

Marine Defense

WE MOVE YOU. WITH AGILITY AND POWER.

A Rolls-Royce solution

 πn



CONTENTS

01 Pioneering the power that matters.	04
02 System solutions	06
More than steel. More than diesel engines.	06
A lifetime of intelligent power.	08
03 Applications overview	10
Propulsion systems tailored to your needs.	10
04 Engines	12
Decisive action requires a strong heart.	12
All engines at a glance. Ready for duty.	14
05 Gensets	18
Gensets for service power and propulsion.	18
06 Propulsion systems	20
Combined propulsion systems - customized options.	20
07 E-Drive solutions	22
Higher performance. More flexibility.	22

08 Emission reduction technologies	24
Low emissions. Maximum flexibility.	24
09 Marine automation systems Controlling the power –	26
<i>mtu</i> NautlQ.	26
10 Lifecycle solutions	28
Our mission:	
Optimize your fleet and availability and uptime.	28
Genuine Spare Parts.	29
Technical documentation.	30
Factury overhaul.	31
Local Support - worldwide.	31
11 Technology and applications overview	32
Overview of engines.	32







PIONEERING THE POWER THAT MATTERS.

We at Rolls-Royce provide world-class power solutions and complete life-cycle support under our product and solution brand *mtu*. Fully utilizing the potential of digitalization and electrification, we strive to develop climate-neutral drive and power generation solutions that are even cleaner and smarter and thus provide answers to the challenges posed by climate change and the rapidly growing societal demands for energy and mobility. We deliver and service comprehensive, powerful and reliable systems, based on both gas and diesel engines, as well as electrified hybrid systems.

A solution provider

mtu systems power the most modern yachts, the strongest tugboats We at Rolls-Royce spend every day working together with our and the biggest land vehicles and provide energy for the world's most customers, to deliver engines, systems and complete life-cycle important mission-critical applications. With advanced solutions such solutions that best fit their needs. We understand that each as microgrids we integrate renewable energies and manage the application is different and has its own specific demands. Our power needs of our customers. engineers embrace the challenge of finding the perfect solution for your unique power requirements. Every step of the way - from project For over 110 years we have provided innovative solutions for our planning, through design, delivery and commissioning; to the lifetime customers - meeting even the most demanding drive and power care of your equipment - we are dedicated to helping you get the requirements. Our products and services span a wide range of most from your mtu investment.

applications and power needs, with both standard and customized options.

An expert in technology

mtu products are known for cutting-edge innovation and technological leadership. That same spirit of innovation inspires our sustainability efforts. Our focus is on developing and implementing system solutions that both maximize efficiency and reduce emissions - which in turn helps to reduce our impact on the environment

- 1 U.S. Coast Guard National Security Cutter CODAG 2x 20V 1163 TB 93, gasturbine
- 2 We are a reliable partner that sets trends. We look ahead to ensure the best results for our customers.
- and precision.

A passionate and reliable partner



You want to know more about *mtu* solutions?



3 We are passionate about fulfilling the needs of our customers with the utmost professionalism

4 As a supplier of high-quality performance propulsion solutions, we stand for the highest level of technological expertise.

System solutions

MORE THAN STEEL. MORE THAN DIESEL ENGINES.

Our engines and propulsion systems play an important role in many countries' armed forces. Our navy propulsion systems are based on *mtu* commercial shipping engines, thousands of which operate successfully all over the world. They are modified according to the special requirements of military and governmental vessels. High power density, low weight, compact design, and mechanical and thermal stability characterize *mtu* engines, just as much as simple operation, straightforward maintenance, and low life cycle costs.

> Ready for your missions More than half a century of experience and expertise makes us a strong partner – worldwide, whatever mission you are on.

System solutions

A LIFETIME OF INTELLIGENT POWER.

Our propulsion is with you all the way, from planning and design to operation. Our expertise in ship applications encompasses every possible propulsion configuration, including engineering services, hardware, and software. No matter how extraordinary your requirements, we can supply tailor-made solutions for vessels ranging from small patrol boats to destroyers.

