Qualification Of ITEX-07 Explosive For Fuze Applications

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PBXN-7 / ITEX-07

- PBXN-7 Composition
  - RDX 35 %
  - TATB 60 %
  - Copolymer (VITON A) 5 %
- Specification MIL-DTL-82874B
- Qualified by the US-Navy
- „PBXN-7“ manufactured with OSI-TATB, evaluated by the US Navy, has enhanced shock insensitiveness
- To describe its improved IM property, this variant of PBXN-7 for future military use has been designated ITEX-07

Qualification – Time Schedule

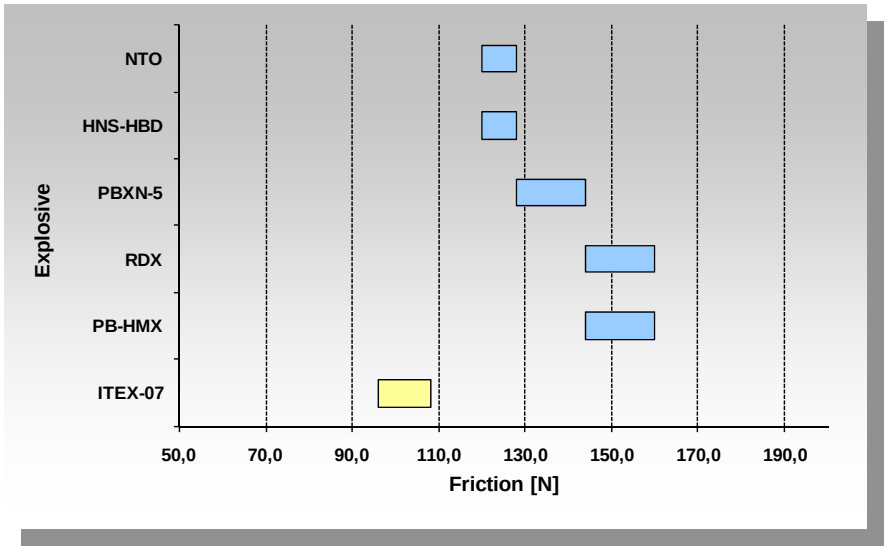
- DynITEC
  - Physical tests and thermal characteristics (related to detonating devices)
  - Finished Jan 08
  - Additional tube tests in summer 08

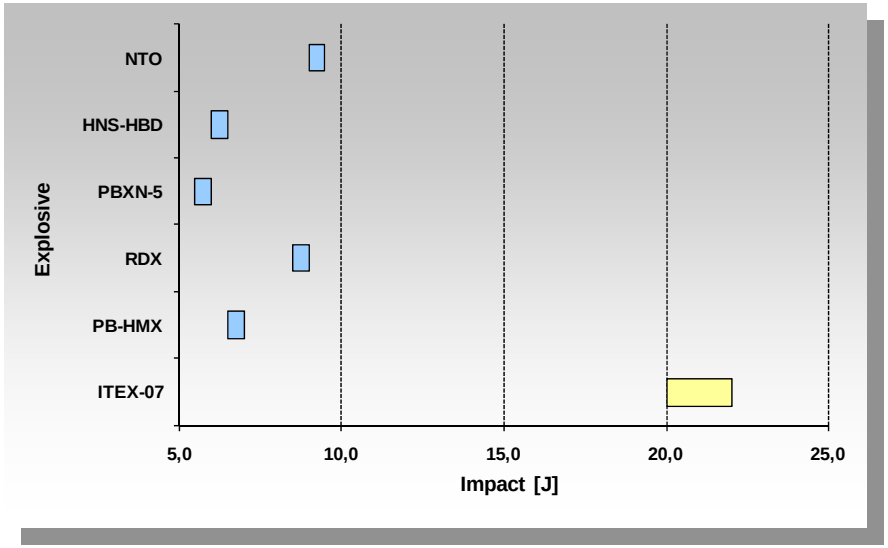
- WIWEB
  - Tests according to STANAG 4170 / TL 1376-0800 / AOP-7
  - Sep 08 – Jan 09
  - Contracted by DynITEC

- QinetiQ
  - EMTAP-Tests (No 35, No 41, No 42)
  - Expected in May 09

Friction / Impact

	Friction		Impact	
Explosive	**No-Go [N]**	**Go [N]**	**No-Go [J]**	**Go [J]**
ITEX-07	96	108	20,0	22,0
PB-HMX	144	160	6,5	7,0
RDX	144	160	8,5	9,0
PBXN-5	128	144	5,5	6,0
HNS-HBD	120	128	6,0	6,5
NTO	120	128	9,0	9,5





