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AMMUNITION - GENERAL

VOLUME 3

TRENCH WARFARE AMMUNITION

PREPARED BY
THE ORDNANCE SCHOOL
ABERDEEN PROVING GROUND, MARYLAND

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NOTE

This publication is a temporary expedient pending the incorporation of the information contained herein in an approved War Department Manual.

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Prepared under the direction of
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LIST OF ILLUSTRATIONS

TRENCH WARFARE AMMUNITION

CHAPTER 1

HAND GRENADES

SECTION I

GENERAL

1. GENERAL. - Hand grenades (see fig. 1) form an important class of ammunition, especially for in-fighting and antimechanized combat, and have proven highly valuable in jungle warfare. Hand grenades are a standard item of issue to most of the fighting arms and commands and are, consequently, important to ordnance personnel. Grenades are a convenient type of ammunition which, within certain limitations, enable the fighting arms to augment their primary weapons with a missile somewhat similar in action to a shell or bomb.

2. TYPES. - a. Classification. - Hand grenades are divided into three general types as listed below. The grenades are classified according to their function or tactical use.

(1) Fragmentation grenades, containing a heavy charge of explosive.

(2) Offensive grenades, not fragmentary, containing a heavy charge of explosive.

(3) Grenades developed for training or practice.

b. Standard grenades. - With each of the classifications listed

FIGURE 1. - HAND GRENADES

above there is a standard grenade for issue to the service. Each of these grenades will be described in its respective section. In addition, there are grenades, no longer manufactured, that are present in the field in quantity. These grenades are called limited standard and will be discussed in a separate section. The standard grenades have the following nomenclature:

(1) Grenade, hand, fragmentation, Mk. II.
(2) Grenade, hand, training, Mk. IA1.
(3) Grenade, hand, offensive, Mk. IIIA1.

3. IDENTIFICATION. - a. Mark number and model. - As a means of identification, grenades and grenade fuzes are assigned a mark number or model designation at the time that they are adopted for manufacture. This mark or model becomes a part of the standard nomenclature of the item, appears on all drawings pertaining to it, and is stenciled or stamped on the item where practicable.

b. Ammunition lots. - (1) General. - An important factor in the identification of hand grenades is the ammunition lot number. This is assigned at the time of manufacture to a definite number of loaded grenades which are assembled under uniform conditions and contain:

(a) Grenade bodies of one type or lot number.
(b) Explosive filler of one lot number.
(c) Loaded fuzes of one lot number.

This grouping of like components results in an ammunition lot, the rounds of which may be expected to function in a uniform manner during their serviceable life.

(2) Ammunition data card. - A 5" x 8" ammunition data card is prepared for each lot of grenades at the time that they are loaded. The card lists the ammunition lot number, the manufacturer, date of loading, contract number, and the various components used in assembling the lot, together with any remarks concerning their general characteristics. A copy of this card is packed in each box of grenades to which the lot number is assigned. All reports on condition, functioning, or accidents in which the ammunition is involved should specifically mention the lot number which is printed on the card and on the outside of the packing box.

c. Packing. - Hand grenades are packed according to specification. Information concerning the packing of a particular grenade is included in the section pertaining to the grenade. The container in which the grenade is packed and the box in which the containers are packed bear information that is of value in identifying the grenade. On the packing box is stenciled the lot number, the nomenclature, the quantity of

grenades packed, and a wealth of other information. Close attention to the stenciling on box and carton makes improper issuance of grenades an improbability.

d. Painting and marking. - Grenades are painted and marked as an aid in identification. They are painted primarily for rust prevention but by varying the color of the paint the secondary function, identification, is achieved. The method of painting and marking will be described in the pertinent sections.

4. REFERENCES. - Complete information as to packing and marking may be secured from Standard Nomenclature List No. S-4, Grenades, Hand and Rifle, and Fuzing Components. Additional information may be found in Technical Regulations No. 1350-B, Infantry and Aircraft Ammunition. Handling and use of hand grenades is covered in Basic Field Manual FM 23-30, Grenades.

SECTION II

GRENADE, HAND, FRAGMENTATION, MK. II

5. DESCRIPTION OF COMPONENTS. - The grenade, hand fragmentation, Mk. II consists of a body, an explosive charge, and a fuze. These components are described as follows (see fig. 2):

a. Body. - The body of the grenade is cast from gray iron. Roughly speaking it is the size of a large lemon and is designed to fit into the hand. Specifically, it is 3.56" long, is 2.25" in diameter at the middle and tapers to a diameter of 0.93" at the bottom and 0.828" at the top. The body is hollow and there is a threaded opening in the top where the fuze is seated. There are eight equally spaced longitudinal grooves and four equally spaced circumferential grooves in the outside surface of the body. On deflagration of the explosive charge, these serrations form lines of least resistance, providing uniform fragmentation of the body. On one side of the body, just above the second circumferential groove from the bottom, is cast the manufacturer's initial or symbol. The dimensions of the body cavity are varied by the manufacturer to obtain a finished weight of approximately 1.06 lbs.

b. Explosive charge. - The body cavity is loaded with 0.74 ± 0.05 ounce of E.C. Blank powder. The powder is loose and granular and the

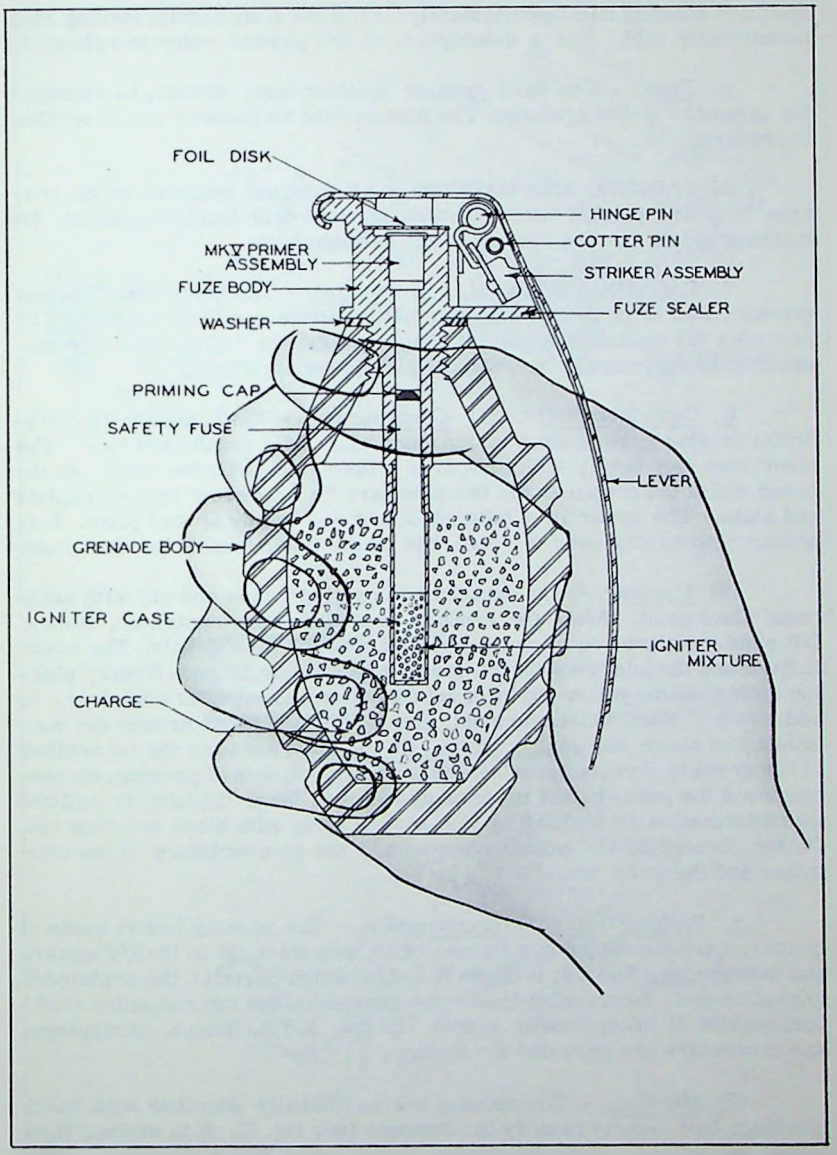


FIGURE 2. - GRENADE, HAND, FRAGMENTATION, MK. II

specified quantity fills approximately 75% of the body cavity, leaving 25% intentionally void. For a description of the powder refer to volume 1.

c. Fuze. - The hand grenade igniting fuze, M10A2, is standard for assembly in this grenade. The fuze and its functioning are described in paragraph 18.

6. PAINTING AND MARKING. - All external surfaces of the grenade body are painted with a lusterless olive-drab lacquer enamel. No marking appears on the surface of the grenade body.

7. PACKING (see fig. 3). - a. General. - The fragmentation hand grenade, Mk. II is packed one complete grenade per fiber container, 25 grenades (25 containers) per wooden packing box. The fuzes are assembled to the grenades and are not packed separately.

b. Container, M41. - (1) Construction. - The container is cylindrical in shape, consisting of an inner and outer cardboard tube. The inner tube fits tightly within, and is longer than the outer tube. At the lower end of the container the two tubes are held together by a terneplate end plate. The cover is a tube, closed at one end by an end plate. It is constructed to slip over the open end of the inner tube of the container.

(2) Marking. - The container is painted inside and out with acidproof black paint. After the grenade is placed in the container, several felt pads are placed on its top so that the cover will fit tightly. The cover is fitted and the joint between the cover and container is made firm by placing an inch-wide yellow strip of adhesive tape around the container. In addition a 1" wide, white, gummed, paper label is placed around the container just above the sealing strip. On the label appears the lot number of the grenade, manufacturer's initials or symbol, date of packing, nomenclature of the grenade, and its drawing number. When the label is omitted this information is lettered on the sealing strip with black marking ink. On the terneplate end plates are stamped the nomenclature of the container and the word "frag."

c. Packing box. - (1) Construction. - The packing box is made of lumber, approximately three-fourths of an inch thick. It is 16-3/4" square and 6-3/4" high. The inside depth is 5-1/4" which permits the containers to rest on end. Reinforcing cleats are attached to the top and sides of the box, making it exceptionally sturdy. Hasps, seals, hinges, strappings, and connectors are provided for closing.

(2) Marking. - The packing box is liberally supplied with black markings that clearly identify the contents (see fig. 3). It is stained light brown and all exposed metal surfaces are coated with a lusterless light brown paint.

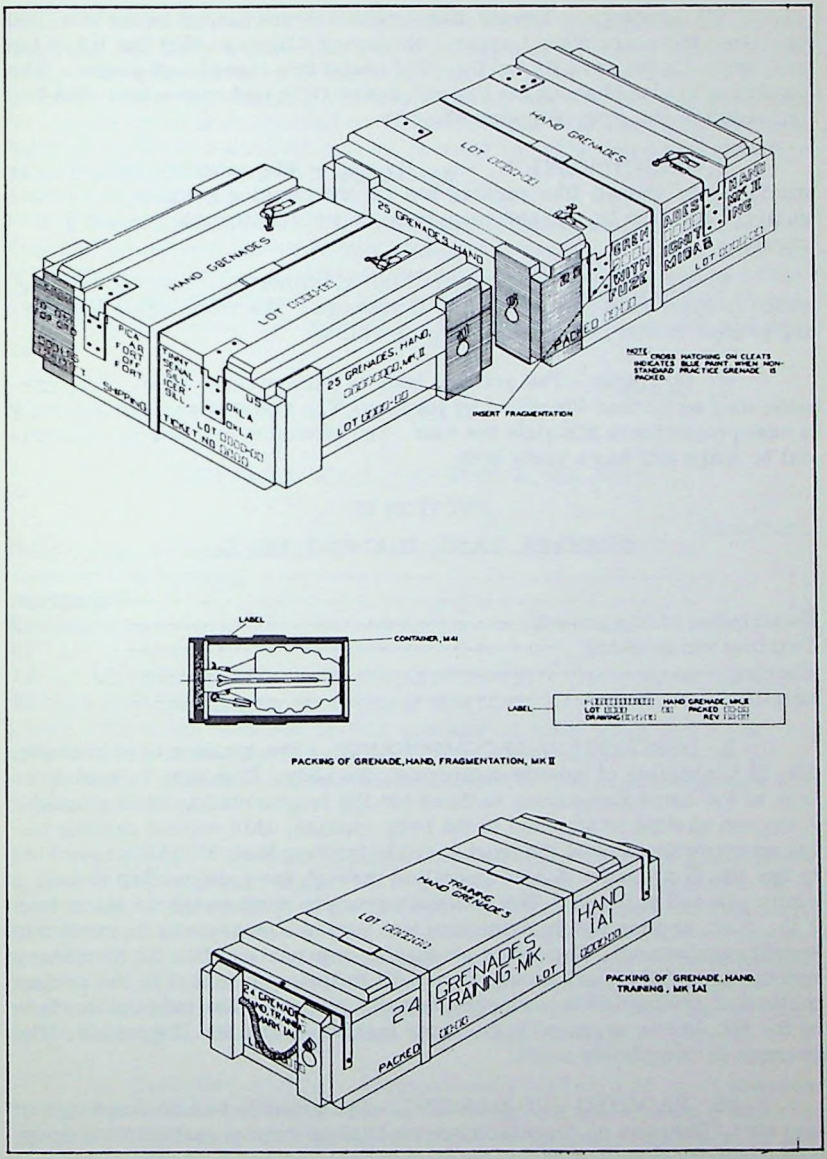


FIGURE 3. - PACKING OF HAND GRENADES

(3) Loading. - Twenty-five containers are placed in the box, end up. Over these are placed several chipboard fillers so that the lid of the box, when closed, will fit tightly. The hasps are closed and sealed. The strapping is placed about the box and drawn tight and connected. The box is ready for shipping, weighing 52.15 lb.

8. IDENTIFICATION. - a. By box. - The square packing box is distinctively shaped (the packing box for the training grenade is rectangular). The box is marked clearly so that its contents are readily discerned.

b. By container. - The end of the container bears the word "frag" which is applicable only to the Mk. II grenade. The label bears identifying printed matter; the sealing strip is yellow.

c. By round. - The grenade body is painted olive drab. The grenade may be further identified by its fuze. The training grenade has only a cast projection to simulate the fuze. The offensive grenade is cylindrical in shape and has a black body.

SECTION III

GRENADE, HAND, TRAINING, MK. IA1

9. DESCRIPTION OF COMPONENTS. - The training hand grenade, Mk. IA1, consists of but one component, the body. The body is cast from iron to the same dimensions as those for the fragmentation hand grenade. A second casting is attached to the body casting, this second casting being an approximation of the hand grenade igniting fuze, M10A2, assembled to the Mk. II grenade. A hole is drilled through the fuze casting to hold a cotter pin and pull ring. The complete grenade must weigh no more than 1 lb., 5 oz. and the inside diameters are varied if necessary to meet this weight requirement. The cotter pin may be removed as often as necessary and the complete round serves very well to train personnel in the proper method of arming and throwing the service grenade. The external surface of the Mk. IA1 is serrated in the same fashion as the Mk. II grenade. The grenade is completely inert.

10. PAINTING AND MARKING. - The grenade has no markings of any sort. There is no manufacturer's initial or symbol cast into the body. The grenade is painted black on all external surfaces, which constitutes the only distinctive marking.

11. PACKING. - The grenades are packed directly into the wooden shipping box, 24 to a box. The box is rectangular, of sturdy construction, stained a light brown, and has no hinges or hasps. The cover is held in place by two steel bands, painted a light brown, one passing over each end of the cover and anchored on the sides of the box. Strapping is drawn tight about the box and held taut by connectors. The box bears stenciled information that identifies the contents.

12. IDENTIFICATION. - The training hand grenade cannot be confused with either of the other two standard grenades. It differs from the Mk. II in being painted black and having a projection to simulate a fuze. It differs from the offensive grenade in its general shape and appearance. The latter is smooth and cylindrical, the former lemon-shaped and serrated.

SECTION IV

GRENADE, HAND, OFFENSIVE, MK. IIIA1

13. DESCRIPTION OF COMPONENTS. - The grenade, hand, offensive, Mk. IIIA1 (see fig. 4), consists of a body, an explosive charge, and a fuze. Since the function of this grenade is blast effect and noise, the body is thin and the explosive charge heavy in proportion to the weight of the grenade. There is no fragmentation effect. The components are described as follows:

a. Body. - The body is composed of an inner and outer tube, closely interfitting, and each made of a heavy fiber paper. The top and bottom are reinforced by metal plates which are rolled and crimped to form rims. Into the top plate a threaded plug is fitted, through which the fuze is inserted. The inner tube of the grenade body is a single piece, while the outer tube is divided circumferentially to form two equal cylinders. The length of the grenade body including the plug is 4-7/16". The over-all diameter is 2-1/8". The weight of the body is approximately 0.235 lb.

b. Explosive charge. - Approximately 0.427 $\pm$ 0.23 lb. of pressed TNT composes the explosive charge. In the pressing operation a well for the fuze 3-1/8" deep and 1/2" in diameter is formed. This well in the assembled grenade is directly beneath the detonator assembly of the fuze, and is lined with a heavy paper. The charge is sealed against metal contact

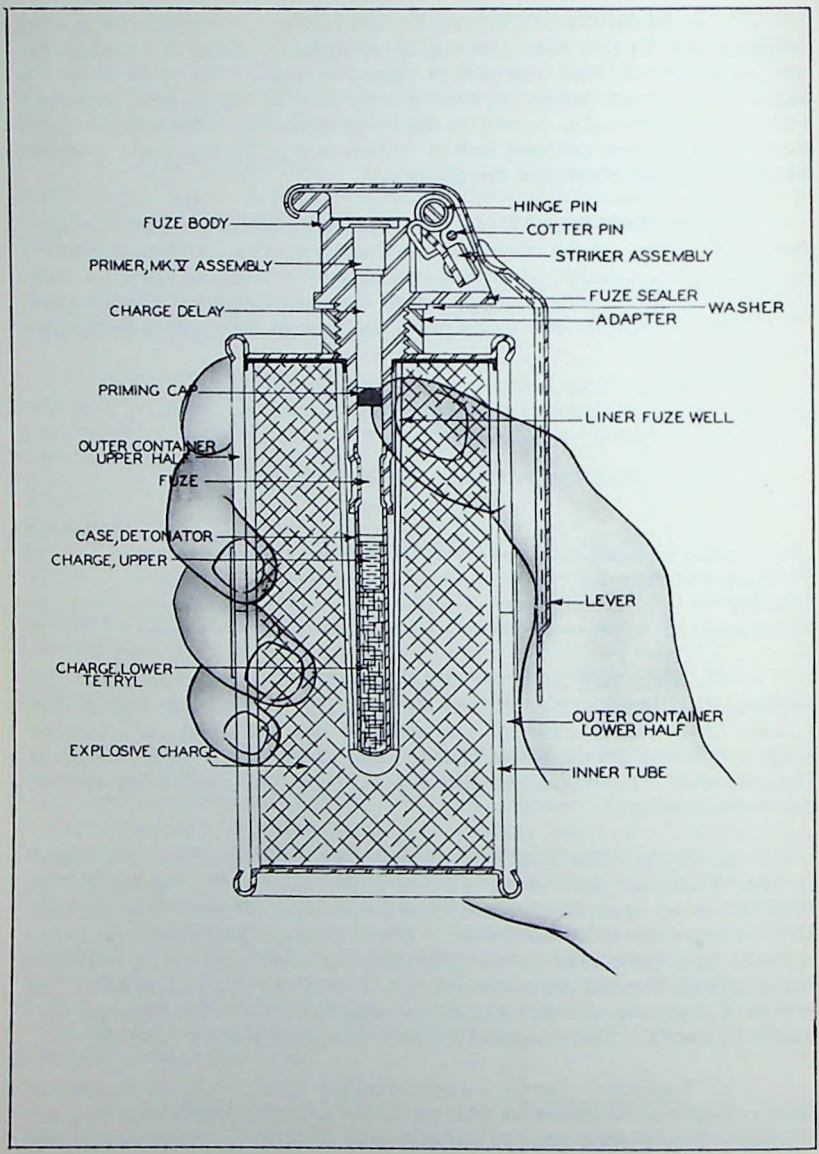


FIGURE 4. - GRENADE, HAND, OFFENSIVE, MK. IIIA1

at top and bottom: at the top a paper seal is inserted, at the bottom a felt pad 1/16" thick is placed.

c. Method of loading. - Glue is applied to the external surface of the inner tube and the tube is then inserted in the lower half of the outer tube, and the bottom end plate crimped in place. The felt pad is placed in the bottom of the container thus formed and the cylinder of TNT is loaded. While the glue is still wet the seal is placed over the top of the inner tube and covered with the upper half of the outer tube to which the top end plate and plug have been crimped. A wooden plug is inserted in the fuze opening since the grenade is packed unfuzed.

d. Fuze. - The hand grenade detonating fuze, M6A2, is standard for use with this grenade. It is not packed assembled to the grenade but is packed separately. For a description of the packing and functioning of this fuze refer to paragraph 17.

14. PAINTING AND MARKING. - a. Painting. - The external surface of the grenade body, except threads, is coated with acid-proof black paint. The fuze surfaces are coated with a commercial rust-resistant compound. The label on the grenade body is waterproofed with a coating of bleached shellac varnish.

b. Marking (see fig. 1). - A commercial, yellow, gummed label is affixed to the body. It is 1" wide, 6-3/4" long and is secured about the middle of the grenade so as to assist in making firm the joint between the upper and lower sections of the outer tube. On the label is printed in black the nomenclature of the grenade, the loader's lot number, and the year and month loaded.

15. PACKING. - a. The Mk. IIIA1 grenade is packed unfuzed. Fifty grenades are stored in a wooden packing box, hole end up. The box is compartmented by means of lateral and cross separators to form 25 sections, and two grenades are placed in each section.

b. The box is 25-11/16" x 13-1/2" x 6-27/32" and is sturdily constructed with top and end cleats (see fig. 5). On the box appears the nomenclature illustrated in figure 5. The box, complete with contents, weighs 54.15 lb., and is stained a light brown color. All external metal surfaces are coated with a light brown enamel.

c. The fuze is packed separately.

16. IDENTIFICATION. - The grenade, hand, offensive, Mk. IIIA1 may be identified by its shape and color. It is cylindrical and is painted black with a yellow label. The body is of paper and the grenade is shipped unfuzed.

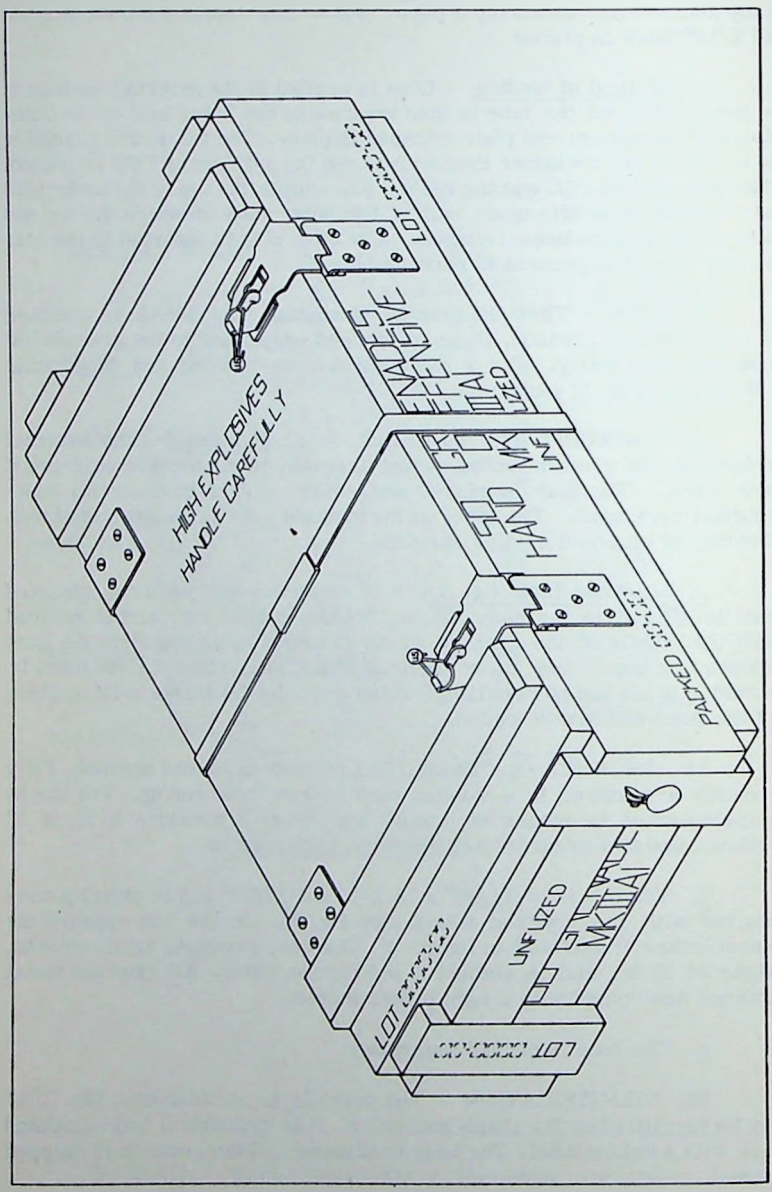


FIGURE 5. - PACKING FOR THE GRENADE, HAND, OFFENSIVE, MK. IIIA1

SECTION V

GRENADE FUZES

17. FUZE, DETONATING, HAND GRENADE, M6A2. - a. General description (see fig. 6). - The fuze is a mechanical device, assembled to the grenade body, which functions the grenade a fixed time after arming. The fuze body is a casting made of zinc-aluminum-magnesium alloy weighing approximately 972 grains (7,000 grains = 1 pound). The fuze body consists of the body proper, the fuze sealer, which is a flange extending from the body to the striker, and the fuze tube. The body is threaded and is screwed into the upper opening of the grenade body. A strip steel lever covers the top of the fuze body, one end being bent over to hook under a protruding lip on the fuze body. The other end of the lever extends downward and is bent to follow the contour of the grenade. On the lever, at the point where it passes over the top of the fuze body, are stamped the designation of the fuze, the manufacturer's initials, the lot number, and the year of loading.

