
DEMISABILITY OF PLATFORM OPTICS AND ELECTRONICS



OHB SYSTEM

ESA CLEAN SPACE DAYS, 08.10.2024

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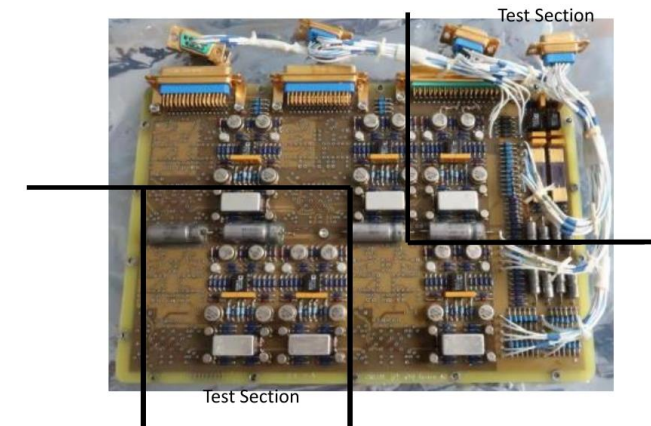
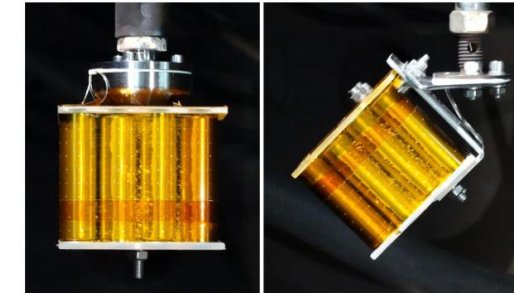
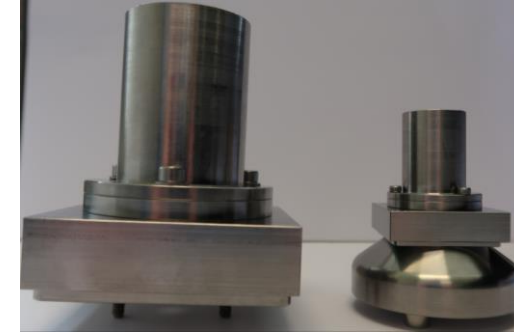
Study Objective

