

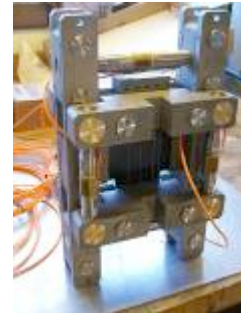
Subproject Cryogenic Storage: Biaxial Tensile Tests

Objectives

- ❖ Search and selection of appropriate composite materials for cryogenic liquid hydrogen (L-H₂) tank shells
- ❖ Demonstration of L-H₂ tightness of selected composite tank shell materials
- ❖ Verification of material properties for combined load cases – multiaxial tensile testing
- ❖ Development of a representative load introduction set-up for sample testing

Description

- ❖ Development of a biaxial tensile test method
- ❖ Development of a test set-up with homogeneous load introduction and a combined load case (biaxial) in the core area of the sample needed for tightness / permeation measurements
- ❖ Measurement of the permeation rate of gaseous helium through the original composite material before cryogenic loading. Measured value between 1,5e-7 and 3.e-7 Scc/sec (Standard cubic centimetre per second)
- ❖ Nominal load for 60 mm wide sample section is 15400 N in the main fibre direction and 5250 N in the perpendicular direction. Applied load levels range from 50% to 125% of this nominal load
- ❖ Measurement of permeation and leak rate after cryogenic L-H₂ immersion and loading with various load levels. Measured values of 1.e-3 Scc/sec after loading of 75% to 100% of nominal for raw composite material
- ❖ Selection of leak barrier material (note: without metallic hydrogen permeation liner) and demonstration of L-H₂ tightness of the tank shell material for nominal load conditions under L-H₂ cryogenic immersion
- ❖ Measurement of permeation and leak rate after cryogenic loading with various load levels on the composite with a leak barrier. Leak rates are 7.e-8 Scc/sec before loading and after loading at 100% of nominal load



Test set-up configuration



Sample with mounted load introduction clamps



Raw sample including leak barrier



Sample mounted on spectrometer for permeation measurement

Future Perspectives

- ❖ Testing of material for multiple L-H₂ immersion and mechanical load cycles
- ❖ Quantitative validation of permeation performance of samples with metallic permeation barrier for different load cases and after thermal and mechanical load cycling

Partners	<ul style="list-style-type: none"> ❖ Air Liquide ❖ Austrian Aerospace GmbH ❖ BMW Forschung und Technik GmbH ❖ Institut für Verbundwerkstoffe GmbH ❖ Linde AG ❖ MAGNA STEYR Fahrzeugtechnik AG & Co KG ❖ MT Aerospace AG ❖ Oerlikon Space AG ❖ Prochain e.V. ❖ Volvo Technology Corporation 	
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Website www.storhy.net



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