

Action code: **WHEN CONVENIENT**

**Fuel Oil Backflushing Filter**

SL2016-615/JFH  
May 2016

**Concerns**

Owners and operators of  
MAN four-stroke diesel engines.  
GenSet types: L16/24, L21/31, L23/30H,  
L27/38, L28/32H, V28/32S

**Summary**

Installing an automatic backflush filter  
in the fuel oil booster/circulation system  
protects the engines against abrasive  
particles and impurities in the fuel oil.

**Reference is made to:**

Engine – operating manual:  
010.000.023-05 Specification of heavy  
fuel oil (HFO) and  
010.000.023-14 Analysis of operating  
fluids.

Dear Sirs

MAN Diesel & Turbo has observed a number of incidents with high wear rates and damage to the fuel injection pumps / fuel injectors after only a few hundred running hours.

The poor performance of worn fuel injection pumps / fuel injectors affects the overall performance of the engine and causes the onset of fouling of the combustion chamber, exhaust gas ducts and turbine section of the turbocharger.

In order to maintain a trouble-free and safe operation of the engine MAN Diesel & Turbo requires that the onboard fuel oil cleaning system is able to bring down the particle content of bunkered fuel oil from 60 ppm to 20 ppm and specifically the catalytic fines content to maximum 15 ppm with a maximum particle size of 5 micron thereby defining the efficiency of the system. If fuel oil with a lower content of particles are bunkered consequently a lower level of particles will remain after treatment.

To ensure the correct cleanliness of the fuel oil and thereby protect the auxiliary engines against abrasive particles and impurities in the fuel oil, a 10 µm (absolute/sphere passing mesh) automatic backflush filter must be installed in the fuel oil booster/circulation system before the branch off to each auxiliary engine. The automatic backflush filter will also serve as an indication of failures in the fuel oil cleaning system and it removes self-generated contamination in the fuel oil booster/circulation system. Installing the 10 µm backflush filter has in more cases extended the service hours of the fuel injection nozzles from as low as 400 to at least 8000 hours.

Yours faithfully

  
**Mikael C. Jensen**

Vice President  
Engineering

  
**Jens Høj**

Mechanical Engineer,  
Operation



*Excessive wear of fuel injector  
(nozzle holes)*



## Background

MAN Diesel & Turbo's marine diesel engines are designed to operate on all commercially available fuels within the fuel specifications: ISO 8217-2012 and CIMAC-2003, provided that the fuel oil is sufficiently treated onboard.

MAN Diesel & Turbo requires that a backflushing filter is installed, since incidents may occur where the use of only separators cannot ensure that the fuel oil specifications are maintained at the inlet to the engine.

This could be the case if the fuel oil separators fail to remove the abrasive particles or if the fuel oil is contaminated with particles generated by wear in the fuel oil booster/circulation system. The particles will initially settle at the bottom of the service tank, but at high sea and rough sea conditions the particles can be hurled up and fed to the fuel pump on the engine.

Inside the fuel pump, a plunger slides back and forth within the pump barrel. The tolerances between the plunger and barrel are relatively small and particles that approximate the size of the clearance will be trapped between the plunger and barrel and may become embedded in the plunger or barrel material. Excessive wear of either of these affects the injection pressure and, thereby, the engine performance. If abrasive wear to the fuel injection pump has occurred, it is impossible to maintain the correct injection timing for the individual cylinder units.

Particles that pass through the fuel injection pump will reach the fuel injectors, and excessive wear of the fuel injectors may change the size and shape of the nozzle holes. Any change in the size and shape of the holes alters the injection spray pattern of the fuel oil, which in turn will decrease the combustion efficiency.

Changes in the fuel injection spray pattern/insufficient atomisation also result in fouling of the combustion chamber components and the turbocharger nozzle ring, and the amount of unburned hydrocarbons (HC) in the exhaust gas will increase.

Abrasive particles in the exhaust gas will wear down the nozzle ring in the turbine section of the turbocharger, thus reducing the efficiency and lifetime severely depending on the number of abrasive particles.

To summarize: The particle content that remains in the fuel oil after centrifugal separation has the potential to cause abrasive wear and damage to the engine. The higher the amount of particles, the greater the risks of engine wear, especially a higher wear rate of fuel injection pumps and injectors has been observed. Such operation conditions increase the risk of engine failure and breakdown/failure of the power supply ("blackout"), and it is likely that the engine will require more frequent maintenance than recommended by MAN Diesel & Turbo.

