or when sluggish action caused by lubricant thickening occurs. No change in grade will be made when a temporary rise in temperature is encountered.

[redacted]

i. Proper lubricant levels. Lubricant levels must be observ[illegible] losel[illegible] steps must be taken to replenish them in order to maintain proper levels at [illegible] mes

j. Lubrication under dusty and sandy conditions. After opera[illegible] on und[illegible] sandy conditions, all points of lubrication should be cleaned, inspected, [illegible] d relub[illegible] necessary. *NOTE: A lubricant which is fouled by dust and sand makes [illegible] abras[illegible] which causes rapid wear of parts.*

k. Painting of equipment. General instructions for the preparation of materiel [illegible] painting, methods of painting, and materials to be used, are contained in TM [illegible]-2851. Instructions for camouflage painting are found in FM 5-20B.

113. PREVENTIVE MAINTENANCE SERVICES. *a. Responsibilities and intervals.* Preventive maintenance services prescribed by Army regulations are a responsibility of the using organization, and consist generally of services required before, during, and after operation, and daily, weekly, and monthly services. They are performed by the using personnel. Prescribed intervals between services are based on a normal 5-hour-day operation and are reduced under abnormal operation or severe conditions. Intervals during inactive periods may be extended accordingly. Preventive maintenance procedures should be coordinated with general instructions given in TM 37-2910. General maintenance instructions for the handling equipment is found in the contractor's manuals and publications.

b. Operator or crew maintenance. To insure efficiency, it is necessary that the missile-handling equipment be inspected systematically at intervals each day it is operated and at least once each week. Defects should be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at designated intervals. Any defects or unsatisfactory operating characteristics beyond the scope of the operator or crew to correct must be reported at the earliest opportunity to the individual in charge. The services set forth in the pertinent sections of the contractor's publications are those performed by the operator or crew before, during, and after operation and daily, weekly, and monthly.

c. Before-operation preventive maintenance. Before-operation services are performed on the handling equipment to ascertain whether or not conditions have changed since the last after-operation service. Many things can happen to equipment between the last check and the time it is used again, and a check is necessary before the equipment is put into operation. The before-operation services should never be omitted even in extremely critical tactical situations.

d. During-operation preventive maintenance. The during-operation services consist of detecting improper performance. While in operation it is important to notice unusual noises or odors or unsatisfactory performance and to take corrective steps before the deficiencies develop to the point of actual breakdown.

e. After-operation preventive maintenance. The purpose of the after-operation services is to prepare the equipment for operation again on a moment's notice. The after-operation preventive maintenance services are particularly important because at this time using personnel can thoroughly inspect the equipment to detect any deficiencies that may have developed and immediately correct those they are permitted to correct. Any defects or troubles should be reported promptly to the section leader or other designated person. If this check is performed thoroughly, the equipment will be ready for use again on a moment's notice. The after-operation maintenance should never be entirely omitted but may be reduced to the bare fundamental services.

f. Periodic preventive maintenance. The daily, weekly, and monthly preventive maintenance services supplement the after-operation services and focus additional attention on iding general tightening, cleaning, and lubrication if required. The should include detailed inspections by the section leader and the ality of maintenance performed.

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CHAPTER 11

EMERGENCY PROCEDURES

Section I. HANDLING PROBLEMS

114. GENERAL. This chapter contains procedures for defueling the missile, depressurizing the missile, removing all explosive components, and disarming the booster of a ready missile. Before attempting to remove either propellant or explosive components, personnel must become thoroughly familiar with available safe handling procedures. *NOTE: The material presented in this chapter on safe handling of guided missile propellants should be supplemented by a thorough reading and understanding of the ordnance publication, Safety Regulations for Guided Missile Propellants, SR 385-310-1, and the draft Department of Army Training Circular, Safety Precautions for Guided Missile Training.*

115. PROPELLANT HANDLING. Guided missile propellants, whether in containers, in bulk, or loaded in missile tanks, must be handled carefully at all times to minimize the hazards of fire, explosion, corrosion, and toxic effects which are inherent in these dangerous materials. *WARNING: Absolutely no smoking is permitted when handling the propellants.* Propellant containers must not be handled roughly, thrown about, dropped, or tumbled over the floor, ground, or other containers. They must not be dragged or pushed along the floor or ground or allowed to bump into other containers, walls, obstructions, projections, sharp edges of metal or other material. Rolling of drums must be avoided at all times, but, if necessary, propellant containers must be rolled slowly, carefully, and attentively. Agitation of liquid propellants, particularly those of a nonconducting nature, may generate electrostatic charges which unless grounded or safely leaked off may result in an explosion or fire. Containers of guided missile propellants should be transported on either a two-wheeled hand truck or a four-wheeled, platform, hand-operated truck. The wheels of all such trucks must be of conducting, nonsparking material when operated over metal, concrete, or similar types of flooring. Wheels must be of bronze, brass, or have conductive-rubber tires. The wheels should be of a size and strength appropriate to the load to be carried. They should be fitted with easy-opening bearings, preferably of the roller or ball-bearing type and well packed with the proper lubricant. The bearings must be housed in order to retain the lubricant and to prevent leakage and possible contact with the oxidizer. I-supports of hand trucks should be of bronze or brass. Any metal on the trucks that can contact the containers being carried or that can strike against any surface or body during operation should be of material which will prevent the discharge of static electricity. Heavy containers of oxidizer may be handled by means of storage-battery-operated industrial trucks of spark-proof or explosion-proof types. If such trucks are used, safe slings, tongs, or lifters that securely engage the rims of the drums must be used on the boom or other suspension of the truck. The supported load must be securely lashed or held during raising, lowering, or carrying so that it cannot fall or strike against any obstruction and so that the contents cannot leak or spill through the required vents of the drums. Leaky drums, or drums upon which propellant has been spilled, should not be handled by storage-battery-operated trucks until the leaks have been stopped and spilled propellants have been cleaned from the drums. Roller conveyers may be used for moving drums or other containers of guided missile propellants, provided they are used in such a manner as to insure against any container falling or dropping. Containers of guided missile propellants should be hoisted and lowered carefully and slowly. Hoists should be operated so as not to jerk the load. Ample time should be allowed for removal of the load from the hoist in a safe manner. All equipment should be frequently inspected and maintained in a safe operating condition. When any equipment is found on inspection or observed during use to be defective or dangerous, the handling in progress should be stopped, and the damage or defective equipment repaired or replaced.

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116. STATIC ELECTRICITY AND HEAT. All propellants, whether in containers or not, should be handled so as to minimize the generation of static electricity and to avoid the production of sparks near exposed propellants. Care must be taken to avoid striking tools on concrete, steel, or hard surfaces. Steel containers must not be pushed against each other or against hard surfaces. Personnel must guard against prolonged exposure of propellants to heated surfaces or to the direct rays of the sun. *CAUTION: The premature mixing of oxidizers, acids, and flammable fuels is highly dangerous. Great care will be exercised to avoid any hazardous mixing.*

117. RED FUMING NITRIC ACID. The oxidizer component of the missile propellant is red fuming nitric acid. This acid is a very active oxidizer and will ignite any organic material. Any material that can be ignited by flame will be oxidized by the acid. If the oxidation products are gaseous, an explosion probably will occur.

a. Physical properties. The melting point of red fuming nitric acid is -51°F (-46.5°C), the boiling point is 130°F (54.4°C), and the density at 68°F (20.5°C) is 1.53.

b. Flammability limits. Nitric acid does not burn but is a strong oxidizing material which will cause fires when it comes in contact with organic substances. Red fuming nitric acid has a vapor pressure of 2,060 mm at 150°F (65.6°C). At high temperatures red fuming nitric acid will give off gaseous oxides of nitrogen.

c. Solubility and solvents. Nitric acid is soluble in water in all preparations. The large amount of heat released when nitric acid is dissolved in water may cause spattering and flame unless precautions are taken to allow time for the heat to dissipate. When mixed with sea water, chlorine and other poisonous gases are liberated. Nitric acid will react explosively with certain organic liquids such as organic amines, furanes, and certain vinyl compounds.

d. Chemical behavior. Nitric acid is classified by the Interstate Commerce Commission (ICC) as a corrosive liquid. Nitric acid is a poison and an oxidizer agent. It may be neutralized by the addition of common alkalies.

118. INSTABILITY OF NITRIC ACID. Nitric acid has the following characteristics:

a. Behavior in fire. When heated, nitric acid will give off poisonous fumes and actively support combustion.

b. Behavior in extreme cold. Nitric acid is stable in extreme cold.

c. Action of detonators. Nitric acid cannot be detonated. However, in contact with organic material of ammonia, explosive compounds may be formed.

d. Sweat or vaporous products. Nitric acid has an appreciable vapor pressure which increases with the amount of dissolved nitrogen oxide. The vapors contain nitric acid and nitrogen oxides, varying in shades from red to dark brown (for red fuming nitric acid). The oxides of nitrogen have a sweet acrid odor.

e. Effect of contamination. Organic material such as oil, paper, or wood will contaminate nitric acid, creating an explosive hazard and will cause the evolution of nitrogen oxides. Upon exposure to light, nitric acid decomposes slightly to form water and nitrogen oxide. Under normal storage nitric acid is stable and can be stored for long periods of time. Nitric acid is hygroscopic and will absorb moisture if exposed to the air.

119. HEALTH HAZARDS WITH NITRIC ACID. Liquid nitric acid is extremely toxic and will produce burns on any body tissues with which it comes in contact. Nitric acid also produces vapors which are toxic when inhaled. Nitric acid, when contaminated with any organic material, produces toxic vapors or gases called oxides of nitrogen. Three of the oxides are common and

important from a toxic standpoint. Nitrous oxide (N_2O or laughing gas) is not considered extremely poisonous except in cases of overdosage. Nitric oxide (NO) is formed by the spontaneous decomposition of nitric acid which, immediately upon contact with air, forms the third of the oxides of nitrogen, nitrogen peroxide. Nitrogen tetroxide or peroxide (NO_2), a reddish-brown gas, is the chief oxide of nitrogen and is poisonous when inhaled. Skin contact with nitric acid in mild concentrations, if of momentary duration, may produce only a yellow staining. Skin contact with concentrated solutions, for any appreciable period of time, will result in a severe chemical burn. Depending on the concentration and duration of the contact, death of the tissues with clotting of the blood vessels in the immediate area may occur and result in scarring and deformity. Nitric-acid contact with the eyes may result in a severe burn and destruction of the tissues of the eyes to cause blindness. Nitric acid will destroy the membranes of the mouth, nose, or throat. Nitric acid, its vapors, and the oxides of nitrogen have toxic effects on the nose, throat, respiratory passages, and lungs when inhaled. The effects of inhaling the oxides of nitrogen are most important because fatal poisoning can be produced with little or no warning to the victim. Several hours after exposure, a sensation of choking and spasmodic coughing will develop. There will be a feeling of burning and shortness of breath in the chest. With a small dose, the victim generally recovers within a few hours after getting into fresh air. In more severe cases, the symptoms are increased in intensity. Fluid will accumulate in the lungs, and pneumonia may develop with fatal results. Inhalation of oxides of nitrogen may produce sudden death from respiratory failure or marked lowering of the blood pressure accompanied by a feeling of vertigo, faintness, and loss of consciousness, and frequently may be fatal. Inhalation of mild concentrations of oxides of nitrogen over a long period of time can produce another type of poisoning. This type is characterized by wearing down and decaying of the teeth, dilation of the lungs, chronic irritation of the breathing passages, a slow pulse rate, and lowering of the blood pressure. Ulceration of the membranes of the nose and mouth also frequently results.

120. PERSONNEL PROTECTION WHEN HANDLING NITRIC ACID. In all operations involving handling or transfer of nitric acid, rubber hoods, rubber aprons, rubber boots, and acid-handling gloves must be worn. Where there is to be exposure to nitric acid in open containers or in atmospheres liable to be contaminated with vapors of nitric acid or oxides of nitrogen, the acid hood must incorporate some form of closed breathing apparatus. The clothing must cover all exposed parts of the worker's body and be adjusted so as to eliminate any possibility of drainage into the gloves or boots. Goggles and face shields are not adequate. A hood which covers the head and shoulders is required. In cases of fire or spillage, the service gas mask furnishes adequate protection only in open spaces such as field areas or weather decks where the concentration will be low. In confined spaces, spillage or fires will produce high concentrations requiring closed breathing apparatus or a supply of uncontaminated air by a hose line.

a. Safety showers in some form are required near the storage and handling areas. An open vessel with adequate amounts of water (preferable fresh) is necessary for all handling stations. In addition, handling stations will be equipped with a large open container filled with a saturated solution of sodium bicarbonate for soaking affected skin areas. A separate two-percent bicarbonate of soda solution in a smaller container such as a 4-ounce bottle will be provided for treatment of eyes.

b. When contaminated, the skin will be immediately and thoroughly washed for at least 15 minutes with large quantities of cool, fresh water or copious amounts of saturated bicarbonate of soda solution, whichever can be reached first. The latter is considered preferable. Qualified medical treatment will be obtained immediately.

c. Contamination of the clothing requires the same treatment as listed above after removal and disposal of the clothing into a vessel containing sodium bicarbonate solution in saturated form.

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d. Eyes will be flushed promptly and copiously with fresh, cool water or a two-percent solution of sodium bicarbonate, whichever can be reached first. The latter is preferable. Qualified medical treatment will be obtained immediately.

e. The effects of swallowing nitric acid are treated by drinking copious amounts of lukewarm water, warm soapy water, or milk, depending upon which is most readily available. Vomiting should be induced. Qualified medical treatment will be obtained immediately.

f. Individuals showing evidence of exposure to nitric acid fumes or the oxides of nitrogen will be removed immediately from the area of concentration and qualified medical treatment will be obtained.

g. Periodic examination of personnel is required. Personnel showing effects of nitric acid poisoning should be rotated to other employment.

121. OTHER HAZARDS. Precautions should be taken to prevent the following occurrences.

a. Nitric acid will react with sea water to liberate chlorine and other poisonous gases.

b. Nitric acid corrodes most metals, especially iron and steel.

c. Nitric acid, in contact with organic materials such as sawdust, straw, wood and wood shavings, paper, cotton waste, or burlap bags, is a fire hazard and may cause spontaneous combustion.

122. METHODS OF TRANSPORTING NITRIC ACID. Before attempting any transportation of nitric acid, careful consideration should be given to the points listed below.

a. Laws. The laws for transporting nitric acid are contained in the applicable ICC regulations. AR 55-157 lists Department of the Army regulations.

b. Packing. The latest edition of the ICC regulations must be followed when packing nitric acid for shipment. Nitric acid may be shipped in glass bottles (5-pint maximum) individually inclosed in tightly closed metal cans and cushioned therein with sufficient incombustible material to completely absorb the contents. The cans must be inclosed in wooden boxes, barrels, or kegs. Drums, tank trucks, or tank cars of suitable corrosion-resisting material, as specified in the applicable ICC regulations for the particular grade or type of nitric acid being transported, can be used.

c. Labels. Each container must carry an identifying label or stencil. For shipment, each container must bear the ICC white label for acids. Tank cars and railroad cars carrying one or more containers of nitric acid must bear an ICC DANGEROUS placard.

123. MAIN STORAGE OF NITRIC ACID. Nitric acid may be stored in metal drums or tanks of approved construction. The importance of containers should not be underestimated.

a. Pressure relief. Each storage tank will be provided with a pressure relief of adequate size discharging at a point outdoors where no working areas will be contaminated.

b. Metals used. Certain heavy metals react violently with nitric acid, evolving fumes of nitrogen oxides. Storage tanks, associated piping, and fittings must be of a material resistant to corrosion by the particular grade or type of nitric acid and its vapor. Aluminum and stainless steels may be used in the storage of certain types of nitric acid. Mixed acid forms a heavy sludge in steel containers, and this sludge may introduce difficulties in using the oxidizer for propellant systems. High-silicon iron is suitable for pumps and valves for service with all types of nitric acid.

