



RDECOM



Initiation Trials of the IMX-101 Explosive in the M795 Projectile

**Anthony Di Stasio
NDIA-IMEM 2010**

UNCLASSIFIED\FOUO



Task Description



Nomenclature

Booster - Multiple

Supp Charge – TNT

Transfer Charge

IM Explosives have larger Critical Diameter (D_{CRIT}) than TNT

Measurement of D_{CRIT}

- TNT - 13mm (0.5")
- IMX-101 - 76mm (3.0")

Measurement of Sensitivity

- ELSGT loaded with IMX-101
 - IMX-101 - 58 to 60 kbars
 - TNT - 25 to 46 kbars

High Output Insensitive S.C.

- TNT Supp Charge will not detonate IMX-101
- TNT will not perform well thermally or respond well to IM testing
- Evaluating candidates for EIDS S.C.
- Evaluating other candidates

EIDS (HC 1.6)

Possibilities

- PBXN-113 (NIH)
 - Qualified for DOD use
- UF-TATB/Kel-F (AF-Eglin)
- IMX-102 (A-ARDEC)



Non-EIDS solution (HC 1.2)

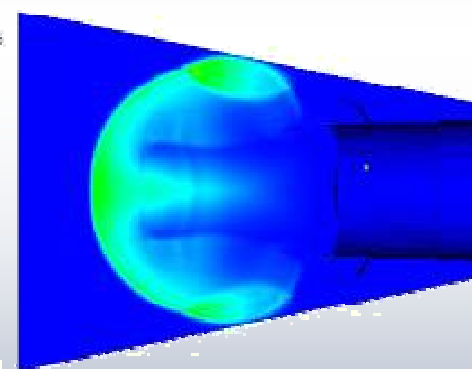
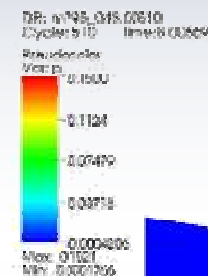
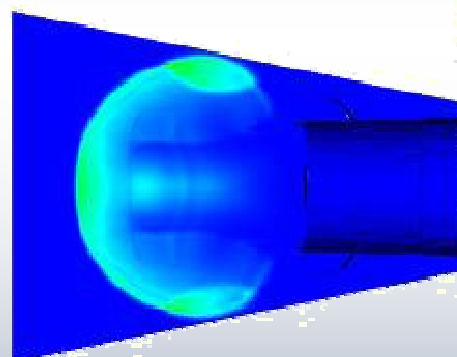
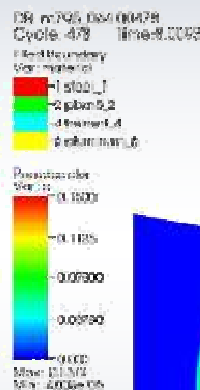
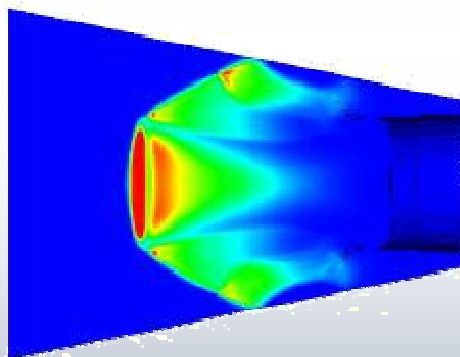
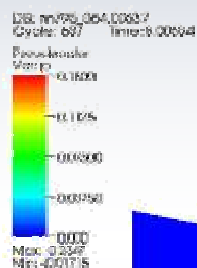
- Probable HC 1.2 for projectile
 - Pending IM/FHC testing
- Qualified Explosive
 - Dictated by project schedule
- Better IM properties than TNT
 - Thermal and Impact testing
- Higher output than TNT
 - To reliably initiate IMX-101