## Installation of the automatic backflush filter

To protect the engines against abrasive particles in the fuel oil, a common automatic backflush filter is standard for new vessels today.

On vessels in service, the backflush filter must be installed in the circulation line before the branch off to the individual auxiliary engines, see Fig. 1, to ensure a safe and economical operation.

Figs. 2 - 4 show examples of minor or no wear on fuel injection nozzles (12,000 running hours) from a fuel oil system with the automatic backflush filter installed.

The recommended automatic backflush filter with a change-over cock, bypass simplex filter and an integrated heating chamber has a mesh size of 10 µm (absolute/sphere passing mesh). The automatic backflush filter permits continuous operation, even during backflushing, without any pressure drops or interruptions of the flow. An automatic cleaning process is started, if the filter inserts are clogged. The filter is equipped with a visual differential pressure indicator and two differential pressure contacts to monitor the clogging of the filter. The backflushing medium is discharged discontinuously to a sludge tank.

If you have any questions or comments please forward your mail to [LEO7-HOL@mandieselturbo.com](mailto:LEO7-HOL@mandieselturbo.com) with reference to this service letter.

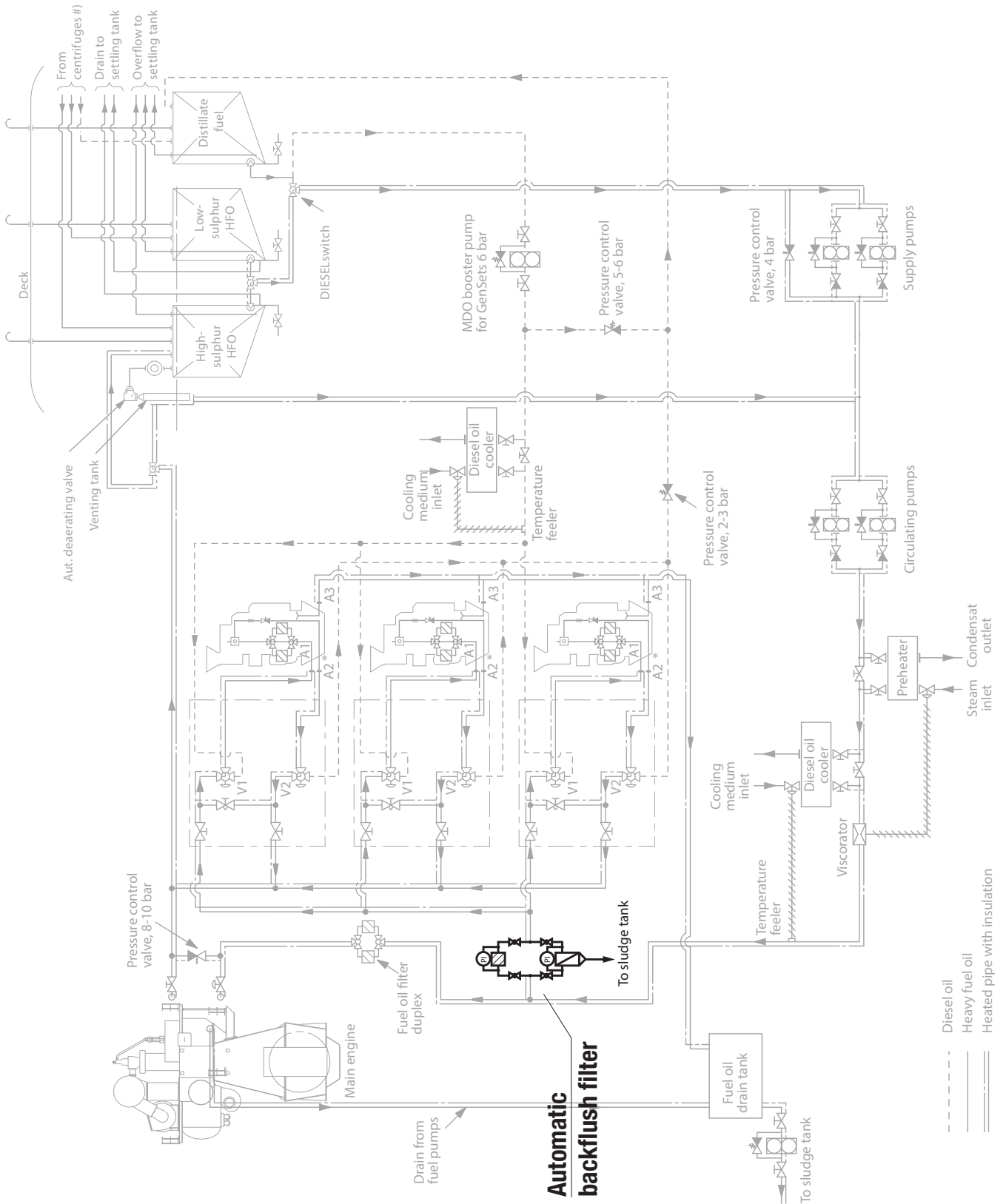
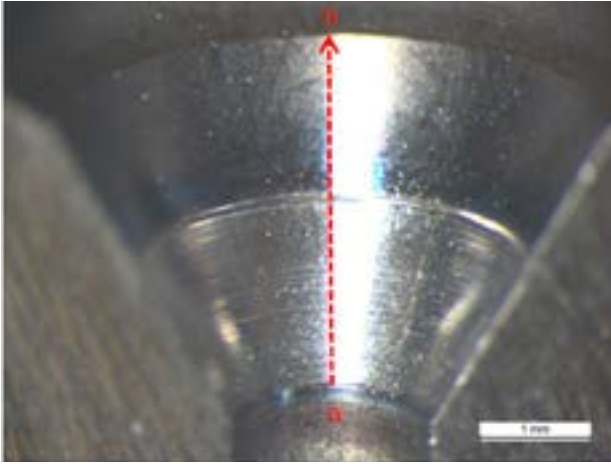
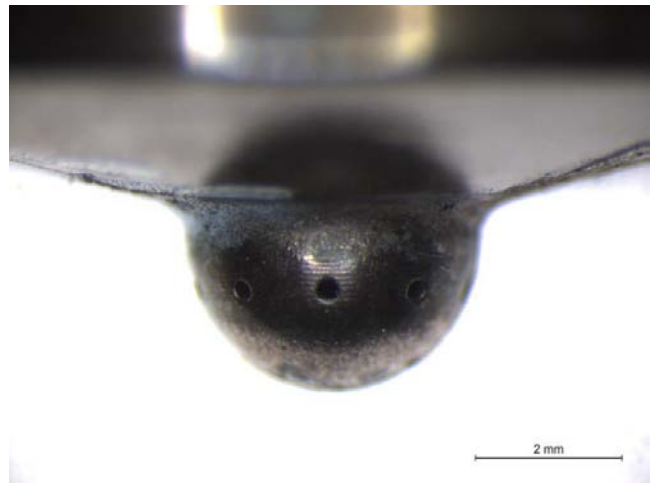


