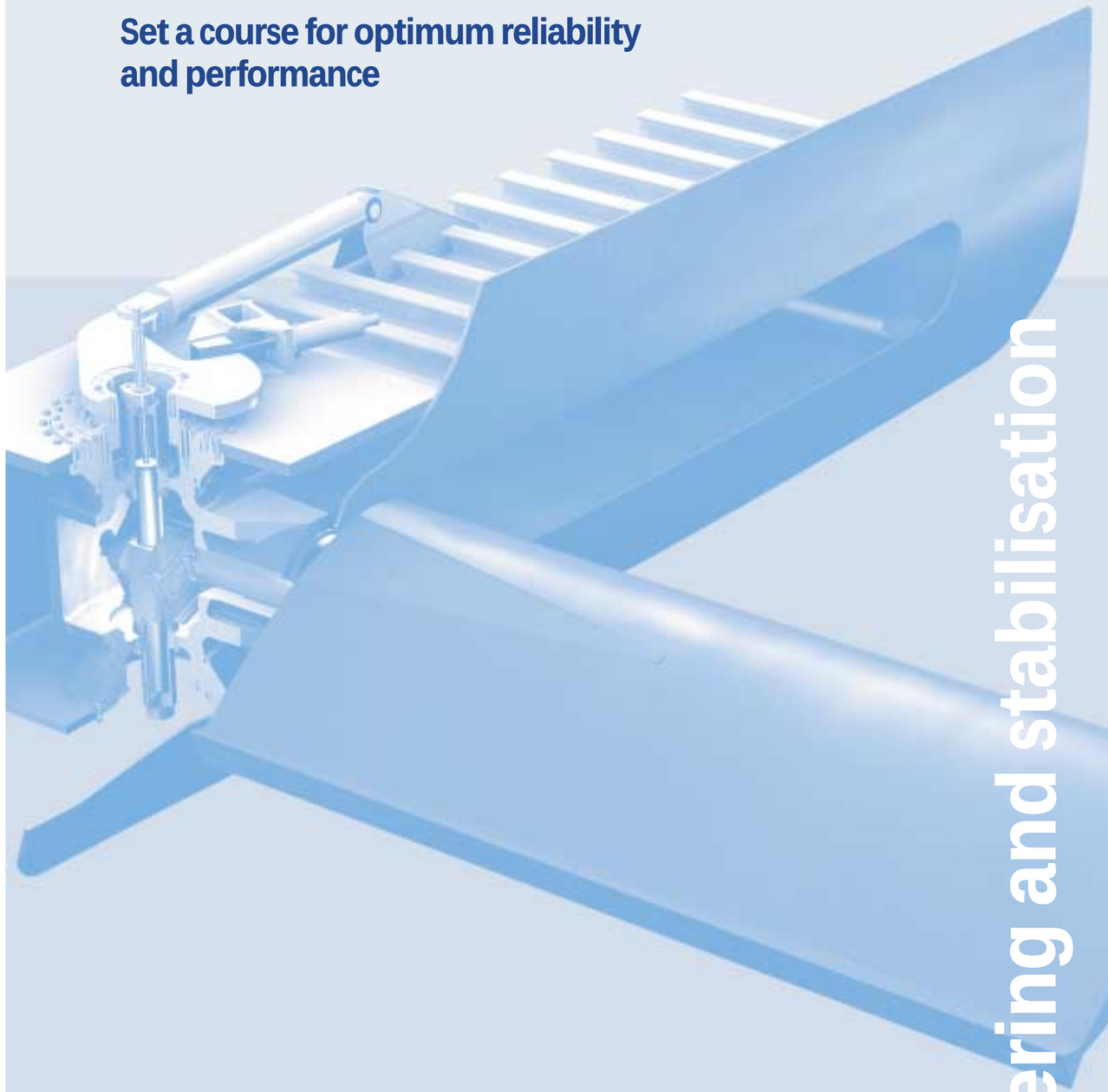
Rolls-Royce

Set a course for optimum reliability and performance



steering and stabilisation

Rolls-Royce®

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Moving your business towards higher profitability

Rolls-Royce is one of the largest international suppliers of marine technology, products and systems. Our design principles are always focused on the future operation and service needs of modern, high-tech vessels which demand the best products available on the market.

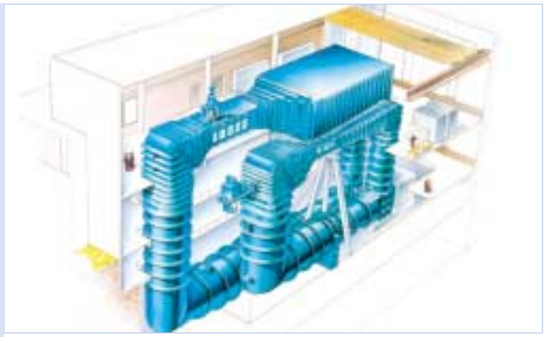
Our vast expertise in marine technology and long traditions of working closely with customers enables us to supply a full range of motion control products and systems. Internationally acclaimed products such as Tenfjord and Frydenbö steering gear, Ulstein Hinze rudders, Brown Brothers fin stabilisers and Intering stabilisation systems.

Many of these products have operational lives of 25 years or more. We are therefore committed to provide services that ensure cost efficient and reliable operation beyond tomorrow.

With a truly international presence with fully qualified local service engineers and technicians, Rolls-Royce provides an unequalled global marine capability. A capability to move your business towards higher profitability.

World famous motion control product names supplied by Rolls-Royce:

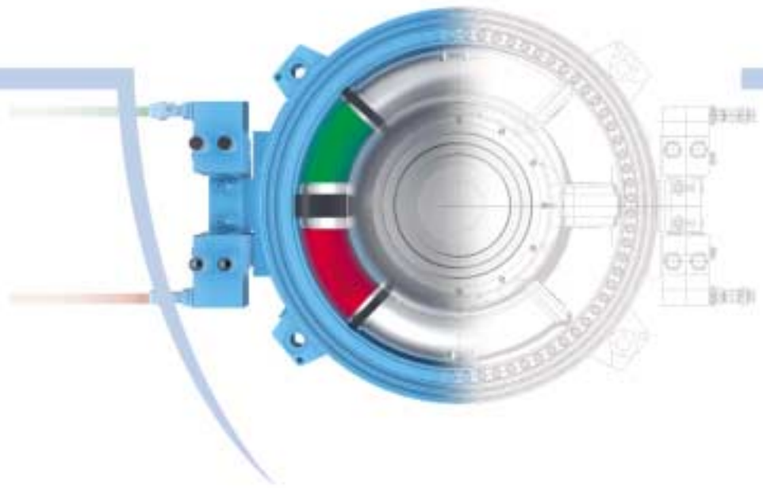
Brown Brothers™
Frydenbö™
Ulstein Hinze™
Intering™
Tenfjord™



The hydrodynamic test centre in Sweden is equipped with two cavitation tunnels, enabling us to optimise manoeuvring equipment on any type of vessel.

Contents:

The best in technology and system solutions



The state-of-the-art hydrodynamic test centre in Sweden allows Rolls-Royce to set standards for steering and stabilisation products. The centre's premium hydrodynamic environment boosts expertise, especially with its two cavitation tunnels. These allow us to study the complex interaction between rudders, propellers and hulls in depth, leading to solutions that meet customer demand for reliability, cost-efficiency and optimal performance – tailored to meet the needs of individual vessels.

However, credit for these products must be given to our customers. They have shared their hard-earned experience and helped refine products to excellence by working closely with our marine engineers. Close collaboration with customers on a project is therefore a key element within the Rolls-Royce range of products.

