120 mm IM HE–MP–T - M339
Multi-Purpose Tank Cartridge

E. Shachar, A. Moran, A Maish, Y. Cohen, G. Strul
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IMI Locations

- Munition System Division/Metal Plant
- ASHOT Ltd.
- Rocket Systems Division (GIVON)
- Munition Systems Division/Chemical Plant
- Keshet
- Small Caliber Ammunition Division (YIZHAK)
- Corporate HQ
- Munition Systems Division
- Land Systems Division (SLAVIN)
- Advanced Systems Division (MALTAM)
- IMI Academy for Security, Anti-Terror Doctrine & Training
- Rocket Systems Division (GIVON)
Munition Systems Division

- Tank & Artillery Ammunition
- Infantry and Medium Cal. Ammo
- Air-to-Ground Munitions
- Smart Munitions
- Warheads
- Ammunition Handling - Storage Management, Reutilization, Demilitarization & Disposal
Outline of the presentation:

- Introduction & Background.
- Goals & Mission
- Insensitive Substances
- IM tests.
- Summary.
The goals of the development program:

- Develop a Multi-Purpose Tank Cartridge
- Can be fired with 120mm smooth bore guns L44/L55
- Developed and qualified according NATO STANAG 4385 and IDF requirements
- Complies with:
  - STANAG 4493
  - STANAG 4369 & AOP 22
  - STANAG 4157
  - MIL-STD-810, ITOP and others

- IM – MIL – STD – 2105 / STANAG 4439
  - HE (CLX663) – Qualified by the IDF
  - LOVA propellant (optionally) – Qualified by the IDF
HE-MP-T 120 - A Multi-Purpose Round

Concrete Wall

Earth & Timber Bunkers

Light Armour

Wall Breaching &

Infantry & AT Squads
The IM goals concept

Energetic materials:

- Explosive classified as 1.5 UN
- Propellant less sensitive as LOVA nitramine.

Ammunition:

- Design to IM.
- Mitigation (if necessary).
- Packaging.
- Pass major tests according 2105/4439.
HE-MP-T 120 - A Multi-Purpose Round
Insensitive energetic compounds

- Cartridge length: 984 mm
- Cartridge weight: 27 Kg
- Projectile weight: 17 Kg
- HE weight (IM-CLX663): 2.3/2.5 Kg
- Muzzle velocity: 900 m/sec
- Chamber pressure: 3,300 bar
- Accuracy (SD): 0.3 mil
**HE-MP-T 120 - A Multi-Purpose Round**

**Insensitive energetic compounds**

Qualified as 1.5 UN Hazard

<table>
<thead>
<tr>
<th><strong>Propelling System</strong></th>
<th></th>
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<tbody>
<tr>
<td>Electric Primer</td>
<td></td>
</tr>
<tr>
<td>Propellant (M26/LOVA)</td>
<td></td>
</tr>
<tr>
<td>Stub Case</td>
<td></td>
</tr>
</tbody>
</table>

| **Projectile**                                |  |
| Warhead / CLX 663                             |  |

Electronic

Device (setting coil)

Combustible Cartridge Case

| **Cartridge**                                 |  |
| Cartridge length                              | 984 mm |
| Cartridge weight                              | 27 Kg  |
| Projectile weight                             | 17 Kg  |
| HE weight (IM-CLX663)                         | 2.3/2.5 Kg |
| Muzzle velocity                               | 900 m/sec |
| Chamber pressure                              | 3,300 bar |
| Accuracy (SD)                                 | 0.3 mil |
**HE-MP-T 120 - A Multi-Purpose Round**

**Insensitive energetic compounds**

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**CLP 15/26 Nitramine propellant**
IMI 120 mm IM HE–MP–T– M339
IM Testing Protocol

- Explosive Qualification
- Propellant testing and qualification
- SCO test
- FCO (Liquid Fire Test).
- FI (Packaged as well)
- BI (Packaged as well)
- Shape charge attack test
- Sympathetic Reaction
CLX 663 - A NEW INSENSITIVE HIGH EXPLOSIVE (IHE)

- QUALIFIED by the IDF
- ENERGY NEAR PBXN 109
- IMPROVED CASTING
- RESISTANCE TO THERMAL TREATS
- WITHSTANDS FCO SCO TESTS.

