

Populations, Activity and Emissions of Diesel Nonroad Equipment in EPA Region 7

PEMS Data QC Criteria Appendix I

Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Prepared for EPA by
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EPA Contract No. EP-C-06-080

PEMS Data Quality Assurance

Note: the following QC steps are provided in the PEMS SOPs, as they may be applied in the field. They are repeated here as they will be reviewed in the office as part of the QC process.

1.1 Exhaust flowrate at idle

If the exhaust flowmeter is working correctly, it should read within approximately 10% of the flowrates listed in the table below when idling at 600 RPM. If the idle speed is not 600 RPM, you can adjust the expected flow as follows:

Flow Expected @ Actual RPM = Flow at 600 RPM x (Actual RPM / 600)

Expected Flowrates at Idle

| Engine size, liters | Engine Speed, rpm | Exhaust Flow, kg/hr |
|---------------------|-------------------|---------------------|
| 3 | 600 | 51 |
| 4 | 600 | 69 |
| 5 | 600 | 86 |
| 6 | 600 | 103 |
| 7 | 600 | 120 |
| 8 | 600 | 137 |
| 9 | 600 | 154 |
| 10 | 600 | 171 |
| 11 | 600 | 188 |
| 12 | 600 | 206 |
| 13 | 600 | 223 |
| 14 | 600 | 240 |
| 15 | 600 | 257 |

If the flowrate is significantly different from this value, do the following:

- Verify that the proper tube diameter is selected in the PPMD software.
- If the actual flowrate is significantly lower than expected, try backpurging the pressure lines at the manifold of the flow tube. Be certain not to backpurge the colored plastic pressure lines leading to the MPS, unless you disconnect them at the MPS.

