

The intelligent propulsion system for safe shipping Voith Schneider Propeller





**50 million years of evolution
made the dolphin a unique
mammal**

More than 80 years of continuous development made the Voith Schneider Propeller a unique and intelligent propulsion system

All over the world, the Voith Schneider Propeller (VSP) is the epitome of precise and reliable maneuvering, even in dangerous situations. Its stepless, exact and fast variation of thrust, both in magnitude as well as in direction, results in maximum vessel maneuverability and flexibility. The development of the Voith Schneider Propeller was modeled upon nature: Its principle displays astonishing parallels to the movement of a dolphin's tail fin. During their rotation, the VSP blades generate thrust based on the principle of hydrodynamic lift.

Thrust generation is very similar to that employed by a dolphin. The profile shape of a dolphin's tail fin is virtually identical to that of a Voith Schneider Propeller blade and the profile path through the water is also comparable. The fascinating functional principle of the Voith Schneider Propeller has remained constant for more than 80 years. Its technical implementation however, has been constantly developed ever since.

Voith Schneider Propeller type 36



Due to their high tail fin efficiency, dolphins are able to carry out fast and precise changes of direction



The flexible Voith Schneider
Propeller control concept helps
to safely transport all cargo to
its destination



Safe

In today's world, ship assistance has turned into an important link between ground and sea transport. Ever-increasing vessel dimensions have resulted in Voith Water Tractors with Voith Schneider Propeller being a decisive safety factor in shipping. They safely master the increase in hazardous goods transport volume as well as the operation in what are often confined waters. In addition, the robust design of the VSP and its functional principle offer maximum protection against ice and driftage.

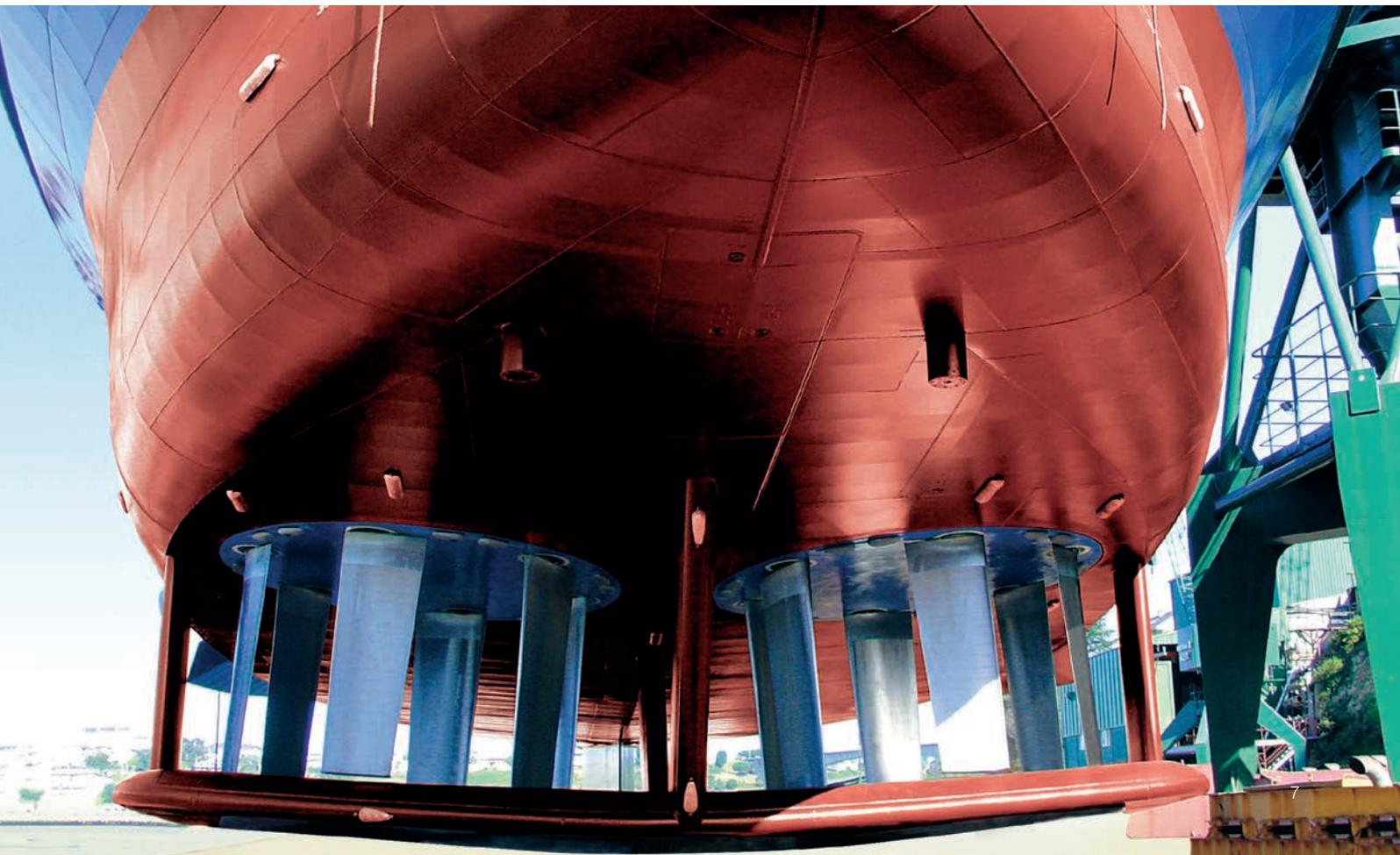
The division into propulsion thrust and steering forces, i.e. steering according to Cartesian coordinates, makes vessel handling an easily understood user-friendly and safe process. thanks to the unique Voith Schneider Propeller technology, thrust variation is a matter of seconds only. The maneuver required is initiated directly and without time lag. This allows the captain to react immediately and maneuver his vessel intuitively; fast and precise even in dangerous situations.

