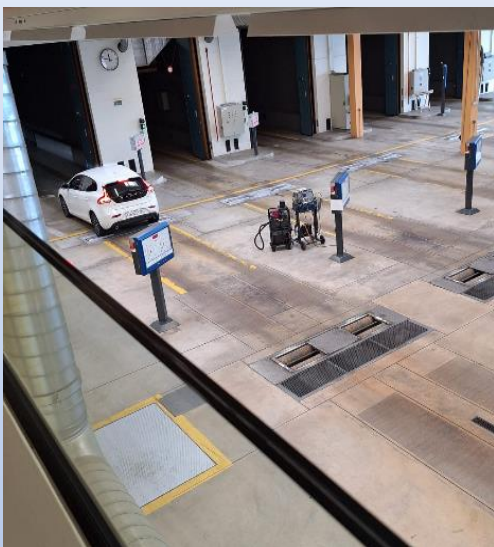


VERT Application Criteria of NPTI Instruments



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March 20thth, 2026

My current Activities

- Wijs-Air Consultancy was founded on May 17th, 2020.
- Wijs-Air supports cleaner and safer air by promoting technologies and instruments that identify key sources of high emitters and help measure combustion generated toxic air and the efficacy of filtration and purification as mitigating principles. This includes understanding the toxicity and influence on human health and the environment.
- Wijs-Air helps to advocate policies that clean up our existing fleet, whilst encouraging migration to cleaner mobility strategies.
- Wijs-Air provides sales and project consulting services for emission testing on both on-road vehicles and non-road Mobile Machinery and for continuous air quality monitoring applications.
- Board member of the VERT Association and Chair of the NPTI working Group.
Chair of Air Monitoring working Group - WCRAQ
- Member of international garage equipment associations (GEA and ASA), including EGEA on emissions, SMMT aftermarket and associate membership of CITA.

VERT Application Criteria for NPTI Instruments

VERT Application Criteria for NPTI Instruments

PN-PTI based on certified particle number counters (PNCs) has been rolled out in four European countries and has now been included by the EU in the newly proposed roadworthiness package (RWP). What can we learn from the experiences of these early adopters in terms of application criteria? How do we ensure the correct test procedure is followed? With centralised and decentralised PTI testing, how do we judge the performance criteria of the PNCs to ensure long term repeatability and traceability also with the use of field calibration systems? With the increasing use of biofuels and the inclusion of gasoline vehicles, can VERT contribute in helping to define and test application criteria for NPTI instruments and provide guidance for a successful roll out in other countries?

Early adopters of PN-PTI and what does the EU/ UNECE recommend?

- Commission Recommendation (EU) 2023/688 of 20 March 2023 on PN measurement for PTI of vehicles equipped with compression ignition engines.
- A common set of minimum requirements for PN measurement should be introduced on the basis of guidelines.
- As soon as the same level of confidence is reached regarding PN measurement method applicable to vehicles with positive engines, corresponding guidelines should be developed.
- In order to be effective, the guidelines should include requirements to the measuring equipment, metrological controls, the measurement procedure, metrological and technical requirements as well a pass/fail limit.

Early adopters of PN-PTI and what does the EU/ UNECE recommend?

- Time intervals and procedures for maintenance, adjustment and verification that are followed in order to comply with MPE.
- Minimum range is from 5,000 #/cm³ to twice the PN-PTI limit value as a minimum value for the upper range (recommended at least 5 times the limit value). Current differences between thresholds of 250k and 1 e6 #/cm³.
- MPE 25% or 50%, relative or absolute ($\leq 25,000$ #/cm³).
- Expanded uncertainty of the reference system at $\leq 12.5\%$ or $\leq 1/3$ of MPE at reference conditions.
- Volatile Removal Efficiency.
- Stability with time or drift and Repeatability.
- Influence quantities – when critical internal temperatures are of range, the instrument does not indicate the measured value and indicates a warning.

Early adopters of PN-PTI and what does the EU/ UNECE recommend?

- The PN-PTI instrument incorporates good particle sampling practises for minimisation of particle losses – diesel and gasoline.
- Requirements for ensuring correct operation.
- Metrological controls – Type examination, Initial/ first and subsequent verification. All tests are performed by or under the control of an National Metrology Institute (NMI).
- Initial verification – soot or other materials such as salt with the set up tested and under the responsibility of the NMI. Inter-laboratory correction factors need to be checked and applied by the NMI.
- Subsequent verification – using polydisperse particles with monomodal size distribution, GMD 70 +/- 20 nm and GSD ≤ 2.1 at 3 PN concentrations; 1/5 of PN-PTI limit; PN-PTI limit and 2 x PN-PTI limit.
- Portable reference system fulfils the same requirements as those used for initial verification, but with expanded uncertainty $< 20\%$ or $\leq 1/3$ of MPE under the responsibility of the NMI.

Early adopters of PN-PTI and what does the EU/ UNECE recommend?

