

## MBDA – Multi-National Missile Programmes

IMEMG European IM Day  
18-19 May 2017

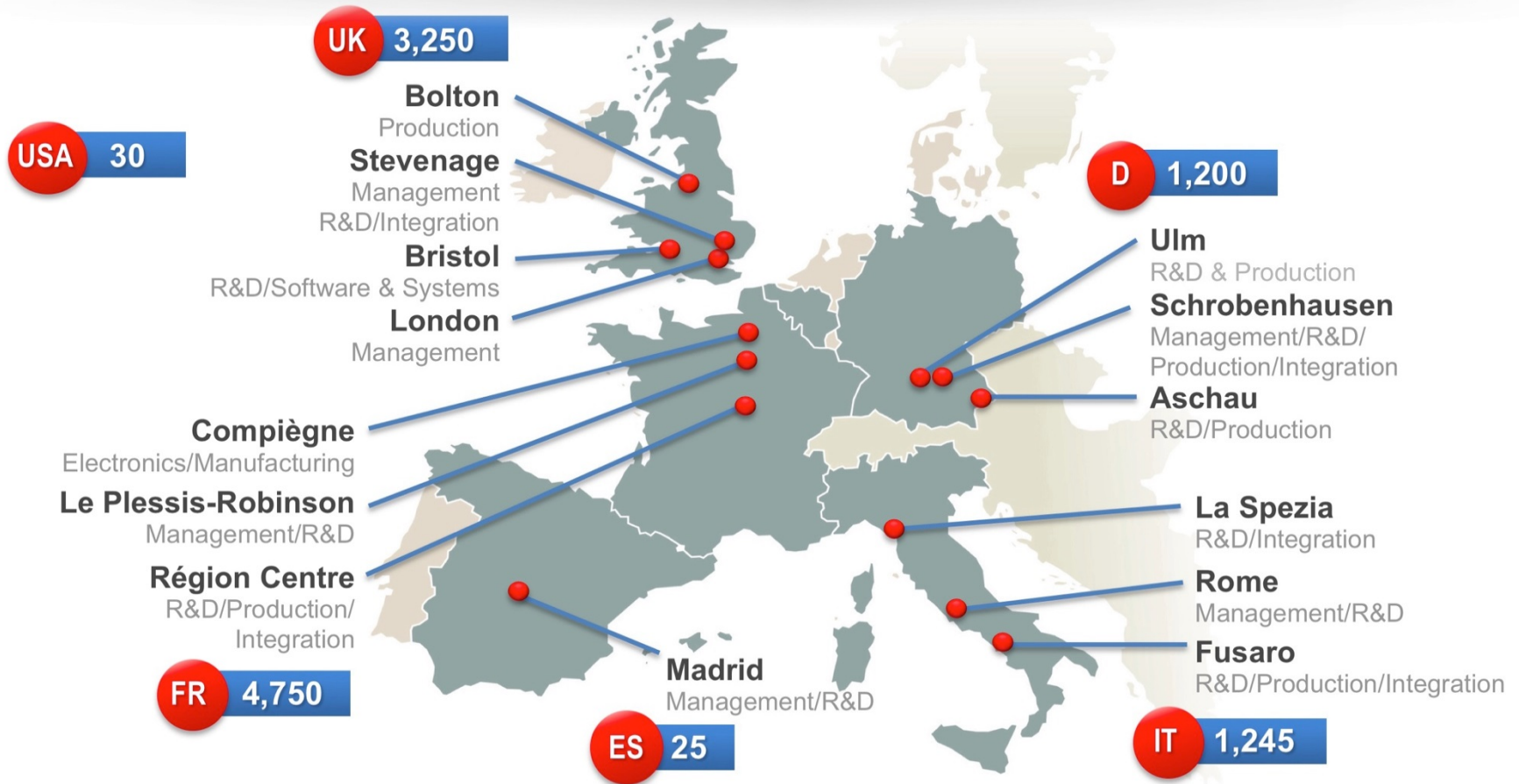
David Crofts  
Head of Complex Warheads  
Centre of Excellence

**MBDA**  
MISSILE SYSTEMS

- **MBDA formed from a consolidation of European missile companies in Fr, UK & Italy, Germany, with Spain more recently joined.**
- **Fully integrated European defence group with a single management and operating structure**
  - Which spreads a coherent strategy into the 5 nations
  - But also has privileged national access, by sustaining capabilities, security of supply, and through life management.
  - Significant focus on exports, limits costs to the national MoDs
- **Extensive experience of delivering international programmes including**
  - Meteor, Storm Shadow/SCALP, Aster, Sea Venom, Taurus

