



Introduction

This application note describes the use of the Cambustion HFR500 Fast FID to obtain real-time [HC] data by sampling gas in the exhaust port of a production 1.8-litre SI gasoline engine under cold-start conditions.

The HFR500 sampled gas from the exhaust port in the position shown in Figure 1.

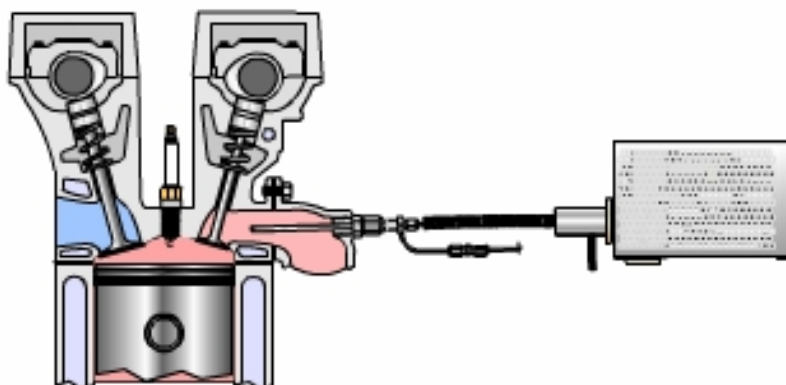


Figure 1: Exhaust port sample point

Results

The data taken is shown overleaf in Figure 2, and additional explanatory notes for the salient points are given below.

- A. Trace begins with a background [HC] of about 8,000ppm. This quiescent gas was left in the exhaust port from a previous start attempt which failed.
- B. The Fast FID detects fresh HC from fuel which was injected during the first motoring cycle just after the exhaust valve opens (as indicated on the cylinder pressure trace). Insufficient fuel had been injected to produce combustion during this cycle. After the exhaust valve closes (at about 1s) the HC level remains constant as there is no flow through the port and the Fast FID is sampling stationary gas.
- C. A rise occurs in the [HC] during the first firing cycle *before* the exhaust valve has opened. This is because the exhaust valve is leaking and unburned mixture is being squeezed through the valve which is nominally closed. Seating of the valve seems to improve later in this data.
- D. The first misfire occurs at around 1.9s. The Fast FID immediately responds to approximately 37,000ppm. This corresponds to the unburned cylinder contents of HC + Air + Residual burned gas. The next cycle is also a misfire, but contains a *smaller* proportion of residual burned gas (because the previous cycle was also a misfire). Therefore the cylinder charge is less diluted with residual burned gas and consequently has a higher [HC] of approximately 43,000ppm.

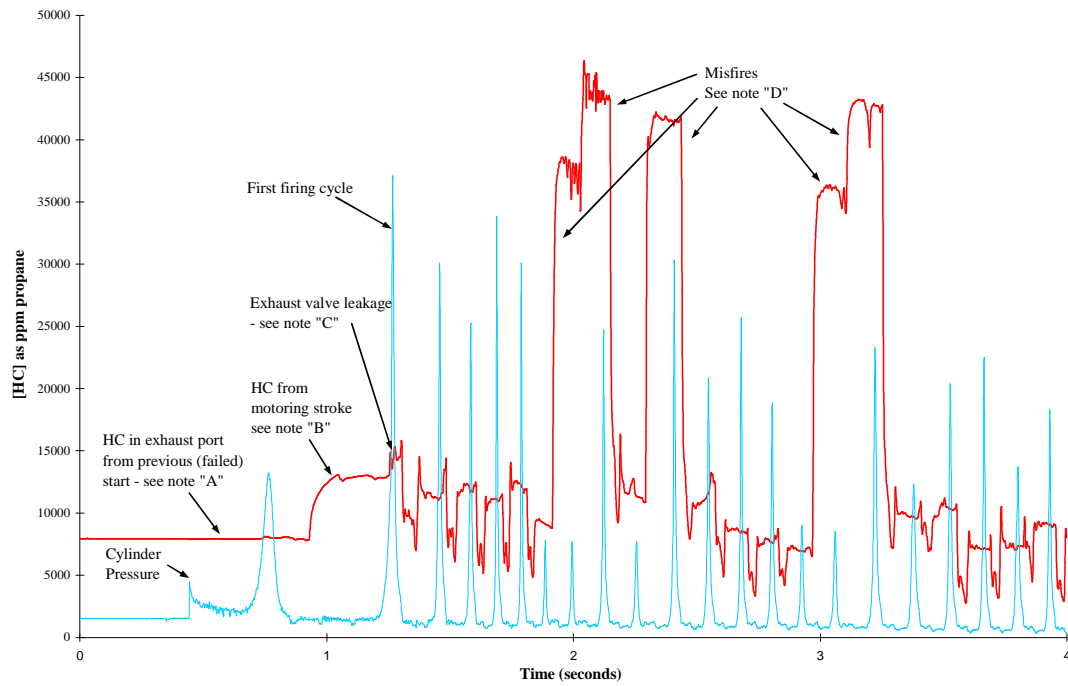


Figure 2: Exhaust Port Cold Start HC Emissions

Summary

The HFR500 is an instrument capable of resolving very fast transient data, with a large dynamic range, and is ideally suited for studies of [HC] emissions during the cold start.