THALES NDIA Briefing

Hard Target Reliability for MAFIS

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Company Background in Fuzing & Shock Hardening

1918 - Shell Fuzing

1940s - Airborne Radar, Shell Fuzing,
Proximity Fuzing (Rockets)
Bomb Fuze for “Bouncing Bomb” etc.

1950s - Naval Proximity Shell Fuzing

1960s - No.907 RF Proximity Fuze for Bombs.

1970s - No.952 RF Proximity Fuze for Bombs.
Multi Role Shell Fuze (MRF)

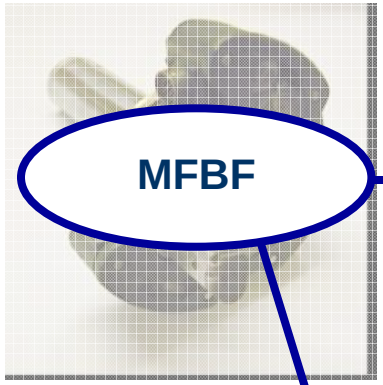
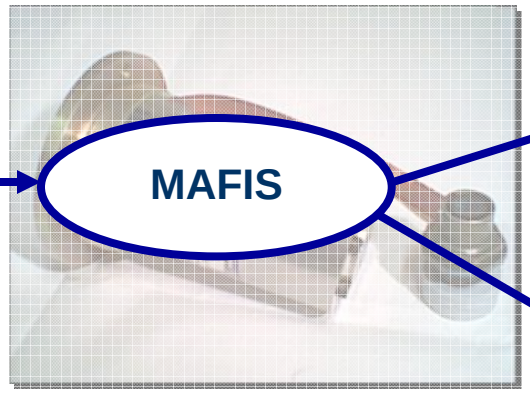
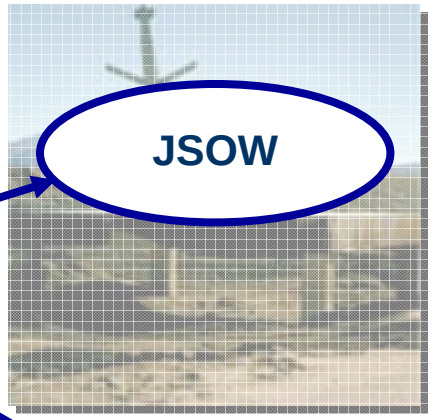
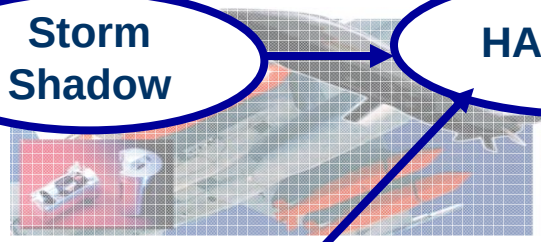
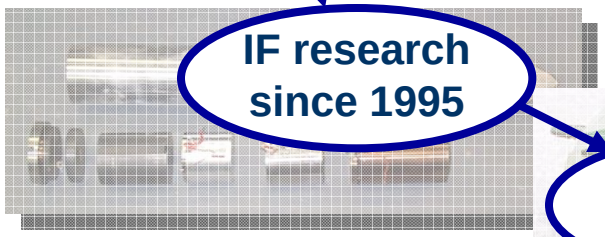
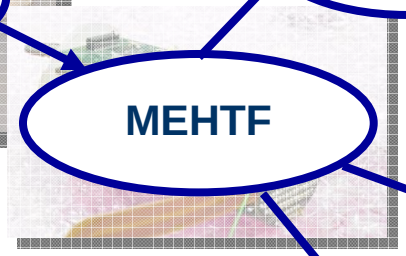
1980s - SG357 Runway Cratering Weapon
MFBF (No.960) Multi-Function Bomb Fuze

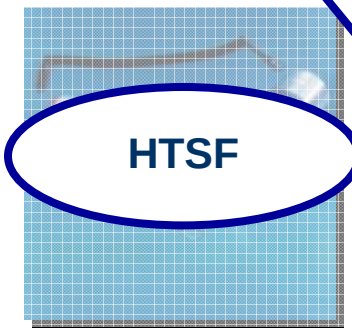
1990s - Intelligent Hard Target Fuzing Research

2000s - Intelligent Hard Target Fuzing Production
and Research, MAFIS, HTSF & AURORA.

Pioneer in hardened fuze electronics

TME Fuzing Family Tree




MFBF

MAFIS

JSOW

Storm Shadow

HARDBUT

IF research since 1995

STRIFE

MEHTF

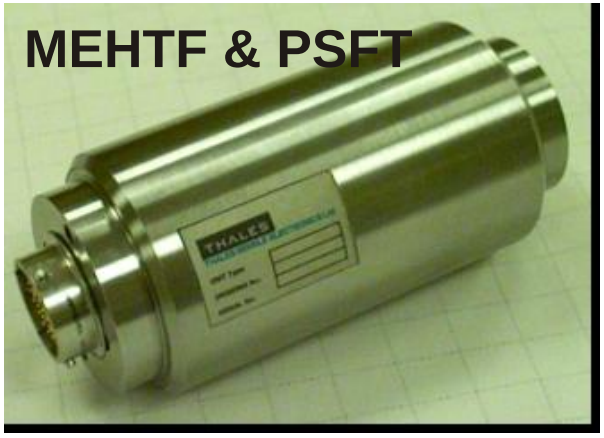
PSFT

AURORA

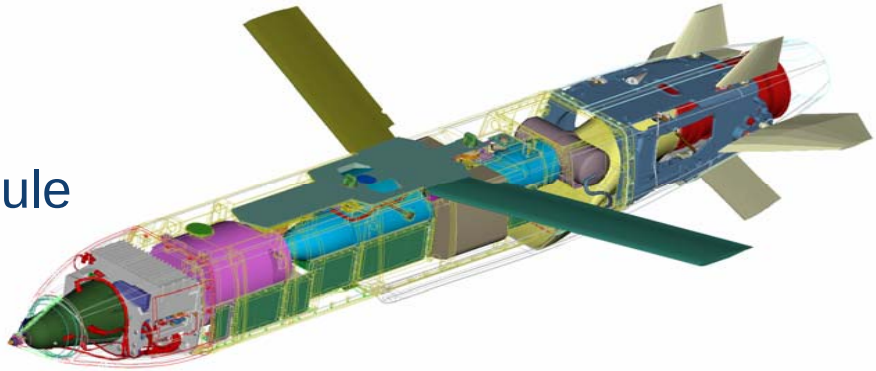
HTSF

FIBDID

TME Hard Target Fuzing



MAFIS (Multi Application Fuze Initiation System)



Modular 3” fuze

- Shock hardened core electronics
- Application specific interface module

High shock survivable for MWS

Out-of-Line arming system

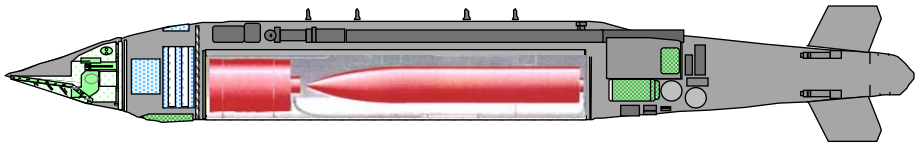
Missile fuze (including reliability requirements)

