Marine & Offshore

SOLUTION GUIDE

Edition 1/23, valid from 08/2023

mtu A Rolls-Royce solution

POWER TO PROTECT.
POWER TO PERFORM.

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 and the biggest land vehicles and provide energy for the world's most important mission-critical applications. With advanced solutions such as microgrids we integrate renewable energies and manage the power needs of our customers.

For over 110 years we have provided innovative solutions for our customers – meeting even the most demanding drive and power requirements. Our products and services span a wide range of 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.

A passionate and reliable partner

We at Rolls-Royce spend every day working together with our customers, to deliver engines, systems and complete life-cycle solutions that best fit their needs. We understand that each application is different and has its own specific demands. Our engineers embrace the challenge of finding the perfect solution for your unique power requirements. Every step of the way – from project planning, through design, delivery and commissioning; to the lifetime care of your equipment – we are dedicated to helping you get the most from your ***mtu*** investment.

1 © Northrop Grumman

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Selection guideline

MARINE AND OFFSHORE

Application group >		1A	1B	1D	1DS
Mechanical propulsion engines					
Yacht	Planing			■	■
	Semi planing			■	■
	Small displ.		■	■	■
	Large displ. > 120 ft.	■	■	■	■
Cargo ships & tankers	Inland freighters	■			
	Coastal ships	■			
	Sea-river ships	■			
Passenger ships	Tourist boats	■	■		
	Passenger ferries		■		
	Cabin cruisers ships	■	■		
RoPax ferries	Double-ended ferries	■	■		
	Fast ferries < 50 m	■	■		
	Fast ferries > 50 m		■		
Tugs & push boats	Tow & push boats	■			
	Harbour tugs	■	■		
	Coastal tugs	■			
	Escort tugs	■	■		
Offshore vessels & crew boats	Crew boats	■	■		
	Offshore supply ves.	■	■		
	Anchor handl. tugs	■	■		
	Pilot boats	■	■		
	Trawler (fishing ves.)	■	■		
	Firefighting ves.	■	■	■	
	Rescue vessels	■	■	■	
	Research vess.	■	■	■	
	Dredgers	■	■		
	Cable laying ves.	■			

The guideline on page 6 - 7 gives a rough overview which application groups can be considered for which type of vessel or business model. To allocate which application group suits your demands best, the intended annual usage and the expected load profile have to be considered.

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

Application group >		3A / 3B / 3C	3A / 3B / 3C
Power generation and diesel-electric propulsion		50 Hz	60 Hz
	On-board powergen	■	■
	Diesel-electric propulsion	■	■
	Emergency powergen	■	■

3C application is available and common for P-engines and emergency for offshore.

Selection guideline

OFFSHORE EXPLORATION & PRODUCTION AND OFFSHORE WIND APPLICATIONS

mtu **diesel engines for**

- Heavy lift vessel
- Diving support vessel
- Pipe-laying vessel
- Cable-laying vessel
- Subsea support vessel
- Well intervention vessel
- Accommodation vessel
- Drill ship
- Offshore wind converter station
- Fixed platform
- Tension-leg platform
- Jack-up rig
- Spar-type platform
- Normally unmanned installation (NUI)
- Conductor support system
- Compliant power
- FLNG
- Semi-submersible
- FPSO

mtu **diesel engines for**
power generation - constant speed

Application group >	3A	3B	3C
Power generation	50 / 60 Hz	50 / 60 Hz	50 / 60 Hz
Power generation	■	■	■
Electric firepump drives		■	■
Electric drilling drives	■	■	

The guideline above gives a rough overview which application groups can be considered for which type of vessel or business model. To allocate which application group suits your demands best, the intended annual usage and the expected load profile have to be considered.

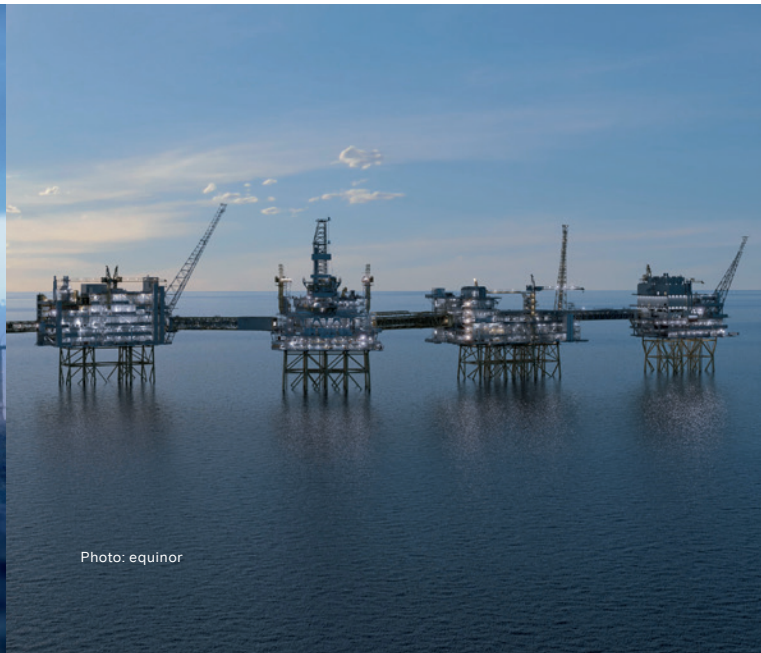
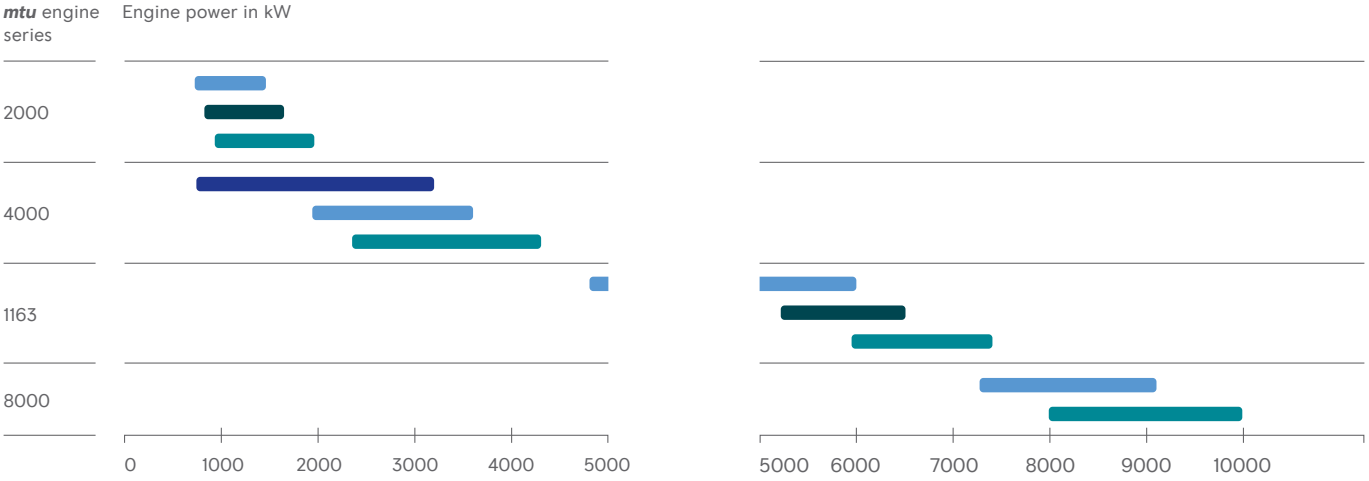


