

Driving forces for leading fleets.

Marine propulsion solutions



EMPOWERING FORCES.



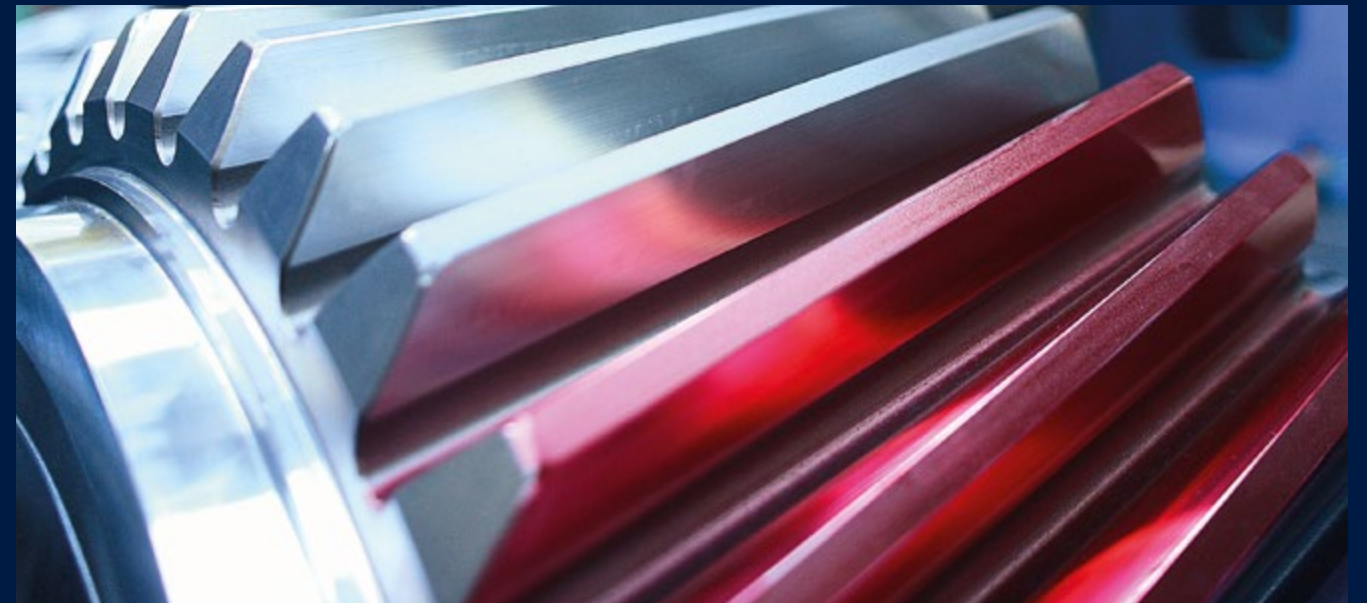
A tradition of excellence.

The RENK history of success

Precision, innovation and performance are the cornerstones of technical leadership. For over 140 years, the German technology company RENK has followed these principles. RENK is a leading innovator of power transmission technology in industries including power generation, vehicle, wind energy and defense.

We draw upon the combined expertise of our 2000 employees world-wide. Teamwork is the essence of our continuing success. It is the only way in which the creativity, commitment and personal dedication of each individual coalesce to bring about an outstanding product.

Virtually each and every product is unique and of unparalleled quality. It is only through the interplay of engineering expertise and manual skills that we can supply gear units that, despite their outstanding complexity, are impressive for their efficiency, dependability and durability.



Innovation and uncompromising technical precision make RENK a world market leader in power transmission technology and a most valuable partner of navies around the globe.



RENK solutions excel through outstanding performance and exceptional endurance. They provide supreme drive power even under extreme conditions.



For many decades, Renk has stood for excellent German engineering quality in the development, production, testing, installation and service of marine propulsion systems.

At home on any ocean.

RENK marine propulsion systems

Quiet, smooth, powerful, and extremely efficient: these are the typical virtues of RENK propulsion systems appreciated by the world's navies and ship owners.

Tooth geometries perfectly adjusted to ensure quiet gear mesh, double-walled gear housings that eliminate resonance vibrations, advanced-engineered bearings for ideal power transmission or elastic mounting on the ship's base for much reduced noise levels – ever since the 1950s our power transmission systems have synchronized utmost efficiency with minimum-noise operation.

Out of such experience, RENK developed complete drive modules such as the RENK AED for electric propulsion. Additionally, the system integration as offered, by RENK is highly welcome.

What set out as a development for the naval sector is nowadays, thanks to RENK, contributing to a more comfortable sail on naval and commercial ships.



Italian Navy Carlos Bergamini class frigates with a 36 MW CODELAG propulsion plant onboard, featuring one gas turbine and the two electric motors on the propeller shafts. Gears produced in cooperation between RENK and Fincantieri.



38 MW mechanical CODAG cross connect propulsion onboard the USCG National Security Cutter, including one gas turbine and two diesel engines.



German Navy Baden-Württemberg class frigates with a 29 MW CODELAG cross connect arrangement including one gas turbine and the two electric motors in front of the gears



SIGMA Class Corvette of the Indonesian Navy with two 10 MW CODELAG diesel propulsion drives and each 1,3 MW electric motor



Turkish Navy MILGEM class corvettes with a 30 MW CODAG cross connect propulsion train onboard, including one gas turbine and two diesel engines.



