

DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

DEPARTMENT OF THE AIR
FORCE TECHNICAL ORDER

TM 9-1900
TO 11A-1-20

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Mr. R. G. Conley
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San Francisco, Calif.

AMMUNITION GENERAL



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DEPARTMENTS OF THE ARMY AND THE AIR FORCE

JUNE 1956

R. H. Conley

UF 153 .A7 T4 TM 9-1900 1956

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Ammunition general

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TM 9-1900
TO 11A-1-20
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DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

AMMUNITION, GENERAL

TM 9-1900
TO 11A-1-20
CHANGES No. 3

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D.C., 11 April 1962.

TM 9-1900/TO 11A-1-20, 1 June 1956, is changed as follows:

Page 262:

140. Types.

* * * * *
b. *Priming and Initiating Components, Accessories, and Tools.*
* * * * *

- (3) (Superseded) Fuse, Blasting, Time: M700 (fig. 197) is in the form of a 0.20-inch diameter cord consisting of a black powder core tightly wrapped with waterproofing materials and a plastic cover. When ignited by a match or a blasting fuse igniter, it transmits a flame to a nonelectric blasting cap that may be installed in a demolition charge. This fuse is for use in demolitions both on land or underwater. The burning rate of the fuse is approximately 40 seconds per foot; however, the burning time should be tested by timing the burning of a 1-foot length of fuse, after cutting off a minimum of 3 inches on the end to remove powder that may have absorbed moisture.

Warning No. 1: Each roll of fuse must be tested, shortly before use. The rate of burning will vary for the same or different roll under different atmospheric and/or climatic conditions, from a burning time of 30 seconds or less per foot to 45 seconds or more per foot.

Warning No. 2: Particular precautions must be taken when used under water as the rate of burning is increased significantly.

The dark green cover is smooth with either single painted bands at 1-foot or 18-inch intervals and double painted bands at either 5-foot or 90-inch intervals, depending on old or new manufacture. These markings are used to estimate the ap-

*These changes supersede C 2, 24 January 1961.

proximate lengths of fuse required for tactical situations, Fuse, Blasting, Time (JAN-F-360) (fig. 198), is in the form of a 0.20-inch diameter cord consisting of a black powder core wrapped with several layers of fabric and waterproofing materials. It is used for similar purposes but is not reliably waterproof. The burning time for this fuse also varies, therefore the fuse should be tested shortly before use and attention given to Warning No. 1 and No. 2 above.

c. *Demolition Equipment, Sets and Kits.*

(4) (Rescinded by C 2, 24 Jan 61.)

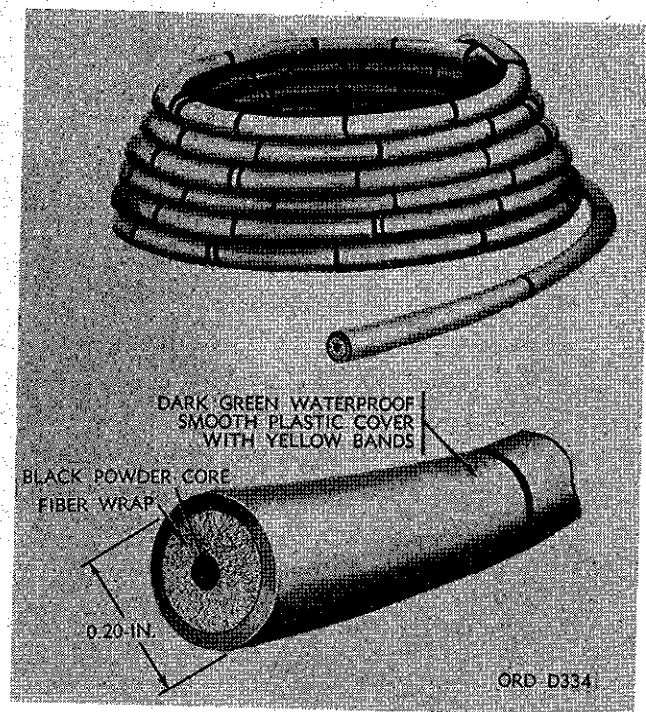


Figure 197. (Superseded) Fuse, Blasting, Time: M700.

Page 235, figure 209. Rescinded by C 2, 24 January 1961.

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

G. H. DECKER,
General, United States Army,
Chief of Staff.

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

CURTIS E. LEMAY
Chief of Staff, United States Air Force.

Official:
R. J. PUGH,
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Active Army:

DCSLOG (1)
CNGB (1)
Tech Stf, DA (1) except
CofOrd (2)
CCmlO (4)
CofT (2)
Ord Bd (1)
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Savanna (20)
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Units organized under following
TOE's (2 copies each):
9-26 9-377
9-86 9-510 (AA,
9-367 AB, AC, DA)

NG: State AG (3); units same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

Royal B Conley

This manual is correct to 30 August 1955

***TM 9-1900/TO 11A-1-20**

TECHNICAL MANUAL
No. 9-1900
TECHNICAL ORDER
No. 11A-1-20

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE

WASHINGTON 25, D. C., 1 June 1956

AMMUNITION, GENERAL

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*This manual, together with TM 9-1903 (when published) supersedes TM 9-1900, 18 June 1945, including CI, 22 October 1952 and CZ, 8 April 1953.

CHAPTER 1

GENERAL

Section I. INTRODUCTION

1. Scope

a. This manual contains information pertaining to the classification and identification of ammunition. Personnel concerned with any phase of ammunition should be thoroughly familiar with the provisions of this manual and TM 9-1903.

b. Information pertaining to nuclear and biological munitions has not been included in this manual, since sufficient data are not available at this time.

c. The appendix contains a list of current references, including supply and technical manuals, and other publications applicable to ammunition.

d. Information pertaining to care, handling, preservation, and destruction of ammunition, which appeared in the previous edition of this manual, is contained in TM 9-1903.

2. Forms

The forms prescribed for use throughout the Army establishment are listed in the current DA Pam 310-2. Requisitions for these forms will be submitted in accordance with AR 310-90.

3. Reports

a. *Accidents.* Responsibilities and procedures for preparation of reports of accidents and recording and reporting requirements for Army accidents are contained in SR 385-10-40.

b. *Accidents Involving Ammunition.* If an accident or malfunction involving the use of ammunition, including land mines, base charges, dynamite, blasting caps, detonating cord, shaped charges, and demolition charges of all types, occurs during training or combat, the range officer for units in training, if there is one, or the senior officer of the unit in training or combat, or, if there is no officer in charge of the unit, the senior noncommissioned officer or enlisted man of the unit involved, will report immediately the occurrence and all available facts of the accident to the technical service representative under whose supervision the ammunition for the unit involved is maintained or issued. It is the duty of the technical service representative to investigate thoroughly all cases of malfunctioning or accidents observed by him or reported to him and to report serious cases to the head of the appropriate technical service as outlined in SR 700-45-6.

c. *Fires.* A fire report will be prepared in all cases of fire or fire explosion that result in loss of life or damage (to the extent that the estimated cost of repair or replacement amounts to \$50 or more) to Army equipment, materials, structures, plants, systems, timber or grasslands, or other property, except motor vehicles or aircraft damaged incident to their operation, at all Department of the Army installations. For further information, see SR 385-45-20. Reports of fire or explosion followed by fire involving ammunition or other explosives are in addition to reports required as specified in SR 385-10-40.

d. *Report of Hazardous Conditions Involving Military Explosives or Ammunition.* Commanding officers of Army installations and activities engaged in the development, testing, manufacture, maintenance, salvage, disposal, handling, transportation, or storage of explosives or ammunition will inform the head of the appropriate technical service of concentrations of explosives or ammunition that are or may become undue hazards and of previously unrecognized hazards or conditions for which existing regulations and instructions appear to be inadequate, in order to permit review by the Armed Services Explosives Safety Board. For further information, see SR 385-15-1.

Section II. GENERAL DISCUSSION

4. Definitions

a. *Munitions.* Munitions consist of everything necessary for the conduct of war and training therefor, except personnel. They include weapons, ammunition, equipment, supplies, food, clothing, forage, and related items.

b. *Military Ammunition.* Military ammunition is that type of munition that consists of explosive or chemical agents, with their characteristic mechanical devices, designed for use against military objectives.

c. *Weapons.* A weapon is any instrument of combat. For descriptions of weapons, see pertinent technical manuals pertaining to each weapon.

d. *Round.* A round of ammunition consists of all the necessary expendable components to fire the system once.

5. Classification

Ammunition is classified according to the characteristics in *a* through *j* below.

a. Type.

- (1) *Small arms ammunition.* Small arms ammunition consists of cartridges used in rifles, carbines, revolvers, pistols, submachineguns, and machineguns and shell used in shotguns.
- (2) *Grenades.* Grenades are explosive- or chemical-filled projectiles of a size and shape convenient for throwing by hand or projecting from a rifle.
- (3) *Artillery ammunition.* Artillery ammunition consists of cartridges;

shot; shell that are filled with high-explosive, chemical, or other active agent; and projectiles that are used in guns, howitzers, mortars, and recoilless rifles.

- (4) *Bombs.* Bombs are containers filled with an explosive, chemical, or other active agent, designed for release from aircraft.
- (5) *Pyrotechnics.* Pyrotechnics consist of containers filled with low-explosive composition, designed for release from aircraft or for projection from the ground for illumination or signals.
- (6) *Rockets.* Rockets are propellant-type motors fitted with rocket heads containing high-explosive or chemical agents.
- (7) *JATOS.* JATOS consist of propellant-type motors used to furnish auxiliary thrust in the launching of aircraft, rockets, guided missiles, target drones, and mine clearing detonating cables.
- (8) *Land mines.* Land mines are containers, metal or plastic, that contain high-explosive or chemical agents designed for laying in or on the ground for initiation by, and effect against, enemy vehicles or personnel.
- (9) *Guided missiles.* Guided missiles consist of propellant-type motors fitted with warheads containing high-explosive or other active agent and equipped with electronic guidance devices.
- (10) *Demolition materials.* Demolition materials consist of explosives and explosive devices designed for use in demolition and in connection with blasting for military construction.
- (11) *Cartridge-actuated devices.* Cartridge-actuated devices are devices designed to facilitate an emergency escape from high-speed aircraft.

b. *Standardization.* Ammunition is classified as—

- (1) Standard.
- (2) Substitute standard.
- (3) Limited standard.

c. *Use.* Ammunition is classified according to use as—

- (1) Service.
- (2) Practice.
- (3) Drill (dummy).

d. *Form.* Ammunition is classified as fixed, semifixed, separated, or separate loading.

e. *Kind of Filler.* Ammunition is classified as explosive, chemical, leaflet, or inert.

f. *Storage.* Ammunition is classified for storage purposes into quantity-distance classes, 1 to 12 inclusive (TM 9-1903).

g. *Storage Compatibility.* Ammunition is grouped for compatibility in storage into 17 groups lettered A to Q, inclusive (TM 9-1903).

h. *Interstate Commerce Commission Shipping Regulations.* Ammunition is classified by Freight Tariff No. 9, publishing ICC shipping regulations, into class A explosives (which are subdivided into type 1 to type 8, inclusive), class B explosives, and class C explosives. The regulations pertain-

ing to transportation of these classes of explosives are published by the Bureau of Explosives, 30 Vesey Street, New York 7, N. Y.

i. *Burning or Explosive Characteristics.* Ammunition is classified in groups according to general burning or explosive characteristics. The four groups are identified by "symbols," which are the Arabic numerals 1, 2, 3, and 4. Each group consists of one or more specific quantity-distance classes (see TM 9 1903).

j. *Security.* Ammunition is classified as to security regulations as unclassified, confidential, secret, or top secret.

6. Identification

a. *General.* Ammunition is identified by painting and marking (par. 10) on items, containers, and packing boxes. This identification does not include grade except in the case of small arms cartridges. For purposes of record, the standard nomenclature of the item, together with its lot number, completely identifies the ammunition. Once removed from its packing, ammunition may be identified by the painting and marking on the items. Other essential information may also be obtained from the marking on ammunition items, packing containers, and ammunition data cards. The muzzle velocity of projectiles may be obtained from the firing tables and ammunition data cards; in the case of some rounds of artillery ammunition of smaller caliber, the muzzle velocity may appear on the packing box.

(1) Included in both the marking and the standard nomenclature are—

- (a) Name of type or abbreviation thereof.
- (b) Caliber, weight, or size.
- (c) Model designation.

(2) Where required, additional information is included such as the model and type of fuze, the model of the weapon in which the item is fired, and the weight of projectile for which a separate-loading propelling charge is suited.

(3) The lot number is marked on the ammunition or shipping container but is not a part of the nomenclature. However, when referring to specific ammunition in shipping documents and field reports, it is necessary to mention both the lot number and the standard nomenclature.

b. *Type Designation.* This is an identifying symbol used with nomenclature to distinguish different models and types of items or equipment within categories and to indicate modifications and changes thereto. Only one type identification will be assigned to items of military supply that are physically and functionally interchangeable. For further information, see SR 715-50-5.

c. *Mark or Model.* To identify a particular design, a model designation is assigned at the time the model is classified as an adopted type. This model designation becomes an essential part of the nomenclature and is

included in the marking of the item. The present system of model designation consists of the letter M followed by an Arabic numeral, for example, M1. Modifications are indicated by adding the letter A and the appropriate Arabic numeral. Thus, M1A1 indicates the first modification of an item for which the original model designation was M1. Wherever a B suffix appears in a model designation it indicates an item of alternative (or substitute) design, material, or manufacture. Certain items standardized for use by both Army and Navy are designated by AN preceding the model designation, for example, AN-M103A1. From World War I to 1 July 1925, it was the practice to assign mark numbers, that is, the word "Mark," abbreviated Mk, followed by a Roman numeral. The first modification was indicated by the addition of MI to the mark number, the second, MII, etc. After 2 April 1945, the mark numbers were indicated by Arabic numerals rather than Roman numerals. Prior to World War I, the letter M followed by the year in which the design was adopted was used as the model designation, for example, M1914. When a particular design has been accepted only for limited procurement and service test, the model designation is indicated by the letter T and an Arabic numeral and modifications by the addition of E and an Arabic numeral. In such cases, if the design subsequently should be standardized, an M designation is assigned; hence there may be encountered some lots still carrying the original T designation (not yet re-marked to show the later standardized M designation). There is no direct relationship between the numerical designation of a T item and that of the item when standardized and assigned an M designation. Items of Navy design are designated Mk, and Navy modifications are designated Mod and appropriate Arabic numeral. On items manufactured in Japan, under the offshore procurement program, the prefix J- is added to the model number (see TB ORD 521). Items manufactured in Europe under this program are marked with an E- preceding the model number (see TB ORD 600).

d. Ammunition Lot Number. At the time of manufacture, every item of ammunition is assigned a lot number. Where the size of the item permits, it is marked on the item itself to insure permanency of this means of identification. In addition to this lot number, there is assigned to each complete round of fixed and semifixed ammunition an ammunition lot number, which serves to identify the conditions under which the round was assembled and the components used in the assembly. This ammunition lot number is marked on every complete round of fixed and semifixed ammunition (except where the item is too small) and on all packing containers. It is required for all purposes of record, including reports on condition, functioning, and accidents in which the ammunition is involved. As far as practicable, in the assembly of components during manufacture of items to make up a particular ammunition lot all like components are selected from the same component lot. To obtain the greatest accuracy in any firing, successive rounds should be from the same

ammunition lot. On items manufactured in Japan, the prefix J- is added to the manufacturer's symbol in the last number and those manufactured in Europe have the prefix E-.

e. Calibration of Lots. Calibration data for certain lots of ammunition are provided in order to effect improvement in the relative accuracy of predicted artillery fire. The data account for variations among ammunition lots due to differences in muzzle velocity level (interior ballistics) and differences in ballistic coefficient (exterior ballistics). The application of corrections determined from the data is intended to reduce variations in performance due to the employment of individual ammunition-weapon combinations and is expected to be of value in unobserved fire under circumstances when the K correction and the velocity error (VE) type of correction may not be applicable because of transfer limitations, changes in ammunition lots, or weapon tube wear. For tables of data and further information, see TB ORD 420.

f. Ammunition Data Card. An ammunition data card, 5 by 8, which is prepared for each lot of accepted ammunition in accordance with pertinent specifications, will be furnished with the shipping ticket with each shipment of ammunition except small arms ammunition. This card contains printed data concerning the item and its components. Information on the data card includes lot number; date packed; identity of components; expected pressures; expected muzzle velocity; assembling and firing instructions when required; and AIC symbols.

g. Ammunition Identification Code Symbols. The ammunition identification code (AIC) symbol is used to facilitate the supply of ammunition in the field. Code symbols assigned to each item of ammunition in a specific packing are to be used in messages, requisitions, and records. These code symbols are published basically in Department of the Army Supply Manual ORD 3 standard nomenclature lists (SNL) of groups P, R, S, and T. A full explanation of the composition and use of the AIC symbol will be found in TB 9-AMM 5.

7. Nomenclature

Standard nomenclature is established so that every item of ammunition supplied by the Ordnance Corps may be specifically identified by name. It consists of the type, size, and model of each item. Its use for all purposes of record is mandatory, except where the use of the AIC symbol (par. 6g) is authorized. Ammunition nomenclature is published in Department of the Army Supply Manual ORD 3 standard nomenclature lists (SNL) of groups P, R, S, and T. The use of exact nomenclature in the requisitioning, shipment, storage, issue, recording, and use of ammunition items will keep errors to a minimum. Ammunition is grouped in the manuals as indicated in *a* through *d* below.

a. Group P contains lists of ammunition for heavy field artillery (155-mm gun and above) and antiaircraft weapons.

b. Group R contains lists of ammunition for light and medium field,

tank, antitank, and aircraft artillery weapons (20-mm gun through 155-mm howitzer), mines, and demolition material.

c. Group S contains lists of bombs, grenades, pyrotechnics, rockets, JATOS, catapults, and explosive components of guided missiles.

d. Group T contains lists of ammunition for small arms.

8. Grading

a. Ammunition is manufactured to rigorous specifications and is thoroughly inspected before acceptance. Ammunition in storage is periodically inspected and tested in accordance with specific instructions of the Chief of Ordnance.

b. Each lot of small arms ammunition is graded primarily on the qualities that make that lot especially suitable for use in a particular class of weapons such as aircraft and antiaircraft machineguns, rifles, and ground machineguns. For current grades of small arms ammunition, see TB 9-AMM 4.

c. Ammunition, other than small arms ammunition, is earmarked as a result of surveillance tests into grades, depending on its serviceability and priority of issue (see SR 755-140-1).

9. Priority of Issue

a. Subject to special instructions from the Chief of Ordnance, ammunition of appropriate type and model will be used in the following order: limited standard, substitute standard, standard. Within this rule, ammunition that has had the longest or least favorable storage will be used first. Among lots of equal age, priority of issue will be given to the smallest lot.

b. To prevent the building up of excess stocks in the field, transfers from one station to another should be arranged within the Army command if no stock of appropriate grade for immediate use is on hand.

c. Certain items because of their scarcity, cost, or highly technical or hazardous nature are known as "regulated items." This includes all ammunition items. Close supervision is exercised over these items in order to insure distribution to appropriate units and commands in accordance with Department of the Army priorities (see SB 725-350 and SB 725-950).

d. Priority of issue for lots of small arms ammunition is established by the Chief of Ordnance and published in TB 9-AMM 4 or in special instructions.

e. Further details will be found in Department of the Army Supply Bulletins of the 9-AMM-series, AR 370-5, and SR 755-140-1.

10. Painting and Marking

a. *Painting.* Ammunition is painted primarily to prevent rust. Secondary purposes are to provide, by the color, a ready means of identification as to type and to camouflage the ammunition by the use of lusterless paint. See figures 1 to 19, inclusive, for the use of color for identifica-

Table I. Color and Markings for Various Types of Ammunition, Except Bombs, Pyrotechnics, and Small Arms Cartridges

Type of ammunition	Color and markings
Armor-piercing (projectile w/HE).	Olive drab w/markings in yellow.
Armor-piercing (projectile w/o explosive).	Black w/markings in white.
High-explosive.....	Olive drab w/markings in yellow.
Illuminating.....	Gray w/one white band and markings in white.
Chemical:	
Persistent casualty gas..	Gray w/two green bands and markings in green.
Nonpersistent casualty gas.	Gray w/one green band and markings in green.
Training and riot control gases.	Gray w/one red band and markings in red.
Smoke.....	Gray w/one yellow band and markings in yellow. (Rifle smoke grenades—one band of the color of smoke produced.)
Incendiary.....	Gray w/one purple band and markings in purple.
Practice.....	Blue w/markings in white.
Dummy (inert).....	Black w/markings in white (bronze or brass assemblies are unpainted).

tion purposes on representative examples of ammunition items.

- (1) For artillery ammunition, grenades, rockets, JATOS, land mines, guided missiles, demolition material, and miscellaneous explosive devices, color and markings are shown in table I.
- (2) For bombs, other than chemical, photoflash, target identification, and practice, the painting is olive drab, with 1-inch color bands painted at the nose and tail ends of the body. When bombs are loaded with composition B, COMP B is stenciled twice, 180 degrees apart, on each inner band. When bombs are loaded with tritonal, TRITONAL is stenciled twice, 180 degrees apart, on each inner band. When TNT or COMP B loaded bombs are equipped with inert end pads, they will be stenciled WITH PADS to distinguish from bombs without pads. The purpose of the inert pad is to render the bomb less sensitive to possible blows on the end during handling and shipping. Small fragmentation bombs have no color bands but the nose and tail are painted yellow. For color and marking of various types of bombs, see table II.
- (3) Small arms cartridges do not require painting. However, the bullet tips of cartridges are painted a distinctive color to aid in ready identification as to type (fig. 1).
- (4) Pyrotechnics are not marked in accordance with the general color scheme but, where color markings are used, they indicate the color of the pyrothentic effect produced. In general, how-

Table II. Color and Marking for Various Types of Bombs

Type of bomb	Color of body	Color of marking	Painted identification bands			
			Color	Number of bands and location		
				Nose	Center	Tail
HIGH-EXPLOSIVE:						
TNT or amatol loaded.	Olive drab.	Black	Yellow	One.....		One.
COMP B-loaded.	Olive drab.	Black	Yellow	Two.....		Two.
Tritonal-loaded.	Olive drab.	Black	Yellow	One ½-inch between two 1-inch.		One ½-inch between two 1-inch.
CHEMICAL:						
Smoke.....	Gray	Yellow	Yellow	One.....	One	One.
Incendiary.....	Gray	Purple	Purple	One.....	One	One.
Persistent gas.....	Gray	Green	Green	Two.....	Two	Two.
Nonpersistent gas.	Gray	Green	Green	One.....	One	One.
TARGET IDENTIFICATION AND PHOTO-FLASH.	Gray	Black				
LEAFLET.....	Olive drab.	Black				
PRACTICE.....	Blue	White				
DRILL.....	Olive drab.	Black	Black	One.....		One.

ever, pyrotechnics are painted gray with marking in black. If the body of the item is aluminum or magnesium, it may not be painted. If the item is intended for incendiary purposes, markings are in purple.

b. Marking.

- (1) The marking stenciled or stamped on ammunition includes all information necessary for complete identification. For further information concerning marking on ammunition, see chapter 3 under the specific type of ammunition.
- (2) Service components or rounds that have been inerted for drill purposes will be marked as in (a) through (e) below.
 - (a) Components such as shell, fuzes, boosters, artillery primers, cartridge cases, bombs, and flares in which all explosives, incendiary, or toxic materials have been simulated by substitution of inert material will be identified by impressed INERT markings.
 - (b) Components such as shell, fuzes, boosters, artillery primers,

cartridge cases, bombs, and flares in which all explosives, incendiary or toxics, and substitutes have been omitted will be identified by impressed EMPTY markings.

- (c) In addition to being marked INERT or EMPTY, components, if size permits, such as empty projectiles, bombs, inert loaded and empty cartridge cases, will have four holes not smaller than one-quarter of an inch drilled through them 90° apart. Exceptions are inert projectiles, such as those used in target practice, practice bombs, and other inert items, the designed usage of which would be impaired by the presence of drilled holes. Such items will be considered suitably identified when they are INERT marked.
- (d) Inert cloth covered components, such as bagged propelling charges, will be marked with durable, waterproof, sunfast ink.
- (e) Inert mortar propellant increments will have the word INERT cut through each increment.

11. Packing and Marking

Ammunition is packed and packing containers are marked in accordance with pertinent drawings and specifications. Containers are designed to withstand conditions normally encountered in handling, storage, and transportation and to comply with Interstate Commerce Commission regulations. Marking of containers includes all information required for complete identification of their contents and for compliance with Interstate Commerce Commission regulations (see also TM 9-1903).

12. Precautions in Use

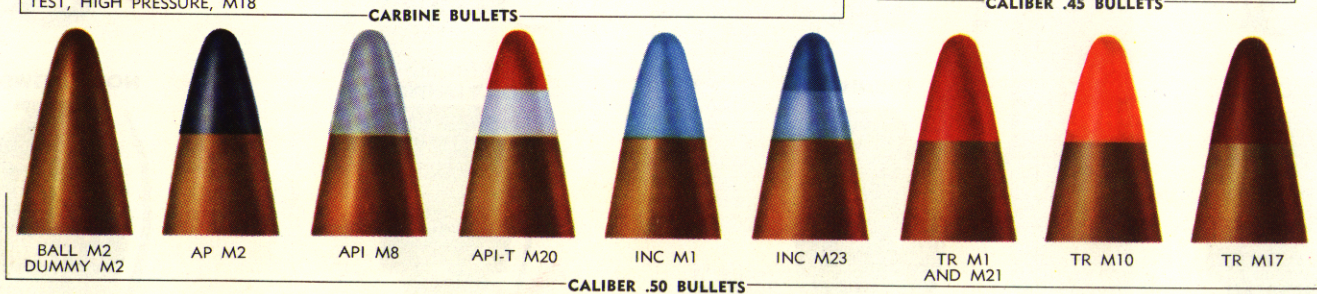
- a. Explosive ammunition must be handled with appropriate care at all times. Explosive elements, such as in primers and fuzes, are sensitive to undue shock and high temperature.
- b. In order to keep ammunition in a serviceable condition and ready for immediate issue and use, due consideration should be given to the general rules in c through g below.
- c. Store ammunition in the original containers in a dry, well-ventilated place protected from the direct rays of the sun and other sources of excessive heat. Keep sensitive initiators such as blasting caps, igniters, primers, and fuzes separate from other explosives.
- d. Keep ammunition and its containers clean and dry and protected from possible damage.
- e. Disassembly of components of ammunition, such as fuzes and primers, without specific authorization, is strictly prohibited. Any alteration of loaded ammunition, except by direction of the technical source concerned and under the supervision of a commissioned officer of that service, is hazardous and must not be undertaken.
- f. Do not open sealed containers or remove protective or safety devices until just before use, except as required for inspection.

g. Return ammunition prepared for firing but not fired to its original packing and mark it appropriately. Use such ammunition first in subsequent firings in order to keep stocks of opened packings at a minimum.

h. The use of live ammunition for training purposes as a substitute for authorized drill ammunition is prohibited. Such substitution must be considered as hazardous and will not be permitted under any circumstances.

13. Firing Data

Firing data for the certain types of ammunition described in this manual are given in firing tables (FT), graphical firing tables (GFT), graphical tables (GT), bombing tables (BT), fluorescent bombing tables (FBT), rocket firing tables (RFT), trajectory charts (TJC), aiming data charts (ADC), and guided missile charts (GMC). For applicable indexes to these publications, see the appendix.



RA PD 167576

Figure 1. Color identification of bullets of small arm cartridges.



FRAGMENTATION



**FRAGMENTATION
(W/TNT)**



TRAINING



PRACTICE



GAS



SMOKE



INCENDIARY



OFFENSIVE

RA PD 103501A



COLOR SMOKE

RA PD 103502B



WP SMOKE



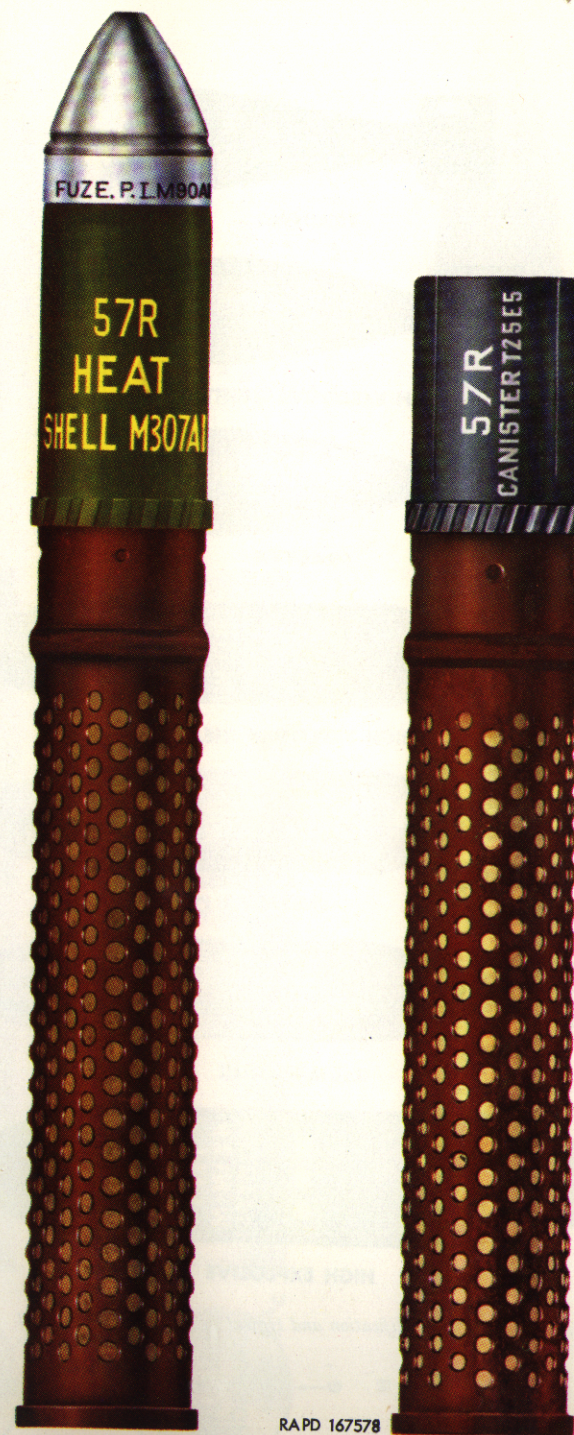
PRACTICE

Figure 3. Color identification and typical marking of rifle grenades.



RA PD, 167577A

Figure 4. Color identification and typical marking of cartridges for aircraft cannon.



RAPD 167578

Figure 5. Color identification and typical marking of rifle cartridges.

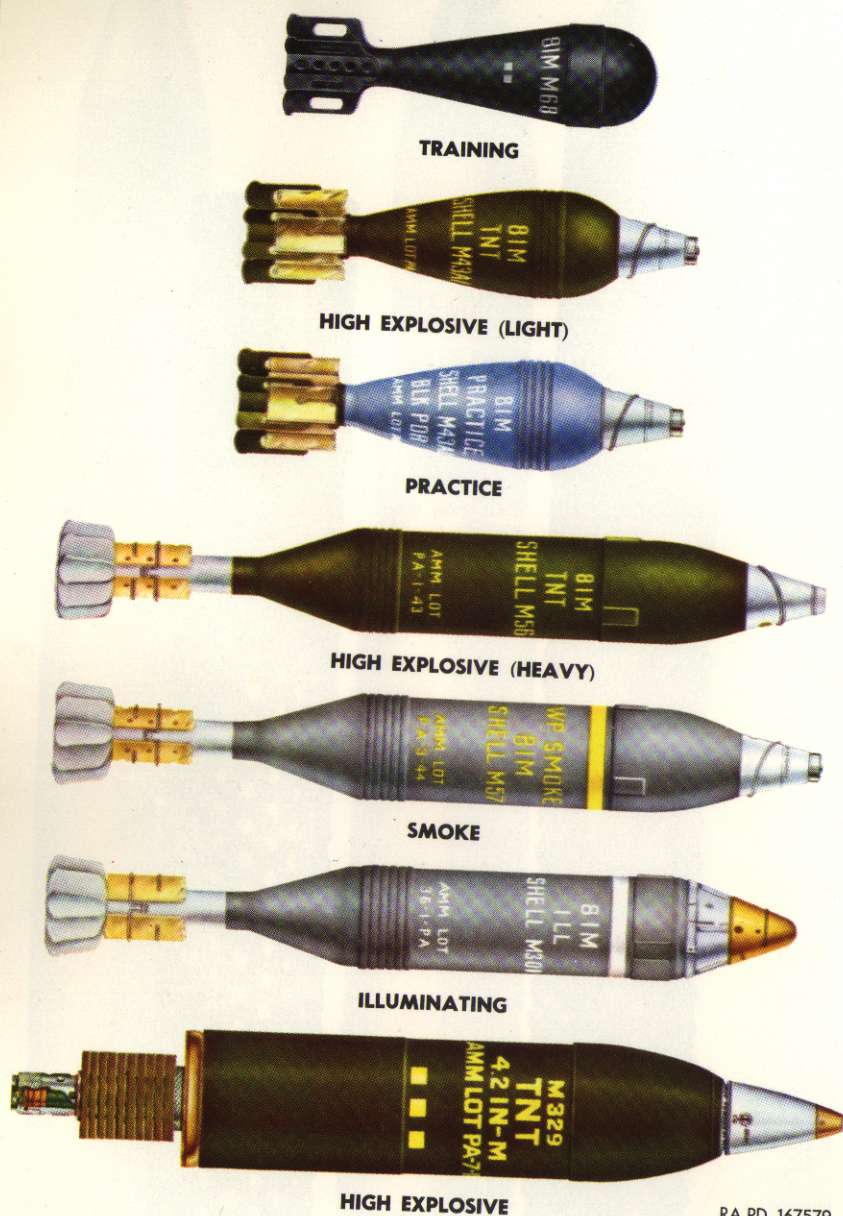


Figure 6. Color identification and typical marking of mortar shell.

RA PD 167579

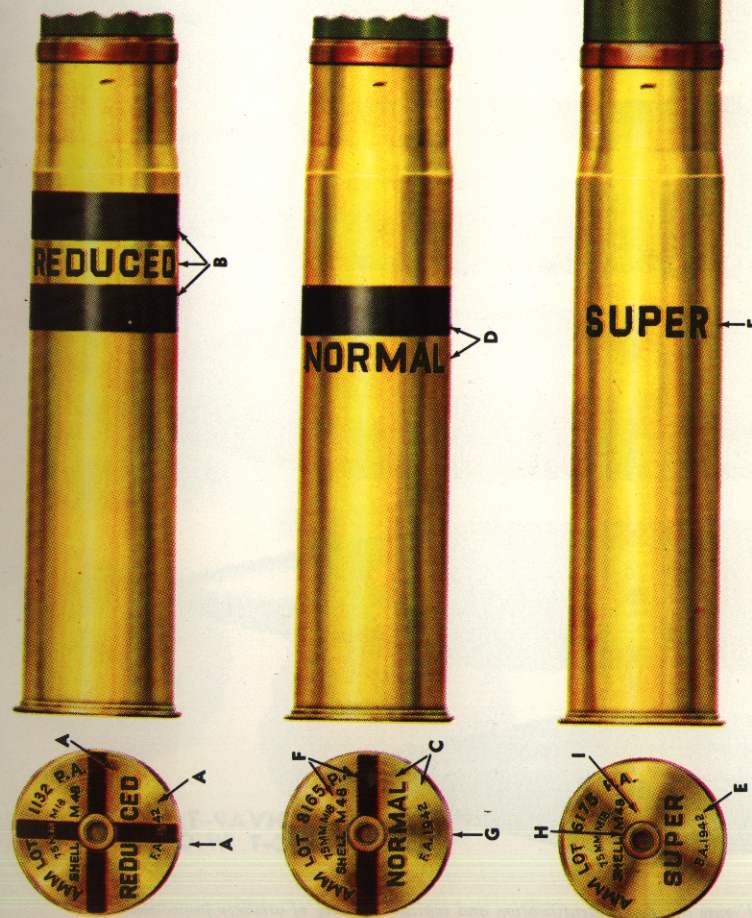


Figure 7 Color identification and typical marking of reduced, normal, and supercharge artillery ammunition.

RA PD 80679

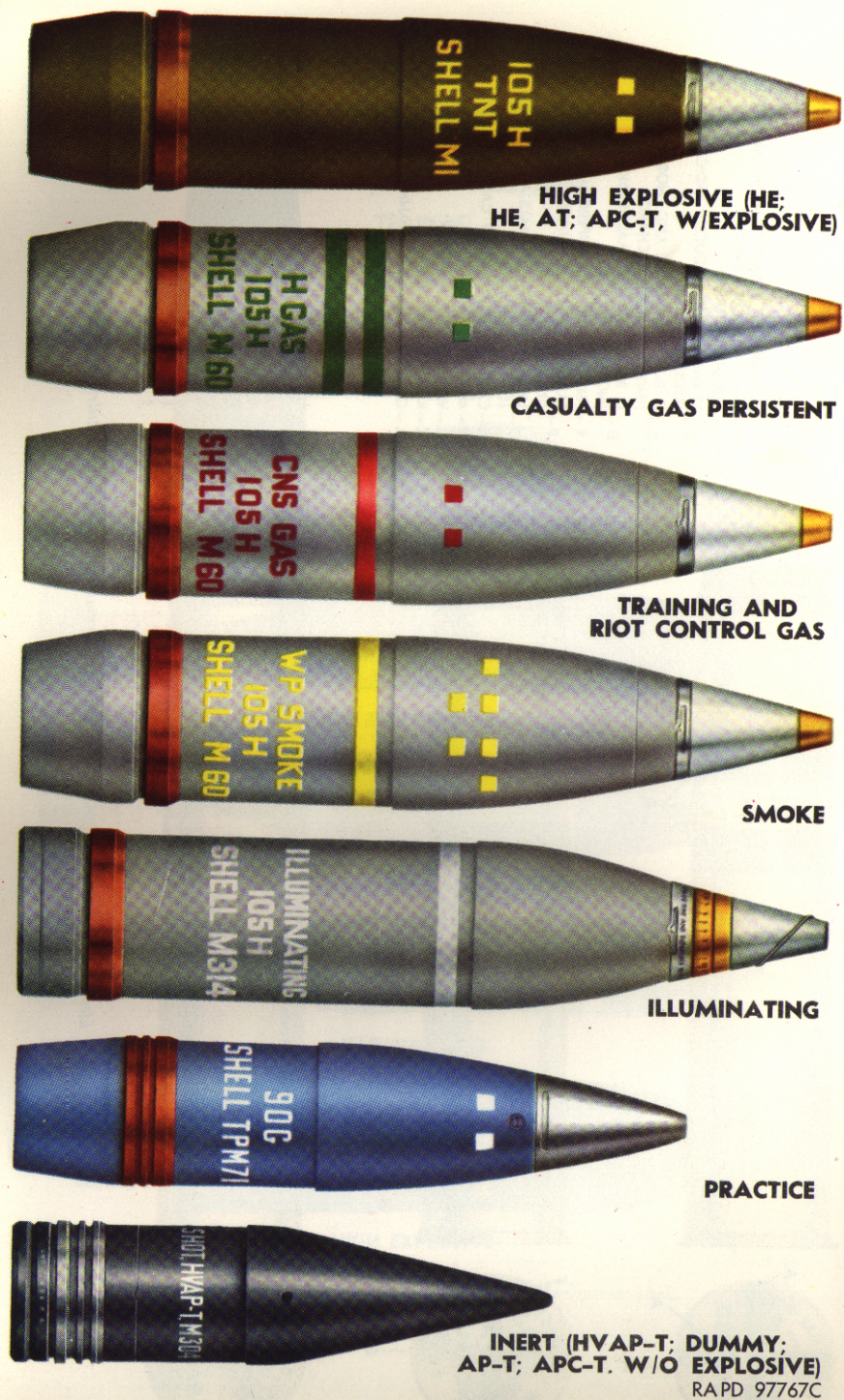


Figure 8. Color identification and typical marking of artillery projectiles.

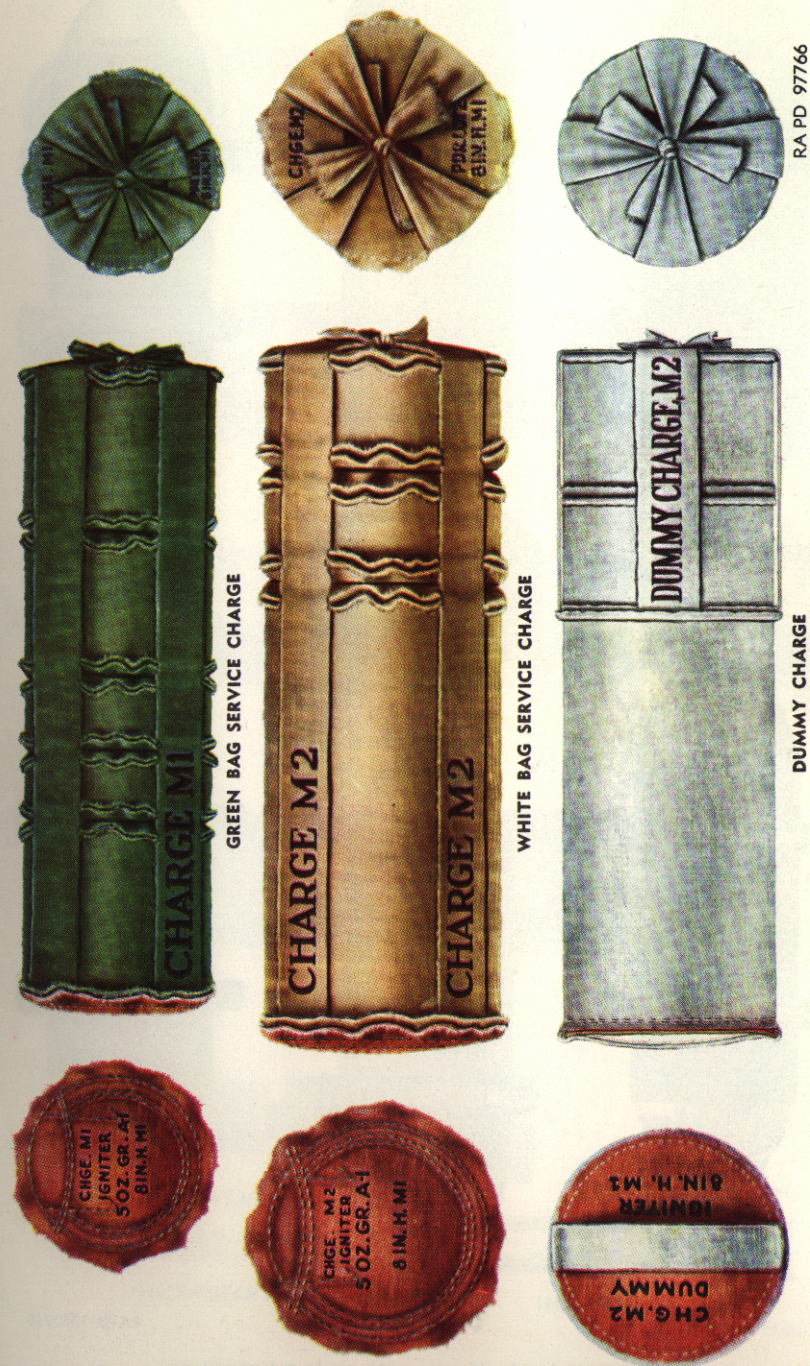
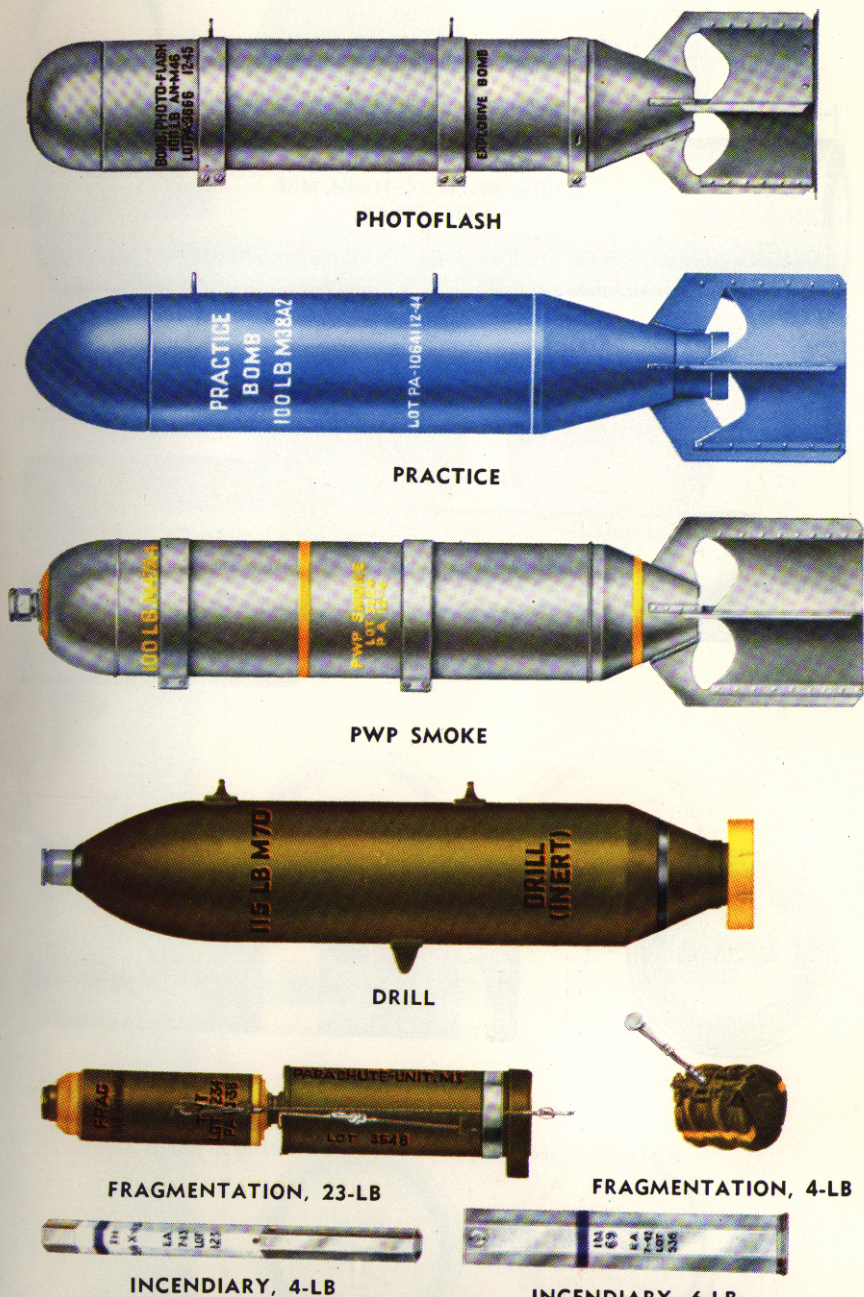


Figure 9. Color identification and typical marking of artillery propelling charges.



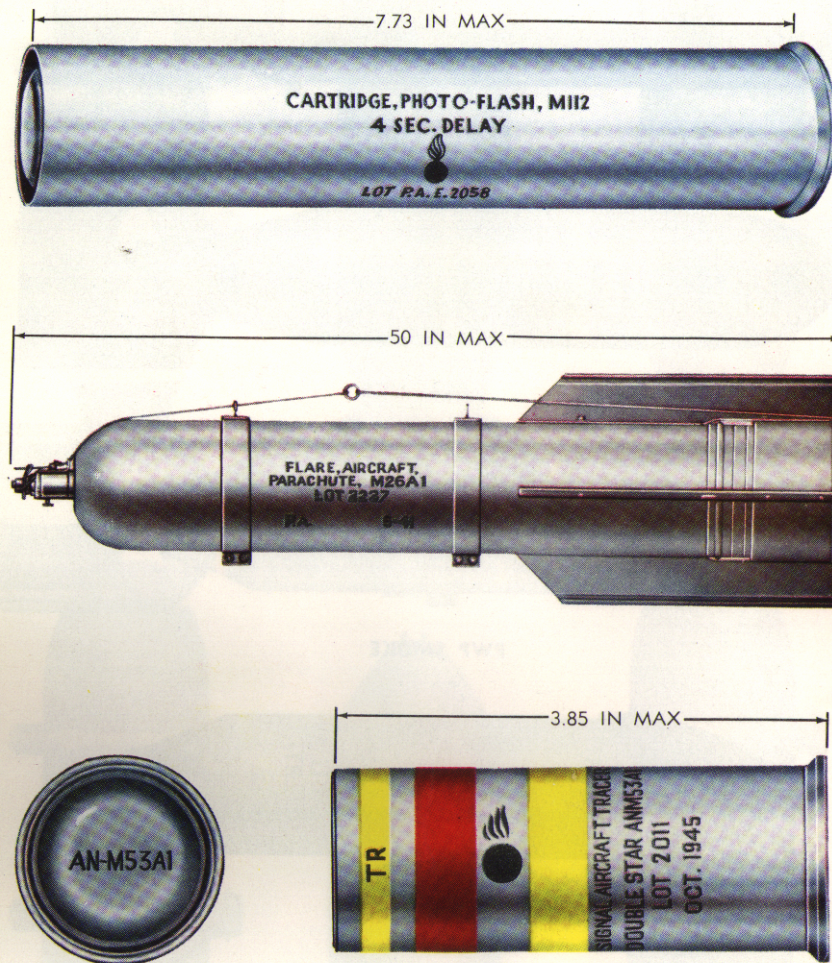
RA PD 108226B

Figure 10. Color identification and typical marking of bombs.



RA PD 108227A

Figure 11. Color identification and typical marking of bombs.



RA PD 167580

Figure 12. Color identification and typical marking of pyrotechnics.



RA PD 167581

Figure 13. Color identification and typical marking of pyrotechnics.

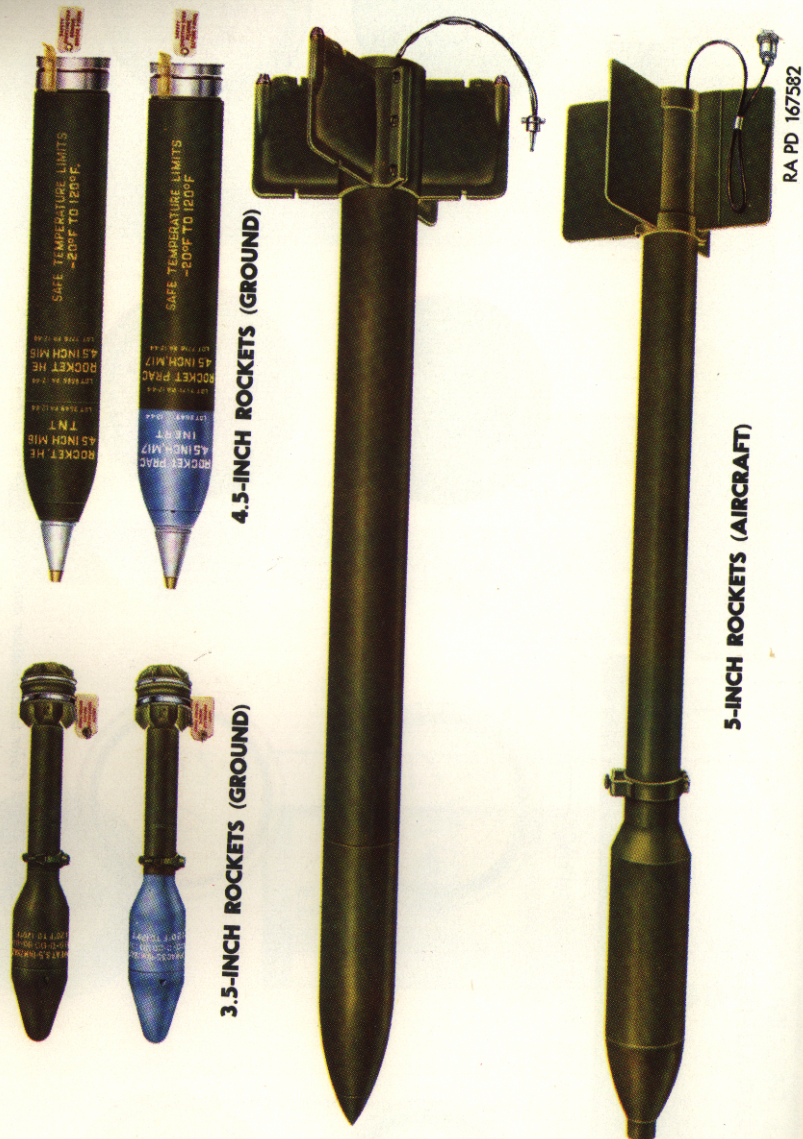


Figure 14. Color identification and typical marking of rockets.



Figure 15. Color identification and typical marking of land mines.

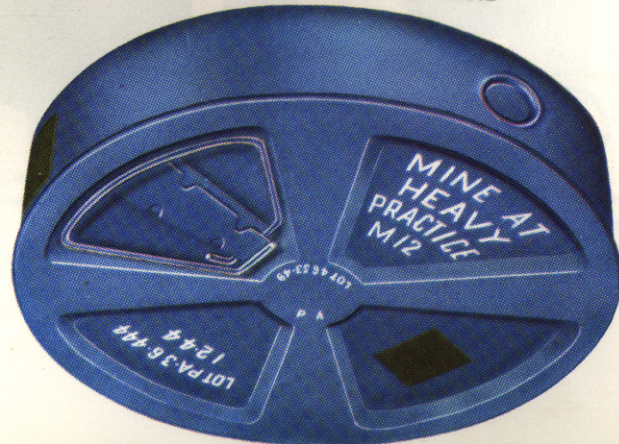
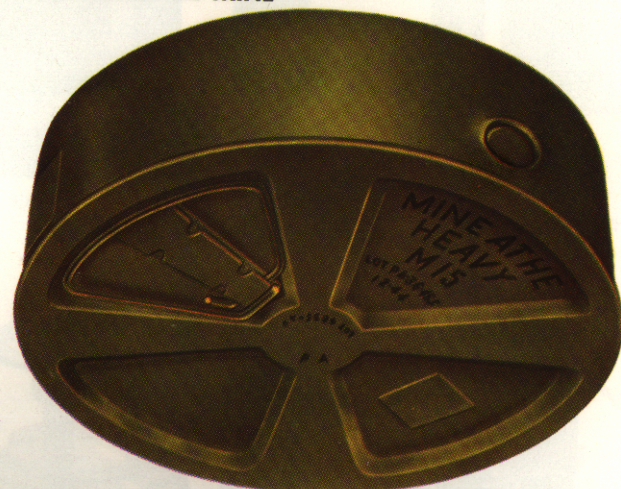
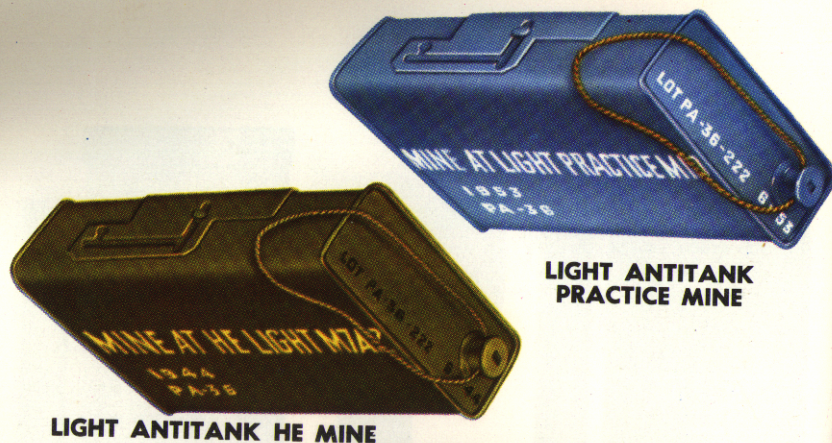


Figure 16. Color identification and typical marking of land mines.

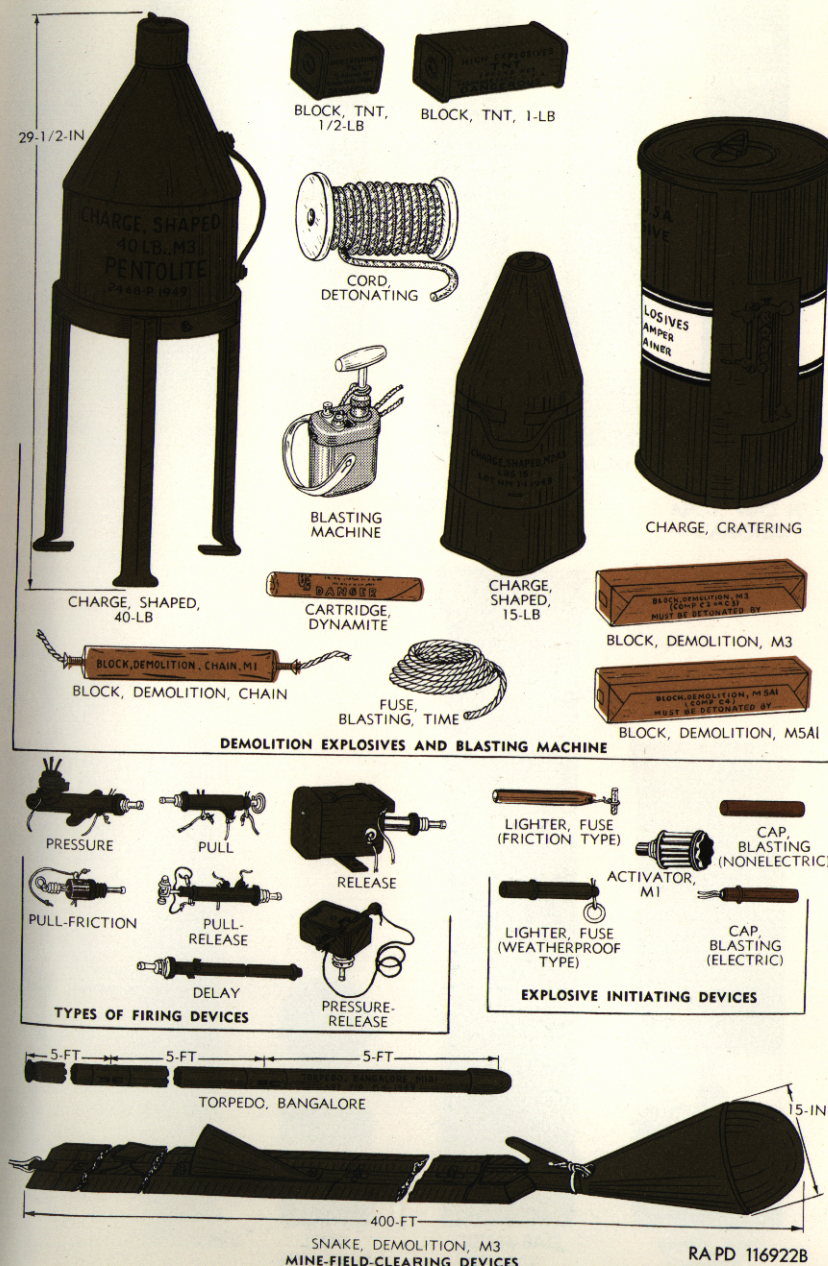


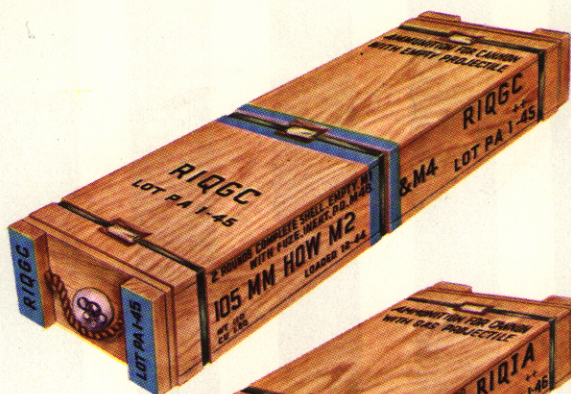
Figure 17. Color identification and typical marking of demolition material.

R. N. Cox

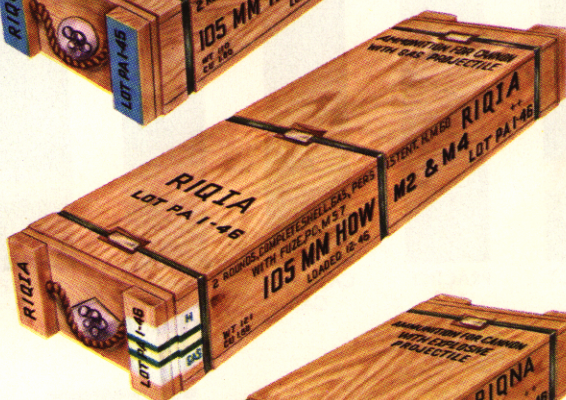


Figure 18. Color identification and typical marking of fiber and metal containers.

FOR PRACTICE
AMMUNITION



FOR CASUALTY
PERSISTENT GAS
AMMUNITION



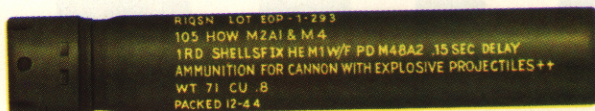
FOR HIGH
EXPLOSIVE
AMMUNITION



FOR SMOKE
AMMUNITION



METAL
CONTAINER



RA PD 97765B

Figure 19. Color identification and typical marking of packing boxes and metal container.

CHAPTER 2

EXPLOSIVE AND CHEMICAL AGENTS

Section I. PROPELLANTS

14. General

Propellants are liquid or solid compositions used to propel a projectile, rocket, JATO, etc. Most explosives currently used as solid propellants have a nitrocellulose base. Various organic and inorganic substances are added to the nitrocellulose base during manufacture to give improved qualities for special purposes. These propellants are distinguished by M or T numbers and by such terms as single-base, double-base, and composite, as well as by commercial trade names or symbols. Black powder, which was formerly classed as a propellant, is no longer used as such but is now used as a delay element, as an igniting charge for propellants, in flash reducers, or for other special purposes.

15. Classification

Solid propellants are classified in accordance with their compositions as indicated in *a* through *c* below.

a. Single-Base Propellant includes compositions that are principally gelatinized nitrocellulose and contain no high-explosive ingredient such as nitroglycerin.

b. Double-Base Propellant includes compositions that are predominately nitrocellulose and nitroglycerin.

c. Composite Propellant includes compositions that do not contain significant amounts of nitrocellulose or nitroglycerin and are mechanical mixtures of a fuel with an inorganic oxidant. A part or all of the fuel may also serve as a binding agent.

16. Physical Characteristics

a. Form. Solid propellants are manufactured in the form of flakes, balls, sheets, cords, or perforated cylindrical grains (fig. 20). They are made in different shapes to obtain certain types of burning. The cylindrical grains are made in various diameters and lengths. Figure 21 shows the relative size of the grains used in some artillery propellants. For small size grains, either no perforation or a single perforation is required. However, for larger grains, seven equally spaced perforations are present in order to have an increasing burning surface area. The critical dimension is the "web size," that is, the average thickness of the grain between burning surfaces. "Web size" or "web thickness" influences the initial rate of burning of the propellent grain.

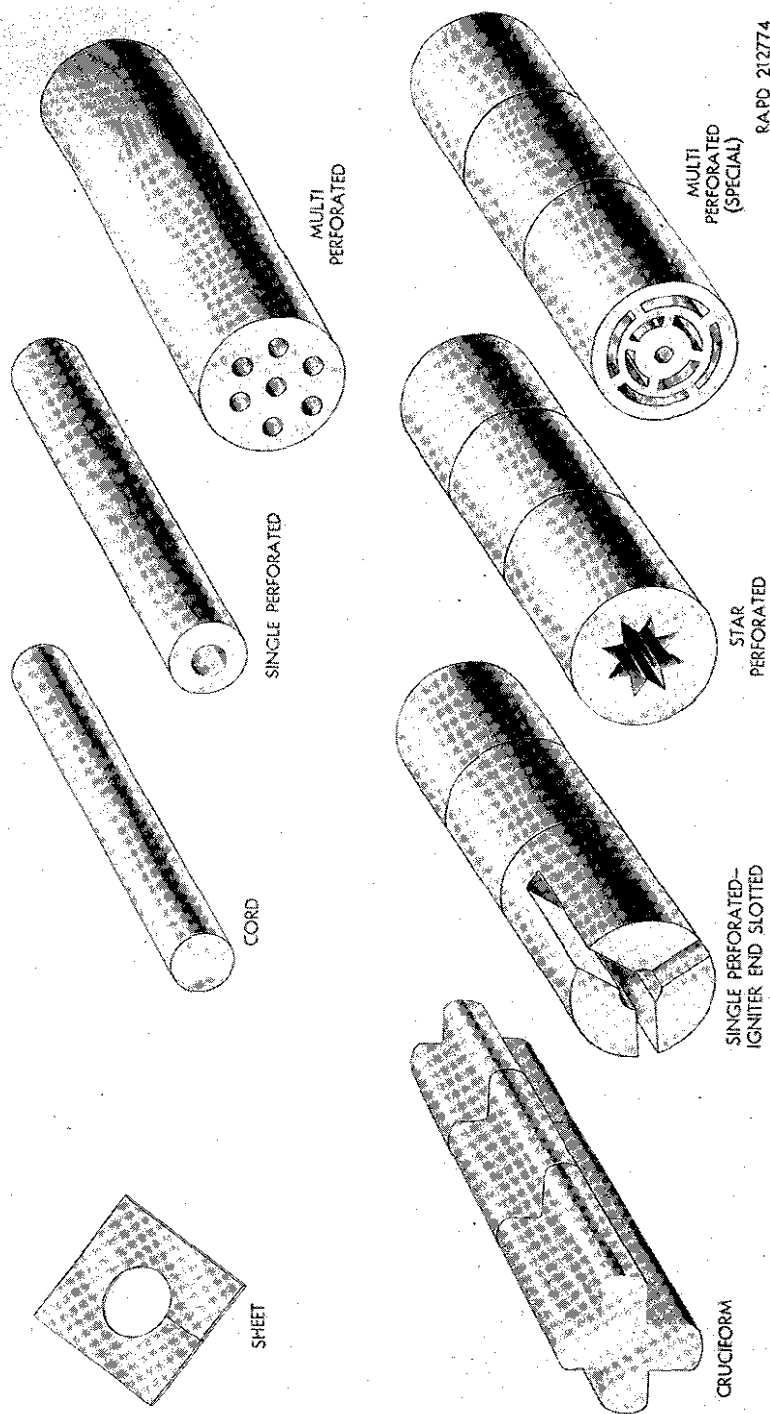


Figure 20. Shapes and forms of propellant grains.

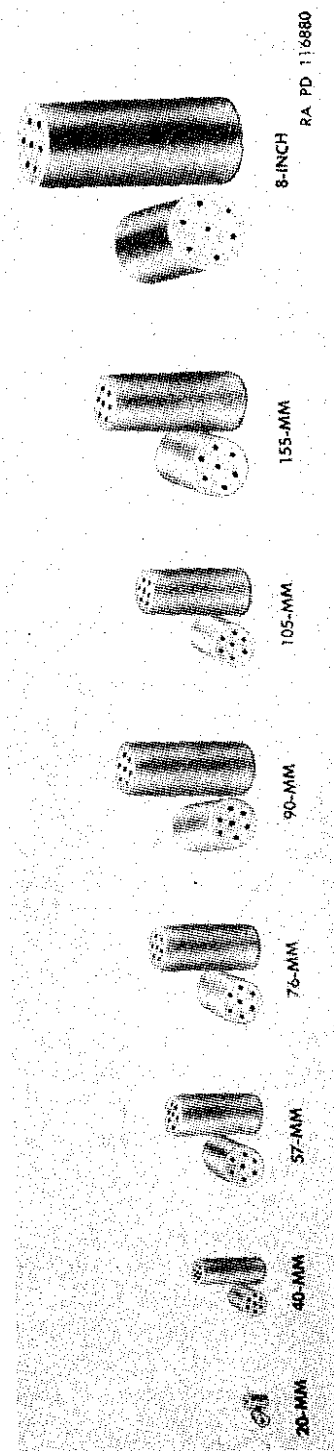
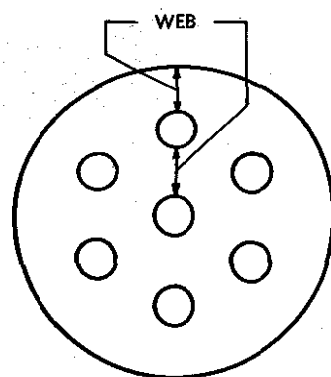
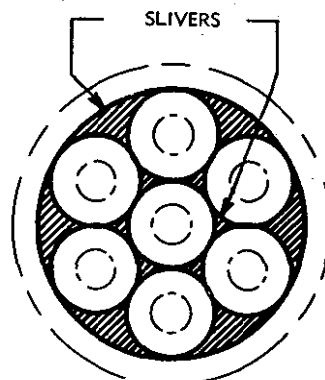


Figure 21. Relative sizes of propellant grains.



A—UNBURNED GRAIN



B—BURNING GRAIN

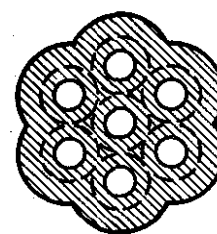
RA PD 4319A

Figure 22. Progressive burning of propellant grains (multi-perforated).

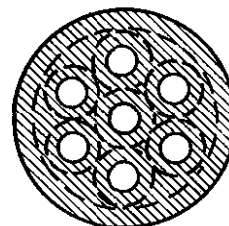
b. Burning Action.

- (1) *General.* Unconfined nitrocellulose propellant burns relatively slowly and smoothly but, when confined, its rate of burning increases with temperature and pressure. In order not to exceed the permissible chamber pressure of the weapon in which it is to be used, the rate of burning of the propellant has to be controlled. At any given pressure, the rate of burning is proportional to the propellant surface free to burn (fig. 23). Therefore, propellants are made into accurate sizes and definite shapes.
- (2) *Degressive burning.* As the surface areas of the cord and strip forms of propellant change with burning, the surface of the grain decreases. The burning action of these grains is, therefore, classified as "degressive."
- (3) *Neutral burning.* As a single-perforated grain burns, the outer surface decreases and the inner surface increases. The result of the two actions is that the total surface remains approximately the same in area. The burning of this type of grain is known as "neutral."
- (4) *Progressive burning.* When the multi-perforated grain burns, the total surface area increases, since the perforated grain burns from the inside and outside at the same time. This type of burning is called "progressive" (fig. 22).
- (5) *Slivers.* When a multi-perforated grain is not completely consumed, portions of the grain remain in the form of slivers (B, fig. 22) and may be ejected as such from the weapon.

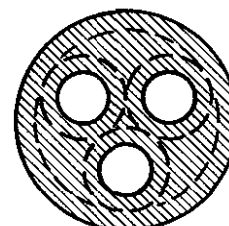
c. *Use.* Nitrocellulose propellants are used for small arms and larger-caliber ammunition. The perforated form of grain is the one most commonly used in the United States military propellants. Single perforated grains are used for small arms, grenade cartridges, minor-caliber weap-



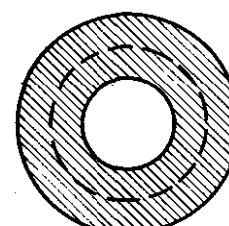
ROSETTE



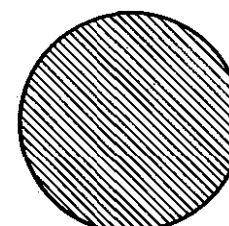
MULTI-PERFORATED



TRI-PERFORATED



SINGLE-PERFORATED



CORD

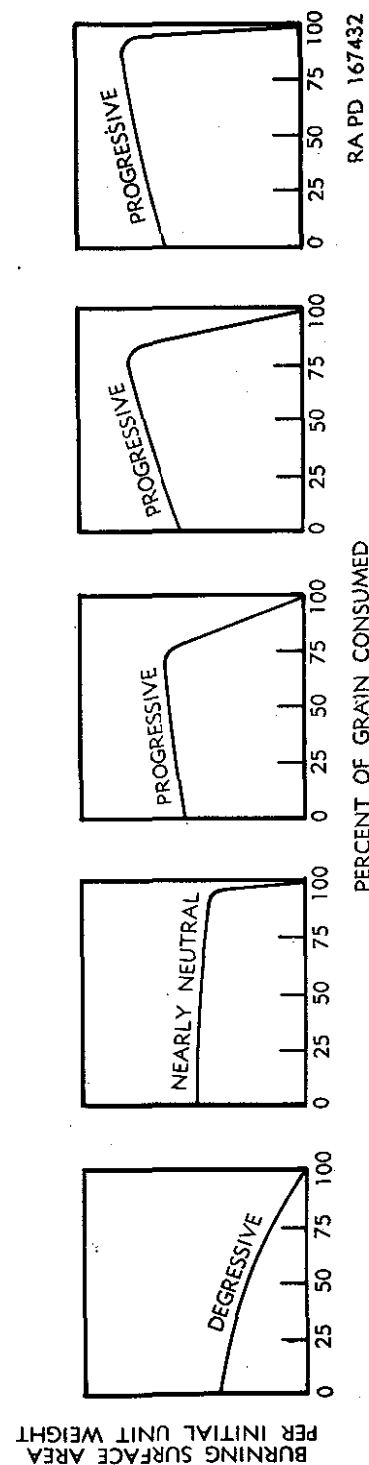


Figure 23. Comparative burning rates of different shaped propellant grains.

ons, certain howitzers, and some rockets. Propellants with seven perforations are used for larger-caliber weapons.

17. Single-Base Propellants

a. *General.* Single-base propellants contain nitrocellulose as their chief ingredient. One of the first standardized nitrocellulose propellants was termed pyrocellulose. Single-base compositions are now used in artillery, small arms, and grenades.

b. *Smokeless and Flashless Characteristics.* Since pyrocellulose propellant was unduly hygroscopic and gave bright flashes when fired, it was replaced before World War II by propellants designated, "flashless non-hygroscopic" (FNH) and "nonhygroscopic" (NH), single-base propellants. These propellants are not truly nonhygroscopic, but they are much less hygroscopic than pyrocellulose. This method of designation has since been replaced, and propellant compositions are now identified by standard M or T numbers. To indicate the performance of a round of ammunition in certain calibers of artillery ammunition, the word FLASHLESS (Fhls), SMOKELESS (Smkls), or FLASHLESS-SMOKELESS (Fhls-Smkls), or the applicable abbreviation, is stenciled on the round and on its packing box. These terms are relative; FLASHLESS (Fhls) indicating ammunition that does not flash more than 5 percent of the time under average conditions; SMOKELESS (Smkls) indicating ammunition that produces less than half the amount of smoke produced by ammunition not so designated. FLASHLESS-SMOKELESS (Fhls-Smkls) designates a propellant with both of these characteristics. Whether ammunition upon being fired is flashless, smokeless, or both, depends on the weapon in which it is used, the type of ignition used, weapon wear, the temperature of the weapon, ambient temperature conditions, and the quantity and composition of the propellant. Some double-base propellants also have flashless and smokeless characteristics.

c. *EC Blank Powder.* EC blank powder, one of the earliest partially colloid nitrocellulose single-base compositions developed, is used in caliber .30 blank ammunition. It is usually orange or salmon pink in color. Though it is soft and light, it resembles coarse sand. It is more sensitive to friction, shock, and heat than completely colloid nitrocellulose propellants. When exposed, it absorbs moisture readily and therefore must be protected from the atmosphere. It burns rapidly in the open and explodes if confined. It is usually exploded by flame from a primer or fuze.

18. Double-Base Propellants

Double-base propellants are those having nitrocellulose and nitroglycerin as their major ingredients, accompanied by one or more minor ingredients such as centralite, vaseline phthalate esters, inorganic salts, etc. These propellants may contain from 15 to 43 percent nitroglycerin. The minor ingredients are used for various purposes, such as to insure

stability, reduce flash or flame temperature (or both), and improve ignitability. The usual practice in this country is to use nitrocellulose of about 13.15 to 13.25 percent nitrogen. Nitroguanidine is used in some double-base propellants, not only to add to the ballistic potential, but to act as a flash reducing agent as well. Double-base propellants are gray green to black in color, and the grains are similar in size and shape to the single-base propellants. Another propellant is in the form of spherical grains from 0.02 to 0.03 inch in diameter and is commonly known as "ball propellant." Generally speaking, double-base propellants are easily ignited, have high burning rates, high flame temperature, and high force, but they erode weapons badly and are more dangerous and costly to manufacture than nitrocellulose propellants. For these reasons and because glycerin is not an abundant material, double-base propellants have tended, in this country, to be used only where some of the properties mentioned above are especially desirable. They have found their principal uses in propellants for shotguns, pistols, mortars, and rockets; and have been generally avoided in rifled weapons (except pistols).

19. Composite Propellants

Composite propellants are principally solid gas producing materials, which contain neither nitrocellulose nor nitroglycerin. They are usually

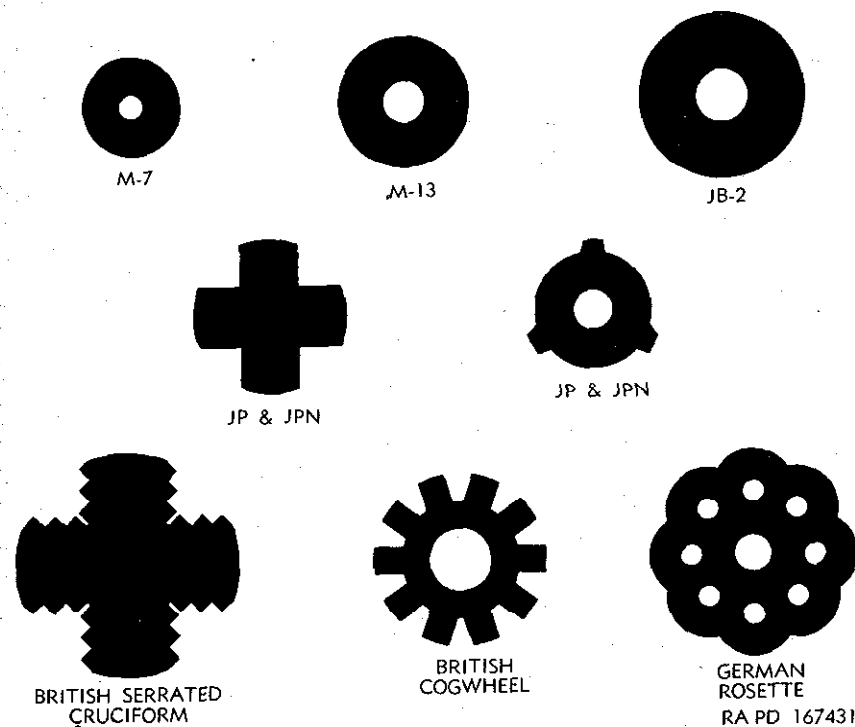


Figure 24. Forms of rocket propellants (United States and foreign).

a physical mixture of an organic fuel, an oxidizer, and an organic binding agent. Unlike the single- and double-base propellants that are manufactured principally by extrusion techniques, composite propellants are molded or cast to form into a single element or grain. They may be coated on the surface with cellulose acetate or other inhibitor material to control the grain burning action. Composite propellant designated as T9 (principally ammonium picrate and potassium nitrate) is representative of such propellants. In form and shape, composite propellants may be as shown in figures 20 and 24, respectively, which illustrate some of the various forms of propellant grains employed in JATOS and various forms of propellants employed in foreign and United States rockets.

a. Like single-base and double-base propellant compositions (which are essentially a fuel and oxidizer), composite propellant compositions are balanced for control of their burning actions.

b. Composite-type propellants are employed in ground- and aircraft-type rockets and JATOS.

c. A solid propellant (double-base or composite), as employed in rockets or JATOS, is contained within the reaction motor of the weapon. On ignition by a flame from a fuze or primer, there results an uninterrupted combustion reaction and generation of a large volume of hot gases within the reaction chamber, which escape through the nozzle opening.

20. Other Solid Propellants

a. *Guncotton.* A nitrocellulose (nitrated cotton, nitrated wood pulp) of high nitration (13.35 to 13.4 percent nitrogen) is employed extensively in the manufacture of single-base as well as double-base propellants. It is also used in electric primers and in electrically initiated destructors. In most propellants, the guncotton is blended with pyrocellulose (12.6 percent N) to give an average of 13.15 percent nitrogen.

b. *Small Arms.* Propellants for small arms are usually coated with dinitrotoluene, which acts as a moisture-proofing agent, causes the first phase of the burning process to take place at a relatively slow rate, and has some antilashing action. In addition, the propellants are usually glazed with graphite to facilitate the uniform action of automatic loading machines and to avoid the development of large static charges in blending and loading, and thus present a black polished appearance. Since the propellant grains are small, in the presence of abnormal temperatures they are subject to more rapid deterioration than the larger grains. Many small arms propellants are nearly as sensitive to friction as black powder. Therefore, precautions used in handling black powder should be observed for small arms propellants.

21. Liquid Propellants

Liquid propellants have recently been explored in an attempt to find propellants for large size rockets, missiles, and projectiles that can be controlled in combustion better than solid propellants. They may include

any viscous or nonviscous fluid or liquified gas that is principally an organic fuel and a strong inorganic oxidizer. Such propellant compounds or mixtures are either composite (fuel and oxidizer combined) or independent (fuel and oxidizer), in a container or containers, separate from the reaction chamber. With or without catalysts, stabilizers, and auxiliary additives (when fed through an arrangement of connecting feed lines, valves, controls, and metering devices), they can be reacted or combusted instantaneously, to produce gaseous products for propelling rockets at velocities greater than the speed of sound (supersonic speeds, approx. 650 mph and over).

a. *Classification.* Liquid propellants can be classified in accordance with the type of reaction system that is involved, either as a monopropellant or a bipropellant, as described in (1) and (2) below.

(1) *Monopropellant* system includes a composite mixture or compound of fuel and an oxidizer, delivered by means of a pump or from a pressurized tank, for eventual reaction in the chamber of a JATO or rocket. To initiate a reaction in such system, a separate source of ignition is required.

(2) *Bipropellant* system includes an organic fuel and oxidizer each contained separately in containers for dual feed, carburetion, and combustion within the reaction chamber. Their reaction may be initiated by either the intimate contact of the fuel with the oxidizer, as may be the case of hydrazine and nitric acid, or by external influence (electrical spark ignition or catalysts), as is the case of a hydrocarbon (alcohol) and liquid oxygen.

b. *Characteristics.* Liquid propellants differ from solid propellants primarily in that they are more adaptable to control of long-term combustion reactions, the former being very adaptable for dynamic regulation and control while the latter is statically controlled by the propellant composition and grain design. Like some chemical agents and explosives, liquid propellants are hazardous, toxic flammable, sensitive, and must be recognized for their inherent dangerous properties.

c. *Uses.*

(1) The common combustible and flammable materials that have been used as fuels and oxidizers in liquid propellant systems are included in (a) and (b) below.

(a) *Fuels*—alcohols (ethyl, methyl, furfural); kerosene, aviation gasoline; octane, heptane, pentane, hydrocarbons; aniline, monoethylaniline, hydrazine, diborane, pentaborane, aluminum borohydride, liquid hydrogen, and anhydrous ammonia.

(b) *Oxidizers*—white fuming and red fuming nitric acids (WFNA and RFNA); liquid oxygen and hydrogen peroxide.

(2) Heretofore liquid propellant materials have been employed in rockets and guided missiles such as the V-2, Corporal E, Regulus, Terrier, and Nike. Development of liquid propellants for use in small arms and artillery weapons is now underway.

Section II. LOW EXPLOSIVES

22. General

To understand the composition and functioning of a complete round of ammunition, a basic knowledge of the characteristics and uses of military explosives is necessary. In order that ammunition may function at the time and place desired, it is necessary to employ different kinds of explosives, each of which has a specific role, either as a propellant or as a bursting charge. Explosives suitable for one purpose may be entirely unsatisfactory for another. Thus, the explosive used to burst a forged steel projectile would not only be unsuited but also highly dangerous if used for ejecting and propelling projectiles out of the weapon or propelling missiles and bodies. Similarly, the explosives used in initiators, such as in primers and fuzes, are so sensitive to shock that only small quantities can be used safely. Other characteristics of various types of explosives (propellants and high explosives) are outlined in paragraphs 14 through 21 and 25 through 28. For further detailed information, see TM 9-1910.

a. Definition. By definition, an explosive includes any chemical compound or mechanical mixture that, under the influence of a flame or a spark, undergoes a sudden chemical change (decomposition) with the liberation of energy in the form of heat and light and accompanied by a large volume of gases.

b. Low Explosives. Military explosives are divided into a class of low explosives or high explosives, according to their rates of decomposition. Low explosives are mostly solid combustible materials that decompose rapidly but do not normally explode. This action is known as deflagration. Upon ignition and decomposition, they develop a large volume of gases that produce enough pressure to propel a missile in a definite direction. The rate of burning is an important characteristic, which depends upon such factors as combustion gas pressure, grain size and form, composition, etc., which were discussed in paragraph 16. Low explosives do not usually propagate a detonation. Under certain conditions, however, they react in the same manner as high explosives; that is, they may detonate. The single-base, double-base, and composite propellants (discussed in pars. 17-19), as well as black powder mixtures are typical examples of low explosives.

c. Requirements for a Low Explosive. Before an explosive (propellant) can be adopted for military use, it must possess the following principal characteristics:

- (1) Possess controlled burning rate.
- (2) Be capable of instant ignition and combustion.
- (3) Be stable over extended periods of storage under normal conditions.
- (4) Be balanced for complete combustion and produce a minimum amount of residue and weapon bore erosion.

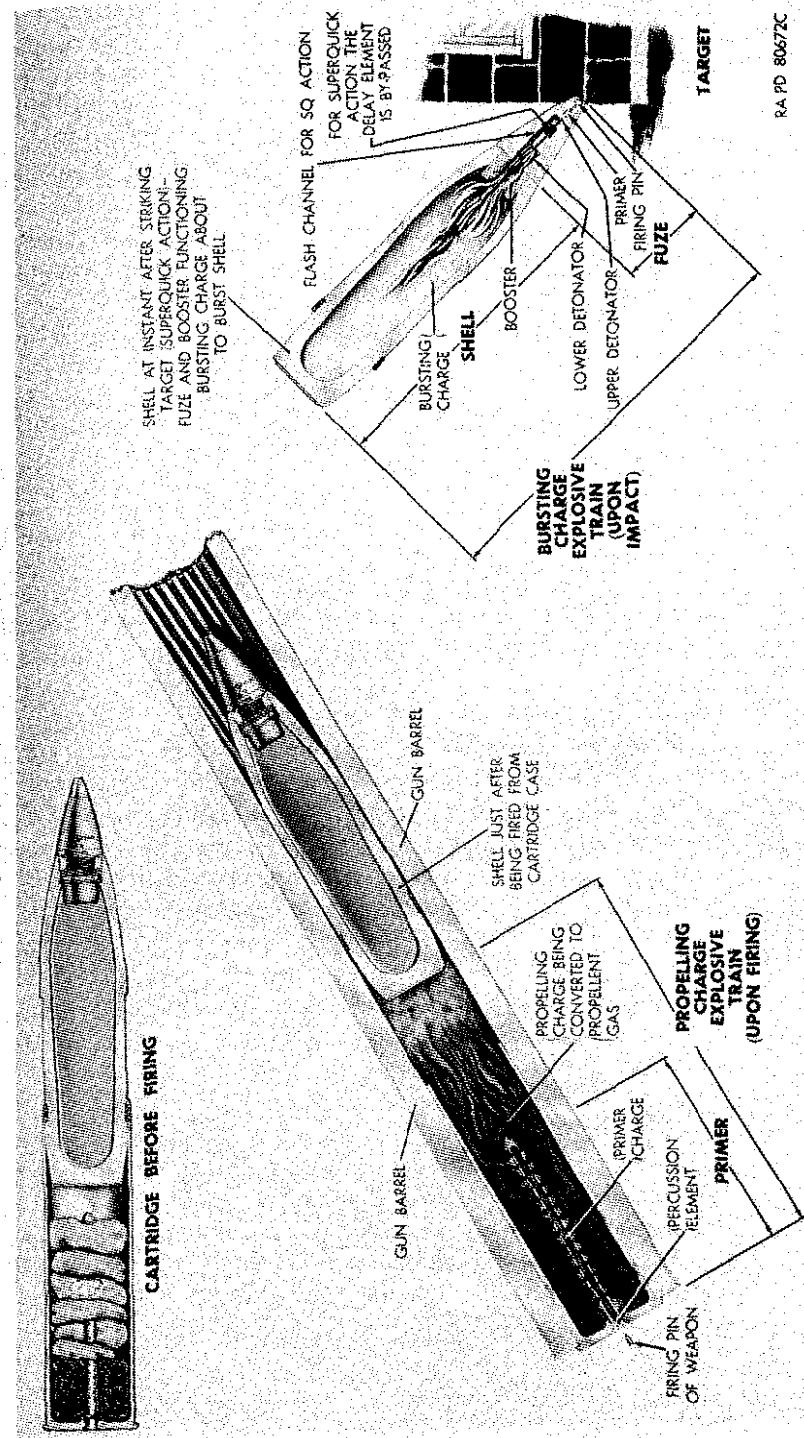


Figure 25. Explosive trains—artillery ammunition.

RA PD 80672C

- (5) Possess a safe minimum toxic and explosive hazard.
- (6) Be able to withstand mechanical shock incident to loading, transportation, and handling by commercial and military carriers.

d. Low-Explosive Train. The arrangement of a series of combustible materials, beginning with a small quantity of sensitive explosive and ending with a relatively large quantity of comparatively insensitive explosive, is termed an "explosive train." In general, there are two explosive trains (fig. 25). These are the propelling-charge explosive train and the bursting-charge explosive train. In all explosive ammunition one or both of these explosive trains will be found.

- (1) The low-explosive or propelling-charge explosive train is employed for the ejection or propulsion of a body or missile from the weapon. This train may consist of a primer, an igniter or igniting charge, and a propelling charge. Thus, a spit of fire from a small quantity of sensitive explosive (primer) is transmitted in a manner so that a large amount of relatively insensitive explosive (the propelling charge) burns in the proper manner to propel the body forward. Although a primer is absent in rockets and the igniter in small arms ammunition, all three elements are found in artillery propelling-charge explosive trains.
- (2) In small arms ammunition (cartridges), where the propelling charge is relatively small, the igniter is not required. The components in this train are a percussion primer and a propelling charge. The firing pin explodes the primer and the flame passes through the vent leading to the powder chamber and ignites the propelling charge; the expansion of the resultant gases forces the bullet out through the bore of the weapon.
- (3) In artillery ammunition, the propelling-charge explosive train is slightly different from the one in small arms ammunition (fig. 25). In this train, it is necessary to place an auxiliary charge of black powder, called the primer charge or igniter charge, between the primer and the propelling charge. The addition of the primer charge is necessary because the small flame produced by the primer composition is not of sufficient intensity to initiate the combustion of the large quantity of propellant. The primer or igniter charge may be continued in the body of the primer, making one assembly of the percussion element of the primer and the primer charge as in fixed ammunition, or it may be divided between the primer body and the igniter pad attached to separate-loading propelling charges.
- (4) In jet propulsion weapons (rockets and JATOS) the propellant explosive train consists of a propelling charge (single or multi-grain, double-base, or composite propellant) and an igniter,

usually a black powder mixture contained together with an electric squib or squibs that act as the initiator.

23. Black Powder

a. Characteristics. Black powder, the oldest explosive known, is an intimate uniform mechanical mixture of finely pulverized potassium nitrate (or sodium nitrate), charcoal, and sulfur. Until the development of nitrocellulose propellants, black powder was the only propellant and explosive available. Potassium nitrate is used in most military black powders. It ignites spontaneously at about 300° C. or 540° F., and develops a fairly high temperature of combustion (2,300° to 3,800° C. or 4,172° to 6,872° F.), which causes erosion in the bore of weapons. Black powder is usually in the form of small, black grains that are polished by glazing with graphite. It is hygroscopic and subject to rapid deterioration when exposed to moisture. If kept dry, it retains its explosive properties indefinitely. It is one of the most dangerous explosives to handle because of the ease with which it is ignited by heat, friction, or spark.

b. Uses. Although black powder has been replaced by single- and double-base and composite propellants, it still is used in several grades in—

- (1) Primers and igniters for artillery shell.
- (2) Delay elements in fuzes.
- (3) Expelling charge for base ejection smoke shell, illuminating shell, and pyrotechnics.
- (4) Saluting and blank fire charges.
- (5) Smoke-puff and spotting charges for practice ammunition.
- (6) Burster in incendiary ammunition.
- (7) Bursting charge for 37-mm explosive shells.
- (8) Safety fuse.
- (9) Quick-match.
- (10) Spotting charges for practice bombs and shells, and subcaliber shells.
- (11) Time-train rings in time and combination fuzes.
- (12) Igniter in jet propulsion units.
- (13) Blasting operations.

c. Precautions. Black powder is particularly sensitive to shock, friction, heat, flame, or spark. When black powder is handled in cans or bags or when it is not absolutely protected against sparks, the precautions described in paragraph 12 will be strictly observed.

24. Pyrotechnic Compositions

a. Characteristics. Pyrotechnic compositions with respect to rapidity of action are low explosives because of their low rates of combustion. The compositions are essentially homogeneous physical mixtures or blends of powdered chemicals. Fuels, such as magnesium, aluminum, charcoal, sulfur, and metallic hydrides, are mixed with oxidizers, such as the ni-

Table III. Characteristics of Low Explosives

	Burning rate		Heat liberated	Temperature developed
	In minutes	In seconds	Cal/GM	° C.
Pyrotechnic compositions...	2-14		500-2, 500	800-3, 500
Black powder.....		4	655	2, 770
Nitrocellulose compositions.		7-12	700-1, 300	1, 700-3, 300

trates of barium, strontium, sodium, potassium; the perchlorates of ammonium and potassium; and the peroxides of barium and strontium. They are generally compressed, with or without a binder, into a definite shape or form. They also contain color intensity and waterproofing materials. On ignition and combustion they produce considerable light and decompose or burn by a process known as deflagration. The functional characteristics of pyrotechnic compositions are their luminous intensity (candle power), burning rate, color, color value, and efficiency of light production. Other important characteristics are sensitivity to impact and friction, ignitibility, stability, and hygroscopicity. That is, for military use, pyrotechnic compositions must have acceptable explosive as well as pyrotechnic characteristics. Table III shows burning performance characteristics of black powder, nitrocellulose composition, and pyrotechnic low-explosive compositions.

b. Uses. Pyrotechnic illuminating and igniting compositions are used in a wide variety of ammunition items. The most important uses are—

- (1) Flares (trip, airport, ground, aircraft, parachute, reconnaissance and landing observation, bombardment, and tow target).
- (2) Artillery projectiles.
- (3) Photoflash cartridges and bombs.
- (4) Igniter in incendiaries.
- (5) Gunflash simulators.
- (6) Igniter for jet propulsion units (rockets, JATOS, and guided missiles).
- (7) Signal smokes.

c. Precautions. Pyrotechnic compositions are hazardous materials. In general, the regulations in paragraph 12 apply to these compositions.

Section III. HIGH EXPLOSIVES

25. General

High explosives are usually nitration products of organic substances, such as toluene, phenol, pentaerythritol, amines, glycerin, and starch and may be nitrogen-containing inorganic substances or mixtures of both. A high explosive may be a pure compound or an intimate mixture of several compounds with additives such as powdered metals (aluminum), plasticizing oils, waxes, etc., which impart desired stability and perform-

ance characteristics. A high explosive is characterized by the extreme rapidity with which its decomposition occurs; this action is known as detonation. When initiated by a blow or shock, it will decompose almost instantaneously, either in a manner similar to an extremely rapid combustion or with rupture and rearrangement of the molecules themselves. In either case, gaseous and solid products of reaction are produced. The disruptive effect of the reaction makes some explosives valuable as a bursting charge but precludes their use as a propellant for the reason that the gases formed would develop excessive pressures that might burst the barrel of the weapon.

a. Terms and Definitions.

- (1) *Primer.* A primer is a relatively small and sensitive initial explosive train component which, on being actuated, initiates functioning of the explosive train and will not reliably initiate high-explosive charges. In general, primers are classified in accordance with the method of initiation, such as percussion, stab, electric, friction, chemical, etc.
- (2) *Detonator.* A detonator is an explosive train component that can be activated by either a nonexplosive impulse or by the action of a primer and is capable of reliably initiating high-order detonation in a subsequent high-explosive component of the train. When activated by a nonexplosive impulse, a detonator includes the function of a primer. In general, detonators are classified in accordance with the method of initiation, such as percussion, stab, electric, friction, flash, chemical, etc.
- (3) *Igniter.*
 - (a) A device containing a readily burning composition, usually in the form of black powder, used to amplify the initiation of a primer in the functioning of a fuze.
 - (b) A device containing a spontaneously combustible material, such as white phosphorus used to ignite the fillings of incendiary bombs and flamethrower fuels at the time of dispersion or rupture of the bomb casing.
 - (c) A device used to initiate burning of the fuel mixture in a rocket combustion chamber.
- (4) *Delay.* A delay is an explosive train component that introduces a controlled time delay in the functioning of the train.
- (5) *Relay.* A relay is an element of a fuze explosive train that augments an outside and otherwise inadequate output of a prior explosive component, so as to reliably initiate a succeeding train component. Relays, in general, contain a small single explosive charge, such as lead azide, and are not usually employed to initiate high-explosive charges.
- (6) *Lead.* A lead is an explosive train component that consists of a column of high explosive, usually small in diameter, used to transmit detonation from one detonating component to a suc-

ceeding high-explosive component. It is generally used to transmit the detonation from a detonator to a booster charge.

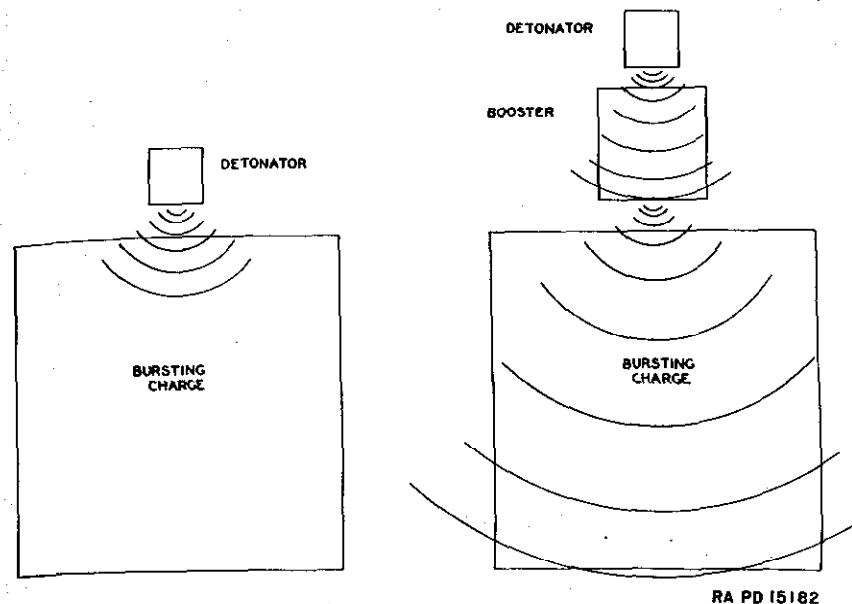
(7) *Booster charge.* A booster charge is the final high-explosive component of an explosive train that amplifies the detonation from the lead or detonator, so as to reliably detonate the main high-explosive charge of the munition.