Photo: equinor

Power range

MARINE AND OFFSHORE

Main propulsion:



***mtu* engine power in kW**

Engines	1A	1B	1D	1DS
2000	–	720 – 1440	810 – 1630	932 – 1939
4000	746 – 3200	1920 – 3600	–	2340 – 4300
1163	–	4800 – 6000	5200 – 6500	5920 – 7400
8000	–	7280 – 9100	–	8000 – 10000

1A	Engines for vessels w/ unrestricted continuous operation
	Average load: 70 - 90% of rated power; Rating definition: ICFN, fuel stop; Typical annual usage: unrestricted*
1B	Engines for fast vessels with high load factors
	Average load: 60 - 80% of rated power; Rating definition: ICFN, fuel stop; Typical annual usage: 5000 hours*
1D	Engines for fast vessels w/ intermittent load factors
	Average load: ≤ 60% of rated power; Rating definition: ICFN, fuel stop; Typical annual usage: 3000 hours*
1DS	Engines for fast vessels with low load factors
	Average load: ≤ 60% of rated power; Rating definition: ICFN, fuel stop; Typical annual usage: 1500 hours*

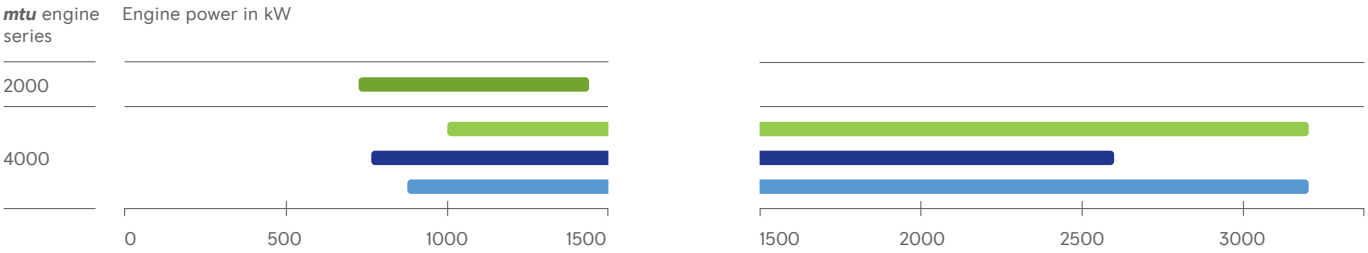
* Application groups (page 6-9) only indicate which ***mtu*** engine suits your demands best. For your type of vessel, you can also choose engines from other application groups than stated in the selection guideline.

Please note: 1A, 1B and 1D ratings are overload capable to 110% (ICXN) for factory acceptance test, but limited to 100% for operation. 1DS ratings are not overload capable at all (exception: 4000M93).

Power range

MARINE AND OFFSHORE

Marine on-board power generation, diesel-electric drives and generator sets: Fix speed and variable speed gensets



mtu engine power in kW – fix speed

Engines	3A / 3B	3A / 3B
Frequency	50 Hz	60 Hz
4000	760 - 2600	895 - 3200

mtu engine power in kW – variable speed

Engines	1B	1A
Speed range	~ 1200 - 2500 rpm	~ 900 - 1800 rpm
2000	720 - 1440	
4000		1000 - 3200

3A / 3B	Engines for onboard power generation and diesel-electric drive

Continuous operation 50 Hz;
Rating definition: ICXN, 10% overload capability
Continuous operation 60 Hz;
Rating definition: ICXN, 10% overload capability

1A	Engines for vessels w/ unrestricted continuous operation
1B	Engines for fast vessels with high load factors

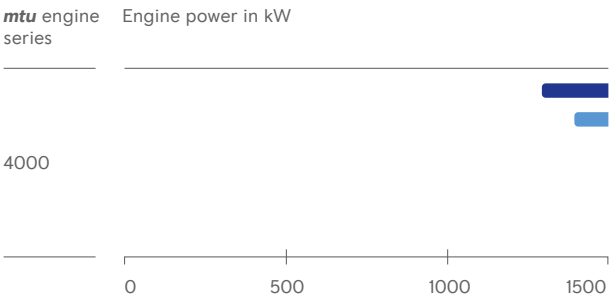
Continuous operation with variable speed / load;
Rating definition: ICFN, temporary 10% overload capability for load steps

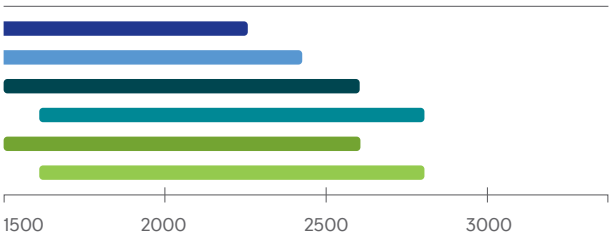
Application groups (page 6-9) only indicate which ***mtu*** engine suits your demands best. For your type of vessel, you can also choose engines from other application groups than stated in the selection guideline.

Power range

OFFSHORE WIND, EXPLORATION & PRODUCTION

Engines and gensets for power generation:





mtu engine power in kW

Engines	3A	3A	3B	3B	3C	3C
Frequency	50 HZ	60 HZ	50 HZ	60 HZ	50 HZ	60 HZ
4000	1350-2245	1455-2425	1560-2600	1680-2800	1560-2600	1680-2800

mtu genset power in kWe

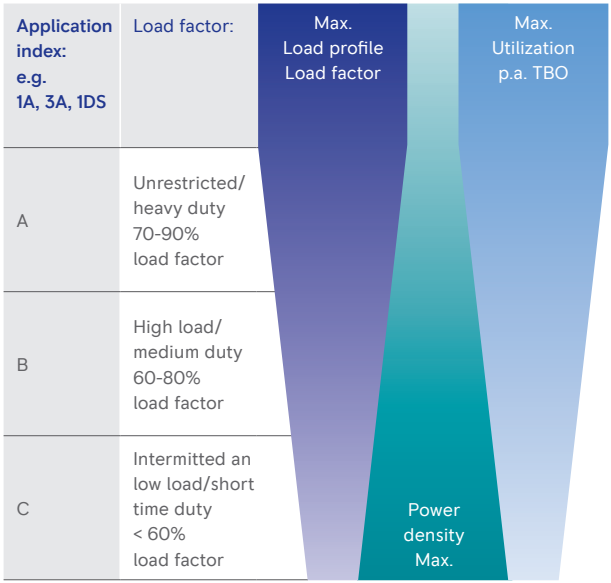
Gensets	3A	3A	3B	3B	3C	3C
Frequency	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
PP 4000	1295-2155	1395-2330	1500-2500	1615-2690	1500-2500	1615-2690

* alternator efficiency of 96% considered, excluding parasitic losses

Application groups (page 6-9) only indicate which ***mtu*** engine suits your demands best. For your type of vessel, you can also choose engines from other application groups than stated in the selection guideline.

