



Johnson Matthey
Inspiring science, enhancing life

DPFi™ electrically regenerated particulate filter system

Mining Diesel Emission Conference, Toronto, October 2022

MDEC 2022

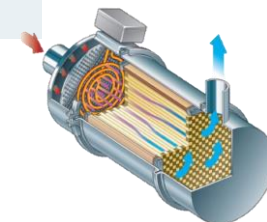


JM – Global leader in DPF technology

DPFi electrically heated filter journey



Over 3 million on-road & 200,000 off-road DPF systems installed in the last 10 years



Over 30 years of DPF Technology Leadership

From On-Road Innovation



to Off-Road know-how



to Underground solutions



JM CRT® – Continuously Regenerating Trap

- Industry benchmark for Heavy Duty Diesel Retrofit Technology.
- 1st filter verified for US EPA's voluntary retrofit program and the 1st filter verified by CARB (California Air Resource Board)

JM Mining CRT® and DPFi

- Thoroughly evaluated in mining (See Stachulak References)
- Long Life, Low Maintenance operation, No increase in NO₂



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DPFi™ electrical regeneration DPF filter for
light duty vehicles

Toyota Land Cruiser, Kubota, Kovatera, Epiroc, and other models

Diesel particulate from light-duty diesel vehicles

Why it is so important

Diesel engines are a valuable power source but their emissions are known to contribute to air pollution and can cause respiratory health problems.

“Light-duty vehicles were responsible for 47% of the underground diesel particulate matter (DPM) burden of the model fleet, while heavy-duty (HD) vehicles were responsible for 53%.”

“EVALUATION OF THE CONTRIBUTION OF LIGHT-DUTY VEHICLES TO THE UNDERGROUND ATMOSPHERE DIESEL EMISSIONS BURDEN, PHASE II - FINAL REPORT. November 2003, Brent Rubeli, Mahe Gangal, Kevin Butler, Wayne Aldred”

“Data indicates that mining vehicles spend a significant percentage of time at engine operating conditions which do not favor passive regeneration. Data obtained at Noranda’s Brunswick Mining and Smelting show that their *vehicles spend an average of over 30% of time at low idle (McGinn 2004), engine operating mode that produce DPM emissions but does not support regeneration.*”

Implementation of diesel particulate filter technology in underground metal and nonmetal mines
A.D. Bugarski, G.H. Schnakenberg, Jr. & L.D. Patts
National Institute for Occupational Safety and Health, Pittsburgh
Research Laboratory, Pittsburgh,
Pennsylvania, USA

Diesel particulate from light-duty diesel vehicles

What are they?

According to a NIOSH study for coal mines in the US by Dr. Bugarski:

“The limited survey that we performed at several mines across the spectrum of the commodities (metal, nonmetal, stone) revealed that the differentiation between HD and LD vehicles is fuzzy and subject of personal interpretation:

1. HD: Haulage trucks, LHD vehicles, drills, fuel/lube truck...
2. MD: (treated sometimes as HD or sometimes as LD): shotcrete truck, ENFO loader, scissor truck, grader, scaler, welding truck...
- 3. LD: personnel carriers, side-by-sides, utility vehicles, tractors, 400 hp pickup trucks...**

The LD and MD vehicles appear to make 60 or more percent of the examined fleets.”

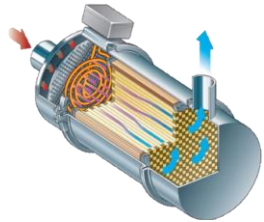
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Johnson Matthey DPFi electrically heated DPF

On-board regeneration system for low temperature applications

JM DPFi™ diesel particulate filters are used for filtration of PM from diesel engines operated in closed environments such as underground mines.

Regeneration type:	Electric
Regeneration time:	60-90 minutes
External structural material:	Stainless steel



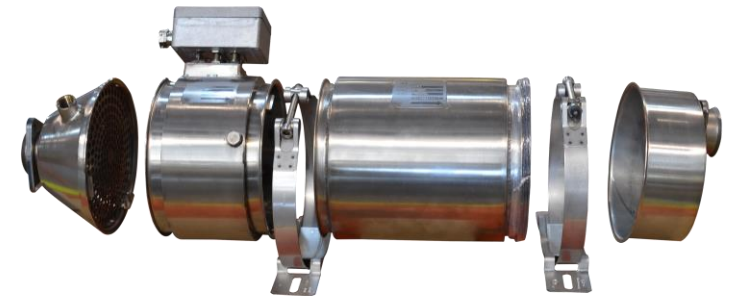
The Benefits

- Works at any exhaust temperature.
- Diesel fuel S content <1000ppm.
- Robust, simple construction for a long working life.
- Service-friendly modular design with quick-release system.
- Electronic filter monitor for greater operational safety
- Flexible mounting options: horizontal or vertical.
- No muffler required as DPFi systems give noise suppression.