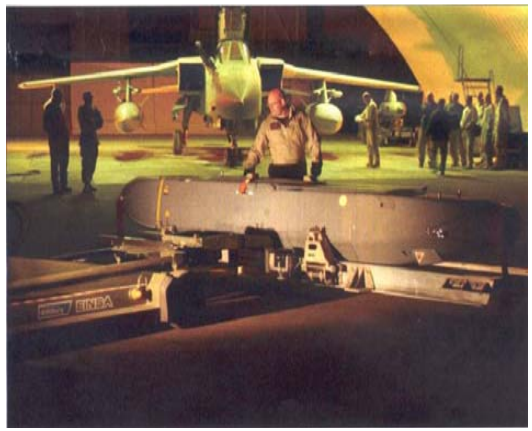
Initially developed for Storm Shadow with BROACH warhead

Modularity permits ready adaptation to other applications

In full production for:

- Raytheon AGM-154C (JSOW)
- MBDA Storm Shadow





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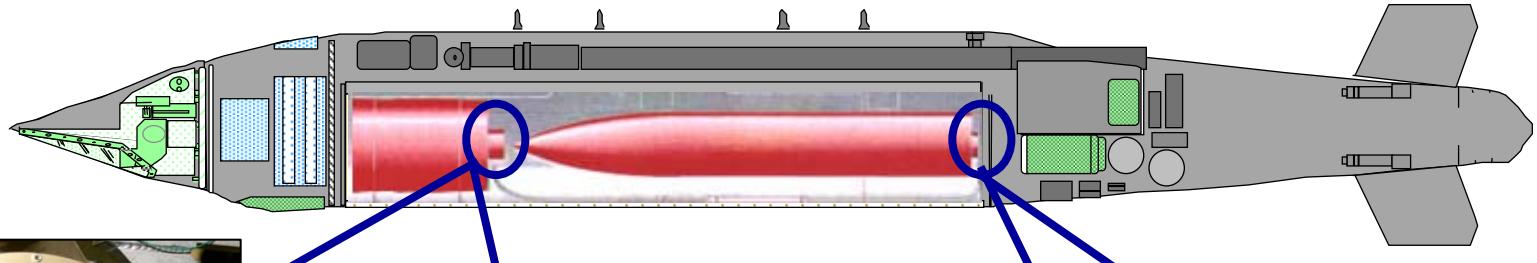
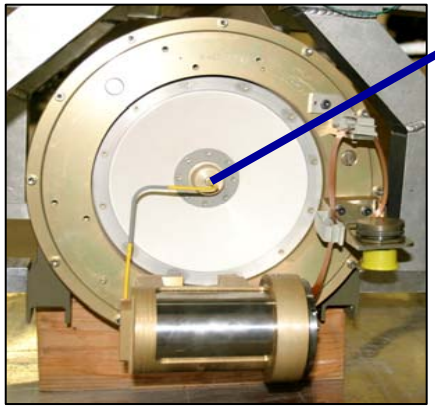
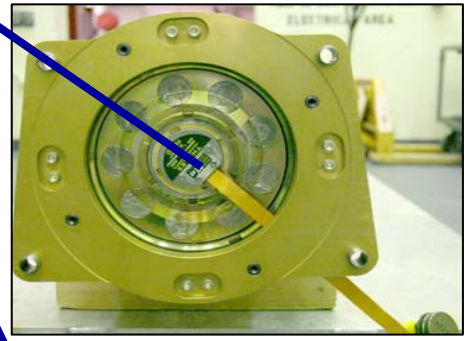
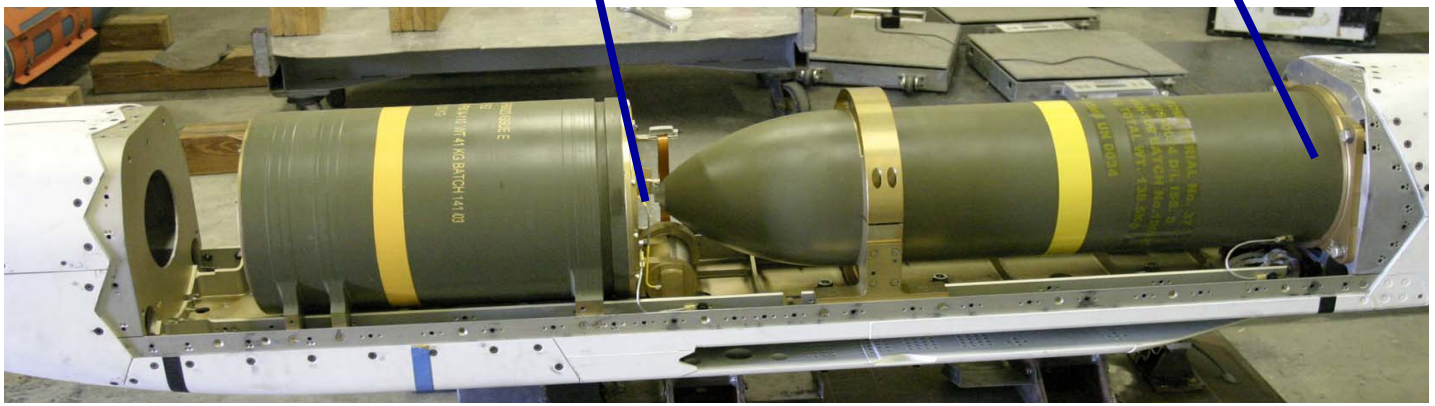
MAFIS (FSU-26/B) in JSOW (AGM-154C)

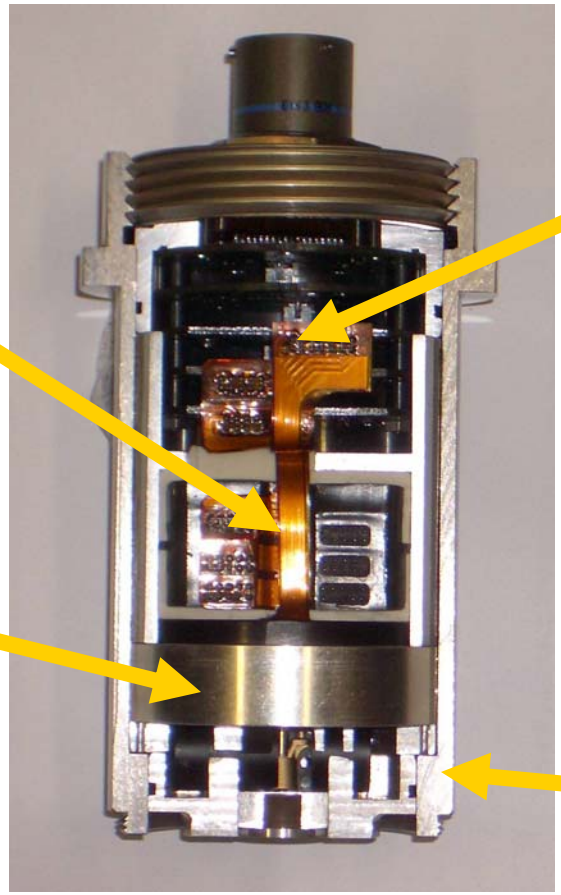








MAFIS for JSOW

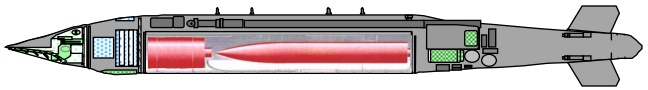


Core Electronics Module (CEM)

Application Specific Interface Module (ASIM)

Detonator Alignment and Safety Module (DASM)