M&S of existing train

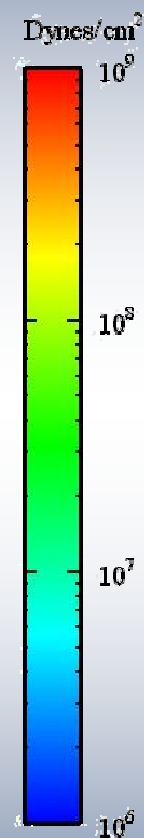
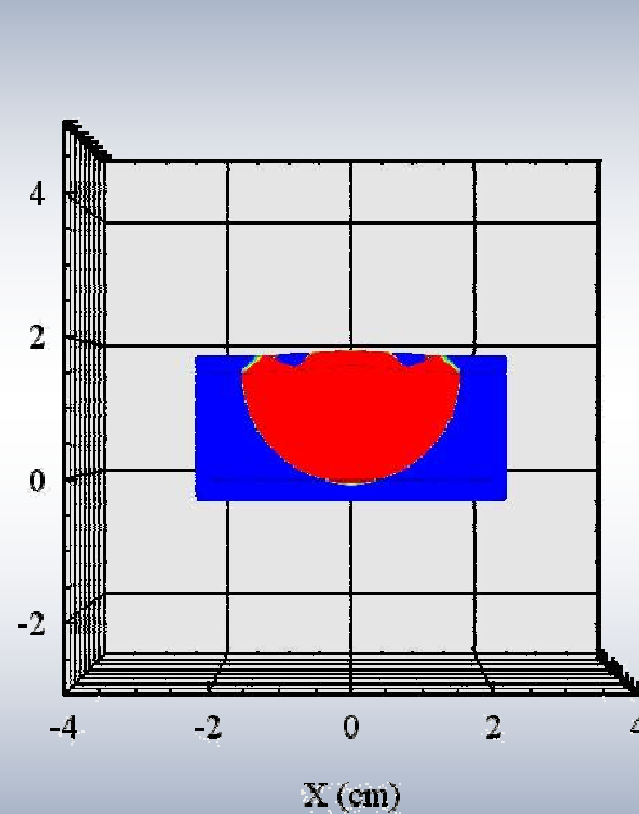
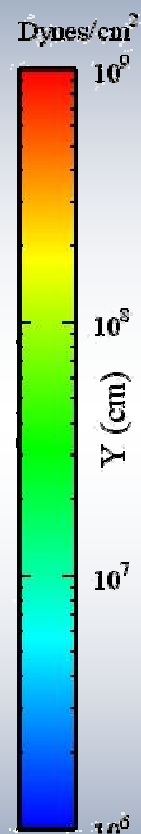
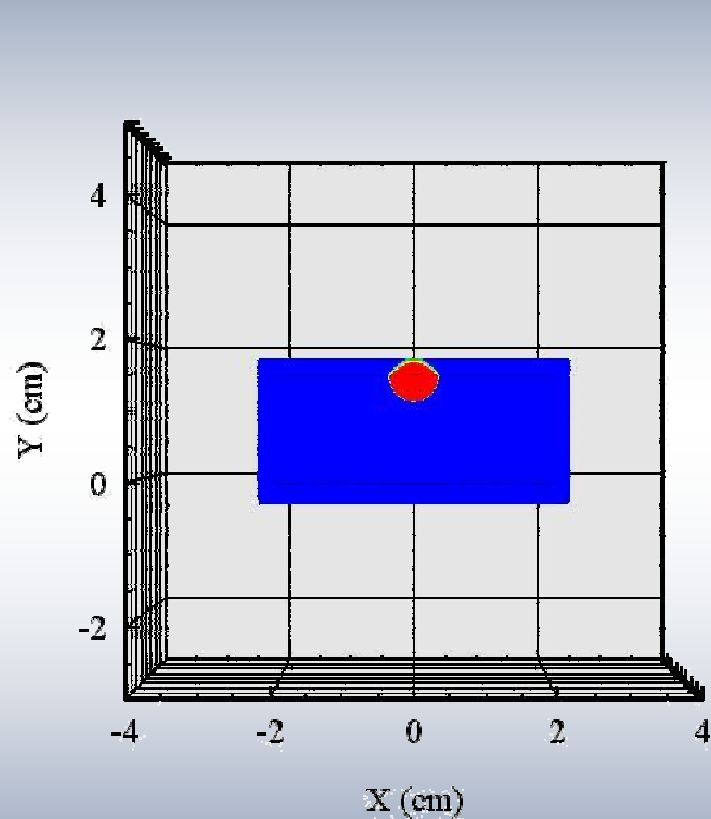