OPERATION

Integrated Logistics Support

Every client is different. Our comprehensive Designed to meet the unique challenges of Naval Operations, Integrated Logistics Support (ILS) delivers mtu ValueCare service solutions portfolio allows a customized package – including analysis, spare parts, us to tailor offerings for each individual customer training and technical documentation – designed to aimed at maximizing performance, uptime, and keep your *mtu* equipment up and running and help you lasting value – at every step: reduce costs throughout the entire life cycle.

PLANNING AND DESIGN

Planning

We supply a complete propulsion solution. Our engineers provide extensive analysis, documentation, and risk mitigation services as well as integrated mechanical, electrical, and electronic interfaces.

Propulsion system integration

We provide comprehensive engineering and technical support for the design and implementation of a vessel's propulsion system. Our PSI team helps to reduce design, installation, and commissioning costs.

PROCUREMENT AND CONSTRUCTION

Propulsion systems

Our engines and propulsion systems are characterized by their high power density, low weight, and excellent response behavior as well as simple operation, optimized maintenance, and low life cycle costs.

CODelAD 2 × 16V 8000 4 × 12V 4000 2 × gearbox 2 × e-drive

Integrated automation system

Our mtu NautIQ marine automation solutions allow operators to monitor and control the whole propulsion plant, the onboard power supply, and the entire vessel. Our automations systems are versatile, user-friendly, and modular.

09

mtu ValueCare

 Complete support and service solutions encompassing spare parts, on-site support, technical documentation and customized support solutions

Modernization

The modernization of propulsion and automation systems is a cost-effective way of preserving and improving fleet availabilty. Our services include the supply of equipment and the planning and implementation of the entire refit.

- Diesel engines, stand-alone or packaged in propulsion modules
- Gensets for service power and propulsion
- Integrated ship automation, including complete propulsion control systems
- Shaft lines, propellers, and water jets Gearboxes

Applications overview

PROPULSION SYSTEMS TAILORED TO YOUR NEEDS.

0

Corvettes, frigates, destroyers

Corvettes, frigates, and destroyers have an impressive presence through their enormous versatility, their wide spectrum of use, and their extraordinary propulsion systems. With our engines and propulsion systems, they are superbly equipped for their demanding tasks.

Amphibious craft

When landing troops for an amphibious operation or landing supplies for disaster relief, you need to get them to their destination on time, delivered with the precision of a Swiss wristwatch. Our propulsion systems help you to keep to schedule wherever you are.

Large amphibious and support vessels Although not on the first line, support vessels are vitally important: they feed the fleet with vital supplies and transport troops and equipment where they are needed. That's reason enough to give support vessels propulsion systems that are always dependable – wherever they operate.

Submarines

The more specific and complex the demands, the more important and valuable expertise and experience are. We have been setting quality and performance standards for submarine engines for decades.

Patrol vessels

With a wide range of duties including police, coast guard, border control, and customs, inshore patrol vessels need propulsion systems with very fast responses. Mine countermeasure vessels We have always made propulsion systems for applications that require highly specialized knowledge and expertise. Our propulsion solutions for mine countermeasure vessels demonstrate this perfectly.

Offshore patrol vessels

Uneventful patrols at high sea can suddenly turn into serious operations. All the more reason to install a robust propulsion system which keeps going – whatever the situation. Engines

DECISIVE ACTION REQUIRES A STRONG HEART.

The higher the requirements and the more specific the application, the clearer the need for one of our propulsion systems, including *mtu* engines, gearbox, shaftline, and propeller/waterjet. We develop the optimum propulsion solutions for all individual tasks – solutions with the highest performance, greatest reliability and availability as well as superior agility.

ENGINE ROOM

04



Engines

ALL ENGINES AT A GLANCE. READY FOR DUTY.

Our customized solutions for large military vessels correspond to strict navy standards and guarantee:

- High reliability and availability
- A broad engine characteristic map and unlimited low load capability
- High power concentration despite low weight
- Excellent maneuverability and acceleration



- Substantial shock-proofing
- Low fuel consumption over the entire operating range
- Long maintenance intervals

Analytics

We use the most diverse analysis and simulation tools to develop state-of-the-art propulsion solutions. That includes vibration analysis, component strength verification, and dynamic response simulations of entire propulsion systems.

