

TI

Technical Instruction

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Cleaning Procedure of Ceramic Diesel Particulate filters

(Applies for catalyzed Wall Flow filter (WFF) substrates of silicon carbide (SiC))

Diesel particle filters are designed to remove over 99% of particle mass (PM) and particle number (PN) from the exhaust and the system is continuously regenerating/cleaning due to the applied catalytic coating.

A fraction of the particles that is accumulated in the filter is inorganic and cannot be regenerated. This include mostly ash, but also various metal oxide particles (oxides of iron, zinc, nickel and copper) from engine abrasion/wear, remains from lube oil additive packages, particles from mineral dust in air intake and impurities from the fuel.

Like a and old-fashioned fireplace, ash and debris must be mechanically cleaned on a regular basis. The cleaning interval will depend on engine duty cycle, fuel quality and consumption of lube oil, dimensioning to ash storage capacity and will range from once every 3 months to once every second year. Most installations will require cleaning at least once a year or between 1000 and 2000 operating hours.

The inorganic debris is accumulated in the filter channels from the inlet side and the following description will focus on removing debris by using compressed air - opposite the normal exhaust flow direction.

The following description will be separated into to two sections depending on the following conditions:

1. The filter is completely regenerated before the cleaning process is started, meaning that no or limited amount of non- regenerated soot is present in the filter inlet surface. The surface is relatively clean with some grey dust. Only mechanical cleaning with compressed air is required.
2. The filter is not completely regenerated, and significant amount of non-regenerated soot is accumulated in the filter and on filter surface. The filter is heavily sooted and there is sticky black on the inlet surface. In this case a combination of baking/heating and mechanical cleaning is required.

The described procedures are generic and may vary depending on operator/supplier equipment and procedures. Content of this document is to be regarded as guidance only.

Cleaning a filter is not easy because some ash particles, other than just accumulated in the channels, are firmly bound inside the porous channel wall due to the so-called van der Waals forces. Therefore, the filter must be carefully and meticulously cleaned to maintain its backpressure requirements. Do not use water or any other liquid and detergents unless documented by the supplier. End of this document some equipment for cleaning is listed for reference purposes only.

Cleaning of filter with limited or no non-regenerated soot and/or only dry soot

#	Process Description	Comment	Approval Criteria
1	Dismantle the filter system and take out the filter module	Check if system is mechanical OK and the latest performance from the exhaust monitoring system	Temperature in line with requirements and back pressure close to maximum threshold. Is cleaning required
2	Check filter surface on inlet and outlet side	Please check for damages. These will be very visible when looking at the outlet side. Inlet side may often be difficult to inspect as dirty.	Outlet side must be completely clean. No black spots indicating bypass/damaged channel wall and/or plugs.
3	<i>If applicable/required Check back pressure and weight of filter</i>	<i>Part of standard procedure for some cleaning companies where special designed test benches are used</i>	<i>Register weight and back pressure. To be used for comparison and/ documentation after cleaning</i>
4	Place filter in a cleaning machine or in a closed environment before cleaning with the inlet side downwards	Please wear mask and gloves and if cleaning machine not applied ensure that dirty air is filtrated	As per instruction
5	Use compressed air to blow from the outlet through each channel of the filter	Use an air gun with max 7 bar pressure. Use a systematic approach to ensure all channels are blown. Take care not to apply air to Interam and the cement interfaces	When no more ash is coming out the filter is clean. Ensure that each channel is blown. Do not use any liquids or chemical substances without suppliers approval/guidelines
6	Expose the filter unit to light mechanical shock and repeat above	Light mechanic shock may loosen some extra ash. Please take care as filter substrate is a ceramic brick	When no more debris is detected under pressure the filter is clean

		that may fracture if exceeded	
7	Reverse the filter and repeat the same process as under 5)	Some ash may have caught in the micro porous channel wall and needs to be removed to keep open porosity and low back pressure	When no more debris is detected under pressure the filter is clean
8	Inspect filter	Mechanical damages to ceramic surface	If filter still looks black and sooted please move on to heating process
9	<i>If applicable/required Weigh filter and measure/test back pressure</i>	<i>Part of standard procedure for some cleaning companies</i>	<i>Record data and compare with weight and back pressure before cleaning</i>
10	Re-install filter in system	Use new gaskets and/or clamps/bolts/nuts	Check fixing, leaks and insulation

Cleaning of dirty filter with non-regenerated soot

#	Process Description	Comment	Approval Criteria
1	Dismantle the filter system and take out the filter module	Check if system is mechanical OK and the latest performance from the exhaust monitoring system	Temperature in line with requirements and back pressure close to maximum threshold. Is cleaning required
2	Check filter surface on inlet and outlet side	Please check for damages. These will be very visible when looking at the outlet side. Inlet side may often be difficult to inspect as dirty.	Outlet side must be completely clean. No black spots indicating by-pass/damaged channel wall and/or plugs.
3	<i>If applicable/required Check back pressure and weight of filter</i>	<i>Part of standard procedure for some cleaning companies where special designed test benches are used</i>	<i>Register weight and back pressure. To be used for comparison and/ documentation after cleaning</i>
4	Place filter in a cleaning machine or in a closed environment before cleaning with the inlet side downwards	Please wear mask and gloves and if cleaning machine not applied ensure that dirty air is filtrated	As per instruction
5	Use compressed air to blow from the outlet through each channel of the filter	Use an air gun with max 7 bar pressure. Use a systematic approach to ensure all channels are blown. Take care not to apply air to Interam and the	This step is to remove "as much as possible" prior to the heating process below

		cement interfaces	
6	Place filter in a kiln to dry and regenerate remaining soot	Place filter with inlet/dirty side downwards and ramp up temperature slowly with 10° C/min up to 200° C and thereafter with 5° C /min up to 450° C. Hold temperature for 1 hour Ensure that oven has circulation with oxygen	Accumulated and non-regenerated soot should now be dried and regenerated. If not clean the process can be repeated. If soot accumulation heavy the process can be continued with 5° C /minute up to 500° C for two hours
7	Cool down of filter unit	Cool of to be handled	Max 40° C recommended
9	Place filter in a cleaning machine or in a closed environment	Please wear mask and gloves and if cleaning machine not applied ensure that dirty air is filtrated	As per instruction. cleaning with the inlet side downwards
10	Use compressed air to blow from the outlet through each channel of the filter	Use an air gun with max 7 bar pressure. Use a systematic approach to ensure all channels are blown. Take care not to apply air to Interam and the cement interfaces	When no more ash is coming out the filter is clean. Ensure that each channel is blown. Do not use any liquids ort chemical substances without supplier`s approval/guidelines
11	Expose the filter unit to light mechanical shock and repeat above	Light mechanic shock may loosen some extra ash. Please take care as filter substrate is a ceramic brick that may fracture if exceeded	When no more debris is detected under pressure the filter is clean
12	Reverse the filter and repeat the same process as under 5)	Some ash may have caught in the micro porous channel wall and needs to be removed to keep open porosity and low back pressure	When no more debris is detected under pressure the filter is clean
13	Inspect filter	Mechanical damages to ceramic surface	If filter still looks black and sooted please move on to heating process
14	<i>If applicable/required Weigh filter and measure/test back pressure</i>	<i>Part of standard procedure for some cleaning companies</i>	<i>Record data and compare with weight and back pressure before cleaning</i>
15	Re-install filter in system	Use new gaskets and/or clamps/bolts/nuts	Check fixing, leaks and insulation

Equipment for use.

Compressed air – air gun

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Cleaning machine

Oven/kiln

Pictures of clean and dirty filter