Austal's Independence class Littoral Combat Ship (LCS) of the United States Navy with four separate waterjet drive trains, two gas turbines and two diesel engines, 65 MW total power.



South Korean Incheon class frigates with 2x24 MW traditional CODOG onboard, including two gas turbines and two diesel engines.



Lockheed Martin's Littoral Combat Ship Freedom class frigates (LCS) of the United States Navy with four waterjets in CODAG configuration, two gas turbines and two diesel engines, 85 MW total power.

Diversity in Consulting.

Our holistic process

RENK Project Development

The specialists at RENK have decades of experience in the design and manufacture of marine gear systems, having successfully completed hundreds of projects working hand in hand with numerous clients all over the world. Trust in what we can do together.

RENK's system's advice – how we can support

RENK's professional project development is the foundation for successfully achieving all the project objectives from development through to commissioning.

Together we develop

- A catalog of the relevant system propulsion requirements
- A selection of individually weighted evaluation criteria for the propulsion system.
- Initial proposals for a variety of propulsion system configurations.

We offer to conduct

- Analyses and determination of the main parameters of individual propulsion system configurations.
- An evaluation of various propulsion system options using agreed criteria and a determination of the degree to which the respective requirements have been met.
- Thorough vibration analysis of the entire propulsion system.

Finally we present

The results of our design study along with a fully elaborated recommendation for the configuration of the propulsion system.

RENK's system integration – the goals we share and pursue

In its role of systems integrator, RENK takes over the following functions:

- Provide advice in the compilation of the requirement specifications and a corresponding plan of tests and verifications for the propulsion system
- Review of the specification of the main propulsion equipment.
- Review of drawings, specification and calculations relevant to the integration of the propulsion system.
- Carry out vibration analysis on the propulsion system.
- Consolidate the interface data, compile and follow up interface specifications.
- Assist the shipyard during the commissioning phase as well as in harbor and sea acceptance trials.

Support throughout the life of your product

Once Integrated Logistic Support (ILS) has been established, customers can, especially in the long-term, benefit from the positive effects of ILS. For example, enhanced reliability and product availability mean much reduced reliance on servicing. And customers can carry out even major repairs quickly and straightforward for themselves. For the purpose of portraying as clearly and transparently as possible our range of services we have subdivided our logistics support into six segments which cover the central aspects and services of ILS:

- Logistic Support Analyses
- Services
- Spare Parts
- Tools
- Spare Parts
- Training
- Documentation



Innovative engineering, precise testing.

RENK's testing facility

RENK's testing facility provides state-of-the art functionality and technology. It is one of the few worldwide to allow customers to personally experience the testing in close proximity of drive systems and their components while safely protected from potential hazards. In a gallery around the test field they can follow the testing of their products in every detail, either on a monitor and through camera installations or live from the viewing platforms.

Maximum functionality – precise settings

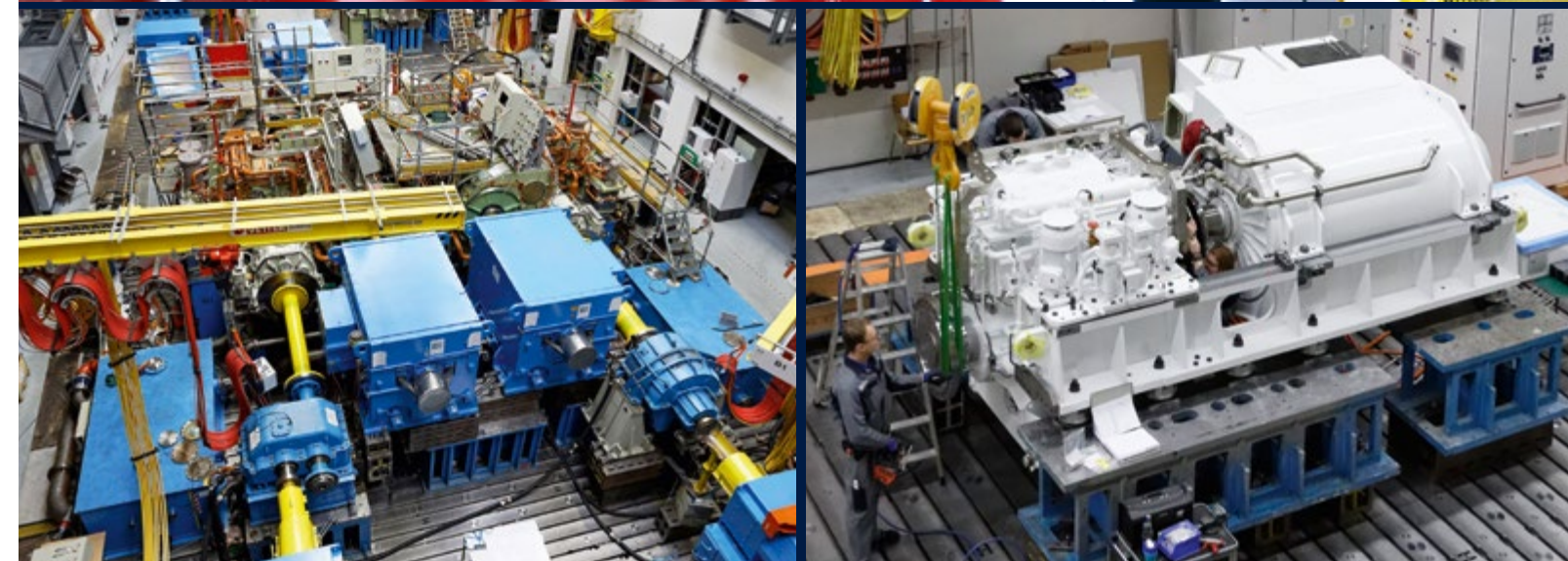
The extensive equipment allows various types of tests: from functional tests to performance tests, measurement of process parameters, as well as a highly dynamic response to the effects of structure and airborne noise. Tests for efficiency are also possible.