(1) A cotter pin with a ring through the eye extends through holes in the lever and the fuze body, holding the lever and striker assembly in place against the action of the spring.

(2) The primer is of the center-fire type and is known as the Mk. V. It consists of a body, a cup, an anvil, a foiling paper disk, and the primer charge. The body is made of brass and is drawn into the shape of a cylinder, open at both ends. At the upper end a rim is formed and a flange reduces the diameter of the opening. Into the lower end is inserted the gilding metal cup, charged with the primer composition. The cup slides into position against the flange. The primer charge fills approximately one-half the volume of the cup and is protected against moisture by a foiling paper disk. The brass anvil is placed in the body and the lower end of the body is roll-crimped to prevent the exit of the anvil. The anvil has flash vents that permit the flame from the primer charge to pass it and leave through the end of the body. The composition of the primer charge is as follows:

Potassium chlorate	37.05%
Lead sulphocyanate	38.13%
TNT	5.69%
Barium nitrate	8.68%
Ground glass	10.45%

A tinfoil disk is secured to the fuze body with orange shellac varnish. This disk covers the opening into which the primer is inserted and prevents moisture from entering the fuze body tube.

(3) Below the primer in the fuze body tube is the delay charge. This charge is approximately 10.03 grains of Grade "A-5" army black powder pressed into the tube under a dead weight of 400 lb.

(4) Extending from the end of the delay black powder charge into the detonator assembly case is a 1-1/8" length of safety fuse. The safety fuse and the delay element in combination provide a delay of from 4.3 seconds minimum to 5.3 seconds maximum. Attached to the upper end of the safety fuse is a priming cup. The safety fuse is difficult to ignite and without the priming cup the fuse might fail to function under the flame from the delay element. The cap consists of a mixture of 95.2% fuze powder and 4.8% celluloid, the latter dissolved in acetone to form a paste with the powder.

(5) The safety fuse at its lower end is in contact with the upper detonator. The upper detonator is a unit of the detonator assembly that is housed in the detonator case. The detonator case is fitted into the lower end of the fuze body tube and crimped into place. The upper detonator consists of a charge of explosive (90% mercury fulminate and 10% pottassium chlorate) inclosed in a gilding metal cup. The 7-grain charge in the cup (weight: 5.8 grains) is inclosed in turn in the detonator assembly case.

(6) Below the gilding metal upper detonator cup and in contact with it is the lower detonator. The lower detonator is a charge of tetryl weighing 13.5 grains. It has no individual cup as does the upper detonator, but is charged directly into the detonator assembly case.

(7) A fiber washer, located just below the fuze sealer, prevents the entrance of moisture into the grenade body.

b. Operation. - When the cotter pin is removed and the lever released, pressure from the spring rotates the striker around the hinge spring. The point of the striker impacts the primer cup and explodes the primer charge by crushing it against the anvil. The flame from the primer charge ignites the delay charge. This charge burns for approximately 1.5 seconds and then ignites the priming cap and the safety fuse. The fuse burns slowly, increasing the delay since the primer was functioned to approximately 5 seconds. The flame from the fuse detonates the upper detonator which, amplified and reinforced by the lower detonator, initiates the explosive charge of the grenade.

c. Note. - Changes may be expected in this fuze, particularly in

the weights of the detonators because the functioning of the present fuze has resulted in a high proportion of low order detonations.

d. Packing. - Since this fuze is for assembly to the grenade, hand, offensive, Mk IIIA1, it is shipped separately. It is packed in cartons which are packed in wooded packing boxes.

(1) The carton (see fig. 6) is made of newsboard to the following dimensions: 11-1/8" x 7-3/8" x 4-11/16". It is in two assemblies, the top assembly, which is the cover, and the bottom assembly, which is the carton proper. The top assembly fits over the bottom assembly and is sealed in place by a strip of gummed kraft paper. The 25 fuzes packed in each carton are held in position by a comb and separators. A white bond paper label 6-3/7" x 2-3/8" is centered on the top of the carton. It bears the lot number of the fuzes, initial or symbol of the loader, month and year packed, number of the fuze drawing, and the quantity and nomenclature of the fuze. The carton packed, sealed, and label attached is dipped in molten paraffin wax.

(2) The box (see fig. 6) is carefully made with all nailheads cement coated and to the following dimensions: 25-1/2" x 16-7/16" x 11-19/32". Reinforcing cleats are added at points of strain to make the box exceptionally sturdy. Eight cartons (the cartons in two layers) and one spanner fuze wrench are packed in each box. A tape trace passes under the center of one box in each layer to facilitate removal. The wrench is placed on top of the filler material covering the top layer of cartons. The box bears stenciled information that clearly identifies the contents to be 200 M6A2 hand grenade fuzes. The box and contents weigh approximately 72 lb.

18. FUZE, IGNITING, HAND GRENADE, M10A2. - General description. - This fuze is identical to the hand grenade detonating fuze, M6A2 described in the preceding paragraph with the following exceptions:

a. There is no detonator assembly. The function of this fuze is to ignite the E.C. Blank powder charge in the Mk. II grenade and this can be accomplished with black powder. Therefore, approximately 8.5 grains of grade "A-4" army black powder are loaded into a copper case weighing 16.7 grains. The charge of powder fills approximately half the copper case. The case is fitted into the lower end of the fuze tube and crimped into place. The safety fuse extends into the upper half of the case and the former is held in the latter by a circular crimp.

b. The lever is shaped differently. Because of the differences in the contour of the two grenades the levers of the two fuzes must differ. The lever for the M10A2 fuze is formed in a long curve. The marking

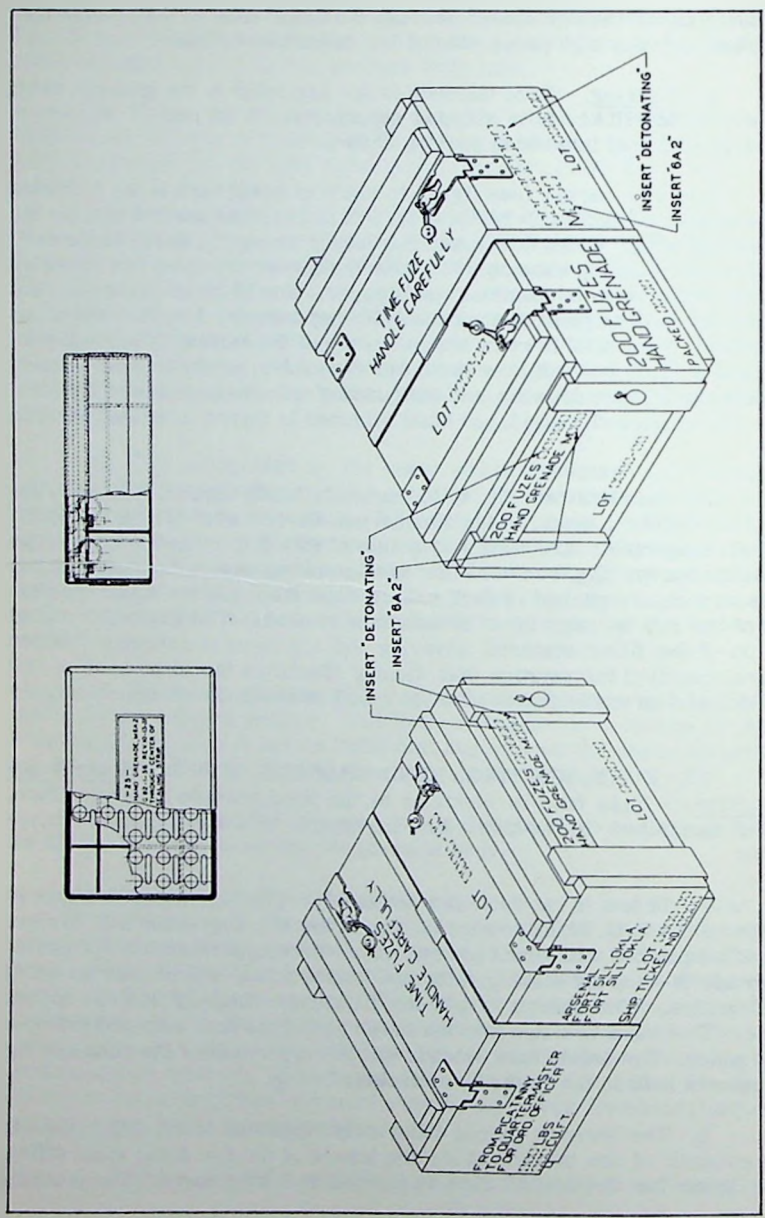


FIGURE 6. - PACKING FOR THE HAND GRENADE, DETONATING FUZE, M6A2

on the top of the lever differs to correspond to the designation of the fuze.

c. Operation. - The fuze operates the same as the M6A2 fuze, except that the safety fuse ignites the black powder charge, which in turn ignites the explosive charge of the grenade.

d. Packing. - The hand grenade igniting fuze, M10A2, is packed assembled to the grenade, hand, fragmentation, Mk. II.

SECTION VI

LIMITED-STANDARD MATERIEL

19. GRENADE, HAND, FRAGMENTATION, MK. II. - a. Description. - This grenade is in every way identical to the Mk. II grenade discussed in section II except that its bursting charge is 1.85 oz. of TNT and it utilizes the hand grenade detonating fuze, M5. This grenade has not been standard for manufacture in recent years but it is believed that there is a large stock on hand. It is packed similarly to the standard Mk. II except that the fuzes are separately packed. The loading of these grenades with TNT was discontinued because it was found that upon detonation the fragments formed were too small to be effective casualty-producing agents.

b. Painting and marking. - Same as the standard Mk. II grenade. See paragraph 6.

c. Identification. - The grenade may be identified by the fact that it is painted olive drab and is shipped unfuzed. It may be further identified, when assembled with a fuze, by the nomenclature stamped on the lever of the fuze, (see a., above). It is important that the markings on the box be noted and the grenade be positively identified prior to issue so that it will not be improperly fuzed.

20. GRENADE FUZES. - a. Fuze, detonating, hand grenade, M5. - With the discontinuance of Mk. II high-explosive grenade the fuze, M5, was also discontinued for manufacture. There is, however, believed to be a large stock of these fuzes still on hand. The construction and operation of the M5 fuze is identical to that of the M10 described in the next subparagraph. The only difference between them is functional, the M5 contains a No. 6 commercial blasting cap to detonate the TNT.

b. Fuze, igniting, hand grenade, M10. - This fuze is identical in

construction and operation with the M10A2 except for the fact that fuze sealer and washer are independent components. A large supply of these fuzes is on hand although manufacture has been discontinued.

CHAPTER 2

ANTITANK GRENADES

SECTION I

GENERAL

21. GENERAL. - A few years ago the rifle grenade went out of service, due largely to the development of the 60-mm mortar. At the present time, because of the need of an effective weapon for the rifleman to use against armored vehicles, the rifle grenade has again been standardized. The grenade is redesigned and operates on a new principle, is in fact a new and efficient weapon for antitank warfare. It is now referred to as an antitank grenade.

22. TYPES. - a. Two types of antitank grenades are standard for issue and manufacture, namely, the high-explosive and the practice. The correct nomenclature of the two standard antitank grenades is as follows:

(1) Grenade, AT, M9A1
(2) Grenade, AT, practice, M11A1

b. The two Limited-Standard grenades are:

(1) Grenade, AT, M9
(2) Grenade, AT, practice, M11

c. In addition to these four grenades, two other grenades were developed, the grenade, AT, M10, and its companion practice grenade, the M13. It was anticipated that these latter grenades would be projected from the cal..50 machine gun but technical difficulties rendered the project impractical. The grenades were modified to become the rocket, H.E., AT, 2.36", M6, and the rocket, practice, AT, M7, respectively.

23. REFERENCES. - For information on packing or marking refer to Standard Nomenclature List No. S-4, Grenades, Hand and Rifle, and Fuzing Components. For information as to use, methods of firing, and identification refer to Basic Field Manual FM 23-30, Grenades, and changes thereto.

SECTION II

GRENADE, AT, M9A1

24. GENERAL. - a. Details of construction of the grenade, AT, M9A1 are not discussed in this text. The similarity of the grenade in all external characteristics to the practice grenade, M11A1, will enable personnel to readily identify the former.

b. The grenade, AT, M9A1, is a potent weapon for antitank warfare. It will penetrate, at its optimum firing distance, any known thickness of armor on a light or medium tank at angles of impact ranging up to 30°. It may be projected from the cal..30 rifle, M1903, using the M2 launcher and from the M1903A1 and M1917 rifles using the M3 launcher. The launchers are now issued as standard accessory equipment of the rifle and not as a part of the rifle grenade kit, as they were issued formerly.

25. GENERAL DESCRIPTION. - The grenade, AT, M9A1 (see fig. 7) is the same size and shape as the grenade, AT, practice, M11A1 described in section III. The essential difference between the two is that the M9A1 has an explosive charge and is painted and marked differently. Both are fired by means of the cartridge, rifle grenade, cal..30, M3. The grenade weighs approximately 1.31 lb.

26. IDENTIFICATION AND PACKING. - a. Identification. - The grenade, AT, M9A1, may be distinguished from the M11A1 by the fact that the former is painted olive drab and the latter black. The lot number, date of loading, and model are stenciled on the M9A1 in yellow and on the M11A1 in white. In addition the surface of the M9A1 is smooth while the surface of the M11A1 is fairly rough. This tactile difference is of assistance in identifying the grenades at night.

b. Packing. - (1) The grenade, AT, M9A1, is packed one per fiber container, ten fiber containers (ten grenades) and one carton of 11 cartridges, rifle grenade, cal..30, M3, per wooden packing box.

(2) Container, fiber, M81 (see fig. 8). - The container consists of a chipboard waterproof inner and outer tube closed by a terneplate end plate, the whole being termed the body assembly. A chipboard tube closed by an end plate forms the cover assembly. An open-end chipboard tube composes the support assembly. The grenade is inserted into the container

FIGURE 7. - ANTITANK GRENADES M11A1 AND M9A1

nose first and comes to rest with its flange resting on the support. The cover is then slipped on and is sealed in place by a yellow adhesive strip. On this strip appears the nomenclature of the grenade in black ink. The container itself is black and this yellow strip, indicating explosive content, assists in identifying the grenade. On the end plates is stamped the nomenclature of the container. The container loaded and sealed is 12-7/32" long and 2-5/8" in diameter and weighs 1.61 lb.

(3) Packing box (see fig. 8). - Ten rounds, in fiber containers, are packed vertically in the packing box. Adjacent containers are packed so that the tail of one and the nose of the other are up. A carton of 11 rifle grenade cartridges is placed in the end compartment. The packing box is made of 3/4" lumber to the following dimensions: 14-5/8" x 16-27/32" x 7-1/16". Reinforcing cleats are located on the cover, which fastens with hinges, hasps, and swivels at one end of the box. A rope handle, run through the cleats, facilitates handling and carrying of the box. The box is stained a light brown and all exposed metal parts are painted the same color. An ammunition data card is placed on top of the layer of filler material just prior to closing and sealing the box. This card gives all pertinent information concerning the ammunition and its components. The packing box bears identifying marking and the warning that the grenades are not to be stored at temperatures over 120° F. The total weight of the loaded box is 30.5 lb.

SECTION III

GRENADE, AT, PRACTICE, M11A1

27. GENERAL DESCRIPTION. - a. The practice grenade, M11A1 (see fig. 7) is designed to enable personnel to develop skill in the handling and firing of antitank grenades, without the dangers or expense incident to the firing of high-explosive antitank grenades. Since the M11A1 practice grenade is similar in appearance and trajectory to the M9A1 H.E. grenade, the use of the former develops skill in the firing of the latter.

b. The grenade, AT, practice, M11A1 (see fig. 9) consists of two assemblies: the body and ogive assembly and the stabilizer assembly. The stabilizer assembly, through repeated use of the grenade, will become bent or damaged and must be replaced.

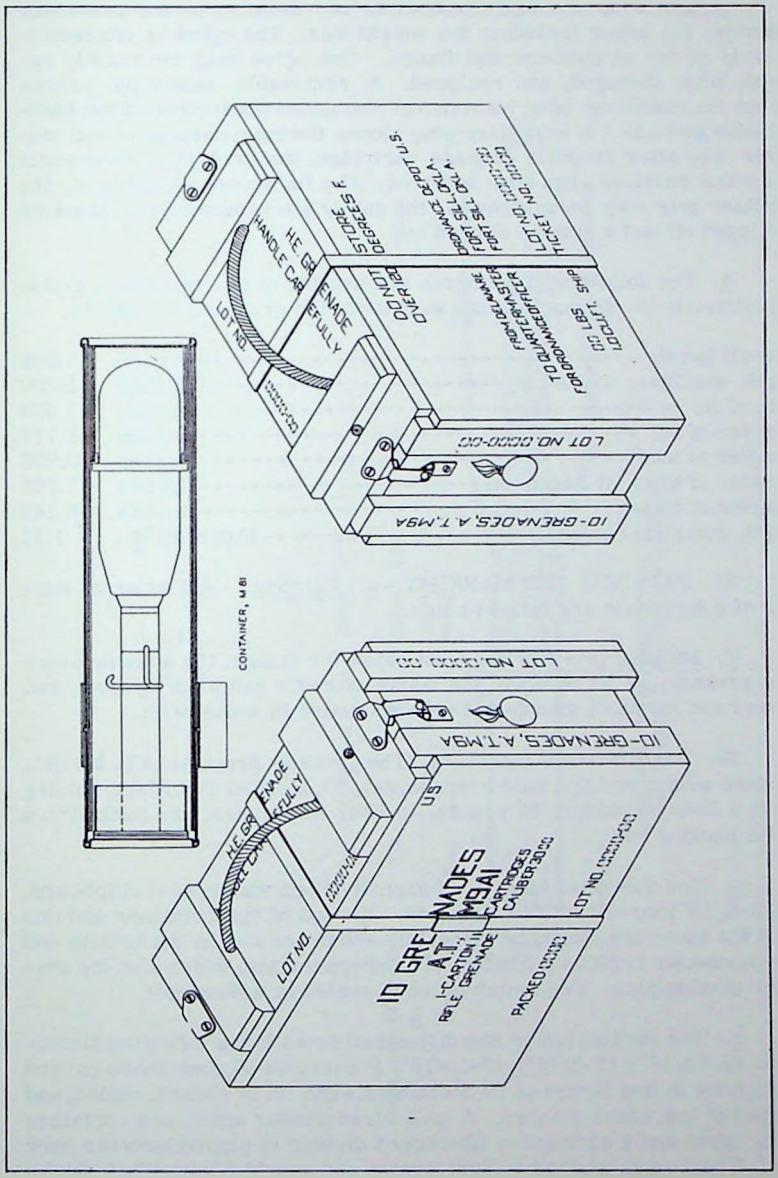


FIGURE 8. - PACKING AND MARKING OF GRENADE, AT, M9A1

c. The body and ogive assembly is threaded to the stabilizer assembly, the latter including the weight bar. The ogive is attached to the body at the circumferential flange. The ogive may be readily removed, when damaged, and replaced. A removable safety pin passes through the stabilizer tube; its removal simulates the arming of the high-explosive grenade. A stabilizer plug closes the rear opening of the stabilizer tube after the rifle grenade cartridge, encased in a waterproof cellophane envelope, has been inserted. If a fin becomes damaged, the stabilizer tube may be unscrewed, the safety pin removed, the damaged fin slipped off and a new fin slipped on.

d. The following dimensions and weights of the grenade are also approximately the dimensions and weights of the grenade, AT, M9A1:

Over-all length	inches	11.068
Length, stabilizer assembly	inches	5.200
Width of fin	inches	1.074
Diameter of fin	inches	1.115
Diameter of tube	inches	0.938
Diameter of head, at flange	inches	1.785
Diameter of flange	inches	2.143
Weight, complete (approx.)	(Approx.) lb.	1.31

28. PAINTING AND MARKING. - a. Painting. - All external surfaces of the grenade are painted black.

b. Marking (see fig. 9). - Just below the flange, the nomenclature of the grenade, its lot number, the manufacturer's initial or symbol, and the year and month of manufacture are stenciled in white paint.

29. PACKING (see fig. 9). - a. The grenade, practice, AT, M11A1, is packed with cartridge, rifle grenade, cal..30, M3, and stabilizer closing plug in a fiber container; 50 rounds, in fiber containers, are packed in a wooden packing box.

b. The container is made of asphalt-filled, waterproof chipboard. It is 12-5/16" long and 2.22" in diameter. One end of the container and one end of the cover are closed by terneplate end plates and in the bottom end of the container is fitted a plain chipboard spacer into which fits the stabilizer closing plug. The container when sealed is waterproof.

c. The packing box is sturdily constructed to the following dimensions: 26-13/16" x 13-3/16" x 13-15/16". It contains 50 containers packed horizontally in five layers of 10 containers each. It is closed, sealed, and strapped in the usual manner. A pull strap passes under one container in each layer and a corrugated fiberboard divider is placed between each layer. The box is stained a light brown and marked with black ink as

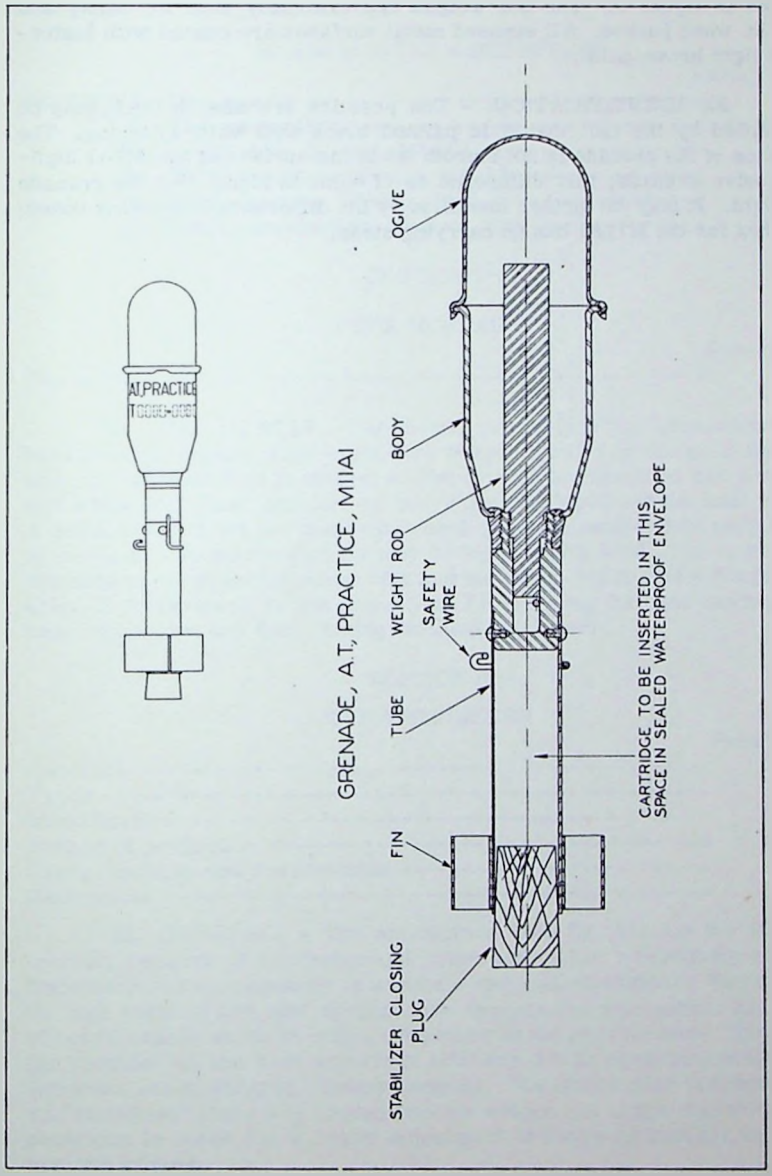


FIGURE 9. - GRENADE, AT, PRACTICE, M11A1 AND PACKING

shown in figure 9. The box weighs approximately 26.3 lb. empty and 103 lb. when packed. All exposed metal surfaces are coated with lusterless light brown paint.

30. IDENTIFICATION. - The practice grenade, M11A1, may be identified by the fact that it is painted black with white lettering. The surface of the grenade is not smooth as is the surface of the M9A1 high-explosive grenade; this difference is of value in identifying the grenade at night. It may be further identified by the difference in packing boxes; the box for the M11A1 has no carrying strap.