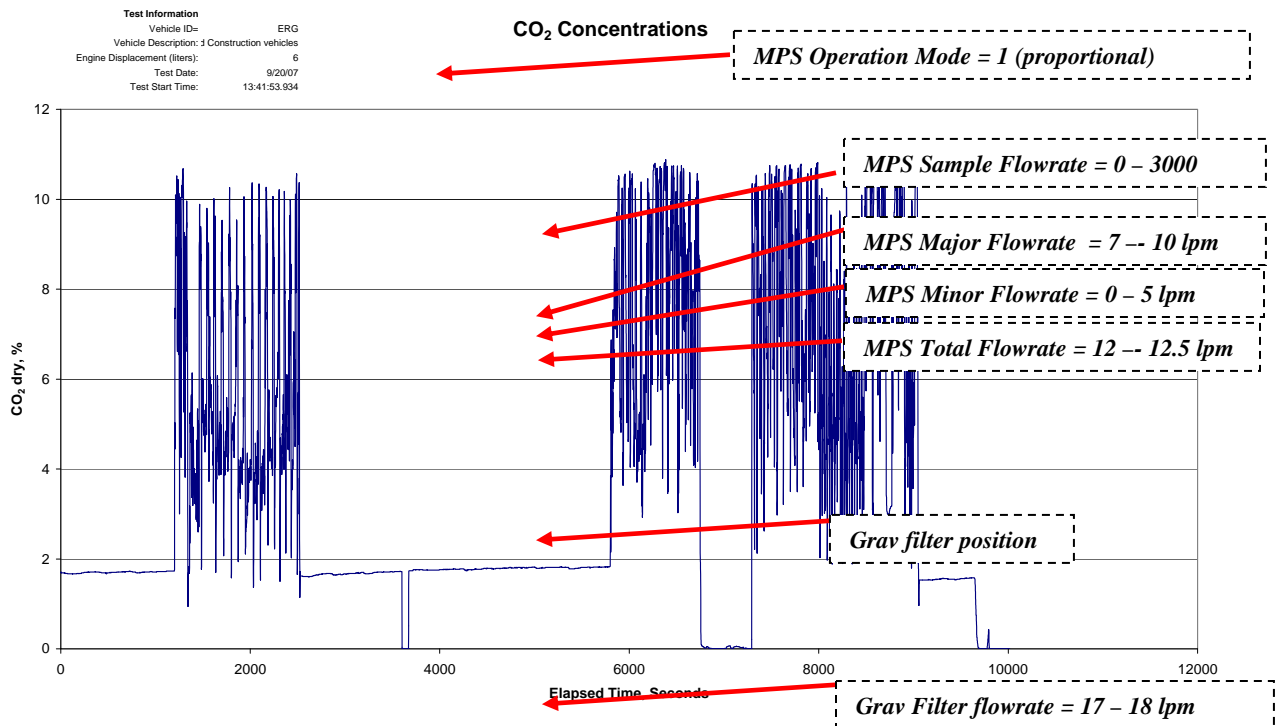
1.2 Verify MPS Flows

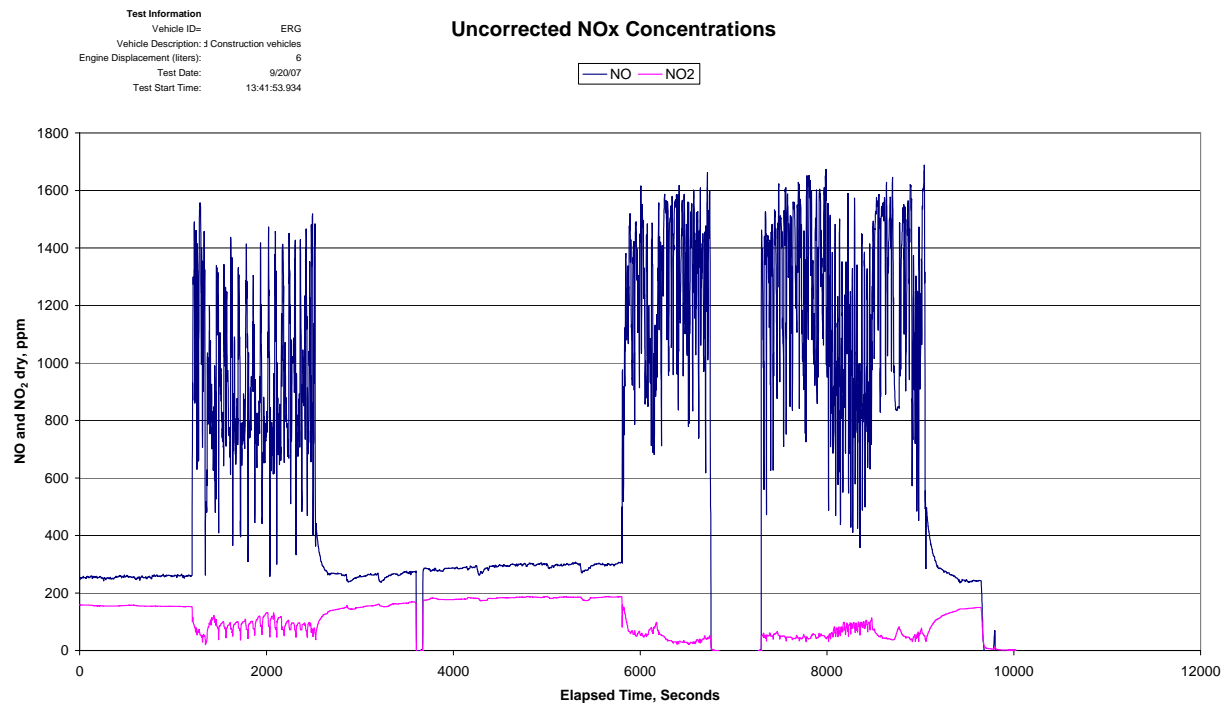
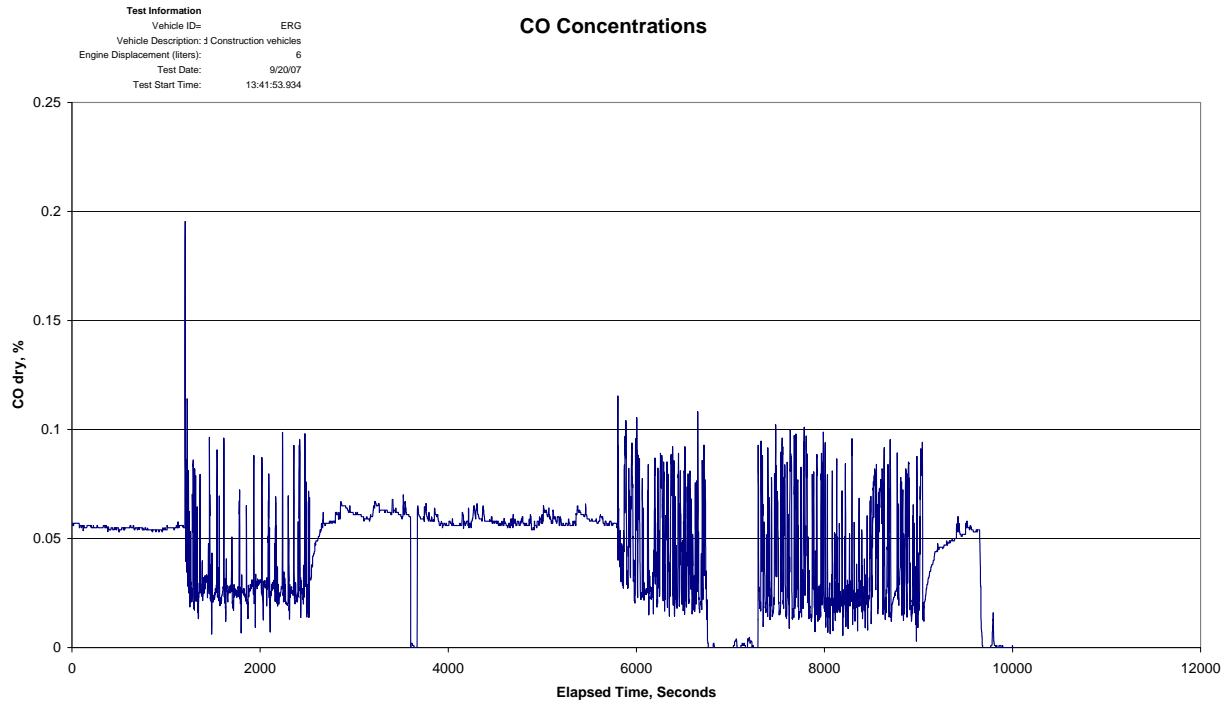
Perform the following MPS checks either with live data or from a recorded data file. Whenever the MPS is in proportional mode:

