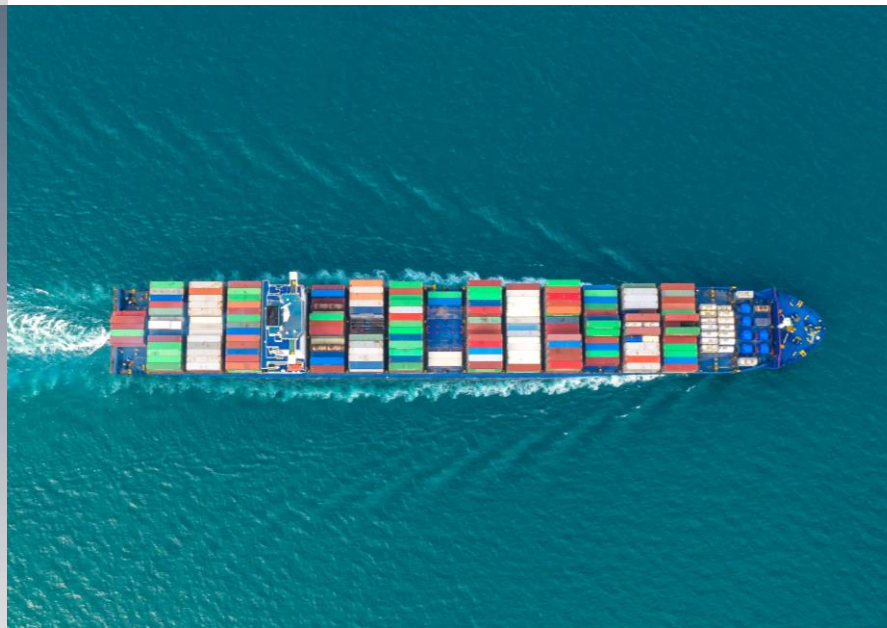




MM-OFFSHORE

RUDDER SYSTEMS





Our Company

The company MM-Offshore GmbH is one of the major designing and producing ship's equipment supplier in the international shipbuilding market. With our experience of more than half a century in our team of German engineers, we are designing high end class products.

State of the Art German design produced in the international shipbuilding market brings all the benefits to our client as you need it.

Long proofed and reliable partner makes the product to an advantage and profit for the customer at the end. A win-win solution is always our goal. We are looking for a long term partnership with our clients.

With our high qualified engineers we are able to design with modern technology the equipment for your requirements, always improving the technology.

Taylor made products as rudders which always need to be fitted to the type of vessel, bring all the advantage to the customer. Finally our product range is setting standards like our hatch covers, shell doors and hydraulic equipment and makes it interesting for shipyards to use with easy handling and built-in.

When the vessel is in service after completion our service team will assist you as a ship owner whenever you need us. Feel free to contact us at any time.

MM-OFFSHORE GmbH

info@mm-offshore.com



President of the board



Rudder Systems

MM-Offshore will make sure with innovative technologies and careful application that the rudder system is optimizing the performance of your vessel.

Our design is always best in class und represents State of the Art German technology.

Together with our clients and partners we are looking with sustainability for economic and ecofriendly solutions for the ship's operation.

Our team of experts assist and support you for the whole life span of the project – from project start, launching to sea trial.

Moreover our experts are available for you 24/7 during the entire operation time of your vessel .

Key Facts:

- Flow- and efficiency optimized rudder
- High maneuvering stability
- Best efficiency and / or energy saving
- Coupling Pin Bearing for minimizing the stresses and forces at rudder blade and stock
- Low maintenance bearing
- Grease free bearing, protecting the environment
- Only forged steel main items, no casted parts
- High life cycle and reliability
- On demand with the feature of heel support for fish trawlers or similar vessels

Additional Options for optimizing:

- Layout with COUNTLESS rudder bulb as extension of the propeller cap
- Combination with all MM-Offshore Rudder Types like the flap rudder with a fully twisted leading edge to an EMPRESS / EMPIRE – Rudder
- Preparation of efficiency forecast by CFD-analysis with prestigious ship model institutes



„Power Package“ EMPIRE Rudder



Conventional Full Spade Rudder with Flap

The “power package”, the EMPIRE-Rudder provides a large pre-balancing and by the rudder flap an extremely high maneuvering characteristic for low and medium speed. Especially ships with many port operations like feeder vessels or vessels operating in difficult passage ways will show the best in class strength for operation of the vessel. Ships which have less maneuvering properties by large main dimensions like Multi-Purpose Vessels or ferries will achieve optimal operation in the narrow port spaces even by avoiding tug boats.

