# Plug Fouling Data

## Introduction

The SPR100 has been designed to allow engineers to make objective assessments of techniques to alleviate plug fouling (additives, strategy etc.). It minimises the requirement for expensive repetitive cold start testing to get statistically significant results.

## Plug Fouling Measurement

The delivery cycle of vehicles from production line to showroom often involves many cold starts followed by short running periods. This causes a progressive build up of deposits on the centre spark plug insulator reducing the insulation (shunt) resistance and eventually leads to misfire and possible catalyst damage.

The SPR100 can be used to investigate the fouling of spark plugs in a running engine by continually measuring their insulation (leakage) resistance to earth. This operating principle is shown in Figure 1.

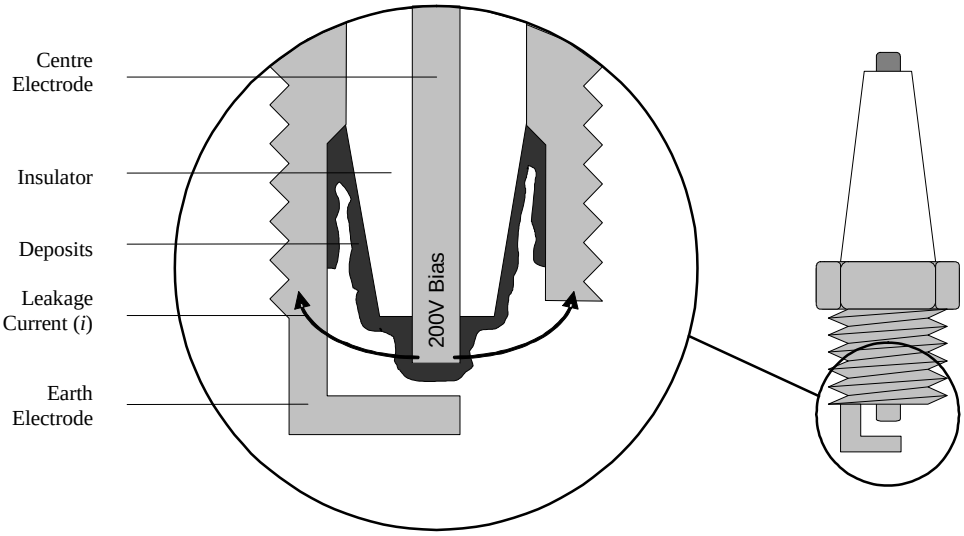


Figure 1: SPR100 operating principle

Traditional investigations of plug fouling have involved the static measurement of the plug resistance immediately before and after a cold start with a 'MEGGER' or similar. However, studies with the SPR100 have shown that the complex interaction of sooting and the formation of condensation from hot combustion gases on cold engine surfaces can lead to a rapidly changing resistance during engine operation. Such effects are undetectable by static methods, as is illustrated by the data overleaf.

## A Plug Fouling Study

Shown below are plots from one cylinder of aV6 engine subjected to the following start sequence which was designed to promote plug fouling.

1. Cool engine to -12°C
2. Start and idle for 15 seconds
3. Engage drive and wait for 5 seconds
4. Open throttle to -0.25 bar gauge manifold pressure for 10 seconds
5. Return to idle for 10 seconds
6. Switch off
7. Cold soak for 1 hour and repeat

**Start 1 (Clean plugs)**

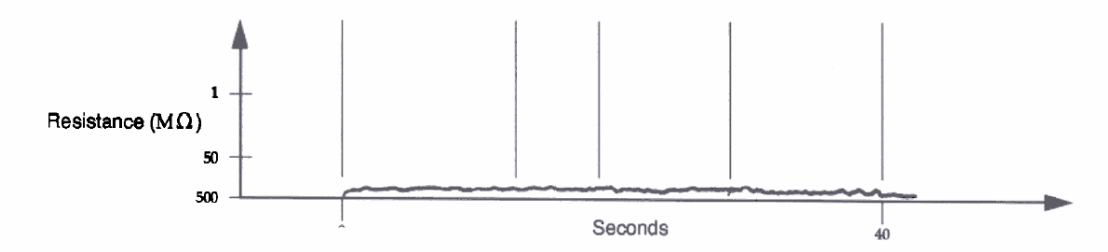


Figure 2: Data from SPR100 during Start 1

The data shown in Figure 2 is as expected with a clean plug. This start shows no problems – the plug resistance is about 500MΩ.