Qualified as 1.5 UN

IM TESTING
Method: TB 700-2 Chapter 5-8
- SCO - PASS TEST
- FCO - PASS TEST
- BI - PASS TEST
- FI - PASS TEST
- LSGT - PASS TEST
- GAP/CAP TEST PASS TESTS

BULLET ATTACK TEST
IMI LOVA PROPELLANT

To maximize the Force

\[ F = R \frac{T_v}{MW} \] (j/gr)

High Energetic materials + Novel Energetic Plasticizer
High Nitrogen Content

Nitramine (RS-RDX)

No Nitroglycerine
# IMI LOVA PROPELLANT

## Thermo-chemical computations

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Force [ j/g ]</th>
<th>$T$ [ K ]</th>
<th>$M_w$ [ g/mol ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form. 1</td>
<td>1169</td>
<td>3517</td>
<td>25.0</td>
</tr>
<tr>
<td>Form. 2</td>
<td>1218</td>
<td>3442</td>
<td>23.5</td>
</tr>
<tr>
<td>CLP-26</td>
<td>1204</td>
<td>3259</td>
<td>22.5</td>
</tr>
<tr>
<td>M-26</td>
<td>1076</td>
<td>3125</td>
<td>24.1</td>
</tr>
</tbody>
</table>

F = $R \frac{T_v}{M_W}$

High force – high performance
IMI LOVA PROPELLANT

IMI has introduced novel high energetic propellants for new 120 mm KE/MP round – CLP 15 / CLP 26.

- Improved Ballistic performances
  - Higher muzzle velocity
  - Low flame temperature (<3500 K)
  - High Impetus (>1200 j/g)

- Stability Shelf life
  - Low weight loss during aging
  - Low stabilizer degradation
  - Extended shelf life

- Enhanced safety properties
  - Low vulnerability in IM test
  - Nitroglycerin free

Qualified by the IDF
IM Tests according STANAG 4439
Insensitive signature
SCO Test according stanag 4382

**Slow Cook-off**  
STANAG 4382

**Results:** Pass test  
Reaction level IV - V
Liquid Fuel Fire (Fast Cook-off) STANAG 4240.

No explosion occurred – parts of the round found at 20 meters.

Results: Pass test
Reaction level IV-V
Fragment Impact acc. STANAG 4496

Fragment Impact According STANAG 4496
Requirement: No explosion or detonation.

Response: type V reaction
Fragment Impact acc. STANAG 4496 (packaged)

Results: Pass test
Reaction level V
Bullet Impact - STANAG 4241

Results: Pass test Reaction level V
Bullet Impact - with Package STANAG 4241

Results: Pass test
Reaction level V
Shaped Charge Jet Impact Test STANAG 4526.

Hollow charge : M-85
T- ambient 21 C
Charge Acceptor : M 339
Shaped Charge Jet Impact Test STANAG 4526.

Results: Failed! Reaction level I-II
Sympathetic Reaction test STANAG 4396.
HE-MP-T 120 – Packaging & Logistical Configuration

Total weight = 950 kg
Sympathetic Reaction test STANAG 4396
(Preliminary)

Results: Pass test Reaction level IV
## Summary of IM Reaction Levels (with CLX663)

<table>
<thead>
<tr>
<th>IM Stimulus</th>
<th>Reaction Level</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Heating (Fast Cook-Off)</td>
<td>IV-V</td>
<td></td>
</tr>
<tr>
<td>Slow Heating (Slow Cook-Off)</td>
<td>IV-V</td>
<td></td>
</tr>
<tr>
<td>Bullet Impact</td>
<td>V</td>
<td>X3 In Fuze</td>
</tr>
<tr>
<td>With Package</td>
<td>V</td>
<td>X3 In Primer</td>
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## Summary of IM Reaction Levels (with CLX663)

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<tbody>
<tr>
<td>Fragment Impact</td>
<td>V</td>
<td>By Targeting the Fuze &amp; Primer</td>
</tr>
<tr>
<td>With Package</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Sympathetic Reaction Preliminary. (Test will be</td>
<td>(IV)</td>
<td>One donor &amp; One acceptor</td>
</tr>
<tr>
<td>repeated)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shaped Charge Jet Impact without barrier</td>
<td>I-II</td>
<td></td>
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</table>
IMI 120 mm IM HE-MP-T - Summary

- IMI has introduced its new 120 mm HE-MP-T tank round. The round is consisted from an insensitive explosive substance and as well a LOVA propellant as an option.

- The round passes major IM tests and failed to pass the shape charge test attack.

- The ammunition meets all ballistics and lethally requirements with high tank crew survivability.

- Further work will be done to improve reaction level for some of the tests.

- A derivative of this type ammunition will be operational for the IDF at Q4 2012.