**Gasoline Particulate Filter (GPF) testing**

*The DPG can be used to load soot on to GPFs much faster than the rate obtainable from a gasoline engine. The GPF's back pressure and filtration efficiency can be evaluated during the load and then the loaded GPF can be fitted and tested on a gasoline vehicle.*

# Need for testing soot-filled GPFs

The introduction of particle number limits (in Europe and elsewhere) for gasoline engines has stimulated interest in GPFs and their ability to limit the tailpipe solid particle number over the lifetime of a vehicle.

Many modern GDI vehicles can meet the PN limit without after-treatment when new, but ageing effects on engine hardware and the associated degradation in fuel vaporisation and combustion quality has led to concerns that GPFs might be required to maintain the vehicles' PN emissions below the permitted limits (currently 6x10E11 per km for Euro 6b).

# Potential problems with loading GPFs with soot (and ash)

Gasoline engines (even GDI) produce relatively little soot compared to Diesels. Also, the higher exhaust temperatures tend to produce passive regeneration of any soot which has been loaded on to the GPF. This poses a problem in producing the larger soot loadings which are required for fully characterising back pressure, filtration efficiency and exotherms generated during regeneration events.

Some OEMs try to increase the engine-out soot rate by reducing the fuel rail pressure to produce less effective fuel vaporisation. They might also increase external EGR. But soot accumulation with an engine still remains slow and expensive.

The deposition of ash along with the soot is also a very long duration project when performed on a gasoline engine.

# Loading a GPF with DPG soot

The DPG can be used to load GPFs with soot derived from burning diesel fuel at rates typically of 1–2g/hour. Although this soot is not produced from burning gasoline, it is soot of a repeatable form and "gasoline soot" varies in morphology and composition depending on the engine's running conditions – especially if the engine has been modified to increase the soot rate.

On the DPG, the soot deposition rate, flow and loading temperature are controlled giving consistent soot loading with no possibility of spontaneous combustion.

Some OEMs have already adopted DPG schedules with a view to systematic GPF testing using this technique and such schedules consist of the following steps:

| Mode | Duration | Interpolation | Total flow | DPF temp |
|---|---|---|---|---|
| Stabilise HWW | 00:01:40 | 0 | 200 | 60 |
| 315C Warmup | 00:05:00 | 0 | 200 | 315 |
| end of warmup | 00:00:07 | 7 | 95.1 | 300 |
| Weigh | 00:00:00 | 0 | 0 | 0 |
| Warmup | 00:05:00 | 0 | 250 | 240 |
| 2g hot weigh load | 02:00:00 | 0 | 250 | 240 |
| 315C Warmup | 00:08:00 | 0 | 200 | 315 |
| Fuel controlled 400C warmup | 00:12:00 | 120 | 138.8 | 370 |
| 315C Warmup | 00:07:00 | 0 | 200 | 315 |
| end of warmup | 00:00:07 | 7 | 95.1 | 300 |
| Weigh | 00:00:00 | 0 | 0 | 250 |
| Standby | 00:00:00 | 0 | 0 | 0 |

This soot load schedule differs from traditional DPF soot loads, in that the flows are interpolated down before a weigh mode. After the soot loading mode and prior to final weighing, the temperature of the loaded GPF is elevated to boil off some of the unwanted HC and H2O mass which can skew they true soot mass loaded onto the filter.

# Some typical GPF soot load data

Soot load data from a GPF, with continuous particle number measurement upstream and downstream.

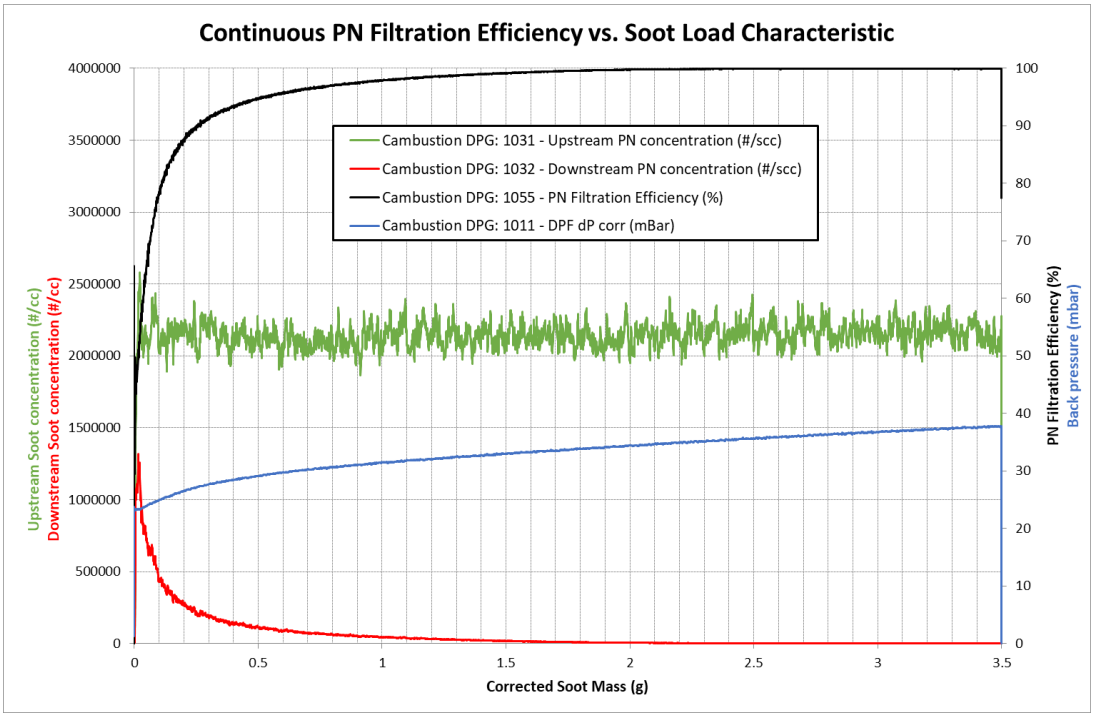


*Figure 1: The back pressure and filtration efficiency results*