In addition to its use in ship handling and escorting, the VSP is also a byword for safety in completely different applications – be it passenger or cargo transportation, rescuing, oil-spill control or offshore work. Our best proof: More than 860 Voith Water Tractors with VSP are now in operation in over 145 ports throughout the world. Classification as “Best Available Technology” (BAT) by the Alaskan environmental authority confirms the efficiency and safety of the Voith Schneider Propeller.

The Voith Schneider Propeller can always be relied upon

The functional principle of the Voith Schneider Propeller protects it from damage by foreign objects. The propulsion system generates thrust by means of blades rotating around a vertical axis. Objects in the water are thus deflected to the outside without damaging the VSP. And thanks to its particularly robust blade design, the VSP is less vulnerable to damage caused by a collision with driftage or ice than other propulsion systems are.

Another proof of the safety of the Voith Schneider Propeller is its extremely short steering time. Thrust changes from hard port to hard starboard or from full ahead to full astern are possible within 3 to 5 seconds, thereby ensuring extremely short stoppage distances. This is of vital importance in unexpected situations of danger to swiftly and effectively avoid potential collision.



**With the precise use of its tail fin,
a dolphin can “walk on water”**



With the Voith Schneider Propeller, positions can be maintained precisely in all applications



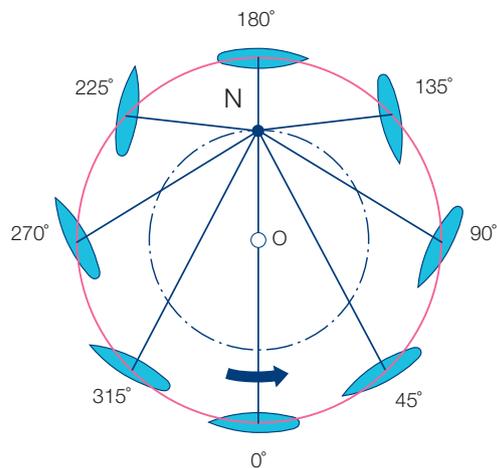
Precise

The Voith Schneider Propeller is perfectly suited to all applications requiring precise steering – e.g. when every second counts during firefighting duties at sea. Vessels with VSP precisely assume the desired position and maintain it – no matter how heavy the wind and how strong the current.

