



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

**Insensitive Munitions (IM) Testing:
25mm Target Practice, Discarding Sabot with Trace (TPDS-T), M910
Cartridge using ECL[®] Propellant**



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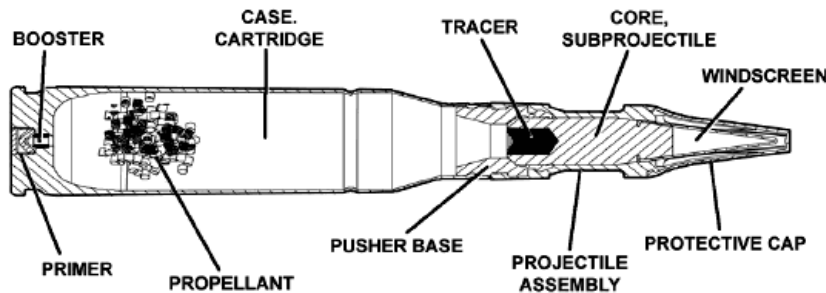
 - ATK Ammunition and Energetics
 - Ms. Kelly Brown Moran

- ❑ Overview
- ❑ System Description
- ❑ Objective
- ❑ Why ECL?
- ❑ Test Results
 - Ballistics
 - Engineering IM
- ❑ Conclusion
- ❑ Planned Effort



- ❑ The U.S. Army is increasingly stressing the necessity of Insensitive Munitions (IM) compliance to provide a more cost effective, efficient means of transporting, storing and handling munitions
- ❑ PEO Ammunition strategy plan adopted an IM initiative to bring medium and large caliber munitions into IM compliance
- ❑ Existing medium and large caliber munitions do not meet Insensitive Munitions (IM) requirements
- ❑ Develop and investigate IM technologies (less sensitive propellant, cartridge case and ammo can venting concepts) to enhance munitions survivability when subjected to extreme environments and unplanned stimuli
 - ↳ IM improvements over the existing designs to enhance the survivability of logistical and tactical combat systems
 - ↳ Does not degrade the performance of the systems
 - ↳ Minimize injury to personnel
- ❑ Developed solutions will be demonstrated for IM enhancement using the 25mm APDS-T, M910 cartridge

- ❑ The 25mm M910 Target Practice, Discarding Sabot with Trace (TPDS-T), M910 cartridge is a limited range munitions ballistically matched to the service cartridge, 25mm Armor Piercing Discarding Sabot with Tracer (APDS-T), M791 cartridge.



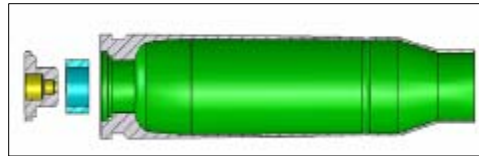
Length (max)	223 mm
Weight	419 g
Projectile Mass	98.8 g
Propellant Weight	98.5 g
Muzzle Velocity	1520 m/s
Chamber Pressure @ Ambient	454 MPa
Trace Time	4.0 sec
Dispersion	0.40 x 0.40 mr

- ❑ Maximum range is less than 8000 meters
- ❑ The M910 is fired in lieu of the M791 from the M242 25mm autogun turret mounted on the M2/M3 Bradley Fighting Vehicle System during live fire gunner training and qualification

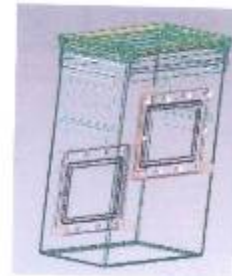
❑ Develop and investigate IM technologies to enhance munitions (**System Level**) survivability when subjected to extreme environments and unplanned stimuli

