Israel Military Industries Ltd. (IMI)

Munition Systems Division

IM tests of a new IMI less sensitive demolition charge

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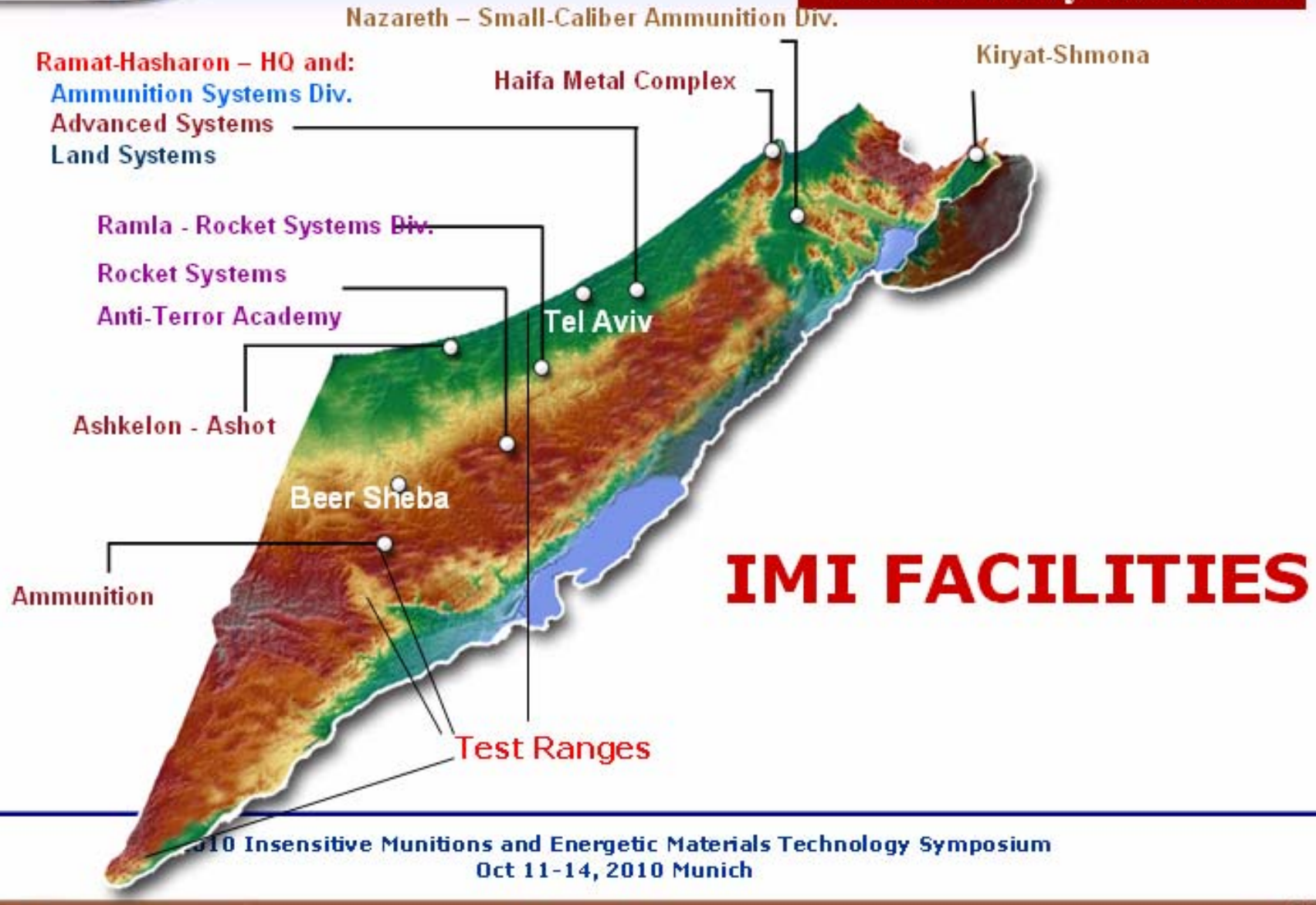
IMI - Munition Systems Division



IMI FACILITIES

Commitment for Safety and Performance

- Tank

LOVA PROPELLANT

- Infantry and medium caliber

- Air-to-Ground

- Artillery

Outline of the presentation :

- Background.
- Objectives.
- Approach.
- IM tests.
- Summary.