The VSP is the precise propulsion system for shipping. With its unique functional principle, it is the system of choice wherever stepless, exact and fast steering is imperative. The reason: The Voith Schneider Propeller's kinematic principle. Its blades move along a circular path while at the same time performing a superimposed oscillating motion. Thrust is set via the amplitude of this oscillating motion. As the individual

blades of the Voith Schneider Propeller travel along a cycloidal path, the VSP is also referred to as cycloidal propeller. The two variables magnitude and direction of thrust are controlled via the hydraulically actuated kinematics with minimum energy expenditure. The magnitude of thrust varies with the pitch, not with the rpm, thereby ensuring the precise maneuvering of vessels with VSP.

Voith Schneider Propeller kinematics



It maneuvers you through any bottleneck

Vessels with VSP maintain their position with maximum accuracy. During dynamic positioning, the short reaction times of the Voith Schneider Propeller allow unparalleled precision even in adverse weather conditions. This characteristic is vital not just for platform supply vessels (PSV) or firefighting boats, but also for diving support vessels, offshore construction vessels and many other vessel types operating offshore, for vessels used for research and installation work as well as for ferries and passenger ships. With its outstanding precision and dynamics, the VSP meets these demands as reliably and safely as it does complicated maneuvering requirements in confined harbors.





Its tail fin makes the dolphin one of the most agile animals in the water



Its blades make the Voith Schneider Propeller the most maneuverable propulsion system in the world

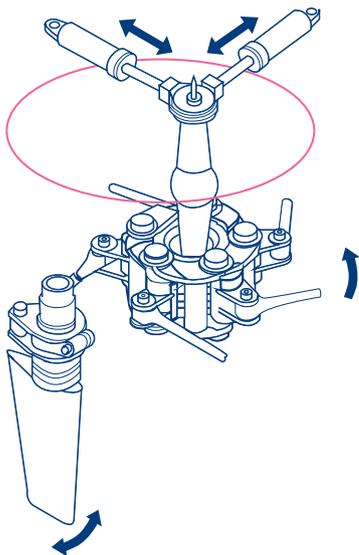
Maneuverable

With the Voith Schneider Propeller, thrust can be varied in any direction. Vessels with one or more VSP therefore offer maximum maneuverability. They can easily turn on the spot, change direction as required and therefore adapt perfectly to any task within no more than a few moments. No matter whether confined harbors or hazardous straits: VSP-equipped vessels defy any danger.

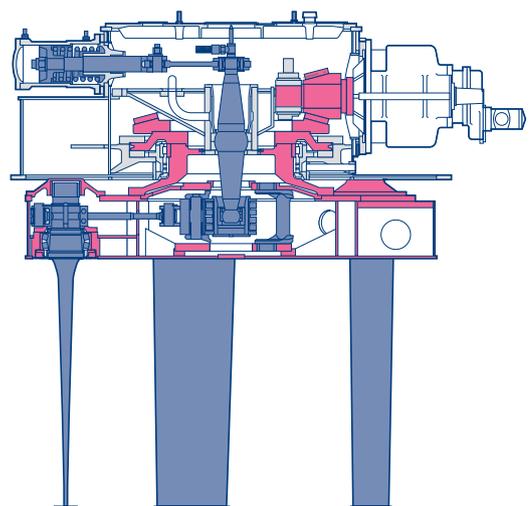
The Voith Schneider Propeller generates thrust by means of profiled blades which protrude from the bottom of the vessel and rotate around a vertical axis. The blades are mounted in a rotor casing which is flush with the vessel bottom. A local oscillating motion of the individual propeller blades is superimposed on the rotary motion of the blades around their common vertical axis. Generation of this oscillating motion is via a kinematic mechanism (kinematics).

