KS22a

The Insensitive High Explosive for Hard Target Defeat Applications

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What's Next? Breakthroughs in IM/EM Technology For the Next Generation of Weapons

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KS22a - The Insensitive High Explosive for Hard Target Defeat Applications

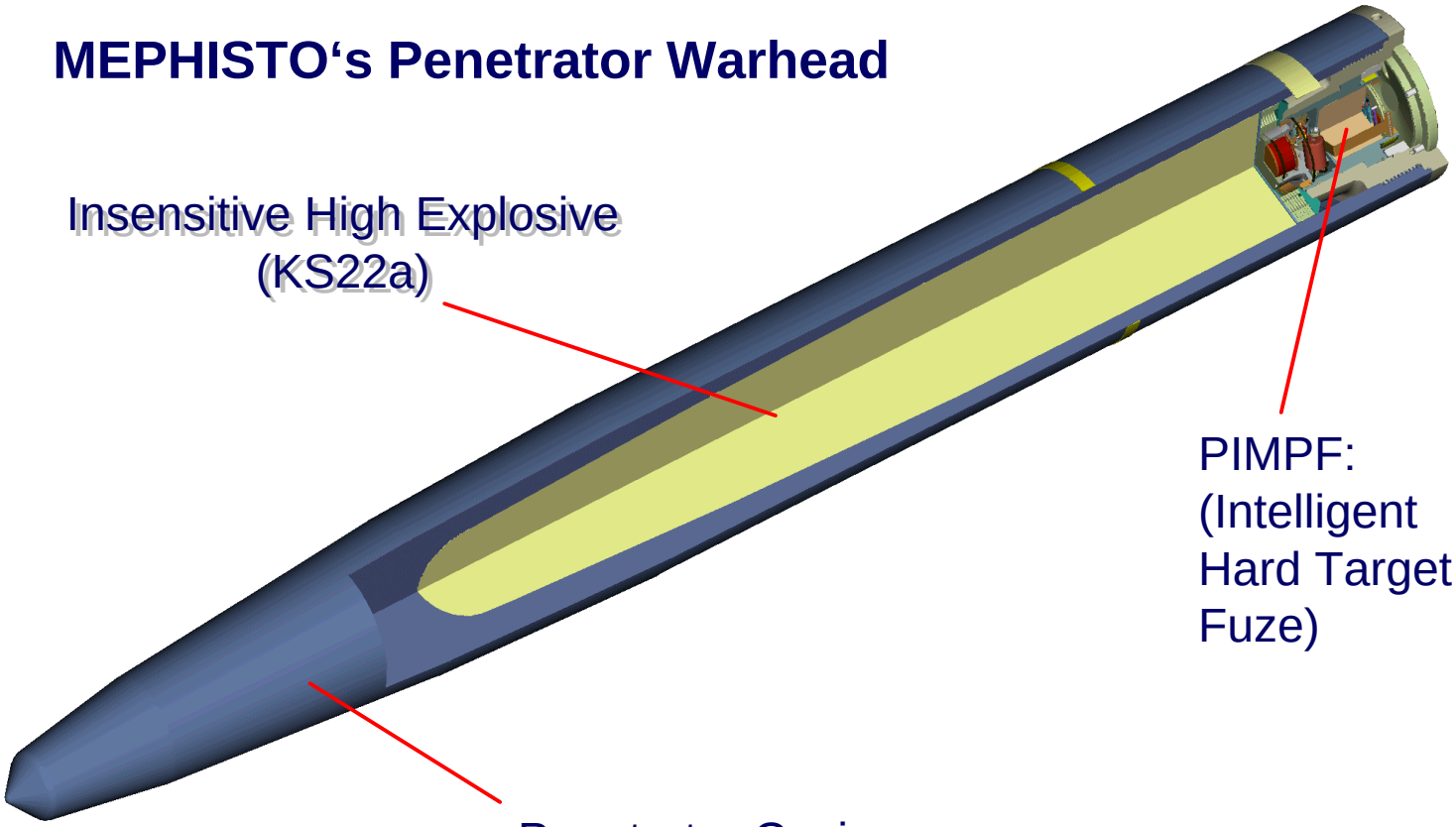
Overview

- What for?
  Current Applications of KS22a
- Starting Point
  Basic Properties of KS22a
- Sample Preparation
  Pre-Shocking of KS22a
- Experimental Results
  Properties of Pre-Shocked KS22a
- Conclusion
  Summary

