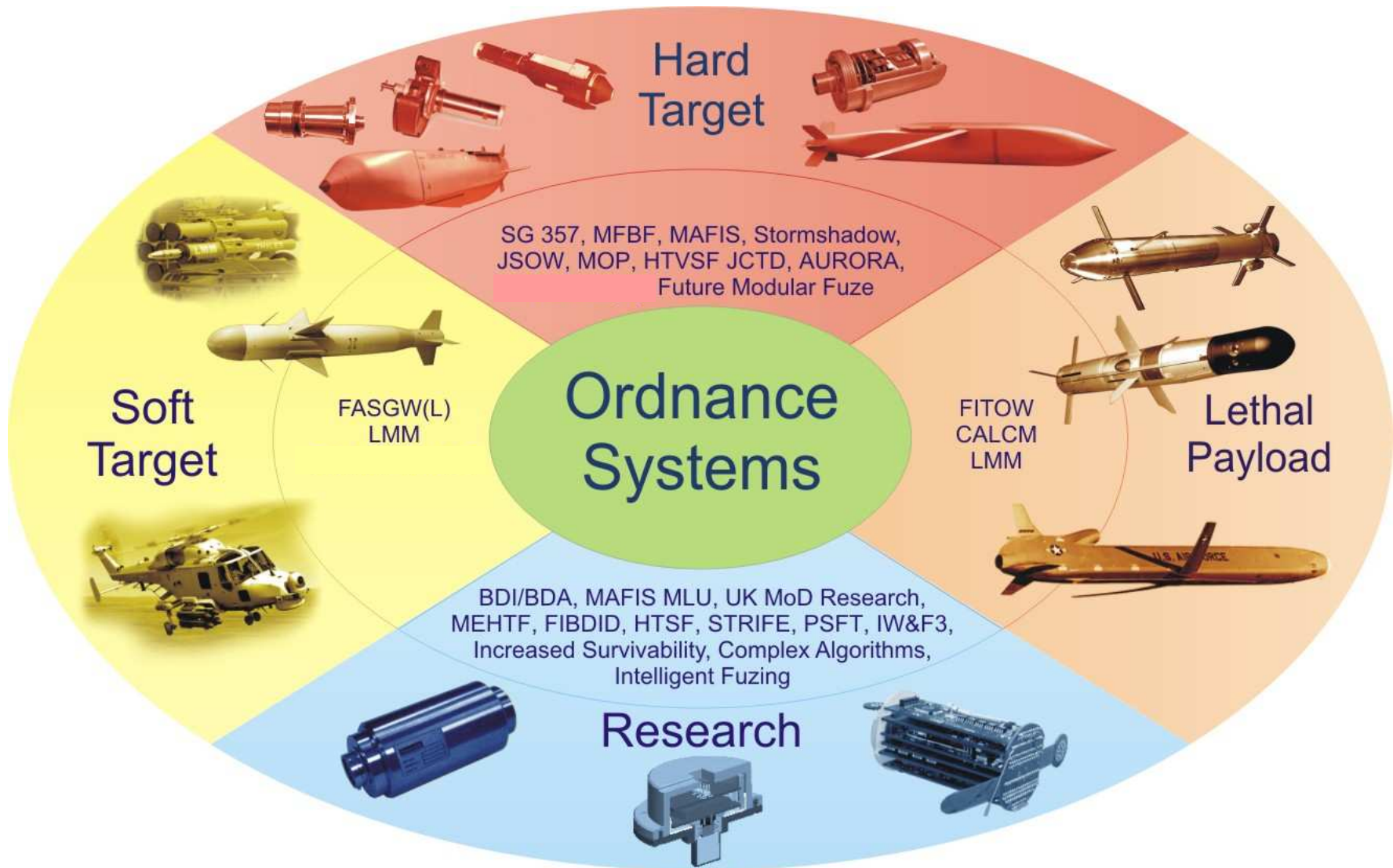




Lightweight Multi-Role Missile Integrated SAFU & Lethal Payload L.J.Turner - Thales



