TECHNICAL BULLETIN

Operating oil-fired boilers on alternative fuels

Considerations for Alfa Laval Aalborg boilers regarding biofuels and LNG

November 2020

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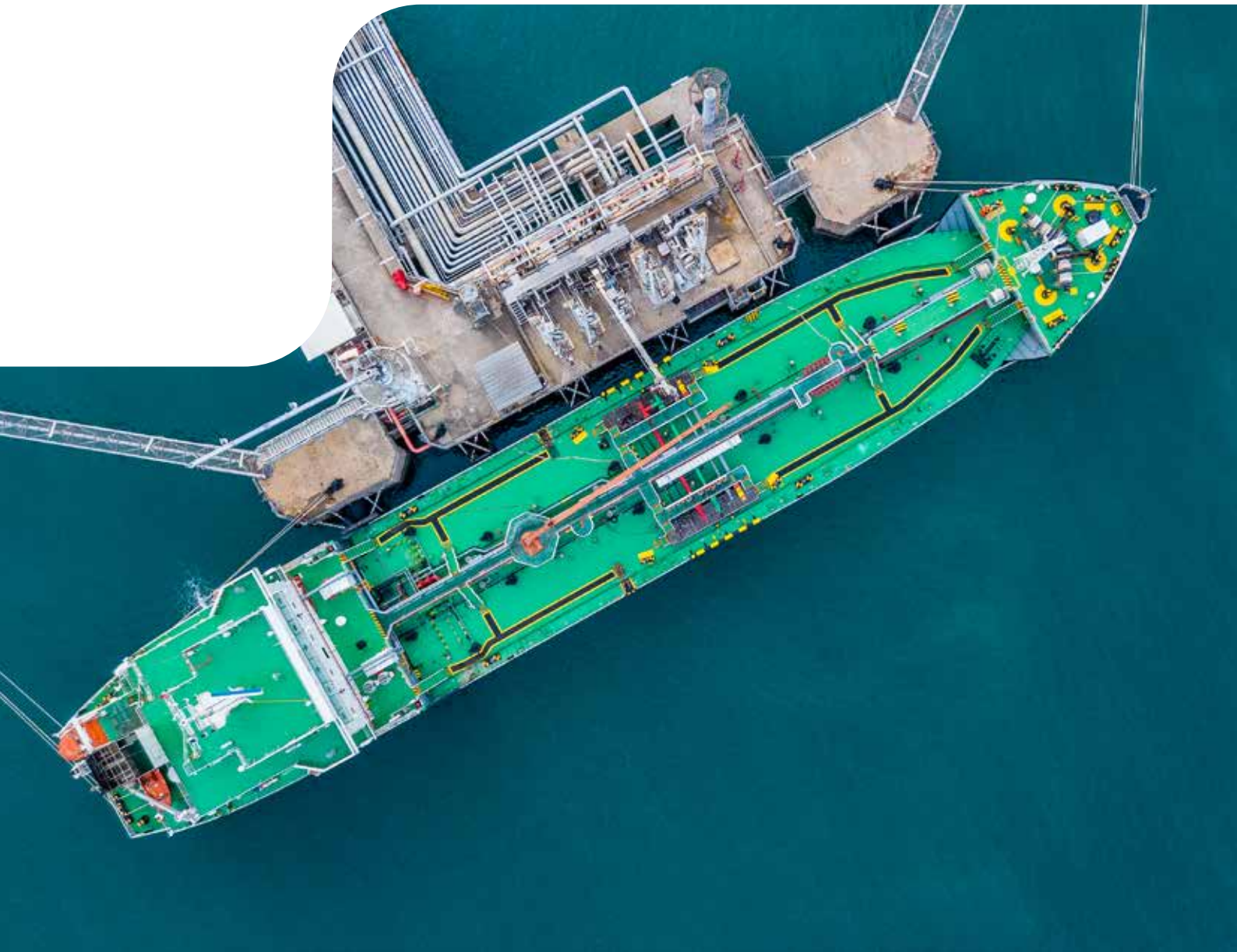
Introduction

Since 1st January 2020, when it entered into force, the IMO global sulphur cap has applied to marine vessels. While a few shipowners have installed SOx scrubbers in order to continue using high-sulphur fuel, most vessels are using compliant fuel to meet ISO 8217:2017 standards.