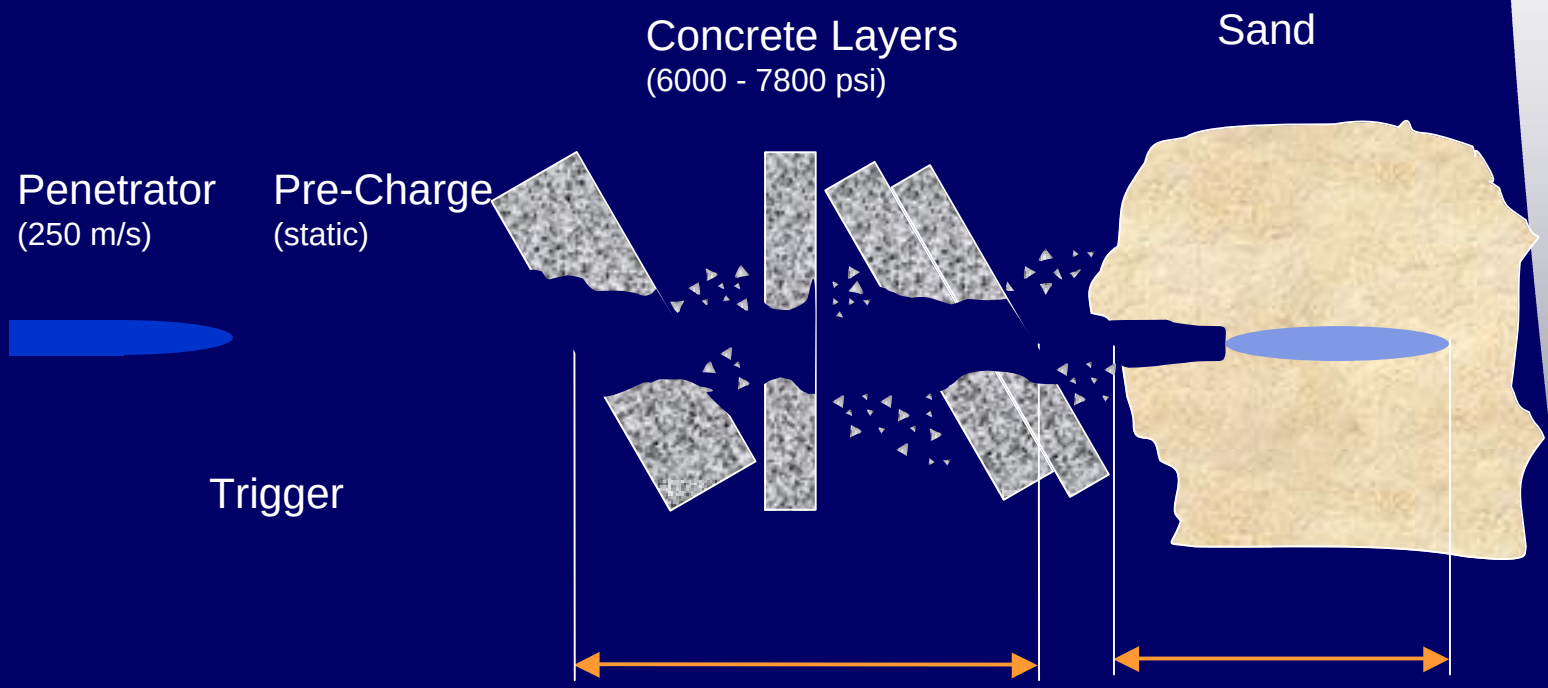
1. Current Applications of KS22a

German SOW MAW Taurus KEPD 350

MEPHISTO‘s Penetrator Warhead

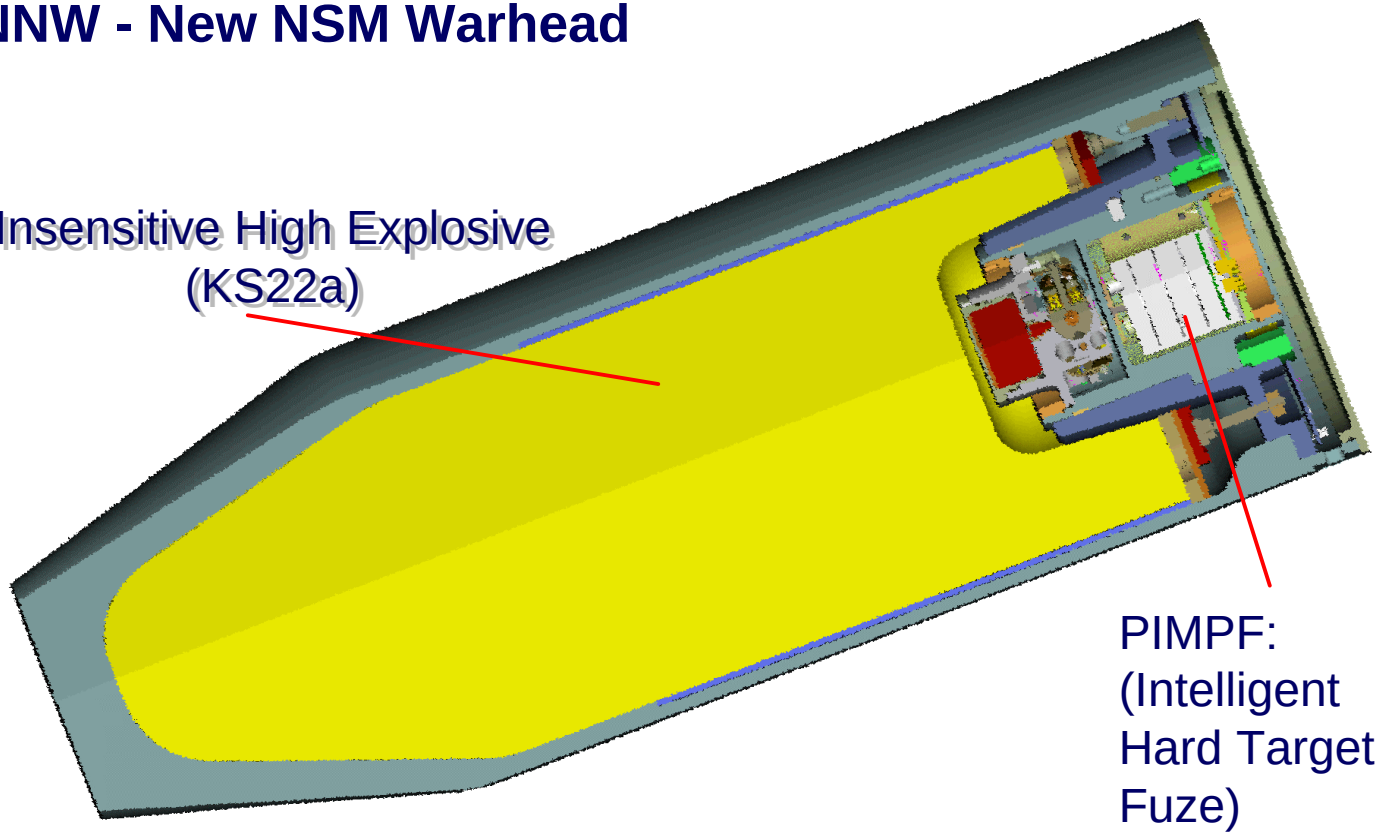


Typical Penetrator Piercing Capability

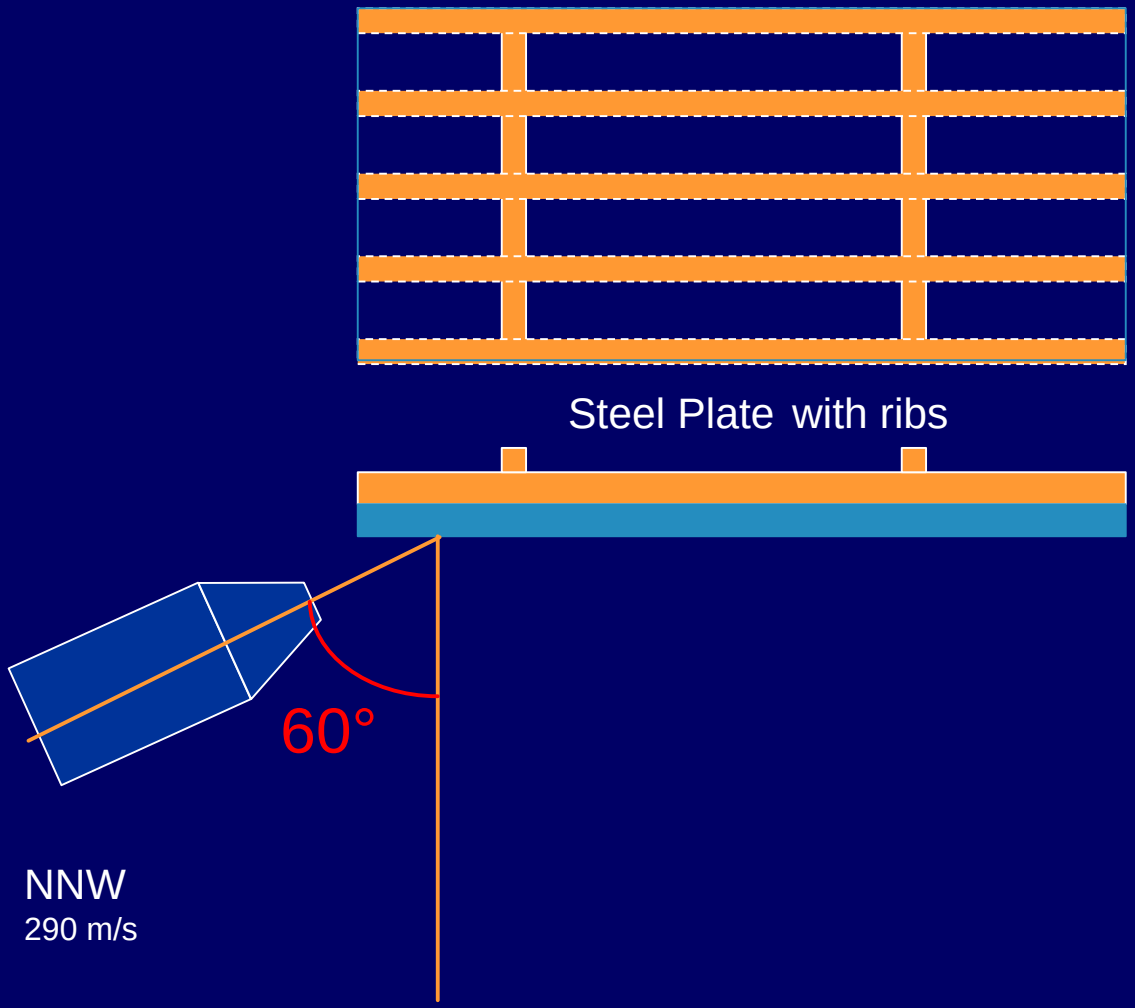


Norwegian NSM (New Anti-Ship Missile)

NNW - New NSM Warhead



NNW Piercing Capability



2. Basic Properties of KS22a

- Gap Test — *Initiation Ability / SDT Sensitivity*
- Plate Dent Test — *Metal Deformation Performance*
- Cylinder Test — *Metal Acceleration Performance (JWL)*
- BKW *(Thermochemical Code)* Simulations — *pV-Diagram, Blast Performance*
- Critical Diameter — *Initiation Ability (Eplosive Train Design)*

Properties of KS22a compared to KS33

Starting Point:

KS33

- Formulation: HMX / PB 90 / 10
- Density: 1.71 g/cc

Aluminum Additions for Blast Enhancement:

KS33 Derivatives

- HMX / Al / PB 80 / 10 / 10, Density = 1.75 g/cc
- HMX / Al / PB 70 / 20 / 10, Density = 1.79 g/cc

Economic Compromise Solution for Penetrators:

KS22a

- Formulation: RDX / Al / PB 67 / 18 / 15
- Density: 1.64 g/cc

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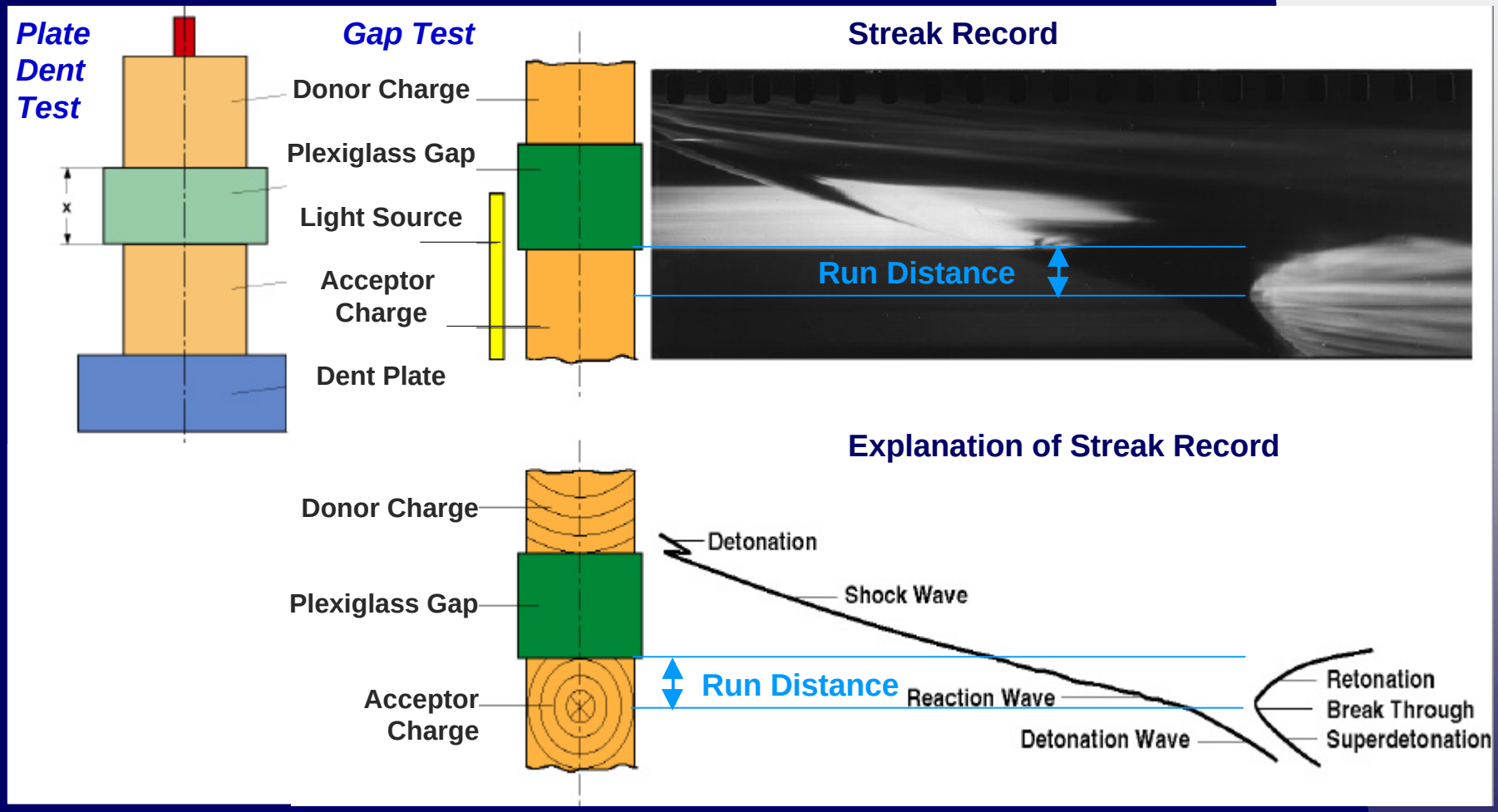
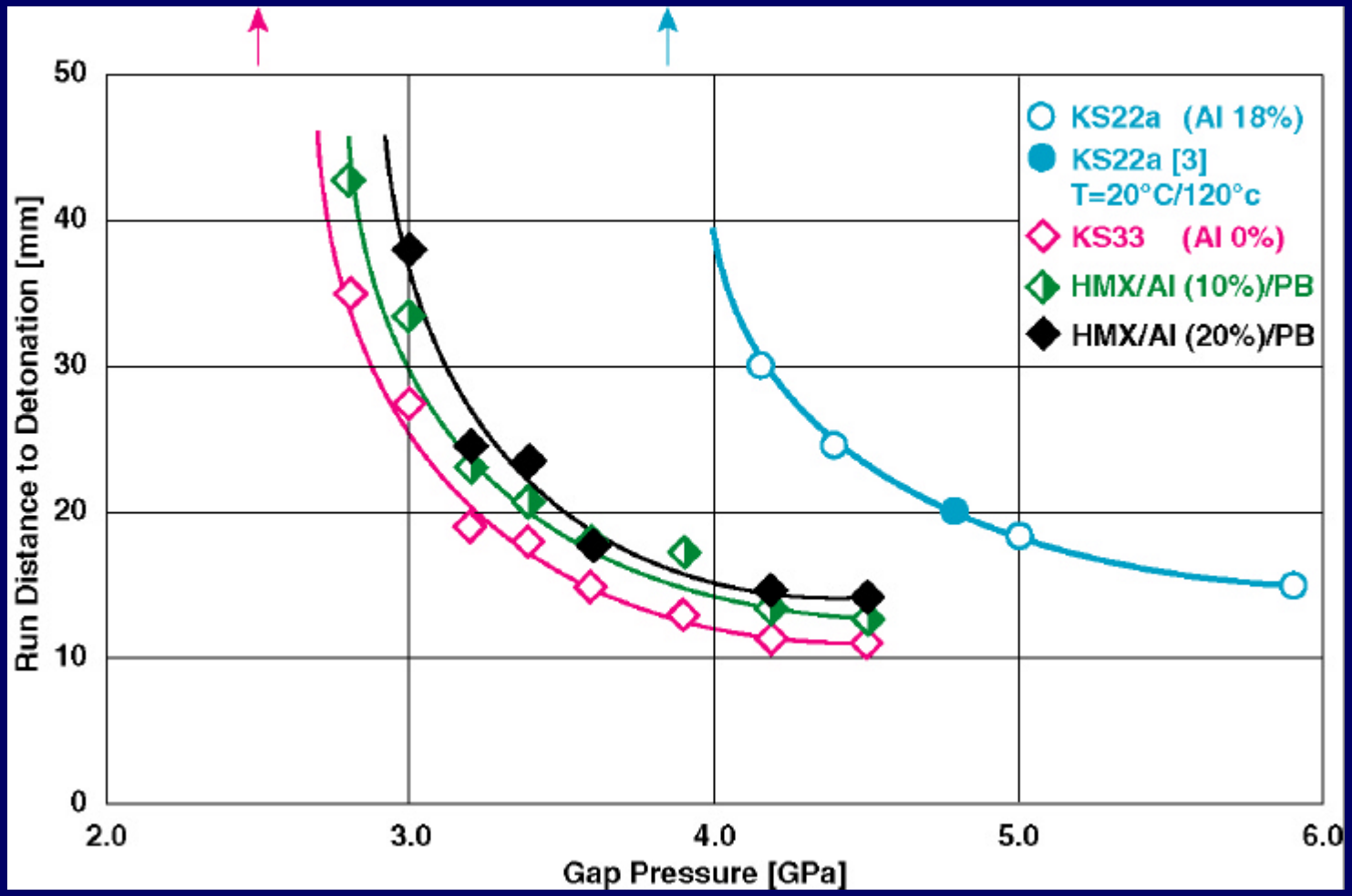
TDW Gap Test: Run Distance to Detonation & Plate Dent Depth



TDW Gap Test: Run Distance to Detonation

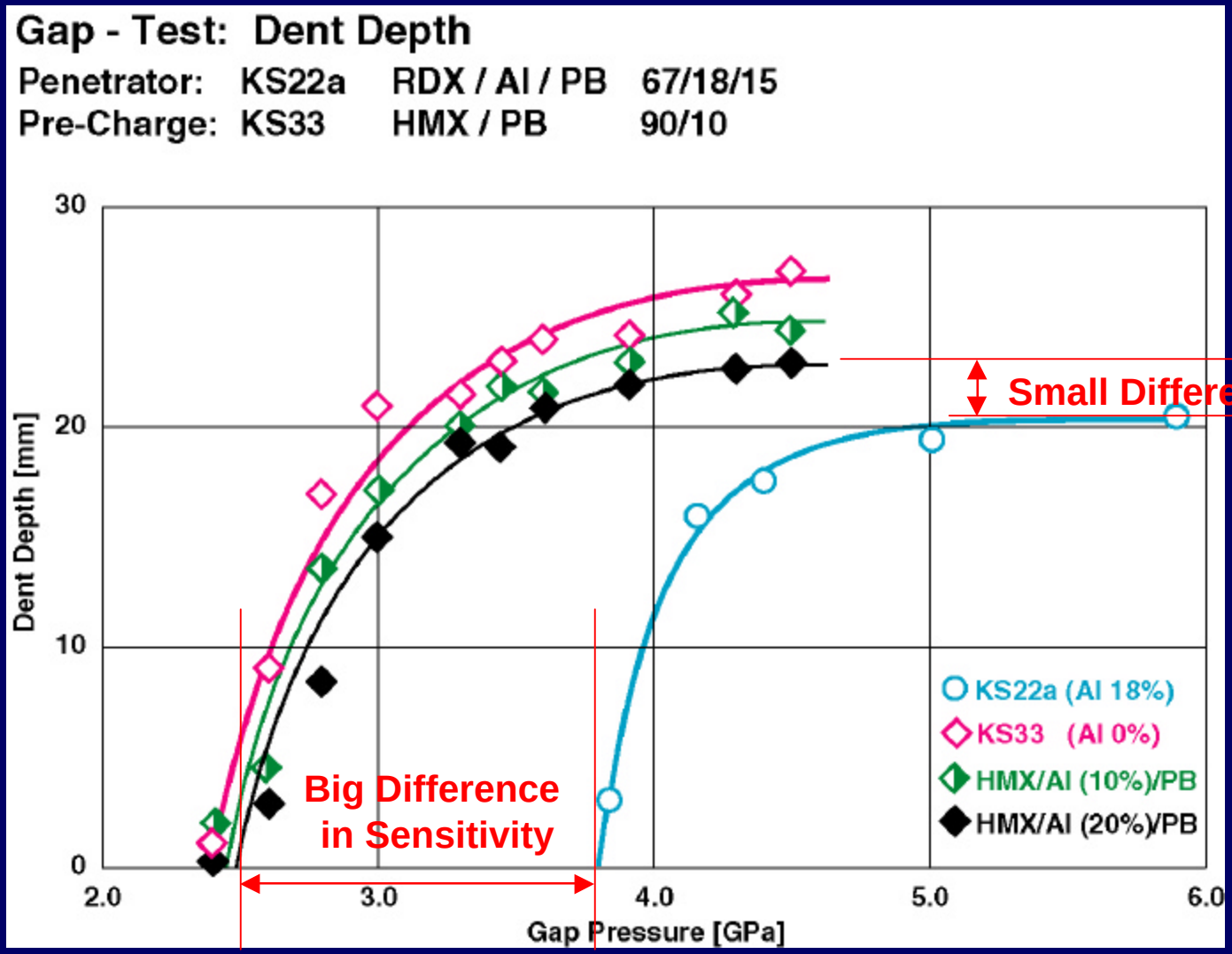


TDW Gap Test: Dents in Witness Plates

Initiation Pressure: P_{init} [kbar] = 105*EXP(-0,0358*Gap Thickness [mm])

20 mm	25 mm	30 mm	32.5 mm	35 mm
51 kbar	43 kbar	36 kbar	33 kbar	30 kbar
5.1 GPa	*4.3 GPa*	*3.6 GPa*	*3.3 GPa*	*3.0 GPa*

TDW Gap Test: Plate Dent Depth



Results of Gap Test and Plate Dent Test:

KS22a Compromise low Sensitivity good Performance.

