CHAPTER 7

AMMUNITION LOADING

Aircraft gun ammunition is developed for specific types of aircraft-mounted guns. The M61A1/A2 uses M50/projectile gun unit (PGU) series 20 millimeter (mm) ammunition. The M50/PGU series consists of various types of cartridges developed for specific applications, including test, dummy, target practice, target practice tracer, armor-piercing incendiary, high-explosive incendiary, semi-armor-piercing, and high-explosive incendiary. Blank and dummy rounds are also used for practice and maintenance.

The M50/PGU series 20 mm ammunition is loaded into the M61A1/A2 gun through the linkless ammunition loading system (LALS) series. The LALS transports rounds from the transporter to the aircraft system, and simultaneously transports spent cases and cleared rounds from the aircraft system to the transporter.

The GAU-21 weapon system and the GAU-16 aircraft machine gun use the .50 caliber series ammunition. The GAU-17 and M240D aircraft machine gun use the 7.62 mm North Atlantic Treaty Organization (NATO) series cartridge. Like the 20 mm series ammunition, there are various types of small arms ammunition developed and used for specific applications.

LEARNING OBJECTIVES

When you have completed this chapter, you will be able to do the following:

1. Describe aircraft gun ammunition configuration.
2. Identify aircraft gun cartridges.
3. Describe the uses of aircraft gun cartridges.
4. Identify the components of the LALS, to include the following: ammunition loader components: Storage container, conveyor assembly, transfer unit assembly, support frame assembly.
5. Identify the components of the ammunition replenisher to include the following: interchange loading assembly, removable frame assembly, and table assembly.
6. Identify the operating procedures to follow when loading/downloading the transporter and aircraft gun system.
7. Identify safety precautions to follow when working with the LALS.

AIRCRAFT GUN AMMUNITION

M50 Configuration Ammunition

M50 configuration ammunition (Figure 7-1) for the M61A1/A2 Navy aircraft gun is issued in the form of cartridges (rounds). A complete service cartridge assembly consists of a cartridge case, electric primer, propellant, projectile, and fuze. All service cartridges have matched ballistics and are electrically primed.

Figure 7-1 — M50 configuration cartridge.
Cartridge Components and General Description

The cartridge components for M50-configured ammunition, as used in a complete round, are discussed in the following paragraphs.

Classification

The M50 configuration ammunition currently issued is classified as follows:

- Dummy cartridge M51A1B1, M51A2 (steel)
- High-pressure test (HPT) cartridge M54A1
- Target practice (TP) cartridge M55A2
- High-explosive incendiary (HEI) cartridge M56A3/A4
- Target practice-tracer (TP-T) cartridge M220
- High-explosive incendiary-tracer (HEI-T) cartridge M242

Cartridge Case

The M103 (brass) and the M103A1 (steel) cartridge cases (Figure 7-2) are marked longitudinally. The lettering is stenciled in waterproof marking ink on the cartridge case. The caliber/case designation is on the first line. The manufacturer symbol, interfix number, lot serial number, and year of manufacture are on the second line. The M103 case is loaded for use with all service ammunition, and the M103A1 is used with the M51A1B1/M51A2 dummy cartridges.

![Figure 7-2 — M103 (brass) and M103A1 (steel) cartridge cases.](image)

Propellant

All M50-configured cartridges are loaded with double-base ball (spherical) propellant WC 870 or WC 872.

M52A3B1 Electric Primer

The electric primer is used in all current M50 configurations. It consists of an open-ended brass cup that contains a brass button insulated from the cup by a plastic liner. The firing pin of the gun contacts the brass button. The ignition charge (a conductive explosive mixture) is in contact with the other side of the button, and is retained by a paper disk and a metal support cup. The electrically initiated primer ignites the propellant charge.
Projectiles
All projectiles, except the HPT, have essentially the same external configuration. The rotating band is a copper alloy swaged into a circumferential groove near the aft end of the steel body.

M505A3 Point Detonating Fuze
The M505A3 point detonating (PD) fuze (Figure 7-3) consists of a body assembly, a rotor assembly, and a booster assembly. The fuze has a delayed arming distance of 20 to 35 feet after it leaves the muzzle of the gun. Before firing the HEI projectile, the rotor and the firing pin are locked in position by the rotor safety spring. The rotor contains the detonator, which is out of line with the firing pin. Centrifugal force causes the spring to open, allowing the rotor to move in line with the firing pin. The fuze functions when the nose of the fuze is crushed against the target, forcing the firing pin against the detonator. The detonator, in turn, initiates the booster, which detonates and initiates the projectile's explosive charge.

Tracer
A tracer mix is direct-loaded into a cavity machined in the base of the TP-T and HEI-T projectiles. It is used in assembling the M220 and M242 cartridges, respectively. The heat and pressure of the propelling charge ignites the tracer. The tracer is visible for about 1,280 yards of projectile flight.

M51A1B1/M51A2 Dummy Cartridges
Dummy cartridges are completely inert assemblies and are used for drill and testing the feeder assembly of a weapon. The dummy cartridge is assembled with the M51A1B1/M51A2 projectile and M103A1 cartridge case to simulate the service cartridge. The two cartridges are the same except for a change to the annulus/primer pocket. The cartridge contains approximately 635 grains of inert material, which is an average overall weight equal to that of the other M50-configured ammunition.

M254 Dummy Cartridge
The M254 cartridge is made of plastic. It is an alternative to the M51A1B1/M51A2 steel dummy cartridge. The M254 differs from live ammunition in its appearance and the feel of its nylon composition. M50 configuration characteristics are shown in Table 7-1.

