
italtecnica
ENGINEERING YOUR IDEAS

SERVICES

Italtecnica has proven experience in the combustion engines field, prototypes and special vehicles produced in small series.

It guarantees a complete, turnkey offer: from the design, to the production and testing, for the construction of vehicles and high-performance powertrains.

POWERTRAIN

Design, production and testing of high-performance combustion engines and hybrid powertrains.

CHASSIS AND SUSPENSIONS

Design, virtual simulation, prototyping and tuning of chassis and suspensions

VEHICLE EQUIPMENT

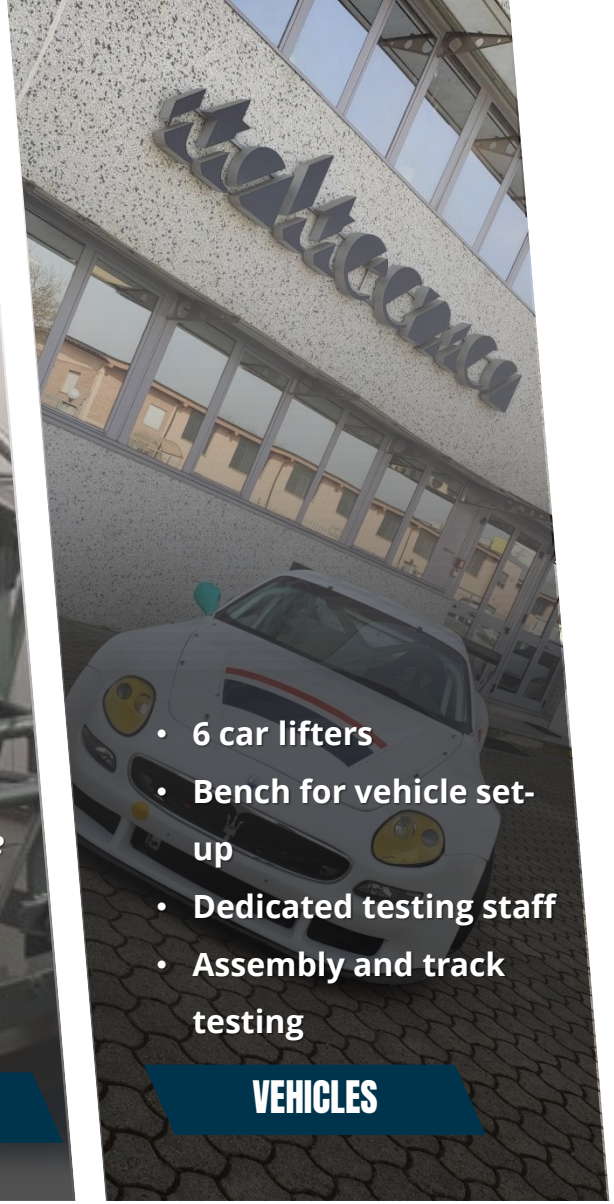
Engineering and validation of every kind of vehicle, including all the auxiliary systems (cooling, lubrication, fuel supply, HVAC, ecc.), engine/parts swap.

- 7 test benches for combustion engines
- 2 test benches for electric powertrains
- Tilting bench
- Flow meter and dedicated equipment
- Assembly and teardown department

POWERTRAIN

- Control plate with *measurement machine*
- TIG and MIG welding
- Laser cutting
- CNC machining

CHASSIS-SUSPENSIONS



- 6 car lifters
- Bench for vehicle set-up
- Dedicated testing staff
- Assembly and track testing

VEHICLES

KNOW-HOW

Italtecnica combines the technical *know how* of its specialized team to a *client-driven* approach, oriented to the problem solving.
Flexibility and adaptation are abilities acquired in the racing environment and then transfered to all the projects.
A tight bond with the suppliers and a solid network with international partners make the company an excellence.

Powertrain: from idea to you

Italtecnica with highly expertise engineers and technicians follow every steps; from preliminary idea to production.