✓ **Less sensitive propellant to mitigate fragment impact deficiency**

✓ Cartridge case venting

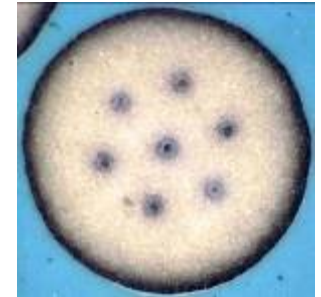


✓ Ammo can venting

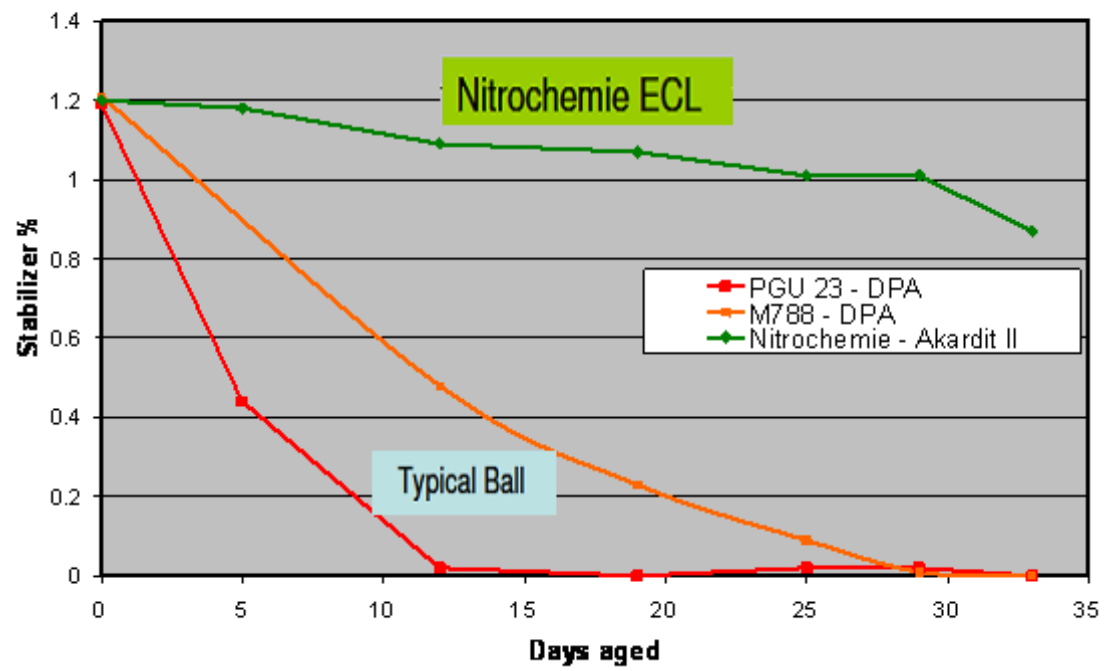


❑ **Main Benefits of new ECL[®] propellants compared to current nitroglycerine-base propellant solutions:**

- **Improved performance potential** due to
 - ✓ High energy density and thermal conversion
 - ✓ Tunable force level, favorable thermodynamic features
- **Improved dispersion, consistency and repeatability**
 - ✓ improved accuracy and precision
- **Direct incorporation of muzzle flash suppressants**
 - ✓ eliminate added flash suppressant granules
- **Higher cook-off resistance**
- **Less sensitive propellant – Enhanced IM characteristics**
 - ✓ No reaction to bullet impact
- **NG-free (safety) / non-toxic "green" formulation**
 - ✓ Avoidance of critical migration problems (plasticizers)
- **Much higher service life in A1 climatic zones due to:**
 - ✓ improved chemical and ballistic stability
 - ✓ improved compatibility
- **Provides equal to or better chemical and ballistic performance and stability when compared to currently fielded NG-containing propellants**



Stabilizer Depletion Vs. Time After Aging at 71°C

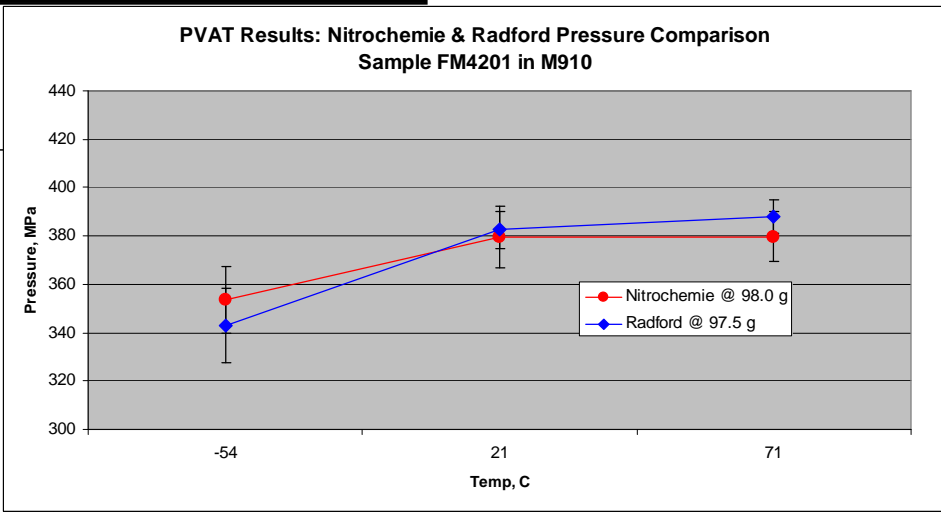
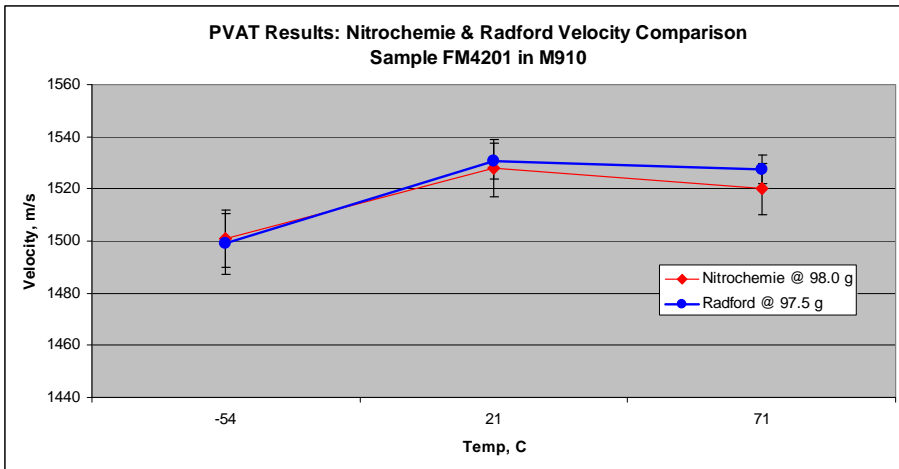