- Qtotal should be 12.5 lpm, +/- 0.5.
- At zero exhaust flow (engine off), Qsample should be less than 0.2 lpm
- At zero exhaust flow, Qminor should be > 4 lpm
- At max exhaust flow, Qminor should be slightly positive, or zero. If Qminor reaches zero at lower exhaust flowrates, or is greater than 0.5 lpm at max exhaust flow, perform adjustments as described in section **Error! Reference source not found.**

1.3 Data Quality Assurance Check after Tests

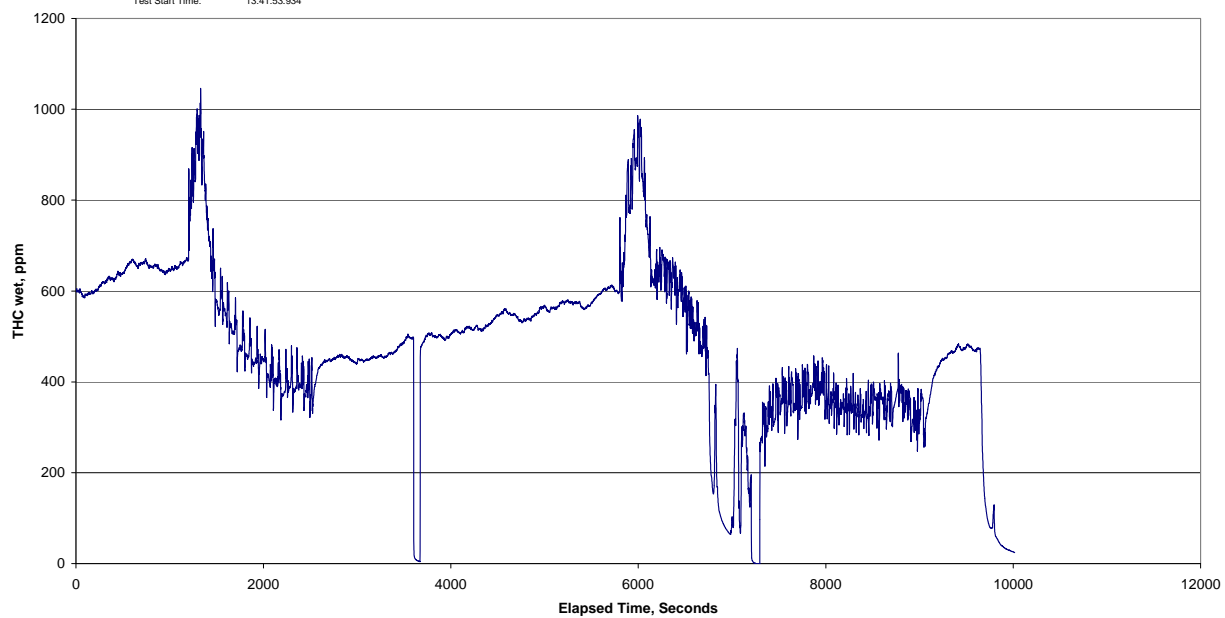
After testing, field technicians will chart the key parameters from the test for initial quality assurance verification. A charting macro has been developed, which will create the charts automatically. Below are examples of “good” data collected during a practice test.