(8) *Fuze explosive train.* A fuze explosive train is an arrangement of a series of combustible and explosive elements consisting of a primer, a detonator, a delay, a relay, a lead, and booster charge, one or more of which may be either omitted or combined. The function of the explosive train is to accomplish the controlled augmentation of a relatively small impulse into one of sufficient energy to cause the main charge of the munition to function.

(9) *Primer compositions.* A primer composition is an explosive that is sensitive to a blow such as that imparted by a firing pin. It is used to transmit shock or a flame to another explosive, a time element, or a detonator. Most military priming compositions consist of mixtures of one or more initial detonating agents, oxidants, fuels, sensitizers, and binding agents. Many compositions contain potassium chlorate, lead thiocyanate, antimony sulfide, lead azide, lead styphnate, mercury fulminate, and a binding agent. The potassium chlorate acts as an oxidizing agent, the lead thiocyanate as the fuel and as a desensitizer to the chlorate, and the explosive as the detonating agent. Other materials such as ground glass and carborundum may also be added to increase sensitivity to friction. Priming compositions for electric primers and squibs may contain barium nitrate as the oxidizing agent instead of potassium chlorate and lead styphnate or DDNP (diazodinitrophenol) as the initiating explosive. Primer mixtures are used in the percussion elements of artillery primers, in fuzes, and in small arms primers and as the upper layer of a detonator assembly.

(10) *Bursting charge.* This is an encased explosive that, when initiated, is designed to break the metal casing into small fragments.

b. High-Explosive Train. Explosive train may be defined as a series of steps by which a small, initial amount of energy is built up to the large amount of energy necessary to insure a high-order detonation for a bursting charge. Fundamentally, an explosive train consists of a detonator, booster, and bursting charge. This sequence is often interrupted by a delay or relay. To illustrate the principle of the explosive train, a 2,000-pound bomb filled with TNT has a fuze of the firing pin type. The TNT by itself will not detonate from the release of the firing pin, because the initial source of energy being a friction or percussion effect of the fir-

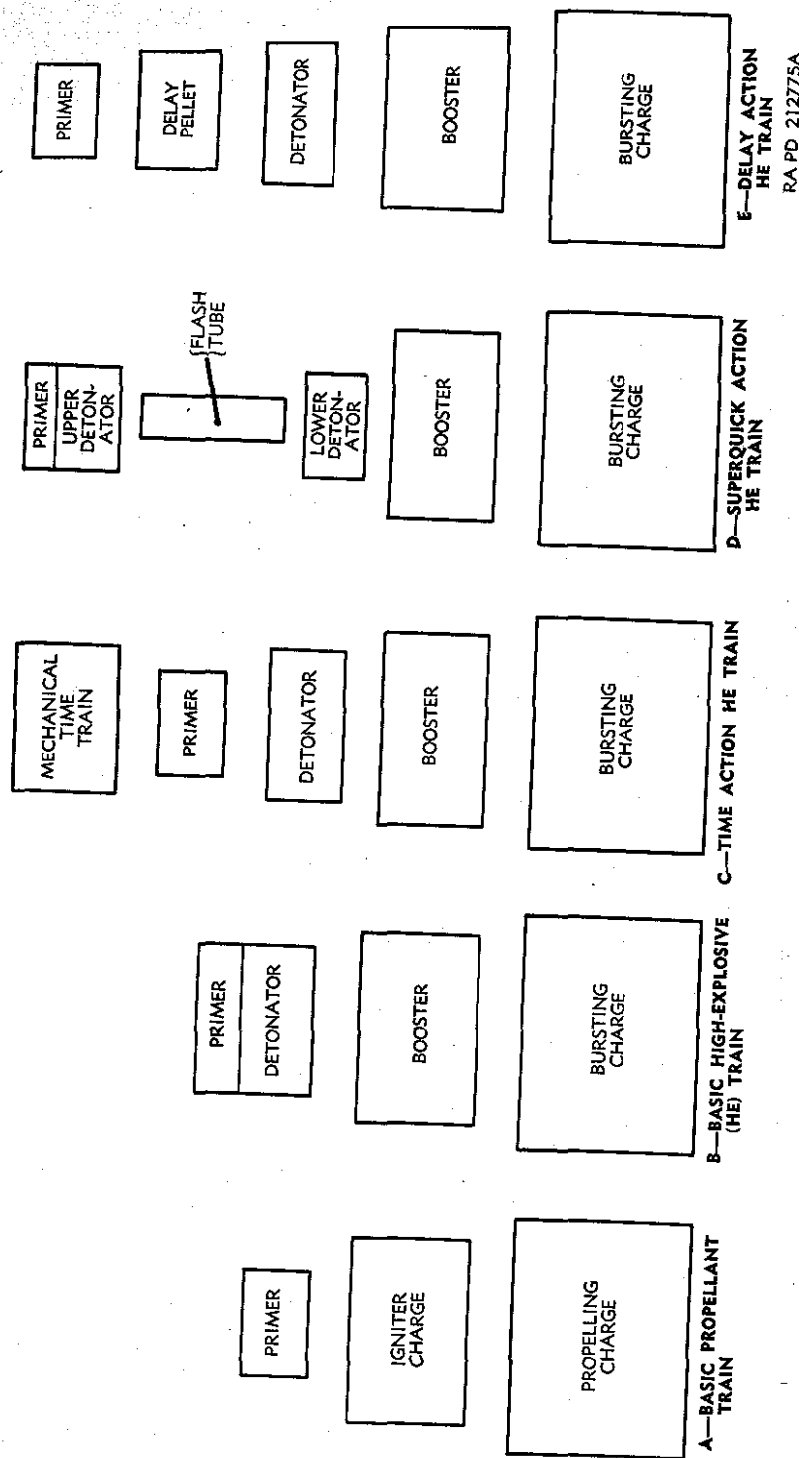


DETONATING WAVE AMPLIFIED BY USE OF BOOSTER

Figure 26. Detonating wave amplified by the use of a booster.

ing pin is insufficient and must be stepped up to a point where it will detonate the TNT. This is always accomplished by means of an explosive train. Components and performance characteristics in explosive trains are discussed in (1) through (6) below.

- (1) The detonator sets up a high-explosive wave when initiated by the stab action of a firing pin or by a flame. This detonation is so small and weak that it will not initiate a high-order detonation in the bursting charge, unless a booster is placed between the two. The booster picks up the small explosive wave from the detonator and amplifies it to an extent that the bursting charge is initiated and a high-order detonation results (figs. 25 and 26).
- (2) To gain the action necessary to control the time and place at which an explosive will function, it is necessary to incorporate other components in a high-explosive train. The action desired may be a burst in the air, a burst instantly upon impact with the target, or a burst shortly after the projectile has penetrated the target. The components that may be used to give these various actions are a primer, a black powder delay pellet or train, an upper detonator, or any combination of these components. Regardless of the arrangement of the components, the basic chain will remain the same, other components being placed in front of the basic chain (fig. 27).



- (3) The action that causes a projectile to burst in the air may be obtained by placing a primer, which is fired when the projectile leaves the weapon or when the bomb is dropped, and a black powder time train in front of the basic chain. The primer ignites the time-train rings, which burn for the length of time desired, and, in turn, initiates the action of the detonator, booster, and bursting charge (schemes A and C, fig. 27).
- (4) To burst the projectile promptly upon impact with the target, a superquick or instantaneous action is necessary. This action is usually obtained by placing an upper detonator in the extreme front of the fuze and a lower detonator in the body near the booster charge. In this manner, the detonating wave is transmitted instantly to the bursting charge (scheme D, fig. 27).
- (5) To permit penetration of the target by the projectile, a delay action is necessary as included in armor-piercing projectile. This is obtained by placing a primer and delay element ahead of the detonator. In some cases this combination of primer and delay is inserted between an upper and lower detonator (scheme E, fig. 27).
- (6) A variation of the high-explosive train is found in chemical shell. In this train there is no large bursting charge such as is found in high-explosive projectiles, as it is only necessary to rupture the shell case and allow the chemical contents to escape. The actual bursting of the case is accomplished by an enlarged booster, known as a burster charge, contained in a tube running down the center of the shell.

26. Classification

High explosives may be subdivided into three types, according to their sensitivity, as initiating, booster, and bursting explosives.

a. Initiating High Explosives. Initiating high explosives are extremely sensitive to shock, friction, and heat. Under normal conditions, they will not burn, but will detonate if ignited. Their strength and brisance are inferior, but are sufficient to detonate high explosives. Because of their sensitivity, they are used in munitions for initiating and intensifying high-order explosions. Mercury fulminate, lead azide, lead styphnate, and diazodinitrophenol are examples of such explosives.

b. Booster Explosives. Explosives of this type include tetryl, PETN, and RDX. They have intermediate sensitivity between initiating explosives and explosives used as bursting charges such as TNT. They may be ignited by heat, friction, or impact and may detonate when burned in large quantities.

c. Bursting Explosives. Bursting explosives include explosive D, amatol, TNT, tetryl, pentolite, picratol, tritonal, RDX compositions, torpex, DBX, HBX, and others.

27. Demolition and Fragmentation Explosives

a. Tetryl.

(1) *Characteristics.* Tetryl (trinitrophenylmethylnitramine) is a fine yellow crystalline material. When heated it first melts and then decomposes and explodes. It burns readily and is more easily detonated than TNT or ammonium picrate (explosive D) and is much more sensitive than picric acid. It is detonated by friction, shock, or spark. It is insoluble in water, practically nonhygroscopic. Tetryl is stable at all temperatures that may be encountered in storage. It is toxic when taken internally; on contact it discolors skin tissue (tobacco stain) and causes dermatitis.

(2) *Detonation.* Brisance tests show tetryl to have a very high shattering power. It is greater in brisance than TNT and is exceeded in standard military explosives only by PETN and some of the newer military explosives, such as RDX.

(3) Uses.

(a) *Charges.* Tetryl is the standard booster explosive and is sufficiently insensitive when compressed to be used safely as a booster explosive. The violence of its detonation insures a high-order detonation of the bursting charge. It is used in the form of pressed pellets. Tetryl is the standard bursting charge for small-caliber (20- and 37-mm) projectiles. It produces appreciably better fragmentation of these shells than TNT. It is also more readily detonated, and yet, in small-caliber shell withstands the force of setback in the weapon. It is also a constituent of tetrytol.

(b) *Detonator.* Tetryl is used in detonators, the tetryl being pressed into the bottom of the detonator shell and then covered with a small priming charge of mercury fulminate, lead azide, or other initiator.

b. *PETN (Pentaerythrite Tetranitrate).* PETN is one of the strongest known high explosives. It is more sensitive to shock or friction than TNT or tetryl. In its pure form, PETN is a white crystalline powder; however, it may be a light gray due to impurities. It will detonate under a long, slow pressure. PETN in bulk must be stored wet. Its primary use is in booster and bursting charges in small caliber ammunition; upper detonator or in some land mines and shells; explosive core of primacord detonating fuze. When suspended in TNT it forms a pentolite explosive of high brisance.

c. *RDX.* RDX, one of the most powerful explosives, is commonly known as cyclonite (cyclotrimethylenetrinitramine), CTMTN, C6; hexogen (H) (German); T4 (Italian); and Tanoyaku (Japanese). It is a white crystalline solid having a melting point of 202° C. (397° F.) and is very stable. It has slightly more power and brisance than PETN. It is

more easily initiated by mercury fulminate than is tetryl. RDX has been used mainly in mixtures with other explosives, but can be used by itself as a subbooster, booster, and bursting charge. It is being combined with nitrohydrocarbons, which also permit cast-loading, or with waxes or oils for press-loading. It has a high degree of stability in storage.

d. *TNT (Trinitrotoluene).* Trinitrotoluene, commonly known as TNT, is a constituent of many explosives, such as amatol, pentolite, tetrytol, torpex, tritonal, picratol, ednatol, and composition B and has been used by itself under such names as triton, trotyl, trilit, trinol, and tritolo.

(1) *Characteristics.* TNT in a refined form is one of the most stable of high explosives and can be stored over long periods of time. It is relatively insensitive to blows or friction. Confined TNT, when detonated, explodes with violence. When ignited by a flame, unconfined TNT burns slowly without explosion, evolving a heavy oily black smoke; however, burning or rapid heating of large quantities, especially in closed vessels, may cause a violent detonation. It is nonhygroscopic and does not form sensitive compounds with metals, but is readily acted upon by alkalis to form unstable compounds that are very sensitive to heat and impact. It usually resembles a light brown sugar but when pure is crystalline and nearly white. When melted and poured into a shell or bomb it forms a solid crystalline explosive charge. TNT is a very satisfactory military explosive. The melting point of standard grade 1 TNT is 80.2° C. (176° F.). Ammunition loaded with TNT can be stored, handled, and shipped with comparative safety.

(2) *Exudation.* When stored in warm climates or during warm summer months, some ammunition loaded with TNT may exude an oily brown liquid. This exudate oozes out around the threads at the nose of the shell and may form a pool on the floor. The exudate is flammable and may contain particles of TNT. Pools of exudate should be removed.

(3) *Detonation.* TNT in crystalline form can be detonated readily by a No. 6 blasting cap or when highly compressed by a No. 8 blasting cap. When cast, it is necessary to use a booster charge of pressed tetryl or an explosive of similar brisance to insure complete detonation.

(4) Uses.

(a) *Bursting Charge.* TNT is used as a bursting charge for high-explosive shell and bombs, either alone or mixed with ammonium nitrate to form 50/50 or 80/20 amatol. Flake TNT is used in fragmentation hand grenades. Other military uses of TNT are in mines and for parts of certain shell and bomb bursters.

(b) *Demolition.* TNT is used to demolish bridges, railroads, fortifi-

cations, and other structures. For such purposes TNT is used in the form of a large shaped charge or a small highly compressed block inclosed in a waterproof fiber container that protects it from crumbling in handling. The triton blocks used by the Corps of Engineers are blocks of pressed TNT inclosed in cardboard containers.

- (c) *Blasting.* TNT is suitable for all types of blasting and produces approximately the same effect as the same weight of dynamite of 50 to 60 percent grade. It is also used as a surround in some amatol-loaded ammunition.

e. *Amatol.*

- (1) *General characteristics.* Amatol, a mechanical mixture of ammonium nitrate and TNT in various percentages, has approximately the same general characteristics as TNT. It is crystalline, yellow or brownish, and insensitive to friction, but it may be detonated by severe impact. It is less sensitive to detonation than TNT and is readily detonated by mercury fulminate and other detonators. It is hygroscopic and in the presence of moisture attacks copper, brass, and bronze, forming dangerously sensitive compounds. Amatol, 50/50, has approximately the same rate of detonation and brisance as TNT, while 80/20 amatol is slightly lower in velocity and brisance than TNT. Amatol, 80/20, produces a white smoke on detonation, and amatol, 50/50, produces a smoke less black than straight TNT.
- (2) *Composition and form.* Amatol, 50/50, consists of 50 percent ammonium nitrate and 50 percent TNT by weight. When hot, it is sufficiently fluid to be poured or cast like TNT. Amatol, 80/20, consists of 80 percent ammonium nitrate and 20 percent TNT. It resembles wet brown sugar. When hot, it becomes semiplastic (consistency of putty) and in that state it can be pressed into shells and bombs.
- (3) *Uses.* Amatol is a substitute for TNT. Amatol, 50/50, was used for 75-mm and larger shell, and 80/20 amatol was used for shell of 155-mm and larger. Amatol was also used in large bombs. Its primary use, however, is for bangalore torpedoes.

f. *Picric Acid (Trinitrophenol).*

- (1) *General.* Picric acid, a nitrated product of phenol under the name of melinite, was adopted as a military high explosive by the French in 1886 and has been used more extensively as a military explosive by foreign nations than by this country. The British designate it as lyddite.
- (2) *Characteristics.* Picric acid is a lemon-yellow crystalline solid. It is stable but reacts with metals when moist, in some cases forming extremely sensitive compounds. Picric acid is more readily detonated by means of a detonator than TNT but has about the same sensitivity to shock. It is not as toxic as TNT

and is also nonhygroscopic although slightly soluble in water. Picric acid has a high melting point—approximately 122° C. (251.6° F.).

- (3) *Uses.* Picric acid is chiefly used for conversion to ammonium picrate (explosive D) and to form bursting-charge mixtures with other nitro compounds.

g. *Ammonium Picrate (Explosive D).*

- (1) *Characteristics.* Ammonium picrate is the least sensitive to shock and friction of all military explosives. This makes it well suited for use as a bursting charge in armor-piercing projectiles. It is slightly inferior in explosive strength to TNT. When heated, it does not melt but decomposes and explodes. It reacts slowly with metals, and when wet it may form sensitive and dangerous compounds with iron, copper, and lead. It is difficult to detonate. When ignited in the open it will burn readily like tar or resin.
- (2) *Special precautions.*
- (a) Ammonium picrate, which has been pressed at a shell-loading plant and removed from a shell, is very much more sensitive to shock or blow than fresh ammonium picrate. It should be protected against coming in contact with lead, iron, or copper because it forms sensitive compounds.
- (b) Although less sensitive than TNT, it can be exploded by severe shock or friction, is highly flammable, and may detonate when heated to a high temperature.
- (3) *Uses.* Explosive D is used as a bursting charge for armor-piercing shell and in other types of projectiles that must withstand severe shock and stresses before detonating.

h. *Picratol.* Picratol is a mixture of 52 percent explosive D and 48 percent TNT. It can be poured like straight TNT and has approximately the same resistance to shock as that of straight explosive D. The brisance of picratol is between that of explosive D and TNT. Picratol is nonhygroscopic. Picratol is a standard filler employed for all Army semi-armor-piercing bombs.

i. *Pentolite.* Pentolite is a 50/50 mixture of PETN and TNT and is commonly known as pentol (German) and pentritol. Pentolite has largely been displaced by composition B. Pentolite should not be drilled to form booster cavities; forming tools should be used. It is superior to TNT in explosive strength and is less sensitive than PETN. It may be melt-loaded and is satisfactory for use—

- (1) As a bursting charge in small caliber shells, e. g., 20-mm.
- (2) In shaped-charge ammunition of many types, e. g., antitank, rifle grenades, and bazookas.
- (3) In rockets and shaped demolition charges.
- (4) In some ammunition, as a booster or booster-surround.

j. *Tetrytol.* Tetrytol is a uniform mixture of 75 percent tetryl and 25

percent TNT. It has higher brisance than TNT and is more effective in cutting through steel and in demolition work. It is less sensitive to shock and friction than tetryl and only slightly more sensitive than TNT. Tetrytol is stable in storage but exudes at 65° C. (149° F.). Tetrytol is nonhygroscopic and is suitable for underwater demolition, since submergence for 24 hours does not appreciably affect its characteristics. Tetrytol is used in chain and individual demolition blocks and in certain destructors.

k. Nitrostarch Explosives.

(1) *Characteristics.* Nitrostarch, gray in color, is nitrated cornstarch used to sensitize combustibles and oxidizing agents in much the same manner that nitroglycerin is used in dynamite. It is highly flammable, and can be ignited by the slightest spark, as may result from friction and burns, with explosive violence. Nitrostarch is less sensitive than dry guncotton or nitroglycerin. As a demolition explosive, it is as insensitive to impact as explosive D and as sensitive to initiation as TNT. Nitrostarch explosives are readily detonated by a No. 6 blasting cap.

(2) *Uses.* A nitrostarch demolition explosive has been adopted as a substitute for TNT and is available as: four ¼-pound units, each ¼-pound unit containing three ½-pound small size pellets (briquets) wrapped in paraffined paper with markings to indicate the location of holes for the blasting caps; ½-pound blocks; and 1-pound blocks. TNT formulas for computing small charges are directly applicable to the nitrostarch demolition explosive. The blocks must not be broken into fragments, as this may cause detonation.

l. Dynamite. Commercial blasting explosives with the exception of black powder are referred to as dynamite. There are several types, each type being subdivided into a series of grades, each type and grade differing in one or more characteristics. Dynamite consists essentially of nitroglycerin absorbed in a porous material. Each composition generally is designated as either a straight, ammonia, gelatin, or ammonia-gelatin dynamite and generally available as paraffin coated ½-pound sticks or cartridges, rated according to the percent by weight of nitroglycerin content.

(1) *Characteristics.* Dynamite of from 50- to 60-percent nitroglycerin content is equivalent on an equal weight basis to TNT in explosive strength. Dynamite of 40 percent is equivalent to TNT in the ratio of 1¼ pounds dynamite to 1 pound TNT. Straight dynamite is more sensitive to shock and friction than TNT and is capable of being detonated by the action of a rifle bullet. Generally, the higher percentages of dynamite have very good water resistance. Explosion of the common types of dynamite produces poisonous fumes, which are dangerous in confined places. Dynamite, as well as other nitroglycerin explosives, are adversely affected by extreme cold; dynamite

freezes at -20° F., consequently, it is unsatisfactory for service under low-temperature arctic conditions.

(2) *Uses.* Dynamite is used as a substitute for nitrostarch or TNT for training purposes. It is also employed by the Corps of Engineers for trench, harbor, dam, flood control, and mining demolitions. The following limitations are applicable to its use—

- (a) Not to be issued or used for destruction of "duds."
- (b) Not to be supplied for training in use of demolition equipment.
- (c) Not to be used in coastal defense submarine mines or mine batteries.

(d) Not to be carried in combat vehicles subject to extremes of temperature.

m. Ednatol. Ednatol is a mixture of haleite or explosive H (ethylene-dinitramine) and TNT and is one of the most powerful explosives. It is less sensitive than tetryl, PETN, or RDX. Ednatol is equivalent to tetryl in brisance. It can be cast in the same manner as amatol. It has no tendency to combine with metals in the absence of moisture and has no toxic effect. In the presence of moisture, haleite hydrolyzes slightly giving an acid reaction, but hydrolysis of ednatol is not appreciable. Ednatol is very stable and can be stored for long periods; it is nonhygroscopic. Ednatol may be used for the same purpose as pentolite, namely, in rockets, grenades, and high-explosive antitank shell. As an explosive for producing blast effect, it is superior to amatol, pentolite, and composition C-3 and nearly equal to composition B.

n. Tritonal. Tritonal is a generic term for explosives containing TNT and powdered aluminum, generally in the ratio of 80/20. It produces a greater blast effect than TNT or composition B. Because of the aluminum powder constituent, the inclusion of moisture in the mixture must be avoided. It is used in light-case and general-purpose bombs.

o. HBX. HBX is an aluminized (powdered aluminum) explosive having the same order of sensitivity as composition B. HBX may produce pressure within a casing due to gassing. It is used as a bursting charge in mines, depth bombs, depth charges, and torpedoes.

p. Composition A. Composition A (comp A) is a mixture containing 91 percent RDX and 9 percent beeswax; a composition that is semiplastic in nature. When the beeswax was replaced by a wax derived from petroleum and with subsequent changes in the method of adding the desensitizer, the designation was changed to composition A-2. Recently the composition has been redesignated as composition A-3, because of changes in the granulation of RDX and the method of manufacture. Composition A-3 is granular in form, resembling tetryl in granulation. It is usually buff in color and is press-loaded in minor-caliber (20-, 37-, and 40-mm) shell. It is 30 percent stronger than TNT; strength is usually dependent on the amount of wax binder.

q. Composition B. Composition B (comp B) is a (59/40/1) mixture of RDX, TNT, and beeswax. Its color may vary from dirty white, light

yellow to brownish yellow. It is less sensitive than tetryl but more sensitive than TNT. It is intermediate between TNT and RDX with respect to sensitivity and initiation. It is only inferior to tritonal and torpex with respect to blast effect. Composition B is an authorized filling for Army-Navy (AN) standard aircraft bombs, mines, torpedoes, anti-tank artillery shells (76- and 105-mm), demolition charges, and in rockets. Composition B containing 60 percent RDX and 40 percent TNT, exclusive of wax, is known as composition B-2, a nonstandard explosive. Because of its greater sensitivity to impact, composition B-2 is not as suitable as composition B for use in bombs.

r. Composition C (Series).

- (1) *General.* Composition C, sometimes referred to as PE, is a plastic explosive, a (88/12) RDX, and an inert plasticizer composition. It was replaced by a (80/20) RDX and an explosive plasticizer composition C-2 containing no tetryl. Composition C-3, a $(77 \pm 2/23 \pm 2)$ RDX and an explosive plasticizer with tetryl substituted in part for RDX, was developed to replace composition C-2. Because of the hardening of composition C-3 at low temperatures (-29°C. , -20°F.), its volatility at elevated temperatures, and its hygroscopicity, a plastic explosive designated as composition C-4 was developed recently and standardized. Composition C, brown in color, plastic in form, about the consistency of putty, has a tendency to leach out (sweat out) plasticizing oils, leaving pure RDX which is too sensitive for use in the field.
- (2) *Composition C-2.* This putty-like composition is about 35 percent stronger than TNT. It was developed to overcome the objections of composition C. It was employed as a demolition charge.
- (3) *Composition C-3.* It is slightly inferior to composition B as an explosive for producing blast effect. It is considerably less sensitive than TNT and may not always be detonated by a No. 8 blasting cap, but will always be detonated by the special Corps of Engineers blasting cap. It was used principally as a commando and demolition explosive, either with or without a container. It is also used as a filler in some types of munitions. If its plasticity is lost by long storage at low temperatures, it may be restored to satisfactory plasticity by molding with the hands after warming by immersion in warm water. It must not be exposed to open flame, as it catches fire easily and burns with an intense flame. If burned in large quantities, the heat generated may cause it to explode. Its explosion produces poisonous gases in such quantities that its use in closed spaces is dangerous. Existing inventories of this material are being exhausted and replaced with a standardized composition C-4.
- (4) *Composition C-4.* This is a (91/9) RDX and plastic explosive

composition. It is a semiplastic putty-like material, dirty white to light brown in color, less sensitive, more stable, less volatile, and more brisant than composition C-3. It is a non-hygroscopic material that has found application in demolition blocks and specialized uses.

s. DBX. DBX is a (21/21/40/18) RDX, ammonium nitrate, TNT, and aluminum powder composition. It is gray in color, with a melting point between 80° and 90°C. (176° and 194°F.). It will react with metals in the same manner as amatol. Because of the inclusion of ammonium nitrate, it is somewhat hygroscopic. It resembles torpex in sensitivity, strength, and brisance.

28. Initiating and Priming Explosives

a. Mercury Fulminate. Mercury fulminate is a heavy crystalline solid, white when pure, but ordinarily having a faint brownish-yellow or grayish tint. It is extremely sensitive to heat, friction, spark, flame, or shock, detonating completely in nearly every instance. Its sensitivity varies with temperature. It has been found that its sensitivity is dependent in part on crystal size. It is nonhygroscopic and may be safely stored for long periods of time at moderate temperatures. However, it will not stand long-term storage at elevated temperatures. For all practical purposes, mercury fulminate has been replaced by lead azide and lead styphnate. It was used on limited scale in a few primers, in fuze detonators, and in blasting caps. It may be used alone or mixed with potassium chlorate. At present this material is no longer included in standard ammunition.

b. Lead Azide. Lead azide, one of the most stable initiators, is used to detonate high explosives. It is a fine-grained, cream-colored compound. It is sensitive to flame and impact but is not certain to detonate by the action of a firing pin. It is not easily decomposed on long continued storage at moderately elevated temperatures. It flashes at a much higher temperature than mercury fulminate. A smaller weight of lead azide than of mercury fulminate is required to detonate an equal amount of TNT, tetryl, etc. Lead azide has replaced mercury fulminate because of its properties and because it stands up better in storage and is less hazardous to manufacture. It is found in primer mixtures and usually loaded in containers of aluminum and in detonator assemblies and fuzes. When in contact with copper metal, it forms a supersensitive explosive.

c. Lead Styphnate. This explosive has been widely employed commercially and as an initiator for foreign military explosives. Recently, it has been adopted by the United States military. It may be pale straw, deep yellow, orange-yellow, or reddish-brown in color. Lead styphnate is slightly less sensitive than mercury fulminate and it has about the same strength as lead azide. It should be stored under water in conductive rubber containers. It is used in detonators to lower the ignition temperature of lead azide. As a primer it produces a very good flame. It

is more easily ignited by an electrical spark than is mercury fulminate, lead azide, or DDNP. As a substitute for mercury fulminate in primer compositions, lead styphnate offers sensitivity, stability, and ample flame. It is useless as a detonator, except as a sensitizing agent when employed in lead azide friction-type primers or lead azide detonators.

d. Diazodinitrophenol (DDNP). Extensively employed in commercial blasting caps, this explosive has found a place in military priming compositions and detonators. It is nonhygroscopic, greenish yellow to brown in color. Its sensitivity to impact is equal to mercury fulminate; however, it is much less sensitive to friction, about that of lead azide. If pressed into a blasting cap shell with a reinforcing cap and a piece of black powder safety fuse is crimped in the shell, a charge of DDNP undergoes detonation when ignited. For the less sensitive high explosives (explosive D and cast TNT), it is a better initiator of detonation than mercury fulminate. For the more sensitive high explosives, DDNP is not superior to lead azide. It is not as stable as lead azide but markedly superior to mercury fulminate. It is used to some extent in loading fuze detonators and the manufacture of priming compositions.

Section IV. CHEMICAL AGENTS

29. General

A military chemical agent is a substance that produces a toxic (casualty) or an irritating (harassing) effect, a screening smoke, an incendiary action, or a combination of these.

30. Classification

Chemical agents are compounds and mixtures other than pyrotechnics and are used as fillers in artillery shell, mortar shell, grenades, rockets, and bombs. They are classified according to tactical use, physiological effect, and purpose, as described in *a* through *d* below.

a. Military Gases. A military gas is any agent or combination of agents that can produce either a toxic or irritating physiological effect. Such agent may be in solid, liquid, or gaseous state, either before or after dispersion. The gases may be persistent (those remaining effective at point of release for more than 10 min.) or nonpersistent (those becoming ineffective w/in 10 min.). Persistent gases are further divided into moderately persistent (those remaining effective in the open 10 min. to 12 hr.) and highly persistent (those remaining effective in the open longer than 12 hr.). The military gases are classified in accordance with their toxic and irritating effects as listed below:

(1) Casualty gases:

Blister gases.

Choking gases.

Blood and nerve poisons.

(2) Training and riot control gases:

Vomiting.

Tear gases.

b. Screening Smokes. A screening smoke is a cloud that consists of small particles of solids, liquids, or both, dispersed and suspended in air.

c. Incendiaries. An incendiary may be a solid, liquid, or a gelled semi-plastic material that, by its intense heat and flame, can start fires and scorch combustible and noncombustible materials, as well as injure and inactivate personnel.

d. Simulated Military Gases. Simulated agents are essentially mild non-toxic harassants (substitute for the real agent) designed specifically for training purposes.

31. Blister Gases (Casualty)

Blister gases are agents that affect the nose, throat, eyes, lungs, or exposed skin tissue. They harass and produce casualties resultant from the injuries (inflammations, blisters, destruction of body tissue). The principal gases in this group are mustard, mustard mixtures, lewisite, and simulated mustard gases.

a. Mustard gas (H) is a dark-brown liquid that slowly evaporates to a colorless gas having the odor of garlic. Distilled mustard gas (HD) may be practically odorless. Its principal physiological effect is to produce skin blisters, although the blistering does not ordinarily appear for several hours after contact. If inhaled, mustard gas vapors have a choking (lung irritant) effect. For complete protection against mustard (H, HD), mustard-T (HT), or the nitrogen mustards (HN-1, HN-2, HN-3), both protective mask and protective clothing are necessary. HN-1 is a colorless to pale yellow liquid, having a faint odor varying from fishy to almost odorless. Because HN-1 may be virtually odorless, harmful effects may be produced without warning. Both HN-1 vapor and liquid are dangerous. HN-1 attacks the respiratory tract as H gas does, but to a lesser degree, and has especially dangerous effects on the eyes that may result in permanent injury or blindness. The tactical use of mustard gas and its mixture is to neutralize areas, contaminate materiel, restrict aggressor movements, and inflict casualties. These agents can be dispersed by artillery and mortar shell and from aircraft bombs. Food contaminated by mustard gases or its mixtures is unfit for use.

b. Lewisite gas (L) is a dark-brown liquid that evaporates to a colorless gas and has an odor of geraniums. In addition to being a blister and choking gas, lewisite acts as an arsenical poison. The protective mask and protective clothing are necessary against L. Lewisite is best destroyed with bleach, DANC solution, or an alcoholic solution of caustic soda. If lewisite is destroyed by burning, there is a danger of contaminating the atmosphere with poisonous arsenic oxide. The tactical use of L and the methods of projection are the same as those for H. It renders food and water permanently unfit for use.

c. Simulated H agents possess physical properties that are similar to mustard gas and generally include a dye, an odoriferous constituent, or both. Unusually nontoxic, such material is employed as a substitute filler for the agent in munitions in simulated military training exercises. A simulated agent may be harmless or partially harmful. The principal materials used are molasses residuum and asbestine suspensions.

- (1) Molasses residuum (MR) is a nontoxic (25 percent solution) thick, sirupy, viscous liquid with a molasses odor. When dispersed from aircraft, chemical spray tanks, artillery shell, mortar shell, or bombs, the spray patterns resemble those of mustard gas (H).
- (2) Asbestine suspension (AS) is a nontoxic suspension of finely ground asbestos in water. It may or may not include butyric acid (odor of rancid butter), a material that imparts a disagreeable lingering scent to the mixture. With butyric acid, it is known as an asbestine-butyric acid suspension; without butyric, it is known as an asbestine suspension. AS is dispersed as a spray from aircraft. When dispersed, it will adhere like MR to surfaces and personnel and show up in contrast to the surrounding medium.

32. Choking Gases

Choking gases affect the nose, throat, and lungs of unprotected personnel. They cause casualties resulting from a lack of oxygen. The principal gas in this group is phosgene. Phosgene (CG) appears on projection as a whitish cloud, changing to a colorless gas. In high concentrations, one or two breaths may be fatal in a few hours. CG produces but a slight irritation of the sensory nerves in the upper air passages; therefore any personnel exposed to this gas are likely to inhale it more than they would equivalent concentrations of other olfactory sensitizing gases. Phosgene is insidious in its action; consequently personnel exposed to it often have little or no warning symptoms until it is too late to avoid serious poisoning. CG as a chemical agent can be employed effectively at very low temperatures, since it freezes only below -155°F .

33. Blood and Nerve Poisons

Blood and nerve poisons, when absorbed by the blood stream, affect the nervous system, respiratory system, or muscular functions of the body, to cause temporary or permanent paralysis or instant death. They can immobilize aggressor forces by rendering them helpless. Hydrocyanic acid and cyanogen chloride are representative of such agents.

a. Nerve gases are usually colorless to light brown at the point of release. Their odor is faint, sweetish, fruity, or nonexistent. On exposure, personnel will experience nausea, vomiting, and diarrhea; these effects are followed by muscular twitching and convulsions. Due to the extreme toxicity of the nerve gases, these effects are caused by extremely

low concentrations of the gases and are quite rapid. Protection requires impermeable clothing and the protective mask.

b. Hydrocyanic acid (AC) is a colorless gas upon release. Its odor is faint and similar to that of bitter almonds or peach kernels. It is not readily detected in the field. On exposure, personnel first experience a rapid stimulation of the respiratory system, later followed by deeper inhalation. Death by paralysis of the respiratory system may occur in a few minutes.

c. Cyanogen chloride (CK) is a colorless liquid. On release in the field, it changes into a colorless gas that is about twice as heavy as air. CK sometimes may be faint in odor, otherwise its odor is sharp and pungent. On contact or exposure, CK will irritate flesh and stimulate a strong flow of tears. Its action is rapid after inhalation, producing paralysis of the respiratory system. Unlike AC, it first produces an involuntary spasm (a warning of its presence) of short duration of the upper respiratory tract. For protection against CK and AC, a protective mask is required.

34. Training and Riot Control Gases

A group of vomiting and tear gases that, when vaporized or dispersed, exist as suspended particles in the atmosphere. They cause partial or complete temporary disability of personnel. The principal ones in this category are chloracetophenone and liquid mixtures of chloracetophenone in hydrocarbon solvents.

a. Chloracetophenone (CN), commonly known as tear gas, having a fruity apple blossom odor, is typical of such agents. It is solid material (white to black in color) that, when converted into a gas, gas-aerosol, or finely divided particles, will cause a profuse flow of tears, necessitating the use of a protective mask for protection. CN in normal concentrations has no permanent injurious effect on the eyes. In high concentrations it irritates the skin, producing a burning and itching sensation. Food and water contaminated by CN possess a disagreeable taste. It is the principal constituent in the filler used in CNS, CNB mortar shell, and CN-DM grenade. It can be used in bursting-type munitions in arctic regions.

b. Tear gas solution (CNB) is a 10 percent liquid mixture of CN in equal parts of benzene and carbon tetrachloride. It is a less severe lacrimator and skin irritator than CNS. For this characteristic, it is used as a filler in hand grenades, artillery shell, mortar shell, small bombs, and aircraft spray for all training purposes. It has a characteristic fruity-benzene odor.

c. Tear gas solution (CNS) is a 23.2 percent liquid mixture of CN in equal parts of chloropicrin (PS) and chloroform. CNS has an odor similar to fly paper. The protective mask is an effective protector against both CNS and CNB. CNS as well as CNB can be used in grenades, mortar shell, small bombs, and aircraft spray.

d. Adamsite (DM) typifies the vomiting gases. It is a yellow or green solid when pure. It is dispersed by burning-type munitions such as candles and grenades and appears as a yellow smoke with an odor resembling coal smoke. Physiologically, it causes lacrimation, violent sneezing, intense headache, nausea, and temporary physical debility. For protection, the protective mask is required. DM has only a slight corrosive effect on metals. It renders food and water permanently unfit for use. Very low-temperature (arctic) conditions impose no special limitations on DM or its mixture with CN (CN-DM burning mixture) when dispersed by hand grenade.

e. Chloracetophenone and diphenylamide chlorarsine (CN-DM mixture) is a solid mixture of CN and DM including nitrocellulose, a burning ingredient. When ignited, it burns to form an irritating yellowish white smoke. CN-DM vapors cause headache, nausea, sneezing, depressed sick feeling, intense eye irritation, and temporary disability. In hot and humid tropical weather, it will irritate exposed skin. A protective mask gives adequate protection against CN-DM smokes and vapors.

35. Screening Smokes

A screening smoke is produced by the dispersion of particles in the atmosphere through the burning of solids or the spraying of liquids. It is used to obscure military movements, blanket the enemy from observation, spot artillery fire and bombing, as well as to disguise cloud gas. Smoke screen producing materials are rated in units for their top obscuring power (TOP*). The principal smoke producing agents are white phosphorus, plasticized white phosphorus, sulfur trioxide-chlorosulfonic acid mixture and hexachlorethane-zinc mixture, with obscuring powers in the order listed.

a. White phosphorus (WP) with a 3,500 unit TOP is a white to light yellow, waxlike, luminous substance (phosphorescent in the dark). On ignition it produces a yellow-white flame and dense white smoke. WP is poisonous when taken internally. Its smoke or fumes are not. When dispersed by ammunition, as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. WP smoke is unpleasant to breathe but harmless; the particles, however, will poison food and water. It is used in bursting-type projectiles, artillery and mortar shell, grenades, rockets, and bombs. It is used as an igniter in incendiary ammunition that contains flammable fuels (IM, NP, PT1). WP, when used in projectiles and burst on terrain covered with soft deep snow, is smothered and produces approximately 75 percent less smoke.

b. Plasticized white phosphorus (PWP) is a finely divided form of WP

* TOP—A relative value that indicates the amount of obscurity (due to reflection and refraction of light rays) that 1 pound of smoke producing material will develop under standard and controlled conditions against a 25-candlepower light source.

suspended in a thickened and gelled xylene rubber mixture. Like WP, it is an effective double purpose screening and incendiary agent that can be dispersed under arctic, tropic, and temperate climatic conditions.

c. Sulfur trioxide-chlorosulfonic acid mixture (FS) with a 2,240 unit TOP, second only to WP and PWP, is a liquid with an acrid and acid odor that produces dense white smoke when dispersed in a humid atmosphere. FS smoke is nonpoisonous. Its liquid irritates and inflames contacted skin tissue. A protective mask is required for protection against exposures to heavy concentrations. The mask and protective clothing should be used for protection against combination FS gas and liquid sprays. Liquid FS renders food and water unfit for use; the smoke merely imparts an unpleasant taste. In view of the fact that liquid FS possesses corrosive properties of strong mineral acids, such as sulfuric or hydrochloric, stringent precautions should be observed at all times for protecting nonaggressor personnel and noncombat forces and materiel during use and handling. FS is dispersed from mortar shells, grenades, and by aircraft spray from cylinders. Since FS smoke mixtures freeze at low temperatures (approx. -22° F.), smoke shells containing this agent are partially or completely ineffective for use at freezing temperatures. Under tropical and high humidity conditions, FS performs very effectively.

d. Hexachlorethane-zinc mixture (HC) with a 2,000 unit TOP is a combination of zinc powder, hexachlorethane, ammonium perchlorate, and ammonium chloride. When ignited, it produces zinc chloride that passes into the air as a dense grayish-white smoke. HC is toxic to unprotected personnel exposed to heavy concentrations for short periods or to light concentrations for extended periods of time. A protective mask offers adequate protection against light concentrations. For heavy concentrations and prolonged exposure, a self-contained oxygen mask is required. Food and water are not spoiled by HC, but acquire a disagreeable odor. HC in canisters, dispersed by base ejection artillery shell, is not effective for use on terrain covered with deep loose snow, because the canisters bury themselves and become smothered. However, they can be employed effectively on hard packed snow or ice. HC is dispersed effectively from fixed and floating smoke pots, base ejection artillery shell, mortar shell, and grenades under favorable (humid atmospheres and hard terrain) arctic, tropic, or temperate region conditions.

36. Incendiaries

Incendiaries start and intensify fires and harass and cause casualties. The principal incendiary solid mixtures as used in ammunition are thermite and thermate (TH). For functioning in arctic regions on ice or deep snow, TH incendiaries (bomb and grenade) are ineffective, since they bury themselves and smother in melted ice or snow. Because thermite and thermate generate great heat, they are useful in destroying equipment and vital parts of materiel that might be in danger of capture by

the enemy. In bursting ammunition (grenade or bomb), they are employed for casualty as well as incendiary effects.

a. Thermite is an intimate uniform mixture of powdered aluminum and iron oxide. On ignition, it produces intense heat (approx. 4,300° F. in a few seconds) with the formation of a white hot mass of molten iron and slag. TH is used in cartridges, bombs, grenades, mortar shell, and artillery shell. TH as a filler is included in thin-walled nonmagnesium metal containers.

b. Thermate is essentially a thermite, barium nitrate, sulfur, and lubricating oil composition contained in a heavy-wall body, usually magnesium or a magnesium alloy. When ignited by electrical or mechanical means, the contents and body burn with an intense heat of about 3,700° F. and are difficult to extinguish.

c. Magnesium, in fine powder or thin ribbon or solid form, is a material that ignites and burns with intense heat and white light. It is a material extensively used in pyrotechnic mixtures and incendiary munitions. As a container body with thermate, it is an effective incendiary.

d. Aluminum, in powder, flake, or grain form (12 to 120 mesh), is silvery gray in color. When ignited in mixture with strong oxidizing agents, such as nitrates, chlorates, or perchlorates, it will burn with great heat and intensely bright light. In a fine powdered form, it is used as a constituent of explosive mixtures and primer compositions, in flares, and various pyrotechnic devices. The coarse granular form of material is used in incendiary bomb mixtures. In flake form, aluminum powder is used as an ingredient in detonating mixtures. Alloyed with magnesium metal, it is used to make an aluminum-magnesium-alloy powder. Such alloy powder is employed in the same manner as aluminum powder. Special precautions are to be taken when loading or blending aluminum and aluminum-alloy powders to avoid undue exposure to humid atmospheres, dampness, and moisture.

e. Incendiary oil (IM) is an 88 percent gasoline mixture thickened with fatty soaps, fatty acids, and special chemical additives (isobutyl methacrylate polymer, naphthenic acid). It may or may not contain metallic sodium or WP particles for ignition. When dispersed and ignited, IM adheres to combustible and noncombustible surfaces. It burns like ordinary gasoline with a hot orange flame and gives off a black smoke. IM is used as a filler in bombs, grenades, and portable and mechanized flamethrowers. Winterized IM incendiary fuels can be dispersed from bombs or grenades and effectively employed under arctic climatic conditions.

f. Incendiary oil, napalm (NP) is a flammable fuel, principally aviation gasoline (approx. 88 percent), thickened with a napalm thickener (a special gelling mixture of fatty acids and fatty soaps and chemical additives). As a filler with or without metallic sodium or WP particles, NP can be used in munitions in the same manner as IM.

g. Incendiary mixture (PT1) is a peptized NP incendiary fuel mixture that is used in the same manner as IM and NP.

37. Flamethrower Fuels

Flamethrower fuels are essentially gelled gasoline and oil incendiary mixtures. When dispersed (bomb, flamethrower) and simultaneously ignited by mechanical, electrical, or chemical means, they cause destruction of materiel and casualties by burning or scorching with hot flame. The main flamethrower fuels are—

a. Gasoline thickened with napalm, octal, or similar thickener to form a gelled gasoline. This mix is known as thickened fuel.

b. Gasoline blended with light fuel oils or lubricating oils. This fuel is known as unthickened fuel (see TM 3-366 and 3-400).

38. Marking and Identification

a. All ammunition containing chemical agents is identified and marked with distinctive symbols or letters and colors, as indicated in table I (par. 10).

b. For the purpose of storage, chemical agents and munitions are segregated into four groups, according to the nature of the filling and their inherent hazards as follows:

- (1) Group A (blister and nerve gases) includes chemical agents requiring complete protective clothing plus protective masks.
- (2) Group B (toxic and smoke) includes chemical agents requiring protective masks.
- (3) Group C includes spontaneously flammable chemical agents, such as WP.
- (4) Group D includes incendiary and readily flammable chemical agents.

CHAPTER 3

BASIC TYPES OF AMMUNITION

Section I. SMALL ARMS AMMUNITION

39. General

Small arms ammunition consists of cartridges of various types and sizes used in rifles (except recoilless type), carbines, pistols, revolvers, machineguns, and submachineguns and shell used in shotguns. Small arms cartridges are similar to each other in general shape and construction. They may be identified as to caliber, model, and type by their size, shape, and color (figs. 28-32) and by marking on packing boxes and cartons. See TM 9-1990 for complete information on small arms ammunition.

40. Cartridges

a. General. A cartridge of the small arms type may consist of a bullet to which a cartridge case is crimped. The cartridge case is fitted with a primer and contains a propelling charge. A cartridge is known as a round of small arms ammunition. A conventional cartridge and the terminology of its components are shown in figure 33.

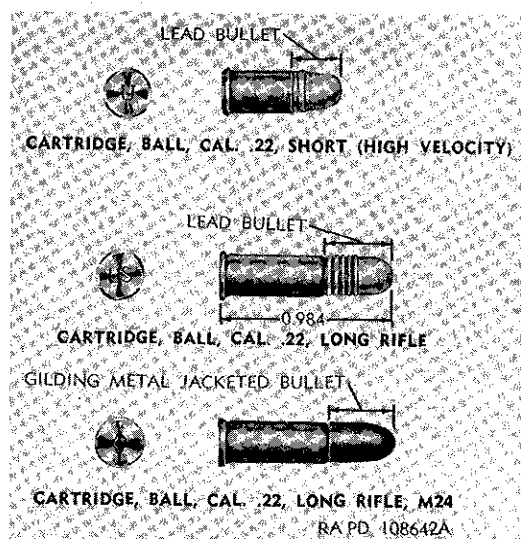
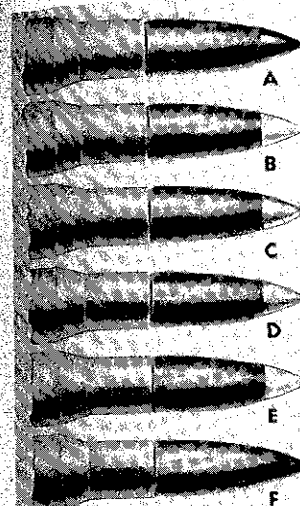


Figure 28. Caliber .22 cartridges.



- A—CARTRIDGE, ARMOR-PIERCING, CAL. .30, M2
- B—CARTRIDGE, ARMOR-PIERCING, INCENDIARY, CAL. .30, M14 (T15)
- C—CARTRIDGE, INCENDIARY, CAL. .30, M1
- D—CARTRIDGE, TRACER, CAL. .30, M1
- E—CARTRIDGE, TRACER, CAL. .30, M25 (T10), (OR M25 (T72E1))
- F—CARTRIDGE, TEST, HIGH PRESSURE, CAL. .30, M1
- G—CARTRIDGE, BALL, CAL. .30, M2
- H—CARTRIDGE, DUMMY, CAL. .30, M2
- J—CARTRIDGE, BLANK, CAL. .30, M1909
- K—CARTRIDGE, BALL FRANGIBLE, CAL. .30, M22 (T44)
- L—CARTRIDGE, SUBCALIBER, CAL. .30, M1925

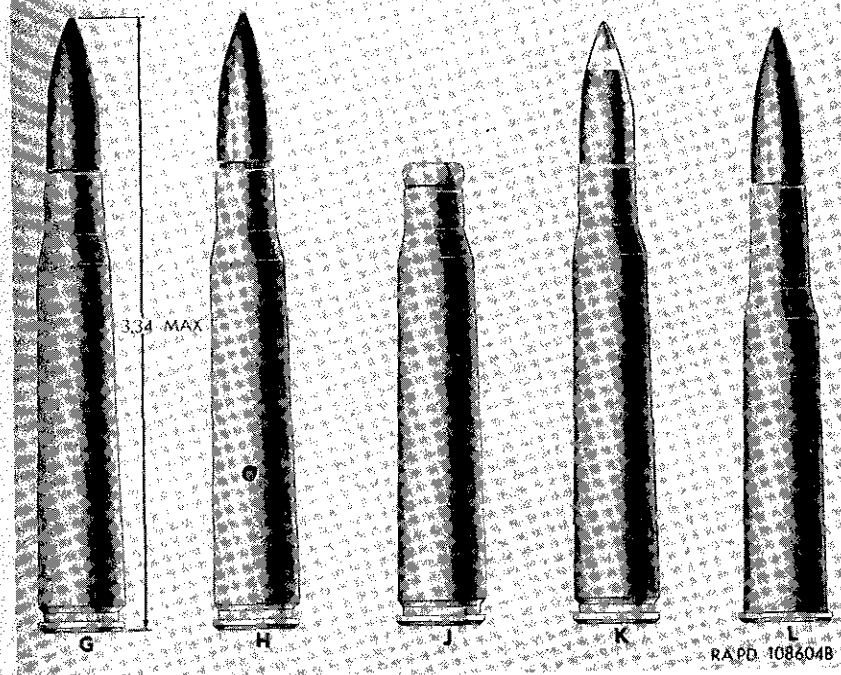


Figure 29. Caliber .30 cartridges.

b. Bullet. Bullets for service use have a metal core or slug that is covered with a gilding metal or gilding-metal-clad steel jacket. The nose of pointed-nose bullets is blunted to a meplat (flattish curve) (fig. 33). Copper-plated steel may be used instead of gilding metal for the

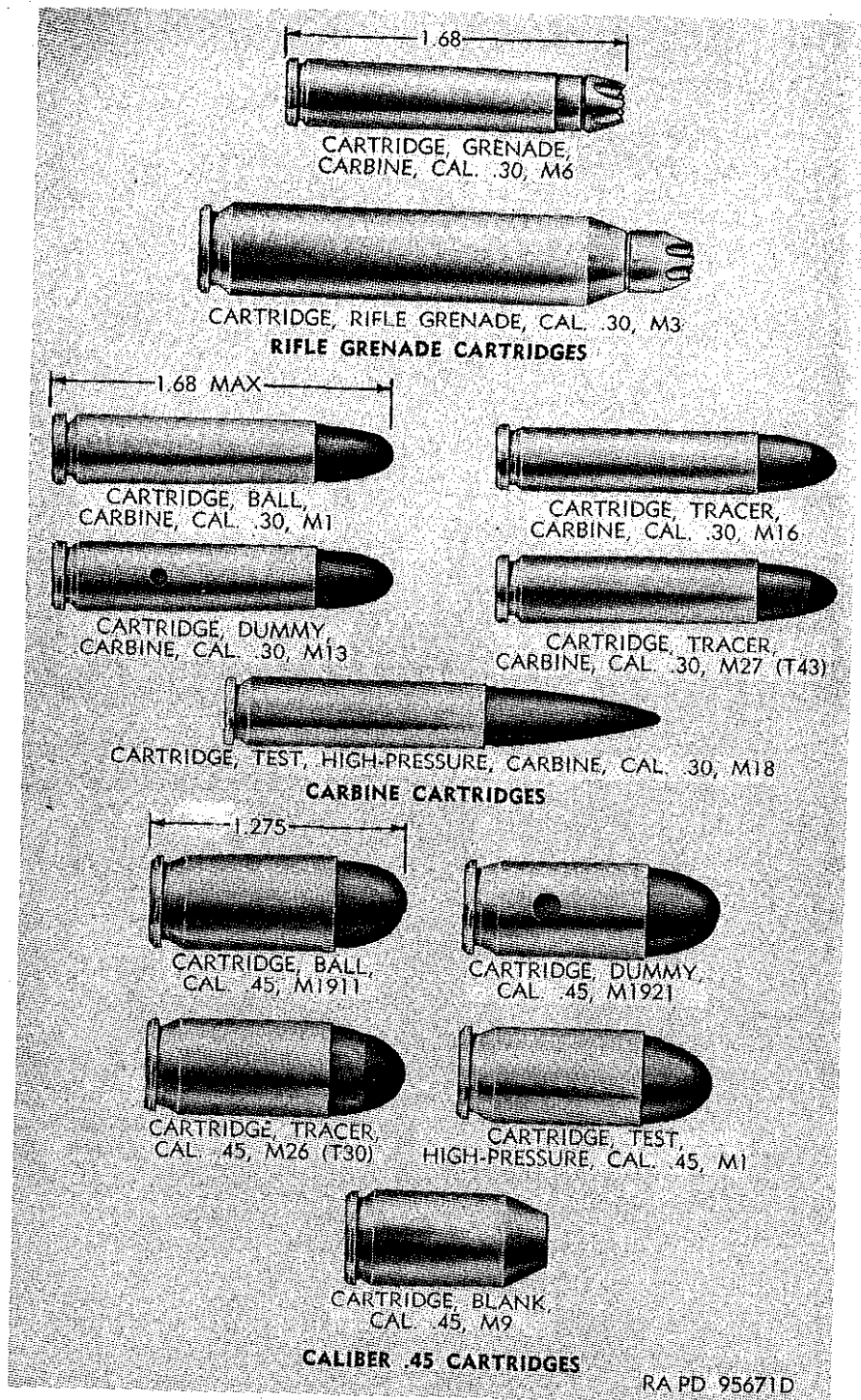


Figure 30. Rifle grenade cartridges, carbine cartridges, and caliber .45 cartridges.

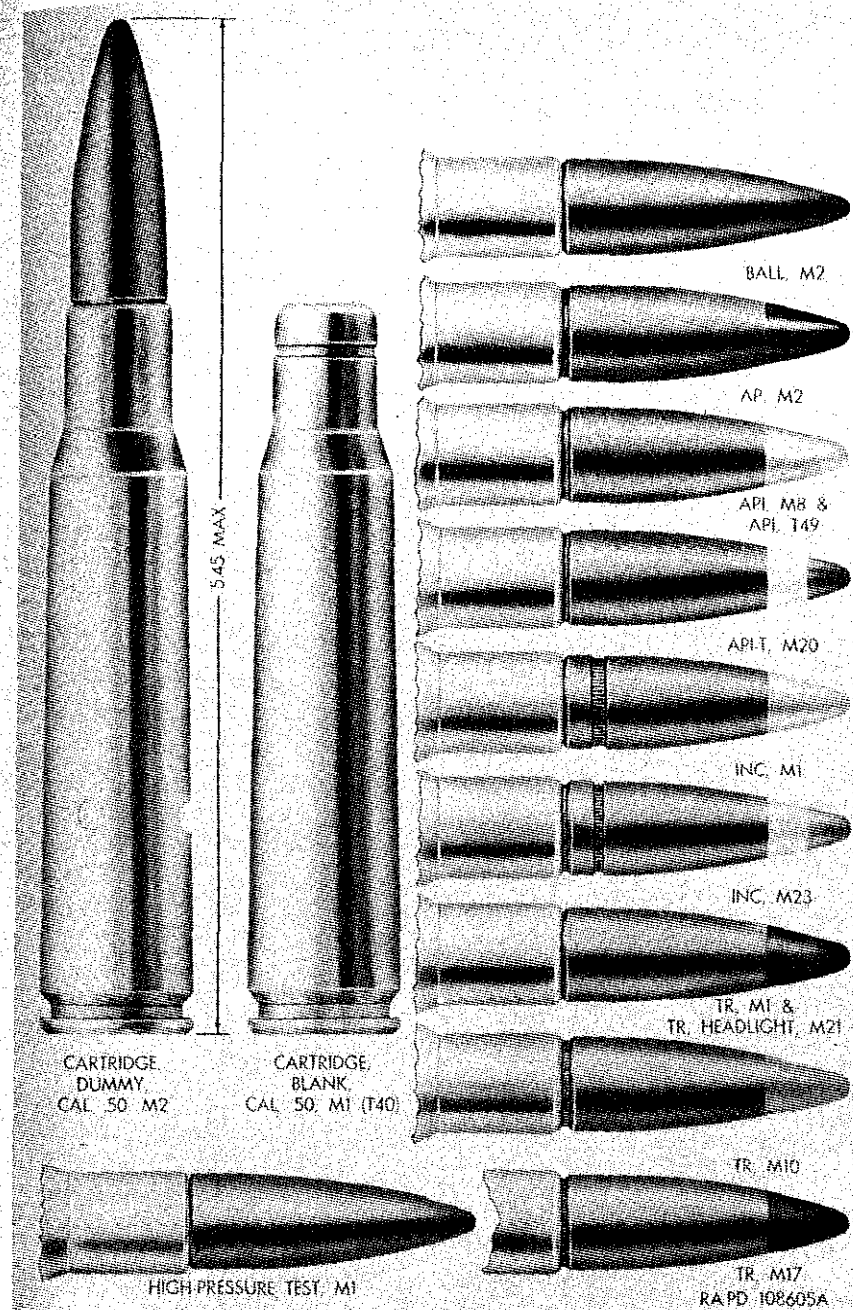
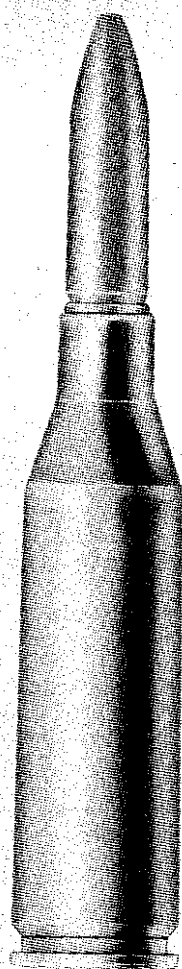


Figure 31. Caliber .50 cartridges.



CARTRIDGE,
BALL, CAL. .60,
T77E1* OR T80**



*PRIMER,
M36A1
(ENLARGED)



CARTRIDGE, HIGH
PRESSURE TEST,
CAL. .60, T33E1*
(FOR USE ONLY IN
TESTING WEAPONS)



CARTRIDGE,
DUMMY,
CAL. .60, T35



**PRIMER,
M52A3
(ENLARGED)

RA PD 167616

Figure 32. Caliber .60 cartridges.

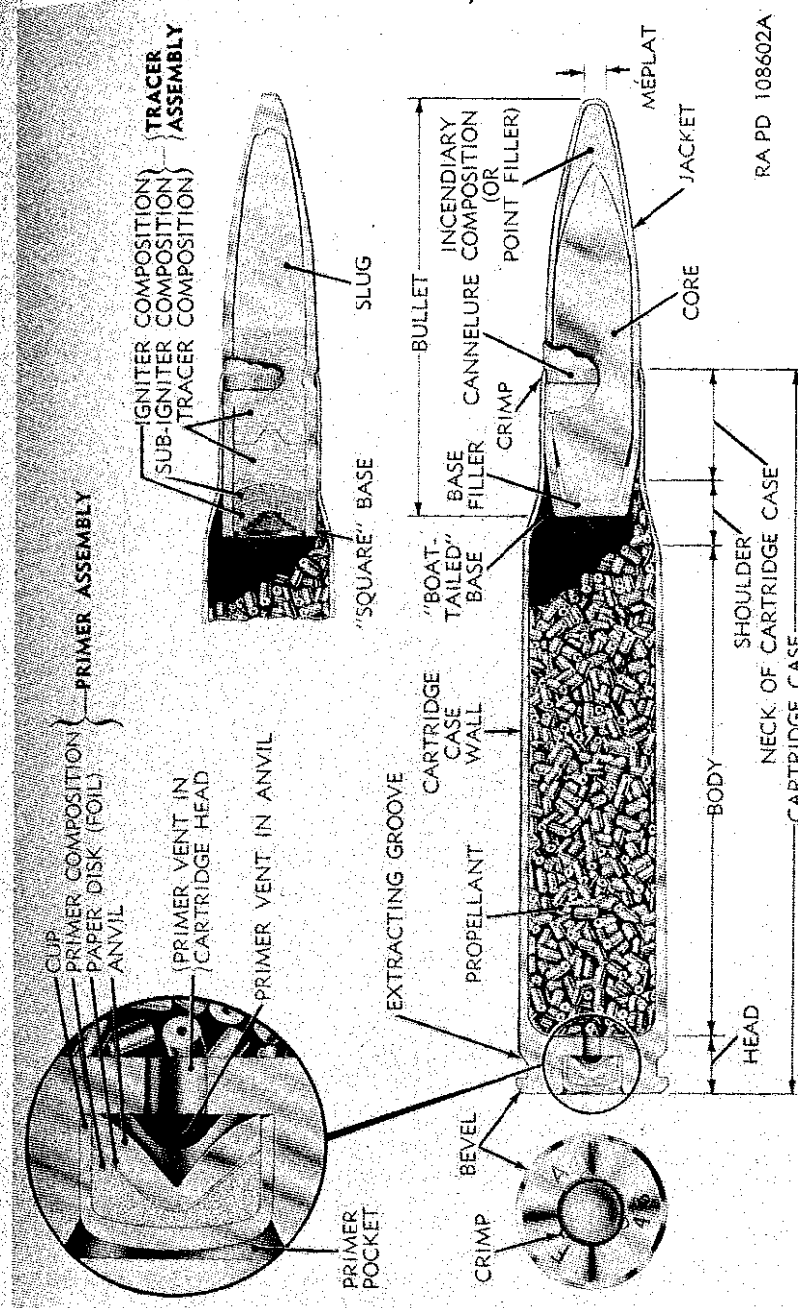


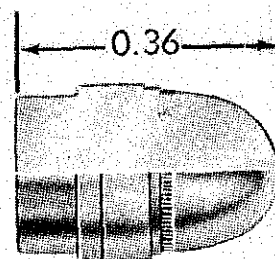
Figure 33. Cartridge terminology.

jacket of caliber .45 bullets. Ball and tracer bullets have a lead alloy or common steel core or slug. Other service-type bullets have a hardened steel alloy core. The base of bullets is either flat or tapered ("boat tailed"). A cannellure or annular knurl is rolled or cut into the jacket of bullets to provide a recess into which the cartridge case is crimped (figs. 35-39). Some commercial-type bullets are molded of lead alloys and may have wax or some chemically plated covering as a lubricant to prevent lead fouling of the weapons. Other commercial-type bullets have a lead core within various designs of gilding metal jackets. Some caliber .60 service-type bullets may have only a metal case and outer covering (or jacket) of gilding metal, while other caliber .60 types consist of a steel core, a gilding metal jacket, a gilding metal sabot, and an active point filler material or an inert point filler material. In addition, the latter types may also have a tracer composition or a high-explosive charge within the steel core.

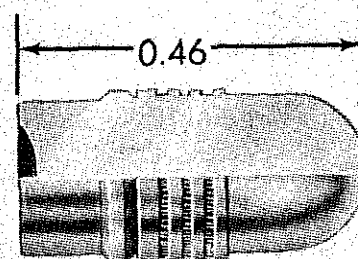
c. Propellant. There are two types of small arms propellants generally used, the single-base (nitrocellulose) type and the double-base (nitrocellulose and nitroglycerin) type (pars. 14-21). The effective difference between the two types is that the double-base type burns more rapidly than the single-base type; the double-base type is used in shotgun shell, some caliber .45 rounds, and carbine ammunition. The weight of the charge and granulation of the propellant of a particular composition are in accordance with specification requirements for velocity and pressure. The charge is assembled loosely in the cartridge case (fig. 33).

d. Primer. The primer assembly of centerfire cartridges (fig. 33) consists of a brass or gilding-metal cup that contains a primer-composition pellet of sensitive explosive, a paper disk, and a brass anvil. A blow from the firing pin of a small arms weapon on the center of the primer cup compresses the primer composition violently between the cup and the anvil, thus causing the composition to explode. The holes or vents in the anvil allow the flame to pass through the primer vent in the cartridge case, thereby igniting the propellant. Rimfire ammunition, such as the caliber .22 cartridge, does not contain a primer assembly; the primer composition is spun into the rim of the cartridge case and the propellant is in intimate contact with the composition. In firing, the firing pin strikes the rim of the case and thus compresses the primer composition and initiates its explosion. Caliber .60 ammunition, used in caliber .60/20-mm automatic aircraft gun, may be assembled with percussion or electric primer. As indicated by the terminology, percussion-primed cartridges can only be initiated by the blow of a firing pin striking the primer cup. Electric-primed cartridges are initiated by the passage of an electric current through the primer composition; a modified firing pin contacts the uninsulated portion of the primer cup and permits the electric current to pass through the primer cup and primer composition to the grounded cartridge case.

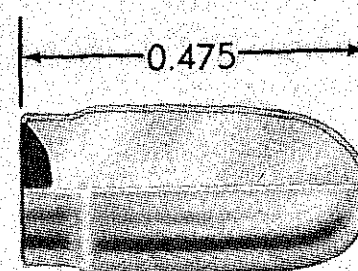
e. Cartridge Case. The cartridge case (fig. 33) is composed of brass



BULLET, BALL, CAL. .22, SHORT



BULLET, BALL, CAL. .22 LONG RIFLE



BULLET, BALL, CAL. .22, LONG RIFLE, M24

RA PD 108643

Figure 34. Caliber .22 bullets—sectioned.

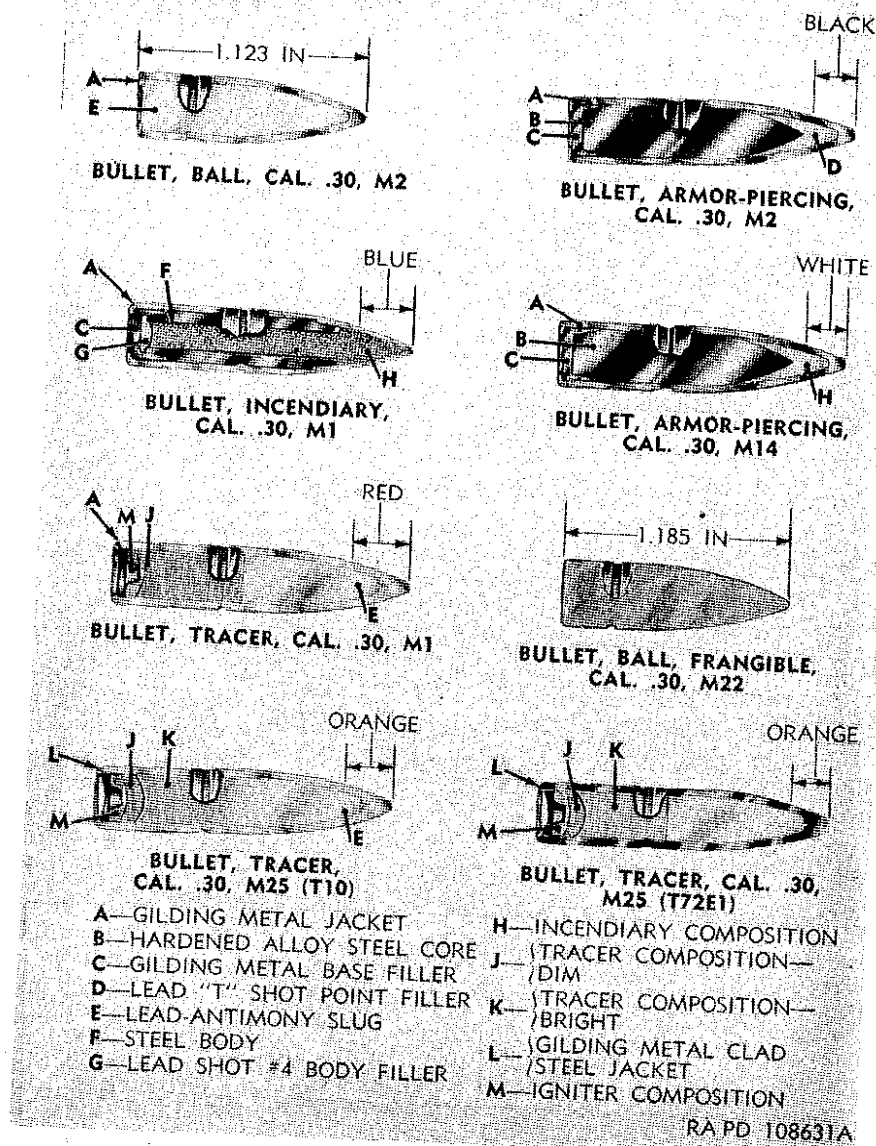
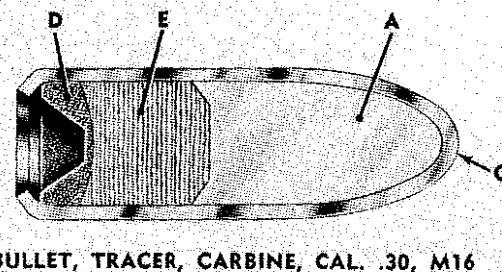
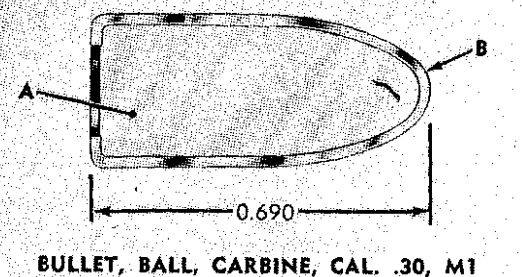
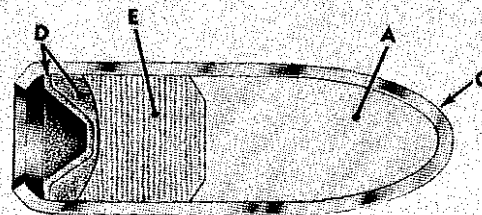


Figure 35. Caliber .30 bullets—sectioned.

(brass, copper, or gilding metal in the case of cal. .22) or steel. With the exception of its larger dimension, the caliber .60 cartridge case is similar in design to the caliber .30 and .50 cartridge cases. The cartridge case serves as a means whereby the other components (primer, propelling charge, and bullet) are assembled into a unit, the cartridge. Another of its functions is to expand and seal the chamber against the escape of gases to the rear when the cartridge is fired. This action is known as

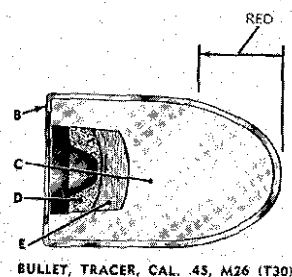
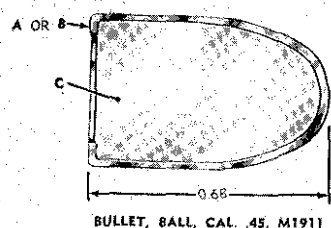


Legend:
 A—LEAD-ANTIMONY SLUG
 B—GILDING METAL JACKET
 C—GILDING METAL CLAD STEEL JACKET
 D—IGNITER COMPOSITION
 E—TRACER COMPOSITION



RA PD 108630A

Figure 36. Caliber .30 carbine bullets—sectioned.



A—GILDING METAL JACKET
B—COPPER-PLATED STEEL JACKET
C—LEAD-ANTIMONY SLUG
D—IGNITER COMPOSITION
E—TRACER COMPOSITION
RA PD 108632A

Figure 37. Caliber .45 bullets—sectioned.

obturation. To make the cartridge waterproof and to keep the propelling charge dry, the primer is sealed in the primer seat and the bullet is sealed in the neck of the cartridge case by a thin film of lacquer or varnish at the time of manufacture. An extractor groove or rim, turned in the head of the cartridge case, provides a means of removing the case from the chamber of the weapon. Shotgun shell and other cartridges are manufactured with a rim at the cartridge case head to facilitate extraction of the fired cartridge from the weapon.

41. Types

Small arms cartridges are classified according to type as follows:

Service	Special
Ball.	Blank.
Ball, hornet.	Dummy.
Armor-piercing.	High-pressure test.
Armor-piercing-incendiary.	Frangible.
Armor-piercing-incendiary-tracer.	Gallery practice.
High-explosive-incendiary.	Subcaliber.
Incendiary.	Grenade.
Tracer.	

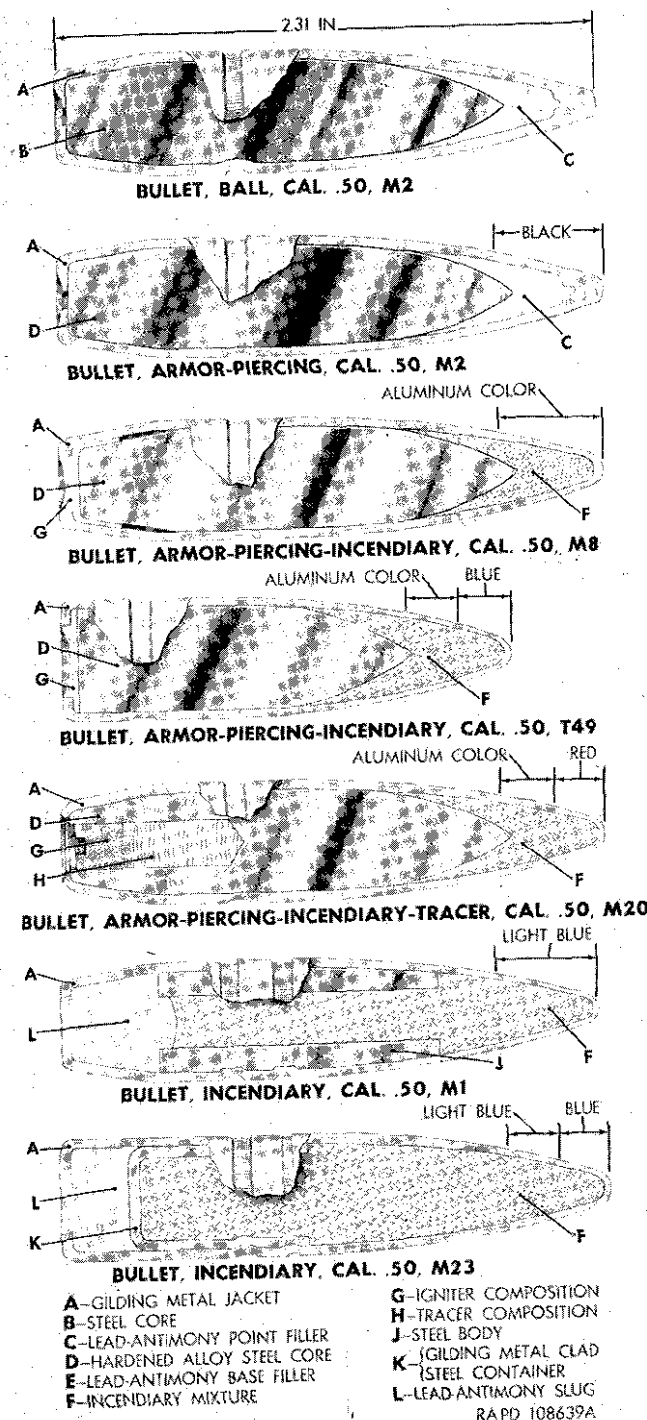
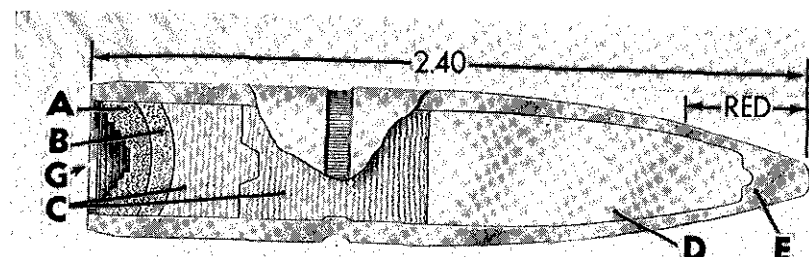
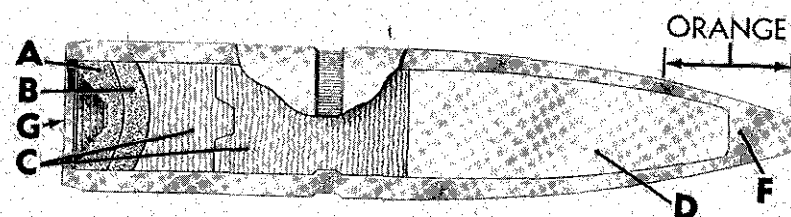


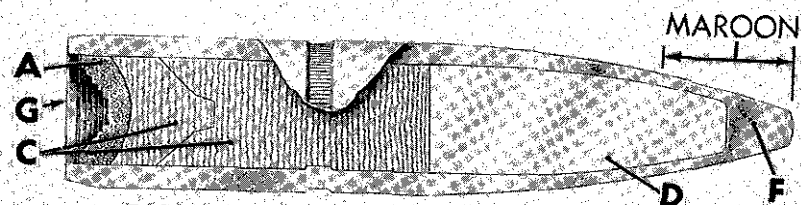
Figure 38. Caliber .50 bullets—sectioned.



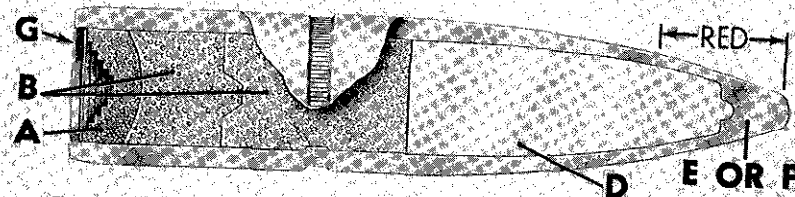
BULLET, TRACER, CAL. .50, M1



BULLET, TRACER, CAL. .50, M10



BULLET, TRACER, CAL. .50, M17

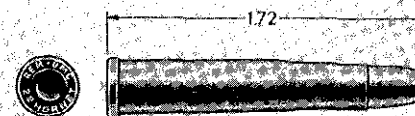


BULLET, TRACER, HEADLIGHT, CAL. .50, M21

- A—IGNITER COMPOSITION
- B—SUB-IGNITER COMPOSITION
- C—TRACER COMPOSITION
- D—LEAD-ANTIMONY SLUG
- E—GILDING METAL JACKET
- F—GILDING METAL CLAD STEEL JACKET
- G—GILDING METAL CLOSURE

RAPD 108640A

Figure 39. Caliber .50 bullets—sectioned.



RAPD 116918A

Figure 40. Caliber .22 hornet ball cartridge.

42. Ball

This type of cartridge, intended for use against personnel and light materiel targets, is the oldest service type. It has been replaced for combat purposes, however, by armor-piercing and other types. The term "ball," which long since ceased accurately to describe the shape of the modern bullet, has been continued in use to designate that type of bullet and ammunition used for the same purposes as ammunition of very early design, the bullet of which was actually a ball.

43. Ball, Hornet

This type of cartridge (fig. 40) is authorized for use in the caliber .22 survival rifle M4 and in the upper barrel of the caliber .22/.410 gage survival rifle-shotgun M6 and is designed for shooting game for food purposes. It has the conventional 45-grain full-jacketed bullet. See paragraph 59 for information on the .410-gage shotgun shell.

44. Armor-Piercing

This type of cartridge is intended for use against armored aircraft and vehicles, concrete shelters, and similar bullet-resisting targets. The bullet has a hardened steel-alloy core. In addition, it may have a base filler and a point filler of a softer metal.

45. Armor-Piercing-Incendiary

This type of cartridge is used in caliber .30, .50, and .60 weapons as a single combination cartridge in lieu of the separate armor-piercing and incendiary cartridges.

46. Armor-Piercing-Incendiary-Tracer

This type of cartridge combines the features of armor-piercing, incendiary, and tracer cartridges and is intended to replace these cartridges.

47. High-Explosive-Incendiary

This type cartridge contains an incendiary composition as the bullet point filler that ignites upon impact with the target; the impact also initiates action of the high explosive.

48. Incendiary

This type of cartridge is similar to ball or armor-piercing ammunition

in outward appearance. It is used for incendiary purposes against aircraft. It contains an incendiary composition, as a central bullet core or as a point filler, that ignites on impact with the target.

49. Tracer

This type of cartridge is intended for use with other types to show the gunner, by its trace, the path of the bullets, thus assisting in correcting aim. It may also be used for incendiary purposes. The tracer element consists of a pressed flammable composition in the base of the bullet; this composition is ignited by the propellant when the cartridge is fired.

50. Blank

This type of cartridge is distinguished by the absence of a bullet. It is used for simulated fire, in maneuvers, and in firing salutes. It is also used in machine guns equipped with blank firing attachments in order to operate these weapons for instructional purposes. EC blank fire propellant is used to produce the noise.

51. Dummy

This type of cartridge is used for practice in loading weapons, to detect finching of personnel in firing weapons, and to simulate firing. The cartridge case of older lots of dummy ammunition is tin-coated but the current method of identification is by means of holes through the side of the case and by the empty primer pocket. The ammunition is completely inert but simulates service ammunition in sufficient detail to meet drill requirements.

52. High-Pressure Test

This type of ammunition is manufactured to produce pressures substantially in excess of the specification pressures of the corresponding service items. It is used for proof-firing of weapons at place of manufacture, test, and repair. Due to the excessive pressures developed by this type of ammunition and the consequent danger involved in firing, the weapons under test are fired only by authorized personnel from fixed rests under hoods by means of mechanical firing devices.

53. Frangible

This type of cartridge is for use in machinegun trainers, caliber .30, T9 and T9E3. It is also used in caliber .30 tank machineguns, firing single shot, for training in tank gunnery. At its normal velocity, the bullet, which is composed of powdered lead and bakelite will completely disintegrate upon striking a $\frac{3}{16}$ -inch duralumin plate at 25 yards from the muzzle of the gun.

54. Gallery Practice

The cartridge used for this purpose is the caliber .22 long rifle car-

tridge (lead bullet) (fig. 28), which is the rimfire cartridge of commercial trade.

55. Subcaliber

Ball cartridge, caliber .22, long rifle (lead bullet) (fig. 28), is used in the caliber .22 interior mount subcaliber rifle M2A1 to subcaliber the 57-mm gun M1. Ball cartridge, caliber .30, M2 (fig. 29), is used in the caliber .30 interior mount subcaliber rifle M1903A2 to subcaliber the 57-mm gun M1. Ball cartridge, caliber .50, M2 (fig. 31), is used in heavy barrel caliber .50 machine gun M2 (flex) on exterior subcaliber mount to subcaliber the 76-mm gun of the M1 series and the 90-mm gun M3 (see TM 9-1901).

56. Grenade

Grenade cartridges (fig. 30) are special blank cartridges for use in propelling grenades and ground signals from launchers attached to rifles or carbines. Rifle grenade cartridges and carbine grenade cartridges are distinguished by a rose-petal crimp at the mouth of the case. The carbine grenade cartridge is no longer used by the Army for launching grenades but is authorized for blank fire for training purposes. For information pertaining to grenades, see paragraphs 64 through 70.

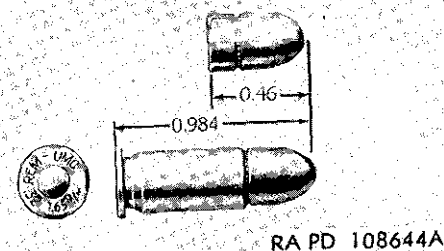


Figure 41. Caliber .32 ball cartridge.

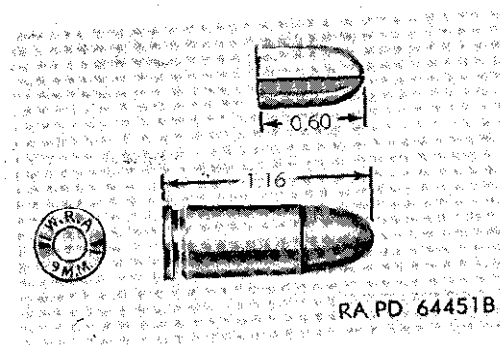
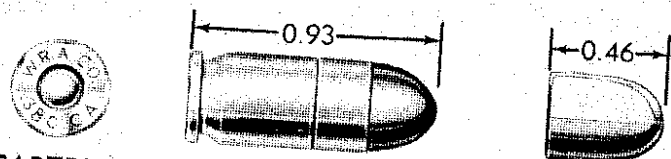
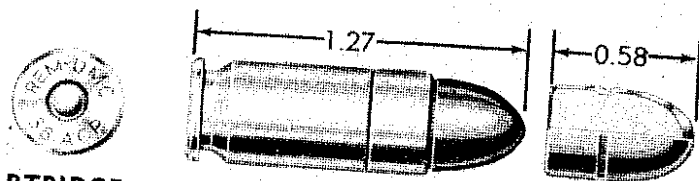


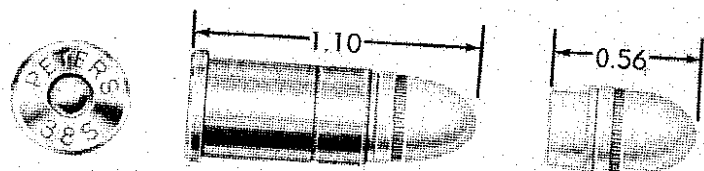
Figure 42. 9-mm ball cartridge.



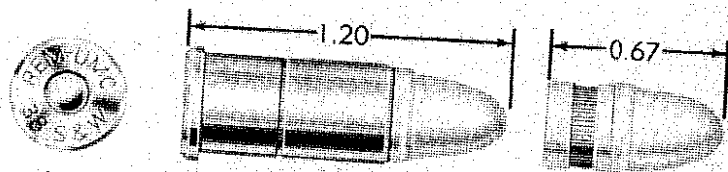
CARTRIDGE, BALL, AUTOMATIC PISTOL, CAL. .380,
95-GRAIN BULLET (9-MM SHORT)



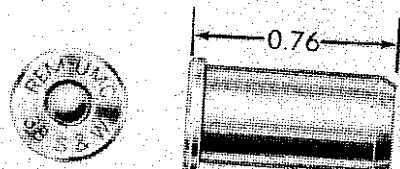
CARTRIDGE, BALL, CAL. .38, SUPER AUTOMATIC COLT,
130-GRAIN BULLET, METAL JACKET



CARTRIDGE, BALL, REVOLVER, CAL. .38, SHORT COLT,
125- OR 130-GRAIN BULLET



CARTRIDGE, BALL, REVOLVER, CAL. .38, S&W,
146-GRAIN BULLET



CARTRIDGE, BLANK, REVOLVER, CAL. .38, S&W
RA PD 108645

Figure 43. Caliber .38 cartridges.

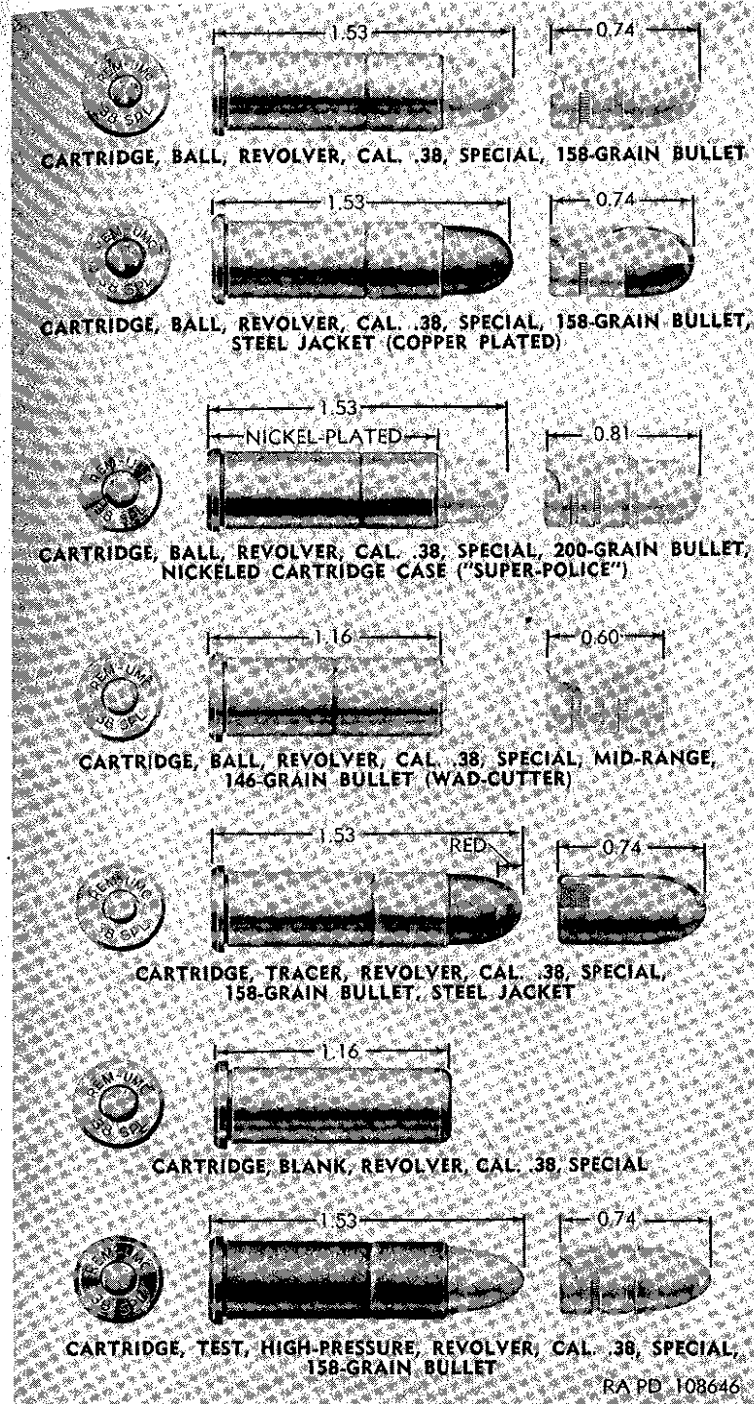


Figure 44. Caliber .38 special cartridges.

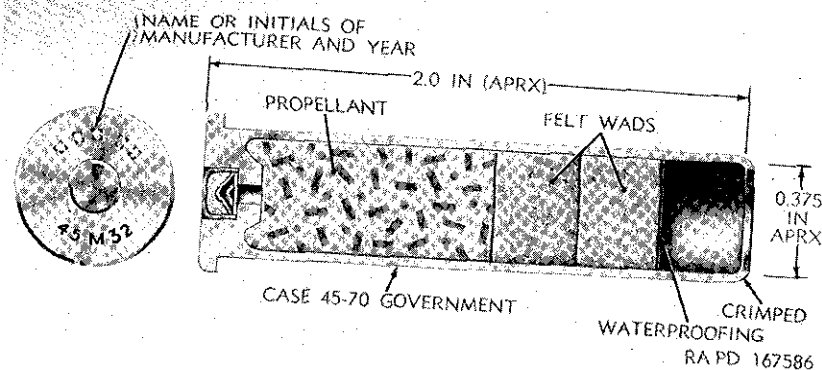


Figure 45. Cartridge, blank, cal .45, M32, line-throwing (Navy).

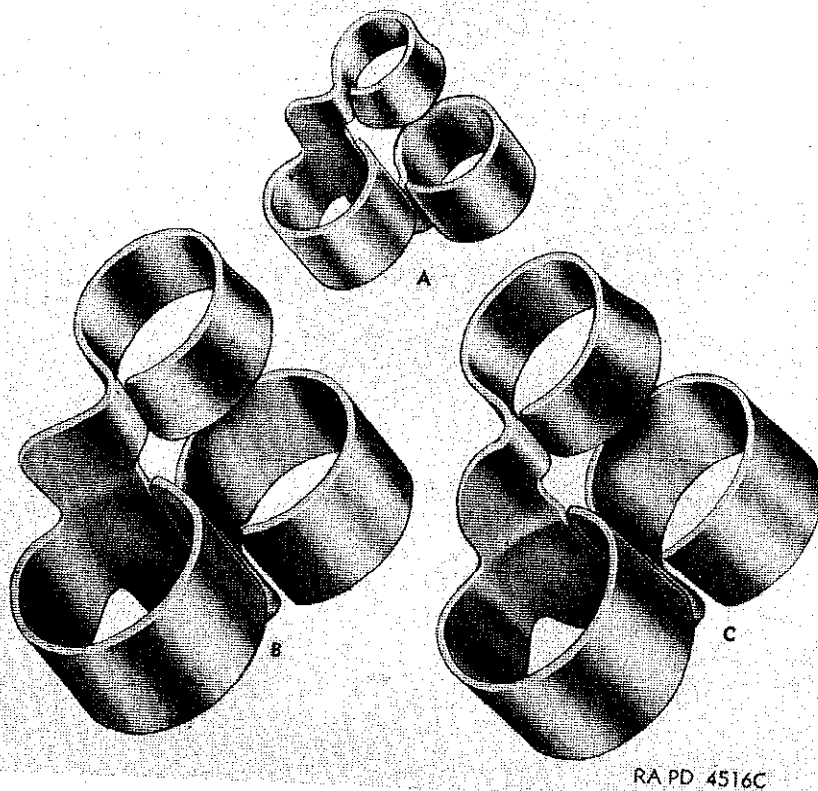


Figure 46. Metallic belt links: A—caliber .30 M1; B—caliber .50 M2; and C—caliber .50 M9.

57. Miscellaneous Small Arms Cartridges

These cartridges (figs. 41–45) consist of various types and calibers used for special or auxiliary purposes. They include: caliber .32 cartridges for use in pistols and revolvers; 9-mm cartridge for use in submachine

gun; caliber .38 cartridges for use in automatic pistols and revolvers; caliber .38 special cartridges for use in special revolvers; and caliber .45 blank line-throwing cartridge for use with a special projectile attached to a standard line in the Navy line-throwing gun.

58. Links, Belts, and Clips

Metallic belt links (figs. 46–48) are used with calibers .30 and .50 cartridges in machineguns. The links are made of steel, processed for

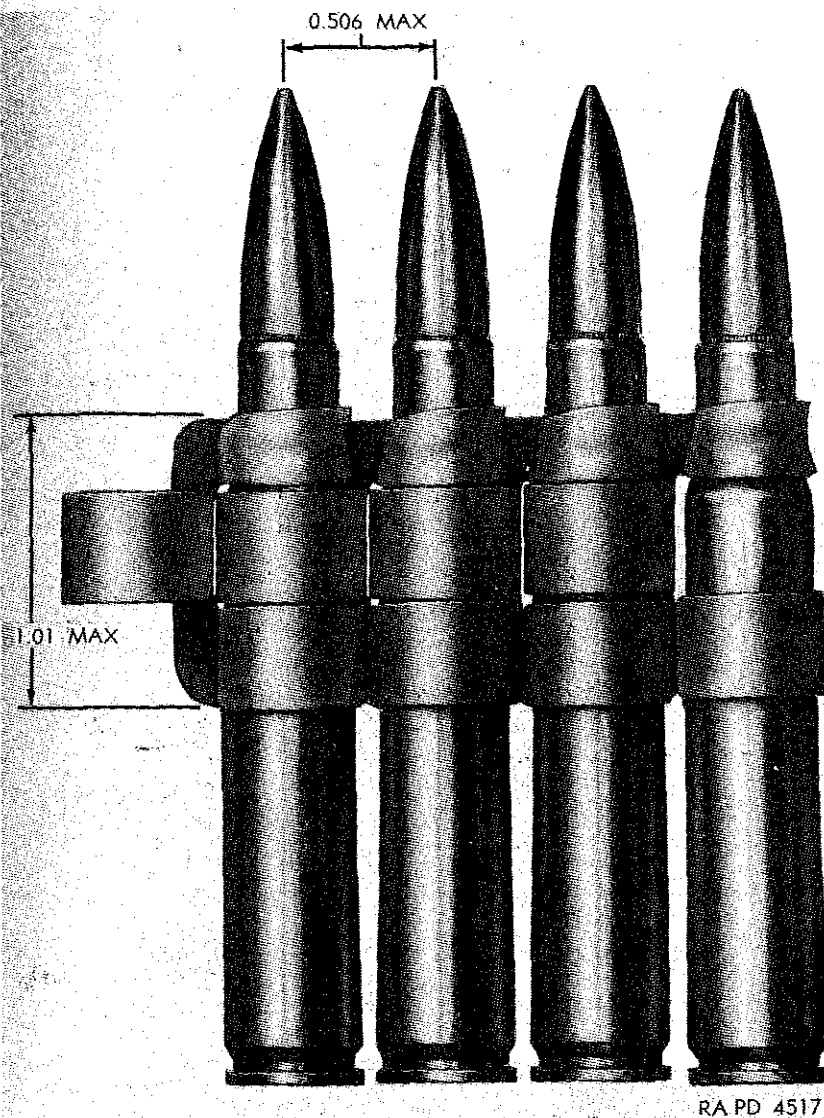


Figure 47. Section of metallic link belt of caliber .30 cartridges.

