DLR Institute of Vehicle Concepts

All-wheel chassis dyno with climate chamber and i3 test vehicle for tyre particle measurements

Tyre and Roadwear Particle measurements

- TRWP measurements at an i3 vehicle
- use of roller testbench and climate chamber
- driving testing cycle WLTC
- environment conditions of 23°C +/- 1°C
- rel. humidity 50%
- background particles <400 #/ccm
- isokinetic sampling
- defined losses and high accuracy in particle collection and transportation

Particle measurements

Size of tyres and rims

for adaptation in the test vehicle:

- measurement of 1 tyre set, 2 back tyres
- size: 225/45R17
- rims: 5x112 bolt cycle 7,5" (width) x17“ (diameter) rim offset ET47 hub diameterr 66,6 mm
- other tyre sizes are also possible
- small size adaptations can be done with the existing setup
- for higher deviations an adapted housing can be manufactured

Individual test requirements

- required amount of WLTC driven (8 each day, in sum 184 km
- after each WLTC time for conditioning of tread temperature (< 30 °C)
- background particle control in chamber und avoidance of smearing effects

Preparation

- weighting, cleaning and preconditioning tyres before testing
- adapting tyres to the vehicle
- mounting vehicle on the test bench
- build up the measurement setup
- managing operation
- tubing and pre-weighting filters
- required amount of testing per tyre set
- test driver included
- test engineer for managing the roller test bench
- particle scientist for overlooking the measurement

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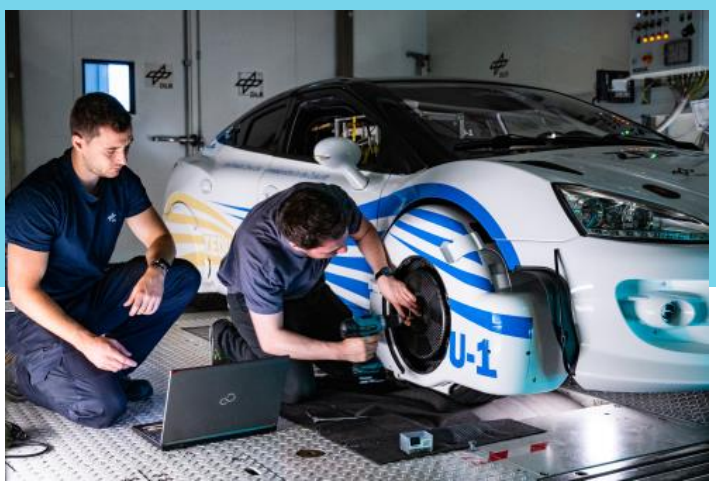

Performance capabilities

- four individually driven 48-inch rollers
- each roller with power rating of 100 kW
- front-wheel, rear-wheel, and all-wheel drive
- wheelbase range: 1.6 m to 4.0 m
- maximum total vehicle weight: 4.5 tons
- maximum speed: 200 km/h
- airflow simulation up to 137 km/h
- climate control range -40 °C bis +60 °C
- relative humidity 20% bis 80%

Analytics PN & Analytics PM

Online particle number measurements:

- CPC+OPS (continuous particle number concentration from 7 nm to 10 µm)
- on both tyres, different tyre sets, 225/45R17
- background particle concentration monitored

Offline Particle mass measurements

- with cyclone on filters, filter material adapted to requirements
- PM10 and PM2.5, PM1 with 3-stage impactor

Measurement Sensitivity	10 µg
Min. SD	5 µg
Max. SD	40 µg
Mean SD	22.5 µg
Mean Measurement	125 mg
% Mean SD	%0.02

i3 test vehicle on the test bench

Tyre weights

- tyre weight before and after measurement
- defined cleaning procedure before weighting with a brush
- weighted with comparator scale
- abrasion rates calculated

Sensitivity scale	1 mg
Min. SD	0.5 mg
Max. SD	40 mg
Mean SD.	20.25 mg
Mean Measurement	20 kg
% Mean SD	% 0,1
Min. SEM	0.016 mg
Max. SEM	23.12 mg
	accounted

Measurements on both back tyres

- left tyre in housing
- right tyre with nozzle measurement
- simultaneous measurement
- similar setup regarding position
- tubing
- flows
- measurement devises

Optional additional analysis

- collecting particles (TWP) in reservoir for offline laboratory analysis (bigger particles),
- instead of the PM2,5 cyclone, ELPI 14 channels, 6nm-10ym)

Certificates:

- ISO 9001:2015
- GTR15
- Akkreditierung ISO 27001
- TISAX

In addition to the scientific programs from the DLR's Transport Division, the All-Wheel- Roller Rig addresses the R&D activities of industry partners and other stakeholders.

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