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

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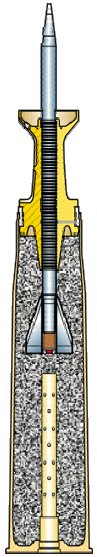
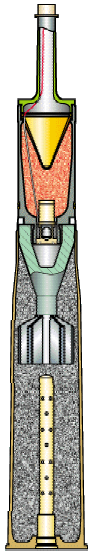
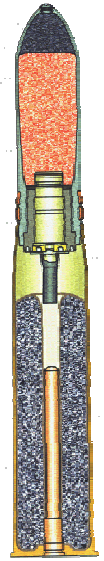
The Main Operational Needs of Armor Corps

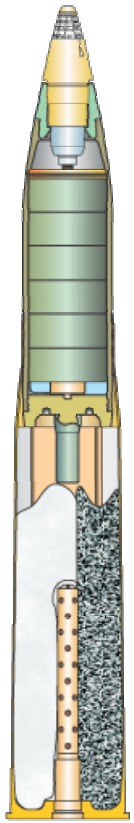
- To destroy Tanks and LAV's
- To breach and penetrate bunkers and buildings with maximum resulting damage
- To incapacitate infantry, especially AT squads.

KE	HEAT	HEP/HESH	WP	AP
				
Heavy - armor	Medium and light armored vehicles and bunkers	Light armored vehicles and bunkers	Screening and Spotting	IMI solutions

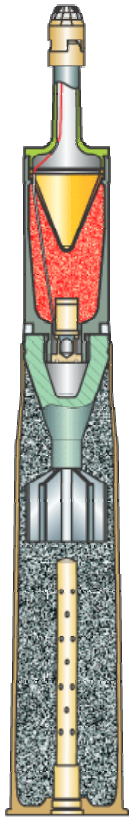
The current 105-mm family rounds

STUN

APAM



M152/6



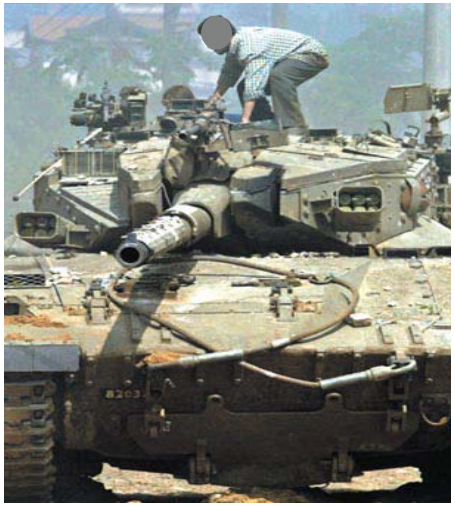
The IMI AP rounds

Tank Stun Rounds - *Mission Statement*

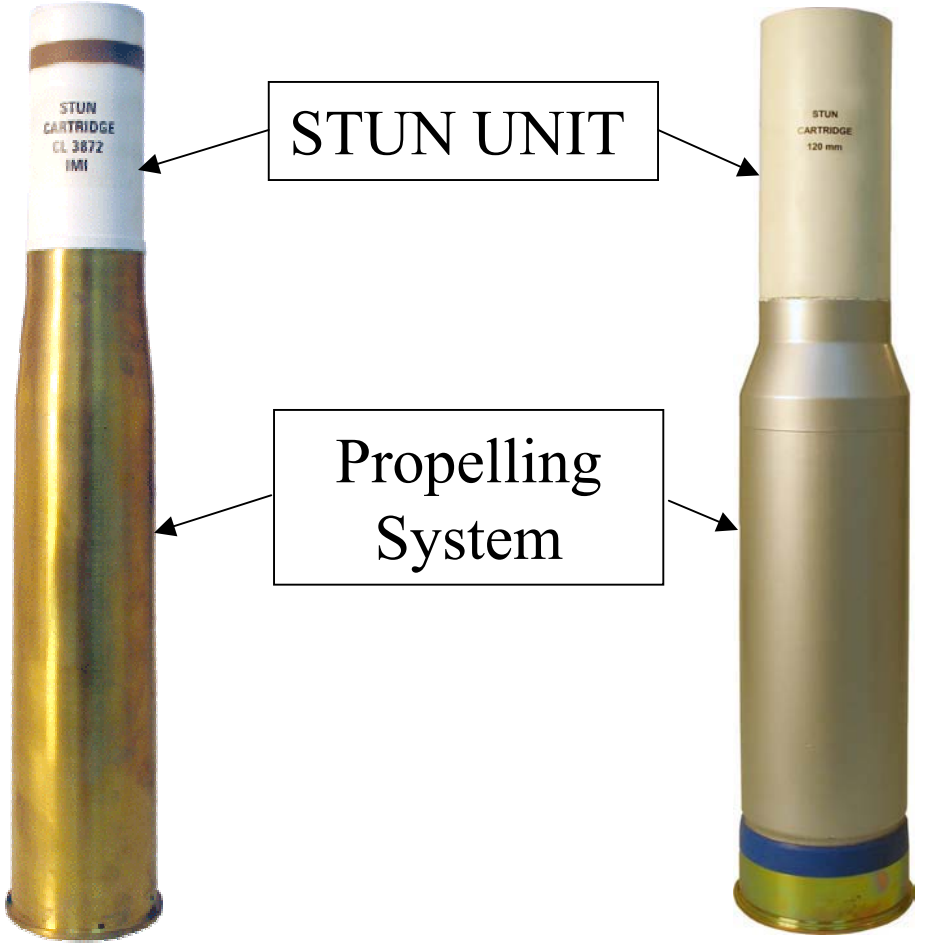
- **A less than lethal tank round for use in low intensity conflicts.**
- **The round is designed to deter by creating a flash, bang and blast effect similar to service ammunition.**

- **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

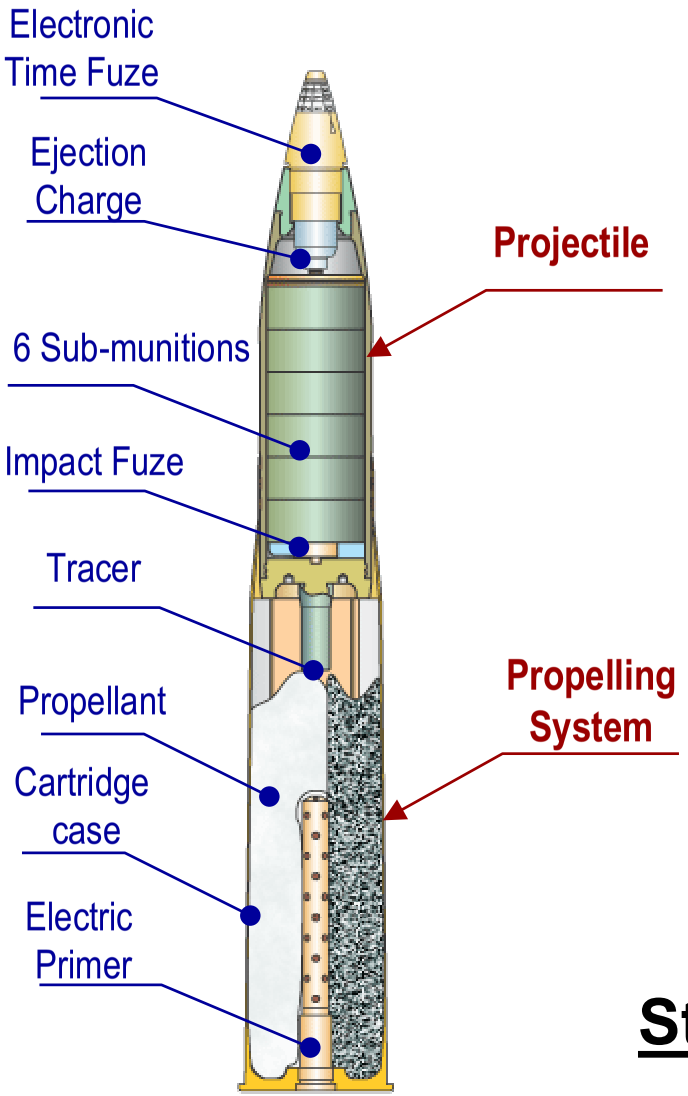
APAM

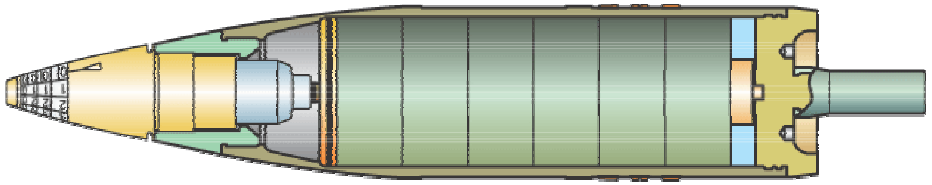
Anti-Personnel/

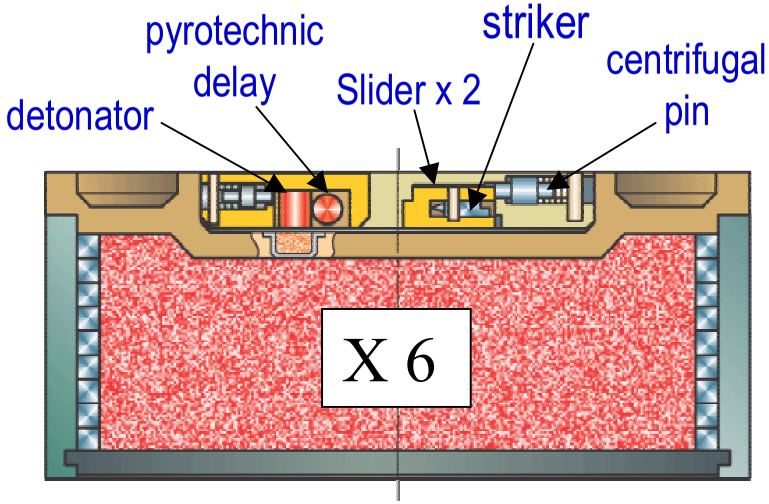
Anti-Materiel

105-mmTank Round

APAM – Anti-Personnel/Anti-Materiel







<u>Status</u>: 105 mm in operational use.

