

EXILATOR

Operation Manual
ExiLencer™ System

January 2021

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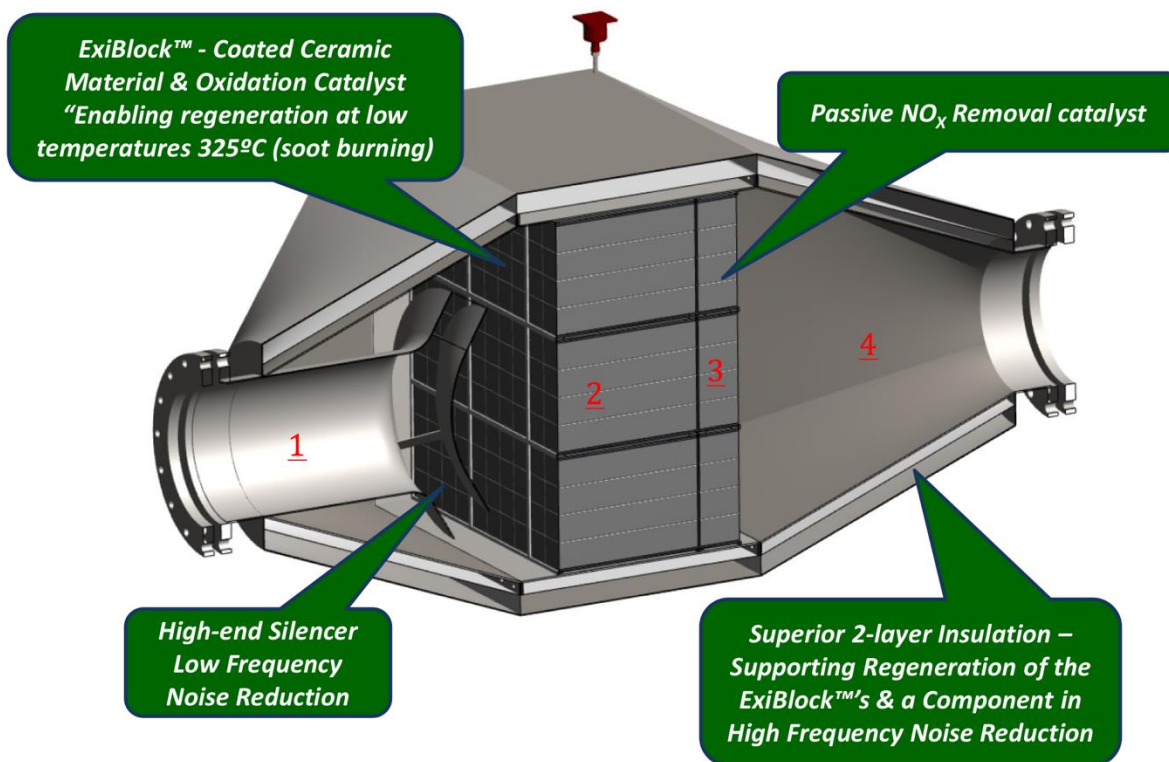
1 ExiLencer™ System

The ExiLencer™ system is a passive system, without any supplementary mechanical equipment or use of additives and chemical substances.

The system consists of 3 standard sections:

1. The inlet section (“1” in figure 1)
2. The DPF section (“2” in figure 1)
3. The outlet (“4” in figure 2)

The NO₂/NO_x reduction section (“3” in figure 1) is optional.



Depending on the engine size the Exilencer™ system is either be square, or round, as shows at Figure 1 (below):

Square design:

The system is modular and custom made: Height, widths and length depends on Generator size and model. Normally used for engines larger than 200 KW (2x Round Standard be for V Engines or if Y pipes are used)

Round design:

The round design exists in 4 variants and is suited for diesel gen-sets and smaller engines. Based on max allowed back pressures 15 kPa sizes use below guide:

- ExiLencer™ Micro, up to 50 kW
- ExiLencer™ Mini, up to 100 kW
- ExiLencer™ Standard, up to 200 kW