Reference PDM No 1015170 Issue 001

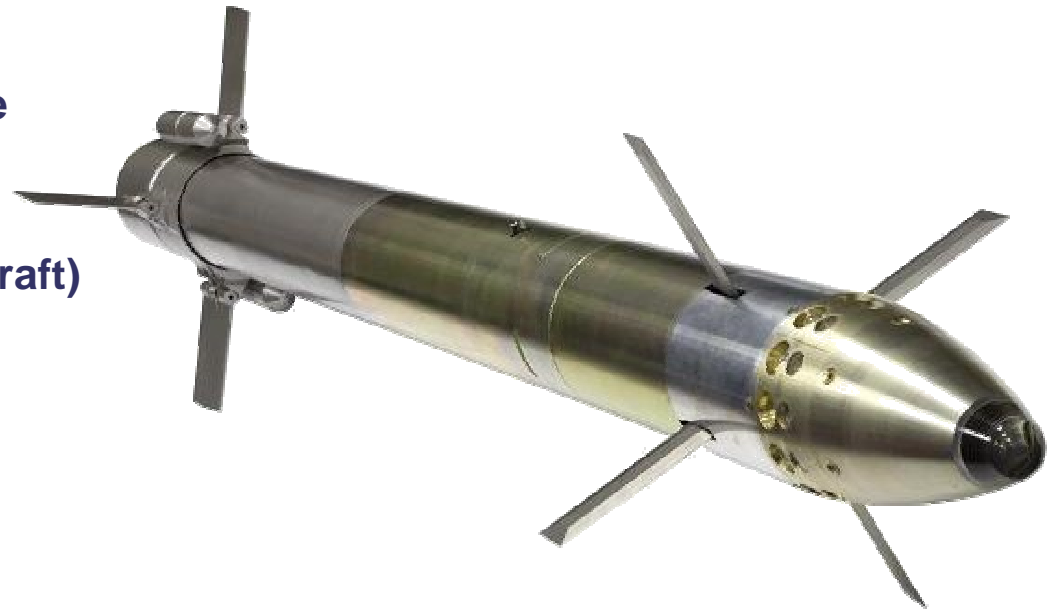
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Lightweight multi-role missile :

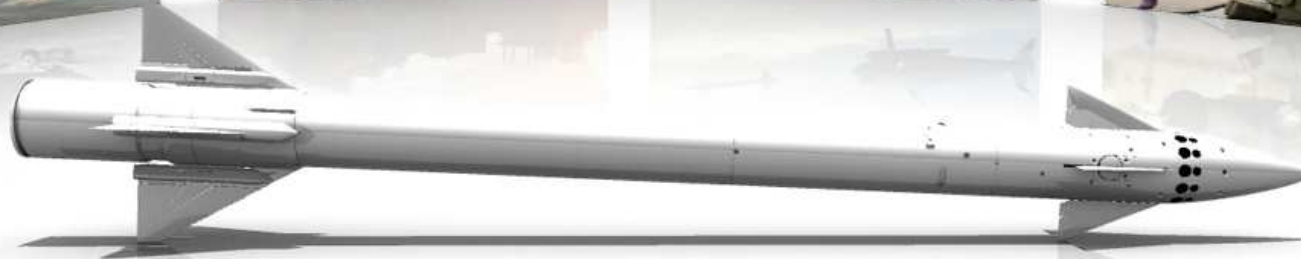
- ◆ low cost/low mass/multi-purpose
- ◆ Precision strike/light platforms.
- ◆ Defeat of Land,Sea & Air targets
- ◆ Anti-FIAC (Fast Inshore Attack Craft)

Family of weapons :