Perfect logistics – the dimensions of the testing facility

The testing area measures 1,250 m² and is subdivided into two large and two small test facilities housed in separate rooms of the building. This area is covered with slabs 30 cm thick and is anchored to reinforced concrete foundations up to 3 m thick for loads of up to 1,000 t. The cranes in place can lift loads of up to 200 t.

Performance specifications

With the aid of intermediate gears, test specimens can be subjected to torques of up to 500,000 Nm and maximum speeds of up to 20,000 rpm under loads of up to 12 MW.



100% consistent. Uncompromising quality.

RENK production competence

The consistently high quality of our products is founded on the principle of zero compromise. The most modern production equipment, continued monitoring, and our highly skilled experts are the basis for your satisfaction.

Heat treatment in one of Europe's finest hardening shops or precision-grinding gearwheel flanks, the exceptional quality of our products is attributable to longstanding in-house expertise. And this applies not only to production. RENK's quality philosophy is demonstrably everywhere: from the initial drawing board discussions via product development, production, inspection, assembly, commis-

sioning and start-up through to workshop training courses and after-sales service. Whatever the product, each is normally exposed to extreme and uninterrupted loads and so dependability is a core element of our corporate philosophy. Continuous measurements verify and document the quality of each individual production steps, and only products that have passed our thorough and uncompromising final inspection under load conditions are released for shipment.

After the products have been commissioned we're still at your side. During in-depth training we show you how to make sure the products are working to the utmost of their ability and how to best service and maintain them. Our all-in service packages make sure that you receive the expert support you require.

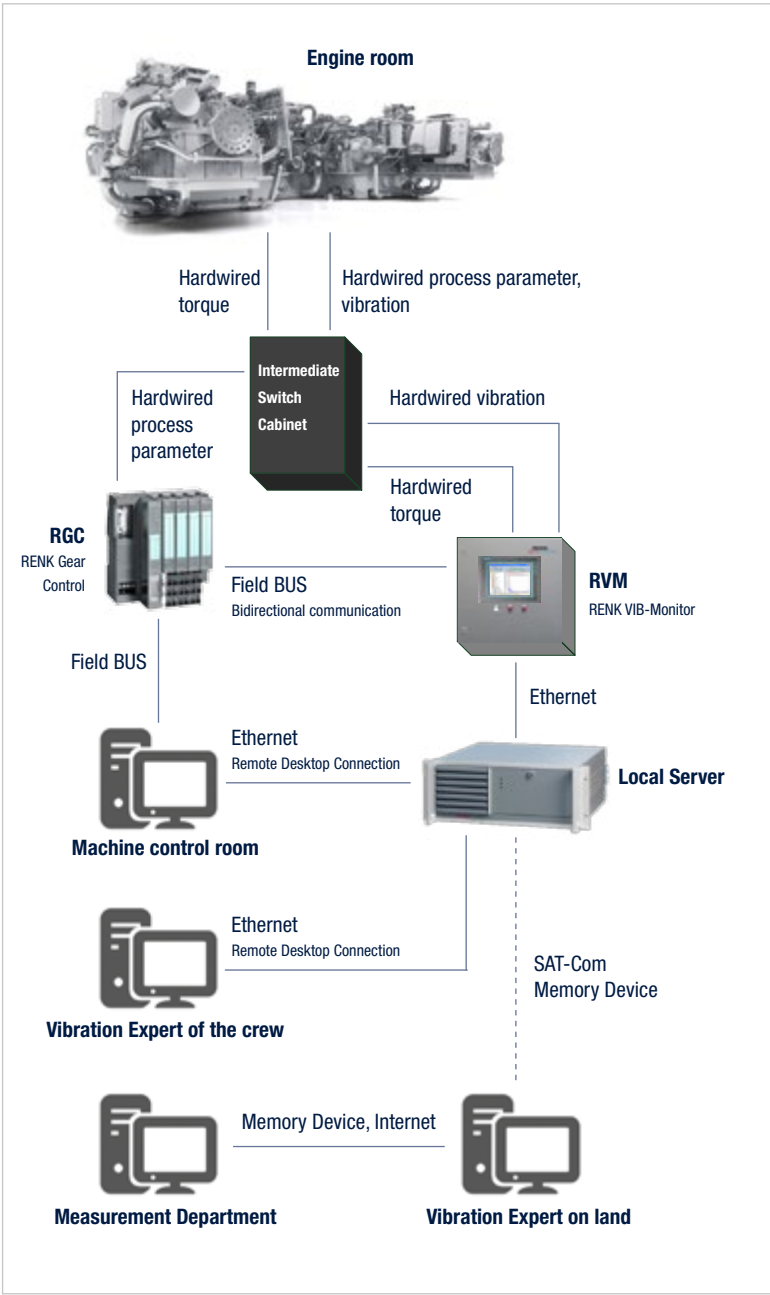


Intelligent condition monitoring.

