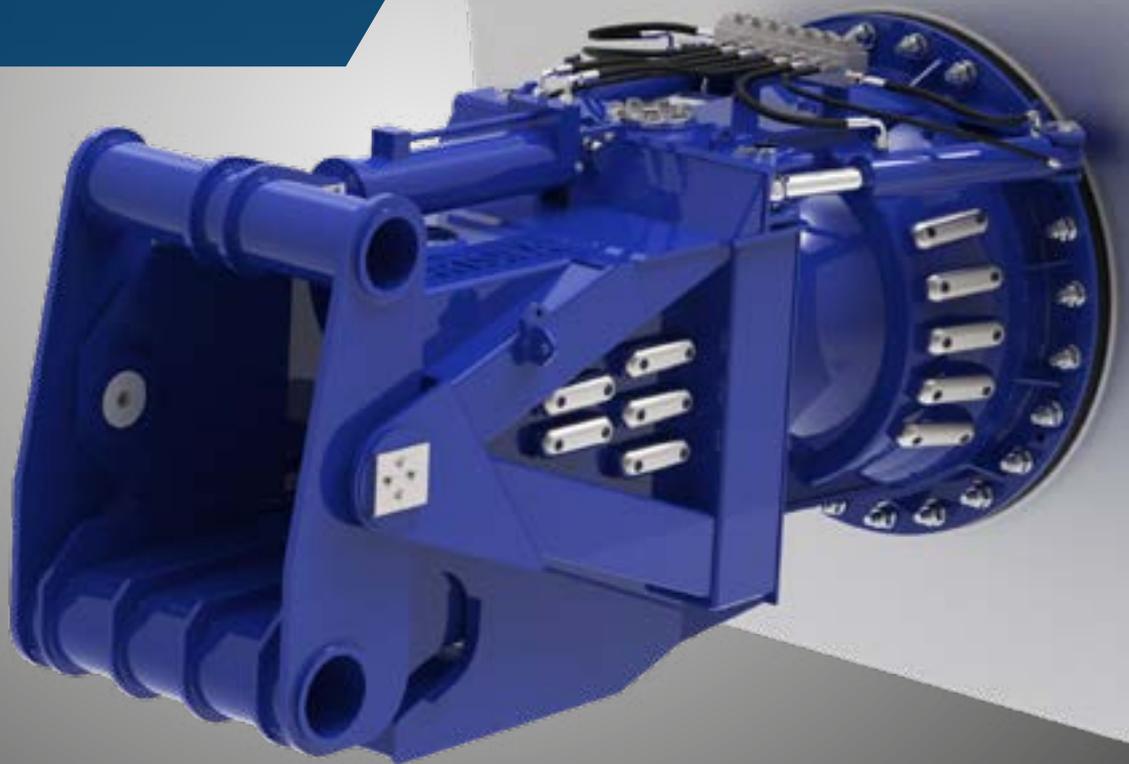


Wärtsilä Waterjets

Jet powered efficiency
and reliability



Midsized and
Modular Solutions



Image courtesy of Incat Australia

Incat Australia 99 m high speed catamaran – HSC Francisco is owned by Argentine-Uruguayan ferry company Buquebus and is operating between Buenos Aires and Montevideo. The ship that accommodates 1,000 passengers and 150 cars is currently the fastest ship in the world (56 knots!)

- 2 x LJX1720SR waterjets

Wärtsilä Waterjets

When deciding on the right waterjet solution there are many variables to consider – from size, weight and power to efficiency, reliability, support and ease of integration. All of this can make it a complicate process, but it doesn't have to be. At Wärtsilä we have been delivering waterjet solutions that meet customer needs and all these variables for over 40 years. At the heart of this is our Smart Marine Vision, where collaboration and the most advanced digital technology come together to deliver solutions with greater efficiency, safety, security and reduced environmental impact throughout the life of the asset.

Wärtsilä waterjets have been developed in line with the latest operating demands for Fast ferries, Littoral combat ships, Fast patrol boats, Rescue vessels, Fast yachts, Fast supply vessels, workboats and Landing crafts. The aim, as with all Wärtsilä products and solutions, is to ensure optimal efficiency, excellent hydrodynamic performance, and less maintenance. With two alternative options, and ranging from 500 to 30,000 kW, Wärtsilä waterjets enable vessels to meet and exceed the performance levels required for today's competitive operating environment.



Image courtesy of OCEA

OCEA France 35 m Multipurpose Fast Patrol boat – P314
Kuwait Coast Guard

- 2 x LJ65E waterjets



Image courtesy of Austal USA

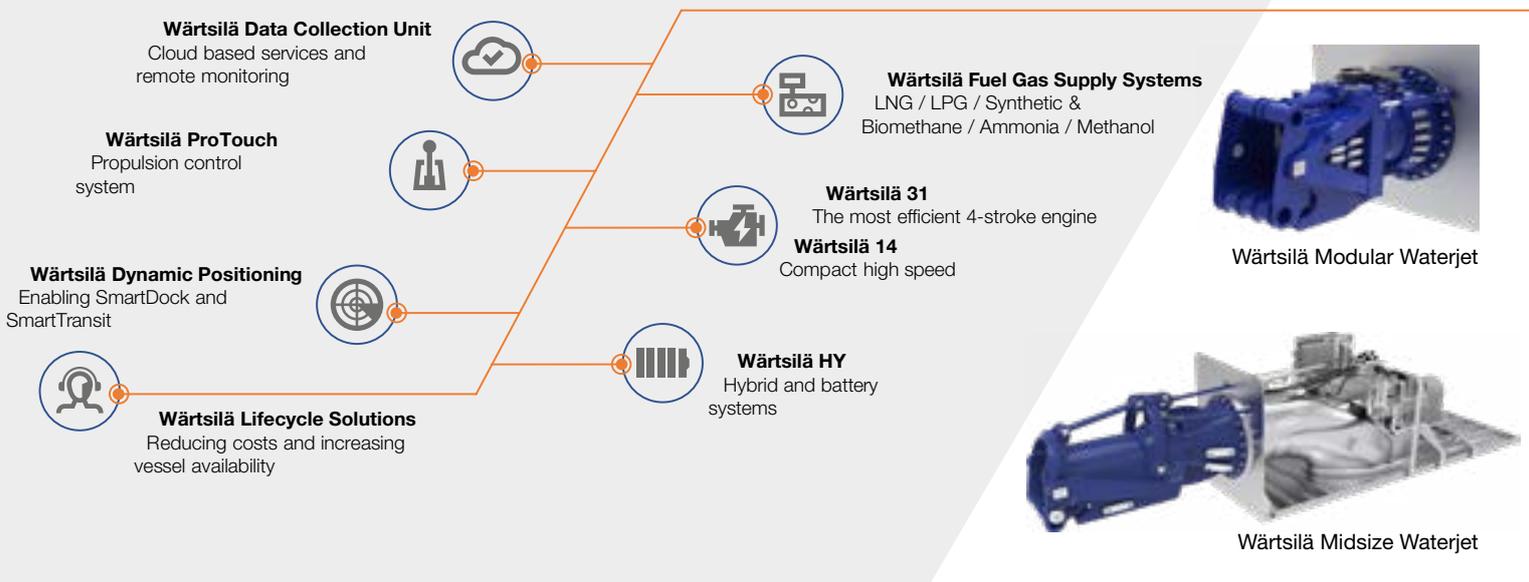
Austal USA 127 m LCS – The Independence class is a class of littoral combat ships built for the United States Navy.