- ◆ Expansion into future variants
- ◆ Multiple Platforms
- ◆ UAV capable



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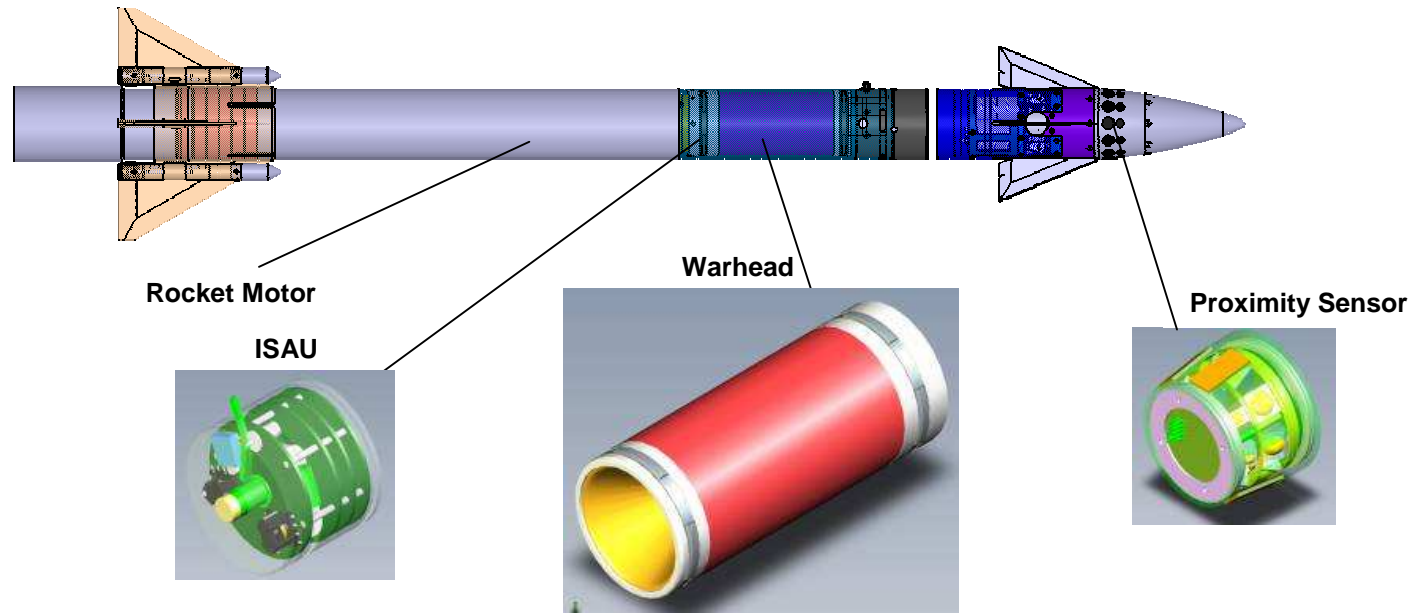


Lightweight Multi-Role Missile

- ◆ Requirement for a novel integrated SAFU
- ◆ For both warhead & second stage rocket motor

Integrate the Lethal Payload

- ◆ Warhead & SAU as a single unit
- ◆ Compact design - small space envelope
- ◆ Integrated safety & arming unit and second stage rocket motor ignition safety
- ◆ Combine the qualification - Reduce Development Time & Cost



Energetic Interface to both rocket motor & warhead

- ◆ Detonator and Through Bulkhead Igniter

Prevents unintentional arming

- ◆ Second stage Rocket Motor & Warhead

Autonomous ignition of the second stage rocket motor

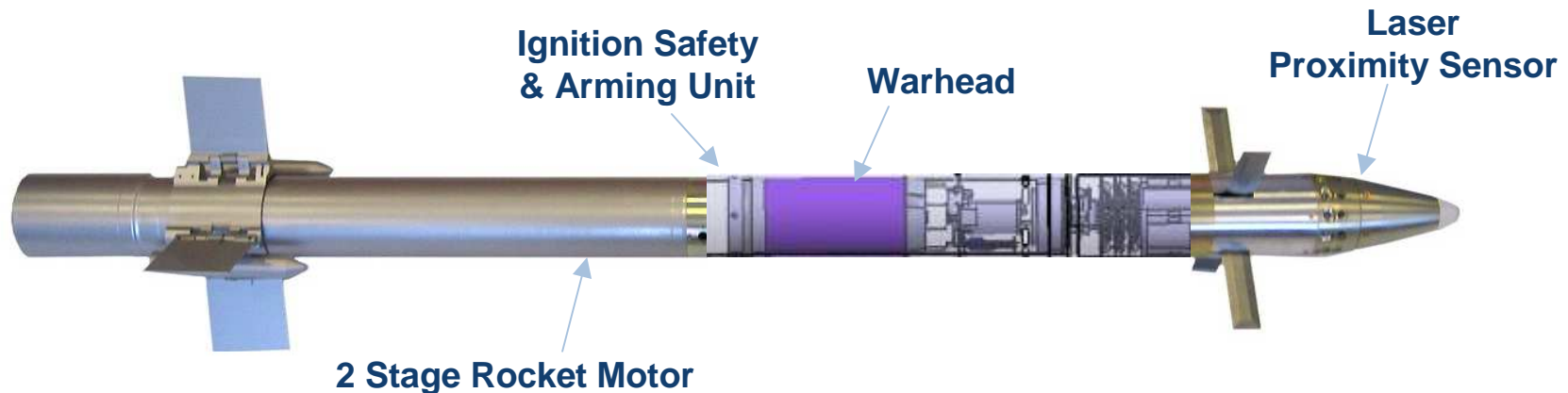
- ◆ After achieving safe distance from the launch platform

