TM 9-1901

WAR DEPARTMENT TECHNICAL MANUAL

ARTILLERY AMMUNITION

WAR DEPARTMENT • *29 JUNE 1944*

RESTRICTED

This Technical Manual supersedes TB 9-1901-1, dated 20 March 1944; TB 9-1901-2, dated 25 May 1944; TB 9-1901-3, dated 28 June 1944; TB ORD 7, dated 10 January 1944; and TB ORD 77, dated 5 June 1944.

CHAPTER 1

GENERAL

Section I

INTRODUCTION

1. PURPOSE.

a. The purpose of this Technical Manual is to impart information of a general and technical nature concerning artillery ammunition, including trench-mortar ammunition, and components thereof, such as may be necessary for their intelligent care, handling, and use. This is a companion volume to TM 9-1900, Ammunition, general.

2. SCOPE.

a. Ammunition for use in artillery weapons, including field, antiaircraft, aircraft, tank and antitank, and in trench mortars, is described. Coast artillery ammunition has not been described since it is covered in TM 4-205. This manual covers the general characteristics, specific data, means of identification, precautions in handling and use, and general information on packing and shipping. An additional chapter concerns destruction of ammunition in case of imminent capture by the enemy.

3. ARRANGEMENT OF TEXT.

a. Chapter 1 covers general ammunition terms, classification of artillery ammunition, means of identification, explosive charges and chemical fillers, packing and marking for shipment, storage precautions, care in handling and use, and a general discussion of projectiles.

b. Chapter 2 presents specific data for and description of the rounds and projectiles used in artillery weapons and trench mortars. Subcaliber ammunition is covered in this chapter.

c. Chapter 3 deals with the components, other than projectiles, of complete rounds: Fuzes, propelling charges, primers, boosters, bursters, and adapter-boosters. Section V covers the components of separate-loading projectiles used in shipping, namely, grommets and eyebolt-lifting plugs.

d. Chapter 4 describes the destruction of ammunition to avoid capture.

e. Tables of complete rounds for ammunition described in chapter 2 are published in chapter 5.

f. A list of references will be found in chapter 6.

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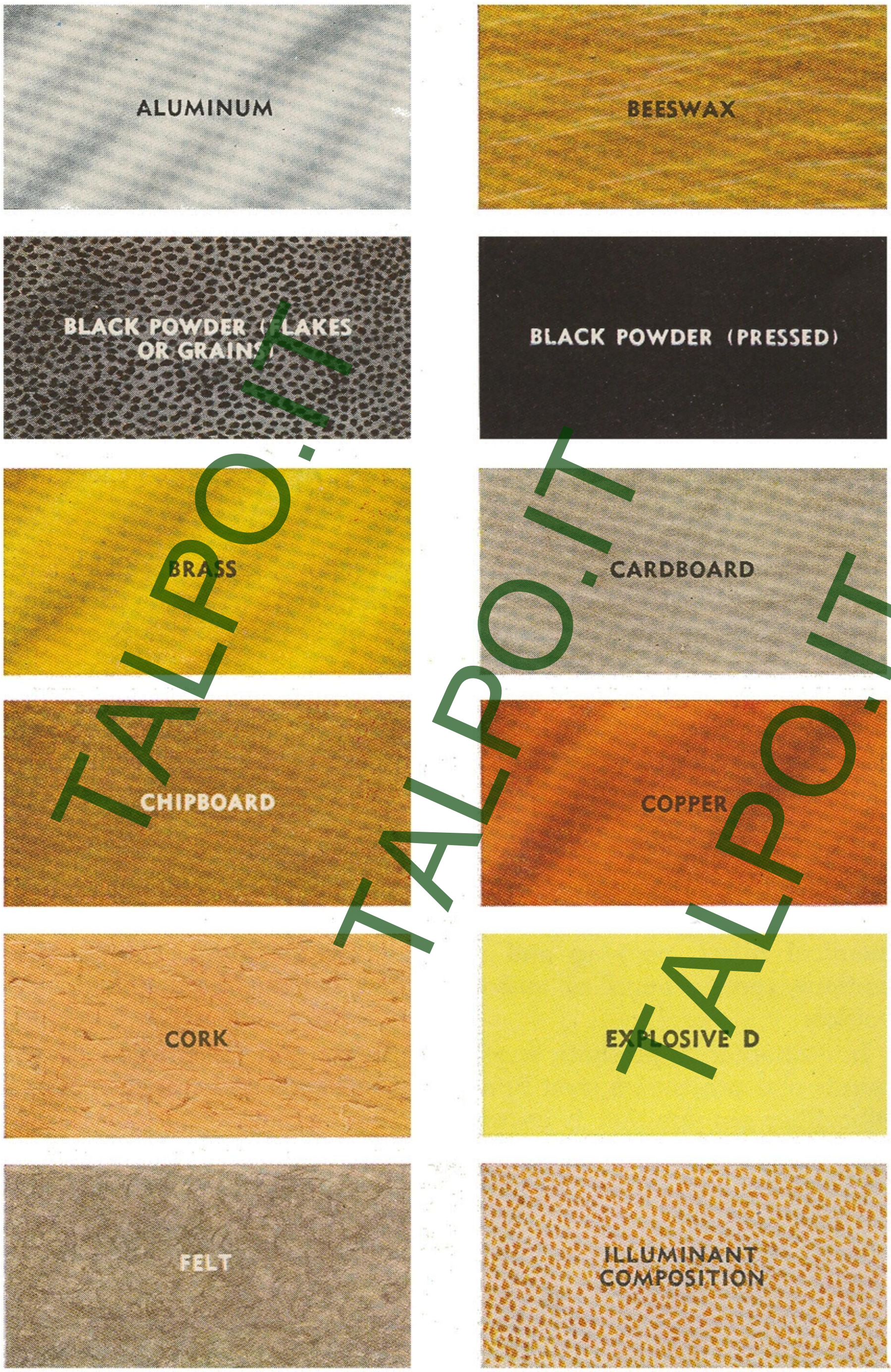
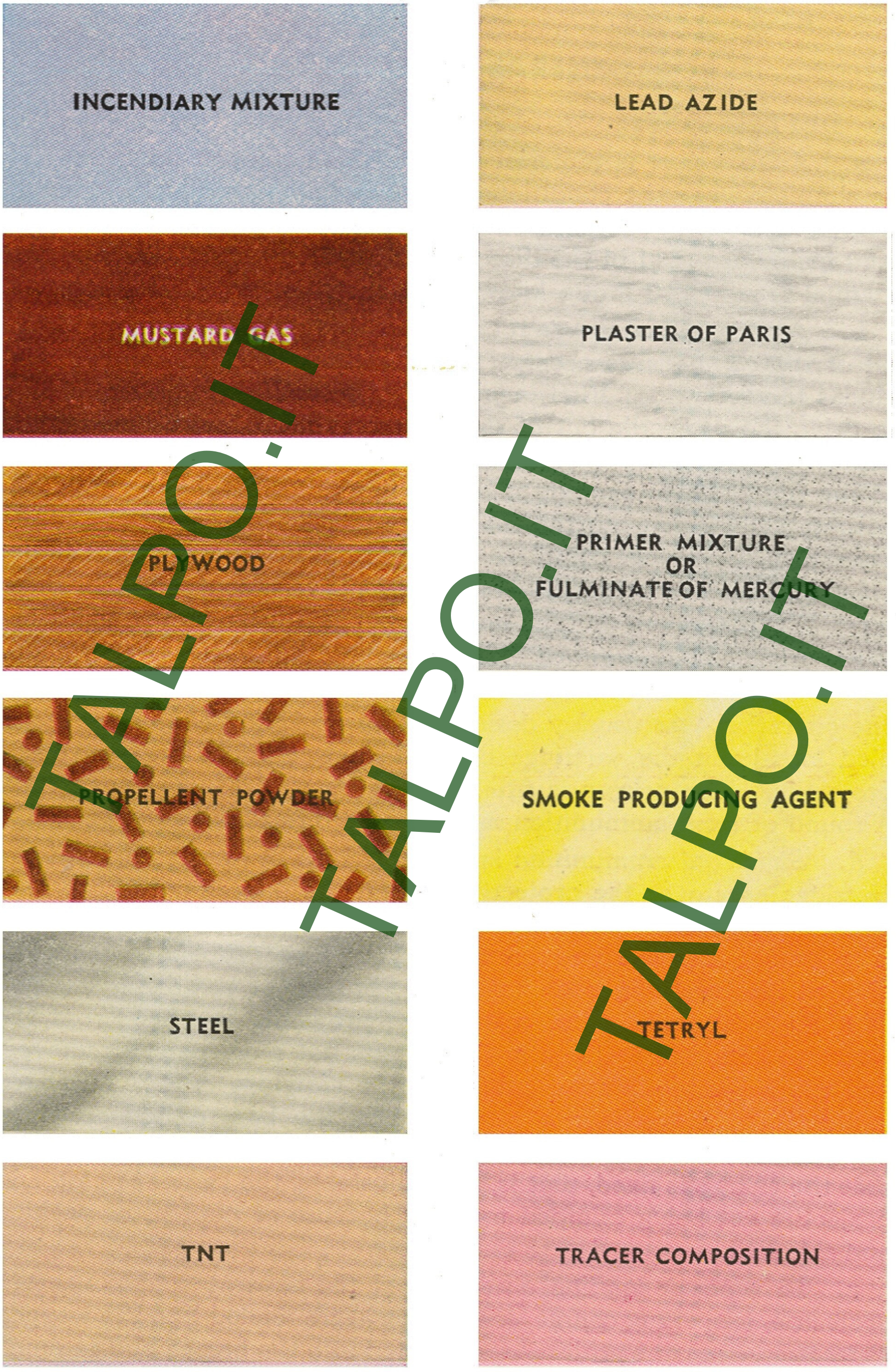


RA PD 15129

Explanatory Color Chart (for Sectioned Views)

GENERAL



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Explanatory Color Chart (for Sectioned Views) — Continued

ARTILLERY AMMUNITION

Section II

GENERAL DISCUSSION

4. DEFINITIONS.

a. *Ammunition* is materiel intended to be expended in combat or simulated combat conditions. *Artillery ammunition* includes all ammunition, except rockets, used in weapons of caliber greater than 0.60 inch. Included in the discussion of artillery ammunition in this manual is a special group known as trench-mortar ammunition.

b. A *round,* or *complete round,* of artillery ammunition comprises all of the components necessary to fire the weapon once. This includes the following: First, a *projectile;* second, a *propelling charge* to drive the projectile out of the weapon; third, a *primer* to initiate the burning of the propelling charge; and fourth, a *fuze* assembled to the projectile to explode it at the time and under the conditions desired. Dependent on the manner in which these components are assembled for firing, complete rounds of artillery ammunition are known as *fixed, semifixed,* and *separate-loading.* See figure 1 for these types of ammunition and for terms applied to their components.

c. In *fixed ammunition,* the propelling charge is fixed, that is, not adjustable, and the components are loaded into the weapon in one operation. As usually designed, the propelling charge is assembled loosely in the cartridge case which is crimped rigidly to the projectile. The primer is fitted in the base of the cartridge case. A round of fixed ammunition may also be termed a *cartridge.*

d. *Semifixed ammunition* is characterized by the loose fit of the cartridge case over the projectile so that the propelling charge may be accessible for adjustment for zone firing. Like fixed ammunition, it is loaded into the weapon as a unit. The propelling charge is divided into sections, each containing propellent powder assembled in a bag. To adjust the charge, the projectile is lifted from the cartridge case, the sections or increments not required are removed, and the projectile is reassembled to the cartridge case. As in fixed ammunition, the primer is assembled in the base of the cartridge case. The 105-mm howitzer H.E., A.T. round is a special type in that the charge is fixed, that is, not adjustable, the cartridge case and projectile not being crimped together because of method of packing and shipping.

e. In *separate-loading ammunition,* the separate components—projectile, propelling charge, and primer—are loaded into the weapon separately. First, the projectile is inserted into the breech and rammed home so that the rotating band seats in the forcing cone; second, the propelling charge in one or more cylindrical cloth bags is placed in the powder chamber immediately to the rear of the projectile;

GENERAL

A—FUZE
B—BOOSTER
C—FUZE WELL LINER
D—SHELL
E—OGIVE
F—BOURRELET
G—BURSTING CHARGE
H—ROTATING BAND
I—CRIMP
J—BASE COVER
K—CARTRIDGE CASE
L—PROPELLING CHARGE
M—PRIMER
N—LIFTING PLUG
O—GROMMET
P—COTTER PIN WITH PULL RING
Q—IGNITER