DPFi filter system delivers critical performance

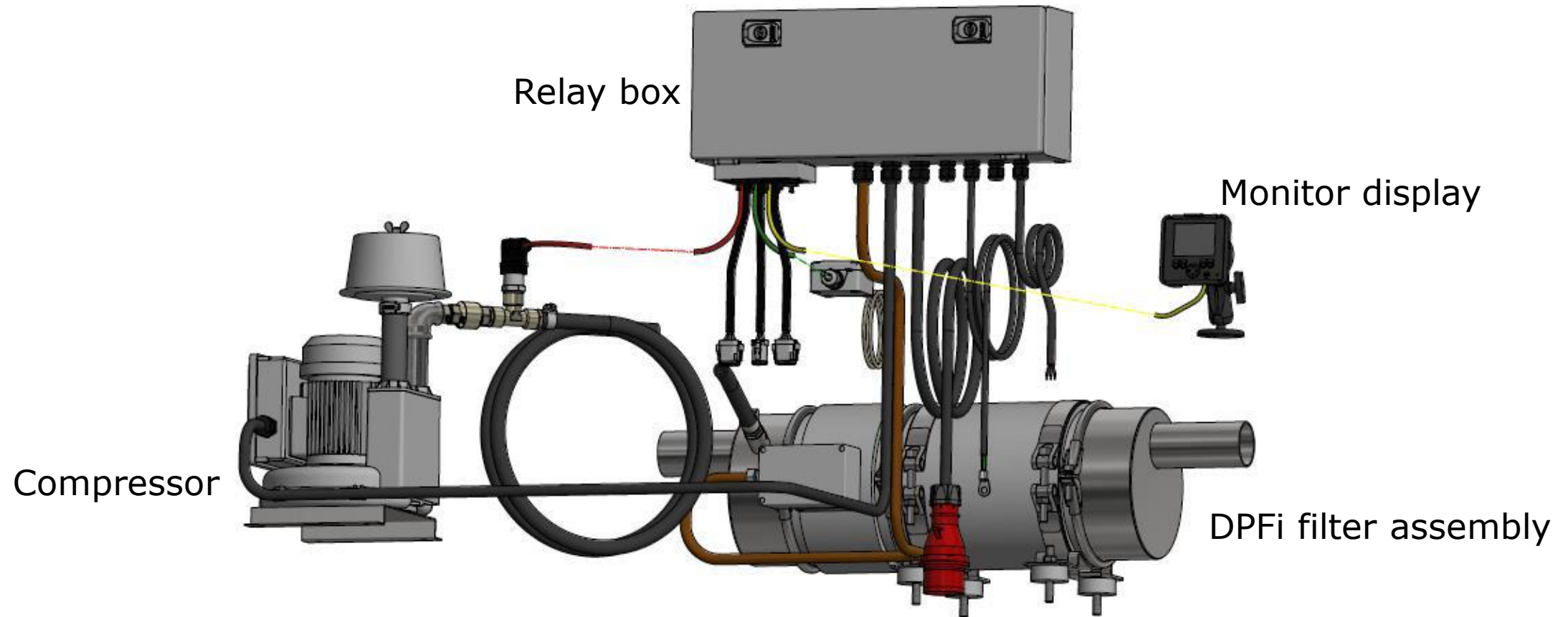
Long Life & Low Emissions

- For vehicles with **insufficient exhaust gas temperature** to facilitate PM regeneration (e.g. Toyota Land Cruisers, Forklifts & Wheel loaders)
- A DPF system that creates **no secondary emissions** such as NO₂ or CO
- **Easy Maintenance, robust, reliable, simple**
- Ability to **monitor filter performance and record data**



DPFi electrically heated DPF - Video

DPF_i System Components



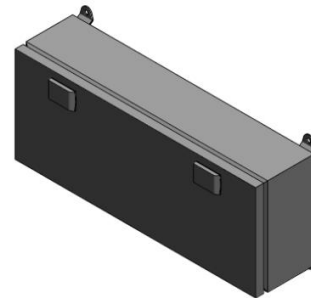
What is a DPFi filter?

