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Air Pollution Control and Chemicals Division

# **PN-based periodic control for construction machinery**

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Federal Office for the Environment FOEN



# Construction Machinery in Switzerland ...



... have to comply with the Directive 97/68/EC.  
... must not exceed the particle count of  $1 \times 10^{12}$   
1/kWh for solid particles (OAPC).

The requirements of the particle count are deemed to be complied with if the construction machine is operated with a particle filter system.

SN 277206:

- ultra fine particle reduction > 97%
- have an electronic on board control
- ...



# Switzerland's periodic control for construction machinery

ABGAS-WARTUNGSDOKUMENT

FICHE D'ENTRETIEN  
DU SYSTÈME ANTIPOLLUTION

DOCUMENTO SULLA MANUTENZIONE  
RELATIVA AI GAS DI SCARICO

**Diesel (Baumaschinen)**

Muss stets im Fahrzeug mitgeführt werden  
Doit toujours rester dans le véhicule  
Il presente documento deve sempre accompagnare il veicolo

**CH**

Gesetzliche Vorschriften auf Seite 6 und 7  
Voir prescriptions légales aux pages 6 et 7  
Prescrizioni legali, vedere pagine 6 e 7

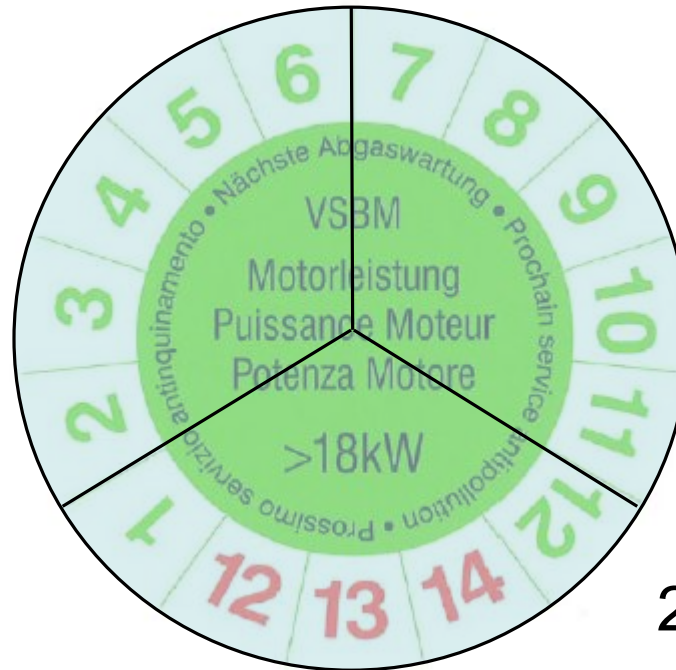
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# Switzerland's periodic control for construction machinery

1. engine check



3. opacity/PN measurement

2. engine adjustment

- At minimum every 24 months
- System of self-control (delegated to the holder or operator) – cantonal controls on a random basis



# How can you decide, if a DPF ist still ok?



Values of opacity: often 0.00 m<sup>-1</sup>

Offizielle Messung

07.12.15 17:06 Uhr

Kennzeichen: .....

Chassisnummer: .....

km-Stand: .....

Kundenname: .....

Durchmesser Messsonde:  
10 mm = Auspuff <= 70 mm

Öltemperatur 91 °C

Drehzahl min <sup>-1</sup>	Drehzahl min <sup>-1</sup>	Trübung m <sup>-1</sup>
960	2500	0.00%
960	2530	0.00%
960	2560	0.00%
960	2590	0.00%
960	2620	0.00%
960	2650	0.00%
960	2680	0.00%
960	2710	0.00%
Mittelwert:		0.00



# Measurement of particle number (PN)

- PN-measurement officially allowed since february 2016 ([Construction Guideline Air](#))
- Opacimeter remains the authoritative measurement
- The new type of particle counters shall replace the opacimeters after a transition period.
- Measurement procedure and reference value – see Annexe A5





# Measuring procedure for the official measurement

Conditioning of the engine and DPF:

- 4 to 6 free accelerations, until engine + DPF are warm
- Stay at maximum speed / high idle speed, until the engine is constant.

Measuring:

- Start measuring by pressing the button of your instrument.
- Read the result and compare with the reference value:  $2.5 \times 10^5$  particles/cm<sup>3</sup>



# Measurement, done by the instrument

Duration of the measurement: 40 seconds

- 15 sec waiting period
  - 5 sec measurement 1 → mean 1
  - 5 sec break
  - 5 sec measurement 2 → mean 2
  - 5 sec break
  - 5 sec measurement 3 → mean 3
- overall mean**





# The reference value

Reference value of  $2.5 \times 10^5$  particles/cm<sup>3</sup>  
(analog to  $1 \times 10^{12}$  particles/kWh written in the OAPC)

- overall mean < reference value: **passed**  
→ DPF and engine are in good condition.
- overall mean > reference value: **failed**  
→ The problem has to be solved.  
Any use of the machine on a construction site is not allowed.





# Measurement of particule number





# Experience until march 2016

- Easy handling
- Compared to the opacimeter no measurement of the engine speed necessary – an advantage
- Scientific notation not common in construction sector (versus  $2.5 \times 10^5$  particles/cm<sup>3</sup> = 250'000 particles/cm<sup>3</sup>)
- Some problems will be solved with the next software release (rounding, error due to humidity, etc.)
- Measurement data will be first collected from many in-use construction machines and then analyzed



# FOEN offers you...

- ... to borrow a PN-measuring instrument.
- ... to test yourself your DPF equipment.

Gain your own experience!

We expect...

- ... to get your data and your experience.



# Thank you for your attention!





# In case of questions:

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