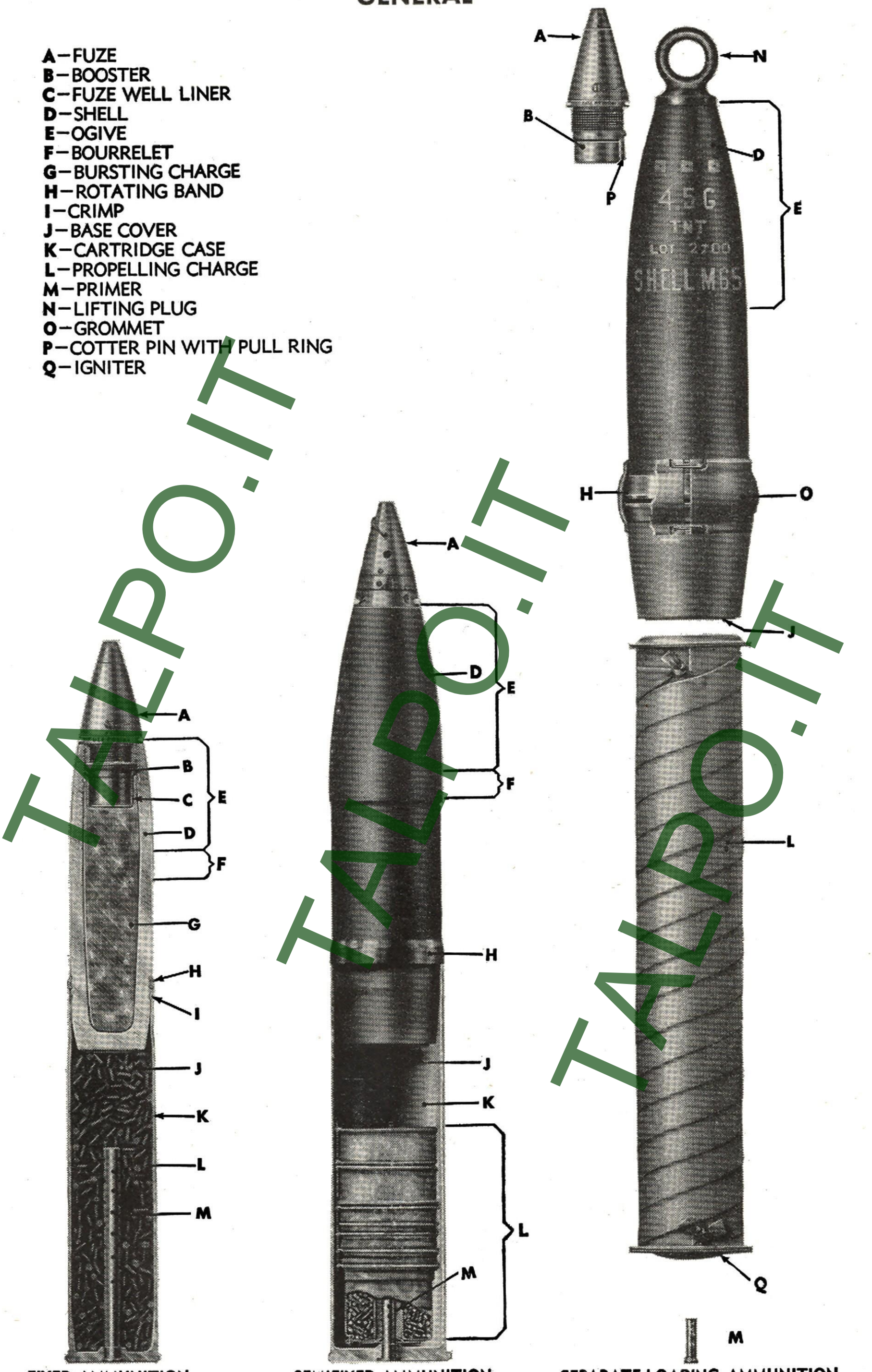


Figure 1 — Ammunition Terms — Complete Rounds

and, third, after the breechblock has been closed and locked behind the charge, the primer is inserted into the firing mechanism. In a special type of separate-loading ammunition, the propelling charge is contained in a cartridge case instead of in a cloth bag, but the projectile does not fit into the cartridge case and is loaded into the cannon separately. In the case of 120-mm (4.7-in.) ammunition the assembled cartridge case is used to ram the projectile into the weapon.

5. CLASSIFICATION.

a. General. Ammunition is classified according to use as service, practice, blank, or drill. It may also be classified according to type of filler as explosive, chemical, or inert.

b. Service Ammunition. Service ammunition is fired for effect in combat. Dependent upon type of projectile, it may be high-explosive, high-explosive-antitank, armor-piercing or armor-piercing-capped (with or without explosive filler), low-explosive (shrapnel), chemical (gas or smoke), illuminating, or inert (canister). See paragraph 14 for descriptions of these types of projectiles and figures 2 to 5, inclusive.

c. Practice Ammunition. Practice ammunition is fired for effect in simulated combat and is provided for training in marksmanship. The projectile in this type of ammunition may have a small quantity of low-explosive filler to serve as a spotting charge, or the filler may be inert.

d. Blank Ammunition. Blank ammunition is provided in small and medium calibers for such purposes as saluting and simulated fire. It has no projectile.

e. Drill Ammunition. Drill or dummy ammunition is used for training in handling and loading ("service of the piece"), and similar purposes. It is completely inert.

6. NOMENCLATURE.

a. Standard nomenclature is established in order that each item supplied may be specifically identified by name. It consists of the type, size, and model of each item, and its use for all purposes of record is mandatory. This nomenclature is published in the ORD 11 Standard Nomenclature Lists (SNL's) of groups P, R, S, and T, and their exact use will keep to a minimum any errors which may result in the shipping, storing, issue, and use of ammunition items.

7. AMMUNITION IDENTIFICATION CODE SYMBOLS.

a. The Ammunition Identification Code (A.I.C.) symbol has been established 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 in ORD 11 SNL's of groups P, R, S, and T.

GENERAL

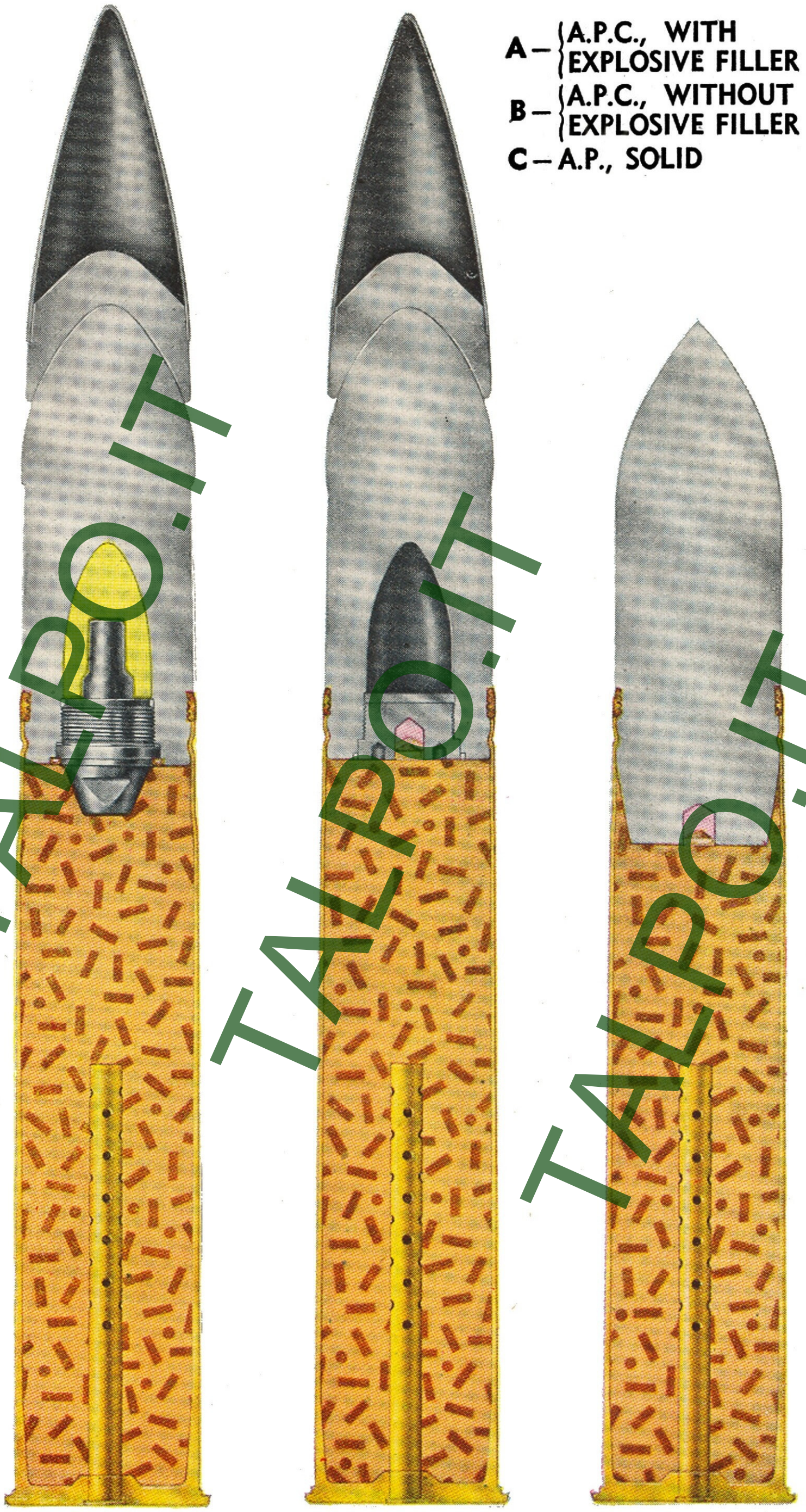
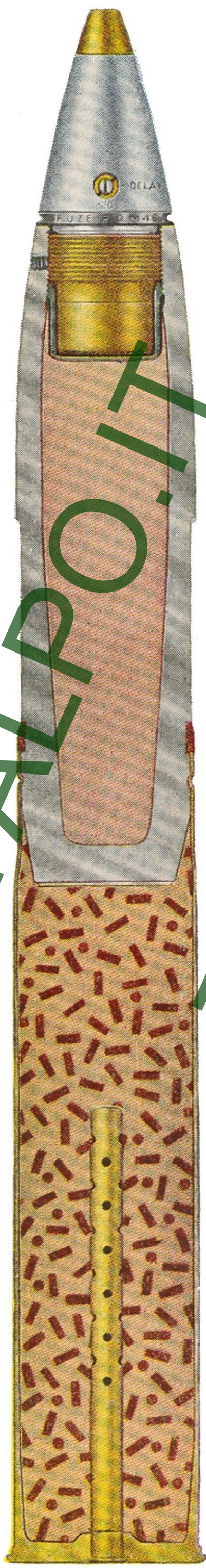
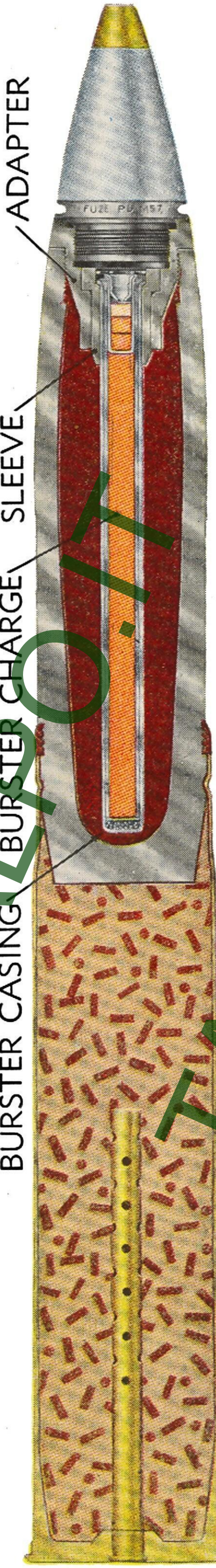


Figure 2 — Typical Armor-piercing and Armor-piercing-capped Complete Rounds

ARTILLERY AMMUNITION



A-75-MM FIXED HIGH EXPLOSIVE COMPLETE ROUND



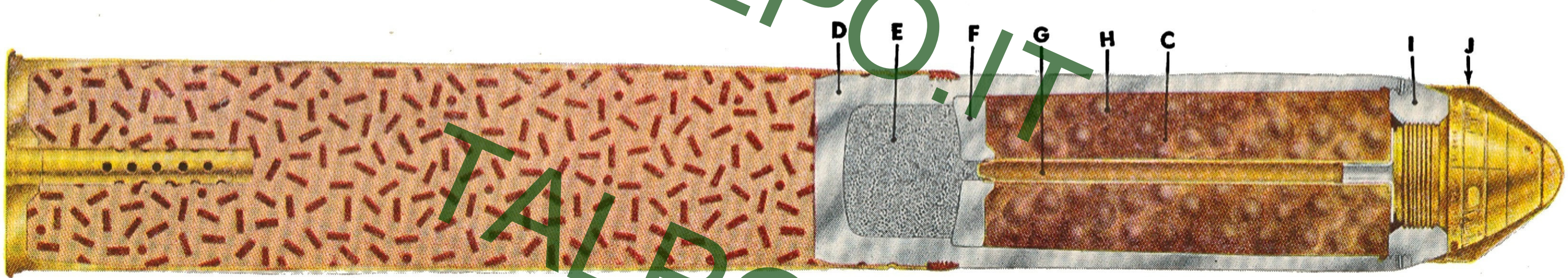
B-75-MM FIXED CHEMICAL COMPLETE ROUND

RA PD 80674

Figure 3 — Typical High-explosive and Chemical Complete Rounds

37-MM GUN CANISTER ROUND

A – STEEL CYLINDERS
B – STEEL BALLS
C – RESIN MATRIX
D – STEEL SHELL
E – BASE CHARGE *(EXPELLING CHARGE)* OF BLACK POWDER
F – STEEL DIAPHRAGM
G – FLASH TUBE
H – LEAD BALLS
I – ADAPTER
J – FUZE COVER *(WATERPROOF)*



