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EURENCO
GROUPE SNPE

Tailored PBX formulations for IM 155mm artillery shells

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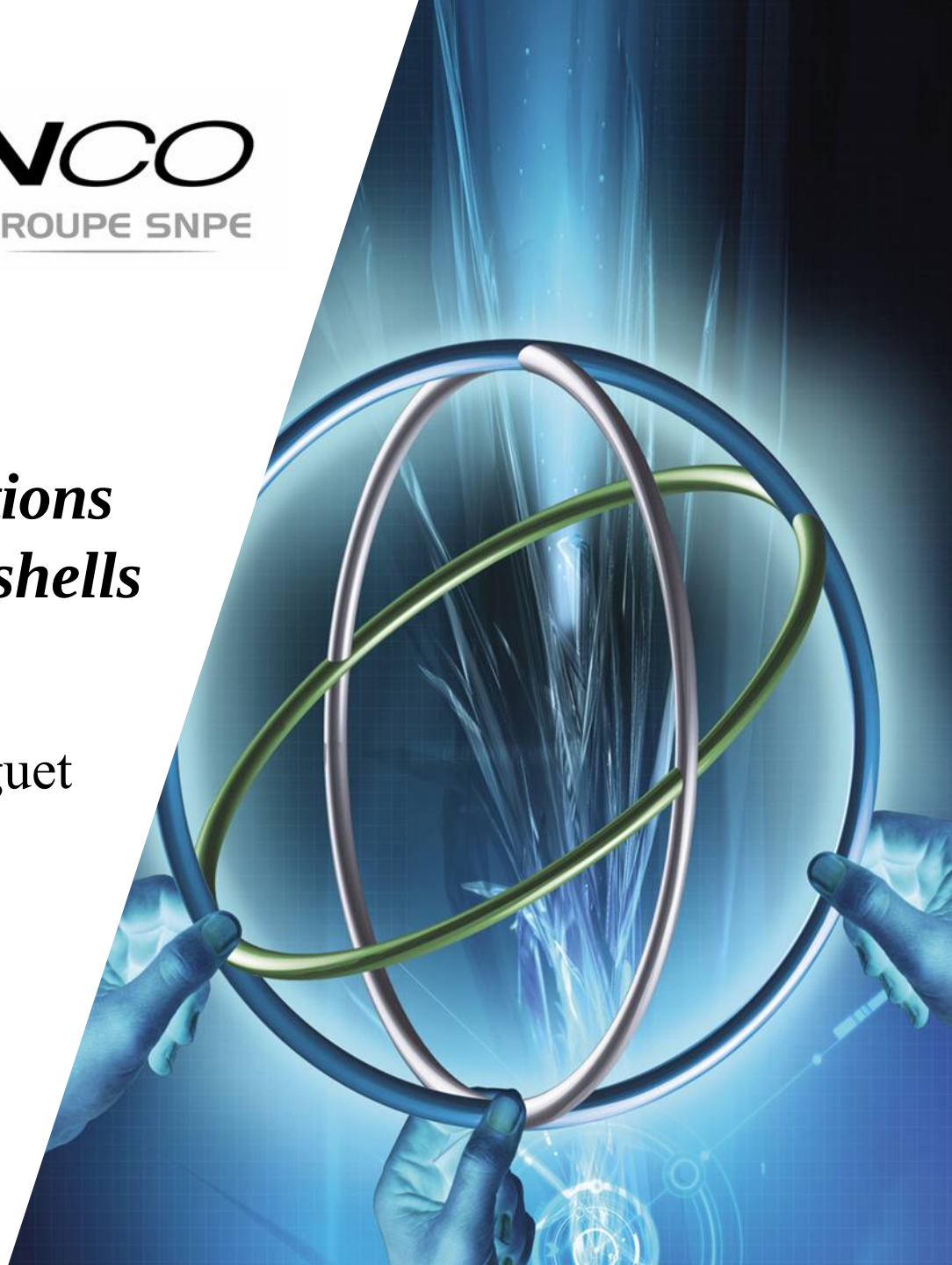
EURENCO-France



SUMMARY

1 - STATE OF THE ART

11 - PROCESS

Bicomponent process for cast cured explosives (worldwide patented)

Composition is split up in 2 components

A - polymer – additives – explosives filler

B - plasticizer – curing agent

Both components are mixed through a static mixer

Advantages

no pot life limitation

all items are casted at same viscosity

possibility to reduce curing time to less than 24 hours

1 - STATE OF THE ART

Full scale production line commissioned in 2006 – Eurenco Sorgues plant

capacity: 50 000 items 155 mm shells per year
100 000 items 120 mm shells per year

production on line :