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c. *Drum storage.* When nitric acid is stored in drums, the [illegible] should be taken: keep the plug up to prevent leakage; keep the drums out [illegible] from heat; relieve internal pressure when received and at least weekly [illegible] after [illegible] loosening the plug, followed by immediate retightening; never use pressure [illegible] lights, and sparks away from the drum openings.

d. *Quantity and distance limits for storage.* The unit SOP should contain [illegible] minimum distances within which certain combustible material may not be stored.

(1) Nitric acid must not be stored with any organic or combustible material. Nitric acid may react explosively with some materials. Nitric acid will attack carbides and metallic powders. Therefore, nitric acid must not be stored with any material other than sulphuric acid.

(2) The bulk storage of nitric acid will be isolated from the bulk storage of combustible materials such as aniline or furfuryl alcohol.

e. *Placarding.* All nitric acid containers and storage rooms will be placarded with at least the following information:

NITRIC ACID

DANGER: CAUSES SEVERE BURNS

VAPOR EXTREMELY HAZARDOUS

MAY CAUSE NITROUS GAS POISONING

DO NOT BREATHE VAPOR

DO NOT GET IN EYES, ON SKIN, OR CLOTHING

IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN OR EYES

WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES

GET MEDICAL ATTENTION

SPILLAGE MAY CAUSE FIRE OR LIBERATE DANGEROUS GAS

f. *Ready storage.* The provisions for main storage also apply to ready storage. Ventilation of storage buildings must be sufficient to prevent any accumulation of fumes or gaseous oxides.

124. HANDLING NITRIC ACID IN STORAGE. A large percentage of accidents are due to faulty handling. The following precautions must be observed:

a. Only pumps, piping, valves, gages, and connections designed for nitric acid use are permitted. The water supply for dilution and flushing of acid leaks and spills must be in the immediate vicinity. Safety showers must be provided.

b. Equipment and materials such as wood or canvas, which may burn in contact with nitric acid, are prohibited.

c. Precautions must be taken to keep the vicinity free from oil, refuse, and other flammable material to avoid fire hazards. Spillage or leakage will be washed down immediately.

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... observe the following precautions: nitric acid must be ... materials such as oil or other propellants when charging mis- ... in case of overfilling must be provided; an adequate supply ... equipment must be adequately protected.

... propellants to and from storage, never use pressure to transfer ... air is used to transfer acid from tank cars, under no circum- ... excess of 30 psi be used. Compressed air must be as free as pos- ... foreign material. Smoking, fire, sparks, and unprotected lights are ... operations. Tank cars and drums shall not be washed out before return- ... completely emptied; drums must be completely drained and all openings ... properly closed. Centrifugal pumps of corrosion-resistant material are recommended for the transfer of nitric acid. Pipe lines should be of suitable corrosion-resistant material; special precautions must be observed to prevent the use of valves, gages, or fittings of metals that react with nitric acid. Threaded fittings should be avoided wherever possible. Flanged joints should be provided with shields to protect them against leaks and splashes resulting from seal failures.

125. ANILINE. The starting mixture is composed of aniline and furfuryl alcohol. Aniline is flammable, toxic, noncorrosive liquid used with the furfuryl alcohol for spontaneous ignition with red fuming nitric acid.

a. Physical properties. Aniline is a colorless, oily liquid which rapidly turns brown upon exposure to light. It has a melting point of 22°F (-5.5°C) and a boiling point of 363.2°F (183.8°C). The density of aniline is 1.02 at 68°F (20.5°C).

b. Flammability limits. The flash point (closed cup) of aniline is 168°F (75.2°C). The ignition temperature is 1418°F (770°C).

c. Solubility and solvents. Aniline is slightly soluble in water. It is soluble in alcohols and ether.

126. INSTABILITY OF ANILINE. Aniline is capable of the following reactions:

a. Behavior in fire. Aniline will burn.

b. Behavior in extreme cold. Aniline will freeze at 22°F (-5.5°C) and is stable in extreme cold.

c. Action of detonators. Aniline is not sensitive to mechanical shock. Information concerning the effect of detonators will be added when available.

d. Effect of contamination. Aniline leakage will cause materials with which it comes in contact to become flammable, producing a fire hazard. Aniline will attack materials such as some nonferrous metals, rubber, and cord.

e. Stabilization of material. Aniline is quite stable and will remain usable for a long period of time if properly stored and sealed. The color of aniline may change to a deep brown but the material will be usable. Aniline should be protected from the sun. It is slightly hygroscopic.

127. HEALTH HAZARDS WITH ANILINE. All personnel working with aniline should be made fully aware of the dangers to their health which may result from a failure to maintain necessary safety precautions.

a. Toxicity. Aniline is toxic through inhalation of the vapor, by ingestion, and absorption through the skin. It is a skin irritant.

[redacted]

b. Effect on skin, eyes, and other parts of the body. Skin contamination is of minor importance. Contact over long periods of time or frequent repetition [illegible] duces skin irritation and eventually a skin rash. Aniline and its fumes produce [illegible] eyes, causing redness, burning, and excess tear production. Poisoning by inhalation [illegible] frequently encountered and the most important toxic effect of aniline. More than [illegible] aniline vapor per million parts of air per working day may produce chronic aniline [illegible] Acute intoxication may be produced by inhalation or ingestion of heavy concentration [illegible] would occur by spillage of large amounts. This form of aniline poisoning is charact[illegible] sudden weakness and prostration, coldness and numbness of the skin, blueness of the [illegible] a decrease of the powers of perception. In addition, there is frequently a shortness of breath and in some instances cessation of respiration and death. Exposure to more moderate concentrations produces acute poisoning characterized by blueness of the skin, dizziness, an unsteady gait, irritability, and labored speech. The chronic form of poisoning as a result of repeated exposures to mild concentrations exhibits symptoms such as headaches, digestive disturbances, and ringing in the ears. More severe forms of chronic poisoning generally show weakness in the limbs, disturbances of sensation, a rapid pulse rate, and often blueness of the skin and difficult labored respiration. Aniline shows its toxic effects chiefly on the blood and nervous systems. In the blood, aniline changes the oxygen-carrying substances within the red blood cells into a compound whose oxygen-carrying power is markedly decreased. The decrease in the power of the blood to transport oxygen is progressive and eventually approaches a condition of internal asphyxia evidenced by a blue discoloration of the skin. The effect of aniline on the nervous system is similar to that produced by narcotic drugs.

128. PERSONNEL PROTECTION WHEN HANDLING ANILINE. In all handling or transporting of exposed aniline, personnel should wear goggles, gloves, and rubber boots. Fire-resistant clothing is desirable. Clothing which has become saturated with aniline should be removed immediately, and the aniline removed from the skin by sponging with a five-percent solution of acetic acid (vinegar). Continued wearing of contaminated clothing produces irritation of the skin and, in addition, is the source of aniline poisoning by absorption through the skin or by inhalation.

a. Accidental spillage or splashing in which aniline gains access to the eyes or the ear canals may also be the source of poisoning by absorption. In ear contamination the ear canals should be flushed with a three-percent solution of acetic acid or other mild acid solution (boric acid). Eye contamination should be flushed immediately with a saturated solution of boric acid.

b. The handling of open aniline containers requires the use of a chemical respirator, self-contained breathing apparatus, or an air-hose line from an uncontaminated source.

c. Safety showers are recommended. An open vessel with adequate amounts of the dilute acetic-acid solution (five-percent) or diluted solutions of other mild acids is required for washing or soaking contaminated skin areas. At least four ounces of saturated boric acid solution is required at handling stations for the treatment of eye contamination. Contaminated clothing should be decontaminated by soaking it in a vessel containing a dilute solution of acetic acid.

d. Personnel who display any of the symptoms of aniline poisoning without the liquid in contact with the body should be removed to fresh air immediately, kept quiet, given a mild stimulant such as black coffee (never alcohol), and kept warm. They should be placed under qualified medical supervision immediately. Artificial respiration should be used if respiration ceases.

e. Periodic health examination of personnel is required.

f. Personnel evidencing the effects of aniline poisoning should be rotated to other duties.

...SPORTING ANILINE. Before attempting any transportation of ... should be given to the points listed below.

... for transporting aniline are contained in the ICC regulations. ... B poison by common carriers. Also see AR 55-157 for Department

...*marking.* Aniline can be packed in steel drums, carboys, tank cars,

... There are no quantity limits for aniline shipping.

... FOR ANILINE. Aniline containers may be made of mild steel. They ... standard specifications for commercially available drums, carboys, and tank ...

a. Quantity and distance limits. Aniline containers may be stored next to each other but must not be stored near any reactive materials.

b. Ready storage. Aniline may be stored in glass carboys or in stainless steel or mild-steel containers. The containers must be stored in a cool place, kept tightly sealed, and away from oxidizers.

c. Handling. Aniline should be handled in stainless steel, iron, or glass equipment. Aniline should be transferred in a clean and preferably closed system.

(1) Combustible equipment or materials should not be exposed to aniline. Aniline will react slowly with some nonferrous metals.

(2) Personnel should wear rubber boots, gloves, goggles, and fire-resistant clothing. In close quarters, breathing apparatus should be used.

(3) Precautions should be taken to permit only necessary equipment and nonflammable materials in aniline storage rooms. Storerooms should be kept clean and free of trash. Spillage or leaks should be cleaned up immediately.

(4) When fueling missiles, aniline must not be permitted to come near any oxidizers. All electrical equipment should be of an explosion-proof type to prevent sparking during transfer. Water, foam, and chemical extinguishers should be readily available.

(5) Empty storage containers should be stored in a designated area (refer to the applicable ICC regulations).

131. FURFURYL ALCOHOL. Furfuryl alcohol will react violently with concentrated acid. Furfuryl alcohol varies from straw yellow to dark amber in color and has a slightly brine-like odor.

a. Physical properties. Furfuryl alcohol has a melting point of -24.9°F (-32°C), and a boiling range of 332.6°F (166.9°C) to 343.4°F (172.8°C). The density of furfuryl alcohol at 60°F (15.6°C) is 1.136.

b. Flammability limits. Closed vessels containing furfuryl alcohol at temperatures above 162.5°F (72.5°C), and below 251.6°F (121.9°C) will have an explosive mixture of vapor and air over the liquid. The flash point of furfuryl alcohol is 167°F (74.4°C).

[redacted]

c. Solubility and solvents. Furfuryl alcohol is soluble [illegible] ether, benzene, and water. It is used as a solvent in paints and plastics.

d. Chemical behavior. With dilute acid or an alkali, furfuryl alc[illegible] a resin. Furfuryl alcohol and its vapors react violently with concentrated ac[illegible] It does not attack ferrous or nonferrous alloys, glass, ceramics, or wood but may att[illegible]

e. Chemical and physical instability. Furfuryl alcohol will burn like ker[illegible] cannot be detonated. Furfuryl alcohol is stable in extreme cold.

f. Sweat or vaporous products. Due to its high boiling point of 340°F [illegible] little vapor is formed at ordinary temperatures. The color of furfuryl alcohol is slowly dark[illegible] by exposure to air.

g. Effect of contamination. Contamination from furfuryl alcohol is not especially critical in minute concentrations. It reacts explosively with dilute or concentrated mineral acids. Leaks of furfuryl alcohol will increase local fire hazards. It is slightly hygroscopic.

h. Toxicity. Furfuryl alcohol is not classified as a toxic material. It is, however, a local irritant if allowed to remain in contact with the skin. Under ordinary conditions of ventilation, the use of furfuryl alcohol is not hazardous to health.

i. Personnel protection. Contaminated skin areas should be washed with fresh water immediately, and contaminated clothing should be removed. Weekly health examination of personnel is not required. Personnel rotation is not necessary.

(1) When fueling missiles, furfuryl alcohol must not be allowed to come in contact with acids or oxidizers. The transfer systems must be clean.

(2) When transferring furfuryl alcohol from and to storage, the usual precautions for transferring any combustible liquid must be observed.

132. TRANSPORTING AND STORING FURFURYL ALCOHOL. No ICC special label is required for shipment. Furfuryl alcohol may be shipped by common carrier.

a. Packing and marking. Furfuryl alcohol can be shipped in iron or steel drums or ordinary tank cars.

b. Quantity limits. There are no special quantity limits.

c. Labels. No special labels are required with furfuryl alcohol.

d. Main storage. Furfuryl alcohol can be stored in iron and steel containers of any size. The containers must conform to standard requirements for iron and steel containers which are commercially available. Keep acids away from furfuryl alcohol during storage.

e. Ready storage. Furfuryl alcohol must be kept separated from acids. Its flammability is comparable to that of kerosene. The provisions applicable to main storage also apply to ready storage. No special equipment is required for handling. Equipment capable of producing sparks, steel or iron tools, and nonexplosive-proof electrical equipment are prohibited.

133. STARTING MIXTURES. The starting mixture is half aline and half furfuryl alcohol and is packed four cans or bottles per box. One can or bottle contains sufficient fuel for one missile.

a. Physical properties. The 50-50 starting mixture has a specific gravity of 1.1 and a freezing point of -44°F and is miscible in water but not in JP-3. It varies in appearance from a clear, colorless liquid to a clear brown. It is flammable, toxic, and noncorrosive.

[redacted]

[redacted]

The starting mixture is poisonous if taken internally. The fumes

...ion. Generally the same precautions should be observed as speci- ... alcohol.

... shipment of this item must conform to ICC regulations. For shipping ... class B poison.

Storage. The starting mixture should be stored in a well-ventilated building of nonabsorptive and fire resistant construction.

Inspection. Only a visual inspection is made. Conditions to be looked for are:

(1) Unserviceable packing boxes and cans or glass bottles with broken seals.

(2) Evidence of jelling in glass bottles.

(3) Presence of any solid bodies in the liquid.

(4) Resinous deposits in the bottom of the glass container.

g. Emergency disposition. The starting mixture may be disposed of by burning in the open with due regard for the direction of the prevailing wind and the toxic vapors which will be given off during the burning.

h. Handling equipment. No special tools or equipment are required in the handling of the starting mixtures.