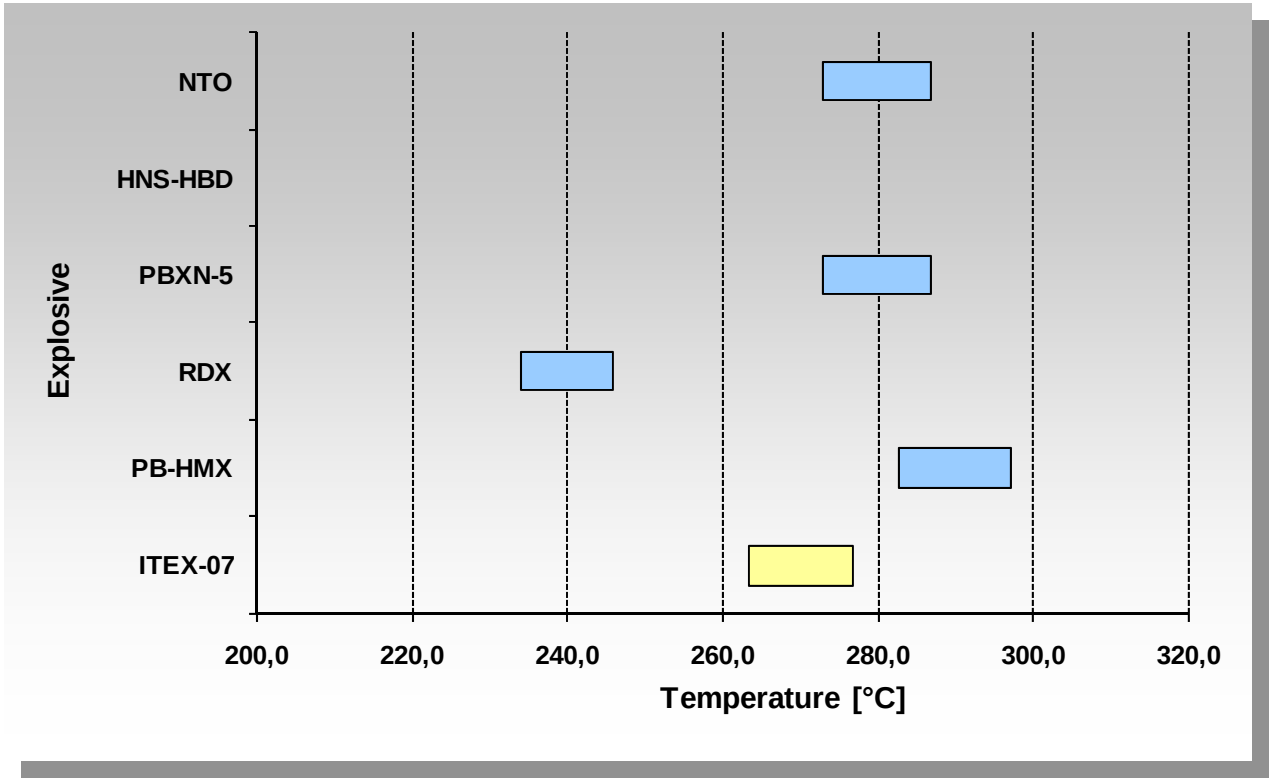
Test set-ups and procedures according to BAM
Determination of no-go-level:
Highest level with no reaction or no detonation in 6 tests.
AOP-7 min. requirements for booster explosives 80 N for friction and 3 J for impact

Ignition Temperature

Explosive	Temperature [°C]
ITEX-07	270
PB-HMX	290
RDX	240
PBXN-5	280
HNS-HBD	> 310
NTO	280

