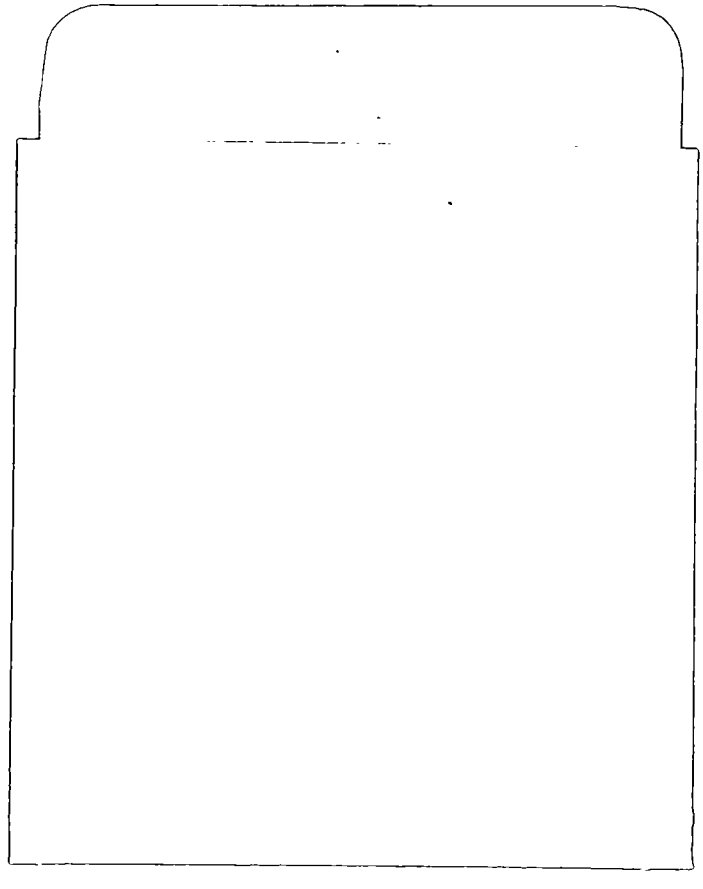
FM 6-54

DEPARTMENT OF THE ARMY FIELD MANUAL

115-MM AREA TOXIC ROCKET SYSTEM

HEADQUARTERS, DEPARTMENT OF THE ARMY
JANUARY 1964

AGO 7460A



FIELD MANUAL
No. 6–54

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *31 January 1964*

115-MM AREA TOXIC ROCKET SYSTEM

* This manual supersedes FM 6–54, 13 August 1962.

CHAPTER 1
GENERAL

1. Purpose and Scope

This manual assists commanders issued the 115-mm area toxic rocket system in organizing launcher platoons within their units and in developing them into efficient, smooth-working teams. It includes information on organization, equipment and ammunition, tests and techniques, tactical employment, capabilities and limitations, and launcher section drill.

2. References

Publications pertaining to the 115-mm area toxic rocket system and auxiliary equipment and covering related matters not discussed in detail in this manual are listed in Appendix I.

3. Comments

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

CHAPTER 2
SYSTEM DESCRIPTION

4. The System

The 115-mm area toxic rocket system is composed of the 115-mm multiple rocket launcher M91, associated sighting and fire control equipment, and the 115-mm gas rocket M55.

5. Multiple Rocket Launcher M91

a. General. The 115-mm rocket launcher M91 is designed for firing M55 gas rockets in attacks of area targets. The function of the launcher is to provide a firing circuit and a

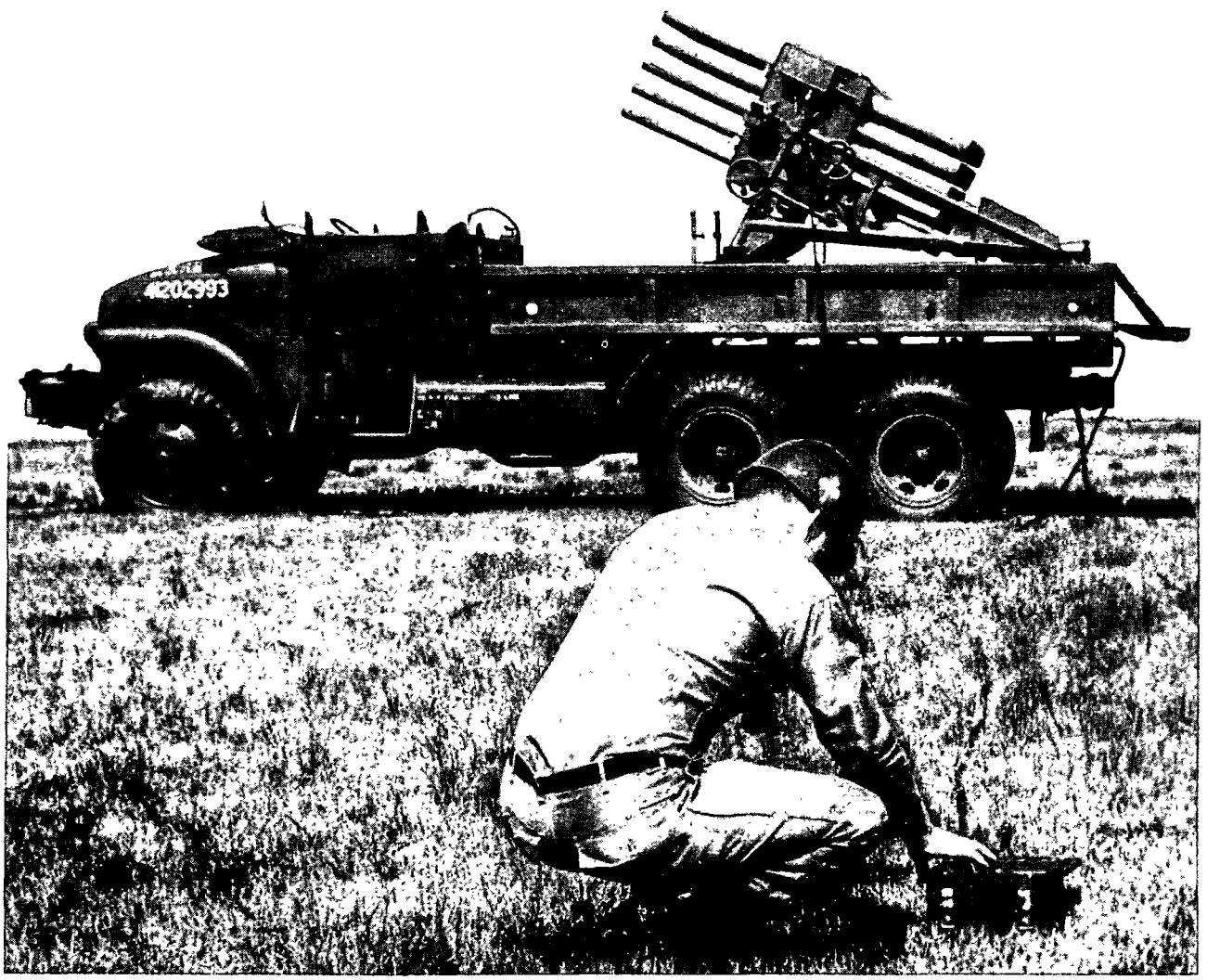


Figure 1. 115-mm rocket launcher M91, mounted (loaded).

platform for rocket orientation prior to firing. Constructed of lightweight welded aluminum, the launcher weighs approximately 1,200 pounds and is mounted on the standard 2½-ton, 6 x 6, cargo truck M35 (fig. 1). The launcher may be fired from its mounted position, or it may be dismounted and fired from the ground (fig. 2). When dismounted it is also helicopter transportable. The launcher consists of a bottom carriage assembly with two removable wheel and spindle assemblies, two stabilizing jack groups forward of the wheels and two detachable trail and ball assemblies (right and left) and a rectangular top carriage assembly (fig. 3), mounting a cluster and conduit assembly. The elevating, traversing, and electrical firing mechanisms (fig. 4) are also mounted on the top carriage assembly. The sight unit is mounted on the left side of the launcher for one-man control in indirect fire. In travel and firing, an elevation lock assembly prevents up or down movement of the cluster and conduit assembly, and a traversing lock group prevents movement of the top carriage assembly to the right or left. An overall cover protects the launcher when it is not in use.

(1) *Cluster and conduit assembly.* The cluster and conduit assembly is installed on the top carriage assembly and pivots on the top carriage trun-

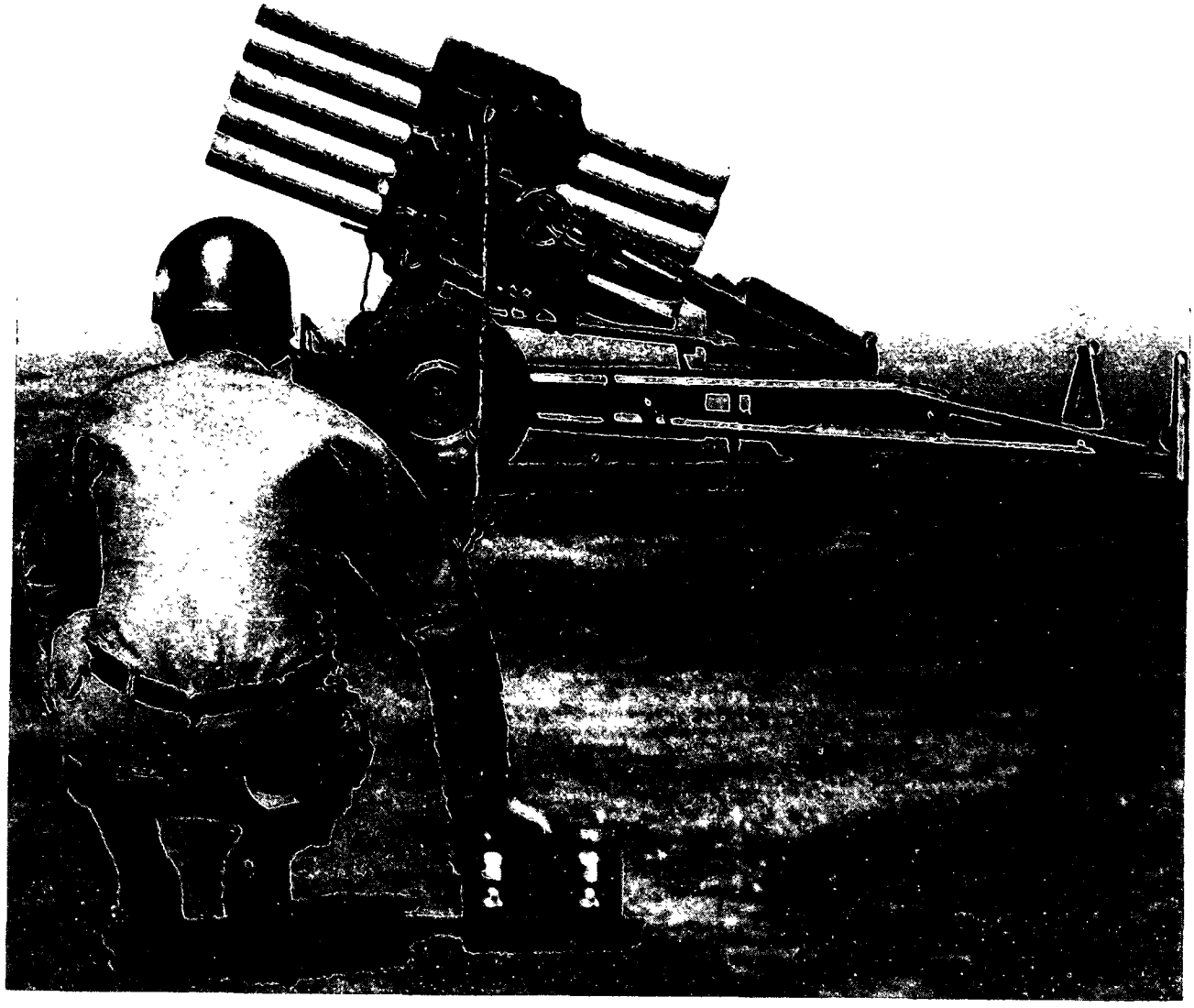


Figure 2. 115-mm rocket launcher M91, dismounted (loaded).

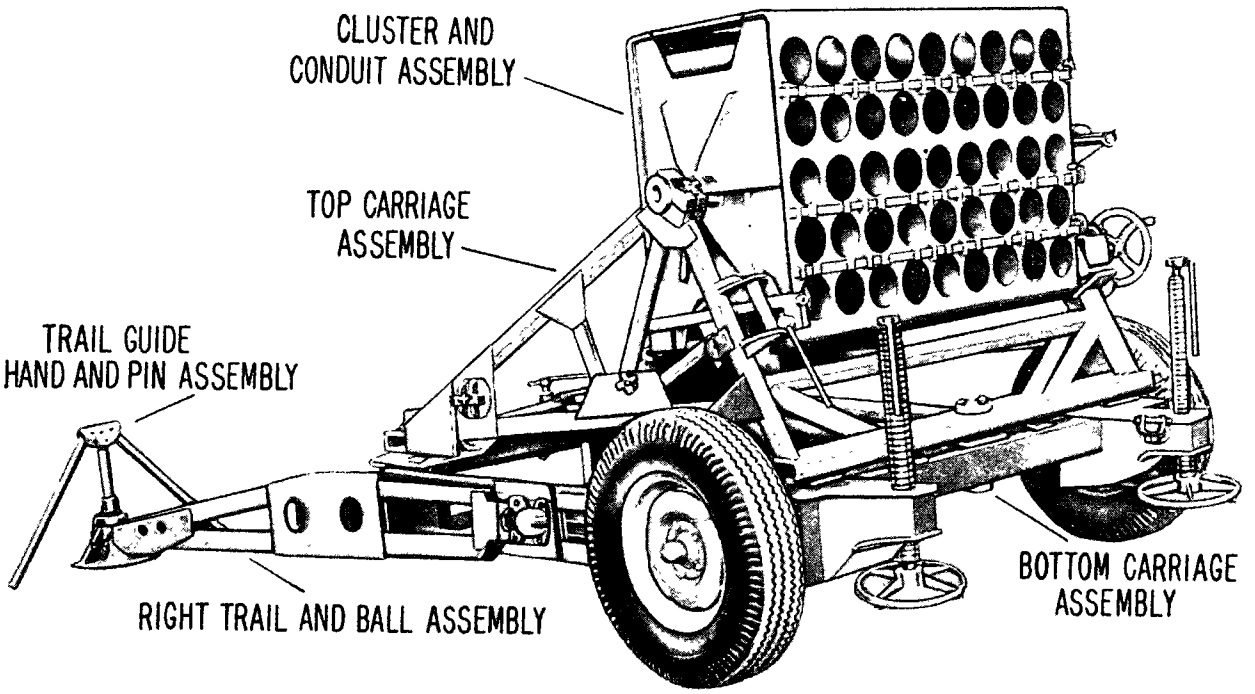


Figure 3. 115-mm multiple rocket launcher M91—right front view.

nion blocks. It may be elevated from 0 mils to +1,067 mils. The rocket shipping-firing containers are loaded in the cluster in five tiers of nine tubes each (fig. 4). Three rocket container locking bar assemblies located on the front of the cluster lock the shipping-firing containers in place for firing. The firing circuit box assembly is mounted on the top left side of the cluster.

(2) *Top carriage assembly.* The top carriage assembly is constructed of aluminum and supports the cluster and conduit assembly between two split trunnion blocks. The top carriage assembly consists of the elevating mechanism assembly, elevation lock assembly, traversing mechanism group, and traversing lock group. One turn of the elevating handwheel elevates (depresses) the cluster 6.37 mils in elevation. One turn of the traversing handwheel traverses the cluster 1.9 mils.

(3) *Bottom carriage assembly.* The bottom carriage assembly is constructed of aluminum and supports the top carriage and cluster and conduit assemblies and permits top carriage traverse from 178 mils (10°) left to 178 mils (10°) right. Two stabilizing jack groups are mounted on the forward end of the carriage, and two removable wheel and spindle assemblies are located on either side of the forward end of the carriage.