Being a single source supplier simplifies product and system integration on board. Well-integrated system solutions minimise running costs and technical risk, as well as maximising a vessel's performance. Furthermore, customers have a single point of contact and receive full service from Rolls-Royce all the way from the initial conceptual design of a vessel and selection of equipment to in-service support and flexible financing.

The flap on the Ulstein Hinze flap rudders gives excellent manoeuvrability.

Scaled down models are tested to ensure optimum integration between the rudder, propeller and hull (HSVA).

Tenfjord™ rotary vane steering gear

General description rotary vane steering gear

Rolls-Royce supplies a complete range of steering gear, suitable for all sizes of ships. The products are designed with the totality of actuator, power pack, steering control and alarm system in mind. Due to a wide range of demands, great care has been taken from material selection through construction in order to meet the strictest quality demands.
Rolls-Royce Tenfjord and Frydenbö series of rotary vane steering gears have been manufactured for more than 50 years, with more than 25 000 machines delivered. The principle of a rotary vane gives more flexibility when choosing the design and types of rudder, thanks to the rudder angles of up to 2 x 70º. Rotary vane steering gear does make navigation through narrow straits safer, because of the vessels' increased manoeuvrability and improved control when docking.

The rotary vane principle also ensures a constant torque throughout the steering sequence, providing the gear with maximum power output. The unique technical solutions ensure very low noise and vibration levels.

The compact and simple design reduces weight and secures fast and easy installation of the steering gear. The actuators are mounted directly on the rudder stock, without necessary use of keys or keyways, facilitating easier assembly and dismantling of the rudder stock. The rudder torque is transmitted by hydraulic coupling or by expansion rings (for the smallest machines). The Brown Brothers rotary vane steering gear range is designed for naval applications and meets the highest standards for noise, shock and vibration.

The Tenfjord SR series is designed with integrated frequency controlled pumps.

Key Product Benefits

- Compact
- Low weight
- Easy installation
- Easy maintenance
- High positioning accuracy
- No external moving parts
- Up to 70° rudder angle
- Available with steering control and rudder angle indicators as one complete system
- Built-in rudder carrier
- Polymer sealings internally for optimal tightness
- Simple and robust components

Tenfjord SR series steering gears

The Tenfjord SR series is suitable for small to medium-sized vessels. The steering gear is designed with integrated frequency controlled pumps.

The pump utilises a reversible hydraulic pump motor together with a frequency converter for changing the speed and the direction of the pump. The design gives smooth starting and stopping of the steering gear, and enables a precise analogue control system. The pump engines are mounted directly on the rudder actuator, which lessens the need for piping work on board a vessel.

Unique technical solutions minimize noise and vibration levels.

Typical applications:

Suitable for vessels such as:
- Work boats
- Fishing vessels
- Offshore supply vessels
- Smaller cargo vessels
- Smaller passenger vessels
- Yachts

The pump engines are mounted directly on the rudder actuator.

Benefits of the SR series

- Low noise level
- Low power consumption
- Low heat generation
- Excellent positioning precision

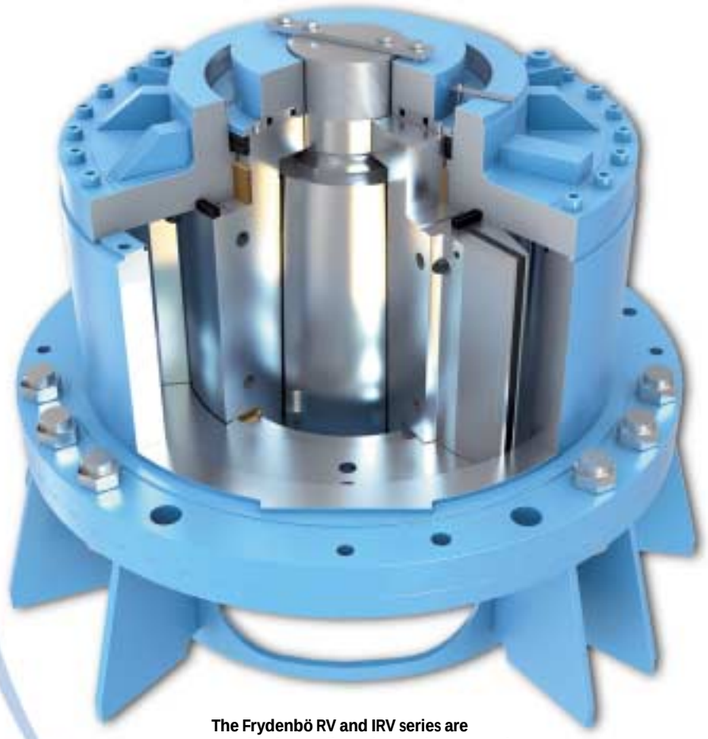
Red indicates pressurised oil. Green indicates excess oil.

The compact and simple design lessens the weight and is quick and easy to install.

SR range

TYPE	Max.stock dia. (mm)	Max. working torque (kNm)	Max. rudder angle	Weight approx. kg	Max. radial load (kN)	Max. axial load (kN)
SR 562L-FCP	140	16	2 x 61.0	400	175	104
SR 562-FCP	160	40	2 x 61.0	400	175	104
SR 622-FCP	200	70	2 x 72.0	620	400	200
SR 642-FCP	240	110	2 x 72.0	920	600	250
SR 662-FCP	280	170	2 x 72.0	1800	700	354
SR 722-FCP	340	275	2 x 74.0	2750	855	370
SR 723-FCP	340	412	2 x 44.0	2800	855	370
SR 742-FCP	395	433	2 x 74.0	3700	1240	480
SR 743-FCP	395	650	2 x 44.0	3800	1240	480

Frydenbö™ rotary vane steering gear



The Frydenbö RV and IRV series are suitable for medium-sized to large vessels.

Frydenbö RV series steering gear

The Frydenbö steering gear has a proven service record on all types of vessels. Today's range is suitable for medium-sized to large ships, including large container vessels and VLCCs. The weight is typically 50-60% of a RAM-type steering gear, with much smaller space requirement. Furthermore, the Frydenbö design's dual, submerged pump power packs makes installation even easier, as no expansion tank is needed. Installation is also simpler because of the integrated storage tank and rudder carrier.

The Frydenbö Modulated Flow Control modulates the oil flow to the actuator in order to give a soft start and low rudder speed for small rudder movements. The oil flow gradually increases to full flow, allowing full turning speed on the rudder. The system ensures a very precise rudder positioning at small rudder angles during course keeping, while the full flow ensures full manoeuvring capability when needed.

Product benefits:

- Modulated flow control
- Integrated oil storage tank
- No expansion tank required
- High levels of positioning precision

Frydenbö IRV series steering gear

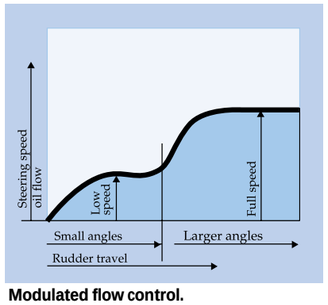
IMO regulations require compliance with the principle of single failure criteria for large tankers over 100,000 dwt. This requirement is met by the IRV series, which incorporates automatic isolation of the actuator's dual hydraulic system. The actuator is equipped with a double sealing system, completely separating the actuator in two individual pressure chambers. In addition, the specially-designed sensor system maintains constant control of the integrity of the seals.