2. Basic Properties of KS22a

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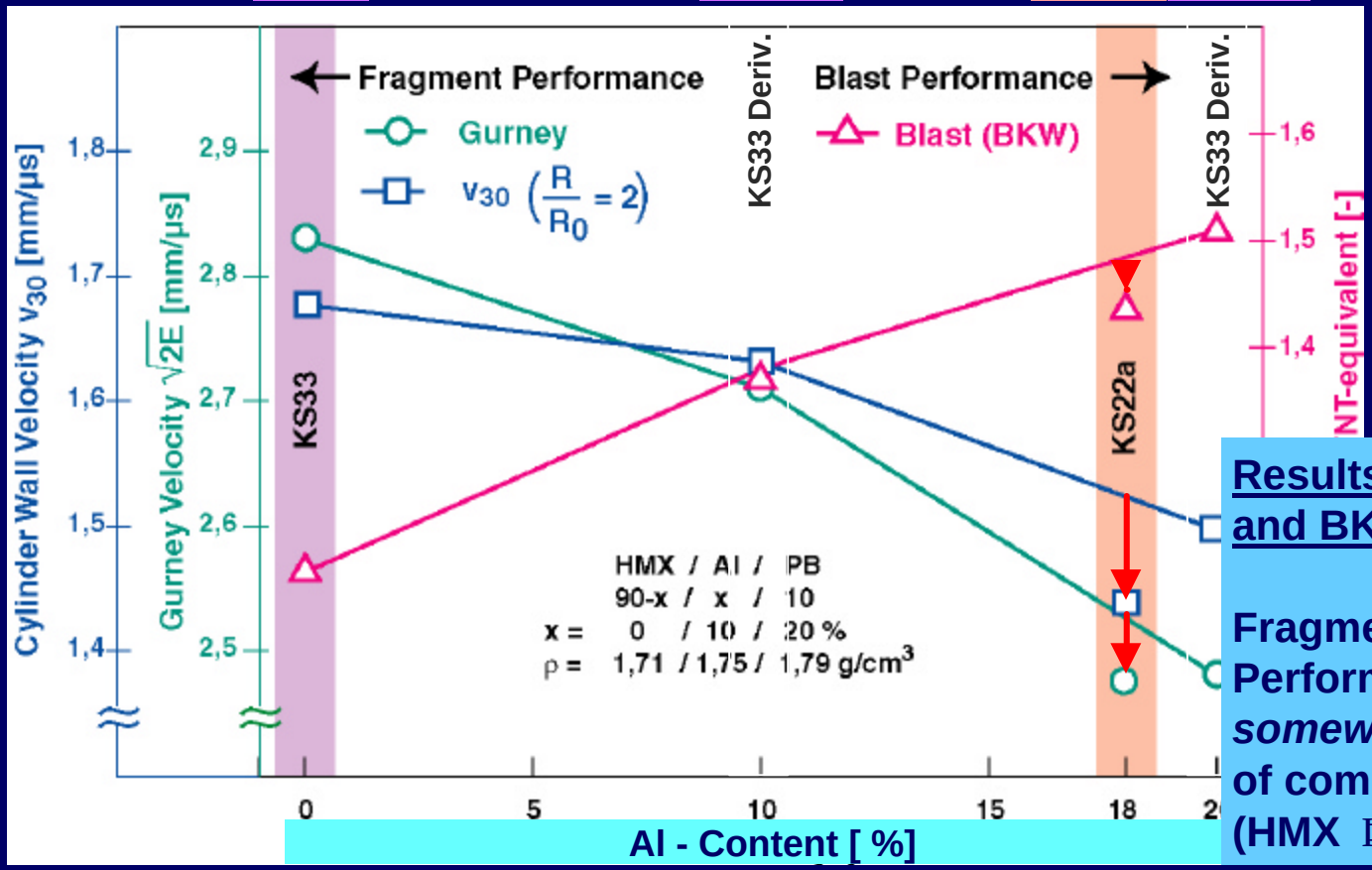
Comparison: Fragmentation / Blast Performance

KS33	KS33D	KS22a	KS33D
0%Al	10% Al	18%Al	20%Al
HMX	*HMX*	*RDX*	*HMX*



Results of Cylinder Test and BKW Simulations:

Fragmentation and Blast Performance of KS22a is *somewhat lower* than that of comparable KS33D-20%Al (HMX þ RDX)

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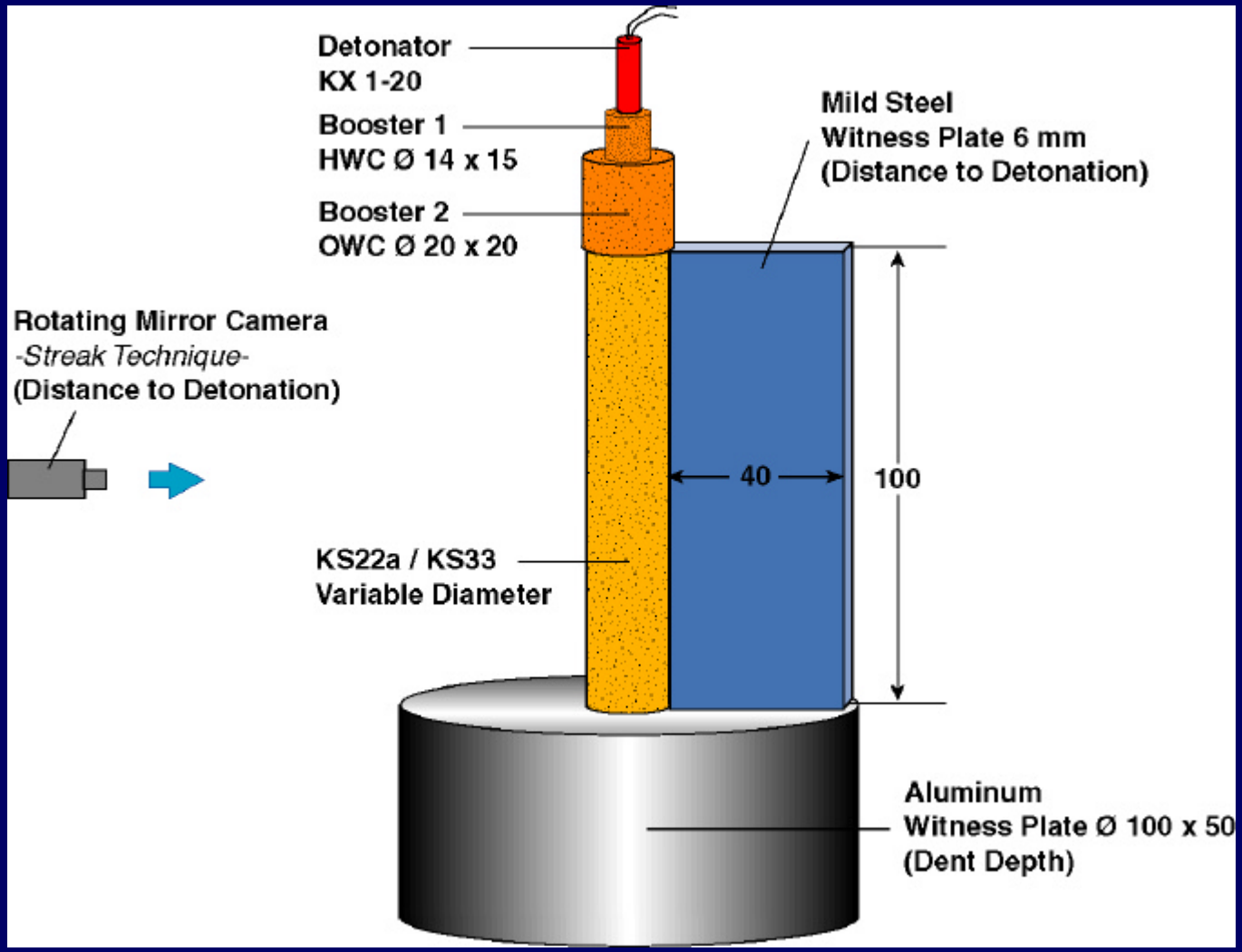
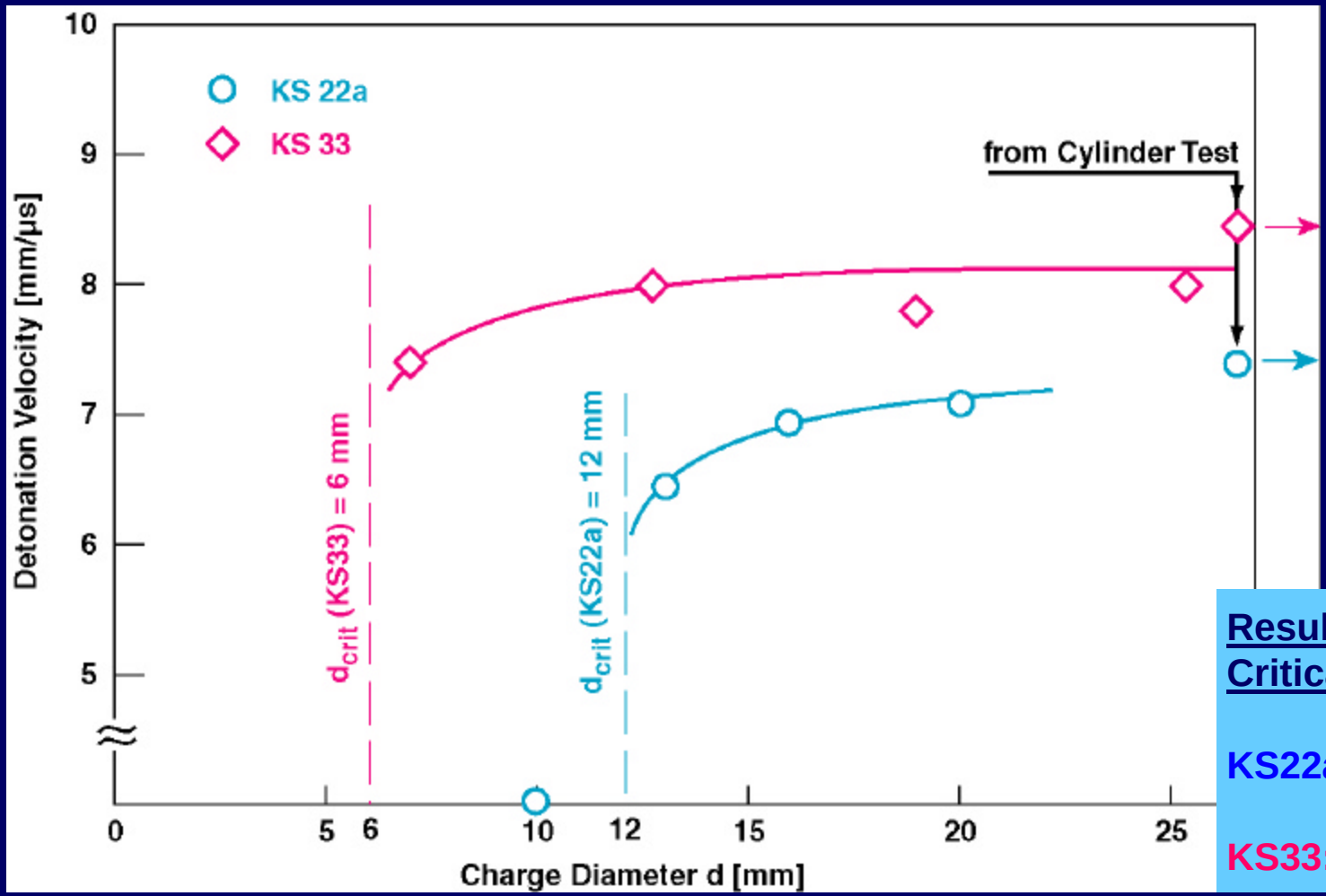
Test Set up: Critical Diameter



