TA Technische Anleitung
Technical instruction
Instruction technique

TA-001/18 Edition July 2018

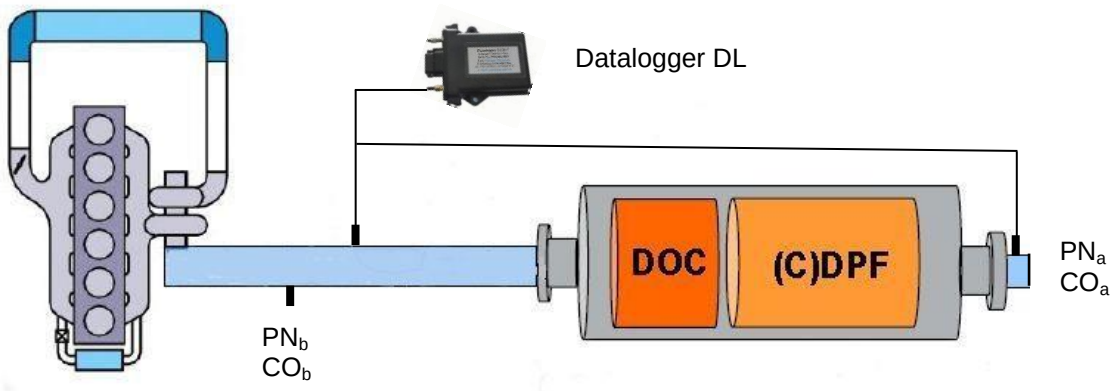
DPF TROUBLESHOOTING DIAGNOSIS AND REMEDY

Technical requirements to prevent malfunctions

- Select a certified DPF – see VERT Filter List www.vert-certification.eu
- Install the DPF correctly – see VERT best practice guide TA 002/18
- Select or adapt the regeneration method to operation profile – see TA 002/18
- Use the correct fuel, confirm sulfur content
- Maintain the engine to prevent excessive lubricant consumption
- use low ash lubricants low SAPS – contact your lube oil supplier
- Respond immediately to alarms – see manufacturer manual
- Maintain the DPF system – see manufacturer operation manuals
- use remote control Datalogger (DL) – contact your DL-manufacturer

Diagnosis tools and instruments:

- Filter monitoring system (→ datalogger analysis, DLA) - see TA 002/18
- PN counter (PN_b /PN_a: measurements before/after filter) - see SN 277206 (CH)
- Opacitymeter (OM_b) – see VAMV 941242 (CH)
- Gaseous emission measuring device (CO, HC, NO_x, O_2) – see VAMV 941242 (CH)



Failure Source 1 ◄ **Interactions** ► **Failure source 2**

Engine or Filter Failure?

Basically there are two entirely different sources of failures:

- Engine Malfunctions
- Aftertreatment (DOC, DPF) Malfunctions.

Without aftertreatment, engine malfunctions are obvious by smell, gas colours (blue, white, brown, black) etc.
With aftertreatment these indications of malfunctions are no longer visible or noticable. The DPF "masks" the engine failures. It is therefore necessary to have a possibility to measure opacity/PN and gaseous emissions not only at the end pipe but also before the inlet to the aftertreatment system.

Backpressure

Symptoms of Malfunction	Diagnosis Tool	Possible Cause	Remedy	Contact Supplier
Back-pressure indication frozen	DLA	Sensor connections are blocked, iced or leaking	Clean pipes and connections; rectify leaks	
		Pressure sensor defective	Sensor test with test pump at 200 mbar	
Back-pressure high, does not return to zero when inoperative	DLA	Connection or pipes are blocked, eventually condensation	Clean pipes and connections; rectify leaks	
			Fit or empty condensate trap	
		Pressure sensor defective	Sensor test with test pump at 200 mbar	
Continuous increase of back pressure: no regeneration	DLA	Exhaust temperature too low	Inspect thermal insulation	
			Verify engine injection timing	
			Adapt regeneration method	X
Rapid back-pressure increase	DLA OM_b EPC [1])	Regeneration fails	Check regeneration system	X
		Engine soot or oil emission high	Engine maintenance	
		Turbocharger failed	Turbocharger replacement	
Back-pressure high despite active regeneration	DLA GEM_a	Burner temperature too low	Burner maintenance	
		Oxygen insufficient	Leakage Turbocharger maintenance Air inlet filter maintenance	
		Regeneration too short	Consult manufacturer	X
		Soot has formed graphite	Raise regeneration temperature; use fuel additive	
Back-pressure base-line rises despite regeneration	DLA	Ash deposit from lubricant	Use low ash lubricant (low SAPS); engine maintenance	
		Gypsum formation	Use low sulfur diesel fuel and lubricants	
		Ash deposits from fuel additive	Decrease additive dosage	
		Mineral dust deposits	Check air inlet filter; use finer pored air inlet filter, use pre-filter, cyclone	
			Do not insert air filter ejector ahead of DPF	

		Muffler fibers	Never fit absorption silencer ahead of DPF	
		Engine abrade	Check engine immediately	
Back-pressure high after clean-ing	DLA	Coking in the filter pore	Emergency cleaning [2])	
		Sticky deposits in the filter	Replace filter	X
		Ash sintering in the filter	Replace filter	X
Back-pressure low	DLA	Connection or pipes are blocked, ev. condensation	Clean pipes and connections; rectify leaks	
			Fit condensate trap	
		Pressure sensor defective	Sensor test with test pump at 200 mbar	
		Filter failure	Replace filter	X