Wood‘s Metal Bath Test in accordance with DynITEC-procedure 3010

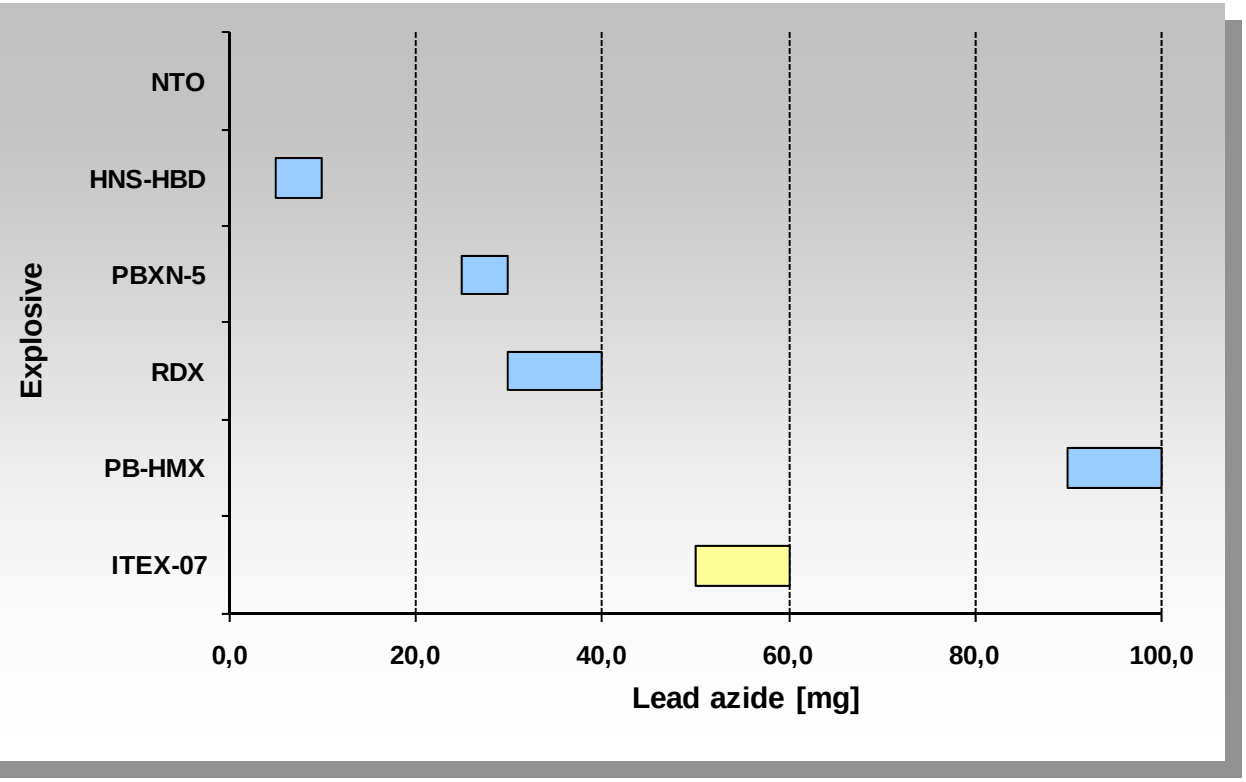
AOP-7 min. requirements for booster explosives > 180°C at 5°C/min



Minimum Priming Charge Test

Explosive	No-Go [mg]	Go [mg]
ITEX-07	50	60
PB-HMX	90	100
RDX	30	40
PBXN-5	25	30
HNS-HBD	5	10
NTO	>110	

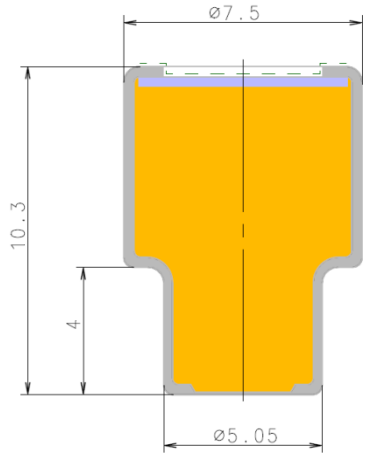
- Special DynITEC-method to evaluate explosives for use in detonating devices
- Determination of the minimum amount of primary explosive to get a reliable initiation of the (secondary) explosive under investigation
- Primary explosive (lead azide 94oD) is changed in 5mg-intervals