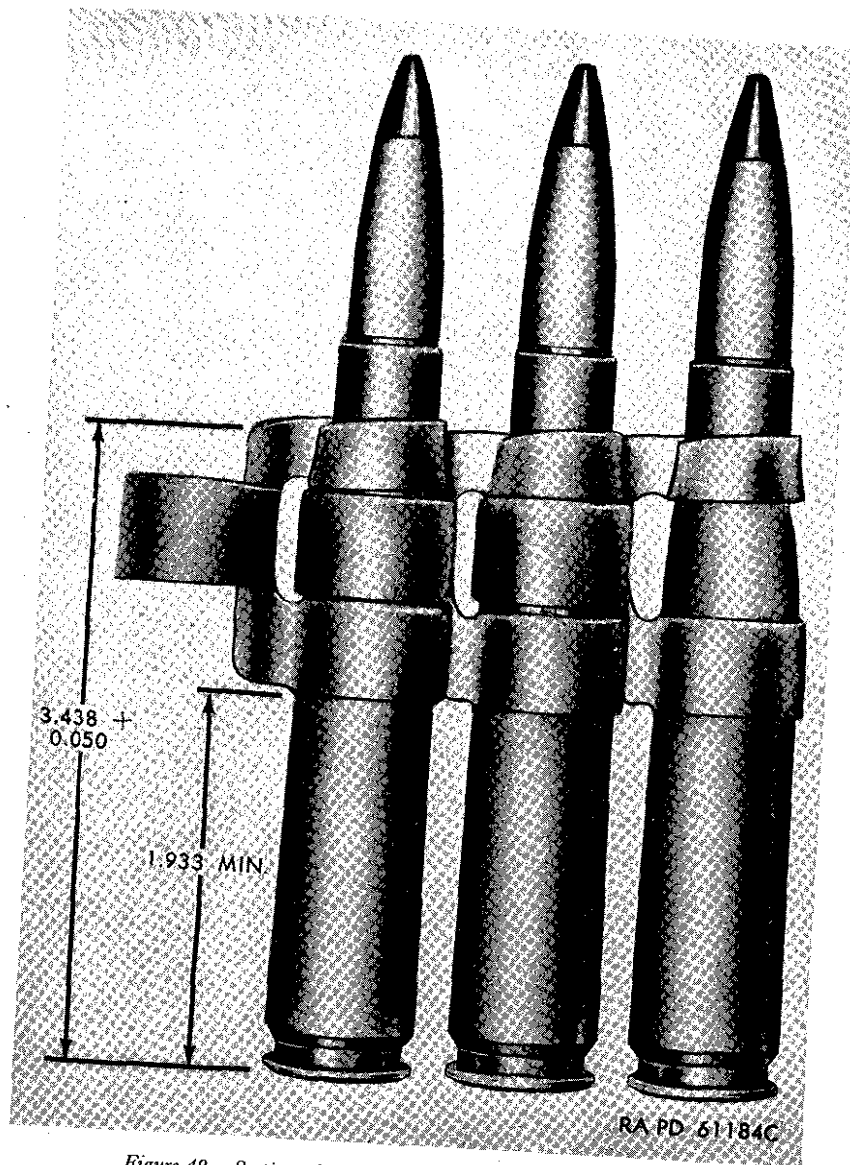


Figure 48. Section of metallic link belt of caliber .50 cartridges.

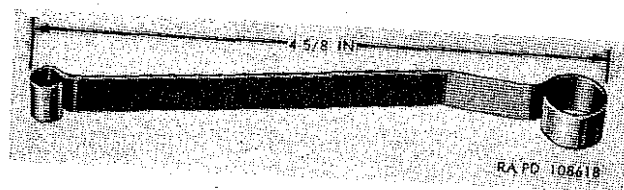


Figure 49. Metallic belt end—caliber .30 M1.

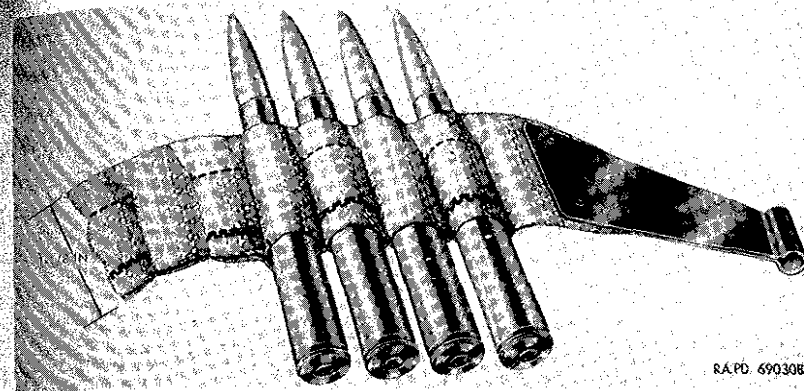


Figure 50. Section of 250-round web belt, caliber .30 M1917.

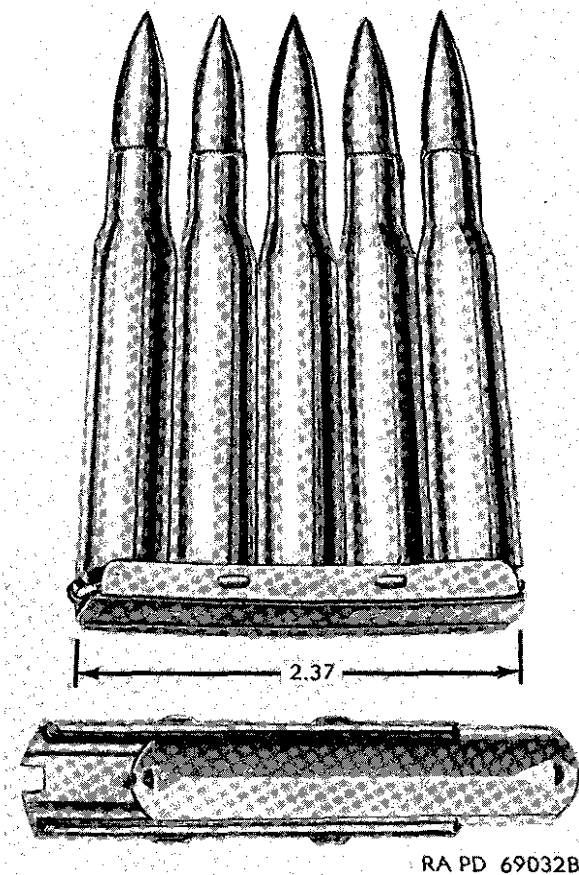


Figure 51. Caliber .30 cartridges in 5-round clip.

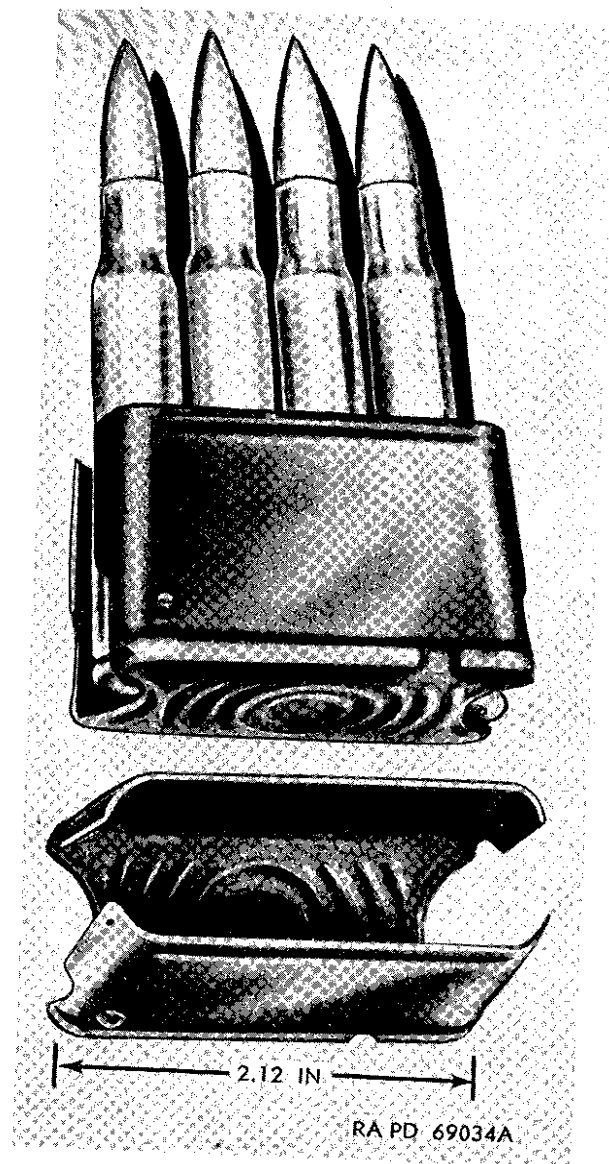


Figure 52. Caliber .30 cartridges in 8-round clip.

rust prevention, and are required to meet specific test requirements, to assure satisfactory ammunition feed and functioning under all service conditions. A metallic belt end (fig. 49) is attached to metallic link belts of caliber .30 cartridges packed in metal boxes for ground machinegun use. The belt end facilitates starting the belt of cartridges through the gun. A belt end is also required for certain aircraft gun installations. For information on metallic belt link linking and delinking machines, see

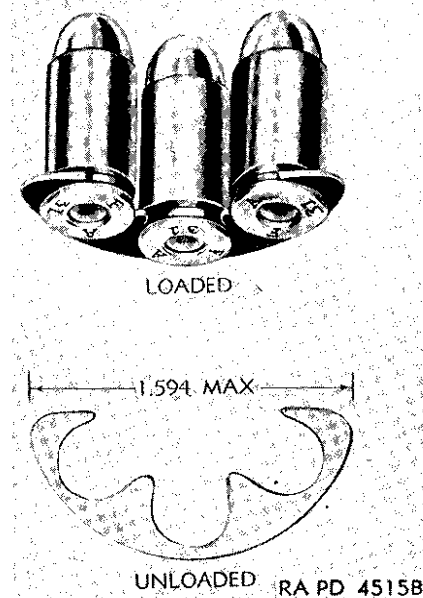


Figure 53. Caliber .45 cartridges in revolver clip.

TM 9-2200. Web belts (fig. 50) of cotton fabric are used in caliber .30 machineguns. Clips (figs. 51-53) are provided for caliber .30 cartridges; the 5-round clip for rifles M1903 and M1917, the 8-round clip (nonexchangeable in peacetime) for the rifle M1, the 10-round clip for the caliber .30 carbine, and the 3-round clip for the caliber .45 revolver.

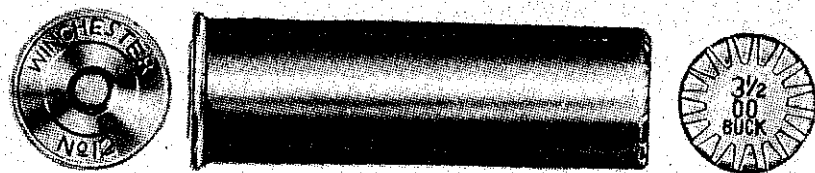
59. Shotgun Shell

Shotgun shell (shot shell) of appropriate loads are procured commercially for use in shotguns of various gages (figs. 54-59). The .410-gage aluminum shotgun shell (fig. 60) is used in the .22/.410 gage survival rifle-shotgun M6 (par. 43).

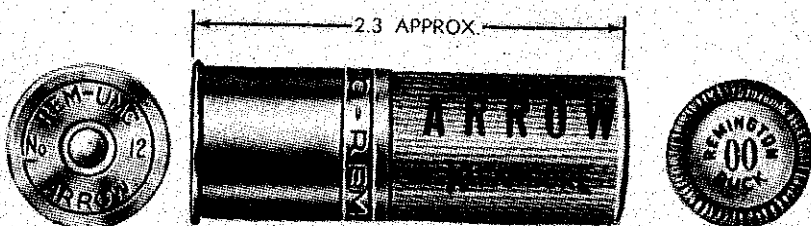
60. Grades and Lots

a. Current grades of existing lots of small arms ammunition are established by the Chief of Ordnance, in accordance with acceptance and surveillance tests, and are published in TB 9-AMM 4. The small arms ammunition lot numbers are on all packing boxes containing carton-packed cartridges and on the cartons. Repacked lot numbers are printed on the repacked lot reference data card. Grade 3 indicates unserviceable ammunition, which will not be issued or used.

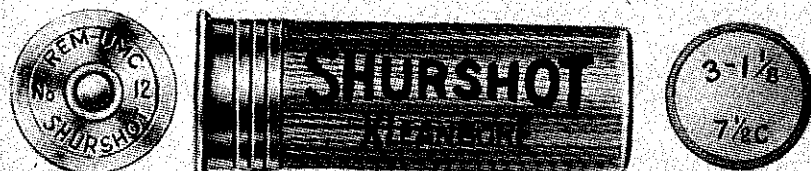
b. Small arms ammunition that has been graded "For Training Use Only" will not be used in demonstrations or on training courses requiring this ammunition to be fired over the heads of participating troops.



SHELL, SHOTGUN, ALL BRASS, 12-GAGE, NO. 00 BUCK, M19



SHELL, SHOTGUN, 12-GAGE, PAPER, LOADED WITH SMOKELESS POWDER AND #00 BUCKSHOT



SHELL, SHOTGUN, 12-GAGE, PAPER, LOADED WITH SMOKELESS POWDER AND #7-1/2 CHILLED SHOT



SHELL, SHOTGUN, 12-GAGE, PAPER, LOADED WITH SMOKELESS POWDER, #8 CHILLED SHOT, AND TRACER

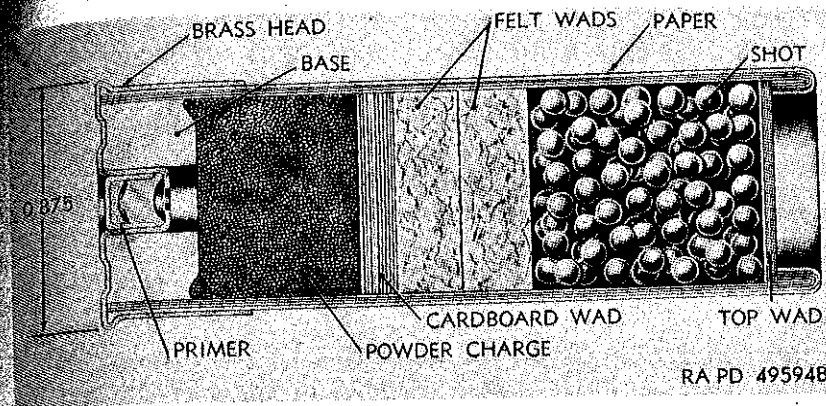
RA PD 230808

Figure 54. 12-gage shotgun shell.

Only those small arms ammunition lots that have been specifically designated for such use by the Chief of Ordnance will be issued for and used in infiltration course firing. When available, these specific lots will also be used in other combat firing training courses.

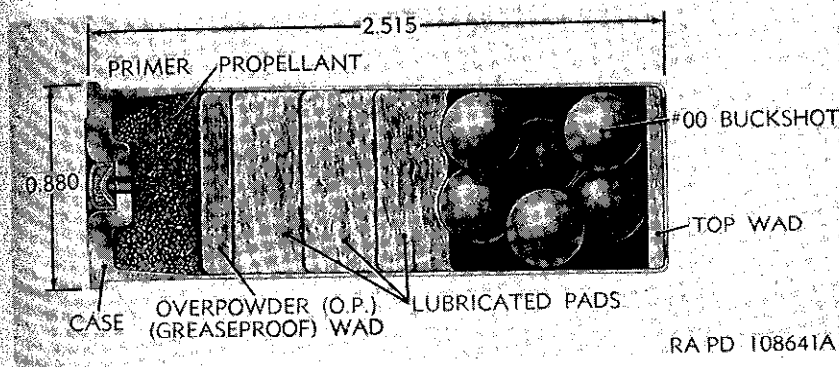
61. Care and Precautions in Handling

a. *Care of Containers.* Small arms ammunition is comparatively safe to handle. However, care must be taken to prevent ammunition boxes



RA PD 495948

Figure 55. 12-gage paper shotgun shell—sectioned.



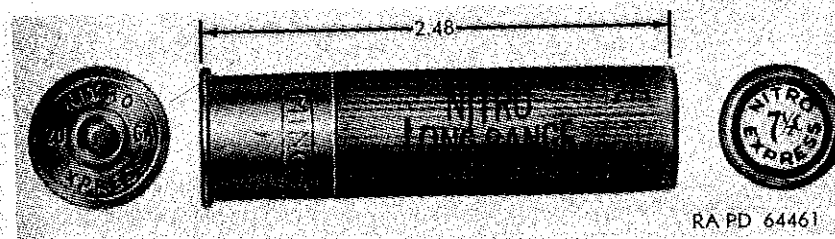
RA PD 108641A

Figure 56. 12-gage brass shotgun shell—sectioned.



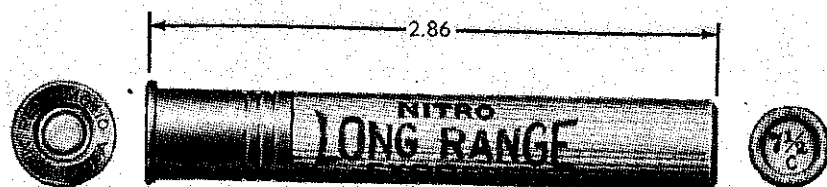
RA PD 64460

Figure 57. 16-gage shotgun shell.



RA PD 64461

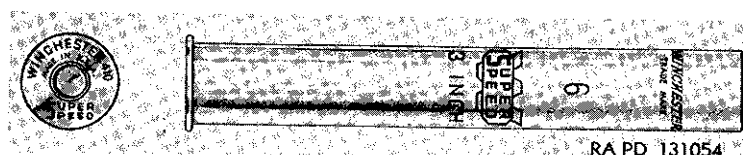
Figure 58. 20-gage shotgun shell.



MARKED ON REVERSE SIDE: "FOR 3 INCH CHAMBER ONLY"

RA PD 64463

Figure 59. .410-gage paper shotgun shell.



RA PD 131054

Figure 60. .410-gage aluminum shotgun shell.

from becoming broken or damaged. Broken boxes must be repaired immediately and careful attention given to the transfer of all markings to the new parts of the box. Metal liners and metal cans should be sealed and air-tested if equipment for this work is available.

b. Preservation of Packings. Ammunition boxes will not be opened until the ammunition is required for use, because ammunition from airtight containers, particularly in damp climates, may corrode and become unserviceable.

c. Marking Opened Packings. When cartridges are taken from their original packings for loading into clips or machinegun belts, the belts or clips should be tagged or marked so as to preserve the ammunition lot number, thereby preventing the ammunition from falling into grade 3 through loss of this means (lot number) of identification.

d. Keeping Cartridges Clean. Cartridges should be carefully protected from mud, sand, dirt, and water. If they get wet or dirty, they should be wiped off at once. If light corrosion or verdigris forms on cartridges, they should be wiped off. However, cartridges should not be polished merely to make them look brighter or better.

e. Protection of Ammunition. The primer of a cartridge should be protected from blows by sharp instruments, as such a blow might explode the cartridge. Ammunition should not be exposed to excessive heat or the direct rays of the sun for any considerable length of time. Such exposure is likely to affect the firing qualities of cartridges.

f. Use of Oil or Grease. The use of oil or grease on cartridges is dangerous and is prohibited. Oil or grease might cause injurious abrasives to collect in automatic weapons and produce excessive and hazardous pressures when fired.

62. Precautions in Firing

a. Misfires and Hangfires.

(1) *In blank firing.* Misfires in which the primer explodes but fails to ignite the powder charge have proved dangerous in firing, as some of the unburned propellant is blown into the bore of the weapon. A series of such rounds will cause an accumulation of powder sufficient to result in serious damage when ignited by a normal cartridge. When misfires in excess of 5 percent occur in firing blank cartridges, the firing of that lot of ammunition will be suspended and reported to the Chief of Ordnance.

(2) *Suspension.* When excessive misfires or hangfires that are not attributable to defects of the weapon occur in any lot, its use should be suspended and a report should be made as prescribed in SR 700-45-6. The ammunition lot thus affected will be withdrawn and replaced by serviceable ammunition, as prescribed in AR 385-63.

b. Identification. No small arms ammunition will be fired until it has been identified as to type, lot number, and current grade. Since different types of small arms ammunition are of similar appearance, the kind of ammunition being issued will be strictly checked from the markings on the packing.

c. Inspection of Bore. Before firing, be sure that the bore of the weapon is free of any foreign matter such as cleaning patches, mud, sand, snow, etc. Firing a weapon with any obstruction in the bore will result in damage to the weapon and may result in injury to the firer.

d. Lodged Bullets. When a bullet lodges in the bore of a rifle, pistol, or machinegun, it should be removed by the application of pressure from the muzzle end of the weapon.

Warning: To attempt to shoot the bullet out with another cartridge is extremely dangerous and therefore prohibited.

e. Defective Rounds. Badly dented cartridges that fail to chamber, cartridges with loose bullets, or otherwise defective rounds should not be fired.

f. Armor-Piercing Cartridges. The use of armor-piercing cartridges is prohibited in demonstrations in which tanks take part. When using armor-piercing ammunition, the cores of bullets that fail to penetrate will rebound. The radius of rebound depends on several factors but may be estimated as a maximum of 100 yards for caliber .30 and 200 yards for caliber .50 armor-piercing cartridges.

g. Firing Blank Cartridges. Blank cartridges should not be fired at a representative enemy at distances less than 20 yards, as the wad or paper cup may fail to break up. The intact wad or paper cup and/or unburned propellant grains may cause injury within this distance. Before firing, blank cartridges should be visually inspected for evidence of any foreign matter within the cartridge case mouth. Any foreign matter therein would be expelled as a projectile in firing.

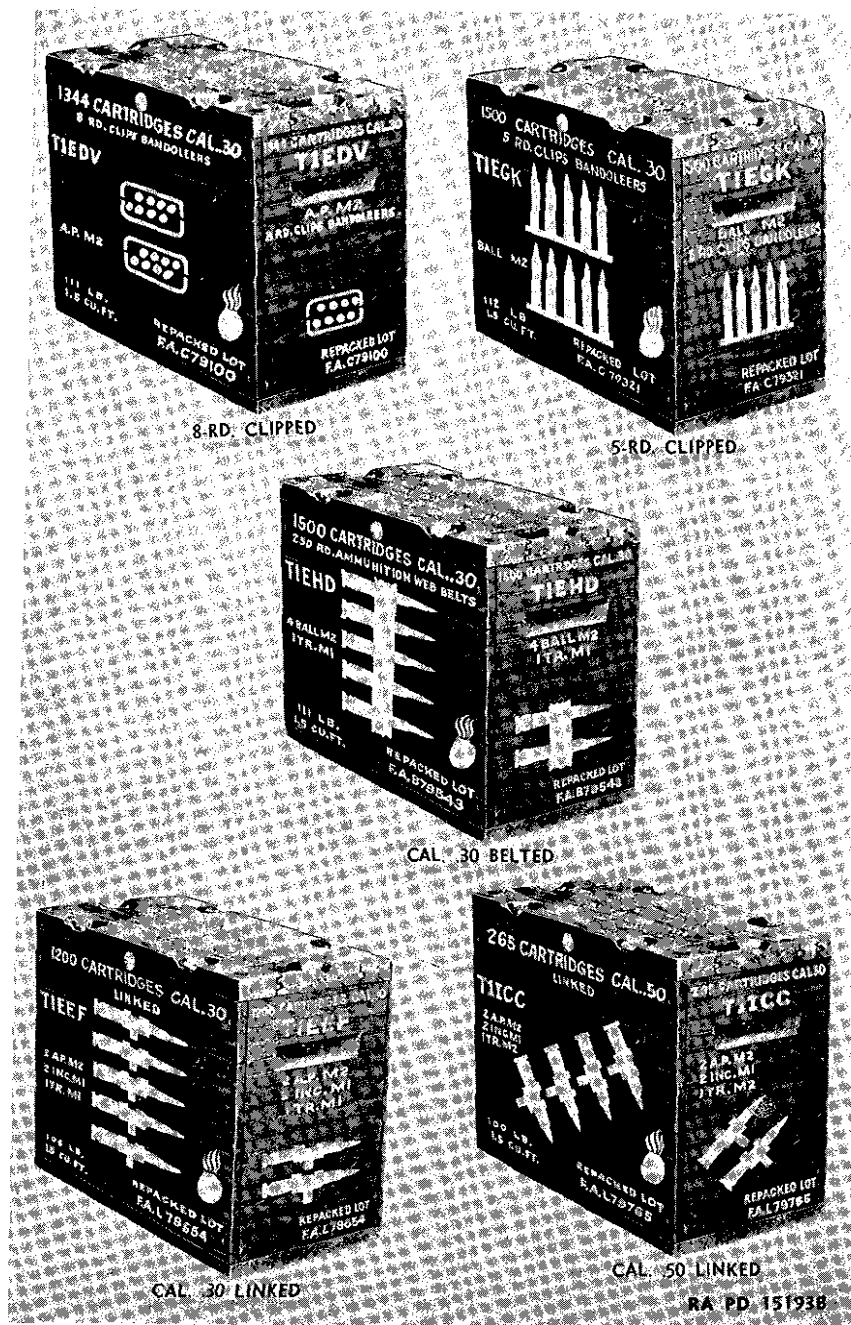
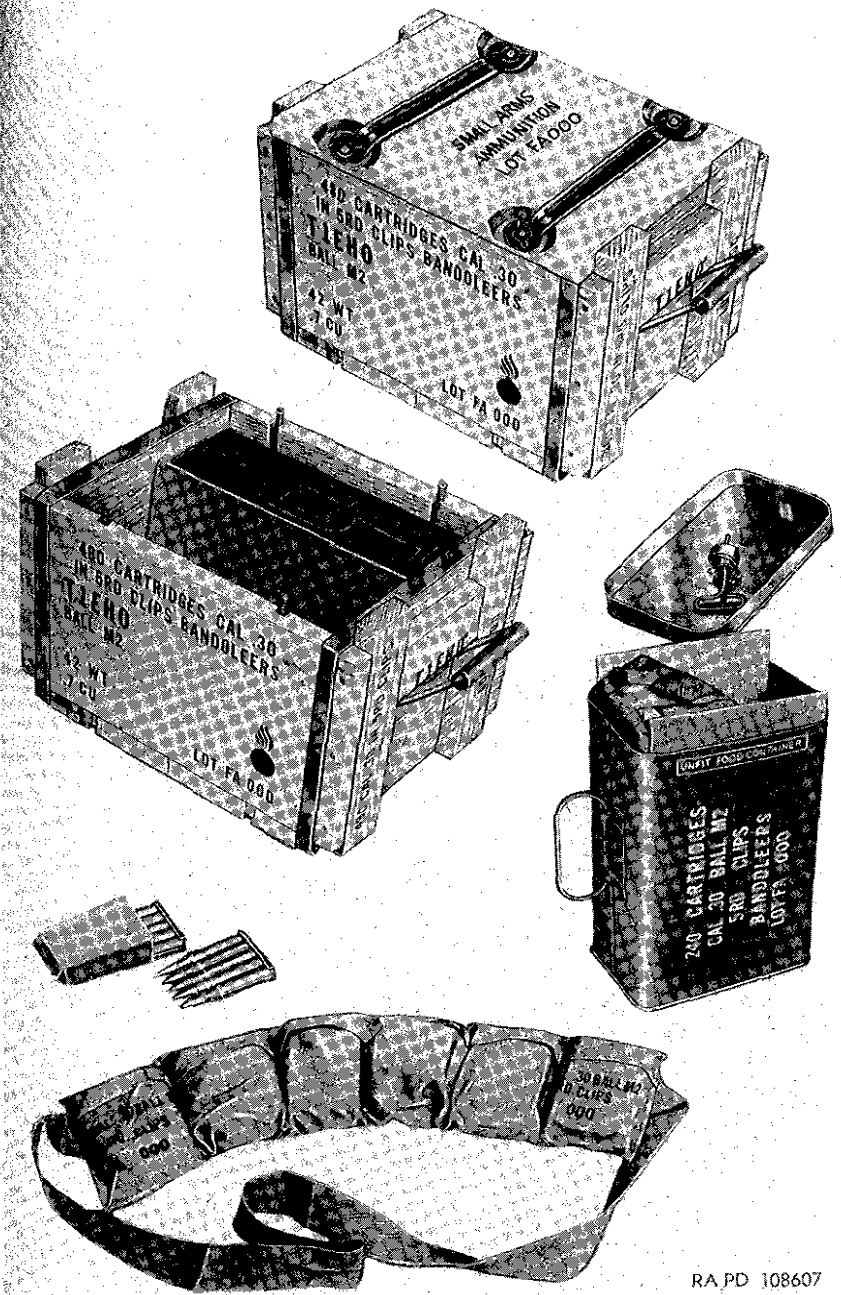


Figure 61. Packing symbols—small arms ammunition in M1917 box.



RA PD 108607

Figure 62. Caliber .30 cartridges in 5-round clips, in bandoleers, in metal can M8, and in box M9.

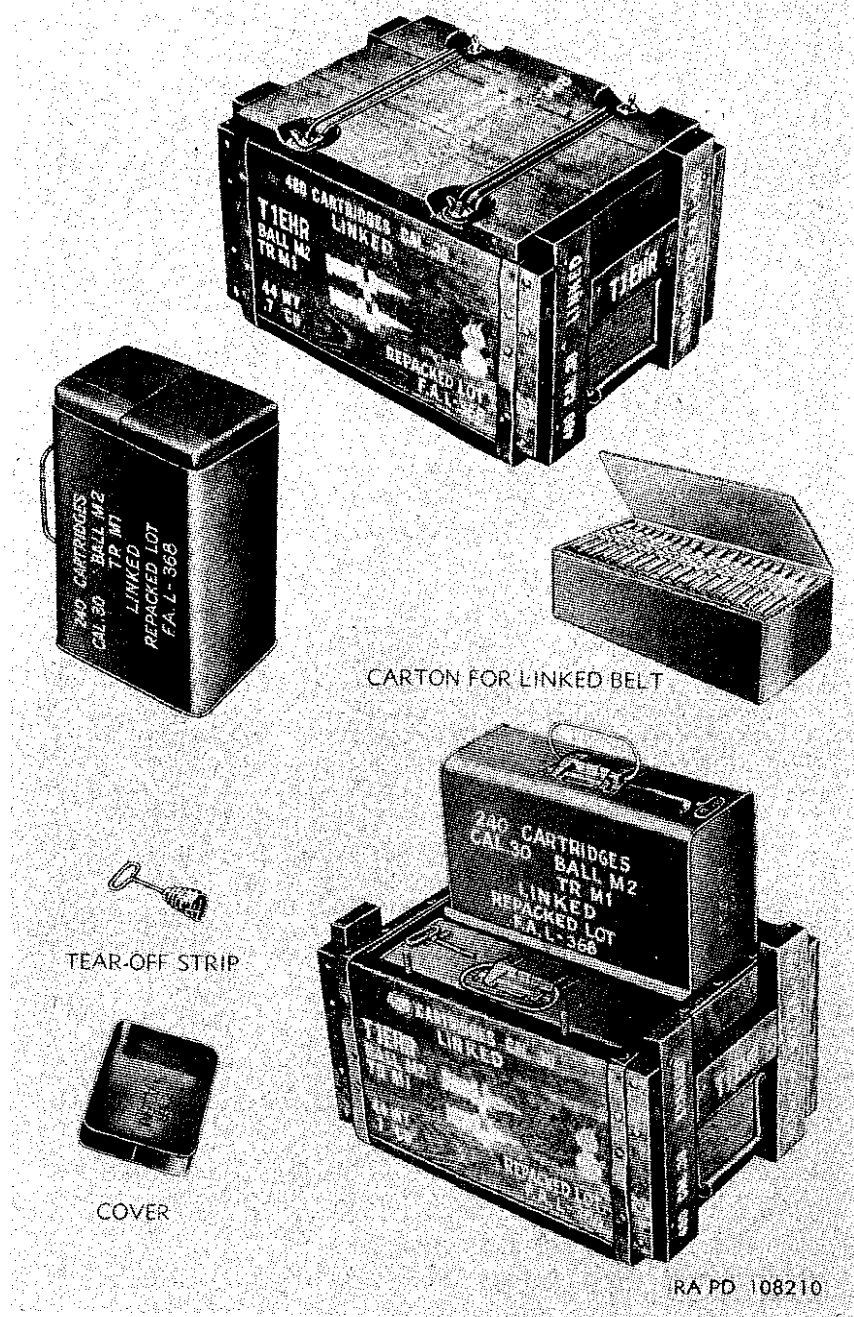


Figure 63. Caliber .30 cartridges, linked, in cartons, in metal can M8, and in box M9.

h. Report of Malfunction. Any malfunction of ammunition must be reported promptly to the technical service representative under whose supervision the ammunition for the unit involved is maintained and issued. As provided in SR 700-45-6, the technical service representative will report such malfunction to the head of the appropriate technical service. It is important, therefore, that all evidence be preserved. This includes the cartridge case, other cartridges from the same box, the weapon concerned, and all recoverable pieces—in short, everything that might determine the cause of the malfunction.

63. Packing and Marking

a. Packing. Dependent on its intended use, small arms ammunition is packed in link or web belts, in clips in bandoleers, or in cartons. For detailed descriptions of the wide variety of small arms ammunition packings and packing materials, see Department of the Army Supply Manual ORD 3 standard nomenclature lists (SNL) of the T group.

b. Marking.

- (1) Small arms packing boxes may be either stained brown with marking in yellow or unstained with marking in black. Metal boxes with replaceable covers, which are usually packed in wirebound boxes, are painted olive drab.
- (2) Instead of the lot number, a functional (repacked) lot number may be stenciled on packing boxes containing web belts and metallic link belts; the serial number of the functional (repacked)

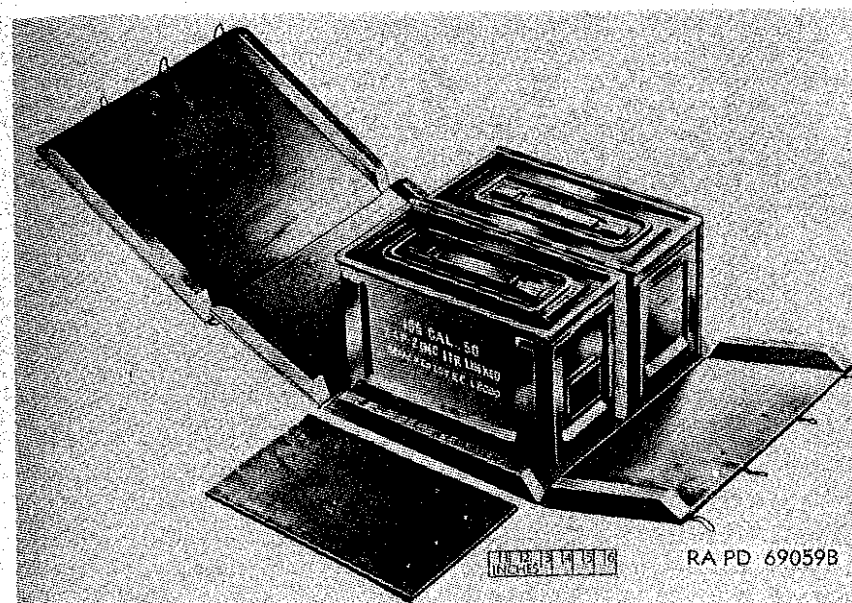


Figure 64. Caliber .50 cartridges in metal ammunition box M2, in wirebound wooden box—outer box opened.



Figure 65. Grenade cartridge assortment in metal can M13.

lot number is preceded by the letter B for belted ammunition and L for linked cartridges.

- (3) To provide a further means of quickly identifying type of packing, stenciled silhouettes are used on boxes and crates containing clipped, belted, and linked cartridges. These silhouettes indicate whether the ammunition is packed in rifle clips, web belts, or metallic link belts. The silhouettes are vertical for caliber .30 cartridges and diagonal for caliber .50 cartridges.

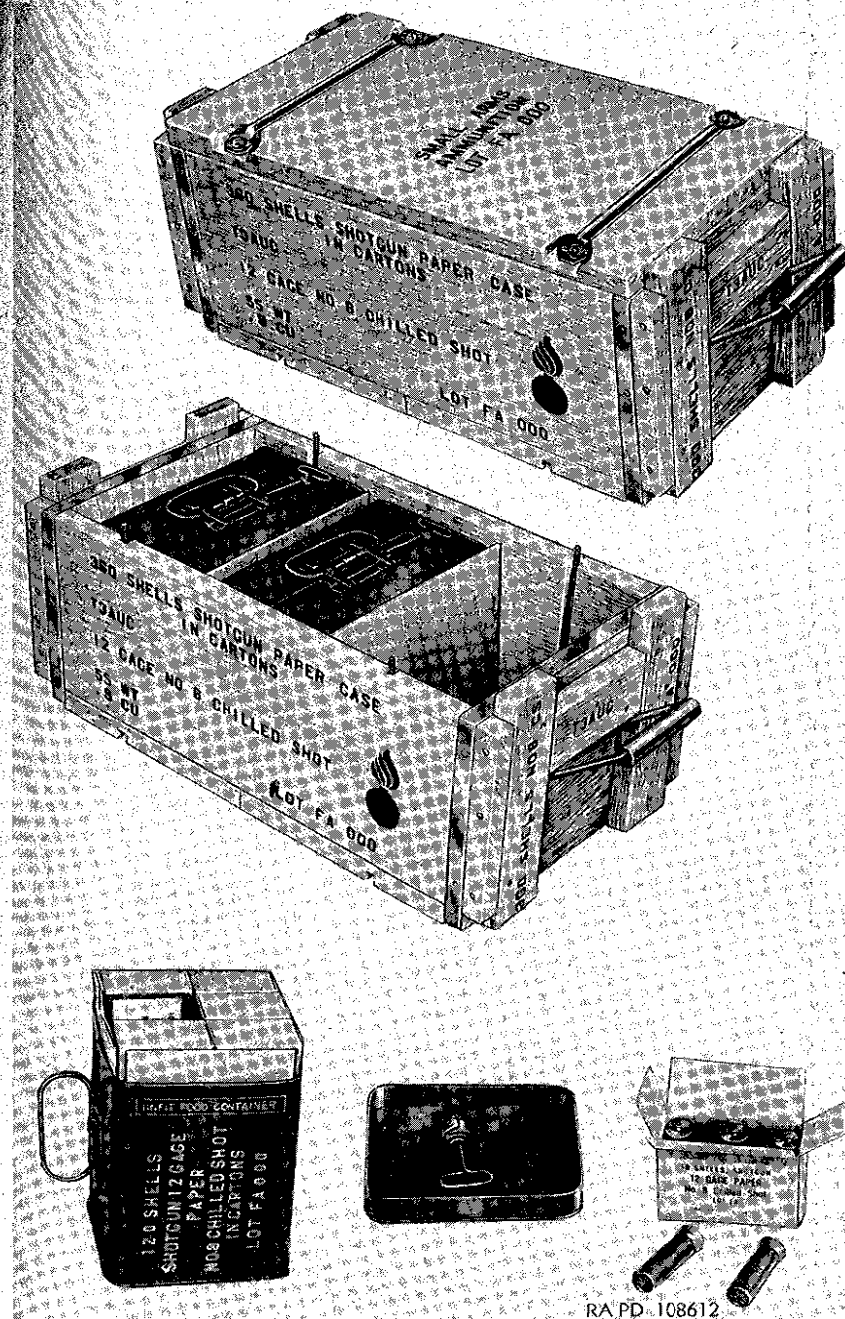


Figure 66. 12-gage paper shotgun shell in cartons, in metal can M10, and in box M15.

The absence of stenciled silhouettes on boxes may indicate carton-packed ammunition.

- (4) The expendable metal ammunition boxes M1A1, M2, M2A1, M19, and M19A1 are painted olive drab with marking in yellow or white.
- (5) Examples of representative packings and markings are shown in figures 61 through 66. For detailed coverage of packings and markings, see TM 9-1990.

Section II. GRENADES

64. General

A grenade is a small (approx. 1 to 1½ lb.) missile filled with high explosive or chemical intended for projection against enemy personnel or materiel at relatively short ranges. The two types are hand grenades and rifle grenades. The hand grenade is thrown by hand in a prescribed manner and the rifle grenade is projected by a special blank cartridge from a caliber .30 rifle equipped with a grenade launcher. The hand grenade is used to supplement small arms for effect against an enemy in close combat and for a screening smoke. The rifle grenade is for use against enemy tanks and for screening and signaling smokes, covering the range between the maximum for hand grenades and the minimum for mortar shell. Service hand and rifle grenades are filled with high-explosive, chemical, or smoke-producing composition. Practice hand grenades contain a small black powder spotting charge. Practice rifle grenades are completely inert. Inert hand grenades are used for training in handling. Grenades are classified according to filler as high-explosive, chemical, practice, or inert. Grenades are identified by the painting and marking on the item (figs. 2 and 3) and on the containers. Service fragmentation hand grenades are painted olive drab with yellow marking; offensive hand grenades are painted black with black marking on a yellow sealing strip; illuminating hand grenades are unpainted with black marking. Service HE, AT rifle grenades are painted olive drab with marking in yellow; smoke rifle grenades are painted gray with yellow marking; and illuminating rifle grenades are unpainted with gray sealing tape and black marking. Practice hand grenades are painted blue. Practice rifle grenades are painted black with marking in white because they are completely inert. Training hand grenades (also inert) are painted black with marking in white. Simulator hand grenades are painted gray with black markings on a white label. Where practicable, inerted items are drilled in conspicuous places, the holes being about ¼-inch diameter, in order to indicate unmistakably the absence of explosive (see SR 385-410-1). For complete information on grenades including tactical employment, see FM 23-30.

65. Hand Grenades

a. General. The three general types of hand grenades are service, practice and training, and simulator. Service hand grenades are classified according to use as fragmentation, offensive, or chemical (burning or bursting). The chemical grenades described herein are issued by the Chemical Corps. Practice hand grenades and "simulated" or "simulator" hand grenades are designed to simulate the fragmentation-type service hand grenades. Fuzes used in explosive grenades are of the M6 series, M204 series, or M206 series "delay-detonating" types. Fuzes used with burning-type chemical grenades are of the M201 "igniting" type and fuzes used with the bursting-type chemical grenades are of the M6 series or M206 series "delay-detonating" type. Fuzes used with practice and training grenades are of the M10 series and M205 series "time" types. Fuzes for the hand grenade simulator or the "simulated hand grenade" consist of a piece of safety fuse and fuse lighter. All hand grenades are issued fuzed or "complete" except the offensive hand grenade, which is issued unfuzed.

b. Fragmentation. A typical fragmentation hand grenade is GRENADE, hand, fragmentation, M26 (T38E1) (fig. 67). This is an improved type that consists of a thin metal body, approximately the size and shape of a lemon, lined with a wire-wound coil, and replaces the older type (Mk 2) cast iron body. The M26 body is approximately 2¼ inches in diameter

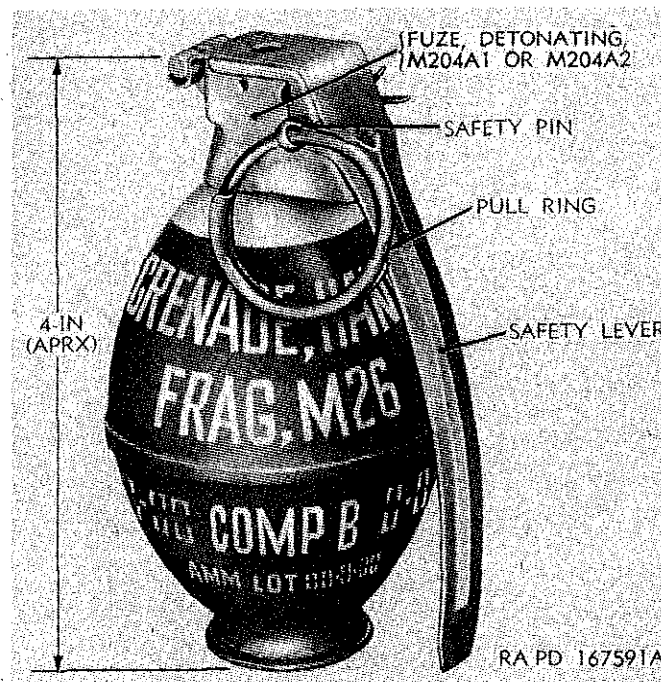


Figure 67. Grenade, hand, fragmentation, M26 (T38E1) fuzed with fuze M204A1 or M204A2.

at the center and 3 inches long; 3.9 inches long including fuze. The explosive charge consists of composition B. This grenade is shipped fuzed with detonating fuze M204A1 or M204A2, which has a striker, primer, delay charge, and detonator. This fuze is of the "silent" type, which

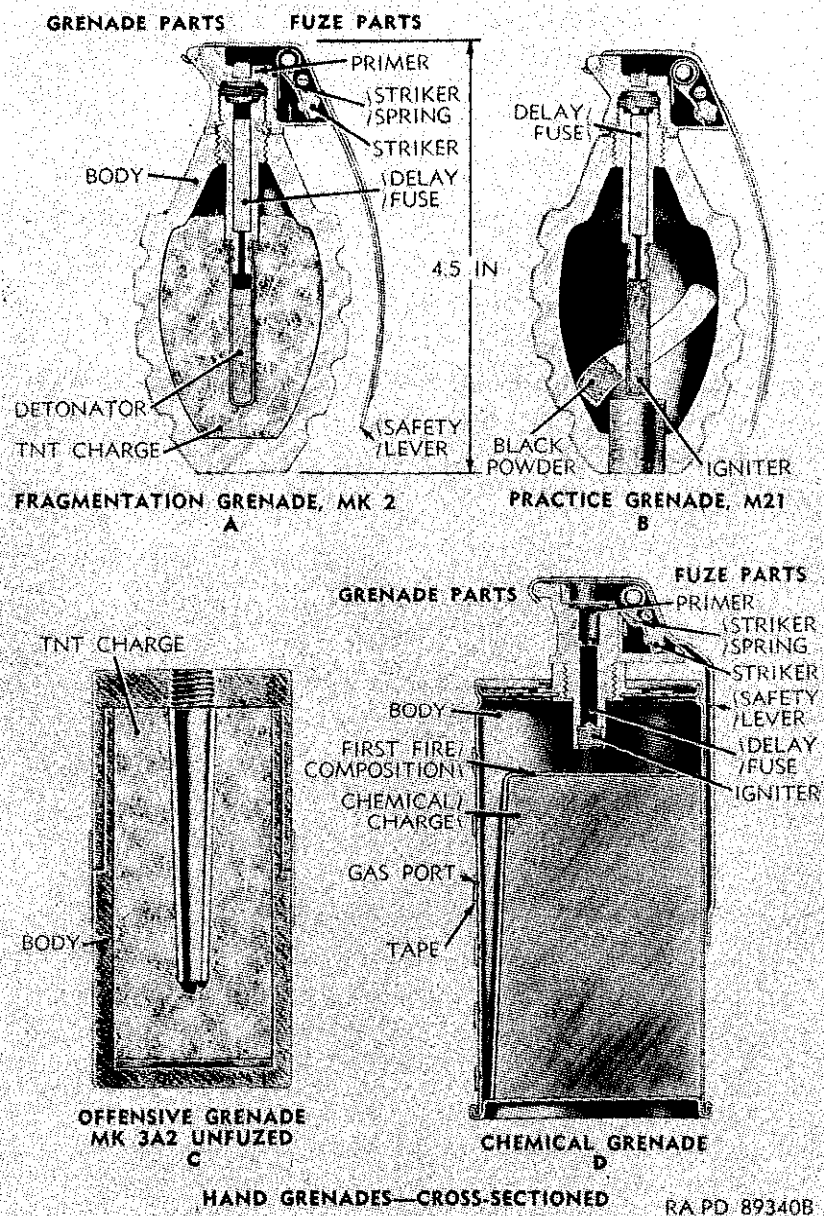


Figure 68. Comparison of hand grenade types.

means only that the delay charge burns silently. The safety lever, which is curved to conform to the shape of the grenade body, is hooked to the top of the fuze and held in place by a safety pin, which holds the striker against the action of a spring. The complete assembly weighs 1 pound. After grasping the grenade and safety lever, in the manner prescribed in FM 23-30, the safety pin is pulled out with the free hand just prior to throwing the grenade with the throwing hand. When the grenade is thrown, the striker under the force of the spring pushes the safety lever free of the fuze and strikes the primer. The primer ignites the delay charge which, after a 4- to 5-second delay, explodes the detonator and the bursting charge thereby fragmenting the grenade body. Since fragments may be projected over 200 yards, fragmentation grenades will not be used in training without adequate cover. An older type grenade, the Mk 2 (A, fig. 68), which has a cast iron serrated body, operates in a similar manner and is also fuzed with M204A1 or M204A2 fuze. Fragmentation hand grenades are painted olive drab with a band at the neck near the fuze and marking in yellow.

c. Offensive. The offensive hand grenade Mk 3A2 (C, fig. 68) is about the same size as the fragmentation hand grenade but is cylindrical in shape. It is used with the "silent" type fuze M206A2. This grenade, which is shipped unfuzed, contains about one-half pound of TNT and is therefore used as a blasting or demolition agent. Since fragments may be projected over 200 yards, offensive grenades will not be used in training without adequate cover.

d. Chemical.

(1) *Burning type.* This type grenade (D, fig. 68) consists of a cylindrical steel container (approx. 2 3/4 diam. x 4 3/4 lg.) filled with a burning-type munition and fitted with an igniting-type fuze, usually the 2-second delay M201 (w/lg. or short safety lever depending upon the type), which is somewhat similar to detonating-type M206A1 except that it has an igniter instead of a detonator. Chemical grenades, depending upon the purpose for which they are employed, contain fillers as follows: the CN-DM irritant gas M6 consisting of tear gas, vomiting gas, and smokeless powder, burning 90 seconds, used to control disturbances; the CN tear gas M7 series, burning 30 to 60 seconds, also used to control disturbance; the white smoke (HC) AN-M8, burning 2 minutes, and colored (green, red, violet, and yellow) smokes M18, burning 1 to 2 minutes, used for screening and signaling; the incendiary thermite (TH) AN-M14, burning 30 seconds at 4,300° F., used to set fire to enemy matériel; and the illuminating Mk 1 (fig. 69), burning 25 seconds at 55,000 candlepower, used to illuminate terrain in night operations. (Violet smoke is used only for demonstration or training.) There is also a CN riot grenade M25A1 ((2) below) that, although functioning as a bursting-type, acts as a burning-type.

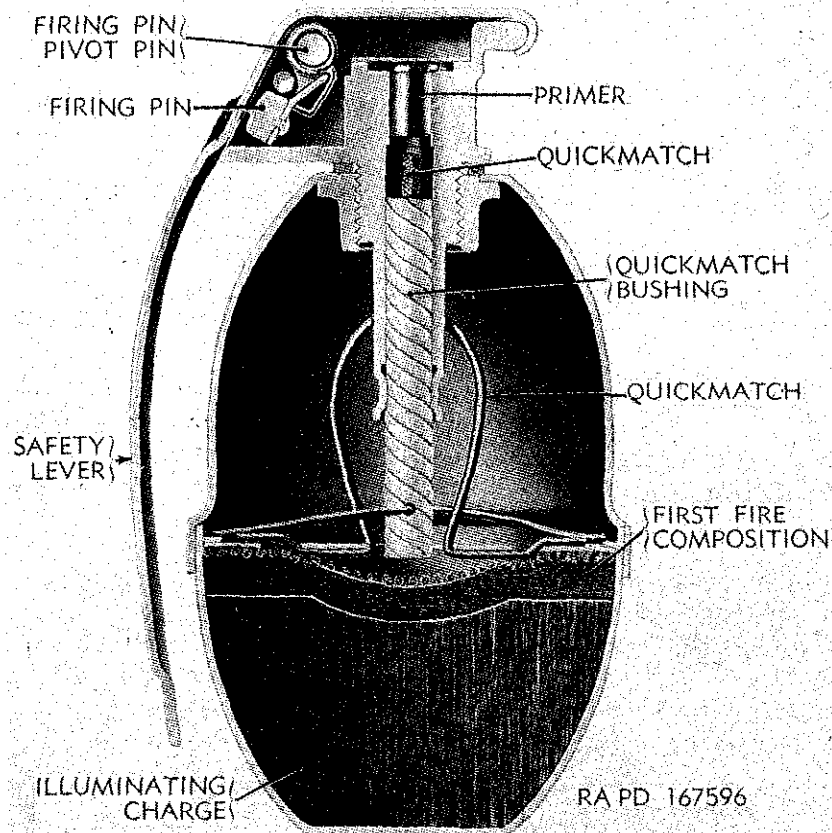


Figure 69. Illuminating hand grenade Mk 1.

(2) *Bursting type.* The two bursting-type grenades are the white phosphorus M15 and the CN riot grenade M25A1. The M15 consists of a cylindrical steel container filled with about one-half pound of white phosphorus. This grenade may be fuzeed either with the "silent-type" fuze M206A2 or with the fuze M6A4D. These fuzes have the 4- to 5-second delay also. This grenade has a tetryl burster that is designed to rupture the grenade body and disperse white phosphorus filler in the form of small particles, which ignite spontaneously on contact with the air and form a dense white smoke. This grenade is a combat weapon used to lay a smoke screen. The CN riot grenade M25 series consists of a 3-inch spherical plastic container filled with CN gas. This grenade is fitted with a detonating-type fuze that has a 2-second delay fuse and a detonator that is designed to burst the grenade body releasing the gas.

e. Practice, Training, and Simulator Types. These types simulate the service types. The practice grenade (B, fig. 68) contains a small black pow-

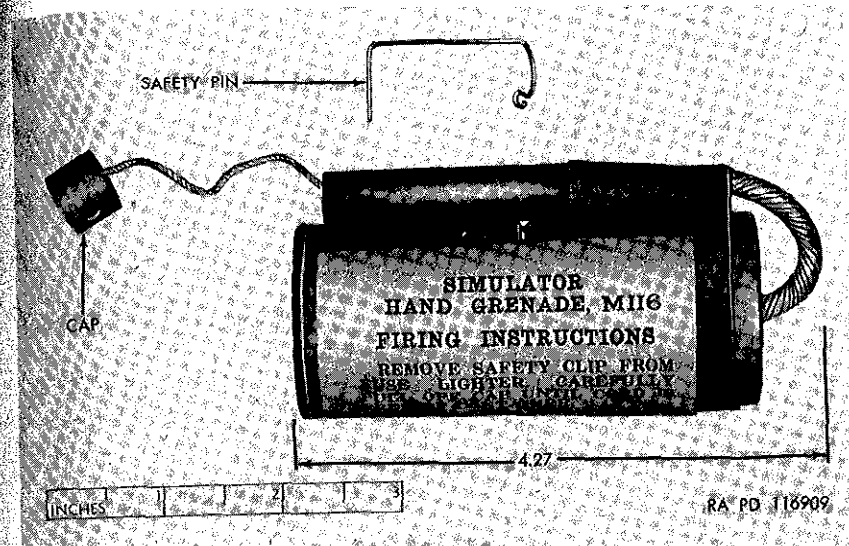


Figure 70. Simulator, hand grenade, M116 (T79).

der spotting charge and is painted blue in accordance with the conventional color scheme for practice ammunition; it is used for practice in throwing. The training grenade, which is completely inert, is painted black in accordance with the color scheme and is used only for training in handling preparatory to throwing. "Practice" models are—the M21 which is fuzeed with the fuze M205A2, or the older fuze M10A3, both of which are fitted with a time fuze; the Mk 2A1, which is fitted with fuze M10A3; and the M30 (T39), which simulates the service grenade M26 (b above). The "training" model Mk 1A1, formerly designated "dummy," is completely inert and simulates the service grenade Mk 2 (A, fig. 68). The "simulator" types are—the hand grenade simulator M116 (T79) (fig. 70), which consists of a closed cylindrical paper tube containing an ounce of photoflash powder, a short piece of safety fuse, and a fuse lighter, for simulating the functioning of a hand grenade (see TM 9-1981); and the GRENADE, hand, simulated, an older type.

66. Rifle Grenades

a. General. The several types of rifle grenades are fragmentation; antitank; chemical; and practice and training. Rifle grenades are projected by caliber .30 rifles equipped with grenade launchers and are authorized for use only with special grenade cartridges (g below). Rifle grenades were formerly also authorized for use with carbines.

b. Fragmentation. There is no fragmentation rifle grenade designed as such. However, a fragmentation hand grenade, either the M26 or the Mk 2 (par. 65), fitted with ADAPTER, grenade-projection, M1A1 or M1A2 (par. 67), constitutes a fragmentation rifle grenade.



Figure 71. Grenade, rifle, HE, AT, M28 and grenade, rifle, practice, M29.

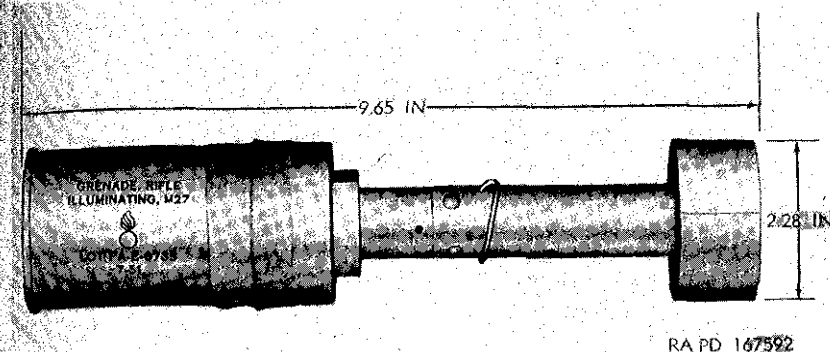


Figure 72. Grenade, rifle, illuminating, M27 (T45).

c. *Antitank.* This type grenade is designed for use against tanks and armored vehicles. The high-explosive antitank (HE, AT) rifle grenade M28 (T41E1) (fig. 71) consists of a body assembly, stabilizer, and fin assembly. The body contains about 12 ounces of high explosive in the form of a shaped charge and a base detonator. A point-initiating fuze is attached to the nose of the grenade. Upon impact, this fuze, which has a small shaped charge, initiates the base detonator, which, in turn, explodes the main charge. At 0 degree obliquity, that is at right angles, the jet from this grenade will penetrate upwards of 8 inches of armor plate and is effective up to 65 degrees obliquity. The new type high-explosive antitank rifle grenade M31 (T37E4) is similar to the M28.

d. *Chemical-Burning Type.* There are two types of burning rifle grenades, the illuminating and the smoke. The illuminating rifle grenade M27 (T45) (fig. 72) consists of a cylindrical body and a stabilizer assembly. The body contains one-half pound of illuminant, a base igniting fuze, and a quickmatch. Upon impact, the illuminant burns for 55 seconds with 80,000 candlepower, illuminating an area 240 yards in diameter. Colored smoke grenades are the green, red, violet, and yellow signaling smokes of the M22 series and the orange (nonstandard) smoke T8E1. Colored smoke streamer grenades of the M23 series are the same color smokes as the M22 series. Colored smoke grenades (fig. 3), which are used for signaling, begin to burn upon impact and burn for 45 seconds. Colored smoke streamer grenades, which are also used for signaling, emit a stream of smoke for about 12 seconds, beginning at 50 feet from the muzzle of the rifle. (Violet smoke is used only for demonstration or training).

e. *Chemical-Bursting Type.* Rifle grenade M19A1 (fig. 3) is the rifle counterpart of the hand grenade M15 (par. 65). The M19A1 has a stabilizer and fin assembly. It contains 8½ ounces of white phosphorus and is equipped with a burster that is actuated by a base detonating fuze on impact. White phosphorus grenades, both hand and rifle, are used to lay down screening smokes.



CARTRIDGE, GRENADE, CARBINE, CAL. .30, M6



CARTRIDGE, RIFLE GRENADE, CAL. .30, M3

RA PD 68318D

Figure 73. Rifle grenade cartridges.

f. *Practice and Training Types.* The two models of practice rifle grenades are the M11 series and the M29. The practice M11A4 (fig. 3), which is the latest model of the M11 series, is used in training. In flight, it simulates the action of a high-explosive antitank grenade. As the M11A4 is completely inert, it is painted black, and since it is intended to be used repeatedly, it is issued with replacement fins and ogives. The M29 (fig. 71), which simulates the flight of the M28 (c above), is also inert and is painted black.

g. *Grenade Cartridges.* These cartridges are especially designed cartridges for use in projecting rifle grenades from caliber .30 rifles equipped with rifle grenade launchers. The two types of rifle grenade cartridges now in use (fig. 73) are—CARTRIDGE, rifle grenade, caliber .30, M3, which is a special blank cartridge with a rose-petal crimped wad-end, used in the chamber of the caliber .30 rifle for projecting a rifle grenade for normal ranges; and CARTRIDGE, grenade, carbine, caliber .30, M6, which is a special blank cartridge with a rose-petal crimped wad-end, used in the chamber of the caliber .30 carbine for projecting ground signals (*rifle grenades are no longer projected from carbines*) and for blank fire training purposes. Ground signals may be fired from rifles equipped with rifle grenade launchers and using rifle grenade cartridge M3 only.

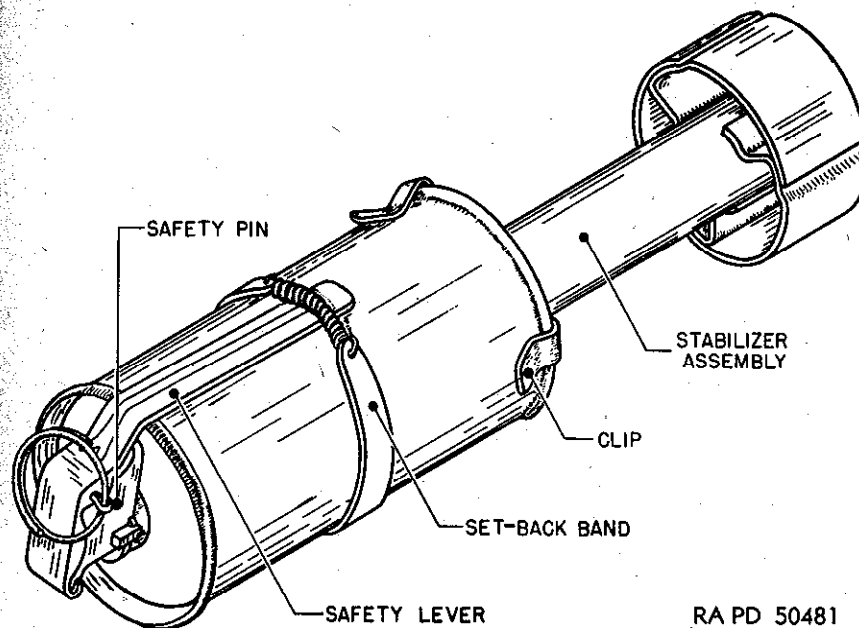
Caution: No blank cartridges other than those prescribed above will be used for firing grenades or ground signals. No bulletted cartridge will ever be used in a rifle projecting rifle grenade or ground signal or in a carbine projecting ground signal (*rifle grenades are no longer authorized for projection from carbines*). Firing instructions and methods of use of grenade launchers are given in FM 23-30. Complete technical information on grenade cartridges is given in TM 9 1990.

67. Adapters and Clip

a. *Fragmentation Grenade-Projection Adapter.* ADAPTER, grenade-pro-

jection, M1A2, the current standard model, consists of a stabilizer and fin assembly. Three spring-steel claws, adjusted so that they will grip the grenade body, are attached to the fin assembly. An arming clip is assembled to the longest claw. When the grenade is placed in the adapter, the safety lever of the grenade is inserted in the arming clip to hold the lever in place until the grenade is fired. Upon firing, the arming clip moves to the rear under the force of setback and the safety lever is thereby released, initiating the fuze. Hand grenades that are authorized for rifle projection in adapters of the M1 series are: the fragmentation hand grenade M26, fragmentation hand grenade Mk 2, illuminating hand grenade Mk 1, and practice grenade M21.

b. *Chemical Grenade-Projection Adapter.* ADAPTER, grenade-projection, chemical, M2A1, the current standard model (fig. 74), consists of a stabilizer and fin assembly. A separate setback band assembly is used with this adapter. At the front end of the stabilizer tube is a base plate and a 3-pronged clip to grip the base of the grenade. The metal setback band fits around the grenade, over the grenade safety lever. When the grenade is fired from a rifle, the setback band moves to the rear, thereby releasing the safety lever and initiating the fuze. Earlier models of this adapter differ only in method of assembly of the stabilizer tube to the plug that holds the clip and base plate. Hand grenades that are authorized for rifle projection in adapters of the M2 series are the chemical grenades mentioned in paragraph 65d except the illuminating grenade Mk 1.



RA PD 50481

Figure 74. Chemical grenade-projection adapter M2 series—as used with chemical hand grenades for rifle projection.

c. *Clip, Launcher, Positioning.* This is a $\frac{1}{16}$ -inch steel strip bent to fit around the rifle grenade launcher. It may be moved to various numbered positions on the launcher to aid in the uniform and rapid positioning of a number of grenades to be fired from the same position on the launcher. Positioning clips are packed in the box with service rifle grenades and adapters (both M1 and M2 series).

68. Care and Precautions in Handling

Due consideration should be given to the observance of general precautions in use of ammunition, which will be found in chapter 1, and appropriate safety precautions in handling grenades, which will be found in TM 9-1903 (see also TM 3-300 and FM 23-30). Representative precautions pertaining to grenades are described in *a* and *b* below.

a. Hand grenades must not be lifted or handled by the pull ring that is attached to the safety pin of the fuze. The safety pin will be removed just before throwing or just before launching if the hand grenade is fitted to a grenade-projection adapter and *at no other time.* Once a hand grenade has been inserted into a grenade-projection adapter, it must not be removed without first reinserting the safety pin. Offensive hand grenades, which are shipped unfuzed, will be fuzed in quantities sufficient only for anticipated current needs, because if fuzed offensive hand grenades should accidentally detonate en masse they might cause the detonation of nearby ammunition.

b. Rifle grenades must not be lifted or handled by the pull ring that is attached to the safety pin. They must be handled with care to prevent damage to the stabilizer assembly. A grenade should not be placed on the launcher unless it is intended to be fired immediately. If it is not fired, it must be rendered safe by replacing the safety pin *before* the grenade is removed from the launcher.

69. Precautions in Firing

General safety precautions for firing hand and rifle grenades are given in *a* through *i* below.

a. The safety pin will not be removed until just before throwing or launching the grenade.

b. After the safety pin is removed from a hand grenade, the safety lever will be held firmly in place, as prescribed in FM 23-30, until the grenade is thrown, tossed, or placed in position.

c. Silent-type fuzes (identified by a T-lug, which protrudes from the top of the fuze through a slot in the safety lever) may be used in fragmentation, offensive, and white phosphorus hand grenades. *Under no conditions*, therefore, will the thrower consider the grenade a dud because no noise, smoke, or sparks are observed upon release of the safety lever.

d. Occasionally, chemical grenades may flash. Hence, when used in maneuvers, they will be so thrown as to function not less than 30 feet from personnel.

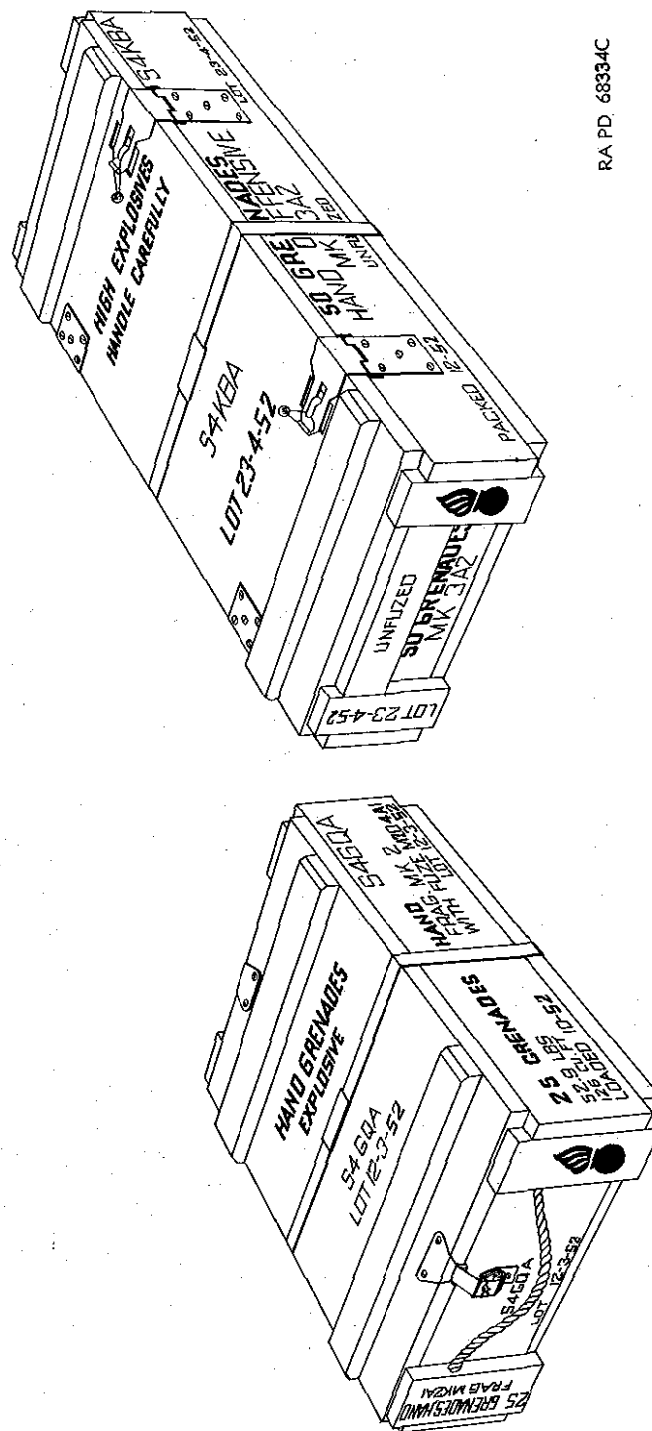


Figure 75. Typical packing of hand grenades.

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e. Since fragments may be projected over 200 yards, fragmentation grenades will not be used in training without adequate cover.

f. Rifle grenades with cracked or distorted stabilizer assemblies will not be used.

g. The appropriate rifle and prescribed combination of launcher and cartridge must be used to launch hand grenades fitted with adapters or to launch rifle grenades.

h. Rifle grenades or adapted hand grenades must never be launched with any cartridges other than the special blank grenade cartridges provided for that purpose. Do not use a bulletted cartridge to project a grenade or a ground signal from a launcher under any circumstances.

i. Detailed information concerning safety precautions to be observed in firing grenades will be found in AR 385-63, TM 3-300, and FM 23-30. Duds will be disposed of in accordance with the provisions of TM 9-1903.

70. Packing and Marking

Grenades are usually packed as fuzed complete rounds, each in an individual fiber container, in wooden boxes. Fragmentation hand grenades are packed 25 containers per wooden box. The offensive hand grenades are packed unfuzed, 24 or 50 per wooden box (fig. 75). The standard packing for rifle grenades is 10 containers per box, with a supply of cartridges for launching from the appropriate weapon. Jungle packing is waterproofed to withstand hot humid climates. Grenade-projection adapters are packed 48 per box, with sufficient number of various grenade cartridges and positioning clips. Inner containers are marked with nomenclature, lot numbers, AIC symbol, and other appropriate data. Packing boxes are marked with nomenclature, AIC symbol, lot number, weight, volume, and other appropriate information. The grenade M25A1 is not marked with identifying symbols, only the container is marked.

Section III. ARTILLERY AMMUNITION

71. General

a. *Designations.* Artillery ammunition is the type of ammunition designed for firing from weapons that, because of their particular characteristics, are designated as guns, howitzers, mortars, or rifles (recoilless-type). The basic components of an item of artillery ammunition, known collectively as a "round," consist of a projectile (solid or filled w/an active agent) and an integral or separate propelling charge (quantity of grained solid propellant), each with means (fuze or primer) of initiating functioning. Rounds of artillery ammunition that are composed of a projectile and an *integral* propelling charge have one basic designation for the complete round, which is the term "cartridge" or the older terminology of "pro-

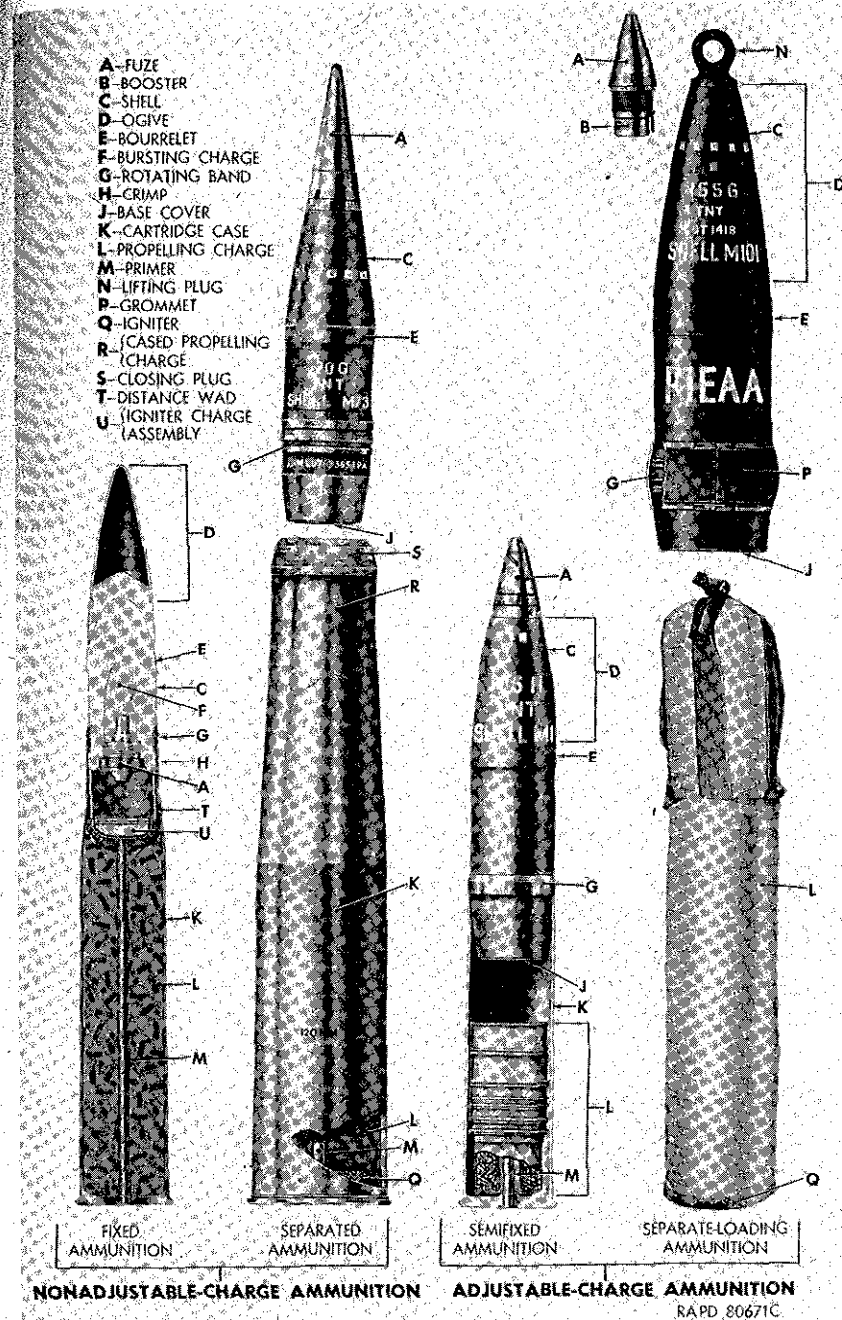


Figure 76. Types of complete rounds of artillery ammunition.

jectile," "shell," or "shot" and the qualifying adjective of "fixed" or "semifixed." Rounds of artillery ammunition that are composed of a projectile and a *separate* propelling charge have a basic designation for the projectile of "projectile," "shell," or "shot" and the basic designation for the propelling charge of "propelling charge." Such rounds are classified as "separated" or "separate-loading" ammunition. Types of complete rounds are shown in figure 76.

b. Identification. Artillery ammunition is identified by color and marking (figs. 4-9). The marking on the ammunition or container, as appropriate, includes: ammunition identification code (AIC) symbol; caliber and type of weapon in which fired (e. g., 75H, 155G, etc.); type and model of projectile (e. g., SHELL, M335, etc.); kind of shell filler (e. g., COMP B, etc.); weight zone markings (crosses or squares); ammunition lot number and loader's symbol; functional marking (e. g., flashless), etc.); range characteristics (e. g., NORMAL, etc.); and any other appropriate information (pars. 4-13). For detailed information on artillery ammunition, see TM 9-1901. For identification of inert ammunition and ammunition components, see paragraph 10.

72. Classification

a. Artillery ammunition is classified according to use as service, target-practice, training, blank, dummy, or test.

b. It is classified according to type as fixed, semifixed, separated, or separate-loading.

c. It is classified according to kind of filler as high-explosive, target-prac-

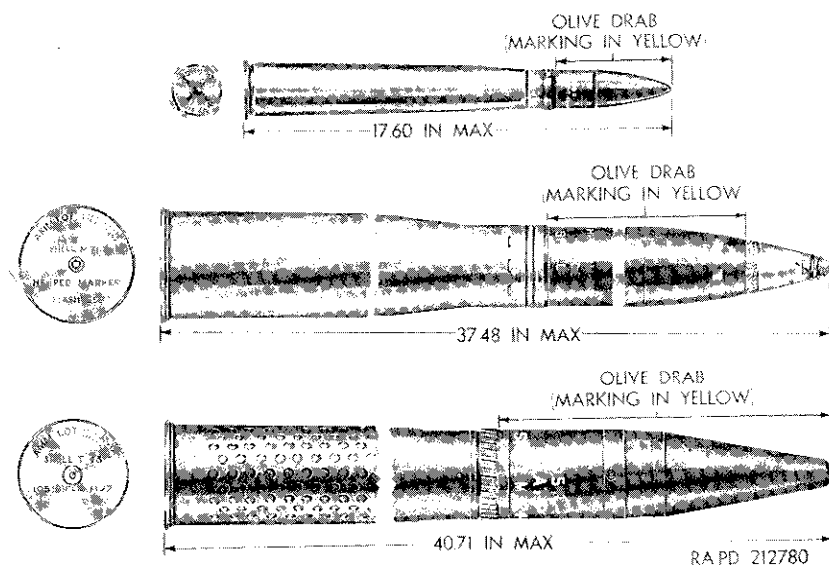


Figure 77. Types of fixed ammunition.

tice (black powder spotting charge), illuminating, chemical (smoke or gas), nuclear, biological, leaflet, or inert.

d. For other classifications of ammunition in general, see paragraph 5.

73. Types

Artillery ammunition is designed in several types for most efficient use in the weapon in which it is fired.

a. Fixed Ammunition. Ammunition in which the propellant is fixed (nonadjustable) is known as "fixed" ammunition (fig. 77). The propellant is loose (or in a cloth bag or held packed by distance wadding) in a metal cartridge case that is rigidly crimped to the projectile. A primer is assembled into the base of the cartridge case. An item of fixed ammunition is loaded into the weapon in which it is fired in one operation. Fixed ammunition is generally used in guns and rifles (recoilless-type). In ammunition for recoilless weapons, the cartridge case is perforated to permit the escape of propellant gases into the chamber and out of nozzles in the breech in order to counteract weapon recoil. This ammunition may be issued fuzed or unfuzed.

b. Semifixed Ammunition. This type of ammunition (fig. 78) is characterized by the adjustability of the propelling charge. The cartridge case

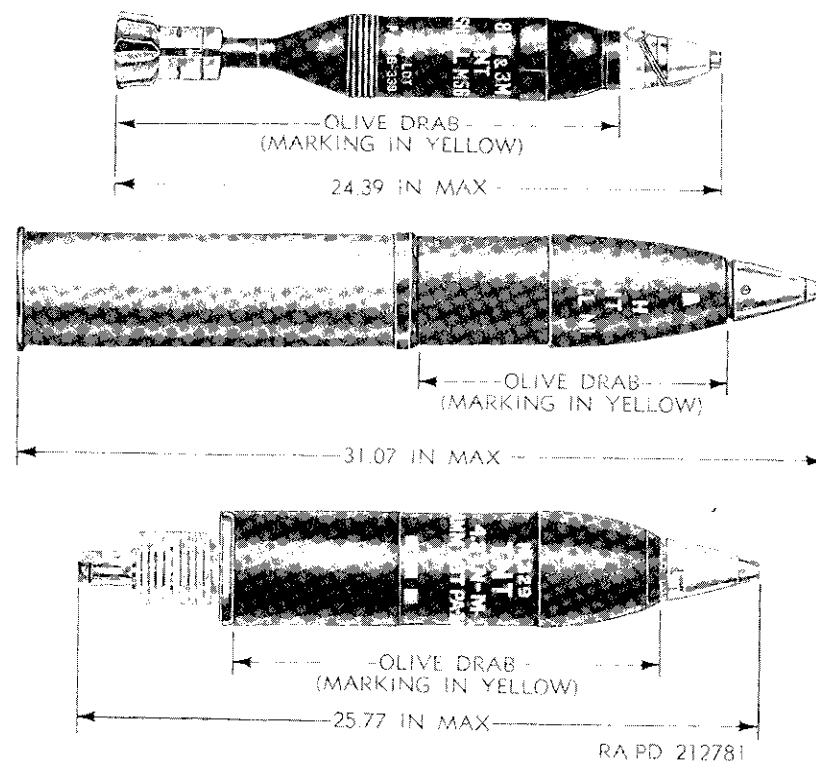


Figure 78. Types of semifixed ammunition.

d. Separate-Loading Ammunition. Ammunition consisting of separate components (projectile, propelling charge, and primer), which are loaded separately into the weapon in which they are fired, is known as separate-loading ammunition (fig. 80). Separate-loading ammunition is generally designed for use in large caliber guns and howitzers. The large caliber HE-filled projectiles are generally shipped with nose plugs, which are replaced in the field with the desired type fuzes.

A complete round of service artillery ammunition comprises all of the ammunition components used in firing a weapon once and to cause the projectile to function at a desired time and place. The components are the projectile, the propelling charge, the primer, the fuze, and the cartridge case (except w/separate loading ammunition) and are defined in paragraphs 75 through 79. Complete rounds of the several types are shown in figure 76.

a. *General.* With a few exceptions, artillery projectiles are of the same general shape, i. e., a cylindrical body, solid or hollow, and an ogival head (or windshield). (Canisters have blunt heads.) Types of projectiles which vary in length from 2 to 6 calibers are shown in figures 81 through 84. The principal characteristic differences are described in (1) through (7) below.

- (1) Location of fuzes—point or base.
- (2) Radius of ogive—smaller for low-velocity, larger for high-velocity projectiles and larger with increased length of ogival section.

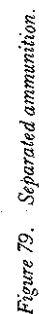


Figure 79. Separated ammunition.

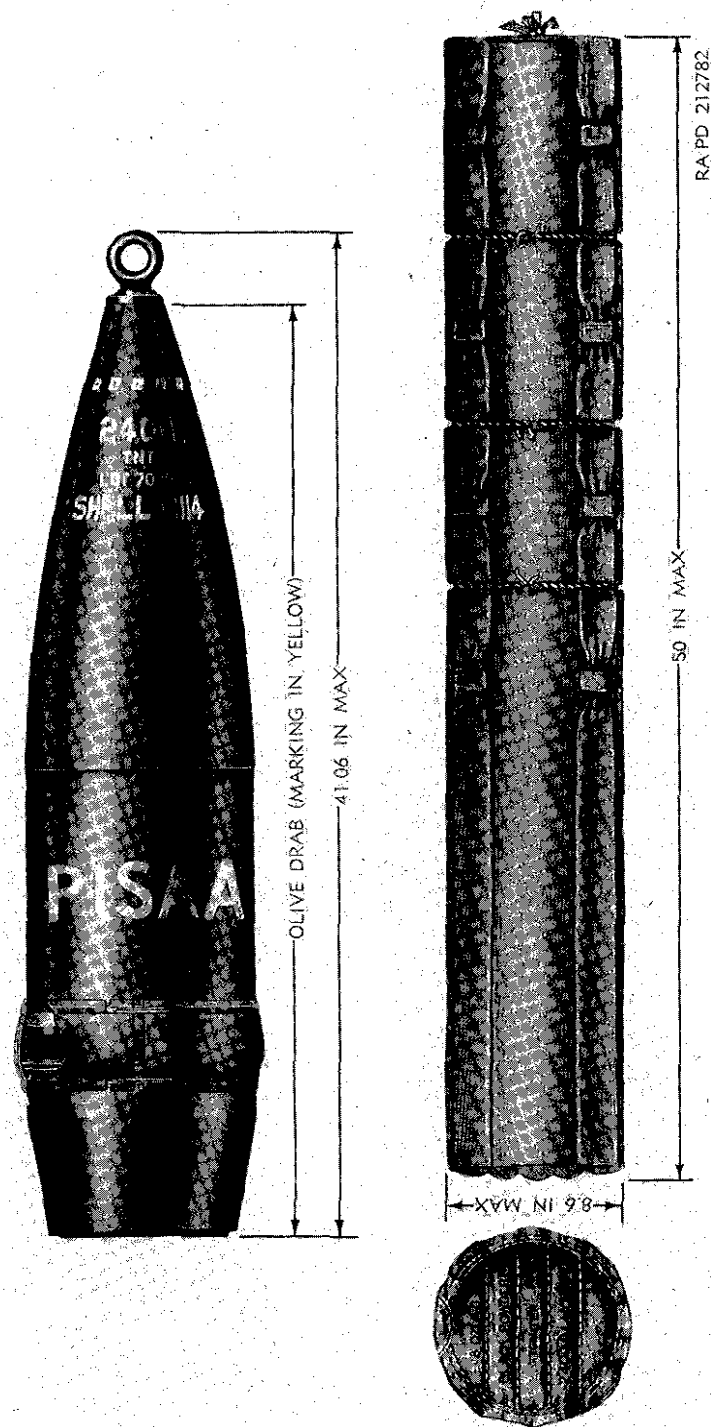


Figure 80. Separate-loading ammunition.

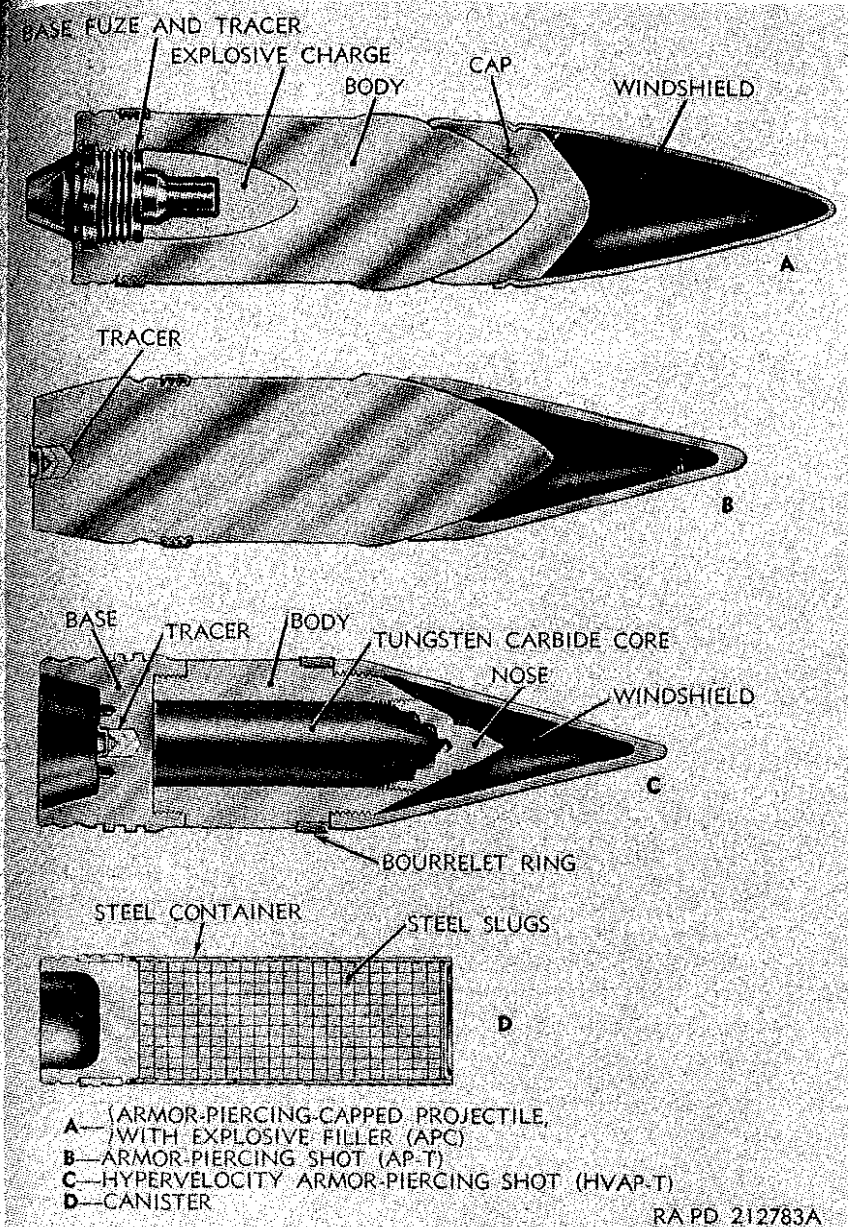


Figure 81. Typical armor-piercing and canister projectiles.

- (3) Rotating band—narrow for low-velocity, wide for high-velocity projectiles.
- (4) Base—tapered ("boat-tailed"), cylindrical ("square") base, hemispherical, or finned.

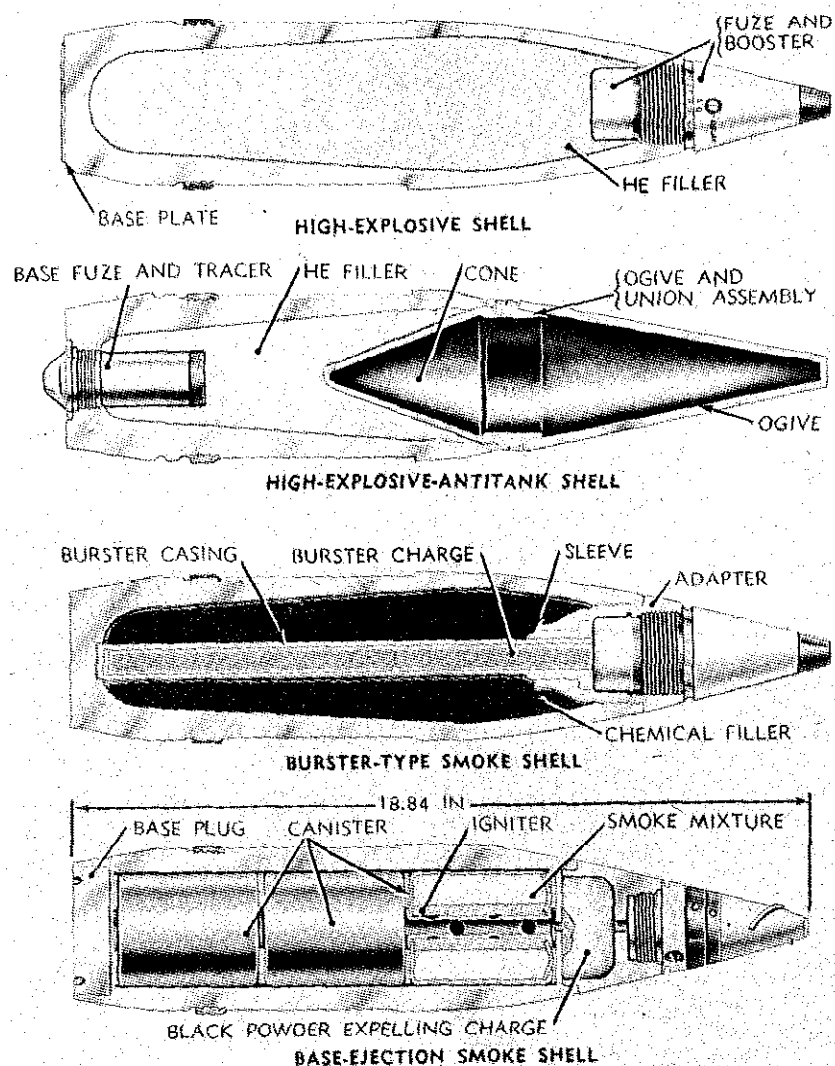


Figure 82. Typical high-explosive, high-explosive antitank, and chemical projectiles.

- (5) Armor-piercing cap—used only with certain armor-piercing projectiles.
- (6) Windshield (ballistic cap or false ogive)—when required for the purpose of incorporating adequate ballistic properties into design.
- (7) Filler—high explosive, gas, smoke, illuminant candle and parachute assembly, or others.

b. Elements.

- (1) *Ogive and windshield.* The forward portion of the projectile from

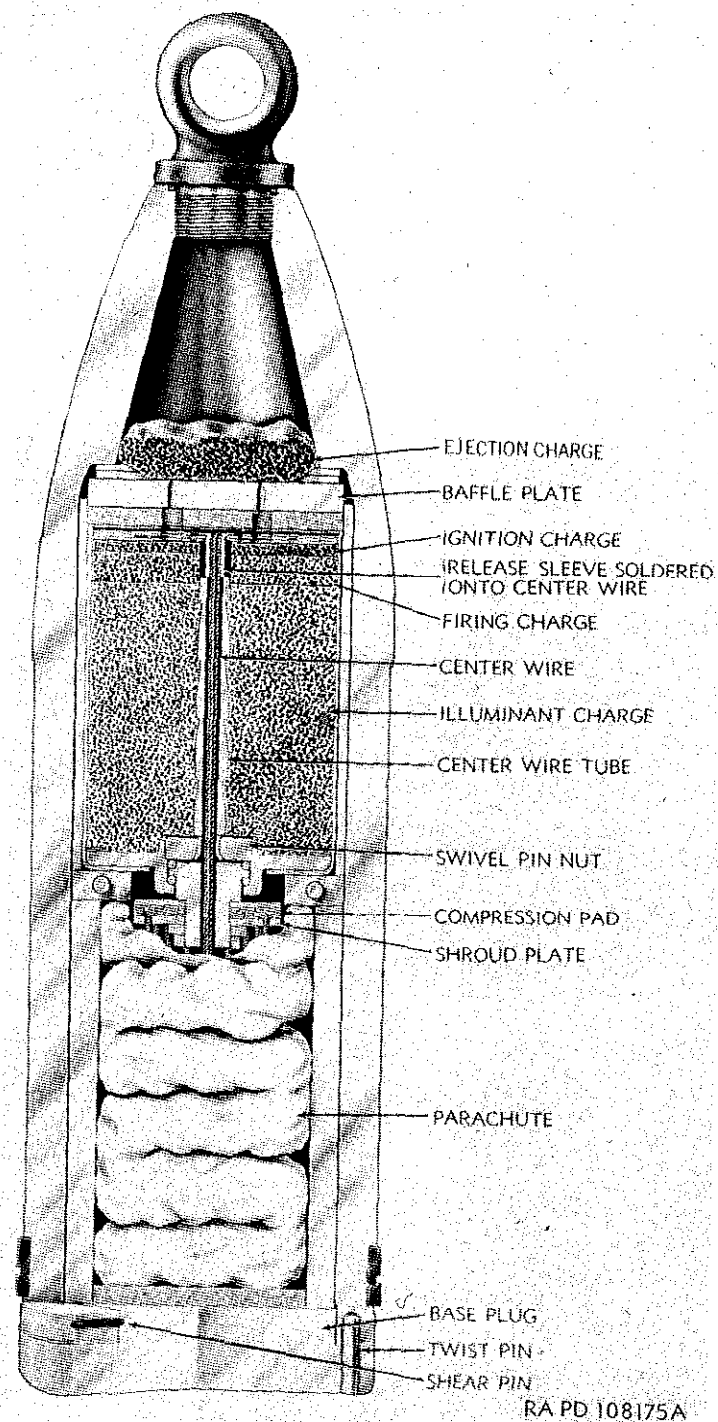


Figure 83. Illuminating projectile (for 155-mm gun or howitzer).

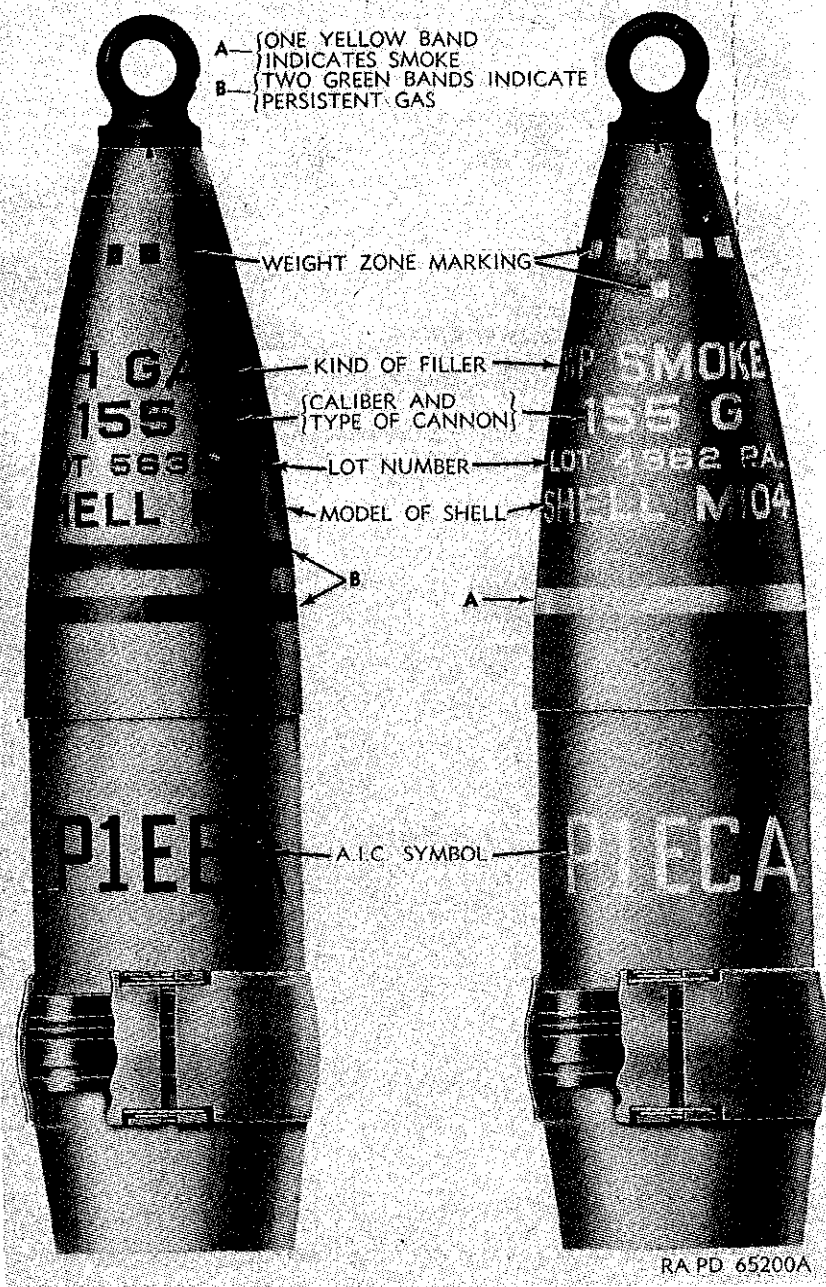


Figure 84. Chemical projectile.

the bourrelet to the point is called the ogive. The length of the ogive influences the flight of the projectile. The generated radius of the ogive has generally varied from 6 to 11 calibers. Shell of recent design, however, have long ogives of radii that exceed these values appreciably. Since armor-piercing projectiles have a short radius of ogive for purposes of penetration, a windshield is placed over the armor-piercing head to impart adequate ballistic qualities to the projectile.