CHAPTER 3

60-MM MORTAR AMMUNITION

SECTION I

THE MORTAR

31. THE MORTAR. - The 60-mm mortar (see fig. 10) is a smoothbore, muzzle-loading, high-angle-fire weapon similar in design to the 81-mm mortar described in chapter 4. The mortar is assembled into a single unit while the mount consists of two units, the bipod and the base plate. A detailed list of the parts and equipment and the essential data pertaining to the 60-mm mortar and mount may be found in SNL A-43. The mortar is attached to the bipod by means of a mortar clamp and is easily dismountable. It is fastened to the base plate by inserting the base cap into the base cap socket and then closing the base cap lever.

SECTION II

THE AMMUNITION

32. GENERAL. - The ammunition (see fig. 11) for the 60-mm mortar, because of its design and construction, has a relatively smooth trajectory and consequently is accurate under all conditions. Because of its high angle of fire and plummetlike descent the ammunition has been of considerable value in jungle campaigns in the present war. The mortar provides all the best aspects of artillery fire in combination with the lightness and mobility of infantry weapons. The ammunition is considered as "semifixed" since it is loaded into the weapon in a single operation, but provision is made for a ready adjustment of the propellant for firing in various ranges.

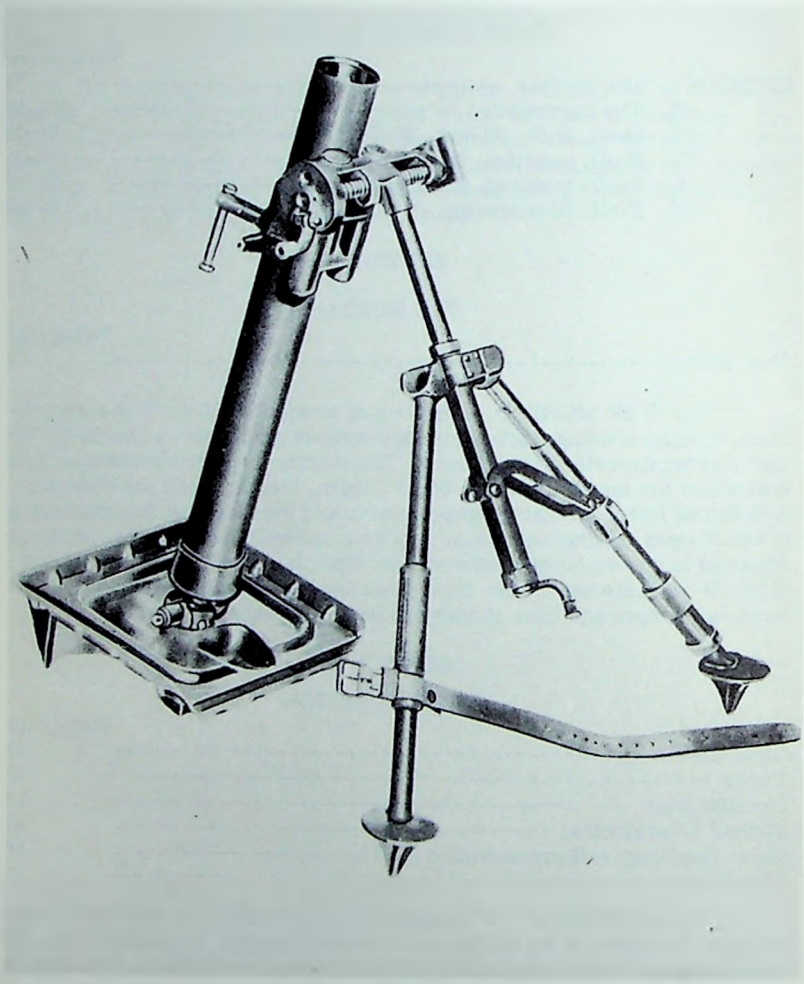


FIGURE 10. - THE 60-MM MORTAR

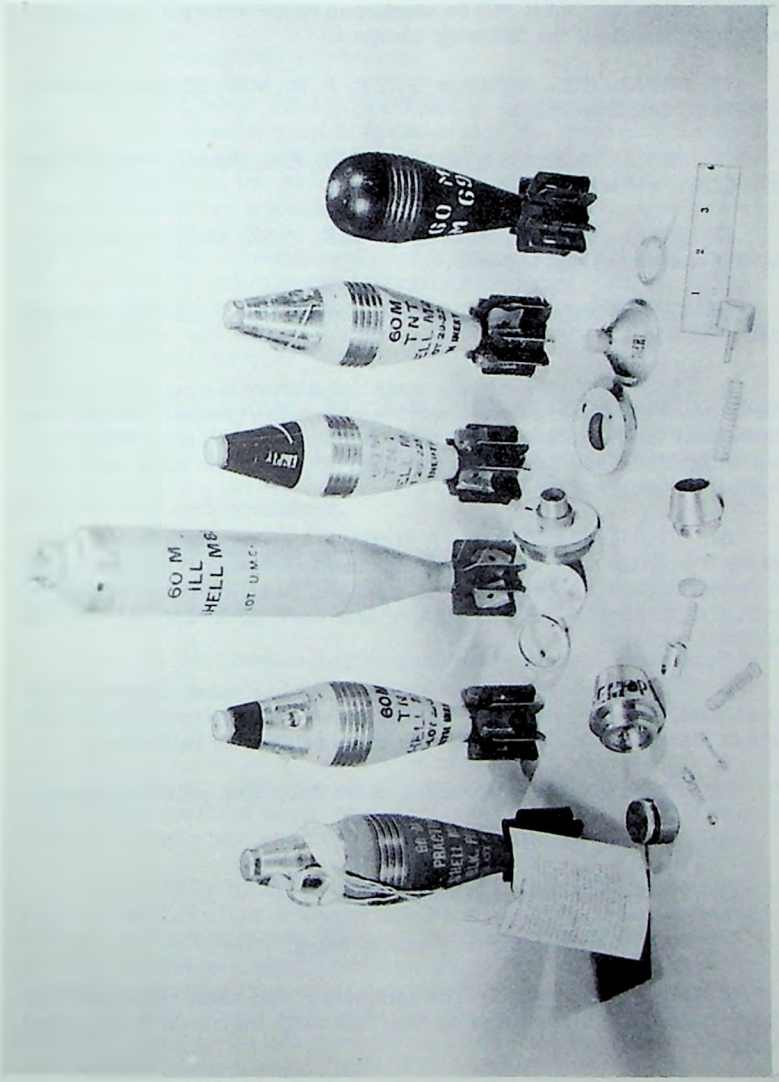


FIGURE 11. - 60-MM MORTAR AMMUNITION

33. TYPES. - a. The four rounds of ammunition listed below are standard for firing from the 60-mm mortar. Complete nomenclature is employed in this list, but it will be abandoned in favor of a shortened nomenclature throughout the following sections.

(1) SHELL, H.E., M49A2, w/FUZE, P. D., M52, 60-mm mortars, M1, and M2, complete round.

(2) SHELL, illuminating, M83, w/FUZE, time (fixed), M65, 60-mm mortars, M1, and M2, complete round.

(3) SHELL, practice, M50A2, w/FUZE, P. D., M52, 60-mm mortars, M1, and M2, complete round.

(4) SHELL, training, M69, 60-mm mortars, M1, and M2, complete round.

b. The first two of the four rounds listed above are service rounds. Under "normal" conditions, the two service rounds are issued in the theater of operations in the proportion of 97% H.E. and 3% illuminating shell. The practice round and the training round are suitable for drill and practice firing purposes only.

34. IDENTIFICATION. - a. Marking on fiber containers. - The contents of original fiber containers are identified readily by the markings on the container. Additional data pertaining to the round contained therein are included on the ammunition data card packed with the round in the fiber container.

b. Color of projectiles. - All projectiles are painted primarily to prevent rust, and secondarily, by means of the color, to provide a ready means of identification as to type. The color scheme is as follows:

(1) High-explosive projectiles, olive drab with yellow markings.

(2) Chemical projectiles, gray.

(3) Practice projectiles, blue.

(4) Dummy or training projectiles, black.

c. Markings on round. - The complete round when removed from its fiber container is identified by the following information stenciled thereon:

(1) Caliber of mortar in which fired.

(2) Kind of filler

(3) Model of shell.

(4) Ammunition lot number.

35. METHOD OF PROJECTION. - A complete round of ammunition is placed nose end up in the muzzle of the mortar. When the round is released to slide down the bore, the hand is quickly removed. The round slides down the bore until the primer strikes the firing pin. This impact sets off the propellant, and the gas from the explosion forces the round from the mortar. The number of propellant increments left in the fin assembly determines the force with which the round is fired from the mortar and consequently determines the range of the projectile. The bourrelet prevents the gas from escaping around the shell thereby reducing the pressure and also provides a bearing surface for the round in its travel through the bore.

36. CARE, HANDLING, AND PRESERVATION. - a. Ammunition is made and packed to withstand all conditions ordinarily encountered in the field. Nevertheless, since explosives are adversely affected by moisture and high temperature, due consideration should be given to its protection from such conditions.

b. Complete rounds, being fuzed, must be handled with care at all times. The explosive elements in primers and fuzes are particularly sensitive to undue shock and high temperature.

c. Do not break moisture-resistant seal until ammunition is to be fired.

d. Do not attempt to disassemble any fuze.

e. Do not allow the ammunition to be exposed to direct rays of the sun for any length of time. More uniform firing is obtained if the rounds are at the same temperature.

37. REFERENCES. - For a complete discussion of packing, marking, and identification of 60-mm mortar ammunition refer to Standard Nomenclature List No. R-4, Ammunition, Trench Mortar, including Fuzes, Propelling Charges, and Other Components. For reference material concerning the mortar and the ammunition, consult Basic Field Manual FM 23-85, 60-MM Mortar, M2. For care in handling and storage of the ammunition refer to the Ordnance Safety Manual OO Form No. 7224. Mortar ammunition is covered in TM 9-1900, Ammunition - General.

SECTION III

SHELL, H.E., 60-MM, M49A2

38. GENERAL. - The shell, H.E., 60-mm, M49A2 (see fig. 14) is the standard, service, high-explosive, fragmentation round for projection from the 60-mm mortars M1, and M2. The complete round is 9.54" long, has a maximum diameter of 2.362" and weighs approximately 2.94 lb. It is packed with four propellant increments, any of which may be readily removed to adjust the range.

39. DESCRIPTION OF COMPONENTS. - The shell, H.E., 60-mm, M49A2 (see fig. 14) consists of a fuze, body, explosive charge, fin assembly, propellant, ignition cartridge, and primer. In the following paragraphs each of the components will be described.

40. FUZE, POINT DETONATING, M52. - a. Description. - Figure 13 presents the cross-sectional views of the fuze and lists the nomenclature of the parts in the major component assemblies. The fuze, weighing 0.45 lb., is made of aluminum alloy throughout except for the slider and safety pin which are made of brass, several minor components made of gilding metal, and the explosive components. The latter have the following composition:

(1) Charge, upper detonator. - This component consists of 0.98 grain of primer mixture pressed into the detonator cup under a dead weight of 10,000 lb./sq.in. Between this charge and the upper opening of the cup is located a detonator disk of aluminum foil to protect the charge from moisture.

(2) Charge, intermediate detonator. - This component consists of 2.93 grains of lead azide. It is located in the detonator cup, just below and in contact with the upper detonator charge. It is pressed into the cup under a pressure of 10,000 lb./sq.in.

(3) Pellet, detonator. - This component consists of 1.26 grains of tetryl. It is located in the detonator cup, just below and in contact with the intermediate detonator. After this pellet is inserted an aluminum closing detonator disk, 0.02" thick, is inserted. The rear rim of the detonator cup is roll crimped over this disk holding the complete assembly in place. The lower, or outer face of the closing detonator disk is coated with red printer's ink so that the lower end of the detonator assembly is readily identifiable. The detonator assembly is placed in its recess in the slider where it rests on a compressed cork detonator cushion, previously inserted.

(4) Charge, booster lead cup. - This component consists of approximately 3.86 grains of tetryl housed in a gilding metal booster lead cup.

(5) Pellet, booster. - This component consists of 256 grains of tetryl pressed into the aluminum booster cup under a pressure of 5,000 lb./sq.in. An onionskin paper booster disk is first placed between the pellet and the bottom of the booster cup.

b. Action. - Figure 12 clearly details the action of this fuze.

c. Fuze, P. D., M52B1. - This fuze is substitute standard for the M52. It differs from the M52 in that it is assembled with a plastic head, body, and booster cup. It weighs 0.29 lb. complete and the booster pellet weighs only 247 grains. The M52 and the M52B1 have the same components and are similar in construction. The fuze is in general use. A recent modification of this fuze has caused a redesignation of its model number. Therefore, fuzes of present manufacture are known as fuze, point detonating, M52B2. The modification entailed a change in the method of assembling the firing pin lock pin and a change from a plastic to a metal head.

d. Identification. - Stamped on the head, just above the joint between head and body, is the name and model number of the fuze, loader's lot number and initials, and date of loading. Sample stamping: "P. D. F. M52, Lot 1234, P. A. 11 - 42."

e. Packing. - The fuze is normally shipped assembled to the round and for this reason its packing will not be discussed, other than to say that, when the fuzes are shipped separately, they are packed in fiber containers, which in turn are packed in a wooden packing box. Personnel will rarely see this packing in the field.

41. BODY. - a. The body of the shell, H.E., 60-mm, M49A2, is made of steel and weighs no more than 1.67 lb. Its general outline can be traced in figure 14, and may be considered to resemble a vase without a base. The body may be forged, cupped, or cast, and in all cases

is given a machine finish of good quality. The forward opening of the body is threaded to receive the fuze and the rear cavity is likewise threaded to receive the fin assembly. Into the outer surface of the body at the point of maximum diameter is machined a series of grooves, approximately 0.04" deep and beveled rearward, that serve as the bourrelet.

b. Stamped on the circumference of the body, one inch to the rear of the bourrelet, is the lot number of the shell, year of manufacture, initials or symbol of the manufacturer, and caliber and designation of the shell.

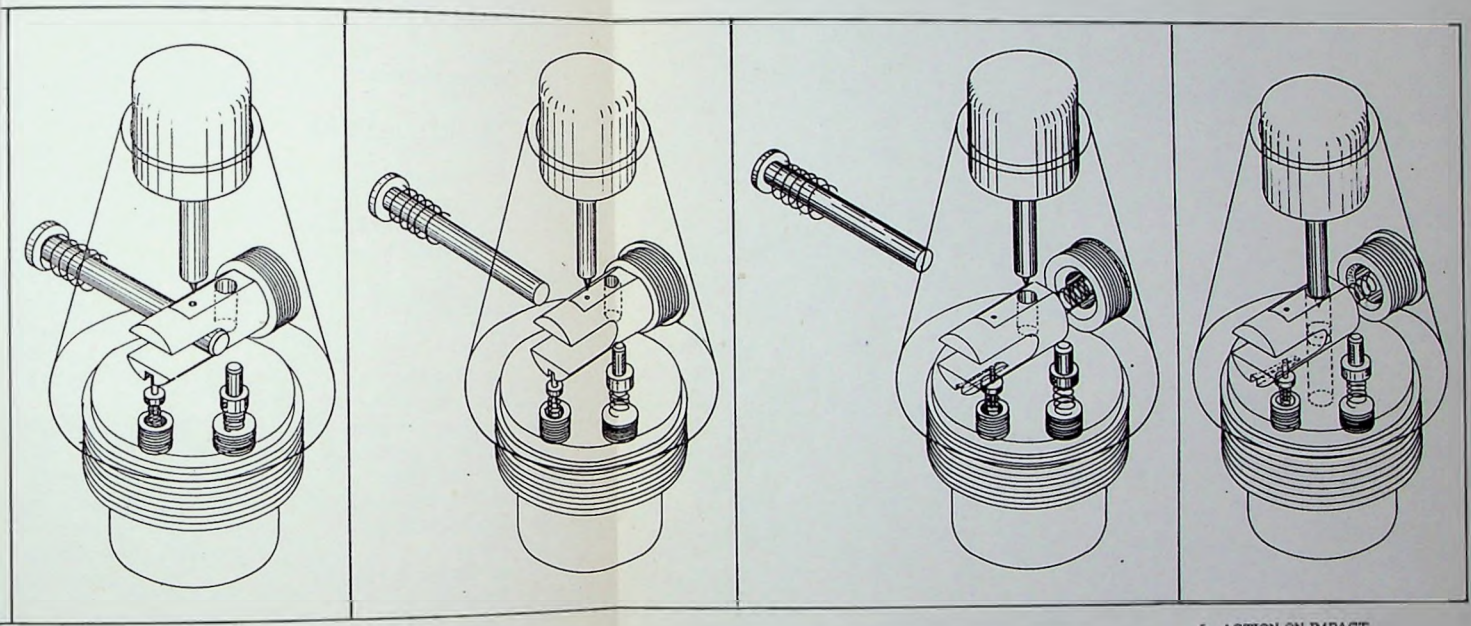
c. The internal surfaces of the body are coated with acidproof black paint; to the threaded surfaces is applied a light coat of shell grease. All external surfaces of the body (bourrelet excepted) are coated with lusterless olive-drab lacquer enamel.

42. EXPLOSIVE CHARGE. - a. The explosive charge loaded into the M49A2 shell is flake TNT. It is pressed into the shell in two separate increments; the first, weighing 0.17 lb., under a pressure of 2,000 lb., the second, an equal amount, under a pressure of 5,000 lb. A recess called the booster cavity, approximately 1.15" in diameter and 0.63" in depth, is formed in the pressing operation for the seating of the booster when the fuze is assembled. In the event that the fuze is not to be immediately assembled, a closing plug is screwed into the fuze opening of the shell body.

b. At the time that the explosive charge is loaded into the shell, the body is coated with olive-drab enamel and then marked. The marking, which is accomplished with yellow marking ink, includes the caliber of the shell, the type of explosive filler (TNT), the name of the shell (Shell, M49A2), and the lot number of the complete round. All of this marking, except the lot number is in characters 3/8" high; the lot number is in 1/4" characters.

43. FIN ASSEMBLY. - The fin assembly (see fig. 14) consists of four double-bladed fins and the cartridge container. The entire assembly weighs 0.43 lb. and, in the complete round, screws into the rear of the shell body.

a. The cartridge container is a steel tube closed at one end. A threaded projection at the closed end has a male thread to fit the shell body recess. The open end has a female thread to receive the primer, M32. The container has an over-all diameter of 0.94", an internal diameter of 0.65", and an over-all length of 2.4". Through the walls of the container are drilled or punched eight pairs of holes which permit the escape of the burning gases from the ignition cartridge, M5, which is housed inside the container.



2. ACTION ON SET-BACK.
   a. Safety pin flies clear of fuze against action of its spring.
   b. Safety pin moves to side under tension of its spring until stopped by mortar wall.

3. FUZE CLEAR OF BORE.
   a. Safety pin flies clear of fuze.
   b. Slider moves to slide under tension of its spring.
   c. Detonator lines up with firing pin.

4. COMPLETE ARMING.
   a. Locking pin moves up under tension of its spring into its recess in the slide.
   b. Slider locks in place.
   c. All explosives are alined.

5. ACTION ON IMPACT.
   a. Striker and firing pin are forced in against action of the spring.
   b. Firing pin crushes upper detonator.
   c. Detonators explode.
   d. Booster lead charge explodes.
   e. Booster charge explodes.
   f. Shell charge detonates.

FIGURE 12. - ARMING OF THE M52 FUZE

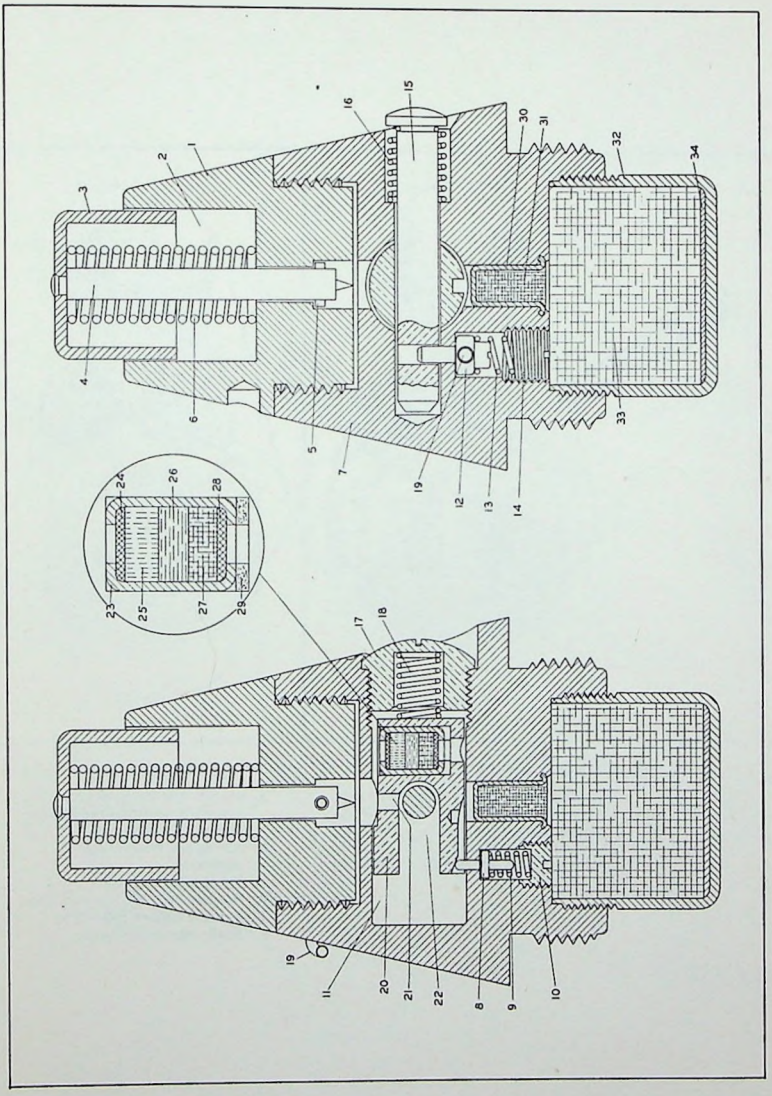


FIGURE 13. - FUZE, P.D., M52

ASSEMBLIES AND NOMENCLATURE OF FUZE, P.D., M52

Numbers are keyed to cross sections of fuze opposite.

HEAD ASSEMBLY

1. Head
2. Striker recess

Firing pin assembly

3. Striker
4. Firing pin
5. Firing pin lock pin
6. Firing pin spring

BODY ASSEMBLY

7. Body
8. Locking pin
9. Locking pin spring
10. Locking pin plug
11. Slider recess
12. Set-back pin
13. Set-back pin spring
14. Set-back plug
15. Safety pin
16. Safety pin spring
17. Slider plug
18. Slider spring
19. Safety wire

SLIDER ASSEMBLY

20. Slider
21. Firing pin safety recess
22. Safety pin riding groove

Detonator assembly

23. Detonator cup
24. Detonator disk
25. Upper detonator charge
26. Intermediate detonator charge
27. Detonator pellet
28. Detonator closing disk
29. Detonator cushion

BOOSTER ASSEMBLY

30. Booster lead cup
31. Booster lead cup charge
32. Booster cup
33. Booster pellet
34. Booster disk

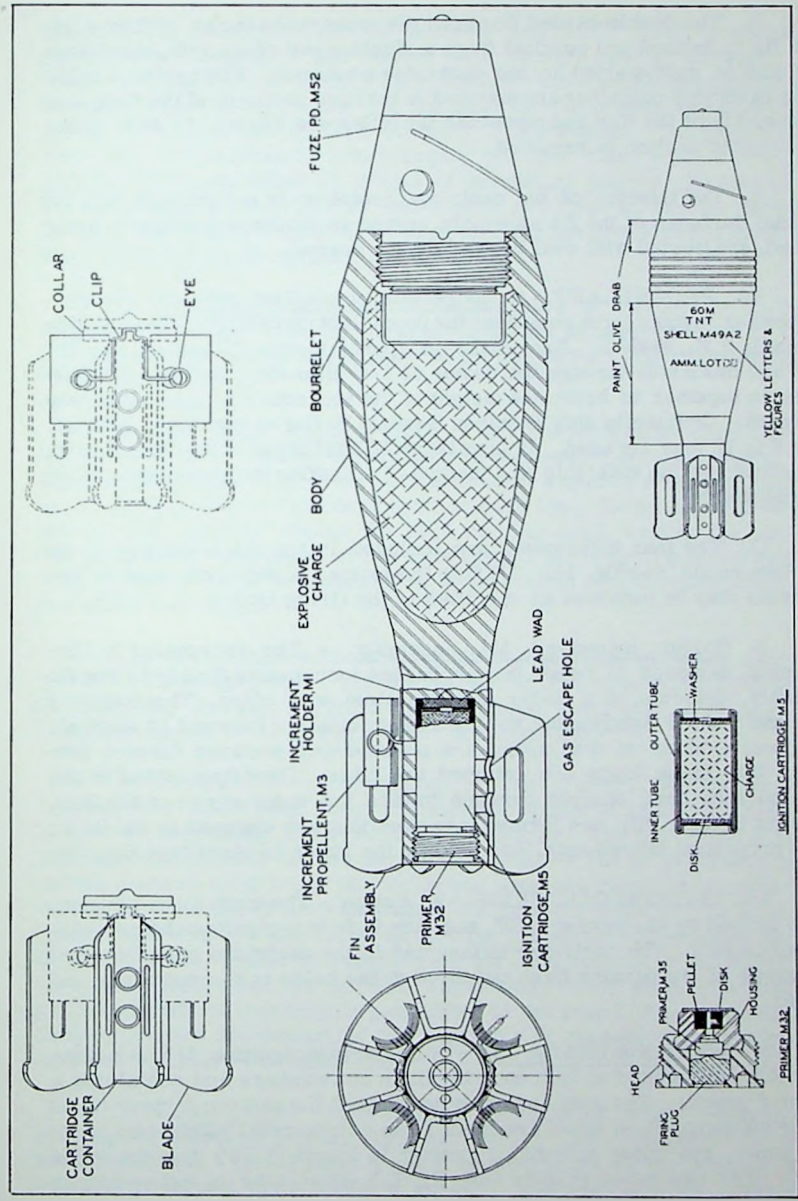


FIGURE 14. - SHELL, H.E., 60-MM, M49A2

b. The double-bladed fins have the appearance shown in figure 14. Each fin is formed and punched from a single sheet of smooth, semigloss steel and is spot-welded to the cartridge container. The pairs of holes in the cartridge container are matched in the base sections of the fins, and in assembly of the fins and container the holes are alined. In each blade an elongated section is removed.

c. The interior of the cartridge container is not painted, but the external surfaces of the fin assembly, unless an oxidized metallic coating is used, are coated with seal brown lacquer enamel.

