

Equipment operation procedures and testing protocols

Context & Objectives

The PEMs4Nano project addresses the development of both a **new portable device** and a **laboratory system** to **detect particles** down to sizes as small as **10 nm** together with a **robust procedure** to measure these particles.



To ensure the correct operation of the new PN measurement systems, an **operation procedure** was defined. In addition, the **testing methodology** using both the **lab PN 10nm** and the **PEMS PN10 nm** was implemented.

Test matrix and emissions measurement

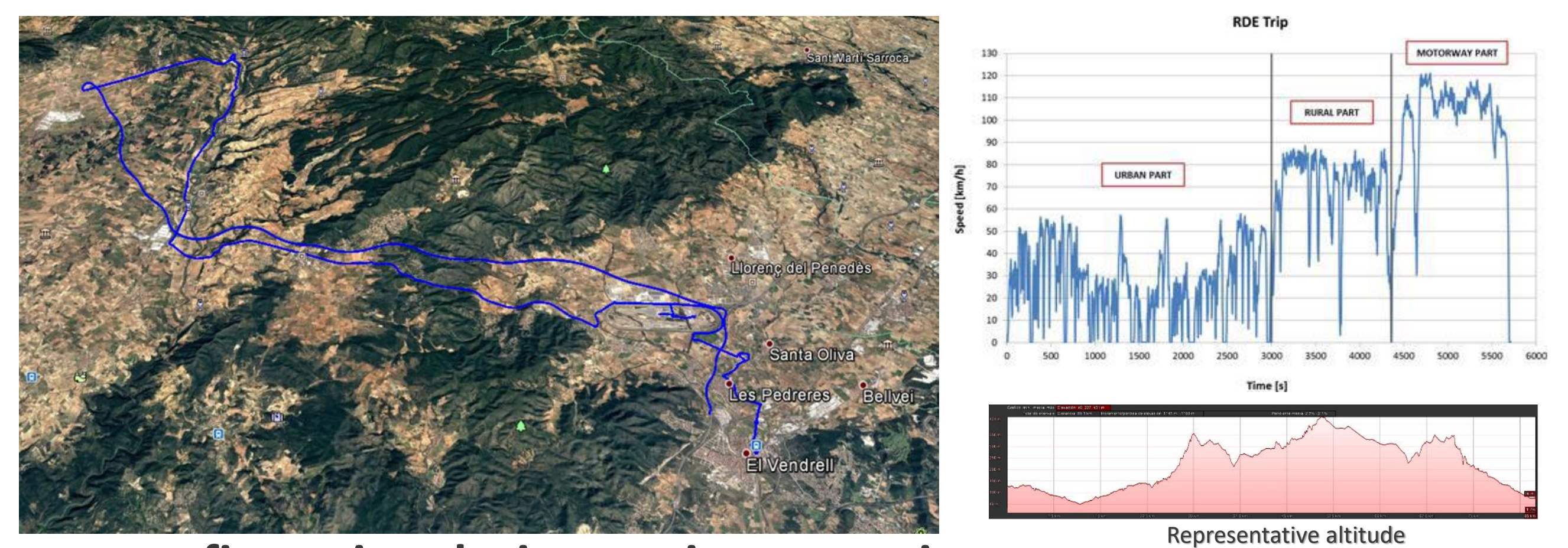
Tests / Facility	Chassis dyno standard emissions	lab PN23nm	lab PN10nm	PEMS standard emissions	PEMS PN23nm	PEMS PN10nm	Nr of tests / configuration
Vehicle 1	WLTC on CD	x	x	x (config A)	x	x	3/config A 1 /config B (*)
	US06 on CD	x	x	x (config A)	x	x	3/config A 1 /config B (*)
	Artemis 130 on CD	x	x	x (config A)	x	x	3/config A (*) 1 /config B (*)
	RDE on Real Road			x	x	x	3/config C
Vehicle 2	WLTC on CD	x	x	x (config A)	x	x	3/config A 1 /config B (*)
	US06 on CD	x	x	x (config A)	x	x	3/config A 1 /config B (*)
	Artemis 130 on CD	x	x	x (config A)	x	x	3/config A (*) 1 /config B (*)
	RDE on Real Road			x	x	x	3/config C