- (2) *Bourrelet.* The bourrelet is the accurately machine surface that bears on the rifling lands of the weapon. It centers the front end of the projectile in its travel through the bore. Generally, the bourrelet is located at the forward end of the projectile, immediately in rear of the ogive. Some projectiles of large caliber have a front and rear bourrelet.
- (3) *Body.* While generally applicable to the entire projectile, the term "body" is used to designate the cylindrical portion of the projectile between the bourrelet and the rotating band. It is generally machined to a smaller diameter than the bourrelet to reduce the surface in contact with the lands of the bore. Only the bourrelet and rotating band bear on the lands.
- (4) *Rotating band.* The rotating band is a cylindrical ring of comparatively soft metal, or similar substance or of steel pressed into a knurled or roughened groove near the base of the projectile (or attached to the base of the projectile as in the 4.2-inch mortar). It affords a closure for the projectile in the forcing cone of the weapon in separate-loading projectiles and centers the rear end of the projectile in the bore of the weapon. In fixed ammunition the rotating band may not seat in the forcing cone until the instant of initial movement upon firing. As the projectile moves forward, the rotating band is engraved by the lands of the bore. Metal displaced during the engraving process flows into annular relief grooves or "cannelures" cut in the rotating band. In the case of 4.2-inch mortar shell, the rotating band is bell-shaped and is expanded into the grooves of the mortar rifling by the pressure of the propellant gases upon a pressure plate. Since the rifling of the weapon is helical, engagement with the band imparts rotation to the moving projectile. The rotating band also provides obturation, that is, prevents the escape of the propellant gases forward of the projectile by completely filling the grooves of the rifling. In the case of recoilless rifle projectiles, the rotating band is preengraved. Some projectiles may be provided with a double band.
- (5) *Type of base.* When the surface to the rear of the rotating band is tapered or conical, it is known as "boat-tailed"; when cylindrical, the projectile is described as having a "square base." Nonrotating mortar shell have fins at the rear for stabilization

of the projectile.

(6) *Base plug.* To facilitate manufacture, some armor-piercing projectiles are closed at the base with a steel plug. In the larger AP shot, the base plug also provides a seat for the fuze. In the smaller calibers, if an explosive charge is loaded in the cavity of the AP shot, the base plug is replaced by a base detonating fuze. In certain types of projectiles, the base plug may contain the tracer element.

(7) *Base cover.* Each high-explosive shell is provided with a base cover to prevent the hot gases of the propelling charge from coming into contact with the explosive filler of the projectile through joints or possible flaws in the metal of the base. The base cover consists of a thin metal disk, which may be caulked, crimped, or welded to the base of the shell. Projectiles with high-explosive filler and base detonating fuzes are not ordinarily provided with base covers, but have caulking or sealing rings.

(8) *Tracer.* For observation of fire, some projectiles are equipped with a tracer element in the base of the projectile. In most smaller-caliber antiaircraft shell, the tracer is used to ignite the filler and destroy the shell should it miss the target. Such a tracer is called "shell-destroying (SD)."

c. *Types of Projectiles.*

(1) *High-explosive (HE) shell.* This type of projectile (fig. 82), usually made of forged or cold extruded steel, has comparatively thin walls and a large bursting charge of high explosive. It is used against personnel and material targets, producing blast or mining effect and fragmentation at the target. It may be fitted with either a time or impact fuze, a concrete-piercing fuze, or an influence (proximity or VT) fuze according to type of action desired.

(2) *High-explosive-antitank (HE, AT) shell.* This is a high-explosive shaped-charge shell (fig. 82) for use against armor plate. Its effect is dependent upon the shape of the charge. It has a conical windshield that provides standoff for the charge as well as ballistic characteristics for the projectile. The round is fitted with a base-detonating fuze having nondelay action.

(3) *Chemical shell.* The two functional types of chemical shell are burster and base-ejection (BE) (fig. 82).

(a) *Burster.* The burster type (fig. 82) is similar to high-explosive shell except for the type of filler, which consists of a chemical such as gas or smoke. An explosive charge, termed a burster charge, located centrally in the shell, is used to rupture the shell body and aid in dispersion of the chemical filler. As the filler is not explosive, a base cover is not used.

(b) *Base ejection (BE).* Base-ejection shells (fig. 82) that are set to function in flight do not have a burster, but have an expelling

charge of black powder, adjacent to the time fuze. This expelling charge, when ignited by the fuze, ignites the smoke mixture of the canisters, strips the threads of the base plug, and forces the canisters from the base of the shell.

Note. The canister in this type of shell is a container for smoke mixture and should not be confused with the canister that is a fixed round projectile and contains steel slugs (cylinders) ((7) below).

(4) *Illuminating shell.* These shell contain a parachute and an illuminant assembly that are ejected by an expelling charge adjacent to the time fuze in a manner similar to base-ejection smoke shell. The illuminant suspended by the parachute burns, lighting up a target area. Illuminating shell are fired from 105-mm howitzers, 155-mm guns and howitzers, and from all mortars. An example, the 155-mm illuminating shell is shown in figure 83.

(5) *Armor-piercing projectiles.*

(a) The term "armor-piercing-capped" (APC) (fig. 81) refers to a shot or a projectile with an armor-piercing cap for use especially in penetrating face-hardened armor plate. The cap is of forged alloy steel, heat-treated to have a hard face and a relatively soft core. On impact, the hardened face of the cap destroys the hardened surface of the armor-plate, while the softer core of the cap protects the hardened point of the projectile by distributing the impact stresses over a large percentage of the area of the head. A tracer may be present in the base plug or in the base end of the fuze.

(b) Armor-piercing (AP) shot (fig. 81) are made of heat-treated high-carbon alloy steel. The head is hardened steel for penetration of armor and the body is tough to withstand the strains imposed by impact and the twisting action of the projectile at high angles of obliquity. A windshield is generally secured to the head of the shot to insure adequate ballistics.

A tracer will be present in the base end of the shot.

(6) *Hypervelocity (velocities above 3,500 fps) armor-piercing shot (HVAP).* This shot is a lightweight projectile (fig. 81) having an armor-piercing core of tungsten carbide. The tungsten carbide core, a steel base containing a tracer element, an aluminum body and nose plug, and an aluminum windshield comprise the HVAP-T shot.

(7) *Canister.* The canister projectile, which consists of a light metal case filled with steel slugs (cylinders) contains no high explosives (fig. 81). Early design canisters contain steel balls instead of slugs. It is fired pointblank at short ranges (up to 600 ft. for larger caliber canisters) for effect against personnel. The case breaks upon leaving the muzzle of the weapon, and the balls or slugs scatter in the manner of shot from a shotgun shell.

- (8) *Leaflet*. These shell are essentially base-ejection shell fitted with a means of dispersing literature from the shell. Identifying colors on packages containing these shell consist of a red band centered in a wider white band.

76. Cartridge Case

A cartridge case (figs. 77 and 78), made of drawn brass or steel of spiral wrapped multipieced or drawn construction, serves as the container for the propelling charge in rounds of fixed, semifixed, and "separated" artillery ammunition. Its profile and size conform to that of the chamber of the weapon in which the round is fired, except for recoilless rifles. The "head" of the case is designed relatively heavy, in order to provide for firm attachment of a primer, and has a flange or groove to permit mechanical extraction. Rounds used in automatic guns have cartridge cases with an extracting groove instead of a flange or rim. The cartridge case, with its attached primer, contains the propellant charge. In nonadjustable (fixed) propellant charge rounds, the case is crimped to the projectile. In adjustable (semifixed) propellant charge rounds, the case is a free fit to the projectile. In "separated" ammunition, the case is plugged and separate from the projectile (w/which it comprises a round). Having a nonadjustable propellant charge, "separated" ammunition may be considered a special type of "fixed" ammunition. Both fixed and semifixed rounds are designed to be loaded into the weapon in which they are fired in *one* operation. Separated rounds (propelling charge and projectile) are also loaded into a weapon in *one* operation. Cartridge cases consist of special compositions of brass or steel, especially processed, in order that they may adequately fulfill (in recoil-type weapons) the functioning of obturation, that is, expansion against the chamber wall under the pressure of burning propellant gases to prevent the escape of these gases from the rear of the weapon. The cartridge case in recoilless-type weapons is perforated in a manner to allow sufficient propellant gases to escape into the weapon chamber and out of the breechblock to the atmosphere to counteract weapon recoil. The interior of recoilless-type cartridge cases contains a lever that serves to cover the perforations in the case, thereby preventing the entrance of moisture and leakage of the propelling charge grains. Liners are made of various materials such as paper, rayon, plastic, etc.

77. Propelling Charges

a. General.

- (1) *Description*. Propelling charges consist of the propellant and igniter or primer, and a container (cartridge bag for separate-loading and semifixed ammunition and cartridge case for separated and semifixed ammunition). The propellant itself is carefully designed for the particular role of the ammunition, in-

cluding such factors as chemical composition, grain size, and of course, charge weight.

- (2) *Propellant*. Propellants are described in paragraphs 14 through 21.
- (3) *Igniter charge*. In fixed and semifixed rounds, the igniter charge (black powder) is present in the artillery primer (fig. 76). In "separated" ammunition, an auxiliary igniter charge is placed around the primer (fig. 76) or on the distance wadding to insure proper ignition of the propellant. In separate-loading rounds, the igniter charge (fig. 85) is in an igniter bag sewed to the base end of the propelling charge and, in some designs, also forms a core running through the center of the propelling charge bag. Cartridge-igniter pads are made of tightly woven silk to prevent the black powder from sifting through. Cloth used for the igniter charge is dyed red to indicate the presence of the black powder igniter. Pads of early manufacture (undyed) are marked IGNITER.
- (4) *Types of propelling charge*. The type of propelling charge depends upon the type and size of complete round, that is: fixed, semifixed, separated, or separate-loading.

b. Fixed and Semifixed Charges.

- (1) *Propelling charge in fixed ammunition*. The propelling charge in a round of fixed ammunition is loose (or in a polyethylene bag) in the cartridge case (fig. 76). In some instances where the charge does not fill the case completely, a spacer or distance wadding, usually a cardboard disk and cylinder, is inserted in the neck of the cartridge case, between the charge and the base of the projectile.
- (2) *Propelling charge in semifixed ammunition*. In semifixed gun or howitzer ammunition, the charge, which is divided into parts or increments for zone firing, is in several cloth bags (fig. 76). The full charge, with all increments in proper order, is in the cartridge case, which is a free-fit-over the rear end of the projectile. Each part of the charge is numbered, the base charge being numbered 1. Thus, for example, to arrange a propelling charge in proper order for firing charge 4, the increments would be arranged in the order 1, 2, 3, and 4, increment 4 being placed uppermost. The charge for 105-mm howitzer ammunition is termed "dualgran" charge. It consists of a charge in which a quick-burning propellant of single-perforated grains is used in charges 1 and 2 and a slowburning propellant of multiperforated grains in charges 3, 4, 5, 6, and 7. This charge is used with a long primer (no charge-retaining spring required) and incorporates a lead foil in charge 5 as a decoppering agent. The increments are of the flat-bag type and they are folded around the primer. Less muzzle flash than

with the older-type charge, improved uniformity of performance, and greater accuracy are obtained with the dualgran charge. Mortar propelling charges, being adjustable, are of the semifixed type. Mortar charges are composed of increments, which consist of thin sheets of propellant arranged to be fitted around the stabilizing fins or to the cartridge container or "boom" at the base of a shell.

c. *"Separated" Ammunition Propelling Charge.* This propelling charge is contained in a brass or steel cartridge case, together with the primer (fig. 76). The charge consists of propellant that is loose in a cartridge case, which is closed by a plastic or asphalt composition plug.

d. *Separate-Loading Charges.*

(1) *Cartridge bags.* Cartridge bags form a suitable and convenient means of containing the propellant in separate-loading ammunition. Acrylic cotton cloth is used as material for cartridge bags. Silk was formerly used.

(2) *Multisection charges.* Multisection charges permit the guncrew to vary the size of the propelling charge and facilitate handling the larger and heavier charges. Multisection charges are subdivided into "base and increment" and "unequal section" types.

(a) *Base and increment.* This type of propelling charge (figs. 76 and 85) consists of a base section or charge and one or more increments. The increments may be of equal or unequal weight. Whereas the base section is always fired, the increments may or may not be fired. With some types, one igniter pad is attached to the base end of the base section only, while

other types have a core-type igniter in the base section and sometimes in one or more increments as well.

(b) *Unequal section.* In the case of certain howitzers, the charge is made up in unequal sections. In the case of guns, the charge may be made up of several equal sections and two or more unequal sections. This type permits firings at reduced velocities and provides the maximum flexibility.

(3) *Color.* In connection with certain howitzers, two base and increment charges are provided, one for inner, the other for outer zones of fire. The cloth of the bags for the inner zones is dyed green to distinguish that charge from the other type, which is in undyed (white) bags. Accordingly, these two types of charges are called "green bag" and "white bag" charges.

(4) *Flash reducers.* Optional flash reducers are cloth packets filled with flash-reducing slats that can be applied to separate-loading propelling charges, specifically for elimination of flash in night firings. The use of these flash reducers increases the amount of smoke and therefore they are not generally favored for daytime use. Flash reducers are provided for use with the "white bag" charges only, in the 155-mm howitzer M1 or M45 and the 8-inch howitzer M1. They consist of pads suitable for inserting between the sections of the propelling charge, in accordance with instructions contained in pertinent technical manuals. No flash reducers are necessary with the "green bag" charges for these howitzers, since the fastest burning propellant is flashless without any assistance. The same precautions should be used in handling flash reducers that apply to the use of any other item containing black powder (par. 88). See TB's ORD 565 and ORD 590 for information on use.

78. Fuzes

a. *General.* An artillery fuze is a mechanical device used with a projectile to cause it to function at the time and under the circumstances desired.

b. *Classification.*

(1) Artillery fuzes are classified according to their position on the projectile as base-detonating (BD) (fig. 86), point-initiating base-detonating (PIBD) (fig. 87), and point-detonating (PD). Base-detonating fuzes are used with some types of armor-piercing projectiles and a few types of high-explosive projectiles. Artillery fuzes are classified according to their method of functioning as *impact*, *time*, or *proximity*, or a combination of these. Impact fuzes are classified, according to type of action, as *superquick*, *delay*, or *nondelay*. The nondelay type, which actually has a measurable, but very slight delay, is used as a base fuze and represents the fastest action possible for the inertia-type

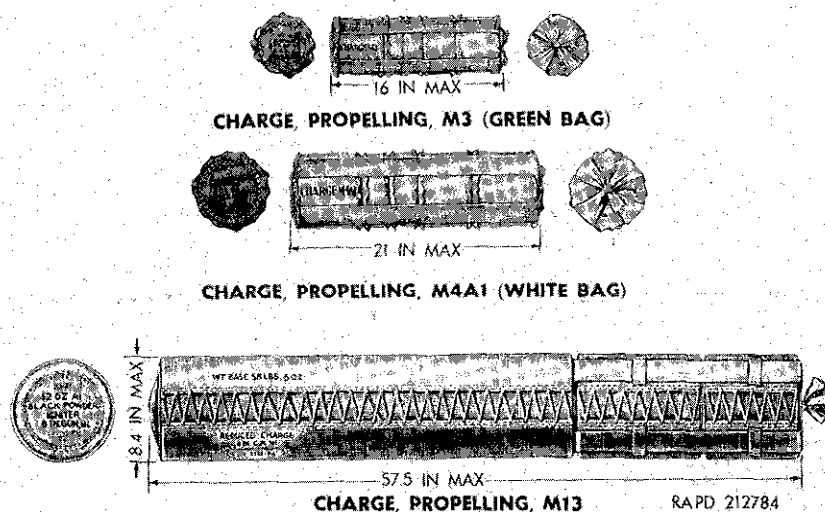


Figure 85. Separate-loading propelling charges.

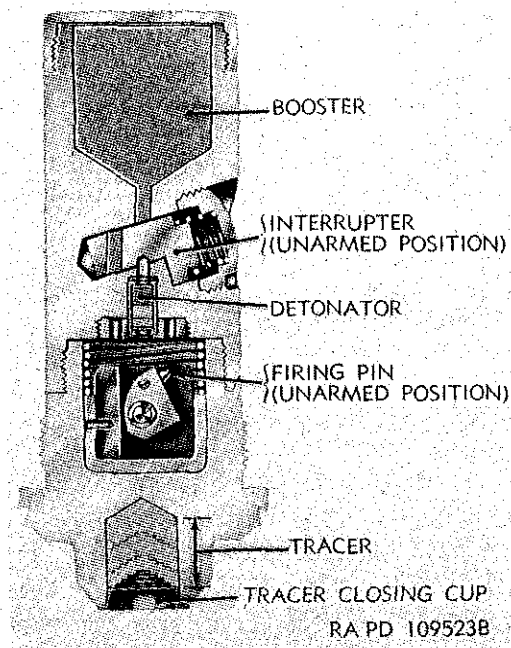


Figure 86. Base-detonating (BD) fuze M91A1.

fuze. On delay fuzes, the time of delay is usually 0.05 or 0.025 second, which refers to the delay action at the instant of impact, whereas on time fuzes, the "time" refers to the length of time from the instant of firing of the weapon to the instant of functioning of the fuze. There are two types of time fuzes. One type makes use of compressed black powder rings that burn for a predetermined length of time and then initiates the high-explosive element of the fuze. The other type incorporates a clocklike mechanism that, through a gear train and escapement, trips a firing pin at a predetermined time, thus causing the fuze to function.

- (2) Selective-type fuzes have time action or more than one type of action, for example, superquick and delay (SQ-DEL) and mechanical time and superquick (MTSQ) (fig. 88). Such fuzes can be adjusted in the field for the type of action desired. Time fuzes can be set ("cut") to function at any desired time of flight after firing (up to the limit of the graduated time scale) by turning a time ring on which the scale is engraved. All MT fuzes should be set in the direction of increasing time of flight, i. e., the setting indicating line should in all cases travel from the minimum reading on the scale toward the maximum reading.

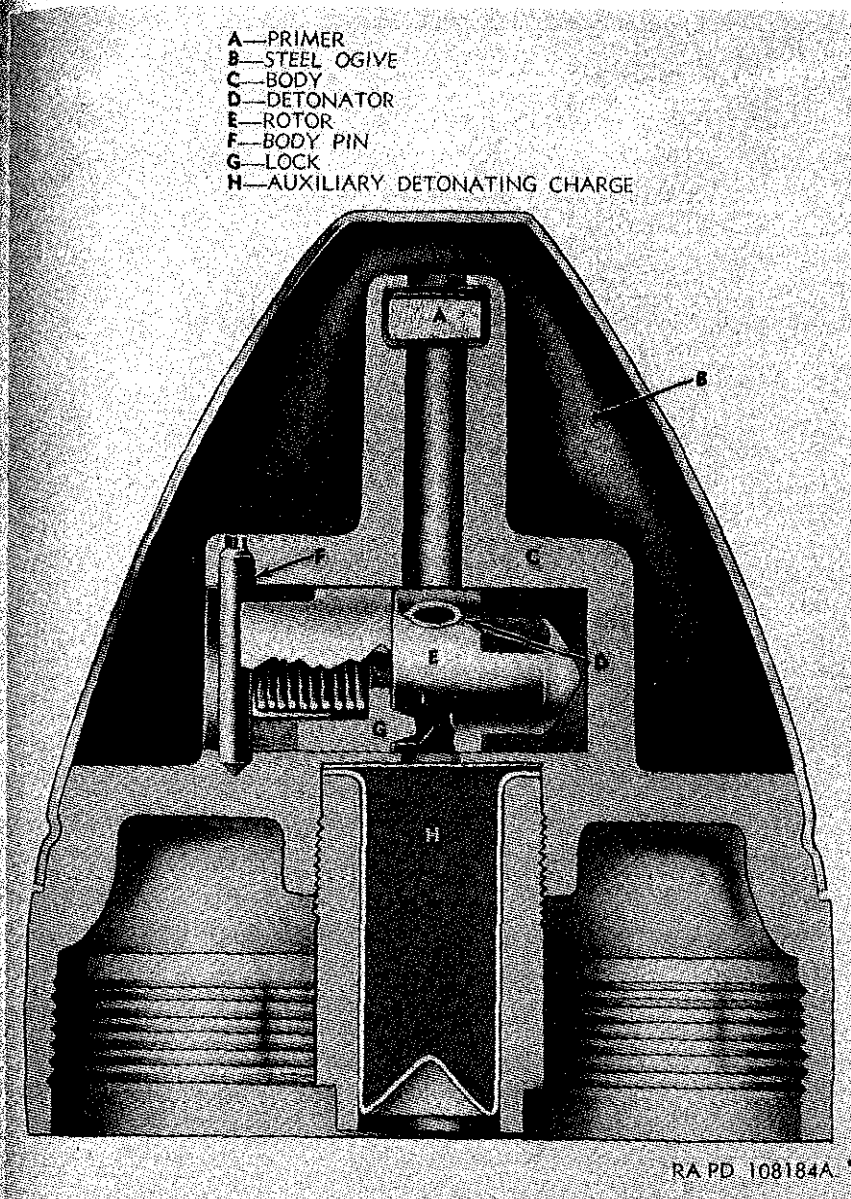


Figure 87. Point-initiating base-detonating (PIBD) fuze M90A1, for 57-mm rifle shell.

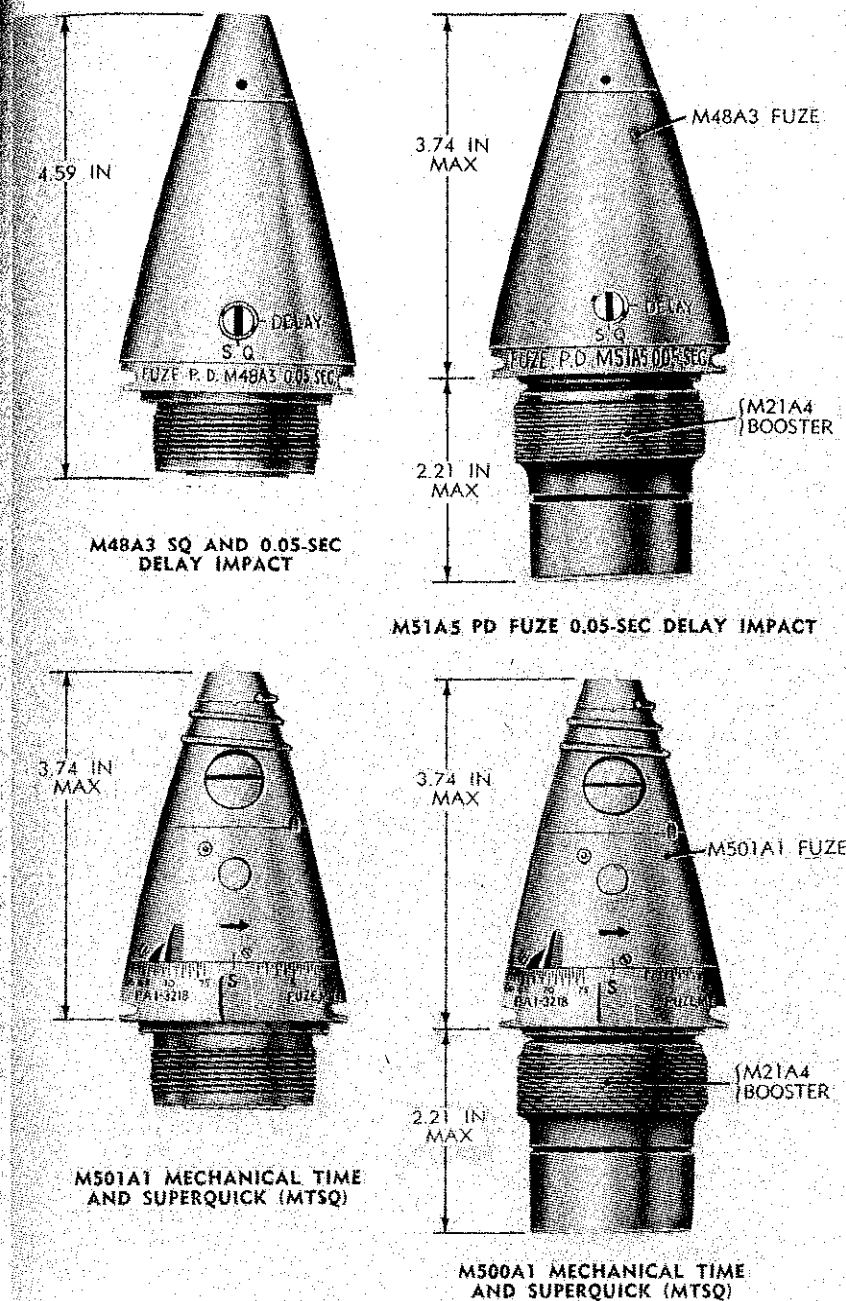
- (3) The "proximity fuze" (VT) is essentially a combination transmitter and receiver. A short time after the projectile leaves the muzzle of the weapon, the fuze becomes armed and begins sending out continuous waves. As the projectile approaches an object, the waves are reflected back to the fuze and picked up by a receiving unit in the fuze. The interaction of the out-

going and incoming waves results in beats. When the beats reach a predetermined intensity an electronic switch is tripped and an electric charge is permitted to flow through an electric firing squib. VT fuzes can be used only in deep cavity shell without the supplementary bursting charge; when "standard contour" fuzes (PD, MTSQ, TSQ, and CP) are used in deep cavity shell, the supplementary bursting charge must be used (fig. 89). Newer-type proximity fuzes are designed for "bracket arming" for anti-aircraft artillery use and "adjustable delay arming" for field artillery use. Fuze, VT, M515 (fig. 90) is of the "bracket arming" type. This fuze has a time ring that must be set to the predicted time-to-target. When fired, the VT element of the fuze becomes armed at a short time pre-target and functions on proximity approach to the target. In the event the fuze does not come within the influence range of a suitable target, the fuze will cause self-destruction of the shell at a time slightly greater than the set time. The fuze also contains an impact element that will function the shell if impact with a resistant object occurs at any time after arming of the impact element, but before arming and functioning of the fuze by the proximity element. Fuze, VT, M514 (fig. 90) is of the "adjustable delay arming" type. This fuze has a graduated time scale that must be set to correspond with the predicted time-to-target. The fuze becomes armed a short time pre-target and functions the shell on proximity approach to the target. This fuze also contains a superquick impact element that will detonate, on impact, any shell that fails to function normally on proximity approach to the target.

- (4) The long-point-type mechanical time fuze, which is used with 120-mm shell, is shown in figure 91.
- (5) The concrete-piercing fuze (fig. 92) is a special point-detonating impact type used against highly resistant targets.
- (6) Many point fuzes are interchangeable because of the "standard contour" and equal weights, hence a variety of uses may be obtained from any one of several types of projectile. See TM 9-1901 for fuze interchangeability chart.

c. Safety Features.

- (1) Artillery fuzes contain safety devices that tend to prevent functioning until after the fuze has been subjected to centrifugal and setback forces, which take place after the round is fired.
- (2) Certain fuzes are said to be "boresafe." A boresafe (detonator-safe) fuze is one in which the path of the explosive train is interrupted so that, while the projectile is still in the bore of the gun, premature explosion of the shell is prevented if any of the more sensitive elements, primer, detonator, or both, should



RA PD 212785

Figure 88. Point-detonating impact superquick and delay (PD-SQ DEL) and point-detonating mechanical-time and superquick (MTSQ) fuzes.

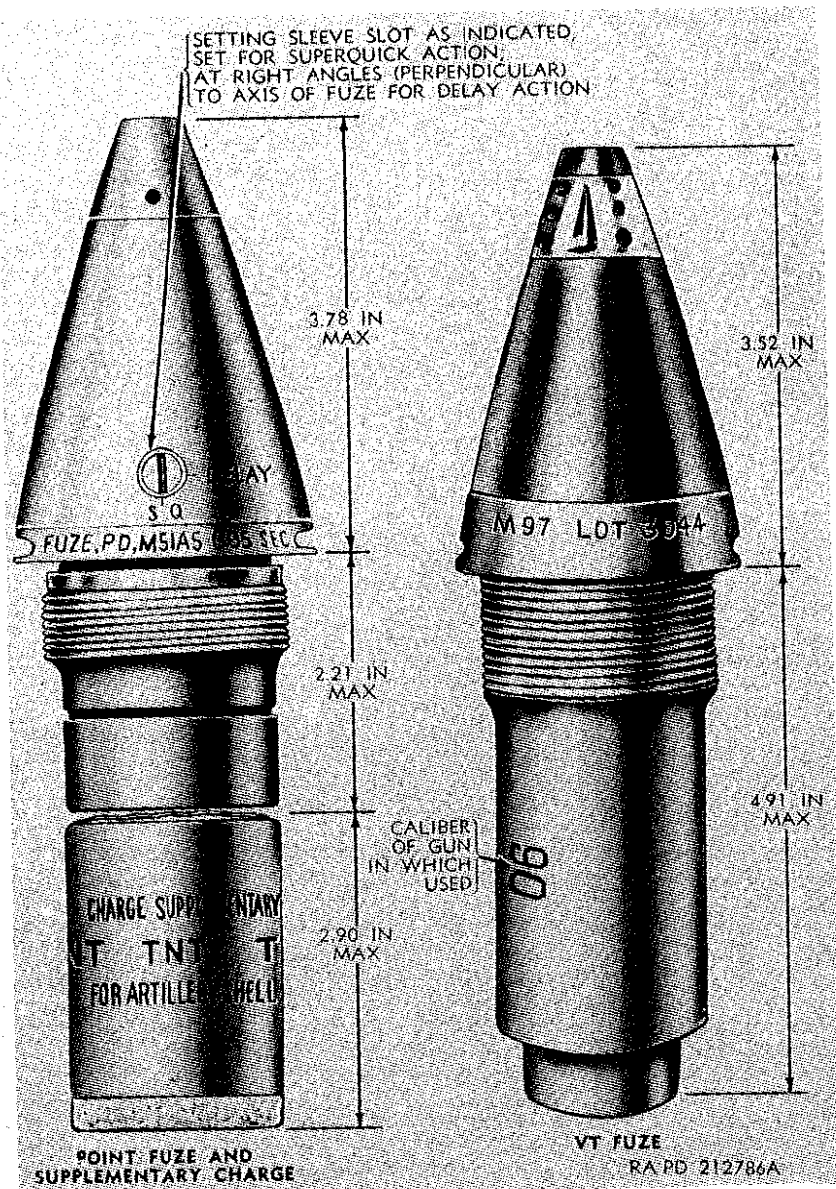


Figure 89. Point-detonating impact superquick and delay (PD-SQ DEL) and point-detonating proximity (VT) fuzes.

- function. Interruption is most generally obtained by out-of-line components or interrupter blocks or slides.
- (3) Certain internal parts of an impact fuze are in "unarmed" positions prior to firing. Upon firing and while the projectile is being rotated and accelerated, centrifugal and setback forces

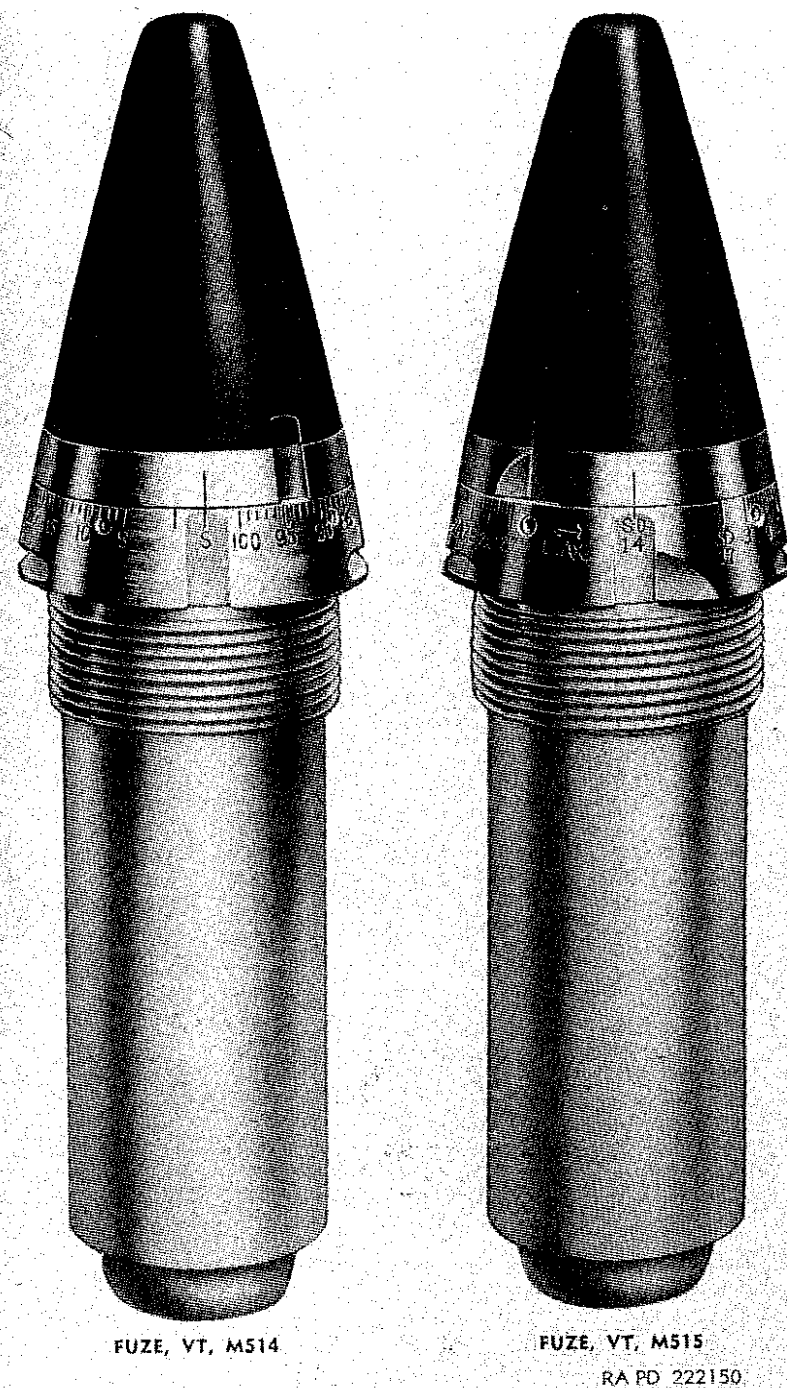


Figure 90. Bracket arming and adjustable delay arming (VT) fuzes.

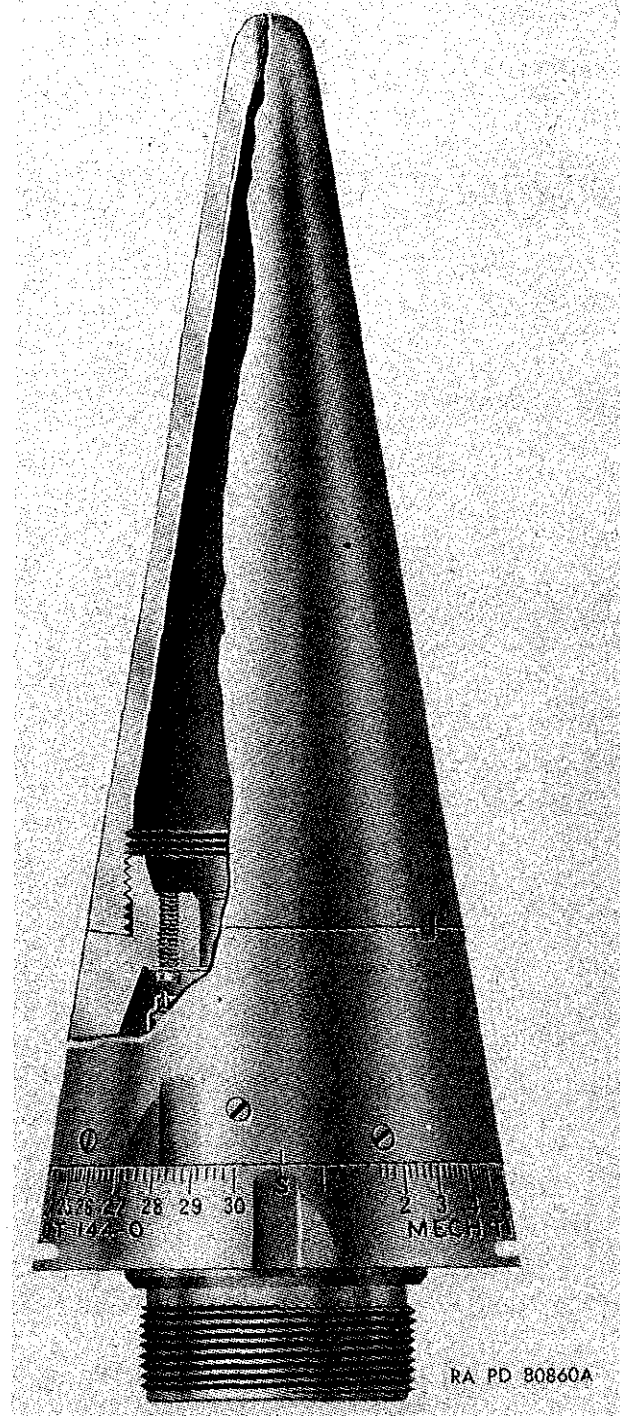


Figure 91. Point-detonating mechanical-time fuze for separated ammunition.

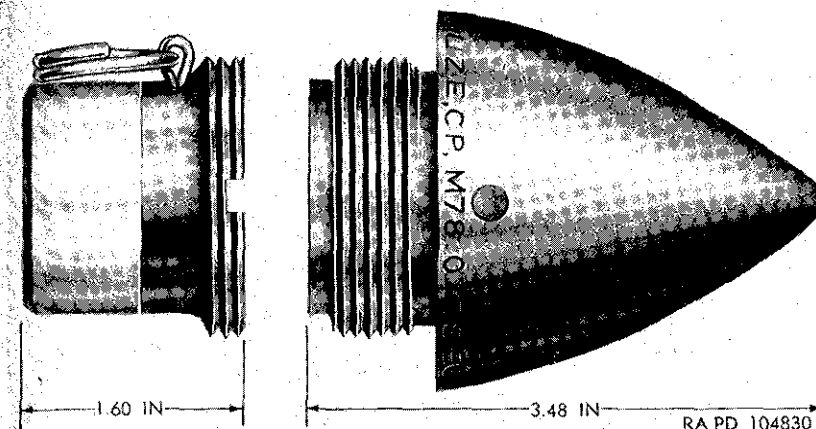


Figure 92. Concrete-piercing fuze and booster.

act upon those parts. As the projectile leaves the muzzle of the weapon, acceleration ceases and hence setback ceases. The combination of centrifugal force and setback in the bore of the weapon together with cessation of setback after the projectile has left the bore of the weapon arms the fuze. The time train of time fuzes is initiated at the instant of firing by setback. To prevent accidental arming in handling and shipping, safety devices such as a safety wire or cotter pin are used. Such safety devices must be removed before firing.

- (4) Arming of VT fuzes is delayed by a series of internal safety devices. The fuze becomes automatically armed a specified length of time after the projectile is fired.

79. Primers

a. General. A primer is the component used to initiate the low- or high-explosive train. Artillery primers consist essentially of a small quantity of sensitive explosive and a charge of black powder or propellant in the case of mortar ammunition encased in a metal tube. In fixed, semifixed, and separated ammunition, the primer is fitted to the head of the cartridge case at time of manufacture. In separate-loading ammunition, the primer is inserted by hand into the breechblock of the weapon.

b. Types. Based on the method of firing, artillery primers are classified as electric, percussion, combination percussion-electric, and ignition.

c. Electric. This type of primer is the very small type such as used in 20-mm cartridges. It is fired by the heat generated when an electric current passes through a resistance wire or conductive primer mixture embedded in a primer composition. The electric primer is distinguished by black insulation that surrounds it in the head of the cartridge case.

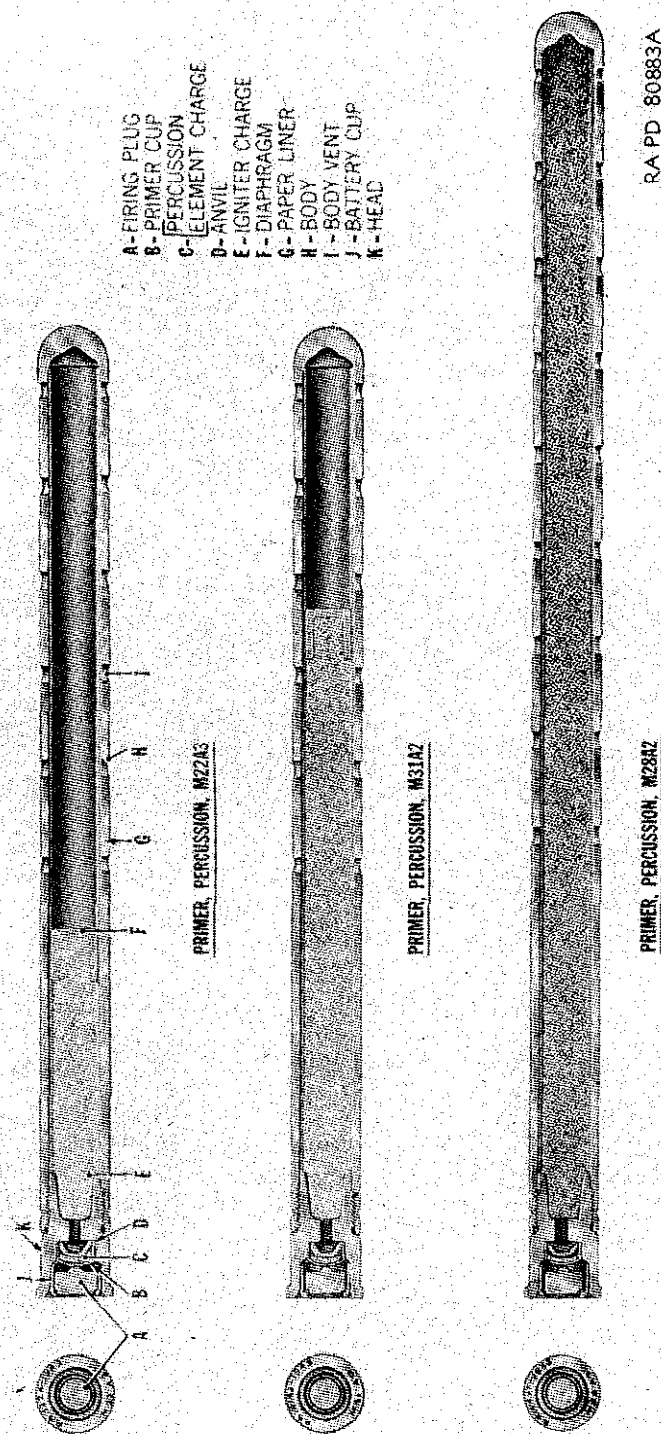


Figure 93. Typical percussion primers for fixed, semifixed, and separated ammunition.

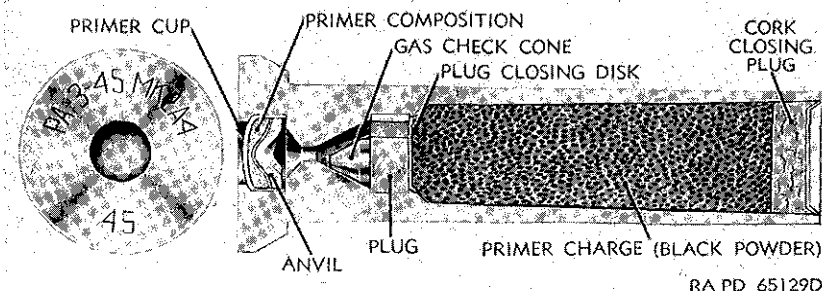


Figure 94. Percussion primer Mk 2A4—for separate-loading rounds.

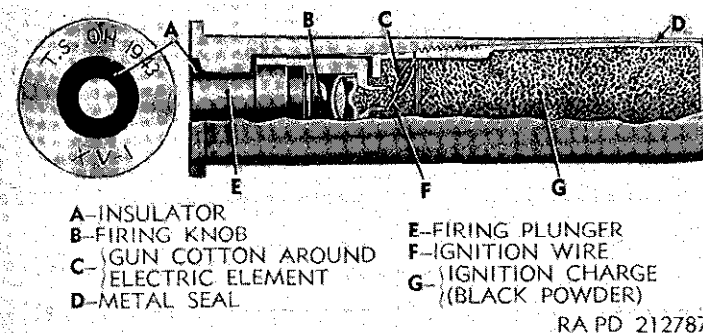


Figure 95. Combination electric and percussion primer Mk 15 mod 1—for separate-loading rounds.

d. Percussion. This type of primer, fired by a blow of the firing pin, is generally used in fixed, semifixed, and separated artillery ammunition (fig. 93). The primers used in cartridge cases contain sufficient black powder to properly ignite the propellant in the cartridge case. Those used with separate-loading propelling charges contain only enough black powder to ignite the black powder igniter charge attached to the propelling charge. The percussion primer used in separate-loading rounds is shown in figure 94.

e. Combination Electric and Percussion. This type of primer (fig. 95) is fired either electrically or by the blow of a firing pin. This primer is used with separate-loading rounds.

f. Ignition. The ignition primer, although somewhat similar to the percussion type, differs in that it contains an inert cap with a hole in it instead of a live percussion cap. It is intended for use in the 75-mm target practice round that is used in the 75-mm subcaliber gun M25, which is used as subcaliber equipment in the 155-mm gun M2. For this purpose, a service primer is fired in the 155-mm gun M2. The flame from this service primer passes through the hole in the inert cap of the ignition primer, thus igniting the black powder charge of the ignition primer.

80. Boosters

The term "booster" is applied to the explosive element in the bursting-charge explosive train that detonates the main charge. Some boosters contain mechanical centrifugally actuated safety devices to prevent premature detonation of the main charge. The booster charge on some mortar fuzes is incorporated within (integral with) the fuze itself. The booster used with fuzes for some shell are contained in a thin metal or plastic casing that is screwed to, and handled as a unit with, the fuze (fig. 88).

81. Burster Charge

An auxiliary high-explosive element in certain types of chemical shell (fig. 82), which ruptures the shell and disperses the chemical agent, is called a burster charge. It consists of a high-explosive charge, a container for the charge, and a metal head. The burster charge is contained in a burster casing in the shell. It may be used in conjunction with a "burster initiator" (75-, 76-, and 90-mm chemical shell).

82. Practice Ammunition

a. *General.* Target-practice (TP) rounds (fig. 96) of all types, fixed, semifixed, separated, and separate-loading, are used for training in marksmanship. The rounds have the same weight and contour as the service rounds they simulate. Moreover, since target-practice ammunition is actually fired at a practice target, the rounds have the same propelling charges as in the service rounds they simulate. Because target-practice ammunition has a live propelling charge and because it is used with the same efforts to achieve accuracy as with service ammunition, it must be handled with the same care and precautions. Thus, where indicated by firing table titles, the same firing data are used for firing practice rounds as are used in firing their service counterparts. Some target-practice projectiles are cast-iron while others are service projectiles loaded with sand or other inert material. Some target-practice projectiles contain a black powder spotting charge that emits a smoke puff to simulate functioning and to assist in spotting. Target-practice shell for mortar contain a black powder charge, propellant, ignition cartridge, and percussion primer. However, training shell for mortars have an inert body

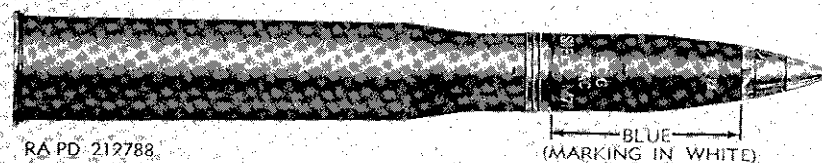


Figure 96. Target-practice shell for 90-mm guns M1, M2, and M3 series, and T8 with dummy fuze M73 or M44A2, or inert fuze of the M51 series.

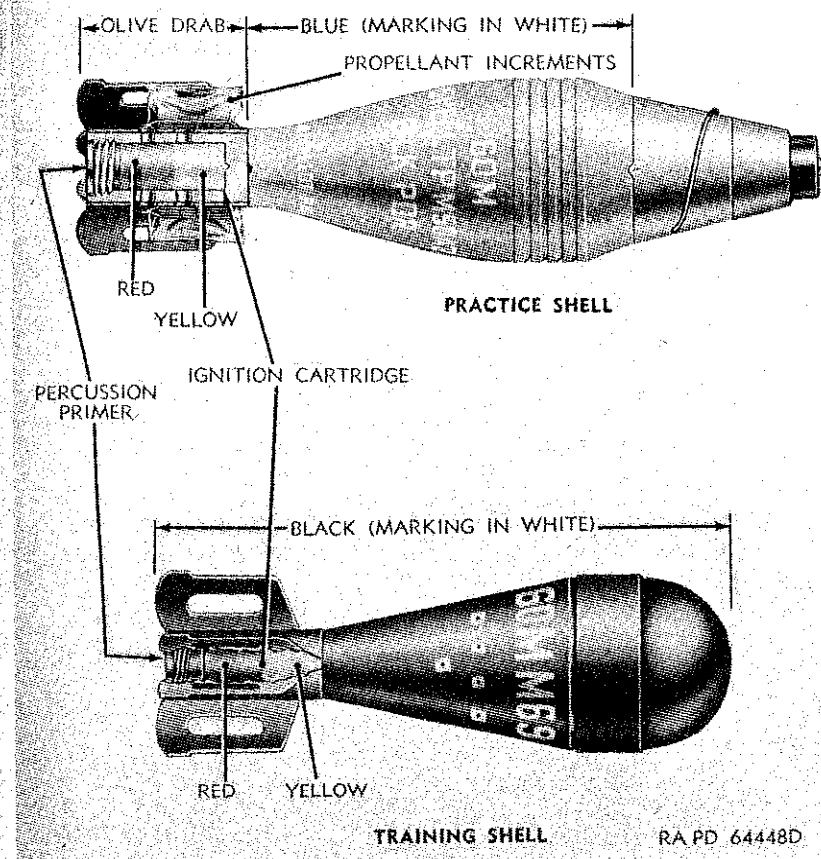


Figure 97. Typical mortar practice and training shell.

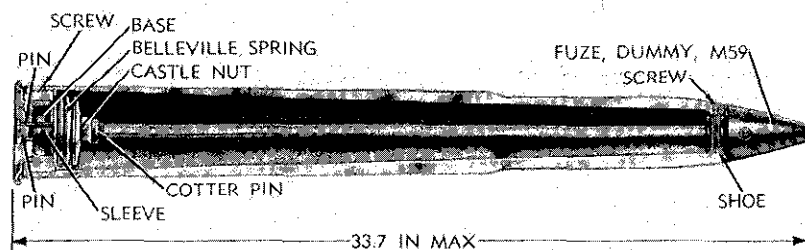
and no propellant as such, being propelled only by an ignition cartridge (fig. 97).

b. *Identification.* For identification purposes, practice projectiles are painted blue with marking in white (table I). The blue color signifies that the round, of which the projectile is a component, is for use in target-practice firing and includes a propelling charge and any other prescribed explosive.

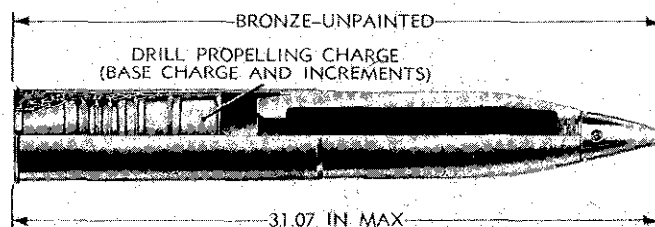
Caution: Some older fixed or semifixed practice rounds may be encountered in which the projectiles were inadvertently painted black because they are inert, even though the cartridge case contained "live" propellant (explosive). In handling any round in which the projectile is painted black (w/or w/o the marking of the word INERT), the complete identifying marking of the round should be noted, and it should be noted whether or not any of the components contain explosive.

For identification marking of inert ammunition, see paragraph 10b.

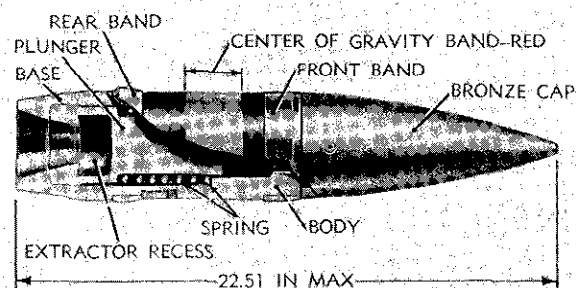
c. *Simulators.* Several types of simulators are used in connection with



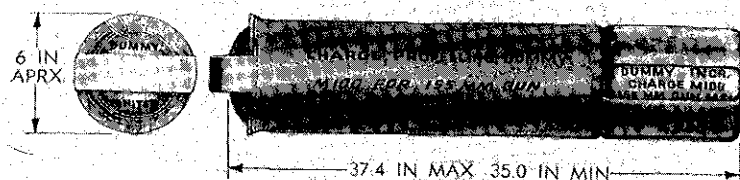
A-TYPICAL DUMMY CARTRIDGE



B-TYPICAL SEMIFIXED DUMMY CARTRIDGE



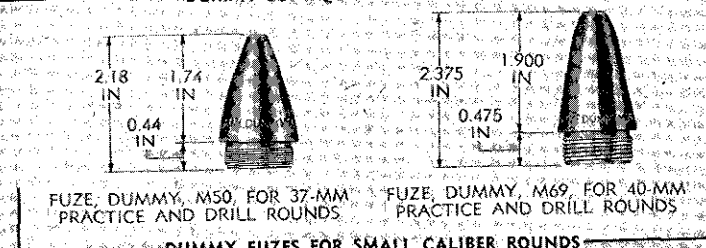
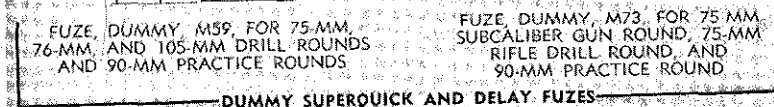
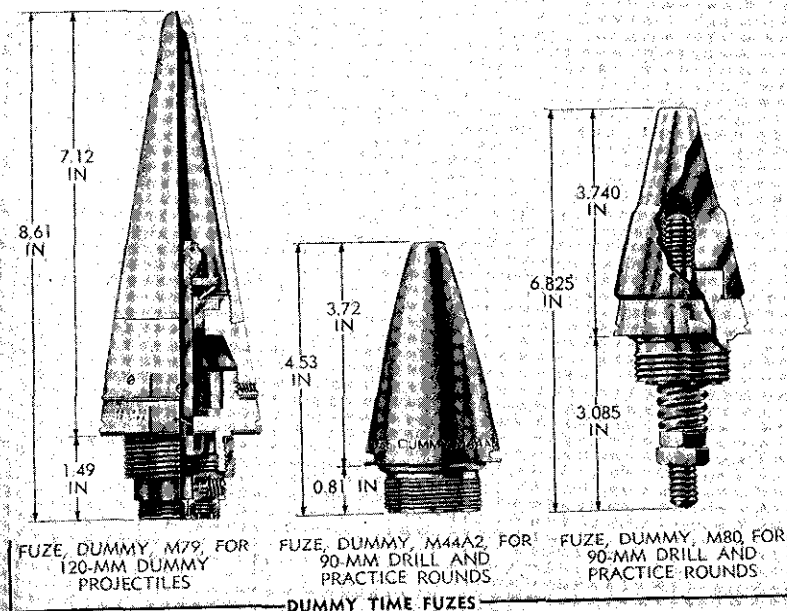
C-TYPICAL SEPARATE-LOADING DUMMY PROJECTILE



D-TYPICAL SEPARATE-LOADING DUMMY PROPELLING CHARGE

RA PD. 89318C

Figure 98. Dummy ammunition.



RA PD. 212789

Figure 99. Dummy fuzes.

artillery training. They are considered pyrotechnic items as they contain pyrotechnic compositions (see TM 9-1981).

(1) The smoke puff charge (fig. 154) is used with a smoke percus-

sion cap and is fired in a smoke puff discharger. The smoke puff simulates the appearance of the burst of an artillery shell.

- (2) The gunflash simulator (fig. 155) simulates the flash and noise accompanying the firing of an artillery weapon.
- (3) The shell burst simulator (fig. 156) simulates battle noises and effects such as whistle, flash, and report.
- (4) The firecracker is a small paper cylinder filled with an explosive composition. It has a black powder cord-type fuse that may be lit with an ordinary match. It may be used to simulate the noise of artillery fire.
- (5) Blank ammunition (par. 85) may be used for limited artillery practice.

d. Field Artillery Trainer. This trainer, which is used in preliminary artillery training, is a compressed air unit consisting of a miniature "gun" mounted on a miniature carriage. Four units are mounted on a "firing" platform to make up a field artillery training battery. The "ammunition" for this trainer consists of a 1-inch commercial steel ball (the simulated projectile) weighing about 2½ ounces and a selection of air pressures (the simulated adjustable (semifixed) propelling charge) up to 80 pounds per square inch. The maximum range is 85 yards at 800-mil (45°) elevation.

83. Dummy Ammunition

Dummy rounds, dummy projectiles, and dummy propelling charges are used for training in loading and unloading ammunition into a weapon. They consist of completely inert replicas of service rounds of ammunition or components. Fixed and semifixed rounds of this type are designated "dummy cartridges," while separate-loading rounds of this type are designated "dummy projectiles" and "dummy propelling cartridges." Representative ammunition of this type is shown in figure 98. Fuzes used in ammunition of this type are shown in figure 99. As this type ammunition is completely inert, no special safety precautions such as those required for "service" and "practice" ammunition are necessary. In accordance with painting and marking requirements (table I), metal components of dummy ammunition (except bronze dummy rounds) are painted black with marking in white. Dummy propelling charges are filled with wood grains simulating "live" propellant grains, and the color of the cloth in dummy propelling charge bags simulates that used in "live" propelling charge bags.

84. Subcaliber Ammunition

a. General. Subcaliber ammunition is ammunition used in subcaliber equipment (subcaliber gun, howitzer, or mortar) to simulate service-weapon target practice. The subcaliber equipment is of smaller caliber than that of the service weapon with which it is used and is arranged for attachment to the service weapon as an "interior" (w/in bore) mount in

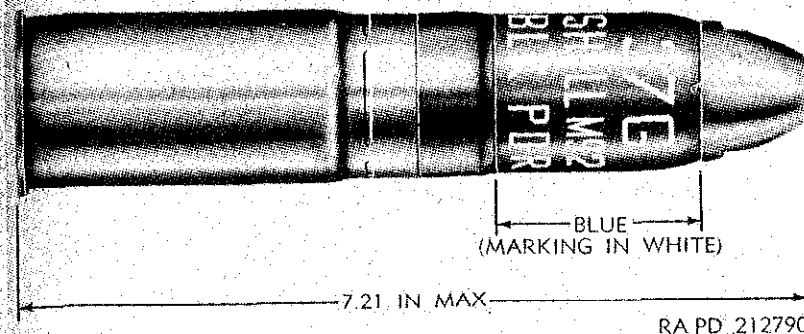


Figure 100. Target-practice shell for 37-mm subcaliber gun.

some calibers of weapons or as an "exterior" mount on certain other calibers of weapons. The use of subcaliber ammunition, being of low cost as compared with the cost of the ammunition it simulates, makes possible economies in training gun crews, avoids wear and tear on service weapons incident to regular target practice (par. 82), and permits training in locations where range limitations exist.

b. Types. Subcaliber equipment for small-caliber service weapons generally uses small arms service cartridges. Subcaliber equipment for medium- and some large-caliber service weapons uses 37-mm shell containing a charge of black powder instead of high explosive. Subcaliber equipment for 155-mm guns uses certain 75-mm service or target practice shell in 75-mm subcaliber guns. Subcaliber equipment for larger weapons consists of a 75-mm howitzer adapted as a subcaliber weapon and uses certain 75-mm ammunition. Special subcaliber equipment is designed for 4.2-inch mortars. Representative type of subcaliber ammunition is shown in figure 100.

Note. The same precautions will be observed in firing subcaliber ammunition as in firing service and practice ammunition.

85. Blank Ammunition

a. General. Blank ammunition is used in certain artillery weapons for a limited type of artillery firing practice, for maneuvers, for firing the morning and evening "gun," and for saluting. A representative type of blank ammunition is shown in figure 101.

b. Complete Round. A complete round of blank ammunition consists of a cartridge case, primer, charge of black powder, and a closing cup sealed in the mouth of the case. The primer is fitted to the cartridge case as in fixed or semifixed rounds of service ammunition. The black powder charge ranges in weight from 0.87 to 2.0 pounds depending upon its caliber and type. The blank cartridge contains no projectile.

c. Charge. The black powder charge for blank rounds consists of loose

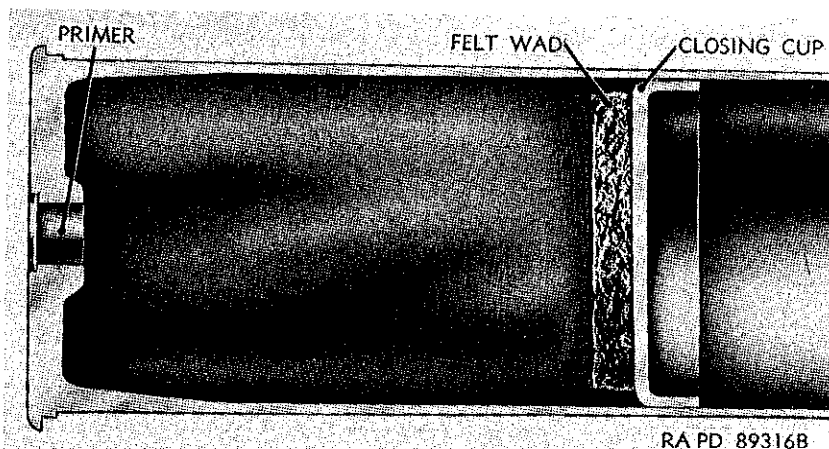


Figure 101. Blank ammunition for 75-mm guns and howitzers.

potassium- or sodium nitrate-type black powder in sewed cotton cloth bags.

86. Propellant Temperature Indicators

Propellant temperature indicators (fig. 102), used in antiaircraft batteries, enable taking the propellant temperatures for ammunition either at battery or in storage at ammunition supply point (ASP). They consist of a thermometer stuck into the propelling charge in a service cartridge case that, in turn, is packed in a fiber container. The thermometer can be read through plastic lenses placed in the head of the assembly. The assembly is then placed with an ammunition lot so that the temperature may be noted. Since firing tables are based on the temperature of the propellant at 70° F. at the time of firing, any deviation from this temperature has to be considered in making firing data corrections.

87. Care and Precautions in Handling

a. General. Reference is made to precautions in paragraph 12 for their general applicability to the various phases of "handling" explosives and ammunition (see also TM 9-1903).

b. Projectiles. Projectiles will be inspected at appropriate times particularly under conditions of abnormally high temperature and moisture, as they contain high explosives which are subject to exudation, gases that may result in injury to personnel if allowed to leak, or illuminants that are particularly hygroscopic and subject to deterioration if allowed to come in contact with moisture.

c. Propelling Charges. Propelling charges of all types will be protected from moisture as they are composed of propellant that is hygroscopic.

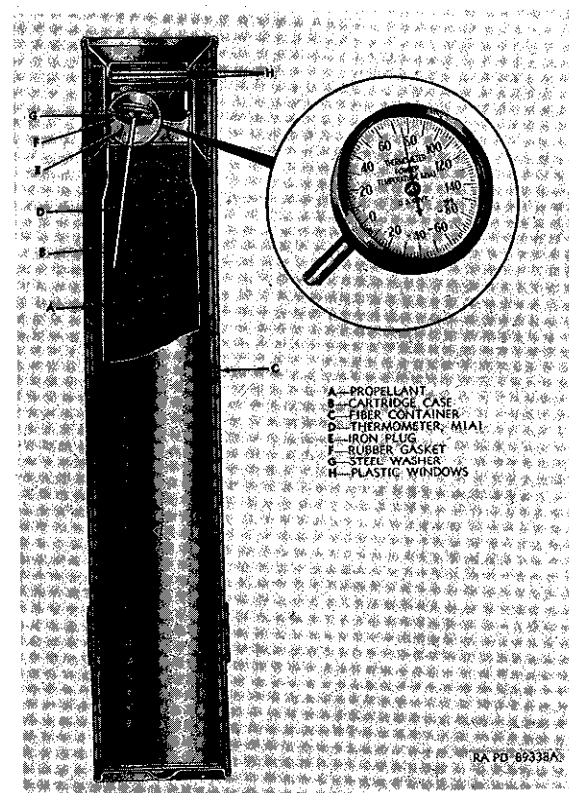


Figure 102. Propellant temperature indicator with thermometer.

The cloth, cotton or silk, in which separate-loading propelling charges are contained will be examined at appropriate periods for discoloration, as these might indicate deterioration of the propellant.

d. Cartridge Case. Cartridge cases, which contain the propelling charge in fixed, semifixed, and separated ammunition, are composed of lightweight brass or steel that is easily dented, hence packages (inner containers) and packings (shipping boxes) will be observed for evidence of damage that might indicate corroded, deformed, or ruptured cases. Such cases, if used, might put a weapon out of action for a considerable period of time.

e. Fuzes and Primers. Fuzes will be handled carefully, as they contain amounts, even though small, of sensitive high explosive such as mercury fulminate, lead azide, or lead styphnate.

Caution: No attempt will be made to disassemble any fuze at any time without specific instructions from the Chief of Ordnance.

Primers contain black powder that is particularly hygroscopic, hence any evidence of corrosion should be noted. In general, fuzes and primers should be kept in hermetically sealed containers.

88. Precautions in Firing

a. Reference is made to TM 9-1903 and AR 385-63 for general precautions and regulations in firing ammunition.

b. Ammunition will be inspected to see that it is clean, free of grease, and free of serious dents, bruises, or corrosion.

c. Semifixed propelling charges such as howitzer or mortar increments become exposed briefly to the atmosphere and weather during preparation for firing. These should therefore be inspected for cleanliness or damage and protected from moisture.

d. The U-shaped packing stop, which engages the fuze wrench slots for the purpose of holding the round (fixed or semifixed) in place in its container, must be removed and discarded before any attempt is made to load the round into a weapon.

e. Ammunition with serious dents, burs, or other deformities will not be used. If such ammunition is fired, a serious blowback or malfunction might result.

f. Separately issued fuzes, such as those issued to be fitted in the field to 90-mm and 120-mm projectiles or to separate-loading projectiles, should not be removed from their hermetically sealed containers until just prior to use. When screwing a fuze into the projectile, it should be tightened with the appropriate fuze wrench and set (cut), when required, with the appropriate fuze setter. Some fuze-projectile assemblies require staking to prevent disassembly during fuze setting operations.

g. Complete rounds, particularly rounds with fuzes, will be handled with care at all times. Explosive elements in fuzes and primers are particularly sensitive to shock and high temperature.

h. The safety wire will be withdrawn from the fuze just before firing and at no other time. Be certain the bore-riding pin is in place in the fuze at the time of dropping a shell into a mortar.

i. When loading mortars, the round is inserted into the muzzle of mortar, cartridge end first. When the shell is released to slide down the barrel, the hands must be instantly removed from in front of the muzzle.

j. All rounds employing a cartridge case with base-affixed primer must be handled with the base *up* to prevent the accidental detonation of the highly sensitive primer.

k. Do not break the moisture-resistant seal on the fiber container until ammunition is to be used.

l. Duds will not be handled or moved. Because their fuzes are armed, they will be destroyed in place as described in TM 9-1903.

m. Particular precautions must be taken with cartridges containing electric primers, such as in 20-mm ammunition, as described in (1) through (5) below.

(1) Live rounds should not be in gun chamber when electric leads are exposed.

(2) Precaution must be taken where any conditions exist, such as wearing of wool, synthetic fibers, or fur clothing, that may de-

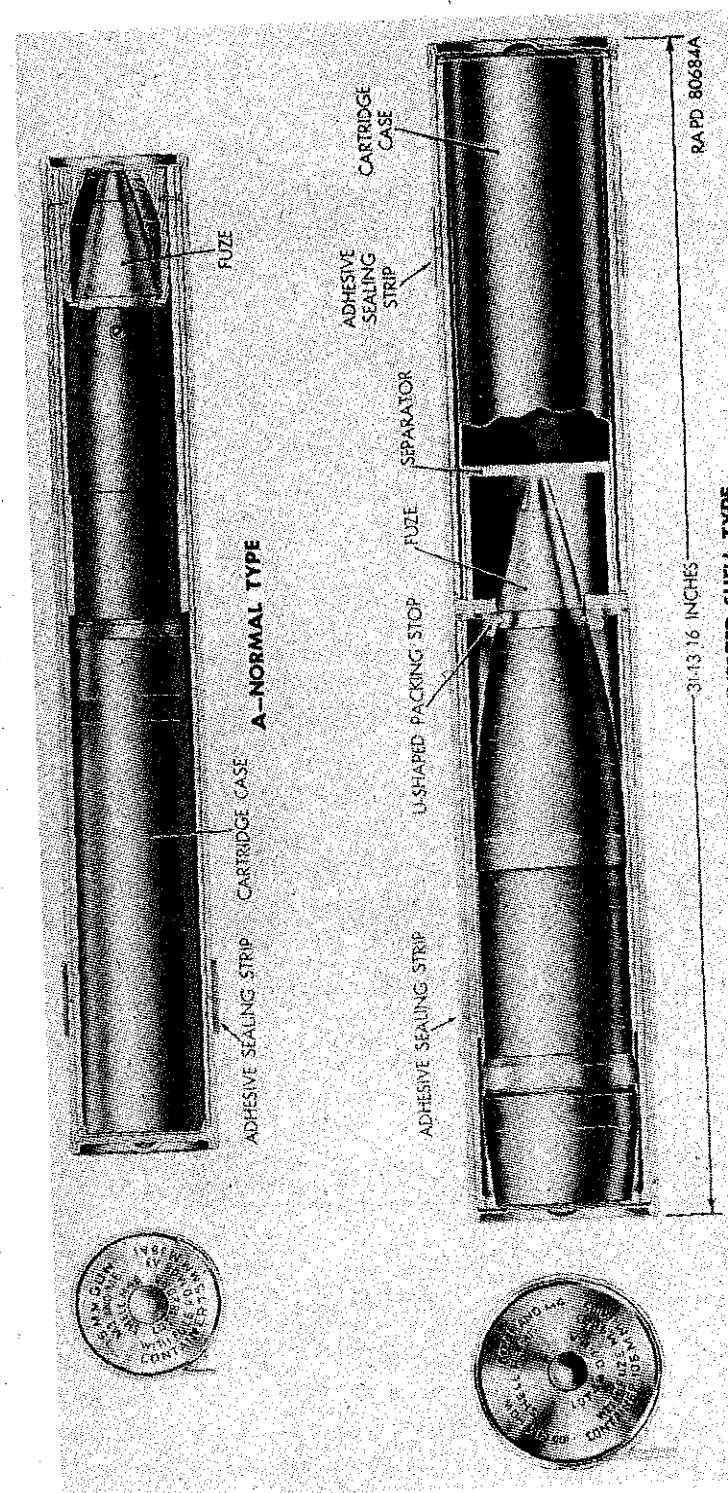


Figure 103. Types of fiber container.

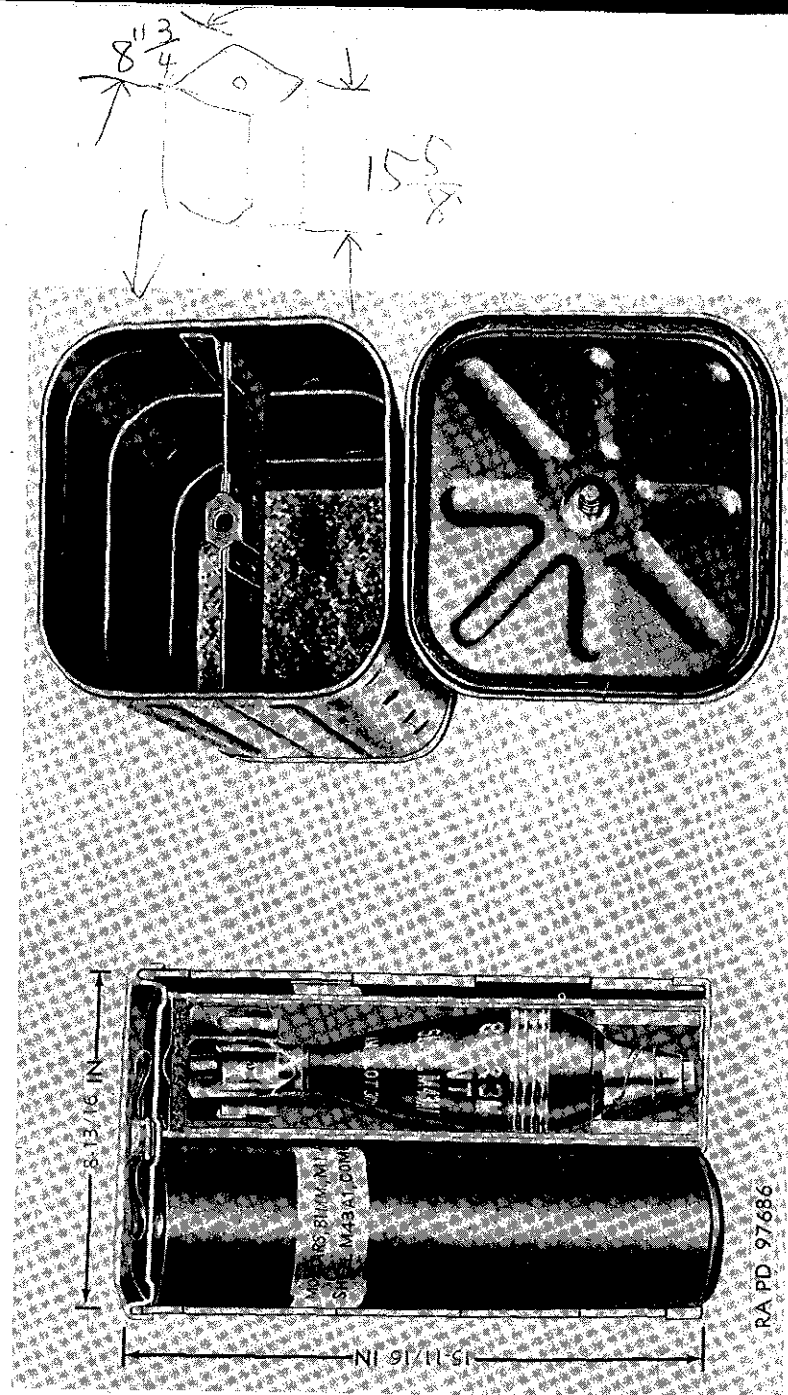


Figure 104. Metal containers for 81-mm mortar shell.

velop static charges or where individuals have reported static charges.

- (3) Armorers handling belted ammunition should not wear rubber soled shoes. Conductive or leather soled shoes should be worn.
- (4) The quick movement of belted rounds across nonconductive surfaces should be avoided as such action may develop a static charge.
- (5) Aircraft should be grounded during ammunition loading operations.

89. Packing and Marking

Fixed, semifixed, and separated artillery ammunition items are packed in moisture-resistant fiber containers in wooden boxes or placed in metal containers (figs. 103 and 104). Crates may be used for additional protection for certain propellant containers (metal containers for propelling charges), projectiles having windshields, and dummy projectiles. Fuzes and primers are packed in hermetically sealed cans, similar to that shown in figure 105, in a wooden box. Representative wooden boxes are shown in figures 106 and 107. Separate-loading projectiles are shipped boxed, crated, uncrated, or palletized. If shipped uncrated, a grommet is around the rotating band and an eyebolt-lifting plug is in the threaded fuze hole. Palletized shell are shown in figure 108. Airtight steel propellant containers, formerly known as cartridge-storage cases (fig. 109), are used to pack separate-loading propelling charges; in packings of recent design, one primer is packed in the propellant container with each charge. Except training ammunition, which may be requisitioned by components, mortar ammunition in the smaller calibers is packed as complete rounds. Each round is packed in an individual fiber container in metal container or wooden packing box. Representative markings on ammunition items are shown in illustrations of various types and

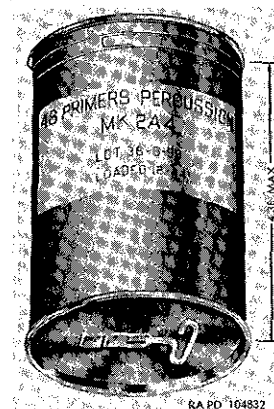
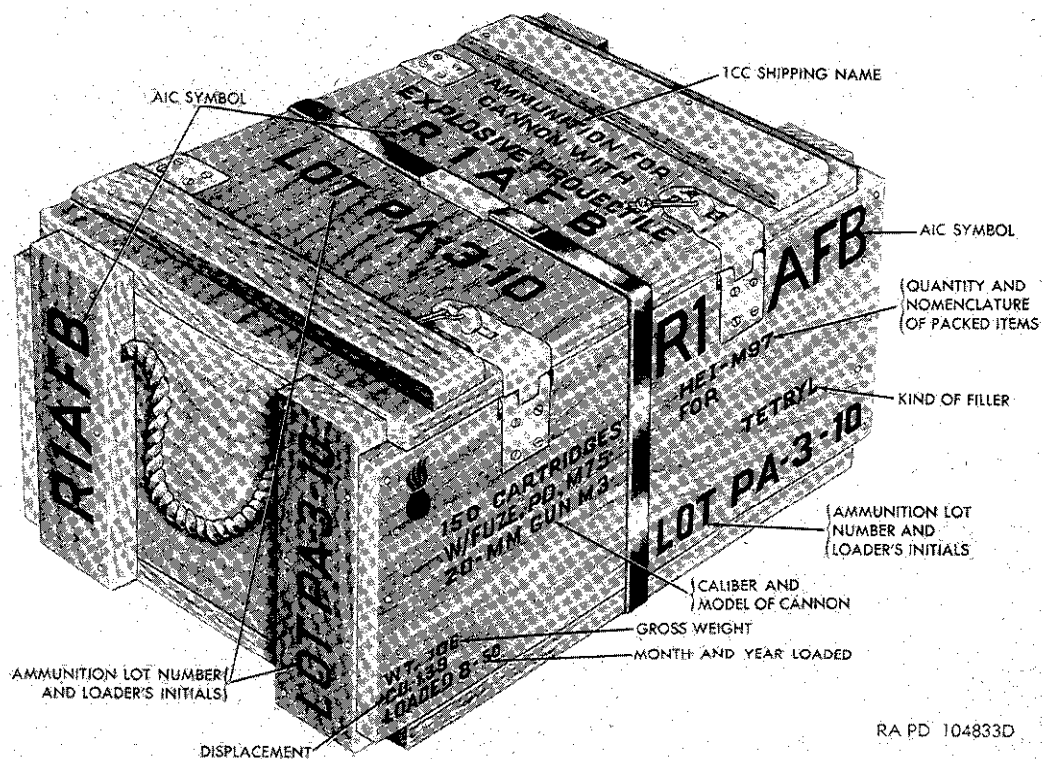
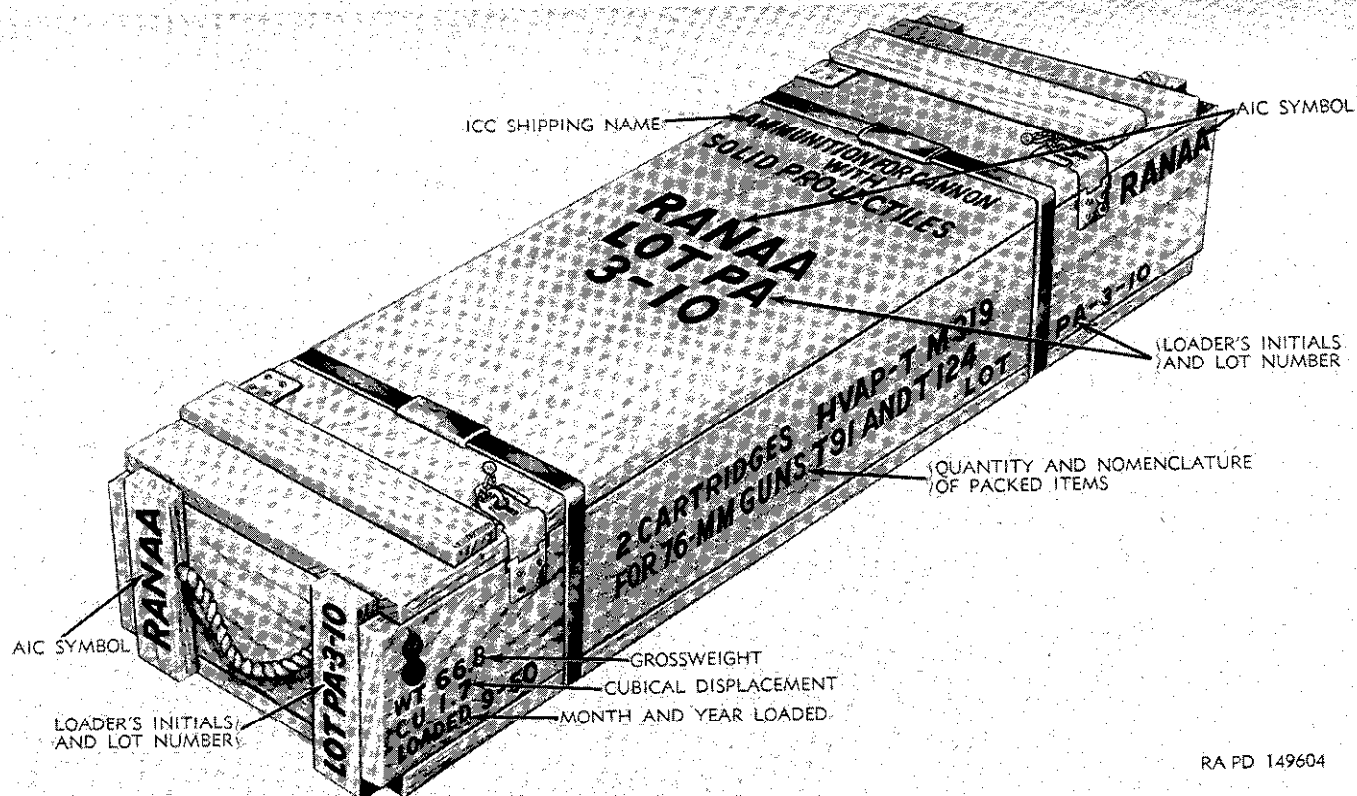


Figure 105. Metal containers for primers.



RA PD 104833D

Figure 106. Packing box for 20-mm ammunition.



RA PD 149604

Figure 107. Packing box for 76-mm ammunition.

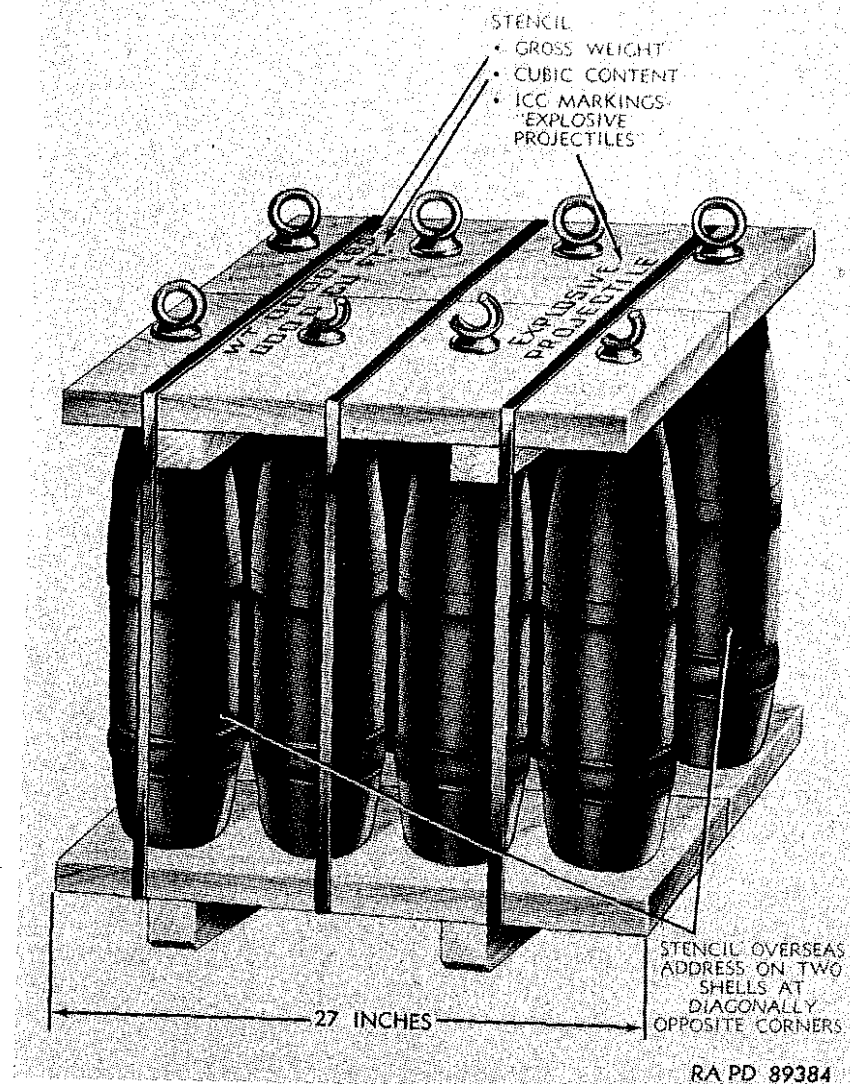


Figure 108. Pallet for separate-loading shell.

described in paragraph 11. Representative markings on packing boxes for shipment are shown in figures 106 and 107.

Section IV. BOMBS

90. General

a. A bomb is a type of ammunition designed to be dropped from an aircraft in flight to inflict damage or to serve a special purpose such as

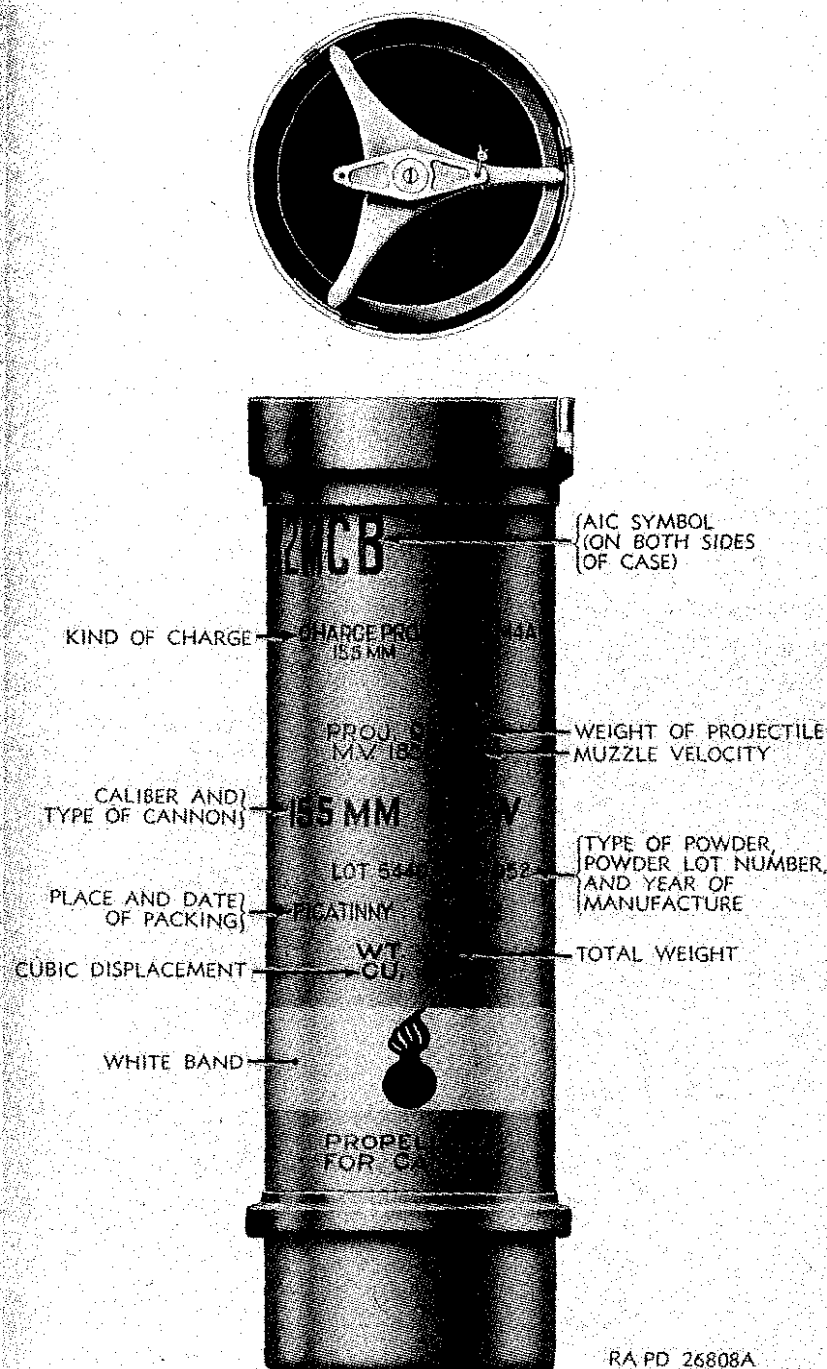


Figure 109. Metal container for propelling charge.

target identification or provision of a light source for photography. A bomb consists essentially of a metal container filled with the active charge, a device for stabilizing its flight, a mechanism for exploding the bomb, and safety devices. The metal container, called the bomb body, is usually streamlined with a rounded (ogival) nose and a tapered tail. The stabilizing device (fin) (par. 95) is attached to the tail end of the body and generally consists of sheet metal fin assembly or a parachute unit. The mechanism for exploding the charge is called a fuze and is generally placed in the nose or in the tail of the body, or both. Two or more fuzes may be used in the same bomb for different effects or to insure reliability of functioning. Safety devices are usually built into the fuze and are held in place during storage and shipment by seal wires or cotter pins. When the bomb is prepared for use, the seal wire and cotter pins are replaced by an arming wire, which is not removed until the bomb is dropped.

b. For reasons of safety, the components of a bomb are usually stored and shipped separately and must be assembled prior to use. The components of bombs (figs. 110 and 111) differ (depending on the particular type and model), but in general, they consist of: unfuzed bomb body containing the charge; fuze or fuzes; fin assembly (assembled to small bombs as shipped); and arming wire assembly.

c. Bombs are installed in airplanes by means of suspension lugs on the side of the body or suspension bands with lugs, arranged for horizontal suspension of the bomb. Some bombs are carried in a rack in the bomb bay of a bombing plane as shown in figure 112. Bombs are also carried on external bomb racks. A cluster of several bombs may be suspended in the carrying station, which may also be used for suspension of a single bomb of larger size (par. 96). The cluster is arranged for dropping as a unit (par. 96).

d. The functioning of bombs depends primarily upon the action of the fuze (par. 93), which may be instantaneous, delay, time, or proximity. The terms "instantaneous" and "delay" refer to the action at the instant of fuze impact. "Time" refers to the time from the release of the bomb to the instant of functioning of the fuze. "Proximity" refers to the characteristics of functioning on approach to, but at some distance from, a target.

e. Bomb fuzes, after being fitted to bombs, are prevented from arming and consequently from functioning during handling by means of an arming wire (par. 94), which is normally withdrawn from the fuze by the bomb's release from the bombing plane. When it is necessary to remove the arming wire to unfuze a bomb, instructions attached to the fuze should be carefully followed. Provision is made for releasing the bomb "safe" from the bombing plane when it is desired that the bomb land without functioning. In this case the arming wire is released with the bomb so that the arming wire is not withdrawn from the fuze, that is, the fuze does not become armed.

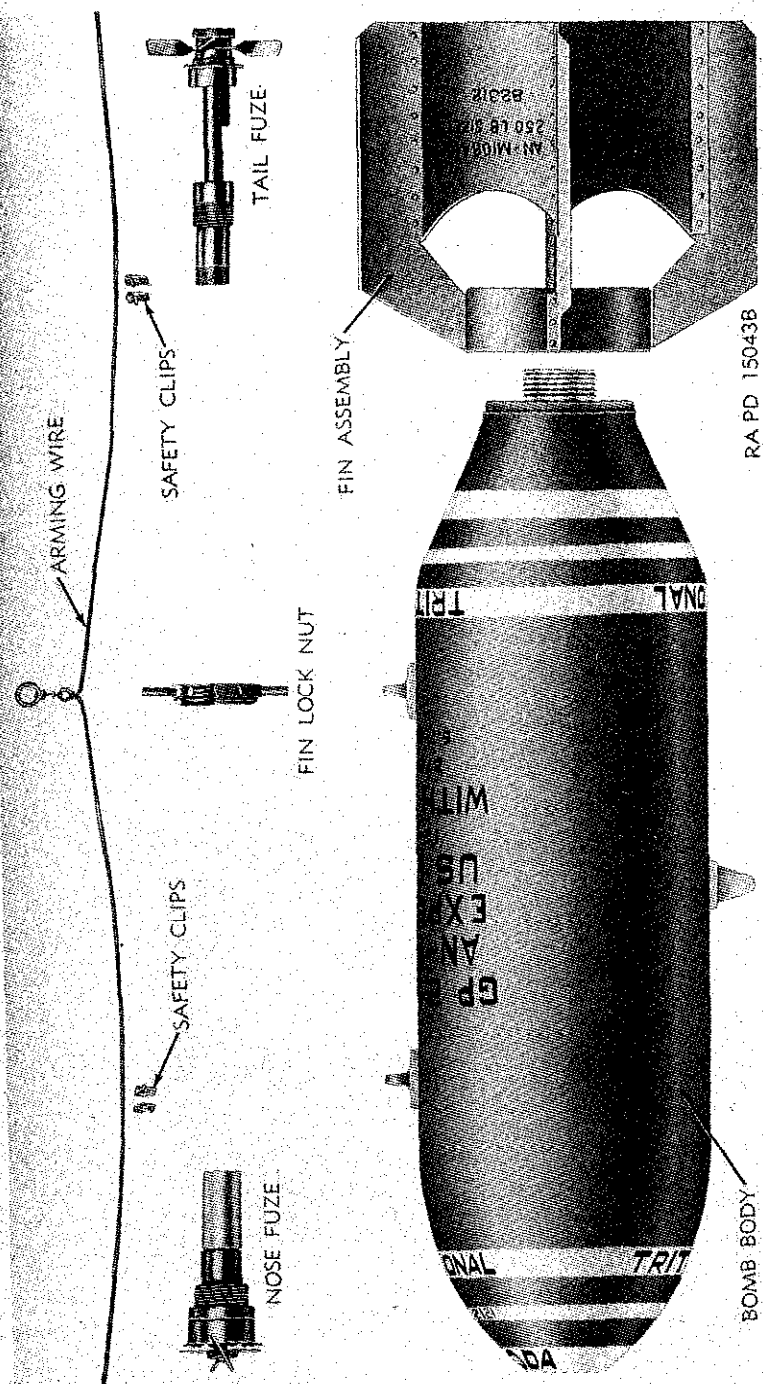
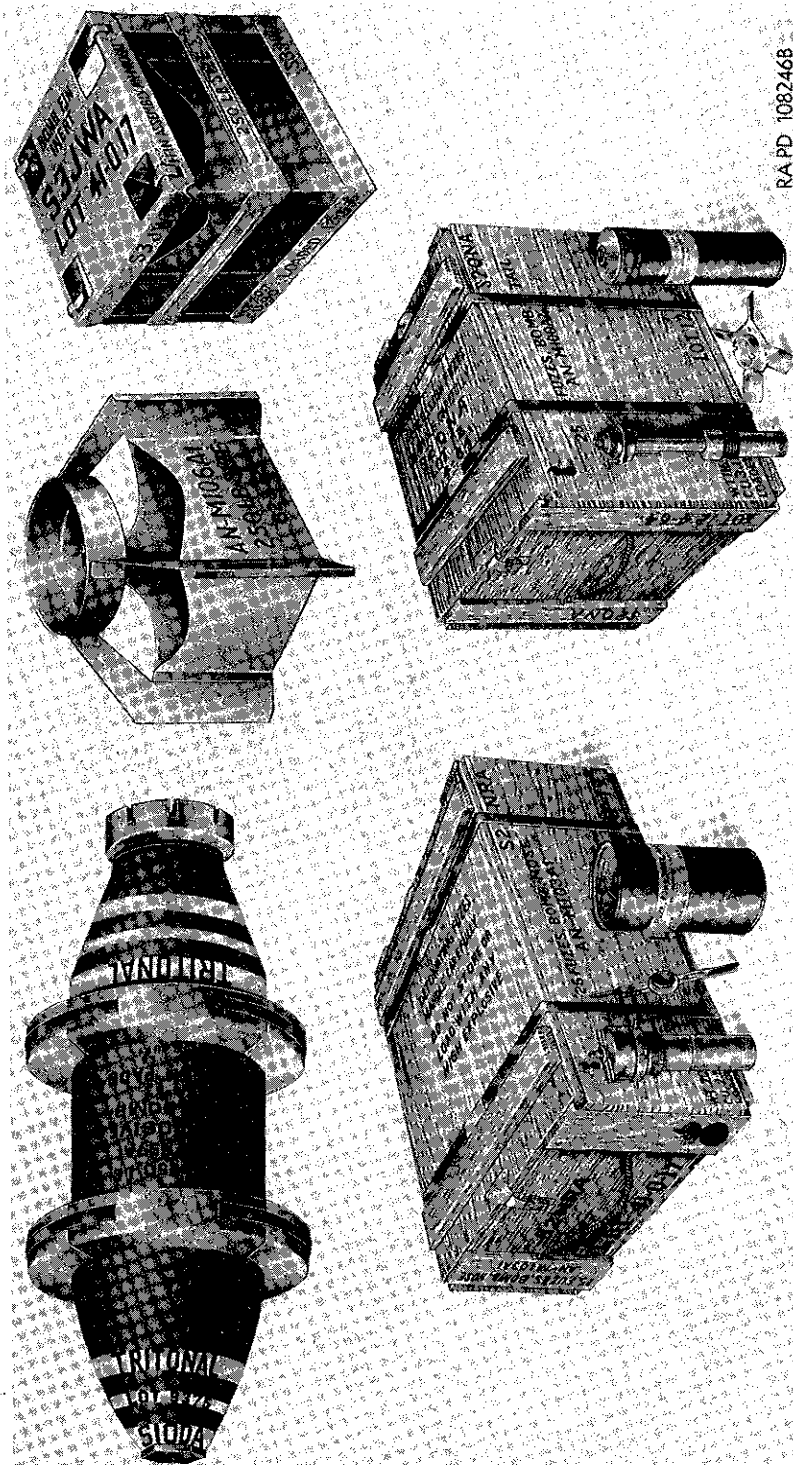
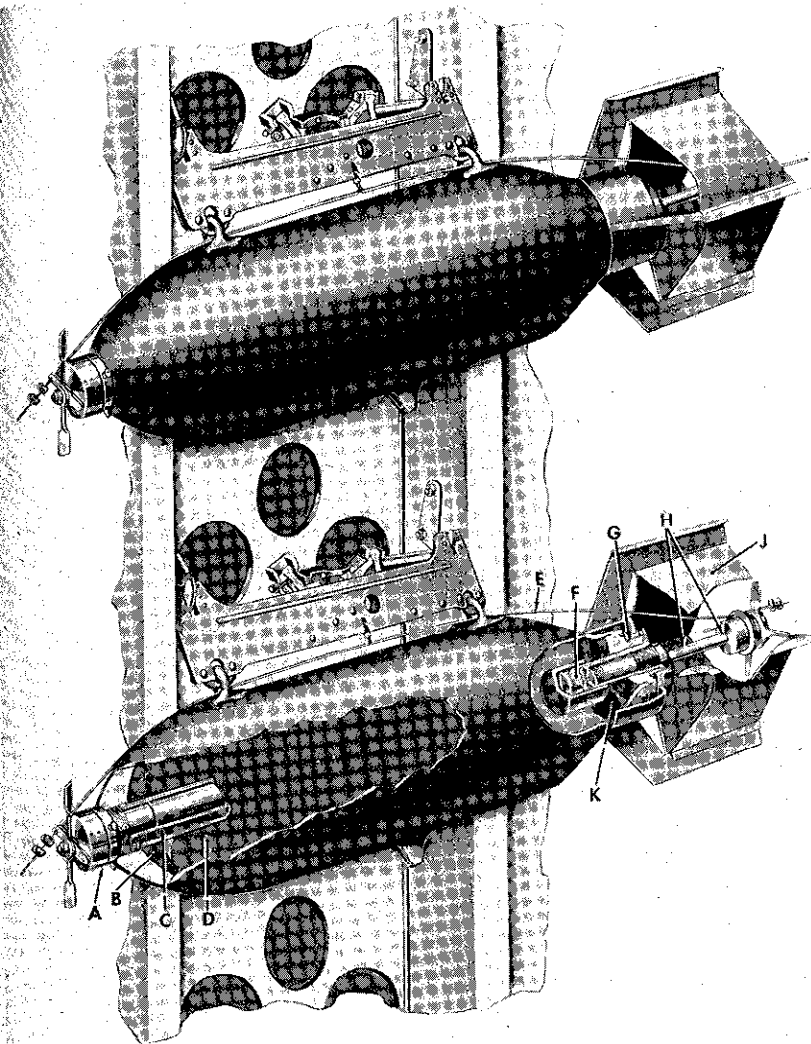


Figure 110. Components of bombs.