Frydenbö 4-vane steering gear

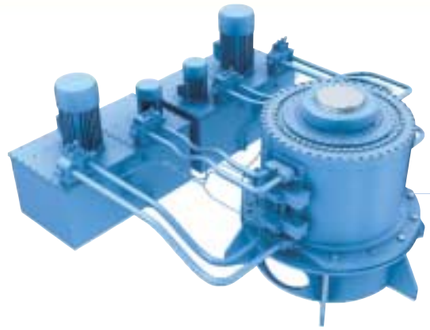
This is a range of extremely compact rotary vane steering gear, which is suitable for large vessels including tankers over 100,000 dwt. The 4-vane steering gear is a further development of the well proven Frydenbö range of steering gear with two and three vanes. The key advantages of this design is its compact size because of the four vanes and its light weight as well. The 4-vane steering gear is available as the standard model as well as the IRV model, which satisfies all statutory requirements for tankers over 100,000dwt. This range also incorporates Frydenbö's proven and unique modulated flow control valve.

Frydenbö Unitized steering gear

The Frydenbö Unitized steering gear is an application of the RV and IRV ranges that combines actuators, power packs, storage tanks and foundations on a single, compact skid. This design can handle most preparatory and work tasks related to steering gear installations on board. This cuts labour costs, minimises risk and helps ensure punctual installation.



Modulated flow control.



The Frydenbö 4-vane steering gear is a further development of the well proven Frydenbö range of steering gears with two and three vanes.

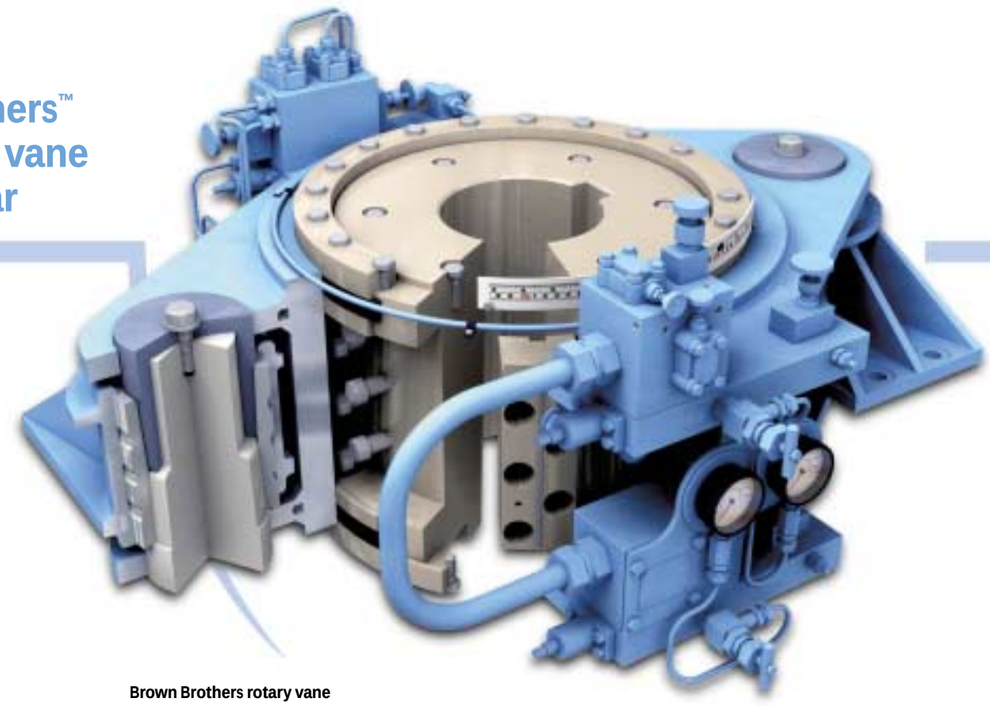
Typical applications:

- Oil tankers
- Ro-Pax vessels
- Container vessels
- Bulkers
- Cruise vessels
- LNG-tankers

The Frydenbö IRV series is renowned for its simplicity, robustness and reliability, and satisfies all requirements for tankers over 100,000dwt.

TYPE	Max. stock dia. (mm)	Max. working torque (kNm)	Max. rudder angle	Weight approx. kg	Max. radial load (kN)	Max. axial load (kN)
RV range						
RV 550-2	370	568	2 x 71.5	3500	1400	500
RV 700-2	410	677	2 x 71.5	5000	1800	700
RV 850-3	420	853	2 x 46.5	3700	1400	500
RV 900-2	450	874	2 x 71.5	6000	1800	700
RV 1050-3	450	1015	2 x 46.5	5000	1800	700
RV 1100-2	510	1094	2 x 71.5	8000	3000	1250
RV 1350-3	495	1312	2 x 46.5	6000	1800	700
RV 1400-2	500	1412	2 x 71.5	8100	1800	700
RV 1650-3	550	1641	2 x 46.5	8000	3000	1250
RV 1700-2	560	1708	2 x 71.5	11000	3000	1250
RV 2050-2	580	2028	2 x 71,5	12000	3000	1250
RV 2600-3	620	2563	2 x 46.5	11500	3000	1250
RV 2700-2	650	2666	2 x 71.5	15000	3000	1250
RV 3050-3	660	3043	2 x 46.5	12000	3000	1250
RV 4000-3	700	4000	2 x 46.5	15000	3000	1250
RV 3050-2	700	3050	2 x 71.5	20000	3000	1800
RV 4200-2	730	4200	2 x 71.5	24000	3000	1800
4-vane						
RV 4500-4	850	4500	2 x 36.5	22000	3000	4500
RV 6000-4	850	6000	2 x 36.5	26000	3000	4500
IRV range						
IRV 2050-2	580	2028	2 x 71.5	12000	3000	1250
IRV 2700-2	650	2666	2 x 71.5	15000	3000	1250
IRV 3050-2	700	3050	2 x 71.5	20000	3000	1800
IRV 4200-2	730	4200	2 x 71.5	24000	3000	1800
IRV 4500-4	850	4500	2 x 36.5	22000	3000	4500
IRV 6000-4	850	6000	2 x 36.5	26000	3000	4500

Brown Brothers™ naval rotary vane steering gear



Brown Brothers rotary vane steering gear.

Brown Brothers' steering gear systems with digital controls and autopilot have been selected by a large number of the world's navies including the USA, Malaysia, India, Australia, Spain, Taiwan and the British Royal Navy. The range has been developed to integrate seamlessly with the vast number of applications deployed in naval fleets.

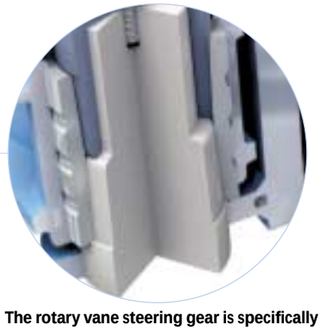
Rotary vane steering gear

The compact size of the rotary vane steering gear facilitates ease of fitting to single or multiple-rudder installations. The standard working angle of a rotary vane unit is 37° to one side, although gears can be supplied to give maximum working angles of 70° and 90° to one side.

17 model range available for torques from 2-256Tm.

