

CEN update

CEN/TC 301/WG 16

Date: 2019-12-20

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Secretariat: AFNOR

Road vehicles — Portable emission measuring systems — Performance assessment

Straßenfahrzeuge — Mobile Abgasmesssysteme (PEMS) — Leistungsbewertung

**Véhicules routiers — Systèmes portatifs de mesure des émissions (PEMS) —
Vérification de la performance**

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PEMS community

PEMS user

ANNEX A (NORMATIVE) DETERMINATION OF THE REFERENCE UNCERTAINTY OF CHASSIS DYNOS

BIBLIOGRAPHY

5: Components

- Technical description and requirements such as accuracy, interference checks etc.

4: Tests

- Vibration profile adapted from ISO 16750-3 Test IV, which was designed as an accelerated durability test for components on passenger vehicles operating on a variety of road conditions.
- PEMS battery voltage test (Voltage change)
- EFM uncertainty check in chassis dynamometer

4: Gas analyser test matrix

- New compared to RDE regulation

Type of test ^{a, b}	Requirements	Zero	Span (x2)	T _s	RH _s	P _s	T _{amb}	RH _{amb}	P _{amb}
Vibration and shock tests	Representative RDE profile	Yes	No	T _{amb}	dry	P _{amb}	T _{amb}	RH _{amb}	P _{amb}
Inclination tests	Tilting left, right, forward, backward direction at angle 15° 15min/direction	Yes	No	T _{amb}	dry	P _{amb}	T _{amb}	RH _{amb}	P _{amb}
Ambient temperature and humidity tests and step changes Step tests: Each point 60 min	Test 1: +23°C to -7°C to 23°C Zero and span allowed only at the beginning of test at 23°C	Yes	Yes	Wet (51 to 60°C dew point)		P _{amb}	Steps and uniform changes	RH as low as possible (and humidification turned off at -7°C) for T= -7°C to 23°C)	P _{amb}
	Test 2: +23°C to +35°C to +23°C Zero and span allowed only at the beginning of test at 23°C	Yes	Yes					RH 90% for T > +23°C to +35°C	
Ambient pressure tests Uniform: within 30min	Starting point: 1000 mbar +/- 50 mbar, set point 850 mbar, end point at 1013 mbar	Yes	Yes	T _{amb}	dry	P _{amb}	T _{amb}	RH _{amb}	Steps and uniform changes