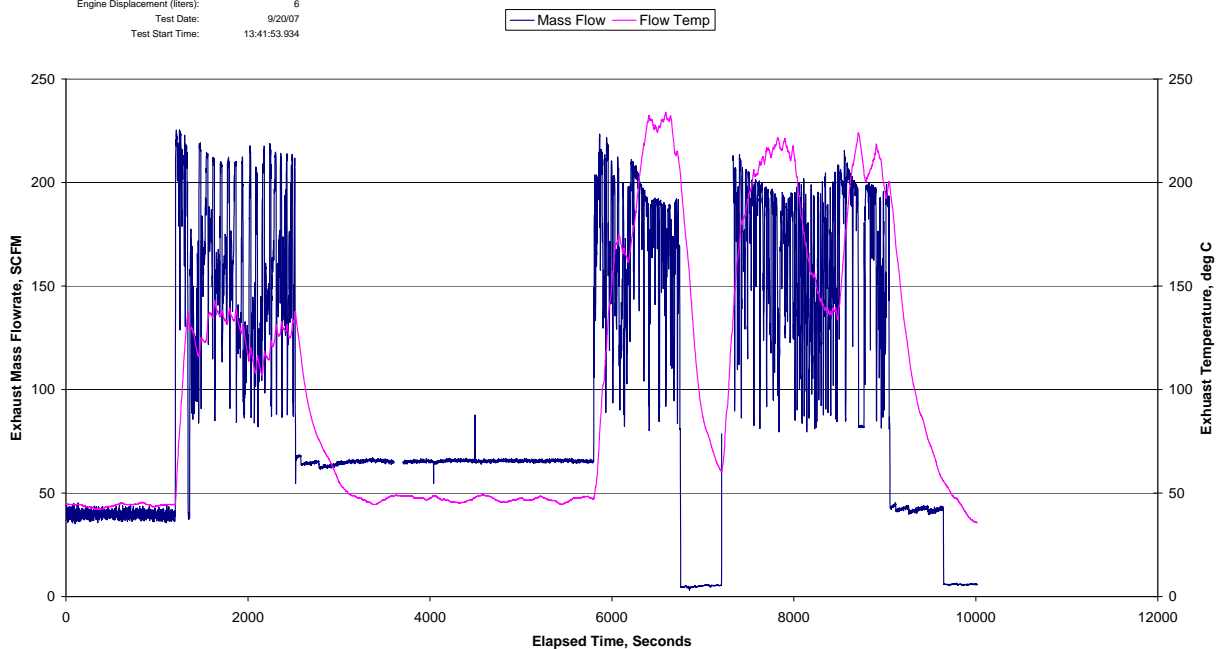
Test Information
Vehicle ID: ERG
Vehicle Description: 3 Construction vehicles
Engine Displacement (liters): 6
Test Date: 9/20/07
Test Start Time: 13:41:53.934