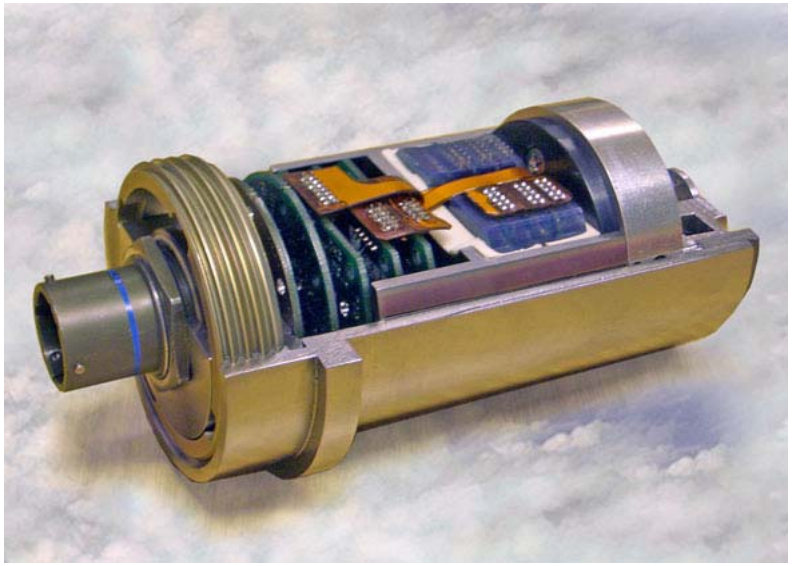
Housing



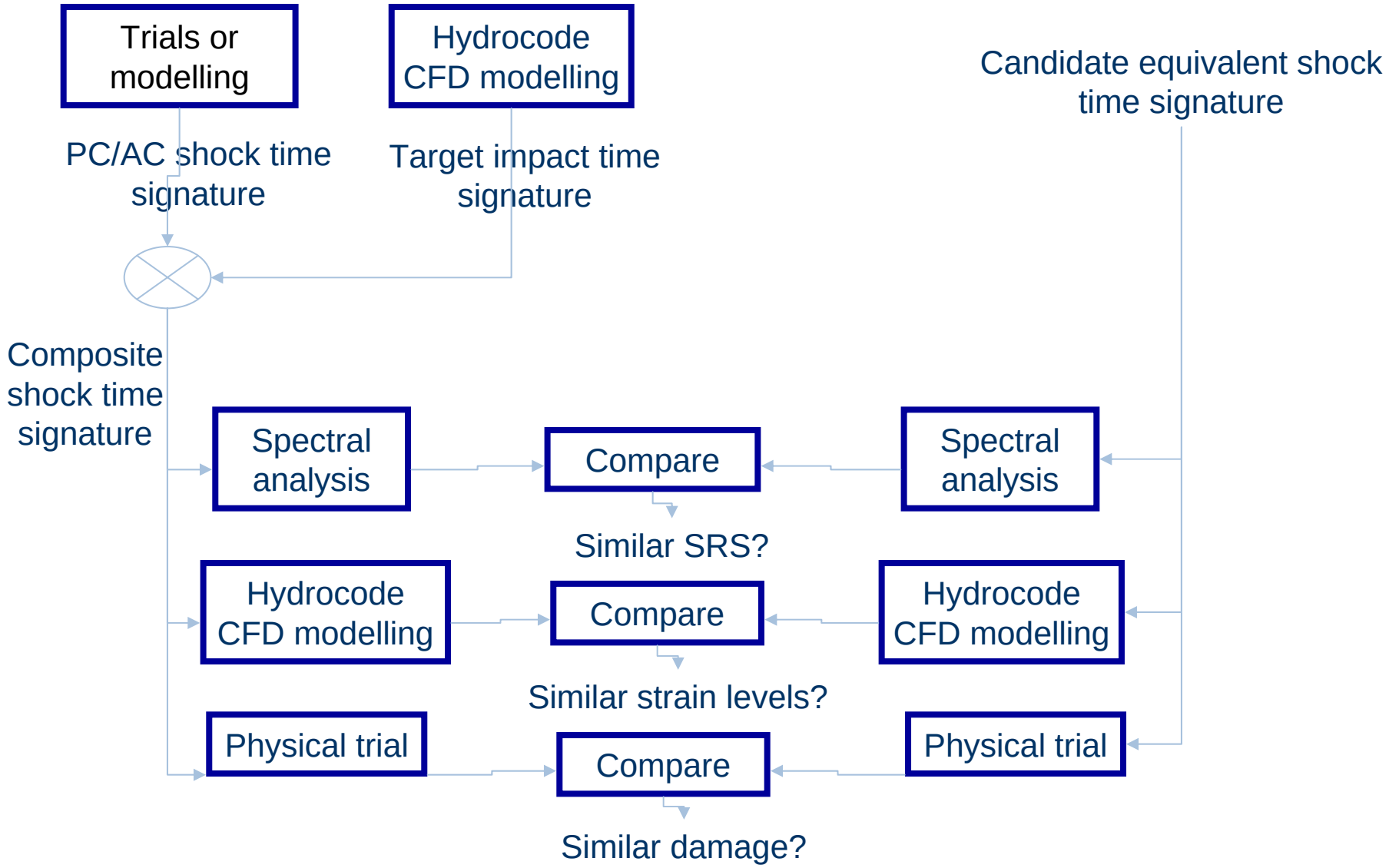
Reliability in High “g” Domain

- Hard Target Fuzing

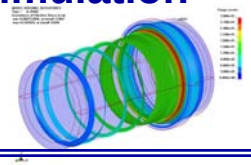
- Severe Environment for survivable electro-mechanics
- Multiple shock effects
  - High “g” levels
  - Multiple Impulses
  - Weapon Attack Angles & Angle of attack
    - **Fuze x 3 Axis – Longitudinal and Lateral**
  - Frequency range
    - **Excitation levels within fuze**
  - All over Temperature Extremes
- Real impact data difficult to collect
- Even more difficult to replicate for test



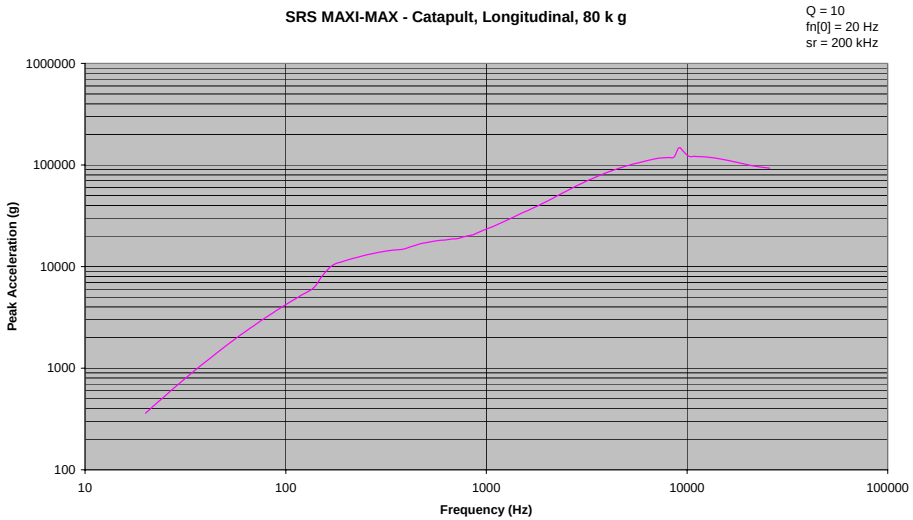
TME Shock Test Methodology



Trials / Evaluation Approach

	Computational Fluid Dynamics Simulation	Sled Trials	Catapult Trials
			
Advantages	•Inexpensive •Repeatable •Rapid	•All up round physical test •Closely replicate the tactical environment	•Inexpensive •Repeatable •Rapid •Adjustable shock environment •Temperature Extremes
Disadvantages	•Difficult to Validate •Easy to misinterpret the results	•Expensive •Non-Repeatable •Infrequent •Ambient Temp	•Requires Validation