(4) *Trail and ball assemblies.* The welded aluminum trails are attached to the launcher bottom carriage for ground emplacement. Trail stakes are positioned in openings at the rear of the trails and driven into the ground to immobilize the launcher during firing. The trails also provide support for limited movement by the crew when the launcher is not vehicular mounted. In the travel position, the trails are removed and mounted on the lower portion of the top carriage. When the launcher is fired from the prime mover the trails have no function and may be stowed in the cargo bed.

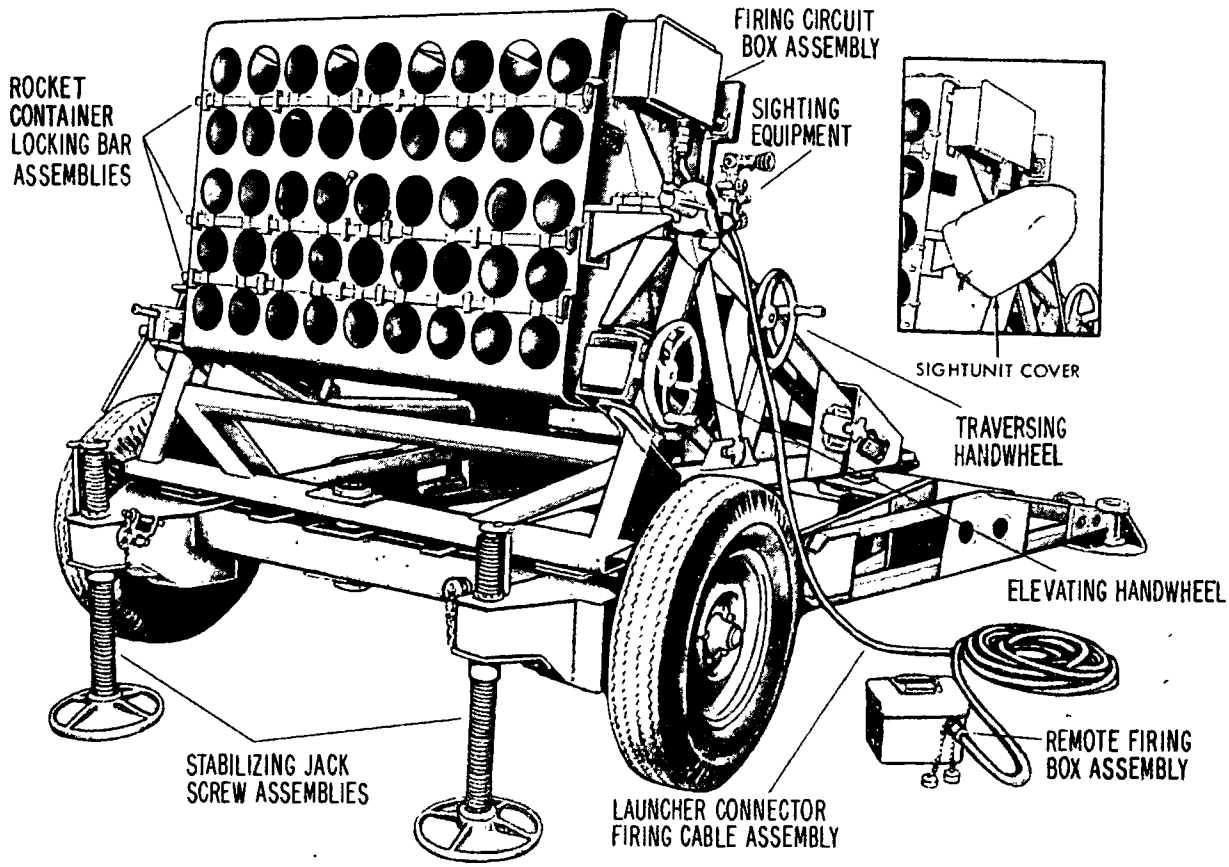


Figure 4. 115-mm multiple rocket launcher M91—left front view.

b. Handling and Auxiliary Equipment.

(1) *Lifting slings.* Standard nylon lifting slings are used to lift and transport the launcher by helicopter.

(2) *Equipment chest.* A steel equipment chest is supplied for storage and transportation of auxiliary launcher equipment.

(3) *Tool and accessories roll.* Each launcher section is equipped with tools and a canvas tool and accessories carrier.

(4) *Launcher overall cover.* The protective cover is a neoprene-coated nylon shelter used to protect the launcher.

c. Sighting and Fire Control Equipment.

(1) The sighting and fire control equipment used with the 115-mm multiple rocket launcher M91 consists of either the sight unit M34A2C or sight unit M53E2 and a telescope mount holder M7 (fig. 4).

(2) Auxiliary equipment includes a carrying case M78 and an instrument light M42 for the sight unit M34A2C or a carrying case M166 and an instrument light M53 for the sight unit M53E2.

(3) The sight unit is mounted to the left side of the cluster and conduit assembly on the telescope mount holder M7, forward of the trunnion. After the launcher is laid and before it is fired (and at other times when the launcher is not in use) the sight unit is removed from its mount, stowed in the carrying case, and placed in the equipment chest. For further description and information, see TM 9–1055–215–12.

(4) A remote firing box assembly provides

firing circuit continuity. During testing and firing, this box is located a safe distance to the flank of the launcher and is cabled to the firing circuit box assembly. When not in use, the remote firing box assembly is stowed in the equipment chest. The 115-mm gas rocket is fired electrically in a preset sequence. The 24-volt battery of the prime mover is used as the primary power source for the firing circuit. A thermal cell 28-volt battery, supplied as a basic item of issue, can be inserted in the remote firing box assembly for use as an emergency power source. The thermal dry cell battery can be used only once, because when activated its power will be expended. Therefore, the thermal battery should not be used during training exercises.

6. The Gas Rocket M55, and M60/M61 Training Ammunition

a. The Complete Round. The complete round of the M55 gas rocket (fig. 5) consists of the following components:

(1) *Fuze.* The M417 point-detonating fuze is used with both standard rounds (*b* below).

(2) *Warhead.* The rocket warhead, an aluminum cylinder, houses the chemical agent filler. A central burster tube, threaded at one end to receive the fuze, extends from the nose to the base of the warhead.

(3) *Motor.* The rocket motor is a cylindrical steel tube containing the double base solid propellant and an igniter assembly. The tube is threaded at each end to receive the warhead and the nozzle plate of the fin-nozzle assembly.

(4) *Fin-nozzle assembly.* The fin-nozzle assembly consists of a nozzle plate and four spring-operated aluminum fins. The nozzle plate contains four rocket motor exhaust nozzles. The lead wires from an electric squib in the igniter assembly of the rocket motor pass through the nozzle plate and are readily available to the loader when the rear cap of the shipping-firing container is removed.

(5) *Shipping-firing container.* A plastic reinforced fiberglass shipping-firing container (fig. 5) fits into each of the 45 rocket tube openings of the 115-mm multiple rocket launcher for firing. The shipping-firing container is closed at each end with a removable cap. Each cap is fitted with a hexagon-head screw plug, which is removed only for testing for chemical agent leakage. An indexing ring circles the shipping-firing container and insures proper seating of the rockets in the cluster and conduit assembly of the launcher.

b. Standard Rounds. There are two standard 115-mm rounds:

(1) *Rocket, gas, persistent, VX, 115-mm, M55.* An identification decal is affixed to the warhead and to the forward end of the shipping-firing container. The decal contains the nomenclature, the symbol for the chemical agent, the lot number, and the filling date. Both the rocket and the container are further identified by a decal containing a ¼-inch yellow band (indicating high explosive burster) and three ⅜-inch green bands (indicating a nerve agent filling) on a gray background.

(2) *Rocket, gas, nonpersistent, GB, 115-mm, M55.* The GB round and its shipping-firing container are marked in the same manner as the VX round.

c. Training Rounds. There are two 115-mm training rounds:

(1) *Rocket training, dummy, 115-mm, M60.* The M60 round, authorized by TA 23–103, is used for maintaining training proficiency during crew drills and simulated firing. The M60 round and shipping container are identified by a blue decal containing the nomenclature stencilled with ⅜-inch letters.

(2) *Rocket practice, simulant EG, 115-mm, M61.* The M61 round is authorized by TA 23–100 for service practice firings. The M61 rocket and container

markings are the same as the M60, with the addition of a ¼-inch yellow band.

d. Packaging. Fifteen M55 rockets in their shipping-firing containers (each weighing 74 pounds) are packed in a wood crate. The rockets are packed in the propulsive state. The crate is designed so that one crate can be interlocked on top of another to facilitate delivery by helicopter. The end panels of the crate are provided with openings to permit removal of the screwplug in the end cap of each shipping-firing container to permit inspection for detection of chemical agent leakage. The wood crate is 28 inches high (including skids), 83 inches long, and 30 inches wide. The weight of the crate filled with 15 rockets is 1,400 pounds. Three crates (4200 lb.) of rockets are required if the entire cluster is to be loaded.

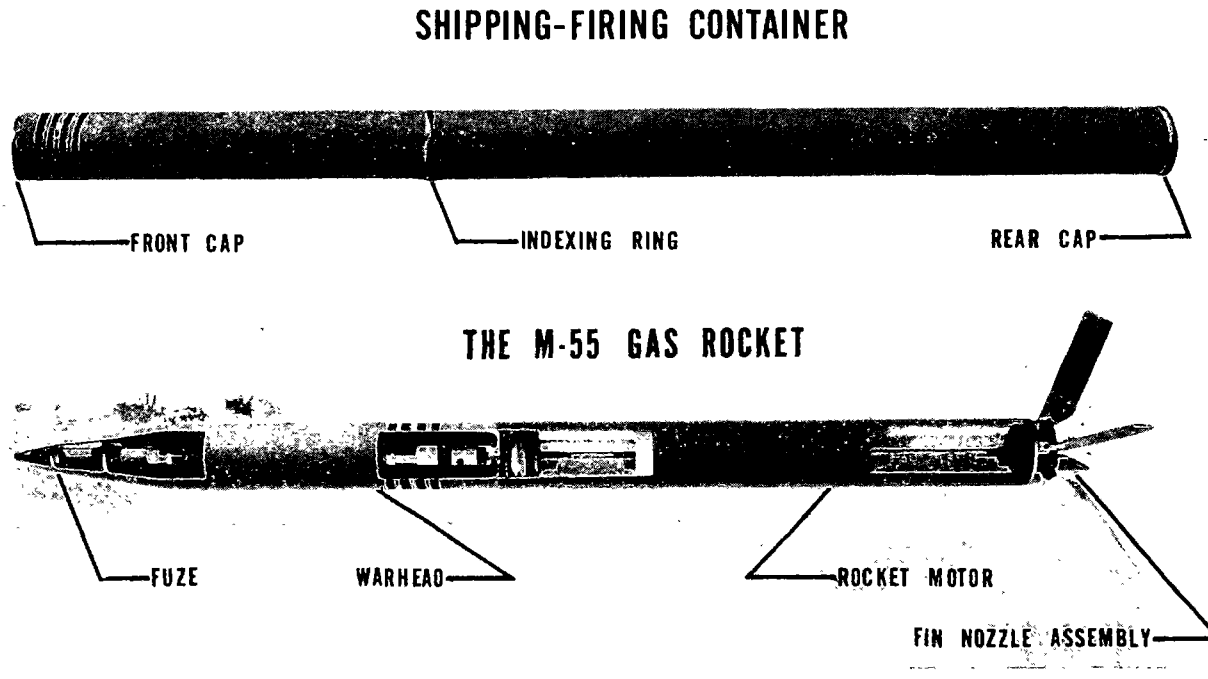


Figure 5. 115-mm gas rocket M55 and shipping-firing container.

CHAPTER 3
ORGANIZATION

7. General

The TOE structure of the artillery firing battery lends itself to rapid transformation to a provisional toxic rocket fire unit for training or for firing a chemical rocket mission.

8. Organizational Concepts

a. Provisional 115-mm Unit. The structure and duties described in this chapter are presented as a guide in organizing a provisional unit for training or to support a prolonged independent chemical mission. The unit consists of a firing platoon, ammunition section, fire direction section, communications section, and a survey section.

(1) *The firing platoon.* The firing platoon normally consists of a platoon headquarters and three launcher sections.

(2) *Fire direction/ammunition/and communications sections.* Regardless of the number of launcher sections assigned to the firing platoon, a requirement exists for fire direction, ammunition, and communication support. The personnel and equipment to provide this support are furnished by the existing sections of the battery assigned the chemical mission.

(3) *Survey section.* Numerous and prolonged chemical missions may require that the provisional 115-mm firing unit be augmented by survey personnel and equipment. Survey requirements for the provisional unit are similar to those of direct support artillery batteries.

b. Strength. The size and composition of the various sections which comprise the provisional unit are not specified because these requirements are solely contingent upon the situation and the mission. For example, if the position area survey has been completed, no requirement exists for a survey section.

c. Typical Launcher Section.

(1) A typical launcher section is composed of a multiple rocket launcher M91, a prime mover, auxiliary equipment, and the following personnel:

(*a*) A chief of section (CS).

(*b*) A gunner (G).

(*c*) Four crewmen numbered 1 through 4 (number 1 is the assistant gunner).

(*d*) A driver-radiotelephone operator (D/RTO).

(2) Section equipment is listed in TM 9–1055–215–12.

9. General Duties of Launcher Personnel

a. Chief of Section. The chief of section commands the section and is responsible for—

(1) The training and efficiency of personnel.

(2) The performance of duties listed under section drill, duties in firing, testing and adjusting sighting and fire control equipment, and inspection and maintenance of all section equipment, including the prime mover.

(3) Observance of safety precautions.

(4) The preparation of field fortifications for protection of equipment, ammunition, and personnel.

(5) Camouflage discipline, local security, CBR, and nuclear defense.

(6) Maintenance of the equipment log book.

(7) Police of the section area.

b. Gunnery. The gunner assists the chief of section in carrying out the duties specified in *a*

above. The gunner's duties during preparation for action, firing, and march order are prescribed in table I through IV.

c. Crewmen. Crewmen perform duties listed in this manual and other duties prescribed by the chief of section.

d. Driver-Radiotelephone Operator. The driver's primary duty is to drive the section prime mover. He also acts as section radiotelephone operator and performs maintenance and such other duties as prescribed by this manual, the technical manual for the section vehicle, and the chief of section.

CHAPTER 4
TACTICAL EMPLOYMENT

10. Classification and Assignment

a. The M91 system is a short range field artillery rocket system designed for area toxic chemical missions.

b. The M91 rocket launcher when authorized by the theater of operations commander or the U.S. Continental Army Commander is assigned to divisional direct support artillery battalions. When authorized, the rocket system will be issued to the battalion supply section and released to firing batteries for chemical missions and training.

11. Capabilities and Limitations

a. Capabilities.

(1) The M91 system supplements the fire capabilities of other field artillery weapons with a GB and VX delivery capability.

(2) The parent battalion augments provisional unit communication, survey and fire direction capabilities as required for each mission.

(3) The M91 rocket launcher is 100% mobile and air transportable by army aircraft.

(4) Provisional units (ch. 3) are capable of independent operation at remote distances from the remainder of the battalion for short periods of time.

(5) The system can be fired during darkness or inclement weather; however, normal employment times and conditions are specified in FM 3–10.

(6) The M91 system provides a capability of delivering large volumes of chemical agents in a short period of time. Thus, the M91 system can deliver chemical fires in mass and retain the element of surprise with attendant effects.

(7) The system can attack heavily defended areas when chemical delivery by tactical aircraft is not feasible.

(8) The system minimum and maximum ranges are: 3000–10,600 meters.

b. Limitations.

(1) Unlike dispersion patterns of conventional artillery, the 115-mm rocket dispersion patterns are significant even though the target area exceeds several hectares (100 meter squares). Because of rocket dispersion attack of small targets is not profitable.

(2) Large probable errors in range and deflection may preclude firing in proximity of friendly troops.

(3) Provisional units are not capable of firing immediately at targets of opportunity.

