# New, more economical e

## Mahle Powertrain: HBM helps make engines go greener

One of the world's leading automotive consultancies, Mahle Powertrain (formerly Cosworth Technology) of Northampton in the UK, has turned to HBM in its drive to produce cleaner burning engines. Throughout the automotive industry manufacturers are seeking to develop more ecologically friendly – greener – engines by improving engine fuel consumption and simultaneously reducing exhaust emissions.

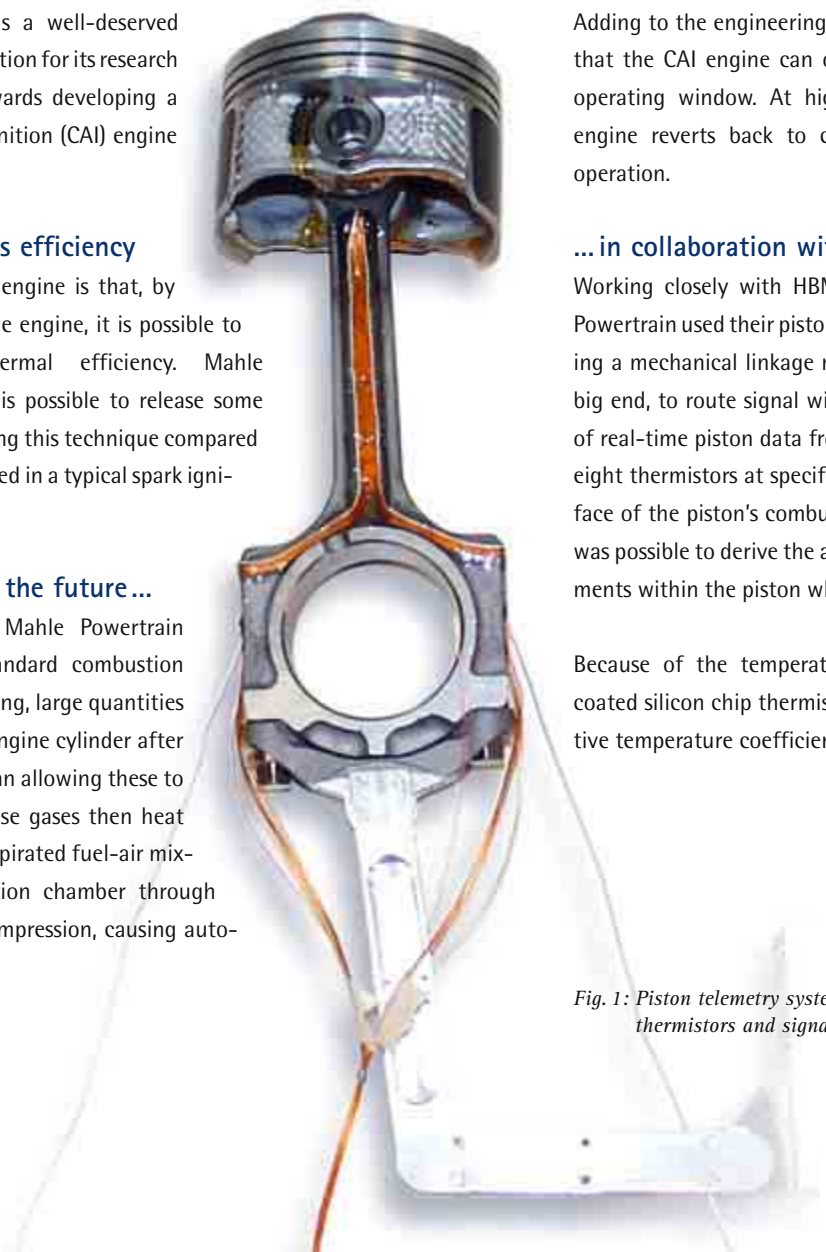
Mahle Powertrain has a well-deserved international reputation for its research that has been directed towards developing a gasoline Controlled Auto-Ignition (CAI) engine to improve fuel economy.

### Auto-ignition improves efficiency

The theory behind the CAI engine is that, by invoking auto-ignition in the engine, it is possible to significantly improve thermal efficiency. Mahle Powertrain believes that it is possible to release some 45 % of the fuel's energy using this technique compared with the roughly 25 % released in a typical spark ignition engine.

### Engine technology for the future ...

To achieve auto-ignition, Mahle Powertrain needed to change the standard combustion cycle by trapping, or re-cycling, large quantities of burned gases inside the engine cylinder after initial combustion rather than allowing these to exhaust to atmosphere. These gases then heat the next charge of freshly aspirated fuel-air mixture entering the combustion chamber through multiple ports and, after compression, causing auto-ignition.



Adding to the engineering complexity is the challenge that the CAI engine can only be used over a limited operating window. At higher speeds and loads the engine reverts back to conventional spark ignition operation.

### ... in collaboration with HBM

Working closely with HBM's team in the UK, Mahle Powertrain used their piston telemetry system, comprising a mechanical linkage mechanism from the conrod big end, to route signal wires enabling the acquisition of real-time piston data from a fired engine. By fitting eight thermistors at specific points just below the surface of the piston's combustion bowl and ring lands it was possible to derive the actual temperature measurements within the piston when the engine was running.