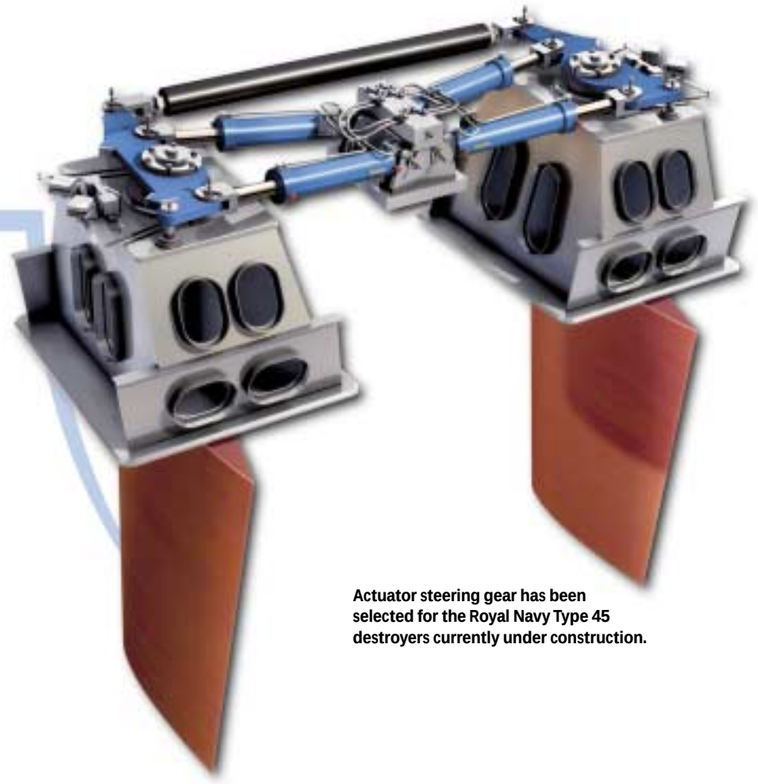
The range has been developed to suit many different types of naval vessels.

Typical applications:
- Corvettes
- Frigates
- Destroyers
- Aircraft carriers



The rotary vane steering gear is specifically designed to conform with international naval standards for noise, shock and vibration.

Brown Brothers™ actuator type of steering gear



Actuator steering gear has been selected for the Royal Navy Type 45 destroyers currently under construction.

The Brown Brothers actuator gears is a cost-effective and reliable solution. The gear is made redundant on a single rudder by means of two actuator systems. For example, one actuator can be bypassed away from the system, and still provide around 50% torque.

Furthermore, use of the actuator type means fewer interface surfaces on board because the actuator's anchor brackets can be welded directly on to the hull cartridge.This means that actuator steering gear is less tolerance-critical for installation.

Typical applications:
- Corvettes
- Frigates
- Destroyers
- Helicopter carriers

If problems occur with the hydraulic driving mechanism, replacing an actuator is easier than a rotary vane or a ram type of steering gear.

Hydraulic power units

- Can be configured to meet specific customer requirements
- Variable or fixed displacement pumps
- Pressure compensated or proportional systems
- Dual or single power units
- Inherent safety and reliability

The steering gear is available with pressure-compensated or proportional systems.

Ulstein Hinze™ conventional rudders, type classic

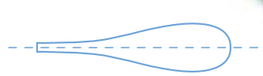
General description rudders

Rolls-Royce is a supplier of rudders as well as propellers. We can therefore draw on our long experience and know-how in the field of cavitation prediction, as this can occur and damage rudders and propellers. Advanced calculation programs ensure optimal propulsive efficiency and manoeuvring performance.

The directional stability of ships in transit must be considered when designing the rudder. We develop and use advanced computer programs to simulate different manoeuvres such as the IMO criteria (e.g. zig-zag test). The software uses the actual hull shape to calculate the hydrodynamic hull forces. With this software we can evaluate different rudder sizes and types to optimise the rudder design for each vessel.

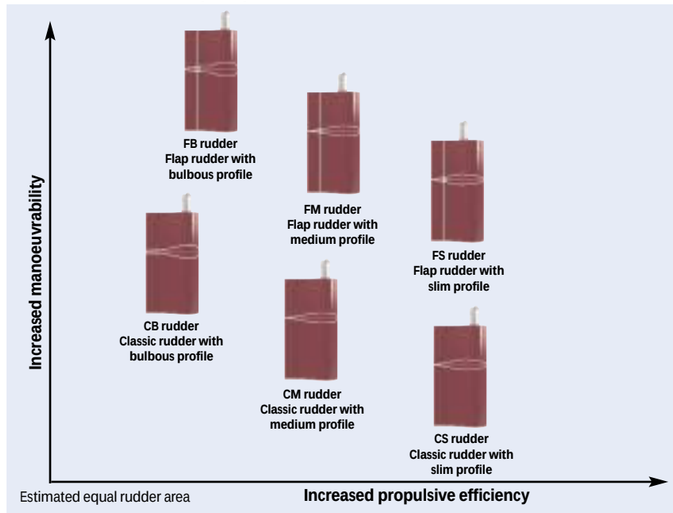
Requirements for good manoeuvrability at low speed often governs a rudder's design. Extensive testing of model vessels has been carried out in collaboration with leading European test centres, in order to optimise and document the manoeuvring properties of our rudders at low speed.

Rolls-Royce offers a range of rudders to meet customer requirements – both with and without flap.



The CB rudder for lower speed. A bulbous profile and large vane end-plates improves manoeuvrability at low speed. Heel module optional. Ulstein Hinze CB has the same profile as FB, but without the flap.

"Rudder Periodic Table" in principle



The rudder design is also important for overall propulsive efficiency. It is a compromise: if a rudder is optimized for propulsive efficiency, you will loose manoeuvrability (especially at low speed) and vice versa. This is why a good understanding of shipowners' requirements is vital when designing rudders.

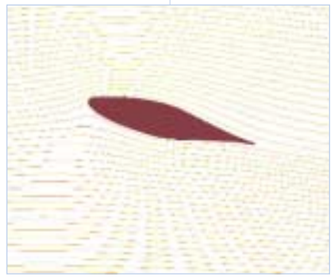
Rolls-Royce

Typical applications:

- Passenger vessels
- Cargo vessels
- High-speed crafts

The CM rudder for medium speed. Medium profile optimises the proportion between manoeuvrability and propulsive efficiency. Tapered or rectangular blade.
Ulstein Hinze CM has the same profile as FM, but without a flap.

The CS rudder for higher speed. Slim profile increases overall propulsive efficiency and reduces cavitation risk. Tapered blade, rounded corners and smooth surface.
Ulstein Hinze CS has the same profile as FS, but without a flap.



The illustration visualises the hydrodynamics for classic rudders.

The Ulstein Hinze conventional rudders, type classic are the result of years of experience in ship design and hydrodynamics. You can rest assured of our guaranteed optimal reliability, excellent manoeuvrability and low lifecycle costs.

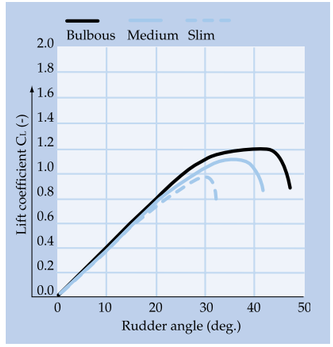
The different rudders are built as full spade rudders with 3 different standard profiles to ensure optimal manoeuvrability for the various types of vessel.

Available options:

- Trunk module with steering gear foundation
- Automatic lubrication system
- Special bearings / liners
- Heel connection module

Product benefits:

- Easy installation
- Easy maintenance
- Custom-built to fit hull
- Optimal performance
- Suits all steering gear



Lift curve for type classic.

