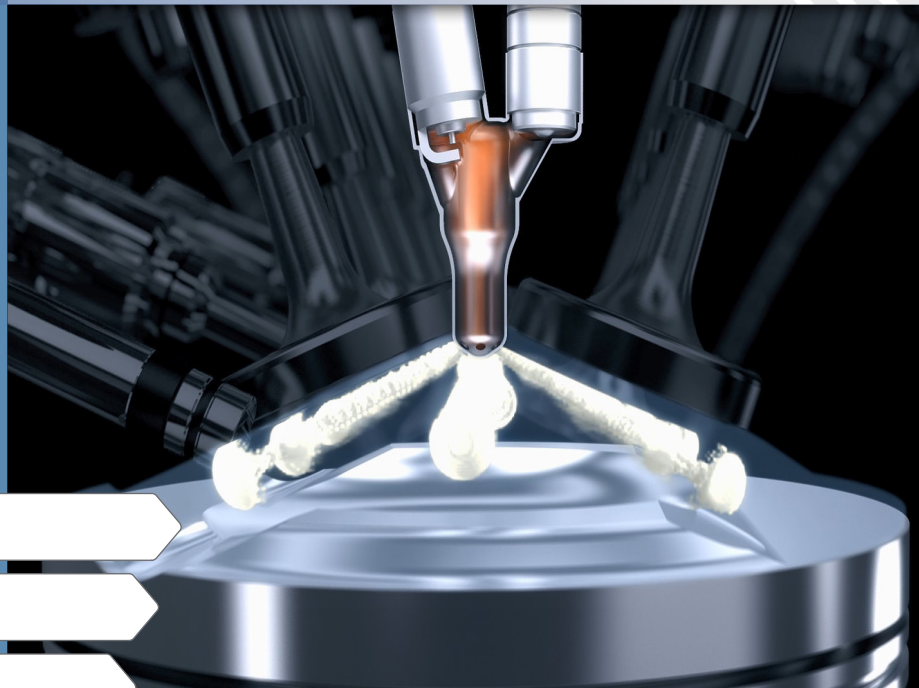


MAHLE Jet Ignition® (MJI)

High Efficiency

Emissions Improvements

Knock Reduction



Injector and spark plug
configuration in active
system

Overview

Combustion development is a key enabler to achieving future vehicle fuel economy and emissions targets. For many years, MAHLE Powertrain has been conducting advanced combustion research, culminating in the development of the MAHLE Jet Ignition® system.

MAHLE Jet Ignition® is a pre-chamber based combustion system, for spark ignited engines, where the spark plug is relocated within a small volume pre-chamber.

Two versions of the MJI system have been developed:

- Active MJI featuring a spark plug and micro-flow fuel injector within the pre-chamber
- Passive MJI which only contains a spark-plug

Achievements

- Stable ultra-lean operation throughout engine map (active)
- Fuel consumption below 200 g/kWh (>42% BTE)
- Catalyst heating and stable idle operation
- Patents on scaling pre-chamber geometry – enables rapid integration of MJI into any engine
- Cold start patents pending

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MAHLE Product Information 05/2019

MAHLE Jet Ignition® (MJl)

Active MJl

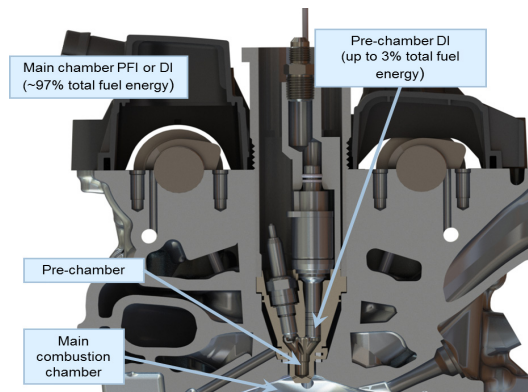
2 fuel injectors utilised:

- 1 Injector (DI or PFI) for delivering the main charge
- 1 Injector (DI) in pre-chamber with a low flow rate

Benefits:

Ultra lean operation ($\lambda \approx 2.0$) benefits:

- High efficiency gasoline (Sub 200g/kWhr, >42% brake thermal efficiency)
- Low NOx emissions (sub 100ppm)
- Knock reduction
- Enables high compression ratio operation



>> Cross section of active system



>> Passive system

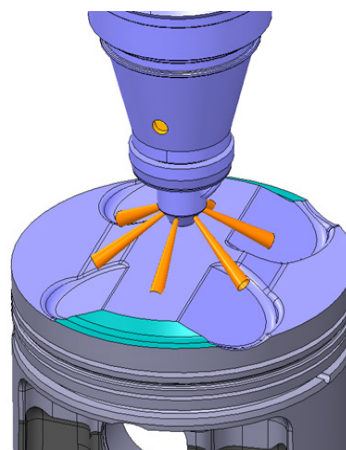
Passive MJl

1 fuel injector utilised:

- 1 Injector (DI or PFI) for delivering the main charge
- No injector required in the pre-chamber (fuelling carried over from main chamber)

Benefits:

- Stoichiometric operation ($\lambda \approx 1.0$) (conventional after-treatment utilised)
- Rapid, stable combustion enables high dilution tolerance allowing high EGR rates
- Enhanced efficiency and $\lambda \approx 1.0$ operation at high loads
- Compatible with Miller-cycle operation
- Knock reduction (enables high CR operation)



>> Typical MJl orifice pattern

System Development

MAHLE has extensive experience developing pre-chamber based combustion systems.

- Detailed understanding of interaction of pre-chamber geometry
- Patented relationships lead to rapid, successful MJl integration into customer engines
- Advanced CFD models correlated to test data for both the active and passive MJl systems
- Post processing tools developed enabling greater degree of insight from empirical data