Tek Ord

CHEMRING GROUP PLC

Dent Block Acceptance Test Susceptibility

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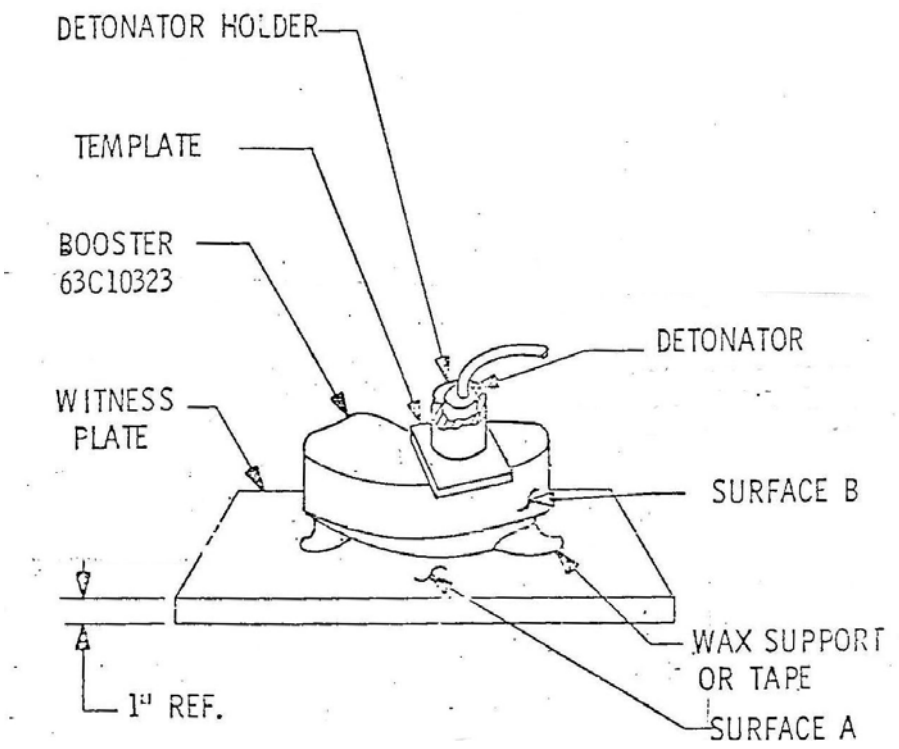
Failure to Detect Change

