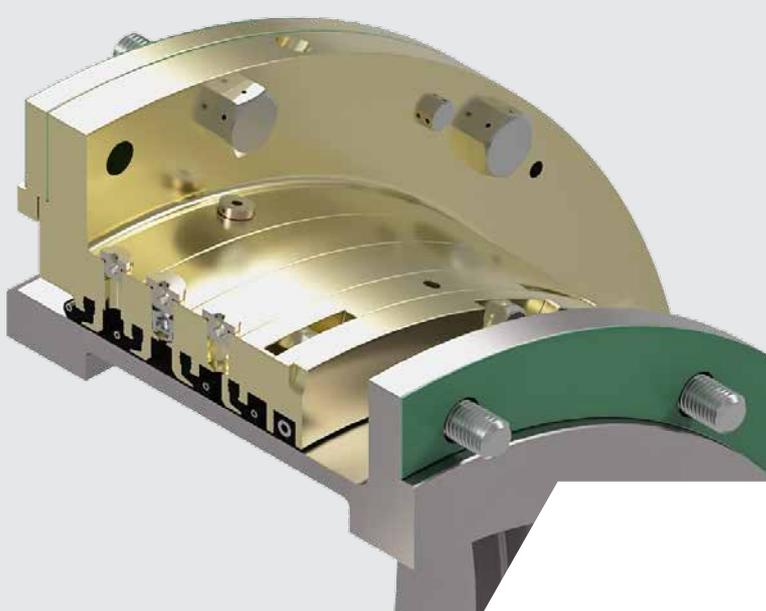


Wärtsilä Airguard seal

BUSINESS WHITE PAPER



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Introduction

— To safeguard the marine ecosystem, ships need to comply with the latest anti-pollution and environmental regulations.

In today's world, it is vital that all vessels comply with the latest anti-pollution and environmental regulations. One particularly important requirement for ship owners is the avoidance of any leakage of oil into the sea or any ingress of seawater into critical components.

For instance, any commercial vessel sailing within three nautical miles of the US shoreline must comply with the revised 2013 Vessel General Permit (VGP) issued by the US Environmental Protection Agency (EPA). This includes two specific requirements for any mineral oils with air/void space seals. Firstly, there must be no oil-to-sea interface in normal operations and secondly, there must be no reasonable possibility of oil leakage to the sea if there is a system failure.

This means that the stern tube seal on an oil-lubricated system must meet high reliability and safety criteria. In conventional sealing systems, the inside of the seal is filled with oil and outside is the seawater. When the seal ring slides, the two can come into contact and mix. The vibration of the shaft can make the problem even worse. Contamination will also occur if there is a serious failure on the seal ring. Finally, if the ship has a large draft, manual adjustment of the oil pressure in the stern tube is necessary to maintain the seal as the load increases.

Previous solutions to this issue have been complex, expensive and ineffective, as the water and oil still came into direct contact. However, Wärtsilä has now developed the Wärtsilä Airguard seal: a highly effective system that uses an air chamber to separate the oil and seawater. Because air is non-polluting, it's an ideal medium for separating the oil and the seawater. The Wärtsilä Airguard is a special anti-pollution lip-type seal that provides an environmentally compliant solution for shaft lines.



Wärtsilä Airguard seal

- The Wärtsilä Airguard complies with environmental regulations, due to the design's ability to stop seawater ingress and lube oil egress.

The Wärtsilä Airguard seal was originally developed for new-build vessels in 1988. Since then, it has been installed on more than 3,000 vessels, with 1,000 of these installations having taken place in the last five years. To date, there has been no reported oil leakage from any vessel with a correctly installed and fully maintained Wärtsilä Airguard seal.