134. JP-3. JP-3 should be handled in accordance with acceptable practices for handling any gasoline.

135. SAFE HANDLING OF EXPLOSIVE COMPONENTS. *a. Classification of explosive components.* Storage-compatibility and quantity-distance tables, covering various types of of explosives, are presented in Ordnance Safety Manual, ORD M-7-224, and other Army regulations and technical manuals. Explosive components are identified by groups and classes in these publications. However, some of the explosive components used in the Nike I are not specifically identified, and the classifications presented herein have been tentatively determined only by the characteristics of the components themselves to serve as a guide in handling.

b. Procedures. Regulations covering the transportation, storage, and handling procedures for explosives have been established by the Office of the Chief of Ordnance. These regulations have been presented in the Ordnance Safety Manual, ORD M-7-224. Numerous Army regulations and technical manuals also cover the handling of explosives at installations other than ordnance establishments. The regulations presented in the Ordnance Safety Manual, Army regulations, and technical manuals will, whenever applicable, govern the handling of the missile explosive components. However, when several types of explosives are combined in a particular application, conditions arise which are pertinent only to that application and may not be covered in standard operating procedures. This paragraph endeavors to cover as many of these conditions as can be foreseen. Personnel handling explosive components must be thoroughly familiar with all safety regulations applicable to the area in which work is being performed. The rules for good housekeeping and care of tools and equipment must be observed at all times. Fire-fighting equipment must be checked periodically and kept in good working condition. Many accidents are caused by practical jokers; horseplay is definitely a hazard to safety when working with explosives. Personnel must be kept to a minimum consistent with efficient work. For the safety of operating personnel, as well as efficient performance of the missile, careful attention must be paid to all

[redacted]

details of removal and installation of the explosive components. Regulation [illegible] safety precautions (care, handling, and preservation of explosives) are pr[illegible]

136. WARHEADS. The missile contains three warheads. They are [illegible] nterchan[illegible] The explosives in the warheads is composition B. The nose warhead is [illegible]d by [illegible] tetryl booster in the base of the warhead. This tetryl booster is installe[illegible] the [illegible] needs only to be connected to the detonating-cord harness after the warhead [illegible] installe[illegible] missile. However, the center and aft warheads are initiated centrally by [illegible] of an [illegible] assembly which consists of a tetryl booster and a detonating-cord lead capped [illegible]t each [illegible] a PETN relay cap. The center and aft warhead initiators are installed just [illegible] to installing the warheads in the missile.

a. Warheads used in the missile can be classified in the same category as fragmentation bombs containing composition B (listed as group G, class 10 explosives in ORD M-7-224). General storage regulations are contained in AR 700-10. Regulations for ordnance establishments are found in the Ordnance Safety Manual, ORD M-7-224).

b. Warheads may be transported by motor vehicles providing both the driver and the vehicle meet the requirements of the applicable section of ORD M-7-224, or equivalent Army regulations.

c. Warheads must be lifted or wheeled and not handled roughly, jolted, or rolled over the floor.

d. Care must be exercised to avoid damaging the wire wrapping on the warheads.

e. The initiator cavities must always be closed with the shipping plugs. The cavities must be inspected for foreign material before inserting the initiator assemblies.

f. After the initiators are installed, warheads are never stored in a magazine or storage area where warheads without initiators are stored.

g. Handling yokes are provided to lift the warheads. The attachment must be secured before the warhead is moved.

h. Personnel in the area must be kept at a minimum consistent with safe and efficient operation.

i. Warheads will be installed only after all other assembly operations have been completed. They must always be removed from the missile before any repair or rebuild operation is performed.

j. Periodic inspection of the warheads is necessary. Any evidence of moisture condensation or sweating must be reported immediately to the officer in charge.

k. All Army safety regulations which affect the handling of warheads must be strictly followed.

137. DETONATING CORD ASSEMBLIES. The detonating cord assemblies, consisting of detonating cord, relay caps, connectors, and a coupling nut, will be received completely assembled and ready for installation in the missile. The assemblies require only a visual inspection. Due to the shock-absorbing characteristic of the cover, the detonating cord is relatively insensitive to sparks, friction, or ordinary shock. However, the PETN relay caps which are cupped to the detonating-cord ends do not have this protection. The cap walls are thin, and rough treatment must be avoided. The accidental initiation of a relay cap could cause detonation of the entire length of detonating cord, causing considerable damage to equipment and endangering the lives of personnel.

... cap ends must never be forced through openings, struck with tools, ... unattached ends of the detonating cord assemblies should be taped ... of the missile until the final inspection is made.

... cord must never be allowed to come in contact with any material which ... with red fuming nitric acid. Red fuming nitric acid reacts with the deto- ...

... detonating cord assemblies must be handled with care to prevent kinks or bends which may cause a malfunctioning in the PETN core. This condition could cause attenuation or complete stoppage of the detonation.

d. If there is evidence of damage to the detonating cord covering, such as cuts or nicks, it should not be used.

e. Damaged sections of the detonating cord must be disposed of in accordance with authorized procedures (ORD M-7-224).

f. No attempt to repair a damaged detonating cord assembly must be made. Damaged assemblies must be replaced.

g. The detonating cord must not be attached to the arming mechanisms until all other warhead system installations and connections have been completed.

h. Separate storage of detonating cord assemblies is recommended when facilities permit. If adequate facilities are not available, the assemblies may be stored as class 9 material (ORD M-7-224).

i. The detonating cord can be stored with other explosives only under certain conditions (ORD M-7-224).

j. Personnel in the immediate vicinity must be kept to a minimum, consistent with efficiency during handling.

k. When it is necessary to return any detonating cord assemblies to the storage area, they must always be replaced in either the original packing or another suitable container. The assemblies are never stored without suitable packing protection.

138. WARHEAD INITIATORS. The warheads are initiated by an initiator assembly. The initiator assembly is shipped in a separate container and is installed in the warhead just prior to the installation of the warhead in the missile. The initiator consists of a length of detonating cord, capped at both ends with a PETN relay cap. One end of the detonating cord lead is butted against a tetryl booster in the warhead. The complete assembly is contained in an aluminum tube approximately 9½ inches long. The tube is inserted in the warhead cavity. At the end of the cavity is a large tetryl booster. When the initiator assembly is installed and connected to the detonating-cord assembly, the explosive train (arming mechanisms, detonating-cord harness, initiator, and warhead) is complete. The initiator is shipped completely assembled and requires only unpacking, and visual inspection before being inserted into the warhead.

a. The initiators must be stored in accordance with storage-compatibility and quantity-distance regulations as prescribed in the Ordnance Safety Manual, ORD M-7-224, or applicable Army regulations.

b. Initiators must be removed from packings outside the magazine.

[redacted]

c. The aluminum tube containing the initiator components ... sible damage during shipping. If the tube is damaged, no attempt to ... will be made.

d. Damaged initiator assemblies must be disposed of in ... ulations and by qualified personnel (TM 9-1900).

e. The initiator assemblies contain detonating cord, PETN, ... be handled carefully at all times.

f. If it becomes necessary to replace an initiator in the magazine ... original packing or some suitable container. Unprotected initiators are not stored.

g. In general the same safety precautions pertain to initiators as to detonating-cord assemblies.

139. ARMING MECHANISMS. The two T93E1 arming mechanisms are essentially clocking mechanisms which contain MK 122, Model O detonators. The detonator is normally in the SAFE position. The rotor is provided with a reference mark indicating the SAFE and ARMED positions. Each arming mechanism is preset and must not be reset or tampered with when received. It requires only a visual inspection and an electrical continuity check with a ballistic galvanometer.

a. The arming mechanisms must be stored in accordance with the applicable storage-compatibility table, ORD M-7-224, for class 1 explosives.

b. The arming mechanisms are shipped in water-resistant paper containers with silica gel desiccating pads. The arming mechanisms must not be removed from the original packing until they are ready for installation unless absolutely necessary. If this necessity arises or if the arming mechanisms are removed for inspection or other purposes, they are always replaced in the moisture-proof containers together with the desiccating pads.

c. Voltmeters, ohmmeters, or other current and/or resistance measuring instruments to check the continuity of the arming mechanisms will not be used.

d. An arming mechanism must not be reset or repaired. If found to be defective, it must be disposed of in accordance with authorized procedures (TM 9-1900).

e. The arming mechanisms must be handled with care.

f. The arming mechanisms are not connected to the detonating cord assemblies during warhead-system installation. They are connected at the launcher. Removable plates provide easy access for connecting the primacord to each arming mechanism.

g. A missile is not transported from one area to another with the arming mechanism connected to the detonating-cord harness.

140. HAZARDOUS MISSILES. The use of explosives and solid propellants in close proximity to nitric acid is a relatively new procedure. The hazards involved in such applications have not as yet been fully established. Until such information becomes available, only very general precautions can be presented. The information given herein should be considered only as a guide to the recognition and subsequent handling of a hazardous condition. When standard procedures are established by the Department of the Army, this text will be revised to conform with standard procedures and applicable safety regulations. There are four conditions which can make a missile unsafe for handling or storage.

a. Contamination of certain explosive components with nitric acid.

[redacted]

...ng of the arming mechanism.

...pressure.

...s combustion caused by acid and aniline leakage.

...MINATION. Acid contamination may occur through accidental spillage ... servicing or through leakage which might develop in the oxidizer system. ... corrosive nature of nitric acid on most materials, any extensive contamina- ... components is likely to damage the components and make the missile hazardous ... handling and/or storage.

a. *Detection of acid contamination.* Acid leakage can usually be detected by visible fuming of characteristic reddish-brown color or by characteristic reddish-brown stains on the contaminated material. Careful inspection of fueled missiles should be made at frequent intervals to detect the possibility of such leaks.

b. *General precautions for acid contamination.* Upon discovery of any acid contamination in a missile, the area should be cleared immediately of all personnel except those required for corrective measures. A qualified officer or authorized noncommissioned officer should immediately survey the contamination to determine the course of action to be taken. As early as consistent with other requirements, the booster should be removed from the missile. If it is suspected that the booster has become contaminated, the booster must be washed with either a soda-water solution or fresh water. Care should be exercised to prevent any of the dilute acid from draining into the booster igniter which contains black powder and must be protected from heat rises. The entire warhead and initiating system must be removed as soon as possible in order to eliminate the possibility of accidental detonation.

(1) Protective clothing must be worn when handling acid-contaminated components.

(2) Acid fumes must not be inhaled.

(3) Containers of soda-water solution and fresh water must be available for washing any part of the missile that has been exposed to acid.

(4) Acid-contaminated components (explosive or otherwise) must not be left in the vicinity of uncontaminated material or where they may be handled by personnel.

(5) After a contaminated missile has been rendered safe, the area must be inspected by personnel wearing protective clothing before the area is again declared safe as a working area.

c. *Acid contamination of warhead initiating system.* Limited tests show that while red fuming nitric acid does not affect PETN it does react unfavorably with the plastic covering on the detonating cord. The reaction causes a heat rise, although the extent over a protracted period of time has not yet been determined. It is conceivable that this heat rise could cause a fire or even an explosion. The warhead initiating system should be removed as quickly as possible from a contaminated missile.

d. *Acid contamination of warhead.* Preliminary tests indicate that red fuming nitric acid reacts little, if at all, with composition B or tetryl. However, the tetryl booster within the warhead is joined to the initiating system by a length of detonating cord which is adversely affected by red fuming nitric acid. If the warhead is contaminated, particularly in the vicinity of the detonating cord connection, the warhead should be considered unsafe.

e. Acid contamination of igniter and booster propellant. [illegible] cates that both the igniter and the booster propellant are adversely [illegible] acid. The degree of hazard involved has not yet been determined, but [illegible] missile in which either the igniter or the booster propellant is suspected [illegible] taminated with acid should be considered unsafe, and immediate steps [illegible] nate the hazardous condition.

f. Remedial action for acid contamination. In order to reduce [illegible] tion(s), the immediate objectives are to neutralize the spilled acid and to [illegible] contamination to other dangerous components of the missile. The order in which [illegible] are accomplished is dependent in a degree upon the amount of contamination [illegible] the components contaminated. A small contamination which has not spread [illegible] ponents may be neutralized by swabbing up the acid with a special sponge [illegible] water solution. More extensive contamination may call for dousing with soda water [illegible] copious quantities of fresh water. During this process care must be exercised to avoid contaminating critical components with diluted acid. Critical components, such as the initiating system, must be removed, and the missile must be separated from the booster as soon as possible in order to prevent contamination of the booster propellant. If free acid has leaked back into the body of the missile, the missile-booster combination should not be tilted to allow the acid to drain back toward the booster. If contamination has resulted from leaks in the oxidizer system, it will be necessary to remove the missile to an area where it may be drained of acid and fuel and turned in for general overhaul.

142. PREMATURE CYCLING OF ARMING MECHANISM. If an arming mechanism is carefully inspected before installation, there is small likelihood of it becoming armed prematurely. However, if inspection reveals that the arming rotor has moved from the SAFE position, that arming mechanism must be carefully removed and replaced with another unit. The faulty mechanism must be disposed of in accordance with directions for handling group N, class 10 explosives.

143. EXCESSIVE AIR PRESSURE. The air storage system in the missile is designed for working pressures up to approximately 4,600 psi. The minimum required operating pressure is approximately 3,000 psi. If the missile is improperly pressurized, large temperature increases may cause a pressure buildup in excess of 4,600 psi. This dangerous condition can be discovered readily by reference to the air pressure gage attached to the propellant-system air storage tank, and immediate steps must be taken to reduce the air pressure to the proper working level.

Section II. MISSILE DEFUELING

144. REMOVAL OF STARTING FLUID. The starting mixture (aniline and furfuryl alcohol) will be removed at the assembly and service area. *WARNING: In order to safely defuel the missile, the starting mixture must be removed before either the fuel or oxidizer. Personnel perform the operations listed in table XII.*

Table XII. REMOVING STARTING MIXTURE

(1)	Raise the nose of the missile 5° above the horizontal with tunnel number 1 up.
(2)	Remove the plug from the starting fluid vent opening.
(3)	Remove the starting fluid filler plug.
(4)	Insert a clean empty syringe, with the handle pushed in, into the filler fitting.

...le until it is fully extended.

...rom the filler fitting and discharge the starting fluid from the container.

... a clean commercial grade of ethyl alcohol.

...syringe into the filler fitting and inject and withdraw the ethyl ... Remove the syringe from the filler fitting and empty it.

... adapter fitting into the starting mixture filler fitting and connect a ... en or dry air supply to the fitting.

(10) ...wer the missile to the horizontal and rotate it until the starting fluid vent opening is pointing down.

(11) Turn on the gas supply and allow it to flow through the starting fluid line until the exhaust through the vent fitting is free of liquid.

(12) Turn off the gas supply. Rotate the missile back to the position where tunnel No. 1 is up. Remove the gas supply line and special adapter fitting from the filler opening.

(13) Reinstall the filler and vent plugs.

145. REMOVAL OF FUEL. The fuel is removed while the missile is in the assembly and service area. Personnel perform the operations listed in table XIII.

Table XIII. REMOVING FUEL

DRAIN LINE INSTALLATION

(1) Raise the nose of the missile 5° above the horizontal with tunnel No. 1 up.

(2) Remove the vent plug from the fuel tank and install the vent adapter and line.

(3) Lower the missile to the horizontal, remove the fuel tank and filler plug, and install the propellant drain valve in the filler fitting. Do not attempt to remove the teflon stopper.

(4) Remove the fuel tank drain plug and connect the drain line assembly to the fuel tank drain opening.

(5) Insert the drain line assembly into an empty 10-gallon container.

TANK DRAINING PROCEDURE

(1) Open the valve at the fuel filler fitting. When opening the valve at the filler fitting be sure to extract the filler fitting stopper. The following procedure is used: To engage the stopper, turn the small outer knob clockwise until it is fully engaged. To extract stopper and open the valve, turn the knob clockwise until the large knob is free from the threads. Pull the knob to the extended position.

(2) Raise the nose of the missile 5° above the horizontal and rotate the missile counter-clockwise (looking forward) until tunnel No. 1 is down.

(3) After draining stops, lower the missile to the horizontal. Rotate the missile so that tunnel No. 1 is up.

(4) Remove the vent and drain line assemblies, install a new stopper loosely and install the tank plugs. Remove the stopper from the drain valve and discard it.

146. REMOVAL OF OXIDIZER. The oxidizer is removed in the ass[illegible] Personnel perform the operations listed in table XIV.

Table XIV. REMOVING OXIDIZER

PRELIMINARY TANK DRAINING

(1) Remove aft warhead cover and aft warhead.

(2) With missile tunnel No. 1 up, raise the nose of the missile 5° above the horizontal.

(3) Remove the vent plug from the acid tank and install the overboard vent line and valve.

(4) Connect the drum vent line to the drum adapter fitting and extend it a safe distance downwind.