- 2 x WLD1720 waterjets
- 2 x WLD1500 waterjets

Waterjets are typically suitable for:

- **High-speed vessels.** Waterjets have better propulsion efficiency at ship speeds above 25-30 knots.
- **Shallow draft vessels.** With no underwater appendages and small radial dimensions of the impeller, axial waterjets are well suited for rescue vessels, inshore passenger ferries, landing crafts and special workboats.
- **High power density.** Because of the pressure build up in the waterjet inlet, the physical dimensions are minimised.
- **High level of manoeuvrability.** Waterjets have integrated steering and reversing capabilities with fast response

Integrated waterjet solutions



Midsized and Modular Waterjets
Wärtsilä offers two main waterjet executions: a pre-assembled (midsized) range, and a modular jet range. The pre-assembled midsized waterjets consist of a skid, with an integrated inlet duct, that allows for installation directly onto the ship's hull. All auxiliary systems, such as the hydraulics and coolers, are pre-mounted on the assembly and the piping connections are installed. These units are available in five sizes up to approx. 4500 kW.

For the large waterjets, the design of the inlet duct is optimised to fit the specific vessel requirements. Because of its size, the waterjet inlet is part of the ship construction. Our design capability for these larger waterjets includes units of up to 50 MW.

Seamless integration

Wärtsilä waterjet solutions are flexible and capable of being integrated with the systems you select. However, when integrated with other Wärtsilä

systems you are also gaining the experience and capabilities from across our portfolio of solutions. This integration allows all of the elements to work together seamlessly, from gas systems, engines and waterjets to data analytics, control systems and smart docking. This integration will offer added operational efficiency and savings with the ability to optimise operations to increase vessel utilisation, reduce costs and support your crew.

” We have Wärtsilä waterjets on several of our fast ferries, so we are familiar with the quality and performance they deliver. We are also familiar with the Wärtsilä 31 engine, which is really in a class of its own in regards to efficiency,

Flemming Kristensen, Technical Director, Molslinjen.



Integrated Wärtsilä 31 engines, WXJ1500SRI waterjets, and ProTouch powering the Express 5 Molslinjen high-speed ferry delivering optimised lifecycle reliability. Length 115 m.

Image courtesy of Austal Ships Pty Ltd

Technological leadership

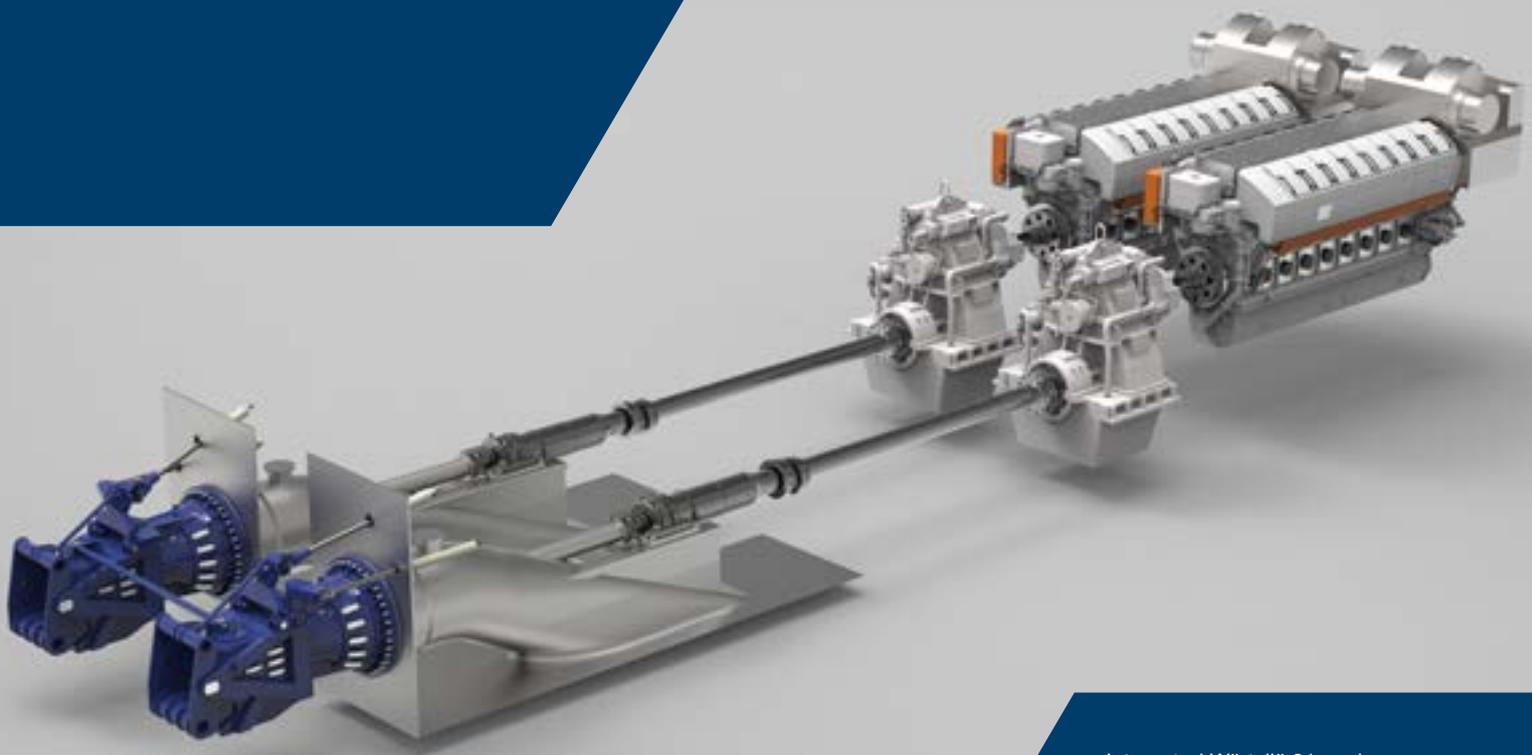
Wärtsilä strives to continuously improve its products by significantly investing in research and development. For our waterjets portfolio, the extensive research programme focuses on fine-tuning our pump technology. This has resulted in greater efficiency, less cavitation (minimising noise and vibration), a reduced environmental impact, lowest size to weight ratio in the market and an optimised maintenance requirement.

