OHB System AG
Mark Fittock
24.10.2018, Clean Space Industrial Days 2018,
ESTEC

SPACE SYSTEMS

New Design for Demise technology concepts for structural joining technologies

We. Create. Space.

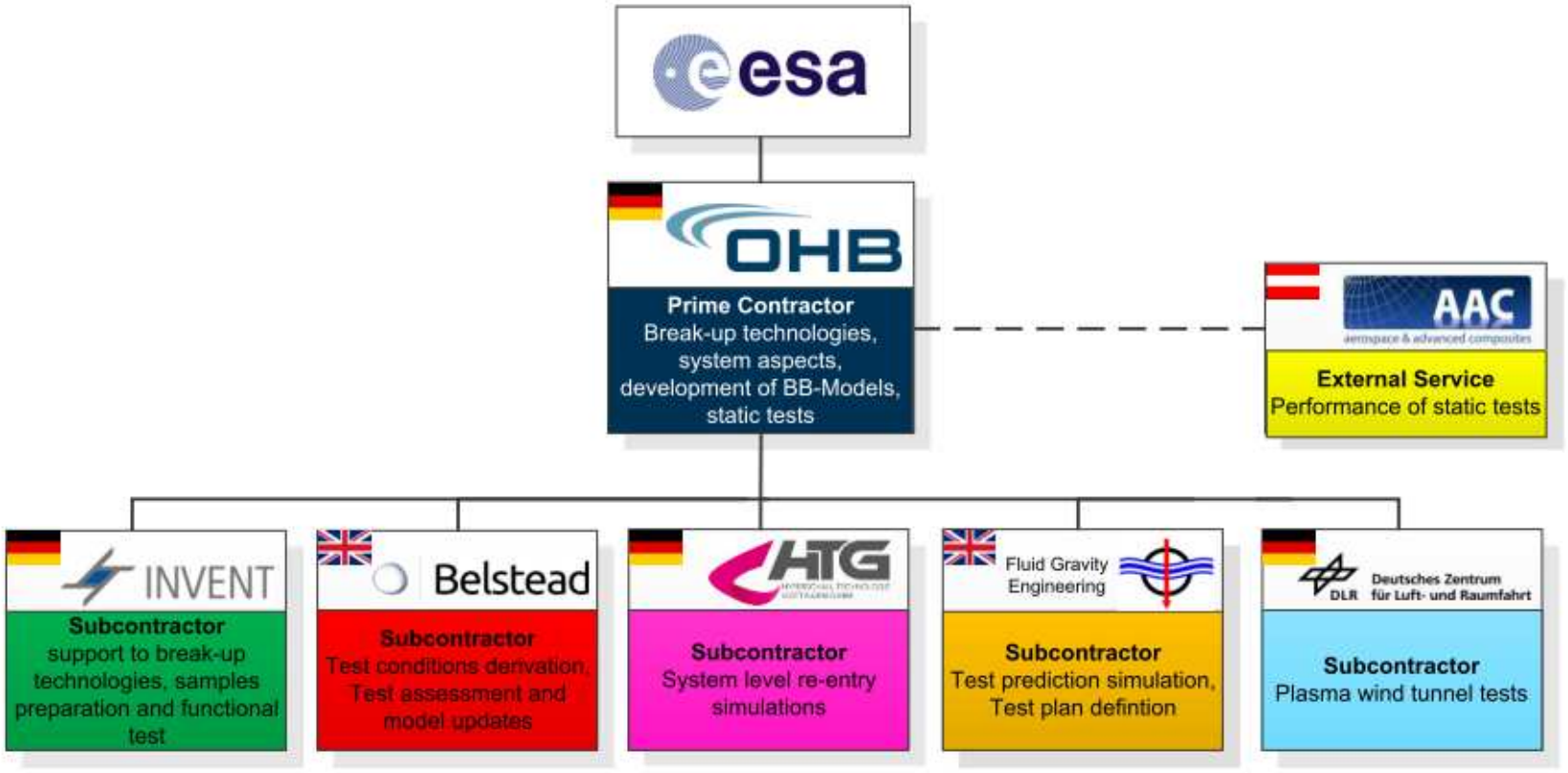
Objectives of the Study

The objectives of the activity are

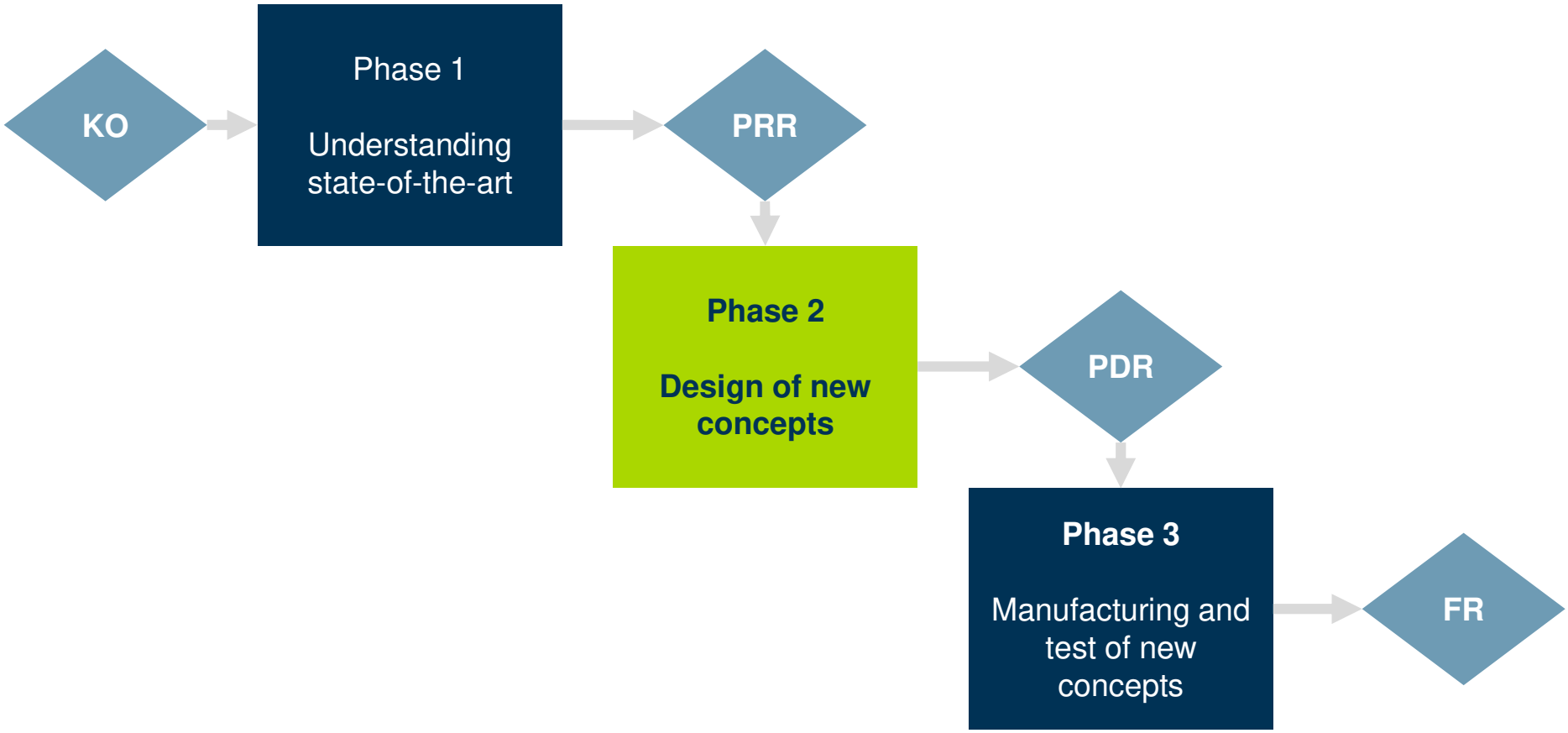
- To define feasible design concepts to achieve a spacecraft structure break-up or structure opening at an altitude above its natural break-up altitude and
- To demonstrate the feasibility of selected technologies by breadboard development and testing.

- Focus is set on technologies to open and/or release external structural elements and spacecraft modules (e.g. payloads and large appendages) to increase the overall spacecraft demisability