- shell preparation
- casting
- curing
- control
- final assembly
- X-ray control
- packing

→ in the same workshop

1 - STATE OF THE ART

Conveyor

Handling robot

X-ray control

X-ray control

Curing oven

Bi component filling machine

1 - STATE OF THE ART

12 – COMPOSITIONS

HBU88B (I-RDX ®)

qualified in 120 mm M934A2 mortar

RH26-2 (I-RDX ®)

qualified in 120 mm tank

qualified in 155 mm artillery

2 – PBX FORMULATION FOR IM 155 mm SHELLS

21 – Objectives

- ☞ low level of shock sensitivity to meet sympathetic detonation requirements without any shielding in 155 mm shell pallets
- ☞ high level of performances
- ☞ feasability compatible with bi component process

2 – PBX FORMULATION FOR IM 155 mm SHELLS

22 – Method and criteria

- Formulation
  - -binder : HTPB
  - -insensitives fillers: I-RDX and NTO
  - -total solid fillers : 84 and 86 %
- Shock sensitivity
  - -ISGT – Stanag 4488, annex B : ≤ 100 cellulose acetate cards
  - -ELSGT – Stanag 4488, annex C : ≤ 50 mm PMMA thickness
- Performances
  - -Detonation velocity: ≥ 7 500 m/s
  - -Critical diameter: ≤ 50 mm

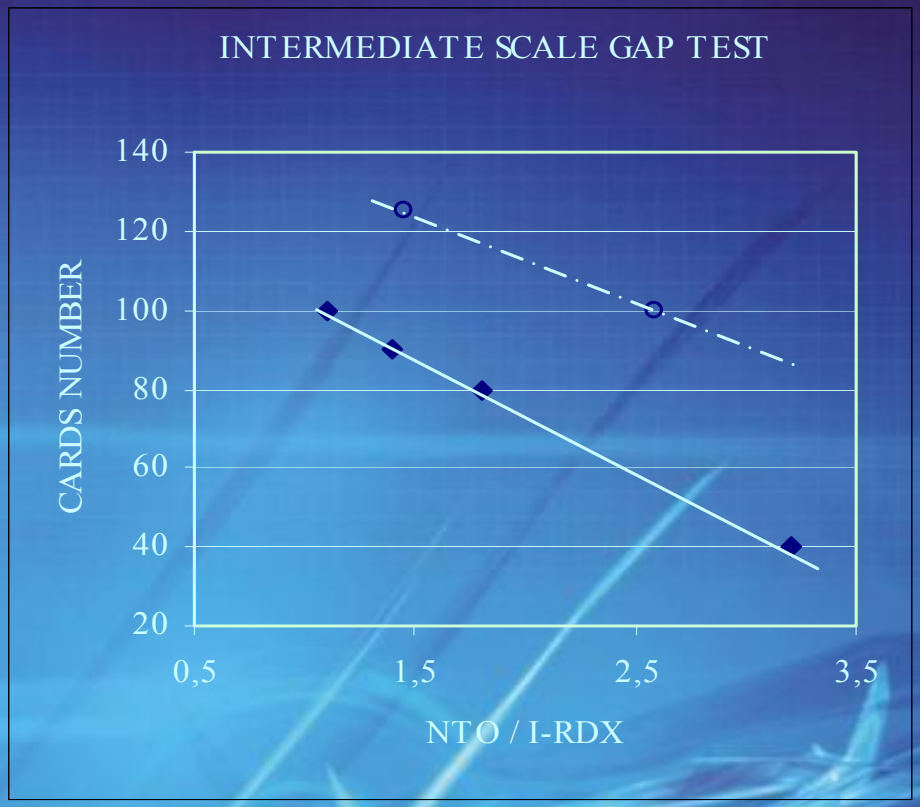
2 – PBX FORMULATION FOR IM 155 mm SHELLS

23 – first results

Loading (%)	NTO (%)	I-RDX® (%)	NTO/I-RDX®	ISGT (cards)	ELSGT (mm PMMA)	Critical Diameter (mm)
84	44	40	1.1	100	65	$19 < \Phi_c < 25$
	49	35	1.4	90	60	$25 < \Phi_c < 30$
	54	30	1.8	80	60	$30 < \Phi_c < 36$
	64	20	3.2	40	45	$\Phi_c > 50$
86	51	35	1.5	125	60	$13 < \Phi_c < 19$
	62	24	2.6	100	55	$25 < \Phi_c < 30$