Background : CLX 15 an alternate to C4 paste comp.

- IMI is the sole qualified producer of C4 in Israel.
- Composition C4 passes BI and FI sensitivity tests, fails to pass Several other IM tests.
- IMI has developed an alternate formulation, CLX 15, with comparable physical properties and moldability; energy output characteristics equivalent to the traditional C4 explosive.
- The new composition, complies to the definition of IHE and IM characteristics.
- Task : Qualify the new composition for the IDF and infantry corps.

The Approach of this task:

- Finalizing the Ingredients for the new composition.
- The new demolition block should be initiated by:
  - Electrical or standard detonator No. 8
  - Detonating cord with an initiator cap.
  - Looped detonating cord without initiator cap.
- Assessing hazard and physical characteristics.
- IM Characteristics

CLX 15 ingredients

- RDX
- Oils mixture
- Taggant (optional)

CLX 15 Testing & Qualification Protocol

- Hazard analysis – Impact, Friction, ESD.
- Exudation test.
- Thermal analysis.
- Vacuum stability.
- Detonation velocity.
- LSGT
- Initiation tests
- IM tests : BI.
  FI.
  SCO.
  FCO.

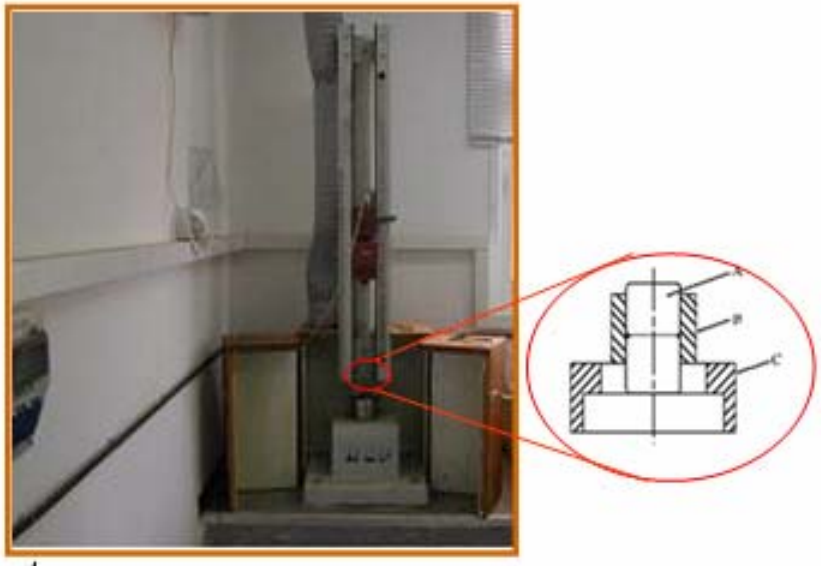
Hazard Characterization - Impact Sensitiveness

Requirement: Less sensitive than RDX and similar to C- 4.

Method: MIL-STD-1751 Method 1101

Results : Impact results remain fairly consistent, results comparable to C- 4 - $E_{50\%}$ Bruceton method– 4.21 Kg m

Explosive	$H_{50\%}$ [cm]	Energy [kg•m]
CLX-15	84.14 *73.56	4.21 *3.7
C-4	85.77 *77.92	4.29 *3.9



* After aging (30d, 65°C) - IDF requirement.