44. PROPELLANT. - a. Increment, propellant, M3. - (1) Propellant powder in flake form composes the propellant increments assembled in the shell, H.E., M49A2. Each flake is approximately 1" square, 0.005" thick and has a hole through the center of 1/4" diameter. Sufficient flakes are sewn together to bring the weight of the increment to approximately 35 grains. Ordinarily this requires sewing 10 flakes together, although from 8 to 12 may be used. It may be noted that some of the increments are notched on the side; this is a method of adjusting the increment to the desired weight.

(2) The four increments are included in the fin assembly of the complete round (see fig. 14). To fire the mortar in different ranges, increments may be removed as specified in the firing tables.

b. Holder, increment, M1, assembly. - The increment holder assembly, designed to retain the propellant increments firmly in the fin assembly, consists of a collar and two steel wire clips. The collar is fitted and welded tightly about the cartridge container forward of the fins. On opposite faces of the collar are pressed-out sections formed into loops. Into these loops are crimped the clips. The clips extend to the rear and then bend sharply outward toward the outer edges of the fins. The ends of each clip are formed into eyes that are engaged in the holes in the propellant increments, thus holding the latter in place (see fig. 14).

45. IGNITION CARTRIDGE. - a. Action. - The cartridge, ignition, M5, is ignited by the primer, M32, and then it, in turn, ignites the propellant increments. The cartridge is inserted in the cartridge container and the flames of its burning flash out through the holes in the container and the fins.

b. Description (see fig. 14). - The cartridge, ignition, M5, is a simple double tube closed at both ends by disks and washers and containing a charge of powder. The body assembly consists of the outer and inner tubes and the washers. Both tubes are made from commercial paraffined cartridge paper, the outer tube being greater in length (1.58") than the inner (1.15"). The two tubes closely interfit; the outer tube is either red or

yellow. The washers, 0.59" in diameter and 0.038" thick, are made of commercial chipboard and coated with orange shellac varnish. The washer, in place, rests on the rim of the inner tube; an onionskin paper disk is placed between the washer and the inner tube to prevent any of the powder from leaking out through the hole in the washer. The washers and disks are held in place by roll crimping the outer tube. After one washer and disk are assembled 47 grains of propellant powder are loaded into the cartridge; the second disk and washer are inserted and the cartridge closed. The crimped ends of the cartridge are sprayed with nitrocellulose lacquer to hasten the ignition of the paper.

c. Identification. - One of the washers is stamped on its outer face with the loader's initial or symbol, the lot number, the date of loading, and caliber and model number of the cartridge. The cartridge itself is red or yellow.

d. Cartridge, ignition, M5A1. - (1) The M5 ignition cartridge has been the cause of erratic velocities and consequent erratic ranges. Extensive investigation of the reasons for this malfunctioning has resulted in the adoption of an improved ignition cartridge, the M5A1. All 60-mm mortar ammunition, except the M69 training shell, now in the hands of the Ordnance Department are to have the M5 cartridge replaced with the M5A1. All present manufacture of these rounds is to be assembled with the M5A1 cartridge.

(2) Little information is available concerning the exact nature of the M5A1 cartridge, except that the charge has been reduced from 47 grains to 40 grains, and that a hollow cylindrical celluloid tube, 3/4" long, has been introduced at the ignition end of the cartridge.

46. PRIMER. - a. Function. - The primer, percussion, M32, assembled to the M49A2 round initiates the series of explosions that culminate in propelling the shell from the mortar. The primer is screwed into the rear opening of the cartridge container and so positioned it receives a sharp blow from the firing pin when the round is dropped down the bore. This sharp blow functions the primer, causing it to ignite the ignition cartridge. The latter ignites the propellant increments, and the gas from these, unable to escape from the bore because of the bourrelet, forces the shell from the mortar. The velocity of the shell is determined by the number of increments assembled to the round. The primer, then, is an important component of the round and is, therefore, carefully constructed to insure its functioning.

b. Description. - The primer, percussion, M32, consists of a housing for a second primer (primer, M35), a black powder pellet, and a head containing a firing plug. Figure 14 clearly shows the position of the various parts, and their action is evident. The head is made of steel and

is threaded to fit the cartridge container. A firing plug increases the area against which the firing pin may strike; the plug is made of brass. The housing is made of steel and contains the primer, M35, and a black powder pellet. This pellet, weighing 1.65 grains, amplifies the flame of the primer, M35. The primer, M35, is essentially the same as the primers, M26 and M28, described in volume 1. Its charge is a pellet of No. 70 primer mixture weighing 0.37 grain. The weight of the complete primer, M32, is 344 grains.

c. Identification. - Stamped on the head of the primer, circumferentially, are the loader's initials, his lot number, the year of loading, and M32. Sample stamping: P. A. 1234-56, 1942, M32.

47. PACKING AND MARKING. - a. Packing. - The shell, H.E., M49A2, is packed in an individual fiber container, M50; six containers, M50 (6 rounds) are packed in the outer fiber container, M51. Three outer containers are assembled into a bundle by means of cloverleaf end plates and bolted together. For oversea shipment the bundle is crated.

(1) Container, M50. - This is the usual fiber container, 10-3/8" long and 2-7/8" in diameter. The complete round is inserted nose end first so that it rests on the support and the fuze is clear of the end plate. The cover is placed and sealed with a yellow adhesive strip, 1" wide and marked as illustrated in figure 15. This figure also shows the markings of the end plate.

(2) Container, M51. - This container, 21-5/16" long and 7-1/32" in diameter is, except for size, generally the same as the container, M50. Into it are packed six M50 containers in three stacks of two containers per stack. The sealing strip is yellow and marked like the strip for the M50. The end plate is stamped as shown in figure 15. The container, complete with 6 rounds, weighs 24.8 lb.

(3) Bundle. - The three containers, M51, are clamped together by end plates, a bolt, a bar, and wing nuts. Since this bundle packing is that most commonly handled by ordnance personnel in the field, they should study figure 15 carefully, noting the information stamped on the identification tags. The bundle is approximately 24" long and weighs approximately 82 lb. These two facts should be remembered for they will be of value in identifying the bundle in the dark. While the packing for the M50A2 practice shell is identical in weight and size to the packing mentioned, the practice shell will be rarely encountered in the operational theaters.

b. Marking. - The markings of the shell, H.E., M49A2, have all been previously explained. Since the markings, in combination with the physical appearance and color of the shell, are of importance in identi-

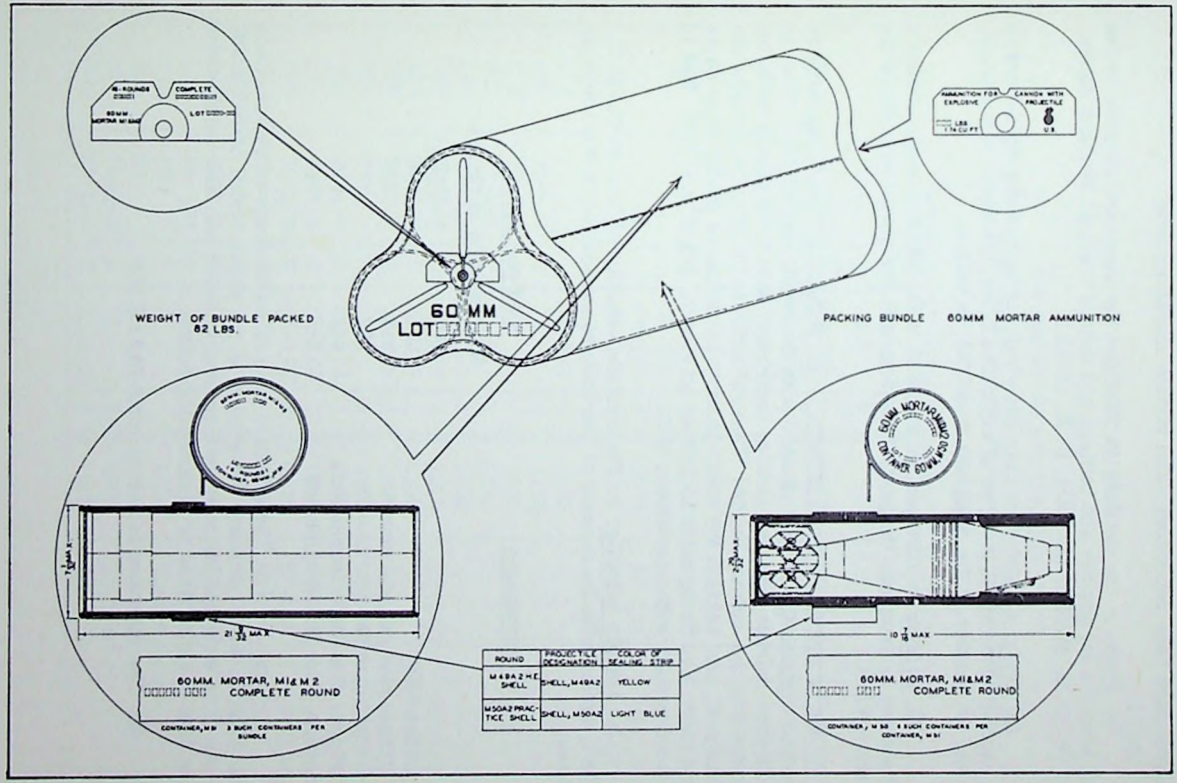


FIGURE 15. - PACKING OF THE SHELL, H.E., 60-MM, M49A2 AND SHELL, PRACTICE, 60-MM, M50A2

fication, they bear repetition. The visible markings are:

(1) Fuze. - On the fuze is stamped the name and number of the fuze, loader's lot number and initials, and date of loading. Sample stamping: "P. D. F. M52B2, Lot 1234, P. A. 11-42."

(2) Body. - Painted on the olive-drab surface of the shell body is the caliber of the shell, the type of explosive filler, the name of the shell, and the lot number of the complete round, all in yellow.

(3) Primer. - Stamped in the head of the primer is the loader's initials and lot number, the year of loading, and the model number of the primer (M32).

48. EXTERIOR BALLISTICS. - a. Range. - The firing table in figure 16 explains the ranges attained with the shell, M49A2, when fired in the 60-mm mortar with the ignition cartridge, M5A1. It should be noted that the 0 in the column headed "Charge" indicates that no propellant increment is used but that the round is fired by means of the ignition cartridge only. The firing table is printed on a card, 7-1/2" x 4-1/2", that is included in each outer container, M51.

b. Muzzle velocity. - The muzzle velocity of the shell, H.E., M49A2, varies with the number of increments assembled in the round, as follows:

No. of increments	Feet per second	
	With ignition cartridge	
	M5	M5A1
Cartridge only	225	188
Cartridge, plus one increment	313	292
Cartridge, plus two increments	387	377
Cartridge, plus three increments	458	449
Cartridge, plus four increments	518	518

c. Burst. - (1) The effective area of burst covered by the shell, H.E., M49A2, when striking the ground at an angle of fall of 70° is 400 sq. yds. The weight of the average fragment is 0.078 oz. The quick action of the fuze permits little or no tunneling action.

(2) The effective radius of burst is 11.3 yds.

FT 60-A-3
(ABRIDGED)

FIRING TABLE

FOR

60-MM MORTAR, M1 AND M2

SHELL, H.E., M49A2 AND SHELL, PRACTICE, M50A2

FUZE, P. D., M52

WEIGHT OF FUZED PROJECTILE - 2.96 LB.

Range yards	Elevation degrees	Charge	Elevation degrees	Charge	Range yards	Elevation degrees	Charge	Elevation degrees	Charge
200	71-3/4	0	82-1/2	1	925	64-1/4	2	71-3/4	3
225	68-3/4	0	81-1/2	1	950	63-1/4	2	71-1/4	3
250	65-3/4	0	80-1/2	1	975	62-1/4	2	70-3/4	3
275	62-1/4	0	79-1/2	1	1000	61-1/4	2	70	3
300	58	0	78-1/2	1	1025	60	2	69-1/2	3
325			77-1/2	1	1050	58-3/4	2	68-3/4	3
350			76-1/2	1	1075	57-1/2	2	68-1/4	3
375			75-1/2	1	1100	56	2	67-1/2	3
400			74-1/2	1	1125			67	3
425			73-1/4	1	1150			66-1/4	3
450	78-3/4	2	72	1	1175			65-1/2	3
475	78-1/4	2	71	1	1200			64-3/4	3
500	77-1/2	2	69-3/4	1	1225			64	3
525	76-3/4	2	68-1/2	1	1250			63-1/4	3
550	76-1/4	2	67-1/4	1	1275	69-1/2		62-1/2	3
575	75-1/2	2	65-3/4	1	1300	69	4	61-3/4	3
600	74-3/4	2	64-1/2	1	1325	68-1/2	4	61	3
625	74	2	63	1	1350	67-3/4	4	60	3
650	73-1/4	2	61-1/4	1	1375	67-1/4	4	59-1/4	3
675	72-1/2	2	59-1/2	1	1400	66-3/4	4	58-1/4	3
700	71-3/4	2	57-1/2	1	1425	66-1/4	4	57-1/4	3
725	71	2			1450	65-3/4	4	56	3
750	70-1/4	2			1475	65	4	54-3/4	3
775	69-1/2	2			1500	64-1/2	4	53-1/2	3
800	68-3/4	2			1600	62	4		
825	68	2			1700	59-1/4	4		
850	67	2	73-1/2	3	1800	56	4		
875	66-1/4	2	73	3	1900	51-3/4	4		
900	65-1/4	2	72-1/2	3	1985	45	4		

FIGURE 16. - 60-MM FIRING TABLE

SECTION IV

SHELL, PRACTICE, 60-MM, M50A2

49. GENERAL DESCRIPTION. - a. The M50A2 shell is designed to give mortar crews practice in firing at various ranges without the dangers or expense incident to firing the high-explosive round. The shell upon impact releases a puff of white smoke that is clearly visible to the observer.

b. The practice round (see fig. 17) is similar to the H.E. round except for the external markings, the color, and the explosive charge. It has the same dimensions, is the same weight, and is assembled with the same components: primer, ignition cartridge, propellant, fin assembly, body, and fuze. These are described in the preceding section. The round is fired in the same manner; in short, the two rounds are very nearly identical.

50. EXPLOSIVE CHARGE. - a. The explosive charge, which produces the white smoke puff, is a pellet of black powder, weighing approximately 391 grains (25.33 grams).

b. The black powder pellet fits into a well, formed in the inert material that fills the body cavity. About 5/8 of the well is occupied by the pellet, the remainder by the booster cup. Felt disks are placed in the bottom of the well, in sufficient quantity to insure a tight fit between pellet and booster cup. The inert material is a mixture of 60% calcined gypsum (plaster of paris) and 40% stearic acid. This mixture brings the weight of the shell to the weight of the M49A2.

51. PACKING AND MARKING. - a. Packing (see fig. 15). - The shell, practice, M50A2, is packed similarly to the shell, H.E., M49A2. However, where a yellow sealing strip is used on the various cartons in packing the M49A2, a light blue strip is used in packing the M50A2. The nomenclature of the M50A2 appears in the same places as would normally appear the nomenclature of the M49A2.

b. Marking. - The exterior surfaces of the shell body (except bourrelet) are coated with light blue lacquer enamel, the characteristic color of a practice round. The shell is marked circumferentially, in white ink, with the caliber, the word "PRACTICE," the name of the shell (Shell, M50A2), and the lot number. All of this stenciling is in characters 3/8"

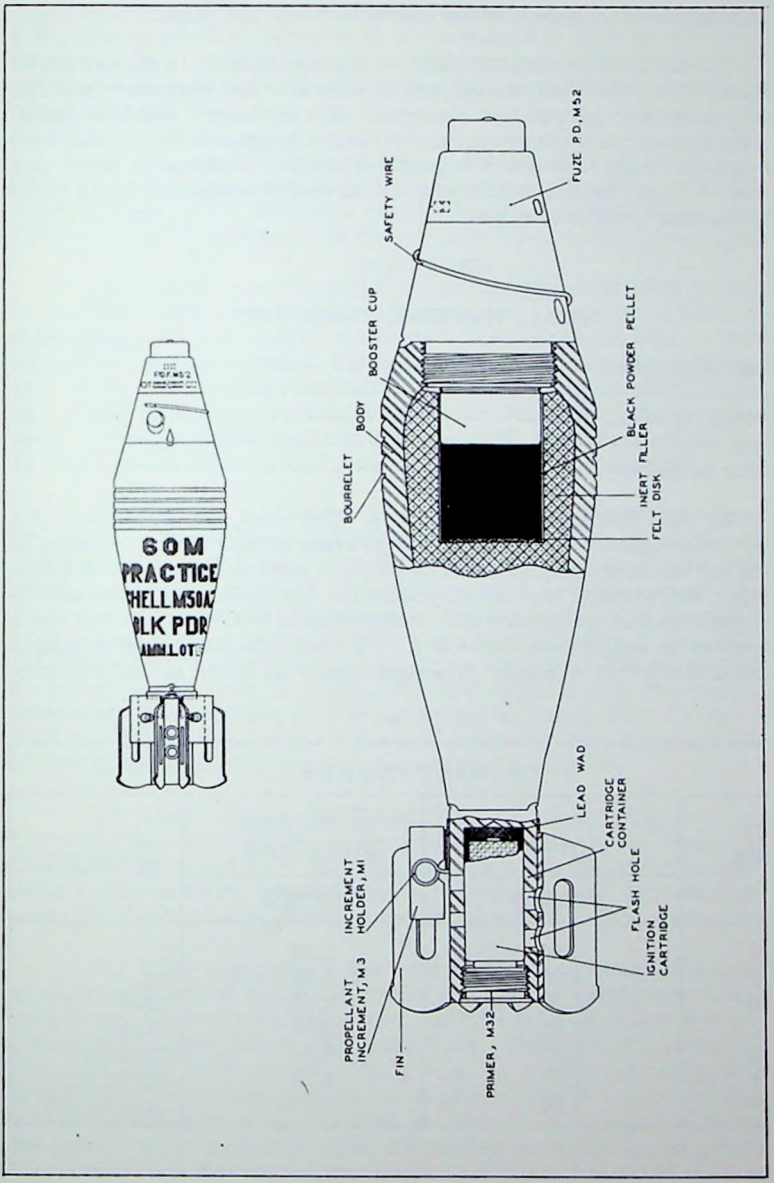


FIGURE 17. - SHELL, PRACTICE, M50A2, FOR THE 60-MM MORTARS, M1 AND M2

high, except the lot number, whose characters are 1/4" high.

52. EXTERIOR BALLISTICS. - All the results in paragraph 48 and figure 16 for the shell, M49A2, are equally true for the practice shell, M50A2, except that information concerned with the "burst" does not apply. The explosion of the black powder pellet causes fragmentation of the shell body, but the fragments are of considerable size. Because of their size and low velocity the fragments are not casualty producing beyond the relatively short radius of burst.

SECTION V

SHELL, TRAINING, 60-MM, M69

53. GENERAL DESCRIPTION. - a. The shell, training, M69, is a simply constructed round, designed to provide mortar crews training in loading and handling ammunition. The round is assembled with the ignition cartridge, M4, which is the only propellant for the shell. The fin assembly is the same as that assembled with the M49A2 and M50A2 shell. The shell body varies in weight from 3.83- to 4.07 lb. and this difference in weight is broken down into a series of weight zones as listed in the following table:

WEIGHT ZONES			
ZONES	OVER	UP TO AND INCLUDING	MARKING
	POUNDS	POUNDS	
1	3.83	3.86	□
2	3.86	3.90	□□
3	3.90	3.93	□□□
4	3.93	3.97	□□□□
5	3.97	4.00	□□□□□
6	4.00	4.04	□□□□□□
7	4.04	4.07	□□□□□□□

Since rounds of different weight have different ranges when propelled by a standard cartridge, adjustment of the mortar is necessary to secure a uniform range. The shells are marked to indicate their weight zone and a firing table included with the ammunition provides the necessary data for adjustment of the mortar.

b. The shell, training, 60-mm, M69, consists of a solid cast iron body, a fin assembly, and an ignition cartridge. The fin assembly is the same as that in the complete rounds, M49A2, and M50A2 (see par. 43). The other two components are described in the following paragraphs.

54. BODY. - a. Description (see fig. 18). - The body of the shell is cast from gray iron to the general shape of a pear and is given a machine finish of good quality. A recess in the rear of the body is threaded to receive the fin assembly. The bourrelet is a raised portion of the body 0.91" wide and 2.362" in diameter. Forward of the bourrelet the body is curved smoothly to a radius of 2.33". To the rear of the bourrelet the body has a diametrical taper of 0.41" per inch. The diameter of the shell at the base is 0.98"; the total length of the shell body is 5.535"

b. Marking. - The markings shown in the table in paragraph 53 are marked on the lacquered surface of the shell body, in white marking ink, according to the weight of the body. In the center of each square a prick punch mark is made that will identify the weight zone of the shell after the stenciling is effaced. All exterior surfaces of the shell body (except bourrelet) are coated with black lacquer enamel. In addition to the weight zone marking the caliber of the shell and its model number are stenciled on the body in characters 5/8" high, just to the rear of the bourrelet. The body has an average weight of 3.95 lb. with a tolerance of 0.12 lb. The fin assembly weighs 0.45 lb.; the ignition cartridge 0.03 lb. The total weight of the complete round is 4.43 $\pm$ 0.12 lb.

55. CARTRIDGE, IGNITION, M4. - a. Description (see fig. 18). The cartridge, ignition, M4, is the propellant for the shell, training, M69. The cartridge, M4, differs from the cartridge, M5, in that the former contains a primer as an integral part of the assemblage. The M4 cartridge consists of a body assembly, a commercial primer, and a powder charge.

(1) Body assembly. - The body assembly is essentially a shotgun shell, being made of paper and having a brass inner and outer base. The body is commercial cartridge paper, the outside layer yellow in color, and reinforced at one end by the brass base. The cylindrical body is 1.89" long and 0.65" in diameter. The primer is inserted in the holes in the brass bases and is firmly held in position by means of a compressed paper wad in the shape of a washer that is crimped to the base and into which the primer is force fitted. After the powder charge is loaded a series of three wads are inserted at the opposite end and the rim of the cylinder

FIGURE 18. - SHELL, TRAINING, 60-MM, M69

roll crimped to hold the wads in place. The complete assembly is then dipped in molten paraffin. The cartridge is held in place in the cartridge container by a push fit of the brass base.

(2) Primer. - The primer assembled in the cartridge is a commercial one and is manufactured to various designs. The composition of the primer mixture, however, must consist of mercury fulminate, antimony sulphide, potassium chlorate, and ground glass (if necessary) in proportions determined by the manufacturer. The effective surface of the primer exposed to the firing pin must have a minimum diameter of 0.2".

(3) Charge. - The charge consists of 47 $\pm$ 0.5 grains of commercial powder, known as Special Infallible Powder.

b. Marking. - The cartridge, ignition, M4, is yellow in color with a brass base. Stamped on the base are the manufacturer's initials, the caliber of the shell in which the cartridge is to be assembled, and the model number of the cartridge. On a white paper disk, glued to the outer surface of the outer wad, is stenciled the manufacturer's initials, lot number, date of loading, and caliber of shell in which the cartridge is to be fired.

56. PACKING. - The packing of this shell is considered neither critical nor essential and consequently no standard packing has as yet been determined. The latest information available indicates that the shell body, the fin, and the ignition cartridge will all be packed separately. Twenty-five of the shell bodies are packed in a nonstandard cardboard container. One hundred and forty-seven fins are packed per nonstandard cardboard container and 500 ignition cartridges are packed in the third container. A packing chest for use as equipment with the mortar in the field contains 10 training shell with accessories.

57. EXTERIOR BALLISTICS. - No firing table is available for inclusion in this text, but the results of proving ground tests are listed below.