(5) Cap one side of the drum with the drum adapter fitting and connect the missile aft drain line assembly to the opposite side.

(6) Remove the cap from the missile oxidizer drain line fitting which is directly in front of the propellant valve and connect the aft drain line assembly to the fitting. *CAUTION: Connecting the line of the fitting will rupture the diaphragm in the fitting. The connection must be tightened quickly.*

(7) Open the two valves in the aft drain line and the valve at the missile vent fitting.

(8) Allow the missile to stand in this position until draining stops. Check the liquid flow at the sight window in the drain barrel Y-fitting.

DRAIN LINE INSTALLATION

(1) Remove the oxidizer tank filler plug and install the oxidizer filler drain valve. Do not attempt to remove the teflon stopper from the filler fitting.

(2) Remove the oxidizer tank drain plug and install the oxidizer tank drain valve.

(3) Connect the oxidizer tank drain line assembly from the missile tank valves to the drum Y-fitting.

(4) Close all valves and rotate the missile 180° until tunnel No. 1 is down.

TANK DRAINING

(1) Open all valves on the missile drain lines and at the drum. When opening the valves at the acid tank filler fitting be sure to extract the filler fitting stopper. To engage the stopper, turn the small outer knob clockwise, until it is fully engaged. To extract the stopper and open the valve, turn the large knob clockwise until the large knob is free from the threads. Pull to extended position.

(2) Open the overboard vent line valve.

(3) Allow the missile to stand in this position until drainage is no longer visible at the Y-fitting sight window.

(4) Lower the nose of the missile from 5° nose up to 3° nose down.

(5) Allow the missile to stand in this position until drainage is no longer visible in the Y-fitting sight window.

(6) Raise the missile nose until the missile is horizontal. Then rotate it until tunnel No. 1 is up.

TANK FLUSHING

[illegible] immediately after it has been drained only if the missile power [illegible] sassembled or any of the propellant lines uncoupled. This procedure may [illegible] power plant system is being drained for purposes other than repairs.

(1) Raise the missile nose 5° above the horizontal.

(2) Shut off the forward and aft drain line valves at the drum Y-fitting and disconnect the lines from the drum at the coupling to the Y-fitting.

(3) Connect a water supply line to the forward drain line assembly.

(4) Open all valves in the forward drain and vent lines. Fill the missile tank with water until it overflows at the vent line.

(5) Open the valve in the aft drain line, close the tank vent valve and allow the water to continue to flow until at least 60 gallons of water have passed through the missile.

(6) Drain the water from the missile as explained in the oxidizer tank draining procedure.

REMOVAL OF FITTINGS AND LINES

If the missile power plant system is to be disassembled or any of the propellant lines uncoupled after draining the acid tank, the lines must be thoroughly flushed out with water.

(1) Close the valve on the overboard vent line and remove the tank vent opening. Reinstall the vent plug.

(2) Close the valve at the tank filler using the large knob only to avoid reinserting the teflon stopper. Close the oxidizer tank drain valve. Disconnect the valves from the missile tank, install a new stopper loosely and reinstall the filler and drain plugs. Remove the stopper from the filler drain valve and discard the stopper.

(3) Close the valve at the oxidizer line drain fitting and disconnect from the missile. Install a new oxidizer line drain fitting diaphragm and reinstall a fitting cap.

Section III. MISSILE DEPRESSURIZATION

147. GENERAL. The two air storage tanks of the missile, one for the hydraulic system and one for the propellant system, are designed so that they may be pressurized at the same time. However, for depressurization, a one-way check valve restricts flow of air from the hydraulic tank. The depressurization process must be performed while the missile is located on the rail with the hydraulic test stand connected to the overboard dump port.

148. DEPRESSURIZATION OF PROPELLANT SYSTEM AIR STORAGE TANK. The propellant system air storage tank will be depressurized before depressurizing the hydraulic system air storage tank. Although it is possible, through design of the missile valves, to bleed off the air from the propellant air tank while depressurizing the hydraulic air tank, the excessive air pressures encountered in this operation may damage some of the hydraulic system valves. Consequently, it is necessary, except for very extreme emergencies, to depressurize the propellant system air storage tank first. Personnel are directed to proceed as follows:

a. Remove the plug from the air fitting of the propellant-system air sto

b. Insert the special bleed fitting in place of the air filler-fitting plug. propellant system air storage tank to bleed down.

c. After the tank is depressurized, remove the bleed fitting and replace it with air filler fitting plug.

149. DEPRESSURIZATION OF HYDRAULIC SYSTEM AIR STORAGE TANK. To prevent possible damage to the hydraulic system valves, the propellant system air storage tank must be depressurized before the hydraulic system air storage tank. Only under extreme emergencies may both tanks be depressurized at the same time. Personnel are directed to proceed as follows.

a. Pull the hydraulic system arming lanyard quick-disconnect plug, opening the hydraulic system air-pressure release valve. After pulling the arming lanyard, apply hydraulic pressure to the missile through the test stand. Move the control fins back and forth by giving steering commands.

b. Continue the hydraulic pressure and fin movements until the hydraulic air tank is completely depressurized. *NOTE: At the end of this depressurization process, the missile hydraulic system will be filled with hydraulic fluid, and the expelled air will have emptied into the test stand reservoir.*

Section IV. REMOVAL OF MISSILE EXPLOSIVE COMPONENTS

150. GENERAL. Before attempting removal of explosive components, personnel must become thoroughly familiar with the safe handling procedures presented in paragraph 136. *Always remove the entire warhead system (three warheads, associated detonating cord assemblies, and arming mechanism) from the missile before attempting any repair or rebuilding, and before transporting the missile to the ordnance depot.* During removal of the explosive components, personnel must be kept to a minimum, consistent with efficient working conditions. After removal of the explosive components, the warheads should be supported or placed in their original crates to prevent damage or inadvertent detonation. If the explosive components are not to be installed within a short time, they must be placed in their original storage. The storage conditions must conform with their respective classifications as explosives (par. 135). After removal, warheads still retaining their initiators must be marked to differentiate them from warheads minus initiators.

151. PREPARATION FOR REMOVAL OF EXPLOSIVE COMPONENTS. In preparation for the removal of explosive components, personnel proceed as follows:

a. Remove the center section door covering the upper half of the center section of the missile body:

(1) With the missile in the missile dolly (fig. 74) and with tunnel No. 1 up, place an improvised support under the rudder and elevator control section and under the motor section. Cushion the missile with felt or some other suitable material in order not to damage the missile body.

(2) Remove the flat-head screws holding the top door to the structural rings.

(3) Remove the flat-head screws holding the top door to the bottom door along tunnels Nos. 2 and 4. Lift off the top door.

...ssile dolly and tunnel No. 4 up, remove the screws ...ection of tunnel No. 4 to the forward section of the ... *Do not remove the center section bottom door.*

...e two upper ring segments of the forward missile-han... the ring segments. Remove the screws attaching the aft ... to the missile body. Remove the aft section of tunnel ...

Re... segments and rotate the missile so tunnel No. 1 is up.

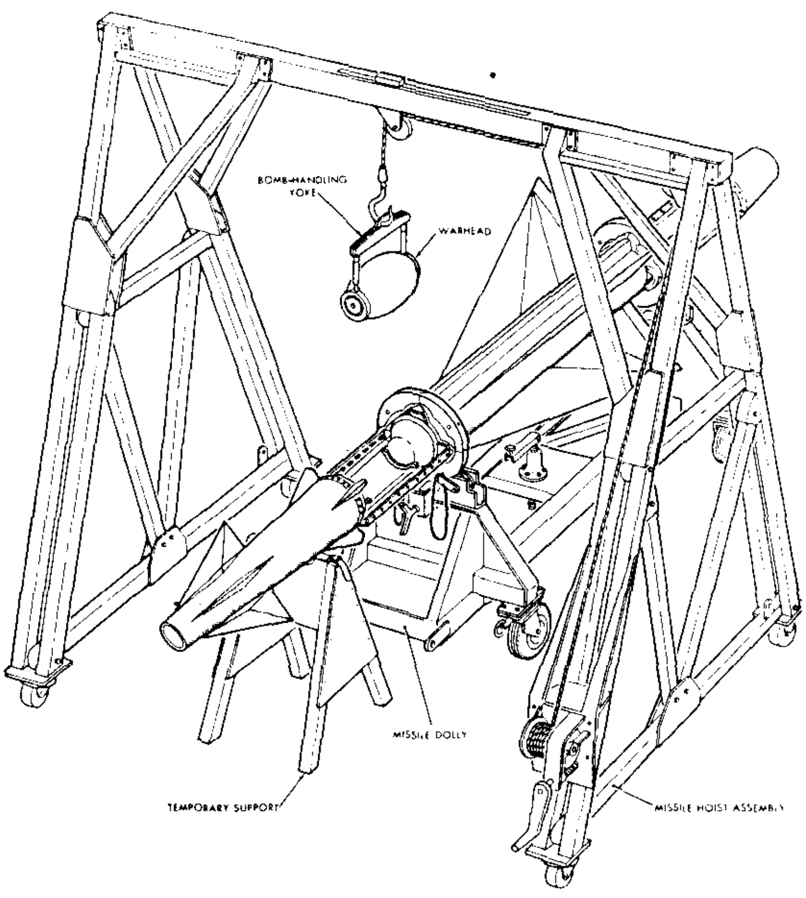

Figure 90. Removal of center warhead.

c. Remove the forward tunnels Nos. 1 and 3:

(1) With the missile in the missile dolly and tunnel No. 1 up, remove the screws attaching the forward section of tunnel No. 1 to the forward section of the missile body. Lift off the forward section of tunnel No. 1.

(2) Rotate the missile so tunnel No. 2 is up. Remove the screws attaching forward section of tunnel No. 2 to the forward section of the missile. Lift off the forward section of tunnel No. 2.

(3) Rotate the missile so tunnel No. 3 is up. Remove the screws attaching forward section of tunnel No. 3 to the forward section of the missile. Lift off the forward section of tunnel No. 3.

(4) Rotate the missile so tunnel No. 1 is up.

d. Remove the door covering the upper half of the motor section forward of the motor:

(1) With the missile in the missile dolly and tunnel No. 1 up, remove the two upper ring segments of the aft missile-handling ring.

(2) Remove the screws in the door and remove the door.

(3) Replace the two upper ring segments of the aft missile-handling ring.

e. Disconnect the arming mechanism detonating-cord lead to the cross fitting and place the detonating-cord end in the metal clip that is provided (fig. 91). Do this for both arming mechanisms.

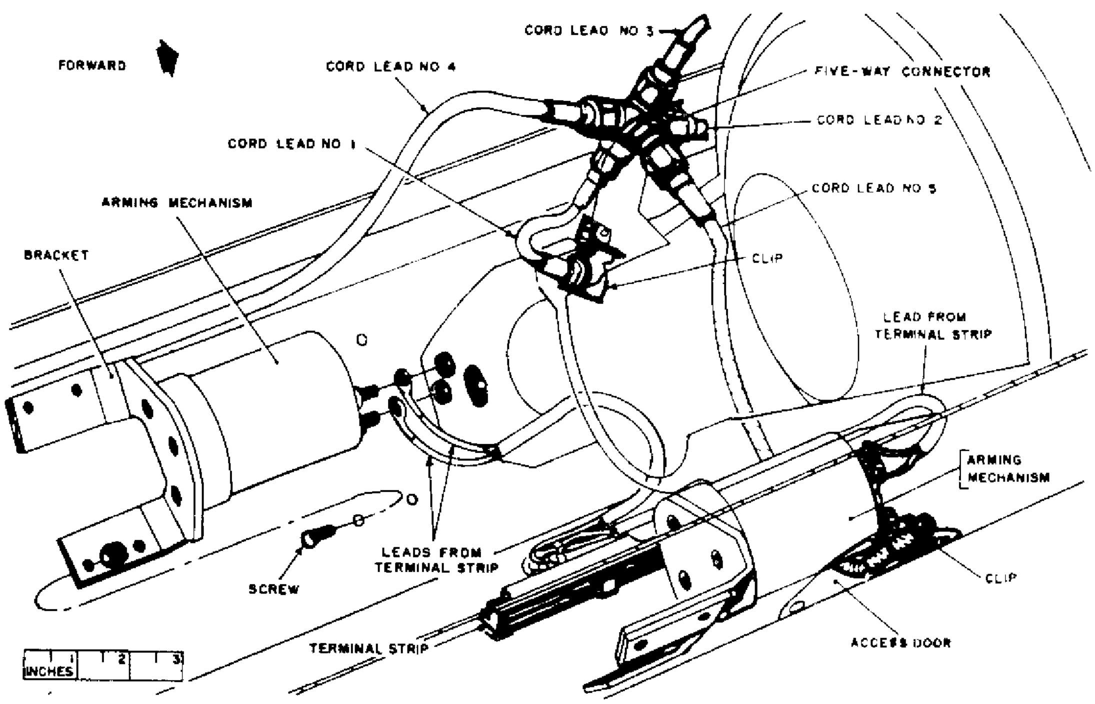

Figure 91. Disconnecting the arming mechanisms.

f. Disconnect the nose, center, and aft warhead detonating cord leads from the cross fitting. *NOTE: Tape the detonating cord leads to a convenient portion of the missile in order to prevent damage or accidental detonation of the sensitive PETN relay caps.*

[redacted]

... section (fig. 92):

... in the nose tip with masking tape to prevent damage.

... the line leading from the stagnation pressure tube trap at the ... in tunnel No. 3.

... Remove the four bolts (one in each tunnel) attaching the nose section to the forward end of the rudder and elevator control section. Remove the nose section.

(4) Place the nose section in a vertical position with the aft end pointing up. NOTE: *The nose section must be in the immediate vicinity of the missile so that the detonating cord length leading to the nose warhead will not be across the ground.*

152. REMOVAL OF ARMING MECHANISM. a. Detach the electrical connections holding each of the arming-mechanism cables to the No. 8-140 terminal strip (fig. 91).

b. Remove the screws and lock washers holding each arming mechanism to the fuze plate. Remove each of the two arming mechanisms.

153. REMOVAL OF NOSE WARHEAD AND DETONATING CORD ASSEMBLY (fig. 92). a. Remove the two bolts and four lock washers holding the ballast plates to the nose warhead retaining ring. Remove the ballast plate.