NOTE
The primer explosive element is sensitive to electromagnetic and electrostatic energy.
### Table 7-1 — M50 Configuration Ammunition Characteristics

<table>
<thead>
<tr>
<th>Designation</th>
<th>Type</th>
<th>M103 Case</th>
<th>M52A3B1 Electric Primer</th>
<th>Propellant</th>
<th>Projectile</th>
<th>Total Wt. (grains) (approx.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>M51A1B1/M51A2</td>
<td>Dummy</td>
<td>1,775</td>
<td>None</td>
<td>635 (Inert)</td>
<td>1,520</td>
<td>3,850 (min)</td>
<td>M103A1 steel case</td>
</tr>
<tr>
<td>M54A1</td>
<td>HPT</td>
<td>1,855</td>
<td>22</td>
<td>590</td>
<td>1,965</td>
<td>4,392</td>
<td></td>
</tr>
<tr>
<td>M55A2</td>
<td>TP</td>
<td>1,855</td>
<td>22</td>
<td>590</td>
<td>1,521</td>
<td>3,935</td>
<td></td>
</tr>
<tr>
<td>M56A3/M56A4</td>
<td>HEI</td>
<td>1,855</td>
<td>22</td>
<td>590</td>
<td>1,565</td>
<td>3,965</td>
<td>M505A3 fuze required</td>
</tr>
<tr>
<td>M220</td>
<td>TP-T</td>
<td>1,855</td>
<td>22</td>
<td>590</td>
<td>1,470</td>
<td>3,935</td>
<td></td>
</tr>
<tr>
<td>M242</td>
<td>HEI-T</td>
<td>1,855</td>
<td>22</td>
<td>590</td>
<td>1,535</td>
<td>3,865</td>
<td>M505A3 fuze required</td>
</tr>
<tr>
<td>M254</td>
<td>Dummy</td>
<td>n/a</td>
<td>None</td>
<td>None</td>
<td>n/a</td>
<td>4,005</td>
<td>Plastic</td>
</tr>
</tbody>
</table>

**M54A1 High-Pressure Test Cartridge**

The M54A1 cartridge is used only for proof firing of the gun at the place of manufacture. The projectile is made from a solid steel bar that has a standard rotating band. The M103 or M103A1 cartridge case is used with the M52A3B1 electric primer.

**M55A2 Target Practice Cartridge**

The M55A2 cartridge does not contain an explosive filler in the projectile. The solid nose is made of aluminum alloy. The projectile shape and ballistic properties are similar to those of the other M50-configured ammunition. The cartridge is used for practice firing, bore sighting weapons, and testing new guns. The M103 cartridge case and M52A3B1 electric primer make up the cartridge.

**M56A3 High-Explosive Incendiary Cartridge**

The M56A3 or M56A4 projectile is used in the M56A3 cartridge. The projectile is loaded with an incendiary and explosive composition, giving the combined effect of the blast of a high-explosive charge plus a fire-starting ability. Both the M56A3 and M56A4 are loaded with aluminized composition A-4 HEI charge. The major difference between the projectiles is their construction. The M56A3 has a base plate to prevent ignition of the HEI charge by the propellant. The M56A4 does not have the base plate. Both cartridges use the M103 case, M52A3B1 electric primer, and the M505A3 PD fuze.

**M220 Target Practice-Tracer Cartridge**

The M221 projectile is used with the M220 cartridge. The M221 projectile is similar to the M55A2 projectile, except it incorporates a tracer in the base of the projectile.

**M242 High-Explosive Incendiary-Tracer Cartridge**

The M242 projectile is used with the M242 cartridge. The projectile has a tracer in the base and aluminized composition A-4 in the forward section. It has a combined effect of a high-explosive
charge plus a fire-starting ability. The projectile is assembled with the M505A3 PD fuze, the M103 case, and the M52A3B1 electric primer.

Identification

Ammunition is identified by the lettering on the body of the projectile and by the painted color of the projectile.

Lettering

The lettering (Figure 7-4) is stenciled in waterproof marking ink around the body of the projectile. The first line of lettering identifies the caliber and type of cartridge; for example, 20 mm HEI, 20 mm TP, or 20 mm HEI-T. The second line gives the cartridge designation; for example, M55A2 or M220. The last line consists of a code number that identifies the manufacturer, interfix number, lot serial number, and year of manufacture. The color of the letters has no meaning.

Color Coding

The color codes for the M50-configured 20 mm ammunition are listed in Table 7-2. You can see exactly where colors are located on the projectile. The projectile (Figure 7-4) is divided into sections marked A, B, C, and D. The corresponding column in Table 7-2 lists the color found in that location for each projectile type.

Information contained in Table 7-2 identifies the high-explosive incendiary-tracer round M242. First, it shows the projectile and its color code in column A. Then, section A of the projectile is not painted; therefore, section A of the projectile remains the natural color of the metal (copper). Column B shows the color for section B of the projectile. Section B area is painted yellow (high explosives), and section B1 is painted red (incendiary). The same procedures are followed for sections C and D. Note the red T markings in the section B area just outside of the B1 section. The red T, and in some cases an orange T, shows the presence of an incendiary explosive (tracer).
Table 7-2 — Color Coding and Marking for M50 Configuration Ammunition

<table>
<thead>
<tr>
<th>Projectile Type and Designation (Except as noted)</th>
<th>Color of Painting</th>
<th>Color of Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Locations (See Figure 7-4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Dummy M51A1B1/M51A2</td>
<td>Chromate finish</td>
<td>Chromate finish</td>
</tr>
<tr>
<td>High-Pressure Test (HPT) M54A1</td>
<td>No paint (copper)</td>
<td>Purple</td>
</tr>
<tr>
<td>Target Practice (TP) M55A2/M55A2B1</td>
<td>No paint (copper)</td>
<td>Blue</td>
</tr>
<tr>
<td>M55A3/M55A3B1</td>
<td>No paint (copper)</td>
<td>Yellow; red band in B1 area</td>
</tr>
<tr>
<td>High-Explosive Incendiary (HEI) M56A3/M56A4</td>
<td>No paint (copper)</td>
<td>Yellow; red band in B1 area</td>
</tr>
<tr>
<td>Target Practice-Tracer (TP-T) M221 (M220 cartridge)</td>
<td>No paint (copper)</td>
<td>Blue</td>
</tr>
<tr>
<td>High-Explosive Incendiary–Tracer (HEI-T) M242</td>
<td>No paint (copper)</td>
<td>Yellow; red band in B1 area</td>
</tr>
<tr>
<td>Plastic Dummy Cartridge M254</td>
<td>No paint (white plastic)</td>
<td>No paint (white plastic)</td>
</tr>
</tbody>
</table>

**Projectile Gun Unit Configuration Ammunition**

The improved 20 mm PGU configuration ammunition for the M61A1/A2 aircraft guns is issued in the form of cartridges (Figure 7-5). All service cartridges have matched ballistics and are electrically primed. Initially procured ammunition is not graded, and all accepted lots are serviceable for issue and use in applicable weapons.