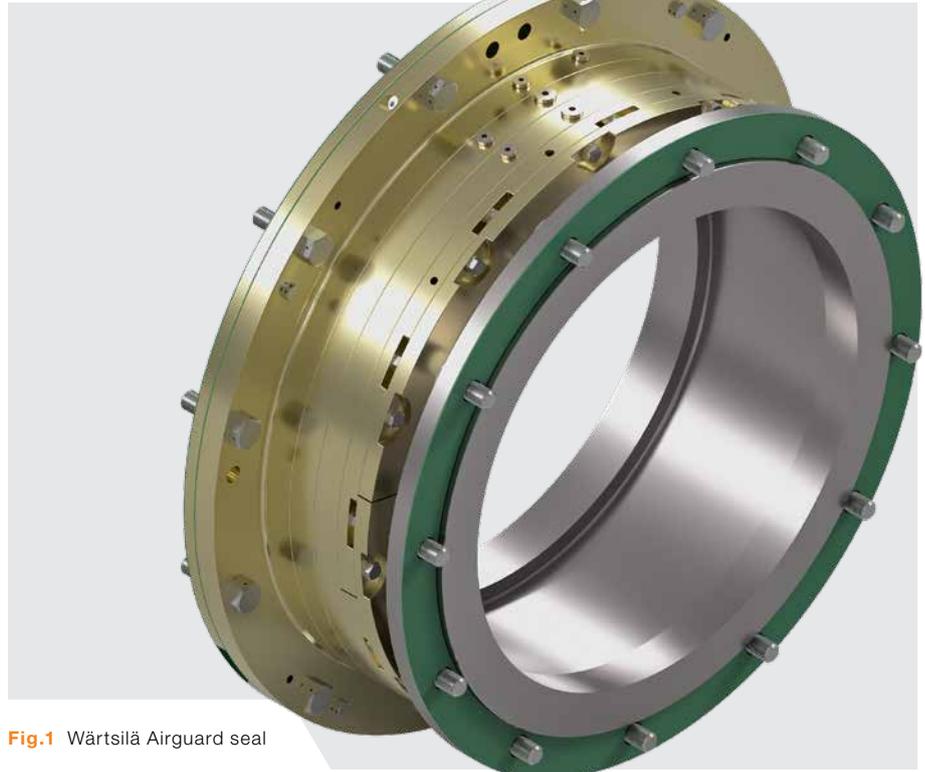


Fig.1 Wärtsilä Airguard seal

This seal has been especially designed for applications that require extra security against the leakage of oil into seawater. The Wärtsilä Airguard has a barrier of air (which is harmless to the environment) that completely separates the stern tube oil from the seawater. It therefore complies with the VGP requirements, as it prevents both seawater ingress inboard and lube oil leakage outboard.

The Wärtsilä Airguard system is designed to be durable, reliable and easy to use. Existing seals that don't comply with the VGP can be upgraded to this system, and existing stern tubes can be retrofitted with the Wärtsilä Airguard.

Product description

— An air chamber is a highly effective way of keeping the oil and seawater separate.

The Wärtsilä Airguard has five key components: the seal rings, the air chamber, the air control unit, the drain collection unit, and the lube oil tank and pump unit.

The seal rings are an integral part of the stern tube seal, which is a multi-barrier, lip-type seal. The seal rings are made of flexible rubber that can adapt to the movement of the shaft whilst ensuring an effective, reliable and long life seal. They are fitted in a seal housing and act against a rotating seal liner fixed to the shaft. They act as an effective seal whenever the pressure on the front side of the seal ring exceeds that on the back. This pressure differential is controlled and maintained throughout by the air control unit.

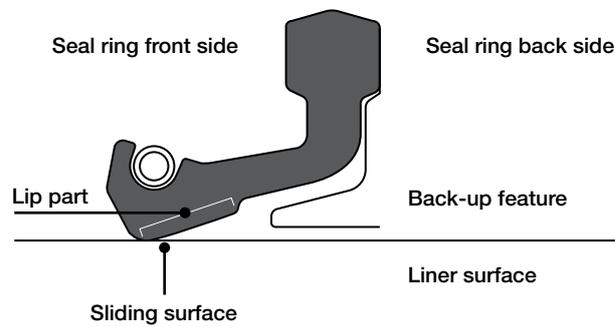


Fig.2 Seal ring



The Wärtsilä Airguard can have either three or four seal rings. It's worth noting that the failure of a seal ring will not lead to the leakage of oil into the sea or the failure of another main component.