Figure 1: Recommended installation of the automatic backflush filter (10 µm absolute)

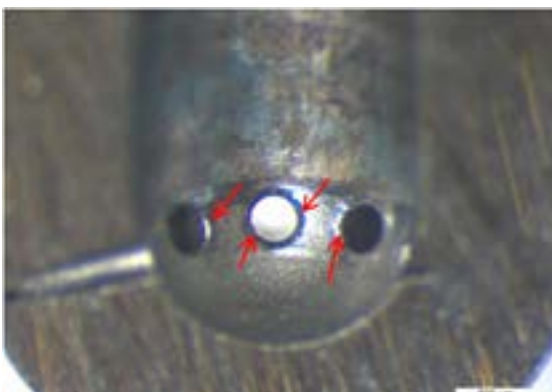
Figs. 2 – 4: Pictures of a fuel injection nozzle (after 12,000 service hours) from a fuel oil system with an automatic backflush filter (10 µm absolute) installed. The fuel nozzle shows sign of normal wear corresponding to 12,000 running hours.



**Figure 2:** After 12,000 hours the needle seat shows minor wear caused by needle impact.



**Figure 3:** The outer surface of a fuel injection nozzle. The spray holes show no visible wear after 12,000 running hours.



**Figure 4:** The inner surface of a fuel injection nozzle. The spray holes show slight wear after 12,000 hours.