Ulstein Hinze™ flap rudders

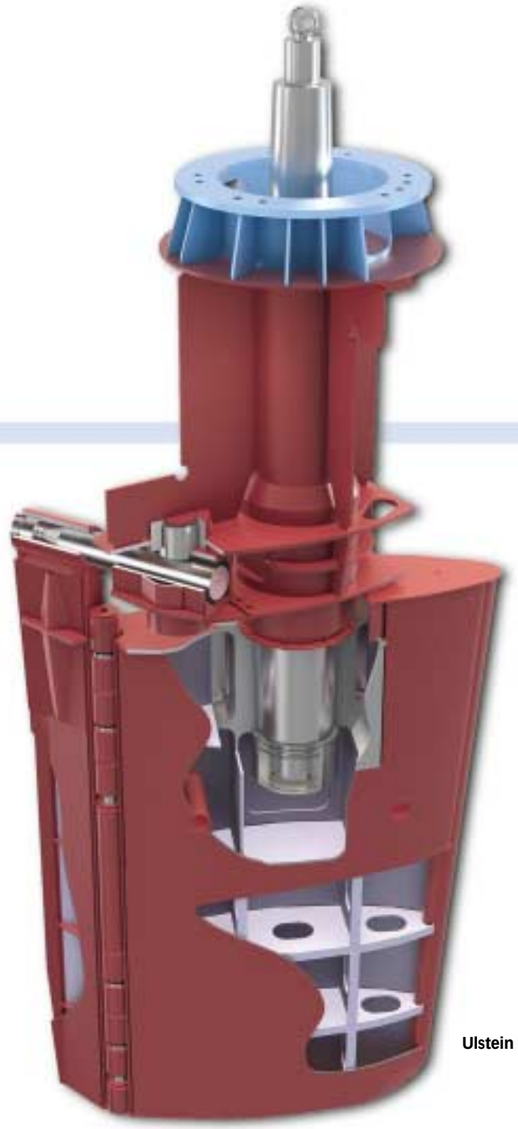
Rolls-Royce has developed and built flap rudders since 1985. The performance of a flap rudder is determined both by the flap, the link mechanism and the profile, as well as the hull and propeller. Rolls-Royce has therefore designed a range of flap rudders to cover different types of vessels and functions, in order to make sure that customers receive a rudder best suited to their vessels and operations.

Ulstein Hinze FB has a bulbous profile for maximum manoeuvring performance, suitable at low to medium speed. This rudder also has large upper and lower vane plates. It is ideal for use on workboats, fishing vessels and offshore vessels, as well as on small tankers, cargo vessels, ferries and other coastal vessels.

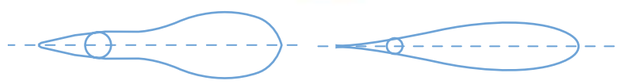
Ulstein Hinze FM has a moderate profile for enhanced manoeuvrability, suitable at medium speed. The rudder is suited to vessels up to 20,000 dwt with high demand for manoeuvrability.

Ulstein Hinze FS has a slim profile, suitable at medium to high speed. The rudder is built around a cast cone module, and has a strong link mechanism and hinge system to withstand high forces. Used for Ro-Ro, Ro-Pax, passenger and cruise vessels and tankers, but it is also an all-round flap rudder suitable for all types of vessels up to approx. 50,000 dwt.

Ulstein Hinze FB/FM.



Ulstein Hinze FS.



Available options:

- Trunk module with steering gear foundation
- Automatic lubrication system
- Special bearings / liners
- Heel connection module

Product benefits:

- Superior steering abilities
- Minimum installation time
- High reliability
- Custom-built to fit hull
- Suits all types of steering gear

Conical hydraulic connection and double sealing system.

Conical hydraulic connection with a cast module for reinforcement. Double sealing system.

The illustration visualises the hydrodynamics for flap rudders.

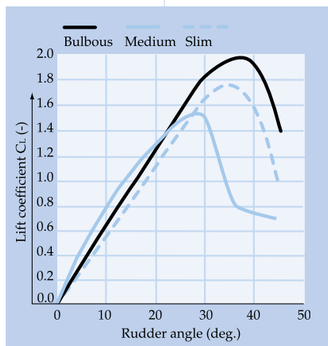
Typical applications:

Ulstein Hinze FB rudders:

- Offshore supply vessels
- Fishing vessels
- Seismic vessels
- Cargo vessels

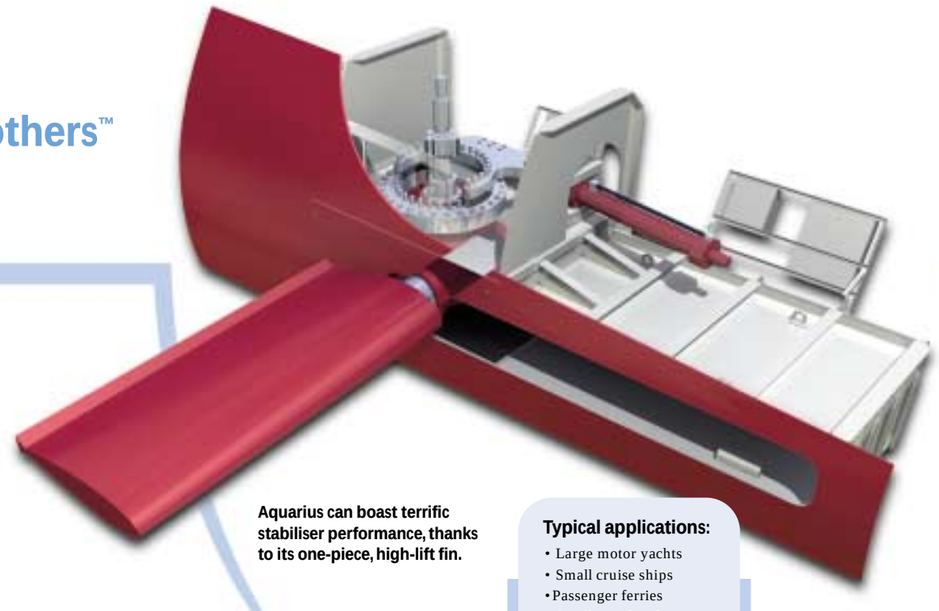
Ulstein Hinze FM/FS rudders:

- Passenger vessels
- Cargo vessels
- High-speed craft



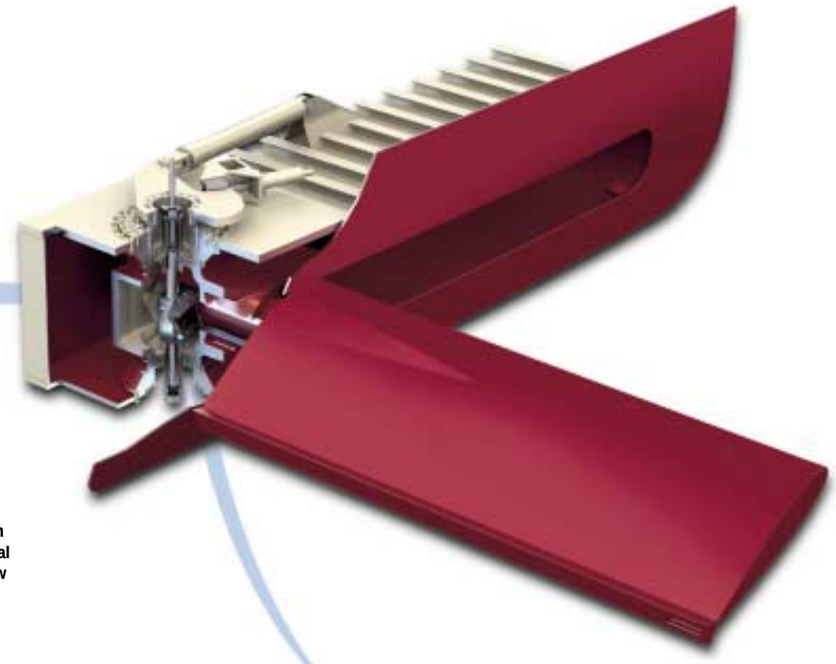
Lift curve for flap rudders.

Brown Brothers™ folding-fin stabilisers



Aquarius can boast terrific stabiliser performance, thanks to its one-piece, high-lift fin.

Typical applications:
- Large motor yachts
- Small cruise ships
- Passenger ferries
- Small naval and coast-guard vessels



The Neptune II folding-fin stabiliser provides optimal vessel performance at low ownership costs.