Arming the warhead

- ◆ Missile has achieved warhead safe separation

Initiate the warhead

- ◆ Receipt of the trigger



Warhead & Rocket Motor

◆ Safety and design issues

- integration of the two different safety functions within the same physical package
- Common safety environmental inputs

◆ Benefits of integrated design

- Reduction of time and cost of qualification

Different safety standards

◆ SAU – STANAG 4187 (Mil-Std-1316)

- Safety functionality should not be mixed
- Shared safety environments
 - Power
 - First Motion (IOM)
 - Bore Rider

◆ MISAU – STANAG 4368 (Mil-Std-1901A)

- Latest version closer to warhead safety standards
 - Shuttered primary energetics
 - In line firing levels greater than 500 Volts

Integration of both standards

◆ Ensure all safety requirements met



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Integrated safety sequence

- ◆ **For autonomous weapon functions**
 - Second stage rocket motor and warhead
- ◆ **Safety 1**
 - Instant of move (IOM) + Arming power
- ◆ **Safety 2**
 - First stage rocket motor
 - Borerider (Set back, spin & tube exit)
 - Two independent electronic timers

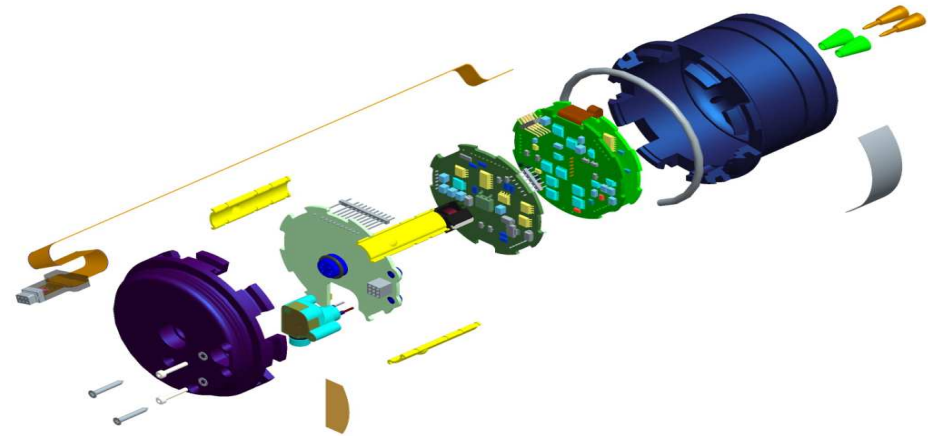
Second stage rocket motor fires

- ◆ **Safety 3**
 - Second stage rocket motor
 - Accelerometer circuit (Acceleration + Time)
 - Two independent electronic timers

Warhead armed

- ◆ **Target Detection**
 - Impact trigger
 - Proximity trigger

Warhead fires



Initial ISAU Safety Functions

- ◆ Power supply on
- ◆ ISAU monitors the Instant of Movement (IOM) and Bore Rider (BR) validation circuits
- ◆ First Stage Rocket Motor Fires
- ◆ IOM circuit detects tape break and switches power on to timer and control circuitry.
- ◆ Circuitry detects BR closure
- ◆ Timers one and two triggered from BR
- ◆ Parallel Timers one and two complete sequence

Rocket Motor Functions

- ◆ Rocket Interface Circuit power is switched on
- ◆ Rocket Static Switch 1, 2 and Rocket Dynamic signal is switched on
- ◆ Rocket interface circuit fires igniter
- ◆ Second Stage Rocket Fires

Warhead Arming Functions

- ◆ Velocity Sensing Accelerometer Circuit acquires velocity within time window
- ◆ Parallel Timers one and two complete sequence
- ◆ Warhead Static Switch 1, 2 and Warhead Dynamic signal is switched on
- ◆ Warhead Charging Circuit power is switched on.
- ◆ HV Capacitor starts charging
- ◆ ISAU transits to Armed
- ◆ Trigger pulse initiates detonation

Independent parallel timers for the Rocket Firing circuit

- ◆ Different technology
- ◆ Triggered by Environmental inputs (IOM & BR)

Independent parallel timers for the Warhead Arming circuit

- ◆ Different technology
- ◆ Triggered by Environmental inputs (IOM & BR)

Physical implementation

- ◆ **Rocket Motor timers**
 - Physically separated
 - Implemented on separate boards
- ◆ **Warhead Arming timers**
 - Physically separated
 - Implemented on separate boards

Rocket Motor Inhibit function

- ◆ Prevent second stage rocket motor firing if Timer not elapsed.