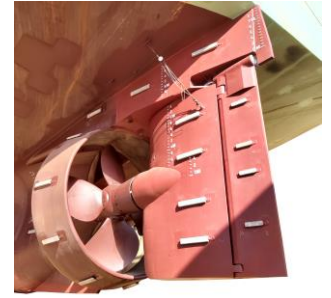
MM-Offshore recommend the EMPIRE-Rudder for the following vessel types:

- Medium Speed vessels
- Multi-Purpose vessels
- Module carriers
- Ro-Pax and ferries
- Small vessels with high maneuvering properties like AHTS, OSV's, research vessels

Key Facts:

- High maneuvering properties
- Simply installation and disassembly properties
- Low maintenance and water lubricated bearings and moving parts
- Operation angle of rudder blade up to 65°
- Operation angle of flap up to 100°





“Enhanced brilliance” Combination Rudder

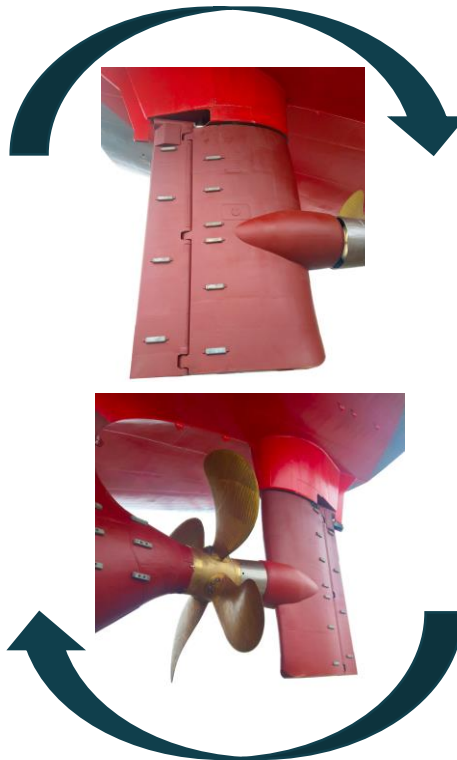
EMPRESS/EMPIRE Rudder

EMPIRE Rudder



Key Facts:

- Highest maneuvering properties
- Simple installation and disassembling properties
- Low maintenance and water lubricated bearings and moving parts



EMPRESS Rudder



Key facts:

- Full-twist leading edge for reducing the resistance, power and fuel consumption
- Outstanding „performance partnership“ between propeller and rudder
- Cavitation risk reduced to a minimum

The EMPRESS/EMPIRE-Combination Rudder provides the best possible combination of highest maneuvering properties and energy efficiency. Ships like feeder vessels or Ro-Pax ferries are using this type of rudder system. Further many tankers or bunker vessels are equipped with the EMPRESS/EMPIRE – Combination rudder system. Especially under consideration of raising efficiency requirements, this rudder system can offer you efficiency gains without compromise on maneuvering properties.

MM-Offshore recommend the EMPRESS/EMPIRE-Rudder for the following vessel types:

- For all speeds
- Ro-Pax and ferries
- Tanker and bunker vessels
- Module carriers
- Multi-Purpose vessels



„Topmodel“ EMPRESS Rudder

Full Spade Rudder with Full-twist leading edge

The „Topmodel“, because of its full-twist leading edge the EMPRESS-Rudder provide an optimum performance and efficiency. The wake-field based design of the rudder enable the highest level of power and fuel savings. The result of this optimized co-operation is the achievement of requested power savings. A further reduction of cavitation is possible with the EMPRESS-Rudder, which is positive for the durability and sustainability of the rudder and the whole vessel.