Critical Diameter Test Results: KS33 & KS22a



Results for Critical Diameter Tests:

KS22a: 12 mm

KS33: 6 mm

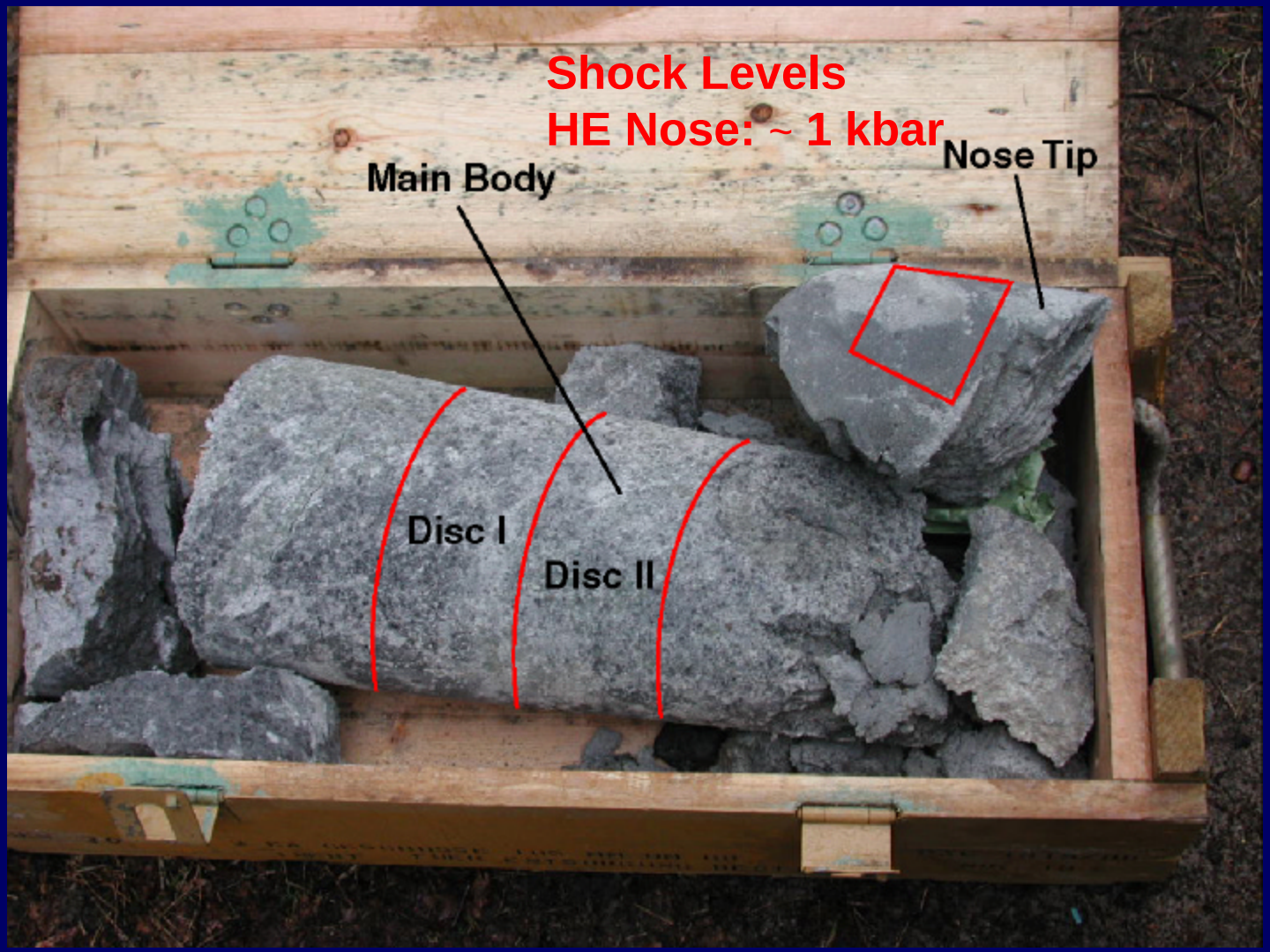
3. Pre-Shocking of KS22a

Video-Clip: Live Test at Meppen Proving Ground

Live Test: Lateral Impact on Concrete Target

Penetrator Casing Ripped Up

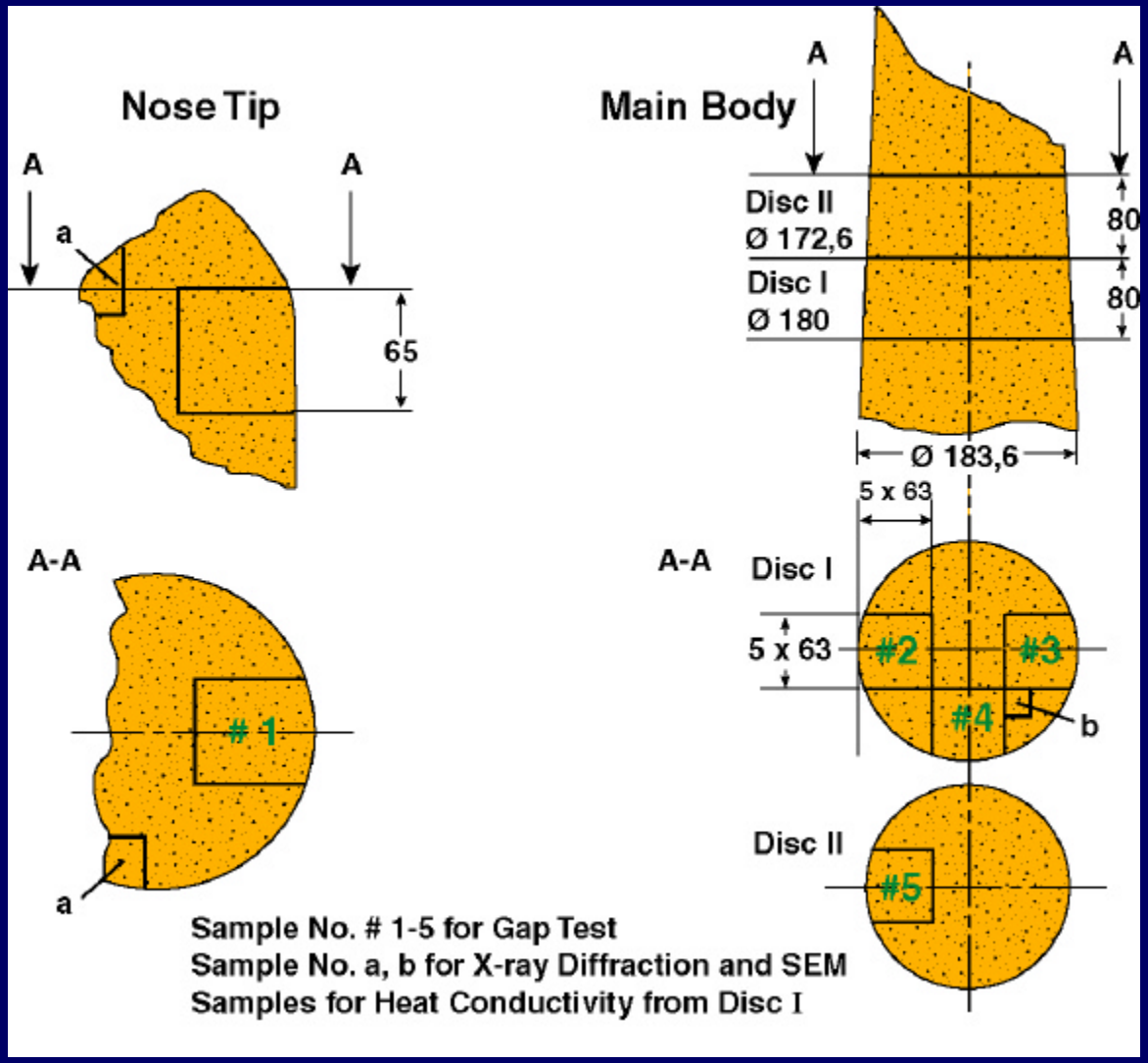
Pre-Shocked KS22a IHE Recovered after Test