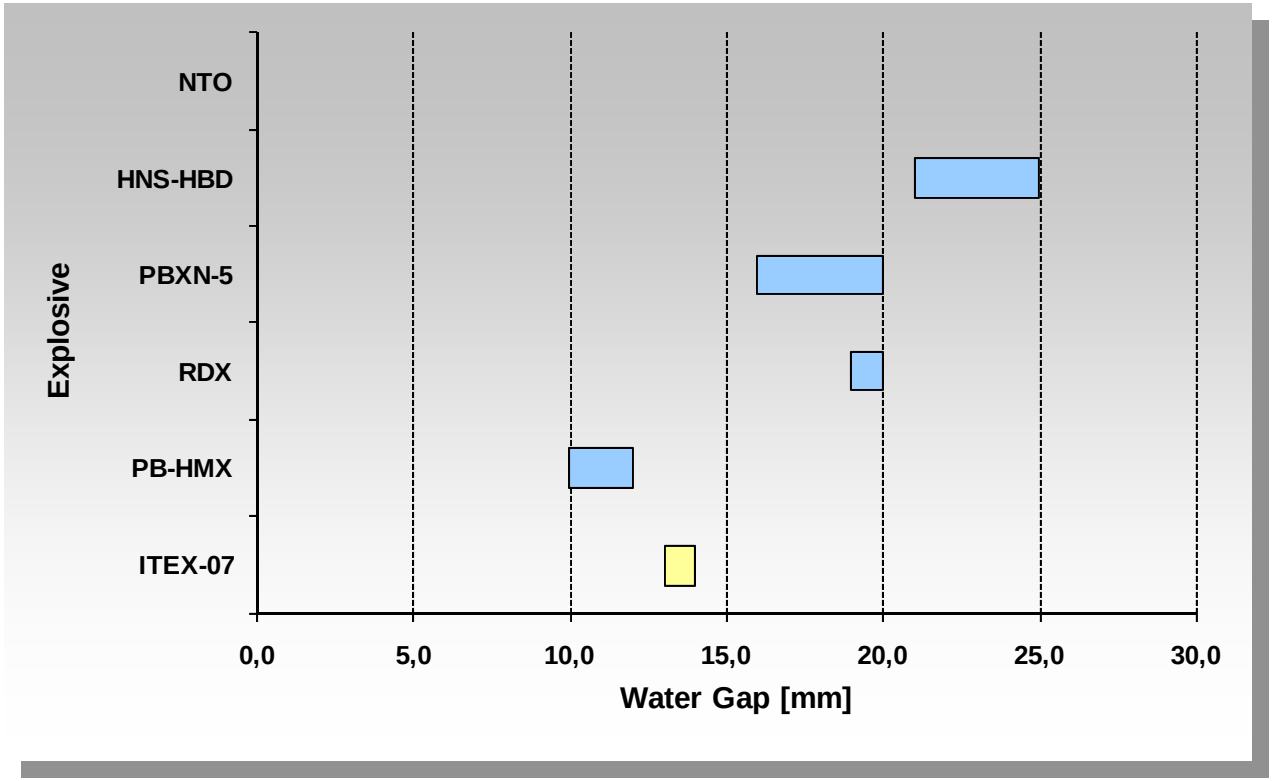


Booster-Gap-Test

Explosive	Go [mm]	No-Go [mm]
ITEX-07	13	14
PB-HMX	10	12
RDX	19	20
PBXN-5	16	20
HNS-HBD	21	25
NTO		< 5

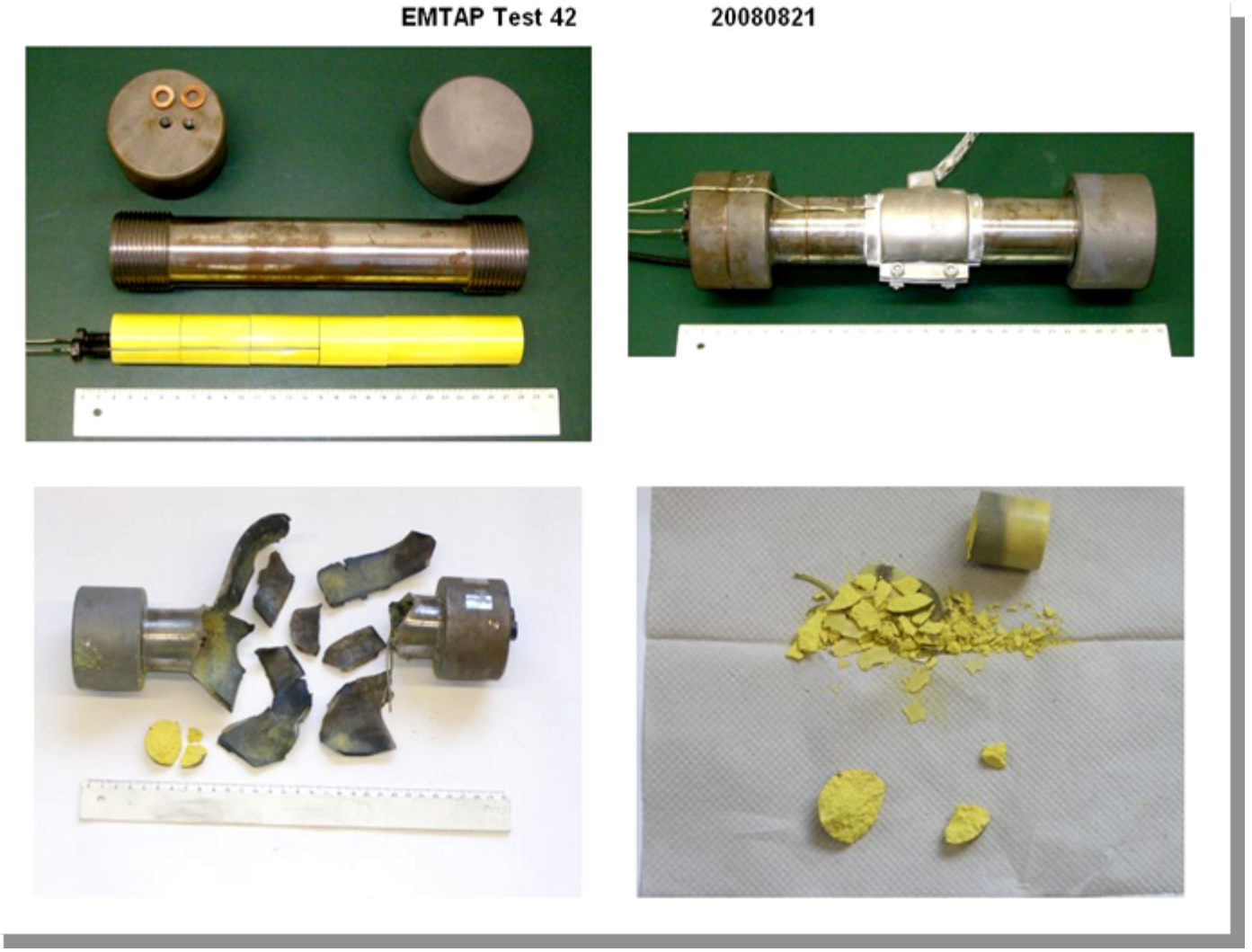
- Test based on STANAG 4363 and AOP-21
- Designed for explosive components (boosters and leads)
- Acceptance criteria for boosters < 28mm water gap