With RENK, maximizing availability and reducing life-cycle costs is easy. By introducing the RENK VIB-Monitor, this extensive state-of-the-art condition monitoring system provides a broad range of data. With its smart machine management it supports the equipment operator, preventing damages and facilitates economical maintenance planning.

The RENK VIB-Monitor performance

- Continuous observation of all major parameters of driver, couplings and gearboxes
- Recording, saving and analysing with software easy to handle
- Simple integration with standardized communication interface
- Support via extensive and intuitive visualisation
- Optional support by clearly represented RENK reporting



RENK AED[®] – Advanced Electric Drive.

Electric motors represent a technically proven and increasingly popular option for marine and hence naval, mega yacht or research vessel propulsion systems.

In contrast to electrical direct-drive systems with their large, bulky and heavy motors running at propeller speed, RENK's AED[®] is a high-speed motor with reduction gear units where the electric motor and the gearing are installed on a common raft that is elastically mounted. This has the advantage of a compact footprint, easy installation, low weight, and incomparably quiet operation.

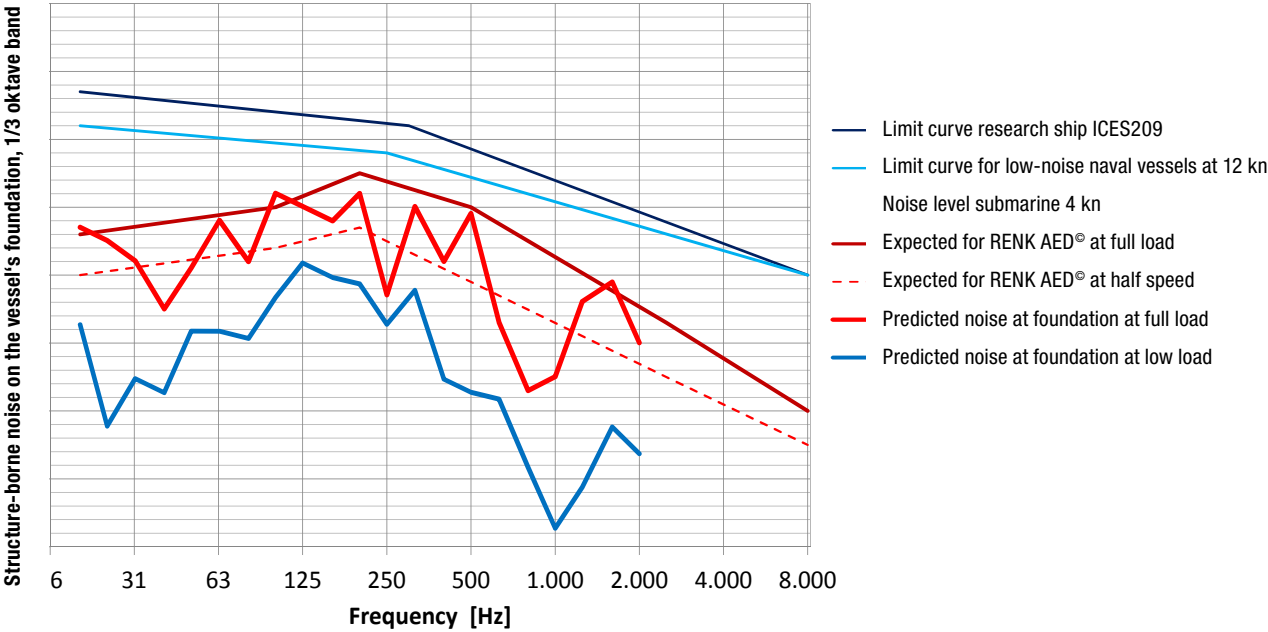
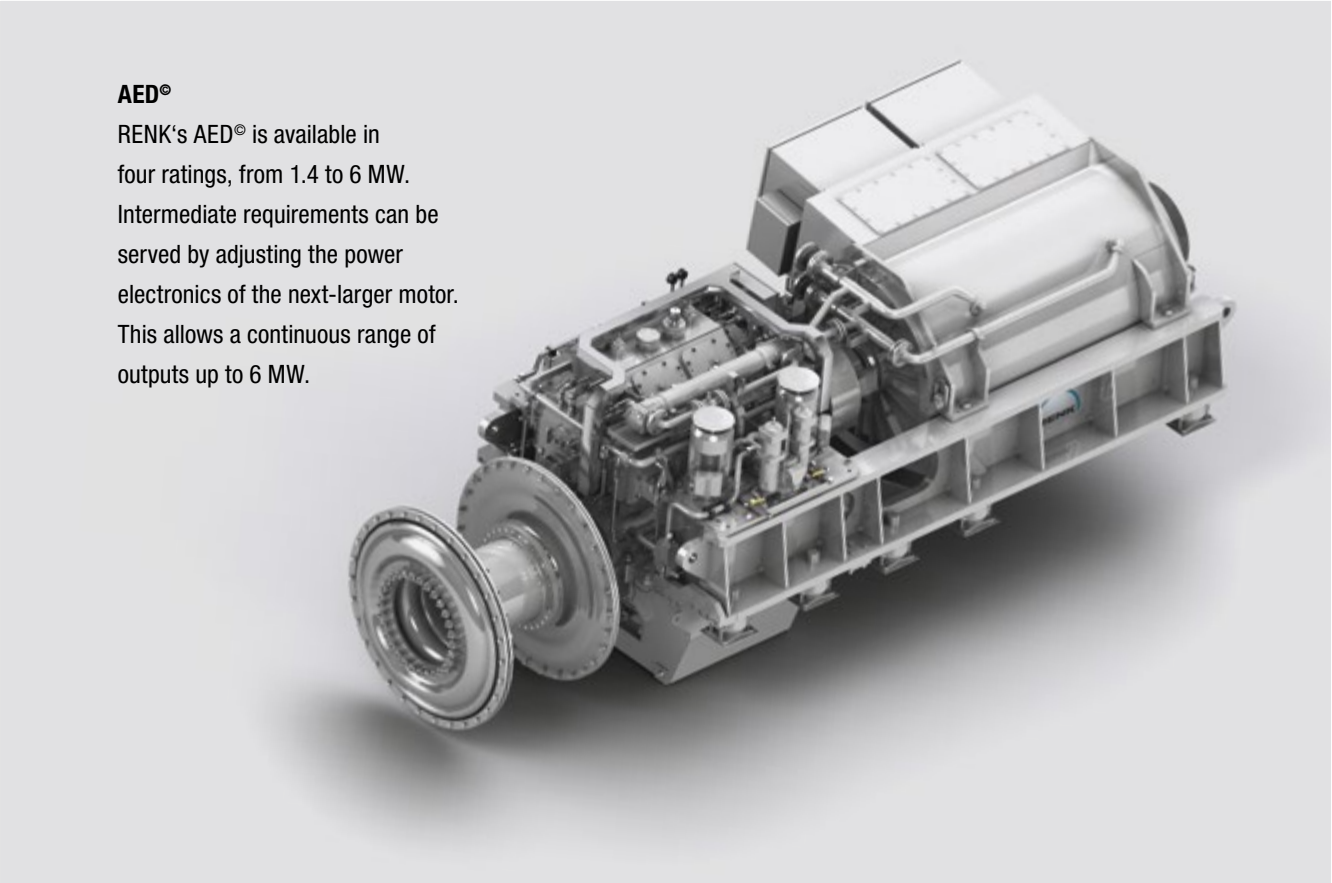
Applications for RENK AED[®]

