

Workshop Tehran –December 14th/15th 2016

DPF Inspection & Maintenance

PART II: DIAGNOSIS + MAINTENANCE

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Maintenance of Emission Relevant Components: Procedure

- **Visual Checks:**
 - tightness of all systems
 - oil and soot deposits in the exhaust pipe
 - signs of overheating of the filter housing
- **Maintenance** of engine, filter system and crank case ventilation (in case of a closed version), corresponding to the instructions of the manufacturer, final check by a PN measurement at low idle (end pipe)
- **Data analysis** (**wireless datalogger**), e.g.:
 - temperatures (e.g. during low idle phases)
 - too high backpressures (when and where on the route)
- **Ash cleaning of filter if necessary**, → the cleaned filter has to be checked by a PN measurement at low idle (end pipe)

Maintenance of Emission Relevant Components: Procedure (cont.)

- **If $PN > 250'000/cc$** (compulsory inspection limit) : → **Check filter efficiency**

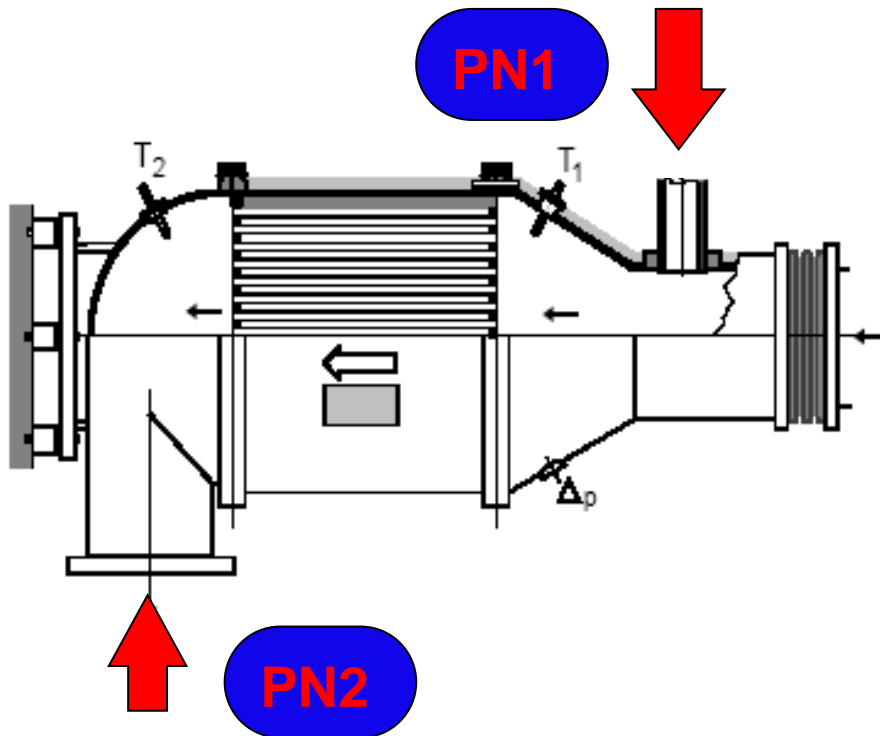
▶ If the efficiency is below 90%



- **Visual check** of the filter for damages (if less than 10%: → repair, otherwise replacement)
- If a **bad engine condition** is assumed: measurement of opacity before filter at free acceleration and determination of the k-value, ev. oil analysis
- **Confirmation** in the inspection document

Determination of Filter Efficiency

The filter masks the engine. Measurement upstream and downstream is needed to get information about engine raw emission and filter efficiency

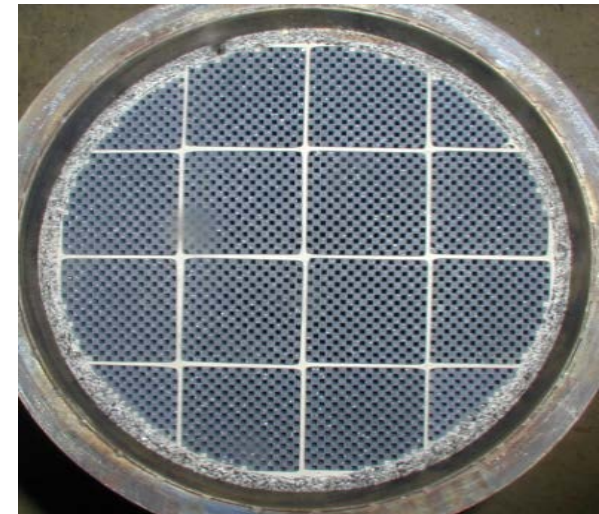


PN1 before the filter determines the emission status of the engine itself, eventual failures, leakages, deterioration, aging