Booster DM 1291; Loading pressure: 0,7 kbar

Tube Test – Electrically Heated Slow Heating (EMTAP No 42)



Test results

- Heating rate 1 K/min
  Reaction time 2:49 [h:m]
- Reaction temperature
  ca. 195°C
- Six fragments
  Reaction type: Cat 2
  Deflagration

Tube Test – Fast Heating (EMTAP No 41)

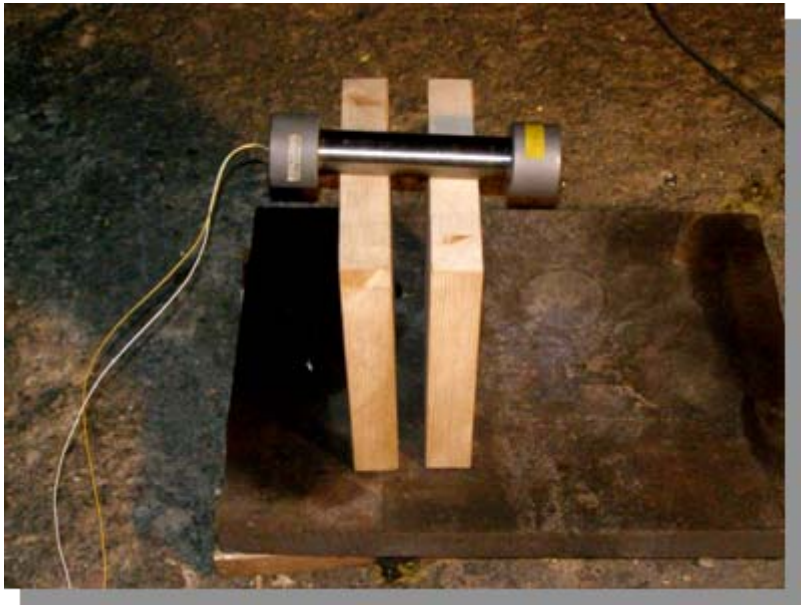
Test results

- Reaction after 339 s
- Two fragments
  Reaction type: Cat 2
- Comparable to Rowanex 3601

Tube Test – Internal Ignition (EMTAP No 35)