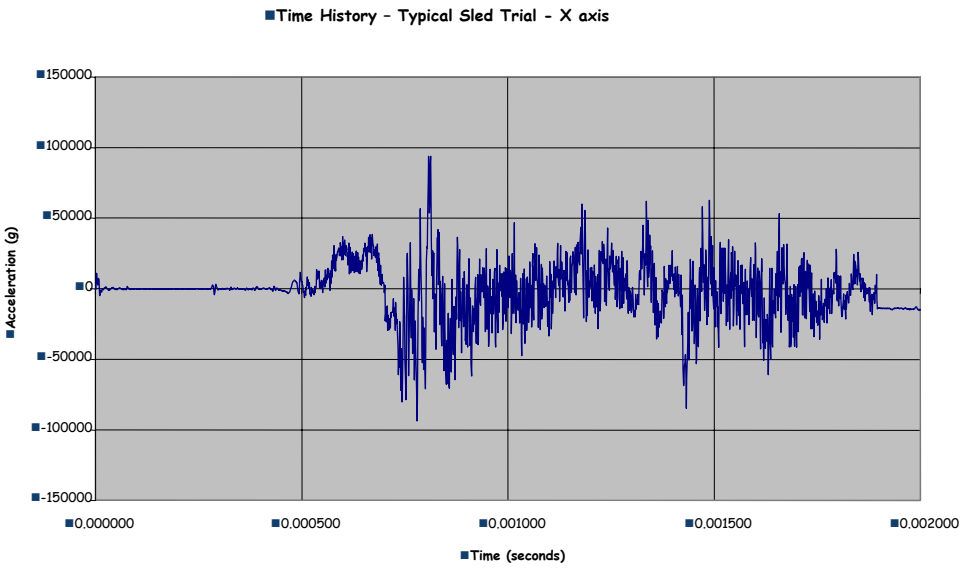
Basis for SRS Analysis and Test

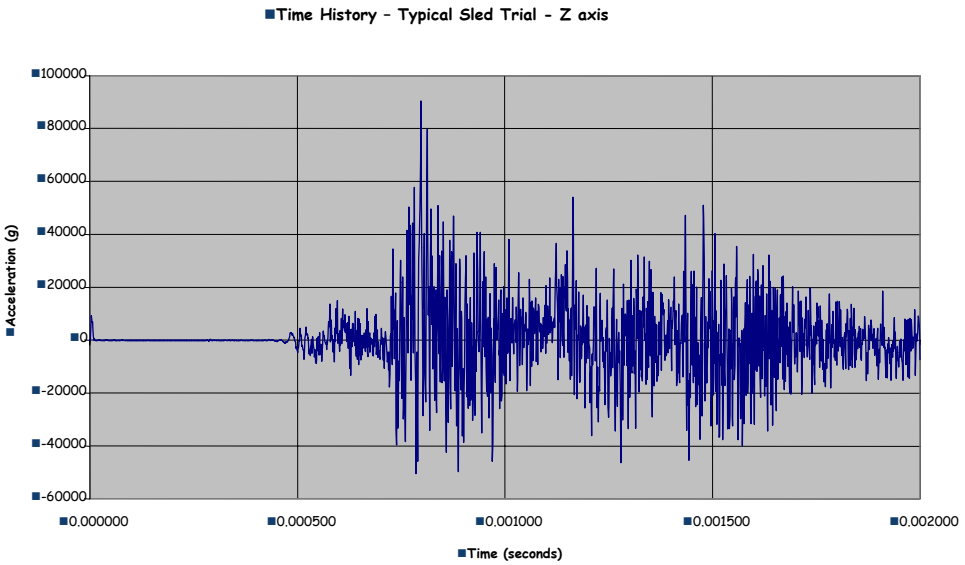


- Shock Response Spectrum

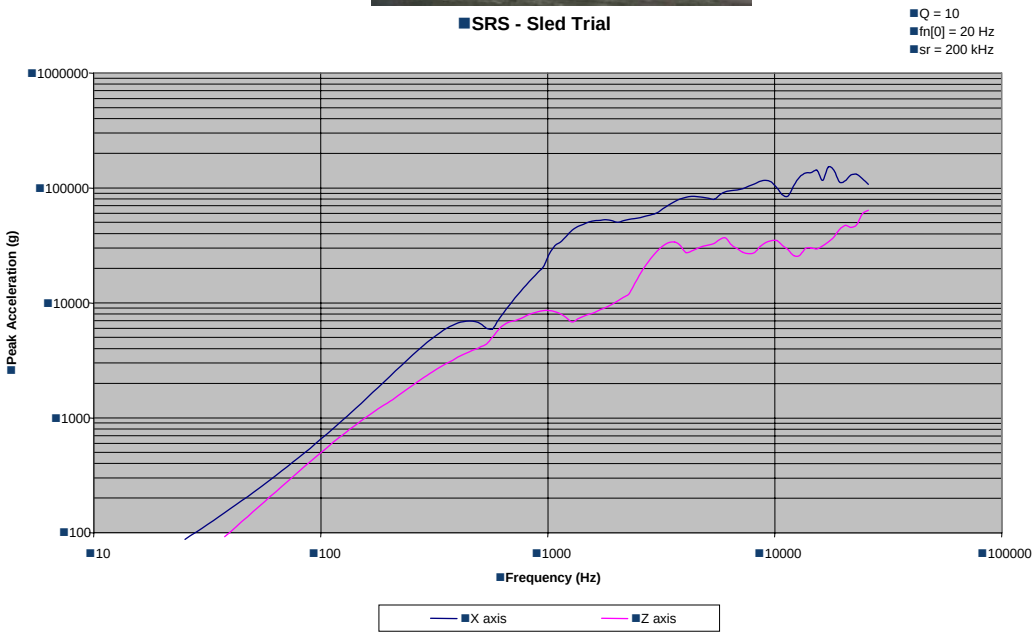
- Applicable for material transient responses with complicated waveforms
- Enables the tailoring of shock exitations from actual data for the operational environment
- Proven technique for shock simulation testing of complex waveforms
- Identified in UK (DEF STAN 00-35) and US standards (MIL-STD-810)
- Purpose of test to demonstrate the adequacy of material to resist degradation of functional / structural performance

