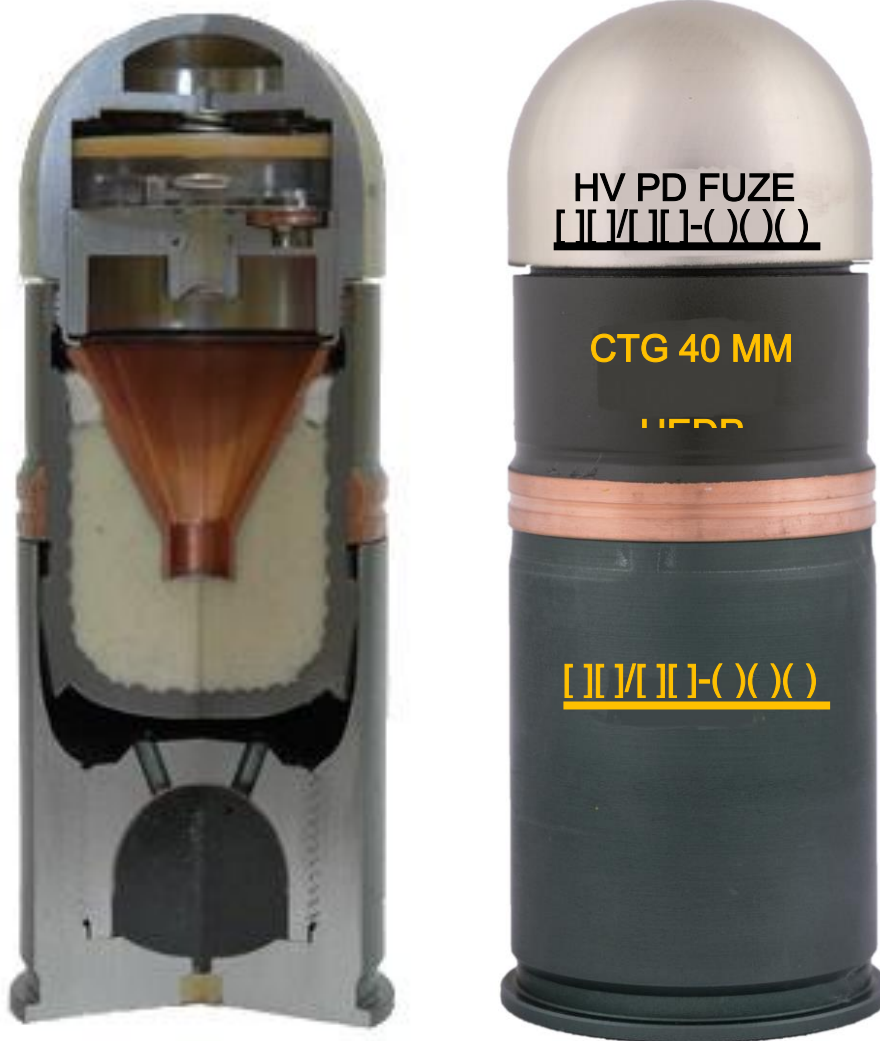




**ADVANCED MATERIAL ENGINEERING PTE LTD  
40MM HIGH VELOCITY HIGH EXPLOSIVE DUAL  
PURPOSE CARTRIDGE  
FOR: 40mm Automatic Grenade Launchers**

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TM\_085X000

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## **1 INTRODUCTION**

The 40mm High Velocity High Explosive Dual Purpose (HEDP) ammunition is a high explosive dual purpose round designed to defeat 2.5 inches thick mild steel or 60mm thick light armour (RHA) steel as well as providing anti-personnel fragmentation effects.

It can be fired from the CIS 40AGL, US MK19 Mod 3, MK 47 Mod 0, Heckler & Koch Grenade Machine Gun (H&K 40GMG) and all approved 40mm Automatic Grenade Launchers at a range up to 2,200 meters. The cartridges are linked in belt of 32 rounds and packed in a PA 120 steel box.

## **2 GENERAL DESCRIPTION**

The 40mm HV HEDP Cartridge is a fixed round ammunition consisting of a point initiating base detonating (PIBD) fuze, an internally embossed steel shell body assembled with a copper driving band, and a cartridge case assembly. The fuze is threaded into the front opening of the shell body to form the projectile. The shell body cavity contains a shaped-charge and filled with explosive charge consisting of Comp A5, which is initiated by a spitback charge at the base of the fuze.

The projectile body is crimped onto the cartridge case assembly, which has a high-pressure combustion chamber. It is formed by a closing plug threaded into the open end of the cartridge case. A percussion primer is fitted into the center of the base of cartridge case. A hemispherical copper cup sits inside the combustion chamber and contains the propellant charge.

## **3 FUNCTIONING**

On firing the weapon, its firing pin strikes the percussion primer, igniting the propelling charge in the high-pressure chamber. The expanding gases from the burning propellant are forced from the high-pressure chamber through vent holes in the closing plug into the low-pressure chamber. The built-up pressure propels the projectile forward, thus engaging the driving band of the projectile onto the rifling of the barrel. The projectile leaves the muzzle at a velocity of 242 m/s and at a spin rate of 12,000 rpm.

The cartridge case contains the propellant charge and primer cap. The deep drawn aluminium case is anodised to protect from corrosion.

#### **4 FUZE FUNCTION**

The acceleration of the projectile retracts the setback pin and the accompanying spin retracts the detent which jointly holds the fuze rotor in the safe position. Dynamic imbalance causes the rotor to rotate to the armed position where the detonator is in line with the firing pin. A fuze escapement mechanism retards rotor movement, thus delaying arming until the projectile has reached a minimum safe distance from the launcher.

Upon impact at the target, the Safe & Arm flies forwards and causes the detonator to hit the point detonating firing pin, thus igniting the spitback charge. This in turn detonates the explosive charge causing a blast and fragmentation of the projectile body and a penetrating jet of metal particles from the liner with armour piercing properties.

#### **5 FUZE SAFETY**

This fuze meets the safety and functional requirements of specific environmental tests in accordance with MIL-STD-1316, MIL-STD-331 and STANAG 4187.