Leading hydrodynamic expertise

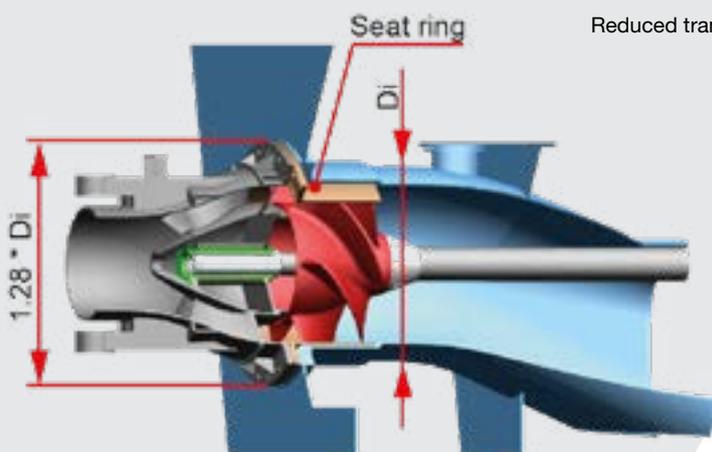
Wärtsilä Marine Solutions has the latest and most modern hydrodynamic tools, as well as extensive in-house experience and know-how. This has enabled us to design and optimise propulsion systems that meet the most stringent requirements of modern shipping. By analysing the vessel's sailing pattern and incorporating the results into the propulsion unit design, Wärtsilä enables owners to maximize their vessels efficiency, while at the same time minimizing both fuel consumption and the environmental

footprint. With more than 25 years experience in advanced numerical flow (CFD) simulations, we can determine the performance of the vessel's propulsion in full scale and at an early phase.

The waterjets are equipped with high performance pump impellers, designed for high power density and good cavitation performance. For each vessel, a dedicated inlet duct design is determined. This allows the vessel's operational profile to be aligned with the optimum waterjet working point. With an optimised inlet design the cavitation, and therefore the vibration levels, are minimised.

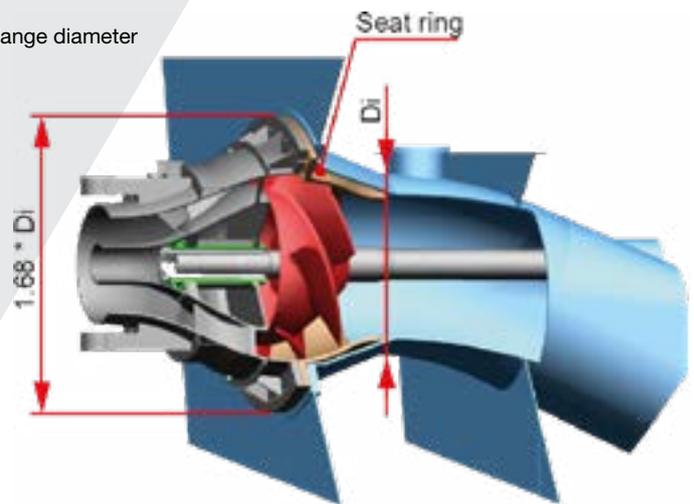


Integrated Wärtsilä 31 engines, gears, shaft and WXJ1500SRI waterjets



Axial waterjet

Reduced transom flange diameter



Mixed flow waterjet

Axial jet technology with mixed flow properties

Wärtsilä axial waterjets are single stage, compact, high performance systems that combine mixed flow properties with an axial construction. This results in much less space being needed on the vessel's transom, and greatly increased waterjet cavitation margins for optimum vessel operational flexibility.

The reduced transom space requirement is achieved without reducing the inlet duct diameter or the size of the waterjet pump in order to maintain maximum efficiency for the lowest fuel burn. For naval

architects, the axial jet technology creates the possibility to apply a larger power density onto narrower hulls in order to achieve top vessel performance.