(4) The relatively low trajectory complicates firing position selection because of intermediate crest clearance considerations.

(5) Simultaneous employment of more than three M91 launchers would seriously degrade the parent artillery unit's ability to perform its primary direct support mission.

(6) The effects of the dust cloud and rocket flashes require the provisional unit to displace immediately upon firing.

(7) The launcher, when dismounted from its prime mover, has limited ground mobility.

12. Command and Control

a. Chemical fire planning is continuous, and is coordinated and integrated with all the fires and maneuver planned of other units at the Division Tactical Operations Center. For detailed fire planning information refer to FM 3–10, and FM 6–20–2.

b. Responsibility for post strike surveillance and assessment of casualties is specified by the division artillery commander.

c. M91 system chemical fires will normally be retained in general support of the force. General position areas will be selected as a part of the target analysis and indicated to the provisional firing unit sufficiently early to allow maximum time for reconnaissance and survey.

13. Reconnaissance, Selection and Occupation of Position

a. General. The general location of the position areas are indicated by division artillery. The minimum size of the position is influenced by the amount of tactical dispersion necessary and safety requirements described in chapter 11. The tactics and techniques applicable to the employment of cannon artillery (FM 6–20–1 and FM 6–20–2) are generally applicable to the area toxic rocket system. The RSOP procedures of FM 6–20–2 apply to the launcher platoon. Sites for the launcher sections are selected within the firing position. The general direction of fire is pointed out to the chiefs of sections or gunners by the platoon leader. The advance party continues to improve the firing position while waiting for the platoon to arrive.

b. Preparation. Advance preparation of a position is normally minimal because of the probability of firing only a single mission from the position. Individual launcher positions should be selected which will insure the safety of all personnel. The launcher should be emplaced on level ground to insure stability in firing and to reduce the probability of error due to cant. Laying the launcher while set on the trial quadrant elevation (if known) will reduce errors caused by cant. If time allows, the general direction of fire for each launcher is marked at the position area with two stakes and a 4-meter engineer tape. The prime mover driver alines his prime mover on the tape upon arrival in the firing area. This procedure eliminates repositioning of the prime mover after laying operations begin.

c. The March Forward. When the firing position is organized and the survey is nearing completion, the platoon leader moves the rocket platoon from the position area to the firing position. To maintain the element of surprise, the launcher should not be moved to the firing position sooner than is absolutely necessary. Upon receipt of the warning order, section personnel accomplish the actions indicated in table I.

d. Occupation.

(1) When the platoon column arrives at the firing position, a guide leads each launcher to its position. "Prepare for action" is directed by the chief of section or gunner. The occupation should be orderly, efficient, quiet, and in conformance with a sound standing operating procedure.

(2) When possible, the launcher should be loaded, the firing circuit tested, and the weapon boresighted prior to movement to the firing position to avoid excessive exposure prior to firing. Boresighting should always be accomplished prior to firing. However, if the launcher is dismounted and fired from the ground, boresighting, firing circuit tests, and loading must be accomplished at the firing position.

(3) The launcher is elevated to the approximate firing elevation by crewman number 1 and then laid by the platoon leader. *Initial laying of the launcher at the approximate firing elevation reduces the effects of cant.* The commands and procedure for laying the platoon (table II) are similar to those used for laying field artillery cannon. It should be noted that the panoramic sight of the launcher is graduated from 0 to 6400 mils, therefore, black numbered scale (0–6400) on the aiming circle should be used during laying operations.

(4) If the platoon is to fire immediately after occupying the position, aiming posts normally are not emplaced, since subsequent missions from the same firing position are not anticipated. The platoon leader may designate a distant aiming point or the aiming circle as a reference point for the launcher section. The use of the distant aiming point or aiming circle as the reference point hastens the mission and allows for rapid evacuation

Table I. Individual Duties Upon Receipt of Warning Order

(Operations applicable only if launcher is to be driven to the firing position with rockets loaded.)

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Driver
1	Supervises work of all members of the section throughout all sequences.	Removes fire control equipment from the equipment chest. Tests fire control equipment.	Unlocks elevating and traversing mechanisms. Installs front and rear boresights.	Remove and store overall cover.		Assists driver.	Lowers windshield. Removes cab top paulin and brackets.
2	Directs boresighting by distant aiming point or testing target method.	Directs traverse of launcher onto boresight aiming point. Makes boresight adjustment if necessary.	Traverse launcher as directed. Removes boresights.	Position test target (if appropriate).		Removes circuit tester, remote firing box, firing cables, and vehicle-to-firing box cable from remote equipment chest.	Places vehicle light switch in blackout drive position.
3	Directs firing circuit test to be performed using vehicular power.	Stows fire control equipment. Tests firing circuit.	Mounts fire circuit tester on cluster. Connects tester leads to tip jack rows. Reports test results to gunner after row test.	Connects firing cable between control box assembly and the remote firing box.	Connects vehicle power cable between vehicle trailer receptacle and remote firing box.	Prepare ammunition crates for loading.	
4	Directs loading operations.	Takes position at rear of cluster and supervises loading operations. Assists number 1 when necessary. Reports ROCKETS ARE LOADED.	Locks traversing and elevation mechanisms in the travel position. Rotates shipping-firing container until "D" handle is alined horizontally.	Takes position at rear of container to be loaded. Assisted by the driver, lifts rocket shipping-firing container.	Takes position in front of cluster, facing to the rear. Accepts front end of container from number 2 and passes it to number 4. Inserts container into cluster, assisted by number 4. Locks cluster locking bars.	Takes position in front of cluster and assists number 3 during loading operation. Accepts front end of container from number 3.	Takes position in front of rocket container and assists number 2 in passing containers to number 3.
5	Checks for presence and adequacy of equipment, to include a thermal battery (emergency power source). Reports to the platoon leader number__ready.						Prepares vehicle for march forward.

Table II. Individual Duties During Occupation of Position

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Driver
1	Commands PREPARE FOR ACTION. Supervises work of all members of the section throughout all sequences. Checks danger zone to insure that zone is clear of equipment and flammable material (TM 9–1055–215–12) and directs removal if necessary. Directs positioning of the launcher in the direction of fire.	Boresights launcher by standard angle. Reports NUMBER_____ READY TO BE LAID.	Unlocks elevating screw and traversing locks. Operates elevation and traversing handwheels.	Remove overall cover. Spread tarpaulin 20 meters to left flank of launcher, and place overall cover on tarpaulin.			Assists in unloading ammunition from prime mover and in preparing for firing. (Applies only if launcher is unloaded.) Places chocks under wheels.
2	Directs boresight operations. Directs leveling procedures. (Applied to dismounted firing only.)	Receives command PLATOON ADJUST, AIMING POINT THIS INSTRUMENT. Refers his sigbt on the instrument identified and reports NUMBER____, AIMING POINT IDENTIFIED. Receives and repeats back command NUMBER__ DEFLECTION_____. Sets announced deflection on his azimuth and micrometer scales and, traversing the launcher, brings tbe vertical cross-hair of the sigbt back on the aiming point. Reports NUMBER____READY FOR RECHECK. Repeats the preceding steps until the reading on his azimuth and micrometer scales corresponds within 0 mils of tbe announced deflection and then reports NUMBER____, DEFLECTION____, 0 MILS.	(1) Unload ammunition, tools, and accessories. (2) Numbers 1 and 2 emplace left trail. (Applies to dismounted firing only.) (3) Numbers 1 and 2 assist numbers 3 and 4 in positioning the launcher. (Applies to dismounted firing only.) (4) Number 1 operates left stabilizing jackscrew assembly during launcher leveling operations. (Applies to dismounted firing only.)	(1) Arrange them in orderly and convenient manner. (2) Numbers 3 and 4 emplace right trail. (Applies to dismounted firing only.) (3) Numbers 3 and 4 assist numbers 1 and 2 in positioning the launcber. (Applies to dismounted firing only.) (4) Number 3 operates right stabilizing jackscrew assembly during launcber leveling operations. (Applies to dismounted firing only.)			Prepares vebicle as follows: Lowers cargo body endgate. Lowers the windshield. Removes cab top paulin, bracket, and seats.
3	Directs a test of the firing circuit. *Note. This test should be accomplished*	Receives command NUMBER____IS LAID. Sets deflection__on bis azimuth and micrometer	Removes fire circuit tester box and cable from equipment chest. Removes firing cable,	Installs plugs of firing circuit cable to tip jacks in cluster rows, proceeding from top to	On order of the gunner secures aiming posts and double times 50 meters in tbe direc-	Emplaces trail stakes. (Applies to dismounted firing only.)	Places vehicle light switch in the blackout drive position. (Switch remains in

Table II. Individual Duties During Occupation of Position—Continued

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Driver
	prior to loading ammunition.	scales. Unit SOP will specify the deflection at which aiming posts will be placed upon completion of laying (par. 13d(4)). *Caution:* Do not traverse the launcher. Using hand signals, directs number 1 in aiining aiming posts and recalls him to the launcher on completion. (Applicable only if distant aiming point or aiming circle is not used as reference point.)	remote firing box, and vehicle connector cable from equipment chest. Connects firing cable to cluster-mounted firing box and remote firing box. Removes safety plugs from remote firing box. Connects vehicle connector cable to remote firing box and to vehicle. Connects firing circuit tester cable to firing circuit box. Installs safety plugs in receptacle in remote firing box. Test fires cluster rows, proceeding from top to bottom. Reports results to gunner. Returns firing circuit tester to equipment chest. (Applicable if launcher is not loaded.)	bottom. Notifies number 1 when each row is ready to test fire. Returns firing circuit tester to number 1. *Note. The proper outlet for each rocket position is above and to the left of the launcher tube. (Applicable if launcher is not loaded.)*	tion directed by the gunner and drops the near aiming post; continues at the double time another 50 meters, stops and, as directed by the gunner, aiines the far aiming post. When the far aiming post is aiined, double times to the near aiming post and aiines it. Returns to launcher on order of gunner. (Applicable only if distant aiming circle is not used as reference point.)		this position until firing is completed when the vehicle is providing the power source.)
4	Insures that the launcher is prepared for action and reports NUMBER ____READY or reports malfunctions to platoon leader. Determines that all tubes clear any masks to the immediate front. Using gunner's quadrant, measures minimum site to mask. Transmits angle of site to mask to the platoon leader.	Assist C/S in measuring minimum site to mask by elevating or depressing the launcher and sighting along the bottom of the bottom tubes. Insures that number 1 has completed test firing the launcher. Assists number 1 in correcting any malfunctions. Reports NUMBER_____IS READY. *Note. If the launcher arrives at the firing position with rockets loaded, the site to mask may be determined by an aiming circle provided the aiming circle is not on higher ground than the launcher.*	Locks elevating and traversing mechanism after laying operations.	Take posts as crewmen prepared for action (fig. 9).			

after firing, thereby decreasing the exposure time of the platoon. If the platoon occupies the position considerably in advance of the expected firing, the standard procedures for emplacing the aiming posts are observed. Since the sight mount is offset from the trunnion, changes in elevation and deflection cause aiming point displacement errors; therefore, the aiming post method provides best accuracy since it allows for displacement corrections.

CHAPTER 5
PREPARING THE LAUNCHER FOR FIRING AND TECHNIQUES REQUIRING SPECIAL ATTENTION

Section I. PREPARING THE LAUNCHER FOR FIRING

14. Loading Rockets

Step-by-step loading procedures are described in table I. As each shipping-firing container is loaded into the cluster, the container indexing ring must be carefully seated against the cluster and conduit assembly.

15. Traveling With Launcher Loaded

Traveling with the launcher loaded requires extreme care. The stress caused by the added weight of the rockets might result in damage to the launcher. Particular care must be exercised in traveling over rough terrain. Speeds must be low. The launcher should not be moved when loaded unless the rocket containers are locked in place and the elevating and traversing locks are engaged. When the launcher arrives at the firing position, shipping-firing container end caps are removed and the electrical squib leads can be connected to the cluster tip jacks.

Warning: **Whenever the launcher is to be moved to the firing position with rockets loaded, a ground strap must be connected to the vehicle to provide a discharge path for any buildup of static electricity.**

16. Precautions in Firing

a. In order to provide the highest possible protection to personnel and materiel, the precautions outlined in this paragraph, in addition to the precautions and safety requirements of AR 385–63, will be observed.

b. Personnel engaged in handling the gas rocket M55 during storage and surveillance must be provided with protective clothing as prescribed in TM 3–304.

Warning: **Failure to observe necessary safety precautions may result in gas casualties.**

c. After the rocket has been prepared for launching, the launcher must not be moved

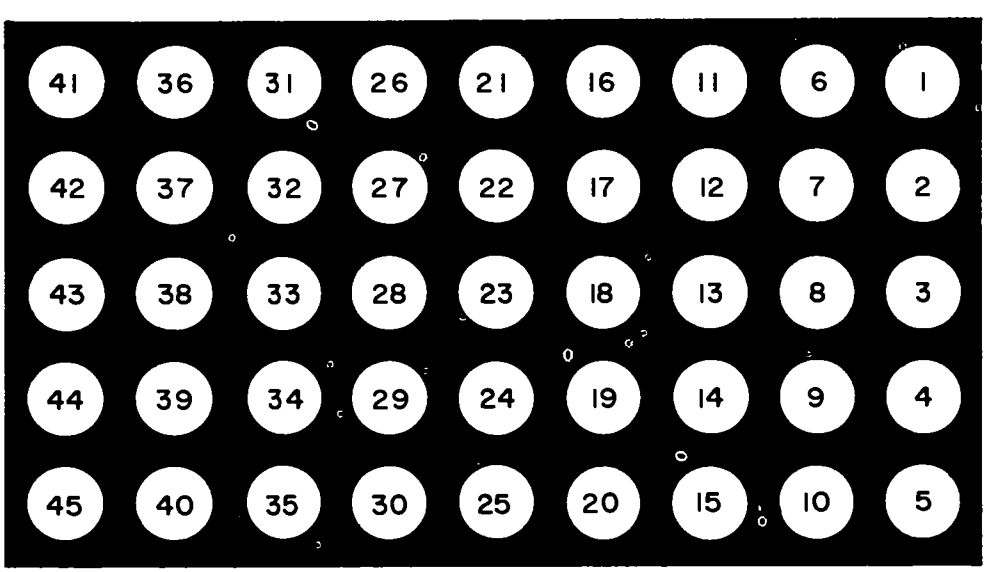


Figure 6. Launcher loading sequence (cluster rear view).

Table III. Individual Duties Upon Receipt of Fire Commands

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Driver
1	Directs loading operations, if necessary. Supervises operation. Checks that all tip jacks are inserted and all end caps removed. Determines powder temperature. Using the anemometer, determines low-level windspeed and direction and transmits this information to the platoon leader.	Perform loading operations indicated in table I, if necessary; to include removal of shipping-firing container end covers and installations of the rocket igniter squib leads in the cluster tip jacks.					
2	Checks deflection and elevation set off by gunner. Insures that all bubbles are level. Reports number____ ready.	Receives announced fire commands, AT MY COMMAND, DEFLECTION _____, QUADRANT ____. Sets off announced deflection and quadrant elevation; traverses and elevates launcher until all bubbles are level. Locks elevation and traversing locking screw. Removes sight and passes it to number 2. Commands CREWMEN POST.	Removes the launcher connector firing cable assembly, tbe remote firing box assembly, and one thermal dry cell battery from the equipment chest. Removes the safety plug from the remote firing box and installs the thermal cell in the thermal housing. Removes the dust caps from the firing cable receptacles in the cluster-mounted circuit box assembly and the remote firing box assembly. Installs the firing cable in the receptacles. Extends the remote firing box assembly tbe full length of the cable to the firing pit. Inserts the safety plug and reports NUMBER _____ SET. (Thermal cell should be used only as an emergency source of power.)	Accepts sight from gunner and places it in its carrying case. Takes post on order of gunner.	Take posts on order of gunner after locking rocket container locking bars.		Runs vehicle at fast idle and places vehicle light switch in blackout drive position. (Applicable only when vehicle provides firing power.)
3	Receives command FIRE___. Directs all crewmen to leave the danger zone. Insures that vehicle light switch is In the blackout drive posltion. (Appll-	Receives and repeats back command QUADRANT _____. If necessary, sets the new quadrant on the launcher. On the com-	Proceed to the left and right of the danger zone.				