Range in yards	Elevation	
	Deg.	Min.
0	90	00
25	86	54
50	83	48
75	80	37
100	77	18
125	73	48
150	70	00
175	65	43

Range in yards (cont'd)	Elevation (cont'd)	
	Deg.	Min.
200	60	36
225	53	06
235	45	00

Muzzle velocity ---------- feet per second 152.5

SECTION VI

SHELL, ILLUMINATING, 60-MM, M83

58. GENERAL DESCRIPTION. - a. The shell, illuminating, M83, was designed to provide a night light of relatively high candlepower that could be fired from a standard infantry weapon. The shell described in this section adequately fills the need, having 100,000 candlepower minimum, and burning for 25 seconds while drifting earthward on its parachute. The shell is longer than the other 60-mm ammunition, measuring 14" approximately, has a tapered tail, and weighs 3.7 lb.

b. The shell (see fig. 19) consists of the following components: fuze, body assembly, parachute assembly, illuminant assembly, fin assembly, propellant, ignition cartridge, and primer. Each of these components will be described in the following paragraphs.

59. FUZE. - a. Description. - The fuze, time, M65 (see fig. 20), is assembled to the shell, illuminating, M83. It is a simple powder time-train fuze whose burning time is fixed. The fuze consists of a body assembly, a time-train ring assembly, a head assembly, and a primer assembly.

(1) Body assembly. - The body is aluminum alloy, die cast to the shape illustrated in figure 20. The upper projection is threaded to receive the head and a recess is drilled to seat the primer. This recess

narrows and is met at right angles by a hole drilled through the wall of the time-train ring recess. The continuation of the primer recess and the hole which meets it form the flash vent for the primer flame. The surface of the base on which the time-train ring rests is cut with eight annular grooves. Glued to this grooved surface is a fuze-cloth body washer. In the rear face of the body a recess is formed for the expelling charge. The lower edge of this recess is threaded to receive the steel expelling charge retainer ring that holds the steel expelling charge retainer disk and crinoline cover against the expelling charge. Leading from the surface of the time-train ring recess base to the expelling charge recess is a third hole, 0.209" in diameter for a distance of 0.44" and 0.076" in diameter for the remaining distance of approximately 1" The hole is drilled at an angle of 45° to the surface of the time-train ring recess base. The upper or larger section of the hole houses the body pellet; the lower section is empty and is the flash hole proper. A fourth hole, 0.128" in diameter, is drilled normal to the surface of the time-train ring recess base. In this hole is seated the brass ring locating pin that fits into a hole in the time-train ring, thus properly locating the ring in the final assembly.

(2) Time-train ring assembly. - The time-train ring is essentially a large, thick washer that fits over the upper projection of the body and rests on the fuze-cloth covered surface of the time-train ring recess base. The time-train ring is made of brass, 2.33" in diameter, 0.38" thick, and with a hole in the center 1" in diameter. In the lower surface of the ring is an annular groove interrupted by a brass plug. This groove houses the groove charge. Leading into the groove from the inner wall of the ring is a hole, 0.166" in diameter and drilled at an angle of 12°. The hole is a continuation of the primer flash vent in the head, and houses a 1/4" length of quickmatch. Drilled from the outer wall of the ring and meeting the annular groove at the junction of the quickmatch hole and the annular groove is still another hole. This hole is closed by a lead vent closing disk and vent crimping support washer. The disk melts on the ignition of the groove charge and permits the combustion gases to escape. An onionskin paper groove cover is shellacked to the lower surface of the ring.

(3) Head assembly. - The head, made of aluminum alloy, has two functions: first, to house the striker; second, to hold the time-train ring securely in place. The striker is housed in a cul-de-sac recess in the top of the head. Passing through the head and the striker is a removable cotter pin and pull ring. Also passing through the striker and head is a shear wire. The inner recess of the head is threaded to receive the projection on the body. An outer flange rests on the top of the time-train ring, and when the head is tightened, holds the ring firmly in place.

(4) Primer assembly. - The primer is the standard primer, M32, described in paragraph 46.

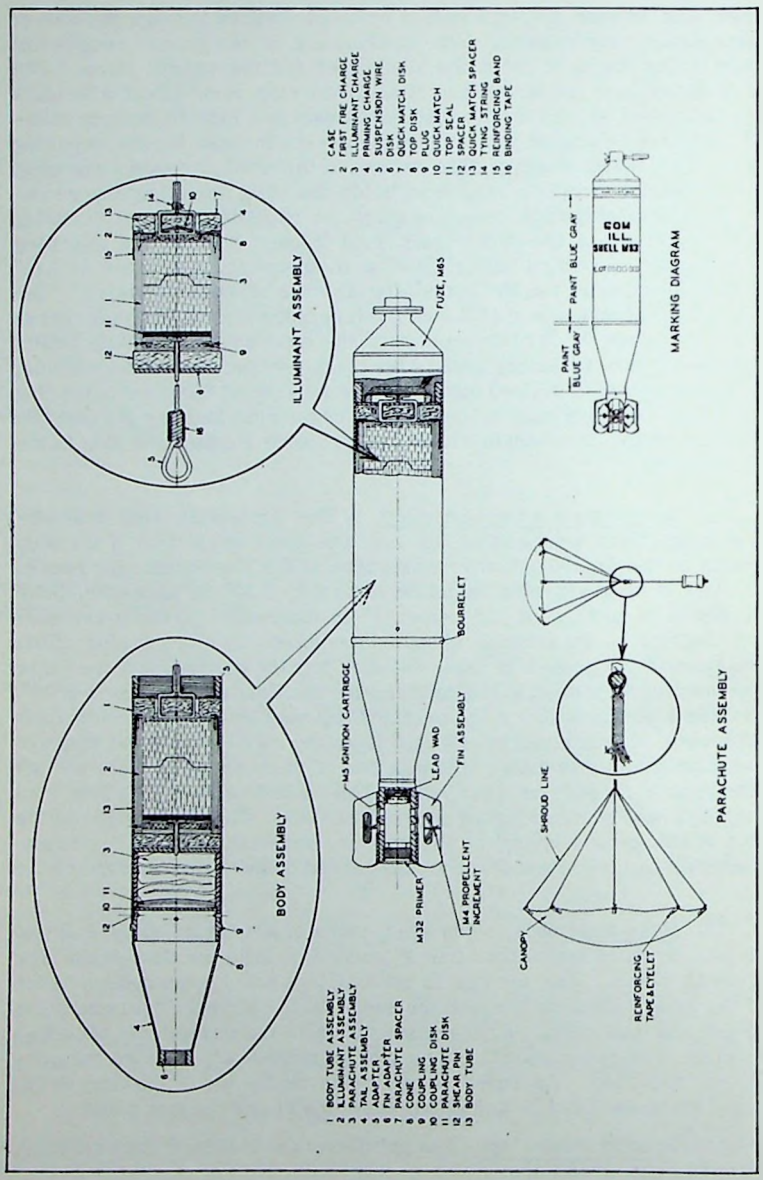


FIGURE 19. - SHELL, ILLUMINATING, M83, FOR THE 60-MM MORTARS, M1 AND M2

FIGURE 20. - FUZE, TIME (FIXED), M65

(5) Explosive components. - In the flash vent of the time-train ring is housed a 1/4" length of quickmatch that transmits the primer flame to the groove charge. The groove charge is approximately 60 grains of fuze powder — black powder of a very fine texture. The powder is pressed into place under a pressure of 68,000 lb./sq. in. The body pellet which leads from the ring to the expelling charge consists of approximately 5.2 grains of black powder pelleted under a pressure of 50,000 lb./sq. in. The body pellet has a core, the pellet charge, consisting of approximately 0.022 grain of nitrocellulose. The expelling charge is 40 grains of black powder.

b. Action. - The cotter pin is removed just prior to dropping the round down the bore of the mortar. The shear wire retains the striker in its normal position. The sudden forward motion of the round under the action of the propellant, causes the striker, through set-back, to shear the wire and move to the rear. The nipple of the striker functions the primer. The flame from the primer ignites the quickmatch in the time-train ring flash ball. The quickmatch in turn ignites the time-train ring groove charge. The groove charge has a burning time about the ring of 14 $\pm$ 3/4 seconds. When the flame from the groove charge has completed its circle about the time-train ring, it ignites the body pellet and pellet charge. The latter powders ignite the expelling charge. The flame from the expelling charge passes to the rear through the apertures in the expelling charge retainer disk. The fixed burning time of the fuze permits the round, fired with full increment charge, to be at its optimum range and height when the fuze has completed its function.

c. Marking. - On the circumferential flange, just above the body threads of the fuze is stamped in small characters "Time fuze, M65."

d. Packing. - The fuze is packed assembled to the round.

e. Safety precautions. - The cotter pin must only be removed immediately before the round is placed in the mortar.

60. BODY. - a. The body (see fig. 19) consists of a body tube assembly and a tail assembly that are fitted together by means of a coupling that is a component of the tail assembly.

b. The body tube assembly consists of the body tube and the adapter. The body tube is a machined steel tube 6.31" long, 2.343" in diameter, and approximately 0.05" thick. Spot-welded into one end of the tube is the steel adapter, an internally threaded ring, that seats the fuze.

c. The tail assembly consists of a cone, fin adapter, coupling, coupling disk, and parachute disk. The cone has the shape outlined in figure 18. The steel fin adapter, internally threaded, is welded into the

sear opening of the cone and the coupling spot-welded into the large forward opening. When the body and tail assemblies are attached, the surface of the coupling is coated with Pettman cement and, with the cement still wet, the body assembly is fitted into place. Four holes (0.089" in diameter) are drilled through the body tube and the coupling and then a shear pin is pressed into each hole. Each shear pin is 1/4" long and 0.095" in diameter. The coupling disk rests on the rim of the coupling and is held in place by the parachute spacers.

61. PARACHUTE (see fig. 19). - a. The parachute assembled in the illuminating shell is of sufficient size to permit the illuminant to burn for 25 seconds while falling to the ground from a height of approximately 400 ft. The parachute assembly consists of a parachute canopy, tying cord, eight eyelets, eight shroud lines, reinforcing tape, and tying thread.

b. The parachute canopy is cut from Fortisan cloth, in the form of an octagon having a width of 36", and pinked on the periphery. The canopy has a porosity of 225 cu. ft. of air per minute per square foot.

c. At each corner of the octagonal canopy an eyelet is crimped into the cloth, the latter being first reinforced by sewing on a strip of cotton tape with nylon thread.

d. One end of each of the shroud lines is tied to an eyelet. The cords in each assembly are the same length, usually 31". The lines are tied together with tying cord, at a point 24" distant from the eyelets.

e. The shrouds are run through the flare assembly loop and tied firmly back upon themselves with tying thread. The canopy is then folded according to specified directions and inserted in the parachute case.

f. After the illuminant assembly is inserted in the body tube, the suspension wire (to which the shroud lines are attached) is coiled in the bottom of the parachute case. The two hemicylindrical steel parachute spacers are fitted into the rear end of the body tube. They fit snugly against the inner wall of the tube and rest on the steel disk of the flare assembly. The two spacers form the cylindrical parachute case into which the chute is placed. The chute and the suspension wire are separated in the case by an onionskin paper separator. The two chipboard parachute disks are forced into place against the walls of the spacers. The coupling disk is rested on the rims of the parachute spacers and the tail assembly is pressed into position and the shear pins inserted.

62. ILLUMINANT ASSEMBLY. - a. The illuminant assembly (see fig. 19) is the functional part, the "heart," of the shell and is carefully designed to insure its effectiveness. The assembly fits into the shell

body and its front face is in contact with the fuze. Its rear face is attached to the parachute assembly by means of the suspension wire. The illuminant assembly consists of a case, first fire charge, illuminant charge, priming charge, suspension wire, steel disk, quickmatch disk, top disk, plywood plug, quickmatch, top seal, spacer, quickmatch spacer, tying string, reinforcing band, and binding tape. All of these components are illustrated in figure 19.

b. From the complete round drawing in figure 19 it may be noted that the quickmatch is in contact with the expelling charge of the fuze. The quickmatch leads through the four alined holes in the steel quickmatch disk, hair felt quickmatch spacer, and top disk, The ends of the quickmatch, which is in two lengths, are exposed to the fuze, and the middles, after passing through the four holes, pass through the priming charge.

c. The priming charge consists of a 0.055-oz. pellet of army black powder that is located just above and in contact with the first fire charge. The latter charge, which, like the primer charge, is pelleted under a pressure of 15,000 lb./sq. in., consists of 0.74 oz. of a mixture of 25% black powder and 75% illuminant composition. Since the illuminant composition is difficult to ignite, the straight black powder priming charge and the partially black powder first fire charge are set up in series to insure ignition of the illuminant. The illuminant charge is just below the first fire charge and in contact with it.

d. The illuminant charge, pressed in two equal increments, weighs approximately 8.8 oz. and has the following composition:

Barium nitrate	52.1%
Sodium nitrate	10.4%
Aluminum	26.0%
Sodium oxalate	5.2%
Sulphur	4.1%
Castor oil	1.1%
Linseed oil	1.1%

The illuminant is ignited by the first fire composition and burns with a clear white light of 100,000 candlepower, minimum, for 25 seconds, minimum. The illuminant (when the shell is in the firing position) rests on a 1/8" thick top seal of fire clay. Just below the fire clay is a 3/8" thick plug of plywood, with a hole through its center widened to a pocket at the side placed next to the fire clay.

e. All of the components of the illuminant assembly mentioned in b, c, and d above, with the exception of the quickmatch disk and quickmatch spacer, are within the illuminant case. The case is constructed of sheet boxboard, 3/8" thick, into the shape of a tube which will fit freely

into the shell body. The quickmatch passes through four holes in the top disk, the latter serving as a cover for the case after being glued and nailed into place. The plywood plug forms the lower cover of the case, being fitted within the rim and then glued and nailed into place. The fire clay top seal, illuminant, priming charge, and first fire charge are all shaped to fit into the case. The quickmatch, in passing through the holes in the top disk and the quickmatch disk and spacer anchors the latter two parts in place.

f. The suspension wire (breaking strength 100 pounds) passes through the hole in the plywood plug with the knotted end fitting flush in the pocket. The wire passes through alined holes in the hair felt spacer and steel disk. The latter forms the rest for the parachute spacers in the parachute case. The suspension wire, from the surface of this disk to the end of the loop, is approximately 11-1/2" long. The loop is formed by wrapping the wire about itself and then binding with tape. The complete illuminant assembly slips freely into the shell case, coming to rest against the fuze.

g. The top disk closing one end of the case is further sealed by the addition of an 8" long, 1" wide strip of crinoline that is pasted over the sides of the case and the top disk.

h. The hair felt spacers serve to protect the illuminant charge against the sudden shocks of set-back and expulsion from the body tube. They also assist in preventing the escape of the expelling charge gases around the illuminant case.

63. FIN ASSEMBLY. - The fin assembly is the same as that assembled with the shell, H.E., M49A2, and is discussed in paragraph 43.

64. PROPELLANT. - The increment, propellant, M4, assembled with the illuminating shell is essentially the same as the propellant increment, M3, described in paragraph 44. The M4 increment is composed of flake propellant powder and the complete increment weighs 28 grains, which is less than the weight of the M3. Four increments are assembled with the illuminating shell, corners of the increments being wedged into the fin blade slots to hold the increments in place. No increment holder is used with the illuminating shell.

65. IGNITION CARTRIDGE. - The ignition cartridge, M5A1, is assembled to the M83 illuminating shell. It is described in par. 45d.

66. PRIMER. - This component of the illuminating shell is the same primer as that assembled with the M49A2 shell and is described in paragraph 46.

67. ACTION. - a. The cotter pin is removed from the fuze and the round is dropped down the bore of the mortar. The round is propelled from the mortar in the same manner as the high-explosive shell, the propellant gases being confined by the bourrelet. Set-back causes the fuze to function in the manner described in paragraph 59b. Ignition of the expelling charge has two functions: first, to ignite the quickmatch and second, to expell the flare assembly. The latter is accomplished by the expelling charge gases acting forcibly against the steel quickmatch disk. The shock caused by these gases is transmitted to the shear pins that hold the body tube to the tail assembly coupling. These pins are sheared and the flare assembly is expelled from the body tube; the tail assembly and the fuze and body tube fall free.

b. As the flare assembly (designation of the parachute assembly and the illuminant assembly together) is forced out of the case, the two parachute spacers fall free as does the coupling and parachute disks. The parachute spacers guide the ejection of the chute from the case and when they fall free the parachute unfolds and checks the descent of the illuminant case. The flame from the expelling charge has ignited the quickmatch, which, in turn has ignited the primer charge. As the quickmatch burns through the holes in the quickmatch disk and the quickmatch spacer it disintegrates; the two components fall free.

c. The priming charge ignites the first fire charge and the latter ignites the illuminant charge. The burning of this illuminant ignites the illuminant case, but the case being in several thicknesses burns at the same rate as the illuminant and is able to support the charge for its period of burning. The fire clay prevents the flame of the burning illuminant from igniting the shroud lines, during the period of descent.

68. PACKING AND MARKING. - a. Packing (see fig. 21). - The illuminating shell is packed, complete, 1 round per fiber container, M58. Six containers (6 rounds) are packed in an outer fiber container, M86, and three outer containers (18 rounds) are assembled into a bundle.

b. Marking (see fig. 21). - All external surfaces of the illuminating shell, except the fin assembly, bourrelet, and fuze, are coated with blue-gray lacquer enamel. Stenciled on the body, circumferentially, midway between fuze and bourrelet, is the caliber of the shell, the designation of the charge, and the name and model number of the round. In smaller characters appears the lot number of the round.

(1) Container, M85. - The container is made of chipboard and is designed much the same as all other fiber containers previously discussed, having a cover and terneplate end plates. The closed container is approximately 15" long and 3" in diameter. The cover is sealed in

FIGURE 21. - PACKING OF THE SHELL, ILLUMINATING, 60-MM, M83

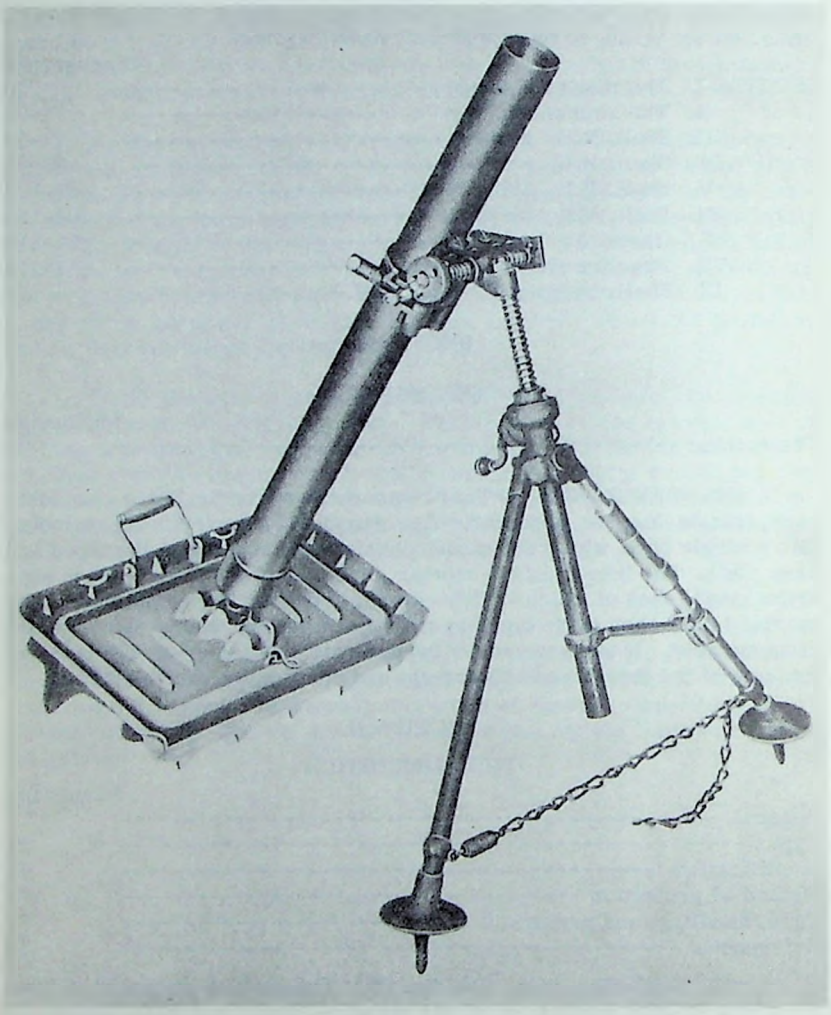


FIGURE 22. - THE 81-MM MORTAR

smooth trajectory and is highly accurate. The light shells, having thick walls, produce considerable fragmentation. The heavy shells having a heavy explosive charge produce a considerable blast effect. Combined with the mortar's ability to render plunging fire, these factors give the mortar all-around usefulness. The mortar ammunition has proven successful and valuable in all campaigns of the present war. Since its use is extensive, ordnance personnel should familiarize themselves with its appearance, components, method of functioning and packing.

c. In the theater of operations, under "normal" operating conditions, an 81-mm mortar is supplied with service ammunition (other than practice or training ammunition) in the following theoretical proportions, ordnance personnel will see 81-mm mortar ammunition in approximately these proportions:

(1) Armored Force. - 20% H.E., light. 80% WP.

(2) Other than Armored Force. - 70% H.E., light. 20% H.E., heavy. 10% WP.

72. TYPES. - a. The 10 rounds of ammunition listed below are standard for firing from the 81-mm mortar, M1, and the 3" mortar, Mk. IA2. Complete nomenclature is employed in this listing, but a shortened form of nomenclature will be used in reference to these rounds throughout the following sections. The rounds:

(1) SHELL, H.E., M43A1, w/FUZE, P. D., M52, 81-mm mortar, complete round.

(2) SHELL, H.E., M56, w/FUZE, P. D., M53, 81-mm mortar, complete round.

(3) SHELL, H.E., M45, w/FUZE, P. D., M45, 81-mm mortar, complete round.

(4) SHELL, H.E., M45B1, w/FUZE, P. D., M53, 81-mm mortar, complete round.

(5) SHELL, smoke, FS, M57, w/FUZE, P. D., M52, 81-mm mortar, complete round.

(6) SHELL, smoke, phosphorous, WP, M57, w/FUZE, P. D., M52, 81-mm mortar, complete round.

(7) SHELL, gas, persistent, HS, M57, w/FUZE, P. D., M52, 81-mm mortar, complete round.

(8) SHELL, practice, M43A1, w/FUZE, P. D., M52, 81-mm mortar, complete round.

(9) SHELL, practice, M44, w/FUZE, P. D., M52, 81-mm mortar, complete round.

(10) SHELL, training, M68, 81-mm mortar, complete round.

b. The first seven rounds listed are classified as service ammunition, that is, ammunition designed for combat firing. The last three rounds listed are suitable for practice or training only, having either no explosive charge or an ineffective explosive charge.

73. IDENTIFICATION. - a. The identification of 81-mm mortar ammunition is carried out in the same manner as 60-mm mortar ammunition, that is:

(1) By markings on fiber containers.
(2) By color of projectile.
(3) By markings on round.

b. The above three methods are described in paragraph 34.

74. METHOD OF PROJECTION. - a. The 81-mm mortar ammunition is projected in the same manner as the 60-mm mortar ammunition described in paragraph 35.

b. The 81-mm mortar ammunition is adapted for use in the 3" trench mortar, Mk. IA2, by reducing the outer zone propelling charge for the M43A1 and M44 shell, from six to four increments; for the M56 and M57 shell, from four to three increments; for the M45 and M45B1 shell, the full charge of four increments may be used. The 81-mm mortar ammunition will not be used in the 3" trench mortar, Mk. I or Mk. IA1. Ordnance personnel must understand this distinction clearly for in many cases the using troops will not be informed of the necessary restrictions in firing 81-mm ammunition in the 3" mortar and serious accidents may occur.

75. CARE, HANDLING, AND PRESERVATION. - The same general rules described for the 60-mm ammunition, listed in paragraph 36, apply to 81-mm mortar ammunition.