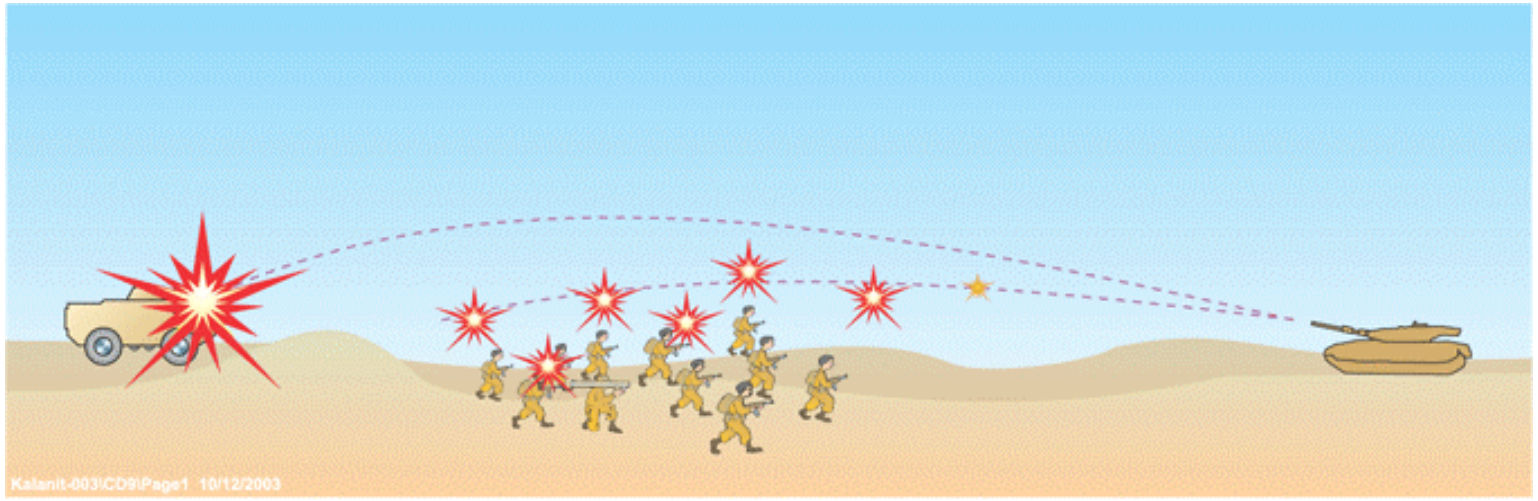
Fuze Setting

Manual fuze setting

Semi-automatic fuze setter

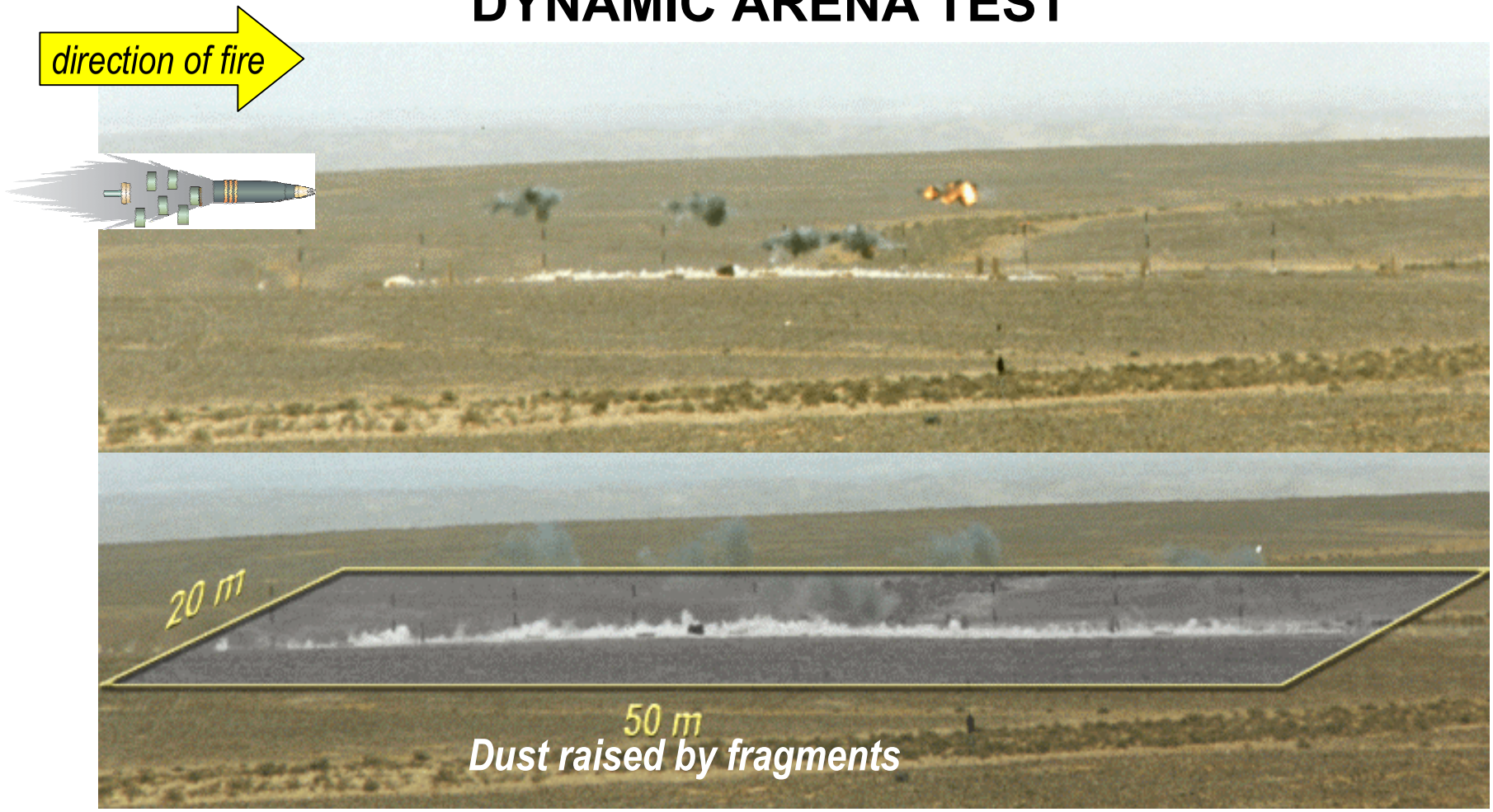
Inductive Fuze Setter (IFS)

APAM – Basic Modes of Operation



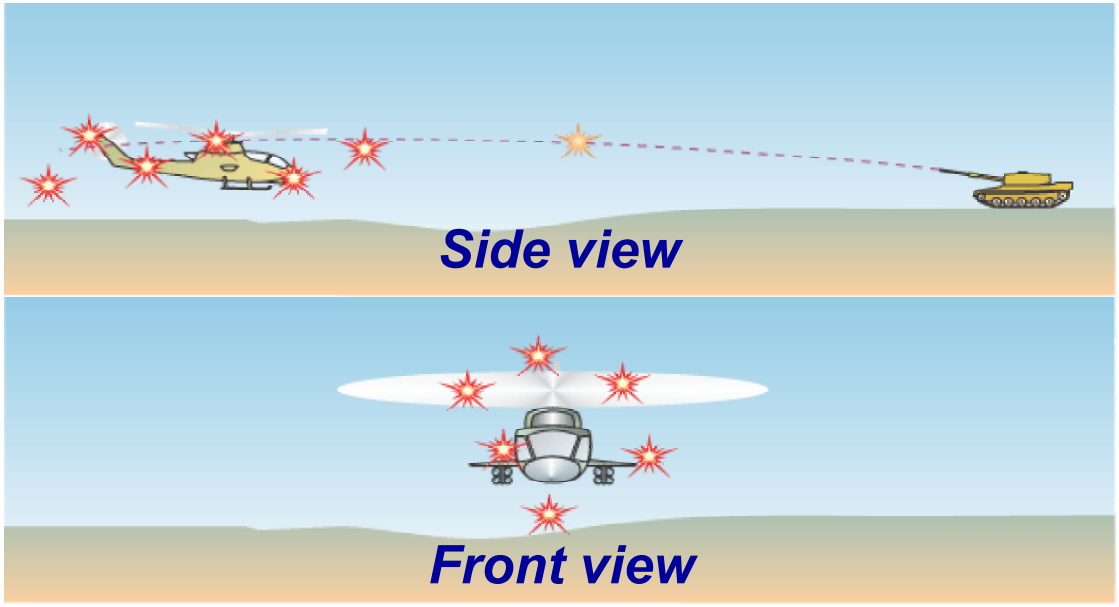
- **Ejection Mode -** Ejected sub-munitions explode sequentially in the air after separation.
  - **Anti-Personnel**
  - **Anti-Helicopter**
- **Impact Mode –** Entire projectile explodes as a unitary warhead upon impact.
  - **LAV's**
  - **Bunkers & Buildings**

AP MODE (EJECTION)
DYNAMIC ARENA TEST



❖ **High effectiveness against hidden and prone targets**

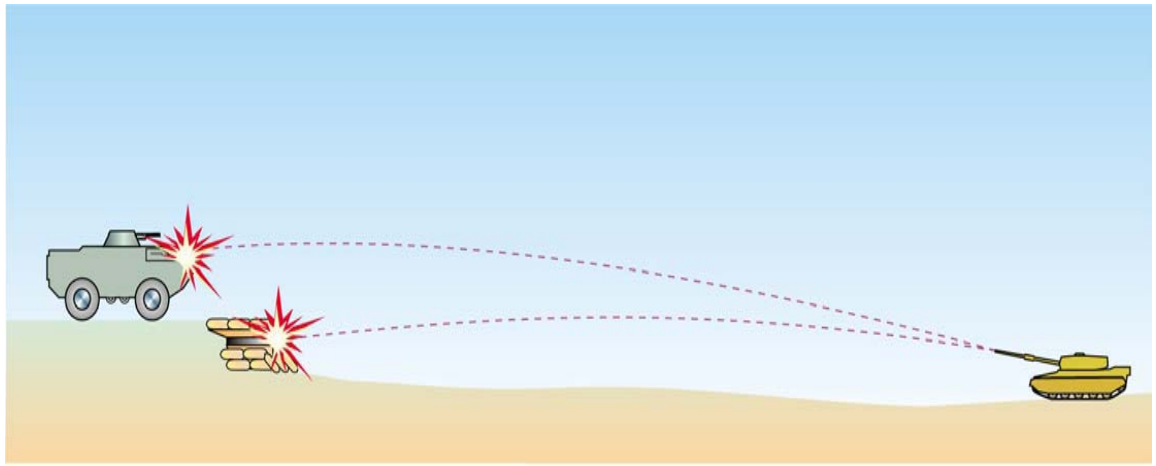
ANTI-HELICOPTER MODE



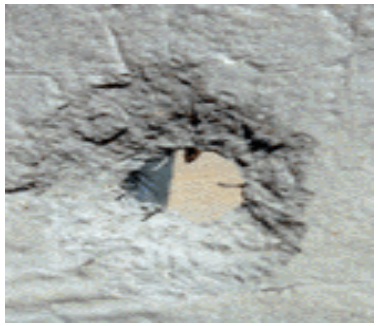
PENETRATION OF 10 mm
RHA TARGET
BY SUBMUNITIONS

- **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)



Light armor



Double reinforced concrete wall

Hits on witness plate

- Projectile will penetrate LAV's and Bunkers.
- High density of lethal fragments inside.

APAM 105 - Damage to Sand & Timber Bunker

1 ROUND

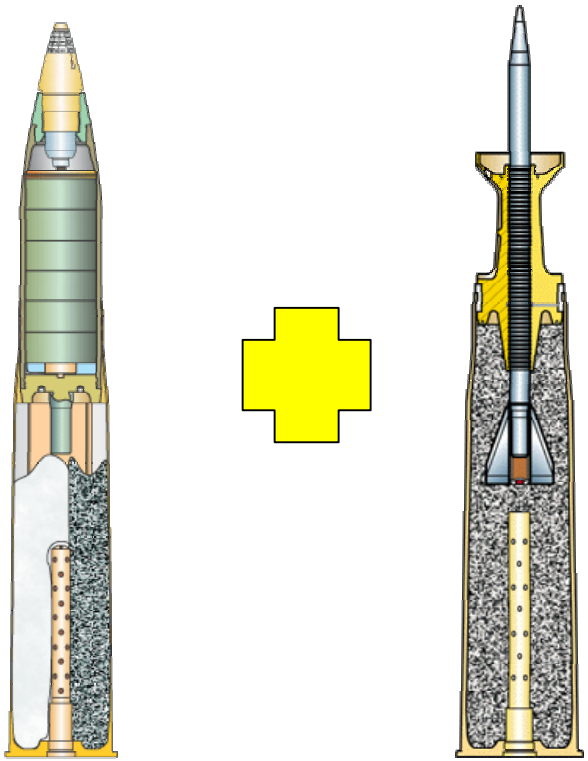
The Optimal Solution !

Infantry,

LAVs,

Bunkers & Buildings,

Helicopters.



Armor

- **Maximum capability with minimum rounds.**
- **Reduced logistic load.**

The alternative… !

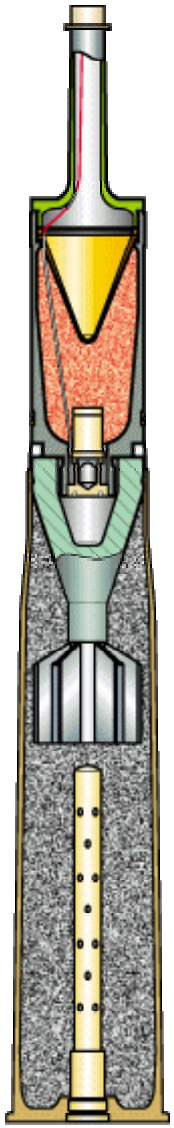
Armies around the world have large stocks of 105-mm HEAT rounds (M456 / IMI M152/3)

- 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

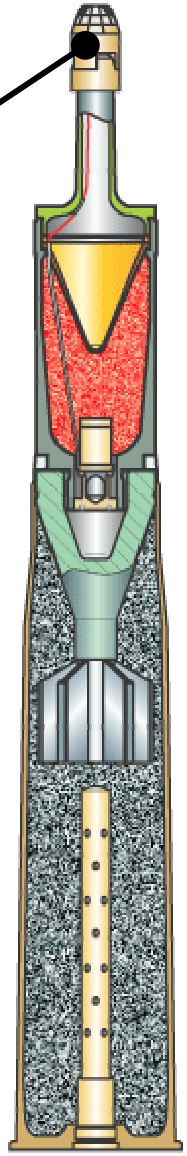
M456 /
IMI M152/3



Conversion

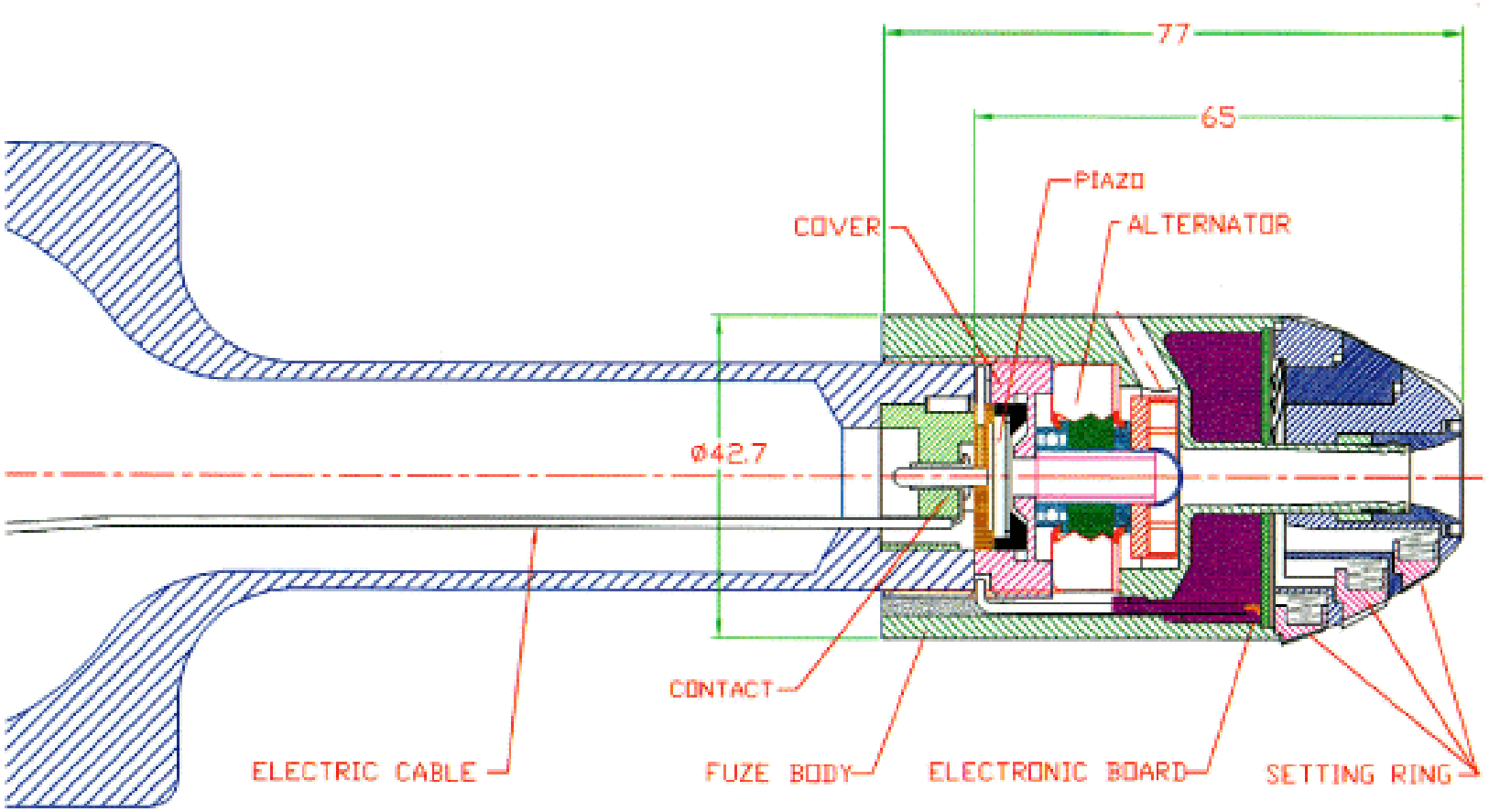
Electronic
Device
"FUZAMAN"