Series 8000 The powerful high-speed engine meeting maximum demands 7,280-10,000 kW (9,763-13,410 bhp) Available as: 16V and 20V



Series 1163

The proven, evolved engine for the naval sector 4,800-7,400 kW (6,4370-9,925 bhp) Available as: 12V, 16V and 20V



Series 2000 The powerful heart for maximum agility 400-1,939 kW (536-2,600 bhp) Available as: 8V, 10V, 12V, and 16V

Electronics

The latest generation of our electronic management system, Advanced Diesel Engine Control (ADEC), controls key systems such as fuel injection and turbocharging that improve fuel consumption, and emission levels as well as vessel performance.

Fuel injection

We optimize fuel combustion in the cylinder by means of its electronically controlled commonrail fuel injection system in combination with other technologies such as exhaust gas recirculation.



Aftertreatment

We offer exhaust gas aftertreatment systems such as selective catalytic reduction to meet IMO Tier 3 emission limits over the engine's lifetime.

Turbocharging

We develop and produce our own turbochargers for high-performance applications. Turbocharging helps to achieve low fuel consumption and high performance across a broad range of operating speeds.

Demagnetization

We are a leader in the field of propulsion systems with low magnetic and acoustic signatures, allowing us to reduce the magnetism of all ferromagnetic parts with our own method to a stable minimum.

Power range

The wide range of engines meet the most extreme demands that can be required from propulsion systems. Solutions include the highest performance, greatest reliability and availability as well as superior agility.

Mounting

Our engines are installed on special rubber mountings to reduce the transmission of structure-borne noise to the ship's hull. New active mountings support the passive rubber mountings and make their noise reduction far more effective.

17

Series	kW	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500	10,000	10,500
2000		400-	-1,939	kW																		
4000			746–4,	300 k\	W																	
4000 U83				1,30	00 kW	(1,500	kW*)															
1163											4,80	0-7,40	0 kW									
8000																7,280	-10,00	00 kW				
	* 0	ptional														Pla fo ma an	ease s r more arine	scan ti e infoi solutio	he QR rmatio ons techni	code n abo cal da	ut ta.	



Series 4000 One of the most successful heavy-duty engines ever 746-4,300 kW (1,000-5,766 bhp) Available as: 8V, 12V, 16V, and 20V



Series 4000 U83 The battery charging unit for submarines 1,300 kW (1,500kW*) Available as: 12V

18



Gensets

GENSETS FOR SERVICE POWER AND PROPULSION.

Our flexible genset solutions are tailored to your needs. You can order them in standardized or customized versions:

- Standardized gensets for cost-effectiveness and favorable lead times based on our proven Series 2000 and Series 4000 engines
- Customized gensets tailored to the specific requirements for the most challenging conditions

Based on our successful Series 2000 and Series 4000 engines, they serve power demands between 330 and 3,015 ekW.

System support from a single source

Upon request, we can act as single-source vendor to take on the technical and commercial responsibility for the entire propulsion, power generation, and automation system – from project engineering and management to support and service. Consolidating these responsibilities reduces the number of interfaces and, therefore, the risks both to the shipyard and the end user.

University

Baseframes in different designs for different purposes





05

Resilient mounting system for acoustic and shock requirements

mtu advanced gensets are engineered and based on a proven design. Depending on your individual requirements, you can choose between a constant or variable speed configuration.

The characteristic feature of these gensets is its double-resilient mounting system, which reduces structure and airborne noise emissions that can significantly reduce the acoustic signature of the vessel.

Preinstallation of components such as filters directly on the base frame reduces installation work and space, allowing easy connection to the ships' interfaces and fast commissioning. All gensets are fully pretested at *mtu's* test facilities with respect to technical guarantees so that component function and readiness for operation on board are proven.

Overall, *mtu* advanced gensets provide the most attractive cost/ performance ratio on the market. The *mtu* Genset will be operated and monitored by the *mtu* genoline system including a local operating panel (LOP).



Propulsion systems

COMBINED PROPULSION SYSTEMS 06 - CUSTOMIZED OPTIONS.

We can deliver combined propulsion systems customized to your needs. You can rely on us to design, build, and integrate the complete propulsion system including gearbox, shaftline, propeller/waterjet, and automation systems. Our engineers provide extensive analysis, documentation and risk reduction services, as well as integrated mechanical, electrical and electronic interfaces.

