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## Challenges in the Development for a Demisable Krypton Tank

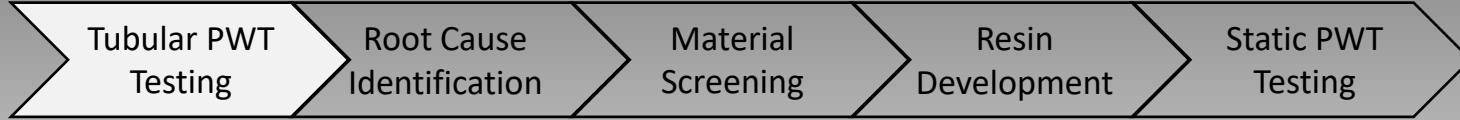
# Composite Overwrapped Pressure Vessels

**Type III** – Aluminum Liner  
and CFRP Overwrap

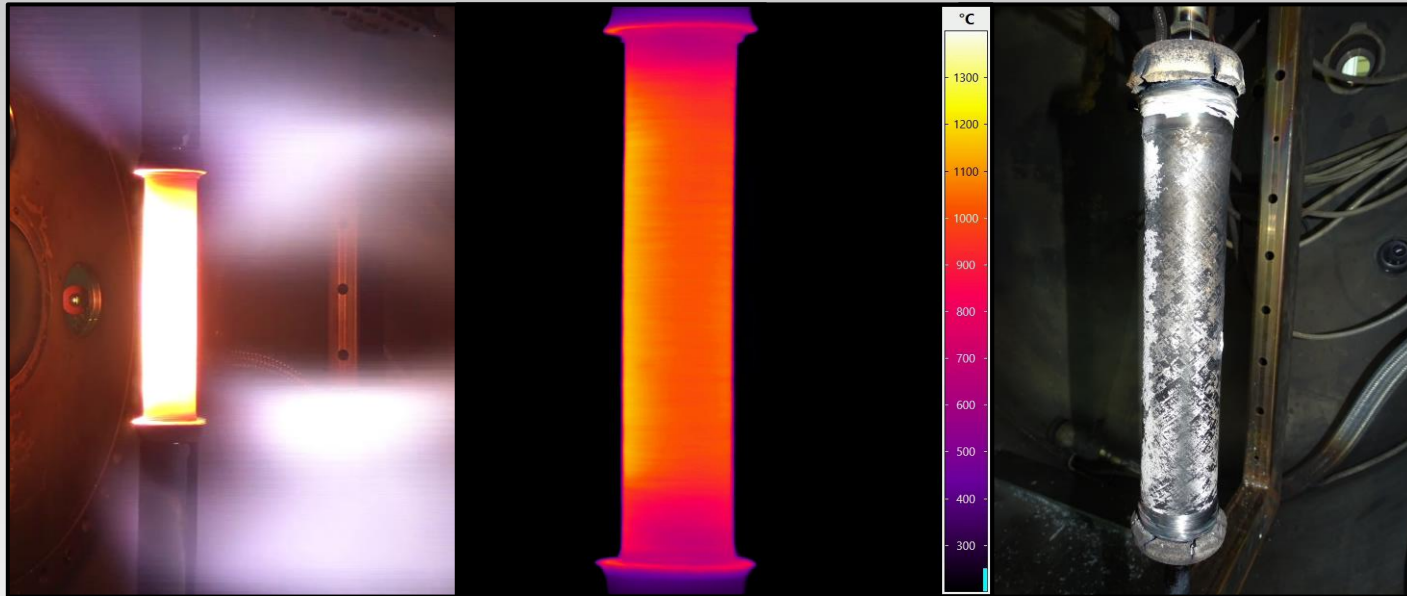
Xenon or Krypton Propulsion  
Tanks for Spacecrafts

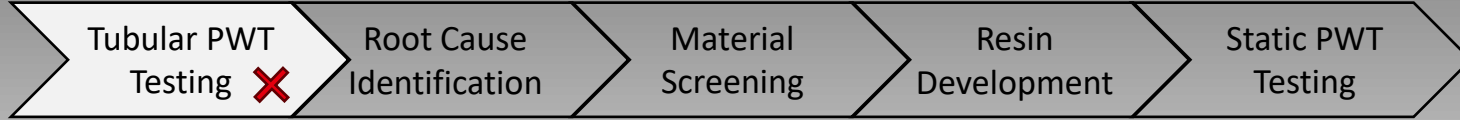
Helium Pressurization Tanks  
for Launchers





