The Modified Tank Ammunition
IMI M152/6 HEAT - AP - T

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The Main Operational Needs of Armor Corps

- To destroy Tanks and LAV’s
- To breach and penetrate bunkers and buildings with maximum resulting damage
- To incapacitate infantry, especially AT squads.
The current 105-mm family rounds

- KE: Heavy - armor
- HEAT: Medium and light armored vehicles and bunkers
- HEP/HESH: Light armored vehicles and bunkers
- WP: Screening and Spotting
- AP: IMI solutions
A less than lethal tank round for use in low intensity conflicts.

The round is designed to deter by creating a flash, bang and blast effect similar to service ammunition.
The stun round gives the tank’s crew the ability to be effective in situations such as:

- Incidents involving non-combatants
- Armed terrorists hiding behind a crowd
- Hostile civilians (mob) trying to approach/climb on the tank
105 mm & 120 mm STUN rounds
(Less-Than-Lethal tank round)

105 mm

120 mm
Video film of the firing test – 105 mm
120-mm
APAM

Anti-Personnel/
Anti-Materiel

105-mm Tank Round
APAM – Anti-Personnel/Anti-Materiel

Status: 105 mm in operational use.
Fuze Setting

Manual fuze setting

Semi-automatic fuze setter
Inductive Fuze Setter (IFS)
APAM – Basic Modes of Operation

- **Ejection Mode** - Ejected sub-munitions explode sequentially in the air after separation.
  - Anti-Personnel
  - Anti-Helicopter

- **Impact Mode** – Entire projectile explodes as a unitary warhead upon impact.
  - LAV’s
  - Bunkers & Buildings
AP MODE (EJECTION)  
DYNAMIC ARENA TEST

- High effectiveness against hidden and prone targets
ANTI-HELICOPTER MODE

- Six submunitions (and the projectile body & base) fly towards the target. One hit is good enough.
- Even in a near miss, the helicopter pilot will see and/or feel the detonations, causing mission abort.
AM MODE (IMPACT)

- Projectile will penetrate LAV’s and Bunkers.
- High density of lethal fragments inside.
APAM 105 - Damage to Sand & Timber Bunker
The Optimal Solution!

- Infantry,
- LAVs,
- Bunkers & Buildings,
- Helicopters.

- Maximum capability with minimum rounds.
- Reduced logistic load.
The alternative… !

Armies around the world have large stocks of 105-mm HEAT rounds (M456 / IMI M152/3)

- IMI’s alternative solution -

**Upgrading HEAT rounds**

- Using the old and well known type of ammunition
- Enhance capabilities
- Improve reliability
- Improve safety
- Cost – effective (high kill probability)
- Providing Armor Corps needs
“FUZAMAN”
High – Reliability Electronic Time Device

RESHEF TECHNOLOGIES, LTD.
AN ARYT COMPANY
**Influence on the aeroballistics performance:**
- Drag Force
- Lift Force
- Static and Dynamic Stability
- Jump

**Influence on the final ballistic trajectory:**
- Dispersion (Accuracy)
- Penetration

**The operational benefits:**
- Warhead detonation above the ground – AP mode
- Warhead detonation upon impact and grazing (reliability and safety)
- Multi-purpose capability

Is it that simple?
Research and Development Activities
Preliminary analysis and wind tunnel tests for the “FUZAMAN”

- The max. frequency of the alternator?
- The axle of the Impeller (bar, tube)?
- Number of Output nozzle holes?
- Stress on the impeller?
- Output nozzle dia.? [mm]
- Material of impeller?
- Input nozzle dia.? [mm]
- Time to Stability?
- Height of the impeller wings? [mm]
- Energy at Stability point?
- 2 parallel energy sources?
- Mach and spin influence?
- MACH = 4.0
Aeroballistics analysis and wind tunnel tests for the Projectile of IMI M152/6