2 - FORMULATION FOR IM 155 mm SHELLS

ISGT – Stanag 4488, annex B :

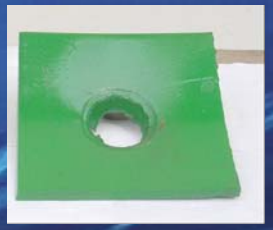


Donnor
RDX/Wax
2 × Ø40 H80 mm

Acetate cellulose cards

Acceptor
Explosive
to be tested
Ø40 H200 mm

Witness plate

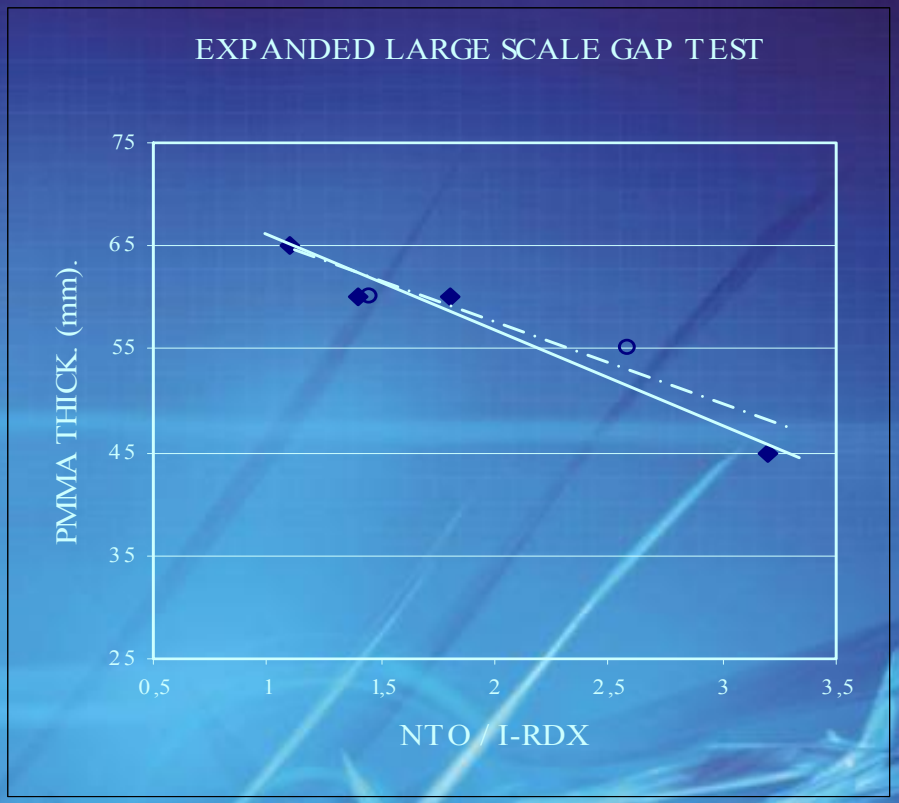


Detonation

No propagation

2 – PBX FORMULATION FOR IM 155 mm SHELLS

ELSGT – Stanag 4488, annex C :