- Corvettes, frigates: silent running at low speed
- Mega yachts: low-noise main propulsion
- Submarines: low-noise main propulsion
- Research vessels: low-noise main propulsion
- Fishery protection vessels: low-noise main propulsion
- Special vessels such as cable- or pipe-laying ships: main propulsion

In all these applications, RENK's AED[®] integrates perfectly with the on-board electrical system and replaces the commonly used direct-drive motor.

Features

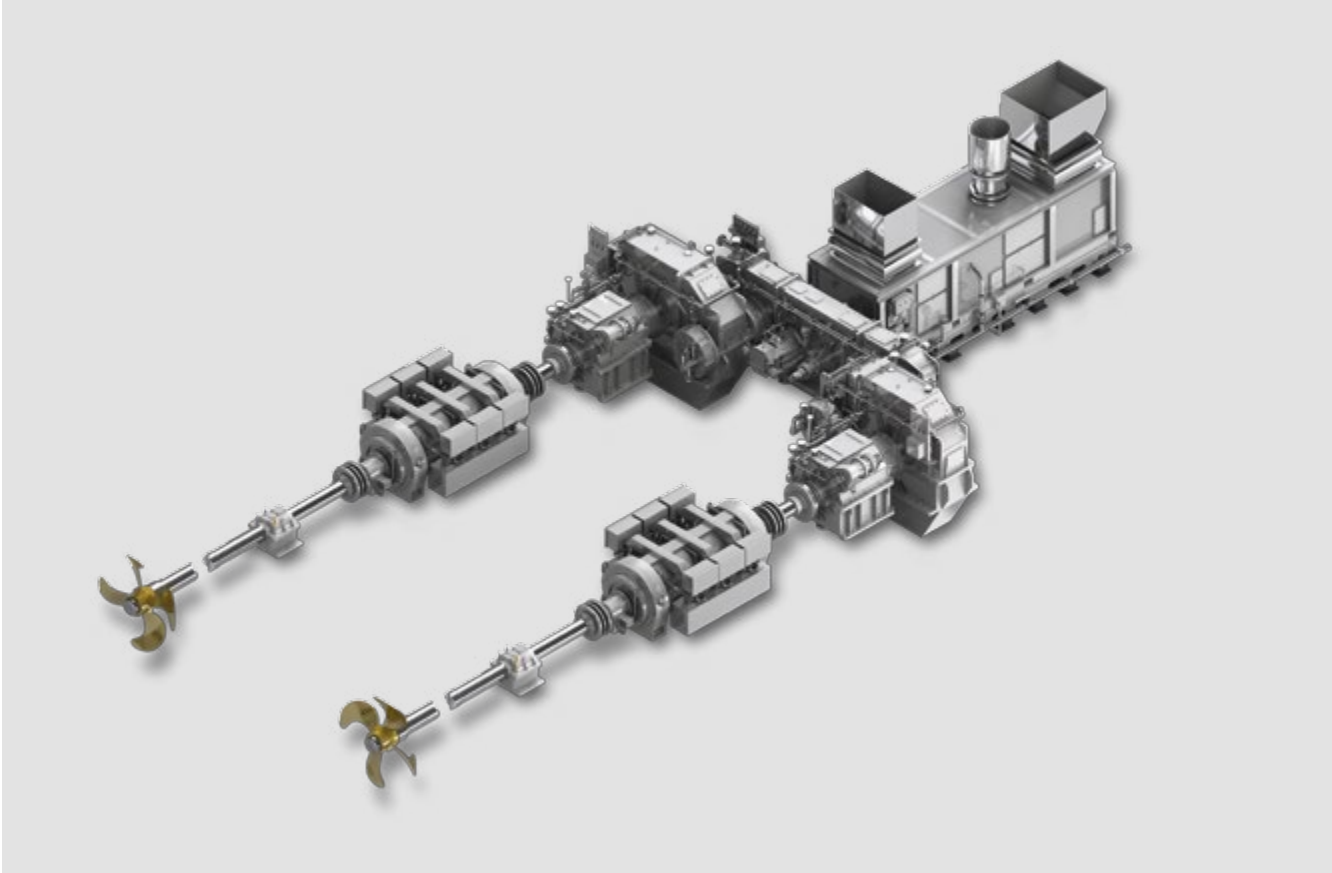
- Pre-assembled very straight forward modular installation
- Compact and ultra-lightweight, 40 percent less than a direct-drive motor
- Very low installation height
- High-elasticity propeller coupling prevents noise radiation
- Low-noise operation thanks to water-jacket cooled electric motor, low-noise gear unit, specially developed soft-elastic mounting
- Suitable for both fixed and controllable pitch propellers
- The lowest noise level to naval standards, so no special adjustments needed
- Output speed adapts flexibly to propeller requirements
- Standard components, therefore low maintenance input