75-MM GUN SHRAPNEL ROUND

RA PD 80675

Figure 4 — Typical Complete Rounds of Canister and Shrapnel

ARTILLERY AMMUNITION

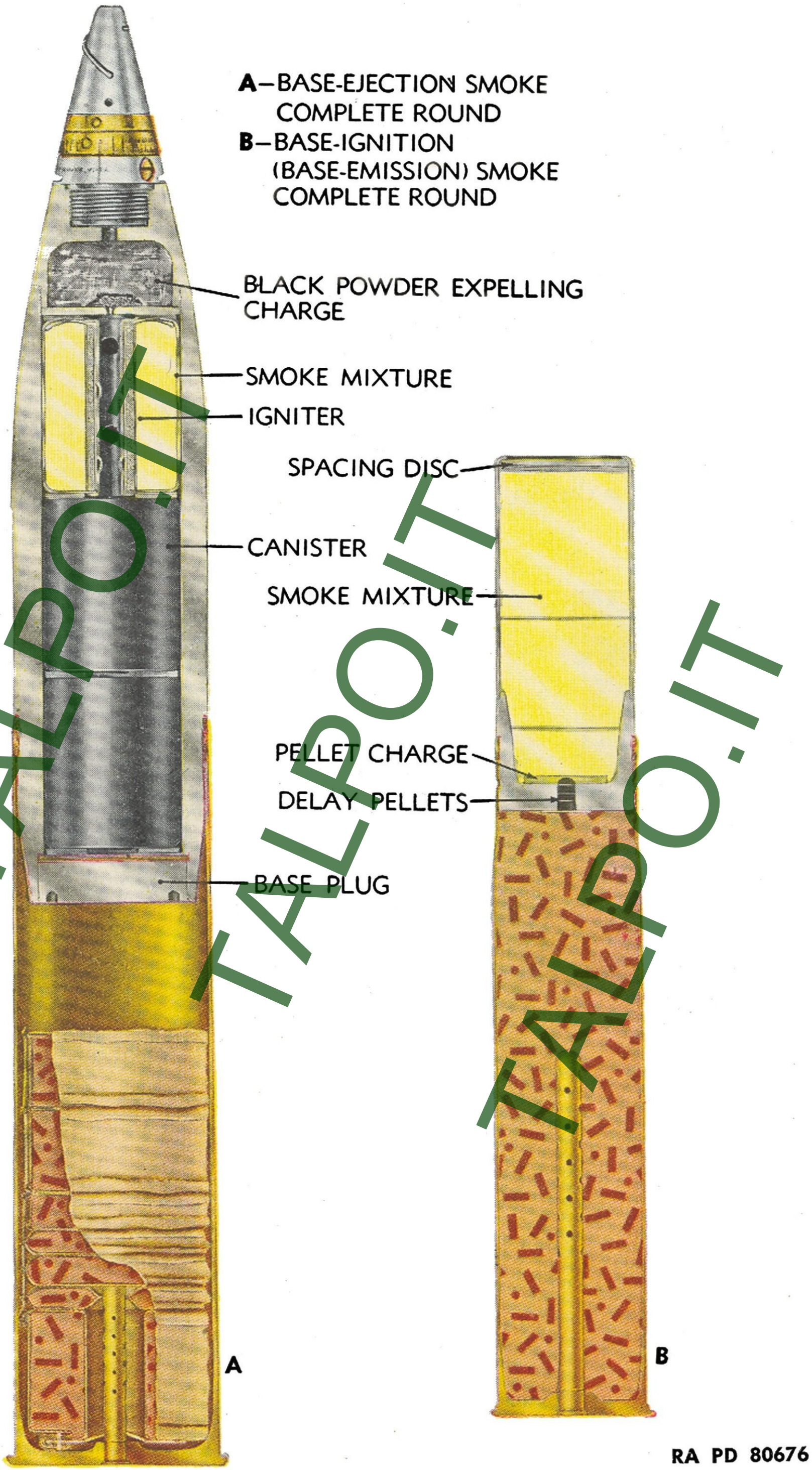


Figure 5 — Typical Base-ignition and Base-ejection Smoke Complete Rounds

GENERAL

8. GRADES OF AIRCRAFT AMMUNITION.

a. A system of grading has been established for aircraft artillery ammunition. The purpose of grading is to provide for higher performance by aircraft ammunition than is required of ammunition acceptable for use in ground guns. These grades are applicable to ammunition for use in 20-mm guns M1, AN-M2, M3, and Br. H.S./A/; 37-mm guns AN-M9, AN-M4, and M10; and 75-mm guns M4, AN-M5, M5A1, and T13E1. The grades are as follows:

Grade AIR—for use in any situation.
Grade NA—for use in any situation except air combat (primarily for training).

b. Steel case rounds or resized case rounds will not be used in aircraft weapons.

9. EXPLOSIVES IN AMMUNITION.

a. General. The characteristics of various types of explosives are given in TM 4-205, Coast artillery ammunition; TM 9-1900, Ammunition, general; and TM 9-2900, Military explosives.

b. Classification. For military purposes, explosives are divided into two basic groups: Propellants (or low explosives) and high explosives. One of the chief differences between these two groups is in the nature of the characteristic reactions. The propellant is considered to react by burning, the rate of which depends upon such factors as pressure, grain form, composition, etc. The high explosive, on the other hand, is used for its detonating properties which are visualized as resulting from an explosion wave traveling through the high-explosive charge at an extremely high velocity (22,000 to 27,500 ft/sec). The velocity of detonation of a particular high explosive is directly proportional to its density.

c. Propellants. Propellants are used to propel the projectile out of the weapon at a prescribed velocity. Those currently used have a nitrocellulose base and are commonly known as smokeless powders. These powders are distinguished by such terms as straight nitrocellulose (NC), or pyro powder; double-base powder containing nitroglycerin (NG) and nitrocellulose. They may be flashless-nonhygroscopic (FNH); or simply nonhygroscopic (NH), depending upon their flash properties in a particular weapon. Black powder (or gunpowder) has been almost completely superseded as a propellant by smokeless powder. The usual form of smokeless powder in artillery ammunition is a cylindrical grain with one or more perforations (ch. 3, sec. II).

d. High Explosives. High explosives, because of their extremely rapid rate of detonation, have a powerful disruptive action. This action, or shattering power, is known as "brisance" and varies for different explosives. The high explosives more sensitive to impact

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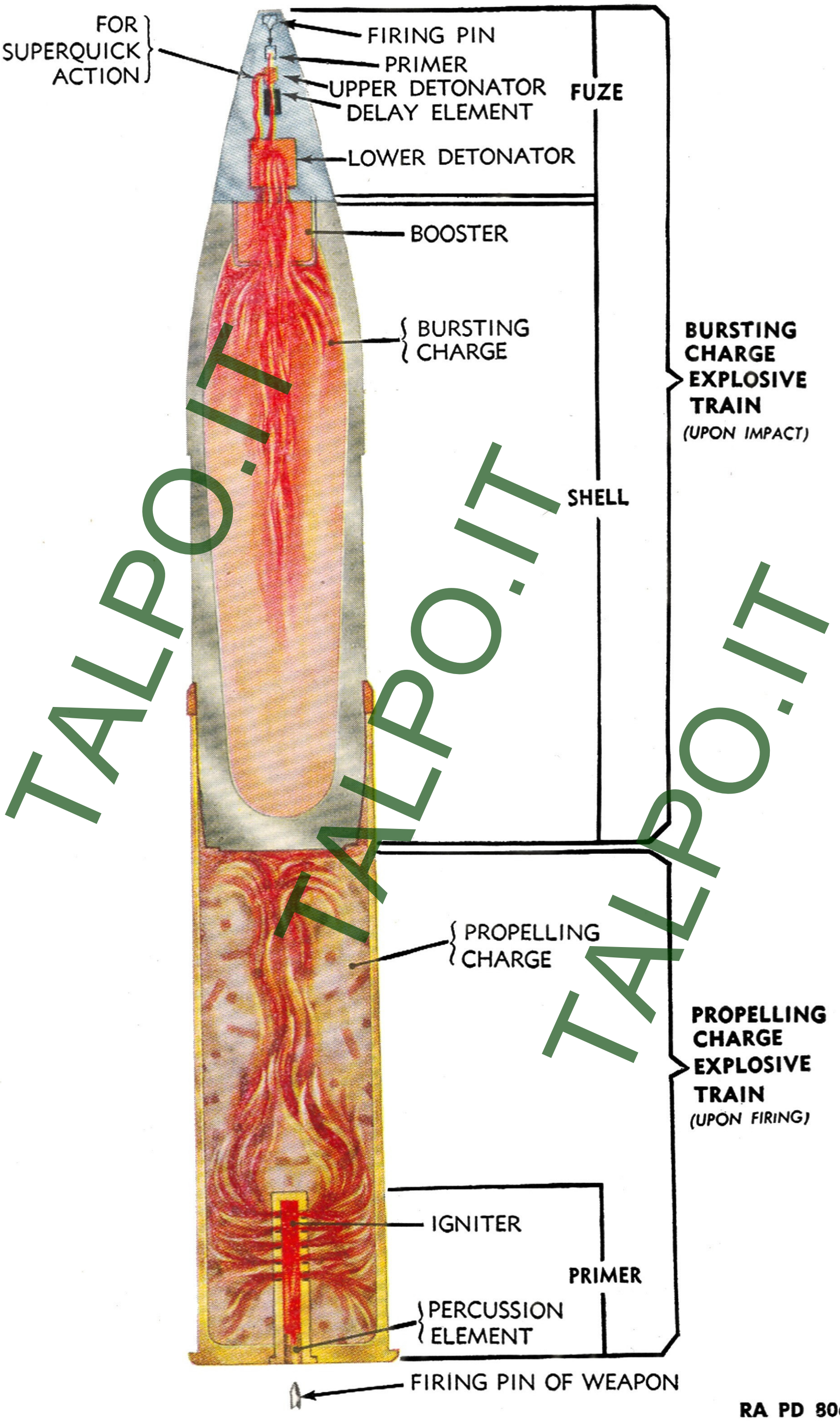

Figure 6 — Explosive Trains — Artillery Ammunition

are used as initiators in primers or detonators, whereas the high explosives less sensitive to impact are used as bursting charges in shell. TNT and Composition B are the standard bursting charges in the United States, and amatol is the substitute explosive. Tetryl has more brisance than TNT but is also more sensitive; hence, it is used only as a bursting charge for small propectiles, of 20-mm, 37-mm, and 40-mm caliber, and as a booster in other calibers to initiate the detonation of TNT or explosive D. Explosive D is the high explosive least sensitive to impact and therefore is used as the bursting charge in armor-piercing projectiles where severe impact is expected. For details and descriptions of explosives, see TM 9-1900 and TM 9-2900.

e. Explosive Train. The arrangement of a series of explosives beginning with a small amount of sensitive explosive, and ending with a large amount of comparatively insensitive explosive, is termed an explosive train. In general, there are two such trains: The propelling charge explosive train and the bursting charge explosive train. These two trains are illustrated in figure 6 for a complete round of fixed artillery ammunition.

10. CHEMICAL FILLERS.

a. Some shell contain a chemical agent. A chemical agent is a substance which, by its ordinary and direct chemical action and in concentrations attainable in the field, produces a toxic or an irritating (harassing) physiological effect, a screening smoke, an incendiary action, or any combination of these. The most common gas used as a chemical filler is mustard gas, denoted by the Chemical Warfare Service symbol "H." This is a *persistent* gas; that is, it remains effective at the point of release for more than 10 minutes. The most commonly used smoke filler is white phosphorus (WP) which, in addition to producing a dense white smoke, also has an incendiary action. Phosphorus is a solid which melts at 110° F. A substitute for phosphorus is FS smoke. This is a sulfur trioxide-chlorsulfonic acid mixture; no mask is required for the FS smoke, the smoke being harmless except in very heavy concentrations. In base-ejection and base-ignition smoke shell, HC smoke is used. This is a hexachlorethane-zinc mixture for which no protection of personnel or materiel is required. Further information on chemical filler will be found in TM 9-1900, TM 3-315, and the Ordnance Safety Manual, O.O. Form No. 7224.

11. IDENTIFICATION.

a. General. Ammunition is completely identified, except as to grade, by painting and marking (which includes the ammunition lot number) on original packing containers. Once removed from its packing, ammunition may be identified by painting and marking on

the ammunition items. Other essential information may also be obtained from the marking on ammunition items. The muzzle velocity of projectiles may be obtained from the firing tables and ammunition data cards; in case of some rounds of smaller caliber, the muzzle velocity also appears on the packing box.

b. 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. Prior to the World War, the year in which the design was adopted, preceded by an M, was used as the model designation, for example M1914. 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 modification was indicated by the addition of MI to the mark number, the second by MII, etc. 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.

c. 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 stamped 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, all complete rounds of any particular ammunition lot are made up of components selected from the same lot. To obtain the greatest accuracy in any firing, successive rounds should be from the same ammunition lot whenever practicable.

d. Painting and Marking.

(1) PAINTING. Ammunition is painted primarily to prevent rust. Secondary purposes are to provide, by the color, a ready means of identification, and, by the use of lusterless paint, for camouflage. The color scheme is as follows:[1]

1—An exception to the basic color scheme is the case of 20-mm projectiles. The high-explosive-incendiary projectile has a yellow body and red ogive.

GENERAL

High-explosive	Olive-drab; marking in yellow
Armor-piercing containing high-explosive	Olive-drab; marking in yellow
Armor-piercing without explosive	Black; marking in white
Low-explosive	Red; marking in black
Chemical	Gray; one green band indicates nonpersistent toxic gas; two green bands indicate persistent toxic gas; two red bands indicate persistent harassing agent; and one yellow band indicates smoke. Marking on the ammunition is in the same color as the band.
Practice	Blue; marking in white[2]
Dummy or drill (inert)	Black; marking in white[3]

(2) MARKING. The components of artillery rounds are marked as follows:

(a) Projectiles (figs. 7, 8, and 9):[4 5]

1. Stenciled on the body:

Ammunition Identification Code (A.I.C.) symbol on separate-loading shell.