IMI M152/6

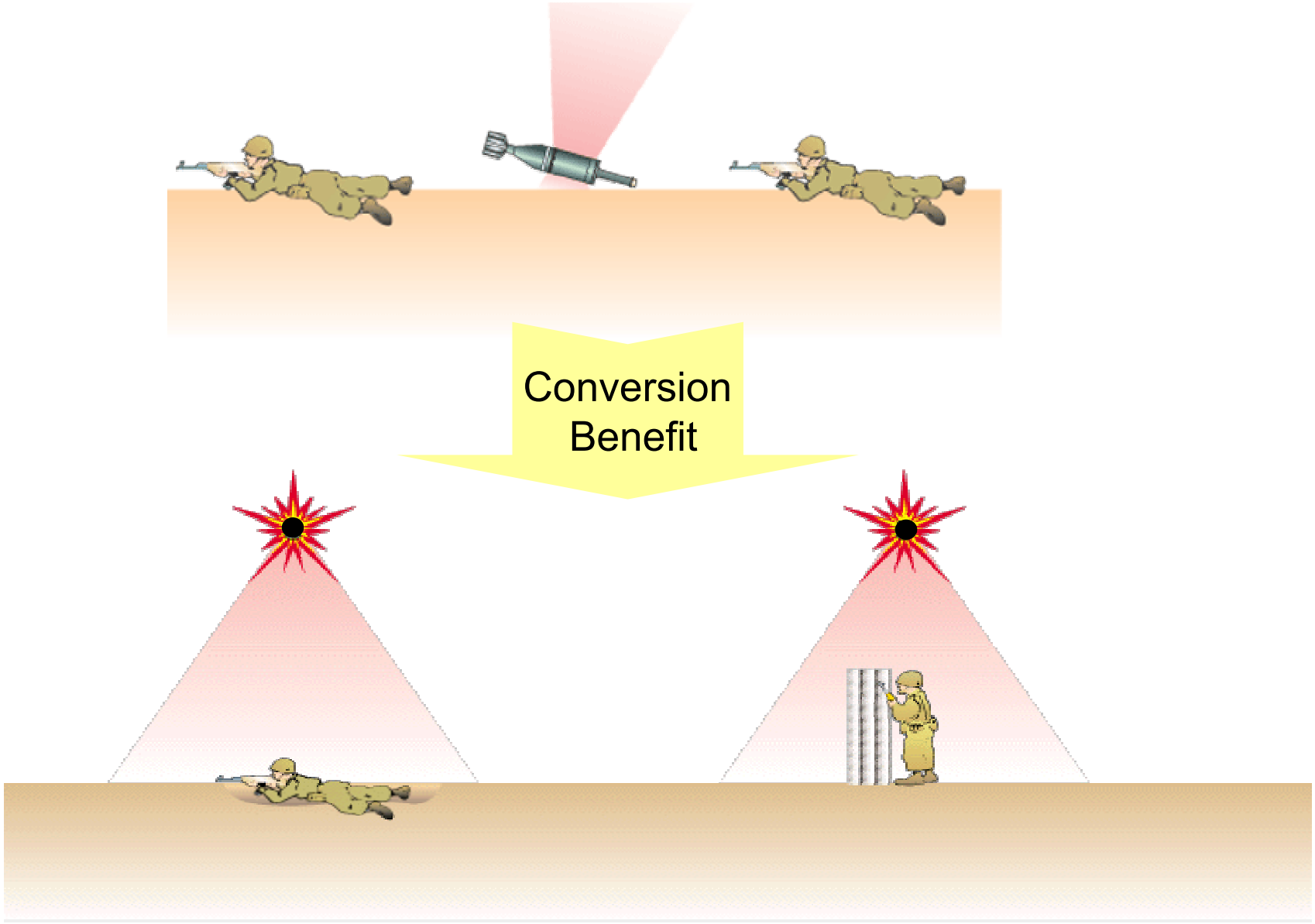


"FUZAMAN"

High – Reliability Electronic Time Device



RESHEF TECHNOLOGIES, LTD.
AN ARYT COMPANY


Conversion
Benefit

- **Influence on the aeroballistics performance:**
  - Drag Force
  - Lift Force
  - Static and Dynamic Stability
  - Jump

Trajectory

Dispersion (Accuracy)

- **Influence on the final ballistic**

Penetration

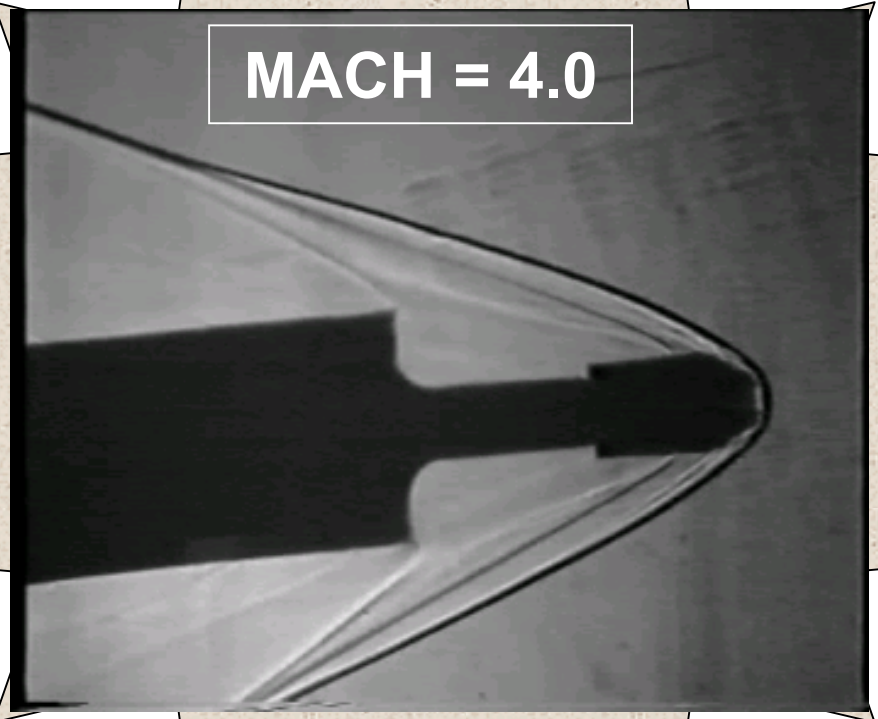
Is it that simple?

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

Improvements

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?

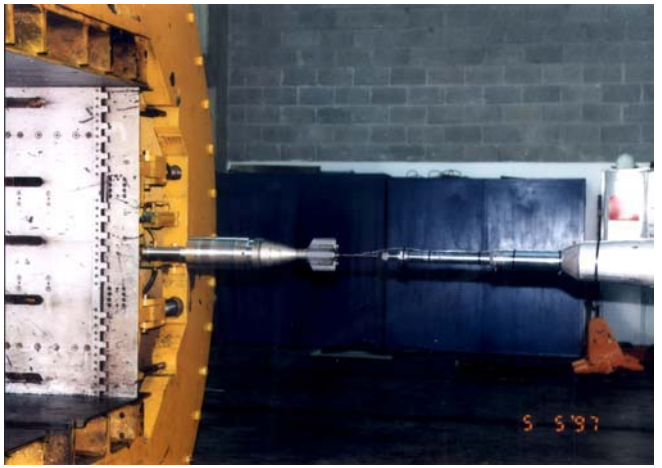
2 parallel energy sources?

Mach and spin influence?

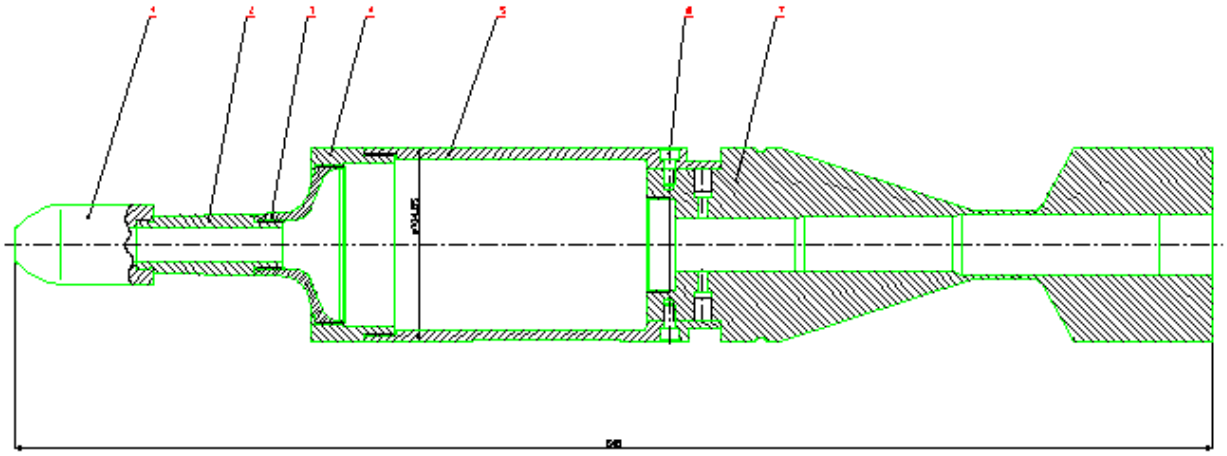
Aeroballistics analysis and wind tunnel tests for the Projectile of IMI M152/6

❖ Wind tunnel tests

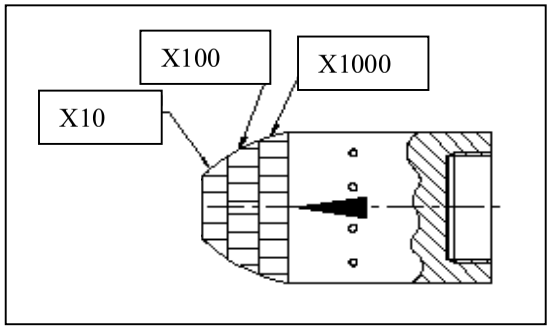
- Mach numbers: 1.2, 1.6, 2.0, 2.2, 2.6, 2.8
- Angle of attack: $-7^{o} \leq \alpha \geq +7^{o}$
- Cd vs Mach
- Aerodynamic coefficients (Cmα, Cnα, Croll, Clα etc.)
- Xcp – Xcg (static stability)



Prototypes for Wind tunnel:



Type No. 1



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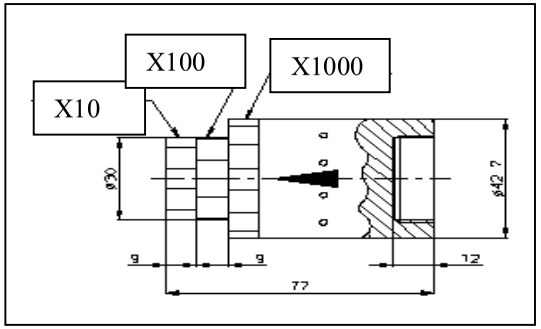
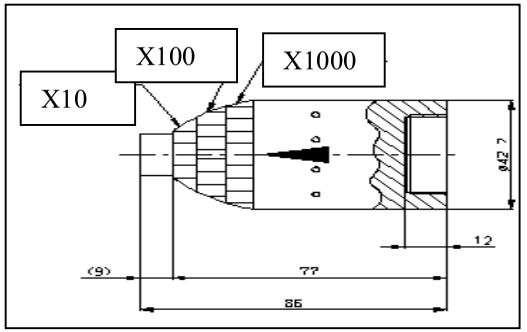
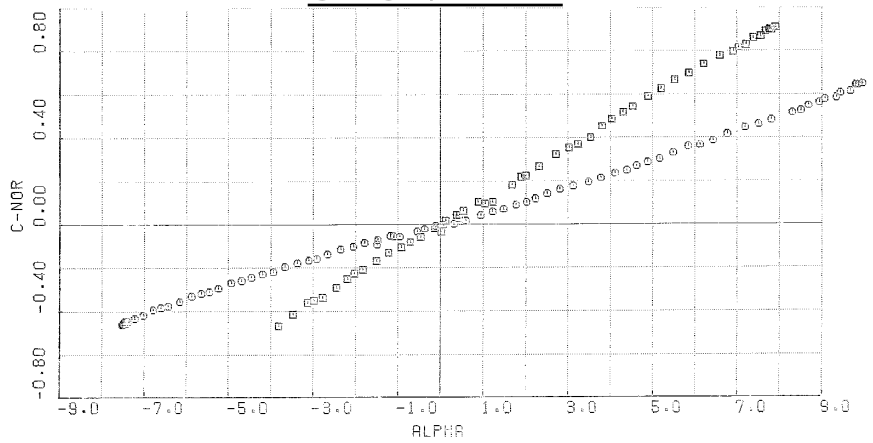