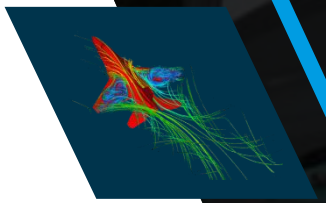
IDEA

Designing of the preliminary virtual model

01-DIMENSIONAL SIMULATION

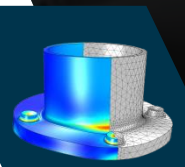
Defining of the main engine characteristics

CFD SIMULATION



Optimizing flows inside the engine

FEM SIMULATION



Optimizing of the most stressed parts

VALIDATION AND TESTING

Production, checking and bench testing of the prototype #0

YOU

Assembling and delivery to customer

ITALTECNICA & INNOVATION

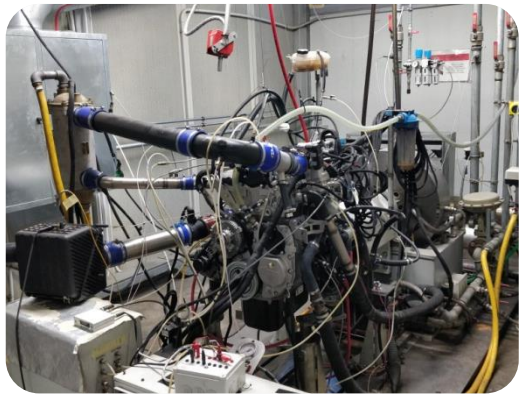
Hydrogen ICEs

Italtecnica always look to the future.

Our highly expert engineers successfully tested different projects of hydrogen ICEs, with some relevant benefits:

- **ZERO** greenhouse gases and particulates (Full Hydrogen mode);
- Relative **short design period**
- **Large application perspective** with small investment by the customers
- In comparison with the fuel cell, it could be faster to apply in a large scale in order to have a **swift reduction of pollution** in urban environment

V8 Engine during assembling phase in Italtecnica



4Cyl Engine during testing phase in Italtecnica

V8 Engine during expo presentation

ITALTECNICA & INNOVATION

FBS project: base idea and motivation

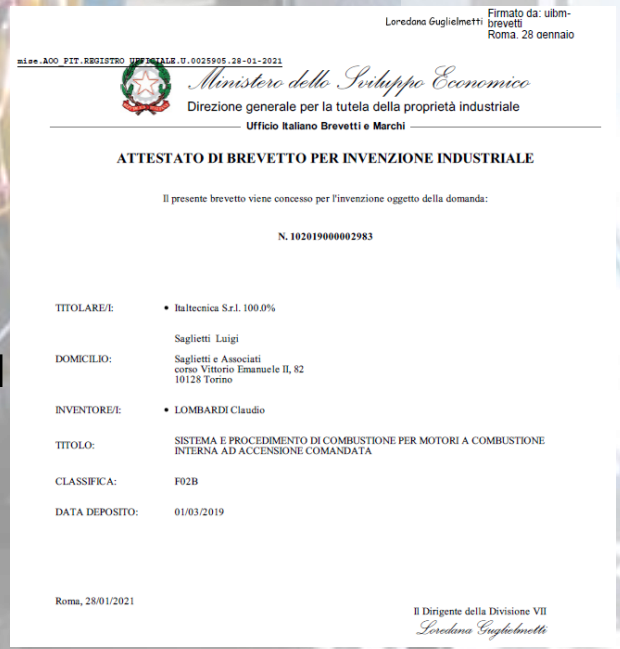
Efficiency ≥ engines Diesel

Reduced pollutant emissions

FBS combustion system

The idea at the base of the FBS project is to have a combustion system that allows a **stable functioning of spark ignition engines with very lean air/fuel mixtures**, with a considerable reduction in the specific fuel consumption, CO_2 and pollutant emissions.

This system called FBS (Fast Burning Cycle), is patented.



