



# Connecting boilers to SOx scrubbers

Solutions for Alfa Laval Aalborg boiler systems



## Contents

1. Introduction .....	3
2. Scrubber systems .....	4
3. Back pressure solution .....	6
4. Control system safety interlock solution .....	8
5. Additional considerations .....	9

More about how the 2020 sulphur cap will impact boiler systems can be found at [www.alfalaval.com/boiler2020](http://www.alfalaval.com/boiler2020)

# 1. Introduction

In 2004, the MARPOL Annex VI Regulations for the Prevention of Air Pollution from Ships were agreed upon and adopted. Regulation 14 of the annex established a stepwise reduction of permissible SO<sub>x</sub> emissions. As of 1 January 2020, the global sulphur cap will be 0.5% m/m, while the previously adopted limit of 0.1% m/m in Emission Control Areas (ECAs) will remain in force.

Complying with Regulation 14 will have a tremendous impact on maritime industry. Vessels will need to find ways to reduce their SO<sub>x</sub> emissions, and there are multiple strategies owners/managers can choose to achieve the necessary reduction. One of these is the installation of a SO<sub>x</sub> scrubber, which will allow continued use of high-sulphur fuel oil (HSFO) while keeping SO<sub>x</sub> emissions at a compliant level.

Although the boiler is only a small source of a vessel's overall emissions, it must also be connected to the scrubber system if HSFO is used for the burner. This means that the boiler will be affected by changes in back pressure, resulting in non-optimized combustion and potential safety risks.

This document aims to provide information about the interaction between boilers and scrubber systems. In addition, it offers an overview of the Alfa Laval Aalborg solutions for maintaining boiler performance and safety when a scrubber is installed.





## 2. Scrubber systems

Wet scrubber systems are used to remove the SO<sub>x</sub> from exhaust gas. The process involves funnelling the exhaust gas through the scrubber tower, where it is sprayed with water. In most cases, the scrubber produces back pressure.

The picture below shows an Alfa Laval PureSO<sub>x</sub> scrubber, which has a U-type design. A U-type design is commonly used when multiple inlet sources are required, such as when a boiler is connected to the scrubber.

The uptake and bypass dampers (or valves) are used to lead the exhaust gas in the desired direction. When the scrubber is in operation, the exhaust gas is led from the engine or boiler through the respective uptake damper to the scrubber, while the respective bypass damper remains closed. When the scrubber is not in operation, the bypass damper will be open and the uptake damper closed, allowing the exhaust gas to exit the funnel.



## 2.1 Interaction between equipment

Back pressure is a function of the exhaust gas flow within the scrubber. It is generated through a combination of the following:

- Exhaust gas flow within the scrubber itself
- Pressure drop caused by the piping that connects the scrubber inlet manifold to the boiler/engines
- Further pressure drop across valves and dampers within that piping

In other words, back pressure is a function of the load on the different equipment connected. When the load increases, the exhaust gas flow increases and, finally, the back pressure increases.

The increase and variation of back pressure on the boiler furnace can lead to combustion issues that may impact the scrubbing process. Moreover, a malfunction of the scrubber system may lead to furnace explosions or other hazards that pose safety risks for personnel and equipment.

To maintain both boiler efficiency and the highest standard of safety, Alfa Laval has developed solutions for Alfa Laval Aalborg boiler systems.