4. Properties of Pre-Shocked KS22a

- Impact / Friction Sensitivity
- Gap Test / Plate Dent Test
- Optical Microscopy
- X-ray Diffraction
- Scanning Electron Microscopy (SEM)
- Heat Conductivity

Pre-Shocked KS22a: Samples for Investigations



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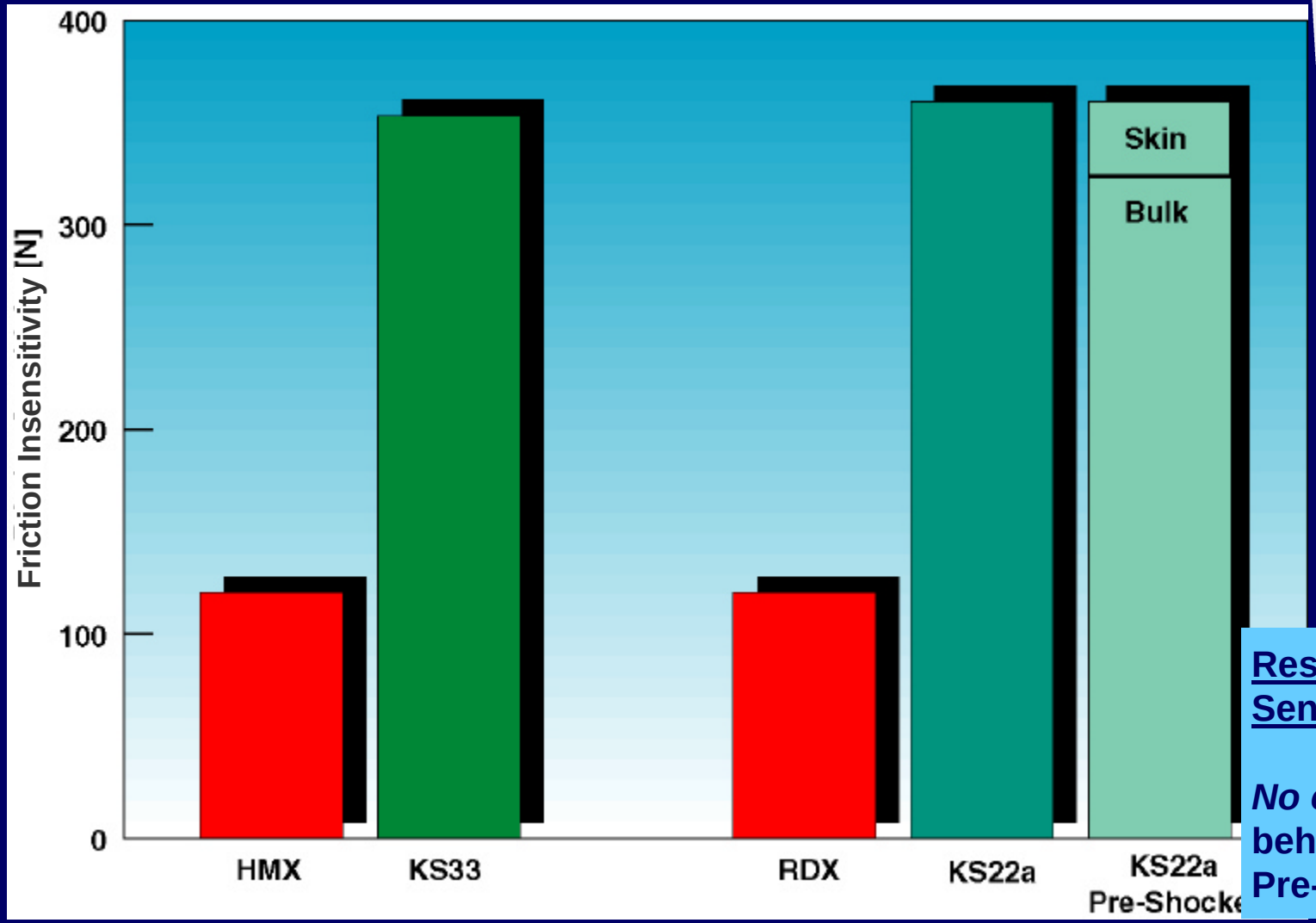
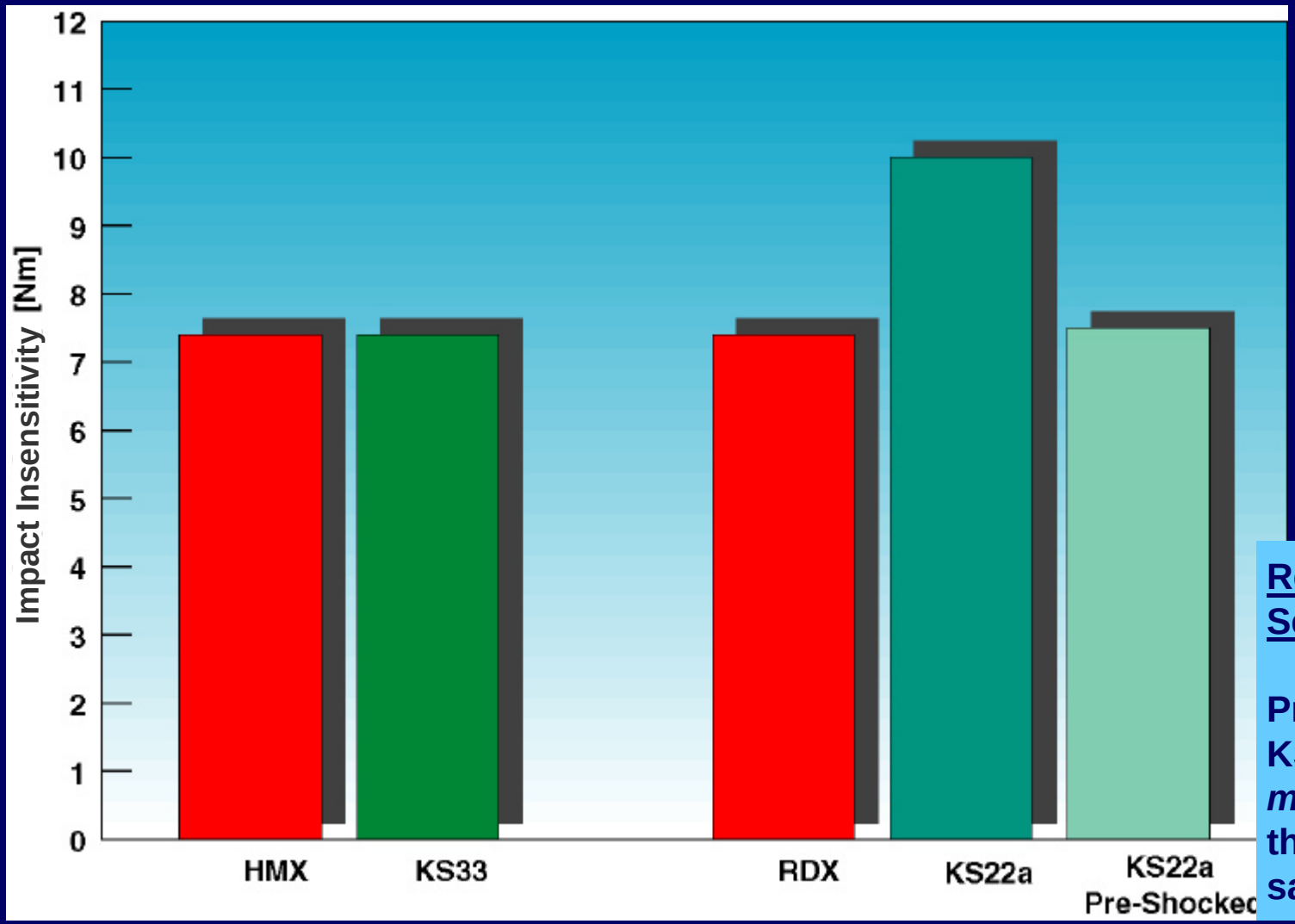
Friction Sensitivity of KS33 and KS22a