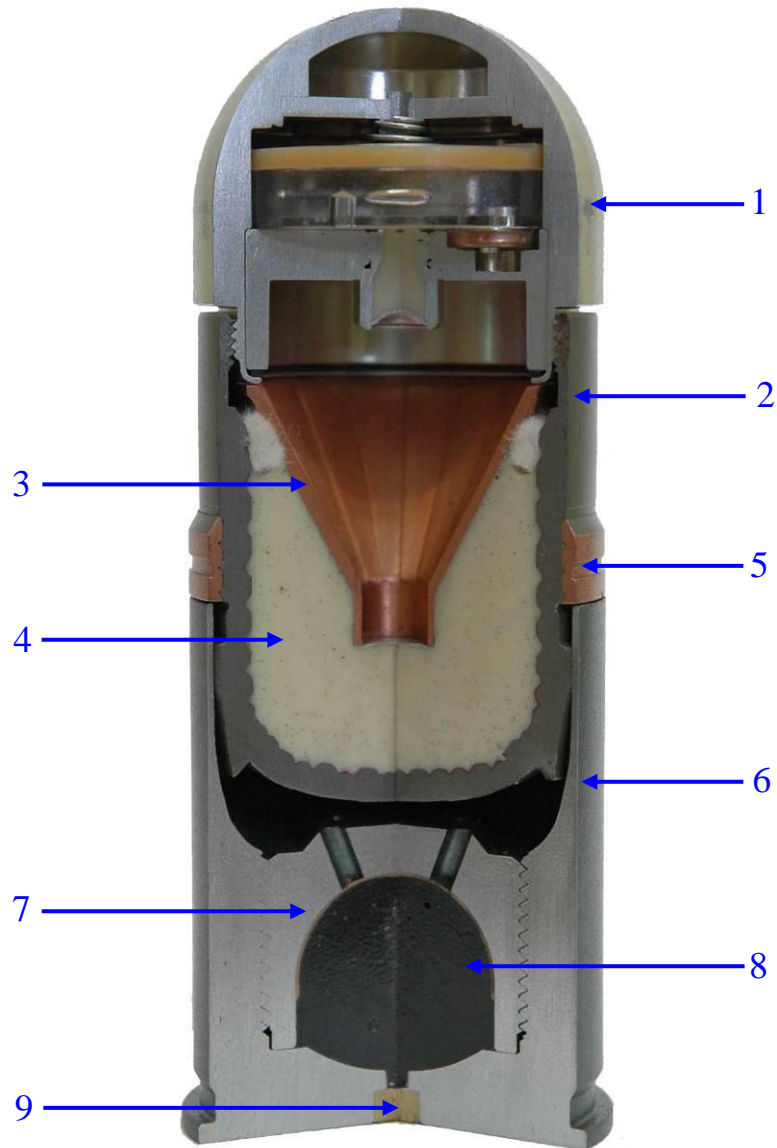
#### **6 CARTRIDGE EFFECTIVENESS**

The effectiveness of the projectile against personnel targets is ensured by consistent high order detonation of the explosive charge and fragmentation of the shell body as the inner surface of the steel shell body is embossed with hexagonal patterns. This results in a regular dispersion of fragments, with a lethal radius of 5m. The shaped-charge explosive effect will defeat most of current armoured personnel carriers.

Accurate delivery of the rounds onto targets is ensured by consistent muzzle velocities and aerodynamically stable projectiles. These result in uniform trajectories, which contribute to predictable target engagement.

**7 TECHNICAL DESCRIPTION (Figure 1)**

- |                  |   |
|------------------|---|
| Fuze             | (1) The nose fuze is a point initiating base detonating (PIBD). Its design ensures muzzle and detonation safety.  |
| Projectile body  | (2) The shell body is made of drawn steel and the inner surface is embossed with hexagonal patterns that form uniform fragments upon detonation.  |
| Shape-charge     | (3) The shaped-charge fluted liner is made of copper and its effect will defeat most of the current armoured personnel carriers.  |
| Explosive charge | (4) The explosive charge consists of approximately 35 grams of Composition A5 pressed into the steel shell body.  |
| Driving band     | (5) The driving band is pressed and crimped onto the projectile body and is machined from copper material.  |
| Primed case      | (6) The primed case has a high-pressure combustion chamber. It is formed by a closing plug (7) threaded into the open end of the cartridge case that the propellant (8) is filled. A percussion primer (9) is fitted into the center of the cartridge case base. The closing plug forms the high-pressure chamber and the hollow cavity in the case acts as a low-pressure chamber. |



**Figure 1**

## 8 TECHNICAL DATA

### 8.1 Complete Round

- |                      |                                 |
|----------------------|---------------------------------|
| 1. Type              | HEDP                            |
| 2. Weight            | approx. 350 g                   |
| 3. Length            | 112 mm                          |
| 4. Used with weapons | CIS 40AGL, H&K GMG, MK 19 Mod 3 |
| 5. Link              | M16A2 metal link                |

### 8.2 Projectile

- |                      |  |
|----------------------|--|
| 1. Body material     | Blanked and drawn steel                        |
| 2. Colour            | Olive drab with white marking and yellow ogive |
| 3. Explosive filling | Comp A5 (NEQ per round: 35.1 g)                |
| 4. Explosive density | 1.6 g/cc                                       |
| 5. Weight            | approx. 250 g                                  |
| 6. Fuze              | PIBD Fuze                                      |

### 8.3 Fuze

- |                    |                       |
|--------------------|-----------------------|
| 1. S&A             | Mechanical            |
| 2. Arming          | a) spin<br>b) setback |
| 3. Arming Distance | 18 to 40m             |
| 4. Spitback        | CH6                   |
| 5. Detonator       | M55                   |

### 8.4 Propulsion Unit

- |                   |                       |
|-------------------|-----------------------|
| 1. Cartridge Case | Bi-chamber, aluminium |
| 2. Propellant     | Double base           |
| 3. Primer         | Percussion            |