- 83% of Akardite in ECL present after 25 days at 71°C
- More than 90% of DPA in ball powder depleted after 25 days aging at 71°C



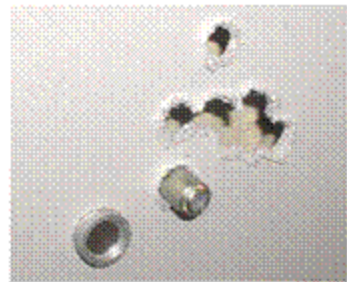
Radford Summary of Results - M910 FM4201 at 97.5 grams				
Temp, °C	Pressure, Mpa	Pres, Std Dev	Velocity, m/s	Vel, Std Dev
-54	342.9	15.3	1498.9	11.70
21	382.5	7.6	1530.7	6.70
71	388.3	6.9	1527.4	5.40

Nitrochemie Summary of Results - M910 FM4201 @ 98.0 grams				
Temp, °C	Pressure, MPa	Pres, Std Dev	Velocity, m/s	Vel, Std Dev
-54	353.5	13.6	1501	11
21	379.6	12.8	1528	11
71	379.7	10.3	1520	10

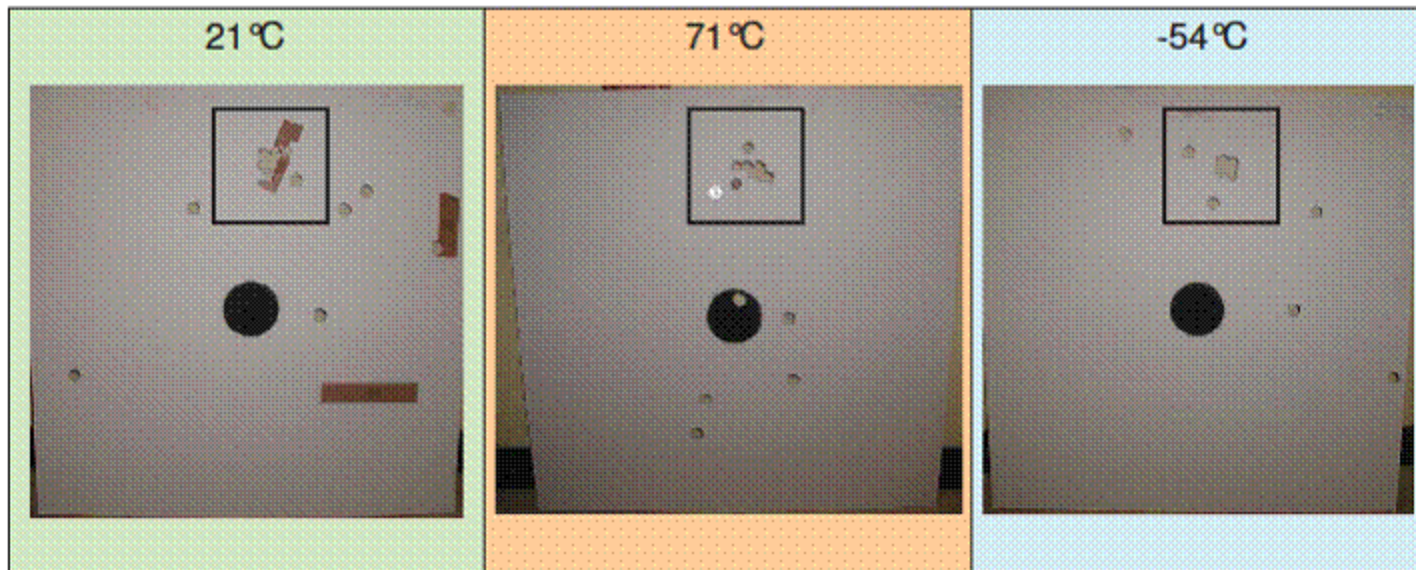


Dispersion Test Results

Dispersion (distance = 50m)
ECL FM 4201

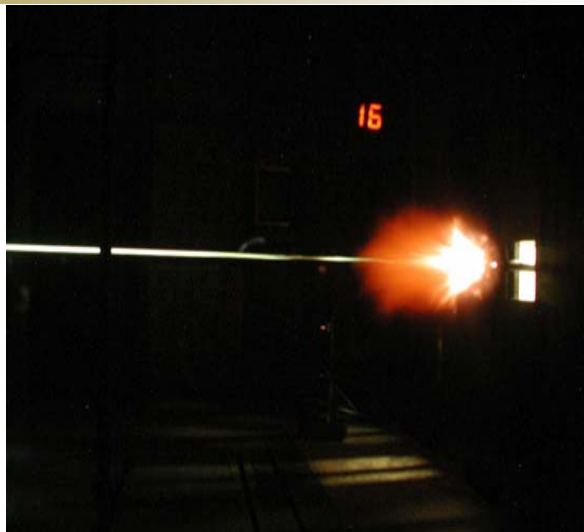


Two type of penetrations:
- Projectile
- Pusher plate



Dispersion in Target Area (50m)

Muzzle Flash Signature



At 21°C



At 71°C

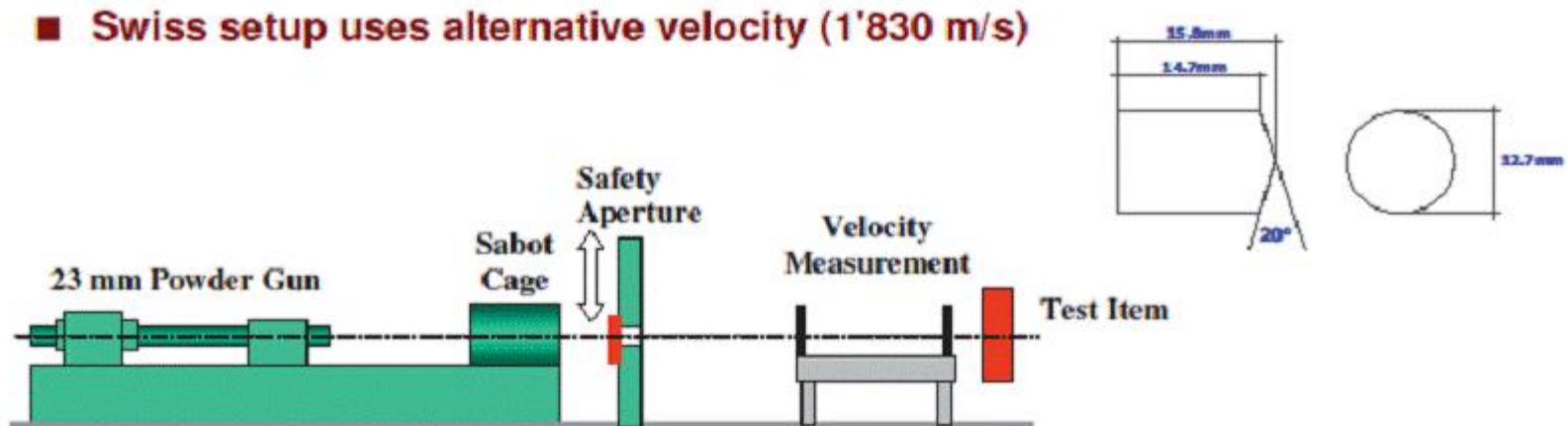


At -54°C



Fragment Impact (STANAG 4496)

- Impact of cylindrical steel fragment at 2'530 m/s (alternatively 1'830 m/s)
- Impact normal to surface of test item
- Assessment of Reaction Type
- Swiss setup uses alternative velocity (1'830 m/s)