Impact Detection function

- ◆ Prevents second stage rocket ignition if an impact is detected (e.g. the ground)

Min safe second stage rocket ignition distance

- ◆ Rocket Timers not to expire before minimum Safe Distance when the missile is travelling at lowest velocity.

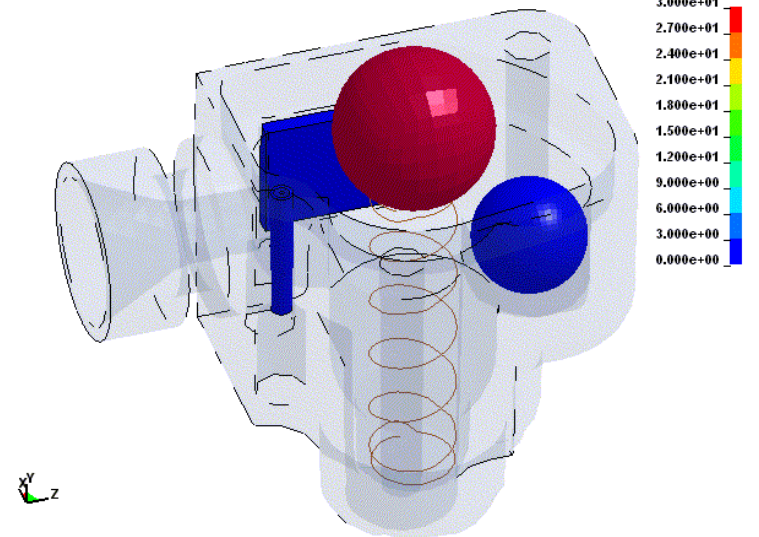
Minimum safe arming distance

- ◆ Warhead Arming Timers, not to expire before missile has travelled beyond safe separation threshold
- ◆ Environment 3 - Missile Velocity verification from second stage rocket motor prior to expiry of Warhead Arming Timer.
- ◆ If the Velocity verification occurs after the timer expires then the Arming process shall be inhibited.

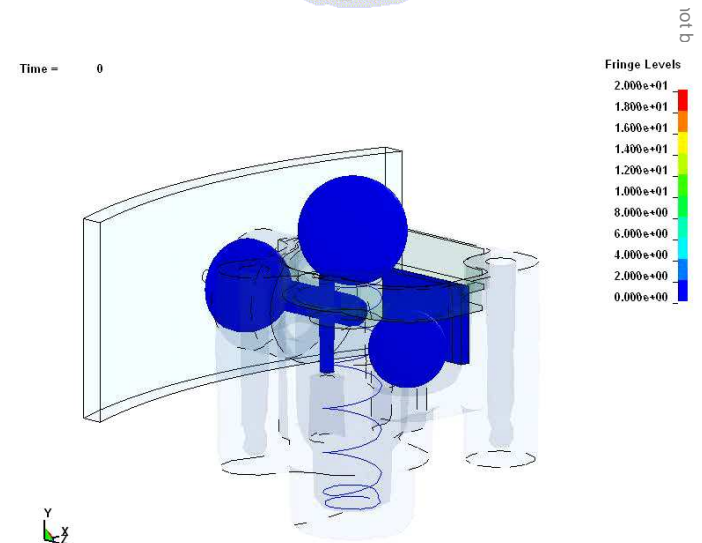
B Model Bore Rider Assembly

- ◆ **Designed to meet STANAG 4187**
 - No stored energy tending to arm
- ◆ **Designed to use 3 available environments**
 - Launch Shock
 - Roll rate
 - Tail pick-up - Cover plate removal
- ◆ **Mechanical latch**
 - Ensures contact if spin rate drops below threshold
- ◆ **LS Dyna modelling**
- ◆ **Catapult testing performed**