Various Supp Charges after 8 μ s



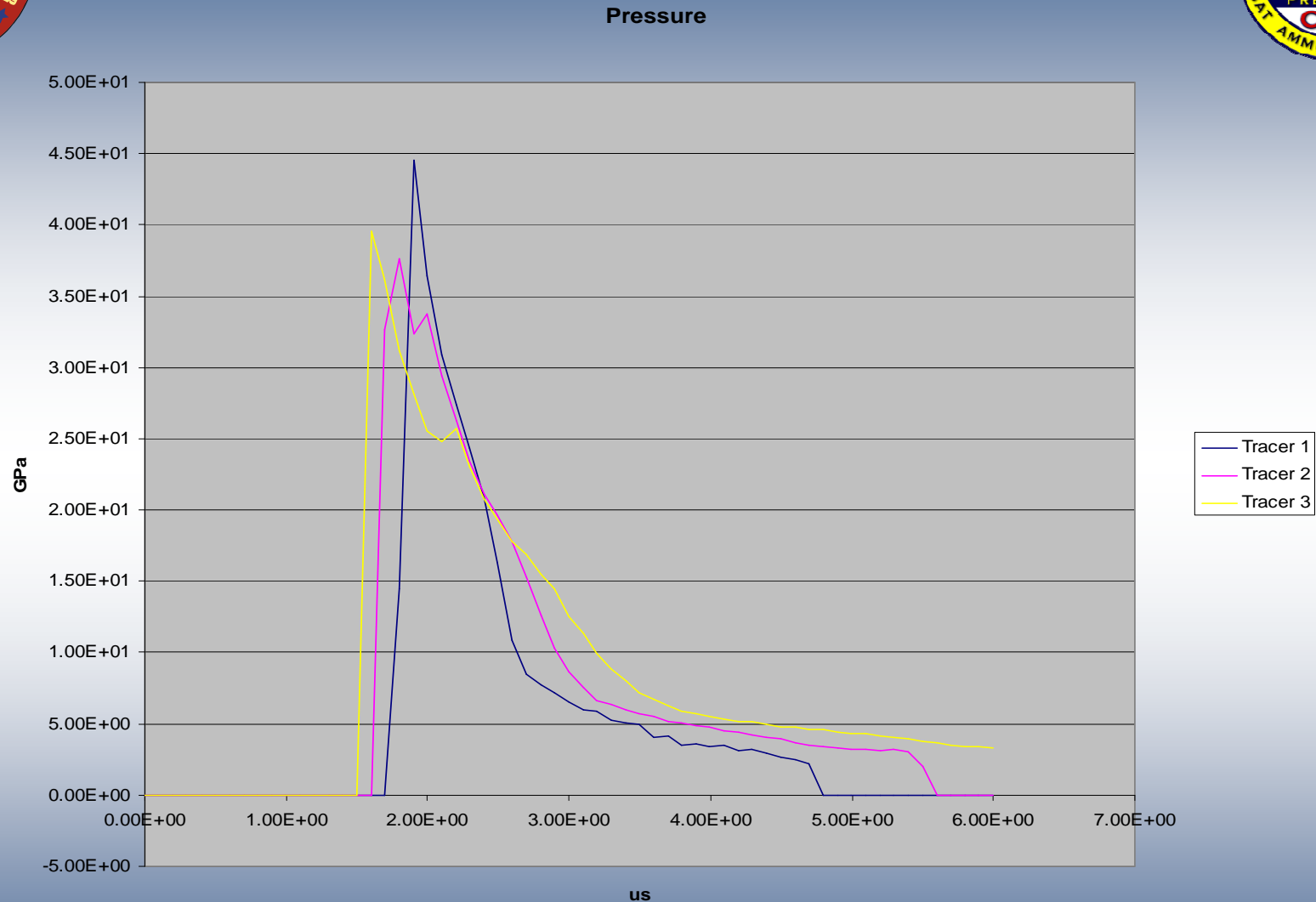


Standard Detonation