Measurement Procedure

- Automatic test procedure must log the time and include measurement procedure as defined and report the measurement and test results.
- Self checks with trigger or message in case of malfunction
- Stabilisation of 15 seconds followed by test duration of 15 seconds with test result being the average PN concentration during the test period.
- Fast fail if during the test phase, the measurement is 2 x limit
- Fast pass is possible as in CH <math><100,000 \text{ \#/cm}^3</math> and in DE <math><50,000 \text{ \#/cm}^3</math>.

Theory v Practice

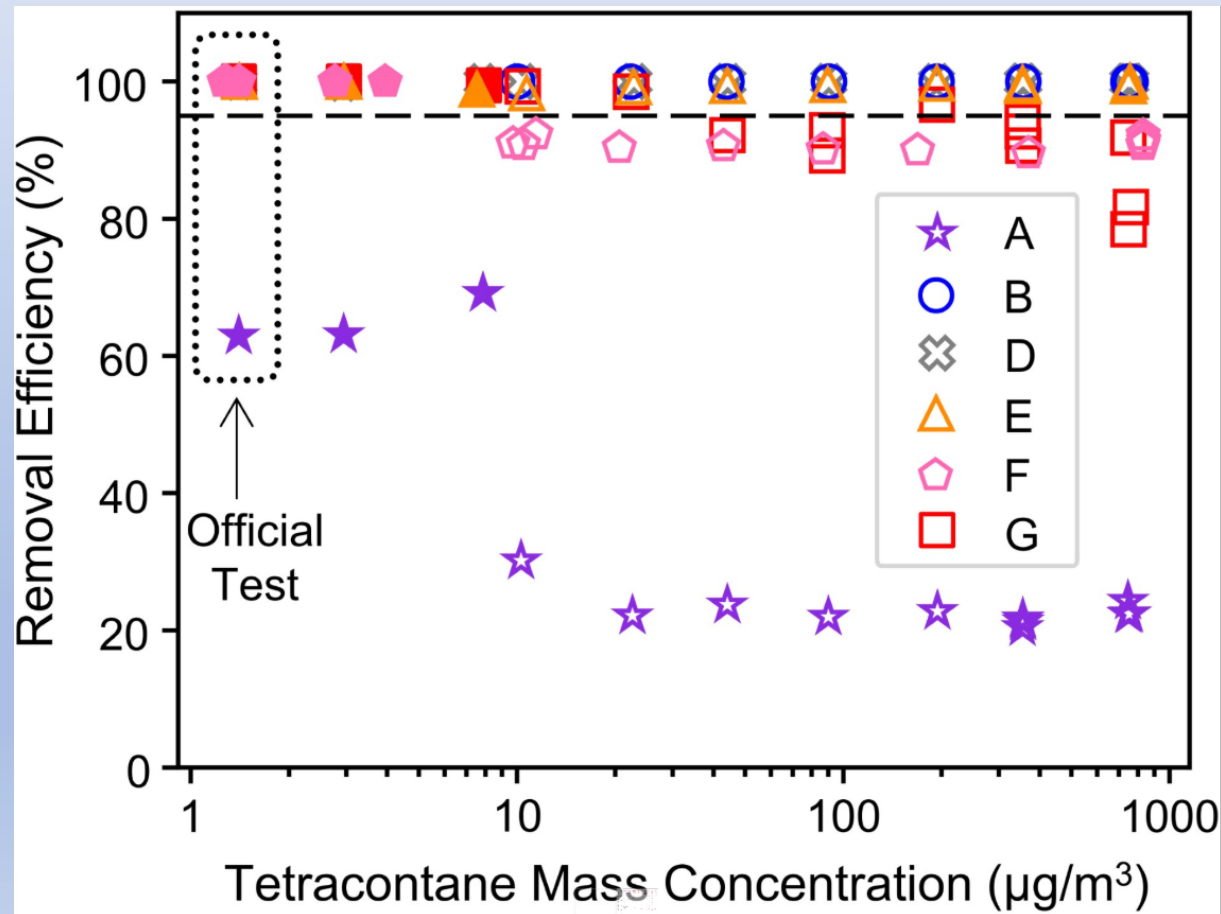
Why do we see a regular divergence between the measurement results from different certified particle number counters (PNC) on the same vehicle or between pre-approval and official tests?

- Traceability and calibration of field reference systems – see METAS report on Correction factors for instruments used in PTI of diesel vehicles.
- Control and monitoring of pre-adjusted calibration status before service and subsequent verification to judge metrological validity and PNC performance during calibration interval.
- In heavy duty centralised PTI markets, it is not uncommon for calibration intervals, which typically include adjustments, to have been reduced from 12 months to 3 months or less to ensure compliance.