Reference PDM No 1015170 Issue 001

LBR08a - latch2a with cold -3sigma
Time = 0Y
Z

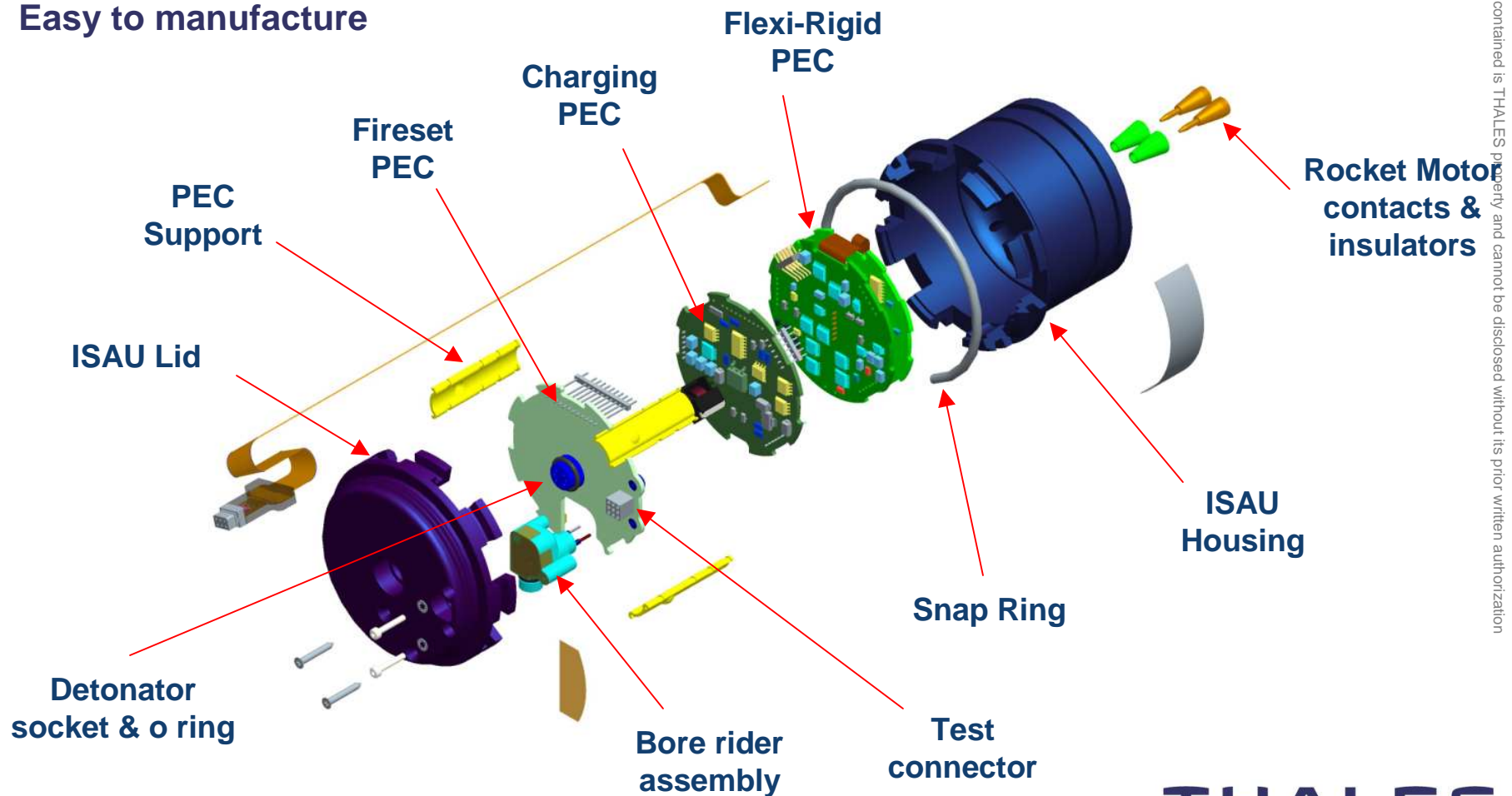
Time = 0

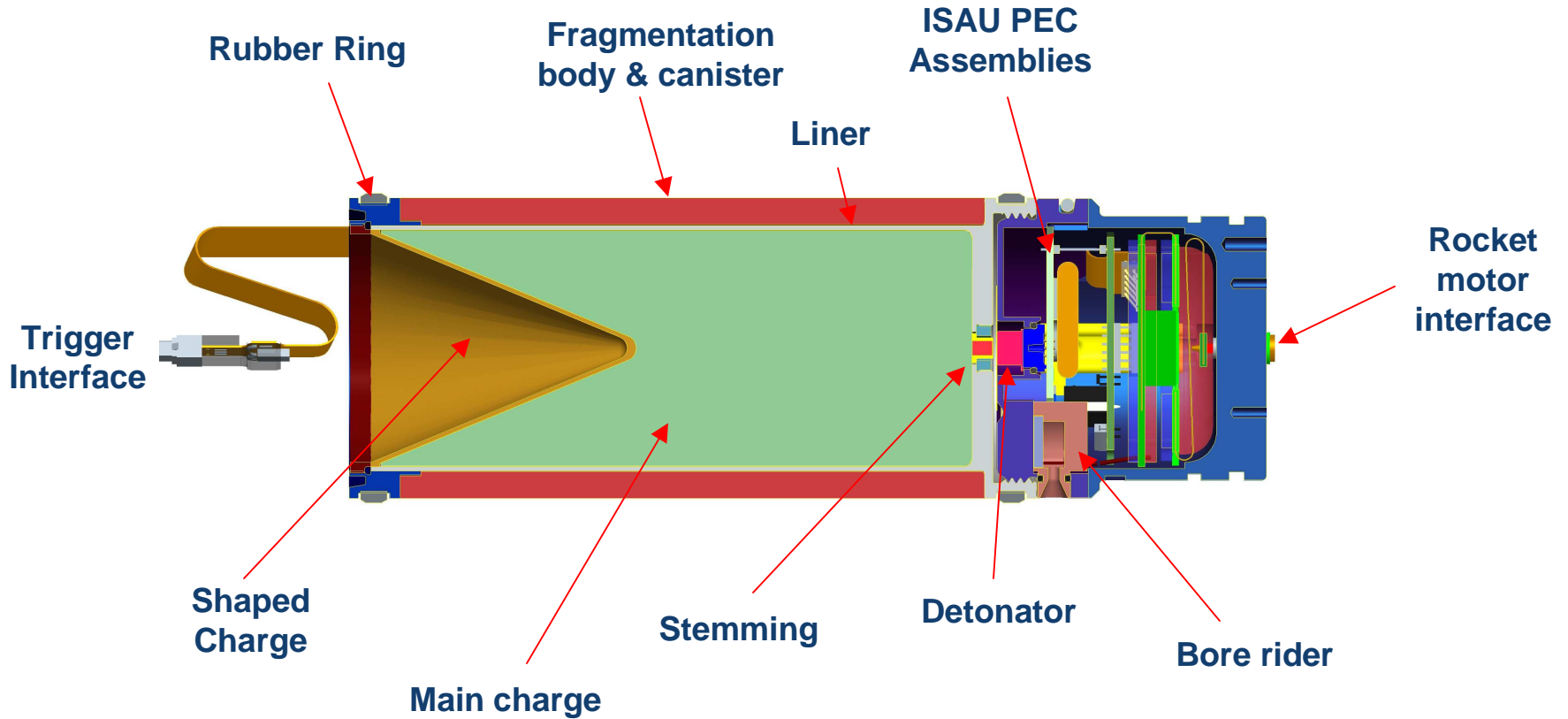
Y
Z

Low risk & low cost design development

Pull through from current product and research activities

- ◆ Integrated in single assembly
- ◆ Simplified “snap together” construction
- ◆ Easy to manufacture



