

# **Air Consult**

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## **SNR 277205**

### **Swiss Rule for Testing Particle Filter Systems**

#### **Abstract**

At present a working group elaborates within the framework of the Swiss Association for Standardization (SNV) a Swiss normative document on the testing of particle filter systems for internal combustion engines.

This so called SN-Rule (SNR 277205) is based to a great extent on the VERT suitability test which is in use since about 10 years. It describes the way particle filter systems should be tested regarding technical, physical and chemical criteria.

The SNR 277205 describes the technical testing procedure only. It does not comprise requirements in the sense of limit values that should be met.

The SN-Rule is expected to be published in September 2007 in German language. French and English translations will follow. The SN-Rule will be available at the Swiss Association for Standardization ([www.snv.ch](http://www.snv.ch)).

## **Working group**

The SN-Rule SNR 277205 is created by the SNV ad hoc committee "VERT particle filters". This committee consists of representatives from industry, federations, federal administration, universities, research institutes, test laboratories and further experts.

The working group headed by the Swiss Federal Office for the Environment (BAFU). The secretary's office is run by the Swiss Association for Standardization (SNV). The elaboration and the editing is done by the author of this poster (Air Consult).

## **Objective of this SN-Rule**

This SN-Rule aims at defining methods and procedures for testing the efficiency and the suitability of particle filter systems for internal combustion engines. Direct addressees of this rule are test laboratories. Indirect addressees are filter manufacturer, operators of installations and public authorities.

## **Technical basis and contents**

The SN-Rule is based to a great extent on the VERT suitability test which is in use since about 10 years. It describes the way particle filter systems should be tested regarding technical, physical and chemical criteria.

The SNR 277205 describes the technical testing procedure only. It does not comprise requirements in the sense of limit values that should be met.

## **Legal import of the SN-Rule**

Like all standards this SN-Rule has no legal force out of itself. It is a technical consensus paper and has the significance of a recommendation. Standards and SN-Rules obtain legal force only if there is made reference to them in private contracts or in laws and ordinances prescribing the import of a specific standard or rule.

## **Publication**

At present the SN-Rule is still in the state of drafting. It is expected to be published in September 2007 in German language. French and English translations will follow. The SN-Rule will be available at the Swiss Association for Standardization ([www.snv.ch](http://www.snv.ch)).

## Guiding principles for filter testing

The guiding principles of this SN-Rule 277205 can be summed up in five items:

1. Filtration is a physical process which - under the same conditions - always works in the same way. It essentially depends on the particle size and the space velocity of the exhaust gases in the particle filter. Therefore on the engine test-bed main emphasis is given to test the pure physical properties of the filter system. These physical properties in principle are independent of the future application of the filter.
2. Filter systems which (a) are based on the same filter technology, (b) consist of the same main components, (c) are constructed in the same way, (d) but only differ in their size, form a so called filter family. As they all are functionally identical, it is enough to test only one single representative of a filter family. The test results can be applied to other samples of the same filter family.
3. The filtration properties of particle filter systems are characterized exclusively by the filtration efficiency for the number of ultra fine solid particles in the size range of 20 to 300 nanometer. This focuses the filtration test on those particles which are most important regarding adverse health effects and, moreover, gives reliable measurement results. Because of the applied hot gas dilution and by restricting the measurement to solid particles, measuring artifacts which could be generated by condensation of volatile exhaust gas components can be eliminated.
4. Particle filter systems can generate toxic secondary emissions. This can particularly be the case if catalytically active substances (e.g. in filter coatings or as fuel borne additives) are used. For this reason, the SN-Rule includes also a secondary emissions test.
5. In addition to the filter testing on the engine test-bed, and with regard to the intended use of the particle filter system, an endurance test under real operating conditions has to be done. This test is carried out in a typical application for which the filter system is intended to be used (e.g. a construction site machine, a road vehicle, a stationary engine). With this endurance test possible weak points of the filter system under long-term stress can be revealed.

## Survey of test sequence

	Test	Main points of test
A	Technical documentation and visual test	Technical description of the filter system and visual test of the construction
B	Filtration test before endurance test	At stationary motor operation: Determination of filtration efficiency for number of solid particle in the size range of 20 nm to 300 nm.  At transient motor operation: Determination of exhaust gas opacity after the filter.
C	Regeneration test	Determination of exhaust gas temperature and back pressure of the filter at the point where regeneration starts. Particle and gaseous emissions during the regeneration phase.
D	Secondary emissions test	Determination of toxic substances which are generated by the filter system (NO <sub>2</sub> and about 40 trace elements).
E	Test of the monitoring of operation before endurance test	Checking the electronic control, monitoring and recording of operation of the filter system, and the triggering of warnings and alerts.
F	Endurance test	Real-world-test by operating the filter system in a typical application during 2000 operation hours.
G	Filtration test after endurance test	Like above in B
H	Test of the monitoring of operation after endurance test	Like above in E
I	Test report	Compilation and discussion of test results.