Results for Friction Sensitivity Tests:

No changes **in behaviour due to Pre-Shocking**

Impact Sensitivity of KS33 and KS22a



Results for Impact Sensitivity Tests:

Pre-Shocked KS22a a little *more sensitive* than untreated samples

4. Properties of Pre-Shocked KS22a

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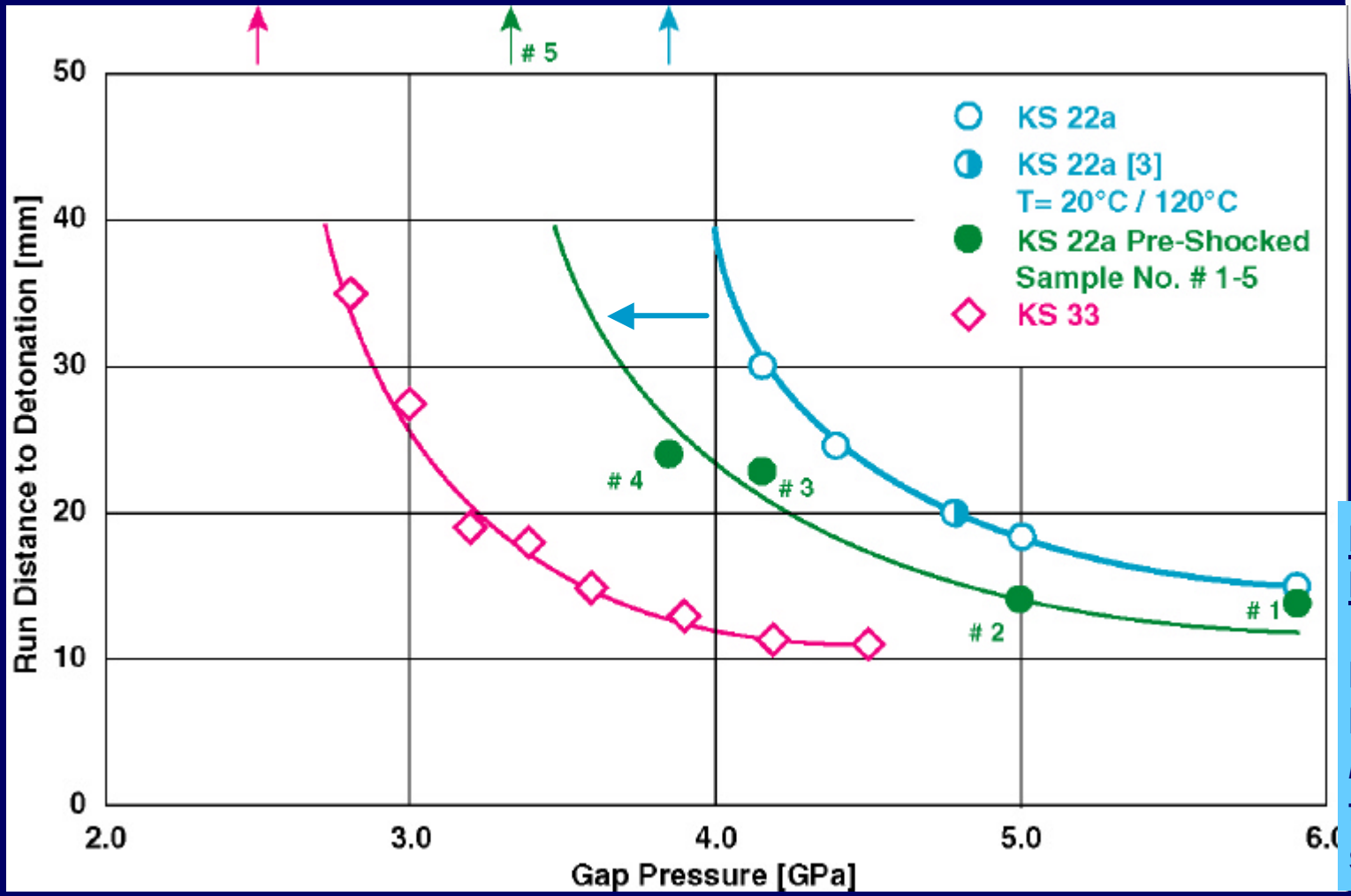
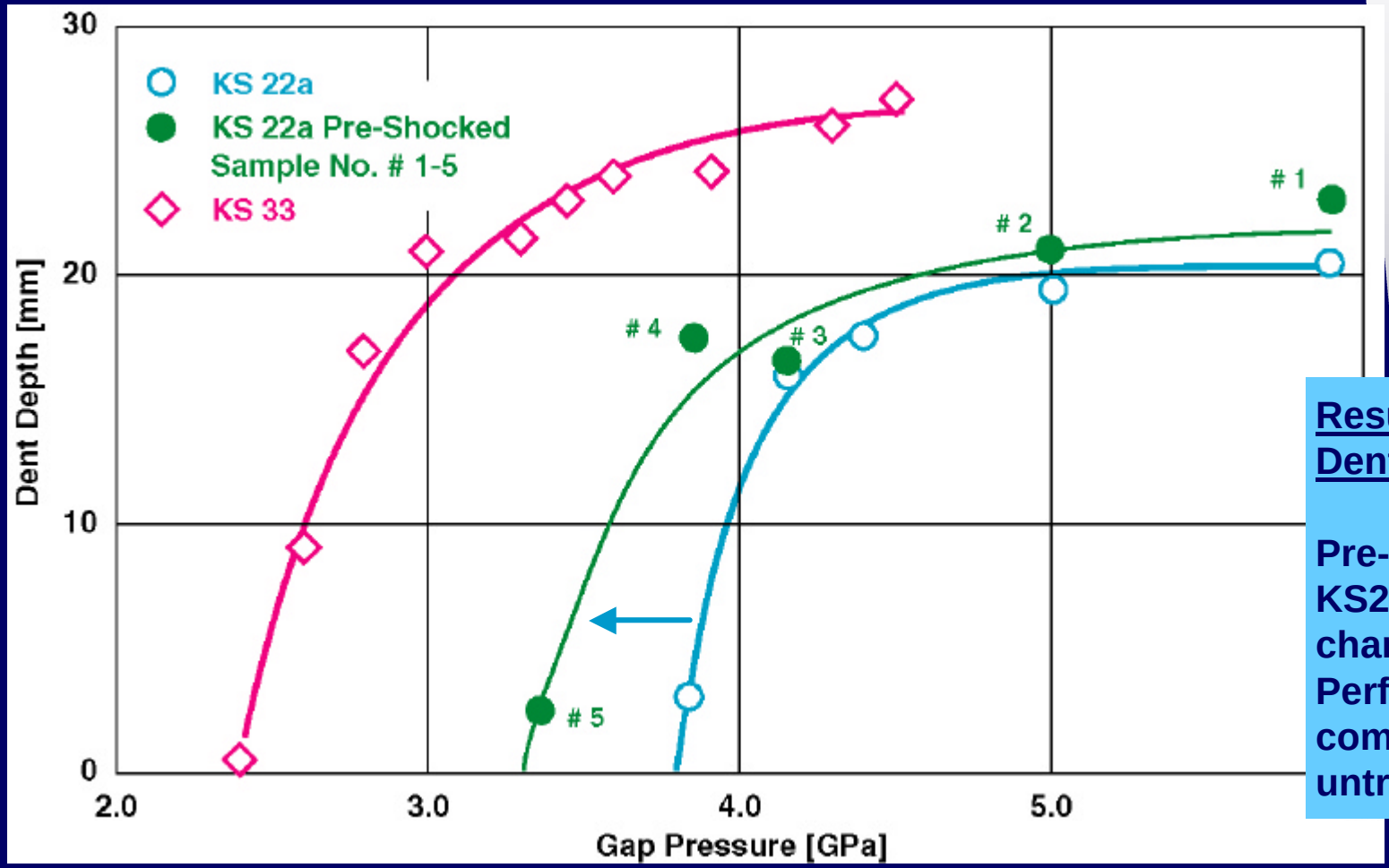
Pre-Shocked KS22a: Run Distance to Detonation



Results for Run Distance Tests:

