Austrian liquid hydrogen tank system technologies

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Consortium

The AUTARK CONSORTIUM comprises companies and RTOs with strategic perspective on hydrogen in aviation – all of the partners have a strong background and are currently active in relevant R&D activities:

Scientific Partners

1. LKR Leichtmetallkompetenzzentrum Ranshofen GmbH
2. AIT Austrian Institute of Technology GmbH
3. HyCentA Research GmbH

Company Partners

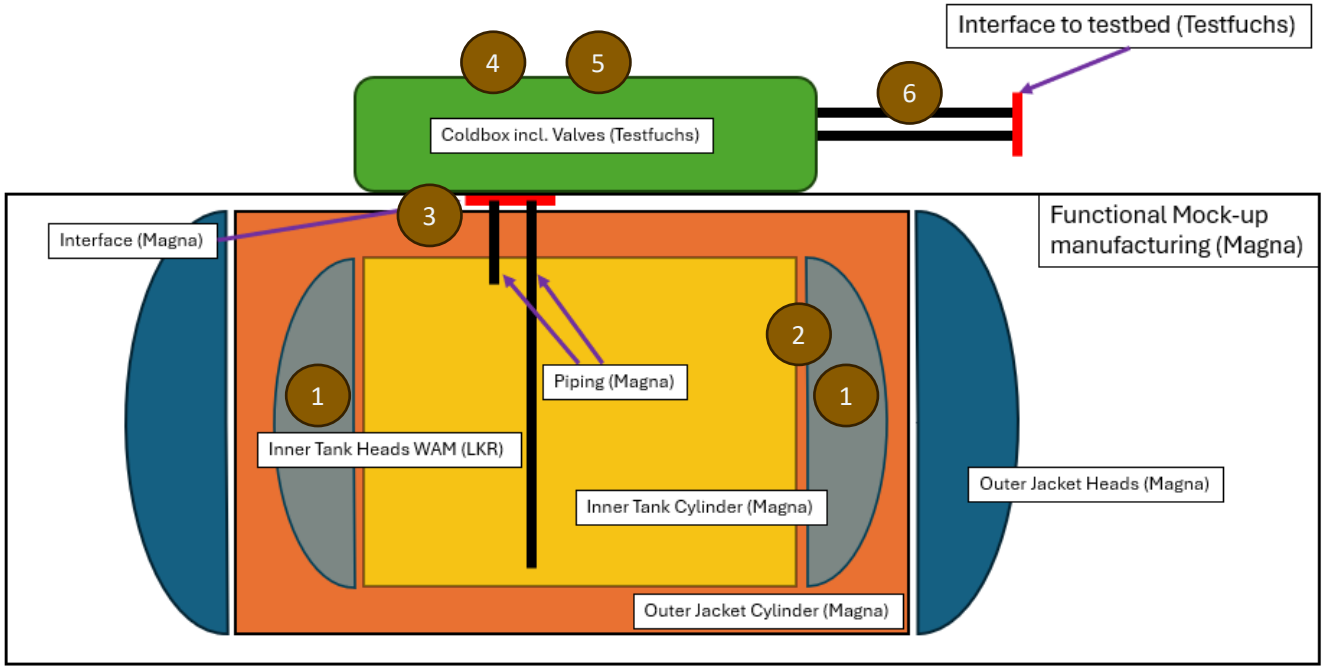
4. MAGNA STEYR FAHRZEUGTECHNIK GmbH & CO KG
5. Test-Fuchs Aerospace Systems GmbH
6. Test-Fuchs GmbH
7. Pegasus Research & Development GmbH
8. Aerospace & Advanced Composites GmbH