3A / 3B / 3C	Engines for power generation, electric fire-pump drives and emergency power – constant speed
3A	Continuous power
50 Hz	Continuous operation power, unrestricted Rating definition: ICXN, 10% overload capability
60 Hz	Continuous operation power, unrestricted; Rating definition: ICXN, 10% overload capability
3B	Prime power
50 Hz	Continuous operation with variable load Rating definition: ICXN, 10% overload capability
60 Hz	Continuous operation with variable load; Rating definition: ICXN, 10% overload capability
3C	Prime power limited
50 Hz	Standby operation with variable load Rating definition: ICXN, 10% overload capability
60 Hz	Standby operation with variable load Rating definition: ICXN, 10% overload capability

RATING PHILOSOPHY



schematic diagram

We are working hard to meet and even exceed the increasing demands of ship owners and operators for cost-effective and eco-friendly solutions. One example is the engine TBO (Time Between Overhauls) which we optimize on the basis of field data analysis and close inspection of engines and components that have already proven their reliability in field operation. Depending on the analysis results, we extend maintenance and TBO intervals keeping safe operation assured.

We offer product lines specifically tailored to customer requirements. Some are laid out for high power density with ideal power-to-weight-ratios (application groups C, D and DS). Other product lines are specifically configured to achieve maximum service life at lower power densities. These are suitable for applications involving high load factors and runtimes up to 8,000 hours per year (application groups A and B).

POWER DEFINITION

The rated power of diesel and gas engines stated in this sales program corresponds to ISO 3046-1:2002 (E) and ISO 15550:2002 (E). The power produced at the flywheel will be within the tolerance of 3 % - according to ISO 15550:2002 (E) – up to 25°C (77°F) combustion air temperature measured at the air cleaner inlet and up to 25°C (77°F) sea or raw water temperature measured at the seawater pump suction inlet, unless other values mentioned explicitly.

ICFN = ISO standard (continuous) fuel stop power
ICXN = ISO standard (continuous) power exceedable by 10 % (ratings also apply to ISO 8665 and SAE J1228 standard conditions)

Barometric pressure: 1000 mbar
Site altitude above sea level: 100 m
Fuel specification for diesel: EN 590 to ASTM D 975-00
(Fuel consumption [with all pumps] in accordance with ISO 3046 [except Series 60], values stated for IMO certification.)

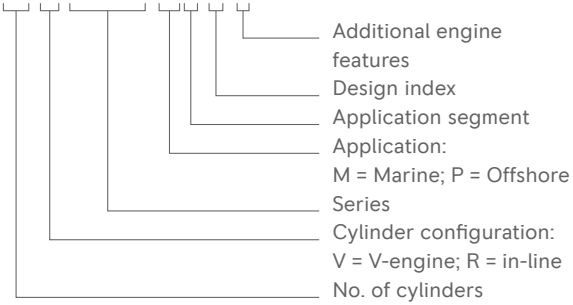
General reference conditions for diesel engines and generator sets:
- Intake air temperature 25°C
- Sea water temperature 25°C

All engines are designed and built according to classification requirements, certificate on request.
Classification with:
- Unrestricted service for engines with 10% overload capacity
- Restricted service for engines without overload capacity

EXPLANATION OF THE ENGINE DESIGNATION

mtu **Series 2000 / 4000 / 1163 / 8000 – Example**

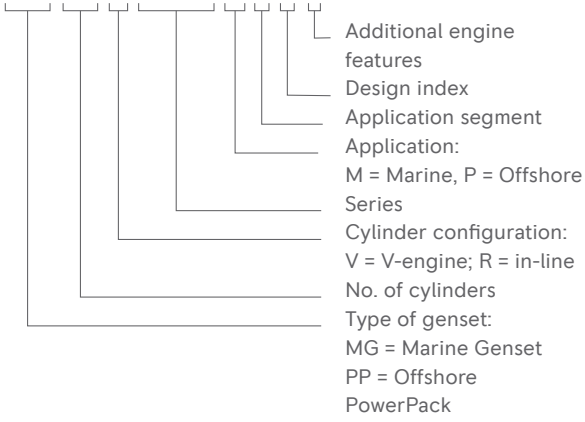
16 V 4000 M7 3 L



EXPLANATION OF THE GENSET DESIGNATION

Generator sets with *mtu* Series 4000 – Example

MG 08 V 4000 M3 5 S



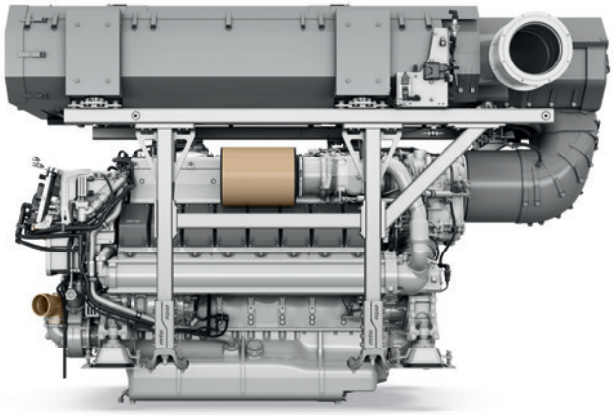
Turbocharged engines/gensets with	
Separate-circuit charge-air cooling	4000 P / 4000 M / 1163 M
Split-circuit charge-air cooling	2000 M / 4000 M / 8000 M

Additional engine/gensets features	
Power uprated	L
Natural Gas	N
Power/speed reduced	R
Frequency	A or F (50 Hz); B or S (60 Hz)

New product introduction

mtu 16V 2000 M97 PROPULSION ENGINE FOR IMO III AND EPA T3R

IMO III
and
EPA T3R



mtu **16V 2000 M97 with SCR**

The new *mtu* Series 2000 M97 meets IMO III and EPA T3r
Our latest generation of the 2000 series sets new standards in the market. With highly integrated and perfectly tuned in-house technology, it is an all-in-one solution for IMO III and EPA T3r applications.

Further benefits are:

- Dual certification EPA T3r and IMO III available
- Highest available power rating in the engine market segment
- Excellent acceleration behaviour at any operating point
- Low-noise and quiet operation to ensure maximum comfort on board
- Thermal insulation for SOLAS compliance or heat optimized version with minimum surface temperature and radiated heat

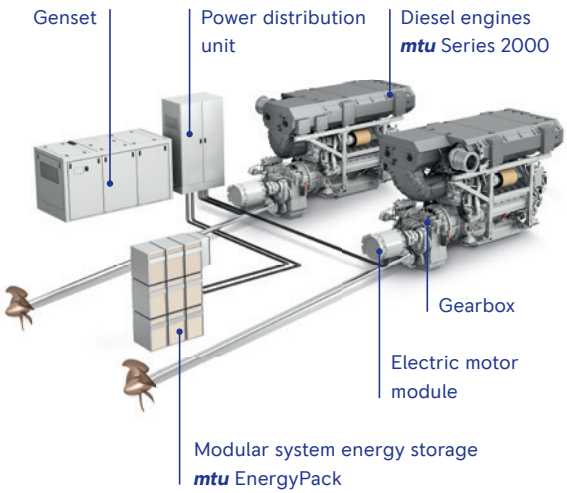
OTAM

Westport

New product introduction

QUIET. CLEAN. SMART.
THE *mtu* HYBRID PROPULSIONPACK

Get the best of two worlds in green, modular and flexible propulsion efficiency. Not only does hybrid power reduce on-board noise levels, emissions and vibrations, it also improves efficiency, dynamics and comfort.