Test results

- No fragments
  Reaction type: Cat 1
- Comparable to Rowanex 3601



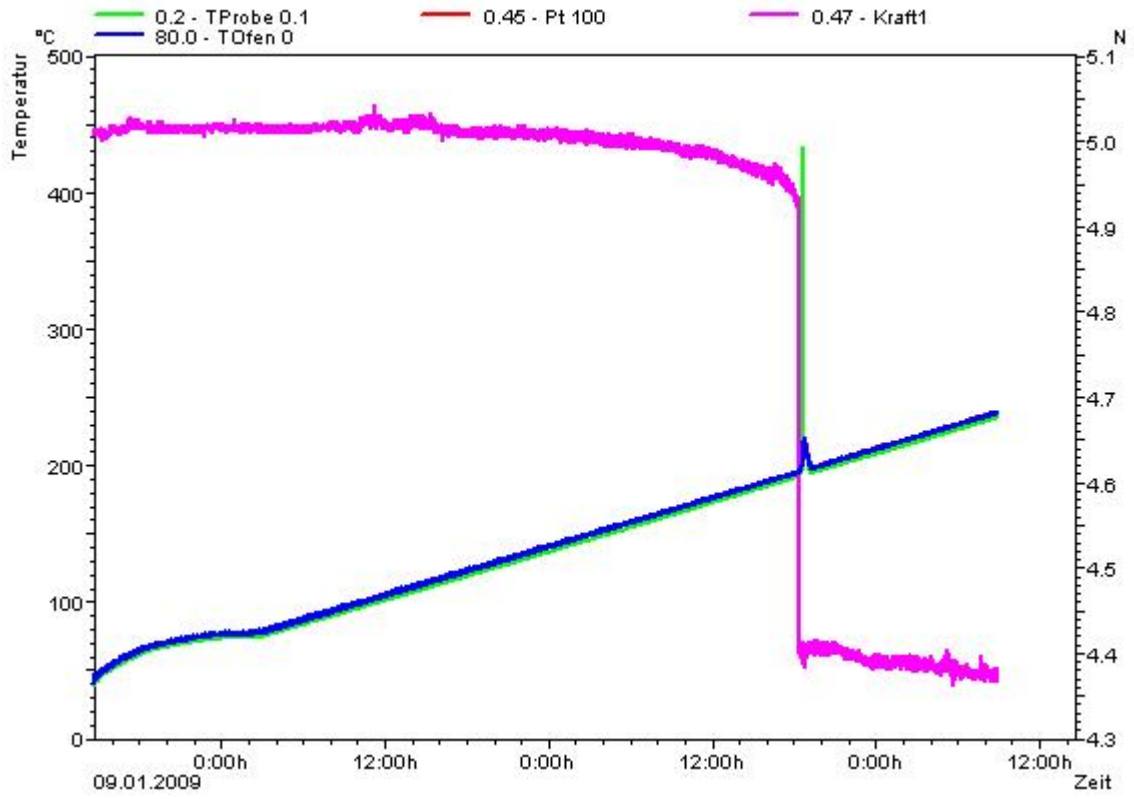
WIWEB Test Results

Characteristic	*Doc. (STANAG)*	*Test*	*Criteria for booster explosives (AOP-7)*	*WIWEB*	*DynITEC*
STANAG 4170					
Vacuum Stability	4556	Gas liberation	< 1.0 ml/g at 100°C for 40 h	./.	24 h: 100°C: 0.04 ml/2.5g 150°C: 2.5 ml/2.5g
Thermal Characterisation	4515	DSC or	Decomposition exotherm peak: > 180°C at a heating rate of 5°C/min	> 180°C	233.8°C
		TGA		ok	ok
Ignition Temperature	4491	Wood's Metal Bath	> 180°C at a heating rate of 5°C/min	231°C	(270°C)
Electrostatic Sensitivity	4490	Small-scale spark test	National	> 32 J	./.
Impact Sensitivity	4489	BAM-Test	3 J: No reaction (10 out of 10 trials)	7,5 J	20 J
Friction Sensitivity	4487	BAM-Test	80 N: No reaction (10 out of 10 trials)	80 N	96 N
Detonation Velocity	AOP-7			≈ 7690 m/s	./.
Variation of properties with age	AOP-7			ok (4 weeks / 80°C)	./.
Explosive response when ignited	4491	see EMTAP-tests			
TL 1376-0800			***Criteria for insensitive explosives***		
Heating		Fast Cook Off (90 K/min)	Reaction type 5 (burn)	Type 5	
Impact		Caliber 12.7 mm vo = 900 m/s Distance = 6 m	Reaction type 5 (burn)	Type 6	
Shock		Gap test Diameter: 21 mm	No detonation ≤ 15 mm	to be determined	
EMTAP (Tube Tests)					
Internal Ignition	No 35		Reaction category <= 2	1 Test performed: Cat 1	
Fast Heating	No 41		Reaction category <= 2	1 Test performed: Cat 2	
Electrically Heated	No 42		Reaction category <= 2	1 Test performed: Cat 2	

Summary

- ITEX-07 is qualified according to STANAG 4170.
- Preliminary EMTAP-tests show excellent IM-properties less than or equal to deflagration Cat 2 reaction.
- Thermal behaviour is dominated by RDX: separate investigation & report.
- Material used for the insensitive booster of the new UK multi-purpose artillery fuze L166A1 (production starts in summer 2009).
- ITEX-07 is currently being allocated an EX-number by the US DoD.

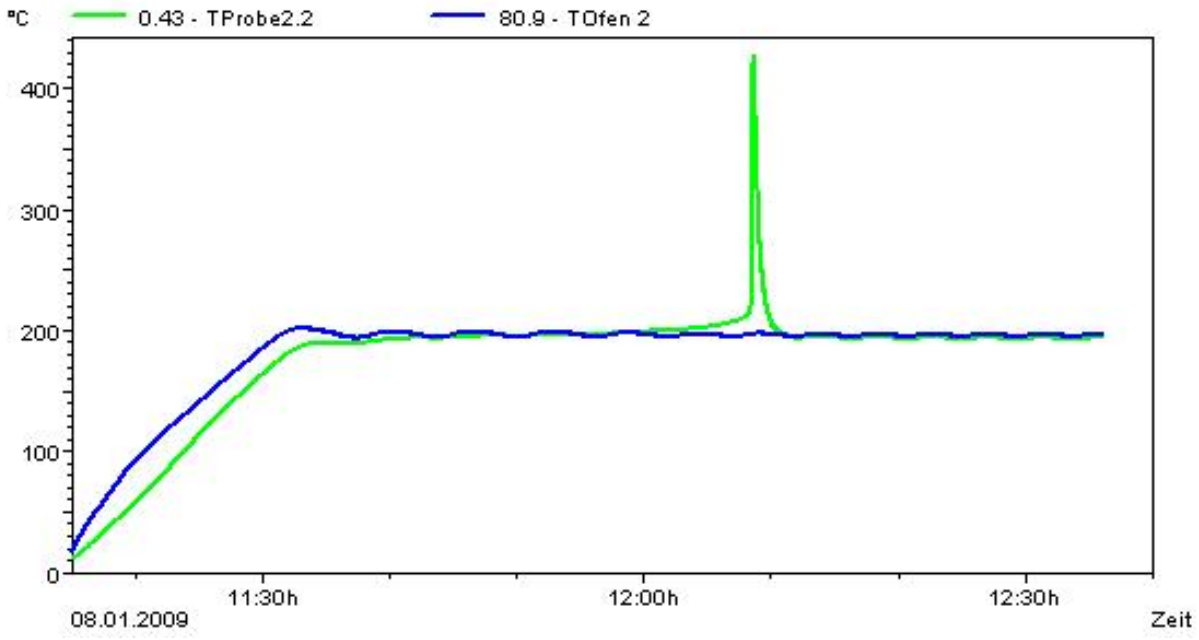
Thermal Stability (heating ramp)