**Cartridge Components and General Description**

The cartridge components for PGU-configured ammunition, as used in a complete round, are discussed in the following paragraphs.

**Classification**

The PGU configuration ammunition currently issued is classified as follows:

- TP cartridge PGU-27/B and PGU-27A/B
- Semi-armor-piercing high-explosive incendiary (SAPHEI) cartridge PGU-28/B and PGU-28A/B
• TP-T cartridge PGU-30/B and PGU-30A/B
• Dummy cartridge PGU-39/B

Cartridge Case
The M103 brass cartridge cases (Figure 7-6) are marked longitudinally or circumferentially with the caliber/case designation on the first line. The manufacturer symbol is on the second line. The interfix number, lot serial number, and year of manufacture are on the third line.

Propellant
All PGU/B-configured cartridges are loaded with ball (spherical) WC 867 propellant. All PGU A/B cartridges are loaded with ball (spherical) WC 868 propellant.

M52A3B1 Electric Primer
The electric primer is used in all current 20 mm PGU configurations. It consists of an open-ended brass cup that contains a brass button insulated from the cup by a plastic liner. The firing pin of the gun contacts the brass button. The ignition charge (a conductive explosive mixture) is in contact with the other side of the button, and is retained by a paper disk and a metal support cup. The electrically initiated primer ignites the propellant charge.

Figure 7-6 — M103 brass cartridge case and markings.
Projectiles

All projectiles have essentially the same external configuration. The rotating band is copper alloy swaged into a circumferential groove near the aft end of the steel body.

PGU-27/B and PGU-27A/B Target Practice

The PGU-27/B and PGU-27A/B projectiles consists of a steel body with a solid aluminum nosepiece swaged or crimped to the steel body.

PGU-28/B and PGU-28A/B Semi-Armor-Piercing High-Explosive Incendiary

The PGU-28/B and PGU-28A/B SAPHEI projectiles consists of a steel body with an internal cavity filled with a sponge zirconium pellet, composition A-4, and RS 40 incendiary mix. The aluminum nose contains RS 41 incendiary mix and is swaged to the steel body on the PGU-28/B and threaded on the PGU-28A/B.

PGU-30/B and PGU-30A/B Target Practice-Tracer

The PGU-30/B and PGU-30A/B TP-T projectiles consists of a steel body with an aft cavity containing the tracer pellet. The aluminum nose is swaged or crimped to the steel body.

Tracer

A tracer pellet is loaded into a cavity machined in the base of the TP-T projectile used in the assembling of the PGU-30/B and PGU-30A/B cartridge. The heat and pressure of the propelling charge ignites the tracer pellet. The tracer is visible for approximately 2.5 seconds during projectile flight.

PGU-27/B and PGU-27A/B Target Practice Cartridge

The PGU-27/B and PGU-27A/B cartridges (Figure 7-7) have no explosive filler in the projectile. The cartridge is used in practice firing, for boresighting weapons, and for testing new guns. The projectile shape and ballistic properties are similar to those of other PGU-configured ammunition. PGU-configured ammunition characteristics are shown in Table 7-3.

NOTE

The primer explosive element is sensitive to electromagnetic and electrostatic energy.

Figure 7-7 — PGU-27/B and PGU-27A/B target practice cartridge.
Table 7-3 — PGU Configuration Ammunition Characteristics

<table>
<thead>
<tr>
<th>Cartridge</th>
<th>Approximate Unit Weight (grains)</th>
<th>Total Wt. (grains) (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation</td>
<td>Type</td>
<td>M103 Case</td>
</tr>
<tr>
<td>PGU-27/B</td>
<td>TP</td>
<td>1,855</td>
</tr>
<tr>
<td>PGU-28/B</td>
<td>SAPHEI</td>
<td>1,855</td>
</tr>
<tr>
<td>PGU-30/B</td>
<td>TP-T</td>
<td>1,855</td>
</tr>
<tr>
<td>PGU-27A/B</td>
<td>TP</td>
<td>1,855</td>
</tr>
<tr>
<td>PGU-28A/B</td>
<td>SAPHEI</td>
<td>1,855</td>
</tr>
<tr>
<td>PGU-30A/B</td>
<td>TP-T</td>
<td>1,855</td>
</tr>
</tbody>
</table>

PGU-28/B and PGU-28A/B Semi-Armor-Piercing High-Explosive Incendiary Cartridge

The PGU-28/B and PGU-28A/B cartridges (Figure 7-8) are for use against aircraft and light material targets, and functions with semi-armor-piercing, high explosive, and incendiary effect.

Figure 7-8 — PGU-28/B and PGU-28A/B SAPHEI.
PGU-30/B and PGU-30A/B Target Practice-Tracer Cartridge

The PGU-30/B and PGU-30A/B TP-T cartridges (Figure 7-9) are virtually the same as the PGU-27/B projectile, except it incorporates a tracer in the base of the projectile.

Figure 7-9 — PGU-30/B and PGU-30A/B TPT.

PGU-39/B Dummy Round

The PGU-39/B cartridge consists of a projectile that has been screwed into a steel body that weighs the same approximate weight as an actual 20 mm round. There is a hole in the base of the casing that allows for the firing pin to protrude without damage while cycling the round through the gun system under test. The PGU-39/B dummy round should be used for all purposes except for testing the serviceability of the LALS prior to issue for use.

PGU Identification

Ammunition type is identified by the painted color of the projectile and by the lettering on the body of the projectile. Figure 7-10 and Table 7-4 contain PGU configuration ammunition identification.

Table 7-4 — Color Coding and Marking for PGU Configuration Ammunition

<table>
<thead>
<tr>
<th>Projectile Type</th>
<th>Color of Painting</th>
<th>Color of Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Locations (See Figure 7-10)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>TP PGU-27/B PGU-27A/B</td>
<td>No paint (copper)</td>
<td>Blue</td>
</tr>
<tr>
<td>SAPHEI PGU-28/B PGU-28A/B</td>
<td>No paint (copper)</td>
<td>Black</td>
</tr>
<tr>
<td>TP-T PGU-30/B PGU-30A/B</td>
<td>No paint (copper)</td>
<td>Blue</td>
</tr>
</tbody>
</table>
The M548 container (Figure 7-11) is made of metal. Quick-release latches at both ends attach the lid. Required information about the ammunition contained inside is listed on the outside of the container. The moisture-resistant seal between the lid and the container should NOT be broken until the ammunition is to be used.