^a 's' refers to sample, 'amb' to ambient

^b Z=Zero gas, S=Span gas, P=Pressure, T=Temperature, RH=Relative humidity

PN analyser test matrix

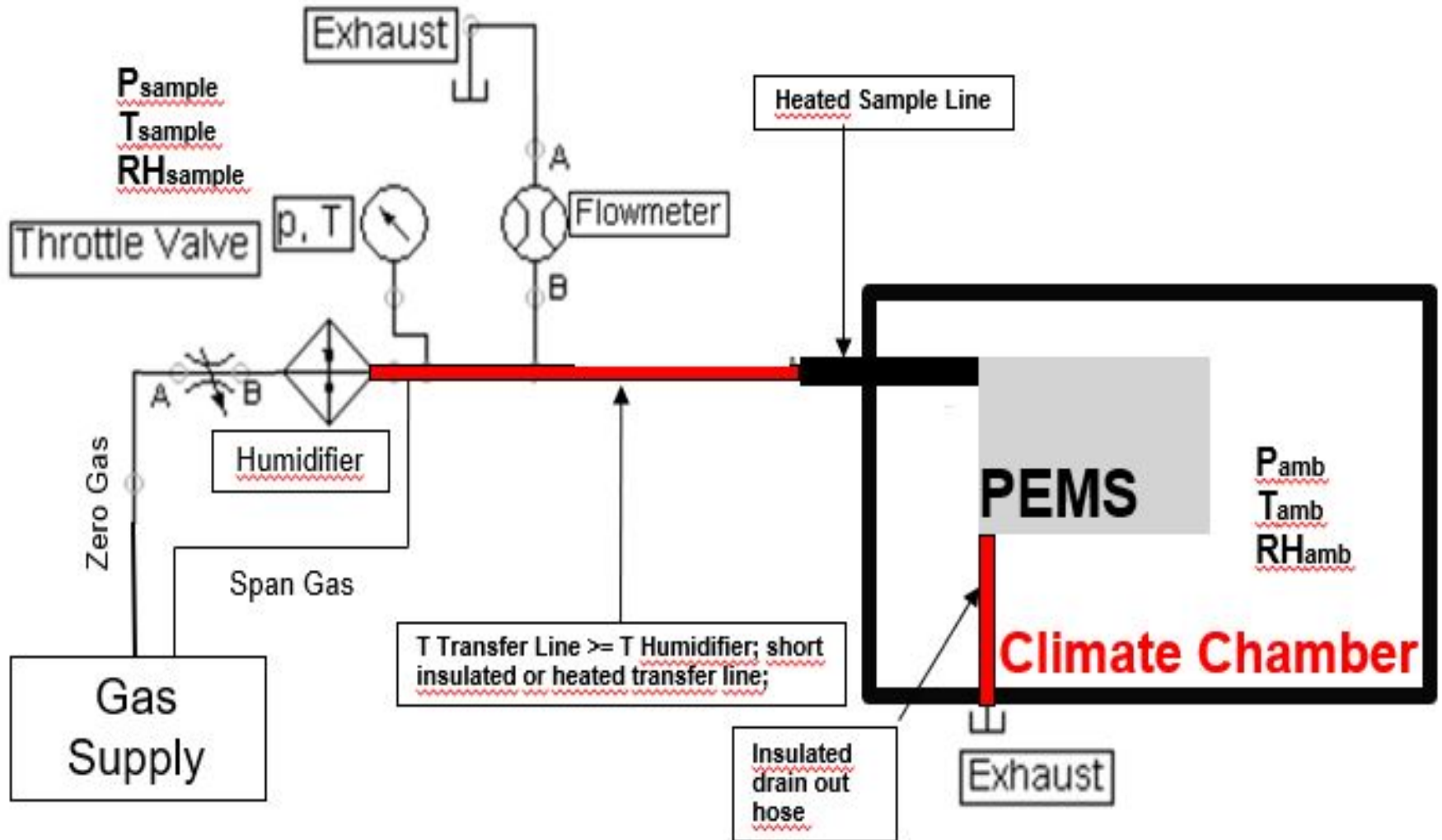
PN analyser ^{a, b}	Requirements	Zero	Span (x2)	T _s	RH _s	P _s	T _{amb}	RH _{amb}	P _{amb}
Vibration and shock tests	Representative RDE profile	Yes	23nm, >45nm	T _{amb}	dry	P _{amb}	T _{amb}	RH _{amb}	P _{amb}
Inclination tests	Tilting left, right, forward, backward direction at angle 15%. 15min/direction	Yes	23nm, >45nm	T _{amb}	dry	P _{amb}	T _{amb}	RH _{amb}	P _{amb}
Ambient temperature and humidity tests and step changes Temperatures within +/- 2°C ^c Each point 60min Changes within 5-15min	Test 1: 23°C, -7°C, 23°C Zero and span allowed only at the beginning of test at 23°C Test 2: 23°C, +35°C, 23°C Zero and span allowed only at the beginning of test at 23°C	Yes	Poly GMD 23nm and GMD>45nm	Dry		P _{amb}	Mod.	<15% >80% At 23°C	P _{amb}
Ambient pressure tests Each point 15 min Changes of pressure within 15-20min	P _{amb} , 850 mbar, P _{amb}	Yes	Yes	Dry		Mod.	T _{amb}	RH _{amb}	Mod.
Sample gas humidity variation tests	Dry sample, wet sample, dry sample Wet sample: 60°C dew point	Yes	Poly GMD 23nm and GMD>45nm	Wet (60°C dew point)		P _{amb}	T _{amb}	RH _{amb}	P _{amb}

^a 's' refers to sample, 'amb' to ambient

^b Z=Zero, S=Size at the concentration level >LOD, P=Pressure, T=Temperature, RH=Relative humidity

^c Initial temperature may be 25°C +/- 5°C, and during the test, the temperature shall not vary of +/- 2°C