Our propulsion systems demonstrate excellent reliability and flexibility. Our on-site engineers supervise the installation of the system, ensuring efficient propulsion system commissioning and trials. The automated control of the system is performed by an *mtu* Callosum_MC integrated propulsion control and monitoring system.

1 CODAD (Combined diesel and diesel) with controllable pitch propellers, e.g. 4 x 20V 8000

Four diesel engines power two controllable pitch propellers (CPP) through two main gearboxes. In cruising operation, one diesel engine powers both shafts; for maximum speed the other two diesel engines are also switched on.

2 CODAG (Combined diesel and gas turbine) and CODOG (Combined diesel or Gas turbine) with controllable pitch propellers, e.g. MT30 + 2 x 20V 8000

Two diesel engines and/or a gas turbine power both CPPs through two main gearboxes and a crossconnect gearbox. If only one diesel engine or only the gas turbine is running, the two CPPs are equally powered through the cross-connect gearbox. If both diesel engines are running, this gearbox can be declutched. Using a two-stage gearbox, one diesel engine can bring the ship to cruising speed. Top speed is reached with the gas turbine or diesel engines and gas turbine.

PROPULSION VARIANTS

SiSo single in / single out CODAD Combined diesel and diesel with controllable pitch propellers.

CODAG Combined diesel and gas turbine with controllable pitch propellers.

CODOG

Combined **d**iesel **o**r **g**as turbine with controllable pitch propellers.

3 CODelAG (Combined diesel electric and gas turbine) CODelOG (Combined diesel electric or gas turbine), e.g. MT30 + 2 x E-Engine

The diesel engines drive generators, which produce electricity for two electric propulsion motors. A gas turbine drives two propeller shafts with CPPs via a gearbox either alone or in combination. The dieselelectric propulsion units ensure the cruising speed of the vessel. Maximum speed is reached when the propulsion system of the vessel runs in combined mode, i.e. diesel-electric plus gas turbine.

CODelAD Combined diesel electric and diesel

CODelAG Combined diesel electric and gas turbine

CODelOG Combined diesel electric or gas turbine

E-Drive solutions

HIGHER PERFORMANCE. MORE FLEXIBILITY.

Hybrid propulsion systems such as E-Drive systems are ideal for more flexibility and maximum ease of use. What's more, conventional electric drive systems can be upgraded using optional battery modules to enable silent operations.

mtu hybrid propulsion for patrol vessels

The main advantages of hybrid systems for marine applications is to optimizes the vessel's maneuverability through its high system redundancy and flexibility.

In addition hybrid system are improved in reducing noise and vibration, the ability to enter ECA (Emission Controlled Areas) and the reduction of life cycle costs for the diesel main propulsion system through ideal engine utilization.

4 Gearbox 5 Electric motor module 6 Battery module

Innovative E-Drive solutions

Our mechanical, electrical, logical, and thermal system integration engineering helps manage the complexity of E-Drive systems. We design and supply customer-specific E-Drive systems including fully integrated automation systems based on the proven Series 2000 and Series 4000 marine diesel engines. While E-Drive propulsion systems require a higher initial investment than standard diesel-mechanical systems, they offer a number of benefits that

Example design of our hybrid E-Drive system

- 1 Electric motors
- 2 Gearboxes
- 3 Main diesel engines
- 4 Switchboard
- 5 Genset

20V 4000 Diesel Electric Drive

Emission reduction technologies

LOW EMISSIONS. MAXIMUM FLEXIBILITY.

The sea is a sensitive environment. Assuming responsibility for protecting the water and air and keeping them clean is second nature to us. We have always played a leading role in developing environmentally friendly engines and, in particular, solutions for reducing emissions. All the key technologies are bundled within our company.

Selective catalytic reduction solution

The airless SCR (selective catalytic reduction) solution developed by us is compact and maintenance-friendly. It has easily accessible doors for the replacement of the SCR catalysts. Highly flexible pipework options make integration easy for the shipyard.

The extra space needed for the exhaust gas aftertreatment system is reduced to a bare minimum. Ammonia slip is prevented under all operating conditions by a closed loop regulated control system.