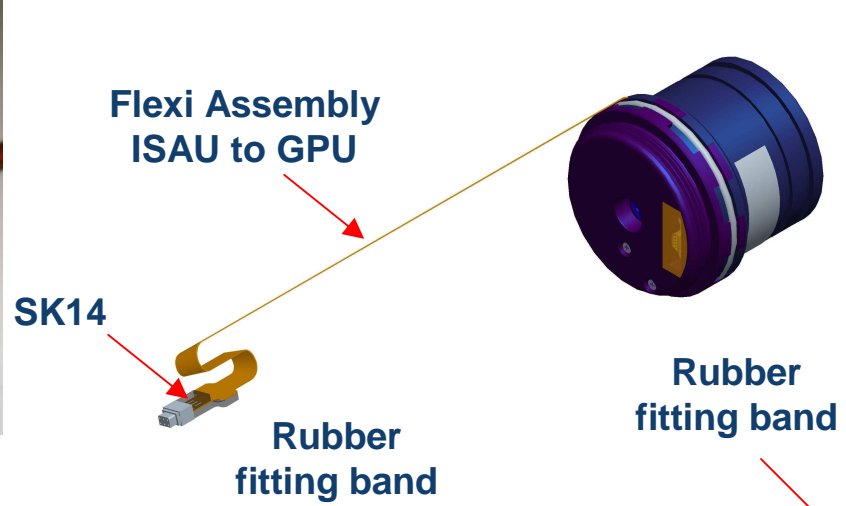


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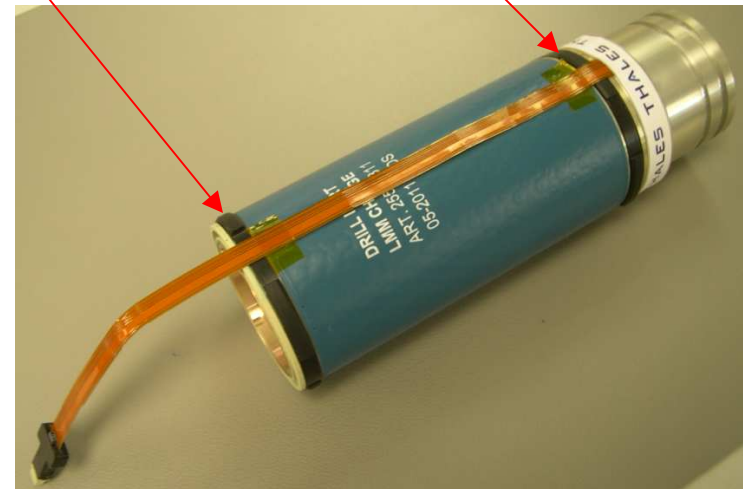
ISAU



Ignition Safety & Arming Unit



Warhead



Lethal Payload

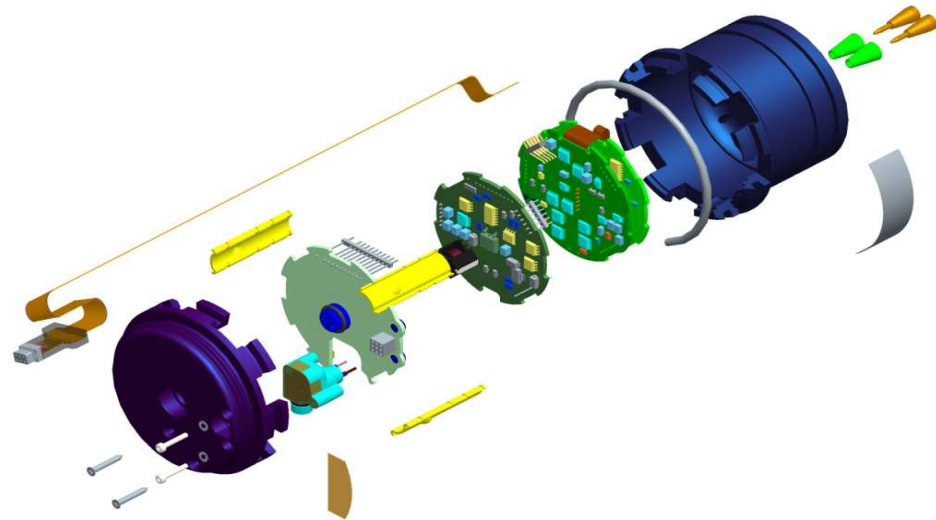
Reference PDM No 1015170 Issue 001

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Safety

- ◆ **Compliance to STANAG 4187 & 4368**

- ◆ **Mixed functionality and safety environments**
 - Work with the national safety board to address early
 - Good partitioning of functionality
 - Ignition circuits separated from Initiation circuit
 - Design now provisionally accepted by UK DOSG



One Stop Shop for Fuzing Systems

Advantages

- ◆ **Single integrated unit**
 - Simplified ESAU design for both warhead & rocket motor ignition
 - Reduced volume, easier to integrate/mount in weapon
 - Reduced complexity – greater reliability
 - Shared safety 1
 - Shared safety 2
 - Shared power supply
- ◆ **Single integrated development & qualification programme**
 - Reduced cost of management and common activities
 - Single qualification programme
- ◆ **Integrated lethal Payload**
 - Integrated approach of warhead and ISAU
 - Common qualification activities



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One Stop Shop for Fuzing Systems

Further integration of the lethal package

◆ Lethal Package defined as Warhead/SAU/MISAU

- Similar to Hard Target Fuze
- Onboard sensor and trigger processing
 - Accelerometer, Processing and intelligent algorithms for Hard Target Fuze
 - Laser or RF detection with processing and algorithms for Prox Fuze

Integration of Safety Standards

◆ STANAGS 4187 (Mil-Std-1316) & 4368 (Mil-Std-1901A)

- Create a single common standard for weapon energetics safety



The Future for Lethal Ordnance Systems

Reference PDM No 1015170 Issue 001



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