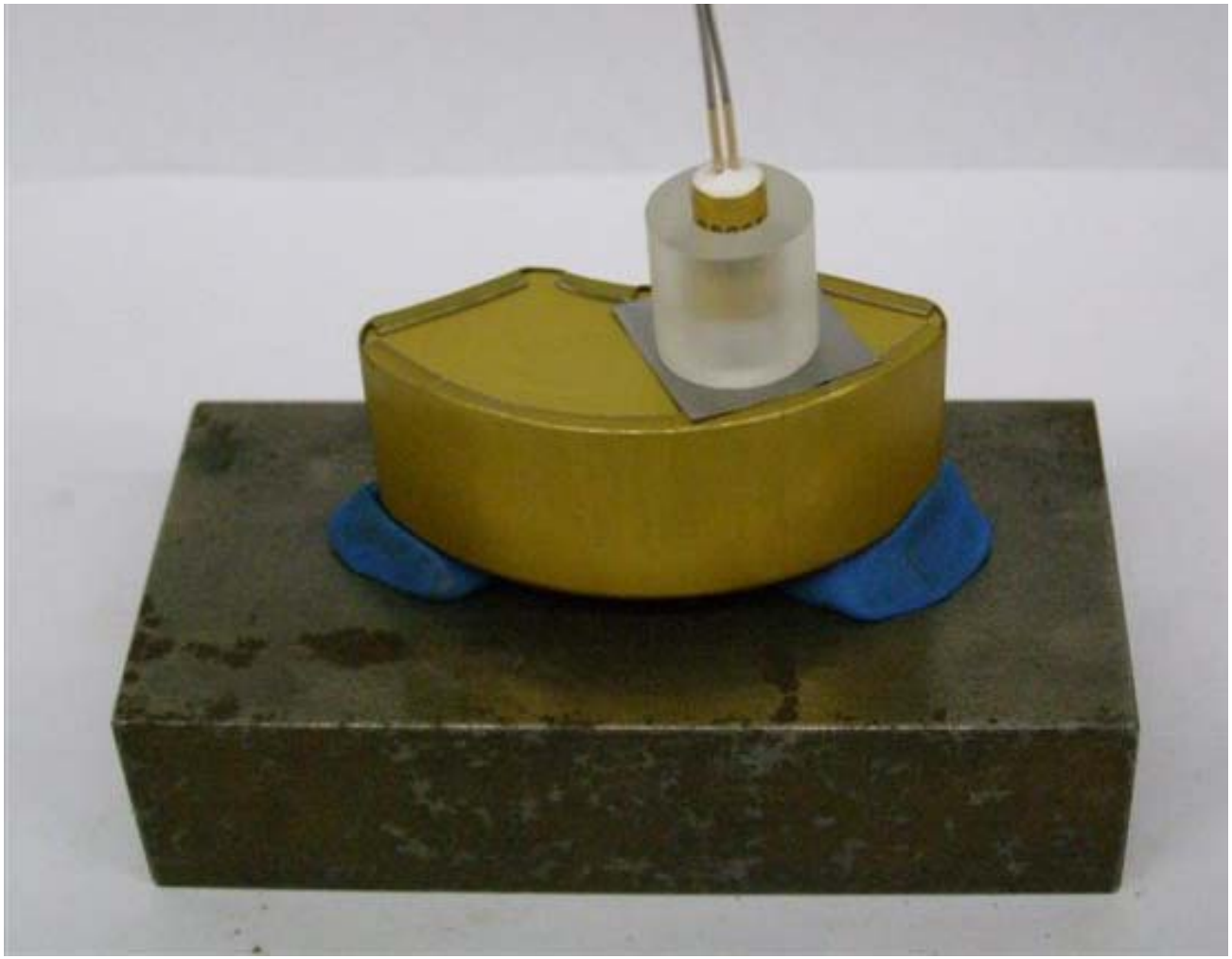
Investigation of a Change in Propagation Reliability for Detonator/Booster Interface after dent testing failed to detect the change