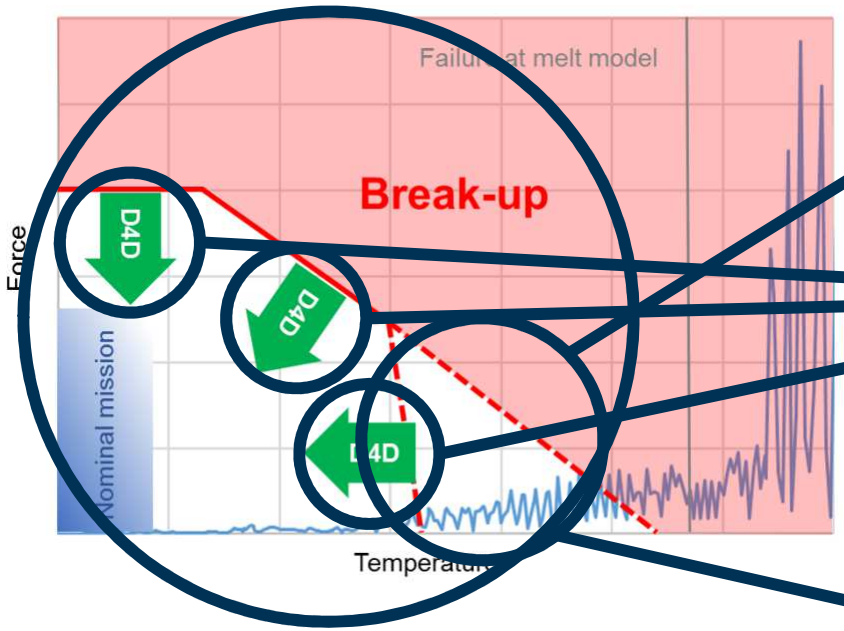
The team to bring D4D to breadboard level