Powerful
Great maneuverability, e-power assisted propulsion

Comfortable
Silent, vibration-free operation

Clean
Meeting the newest emission regulations

Reliable
Optimized maintenance and operation costs

The components for onboard power and propulsion are modular and scalable. Each hybrid system can be individually designed to meet your requirements.

Enjoy the benefits of silent but highly efficient electric propulsion, exhaust emission-free anchoring – no smell, no smoke, no noise – emission-free maneuvering in harbor areas, and an all-round environmentally friendly system.

Combination for perfect power availability for any scenario:

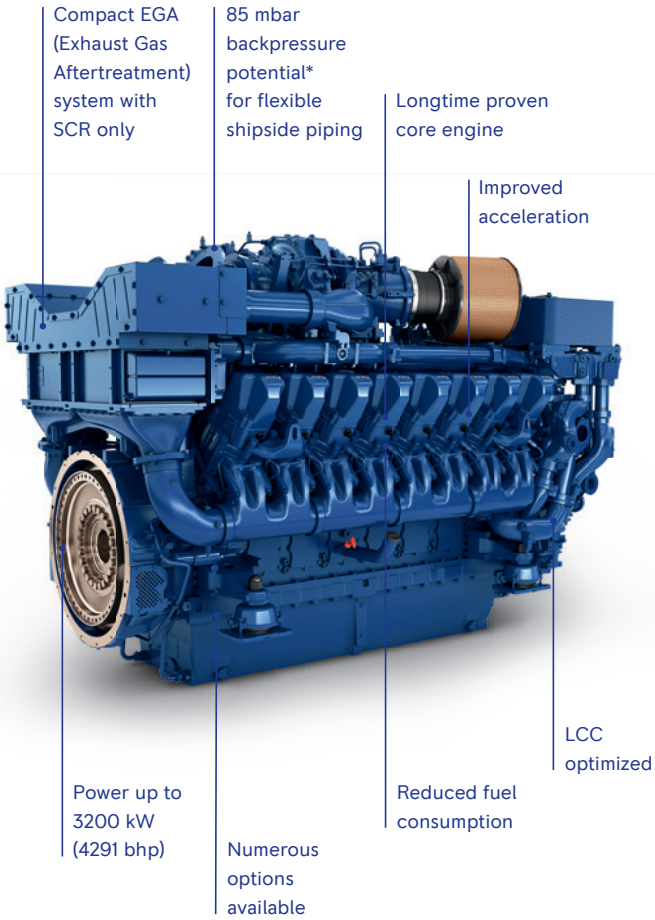
Silent cruising
Imagine a vessel which moves like by magic, with no noise, no vibration & no air pollution resolving into superior comfort. The silent mode offers an enjoyable journey through costal or nature reserve areas without the side effects of a conventional propulsion system.

Performance
Combining the best out of two different worlds, the high torque of an electric machine and the superior power density of an combustion engine, is resolving into an compact high performance system.

Eco-friendly cruising
The ***mtu*** Hybrid PropulsionPack is the pioneer of decarbonisation for marine propulsion.
The latest developments from our ***mtu*** solutions make it possible to reduce the carbon and air pollution footprint.

mtu Series 4000 M05

LATEST GENERATION OF THE PROVEN SERIES 4000.



*after SCR-System

up to
3200 KW (4291 BHP)

Our ***mtu*** Series 4000 M05 is the latest marine engine of our powerful Series 4000 family. When designing the ***mtu*** Series 4000 M05 we kept three topics always in our mind: Lifecycle costs, performance and ease of maintenance.

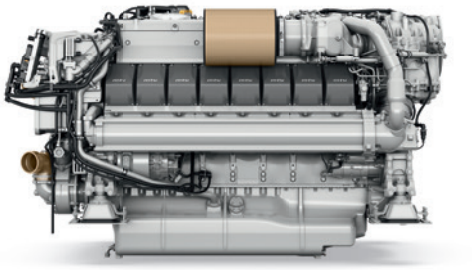
We used our legendary IRONMEN engines as a basis but finetuned it with high attention to detail to maximize durability, performance and efficiency. Only SCR is needed to fulfill IMO III and EPA Tier 4 emissions regulations.

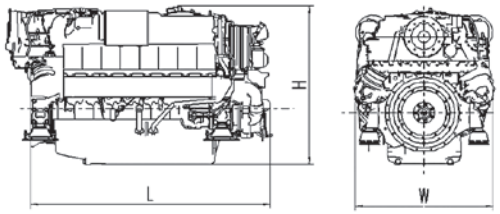
We also help customers to design and integrate the engine/ SCR combination into their vessel design.

more than
25 YEARS
OF
EXCELLENCE

ENGINES OVERVIEW

mtu SERIES 2000





Marine and offshore

Engine	Displacem. total	Dimensions, max.	Mass, max. TEN/EB
Cylinder config.: 90°V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
10V 2000 M86/96	22.3 (1361)	1604 x 1165 x 1347 (63 x 46 x 53)	2305 (5082)
12V 2000 M86/96*	26.8 (1635)	1812 x 1293 x 1414 (71 x 46 x 53)	2810 (6195)
16V 2000 M86/96	35.7 (2179)	2258 x 1293 x 1453 (89 x 51 x 57)	3450 (7606)
16V 2000 M87/97/97L**	35.7 (2179)	3297 x 1648 x 2124*** (130 x 65 x 84)***	5020*** (11067)***

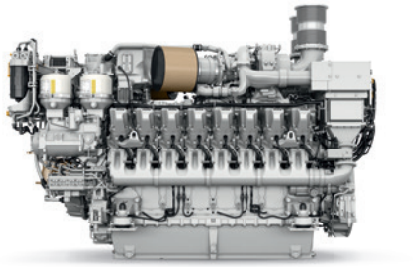
* with SAE1 flywheel housing
** with additional exhaust gas aftertreatment
*** with SOLAS thermal insulation for exhaust gas aftertreatment

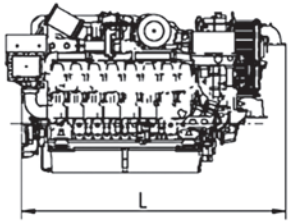
Marine and offshore

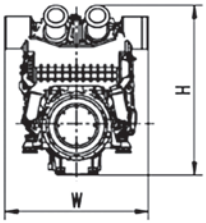
Engine	Displacem. total	Dimensions, max.	Mass, max. TEN
Cylinder config.: 90°V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
8V 2000 M72/84/94	17.9 (1093)	1379 x 1130 x 1200 (54 x 44 x 47)	1970 (4343)
10V 2000 M72	22.3 (1361)	1544 x 1130 x 1230 (61 x 44 x 48)	2230 (4916)
12V 2000 M72	26.8 (1635)	1869 x 1293 x 1364 (74 x 51 x 54)	2780 (6129)
16V 2000 M72	35.7 (2179)	2287 x 1293 x 1404 (90 x 51 x 55)	3337 (7357)

Engine mounted heat exchanger as standard.

mtu SERIES 4000







Marine and offshore

Standard stroke (190 mm)

Engine	Displacem. total	Dimensions, max.	Mass, max.
Cylinder config.: 90°V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
12V 4000 M73/93	51.7 (3155)	2870 x 1850 x 2185 (113 x 73 x 86)	8410 (18541)
16V 4000 M73/93	69.0 (4210)	3510 x 1850 x 2185 (138 x 73 x 86)	9890 (21803)
20V 4000 M73/93	86.2 (5260)	4040 x 1470 x 2440 (159 x 58 x 96)	12900 (28439)

Engine mounted heat exchanger as standard.