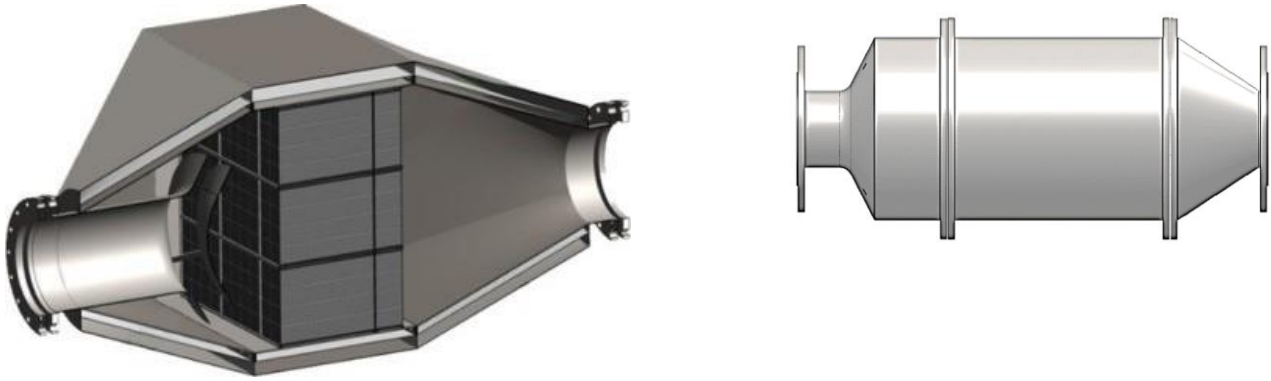


Figure 1: Square Filter (to the left) and the ExiLencer™ Round (to the right, where the middle section contains the coated R-SiC ceramics)

2 Operation

2.1 Back Pressure

The most important parameter to monitor is the “back pressure” (BP), as this relates to the design of the diesel engine design maximum back pressure and ExiLencer operational performance.

Max BP is typically between 7 kPa and 10 kPa for engines larger than 100 kW and between 10 kPa to 18 kPa for engines smaller than 100 kW. Please refer to Generator Manufacturer Specifications for the “maximum allowed back pressure”

Recommendations: Normal BP should not exceed 80% of BP_{Max} , as there has to be a margin for loading the engine for passive regeneration.

Recommendations: Load the engine to a sufficient high temperature, allowing for passive regeneration, when 80% of BP_{Max} is reached.

2.2 Differential Pressure

As water cooling and current exhaust design influences the back pressure it can be difficult to judge the system performance based on back pressure alone. Therefore, the differential pressure over the system is important.

$\Delta P_{Limit} = P_{Before\ filter} - P_{After\ filter}$, therefore there are two (2) pressure sensors installed.

Please make notes or get the following values from when installing the system:

Back Pressure Low Load P_{Idle} : _____ kPa or _____ mbar (10% to 15% engine load).

Back Pressure Normal Load P_{Normal} : _____ kPa or _____ mbar (30-60 % engine load)

Back Pressure Max Load P_{Max} : _____ kPa or _____ mbar (80 % + engine load)

Normal ranges:

Back Pressure Idle Load: Before ExiLencer installed backpressure + 1-2 kPa

Back Pressure Normal Load: Before ExiLencer installed back pressure + 2-3 kPa

Back Pressure Max Load: Before ExiLencer installed back pressure + 3-4 kPa

Regeneration required (Back Pressure exceeds Normal Ranges by min 5 kPa)

Increase load/exhaust temperature > 325 Degrees Celsius for 20-30 min

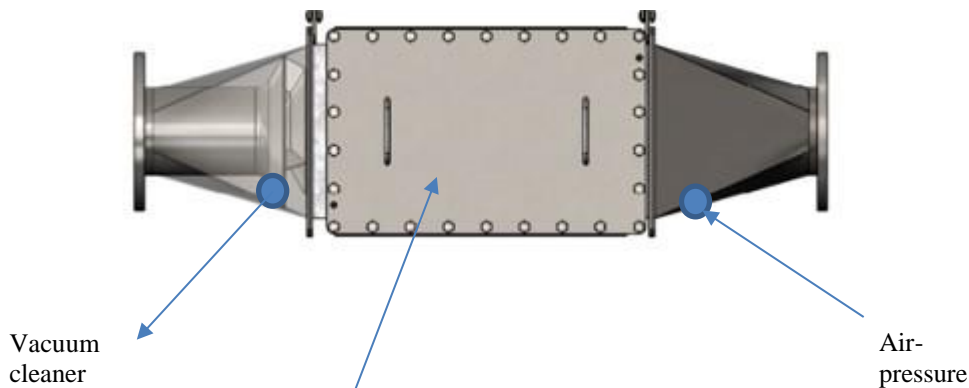
When filter has regenerated, Back Pressure should return to **Normal Ranges +- 1 kPa**