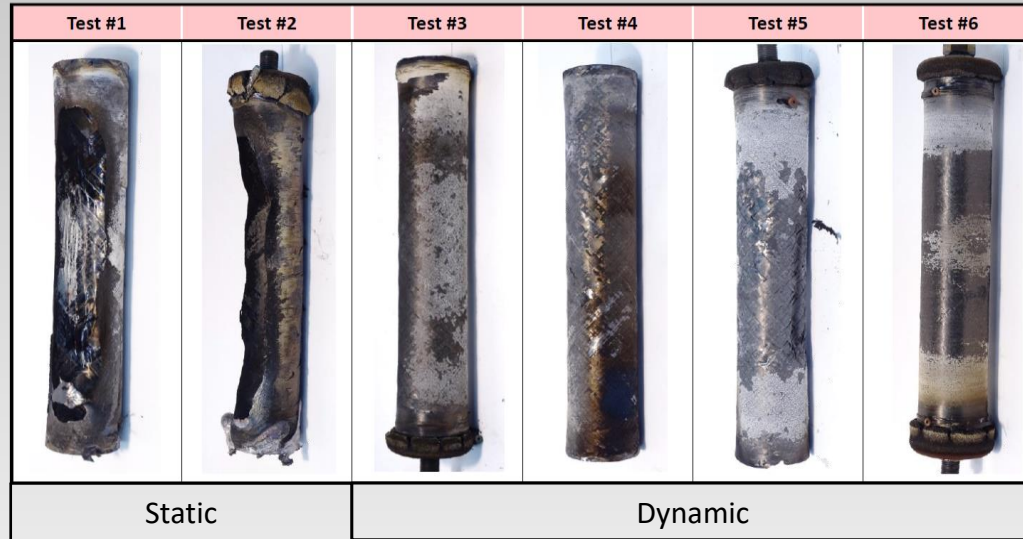
## Baseline: Plasma Wind Tunnel Test @ DLR

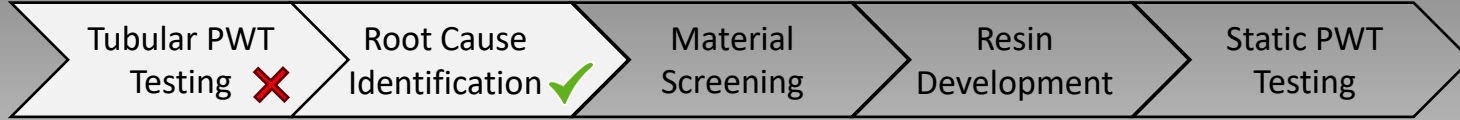




## Baseline: Plasma Wind Tunnel Test @ DLR

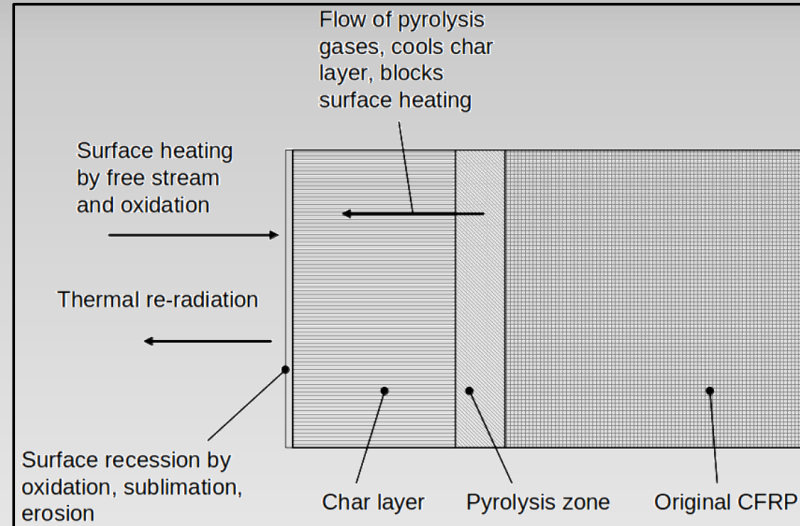
- Tubular Test Specimen
  - static/dynamic
  - high/low Heat Flux
  
- No sufficient demise behaviour





## Root Cause

- Char Formation has been underestimated
- Resin has more influence on demisability than expected

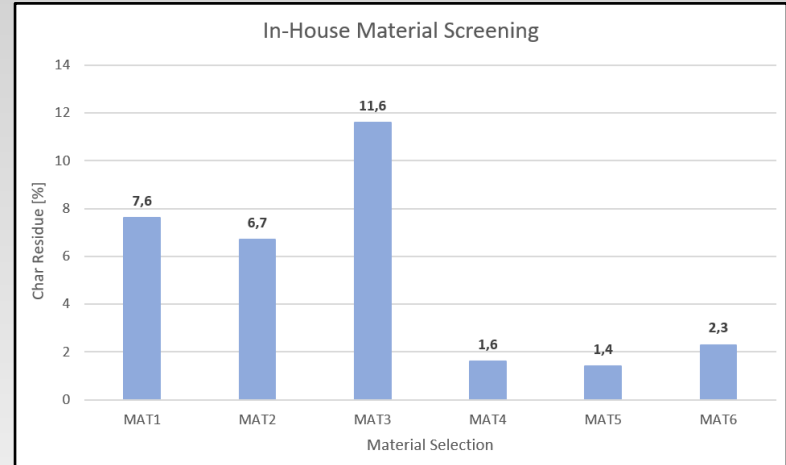


Source:  
About the demisability of propellant tanks during atmospheric re-entry from LEO', Journal of Space Safety Engineering



