



near marine

THE FUTURE BUILDS ON A CENTURY OF STEAM

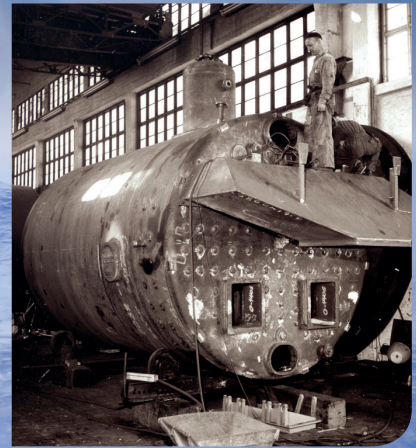
In 1919, when the first marine boiler left the Aalborg Shipyard in Aalborg, Denmark, no one could have known the significance it would have. 100 years later, the Aalborg name has become synonymous with boiler expertise.

That first Aalborg boiler went to sea in a very different time than today. There were no demands for energy efficiency, no regulations governing emissions nor any of the complexities found on modern vessels. But there was a constant demand for steam, and that remains to this day.

In a century of generating steam at sea, our partnership with marine customers has grown stronger and deeper – just like the solutions themselves. What

were once boilers are now complete boiler solutions, comprising far more than the steel they're built with.

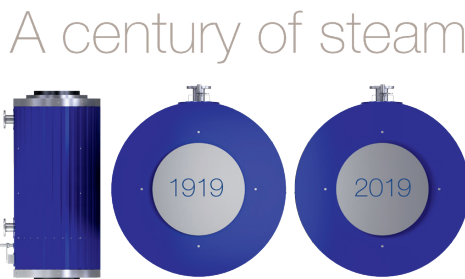
Alfa Laval Aalborg boiler solutions encompass boiler, combustion and control technologies, as well as the services and know-how to secure uptime and ongoing efficiency. As the marine industry sails towards new challenges and opportunities, we're providing the steam to keep it moving forward.



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Boiler innovation – inside and out

The basic function of a marine boiler is the same today as it was 100 years ago. Seen from outside the steel drum, it might appear that little at all has changed. But the advances in technology have been nothing short of extraordinary, and Alfa Laval Aalborg boiler solutions have always been at the forefront.



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1919

The first Aalborg marine boilers (Scotch type) are designed and built at the Aalborg Shipyard.

1920s

Design and manufacturing of industrial boilers for process industries (e.g. dairies and textile factories) begins.

1930s

The shipyard starts designing and producing its own burners.

1940

The boilers are now welded instead of riveted, which speeds up production and enables increases in design pressure, size and durability.

1944

The first power plant boilers are built.

**CONTINUED STORY FOR "BOILER INNOVATION
- INSIDE AND OUT"**

"A boiler is more than a giant kettle, even if what it produces is steam or hot water," says Lars Skytte Jørgensen, Vice President Product Centre Boilers. "There's deceptive complexity in the tubes and internal configurations. Constantly optimizing the heating surfaces and the flow of media through the boiler has been the key to reliability and efficiency."



Over the years, Aalborg boiler innovations have saved fuel by increasing the thermal output from every square millimetre of heating surface. But advances have also been made by seeing the boiler as a part of a wider system. The best example is waste heat recovery, which today provides steam, electrical power and even energy for propulsion.

"When we pioneered it in the 1960s, we couldn't have imagined the importance of waste heat recovery today," Jørgensen says. "Back then, heating boiler surfaces with exhaust gas was a novelty. Today, it's an integral part of saving fuel in an era of energy efficiency."



Multi-fuel Aalborg boiler at the Alfa Laval Test & Training Centre

A higher level of control

Steel is only a small part of Alfa Laval Aalborg boiler solutions. Effective control ensures safety, fuel efficiency and lower emissions by securing ideal combustion conditions and adjusting the systems as needed.

Alfa Laval Aalborg boiler solutions were the first to provide self-diagnostic testing and a clear visualization of operating sequences. But today's Alfa Laval Touch Control brings boiler control to a completely standard. The graphical touchscreen display and intuitive navigation make it easy for crews to secure efficient boiler operation, giving them a complete plant overview and access to any data or function in only two touches of the screen.



With its robust PLC-based design, Alfa Laval Touch Control offers future-proof expansion possibilities. But just as importantly, it can easily be retrofitted to boiler systems that already exist.