NOTE
M50/PGU series ammunition is normally packed in the M548 container as loose rounds (not pre-belted). The LALS eliminated the requirement for pre-belted ammunition.
The rounds are packed in the container in layers. There are cardboard partitions between each layer and between the rounds on all sides of the container. Each round has a cardboard protector around the projectile. These cardboard partitions and tubular protectors should be used when repackaging the ammunition in the containers.

SMALL ARMS AMMUNITION

There are numerous types of small arms ammunition available to the fleet for service use. The small arms ammunition described below is a cartridge or a family of cartridges. Their intended use is in various types of mounted, hand-held, or shoulder-fired weapons, .22 through .50 caliber. The following paragraphs will provide information on cartridge terminology and cartridge components that make up small arms ammunition.

Cartridges

A small arms cartridge is an assembly consisting of a cartridge case, a primer, a quantity of propellant, and a bullet. A paper closure disk (instead of a bullet) seals rifle grenade and blank cartridges. Dummy cartridges consist of a cartridge case and a bullet. Some dummy cartridges use an inert granular material to simulate the weight and balance of live cartridges. Figure 7-12 illustrates a typical cartridge and its component terminology.
Case
Steel, aluminum, zinc, and plastic materials have all been experimented with for manufacturing cartridge cases. However, a brass composition of 70 percent copper and 30 percent zinc is the most commonly used material for military cartridge cases.

Propellant
Cartridges are loaded with various propellant weights that impart sufficient velocity, within safe pressure, to obtain the required ballistic projectile performance. The propellants are either a single-base (nitrocellulose) or double-base (nitrocellulose and nitroglycerine) composition.

Primer
Center-fire small arms cartridges contain a percussion primer assembly. The assembly consists of a brass or gilded metal cup. The cup contains a pellet of sensitive explosive material secured by a paper disk and a brass anvil. The weapon's firing pin strikes the center of the primer cup base, compressing the primer composition between the cup and the anvil, causing the composition to explode.

Bullet
Lead bullets were originally manufactured in the shape of a ball. With the advent of rifling in weapons, the ball was replaced by a cylindrical lead bullet that engaged the rifling. Except in special cases, .22 through .50 caliber bullets are either lead (lead alloy) or assemblies of a jacket and a lead or steel core. The lead used in lead-alloy bullets is combined with tin or antimony (or both) for bullet hardness. The alloying reduces barrel leading and helps prevent the bullet from stripping (jumping) the rifling.
Jacketed bullets are used to obtain high velocities and are better suited for automatic and semiautomatic weapons because the lead bullet may be damaged by the loading.

A bullet jacket may be either gilding metal, gilding metal-clad steel, or copper plated steel. In addition to a lead or steel core, they may contain other components or chemicals that provide a terminal ballistic characteristic for that bullet type.

**Cartridge Classification**

**Ball Cartridges**
The ball cartridge is for use in rifles, pistols, carbines, revolvers, machine guns, and sub-machine guns against personnel and unarmored targets. The bullet (normally a metal jacket and a lead slug) is for general-purpose combat and training purposes. The .50 caliber ball bullet and 7.62 mm ball bullet contain soft steel cores.

**Tracer Cartridges**
The primary purpose of the tracer cartridge is to see the line of fire by means of a flame and smoke trail. It permits visible observation of the bullet’s in-flight path or trajectory to the point of impact.

**Armor-Piercing Cartridges**
The armor-piercing (AP) cartridge is for use in machine guns or rifles against personnel, light armored targets, unarmored targets, concrete shelters, and similar bullet resisting targets. The bullets have a jacket and a core of hardened steel alloy (such as tungsten-chromium, tungsten carbide, manganese-molybdenum, or tungsten alloy).

**Armor-Piercing Incendiary Cartridge**
The armor piercing incendiary (API) is a single combination instead of a combination of separate armor piercing and incendiary cartridges for machine guns. The bullets have a jacket and a core of hardened steel alloy (such as tungsten-chromium, tungsten carbide, manganese-molybdenum, or tungsten alloy) and a point filler of incendiary mixture instead of lead.

**Armor-Piercing Incendiary-Tracer (API-T) Cartridge**
The armor piercing incendiary-tracer (API-T) cartridge is only for use in the .50 caliber weapon. It can replace the AP and the API cartridges. The bullets have a jacket and core of hardened steel alloy (such as tungsten-chromium, tungsten carbide, manganese-molybdenum, or tungsten alloy).

**Spotter Tracer Cartridge**
The spotter tracer cartridge is for use in coaxially-mounted .50 caliber spotting rifles. The bullet trajectory is approximately the same as that of the 106 mm recoilless rifle. It serves as a fire control device to verify weapon sight setting before firing the 106 mm recoilless rifle. The bullet contains an impact detonator and an incendiary composition that will identify the point of impact by flash and smoke.

**Match Cartridge**
The match cartridge is used in national and international match shooting competitions. The bullet consists of a copper alloy jacket over a lead slug. The national match (NM) initials or the word Match on the head face identifies the center-fire match cartridge. A 360 degree cannelure on the exterior of the cartridge case near the base identifies 7.62 mm match (M852) cartridges. Markings on the cartridge boxes identify rimfire match cartridges.
Blank Cartridge

The absence of a bullet distinguishes and identifies the blank cartridge. The purpose of the blank cartridge is to simulate fire for gun salutes, and training maneuvers. Rifles and machine guns, as well as revolvers and pistols, equipped with blank firing attachments are the weapons used to fire the blank cartridge.

Grenade Cartridge

The purpose of the grenade cartridge is to propel rifle grenades, line-throwing projectiles, and ground signals from launchers attached to rifles. The distinguishing features of rifle grenade cartridges are the rosette crimp closure of the case mouth and the absence of a bullet.

Incendiary Cartridge

The incendiary cartridge bullet contains a core of incendiary mixture with a lead-antimony slug at the base end. A hollow steel cylindrical body or clad steel container may be inserted within the jacket. The purpose of the incendiary cartridge is for aircraft and ground weapon use to ignite combustible targets such as vehicles and aircraft fuel tanks. The compressed incendiary mixture ignites upon impact with the target.