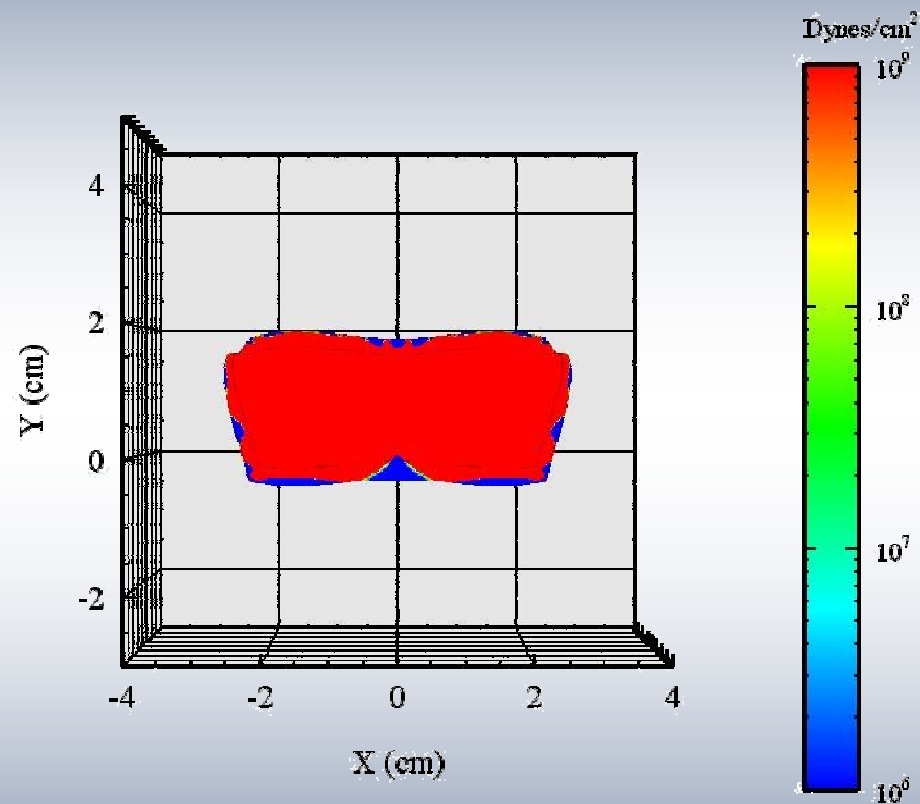
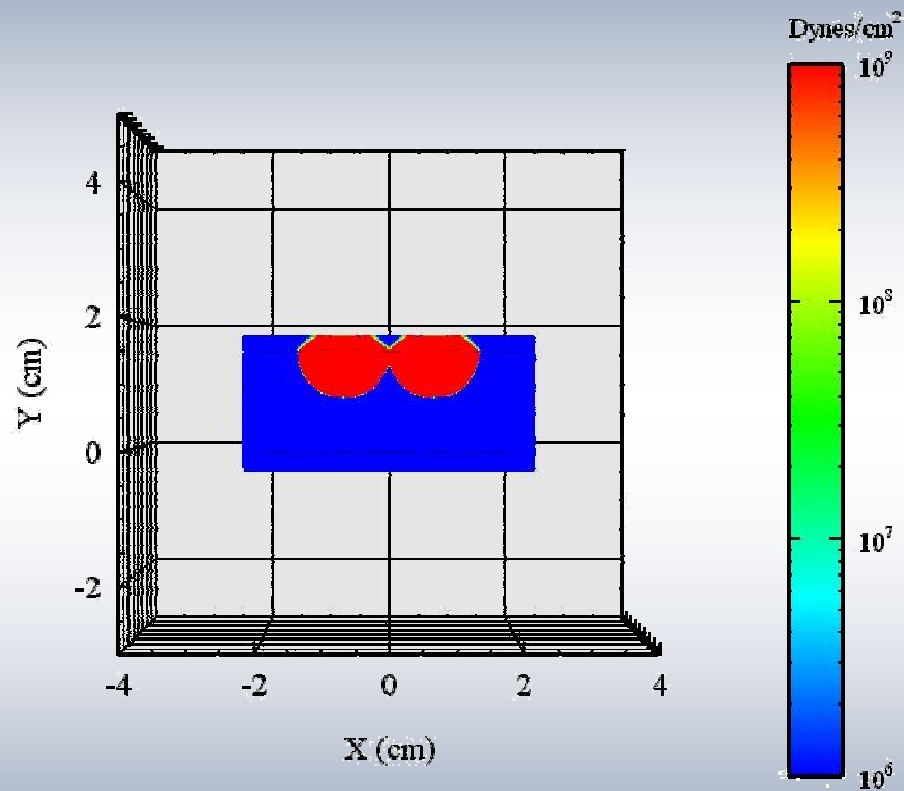
Standard Detonation Pressure