As the VSP combines propulsion and steering forces, there is no need for an additional rudder. The Voith Schneider Propeller has no preferential direction of thrust and allows stepless variation of thrust magnitude and direction over 360°. Captains of a VSP-equipped vessel can therefore rely on a combination of maximum maneuverability and perfect safety.

Kinematic principle



Sectional view of a Voith Schneider Propeller



A fantastic invention with minimized turning circle

The intuitive control system makes it possible to carry out any maneuver without problems. Magnitude and direction of thrust can be varied from the bridge using a joystick. It actuates the control rod inside the VSP via two orthogonally arranged servomotors. The propulsion servomotor is used to adjust the pitch for longitudinal thrust (forward and reverse motion of the ship). The rudder servomotor is used to adjust the pitch for transverse thrust (motion to port and starboard). The two servomotors permit steering according to Cartesian X/Y coor-

dinates (identical with the principal axes of the ship). Controlled changes in thrust are possible via the thrust-free condition. The direction of thrust can for example be changed from full ahead to full astern at a constant rpm of rotation without creating disturbing transverse forces or requiring reversing the main engine. With a VSP, all demanding maneuvers such as traversing or turning on the spot can be carried out fast, intuitively and safely.





**With their tail fin, dolphins
generate a thrust of more
than 940 Newton**

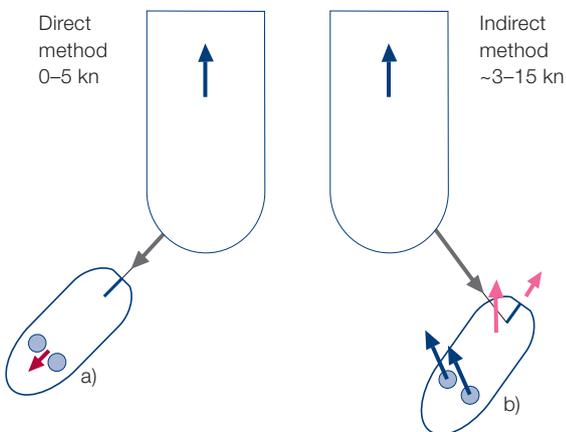


With its blades, the Voith Schneider Propeller generates a thrust of up to 490 500 Newton

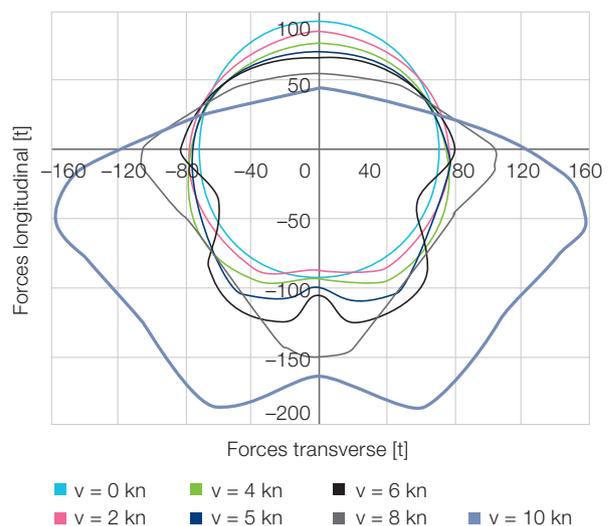
Powerful

When escorting, for example, a Voith Water Tractor (VWT) must keep vessels with a load capacity of up to 500 000 tons on course or decelerate them as fast as possible. This requires immense steering forces. This is a critical safety factor, particularly in cases where technical defects on the escorted vessel result in failure of the main engine or the rudder. The combination of VSP and vessel hull of the Voith Water Tractor meets these demands with the indirect method. The high steering forces guarantee the safety of passengers, goods and the environment – time and time again.