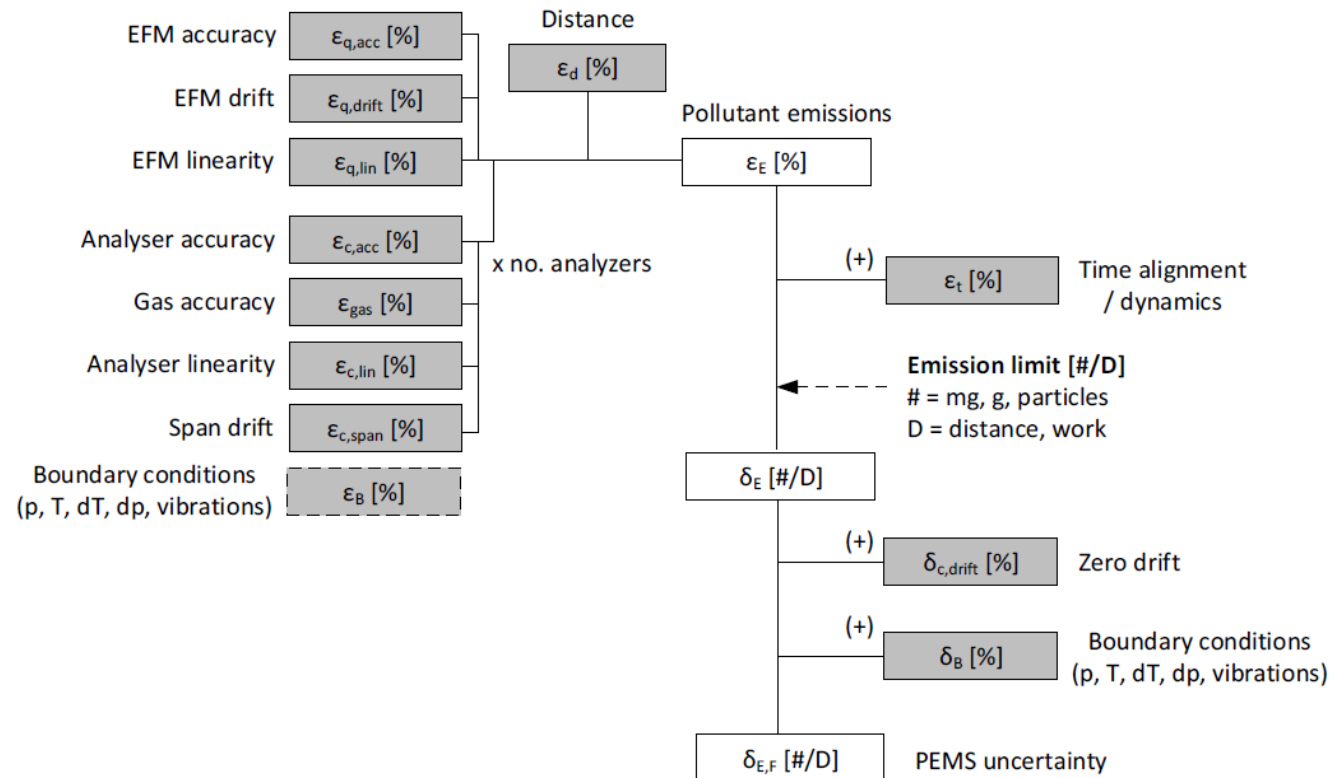
4: Example of setup



6: PEMS measurement uncertainty

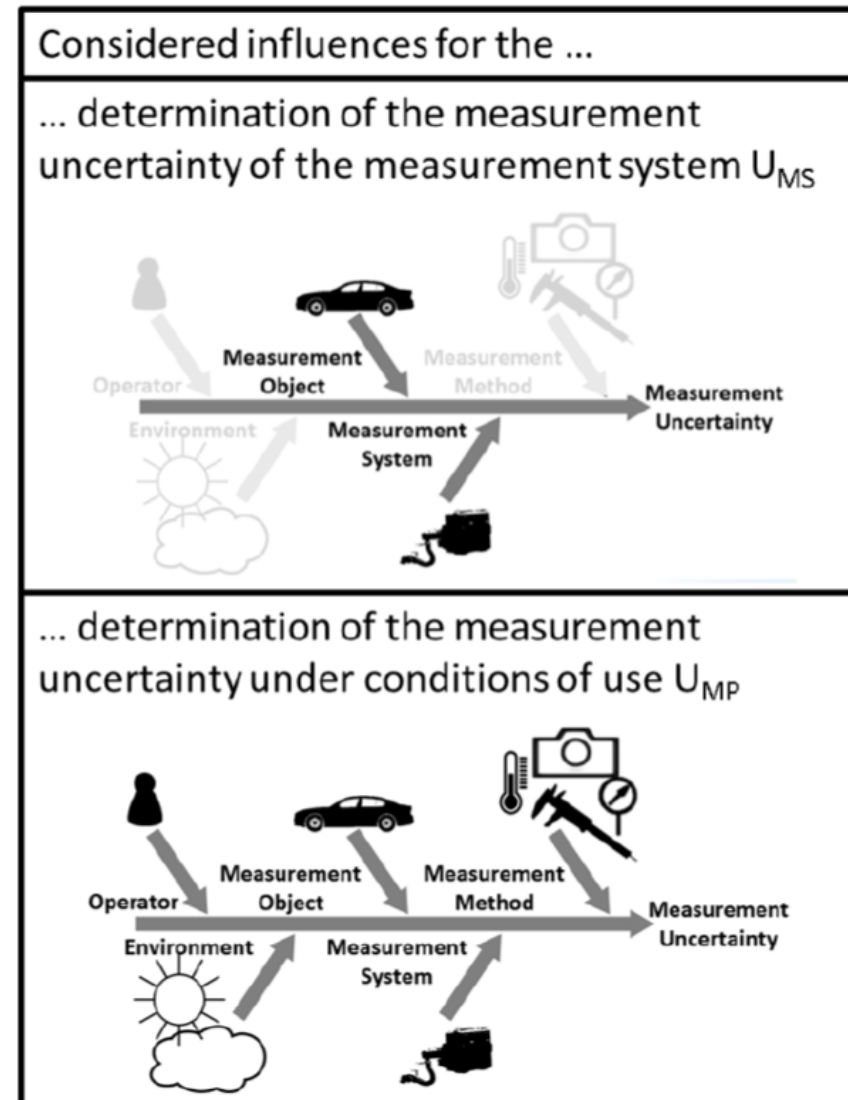
- JRC framework for PEMS measurement uncertainty
- Uncertainty based on the components

- + Adaptable
- + Results of PEMS manufacturers (Chapter 4 and 5) transferable
- Limited experimental confirmation