RA PD 108246B

Figure 111. Components of bombs as received.



A—NOSE FUZE
B—NOSE SEALER (INERT)
C—FUZE SEAT LINER
D—BURSTING CHARGE
E—ARMING WIRE

F—ADAPTER BOOSTER
G—FIN LOCK NUT
H—TAIL FUZE
J—FIN ASSEMBLY
K—TAIL SEALER (INERT) RAPD 108245A

Figure 112. The complete round in bomb bay.

91. Classification

Bombs are classified according to filler as explosive, chemical, incendiary, pyrotechnic, or inert. They are classified as to use as armor-piercing (AP), demolition, general-purpose (GP), light case (LC), fragmentation, depth, semiarmor-piercing (SAP), gas, smoke, incendiary, photoflash, target identification (TI), leaflet, practice, and dummy. Leaflet bombs are

light metal cases that may be filled with literature for release over a specific territory. Practice bombs are usually inert-loaded except for a spotting charge of black powder or smoke mixture. A sound device may also be used for spotting. Dummy bombs are completely inert and are used for training in loading a bombing plane.

Note. Incendiary and chemical bombs are the responsibility of the Chemical Corps and are described in TM 3-400.

92. Types

a. High Explosive. High-explosive bombs are intended for the destruction of enemy buildings, bridges, military installations, and the like. The destructive effect is produced by detonation (blast effect), by projection of fragments of the case (fragmentation), and by displacement of earth and structures (mining). An explosive train of bombs is shown in figure 113.

- (1) *General-purpose (GP) and demolition.* General-purpose (fig. 114) and demolition bombs are used for the majority of bombing situations and can produce blast, fragmentation, or mining effect. The various models range in size from 100 to 12,000 pounds. The explosive charge averages 50 percent of the total weight. The bombs are usually loaded with tritonal but may be loaded with TNT, amatol, or COMP B. The bomb body is cylindrical, has an ogival nose, and tapers conically to the base. The bombs are fin-stabilized but the fin assembly of some sizes of bombs may be replaced by an antiricochet device (par. 95c) for low-altitude bombing. Bombs of the 2,000-pound size or smaller are adapted for both nose and tail fuzes. Both fuzes are generally used, as the secondary fuze is used as insurance against malfunction. The 12,000-pound bombs do not use a nose fuze, but are provided with three identical tail fuzes.
- (2) *Light case (LC).* Light case bombs (fig. 115) and some demolition bombs are designed to carry a heavy charge to produce a maximum blast effect. The explosive charge is 70 percent or more of the total weight. The total weight is approximately 4,000 and 10,000 pounds. The bomb is similar in shape to the GP 50 percent explosive-loaded demolition types but the case is lighter and thinner. This type of bomb cannot be used for penetration and must be used with VT, instantaneous and non-delay fuzes to provide aboveground burst. In other respects, LC bombs are similar to the GP bombs.
- (3) *Armor-piercing (AP).* Armor-piercing bombs (fig. 116) are used to pierce highly resistant targets, such as concrete bombproof construction and the heavy deck armor of battleships. The various models range in size from 1,000 to 1,600 pounds. The case of the AP is very thick, especially at the nose. The percentage of explosive is approximately 15 percent of the total

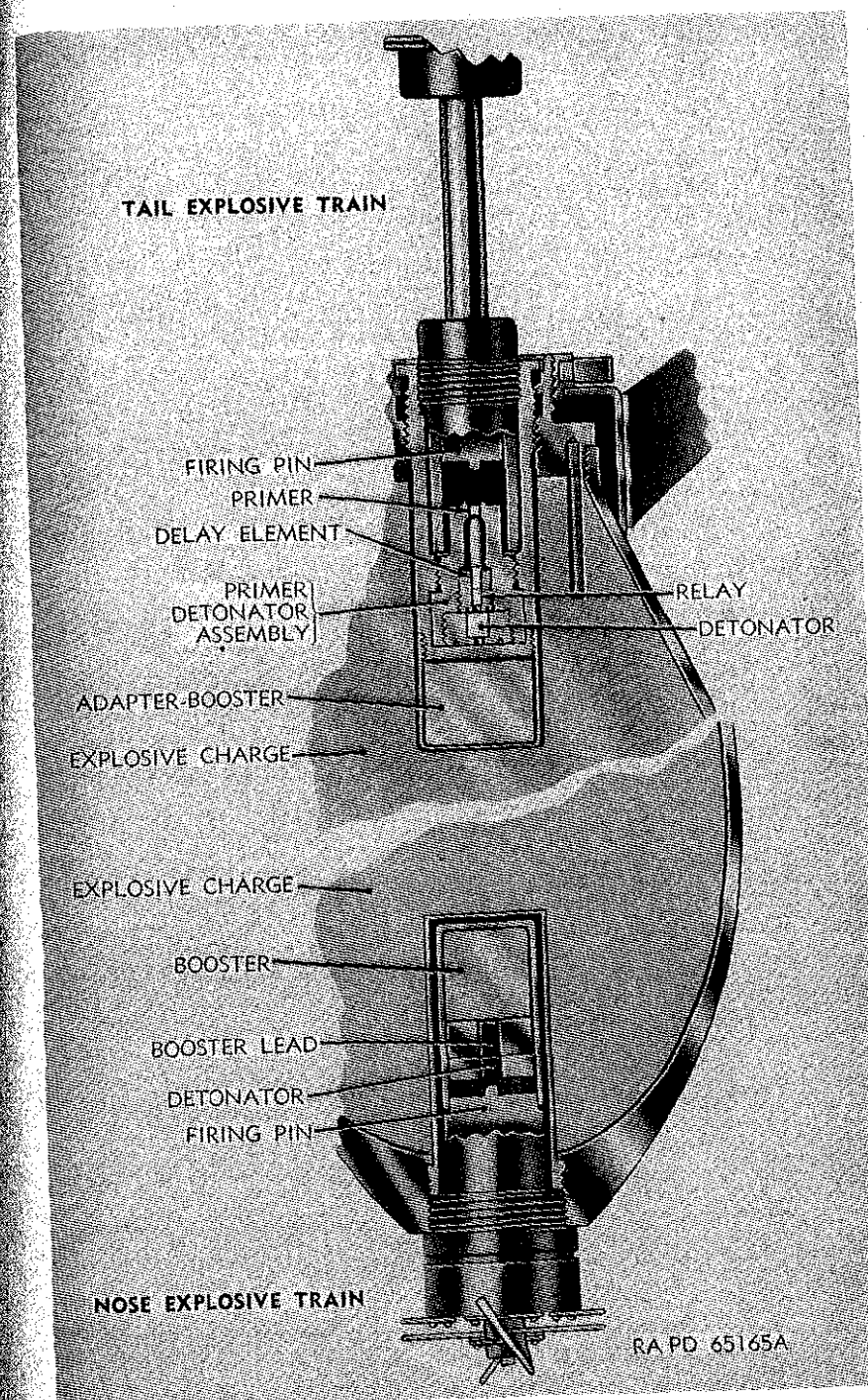


Figure 113. Explosive train.

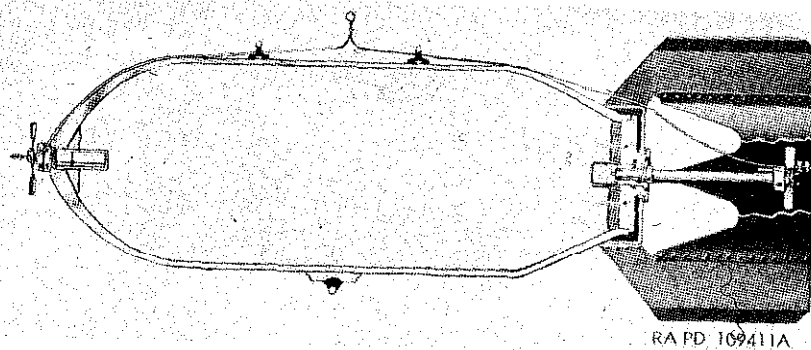


Figure 114. General-purpose bomb—section.

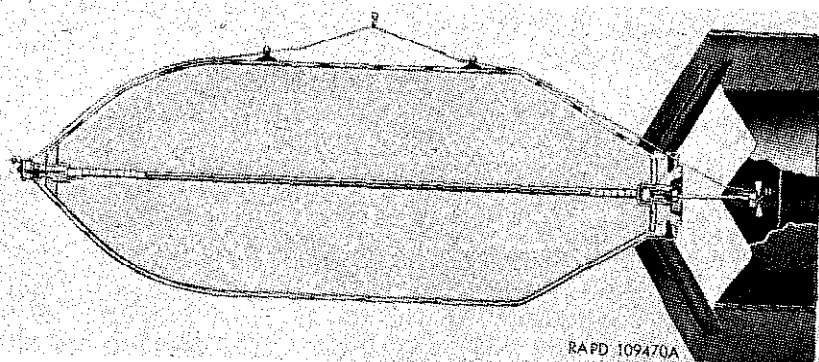


Figure 115. Light case bomb—section.

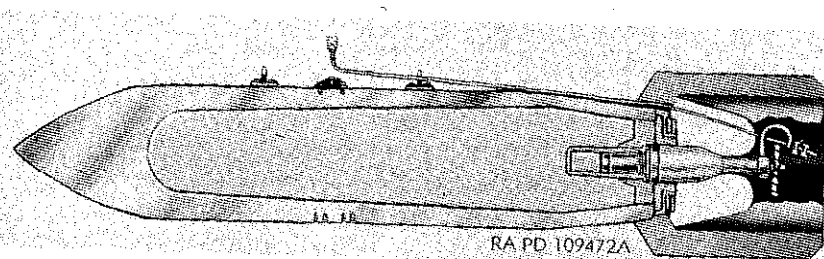


Figure 116. Armor-piercing bomb—section.

weight. This type of bomb is loaded with explosive D, which is sufficiently insensitive to withstand the force of impact without exploding. The bomb is adapted for a tail fuze only, which is of the delay type to permit deep penetration of the target before detonation.

- (4) *Semi-armor-piercing (SAP).* Semi-armor-piercing bombs (fig. 117) are used against reinforced concrete construction and lightly armored shipping. The various models range in size from 500

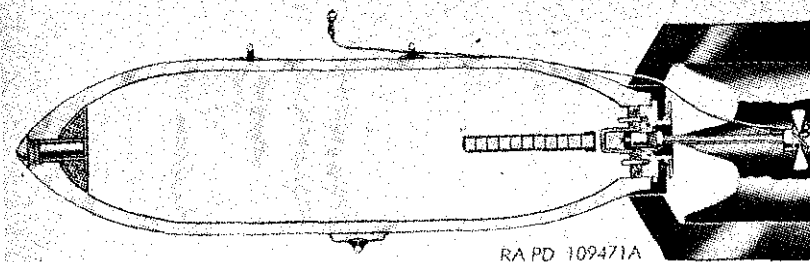


Figure 117. Semi-armor-piercing bomb—section.

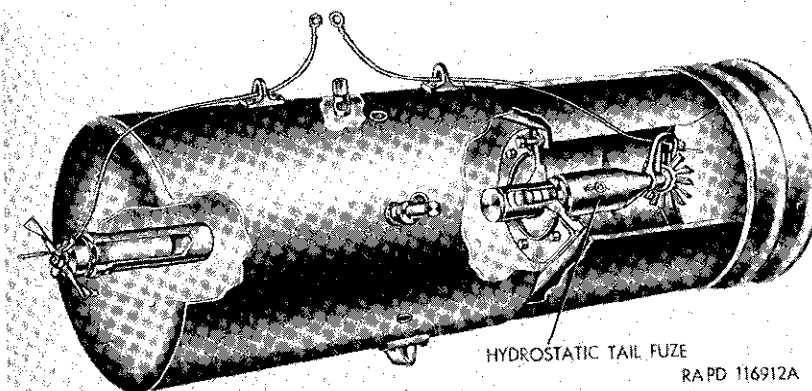


Figure 118. Depth bomb—section.

to 2,000 pounds. The case of SAP bombs is intermediate in thickness between that of AP and GP bombs. The percentage of explosive is approximately 30 percent of the total weight. This type of bomb is loaded with picratol. A delay tail fuze is used with this type of bomb. Although some of these bombs are adapted for a nose fuze, it is rarely used. The fuze hole is ordinarily closed by an armor-piercing plug.

- (5) *Depth.* The depth bomb (fig. 118) is a light case type of bomb designed primarily for use against submarines. It averages 70 percent explosive and is loaded with HBX, HBX-1, or TNT. The case is cylindrical and has a flat nose to reduce or prevent ricochet when dropped from planes flying at low altitudes. The depth bomb is fuzed with a hydrostatic tail fuze that functions at a predetermined depth. A nose fuze that functions with instantaneous action on impact may be used to produce a surface burst, when the bomb is used against a surface target.
- (6) *Fragmentation.*
- (a) *General.* Fragmentation bombs (fig. 119) are designed for

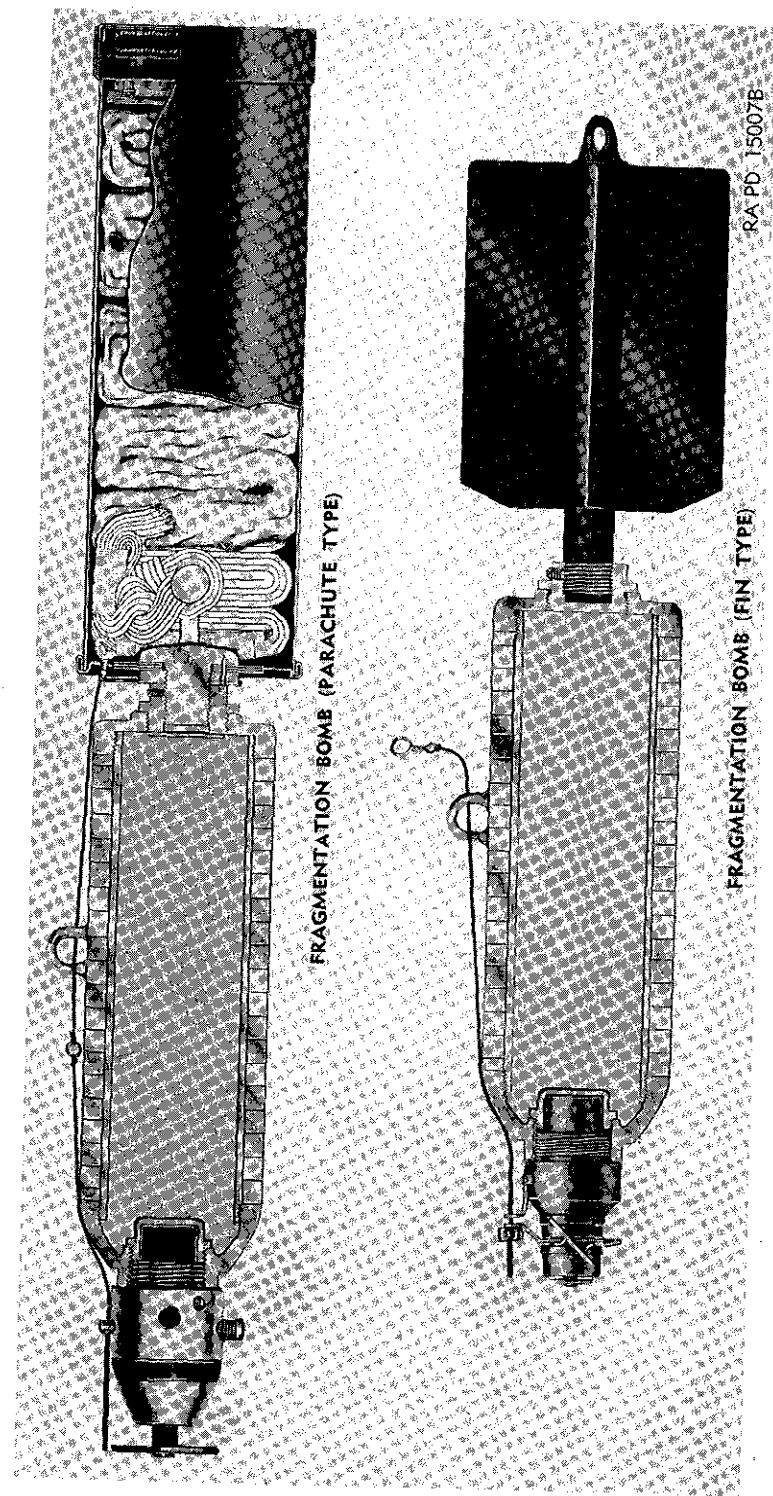


Figure 119. Fragmentation bombs, 20 and 23 pounds—section.

high-velocity projection of fragments of a square steel bar that is wound helically around the bomb. They are effective against personnel and light materiel. The bombs are usually loaded with COMP B or TNT and the explosive charge averages 14 percent of the total weight. Fragmentation bombs range in size from 4 to 260 pounds. All small and medium sizes may be assembled in clusters by use of cluster adapters (par. 96). The cluster is dropped from the airplane as a unit. Withdrawal of the arming wire when the cluster is dropped acts to release the bombs from the cluster. This action is accomplished either by mechanical means directly or by arming a mechanical time fuze that opens the cluster after an interval.

- (b) *Fin-stabilized.* This type of fragmentation bomb is stabilized by fins. This type is fitted with arming-vane type fuzes that function instantaneously on impact. Proximity nose fuzes may also be used to produce air burst. Bombs of the 220-pound size or larger are adapted for both nose and tail fuzes. The smaller bombs use a nose fuze only.
- (c) *Parachute-stabilized.* This type of fragmentation bomb is fitted with a parachute unit to stabilize the bomb and retard its fall. It is used for low-altitude bombing, and the time interval between release of the bomb and its functioning on impact permits the airplane to clear the danger area. The parachute-fragmentation bomb uses an arming-pin type of nose fuze. The fuze has a delay in arming after the arming wire is withdrawn by the opening of the parachute but functions instantaneously on impact.
- (d) *"Butterfly wing"-stabilized.* This type is the 4-pound "butterfly" bomb (fig. 120), which is a cylindrical bomb used only in clusters. Metal "butterfly wings," which encase the body, are opened by spring action when the bomb is released from the cluster. The wings are forced to the top of a cable extension and caused to rotate by the airstream. The wings retard the fall of the bomb and, by turning the cable, withdraw the fuze arming stem, thus arming the fuze. The fuze is located transversely in the side of the cylindrical body. The action of the fuze may be air-burst, instantaneous on impact, delay after impact, or antidisturbance.

b. *Pyrotechnic.* Photoflash and target identification bombs contain pyrotechnic material but are classified as bombs because of their similarity to bombs in body, fuzing, and method of suspension. Photoflash bombs also have an explosive effect but this is only incidental to their purpose.

- (1) *Photoflash.* Photoflash bombs (fig. 121) are thin-cased bombs designed to burst in the air to produce a light of high intensity

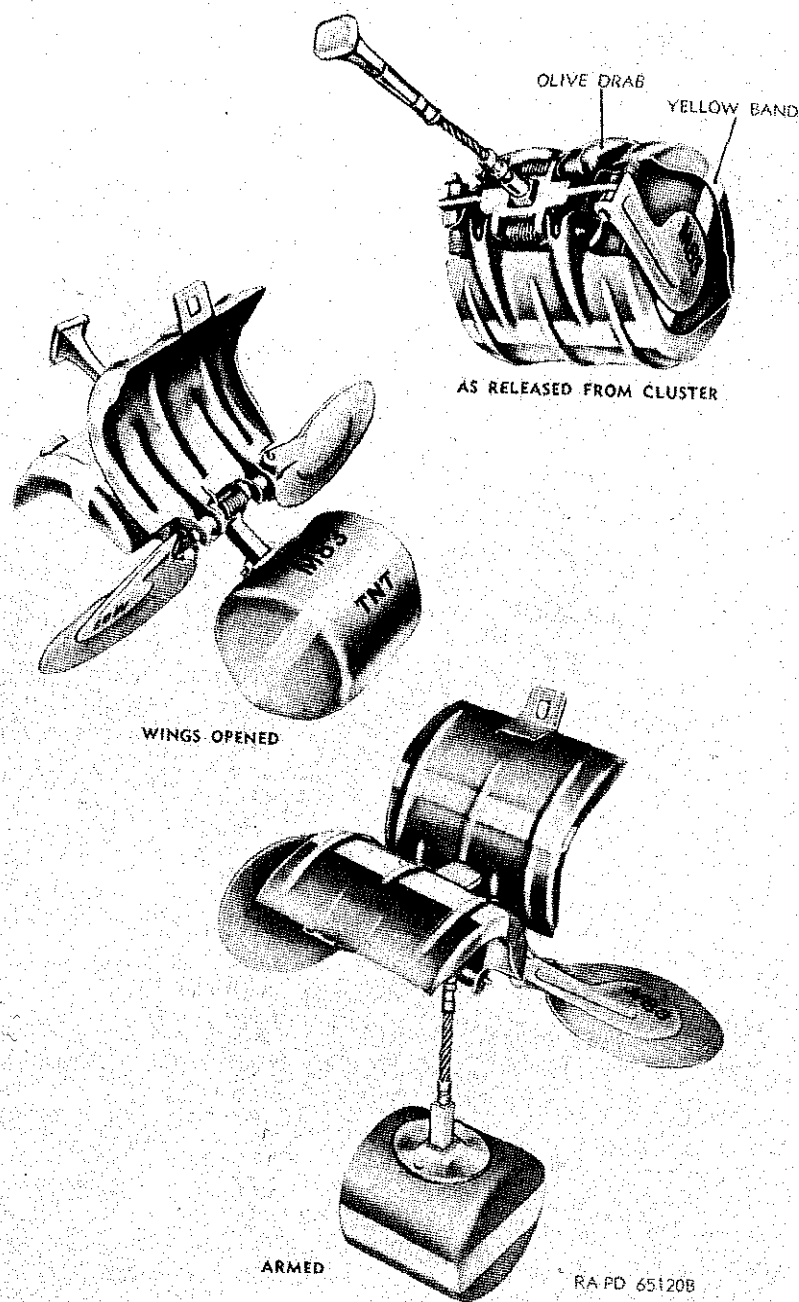


Figure 120. "Butterfly bomb" (fragmentation bomb, 4-lb.).

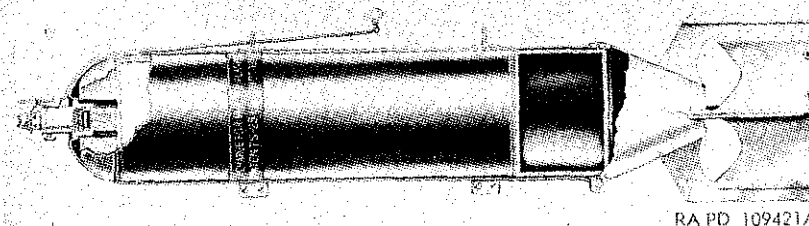


Figure 121. Photoflash bomb—section.

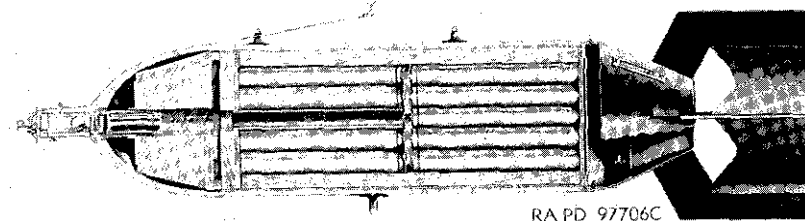


Figure 122. Target-identification bomb—section.

and short duration for night photography. The bombs contain a charge of photographic flash powder or of metal-alloy dust representing approximately 45 or 75 percent, respectively, of the total weight. The metal-dust type of bomb produces greater candlepower and is more resistant to detonation by bullet or flak penetration. Photoflash bombs are equipped with mechanical time nose fuzes of either the arming-pin or arming-vane type to produce air burst. The bombs are fin-stabilized and may also be equipped with a trail plate or trail angles to alter the trajectory or angle of trail.

- (2) *Target identification (TI).* There are two types of TI bombs, both of which are fin-stabilized and provided with mechanical-time nose fuzes to produce air burst.
 - (a) The ground-marker type (fig. 122) contains pyrotechnic candles and is used to locate, illuminate, and mark targets at night. The bomb functions in the air, the candles being ignited and ejected from the bomb tail. The candles fall to the ground and continue to burn for their prescribed time. The several models of these bombs differ only in the color and function (delay time, burning time, nonexploding, or exploding) of the pyrotechnic candles.
 - (b) The red smoke type is used to indicate a bomb release point when ground targets are not discernible. The body contains iron oxide (hematite) filler and a burster. The bomb func-

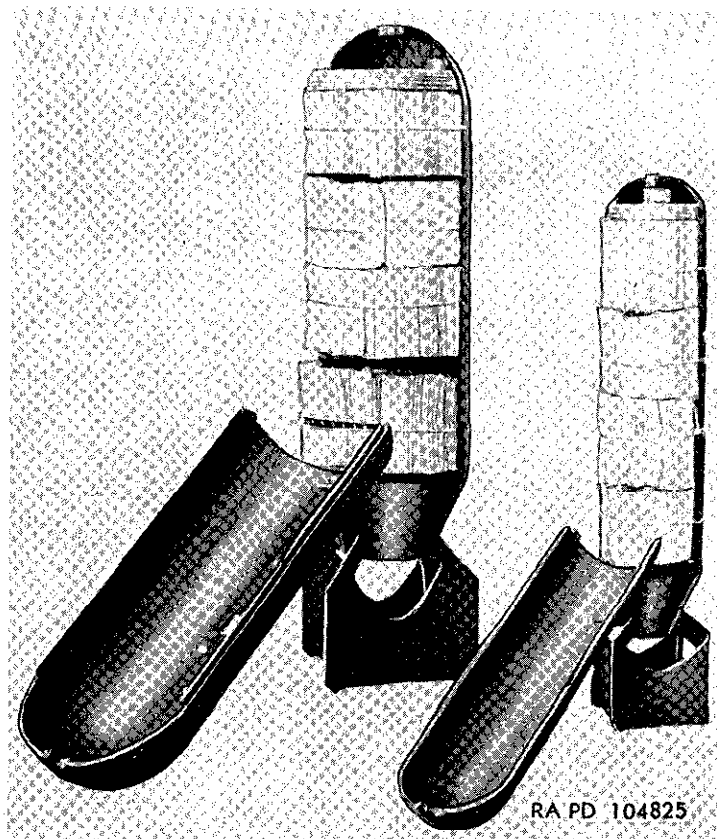


Figure 123. Leaflet bombs, 100 and 500 pounds—open.

tions in the air, the burster rupturing the case and expelling the filler to produce a persistent cloud of red smoke.

c. *Leaflet.* Leaflet bombs (fig. 123) are used to distribute literature from aircraft. The bombs are similar to 100- and 500-pound aimable-type cluster adapters (par. 96). The bombs are issued empty. The bomb body is packed with leaflets and fuzed with a mechanical-time nose fuze to compose the complete round. The fuze is set to open the body in the air at an altitude to accomplish the most effective dispersion of the leaflets.

d. *Practice and Practice Target.*

- (1) Practice bombs (fig. 124) are used for target practice and are available in sizes from 23 to 250 pounds to simulate service bombs. Miniature practice bombs in 3- and 4.5-pound sizes are also provided. Most practice bombs have a spotting charge and fuze, others are completely inert. Some may be fitted with a parachute, in which case the parachute serves for spotting purposes. Some models of practice bombs require

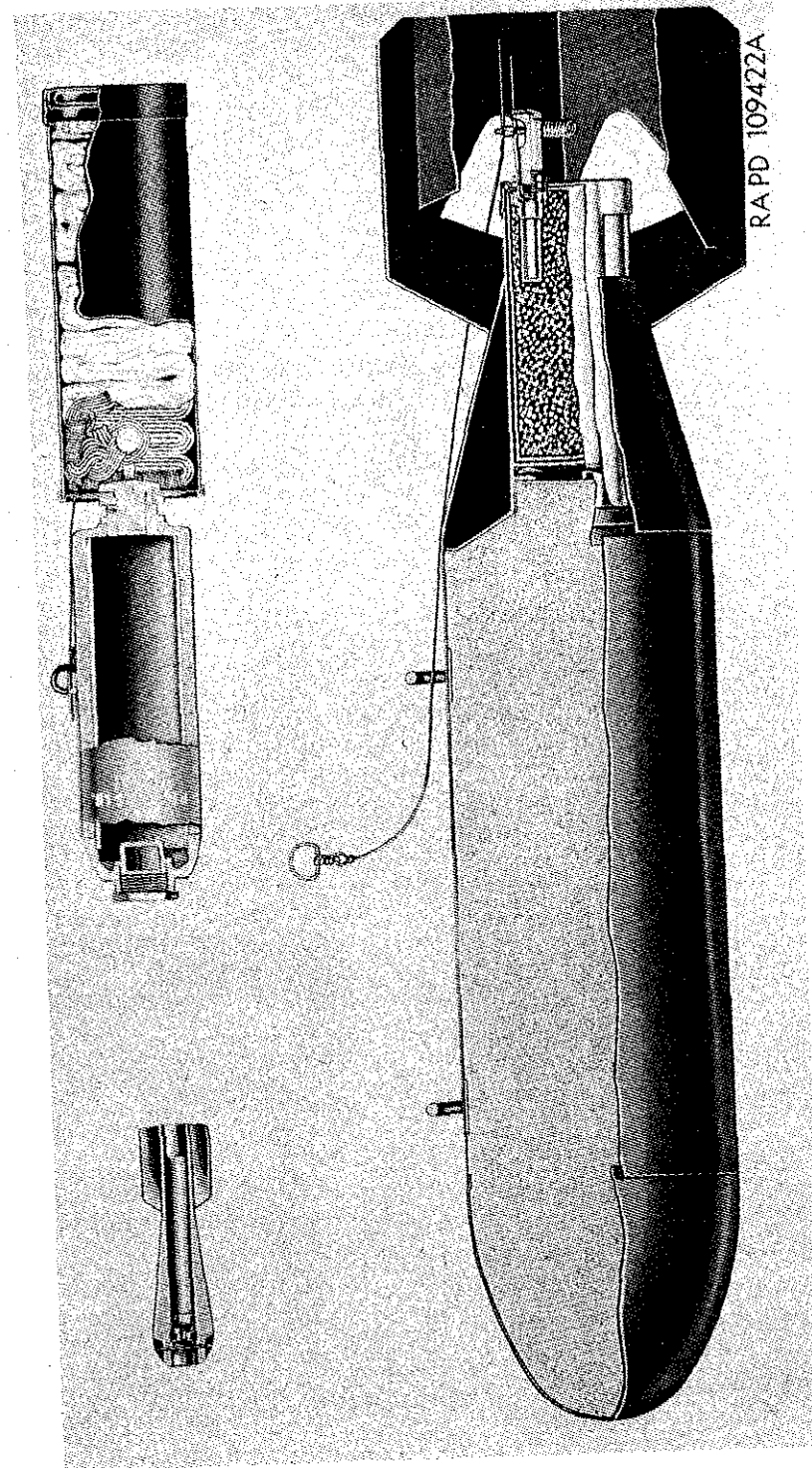


Figure 124. Practice bombs—sections.

sand-loading to weight before use; others are constructed completely of reinforced concrete except for fin assembly and spotting charge.

- (2) Practice target bombs are of the 100-pound size and are used to produce a colored target on snow covered ranges. The bomb is fitted with a nose fuze and a burster to scatter the iron oxide (hematite) filler, producing red coloration of the target area.

e. Dummy. Completely inert bombs and components are used for training of ground crews in assembling, fuzing, unfuzing, and other handling of bombs. Each type and weight of service bomb is represented by a corresponding dummy bomb. Dummy bombs are made up from the metal parts of service bombs, inert-loaded when necessary. Dummy bombs, unlike practice bombs, are not expendable; they are not used for bombing practice.

93. Fuzes

a. General. Bomb fuzes are devices used to initiate detonation of bombs under the circumstances desired. The fuzes are classified according to position as nose, tail, and body and according to function as time, impact, hydrostatic, and proximity (VT). Fuzes are also classified according to method of arming as arming-pin type and arming-vane type.

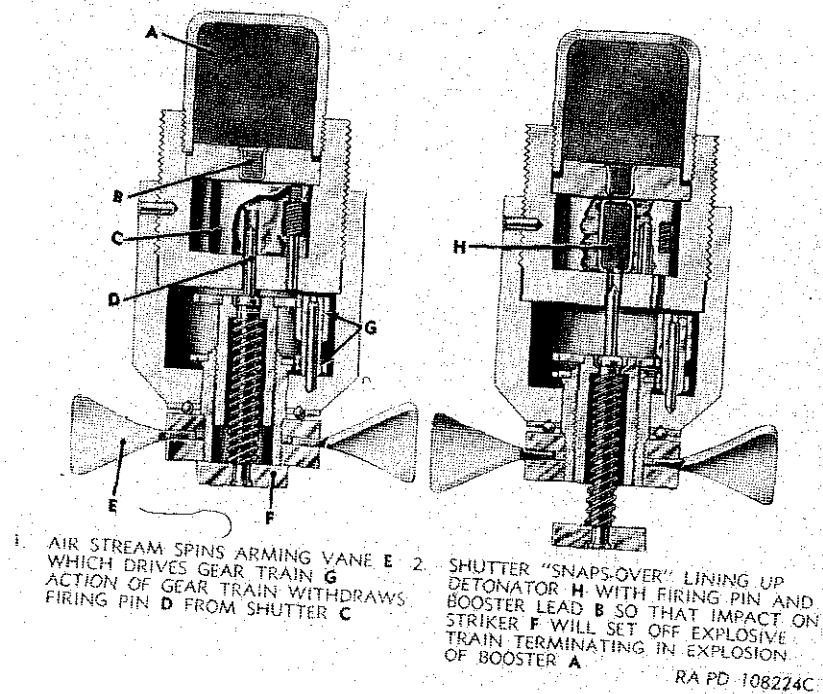


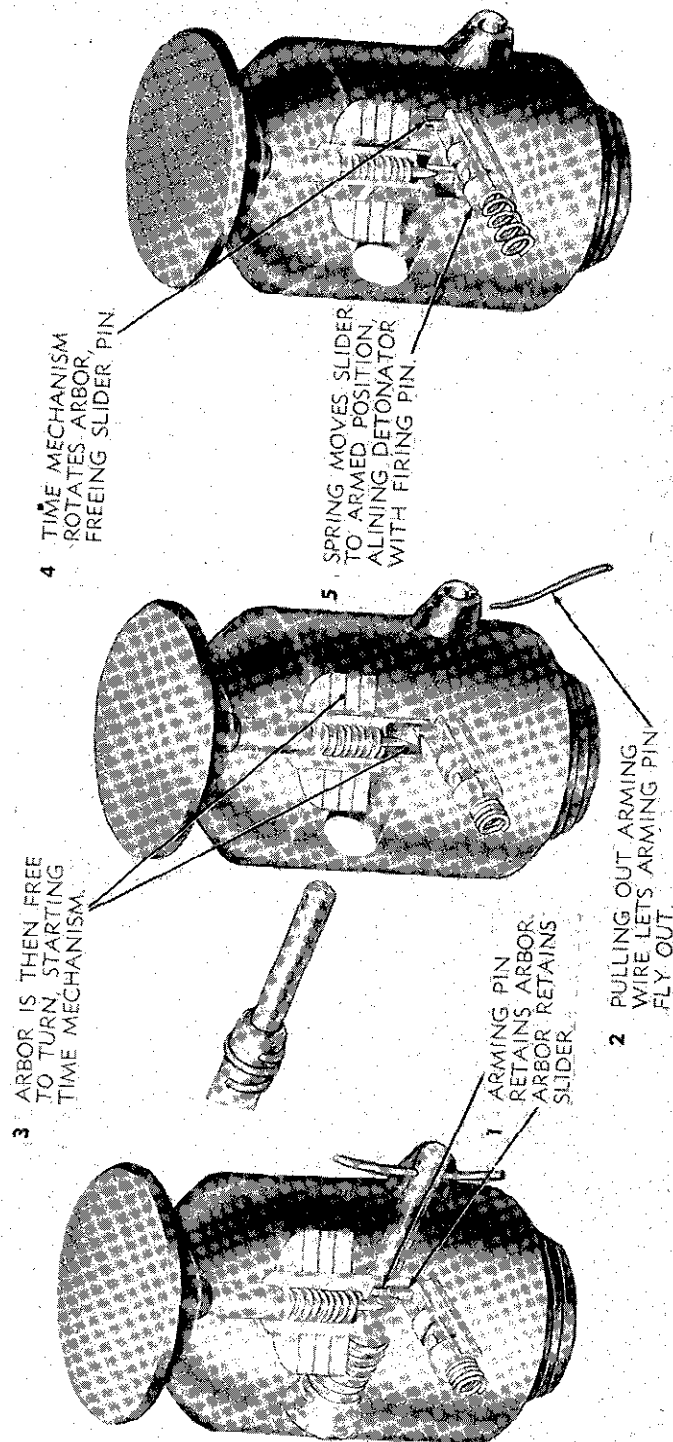
Figure 125. Method of arming—arming-vane-type fuze.

b. Arming. Fuzes are so constructed that they cannot function while they are unarmed. A fuze is considered armed when the next normally expected event will initiate functioning of the fuze; that event may be impact (impact fuzes), time train running to completion (mechanical-time fuzes), or approach to the target (VT fuzes). As shipped, the fuzes are in a safe (unarmed) condition. In an unarmed fuze, the firing pin is mechanically restrained from initiating the explosive train of the fuze. In a "detonator-safe" fuze, the explosive train is interrupted, since the detonator is held out of line with the firing pin and booster lead until the fuze arms.

- (1) *Arming-vane type fuzes* (fig. 125). When the arming wire is withdrawn on release of the bomb, the vane rotates in the airstream. The rotation is transmitted, generally through a reduction gear train, to a shaft or threaded stem in the fuze. In VT fuzes, a shaft turns a rotor, bringing the detonator into line and also connecting it in the electrical firing circuit. Mechanical arming delay devices can also be attached to certain VT fuzes to increase the arming delay. The device has its own vane and reduction gears. The device prevents rotation of the fuze vane until a preset amount of air travel has been accomplished. In other nose fuzes, the rotation unscrews an arming screw and releases an arming stem, causing the detonator to move into line in the detonator-safe type. Safety blocks are also ejected from between the striker and the fuze body, thus freeing the firing pin from restraint. In tail fuzes, the rotation unscrews an arming stem from an inertia-type firing pin or cocked (spring-loaded) firing pin, thus releasing the firing pin to function at preset time (mechanical-time fuzes) or on impact. A definite number of turns of the vane is required to arm each model of fuze. The speed of rotation of the vane under like conditions depends on the angle of twist of the vane blades; hence different vane models may be used with the same fuze model to produce the desired arming time. Anemometer wind vanes (w/cup-shaped blades) are used to produce rotation of the vane in the plane of the airstream. Such vanes are required for sidearming tail fuzes that are used on some bombs.
- (2) *Arming-pin-type fuzes* (fig. 126). When the arming wire is withdrawn on release of the bomb, the arming pin is ejected. The ejection of the arming pin may arm the fuze directly. Usually, this ejection initiates a powder train or clockwork mechanism that arms the fuze after a predetermined time.

c. Functional Types of Fuzes.

- (1) *Mechanical time.* Nose and tail mechanical-time fuzes (fig. 127) function to explode the bomb a certain number of seconds after release. Armed fuzes will also function on impact. The fuze contains an arming pin as well as an arming vane. Ejection of



RA PD 15024B.

Figure 126. Method of arming—arming-pin-type fuze.

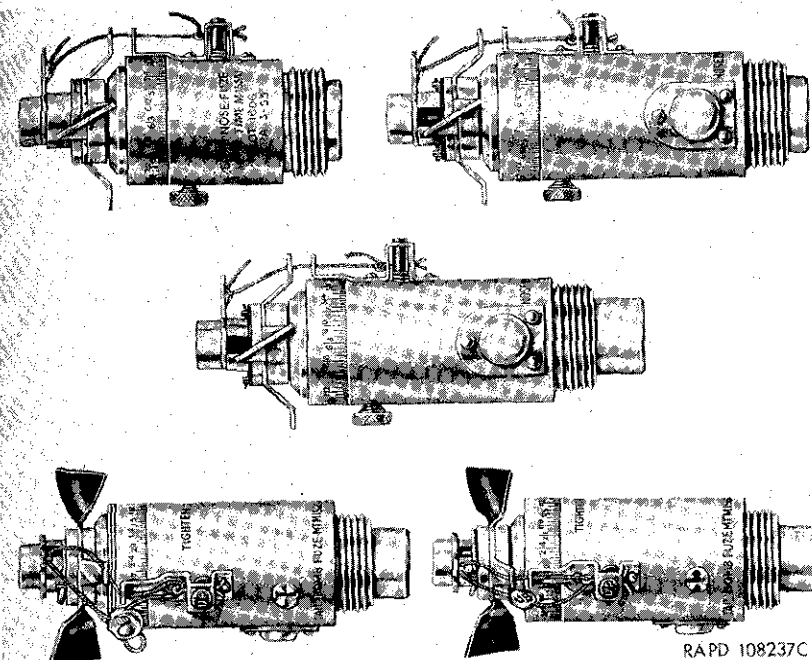


Figure 127. Mechanical-time nose and tail fuzes.

the arming pin on withdrawal of the arming wire (which actually takes place about 0.2 second after release) initiates the action of the mechanical-time (clockwork) mechanism. In addition to mechanical arming actuated by the arming vane, a "time arming" feature is incorporated in the time mechanism of most models. Time arming means that the fuze is unarmed (usually because the detonator is kept out of line) until the time mechanism has run for a fixed time interval. The running time of the mechanism is usually adjustable and can be set when the complete round is assembled or as long as the fuze is accessible. A typical time range is 5 to 92 seconds. One type of body fuze has a mechanical-time mechanism that is set at manufacture to function with a delay time of 10, 20, 30, 40, 50, or 60 minutes.

- (2) *Impact.* Nose and tail impact fuzes (fig. 128) begin their function when the bomb strikes a resistant material. Fuzes classed instantaneous (nose) or nondelay (tail) act to explode the bomb when the striker of the fuze hits the target or when the inertia plunger strikes the fuze primer, respectively. The inherent delay in functioning is about 0.0005 second for the instantaneous and for the nondelay type. Impact fuzes classed as delay contain an element that delays the explosion of the bomb until a

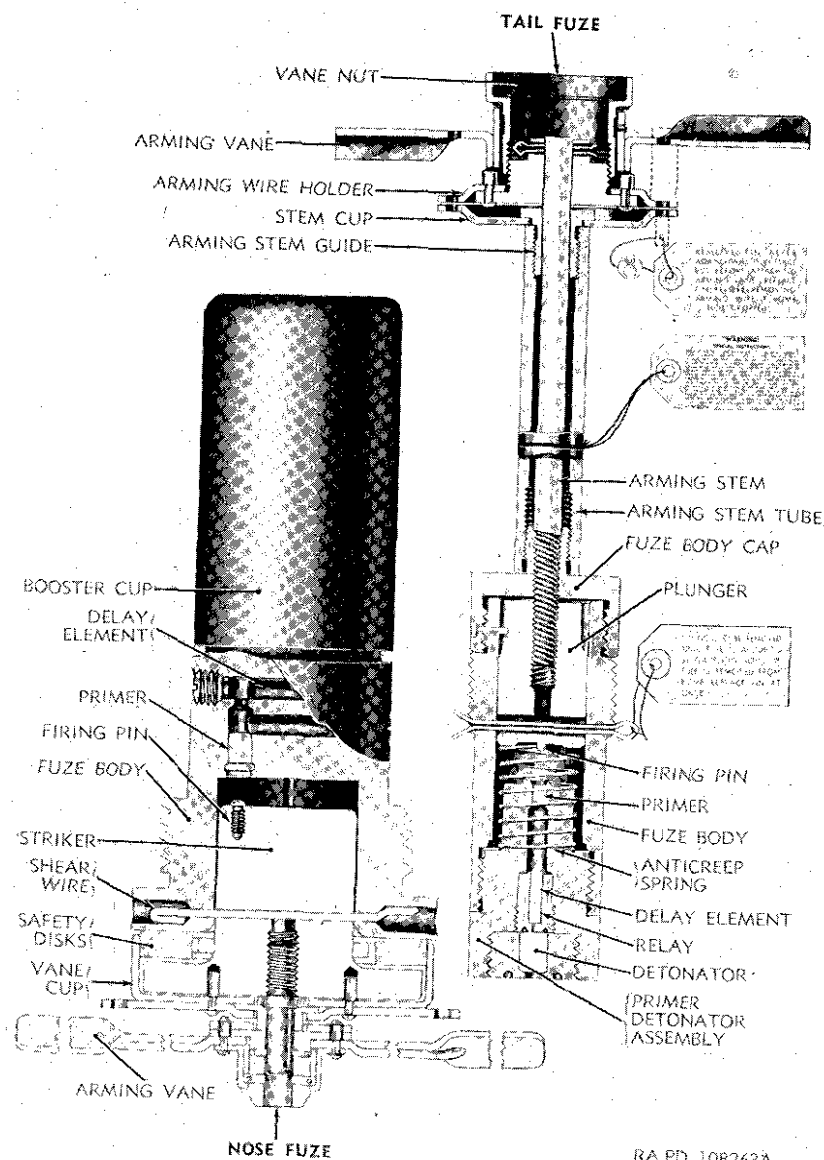


Figure 128. Impact nose and tail fuzes—sections.

fixed time has elapsed after impact. The delay may be provided by a slow-burning delay charge, a clockwork mechanism, or a chemical reaction. The slow-burning element is used in nose or tail fuzes to provide short delay times (less than 1 sec.) and in tail fuzes to provide medium delay times (4 to 15 sec.). A chemical reaction is used in tail fuzes to provide long delay

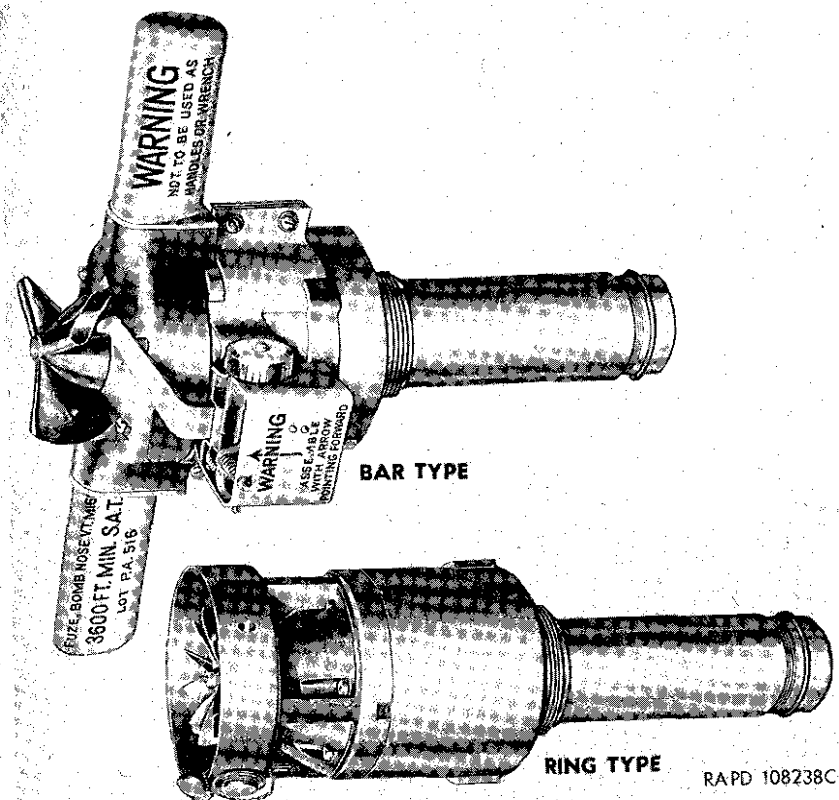


Figure 129. VT fuzes.

- times (10 min. up to 144 hr.). Antidisturbance fuzes detonate the bomb only if the fuze is disturbed after impact.
- (3) *Hydrostatic.* Hydrostatic fuzes (fig. 118) act under the influence of water pressure to explode a bomb at a predetermined depth below the surface. They are used in depth bombs for antisubmarine warfare. Hydrostatic fuzes are usually tail fuzes of the arming-vane type. Before assembly to the bomb, they can be set for depths of 25, 50, 75, 100, or 125 feet.
 - (4) *Proximity (VT).* Standard VT bomb fuzes (fig. 129) are self-contained electronically operated fuzes that function as automatic time fuzes, without setting or adjustment, to detonate the bomb as it approaches the target. They produce air bursts at heights between 20 and 125 feet over average land. A VT fuze is a nose fuze with a vane that arms the fuze mechanically and electrically and also drives an electric generator. The generator furnishes power to charge a firing capacitor and to operate a radio transmitting and receiving unit. In flight, the

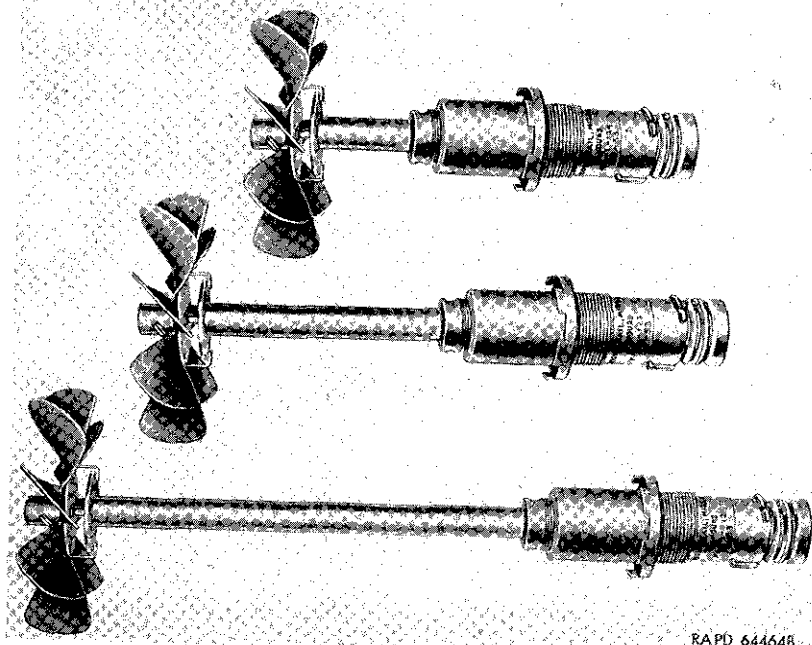


Figure 130. Series of tail fuzes.

fuze broadcasts a continuous radio signal. When this signal is reflected from an object to the armed fuze, the reflected signal interacts with the transmitted signal to produce beats. When the beat reaches a predetermined intensity, it trips an electronic switch that permits the firing capacitor to discharge through an electric detonator, thus exploding the bomb. There are two types of VT fuzes, the bar and the ring, which differ in behavior as well as appearance. Bar-type fuzes generally produce somewhat higher bursts than ring-type fuzes and are less apt to show a variation in burst height as the bomb type is varied. The bar-type fuzes give higher burst heights for steep angles of approach to the target where the ring-type fuzes produce higher burst heights for shallow angles of approach.

d. *Differences Between Nose and Tail Fuzes.* In addition to the general methods by which nose and tail fuzes are held unarmed (b(1) above) and the forces acting on the firing pin on impact (c(2) above), there are other differences between nose and tail fuzes, which are due to their relative positions on the bomb. The position of the vanes is reversed for the two types; to adapt a nose fuze for use as a tail fuze, as has been done for some mechanical-time fuzes, the pitch of the vane blades is reversed. Tail fuzes are more protected than nose fuzes in that they are not subjected to the striking force of the complete round on impact. For this reason,

the long-delay chemical fuzes are tail fuzes only. The arming vane of a tail fuze on a fin-stabilized bomb must be positioned near the rear of the fin assembly so as to project into the airstream. For this reason, the vane is separated from the fuze body by a long arming stem. Series (fig. 130) of tail fuzes that differ only in the length of the arming stem are provided for use with bombs of different sizes. Tail fuzes with arming stems of special lengths are provided for use with conical fin assemblies that are longer than the corresponding box-type fin assemblies. In the case of fin-stabilized bombs, using side-arming tail fuzes, the arming vane is located near the forward end of the fin assembly.

94. Arming Wire Assemblies

Arming wire assemblies are used to prevent arming of fuzes while fuze bombs or clusters are being loaded or carried in aircraft or to permit the rounds to be dropped safe. An arming wire assembly consists of a length of brass wire, to which a swivel loop is attached, and separate Fahnestock clips. A single (1-branch) assembly, used for one fuze only, has the swivel loop at one end. A double (2-branch) assembly, used for two fuzes on the same bomb, has the swivel loop between the ends. Multibranch assemblies are used for quick-opening adapters, which are equipped with release mechanisms or time fuzes. The wire is threaded through holes in the fuze arming pin or vane tab and usually held in

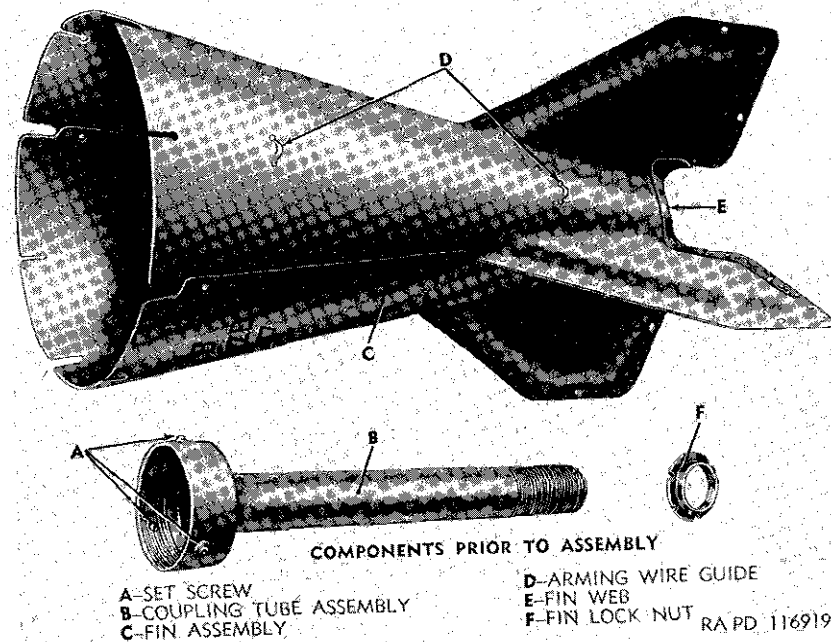


Figure 131. Conical fin assembly.

place by safety clips (Fahnestock). The swivel loop is attached to a pawl on the shackle. Normally, the arming wire assembly is retained in the aircraft when the round is dropped so that the wire is withdrawn from the fuze permitting the fuze to arm. When the bomb or cluster is dropped safe, the arming wire assembly is released at the same time and prevents the fuze from arming. The models of arming assemblies authorized for different rounds differ in number of branches and in the diameter and length of the branches.

95. Fins

a. General. A fin assembly is usually used to stabilize a bomb or aimable cluster in flight. Some other means of stabilization, such as a parachute unit, may be required by the tactical use of the bomb.

b. Fin Assemblies. Fin assemblies are made of sheet metal. The box-type assembly consists of a fin sleeve that fits over the tail of the bomb and is secured by a fin locknut and fin blades fabricated to the sleeve forming a square box-like assembly. Although more recent designs require the use of heavier gage steel to strengthen the assembly, box-type fins are not strong enough for use on bombs dropped from high altitudes or carried externally on high-speed aircraft. For this use, conical fin assemblies (fig. 131) have been developed. The conical fin assembly consists of an elongated fin cone (fin sleeve) and four streamlined blades assembled perpendicularly to the cone. In some cases, a coupling tube assembly and fin locknut is used to secure the assembly to the bomb. In other cases, the fin assemblies are attached to the bomb by means of

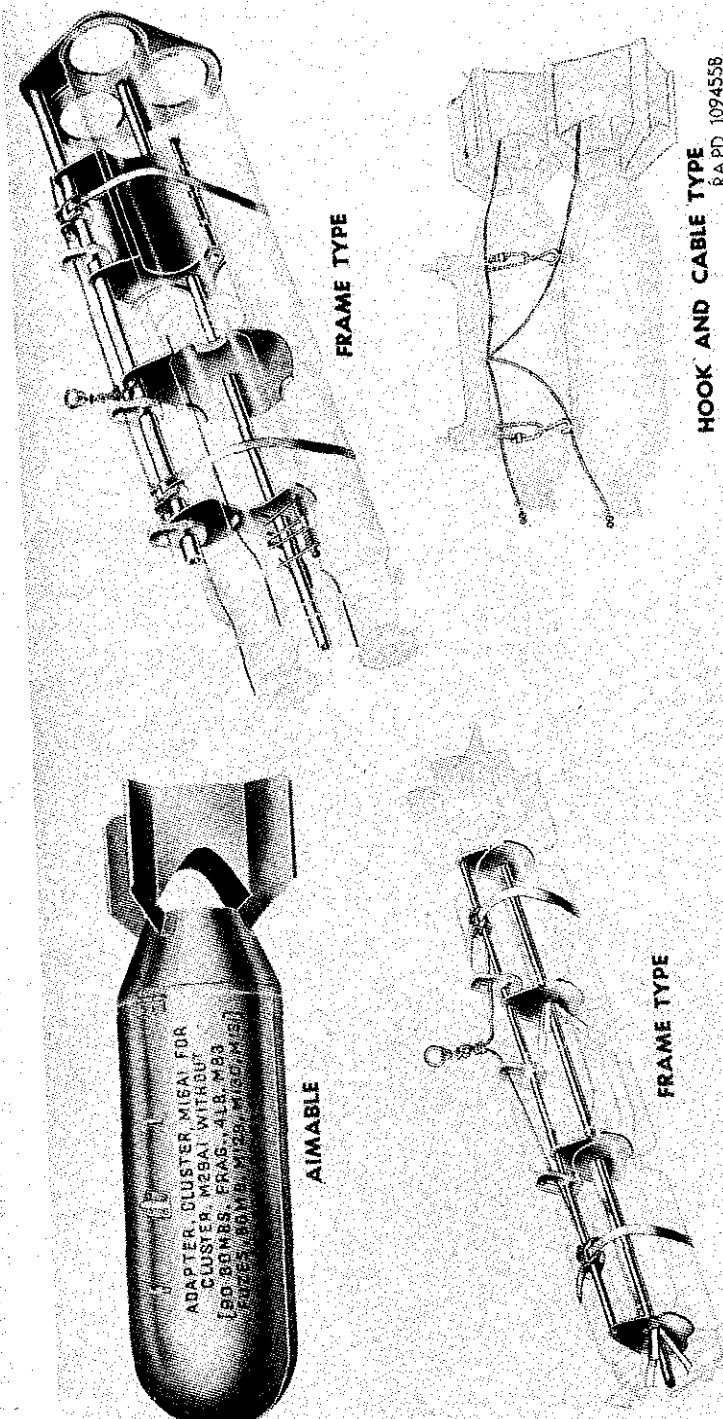
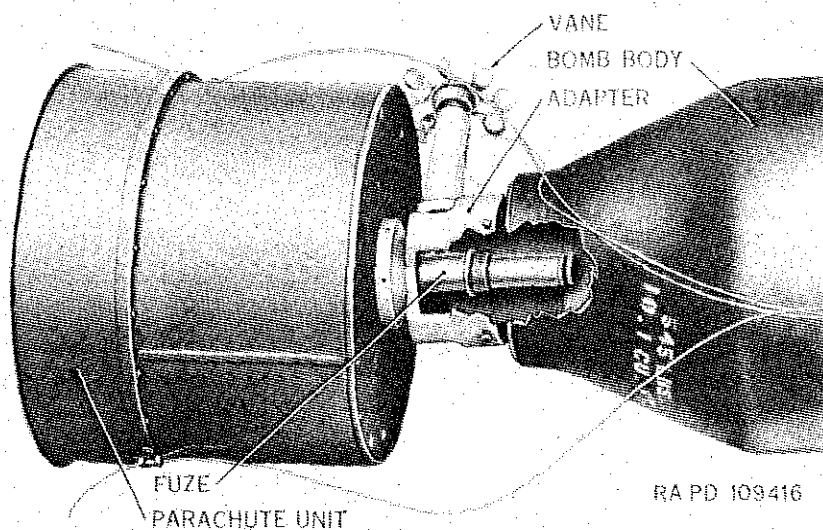


Figure 133. Types of cluster adapters.

radial screws or by bolts. For some 100-pound and all larger bombs, the fin assembly is packed and shipped separately from the bomb body. The assembly is attached to the body when the complete round is assembled.

c. Other Means of Stabilization. For low-altitude bombing, some bombs are equipped with parachute units, in place of fin assemblies, to retard the fall of the bomb. The unit consists of a closed metal case containing the parachute and its attachment. The cover is removed by withdrawal of the arming wire or by means of a hangwire when the bomb is released. Tail fuzes are generally not used in parachute bombs. A modified (anemometer vane) tail fuze and a fuze adapter are required for this use. When an adapter and modified fuze are furnished with a parachute unit, the complete kit is called an antiricochet device (fig. 132). The means of stabilization used with the 4-pound "butterfly" fragmentation bomb (fig. 120) is the metal "butterfly wing" assembly described in paragraph 92a(6)(d).

96. Clusters and Adapters

a. General. A cluster consists of several bombs that are suspended and released from a carrying station in the aircraft intended for one bomb. The mechanical devices required to accomplish this suspension are called adapters (fig. 133). Adapters are of three types: quick-opening (frame), aimable, and hook and cable.

b. Quick-Opening (Frame) Adapters. This type consists of a frame to which several bombs are attached by means of straps, thus forming an assembly that may be suspended and released as a unit. The straps are fastened with clamps that may be released when the arming wire is withdrawn or by the action of a time fuze to provide for delay opening. The frame is also equipped with a fuze lock that prevents arming of the bomb fuzes until after the bombs are released from the cluster.

c. Aimable Adapters. This type consists essentially of a streamlined metal body to contain the clustered bombs, a fin assembly or other means of stabilization, and a time fuze. The fuze actuates the opening of the body to release the individual bombs from the adapter at the time desired. Some models of aimable adapters can be equipped with a spoiler ring at the nose and a drag plate over the rear end of the fin assembly to alter the trajectory.

d. Hook and Cable Adapters. This type consists of a set of hook and cable assemblies, by means of which several bombs or clusters may be suspended from the same station. This type of adapter differs from the other two types in that it serves only as a means of hanging more than one bomb or more than one cluster of bombs to a shackle. Once the hook and cable cluster is released from the plane, all the items (bombs or clusters) fall freely. The items can be released safe since each item is provided with its own arming wire.

97. Care and Precautions in Handling

The general precautions in *a* through *h* below will be observed in handling bombs and components, in addition to the precautions in TM 9-1980.

a. Bombs and bomb components will be stored as shipped.

b. Complete rounds will not be assembled in advance of requirements, and those rounds prepared for use but not used will be disassembled and returned to storage.

c. Assembled rounds will be carried with sealing wires and safety pins in place at all times up to the time of installation in the plane. The arming wire will remain in place until the bomb is released or the safety pins and sealing wire are replaced and secured.

d. Packings will not be opened until the items are required for use or inspection. Partly used boxes will be resealed and marked and will be used before other boxes are opened.

e. Packing will not be opened, repaired, or replaced within 100 feet of stored explosives.

f. Fuzes should be protected against shock, moisture, and high temperature. Boxes containing fuzes must not be subjected to any friction or jarring.

g. No attempt will be made to disassemble any fuze without authority of the chief of the technical service concerned.

h. Since most clusters of bombs, unlike other bombs, are stored and shipped fuzed, they must be handled with extreme care. Boxed clusters must be handled with the same care as boxed fuzes. When a box containing a cluster is opened, the cluster must be inspected to insure that the fuze safety devices are in place.

98. Packing and Marking

a. Packing. In general, bombs are shipped unfuzed with the fuze holes closed by metal shipping plugs. Large bombs are shipped uncrated with shipping bands that protect the suspension lugs. Some bombs, to which protruding suspension lugs are not assembled during shipment, are shipped without shipping bands. The very large bombs are shipped on skids or pallets. The fin assemblies of all large bombs are shipped separately in metal or wooden crates, cartons, or wooden boxes. Some smaller bombs are shipped finned in metal crates. Small fragmentation bombs are packed in wooden boxes, sometimes with fuzes in the same box. Clusters of bombs are shipped fuzed in metal drums, wooden boxes (usually metal-lined), or sealed containers. Fuzes are shipped in individual sealed containers packed in quantity in wooden boxes. Miscellaneous components such as arming delays, primer-detonators, adapter-boosters, and vane assemblies are generally packed in wooden boxes.

b. Marking. Wherever appropriate, the color scheme used for painting the bombs (par. 10a(2)) is used on the packing boxes or crates. All in-

GROUND

- B—SIGNAL, FLASH AND SOUND, M74
- C—SIGNAL, DISTRESS, 2 STAR, AN-M75
- E—[SIGNAL, GROUND STAR AND SMOKE, M125 THROUGH M130 AND [SIGNAL, DISTRESS, RED STAR, PARACHUTE M131]
- F—SIGNAL, GROUND, HIGH BURST RANGING, M27A1B1
- G—SIGNAL, GROUND (GRENADE LAUNCHER TYPE)
- N—FLARE, AIRPORT, M76

AIRCRAFT

- A—[SIGNAL, AIRCRAFT, SINGLE STAR, DOUBLE STAR, [AND TRACER DOUBLE STAR
- D—CARTRIDGE, PHOTOFLASH, M112
- H—MARKER, SLICK, AN-M59
- J—FLARE, AIRCRAFT, PARACHUTE, M9A1
- K—FLARE, TOW-TARGET, M50
- L—FLARE, TOWED, M77, M78, M79
- M—FLARE, AIRCRAFT, PARACHUTE, M8A1
- P—FLARE, AIRCRAFT, PARACHUTE, M26A1

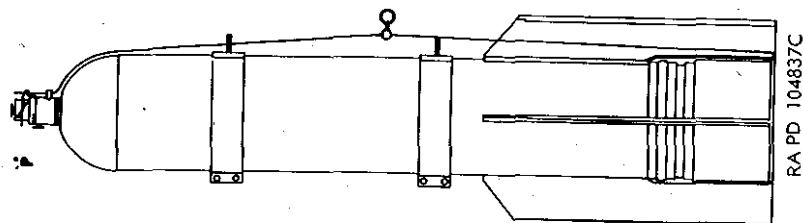


Figure 134. Military pyrotechnics—types and comparative sizes.

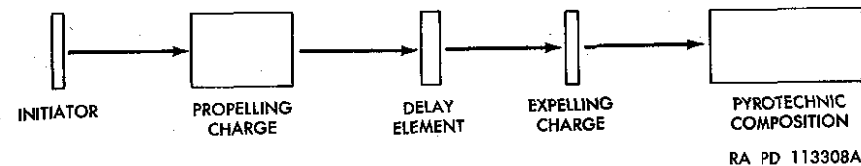


Figure 135. Representative ignition train for pyrotechnics.

formation for identification and directions for shipping are marked on containers for bombs and components and on the bomb bodies when no container is used.

Section V. PYROTECHNICS

99. General

a. *Definition.* Military pyrotechnics (fig. 134) are items of ammunition used in military operations for producing light for illumination, smokes or lights for signaling, or sound to simulate battle noises and effects in training. For detailed information on military pyrotechnics, see TM 9-1981. Illuminating and colored smoke grenades, illuminating and colored smoke artillery shell, and photoflash and target-identification bombs are described in other publications and referred to in paragraph 102c.

b. *Complete Round.* Pyrotechnics are usually issued in the form of complete rounds, each consisting of all the elements necessary for functioning. Large aircraft pyrotechnics, as in the case of photoflash and target-identification bombs, are issued separately and fuzes therefor, also issued separately, are fitted in the field. These fuzes are of the mechanical-time, nose, delay-arming type (pars. 90-98).

c. *Ignition Train.* Pyrotechnics generally function by means of an "ignition train" (fig. 135), similar to the "explosive train" of other ammunition. The train is initiated by means of a primer, which may be of the percussion, friction, or electric type. The flame produced on initiation is transmitted successively to a propelling charge delay element, expelling charge, and finally to the pyrotechnic composition. One or more of the intermediate elements between initiator and pyrotechnic composition may be omitted depending upon the requirements of the pyrotechnic.

d. Pyrotechnic Compositions.

- (1) In general, pyrotechnic compositions consist of physical mixtures of various combinations as described in (a) through (e) below.
 - (a) Oxidizers such as chlorates, perchlorates, peroxides, chromates, and nitrates that provide some oxygen for burning. Pyrotechnic compositions may not always contain sufficient

oxygen for burning and, in such cases, must use oxygen from the air.

- (b) Fuels, such as aluminum and magnesium powder, their alloys, sulfur, lactose, and other easily oxidizable materials.
 - (c) Binders and waterproofing agents, such as asphalt, shellac, linseed oil, resins, resinates, and paraffin.
 - (d) Organic dyes or inorganic salts are used to produce colored smokes.
 - (e) Color intensifiers, such as polyvinyl chloride, hexachlor benzene, and other organic chlorides. In some cases, a single material may perform more than one of the functions in (a) through (d) above.
- (2) Pyrotechnic smoke compositions are of two general types.
- (a) Those that burn with practically no flame but with the formation of a dense colored smoke as a product of combustion.
 - (b) Those that burn at a temperature so low that an organic dye ((1) (d) above), in the composition will only volatilize rather than burn and hence will color the smoke.

e. Identification. In addition to the means of identification as described in paragraphs 4 through 13, signal types are marked with colored bands or patches to indicate the color of the signal produced. The top of a launcher-type ground signal is painted the color of the signal and is also marked with two embossed letters for identification in the dark. The first letter is the initial of the color. The second letter indicates the type, "P" for parachute or "S" for star (fig. 13). Overage flares and those of substitute composition, assigned to training, have a 2-inch blue band stenciled around the body; they may also be stenciled "FOR TRAINING USE ONLY." For the information of those installing the flare M8A1 in airplanes, the word "FRONT" is stenciled on the front of the case, and the location of suspension bands is indicated by black bands painted on the case. Guide flares have a patch on the closing cover indicating the color of the flare. Embossed points at the center of the patch permit identification in the dark. One, two, or three embossed points identify the T6E1 (white), T7E1 (red), or T8E1 (green), respectively.

f. Projection. Mechanical equipment, mounted in an airplane, or a pyrotechnic pistol is usually required to launch or project aircraft pyrotechnics. Signals that are fired from the ground are projected as indicated in (1) through (5) below.

- (1) Pyrotechnic projector or pistol.
- (2) Grenade launcher (FM 23-30) attached to a small-arms rifle or carbine, each using a *special* blank cartridge. Only the caliber .30 rifle grenade cartridge M3 is used when firing ground signals from rifles, and only the caliber .30 carbine grenade cartridge M6 is used when firing ground signals from carbines.

Caution: Neither *regular* blank cartridges nor bulletted cartridges will be used in connection with firing signals.

- (3) Hand-held.
- (4) Hand-held expendable launcher that forms part of the signal assembly for rocket-assisted signals (par. 108b(2)).
- (5) Manually operated (lanyard-type) ground signal projector mounted on a staff-like support that is anchored to the ground by a spike.
- (6) Some simulators burn in place; others are thrown by hand. The white smoke puff charge is fired from a smoke puff discharger; powder from the charge, which is ignited by a smoke puff percussion cap, serves as the propellant. The gunflash simulator is fired from a steel firing tube imbedded in earth or sand bags.

100. Classification

Pyrotechnics are classified according to purpose as illuminants, signals, and simulators; and, according to use, as aircraft and ground.

101. Visibility

- a. The principal factors controlling the visibility of pyrotechnics are design, position, and natural conditions of light and atmosphere.
 - (1) Factors of design include luminous intensity (candlepower); color (hue and degree of color saturation); and degree of separation of a composite signal.
 - (2) Factors of position include height at which the flare or signal functions; distance of observer from signal; distance of flare from objective to be illuminated; background; and relative position of flare, objective, and observer.
 - (3) Natural conditions of light and atmosphere are influenced by degree of natural illumination; color and brightness of the sky; and clarity of the atmosphere as affected by presence of haze, fog, dust, smoke, rain, or snow.

Table IV. Pyrotechnic Types and Candlepower

Type	Candlepower
Trip flare or tow target.....	50,000.
Illuminating projectile.....	300,000 to 1,000,000.
Airport flare, fusees.....	60,000.
Aircraft parachute.....	60,000—750,000—900,000.
Reconnaissance and landing.....	800,000.
Photoflash cartridge.....	120,000,000 peak—duration 0.03 second.
Photoflash bomb.....	80,000,000 candle—second for optimum 0.040 second.*
Signals—white.....	50,000 for 20 to 30 seconds.
green.....	5,000 for 20 to 30 seconds.
amber.....	4,000 for 20 to 30 seconds.
red.....	20,000 for 20 to 30 seconds.

*3,000,000,000 to 4,000,000,000 candlepower at peak.

b. A table of pyrotechnic technical data pertaining to specific items is published in TM 9-1981. Tables of factors including candlepower of specific items and optimum height, area illuminated, and distance for pyrotechnic suitable for battlefield illumination are published in TC 30 (1952), pending revision of the pertinent field manual. Table IV shows candlepower of various types.

102. Types

a. *General.* Types of pyrotechnics (fig. 134) consist of flares, signals, photoflash cartridges, and items designed for various kinds of training in the use of pyrotechnics.

b. *Purposes.* Flares are designed to provide a strong light for an appreciable period to illuminate terrain for various air and ground tactical operations. Types of flares consist of aircraft flares (projected from aircraft), ground flares (operated on, or projected from, the ground), guide flares, and ignition flares. Signals are designed for both aircraft and ground use for various types of signaling in tactical and protective operations. Photoflash cartridges are designed for use in connection with aerial photography at 500 to 8,500 feet during reconnaissance missions. Pyrotechnic training items are designed to provide targets for antiaircraft gunnery practice and to provide devices that simulate ammunition items in order to accustom troops to combat conditions.

c. *Pyrotechnic Compositions in Illuminating and Signaling Grenades, Artillery Shell, and Bombs.* Grenades using pyrotechnic compositions are designed for illumination or signaling in nearby combat areas; for detailed information pertaining to these grenades, see paragraphs 64 through 70 and FM23-30. Artillery shell using pyrotechnic compositions are designed for use in lighting and signaling in the area of distant objectives; for information pertaining to these shell, see paragraphs 71 through 89 and TM 9-1901. Photoflash bombs, which use pyrotechnic compositions, are designed to produce light for high-altitude (up to 50,000 ft.) night photography; for information pertaining to these bombs, see paragraphs 90 through 98 and TM 9-1980. Target-identification bombs, which use pyrotechnic composition, are designed for use in identifying targets for bombing groups; for information pertaining to these bombs, see paragraphs 90 through 98 and TM 9-1980.

103. Aircraft Flares

Flares for aircraft use furnish illumination for reconnaissance, observation, bombardment, landing, and practice firing for antiaircraft guns. These flares produce a white or yellow-white light of 60,000 to 1,000,000 candlepower for periods ranging from 1 to 3 minutes depending on the design of the particular model. They are generally parachute supported to retard their speed of fall and thus provide a longer interval of illumination. The flares have some form of delayed ignition to insure their clearing the plane as they descend to a specified altitude before starting

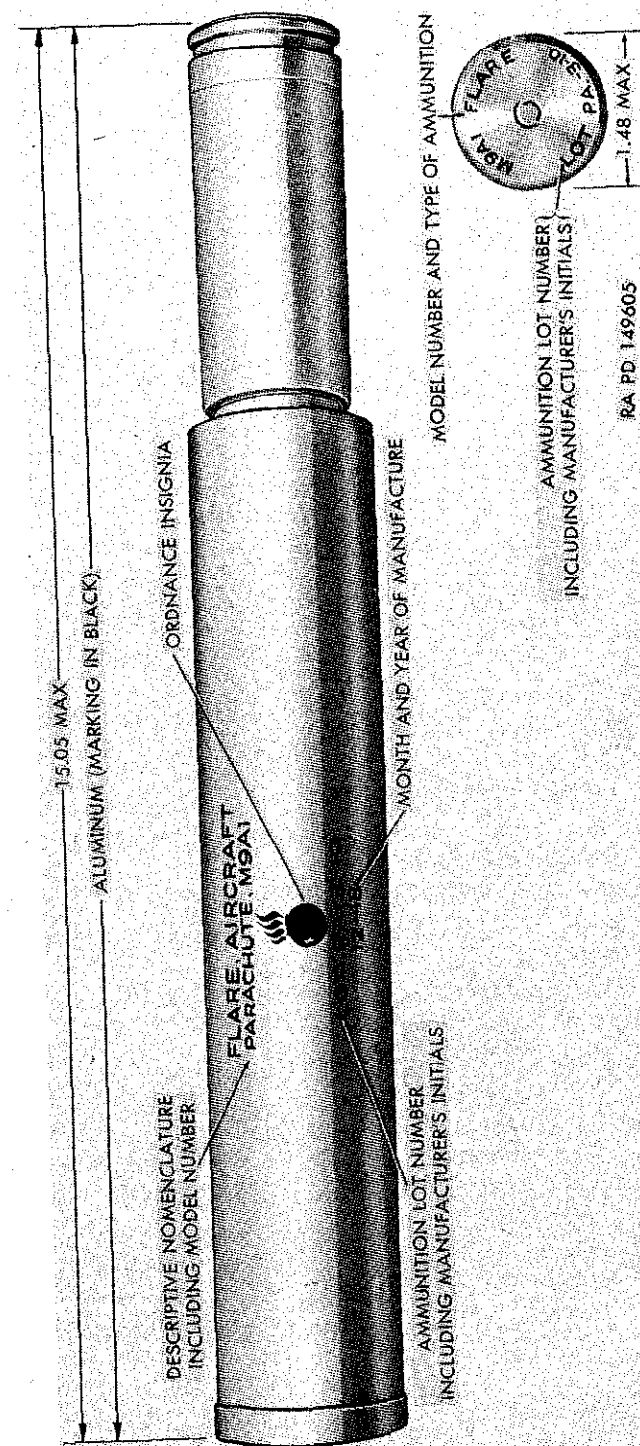


Figure 136. Flare, aircraft, parachute, M9A1.

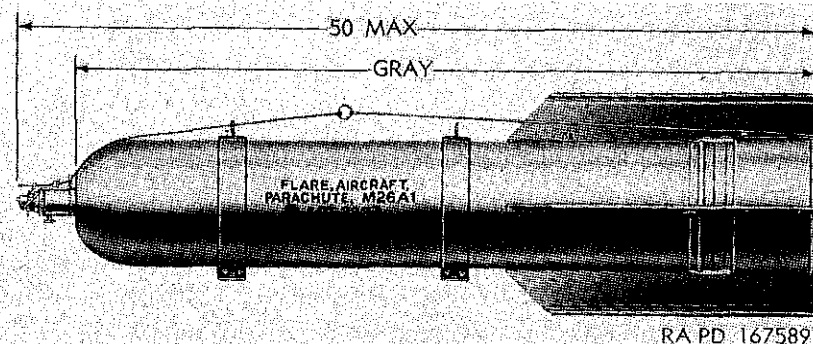


Figure 137. Flare, aircraft, parachute, M26A1.

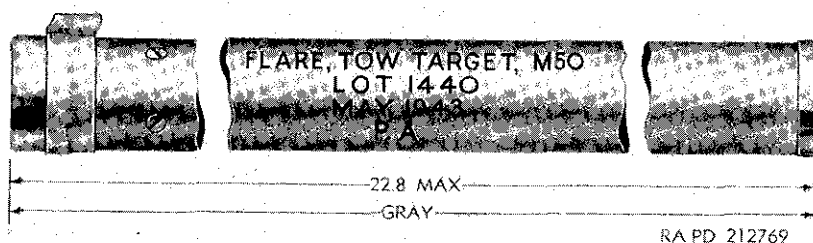


Figure 138. Flare, tow-target, M50.

to burn. Flares intended for use in connection with bombardment are provided with umbrella-type shades to shield the bombardier from the glare. A representative aircraft flare is the parachute flare M9A1 (fig. 136), which is used for reconnaissance. It is fired from pyrotechnic pistol AN-M8 or projector M9 and after a 2½-second delay, during which it drops clear of the airplane, ejects a parachute and ignited candle that burns about 1 minute at 60,000 candlepower. Another representative type of aircraft flare is parachute flare M26A1 (fig. 137), used to illuminate a target for night bombing. The flare is released from a rack in the airplane; a variable time fuze may be set so that the flare will drop 300 to 12,000 feet where the flare ignites and burns up to 3½ minutes with 800,000 candlepower. "Towed" flares are used as assembly markers in flight formations; the towed flares M77 (red), M78 (amber), and M79 (green) differ only in color, candlepower, and hence visibility. "Tow-target" flares are towed by an airplane at the end of a steel cable and provide a target for day and night antiaircraft practice firing. The M50 is shown in figure 138.

104. Ground Flares

Flares for ground use are designed for illumination of airplane landings at emergency fields, for lighting airports in case of power failure, or

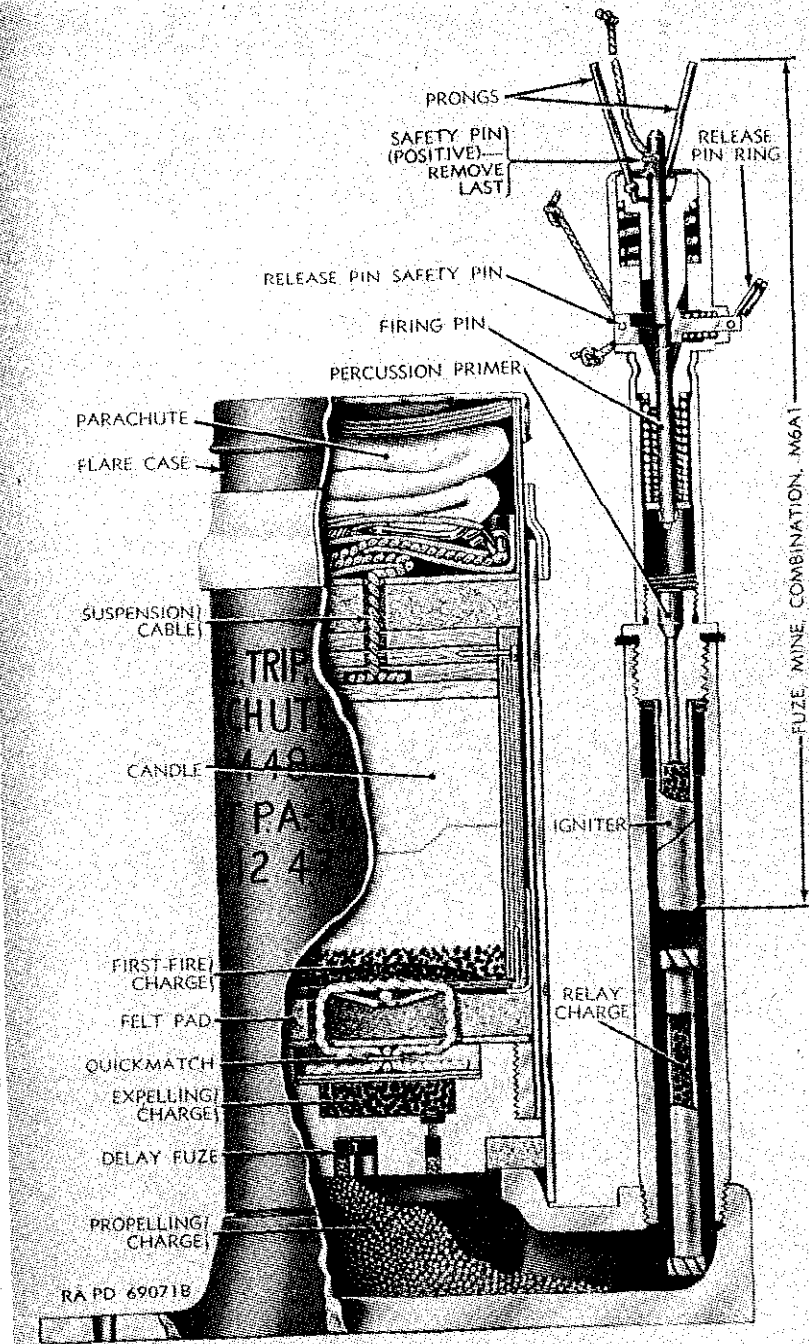


Figure 139. Flare, trip, parachute, M48.

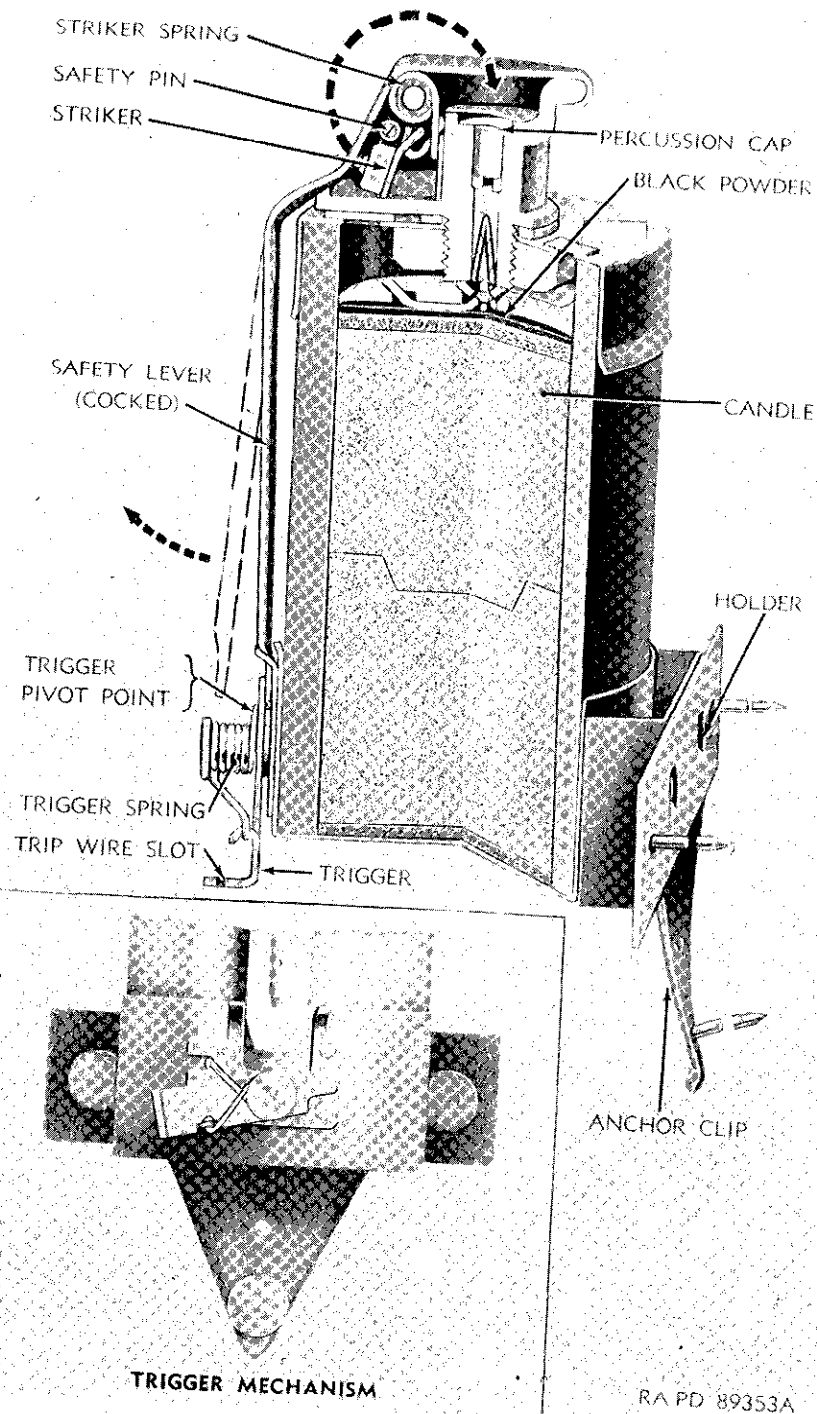


Figure 140. Flare, trip, M49.

to warn of attempted infiltration by enemy troops. Certain ground flares such as fuseses may be used as recognition signals. Representative ground flares are—

a. The airport flare M76, which is a 20-pound cylindrical charge of illuminant (candle) encased in a zinc-sheathed box-board tube fitted with means of ignition, which burns with a yellow flame visible for 5 to 7 minutes at a distance of 20 to 30 miles depending upon atmospheric conditions.

b. The red fusee M72, which is a 20-minute "red-fire" candle for use in outlining airport boundaries.

c. The parachute trip flare M48 (fig. 139), which outwardly resembles the antipersonnel mine M2 series and is set to be actuated by, and thus serve as a warning of the approach of, infiltrating enemy troops.

d. The trip flare M49 (fig. 140), which resembles an offensive hand grenade and is used for booby trapping. For operation of booby traps, see FM 20-32.

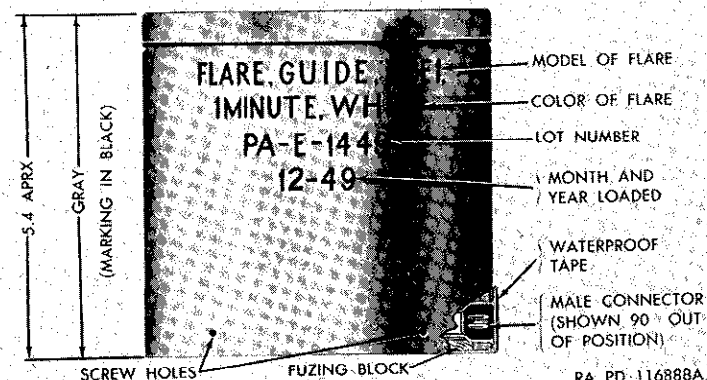
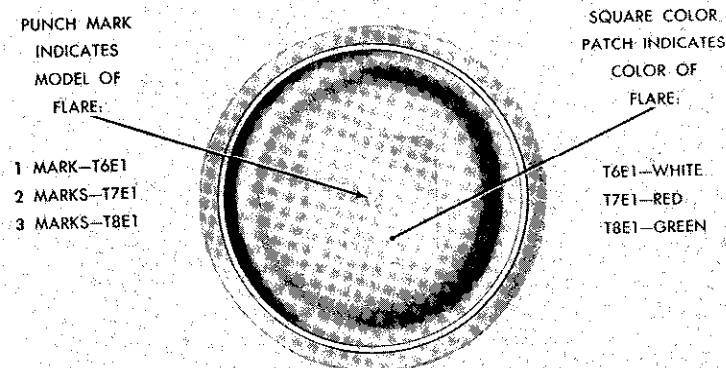
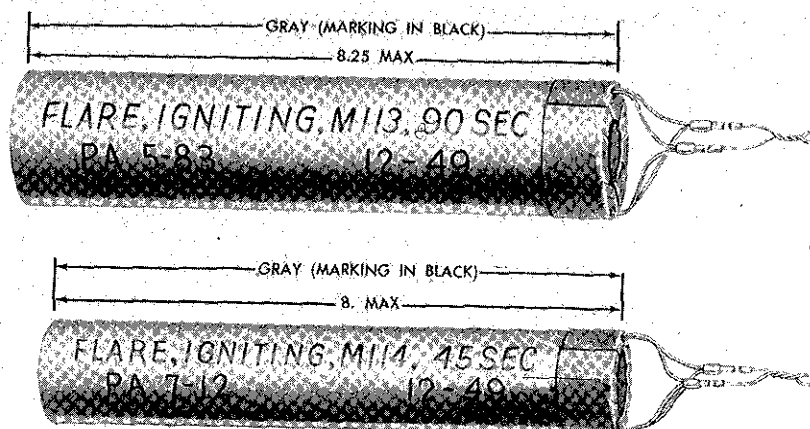


Figure 141. Flare, guide, 1 minute, T6E1 (white).



RA PD 116906

Figure 142. Flare, igniting, M113, 90-second, and flare, igniting, M114, 45-second.

105. Guide Flares

Guide flares are electrically ignited and are intended for use with bombs. The guide flares T6E1 (white) (fig. 141), T7E1 (red), and T8E1 (green) are similar, except for color and candlepower of light produced and marking. They burn for 45 to 60 seconds and produce 650,000, 700,000, and 900,000 candlepower, respectively.

106. Igniting Flares

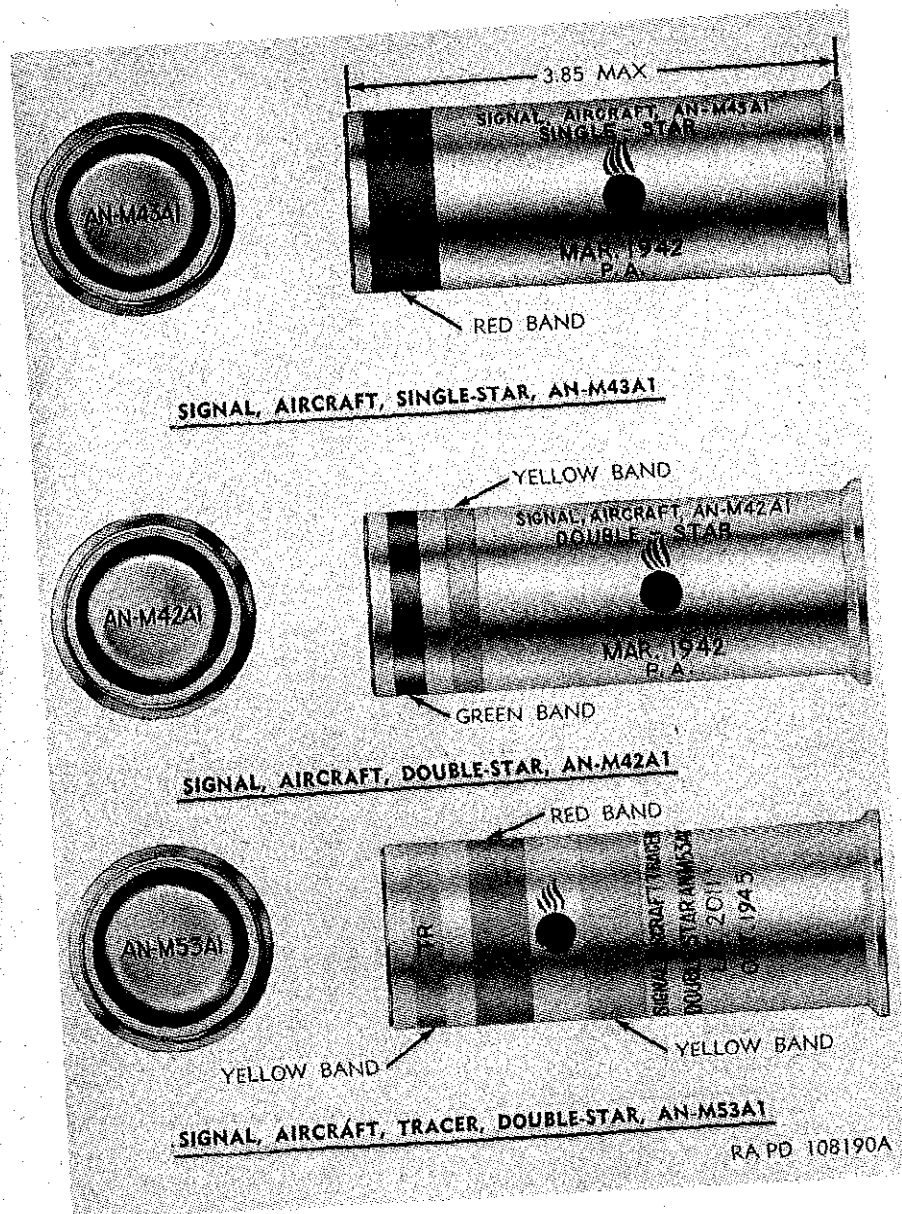
Igniting flares are a special type of electrically ignited flare used to ignite fuel-air mixtures in ram-jet engines of guided missiles. The flares contain a pyrotechnic composition that releases sufficient heat to maintain ignition of the fuel-air mixtures for a length of time dependent upon the model of flare used. The igniting flare M113 (fig. 142) is issued with nominal burning times of 45 and 90 seconds. The igniting flare M114 has a nominal burning time of 45 seconds. Igniting flares M132 through M135 have burning times of 90, 16, 10, and 20 seconds, respectively.