General description fin stabilisers

Rolls-Royce fin stabiliser systems use one or more pairs of hydrofoil shaped fins projecting from a vessel's bilge area. Vessel speeds, and the angle of the fins in the water, determine the extent of generated lift, either up or down. The stabiliser control system senses the degree of ship movement, and signals the stabiliser hydraulics to alter the angle of the fins to return the vessel to an even keel. The result is usually an 80 - 90% reduction in roll when compared with an un-stabilised vessel.

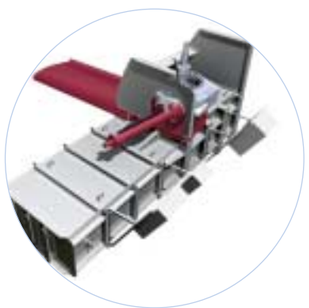
The Brown Brothers Neptune and Aquarius folding-fin stabilisers, both incorporate a one-piece fin construction, with a "fishtail" high-lift profile. When not in use, the fins are folded into recesses in the hull, flush with the vessel's side.

For applications where retraction of the fin is not required, the Modular range is available for naval applications and the Gemini range for smaller commercial vessels where high performance and low costs are important factors.

Aquarius folding-fin stabilisers

The Brown Brothers Aquarius folding-fin stabiliser range gives high-performance roll damping, with a compact, lightweight design and state-of-the-art controls. The fin operating mechanism is especially configured to meet the requirements of smaller vessels, with minimum size, weight and number of parts. The stabiliser comes supplied complete with a fin-box and any necessary local stiffening, ready for the shipyard to weld into place.

Product benefits:
- Enhanced stabiliser performance thanks to the one-piece high-lift fin
- Low installation costs for hydraulic, mechanical and control equipment
- Ease of integration with ship's alarm and monitoring systems
- Small hull aperture
- Linear actuators for fin tilt and extension
- Integral lubrication system
- Fin-box can be shipyard supplied
- Load sensing hydraulics
- Latest generation controls



Brown Brothers Aquarius folding-fin stabiliser range is specially configured for smaller vessels.

Technical data, Aquarius folding-fin stabilisers

Aquarius model	Fin area (m^2)	Total weight (tonnes)
50	1.82	19.3
	2.42	19.8
	3.03	20.3
	3.51	20.8
100	4.21	35.5
	4.73	37
	5.26	39
	5.78	40.2

All data subject to change without prior notice.

Neptune II folding-fin stabilisers

The one-piece fin is built of fabricated materials, with a modified NACA (North American Committee on Aeronautics) section to maximise lift properties and minimise drag, with a similar effect as flapped fins.

Features include an innovative tilt ram attribute, which facilitates cylinder and seal maintenance without dry docking, simplified crux assembly, improved hydraulic and lubrication systems, lower weight and a new fin extension-locking mechanism for improved safety. Neptune II offers optimal vessel performance with low ownership costs.

Product benefits:
- Enhanced stabiliser performance due to one-piece, high-lift fin
- Ease of integration with ship's alarm and monitoring system
- Small hull aperture
- Modular construction
- Simplified main seal replacement
- Load sensing hydraulics
- Latest generation controls

Neptune II gives small hull aperture.

Typical applications:
- Cruise ships
- Ferries
- Container vessels

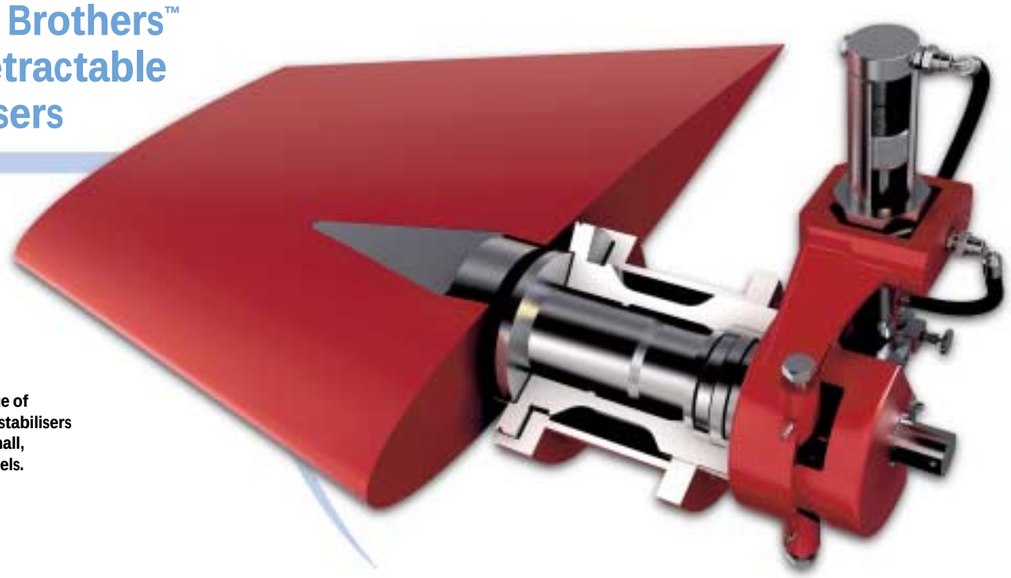
Medium to large naval vessels:
- Landing ships
- Helicopter carriers
- Auxiliary platforms

Technical data, Neptune folding-fin stabilisers

Neptune model	Fin area (m^2)	Total weight (tonnes)
100	4.2 – 5.8	36.5 – 42
200	5.45 – 7. 48	44 – 52
300	7.0 – 9.62	67.5 – 78.1
400	9.42 – 12.95	90 – 102.5
500	12.5 – 17.19	127 – 142
600	16.24 – 22. 33	173 – 190

All data subject to change without prior notice.

Brown Brothers™ non-retractable stabilisers



The Gemini range of non-retractable stabilisers are suited to small, commercial vessels.

Gemini non-retractable stabilisers

For applications where retraction of the fin is not required, the Gemini range is available for smaller commercial vessels where high performance and low cost are important factors.

The Brown Brothers Gemini range of non-retractable stabilisers can be supplied with a plain or high-lift profile fins depending on the application. Gemini stabilisers provide high performance roll damping, as well as a compact, lightweight design and modern controls, as well as proving highly dependable with low maintenance costs. The power unit is compact, incorporating pump, motor, proportional control valves and cooler. All items required are packed away in the power unit for easy installation.

Product benefits:

- Enhanced stabiliser performance due to high-lift fin
- Compact power unit containing all the hydraulic, mechanical and control equipment
- Ease of integration with ship systems

Typical applications:

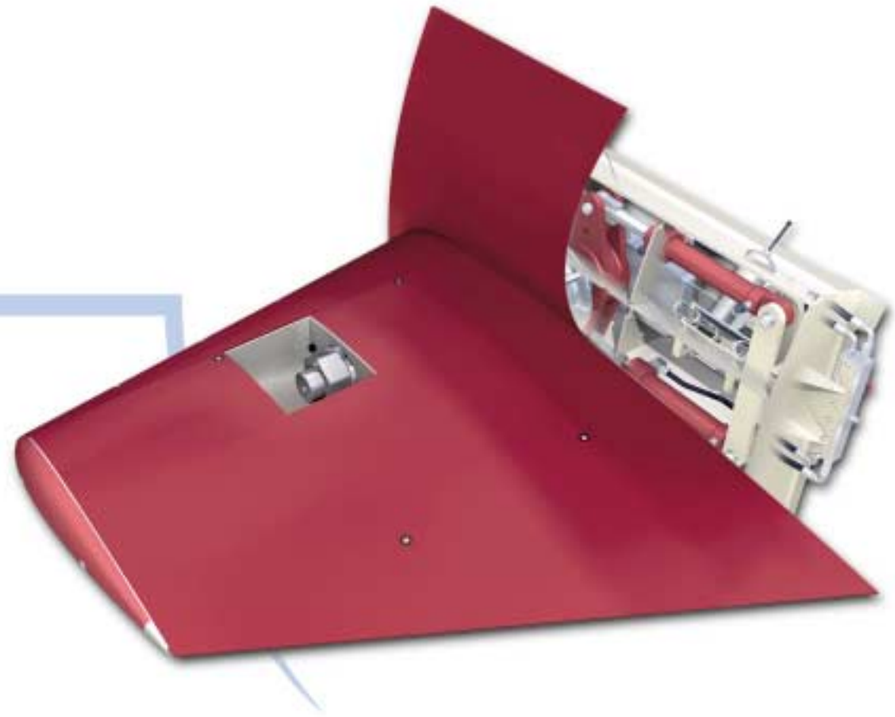
- Large motor yachts
- Fast ferries
- Small naval and coastguard vessels

Gemini offers a compact low weight design.