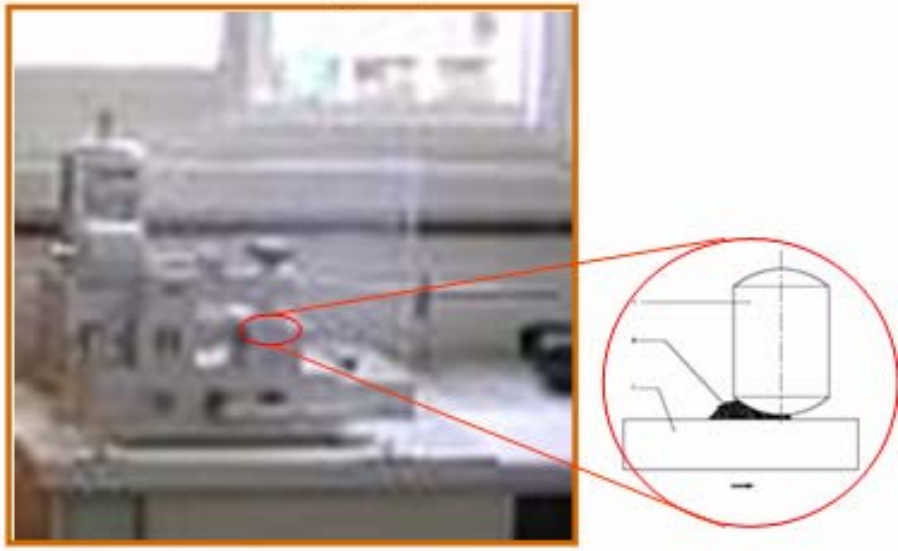
Hazard Characterization - Friction Sensitiveness

Requirement: Less sensitive than RDX and similar to C- 4.

Method: MIL-STD-1751 Method 1024

Results : 6/6 consecutive negative tests - no reaction at 36 Kg F (72 Lb f)

Explosive	Friction Sensitivity [kgf]
CLX-15	36.0 *36.0
C-4	36.0 *36.0



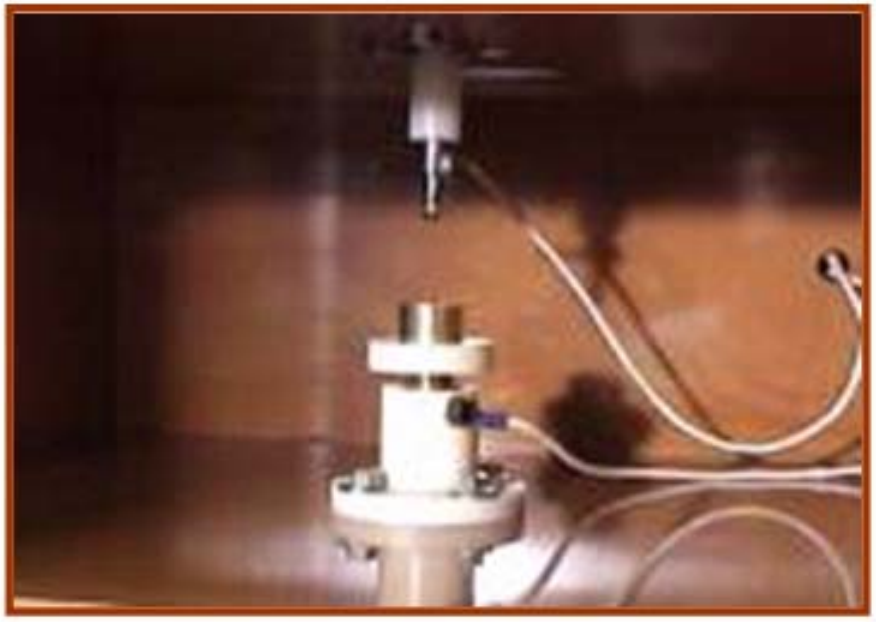
* After aging (30d, 65°C) – IDF requirement.

Hazard Characterization - ESD Sensitiveness

Requirement: 30/30 No Fires at 0.25 J

Method: MIL-STD-1751 Method 1032

All results pass.