Typical Sled Trial Signatures

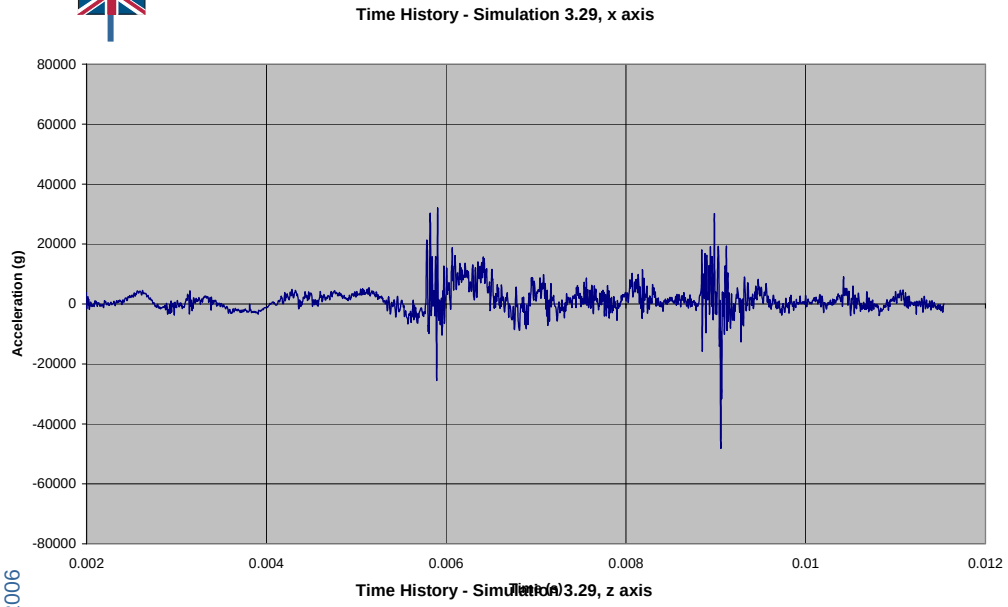


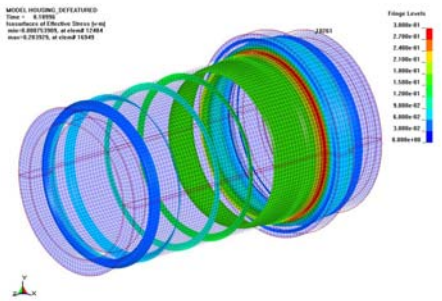


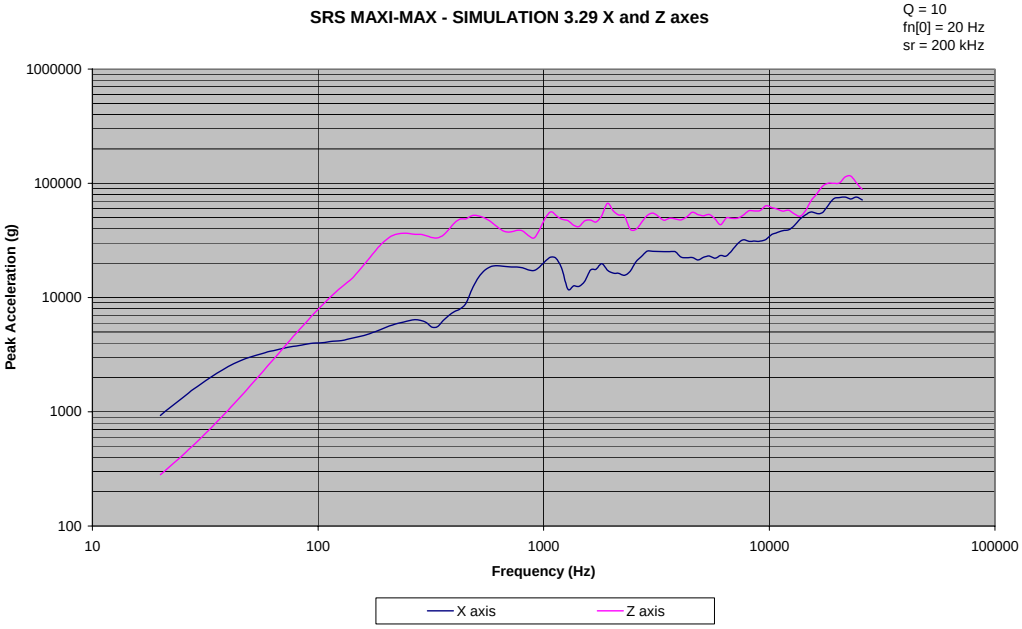
SRS - Sled Trial