Marine and offshore

Long stroke (210 mm)

Engine	Displacem. total	Dimensions, max.	Mass, max.
Cylinder config.: 90°V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
8V 4000 M23/24/33/53/54/63	38.2 (2331)	2386 x 1615 x 1972 (94 x 64 x 78)	5710 (12588)
8V 4000 M55RN	38.2 (2331)	2050 x 1820 x 2100 (81x72x83)	6100 (13448)
12V 4000 M23/33/53/63/24/34/54/64/35/65	57.2 (3491)	2750 x 1793 x 2370 (108 x 71 x 93)	8000 (17637)
16V 4000 M23/33/43/53/63/24/34/54/64/25/35/65	76.3 (4656)	3270 x 1570 x 2370 (129 x 62 x 93)	9460 (20856)
16V 4000 M55RN	76.3 (4656)	3233 x 1820 x 2100 (127 x 72 x 83)	9555 (21065)
20V 4000 M35/65	95.3 (5815)	3696x1573x2072 (146x62x82)	11180 (24648)

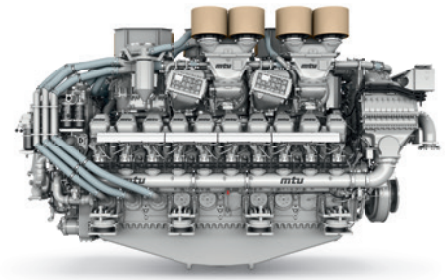
Offshore wind, exploration & production

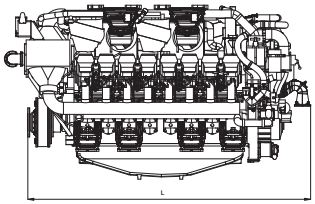
Long stroke (210 mm)

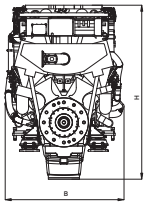
Engine	Displacem. total	Dimensions, max.	Mass, max.
Cylinder config.: 90°V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
12V 4000 P63/83	57.2 (3491)	2530 x 1590 x 2065 (100 x 63 x 81)	7300 (16093)
16V 4000 P63/83	76.3 (4656)	3000 x 1590 x 2065 (118 x 63 x 81)	8800 (19400)
20V 4000 P63/83	95.4 (5822)	3470 x 1590 x 2065 (137 x 63 x 81)	10680 (23545)

For most of the models, engine mounted heat exchanger as standard, some models with external heat exchanger as option. Engine model specific weight & dimensions therefore only upon request.

mtu SERIES 1163





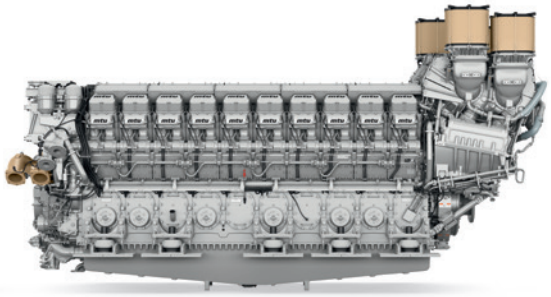


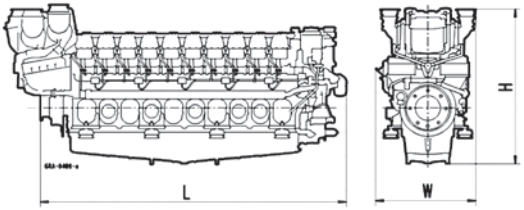
Marine and offshore

Engine	Displacem. total	Dimensions, max.	Mass, max.
Cylinder config.: 60°V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
16V 1163	186.1 (11357)	4685 x 2000 x 2896 (184x79x114)	21240 (46826)
20V 1163	232.6 (14194)	5345 x 2000 x 3034 (210x79x119)	25050 (55226)

External heat exchanger version as standard.

mtu SERIES 8000



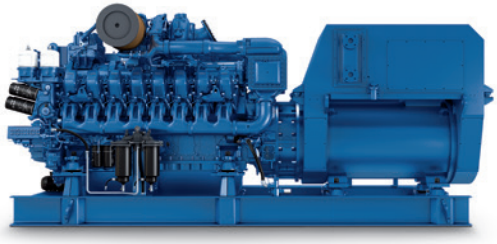


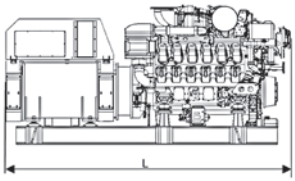
Marine and offshore

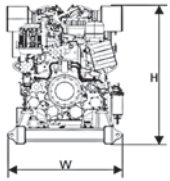
Engine	Displacem. total	Dimensions, max.	Mass, max.
Cylinder config.: 48°V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
16V 8000	277.9 (16959)	5682 x 2279 x 3410 (224 x 90 x 134)	41800 (92154)
20V 8000	347.4 (21200)	6622 x 2279 x 3439 (261 x 90 x 135)	48840 (107674)

External heat exchanger version as standard.

mtu SERIES 4000 GENSET 50 HZ / 400 V







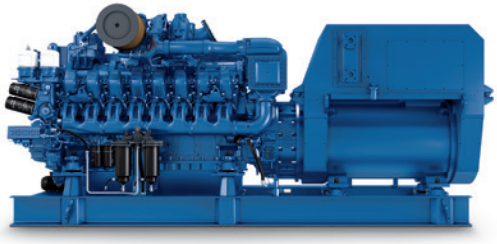
Marine and offshore

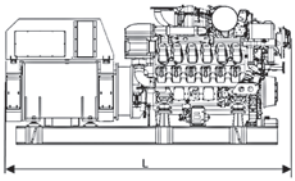
Genset model*	Displacem. total	Dimensions	Mass
50 Hz / 400 V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
MG08V4000M23F	38.2 (2331)	4300 x 1825 x 2000 (169 x 72 x 79)	10500
MG08V4000M33F	38.2 (2331)	4300 x 1825 x 2000 (169 x 72 x 79)	10500
MG12V4000M23F	57.2 (3491)	4600 x 1825 x 2285 (181 x 72 x 90)	13500
MG12V4000M33F	57.2 (3491)	4600 x 1825 x 2285 (181 x 72 x 90)	14000
MG12V4000M35F	57.2 (3491)	4700 x 1825 x 2285 (185 x 72 x 90)	15000
MG12V4000M35F	57.2 (3491)	4700 x 1825 x 2285 (185 x 72 x 90)	15500
MG16V4000M23F	76.3 (4656)	5200 x 1825 x 2285 (205 x 72 x 90)	16000
MG16V4000M33F	76.3 (4656)	5400 x 1825 x 2285 (213 x 72 x 90)	17000
MG16V4000M35F	76.3 (4656)	5600 x 1825 x 2285 (220 x 72 x 90)	17500
MG16V4000M35F	76.3 (4656)	5700 x 1825 x 2285 (224 x 72 x 90)	18500
MG20V4000P63	95.2 (5809)	REQ.	REQ.
MG20V4000P63	95.2 (5809)	REQ.	REQ.

