

Mobile CO&CO2 measurement on-board a gasoline vehicle

Introduction

The fast NDIR500 CO&CO2 analyzer was adapted for mobile, on-board, measurement. Power requirements were reduced by using only one channel and a smaller vacuum pump. This allowed the unit to be powered from a battery and inverter after warming up and calibration on the mains. Warming up and calibrating when connected to the mains reduced the in-rush load on the battery and removed the need to carry calibration gases on-board. The vehicle tested was a Euro 3 1.0 litre gasoline Nissan Micra driven on a short urban route. Results were recorded via the instruments user interface and correlated with audio and video (gear shifter) of engine transients.

Vehicle summary

- Nissan Micra K11 "Celebration"
- Year 2000
- 63,000 km
- 1.0 litre gasoline
- Euro 3

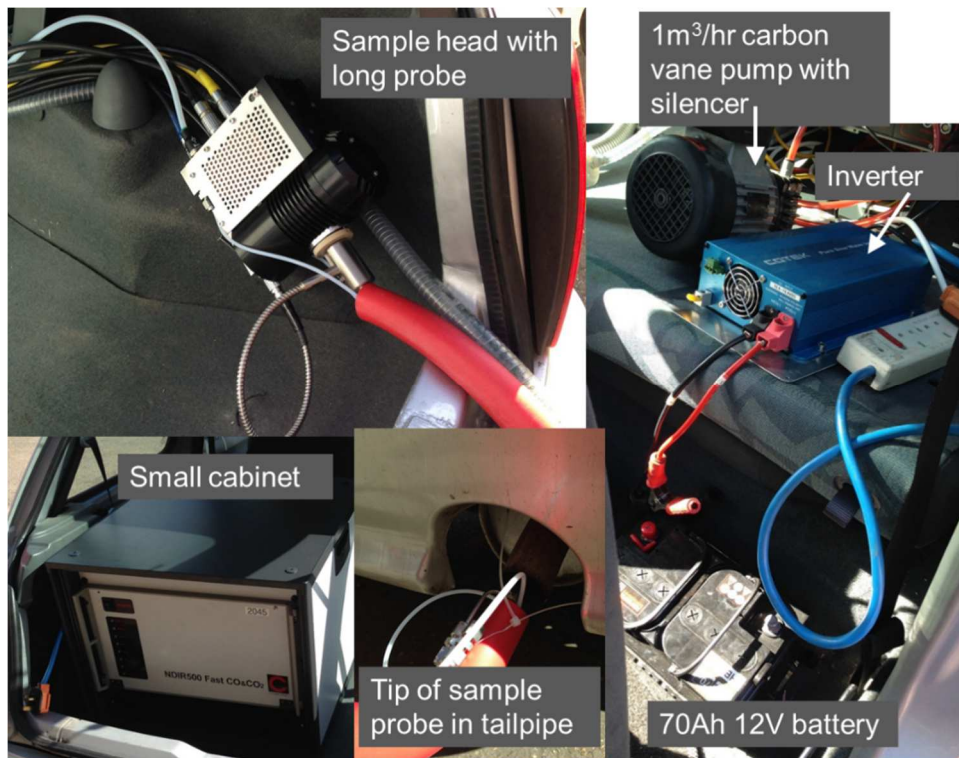
Changes to standard configuration

- Smaller vacuum pump to reduce power consumption < 500W
- Single channel
- Small cabinet enclosure
- 600W 12V – 230V inverter
- Suitable battery (in this case 70Ah)
- Long sample probe
- Sample filter (optional)

Changes in instrument specification

Feature	Standard NDIR500	Mobile configuration
T10-90% response time	8ms	~50ms
No. of channels CO&CO2	2	1
Available sample points	Intake, turbo, in-cylinder, exhaust	Tailpipe only
Enclosure	114cm high cabinet including vacuum pump	46cm high, vacuum pump external
Power supply	Mains 230/115V	12V inverter (500W)

Instrumentation photos



Important user note: avoid fitting probe tip too far into exhaust tailpipe and sampling water from muffler. Vacuum pump exhaust pipe should be routed to outside to avoid toxic gases entering the vehicle.

The (urban) route

Route is a circuit starting at Cambusion, marked by the red pointer.



Results

<https://www.youtube.com/watch?v=GG8RyENS8Ic> (best viewed with audio to hear engine transients and correlate with emissions)

Conclusions

- Large spikes of CO during rich excursions (corresponding to $\Lambda = 0.6$)
- CO₂ quickly returns to zero during decelerations
- After catalyst light-off, significant CO breakthrough can still be seen during transients