Technical data, Gemini folding-fin stabilisers

Gemini model	Fin area (m^2)	Total weight (tonnes)
10	1.4	1.92
20	2	3.75
30	3.2	6.75

All data subject to change without prior notice.



Brown Brothers modular stabilisers meet military standards for noise, shock and vibration levels.

Brown Brothers Modular stabilisers

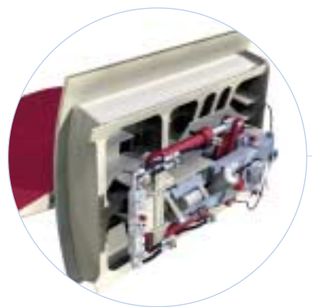
The Brown Brothers Modular non-retractable stabilisers incorporate superior hydrodynamic features, and fully satisfy military standards for noise, shock and vibration levels.

The latest finshaft coatings and reduced-friction, long-life bearings are used throughout the design to ensure long service. A keyless taper socket fin attachment allows the hydrodynamic profile of the fin blade to remain unbroken, reducing the potential for cavitation. If required, air emission from the leading edge of the fin can also be utilised to minimise noise induced by cavitation.

The hull-closing plate is an integral part of the fin unit. Installation is easy, as the unit is shaped to fit the hull lines exactly, so expensive seating structures and finishing work can be avoided. Maintenance costs are also significantly lower because of the simplified design with the option of using an inflatable seal to enable replacement of the main sea gland packing at sea.

Product benefits:

- Self-aligning bearings
- Special finshaft coating
- Simple installation procedure
- Fully satisfies military standards for noise, shock and vibration levels
- Fin-size tailored in consistence with the design and performance of individual ships.



The hull-closing plate is included as an integral part of the fin unit.

Typical applications:

- Corvettes
- Frigates
- Destroyers
- Aircraft carriers

Technical data, Modular range

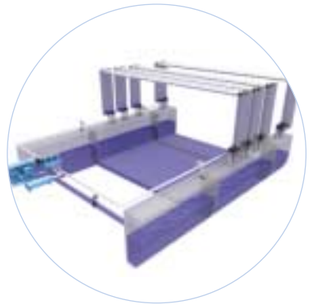
Model	Fin area (m^2)	Design speed (knots)	Weight (tonnes)
NR17	0.8	30	3
	1.5	19	3.5
NR22	1.9	30	6.8
	2.9	19	8.4
	3.5	27	9.04
	4.8	19	12.2
NR26	5.0	27	14.4
	6.5	19	18.6
NR30	7.0	26	21.1
	9.0	19	26.6
NR35	9.5	25	29.9
	12.0	18	36.72
NR41	13.0	25	42.4
	16.5	18	52.1

All data subject to change without prior notice.

Intering™ stabilisation systems

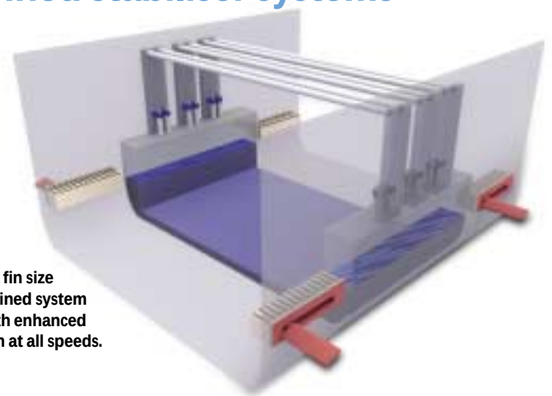
General description stabilisation systems

Rolls-Royce is a turnkey supplier of marine stabilisation systems, including the Intering tank stabilisation systems and Intering Anti-heeling systems. This range of products can be supplied as stand-alone systems or as part of a collective system. More than 650 vessels to date have been fitted with Intering motion control equipment.



The illustration visualises a combined tank stabiliser and anti-heeling system.

Brown Brothers™/Intering™ combined stabiliser systems



The required fin size for the combined system is smaller with enhanced roll reduction at all speeds.

Rolls-Royce can supply a combination of fin stabilisation and passive tank stabilisation systems, giving advantages which cannot be achieved from a single system alone.

Tank stabilisers are an attractive complement to fin stabilisers, which need a minimum speed of six or seven knots in order to be effective. A combined system can reduce the required fin size and improve roll reduction at all speeds.

Product benefits

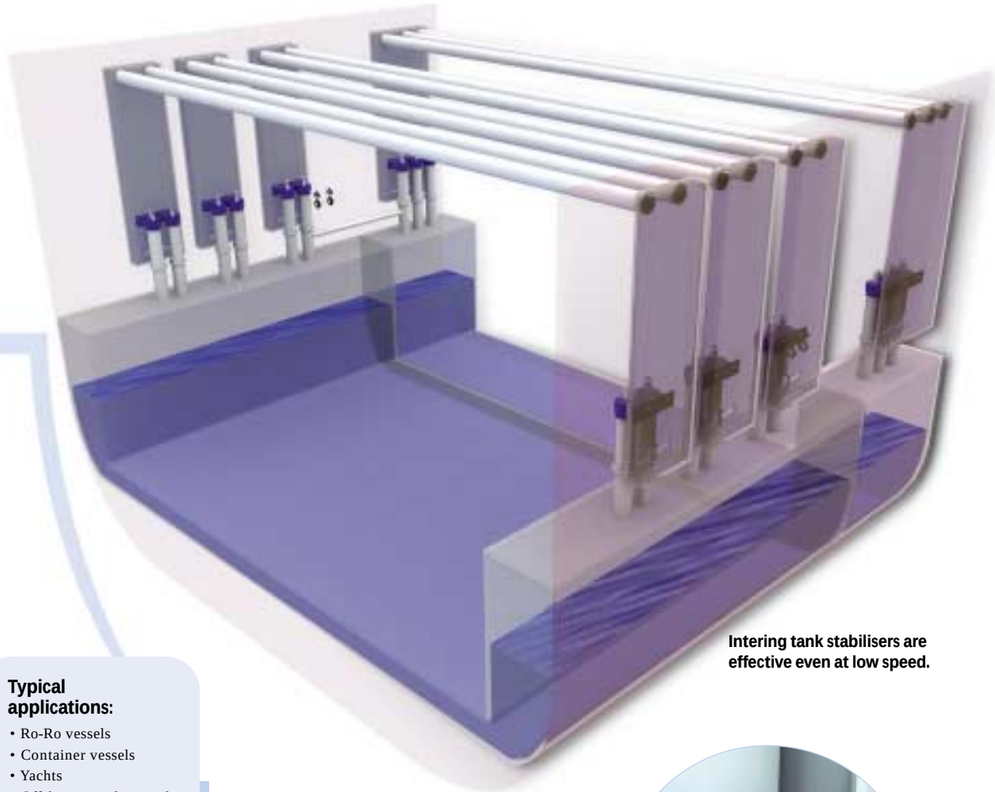
- Roll reduction achieved at all speeds
- Reduced drag from using smaller fins
- Fins do not need to be off-set, thereby increasing efficiency

Intering™ tank stabilisation systems

Intering controlled tank systems are designed to give 40-50% lower roll on average. Unlike passive tanks, Intering tank stabilisers react immediately and individually to any changes in roll motion, providing top performance and flexibility. They are also effective at low speed or when stationary.