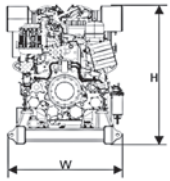
* Standard configuration: external engine heat exchanger, flange mounted, water cooled (IP54) synchronous generator (50 Hz - 400 V / 60 Hz - 450 V)

Options: 690 V, air cooled generators, and more options available on request
Gensets version with double resilient mounting systems for higher drew comfort also available.

mtu SERIES 4000 GENSET 60 HZ / 450 V







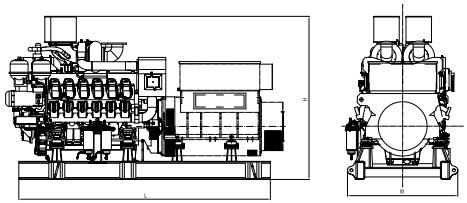
Marine and offshore

Genset model*	Displacem. total	Dimensions	Mass
60 Hz / 450 V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
MG08V4000M23S	38.2 (2331)	4300 x 1825 x 2000 (169 x 72 x 79)	10500
MG08V4000M33S	38.2 (2331)	4300 x 1825 x 2000 (169 x 72 x 79)	10500
MG12V4000M23S	57.2 (3491)	4600 x 1825 x 2285 (181 x 72 x 90)	14000
MG12V4000M33S	57.2 (3491)	4600 x 1825 x 2286 (181 x 72 x 90)	14500
MG12V4000M35S	57.2 (3491)	4700 x 1825 x 2285 (185 x 72 x 90)	15000
MG12V4000M35S	57.2 (3491)	4900 x 1825 x 2285 (193 x 72 x 90)	16000
MG16V4000M23S	76.3 (4656)	5400 x 1825 x 2285 (213 x 72 x 90)	17000
MG16V4000M33S	76.3 (4656)	5400 x 1825 x 2285 (213 x 72 x 90)	18000
MG16V4000M43S	76.3 (4656)	5700 x 1965 x 2284 (224 x 77 x 90)	18000
MG16V4000M25S	76.3 (4656)	5700 x 1965 x 2285 (224 x 77 x 90)	18000
MG16V4000M35S	76.3 (4656)	5700 x 1965 x 2285 (224 x 77 x 90)	18500

Genset model*	Displacem. total	Dimensions	Mass
60 Hz / 450 V	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
MG16V4000M35S	76.3 (4656)	5700 x 1965 x 2285 (224 x 77 x 90)	20000
MG20V4000M35S	95.2 (5809)	6800 x 1965 x 2285 (268 x 77 x 90)	25000
MG20V4000M35S	95.2 (5809)	6800 x 1965 x 2285 (268 x 77 x 90)	25000

* Standard configuration: external engine heat exchanger, flange mounted, water cooled (IP54) synchronous generator (50 Hz - 400V / 60 Hz - 450 V)

Options: 690 V, air cooled generators, and more options available on request
Gensets version with double resilient mounting systems for higher drew comfort also available.



Offshore wind, exploration & production

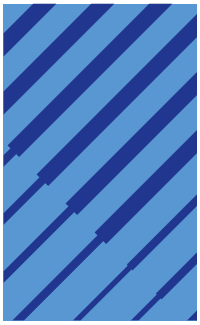
Long stroke (210 mm)

Genset type	Displacem. total	Dimensions, max.	Mass, max.
	l (cu in)	L x W x H mm (in)	(dry) kg (lbs.)
PP12V4000 P63*/83	57.2 (3491)	4850 x 1950 x 2450 (191 x 77 x 96)	14500 (31970)
PP16V4000 P63/83	76.3 (4656)	5720 x 1950 x 2450 (225 x 77 x 96)	18500 (40786)
PP20V4000 P63/83	95.4 (5822)	6950 x 1950 x 2450 (274 x 77 x 96)	24300 (53575)

P engines only available with external heat exchanger. Same will be applicable for M05 if added!

Gensets with S4000P also available, in particular suitable for emergency applications in Marine and offshore.

DIESEL/GAS ENGINES FOR MECHANIC PROPULSION



Diesel/gas engines for mechanic propulsion

720 KW - 1939 KW (966 BHP - 2600 BHP)

mtu Series 2000

Engine model	Rated power ICFN			Application group		
	kW	bhp	rpm	1A	1B	1D
8V 2000 M72	720	966	2250		■	
8V 2000 M84	810	1085	2450			■
8V 2000 M84L	895	1200	2450			■
10V 2000 M72	900	1205	2250		■	
8V 2000 M94	932	1250	2450			
10V 2000 M86	1015	1360	2450			■
12V 2000 M72	1080	1450	2250		■	
10V 2000 M96	1120	1500	2450			
10V 2000 M96L	1193	1600	2450			
12V 2000 M86	1268	1700	2450			■
12V 2000 M96	1342	1800	2450			
12V 2000 M96L	1432	1920	2450			
16V 2000 M72	1440	1930	2250		■	
12V 2000 M96X	1472	2002	2450			
16V 2000 M86	1630	2186	2450			■
16V 2000 M87	1630	2186	2450			■
16V 2000 M96	1790	2400	2450			
16V 2000 M97	1790	2400	2450			
16V 2000 M96L	1939	2600	2450			
16V 2000 M97L	1939	2600	2450			

Applic. group	Fuel consump. at rated power		Optim.	Emissions Optimization			
1DS	g/kWh	l/h	g/kWh	IMO	EPA	EU	CN
	212	184	195	II	T2c*	IIIA*	C1*
	218	213	192	II	T2c*	CCNR II	C1*
	227	245	194	II	T2c*	–	C1*
	215	233	197	II	T2c*	IIIA*	C1*
■	226	254	195	II	T2c*	CCNR II	C1*
	219	268	192	II	T3r/T3c*	RCD 2	C2
	208	271	195	II	T2c*	IIIA*	C1*
■	220	297	192	II	T3r	RCD 2	C2
■	223	320	192	II	T3r	RCD 2	C2
	214	326	196	II	T3r/T3c*	RCD 2	C2
■	215	347	195	II	T3r	RCD 2	C2
■	216	373	193	II	T3r	RCD 2	–
	206	357	195	II	T2c*	IIIA*	C1*
■	218	387	194	II	T3r	RCD 2	–
	217	426	193	II	T3r/T3c*	RCD 2	C2
	REQ	REQ	REQ	III	T3r	RCD 2	–
■	215	463	190	II	T3r	RCD 2	C2
■	REQ	REQ	REQ	III	T3r	RCD 2	–
■	216	505	190	II	T3r	RCD 2	–
■	REQ	REQ	REQ	III	T3r	RCD 2	–

“ For the 12V 2000 M96X power rating = mhp
* emission stage has been superseded, therefore engine is not available with certificate, but compliant only. local exemptions may apply.