Heating rate: 3 K/h

Sample volume: 8 cm³ cube

Thermal Stability (isoperibolic)



$T_{isoperibolic}$: 195 °C

Sample volume: 1,7 cm^3 cube

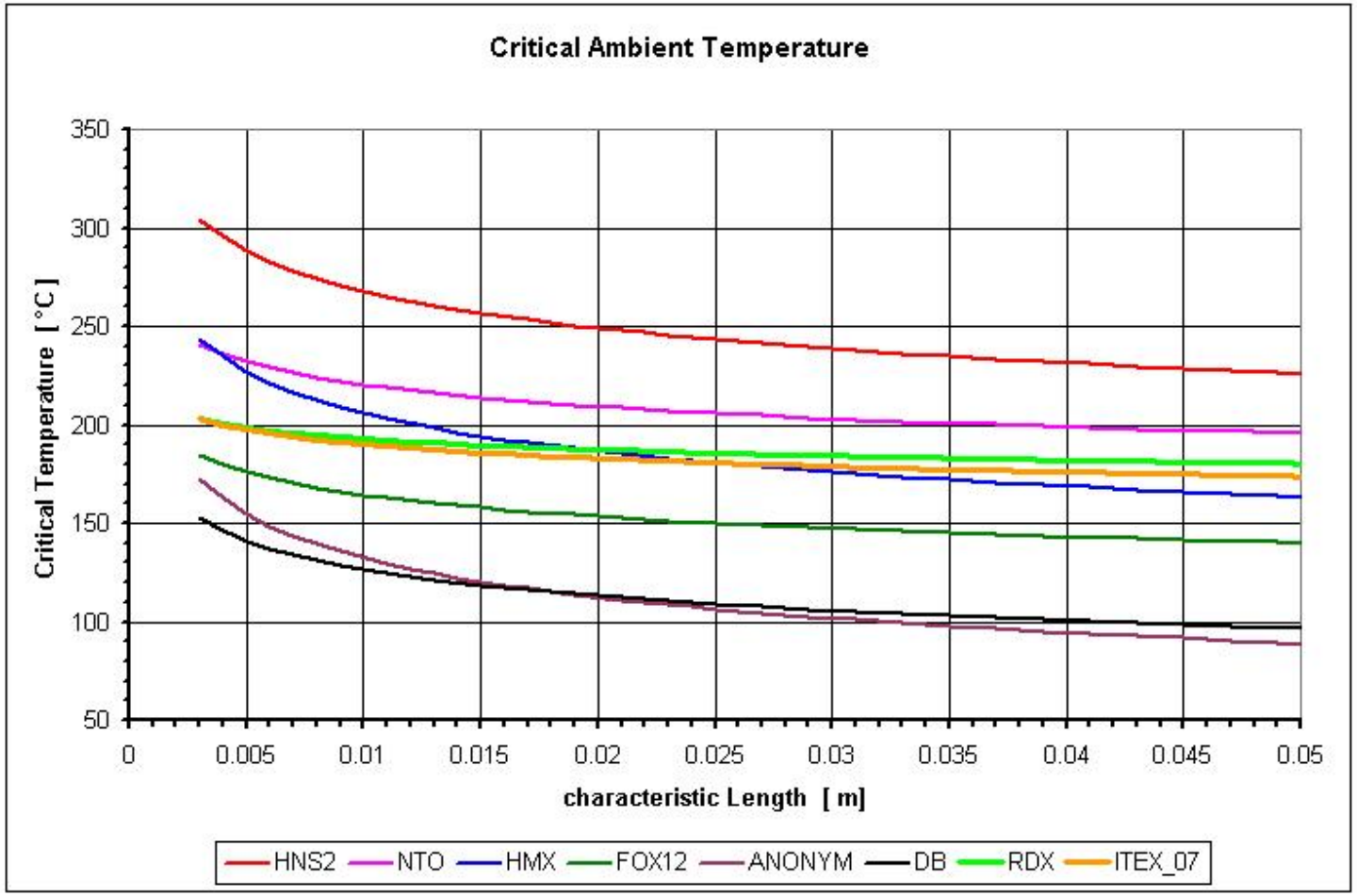
Volume-dependent self-ignition temperatures for ITEX-07