7: Uncertainty of performance testing

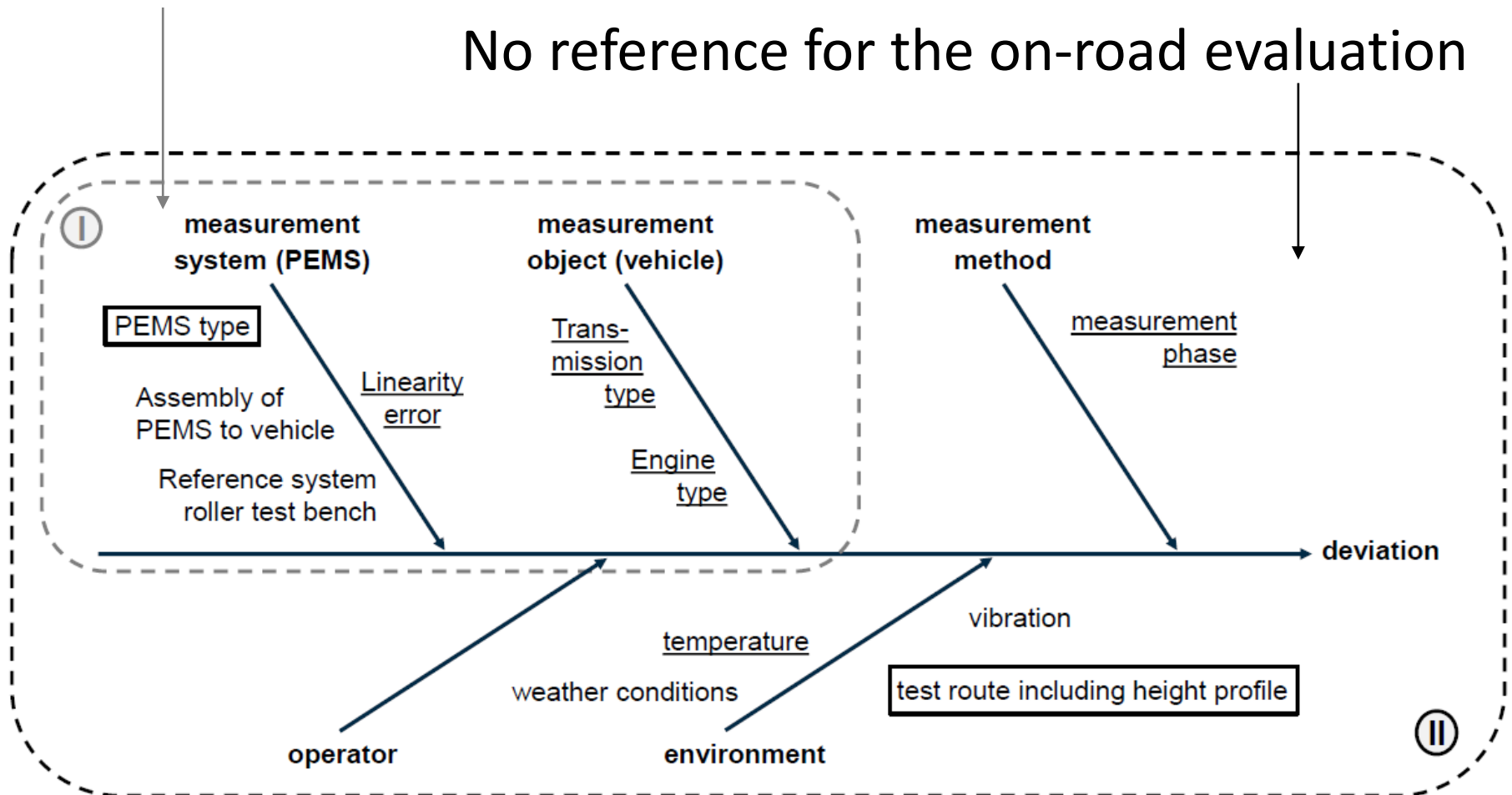
- + Based on experimental comparisons and identification of parameters that could have an effect
- Need of big amount of testing (risk of bias of who does the testing and what is reported)
- Not necessarily transferable to other PEMS, cars etc



7: Uncertainty of performance testing

The lab evaluation is like current “validation” test

No reference for the on-road evaluation



7: Uncertainty of performance testing

- At the moment there is no reference instrument for RDE testing. Thus the variability includes the vehicles emissions variability

Table 15 — measurement uncertainty budget

	contribution / ratio		Calculation
PEMS validation	Repeatability at standard	u_{EVR}	$\Delta x = x_{Ref} - x_{PEMS}$ $u_{EVR} = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (\Delta x_i - \overline{\Delta x})^2}$
	Systematic deviation	u_{BI}	$u_{BI} = \frac{1}{\sqrt{3}} \overline{x_{Ref}} - \overline{x_{PEMS}} $
RDE testing	uncertainty from repeatability on measured test vehicles	u_{EVO}	$u_{EVO} = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$
	Combined uncertainty	u_{MP}	$u_{MP} = \sqrt{u_{BI}^2 + \max\{u_{EVR}^2; u_{EVO}^2\}}$

7: Uncertainty of performance testing

- There are some claims that the limit values should consider the process uncertainty (paragraphs 7.8.1 and 7.8.2)
- This is not appropriate (for the margin) as it includes the vehicle variability

CEN new elements

- Extension of testing to low/high temperatures, pressures, vibrations etc.
- Regulations independent
- PEMS uncertainty framework (based on components)
- RDE uncertainty (eg for laboratories assessment of uncertainty)

Time frame

- Submission for Final Vote December 2020
 - PEMS manufacturers can start applying the procedures
- CEN standard summer 2021



Timeframe

	2019				2020												
	Sep	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	August	Sep	Oct	Nov	Dec	
Work Item PEMS								CEN enquiry									

2019-10-30
Official deadline to submit the draft to CEN for ballot

Draft submission to CEN for enquiry

Expected in June/July F2F to solve comments from enquiry