High Explosives Charges for Insensitive Artillery and Mortar Ammunitions
In Europe, **Cast PBX** *is the Most Used Explosive to make Insensitive Munitions.*
*Cast PBX: Cast Plastic Bonded Explosive*

- **Binder** = HTPB (synthetic rubber)
- **Energetic Filler** = RDX, HMX, NTO…
Norway: Nammo Raufoss
Sweden: Nammo Karlskoga
UK: BAE Systems GCS
Germany: Rheinmetall, TDW, Diehl
Switzerland: SBDS
France: Eurenco
Spain: Expal
Italy: OTO, SEI, Simmel

CAST PBX in the European DITB
European Countries using cast PBX in Insensitive 60mm to 155mm Caliber Ammunitions

- UK: 81mm, 105mm, 155mm…
- GERMANY: 120mm, 155mm
- NETHERLANDS: 81mm, 155mm
- FRANCE: 76mm, 81mm, 120mm
- ITALY: 76mm, 127mm
- SWITZERLAND: 60mm, 120mm
Cast PBX in USA: A well established Technological and Industrial Base
The Most Implemented Insensitive High Explosive

- Aircraft Bombs
- Torpedoes
- Cruise Missiles
- Anti Ship Missiles
- Air-to-Air Missiles
- Air Defense Missiles
- Air-to-Ground Missiles
- Artillery
- Mortars
- Tanks
- Sea Mines
- Rockets
CAST PBX: The Origins

Major Disasters on High Value Combat Platforms led to find a Mature and Effective IM Solution

Aircraft Carriers Accidents  Best Insensitive Explosive for IM Bombs
Cast PBX technology is based on a 50 year background shared with Solid Rocket Motor technology.

- Large Catalogue of Qualified Formulations

- Extensive Scientific Knowledge on these formulations (chemical, physical, mechanical properties, ageing...)

- Production Processes adapted to various types of applications
CAST PBX: Advantages for IM

A material with Excellent Intrinsic Properties

- **Structural Reliability**
  (no internal cracks)

- **Homogeneity**
  (no micro-voids)

- **Thermal Stability**
  (no reverse melting)
- Affordable product (no high-cost ingredient needed)
- Performances comparable to non-IM explosives (Comp-B, TNT/Al…)
- Flexibility of design
How to Produce High Volumes of Cast PBX Shells?
Step 1: Mixing (with cross linking agent)

Step 2: Casting (pot life limited)

Step 3: Curing (several days)

CAST PBX: The Batch Process

Batch Process is well adapted for Production of Explosive Charges for Bombs, Missile Warheads...
CAST PBX: Issues with Batch

Batch Process is Not Optimized for Production of Shells (60mm, 81mm, 105mm, 120mm, 155mm...)

- Casting time is limited (pot life constraint)
- Curing takes days (large oven areas)
- Large mass of explosive in the workshop
The Solution: The Bi-Component Process

- Two components:
  - Component A: All ingredients, except curing agent
  - Component B: Curing agent

- Filling « on demand » through a static mixer
Advantages of Bi-Component Process:

- **NO POT LIFE ISSUE**

- Reduced Curing Time (< 24 h) short cycle

- Minimized Costs (production & capital investment)

- Versatile Industrial Organization…

- Well Adapted to medium and large caliber shells
Bi-Component Process: EURENCO Facilities

Full scale production line commissioned in 2006

"POGS Workshop"

1.3 HD
1,200 m²

Capacity (items/year) with one Filling Station

155 mm: 50,000
120 mm: 100,000
"All-in-One" Workshop
(Empty Shells Get In ............ Packed Filled Shells Go Out)
Bi-Component Process:
EURENCO Facilities

AUTOMATED HANDLING

AUTOMATED CASTING
Bi-Component Process:
EURENCO Facilities

LINEAR CURING OVEN
Bi-Component Process:
EURENCO Facilities

IN-LINE DIGITAL X-RAYS
Some Applications
Naval Artillery

- 76mm n°1 Artillery Qualified, Production 2011
- 76mm n°2 Artillery Development
- 127mm (5") Artillery Production 2011
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<th>Gun Type</th>
<th>Description</th>
<th>Production Dates</th>
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<td>155mm nº1 Artillery</td>
<td>Qualified, Production 2011</td>
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<tr>
<td>155mm nº2 Artillery</td>
<td>Production 2006-2007 (Combat Proven)</td>
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155mm Artillery (RWM RH30-40)

Fast Cook Off

Comp-B

IM SIGNATURE

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RH26

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<th>V</th>
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Source: RWM and MSIAC

I = Detonation  II = Partial Detonation  III = Explosion  IV = Deflagration  V = Burn
**155mm Artillery (New EURENCO Formulations B2268 & B2267)**

- **B2267 (RDX/NTO)**: Type III
- **B2268 (RDX/NTO/AL)**: Type V

**B2268 Shot**

**Comp-B**

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- V* Prediction; Source: EURENCO

**Shaped Charge**

- Dia. 68mm

**IM SIGNATURE**

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- V* IV/III* V/III
Tank Ammunitions

120mm n°1  Tank HE  Production 2010/2011
120mm n°2  Tank HE  Development
105mm      Tank HE  Development
Mortar Ammunition

- 120mm n°1
- 120mm n°2
- 120mm n°3
- 81mm n°1
- 81mm n°2
- Mortar
- Mortar
- Mortar
- Mortar
- Mortar
- Qualified
- Qualified
- Development
- Development
- Production 2009/2010
As a reminder: **120mm HE Mortar Ammunition (M934A2)**

- Prime Co.: GD-OTS CANADA
- Customer: US ARMY
- Development: 2001/05; TC 2006
- High Blast / Frag (ref. Comp-B)
- Meets IM Requirements
- Licenses for HBU88-B and BC Process
120mm HE Mortar Ammunition M934A2
(US ARMY Type Classified with EURENCO HBU88B)

**Mortars for USA**

* Fuze/Adapter Thrown >49 ft ; Source : US ARMY
**Conclusion**

- **Cast PBX** is the **most used and mature** IM explosive technology available.
- **Cast PBX** is affordable and provides same performances as non-IM Explosives.
- **Bi-Component** process is the **right economical / technical trade-off** for filling large caliber ammunitions with cast PBX.
The Insensitive Munitions European Manufacturers Group

EURENCO is Member of IMEMG

GOING FROM STRENGTH TO STRENGTH