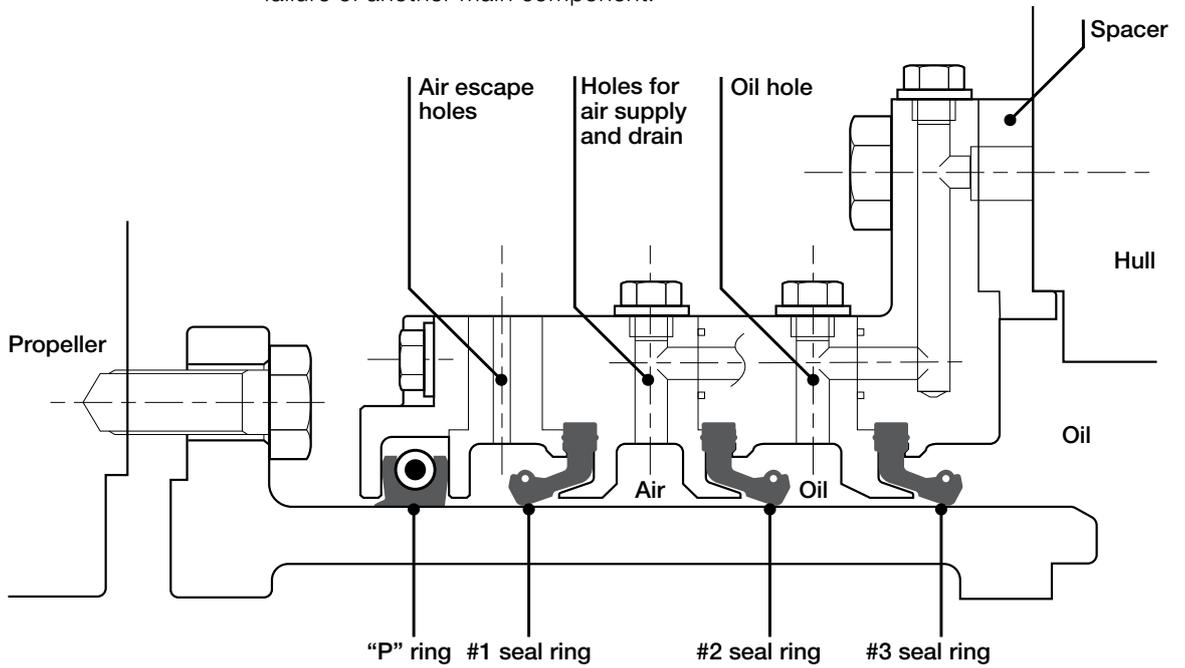


Fig.3 The Wärtsilä Airguard OLS3A-P three-seal assembly

The air chamber or void space between the seal rings is one of the reasons behind the effectiveness of the Wärtsilä Airguard seal. It physically separates the seawater and oil.