107. Tracking Flares

Tracking flares are a special type of flare for use in the tracking of guided missiles. The tracking flares 75-second M136 (T131) and the 95-second M137 (T132) have nominal burning times as indicated, with 70,000 and 150,000 candlepower output, respectively.

108. Signals

Pyrotechnic signals are designed to produce: light of various intensities, duration, and color; smoke of various colors and densities; sound of various degrees of loudness; or any combination of these. Signals may consist of a single parachute-supported "star" or a number of free-falling



RA PD 108190A

Figure 143. Aircraft signals.

stars or clusters of various colors. Smoke signals are usually of the slow-burning type designed to leave trails of smoke. For complete information on signals, see TM 9-1981. For a guide to the employment of pyrotechnic illuminating devices, see TC 30 (1952), pending revision of the pertinent field manual.

a. *Tactical Aircraft Signals.* Aircraft signals (fig. 143) used directly in

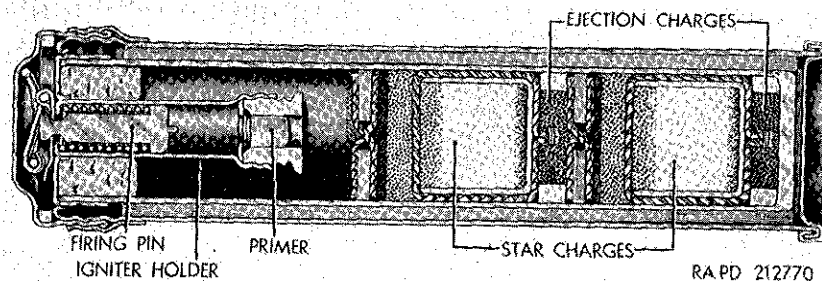


Figure 144. Signal, distress, two star, red, AN-M75 (T49).

connection with combat operations were originally intended for signaling air-to-air or air-to-ground, but since the introduction of pyrotechnic pistol AN-M8 and the hand pyrotechnic projector M9, aircraft signals have been used by ground troops for ground-to-ground and ground-to-air signaling. Single-star signals, double-star signals, and tracer-double-star signals contain green, red, or yellow candles of pyrotechnic composition. Stars may be distinguished at distances up to about 5 miles at night and 2 to 3 miles in daylight. Total burning time is 7 to 13 seconds for both single- and double-star signals. For the tracer-double-star signals, the tracer burns for $2\frac{1}{2}$ to 4 seconds and each star burns for 3 to $4\frac{1}{2}$ seconds.

b. *Distress Signals.* Distress signals for daytime use produce smoke, those for night use produce a light or stars, and those for either day or night produce both smoke and light. Signals, flares, other pyrotechnics or smoke grenades may also be used for distress signaling. Signals intended primarily for distress signaling are hand-held self-contained units.

- (1) A representative two-star distress signal is the AN-M75 (fig. 144), which ejects two red stars, one after the other. It is used at sea from boats or life rafts. The stars, which are projected to a height of 100 to 250 feet, burn for 4 to 6 seconds and can be seen $2\frac{1}{2}$ to 3 miles on a clear day and from 12 to 15 miles on a clear night.
- (2) Another representative type is the parachute signal M131 (fig. 145), which is a ground-type rocket-propelled signal fired from the hand-held expendable launcher, which forms an integral part of the signal, as issued. When fired, this signal reaches an altitude of 1,500 feet and produces a parachute-supported single red star that burns for 30 seconds and is identifiable at distances up to 30 miles.
- (3) The hand smoke distress signal AN-MK 1 Mod 1 (fig. 146) is for daytime use. When ignited, the signal burns for approximately 18 seconds while being held in the hand, producing a brilliant orange smoke.
- (4) The distress signal AN-MK 13 Mod 0 represents the "day and night" type.

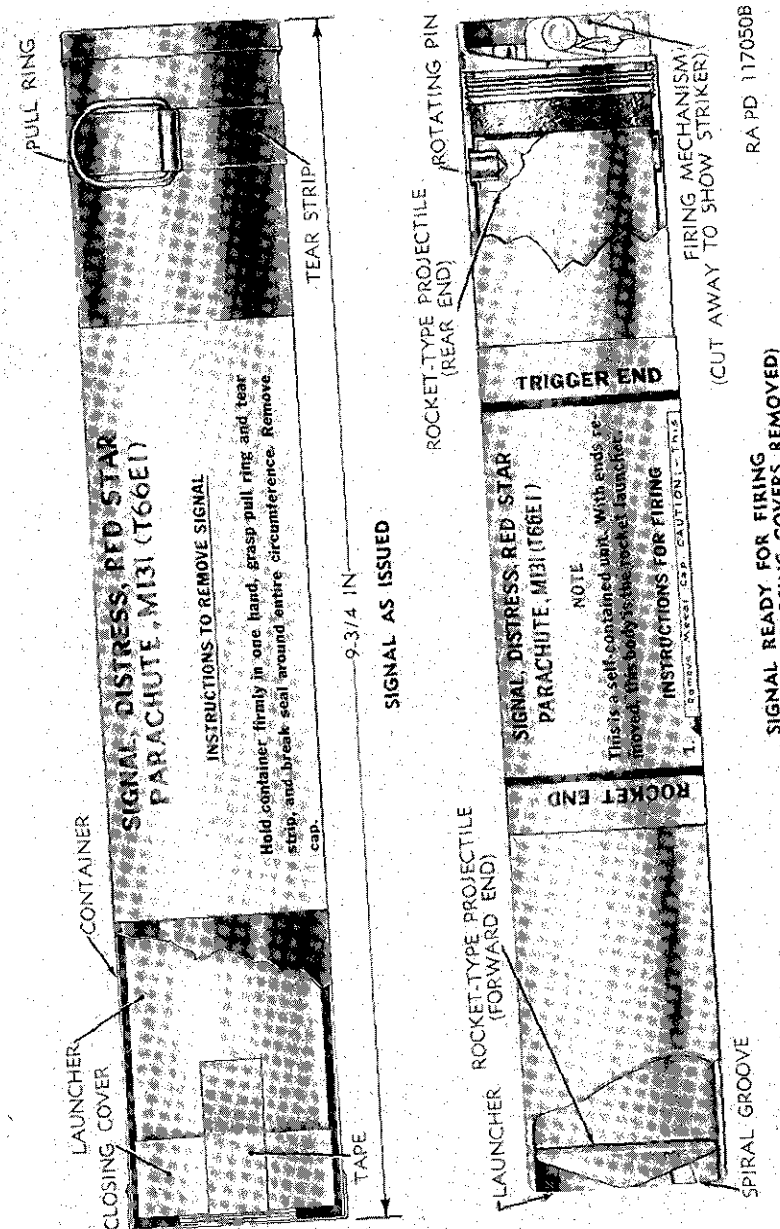


Figure 145. Signal, distress, red star, parachute, M131 (T66E1).

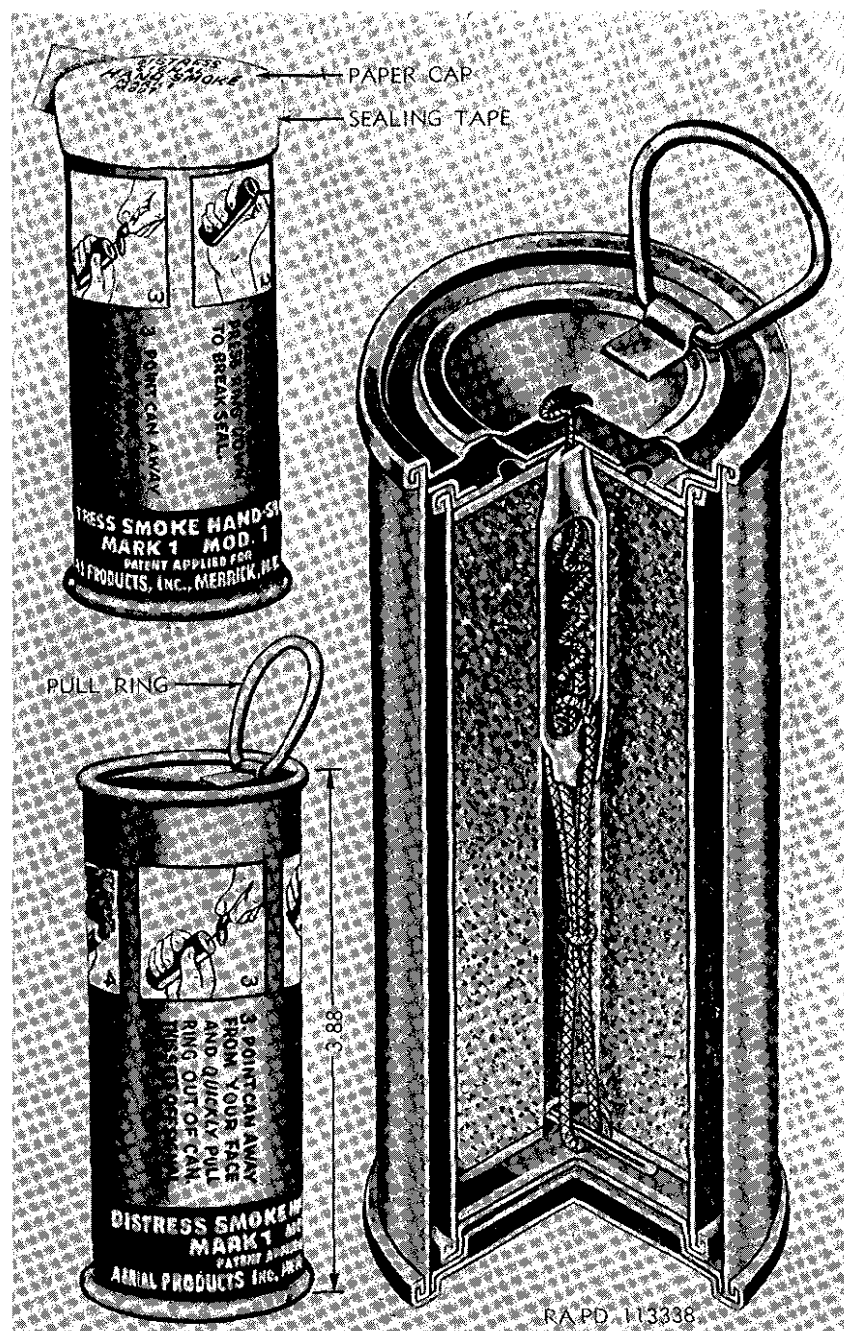


Figure 146. Signal, distress, smoke, hand, AN-MK 1 MOD 1.

c. Drift Signals, Markers, and "Lights."

- (1) These pyrotechnic devices are used by aircraft over water as an aid to navigation by providing a stationary reference point for determination of drift of an airplane. They are also used to mark the location of a submarine or other object for the attention of surface vessels, for determining the wind direction before landing an airplane, or to mark the location of the surface for emergency landing at night. The signals contain a pyrotechnic candle that ignites on impact with the surface of the water and floats, nose down, emitting flame and smoke from the tail. One type of marker produces a slick on the water surface. The other types, which produce smoke and flame, are called "night drift signals" or "aircraft float lights." Drift signals and markers are thrown overboard from an aircraft.
- (2) The slick marker AN-M59, which is for daytime use, contains a 2¼-pound cylinder of uramine, a soluble dye salt, in a brittle plastic case. The marker, although not a pyrotechnic, has a somewhat similar effect. It produces a colored film or slick on the surface when the case is shattered by impact with water. The yellowish green fluorescent slick produced by the uramine is approximately 20 feet in diameter. The slick persists for at least 2 hours and can be seen at a range of 10 miles from an altitude of 3,000 feet.
- (3) The night drift signal AN-MK 4 (fig. 147) is a torpedo-shaped item consisting of a hemispherical metal nose that contains a water impact fuze, a wooden body, and a metal tail fin assembly. The body contains one single-unit candle that produces flame and white smoke while burning. The signal burns for 180 to 210 seconds and produces 800 candlepower. The flame can be seen on a clear night at a distance of 9 to 11 miles and during the day its visibility is 6 to 7 miles.
- (4) The night drift signal AN-MK 5 Mod 1 (fig. 147) is similar to the AN-MK 4 ((3) above) except that it has a flat nose and a longer body. The body contains a three-unit candle that burns for 720 to 900 seconds, producing 650 candlepower. The effects and visibility are similar to those of the AN-MK 4.
- (5) The aircraft float light AN-MK 6 Mod 2 (fig. 148) provides a long-burning surface marker for night or day use. A pull-type igniter is located in the tail of the body. The "light" may be launched from surface vessels as well as aircraft. The candles burn successively, producing flame and dense grayish-white smoke for 1 hour.

d. Ground Signals.

- (1) Flash and sound signals are intended to simulate airbursts of artillery fire for training troops. The flash and sound signal M74 (fig. 149) is fired from the pyrotechnic pistol AN-M8. On

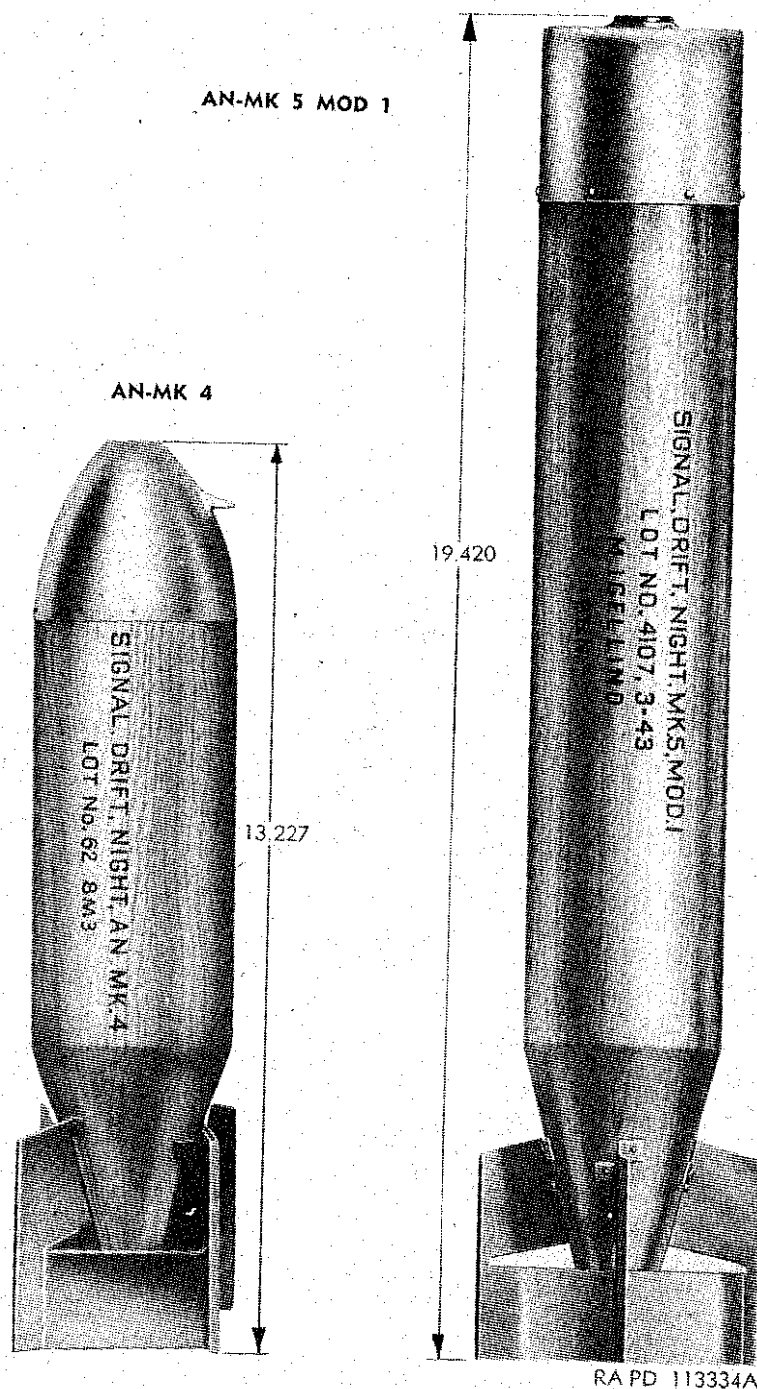


Figure 147. Signal, drift, night, AN-MK 4 and signal, drift, night, AN-MK 5 MOD 1.

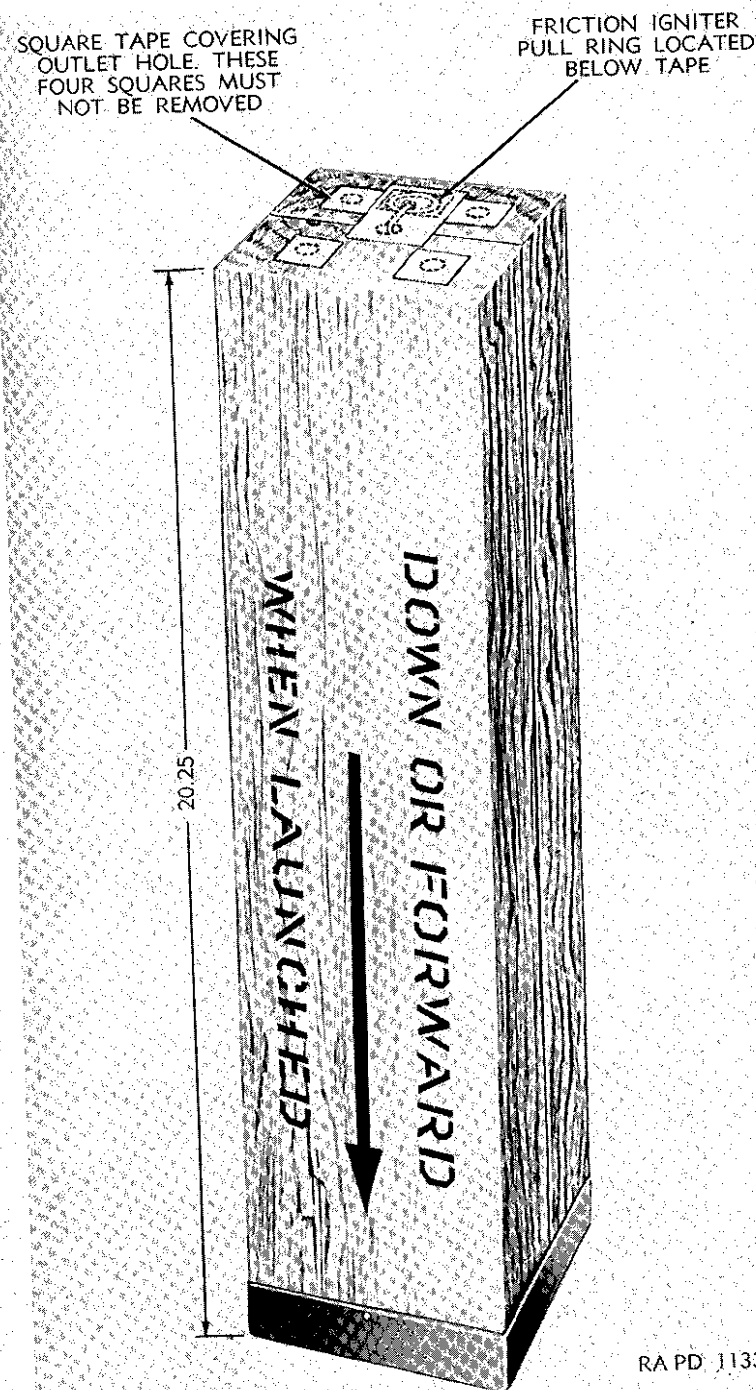
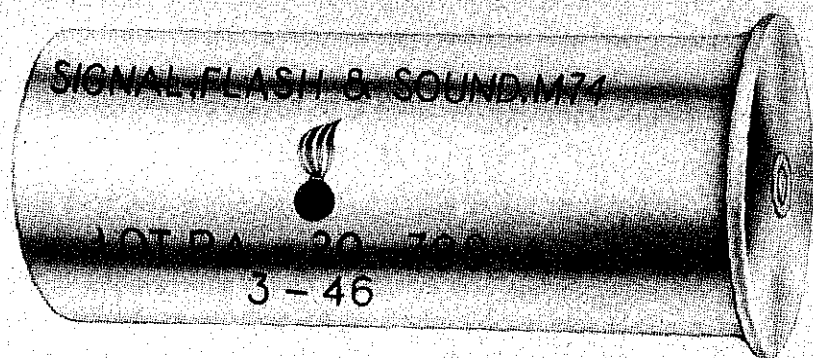


Figure 148. Light float, aircraft, AN-MK 6 MOD 2.



RA PD 108229

Figure 149. Signal, flash and sound.

being fired, a percussion primer ignites a propelling charge that ignites a delay fuse. An inner case containing a bursting charge is propelled approximately 150 feet before it bursts with a bright flash and loud noise.

Caution: The hand pyrotechnic projector M9 will not be used to fire flash and sound signal M74 because of the danger of a malfunction.

- (2) *High burst ranging signals* are used to simulate the air burst of an artillery shell in ranging practice.
 - (a) SIGNAL, ground, high burst ranging, M27 (fig. 150) is fired from ground signal projector M1A1. The signal assembly rises to a height of approximately 650 feet before the signal bursts, producing a puff of smoke.
 - (b) SIGNAL, ground, high burst ranging, M27A1B1 (fig. 151) is a signal M27 modified to adapt it for projections from a grenade launcher attached to a caliber .30 rifle or carbine. The signal rises to a height of approximately 700 feet before it bursts. The burst is accompanied by a flash, a puff of gray smoke, and a noise that can be heard for a distance of at least 2,000 yards. In daytime, the flash and smoke can be seen at distances up to 3,500 yards.
- (3) *Grenade-launcher-type ground signals* (fig. 13) are projected by means of grenade launchers attached to a caliber .30 rifle or carbine, using special blank cartridge, which is the standard grenade cartridge. A propelling charge in the signal supplements the cartridge, supplied with the signal, to attain the required altitude. The signal rises to a height of 600 to 700 feet where the signal functions according to type.
 - (a) The parachute-supported star ground signal produces a single

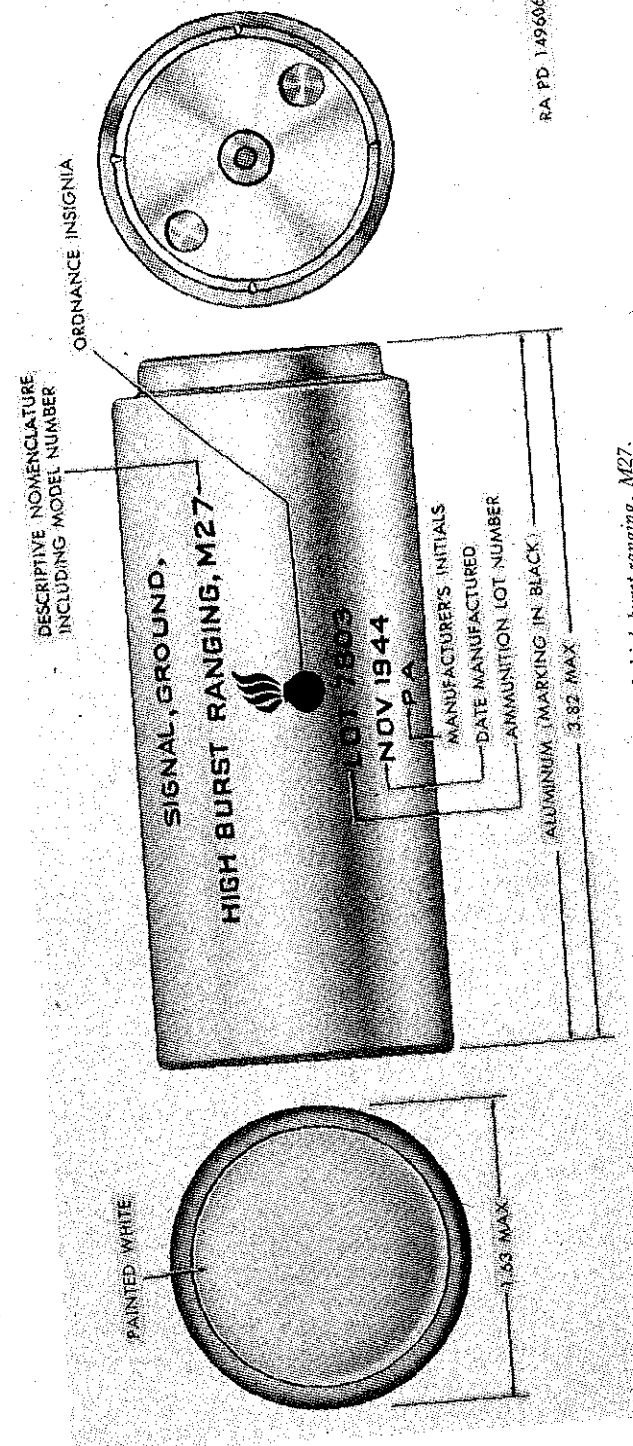


Figure 150. Signal, ground, high burst ranging, M27.

RA PD 149606

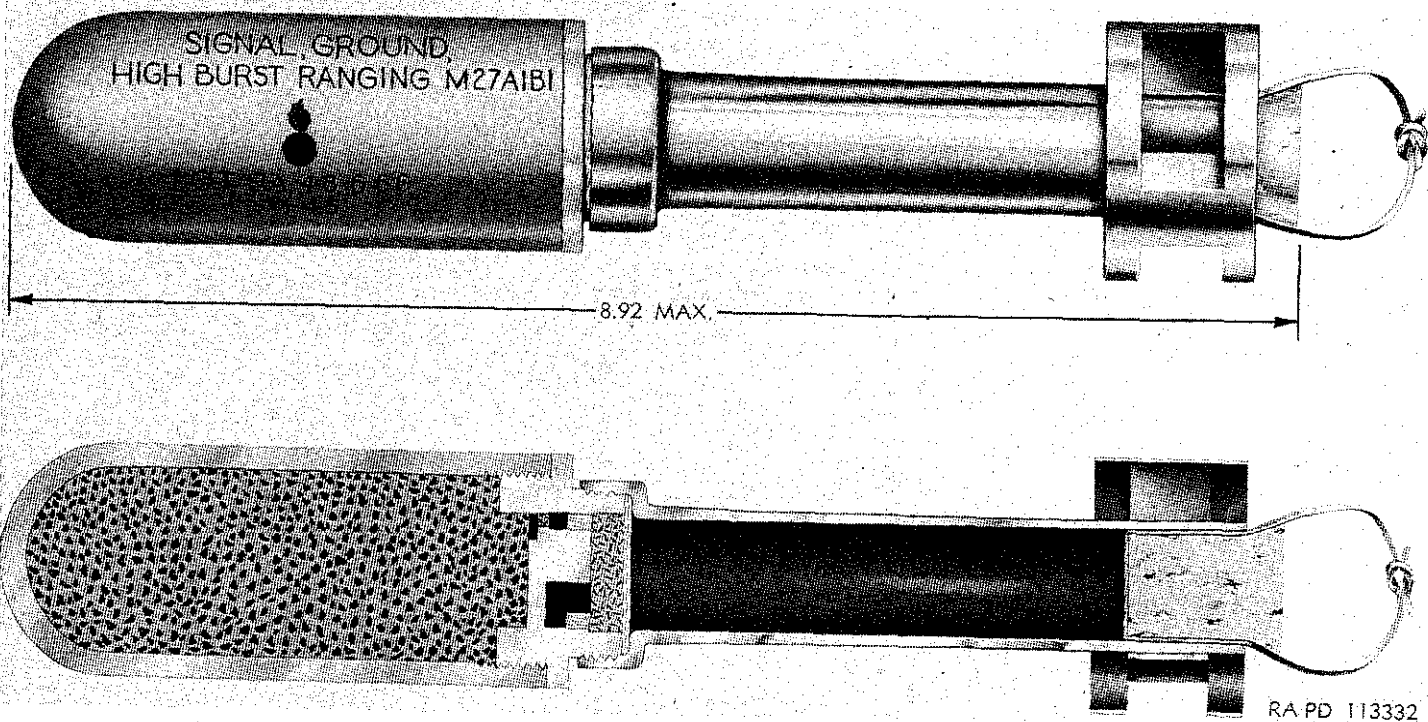


Figure 151. Signal, ground, high burst ranging, M27A1B1.

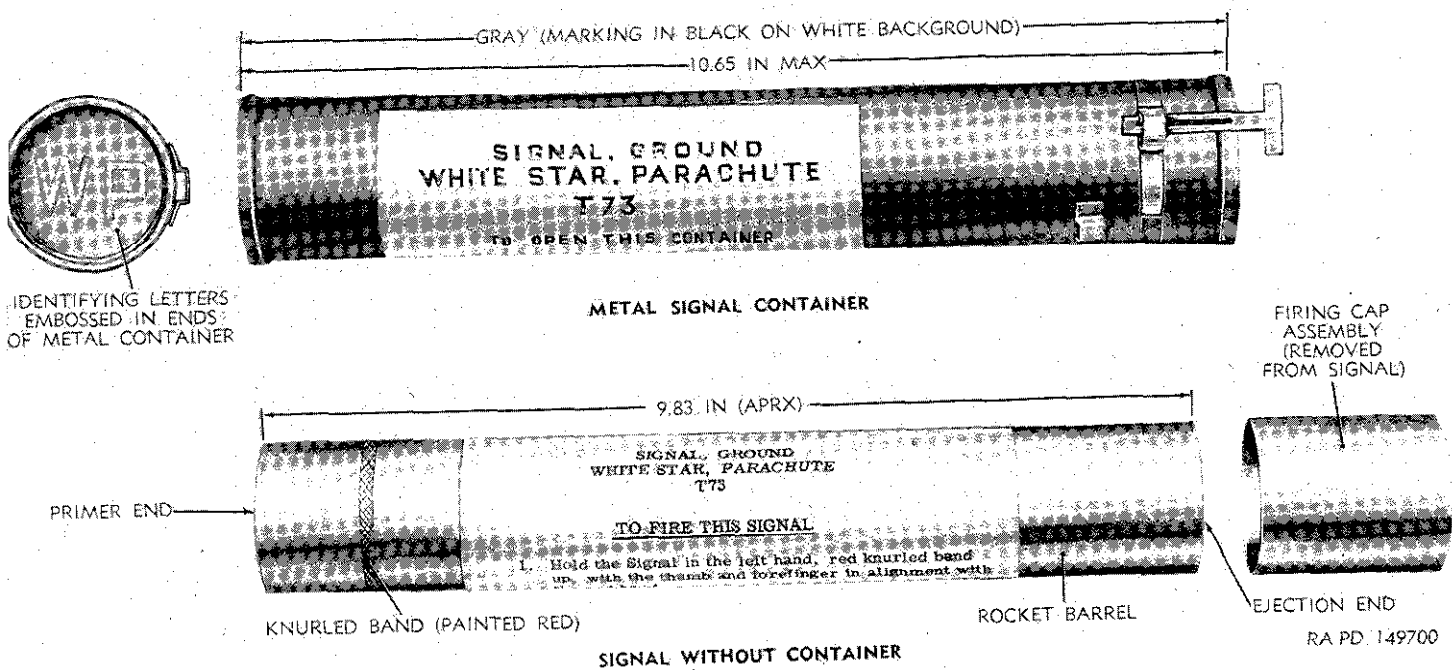


Figure 152. Signal, ground, white star, parachute, M127 (T73).

star that burns from 20 to 30 seconds. The different models produce amber, green, red, or white stars. Candlepower and visibility vary according to the color of the star.

- (b) The cluster-type star ground signal produces five freely falling stars, all of one color, with a burning time of 4 to 10 seconds. The different cluster models produce stars of the same colors as the single-star parachute models. The parachute and the cluster type signals are similar in appearance and design.
 - (c) Smoke ground signals produce six freely falling smoke pellets of the same color. Each smoke pellet leaves a stream of colored smoke that extends approximately 250 feet. The burning time is 4 to 8 seconds. The different models produce colored smoke: red (M62), yellow (M64), green (M65), and violet (M66). Violet smoke is used for training or demonstrations only.
 - (d) SIGNAL, ground, high burst ranging, M27A1B1, which is a launcher-type ground signal, is described under "high burst ranging signals" in (2)(b) above.
- (4) *Rocket-propelled ground signals* are hand-held, fin-stabilized signals that have the launching mechanism integral with the signal. An example of this type is the parachute signal described in b(2) above. The signals are composed of three main units, an aluminum rocket barrel, a firing cap with firing pin, and the signal, which includes signal body, rocket motor, and folding-fin stabilizing device. The signals rise to a height of 650 to 700 feet.
- (a) Parachute star signals produce a parachute-supported star. SIGNAL, ground, red, parachute, M126 (T72) produces a red star that burns for a minimum of 50 seconds. SIGNAL, white, parachute, M127 (T73) (fig. 152) produces a white star that burns for a minimum of 25 seconds. Since the star produces a light of 50,000 candlepower, the signal is effective for battlefield illumination.
 - (b) Cluster star signals produce five free-falling stars. SIGNAL, ground, green star, cluster, M125 (T71) produces green stars that burn 4 to 8 seconds.
 - (c) Smoke parachute signals produce a single parachute-supported smoke pellet. The M128 (T74) produces green smoke and the M129 (T75) produces red smoke. Both signals burn for a minimum of 40 seconds.
 - (d) Smoke streamer signals emit colored smoke through ports in the base of the case. SIGNAL, yellow smoke, streamer, M130 (T76) emits yellow smoke, beginning within approximately 50 feet of the point of firing and continuing throughout its flight. Green and red smoke streamer signals are being developed.

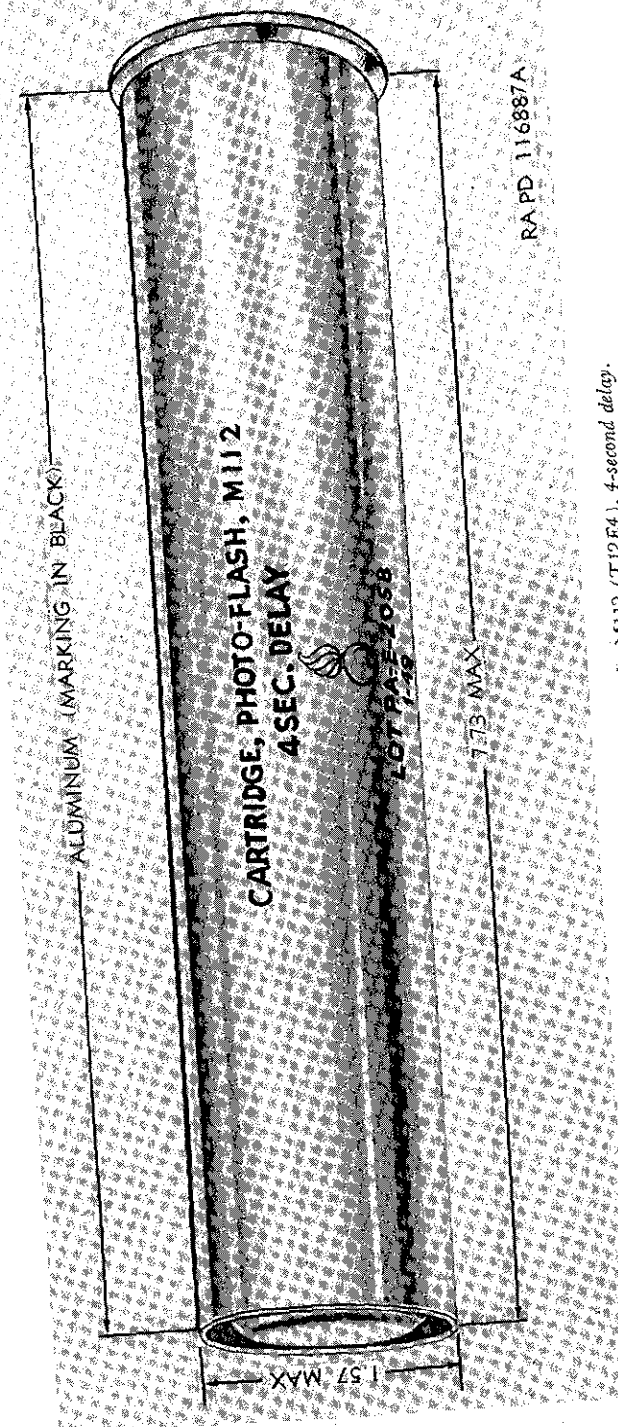
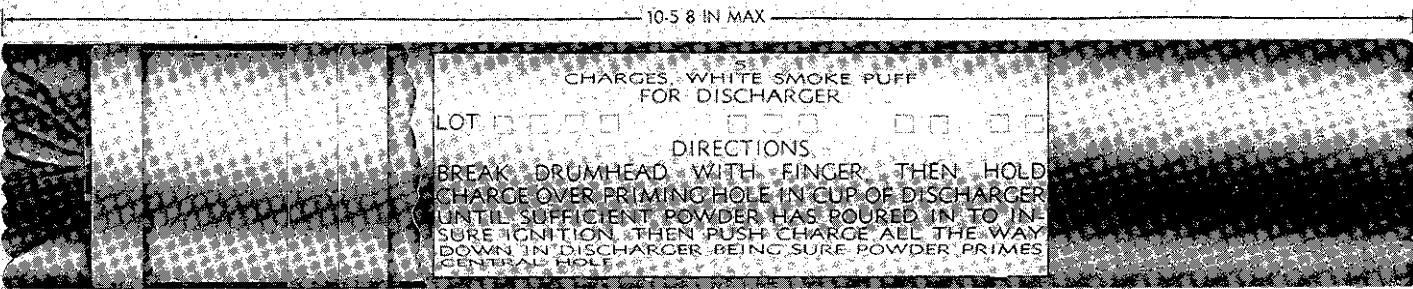


Figure 153. Cartridge, photoflash, M112 (T12E4), 4-second delay.



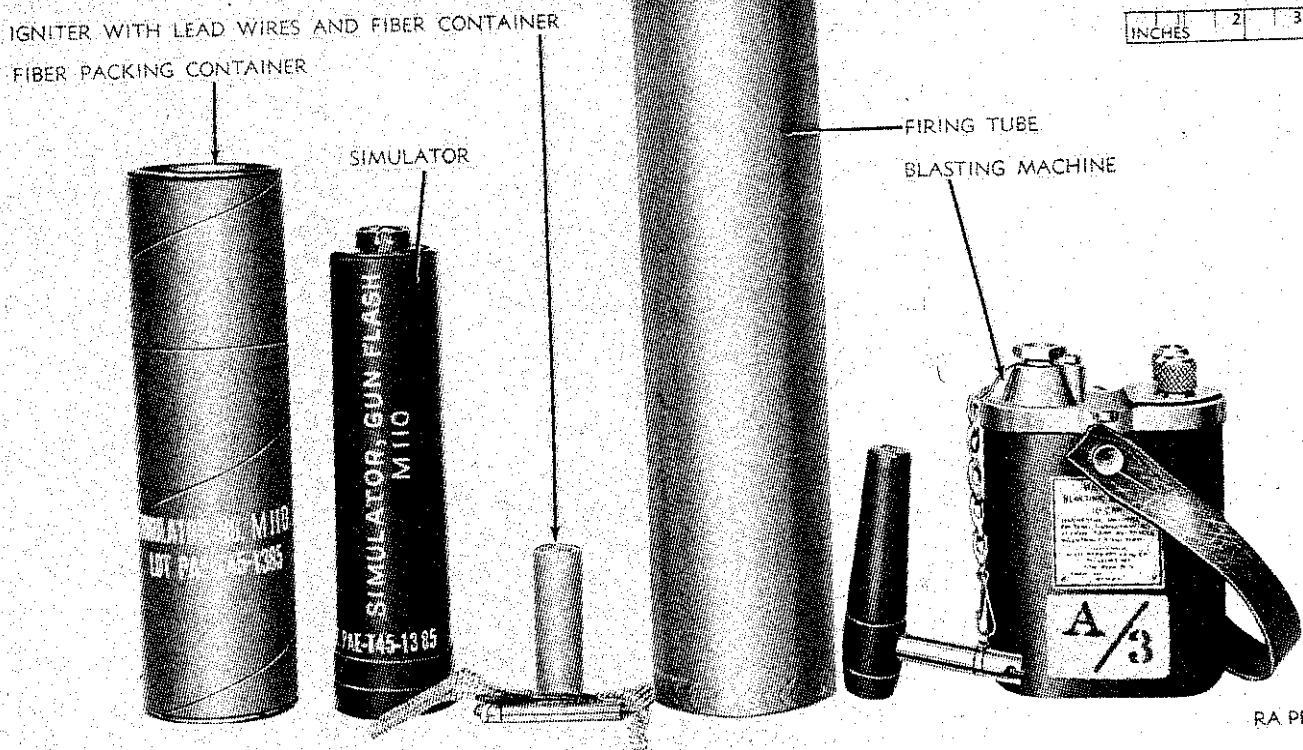
CAP, PERCUSSION SMOKE PUFF



CONTAINER FOR 5 CHARGE, SMOKE PUFF

RA PD 26737

Figure 154. Charge, smoke puff, white.



FIBER PACKING CONTAINER

SIMULATOR

-FIRING TUBE

BLASTING MACHINE

RA PD 113323

Figure 155. Simulator, gunflash, M110, fiber container and firing tube.

109. Photoflash Cartridges

These cartridges are used in connection with aerial photography during reconnaissance missions and are fired from electrically powered projectors. Practice photoflash cartridges are fired from the same projector.

a. A service photoflash cartridge consists of a photoflash charge and delay fuze assembled in a case that, in turn, is assembled in an electrically primed cartridge case together with a small propelling charge.

(1) CARTRIDGE, photoflash, M112 (T12E4) (fig. 153) is provided for use at altitudes of 500 to 3,500 feet. It contains 7 ounces of photoflash powder and has a peak light emission of 120 million candlepower. A pyrotechnic delay fuze in the ignition train delays ignition of the photoflash powder for 1, 2, or 4 seconds dependent upon the particular type fired.

(2) CARTRIDGE, photoflash, M123 (T89) contains 1.75 pounds of photoflash powder and has a peak light emission of 260 million candlepower. Cartridges with delays of 2, 4, and 6 seconds are provided.

b. A practice photoflash cartridge consists of an inert solid unit that is assembled in an electrically primed cartridge case together with a small propelling charge.

(1) CARTRIDGE, photoflash, practice, M121 simulates the M112 (a(1) above) and is used as a practice round in the same projector.

(2) CARTRIDGE, photoflash, practice, M124 simulates the M123 (a(2) above) and is used as a practice round for use in projectors for the cartridge M123.

110. Training Pyrotechnics.

a. Flares used primarily for training purposes are FLARE, tow-target,

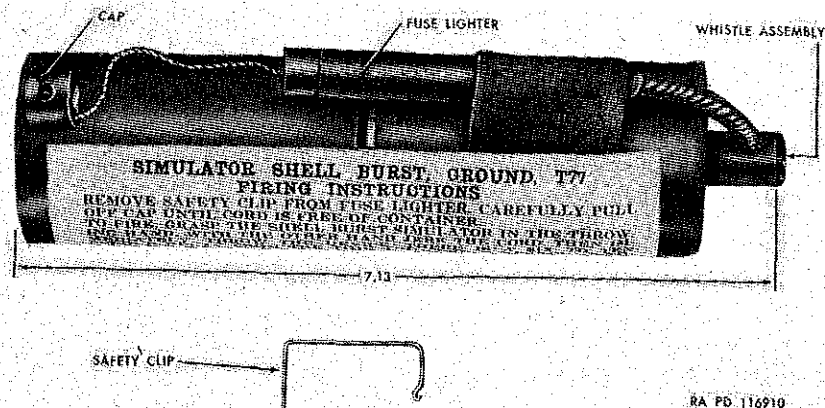


Figure 156. Simulator, shell burst, ground, M115 (T77)

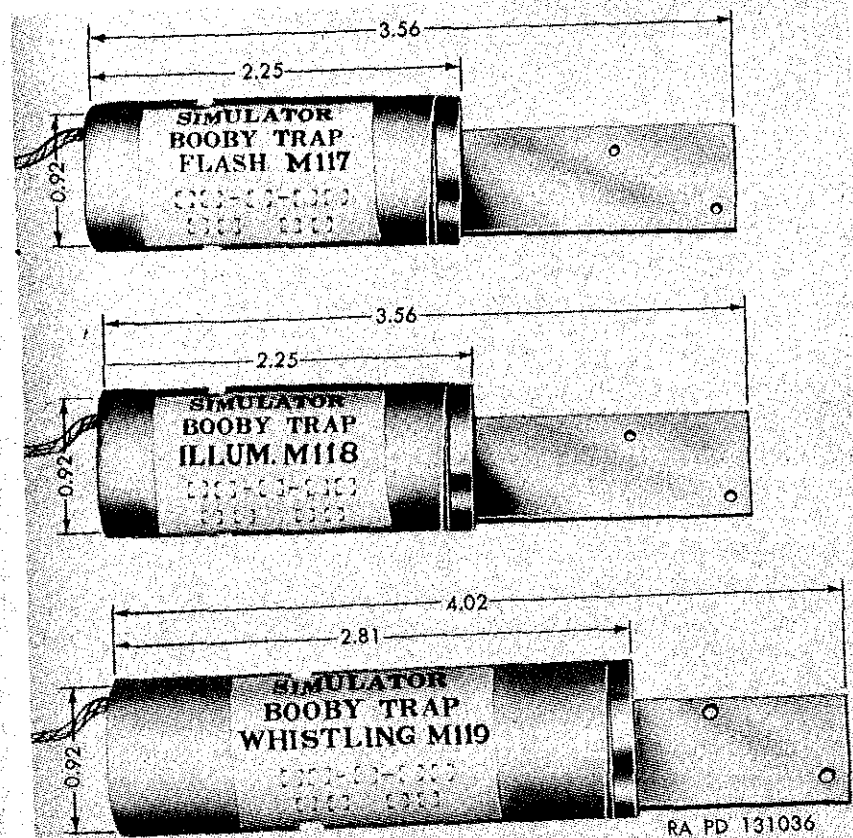


Figure 157. Simulator, booby trap, flash, M117 (T80); illuminating, M118 (T81); and whistling, M119 (T82).

M50, and FLARE, aircraft, parachute, M26 or M26A1, blue band. The "blue band" flares have a blue band painted around the body for identification.

b. Signals used primarily for training purposes are SIGNAL, flash and sound, M74 (par. 108d(1)), and SIGNAL, ground, high burst ranging, M27 or M27A1B1 (par. 108d(2)(a) and (b)).

c. Photoflash cartridges used for training purposes are CARTRIDGE, photoflash, practice, M121 and M124 (par. 109b(1) and (2)).

d. Simulators are pyrotechnic devices designed to imitate the actual battle sounds, flashes, and lights of service items of ammunition. They are used in the training of troops for conditioning without being subjected to the hazards of handling live ammunition. The details of purpose, description, functioning, instructions, and precautions are given in TM 9-1981. Training pyrotechnics are to be handled with the same precautions as prescribed for their service counterparts. Representative types of simulators are mentioned in (1) through (8) below.

- (1) CHARGE, smoke puff (fig. 154), with CAP, percussion, smoke, simulates the appearance of the burst of artillery shell.
- (2) FIRECRACKER, M80, simulates the sound of an exploding booby trap or land mine and the firing of a rifle or machine-gun.
- (3) SIMULATOR, gunflash, M110 (fig. 155) simulates the flash and noise accompanying the firing of an artillery weapon or rocket.
- (4) SIMULATOR, shell burst, ground, M115 (fig. 156) simulates battle noises and effects such as whistle, flash, and report.
- (5) SIMULATOR, hand grenade, M116 simulates flash and report of a grenade explosion.
- (6) SIMULATOR, booby trap, flash, M117 (fig. 157) simulates a trip wire-actuated land mine or booby trap with accompanying flash and report.
- (7) SIMULATOR, booby trap, illuminating, M118 (fig. 157) simulates a trip wire land mine or booby trap with 30-second flame and report.
- (8) SIMULATOR, booby trap, whistling, M119 (fig. 157) simulates a trip wire land mine or booby trap with whistle, flash, and report.

111. Care and Precautions in Handling

a. General. Due consideration should be given to the observance of appropriate safety precautions in handling pyrotechnics ammunition. Pyrotechnic compositions are particularly susceptible to deterioration by moisture and are of an especially hazardous nature, being more readily ignited than most types of high explosives. Information concerning the care to be exercised in handling pyrotechnics will be found in TM 9-1903 and TM 9-1981.

b. Types of Pyrotechnics. The specific precautions in (1) through (4) below apply to the several types of pyrotechnics.

- (1) *Flares.* Care should be exercised to avoid damage to fiber cases and rip cords located outside the casing of certain types of flares. Before the lead wires of electrically ignited flares are connected, it must be assured that there is no electrical energy in the electrical circuit.
- (2) *Signals.* Signals with dented, deformed, or cracked barrels or with loose closing caps will not be used. Signals will be guarded against a blow on the primer, because such a blow may ignite the signal.
- (3) *Photoflash cartridge.* The shunt cap must not be removed from the cartridge until just prior to loading the cartridge into the projector.
- (4) *Simulators.* Protective or safety devices should not be removed

from simulators until just before use. The gunflash simulator contains an explosive filler similar to that of a photoflash bomb and requires the same care in handling. The electric squib used to fire the simulator requires the same care as an electric blasting cap. When handling gasoline, used to fill the simulator, the precautions of AR 850-20 will be observed. All simulators that have been filled with gasoline will be fired or, if not fired, will be destroyed in accordance with TM 9-1903.

112. Precautions in Firing

a. Detailed information concerning safety precautions to be observed in firing pyrotechnics will be found in TM 9-1981. For regulations in firing ammunition in training and combat, see AR 385-63.

b. General safety precautions for firing pyrotechnics are described in (1) through (3) below.

- (1) When firing pyrotechnics, extreme care should be taken to fire them in such a manner that burning material or burned out signals will not fall on friendly personnel or into boxes of pyrotechnics or other ammunition. Care should also be exercised when firing through trees or other obstructions.
- (2) Projected pyrotechnics (except rocket-propelled ground signals) may cause heavy recoil when fired.
- (3) The shell burst simulator projects burning paper fragments to a distance of 10 yards. It can ignite dry leaves and grass. The flash booby trap simulator is dangerous for personnel within 6 feet at time of functioning. The illuminating booby trap simulator produces a flame that will ignite wood or other combustible material with which it comes in direct contact.

113. Packing and Marking

a. Packing. In general, pyrotechnic compositions are hygroscopic, and unless they are hermetically sealed, special precautions in packing must be observed. Hence pyrotechnics are packed in fiber containers or cartons, metal containers, or without inner packing, dependent upon the watertightness of the item casing. The items, either with or without inner packing containers, are packed in wooden boxes of such size and weight as to be easily handled by one man.

b. Marking. In addition to descriptive nomenclature, quantity, ammunition lot number, and month and year loaded, packages offered for shipment are marked with the Interstate Commerce Commission (ICC) shipping name or classification of the article, volume and gross weight, and the Ordnance Corps insignia, or more recently, a stamp showing an eagle within a circle. The Ammunition Identification Code symbol is included in the marking when applicable. Packing boxes that contain "blue band" flares, authorized for training only, have a blue band painted around the box near one end.

Section VI. ROCKETS

114. General

A rocket is a projectile that is propelled by the reaction from the discharge of a jet of gas to the rear. The gas is produced by the burning of a propelling charge within the rocket. A military rocket, certain types of which are designated "free flight" to distinguish them from "guided" rockets (missiles), consists of a head and a motor. The sizes of rockets range in general from 1½ inches to a foot or more in diameter. Motors may have the same diameter as the head or may have a smaller diameter than the head. The head contains an explosive or chemical charge and a fuze; the head is similar in function to a bomb or an artillery shell. The motor consists of a tube closed at one end and constricted near the other end to form one or more nozzles. Motors are of two types, the solid propelling charge type and the liquid propelling charge type. To stabilize a rocket in flight, fins may be attached to the motor, or the "nozzle" may consist of a group of nozzles canted at an angle to cause the rocket to rotate. The weapon used in firing a rocket is designated a launcher, since it serves only to give the rocket its initial direction and does not project the rocket as a conventional artillery piece projects a shell. The advantages of rocket ammunition are: it imparts no recoil to the weapon; it does not require a rifled barrel; the forces of setback are spread over a relatively long period of acceleration rather than concentrated in a very short time as in a gun, with the result that light-case missiles of high capacity with fuzes of more fragile construction can be used; more fire power can be delivered in a given short time using multiple rocket launchers than with conventional artillery and/or mortar fire; and the lighter weight rocket launchers can be moved over rough terrain more quickly to new positions without the need of heavy moving equipment. The disadvantages are that protection is required against the blast of hot gas from the rear of the rocket and that dispersion is greater than that of shell of similar caliber. Representative types of military rockets are illustrated in figure 158. For detailed information and data on rockets, see TM 9-1950.

115. Classification

a. Use. Rockets are classified according to use (source of launching) as ground and aircraft.

b. Purpose. They are classified according to purpose as service, practice, target, drill, or proof. Service rockets are used for effect in combat; practice rockets are used for target practice; target rockets are used as moving aerial targets for practice in firing automatic antiaircraft weapons; drill rockets are used for training in handling; and proof rockets are used for testing automatic launching installations.

c. Filler. Rockets are classified according to filler in the head as high-explosive, chemical, inert head, or inert. High-explosive (usually TNT

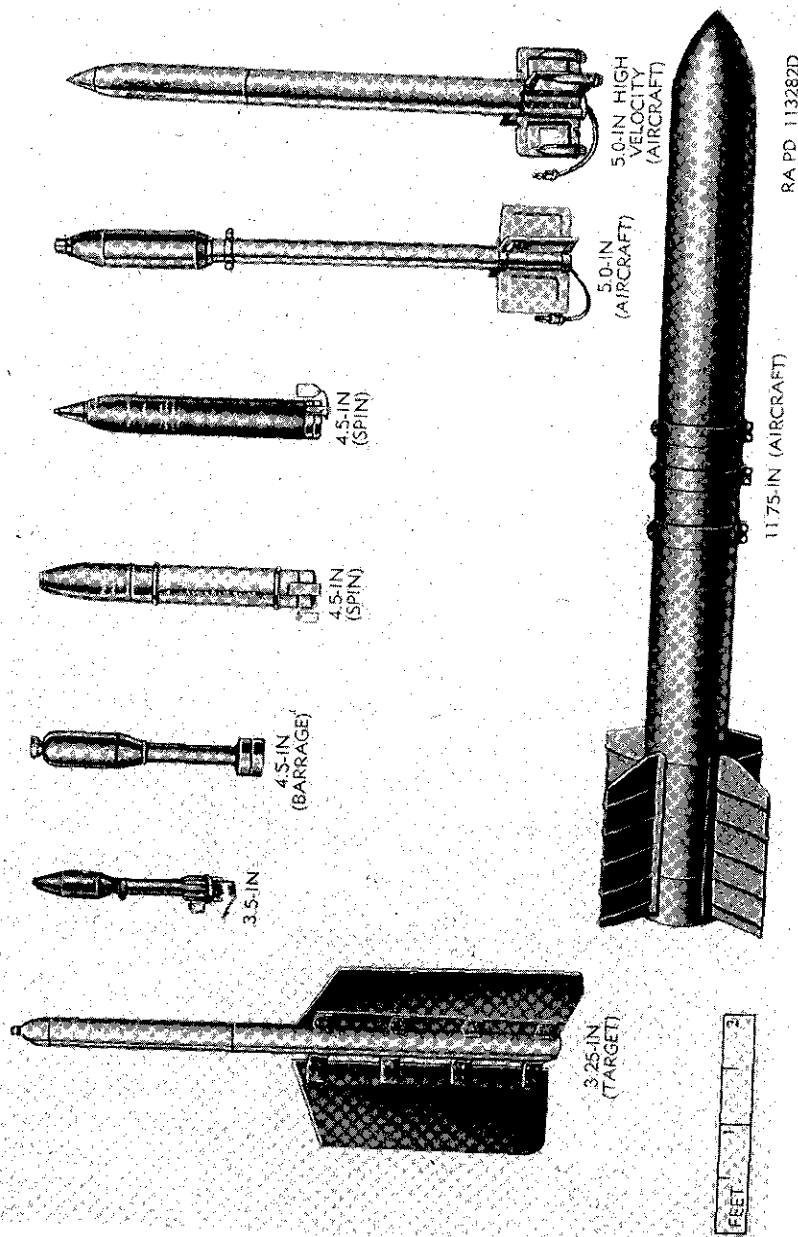


Figure 158. Representative types of rockets.

or COMP B) rockets are for blast or fragmentation effect. High-explosive antitank (HE, AT) rockets, which contain a shaped charge, are used for penetration of armored targets. Chemical rockets contain a gas for toxic or harassing effect (toxic gases in sublethal concentrations) or a smoke-producing agent for laying a smoke screen. Inert head rockets are used for target practice; the motor contains a propellant charge similar to that of the high-explosive and chemical rockets. Inert rockets are completely inert, both head and motor; they are used for training in handling.

116. Ground Type Rockets

a. General. Ground type rockets of certain types are used by the Army and certain other types are used by the Navy. Calibers currently standardized and in authorized use range from 3.25 to 11.75 inches. Other calibers are currently under development. The 3.5-inch ground type rocket is fired, at relatively short ranges, from shoulder-fired launchers, commonly known as "bazookas." The 3.25-inch ground type is a target rocket fired from a special launcher and used as a moving aerial target for practice in firing anti-aircraft weapons. The 4.5-inch rockets used by the Army are the spin-stabilized type used in field operations for ranges up to 10,000 yards and are usually fired from multiple-tube-type launchers. The 4.5-inch rockets used by the Navy and consisting of Navy components are of the shroud-fin-stabilized type, commonly known as the beach barrage type and are fired from Navy launchers. The motors of solid-propelling-charge-type rockets usually contain double-base propellant in single or multiple stick form together with a black powder igniter and an electric squib. The motors of liquid-propelling-charge-type rockets, which are constructed along the same general lines as those of the solid-propelling-charge-type, usually contain one or more acids, anilines, alcohols, or other agents and appropriate oxidizers together with means of ignition.

b. 3.25-Inch Rocket. This rocket (fig. 158) is designed to provide a fast-flying target for the training of gun crews operating automatic anti-aircraft guns. The target rocket M2A2 has a long motor with a yellow light flare at the nose to provide a night target. The rocket M2A1 is used for daytime firing and has a distinguishable oversize 3-bladed plywood fin. This rocket is fired electrically by igniter M22 from target rocket projector M1. The rocket has a range of 2,350 yards and a maximum velocity of 645 feet per second. Its flare burns from 20 to 30 seconds.

c. 3.5-Inch Rockets. These rockets (fig. 159) represent the types used in the 3.5-inch shoulder-type launchers M20A1 and M20A1B1 that have the contactor latch group assembly, which indexes the rocket in the launcher and does away with the lead-in squib wires used on earlier models. These rockets also represent the types used in the 3.5-inch tripod mounted repeating launcher M25. The high-explosive antitank

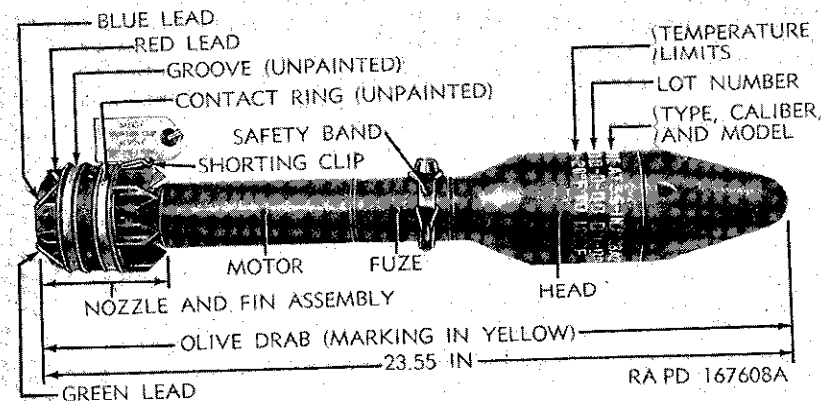
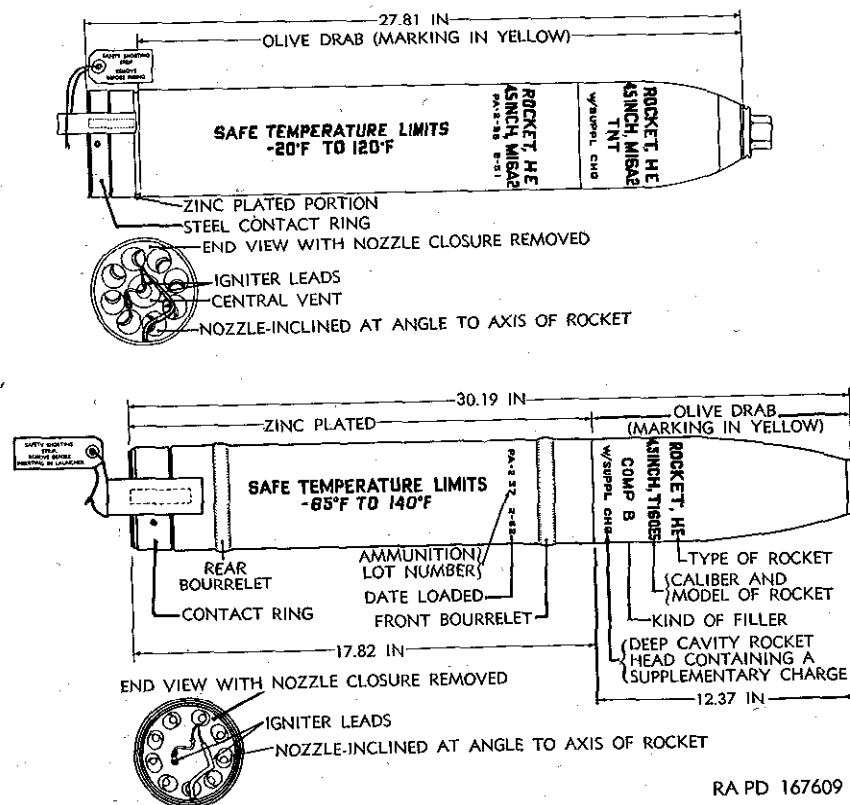


Figure 159. Rocket, HE, AT, 3.5-inch, M28A2.

(HE, AT) rocket M28A2 has the conventional electrically ignited solid propellant motor with fixed fin and uses the base detonating fuze M404A1 with waterproofing safety band. The rocket M28A2 has a velocity of 320 feet per second, will penetrate upwards of 10½ inches of armor-plate, and has a maximum range of 850 yards. The smoke (WP) rocket M30 (T127E3) has the same general shape, weight, and ballistics as the HE, AT rocket M28A2 and uses the same type motor and detonating fuze; the head is filled with white phosphorus for producing screening smoke. The practice rocket M29A2 is the same as the HE, AT rocket M28A2 except that it has cast iron inert head and dummy fuze.

d. 4.5-Inch Rockets. These rockets are of three types, the fin-stabilized, the spin-stabilized, and the drill.

- (1) The fin-stabilized type is represented by the Navy barrage-type rockets of which there are the "high capacity" model that has TNT-filled head designated Mk 3 Mod 0 (fig. 158), the smoke (FS)-filled head designated Mk 7 Mod 0, and the smoke (WP)-filled head designated Mk 10 Mod 0.
- (2) The spin-stabilized type is represented by the high-explosive (COMP B) rockets T160E5 and M16A2 (fig. 160); the practice rockets T161E5 and M17A2; the smoke rocket T162; and the chemical rockets T164E1, T165E1, and T166E1. The rockets T160E5—T166 series have longer heads than the M16—M17 series, with a nonalloy-type steel motor. This motor has two bourrelets; is loaded with new-type propellant M16 (T6); and contains igniter T14E2 with the squib M1A1. The rockets M16A2 and M17A2 have the older-type head and alloy-steel motor. The high-explosive rockets T160E5 and M16A2 use the fuze M81A1, which is an assembly of the M48A3 fuze and the M24 booster, or the VT fuze M402A1. The heads of these



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Figure 160. Rocket, HE, 4.5-inch, M16A2, and rocket, HE, 4.5-inch, T160E5.

rockets contain supplementary bursting charges which must be removed when using VT fuzes. These rockets are usually fired from 4.5-inch multiple tube launchers of the T66 series (24 tubes) or M21 (25 tubes) types.

Caution: The fuze M48 series with any other booster than the M24 or any fuzes M51 series will not be used in 4.5-inch rockets because of their relatively low setback forces which are insufficient to arm boosters other than the M24.

- (3) The drill rocket M24 is used for training in handling and operation of rockets M16 series and T160 in multiple (25 tubes) launcher, M21 (T123), or in multiple (24 tubes) launchers of the T66 series. This drill rocket is made up of the same metal parts as rockets of the M16 series. The motor is "loaded" with wooden sticks simulating sticks of propellant. The head, which is inert loaded, is fitted with dummy fuze M73. To simulate the ignition of a series rocket M16, a light glows in the nozzle of the drill rocket when the firing switch connected to the launcher is closed.

117. Aircraft-Type Rockets

a. *General.* Several types of Navy rockets are used by the Air Force for forward firing from aircraft fitted with Navy type post (zero length) or rail launchers. One type of Navy rocket (5.0-inch high-velocity aircraft rocket (HVAR)), after replacing the Navy fin by a special Army fin, is used by the Air Force for forward firing from aircraft fitted with the retractable jettisoning launcher.

b. *2.25-Inch Rockets.* The 2.25-inch forward firing subcaliber aircraft rockets (SCAR-Navy) (fig. 161), which have a 2.25-inch solid head and a 2.25-inch service motor, are used as practice ammunition to simulate the action of the 3.5-inch and 5.0-inch Navy aircraft rockets used by the Air Force. The trajectory and velocity of the 2.25-inch rocket, which is composed of the Mk 3 Mod 2 solid head and the Mk 11 motor, approximate those of the 3.5-inch aircraft service rocket and the 5.0-inch high-velocity aircraft rocket (HVAR). The trajectory and velocity of the 2.25-inch rocket, which consists of the Mk 3 Mod 2 head and the Mk 13 (mods) motor, approximate those of the 5.0-inch aircraft rocket (AR).

c. *3.5-Inch Rockets.* The 3.5-inch aircraft rockets (Navy) are fin-stabilized, using 3.5-inch head and a 3.25-inch motor (fig. 162). These rockets are used on Navy or Air Force aircraft in forward firing against light armored vehicles and for penetrating submarines and other light-armored vessels. These have a velocity of 1,140 feet per second. The head is a 20-pound solid steel ogival-nose shot. When fired at 20° (or less) from the horizontal, this rocket has a lethal underwater range of approximately 60 to 120 feet, depending upon the bluntness of particular model of head used. Types of head include the armor-piercing and drill, which have no fuzes, and the chemical (smoke), which has the nose fuze Mk 155 Mod 0. The motor consists of a 3.25-inch steel tube containing a single inhibited cruciform grain weighing 8½ pounds. Inhibitors, sometimes called deterrents, consist of certain types of combustible plastic material that are coated or cemented on parts of a propellant grain to control the rate of burning. At the rear of the motor is the nozzle, which is sealed with a waterproof closure. The motor, which is shipped separately, is provided with front and rear shipping caps to protect it during storage and shipment.

d. *5.0-Inch Aircraft Rockets.* The 5.0-inch aircraft rockets (Navy-AR) are fin-stabilized, using the 3.25-inch motor (fig. 163). The head of the service rocket is filled with TNT and equipped with both nose and base fuzes. The motor is the same type as that used with the 3.5-inch rocket (c above). The service rocket, which has a velocity of 715 feet per second, is used in Navy or Air Force aircraft fitted with Navy-type post launchers against light shipping, enemy troops and bivouac areas, and light-armored vehicles. Certain model heads are arranged for VT fuzes for air-to-surface firing. The target practice rocket has an inert head that may be fitted with a dummy nose fuze. The drill rocket is completely inert.

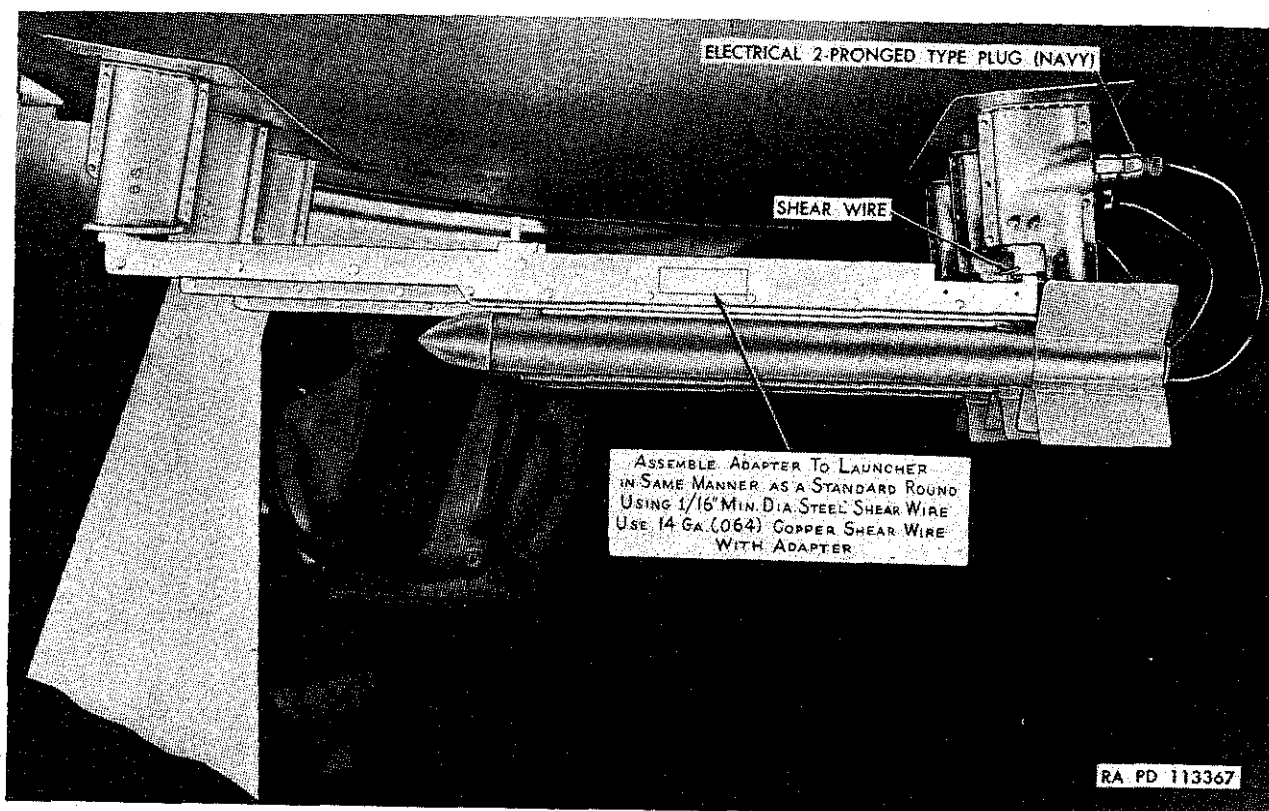


Figure 161. 2.25-inch subcaliber aircraft rocket with MK 6 adapter on the MK 5 post launcher.

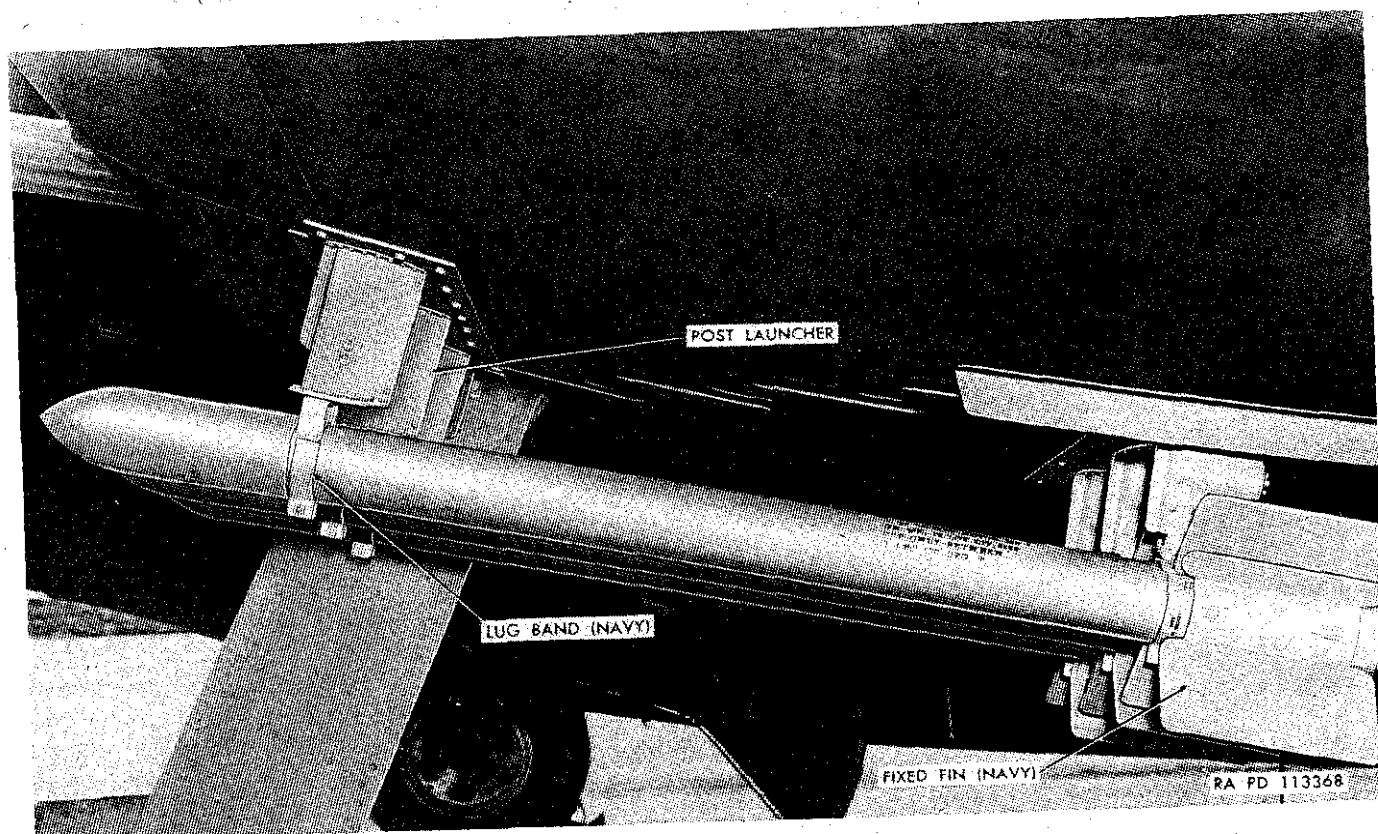
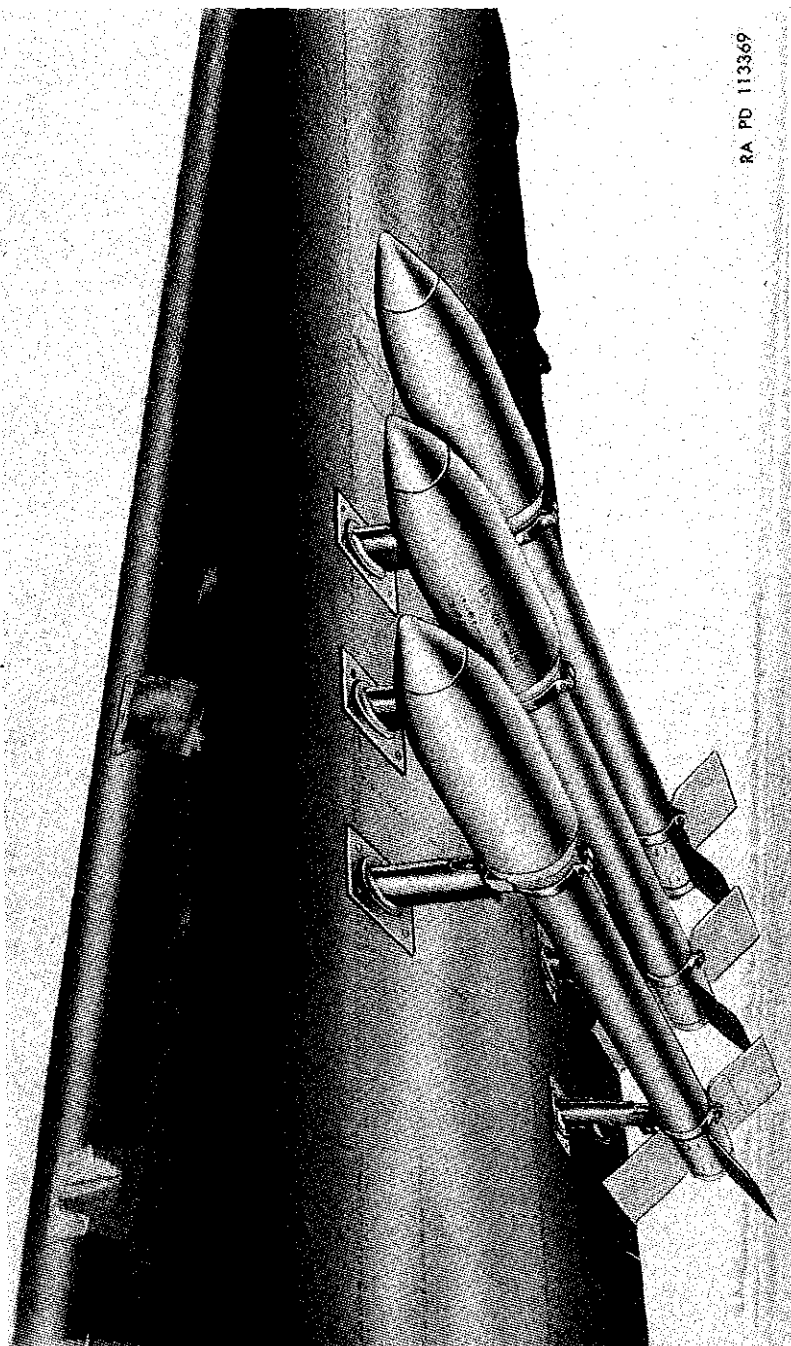
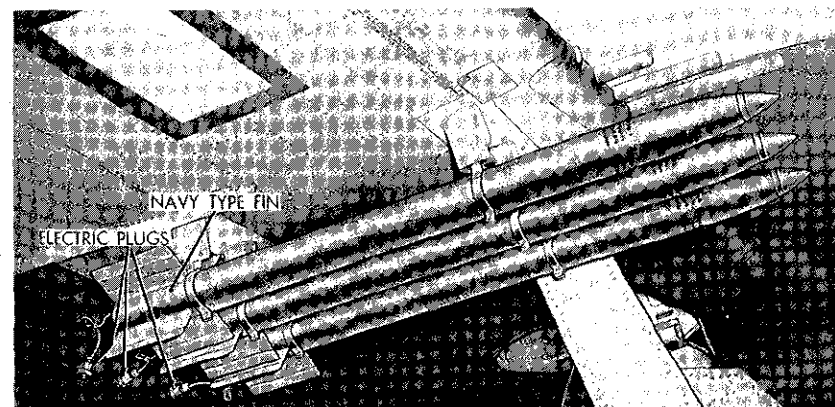


Figure 162. 3.5-inch aircraft rockets on Navy post launcher.

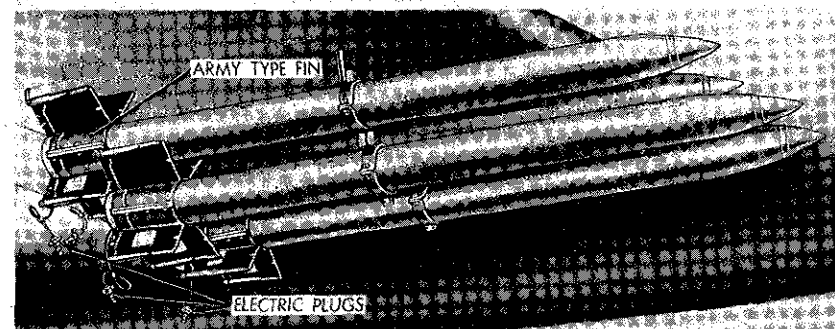


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Figure 163. 5.0-inch aircraft rockets on Navy post launchers.



A-5.0-INCH HIGH VELOCITY AIRCRAFT ROCKETS ON POST LAUNCHERS—AS USED BY THE NAVY



B-5.0-INCH HIGH VELOCITY AIRCRAFT ROCKETS ON RETRACTABLE JETTISONING LAUNCHERS—AS USED BY THE AIR FORCE

RAPD 167610

Figure 164. 5.0-inch high-velocity aircraft rockets (Navy-HVAR).

e. *5.0-Inch High-velocity Aircraft Rockets.* The 5.0-inch high-velocity aircraft rockets (Navy-HVAR) are used for forward firing from Navy or Air Force aircraft against heavy tanks, gun emplacements, bridges, and supply concentrations. This rocket uses a 5.0-inch motor, which contains approximately 24 pounds of propellant. This propellant imparts a velocity to the rocket of 1,360 feet per second, which is nearly double that of the 5.0-inch aircraft rocket (AR) that has the 3.25-inch motor (*d* above). The heads used in the service rounds are: the TNT-filled head (Mk 6 Mod 1) fitted with a nose fuze and a base fuze; the COMP B-filled shaped-charge head Mk 25 Mod 1 fitted with a nose fuze (complete round consisting of the Mk 25 Mod 1 head and the Mk 10 Mod 5 motor (with JPN cruciform grain) is designated Mk 32 Mod 1); and the TNT-filled head (Mk 6 Mod 4), which is deep-cavitized to receive the VT fuze M403 (Navy Model Mk 172 Mod 0) for plane-to-ground (air-to-surface) firing. Head, motor, and fuze are shipped each in separate

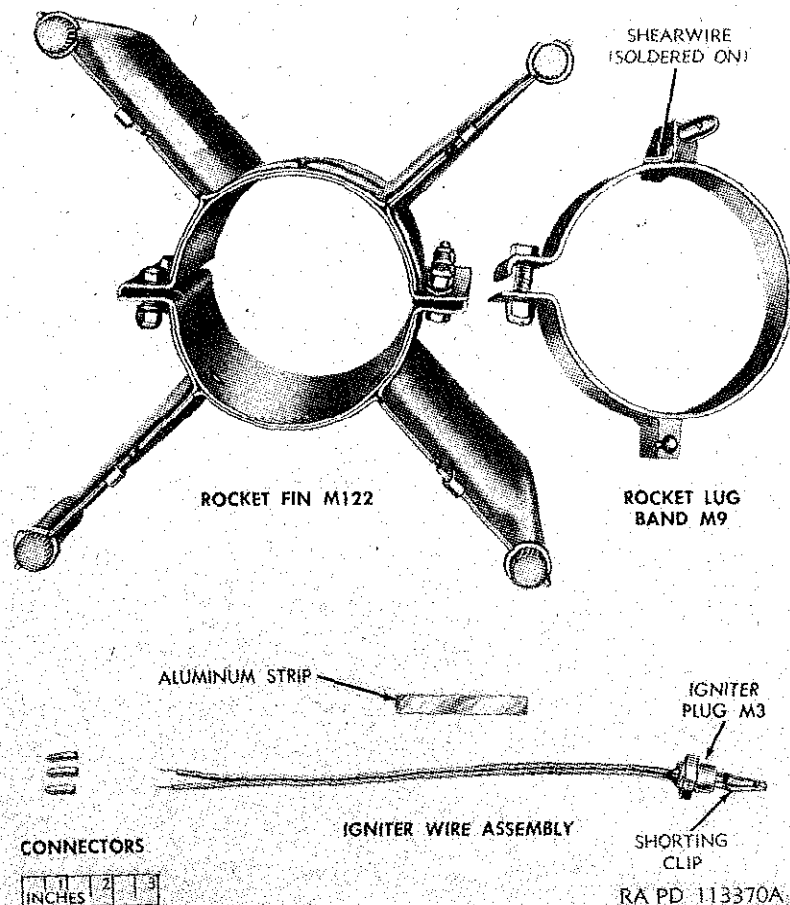


Figure 165. Kit, modification, M34, for 5.0-inch high-velocity aircraft rocket (Navy-HVAR).

containers in a packing box. The head used in the target practice round is the same type as that of the TNT service head except that it is plaster-filled and that it may have a conical nose plug and omits the base fuze.

f. Modification of 5.0-Inch High-velocity Aircraft Rocket (Navy-HVAR). When used by the Air Force, this rocket is modified by removing the Navy fin and replacing it with the Army fin that adapts the rocket for use on the retractable jettisoning launcher with which certain Air Force aircraft are equipped. Aircraft so equipped are also equipped with bomb-arming type controls from which arming wires extend through nose fuze holes provided. The rockets as used on Navy aircraft post launchers are shown in A, figure 164. The rockets as modified for use on Air Force aircraft equipped with retractable jettisoning launchers

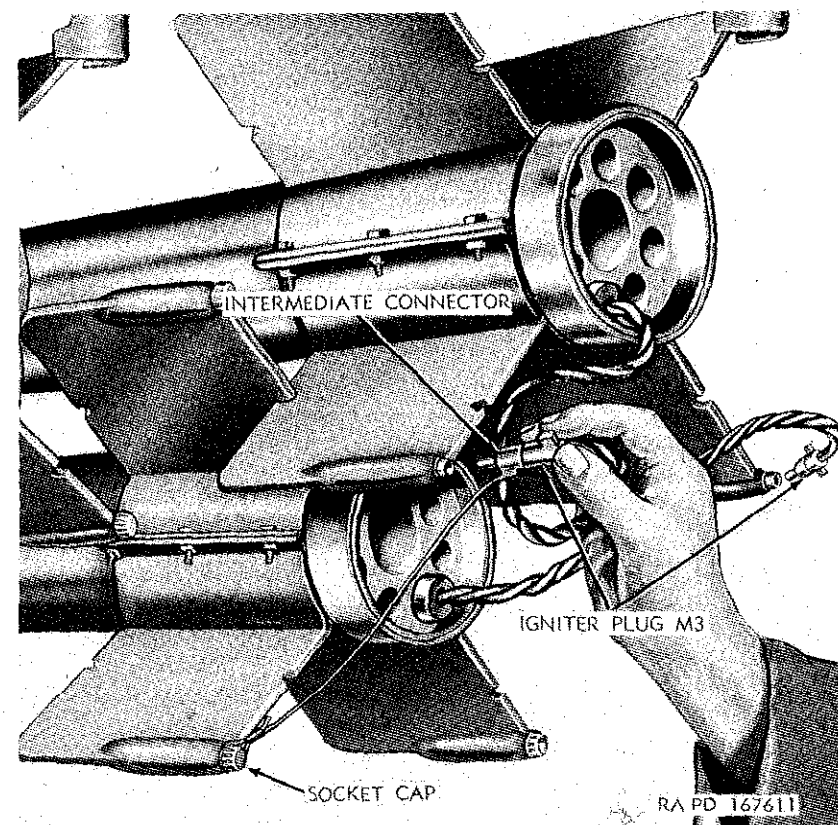


Figure 166. Intermediate connector being inserted into sockets of double-hung 5.0-inch high-velocity aircraft rockets preparatory to plugging igniter plug M3 into the socket of the connector.

are shown in B, figure 164. The modification is accomplished by the use of the modification kit M34 (fig. 165). In order to locate the rocket lug band M9 in the proper position for installation on a particular aircraft equipped with retractable jettisoning launchers, rocket modification tool kit M35 is used. When rockets are "double-hung," that is, one hung below another as shown in B, figure 164, an intermediate connector must be used as a precautionary measure to short circuit the upper rocket and thus prevent its being fired until the lower rocket is fired. This intermediate connector is installed as shown in figure 166. Then the igniter plug M3 is inserted in the proper socket as indicated on the diagram on the rocket fin to complete the final preparation for firing. For further information on modification and preparation of this rocket, see TM 9-1950 and specific instructions furnished with modification kit M34.

g. 11.75-Inch Rocket. This Navy-designed rocket (fig. 158) is used by the Air Force in forward firing from aircraft against heavy shipping and

large ground targets. The complete round weighs 1,283 pounds (maximum) and has a velocity of 830 feet per second. The round consists of a TNT-filled head (plaster-filled or empty for target practice head) fitted with three base fuzes and a fin-stabilized motor containing a 146-pound charge consisting of four large cruciform grains of propellant.

118. Igniter Circuit Continuity Testing

Where requirements call for the application of electrical energy to the igniter circuit of a rocket for testing its continuity such as during manufacture, renovation, or preparation for shipment, the testing devices used must be approved by the Chief of Ordnance. Testing operations will be conducted with due consideration to the safety of personnel. Areas selected for these operations should be remote from sources of electrical currents, which might result in accidental ignition of the rocket. Continuity testing of circuits in rockets in ground launchers immediately prior to firing or in rockets positioned on aircraft launchers immediately prior to takeoff will not be done except under authority of, and with testing equipment approved by, the chief of the technical service concerned.

119. Care and Precautions in Handling

General precautions pertaining to all ammunition (par. 12) will be observed. In addition, since some of the explosive components of rockets have different characteristics from those of other types of ammunition, the considerations in *a* through *f* below should be observed.

a. The composition of solid propellants used in rocket motors is usually designated "double-base," a mixture of nitrocellulose and nitroglycerin, which is somewhat more susceptible to deterioration especially under extremes of temperature and humidity than other types of propellants such as those used in artillery ammunition. Therefore, rockets should be kept in a dry, cool place if possible, never in the direct rays of the sun. They should not be kept where temperatures are beyond the limits marked on the rockets and measures should be taken to see that no moisture enters fuze or motor. Nozzle closures of rockets that have been subjected to wide temperature fluctuations should be examined for evidence of looseness that may have permitted the entrance of moisture into the motor where it would damage the propellant and affect rocket accuracy. Ice should not be allowed to accumulate on any part of the motor, as such accumulation might cause erratic flight.

b. Assembled rockets (complete rounds) are similar to rounds of fixed or semifixed artillery ammunition with two significant exceptions: the first exception is that the propellant (since it contains a proportion of the high explosive, nitroglycerin) will detonate if the head is accidentally detonated. This means that the explosive hazard of a rocket is double that of fixed or semifixed artillery shell having about the same weight of high explosive and propellant. The second exception is that in the event of fire, rockets may be propelled over wide areas, therefore, unlike artil-

lery ammunition, the range of the rocket must be considered in establishing danger areas (see TM 9-1903).

c. A rocket motor that is closed at the forward end with a closure having substantially the same strength as the motor body (tube) will be treated as a rocket, because upon accidental ignition such motor would tend to "takeoff" in the direction in which it is pointed.

d. A rocket complete round should never be placed on the tail, as this may damage fins or electrical connections. If it is ever necessary to stand a round on end, it should be pointed nose downward so that on any accidental ignition it would have a tendency to bury itself in the ground.

e. At the time of manufacture, rocket heads, motors, and fuzes are made as nearly waterproof as practicable. Some relatively delicate items such as VT fuzes, however, are packed in hermetically sealed containers. To insure best performance from VT fuzes, for example, they should not be removed from their hermetically sealed containers until just prior to assembly to a rocket in preparation for firing.

f. Care should be exercised to prevent ignition of rockets, due to extraneous electrical currents, such as static and induction by electromagnetic radiation from such sources as high-amperage circuits and transmitters.

120. Precautions in Firing

a. The propellant in most types of rockets burns normally for a short time after leaving the launcher depending upon the operating temperature. In some cases of very high-operating temperatures, the burning of the propellant may be completed before the rocket leaves the launcher. At low-operating temperatures burning may continue after the rocket has left the launcher and a phenomenon known as "after burning" may occur. With all rockets at all temperatures a blast from the rear of the launcher known as "backblast" occurs. Personnel should not be permitted in the "danger area" (the triangular area directly to the rear of the rocket) in which this backblast occurs unless protected by adequate shelter. See TM 9-1950 for danger area of rockets. In particular, eyes must be protected when firing a rocket at any temperature. Face and hand protection are *mandatory* when firing shoulder-launched rockets at any temperatures below freezing. To avoid injury by possible accidental ignition of rockets during loading, care should be exercised to see that the loader does not stand directly behind launcher and rocket.

b. Safe firing temperature limits are marked on each rocket. Firing at temperatures above the "safe limit" may produce dangerously high pressures within the motor. Firing at temperatures below the "safe limit" may cause erratic flight and duds or other malfunctions. Dents in the motor or bent fins may also cause erratic flight.

c. When firing from launchers M18, M20, and M25 series (bazooka type), care should be taken by the loader to see that the yoke of the con-

tactor latches are properly engaged in the unpainted notches or grooves of the rocket fin assemblies, because if the latch is engaged forward of its proper place, the rocket may be prevented from being expelled from the launchers, in which case injury to personnel may result.

d. Care should be exercised in firing through a screen of brush or trees, since impact with a branch may deflect the rocket or cause it to detonate.

e. Misfires or hangfires may be encountered especially under extreme weather conditions or other adverse circumstances. All practicable precautions such as protection and inspection, particularly in the case of exposed electric lead wires and connections, should be taken to prevent such malfunction. It should be noted particularly that misfires cannot be immediately distinguished from hangfires and that certain periods of waiting before proceeding with firing are prescribed. References should be made in this connection to AR 385-63.

Caution: During intervals of hangfire (if any such occur) and while making an examination of firing circuits incident to such hangfire, the launcher should be kept trained on the target and personnel should be kept clear of the blast area.

f. In the case of rockets the components of which are issued separately, such rockets will not be assembled into complete rounds in amounts greater than immediate requirements. Any such round assembled but not used will be returned to its original condition, packings, and markings.

g. Safety devices will be removed as specified in preparation for firing but at no other time.

h. No attempt will be made to disassemble any fuze or to remove a base fuze.

i. Rocket duds, which are rockets that have been fired but the head of which has failed to explode, must be regarded as being *liable* to explode at any time. They will not be moved but will be destroyed in place by authorized personnel (see TM 9-1903).

j. Instruction sheets are furnished for rockets and kits where operating details are sufficiently extensive to warrant such sheets.

121. Packing and Marking

Small rockets, that is, 3.5-inch, are packed as assembled complete rounds in sealed fiber or metal containers that are packed in turn in wooden boxes. Medium caliber rockets, 4.5-inch, are packed fuzed or unfuzed as required in fiber containers that are in turn packed in metal containers or wooden boxes (fig. 167). Rockets of the Navy type are shipped with head and motor unassembled in one box or components may be shipped separately. Certain point-detonating fuzes are shipped assembled to rockets or separately in hermetically sealed containers in wooden boxes. VT fuzes are packed in hermetically sealed containers



Figure 167. Packing—outer metal and inner fiber containers for 4.5-inch rocket.

rockets are integral. Base fuzes (Navy type) are shipped assembled to rocket heads and *are not to be removed* from the heads. In the case of assembled heads and motors, packing boxes are marked to indicate the "nose end" because storage requirements are that these assemblies must be stored in such a position that if the assembled rocket is propelled as a

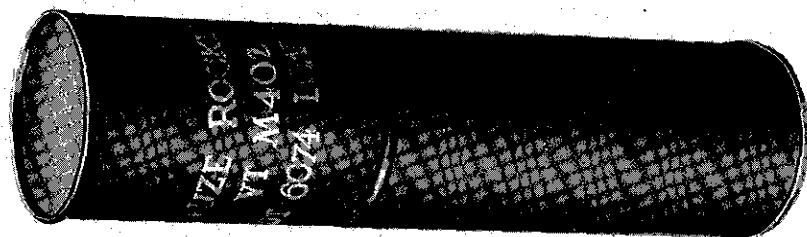


Figure 168. Hermetically sealed container for VT fuze.



Figure 169. Metal packing box for VT fuzes.

result of accidental ignition of the propellant, it will be propelled in a direction that will do the least damage (dwg 20-4-613). Dimensions and weights of shipping boxes and other packing and shipping data are published in Department of the Army Supply Manual ORD 3 SNL S-9.