Pressure peaks at 44.5 GPa at the bottom surface of the pellet

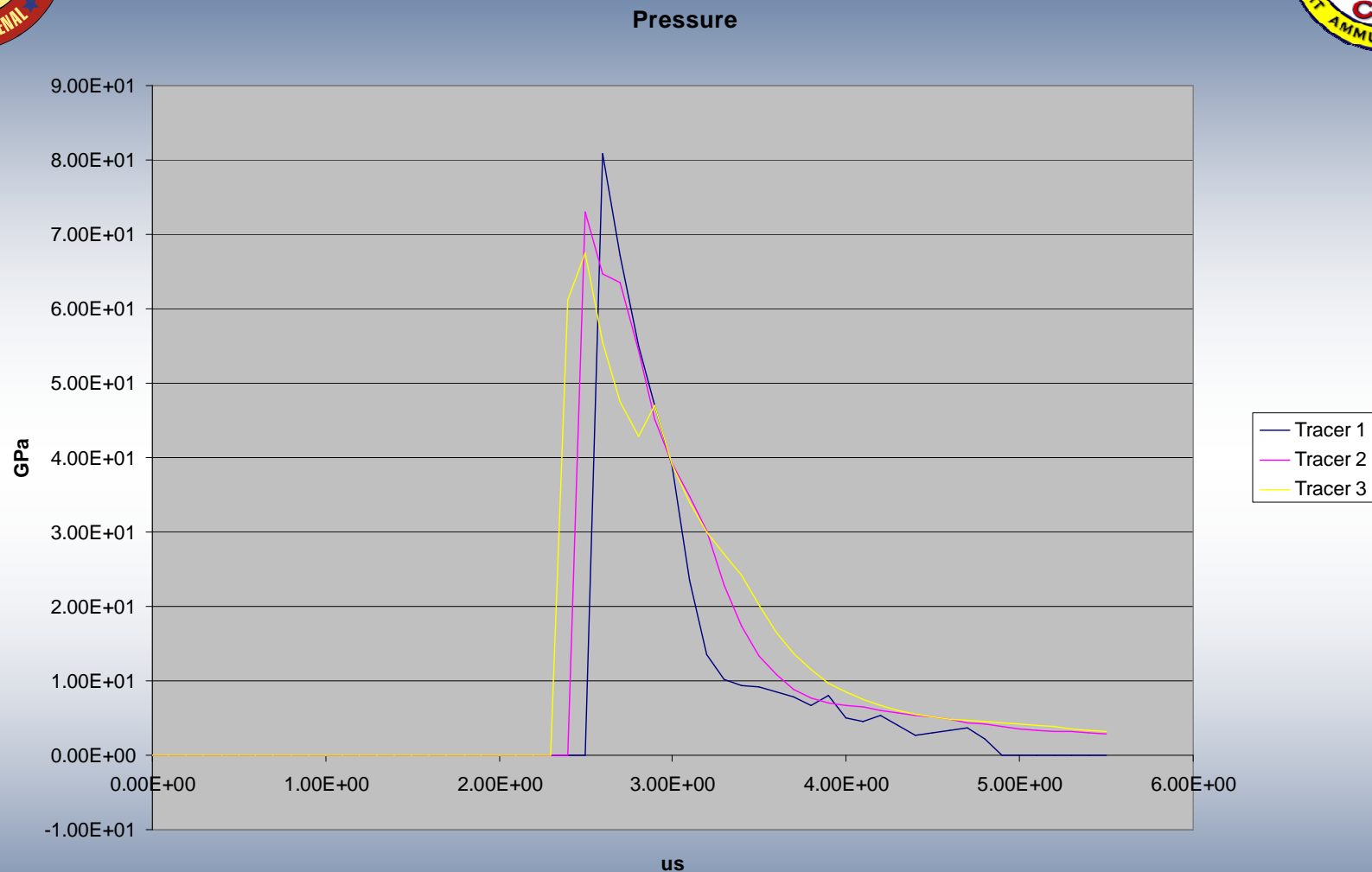


Wave-Shaped Detonation





Wave-Shaped Detonation Pressure



Pressure peaks at 80.9 GPa at the bottom surface of the pellet



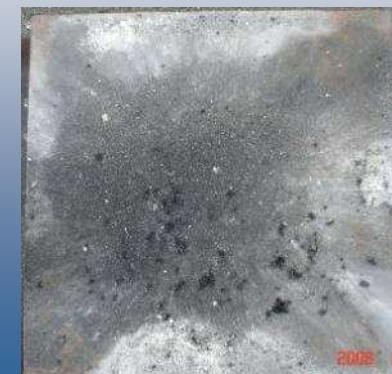
Static Detonation trials



Baseline



+



RDECOM



MPI Trial with Transfer Charge



+



+

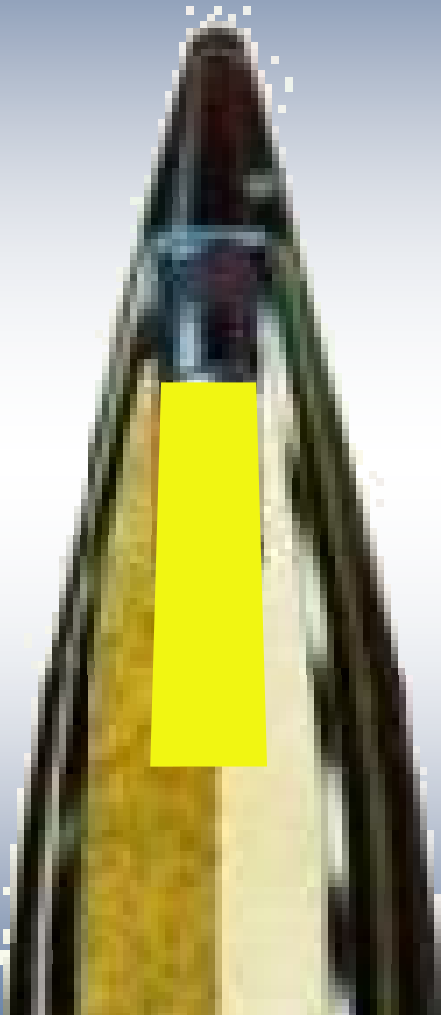


=





EIDS Trials



- EIDS explosive PBXN-113 detonation trials
- 225g was needed to detonate IMX-101
- Result was much longer Supp Charge
 - Additional 3" into charge
- M795 would never be compatible with deep intrusion fuzes
- Frags in O-give section would lose significant velocity and lethality



Possible Artillery Fuzes



	TYPE	COMP	(GM)	(IN)	
M557	PD	A5	23.26	2.21	OBSOL
M564	MTSQ	A5	27.3	2.22	OBSOL
M582	MTSQ	A5	23.3	2.21	OBSOL
M728	PROX	TETRYL IN PBA	25	4.907	OBSOL
M582A1	MTSQ	A5	23.3	2.21	STD
M732	PROX	CH-6	5.85	2.21	OBSOL
M732A2	PROX	A5	27	2.21	STD
M739A1	PD	A5	21.58	2.21	STD
MK399 MOD 1	PD	CH-6	11	2.21	STD
M767	ET	A5	27.3	2.21	STD
M767A1	ET	PBXN-5	30	2.21	STD
M782	MULTI-OPT	PBXN-5	22.16	2.21	STD