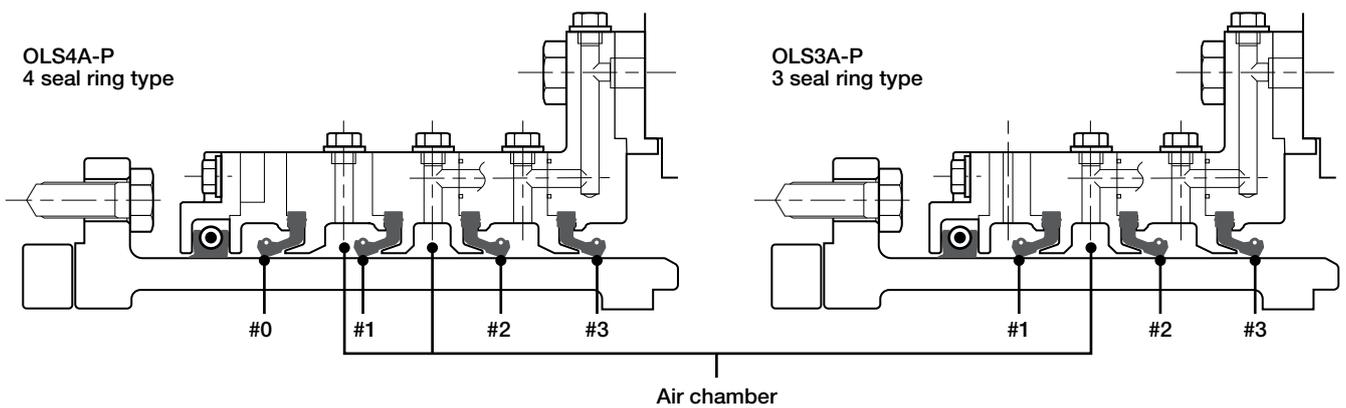


Fig.4 Air chamber separating lube oil and seawater, showing three or four seal ring systems

The air control unit includes air filters, pressure regulators, flow meters, flow controllers, air relays and a pressure switch. The flow controller provides a constant flow of compressed air into the void space between the seal rings at a pressure higher than that of seawater. A small amount of pressurised air is forced out into the seawater through a clearance under the lip of the aft seal ring.

This whole procedure ensures that the air chamber keeps the seawater and lube oil separate. The air control unit has two independent piping lines to ensure redundancy. In contrast with other sealing systems, the Wärtsilä Airguard seal does not require any draft sensors.

The pressurised air is distributed to the aft seal air chamber and the lube oil tank unit, which are linked to enable optimum pressure balancing in the aft seal. The air from the air relay pressurises the oil in the lube oil tank so that the oil between two of the seal rings and the stern tube is at a higher pressure than the air pressure. The pressure difference is dynamically monitored and controlled by the system to ensure that the pressure in the air chamber always remains higher than the fluctuating pressure in the surrounding seawater. This reduces the pressure and load on the seal rings, and minimises wear on the liner.