Typical CFD Simulations

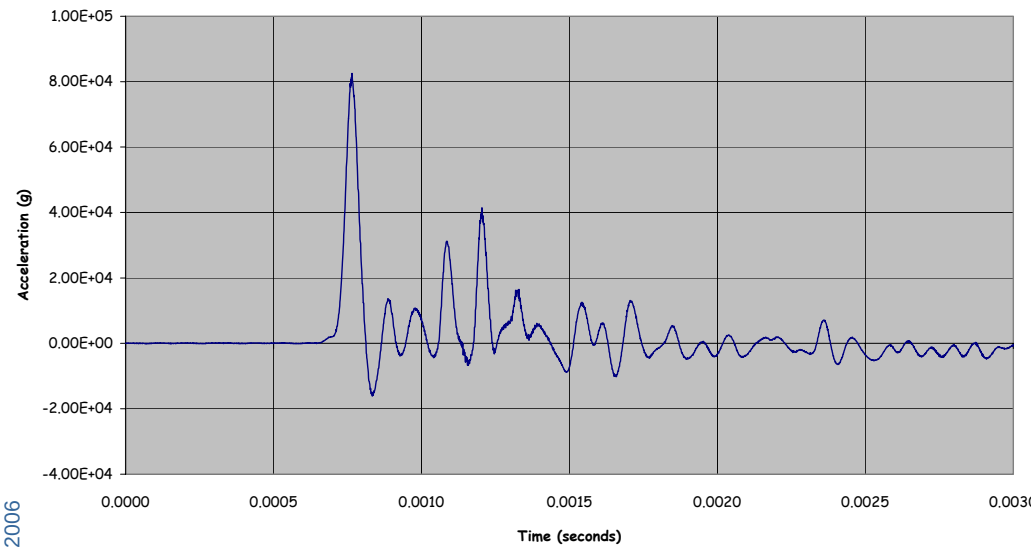


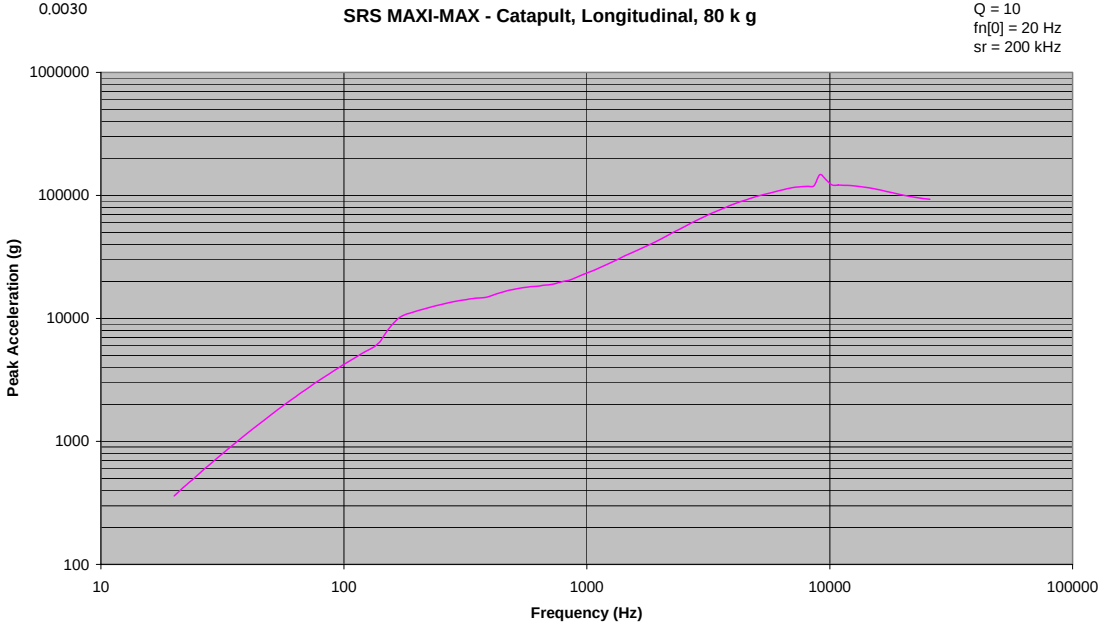




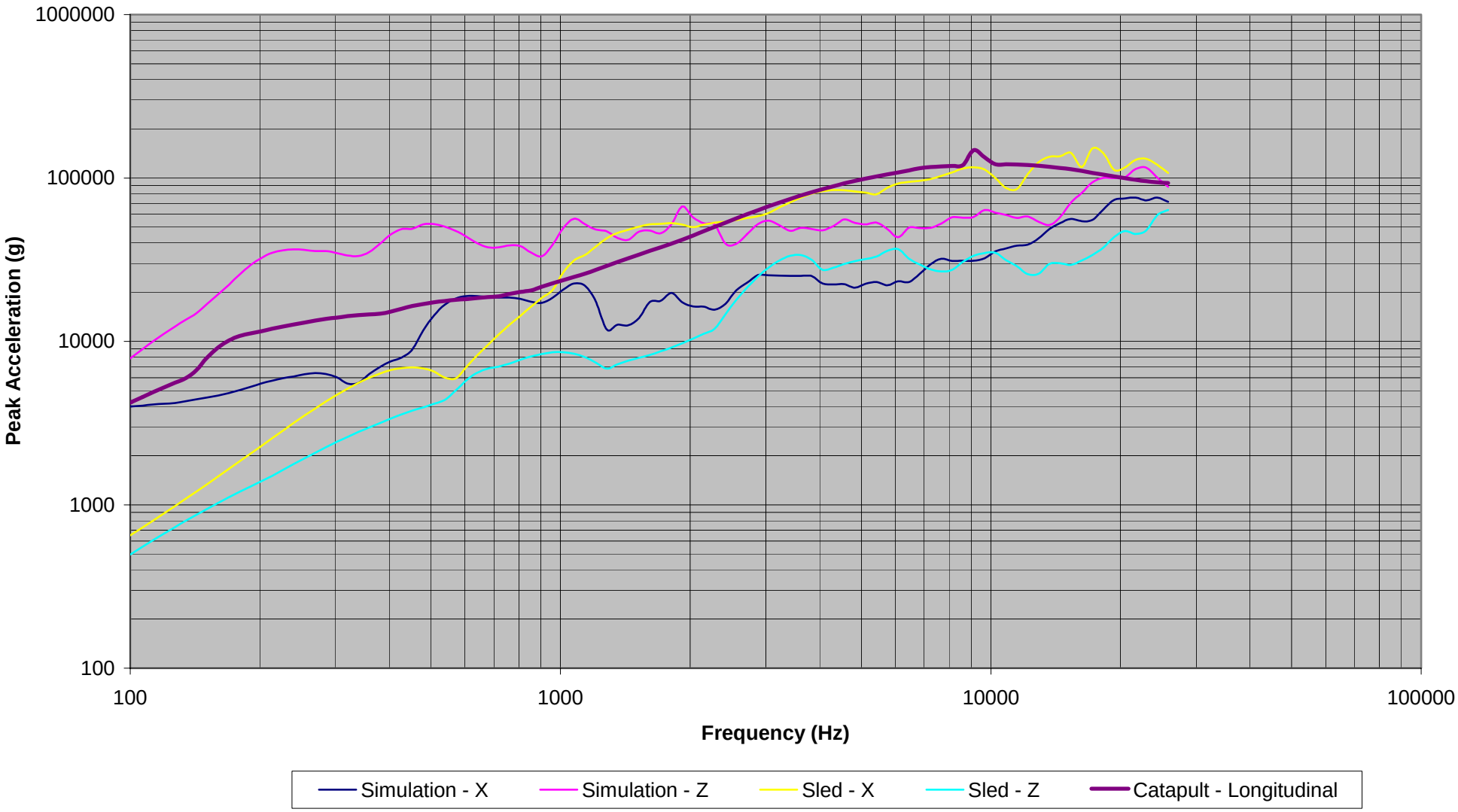
CFD Model construction can affect simulation