THC Concentrations



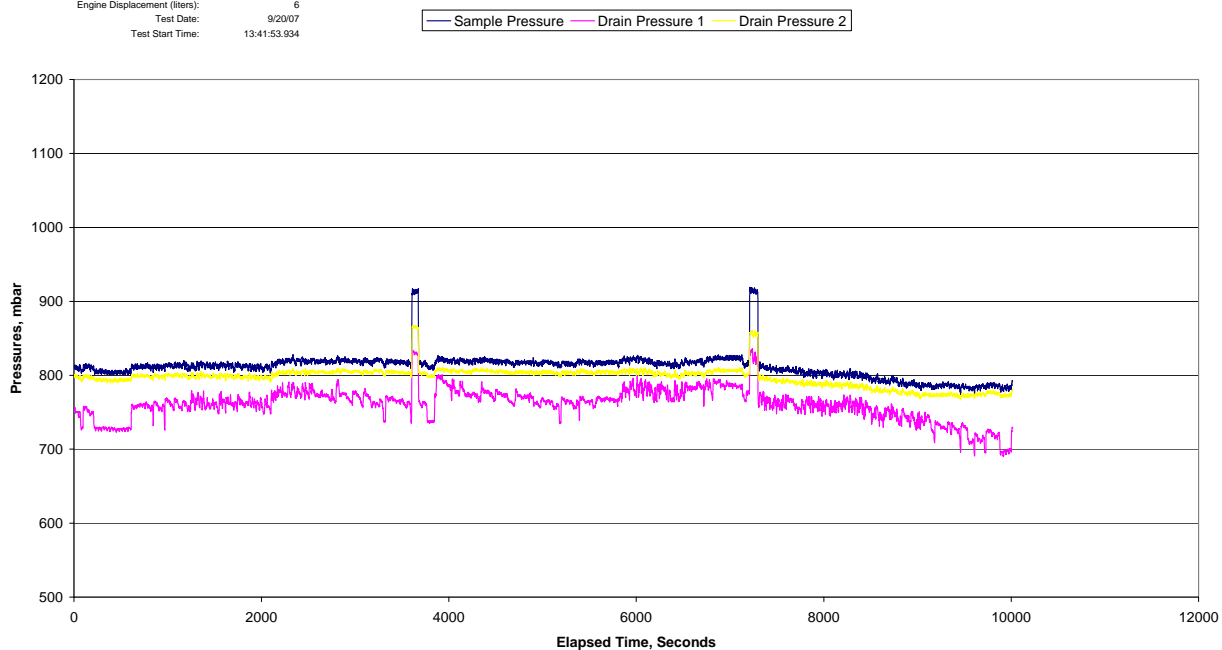
Test Information
 Vehicle ID: ERG
 Vehicle Description: 3 Construction vehicles
 Engine Displacement (liters): 6
 Test Date: 9/20/07
 Test Start Time: 13:41:53.934

