Technical Bulletin for
exhaust gas boilers

Considerations for exhaust gas boiler operation and thermal balance during slow steaming as a result of engine power limitation

New regulations to promote shipping decarbonization will result in a range of efficiency measures on board. Exhaust gas boilers contribute to sustainability, but their operation and capacity could be impaired by one such measure: slow steaming due to engine power limitation.

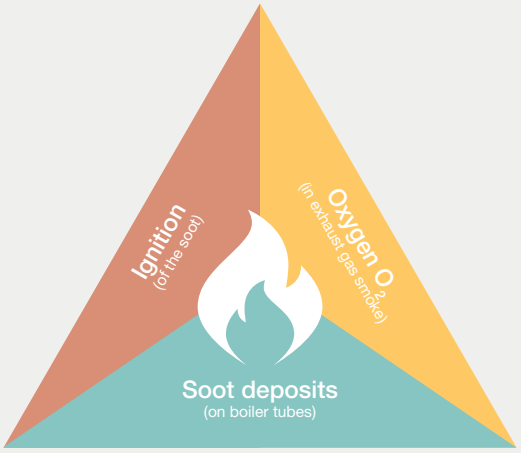
MEPC 76 introduced mandatory goal-based technical and operational measures to reduce the carbon intensity of international shipping. The most significant measures related to existing vessels are:

- The Energy Efficiency Existing Ship Index (EEXI), applicable from the first annual, intermediate or renewal IAPP survey after 1 January 2023
- The operational Carbon Intensity Indicator (CII) rating scheme, taking effect from 1 January 2023

Guidelines for calculating EEXI and CII have been adopted. Whereas shipowners will need to comply with mandatory annual reduction factors for CII, EEXI is a one-off exercise. In order to achieve the necessary EEXI targets, it is anticipated that some shipowners and ship managers will choose the option of engine power limitation (EPL). This could potentially have implications for the operation of exhaust gas boilers.

Most oceangoing vessels are fitted with exhaust gas boilers, which recover waste heat from the engine exhaust gas in order to satisfy the steam demand during a voyage. Designed according to the steam requirements at sea, the exhaust gas boilers are optimized for heat recovery based on the flow, temperature and velocity of the exhaust gas.

In slow steaming conditions, the three parameters mentioned will be impacted significantly. In addition, depending on the engine type, there may be incomplete combustion during low loads. If so, this will result in greater/faster soot accumulation on the heating surface of the exhaust gas boiler. This, too, will have some important consequences.



Safety risk from potential soot fires

When soot accumulation is exposed to a sufficient amount of oxygen and a high enough temperature, it has the potential to ignite and cause a soot fire. Although the ignition temperature of the soot layer itself is around 300–400°C, the presence of unburned oil can reduce it to as low as 150°C. Oil residue could appear in the exhaust gas as a result of slow steaming, or even due to manoeuvring or insufficient engine maintenance. As a result, any sparks coming from the main engine could ignite the soot layer built up.

Exhaust gas boilers with an extended heat transfer surface are more susceptible to dangerous soot fires, as their larger surface area provides more space on which soot can potentially accumulate. In addition, the extensions themselves normally have a higher metal temperature that can act as an ignition source. For this reason, exhaust gas boilers with an extended heating surface are equipped with soot-blowers to remove any soot deposits.

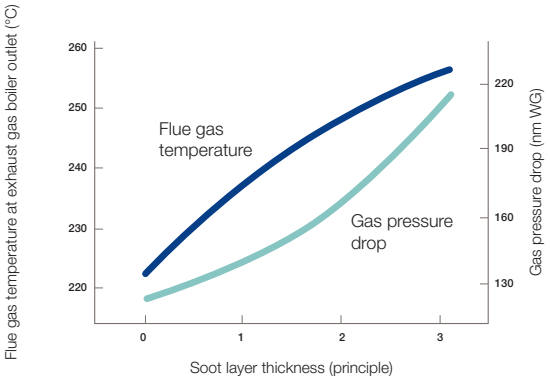
Smoke-tube exhaust gas boilers, which have straight tubes, are not normally installed with soot blowers. These boilers are intended to be self-cleaning and depend on higher exhaust gas velocities to blow the soot away. During slow steaming, the exhaust gas velocities may not be sufficient to guarantee proper self-cleaning.