RENK, the drive behind leading fleets.

Leading fleets are distinguished by their speed. And their reach. And their low signature. Their performance profile may be very different, but they have one thing in common: RENK drive technology. RENK is the force behind many of the best known and most innovative fleets.



Superior Technology for Naval Gears.

FREMM

For the Italian Navy, RENK delivers the main propulsion system for ten frigates of the Bergamini class FREMM type frigates.

The propulsion system for these frigates consists of one 32 MW gas turbine and two 2,1 MW electric motors in a CODELAG arrangement, by which all three drivers generate simultaneously the power for maximum speed. Cruise speed is being served for with the electric motors only, the gas turbine is used for high speeds.

It was the world's first drive of this type. Fincantieri S.p.a. designed the vessels and continues to commission one ship per year. RENK designed the sophisticated CODELAG gear set and manufactures in the frame of a cooperation agreement with Fincantieri the hardware components.

It consists of a cross connect gear transferring the power from the gas turbine to both propeller shafts. Main gears are connected with the shaft lines via as specialty newly developed clutch systems RENK APC for disengagement of the gears in electric motor modes. Proven RENK gear technology such as double helical gearing for lowest noise levels is applied throughout the entire gear train.

Superior Technology for Naval Gears.

NSC Deepwater

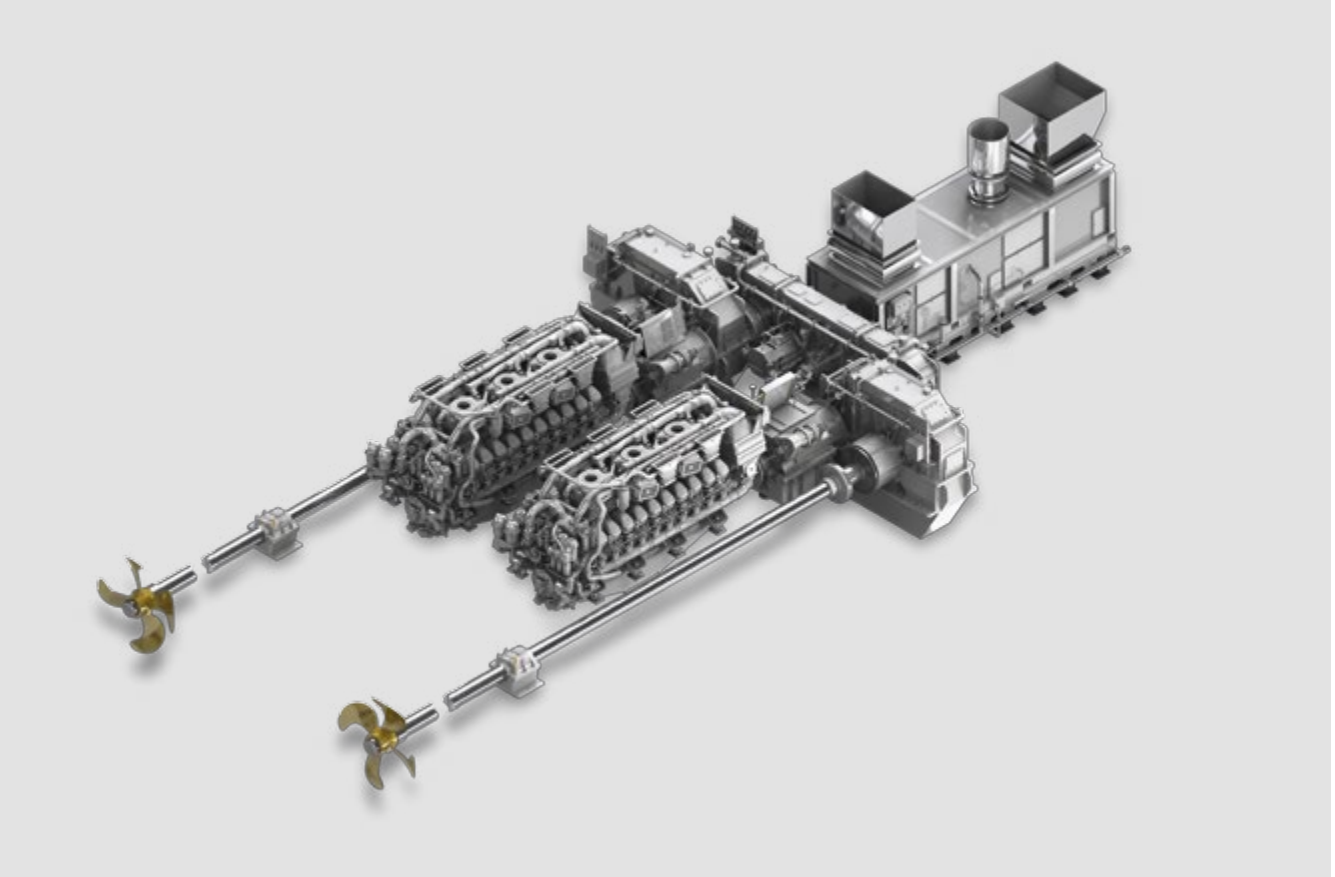
Mechanical propulsion systems with combining gears provide the combination of gas turbines and diesel engines. In particular RENK CODAG propulsion gears (combined Diesel And Gas turbine) have been implemented with a wealth of applications such as the German Sachsen-class frigates or the US Coast Guard National Security Cutters.

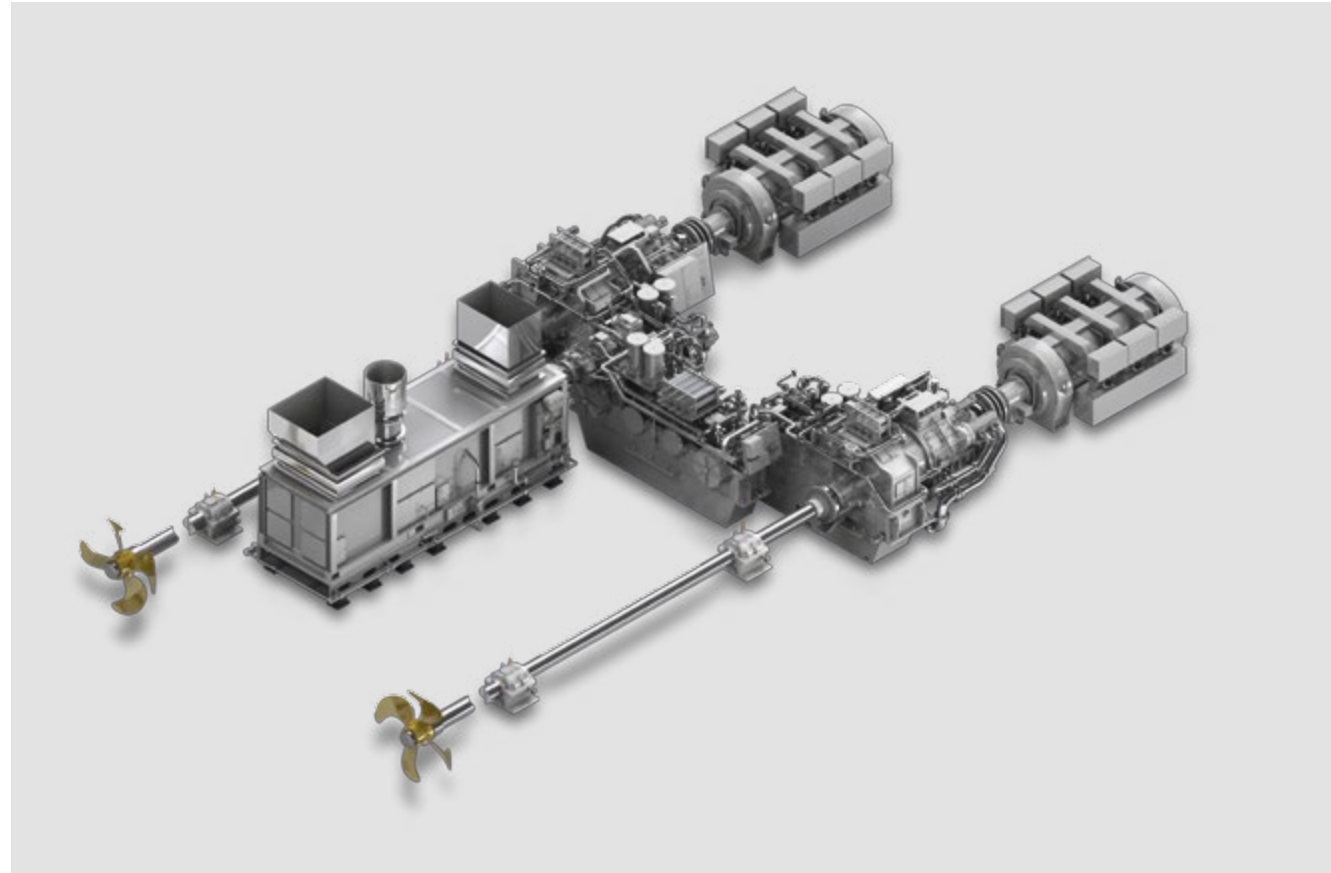
Based on the excellent experience with the first worldwide CODAG application on the German frigate F124, RENK was awarded the project for similar propulsion systems for the National Security Cutters (NSC) of the United States Coast Guard. The propulsion plant features one gas turbine and two diesel engines as prime movers, the RENK CODAG gear system and two controllable pitch propellers as propulsors. The gear plant consists of two main reduction gears and one cross connect gear. The main gears include a two stage input unit for the diesel engine to accommodate the reduction ratio for cruising speed with a high gear ratio, and, for sprint speed, a low gear ratio.

