



Umweltschutz-Technologien
Environment Protection Technologies


**HJS / TF Hudgins Approach for NO₂ -
Neutral DPM Technology by SMF[®] 2 -
19th MDEC Conference**


 **T.F. HUDGINS**
INCORPORATED

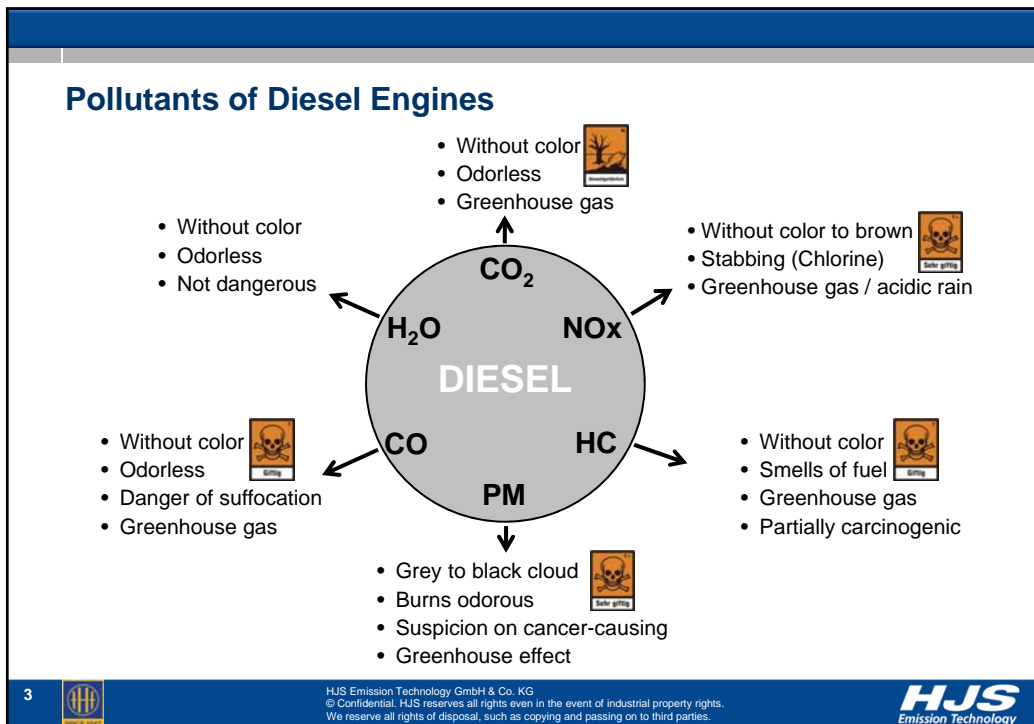
Klaus Schrewe, HJS Emission Technology
[Bob Clayton, T.F. Hudgins Inc.](#)
Toronto, Canada, October 08th – 10th 2013

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Pollutants of Diesel Engines


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Underground Mining Diesel Emission Legislation

- Workers in underground mines are at risk of developing occupational disease or suffering respiration-related death caused by ventilation hazards and exposure to diesel emissions (Ontario Ministry of Labor).
- USA - U/G Coal DPM Rule, 7-19-05: all non-permissible 2.5 g/hr DPM
- USA - U/G M/NM DPM Rule, 5-20-08: personal exposure to DPM in underground mines must not exceed an average eight hour equivalent of airborne concentration of 160 micrograms of total carbon per cubic meter of air (160TC μ g/m³)
- In Ontario alone, roughly 18K people work in about 40 active underground mines.
- Canada - U/G mining fall under provincial jurisdiction, engines are not directly regulated, provincial regulations exist for ventilation rates in mines.
- Canada – off-road follow US tier 4 standard for non road engines (1-16-2012)

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SMF[®]-AR Technology to Reduce Pollutants

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SMF[®]-AR – DPM Reduction with Fully Automatic Regeneration