Main hardware components to be investigated BY AUTARK CONSORTIUM

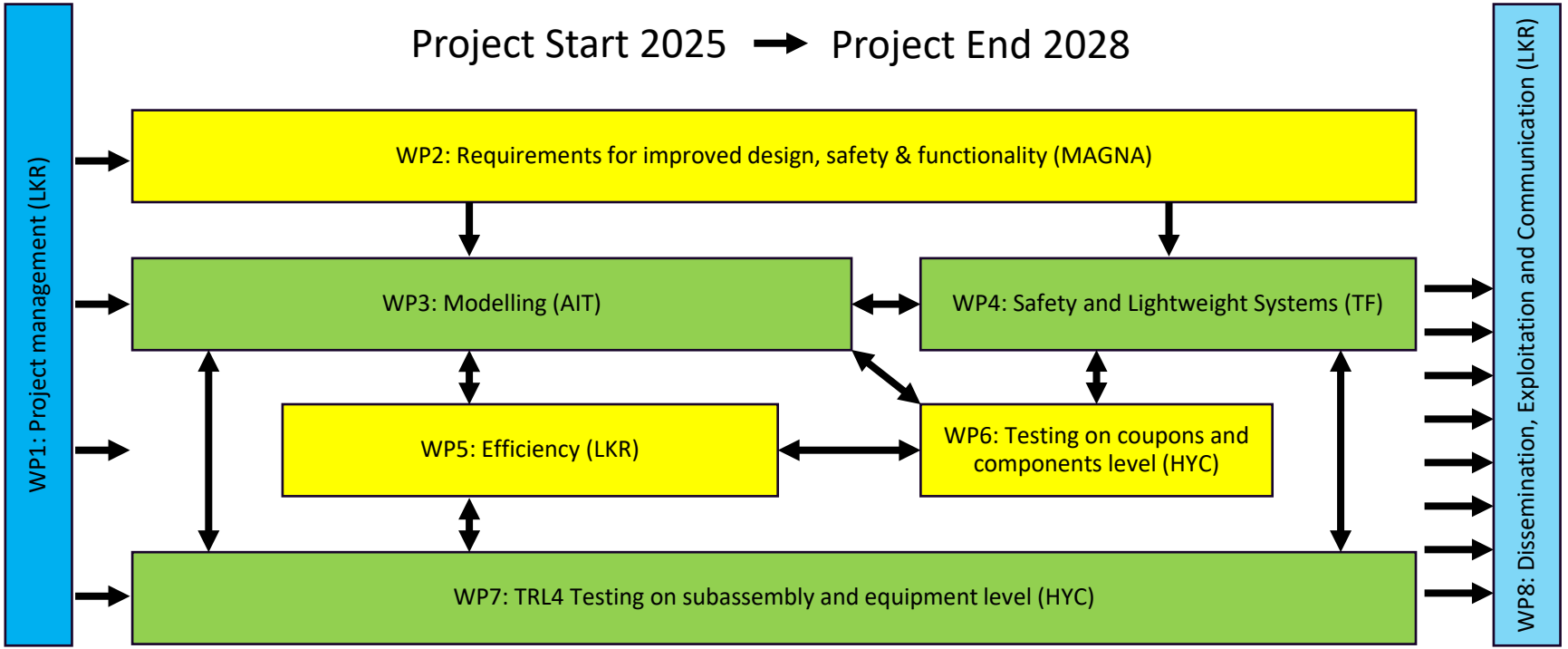
Physical test articles

1. Inner tank (IT) dome (heads) incl. HEX
2. Inner tank (IT) welded assembly
3. Tank / Coldbox interface
4. Cold Box built in aluminium
5. Aluminium SOV+PRV in aluminium
6. Venting pipes with CV

HEX: heat exchanger
CV: check valve
SOV: shut of valve
PRV: pressure relief valve
OJ: Outer jacket



PERT Chart


Project Start 2025
Project End 2028
WP1: Project management (LKR)
WP2: Requirements for improved design, safety & functionality (MAGNA)
WP3: Modelling (AIT)
WP4: Safety and Lightweight Systems (TF)
WP5: Efficiency (LKR)
WP6: Testing on coupons and components level (HYC)
WP7: TRL4 Testing on subassembly and equipment level (HYC)
WP8: Dissemination, Exploitation and Communication (LKR)

Project goals

- Improved Safety
- Higher gravimetric index
- Lower manufacturing costs
- Enhanced design, modelling & testing expertise

Source: Airbus.

Improved Safety

Innovative approach

- A/C Venting system architecture to allow safe venting in all flight situations
- Icing prevention through design solution and/or additional features
- Investigation of sloshing impact to ensure safe operation
- Improving safety by using fatigue-test-verified multi-material transition joints

Methods

- Simulation and testing to validate design
- Use of state-of-the-art CFD simulation approaches applied to the evaluation of application-specific icing issues
- Validation of simulation results with existing test data

Risks & mitigation opportunities

- Deflagration/detonation proof design
- Icing and blocking of valves and piping
- Mechanical load assessment of pressure spikes

Higher gravimetric index

Innovative approach

- Use lighter materials to reach gravimetric index > 30%
- Cold box case and components are made from stainless steel and should be redesigned to aluminium
- Study on common function blocks instead of separate component and pipes
- Using stainless steel/aluminium transition joints to allow most efficient material combination

Methods

- Redesign components to lighter materials and analyse their effects
- Produce at minimum one demonstration model for an aluminium valve and test it with LH2
- Redesign the vacuum cold box in aluminium and build up a demonstrator

Risks & mitigation opportunities

- Not all heavy stainless steel parts can't be avoided/replaced with lightweight material due to higher thermal expansion & thermal conductivity → mixed metal design

Lower manufacturing costs

Innovative approach

- Using additive manufacturing to combine functional and structural elements of a LH2 tank
- Substitute metal spinning of domes by deep drawing technology of non-heat treatable aluminium alloys
- Semi-automatic / fully-automatic welding by using a welding robot
- Analyse the use of multi-functional blocks instead of separate components and interconnections
- Analyse integration of cold box into primary vacuum chamber of LH2 tank

Methods

- Selecting proper design and alloys to reduce manufacturing processes
- Integrated system approach

Risks & mitigation opportunities

- Switch from 6000 series aluminium to 5000 series (non-heat treatable, cold hardening) leads to higher mass → redesign with alternative aluminium alloys
- Upscaling of dome manufacturing by deep drawing hindered by lack of suppliers at reasonable costs

Enhanced design, Modelling & testing expertise

Innovative approach

- Use of CFD and improvement of reduced-order models for investigating complex phenomena and improve component design
- Development and experimental validation of a digital twin model of the tank system

Methods

- Experimental investigations of components (valves, filling lines) and tank system with LH2 for design verification
- Multi-phase CFD approaches, 0D/1D models, data regression, and generation of reduced-order models
- State-of-the-art FEM approaches

Risks & mitigation opportunities

- Modelling/Sim. could be too complex in terms of simulation time/stability → mitigation via cleverly defining system boundary conditions or breaking simulation domain into reasonable sub-simulations

Exploitation potential

Knowledge

- Knowhow for lightweighting LH2 tanks in order to achieve market oriented gravimetric index values
- Validated technologies & improved expertise for further development of safe components, subassemblies & systems in contract research
- Exploitation of validated simulation models and enhanced physics knowledge to advance further the technologies
- Demonstrating research excellence in the field of LH2 in Austria through high-quality publications
- Newly generated knowhow will flow into education through HyCentA`s close ties with the TU Graz

European projects

- Offering the best solution for the Clean Aviation Call#3: Integration of LH2 propulsion system into experimental CS23/CS25 aircraft
- Applying in parallel for HORIZON-JU-CLEAN-AVIATION- 2026 Phase 4

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