Loredana Guglielmetti Firmato da: uibm-brevetti Roma. 28 gennaio

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Ministero dello Sviluppo Economico

Direzione generale per la tutela della proprietà industriale

Ufficio Italiano Brevetti e Marchi

ATTESTATO DI BREVETTO PER INVENZIONE INDUSTRIALE

Il presente brevetto viene concesso per l'invenzione oggetto della domanda:

N. 102019000002983

TITOLARE/I:	• Italtecnica S.r.l. 100.0%
	Saglietti Luigi
DOMICILIO:	Saglietti e Associati corso Vittorio Emanuele II, 82 10128 Torino
INVENTORE/I:	• LOMBARDI Claudio
TITOLO:	SISTEMA E PROCEDIMENTO DI COMBUSTIONE PER MOTORI A COMBUSTIONE INTERNA AD ACCENSIONE COMANDATA
CLASSIFICA:	F02B
DATA DEPOSITO:	01/03/2019

Roma, 28/01/2021

Il Dirigente della Divisione VII

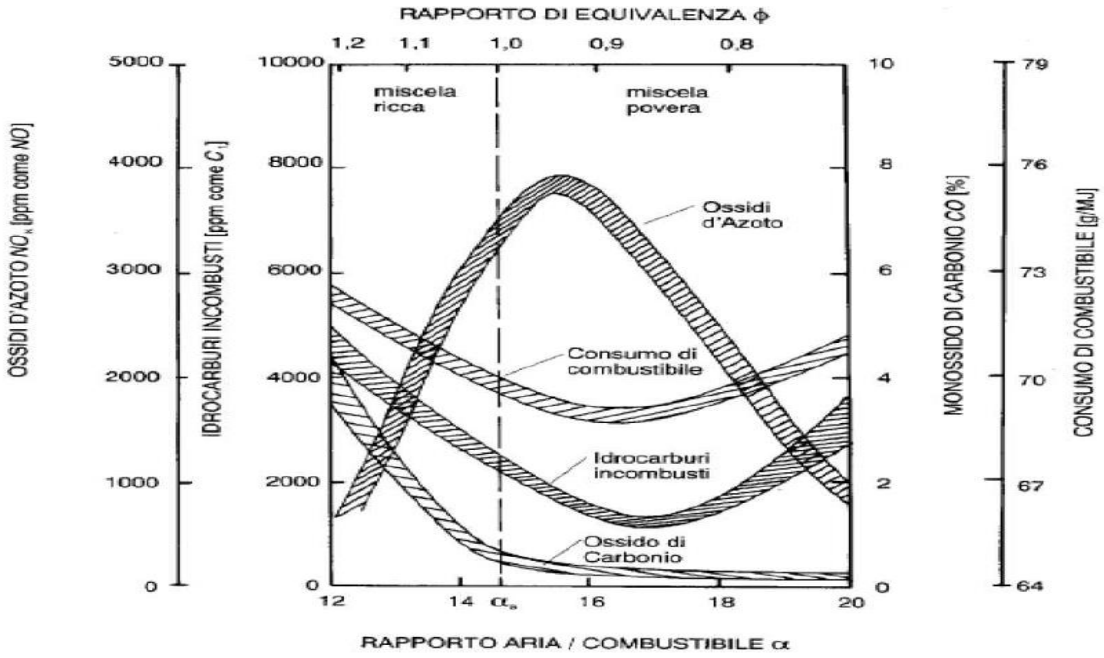
Loredana Guglielmetti

ITALTECNICA & INNOVATION → FBS SYSTEM

As it is known from literature, in spark ignition engines, the combustion of lean mixtures (α >14,7 for gasoline) is advantageous in terms of reducing pollutant emissions and improve efficiency.

Over a certain value of A/F ratio, the quality of the combustion in conventional engines decreases. Some phenomena such as “misfiring” start to occur and pollutant emissions, in particular unburned hydrocarbons (HC) increase significantly, not allowing the engine to operate in such conditions.

The FBS system allows the engine to operate in a stable way with ultra-lean mixtures, with significant advantages in terms of efficiency, without incurring in the problems discussed above.