Regeneration

Symptom of Malfunction	Diagnosis Tool	Possible Cause	Remedy	Contact Supplier
Regeneration interval continuously decreasing	DLA OM_b	Excessive ash deposits	Clean filter [3])	X
		Raw emission very high	Inspect and maintain engine	
		Regeneration incomplete	Verify regeneration	

Noise

Ignition frequency		Exhaust pipe leakage	Repair flange leakage	
Whistling		Inlet and/or exhaust system leakage	Repair leakage or cracked inlet/exhaust pipe	
Rattling, also at idling		Loose parts	Repair loose parts	
		Lose Filter element	Replace filter element	X
Low frequency droning noise		Engine/exhaust connection not vibration decoupled	Improve filter vibration isolation from engine; insert bellows	

Emissions

Visible smoke emission and back-pressure high	DLA	Filter soot load is extreme	Regenerate filter by running at full load	
		Regeneration ineffective	Emergency cleaning [2])	
			Clean filter [3])	X
			Adapt regeneration procedure to actual deployment operation temperatures	X

Visible smoke emission and back pressure low	DLA	Filter element damaged	Replace filter	**X**
		Canning bypass	Replace filter	**X**

Sparks in exhaust gas In particular near inflammable material or in forests	EPC *) PN_b PN_a	Filter soot deposits are excessive	Maintain engine and regeneration system	
		Deposits downstream of DPF	Verify filter efficiency	
		Extremely high regeneration temperature peaks	Improve regeneration	
			Install spark-arrester disc downstream DPF	
Flames in exhaust gas	GEM_b	Massive oil deposits downstream of DPF and/or substantial unburned HC	Verify state of engine; check eninge injectors	
White smoke - No smell - Fuel smell		Water vapour from condensation in cold DPF	Install water spill upstream DPF at lowest point	
			If mounted vertically never use an open stack, install rain flap	
		Unburned fuel	Maintain engine	
Blue smoke		High lubricant consumption	Maintain engine	
Soot deposits in tail pipe	DLA	Filter damage	Replace filter element	**X**
Smoke only during acceleration	PN_b, PN_a	Low filtration efficiency	Check filter efficiency	**X**
High engine-out smoke emission	OM_b	Turbocharger, injection system, air inlet filter	Engine maintenance	

Engine

Symptom of Malfunction	Diagnosis Tool	Possible Cause	Remedy	Contact Supplier
Engine power deficit	DLA	DPF back pressure?	Verify back-pressure: if < 200 mbar → malfunction is not due to DPF	
Fuel consumption increased	DLA	DPF back pressure?	Verify back-pressure: if < 200 mbar → malfunction is not due to DPF	
		Injection nozzles spoiled due to FBC	Change FBC	**X**
Water temperature increased	DLA	Thermostat failed Water level low Back-pressure ?	Verify back-pressure: if < 200 mbar → malfunction is not due to DPF; → check thermostat	

Visual Observations

Symptom of Malfunction	Diagnosis Tool	Possible Cause	Remedy	Contact Supplier
Tailpipe black		Filter leackage	Clean tailpipe and check next day again; if black again	X
Tailpipe oily		Engine oil leakage Turbo failure	Maintain Engine	
Soot traces near exhaust upstream filter		Lose flanges Welding cracks	repair	
		Filter plugged and back-pressure sensor failed	Dismantle filter element and check	X
Materials near DPF discol-oured, charred, burned		Surface temperature of DPF too high	Improve DPF insulation and/or install heat shield Increase distance to inflam-mable material	X

How to proceed in case of an unclear Emergency Message

(backpressure, low power, white or brown smoke, noise, overheated surfaces, sparks)

- Stop the operation of the vehicle immediately
- Don't ask the driver to run high load for filter cleaning
- Don't ask for limp-home to the garage
- Download DL to check for previous pressure exceedances (warranty!)
- Active Filter: try regeneration mode
- Test loadstep (stall, hydraulics) rather than run free acceleration (for safety)
- De-install DPF and check both surfaces for soot, oil, fuel, ash – smell + visual check
- De-Install DOC and check inlet surface and cell plugging
- Write a failure note on damage and conclusion to be signed by both parties
- Replace by identical substrate type or temporary by silencer

Failure Statistics

- Optimal maintenance, passive filters, large fleets: 1% within one year; 10% within 10 years
- Good maintenance small fleets, passive filters: 2% per year
- Active filters: depend very much on maintenance
- Backpressure increase after ash cleaning: 3% per cleaning
- Fuel consumption increase: 0 - 2% - in daily operation not noticable
- Overheating and fires: very rare if insulation and heat shields are used
- Risk by glowing sparks: very rare, but in critical environments use spark arrester

Glossary

[1]) EPC: Tail pipe check

[2]) Emergency cleaning: Inject emergency cleaning liquid as commercially available.

[3]) Filter cleaning: External burn-off with air, clean by pulse-air (scanning nozzles)(ceramic filters) or wash (metal substrates).

Acronymes

-- $_a$	After DPF
-- $_b$	Before DPF
DLA	Datalogger analysis
DPF	Diesel particulate filter
EPC	End pipe check
FBC	Fuel born catalyst
GEM	Gaseous emission measurement
OM	Opacity measurement
PN	Particulate number
SAPS	Sulfated ash, phosphorus, sulfur

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Publisher

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The VERT Association publishes on its web site information on the topic of particle filter retrofitting. The site also has a comprehensive database of already retrofitted vehicles and machines. The VERT Filter List documents the certified filter systems and their manufacturer: www.VERT-dpf.eu.

The PDF version of this publication can be downloaded at www.VERT-certification.eu.