**Start 2**

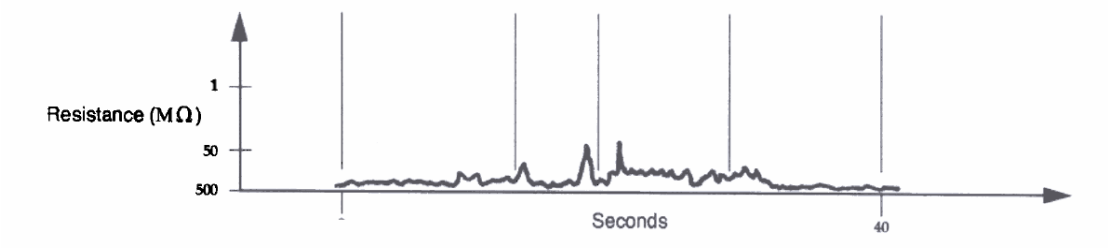


Figure 3: Data from SPR100 during Start 2

Figure 3 shows the first signs of plug fouling beginning to appear. However, this level of fouling is not sufficient to cause any misfire.

**Start 3**

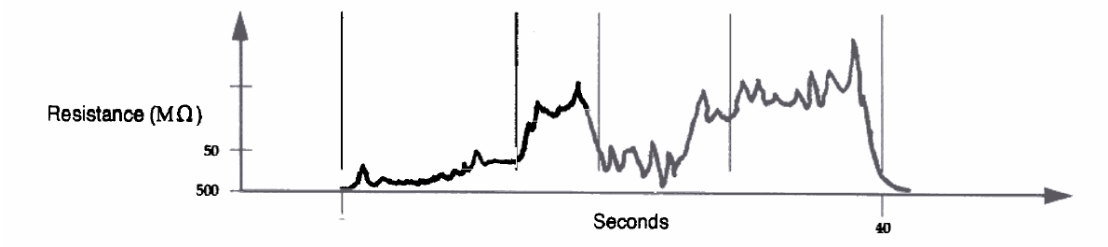


Figure 4: Data from SPR100 during Start 3

In Figure 4 we see a sudden fall in plug resistance to around 1MΩ with the cylinder misfiring. The resistance changes very rapidly during running but recovers quickly to a high value when the engine stops. This highlights the importance of measurement whilst the engine is running. If this plug was measured statically before and after the test it would appear electrically clean – only when running do problems appear.

It is also interesting to note that, for this engine, 3 of the 6 cylinders consistently showed a greater tendency to foul than others. Shown in Figure 5 is the plot for an adjacent cylinder, also from Start 3 which shows no signs of fouling.

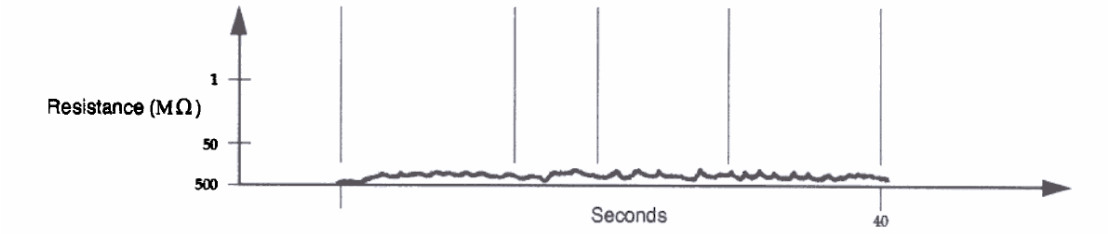


Figure 5: Data from SPR100 during Start 3 - adjacent cylinder