Dummy Cartridge

The dummy cartridge consists of a cartridge case and a ball bullet. Distinguishing features are: two or more holes drilled in the case, longitudinal corrugations in the case, and an empty primer pocket. The dummy cartridge is used for training personnel in loading, unloading, and firing the weapon. The dummy cartridge is completely inert.

.50 Caliber Ammunition

The .50 caliber machine gun fires various types of ammunition and each one is used for a specific situation or mission. The information provided below will give you a general description and the application of the .50 caliber cartridge (Figure 7-13) that is available for service use.

Figure 7-13 — .50 caliber cartridge.
M2 Armor-Piercing

The M2 cartridge is for use in .50 caliber machine guns against armored vehicles, armored aircraft, concrete shelters, and similar bullet-resisting targets. The brass cartridge case has a gilded metal-jacketed bullet that has a hardened core of manganese-molybdenum steel and a point filler of lead-antimony. The bullet tip is black for identification.

M8 Armor-Piercing Incendiary

The M8 cartridge is used in .50 caliber machine guns against armored targets. Upon impact with the target, the incendiary mixture bursts into flame and ignites the flammable material. The brass cartridge has a gilded metal-jacketed bullet that has a hardened core of manganese-molybdenum steel, a point filler of incendiary composition, and a base filler seal of lead-antimony. The bullet tip is aluminum-colored for identification.

M20 Armor-Piercing Incendiary-Tracer

M20 cartridges are used in .50 caliber machine guns against armored targets. It is similar to the M8 API cartridge with the addition of a tracer element. The brass cartridge case contains a gilded metal-jacketed bullet, similar to the M8 API bullet but with a tracer element. The bullet has a red tip and a gray stripe for identification.

M2 Ball

The M2 cartridge is procured for use in all .50 caliber weapons against personnel and unarmored targets. The brass cartridge case has a gilding metal jacketed bullet that has a soft steel core and lead-antimony alloy point filler. The boat-tailed bullet has an unpainted tip.

M33 Ball

M33 cartridges are used in all .50 caliber weapons against personnel and unarmored targets. The cartridge is a brass or steel case. A crimp secures the primer in the pocket and the joint has a waterproofing material applied.

M1 Incendiary

The M1 cartridge is used in .50 caliber machine guns against combustible targets. It contains an incendiary mixture that ignites upon impact with the target. The brass cartridge case has a gilding metal-jacketed bullet the size and shape of the AP M2 bullet but has a hollow cylindrical steel body, a lead-antimony base slug, and point filler of incendiary composition. The bullet has two knurled cannelures rolled into the jacket and the tip is light blue.

M10 Tracer

The M10 brass cartridge case has a gilding metal-clad steel jacketed tracer bullet that is basically the same as the M1 tracer bullet. The tip is orange for identification. When fired, the trace is dim or invisible for the first 225 yards (205 meters) of flight, followed by a bright trace to a distance of not less than a 1,600-yard (1,463-meter) range from the gun.

M17 Tracer

The M17 cartridge is used for firing observation. It was originally designed to replace the tracer M1 cartridge. It can substitute for the API-T M20 except that penetration is not as great. The M17 tracers with deteriorated elements come linked together in groupings of four M17 tracers to one API-T M20. The M17 tracer rounds serve as ball rounds in that configuration. The brass cartridge case has a gilding metal-clad, steel jacketed bullet and the tip is brown for identification.
M1 Tracer
M1 cartridges are for use in .50 caliber machine guns for firing observation. Its only use is for training in the continental United States. For combat use, the tracer M17 cartridge replaces the M1 tracer. The cartridge is brass and the bullet has either a gilding metal or a gilding metal-clad steel jacket, a lead-antimony slug that fits the forward end of the jacket, and a tracer and igniter composition. The tip is red for identification. The bullet is cylindrical to the base (not boat-tailed), which is open to let the propelling charge ignite the tracer composition.

Linked Configuration
The .50 caliber cartridge for use in machine guns is issued in metallic link belts. The belts are made of unit cartridge links and cartridges—one link for each cartridge. Each link has two loops fitting around one cartridge and a third loop fitting around an adjacent cartridge.

Closed Loop Link
The .50 caliber M2 and M9 cartridge links (Figure 7-14) are manufactured with closed loops. When assembled in belts, the links sit on the cartridge shoulder to hold them in proper alignment for feeding into the weapon. Weapons designed for the closed-loop link belts require additional space for retraction in the rear of the receiver.

Open Loop Link
M15A2 links (Figure 7-14) are manufactured with partially open loops and have a positioning finger on one side that snaps into the cartridge extractor groove. The weapon bolt pushes the cartridge forward and out of the link into the weapon chamber. Weapons using the open-loop link belts are manufactured with a shorter receiver.

M2 Link
These links are intended for use in linking cartridges for use in .50 caliber machine guns (Browning M2HB, AN-M2 aircraft, and XM218). Weapons designed for use with these links require additional space in the rear of the receiver for extraction of the cartridge from the link. M2 links are manufactured with closed loops. When assembled with cartridges in belts, these links fit on the cartridge shoulder. The tapered front loops of these links are positioned firmly on the cartridge shoulder to hold the cartridge in proper alignment for feeding into the weapon. This design requires the cartridge to be extracted from the rear and dropped into position for feeding into the chamber for firing. The M2 link may be distinguished from the M9 link by a tab that protrudes from the top of the
single loop where it connects with the neck loop. In addition, the links are marked indicating if they are M2 or M9.

**M9 Link**

These links are intended for use in linking .50 caliber cartridges for use in .50 caliber machine guns (Browning M2HB, AN-M2 aircraft, and XM218). Weapons designed for use with these links require additional space in the rear of the receiver for extraction of the cartridge from the link. M9 links are manufactured with closed loops. When assembled with cartridges in belts, these links fit on the cartridge shoulder. The tapered front loops of these links are positioned only on the cartridge shoulder to hold the cartridge in proper alignment for feeding into the weapon. This design requires the cartridge to be extracted from the rear and dropped into position for feeding into the chamber for firing. The M2 link may be distinguished from the M9 link by a tab that protrudes from the top of the single loop where it connects with the neck loop. In addition, the links are marked, indicating if they are M2 or M9.