Cleaning Required

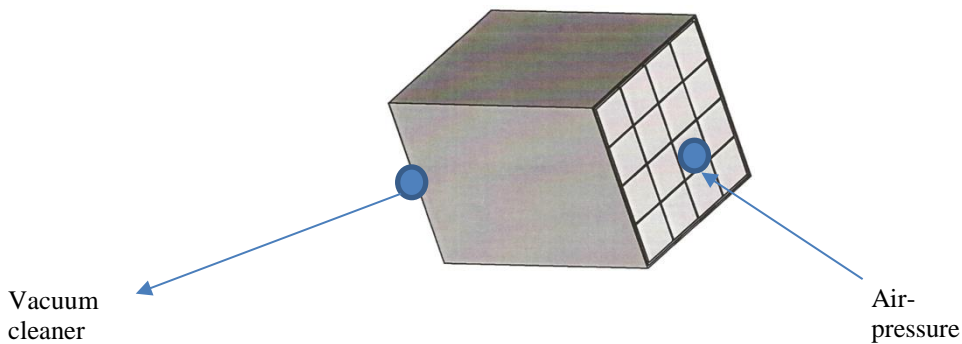
If Back Pressure does not return to **Normal Ranges + 5 kPa after Regeneration**

On-Board Cleaning Procedure (Square System):

2019 Models: Stop engine, let engine cool down (faster if insulation is removed/loosened) remove pre-installed bolts/screws (inlet and outlet side), use vacuum cleaner on inlet side, and air-pressure on the outlet side

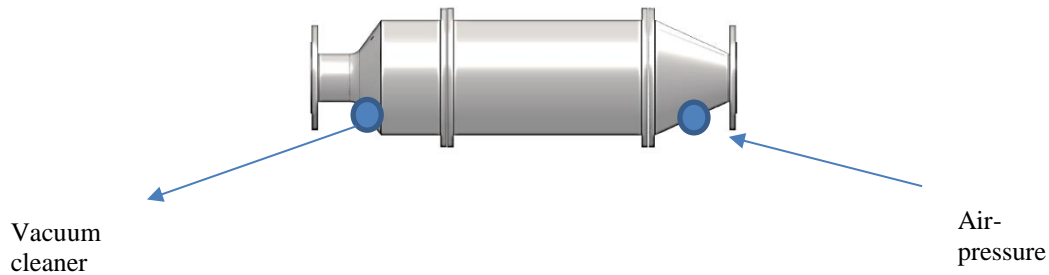


Models from 2018 or before : Remove hatch, take out filter section, and clean filters using vacuum cleaner (inlet side) and air pressure (outlet side) - Be careful with insulation inside the system as should be reused if possible- ExiLator can provide new insulation material.

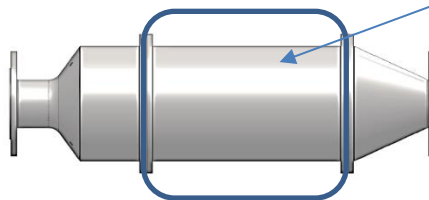


On-Board Cleaning Procedure (Round System):

2019 Models: Stop engine, let engine cool down (faster if insulation is removed/loosened) remove pre-installed bolts/screws (inlet and outlet side), use vacuum cleaner on inlet side, and air-pressure on the outlet side. When clean, plug pre-drilled holes with right sized bolts/screws.



Model from 2018 and before: Stop engine, let engine cool down (faster if insulation is removed/loosened) remove filter section, use vacuum cleaner on inlet side, and air-pressure on the outlet side, reinstall filter section after cleaning



NOTE: Filter Mask should be used when cleaning filters on board to avoid inhaling particles/ashes. Ensure used vacuum cleaner bag is delivered proper authorities for proper handling.

After On-board cleaning Back Pressure should return to Normal Ranges plus up to 20 %. If not, repeat cleaning procedure. If still not in Normal Ranges plus up to 20 %, then arrange cleaning of filter through one of the Exilator Partners

It is recommended, to have filters cleaned/inspected by local Exilator partners once every year to ensure filters are properly cleaned and not damaged

NOTE

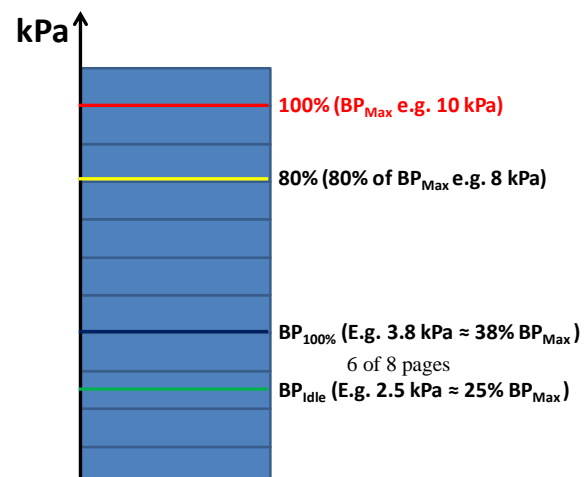
There are two (2) differential pressures to have in mind:

1. When running at low engine load (idle):
 $\Delta P_{Idle} = \text{_____ kPa or _____ mbar.}$
2. When running close to or at full load:
 $\Delta P_{100\%} = \text{_____ kPa or _____ mbar}$

The differential pressure to be monitored is the low load BP, as the exhaust gas temperature normally is below the passive regeneration point.