- 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

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TEST SAMPLE OVERVIEW

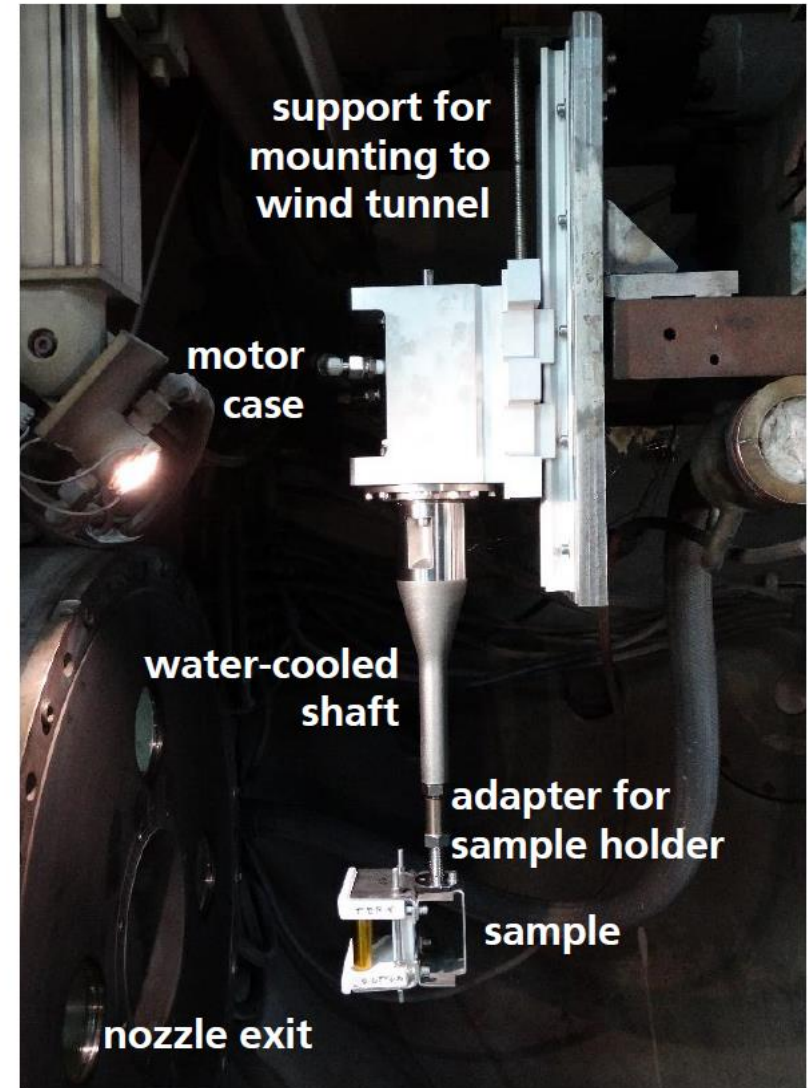
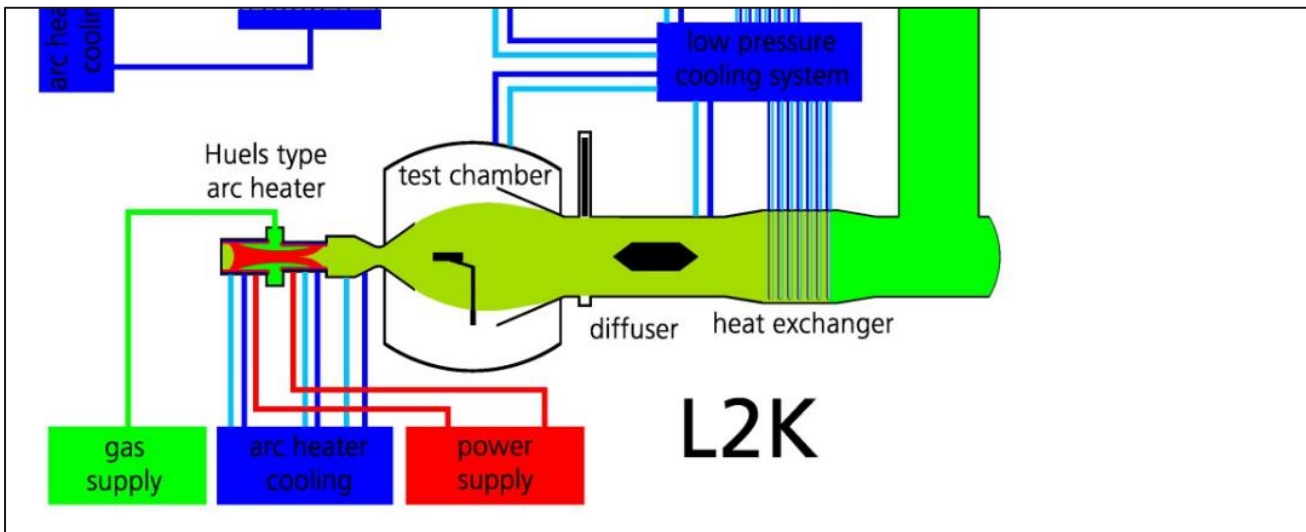
- Altogether test samples for three types of equipment were tested:
 - Star Trackers
 - Batteries
 - Single Cells
 - Blocks / Modules
 - Electronic Equipment
 - Electronic Cards / Boards
 - Electronic Units
- Test samples simplified to better understand the influence of individual critical parts on the demise process in an incremental approach
- Two test campaign were conducted:
 - First Campaign – Static test set-up
 - Second Campaign – Rotational test set-up