The global sulphur cap and IMO's stated ambition to reduce the carbon footprint of shipping have also led to the emergence of alternative fuels. These fuels not only have low sulphur content, but also offer possibilities to significantly reduce CO_2 emissions. They include other liquid fuels, such as biofuels, methanol and ammonia, as well as gas fuels like LNG and LPG.

While the traditional fuels used in the marine industry have always adhered to ISO 8217:2017 standards, the new alternative fuels deviate from this practice. This document outlines the impact on Alfa Laval Aalborg boilers when some of these fuels are used.



Boiler design and the impact of fuel properties on the burner and fuel system

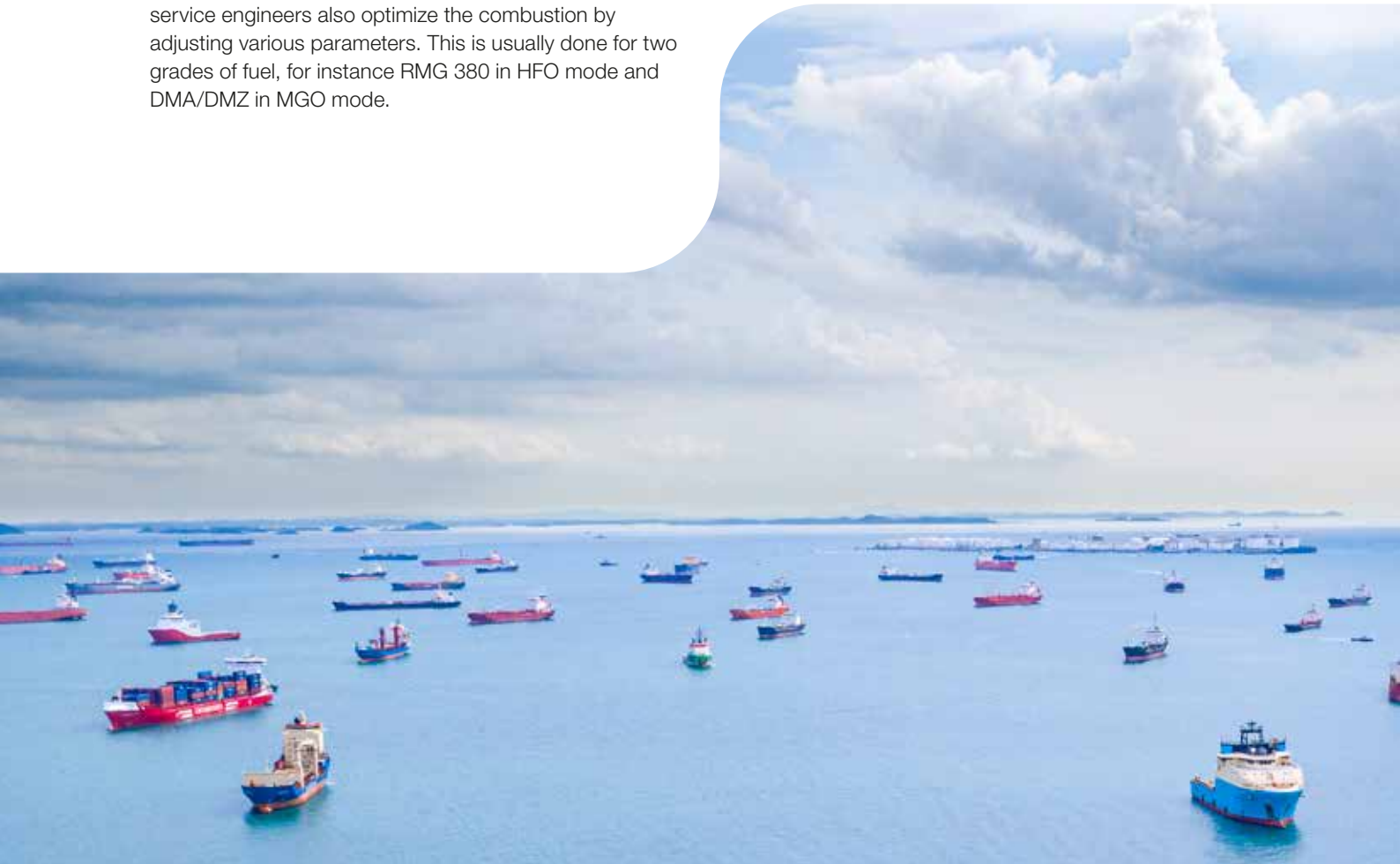
ISO 8217:2017 standards for the use of fuel on ships specify seven categories of distillate fuel and six categories of residual fuel. The standards define limits for certain properties that impact the safety and usability of each fuel on board, many of which also influence fuel combustion in the boiler combustion system.