Type No. 3

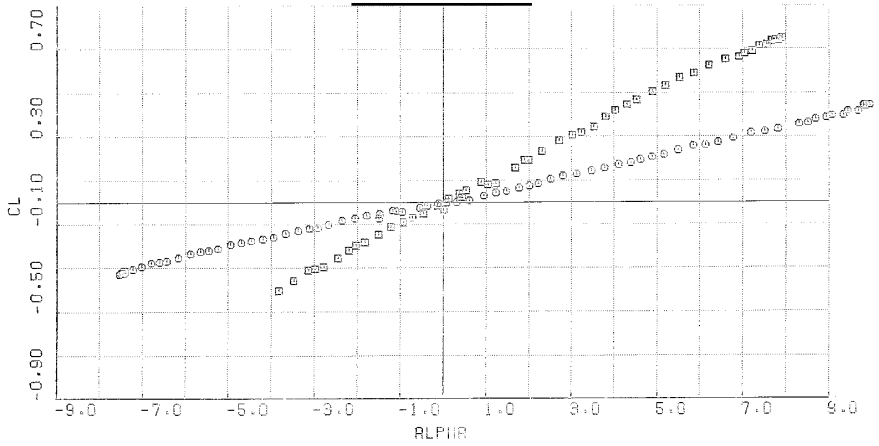



MACH = 2.8
SWEEP ALPHA

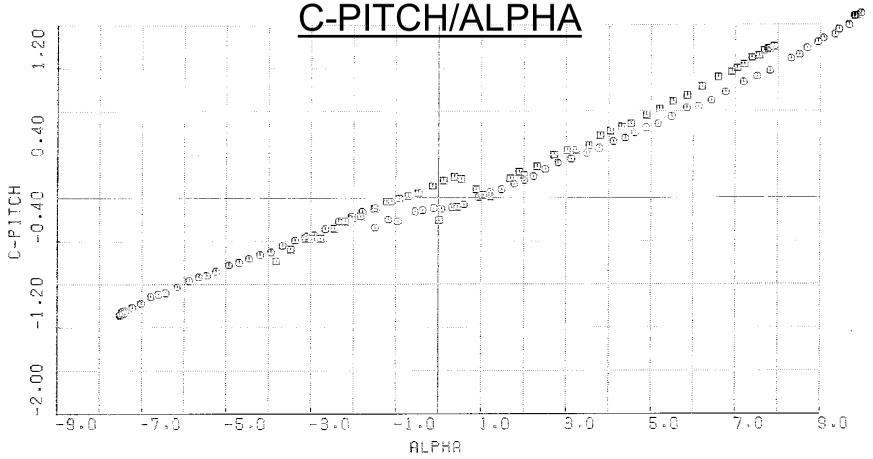
C-NOR/ALPHA



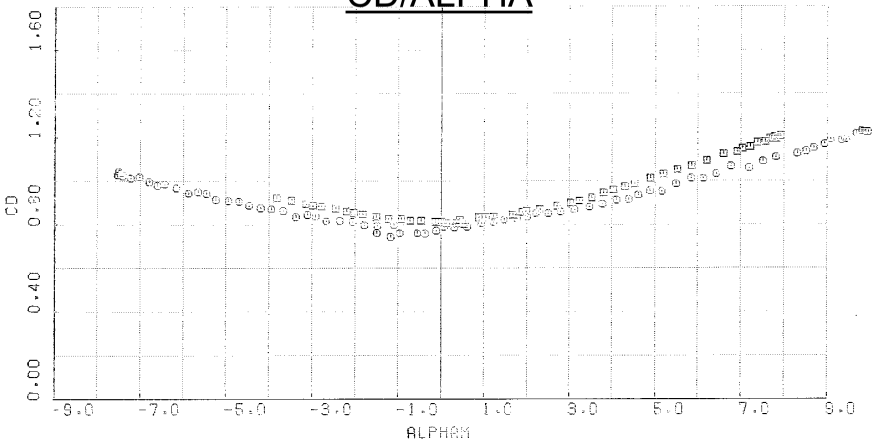
CL/ALPHA



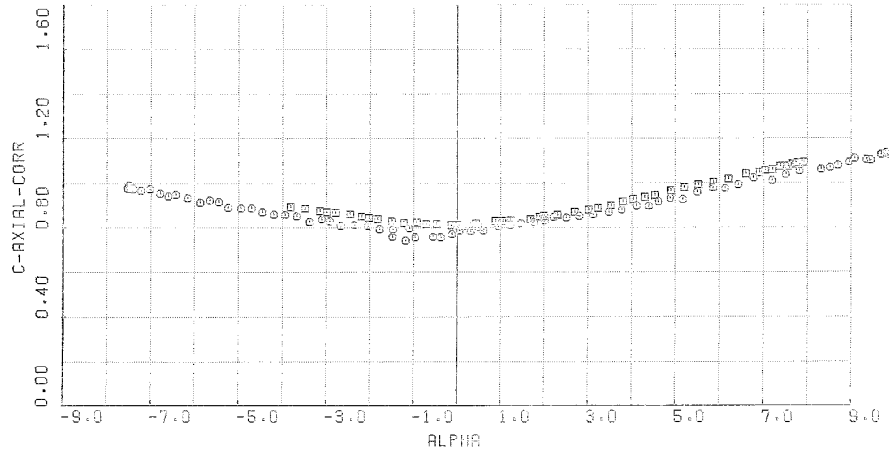
C-PITCH/ALPHA



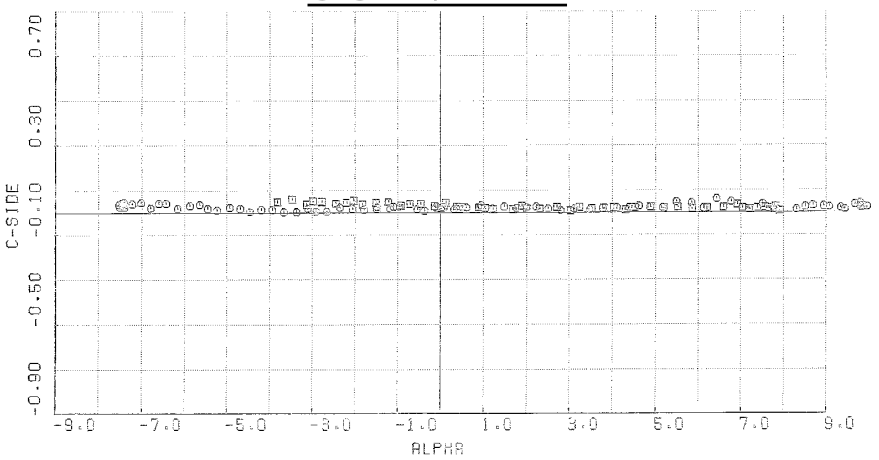
CD/ALPHA



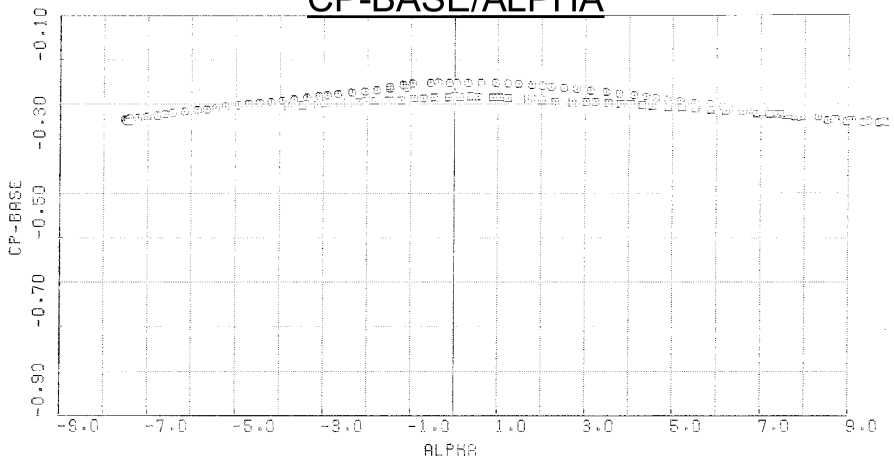
C-AXIAL/ALPHA



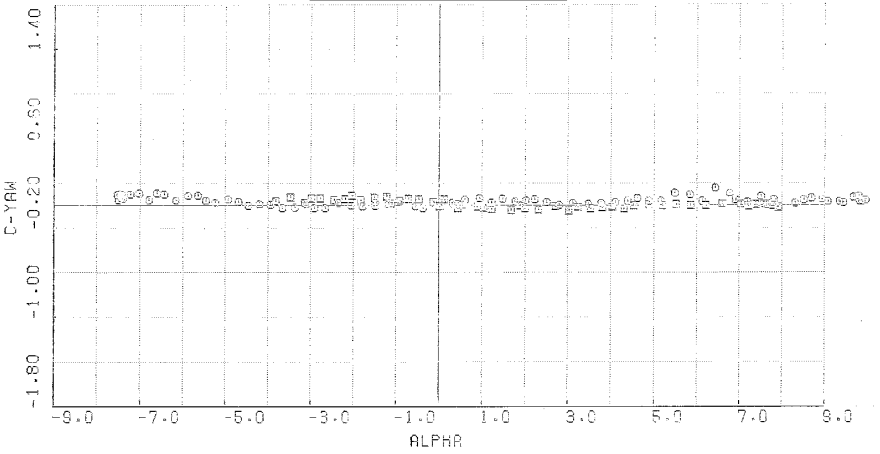
C-SIDE/ALPHA



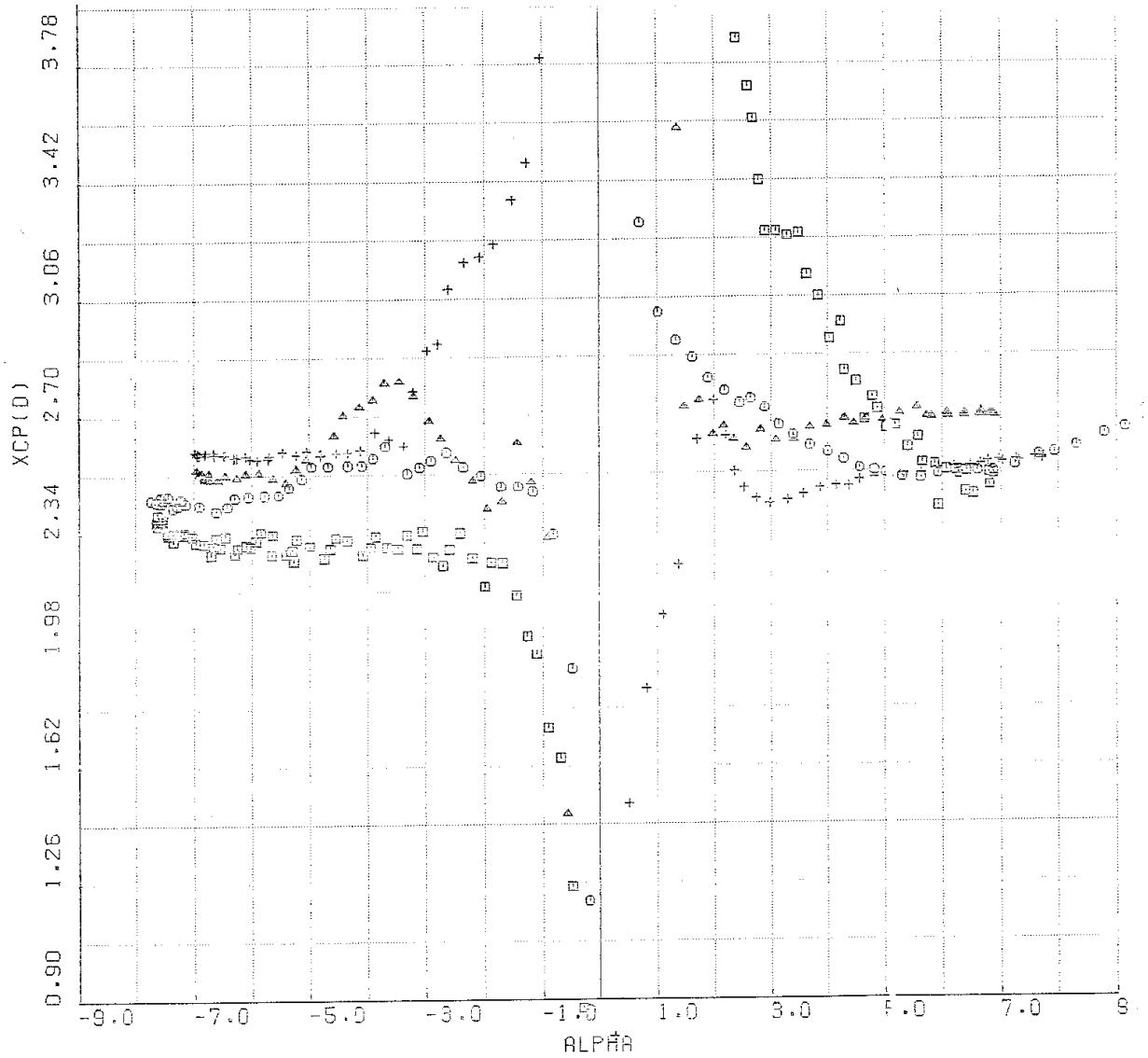
CP-BASE/ALPHA



C-YAW/ALPHA

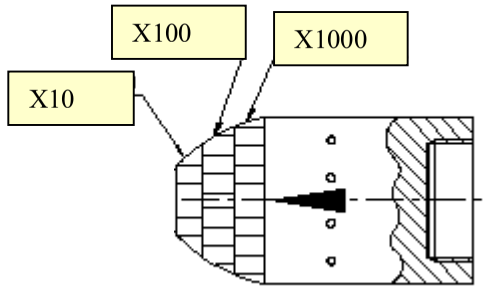


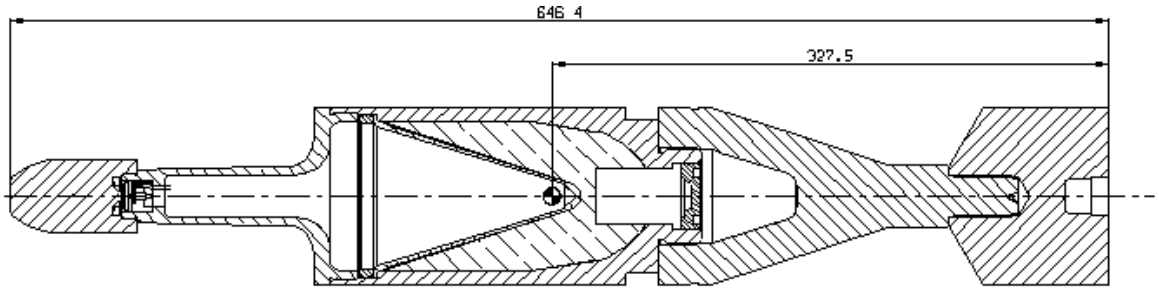
XCP(D)/ALPHA

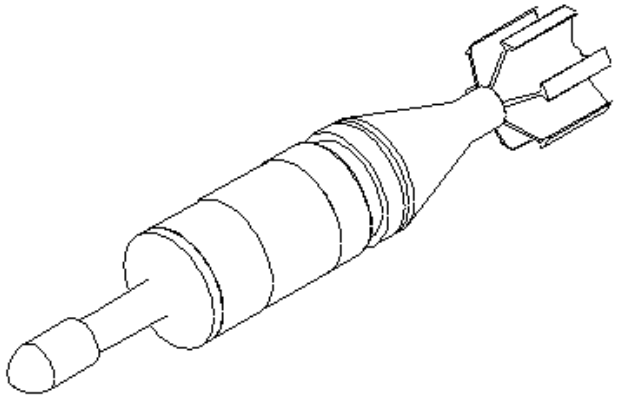

XCP(D)
0.90
1.26
1.62
1.98