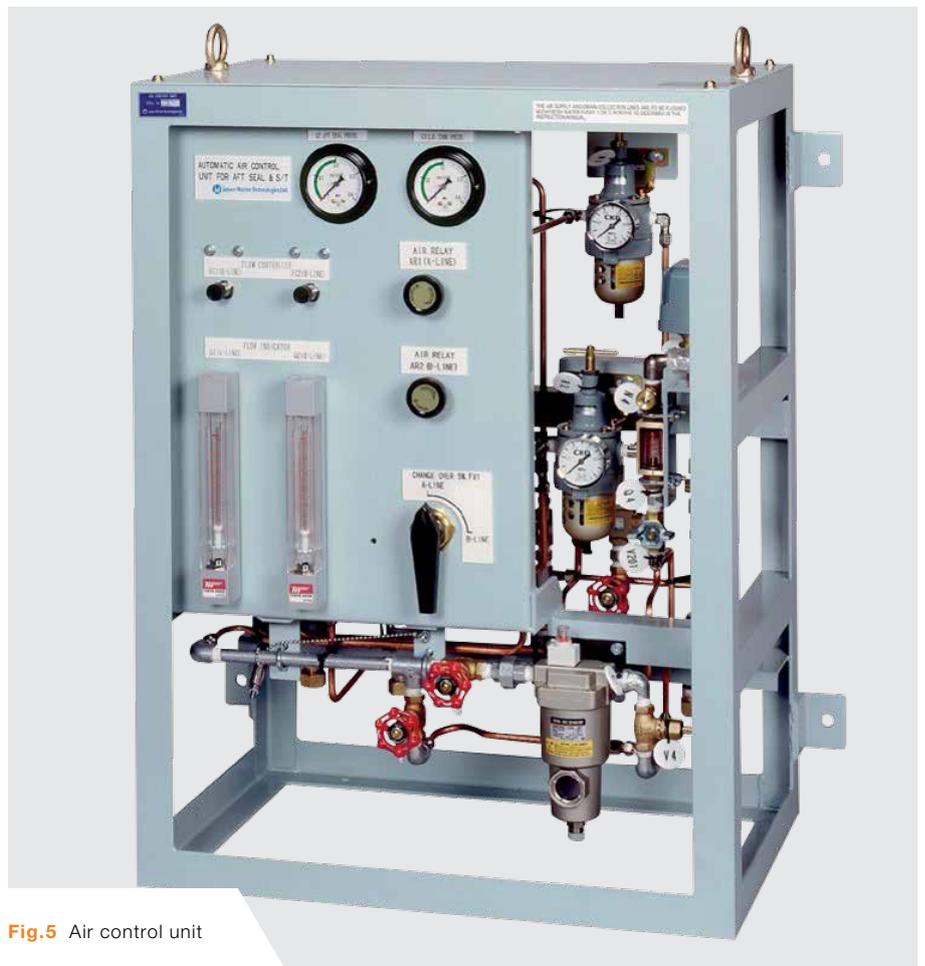


Fig.5 Air control unit



Fig.6 Drain collection unit

The inboard drain collection system is another important component. It includes an automatic drain collector, needle valves and a filter. The drain collection pipe is connected to the bottom of the air chamber. Under normal operating conditions, no oil or seawater will enter the air chamber. However, if it does, the air pressure in the system forces it downwards and out through the drain collection pipe. If the pipe becomes clogged with salt from the seawater, this can easily be flushed out with fresh water.

This system ensures that all leakages will be drained inboard, preventing oil leaking outboard or seawater entering the stern tube. It also means that if a seal ring is damaged, any leakage of oil or seawater will still be safely drained away.



The lube oil tank includes a pressurised tank, a safety valve, a level switch and a sight glass. The oil is piped by the pump unit (which includes oil pumps, oil filters and cooler (option)) and is connected with the stern tube and the oil chamber between the seal rings. The pump unit will change the dual units over in the event of an issue. The pump supplies most of the oil to the stern tube, with the rest going to the oil chamber.

A flow meter confirms the flow to the oil chamber. Pressure gauges periodically measure the air pressures in the air control unit, drain collection unit and lube oil tank, and the oil pressures in the pipeline, to ensure that the system is operating correctly.

In the Wärtsilä Airguard system, only the second seal ring (#2 seal ring) rubs directly on the liner and is lubricated by the oil. The first (#1 seal ring) and third (#3 seal ring) seal rings operate under a floating condition due to the air and oil films. Effectively, the third seal ring acts as a spare second seal ring. In instances where the second seal ring is damaged – the valve to the oil chamber can be closed and the system works using just the first and third rings, providing additional safety and reliability.