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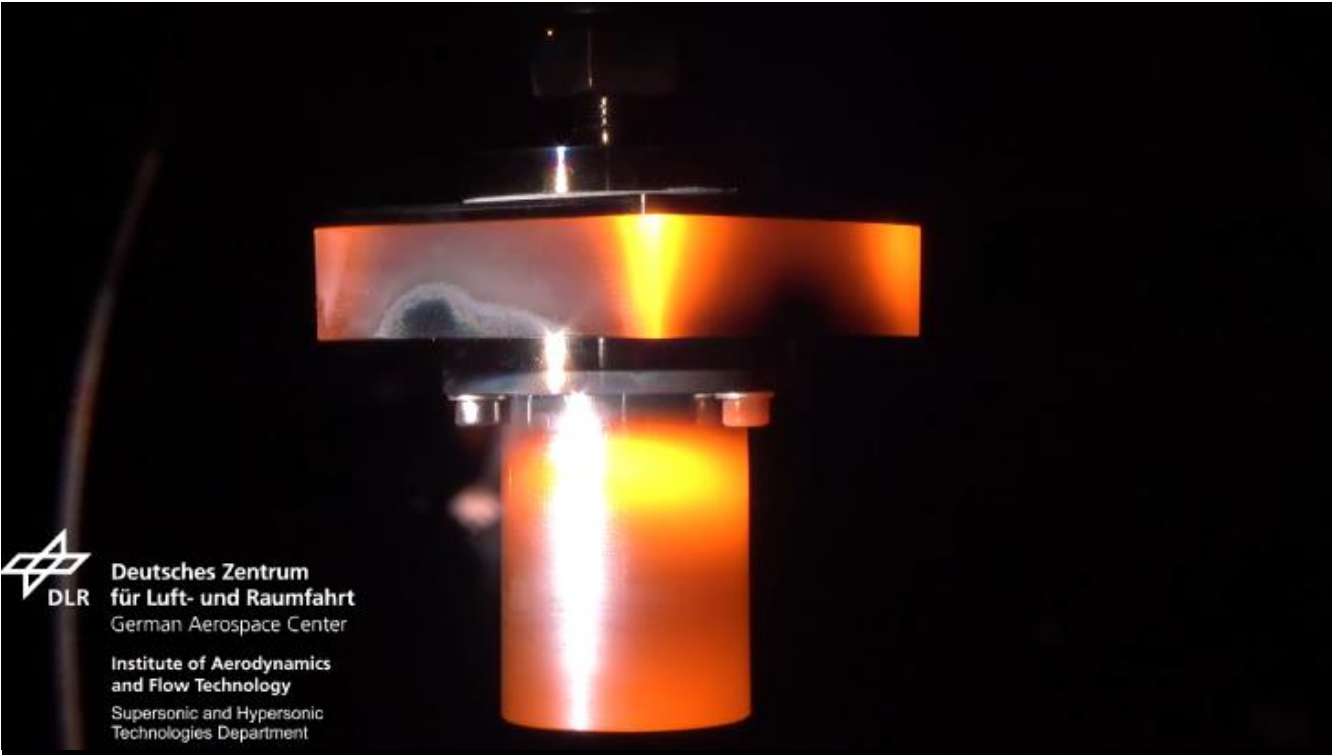
TEST FACILITY & INSTRUMENTATION

- Tests are conducted in DLR's L2K arc-heated wind tunnel
- The rotational sample set-up was used
- Test Instrumentation
 - Video and IR Imagery
 - Pyrometers
 - Type K thermocouples are used to monitor the temperatures experienced during testing



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STAR TRACKERS



Star Track Imaging System Mock-up @ 0.1Hz

Star Tracker Conclusions

- Titanium parts are critical elements
 - Single (connected) titanium part
 - Possible separation with helicoil issue
- Basic modelling good
 - One part is expected to land for larger star trackers
 - Some probability of demise for small star trackers
- Titanium material model good
 - Separation of parts in dynamic tests
 - Helicoils – needs to be tested
 - Not enough data/evidence to include in models
- Glass melting of interest
 - Testing of range of glasses is recommended
 - Developed model should be able to catch behaviour using viscosity data