SCR - the ideal solution for the marine world

We regard SCR as the preferred solution to maintain the reliability of our engines and the safety of your vessel and crew. SCR technology allows lower-quality fuel to be used. As well as reducing emissions, our SCR system also helps achieve lower noise levels.

Developing all major key technologies – such as SCR, exhaust gas recirculation, turbocharging, and common rail fuel injection in-house means we can design the ideal solution to meet IMO III and EPA Tier 4 emissions regulations.

SCR box designed as a cube, for assembling in horizontal direction.

Marine automation solutions

CONTROLLING THE POWER *mtu* NautlQ

Controlling power with intelligent electronics. As a systems supplier, we not only provide you with the perfect engine, but also with an automation system which is exactly adjusted to it.

mtu NautlQ offers a wide range of solutions

mtu NautlQ Master

mtu NautlQ Master is an Integrated Platform Management System (IPMS) and offers the optimal solutions to meet a wide range of requirements for all types and sizes of vessels. Typically used on military and complex commercial projects.

Our engines are powerful and technologically advanced. But in order to offer the best efficiency, reliability, safety, and environmental compatibility, they need more than just power. They need intelligent electronic management. Modern engine management systems handle the control and monitoring of the hardware and enable perfect performance. Our ship automation systems *mtu* NautlQ are designed to offer the ideal combination of performance and precision individually for your applications from a wide range of solutions.

You want to know more about *mtu* NautIQ? Scan the QR-Code or talk to our experts.

mtu NautlQ Core

mtu NautlQ Core Alarm and Monitoring System (AMS) option is an entry-level system that offers a reliable and highly cost-effective solution and is designed using pre-engineered building blocks incorporating built-in expansion for future proofing. A selection of display systems are available to meet operational requirements and console design.

mtu NautlQ Foresight

mtu NautlQ Foresight is an Equipment Health Management System (EHMS). It allows you to monitor and have full control over the technical condition of your vessel and your complete fleet.

mtu NautlQ BlueVision NG

Our standard automation systems are delivered ready for installation, perfectly matched to your propulsion system, giving you a complete package where everything is fine-tuned to your requirements: powerful engine performance, maximum efficiency, uncompromising reliability and green credentials.

mtu NautlQ Genoline NG

With the *mtu* NautlQ Genoline NG system, your engine and generator sets are optimized to work at their best, whatever the operating conditions.

Lifecycle solutions

OUR MISSION: OPTIMIZE YOUR FLEET AVAILABILITY AND UPTIME.

Integrated Logistics Support

Designed to meet the unique challenges of military operations, Integrated Logistics Support (ILS) offers customers a customized package that includes analysis, spare parts, training, and technical documentation. ILS keeps your *mtu* equipment up and running at the highest level of availability and reliability.

Our Integrated Logistics Support includes:

- RAM / LCC analysis
- Technical documentation
- Training
- Genuine spare parts and consumables

GENUINE SPARE PARTS

Only we can guarantee genuine spare parts that are designed, tested and approved specifically for *mtu* engines and systems to reach maximum uptime.

Genuine parts maximize performance, prolong engine life and meet today's strict requirements (e.g. emission regulations), all thanks to years of intensive research and development, quality audits, and progressive modifications - making them the best possible match for your engine and guaranteeing state-of-the-art technological fit. We offer a supply chain management, optimizing your purchasing and ordering processes

Please scan the QR code for more information about mtu's lifecycle solutions.

Take advantage of broad benefits of *mtu* genuine spare parts:

- Engineered to secure high engine reliability and availability
- Value sustainability of your equipment / the only parts that live up to **mtu** standards
- Factory / OEM warranty coverage incl. professional service support
- Long-term supply solutions through the entire equipment lifetime
- State-of-the-art Parts Logistics Centers

Non-genuine parts are simply not worth the risk of endangering your mission.

TECHNICAL DOCUMENTATION

Our high-quality technical documentation is easy to understand and available at the right time, in the right place and in proper format.

The *mtu* technical documentation can be individualized to specific propulsion system configuration in order to support the optimal fleet availability by providing the appropriate technical specifications for seamless operations on board and onshore.