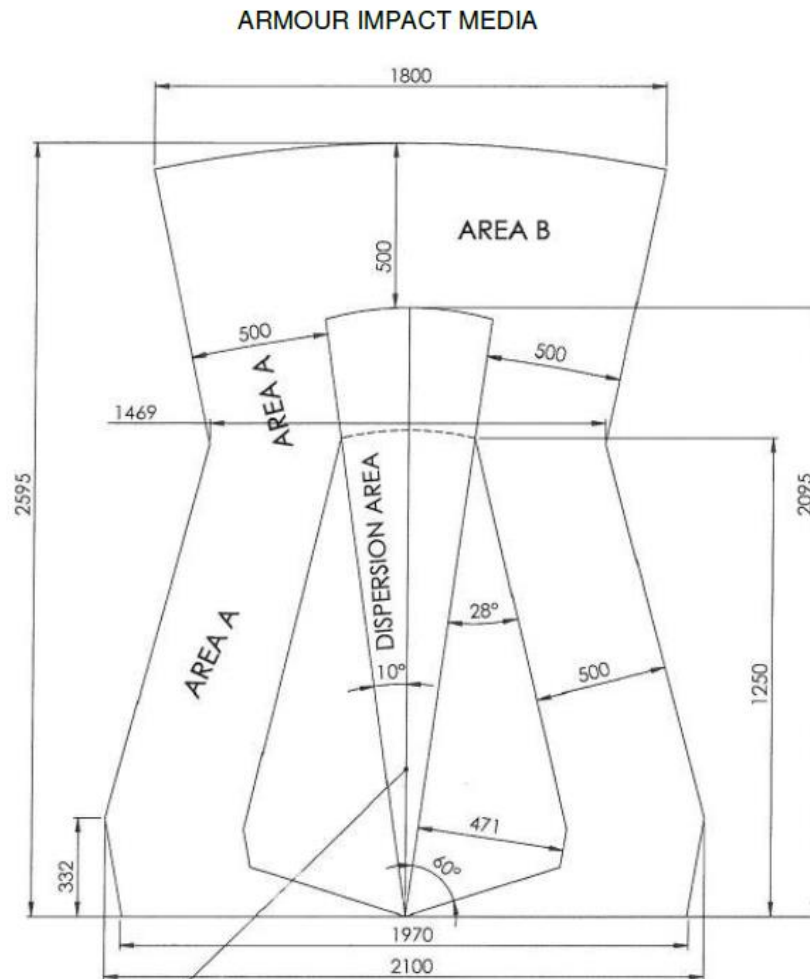
### 8.5 Performance

- |                    |  |
|--------------------|--|
| 1. Muzzle velocity | 242 m/s                                |
| 2. Maximum range   | 2,200 m                                |
| 3. Lethal radius   | 5 m                                    |
| 4. Penetration     | 2.5" thick mild steel (60mm thick RHA) |

**8.6 Ballistic Data**

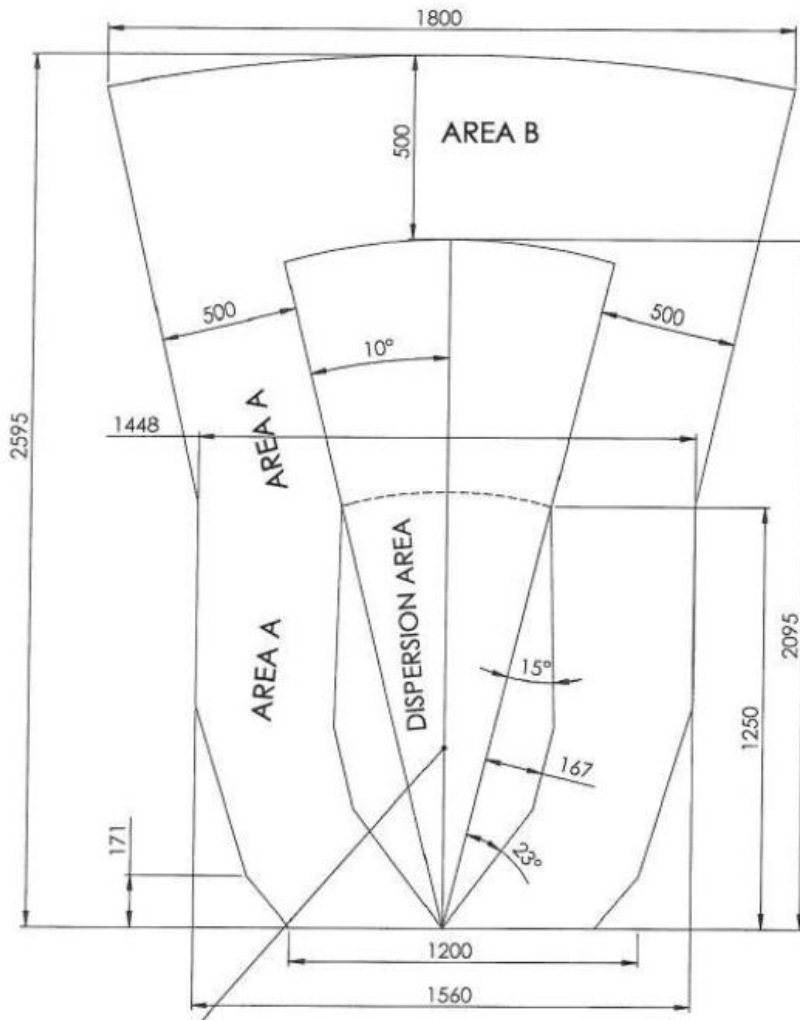
FIRING TABLE FOR 40 MM HIGH VELOCITY GRENADE (HV HEDP)										
RANGE	SUPER- ELEVATION	DX/DSE	DH/DX	DRIFT	TIME OF FLIGHT	10 KM/HR CROSS- WIND DEFLECTION	MAXIMUM ORDINATE	RANGE TO MAXIMUM ORDINATE	ANGLE OF FALL	REMAINING VELOCITY METERS/ SEC
		METERS/ MIL	METERS/ 100M							
0	0	12	0	0	0	0	0	0	0	242
<b>100</b>	<b>8.8</b>	<b>11</b>	<b>0.9</b>	<b>0.5</b>	<b>0.4</b>	<b>0.3</b>	<b>0.2</b>	<b>50</b>	<b>9</b>	<b>229</b>
200	18.4	10	1.9	1	0.9	0.7	0.9	102	20	216
300	28.7	9	3.1	1.5	1.3	1	2.2	154	32	205
400	39.8	9	4.5	2.1	1.9	1.4	4.2	207	46	194
<b>500</b>	<b>51.8</b>	<b>8</b>	<b>6.1</b>	<b>2.7</b>	<b>2.4</b>	<b>1.8</b>	<b>7</b>	<b>262</b>	<b>62</b>	<b>183</b>
600	64.9	7	8	3.4	3	2.2	10.7	317	81	173
700	79.1	7	10.1	4.1	3.5	2.6	15.5	373	102	164
800	94.4	6	12.5	4.9	4.2	3.1	21.6	429	127	155
900	111.2	6	15.3	5.8	4.9	3.5	29.1	487	154	147
<b>1000</b>	<b>129.5</b>	<b>5</b>	<b>18.5</b>	<b>6.8</b>	<b>5.6</b>	<b>4</b>	<b>38.4</b>	<b>546</b>	<b>186</b>	<b>140</b>
1100	149.7	5	22.2	7.9	6.3	4.5	49.8	606	222	133
1200	171.8	4	26.4	9.2	7.2	5	63.7	666	263	126
1300	196.3	4	31.4	10.6	8	5.6	80.4	727	310	120
1400	223.6	3	37.2	12.2	9	6.2	100.8	789	363	115
<b>1500</b>	<b>254.2</b>	<b>3</b>	<b>44.1</b>	<b>14</b>	<b>10</b>	<b>6.9</b>	<b>125.5</b>	<b>852</b>	<b>423</b>	<b>110</b>
1600	289.2	3	52.3	16.2	11.2	7.6	156	915	491	106
1700	329.8	2	62.4	18.8	12.4	8.4	193.9	980	568	103
1800	378.5	2	75.2	22.1	13.9	9.3	242.7	1045	657	100
1900	440.9	1	92.9	26.5	15.7	10.5	309.5	1112	762	99
<b>2000</b>	<b>534.5</b>	<b>1</b>	<b>122</b>	<b>33.8</b>	<b>18.2</b>	<b>12.2</b>	<b>416.4</b>	<b>1179</b>	<b>901</b>	<b>99</b>
ELEVATION - DEGREES						5	10	15	30	38
RANGE - METERS						765	1225	1537	1999	2051
MAXIMUM ORDINATE - METERS						19	68	136	415	579
DH=Change in Height										
DX=Change in Range						Source: 40mm HV HEDP				
DSE=Change in Superelevation						Limit cycle in drag curve				