2.34
2.70
3.06
3.42
3.78
-9.0
-7.0
-5.0
-3.0
-1.5
1.0
3.0
5.0
7.0
ALPHA

External Ballistics test - IMI M152/6

Prototype No. 1







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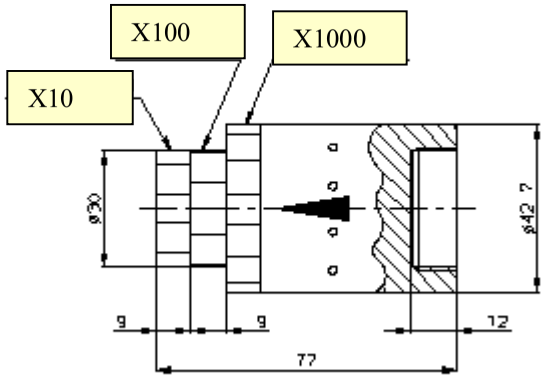

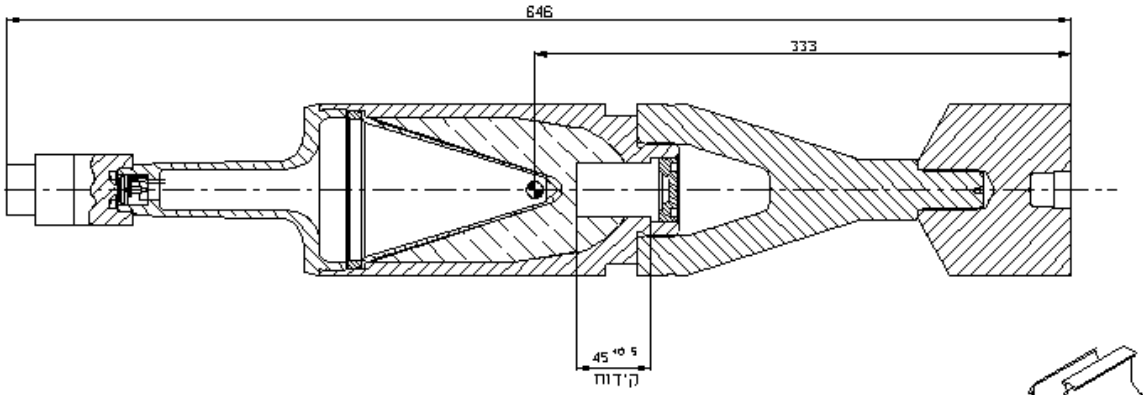

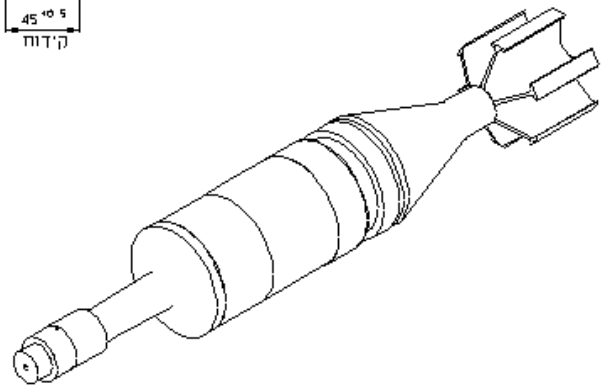

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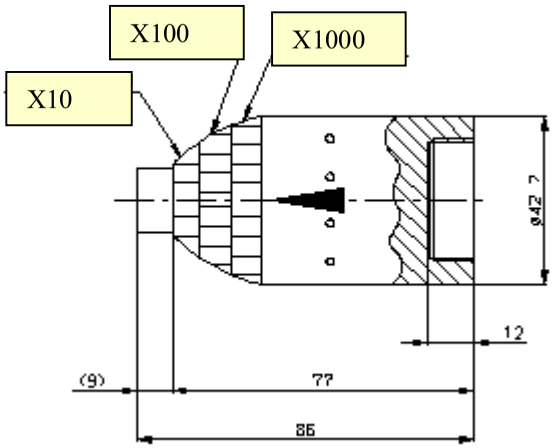
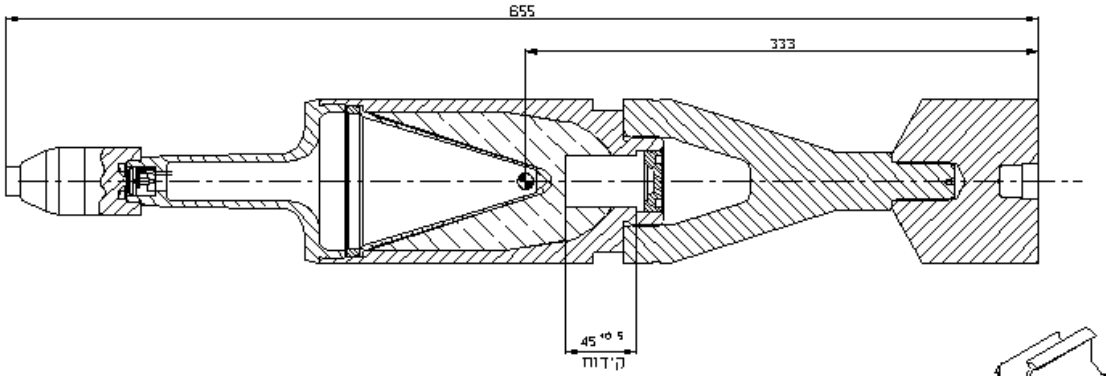
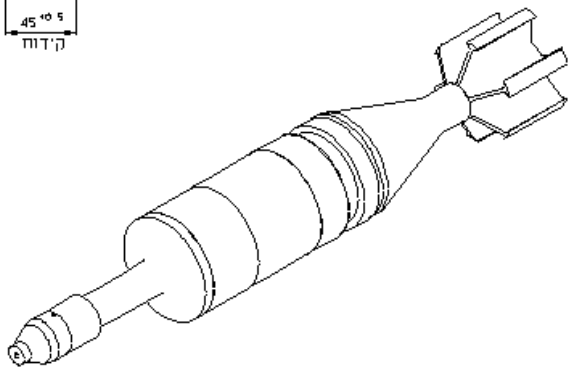
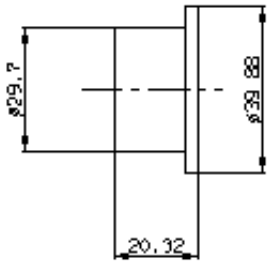


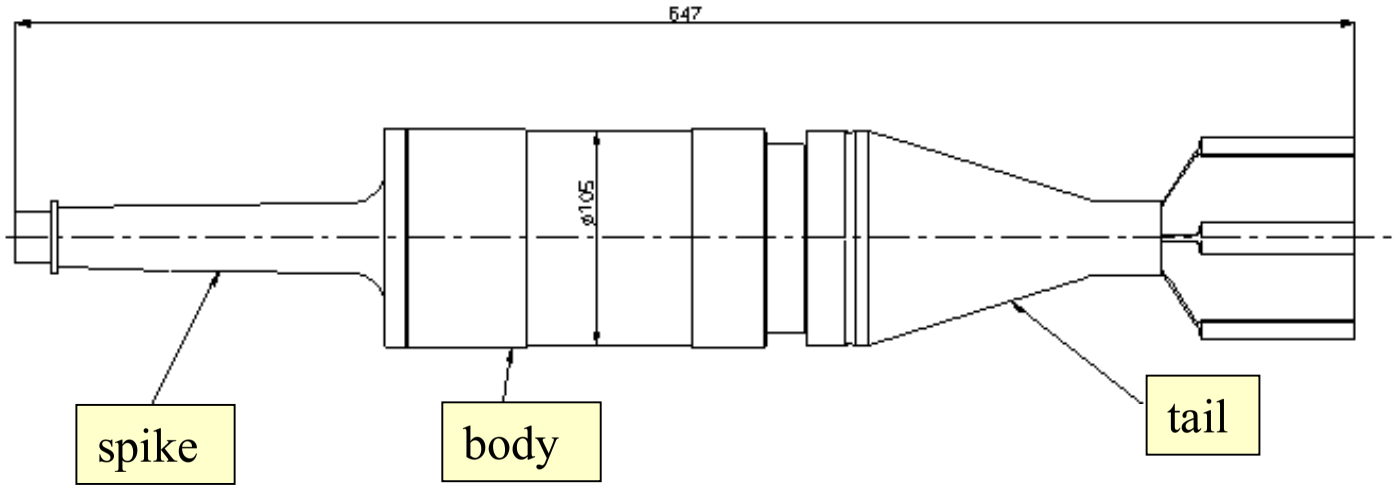




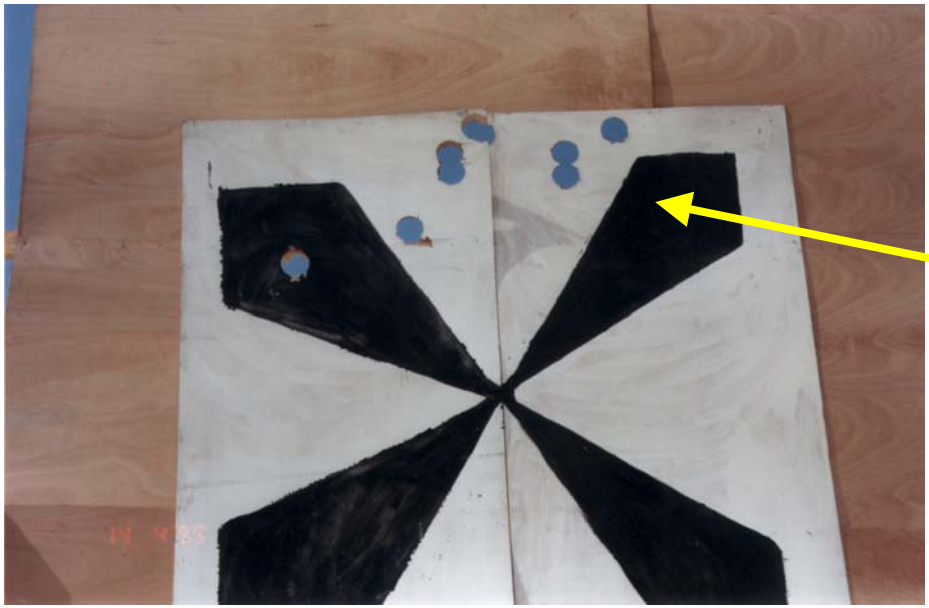
M456 / IMI M152/3

(Reference)