On-board regeneration system components

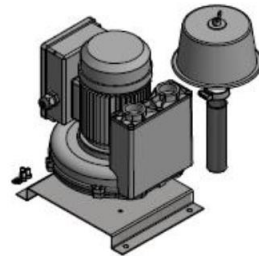
Filter
Control
Monitor – in
cab



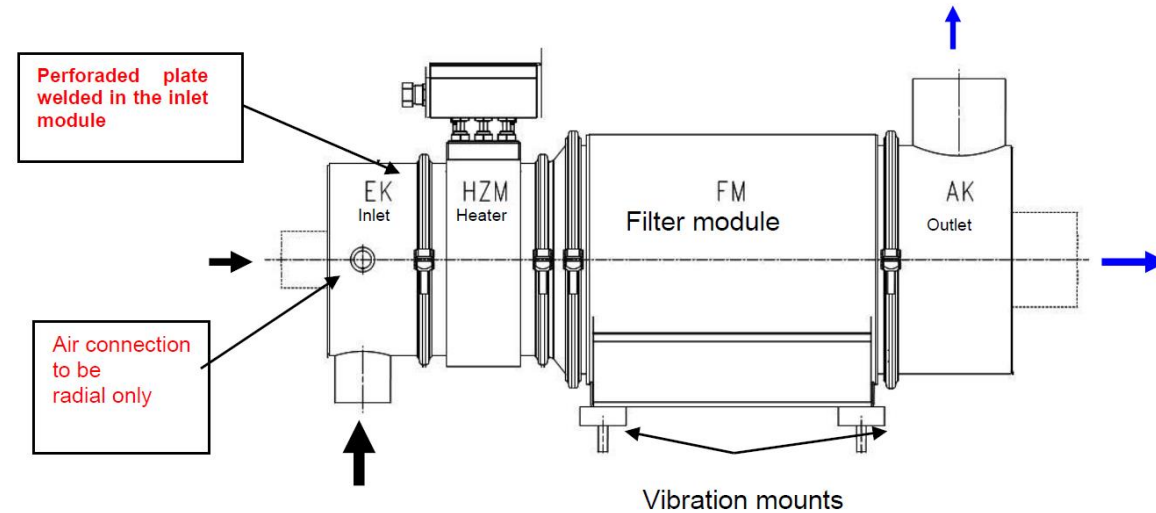
Relay box –
in vehicle



Compressor
Set – in
vehicle

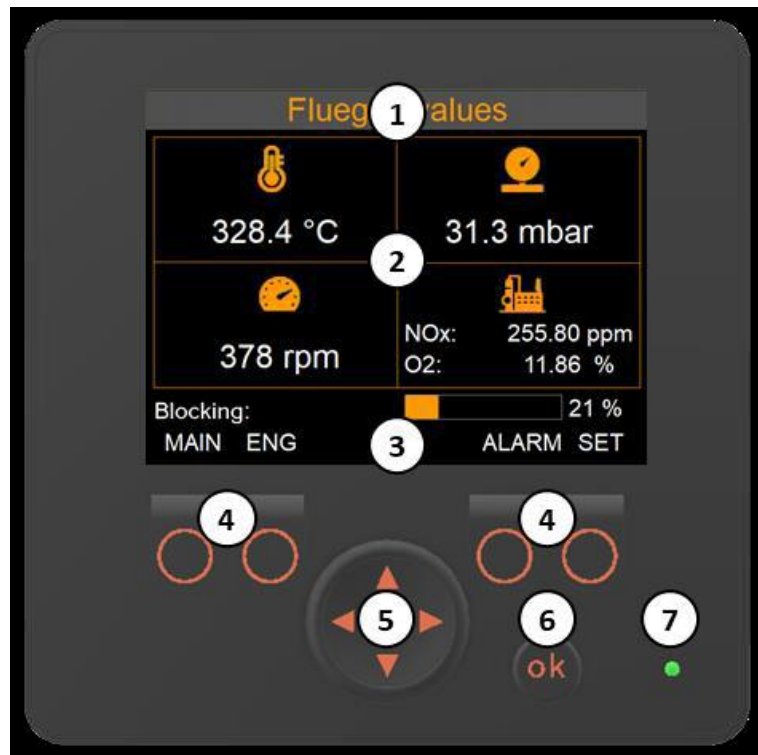


Connector-
Set



PIO-CAN Data Monitor/ Logger

**Standard with all JM DPFi®
Systems,
Easy In-Cabin Installation**



System Highlights

- 1. Filter monitor:** Back pressure and exhaust gas temperature with alarm, pre alarm and AD-values (for sensor check). Monitoring, RPM, min.-max. alarms and adjustable delay timers. Alarms: optical with alphanumeric messages and buzzer.
- 2. Adjustable alarm relay:** For external signals, i.e. flashing lights or engine shut down function.
- 3. Recording:** Operational and failures including date and time, tamper resistant, print in TXT file format.
- 4. Datalogger:** Maximum of 8 channels with variable configuration. High logging memory: up to 1,248 operation hours.
- 5. Electrical Regeneration:** Control and monitor of the electrical regeneration system DPFi for on-board and off-board units.
- 6. Power supply:** 12-24VDC with zero power consumption in stand-by mode.