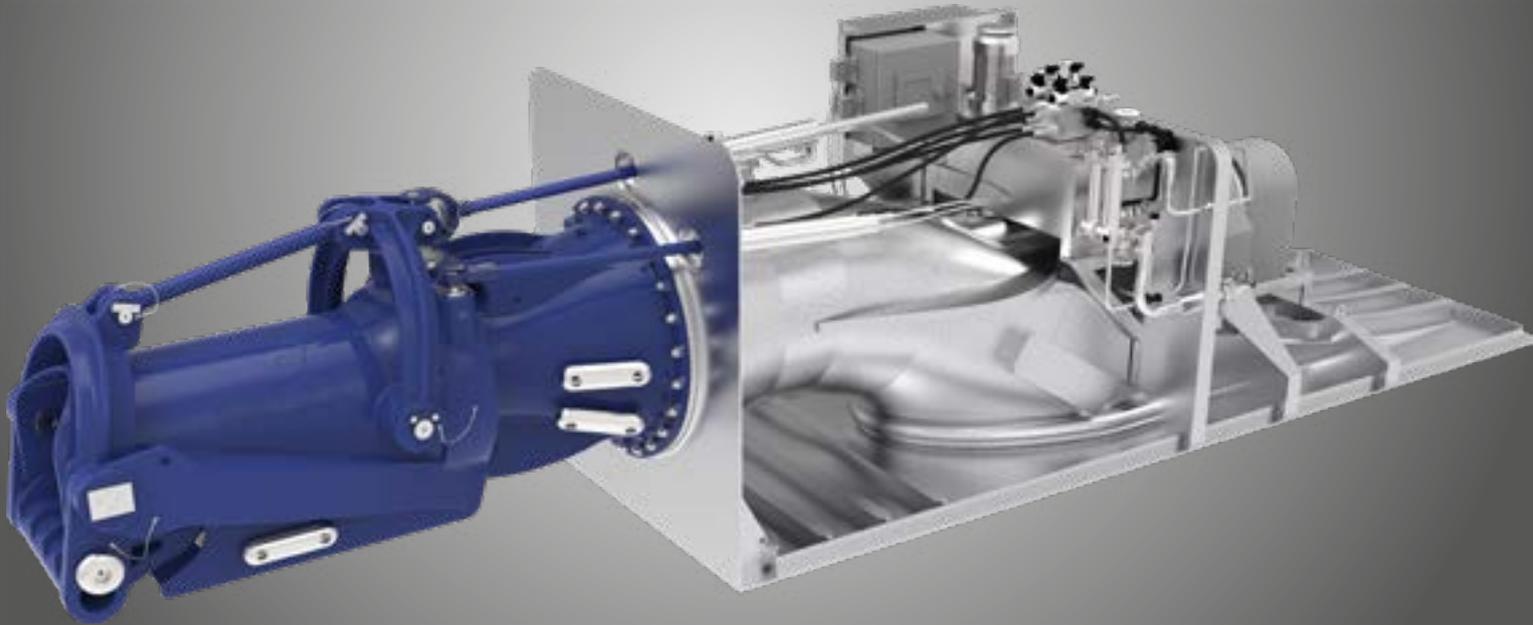
Average 25% reduced transom occupancy. Unlike a non-axial design, the Wärtsilä axial design waterjet does not expand in a radial direction downstream. As the water flow is directed through the pump along the most efficient path, it is easier to fit the jet to the available transom space.

On average 15% less weight. The reduced transom size also decreases the weight of the

installation significantly. These weight optimisations and savings can be as high as 20% compared to non-axial jet designs.

Improved operating flexibility and manoeuvring. Thanks to the increased pump cavitation margin of 35% and the lower impeller tip speed, more power can be introduced to the pump during manoeuvring. This results in a 15% higher manoeuvring thrust and faster response to acceleration. The operating flexibility is improved because of the combination of the reduced number of shaft lines and the higher loads of the remaining engines.

Large-size quality in a pre-assembled plug-and-play package. The midsize waterjet is the most complete waterjet package available in the market.



Midsized waterjet

For engine powers of up to 4500 kW, Wärtsilä has developed a compact, lightweight and easy to install waterjet package. To reduce shipyard installation work and costs, the waterjet is pre-assembled on a skid for direct 'weld-in' or 'bolt-in' connection to the hull. The driveline of the jet is aligned and all auxiliary systems are mounted on the skid, complete with all piping connections.

- A compactly designed axial pump with excellent efficiency, cavitation, and noise characteristics.
- The waterjet unit is completely pre-assembled, thereby reducing installation and commissioning time.
- High performance components in stainless steel to prevent wear and corrosion.
- The water lubricated bearing in the stator bowl provides an environmentally friendly solution.
- Water lubricated face type stern tube seal with an optional inflatable emergency seal.