$\Delta P_{Limit} = 80\% \text{ of } BP_{Max} - \Delta P_{Idle} = \text{_____ kPa or _____ mbar.}$

(Example to right: $\Delta P_{Limit} = 8 \text{ kPa} - 2.5 \text{ kPa} = 5.5 \text{ kPa}$).



The 20% margin off BP_{Max} should be able to handle the pressure increase caused by the engine loading when going from load to high engine load.

Recommendations: Load the engine to a sufficient high temperature, allowing for passive regeneration, when ΔP_{Limit} is reached.

2.3 Exhaust Gas Temperature

The coated R-SiC ceramics (DPF) has a balance designed point (T_{BP}) of $325^{\circ}C (\pm 10^{\circ}C)$, meaning that passive regeneration happens at exhaust gas temperatures above T_{BP} .

Recommendations: When passive regeneration is needed exhaust gas temperature has to be above the designed balance point T_{BP} . Recommendation is to get a sufficiently high exhaust gas temperature to allow a fast regeneration; typically above $400^{\circ}C$ (the higher exhaust gas temperature the faster regeneration).

3 Maintenance of the ExiLencer™ System

Maintenance/Cleaning can be carried out on board or in corporation with Exilator's local Partners.

The maintenance/Cleaning intervals depend strongly on fuel type, age of engine, brand and use of additives.

When running without fuel additives and fuel type with max 0.01% Sulphur (100 ppm, low sulphur diesel) the ExiLencer™ system can be expected to have long cleaning intervals and very long lifetime:

1. The normal service intervals are based on annual visit.
2. The expected cleaning interval is up to 2,000 running hours – but it is recommended to do annual cleaning irrespective of running hours.
3. The Round Filter Section and ExiBlock™'s of the system are expected to withstand up to 10 times cleaning before the Filters/Filter Section must be replaced.
4. Cleaning and lifetime will be reduced significantly, when using fuel with higher sulphur content, using fuel additives or “dirty fuel” and the consequences are:
 - o Cleaning interval can be reduced by a factor 10-20
 - o The expected lifetime can be reduced by a factor 10 and the consequence can be that the ExiBlock™'s must be replaced with a new filter section.
 - o For engines, with more than 2,500 running hours per year, the service visit should be carried out in connection with cleaning.

NOTE

Exilator cannot recommend using fuel additives as some additives can harm the ceramic material or destroy the precious metal coating

The consequence of using fuel with high fuel sulphur (>0.01 %) is faster deterioration of the precious metal coating and lifetime

3.1 Regeneration

It can take between 6 - 20 operational hours to reach a sufficient soot load, depending on the engine and its combustion.

As the regeneration depends on exhaust gas temperature, below behaviour can be expected:

- Below balance point, T_{BP} of $325^{\circ}C \pm 10^{\circ}C$: Soot starts burning at $250^{\circ}C$, but at a much slower rate than the system accumulates soot → back/differential pressure builds-up.
- At balance point, T_{BP} of $325^{\circ}C \pm 10^{\circ}C$: Soot is burned but at the same rate as it is produced by the engine → the back/differential pressure stagnates (the build-up stops).

- Above balance point, T_{BP} of $325^{\circ}\text{C} \pm 10^{\circ}\text{C}$: Soot is burned but at a higher rate than the system accumulates
 → Back/differential pressure drops (the actual rate depends on the exhaust gas temperature).

3.2 Emergency Procedure

If the system is not able to passively regenerate under normal load/conditions, the temperature needs to be increased to above 325 degrees celcius.

In case regeneration and cleaning does not reduce the back pressure, it is recommended to carry out one of the following procedures:

For the Squared ExiLencer™ and in event of a fully blocked System, follow these steps:

1. Stop the engine of concern.
2. Remove all insulation, so ExiLencer™ system can cool down
3. Remove hatch and take out the first column of ExiBlock™'s, and potentially replace with emergency blocks (with or without any R-coated SiC ceramics).
4. Re-attach the hatch, and restart engine.
5. Contact Exilator or an Exilator service partner to ensure proper service/replacement of filter section at next port of call.

For the Round ExiLencer™ (Micro, Mini & Standard) the standard supply includes a spare Mid-Section (emergency) section, which can replace the filter section. In the event of a fully blocked System, follow these steps:

1. Stop the engine of concern.
2. Remove/loosen the insulation, so system can cool down faster.
3. Remove filter section, and replace by “Empty Mid Section” section
4. Install “Empty Mid Section” and restart engine
5. Contact Exilator or an Exilator service partner to ensure proper service/replacement of filter section at next port of call.

Note: In some cases a by-pass valve is installed - to avoid above procedure.