(*) extra-tests, not included in the initial proposal

Testing procedures

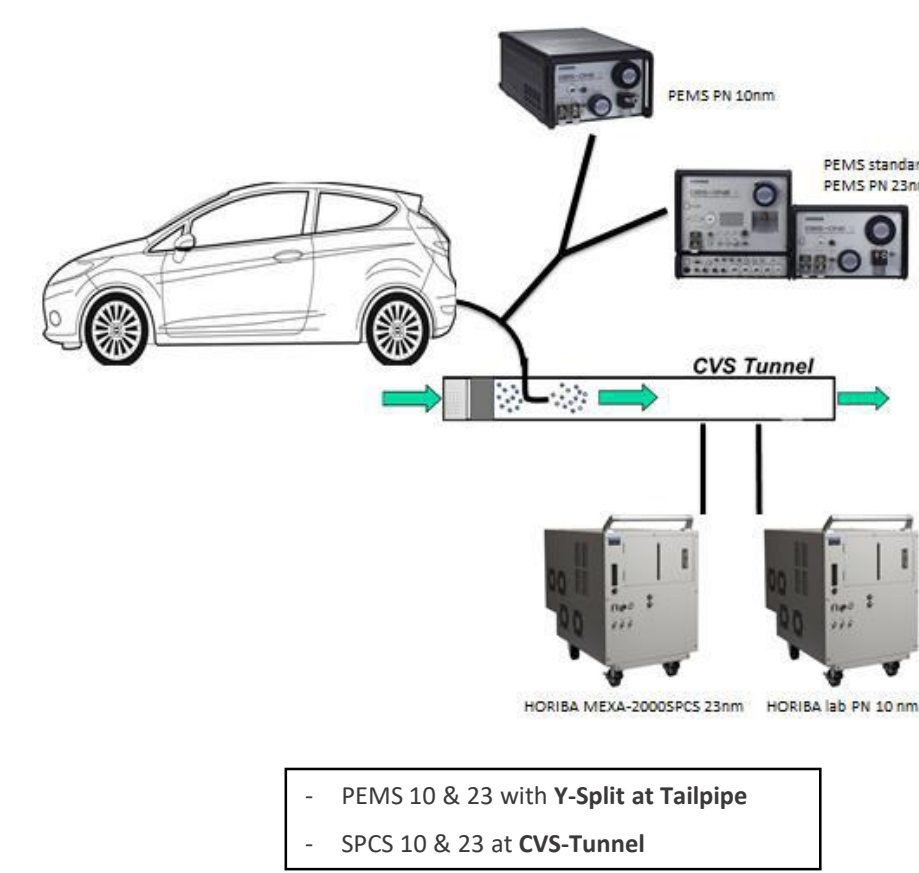
Test Cycle Definition

Different cycles were performed both on the **Chassis Dyno (CD)** and on **real road (RR)**. The **WLTC Cycle** and a combined **US06 + Artemis 130 Cycle** were defined for CD tests. A **RDE Cycle test** on RR was set. The images below show the main characteristics:

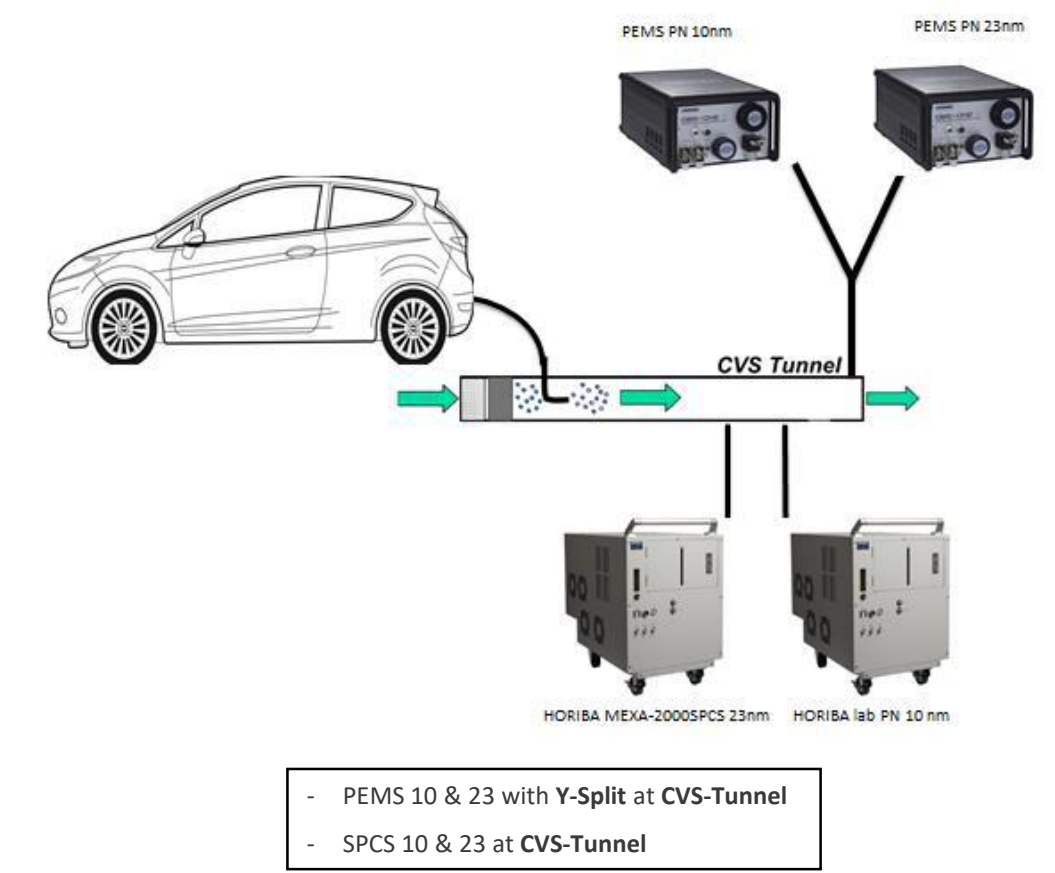


Equipment configuration during testing campaign

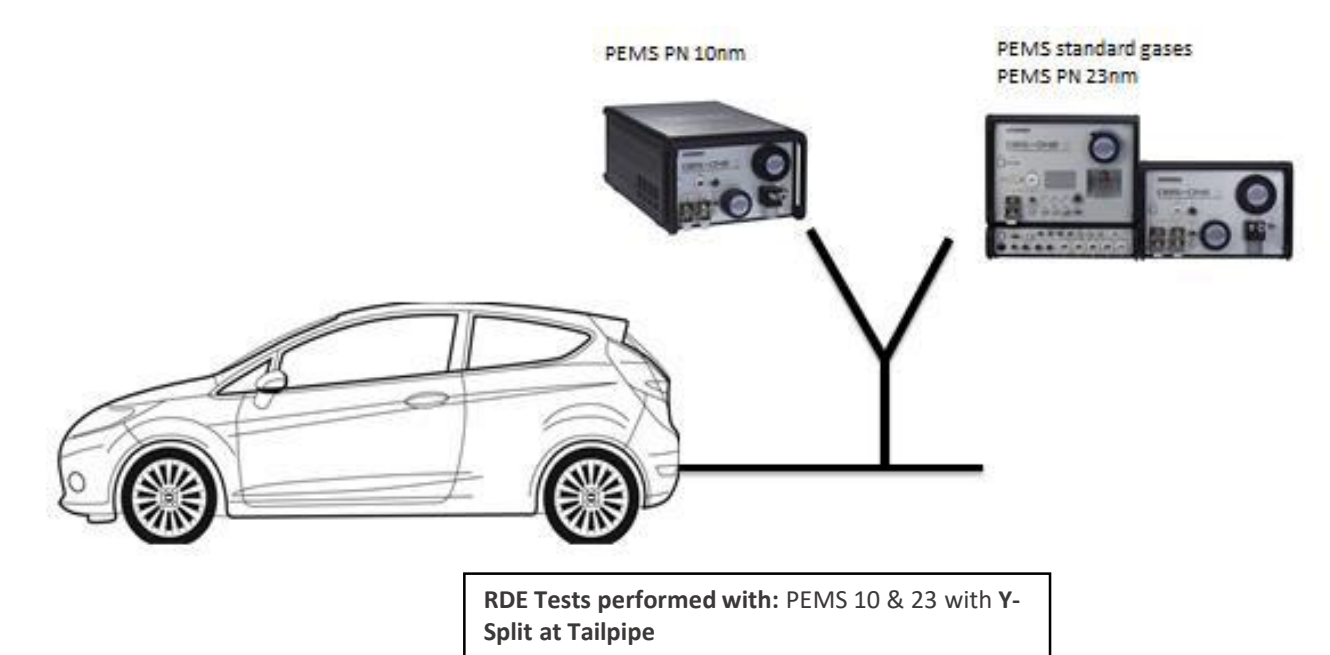
Configuration A (CD)



Configuration B (CD)



Configuration C (RR)



Vehicle definition

Vehicle Specs	Vehicle 1	Vehicle 2
Segment	C	SUV
Regulation	Euro 6d-Temp	Euro 6b
Engine size	1.0L GDI	1.4L GDI
Particle Filter	GPF	---
Selling Vehicle	Top 1 - 2018	Top 7- 2018
Fuel	EU6cert	EU6cert

Emissions measurement:

- Bag measurement in g/km of CO, CO2, NOx and PM.
- Second by second (diluted) exhaust emissions measurements of standard gases THC, CO, CO2 and NOx.
- Second by second Pre/Mid/Post-catalyst (raw) exhaust emissions measurements of standard gases THC, CO, CO2, NOx and O2.
- Particle Number (PN) measurement
 - Standard PN23nm Lab System
 - PEMs4Nano PN10nm Lab System
 - Standard PN23nm PEMS
 - PEMs4Nano PN10nm PEMS

Equipment Start-Up

During the project, the **methodology** to be used in the measurements with the new systems has been established (**procedures, how and where to measure**).

The correct use and handling of the equipment was defined.

The Gantt Charts below show the methodology followed in both systems.