Filtration efficiency:

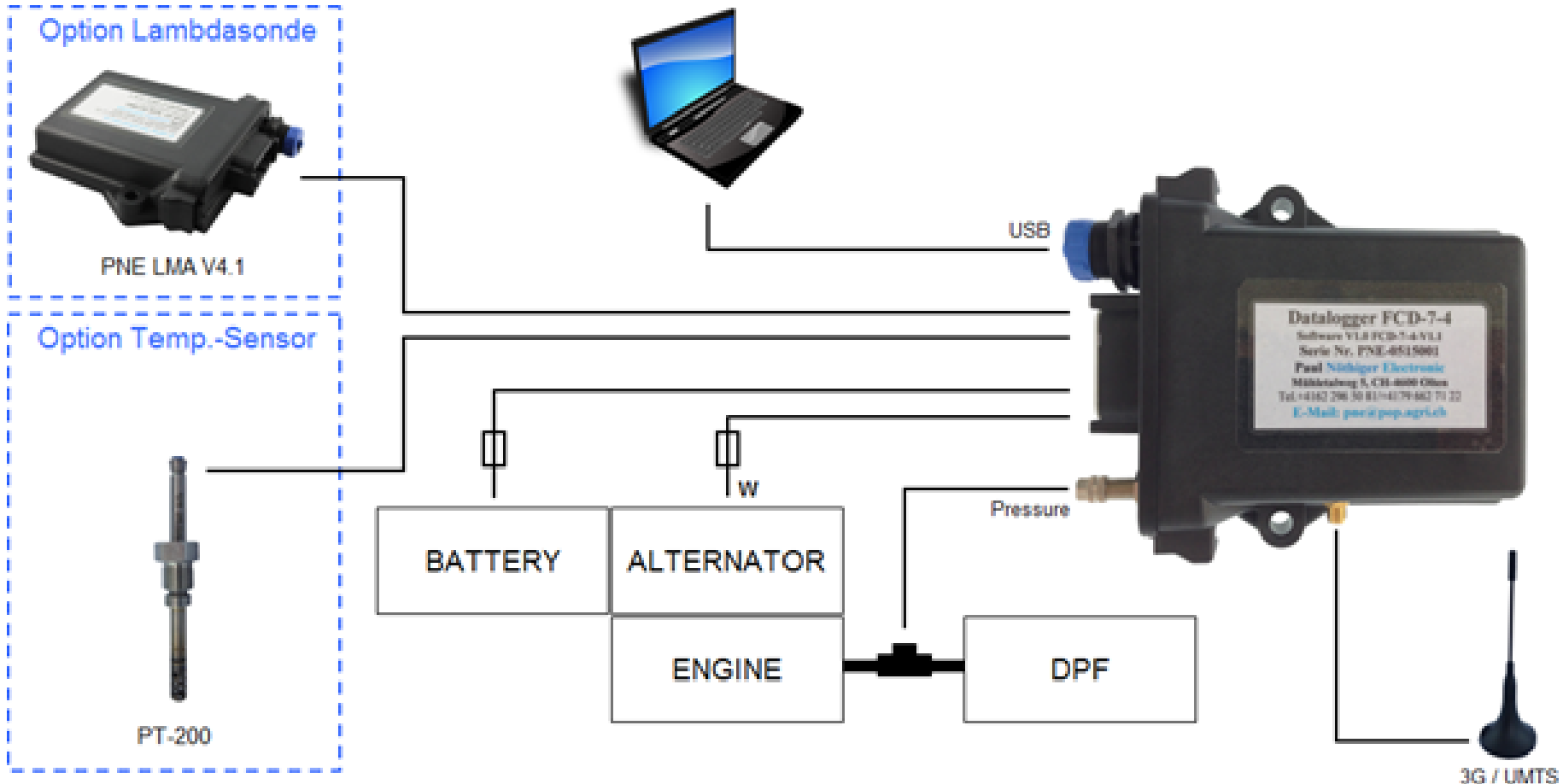
$$\eta = (PN1 - PN2) / PN1 \cdot 100 [\%]$$