Caliber and type of cannon in which fired ("75 H", etc.)[6]

Kind of filler ("TNT," "WP SMOKE," "H GAS," etc.)

Type and model of projectile ("SHELL M60," "PROJ. A.P.C. M61," etc.)

The word "TRACER" when projectile contains a tracer.

Lot number of loaded projectile. For fixed and semifixed rounds, the lot number is stenciled below the rotating band, in which position it is covered by the neck of the cartridge case.[7]

Ammunition lot number, in the case of 20-mm, 37-mm, and 40-mm projectiles only.

Weight zone (crosses or squares) or weight to nearest pound of loaded projectile. Exceptions are armor-piercing projectiles which are components of fixed rounds and base-ignition and base-ejection smoke shell.

2—There are on hand some target-practice projectiles of larger caliber which have been painted black. It is contemplated that when replacement or repainting is required, they will be painted blue in agreement with the basic color scheme.

3—Nonferrous metal parts or assemblies (such as of brass or bronze) are not painted.

4—In addition to the identification listed, chemical shell also are marked with color bands indicating the type of filler; subparagraph d (1), above.

5—Navy projectiles are marked in accordance with Navy practice.

6—Shrapnel for 155-mm gun or howitzer may be found marked either "155-mm G" or "155-mm H." These items are identical with shrapnel properly marked "155-mm GH."

7—In older types and lots, the lot number of loaded projectile may not be below the rotating band.

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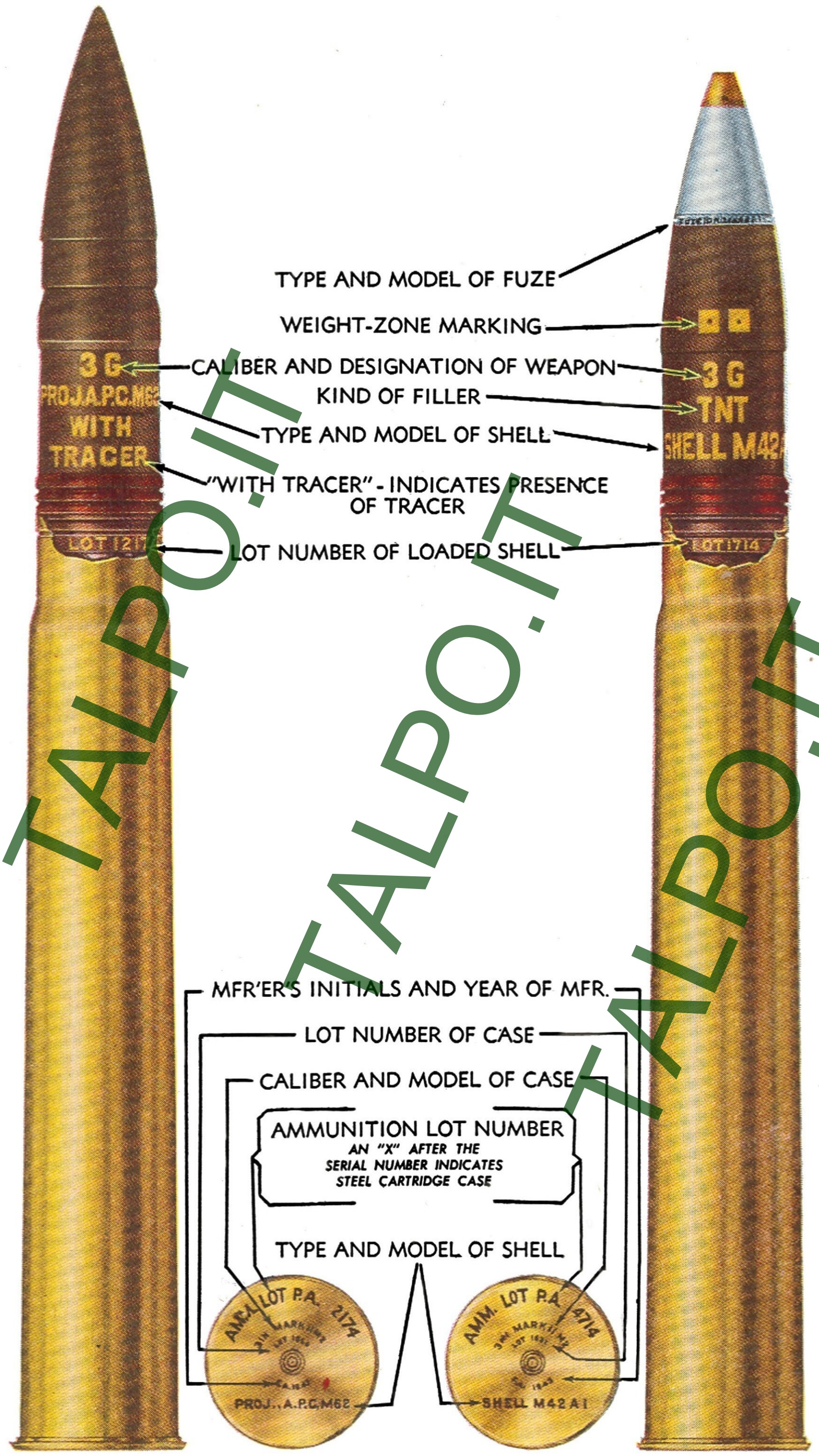

RA PD 80678

Figure 7 — Typical Marking of Fixed Ammunition

GENERAL

A — WEIGHT ZONE MARKING
B — WEIGHT TO NEAREST LB.
C — CALIBER AND TYPE OF WEAPON
D — KIND OF FILLER
E — LOT NUMBER OF LOADED SHELL
F — TYPE AND MODEL OF SHELL

RA PD 80680

Figure 8 — Typical Marking of Separate-loading High-explosive and Armor-piercing Projectiles (Early Type Grommet Fastening Shown)

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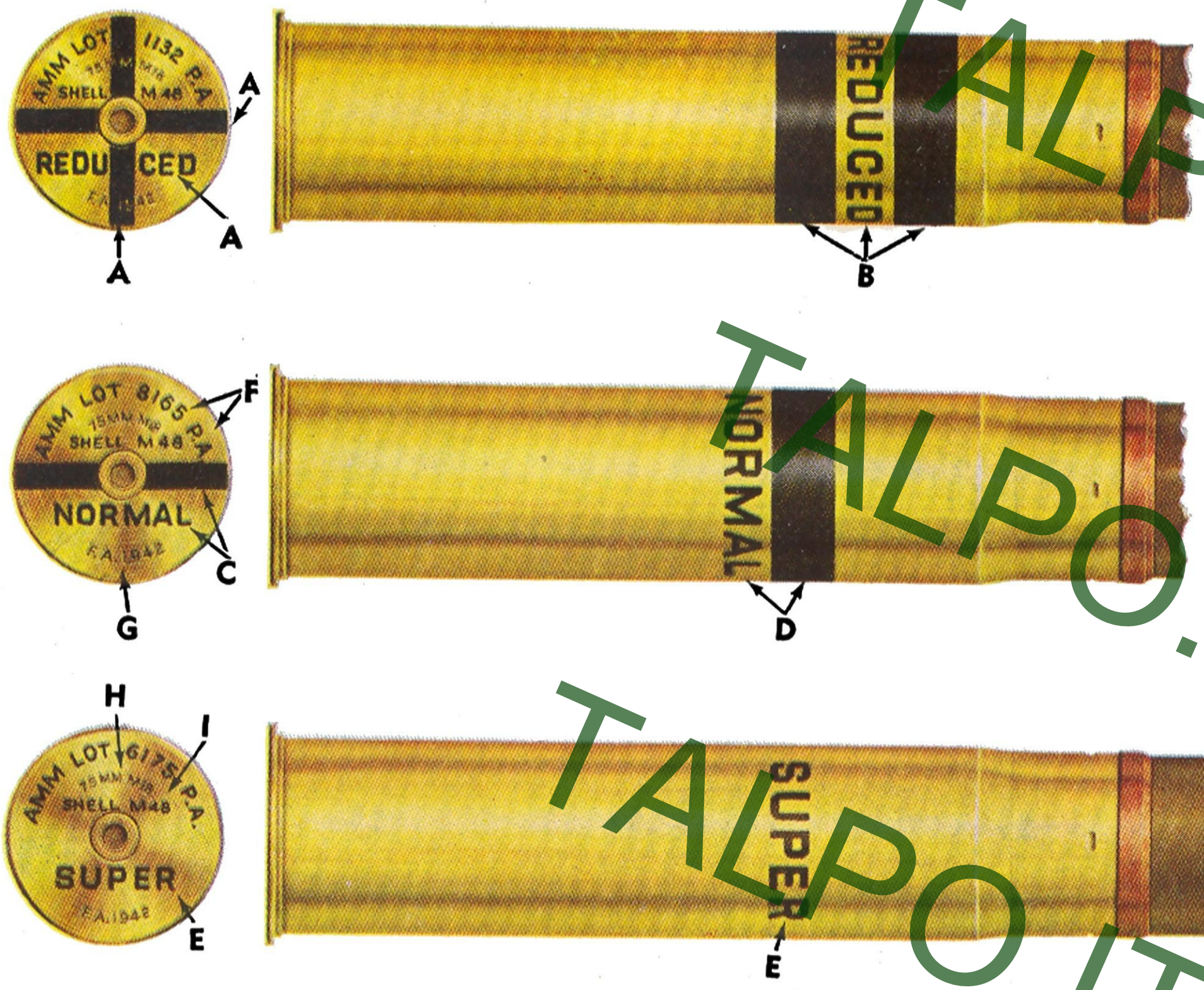
RA PD 80681

Figure 9 — Typical Marking of Separate-loading Chemical Projectiles (Early Type Grommet Fastening Shown)



A – 2 DIAMETRAL STRIPES AT RIGHT ANGLES AND "REDUCED" INDICATE REDUCED CHARGE

B – 2 BANDS AND "REDUCED" INDICATE REDUCED CHARGE

C – 1 DIAMETRAL STRIPE AND "NORMAL" INDICATE NORMAL CHARGE

D – 1 BAND AND "NORMAL" INDICATE NORMAL CHARGE

E – "SUPER" INDICATES SUPERCHARGE

F – AMMUNITION LOT NUMBER AND LOADER'S INITIALS

G – MANUFACTURER'S INITIALS AND YEAR OF MANUFACTURE

H – CALIBER AND MODEL OF CARTRIDGE CASE

I – MODEL OF SHELL

J – WEIGHT-ZONE MARKING

K – KIND OF FILLER

L – CALIBER AND TYPE OF CANNON

RA PD 80679

Figure 10 — Marking of 75-mm Complete Rounds Indicating Reduced, Normal, and Super Charges

2. Stamped on or forward of the rotating band:

Lot number of empty shell.
Manufacturer's initials or symbol.
Caliber and model of shell.
Year of manufacture.

(b) Cartridge Case (figs. 7 and 10):

1. Stenciled on the base:

Ammunition lot number and loader's initials. For 37-mm and 40-mm rounds, this ammunition lot number appears on the projectile instead of the base of the cartridge case.
Type and model of shell.
For 75-mm gun rounds: "NORMAL" below one diametral stripe, indicating normal propelling charge; "REDUCED" and two diametral stripes at right angles, indicating reduced charge; "SUPER" indicating supercharge.

2. Stenciled on the side of the cartridge case:

For 75-mm gun rounds: "NORMAL" below one stripe, indicating normal propelling charge; "REDUCED" between two stripes indicating reduced charge; "SUPER" indicating supercharge.
For 37-mm gun, M9, APC M59, round: "37 G, M9, MV 2,800" to distinguish this from the similar round for the M1A2 gun.
For 75-mm aircraft gun rounds: "FOR 75-MM AIRCRAFT GUNS."

3. Stamped on the base:

Caliber and model of cartridge case. "B1" after the model designation indicates a steel case.
Lot number of cartridge case. An "X" appearing after the lot number indicates a steel case.
Manufacturer's initials and year of manufacture.

(c) Propelling Charges (ch. 3, sec. II):[1]

1. Stenciled on each charge or section thereof:

Designation of section, for example, "1/16 CHG.," "BASE," "INCR." or "INCREMENT," "CHARGE 2," etc.
Model of charge, for example, "CHARGE M1A1."
Caliber and models of cannon for which adapted.
Weight of charge or section.
Weight or weights of projectiles with which charge may be used.
Powder lot (includes type of powder, the word "LOT," initials of manufacturer, serial number of lot, and year of manufacture).
Zone number of each section on the top end.

1—To distinguish green bag charges from white bag charges, the cartridge bag cloth for the green bag charges is dyed green; that for white bag charges is white. The cloth used for igniters is dyed a bright red; this is to show clearly the location of the igniter and to indicate the presence of black powder (low-explosive). Igniters of older manufacture will be found in service made from uncolored cloth. In this case, the stenciling and the quilting which holds the black powder in place will serve to locate the end of the propelling charge which contains the igniter.

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2. *Stenciled on igniter:*

Weight, grade, and kind of igniter powder.
"IGNITER."
Caliber and models of cannon in which fired.
Month and year of loading.

(d) Fuzes (Stamped on the Body):

Type and model of fuze.
Manufacturer's initials.
Lot number of fuze and year of manufacture.
Action of fuze, for example, "DELAY" and length of delay in seconds, "SQ" (superquick), or time in seconds on a graduated time ring.