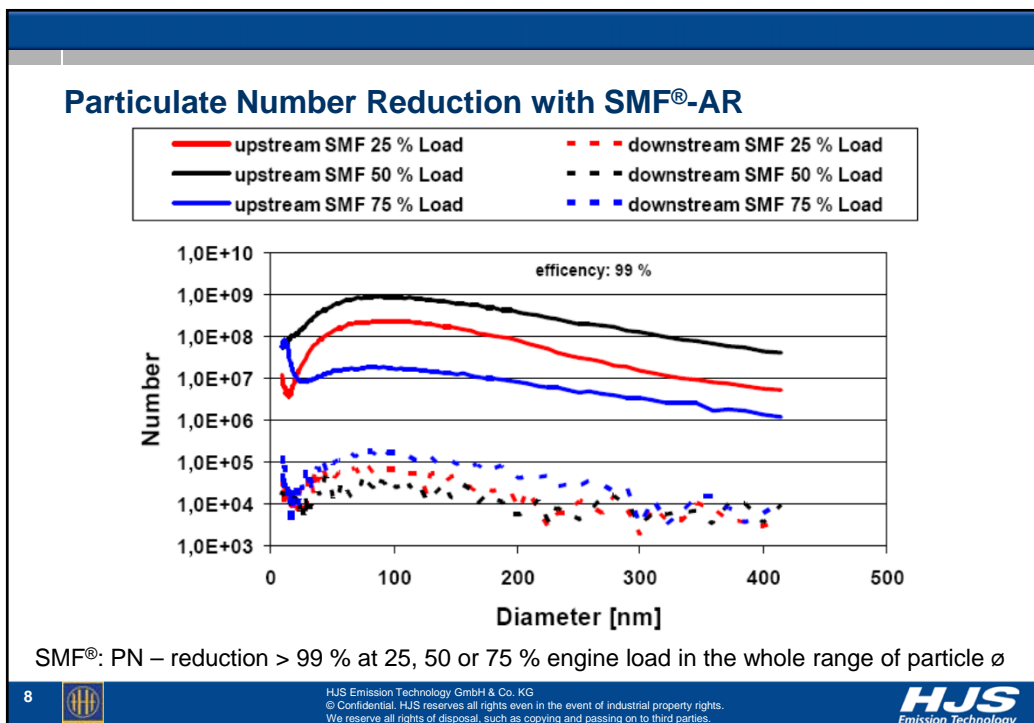
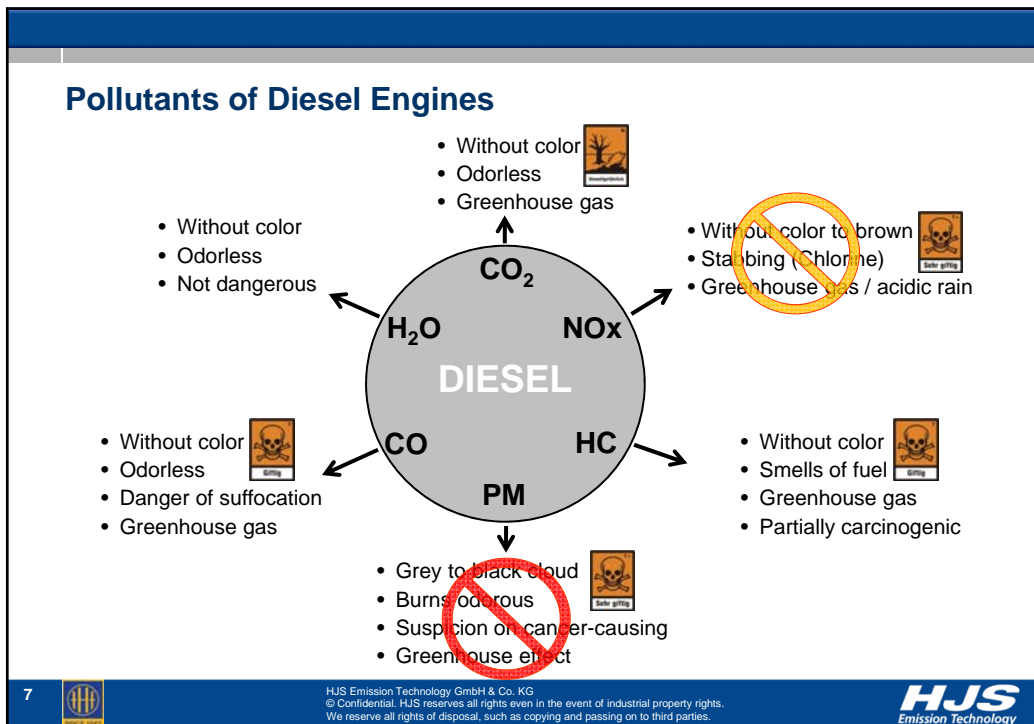
SMF[®]-AR