Repair Small Failures by Ceramic Cement



Data Analysis (Diagnosis)

Filter Monitoring System (FMS): Elements



Store Data

- On-board memory
- Remote server
- Download data from memory: (**password protected**)
 - local: USB, WLAN, Bluetooth
 - remote: GSM (GPRS)

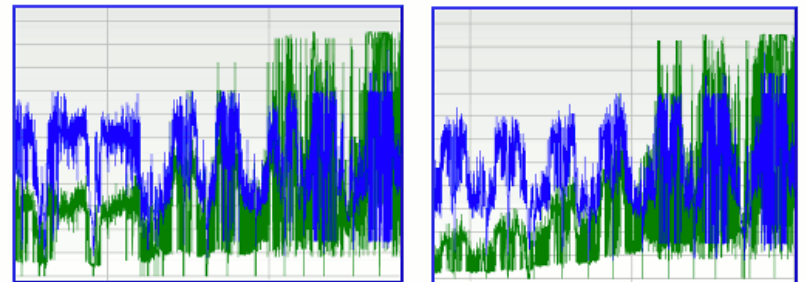
GSM = General System for Mobile Communication

Source: Paul Nöthiger Electronic



Evaluation

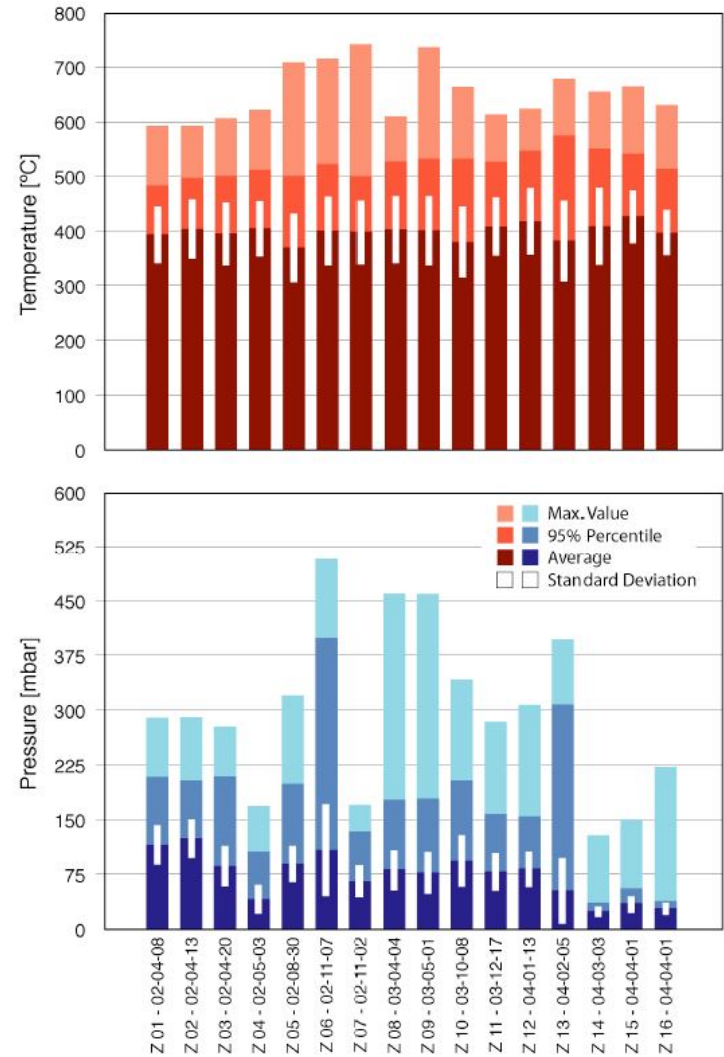
- **Statistics of DPF and vehicle operation**
- **Separation of operating hours and idle time**
- **Real time display and stored data analysis**
- **Trends of temperature and back pressure (normal, unusual)**
- **Comparison of vehicles and filters**
- **Prediction for filter cleaning and other maintenance needs**