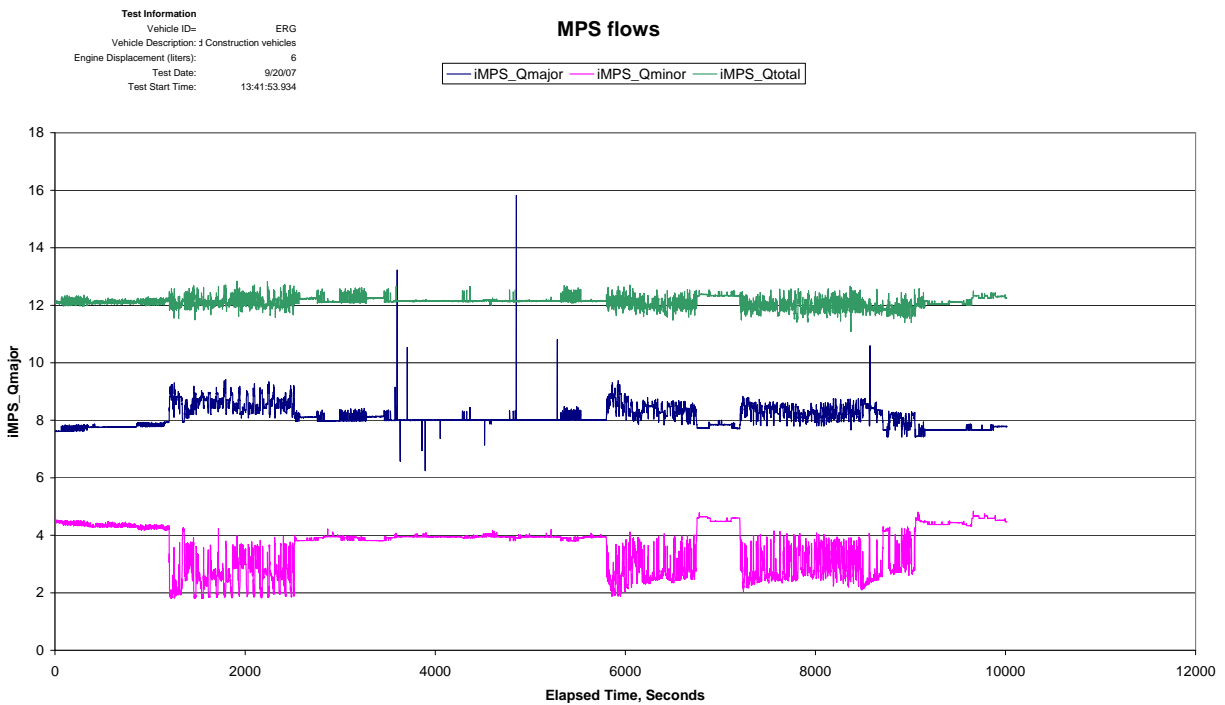
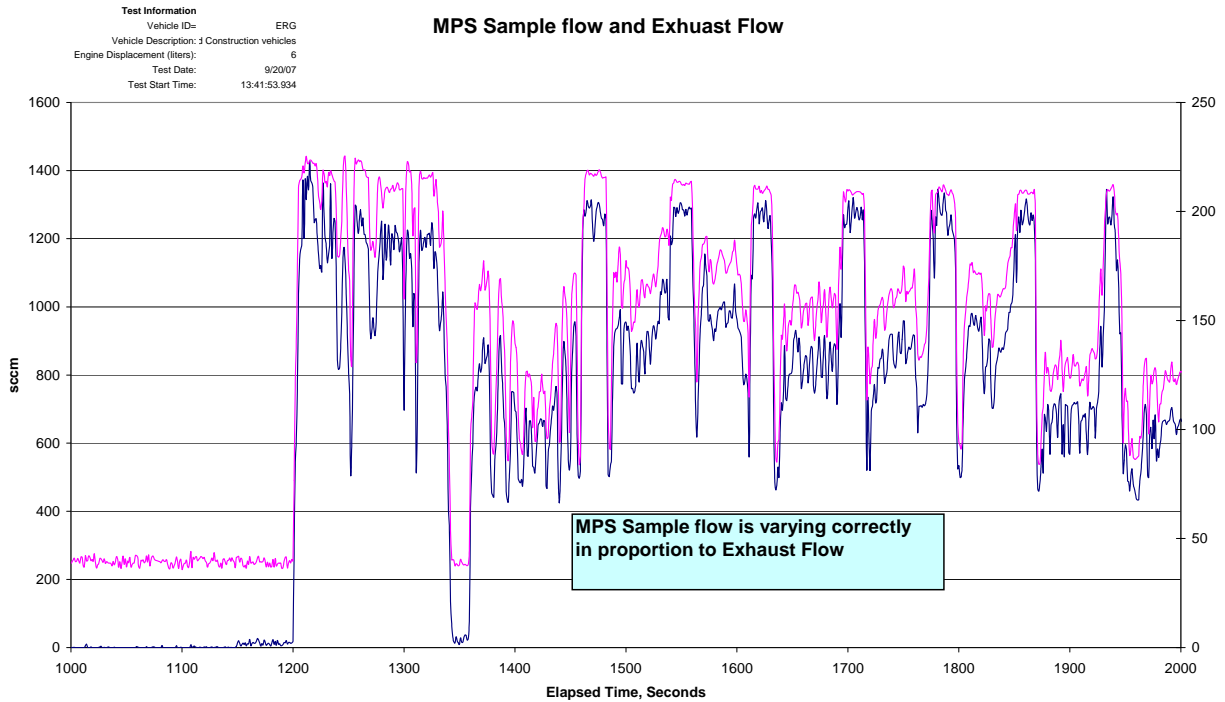
Exhaust Mass Flowrate



Test Information
 Vehicle ID: ERG
 Vehicle Description: 3 Construction vehicles
 Engine Displacement (liters): 6
 Test Date: 9/20/07
 Test Start Time: 13:41:53.934