- 7. Connectors:** Company Deutsch type connectors.
- 8. More features:**
 - Easy installation
 - Cabling available in other lengths (option)
 - Heavy duty case protection class IP65
 - High quality pressure sensor and thermocouple
 - Remote Monitoring

Q & A - JM DPFi System

What is estimated interval between maintenance (Ash Cleaning) for the DPFi System?

- Passenger vehicles do have much lower PM emissions – typically 0.07mg/km. Based on the hours and miles operated, it can be estimated how quickly the filter will fill.
- Very dependent on the duty cycle of the vehicle. It is not possible to predict a precise time between regeneration.
- The alarm signals can be adjusted to accommodate the maximum back pressure permitted and allow operation until the vehicle can be located near a regeneration point.

Q & A - JM DPFi System

Is there a performance guarantee? A system monitor?

- Yes, Every DPFi system comes with a PIO-CAN Filter Monitor. Features include - Back pressure and exhaust gas temperature monitoring with alarm and datalogging.

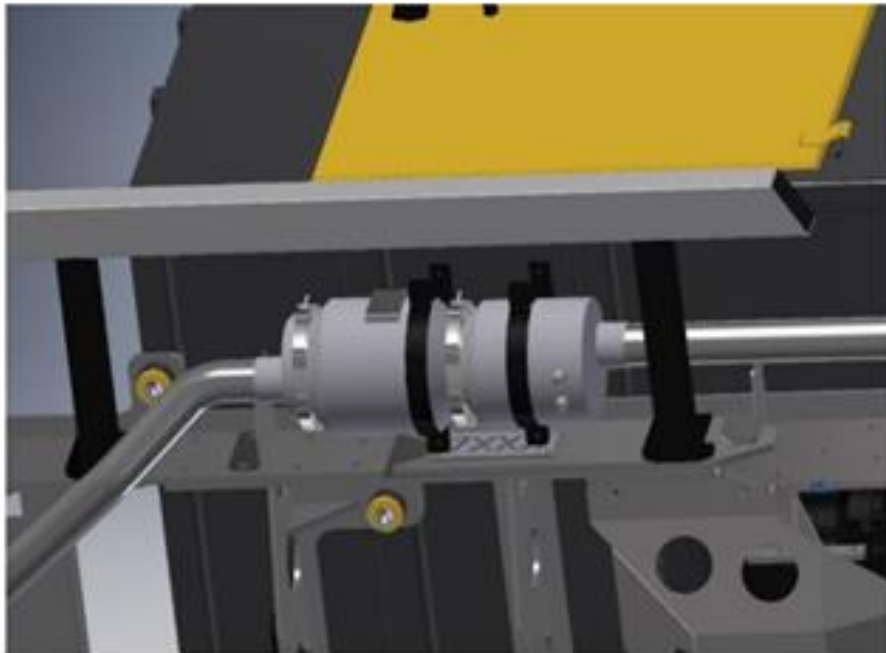
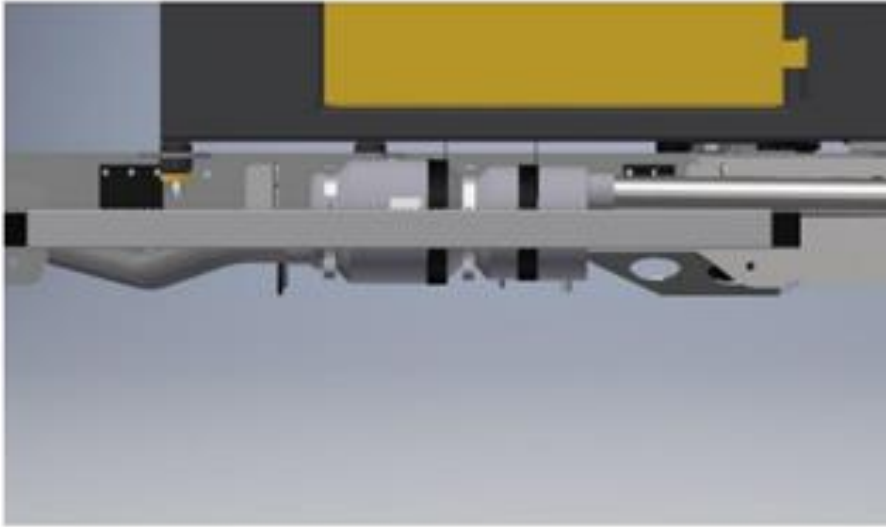
DPFi Toyota Land Cruiser fit-up