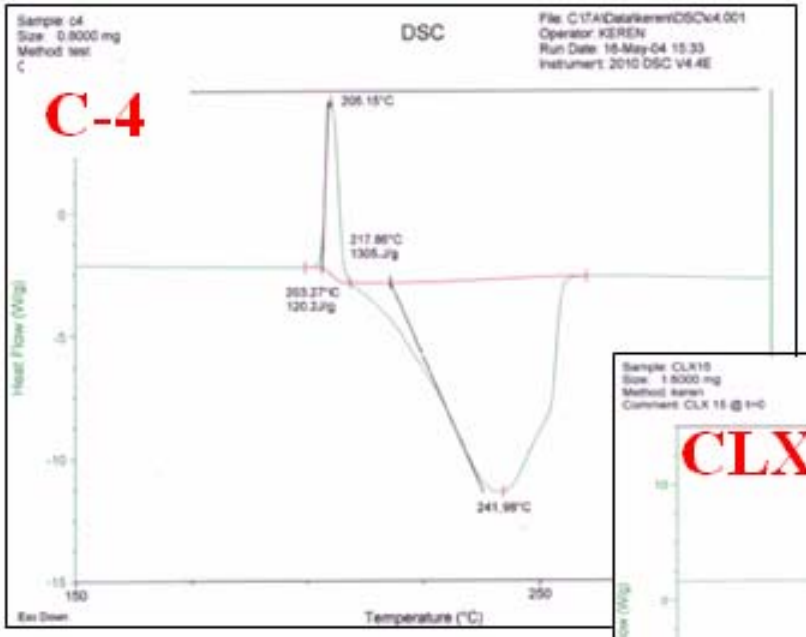
Hazard Characterization - Exudation Test

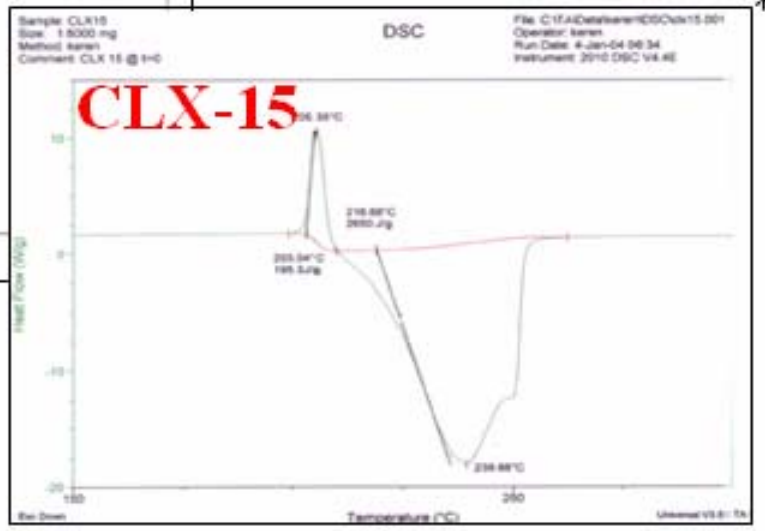
This test evaluates the binders and oil exudation during the service life of the charge. This assures molding characteristics for a long service time.

Explosive	Oil exudation After 30 days at 65°C
CLX-15	0.001%
C-4	0.181%

Exudation test

Thermal Analysis : DSC





Explosive	Auto ignition Temp. [° C]
CLX-15	218.9 215.9 (Aging)
C-4	217.9 215.7 (Aging)

* After aging (30d, 65°C) - IDF requirement

Vacuum Stability

This method is used to determining the energetic material stability by measuring the volume gas liberated of a heated sample under vacuum.

Explosive	Volume/gr (mm)	IDF Req.
CLX-15	0.23	Less than 1 ml/gr
C4	0.57	
Comp B	0.24	

Detonation Velocity

Sample	Detonation Velocity (m/s)
CLX-15	7959 ± 62 (ρ=1.48)
C-4	7302 (ρ=1.39)

Large Scale Gap Test (LSGT)

Requirement: No clean hole punched through the plate.
Method: TB 700-2 Chapter 5-8 (UN Test 7 (b))
Results : Dents in witness plates

The test is used to predict the sensitivity of an EIDS candidate, under confinement in a steel tube, to a specified shock level i.e. a specified donor charge and gap.

