



Contents of Work Package WP 02 Advanced Concepts of ICEs

1-WP02-004 | Module for the experimental investigation of port injection mixture formation

1-WP02-005 | Mule engine for friction loss measurement

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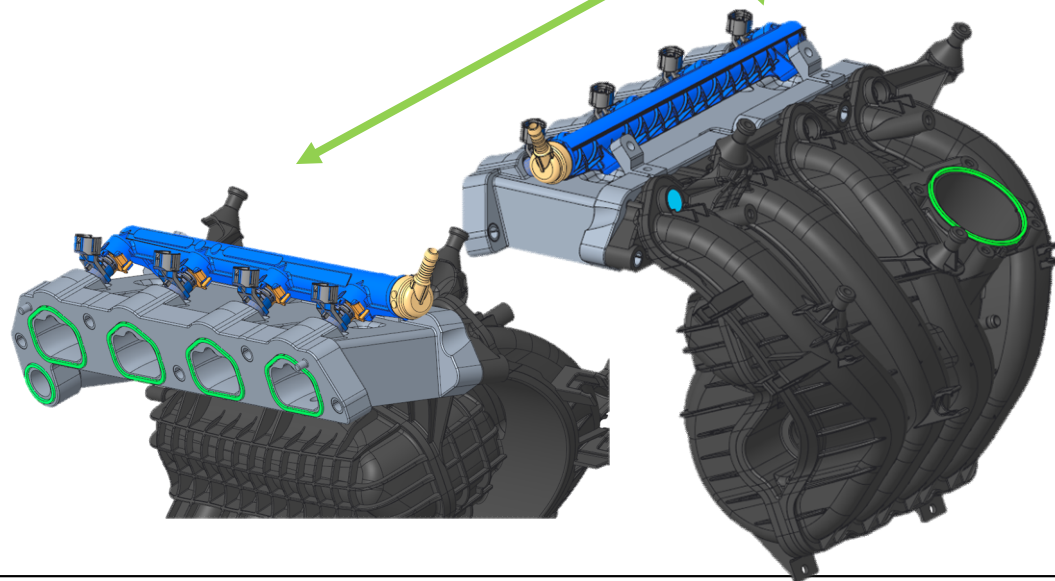
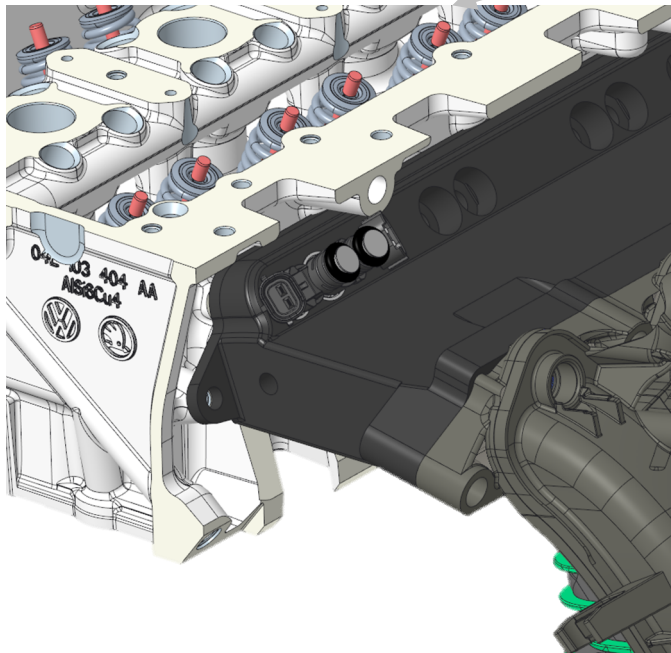
Technical University Liberec



1-WP02-004 | Module for the experimental investigation of port injection mixture formation

Requirements:

- The possibility of using a second fuel strip in the intake,
 - possibility to use fuel rail 04E.133.319.BB and AN,
 - hole to place an endoscope,
 - hole to place the thermocouple.
- Option 1 - TUL
 - Dimensional possibilities, collision screening,
 - positioning the injector pair side by side.
 - Option 2 - partner ŠKODA auto
 - Modifying the module (positioning the injector pair side by side),
 - optimizing channel shape.





1-WP02-004 | Module for the experimental investigation of port injection mixture formation

Current situation

- Produced by the 3D-printing prototype of the intake module - using HP PA12 material - gradually fitted with the original 'accessories'.
- Preparation of engine station for engine installation (ŠA 1.5MPI).
- Preparing to carry out experiments.



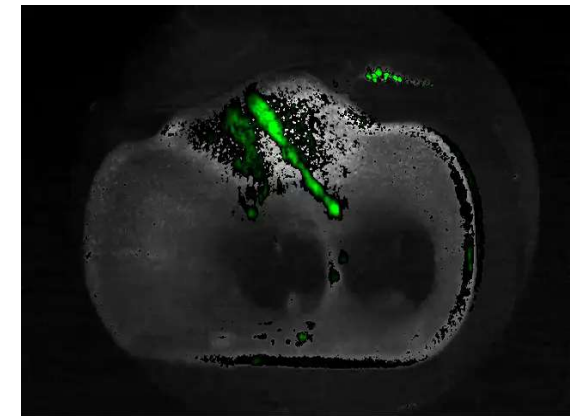
prototype from 3D printing

Process visualization

- Demonstration of the use of a visualization technique to optimize fuel injection in real-time operation.