76. REFERENCES. - For a complete discussion of packing, marking, and identification of 81-mm mortar ammunition refer to Standard Nomenclature List No. R-4, Ammunition, Trench Mortar, including Fuzes, Propelling Charges, and Other Components. For reference material concerning the mortar and its ammunition, consult Basic Field Manual

FIGURE 23. - THE AMMUNITION

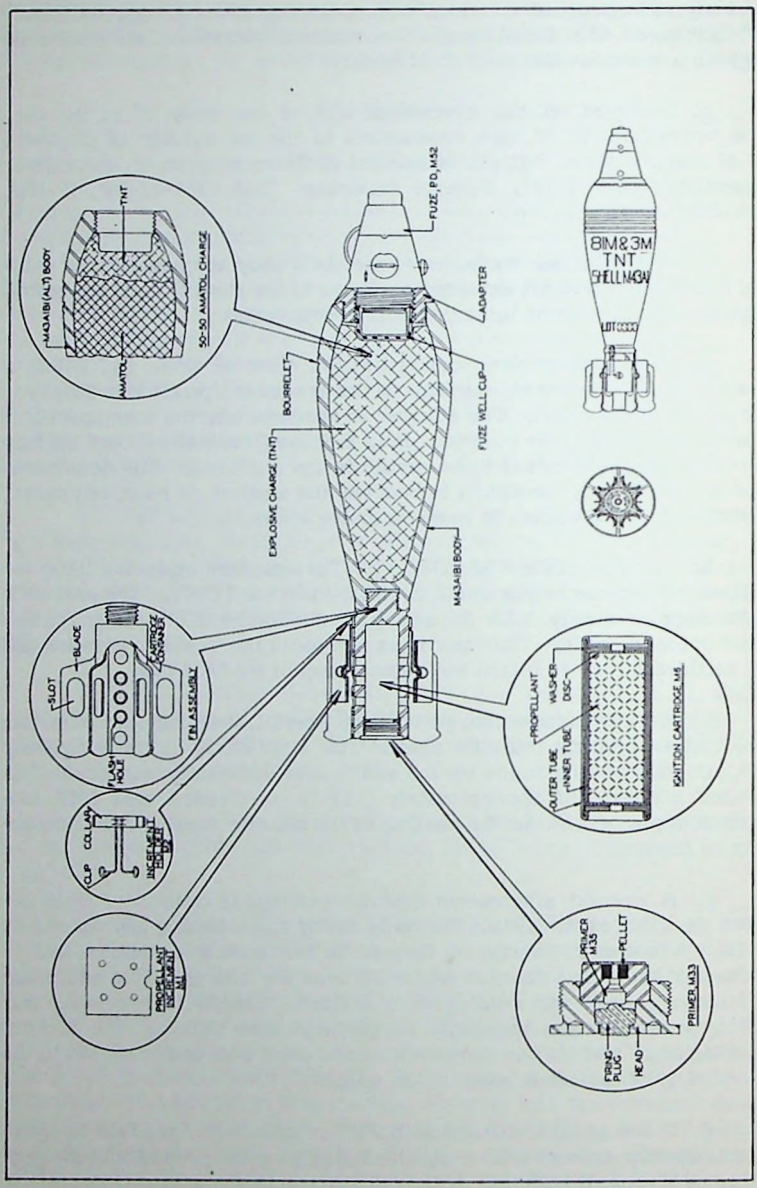


FIGURE 24. - SHELL, H.E., M43A1

e. At the time that the shell body is loaded with explosive, all external surfaces of the shell body (except bourrelet) are recoated with olive-drab lacquer enamel. The identifying marks stamped in the shell body are thus obscured or partially obscured. Then circumferentially, on the surface of the shell, below the bourrelet, is stenciled the designation of the weapon in which the round is to be fired, the type of explosive filler, the name of the round (SHELL, M43A1), and the lot number. The type of explosive filler is stenciled as follows:

"TNT" for cast TNT.

"AM 50-50" for 50-50 amatol.

"TRIMONITE" for cast trimonite.

All stenciled characters are 5/8" high except those of the lot number which are 3/8" high.

82. FIN ASSEMBLY. - a. The fin assembly is essentially the same as that assembled with the 60-mm ammunition (see par. 43). The shape of the fins is somewhat different, having a sharper point at the bearing surface at the rear face of the blade*; the forward edge of the fin is curved more to take a larger rivet in assembly with the cartridge container. The dimensions of the fins are generally a third larger, although the slots in the blades are only 0.1" longer. Each fin has three flash holes instead of the two in the 60-mm fin.

b. The cartridge container of the 81-mm fin assembly is similar to the cartridge container of the 60-mm fin assembly. The essential difference between the two, aside from size, is that the former has 18 flash holes, while the latter has 16. The container is 3.52" in over-all length and 1.23" in diameter.

c. All components of the 81-mm fin assembly are painted or treated in the same manner as the 60-mm fin assembly.

83. PROPELLANT. - a. Increment, propellant, M1. - Propellant powder in flake form composes the propellant increments assembled in the complete round, M43A1. Each flake is approximately 1.5" square, having a hole 0.2" in diameter in the center and four smaller holes (0.08" diameter) spaced about the center hole. Each flake is approximately 0.001" thick; approximately 15 flakes are sewn together to form a bundle,

---

*Blade is the upright section of the fin. The fin consists of two blades and connecting center section which bears the rivet holes and flash holes.

called an increment. The sides of the increment may be notched to bring the weight to 117 ± 2 grains.

b. Assembly. - Six increments are included in the fin assembly of the complete round (see fig. 24). To fire the ammunition in different ranges or in different models of mortars, the increments are removed as specified in firing tables.

c. Holder, increment, M2 assembly. - In general design and function this increment holder resembles the holder assembled with the 60-mm shell, M49A2. The M2 assembly consists of three clips and a collar, all having greater dimensions than those of the M1 assembly, but assembled together and to the round in much the same way. The three clips hold the increments firmly in place by drawing the centers of the increments downward against the tension afforded by the corners being lodged in the blade slots.

84. IGNITION CARTRIDGE. - The ignition cartridge, M6, is, except for size, exactly the same as the ignition cartridge, M5, described in paragraph 45. It is the same in design, function, and assembly. It is 2.23" long after the ends are crimped, 0.795" in diameter, has a 120-grain propellant powder charge, is red or yellow in color, and bears identification on its outer washer similar to that of the M5 cartridge.

85. PRIMER. - The primer, M33 (see fig. 24) assembled with the 81-mm shell, M43A1 is essentially the same as the primer, M32 (see par. 46). Here again the primer, M35, is housed within the primer housing of the primer, M33, and its flame is reinforced by the action of a black powder pellet. The head of the primer, M33 (81-mm shell) is larger than the head of the M32 (60-mm shell), but all other components are approximately the same size. The external surface of the firing plug, through design of the primer, is above the surface of the head or flush with it. In action, construction, and identification the two primers are similar.

86. PACKING AND MARKING. - a. Packing (see fig. 25). - The shell, M43A1, is packed in an individual fiber container, M36A1, six containers (6 rounds) per bundle. The bundle packing is the most common packing personnel will see and handle in the field and they should be familiar with its properties.

(1) Container, M36A1. - This is the standard fiber container, similar in design to the individual fiber container employed in packing the 60-mm shell, M49A2 (see par. 47). The container is made of waterproof chipboard with terneplate ends. A chipboard support and terneplate reinforcing ring prevent the striker of the fuze from contacting the lower end plate. A yellow adhesive sealing strip 2" x 30" wrapped about

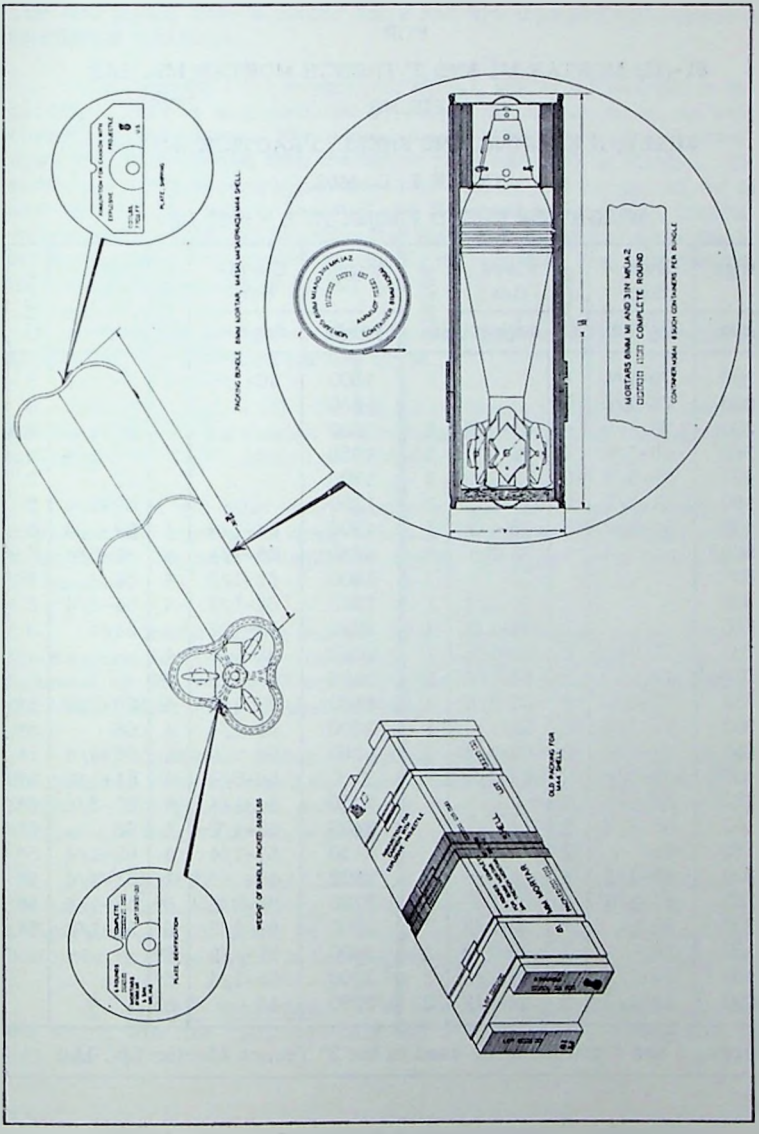


FIGURE 25. - PACKING AND MARKING OF THE SHELL, H.E., 81-MM, M43A1

ORDNANCE SCHOOL

FIRING TABLE

FOR

81-MM MORTAR M1 AND 3" TRENCH MORTAR MK. 1A2

FIRING

SHELL, H.E., M43A1 AND SHELL, PRACTICE, M43A1

FUZE P. D. M52

WEIGHT OF FUZED PROJECTILE - 6.87 LB.

Range	Elevation	Charge	Elevation	Charge	Range	Elevation	Charge	Elevation	Charge
yards	degrees		degrees		yards	degrees		degrees	
200	79-1/4	0			1500	46-1/4	2	66-1/2	3
250	76-1/4	0			1550			65-1/2	3
300	73	0	81-1/4	1	1600			64-1/2	3
350	69-1/2	0	80	1	1650			63-1/4	3
400	65-3/4	0	78-1/2	1	1700			62	3
450	61-1/2	0	77	1	1750			60-3/4	3
500	55-3/4	0	75-1/2	1	1800	67-1/4	4	59-1/4	3
550			73-3/4	1	1850	66-1/4	4	57-3/4	3
600			72	1	1900	65-1/2	4	56	3
650			70-1/4	1	1950	64-1/2	4	55-3/4	3
700			68-1/2	1	2000	63-1/2	4	51	3
750	75	2	66-1/2	1	2050	62-1/2	4		
800	74	2	64-1/4	1	2100	61-1/2	4		
850	72-3/4	2	61-3/4	1	2150	60-1/2	4	66-3/4	5*
900	71-1/2	2	59	1	2200	59-1/4	4	66	5*
950	70-1/2	2	55-1/4	1	2250	58	4	65-1/4	5*
1000	69-1/4	2	49-1/4	1	2300	56-3/4	4	64-1/2	5*
1050	67-3/4	2			2350	55-1/4	4	63-3/4	5*
1100	66-1/2	2			2400	53-1/2	4	63	5*
1150	65	2			2450	51-1/4	4	62-1/4	5*
1200	63-1/2	2			2500	48	4	61-1/4	5*
1250	61-3/4	2			2700	62-3/4	6*	57-1/4	5*
1300	60	2	70-1/2	3	2900	59-1/2	6*	51-1/2	5*
1350	58	2	69-1/2	3	3000	57-1/2	6*		
1400	55-1/2	2	68-1/2	3	3100	55-1/4	6*		
1450	52-1/2	2	67-1/2	3	3290	46	6*		

*Charges 5 and 6 are not to be used in the 3" Trench Mortar Mk. IA2

FIGURE 26. - FIRING TABLE FOR SHELL, H.E., M43A1

the joint between cover and body bears identifying marking in black ink. The end plates have a center bulge and are stamped and painted with identifying markings.

(2) Bundle. - Six containers, M36A1, are assembled into a bundle packing. This is accomplished by employing center plates as well as cloverleaf end plates. Three containers, M36A1, are packed cover end down into an end plate; then the center plate assembly is located. Three additional containers are packed cover end up, and the second end plate assembled. The bar is inserted and tightened by wing nuts, making the entire bundle rigid. An identification plate and a shipping plate are located so that their information is readily discernible. The complete bundle is 30-5/8" long and weighs 58.01 lb.

(3) Crate. - For oversea shipment three bundles (18 rounds) are assembled into a wooden packing crate.

b. Marking. - (1) On the fuze appears the name and number of the fuze, loader's lot number and initials, and the date of loading. Sample stamping: "P. D. F., M52, Lot 1234-56, P. A. 11-42."

(2) On the olive-drab lacquered surface of the complete round, in yellow ink, appear the designation of the weapon in which the round is to be fired, the type of explosive filler, the name of the round, and the lot number.

(3) On the yellow sealing strip appear the name and number of the weapons in which the round may be fired, the projectile designation followed by the words "Complete Round." The projectile designation for the M43A1 H.E. shell is "shell M43A1."

(4) On the end plates are stamped the name of the weapon in which the round is to be fired and the name of the container "Container, 81-mm, M36A1." The projectile designation and the loader's initials and lot number are marked in white paint.

87. EXTERIOR BALLISTICS. - a. General. - Figure 26 illustrates the ranges obtained by firing the shell, H.E., M43A1, with varying propelling charges. It should be noted that a 0 in the column headed "Charge" indicates that the round is being fired with the ignition cartridge only.

b. Muzzle velocities. - The muzzle velocities obtained by firing the round with the cartridge only and with additional increments is as follows:

Charge	Feet per second
Cartridge only	235
Cartridge plus one increment	332
Cartridge plus two increments	419
Cartridge plus three increments	499
Cartridge plus four increments	572
Cartridge plus five increments	638
Cartridge plus six increments	700

c. The firing table in figure 26 and listing of muzzle velocities are based on firings conducted at the Aberdeen Proving Ground.

SECTION IV

SHELL, H.E., M56

88. GENERAL. - a. The shell, M56 (see fig. 27), is the standard heavy high-explosive round for projection from the 81-mm mortar, M1, and the 3" mortar, Mk. IA2. It is 22.89" long, and weighs approximately 10.77 lb., the weight varying with the type of explosive charge. It is packed with four propellant increments, any of which may be readily removed to adjust the range.

b. The M56 shell is equipped with a delay fuze; the explosive charge comprises 45% of the weight of the shell (the charge of the M43A1 comprises approximately 17% of the weight of the shell); the walls of the shell are relatively thin. These three facts indicate that the M56 is designed to give a powerful blast effect coupled with a mining effect derived from its high trajectory. The M56 supplements of action of the M43A1, which is primarily designed to produce a heavy fragmentation effect.

89. DESCRIPTION OF COMPONENTS. - The shell, H.E., M56 (see fig. 27), consists of a fuze, body, explosive charge, fin assembly, propellant, ignition cartridge, and primer. In the following paragraphs each of these components will be described.

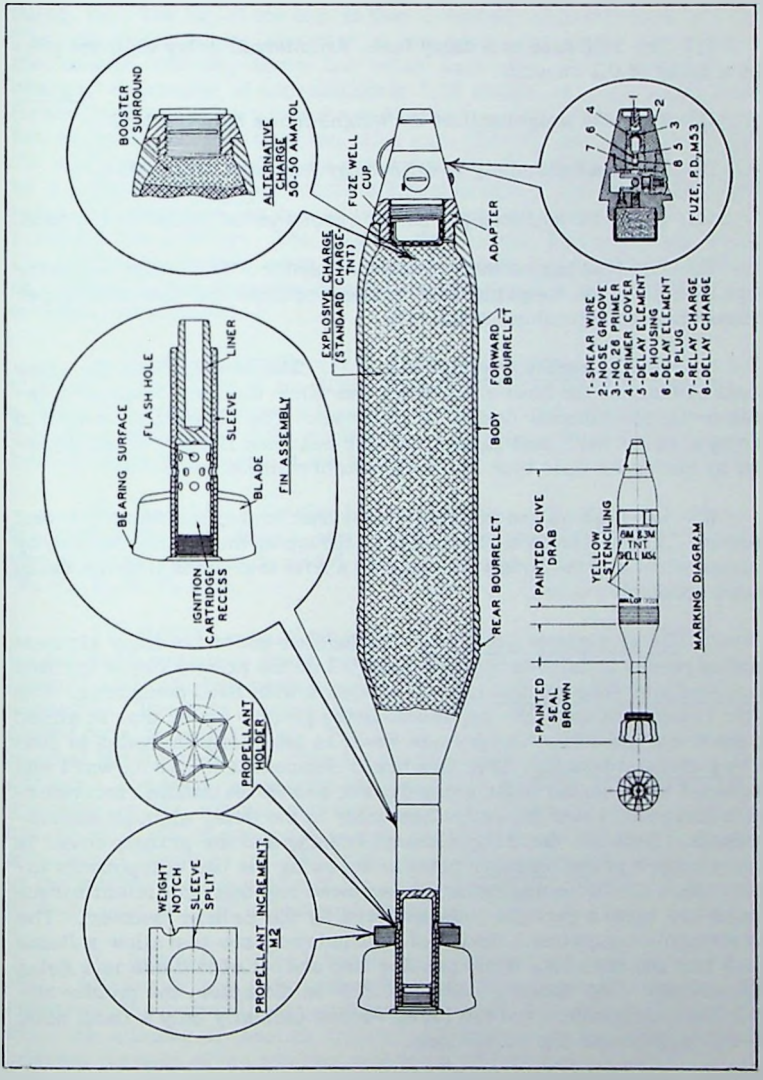


FIGURE 27. - SHELL, H.E., 81-MM, M56

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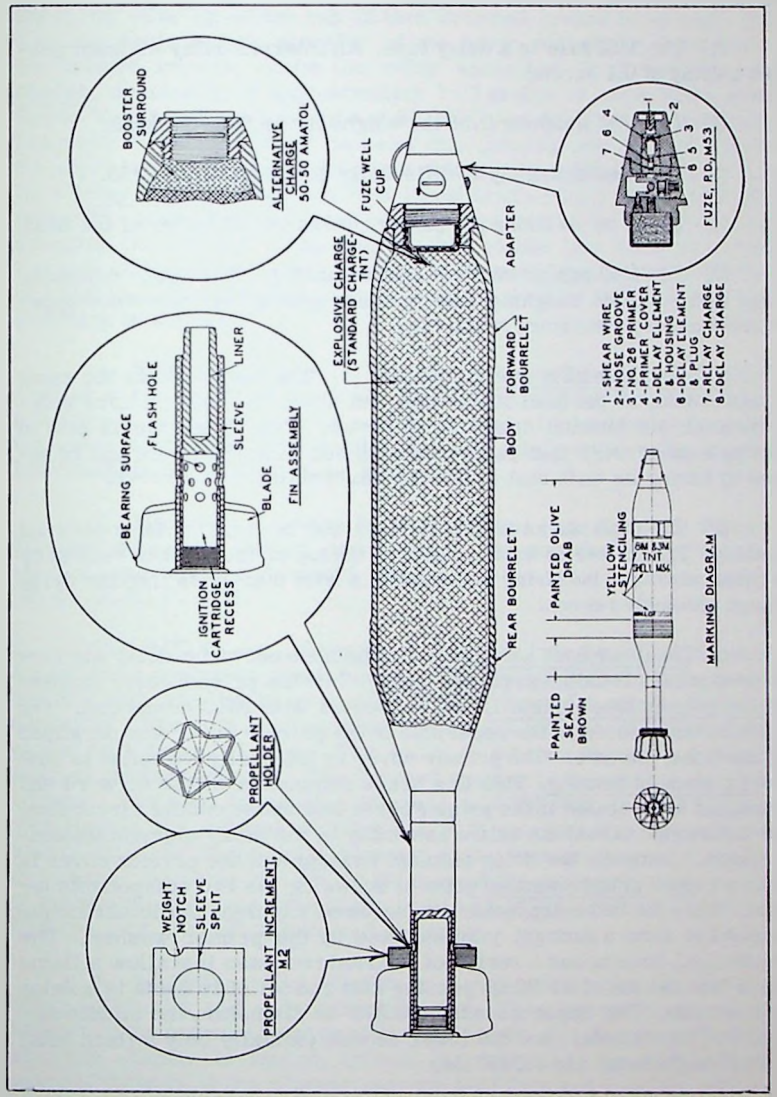


FIGURE 27. - SHELL, H.E., 81-MM, M56

90. FUZE. - a. M52 and M53. - The M53 fuze differs from the M52 fuze in several important respects.

(1) The M53 fuze is a delay fuze. An internal delay element provides a delay of 0.1 second.

(2) The M53 weighing 0.54 lb. weighs more than the M52.

(3) The head assembly is differently designed in the M53.

(4) There is no firing pin safety recess in the slider of the M53.

(5) The M53 has no intermediate detonator. The upper detonator charge of lead azide weighing 3.86 grains replaces the combined upper and intermediate detonators of the M52.

b. Head assembly (see fig. 27). - (1) The head follows the same general contour as the head of the M52, but since the fuze contains a delay element, its internal design is different. The firing pin is held in place by a shear wire that passes through head and firing pin and is secured by having its ends bent into a circumferential nose groove.

(2) The head has an internal recess that houses the delay element assembly. The striker is held in place at the top of the striker recess by the shear wire, and the firing pin rides in a hole that leads into the delay element assembly recess.

c. Delay element assembly. - In the nose end of the delay element assembly recess is the brass primer cover. Into the primer cover is fitted a No. 26 primer (see volume 1) that is coated with NRC compound. The primer is centered below the upper hole in the primer cover that is alined with the firing pin hole. The primer cover is internally threaded to seat the delay element housing. This is a brass component whose forward end is threaded to be seated in the primer cover and whose middle circumference is threaded to hold the entire assembly in the delay element assembly recess. Between the delay element housing and the primer cover is placed a copper primer washer prior to screwing the two components together. When the two components are screwed together, sufficient torque is applied to form a gastight joint assisted by the primer washer. The delay element housing has a series of internal recesses that allow a flame to pass into and out of it. While passing into and out of it there is a delay of 0.1 seconds. The upper recess is 0.226" in diameter, the middle recess 0.124" in diameter, and the lower recess (actually only a flash hole) is 0.051" in diameter and 0.045" long.

d. Explosive components. - In the primer cover is assembled primer No. 26. In the bottom of the middle recess of the delay element

housing is placed a relay charge. This charge, 0.77 grain of lead azide, is pressed into an aluminum relay cup under a pressure of 25,000 lb/sq. in. The lip of the cup is then crimped inward to an angle of 45°. The cup rests on the shoulder of the lower recess, or flash hole. In the middle recess, above the relay assembly, is pressed the delay charge, consisting of approximately 1.23 grains of army black powder, Grade "A-5," under a pressure of 60,000 lb/sq. in. This pressure simultaneously closes the lip of the relay cup, leaving only a small aperture. To apply the pressure to the delay charge, the middle recess is closed by a delay element plug, made of Naval brass. This plug under 60,000 lb/sq. in. pressure, is forced into the recess, at the same time compressing the powder. The plug is then locked into place by crimping the wall of the recess over the rim of the plug under a dead load weight of 1,000 lb. The complete delay element assembly is assembled before insertion in the head.

e. Slider assembly. - In general design the slider of the M53 is similar to the slider of the M52. In the former there is no necessity for a firing pin safety recess and none is formed. In the detonator assembly the upper detonator, 3.86 grains of lead azide, replaces the upper and intermediate detonators of the M52.

f. Marking. - On the head of the fuze just above the flange are stamped with 1/8" letters and figures, the manufacturer's initials or symbol, and name and model number of the fuze. Sample stamping: "P. A., P. D. F. M53."

91. BODY. - a. General. - The body (see fig. 27) of the shell is forged from seamless steel tubing. The rear of the tube is tapered in a boattail and into the narrow rear face is formed a recess for the tail assembly. The hole leading from this recess into the explosive cavity is closed by a threaded plug. The walls of the tube thicken and curve inward at the forward end. The forward opening is threaded to receive the adapter. The body (minus the adapter) is 14.50" long, is 2.92" in internal diameter in the central section; 3.175" in external diameter at the rear bourrelet; 3.181" in external diameter at the forward bourrelet; tapers to an internal diameter of 1.08" at the rear of the explosive cavity and 2.06" at the mouth; the rear face of the shell is 1.14" in external diameter; the forward face is 2.38" in external diameter.

b. Adapter. - The adapter is a ring-shaped plug of cold-drawn steel, internally and externally threaded. The external threads seat the adapter in the forward opening of the shell body. The flange of the adapter, when the adapter is seated, follows the contour of the shell body. The internal threads of the adapter seat the M53 fuze and fuze well cup, when the cup is necessary.

c. Bourrelet. - (1) The rear bourrelet consists of a series of five finely machined parallel circumferential grooves, each 0.08" wide and 0.16" apart, beveled toward the rear in a raised portion of the shell body. The width of the bourrelet is 1.26" and the diameter of the shell at the bourrelet is 3.175".

(2) The forward bourrelet is a three-point-contact bourrelet. The three bearing surfaces are each 1.00" long and 0.54" wide. The diameter of the shell at the bearing surfaces is 3.181", at the surface of the band, 3.15".

d. Marking and painting. - (1) Stamped on the circumference of the body, 1" forward of the rear bourrelet, with 1/8" letters and figures are the number of the shell, initials, or symbols of the manufacturer, caliber and designation of the shell, and year of manufacture. Sample stamping: "Lot 1234 F.A., 81-mm, M56 1942."

(2) All exterior surfaces of the shell body (except rear bourrelet) are coated with lusterless olive-drab lacquer enamel. The interior surface of the shell body is coated with acidproof black paint.