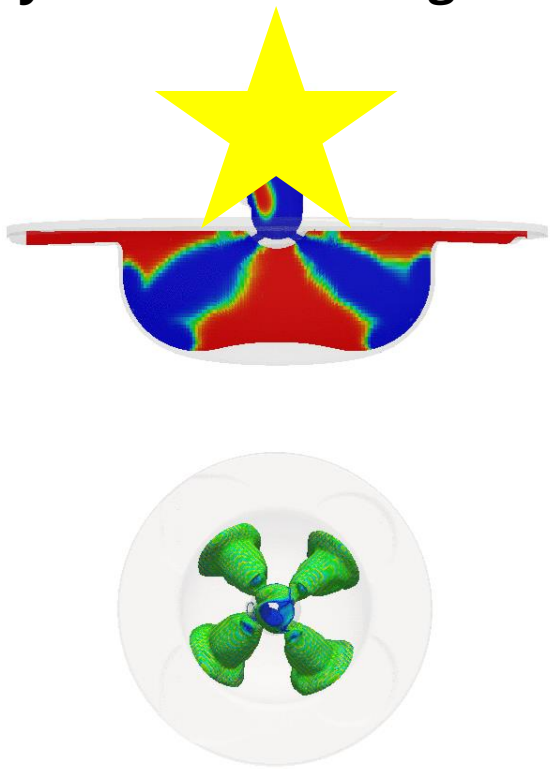


Pollutant emissions as a function of α in a conventional spark ignition engine

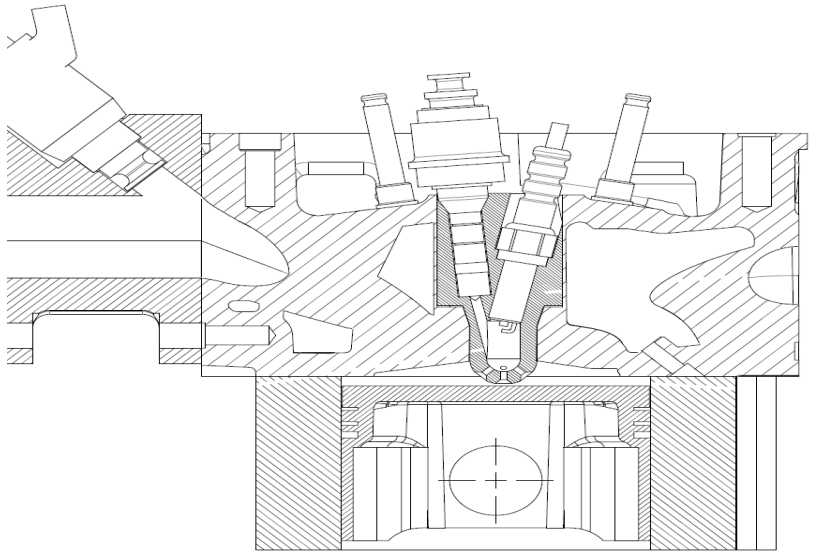
FBS system functioning:

The system is made of a main combustion chamber and of a small pre-chamber from where partially oxidized highly reactive mixtures are ejected. Their purpose is to increase the activation energy of the combustion inside the main combustion chamber.

The combustion inside the main chamber doesn't develop as a flame front but it is of a diffusive type. In fact a fast **increase in the flame speed** occurs, which determines a significant increase in the thermal efficiency, allowing the engine to operate with A/F ratios much greater than stoichiometric.



Picture of the combustion system in operative condition



Picture of the combustion system without reference to the patented design

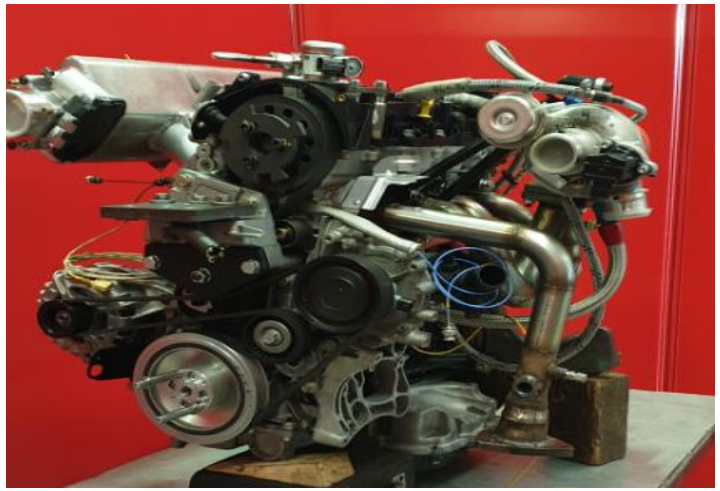
The system is different from the other pre-chamber ones thanks to some distinctions in the design of the pre-chamber and the injection modalities. Moreover it is designed to provide a good scavenging and cooling of the pre-chamber, limiting the formation of carbonaceous residues and nitrogen oxides NOx. Another characteristic is the reduction in the production of particulate matter (PM), so it is possible to avoid expensive devices which nowadays are necessary also in spark ignition engines.
The originality of this pre-chamber system, **applicable both to the active pre-chamber solution and to the passive one**, is based on the mutual positioning of injector and spark plug inside the pre-chamber and allows the chamber to **operate also at low engine loads**.