Study Overview



Technologies to increase a satellite‘s break-up altitude



Phase 1

Understanding state-of-the-art

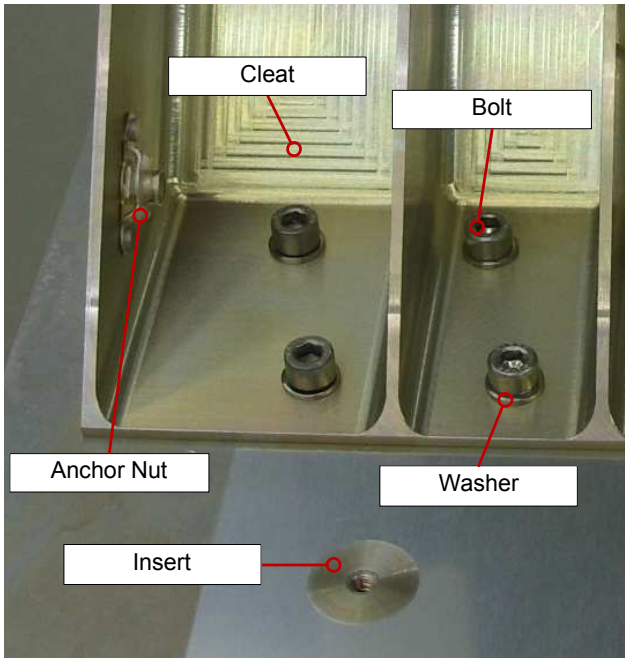
Phase 2

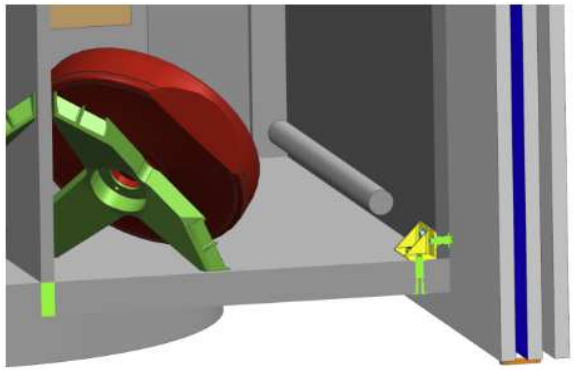
Design of new concepts

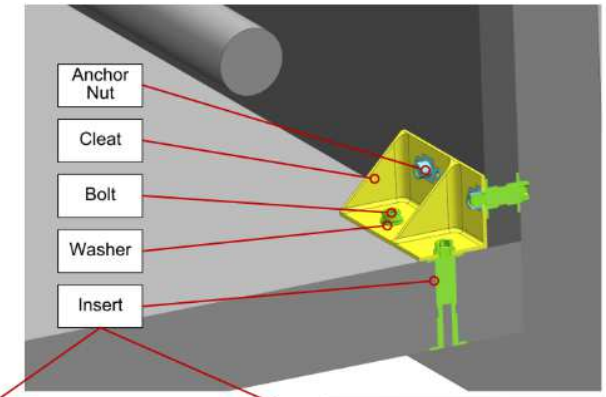
Phase 3

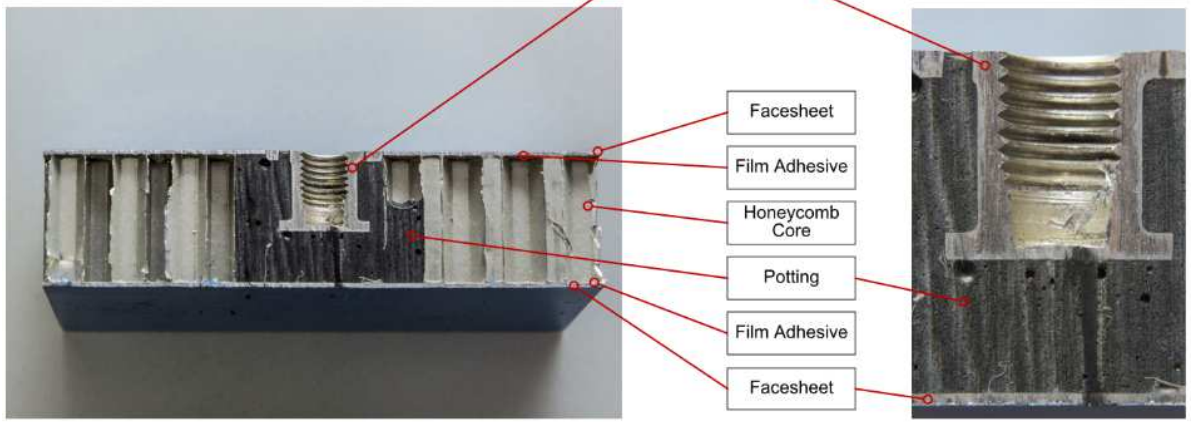
Manufacturing and test of new concepts

Common joining technology

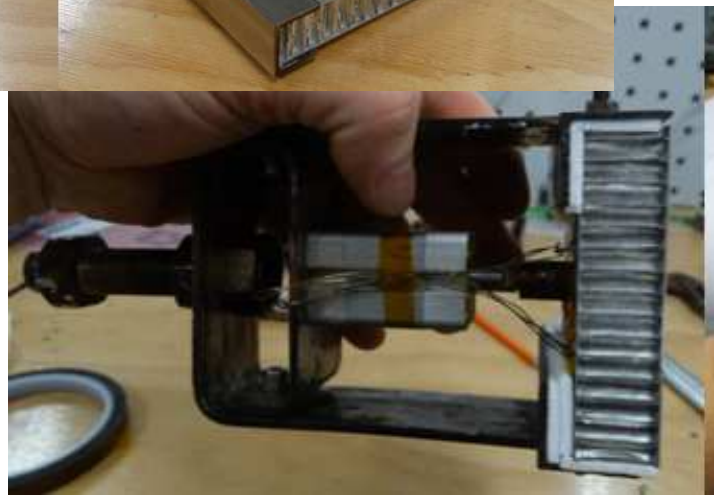








Test Samples



Path to New Technology concept

Core question:

How to “achieve a spacecraft structure break-up or structure opening at an altitude above its natural break-up altitude”?

Study Objective Keywords:

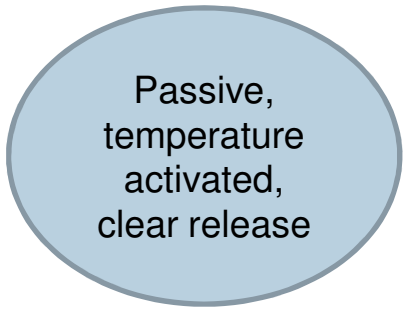
Feasible, Demonstrate, Breadboard, Test, External Structural Elements

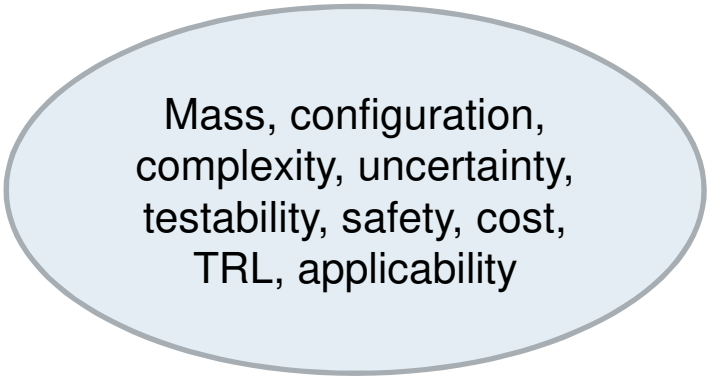
Input knowledge:

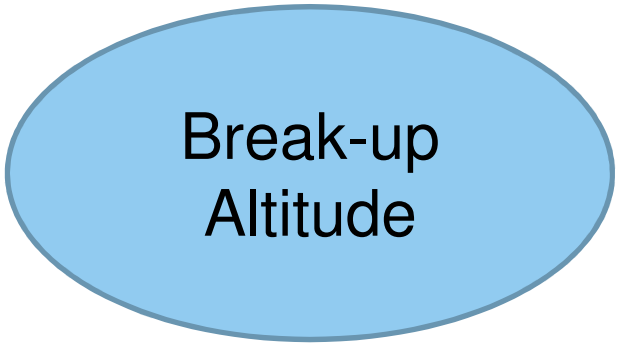
State-of-the-art, first phase testing, demisability understanding

Iterative Process

- Brainstorming session with broad range of parties
- Narrowing down on potential solutions via trade-off
- Further development of promising technologies
  - Analysis of concepts
  - Additional review during development for alignment
- Selection of technologies to be tested



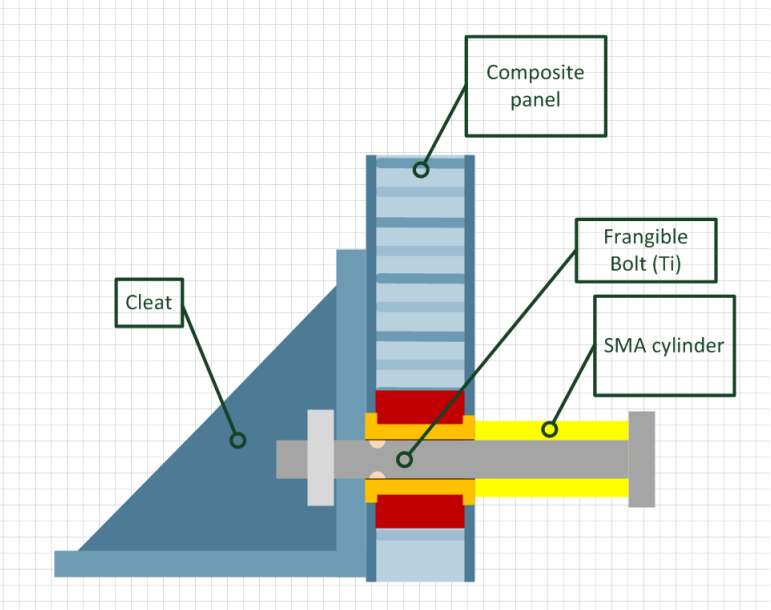




4 core concepts

- SMA cylinder bolt fracture
- 2 part insert with soldered segment
  - 2 part insert with adhesive
- Composite insert
  - Bolt/Anchor Nuts
  - Thermoplastic cleats
- Bonded Cleats
  - Segment bonded externally

SMA cylinder bolt fracture



- Trigger temperature at 180-200°C
- When temperature is reached, material elongates
- Self-induces a force to fracture bolt
- Solution considered together with Altran/Nimesis for use of a Nimesis Triggy-HT

- Future potential in integrated applications i.e. as insert replacement

2 part inserts with soldered segment

- Where 2 parts are held together with a low melting temperature material or a segment completely replaced
- Failure of insert itself at higher temperatures ➔ break up of panels / components
- Identified Zone of activation: approx. 110 km
- Was assessed for using both solder and adhesive
- Technologies are adaptable for numerous insert I/F
- Pre-development tests:
  - No mechanical performance degradation, acc. to tensile rupture load tests at RT (conventional primary structure sandwich configuration)

2 part Insert sample with adhesive technology

2 part Insert sample with solder technology

Composite insert

- 1 to 1 replacements of aluminium inserts with CFRP inserts
- Currently available as COTS components
- Little known about demisability and potential processes
- Failure of CFRP matrix at higher temperatures ➔ break up of panels / components
- Pre-development tests:
  - No mechanical performance degradation wrt aluminium insert, acc. to tensile rupture load tests at RT (conventional primary structure sandwich configuration)