92. EXPLOSIVE CHARGE. - a. The standard explosive charge (see fig. 27) for the shell, M56, is Grade I, TNT. The cast TNT weighing approximately 4.30 lb. fills the entire shell cavity, except for the fuze well (see par. 81).

b. An alternative charge is 50-50 amatol, weighing approximately 3.89 lb. when cast in the shell. The booster surround (see par. 81b) is 0.20 lb. of TNT to a minimum depth of 0.5".

c. A second alternative charge is cast trimonite weighing approximately 4.46 lb. The bakelite fuze well cup (see par. 81c.) weighs approximately 0.01 lb.

d. A closing plug is inserted in the shell loaded with TNT or amatol if the fuze is not to be immediately assembly.

e. At the time that the shell body is loaded with explosive, all external surfaces of the shell body (except bourrelets) are recoated with olive-drab lacquer enamel. The identifying marks stamped into the body are thus partially or totally obscured. Then circumferentially, on the surface of the shell, between the bourrelets, are stenciled in yellow marking ink the designation of the weapon in which the round is to be fired, the type of explosive filler, the name of the round (SHELL M56), and the lot number. The type of explosive filler is stenciled as

explained in paragraph 81e. All stenciled characters are 5/8" high except those of the lot number which are 3/8" high.

93. FIN ASSEMBLY. - a. General. - The fin assembly (see fig. 27) for the M56 shell is different from the fin assembly of mortar shells previously discussed. It consists of a fin, having 12 blades and a liner. Complete, the assembly is 6.12" long; the fin has a maximum diameter of 3.181", and the whole assembly weighs approximately 0.89 lb.

(1) Fin. - The fin is a die casting from an aluminum base alloy. It consists of a sleeve, 1.01" in internal diameter at the rear and narrowing sharply to 0.812" in internal diameter at a point 3.06" from the rear. The external diameter of the sleeve, 1.15", remains the same throughout the length. The blades extend radially from the rear of the sleeve and are 1.75" long and approximately 1" high. The raised bearing surface at the top rear face of the blade is 0.2" long and 0.08" wide. The blades have the outline shown in figure 27.

(2) Liner. - The liner fits inside the sleeve and complements the internal shaper of the latter. The liner has two recesses: one, opening to the rear and threaded at its outer end, that houses the ignition cartridge, and seats the primer; the other a boring opening to the front. The two recesses are separated by a solid section near the middle of the liner. The liner projects beyond the forward opening of the sleeve approximately 0.75". This portion is threaded and fits into the rear recess of the shell body. By tightening the fin assembly both sleeve and liner are locked in place due to the internal shoulder arrangement.

b. Flash holes. - Through sleeve and liner, forward of the blades are drilled six sets of three holes per circumference, each hole 7/32" in diameter. Each set of holes is 0.35" apart and the series of holes are staggered.

c. Painting. - The internal surfaces of the rear cavity in the liner are coated with lacquer, and the threads of the forward projection of the liner are lightly coated with shell grease.

94. PROPELLANT. - a. The propellant increment, M2, is assembled to the shell, M56 (see fig. 27). The increment consists of approximately 14 square flakes of propellant powder sewed together into a bundle. Each flake is 2.22" square, 0.007" thick, and has a central hole 1.21" in diameter. The flakes are sewed together to form a bundle weighing approximately 205 ± 3 grains. The increments may be adjusted to the desired weight by notching the side. One side of the increment is split from the edge to the hole so the increment may be fitted over the fin sleeve.

b. The increments are held in place by means of a five-point star-shaped music-wire holder. The propellant holder is designed so that the hollows between points fit snugly to the fin and press the increment back against the forward base of the blades.

95. IGNITION CARTRIDGE. - The cartridge, ignition, M6, is standard for assembly with the M56 shell. It is described in paragraph 84.

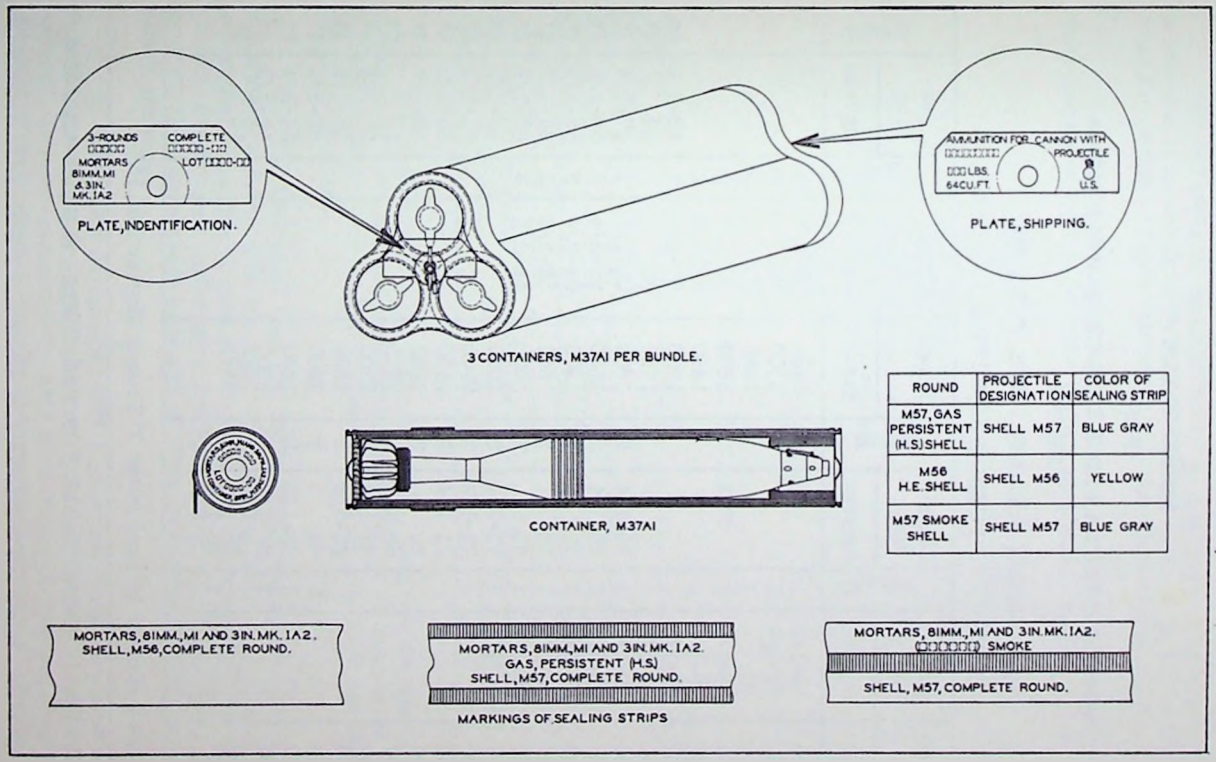
96. PRIMER. - The percussion primer, M34, is standard for assembly with the M56 shell. It resembles in general appearance and design the primer, M32, described in paragraph 46. The major changes are in size; the M34 (81-mm) houses the M35 primer as does the M32 (60-mm). The over-all dimensions of the M34 (81-mm) are: head - 1.0" in diameter (M32 - 0.82"), 0.6" deep (M32 - 0.572"); primer housing - 0.56" in diameter (M32 - 0.50"), 0.40" deep (M32 - 0.265"); disk - 0.50" in diameter (M32 - 0.44"); firing plug - 0.257" thick (M32 - 0.227"). All other general dimensions of the M34 primer are the same as the M32. The black powder pellet in both primers has the same weight. The action of the two is identical.

97. PACKING AND MARKING. - a. Packing (see fig. 28). - The shell M56 is packed one per individual fiber container, M37A1. Three such containers are bolted together — two cover end up, one cover end down — into a bundle weighing 42.2 lb. The M37A1 container follows the usual design for such containers, and is made of chipboard in the form of an interfitting inner and outer tube and cover. Terneplate ends are crimped to covers and tubes. A chipboard support is provided to prevent the striker of the fuze from contacting the end plate. The three containers, each 24" long and 4" in diameter, are formed into a bundle by the use of cloverleaf end plates, bolts, and wing nuts. The bundle thus formed is 25-3/4" long, 7-1/2" high, and weighs 42.2 lb. Identification and shipping plates are located beneath the wing nuts on the outer face of the cloverleaf end plates.

b. Marking. - (1) Sealing strip. - A yellow adhesive sealing strip 2" x 30" closes and seals the joint between the cover and outer tube of the container. About 3" of the end of the tape is folded back on itself and left free to facilitate unsealing the container. On the strip in black marking ink are stenciled the names of the weapons in which the contained round is to be fired, the name of the round (SHELL, M56), and the words "Complete round."

(2) End plates. - On the end plates appear the nomenclature of the weapon and the container, the name of the round, and its lot number.

(3) Plates. - On the identification plate and the shipping plate is stamped all the information shown in figure 28.



ROUND	PROJECTILE DESIGNATION	COLOR OF SEALING STRIP
M57, GAS PERSISTENT (H.S) SHELL	SHELL M57	BLUE GRAY
M56 H.E. SHELL	SHELL M56	YELLOW
M57 SMOKE SHELL	SHELL M57	BLUE GRAY

FIGURE 28. - PACKING AND MARKING OF THE SHELL, H.E., 81-MM, M56 (AND CHEMICAL SHELL)

FIRING TABLE

FOR

81-MM MORTAR M1 AND 3" TRENCH MORTAR MK. IA2

FIRING

SHELL, H.E., M56 FUZE, P. D., M53

WEIGHT OF FUZED PROJECTILE - 10.62 LB.

Range	Elevation	Charge	Elevation	Charge	Range	Elevation	Charge	Elevation	Charge
yards	degrees		degrees		yards	degrees		degrees	
200	83-1/2	1			1450	67-1/4	3		
250	81-3/4	1			1500	66	3		
300	80	1			1550	65	3		
350	78-1/4	1			1600	63-3/4	3		
400	76-1/2	1			1650	62-1/2	3		
450	74-1/2	1			1700	61-1/4	3	68-3/4	4*
500	72-1/2	1			1750	60	3	68	4*
550	70-1/2	1	79-1/4	2	1800	58-1/2	3	67-1/4	4*
600	68-1/4	1	78-1/4	2	1850	56-3/4	3	66-1/4	4*
650	65-3/4	1	77	2	1900	54-3/4	3	65-1/2	4*
700	63-1/4	1	76	2	1950	52-1/2	3	64-1/2	4*
750	60-1/4	1	75	2	2000	49-3/4	3	63-1/2	4*
800	56-1/2	1	73-3/4	2	2050			62-1/2	4*
850			72-1/2	2	2100			61-1/2	4*
900			71-1/4	2	2150			60-1/2	4*
950			70	2	2200			59-1/4	4*
1000			68-1/2	2	2250			58	4*
1050			67-1/4	2	2300			56-3/4	4*
1100			65-3/4	2	2350			55-1/4	4*
1150	73	3	64	2	2400			53-3/4	4*
1200	72	3	62-1/2	2	2450			51-3/4	4*
1250	71	3	60-1/2	2	2500			49-1/2	4*
1300	70-1/4	3	58-1/2	2	2560			45	4*
1350	69-1/4	3	56-1/4	2					
1400	68-1/4	3	53	2					

*Charge 4 is not to be used in the 3" Trench Mortar Mk. IA2

FIGURE 29. - FIRING TABLE FOR THE SHELL, H.E., 81-MM, M56

98. EXTERIOR BALLISTICS. - a. General. - Figure 29 is a reproduction of an abridged firing table for the shell, H.E., M56, and indicates the various ranges obtainable with the various increments.

b. Muzzle velocities. - The following list represents the approximate muzzle velocities with the various propelling charges.

Charge	Muzzle velocity feet/second
Cartridge plus one increment	306
Cartridge plus two increments	412
Cartridge plus three increments	502
Cartridge plus four increments	583

SECTION V

SHELL, H.E., M45

99. GENERAL. - a. The shell, H.E., M45, was declared limited standard — i.e., manufacture discontinued, stock on hand to be issued until exhausted — on March 8, 1940, the same date when the M56 was declared standard.

b. The M45 shell (see fig. 30) is 23.59" long and weighs 15.10lb., the weight varying with the type of explosive filler. It is designed for projection from the 81-mm mortar, M1, and the 3" mortar, Mk. IA2. It may be fired in the latter with its full charge of four propellant increments. The increments assembled in the fin may be readily removed to adjust the range.

c. The shell is equipped with a point detonating, selective setting fuze that provides for impact burst or for a slight tunneling effect. Since the shell closely resembles the M56 shell it may be considered to be designed for blast effect primarily and fragmentation effect secondarily.

100. DESCRIPTION OF COMPONENTS. - a. General. - The shell, H.E., M45, (see fig. 30) consists of a fuze, body, explosive charge, fin, ignition cartridge, and propellant. Those components which do not vary too greatly from similar components of the shell, M56, will be described below. Dissimilar components will be described in the following paragraphs. Since the shell is limited standard all descriptions will be brief.

b. Body. - The body of the shell, M45, has the same general shape and appearance as the body of the shell, M56. The following specific differences between the two are noted:

(1) The M45 body is 2" longer.

(2) The rear bourrelet is 0.2" wider. There is no forward bourrelet.

(3) The M45 body is 0.004" greater in central external diameter; the diameter at the bourrelet is the same as the M56 body.

(4) The walls of the M45 body are generally 0.16" thicker.

(5) The capacity of the M45 body is 80.4 cu. in., 3.15 cu. in. more than the M56.

(6) The adapter of the M45 body is similar to the M56 adapter, except that the fuze well cup is fitted to a different threaded section instead of to the same section as the fuze.

(7) The bodies are marked and painted in the same manner.

c. Explosive charge. - TNT in the amount of 4.48 lb. is the standard charge for the shell. When casting the TNT, a fuze well is formed 1.56" in diameter, and 0.67" deep from the lip of body. An alternative charge is 4.25 lb. of 50-50 amatol with a TNT booster surround. A second alternative charge is 4.65 lb. of tridite. A bakelite fuze well cup is assembled with the TNT or alternative charges. The body is painted and marked in the same manner as the body of the M56.

101. FUZE. - a. General. - The point detonating fuze, M45, was declared limited standard on July 13, 1939. However, since a large supply of the fuzes was on hand, personnel will continue to see them in the field, and for that reason a brief description is included in this text. The M45 is a selective arming fuze — either superquick or 0.1 second delay.

b. Design. - (1) Similarity to M52 and M53. - The fuze is generally similar to the M52 and M53 fuze in that its bore safety is achieved in the same manner, that is, by interrupting the explosive train with the

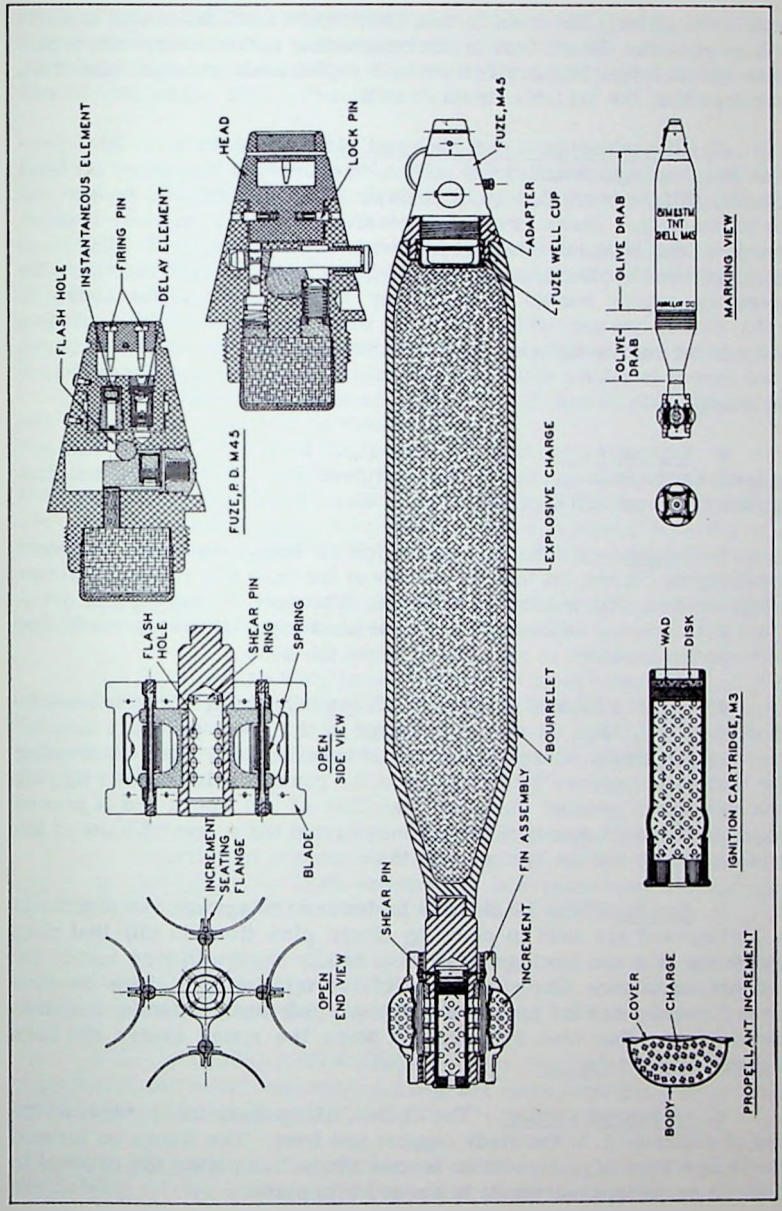


FIGURE 30. - SHELL, H.E., 81-MM, M45

metal of the slider. The train is thus interrupted until the round has left the bore when the slider, free of the restraining action of the safety pin, moves and is locked into position with its explosive component alined in, and completing, the explosive train.

(2) Dissimilarity to the M52 and M53. - Because the M45 provides both superquick and delay action, the internal design of its head assembly differs from that of the M52 or M53. The head is free to rotate in the body. There are two explosive elements, in one of which there is a delay element, charged in the recesses in the head. The flash hole in the body is off-center, so that when the head is rotated, either the superquick charge recess or the delay recess is directly above it. To the striker are assembled two firing pins. On impact each explosive charge in the head is initiated, each burns completely, but only the charge whose recess is alined with the flash hole will initiate the slider detonator charge.

c. Explosive elements. - In general, all the explosive elements are the same as those in the two fuzes mentioned above, in varying weights. The delay element is 0.8 grains of army black powder, Grade "A-5."

d. Setting. - To set to superquick or delay, the head is rotated. Identifying marks are cut into the surface of the fuze that clearly indicate in light or dark, the setting of the fuze. The fuze, on receipt, is set at superquick. Internal locking pins hold the head in one of the two positions, and moderate pressure is required to move the head.

102. FIN ASSEMBLY (see fig. 30). - a. General. - The fin assembly of the shell, M45, is an interim type in the development of fins for heavy mortar shells. Considerable effort was directed toward designing a fin that would improve the ballistics of the round. This fin (see fig. 30) when open has a greater diameter than that of the shell, but it proved impractical since it was subject to damage from the powerful blow of the propellant gases and the springs lost their tension in storage.

b. Action. - The blades are folded inward against the tension of the springs and are held in place by shear pins (four in all) that pass through the fins and are anchored in a brass shear pin ring inside the cartridge container. On deflagration of the ignition cartridge the ring moves forward under the pressure of the gas released, shearing the pins. The blades are then free to move and when the round clears the bore they open completely.

c. Increment seating. - The blades, along their inner edge, at the point of attachment to the blade support are bent. The flange so formed acts as one edge of a groove (a second blade completes the groove) in which the propellant increment is wedged into place.

103. IGNITION CARTRIDGE. - The cartridge, ignition, M3, is standard for assembly with the shell, M45. The M3 cartridge is in almost all respects identical to the cartridge, ignition, M4, assembled to the 60-mm shell, M69. The differences are:

a. The M3 is bigger. Its capacity is 0.95 cu. in. compared to the 0.39 cu. in. capacity of the M4. The M3 is 2.64" long and 0.886" in diameter at the head. Similar dimensions in the M4 are 1.75" and 0.728".

b. The outer wad of the M3 is made of greaseproof felt and has a bond paper disk on both faces; the M4 has a chipboard outer wad with a disk on its outer face only.

c. The charge of the M3 is 120 grains of propellant powder.

d. A commercial primer is used in both, and in other respects the two primers are identically designed.

104. PROPELLANT. - a. General. - The propellant for the shell, M45, has the appearance of a chocolate drop on a flat base. It consists of a cover, body, and charge. Assembled it has a maximum diameter at the cover of approximately 1-1/2", a height of 5/8", and weighs 108 grains.

b. Cover. - The cover is a thin disk of polished celluloid formed with three circular grooves as shown in figure 30.

c. Body. - The body is also shaped from polished celluloid in the shape of a slightly flattened cup. The diameter of the cup is approximately 1-1/4". After the charge is loaded into the cup, the cover is cemented to the body with celluloid cement, and the flange formed is trimmed to the specified diameter.

d. Charge. - The charge consists of 100 grains of propellant powder.

e. Assembly. - Four increments are assembled with the round and are held in place by the fins in their closed position.

f. Modification. - This increment has been replaced by the flake increments in rounds of recent issue. This was occasioned by the inability to secure a tight joint between cover and body.

105. PACKING AND MARKING. - a. Packing. - The shell, M45, is packed in the same manner and using the same containers as the shell, M56 (see fig. 28 and par. 97).

b. Marking. - The marking for the packing components for the shell, M56, is the same as the marking of the components for the M45.

Figure 28 illustrates the packing of the M56 and is applicable to the M45, with the substitution of the latter's nomenclature for the former.

106. EXTERIOR BALLISTICS. - a. Firing table. - Figure 31 gives the ranges through which the round may be fired utilizing the various combinations of cartridge and propellants. It should be noted that no provision is made in the firing table for projection with the cartridge alone.

b. Muzzle velocities. - The following table shows the muzzle velocities obtainable, and are based on firings conducted at Aberdeen Proving Ground over a period of 6 years.

Charge	Muzzle velocity feet/second
Cartridge plus one increment	216
Cartridge plus two increments	276
Cartridge plus three increments	330
Cartridge plus four increments	380

107. MISCELLANEOUS. - a. It must be remembered that the shell, H.E., M45, is limited standard and that in some cases its functioning will be imperfect due to prolonged storage. The rounds should be carefully inspected prior to issue, attention being given to the fin assembly.

b. The fuze, P. D., M53, may be assembled to the shell, M45, and in many cases the round will be so received.

c. The shell can be readily identified by its size and its distinctive fin assembly.

SECTION VI

SHELL, H.E., M45B1

108. GENERAL. - a. The shell, H.E., M45B1, is a limited-standard round for projection from the 81-mm mortar and the 3" mortar Mk. IA2. It is, with the differences noted in paragraph 109 below, the same round as the M45, and has the same exterior ballistics. Since it is assembled with the M53 fuze, no selective setting or superquick firing is possible.

81-MM MORTAR M1 AND 3" TRENCH
MORTAR MK. IA2

FIRING SHELL H.E. M45

FUZE P.D. M45

WEIGHT OF FUZED PROJECTILE 15.05 LB.

Range	Elevation	Charge	Elevation	Charge	Range	Elevation	Charge	Elevation	Charge
yards	degrees		degrees		yards	degrees		degrees	
100	83-1/2	1			725	66	3		
125	81-3/4	1			750	65	3		
150	80-1/4	1			775	63-3/4	3	71	4
175	78-1/2	1	82-3/4	2	800	62-1/2	3	70-1/2	4
200	76-3/4	1	81-3/4	2	825	61-1/4	3	69-3/4	4
225	75	1	80-3/4	2	850	59-3/4	3	69	4
250	73-1/4	1	79-3/4	2	875	58-1/4	3	68	4
275	71-1/4	1	78-1/2	2	900	56-1/2	3	67-1/4	4
300	69	1	77-1/2	2	925	54-1/4	3	66-1/2	4
325	66-3/4	1	76-1/4	2	950	51-3/4	3	65-3/4	4
350	64-1/4	1	75	2	975			64-3/4	4
375	61-1/2	1	74	2	1000			64	4
400	58-1/2	1	72-3/4	2	1025			63	4
425	54-1/4	1	71-1/4	2	1050			62	4
450			70	2	1075			61	4
475	75-1/2	3	68-3/4	2	1100			59-3/4	4
500	74-3/4	3	67-1/4	2	1125			58-3/4	4
525	73-3/4	3	65-3/4	2	1150			57-1/2	4
550	73	3	64-1/4	2	1175			56	4
575	72	3	62-1/2	2	1200			54-1/4	4
600	71-1/4	3	60-3/4	2	1225			52-1/4	4
625	70-1/4	3	58-3/4	2	1250			49-3/4	4
650	69-1/4	3	56-1/2	2	1275			45	4
675	68-1/4	3	53-1/4	2					
700	67-1/4	3	49-1/4	2					

FIGURE 31. - FIRING TABLE FOR THE SHELL, H.E., 81-MM, M45

b. The round consists of a fuze, body and adapter, explosive charge, fin assembly, propellant, and ignition cartridge.