## Investigation of different „heritage“ matrix systems

- Thermogravimetric Analysis (TGA)
- Comparison of Char Formation



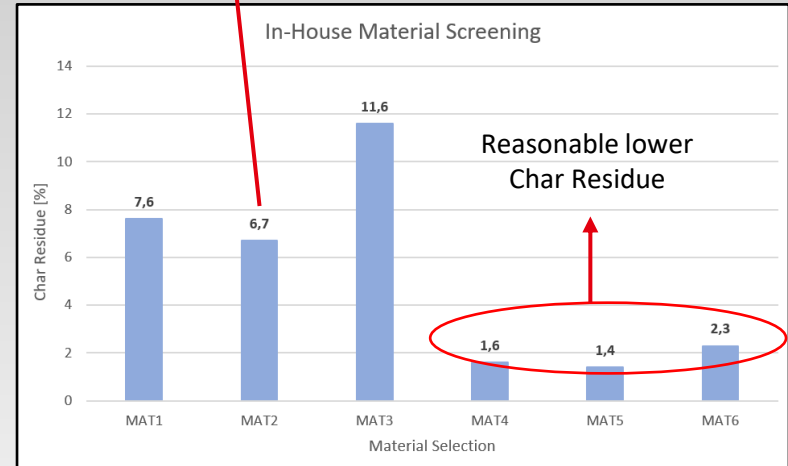


## Investigation of different „heritage“ matrix systems



Material of previous PWT Test

- Thermogravimetical Analysis (TGA)
- Comparison of Char Formation
  - *MAT2* is material of previous PWT Test
  - *MAT5* Resin as baseline with good performance from DLR

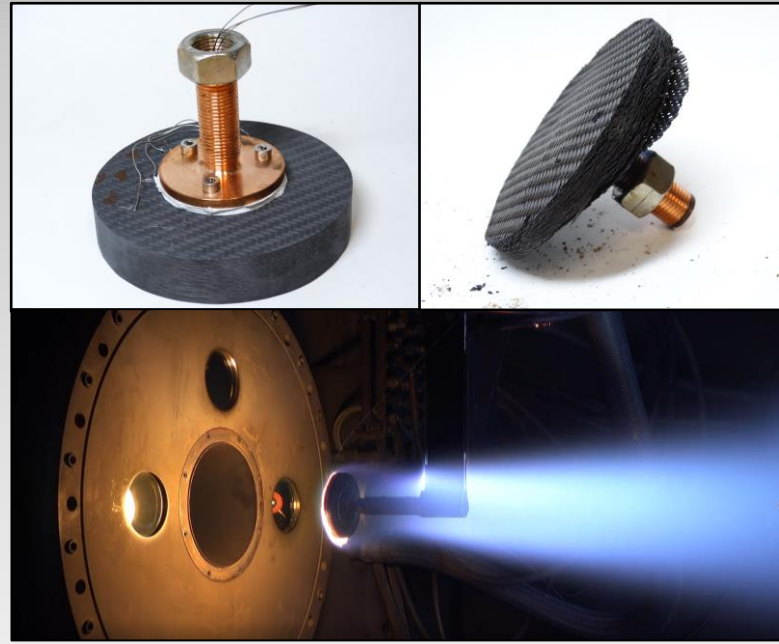






## Static PWT Test on 4 Samples

- CFRP Sheets  $\varnothing 100 \times 20 \text{mm}$
- Characterize demise behaviour
- Correlate with TGA Analysis