Table III. Individual Duties Upon Receipt of Fire Commands—Continued

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Driver
	cable only when vehicle provides firing power.) Checks the launcher and determines the number of rounds fired. Reports NUMBER ____ ROUNDS COMPLETE or NUMBER ___ ROUNDS COMPLETE, _____ ROUNDS MISFIRED. (See par. 44, TM 9-1055-215-12.)	mand to fire, pushes the remote control handle and lever to the extreme position until it releases the thermal cell activating lever. Moves the toggle switch to the fire position and holds it there until firing is completed.					

Note 1. Operations in tables I and II must be completed prior to performing the operations in this table.

Note 2. Actions of gunner and number 2 are written to conform to firing using the thermal battery as the power source. If the prime mover is used as a source of power, these procedures must be modified to include connection of the remote firing box to the prime mover trailer receptacle.

Table IV. Individual Duties During March Order

Sequence	Chief of Section	Gunner	Number 1	Number 2	Number 3	Number 4	Driver
1	Commands MARCH ORDER.	Places gunner's quadrant in carrying case in the equipment chest.	Unlocks elevating and traversing locking mechanisms.	Replaces remote firing box and firing cable in equipment chest. Discards thermal cell, if used, or places the unused cell in the equipment chest.	Disconnects power cable from vehicle trailer connector and places it in the equipment chest.	Removes trail stakes and places them in the tool and accessory roll. (Applicable to ground firing only.)	Replaces vehicle seats and hacks.
2	Removes safety plug from remote firing box.	Traverses and depresses cluster assembly to the travel position.	Recovers aiming stake and places them on the prime mover.				Loads windshield and cab top in cargo bed.
3	Supervises rocket unloading procedures and insures that only the minimum number of personnel remain in the area during unloading.	Directs unloading of any rockets not fired. (Follow procedures outlined in par. 44–46, TM 9–1055–215–12.)	Assists gunner during unloading procedures. Locks elevating and traversing locking mechanisms.	Lowers left stabilizing jackscrew assembly until left wheel is on the ground and jack is in travel position. (Applicable to ground firing only.)	Lowers right stabilizing jackscrew assembly until right wheel is on the ground and jack is in travel position. (Applicable to ground firing only.)		Places vehicle light switch to the off position.
4	Supervises section loading procedures.	Installs the tool and accessory roll on the front end of the top carriage.	Unlock left trail group and place it on the bottom carriage. (Applicable to ground firing only.)		Unlock right trail group and place it on the bottom carriage. (Applicable to ground firing only.)		Raises cargo body endgate and secures it with chains.
5			Attaches the special lifting slings to the helicopter lifting post assemblies. (Applicable to ground firing only.)	Place the launcher overall cover in the cargo bed.			Removes chocks from vehicle wheels.

except for elevating and traversing the top carriage assembly and cluster and conduit assembly to adjust the angle of fire.

d. The entire launching area should be free of combustible material which might be ignited by the blast from the rocket.

e. After launching the rockets, personnel will not be permitted to approach the launching site until the all clear signal has been given by the officer in charge of the launching site.

17. Prepare for Action

a. When the launcher is in position, the command PREPARE FOR ACTION is given. If PREPARE FOR ACTION has not been ordered by the platoon leader before the launcher is emplaced in the firing position, the command is habitually given by the chief of section as soon as the launcher is positioned. At PREPARE FOR ACTION, the section performs the duties for PREPARE FOR ACTION as listed in table II.

b. At the command FIRE MISSION, the section performs the duties listed in table III.

18. Cease Firing

The command CEASE FIRING is normally given to the section by the chief of section, but in emergencies anyone present may give the command. At the command CEASE FIRING, regardless of its source, firing ceases immediately. To interrupt the firing sequence the toggle switch in the remote assembly is released and permitted to return automatically to the OFF position. If the launcher is loaded, the chief of section reports that fact to the platoon leader. The platoon leader acknowledges this report by saying "Number____loaded." The platoon leader should remove the safety plug from the remote firing box as an added safety precaution and to preclude inadvertent resumption of firing. If CEASE FIRING came from the fire direction center, firing is resumed at the announcement of the quadrant elevation. If CEASE FIRING came from within the platoon, the platoon leader will investigate the condition that caused the command, and if necessary, inform the fire direction center the nature of the delay. When the condition has been corrected, firing is resumed at the platoon leader's announcement of the quadrant elevation.

19. March Order

When the command MARCH ORDER is given, the section performs duties as listed in table IV.

Section II. TECHNIQUES REQUIRING SPECIAL ATTENTION

20. Precision in Laying

a. Sighting and laying instruments and elevating and traversing mechanisms must be properly operated to reduce the effects of lost motion. To achieve uniformity and accuracy and to eliminate lost motion, all final motions in setting scales and operating handwheels should be from left to right in deflection and toward greatest resistance in elevation. The chief of section should verify the laying after the gunner has laid the launcher and before the sight is removed from the launcher for firing.

b. When setting and reading a scale or centering a bubble, the line of sight should be at a right angle to the scale or level vial to prevent parallax errors. Bubbles must be centered.

21. Construction of Testing Target

a. Construction. A testing target provides the most accurate method of boresighting. To construct a testing target, use the dimensions indicated in figure 7. To facilitate boresighting in darkness, bore a one-sixteenth inch hole through the mounted testing target at the center of each aiming diagram. A flashlight held against the target behind the appropriate hole provides an aiming point for use in blackout conditions. Fasten patches of felt padding on the back of the target, covering the regions of each hole so that light from the flashlight cannot be seen in any direction other than through the hole.

b. Material. The testing target can be improved by mounting it on a flat piece of masonite, wallboard, or similar material covered with a sheet of weather resistant paper. The target should be stabilized by fastening it to a stand similar to that used with training aid charts. A mil scale, for use in leveling or canting the test target, may be inscribed at the bottom of

the target. A small nail should be placed at the top to mark the center from which the arc was drawn and to serve as a hook from which to suspend the plumb line (fig. 7). Vertical reference lines may be drawn parallel to the center of each of the diagrams. These lines may be used to adjust the testing target with the cant angle of the launcher when the trunnions cannot be leveled.

22. Care of Ammunition

a. To insure uniform results in firing, to prolong the life of the cluster, and to avoid accidents, personnel must exercise care in storing and handling rockets at the battery. Personnel engaged in handling M55 rockets must be provided with protective clothing as prescribed in TM 3–250 and TM 3–304. Chapter 4, TM 9–1055–215–12 and TB CML 73 are applicable to rocket maintenance and should be followed carefully. In the field, conditions existing at each position will determine the amount of time, labor, and materials required to store and preserve the rockets adequately. If the position is to be occupied for only a short time, a tarpaulin spread on the ground may be sufficient; for longer periods of time, more adequate facilities should be provided. Rockets should be protected from the direct rays of the sun to provide uniform propellant temperature.

b. Rockets must be protected from damage. The temperature of rockets should be kept as uniform as possible and should never exceed 125° F. Ammunition data cards should be maintained for each lot until all rockets for that lot are expended. Rocket shipping-firing containers should be left in their crates until their use is imminent. Protection should be provided against moisture, dirt, direct rays of the sun, and, as far practicable, hostile fire and bombing. Six inches of dunnage should separate rocket containers from the ground. Protection against weather, dirt, and sun can be improved by the use of double tarpaulins below and above the ammunition and suitable dunnage between the layers. Protection against hostile fire may be improved by the use of small dispersed stacks, trenches, or dugouts. Each stack should contain not more than 45 rockets. Stacks should be at least 10 meters apart. The rockets should all point in one direction, preferably with the nose toward a barricade. If this cannot be done, they should be stacked so that they point in the direction likely to cause the least damage in the event of accidental ignition of the propellant.

c. Misfire rockets are kept separate from other rockets as they must receive special handling (ch. 11). Rockets that are merely unloaded (not misfires) are repacked for future use. In the event of a misfire, the procedures in TM 9–1055–215–12 must be followed. If the rocket must be unloaded, the command is UNLOAD. Unloading is performed under the direct supervision of an officer. As few personnel as possible should be in the immediate vicinity of the launcher during unloading.

d. The steps to be followed in unloading (see TM 9–1055–215–12) are as follows:

(1) The gunner removes the safety plug from the remote fire control assembly.
(2) Number 1 disconnects the vehicle connector cable assembly from the vehicle blackout light receptacle and turns the light switch to OFF.
(3) The gunner unlocks the elevation lock and depresses the cluster to approximately 90 mils elevation.
(4) Number 1 unlocks the rocket tube locking assemblies.
(5) The gunner disconnects the firing connector from the tip jacks.
(6) The gunner and number 1 unload the rocket containers in the reverse order of loading (fig. 6).
(7) The gunner replaces the firing connector and cable in the rocket container, replaces the rear cap, and pushes the container forward through the cluster.
(8) Number 1 replaces the front rocket container cap and, assisted by the gunner, draws the rocket container forward until it is clear of the cluster and all other rocket containers.

23. Testing the Firing Circuit

a. General. For increased reliability firing circuit continuity should be checked prior to a fire mission. The firing circuit is tested by using the firing continuity electrical circuit test set and the firing circuit testing cable assembly.

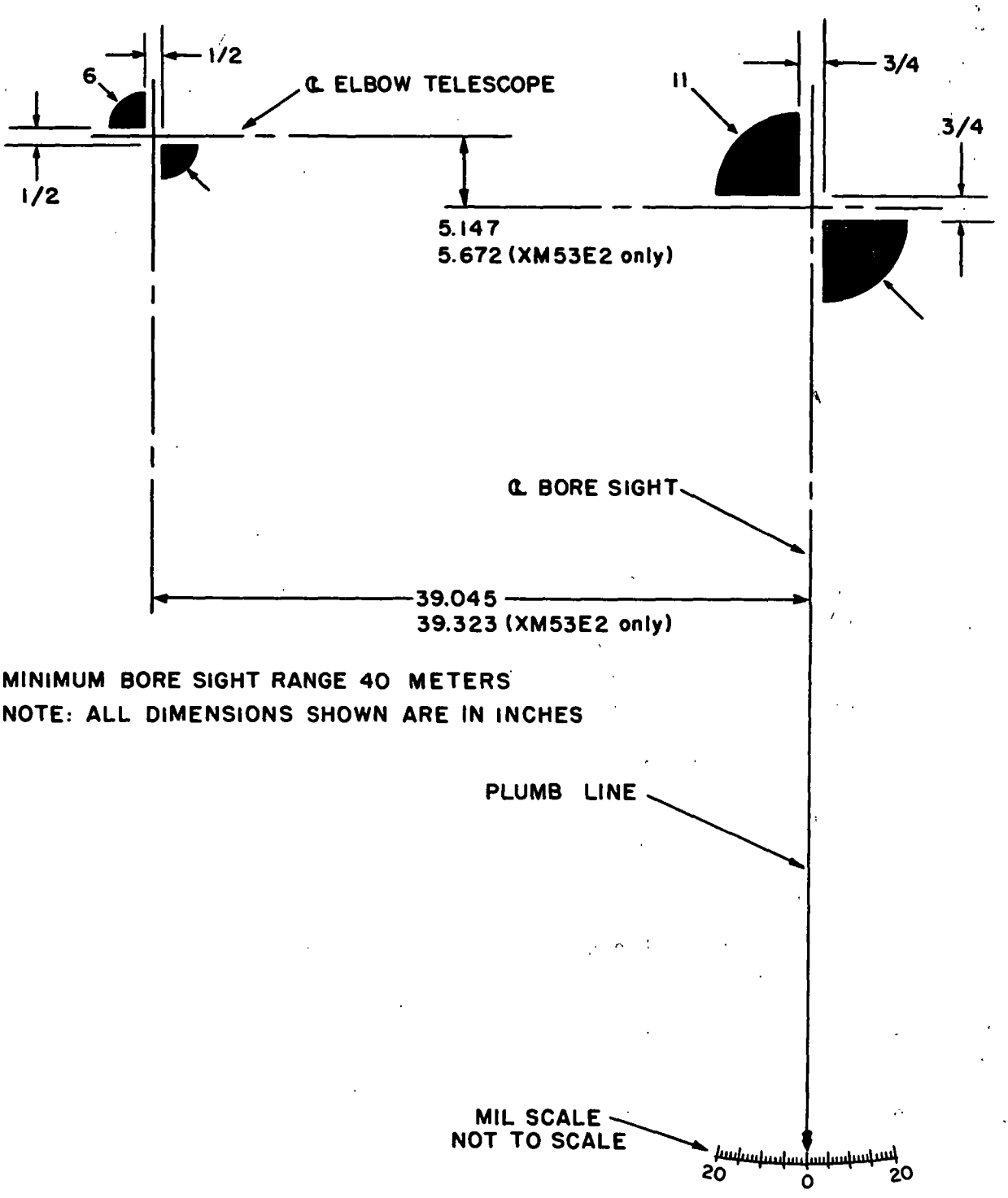


Figure 7. An improvised testing target.

b. Test Procedures.

(1) Number 1 removes the test set and cable assembly from the equipment chest.

(2) The driver starts the prime mover and runs the engine at a fast idle to reduce current drain on the vehicle battery and places the vehicle light switch in the blackout drive position.

(3) Number 1 installs the firing circuit testing cable plug in the receptacle on the test set panel and positions the test set on the rear of the cluster so that the nine lamps on the test set face to the rear of the vehicle.

(4) Number 2 inserts the nine circuit testing cable pin plugs into the top row of cluster assembly tip jacks.

(5) The gunner prepares the remote firing box for firing, using the prime mover battery as the power source.

(6) Number 2 observes that each of the test set lamp glows in sequence during simulated firing.

(7) Steps 4 through 6 above are repeated for the remaining four rows on the cluster.

c. Continuity. A flash from each of the nine lamps, when a cluster row is being tested indicate firing circuit continuity. Failure of a lamp or lamps to glow indicates an incomplete firing circuit. For corrective action, refer to chapter 3, section 4, TM 9–1055–215–12. Upon completion of the test, keep the firing button depressed until audible clicking ceases and firing sequence is reset.

24. Preparation for Ground Firings

a. General. The launcher may be removed from the prime mover by following the steps outlined in TM 9–1055–215–12. The six-man crew can mount the launcher on, or remove the launcher from, the prime mover in approximately 10 minutes. Wheels are provided for moving the launcher short distances on the ground.

b. Airlift Operations. Lifting slings are provided for use during helicopter operations.

c. Power Sources. When the launcher is not mounted on the prime mover the launcher may be cabled to the trailer receptacle of any vehicle at the firing position, or the thermal battery may be used to provide the source of power for firing.

CHAPTER 6
SURVEY AND GUNNERY

Section I. SURVEY

25. General

Survey required by the rocket platoon is performed by the survey parties organic to the battalion. The survey is performed with the T16 theodolite, survey set, third-order, and a standard, eight-man survey party.

26. Survey Requirements

a. Position Area Survey. The platoon centers and orienting lines are established to fifth-order (1:1000) accuracy.

b. Target Area Survey. Target locations are furnished by higher headquarters, by an external source, or by a battalion survey team operating a target area base.

27. Survey Control

Survey control for position areas and alternate position areas is accomplished by the battalion survey section.

28. Survey Procedures

Procedures as outlined in FM 6–2 are applicable. The accuracies outlined in paragraph 26*a* are desired for firing. In emergency situations, map-spotted coordinates, with direction provided by a declinated aiming circle, may be used, since targets attacked by the M91 system will be area targets as opposed to point targets.

Section II. GUNNERY

29. General

Gunnery procedures and techniques applicable to the employment of the 115-mm area M91 system are generally those used for heavy and very heavy cannon artillery and rockets. A modified predicted fire technique is used whereby chart range and deflection are corrected for known nonstandard conditions of weather and materiel. A knowledge of rocket ballistics is helpful in understanding the procedures and techniques used to solve the gunnery problem for the 115-mm rocket.