109. DIFFERENCES. - a. General. - The following subparagraphs list the differences between the shell, M45, and the M45B1. Unless a difference is specifically mentioned, the two rounds are similar in other respects.

b. Fuze. - The fuze, point detonating, M53, is assembled to this round. The fuze is described in paragraph 101.

c. Explosive charge. - The second alternative charge for the M45B1 is trimonite. The weight of the trimonite loaded into the M45B1 is equal to the weight of the tridite loaded into the M45.

d. Booster surround. - In the M45B1 shell approximately 0.15 lb. of cast TNT composes the booster surround.

e. Marking. - "B1" is added to the model designation of the round stenciled to the surface of the shell. When trimonite is the explosive charge, "trimonite" will appear in the marking as an indication of the type of explosive filler.

f. Body. - The body is made of seamless steel tubing and a small hole, left in the rear end of the body, is plugged with a tapered steel pin, 0.25" thick at its head and 0.5" long. This is the change that necessitated the addition of the "B1" to the "M45." Changes in manufacturing methods are indicated in the model numbering by a "B" followed by a numeral. The body of the M45 is a forging.

g. Propellant. - Flake propellant powder, in bundles, is engaged in the fin assembly instead of the "chocolate drop" increments with the M45. The bundles are the same as those assembled in the M43A1 shell and described in paragraph 104.

110. PACKING AND MARKING. - With the exception of the difference in nomenclature — the addition of "B1" to "M45" — which affects the marking, the shell, M45B1, is packed and marked in the same way as the M45 (see par. 105).

SECTION VII

CHEMICAL SHELLS

111. GENERAL. - a. Three chemical shells (see fig. 32) are standard for projection from the 81-mm mortar, M1, and the 3" mortar, Mk. IA2. Except for a difference in the type and weight of the chemical fillers the three shells are identical. To distinquish between the three they are marked distinctively as explained in paragraph 114, below.

b. In general the three chemical shells are duplicates of the H.E. shell, M56. Since a chemical filler is loaded into the shell a burster is added to scatter the filler. With the addition of the burster a redesign of the adapter is necessary. The fuze, M52, replaces the M53 assembled to the M56 shell, since superquick action rather than mining action is desirable in a chemical shell.

c. The components of the three chemical shells are the fuze, body, burster and casing, chemical filler, fin assembly, propellant, ignition cartridge, and primer. Of all these components only the fuze, burster and casing, filler, and the adapter of the body are additions to or variations from the shell, M56.

d. The three standard chemical shells are:

(1) Round, complete, shell, smoke, (WP — phosphorous), M57 (with fuze, P. D., M52).

(2) Round, complete, shell, smoke, (FS), M57 (with fuze, P. D. M52).

(3) Round, complete, shell, gas, persistent, (HS), M57 (with fuze, P. D., M52).

112. FILLERS. - a. Into the FS smoke shell is loaded approximately 4.59 lb. of chlorosulfonic acid — sulphur trioxide solution (FS), which brings the complete round to a total weight of 12.07 lb.

b. Into the WP smoke shell is loaded approximately 4.09 lb.

of white phosphorous (WP), which brings the complete round to a total weight of 11.57 lb.

c. Into the HS gas shell is loaded approximately 3.15 lb. of persistent mustard gas (HS), which brings the complete round to a total weight of 10.56 lb.

113. BODY ASSEMBLY. - a. Body. - The body of the shell, M57 (all types, see fig. 32) is identical to the body of the shell, M56.

b. Adapters. - The adapter assembled into the nose of the M57 body differs from the M56's adapter. The outlines of the adapters in figures 27 and 32 illustrate this difference. The M57 adapter has a long body into which is inserted the burster nose. The over-all length of the M57 adapter is 2.53", the diameter of the recess seating the flange of the burster sleeve is 1.41"; the diameter of the sleeve body recess is 1.00".

c. Burster assembly. - (1) M1 burster charge. - The burster assembly consists of the M2 burster casing and the burster charge, M1. The M1 burster charge consists of an aluminum alloy burster tube 9.82" long, 0.378" in diameter, and open at both ends. Into the tube are pressed approximately 36 tetryl pellets under a pressure of 3,000 lb./sq. in. Each pellet weighs 8.1 grains and the total charge weighs approximately 265 grains. To each end of the tube are secured onionskin paper disks. The complete M1 burster charge assembly weighs approximately 33.34 grams.

(2) M2 burster casing. - This component consists of the sleeve mentioned in b. and a seamless steel casing, approximately 9.96" long, 0.568" in diameter at the closed end, and 0.75" at the open flanged end. The flange is silver soldered in the circular recess at the forward opening of the sleeve.

(3) Assembly. - After the chemical charge is loaded, the M2 casing is pressed into place. The M1 burster charge is inserted in the casing immediately prior to seating of the fuze. The casing does not extend the full length of the body cavity, but only approximately two-thirds of the distance. The charge of tetryl is sufficient to rupture the body wall and spread the chemical filler.

114. IDENTIFICATION. - a. Painting. - All external surfaces (except bourrelets) of the three chemical rounds are coated with blue-gray lacquer enamel (see fig. 32).

b. Smoke (FS) shell. - Below the forward bourrelet is painted a 1/2" circumferential yellow band. In letters and figures 5/8" high are

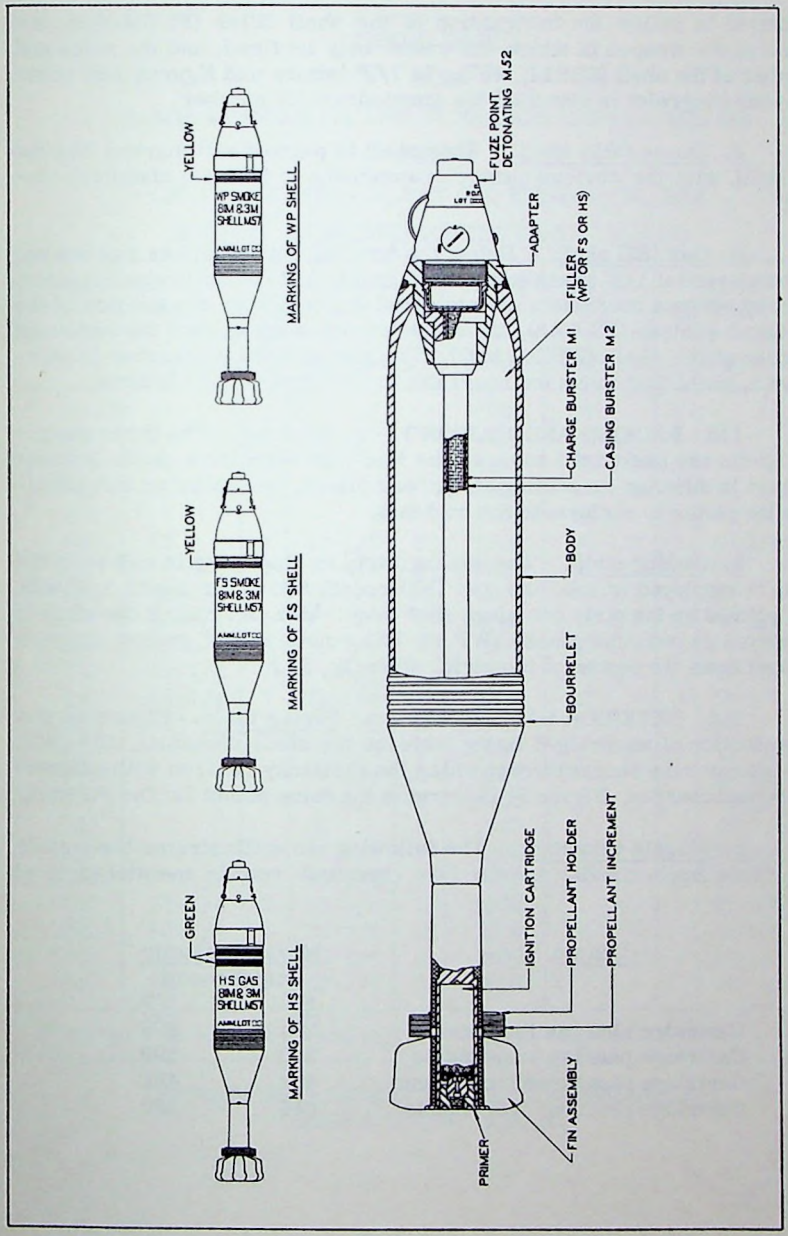


FIGURE 32. - SHELL, CHEMICAL (ALL TYPES), 81-MM, M57

stenciled in yellow the designation of the shell filler (FS SMOKE), the name of the weapon in which the round may be fired, and the name and number of the shell (SHELL M57). In 1/2" letters and figures just above the rear bourrelet is stenciled the ammunition lot number.

c. Smoke (WP) shell. - This shell is painted and marked like the FS shell, with the obvious change in stenciling to indicate chemical content.

d. Gas (HS) shell. - Below the forward bourrelet are painted two circumferential 1/2" green bands, 1/4" apart. In 5/8" letters and figures, midway between bourrelets are stenciled in green, the designation of the chemical content (HS GAS), the name of the weapon, and the name and number of the shell (SHELL M57). The ammunition lot number is stenciled in green just above the bourrelet in 1/2" figures and letters.

115. PACKING AND MARKING - a. General. - The three chemical shells are packed the same as the M56 high-explosive shell. Nomenclature is different on sealing strips, end plates, and shipping and identification plates to conform to the contents.

b. Sealing strip. - The sealing strip is blue-gray in color. If the strip is employed to seal the gas (HS) round, two green bands 3/8" wide are painted on the strip one along each edge. (See fig. 32.) If the strip is employed to seal the smoke (WP or FS) round a 1/2" yellow stripe is painted down the center of the strip. (See fig. 32.)

116. EXTERIOR BALLISTICS. - a. Firing table. - Figure 33 is a reproduction of an abridged firing table for the shell, chemical, M57 (WP) and indicates the ranges through which the shell may be fired with different propellant charges. Figure 34 illustrates the same points for the FS shell.

b. Muzzle velocities. - The following table illustrates the muzzle velocities (approximate) for the two chemical rounds mentioned in a. above.

Charge	Muzzle velocity feet/second	
	FS	WP
Cartridge plus one increment	291	299
Cartridge plus two increments	390	399
Cartridge plus three increments	472	484
Cartridge plus four increments	544	560

FIRING TABLE

FOR

81-MM MORTAR M1 AND 3" TRENCH MORTAR MK. IA2

FIRING

SHELL, CHEMICAL, M57 (FS) FUZE, P. D., M52

WEIGHT OF FUZED PROJECTILE - 11.86 LB.

Range	Elevation	Charge	Elevation	Charge	Range	Elevation	Charge	Elevation	Charge
yards	degrees		degrees		yards	degrees		degrees	
200	83	1			1350	67	3		
250	81	1			1400	65-3/4	3		
300	79	1			1450	64-1/2	3		
350	77	1			1500	63-1/2	3		
400	75	1			1550	62	3		
450	73	1	80-1/2	2	1600	60-1/2	3	68-3/4	4*
500	70-3/4	1	79-1/2	2	1650	59	3	68	4*
550	68-1/4	1	78-1/4	2	1700	57-1/2	3	67	4*
600	65-3/4	1	77	2	1750	55-1/2	3	66-1/4	4*
650	62-3/4	1	75-3/4	2	1800	53-1/2	3	65-1/4	4*
700	59-1/2	1	74-1/2	2	1850	50-3/4	3	64-1/4	4*
750	55-1/4	1	73-1/4	2	1900	47	3	63-1/4	4*
800	48	1	72	2	1950			62	4*
850			70-1/2	2	2000			61	4*
900			69-1/4	2	2050			59-3/4	4*
950			67-3/4	2	2100			58-1/2	4*
1000			66	2	2150			57-1/4	4*
1050	73-1/4	3	64-1/2	2	2200			55-3/4	4*
1100	72-1/4	3	62-1/2	2	2250			54-1/4	4*
1150	71-1/4	3	60-3/4	2	2300			52-1/2	4*
1200	70-1/4	3	58-3/4	2	2350			50-1/4	4*
1250	69-1/4	3	56-1/4	2	2400			47-1/2	4*
1300	68	3	53-1/4	2	2430			45	4*

*Charge 4 is not to be used in the 3" Trench Mortar Mk. IA2

FIGURE 33. - FIRING TABLE FOR THE SHELL, SMOKE (FS) 81-MM, M57

FIRING TABLE

FOR

81-MM MORTAR M1 AND 3" TRENCH MORTAR MK. IA2

FIRING

SHELL, CHEMICAL, M57 (WP) FUZE, P. D., M52

WEIGHT OF FUZED PROJECTILE - 11.36 LB.

Range	Elevation	Charge	Elevation	Charge	Range	Elevation	Charge	Elevation	Charge
yards	degrees		degrees		yards	degrees		degrees	
200	83	1			1450	65-1/4	3		
250	81-1/4	1			1500	64	3		
300	79-1/2	1			1550	62-3/4	3		
350	77-1/2	1			1600	61-1/2	3		
400	75-3/4	1			1650	60	3		
450	73-3/4	1			1700	58-1/2	3	67-1/4	4*
500	71-1/2	1			1750	56-3/4	3	66-1/4	4*
550	69-1/4	1	78-1/2	2	1800	55	3	65-1/2	4*
600	66-3/4	1	77-1/2	2	1850	52-3/4	3	64-1/2	4*
650	64	1	76-1/4	2	1900	50	3	63-1/2	4*
700	61	1	75	2	1950			62-1/2	4*
750	57-1/4	1	73-3/4	2	2000			61-1/2	4*
800	52-1/4	1	72-1/2	2	2050			60-1/4	4*
850			71-1/4	2	2100			59	4*
900			70	2	2150			57-3/4	4*
950			68-1/	2	2200			56-1/2	4*
1000			67	2	2250			55	4*
1050			65-1/2	2	2300			53-1/2	4*
1100			63-1/4	2	2350			51-3/4	4*
1150	71-1/2	3	62	2	2400			49-1/2	4*
1200	70-1/2	3	60	2	2450			46-1/2	4*
1250	69-1/2	3	57-3/4	2					
1300	68-1/2	3	55-1/4	2					
1350	67-1/2	3	52	2					
1400	66-1/2	3	47	2					

*Charge 4 is not to be used in the 3" Trench Mortar Mk. IA2

FIGURE 34. - FIRING TABLE FOR THE SHELL, SMOKE (WP), 81-MM, M57

SECTION VIII

PRACTICE SHELLS

117. GENERAL. - a. Use. - The two 81-mm mortar practice rounds (M43A1 practice and M44) are used interchangeably in the 81-mm mortar, M1, and the 3" mortar, Mk. IA2. They are both identical in weight, contour, and general appearance to the H.E. round, M43A1. Each contains a charge of black powder which, upon impact of the shell and functioning of the fuze, releases a puff of white smoke visible at all ranges. Being of the same weight and shape as the H.E. round, the practice rounds have the same exterior ballistics. The practice shells give personnel training in the handling and firing of mortar ammunition without the dangers or expense inherent to the firing of the high explosive shell.

b. Differences. - The two shells are practically identical in all characteristics. Exceptions are:

(1) The M43A1 body is forged of steel, while the body of the M44 is cast iron.

(2) The M43A1 has an adapter; the M44 has none.

(3) The M43A1 contains 2.5 oz. of black powder in pellet form; the M44 contains 3 oz. of black powder in a cotton sheeting powder bag.

(4) The M43A1 is the alternative round for the M44, and not vice versa.

c. Shell, practice, M43A1. - This shell (see fig. 35) is very similar to the M43A1 H.E. round. It is brought up to the weight of the latter by loading the body cavity with inert material. The shell is painted blue (except bourrelet), and identifying marking is stenciled in white.

d. Shell, practice, M44. - This shell (see fig. 35) is very similar to the M43A1 H.E. round except that it has no adapter. The shell is brought to a weight equal to that of the H.E. round by the addition of the same inert material (barium carbonate and paraffin) that is used in the M43A1 alternative practice round. The shell is painted blue (except bourrelets) and is stenciled in white.

118. PACKING AND MARKING. - a. Both shells are packed in the same containers and in the same manner as the shell, H.E., M43A1 (see par. 86 and fig. 25). The sealing strip, however, is blue and bears

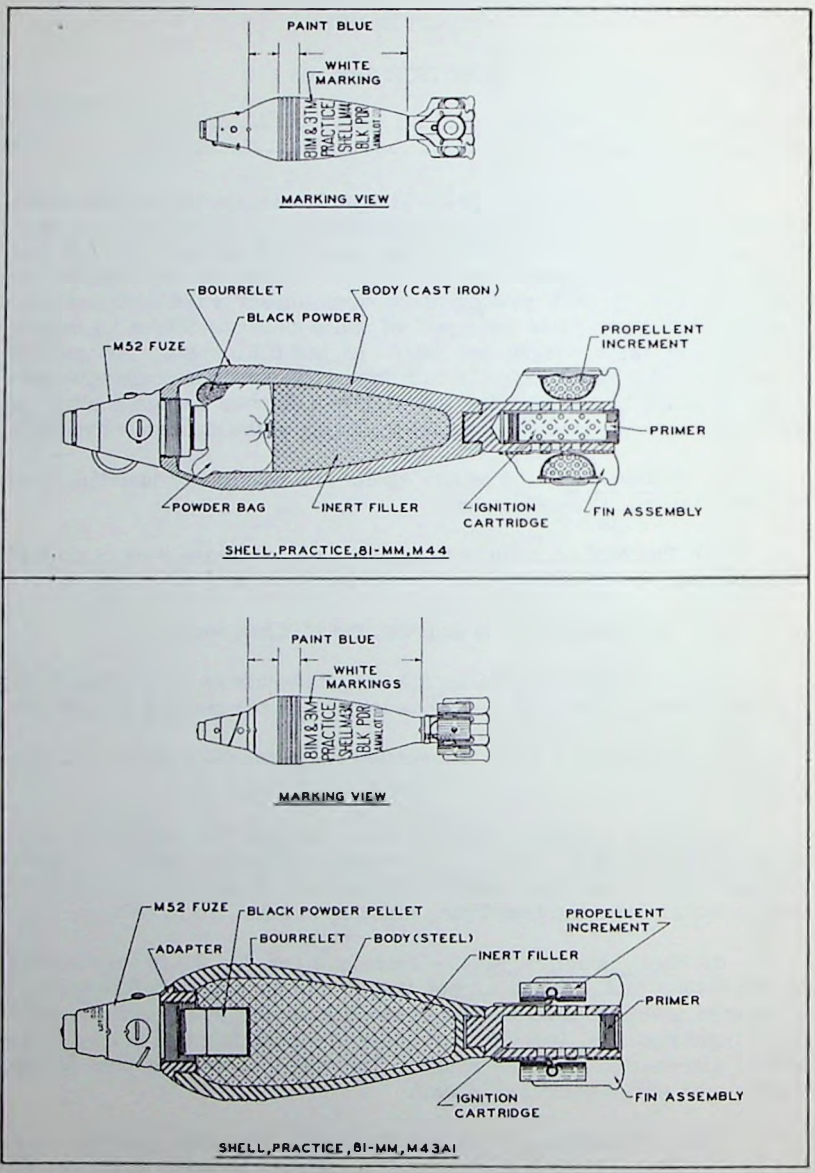


FIGURE 35. - 81-MM PRACTICE SHELLS

white lettering and figures. Nomenclature applicable to the H.E. round is changed to agree with the contents when the practice round is loaded.

b. Earlier, the M44 round was packed 8 rounds (1 round per fiber container, M36A1) per wooden packing box. The box was approximately 36" x 9-1/2" x 8" in dimensions, and had a 3" blue stripe encircling the center of the box. The same color was applied to the vertical cleats at either end of the box. Personnel may still see this packing in the field.

SECTION IX

SHELL, TRAINING, 81-MM, M68

119. GENERAL DESCRIPTION. - a. General. - The shell, training, M68 (see fig. 36) is a simply constructed round designed to provide mortar crews with training in the loading and handling of mortar ammunition. The round is assembled with the M3 ignition cartridge (assembled with the M45 H.E. round, as well), which is the only propellant for the shell. The fin assembly is the same as that assembled with the M43A1 and M44 shells, except that it is not threaded to seat a primer. The shell body varies in weight from 9.50- to 10.10 lb., and this difference in weight is broken down into a series of weight zones as listed in the following table.

WEIGHT ZONES			
ZONES	OVER	UP TO AND INCLUDING	MARKING
	POUNDS	POUNDS	
1	9.50	9.57	□
2	9.57	9.63	□□
3	9.63	9.70	□□□
4	9.70	9.76	□□□□
5	9.76	9.83	□□□□□
6	9.83	9.90	□□□□□□
7	9.90	9.96	□□□□□□□
8	9.96	10.03	□□□□□□□□
9	10.03	10.10	□□□□□□□□□

Since rounds of different weight have different ranges when propelled by a standard cartridge, adjustment of the mortar is necessary to secure a uniform range. The shells are marked in accordance with their weight and a firing table, included with the ammunition, provides the necessary

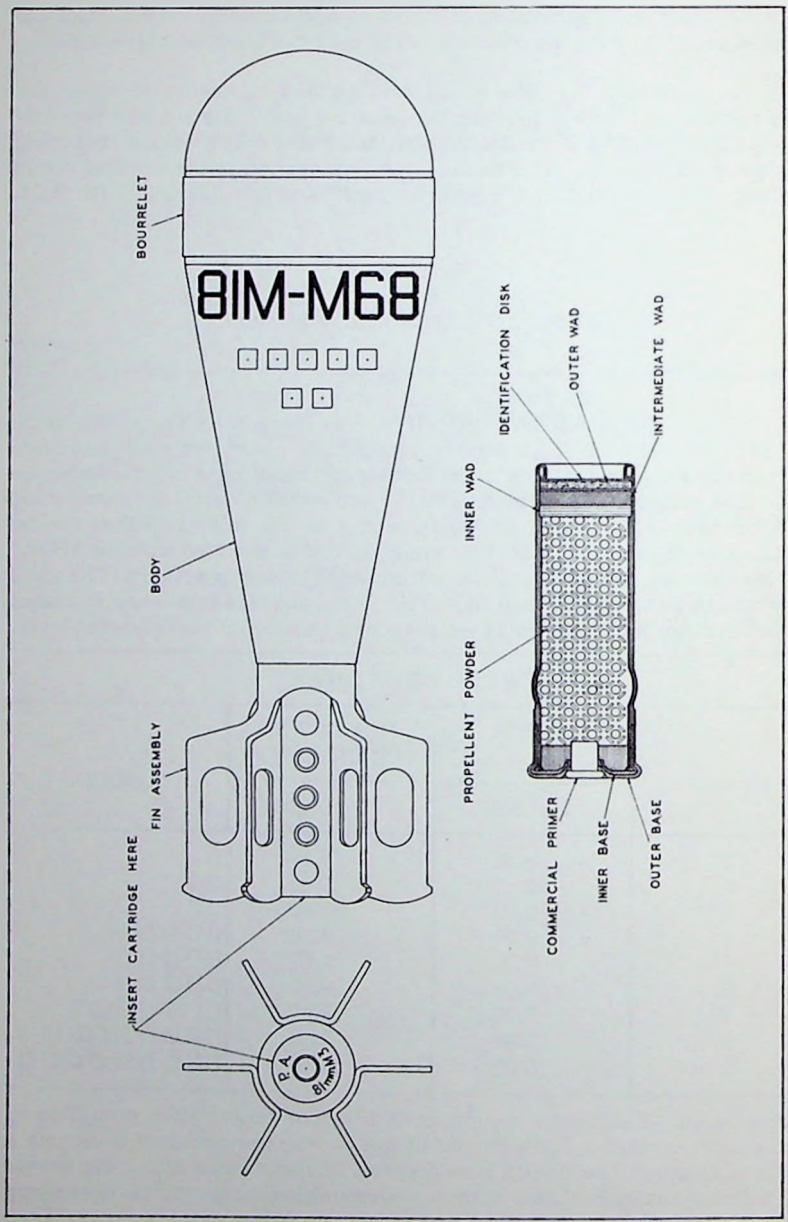


FIGURE 36. - SHELL, TRAINING, 81-MM, M68

M68 TRAINING PROJECTILE FIRED FROM

81-MM MORTAR, M1 AND 3" TRENCH MORTAR MK. IA2.

MUZZLE VELOCITY: 172.8 F/S

Range yards	Elevation degrees	minutes
0	90	00
25	87	35
50	85	09
75	82	42
100	80	11
125	77	36
150	74	54
175	72	04
200	69	03
225	65	44
250	61	56
275	57	17
300	49	55
306	45	00

FT 81-F-1
(Abridged)
A. P. G., Md., Nov. 1942

FIGURE 37. - FIRING TABLE FOR THE SHELL, TRAINING, 81-MM, M68

data for adjustment of the mortar. The M68 consists of a solid cast iron body, a fin assembly, and an ignition cartridge.

b. Body. - The body of the shell (see fig. 36) is cast from gray iron to the general shape of a pear. A recess in the rear is threaded to seat the fin. The bourrelet is a raised portion of the circumference, 1.02" wide and 3.175" in diameter, and it alone is given a machine finish of good quality. Forward of the bourrelet the body is curved smoothly to a radius equal to half the diameter of the shell (diameter immediately forward of the bourrelet: 3.13"). To the rear of the bourrelet the body tapers uniformly to a minimum diameter at the rear of 1.25". The total length of the shell is 7.92".

c. Marking. - The shell is marked in much the same manner as the similar 60-mm shell (see par. 54b). The weight-indicating squares contain central punches and no more than five squares are placed on a single line.

d. Packing. - No standard packing has been devised for this shell. The body and fin assembly are packed separately. The round is used repeatedly and damaged fins are replaced when necessary.

e. Exterior ballistics. - Figure 37 is a reproduction of an abridged firing table for the shell, training, 81-mm, M68, and also includes the muzzle velocity.

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