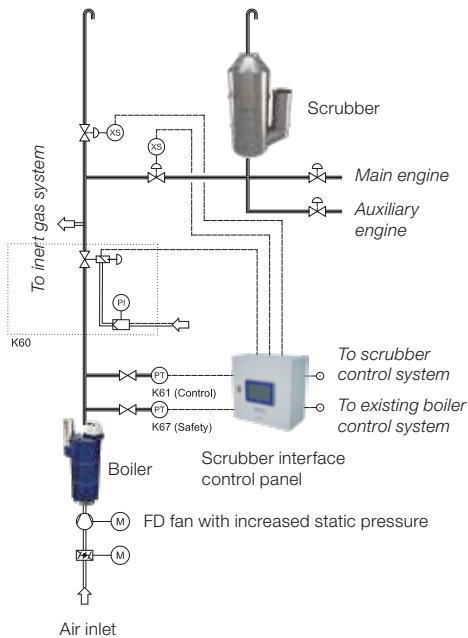
## 2.2 Alfa Laval Aalborg boiler–scrubber interface solutions

Scrubber systems and boiler configurations vary from vessel to vessel. In light of these variations, Alfa Laval has developed different upgrade packages adapted to different scrubber and burner combinations:

- Back pressure solution
  - Forced-draught (FD) fan application
  - Induced-draught (ID) fan application
- Control system safety interlock solution

Scrubber connected to Alfa Laval Aalborg boiler	Back pressure within acceptable limits for boiler?	Which burner type?		Back pressure solution		Safety interlock solution
		Yes	No	ID fan	FD fan	
	Yes			×	×	✓
	No		Steam-atomizing /KBM	×	✓	✓
			Other	✓	×	✓

## 3. Back pressure solution



The means needed to compensate for additional back pressure generated by the scrubber depends on the specific scrubber and burner systems used on board. Whereas some scrubber suppliers propose built-in induced-draught fans, others do not. Likewise, Alfa Laval Aalborg boiler systems make use of several burner types, depending on the boiler size and customer preference.

Alfa Laval's back pressure solution is thus available in two versions with different fan types.

### 3.1 Forced-draft (FD) fan application

This back pressure solution applies when the following equipment types are used in combination:

- Scrubber (any brand) without a built-in induced-draught (ID) fan
- Alfa Laval Aalborg steam-atomizing burners and KBM burners

### Solution package

#### Replacement of the burner FD fan with a higher-capacity unit

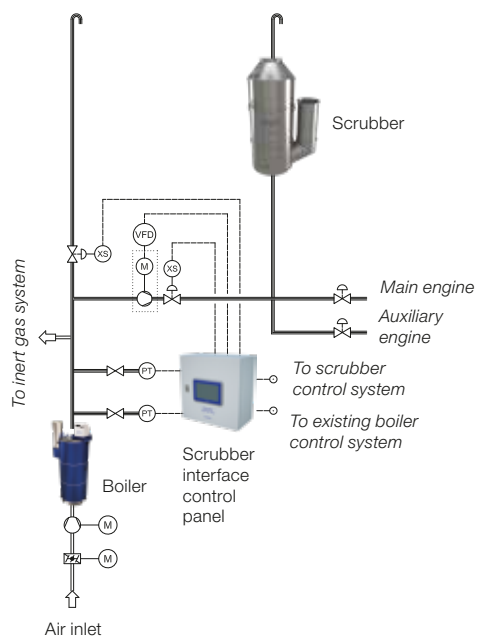
The new FD fan is designed to compensate for the maximum amount of back pressure (i.e. the maximum load on connected equipment).

#### Back pressure control valve (K60)

Load variation on equipment connected to the scrubber leads to fluctuation in back pressure. The position of the control valve will be adjusted in order to maintain stable back pressure on the boiler furnace.

#### Control panel

The control system will regulate the back pressure control valve. The FD fan solution also demands a boiler/scrubber control system safety interlock. Safe operation of the boiler requires integration of some of the scrubber status signals (e.g. uptake and bypass damper position) and pressure measurement (K61). Likewise, safe scrubber operation requires status signals from the boiler (e.g. boiler load).



## 3.2 Induced-draft (ID) fan application

This back pressure solution applies when the following equipment types are used in combination:

- Scrubber (any brand) without a built-in induced-draught (ID) fan
- Alfa Laval Aalborg pressure-atomizing burners and rotary cup burners

## Solution package

### Implementation of an ID fan

The new ID fan is designed to compensate for the maximum amount of back pressure (i.e. the maximum load on connected equipment).

