



COMBUSTION MEASUREMENT TECHNOLOGIES

GASOLINE ENGINES COLD START CALIBRATION

Mixture formation for optimum combustion stability and emissions

The Task

From standstill until driving, each individual cycle has to fulfil specific combustion tasks. After first ignition, each cycle must contribute to engine speed up. As the engine is up at speed, ignition is retarded to provide fast catalyst light off. With cat light off achieved, ignition is set to normal mode and the engine is throttled for idle or part load as commanded by the driver (engine speed sequence A).

The Challenge

Engine emissions quality is decided in the start procedure. Ignition cycles, speed up, catalyst heating and regular part load operation must be achieved with the minimum number of cycles.

Starter cranking speed, fuel injection, throttle position and spark timing are the actuators to achieve these targets. Their core task is to provide conditions which support mixture formation for successful combustion.

Detecting individual cycle behaviour:

Engine speed up is measured with the engine's 60-2 encoder signal on a high resolution time base. From standstill onwards, each cycle is evaluated for its contribution to engine acceleration. Perfect speed up cycles have a rpm signature as in (B). With such high resolution engine speed data, underperforming or misfire

With such high resolution engine speed data, underperforming or mis cycles are easily identified. See rpm signature in (C).





Why misfire or underperforming cycles?

Fuel evaporation to form an ignitable, homogeneous, stoichiometric mixture is severely impaired in starting engines at low temperature. This deficit is partly compensated by over-fuelling. The excess fuel, however, can quench combustion and cause partial burn or misfire. Unburned fuel together with deposits can furthermore cause uncontrolled ignition and premature combustion. Precise metering of fuel injection for fast changing starting conditions thus is a key condition for successful start calibration.



Detecting the causes for underperforming and misfire cycles:

- cylinder pressure, rate of heat release and flame radiation signal sequences identify
- misfire
- rich combustion without heat release in cycle nr. 6
- cycle 7: irregular ignition from residual flame activity out of cycle 6
- then regular combustion

Benefits

- identify deficit cycles in cold start tests
- use signal library to understand root causes for imperfect combustion
- achieve calibration parameters for safe and clean cold start procedures

Technical Data

- "cold start diagnostics" package comprising
 - high time resolution engine speed recording
 - VisioPressure spark plug or VisioPressure sensor
 - fuel injection and ignition current signal pickup
- on board, battery operated VisioFEM and Indimodul signal recorder
- IndiCom signal evaluation procedures
- analysis guided by evaluation software

Project and Product Packages

- "cold start diagnostics" package is available in AVL calibration projects
- VisioFEM gasoline modules
- sensor: VisioPressure spark plug or VisioPressure sensor for indicating bore