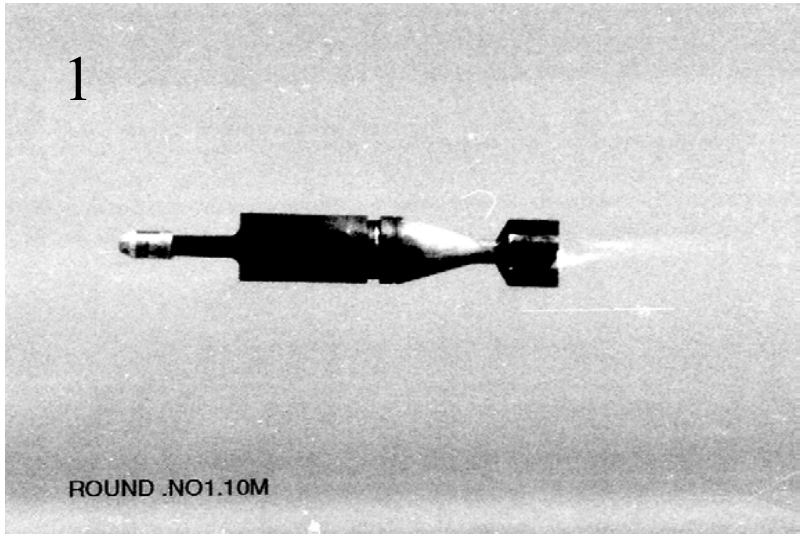


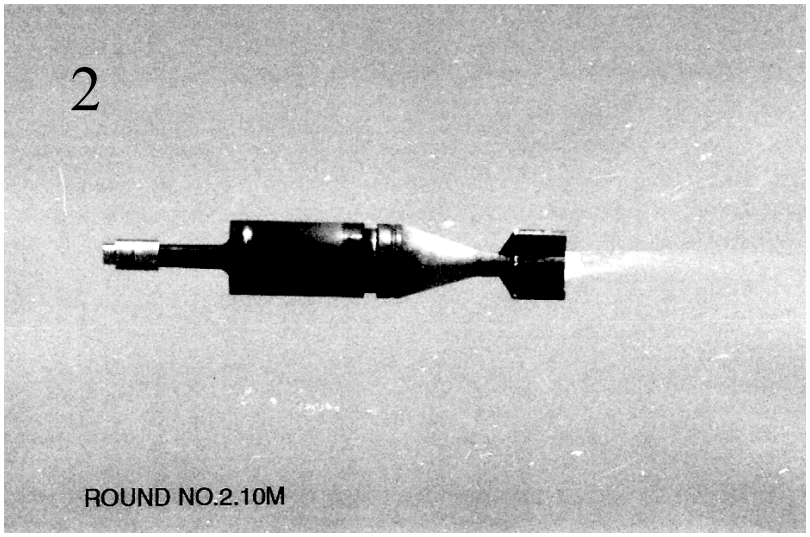


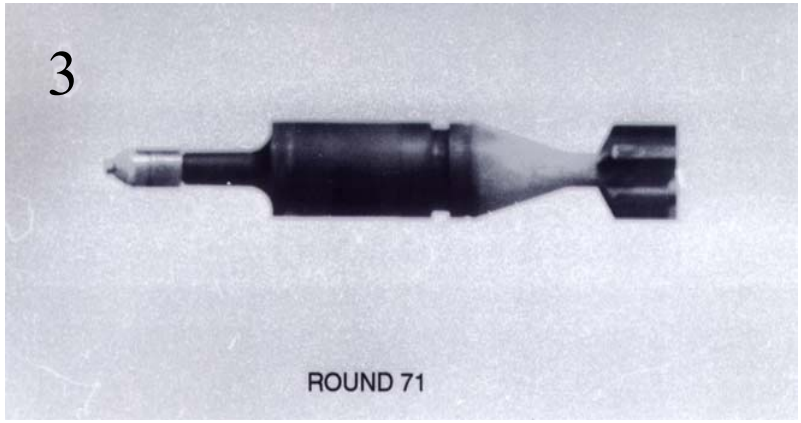
❖ Dispersion / accuracy (2,000 m)

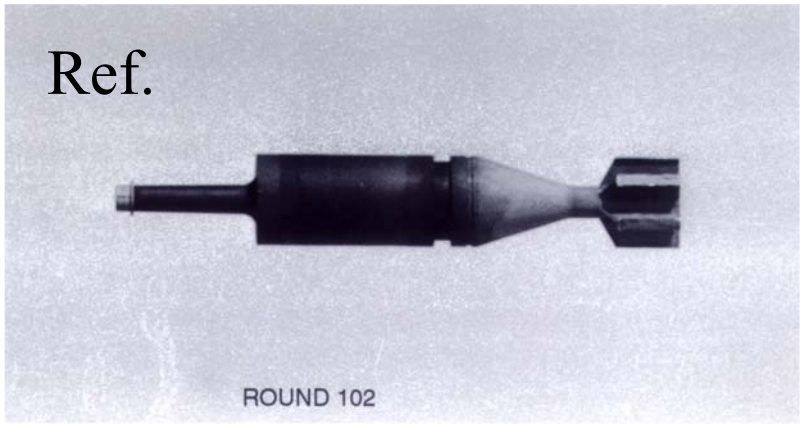


❖ Ballistically matched trajectory

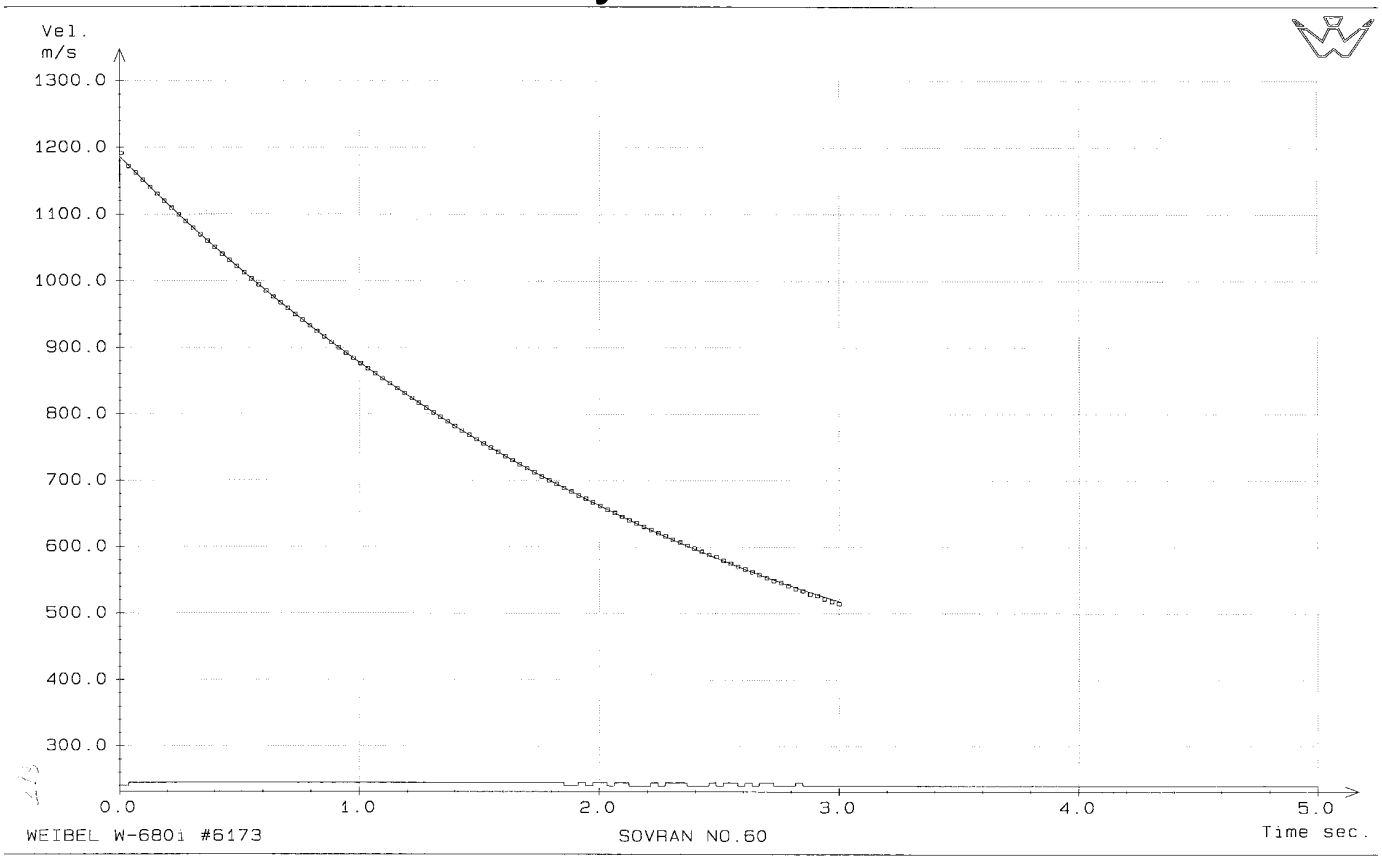








Velocity vs. Time



Final Ballistics test - IMI M152/6

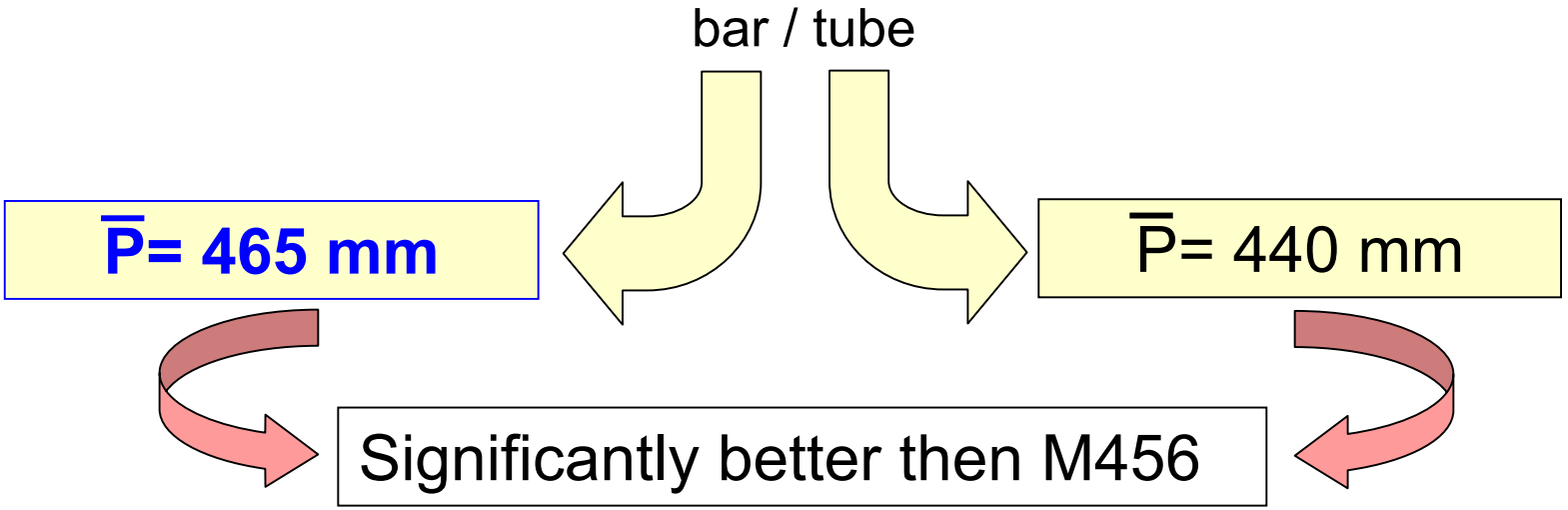
- **Safety Firing Test**
  - Simulated cartridge with pyrotechnic (flash) composition

❖ Firing test – Yaw

- ➢ Wave length
- ➢ Dynamic stability

❖ Penetration tests

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

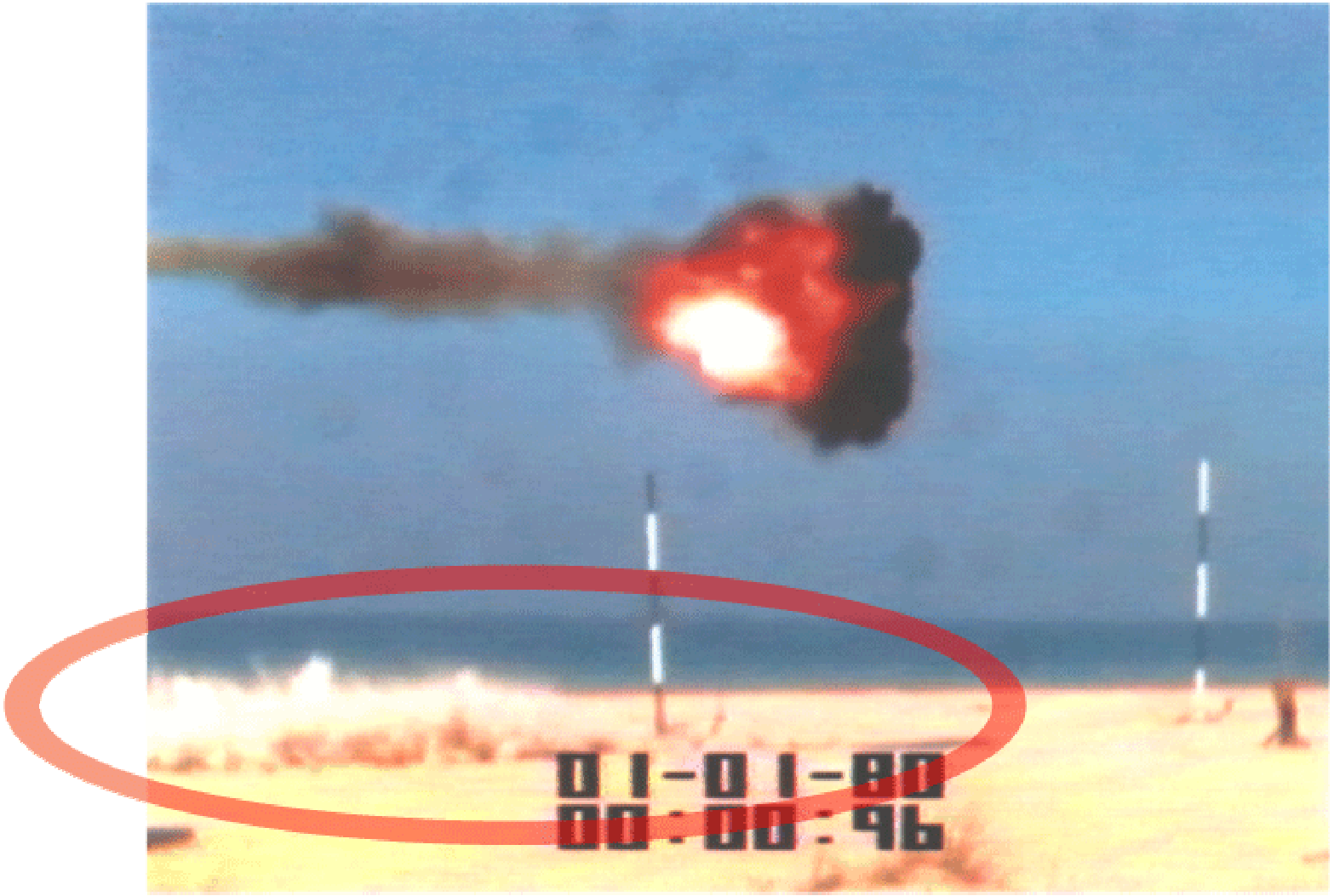


Front Side

Back Side

❖ Dynamic arena test (AP mode)