30. Ballistics

Cannon ballistics are usually divided into internal and external ballistics. Rocket ballistics are divided into propulsion and free-flight ballistics. Propulsion ballistics pertain to that portion of the rocket trajectory from launch to rocket motor burnout. Through the remainder of the rocket trajectory, the rocket coasts in free flight, as a cannon projectile coasts after leaving the tube.

a. Factors which affect the powered portion of the trajectory are the temperature of the rocket propellant and the effects of low-level wind variations. A propellant temperature correction can be related to the powder temperature correction of cannon artillery, in that it is handled in much the same manner as in the cannon problem. Propellant temperature is measured by firing section personnel and reported to the FDC, where unit correction for range is applied to determine a range correction. Corrections for low-level wind effects have no comparable application in the cannon gunnery problem.

b. Free-flight ballistics is the study of the motion of the rocket and the factors affecting that motion after burnout. The factors that must be considered are meteorological effects. The meteorological (met) message is a coded

tabulation of meteorological information. Firing tables are based on the North Atlantic Treaty Organization (NATO) met message data. A description and explanation of the use of the NATO met message can be found in the introduction to the firing table.

31. Fire Direction Center

a. Organization. Minimal FDC requirements include one radiotelephone operator per FDC and two computers per firing platoon.

(1) *Duties of the fire direction computer.* The fire direction computer prepares the firing chart; determines the range, vertical interval, and corrections for nonstandard conditions; and prepares fire commands.

(2) *Duties of the radiotelephone operator.* The radiotelephone operator operates and maintains the two radios and one telephone required at the fire direction center. For artillery radiotelephone operating procedures, see FM 6–10.

b. Procedures.

(1) The FDC of the higher artillery headquarters exercising tactical control over the fires of the M91 will order the mission to be fired. The fire mission will include applicable elements as follows:

Element	*Example*
Identification	THIS IS DANGER 9.
Warning	FIRE MISSION.
Type rocket	M55.
Type warhead	GB/VX.
Target coordinates	WX3675392384.
Target altitude	1302 METERS.
Number of rockets to fire.	90 ROUNDS.
Predicted time of fire	PREDICTED TIME 0500.
Concentration number.	EF102.

(2) The fire order consists of some or all of the following elements and is announced in the sequence indicated:

Element	*Example*
Launcher(s) to fire	LAUNCHER NUMBER 2 (and 3).
Firing point	FIRING POINT NUMBER 1.
Concentration number	EF 102.

c. Phases of Command. Fire commands originate in the FDC and include data necessary for positioning, laying, loading, and firing the rockets. These fire commands are normally sent to the launcher firing platoon in three phases as shown in (1) through (3) below. Low-level wind corrections are applied just prior to firing.

(1) The first phase, the warning order, should include the following elements:

Element	*Example*
(*a*) Launcher(s) to fire	Launchers number 2 and 3.
(*b*) Firing point	Firing point 1.
(*c*) Type rocket	M55.
(*d*) Type warhead	GB.
(*e*) Method of fire	90 rounds, at my command.
(*f*) Predicted time of fire.	Time on target 0500.

(2) Second-phase elements include initial laying data as follows:

Element	*Example*
(*a*) Azimuth of orienting line*	285mils
(*b*) Azimuth of fire	4625mils
(*c*) Orienting angle*	2060mils
(*d*) Quadrant elevation (trial)	688mils

**Note.* Applicable when survey control is established at the firing point.

(3) The final phase includes firing data corrected for nonstandard ammunition and weather conditions. These corrections are applied to deflection and quadrant elevation.

d. Firing Data Computations. Firing data computations are outlined in detail in the sample problem found in FTR 115–C–1.

e. Determination of Minimum Elevation. The procedures for determining minimum quadrant elevation to clear piece mask are the same as those outlined in FM 6–40. The data, for determining minimum quadrant elevation when piece mask ranges are less than 3,000 meters, are provided below. The values given for complementary angle of site are listed only for positive angles of site.

M55 and M61 Piece Mask Data

Range	*El*	*Fork*	*Comp site factor*
m	*mils*	*mils*	
500	148	30	—0.099
1000	160	30	—0.101
1500	169	31	—0.102
2000	178	32	—0.102
2500	187	34	—0.102
3000	197	38	—0.102

CHAPTER 7
LAUNCHER SECTION DRILL

Section I. GENERAL

32. Objective

The objective of section drill is the attainment of maximum efficiency and precision coupled with high speed.

33. Instructions

a. To develop maximum efficiency and to prevent injuries to personnel and damage to equipment, the drills prescribed in this manual must be observed. Section drill should be conducted in silence except for commands and reports. The section must be drilled until reactions to commands are automatic, rapid, and efficient.

b. Mistakes are corrected immediately. Each member of the section must be impressed with the importance of reporting promptly to the section chief any mistakes discovered before the command to fire has been given. The section chief will report mistakes immediately to the platoon leader.

c. Battery officers will supervise the drill to insure that instructions are carried out and that maximum efficiency is obtained.

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

e. During advanced phases of launcher section drill, emphasis is placed on the efficient functioning of the section under simulated combat conditions of nuclear and CBR attack, infiltration and counterbattery attack. Realistically, whenever a counterbattery threat exists personnel should wear masks.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

34. To Form the Section

a. To Fall In. The chief of section takes his post. On the command of execution, the section forms in a single rank at close interval, centered on and facing the section chief at a distance of three paces. Higher numbered crewmen, if present, form in order between number 4 and the driver. The chief of section may indicate in his preparatory command the place and direction in which the section is to form. At the first formation for a drill or exercise, the caution "As launcher section(s)" precedes the command. The commands are FALL IN; or 1. IN FRONT (REAR) OF YOUR LAUNCHER(S), 2. FALL IN; or 1. ON THE ROAD FACING THE PARK, 2. FALL IN. Execution is as follows: The launcher section moves at double time and forms at close interval, at attention, guiding on the gunner.

b. To Call Off. The section being in formation, the command is CALL OFF. At the command CALL OFF, all personnel in ranks except the gunner execute eyes right. The section then calls off in sequence "Gunner," "1," "2," "3," "4," "Driver." As each man calls out his designation, he turns his head to the front.

35. Posts of the Section

The command is 1. CREWMEN, 2. POSTS. The command is general and is applicable

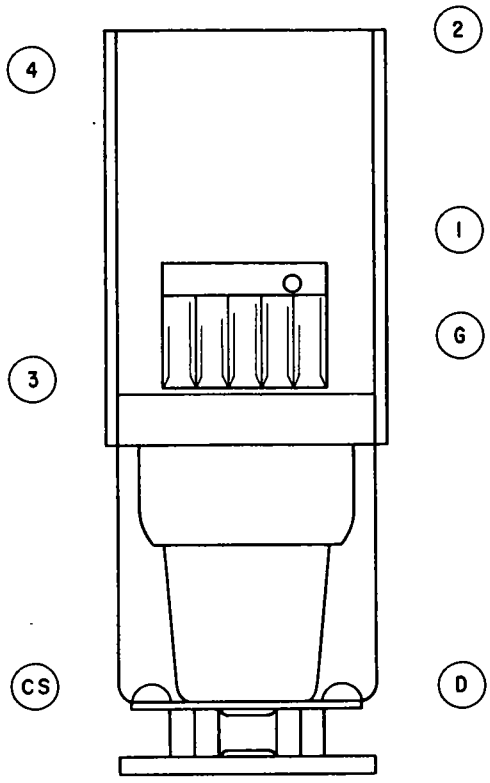


Figure 8. Posts of section.

whether the section is in or out of ranks, at a halt, or marching. All movements are executed at double time and are terminated at the position of attention. The section moves to posts as shown in figure 8. All personnel face to the front in a column 2 feet from the prime mover (or the rocket launcher if in the dismounted configuration).

36. To Change Posts

Posts should be changed frequently to acquaint the members of the section with all duties and to lend variety to the drill. With the section *IN FORMATION,* the commands are 1. CHANGE POSTS, 2. MARCH, or 1. SECTION CHANGE POSTS, 2. MARCH.

a. At the command CHANGE POSTS, MARCH, only the numbered crewmen change posts. On the preparatory command, number 4 takes one step to the rear and executes a right face. On the command of execution, he moves quickly behind the section to the post of number 1. Other numbered crewmen take two left steps,

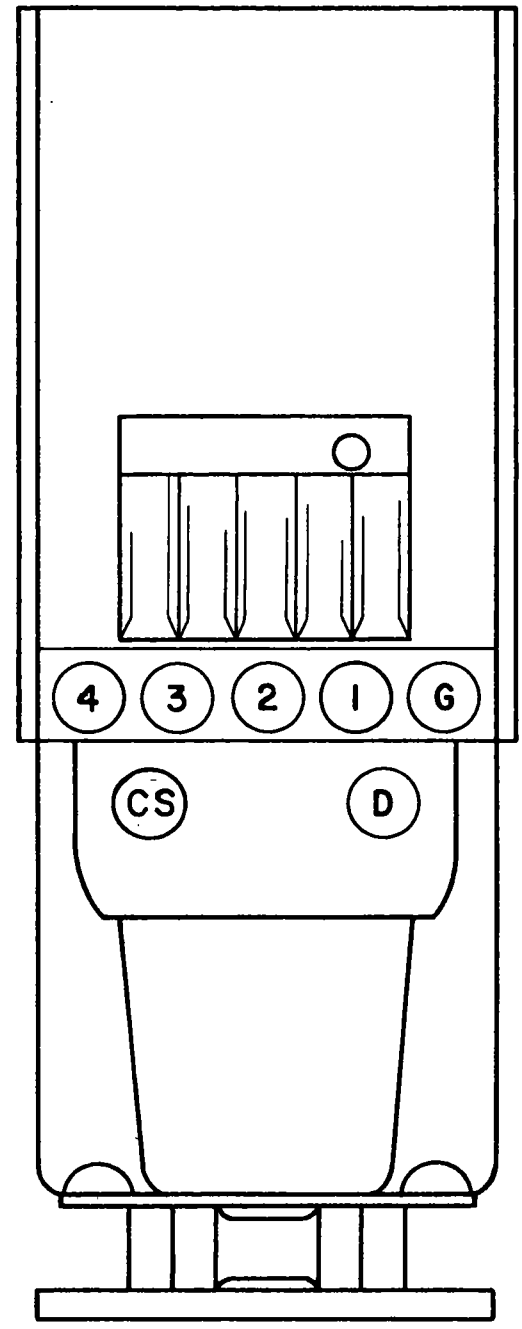


Figure 9. Section mounted.

which places them at the post of the next higher numbered crewmen.

b. At the preparatory command SECTION CHANGE POSTS, the driver (or leftmost man) takes one step to the rear and executes a right face. On the command of execution, he moves at double time in the rear of the section to the

gunner's post. The gunner and all crewmen take two left steps as in *a* above.

37. To Mount

a. The commands are 1. PREPARE TO MOUNT, 2. MOUNT; or MOUNT. If any members of the section are to remain dismounted, their designations are announced with the caution "Stand fast" given between the preparatory command and the command of execution for example, 1. PREPARE TO MOUNT, "Driver stand fast," 2. MOUNT.

b. At the preparatory command 1. PREPARE TO MOUNT, the section moves at double time to the positions shown in figure 8. At the command of execution 2. MOUNT, the gunner and crewmen mount in order and take seats as indicated in figure 9. They are assisted in mounting by the man behind or in front or by the chief of section and driver to insure rapid mounting and to prevent injuries. Before mounting, the chief of section and the driver verify that the launcher is properly secured, that personnel and equipment are aboard, and that the tailgate and safety straps are secure.

c. When the command MOUNT is used without the preparation command, the section executes, without pausing, all actions prescribed for the command 1, PREPARE TO MOUNT. 2. MOUNT.

38. To Dismount

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

a. At the preparatory command 1. PREPARE TO DISMOUNT, members of the section assume positions which will permit them to dismount quickly; at the command of execution 2. DISMOUNT, they dismount and at double time take posts as shown in figure 8.

b. At the command DISMOUNT, the section executes without pausing all that is prescribed for the command 1. PREPARE TO DISMOUNT, 2. DISMOUNT.

39. To Fall Out

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

b. When Firing. When firing has been suspended but it is desired to have the section remain in the vicinity of the launcher, the command FALL OUT is given. Men stand clear of the launcher to insure that settings and laying remain undisturbed. During these periods, the chief of section may direct his men to improve the position or to do other necessary work.

CHAPTER 8
BORESIGHTING AND BASIC PERIODIC TESTS

Section I. GENERAL

40. Purpose and Scope

The purpose of this chapter is to outline the procedures for boresighting and making basic periodic tests of on-carriage fire control equipment. The procedures covered will include only those that may be accomplished at battery level (TM 9–1055–215–12).

41. Equipment

The following equipment is needed for performing boresighting and periodic tests:

a. Boresights. Boresights are issued with each launcher (TM 9–1055–215–12). The rear boresight contains a small hole in its center, and the front boresight contains the cross hairs. When emplaced in the center cluster tube the boresights should fit snugly.

b. Testing Targets. A testing target or suitable substitute is required for both boresighting and testing. If a testing target has not been prepared (par. 21), a clearly defined aiming point 2,000 or more meters from the launcher may be used for boresighting.

c. Plumb Line. Although not essential for boresighting, a plumb line must be used in the basic periodic tests in order to obtain maximum accuracy. The farther the plumb line is placed, from the launcher, the longer the line must be. For example, to be effective at 5 feet in front of the launcher tubes, the line must be approximately 14 feet long. To keep such a long plumb line taut, it may be necessary to add a weight to it. A wrench or rock may be used. The tendency of the weight to swing may be decreased by suspending the weight in a bucket containing water or some other liquid. If a convenient means of suspending the plumb line is not readily available, a pole may be used in place of the plumb line. A plumb line suspended from a building or tree, as shown in figure 10, is more desirable, and this method should be used if possible. Units in garrison may find it convenient to rig a plumb line on a building. The line may then be fastened in place so that it can be used permanently.

d. Tools. The section equipment includes tools necessary for boresighting and testing. Care must be taken in selecting and using the screwdrivers and wrenches to insure that damage does not result through carelessness or the use of inappropriate tools.

