Reliable catalyst solutions

Evaluate temperature and thermoshock situations

Understand – reduce – avoid thermal risk situations for catalytic converters

The task: In the workflow of SI engine development, focus is given to the selection, integration and calibration of three-way catalyst units (TWC). The need for efficient and clean combustion in highly dynamic test situations imposes restrictions to fuel enrichment as otherwise used for component protection. The task, therefore, is to precisely control the thermal loading of TWC components in any conceivable drive situation. Simulation and virtual testing are an integral part of such development workflow, but finally, experimental tests under normal drive situations must confirm functionality and durability of the TWC brick. Risks arise from high temperature reactions in response to specific drive situations and, as was found in long term tests, from thermoshock situations related to the gas dynamics at normal and especially borderline engine operation.

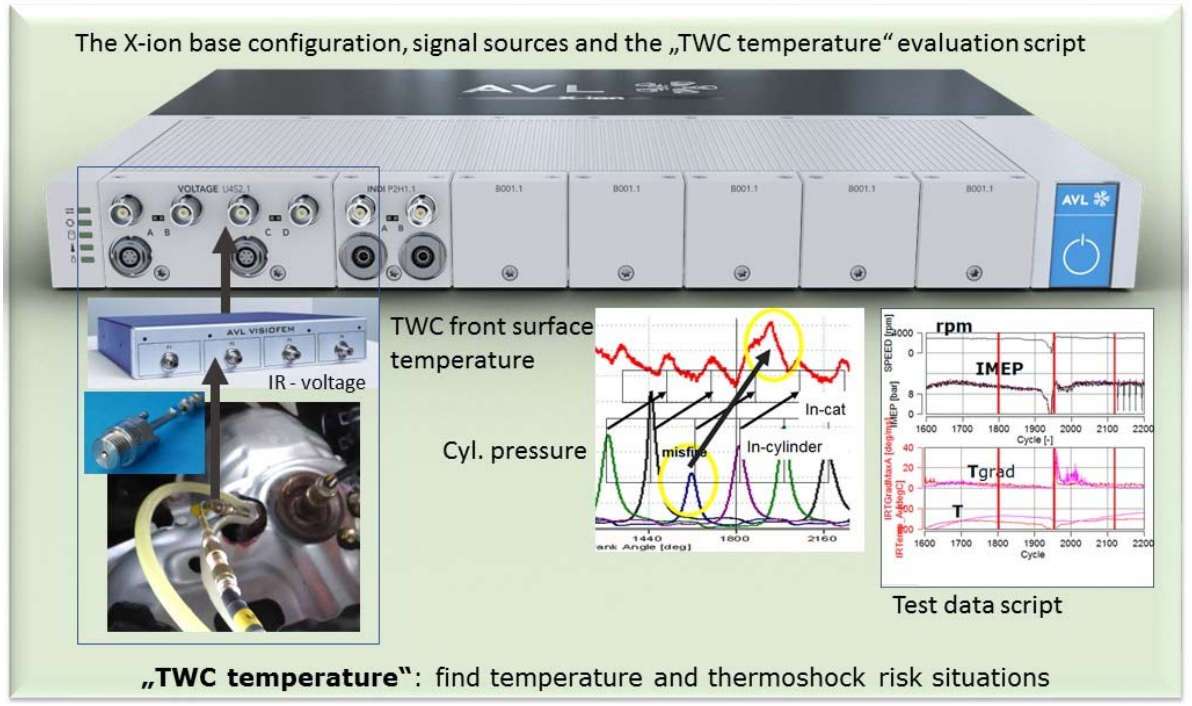
What to do? Measure and evaluate temperature and thermoshock risks for TWC components. Thermocouples are unsuitable for such tasks! A successful method is based on measurement of a TWC brick's thermal radiation. As the method, by definition, is free from any thermal inertia, evaluation of time resolved radiation signals yields data for instantaneous brick surface temperatures. The response of specific areas to the gas pulses introduced by exhaust gas blowdown is evaluated for high temperatures as well as high temperature gradients – so called thermoshock situations.

The solution: Temperature and temperature time gradients are compared to pre-selected levels for respective limits of "recommended - riskfull - high risk" operation regimes. Such three-level risk evaluation forms an integral part of routine test sequences and supports identification of required improvements in exhaust system design and engine calibration.

Further benefits of the AVL approach include:

- **On testbed and in vehicle application**: The TWC front face is instrumented with an access bore for the fiber optic sensor head and with a thermocouple to provide for the temperature to radiation calibration.

- **No contact / no thermal inertia**: surface radiation is directly captured with the fiber optic sensor head; the radiation signal is recorded at crank angle-based time resolution. The signals resolve each gas pulses' effect on the TWC's temperature response.
- **Real time signal evaluation**: Temperature levels and temperature gradients are evaluated in real time and compared with user selected limits for safe - riskful - high risk levels. Simultaneous, synchronized recording of combustion pressure and vehicle signals provides insight into drive conditions in need of improvement.



Sensors, instrumentation and signal examples