FBS system advantages with respect to conventional spark ignition engines:

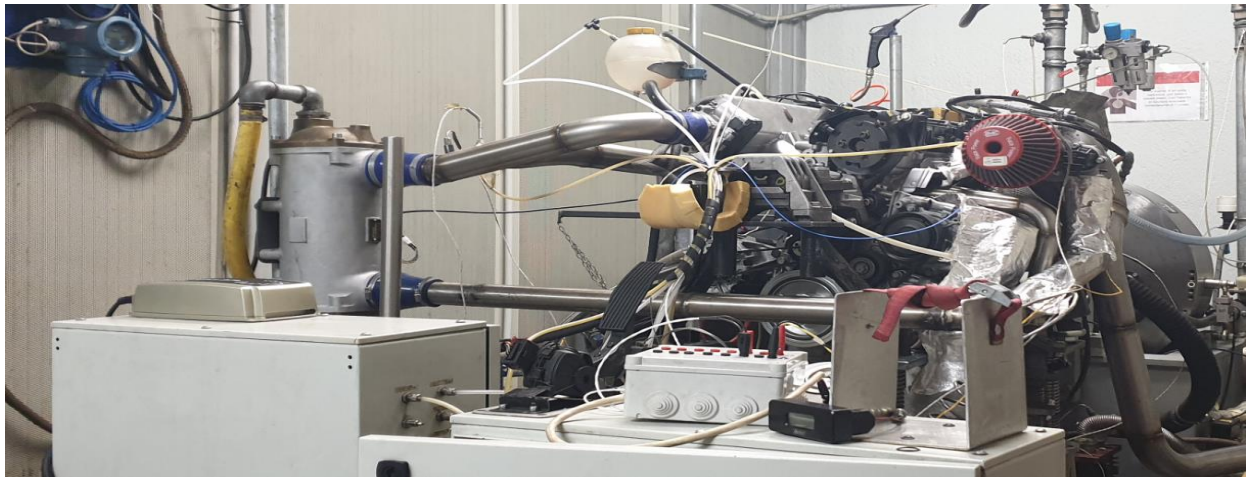
Improved thermal efficiency

Significant reduction of pollutant emissions, in particulart NO_x, PM and CO_2

Reduction in specific fuel consumption



First FBS prototype realized



FBS prototype installed on the test bench

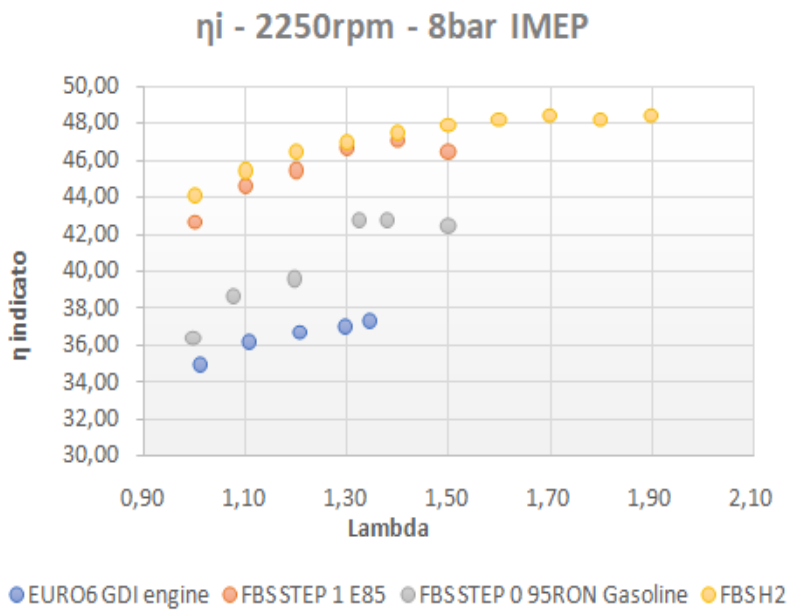
Comparison with other combustion systems being studied:

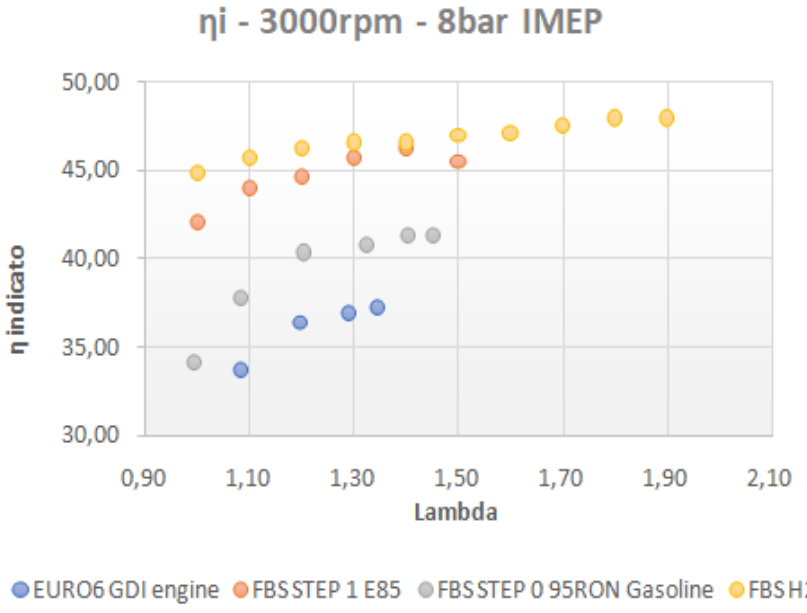
	Advantages:	Disadvantages:	Disadvantages solution with FBS system combustion engine
Stratified charge combustion	Improvement of the combustion efficiency	High NOx production	Reduced NOx formation thanks to combustion temperature control
	Reduction of specific fuel consumption and CO2 emissions	Particulate matter formation	Substantial delete of PM formation by homogeneous charge combustion
Homogeneous Charge Compression Ignition (HCCI)	High thermodynamic efficiency	Difficult engine control	Reduced engine control difficulty due to the presence of the ignition system
	Reduction of specific fuel consumption and CO2 emissions	Not possible to use it in all engine operating conditions	The system remains a spark ignition and it is not subjected to spontaneous ignitions phenomena that make difficult the control of HCCI combustion
	Reduction of NOx emissions	Difficult cold starts	
		Increased CO & HC emissions	The ejection of highly reactive compounds from the pre-chamber allows the system to virtually overcome “misfiring” and incomplete combustion phenomena that lead to CO & HC production
Combustion with pre-chamber	Improved combustion efficiency	Possible pre-chamber overheating, in particular of spark plug	The system is designed to operate a good scavenging and cooling of the pre-chamber, limiting the formation of carbon deposits
	Reduction of specific fuel consumption and CO2 emissions	Possible formation of carbon deposits in the pre-chamber that can cause abnormal combustions or knock	
		Increased NOx and PM concentration at exhaust	To reduce NOx formation the combustion temperature is kept under control