MM-Offshore recommend the EMPRESS-Rudder for the following vessel types:

- Medium & high speed vessels
- Large and ultra large container vessels
- Naval / Military vessels
- Special vessels like cruise liner and other ferries
- In general this type of rudder fits to a wide range of vessels

Key facts:

- Full-twist leading edge for reducing the resistance of whole hull
- Outstanding „performance partnership“ between propeller and rudder, caused by the wake-field based optimization
- Noise reductions in the aft end section of vessel
- Outstanding maneuvering and course keeping properties
- Cavitation reduced to a minimum
- Power & Fuel savings on highest level





COUNTESS Bulb

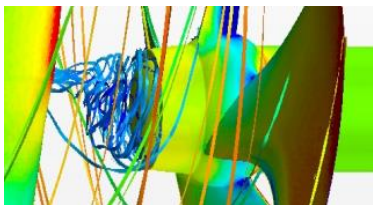
„Equalizer“

Rudder bulb solution

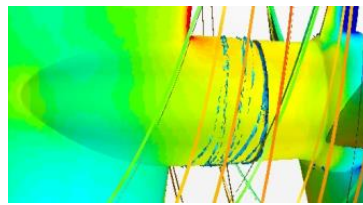


Facing the tremendously raising requirements in respect carbon foot print regulations, the MM-Offshore GmbH can support owners with the COUNTESS rudder bulb solution. Adding the COUNTESS rudder bulb to a new building rudder brings huge benefits in the EEDI. Further the good possibility to provide the COUNTESS rudder bulb to existing rudders of the sailing fleet can contribute a major positive figure to the EEXI and CII.

Problem



Solution



1.5% to 4.5% savings in P_D

Key facts:

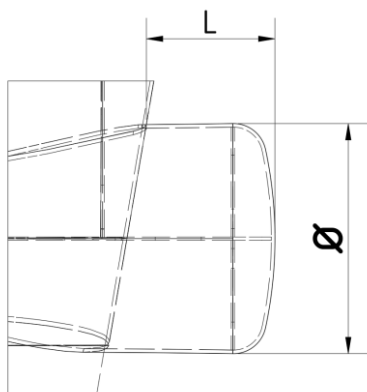
- Absorbing the hub vortex
- Improving the efficiency by raising the propulsion efficiency of propeller
- Lowering the risk of hub vortex cavitation
- Avoiding of "jumping" of hub vortex
- Avoiding of "negative" thrust by splitting of contraction

- Best energy savings for new building and retro-fit
- Reasonable ROI in case of retro-fit to existing rudder
- Design prior to scheduled docking
- Short installation time for retro-fit

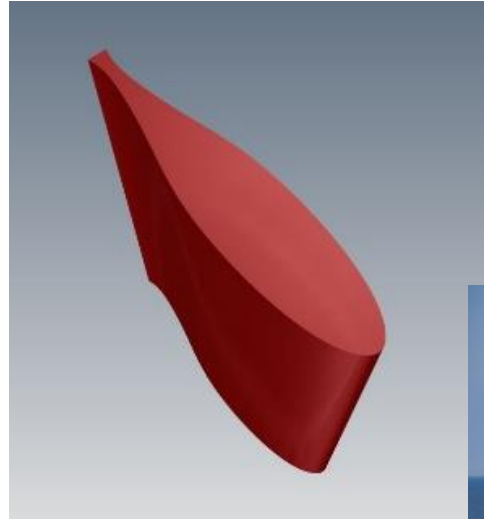


MM-Offshore recommend the COUNTESS-Bulb for:

- All kind of vessels
- New Building
- Retro-fit Projects



| Standard Series for reference | No. | Ø bulb [mm] | L1 [mm] | L2 mm] |
|-------------------------------|-----|-------------|-----------|------------|
| | 1 | 800 | up to 300 | up to 600 |
| | 2 | 900 | up to 300 | up to 600 |
| | 3 | 1000 | up to 400 | up to 800 |
| | 4 | 1100 | up to 400 | up to 900 |
| | 5 | 1200 | up to 500 | up to 1000 |
| | 6 | 1400 | up to 600 | up to 1000 |
| | 7 | 1650 | up to 700 | up to 1100 |
| | 8 | 1850 | up to 800 | up to 1200 |



„Basic“

PRINCE Rudder

Conventional Full Spade Rudder with fish tail profile

The “base model”, the PRINCE-Rudder provides with its maximum rudder angle and its fish tail profile the application for a large range of ships. Vessels with short distance trips and frequent port operation should be equipped with the PRINCE-Rudder. Furthermore vessels like bulk carrier or VLCC gets their benefits by the high lift of the PRINCE-Rudder.

