



# AVL Test System Solutions for Alternative Fuels in Large Engines

Methanol, Hydrogen, and Ammonia

# Engine Development for Alternative Fuels

As the global push for sustainable energy and transportation intensifies, alternative fuels that reduce greenhouse gas emissions are increasingly taking center stage. Ammonia, methanol, and hydrogen offer a promising pathway to substantial emissions reductions while maintaining performance and reliability.

## ENGINE DEVELOPMENT

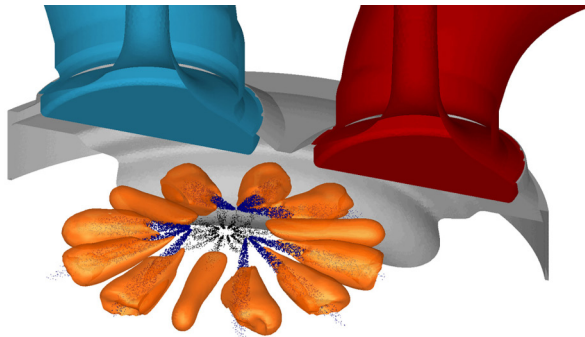
AVL's unique methodology in large engine development proves exceptional for minimizing development time and costs while achieving a high degree of accuracy. This methodology integrates single cylinder engine tests with comprehensive 1D and CFD simulation and advanced measurement techniques.



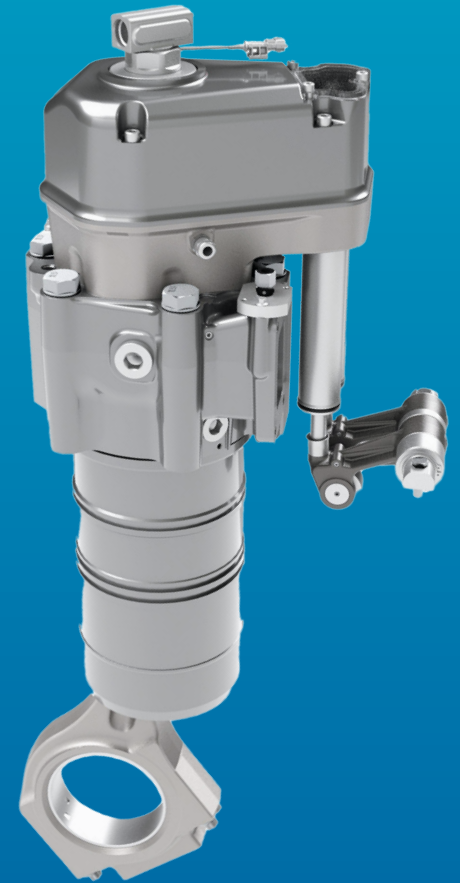
AVL high-speed Single Cylinder Engine - 5.2 l