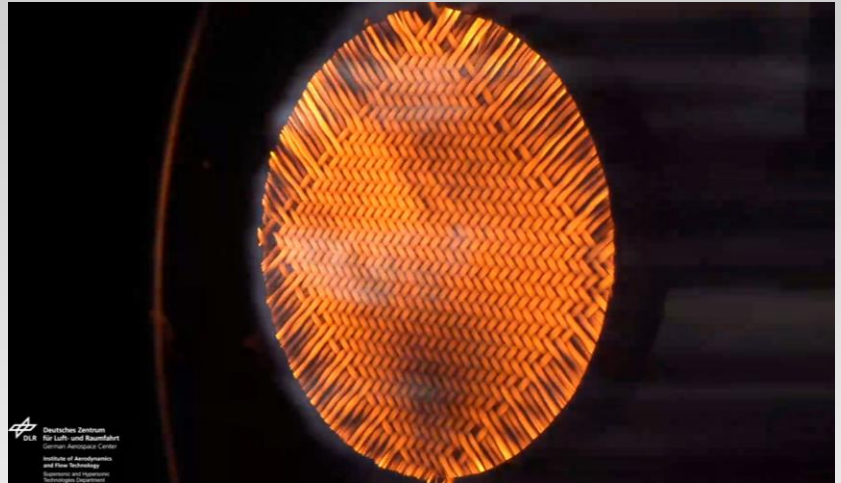


## Static PWT Test 1

MAT2 PWT Sample



MAT5 PWT Sample





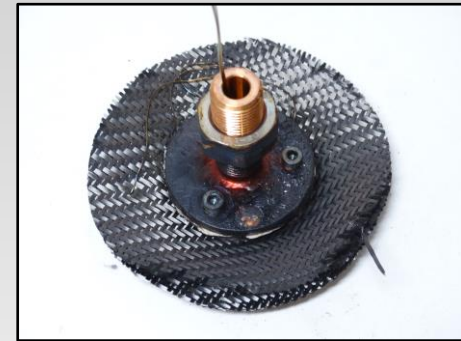
## Static PWT Test 1 Outcome

- „Heat Shield“ from previous test could be repeated (*MAT2*)
- TGA can be used as an estimation to characterize demisability
- One heritage material showed good results (*MAT4*)

Test Conditions:  
Duration 900s  
Heat Flux 400kW/m<sup>2</sup>



MAT2 PWT Sample

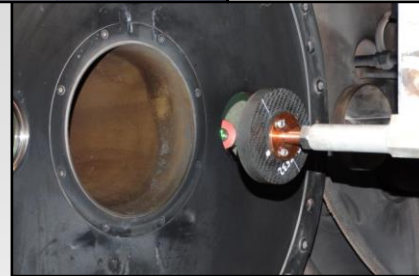
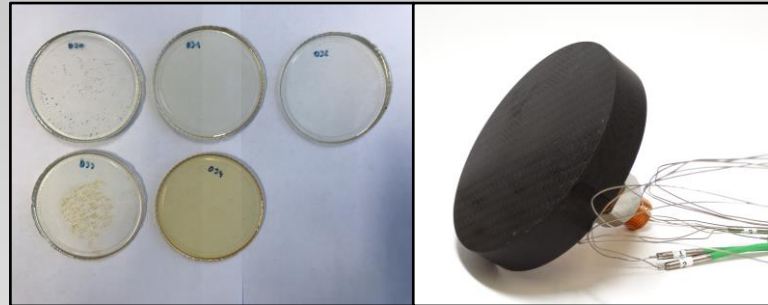


MAT5 PWT Sample



## Resin Development

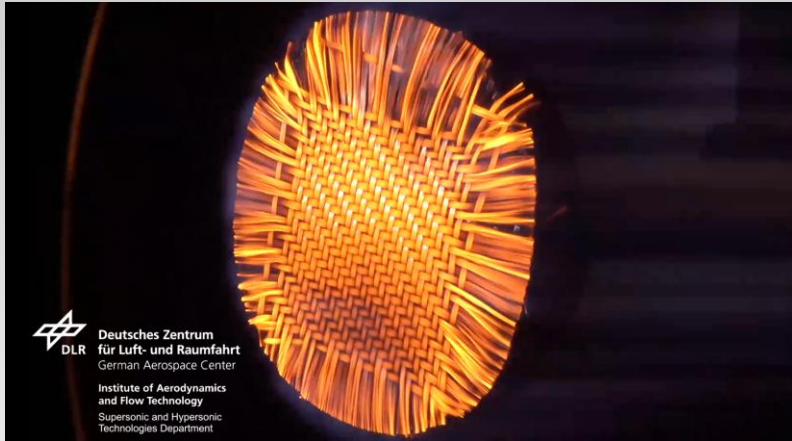
- Investigation of base materials
  - 3 types of resin
  - 2 types of curing agents
  - 4 types of additives
- Comparison by TGA and Char Residue
- 3 formulations (+1 Thermoplast) used for PWT Testing





## Static PWT Test 2

MAT8 PWT Sample



MAT10 PWT Sample





## Static PWT Test 2 Outcome

- Complete demise after 9min of new resin formulations (e.g. *MAT8*)
- Thermoplast also promising candidate (*MAT10*)

*Matrix essential for a good demisability performance!*

Test Conditions:  
**Duration 900s**  
Heat Flux 400kW/m<sup>2</sup>



MAT1 PWT Sample

Test Conditions:  
**Duration 561s**  
Heat Flux 400kW/m<sup>2</sup>



MAT8 PWT Sample



**THANK YOU FOR YOUR ATTENTION!**