In the boiler design stage, careful consideration is given to the properties of the fuel intended for use. Accordingly, necessary design elements are incorporated into the boiler's burner and fuel system. As a standard, oil-fired boilers are designed for operation on fuels conforming to ISO 8217:2017 standards.

During the commissioning of Aalborg boilers, Alfa Laval service engineers also optimize the combustion by adjusting various parameters. This is usually done for two grades of fuel, for instance RMG 380 in HFO mode and DMA/DMZ in MGO mode.

A record of the design data is available in the boiler manual, while the combustion settings are normally included in the commissioning report.

When the properties of the fuel in use change, the boiler combustion settings must also be changed. The fuel can be used so long as it conforms to one of the ISO 8217:2017 grades, albeit with certain operational considerations that depend on the type of fuel system installed on the boiler. Alfa Laval issued various technical bulletins addressing this topic in the run-up to 2020 and the global sulphur cap, which are now available on demand.



The use of alternative fuels

With more and more shipowners opting to evaluate alternative fuels, questions have been raised about the suitability of these fuels for existing boiler systems. The challenges and concerns, however, depend on the type of fuel in question.

This paper addresses only the issues associated with biofuels and LNG. A paper covering other alternative fuels, such as LPG, methanol and ammonia, will be prepared at a later date.

3.1 Biofuels

Although ISO has established standards for most bio-fuels, there is a lack of globally accepted standards specific to marine biofuel use. This presents challenges and concerns due to the varying composition and characteristics of biofuels.

Nonetheless, there may be some biofuel blends that do comply with ISO requirements for marine use. Such blends are possible because of an ISO decision from 2016 that allows blending of up to 7% FAME (fatty acid methyl ester) content in distillates for marine use. These fuels are classed within the DF grade under ISO 8217:2017 standards.

Fuels having a higher percentage of FAME, which are thus beyond the DF grade limits, fall outside the scope of ISO standards for marine use. Therefore, such fuels are not recommended for use with Alfa Laval Aalborg boilers, unless their use has first been tested and approved by Alfa Laval. Because these fuels do not meet the design limits, usage of them also voids the system warranty.

Many biofuels exhibit high FAME content, which includes substances like phenol and other chemicals. These fuels have a corrosive, damaging effect that could lead to significant wear and tear on fuel oil system components, such as pumps, pipes, valves, transmitters, flow meters, gaskets, O-rings, diaphragms and sensors that were not designed for use with fuels of this composition.

Furthermore, unless the biofuel in question has been tested on boiler systems, it is unknown whether it will create corrosive flue gas that will adversely affect the convection section.

Recommendation

Alfa Laval's recommendation is to always use fuels meeting ISO 8217:2017 requirements, and to operate Alfa Laval Aalborg boilers on those fuels in accordance with the technical bulletins already issued. Burner adjustment may be required, depending on the characteristics of the fuel.