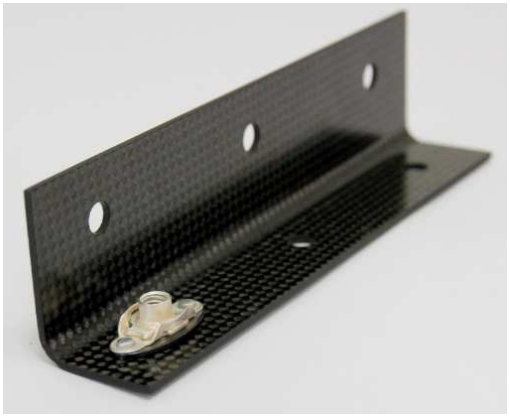
- Composite bolts is a similar alternative
- Thermoplastics and other materials for replacements of components has future potential

Left: conventional insert; Right: CFRP insert

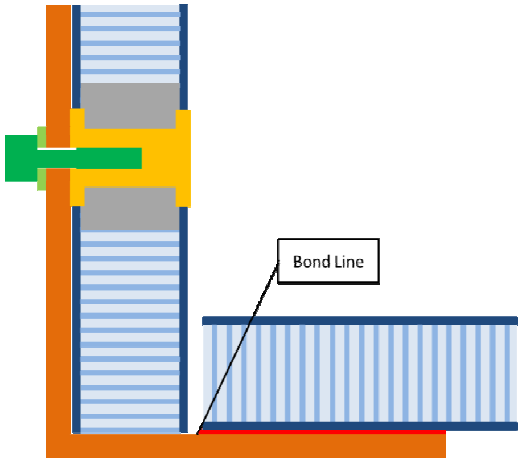
CFRP Insert sample

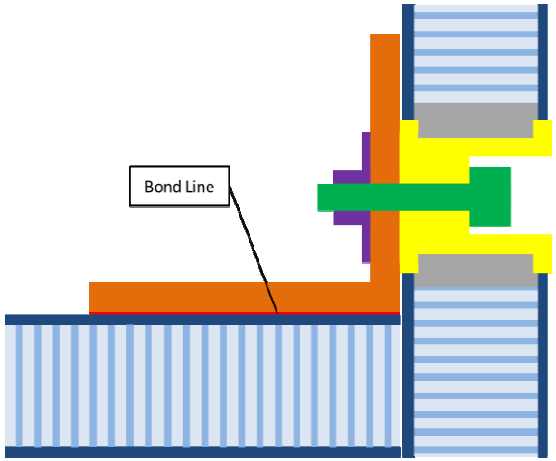
© ICOTEC

Bonded Cleats



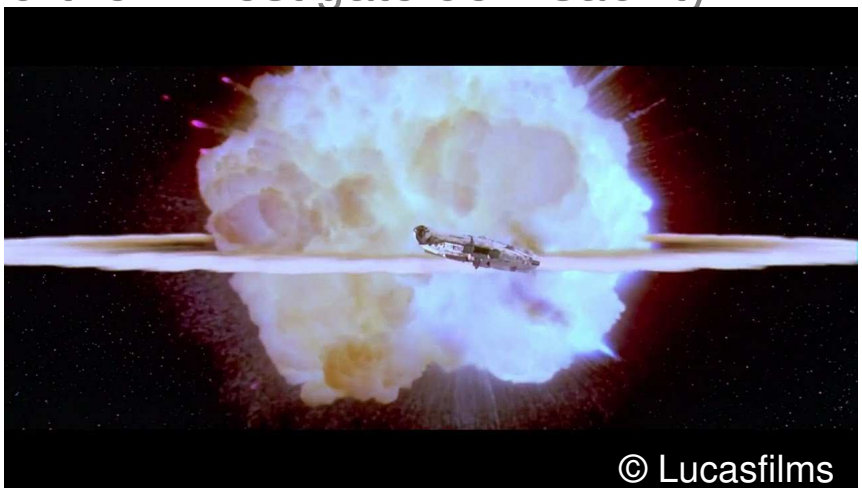
- Change from bolted (at both segments) to bonding one side of the cleats
- Thermal sensitivity of bonded joint is relevant for earlier break-up of S/C
- Bonded cleats are an established technology
- Broad range of adhesives available
  - Can tailor for specific failure temperatures
- Many configuration options
- Some restrictions





Where to next?

- Build of breadboard models
- Test of concepts
- Analysis
- …
- Future efforts to further investigate demisability



OHB System AG
Mark Fittock
24.10.2018, Clean Space Industrial Days 2018,
ESTEC

Mark Fittock
OHB System AG
Bremen, Germany
mark.fittock@ohb.de

SPACE SYSTEMS

New Design for Demise technology concepts for structural joining technologies

We. Create. Space.