❖ Reliability - Detonation above the ground (AP mode)

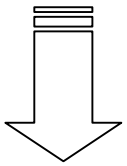


❖ Operational Research -

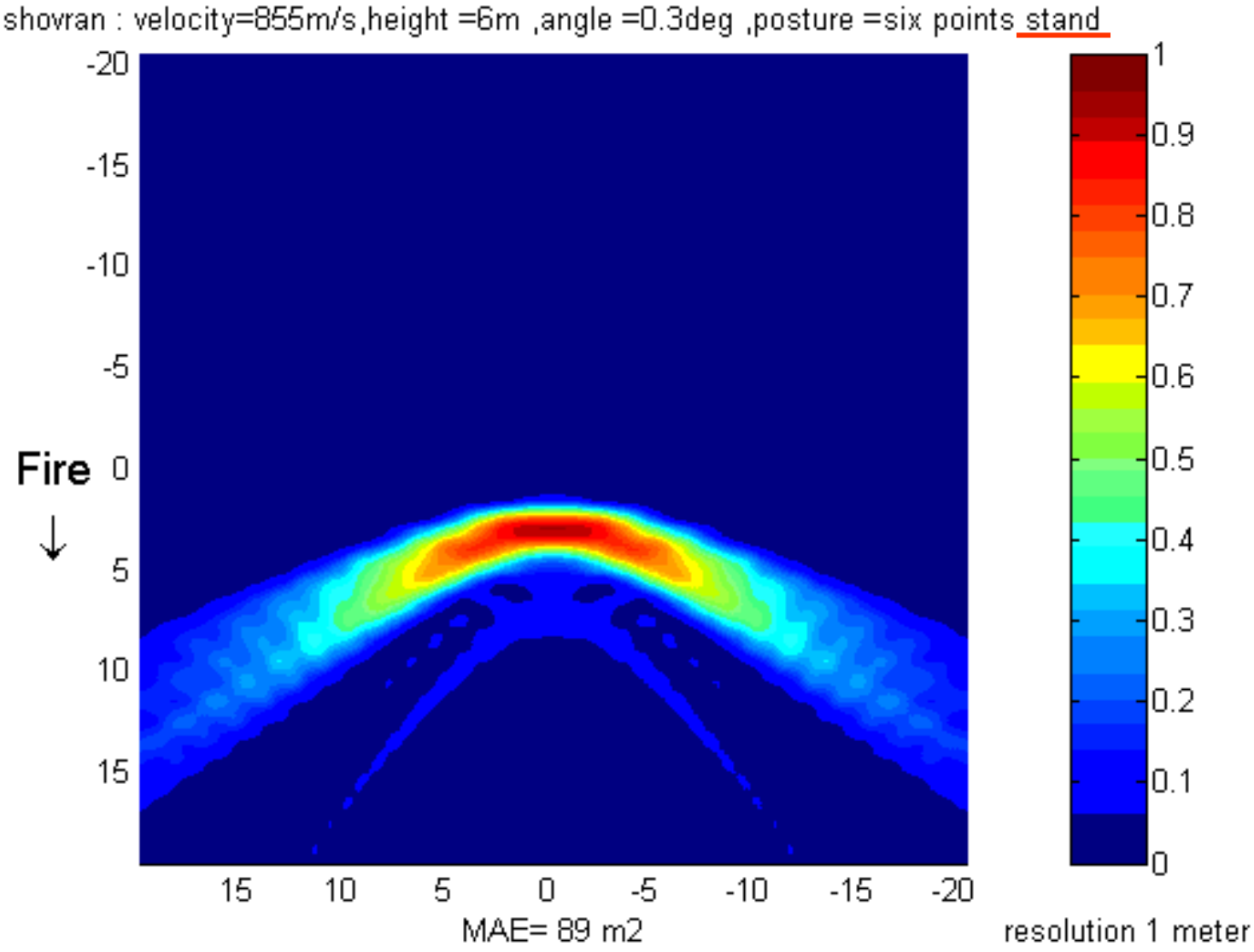
- *Lethal Area - 20x50 m*
- *Criteria: Personnel Enemy*
  Standing / Prone 30" assault
- *Firing: 1 round / series of 3 rounds*
- *Remaining velocity - 855 m/sec*
  (2,000 m)
- *Angle of fall - 0.3 deg.*

❖ Results -

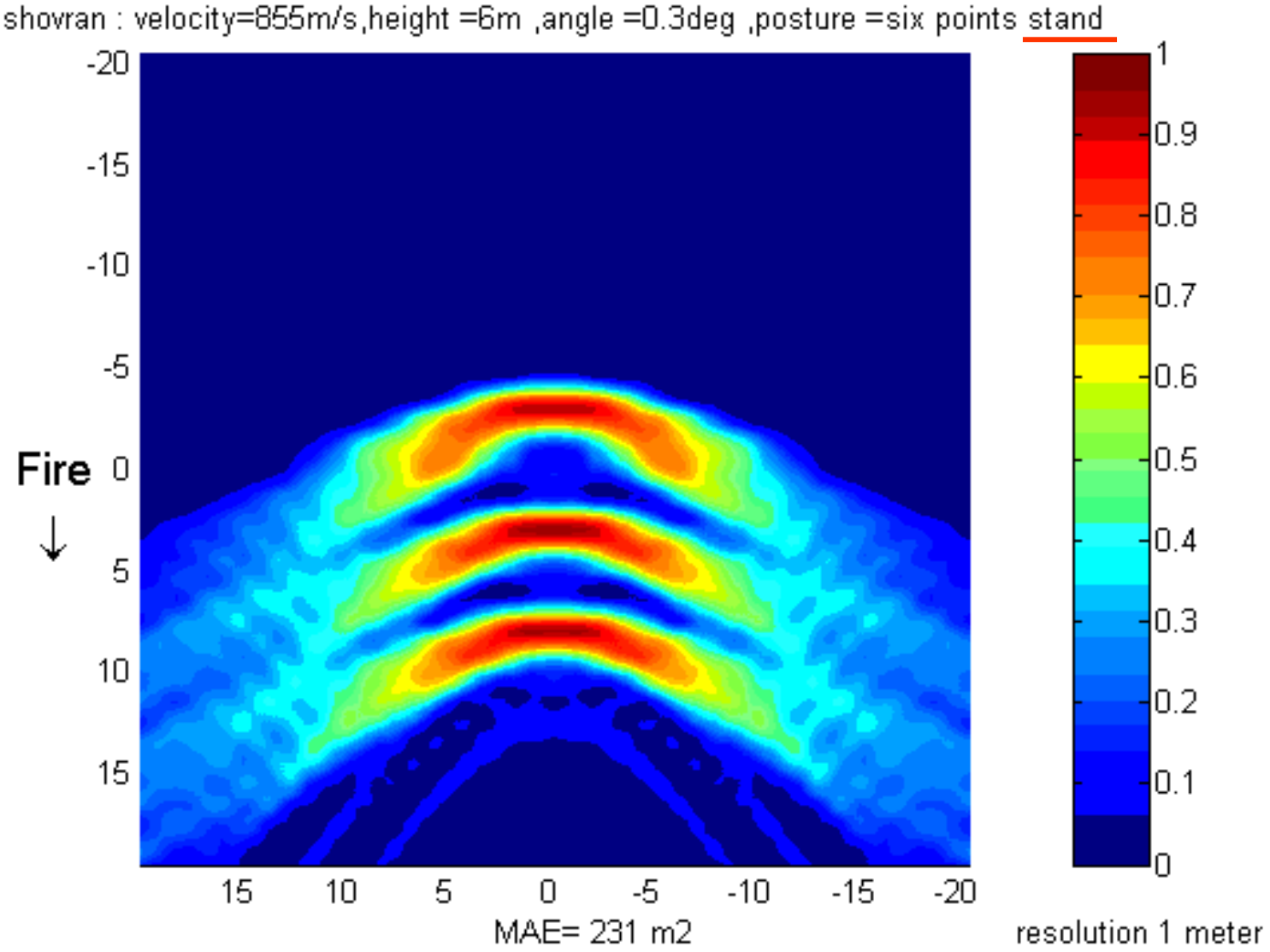
- ✓ The optimal height of detonation (above ground) - 6 m
- ✓ Mean Area of Effectiveness (MAE) / Lethal Area and Incapacitation Probability Maps