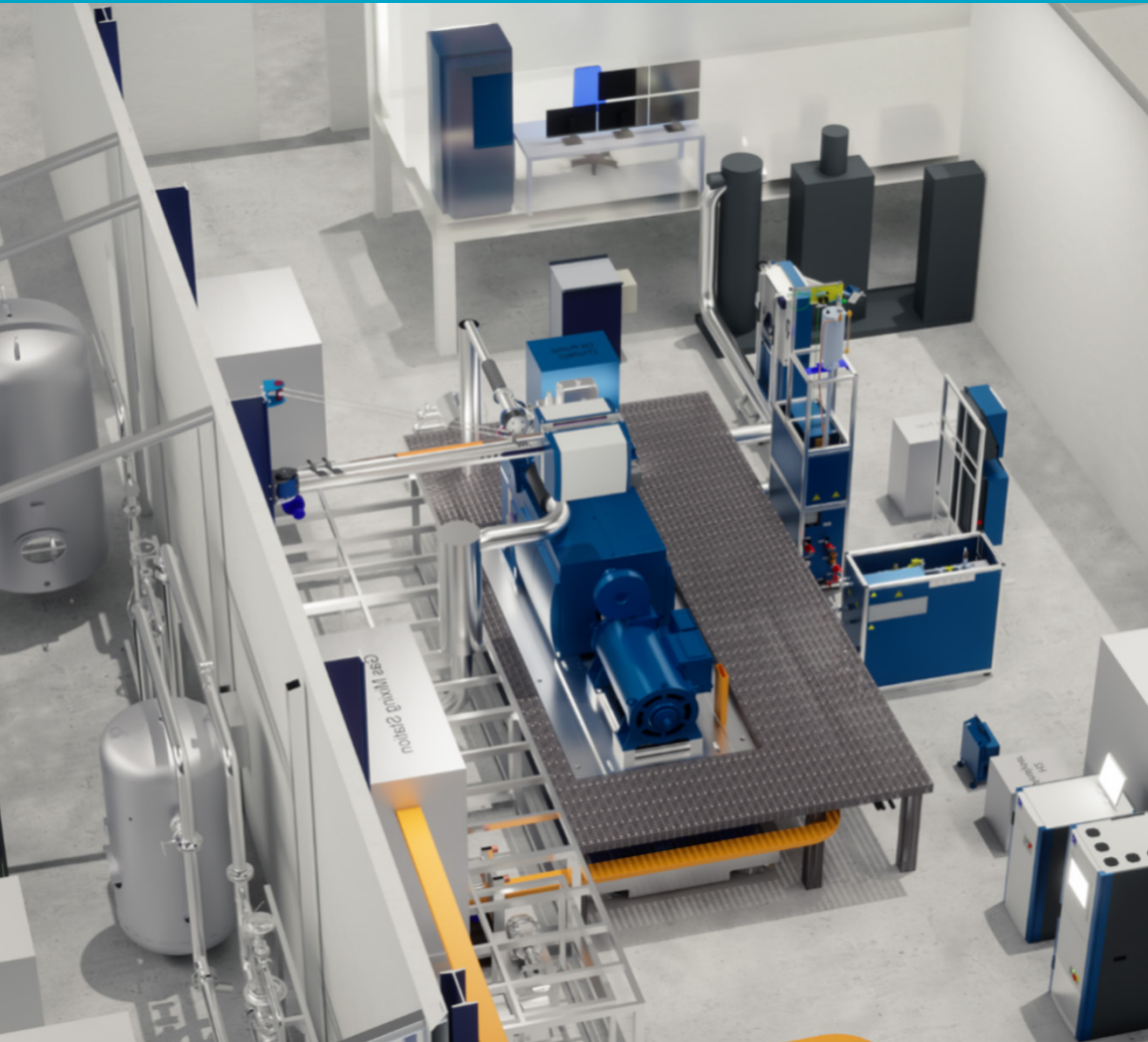
## SIMULATION

AVL's simulation solutions enable engineers to optimize the modern combustion engine and achieve carbon neutrality. Scalable simulation models and robust application methods support the development of alternative fuel ICEs in terms of performance, emissions, durability, and acoustics.



Simulation of methanol direct injection





Concept engineering of a Single Cylinder Testbed 230 mm bore for multifuel operation and gas mixing unit (hydrogen, CNG, propane, CO<sub>2</sub>, and ammonia)

# New Fuel Supply and Testbed Infrastructure

## FROM REQUIREMENTS TO REALITY

With the holistic AVL Tech Center Solution approach, we are focusing on the integration of test systems into the building and establishing of all utility interfaces, which results in a complete, superior solution. Customer needs can range from rough plans to detailed specifications. AVL provides best practice solutions based on a high level of expertise in automotive and marine engine testing.

### SAFETY

- Handling methanol, hydrogen, and ammonia in liquid or gaseous states presents specific risks.
- AVL assesses and transforms the testing environment, focusing on safety and toxicity, fuel infrastructure, and integration of safety routines into the automation system.

# Testbed Instrumentation

## SAFE AND ACCURATE MEASUREMENT SYSTEMS

AVL's exhaust emission measurement systems incorporate device- and fuel-specific safety measures and adaptations for correct and reliable measurement as well as dedicated evaluation routines. Thus, ensuring compliance with the regulatory and measurement application-specific demands related to hydrogen, ammonia, and methanol.

Combustion analysis and flame visualization is crucial during the engine development phase to optimize every single combustion cycle. This requires highly accurate sensors compatible with the specific fuel characteristics. The data acquisition platform AVL X-ion™ maximizes the data quality to successfully achieve the development targets.



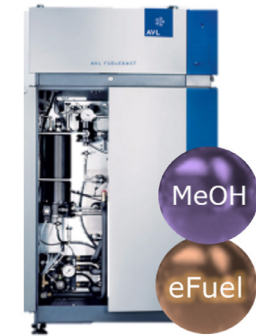
AVL HyTron™



AVL AzanTron™



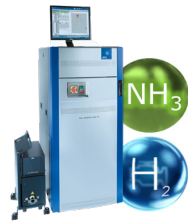
AVL Blow By Meter™



AVL FuelExact™ FlexFuel



AVL AMA SL™  
Exhaust Measuring System



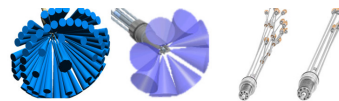
AVL SESAM i60 FT™  
FTIR Measuring System



AVL X-ion™



AVL IndiCom™



AVL Visiolution



AVL H2D™/AVL H2D™ +  
Mass Spectrometer



AVL Smart Sampler PLUS  
Partial Flow Dilution

AVL gaseous and particulate exhaust emissions measurement technology for hydrogen, methanol, and ammonia