Rolls-Royce Intering U-shaped tank stabiliser systems use water or heavy fluid, and can be supplied as stand-alone systems. They can also be combined with an anti-heeling system for increased safety / payload or Brown Brothers fin stabilisers for for enhanced roll reduction at any speed.

The U-shaped tank stabiliser comprises two tanks which are linked by a channel across the ship; one port and one starboard. The system is tuned so that when a ship rolls, more water will rise on the "high" side, thus creating a righting moment to reduce the roll. Valves block the water flow in cycles by controlling the air pressure above the waterline to create optimal effect. The inevitable free surface effect of stabiliser tanks can be compensated if these are included in a ship's design from the outset.



Intering tank stabilisers are effective even at low speed.

Typical applications:

- Ro-Ro vessels
- Container vessels
- Yachts
- Offshore supply vessels
- Diving support vessels
- Paper carriers
- Ice breakers
- Cable layers

Intering tank stabilisers are optimised to be effective in different loading conditions. More than one set of tanks can be fitted when necessary.
Where tank space is limited, Intering systems can use a corrosion-inhibiting heavy fluid, reducing the space required by more than 30%.

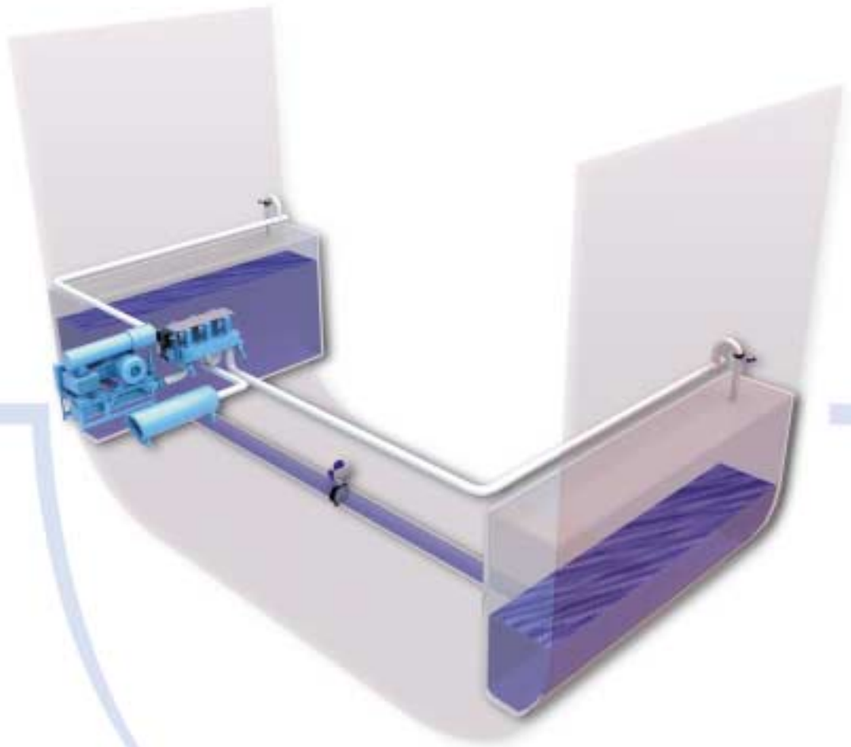
Product benefits:

- Up to 40 – 50% roll reduction at sea
- Damage to cargo and ship avoided
- More comfort and smoother running of vessels
- Efficiency independent of ships speed
- Immediate and individual reaction to any change in roll motion
- Dual use of tanks in harbour for anti-heeling operation
- No need to alter tank water levels.
- Low maintenance – no moving parts in water

The Valves are maintenance-free, and provide smooth and precise operation.

Intering tank stabilisation systems provide roll reduction of up to 40 – 50% in normal rough seas, which is enough to prevent damage from rolling.

Intering™ anti-heeling systems



The anti-heeling system keeps ships upright during loading and unloading.

The Anti-heeling were developed to keep ships upright during loading and unloading. The Intering anti-heeling system uses a constant pneumatic air purge and regulating valve system to force air into the top of one tank while venting the one on the other side. This rapidly transfers water from one side of the vessel to the other, creating a righting moment, which compensates for heeling forces. This system is available as a stand-alone system and / or in combination with the functionality of continuous cyclical heeling in level ice (Ice-Heeling System).

Intering systems up to 5,000 tonnes metres per minute are in operation and can be supplied as either stand alone air blower activated, combined with tank stabilisers, pump activated, with dedicated heeling pump or integrated into the ballast system. Trim control systems can be combined with the anti-heeling systems. Unlike anti-heeling systems, these make use of ballast tanks fore and aft in the vessel to compensate for any trim moments automatically or on the command of a controller. be operated by dedicated trim pumps or designed as an integral element within the ballast system.

Product benefits

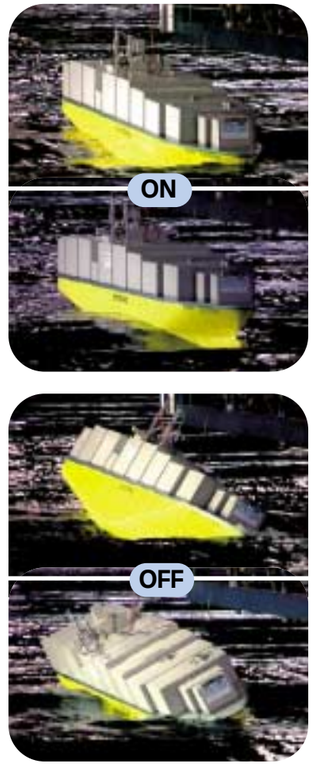
- Rapid loading and unloading
- Damage avoided to ramps, rolling cargo, cell guides and containers
- Unlimited change of water flow direction (air blower system)
- No current peaks for motor starts during operation (air blower system)
- Loading and discharging quicker
- Harbour time reduced thus saving on port costs
- Systems with heel compensation have a rate of up to 5,000 tm / min when in operation

Typical applications:

- Ro-Ro vessels
- Container ships
- Ferries
- Paper carriers
- Ice breakers
- Offshore supply vessels
- Heavy lift ships

The fast reacting valve group is an integral part of the air blower anti-heeling system

Intering™ Parametric roll prevention system (IPRP)



These images show the benefit of the parametric roll prevention system.

Parametric roll prevention systems are designed to prevent the build up of parametric roll in head or following seas. Sea-keeping model tests demonstrate that the Intering Parametric Roll Prevention system can reduce the risk of parametric disturbance by shifting the critical wave threshold to such high values that the the chances of ever encountering such a roll during a vessel's service life are extremely low.

A typical example of a complete ship system will include several pairs of U-shaped tanks and pneumatically controlled air valves, plus a control unit with pitch and roll sensors. The controller detects the onset of parametric rolling and uses the damping effect of the tanks fluid's oscillations, which is controlled by air valves in accordance with the ship's motion.

The system is effective in preventing parametric roll and also in minimising regularly disturbed roll motion by up to 20%.

Product benefits:

- Prevents the build-up of parametric roll in a head or tail wind for improved safety
- Reduces regular ship roll by about 20%
- Automatic response – system is always in standby mode

Typical applications:

- Mainly large container ships