Recommendations to prevent soot fouling

Regardless of the tube type, it is essential to prevent excessive fouling of the heat exchange surface as a general rule. Alfa Laval has the following recommendations in this regard:

- Make differential pressure and temperature curves (see example below) using measurements for every 10% increase in ME load up to full load. The boiler must be clean during this procedure.
- While slow steaming, constantly (at least daily) compare the actual pressure and temperature conditions with the curve.
- If a soot blower is installed, perform soot blowing 2–3 times per day as a minimum, or more frequently if the differential pressure reveals soot build-up. Soot blowing should be done with at least 75% engine load, as high gas velocity will help carry the soot out.
- Perform a visual inspection of the heating surface at least every three months.
- Adjust the frequency of soot blowing to obtain a reasonably clean boiler condition and/or perform water washing as necessary.*

* *When performing water washing, it is important to ensure that the washing is complete: the soot should not simply be flushed from the upper part of the boiler into a lower part. However, as water washing corrodes the boiler slightly each time, it should never be performed unless deemed necessary.*



An example of differential pressure and temperature curves

Monitoring to warn of soot fouling

Alfa Laval can also supply a pressure and temperature monitoring system for exhaust gas boilers that can provide an early warning of boiler fouling. For more information, please contact your local Alfa Laval office.

Acidic corrosion of boiler tubes

Lower exhaust gas temperatures are another direct consequence of slow steaming, and they can lead to further concerns. Depending on the type of fuel and its sulphur content, acidic corrosion of the boiler tubes may occur if the exhaust gas temperature drops below the dew point.

Recommendation to avoid corrosion risk

To keep corrosive condensation from appearing, Alfa Laval recommends operating the main engine so that the exhaust gas temperature is at least 160°C at the exhaust gas boiler outlet.

Decreased steam production

Apart from the direct risks that it poses to exhaust gas boilers, slow steaming can have implications for their capacity. In slow steaming conditions, during which the exhaust gas flow and exhaust gas temperature will both be lower, the steam production capacity will naturally be reduced. Moreover, even a small amount of soot accumulated on the heating surface will reduce heat transfer efficiency. If the surface is covered with soot, the steam production will be reduced significantly, which means use of the oil-fired boiler may be required for sufficient heating.

Retrofit solutions to support steam production when slow steaming

Alfa Laval can provide a number of retrofit solutions to secure sufficient steam production during slow steaming, as well as to limit and optimize fired boiler use.

- **Alfa Laval Aalborg Micro**
  The Aalborg Micro is an extremely compact and efficient waste heat recovery system that is easy to install after the auxiliary engines. During slow steaming, the Aaborg Micro can produce additional steam, compensating for the reduced steam production by the exhaust gas boiler after the main engines. Depending on the auxiliary engine size, this may eliminate the need to fire the auxiliary boiler.
- **Low-load upgrade**
  On vessels with Alfa Laval Aalborg OL/OM/D boilers and KBSD/KBSA burners with Mission control systems or Alfa Laval Touch Control, we can provide a low-load upgrade that reduces the minimum boiler load to around 5%. This will reduce the number of stops and starts, thereby lowering operating costs for the oil-fired boiler.
- **Combustion modifications**
  If there is a need to reduce the minimum firing level for pressure jet and rotary cup burners, Alfa Laval can investigate possible modifications to the combustion system.

Please contact your local Alfa Laval office for more information or additional support.

Alfa Laval Aalborg Micro

100005844-1-EN 2203

How to contact Alfa Laval
Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com