- **Wind tunnel tests**
  - Mach numbers: 1.2, 1.6, 2.0, 2.2, 2.6, 2.8
  - Angle of attack: $-7^\circ \leq \alpha \geq +7^\circ$
  - $C_d$ vs Mach
  - Aerodynamic coefficients ($C_{m\alpha}$, $C_{n\alpha}$, $C_{roll}$, $C_{l\alpha}$ etc.)
  - $X_{cp} - X_{cg}$ (static stability)
Prototypes for Wind tunnel:

Type No. 1

Type No. 2

Type No. 3
MACH = 2.8
Sweep Alpha
C-NOR/ALPHA

C-PITCH/ALPHA

CL/ALPHA

CD/ALPHA
External Ballistics test - IMI M152/6

Prototype No. 1
Prototype No. 2
M456 / IMI M152/3

(Reference)
Dispersion / accuracy (2,000 m)
Ballistically matched trajectory
Velocity vs. Time
Final Ballistics test - IMI M152/6

- Safety Firing Test
  - Simulated cartridge with pyrotechnic (flash) composition
- **Firing test – Yaw**
  - Wave length
  - Dynamic stability

- **Penetration tests**
  - M152/3 warhead
  - RHA target (225 mm plate at 120-m from the muzzle)
  - 60° NATO
  - Alternator axle in the “FUZAMAN”:

  ![Diagram](image)

  - $\bar{P} = 465 \text{ mm}$
  - $\bar{P} = 440 \text{ mm}$

  Significantly better then M456
Dynamic arena test (AP mode)
Reliability - Detonation above the ground (AP mode)
Operational Research -

- Lethal Area - 20x50 m
- Criteria: Personnel Enemy
  Standing / Prone 30” assault
- Firing: 1 round / series of 3 rounds
- Remaining velocity - 855 m/sec
  (2,000 m)
- Angle of fall - 0.3 deg.

Results -

- The optimal height of detonation (above ground) - 6 m
- Mean Area of Effectiveness (MAE) / Lethal Area and Incapacitation Probability Maps
Incapacitation Probability ($\rho_k$) Map

shovran : velocity=855m/s, height =6m, angle =0.3deg, posture =six points stand

Fire

MAE= 89 m2
Incapacitation Probability ($\rho_k$) Map

Parameters:
- velocity = 855 m/s
- height = 6 m
- angle = 0.3 deg
- posture = six points stand

Resolution: 1 meter

MAE = 231 m²
Incapacitation Probability ($\rho_k$) Map

showran: velocity=855m/s, height = 6m, angle = 0.3deg, posture = prone

MAE = 76 m²

resolution 1 meter
Incapacitation Probability ($\rho_k$) Map

$\text{showran: velocity=855m/s, height=6m, angle=0.3\deg, posture=prone}$

Fire

MAE = 204 m$^2$

resolution 1 meter
Grazing (impact switch) Functioning test
Conversion of M456 or IMI M152/3 to IMI M152/6 at field level
Growth Potential – 120 mm

CHARACTERISTICS

Cartridge
- Weight: 25 kg
- Length: 984 mm

Projectile
- Weight: 15 kg
- Length: 726 mm
- Body material: steel
- Explosive: Comp. B, 1.8 kg

Other Components
- Cartridge case: combustible
- Propellant: M30, 5.6 kg
- Primer: electric, M4513
- Fuze: dual mode, electronic time/point initiated base detonation (ET-PIBD)

BALLISTIC PERFORMANCE
- Muzzle velocity: 1078 m/s
- Accuracy, typical SD: 0.25 mil, H and B
- Effective range: more than 3000 meters
- Set for time: projectile detonates 5 m (-distance) functioning above ground

BALLISTIC PERFORMANCE
- Temp. limits, firing: -40 to +52°C
- Temp. limits, storage: -40 to +63°C
- Various tests IAW MIL-STD-810D and NATO standards
Summary - Targets and Operating Modes

**MBT & LAV**

- If the projectile grazes the ground, an impact switch functions and detonates the warhead (no duds).

**AP**

- Manuel/Automatic settings for the MGS (striker).

**Bunkers & Buildings**

**Grazing (safety)**

- If the projectile grazes the ground, an impact switch functions and detonates the warhead (no duds).