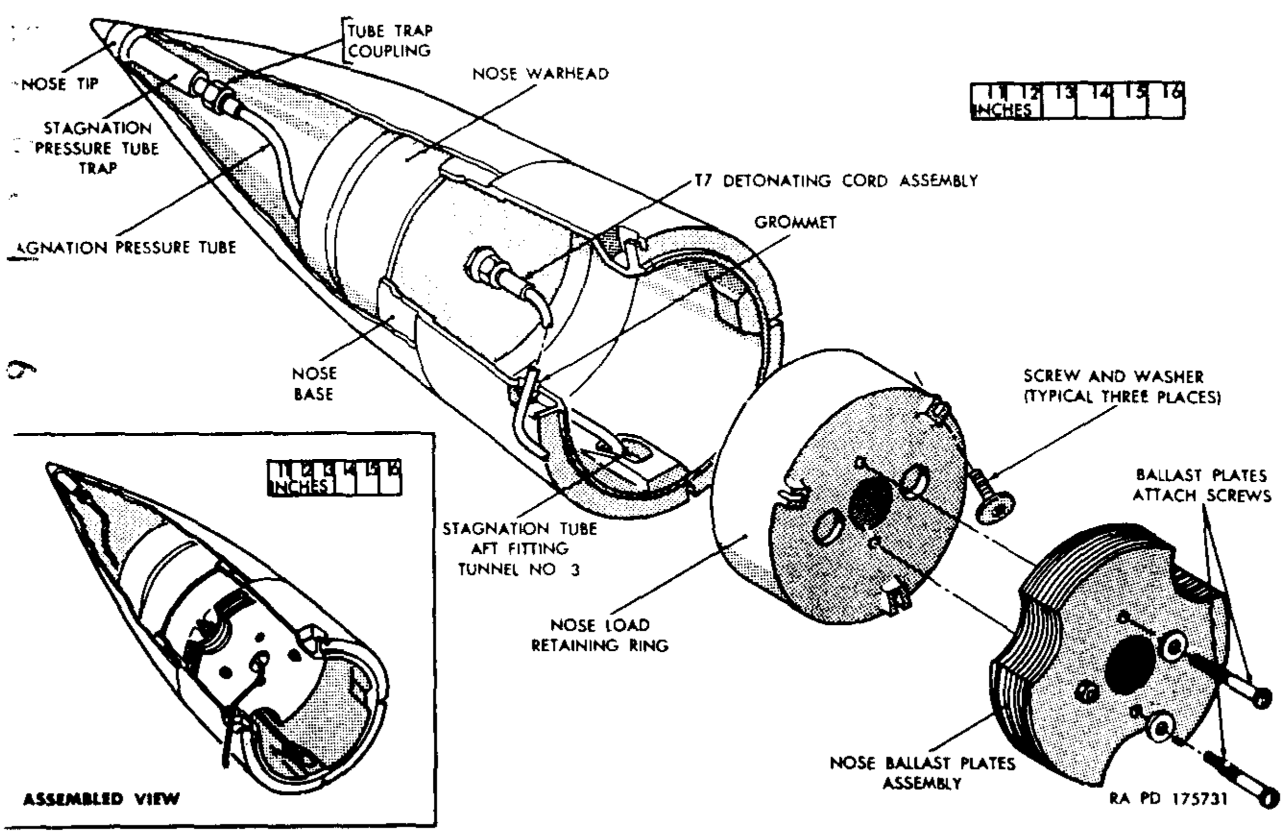

Figure 92. Removal of nose warhead.

[redacted]

b. Remove the hold-down screws and flat washers holding [illegible] ring [illegible] the nose warhead. Remove the nose warhead retaining ring.

c. Disconnect the detonating cord assembly from the nose [illegible] emovi[illegible] connector. Untape the opposite end of the assembly. Remove the nose [illegible] nating[illegible]

d. Lift out the nose warhead. Screw the shipping plug over th[illegible] g cor[illegible] cavity. Place the nose warhead in the shipping crate or a suitable containe[illegible]

154. REMOVAL OF CENTER AND AFT WARHEAD DETONATING [illegible] ASSEMBLI[illegible] a. Detach the detonating cord assembly from the center warhead. Untape the opposite end of the assembly. Remove the detonating cord assembly. Replace the shipping plug over the cent[illegible] warhead initiator.

b. Detach the detonating cord assembly from the aft warhead. Untape the opposite end of the assembly. Remove the detonating cord assembly. Replace the shipping plug over the aft warhead initiator.

155. REMOVAL OF CENTER WARHEAD (fig. 90). a. Remove the anchor lugs, bolts, and nuts from the mounting brackets holding the center warhead.

b. Attach the bomb-handling yoke to the center warhead handling loops. *Check the security of the attachment before lifting out the warhead.*

c. Remove the center warhead from the missile. Place it in the original shipping crate or another suitable container. NOTE: *If the warhead is to remain out of the missile for more than 12 hours remove the initiator with a socket wrench.*

156. REMOVAL OF AFT WARHEAD. a. Remove the anchor lugs, bolts, and nuts from the mounting brackets holding the aft warhead.

b. Attach the bomb handling yoke to the aft warhead handling loops. Check the security of the attachment before lifting out the warhead.

c. Remove the aft warhead from the missile. Place it in the original shipping crate or another suitable container. *NOTE: If the warhead is to remain out of the missile for more than 12 hours, remove the initiator with a socket wrench.*

Section V. BOOSTER DISARMING

157. THE BOOSTER UNIT. The Nike I booster unit is designed to produce an average thrust of 59,000 pounds for a period of approximately 3 seconds. The igniter, mounted on the head end of the booster, consists of 400 grams of FFFG black powder and four electric squibs enclosed in a short cylindrical cellulose-acetate container. These squibs, connected in a series as pairs and two pairs in parallel, are connected to a closed-circuit shorting jack which is mounted in the cellulose-acetate case. The jack shorts the squibs when the igniter is not in use and also forms the electrical contact when mounted on the phone plug located at the head end of the booster. When voltage is applied to the igniter, the electric squibs fire the black powder in the igniter, which in turn ignites the booster sheet powder and the propellant charge.

158. REMOVAL OF BOOSTER IGNITER ASSEMBLY (fig. 93). The booster can be rendered nonpropulsive by removing the igniter. Directions for removing the igniter from the booster are as follows:

a. Install the shorting plug at the nozzle closure.

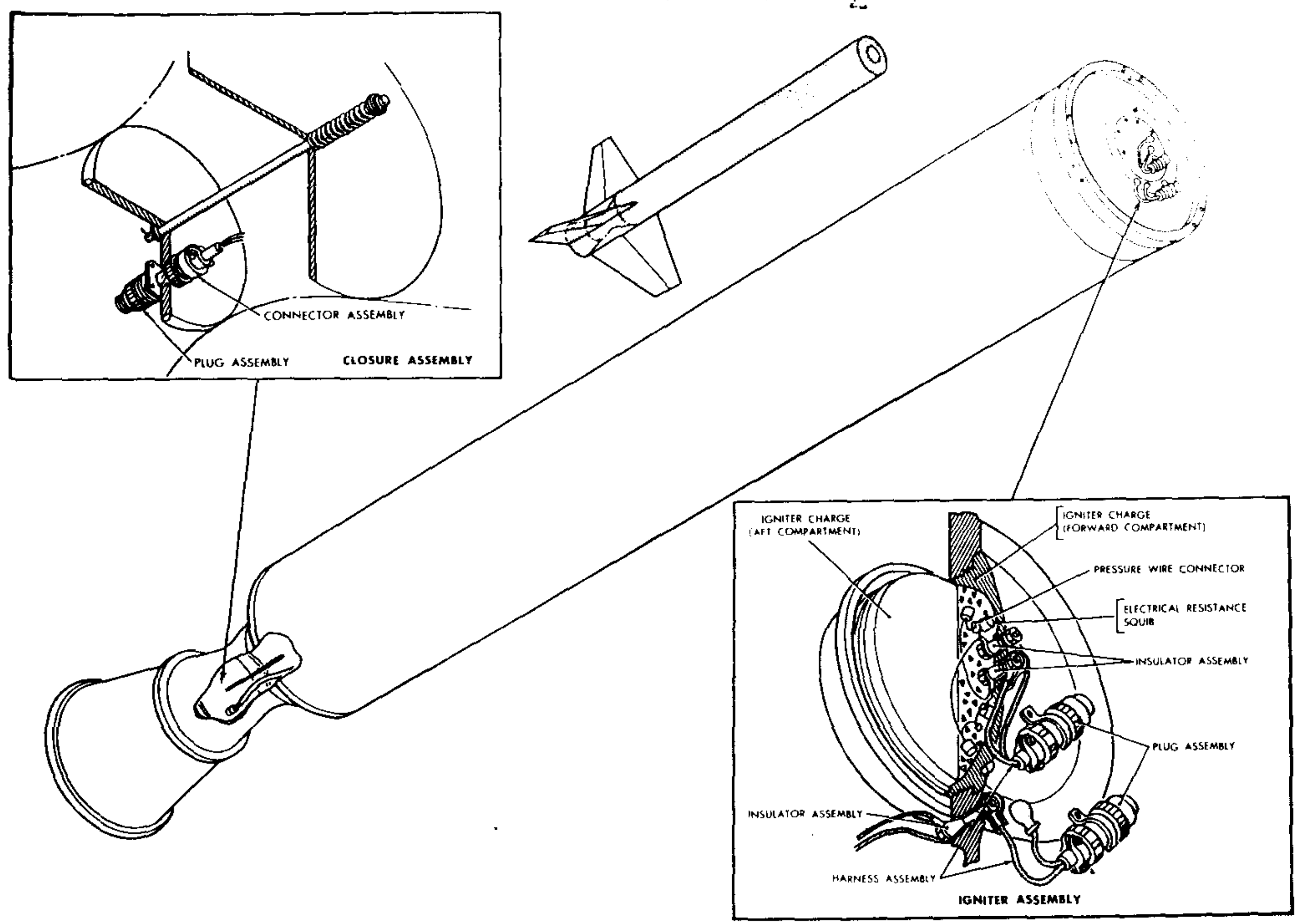

Figure 93. Booster igniter assembly.

b. Disconnec the cannon plug ... [illegible]

c. Install the igniter shorting plug ... [illegible]

d. Using a spanner wrench, unscrew the igniter ... [illegible] the igniter.

e. Install the igniter shipping plug. If the igniter ... [illegible] booster, it must be stored in accordance with the instructions ... [illegible] manuals.

9 1 ... 1 3

[redacted]

APPENDIX I

REFERENCES

[illegible] Explosives and Other Dangerous Articles.

[illegible] Motion Pictures and Film Strips.

[illegible] Dictionary of United States Army Terms.

[illegible] Authorized Abbreviations.

[illegible] Safety, Launching Guided Missiles and Heavy Rockets.

FM 21-5, Military Training.

FM 21-8, Military Training Aids.

FM 21-30, Military Symbols.

FM 44-1, Antiaircraft Artillery Employment.

FM 44-4, Antiaircraft Artillery Guns.

FM 5-20, Camouflage, Basic Principles.

TM 9-1900, Ammunition, General.

DATC 25, Safety Precautions for Guided Missile and Heavy Rocket Training.

DA TC, ( ), Organization and Tactical Principles for the Employment of Antiaircraft Guided Missiles (Nike I) in Air Defense, Zone of Interior (when published).

ORD M-7-224, Ordnance Safety Manual.

GM 51/8, Glossary of Guided Missile Terms, prepared by the Committee on Guided Missiles, Department of Defense Research and Development Board.

ACP 165, Allied Communications Publications (with changes).

OCM 34755, 1 May 1953.

OCM 34632, 23 January 1953.

OCM 34155, 13 March 1952.

Contractors Manuals (as published).

[redacted]

[redacted]

AP[illegible]

CONTRACTOR-RECOMMENDE[illegible]

1. D[illegible]g holes several inches wider tha[illegible] [illegible]iameter [illegible] ing [illegible]tation and loose soil, and attempt to reach [illegible] well-compacted subs[illegible] [illegible] as [illegible] seacoast areas, remove sand drifts, vegetation, and rubble to reach [illegible] layer of s[illegible] uniform in composition.

2. Backfill the hole with sand continuously tamped as it is added to [illegible] [illegible]aring surface to bottom of top soil. In case of sandy soil, tamp the surface on which footing pad is to bear and, if necessary, add more tamped sand to bring the bearing area up to the base of the vegetation.

3. After setting the mount in place, load so that each footing carries at least 2,000 pounds. This will cause the earth to compact rapidly under each of the pads.

4. After the mount has been loaded in this manner for one hour or more, unload so that each footing carries about 1,500 pounds. This will preclude the possibility of the load subsequently falling below 1,000 pounds on any footing due to wind load.

5. In extremely unstable soils where it may be impossible to reach a compacted layer of subsoil immediately below the surface, such as peat bogs, it may be necessary to emplace concrete footings or drive piles extending downward to compact earth.

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APPENDIX III

GENERAL SAFETY PRECAUTIONS

GENERAL. Although the repetitious performance of hazardous duties often breeds carelessness, the use of uninstructed personnel to perform seemingly simple tasks can prove disastrous. To counteract this danger, the unit commander will insure that safety programs are actively carried out. It is imperative that all persons who may supervise or perform work in connection with the inspection, care, preparation, or handling of guided missiles and missile components insure that all regulations are rigidly observed. Personnel should be frequently warned as to the necessity of using the utmost care in the performance of their work. No relaxation of vigilance must ever be permitted.

a. Conditions not covered by safety regulations may arise, which, in the opinion of the commanding officer, may render firing unsafe. Nothing in any safety regulation should be construed to authorize firing under such conditions.

b. Changes, modifications in, or additions to ordnance materiel or other materiel used in connection therewith, will not be made without explicit authority.

c. Applicable safety orders should be posted in conspicuous places of easy access, and the personnel concerned should be frequently and thoroughly instructed and drilled in their observance.

2. STANDING OPERATING PROCEDURES (SOP). This SOP will take into consideration all safety precautions provided in SR 385-310-1; the draft Department of Army Training Circular, Safety Precautions for Guided Missile Training, and individual missile manuals which may have been issued. Once this procedure has been established, no deviation will be permitted without approval of the commanding officer. Copies of the established SOP will be conspicuously posted at all stations involved in the operations.

3. FUELS AND OXIDIZERS. The dangerous chemical properties of guided missile propellants necessitate that they be handled at all times with great care. Storage areas, ranges, launching sites, or any building in which these fuels and oxidizers are handled should be isolated from inhabited regions to minimize fire, explosion, and toxic hazards. A detailed description of the properties of missile propellants and the precautions that should be taken in their handling and storage is provided in the draft Department of the Army Training Circular, Safety Precautions for Guided Missile and Heavy Rocket Training.

4. PRESSURE SYSTEMS. Pressure systems used in guided missile operations create potentials which are extremely dangerous if ruptures occur. The use of an appropriate drill procedure will promote greater safety and lessen the probability of error while working with high pressure gases. A discussion of the most commonly used gases as well as a suggested color code for visual warning can be found in draft Department of the Army Training Circular, Safety Precautions for Guided Missile and Heavy Rocket Training. It is recommended that personnel acquaint themselves particularly with that part of the color code which pertains to the fuels, oxidizers, and pressure systems which they will encounter.

5. MISFIRES. As soon as it is determined that a misfire has occured, the following steps will be performed at the section control panel:

a. The section control panel operator will designate a new launcher to fire. (If only one missile has been prepared, the section control panel operator will designate NONE with the selector switch.)

[redacted]

b. The crew safety switch key will be [illegible]

c. Missiles will be fired from the remaining launchers [illegible]

d. When all missiles have been fired from the [illegible] switch will be opened.

e. The faulty missile will be disarmed according to the [illegible] cedure. *CAUTION: Personnel will not be permitted to enter the launcher [illegible] ricades in the launcher area until 30 minutes have elapsed after the [illegible] missile.*

(1) The squib connection will be removed from the booster [illegible] the rear shorting plug will be inserted.

(2) The launcher will be lowered.

(3) The squib connection will be removed at the front end of the booster and the front shorting plug will be inserted. The squib is then removed.

(4) The safety pin will be replaced in the air regulator.

(5) The two arming mechanism detonating-cord leads to the cross fitting will be disconnected, and the detonating cords placed in the metal clips provided.

(6) The missile and booster will be moved to the reject rack.

(7) A detailed inspection will then be made to determine the cause of the misfire.

6. PROTECTIVE EQUIPMENT. All personnel handling liquid propellants are required to wear protective clothing. The protective clothing that should be worn for each specific operation, the proper construction and composition for this clothing, and the maintenance that is required for it is fully prescribed in draft Department of the Army Training Circular, Safety Precautions for Guided Missile and Heavy Rocket Training.