Forces acting on a VWT
in direct and indirect method



Steering forces of a VWT



Powerful propulsion for any task

Voith Water Tractors are perfectly suited to safely escort vessels in difficult waters. Apart from the conventional direct method, an indirect method was introduced with the Voith Water Tractor. During this maneuver, the Voith Water Tractor assumes a position at an angle to the current. This results in steering forces in the magnitude of twice the bollard pull or more. From approx. five knots onwards, the hydrodynamic forces of the VWT hull can be used for the indirect method.

The steering forces are generated by the unique underwater shape of the Voith Water Tractor combined with the Voith Schneider Propeller and can be as high as 170 tons. Installation of the Voith Turbo Fin permits even higher steering forces. The special rotating cylinder at the front edge of the fin increases the steering forces of the Voith Water Tractor by up to another 20 percent.



**A dolphin's spinal muscles
are particularly strong**



With its particularly robust components, the VSP reliably transfers maximum power to the water



Robust

Strong currents, high waves, adverse weather conditions, driftage – the list of potential dangers is long for any vessel propulsion system. Thanks to its intelligent and robust design, the Voith Schneider Propeller is reliable even under the most adverse conditions. Highest component material quality and perfect workmanship ensure high system reliability and trouble-free operation of the VSP.

When a VSP is being produced, the end result is a propulsion system of the highest quality. The components used are made of high-performance and highly durable material. This guarantees a long lifetime of the Voith Schneider Propeller. Many decades of research, development and experience have resulted in perfect adaptation of the individual components to one another. Which then means: A highly robust propulsion system with a high degree of availability.

Amongst other things, the VSP has impressive propeller blades which transfer incredible forces to the water. They consist of particularly strong high-alloy steel. This ensures that even extreme requirements can be met reliably. The extremely robust blade design makes the VSP less vulnerable to a collision with foreign objects such as ice or driftage than any other propeller.

The robust propulsion system for adverse conditions

The VSP operates at very low rpm and reaches high degrees of efficiency with minimum wear of the individual components. The VSP therefore does its job for a long time and is ideal for any extreme situation, be it at sea or in a harbor.

No matter whether adverse conditions or driftage – the design of its parts guarantees absolute reliability. Take the bevel gear manufactured by Voith as an example – the largest one worldwide. The robust steel giant with a ring diameter of 2.3 meters and a weight of 5 tons transmits enormous torques.





A dolphin uses its fin as a stabilizer to prevent a rocking motion during swimming

The innovative VSP reduces the rolling motion by up to 80 Percent – both at standstill as well as on the move



Innovative

In our internal research and development center, we constantly strive to improve the Voith Schneider Propeller. One of the innovative developments: It combines steering, propulsion and roll reduction in one unit. In adverse weather conditions in particular, this ensures a more stable position in the water. Whether during loading or unloading at offshore platforms or when transporting passengers: Vessels with VSP ensure comfort and safety for crew, passengers and goods.

The VSP provides additional stabilization by reducing rolling movements both at standstill as well as during sailing. Wind- and wave-related rolling of the vessel is reduced – crew and cargo can remain in position much more comfortably and safely. A sensor measures the vessel acceleration and transmits the data to a digital controller which calculates and coordinates the counteracting forces required from the Voith Schneider Propeller, thereby reducing vessel rolling by up to 80 percent. And what's more: Propulsion system, control and

roll reduction are all integrated into one unit. This technology can be used in many applications. Be it in passenger transport or when loading and unloading at offshore platforms – even in heavy seas – or when used in workboats: Vessels with a VSP can effectively reduce the rolling motion in the water. This in turn leads to a more comfortable stay on board as well as to safer operation.