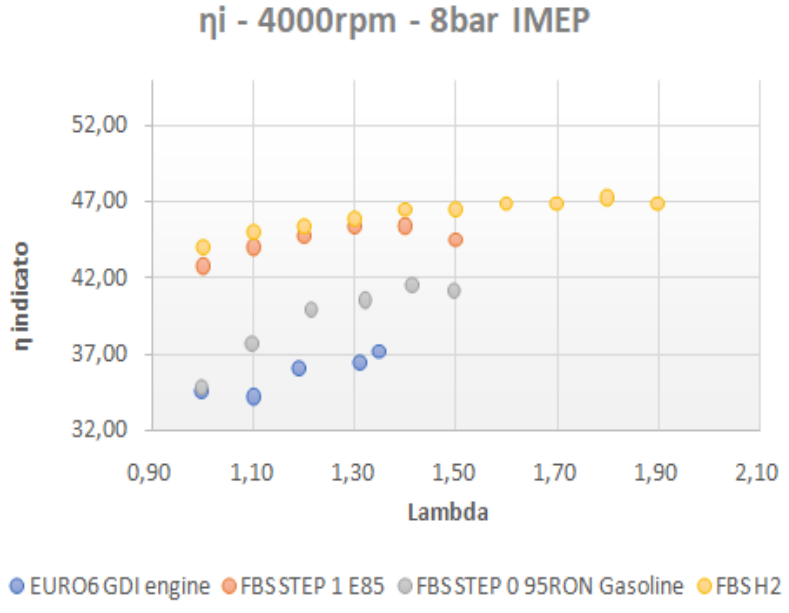
Testing results comparison

Comparison test performed with same bourdary conditions below indicated:

- Cylinder displacement (0.5l)
- Intake manifold air temperature
- Oil and water temperature
- Fuel consumption / Engine IMEP
- Exhaust gas pressure
- Misfiring is identify if IMEPCoV>3
- Knock is identify if MAPO>rpm/1000
- Test performed with passive prechamber + PFI configuration
- **λ** limit with H2 fuel reach for acquisition problem
- H2 tests performed with PFI configuration pfuel=30bar