## 8.7 Safety Template



Minimum Engagement  
Range is 310m

*Reference to Range Safety Document DA PAM 385-63, 16 APRIL 2014*

**EARTH IMPACT MEDIA**


Minimum Engagement  
Range is 310m

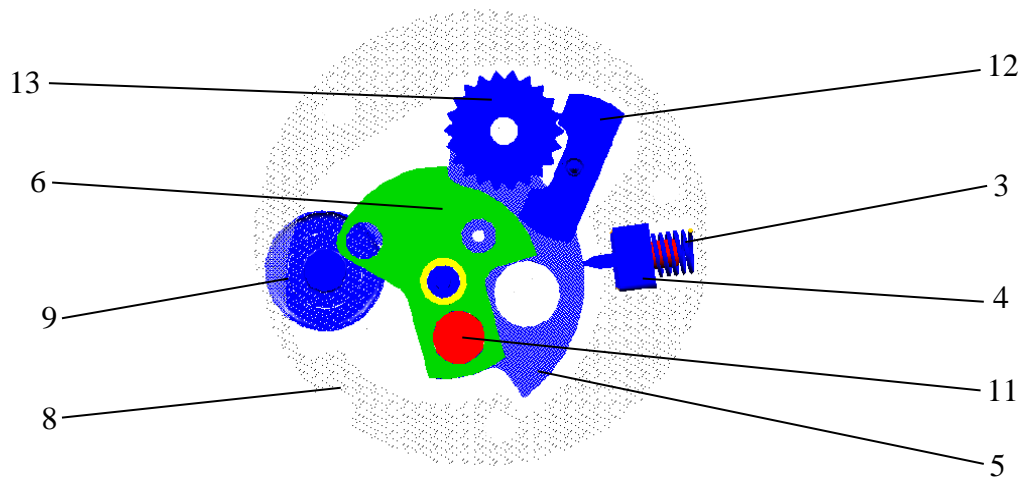
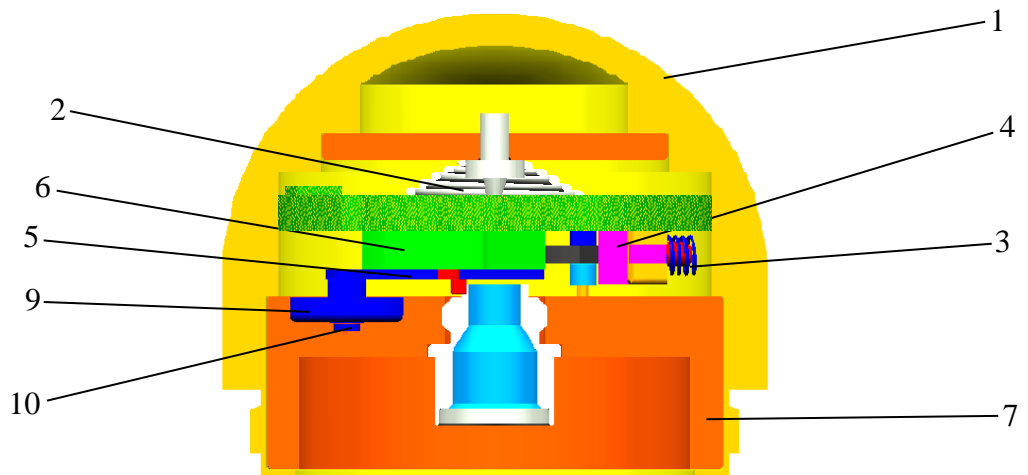
*Reference to Range Safety Document DA PAM 385-63. 16 APRIL 2014*

## **9 FUZE**

### **9.1 Point Initiated Base Detonating (PIBD) Fuze**

#### **9.1.1 Fuze components (Figure 2)**

- 1 Ogive
- 2 Conical Spring
- 3 Detent Spring
- 4 Detent
- 5 Sector Gear
- 6 Rotor
- 7 Support Bottom
- 8 Escapement Assembly (S & A)
- 9 Setback Spring
- 10 Setback Pin
- 11 Detonator, Stab M55
- 12 Verge Assembly
- 13 Pinion Assembly