**M15A2 Link**

These links are open-looped and intended for use in linking .50 caliber cartridges for use with the M85 machine gun. M15A2 links are manufactured with partially closed loops and have a positioning finger on one side, which snaps into extractor grooves of the cartridge to retain the cartridge in proper feed alignment. The M15A2 link design permits a portion of the bolt to ride through link loop openings and push cartridges forward and out of the link into the chamber for firing.

**7.62 MM Ammunition**

The ammunition for the 7.62 mm weapon (*Figure 7-15*) was developed with the intention of replacing the .30 caliber carbine and rifle ammunition. The intent was to standardize the use and ease the supply and interchangeability within all NATO countries. This ammunition is commonly called 7.62 mm NATO ammunition.

**M80 NATO Ball**

M80 cartridges are used in the M60 series, Mark (Mk) 43, Mk 25 (GAU-2B/A), GAU-17, and M240 machine guns and the 7.62 mm M14 rifle against personnel and unarmored targets. The cartridge consists of a brass cartridge case and an unpainted bullet. The bullet is either gilding metal or gilding metal-clad steel jacket with a lead-antimony slug.

![Figure 7-15 — 7.62 cartridges.](image)
M62 NATO Tracer
M62 cartridges are used in M60 series, Mk 43, Mk 25 (GAU-2B/A), GAU-17 and M240 machine guns, and M14 rifles for signaling, incendiary, target designation, and range estimation. The cartridge consists of a brass cartridge case and a bullet with an orange tip for identification.

M60 NATO Test High-Pressure
The M60 cartridge is procured for proof-firing rifles, machine guns, and barrels. The propellant composition load results in a higher chamber pressure than other 7.62 mm cartridges. The excessive chamber pressure and the consequent danger when firing the M60 cartridge require certain safety precautions. These include test firing guns under a hood, from a fixed rest with a mechanical firing device. Only authorized personnel carry out these tests.

M63 NATO Dummy
The M63 dummy cartridge is completely inert and is used to train personnel in handling and loading 7.62 mm rifles and machine guns. The cartridge simulates service ammunition in detail to meet drill requirements. It is 2.80 inches (7.11 centimeters) long, weighs approximately 250 grains (16.20 grams), and contains neither primer nor propellant composition.

M64 NATO Grenade Rifle
M64 cartridges are used in M14 rifles. When assembled with the M76 grenade launcher, it projects high-explosive, fragmentation, illuminating, smoke, and chemical grenades. Another use is to launch ground signals and the projectile contained in the Mk 87 Line-Throwing Rifle Adapter Kit.

M82 NATO Blank
The M82 cartridge is used in rifles and machine guns for training programs with 7.62 mm weapons. The cartridge consists of a 2.61-inch (6.63-centimeter) long brass cartridge case loaded with 14.5 grains (0.94 gram) of propellant composition (SR 8231) and a primer. The case is shaped approximately to the configuration of the combat cartridge with no bullet. The propellant is held in the case by a wad, and the mouth is sealed with purple lacquer and crimped (with more than five petals) for protection against air and moisture.

M118 NATO Match/Special Ball
The M118 NATO match/special ball cartridges are used in the M14 rifle, as well as the Remington 700 and McMillan M86 sniper rifles for target practice and the Navy competitive match programs.

M118 NATO Special Ball Long Range
The M118 NATO special ball long range cartridge is used in the M14 rifle, as well as the Remington 700 and McMillan M86 sniper rifles. The cartridge is intended for practice and Navy competitive match programs.

NATO 5 Round Clips
Cartridges for the 7.62 mm M14 rifles are assembled in five-round clips.
All cartridges are packed in bandoleers with separate magazine fillers. The clip, which consists of a channel-shaped body containing a spring, facilitates loading of magazines. Loaded clips are fitted into the top of the rifle receiver and cartridges are pressed into the magazine assembly. Magazine filler, which adapts clips to the magazine, allows individual magazines to be loaded with clipped ammunition.
M276 Dim Tracer

The M276 cartridge is used with night vision devices (NVDs) where the use of a standard tracer cartridge would cause “blooming,” rendering the NVDs ineffective for a short time. The cartridge is designed for use in M60 series, Mk 43 and M240 machine guns, and GAU-17 and GAU-2/B miniguns for signaling, target designation, and range estimations. The cartridge consists of a brass cartridge case and a bullet with identifying markings. On the older cartridge, the bullet has a green tip above a white band. On the newer cartridge, the bullet has a purple band superimposed on a pink tip.

M80E1 Flash Suppressed

M80E1 cartridges are used with NVDs where the use of a standard M80 ball cartridge would cause “blooming.” The cartridge is designed for use in M60 series, Mk 43 and M240 machine guns, and GAU-17 and GAU-2/B minigun.

M993 Armor-Piercing

The M993 cartridge is loaded with flash-suppressed propellant designed for use with NVDs. Flash-suppressed propellants reduce "blooming." The M993 cartridge is designed for use in M60 series, Mk 43 and M240 machine guns, and GAU-17/A and GAU-2B/A aircraft "minigun" machine guns. The cartridge consists of a cartridge case, primer, propellant, and bullet. The bullet has a black band that is approximately 0.5 inch (1.27 centimeters) wide.

Belts and Clips

Typically .50 and 7.62 caliber small arms ammunition are packed and issued in two primary methods, belts and clips.

Belts

The unit issue for ammunition used in machine guns is metallic link. Ammunition packed in web belts is no longer used. The makeup of the metallic link belt is unit cartridge links and cartridges—one link for each cartridge. Each link has two loops fitting around one cartridge and a third loop fitting around one adjacent cartridge. A process applied at manufacture of the steel links prevents rusting. The 7.62 mm M13 belt links (Figure 7-16) have partially open loops and a positioning finger on one side. The positioning finger snaps into the extractor groove of the cartridge permitting the weapon bolt to push the cartridge forward out of the link and into the chamber. Weapons using this type link come from the manufacturer with a short receiver.

Clips

The five-round 7.62 mm cartridge clip consists of a channel-shaped body containing a spring and holds five cartridges. The purpose of the clip is to facilitate loading the magazine of the 7.62 mm M14 rifle. The loaded clip fits into the top of the rifle receiver. The thumb is used to press the cartridges into the magazine assembly.
LINKLESS AMMUNITION LOADING SYSTEM
A/E32K-7

The LALS (Figure 7-17) consists of an ammunition loader, ammunition transfer system, or an ammunition replenisher. The components of the LALS allow a load of 1,800 rounds of 20 mm ammunition to be simultaneously loaded, and download the spent cases and unfired rounds.