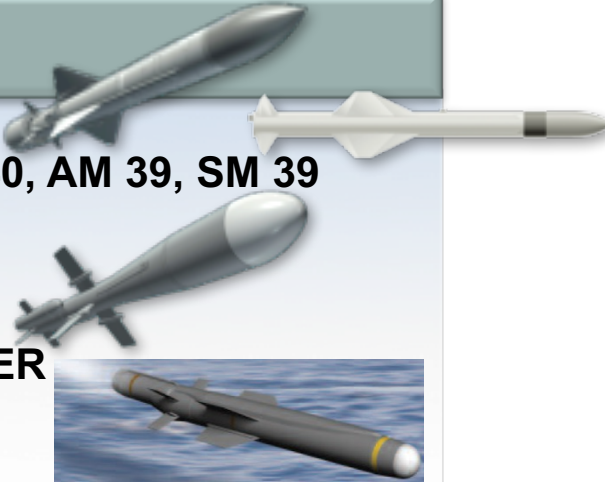


More than 10,000 people worldwide, 60% in Technical/Engineering functions



## Anti-Ship

- Exocet MM40, AM 39, SM 39
- Teseo Mk2
- Marte Mk 2,
- Marte Mk 2 ER
- Sea Venom



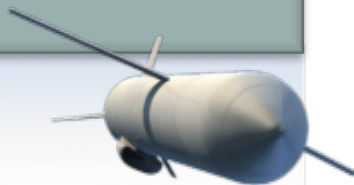
## Naval Air Defence

- Aster 15 & 30 PAAMS
- VL MICA
- Mistral
- Sea Ceptor



## Deep Strike

- MdCN



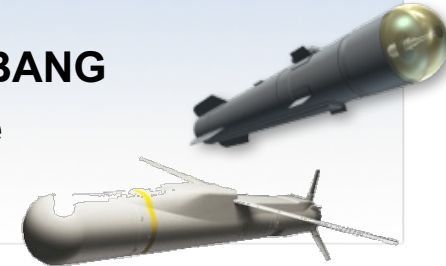
## Deep Strike

- Storm Shadow / SCALP
- Taurus
- ASMPA



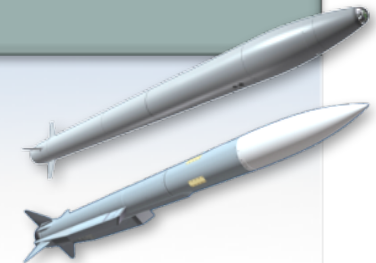
## Air-to-Ground

- CBEMS / BANG
- Brimstone
- SPEAR 3



## Air-to-Air

- ASRAAM
- MICA
- Meteor





### Medium Range Area Defence / ATBM

- Aster 30 (SAMP/T)
- MEADS

### Short Range



- Spada/Aspide 2000
- VL MICA
- EMADS

### Battlefield Engagement

- Eryx
- MILAN
- MILAN ER
- MMP

### Air-launched combat support

- Brimstone
- PARS 3 LR



### Very Short Range

- MANPADS
- Mistral



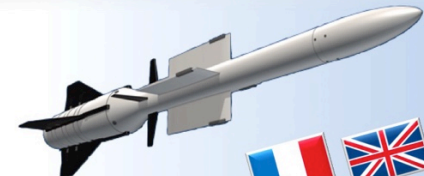
## Promoting International Co-operations



**STORM SHADOW / SCALP**



**METEOR**



**ASTER Family**



**TAURUS KEPD 350**

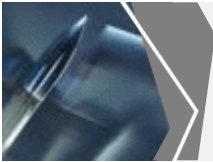


**SEA VENOM / ANL**



**MEADS**





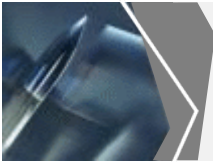
## MBDA Missiles IM Solutions



- MBDA's Missile systems must operate reliably throughout their lifecycle.
- Safety need to prevent unintended explosive response of missiles for the safety of our Armed Service Personnel.
- Examples which contain effective design measures to protect against unintended initiation are ....
  - Storm Shadow
  - ASRAAM
  - Meteor
  - Brimstone

Long range cruise missile  
Short range air-air  
Beyond visual range air-air  
Smart anti-armour





- **Simplistically!**
  - IM Hazards = **Impacts** or **Heating**
  - Response dominated by
    - I. Insensitiveness of explosive
    - II. degree of containment
  - If the aggression destroys the containment, the response of an insensitive explosive will be **“no more severe than burning”**
  
- **But**
  - Our air-launched missiles live in a severe environment
    - long air carriage life
    - Resistant to heat (and cold), vibration, shocks, and flight loads.
    - Target penetration.
  - Need for robustness often conflicts with good IM performance.
  