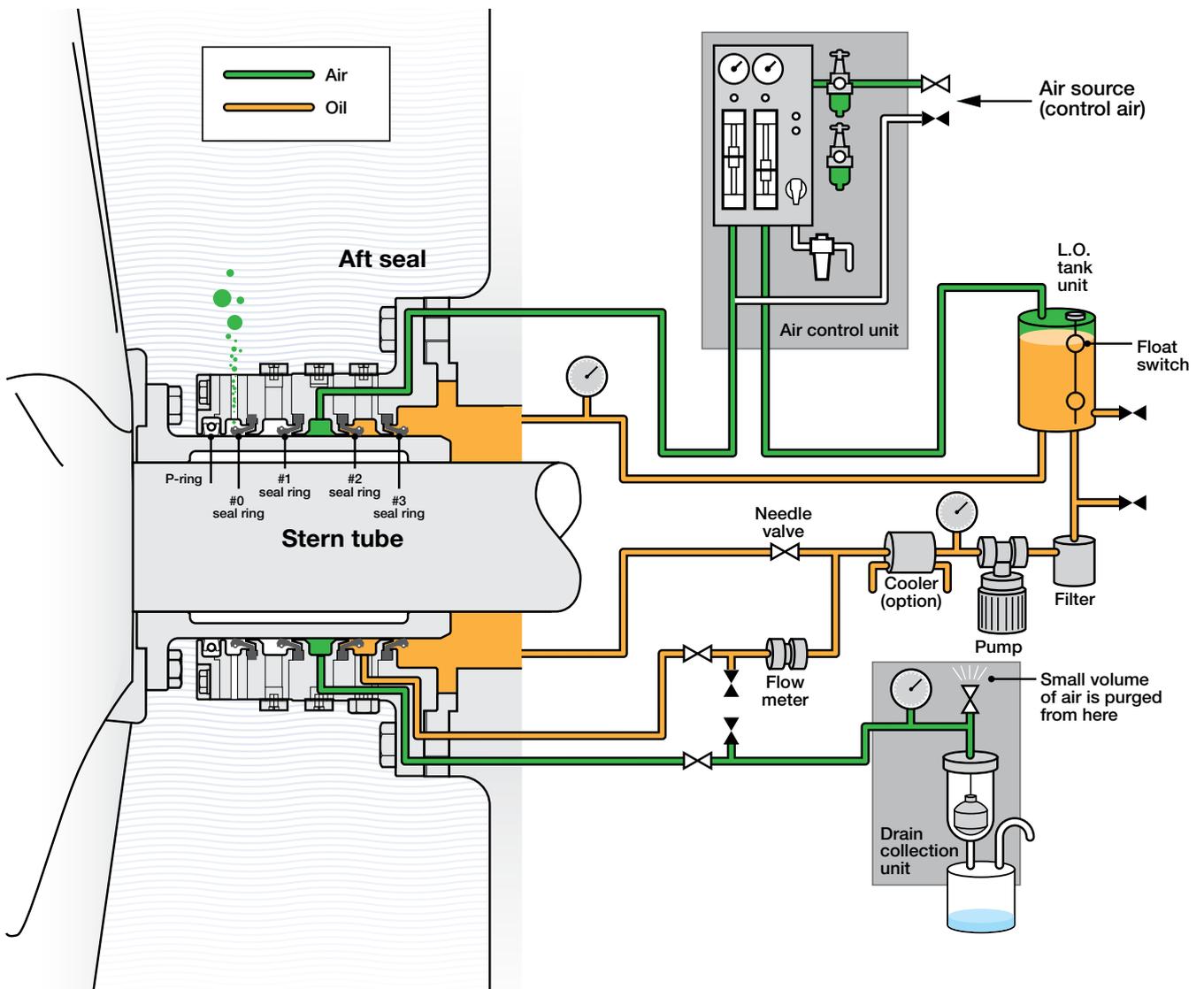


Fig.7 Wärtsilä Airguard system

As an additional safety feature, all Wärtsilä Airguard systems are fitted with a UNET protection device, in the form of a specially designed P-ring that protects the seal ring from being damaged by fishing nets and lines and foreign objects.

Features and benefits

— The Wärtsilä Airguard seal uses high-specification materials and is resistant to wear and corrosion.

The Wärtsilä Airguard seal is the result of years of research and development. It has been engineered to meet customer needs and to provide a smooth installation process. The latest upgrade includes enhancements to the flexibility of the seal installation and the reliability of the assembly.

Pressure balance

The aft stern tube seal contains three or four seal rings running on a seal liner, to prevent grooving of the shaft. In a four seal system, two seal rings face the stern tube towards the oil, providing double security against oil spills. The other two face towards the seawater to provide a seal against seawater and sediments. Because the pressurised air in the void space is constantly controlled and monitored, the system is always pressure-balanced.

Sealing excellence

The Wärtsilä Airguard system uses standard Viton® manufactured seal rings, which provide excellent chemical and thermal stability, and wear resistance. The seal liner is made of a special high nickel chromium steel, which gives optimum wear and corrosion resistance.

Lower operational costs

The Wärtsilä Airguard seal is designed to enable an additional shift of the sealing position on the liner without shaft or propeller removal. The seal can be provided with a double spacer ring option that reduces the operational cost due to a longer liner life and easier seal servicing.

FEATURES	ADVANTAGES	BENEFITS
Continuously pressure balanced.	Reduces load on seal rings.	Extends seal and liner lifetime, reducing operational costs.
Four lip seal arrangement running on chromium steel liner.	Allows extended 5–7.5* year dry docking cycles.	Extended dry docking cycles can reduce operational costs.
Continuous air flow.	Continuous collection of potential oil or water leakages.	Gives an additional level of reliability and operational safety.
Air barrier between oil and seawater.	The vessel can be operated with mineral oil according to the VGP 2013.	Avoids use of costly EALs and oil treatment systems saving operational costs.
Additional standby sealing ring.	This seal ring can be easily activated in the event of oil leakage from the engine room.	Gives an additional level of reliability and operational safety.
UNNET fishing line and net protector included as standard.	Protects efficiently against fishing lines, nets and sediments.	Significantly reduces the risk of seal damages, especially when vessels are operating near the shore or in rivers. This provides increased operational safety and reduced costs.
Balanced, closed oil lubrication and air supply system.	Reduces seal sensitivity for axial and radial shaft movements and hull vibrations.	Reduces oil and water leakages, providing operational cost savings and enhanced safety.
Double spacer option.	Enables additional shift of the sealing position on the liner without shaft or propeller removal.	Reduces operational cost through extended liner life and simplified seal service.