A propulsion system undergoing continuous development

Engineers at Voith Turbo continuously strive to further develop the Voith Schneider Propeller and produce new propeller generations with higher bollard pull values at the same power level. This is achieved by optimizing the blade profiles, reducing weight by means of hollow-drilling and introducing innovative blade geometries. Innovations such as these are only possible because Voith uses state-of-the-art development

processes. In the Voith circulation basin for example, tests to improve the propulsion system can be carried out. Together with detailed computer calculations and the expertise of the Voith engineers, this continuously results in new generations of powerful Voith Schneider Propellers, developed and produced by one source.



Thanks to their physique,
dolphins can easily handle
storms and high waves



**The Voith Schneider Propeller
increases the operating time and
therefore the profitability of vessels**



Efficient

The Voith Schneider Propeller is an investment that pays off. It requires little maintenance, has a high degree of operating safety and a very long service life. Its maneuverability and precision allow for fast and safe berthing and unberthing, thus making it possible to increase operation windows as well as the number of operations. In addition, fuel consumption and exhaust emissions are reduced while at the same time optimizing the use of the capacities available.

Offshore supply vessels, Voith Water Tractors and ferries must excel in fast and precise maneuvering and have a very high open-water efficiency to ensure profitable reaching of their destinations. Adverse weather conditions or complex maneuvers must not lead to time schedules not being met. The dynamics of the VSP ensure that berthing and unberthing are no problem, even in heavy seas. Time schedules can therefore be adhered to.

As a result of its functional principle, its low operating rpm and the innovative blade profiles, the VSP has an extraordinary degree of hydrodynamic efficiency, especially when combined with an optimized vessel hull. The interaction of all these Voith Schneider Propeller characteristics results in a significant reduction of the vessel's fuel consumption and in highly profitable operation. In a nutshell: A VSP saves you time, fuel and money.

The Voith Schneider Propeller saves time and money

The low-wear operation of the Voith Schneider Propeller reduces the need for comprehensive maintenance work. Not only does this save service costs but it also leads to less downtime. The VSP has an outstanding degree of availability and impresses with long service intervals. In other words: The VSP has a long service life and the vessels it propels can be used long-term – the VSP pays for itself.

Another proof of the profitability of a VSP: In high seas, the Voith Roll Stabilization can be activated. The cargo can thus be handed over fast and safely even in adverse weather conditions. This guarantees that the daily business can be carried out trouble-free. Others may need to stop their loading process due to the weather – but with a VSP there is no need to call it a day.



The streamlined body of a dolphin minimizes friction loss – and saves energy



The optimized vessel hull lowers fuel consumption – and protects the environment



Eco-friendly

Together with the Voith Schneider Propeller, the optimized hull of VSP-equipped vessels increases the propulsion efficiency. Thereby reducing fuel consumption. At the same time, the high maneuverability of the Voith Schneider Propeller allows faster and safer berthing and unberthing and reduces maneuvering time. And the low hydroacoustic signature also limits the impact on the underwater world. This holistic approach makes it an eco-friendly propulsion system.

Increasing the propulsion efficiency by optimizing the hull form



The propulsion system for eco-minded shipping

For more than ten years now, hydrodynamic development at Voith has not only included model testing in the company-owned circulation tank but also consistently includes numerical processes to calculate the relevant flows. Computational fluid dynamics (CFD), calculated on a large-capacity computer, provide deep insights into fluid physics, thereby constantly revealing room for further improvement. Calculations are done both for the VSP as well as for vessel hulls. CFD-optimized vessel shapes contribute to reducing the power requirements. This in turn translates into lower fuel consumption at the same

speed – and into more eco-friendly shipping. The perfectly matched combination of VSP and vessel hull ensures maximum efficiency of the vessel moving through the water. And at the same time the propulsion system impresses with its hydroacoustic properties: Despite its enormous thrust force, it operates quietly due to its low rpm. The low hydroacoustic signature of the Voith Schneider Propeller increases the comfort of passengers while at the same time protecting the sea life.



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