Diesel/gas engines for mechanic propulsion

746 KW - 2000 KW (1000 BHP - 2688 BHP)

mtu Series 4000

Engine model	Rated power ICFN			Application group		
	kW	bhp	rpm	1A	1B	1D
8V 4000 M53R	746	1000	1600	■		
8V 4000 M55RN	746	1000	1600	■		
8V 4000 M54R	746	1000	1600	■		
8V 4000 M54	895	1199	1800	■		
8V 4000 M53	920	1234	1800	■		
8V 4000 M63	1000	1340	1800	■		
12V 4000 M55R	1119	1499	1600	■		
12V 4000 M53R	1140	1529	1600	■		
12V 4000 M54	1193	1600	1800	■		
12V 4000 M53	1380	1851	1800	■		
12V 4000 M64	1398	1875	1800	■		
12V 4000 M65R	1492	2001	1600	■		
16V 4000 M55RN	1492	2001	1600	■		
12V 4000 M63	1500	2016	1800	■		
16V 4000 M53R#	1520	2038	1600	■		
12V 4000 M65L	1680	2252	1800	■		
16V 4000 M54	1685	2260	1800	■		
16V 4000 M53	1840	2473	1800	■		
16V 4000 M65R	1840	2473	1600	■		
12V 4000 M65L	1920	2575	1800	■		
16V 4000 M63R*	1920	2575	1600	■		
12V 4000 M73	1920	2575	1970		■	
16V 4000 M64	1999	2681	1800	■		
16V 4000 M63	2000	2688	1800	■		
16V 4000 M65R	2000	2688	1600	■		

Applic. group	Fuel consump. at rated power		Optim.	Emissions Optimization			
1DS	g/kWh	l/h	g/kWh	IMO	EPA	EU	CN
	206	185	196	II	T2c*	IIIA*	–
	203	–	195	III	–	–	–
	206	185	196	II	T3c*	–	–
	212	228	196	II	T3c*	–	C2
	208	231	192	II	T2c*	IIIA*	–
	209	252	189	II/III	T2c*	IIIA*	–
	198	267	196	III	T4c	–	–
	201	276	200	II	T2c*	IIIA*	–
	209	300	REQ.	II	T3c*	–	C2
	201	334	196	II	T2c*	IIIA*	C1*
	211	355	REQ.	II	T3c*	–	C2
	194	349	190	II/III**	T4c	–	–
	204	–	195	III	–	–	–
	201	363	196	II	T2c*	IIIA*	C1*
	199	364	198	II	T2c*	IIIA*	–
	203	411	202	II/III	T4c	–	–
	206	417	195	II	T3c*	–	C2
	199	441	198	II	T2c*	IIIA*	C1*
	REQ.	REQ.	REQ.	II/III	T4c	–	–
	204	472	202	II/III	T4c	–	–
	203	468	203	II	–	–	–
	212	490	210	II	T2c*	–	C1*
	202	485	194	II	T3c*	–	C2
	199	480	192	II	T2c*	IIIA*	C1*
	REQ.	REQ.	REQ.	II/III	T4c	–	–

\# 1492 kW with 1600 rpm available on request
* 1840 kW with 1600 rpm available on request

* emission stage has been superseded, therefore engine is not available with certificate, but compliant only. local exemptions may apply.
** fuel consumption values for IMO II/III on request
*** fuel consumption values for EPA T4/4c on request

Diesel/gas engines for mechanic propulsion

2160 KW - 10000 KW (2895 BHP - 13410 BHP)

	Engine model	Rated power ICFN			Application group			Applic. group	Fuel consump. at rated power		Optim.	Emissions Optimization			
		kW	bhp	rpm	1A	1B	1D	1DS	g/kWh	l/h	g/kWh	IMO	EPA	EU	CN
mtu Series 4000	12V 4000 M73L	2160	2895	2050		■			213	554	210	II	T2c*	–	C1*
	16V 4000 M65L	2176	2918	1800	■				199	522	192	II/III	T4c	–	–
	16V 4000 M65	2240	3004	1800	■				202	545	193	II	–	–	–
	16V 4000 M63L	2240	3004	1800	■				195	526	194	II	T2c*	IIIA*	C1*
	16V 4000 M65L	2240	3004	1800	■				199	537	192	III	T4c	–	–
	12V 4000 M93	2340	3145	2100				■	216	609	205	II	T2c*	–	C1*
	16V 4000 M65L	2350	3151	1800	■				200	566	192	II/III	T4c	–	–
	16V 4000 M73	2560	3433	1970		■			218	672	205	II	T2c*	–	C1*
	16V 4000 M65L	2560	3433	1800	■				201	619	192	III	T4c	–	–
	12V 4000 M93L	2580	3460	2100				■	217	675	205	II	T2c*	–	–
	20V 4000 M65L	2800	3755	1800	■				209	705	202	II/III	–	–	–
	16V 4000 M73L	2832	3798	2050		■			219	747	210	II/III**	–	–	–
	16V 4000 M73L	2880	3862	2050		■			220	763	205	II	T2c*	–	C1*
	16V 4000 M93	3120	4185	2100				■	224	842	205	II/III**	T2c*	–	C1*
	20V 4000 M65L	3200	4291	1800	■				208	802	202	II/III	–	–	–
	20V 4000 M73	3200	4291	1970		■			213	821	210	II	T2c*	–	–
	16V 4000 M93L	3440	4615	2100				■	230	953	205	II	T2c*	–	–
	20V 4000 M73L	3540	4747	2050		■			219	934	210	II/III	–	–	–
	20V 4000 M73L	3600	4830	2050		■			212	920	210	II	T2c*	–	–
	20V 4000 M93	3900	5242	2100				■	212	996	205	II/III	T2c*	–	C1*
	20V 4000 M93L	4300	5780	2100				■	220	1140	210	II	T2c*	–	C1*
mtu Series 1163	16V 1163 M74	4800	6437	1250		■			210	1214	202	II/III**	–	–	–
	16V 1163 M84	5200	6973	1280			■		205	1284	200	II/III**	–	–	–
	16V 1163 M94	5920	7939	1325				■	212	1512	201	II/III**	–	–	–
	20V 1163 M74	6000	8046	1250		■			208	1504	195	II	–	–	–
	20V 1163 M84	6500	8717	1280			■		208	1629	195	II	–	–	–
	20V 1163 M94	7400	9923	1325				■	210	1872	195	II/III**	–	–	–
mtu Series 8000	16V 8000 M71L	7280	9763	1150		■			195	1710	190	II/III**	T2c*	–	–
	16V 8000 M91L	8000	10728	1150				■	199	1918	188	II/III**	–	–	–
	20V 8000 M71	8200	10996	1150		■			197	1946	183	II/III**	T2c*	–	–
	20V 8000 M71L	9100	12203	1150		■			196	2149	185	II/III**	T2c*	–	–
	20V 8000 M91L	10000	13410	1150				■	198	2386	185	II/III**	–	–	–

N = Gas engine

* emission stage has been superseded, therefore engine is not available with certificate, but compliant only. local exemptions may apply.