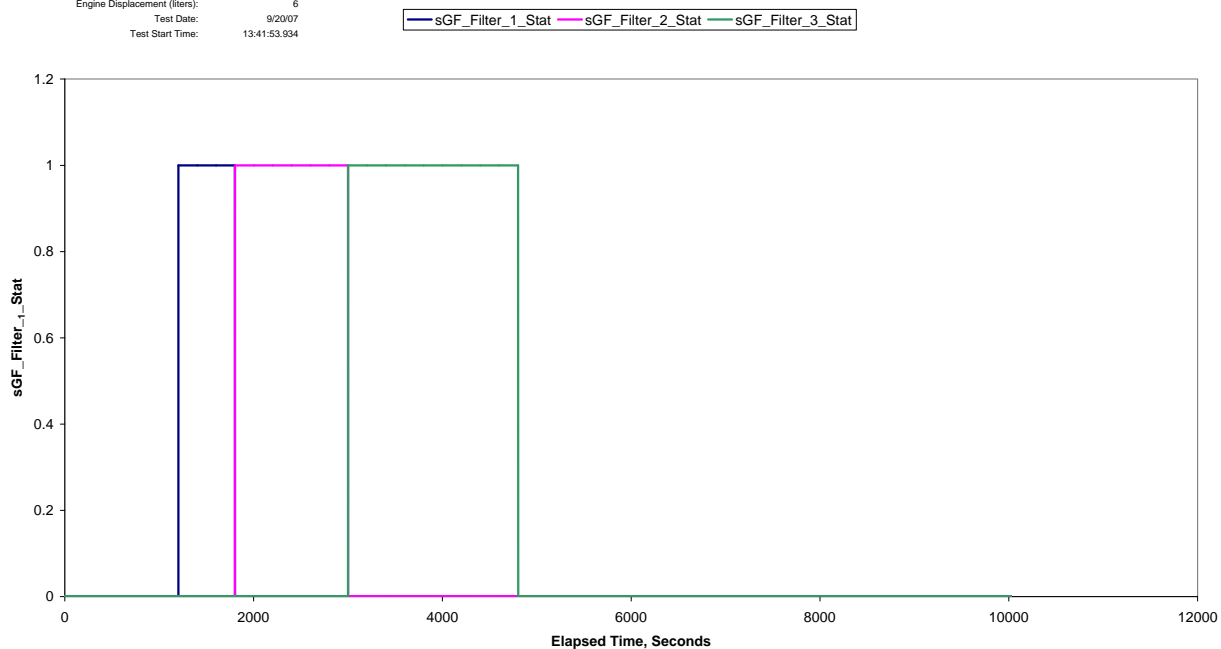
SEMTECH Pressures





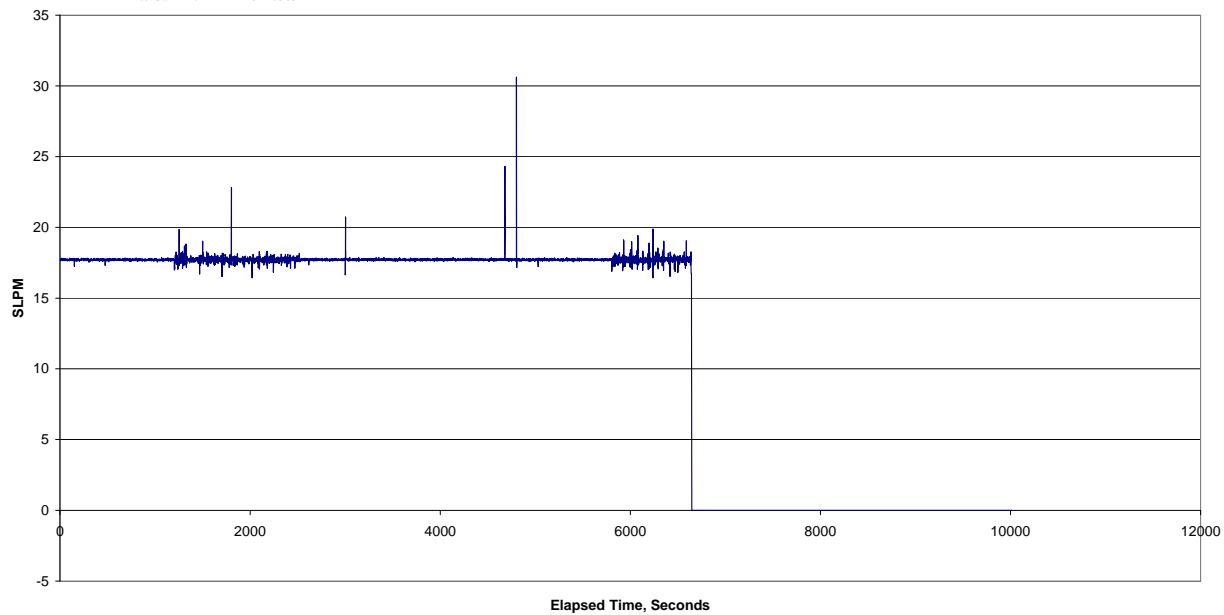
Test Information
 Vehicle ID: ERG
 Vehicle Description: 3 Construction vehicles
 Engine Displacement (liters): 6
 Test Date: 9/20/07
 Test Start Time: 13:41:53.934