Reliability Testing

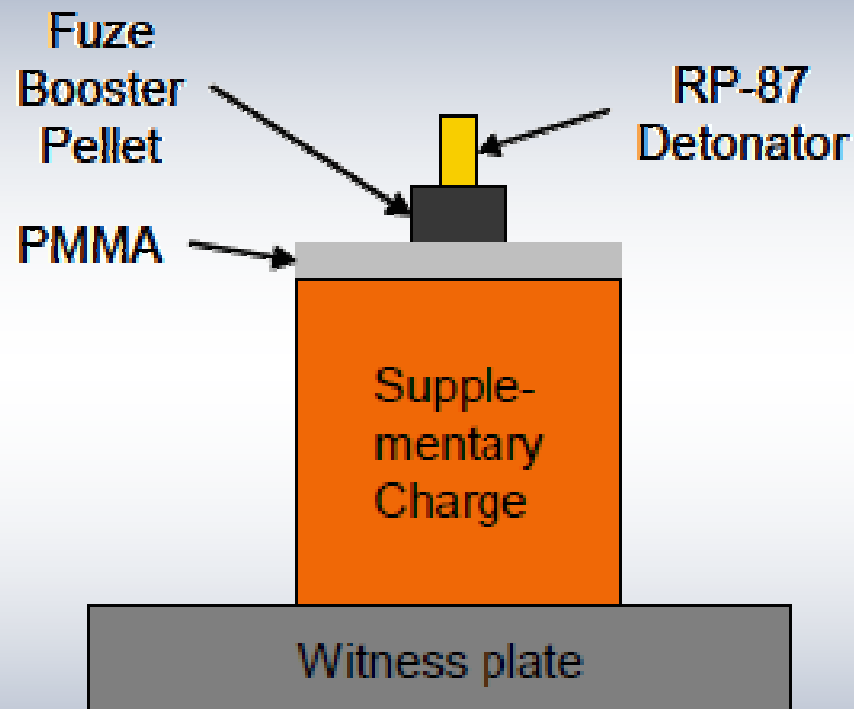


Figure 1 – Test Series 1 Configuration

Initiation of the 150g N9
supp charge with “typical”
fuze booster pellet

- M739A1 with ~22g HE
- Mk399 with ~11g HE

Vari-gap testing series
selected for analysis

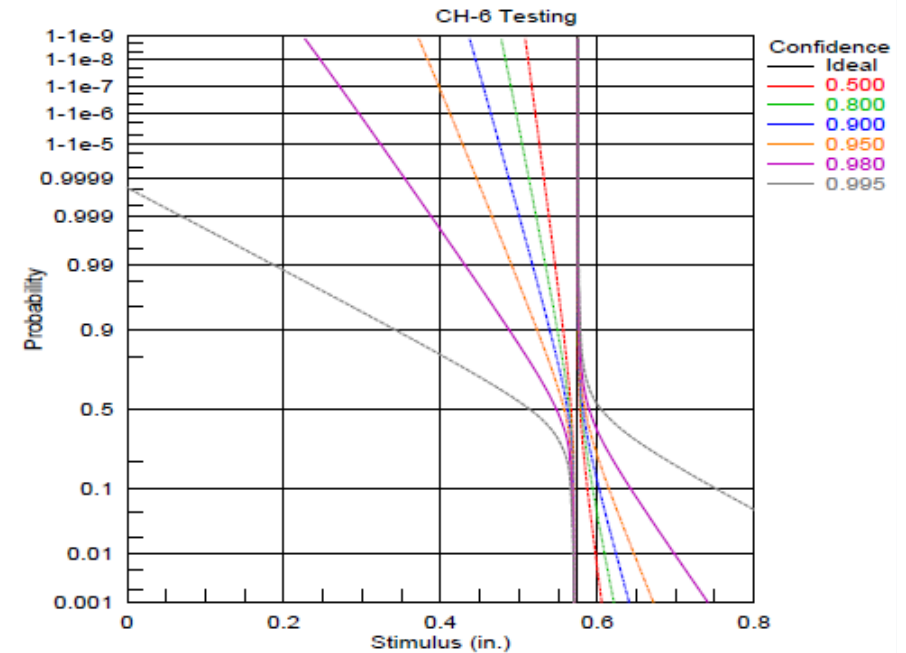
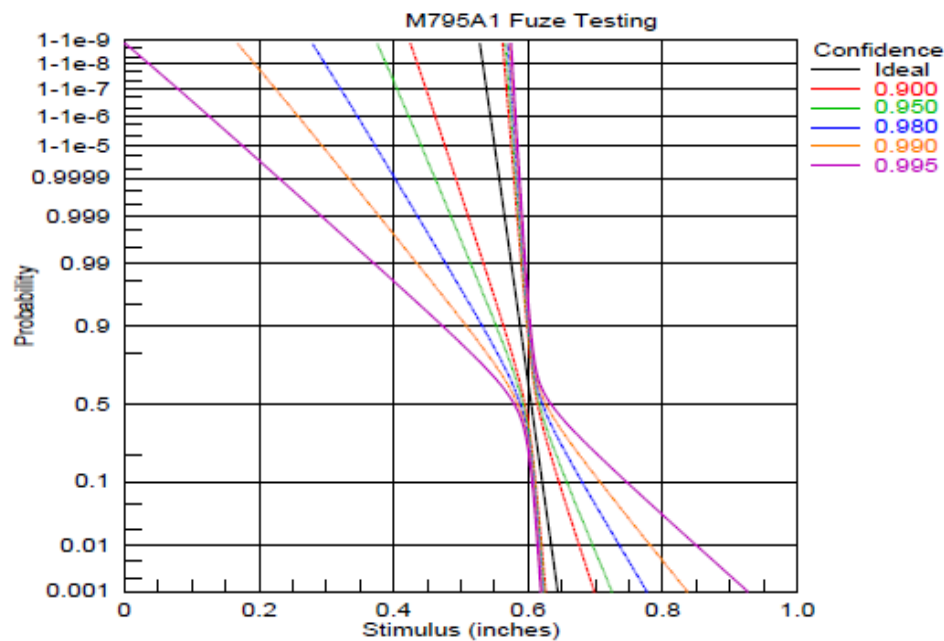