Shot 1: III



Shot 2: III-IV

ECL FM 4201 in 35mm steel cartridge



Shot 1: III



Shot 2: III-IV

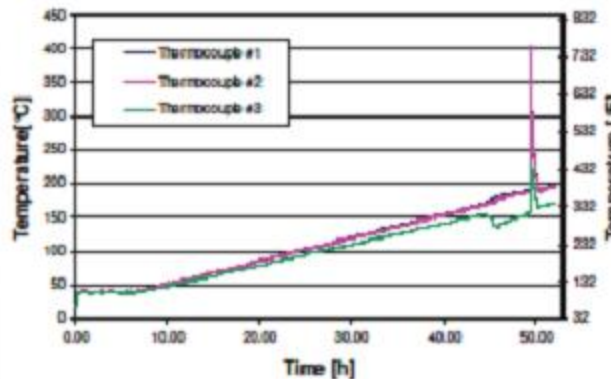
ECL FM 4201 in 35mm steel tube

Slow Heating (STANAG 4382)

- Heating Rate: 3.3°C / h
- Assessment of Cook-Off Temperature and Reaction Type



Measured temperature during Slow Cook-off #1



Test available
at armasuisse



Armaments and Munitions Systems
Development and Production of Arms
Development and Production of Arms
Development and Production of Arms

Engineering IM SCO Test Test Setup (Cont'd)



Results IM engineering tests

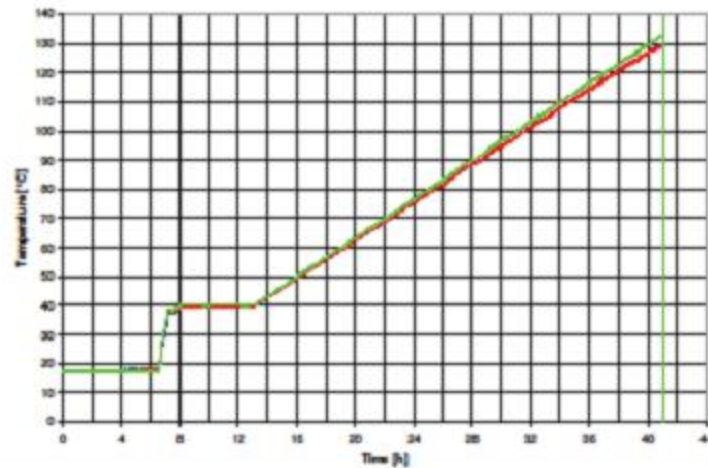
Slow cook-off SCO, 1st run 200807, 06/17/2008
Propellant: FM 4201 in 35mm steel cartridge,



Autoignition: 130.6°C
Fragmentation: III



SCO 200807



Results IM engineering tests

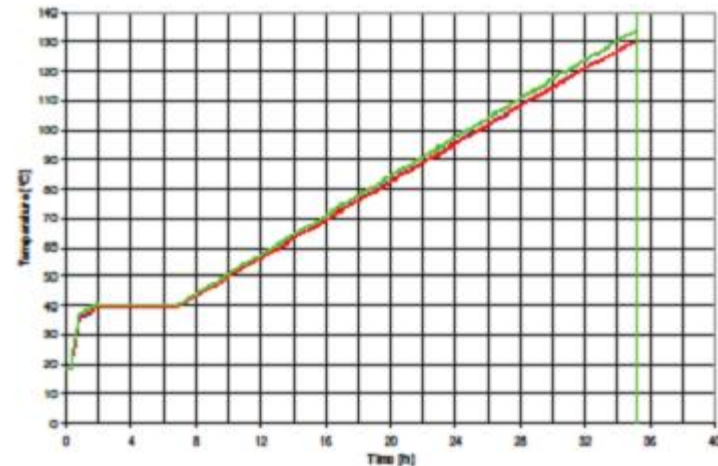
Slow cook-off SCO, 2nd run 200808, 06/19/2008
Propellant: FM 4201 in 35mm steel cartridge,



Autoignition: 131.3°C
Fragmentation: III



SCO 200808



□ ECL Provides:

- Enhanced IM characteristics
- Provides equal to or better chemical and ballistic performance and stability when compared to currently fielded NG-containing propellants
- Improved ballistic performance with flat tunable temperature
- Increases stability / service life

- ❑ Finalize the design of:
 - cartridge case venting
 - ammo can (PA125) with vent windows
- ❑ L/A/P M910 cartridges with ECL propellant
- ❑ Conduct abbreviated ballistic performance tests per MIL-PRF-70775B
- ❑ Conduct full scale IM tests per MIL-STD-2105C
- ❑ Conduct abbreviated safety/environmental tests