The DPFi fits up to the existing engine exhaust tail pipe

The entire DPFi and new tailpipe than fit into the Toyota Land Cruiser chassis as shown here

Kovetera UT99 DPFi installation



The inlet and outlet cones of the DPFi filter permit direct connection to the existing inlet and outlet tailpipes.

DPFi experience

Equipment

Johnson Matthey has more than 20 years' experience engineering retrofit diesel DPFi particulate filter systems for many makes of construction and mining machinery already in service, including:

- | | |
|--------------------------------------|-------------------------------------|
| <input type="checkbox"/> Volvo | <input type="checkbox"/> Hitachi |
| <input type="checkbox"/> Deutz | <input type="checkbox"/> Isuzu |
| <input type="checkbox"/> Mercedes | <input type="checkbox"/> YANMAR |
| <input type="checkbox"/> Caterpillar | <input type="checkbox"/> Cummins |
| <input type="checkbox"/> Perkins | <input type="checkbox"/> Saurer |
| <input type="checkbox"/> Iveco | <input type="checkbox"/> Scania |
| <input type="checkbox"/> Deere | <input type="checkbox"/> Winterthur |
| <input type="checkbox"/> Komatsu | <input type="checkbox"/> Steyr |
| <input type="checkbox"/> MAN | |

Drilling machines
Mobile concrete pumps
Mobile cranes
Backhoe loaders
Excavators
Concrete mixers
Decentral power generation engines
Busses
Boat lifts
Compact loaders
Compressors
Diesel locomotives

Railway construction machines
Fire-extinguisher pumps
Fire trucks
Fork lifts
Generators
Graders
Lifting ramps
Road sweepers
Marine (auxiliary engines)
Mining machinery
Dozers
Dumpers

Case Study 1: JM DPFi System on Wheel Loader

Application

Installation Date: 2010
Product: DPFi 2011SL, electrical regeneration
Application: Volvo wheel loader L60E
Engine: Volvo D6D, 103 kW, 5.7iL
Location: Germany



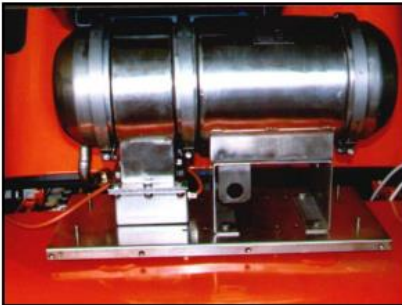
Project Details

- For this application, a DPFi system with electrical regeneration was chosen.
- The wheel loader was operating with low load and did not reach the temperature requirements for a passive DPF system.
- The DPFi collects the soot over the operating time and will then regenerate in 90-120 minutes.
- The filter is regenerated daily at the end of the shift. The operator plugs it in to start the regeneration program and the system shuts down automatically after the program has finished. The machine is then ready to be used for the next shift.

Case Study 2: JM DPFi System on Forklift Truck

Application

Installation Date:	2009
Product:	DPFi 80SL, electrical regeneration
Application:	Toyota 2.5 tons
Engine:	Toyota, 44kW
Location:	Germany



Project Details

- Forklift trucks operating in closed or partly closed areas in Germany need to have a DPF system installed according to the TRGS554 regulation.
- These material handling applications often operate at very low exhaust gas temperature (below 200°C) and cannot be fitted with a continuously regenerating filter system.
- The truck has a monitor that informs the operator when a regeneration is needed.
- The regeneration program runs for 60 minutes and shuts down automatically. After unplugging the connection the forklift and filter are ready to operate the next shift.



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DPFi – Demonstration Unit

Mining CRT – Single Filter



Thank
you!

Questions?