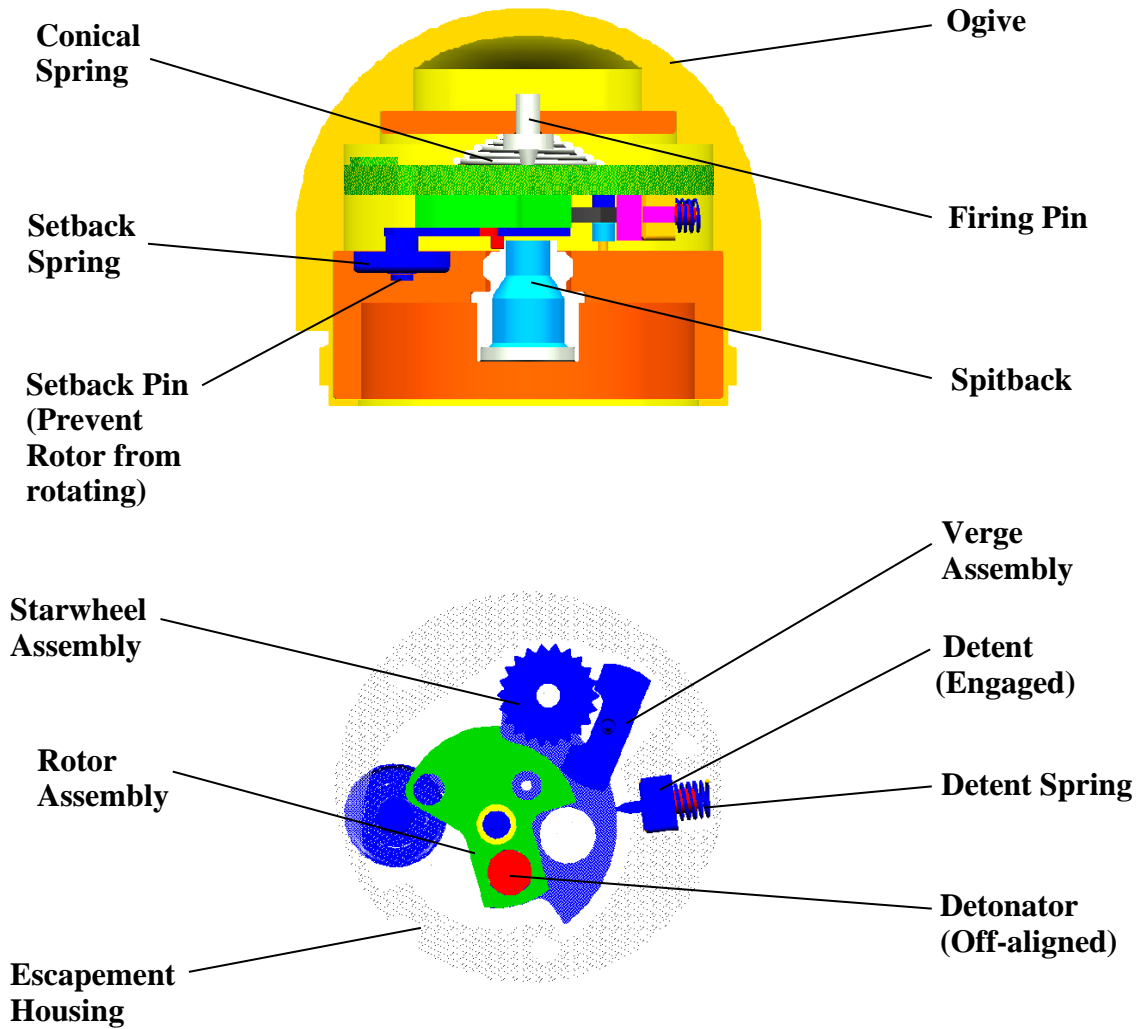


**Figure 2: Fuze Components**

### 9.1.2 Fuze Functions

#### Fuze Safe (Figure 3)

The Detent and the Setback Pin lock the Rotor Assembly in an unaligned 'SAFE' position. The Setback Pin will only function when a setback force is exerted on the projectile i.e. when projectile is propelled through the muzzle.