Our scope: Manuals for Operation, Maintenance, Repair and Workshop Spare Parts Catalogs

- Available in all standard structures and formats
- Fulfills specifications: ASD S1000D, ASD S2000M
- Material number codification in accordance with the customer standards for the entire lifecycle

Configuration Management

Configuration management at *mtu* fulfills ISO 10007, STANAG 4159 and JSP886 in terms of content. Monitoring of design status and obsolescence to ensure supply availability and increase system availability with annual reports and updates of technical documentation. Logistic processes are ensured.

Scope of supply

Configuration management plan, obsolescence management plan, change memos if required, yearly reports and updates of technical documentation.

Interactive 3D Technology

New 3D visualization technology for systems, engines and components is available and fully interactive offering support for trainings with state-of-the-art technology for greater efficiency and clarity.

3D animated Maintenance Tasks

Animated step-by-step support for execution of maintenance and repair tasks. Format: HTML

Augmented Reality

AR for maintenance task descriptions with supportive functions and information.

Lifecycle solutions

FACTORY OVERHAUL

Turn back the clock.

mtu engines are built to last thanks to our high engineering standards and unwavering commitment to service and support. After a long and productive life, our factory overhaul can further extend it. Provided by the same experts who built the original engine, a factory overhaul restores it to like-new condition – delivering the same high standards of performance, service, life and quality as comparable new products.

LOCAL SUPPORT – WORLDWIDE

The most important part of your power system isn't a part at all – it's your local service team. With more than 1,200 service locations worldwide – backed by our own regional Parts Logistics Centers

 Vorte
 Vorte

 Vo

- Full factory warranty of the overhauled engine up to 12/18 months
- Fixed pricing options available or on time and material basis
 Complete reworking of all components by original manufacturer
- / specialist department e.g. crankshaft by OEM
- $-\operatorname{New}$ design and model-related updates incorporated
- Comprehensive packages for complete systems, including gearbox, coupling, etc.
- Rigorous dynamometer testing under simulated customer-specific operating conditions

in Europe, Asia, and America - you can count on responsive support by expert technicians, wherever the next mission takes you.

Technology and applications overview

OVERVIEW OF ENGINES.

Application group >	Mechanical propulsion engines	1A	1B	1D	1DS
	Fast attack craft			•	•
	Corvettes			•	
Marine naval vessels	Frigates and destroyers				
	Amphibious craft				
	Large amphibious and support vessels				
	Mine countermeasure vessels				
Submarine					•
	Small patrol craft				
Patrol vessels	Coastal patrol craft				•
	Large patrol vessels > 120 ft.	•	•	•	•

1A engines for vessels with unrestricted continuous operation Average load: 70–90% of rated power; rating definition: ICFN, fuel stop; typical annual usage: unrestricted*

1A engines for vessels with unrestricted continuous operation Average load: 60–80% of rated power; rating definition: ICFN, fuel stop; typical annual usage: 5,000 hours*

1D engines for fast vessels with intermittent load factors

Average load: ≤60% of rated power; rating definition: ICFN, fuel stop; typical annual usage: 3,000 hours*

1DS engines for fast vessels with low load factors

Average load: ≤60% of rated power; rating definition: ICFN, fuel stop; typical annual usage: 1,500 hours*

Engine power in kW	Main propulsion							
Engine	1A	1B	1D	1DS				
Series 2000	400-800	720-1,440	810-1,630	932-1,936				
Series 4000	746-2,240	1920-3,600	_	2,340-4,300				
Series 4000 U83	1,300 (1,500**)							
Series 1163	_	4,800-6,000	5,200-6,500	5,920-7,400				
Series 8000	_	7,280-9,100	-	8,000-10,000				

	Onboard power						
Genset power in kWe	3A/3B	3A/3B					
Genset Frequency	50 Hz	60 Hz					
Series 2000	330-770	400-930					
Series 4000	760-2,600	895-3,015					
Series 4000 U83	1,300	(1,500**)					

** optional

_

For more information, or to download datasheets of the full marine solutions programm please scan the QR code.

NOTES

NOTES

Rolls-Royce Group www.mtu-solutions.com/marinedefense

and follow mtusolutions under:

Stay posted with more powerful information