
DEMISABILITY OF PLATFORM OPTICS AND ELECTRONICS

OHB SYSTEM AG

D4D-ONE TEAM, 19.10.2023



DEMISABILITY OF PLATFORM OPTICS AND ELECTRONICS

INTRODUCTION

Study Objective

- Characterisation of the demise process of critical platform optics and electronic equipment and development of validated materials and equipment reentry models for the tested equipment
 - Characterization the fragmentation and demise process of critical equipment through simulations and tests
 - Development of equipment level models, potentially including updated materials ablation and aerothermal models
 - Proposal of design changes to improve the demise of these equipment and develop models to evaluate and verify their impact
 - Focus on star trackers, electronic boxes, and batteries



OVERVIEW OF TEST CAMPAIGN

TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE OVERVIEW

- Altogether test samples for three types of equipment were procured:
 - Star Trackers (5 static tests / 2 dynamic tests)
 - Batteries (5 static tests / 2 dynamic tests)
 - Single Cells
 - Blocks / Modules
 - Electronic Equipment (5 static tests / 4 dynamic tests)
 - Electronic Cards / Boards
 - Electronic Units

- Test samples simplified and therefore vary from actual flight hardware due to three main reasons:
 - limited budget and lead times
 - limited test sample volume (and mass) in L2K
 - to better understand the influence of individual critical parts on the demise process in an incremental approach



TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE OVERVIEW

- Test sample simplification was generally approached in the first step as follows:
 - Part geometries are simplified to basic shapes (where sensible or possible)
 - Undemisable / hard to demise materials (e.g. titanium, ceramics, silica) will be equivalent to FM materials
 - Materials with uncertain demise behaviour (e.g. GFRP) will be equivalent to FM materials
 - Non-critical materials are replaced by similar low-cost materials in respect to thermal properties or even dismissed if sensible



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TEST SAMPLE OVERVIEW

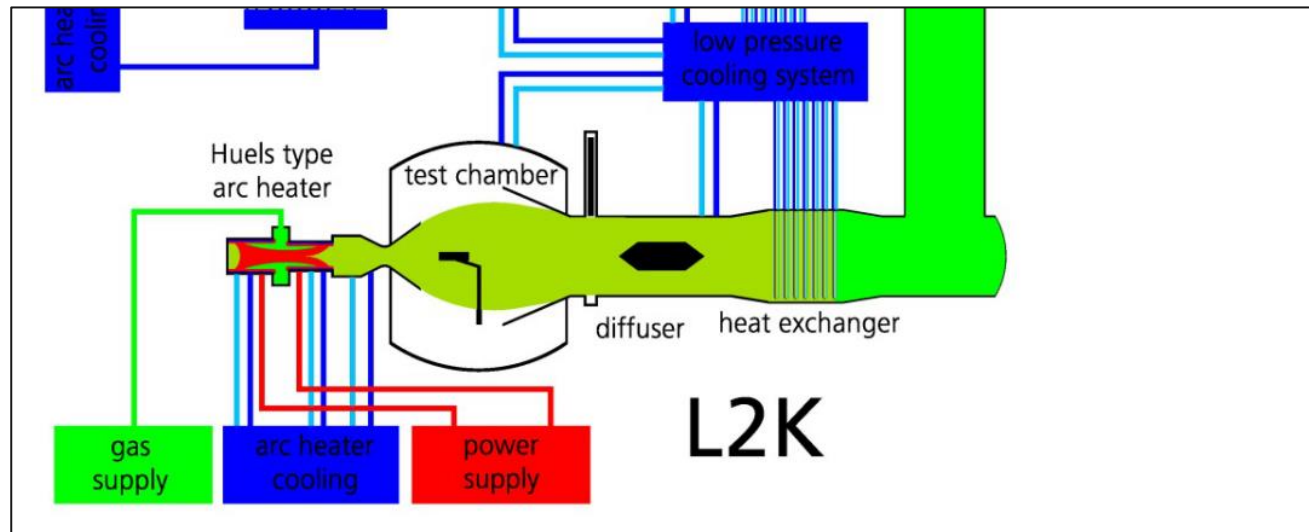


Concept #	Star Tracker	Batteries & Modules	Electronics Boards
Schematics			
Test Sample			
Concept Design Aspects	<ul style="list-style-type: none"> • Simplicity <ul style="list-style-type: none"> ➢ components (star tracker) ➢ geometry (mock-ups) • Measurement of temperatures (star tracker) 	<ul style="list-style-type: none"> • Manufacturing configurations • Demisability change due to orientation to plasma flow 	<ul style="list-style-type: none"> • Demise of different components on PCBs • Effect of housings and large-mass components peripheral to PCB • Demisability on bare boards

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TEST FACILITY & INSTRUMENTATION