*7.5 years dry-docking cycle is subject to terms and conditions.

Wärtsilä Shaft Line Solutions

Our products provide maximum efficiency with minimum operational risk.

Ship owners are increasingly focusing on improving lifecycle cost management. As a result, the demand for components such as seals and bearings are moving towards higher level, technologically advanced products giving a longer service life that compensates for their initial higher cost.

Wartsila's products and services are designed to provide maximum efficiency whilst minimising operational risks, at the lowest lifecycle cost. We specialise in providing sealing solutions for stern tubes, rudders, bulkheads, waterjets, thrusters, electric pods and special applications. We supply all Original Equipment Manufacturer (OEM) spare parts for Cedervall, Deep Sea Seals (DSS), Japan Marine Technologies (JMT) and Wärtsilä shaft seal and bearing systems.

We also provide complete stern tube packages, including seals and bearings that are all manufactured by Wärtsilä. Our upgrade solutions maximise equipment performance and operational efficiency throughout the installation's life. They bring ageing systems up to today's technical standards so that they meet our customers' requirements.

In addition to our extensive product range, the expertise of our engineers enables us to provide complete, custom-engineered solutions to specific customer needs. Wärtsilä also has a large testing capability with various research and development facilities where validation is required, based in the UK, Spain, China and Japan.



Summary

- The Wärtsilä Airguard seal provides complete protection against the leakage of lube oil and the entry of seawater.

The Wärtsilä Airguard system successfully takes away the oil-to-sea interface and isolates the oil and water from each other. This is due to the air and oil pressures automatically adjusting to changes in the seawater pressure, due to the constant air flow rate and the operation of the aft seal ring. As an extra advantage, the constant, low loading on the seal rings provides a stable environment and increases their expected life.

In summary, the key elements of the Wärtsilä Airguard system are:

- An air chamber that isolates the oil and the seawater.
- Any leakage into the air chamber is drained away.
- The seal rings operate under a stable condition, improving their reliability.
- In the Wärtsilä Airguard seal system, the third seal ring acts as a spare.
- The P-ring protects against any oil leakage due to fishing nets or lines getting wound around the seal.
- Once the oil and air pressures are set up, no manual adjustment is necessary.
- The air consumption by the unit is very small, so there is no need for extra capacity.
- Only one lube oil tank is needed, simplifying the piping required.

Wärtsilä Airguard therefore offers complete protection against the leakage of lube oil outboard or the ingress of seawater inboard. The system complies fully with the specifications of the 2013 Vessel General Permit and can be safely operated with mineral oil. It forms an integral part of Wärtsilä's wider commitment to maintaining the marine environment by developing more sustainable shipping strategies.

With over 180 years of engineering excellence, Wärtsilä is a global leader in advanced technologies and complete lifecycle solutions within the marine and energy markets. Wärtsilä Shaft Line Solutions is committed to providing products and services that deliver minimal downtime and increased longevity and reliability. We help to ensure that ship owners can comply with new rules and new environmental legislation.



An industry leader in shaft line components Wärtsilä Shaft Line Solutions delivers a portfolio of end-to-end services and integrated solutions for the marine markets that builds on our core values: lifecycle efficiency, risk reduction, environmental leadership and design excellence. As an original equipment manufacturer operating in 75 countries, we have the capabilities to support customers on a global scale, and remain committed to providing in-country and round-the-clock expertise.

[wartsila.com/shaft-line-solutions](https://www.wartsila.com/shaft-line-solutions)

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