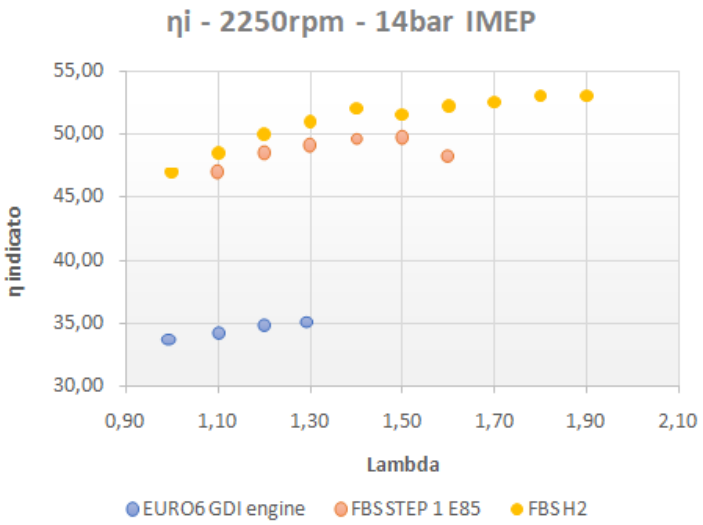


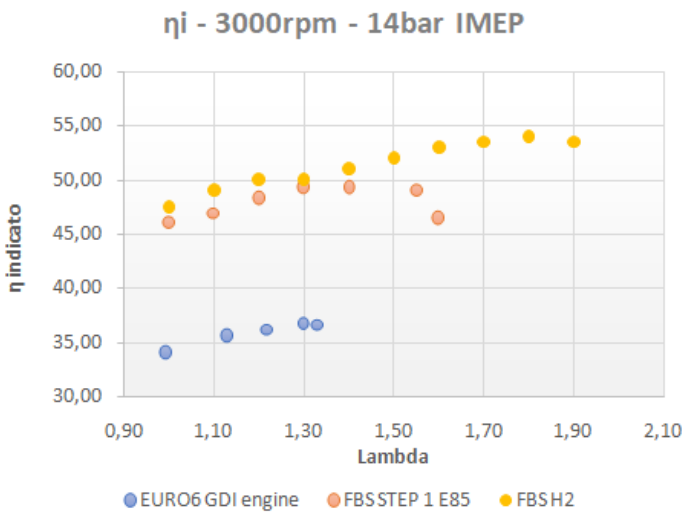


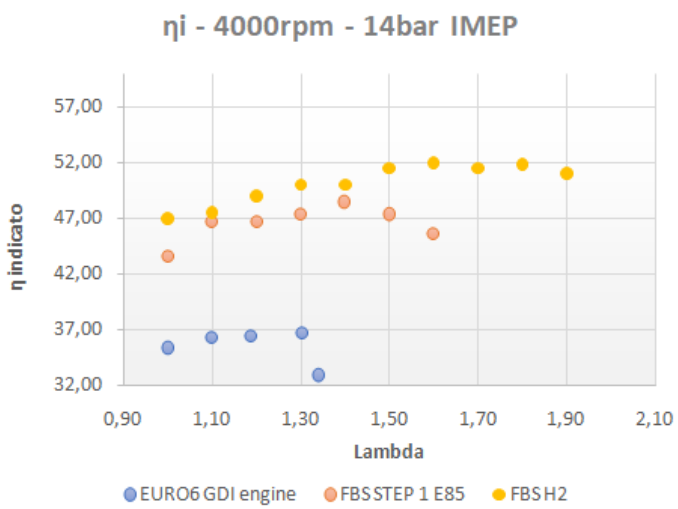


It is reasonable to think that the further development of the system through tests of different configurations of prechamber volumes and geometries of communication orifices can increase efficiency and lead to results of significant interest.

Testing results comparison







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- **ZERO** greenhouse gases and particulates (Full Hydrogen mode);
- Relative **short design period**
- **Large application perspective** with small investment by the customers
- In comparison with the fuel cell, it could be faster to apply in a large scale in order to have a **swift reduction of pollution** in urban environment

FBS Possible applications:

Engines equipped with this combustion system can be industrialized and introduced on the market in a very limited amount of time and with limited money investments. In fact **this combustion system –especially in passive version- can be applied to common production engines** and can be produced using conventional components and equipment (the pre-chamber is subjected to thermal and mechanical stresses similar to the exhaust valves ones).

In other words, the system here proposed represents a solution with an efficiency similar to the Diesel engine one, but with much less pollutants production, in particular PM and NOx.

This system, thanks to its high efficiency and reduced pollutant emissions, can be suitable in passive and active variants for many applications with fuel gasoline, CNG, H_2, CNG+H_2, methanol in different fields:

- Car and commercial vehicles powertrains
- Small aircraft powertrains
- Heavy duty vehicles powertrains
- Thermal engines for electricity generation and cogeneration

Developement team:

Ing. **CLAUDIO LOMBARDI** (inventor of the system)

- FIAT AUTO (1969/1976) Research & Development
- LANCIA (1976/1982) responsible for engine design and development
- ABARTH (1982/1990) Engine technical director- General director
- FERRARI (1990/2000) F1 and GT engine responsible
- APRILIA (2000/2010) responsible for 4 stroke engines design
- from 2011: automotive consultant for energy production systems based on renewable energies.

ITALTECNICA s.r.l. (system developer)

- PEUGEOT SPORT (1986/1998): Racing team in Italy, Germany and Switzerland
- ALFAROMEO (1992/1995) :V6 ICE development
- PININFARINA (1995/2008): Prototypes and one-off vehicles
- FERRARI (1999/2004): Prototype ICE construction
- ITALDESIGN (from 2004): Prototype vehicles construction
- MASERATI (2004/2010): GT V8 & V12 ICE development
- GENERAL MOTORS / PUNCH (from 2004): Diesel and e-fuel ICE development
- ABARTH (2013/2017): Racing ICE development
- FPT/NATO (2016/2018): alternative fuels ICE development
- EATON (from 2017): tests for optimization of engine components
- NGV Powertrain (from 2020): CH_4, H_2 and NH_3 ICE development

POLITECNICO MILANO

ICE GROUP POLITECNICO DI MILANO

The Energy Department of Politecnico Milano is a project partner and is responsible for carrying out a detailed study of the proposed combustion system and optimizing it through CFD calculation activities.
It is composed by 5 full professors, 3 researchers, 2 researcher and 5 doctoral students. The research activities are focused on the modeling of the thermo and fluid dynamic processes that occur in internal combustion .
The activities of the ICE-Group are known to the international scientific community. Since 2000, the group has presented over 200 publications at international conferences (SAE) and in scientific journals

MAIN CUSTOMERS AND PARTNERS

CONTACTS

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