"Retrofitting Alfa Laval Touch Control is a simple process of just five steps," says Stig Person, Vice President Aalborg Service. "The new generation of boiler control can help customers get the best from their boiler systems – whatever generation those happen to be."

The answers to burning needs

As the marine fuel landscape changes, so do the demands placed on boiler combustion. Alfa Laval Aalborg boiler solutions are giving customers the flexibility and reliability they seek.

The burner is just as important as the boiler in a fired boiler system, where changes in one impact the other. "We optimize our burners for reliable ignition and precise combustion," says Lars Skytte Jørgensen, Vice President Product Centre Boilers. "But we also fine-tune them to match the specific boiler configuration."

Today that process involves a whole range of fuels. With many vessels running on gas and other alternatives, Alfa Laval Aalborg

multi-fuel burners are providing flexibility as well as efficiency and fuel economy.

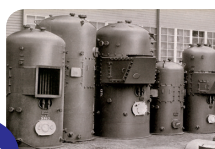
"Multi-fuel solutions are a key focus of our work at the Alfa Laval Test & Training Centre," says Jørgensen. The 1350 m² facility in Aalborg, Denmark, has performed extensive tests and flame analyses using different fuels to secure ideal combustion with the full range of alternatives. "Whether customers work with gas, synthetic fuels or traditional HFO, they can expect top combustion performance."

1950



After World War II, Aalborg marine boilers are supplied to an increasing number of international shipyards and ship owners.

1960s



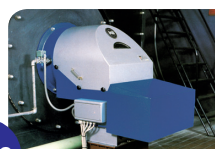
The number of boilers going to European shipyards increases. During this decade, the unique combined oil and exhaust gas boiler is designed and introduced to the market.

1982



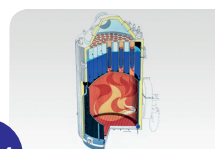
The first large waste heat recovery (WHR) plant after a turbo generator is delivered. Over the years, the largest WHR plants for the largest container ships in the world will follow.

1988



The KB oil- and gas-fired burners are added to the product range through the acquisition of Dansk Fyrings Teknik A/S, based in Odense, Denmark.

1994



The Sunrod Group, with its portfolio of marine boilers, exhaust gas economizers and marine boiler service, is acquired from ABB.



A small boiler makes big news

In waste heat recovery (WHR), a compact new boiler offers expansive energy savings.

The Alfa Laval Aalborg Micro is a uniquely compact WHR boiler for marine and industrial use. Designed to recover waste heat from smaller gas turbines and auxiliary engines using gas,

MDO or HFO, it can naturally generate steam or hot water. But it can also be used to heat media such as triethylene glycol (TEG) and thermal fluid (TFO), or to raise the temperature of boiler feed water. Despite its small size, it typically doubles the thermal efficiency of the turbine or engine – which means lower fuel costs and emissions.

Advancing on land as well

As environmental challenges and regulations intensify, waste heat recovery (WHR) systems are improving total energy efficiency – and even boosting electrical capacity – without increasing emissions or fuel consumption. This is true at sea but also at power plants on land.

Renewable energy is fulfilling a larger share of the world's energy needs, but its fluctuating availability demands responsive backup power that adapts to load changes. Engine power plants must be able to start and stop quickly and repeatedly, which poses both challenges and opportunities for WHR systems. Today, Alfa Laval Aalborg WHR solutions are at the cutting edge.

When Alfa Laval entered the engine power business, most plants were of the traditional single-cycle type. These use only a small portion of the available WHR capacity for fuel heating, letting the rest go unutilized. Alfa Laval took plant efficiency further by developing secondary cycle applications. Of the almost 1500



Aalborg WHR systems supplied to nearly 100 countries so far, half of them provide full WHR.

Towards the end of the 1990s, WHR boilers with natural circulation were adapted to engine power plants. Alfa Laval has been at the forefront of their development ever since, and today natural circulation is also becoming a standard in WHR systems for cruise vessels.

Naturally, development continues. Having worked for decades at challenging remote sites worldwide, Alfa Laval is focused on customer-oriented solutions for fast and easy installation. The latest of these is a containerized steam turbine generator system.