Pre-Shocked KS22a a little *more sensitive* than untreated samples

Pre-Shocked KS22a: Plate Dent Depth



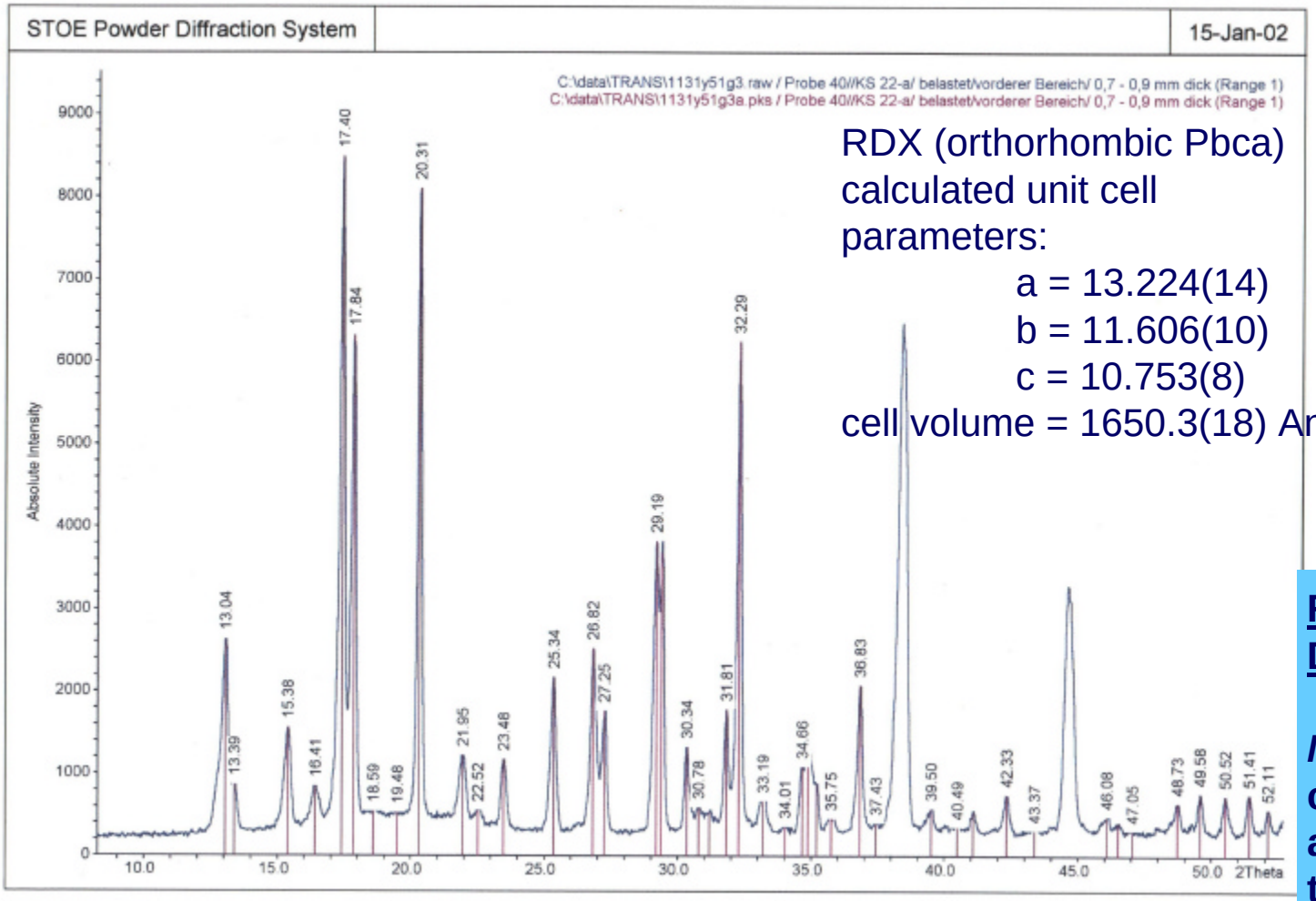
Results for Plate Dent Tests:

Pre-Shocked KS22a shows no change in Performance compared to untreated samples

4. Properties of Pre-Shocked KS22a

- Impact / Friction Sensitivity
- Gap Test / Plate Dent Test
- Optical Microscopy
- X-ray Diffraction
- Scanning Electron Microscopy (SEM)
- Heat Conductivity

Pre-Shocked KS22a: X-Ray Diffraction (Nose Tip)



RDX (orthorhombic Pbca) calculated unit cell parameters:

a = 13.224(14)
b = 11.606(10)
c = 10.753(8)

cell volume = 1650.3(18) Ang

Results for X-Ray Diffraction Tests:

No changes **in cell volume and structure due to Pre-Shocking**

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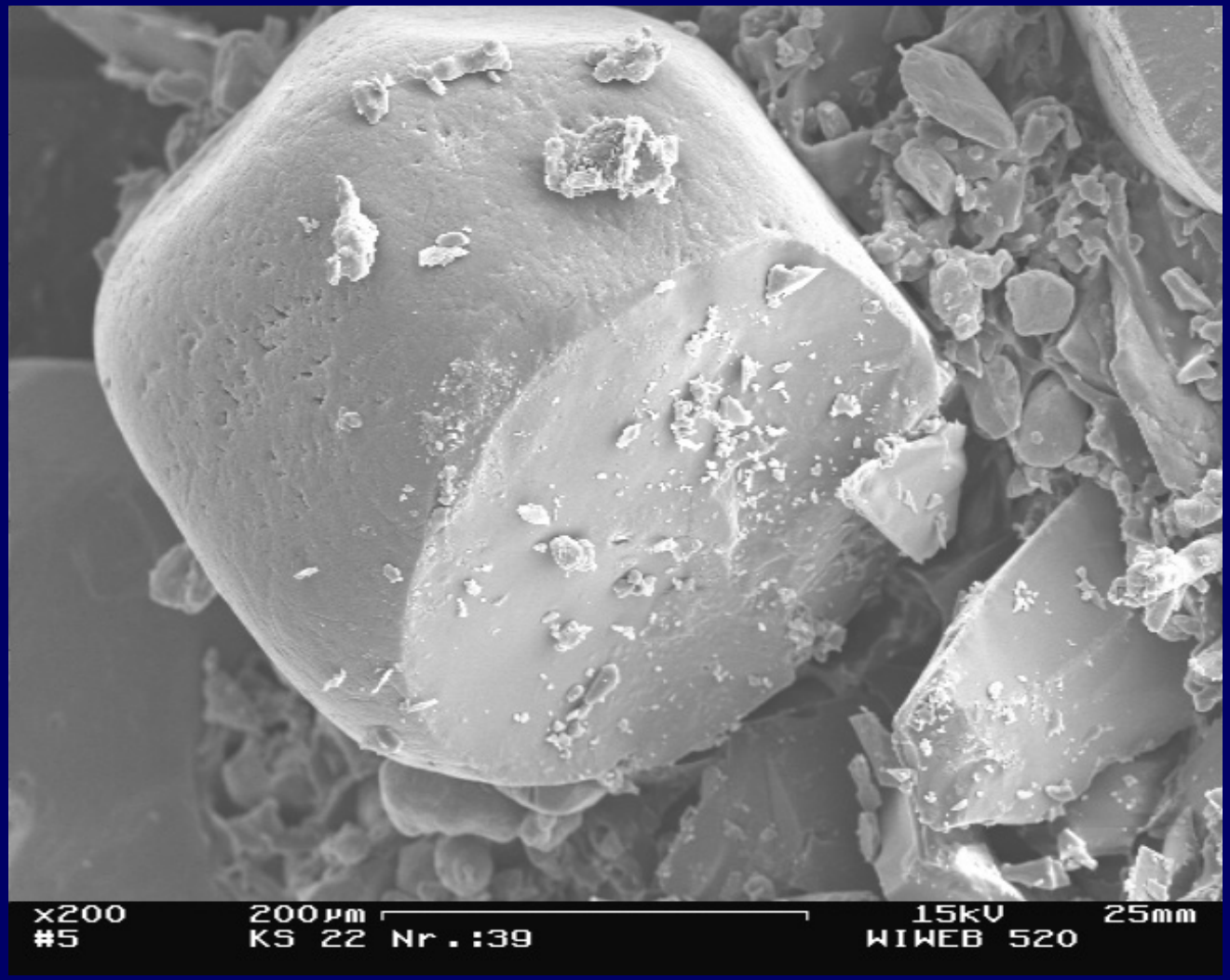
- Scanning Electron Microscopy (SEM)
- Heat Conductivity

Pre-Shocked KS22a: SEM Test (Nose Tip)



Results of SEM Tests:

No changes **in behaviour due to Pre-Shocking**

4. Properties of Pre-Shocked KS22a

- Impact / Friction Sensitivity
- Gap Test / Plate Dent Test
- Optical Microscopy
- X-ray Diffraction
- Scanning Electron Microscopy (SEM)
- Heat Conductivity

Heat Conductivity

No Significant Changes in Heat Conductivity Parameters
Conclusion:

- No Extra Pores Produced
- No Cracks Produced
- No Relevant Microstructural Damage
- ...

5. Summary

Conclusions

KS22a - The Insensitive High Explosive for Hard Target Defeat Applications

KS22a is well suited for Hard Target Defeat Applications:

- ➢ High Blast & Fragmentation Performance
- ➢ Low Sensitivity
- ➢ Survives High Shock Loads
- ➢ No Relevant Microstructural Damage
- ➢ Only Minor Increase of Sensitivity due to Shock Loads