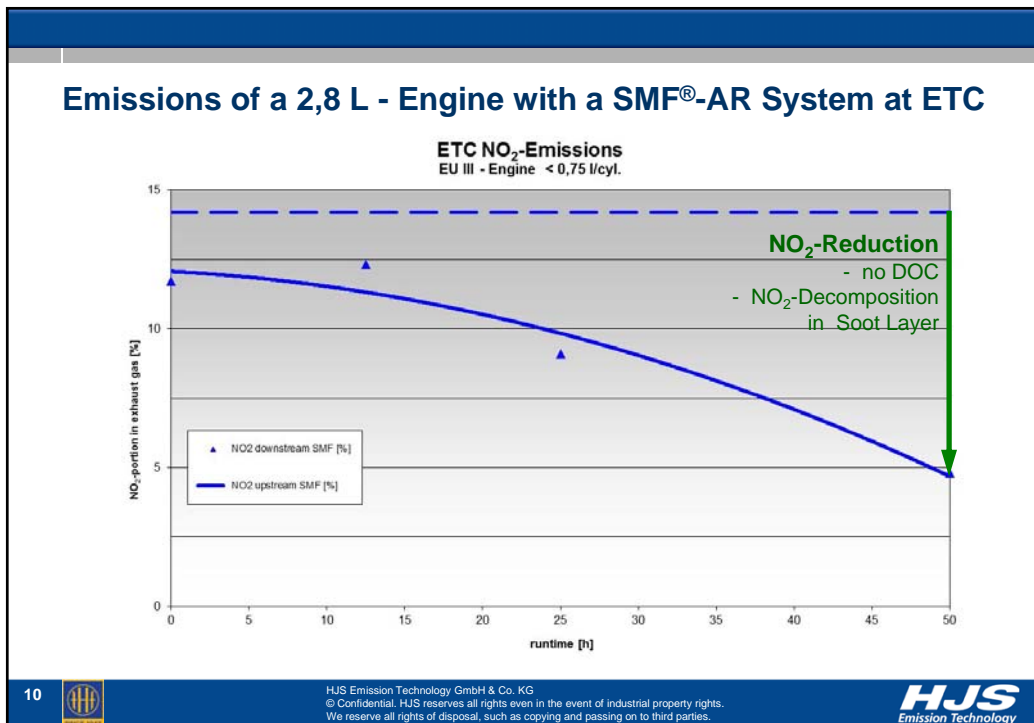
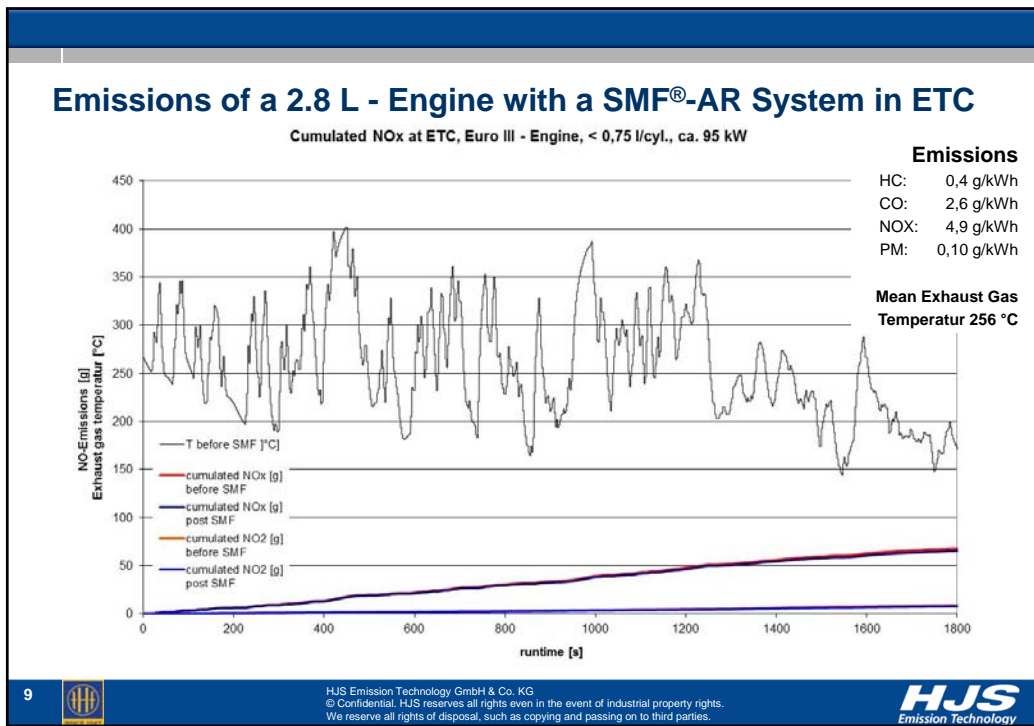
Filter Systems for Mining Applications