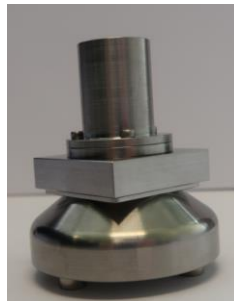
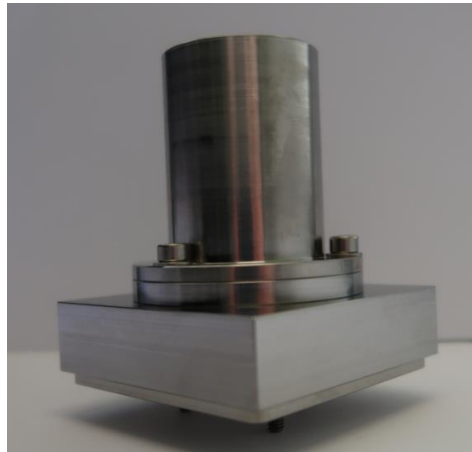
- Tests are conducted in DLR's L2K arc-heated wind tunnel
- Allows the use of samples up to approx. 100mm width and height, with up to 1.4MW of energy to energise the working gases
- Test Sample Instrumentation
 - Type K thermocouples are used to monitor the temperatures experienced during testing



TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE – STAR TRACKERS

- EM Test samples
 - Same materials for critical parts
 - Part design / geometry details comparable to flight hardware
 - Internal components / parts
 - EM optical barrel with lenses
 - EM-equivalent star tracker titanium structural models
 - Scaled down star tracker titanium structural models



Startracker



Overall Dimensions: 154 mm x 154 mm x 237 mm
Total Mass: 2 kg

TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE – STAR TRACKER VIDEO



 **Deutsches Zentrum
für Luft- und Raumfahrt**
German Aerospace Center

**Institute of Aerodynamics
and Flow Technology**

Supersonic and Hypersonic
Technologies Department

 **OHB**

 **Belstead**

 **DLR**

- Video playback

4.5x speed!

TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE – BATTERIES

Battery Single Cell

- Single Cell Test Samples - FM equivalent single cells

Battery Cell Module

- Module type 1 (4x4 cell block with potting and cover sheets)
- Module type 2 (3x3 cell block with potting and top and bottom plate)
- Cell block made from FM equivalent single cells
- Cover sheets and potting made of COTS representative materials (GFRP / FR4 / Epoxy Resins) without wiring and electronic components (shunt resistors, heaters etc.)



TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE – SINGLE BATTERIES VIDEO



- Video playback

8x speed!

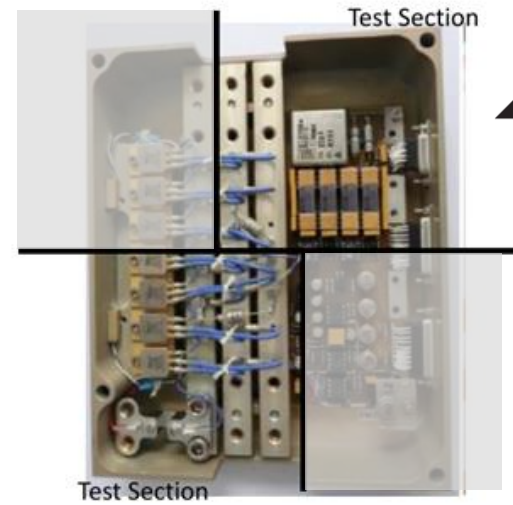
TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE – ELECTRONICS



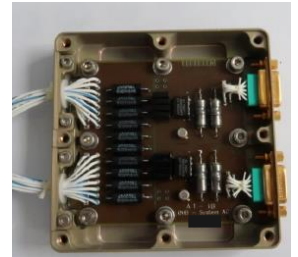
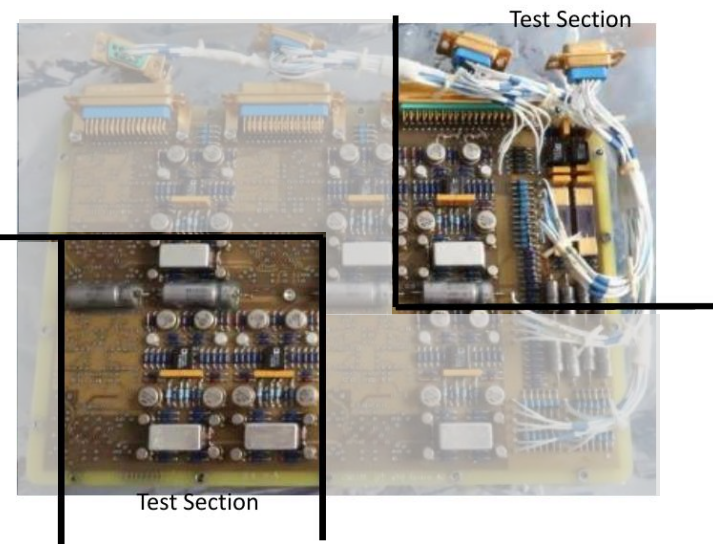
Electronic Cards / Boards