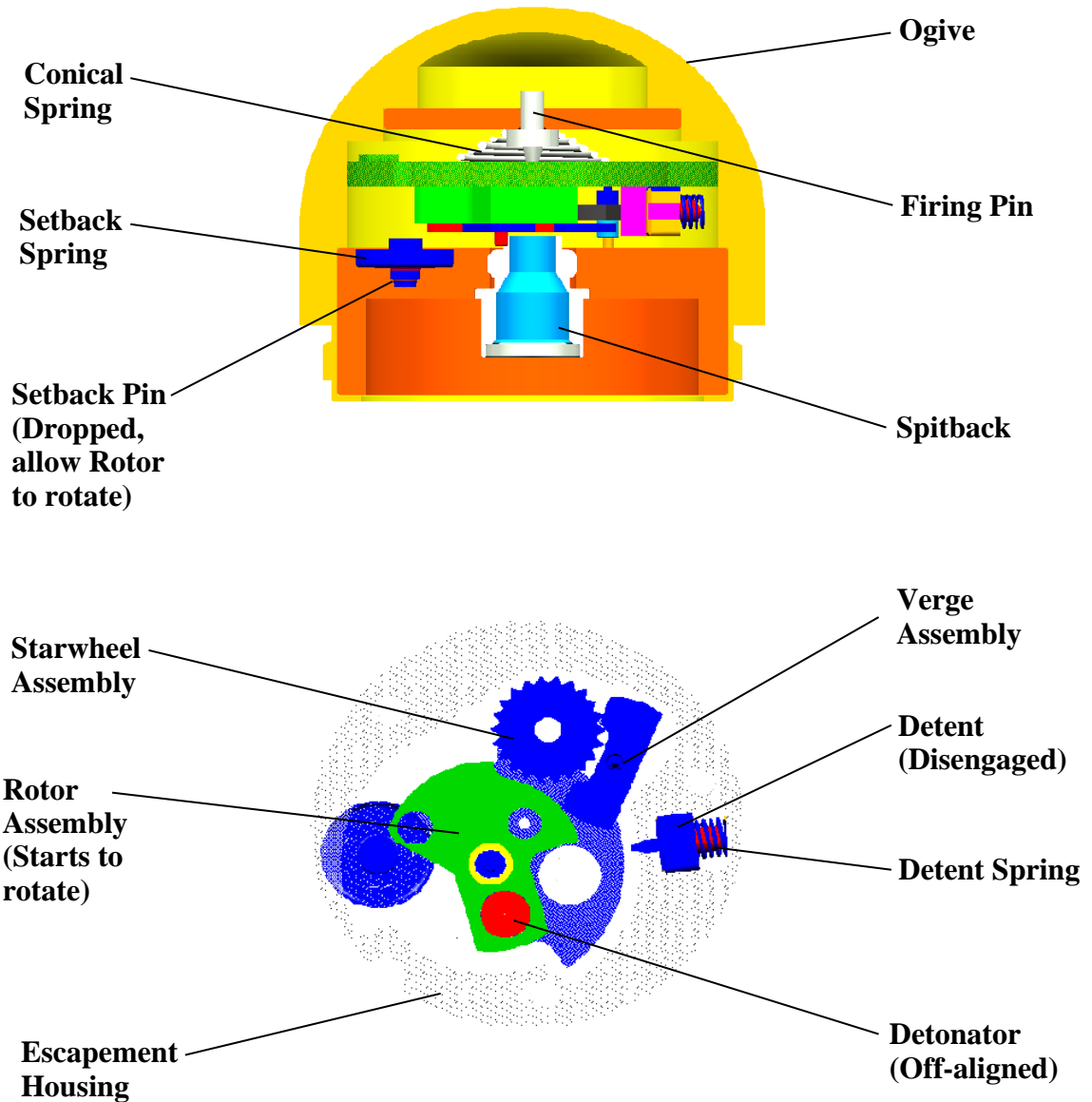
**Figure 3: Fuze Safe**

#### Muzzle Safety (Figure 4)

When fired, the Setback Pin is retracted as the projectile experiences a setback force during launch. As the projectile is accelerated up the barrel and driven into rotation, and due to the axially acting acceleration forces and the friction resistance arising, the rest of the fuze components remain in their positions. The fuze remains secured and barrel safety is guaranteed.

After leaving the barrel muzzle, the projectile has reached the full speed of rotation at muzzle (spin). Acceleration has fallen to zero. Under the influence of the radial acting centrifugal forces, the Detent is retracted thus allowing the Rotor Assembly to rotate into the armed position. However, due to the Verge Assembly and the Starwheel, the Fuze shall not arm itself until after it has reached its arming distance.

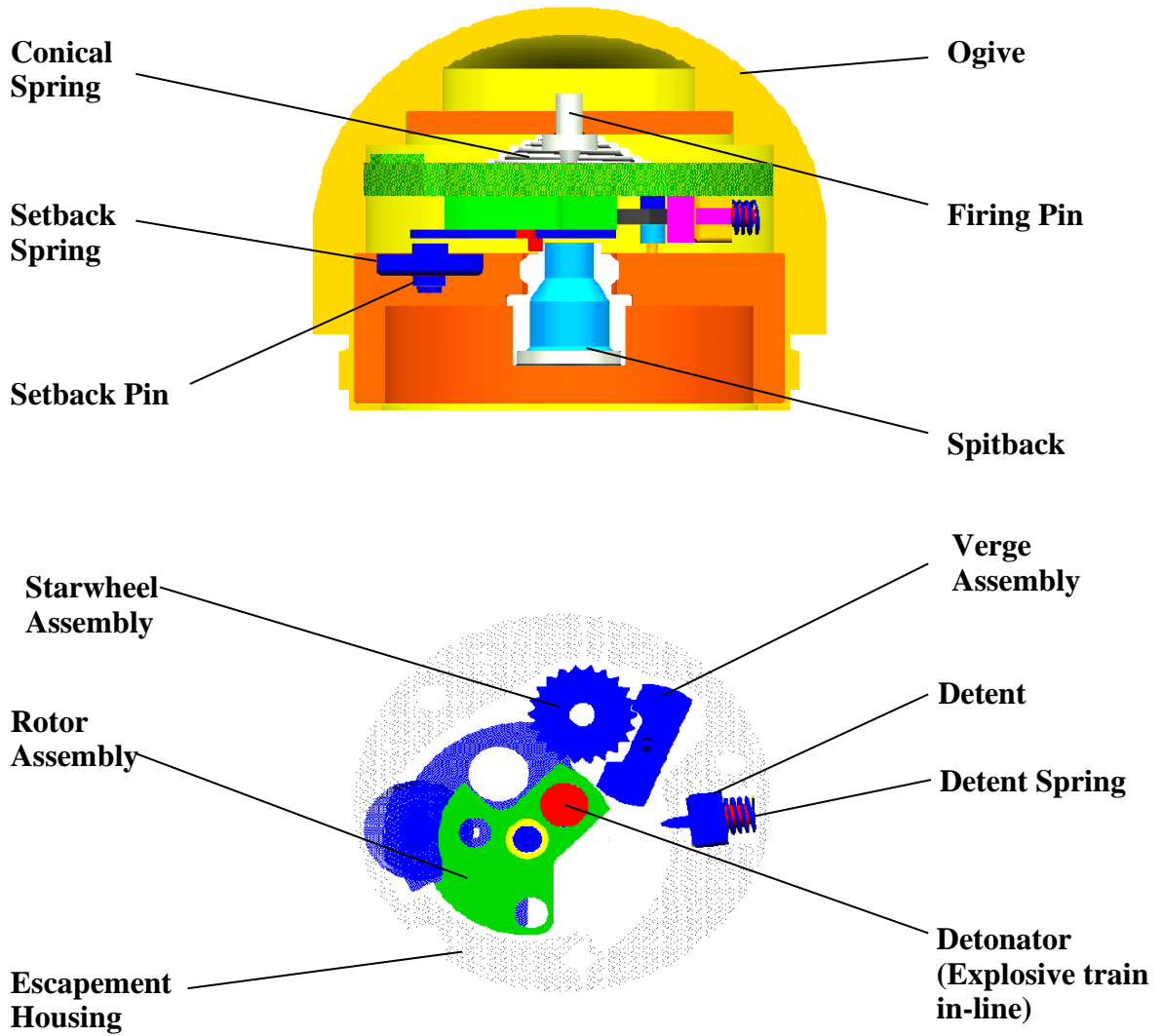
The timing of these fuze functions guarantees a minimum muzzle safety of 18m.