7. DISPOSAL AND DECONTAMINATION. a. The disposal site will be isolated from inhabited buildings, railroads, public highways, storage areas, and operating areas.

b. The disposal site will be stripped of all organic or combustible materials. Personnel and equipment will be protected by barricades or natural cover.

c. Warning signs will be posted at the entrance and on all sides of the disposal operations. In those cases where poisonous propellants are bled or vented to the atmosphere, additional signs will be posted.

d. Fire-fighting equipment will be present during burning and disposal operations.

e. Safety showers or other suitable means for personnel decontamination will be provided.

f. A single individual will never be permitted to work alone on any phase of disposal operations. One member of a disposal crew will always be a safe distance from the operation but in a position to observe and report. He will perform rescue measures if an accident occurs.

g. Protective equipment will be worn by all persons engaged in disposal operations.

h. No pit will be used on the same day for successive fuel disposals by burning.

...ch has been used in propellant transfer operations will be ... to storage. Lines will be drained as much as possible, the ...ge neutralized and washed with water.

... equipment will be made only after it has been emptied, dis-...d

... repaired will be removed to a designated area before operations

... have contained flammable liquids will be cleaned by steaming, filling ... with an inert gas before welding or soldering.

... qualified personnel who are wearing protective clothing will be assigned to ... and decontamination of work.

n. Tools used in repair operations will be thoroughly decontaminated after use and prior to returning to storage.

o. More detailed and specific instructions concerning disposal and decontamination can be found in SR 385-310-1 and draft Department of the Army Training Circular, Safety Precautions for Guided Missile and Heavy Rocket Training.

8. FIRST AID. First aid treatment must always be considered to be a stopgap measure until the injured person can be placed in the hands of a medical officer or hospital. However, if the patient is contaminated with any propellant, the propellant will be immediately flushed off with water. Time is usually precious in this procedure, and the flushing will begin while the contaminated person is fully clothed. Clothing will be removed while the patient is under the shower. Eyes, if contaminated, should always receive priority; they will be held open and thoroughly flushed.

a. If a person is affected by gas or vapors, he will be removed to fresh air. Medical attention will be sought at once. Only by permission of a medical officer will the gassed person be allowed to remain at the site or return to duty. If the patient's breathing stops, artificial respiration (appendix IV) will begin at once. Oxygen will be administered if breathing becomes difficult while medical attention is being sought. Alcoholic stimulants or drugs will never be given. The patient should be made to lie down at all times.

b. Electrical shock may be encountered by personnel handling electronic equipment. First aid treatment for electric shock is fully described in appendix IV.

c. Neutralizing agents will be applied to contaminated body areas after flushing. This application consists of washing all burned areas with liberal amounts of the appropriate neutralizing agent. A sterile dressing or towel soaked with the neutralizing agent is then placed over the burn to protect it while the patient is en route to the hospital. If the agent is also made in paste form, it may be used in place of the soaked dressing.

d. A medical noncommissioned officer should be appointed to insure that all necessary medical equipment and supplies are available and in first class condition. Any discrepancy he may find should be immediately reported to the unit commanding officer.

[redacted]

APPENDIX IV

FIRST AID TREATMENT FOR ELECTRIC SHOCK

1. RESCUE. In case of electric shock, shut off the high voltage at once and ground circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. 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 axe may be used to cut the high voltage wire. Use extreme caution to avoid the resulting electric flash.

2. SYMPTOMS. a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while, and normal breathing is resumed provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim usually is very white or blue. The pulse is very weak or entirely absent, and unconsciousness is complete. Burns usually are present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration still must be given. The ordinary and general tests for death should not be accepted.

3. TREATMENT. The following methods of artificial respiration, back-pressure arm-lift, the back-pressure hip-lift, and the chest-pressure arm-lift (modified Silvester) are to be used in lieu of the Schaefer or prone pressure and Eve's rocking methods. The back-pressure arm-lift method of manual artificial respiration is the method of choice and will supplant the Schaefer method of artificial respiration. The back-pressure hip-lift method should be used on victims with arm injuries when indicated. The chest-pressure arm-lift methods, with the victim lying on his back, should only be used when he cannot be placed face down. The following general principles must always be observed in performing manual artificial respiration.

a. Time is of prime importance, seconds count. Begin at once. Do not take time to move the victim to a more satisfactory place unless demanded by the situation. Do not delay resuscitation to loosen clothes, to warm the victim, or to apply stimulants. These actions are secondary to the main purpose of getting air into his lungs.

b. Quickly place the victim's body in the prone position, slightly inclined in such a way that fluids will best drain from his respiratory passages. His head should be extended and turned sideward, not flexed forward, and his chin should not sag, lest obstruction of the respiratory passages occur.

c. Quickly sweep your fingers into the victim's mouth to remove froth and debris and draw his tongue forward.

d. Begin artificial respiration at once and continue it rhythmically and without interruption until spontaneous breathing starts or the victim is pronounced dead. A smooth rhythm is desirable, but split-second timing is not essential.

e. As soon as the victim is breathing by himself, or when additional help is available, see that his clothing is loosened (or removed if wet) and that he is kept warm. Shock also should receive adequate attention.

f. If the victim begins to breathe on his own, adjust your timing to assist him. Do not fight his attempts to breathe, but synchronize your efforts with his. After resuscitation, he should remain lying down until seen by a physician or until recovery seems insured.

[redacted]

[redacted]

[illegible] ...nical resuscitation but, when an approved model is available, [illegible] ...al resuscitation is only slightly more effective than a properly per- [illegible] technique, which is immediately available and effective and accom- [illegible] ventilation. Good mechanical resuscitators do have important advantages, since [illegible] fatiguing and can furnish 100 percent oxygen. Also, the resuscitators need only be [illegible] victim's face and can be employed when physical manipulation of his body is im- [illegible] would be harmful, e.g., during surgery; in accident cases with extensive burns, broken vertebras, ribs, or arms; for victims trapped under debris, excavations, or overturned vehicles, and during transportation of the victim. Some resuscitators signal when the air passage is obstructed and provide an aspirator.

4. BACK PRESSURE ARM-LIFT METHOD (fig. 94). *a. Position of the victim.* Place the victim in the face-down (prone) position. Bend his elbows and place his hands one upon the other. Turn his face to one side, placing his cheek upon his hands.

b. Position of the operator. Kneel on either the right or left knee at the head of the victim and facing him. Place the knee at the side of the victim's head and close to the forearm. Place the opposite foot near the elbow. If it is more comfortable, kneel on both knees, one to either side of the victim's head. Place the hands upon the flat of his back in such a way that the heels of the hands lie just below the lower tip of the shoulder blades. With the tips of the thumbs just touching, spread the fingers downward and outward.

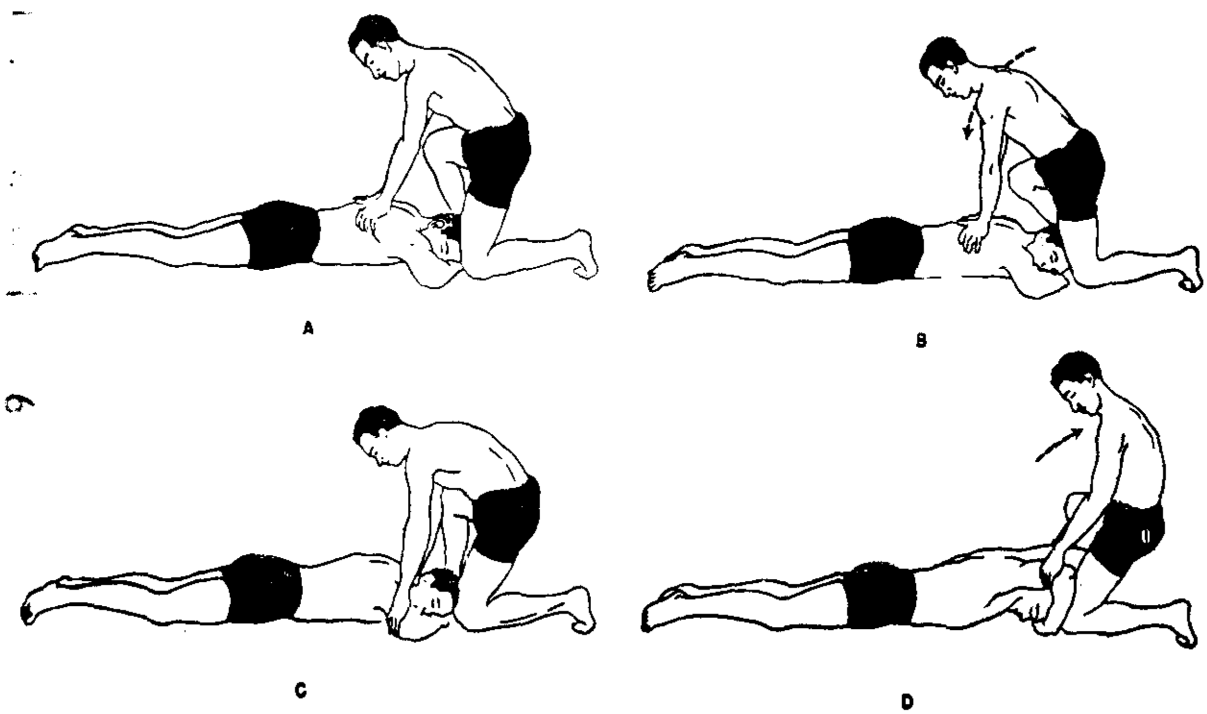

Figure 94. Back-pressure arm-lift method.

c. Compression phase. Rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure downward upon the hands. This forces air out of the lungs. Keep the elbows straight and exert pressure almost directly downward on the back.

[redacted]

d. Expansion phase. Release the pressure, avoiding a final thrust, and commence to rock slowly backward. Place the hands upon the victim's arms just above his elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the victim's shoulders. Do not bend the elbows, and as you rock backward, the victim's arms will be drawn toward you. The arm lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest. Then drop the arms gently to the ground or floor. This completes the full cycle. You are now ready to repeat the cycle.

e. Cycle timing and rhythm. This cycle should be repeated about 10 to 12 times per minute at a steady uniform rate to the rhythm of press, release, lift, release. Longer counts of about equal length should be given to the press and lift steps of the compression and expansion phases. The release periods should be of minimum duration.

f. Changing position of operator.

(1) Remember that either or both of your knees may be used, or you may shift knees during the procedure with no break in the steady rhythm. Observe how you rock forward with the back pressure and backward with the arm-lift. This rocking motion helps to sustain the rhythm and adds to the ease of operation.

(2) If you get tired and another person is available, you can take turns. Be sure that you do not break the rhythm in changing. To change operators, move off to one side while your replacement comes in from the other side. The replacement begins the press-release after one of the lift-release phases while you move away.

5. BACK PRESSURE HIP-LIFT METHOD (ALTERNATE) (fig. 95). *a. Position of the victim.* Place the victim in the face-down (prone) position with his elbows bent. Turn his face to one side and rest it on the back of one hand. His other hand is placed alongside and above his head.

b. Position of the operator. Kneel on either the right or left knee at the level of the victim's hips. Straddle him and place your foot on the ground near his opposite hip. Thus, your other heel is directly opposite you kneeling knee. Now place your hands, with fingers spread, on the middle of the victim's back just below his shoulder blades. The tips of your two thumbs just about touch each other and your fingers are pointed outward and downward.

c. Compression phase. Rock forward and allow the weight of the upper part of your body to exert slow, steady, even pressure downward upon the hands. This forces air out of the victim's lungs. Keep your elbows straight and exert pressure almost directly downward. Do not exert sudden or too much pressure and do not place your hands high on the victim's back or his shoulder blades.

d. Expansion phase. Now release the pressure by quickly removing your hands. This is done by peeling your hands from the victim's back without giving an extra push with the the release. As you release, rock backward and allow your hands to come to rest on his hips several inches below his waist. Do not grasp his waist, but slip your fingers under his hip bones where they touch the ground or floor. Now lift both hips upward and toward you, approximately four to six inches from the ground. This allows his abdomen to sag downward; his diaphragm descends and air is sucked into his lungs. Be sure to keep your arms straight as you lift; do not bend your elbows. In this way the work of lifting is done with your shoulders and back instead of with your arms. Gently replace (do not drop) his hips on the ground or floor in their original position. You are now ready to repeat the cycle.

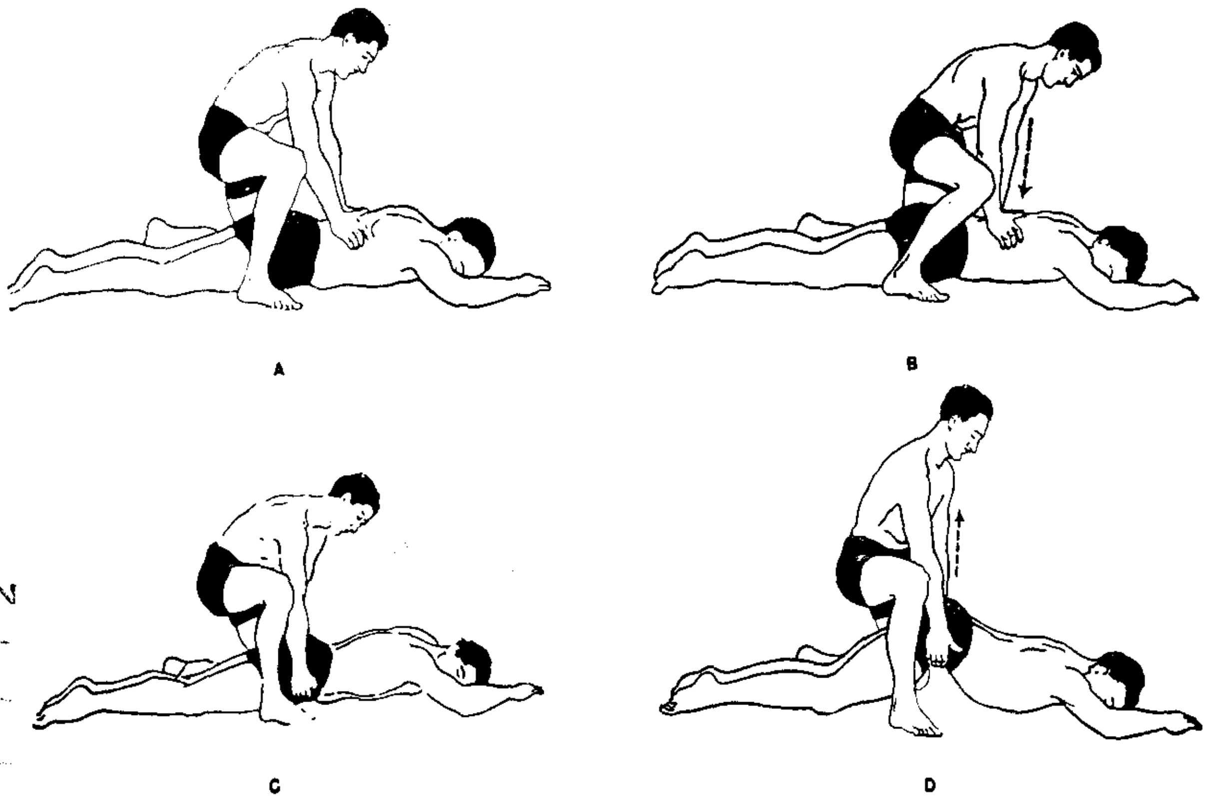

Figure 95. Back pressure hip-lift method (alternate).

e. Cycle rhythm and timing. This cycle should be repeated about 10 to 12 times per minute at a steady uniform rate to the rhythm of press, release, lift, release. Longer counts of about equal length should be given to the press and lift steps; the release periods should be of minimum duration.

f. Changing position or operator.