(e) Primers (Stamped on the Base):

Loader's initials, lot number, and year of loading.
Model designation.

(3) WEIGHT OR WEIGHT-ZONE MARKINGS.

(a) In the manufacture of shell containing explosives or chemical agents, variations in weight occur. Ballistic corrections are provided in firing tables for these variations in weight. For most separate-loading projectiles of medium and large caliber, the weight to the nearest pound is stenciled on each projectile. For fixed and semi-fixed shell and for certain medium caliber separate-loading projectiles, shell of one lot number falling within a certain range of weights are considered to be in a *weight zone.* The weight zone of the projectile is indicated by crosses on 75-mm projectiles, and by squares with a prick punch in the center of each on projectiles of 76-mm caliber and over, in the same color as the original markings. One, two, three, or more are used, depending on the weight of the projectile. Weight zones lighter than that of one cross are indicated by one "L" or more, as required. The following crosses or squares indicate "standard" or "normal" weight, that is, the range of weights for which no corrections in range tables are required.

Caliber of Projectile	"Standard" or "Normal" Weight Zone
75-mm	2 crosses
3-in., 76-mm	1 square
90-mm, 105-mm, 4.5-in., 6-in	2 squares
120-mm (4.7-in.), 155-mm, 8-in. how., 240-mm how.	4 squares
8-in. gun, 10-in. and above	None (weight to nearest pound used)

(b) Small-caliber projectiles; trench-mortar rounds; canister, high-explosive-antitank, armor-piercing, base-ejection smoke, and base-ignition smoke projectiles do not require weight-zone markings. Armor-piercing projectiles, 6" caliber and above, have weights to the nearest pound.

12. CARE, HANDLING, AND PRESERVATION.

a. Ammunition is packed to withstand conditions ordinarily encountered in the field, moisture-resistant containers and suitable packing boxes or crates being used to provide the desired protection for shipment and storage. Care must be observed to keep packing boxes from becoming broken or damaged. All broken boxes must be repaired immediately and careful attention given to the transfer of all markings to the new parts of the box. When the packing box contains a metal liner, the liner should be air-tested and sealed provided equipment for this work is available. This air-testing is also applicable to cartridge-storage cases for propelling charges.

b. Since explosives are adversely affected by moisture and high temperature, due consideration should be given to the following:

(1) Do not break the moisture-resistant seal until ammunition is to be used. Ammunition removed from the airtight container, particularly in damp climates, is apt to corrode, thereby causing the ammunition to become unserviceable.

(2) Protect the ammunition, particularly fuzes, from sources of high temperatures, including the direct rays of the sun. More uniform firing is obtained if the rounds are at the same temperature.

c. Ammunition and ammunition components should be protected from mud, sand, dirt, and water. Wet or dirty ammunition should be wiped off at once, and any verdigris or light corrosion removed. Ammunition should not be polished, however, to make it look better or brighter.

d. Explosive ammunition, or components containing explosives, *must* be handled with appropriate care at all times. The explosive elements in primers and fuzes are particularly sensitive to shock and high temperature. The adoption of high explosives such as composition B, pentolite, and tetrytol makes it even more necessary to follow the precautions prescribed for handling ammunition as stated in TM 9-1900.

e. Ammunition, or components of ammunition, prepared for firing but not fired will be returned to their original condition and packings, and appropriately marked. Such ammunition will be used first in subsequent firings in order that stocks of opened packings may be kept at a minimum.

f. Do not attempt to disassemble any fuze. Any alteration of loaded ammunition except by the technical service concerned and under the supervision of a commissioned officer of that service is hazardous and is therefore prohibited (AR 750-10, par. 2 e, 22 Jan 44).

g. Do not remove protection or safety devices from fuzes until just before use.

GENERAL

h. Cartridge cases are easily dented and should be protected from hard knocks and blows. A dented cartridge case may result in loss of obturation, jamming in the chamber, and difficulties in extraction.

i. Do not remove the eyebolt-lifting plug from unfuzed projectiles until the fuze is to be assembled thereto. The plug is provided to keep the fuze opening free of foreign matter as well as for convenience in handling. When separate-loading projectiles are stored in the field, frequent inspection of the plugs must be made for evidence of corrosion. At the first sign of corrosion, the threads must be coated with a thin film of light, rust-preventive compound, to prevent the plug from sticking or "freezing" in the projectile.

CAUTION: *This lubrication should be done sparingly.*

j. Blank ammunition with loose or broken closing cup will not be used or fired but will be reported to the Ordnance officer for disposition.

k. Do not handle duds. Because their fuzes are armed, and hence extremely dangerous, duds will not be moved or turned, but will be destroyed in place in accordance with TM 9-1900.

l. Precautions in handling, including procedures to be taken in case of misfires, will be found in TM 9-1900 and in the various Technical Manuals and Field Manuals on the weapon.

13. STORAGE PRECAUTIONS.

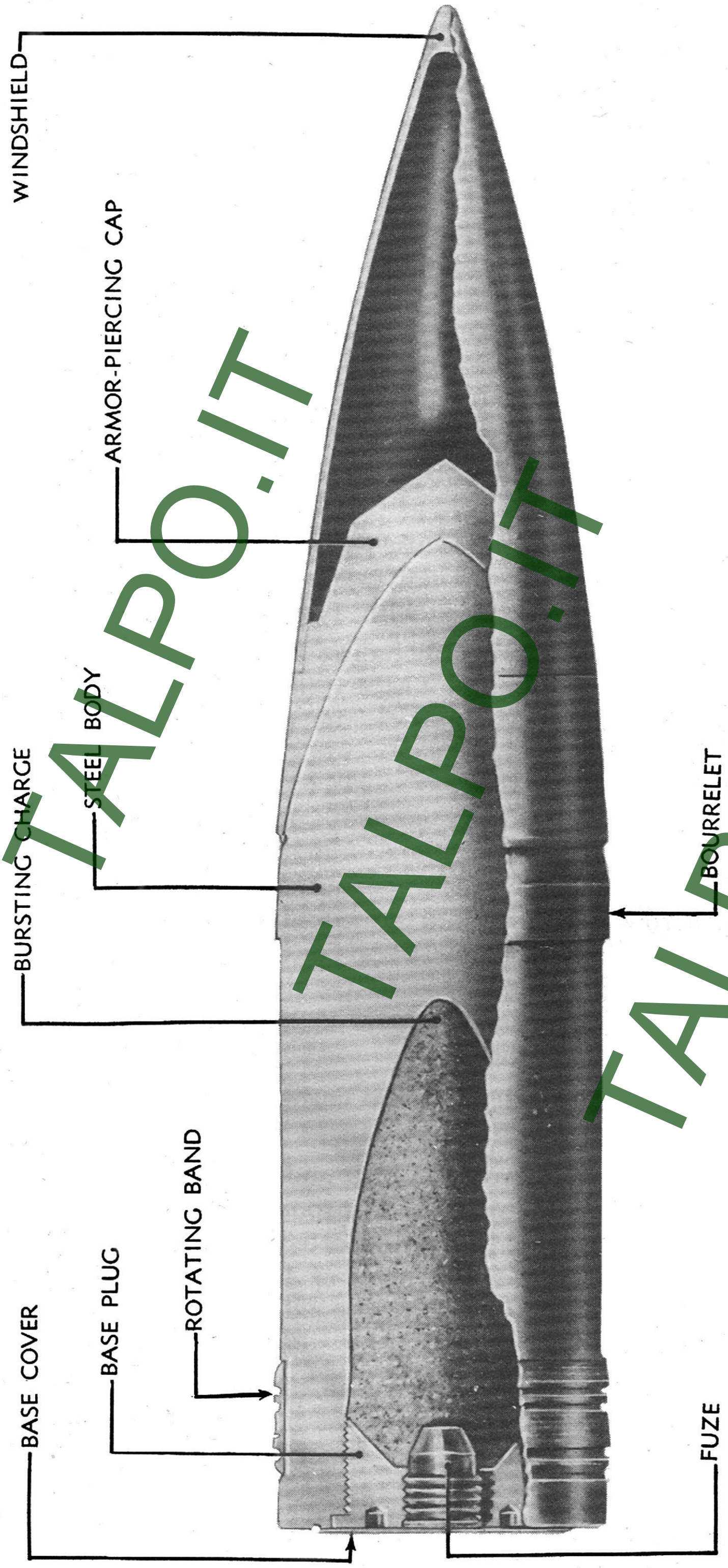
a. When necessary to leave ammunition in the open, raise it on dunnage at least 6 inches from the ground and cover it with a double thickness of tarpaulin. Wherever possible, dunnage should be used between each row to permit full air circulation. Suitable trenches should be dug to prevent water from flowing under the pile. Tarpaulin should be arranged so as to permit free circulation of air through the pile. The tarpaulin should be kept at least 6 inches from the pile on top, ends, and sides.

b. Detonating fuzes will be stored and transported separate from other explosive ammunition.

c. Shell containing phosphorus, or rounds having phosphorus-filled shell, should preferably be stored or transported on their base. Should such ammunition be stored or transported on their sides and the temperature reaches the neighborhood of 110° F, the melting point of phosphorus, this filler may flow to one side of the shell and thereby cause erratic ballistics.

d. Fires involving fuzed ammunition can generally be fought for approximately the first 10 minutes of the fire. This may allow sufficient time in which to bring the fire under control.

e. For further storage precautions, see TM 9-1900, TM 4-205, and the Ordnance Safety Manual, O.O. Form No. 7224.



RA PD 4034A

Figure 11 — Typical Armor-piercing Projectile Showing Parts

GENERAL

14. DISCUSSION OF PROJECTILES.

a. General. An artillery projectile may be either solid or hollow. When hollow, the projectile may be empty or it may be partly or completely filled with explosive, and have a fuze for the purpose of detonating the explosive. Service types of projectiles are mentioned in paragraph 5 **b**. These types are described more fully in this paragraph. With the exception of canister, base-ignition smoke shell, and proof projectiles, artillery projectiles, although differing in characteristic details, are of the same general shape, in that they have a cylindrical body and an ogival head. The projectiles vary in length from 2 to 6 calibers. Their principal characteristic differences are in:

(1) Location of fuzes—point or base.

(2) Radius of ogive—smaller for low-velocity, larger for high-velocity projectiles.

(3) Rotating band—narrow for low-velocity, wide for high-velocity projectiles.

(4) Base—tapering ("boat-tailed") or cylindrical ("square" base).

(5) Armor-piercing-cap—only for certain armor-piercing projectiles.

(6) Windshield, ballistic cap, or false ogive—when required for improved ballistics.

b. Components of Projectiles. A typical projectile with principal parts named is shown in figure 11. These parts are described briefly below. Additional information will be found in TM 9-1900.

(1) LOCATION OF FUZES. High-explosive shell generally require point-detonating fuzes or time fuzes located in the nose of the shell. The high-explosive shell shipped unfuzed are fitted with eyebolt-lifting plugs (ch. 3, sec. V) to protect the fuze hole threads and to provide for ease in handling. Armor-piercing shell require base-detonating fuzes with either delay or nondelay action.

(2) OGIVE. The curved portion of the projectile from the point to the bourrelet, is called the ogive. Since armor-piercing projectiles have a short radius of ogive for purposes of penetration, a ballistic cap, often called a false ogive or windshield, is placed over the armor-piercing head to increase the ability to overcome air resistance.

(3) BOURRELET. The bourrelet is the accurately machined surface, of slightly larger diameter than the body, which bears on the lands of the bore. It centers the projectile in the bore and guides it in its travel through the bore. Generally, it is at the forward end of the body, but in the case of the 4.5-inch projectile it extends from the ogive to the boat-tailed base. In addition, some projectiles of large caliber have a front and rear bourrelet.

(4) BODY. While 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.

(5) BURSTING CHARGE. The high explosives fill the entire cavity in the shell except for space into which the booster or the fuze fits. In the case of chemical shell the bursting charge of tetryl is contained in a narrow cylindrical burster tube fitted in the center of the shell. This burster for chemical shell ruptures the shell sufficiently to allow the chemical filler to escape without excess dispersion. The percentage of explosive in shell varies with the type of shell and the following figures are generally applicable:

Type of Shell	Percent by Weight of High Explosive (Approx)
H.E. shell, gun or howitzer	7.5—18
H.E. shell, mortar:	
Light	12—18
Heavy	30—40
A.P. shell	0.9—1.4
Chemical shell	0.34—0.55

(6) ROTATING BAND. The rotating band is a cylindrical ring of copper or gilding metal pressed into a knurled or roughened groove near the base of the projectile. It affords a snug seat for the projectile in the forcing cone and centers the base in the bore. As the projectile moves forward, the soft rotating band is engraved by the lands of the bore. Because of compression of the band, excess metal flows toward the rear. This flow of metal is taken up by cannelures, or grooves, cut in the rotating band. Since the rifling of the weapon has a helical twist, rotation is imparted to the moving projectile by the engraved rotating band. In addition, the rotating band prevents the escape of the propellent gases forward of the projectile by completely filling the grooves of the rifling.

(7) TYPE OF BASE. When the surface to the rear of the rotating band is cylindrical, the projectile is said to have a "square" base; when tapered or conical, it is known as "boat-tailed." From a velocity of 2,500 feet per second to velocities below that of sound, the boat-tail decreases the retardation due to air resistance, by reducing the vacuum-forming eddy currents of air in the wake of the projectile, increasing the range. Accordingly, the boat-tailing is effective in low-velocity weapons and in high-velocity weapons at velocities of 2,500 feet per second or less. The taper of boat-tailed bases varies from 5 to 9 degrees.