Results



M739A1

Mk399



Both the M739A1 and Mk399 tests met the reliability requirement with a confidence level of 90%



Supp Charge to Main Fill

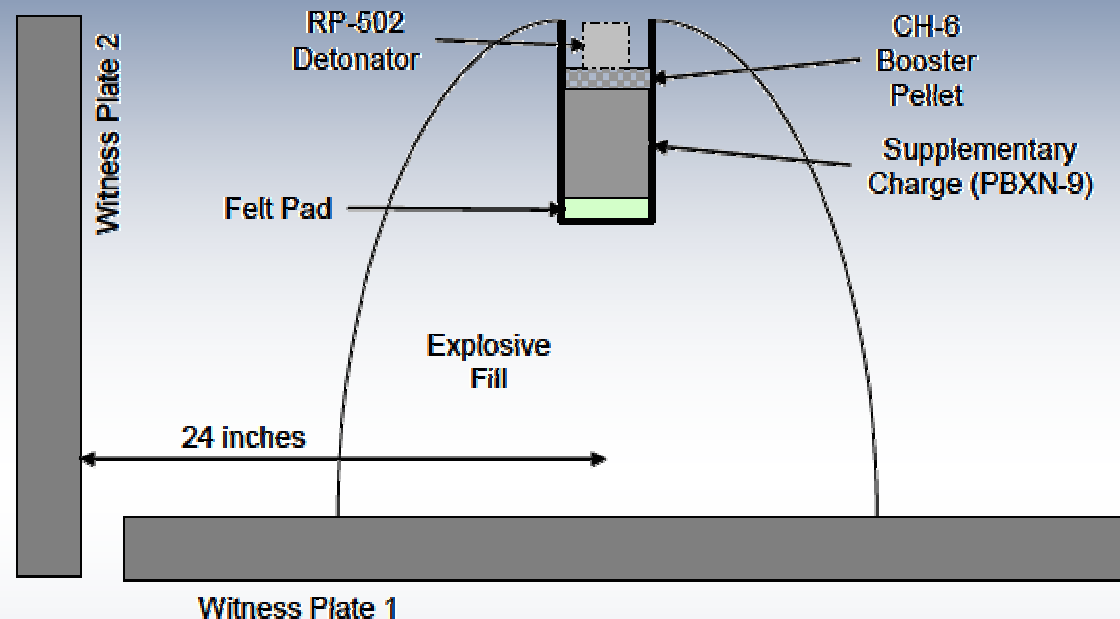


Figure 2 – Test Series 2 Configuration

Initiation of the Main IMX-101 charge with 150g of PBXN9

- Due to geometry restraints, Vari-Gap could not be used
- Vari-Drive was selected as the most direct route to obtain reliability
 - Energy input to the Main Fill would be varied by changing the density of the PBXN-9