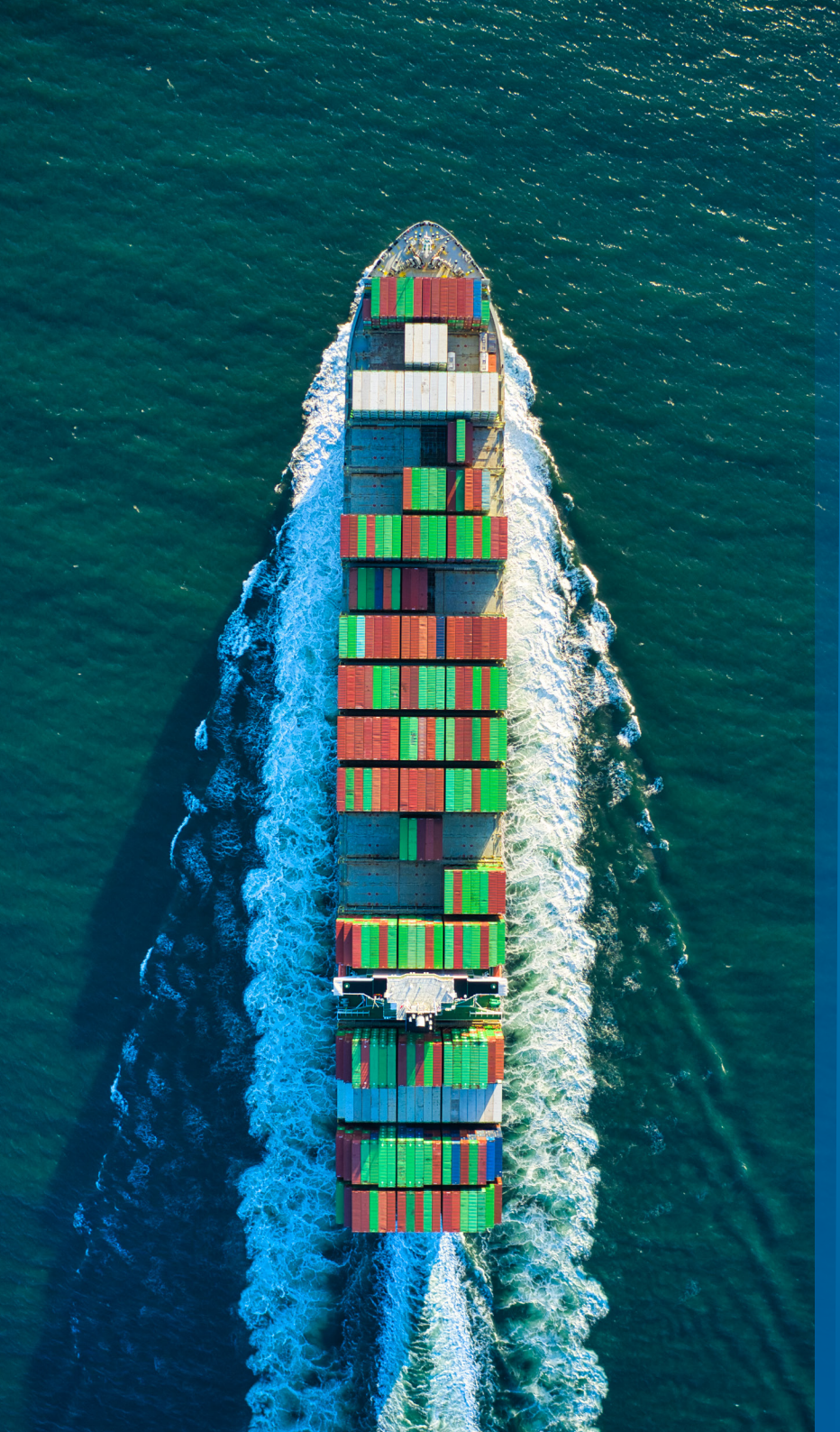
Study of preignition and knocking phenomena with IndiCom, X-ion, and Visiolution

## FUEL CONSUMPTION MEASUREMENT AND CONDITIONING

AVL HyTron™, AVL AzanTron™, and AVL FlexFuel™ are integrated solutions for hydrogen, ammonia, and methanol, achieving measurement accuracy, safe operation, and a stable thermodynamic state guaranteeing precise flow, pressure and temperature conditions according to the demands.

## BLOW BY MEASUREMENT FOR H<sub>2</sub>

The AVL 442H Blow by Meter can safely measure the blow by gas when high concentrations of hydrogen are present.



## Why Partner with Us?

- **Reliable Solutions and Insights**  
Leverage our automotive expertise and knowledge to gain reliable solutions and valuable insights for the development and validation of large engines.
- **Holistic Testing Approach**  
Our comprehensive approach covers critical aspects such as safety and toxicity, fuel infrastructure, thermal management, and system integration, ensuring comprehensive and reliable results for your next-generation engine endeavors.
- **Cost Efficiency**  
Optimize your engineering and testing processes, enhance efficiency, and make informed decisions to reduce overall development costs with our cost-efficient solutions tailored to your needs.
- **Cutting-Edge Testing Technology**  
Stay ahead of the competition with our state-of-the-art testing systems, methodologies, and software. Leverage the latest advancements to navigate the new large engine generations.
- **Global Reach, Local Expertise**  
Benefit from our global presence and local network of experts. We provide local support and expertise wherever you operate.

With our comprehensive services and products, AVL supports your efforts throughout the entire process of developing alternative fuel engines, from concept through detailed design to testing.



# *Reimagining Motion*

**For a greener, safer, better world of mobility.**

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