Components

A brief description of the components in the LALS is contained in the following paragraphs.

Ammunition Loader

The ammunition loader (Figure 7-18) is a mechanical ammunition storage and loading device driven by a handcrank or a pneumatic drive tool. It consists of four weapons replaceable assemblies (WRAs): a storage container, conveyor assembly, transfer unit assembly, and support frame assembly. The support frame assembly consists of three shop replaceable assemblies (SRAs): a forward housing assembly, aft housing assembly, and base frame assembly.

Figure 7-18 — Ammunition loader.
Ammunition Replenisher

The ammunition replenisher (Figure 7-19) is a mechanical ammunition feed device, which interfaces with the ammunition loader during replenishment. It consists of a load tray assembly, dump tube chute assembly, replenisher interchange assembly, and replenisher mounting base assembly.

GFU-24A/E32K-7 Ammunition Transfer System

The ammunition transfer system (Figure 7-20) is used to load 20 mm rounds of ammunition into and from the ammunition loader. The ammunition transfer system can be operated by a handcrank or can be driven by pneumatic or electric tools.

The system has three major components, a table assembly, a removable frame, and an interchange loading assembly. The system can be operated using the table assembly, or the removable frame and interchange loading assembly can be used independently and attached to the loader directly.

Table Assembly

The table assembly is an assembly that supports both the removable frame assembly and interchange loading assembly. The assembly is a welded frame with two large solid rubber tires, two smaller swivel casters, a round collection bin, two ammunition container support plates, and two
adjustable rear shelf supports. All of the tires and caster have braking mechanisms. The large diameter tires allow easy transport over rough terrain and the large tire footprint helps the unit to remain stationary during loading operations.

**Removable Frame Assembly**

The removable frame assembly is a frame that supports the interchange loading assembly. The frame is designed to be used either on the table assembly or used independently. When used separately, the removable frame assembly is physically removed from the table assembly. Arms located on the frame are raised and locked into position, prior to removal from the table. Once removed, the frame and interchange assembly are mounted directly to the LALS loader using mounting lugs located on the loader. The removable frame can be mounted on either of two positions on the loader.

**Interchange Loading Assembly**

The interchange loading assembly is the main body of the ammunition transfer system. The interchange loading assembly is the mechanism that transfers ammunition rounds to and from the aircraft interface unit (AIU). The interchange loading assembly also includes a load tray assembly and a download assembly. The system also has a rounds counter, a planetary reduction gear, and a handcrank that can be stowed on the interchange assembly when not in use. The ammunition transfer system incorporates an auto detection system that will automatically stop the system, should an empty element space occur. In the event that an empty space is detected, the operator can place a round into the empty element in the transfer system. Override of the automatic shutdown feature, auto detection system, can be accomplished by using the pawl override. Pawl override permits continued operation in either direction. The downloaded unfired rounds and spent cases are separated into the rounds collection bin and spent case exit.

**Operation**

Operation of the LALS is divided into four modes: replenishment mode, aircraft servicing mode, transport mode, and storage mode. Replenishment mode is an intermediate-level function and aircraft servicing mode is an organizational-level function.

**Replenishment mode**

To load the ammunition loader, the access door is unlatched, folded up and back to the open position, and secured. The ammunition transfer system is used either with the table assembly or attached directly to the loader using the removable frame assembly (Figure 7-20). Remove the AIU from the stowed (Figure 7-21) position and attach to the ammunition transfer assembly.

One empty ammunition container is placed beneath the ammunition transfer system. The container collects the spent cases downloaded from the ammunition loader.

**Figure 7-21 — AIU stowed position.**
Ammunition is hand-fed into the load tray assembly. The ammunition transfer system is driven either by handcrank or using pneumatic or electric hand tools. The ammunition is transferred from the load tray assembly and the rounds are transferred to the interchange system’s conveyor belt elements.

The ammunition rounds are then handed off from the conveyor belt elements to the AIU and conveyor assembly ammunition chutes. In the ammunition loader transfer unit the single stream of ammunition is divided into three streams, decelerated, and transferred into the three bays in the storage container assembly. At the same time, the spent cases and unfired rounds are downloaded from the ammunition loader through the lower half of the transfer system interchange assembly. The ammunition is transferred from the download rotor on the AIU into the conveyor belt assembly located in the interchange assembly. As the ammunition moves along the bottom of the conveyor belt assembly, the spent cases fall into a spent case container. Unfired rounds continue further upstream into the download ramp and into the rounds collection bin where they are then manually picked up and placed into ammunition containers.

**Aircraft Servicing**

The M61A1/A2 aircraft gun system can be serviced while simultaneously removing expended casings and unfired rounds. To service the aircraft gun system, the aircraft gun feed system (AGFS) must be timed. The AIU is positioned to provide operator crew access. The AIU shift lever handle (Figure 7-22) is placed in the down (BYPASS) position, the manual drive knob is rotated to align the AIU to the timed position, and the timing pin is engaged. The AIU is then attached to the AGFS and the timing pin is disengaged. The AIU shift lever handle is then placed in the up (LOAD) position. A hand crank or pneumatic drive tool is attached to the AGFS gun drive socket and is used to cycle the ammunition through the storage container assembly into the aircraft gun systems. As the rounds from the three bays in the loader travel through the terminal drive sprockets, they are fed into the lower half of the transfer unit. All three streams of ammunition are merged and accelerated into a single stream of ammunition.

From the transfer unit assembly, the ammunition is driven through the lower half of the conveyor chute assembly into the AIU and is passed into the aircraft gun system. At the same time, unfired rounds and spent cases are downloaded through the upper rotor of the AIU into the upper half of the conveyor chute assembly. At the transfer unit assembly, the single stream is decelerated, divided into three streams, and transferred into the three bays of the storage container assembly.

**Transport Mode**

In the transport mode, the ammunition loader is used to transport ammunition from the magazine to the aircraft. It can be mounted on a variety of transporters and trailers. A forklift truck can be utilized to move the ammunition loader short distances. Forklift guides are an integral part of the mounting base assembly. When ashore, the ammunition loader will be transported on an A/M32K-4A, MHU-126/M, MHU-126A/M, MHU-151/M, or MHU-202/M trailer. Afloat, the ammunition loader will be mounted on an MHU-191/M munitions transporter.
Stowage Mode

The ammunition loader or ammunition transfer system (Figure 7-23) will be stored in a designated storage area. The ammunition loader or ammunition transfer system must be empty of all ammunition and spent cases.