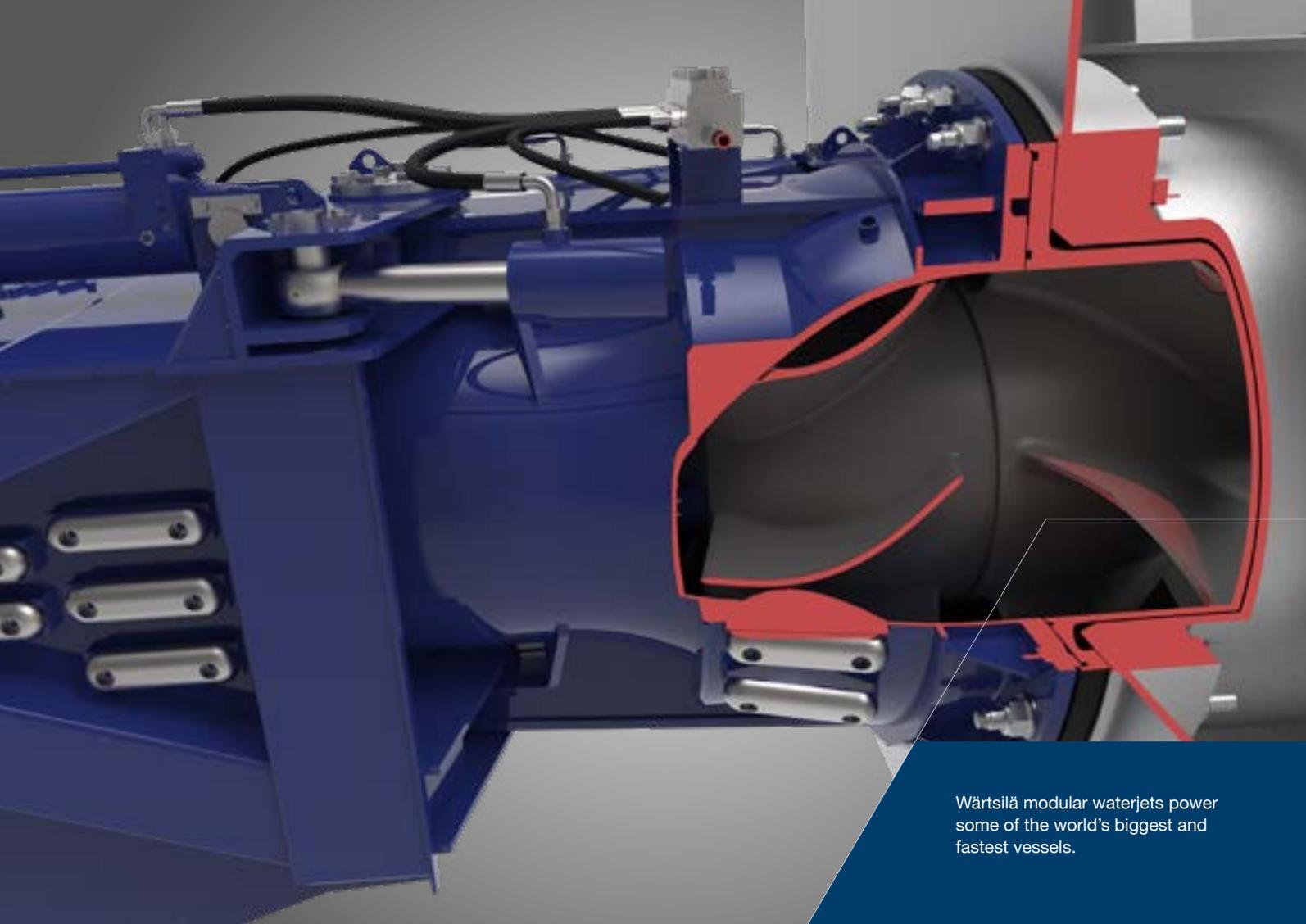


Image courtesy of Millenium Superyachts

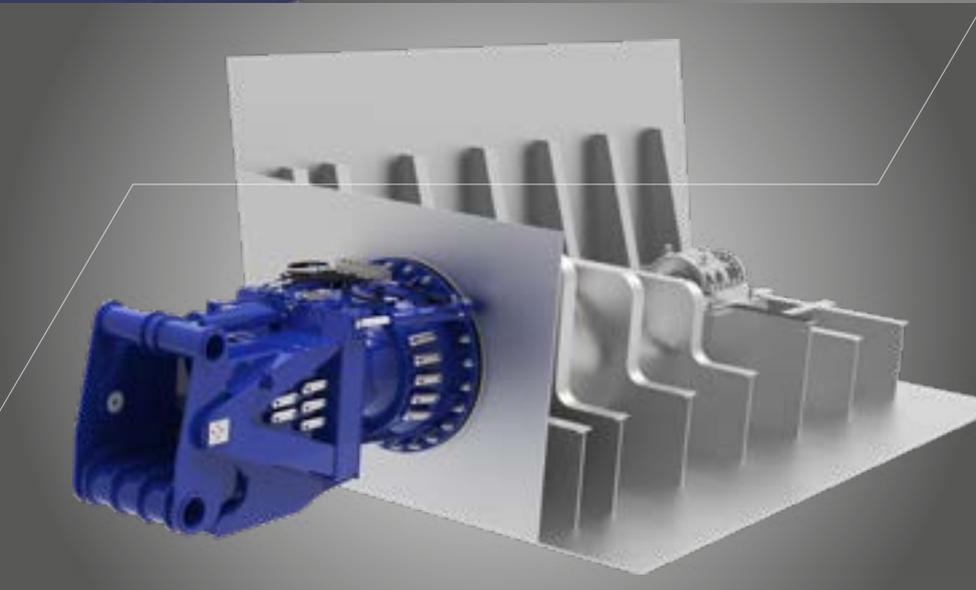
- Inboard mounted thrust bearing block, for increased life and easy maintenance.
- Inboard hydraulics provide an environmental friendly solution, increased life, and cost saving easy maintenance.
- Machinery controls integrated within the unit.
- Reduction of total costs of ownership

The fastest yacht in the world.
70 knots top speed powered
by Wärtsilä waterjets.
Length 42 m.

■ 2 x LJ77E 2x LJ84E



Wärtsilä modular waterjets power some of the world's biggest and fastest vessels.



compared to its predecessor, the “LJ type” with a mixed flow pump design, while the small transom interface dimensions, and best in class weight are unchanged.

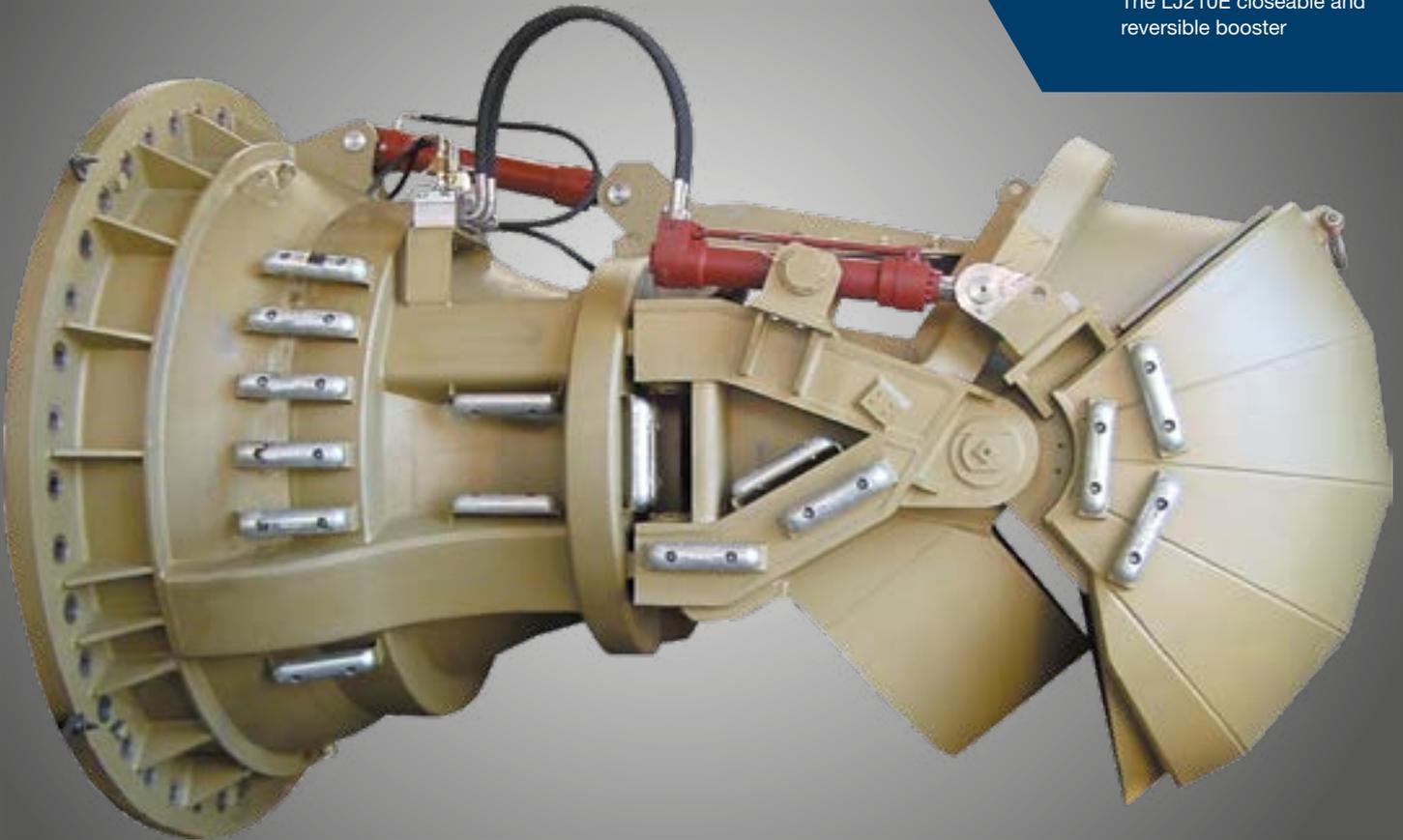
- Lowest size to weight ratio in the market
- Axial pump design means less space on the transom
- Worldwide availability, including China, Japan, Korea, etc.
- Inboard mounted thrust bearing block, for increased life and easy maintenance
- Optional inboard hydraulics
- High-performance components in Duplex stainless steel to prevent wear and corrosion
- Impeller tip clearance guaranteed due to axial shape and no risk of impeller housing collisions.
- Customisable to meet your needs
- Fully integrated solutions available