- ✓ Suitable for OE and retrofitting applications
- ✓ Suitable for underground mining applications
- ✓ Over **99% reduction of soot particles**, incl. fine particulate matter
- ✓ **NO₂-neutral DPF regeneration**
- ✓ Fully automatic, active regeneration
- ✓ Modular construction
- ✓ Reliable operation and low maintenance

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SMF[®]-AR Improvement By Exhaust Flow Sensor

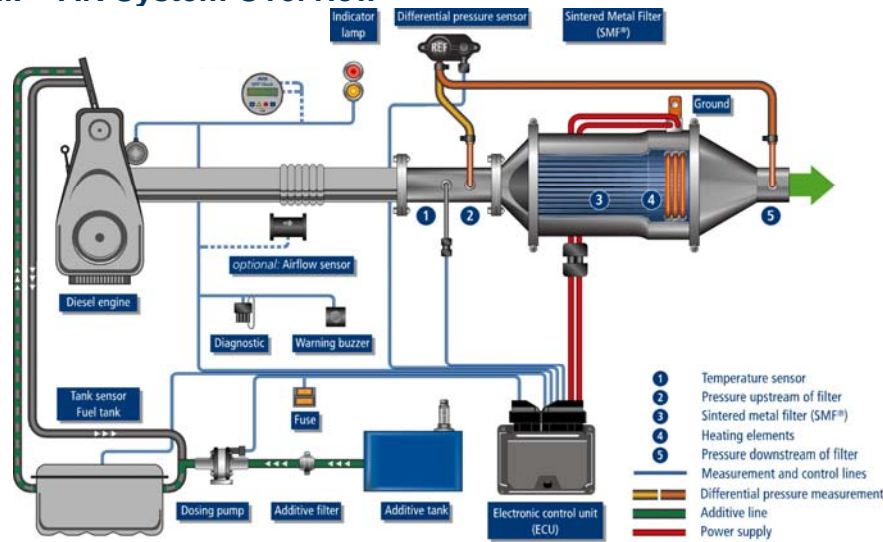
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SMF[®]-AR System Overview




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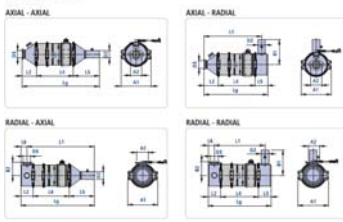
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HJS SMF®-AR System Applications



SMF®-AR – 1,8 m²



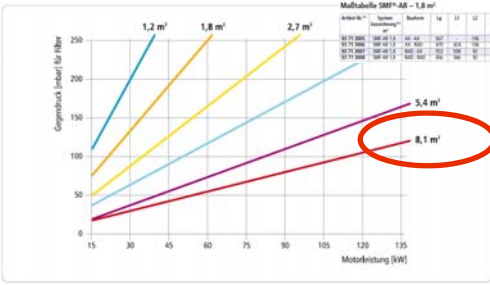


e.g. GHH LF-6
136 kW

Limit due to engine power / backpressure correlation

Solution for Higher Power

Dual SMF®-AR System




Arbeitsdruck (mbar)	Stufen	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
100	1	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110

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Dual SMF®-AR Application Example - Mining Loader, 354 kW

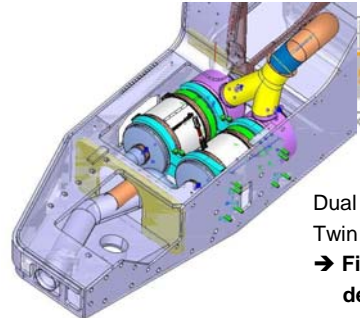


DPF weighting: DPF1 = 201g
DPF2 = 167g

no regeneration

50% max. engine power



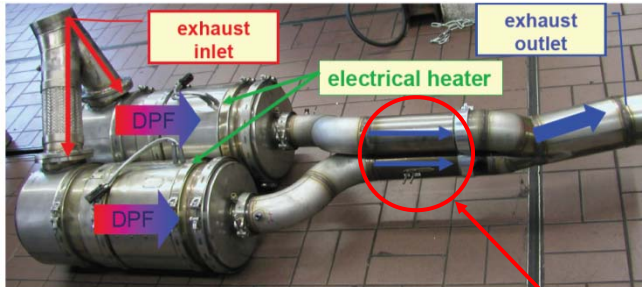


Dual SMF-AR 8.1 m², 24 V
 Twin filter regeneration,
 → Filter selective soot load detection mandatory

