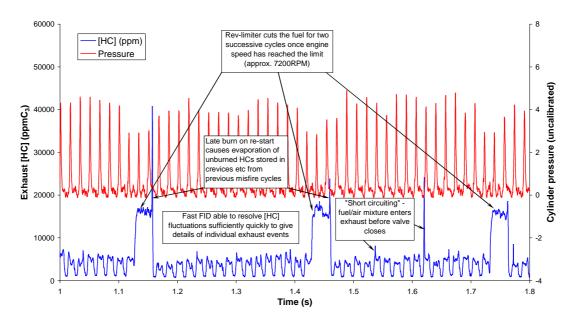# High rpm fuelling control

Introduction

The HFR500 Fast FID sampling probe was fitted to the exhaust port of a production 1.8 litre, 16 valve, 4-stroke engine (as shown Figure 1). This enabled exhaust gas to be sampled close to the exit from the exhaust valve and clear cycle-by-cycle [HC] data recorded. Cylinder pressure was recorded using a piezoelectric pressure transducer washer mounted beneath the spark plug.

Figure 1: HFR500 sampling head and probe in exhaust port

Results

The HFR500's *sub-millisecond* response time allows good resolution of cyclic phenomena even at high engine speeds and tests were conducted close to the engine's limited speed of approximately 7,200rpm.

Figure 2: Engine run WOT, no load, with rev-limiter cutting-in at 7200RPM

In Figure 2 the maximum engine speed is limited by the ECU cutting the fuel injector periodically at high speed. This results in one or two successive misfires of the cylinder and the high [HC] exhausted during these misfires can clearly be seen. During high speed firing of the engine, there is some evidence of occasional short-circuiting of fuel/air mixture at the time of valve overlap.
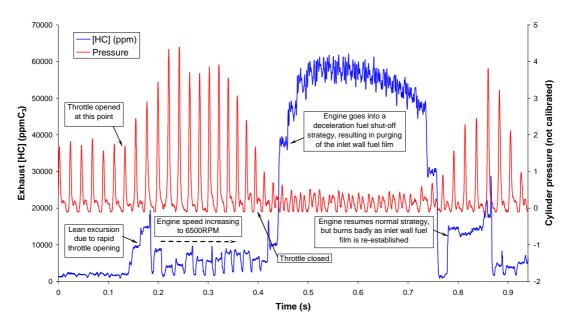

Figure 3: Throttle transients at high speed (4100-6500RPM and 6500-5500RPM), no load

Figure 3 shows how effective transient fuelling of the engine is impaired by the gasoline fuel film on the intake port wall.

When the throttle is rapidly opened, the increased air flow and delay in increased fuel delivery to the cylinder results in a lean excursion lasting 2-3 cycles.

On throttle closing, deceleration fuel shut-off occurs and the inlet port fuel film is purged through the engine. When the throttle is re-opened, the re-start of fuelling results in some poor combustion as the correct fuel/air ratio is established over 3-4 cycles.

Summary

The HFR500 is capable of resolving very fast transient data, and so is suitable for fuelling optimisation in engines with operate at high speeds (e.g. small engines and high performance racing engines).