Modular waterjet

The Wärtsilä WXJ modular waterjets represent the state-of-the-art in this field, delivering outstanding benefits and performance and offering a high level of customisation with a wide variety of options available depending on the vessel type.

The Wärtsilä WXJ series features an improved axial pump design,

which boosts performance with an increased thrust of as much as 3 percent, while the improved cavitation margins help reduce the environmental impact by lowering noise levels. This axial pump design comes with a 25% reduction in mounting flange diameter, 10% overall weight reduction and a 35% increase in cavitation margin



Special waterjet designs

Special applications can, and have been, developed by Wärtsilä's dedicated and experienced waterjet engineering team together with other R&D departments. Some examples:

Waterjet and propeller combination

When a mix of operational parameters needs to be addressed, such as the requirement to achieve a high top speed, and at the same time have a moderate cruising speed combined with long range capability, Wärtsilä developed the hybrid "Waterjet And Refined Propeller System".

In this unique WARP system, a waterjet is combined with two (controllable pitch) propellers. By combining both propulsion technologies, most of the total installed vessel power is absorbed by the waterjet. With the waterjet taking the majority of the total vessel power, the propellers can remain small in diameter while at the same time reducing the draft of the vessel. The propellers are fully optimised for lower cruising speeds, delivering optimum



The LJ90DT 360 degrees azimuthing waterjet

efficiency with low noise and vibration levels. The result is a very attractive propulsion solution that allows for an efficient low and high-speed operational profile.

360° DT Waterjet

The LJ 90 DT azimuth waterjet is a special design that has been developed to provide 360 degrees thrust without extending below the bottom of the ship at maximum efficiency. It is in use on more than 60 Navy vessels specially designed to

offload equipment to any shore.

The waterjet thruster delivery consists of a pre-assembled module, which is welded into the hull structure.

Closeable and reversible booster

To meet specific operational profile demands of a vessel, a reversing system combined with an inlet closing system has been designed for a size LJ210E waterjet.

Wärtsilä Propulsion Control System and Automation

The components of the Wärtsilä Propulsion Control System (PCS) can be combined into configurations suitable for a wide range of applications and meets the requirements of high-speed vessel operators with a choice of lever controls, joystick plus touch screens for ease of use and ultimate vessel and waterjet control.

With the capability to control various numbers of waterjets from a number of operator stations, the Wärtsilä PCS seamlessly integrates with Wärtsilä dynamic positioning (all levels available) and Wärtsilä **SmartMove** Suite. The suite brings together tools using automation capabilities to assist the crew with challenging waterjet maneuvers such as harbor entering, docking, or quay-to-quay transit. Advanced motion prediction provides the operator with a complete overview and full control over each vessel's movement **enhancing situational awareness and improving the safety of operations.**

SmartDock is the world's first market-ready step towards realising the full potential of vessel autonomy through the provision of docking sensors, dynamic positioning and automation technology for seamless, hands-off mooring operation. SmartDock utilises the Wärtsilä DP system Control Processor (CP) which has the required building blocks including – sensor processing, guidance and control



Dynamic Positioning - Working in conjunction with Shell Oil, Wärtsilä DP (as Honeywell) developed the very first DP systems ever constructed used for the Cuss 1 in 1961.



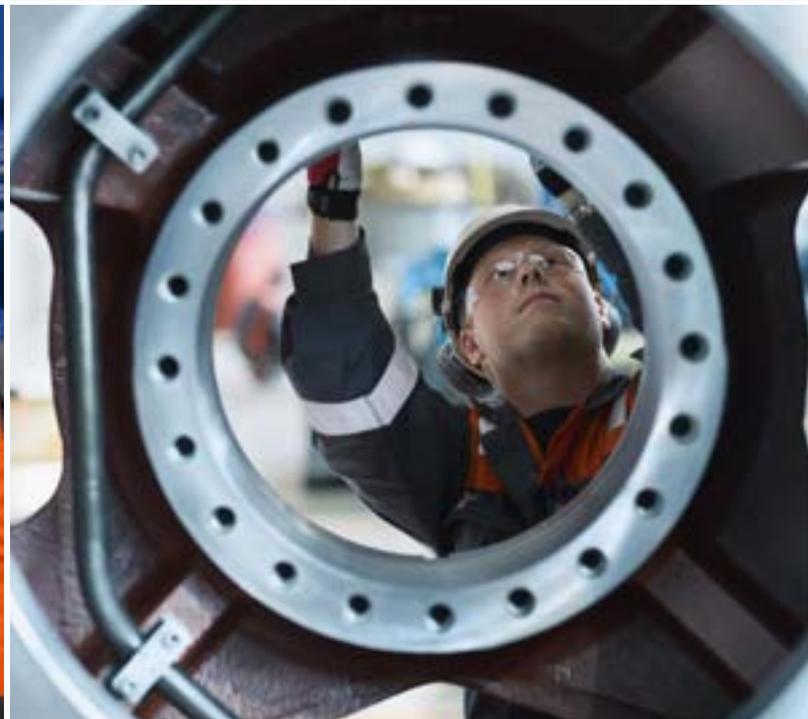
Wärtsilä SmartDock

logic, waterjet allocation, track follow capability.