Aided by a programmable logic control system, the following different propulsion modes can be automatically accomplished:

- Loitering mode with one diesel engine driving both propellers; half of the power is transmitted to the propeller on the opposite side via the cross connect gear.
- Cruise mode with both diesel engines operating both propellers independently.
- High speed mode with the gas turbine driving both propellers.
- Sprint speed with the gas turbine and both diesel engines driving simultaneously the propellers (CODAG mode).

The different drive modes and the appropriate gear ratio for the diesel engine are achieved with electronically controlled multi disk clutches, the gas turbine is automatically engaged and disengaged by an overrunning clutch. Fluid couplings on the diesel engine inputs provide damping of torsional vibrations and smooth operation. Approved RENK thrust bearings are included in the main reduction gears to safely transmit the propulsion power to the hull. All gears are accommodated in sleeve bearings for maintenance free and quiet performance. Case carburized, precision ground double helical gears guarantee reliable and noise optimized operation.





Superior Technology for Naval Gears.

German Navy F 125

The propulsion system for four frigates consists of two 4.5 MW electric motors and one 20 MW gas turbine driving a main gear unit on the port side and starboard side respectively. A cross-connect gear interconnects these two gear units.

Depending on the cruising condition, the two electric motors and the centrally located gas turbine can drive both propellers independently or together: the electric motors are used for slow speed drive whereas the gas turbine and both electric motors running at the same time (CODELAG) are used for sprint speed.

The electric motors are positioned forward of the gear unit and drive the propeller shaft directly without a reduction gear stage via shiftable multi-disc clutches through a hollow shaft arrangement. In this low speed mode the gear train is not rotating and thus the gears would not generate any structure borne noise. The gas turbine is linked to the cross-connect gear via an over-running clutch. A special feature is the arrangement of the clutch between electric motors and main gear unit.

Two coaxially arranged shiftable multi-disc clutches between the electric motors and the gears transmit power to the propellers in the various drive modes. A sophisticated control system – equally part of RENK's scope of delivery – ensures smooth switching between all operating states – which is a further proven characteristic of RENK's gear unit systems.

The finest service at your service.

Sure. Knowledgeable. Dependable.

Our strategy is very simple: to provide service of exceptional quality to ensure the full availability of your systems throughout their life. A service that protects your capital assets. Day after day, around the clock, around the world. A strategy we pursue with profound passion.

We're there at your side. For the lifetime of the equipment.

Our experienced service team will provide you with outstanding technical support throughout the life of the equipment. You benefit from our expertise and ongoing product refinements as well as from the innovative resources backing the RENK brand. Whatever the need is, whether your equipment requires repairing or upgrading, or your staff need training – we're at your service.



We're repeatedly refining our service systems in order to provide perfect support for our customers at all times.



Repairs. For your productivity.

Our experienced service engineers carry out maintenance work worldwide that protects your capital assets – anywhere, anytime. Perfect planning, the availability of professional personnel and all the parts and special tools required make certain that the work proceeds smoothly at every stage. On-time completion to your satisfaction is just as assured as a transparent breakdown of costs. Our experience lets us keep servicing time short in order to maximize the availability of your equipment.

Always a step ahead with us.

RENK can upgrade your system to state-of-the-art technology: by retrofitting electronic controls, replacing outdated hydraulics or fully reengineering the hydraulics. An upgrade will include installing the newest PLC control systems for the gear units.

Sharing our knowledge. With you. For your success.

The operational reliability of your equipment hinges on the skills and qualifications of your human resources. In the course of our training sessions during which they acquire the necessary knowledge, we deepen their understanding of operational interactions and interrelationships with a view to reducing M&R costs and promoting the efficiency of your equipment. We put together training and certification programs individually tailored to your needs and applications to ensure a constantly high level of employee skills. Training sessions are conducted by our knowledgeable specialists – backed by longstanding experience in the design and production of propulsion systems and expertise in plant operation – either onboard the vessel or in our brand new training center.

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