Section VII. JATOS

122. General

a. Terminology. The term JATO is derived from the initial letters of Jet Assisted Take-Off, indicating the first of several uses for which JATOS have been developed. A JATO, like a rocket, is a device that produces thrust. JATOS, however, do not have a warhead as rockets do. The thrust of a JATO results from the reaction of the products of combustion of a propellant being accelerated to a very high velocity in the nozzle.

b. Complete Round. The complete round consists essentially of a combustion chamber (body), a propellant contained in the chamber, means for ignition, and one or more nozzles to control the escape of the products of combustion as the propellant burns. For a typical JATO (fig. 170), the essential components (fig. 171) consist of a chamber (body), nozzle, nozzle closure, propellant grains, trap, and igniter assembly. The combustion chamber is usually a hollow metal cylinder closed at the front end and fitted with a nozzle at the other end. The propellant usually consists of one or more grains in the solid state. Some surfaces of the grain may be coated or covered with sheets of an inhibitor, a slower burning material, to control the burning rate. In some JATOS, resonance rods are included, which aid in controlling the burning rate by dampening pressure waves resulting from the rapid burning of the propellant. The rods are usually suspended from the head end of the JATO. A trap, grid-like in form and located on the approach side of the nozzle, may be used to prevent unburned portions of the propellant from being ejected. Ignition is by means of an electrically fired igniter (par. 125). The nozzle is usually of the convergent-divergent type, the streamlined shape providing for nonturbulence and relatively frictionless flow of the escaping gases. The throat (constricted portion) of the nozzle may be lined with a refractory substance, such as graphite, to prevent

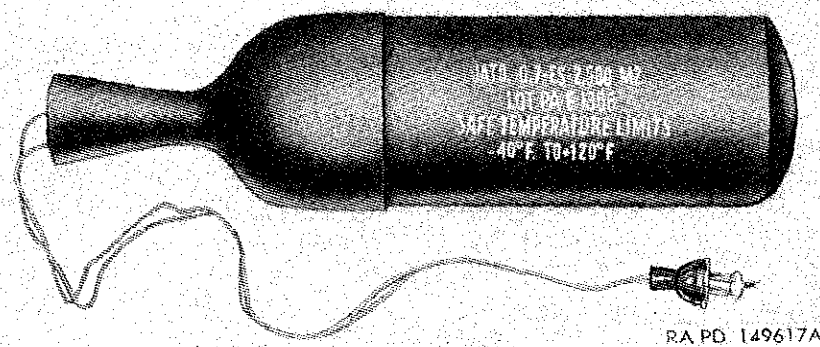
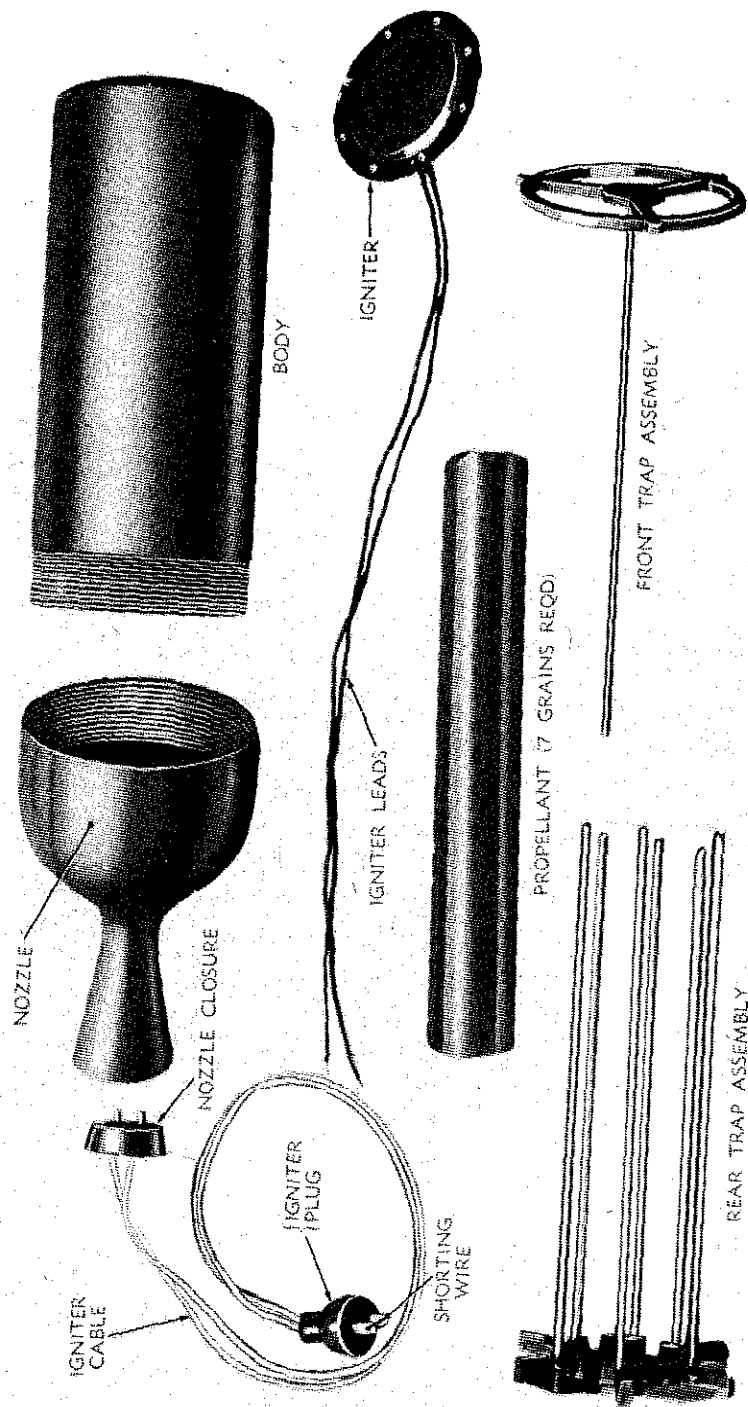


Figure 170. Typical JATO.



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Figure 171. Components of a typical JATO.

the action of the hot gases from changing the throat dimensions. A small change in throat area affects the functioning of the JATO by altering the rate at which the gases escape. Nozzle closures or seals prevent moisture from entering the JATO and, in some cases, aid ignition of the propellant by causing pressure to be built up within the chamber when the igniter is fired. Special safety devices such as pressure release valves limit the pressures and hence prevent rupturing the chamber. Means are generally provided for attaching the JATO securely to the unit with which it is used.

c. Uses. JATOS are used to assist the takeoff of airplanes under unusual conditions by providing additional power for a short time either in the case of a heavily loaded plane or a relatively short runway. JATOS are also used to assist in propelling missiles. A JATO that functions only during the acceleration period of the missile is used as a "booster unit." A JATO that propels a missile after the end of the acceleration period is used as a "sustaining unit." Another use of the JATO is to carry linear explosive charges into position on minefields for mine clearing purposes. Some JATOS can be reloaded with propellant and igniters, after firing, and reused.

d. Identification. JATOS are completely identified by the standard nomenclature and the ammunition lot number (batch number) that are marked on all packings and on the item itself. The standard nomenclature consists of the basic noun JATO, the principal characteristics (type and physical state of propellant and duration and magnitude of thrust), and the model designation. In JATOS where the characteristics are classified, only the term JATO and model designation are used in the nomenclature. The symbols that indicate the principal characteristics are explained in paragraph 124. The model designation for JATOS of Army and Air Force responsibility uses the prefix T, or more recently XM, for development items and M for standard items. The model designation for JATOS of Navy responsibility uses the prefix X for development items and Mk for standard items.

123. Classification

a. A JATO may be defined as a complete self-contained auxiliary rocket-type propulsion unit having a definite burning time and thrust and used for applying thrust to some structure or apparatus.

b. JATOS are classified according to the type and physical state of the propellant used and duration and magnitude of thrust as explained in paragraph 124.

124. Types

JATOS are identified as to type and physical state of propellant and duration and magnitude of thrust by a symbol composed of numerals and letters separated by dashes in the form: 2-CS-16000. The first numeral in the symbol indicates the duration of the thrust in seconds;

the two letters, the type and physical state of the propellant in accordance with the significance shown below; the second numeral, the nominal thrust in pounds.

Letter	Type of propellant
A.....	Acid with fuel or asphalt with perchlorate.
B.....	Ball or chopped double base.
C.....	Composite (picrate-nitrate).
D.....	Double base, cast (may contain composite strands or particles).
E.....	Extruded double base.
F.....	Furfuryl alcohol with oxidizer (includes all alcohols higher than ethyl).
H.....	Hydride fuels.
K.....	Perchlorates, cast with binder fuel other than asphalt.
N.....	Nitrates and nitro-compounds other than those designated above.
O.....	Liquid oxygen with alcohol or hydrocarbons.
Letter	Physical state of propellant
L.....	Liquids.
P.....	Plastic compositions (which can be deformed under moderate stress).
S.....	Solids (which are not readily deformed at ordinary temperatures).

Thus for the example 2-CS-16000, the burning time is of 2 seconds duration, the propellant is composite (picrate-nitrate) and in a solid state, and the thrust produced is 16,000 pounds.

125. Igniters

The igniter assembly typically consists of one or more electric squibs and an igniting charge of black powder or pyrotechnic composition housed in a container. Leads from the squibs are passed from the igniter housing to an external point where they can be attached to the firing circuit. The squib contains a heat-sensitive composition that is fired by the heat generated in a wire by an electric current. The squib ignites the black powder that, in turn, ignites the JATO propellant, either directly or by means of a booster charge of sheet powder. When more than one squib is provided in an igniter, the squibs are usually wired in parallel, so that insurance against misfire is provided. For safety during handling, storage, and shipment, the igniter leads are shorted to prevent accidental ignition by stray or induced currents or other sources of electrical energy.

126. Igniter Circuit Continuity Testing

Where requirements call for the application of electrical energy to the igniter circuit of a JATO for testing its continuity such as during manufacture, renovation, or preparation for shipment, the testing devices used must be approved by the Chief of Ordnance. Testing operations will be conducted behind appropriate barriers, in areas that have been shown by tests to be free of sources of electrical energy that might initiate the unit under test and with due consideration to the safety of personnel and equipment. Continuity testing of circuits in JATOS immediately prior to

firing will not be done except under authority of, and with testing equipment approved by, the chief of the technical service concerned.

127. Care and Precautions in Handling

a. General. In order to insure that the JATO will remain in serviceable condition and to provide protection to personnel and matériel, the general precautions in *b* through *e* below and the precautions specified in TM 9-1955 should be observed.

b. Mechanical Shock. The JATO or packings that contain JATOS should not be handled roughly. Such handling at low temperatures may result in damage to JATO components, in particular to the JATO propellant, which, if cracked and broken, can cause dangerous pressures to be built up within the JATO when fired.

c. Temperature.

(1) JATOS will not be stored where temperatures range beyond storage limits specified for each unit. JATOS should not be subjected to temperatures beyond the storage limits during shipment.

(2) JATOS should not be subjected to rapid and extreme temperature changes, since such exposure may cause the propellant to crack or break, thus causing dangerous pressures to be developed in the unit when fired.

d. Moisture. Since explosives are adversely affected by moisture, JATOS and, particularly, separately packed igniters should not be removed from their packings nor should moisture-resistant seals be broken until the unit is to be used.

e. Storage. JATOS should be stored in a dry, relatively cool location. Due consideration must be given to the temperature limitations in *c* above.

128. Precautions in Firing

a. Preparation for Firing.

(1) JATOS, which are shipped with some components not assembled, should not be assembled in advance of anticipated requirements. Those assembled for use but not used will be disassembled and each component will be returned to its original condition and packings. Care should be taken to insure that separately packed igniters are repacked in a moistureproof manner.

(2) Safety devices (shorting wires, clips, and receptacles) will not be removed except as required for testing and preparatory to firing.

(3) No JATO or component thereof, as issued, will be disassembled except as specifically authorized by the chief of the technical service concerned.

(4) Extreme care should be exercised during the installation of the JATO to insure completeness of mounting and attachment. A

JATO improperly or insecurely installed may break loose upon being fired and will travel at a high velocity in an uncontrolled and unpredictable flight.

- (5) Safe firing temperature limits are marked on each JATO. Firing at temperatures above the "safe limit" may produce dangerously high pressures within the chamber. Firing at temperatures below the safe limit may cause erratic flight and duds or may produce dangerously high chamber pressures caused by cracks in the propellant that expose greater areas to burning.
- (6) The firing circuit must be open (switch off) when the igniter leads or plugs are connected into the circuit. The leads or plugs should be connected into the firing circuit as the last operation in preparation for firing.
- (7) The JATO will not be fired until all personnel and matériel are clear of the danger area (*b* below) or protected by adequate shelter.

b. Danger Area. When a JATO is fired, a blast of hot gases and flame from the rear of the JATO known as "backblast" occurs. The blast is attended by the discharge at high velocity of small missiles such as fragments of wiring, plugs, closures, and unburned propellant. The area in which blast and missiles occur is known as the danger area.

c. Misfires and Hangfires. Misfires or hangfires may be encountered especially under extreme weather conditions or other adverse circumstances. All practicable precautions such as protection against entry of moisture into the JATO or igniter and inspection, particularly in the case of exposed electric lead wires and connections, should be taken to prevent such malfunction. It should be noted particularly that misfires cannot be immediately distinguished from hangfires and that certain periods of waiting before proceeding with firing are prescribed. The specific time interval to be observed for each JATO is given in TM 9-1955 series. If subsequent examination reveals that the failure to fire was due to a faulty firing mechanism, the defect may be corrected and the JATO may be reinstalled and fired. If the examination reveals no defect in the firing mechanism or electrical circuit, the JATO is considered as faulty. The safety devices must be replaced on the JATO and the JATO must be removed from the item to which it is attached and kept segregated until disposed of. During hangfire intervals and subsequent examination of the firing circuit, personnel should keep clear of the danger area (*b* above).

129. Packing and Marking

a. Packing. JATOS are generally shipped completely assembled; however, certain igniter assemblies and propelling charges (refills) are shipped separately. The JATO, dependent upon size and weight, may either be packed for shipment in a wooden box, wooden crate, or on a pallet. The specific packing data for each JATO and separately issued compo-

nents are published in Department of the Army Supply Manual ORD 3 SNL S-9.

b. Marking. In addition to the usual identification marking, packing boxes are marked to indicate the "nose end" in order that the boxes may be stored in such a position that minimum damage would result should the JATOS be accidentally initiated. For further information on packing and marking, see TM 9-1903.

Section VIII. LAND MINES

130. General

A land mine is an encased explosive or other material, intended for placement on the ground or beneath the surface of the ground, and is designed to destroy or damage vehicles, or to wound, kill, or otherwise incapacitate personnel, or to contaminate strategic areas. It may be initiated by the action of its victim, by passage of time, or by controlled means. Land mines, their components, and ammunition for simulated booby traps and land mine fire are listed in Department of the Army Supply Manual ORD 3 SNL R-7. For technical information on land mines, see TM 9-1940. For tactical information on land mines, see FM 20-32.

131. Classification

a. Use. Land mines are classified according to the use for which they are designed as antipersonnel or antitank. An antipersonnel mine is a mine designed to kill or disable personnel. An antitank mine is a mine designed to immobilize or destroy tanks or other vehicles.

b. Purpose. Land mines are classified according to purpose as service or practice. Service mines currently being issued are filled with high explosives. Practice mines are classified as "practice" or "inert." A practice mine is a replica of a service mine, having the same features and weight as the mine it represents. It is constructed to emit a puff of smoke or make a noise to simulate detonation. An inert mine is an inert replica of a service mine, used for instructional purposes. A service mine taken out of the production line before it is filled with explosives is a variety of inert mine known as an empty mine. No phony mines are currently being manufactured; however, an improvised object used to simulate a mine is known as a phony mine.

c. Identification.

- (1) In the case of service antitank mines, the designation HE (high explosive) appears in the nomenclature. Practice mines are marked PRACTICE, INERT, or EMPTY. Nomenclature is marked on the items and on the packing boxes.
- (2) Mines filled with high explosives are painted olive drab with marking in yellow. Practice mines are painted blue with marking in yellow.

marking in white. Inert mines are painted black with marking in white.

132. Antipersonnel Mines

a. General. Antipersonnel service mines are used primarily to produce casualties to enemy foot troops. They consist of a small amount of high explosive, generally less than 1 pound, in a metallic or nonmetallic container fitted with a fuze arranged for activation by pressure or release of pressure, by pull on a trip wire, or by release of tension (by cutting) of a taut trip wire. Antipersonnel practice mines are issued for practice and training purposes. The practice mines and associated fuzes are completely inert or contain small quantities of explosive (usually black powder) or smoke or noisemaking composition to simulate the functioning of a service mine.

b. Antipersonnel Service Mines.

- (1) *Bounding type.* The mine M2A4 (fig. 172) and earlier models of the M2 series consist of a short 2½-inch tube (projector) with attached fuze of the "firing device" type. The complete assembly weighs 5 pounds. When initiated by pressure on any of the prongs of the fuze or pull on a trip wire attached to the release pin ring, the mine projects, by means of a small propelling charge of black powder, a shell filled with 0.34 pound of TNT to a height of about 6 feet where it explodes. For use against enemy personnel, it is laid just below the surface of the ground. It has an effective radius of about 10 yards and is dangerous at 100 yards. The mine and fuze are painted olive drab, except for the mine base, which is painted yellow.
- (2) *Bounding-fragmentation type.* The mine M16 (T6) (fig. 173) consists of a cylindrical cast-iron shell containing high-explosive detonators, boosters, and bursting charge with axial fuze well. As shipped, a hexagonal shipping plug closes the fuze well. When laid, the mine is fitted with a combination (pressure or pull) type fuze (M605). The mine is completely waterproof and can be readily detected with the use of magnetic mine detectors. When initiated by pressure (8 to 20 lb.) on either of the three prongs of the fuze or by pull of 3 to 8 pounds on a trip wire attached to the release pin ring on the fuze, the mine propelling charge projects cast-iron shell upward from the mine body to a height of 2 to 4 feet, where it explodes. The mine is laid just below the surface of the ground. It has a casualty radius of about 35 yards and is dangerous at 200 yards. The mine and fuze are painted olive drab with markings in yellow.
- (3) *Blast type.* The two-part plastic case of this mine (fig. 174) is cylindrical, approximately 2¼ inches in diameter and 1½ inches high. The upper part of the case contains an integral fuze. A belleville spring of reinforced plastic, to which the firing pin is

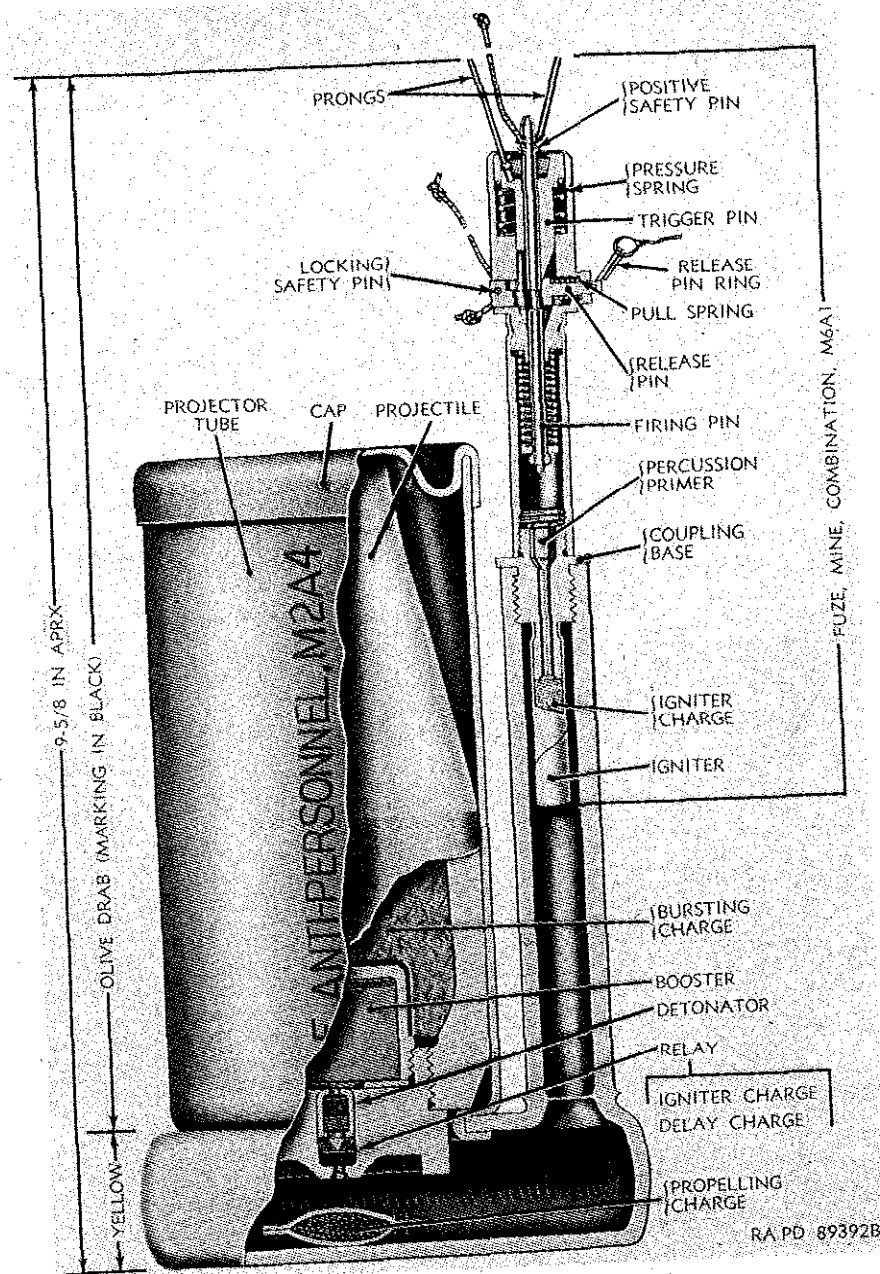


Figure 172. Mine, antipersonnel, M2A4, and fuze, mine, combination, M6A1.

attached, fits into a recess in the lower part of the upper case. The lower case contains the relatively small but powerful high-explosive charge of tetryl and a detonator well. The mine is designed for laying just below the level of the ground. It is in-

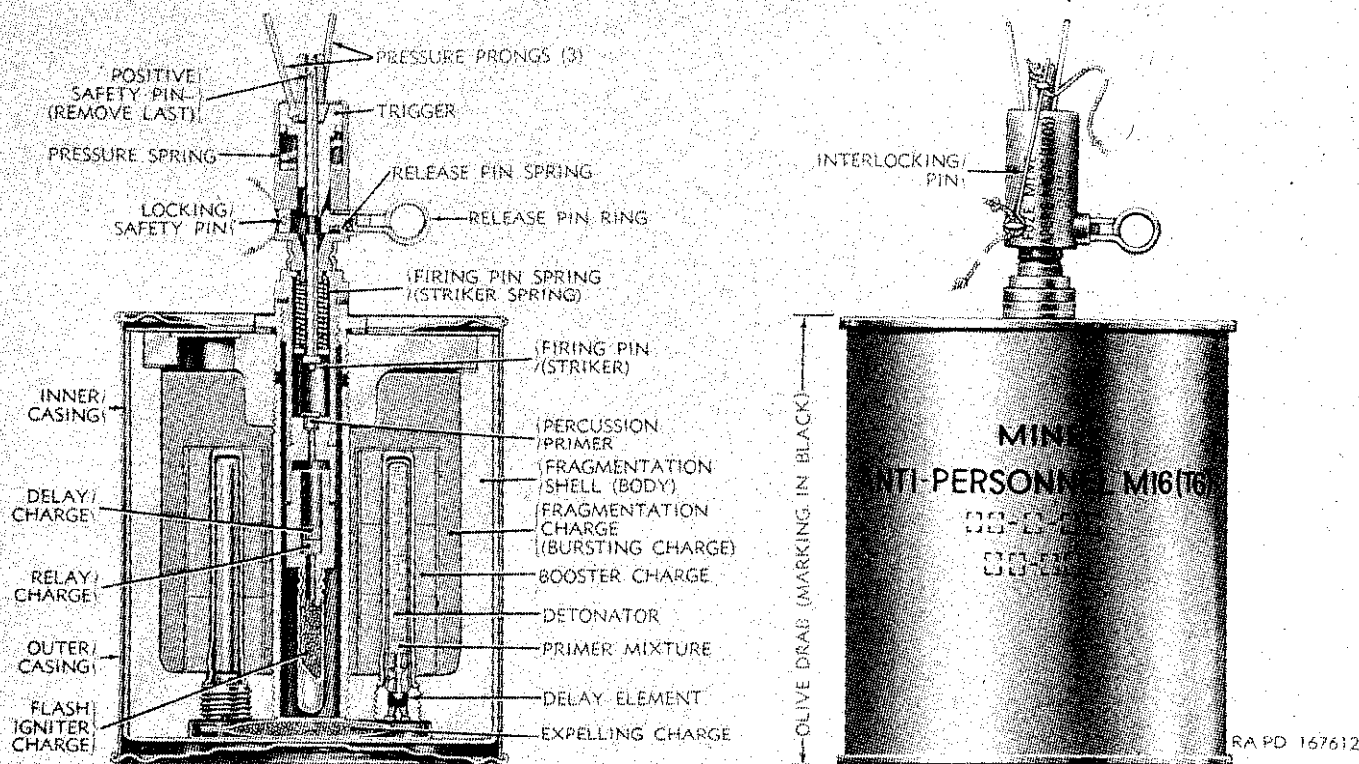


Figure 173. Mine, antipersonnel, M16, and fuze, mine, antipersonnel, M605.

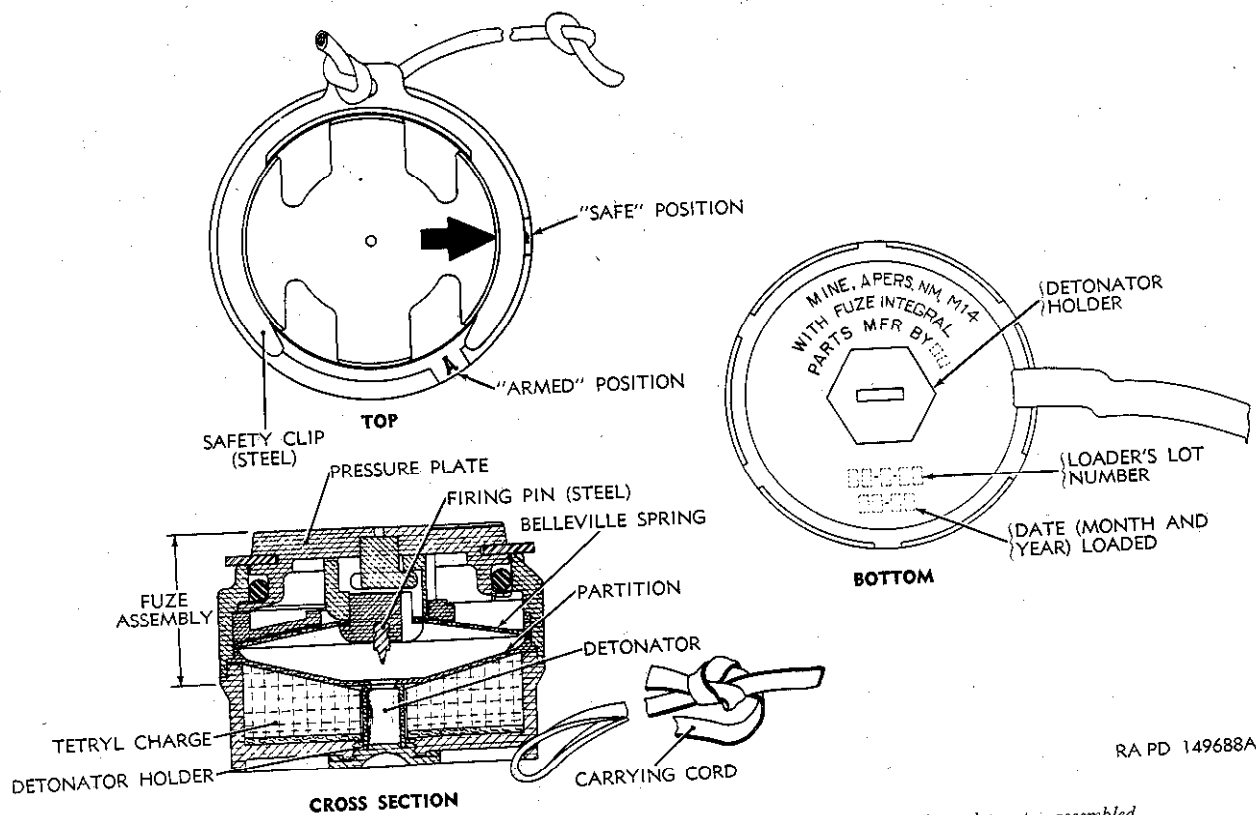


Figure 174. Mine, antipersonnel, NM, M14—integral fuze—top, bottom, and cross section—detonator assembled.

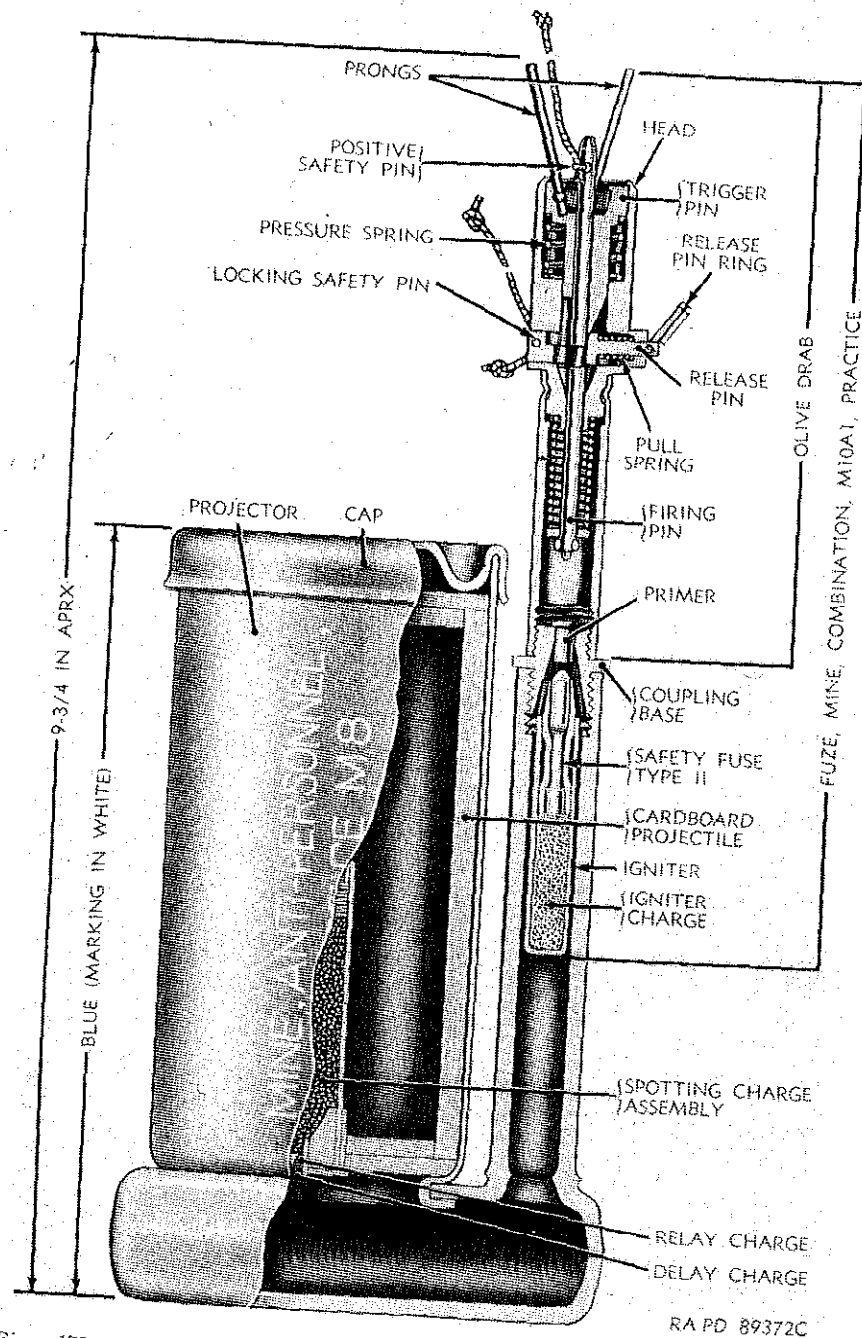


Figure 175. Mine, antipersonnel, practice, M8 (T4), and fuze, mine, combination, M10 (T14) or M10A1, practice.

tended to produce nonlethal casualties to enemy foot troops. When the mine is armed, that is, with the pointer turned from "S" (safe) to "A" (armed) and the safety clip removed, a load of 20 to 35 pounds on the pressure plate on the top of the mine causes the fuze to function, releasing the belleville spring that drives the firing pin into the detonator, thus exploding the main charge. As shipped, the lower part of the mine case contains a safety plug instead of the detonator and the mine is set safe, so that a slotted plastic sleeve restrains the downward movement of the pressure plate that is also restrained by a safety fork.

c. Antipersonnel Practice Mines.

- (1) *Bounding type.* Inert mines M2 and M2A1 with inert fuzes simulate the appearance of the "bounding" type antipersonnel service mines M2 series except in color and marking. The practice mine M8 (fig. 175) simulates the service mine M2A4. The metal parts of the M8 are the same as those used for the service mine M2A4 except for the projectile, which is made of cardboard, and the igniter, which contains a delay element to provide for a delay functioning of the mine 4 seconds after functioning of the fuze. The projectile contains a spotting charge assembly that resembles a shotgun shell with a delay element in place of the primer. The spotting charge, when initiated by the delay element, blows off the top of the projectile and the mine cap with a loud report and accompanying smoke. In order that the mine M8 may be used several times, the following replacement parts are issued:
 - (a) Cap, mine (cover).
 - (b) Igniter and primer assembly.
 - (c) Projectile.
 - (d) Propelling charge.
 - (e) Spotting charge.
- (2) *Bounding-fragmentation type.* The practice mine T34 is used to simulate the MINE, antipersonnel, NM, M14.

133. Antitank Mines

a. *General.* Antitank service mines are metallic or nonmetallic mines consisting of three types, the plate-shaped heavy, the square-shaped nonmetallic heavy, and rectangular-shaped light. There are three weights of the heavy mine—the 30-pound mine M15 and the 20-pound mine M6 series and the 28-pound nonmetallic mine. The light type (M7 series) weighs about 5 pounds. A light antitank mine requires a pressure of 140 to 240 pounds to initiate the fuze, but a heavy antitank mine requires a pressure of 300 to 500 pounds. Heavy antitank mines are usually not dangerous to foot troops unless they attempt to run across them. The light mine is intended for use against light tanks or vehicles. A group of two or more light mines can be used against heavy tanks. By use of sec-

ground, the setting knob is turned from "S" to "A," and the mine is then covered and concealed with dirt or other substance. As the mine is waterproof, it may be laid in swampy as well as dry ground. A force of 300 to 400 pounds is required to initiate the mine.

- (2) *Heavy (M6 series).* This heavy antitank mine (fig. 177) is known as a high-capacity type but the increase in weight and protection of modern tanks has necessitated the development of a more powerful mine ((1) above). The "heavy" mine of the M6 series is practically the same as the M15 except that it is about one-third less in thickness and has an explosive charge of 12 pounds of TNT as compared with 22 pounds of Composition B in the M15. Activator M1 is used with this mine in the same manner as with the M15. Older types of the M6 series were fitted with the old-style reversible arming plug M3 and the chemical fuzes M600 or M601 with integral boosters but these have been superseded by the M4 setting knob-type arming plug and the antitank mine fuze M603 (fig. 182) without booster. All antitank mines are now shipped with booster M120 installed in the bottom of the main fuze well. In some cases where a more powerful antitank defense is desired than is obtainable from a single mine M6 series, a special 8-pound cast TNT block is used in connection with the mine to augment its power. The mines M6 series, which were formerly packed in metal crate M153A1, are now packed in a wooden box.
- (3) *Heavy nonmetallic (M19 type).* The recently developed mine M19 is a heavy, blast-type mine constructed of plastic material. The mine is 13 inches square by 3 inches high and contains 21 pounds of cast Composition B explosive. The mine M19 is fitted with fuze M606, which is also constructed of a plastic material and is pressure actuated requiring 350 to 500 pounds for functioning. The total weight of mine is approximately 28 pounds. This mine is fitted with side and bottom wells suitable for attaching either metallic or nonmetallic firing devices for booby-trapping purposes. This mine will cause severe damage to medium and heavy tanks and cannot be detected at any depth of burial with small metals detectors.
- (4) *Light.* The light antitank mine (M7 series) (fig. 178) consists of a 3.6-pound explosive charge of tetrytol in a quart-size rectangular metal body intended for use against light tanks and vehicles. A group of two or more light mines can be used against heavy tanks. By use of secondary fuze wells and suitable firing devices, antitank mines can be adapted to antipersonnel use. The complete round consists of the loaded mine body, pressure plate, and fuze, and weighs 5 pounds. Cover for MINE, antitank, HE, M7 and M7A1, and practice, M10 (fig. 181), is a

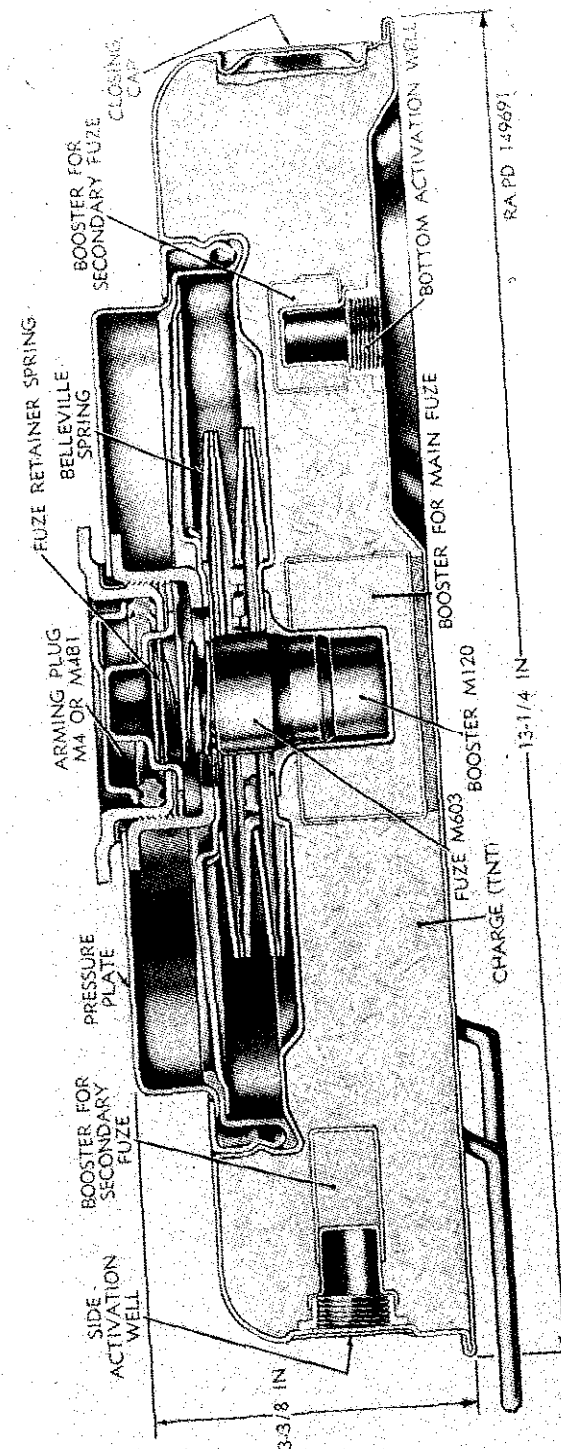


Figure 177. Mine, antitank, HE, heavy, M6A2, and fuze, mine, AT, M603 (T17E2).

ground, the setting knob is turned from "S" to "A," and the mine is then covered and concealed with dirt or other substance. As the mine is waterproof, it may be laid in swampy as well as dry ground. A force of 300 to 400 pounds is required to initiate the mine.

- (2) *Heavy (M6 series)*. This heavy antitank mine (fig. 177) is known as a high-capacity type but the increase in weight and protection of modern tanks has necessitated the development of a more powerful mine ((1) above). The "heavy" mine of the M6 series is practically the same as the M15 except that it is about one-third less in thickness and has an explosive charge of 12 pounds of TNT as compared with 22 pounds of Composition B in the M15. Activator M1 is used with this mine in the same manner as with the M15. Older types of the M6 series were fitted with the old-style reversible arming plug M3 and the chemical fuzes M600 or M601 with integral boosters but these have been superseded by the M4 setting knob-type arming plug and the antitank mine fuze M603 (fig. 182) without booster. All antitank mines are now shipped with booster M120 installed in the bottom of the main fuze well. In some cases where a more powerful antitank defense is desired than is obtainable from a single mine M6 series, a special 8-pound cast TNT block is used in connection with the mine to augment its power. The mines M6 series, which were formerly packed in metal crate M153A1, are now packed in a wooden box.
- (3) *Heavy nonmetallic (M19 type)*. The recently developed mine M19 is a heavy, blast-type mine constructed of plastic material. The mine is 13 inches square by 3 inches high and contains 21 pounds of cast Composition B explosive. The mine M19 is fitted with fuze M606, which is also constructed of a plastic material and is pressure actuated requiring 350 to 500 pounds for functioning. The total weight of mine is approximately 28 pounds. This mine is fitted with side and bottom wells suitable for attaching either metallic or nonmetallic firing devices for booby-trapping purposes. This mine will cause severe damage to medium and heavy tanks and cannot be detected at any depth of burial with small metals detectors.
- (4) *Light*. The light antitank mine (M7 series) (fig. 178) consists of a 3.6-pound explosive charge of tetrytol in a quart-size rectangular metal body intended for use against light tanks and vehicles. A group of two or more light mines can be used against heavy tanks. By use of secondary fuze wells and suitable firing devices, antitank mines can be adapted to antipersonnel use. The complete round consists of the loaded mine body, pressure plate, and fuze, and weighs 5 pounds. Cover for MINE, anti-

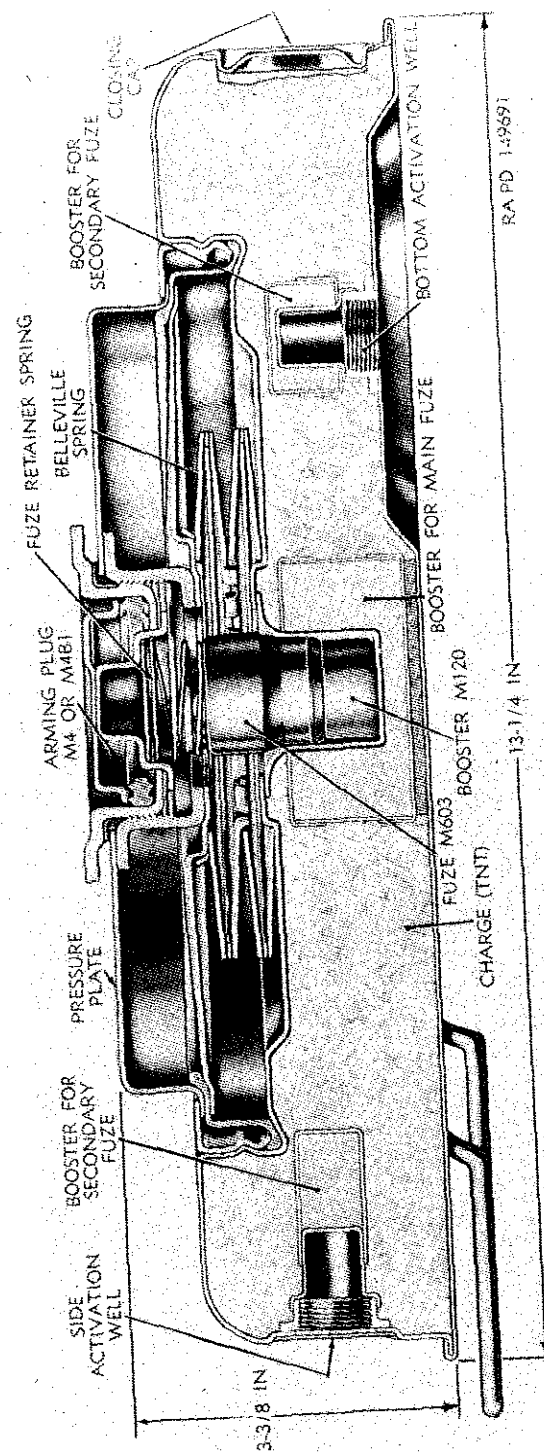


Figure 177. Mine, antitank, HE, heavy, M6A2, and fuze, mine, AT, M603 (T17E2).

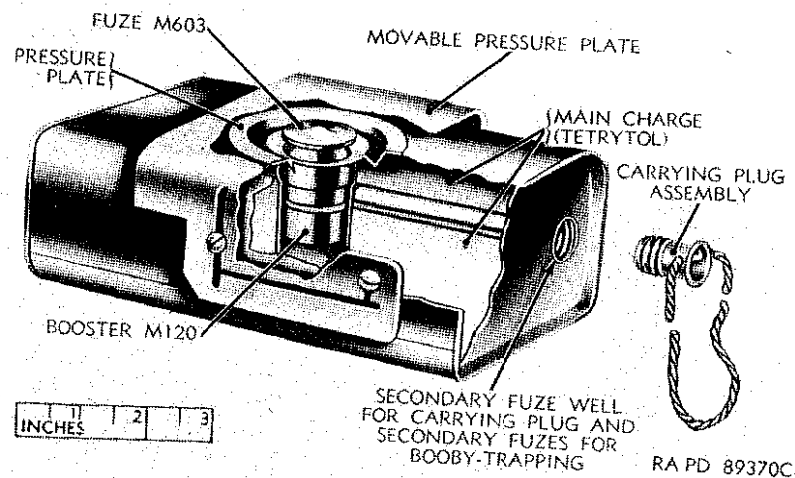


Figure 178. Mine, antitank, HE, light, M7A2, and fuze, mine, antitank, M603 (T17E2).

cloth sack of moisture-resistant mildew-proof fabric. This cover is provided for use with light antitank service and practice mines to keep such dirt, stones, or sand as would prevent functioning from working between the mine body and the pressure plate. Some limited standard antitank mines M7 series do not have secondary fuze wells; this mine cannot be used with a secondary (firing device-type) fuze. Activator M1 is not used with antitank mines M7 series, as secondary fuze well will not accommodate activator M1. Hence, if it is desired to booby-trap this mine, a secondary fuze may be made up of any standard firing device with a nonelectric blasting cap and installed in the secondary fuze well. As shipped, this mine has a carrying handle installed in the secondary fuze well. The main fuze well is in the center of the top surface of the body. The mine pressure plate, which may be slid into the "armed" position over the fuze, has a steel pad on its under surface that is in position to exert pressure on the pressure plate of the fuze when the mine pressure plate is in the armed position. Earlier models of the series light antitank mines M7 have all been modified by the incorporation of booster M120 so the FUZE, mine, antitank, M603 can be used. The MINE, antitank, HE, light, M7A2 uses the FUZE, mine, antitank, M603 (fig. 182).

c. Antitank Practice Mines.

- (1) General. Antitank practice mines are issued for practice and training purposes. Antitank practice mines and associated fuzes are completely inert or contain small quantities of explosive (usually black powder) or smoke-producing or noise-making composition that make either a smoke puff or a loud report or

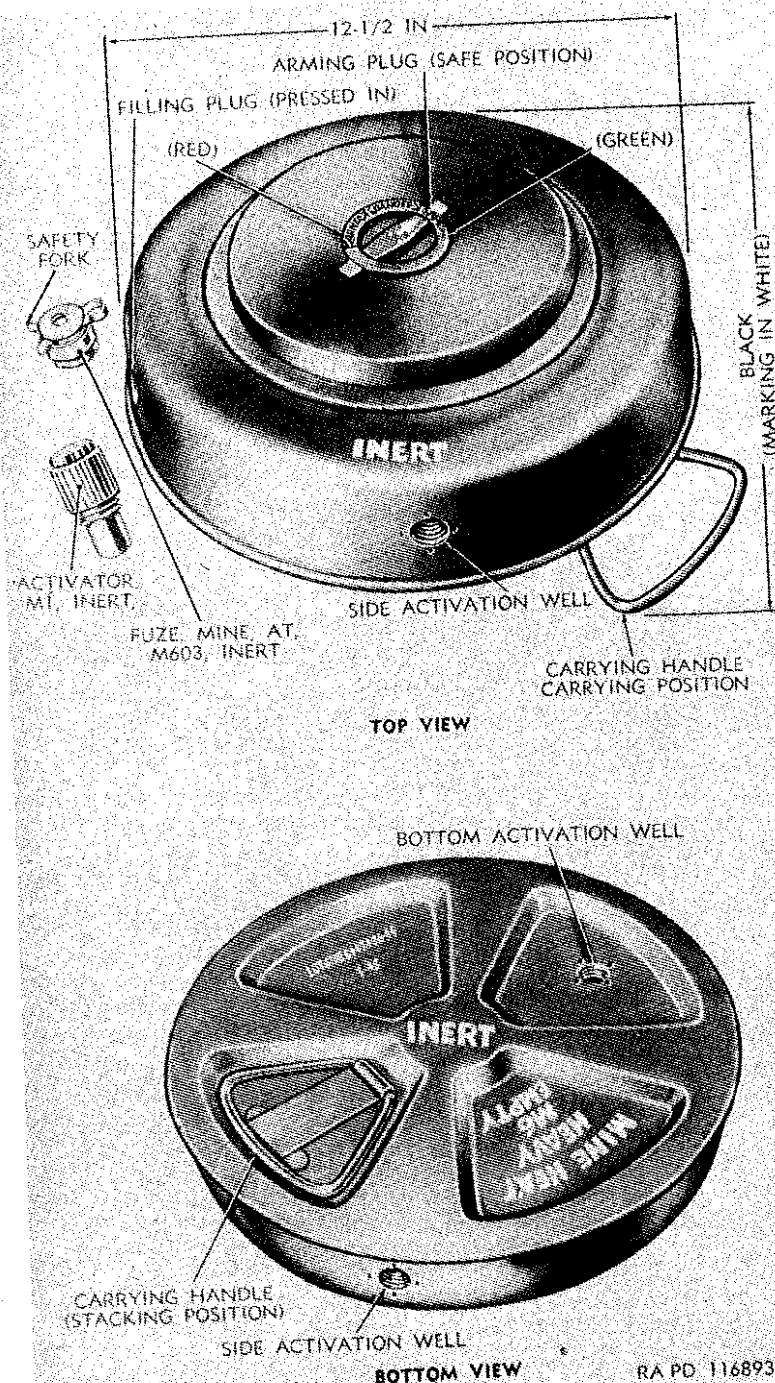


Figure 179. Mine, antitank, heavy, M6, empty—top view showing arming plug in unarmed position showing marking.

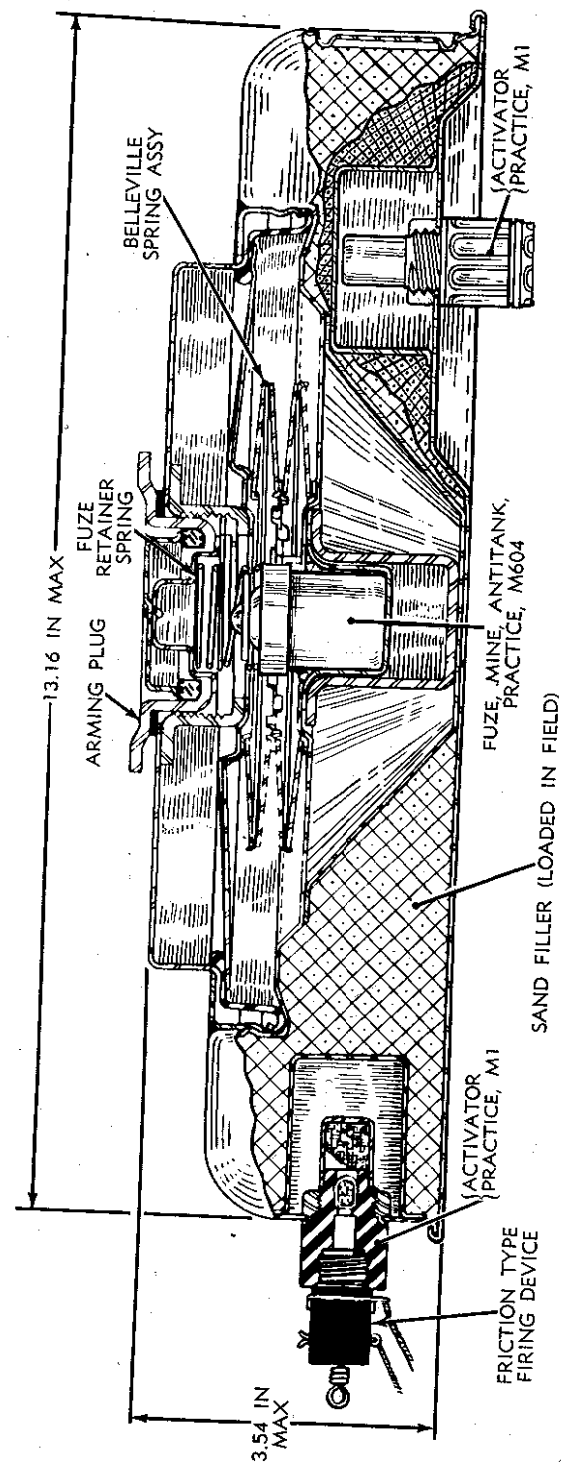


Figure 180. Mine, antitank, heavy, practice, M12 (T8E1), with fuze, mine, antitank, practice, M604.

both to simulate the functioning of a service mine. Inert mines used for practice and training are painted black and marked "INERT" in white. Practice mines are painted blue with markings in white. Practice fuzes are identified by marking either on the item or, if that is not practicable, by marking on the packing container. As firing devices, which are used in both practice and service mines, have a primer in the coupling base, they are painted olive drab, except the pull-friction firing device M2, which is black plastic. Special safety rules to be observed in connection with the use of practice mines are given in TM 9-1940. Both activator M1, inert, and practice activator M1, which are made of black plastic, are used in training in activation (par. 135). Activator M1, inert, which is marked "INERT," has a black booster cup and $\frac{3}{4}$ -inch outer thread. It is used only with inert mines of the M6 series and the inert M15. Practice activator M1 has a blue booster cup containing a charge of smoke composition and an $\frac{1}{16}$ -inch outer thread. It is used only with the heavy practice mine M12, which has a mating $\frac{1}{16}$ -inch threaded activator well.

- (2) *Heavy.* MINE, antitank, heavy, M6, empty (fig. 179), is completely inert and is used with an inert main fuze and an inert activator M1 to simulate the high-explosive heavy antitank mine of the M6 series for training. The inert mine M6 is also issued without fuze or activator to be used in practice with inert fuze M603 and inert activator M1. MINE, antitank, heavy, practice, M12 (T8E1) (fig. 180) is used for practice in handling and laying high-explosive heavy antitank service mines of the M6 type. Except for the smoke charge contained in the practice fuze (M604), or practice activator M1 with firing device when used as a secondary fuze, the mine M12 round is inert, the mine body being loaded with an inert substance. The weight of a vehicle passing over the mine causes functioning of the main fuze, which emits a smoke puff followed by a loud report. MINE, antitank, practice, heavy, M20 is used to provide a practice mine for the standard mine M15. It is identical in size, shape, method of arming, and method of use as the standard MINE, antitank, HE, heavy, M15. By filling the body of the mine M20 with sand, through the opening provided in the mine body, the weight of the mine M15 can be duplicated. The practice mine M20 uses the FUZE, mine, antitank, practice, M604 and functions the same as the practice mine M12. The practice mine M20 is provided with side and bottom fuze wells suitable for attaching practice activator M1. Booby-trapping may be accomplished by fitting a practice activator M1 with any standard firing device in one or both of the activator wells provided for the purpose. When initiated, the practice

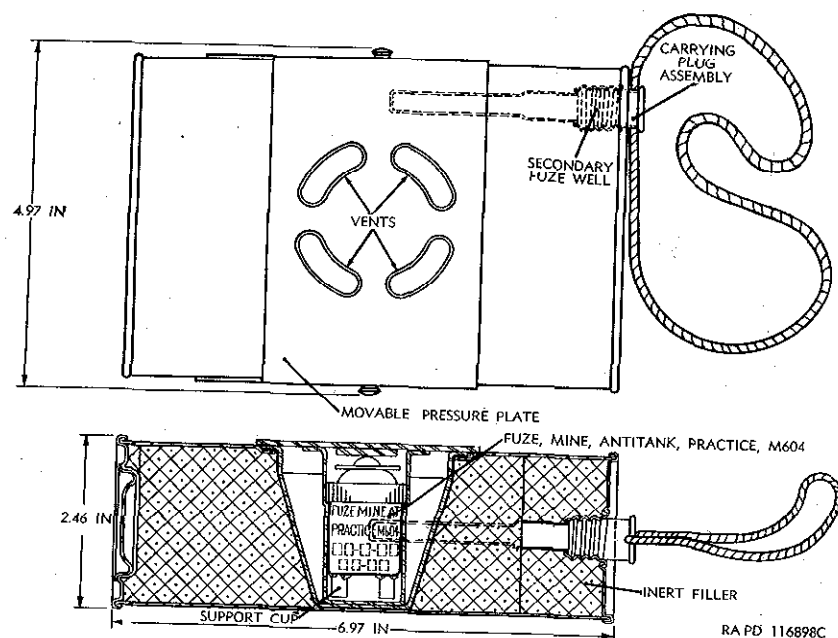


Figure 181. Mine, antitank, light, practice, M10 (T9), with fuze, mine, antitank, practice, M604.

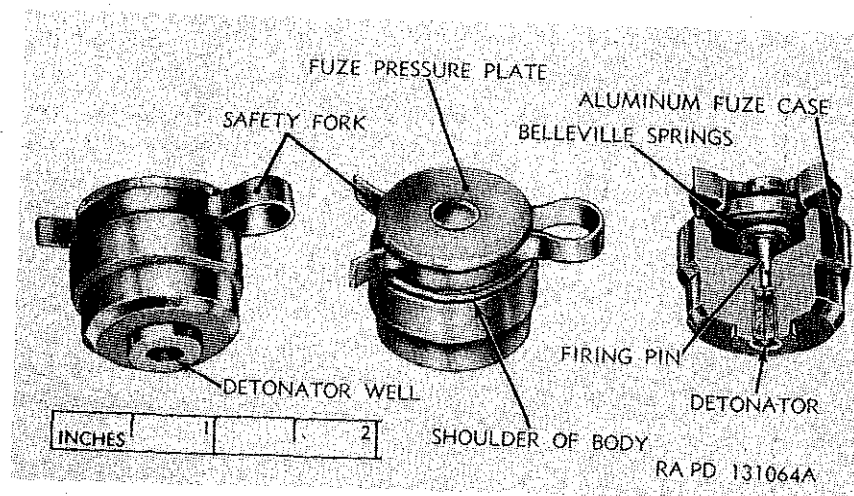


Figure 182. Fuze, mine, antitank, M603 (T17E2)—showing bottom, top, and cross section.

activator emits a puff of smoke. It is to be noted that the activator M1 is usable only with the mines M6 series and M15, and that the practice activator M1 is usable only with the practice mine M12.

Caution: Activator M1 (service) should not be used with inert mines.

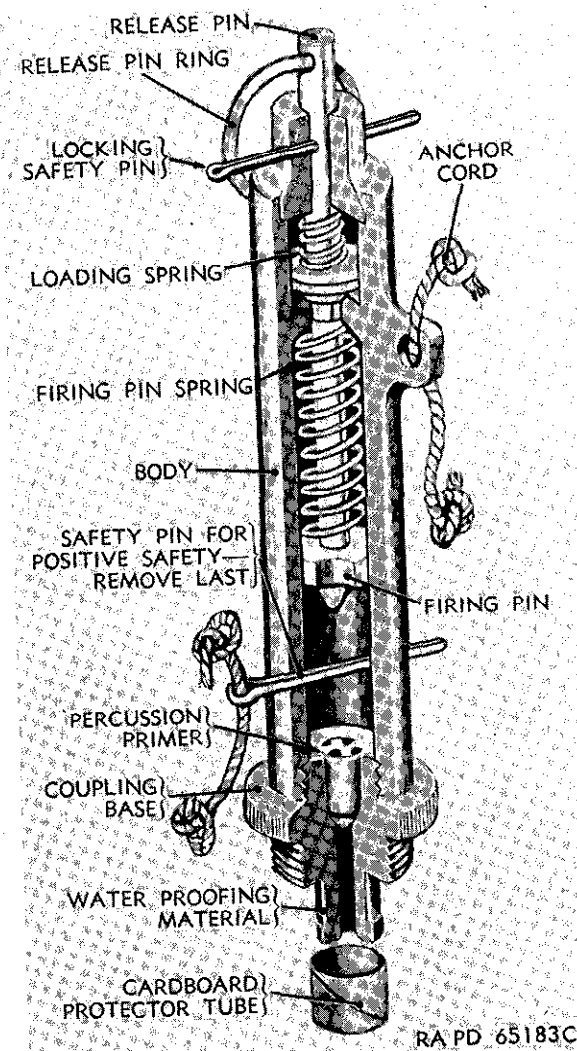


Figure 183. Firing device, pull type, M1.

- (3) **Light.** MINE, antitank, light, M7, inert, without fuze, and MINE, antitank, light, M7A1, inert, with fuze, mine, chemical, AT, M600 or M601 inert, are used to simulate high-explosive light antitank mines of the M7 series. MINE, antitank, light, practice, M10 (T9) (fig. 181) is used for training personnel in the proper methods of handling and laying high-explosive light antitank mines of the M7 type. Except for the smoke charge contained in the practice fuze (M604), the practice mine M10 is inert. The weight of a vehicle passing over the mine causes

the practice fuze to function, emitting a puff of smoke followed by a loud report. A standard firing device, which includes a primer but which should *not* be fitted with a blasting cap in this case, may be used in the secondary fuze well for simulating booby-trapping (par. 135).

d. *Fuzes for Antitank Mines.* The main fuze used with both the heavy and the light type antitank service mines is the M603 (fig. 182). The fuze used with the mine M19 is the M606. The fuze used with both the heavy and light antitank practice mines is the M604 (figs. 180 and 181). The M604 has an integral smoke charge and is the size of the fuze M603 and booster M120 combined. Hence no booster is used in the main fuze wells of the practice antitank mines M10 light and M12 heavy. An inert fuze M603 may be used with the inert heavy mines M15 or M6 series or the light mines M7 series fitted with inert booster M120. A secondary fuze for the heavy service mines M15 or M6 series consists of any standard firing device, for example, the pull-type shown in figure 183 and activator, M1 (fig. 184). A secondary fuze for the heavy antitank practice mine M12 consists of any standard firing device and activator, practice, M1 (fig. 185). A secondary fuze for the light service mines M7 series

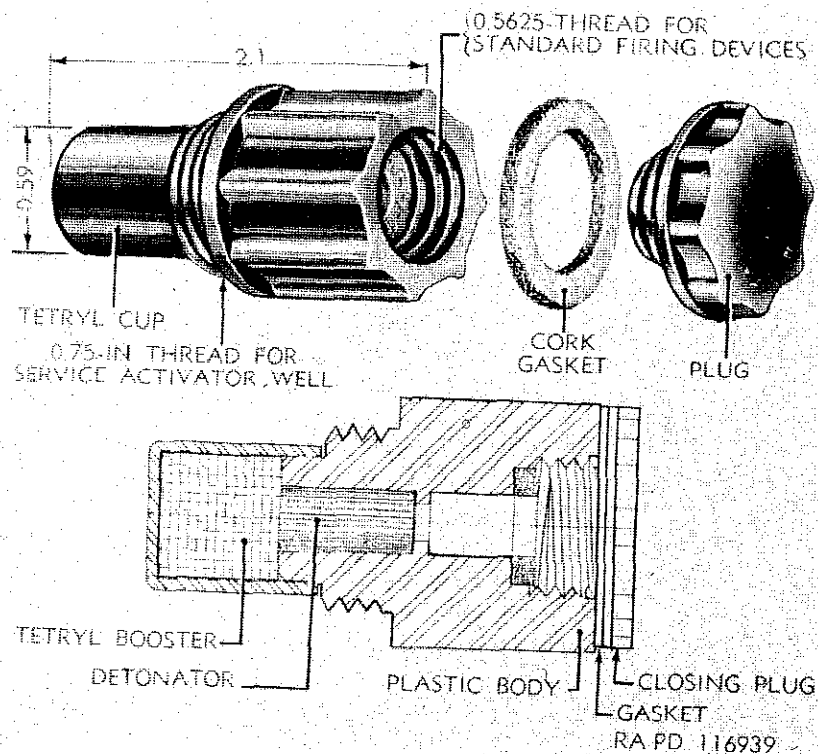


Figure 184. Activator, M1.

can be made of any standard firing device fitted with a blasting cap. A secondary fuze for the light practice mine M10 can be made of any standard firing device without blasting cap. An inert firing device and activator, M1, inert, may be used with an inert mine M15 or M6 series or an inert secondary fuze. An inert firing device and an inert blasting cap may be used with an inert mine M7 series or an inert secondary fuze.

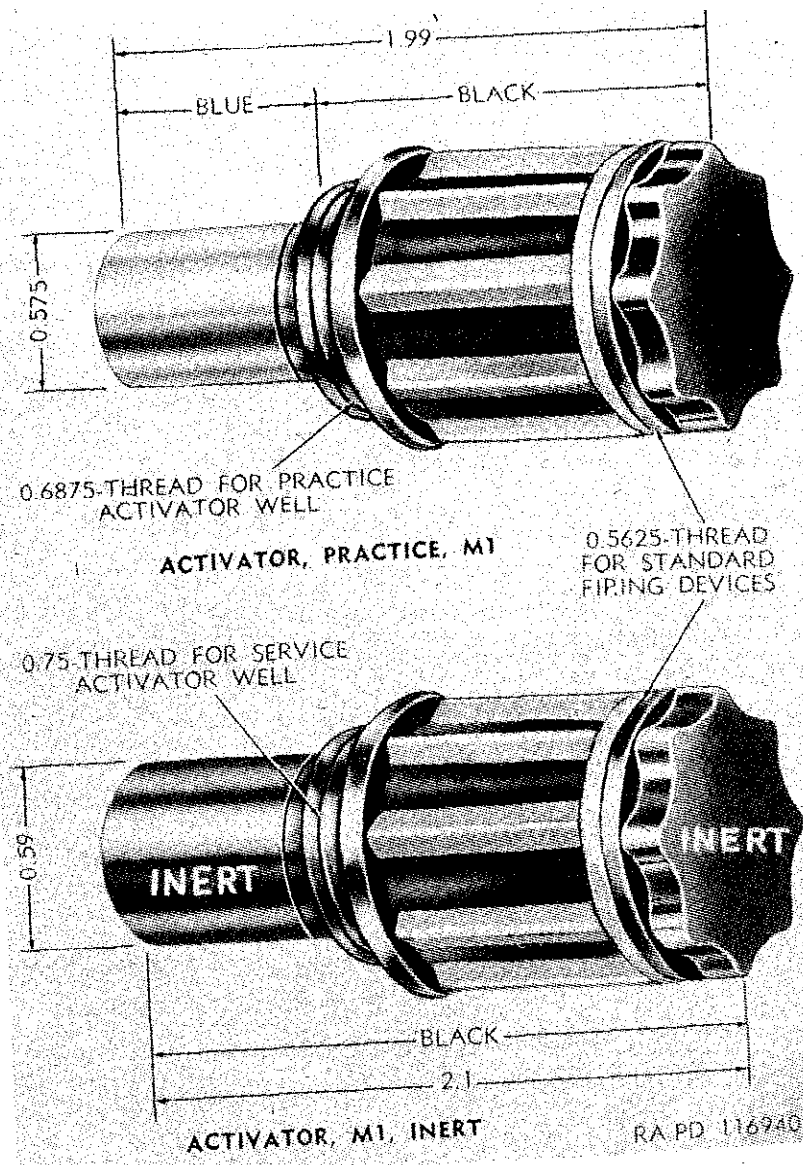


Figure 185. Activator, practice, M1, for use in practice mine, M12, and activator, M1, inert, for use in antitank mine M6, inert.

134. Chemical Mines

a. *General.* Chemical land mines are used by defending forces to contaminate important areas with blister gas. The mines are exploded either by remote control or by trip action, spreading blister gas to hinder and inflict casualties upon the enemy.

b. *Description.* The standard chemical land mine is a rectangular 1-gallon container (common varnish or syrup can). Two copper wires are soldered to one side for fastening a burster. When filled with blister gas, the can weighs about 11 pounds. For additional information about chemical land mines, see TM 3-300.

135. Booby-Trapping and Improvisation

a. *Booby-Trapping Antitank Mines.* A booby-trapping (equipped with antiremoval device) antitank mine (fig. 186) is one that, in addition to its main fuze, is fitted with one or more secondary fuzes that are intended to act as an antilift device and to cause the mine to explode when an attempt is made by the enemy to remove it. In the case of a heavy type service or practice antitank mine, a secondary fuze consists of a firing device and the appropriate activator (par. 133d). In the case of a light type service or practice antitank mine, a secondary fuze consists of a firing device fitted with a nonelectric blasting cap. Secondary fuzes may be fitted to an antitank mine or to another mine or explosive charge laid close beneath or beside it. The mines or charges and firing devices in such an arrangement are connected by wires and laid in a manner that, upon the enemy's attempt, by his prescribed method of "safe" removal,

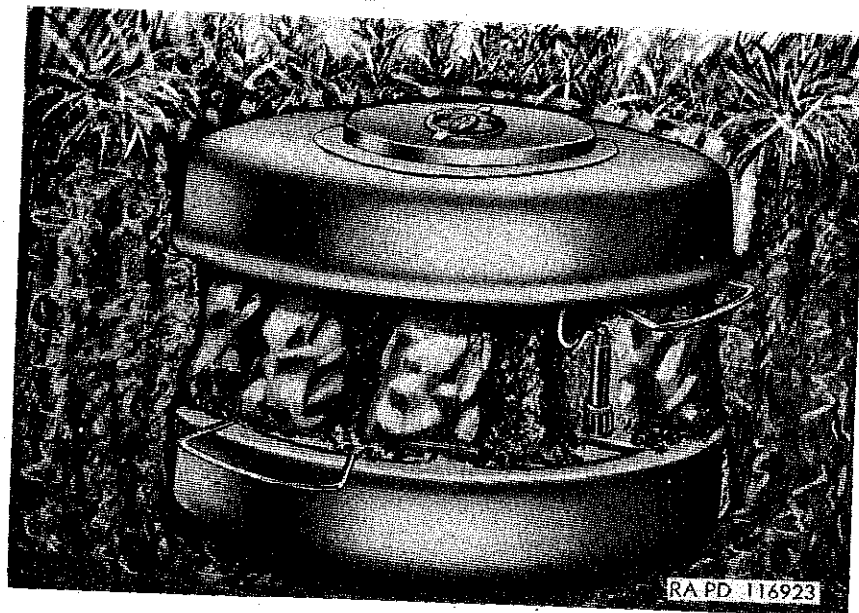


Figure 186. Installation of a boobytrapped antitank mine.

to remove the mine his suspicion of the presence of the other mines or charges will not be aroused but the whole arrangement will explode.

b. *Improvisation.* All types of land mines are subject to a variety of uses as improvised mines; in combination with each other, with all types of explosive charges and firing devices, with bombs or artillery shell, with fougasses, or with dummy mines.

c. *Special Training Required.* Laying antipersonnel mines and installing the many possible types of antiremoval devices, booby-trapping, and improvisations are specialized operations that are performed only by well trained troops.

136. Care and Precautions in Handling

a. General instructions for care and precautions (par. 12) for all types of ammunition will be as indicated in b through g below. See also AR 385-63 for additional safety precautions.

b. All types of mines must be handled with appropriate care at all times. As fuzes, primers, detonators, activators, and firing devices contain explosives that are particularly sensitive, boxes containing mines that usually also contain these sensitive items must be protected against shock, friction, and high temperatures and grounded to prevent accumulation of static electricity whenever practicable.

c. Mines are waterproofed for laying in the ground that at times may become wet. However, mines and components in their packings should be protected against moisture until used. When it is necessary to leave a stack of packed mines in the open, they should be raised on dunnage and covered with a double thickness of paulin, leaving enough space all around the stack for circulation of air. Paulins should be supported in such manner as to provide 12 inches of space between top of stack of mines and the paulins.

d. Packing boxes containing mines or components should not be opened within 100 feet of any kind of magazine, either for long-term or for temporary storage, or at any ammunition dump. In unpacking and repacking operations, safety (nonsparking) tools, those made of copper or wood, if available, should be used.

e. Safety pins, safety forks, safety clips, and similar devices, which are designed to prevent initiation of a mine while being handled, must be left in place until the latest moment practicable before "arming" and restored when "disarming," as prescribed in TM 9-1940 and FM 20-32.

f. Mines in general will function satisfactorily at temperatures of -40° to 160° F. If mines are laid in wet places where the temperature fluctuates above and below freezing, provision should be made for drainage to prevent water from accumulating around and over mines where it might subsequently freeze and neutralize them.

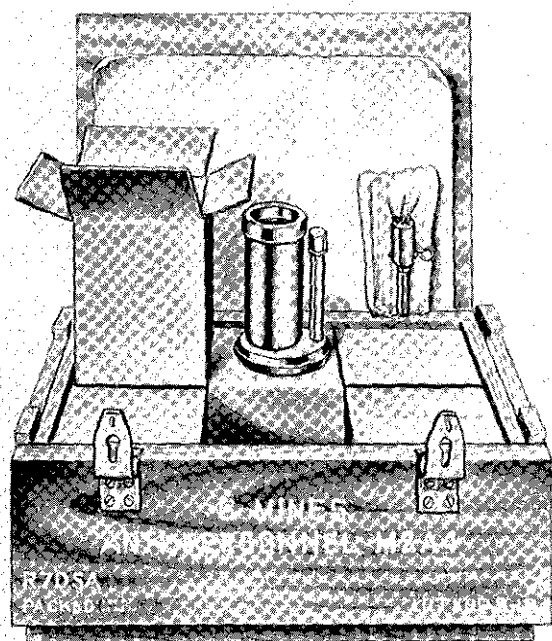
g. For purposes of effective training, all rules, regulations, and precautions that pertain to high-explosive-filled service mines should be observed in connection with the employment of all inert mines used for training in

handling and all practice mines used for simulating actual service conditions.

137. Packing and Marking

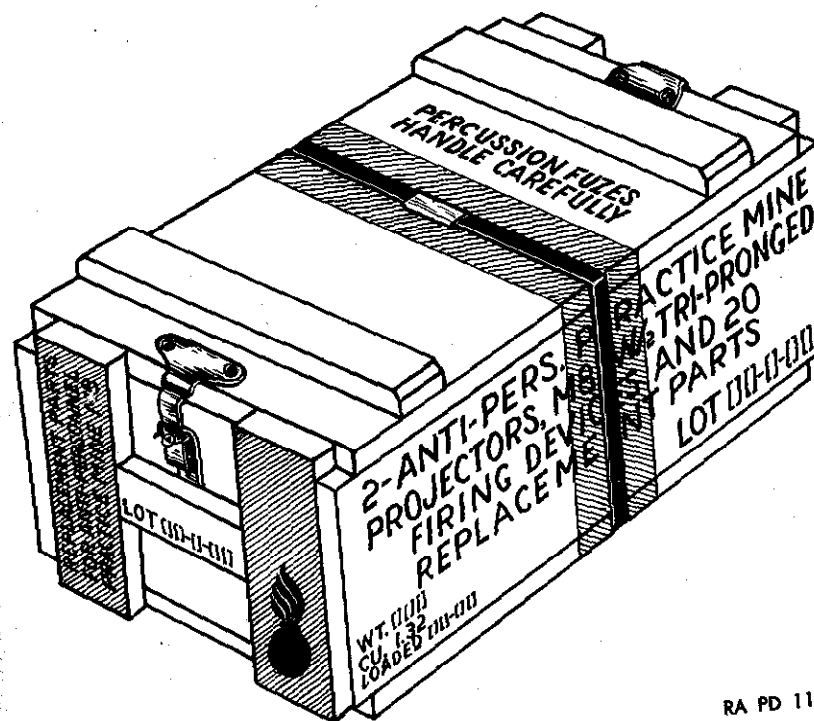
a. *Antipersonnel Mines.* The bounding antipersonnel mine is packed complete with fuze and spool of steel wire in a juteboard or double kraft-lined board carton. Six such cartons are packed into a wooden box, which is stained light brown with marking in yellow or, more recently, unstained with marking in black (fig. 187). The cast-iron fragmentation antipersonnel mine is packed four mines, four fuzes in individual containers, and four spools of wire per wooden box, or six mines, six fuzes in individual containers, and six spools of wire per wooden box. Non-metallic antipersonnel mines are packed 90 mines in a carton with 90 detonators in a set-up box and 6 wrenches per wooden box. The practice antipersonnel mine M8 is packed 2 mine bodies and 2 fuzes, with 20 replacement parts, per wooden box (fig. 188). The box has markings in black, a blue center band and blue vertical end cleats or, more recently, is unpainted with markings in black.

b. *Antitank Mines.* The mine M15 series, with one fuze and one activator each in an individual metal container, are packed one per wooden box (fig. 189). The mine M6 series, with one fuze and one activator each in an individual metal container, are packed two each per wooden box.



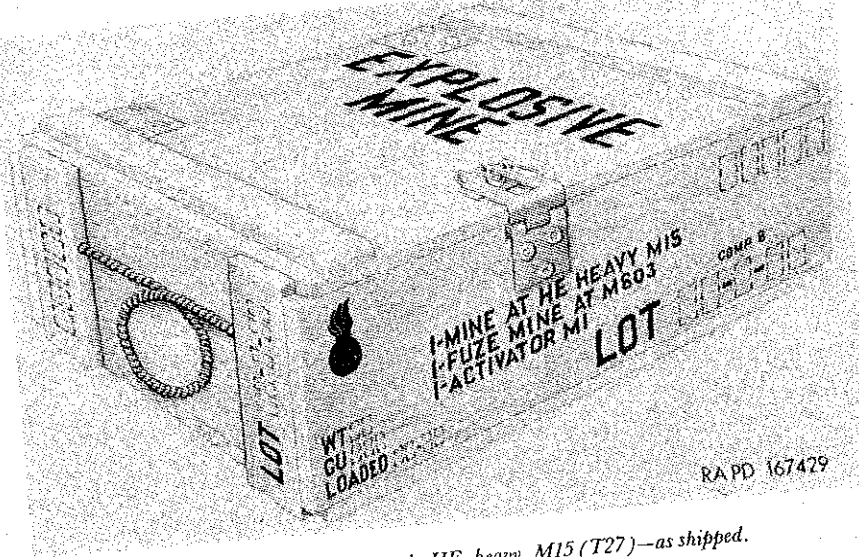
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Figure 187. Packing box for antipersonnel mine M8.



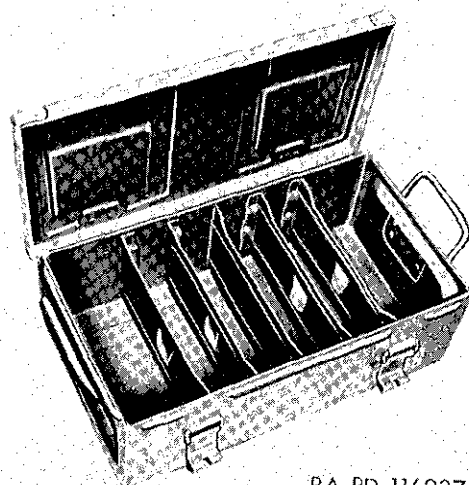
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Figure 188. Packing box for antipersonnel practice mine M8 and replacement parts.



RA PD 167429

Figure 189. Mine, antitank, HE, heavy, M15 (T27)—as shipped.



RA PD 116937

Figure 190. Metal packing box M156 for 8 mine, antitank, HE, M7A1, and 8 fuze, mine, antitank, M603, or 12 mine, antitank, light, practice, M10, without fuze.

Inert mines M6 without fuze and without activator are packed 2 per wooden box. The mines M7 series are packed 8 mines and 8 fuzes in a metal box (fig. 190) or 12 mines and 12 fuzes in a wooden box. Wooden boxes containing high-explosive mines are stained light brown with marking in yellow or, more recently, unstained with marking in black. Metal boxes are painted olive drab with marking in yellow. Inert mines M7 without fuzes are packed 8 or 12 per metal box. The practice mines M10 (light) are packed 10 mines with 20 practice fuzes (smoke-puff type) in individual metal containers per metal box, which is painted olive drab with marking in yellow. The practice mines M12 (heavy) without fuze are packed two per wooden box. Wooden boxes containing practice mines are painted with a blue band around the center of each box and blue cleats on the ends of each box. Both service and practice activators are also packed, each in an individual metal container, 180 such containers in a wooden box.

Section IX. DEMOLITION MATERIALS

138. General

a. The term "demolition materials" refers to a variety of explosive charges of different sizes and shapes, explosive initiating devices designed for use with such charges, explosive and nonexplosive mechanical devices, and apparatus such as instruments, tools, and equipment used with the

charges for performing various military demolition functions. These functions include such operations as destruction of earthworks, fortifications, railroads, dams, bridges, and buildings, and excavation for construction projects and clearing obstacles and minefields. Certain demolition materials are grouped into "kits" and "sets" for the convenience of especially designated military units in performing prescribed kinds of demolition work or missions and training therefor.

b. Demolition materials, components, auxiliary items, and "kits" and "sets" for service use and packing data are listed in Department of the Army Supply Manual ORD 3 SNL R-7. Inert items and simulated service items for training and packing data are listed in Department of the Army Supply Manual ORD 3 SNL R-6. For complete technical information on military demolition material, see TM 9-1946. For complete information on military explosives, see TM 9-1910. For tactical information pertaining to demolition material, see FM 5-25 and FM 20-32.

139. Classification

Demolition materials are classified as to composition as explosive or nonexplosive, as to use as service or training, and as to type as explosive charges, priming and initiating material, demolition equipment sets, and mine-clearing devices. Types of demolition material are as described in a through d below.

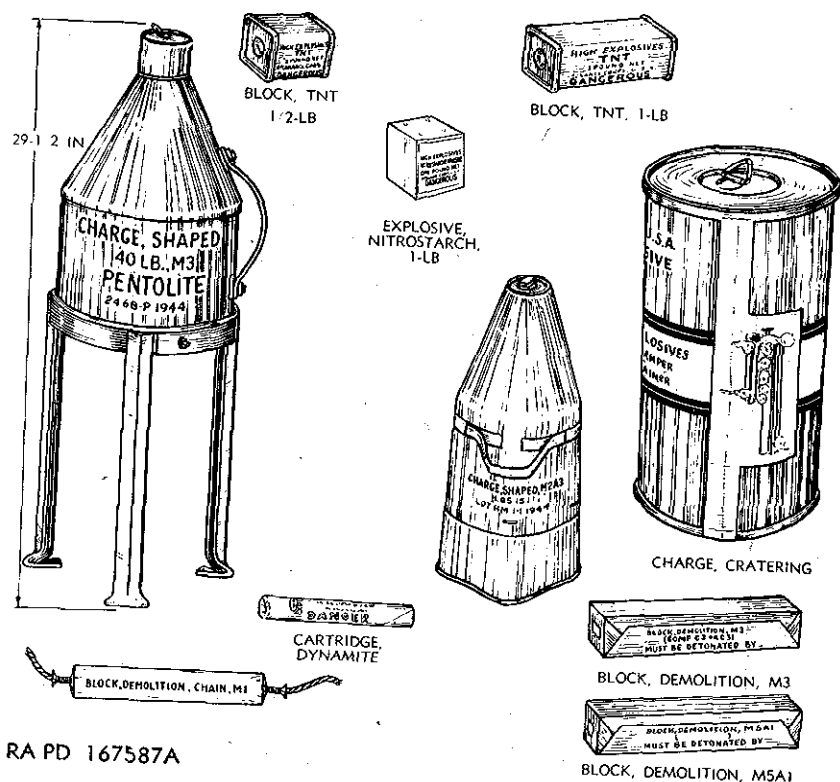
a. *Explosive Charges.* These consist of high explosives in various sizes and shapes used as the main charge in conjunction with appropriate detonating devices, as in the case of "demolition blocks" or commercial dynamite "sticks" for general demolition, or used in the form of charges for special mechanical apparatus, such as mine-clearing devices.

b. *Priming and Initiating Materials.* These consist of explosive fuse, cord, and firing devices, together with instruments and explosive, electric, and mechanical accessories used to initiate demolition charges.

c. *Demolition Equipment Sets.* These sets are made up of selected explosive and nonexplosive items with containers and carrying attachments for the efficient performance of particularly designated demolition tasks. Demolition training kits are made up of inert items for use in training. Certain sets and kits are designed for a particular kind of demolition operation such as mine-field-clearing or for preparing excavations.

d. *Mine-Clearing Devices.* These are long, narrow, flexible explosive devices used for breaching minefields.

- (1) The antipersonnel mine-clearing detonating cable is used for clearing narrow lanes through antipersonnel minefields and is propelled by a jet propulsion unit operating on the rocket principle.
- (2) Demolition snakes, which are used for breaching antitank minefields, are designed to be either pushed or towed by tanks.



RA PD 167587A

Figure 191. Explosive demolition charges.

140. Types

a. Explosive Charges.

- (1) Demolition blocks (fig. 191) are 11 by 2 by 2, or slightly larger, rectangular blocks composed of explosives, usually of the COMP C-series, which are more effective than TNT in cutting steel. These blocks are also used in demolition work.
 - (a) BLOCK, demolition, chain, M1 consists of eight special demolition blocks cast on a 16-foot length of detonating cord with 8 inches of cord between adjacent blocks. Each block is a paper-wrapped 2½-pound charge of 75/25 tetrytol with a cylindrical tetryl pellet cast in each end. The detonating cord is detonated by blasting cap or detonator.
 - (b) BLOCK, demolition, M2 is similar in size to one of the eight blocks of BLOCK, demolition, chain, M1. It has a threaded detonator well in each end to receive any standard firing device with blasting cap attached.
 - (c) BLOCK, demolition, M3 (2¼-lb COMP C-2), BLOCK, demolition, M3 (2¼-lb COMP C-3), BLOCK, demolition, M5

(2½-lb COMP C-3), and BLOCK, demolition, M5A1 (2½-lb COMP C-4) are all blocks of plastic explosive. Any of these can be molded by hand at temperatures between -20° and 125° F. and packed into close contact with irregular objects to produce high-demolition efficiency. Below -20° F., the explosives become brittle but are not otherwise affected. Being insoluble in water, blocks of composition C-2, C-3, or C-4 are suitable for underwater demolition. Initiation may be by detonating cord tied in a double knot with explosive formed into a ball around the knot. The block M5A1 is safer for use in closed spaces than block M3 or M5 because of less danger from poisonous gases from the explosion of COMP C-4.

- (2) Nitrostarch explosive is used in general demolitions especially for cutting and breaching. Its use is similar to that of TNT but it is more sensitive to flame, friction, and impact. It is also less water resistant and should be detonated promptly if used under water. Nitrostarch is issued in the form of a 1-pound package, which is made up of four ¼-pound packages each containing three square blocks. Each block has a central hole. The blocks are arranged to form continuous "cap wells" through the 1-pound package, which is primed by passing detonating cord through one cap well and back through the well at the diagonally opposite corner and tying a knot in the end of the cord to keep it in place. The cord may be detonated at the opposite end by the 8-second delay detonator M2, the 15-second delay detonator M1, or by a blasting cap, which, in turn, may be detonated by time blasting fuse initiated by fuse lighter.
- (3) Trinitrotoluene (TNT) is a powerful high explosive used in general demolitions primarily for cutting and breaching. It is relatively insensitive to shock. Although it may not be exploded by the impact of a single rifle bullet, it would probably be exploded by concentrated rifle or machine gun fire. TNT can be burned in the open in small quantities without exploding. If an attempt is made to destroy it by burning when confined or if a large quantity in the open is ignited, the mass of TNT will explode. TNT is insoluble in water and therefore can be used in underwater charges. EXPLOSIVE, TNT, ½-pound block, is in a yellow container 1½ inches square and 3¾ inches long. One end of the block may have a threaded or an unthreaded cap well, depending on the date of manufacture, into which a special blasting cap or detonator can be inserted for initiating. EXPLOSIVE, TNT, 1-pound block, is in an olive-drab container 7 inches long and has a threaded cap well. Blocks with threaded cap wells will receive: 8- or 15-second delay detonation; electric or nonelectric blasting caps with prim-

ing adapter; or nonelectric blasting cap crimped to any standard firing device.

- (4) Shaped charges used in military demolition consist of cylindrical blocks of high explosive having a conical or hemispherical metal- or glass-lined cavity in one end and a blasting cap well at the other end. Detonation of the charge travels from the cap well to the cavity where the detonation wave is "focused" to produce a high-speed penetrating or cutting jet that will blast boreholes in steel, concrete, and similar material. Maximum penetration of a shaped charge is obtained when it is exploded at a certain characteristic distance, called "stand-off," from its target. The stand-off is provided for by a fiber sleeve or metal legs supporting the charge at time of firing. See TM 9-1946 for precautions in use of shaped charges. CHARGE, shaped, 15-pound, M2A3 contains approximately 11½ pounds of 50/50 pentolite in a moisture-resisting fiber container. Charges of later manufacture contain COMP B with a 50/50 pentolite booster. The top of the charge has a threaded cap well for receiving a blasting cap and adapter or any standard firing device. A cylindrical fiber base slips on the end of the charge to hold the charge at the proper stand-off distance. The cavity liner is a cone of high-density glass. This charge will pierce 36 inches of reinforced concrete or in a wall of greater thickness will produce a hole 30 inches deep and 2 to 3 inches in diameter. CHARGE, shaped, 40-pound, M3 (T3) consists of approximately 30 pounds of 50/50 pentolite, or COMP B with a pentolite booster in charges of later manufacture, in a metal container. The top of the charge has a threaded cap well for receiving a blasting cap and adapter or any standard firing device. A metal tripod for gaging stand-off distance is shipped unassembled with the charge. CONTAINER, charge, cavity, Mk 2 consists of a sheet-metal body, a sheet-metal cone, and wire legs. The body is a small hollow cylinder. The cone fits into one end of the body to shape the charge of COMP C3 with which the container is to be packed. The three legs attached to the cone end of the body provide proper stand-off distance. The loaded container is intended to open thin-skinned explosive-filled ammunition or charges by initiating low-order detonation for destruction purposes. The charge is detonated by a nonelectric or electric special blasting cap.
- (5) The explosive cratering charge is a 40-pound charge of ammonium nitrate in a cylindrical metal container. The central section of the charge of ammonium nitrate consists of a booster. A cap well and detonating cord tunnel for blasting caps or detonating cord are attached to the container opposite the booster. The charge is used for blasting craters in roads and for similar

demolitions. It is suitable for blasting frozen ground but not for cutting steel.

- (6) Dynamite, the most common commercial high explosive, may be one of several types such as straight dynamite, ammonia dynamite, ammonia gelatin dynamite, and gelatin dynamite. These types are produced in various grades designated by a weight-strength marking given in percentage. The percentage designation of straight dynamite is the percent by weight of nitroglycerin it contains. In types other than straight dynamite, the percentage indicates equal strength, weight for weight, with straight dynamite containing that percent of nitroglycerin. Since straight dynamite consists of nitroglycerin absorbed in a porous material that contains other energy-producing ingredients, increasing the percent of nitroglycerin decreases the amount of other energy-producing ingredients. Hence the actual blasting power of the dynamite does not increase directly with an increase in the percentage designation. Fifty to sixty percent straight dynamite is roughly equivalent to TNT and may be substituted for it. This dynamite does not resist water as well as TNT but may be used under water if fired within 24 hours after submersion. In ammonia dynamite, part of the nitroglycerin is replaced by ammonium nitrate. This change in composition results in less poisonous fumes, less fragmentation, and less water resistance than for straight dynamite of the same strength. Ammonia dynamite is not satisfactory for underwater use. Ammonia gelatin dynamite is a plastic dynamite that has an explosive base of nitrocotton dissolved in nitroglycerin with ammonium nitrate added. It produces less poisonous fumes than straight dynamite, which it equals in water resistance. Gelatin dynamite is a plastic dynamite that has an explosive base of nitrocotton dissolved in nitroglycerin and which is insoluble in water. Its high velocity, when confined, produces a quick, shattering action. It is used for submarine blasting and blasting in extremely hard rock. Dynamite is exploded by a No. 6 or larger commercial blasting cap, or by Ordnance Corps special blasting caps. Dynamite is normally issued in paraffin-treated paper cartridges (also called "sticks") packed 50 pounds per wooden box. The standard cartridge size is 1¼ diameter by 8 long. The number of cartridges per box varies in inverse proportion to the density of the particular type and grade of dynamite, for example, a cartridge of 40 percent dynamite 1¼ by 8 weighs approximately ½ pound.
- (7) The bangalore torpedo (fig. 192), which is made up of high-explosive-filled steel tubes that may be used singly or joined in multiple lengths with connecting sleeves, is used for blasting a

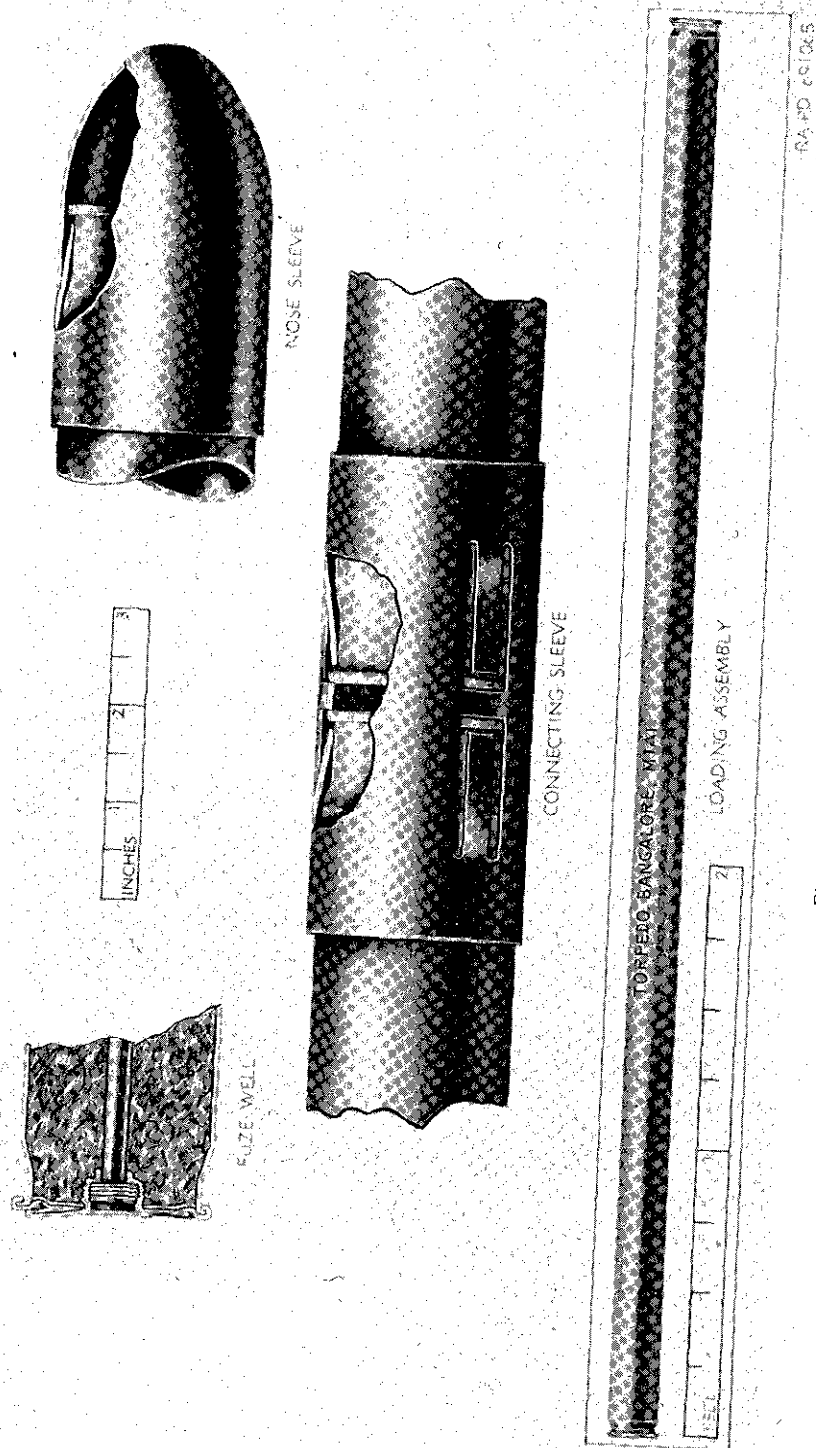


Figure 192. Torpedo, bangalore, M1A1.

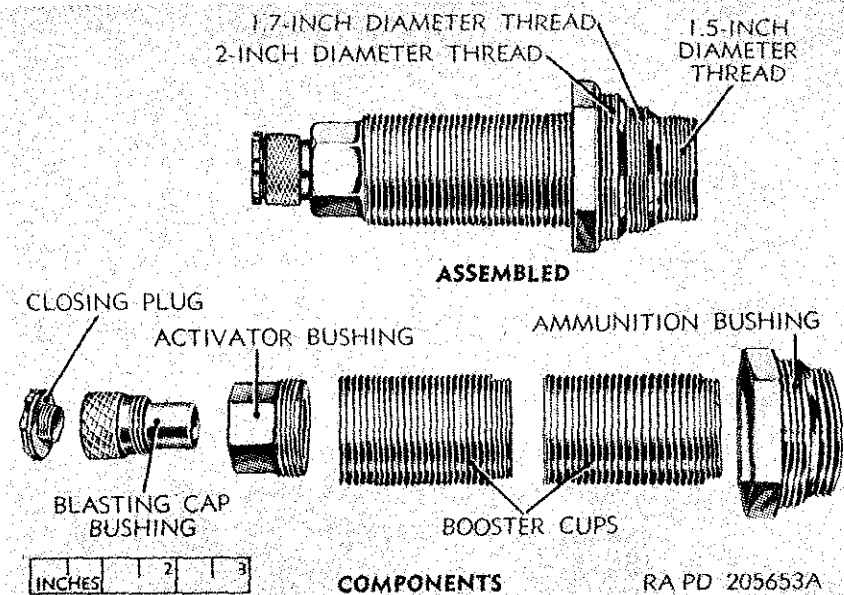


Figure 193. Destructor, high-explosive, universal, M10.

path through wire entanglements or other obstructions. The individual tubes, called loading assemblies, may be used as explosive charges for other demolition purposes. TORPEDO, bangalore, M1A1 consists of 10 loading assemblies, 10 connecting sleeves (new type), and 1 nose sleeve. The loading assembly is a 5-foot-long steel tube filled with amatol, with about 4 inches of TNT at each end. Total weight of explosive in each tube is about 9 pounds. Each end of the tube contains a threaded well to accommodate a detonator or any standard firing device with blasting cap crimped thereto. An Army special blasting cap or a commercial No. 8 (or stronger) cap is required. A firing device may be fitted with an 8- or 15-second-delay detonator, concussion detonator, or Army special blasting cap to initiate the entire bangalore torpedo. Detonation may also be accomplished by a detonator or four turns of detonating cord wrapped around one end. The connecting sleeve is a short tube into which the ends of two loading assemblies can fit and be held by three spring clips. The nose sleeve, which is held in place by a spring clip, has a rounded point for ease in pushing the torpedo through obstacles.