Initiation Tests – A. detonator No. 8

Requirement: Dent / breakage of witness plate.

Results : breakage of witness plates (triplicate)

Initiation Tests – B. Detonating cord with an initiator cap under water

Detonating cord with an initiation cap

Detonating cord inside demolition charge

Demolition charge under water inside barrel

Barrel after test

Requirement: Complete Detonation.

Method: MIL-STD-810F method 512.4

Results : Full detonation, barrel found 25 m from test arena

The demolition charge was placed under water for 24 h prior to test and initiated under 1 m of water.

Initiation Tests – C. Initiation with a looped standard detonating cord

Double bond at the end of a detonating cord

Requirement: Complete detonation (8 of 8 detonations).
Method: Penalty method.
Results : High reliability (confidence level of 95%)

IM testing of CLX-15 - Bullet Impact (BI)

The bullet impact test is used to evaluate the response of an EIDS candidate to the kinetic energy transfer associated with impact and penetration of a given energy source, i.e. a 12.7 mm projectile, traveling at a specified velocity (840 ± 40 m/s).

Bullet Impact

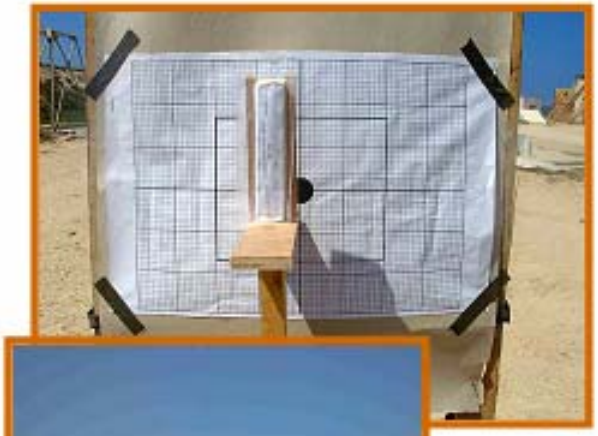
Requirement: No explosion or detonation.

Method: TB 700-2 Chapter 5-8 (UN Test 7 (d))

Results : 6/6 Explosive scattered.

Response: type V reaction

IM testing of CLX-15 – Fragment Impact (FI)



- **Fragment Impact is used to evaluate the response of a a munition to a steel projectile that is precisely defined by mass and velocity (1830 m/s).**

- **The demolition charge <u>fails</u> to pass test.**
- **The test will be repeated**

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

Response: type I-II reaction !!

IM testing of CLX - 15 Slow Cook off Test (SCO)

Set up test / control heated chamber

Response: Moderate burning type V reaction

IM testing of CLX-15 – Fast Cook Off test (FCO)

The Fast Cook-off test is used to assess the reaction, if any, of weapon systems to heat fluxes which are typical of the fast heating likely to be generated within an incandescent flame envelope of a large liquid hydrocarbon fuel fire.

Requirement: Non propulsive burning.
Method: STANAG 4240
Results : Moderate burning. – **Type V reaction**

Phase I – one demolition charge

IM testing of CLX-15 – Fast Cook Off test (FCO)

Requirement: Non propulsive burning.
Method: STANAG 4240
Results : Moderate burning. – **Type V reaction**

Phase II –14 demolition charges Inside a metal container

Conclusions & Summary

- IMI has introduced a new Demolition Charge – CLX 15.
- Comparable physical properties to newly manufactured C-4.
- Superior physical characteristics after accelerated aging.
- According to the tests results described above, IMI's CLX 15 formulation was designated as Insensitive Detonating Substance.
- CLX 15 was qualified by the IDF as less sensitive demolition block.

Acknowledgments

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