**Figure 4: Muzzle Safety**

### Fuze Armed (Figure 5)

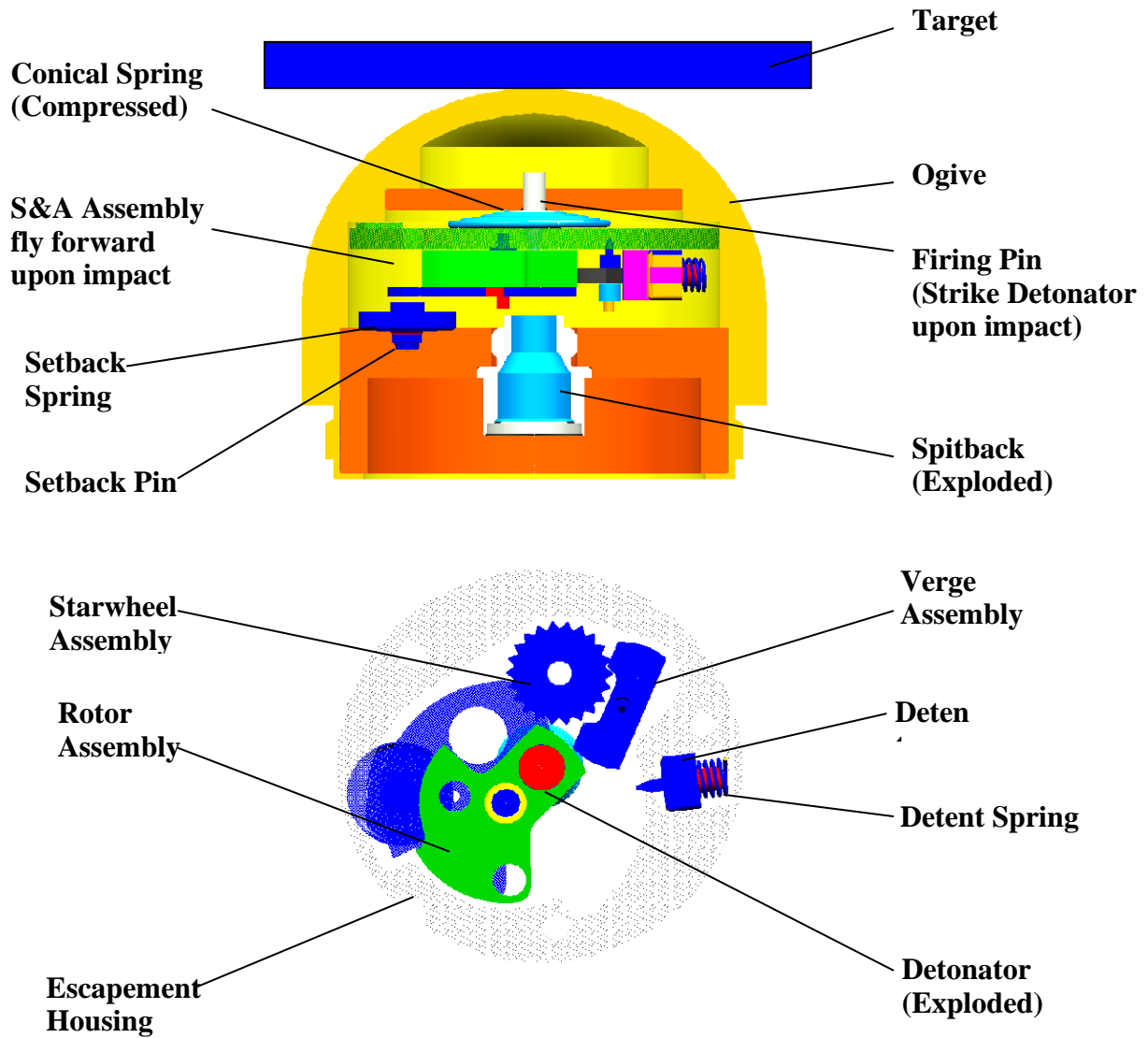
After the projectile had traveled a distance of about 18 to 40m, the Rotor Assembly will be aligned in the 'ARMED' position. The Detonator is now in-line with the PD Firing Pin.



**Figure 5: Fuze Armed**

### Fuze Impact (Figure 6)

Upon striking a target, the velocity of the shell decreases tremendously with a sharp retardation. At this time, the whole Escapement Assembly flies forwards due to the sudden reduction in velocity and causes the Detonator to hit the Point Detonate (PD) Firing Pin. This causes ignition of the Detonator, which brings about the detonation of the whole explosive train thus causing the detonation of the projectile.



**Figure 6: Fuze Impact**

## 10 Packaging, Transportation, Storage, Surveillance and Handling of 40mm Ammunition

### 10.1 Packaging

- The 40mm ammunitions are supplied ready for use in PA 120 metal ammunition boxes.
- Packages shall only be opened with immediate use of ammunition.
- Ammunition from already opened packages should be used first.
- Empty ammunition boxes are to be used for packaging ammunition components (cases, links, etc) for return to depot.

#### 10.1.1 Metal Box

The metal cover is fastened to the metal box by two latches. A rubber seal provides hermetic sealing.

After opening latches, the cover can be lifted off.

The cartridges are packed in vacuum enclosed barrier bag and separated by separators and fillers.

#### 10.1.2 Unit Packing

32 rounds of Cartridge 40mm HV HEDP are linked (M16A2) in a belt and placed in a PA 120 steel box. The quantity and calibre of the cartridges lot number, gross weight and volume are marked on the box.

##### Packaging Box (Figure 7)

- Packaging box	32 rounds belt per PA 120 steel box
- Weight (Gross)	19 Kg
- Dimensions (mm)	L477 x W162 x H264
- Volume (m <sup>3</sup> )	0.02


**Figure: 7**
**Palletization (Figure 8)**

- Number of Packaging box	42 packed boxes per pallet
- Weight (Gross)	approx.. 892 Kg
- Dimensions (mm)	L1200 x W1000 x H980
- Volume (m <sup>3</sup> )	1.180


**Figure: 8**
**10.1.3 Shipping and storage**

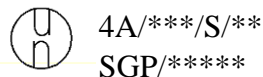
- Hazard division	1.1
- Compatibility group	E
- UN Serial No.	0006

#### 10.1.4 Operating Temperature

The operational is safe for handling and suitable for service from of -40°C to +63°C.