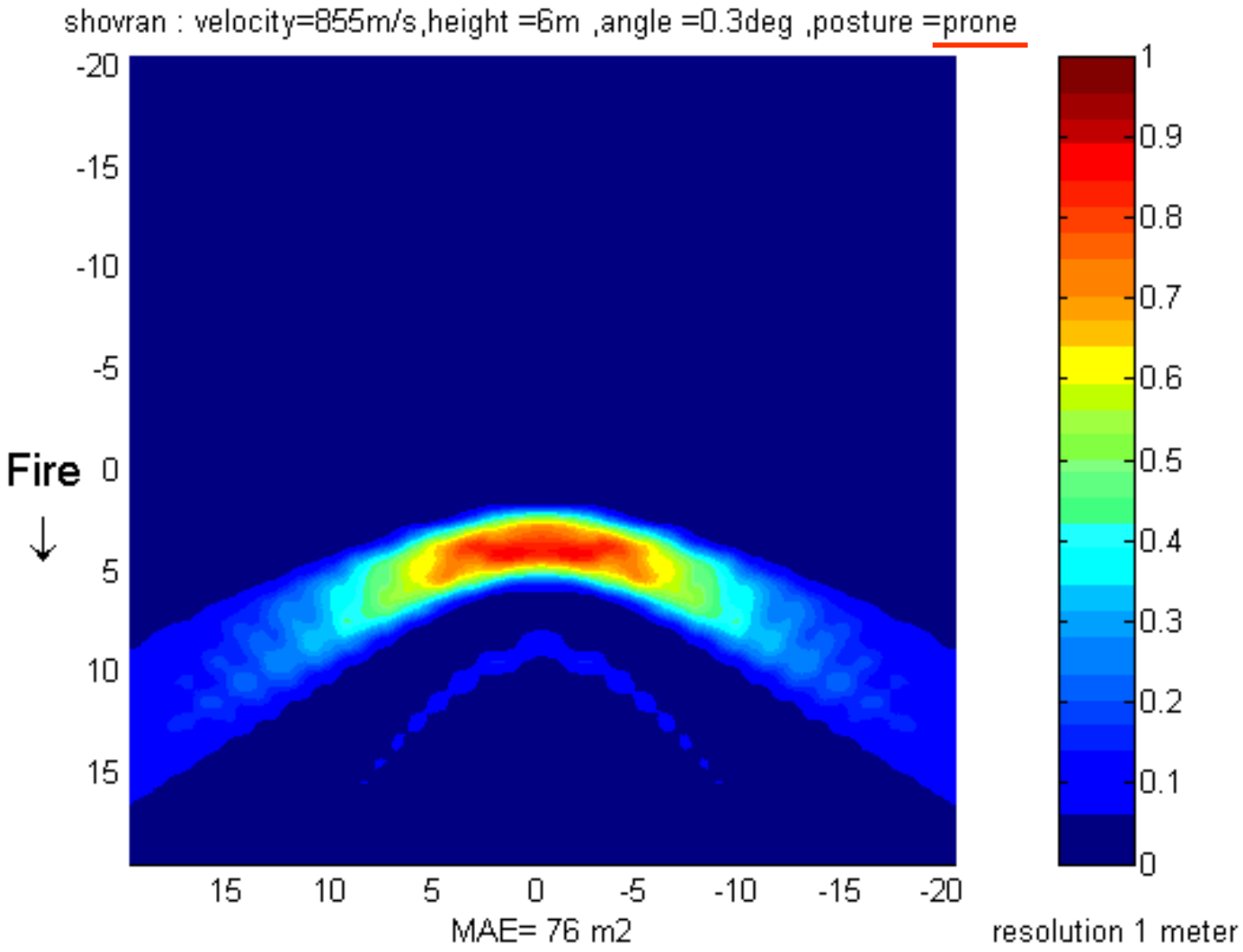
Incapacitation Probability (ρ_k) Map



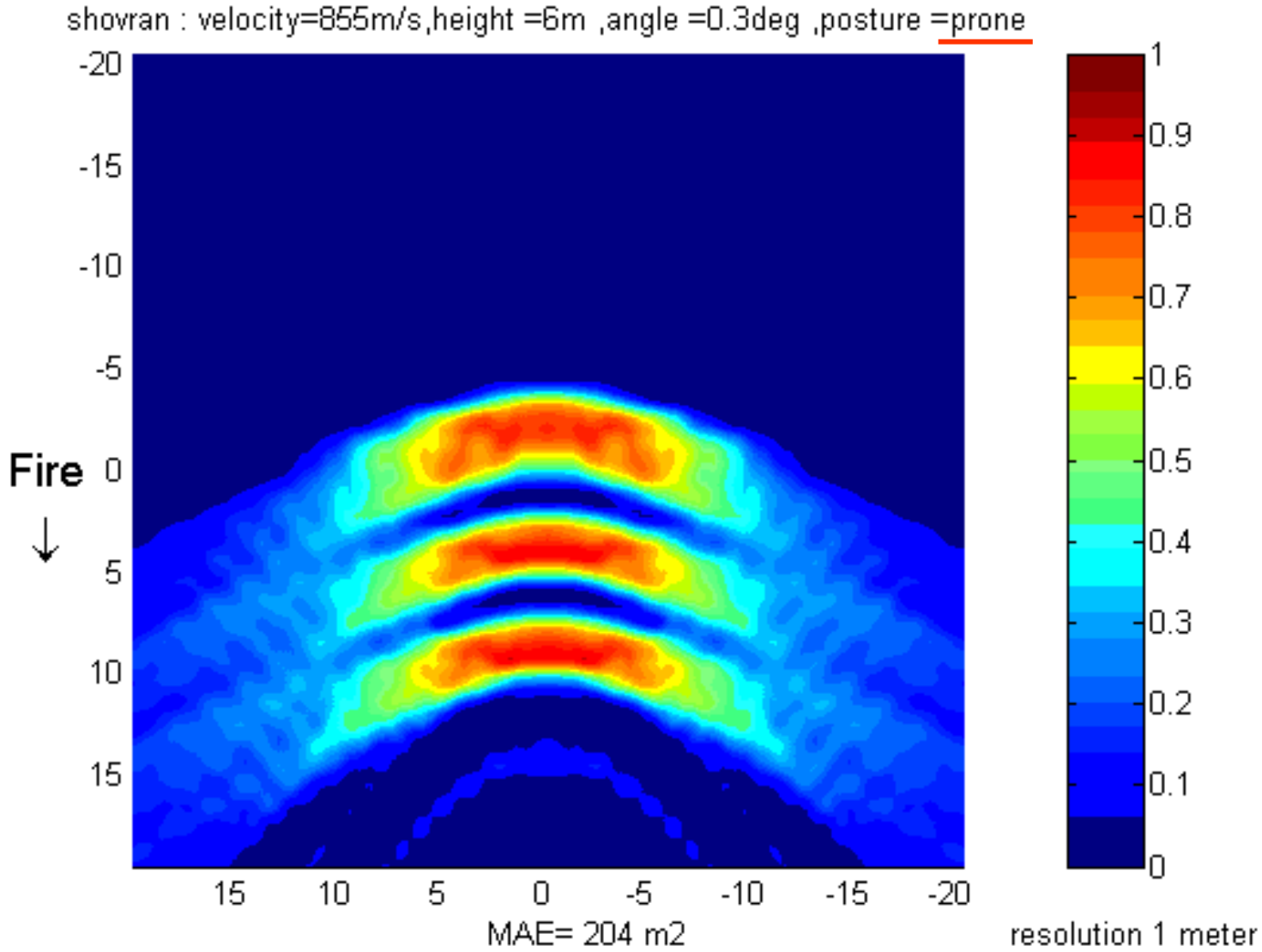
Incapacitation Probability (ρ_k) Map



Incapacitation Probability (ρ_k) Map

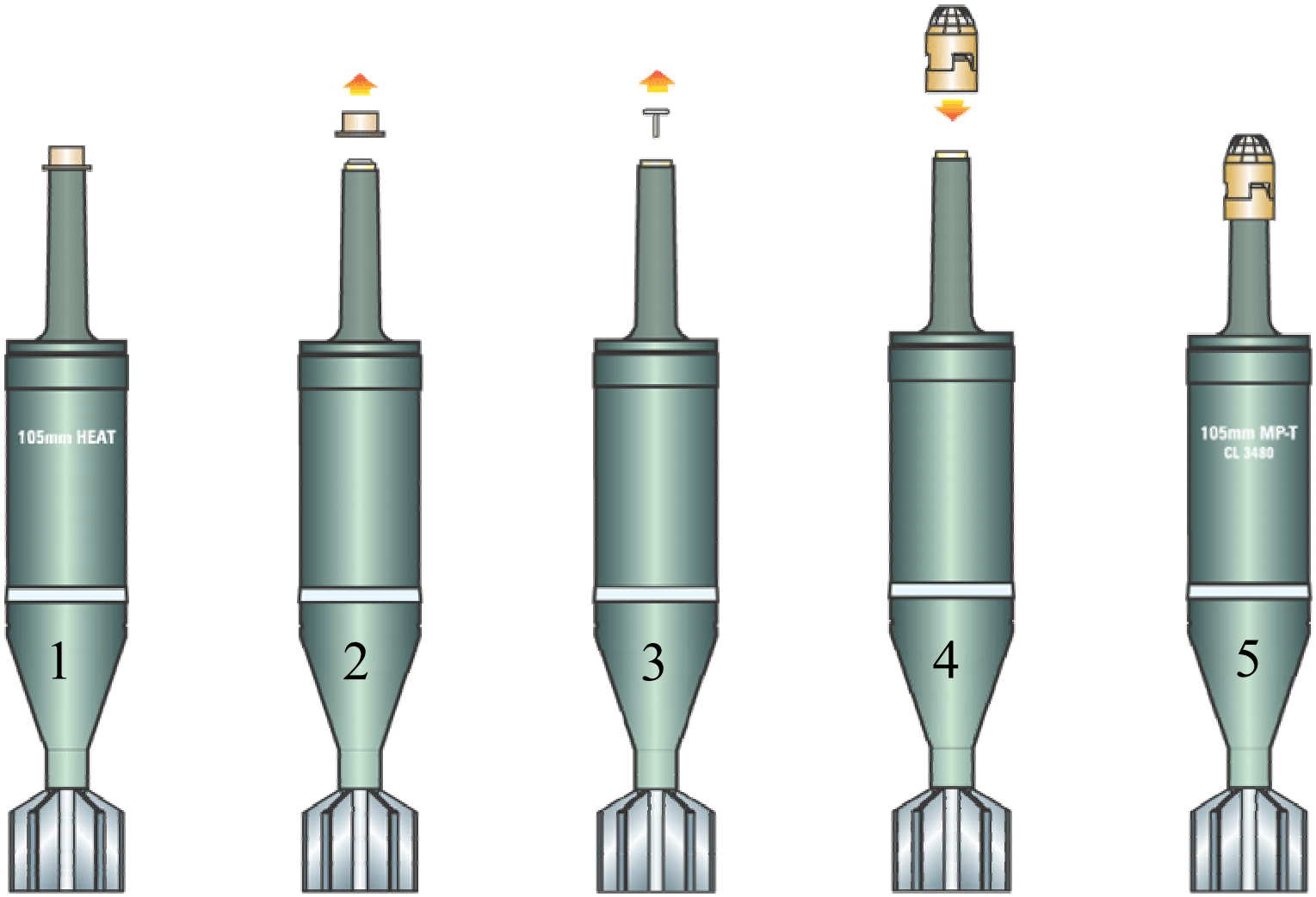


Incapacitation Probability (ρ_k) Map

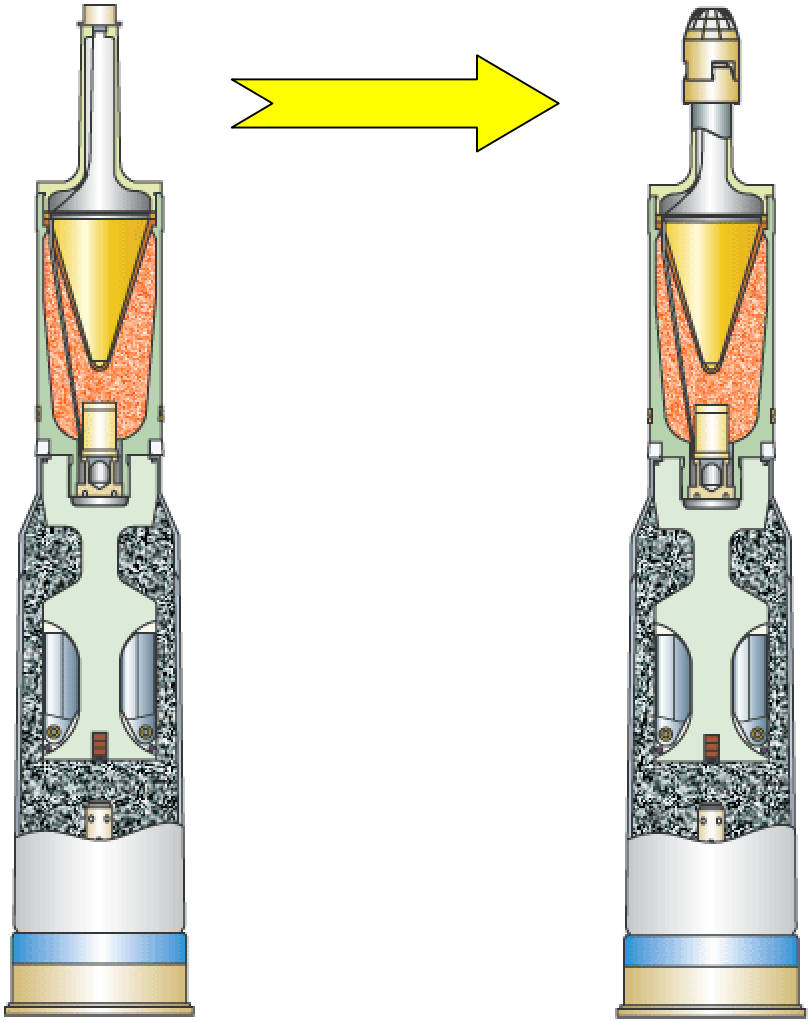


❖ Grazing (impact switch) Functioning test

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)

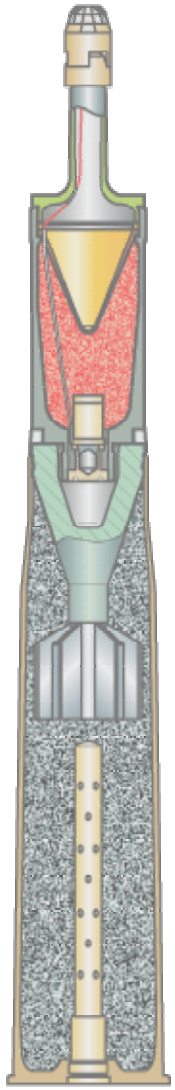
BALLISTIC PERFORMANCE

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

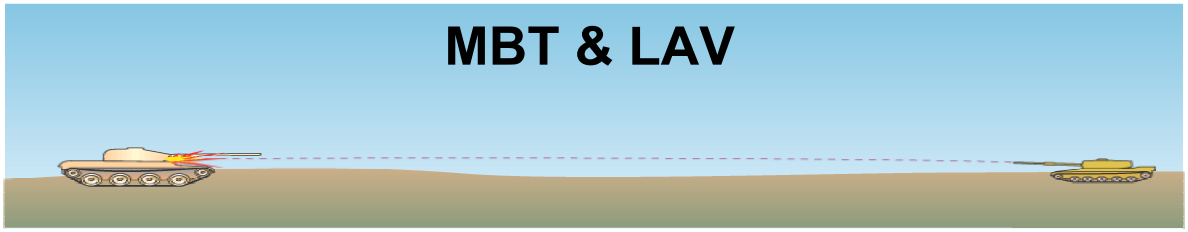
BALLISTIC PERFORMANCE

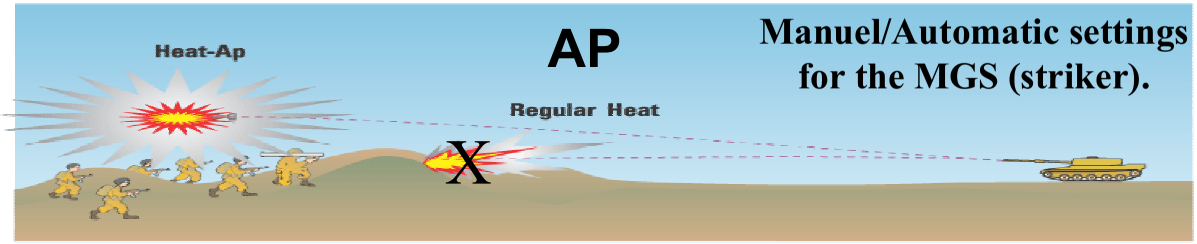
Temp. limits, firing	-40 to +52°C
Temp. limits, storage	-40 to +63°C
Various tests IAW MIL-STD-810D and NATO standards	

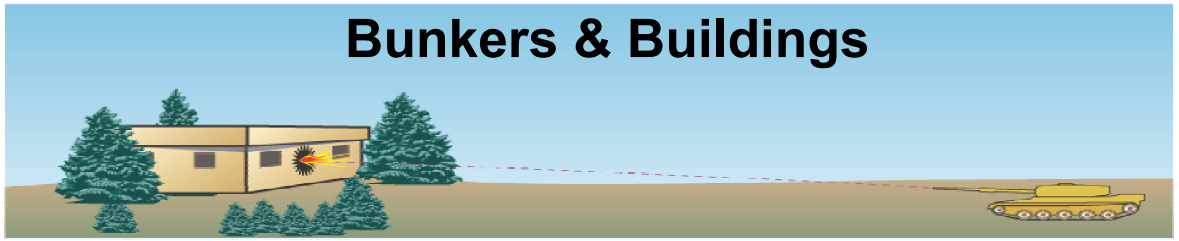
Summary - Targets and Operating Modes



M152/6







Grazing (safety)

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