To ensure the ammunition loader is empty, three marked dummy rounds are cycled completely through the storage container assembly, transfer unit assembly, and conveyor assembly. A dummy round will also be cycled through the ammunition transfer system prior to storing it. The ammunition loader can be moved to the designated storage area with a forklift or a chain hoist and rail system. A lifting beam mounted in the ammunition loader is used to attach the ammunition loader to the chain hoist. The lifting of the ammunition loader should be accomplished by at least two personnel to ensure the ammunition loader is under control at all times. Both the ammunition loader and the ammunition transfer assembly are secured to the deck using tie-downs.

For further information on the LALS A/E32K-7, refer to Intermediate Operation and Maintenance Instructions with Illustrated Parts Breakdown Linkless Ammunition Loading System A/E32K-7A, Commander, Naval Air Systems Command (NAVAIR) 19-1-269.
SAFETY PRECAUTIONS

The following general safety precautions are not related to any specific equipment or procedure. These precautions are recommended safety precautions that all personnel should follow when operating and maintaining equipment.

- All persons who supervise or perform work in connection with the ammunition handling should be familiar with the Explosives Safety Accidents and Lessons Learned, Commander, Naval Sea Systems Command (NAVSEA) SW020-AD-SAF-010
- Personnel must be certified for handling aviation ordnance in accordance with the requirements of current instructions/directives
- Before undertaking any operation for which a checkoff list exists, you must read the checkoff list to all personnel who will take part in the operation
- When provided, always use safety devices to prevent accidents; keep safety devices in good operating order at all times
• Electrically primed ammunition can be fired by percussion; NEVER cycle live ammunition through a gun for testing purposes

• The explosive elements in electric primers are highly sensitive to static electricity; make sure the primer button does not come into contact with the human body

• Observe fire regulations and maintain good ventilation when using cleaning solvents and other volatile maintenance materials

• Before performing maintenance actions involving pneumatic or hydraulic pressurized components, ensure that all pressure is removed and the component is in the safest possible condition

• No ammunition or explosive assembly shall be used in any gun or equipment for which it is not designated, nor shall any explosive or pyrotechnic device be manufactured, purchased, or assembled for use in displays, demonstrations, tests, or for any other purpose unless authorized by NAVSEA

• When test firing is conducted using live ammunition, observe all existing range regulations

• Strict compliance with procedures and precautions in NAVSEA OP 3565/NAVAIR 16-1-529/NAVELEX 0967-LP-624-6010 is mandatory when in a hazards of electromagnetic radiation to ordnance (HERO) environment
End of Chapter 7
Ammunition Loading

Review Questions

7-1. A complete M50 service cartridge consists of what total number of components?
   A. Two
   B. Three
   C. Four
   D. Five

7-2. Which of the following cartridge cases is made of steel?
   A. M101
   B. M102
   C. M103A1
   D. M105B

7-3. All projectiles have essentially the same configuration with the exception of which of the following projectiles?
   A. High explosive incendiary
   B. High pressure test
   C. Target practice
   D. Target practice-tracer

7-4. Which of the following statements is one way to identify the type of 20 mm ammunition?
   A. The color of the cartridge and the color of the letters
   B. The painted color on the projectile and the lettering on the body
   C. The shape, size, and lettering on the bullet
   D. The weight of the cartridge and the bullet

7-5. The semi-armor-piercing high explosive incendiary (SAPHEI) cartridge has which of the following projectile gun unit designations?
   A. PGU-27/B and PGU-27A/B
   B. PGU-28/B and PGU-28A/B
   C. PGU-30/B and PGU-30A/B
   D. PGU-31/A and PGU-32/B

7-6. The M50/projectile gun unit series ammunition is normally packed in what container?
   A. M548
   B. M549
   C. M559
   D. M600
7-7. A small arms cartridge is an assembly consisting of a cartridge, a primer, and what other component?

A. Bullet  
B. Firing pin  
C. Link  
D. Triple base propellant

7-8. Ball cartridges are used against what type of targets?

A. Armored and unmanned aircraft  
B. Personnel and armored vehicles  
C. Personnel and unarmored targets  
D. Unarmored vehicles and aircraft

7-9. What type of .50 caliber cartridge is used against combustible targets?

A. Ball  
B. Incendiary M1  
C. Tracer  
D. Tracer M10

7-10. Which of the following .50 caliber cartridge configurations is used in the aircraft machine gun?

A. Five-round clips  
B. Loose rounds in cardboard boxes  
C. Metallic link belts  
D. Single rounds in ammo boxes

7-11. What cartridge is used in the GAU-17, M240, and M14 rifle for signaling, incendiary, target designation, and range estimation?

A. NATO ball, M80  
B. NATO match/special  
C. NATO test, high-pressure M60  
D. NATO tracer, M62

7-12. The linkless ammunition loading system A/E32K-7 consists of the ammunition loader, ammunition transfer system, or what other component?

A. Ammunition delinking assembly  
B. Ammunition replenisher  
C. Case stowage assembly  
D. Conveyor
7-13. What weapons handling equipment is used with the LALS when afloat?

A. MHU-126
B. MHU-151
C. MHU-191
D. MHU-202

7-14. What action must be done to ensure that the ammunition loader is empty?

A. One round must be cycled completely through the storage container assembly
B. Six marked dummy round must be cycled completely through the storage container assembly, transfer unit assembly, and conveyor assembly
C. The storage container assembly must be cycled until the last round comes through
D. Three marked dummy rounds must be cycled completely through the storage container assembly, transfer unit assembly, and conveyor assembly

7-15. In what type of environment must transporter loading or downloading operations be conducted?

A. Hazard of electronic moisture content to ordnance-free
B. Hazards of electromagnetic radiation to ordnance-free
C. Noise-free
D. Vibration-free

7-16. To prevent explosive primers on gun ammunition from being exposed to static electricity, what action should be taken?

A. Apply grease to the primer
B. Install the safety protective cover on all primer buttons to keep it safe
C. Keep the cardboard covers on the primer button
D. Make sure that the primer button of the ammunition doesn't come into contact with the human body
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