Typical Catapult Trials Data

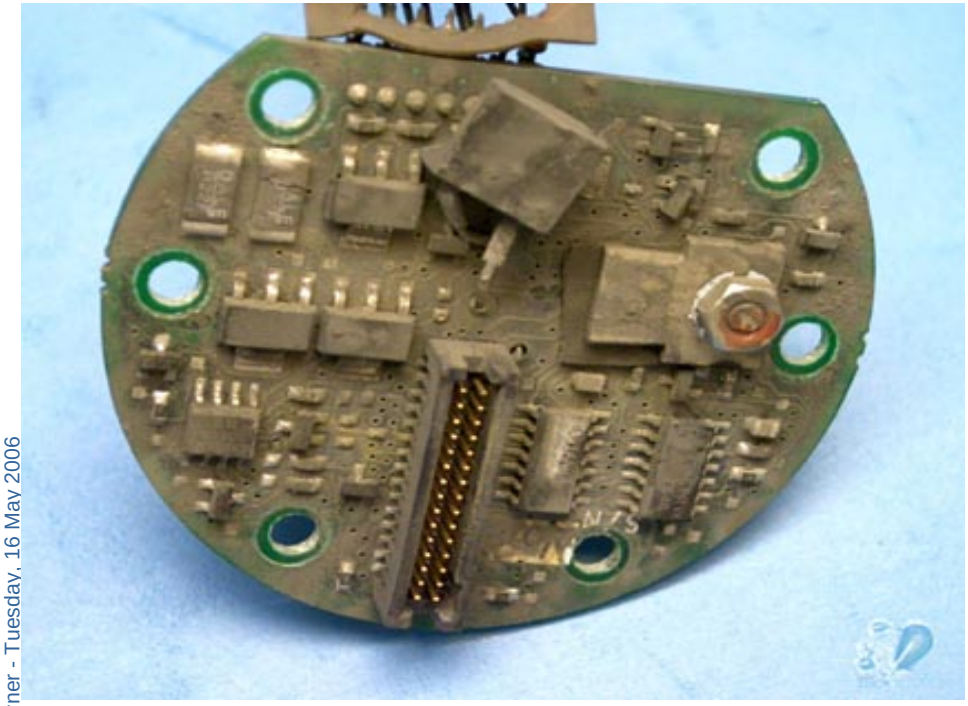


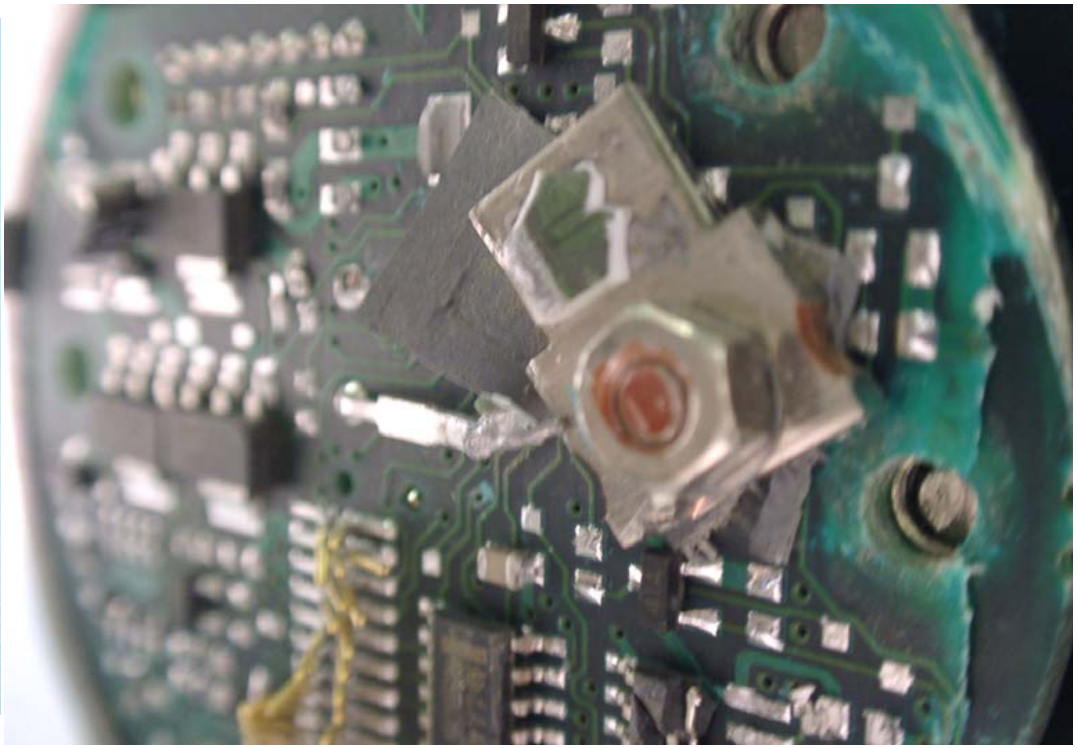


Sled / CFD / Catapult Comparison



Achieving comparable damage



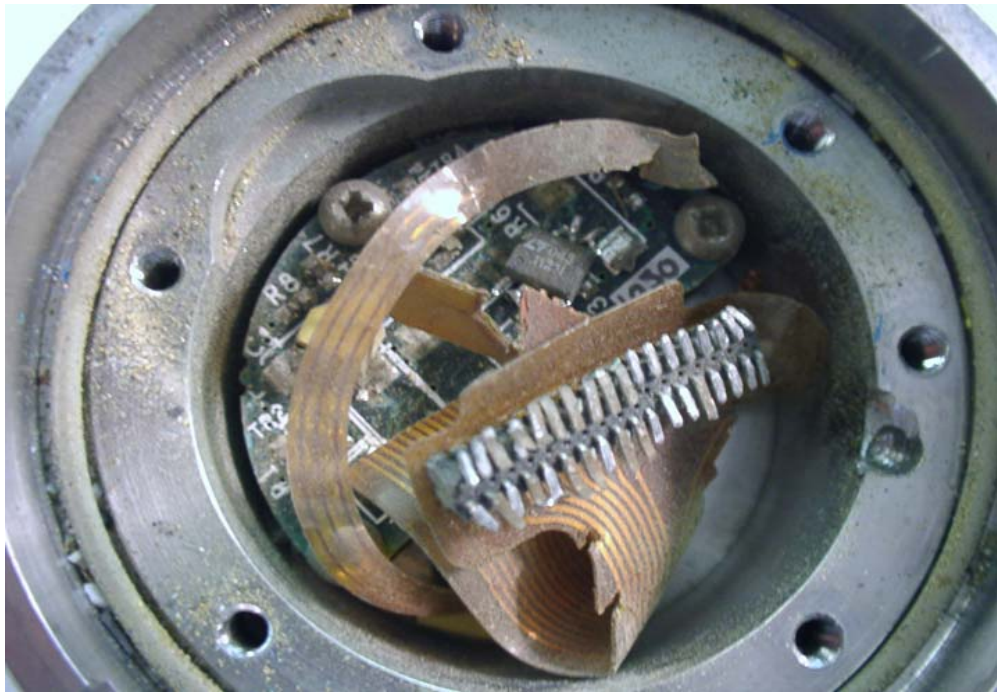


Sled Trial Damage

Catapult Test Damage

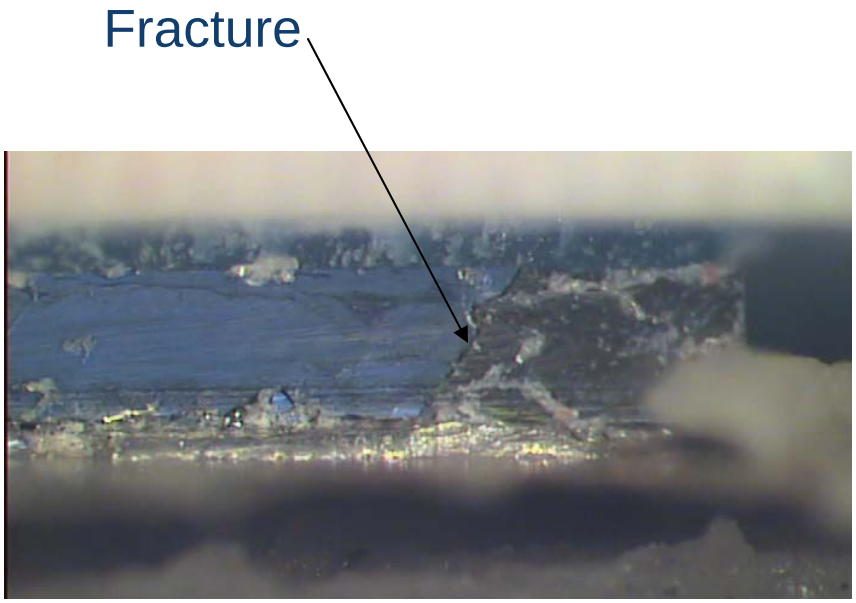
Achieving comparable damage

Sled Trial Damage



Catapult Test Damage

Damage to silicon component die



Sled Trial Damage

Catapult Test Damage

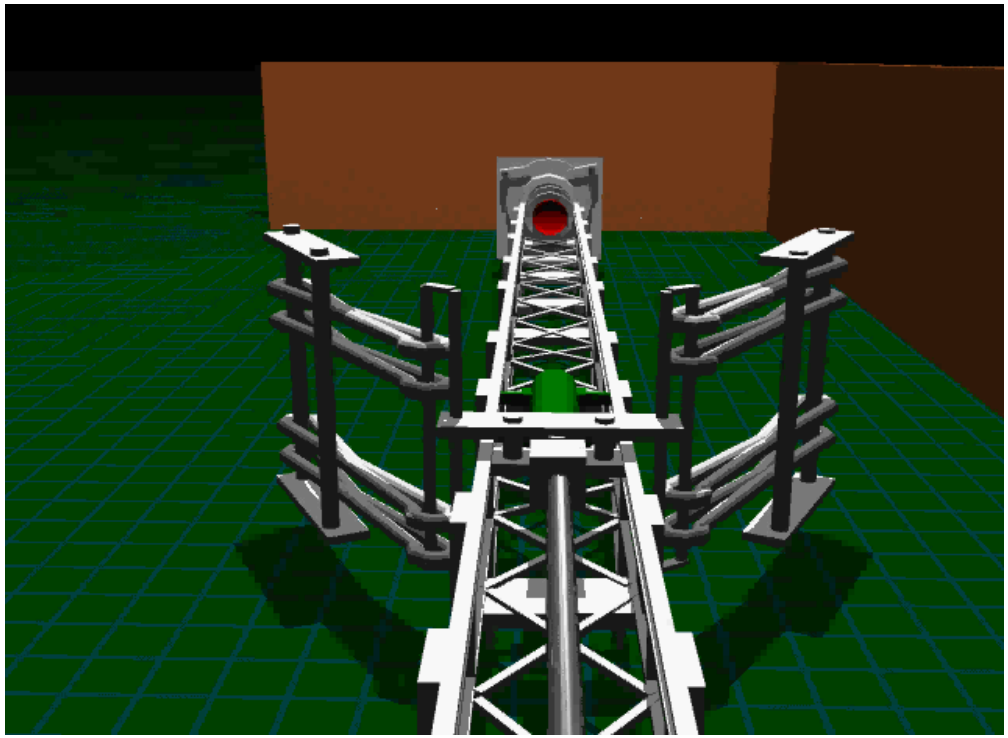
Catapult & Shock / Counter Shock Test Facilities

