

ADAPTH₂

FOR ULTRA-LEAN H₂ COMBUSTION

IGNITION:
SAME-CYCLE SPARK CONTROL
→ STABLE COMBUSTION

PRECHAMBER:
COMPOUND VORTEX & ACTIVE
SCAVENGE FLOW → FAST FLAME SPEED

INJECTOR:
FLEXIBLE JET DYNAMICS
→ HOMOGENEOUS MIXTURE

H₂-ICES
Diesel-like performance
with zero emissions

ALTRONIC

PROMETHEUS APPLIED TECHNOLOGIES

HOERBIGER

A unique holistic solution for ultra-lean H₂ combustion

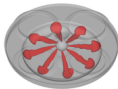
A cooperation between HOERBIGER, Altronic and Prometheus Applied Technologies

Achieve diesel-like performance with zero emissions in your H2 engine

HOERBIGER, ALTRONIC and PROMETHEUS are technology leaders in H2 injection, ignition and combustion solutions, respectively. They have developed the AdaptH2 holistic solution for ultra-lean H2 engines which has been tested extensively and has demonstrated the potential to achieve diesel-like performance with zero emissions in Marine, Power Generation and Mobile (On & Off-Road) applications (1, 2, 3, 4).

Prechamber combustion

Patented flow-dynamics enables fast, ultra-lean combustion via turbulent flame jet ignition



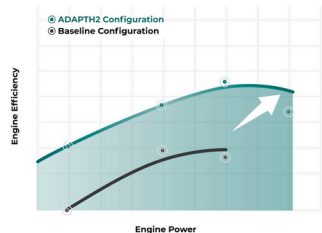
Same-cycle adaptive ignition

Patented predictive, model-based spark control enables robust flame initiation



Homogeneous mixture

Flexible H2 injector diffusivity enables high in-cylinder air-fuel conformity

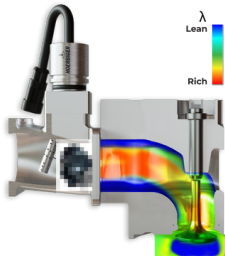


Engine test references

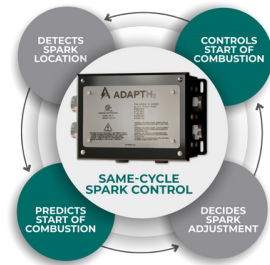
- (1) Sotiropoulou, E., et al: Same-Cycle Spark Control: The Future of Hydrogen Engines. 13th Dessau Gas Engine Conference, Dessau, Germany, 2024.
- (2) Tozzi, L., et al: Improving the Efficiency/Emissions Trade-off with a Novel Lean-Burn Precombustion Chamber. 10th Dessau Gas Engine Conference, Dessau, Germany, 2017.
- (3) Lepley, D.T., et al: Optimizing High-Energy Tunable Ignition Technology: Preventing Electrode Damage while Extending the Lean Limit of Gas Engines. In: GMRC Gas Machinery Conference, Nashville, TN, USA, 2014.
- (4) Buckley, J.: [Zemann B.] Hydrogen Injectors for IC Engines, Diesel Progress International, May-June 2022.

How it works

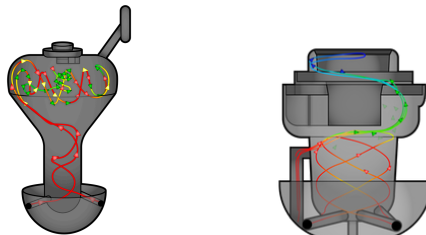
To assure homogeneity of the H₂-air mixture, a flexible jet dynamics injector, tailored to the specific intake port design, combined with an intake turbulence inducer and a port deflector are used to define the flow characteristics needed to enhance the H₂ in-cylinder mixing.



The “Predictive Model-Based Spark Control” patented technology(1,2), enables to adjust the ignition energy within microseconds from the initiation of the spark to ensure stable combustion throughout the range of speed, load and transient operations.



Moreover, patented prechamber technologies, like the Compound Toroidal Vortex(3) and the Active Scavenge(4), are used to minimize the thermodynamic losses from ultra-lean H₂ flames and, hence, assure fast and stable combustion under all operating conditions.



Patents

- (1)Tozzi L.: “Model-based Predictive Spark Control” US18/219,692 , 18/732,374, etc.
- (2)Lepley J. M.: “High Tension Capacitive Discharge Ignition with Reinforcing Pulses” US7,401,603, etc.
- (3)Tozzi, L.: “Lean Burn Pre-Combustion Chamber” EP3203050, 4/17/2019, etc..
- (4)Sotiropoulou, E. M. : “Active Scavenge Prechamber” EP2971635, 9/20/2017, etc.

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