(8) BASE PLUG. To facilitate manufacture, armor-piercing projectiles are closed at the base with a heavy steel plug. In the larger

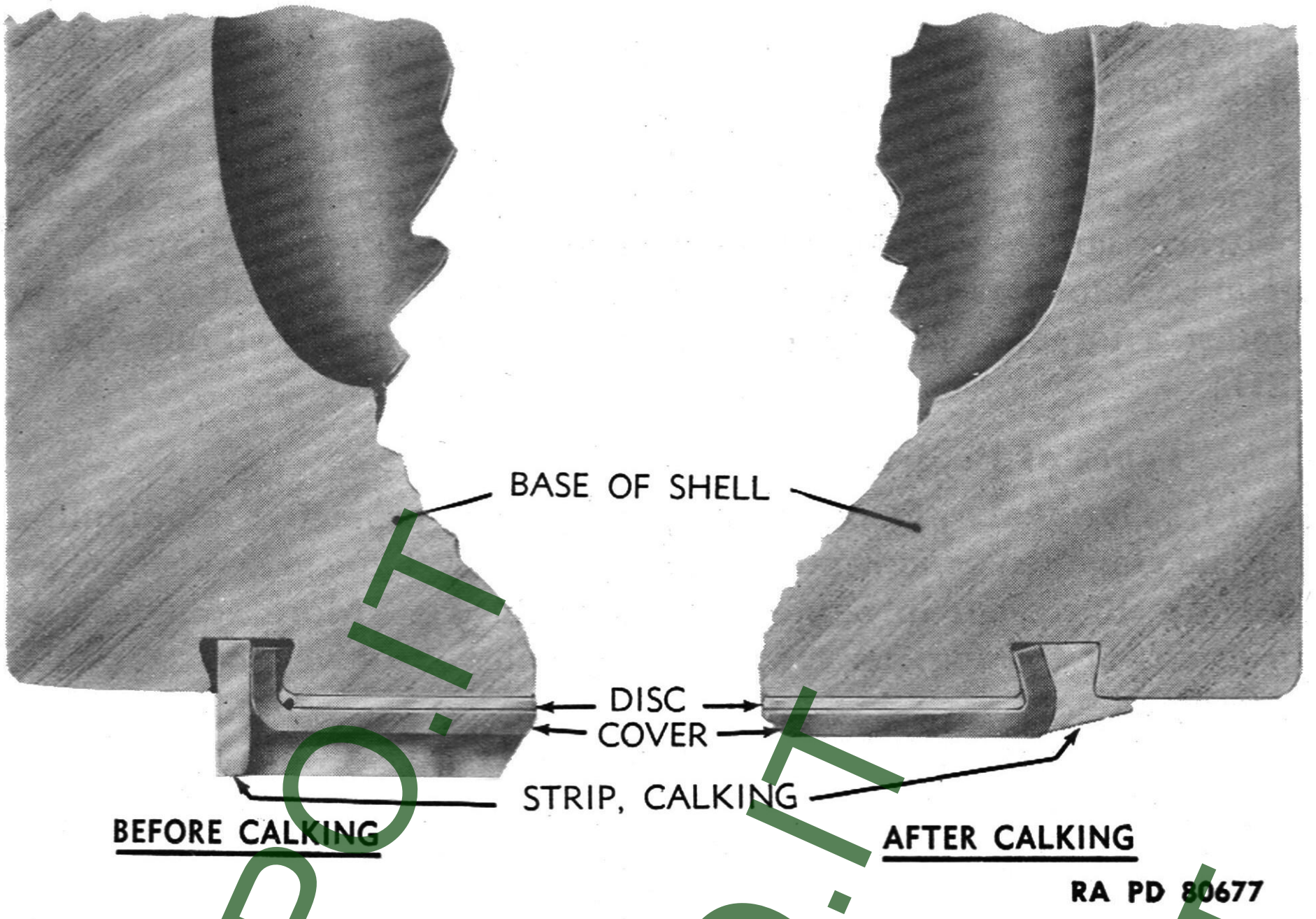


Figure 12 — Calked Type of Base Cover for Shell With Explosive Filler

calibers, the base plug also provides a seat for the fuze plug and fuze. In the smaller calibers, if an explosive charge is loaded in the cavity of the projectile, the base plug is replaced by a base fuze. The tracer element, in the smaller calibers, is contained in the base of the projectile, in a base plug, or in the base fuze.

(9) BASE COVER. The 20-mm projectiles and projectiles of 75-mm or larger caliber containing high explosive are provided with a base cover to prevent the hot gases of the propelling charge from coming in contact with the explosive filler of the projectile through joints or possible flaws in the metal of the base. Small and medium caliber armor-piercing projectiles with high-explosive filler and base fuzes are not ordinarily provided with base covers. Base covers may be crimped, calked, or welded to the base of the projectile (fig. 12).

(10) ARMOR-PIERCING CAP. Some armor-piercing projectiles are fitted with an armor-piercing cap for use especially in penetrating face-hardened armor plate. The cap is made of forged alloy steel, heat-treated to have a hard face and relatively soft but tough core. On impact, the hardened face of the cap destroys the hardened face 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 area of the head. See also subparagraph *c* (4), below, describing armor-piercing projectiles.

(11) WINDSHIELD. The windshield, also known as the false ogive or ballistic cap, is made of steel or aluminum and is secured to the

armor-piercing cap or the head of the projectile to give improved exterior ballistics.

(12) TRACER. For observation of fire, some shell are fitted with a tracer in the base. In some antiaircraft and aircraft gun projectiles, the tracer ignites a pellet which after burning a prescribed number of seconds, detonates the explosive filler, should the fuze fail to operate against a target. This type of tracer is known as "shell-destroying" (SD).

c. Types of Projectiles.

(1) GENERAL. Dependent upon type of projectile, ammunition may be classified as indicated in paragraph 5. Typical service projectiles are illustrated in figures 2 to 5, inclusive. More complete descriptions of the various types of projectiles are given below and in TM 9-1900.

(2) HIGH EXPLOSIVE (H.E.) SHELL. This projectile, made of common forged steel, has comparatively thin walls and a large bursting charge of high explosive. It is used against personnel and materiel targets, producing blast effect and fragmentation at the target. It may be fitted with either a time or impact fuze, according to type of action desired.

(3) HIGH-EXPLOSIVE-ANTITANK (H.E., A.T.) SHELL. This is a special type of high-explosive shell for use against armored or concrete targets. Its effect is dependent upon the type and shape of its high-explosive charge. It blasts a hole in the target. It has a conical windshield which crushes on the target, and a base-detonating fuze having nondelay action.

(4) ARMOR-PIERCING (A.P. OR A.P.C.) PROJECTILE. Armor-piercing projectiles are made of heat-treated high carbon alloy steel. The head is very hard for penetration of armor and the body is tough so that it will withstand the strains imposed by the twisting action of the projectile at angles of impact oblique to normal. To aid in overcoming face-hardened armor plate, an armor-piercing cap (subpar. b (10), above) is attached to the head of the projectile. These armor-piercing projectiles have thick walls and generally a small cavity which may be either empty or filled with explosive D and fitted with a base-detonating fuze having a delay action. A steel or aluminum windshield is generally attached to the body or to the armor-piercing cap by screw threads or crimping. A tracer may be present in the base plug or in the base end of the fuze.

(5) CHEMICAL SHELL. There are three general types of chemical shell. The burster, the base-ejection, and the base-ignition (base-emission) types. The burster type is very similar to high-explosive shell, except for type of filler (par. 10), and the absence of a base cover. A large booster charge, termed a burster (subpar. b (5),

above), is used to break the shell body and aid in dispersion of the chemical filler. In older types of chemical shell, the nose is fitted with tapered threads to form a gastight joint with the adapter. Modern types use standard threads with silver soldering for the adapter and a force fit for the burster casing. Base-ejection shell do not have a burster, but have an expelling charge of black powder, adjacent to the time fuze, which ignites and blows the three or four smoke canisters out through the base of the shell. In the base-ignition smoke shell, the smoke filler is ignited through a hole in the base by the propelling charge. Shell of older manufacture have a low-melting fusible metal plug in this base hole, whereas shell of new manufacture have delay pellets.

(6) ILLUMINATING SHELL. These shell contain parachute and illuminant assemblies which are ejected by an expelling charge adjacent to the time fuze. The illuminant burns lighting up a target area.

(7) CANISTER. Canister consists of a light metal cylindrical case, filled with steel balls, containing no explosives. It is fired point-blank for effect against personnel. The case breaks upon leaving the muzzle of the cannon, allowing the balls to scatter with shotgun effect.

(8) SHRAPNEL. Shrapnel are point-fuzed with a combination time and superquick or an AA. time fuze. An expelling charge of black powder is assembled in the base. A central flash tube connects the fuze and base charge. When the time fuze has burned its predetermined time, the magazine charge flashes through the central tube to ignite the base charge. This results in the ejection of the steel diaphragm, balls, head, and fuze from the case at a velocity of about 350 feet per second added to that of the shrapnel at time of burst. The case is not ruptured. The balls are projected forward in the form of a cone, due to rotational velocity. Shrapnel are authorized only for training purposes.

(9) TARGET-PRACTICE PROJECTILES. Target-practice projectiles, generally made of cast iron, are provided for target practice. These projectiles have the same dimensions, weight, and center of gravity, as the service projectiles they simulate. Some target-practice projectiles must be sand-loaded to bring them up to standard weight. Target-practice shell, including those used in subcaliber firings, sometimes contain a black powder spotting charge.

(10) DUMMY PROJECTILES. Drill or dummy (inert) projectiles are used with fixed, semifixed, and separate-loading drill rounds for training purposes. Those which are part of fixed and semifixed rounds (drill cartridges) are usually inert service projectiles, with or without modifications. Separate-loading dummy projectiles are of two types: sliding-ring type and internal-plunger type. In the sliding-ring type, a rear ring on a cylindrical sliding assembly simulates the rotating band.

After the rear band is seated in the forcing cone of the bore, the dummy projectile can be pulled sharply to the rear for a short distance by means of an extractor inserted in the base end of the dummy projectile. In the internal-plunger type, an internal plunger, held to the rear by a spring, moves forward against the spring when the projectile is rammed home. The plunger then snaps back loosening the projectile in its seat so that it can be extracted more easily.

d. Armor-piercing Data.

(1) The penetration data of specific projectiles are given in chapter 2. Certain general armor-piercing data for projectiles are given herein. *Penetration* generally refers to the piercing of armor plate, whereas *perforation* indicates complete penetration of the projectile through one side and out of the other side of the plate.

(2) The angle of impact is important in penetration. Once the perforation is known at normal impact, the perforation at any angle can be estimated as follows:

Angle (deg)	Percentage Lost in Perforation	Angle (deg)	Percentage Lost in Perforation
0	0	25	16
5	2½	30	20
10	5	35	27
15	8	40	34
20	13	45	41

(3) Approximate penetration for different caliber armor-piercing projectiles is given in Table 1, below.

TABLE 1 — ARMOR PENETRATION TABLE

Caliber	Approx. Inches of Penetration of Armor Plate at 1,000 Yards (Normal Impact)		Caliber	Approx. Inches of Penetration of Armor Plate at 1,000 Yards (Normal Impact)	
	Homogeneous Plate	Face-hardened Plate		Homogeneous Plate	Face-hardened Plate
20-mm A.P.	0.9	0.6	75-mm H.E., A.T...	3⅝*	—
37-mm AA., A.P.....	0.7	0.7	76-mm A.P.C.	4.5	4.7
37-mm A.T., A.P.C.	2.3	2.1	3-inch A.P.C.	4.5	4.7
40-mm A.P.	1.8	1.7	90-mm A.P.C.	5.5	6.0
57-mm A.P.C.	3.6	3.7	105-mm H.E., A.T.	4.0*	—
75-mm A.P.C.	2.8	3.4	155-mm A.P.	7.5	—

*—At any range.

GENERAL

15. BLANK AMMUNITION.

a. General. Blank ammunition is made up for cannon of calibers up to and including 105-mm for practice purposes in maneuvers, in firing the morning and evening gun, and for saluting purposes.

b. Complete Round. A complete round of blank ammunition consists of a black powder charge contained in either a loose-fitting cloth bag which sags around the primer or in one or two compressed cylindrical pellets wrapped in cellophane fitting around the primer, assembled in a brass cartridge case. A chipboard closing cup is inserted in the mouth of the case and sealed to hold the charge in place and to prevent powder from leaking out. A 10-gage blank cartridge, with a suitable adapter made from a service cartridge case, is used for blank firing of 37-mm weapons.