### Variable-frequency drive (VFD)

Load variation on equipment connected to the scrubber leads to fluctuation in back pressure. The VFD will adjust the ID fan speed in order to maintain stable back pressure on the boiler furnace..

### Control panel

The control system will regulate the VFD. The ID fan solution also demands a boiler/scrubber control system safety interlock. Safe operation of the boiler requires integration of some of the scrubber status signals (e.g. uptake and bypass damper position) and pressure measurement (K61). Likewise, safe scrubber operation requires status signals from the boiler (e.g. boiler load).

## 4. Control system safety interlock solution

### Application

The control system safety interlock solution applies when the following equipment types are used in combination:

- Scrubber (any brand) with a built-in induced-draught (ID) fan
- Any Alfa Laval Aalborg burner

### Solution package

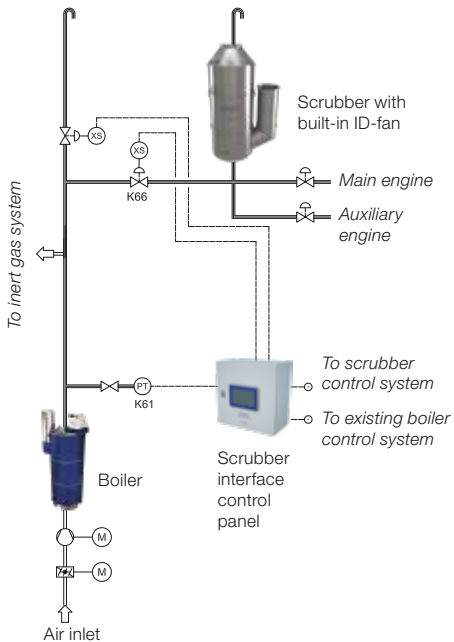
#### No additional components

When the scrubber supplier has designed the system with a built-in ID fan and a mechanical pressure control system, the flue gas is bypassed in the event that the pressure exceeds the set point.

Theoretically, this means there are no additional components required to compensate for back pressure. However, the scrubber supplier must ensure that the back pressure at the boiler outlet is consistent and within the range of  $-20$  to  $0$  mm WC.

#### Control panel

A boiler/scrubber control system safety interlock is necessary. Safe operation of the boiler requires integration of some of the scrubber status signals (e.g. uptake and bypass damper position) and pressure measurement (K61). Likewise, safe scrubber operation requires status signals from the boiler (e.g. boiler load).







## 5. Additional considerations

### 5.1 Open-loop scrubbers

If an open-loop scrubber is installed, the boilers need to be upgraded and certified for safe operation on LSMGO or compliant HFO in harbours where open-loop scrubbers are prohibited.

We recommend reviewing "Preparing boilers for the 2020 sulphur cap: Fuel line recommendations for Alfa Laval Aalborg systems". This document and other valuable information can be found at [www.alfalaval.com/boiler2020](http://www.alfalaval.com/boiler2020)

### 5.2 Inert gas systems

The design of the inert gas system on board may result in sulphur carryover to the cargo tanks and overboard discharge of untreated high-sulphur water, as well as possible ventilation of high-sulphur exhaust gas through the pressure control ventilator.

To avoid these issues, at least one boiler should be operated on compliant fuels during discharge for inert gas operation. To ensure your boiler systems are safe for burning compliant fuels, we recommend reviewing "Preparing boilers for the 2020 sulphur cap: Fuel line recommendations for Alfa Laval Aalborg systems". This document and other valuable information can be found at [www.alfalaval.com/boiler2020](http://www.alfalaval.com/boiler2020)

## About Alfa Laval

Alfa Laval is a leading global provider of specialized products and engineering solutions.

Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again. We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuff, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

### **How to contact Alfa Laval**

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