Source: Paul Nöthiger Electronic

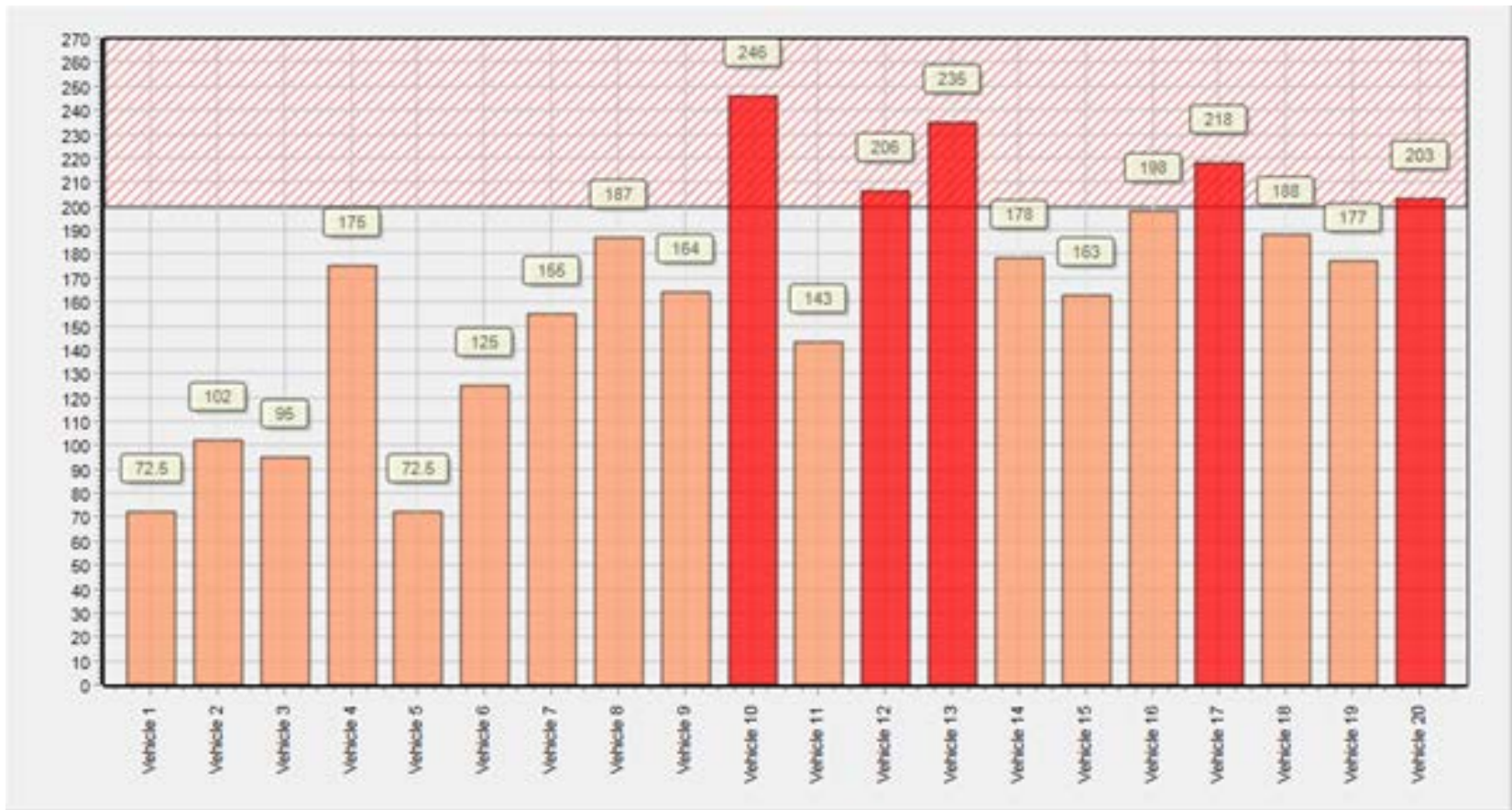
Trend Analysis

Background informations about longterm trends of filter loading and exhaust gas temperatures allow conclusions on normal or unusual operation of filter and engine



Source: Paul Nöthiger Electronic

Fleet Overview Report



Source: Paul Nöthiger Electronic

Back pressure – weekly 95%-percentiles

Conclusions

The instruments are ready:

- PN-measurements at low idle for DPF and engine control
- Filter monitoring with remote control (datalogging)
- DOC- and SCR conversion activity control is in the test phase (for future CRT and SRC systems)

For the implementation of a consistent I&M strategy

- **Regulations are needed**
- **Periodic independent checks are needed**
- **A documentation is needed (emission document on-board)**

Thank you for your attention