16. PACKING AND MARKING FOR SHIPMENT.

a. General. Moisture-resistant containers are used for practically all ammunition, except separate-loading projectiles and primers. These packing containers are marked to furnish all essential information. Specific packing data for each ammunition item will be found in ORD 11 Standard Nomenclature Lists.

b. Packing. Separate-loading projectiles do not require any outer packings; they are shipped unfuzed with an eyebolt-lifting plug in the nose and a grommet to protect the rotating band (ch. 3, sec. V). Exceptions are those projectiles having a windshield and dummy projectiles which are shipped in a crate (fig. 21). Separate-loading primers are packed 50 to a sealed metal can (fig. 13), and these cans are packed in a wooden box. In the smaller calibers, other components and rounds of artillery ammunition are packed in a slip-cover fiber container of the mailing tube type. For further protection, rounds assembled with point-fuzed projectiles may have U-shaped packing stops fitted into the fuze wrench slots. These must be removed before firing. All fiber containers are packed in wooden boxes or in bundles of three containers. For typical packing boxes, see figures 14, 15, and 22, and for fiber containers, including the inverted 105-mm type, see figure 16. Some of these packing boxes have a carriage bolt and rod holding and reinforcing the two ends of the box. Bundle packings are illustrated in figures 17 and 18. Bundles are crated for oversea shipments as shown in figure 19. In addition to bundle packing, separate-loading propelling charges are packed in hermetically sealed metal cartridge-storage cases (fig. 20). An igniter-protector cap, made of cloth or paper, serves as protection to the igniter end of propelling charges as shipped. Metal containers are the latest type of packing for single rounds of artillery ammunition and one, four, or eight rounds of trench-mortar ammunition. Rounds for the 105-mm howitzer, 60-mm and 81-mm mortars are packed in standard fiber con-

tainers prior to packing in the metal container. Eight 60-mm mortar rounds, four light 81-mm mortar rounds, or one heavy 81-mm mortar round are placed in one metal container. The metal containers are cylindrical, made of steel, and sealed against moisture by a rubber gasket in the sealing cover. A screw and pressure plate cover assembly hooks under a locking ring on the metal container and provides pressure over the sealing cover and gasket.

c. Sealing. Each container, after the contents are properly packed, is sealed in some manner which will indicate whether or not the container has been tampered with. Where metal strapping is used around boxes, paper seals are not necessary and are no longer used.

d. Marking for Shipment.

(1) GENERAL. Ammunition items are marked as described in paragraph 11. Packing containers are marked in accordance with Army Regulations, specifications, and I.C.C. regulations.

(2) Each package of supplies turned over for shipment on a Government bill of lading is marked with the following:

(a) Name and address of destination or port officer (or code marking) preceded by word "To."*

(b) Name and address of ultimate consignee, preceded by word "For."*

(c) List and description of contents.

(d) Ammunition code symbol, published in ORD 11 SNL's.

(e) Gross weight in pounds, displacement in cubic feet.

(f) The number of the package or shipping ticket.*

(g) The letters "U.S." in several conspicuous places.

(h) Order number or contract number.

(i) Ordnance insignia.

(j) Name or designation of consignor preceded by the word "From."*

(k) Lot number.

(l) Month and year packed.

(m) Inspector's stamp.

(3) The adhesive sealing strips on fiber containers are in the same color as ammunition item, in accordance with basic color scheme. Thus, blank ammunition has sealing strips in red, to indicate low explosive (black powder). It will be noted, however, that for rounds with high-explosive projectiles, the strips are yellow with black marking.

(4) Wooden packing boxes are painted or stained brown; markings in yellow.

(5) Metal containers are painted olive drab; markings in yellow.

(6) Containers for green bag propelling charge, white bag pro-

*—May be omitted on individual packages in carload shipments of packages of standard weights and dimensions containing standard quantities.

GENERAL

Figure 13 — Metal Container for Primers

pelling charge, or section of propelling charge containing the black powder igniter, are painted with green, white, and red stripes, respectively.

(7) The muzzle velocity of rounds of smaller caliber is indicated on the packing box.

(8) To distinguish rounds assembled with brass cartridge cases from those with steel cartridge cases, the words "steel case" are marked on those boxes containing steel case rounds.

(9) Linen data tags, containing pertinent information, are attached to separate-loading propelling charges. Ammunition data cards for other ammunition accompany shipping tickets for ammunition packings. Firing table cards are inclosed in the packings of trench-mortar complete rounds.

17. FIELD REPORT OF ACCIDENTS.

a. When an accident occurs during training practice, procedure prescribed in AR 750-10 will be observed by the Ordnance officer under whose supervision the ammunition is maintained or issued. Where practicable, reports covering malfunctions of ammunition in combat will be made to the Chief of Ordnance, giving the type of malfunction, type of ammunition, type of weapon, the lot number of the complete rounds of separate-loading components, and conditions under which fired.

ARTILLERY AMMUNITION

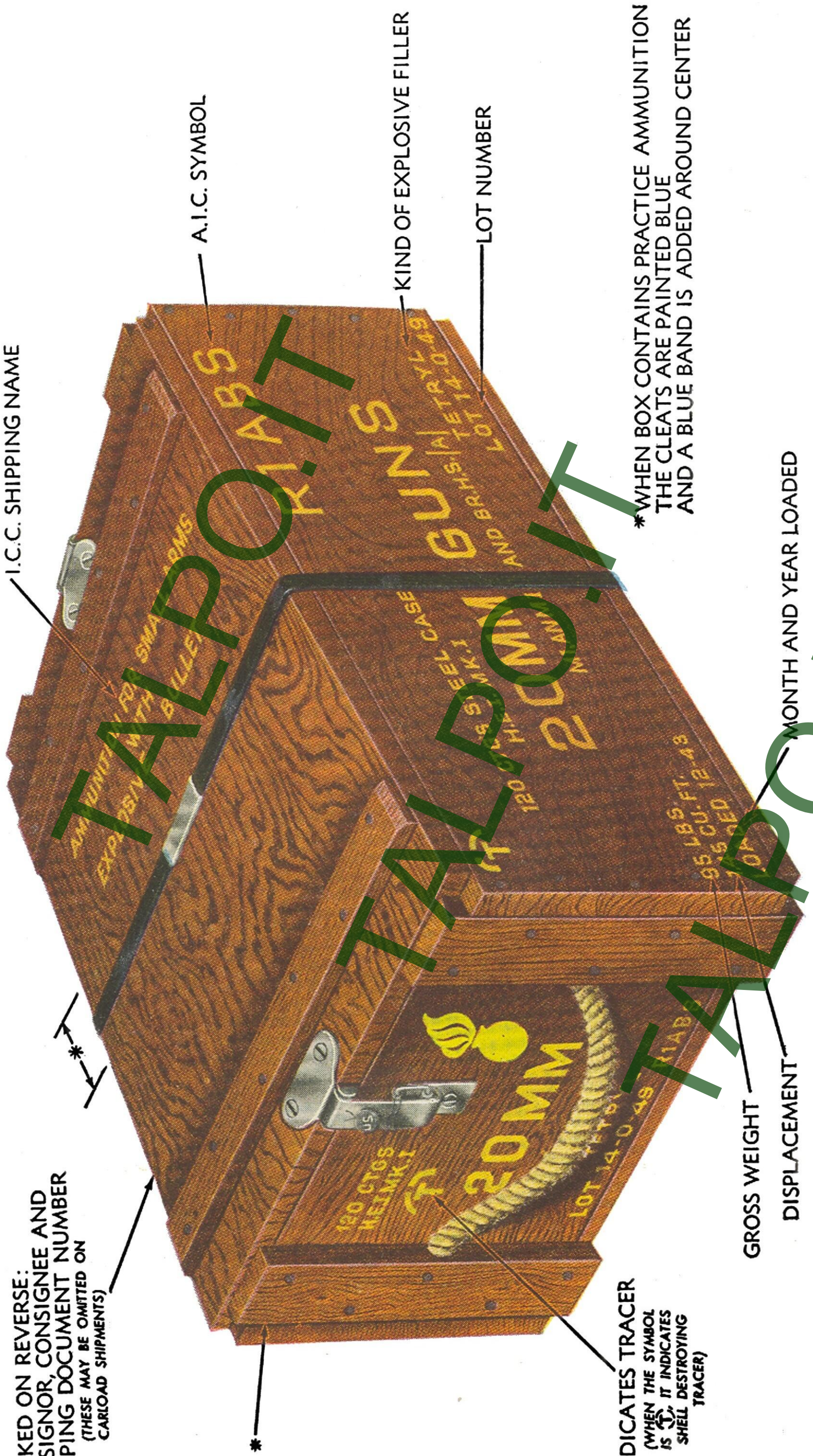
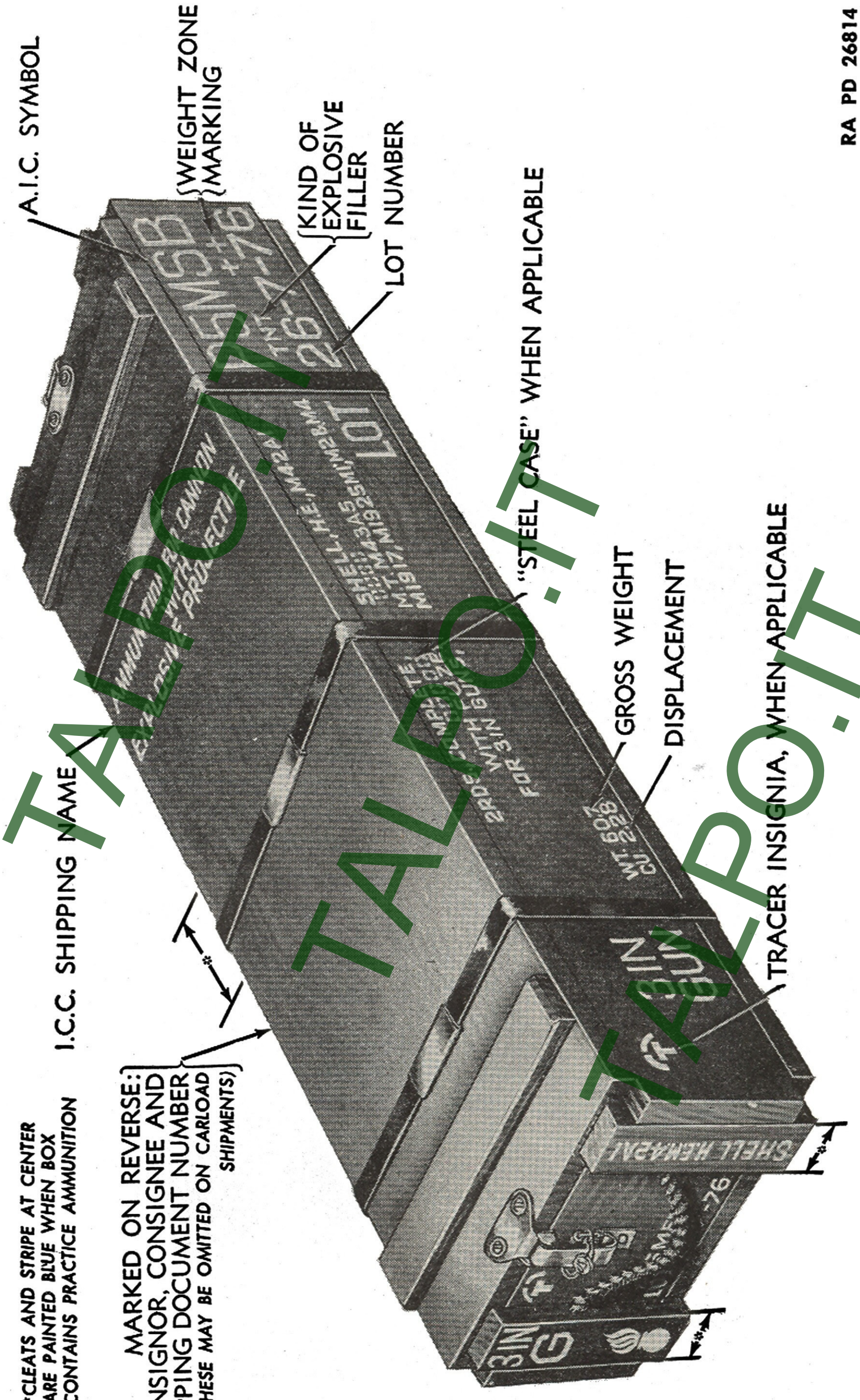