42. Leveling

The launcher should be placed in its center of traverse prior to starting the tests. Although it is not absolutely necessary to level the trunnions for boresighting, it is advisible to do so whenever possible. More accurate results can be obtained if the trunnions are level, since a corresponding tilt does not have to be introduced in the panoramic telescope mount and in the testing target. When the launcher is mounted, the trunnions can be leveled by leveling the ground under the wheels of the prime mover or by blocking one axle or wheel. Most accurate testing results can be obtained by dismounting the launcher from the truck. A dismounted launcher can be leveled by the use of its jacks. Leveling is determined by placing the gunner's quadrant on the quadrant mounts of the sighting unit.

a. Plumb Line. The best method to check leveling is by means of a plumb line. The line is suspended approximately 5 feet directly in front of the axis of the center tube. When the trunnions are level, the line of sight should track the plumb line as the tube is depressed and elevated throughout the limits of eleva-

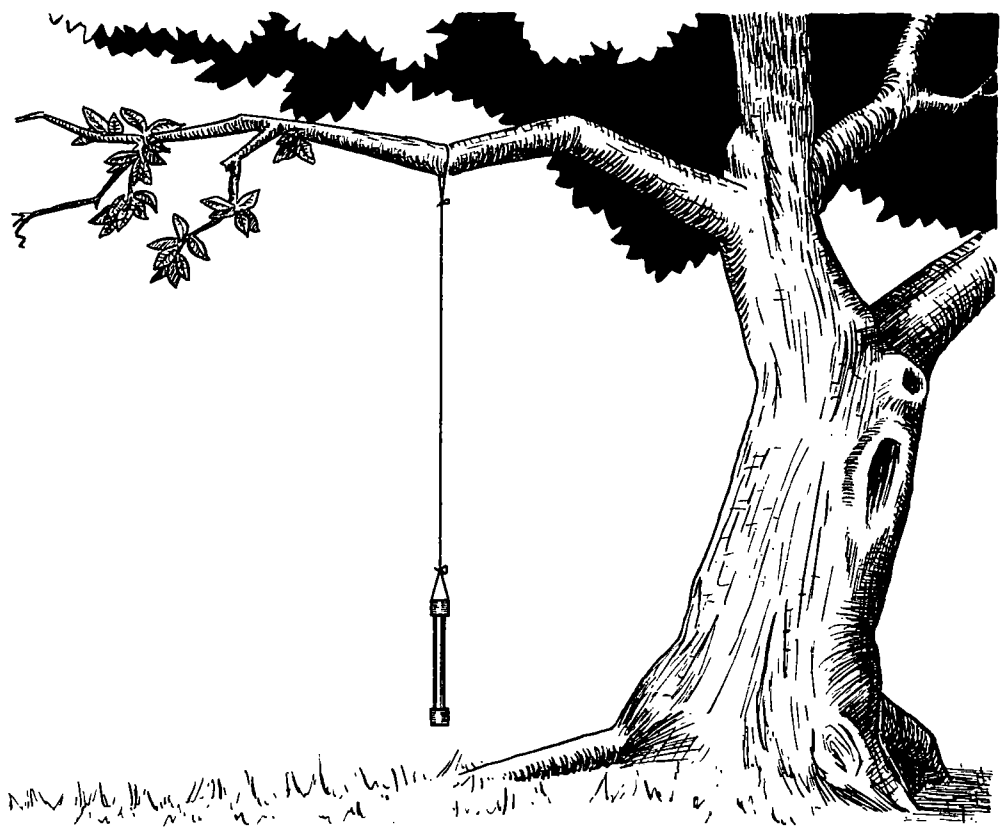


Figure 10. Plumb line suspended from tree.

tion and should deviate from the line by no more than the thickness of the crosshair on the muzzle boresight.

b. Fire Control Quadrant (Gunner's Quadrant). When a gunner's quadrant is used, a quadrant that has been tested (par. 49) and found to be accurate is used.

c. Launcher Not Level. If it is impossible to level the trunnions, the cross-level bubble cannot be used. If the cluster cannot be leveled, the longitudinal-level bubble cannot be used. To permit boresighting when either of these conditions exists, lines should be scribed on certain sight mount components after a basic periodic test (par. 50) when the sighting equipment is in correct adjustment. These scribed lines can be matched later, when leveling is impossible, to attain the same relationship between the axis of the cluster and moving parts of the on-carriage sighting equipment. After a basic periodic test when the cluster and sight are in perfect alinement, a knife blade or other sharp metal point can be used to scribe the lines on the azimuth micrometer knob, the elevation scale, and the cross-leveling knob. Care should be taken that the lines are scribed in the paint *only* and are not cut into the metal. The scribed lines should be filled with white paint and the excess paint wiped off. If the cluster cannot be leveled, longitudinal compensation for an unlevel (elevated or depressed) cluster may be made by matching the scribed lines on the elevation scale. If the trunnions cannot be leveled, cross-level compensation may be made by matching the scribed lines on the cross-leveling knob. The scribed line on the azimuth micrometer knob opposite the slipping azimuth micrometer index will represent deflection zero.

Section II. BORESIGHTING

43. General

a. Description. Boresighting is the process by which the optical axis of the telescope is made parallel to the line of sight through the center of the launcher tubes. It consists of those tests and adjustments that are performed by the crew to insure accuracy in laying for elevation and direction. The launcher should be placed near its center of traverse prior to boresighting. All instruments and mounts must be positioned securely; there must be no free play. Boresighting is conducted before firing and when necessary, during lulls in firing.

b. Methods. The four methods of boresighting the M91 multiple rocket launcher are—

(1) Distant aiming point.
(2) Testing target.
(3) Aiming circle.
(4) Standard angle.

c. Procedures. The procedures indicated in paragraphs 44 through 47 apply specifically to the sight unit M34A2C. Units performing boresighting with the sight unit M53E2 will note that procedural steps and nomenclature of components vary slightly. Therefore, procedures for using the M53E2 sight unit should be verified by reference to changes number 1 to TM 9–1055–215–12.

44. Distant Aiming Point Method

a. General. The distant aiming point method consists of alining the lines of sight through the center tube and the telescope on a common point at least 2,000 meters from the launcher. Because the lines of sight converge on a single point, accurate cross-leveling of the trunnions is unnecessary when boresighting on a distant aiming point. Normally, the cluster will not be level, so the scribed lines must be matched.

b. Procedure.

(1) Insert the boresights (par. 46).
(2) Bring the matching index lines on the elbow telescope into coincidence.
(3) Bring the matching index lines on the elbow telescope and the telescope holder bracket into coincidence.
(4) Sight through the center tube and traverse and elevate the cluster until the line of sight through the axis of the center tube is on the aiming point.
(5) Sight through the telescope and, with the azimuth and elevation micrometer knobs, place the crosshairs of the telescope on the aiming point.
(6) If the azimuth micrometer scale does not read 0, depress the azimuth micrometer release button, slip the azimuth micrometer scale to 0, release the button, and verify the alinement.
(7) Check the other azimuth scale zero alinement with the index. If it is not in alinement, loosen the wingnut, slip the scale to 0, and tighten the wingnut.
(8) If the elevation micrometer scale does not read 0, loosen the three clamping screws, slip the elevation micrometer scale to 0, and retighten the screws. Verify the adjustment.
(9) Check the elevation scale zero alinement with the index. If it is not in alinement, loosen the two elevation scale clamping screws, slip the elevation scale to 0, and tighten the screws.

45. Testing Target Method

a. General. The testing target method consists of making the line of sight of the telescope parallel to the axis of the tubes by using the aiming diagrams of the testing target (fig. 7) as aiming points. The testing target is placed about 50 meters in front of the launcher. Cant in the launcher trunnions must be duplicated in the testing target, and, if the cluster is not level longitudinally, the testing target must be tilted so that its face is perpendicular to the line of sight through the axis of the tubes.

b. Procedure.

(1) Insert the boresights.
(2) Level the trunnions as exactly as possible. In no case should cant exceed 20 mils. If the trunnions cannot be leveled, match the scribed lines on the sight; if the trunnions can be leveled, level the cross-level bubble. If the

trunnions are not level, introduce the proper amount of corresponding cant in the testing target (par. 42).

(3) Using the gunner's quadrant, level the cluster. If the cluster cannot be leveled longitudinally, tilt the testing target as indicated in *a* above.

(4) Proceed as indicated in paragraph 44(3) through (10), except that the telescope crosshairs and the boresights must be alined on their respective aiming point.

46. Aiming Circle Method

a. General. The aiming circle method of boresighting may be used when weather or terrain conditions prohibit the use of the distant aiming point method and a testing target is unavailable. The aiming circle method makes no provision for longitudinal adjustment. Any misalinement discovered during boresighting by the aiming circle method should be corrected, and the correction should be verified at the earliest opportunity by boresighting with a distant aiming point or the testing target. To facilitate boresighting with the aiming circle, certain preparatory steps must be performed. These operations, described in *b* below, should be performed after a basic periodic test (par. 50) when the sighting equipment is in correct adjustment.

b. Preliminary Operations.

(1) The greatest care must be exercised in all phases of these operations. All final movements of the instruments must be made so that the vertical hairs in the reticles approach the final position from left to right in order to eliminate lost motion in the gears.

(2) Parallax in the aiming circle and the telescope must be eliminated. Parallax in the aiming circle is eliminated by either placing a dark-colored cardboard or metal parallax shield of the same diameter as the eyepiece lens housing in front of the eyepiece lens. The shield should have a vertically and horizontally centered slot one-sixteenth inch wide and one-fourth inch long. The shield is placed in front of the eyepiece with the elongated slot in the vertical position; it may be held in place with a piece of adhesive tape around the edge of the lens housing. Parallax in the telescope may be eliminated by mounting a shield of the same diameter as the eyepiece lens housing and with an exactly centered hole one-sixteenth inch in diameter in front of the eyepiece lens. A more permanent parallax shield may be constructed of brass or bronze shim stock (fig. 11). With a series of fingers approximately three-sixteenths inch wide and one-fourth inch long, separated by one-fourth inch spaces, extending beyond the perimeter of the shield. The fingers should be bent along the circumference of the circle until they form an angle of 1,600 mils with the surface of the shield. The fingers permit quick installation and removal of the shield. When the eyepiece has a rubber eyeguard, the fingers permit alinement within the guard without its removal.

c. Procedure.

(1) Insert the boresight in the center tube with the element containing the crosshairs in the end of the tube closest to the aiming circle.

(2) Level the launcher trunnions as exactly as possible.

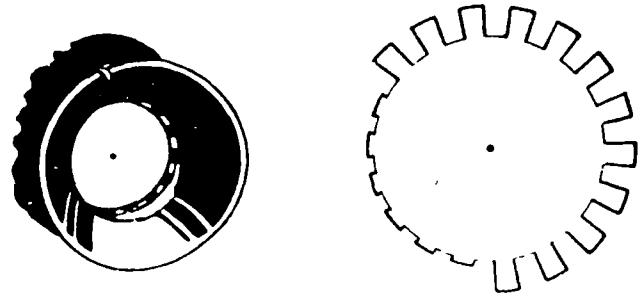


Figure 11. Parallax shield.

(3) Sight through the boresights and aline the aiming circle either in front or in rear of the launcher at a distance of 50 meters.

(4) Set up the aiming circle and, with the scales set at 0, sight through the center tube of the launcher.

(5) Sight through the axis of the center tube. Using the elevating and traversing mechanisms, aline the line of sight through the tube exactly on the objective lens of the aiming circle.

(6) Recheck to insure that at zero setting the line of sight through the aiming circle is directly through the axis of the center tube.

(7) With the upper motion of the aiming circle, turn to the telescope of the launcher.

(8) With the telescope of the launcher, turn to the lens of the aiming circle.

(9) Recheck to insure that lines of sight through both the aiming circle and the telescope are centered exactly on the objective lenses of the instruments to which they point.

(10) Announce the deflection reading on the aiming circle.

(11) If the deflection announced does not agree with the deflection set on the sight, loosen the azimuth micrometer slipping clamp and slip the azimuth micrometer scale to the announced deflection.

(12) Tighten the clamp and verify the adjustment.

47. Standard Angle Method

a. General. Frequently in combat, blackout requirements or lack of time may preclude boresighting by the methods previously described. Under such circumstances, the alinement of the optical axis of the on-carriage sighting equipment is tested and adjusted by reference to a selected point on the launcher. The use of the standard angle method allows a check of telescope alinement after the launcher is loaded.

b. Standard Angles. The deflection angle necessary to refer the line of sight of the telescope to the reference points on the launcher is known as the standard angle.

c. Reference Points. After the basic periodic test determines the telescope to be in correct alinement, reference marks must be established for later use of the standard angle (par. 48).

d. Adjustments. Any misalinement discovered during boresighting by the standard angle method corrected, and the correction should be verified by a more precise method at the earliest opportunity.

e. Procedures. The following procedures should be used when boresighting by the standard angle method:

(1) Match the elevation and cross-level scribe marks (*c* above).

(2) Install the parallax shield and sight on the forward edge of rocket 43 (fig. 6) shipping-firing container.

(3) Record the deflection scale reading and compare it with the standard angle scale reading established after the periodic tests. (Typical standard angles using the above method are approximately 400‰.)

Section III. BASIC PERIODIC TESTS

48. General

Basic periodic tests are performed by the crew under the supervision of the platoon leader and the artillery mechanic. These tests are performed at the discretion of the unit commander. The suggested frequency for performing the basic periodic tests is once each year if the launcher is used only for nonfiring training; once every 3 months if the launcher is fired; as soon as possible after extensive use, accidents, or traversing extremely rough terrain; and whenever the launcher fires inaccurately for no readily apparent reason. The tests reveal whether the on-carriage sighting equipment and the gunner's quadrant are in correct adjustment. For the on-carriage equipment to be in correct adjustment, the following conditions must exist:

a. The line of sight of the telescope must be parallel to the axes of the tubes.

b. Mounts and instruments must be securely attached, and there must be no binding or excessive backlash between gears.

c. With the trunnions, cluster, and both bubbles leveled, all scales must read 0 and all indexes must match.

d. The sighting equipment must satisfactorily meet all tests described in paragraph 50.

e. When testing on-carriage fire control equipment, the trunnions should be as level as possible. Leveling may be checked by tracking a plumb line or by using the gunner's quadrant as described in paragraph 42.

49. Test of Fire Control Quadrant (Gunners)

a. General. The gunner's quadrant must be in proper adjustment before it is used to test and adjust other sighting and fire control equipment. Inspect the shoes of the gunner's quadrant for dirt, nicks, or burs. Also inspect the surfaces of the quadrant mount. Dirt, nicks, or burs on these surfaces will cause inaccurate instrument readings.

b. End-for-End Test.

(1) Set both the index arm and the micrometer scale of the gunner's quadrant at 0, making sure the auxiliary indexes match.

(2) Place the quadrant on the quadrant mounts, with the line-of-fire arrow pointing toward the front, and center the quadrant bubble by turning the elevating handwheel.

(3) Reverse the quadrant on the quadrant mounts (turn it end-for-end). If the bubble recenters, the quadrant is in adjustment and the test is completed.

(4) If the bubble does not recenter, try to center it by turning the micrometer knob.

(*a*) If the bubble centers, read the black figures and divide by 2. This is the correction.

(*b*) Place the correction on the micrometer and level the cluster, using the elevation handwheel.

(*c*) Check by again reversing the quadrant. The bubble should center.

(5) If the bubble does not center as in (4) above, move the arm down one graduation (10 mils).

(*a*) Turn the micrometer until the bubble centers.

(*b*) Add 10 to the reading on the micrometer, and divide the sum by 2.

(*c*) Leaving the arm at minus 10, place this reading on the micrometer: level the cluster with the elevation handwheel.

(*d*) Check by reversing the quadrant on the leveling surface. The bubble should center. If the correction of error amounts to more than plus or minus 0.4 mil, send the quadrant to ordnance for adjustment or repair.

c. Micrometer Test.

(1) Set the index arm to read 10 mils on the graduated arc and set the micrometer scale at 0.

(2) Place the quadrant on the quadrant mounts with the line-of-fire arrow pointing toward the front, and center the quadrant bubble by elevating the cluster.

(3) Set the index arm at 0 on the graduated arc and turn the micrometer one revolution to read 10 mils.

(4) Reseat the quadrant on the quadrant mounts. The bubble should center. If the bubble does not center, the micrometer is in error and must be adjusted by ordnance personnel.

Caution: **Do not disturb the laying of the cluster.**

d. Comparison Test. Compare readings taken at low, medium, and high elevations with all of the gunner's quadrants of a platoon on a ***single*** launcher that has been accurately cross-leveled. Any quadrant differing from the average by more than 0.4 mil at any elevation should be sent to ordnance for adjustment.

e. Correction. When a gunner's quadrant requires a correction as determined by the end-for-end test, this correction is not carried during firing but is applied only when making sight tests and adjustments.

50. Test of Telescope and Mount

a. General. The purpose of this series of tests is to determine whether the fire control equipment correctly transmits the motion of the cluster to the line of sight through the telescope at all elevations. These tests check the adjustment and mounting of the various fire control components and reveal whether the launcher operates within prescribed tolerances.

b. Test Wherein Trunnions Need Not be Level (Plumb Line Required).

(1) With the boresights in place in the center tube, the cluster near zero elevation, and the plumb line suspended in front of the center tube, traverse so that the line of sight through the tube is on the plumb line.

(2) Level the telescope mount in both directions by centering the cross-level and longitudinal-level bubbles.

(3) Place the intersection of the reticle crosshairs of the telescope on a sharply defined aiming point near deflection 3000 and note the deflection set.

Note. If longitudinal displacement of the sight is necessary to place it on the aiming point, it is obtained by rotating the telescope in the holder bracket so that the level of the bubbles is not disturbed.

(4) Elevate the cluster from 0 to maximum elevation (or to the limit of the plumb line) in 100-mil steps. At each step, traverse the weapon (if necessary) to bring the line of sight through the center tube back on the plumb line. If the line of sight through the tube tracks the plumb line at all elevations, the trunnions are level. If it is necessary to traverse to bring the line of sight back to the plumb line, the trunnions are not level.