On the front lines of oil and gas

As the oil and gas industry becomes increasingly mobile, Alfa Laval is providing the big solutions needed for self-sufficiency.

Alfa Laval Aalborg boiler solutions have been part of offshore oil exploration for decades. Since the development of floating production storage and offloading (FPSO) vessels in the 1980s, the work has become increasingly remote – creating the need for larger, more self-sufficient vessels with constant demands for steam and hot water.

Alfa Laval has a broad portfolio of solutions for FPSOs including fired multi-fuel boilers, waste heat recovery systems and thermal fluid systems. One of the most relied on is the massive Aalborg D boiler, which can deliver 120 tonnes per hour of superheated steam. No matter how large the project, Alfa Laval can support it from concept to completion.



1996

The trendsetting MISSION modular boiler concept is launched. The first MISSION product is the oil-fired MISSION OS marine boiler.



1997

UNEX marine boilers and exhaust gas waste heat recovery systems are added to the portfolio through the acquisition of Pipemasters Oy, based in Rauma, Finland.



2005

Aalborg Industries delivers the first of a new generation of WHR-TG boilers to A.P. Møller Maersk, providing up to 11% savings in fuel and equivalent emissions.



2007

A new generation of MISSION boilers with reduced environmental impact is launched: the self-cleaning MISSION TCi series. The boilers are now delivered as one complete unit.



2011

Aalborg becomes a product brand name when Aalborg Industries joins Alfa Laval, replacing the previous MISSION brand.

Taking service on board and online

With a committed global service network and a growing connectivity offering, Alfa Laval works 24/7 to secure boiler uptime and optimization. No matter how challenging the task or conditions.

The dedication behind Alfa Laval Aalborg boiler solutions doesn't stop at delivery. Boiler solutions are intended to last the lifetime of the vessel, and Alfa Laval Aalborg service experts are ready to make sure that they do.

Around the clock and around the world, our experts secure genuine spare parts, perform inspections and handle even the most complicated repairs. Sailing with the vessel if needed, they do whatever it takes to maximize boiler system uptime. But they also work to boost system efficiency, providing upgrades, enhancements and deep knowledge for optimization.

Increasingly, connectivity is a part of those services. Alfa Laval Aalborg Connected Crew, for example, relays boiler data to Alfa Laval's

global service helpdesk to provide better troubleshooting assistance for the crew. If onboard service proves necessary, it supports faster resolution by ensuring that the service expert arrives with the right parts in hand.

For more proactive connectivity, vessels can take advantage of the Alfa Laval Aalborg Steam Audit, a monthly subscription service that relays boiler data to Alfa Laval for deep analysis. This leads to regular recommendations for efficiency improvements, which can result in fuel savings of 5–10%.

On board, online, anytime and anywhere in the world, Alfa Laval is there to ensure peace of mind and the very best boiler system performance.



Preparing boilers for the 2020 sulphur cap

Many of the challenges facing the marine industry are related to the coming global sulphur cap. Those challenges affect boilers as well.

Changes in marine fuels will impact not only engine fuel systems, but also boiler fuel systems. Having worked with marine boilers for 100 years, Alfa Laval can provide full support for any vessel and fuel strategy. That support includes detailed recommendations

for adapting the boiler fuel line and its layout, or for incorporating the boiler into the vessel's scrubber system. But it also extends to boiler equipment upgrades, such as multi-fuel burners to support a retrofit conversion from HFO to LNG.

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Project manager Alfa Laval: Anne Henningsen, anne.henningsen@alfalaval.com **Production:** Pyramid, Helsingborg, Sweden **Editor:** Mark Drake, mark.drake@pyramid.se **Layout:** Pyramid, Helsingborg, Sweden
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2013



Aalborg Keystone technology is integrated with existing design for large waste heat recovery installations on FPSO vessels, becoming the new preferred solution.

2014



Alfa Laval inaugurates the Alfa Laval Test & Training Centre on the site of the original Aalborg Shipyard. A full-scale machinery room on land, the centre provides a springboard for boiler development.

2015



The next generation of boiler control arrives with the launch of a new control system based on Alfa Laval Touch Control.

2017



The Alfa Laval Test & Training Centre is expanded with a full section devoted to gas applications and combustion, including multi-fuel burner technology for boilers.

2019



Alfa Laval celebrates the 100th anniversary of Aalborg marine boiler production.