MM-Offshore recommend the PRINCE-Rudder for the following vessel types:

- Medium Speed vessels
- Large vessels like Bulk Carriers or Tankers
- Vessels with short distance intervals and frequent harbor operation

Key Facts:

- Large rudder angles with extremely maneuvering properties
- High Lift properties
- Reducing the induced resistance of the rudder by overhanging top and bottom plate
- High course keeping properties





"High Quality Main Components"

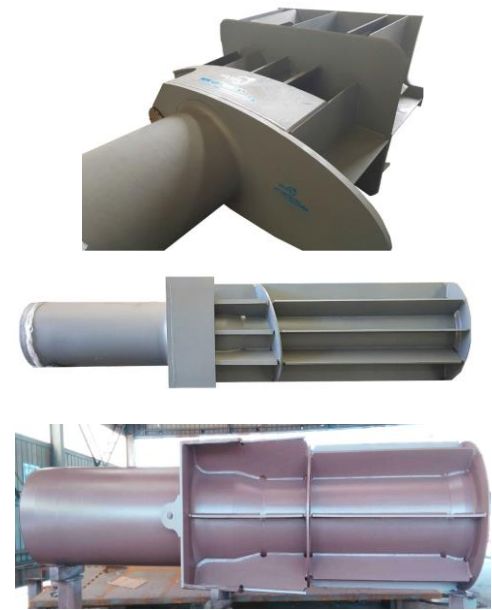
Rudder Blades



Rudder Stocks



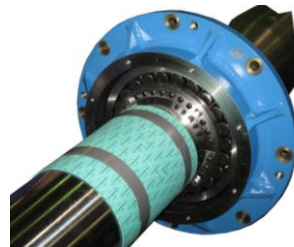
Trunk Sections



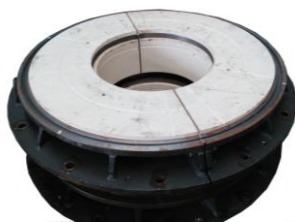
"High Quality Accessories"



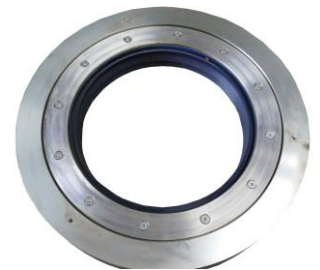
Carrier Bearing - Sliding Unit



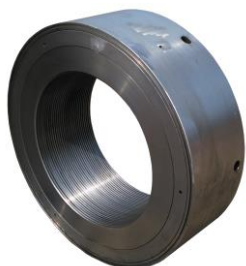
Carrier Bearing - Spherical roller bearing fitted to housing and rudder stock