(1) If the knee on which you began the procedure becomes tired or uncomfortable, you may switch to the opposite knee with practically no break in the steady rhythm. The best time for changing knees is immediately following the press release steps.

(2) Continue the complete routine as long as possible. If you become tired you may continue the compression phase alone at a slightly faster rate (12 to 15 times per minute), resuming the hip-lift after each second, third, or fourth back pressure or as often as possible.

(3) If a second person is available, he can take over with practically no break in rhythm. He does this by coming in on the side opposite where you are kneeling. He begins the press-release after one of the lift-release steps, while you move away. The relief operator should be in position by the time the next expansion phase of the cycle is due.

6. CHEST PRESSURE ARM-LIFT (MODIFIED SILVESTER) METHOD (fig. 96). *a. Position of victim.* Place the victim in the supine (face-up) position with his arms folded on his chest. His chin should be raised upward and his head turned to the side. If available, a small

object, such as a block or article of clothing, should be placed beneat… his head will drop backward. Great care must be exercised to insure that… main clear with this method. The tongue is usually set in place by the… his index and middle fingers into the victim's mouth and pressing the tongu… A pin if available may be inserted through the tongue to hold it out of the… rescuer is available, have him hold the tongue forward.

b. Position of operator. Kneel on either knee at the victim's head… alongside of his head. If the victim is on an operating table or some other… operator stands at the patient's head.

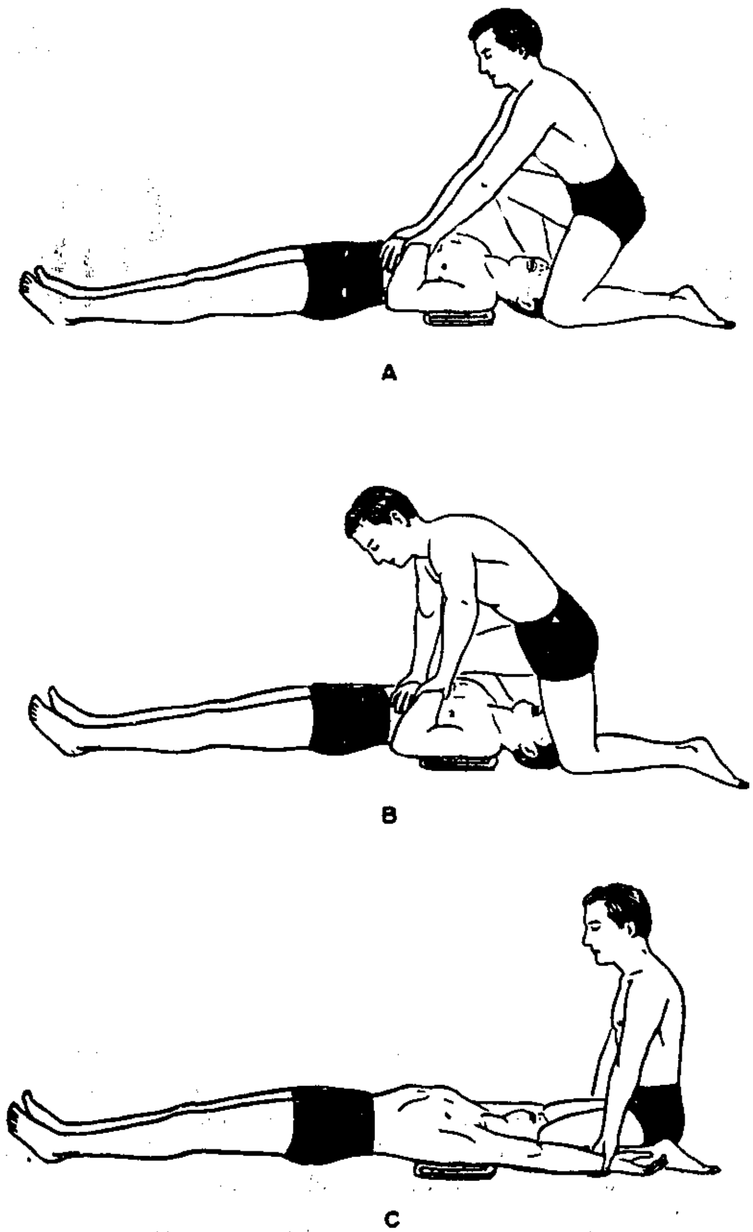

Figure 96. Chest pressure arm-lift (modified Silvester) method.

[illegible] Grasp the victim's arms just above the wrists, place them on the chest and exert steady uniform pressure almost vertically downward [illegible] This pressure forces air out of the lungs.

[illegible] Lift the arms slowly outward from the victim's body and upward [illegible] motion of his arms and sweep them above his head and backward [illegible] keep his arms straight throughout the maneuver as you raise them [illegible] above his head. Lifting and stretching of the arms increases the [illegible] the lungs. Now slowly replace his arms on his chest and repeat [illegible]

[illegible] *Rhythm and timing.* The cycle should be repeated about 10 to 12 times per minute in the rhythm of press, lift, stretch, release. At press, the chest pressure is exerted; with the lift, the arms are raised upward from the chest. With the stretch, they are drawn above the victim's head; at release, they are moved back toward the chest. Each of these four steps is of about equal duration so that each step is slightly less than 1½ seconds long, giving about a 6-second total cycle with 10 to 12 cycles per minute.

f. Changing position or operator.

(1) If you become tired or uncomfortable on one knee, quickly switch to the other knee. If it is more comfortable to kneel on both knees this may be done, although the forward and backward motion may best be attained while kneeling on only one knee.

(2) When a second rescuer is available, he may take over the chest pressure arm-lift with practically no break in the rhythm. To change operators, move off to one side while your replacement comes in from the other side. When the replacement is ready, release the victim's arms at the stretch phase. The new operator grasps them and continues the application.

7. STIMULANTS. a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then only for 1 or 2 seconds every minute.

b. After the victim has regained consciousness he may be given hot coffee, hot tea, or a glass of water containing a half teaspoon of aromatic spirits of ammonia. Do not give any liquids to an unconscious victim.

8. CAUTIONS. a. After the victim revives keep him lying quietly. Any injury may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully because he may suddenly stop breathing. Never leave a resuscitated person alone until it is certain that he is fully conscious and breathing normally.

[redacted]

[illegible]

P[illegible]NCIPAL TECHNICA[illegible]

RADIO SET	SCR-188	AN/GRC-[illegible]	AN/GRR-[illegible]	AN/VRC-[illegible]
RCVR	BC-342	RT-77/GRC-9	[illegible]	Set 1 RT-67/GRC (2 each)
TRANS	BC-191	RT-77/GRC-9		
FREQ IN MEG	TRANS: 1.5-12.5 RCVRS: 1.5-18.0	2 - 12 2 - 12	1.5 - 18.0	27.0 - 38.9 27.0 - 38.9
MOD	AM	AM	AM	FM
EMISSION	C-W,MC-W, phone	C-W,MC-W,phone		C-W,MC-W, phone
RANGE (MILES)	STA-100,70,30 MOV–	30, 20, 15 20, 10, 10		10 - 1[illegible]
CHANNELS			10(preset)	
INPUT VOLTAGES	115-130 V, a-c Commercial a-c	6,12,24 V d-c	6,12,24 V d-c 115 V a-c Dry battery	12,24 V d-c
SOURCE OF VOLTAGES	Gas generator	VEH battery BA-48, GN-58		Vehicle battery
WEIGHT (LB)	900	116-210	40	230
TYPE OF SERVICE	Ground	Vehicular, field ground transport-able	Vehicular, field	Ground or vehicle
TACTICAL USES	Fixed installa-tion command set	General purpose command set	General purpose receiver	General purpose command set

[redacted]

[redacted]

APPENDIX VI

CHECK LIST, FIRE CONTROL OFFICER

Unit ______________
Date ______________
FCO ______________

PREENERGIZING THE SYSTEM.

a. Target designate panel:

LOCAL REMOTE switch turned to LOCAL. ______________

b. Event recorder (check with switchboard operator):

(1) TEST OPERATE switch in OPERATE position. ______________

(2) RECORD-VIEW switch in RECORD position. ______________

2. NIKE I ALERT STATUS WHITE.

a. Tactical control panel:

ALERT STATUS switch in WHITE alert. ______________

b. Control console.

(1) PPI indicator GAIN turned counterclockwise. ______________

(2) PPI indicator adjusted for proper picture. ______________

(3) PPI indicator gain adjusted. ______________

(4) RANGE switch in 120,000-yard position. ______________

3. NIKE I ALERT STATUS YELLOW.

a. Tactical control panel:

ALERT STATUS switch in YELLOW alert. ______________

b. Battery control signal panel:

NUMBER PREPARED meter shows number of missiles ready for firing. ______________

4. NIKE I ALERT STATUS BLUE.

Tactical control panel:

ALERT STATUS switch in BLUE ALERT. ______________

5. NIKE I ALERT STATUS RED.

a. Tactical control panel:

(1) ALERT STATUS switch in RED ALERT. ______________

(2) MISSILE DESIGNATE lamp GREEN (changes from AMBER). ______________

(3) MISSILE READY lamp GREEN (changes from AMBER). ______________

[redacted]

MISSILE TRACK [illegible]
if the missile is accepted [illegible]

[illegible] indicator.

[illegible] target located on scope. ______

c. [Acq]uisition control panel:

(1) CHALLENGE button pressed. ______

(2) GREEN CHALLENGE lamp lights. ______

(3) If no response, FOE button pressed. ______

(4) FOE lamp GREEN (changes from AMBER). ______

d. *Target designate control panel:*

(1) RANGE handwheel turned until range circle is on target. ______

(2) Flashing azimuth line on target. ______

e. *Target designate control panel:*

DESIGNATE-ABANDON switch at DESIGNATE. ______

f. *Battery control signal panel:*

TARGET CONFIRMED lamp GREEN (changes from AMBER). ______

g. *Battery control signal panel:*

(1) TARGET TRACKED lamp GREEN (changes from AMBER). ______

(2) READY TO FIRE lamp GREEN (changes from AMBER four seconds after TARGET TRACKED lamp changes from AMBER to GREEN). ______

(3) Horizontal plotting board plotting target present position. ______

(4) Altitude plotting board plotting height of intercept point. ______

h. *Tactical control panel:*

(1) FIRE switch operated. ______

(2) FIRE lamp GREEN (changes from AMBER). ______

(3) LAUNCH lamp GREEN (changes from AMBER). ______

(4) MISSILE DESIGNATED and MISSILE READY lamps AMBER (change from GREEN). ______

(5) Five seconds after launch, computer takes control. ______

(6) MISSILE DESIGNATED and MISSILE READY lamps GREEN (change from AMBER). ______

(7) BURST lamp GREEN (changes from AMBER). ______

[redacted]

APPENDIX VII

MISSILE RADAR OPERATOR

Unit ____________

Date ____________

Operator ____________

NIKE I ALERT STATUS YELLOW.

a. Radar power control panel:

(1) MISSILE POWER switch ON. ____________

(2) MISSILE PLATE VOLTS READY lamp lighted after 20 seconds. ____________

(3) MISSILE HIGH VOLTS HOT and MISSILE HIGH VOLTS READY lamps lighted after 5 minutes. ____________

(4) MISSILE PLATE VOLTS switch ON. ____________

(5) Power supply voltage correct. ____________

b. Missile track control panel:

(1) IND HV switch ON. ____________

(2) HV SUPPLY control knob rotated counterclockwise. ____________

(3) HV SUPPLY button depressed. ____________

(4) HV SUPPLY control knob rotated clockwise. ____________

(5) MAGNETRON meter reads 14.5 milliamps. ____________

c. Track range indicator:

(1) INTENSITY control knob shows visible trace. ____________

(2) FOCUS control knob shows clear trace. ____________

3. NIKE I ALERT STATUS BLUE.

a. Missile track indicating panel:

Missile track antenna slewed to test responder (monitor ELEVATION and AZIMUTH dials to check). ____________

b. Track range indicator:

Missile track antenna slewed to test responder (monitor RANGE dial to check). ____________

4. NIKE I ALERT STATUS RED.

a. Missile track indicating panel:

SECTION and LAUNCHER lamps GREEN. ____________

[redacted]

[illegible]

[illegible] MF [illegible]

[illegible] ED lamp [illegible] changes [illegible] accepted). Monitor RECEIVED SIGNAL meter [illegible] reaches desired level, the missile [illegible] accepted. If not, the missile is manually rejected.

c. *Missile track control drawer:*

(1) REJECT button pressed (if missile is rejected.)

(2) New missile designated at launcher area.

(3) Again monitor RECEIVED SIGNAL meter to check on new missile (par b(2) above).

d. *Missile track equipment drawer:*

(1) FIRE lamp GREEN (changes from AMBER).

(2) LAUNCH lamp GREEN (changes from AMBER).

(3) DESIGNATE and READY lamps GREEN (change from AMBER).

(4) BURST lamp GREEN (changes from AMBER).

(5) Missile-tracking radar slewed to position of new missile or to test responder three-tenths of a second after burst.

[redacted]

APPENDIX VIII

TARGET RADAR

Unit ______________

Date ______________

Operator ______________

TARGET RADAR ELEVATION OPERATOR

1. NIKE I ALERT STATUS WHITE.

   No action.

2. NIKE I ALERT STATUS YELLOW.

   Track elevation indicator:

   (1) INTENSITY control knob rotated so trace is visible. ______________

   (2) FOCUS adjusted for clear defined trace. ______________

3. NIKE I ALERT STATUS BLUE.

   No action.

4. NIKE I ALERT STATUS RED.

   Target track control drawer:

   (1) Target track antenna set to approximate reported elevation using ELEVATION handwheel. ______________

   (2) ELEVATION handwheel rotated until target pip appears in range notch. ______________

   (3) Operators informed that radar is on target. ______________

   (4) Elevation MAN-AID-AUTO switch in AUTO. ______________

TARGET RADAR RANGE OPERATOR

1. NIKE I ALERT STATUS WHITE.

   No action.

2. NIKE I ALERT STATUS YELLOW.

   Track range indicator:

   (1) INTENSITY control knob rotated so trace is visible. ______________

   (2) FOCUS adjusted for clear defined trace. ______________

3. NIKE I ALERT STATUS BLUE.

   No action.

[redacted]

[illegible]

[illegible] ha[illegible] [illegible]

[illegible] has [illegible] rotated to place target pip in center of range [illegible] after ELEVATION operator has found target in scope.

(3) Range MAN-AID-AUTO switch in AUTO.

TARGET RADAR AZIMUTH OPERATOR

1. NIKE I ALERT STATUS WHITE.

No action.

2. NIKE I ALERT STATUS YELLOW.

a. Target track console:

YELLOW ALERT STATUS LAMP lights and GONG sounds.

b. Radar power control panel:

(1) PHASE C switch in C position.

(2) PHASE C adjusted to 120 volts and positions A and B checked.

(3) MAIN POWER switch ON.

(4) TARGET POWER switch ON.

(5) Amber light comes on at end of 20 seconds.

(6) After 5 minutes, amber TARGET VOLTS HOT and green TARGET HIGH VOLTS READY lamps are lighted.

(7) TARGET PLATE VOLTS switch ON.

(8) Power supply voltage checked.

c. Target track control panel:

(1) IND HV switch ON.

(2) HV SUPPLY knob rotated counterclockwise to start.

(3) HV SUPPLY switch ON.

(4) HV SUPPLY knob rotated to monitor magnetron meter reading to 4.9 kilovolts or to STOP.

d. PPI indicator.

(1) GAIN turned counterclockwise.