Figure 14 — Typical Packing Box for Small Caliber Fixed Ammunition

GENERAL

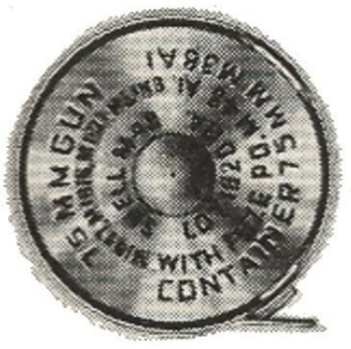


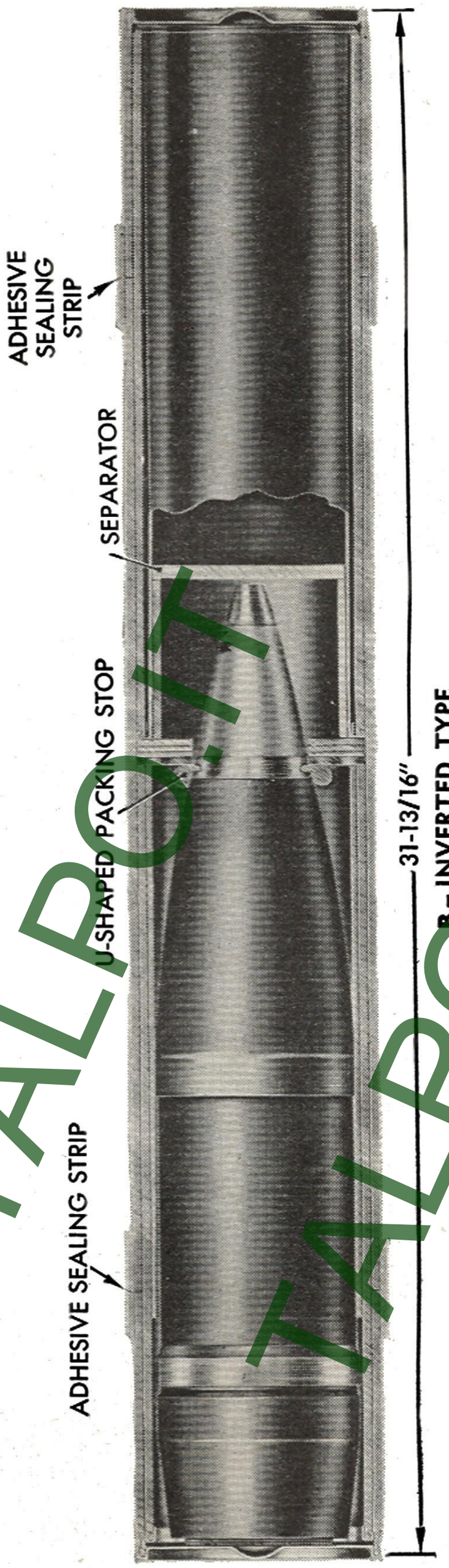
RA PD 26814

Figure 15 — Typical 2-round Packing Box

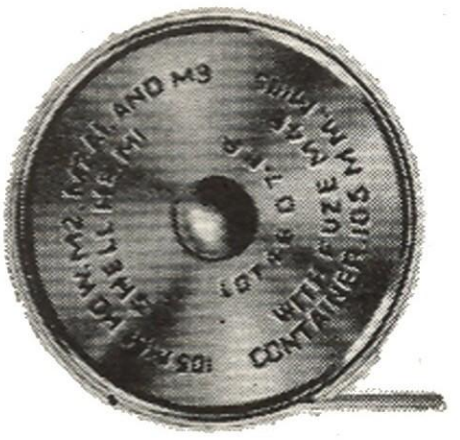
ARTILLERY AMMUNITION

A – NORMAL TYPE





B – INVERTED TYPE



RA PD 80684

Figure 16 — Fiber Containers

GENERAL

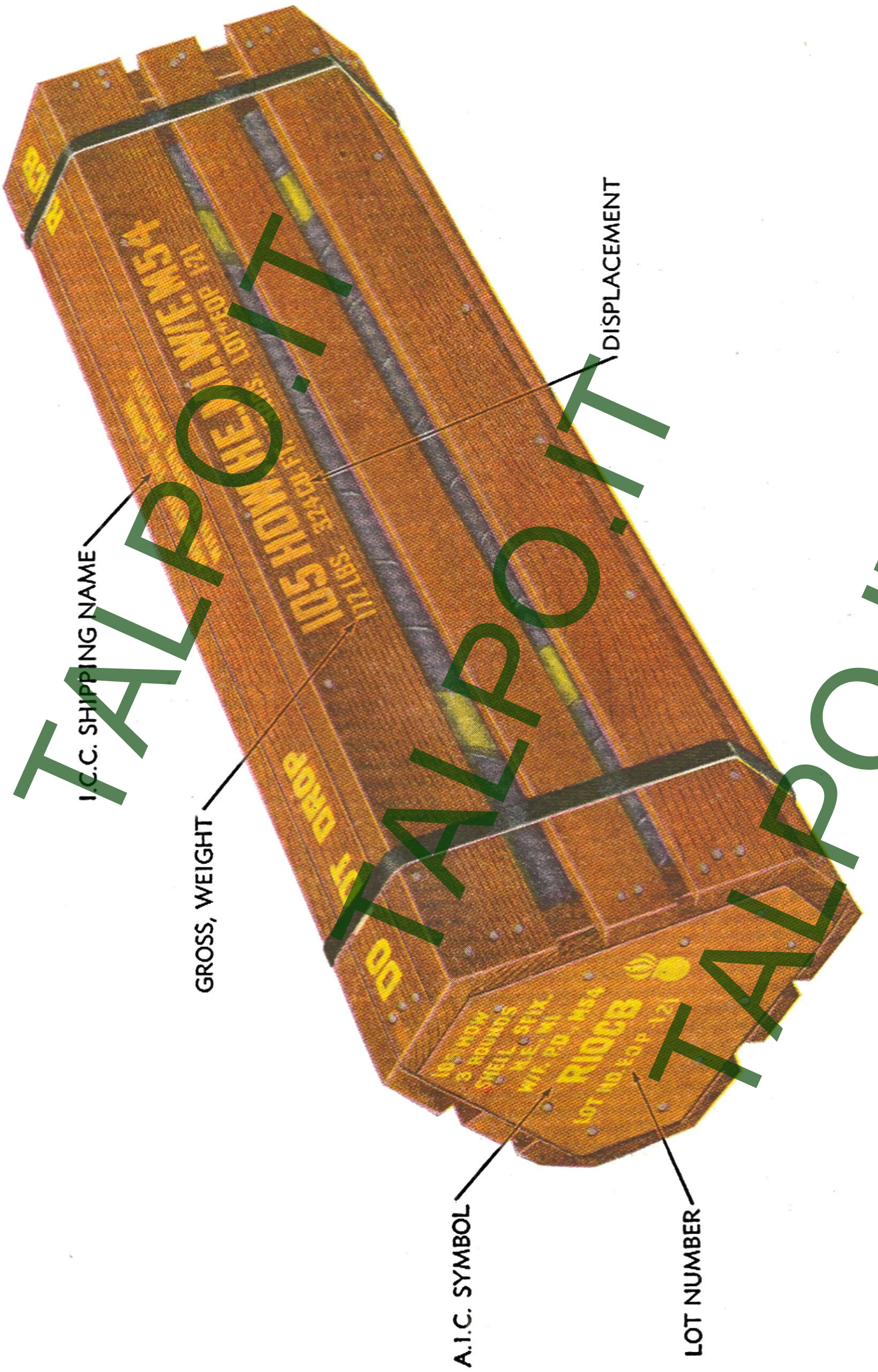
RA PD 80685

Figure 17 — Typical Bundle Packing for Complete Rounds

ARTILLERY AMMUNITION

RA PD 80686

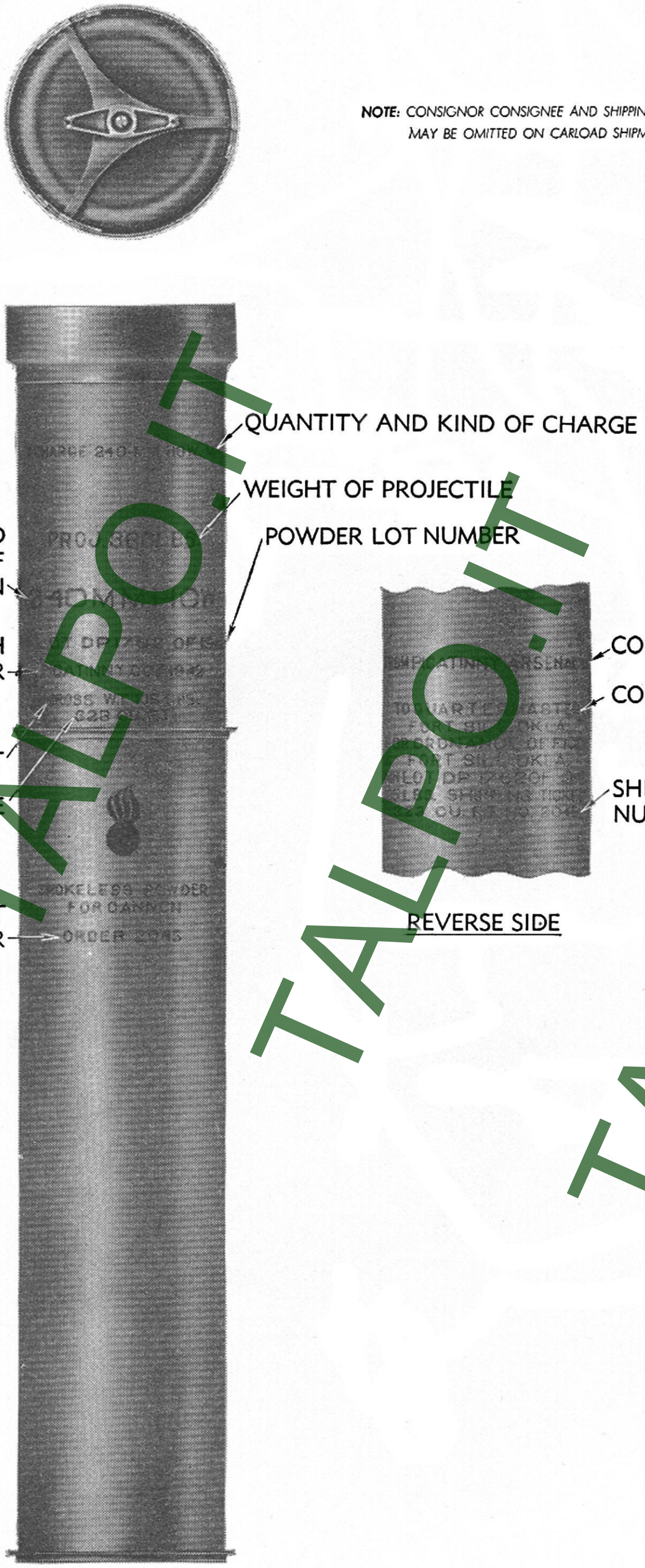
Figure 18 — Typical Bundle Packing for Separate-loading Propelling Charges



RA PD 80687

Figure 19 — One-bundle Crate for Oversea Shipments

ARTILLERY AMMUNITION



NOTE: *CONSIGNOR CONSIGNEE AND SHIPPING TICKET NUMBER MAY BE OMITTED ON CARLOAD SHIPMENTS.*

RA PD 53905

Figure 20 — Typical Cartridge-storage Case

GENERAL

RA PD 80691

Figure 21 — Crate for Separate-loading Projectiles

ARTILLERY AMMUNITION

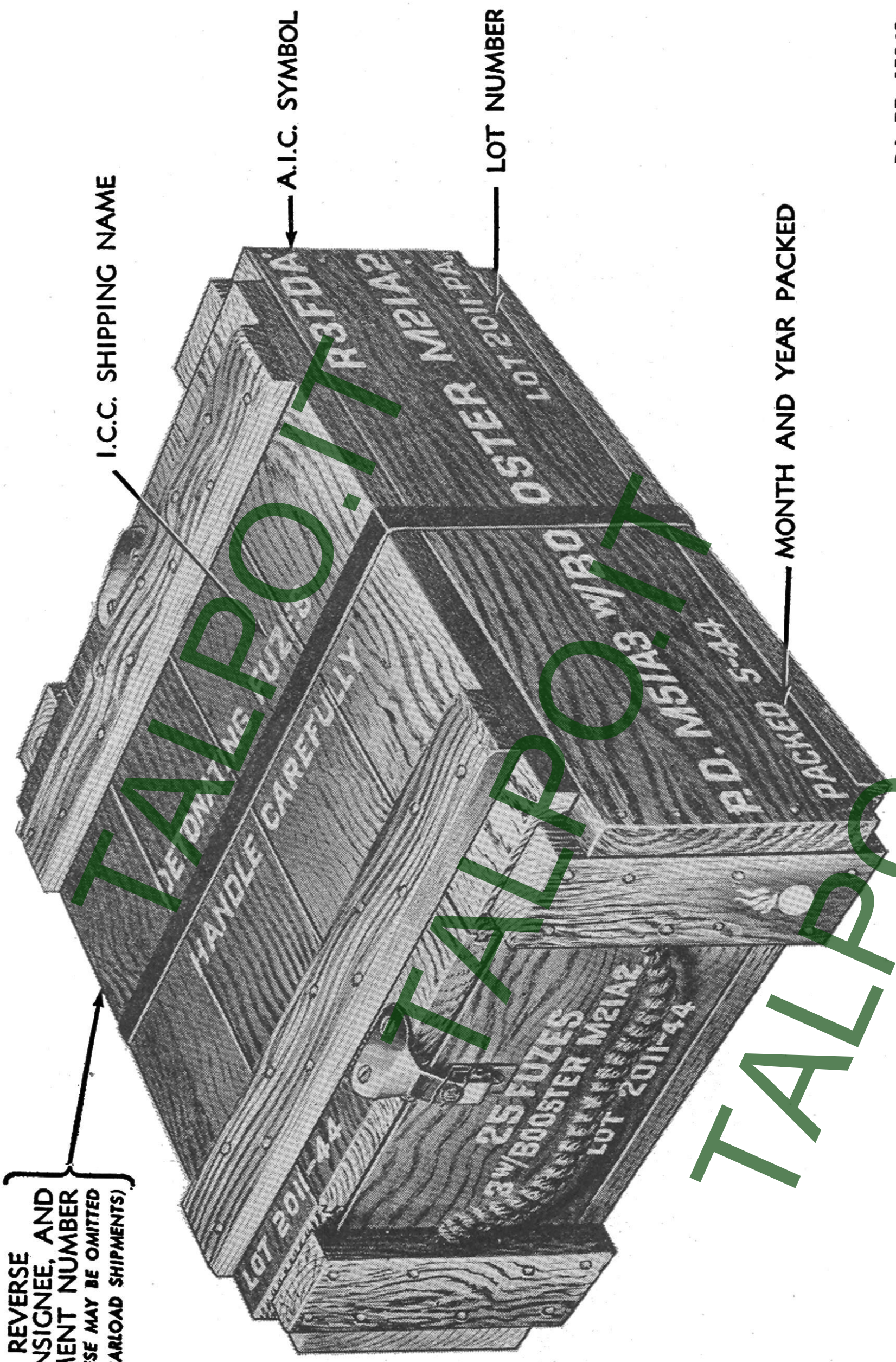


Figure 22 — Typical Packing Box for Fuzes