Carrier Bearing - Bearing Unit



Upper Stuffing Box- with synthetic rudder stock sealing



Lower Hydraulic Nut

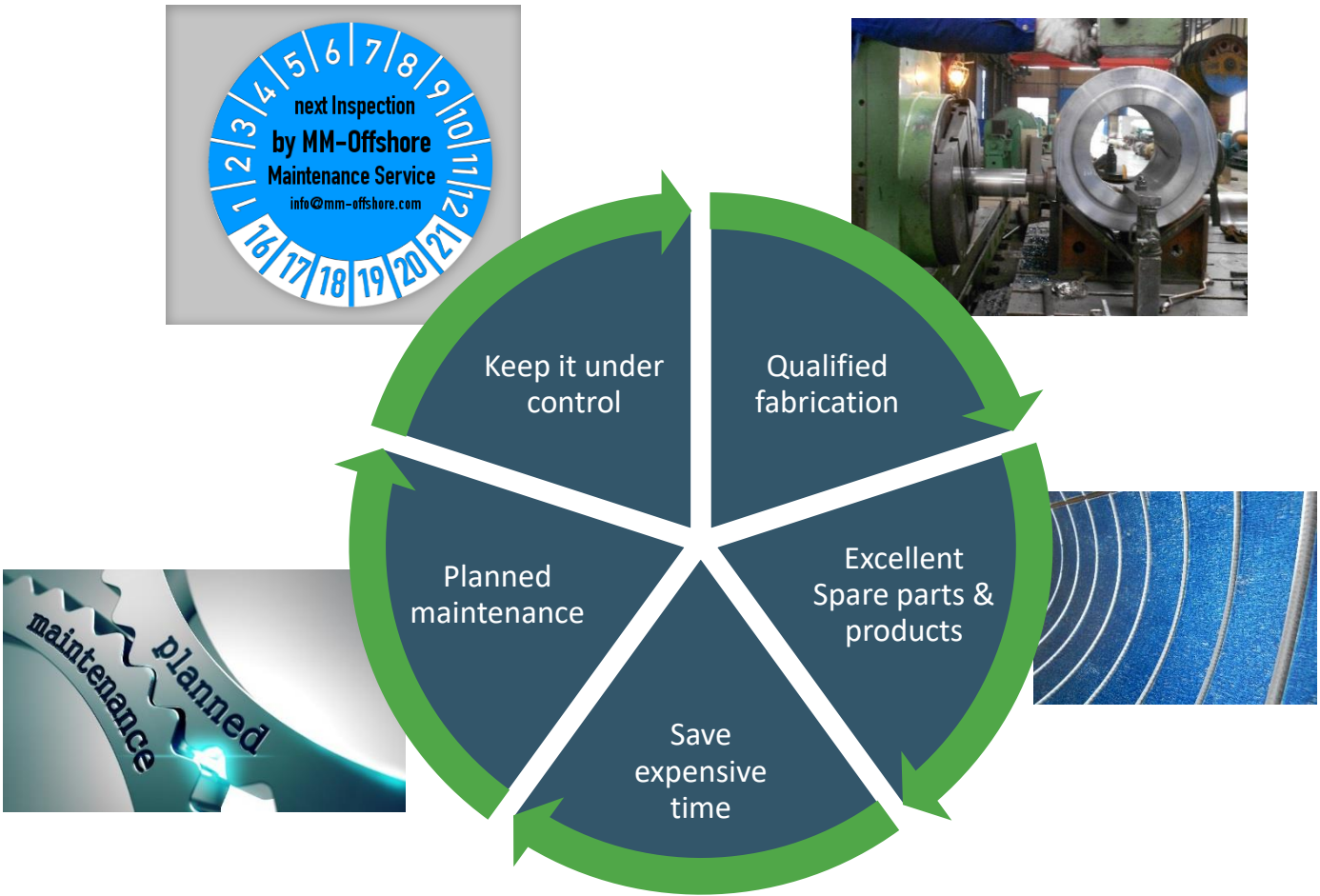


Synthetic Bearing Bushes



Installation and measuring tools

Service & Repair



MM-Offshore assists you to keep the course:

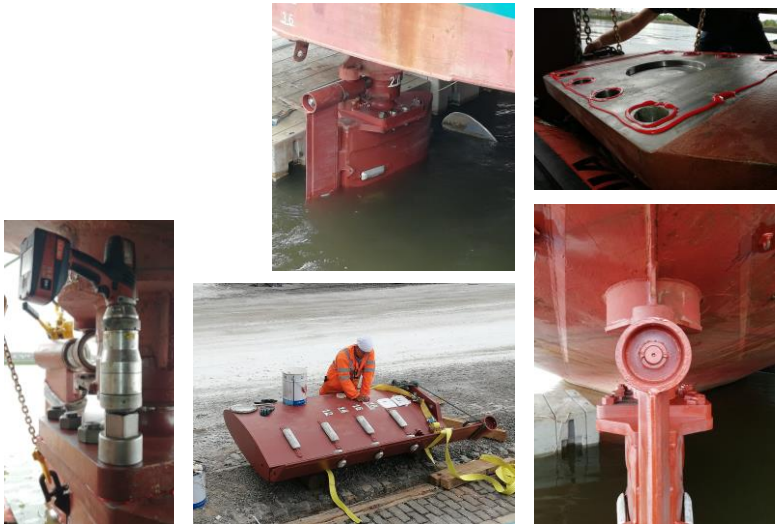
Our service offers all facets of different solutions - from the fabrication of tailor-made spare parts up to the planned maintenance - which you need to ensure a smooth flow of your vessel in service.

The MMO network of experts will help you for the execution of maintenance inspections and provide you the spare parts -24/7.

Key facts:

- High quality spares
- Maintenance inspections
- Planned reliability in vessels service
- Overview and control
- 24 / 7 service time worldwide

Installation of a replacement rudder blade and stock to a floating vessel without dry docking





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