(2) INTENSITY adjusted. __________

(3) GAIN adjusted. __________

e. Precision indicator:

(1) GAIN turned counterclockwise. __________

(2) INTENSITY adjusted. __________

(3) GAIN adjusted. __________

f. Track azimuth indicator:

(1) GAIN turned counterclockwise. __________

(2) INTENSITY adjusted. __________

(3) GAIN adjusted. __________

(4) SWEEP LENGTH in desired position. __________

3. NIKE I ALERT STATUS BLUE.

Target track console:

Blue alert status lamp lighted. __________

4. NIKE I ALERT STATUS RED.

a. Target track console:

Red alert status lamp lighted. __________

b. Target track console:

Buzzer sounds showing target has been designated. __________

c. Target track signal panel:

DESIGNATE lamp GREEN (changes from AMBER). __________

d. Target track control drawer:

Target appears in precision indicator (ACQUIRE switch held to right). __________

e. Target track signal panel:

CONFIRM light GREEN (changes from AMBER). __________

f. Target track control drawer:

Target on azimuth line (AZIMUTH handwheel rotated). __________

g. Target track control drawer (after target elevation operator has found the target and rotated AZIMUTH handwheel):

(1) Two pips of equal height appear on azimuth indicator. __________

[illegible]

[illegible]

[illegible] A [illegible]

[illegible] CEF [illegible] ton [illegible]

b. *Target track signal panel:*

Track lamp GREEN (changes from AMBER).

c. *Target track signal panel (on fire command):*

(1) FIRE light GREEN (changes from AMBER).

(2) LAUNCH light GREEN (changes from AMBER).

(3) BURST light GREEN (changes from AMBER).

[redacted]

APPENDIX IX

NIKE I ALERT COMPUTER OPERATOR

Unit _______________

Date _______________

Operator ____________

---

1. NIKE I ALERT STATUS WHITE.

No action.

2. NIKE I ALERT STATUS YELLOW.

Computer power control panel.

(1) COMPUTER POWER switch ON. _______________

(2) Computer power READY light comes on after 20 seconds. _______________

(3) PLATE VOLTS switch ON. _______________

(4) SERVO DC switch ON. _______________

(5) PLOTTING BOARD CONTROL switch in REF MARK position. _______________

(6) Plotting board CONDITION switch returned to STANDBY position when pens stop moving. _______________

3. NIKE I ALERT STATUS BLUE.

a. Tactical control panel:

Plotting board CONDITION switch in OPERATE position. _______________

b. Computer control panel:

(1) Computer CONDITION switch at ACTION. _______________

(2) Green ACTION lamp lights. _______________

(3) Green COMPUTER ACTION lamp lights. _______________

4. NIKE I ALERT STATUS RED.

a. Tactical control panel:

Plotting board CONDITION switch at PLOT. _______________

b. Horizontal plotting board:

(1) Target ground coordinates plotted if target is being tracked automatically. _______________

(2) Intercept point ground coordinates plotted 4 seconds after the TARGET TRACKED lamp comes on. _______________

[illegible]

d. [illegible]

(1) [illegible] coordinates plotted.

(2) Target ground coordinates plotted.

e. Vertical plotting board (at command FIRE):

(1) Target altitude as a function of time plotted.

(2) Missile altitude as a function of time plotted.

[redacted]

APPENDIX X

[illegible]CK LIST, ACQUISITION RADAR OPERATOR

Unit ____________

Date ____________

Operator ________

[illegible] STATUS WHITE.

[illegible]quisition power control panel:

(1) PHASE rotary switch in C position. ____________

(2) PHASE C adjusted until line volts read 120 volts. ____________

(3) Phases A and B checked. ____________

(4) MAIN POWER switch ON. ____________

(5) ACQUISITION POWER switch ON. ____________

(6) After 20 seconds, amber plate volts light comes on. ____________

(7) 15-minute delay energized. ____________

(8) Green light comes on at end of 15-minute period. ____________

(9) PLATE VOLTS switch ON. ____________

(10) Power supply voltage checked. ____________

b. Acquisition control panel:

(1) IND HV switch ON. ____________

(2) HV SUPPLY control in start position. ____________

(3) HV lamp lighted. ____________

(4) HV SUPPLY control knob rotated clockwise until magnetron current meter reads 46 milliamps or to STOP. ____________

(5) ANTENNA AZIMUTH RATE switch at 10 or 20 rpm. ____________

c. Acquisition control panel:

(1) ANTENNA ELEVATION switch set to desired height. ____________

(2) FREQUENCY switch set to desired operating frequency. ____________

(3) SENSITIVITY TIME CONTROL checked. ____________

(4) AUTOMATIC FREQUENCY CONTROL light checked. ____________

(5) MTI operation when directed by FCO checked. ____________

[redacted]

[illegible]

[illegible]

[illegible]

[illegible] ment lamp ON.

3. NIKE ALERT STATUS BLUE

No action

4. NIKE ALERT STATUS RED.

Target designate control panel:

(1) Range circle on target (observed on the precision indicator). __________

(2) Flashing azimuth line on target (observed on the precision indicator). __________

[redacted]

[redacted]

APPENDIX XI

CHECK LIST, LAUNCHER CONTROL TRAILER OPERATOR

Unit ____________

Date ____________

LCO ____________

Panel Operator ________

---

1. NIKE I ALERT STATUS WHITE.

Launcher control trailer console:

(1) CONSOLE in operation. ____________

(2) SWITCHBOARD OPERATOR on duty. ____________

(3) GENERATOR running. ____________

2. NIKE I ALERT STATUS YELLOW.

Launcher control trailer console:

(1) SIREN sounds. ____________

(2) SIREN turned off when sections have reported ready. ____________

(3) CATHODE HEATERS automatically activated. ____________

(4) FILAMENT light is lighted. ____________

(5) SECTION SELECTOR switch at RESPONDER. ____________

(6) SECTION SELECTED light GREEN (changes from RED). ____________

(7) Red PLATE lamp lights on expiration of the plate current time delay. ____________

(8) RESPONDER activated. ____________

(9) Missile-tracking radar operator informed of response of meter to:

(a) YAW commands. ____________

(b) PITCH commands. ____________

(c) COMMAND BURST signals (indicated by clear light). ____________

(d) FAIL SAFE circuits 6 or 7 seconds after command signal lost by responder. ____________

[redacted]

3. [illegible]

[illegible]

(1) [illegible] switch [illegible]

(2) NOT READY light extinguished.

(3) READY light lighted when section [illegible]

4. NIKE [illegible] STATUS RED.

Launcher control trailer console

(1) READY section selected by positioning SECTION SELECTOR switch. __________

(2) SECTION SELECTED button depressed. __________

(3) LAUNCHER DESIGNATED light Green. __________

(4) Green MISSILE READY light appears. __________

(5) MISSILE REJECT light green (if missile has been accepted by missile-tracking radar). __________

(6) LAUNCH ORDER light on the console green (2 seconds after fire command is initiated at battery control trailer). __________

[redacted]

[redacted]

APPENDIX XII

LAUNCHER SECTION PANEL OPERATOR

Unit ____________

Date ____________

Panel Operator ________

1. NIKE I ALERT STATUS WHITE.

No action.

2. NIKE I ALERT STATUS YELLOW.

Launcher section panel:

(1) Start GENERATOR. ____________

(2) Turn MAIN POWER switch ON. ____________

(3) Depress ALERT ALARM SHUT-OFF button when all personnel are at their stations. ____________

(4) When launcher is ready for test operations, turn LAUNCHER DESIGNATE switch to that launcher and depress LAUNCHER DESIGNATE pushbutton. ____________

(5) Perform prelaunch checks. ____________

(6) When missiles are on each launcher and are ready, depress PREPARED pushbutton. Green lamp comes on. ____________

3. NIKE I ALERT STATUS BLUE.

Launcher section panel:

(1) All personnel in revetment when green ON DECK light appears. ____________

(2) LAUNCHER READY switches ON. ____________

(3) LAUNCHER ELEVATION switch UP. ____________

(4) HEATERS AND GYROS switch ON. ____________

(5) MISSILE READY-TO-FIRE light GREEN for only one launcher (after 60-second time delay). ____________

(6) LAUNCHER DESIGNATE switch shows launcher to fire. ____________

(7) LAUNCHER DESIGNATED pushbutton depressed. ____________

(8) DESIGNATED light GREEN. ____________

[redacted]

[redacted]

APPENDIX XIII

CHECK LIST, LAUNCHER CREW

Unit________________

Date ________________

Crew members:
Section Chief____________
Member ____________
Member____________

---

1. NIKE I ALERT STATUS WHITE.

No action.

2. NIKE I ALERT STATUS YELLOW.

(1) BOOSTER CONDITIONING equipment removed (if used). __________

(2) Missile air pressure checked (pressure gage located to the left of the top tunnel. Top off if necessary). __________

(3) Missile inspected for any sign of damage and fluid leaks. __________

(4) TEST-FIRE switch in TEST position. __________

(5) RAIL SELECTOR switch in LAUNCHER position. __________

(6) LAUNCHER DC POWER switch ON. __________

(7) Voltmeter reads 28 VOLTS DC. __________

(8) HEATERS AND GYROS switch at HEATERS AND GYROS. __________

(9) VIBRATOR switch turned to VIBRATORS (after 60 seconds). __________

(10) HYDRAULIC SELECTOR VALVE at LAUNCHER. __________

(11) MISSILE HYDRAULIC switch at MISSILE HYDRAULICS. __________

(12) MISSILE TESTING HYDRAULIC UNIT operates until 1,900 psi is reached. __________

(13) Ammeter reads approximately 9.5 amperes. __________

(14) Prepared launcher designated by operator at section revetment. __________

(15) INTERNAL-EXTERNAL switch at INTERNAL. __________

(16) INTERNAL-EXTERNAL switch at EXTERNAL when voltmeter indicating missile battery voltage reads 33.5 volts. __________

(17) Section operator slews missile. __________

NOTE: Depress only one command test button at a time.

(18) COMMAND TEST ROLL pushbutton depressed (movement should be for a right turn). __________

[redacted]

e.

ton.

(1) [illegible]

(2) [illegible] pushbutton depressed [illegible] indication may be received at either the test equipment [illegible] the launcher junction box or by the technical loop telephone headset.

[redacted]

[redacted]

APPENDIX XIV

NOMENCLATURE TABLE

[illegible] nomenclature as set forth in Ordnance Committee Meeting (OCM) items [illegible] the corresponding nomenclature used in this special text as well as [illegible] contractor in his publications. It is included to facilitate the change-[illegible] nomenclature to official nomenclature. It is recommended this table be [illegible] official terminology is published.

OCM	SPECIAL TEXT	CONTRACTOR
1. Director station, fire control, trailer-mounted. a. Director central, fire control. b. Trailer, van, director station.	1. Battery control trailer. a. Battery control console. b. Battery control trailer.	1. Battery control van. a. Battery control console assembly. b. Battery control trailer.
2. Cable system, fire control. a. One interconnecting group, cable, fire control. b. 12 cable assembly, CX-1065/G. c. 32 cable assembly, CS-162/8	2. Cables; cable system.	2. Cable system.
3. Tracking station, trailer-mounted. a. Tracking central, radar. b. Trailer, van, radar tracking center.	3. Radar control trailer. a. Missile-tracking radar console target-tracking radar console. b. Radar control trailer.	3. Radar control van. a. Missile track console target track console. b. Radar control trailer.
4. Antenna-receiver-transmitter group, target tracking; mounted on trailer, drop-bed, antenna mount.	4. Target-tracking radar; target-tracking radar trailer.	4. Target track antenna assembly; mounted on antenna mount drop-bed trailer.
5. Antenna-receiver-transmitter group, missile tracking; mounted on trailer, drop-bed, antenna mount.	5. Missile-tracking radar; missile-tracking radar trailer.	5. Missile track radar assembly; mounted on antenna mount drop-bed trailer.

[redacted]

[illegible] receiver-transmitter group, acquisition.	[illegible]	[illegible] radar.
[illegible] Collimating set, radar. Test set, radar, radio frequency. [illegible] Antenna group, radar collimation.	[illegible] Radar test antenna and bore sighting mast assembly. a. Radar r-f test set. b. R-f horn and optical target assembly.	[illegible] test mast assembly [illegible] assembly. [illegible] test set. Radar test mast assembly [illegible]
8. Electronic shop, trailer-mounted. Trailer, fire control van, 2-ton, 4-wheel, M244.	8. Maintenance and spare parts trailer.	8. Maintenance and spares van. Maintenance and spares trailer.
9. Launching control station, trailer-mounted. a. Launching central, control. b. Trailer, van, launching, control.	9. Launcher control trailer. a. Launcher control console. b. Launcher control trailer.	9. Launcher control van. a. Launcher control operator console. b. Launcher control trailer.
10. Control-indicator group.	10. Launcher section control panel.	10. Launcher section operaating and power cabinets.
11. Test set, radar, responder.	11. Test responder and mast.	11. Test responder and mast.
12. Power supply group, launching section.	12. Cables; power supply.	12. Cable system; launching section power cabinet.
13. Test set, launching area, portable electrical equipment. Test set, radio frequency, guided missile.	13. Test equipment. R-f test set.	13. Portable test equipment. R-f test set.
14. Test set, electrical equipment, guided missile. Test set, radio frequency, guided missile.	14. Missile test equipment. R-f test set.	14. Complete missile test equipment. R-f test set.

[redacted]

1[illegible] [illegible] ... [illegible] interconnecting groups, cable, launching section. [illegible] interconnecting groups, cable, launching.	15. Cables; cable system.	15. Cable system.
16. Rack, battery-charging.	16. Not used.	16. Console, battery charging and storage.
17. Launcher-loader, guided missile.	17. Launcher and loading and storage racks.	17. Launcher and loading and storage racks.
18. Jato, 2.5-DS-59000.	18. Booster.	18. Booster.
19. Jato kit (includes lugs, fins, fin attachment fittings, shroud, jato thrust structure, and bolts).	19. Component parts of this kit are listed as separate items.	19. Booster assembly.
20. Servicer, acid, guided missile.	20. Oxidizer servicing assembly.	20. Oxidizer fill equipment.
21. Servicer, fuel, guided missile.	21. Fuel servicing assembly.	21. Fuel fill assembly.
22. Launcher, guided missile.	22. Launcher.	22. Launcher assembly.
23. Rail, launching and handling.	23. Launching and transporting rail.	23. Launching and transporting rail.
24. Trailer, flat bed, missile-booster.	24. Transporter trailer.	24. Missile transporter trailer.
25. Truck, bracket, hand, booster.	25. Booster dolly.	25. Booster dolly.

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28.	[illegible]	[illegible]	[illegible] racks.	[illegible]	[illegible] storage racks.
29.	Truck, lift, hand, missile.	29.	Joining hoist	29.	Missile-booster joining hoist.
30.	Tester, missile, propulsion plumbing.	30.	Not used.	30.	Propulsion plumbing testing assembly.
31.	Truck, bracket, hand, guidance section.	31.	Not used.	31.	Guidance section dolly.
32.	Warhead, fragmentation, 150-lb, T22E1.	32.	Center warhead. Aft warhead.	32.	Center warhead. Aft warhead.
33.	Warhead, fragmentation, 11-lb, T26E1.	33.	Nose warhead.	33.	Nose warhead.
34.	Cord assembly, detonating, T7.	34.	Primacord.	34.	Primacord.
35.	Igniter, jato, electric (consists of igniter head, black powder container, squibs, and necessary gaskets, bolts, washers, etc. Has electric ignition circuit).	35.	Not referred to as a kit. Component parts listed by name.	35.	Booster assembly.

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