SmartTransit builds on the autonomous vessel concept to connect the endpoints of SmartDock capabilities. This provides true “dock-

to-dock” automation. In the future the system can be combined with our advanced navigation systems and sensors to provide collision detection, optimised route planning and to deliver enhanced transit capabilities.





Services

Throughout the lifecycle of the vessel, Wärtsilä is there to support and assist. Wärtsilä continuously broadens its range of services in order to provide support for the equipment on board your vessel. Our extensive global support includes numerous workshops plus a well established distributor and agent network – delivering the support you need where you need it. Our services cover everything

from basic support with parts, field service, and technical support (also online), to service agreements, upgrades and conversions, and condition based maintenance.

Wärtsilä adds value to your business at every stage in the lifecycle of your installations. With us as your service partner, you receive many measurable benefits such as availability and performance, productivity gains, and cost benefits.

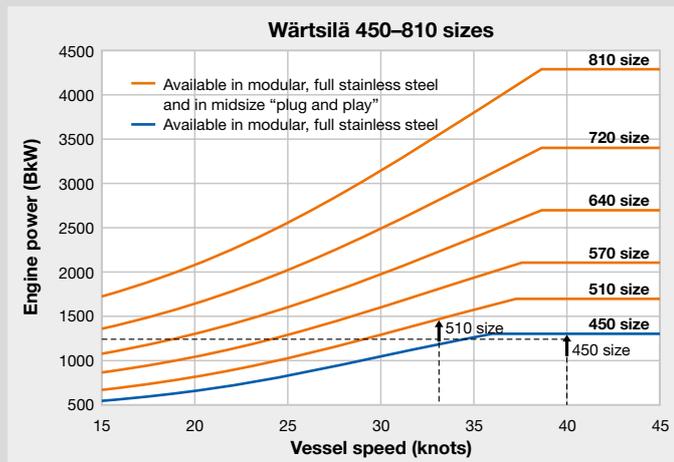
Above all, you get peace of mind in the knowledge that the most experienced partner you could have – Wärtsilä, is servicing your installation.

Waterjet size selection

The graphs indicate the jet size required based on the relation between the engine power and the design speed of the vessel. For instance, a ship with four 1250 kW engines and a corresponding vessel speed of 33 knots will need four 510 midsize waterjets. A ship with a design speed of 40 knots at 1250 kW power can use 450 size waterjets. The correct jet size is thus indicated by the line above the intersection of the power and the corresponding vessel speed.

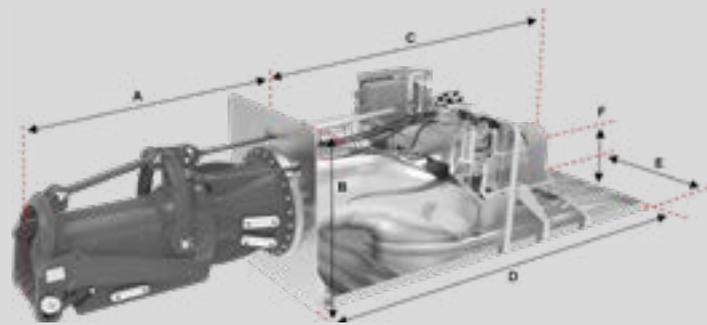
Please contact our global waterjets team for an optimized jet selection based on specific vessel design parameters and operating profile, or for details on waterjets above 50 knots or 30 000 kW. DXF/DWG format general arrangement drawings of the most often used sizes are available.

Midsize waterjet selection

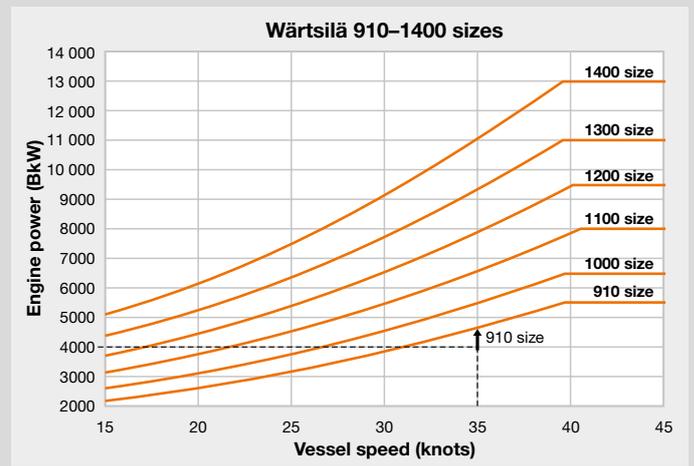


Weight & dimensions table

Size	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Weight steering (kg)	Weight booster (kg)	Entrained water (l)
510	1 540	1 065	2 350	2 975	1 100	510	1 400	1 050	450
570	1 730	1 190	2 520	3 325	1 200	570	1 750	1 300	600
640	1 930	1 335	2 720	3 735	1 400	640	2 400	1 800	850
720	2 170	1 500	3 000	4 200	1 400	720	2 850	2 250	1 250
810	2 440	1 690	3 220	4 725	1 400	810	3 600	3 000	1 750