  - Missiles have very different requirements, so design for IM needs to be very specific.

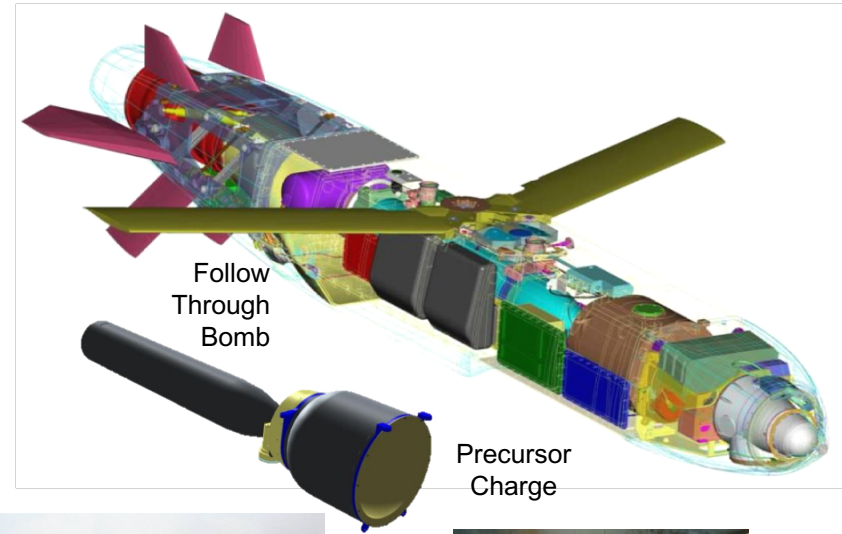


# Case Study

## BROACH in Storm Shadow SCALP

### DESIGN FEATURES

|                                  |  |
|----------------------------------|--|
| High Strength Steel Casing       | Fragmentation & penetration performance. Protection of charge. |
| Polymer Bonded Explosives        | No DDT, low explosiveness, shock insensitivity.                |
| Insensitive Boosters             | Thermal stability, shock insensitivity.                        |
| Polymeric Lining                 | Thermal and mechanical insulation.                             |
| Vent ports (FTB)                 | Gas vent path from decomposing PBX.                            |
| Thermal Igniter (FTB)            | Controlled ignition point.                                     |
| Frangible aluminium closure (PC) | Pressure relief of decomposing PBX.                            |



### IM ASSESSMENT

|                      |         |                         |
|----------------------|---------|-------------------------|
| Fast Heating         | Type V  | Missile test            |
| Slow Heating         | Type V  | PC / FTB test           |
| Bullet Impact        | Type V  | PC / FTB test           |
| Fragment impact      | Type V  | Assessment / readacross |
| Sympathetic Reaction | Type IV | Container test          |

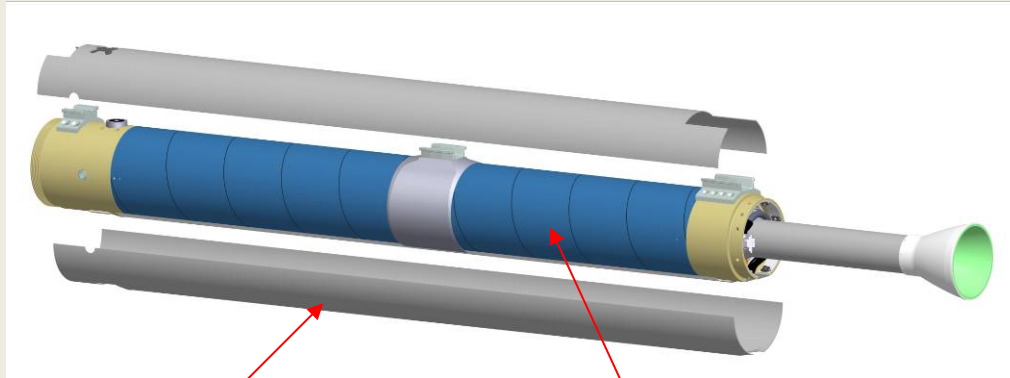


## Case study – Rocket Motors Fast Cook Off

- ASRAAM and Meteor are both very high performance systems
  - Fierce aero-heating owing to high Mach No.
  - ASRAAM > 1000°C for a few tens of seconds
  - Meteor > 500°C for a few minutes
- To achieve a good response to Fast Heating (FCO)
  - The case of the motor must degrade before propellant cook-off
  - The boost charges are composites and will react at >200°C
- Our Rocket Motor suppliers were faced with very difficult design requirements
  - ASRAAM– Roxel, Summerfield
  - Meteor– Bayern Chemie, Aschau