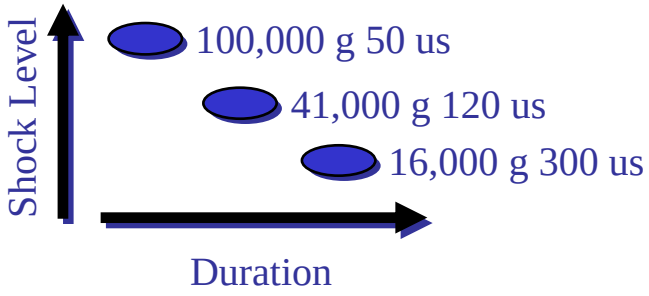
- Selected for capability to generate comparable SRS levels
- Creates ‘equivalent damage’
- Quick testing turnaround
- Multiple Test configurations
- Longitudinal
  - Predominately axial shock application – Multiple impacts
  - Variable shock parameters – “g” x Duration
  - Selectable Fuze roll orientation
  - Temperature extremes
- Lateral
  - As above plus simultaneous lateral and axial shock application – Multiple impacts

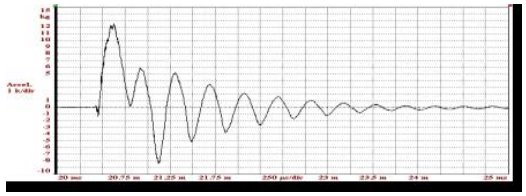
Testing for Survival and Function – Catapult

Test vehicle:

- Mass: 22 kg max
- Velocity: 50 m/s max
- Shock: 100,000 g







Typical shock signature

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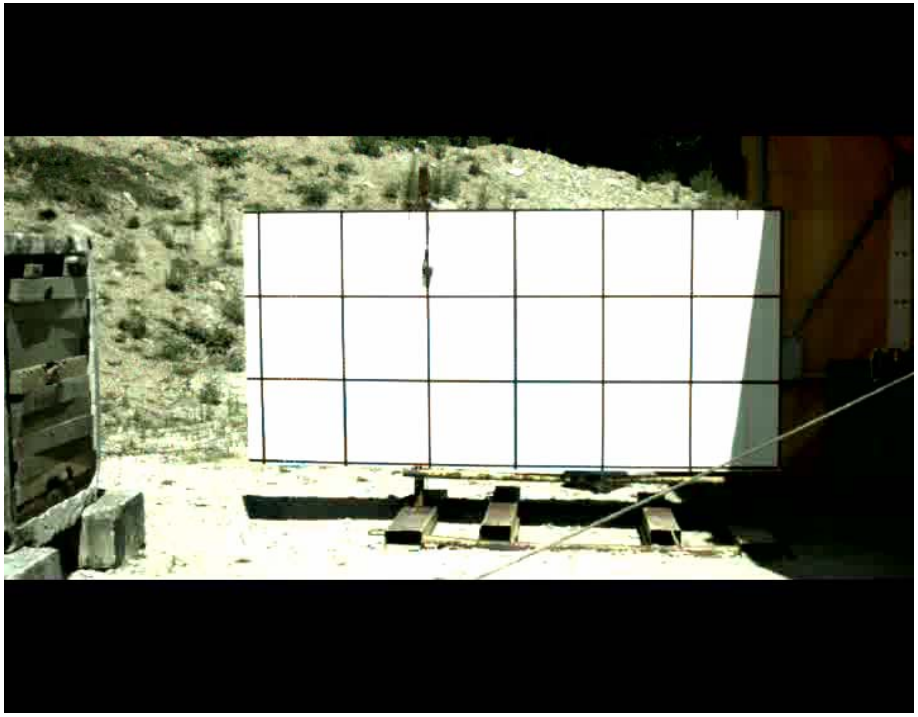
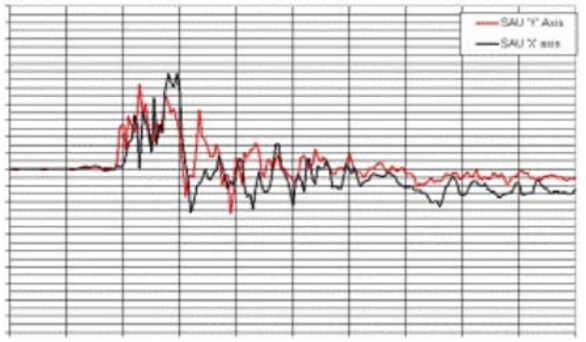
Testing for Survival and Function - Guns

- Shock counter shock (SCS) facility
  - High speed impacts
  - Multiple shocks
    - (typically +50kg for 700μs, -20kg for 600 μs)
  - High off-axis angles (Sub Modules)



Shock-Counter-Shock High Impact gun tests



Off axis test vehicle

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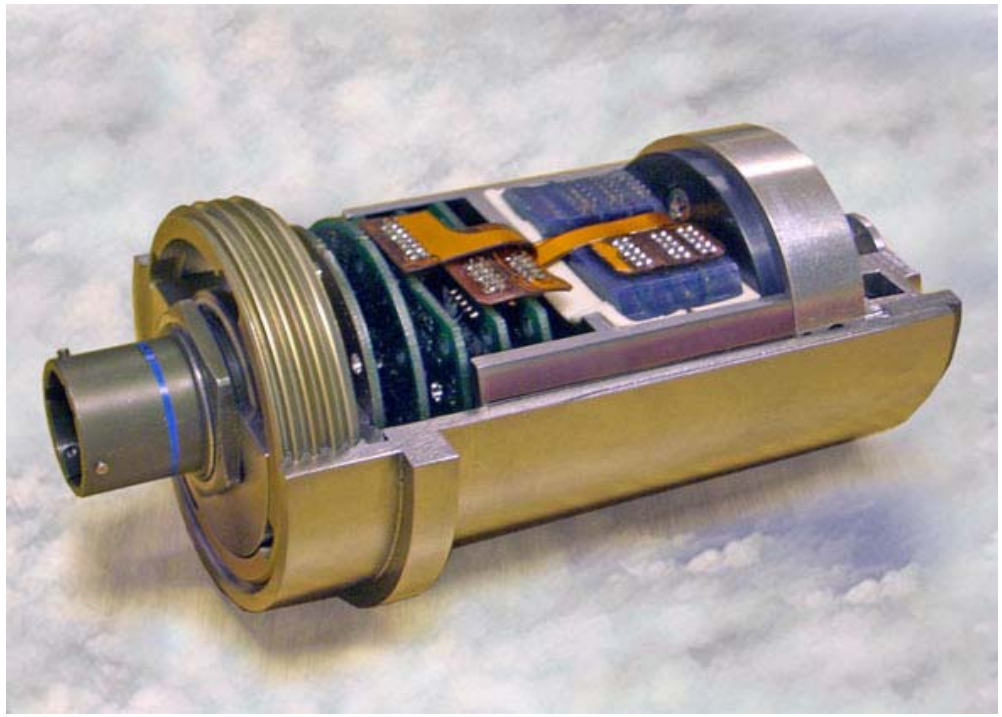
Conclusions

- MAFIS Hard Target Fuze
- Successfully tested in excess of 50 K"g"
  - Multiple effects, 3 Axis, temperature extremes etc.
  - High reliability – Missile levels
- In full scale production
- In service with RAF and USN
  - Storm Shadow & JSOW
- Growth path
  - Void & Layer insertion
  - BDI/BDA
  - In-Line Technology
  - Supersonic Applications



MAFIS Proven Hard Target Fuze

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