#### 10.2 Transportation

- Loading, unloading, and transportation of ammunition must be carried out carefully and all necessary precautions observed.
- Neither throws nor drop ammunition boxes.
- The handling safety of the ammunition in the packaging box is however retained up to a falling height of 12m.
- UN Marking (design type of packaging approval) in accordance with UNRTDG.



\*\* To be replaced by the last two digits of the year of manufacture.

#### 10.3 General Storage Conditions

The manufacturer's guarantee is valid only for ammunition that has been stored under the following conditions.

##### Long Term Storage Temperature and Shelf Life

The recommended storage temperature for the rounds, in its original packaging is as follows: -

From temperature 0°C to +37°C and RH of up to 98% in well ventilated storehouses, the ballistic and chemical shelf life shall be five (5) years and twenty (10) years respectively.

The round, once removed from its original packing, shall be expended as soon as possible and shall not be returned to storage.

It is recommended that the rounds should not be stored at temperature above 40°C to prevent degradation of the ballistic performance of the rounds.

#### Short Term Storage (One month) Temperature

The recommended storage for the rounds, in its original packaging is 0°C to 63°C and RH of up to 98% in well ventilated storehouses.

### 10.3.1 Special Storage Conditions

#### 10.3.1.1 Depot storage conditions

- Ammunition should only be stored in well-ventilated dry rooms.
- The stability and loaded capacity of the flooring must be sufficient to support the weight of the ammunition quantity to be stored.
- The building must be of solid construction and securely locked.
- The storing of ammunition in light corrugated iron or wooden barrack buildings should be avoided.
- Good access, separate if possible, for incoming and departing vehicles must be available.
- The use of lights with exposed flame, such as kerosene lamps and candles, is prohibited.
- Ammunition depots must never be located under high voltage lines.
- Ammunition crates must always be placed on wooden racks 40cm clear of walls and ceiling and 10cm clear of floor.
- Good ventilation of the ammunition stack is thus ensured.
- Store different types of ammunition separately.

#### 10.3.1.2 Field storage conditions

The following guidelines are to be observed for the storage of ammunition near gun emplacements and under field conditions.

- Protect ammunition from direct sunlight.
- Erect tents to protect ammunition from moisture.
- Place ammunition crates on wooden flooring – never directly on the ground.
- Camouflage the ammunition dump by arranging ammunition stacks to merge with the surroundings.
- Entrench the ammunition for protection against bombardment and against pressure waves from atomic explosions.
- Never locate an ammunition dump in the vicinity of or directly beneath high voltage lines.
- Store different types of ammunition separately.

#### 10.4 Reliability

The rounds shall have a functional reliability of at least 95% at 95% confidence level within the warranty period.

#### 10.5 Surveillance

During long term or depot storage we recommend an inspection every 2–4 years.

The quantity can be determined by carrying out a complete acceptance in accordance with the acceptance conditions.

We would suggest that, as a minimum, the following should be checked:

- Visual inspection
- Functional firing test

## 10.6 Ammunition treatment

### 10.6.1 Ammunition handling

Careful and correct handling of the ammunition is essential to ensure the faultless functioning of ammunition and gun when in action.

#### Transportability

With the original packaging, the round shall be safe and suitable for transportation by military trucks, rails, vessels and aircrafts, provided the ammunition are well secured. After the transportation, the safety and performance of the ammunitions shall not be degraded.

#### 1.5 meter Drop

Without packaging, the round shall be safe for handling and suitable for service after being dropped from a height of 1.5 meter onto a flat concrete floor, provided that there is no obvious damage and the round can be chambered. Any round that is visibly damaged is to be disposed

#### 4 meter Drop

With original PA 120 steel box packaging, the round shall be safe for handling and suitable for service after being dropped from a height of 4 metres onto a concrete floor, provided that there is no obvious damage and the round can be chambered.

#### 10.6.1.1 Inspection before Use

The round should be inspected for visible damage and/or missing components that may impair the function of the round, e.g. missing primer, dented case, etc. Any round found with such damage or missing components should not be used and be disposed appropriately.

#### 10.6.1.2 Rules for Handling Ammunition

- Make sure hands are clean before handling
- Lay ammunition only on a clean surface
- Use only clean metal box, or clean links.

**Before Firing:**

- Remove the rounds from the ammunition box and feed into the weapon feed tray.
- The ammunition is supplied ready for use. It requires no further treatment and can be put into use immediately.
- Ammunition put ready for use must be protected from moisture and from direct sunlight.

**During Firing:**

- Additional ammunition must be held in readiness in a dry location shielded from the direct rays of the sun.

**After Firing:**

- Unfired ammunition shall be expended as soon as possible and shall not be returned to storage.
- Additional ammunition must be held in readiness in a dry location shielded from direct rays of the sun.

### 10.6.1.3 Maintenance of Ammunition

The 40mm HV HEDP Cartridge does not require any maintenance. A partially unexpended belt can be stored back in the metal box, provided that the rubber seal is undamaged. Unexpended belts stored back in the metal box should be expended as soon as possible.

### 10.6.2 Ammunition malfunction

- If a round fails to fire, the firing mechanism of the weapon should be checked (firing pin missing, weak spring, dirt in cartridge chamber or bolt head, etc).
- Cartridges that do not fire after correct manipulation of the triggering facility a second time should be unloaded, singled out, and disposed.
- Cartridges that have been deformed by external influences (jamming, compression, etc) should be singled out and disposed.

### 10.6.3 Blind

During firing, when firer observed no explosion upon impact must sound off 'Blind' and remember the location of the round landing.

At the earliest possible time, the blind projectile location must be marked with visual aid like white tape for bomb/ explosive diffusion and disposal specialist to destroy the blind.

### 10.6.4 Destruction

The destruction of unexploded projectiles that have been discovered must be undertaken by specialists in accordance with the prevailing regulations.

The destruction procedure to be followed is dictated by the locality and surroundings and by the ammunition type. This latter should be estimated by the colour and possibly by the shape of the projectile.