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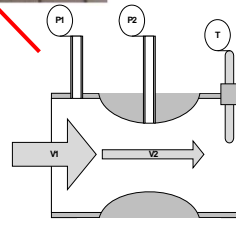
Exhaust Flow Sensor (EFS) Downstream of SMF®-AR Principle based on Bernoulli



- EFS used for exhaust gas volume flow measurement
- Soot load detection via exhaust volume flow and differential pressure
- Regeneration control based on soot load and engine conditions
- Applicable for single and multiple filter systems

$$\frac{1}{2} \rho_1 u_1^2 + p_1 = const = \frac{1}{2} \rho_2 u_2^2 + p_2$$

$$v_1 = A_2 \cdot \sqrt{\frac{2\Delta p}{\rho(A_1^2 - A_2^2)}}$$



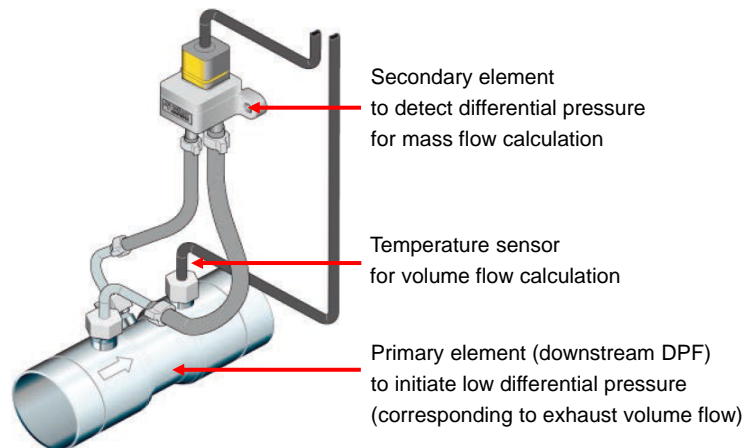
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EFS: Primary and Secondary Element



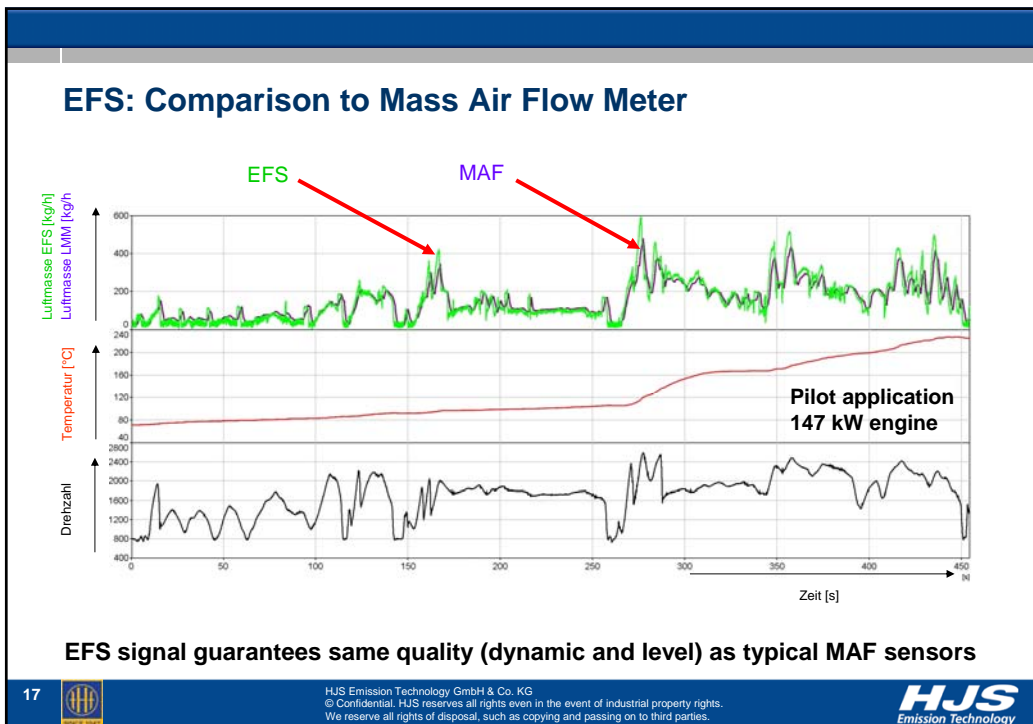
Geometry of primary element is comparable to a Venturi nozzle.