# ASRAAM Motor Roxel



Aeroheat protection

SSL Structure

Features:

- SSL metallic composite case
- Aeroheat layer to provide protection of SSL in Free Flight

Motor under test

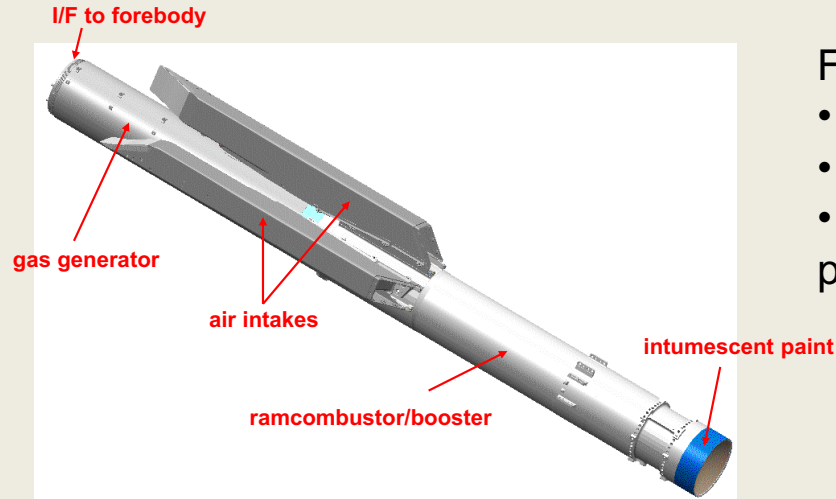


Debris post trial



Response to fast heating

- Motor immersed in flame at  $\sim 900^{\circ}\text{C}$
- After about 1 minute case weakens and confinement destroyed
- Propellant ignites and burns out



## Features:

- High strength steel case
- Thick internal heat shield
- Intumescent paint strategically placed



Initial reaction

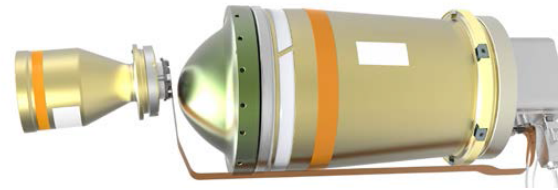


Later stage of reaction

- ## Response to fast heating (FCO test)
- Motor immersed in flame at  $\sim 900^{\circ}\text{C}$
  - Case weakens after  $\sim 1-2$  minutes
  - Propellant ignites, mild pressure burst
  - Propellant burns out mildly

## TDW IM Warhead

## Roxel IM Rocket Motor



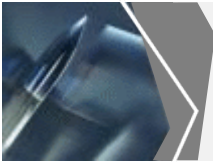
- Tandem warhead with KS33 HMX based PBX main charge
- Vulcan rocket motor with elastomer modified cast double base propellant
- IM mitigation features and low explosiveness compositions enabled:-
  - State of the art IM characteristics
  - Cost savings for manufacture, storage and transport
  - Improved flexibility for operational usage



*Type V Burning Response in BI Trial*



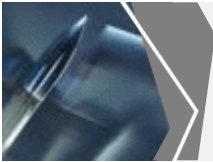
*Type IV Response in FI Trial*



## Conclusions



- IM is a key requirement for missile systems
- MBDA works closely with major international sub-contractors & subsidiaries to develop technologies to provide effective solutions.
  - e.g. Roxel, Bayern Chemie, TDW, BAE Systems, Eurenco, Chemring, Thales & Saab Bofors
- Integrating IM solutions without degrading missile performance is a complex (and expensive) activity
  - This trade will always represent a serious challenge.
- IM solutions have to be carefully tailored to specific applications
  - One IM solution is unlikely to be universally applicable
  - Requires a significant investment for each new system



- **For Energetic Materials, complex supply chain and extended production run can result in .....**
  - Facility closure, consolidation and transformation
  - Material obsolescence
  - Change of suppliers
  - Change in manufacturing locations
  - **= requirement for Re-qualification.**
- **The following re-qualification activities may be required:**
  - Explosives qualification
  - Warhead / Motor Type qualification
    - Environmental, Safety / IM & Performance
- **Robust characterisation of original material provides good baseline for assessment of new / replacement material.**
  - ..... can mitigate risk of time consuming & expensive Type requalification.
  - Translation between national test standards can provide significant benefits.