Results



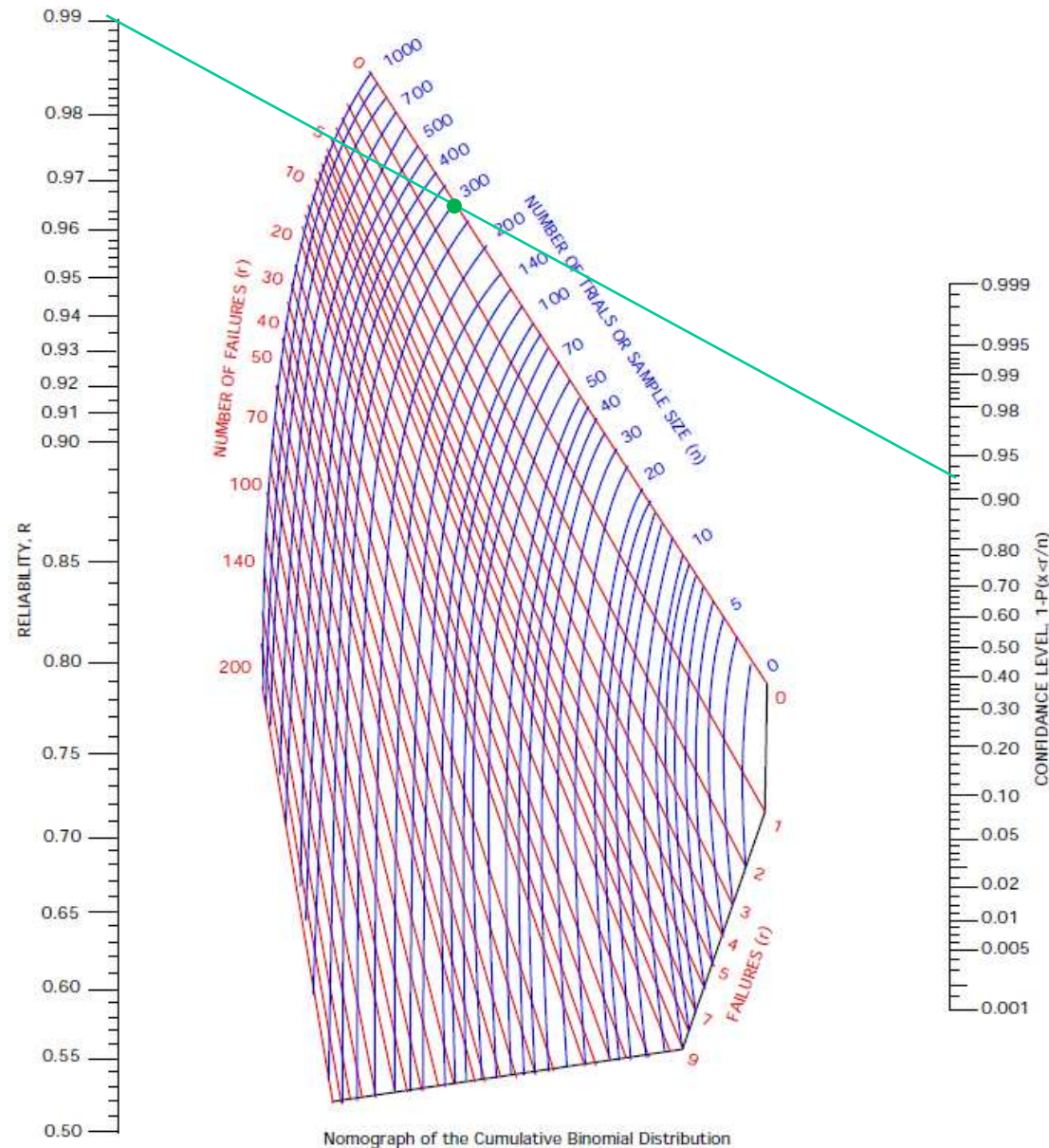
Test Round Number	Sup Charge Density (g/cc)	Dent Depth	Result
T01	1.70	0.773	GO
T02	1.70	0.759	GO
T03	1.50	0.801	GO
T04	1.50	0.789	GO
T05	1.35	0.809	GO
T06	1.35	0.766	GO
T07	1.35	0.810	GO
T08	1.35	0.793	GO
T09	1.35	0.800	GO
T10	1.40	0.817	GO
T11	1.40	0.787	GO

Table 3: Results of Supplementary to main fill (IMX-101) testing.

- No failures experienced even at 20% penalty
- Zero duds or low-order detonations recorded in over 300 ballistic firings using standard density supplementary charges



Reliability Plot





Summary



- **Initiation of the IMX-101 explosive in the M795 projectile was vigorously tested using multiple designs and materials**
- **The Cost, Time and Performance constrains dictated the test plans, strategy and results**
- **The M795 IM projectile was shown to be just as, or more reliable than the legacy TNT round.**



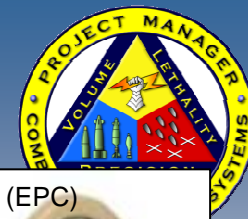
Thanks



- Ductri Nguyen – Projectile Team
- Charlie Patel – OPM-CAS
- Erik Wrobel – T&E
- David Pfau – M&S



Joint Effort



EIDS Testing (NAWCWD)



Loading (DZI)



Loading (IAAAP)



MFP (EPC)



TOX (CHPPM)



ELSGT (ARL)



Arena (Dalghren)



Gun Launch (YPG & APG)



PBXN-9 Supp Charge



IM (NTS)



EMQ. (HERD)



Production (HSAAP)



RD



Questions

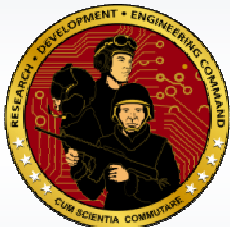




Backup



DoD / Industry Participants



Booz | Allen | Hamilton



MINISTRY OF DEFENCE