(5) After placing the line of sight through the center tube back on the plumb line, relevel the bubbles at each 100-mil elevation and check for deviation of the line of sight from the aiming point. If the vertical line is off the aiming point, it is brought to the aiming point by turning the azimuth micrometer knob, and the deviation is measured on the azimuth micrometer. If the horizontal line is off the aiming point, it is brought to the aiming point by turning the elevation micrometer knob.

(6) Note the displacement of the longitudinal-level bubble. If the vertical line deviates from the aiming point by more than 1½ mils from the original deflection at any elevation tested or if the correction for the deviation of the horizontal line causes the longitudinal-level bubble to travel in excess of one vial graduation, some component of the on-carriage fire control equipment is out of adjustment. The weapon must be referred to authorized ordnance maintenance personnel for adjustment or correction.

c. Tests With Trunnions Level.

(1) *Cross-level test.*

(*a*) If the trunnions are not level (*b*(4) above), level them by removing soil from beneath one wheel, if necessary, so that the line of sight through the center tube tracks the plumb line at all elevations.

(*b*) Center the longitudinal-level bubble.

(*c*) Center the cross-level bubble.

(*d*) Elevate the cluster to maximum elevation, keeping the longitudinal-level bubble leveled and noting the cross-level bubble. If the cross-level bubble does not remain centered within one vial graduation, either the telescope mount is misalined or the cross-level vial is incorrectly set. Refer the mount to authorized ordnance personnel for adjustment.

(2) *Longitudinal-level test.*

(*a*) Level the cluster longitudinally with the gunner's quadrant.

(*b*) Center the longitudinal-level bubble.

(*c*) Operate the cross-leveling knob throughout the limits of motion; the longitudinal-level bubble should remain centered within one vial graduation. If the bubble moves in excess of the tolerance, either the level vial or the sight mount is not alined

correctly and the launcher should be sent to ordnance for adjustment.

(3) *Telescope mount alinement test.*

(*a*) With the cluster level, center the cross-level bubble.

(*b*) Without elevating or traversing the cluster, operate the elevation micrometer knob throughout the limits of motion, noting the cross-level bubble. If the cross-level bubble does not remain centered within one vial graduation, either the mount is misalined or the cross-level vial is incorrectly set. Refer the mount to ordnance for adjustment.

(4) *Elevation mechanism test.*

(*a*) Level the cluster longitudinally with the gunner's quadrant.

(*b*) Level the cross-level and longitudinal-level bubbles.

(*c*) Check to see that the elevation scale and the elevation micrometer read 0.

(*d*) Repeat this check of quadrant settings against quadrant elevation settings at low, medium, and high angles of elevation. If the elevation scale does not agree with the elevation set on the gunner's quadrant within 1½ mils at any of the elevations compared, the launcher should be sent to ordnance for adjustment.

51. Ordnance Check

It is not expected that using units will have the necessary facilities, tools, or skilled mechanics to perform the more precise tests and adjustments of sighting and fire control equipment. When deficiencies recur or when defects cannot be corrected in the field, ordnance checks should be requested.

CHAPTER 9
MAINTENANCE AND INSPECTION

52. General

Maintenance and inspection are essential to insure that the section is prepared to carry out its mission. Systematic maintenance and inspection drills provide the best insurance against unexpected breakdown at the critical moment when maximum performance is essential.

53. Disassembly, Adjustment, and Assembly

Disassembly and adjustment of the weapon authorized to be performed by platoon personnel is prescribed in TM 9–1055–215–12, supplemented by instructions contained in Department of the Army supply manuals. No deviation from these procedures is permitted unless authorized by the responsible ordnance officer.

54. Records

The principal records pertaining to the weapon are the equipment log book and DA Form 2407, Maintenance Request. Information on the purpose and use of these records may be found in TM 38–750.

55. Maintenance

For detailed instructions concerning maintenance of the multiple rocket launcher M91, see TM 9–1055–215–12 and the lubrication order therein. For detailed instructions concerning maintenance of the prime mover see the technical manuals and lubrication orders pertaining to that vehicle.

56. Inspections

Regular inspections are required to insure that materiel is maintained in serviceable condition.

a. The platoon leader, accompanied by the artillery mechanic, should make regular informal inspections. Different parts of the weapons should be checked during successive inspections to insure complete coverage. At least once a month the platoon leader should make a thorough mechanical inspection of weapons, auxiliary equipment, tools, and repair parts.

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

c. For details on inspecting the M91 launcher, see chapter 3, TM 9–1055–215–12. For details on inspecting the prime mover, see the appropriate technical manual for that vehicle. Deficiencies found during inspections should be corrected promptly.

d. The duties of individuals in performing the necessary inspections and maintenance of the launcher are outlined in paragraphs 57 through 61. The drills outlined in these paragraphs must be followed so that inspections and maintenance are routine, thorough, and rapid. When the section is reduced in strength, the chief of section must reassign duties to insure that all maintenance steps are completed.

57. Duties in Inspection Before Operation

The inspection performed before operation is a final check on materiel before leaving the motor park for training in the field, or before displacement. When all deficiencies discovered during the inspection are corrected, the section is ready to go into action. The responsibilities and duties of section personnel are as follows:

a. Chief of Section.

(1) Commands PERFORM BEFORE MARCH INSPECTION. Supervises inspections by members of the launcher section in all sequences.

(2) Verifies that the launcher is properly mounted and equipment is installed.

(3) Verifies the presence of the proper supply of gasoline, oil, water, and emergency rations.

(4) Verifies the presence of the technical manuals and lubrication orders for the prime mover and launcher, the vehicle accident identification card, and the equipment log book.

(5) Inspects the loading of section equipment for completeness and security.

(6) Inspects ammunition for lot number, condition, and stowage.

(7) Receives reports of personnel of his section upon completion of their duties in inspection.

(8) Reports to the platoon leader when section personnel have completed their duties, "Sir, number (so and so) in order," or reports any defects which the section cannot remedy without delay.

b. Gunner.

(1) Assisted by number 1, removes the overall cover.

(2) Inspects the condition, completeness, and security of contents of the equipment chest.

(3) Verifies that the elevating lock is engaged.

(4) Verifies that the traversing lock is engaged.

(5) Assisted by number 1, replaces the overall cover and assures himself that all fastenings are secured.

(6) Reports "Gunner ready."

c. Number 1.

(1) Assists the gunner in removing the overall cover.

(2) Assists the gunner in replacing the overall cover.

(3) Reports "Number 1 ready."

d. Numbers 2 through 4. Numbers 2 through 4 perform duties as prescribed by the chief of section.

e. Driver.

(1) Performs *before operation* services as prescribed in the appropriate TM assisted by other personnel of the section when so directed by the chief of section.

(2) Reports "Driver ready."

58. Duties in Inspection During Operation

The inspections performed during march are constant checks on the operation of the materiel and the security of all the stowed equipment. There is no command for this inspection; it is continuous during operation. The responsibilities and duties of section personnel are as follows:

a. Chief of Section.

(1) Supervises march discipline.

(2) Assigns duties for air defense and antimechanized security.

b. Gunner.

(1) Listens for abnormal or unusual noises and observes load for security. Signals chief of section in case of malfunction.

(2) Observes carried load for security.

c. Numbers 1 through 4.

(1) Perform duties as air defense and antimechanized security sentries as assigned by the chief of section.

(2) Listen for abnormal or unusual noises indicating malfunction of the vehicle.

d. Driver. Performs *during operation* services as prescribed by the appropriate technical manual for the vehicle.

59. Inspection Duties Before and During Firing

Inspection before and during firing is a continuing inspection to insure proper functioning of materiel. No command is necessary; each member of the section performs appropriate inspections before and during firing as shown in *a* through *g* below.

a. Chief of Section.

(1) Supervises and commands the section.

(2) Insures proper handling and preparation of ammunition.

b. Gunner.

(1) Checks operation of the elevating and

traversing mechanisms. *Cleans and* lubricates as required.

(2) Assisted by number 1, cleans and inspects the electrical tip jacks on the cluster and conduit assembly.

(3) Tests and adjusts sighting and fire control equipment.

(4) Installs instrument light batteries and sees that lamps light.

c. Number 1. Assists the gunner in cleaning and inspecting the electrical tip jacks.

d. Number 2.

(1) While preparing ammunition for firing, carefully examines the rockets to see that the caps are in place and that rockets are free of foreign matter, moisture, and grease.

(2) Performs such other duties as assigned by the chief of section.

e. Number 3.

(1) Installs aiming post light batteries and sees that lamps light.

(2) Performs additional duties assigned by the chief of section.

f. Number 4. Performs duties assigned by the chief of section.

g. Driver. If the launcher is to be dismounted and fired from the ground and unless directed otherwise by the chief of section, the driver moves his vehicle to the truck park and performs *after operation* duties as prescribed by the appropriate technical manual.

60. Inspection Duties and Maintenance After Operation

Immediately after operation, the launcher is inspected to determine what servicing and maintenance is needed to prepare it for further sustained action or to determine whether maintenance by higher echelons is required. The inspection and maintenance operations may be performed in the motor park or bivouac area. The responsibilities and duties of section personnel are as follows:

a. Chief of Section.

(1) Commands PERFORM AFTER OPERATION INSPECTION. Supervises detailed inspection and maintenance of launcher in all sequences.

(2) Inspects tools, accessories, and equipment for completeness and condition.

(3) Inspects ammunition for lot number and condition.

(4) Verifies the presence of, and makes current entries in, the equipment log book and other required documents.

(5) Verifies the supply of emergency rations, oil, water, and gasoline.

(6) Receives reports from members of the section as they complete inspection and maintenance operations.

(7) Reports to platoon leader when section personnel have completed their duties, "Sir, number (so and so) in order," or reports any defects which the section cannot remedy without delay.

b. Gunner.

(1) Assisted by number 1, removes the overall cover, if in use.

(2) Cleans the optical parts of the telescope as prescribed in TM 9–1055–215–12.

(3) Cleans and oils the elevating screw.

(4) Checks the equipment chest for cleanliness, completeness, and arrangement of contents.

(5) Assisted by number 1, replaces the overall cover.

c. Number 1.

(1) Assists the gunner in removing the overall cover, if in use.

(2) Lubricates all lubrication points in the vicinity of the cluster, trunnions, elevating and traversing controls, and axle according to the lubrication chart.

(3) Assists the gunner in replacing the overall cover.

d. Number 2.

(1) Cleans the trail stakes.

(2) Inspects the tires and wheels of the launcher for damage and loose and missing parts; tests and corrects, if necessary, the air pressure of the tires.

(3) Assists the driver in inspections and maintenance unless directed otherwise by the chief of section.

e. Number 3.

(1) Removes the aiming posts from their case, inspects them, and performs any necessary maintenance. Returns them to the case.

(2) Inspects the blackout light system for operation and wear.

f. Number 4. Performs duties assigned by the chief of section.

g. Driver. Performs *after operation* services as prescribed by the appropriate technical manual, assisted by number 2 when available.

61. Duties in Weekly Inspection and Maintenance

In garrison, inspection and maintenance duties are performed weekly. On maneuver or in combat, these duties are performed after each field operation as prescribed in TM 9–1055–215–12 and the lubrication order for the launcher. The responsibilities and duties of section personnel are as follows:

a. Chief of Section.

(1) Supervises the section in the weekly inspection and maintenance of launcher, tools, accessories, and equipment.

(2) Assisted by the artillery mechanic, supervises necessary authorized disassembly and adjustment.

b. Gunner and Numbers 1 Through 4. Perform normal inspection of launcher, tools, accessories, and equipment and perform lubrication services as set forth in TM 9–1055–215–12 and as directed by the chief of section.

c. Driver. Performs scheduled maintenance duties and as directed by the chief of section.

CHAPTER 10
DECONTAMINATION AND DESTRUCTION OF EQUIPMENT

Section I. DECONTAMINATION

62. General

Equipment that has been contaminated by chemical, biological, or radiological agents constitutes a danger to personnel. Contamination is the presence of toxic chemical agents, biological agents, or radioactive materials in dangerous amounts on a person, an object, in an area or in food and water. Persons, objects, or terrain may be contaminated. *Decontamination* is the process of making any contaminated place or object safe for unprotected personnel. This can be done by covering, removing, destroying, or changing into harmless substances the contaminating agent or agents. Personnel undertaking decontamination duties must wear protective clothing in accordance with TM 3–220 and TM 3–304.

63. Decontamination for Chemical Agents

a. General. Detailed information on decontamination is contained in TM 3–220. A DS2 solution reacts with GB to effectively reduce the hazard within 5 minutes after application. The solution is effective for all toxic chemical agents, to include V-agents. DS2 is a general purpose decontaminant which will eventually replace the DANC solution. STB super tropical bleach is a decontaminant for biological as well as chemical agents. Soap is a readily available decontaminant and is most effectively used in a hot water solution.

b. Decontaminant/Preparation.

(1) DS2 is available in 1⅓ quart cans and 5-gallon drums in ready to use solutions.

(2) DANC solution is issued in a dual container holding quantities of RH 195 and acetylene tetrachloride which, when mixed, produce 3 gallons of solution. Small amounts may be mixed by adding one part (by volume) of RH 195 to six parts of solvent.

Caution: **DANC solution contains acetylene tetrachloride, which damages plastic or hard rubber surfaces. DANC solution and its vapors are highly toxic. Personnel should wear protective masks and clothing when handling DANC solution. In the event acetylene tetrachloride or DANC solution gets on the skin the affected area should be immediately washed with soapy water.**

(3) STB is packaged in 8-gallon drums and is mixed with water to form a slurry. The most effective slurry consists of approximately equal parts (by weight) of STB and water (approximately six D-handle shovelsful of bleach to a 14-quart bucket of water). The slurry should not be used on metallic surfaces, as it is highly corrosive. Slurry applicants and waste should be disposed of in accordance with TM 3–220. Slurry may be applied with swabs, brushes, or brooms.

c. Decontamination of Instruments. Instruments exposed to corrosive gases should be cleaned as soon as possible with alcohol (or gasoline, if no alcohol is available) and a thin coat of light machine oil should be applied. A rag dampened with DS2 or DANC may be used to clean the instruments, followed by drying with a clean rag and then applying a coat of machine oil.

d. Decontamination of Weapons. Dirt, dust, grease, and oil should be removed from the weapons. Wet mix should not be applied; the surfaces should be allowed to air after soil and dirt have been removed. DS2 or DANC can be

used on all metal surfaces, except electrical contacts. Hot water, cleaning solvent, or, in an emergency, repeated applications of gasoline on swabs can also be used effectively on metal. If gasoline-soaked swabs are used (FM 21–40), extreme care must be taken to insure that the gasoline does not spread the contamination and that no gasoline in liquid or vapor form remains. This excess would ignite when the launcher is fired. After decontamination, the weapons should be dried and oiled.

e. Decontamination of Vehicular Equipment. Light contamination from spray can be decontaminated by weathering. For heavier contamination, DS2 or DANC can be used on interior or exterior surfaces that personnel are likely to touch. For overall vehicle decontamination soap and water may be used. Care should be taken that contaminated run-off does not interfere with other operations.

64. References

For further information on decontamination, see FM 21–40 and TM 3–220 and TM 3–304.

Section II. DESTRUCTION

65. General

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

b. The destruction of equipment subject to capture or abandonment in the combat zone will be undertaken only upon authority delegated by a division or higher commander.

c. All platoons must prepare plans for destroying their equipment in order to reduce the time required should destruction become necessary. The following principles are to be observed.

(1) Plans for destruction of equipment must be adequate, uniform, and easily carried out in the field.

(2) Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires considerable time, priorities must be established so that the more essential parts are destroyed first.

(3) The same essential parts must be destroyed on all like equipment to prevent the enemy from constructing a complete piece of equipment from damaged equipment.

(4) Repair parts and accessories must be given the same priorities as the parts installed on the equipment.

d. GB and VX rockets will not be destroyed in the field except as directed by the theater commander. When orders to destroy this ammunition are issued, destruction will be performed only by specially trained chemical EOD personnel.