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EFS Validation by SMF[®]-AR Field Trials

Example: CAT 308D excavator (41 kW), 2.7 m²

Validation Field Trial

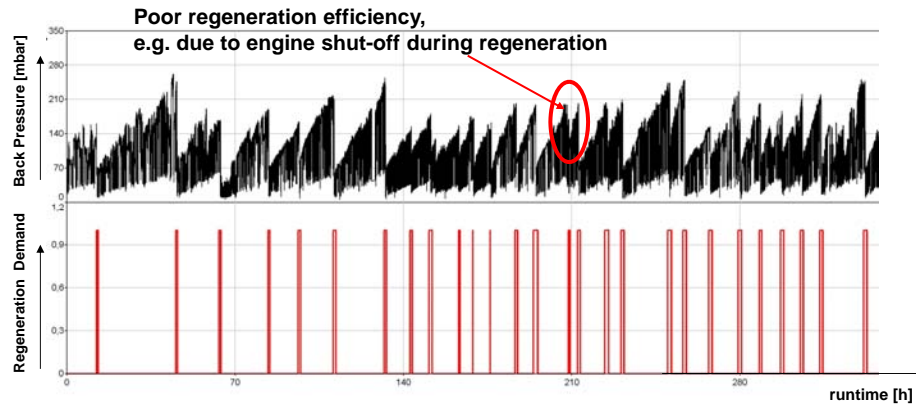
- ca. 10 applications
- ca. 1 year
- No problems at all

Limited space in engine compartment
 Integrate EFS in tailpipe possible
 Integration of MAF at air inlet not possible

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SMF[®]-AR with EFS – Operational Behavior



Soot load detection via EFS-signal initiates regeneration at the right time (soot load)
(demonstrated by repeated regeneration start after short engine operation period)

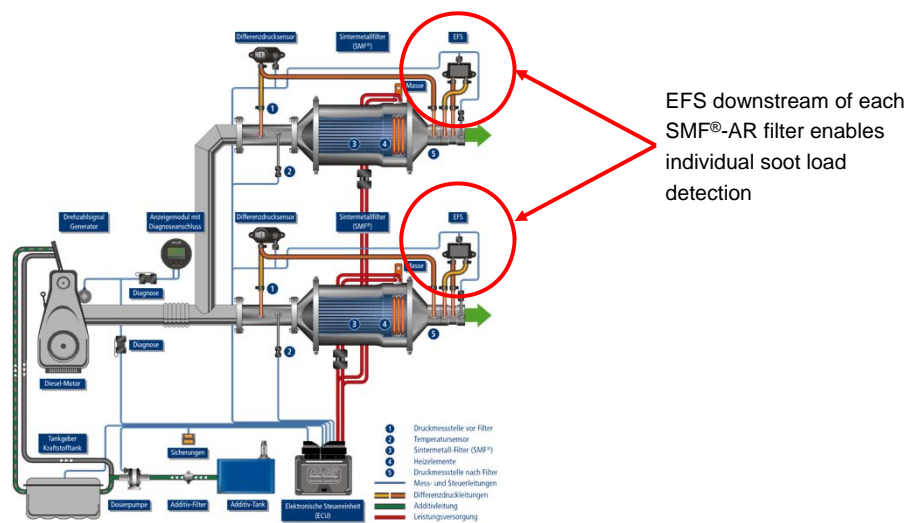
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Dual SMF[®]-AR with EFS



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EFS - Summary

- A very low differential pressure due to EFS
- Precise mass flow signal for SMF[®]-AR regeneration strategy
- Reduced installation costs due to EFS
- Dual SMF[®]-AR System realized with EFS
- More applications for SMF[®]-AR
- Successful SOP in the beginning of 2013

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Thank You

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DIESEL PARTICULATE FILTERS

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