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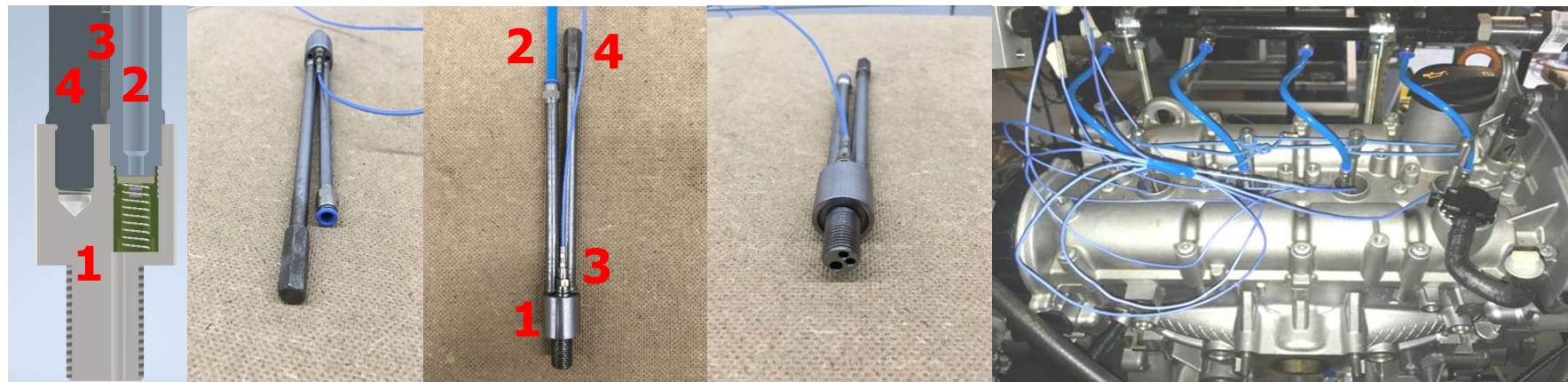
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1-WP02-005 | Mule engine for friction loss measurement

Measuring mechanical losses by motoring of ICE with increased pressure in-cylinder

- Motoring regime with disconnecting the valve control on all cylinders (the valves are closed).
- When motoring the 4-stroke engine with permanently closed valves, the exchange of the cylinder contents is removed from the working cycle ('2-stroke' mode).
- Compression and expansion phases take place at twice the frequency.
- Instead of spark plugs are screwed in the cylinder head special multifunction bolts (1).
- The multifunctional bolts consist of self-action one-way valves with a controlled supply of compressed air to the cylinders (2), pressure sensors (3), and decompression bolts (4).
- No technical problem(s) with the last version of the special one-way valve (fully function).





1-WP02-005 | Mule engine for friction loss measurement

□ **Variant B:**

- Closed working cycle („close-loop“ motored cycle) by connecting the exhaust to the intake.
- In the intake manifold is sets pressure of compressed air and thus maintains the cylinder pressure at the beginning of the compression stroke
- Motoring of the typical 4-stroke engine.
- Technical problem(s) with the oscillation of pressure in system (intake-cylinder-exhaust).





1-WP02-005 | Mule engine for friction loss measurement

Measuring mechanical losses by motoring of ICE with increased pressure in-cylinder

☐ **Variant A:**

- The test results show that **variant A** (disconnecting the valve control) is a more suitable way to investigate the mechanical losses in the internal combustion engine (ICE).
- This variant can be used to accelerate wear tests of a piston group especially piston rings.
=> The piston group is loaded with the twice frequency against the standard 4-stroke ICE.
- The main advantage of variant A with permanently closed valves is that less energy is required than for motoring the fully functional engine with closed cycle.

☐ **Variant B:**

- The values of the indicated mean effective pressure (IMEP) of the motored engine are in good agreement.
- But the experiment results show that **variant B** (closed air circulation) occurs to pulsations caused by intermittent airflows from the side of the exhaust pipe and intermittent air intakes on the side of the intake pipe.
=> This affects the reliability of cylinder exchange filling (IMEPL) measurements, and thus the measurement of the mechanical losses by motoring the engine.



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Conclusions

- 1-WP02-004: The aim was fulfilled - the prototype of module for the experimental investigation of port injection mixture formation was produced by the 3D-printing method. The experimental work is now underway in the laboratories.
- 1-WP02-005: The aim was fulfilled - the dummy of combustion engine for measuring mechanical losses by motoring of ICE with increased pressure in-cylinder was create. Functionality has been verified.
- (1-WP02-006: The aim is just about to be completed - the report is gradually being finalized. The report will show experiments and describes of dynamic phenomena in the hydraulic system for variable valve control and adjacent lubrication system.)



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Thank you for you attention

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