- (8) The universal high-explosive destructor M10 (fig. 193) is a high-explosive charge initiated by means of blasting caps or mine actuators and standard firing devices. The destructor M10 is essentially an adapter-boosters, with a threaded bushing that

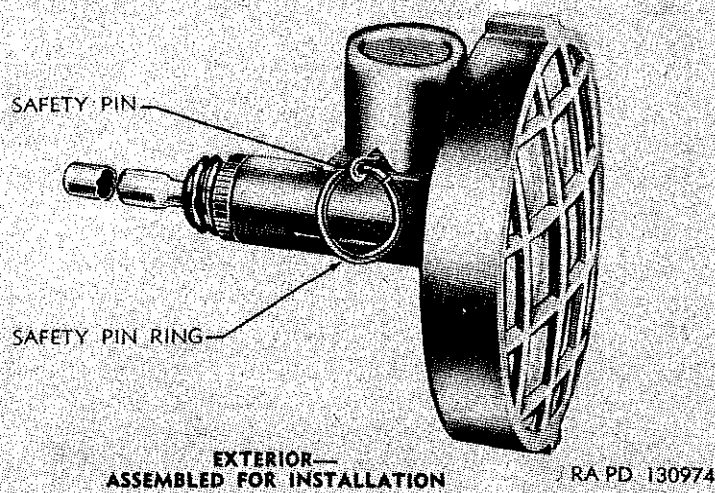
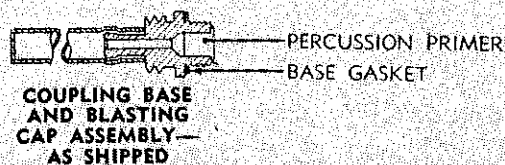
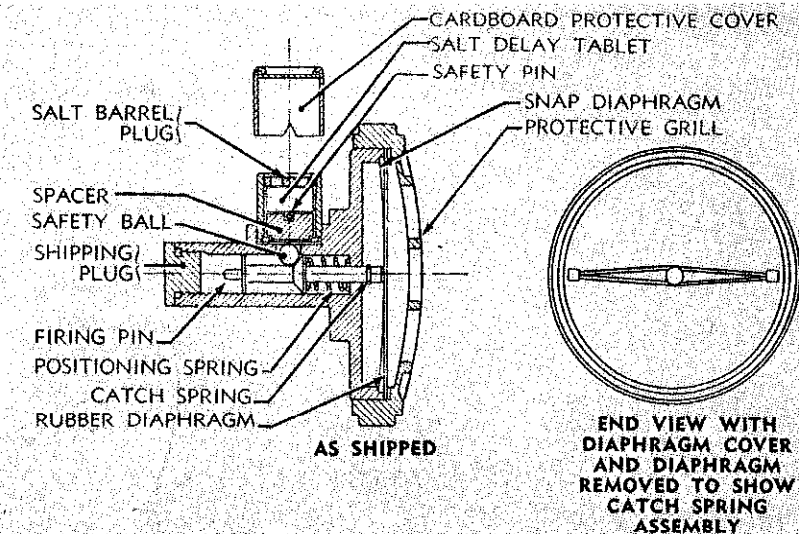


Figure 194. Detonator, concussion type, M1.

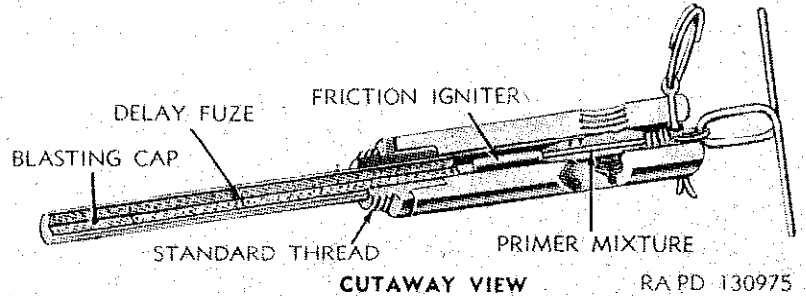
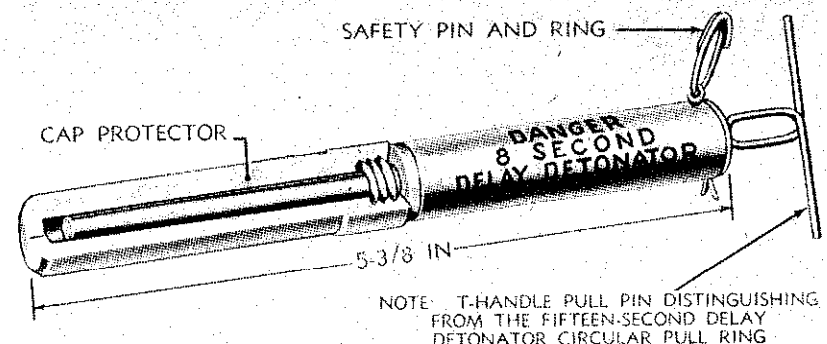


Figure 195. Detonator, 8-second delay, M2.

will fit 1.5-, 1.7-, and 2-inch standard right hand threaded fuze cavities. It is used in preparing loaded projectiles and bombs as improvised mines, booby traps, and demolition charges. It is also used by disposal units to destroy deteriorated or abandoned ammunition. The destructor is composed of a plastic closing plug, standard priming adapter, blasting cap bushing, activator bushing, two booster cups (containing tetryl pellets), and an ammunition bushing. The booster cavities of bombs and large projectiles should be filled to the full depth by adding booster cups to the destructor M10 as required.

b. Priming and Initiating Components, Accessories and Tools.

(1) Detonators are of the concussion type or of the friction-igniter type.

(a) DETONATOR, concussion type, M1 (fig. 194) is a mechanical firing device that is actuated by a concussion wave of a nearby blast. A concussion wave strong enough to overcome the snap diaphragm causes the detonator, when armed, to function. These detonators can be used to fire several charges simultaneously without interconnecting the charges with wires or detonating cord. A single charge fired in water or in air will detonate all charges equipped with concussion detonators within range of the main charge or each

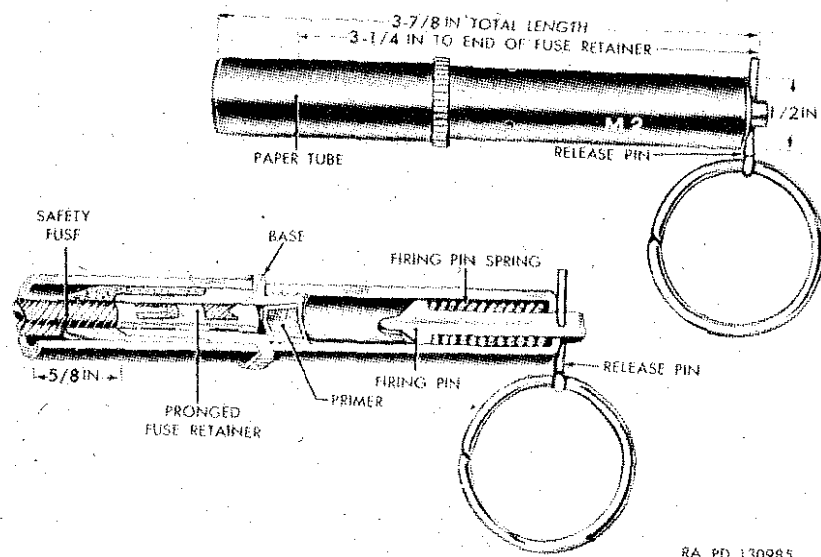


Figure 196. Lighter, fuse, weatherproof, M2.

other. For safety while arming the device in water, blue and yellow water-soluble time-delay salt tablets are supplied with the detonator. The blue tablet gives a delay of approximately $3\frac{1}{2}$ minutes and the yellow a delay of approximately 7 minutes. See TM 9-1946 for operating range of concussion detonators.

- (b) Friction-igniter, delay-type detonators are devices for detonating explosive charges after a definite period of delay. The initiating mechanism (a pull wire coated with friction material set in a flash compound), delay system, and detonator are all integral parts of the unit. These detonators are used for delay firing of demolition charges, particularly during assault demolitions. The detonators are also used to fire underwater charges. The standard detonators of this type are DETONATOR, 8-second delay, M2 (fig. 195), and DETONATOR, 15-second delay, M1, which are almost identical in overall appearance and in functioning except for time of delay. These detonators can be identified in darkness, since the 8-second delay has a "T" type pull pin handle and the 15-second delay has a circular pull ring.
- (2) Fuse lighters are used to ignite safety fuse or time blasting fuse.
 - (a) LIGHTER, fuse, friction type, M1 is a paper tube containing friction powder. Barbs inside the open end of the fuse lighter permit the fuse to be inserted but prevent its removal except by force. A pull on the loop or handle at the closed

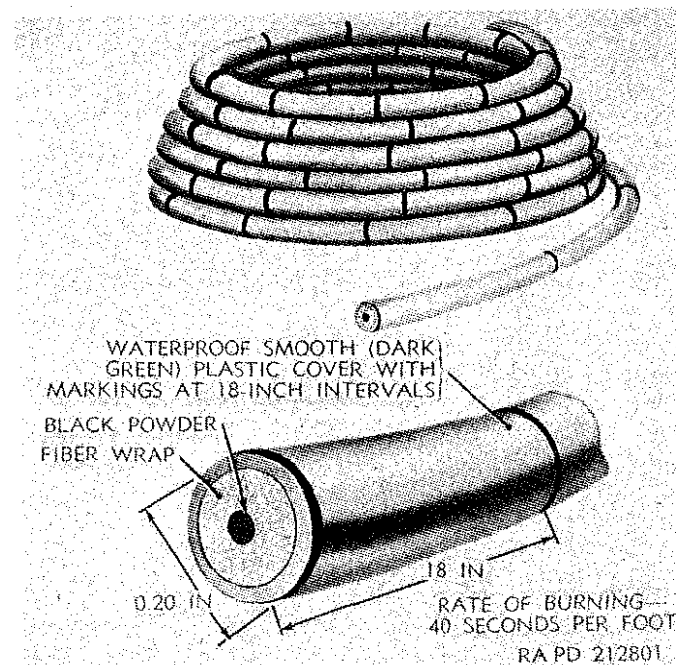


Figure 197. Fuse, safety.

end of the friction-type lighter mechanically ignites the friction compound that, in turn, fires the powder train in the fuse.

- (b) LIGHTER, fuse, weatherproof, M2 (fig. 196) consists of a barrel that holds the firing mechanism and a coupling base that contains a percussion cap primer and has a pronged fuse retainer. Plastic sealing material is used to waterproof the joint of fuse and fuse lighter. When a release pin is pulled, a firing pin strikes a percussion cap primer that, in turn, ignites the fuse. The lighter will ignite the fuse under all weather conditions, even under water.
- (3) FUSE, safety, M700 (fig. 197) is in the form of a 0.20-inch diameter cord consisting of a flammable cord tightly wrapped with waterproofing materials. When ignited by ordinary match or by a weatherproof fuse lighter, it transmits a flame to a non-electric blasting cap that may be installed in an explosive charge. This fuse is limited standard for use in general demolitions, both on land and under water. The burning rate of fuse is approximately 40 seconds per foot, however, the burning time should be tested by timing the burning of a 1-foot length of fuse, after cutting off a minimum of 3 inches on the end to remove powder that may have absorbed moisture. The dark

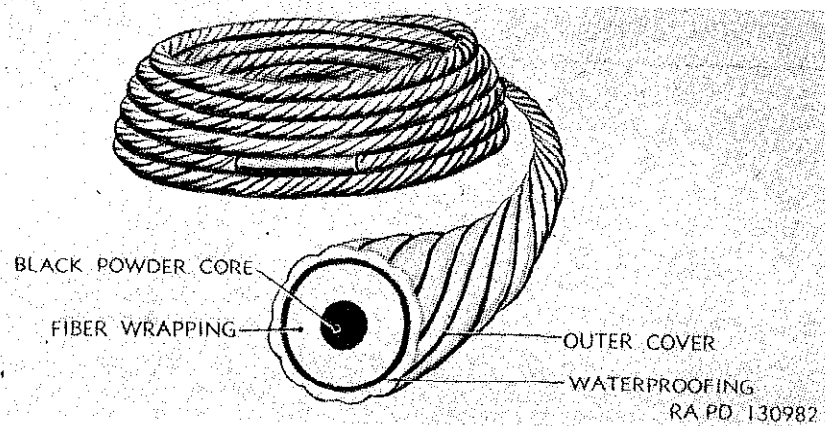


Figure 198. Fuse, blasting, time.

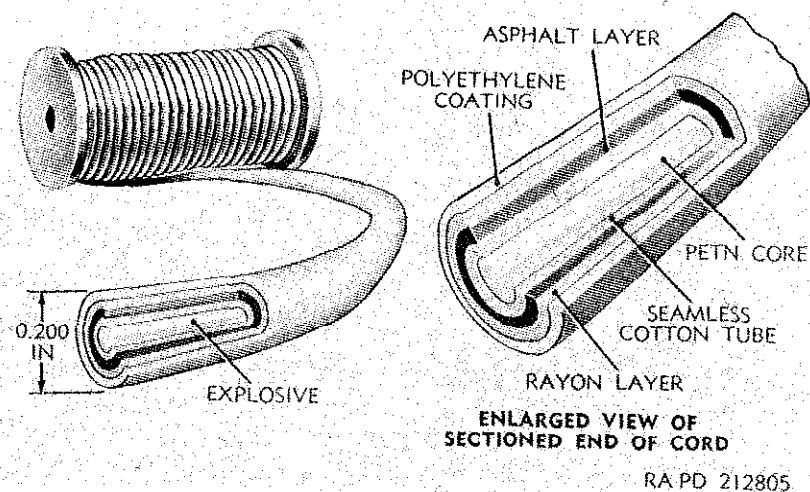


Figure 199. Cord, detonating, waterproof.

green cover is smooth with abrasive marking at 18-inch (1 minute) intervals. FUSE, blasting, time (commercial) (fig. 198), which is in the form of a 1/4-inch diameter cord consisting of a black powder core wrapped with several layers of fabric and waterproofing materials, is used for similar purposes but is not reliably waterproof. This is the ordinary commercial-type safety fuse. FUSE, blasting, time, is authorized for issue only for use in the continental United States.

- (4) Waterproof detonating cord (fig. 199) consists of an explosive core of PETN contained in a braided seamless cotton tube. On the outside of this tube is a layer of asphalt on which is a layer of rayon. The outer covering is a continuous extruded

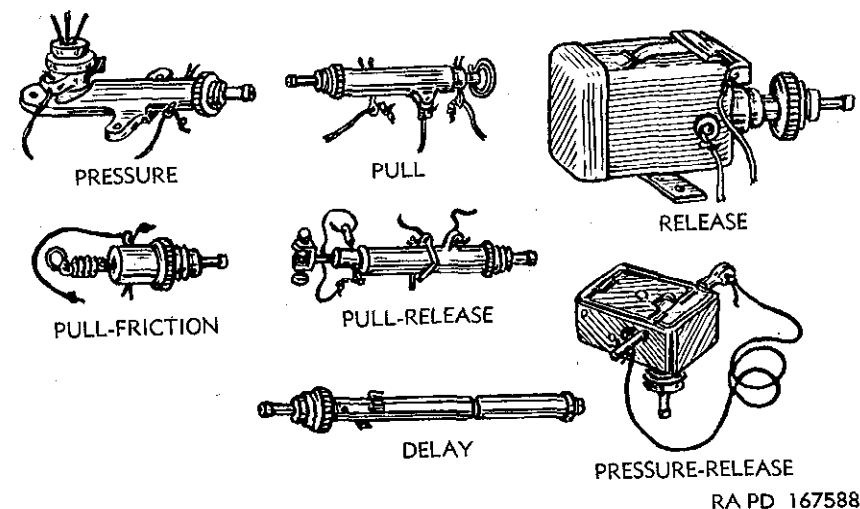


Figure 200. Firing devices.

- coating of polyethylene plastic, which is colorless and smooth to the touch. The outside diameter of the cord is 0.200 inch. This waterproof detonating cord is the standard cord for general use in military demolitions, both on land and under water.
- (5) Detonating cord (primacord) consists of a flexible tube filled with PETN in the approximate amount of 40 grains per foot (approximately 5.7 lb per 1,000 ft). This cord is a limited standard item and will be used for training purposes only as soon as sufficient supply of waterproof detonating cord becomes available. It is ordinarily used to transmit a detonation from a primed or from a delay detonator to a charge of high explosive or from one charge of high explosive to another without requiring the use of a second cap.
- (6) Firing devices (fig. 200) are of two general types, the tubular type and the box type. The coupling base, fitted to all types, has the standard thread and nipple and always contains a percussion cap primer. The coupling base may be of the removable type or the type that is not to be removed (as in the pull-friction and delay types), depending on the particular model of firing device. All firing devices may be used interchangeably as appropriate for the particular task to be accomplished. Firing devices may be used with heavy antitank mines and activators, with light antitank mines and blasting caps, and with improvised explosive charges and primed blasting caps. When a firing device is used with a service activator or a practice activator (see TM 9-1940), no blasting cap or black powder igniter charge is needed. When used directly with light

antitank service mines or with demolition blocks, a firing device requires a crimped-on blasting cap.

(a) The tubular-type firing devices, consisting generally of head, case, coupling base, and percussion cap primer are arranged for actuation by pressure, pull or release of pull, or chemical action, according to the design of the particular model.

1. FIRING DEVICE, delay type, M1 is a chemical device used for firing a delay-action mine or demolition block. Delay action is initiated by crushing a glass capsule, filled with corrosive liquid, that is contained in a thin-walled portion of the case. An identification and safety strip, colored to indicate the delay time of the device, is visible through an inspection hole in the coupling base. The nominal delay time (at 75° F.) and corresponding colors are: 9 minutes, black; 15 minutes, red; 1 hour, white; 2½ hours, green; 5½ hours, yellow; and 11½ hours, blue. The nominal delay time is subject to temperature correction in accordance with a table furnished with the firing device.
2. FIRING DEVICE, pressure type, M1A1 is actuated by pressure and is used in setting up booby traps. When a safety pin between the firing pin and primer has been removed, a pressure of 20 pounds on the pressure cap acts to release the spring-loaded firing pin that fires the primer.
3. FIRING DEVICE, pull-friction type, M2, which contains a friction initiated primer, is actuated by a pull wire and is used in setting up booby traps. The body is plastic and the base is nonremovable. A coated wire, to which a spring and pull ring are attached, passes through the body, through the friction compound, and into a nipple on the base. A direct pull of 3 to 11 pounds on the trip wire (pull wire) stretches the spring and draws the coated wire through the friction compound thereby igniting it. Once fired, the device cannot be reused.
4. FIRING DEVICE, pull-release type, M3 is a mechanical device actuated by either an increase (pull) or a decrease (release) of tension in a taut trip wire and is used with antipersonnel mines M3 or in setting up booby traps. A direct pull of 6 to 10 pounds on the trip wire or release of tension, such as cutting or detaching the trip wire, act in different ways to release the spring-loaded firing pin that fires the primer.
5. FIRING DEVICE, pull type, M1 is a mechanical device actuated by a pull on a trip wire and is used with antipersonnel mines M3 for activation of antitank mines and in setting up booby traps. A direct pull of 3 to 5 pounds

on the trip wire releases the spring-loaded firing pin that fires the primer.

- (b) The box-type firing devices, consisting of a rectangular steel body and primed coupling base, are actuated by release of pressure.
 1. FIRING DEVICE, pressure-release type, M5 is a mechanical device used to activate antitank mines equipped with supplementary fuze wells (cap wells) and for general booby-trap installations with charges having a threaded well. A release plate will release the spring-loaded firing pin, which fires the primer, when a restraining load of at least 5 pounds is displaced more than five-eighths of an inch. This firing device may be reused.
 2. FIRING DEVICE, release type, M1 is actuated when a restraining weight is removed from it and is used in setting up booby traps. A restraining weight of at least 2 pounds is applied on the top face of the latch at the time of installation. After the safety pin has been removed, displacement of the restraining weight releases the latch, allowing a spring lever to actuate the firing pin that strikes the primer.
- (c) Inert firing devices used for training purposes are to be employed in exactly the same manner and *with the same care and precautions* as are the explosive items comprising the firing devices simulated, hence it is essential that personnel in training be fully conversant with all procedures and instructions given in this manual pertaining to the explosive firing devices. For descriptions of individual service firing devices, see TM 9-1946.
- (7) Percussion cap primers produce a small flame when struck by a firing pin to initiate a blasting cap or igniter charge. PRIMER, percussion, M27; PRIMER, percussion cap, M2; and the similar PRIMER, percussion cap, improved No. 3 consist of a flanged copper or gilding metal cup with a hole in the bottom of the cup. The primers contain an inner inverted cup, an initiating charge, and an anvil. Firing devices are issued with this type of primer installed in the coupling base. Coupling bases of newer manufacture are fitted with percussion primer M27. Coupling bases of earlier manufacture were fitted with percussion cap primer M2. The primer is also issued separately for repriming firing devices used with regular practice mines or with improvised practice mines or booby traps.
- (8) Blasting caps (figs. 201 and 202), used for initiating explosives, are of the Army nonelectric and electric types and the commercial nonelectric and electric types. The Army types consist of

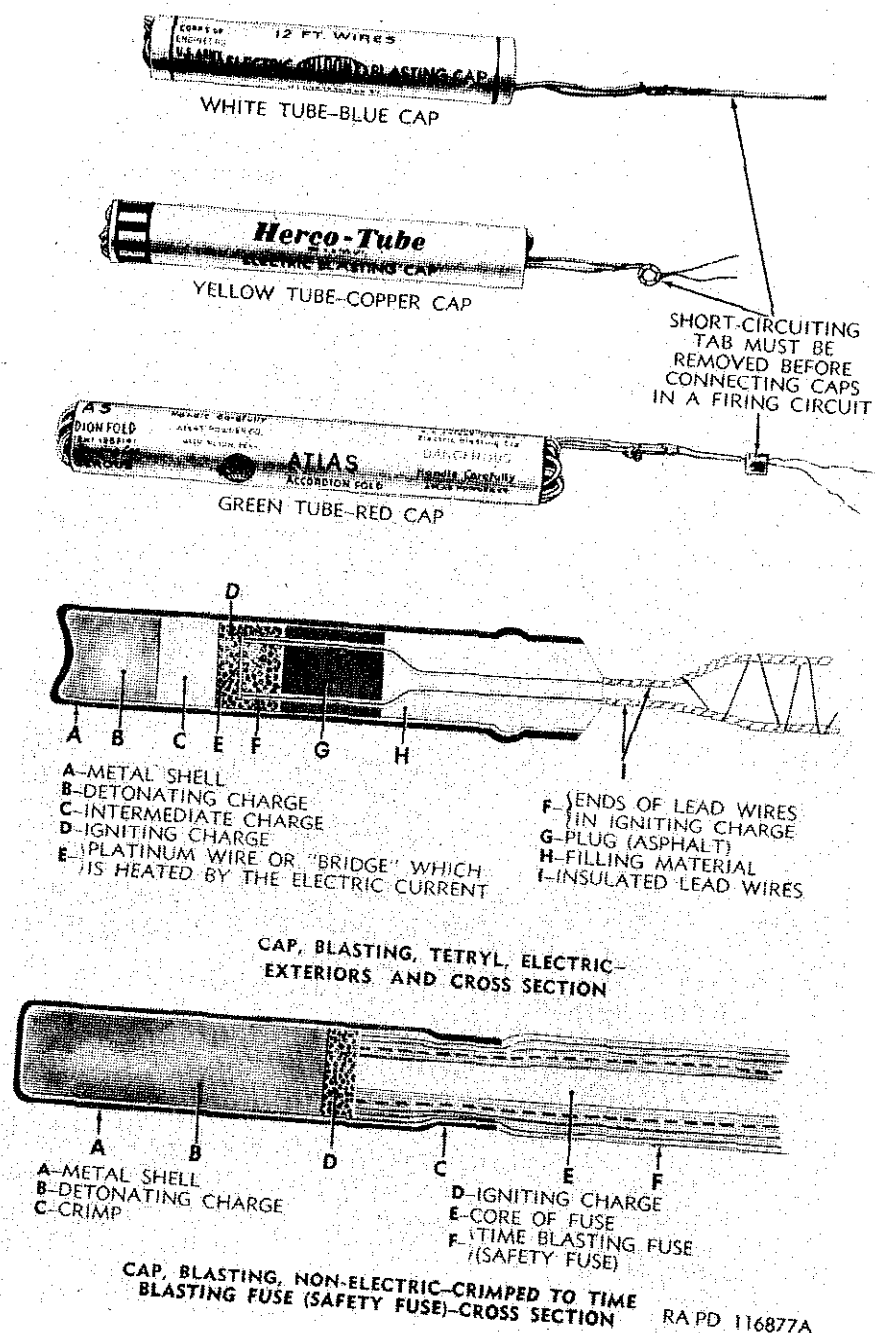


Figure 201. 'Blasting caps.



Figure 202. Blasting caps (nonelectric).

a thin tubular metallic shell of noncorrosive metal about $2\frac{1}{2}$ inches long and $\frac{1}{4}$ inch in diameter filled with a sensitive high explosive. In priming, the caps are inserted into the cap wells of demolition explosives. The electric type has wires for attachment to a blasting machine and the nonelectric type may be crimped to any standard firing device. The nonelectric caps may also be crimped to safety fuse (time blasting fuse) fitted with a fuse lighter or crimped to detonating cord fitted with a delay detonator. Special Army caps, both electric and nonelectric, loaded with pentaerythrite tetranitrate (PETN) are used to detonate the less sensitive military explosives, such as TNT and ammonium nitrate. Commercial caps, principally the No. 6 and No. 8, may be used to detonate the more sensitive explosives, such as dynamite, gelatine dynamite, or nitro-starch. The No. 8 cap is more powerful and more expensive than the No. 6 cap. For description of wiring and electric wiring circuits, see FM 5-25.

- (9) Accessories are issued for use with priming and initiating material.
- (a) ADAPTER, priming, M1A4 is a small hollow plastic hexagonal-head cylinder that is threaded on one end. The adapter simplifies the priming of military explosives having threaded cap wells. The adapter is used with electric blasting cap, with nonelectric blasting cap and safety fuse, and with detonating cord.
- (b) ADAPTER, priming, M1A3 and earlier models are similar to adapter M1A4 except their external shape is round. The adapter M1A3 is now limited standard and is mandatory for

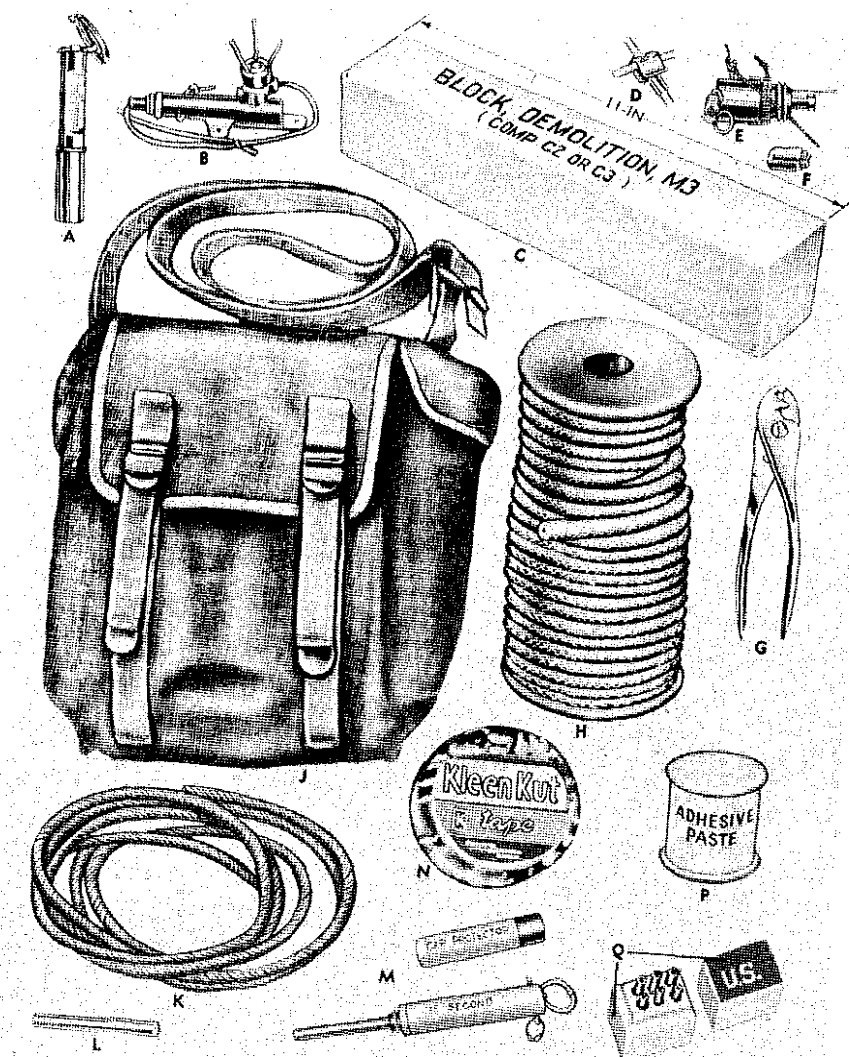


Figure 203. Demolition equipment set No. 1.

- use in training until present supply is exhausted.
- (c) CLIP, cord, detonating, M1 is a small metal device used to join detonating cord.
 - (d) Waterproof blasting cap sealing compound is used to moistureproof the connection between a nonelectric blasting cap and safety fuse and to moistureproof dynamite primers. The compound does not make a permanent waterproof seal.
 - (e) Single-conductor No. 20 AWG annunciator wire is issued for making connections between electric blasting caps or between cap and firing wire.
 - (f) Firing wire for electric firing of charges consists of two-conductor No. 18 AWG vinyl polymer- or rubber-covered wire or of two-conductor No. 20 AWG vinyl polymer-covered wire. The wire is carried on 500-foot or 1,000-foot firing wire reels.
- (10) Instruments and tools are issued for use with priming and initiating material.
- (a) The blasting galvanometer is used to test electrical firing wire circuits. It contains an electromagnet, a small special silver chloride dry cell, a scale, and indicator needle.
 - (b) Blasting machines are small electric generators that produce current for firing electric blasting caps. There are two types in Army use, the 10-cap twisting-handle type and the 30-, 50-, and 100-cap push-down-handle (rack-bar) type. The

- A—3 box, cap, 10-cap capacity, infantry
 B—5 firing device, pull-friction type, M2
 C—30 clip, cord, detonating, M1
 D—5 firing device, pressure type, M1A1
 E—10 detonator (five 15-sec delay, M1, and five 8-sec delay, M2)
 F—1 chest, demolition squad
 G—1 reel, wire, firing, 500 ft, RL-39A, w/2 carrying straps, w/winding device, w/o spool, w/o wire, and 1 spool, DR-8A, empty, reel, wire, firing, 500 ft
 H—1 block, demolition, chain, M1 (eight 2½-lb block strung on cord, detonating)
 J—1 wire, firing, 2-conductor, vinyl-polymer covered, 500-ft roll, No. 18 awg
 K—2 wire, annunciator, single-conductor, cotton covered, 200-ft roll, No. 20 awg
 L—1 fuse, safety, M700, or fuse, blasting, time (50-ft coil)
 M—30 adapter, priming, M1A4, or adapter, priming, M1A3 or adapter priming, M1A2
 N—30 cap, blasting, special, nonelectric (type I (J1 PETN))
 P—1 knife, pocket, general purpose, 74-K-65 (stored, issued, and reviewed by Quartermaster Corps)
 Q—8 block, demolition, M3 (comp C3) (2¼-lb block)
 R—8 block, demolition, M2 (2½-lb block)
 S—3 cord, detonating (PETN) (100-ft spool)
 T—1 twine, hemp, No. 18, 4-oz. ball
 U—1 machine, blasting, 10-cap capacity, class A
 W—3 tape, friction, general use, grade A, ¼-in wide, ½-lb roll
 X—1 galvanometer, blasting (w/leather case and carrying strap)
 Y—30 explosive, TNT, 1-lb block
 Z—40 lighter, fuse, weatherproof, M2
 AA—25 cap, blasting, special, electric (type II (J2 PETN))
 BB—2 crimper, cap (w/fuse cutter), M2
 CC—1 pliers, lineman's, side-cutting, length 8 in, 2 destructor, high-explosive, universal, M10 (T20)

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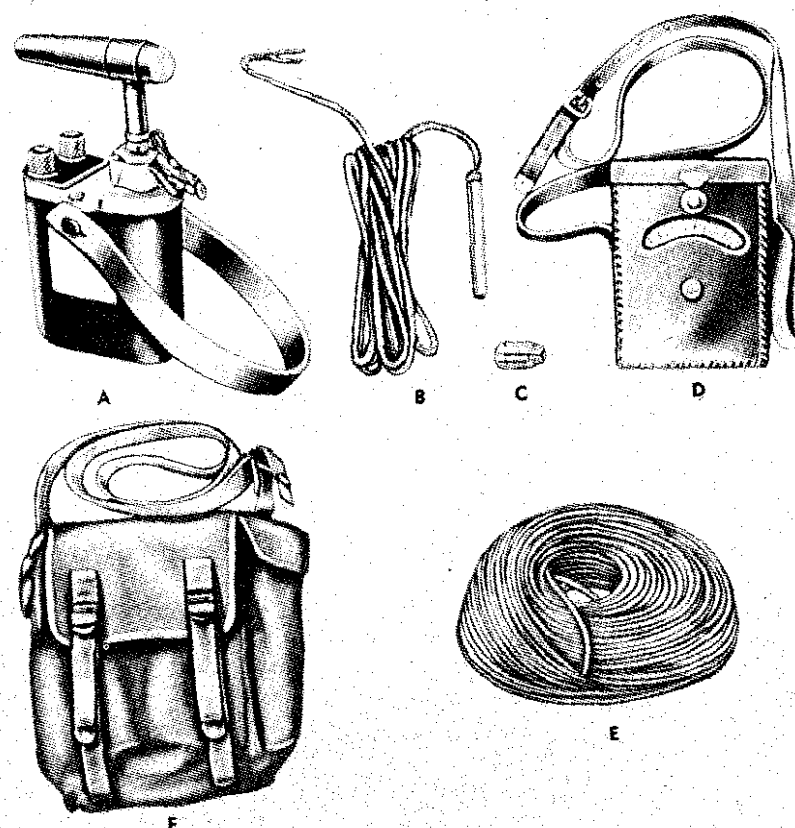


- A—LIGHTER, FUSE, WEATHERPROOF, M2
 B—FIRING DEVICE, PRESSURE TYPE, M1A1
 C—BLOCK, DEMOLITION, M3
 D—CLIP, CORD, DETONATING, M1
 E—FIRING DEVICE, PULL
 FRICTION TYPE, M2
 G—ADAPTER, PRIMING, M1A4 OR
 M1A3 OR ADAPTER, PRIMING,
 EXPLOSIVE, M1A2
 H—CRIMPER, CAP, W/FUSE CUTTER, M2
 I—CORD, DETONATING (100-FT. SPOOL)

- J—BAG, CANVAS, CARRYING,
 DEMOLITION EQUIPMENT
 K—FUSE, BLASTING, TIME (25-FT. COIL)
 L—CAP, BLASTING, SPECIAL,
 NONELECTRIC, J1 (PETN)
 M—DETONATOR, 15-SEC DELAY, M1
 N—TAPE, FRICTION, GENERAL USE,
 BLACK, WIDTH 3/4-IN, 8 OZ. ROLL
 O—ADHESIVE, PASTE, FOR DEMOLITION
 CHARGES, 1/2-LB. CAN, M1
 P—BOX, CAP, 10-CAP CAPACITY,
 INFANTRY

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Figure 204. Demolition equipment set No. 5.

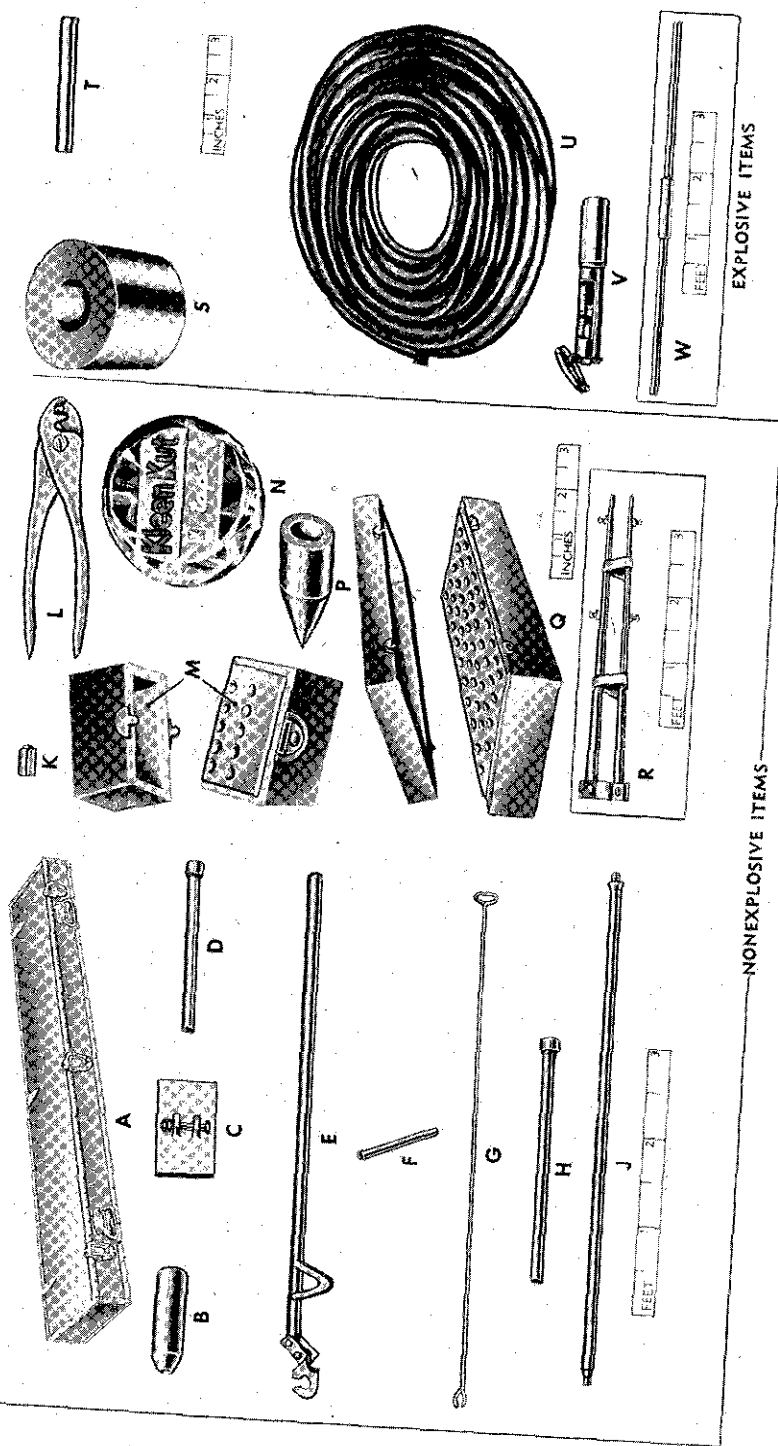


- A—MACHINE, BLASTING, 10-CAP CAPACITY, CLASS A, W/EXTRA HANDLE
 B—CAP, BLASTING, SPECIAL, ELECTRIC, J2 (PETN)
 C—ADAPTER, PRIMING, M1A4 OR ADAPTER, PRIMING,
 M1A3 OR ADAPTER, PRIMING, M1A2
 D—GALVANOMETER, BLASTING, W/LEATHER CASE AND CARRYING STRAP
 E—WIRE, FIRING, 2-CONDUCTOR, VINYL-POLYMER COVERED,
 1500-FT. ROLL, NO. 20 AWG
 F—BAG, CANVAS, CARRYING, DEMOLITION EQUIPMENT

RA PD 131022B

Figure 205. Demolition equipment set No. 7.

- capacity of a blasting machine is the number of electric blasting caps properly connected in series that it will fire if operated correctly.
- (c) Blasting machine testing rheostats of two types are used in the Army in connection with testing blasting machines. The types of rheostats are the six-post and the nine-post.
1. RHEOSTAT, blasting machine, testing, 6-post, consists of a series of coils of electrical resistance wire in a rectangular block-type case. The terminals of the resistance coils are connected to the internal ends of six brass binding posts



RA PD 149678A

Figure 206. Rod, earth, blast-driven, M13.

that extend through the top of the case. Numbers on the side of the case between adjacent pairs of binding posts indicate the number of caps in series having the same resistance as the internal resistance coil connected to that particular pair of posts. The number of caps in series having a resistance equal to that between any pair of posts is obtained by adding the figures between the pair selected. This rheostat may be used to test a blasting machine from 5- to 100-cap capacity.

2. RHEOSTAT, blasting machine, testing, 9-post, is similar to the 6-post rheostat except that it is longer and has nine binding posts and correspondingly larger capacity. It may be used to test a blasting machine from 5- to 310-cap capacity.

- (d) Cap crimpers are designed to squeeze the shell of the non-electric cap tightly enough around safety fuse or detonating cord to prevent it from being pulled off easily and still not interfere with the burning of the powder train in the fuse. The standard cap crimper is CRIMPER, cap (with fuse cutter), M2, which has a narrow jaw that crimps a water-resistant groove.

c. Demolition Equipment, Sets and Kits.

- (1) Demolition equipment sets (figs. 203-205) contain explosive and nonexplosive items for the performance of particularly designated demolition tasks. Complete lists of the components of specific demolition equipment sets are published in Department of the Army Supply Manual ORD 3 SNL R-7. The sets are designated as follows:

- (a) DEMOLITION EQUIPMENT set No. 1, engineer squad.
- (b) DEMOLITION EQUIPMENT set No. 2, engineer platoon.
- (c) DEMOLITION EQUIPMENT set No. 5, individual.
- (d) DEMOLITION EQUIPMENT set No. 7, electrical.

- (2) The blast-driven earth rod set is used for making holes as deep as 6 feet and several inches in diameter in earth or soft shale. It is not usable in rock or other hard material. The assembled

A—1 chest
B—1 chamber, firing
C—1 plate, base, extractor, assy
D—1 rod, extension
E—1 extractor, rod
F—1 rod, handles and starting
G—1 rod, inserting
H—2 rod, intermediate
J—2 rod, main, long
K—100 adapter, firing, explosive, M1A3 or M1A4
L—1 crimper, cap, M2 (w/fuse cutter)
M—1 box, cap, 10-cap capacity, infantry

N—2 tape, friction, general use, black, 1/4-in wd, 8-oz roll
P—100 point
Q—2 box, cap, 50-cap capacity, engineer
R—1 tripod
S—100 charge, propelling, M12 (T1) (w/primer, M44)
T—100 cap, blasting, special, nonelectric (type I (J1 PETN))
U—2 fuse, safety, M700, or fuse, blasting time, 50-ft coil
V—200 lighter, fuse, weatherproof, M2
W—100 charge, springing

Figure 206—Continued.

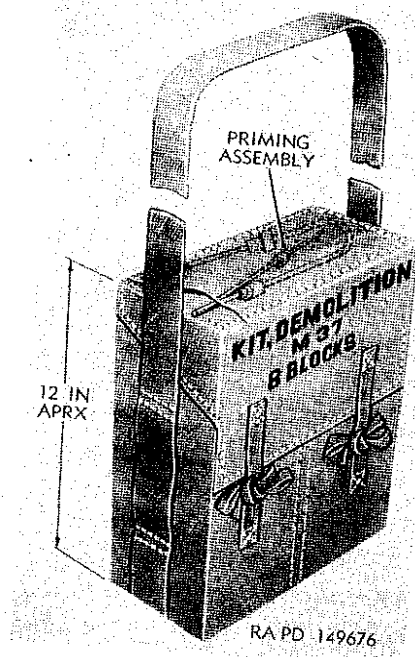


Figure 207. Kit, demolition, M37—in haversack.

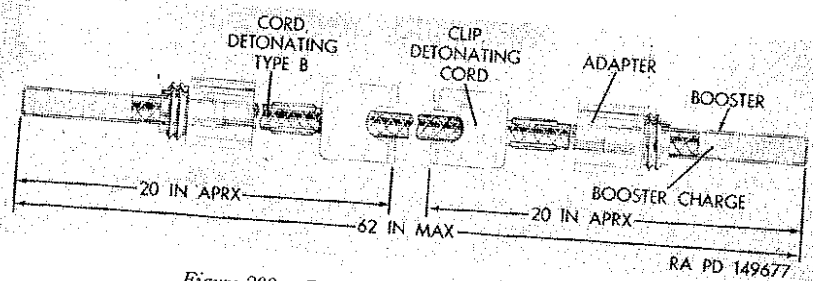


Figure 208. Priming assembly, demolition, M15.

hole-making unit of ROD, earth, blast-driven, M13 (fig. 206) consists of a 6-foot steel rod, a detachable point that fits the lower end of the rod, and a cylindrical firing chamber that screws on the upper end. Propelling charge M12, when placed in the firing chamber and exploded by primer M44, which is attached to a piece of time blasting fuse and a fuse lighter, drives the rod into the earth. A tripod with adjustable legs is used to hold the rod steady for firing. A removable handle, an extractor that grips and lifts the rod, and an extension that can be used to lengthen the rod are used to pull the rod from the earth. A forked inserting rod is furnished for inserting detonating cord charges into the hole made by the rod. The



- A—26 explosive, TNT, 1-lb block, inert
- B—8 block demolition, chain, M1, inert
- C—16 block, demolition, M3, inert
- D—12 block, demolition, ½-lb, inert
- E—1 torpedo, bangalore, M1A1, inert
- F—1 charge, shaped, 15-lb, M2A3, inert
- G—1 charge, shaped, 40-lb, M3, inert
- H—2 detonator, 15-sec delay, M1, inert
- J—2 detonator, 8-sec delay, M2, inert
- K—2 detonator, concussion-type, M1, inert
- L—50 adapter, priming, explosive, M1A3
- M—50 clip, cord, detonating, M1
- N—10 firing device, pressure-type, M1, inert
- P—10 firing device, pull-friction-type, M2, inert
- Q—5 firing device, pressure-release-type, M5, inert
- R—4 cord, detonating, inert (100-ft spool)
- S—3 fuse, time blasting, inert (100-ft spool)

- T—100 cap, blasting, special, electric (type II (J2 PETN)), inert
- U—100 cap, blasting, tetryl, nonelectric, inert
- V—30 lighter, fuse, weatherproof, M2, inert
- W—2 crimper, cap, M2 (w/fuse cutter)
- X—1 machine, blasting, 10-cap capacity (class A)
- Y—1 galvanometer, blasting, complete
- Z—2 tape, friction, general use, black, ¼-in wd, 8-oz roll
- AA—1 wire, firing, 2-conductor, vinyl-polymer covered, 250-ft roll, No 20 awg, training
- BB—1 wire, annunciator, single-conductor, cotton covered, 50-ft roll, No 20 awg, training
- CC—1 knife, pocket, general purpose
- DD—2 twine, hemp, No 18, 4-oz ball
- EE—1 chest, demolition squad

Figure 209. Demolition training kit T38.

diameter of the hole may be expanded from top to bottom, as, for example, when making a post hole, by using one or more springing charges or detonating cord, stranded.

(2) Demolition kit M37 (fig. 207) consists of eight demolition blocks

M5A1, eight demolition block hook assemblies, and two demolition priming assemblies M15. Demolition block M5A1 is described in a(1)(c) above. The priming assembly M15 (fig. 208) consists of a length (approximately 5 ft) of detonating cord, two hexagonal-shaped plastic adapters, each holding a booster, and two detonating cord clips. The adapters that are attached to the cord, one at each end, are threaded to fit the cap well of demolition blocks and light antitank mines. Each booster contains a charge of 13.5 grains of RDX. The clips, which are in place on the cord about 20 inches from either end of the assembly, are for making junctions on main lines of detonating cord in a demolition system. The demolition kit M37, together with main lines and their initiators, is used to form a demolition system with one or more demolition blocks M5A1 as the main explosive charge.

- (4) Demolition training kits consist of inert items only. KIT, demolition, training, T38 (inert) (fig. 209), and KIT, demolition, training, T39 (inert) are provided for the training of personnel

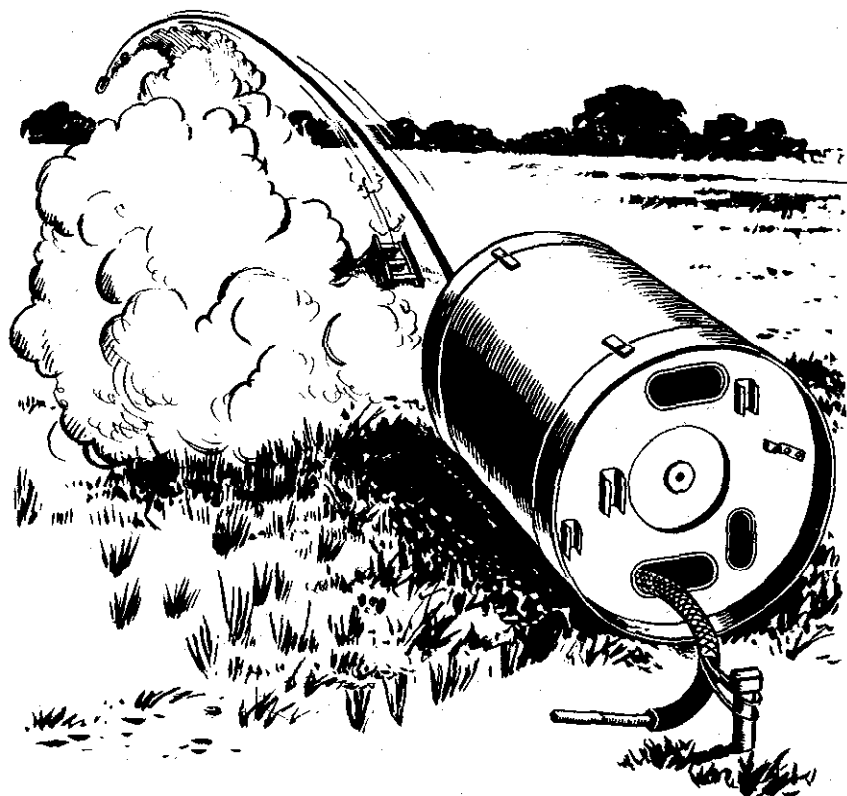


Figure 210. Cable, detonating, mine clearing, antipersonnel, M1—being laid over mine field by jet propulsion unit.

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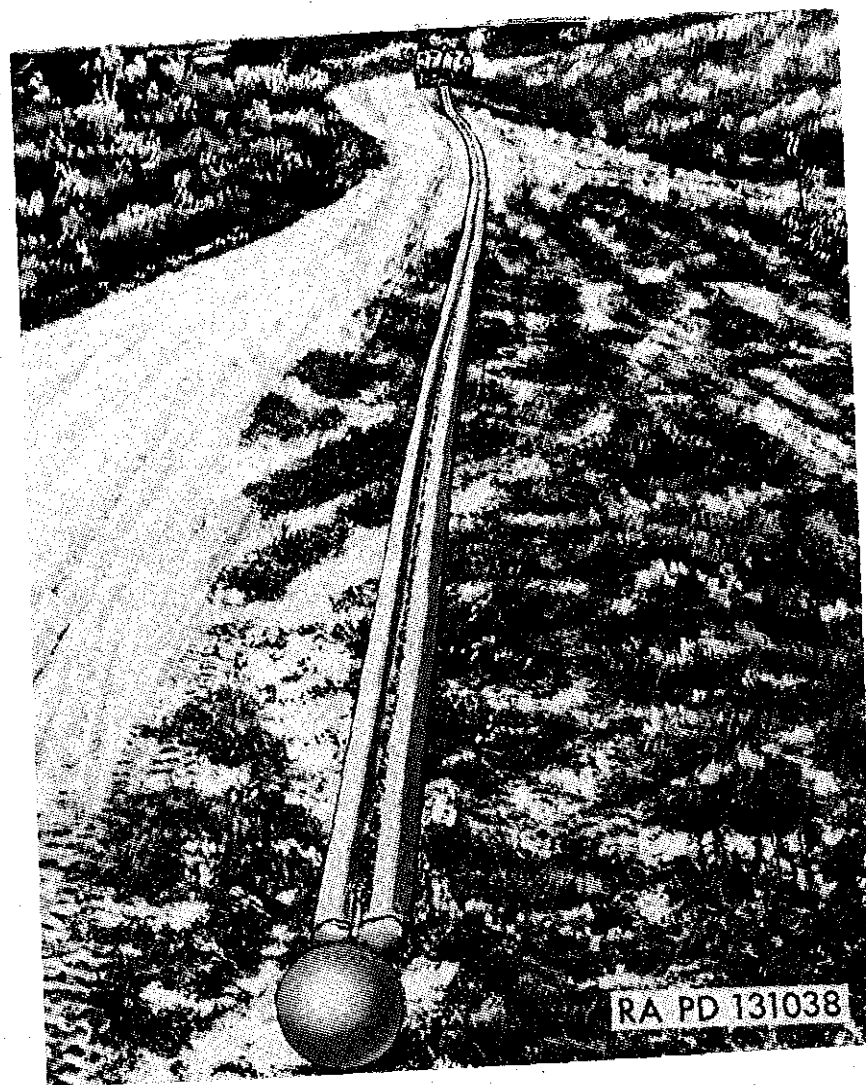


Figure 211. Snake, demolition, M3—being pushed by medium tank.

in the use of demolition materials. Inerted items used for training are to be employed in exactly the same manner and with the same care and precautions as their explosive counterparts used in service. See TM 9-1946 for details concerning demolition training kits.

d. Mine-Clearing Devices.

- (1) The antipersonnel mine clearing detonating cable is a flexible linear charge used to clear narrow lanes in antipersonnel mine fields. CABLE, detonating, mine clearing, antipersonnel, M1 (fig. 210) is a nylon-covered cable 170 feet long and about 1

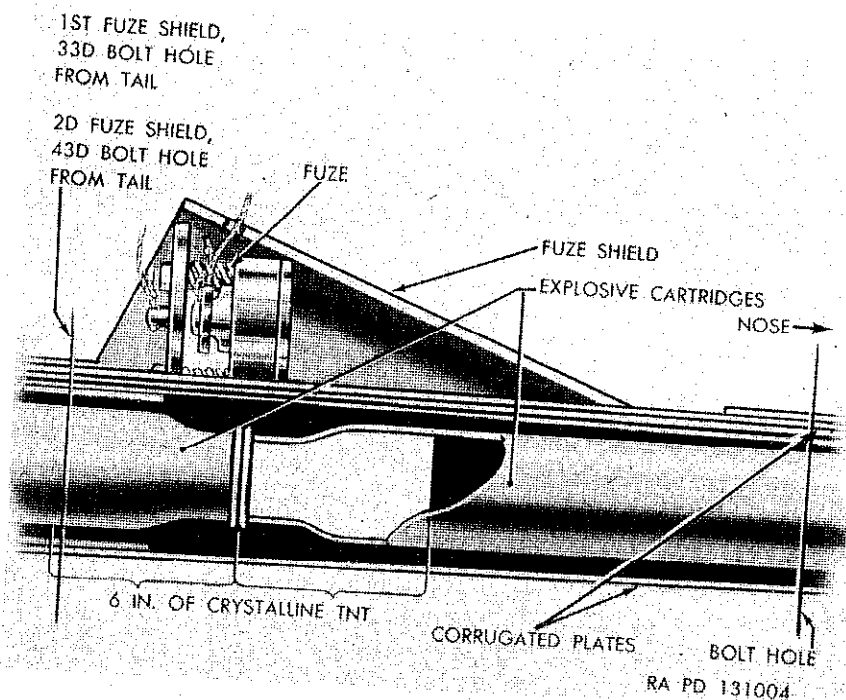


Figure 212. Snake, demolition, M3—longitudinal section at fuze, bullet impact, M1A1.

inch in diameter, which weighs 63 pounds and contains 46 pounds of oil-soaked PETN. This charge consists of 19 strands of special detonating cord, each strand containing approximately 100 grains of PETN per foot. Regular detonating cord should not be used as a substitute. One end of the cable has a cable grip with loops for anchoring the cable to a stake driven in the ground. This end contains a booster charge and a threaded cap well for inserting a 15-second delay detonator for exploding the cable. In the carrying case, the cable is coiled around a cone, which is removed before the unit is fired. The cable is projected across the minefield by a JATO, where it is exploded by the detonator in the anchored end. A launcher, which is a folding stand of aluminum angles, is used to hold the JATO in position for firing. The cable is issued either with or without the JATO. In the latter case, the JATO is requisitioned separately. One LIGHTER, fuze, M2 is provided for igniting the JATO. The entire assembly is contained in a carrying case, which is a cylindrical aluminum can with removable lids, provided with carrying handles on both ends. The loaded case weighs 92 pounds.

(2) Demolition snakes (figs. 211 and 212) are used principally to

breach minefields. They may also be used to breach bands of log posts, steel rails, antitank ditches, and some small concrete obstacles. A demolition snake consists of sections made up of two parallel linear explosive charges encased between corrugated metal plates, bolted together to form a rigid assembly that can be towed or pushed by a light or medium tank. The snake is exploded by action of a bullet impact fuze that is actuated by fire from a machine gun on the tank. Complete lists of the components of specific models of demolition snakes are furnished in Department of the Army Supply Manual ORD 3 SNL R-7.

- (a) SNAKE, demolition, M2, and SNAKE, demolition, M2A1, which are similar except in total explosive load and in minor details, are earlier models. CHARGE, snake, demolition, M2 is used in the snake M2. The charge used in the snake M2A1 is the same as that used in SNAKE, demolition, M3 described in (b) below. The corrugated plates used for both snakes M2 and M2A1 are steel. The plates for the demolition snake M3 are of aluminum.
- (b) SNAKE, demolition, M3 is 14 inches wide, 5 inches high, and 400 feet long when assembled. It weighs approximately 9,000 pounds, including 4,500 pounds of explosives. Corrugated aluminum plates 9 feet long, fastened with steel bolts, washers, and nuts, form the body of the snake. A pear-shaped aluminum nose, attached to the forward end of the snake in such a way that the nose can swivel slightly, aids in guiding the snake over and around obstructions. Other components and accessories adapt the snake for pulling or pushing by a tank. One hundred twenty-eight CHARGE, for snake, demolition, M2A1 and M3 are issued with each SNAKE, demolition, M3. The charge is elliptical in shape, encased in sheet aluminum, is 5 feet long and weighs 40 pounds, including approximately 35 pounds of explosive. The explosive is 80/20 amatol with a booster charge of crystalline TNT in each end. One end contains a cap well to receive a blasting cap when the explosive cartridges are used individually for general demolition work. The explosive charges are loaded in 320 feet of the 400-foot snake, giving an explosive weight of 14-pounds per loaded foot. Dirt-filled tamping bags are placed adjacent to the charges, extending 10 feet toward the nose of the snake and 20 feet toward the rear, to prevent the charges from shifting. Loading assemblies for bangalore torpedoes may be used as an alternative explosive charge. Two FUZE, bullet impact, M1 are supplied with each demolition snake.

141. Care and Precautions in Handling

a. *General.* Due consideration should be given to the observance of appropriate safety precautions in handling demolition material.

b. *Types of Explosive Charges and Groups.* Information concerning the care to be exercised in handling demolition materials will be found in TM 9-1903, TM 9-1946, FM 5-25, and in AR 385-63.

- (1) Demolition charges must be handled in accordance with the sensitivity of the explosive comprising the charge. For complete information on characteristics of explosives, see TM 9-1910.
- (2) Demolition blocks of plastic explosive must not be exposed to open flame as they ignite easily and burn with intense heat. If burned in large quantities, they may explode. Dynamites must be handled with caution because they may be exploded by flame, sparks, friction, and sharp blows, including impact from bullets or shell fragments. They are more sensitive than other explosives used in demolition or blasting.
- (3) Priming components such as safety fuse (time blasting fuse) and detonating cord are sensitive to flame. They should be stored separately from explosive charges or blasting caps.
- (4) Initiating components such as detonators, blasting caps, and primers must be protected from shock and high temperature since they contain sensitive explosive elements. Blasting caps will be stored separately from dynamite.

142. Precautions in Firing

a. Detailed information concerning safety precautions to be observed in firing demolition charges will be found in TM 9-1946 and FM 5-25.

b. General safety precautions in firing are in (1) and (2) below.

(1) *General.*

- (a) Lightning and other sources of extraneous electricity constitute definite hazards when firing charges either electrically or nonelectrically. A strike or a near miss by lightning is almost certain to detonate either type of circuits. For this reason, blasting operations should be suspended and personnel moved to a safe distance upon approach of an electrical storm. Other possible sources of static electricity, such as moving belts, escaping steam, and operating machinery, should be considered and eliminated before connecting up charges, especially when working with electric circuits. Radio transmitters and power lines also produce electrical energy and any electric blasting within 1 mile of a broadcasting or high-power short-wave station or within one-quarter mile of all other radio transmitters must be considered a potential hazard. Nonelectric and detonating cord systems are recommended in such locations.

(b) The ammonium nitrate cratering charge, nitrostarch and TNT charges, some demolition blocks, and some dynamites are dangerous to use in inclosed spaces because poisonous fumes result from the explosion.

(c) For demolitions in wet surroundings or under water, only those charges and priming and initiating components that are recommended for such use should be employed.

(d) Safety-distance requirements for preparation of primers and demolition charges must be observed (see TM 9-1946).

(e) Dual-firing systems should be used, whenever practicable, in order to increase the likelihood of a successful operation and to minimize the danger of unexploded charges (see FM 5-25).

(f) Primed explosive charges should not be forced into a drill hole (bore hole). Charges should be tamped only with blunt wooden tamping sticks.

(2) *Priming.*

(a) *Electric.*

1. All caps used in a circuit will be of the same manufacture.
2. Caps will be tested with an approved galvanometer before priming.
3. Caps will be short-circuited by means of the accompanying shunt or by twisting the bore ends of the wires together until ready to be connected into the circuit.
4. Only after all caps have been connected in the circuit will the final connection be made to the firing wire.
5. The ends of the firing wire at the charge will be kept twisted together until ready to tie into the cap circuit. The blasting machine ends of the wire will be kept twisted together until after the warning signals are given preparatory to connecting the blasting machine.
6. The blasting machine or an essential component thereof will be kept under guard at all times during preparation of the charge until ready to fire.
7. The cap lead wires will not be pulled or tampered with.
8. Only the batteries issued for the galvanometer will be used in the galvanometer.
9. In the event of a misfire in an electric circuit, the leading wires must be disconnected from the source of power before leaving the firing point to investigate. Investigation should be delayed long enough to insure that the misfired charge is not burning.

(b) *Nonelectric.*

1. When crimping caps, crimp near open end, pointing it out and away from the body, using only the issued cap crimpers.
2. Caps will be removed from the cap box with the fingertips.

The only materials to be inserted into the end of caps will be time fuse, detonating cord, or standard fuse base. They will not be forced.

3. Charges will be placed on the ground or on the material to be demolished before lighting their fuses.
4. Prime explosives only when planning to detonate them immediately, and *never* store primers after they are assembled.
5. Wait *at least* 30 minutes after the expected time of detonation before investigating any nonelectric misfires.
6. Test time fuse by burning and timing a short length before using. Before using, cut off and discard 2 or 3 inches of the end of the roll to eliminate any absorbed moisture.
7. When using a fuse lighter with less than 1 foot of time fuse, tape the cap-fuse connection to prevent the flash of the fuse lighter from spitting directly into the cap.

143. Packing and Marking

a. Packing.

- (1) *Explosive charges.* The chain demolition block is packed one chain per haversack, two haversacks per wooden box. Demolition blocks are packed eight per haversack, two haversacks per wooden box. An exception are the demolition blocks M5 and M5A1, which are packed 24 per plastic bag, 1 bag per wooden box. Nitrostarch and TNT explosives are packed 50 pounds per wooden box. The ammonium nitrate cratering charge is packed one per wooden box. Shaped charges are packed in wooden boxes. From one to eight charges are packed per box, according to the weight of the charge. Dynamite is usually packed 50 pounds per commercial wooden box. High-explosive destructors are packed 1 per fiber container and 50 containers per wooden box.
- (2) *Priming and initiating components, accessories, and tools.* Concussion-type detonators are packed in individual metal containers, 50 containers per wooden box. Delay-type detonators are packed 10 per package, 5 packages per inner package, 4 packages (200 detonator) per wooden box. Weatherproof fuse lighters are packed 5 per waterproof carton, 30 cartons per wooden box. Time blasting fuse is packed in 50-foot coils, 2 coils per package, 5 packages per sealed metal can, 8 cans (4,000 feet of fuse) per wooden box. The 2-coil packages are also packed either 30 or 60 per wooden box. Detonating cord is issued in spools of 50, 100, 500, or 1,000 feet. The 50-foot spools are packed 100 per wooden box; 100-foot spools, 50 per wooden box; 500-foot spools, 8 per wooden box. Firing devices are packed 5 or 10 devices per inner box. Trip wires are packed with pull-type firing devices. Inner boxes are packed in

wooden boxes that contain from 150 to 250 devices. Primers are packed 5,000 or 10,000 per wooden box. Blasting caps are packed 500 to 10,000 per wooden box or as required. Most accessories and tools are packed as required.

- (3) *Demolition equipment, sets and kits.* The explosive items of demolition equipment sets are packed, shipped, and stored separately from the nonexplosive items. No standard packing is prescribed. The blast-driven earth rod set is packed in a plywood box. Demolition kit M37 is packed in a carrying case of the haversack type with priming assemblies attached to the top of the case. Bangalore torpedo M1A1 is packed in a wooden box. Demolition training kits are packed in the standard squad demolition chest.
- (4) *Mine-clearing devices.* The antipersonnel mine-clearing detonating cable, including accessories, is contained in a waterproof aluminum carrying case. The carrying case is packed in a wooden box.

b. *Marking.* In addition to nomenclature and ammunition lot number, packages prepared for shipment are marked with the Interstate Commerce Commission (ICC) shipping name or classification of the article, volume and weight, and the Ordnance Corps escutcheon. The Ammunition Identification Code (AIC) is included in the marking when specified by the packing drawing.

Section X. GUIDED MISSILES

144. General

a. The term "guided missile" refers to an unmanned vehicle moving above the earth's surface or under water, the trajectory or flight path of which is capable of being altered by a mechanism within the vehicle. The missile usually carries a lethal or useful military load.

b. For reasons of safety and ease in handling and shipping, the components of a guided missile are usually stored and shipped separately and must be assembled prior to use. Assembly is performed at predesignated assembly areas. The components of the various guided missiles differ, depending upon the particular type and model. In general, a guided missile is composed of seven basic and distinct major components, described in (1) through (7) below.

- (1) *Aerodynamic structure.* This refers to the design and fabrication of the missile body.
- (2) *Control system.* The control system is that component that acts as a pilot to keep the missile in a stable flight attitude and make changes in course in response to signals from the guidance system. The control system operates the control surfaces and the propulsion unit.

- (3) *Guidance system.* The guidance system is that component that provides continued target intelligence (course data) that will take the missile to its target.
- (4) *Propulsion system.* The propulsion system is that component of a guided missile that supplies the power for the missile flight.
- (5) *Warhead.* The payload of a guided missile is its warhead. The warhead contains a lethal or useful military load. The mission of a guided missile is to deliver the warhead to a point where maximum effect will be inflicted on a specific target.
- (6) *Fuze.* The fuze is that component of a guided missile that causes the warhead to function at the time and under the circumstances desired.
- (7) *Electrical power system.* The electrical power system provides electricity for the operation of guidance, control, and fuzing systems of the missile.

145. Classification

a. General. Guided missiles are classified according to the origin of the missile and its destination. They are also designated by service letter, model number and modification letter, prefix letter, popular name, and other appropriate designations.

b. Basic Designations Based on Origin and Destination. Basic designations of guided missiles are:

AAM—Air-to-air missile
 ASM—Air-to-surface missile
 AUM—Air-to-underwater missile
 SAM—Surface-to-air missile
 SSM—Surface-to-surface missile
 SUM—Surface-to-underwater missile
 UAM—Underwater-to-air missile
 USM—Underwater-to-surface missile

c. Service Letter, Model Number, and Modification Letter. Each basic designation is followed by a service letter, model number, and modification letter. For example, AAM-N-5b is an air-to-air missile developed by the Navy; it is the fifth model and second modification.

d. Prefix Letters. The status of development is indicated by prefix letters. The letter X indicates experimental; Y indicates service test of the missile; Z indicates obsolescence. For example, XAAM designates an experimental air-to-air missile.

e. Popular Names. Names such as Viking, Nike, Terrier, and Falcon may be assigned to guided missiles.

146. Identification

Guided missiles and their components may be identified by the painting and marking thereon. The markings include such data as name of the component, its model designation, lot number and manufacturer,

date of manufacture, type of warhead, and other appropriate identifying markings.

147. Warheads

The useful military load of guided missiles is contained in the warhead. Dependent upon the target and the effect desired, the types of warheads that may be used are indicated in *a* through *e* below.

a. High Explosive. The high-explosive warhead depends upon blast-effect for destruction or demolition of the target.

b. High-Explosive Fragmentation. The effect of this warhead is produced primarily by the fragments of the warhead being projected at high velocity. The blast at the point of functioning will cause additional damage to the target or nearby objects.

c. Chemical. This type may contain toxic chemical agents.

d. Atomic. This type may be designed to produce casualties (by thermal radiation, blast, and nuclear radiation), to cause destruction and damage to structures and equipment, and/or to deny the use of an area due to residual radioactive effects.

e. Practice. Practice warheads simulate service warheads and are provided for such purposes as training in handling, fuzing, and loading.

148. Fuzes

a. General.

(1) A guided missile fuze is a device used with a warhead to cause it to function at the time and under the circumstances desired.

(2) One or more fuzes may be used in conjunction with any of the warheads described in paragraph 147. Depending on the type of target and effect desired at the target, fuzes used with guided missiles may be of the impact, VT (proximity), or ground-controlled types.

b. Impact Fuze. An impact fuze is one that is actuated by striking the target. Functioning time after impact depends upon the design of the fuze and the nature of the target.

c. VT Fuze. VT fuzes function on approach to a target. Each type of VT fuze is actuated by some characteristic of, and at a predetermined distance from, the target. Five basic types of guided missile VT fuzes are—

- (1) Radio-proximity.
- (2) Pressure-proximity.
- (3) Electrostatic-proximity.
- (4) Photoelectric-proximity.
- (5) Acoustic-proximity.

d. Ground-Controlled Fuzing. In ground-controlled fuzing, the mechanism for determining target proximity is not housed in the fuze, but is on the ground. When the proper proximity relationship is reached between the missile and the target, a signal to detonate is sent to the missile.

149. Electrical Power System

This system supplies electrical power for operation of the guidance and control mechanisms and for the fuzing of the warhead. The types of systems are as described in *a* and *b* below.

a. Battery supply, with or without electronic rectifier and transformer circuit. This type is suitable for small, short-range missiles.

b. An alternating-current generator using a turbine driven by wind, battery, engine, or compressed air. This type is suitable for longer range missiles.

150. Propulsion System

a. General. The propulsion system used in guided missiles employs a jet-type engine, which is the only known type capable of propelling such missiles at the required speeds. A jet engine is one that operates on the reaction principle. It consists essentially of a combustion chamber and a nozzle. When a fuel is burned in the combustion chamber, a thrust is produced as a result of the products of combustion expanding and passing through the nozzle.

b. Types. Jet engines are of two general types, the air-breathing type, and the nonair-breathing type. The air-breathing type, of which the pulse jet, ram jet, and turbo jet engines are examples, uses liquid fuel and atmospheric oxygen as the oxidizer. The nonair-breathing type, of which rocket engines are examples, uses solid propellant (fuel and oxidizer combined) or liquid fuel with an oxidizer.

c. Fuels and Propellants. Fuels and propellants for jet engines are discussed in paragraphs 14 through 21.

d. Phases of Operation. The complete missile propulsion system generally operates in two phases: the launching phase, during which the missile is accelerated to the cruising speed by some means such as a catapult or a high-thrust jet engine sometimes called a "booster unit" or "JATO"; and the cruising phase, during which the missile is maintained at cruising speed by a relatively lower-thrust jet engine sometimes called a "sustainer unit." In other cases, the missile propulsion system does not require a "booster unit" or catapult and operates in only one phase.

151. Control and Guidance Systems

a. General. The control and guidance are parts of an integrated system for automatically directing the flight of the missile.

b. Control System.

(1) *General.* The control system includes all the components necessary for complete automatic control of a missile in flight. The system receives intelligence from a radio signal or other electrical device and makes corrections for changes in yaw, pitch, and roll. The systems usually include gyroscopes, signal amplifiers, servomotors, and control surfaces. The system may also

receive internal or external guidance signals in order to adjust the path of a missile.

(2) *Gyroscopes.* The gyroscope is used in a missile to fix a reference direction.

(3) *Electric amplifiers.* The amplifier increases the signal strength to a sufficient level to control the servomotors.

(4) *Servomotors.* The servomotor supplies power to the control surfaces to change the flight path of a missile.

(5) *Control surfaces.* The control surface changes the missile path by application of some force in response to a directing signal. This change in path (steering) is accomplished by one or more of the following devices: air vanes, jet vanes, movable jet motor, or side jets.

c. Guidance System. The main functions performed by the guidance system are tracking, computing, and directing. Tracking is the process of determining the location of a missile and its target with respect to the launcher, and missile and target with respect to each other and some other reference. Computing is the process of calculating the directing signals for the missile by the use of tracking information. Directing is the process of sending the computed signal to the missile. Directing may also be accomplished from within a missile. The directing signals are sent to the control system, thus giving control of missile flight. Some basic guidance systems are described in (1) through (8) below.

(1) *Preset guidance system.* A "preset system" is a guidance system wherein a predetermined path is set into the missile before launching and cannot be adjusted after launching.

(2) *Terrestrial reference guidance system.* A "terrestrial reference system" is a guidance system for a predetermined path, wherein the path of the missile can be adjusted after launching, by devices within the missile that react to some phenomena of the earth.

(3) *Radio navigation guidance system.* A "radio navigation system" is a guidance system for a predetermined path wherein the path of the missile can be adjusted by devices within the missile that are controlled by external radio signals.

(4) *Celestial navigation guidance system.* A "celestial navigation system" is a guidance system for a predetermined path wherein the path of the missile can be adjusted by the use of continuous celestial observation.

(5) *Inertial guidance system.* An "inertial system" is a guidance system for a predetermined path wherein the path of the missile can be adjusted after launching by devices wholly within the missile.

(6) *Command guidance system.* A "command system" is a guidance system wherein the path of the missile can be changed after

launching by directing signals from some agency outside the missile.

- (7) *Beam climber guidance system.* A "beam climber system" is a guidance system wherein the direction of the missile can be changed after launching by a device in the missile that keeps the missile in a beam of energy.
- (8) *Homing guidance system.* A "homing system" is a guidance system wherein the direction of the missile can be changed after launching by a device in the missile that reacts to some distinguishing characteristic of the target.

152. Launchers

a. *General.* Launchers are mechanical structures that provide whatever control and acceleration are needed during the initial stages of flight to enable the missile's control and guidance system and the propulsion system to direct and carry it to the target.

b. *Types of Launchers.* Some basic types of launching devices are trainable platform, vertical tower, vertical ramp, ramp or rail (other than vertical), zero length (a launcher on which there is negligible travel by the missile), gun type, catapult, and aircraft.

c. *Firing.* Firing of guided missiles from a launcher is usually accomplished electrically by remote control.

d. *Blast Protection.* Due to the dangerous blast of flame emitted by guided missiles, the launching site must be cleared of all personnel and unnecessary equipment. All unprotected combustible material must also be removed from the launching area.

153. Care, Handling, and Preservation

In general, the same regulations apply to guided missiles as to other types of ammunition. However, certain components of the missile require special handling. The control equipment, which includes such items as gyroscopes, homing devices, electronic equipment, and other precision instruments, must be protected from rough or careless handling. Special precautions must be taken with certain of the fuels and oxidizers due to fire, explosion, contact, and inhalation hazards. Protective clothing and masks must be used when handling certain of the fuels and oxidizers. Careful training in safety measures, procedures for handling, and precautions in use of guided missile explosive or flammable components is essential.

154. Packing and Marking

a. *Packing.* The components of guided missiles are packed in appropriate types of containers. Fuzes and warheads are packed in wooden or metal containers. Propellants, which includes fuel, oxidizer, reducer, and solid and liquid propellants, are packed in specially designed tanks, metal drums, glass bottles, or fiber containers in wooden boxes. Control

and guidance equipment are packed in specially constructed packings since they are precision instruments. Propulsion systems are packed in metal crates or wooden boxes. Special equipment such as compressors, cable sets, storage batteries, firing panels, and similar items are also packed in suitable boxes, crates, and containers.

b. *Marking.* The packing boxes, crates, drums, and containers in which guided missile components are packed are marked for easy identification. They may or may not be coded for a specific guided missile complete round. Packings of propellants and components of propellants, fuzes, and warheads are also marked to indicate the Interstate Commerce Commission shipping name and any important instructions in handling or storage.

Section XI. CARTRIDGE-ACTUATED DEVICES FOR AIRCRAFT USE

155. General

Cartridge-actuated devices for aircraft use include such items as catapults, removers, initiators, and thrusters. These devices are actuated by special blank cartridges and are used in emergency-escape mechanisms in high-speed aircraft.

156. Catapults

a. *General.* A catapult is a cartridge-actuated device designed to facilitate an emergency escape from high-speed combat or bomber aircraft by forcibly ejecting the pilot seat and pilot away from the aircraft. The ejection may be upward or downward from the aircraft depending upon the models of aircraft and catapult. Structurally, an aircraft catapult is composed of three tubes; outer tube, telescoping tube, and inner tube. One end of the catapult is attached to the pilot seat and the other end is attached to the aircraft structure. The catapult is actuated by gas pressure from the burning propellant of a special blank cartridge incorporated in the catapult. This blank cartridge is fired by a firing pin in the catapult that, in turn, is actuated by gas pressure from a remotely

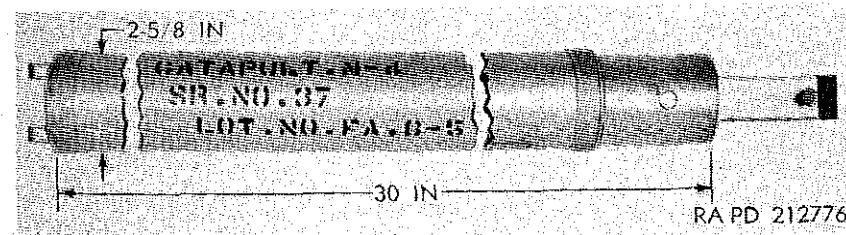
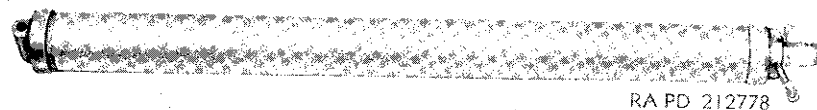


Figure 213. Catapult M4.

located (in the aircraft) initiator. Pressure, generated within the initiator by an integral special blank cartridge, is transmitted to the catapult through a system of connecting hose or tube.

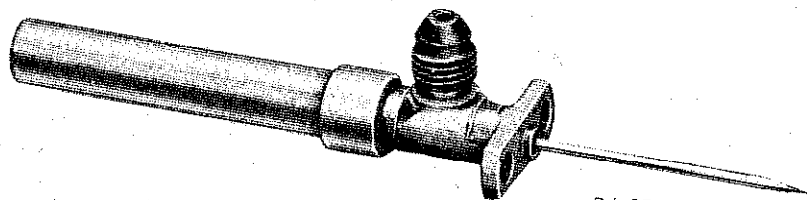
b. Types.

- (1) Representative types of service catapults are the M3 for "upward" ejection in high-speed bomber aircraft, the M4 (fig. 213) for "downward" ejection, and the M5 for "upward" ejection in fighter planes. Each of these types is operated by a system consisting of the initiator M3 (fig. 217), which provides for remote (in the aircraft) actuation. This initiator contains CARTRIDGE, CAD, M38, which, when fired, furnishes gas pressure through aircraft hose to the catapult. The gas pressure exerts a force on the catapult firing pin, forcing firing pin downward, shearing the shear pin, unlocking the catapult, and the remainder of the movement of the firing pin fires the CARTRIDGE, CAD, M36 in the catapult M3; the CARTRIDGE, CAD, M37 in the catapult M4; or the CARTRIDGE, CAD, M28A1 in the catapult M5.
- (2) Representative types of training catapults are the M2 that utilizes CARTRIDGE, CAD, M30A1 and the M6 that uses CARTRIDGE, CAD, M57. The catapult M2 is used, in simulating the action of a service catapult, on a fixed tower. It consists of a pair of telescoping tubes, one of which is attached to the pilot training seat and the other to the training tower. Upon firing the cartridge, which simulates the action of the service catapult cartridge, the tubes telescope and the inner tube continues in the training flight attached to the seat. The training



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Figure 214. Remover M2A1.



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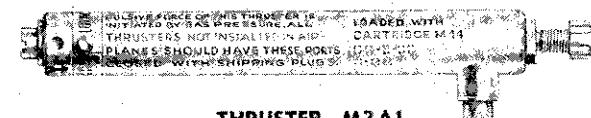
Figure 215. Exactor M1.

catapult M6 is used in conjunction with a mobile seat trainer rather than on a fixed tower as the training catapult M2.

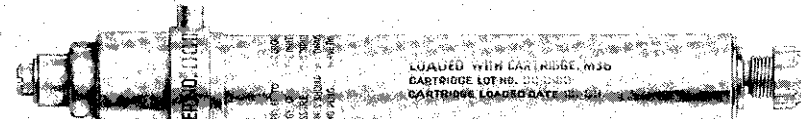
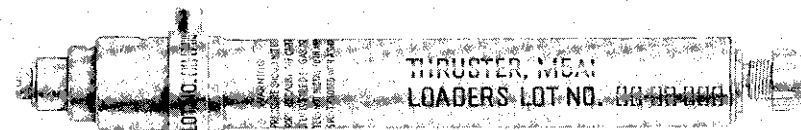
157. Removers

a. General. A remover is a device designed to jettison an aircraft canopy from an aircraft in an emergency, to provide an exit for the pilot when he is ejected by a catapult. The remover is actuated just prior to actuation of the catapult. The remover is a telescoping tube ejector similar to a catapult but smaller and somewhat less powerful. One end of the remover is attached to the canopy, the other to the aircraft structure. Upon firing the remover cartridge, the remover is extended axially and the head and inner tube are ejected with the canopy. The exactor M1 (fig. 215), which is not integral with the remover but attached to it, is connected to an initiator, and functions independently of the catapult. The initiator gas pressure operates the exactor plunger, thus releasing the canopy firing pin that fires the remover cartridge. The initiator generally employed in this capacity is the M3, which is a mechanically (lanyard or cable) operated device.

b. Types. Representative types of removers are the M1A1, M2A1 (fig. 214), and M3. Each model of these series is designed with a particular cartridge for a particular type of aircraft. The remover M1A1 uses



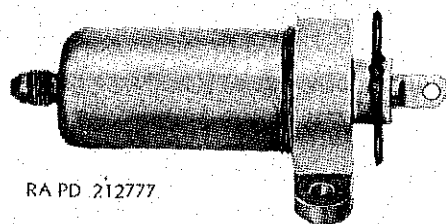
THRUSTER, M3A1



THRUSTER, M5A1

RA PD 222156

Figure 216. Thrusters M3A1 and M5A1.



RA PD 212777

Figure 217. Initiator M3.

CARTRIDGE, CAD, M29A2 and is operated by exactor M1, which is actuated by initiator M3. The remover M2A1 uses CARTRIDGE, CAD, M31A1 and is actuated by a sear, which is operated by a cable or linkage-type system in the aircraft. The remover M3 uses CARTRIDGE, CAD, M31A1 and is actuated by initiator M3.

158. Thrusters

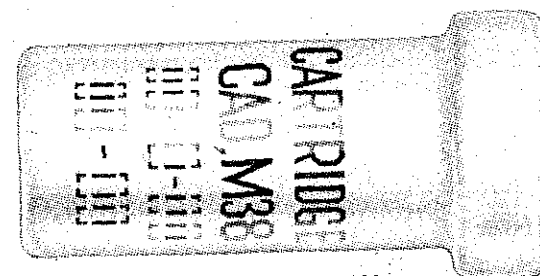
a. General. Thrusters are cartridge-actuated devices used in aircraft to position various components of the aircraft, as an initial operation to facilitate the subsequent emergency escape of personnel. Thrusters consist essentially of a cylinder, piston, cartridge, and a firing pin, which is actuated by gas pressure furnished from an initiator. When the thruster cartridge is ignited, the piston is forced down the cylinder, exerting a thrust on the related aircraft component. The various models of thrusters differ in design details such as thrust exerted, length of stroke, etc.

b. Types. Representative types of thrusters are the M1 and M1A1, which use CARTRIDGE, CAD, M42; the M2 and M2A1, which use CARTRIDGE, CAD, M43; the M3 and M3A1, which use CARTRIDGE, CAD, M44; and the M5 and M5A1, which use CARTRIDGE, CAD, M38 (fig. 216).

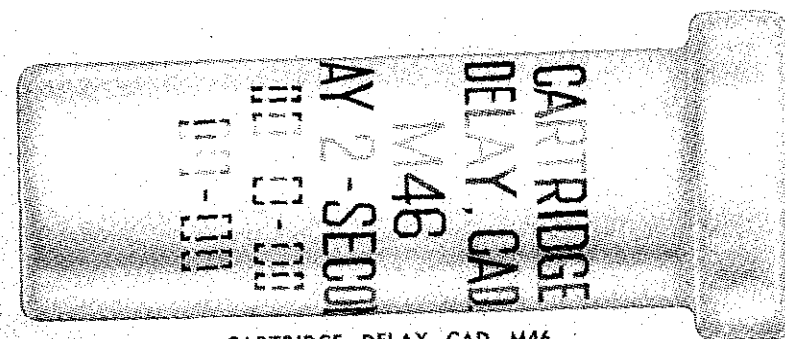
159. Initiators

a. General. Initiators are cartridge-actuated devices that are used in aircraft emergency escape systems to provide a source of gas pressure, which actuates another component of the system, such as a catapult or thruster. Initiators may differ in the method of firing; that is, they may be fired mechanically by the operation of some form of lanyard as is the initiator M3 or by gas pressure furnished by the preceding item in the system as in the case of the initiators M5 and M5A1. Delay initiators incorporate a delay element in the initiator cartridge.

b. Types. Representative types of initiators include the M3 (fig. 217), M5, and M5A1, which use CARTRIDGE, CAD, M38. Representative types of delay initiators are the M4, M6, and M6A1, which use CARTRIDGE, delay, CAD, M46.



CARTRIDGE, CAD, M38



CARTRIDGE, DELAY, CAD, M46

RA PD 222157

Figure 218. Cartridges.

160. Cartridges

With exception of CARTRIDGE, delay, CAD, M46 (fig. 218), all the CAD cartridges are similar in general design, consisting of an aluminum case, a percussion primer, and a propellant. They differ in size and in the amount of propellant as determined by the military requirements of the item to which they are assembled. The CARTRIDGE, delay, CAD, M46 differs from the other cartridges in that a 2-second delay element M5 is provided between the primer and the propellant. The delay element M5 consists of a cylindrical metal body containing a 2-second fuze with a flash hole on one end of the body and a primer pocket on the other end.

161. Care and Precautions in Handling

a. General. Due consideration should be given to the observance of appropriate safety precautions in handling cartridge-actuated devices. Information concerning the care to be exercised in handling these devices will be found in TM 9-1903 and in pertinent Air Force Technical Orders (see app.).

b. Types.

- (1) All types, that is, catapults, removers, thrusters, and initiators, must be handled with care as they contain a cartridge.
- (2) Air or gas pressure should not be applied to the inlet ports of those devices that are initiated by gas pressure. When not installed in an airplane, these ports should be kept closed with a shipping plug.
- (3) The cotter pin must not be taken out until removers are installed in an airplane and then only if lock pin is in place. Do not remove removers from the airplane unless cotter pin is replaced in the hole.
- (4) The safety pin (M3 and M4 type initiators) will always be inserted in the initiator except when the initiator is installed in an aircraft and the aircraft is in flight. Do not remove the initiator from the aircraft or perform any maintenance in the initiator or in the immediate area unless the safety pin is installed.

162. Packing and Marking

a. Packing.

- (1) Catapults and training catapults are assembled and shipped as a sealed unit, with the cartridge contained therein. All catapults are packed one per corrugated fiberboard carton, four cartons per wooden box, with the exception of the catapult M3, which is packed two (in fiber container) in a wooden box.
- (2) Removers are assembled and shipped as a sealed unit, with the cartridge contained therein. All removers are packed four in a carton in a wooden box, with the exception of the remover M3, which is packed six (in fiber containers) in wooden box in two layers, three per layer.
- (3) Initiators are assembled and shipped as a sealed unit, with cartridge contained therein. All initiators are packed 4 per corrugated fiberboard carton, 12 cartons per wooden box.
- (4) Thrusters are assembled and shipped as a sealed unit, with the cartridge contained therein. All thrusters are packed in fiber ammunition containers, 12 containers per wooden box, with the exception of thrusters M2 and M2A1, which are packed 9 containers per wooden box.

b. Marking. In addition to nomenclature and ammunition lot number, packages prepared for shipment are marked, in accordance with Interstate Commerce Commission shipping regulations, the same as small-arms ammunition. The ammunition Identification Code Symbol (AIC) is included in the marking when specified by the packing drawing.

APPENDIX

REFERENCES

1. Publication Indexes

DA pamphlets of the 310-series, DA Pam 108-1, and TO 00-101 should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to the matériel covered in this manual.

2. Forms

- DA Form 9-5 Ammunition Inspection and Lot Number Report (cut sheet).
- DA Form 9-6 Ammunition Inspection and Lot Number Report (continuation sheet) (cut sheet).
- DA Form 9-8 Ammunition Stores Slip (pad of 100).
- DA Form 347 Registry of Injury Claims (cut sheet).
- DA Form 580 Ordnance Ammunition Stock Status Report (cut sheet).
- DA Form 580-1 through 12 Ordnance Ammunition Stock Status Report (cut sheets).
- DA Form 581 Ammunition (cut sheet).
- DA Form 583 Ammunition Visible Index (card).
- DA Form 953 Summary of Accident Experience (cut sheet).

3. Types of Ammunition

90-mm HE Shell M71 with PD Fuze; Calibration	
Data for Certain Lots	TB ORD 420
Ammunition: Identification Code (AIC)	TB 9-AMM 5
Ammunition: Restricted or Suspended	TB 9-AMM 2
Artillery Ammunition	TM 9-1901
Bombs for Aircraft	TM 9-1980
Chemical Bombs and Clusters	TM 3-400
Demolition Materials	TM 9-1946
Employment of Land Mines	FM 20-32
Flame Thrower and Fire Bomb Fuels	TM 3-366
Hand and Rifle Grenades	FM 23-30
JATOS, General	TM 9-1955
Land Mines	TM 9-1940
Military Chemistry and Chemical Agents	TM 3-215
Military Explosives	TM 9-1910
Military Pyrotechnics	TM 9-1981

Miscellaneous Chemical Munitions	TM 3-300
Pricing Guide—Ammunition	ORD 5-3-6
Reducer, Flash, M1: Change in Authorized Use When Firing Charge, Propelling, M19, in Gun, 155-mm. M2	TB ORD 565
Reducer, Flash, M2 (T2): Clarification of Authorized Use When Firing Charge, Propelling, M4 or M4A1, in Howitzer, 155-mm M1 or M45 (T186E1)	TB ORD 590
Rockets	TM 9-1950
Small-Arms Ammunition	TM 9-1990
Type M3 Initiator	TO 11P3-3-2-1
Type M4 Delay Initiator	TO 11P3-2-2-1
Type M5 Initiator	TO 11P3-2-3-1
Type M6 Delay Initiator	TO 11P3-2-4-1

4. Safety

Accident Experience; Reporting and Records	SR 385-10-41
Accident Reporting	SR 385-10-40
Coordination with Armed Services Explosives Safety Board	SR 385-15-1
Fire Report	SR 385-45-20
Identification of Inert Ammunition and Ammunition Components	SR 385-410-1
Miscellaneous: Precautions in Handling Gasoline	AR 850-20
Regulations for Firing Ammunition for Training, Target Practice, and Combat	AR 385-63

5. Camouflage

Camouflage, Basic Principles	FM 5-20
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6. Decontamination

Decontamination	TM 3-220
Defense Against CBR Attack	FM 21-40

7. Destruction

Explosives and Demolitions	FM 5-25
Land Mines and Components; Demolition Explosives and Related Items; and Ammunition for Simulated Artillery, Booby Trap, Hand Grenade; and Land Mine Fire	ORD 3 SNL R-7

8. Disposal

Disposal of Supplies and Equipment: Ammunition	SR 755-140-1
Disposal of Supplies and Equipment: Disposition of Foreign Excess Personal Property	AR 755-10

Explosive Ordnance Reconnaissance and Disposal	FM 9-40
Explosives: Disposal by Dumping at Sea	SR 75-70-10
Explosives: Responsibilities for Explosive Ordnance Disposal	AR 75-15
Tool Set, Maintenance (Field), Explosive Ordnance, Disposal Squad	ORD 3 SNL J-8, Sec 1

9. Maintenance and Renovation

Abrasive, Cleaning, Preserving, Sealing, Adhesive, and Related Materials Issued for Ordnance Matériel	TM 9-850
Ammunition Renovating Tools	ORD 3 SNL J-11, Sec 2
Ammunition Renovation	TM 9-1905
Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials	ORD 3 SNL K-1
Tool Set, Maintenance (Field), Ammunition Renovation Platoon	ORD 3 SNL J-8, Sec 4

10. Surveillance

Ammunition Inspection Guide	TM 9-1904
Inspection of Ordnance Matériel in Hands of Troops	TM 9-1100
Inspection of Separate Loading Propelling Charges and Bulk Propellants	SR 742-140-1
Reports	SB 9-AMM 8

11. Supply

Ammunition, Blank, for Pack, Light, and Medium Field, Tank, and Antitank Artillery	ORD 3 SNL R-5
Ammunition, Fixed and Semifixed, Including Subcaliber for Pack, Light, and Medium Field, Aircraft, Tank, and Antitank Artillery, Including Complete Round Data	ORD 3 SNL R-1
Ammunition for Antiaircraft Artillery	ORD 3 SNL P-5
Ammunition, Instruction Material for Aircraft Bombs, Grenades, Pyrotechnics, and Rockets	ORD 3 SNL S-6
Ammunition, Instruction Material for Pack, Light and Medium Field, Aircraft, Tank, and Antitank Artillery	ORD 3 SNL R-6
Ammunition, Instruction Materials for Antiaircraft, Harbor Defense, Heavy Field Artillery, Including Complete Round Data	ORD 3 SNL P-8
Ammunition, Mortar, Including Fuzes, Propelling Charges and Other Components	ORD 3 SNL R-4
Ammunition Renovating Tools	ORD 3 SNL J-11, Sec 2
Ammunition, Revolver, Automatic Pistol, and Submachine Guns	ORD 3 SNL T-2

Ammunition, Rifle, Carbine, and Automatic Gun. ORD 3 SNL T-1

Ammunition: Supply Within the Continental United States. SB 9-AMM 6

Bombs, Aircraft, All Types. ORD 3 SNL S-1

Ammunition, Over 125—Millimeter. SM 9-5-1320

Fin Assemblies and Miscellaneous Inert Components for Aircraft Bombs. ORD 3 SNL S-3

Fuzes and Miscellaneous Explosive Components for Aircraft Bombs. ORD 3 SNL S-2

Fuzes, Primers, and Miscellaneous Items for Antiaircraft and Heavy Field Artillery; Blank Ammunition for 90-mm Guns. ORD 3 SNL P-7

Grenades, Hand and Rifle, and Related Components. ORD 3 SNL S-4

Chemical Corps Regulated Items. SB 725-350

Ordnance Corps Regulated Items. SB 725-950

Issue of Supplies and Equipment: Processing Requisitions. SR 725-10-2

Land Mines and Components; Demolition Explosives and Related Items; and Ammunition for Simulated Artillery, Booby Trap, Hand Grenade; and Land Mine Fire. ORD 3 SNL R-7

Miscellaneous Service Components of Small-Arms Ammunition for Field Service Account, Instruction Material, and Ammunition for Simulated Small-Arms Fire. ORD 3 SNL T-4

Ordnance Maintenance and General Supply in the Field. FM 9-10

Procurement of Supplies and Equipment: Standardization of Type Designations. SR 715-50-5

Projectiles and Propelling Charges, Separate Loading, for Medium Field Artillery, Including Complete Round Data. ORD 3 SNL R-2

Ammunition, Over 125-Millimeter. SM 9-5-1320

Pyrotechnics, Military, All Types. ORD 3 SNL S-5

Rockets, All Types, and Components. ORD 3 SNL S-9

Service Fuzes and Primers for Pack, Light and Medium Field, Aircraft, Tank, and Antitank Artillery. ORD 3 SNL R-3

Shells, Shotgun. ORD 3 SNL T-3

Small-Arms Ammunition: Lots and Grades. TB 9-AMM 4

Subcaliber Ammunition for Harbor Defense, Heavy Field, and Railway Artillery. ORD 3 SNL P-6

Supply Control: Distribution of Ammunition for Training. AR 710-1300-1

Tool Set, Maintenance (Field), Ammunition Renovation Platoon. ORD 3 SNL J-8, Sec 4

Tool Set, Maintenance (Field), Explosive Ordnance, Disposal Squad. ORD 3 SNL J-8, Sec 1

12. Shipment and Storage

Additional Distinguishing Marking of Weapons and Ammunition Made Under the Offshore Procurement Program in Europe. TB ORD 600

Additional Distinguishing Marking of Weapons and Ammunition Made Under the Offshore Procurement Program in Japan. TB ORD 521

Army Shipping Document. TM 38-705

Instruction Guide: Ordnance Preservation, Packaging, Packing, Storage, and Shipping. TM 9-1005

Marking and Packing of Supplies and Equipment: Marking of Oversea Supply. SR 746-30-5

Military Standard—Marking of Shipments. MIL-STD-129*

Preparation of Supplies and Equipment for Shipment: Processing of Unboxed and Uncrated Equipment for Oversea Shipment. AR 747-30

Preservation, Packaging, and Packing of Military Supplies and Equipment. TM 38-230

Protection of Ordnance General Supplies in Open Storage. TB ORD 379

Shipment of Supplies and Equipment: Report of Damaged or Improper Shipment. SR 745-45-5

Shipping and Packing Containers and Materials, Including Such Items as Bandoleers, Belts, Clips, Links, and Ends, for Small-Arms Ammunition. ORD 3 SNL T-5

Supplies and Equipment: Unsatisfactory Equipment Report. AR 700-38

Transportation by Commercial Means; General. AR 55-105

Transportation by Water of Explosives and Hazardous Cargo. AR 55-228

13. Other Publications

Battlefield Illumination. TC 30 (1952)

Instruction Guide: Small-Arms Accidents, Malfunctions and Their Causes. TM 9-2210

Installations: Report of Loss, Theft, and Recovery of Government Property. SR 210-10-10

Introduction. ORD 1

Military Publications: Distribution of Department of the Army Publications and Blank Forms. AR 310-90

*Copies may be obtained from Aberdeen Proving Ground, Aberdeen, Md.

Military Security: Safeguarding Security Information	AR 380-5
Ordnance Ammunition Service in the Field	FM 9-6
Ordnance Service in the Field	FM 9-5
Qualification in Arms: Qualification and Familiarization .	AR 370-5
Supplies and Equipment: Report of Malfunctions and Accidents Involving Ammunition and Explosives (During Training or Combat)	SR 700-45-6
Targets, Target Material, and Training Course Layouts .	TM 9-855
Care, Handling, Preservation and Destruction of Am- munition	TM 9-1903
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BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

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USAR: None.

For explanation of abbreviations used, see SR 320-50-1.