Filter Status



Test Information
 Vehicle ID: ERG
 Vehicle Description: 3 Construction vehicles
 Engine Displacement (liters): 6
 Test Date: 9/20/07
 Test Start Time: 13:41:53.934

GF Mass Flow



Summary of Nonroad PEMS data QC criteria

| Parameter | Range | What to Look for |
|-----------------------------------|-------------|---|
| Date / Time Stamp | Varies | Ensure times accurate, internal clock not reset, corresponds with recorded session start/end times |
| CO ₂ (%) | 3 - 8 | Range, Saturation, Response - drop during autozero |
| CO (%) | .02 - .08 | Range, Saturation, Response - drop during autozero |
| NO (ppm) | 100 - 800 | Range, Saturation, Response - drop during autozero |
| THC (ppm) | 100 - 200 | Range, Saturation, Response - drop during autozero |
| O ₂ | 8 - 16 % | Range, Saturation, Response - drop during autozero |
| Backpressure / MPS Inlet Pressure | 0.1 - 4 kPa | |
| Filter Auto Zeros? | N/A | Identify when this happens, should not occur |
| Ex Mass Flow (SCFM) | 300 - 900 | Range, Temps, Outliers - No drop during autozero - also compare flowrates at idle and high RPM with known values corrected for displacement |
| Exh Temp Ranges | 250 - 600 | |
| Chiller Temp Range (C) | 0 - 15 | |
| Ambient Temp Range (C) | 25 - 45 | |
| Auxiliary Temp Range (C) | Varies | This is the temp inside the PEMS rack |
| External Line Temp (C) | 190 | Recorded in Ph 3, independent control (not recorded) in Phases 1 & 2 |
| SEMTECH Pressure Ranges (mbar) | 800 - 900 | All jump > 75 during an autozero |
| SEMTECH Pressure Deltas (mbar) | 50 | Delta over test for any individual pressure measurement, not between pressures |
| Fuel Rate (gal/sec) | .001 - .004 | Idle, operation range |
| MPS Sample Flowrate (sccm) | 0 - 3000 | Response, correlation, outliers |
| MPS Mjr Flowrate (lpm) | 7 - 10 | Response, correlation, outliers |
| MPS Mnr Flowrate (lpm) | 0 - 5 | Response, correlation, outliers |
| MPS Tot Flowrate (lpm) | 12.5 | Response, correlation, outliers |
| Grav Fltr Flowrate (lpm) | 17 - 18 | Step pattern, outliers, range |
| MPS Gas Temperature | Varies | This is at inlet to MPS (after diluter), depends on exhaust temp |
| GF manifold temp (C) | 47 ± 5 | (42 to 52) - this is downstream of filters, so temp isn't critical |
| GF cyclone and filter temps (C) | 47 ± 5 | (42 to 52) |
| Check MPS proportionality | | MPS sample flow correlation, relative magnitudes, proportionality |
| Engine Speed (RPM) | Varies | Range, scale factor (calibration), spikes, dropouts, alignment with pollutants and exhaust flow |
| Time alignment | N/A | Ensure pollutants, exhaust flow and RPM are aligned |
| THC autorange setting | | This info is available in the raw file, SxS records, 2 nd character string (the first is the timestamp). For this study, the FID was hard-set to 1000 PPM. |