Theory v Practice

- Follow automated official test procedure as legally prescribed and NOT in the continuous mode by transferring the probe from one tail pipe to another.
- The automated test requires the instrument to perform self checks to ensure conformity.
- Review VPR efficiencies – Increasing use of bio fuels such as HVO can reduce PN but increase VOCs. A recent study between Bartec Emissions and Ricardo showed a bi-modal PSD, which can affect PN test results on vehicles with compromised filters between devices at the margins.
- Possible even more relevant on gasoline applications as reported in a recent METAS study by Una Trivanovic.

VPR Efficiencies – METAS Report



Additional critical situations

- Automatic 24 hr leak test. Robert Fraser reported that surveys showed that 13.1% of PN testers failed this test.
- Hostile environmental testing locations, vibrations, dust, extreme temperatures, humidity.
- Testing procedures – avoid testing during or immediately after DPF regenerations.
- Pre-conditioning of vehicle
- Accuracy near limits – with +/-25% MPE or higher, devices could be operating at different levels within this scope, resulting in conflicting pass/fails.
- User maintenance and self checks. Probe, leak, filter checks

Initiatives

- METAS on test procedures and market surveillance.
- NMI, NL project with the objective to align subsequent verification testing with the EU recommendations for particle counter testing.
- NMI to conduct calibration tests of field calibration equipment used for subsequent verification.
- GOCA/ VIAS use of a master field calibration reference system to ensure traceability and repeatability and use of automatic test procedure.

Correct procedures and performance monitoring

Kontrolle der eichpflichtigen Messmittel für Nanopartikel aus Verbrennungsmotoren

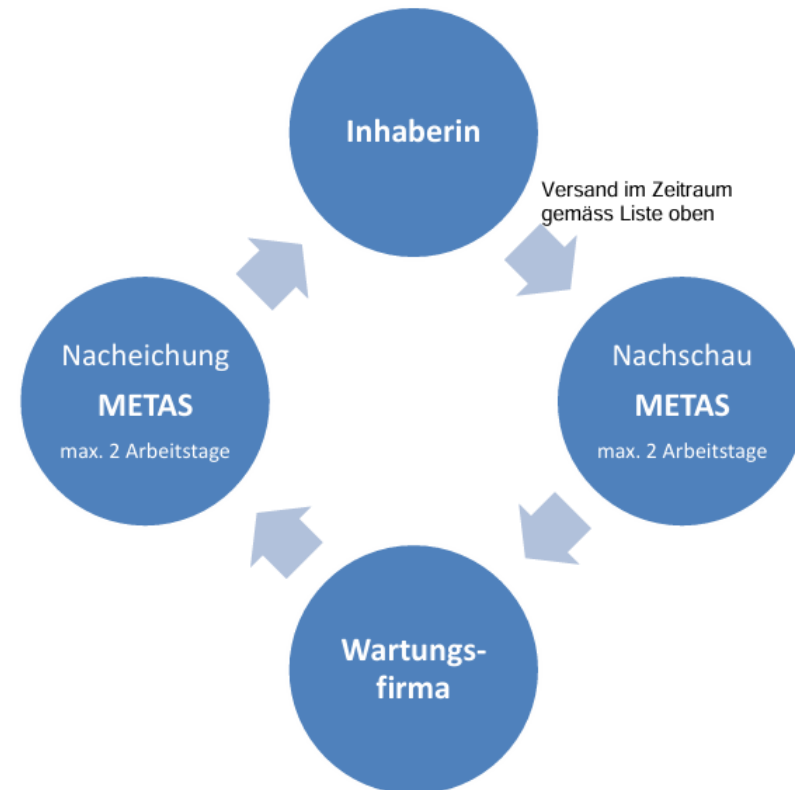
Wichtiger Hinweis

November 2025

Messungen während der Fahrzeugprüfung (Abgas-Nachkontrolle durch die Zulassungsbehörde) und während Abgaswartungen sind **ausschliesslich im Messmodus "Offizielle Messung"** zu tätigen.

Der Messmodus **"Kontinuierliche Messung" resp. "Standardmessung"** ist weder geprüft, noch zugelassen, noch geeicht und ist entsprechend **nicht** zu benutzen.

Ablauf



VERT NPTI Application Criteria

- How can the VERT Association Assist?
- VERT Certification of both particle filters and NPTI instruments?
- Emergence of several classifications of certified PNCs, with their suitability defined between heavy duty centralised PTI testing or lower throughput non centralised markets, between supporting both diesel and gasoline applications, sensor design, sampling and VPR efficiency. These observations may also be PN-PTI limit dependent.

Acknowledgements

- Ricardo – Jason Southgate – Principle Consultant – Particle Measurement Centre
- Scale MT – Peter Schwanzer
- METAS – Konstantina Vasilatou, Kevin Auderset, Una Trivanovic
- Robert Fraser – VERT Association & CEO at Purexhaust SA
- Dr Andreas C.R. Mayer – Chairman of the Scientific Committee at the VERT-Association (www.vert-dpf.eu)
- Bartec Emissions – <https://www.bartecautoid.com/emissions>
- VERT Association - <https://www.vert-dpf.eu/>