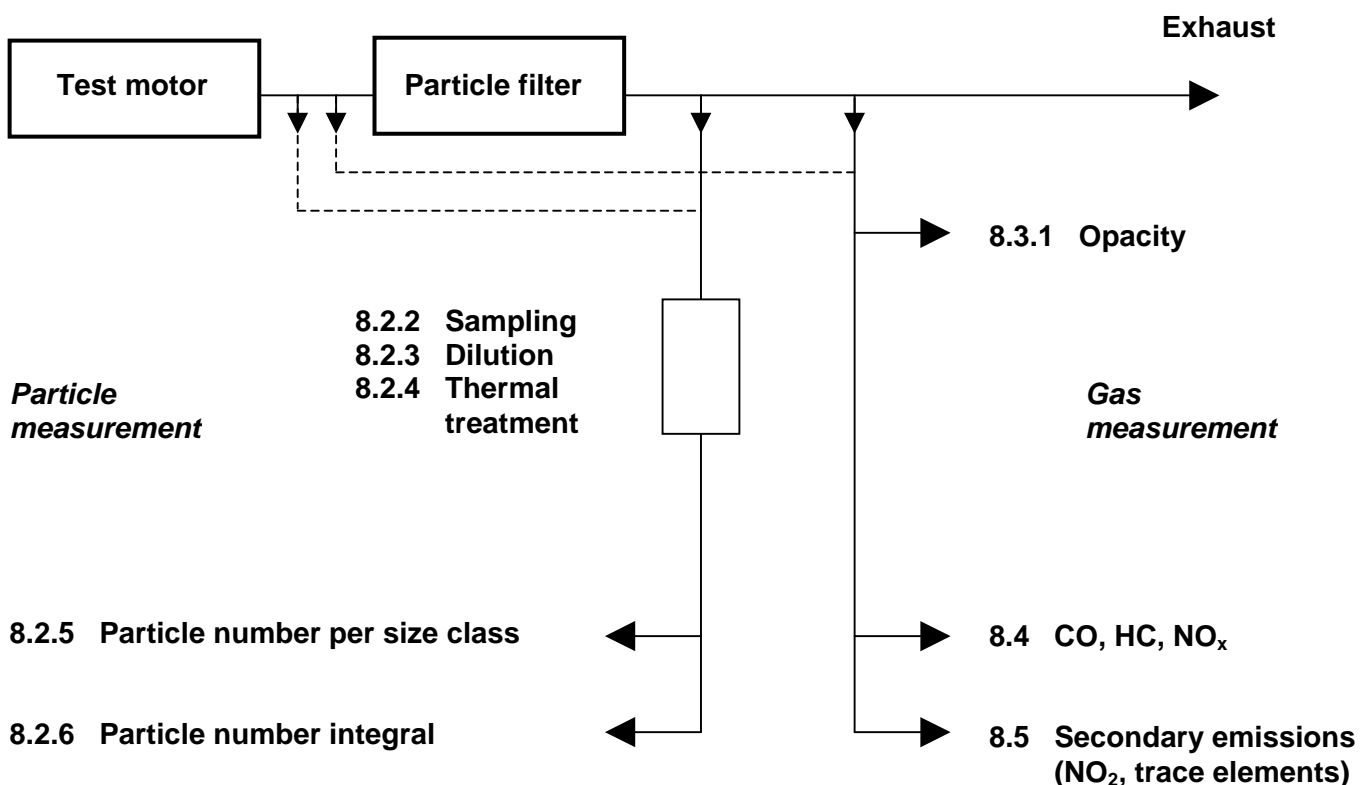
## Engine test-bed

Unless otherwise stated in the SN-Rule, the equipment of the engine test-bed and the carrying out of the test-bed measurements have to conform with ISO 8178-1.

The test motor and the test-bed equipment must be suited to run the test cycles according to chapter 8 of the SN-Rule and to make the required emission measurements.

As test motor any 4-stroke-Diesel-engine without exhaust gas recirculation and without exhaust gas aftertreatment may be used. The test motor and the filter system to be tested must be matched so that at nominal operating conditions of the test motor the space velocity of the exhaust gases in the filter reaches the maximum value allowed by the filter manufacturer.

### Schematic of test-bed setup and emission sampling



(The number in the schematic refer to the corresponding chapters in SNR 277205.)

## Prüfung von Partikelfiltersystemen für Verbrennungsmotoren

Test de systèmes de filtres à particules pour moteurs à combustion

Collaudo di sistemi di filtri antiparticolati per motori a combustione

Testing particule filter systems for internal combustion engines

Für diese Norm ist in der Schweiz die Arbeitsgruppe <<VERT Partikelfilter>> des interdisziplinären Normenbereiches zuständig.

En Suisse la présente Norme est de la compétence du Comité <<VERT systèmes de filtres à particules >> du Secteur interdisciplinaire de normalisation

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