Overview

- MK 80 Bomb explosive train
- Simulation for testing



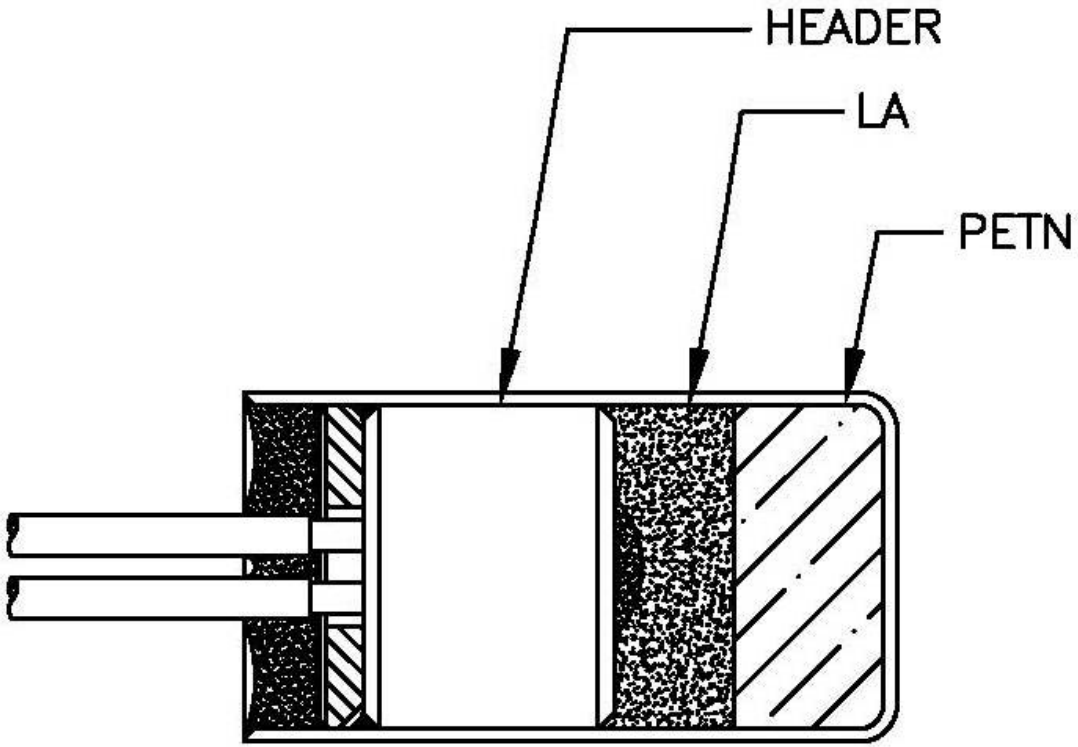
Test Set-up



History of Detonator Design

- Original: Plastic plug, epoxy seal, aluminum cup (AF 62A11810)
- Redesign: Glass header, hermetic solder seal, plated stainless steel cup
- Redesign reliability verified
- Witness block dent criteria confirmed

Detonator Construction



Problem

- Failure of Detonator to initiate Booster discovered during periodic interface testing
- Change in reliability of explosive transfer
- Historically: 30% margin on 99.9% reliability at 95% confidence
- Recently: 50% failures
- Detonator witness block testing demonstrated nominal detonator characteristics

Booster Propagation Data

Det. Lot	Cup Thk	Booster Func. (Req'd. 5.9 mm)	Bruceton 50% Pt.(mm)
99H001-001	0.0105		10.67
02H001-008	0.0105		11.04
06F003-001	0.0105	5/5	
07K003-005	0.0115	3/14	
08A003-006	0.0115	20/22	

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Dent Data

Lot	Avg Dent	Max Dent	Min Dent	Cup Thk
99H001-001	0.020	0.021	0.019	0.0105
02H001-008	0.020	0.021	0.018	0.0105
04L002-002	0.021	0.022	0.020	0.0105
06F003-001	0.020	0.021	0.018	0.0105
07K003-005	0.022	0.025	0.021	0.0115
08A003-006	0.020	0.023	0.018	0.0115

Investigation of Variables

- Booster changes
- Detonator cup changes
- Lead Azide changes
- PETN changes
- Manufacturing process changes
- Test set-up changes

Detonator Construction Variables Testing

Parameter	Function Results 8mm	9mm	10mm
0.0115 cup end thk	1F/2S	3F/2S	2F
0.0105 cup end thk	-	4S	1S
Normal PETN qty	1F/2S	3F/5S	1F/1S
Increased PETN qty	-	1S	1F
Normal DLA qty	2S	3F/1S	1F
Increased DLA qty	-	1F/2S	1S
DLA	1F/1S	2F/5S	1F/1S
SPLA	1S	1F/1S	1F

Summation

- Detonator cup end thickness had greatest effect
- Flier plate transfer mechanism likely
- No other strong effects noted
- Another unidentified variable contributed to problem
- Additional increase in reliability desired

Booster Propagation Data

Det Lot	Variable Tested	Bruceton 50% Pt.(mm)
99H001-001	Std Const	10.67
02H001-008	Std Const	11.04
S001	0.0105” cup thk	8.25
S002	18% inc DLA	8.75
S003	12% inc PETN	9.21
08M004-001	38% inc PETN	9.10

Effort to Increase Margin

- Increased LA: improved results
- Increased PETN quantity: greater effect

Final Conclusions

- Interface common to many explosive trains
- A small change in cup material thickness within drawing requirements had an unexpected change in explosive train performance
- Changes within normal tolerances may result in unexpected results