If the use of a fuel falling outside ISO 8217:2017 standards cannot be avoided, we advocate paying close attention to the whole fuel oil system, through increased monitoring and examination of components. It is important to monitor the effect on combustion by means of regular boiler inspections, and to watch for any adverse impact on the pressure section.

The Alfa Laval Test and Training Centre, located in Aalborg, Denmark, is equipped to assist interested parties in testing biofuels prior to commencing their use on board. To learn more about the cost and other practicalities, please contact your Alfa Laval office.

3.2 LNG

LNG is a bridge fuel in the work of achieving IMO's greenhouse gas reduction targets. This transitional role has led to widespread interest in the operation of boilers on LNG. When converting an oil-fired boiler plant to use LNG as fuel, however, there are a few points that need to be considered.

Adjustments to the combustion system during conversion

The boiler's existing combustion system is designed to operate on liquid fuels. Below is a list of the major changes that need to be carried out in order to upgrade it for dual-fuel operation:

- Replacement of the burner with a MultiFuel burner (Alfa Laval Aalborg MF PA or MF SA) designed for use with gas (LNG) and liquid fuel (HFO, VLSFO, ULSFO or MGO)
- Revision and possibly upgrade of the fuel supply system, depending on the existing system*
- Installation of a gas valve unit (GVU)
- Installation of an extraction fan for the GVU and double-wall piping
- Replacement of the existing boiler control system with an Alfa Laval Touch Control system designed for MultiFuel burners (Aalborg MF PA or MF SA) and dual-fuel operation.
- Installation of an oxygen sensor in the boiler outlet for oxygen trim by the control system

** When a steam-atomizing Aalborg MF SA burner is installed, the existing fuel system can be reused. In some cases, the system is modified to operate on MGO as liquid fuel if no HFO/VLSFO is used.*

Adjustments in steam balance due to conversion

When operating on LNG, the overall steam balance on board will likely be impacted due to the difference in steam supply and steam demand.

A traditional boiler designed to use liquid fuel will see a reduction in steam output when it is operated on LNG. This is due to the following factors:

a) The boiler design output is a result of the radiant heat in the furnace combined with the convection heat in the exhaust gas from the furnace. Since the radiant heat from a gas flame is less than that from an oil flame, the the output of some boiler types will be reduced by 10–20% depending on the design. This can be calculated by Alfa Laval boiler specialists.

b) The flame length is a function of furnace size. The maximum gas flow is therefore limited by the maximum flame length that can be accommodated in the existing furnace.

Similarly, the vessel's steam demand may be affected for following reasons:

a) The heat required for the fuel oil service and storage tanks will likely be reduced.

b) Depending on the gas conditioning system, it may cause an increase in steam demand, thereby equalling or increasing the existing total steam demand.

Furthermore, depending on the vessel's LNG system design, the boiler may need to be able to act as a Gas Combustion Unit (GCU). In this case, the installation of additional equipment is required to meet classification society requirements.

LNG conversion assistance

For some years, Alfa Laval has been the market leader in the supply of dual-fuel boiler systems for new vessels. In addition, we have proven experience in the conversion of existing oil-fired boilers for operation on LNG.

To learn more about our conversion solution for Alfa Laval Aalborg boilers, please refer our solution leaflet paper "LNG conversion of Alfa Laval Aalborg Boilers".

This is Alfa Laval

Alfa Laval is active in the areas of Energy, Marine, and Food & Water, offering its expertise, products, and service to a wide range of industries in some 100 countries. The company is committed to optimizing processes, creating responsible growth, and driving progress – always going the extra mile to support customers in achieving their business goals and sustainability targets.

Alfa Laval's innovative technologies are dedicated to purifying, refining, and reusing materials, promoting more responsible use of natural resources. They contribute to improved energy efficiency and heat recovery, better water treatment, and reduced emissions. Thereby, Alfa Laval is not only accelerating success for its customers, but also for people and the planet. Making the world better, every day. It's all about *Advancing better*™.

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