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BATTERIES



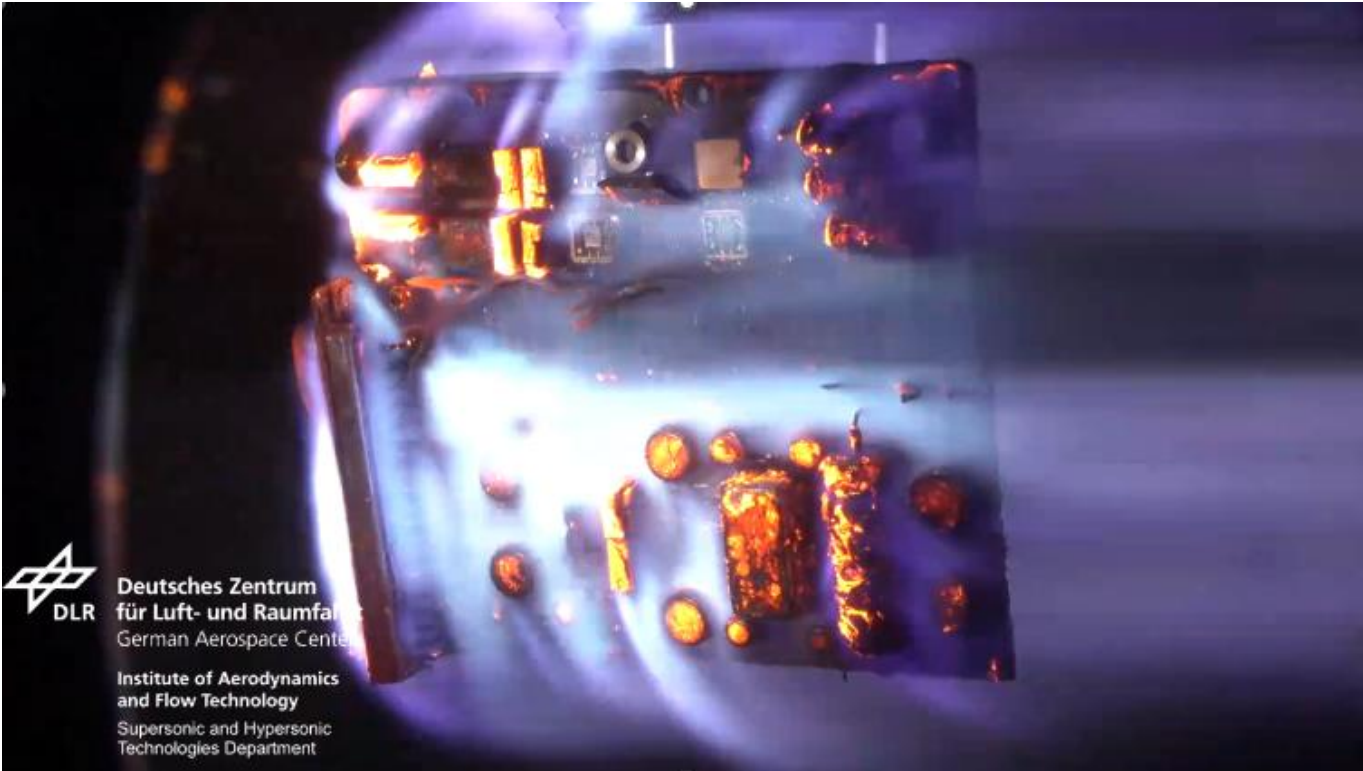
4x4 Battery Module @ 2Hz

Battery Conclusions

- Small cells expected to demise for all uncontrolled release altitudes of interest
 - GFRP sheets have impact, but minor
- Battery behaviour consolidated from small cells
 - Material model based on steel can
- Fragmentation driven by GFRP material
 - Should be included in model
 - As GFRP is torn apart, no need to be included in casualty risk
- Other cells still required to be tested
 - Cells are larger – and are predicted to be higher risk

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ELECTRONIC CARDS



PD Board Section @ 0.1 Hz

Electronics Card Conclusions

- GFRP likely to land
 - Will change shape and warp, may tear
 - Not evidence that tearing will occur for cards – would need different tests
 - Some large components can be a risk, such as transformers
- Cannot be ignored as risk, but difficult to assess
 - Cards will probably survive intact
 - GFRP is very low demisability, but also has very low strength at high temperatures
 - Where there are forces (two masses) the material will tear
 - Investigation into material tear at higher forces recommended
- Model based on glass balance integral model captures behaviour

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SUMMARY

- Consolidation of findings from previous activities on the demisability of batteries and electronics cards
- Test result support the expected behaviour of star tracker internal parts
- Results also show that further testing is needed to fully understand the re-entry behaviour of electronic equipment





THANK YOU!

ANY QUESTIONS?