Volume	SIT_{exp}	$T\_U_{krit.,theoret.}$
0,2 cm^3 L=0,003 m	203 °C	203 °C
1,0 cm3 L=0,005 m	197 °C	197 °C
1,7 cm^3 L=0,006 m	194 °C	195 °C
8 cm^3 L=0,01 m	190 °C	190 °C

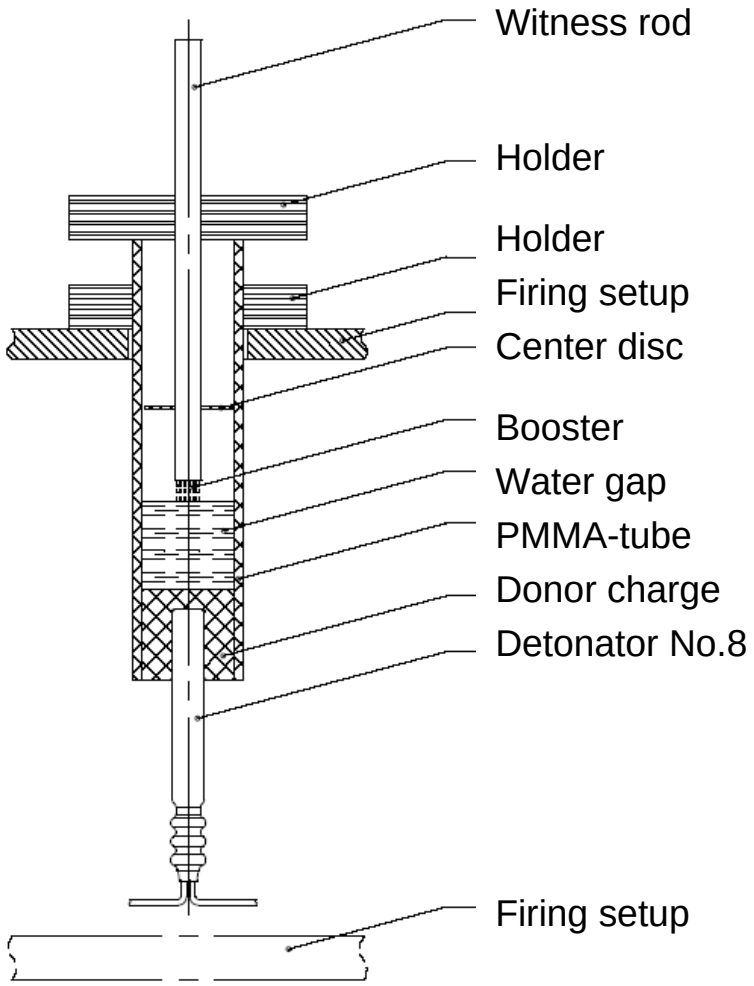
SIT_{exp}: Self-ignition temperature determined by experiment

$T\_U_{krit.,theoret.}$: Self-ignition temperature according to the thermal explosion theory

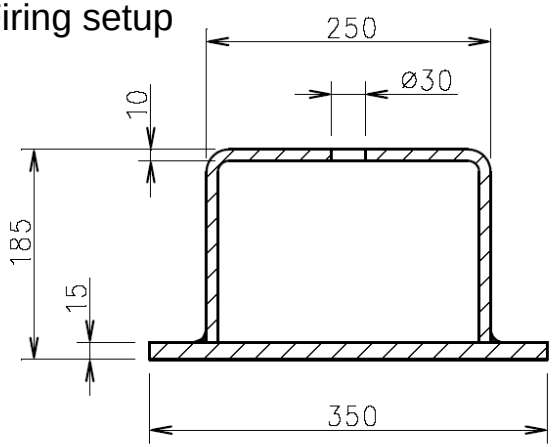
Volume-dependent self-ignition temperatures (acc. to thermal explosion theory)



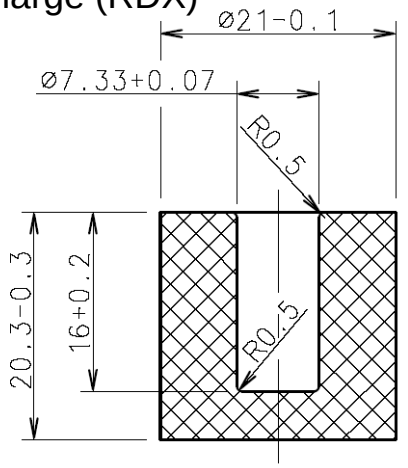
Booster-Gap-Test: Experimental Setup



Firing setup



Donor charge (RDX)



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