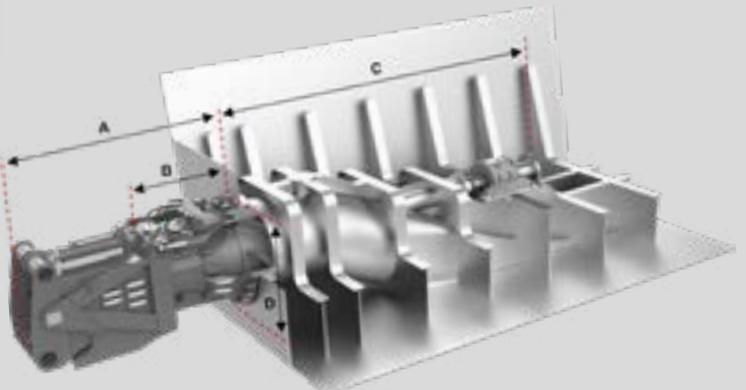


Modular waterjet selection



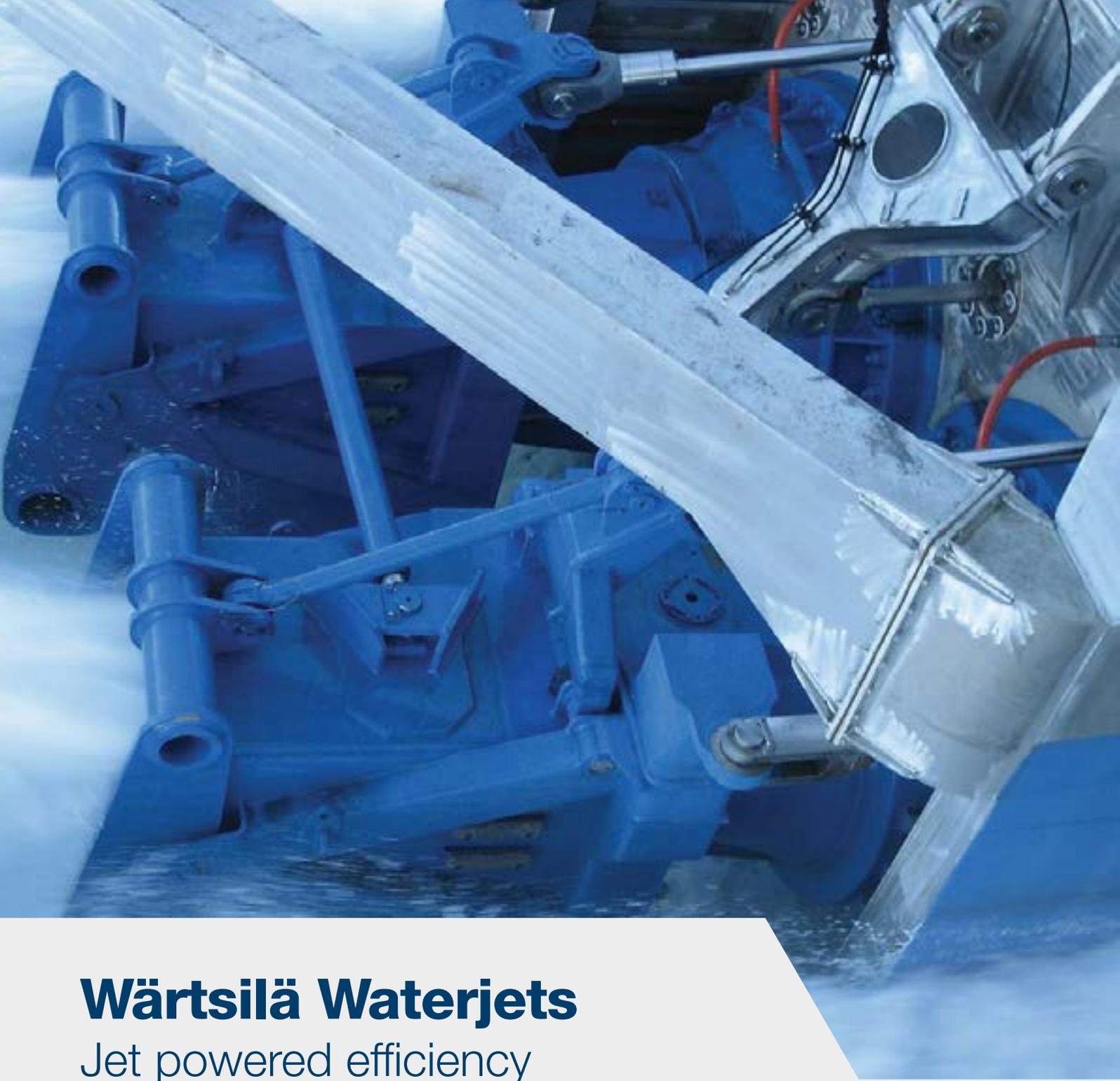
Weight and dimension table

Size	A (mm)	B (mm)	C (mm)	D (mm)	Weight Steerable (kg)	Weight Booster (kg)
510	1500	610	2510	655	750	550
570	1650	650	2790	730	1050	750
640	1860	730	3040	820	1450	1150
720	2040	790	3360	920	2050	1450
810	2310	900	3670	1035	2850	1950
910	2560	980	4110	1165	4150	2550
1000	2800	1060	4420	1280	5150	3450
1100	3040	1130	4770	1405	6700	4300
1200	3320	1230	5230	1535	8600	5750
1300	3580	1330	5590	1665	10950	7100
1400	3870	1450	5940	1790	13150	8200
1500	4120	1520	6430	1920	15900	10100
1620	4470	1650	6860	2075	20400	12650
1720	4770	1780	7270	2200	21500	15300
1880	5200	1930	7840	2405	31450	18900
2020	5550	2140	8320	2585	36150	23400
2180	6000	2300	8880	2790	43900	29100
2350	6440	2470	9460	3005	53000	34000



More information

More detailed (engineering) information about Wärtsilä's two waterjet series and Propulsion Control Systems can be found in the product guides, available from our website www.wartsila.com waterjets@wartsila.com



Wärtsilä Waterjets

Jet powered efficiency
and reliability

Wärtsilä is a global leader in smart technologies and complete lifecycle solutions for the marine and energy markets. By emphasising sustainable innovation, total efficiency and data analytics, Wärtsilä maximises the environmental and economic performance of the vessels and power plants of its customers.

[wartsila.com](https://www.wartsila.com)

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