66. Methods

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

67. References

For detailed information on destruction of the M91 multiple rocket launcher and fire control equipment, see TM 9–1055–215–12; for destruction of ammunition, see TM 9–1300–203, TM 9–1905, and TB CML 73. For destruction of the prime mover, see the technical manual appropriate to the vehicle being used.

CHAPTER 11
SAFETY PRECAUTIONS

68. General

Safety precautions to be observed in training are prescribed in AR 385–63. Additional information is found in FM 6–140, TM 9–1055–215–12, TM 9–1900, and TM 9–1950. The more important safety precautions are summarized in paragraphs 69 through 71. Personnel handling, storing or shipping GB and VX filled rounds must observe the safety precautions described in TM 3–250.

69. Ammunition

a. All rocket containers at the firing position must be placed where they are protected from the backblast of the launcher and from explosion in case of accident at the position. Flammable and explosive materials, such as gasoline, must be kept away from ammunition. Rocket containers should be protected from the direct rays of the sun by a double tarpaulin or other suitable covering.

b. Platoon personnel must not attempt to remove rockets from rocket containers.

c. To minimize damage, should the rocket propellant be accidentally ignited, rocket containers should be pointed nose down or toward a barricade (TM 9–1950) during handling and when in storage. Rocket containers ordinarily are stored in shipping crates.

d. All rockets that have been prepared for firing and not fired must be checked by the chief of section to insure that they are restored to their original condition and packed and marked for priority of use. These rockets will be used first in subsequent firings. Opened packages and containers must be kept to a minimum.

70. Failure to Fire

Caution must be observed in removing a rocket that failed to fire. Since the failure may be merely a delay in the functioning of the propelling charge explosive train, the prescribed delay should be observed before the rocket is removed from the tube. (For further information on misfires and hangfires, see TM 9–1055–215–12.) The following definite waiting intervals, after failure to fire, have been established on the basis of experience and characteristics of the weapon:

a. If a rocket fails to fire, actuate the firing switch two additional times in attempts to fire.

b. If the rocket still fails to fire, wait 10 minutes from the last attempt to fire, check the

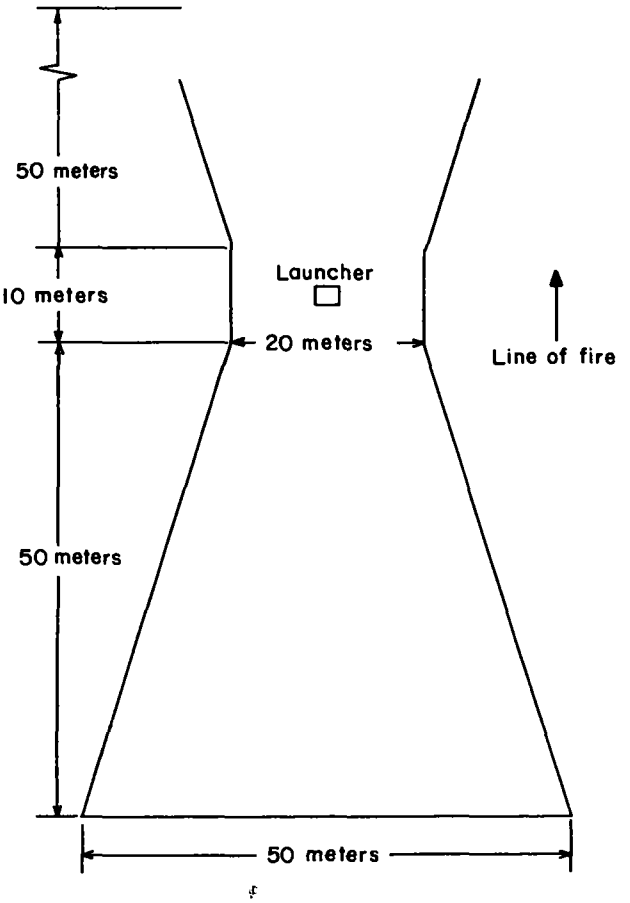


Figure 12. Diagram of danger zone.

electrical circuit for breaks, shorts, and poor contacts, and again attempt to fire.

c. After making any necessary adjustments, actuate the firing switch three times.

d. If the rocket still fails to fire, wait 10 minutes after the last attempt to fire, check the electrical circuit, and actuate the firing switch three times.

e. If the rocket still fails to fire, wait 10 minutes after the last attempt to fire and then remove the rocket container as prescribed in paragraphs 49 and 50, TM 9–1055–215–12. The ammunition is considered to be defective unless, upon examination, a faulty electrical circuit not previously detected is found.

f. During the operations described in *a* through *e* above, the launcher must be adjusted on the target and all personnel must stand clear of the muzzle and the path of the backblast (fig. 12).

g. The unloaded rocket shipping-firing container must be kept separate from other rocket containers until the cause of failure to fire is determined. If the rocket is defective, it must be kept separate until disposed of. If the firing switch is found to be defective, the rocket may be reloaded and fired after correction of the faulty firing switch.

71. Drill and Firing

a. The launcher must be kept unloaded except when firing is imminent or when loading dummy rounds during training.

b. Personnel, equipment, and flammable material must be cleared from the area to a distance of 50 meters ahead of and behind the launcher and to a distance of at least 10 meters from each side of the launcher before the safety plug is installed. The danger zone of 50 meters is shown in figure 12. Safety procedures in AR 3852–63 pertaining to the M91 will govern during service practice.

CHAPTER 12
COMMUNICATIONS

72. General

Both radio and wire can be employed by the launcher platoon. Radio is used initially but should be augmented by wire when wire nets are deemed appropriate. FM 6–10 gives information on radio and wire nets for all field artillery units.

73. Radio

The launcher platoon operates in the battalion radio nets in which the battery assigned the chemical mission normally operates. The platoon uses communications equipment organic to the firing battery; additional communications equipment is supplied by the battalions as required.

74. Wire

The launcher platoon employs wire as early as possible. Lines are laid to the battalion FDC, and a hot loop (fig. 13) is used within the platoon for command and control. To avoid confusion and delay during fire missions, gunners should be equipped with head and chest sets.

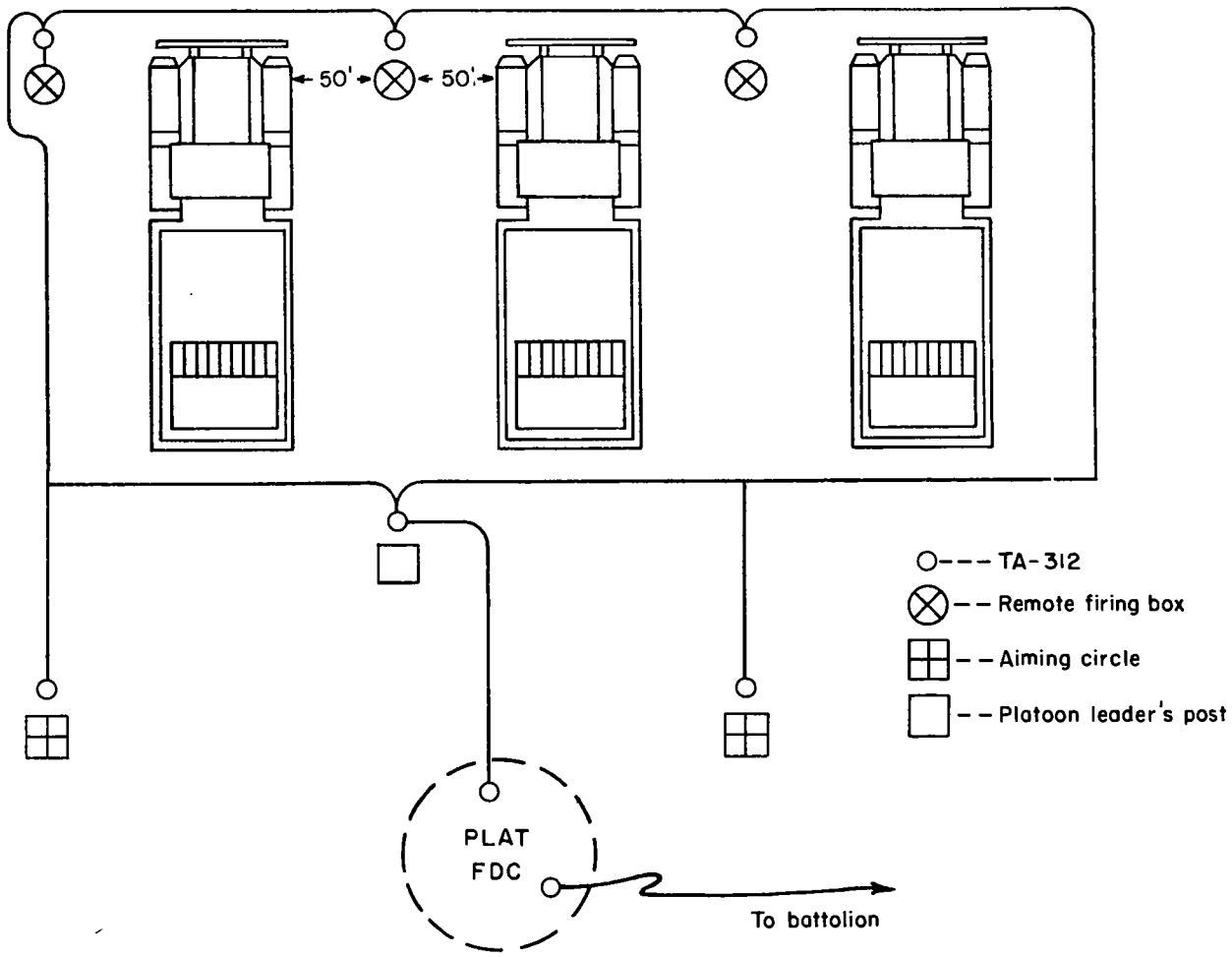


Figure 13. Schematic wire diagram for a launcher platoon.

APPENDIX I
REFERENCES

AR 385–63	Safety: Regulations for Firing Ammunition for Training, Target Practice, and Combat.
AR 611–201	Manual of Enlisted Military Occupational Specialties.
ATP 6–100	Army Training Program for Field Artillery Units.
FM 3–10	Chemical and Biological Weapons Employment.
(S) FM 3–10A	Chemical and Biological Weapons Employment (U).
FM 5–15	Field Fortifications.
FM 6–2	Artillery Survey.
FM 6–10	Field Artillery Communications.
FM 6–20–1	Field Artillery Tactics.
FM 6–20–2	Field Artillery Techniques.
FM 6–40	Field Artillery Cannon Gunnery.
FM 6–125	Qualification Tests for Specialists, Field Artillery.
FM 6–140	The Field Artillery Battery.
FM 21–5	Military Training.
FM 21–40	Small Unit Procedures in Chemical, Biological, and Radiological (CBR) Operations.
FM 25–10	Motor Transport Operations.
TA 23–100	Ammunition for Training.
TA 23–103	Dummy Drill and Inert Ammunition.
TB CML 73	Rocket, Chemical, 115-MM, M55 (GB- and VX-Filled) Rocket, Training, Dummy, 115-MM, M60 and Rocket, Practice, Simulant EG, 115-MM, M-61.
TM 3–200	Capabilities and Employment of Toxic Chemicals.
TM 3–220	Chemical, Biological and Radiological Decontamination.
TM 3–250	Storage, Shipment, and Handling of Chemical Agents and Hazardous Chemicals.
TM 3–304	Protective Clothing and Accessories.
TM 9–1055–215–12	Operator and Organizational Maintenance: 115-MM Multiple Rocket Launcher M91.
TM 9–1055–215–20P	Organizational Maintenance Repair Parts and Special Tool List for 115-MM Multiple Rocket Launcher (M-91).
TM 9–1300–203	Ammunition for Antiaircraft, Tank, Antitank, and Field Artillery Weapons.
TM 9–1900	Ammunition, General.
TM 9–1905	Ammunition Renovation.
TM 9–1950	Rockets.
TM 21–305	Manual for the Wheeled Vehicle Driver.
TM 38–750	The Army Equipment Records System and Procedure.
FTR 115–C–1	Firing Tables, Launcher, Rocket, Multiple: 115-MM, M91; Firing Rocket, Gas, Nonpersistent GB, 115-MM: M55.

APPENDIX II
TRAINING

Section I. GENERAL

1. Purpose and Scope

The purpose of this appendix is to present the minimum requirements for training the personnel of a launcher section in the performance of their duties in service of the piece. It includes general information on the conduct of training and a minimum training schedule.

2. Objectives

The objectives of training and section drill are—

a. To develop proficiency of individual members of the provisional unit.

b. To weld members of the provisional unit into a coordinated team capable of efficient performance in combat.

3. Conduct of Training

a. Training will be conducted in accordance with the principles laid down in FM 21–5. The goal of training should be the standards set forth in AR 611–201 and ATP 6–100.

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

c. The application of prior instruction to current training must be emphasized.

d. A record of the training received by each individual should be kept on a progress card maintained by each chief of section for each man in his section. This card should show each period of instruction attended, tests taken, and progress made. Progress cards should be inspected frequently by the platoon leader to make sure that they are maintained properly and to determine the state of training. *Requiring the chief of section to keep these records emphasizes his responsibility toward his section.*

e. The necessity for developing leadership and initiative in noncommissioned officers must be emphasized constantly throughout training.

Section II. MINIMUM TRAINING SCHEDULE

4. General

The training schedule outlined in paragraph 6 of this appendix is a guide to meet the minimum training requirements for personnel of a rocket section in subjects covered in this manual.

5. Individual Periods

a. Individual periods of training in service of the piece should be coordinated with other battery training into a balanced training program, taking into consideration the basic principles of training.

b. In general, except for service practice, periods of instruction on any subject should not exceed 1 hour.

c. Rocket launcher drill periods should be preceded and followed by periods on subjects that are logically related to the drill. For example, a period of rocket drill should be preceded by a period on testing and adjusting sighting and fire control equipment and followed by a period on inspection and maintenance drills.

6. Schedule

Method	Hours	Subject	Text references	Training aids and equipment
C, D, PW	1	Organization and composition of the rocket platoon, general duties of individuals, and formation of a rocket section.	Pars. 7–9.	Rocket launcher, prime mover, TOE equipment, and M60 dummy round.
C, D, PW	6 (½-hour periods)	Posts and posting of crewmen and duties in firing and indirect laying.	Pars. 14–39.	Do.
C, D, PW	2 (1-hour periods)	Testing and adjusting sighting and fire control equipment.	Pars. 40–50.	Do.
PW	1	Preparation of launcher for airlift operations.	TM 9–1055–215–12 (par. 36).	Do.
C, D, PW	1	Inspections and maintenance.	Pars. 52–61.	Do.
PW	4	Service practice.	Pars. 13–37.	Rocket launcher, prime mover, and training ammunition (M61 training round).
C	2	Care and handling of chemical ammunition to include safety precautions.	TM 3–250	
C, PW	2	Review of and tests on subjects previously covered.	All previous references.	Rocket launcher, prime mover, and TOE equipment.

C, conference; D, demonstration; PW, practical work (19 hrs.).

INDEX

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

DCSPER (2)
ACSI (2)
DCSLOG (2)
CORC (2)
CRD (1)
COA (1)
CINFO (1)
TIG (1)
CNGB (2)
USAARTYBD (2)
USCONARC (5)
ARADCOM (2)
USACDC (2)
Armies (5)
USA Tng Cen (2) except
USATC, FA (5)
Corps (3)
Div (2)
Div Arty (2)
FA Gp (2)
USMA (1)
USACGSC (25)
Br Svc Sch (2) except
USAAMS (40)
USAARMS (25)
USACMLCSCH (5)

NG: Corp Arty (2); Div (2); Div Arty (2); Bde (1); Regt/Gp/BG (1).
USAR: Same as Active Army except allowance is one copy to each unit.
For explanation of abbreviations used, see AR 320–50.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1964—700507

FM 6—54 115—MM AREA TOXIC ROCKET SYSTEM—1964