Because of the temperatures in the pistons, glass-coated silicon chip thermistors were used of the negative temperature coefficient variety.

*Fig. 1: Piston telemetry system with installed thermistors and signal leads*

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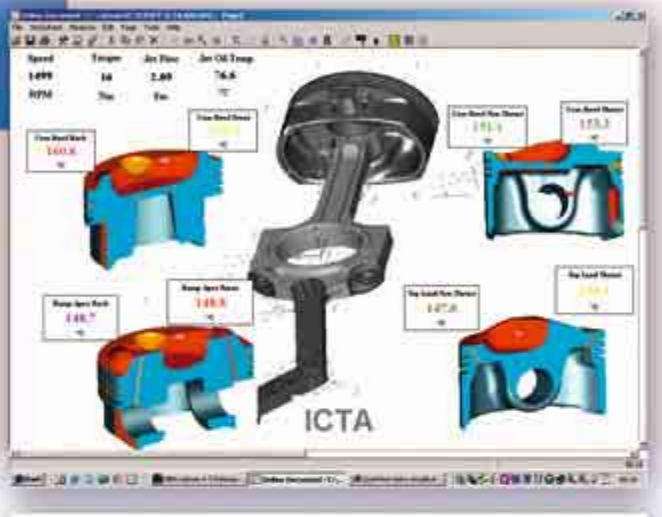
*Fig. 3:*
*Fully installed piston telemetry system*

*Fig. 4*
*Position of the eight thermistors in the piston of the CAI engine*

*Fig. 2:*
*Eight thermistors are placed under the combustion recess of the piston*




"The challenge with these thermistors is that they produce a non-linear output. However, HBM's catman® software is more than capable of dealing with this aspect."

Carl Godden, senior instrumentation engineer, Mahle Powertrain

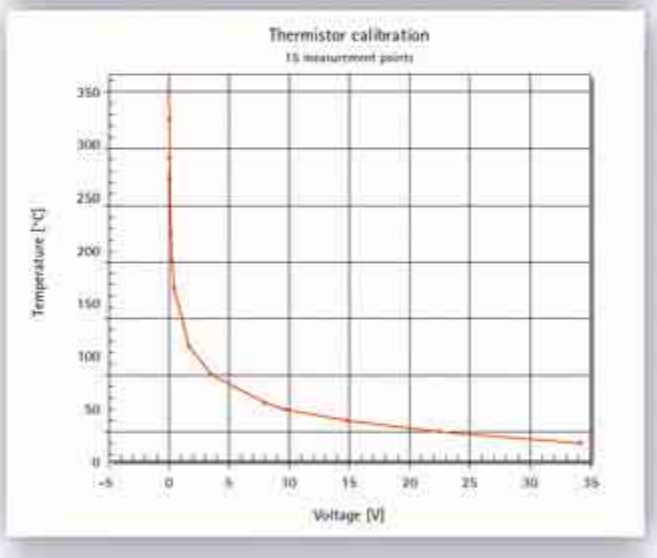
## Data acquisition with MGCplus and catman®

This set-up produced a twelve-point calibration curve for each sensor at temperatures of up to 350°C. The curves were incorporated into catman® as user scaling files (USC). catman® was configured to perform linear interpolation between the calibration points. To provide a complete picture for Mahle Powertrain, HBM had a number of other inputs into the MGCplus. The oil feed temperature and flow, which is controlled automatically using a heater and valve, were also monitored along with other basic engine parameters such as the torque and speed. The measured data was simply and clearly displayed using catman® real-time graphical tools.

Carl Godden, senior instrumentation engineer at Mahle Powertrain recommends the solution:

"The MGCplus and catman® combination proved to be an excellent solution for our data acquisition requirements. It was particularly rewarding to obtain a multi-point linearization of the thermistor signals that was very simple, and highly effective, to implement."

Carl Godden



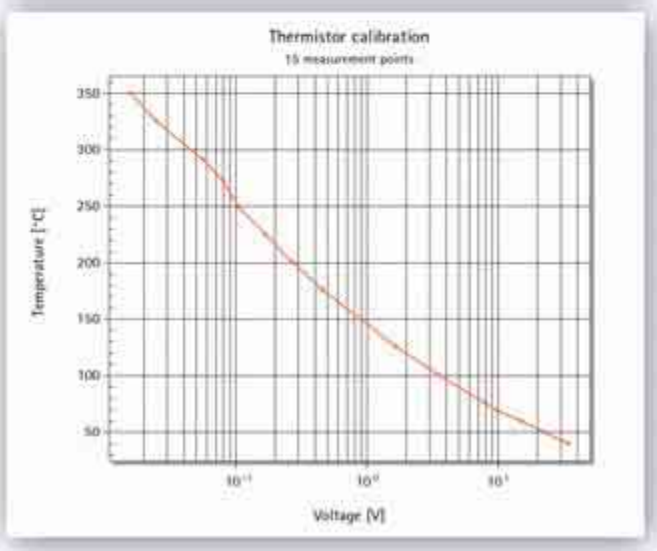




*Fig. 5: The MGCplus amplifier system uses catman® software to record the thermistor calibration data, etc.*