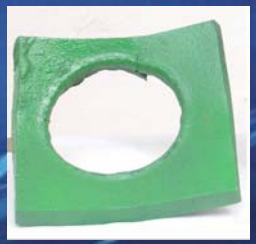


Donnor
RDX/Wax
Ø95 H95 mm

PMMA
Attenuator

Acceptor
Explosive
to be tested
Ø75 H280 mm

Witness plate

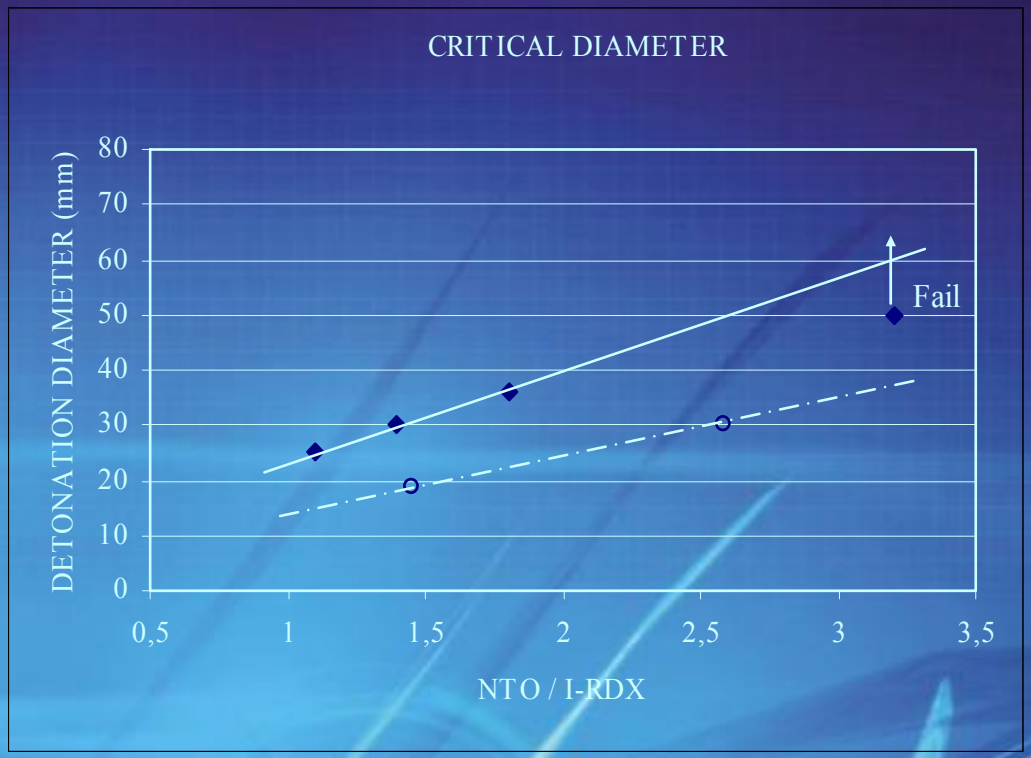


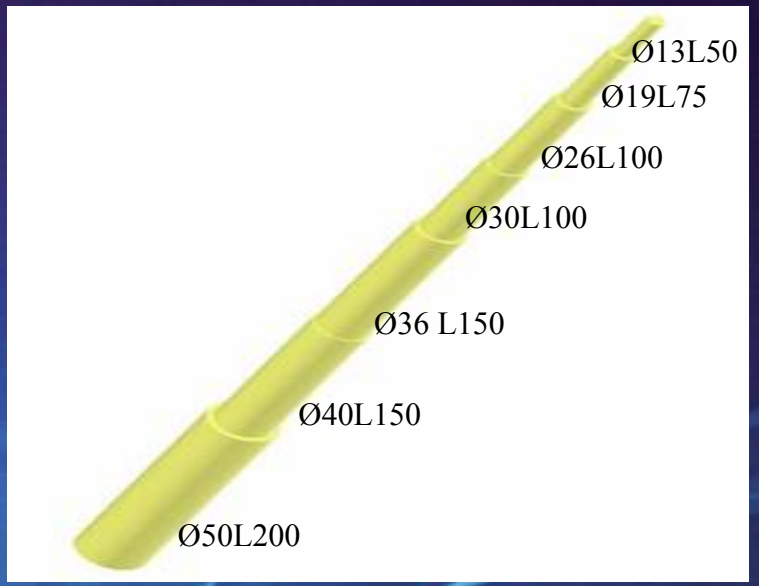
Detonation

No propagation

2 – PBX FORMULATION FOR IM 155 mm SHELLS

Critical diameter:





2 – PBX FORMULATION FOR IM 155 mm SHELLS

24 – final selection

Formulation

HTPB Binder : 14 %
I-RDX® : 22 %
NTO : 64 %
NTO/I-RDX® : 2.9

Viscosity

At casting time: 100 Pas
After 6 hours : 500 Pas

Density 1.670

Mechanical properties (20°C)

Hardness: 70 Shore A
Tensile test
Smt : 0.7 MPa
emt : 7.2 %

Shock sensitivity

ISGT : 95 cards
ELSGT : 55 mm PMMA

Performances

critical diameter : 30 < Øc < 36
Detonation velocity : 7 570 m/s
(unconfined cylinder Ø 50 mm)

3 – CONCLUSIONS

EURENCO France has designed a PBX formulation based on NTO and I-RDX® to get the best trade-off between detonation performances and very low levels of shock sensitivity in order to meet the sympathetic reaction requirement without any shielding in 155 mm shell pallets.

A final sympathetic detonation test remains to be performed with actual 155 mm projectiles in a pallet configuration (planned at the end of 2007).

After the experimental validation, this tailored formulation will enter the official qualification process.

THANK YOU FOR YOUR ATTENTION