- Different types of electronic cards from OHB in-house sources – EM / spares from past projects
 - Various representative populated card sections



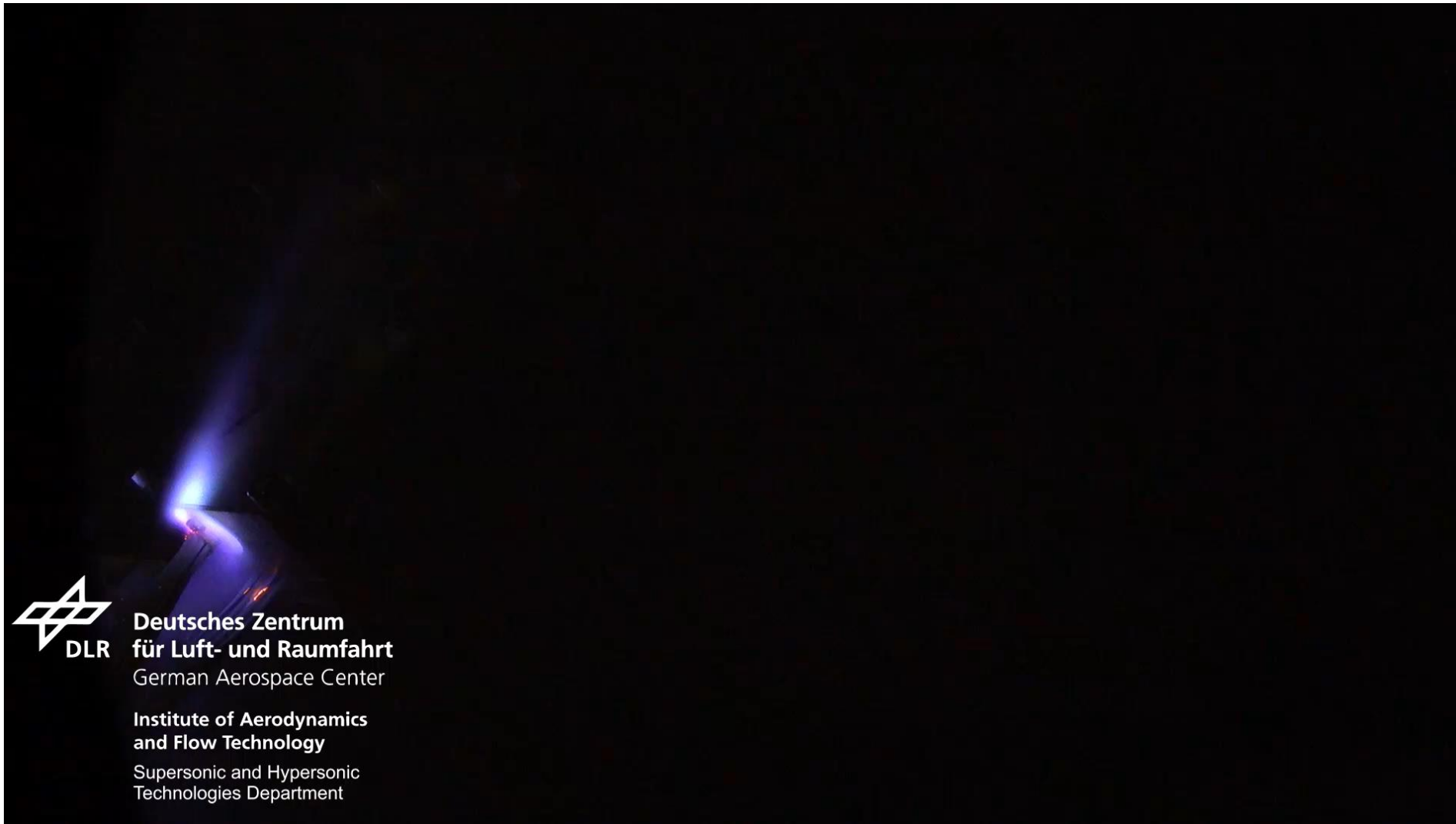
Electronic Unit Test Samples

- Unit is downsized fit in flow field
- Interior made of stacked cards (same approach as for cards above)
 - Cards are equipped with aluminium frame
 - Exterior aluminium housing with connectors (OHB EM / FM equipment)
- Representative tests critical → real electronics components not required
 - good material representation is sufficient.



TASK 2 - SAMPLE PROCUREMENT

TEST SAMPLE – ELECTRONICS UNIT VIDEO



 OHB

 Belstead

 DLR

- Video playback

2x speed!



THANK YOU!

ANY QUESTIONS?