** fuel consumption values for IMO III on request

*** fuel consumption values for EPA T4c on request

ENGINES AND GENSETS FOR ON-BOARD POWER GENERATION AND ELECTRIC PROPULSION

Engines and gensets for on-board power generation and electric propulsion – 50 Hz @ 1500 rpm

760 KW - 2600 KW

Engine model	Rated power ICXN	Genset model	Rated power	
	kW		kWe	kVA
8V 4000 M23F	760	MG08V4000M23F	720	900
8V 4000 M33F	880	MG08V4000M33F	830	1038
12V 4000 M23F	1140	MG12V4000M23F	1080	1350
12V 4000 M33F	1320	MG12V4000M33F	1260	1575
12V 4000 P63	1350	■	1300	1625
12V 4000 M35F	1380	MG12V4000M35F	1320	1650
16V 4000 M23F	1520	MG16V4000M23F	1460	1825
12V 4000 P63	1560	■	1500	1875
12V 4000 M35F	1560	MG12V4000M35F	1500	1875
16V 4000 M33F	1760	MG16V4000M33F	1680	2100
16V 4000 P63	1800	■	1720	2150
16V 4000 M35F	1840	MG16V4000M35F	1760	2200
16V 4000 M35F	2080	MG16V4000M35F	2000	2500
16V 4000 P63	2080	■	2000	2500
20V 4000 P63	2245	■	2150	2688
20V 4000 P63	2600	■	2500	3125

Applic. group		Fuel consump. at 75%		at 100%		Emissions Optimization		
3A	3B	g/kWh	l/h	g/kWh	l/h	IMO	EPA	CN
■		216	148	207	189	II	–	–
	■	211	167	205	217	II	–	–
■		211	217	200	274	II	–	–
	■	205	244	197	312	II	–	C1*
■		204	248	204	331	II	–	–
	■	202	252	200	333	II/III	–	–
■		210	287	201	367	II	–	–
	■	202	284	202	378	II	–	–
	■	202	285	200	376	II/III	–	–
	■	205	325	199	420	II	–	C1*
■		201	326	198	428	II	–	–
	■	REQ.	REQ.	REQ.	REQ.	II/III	–	–
	■	REQ.	REQ.	REQ.	REQ.	II/III	–	C1*
	■	199	373	197	492	II	–	–
■		210	425	207	558	II	–	–
	■	206	482	211	659	II	–	–

* emission stage has been superseded, therefore engine is not available with certificate, but compliant only. local exemptions may apply.

** fuel consumption values for IMO III on request

■ on request

Engines and gensets for on-board power generation and electric propulsion – 60 Hz @ 1800 rpm

895 KW - 3200 KW

Engine model	Rated power ICXN	Genset model	Rated power	
	kW		kWe	kVA
8V 4000 M24S	895	MG08V4000M24S	850	1063
8V 4000 M23S	920	MG08V4000M23S	870	1088
8V 4000 M33S	1040	MG08V4000M33S	990	1238
12V 4000 M24S	1193	MG12V4000M24S	1140	1425
12V 4000 M23S	1380	MG12V4000M23S	1310	1638
12V 4000 M34S	1398	MG12V4000M34S	1340	1675
12V 4000 P83	1455	■	1400	1750
12V 4000 M33S	1560	MG12V4000M33S	1480	1850
12V 4000 M53B	1650	■	REQ.	REQ.
12V 4000 P83	1680	■	1610	2013
12V 4000 M35S	1680	MG12V4000M35S	1610	2013
16V 4000 M24S	1685	MG16V4000M24S	1620	2025
16V 4000 M23S	1840	MG16V4000M23S	1760	2200
12V 4000 M35S	1920	MG16V4000M35S	1840	2300
16V 4000 P83	1940	■	1860	2325
16V 4000 M34S	1999	MG16V4000M34S	1920	2400
16V 4000 M33S	2080	MG16V4000M33S	2000	2500
16V 4000 M53B	2200	■	REQ.	REQ.
16V 4000 M43S	2240	MG16V4000M43S	2150	2688
16V 4000 M25S	2240	■	2150	2688
16V 4000 M35S	2240	MG16V4000M35S	2150	2688
16V 4000 P83	2240	■	2150	2688
20V 4000 P83	2425	■	2320	2900
16V 4000 M35S	2560	MG16V4000M35S	2460	3075
20V 4000 P83	2800	■	2700	3375
20V 4000 M35S	2800	MG20V4000M35S	2700	3375
20V 4000 M53B	3015	■	REQ.	REQ.
20V 4000 M35S	3200	MG20V4000M35S	3100	3875

Applic. group		Fuel consump. at 75%		at 100%		Emissions Optimization		
3A	3B	g/kWh	l/h	g/kWh	l/h	IMO	EPA	CN
■		219	176	215	231	II	T3c*	–
■		221	183	211	233	II	T2c*	–
	■	218	204	210	262	II	T2c*	–
■		221	237	208	298	II	T3c*	C2
■		215	267	205	340	II	T2c*	C1*
	■	223	499	210	352	II	T3c*	C2
■		211	276	203	355	II	T1NRMM*	–
	■	210	295	206	386	II	T2c*	C1*
■		215	319	211	418	II	–	–
	■	207	313	207	418	II	T1NRMM*	–
	■	210	319	207	419	II/III	–	–
■		REQ.	REQ.	REQ.	REQ.	II	T3c*	–
■		214	355	207	457	II	T2c*	C1*
	■	207	359	207	479	II/III	–	–
■		211	369	205	477	II	T1NRMM*	–
	■	228	410	202	484	II	T3c*	C2
■		209	393	203	509	II	T2c*	C1*
	■	208	414	208	551	II	–	–
	■	208	421	203	548	II	T2c*	–
■		208	421	207	559	II	–	–
	■	REQ.	REQ.	REQ.	REQ.	III	–	–
	■	205	413	204	549	II	T1NRMM*	–
■		211	461	209	608	II	T1NRMM*	–
	■	207	479	207	638	II/III**	–	–
	■	209	527	215	723	II	–	–
	■	210	531	207	698	II/III	–	–
	■	214	583	204	741	II/III	–	–
	■	206	596	205	790	II/III	–	–

* emission stage has been superseded, therefore engine is not available with certificate, but compliant only. local exemptions may apply.
** fuel consumption values for IMO III on request
■ on request

Engines and gensets for on-board power generation and electric propulsion – variable speed genset

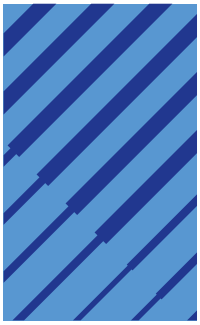
720 KW - 3200 KW

	Engine model	Rated power ***	Speed range / power ***		Fuel consump. at 100% **		Emissions			
		kW	rpm	kWe	g/kWh	l/h	IMO	EPA	EU	CN
mtu Series 2000	8V 2000 M72	720	1400 - 2250	675	212	184	II	T2c*	IIIA*	C1*
	10V 2000 M72	900	1400 - 2250	850	215	233	II	T2c*	IIIA*	C1*
	12V 2000 M72	1080	1400 - 2250	1020	208	271	II	T2c*	IIIA*	C1*
	16V 2000 M72	1440	1400 - 2250	1370	206	357	II	T2c*	IIIA*	C1*
mtu Series 4000	8V 4000 M63	1000	900 - 1800	960	209	252	II/III	T2c*	IIIA*	–
	12V 4000 M63	1500	900 - 1800	1440	201	363	II	T2c*	IIIA*	C1*
	12V 4000 M65L	1680	900 - 1800	1610	203	411	II/III	T4c	–	–
	12V 4000 M65L	1920	900 - 1800	1840	204	472	II/III	T4c	–	–
	16V 4000 M63L	2240	900 - 1800	2150	195	526	II	T2c*	IIIA*	C1*
	16V 4000 M65L	2240	900 - 1800	2150	199	537	III	T4c	–	–
	16V 4000 M65L	2560	900 - 1800	2460	201	619	III	T4c	–	–
	20V 4000 M65L	2800	900 - 1800	2700	209	705	II/III	T4c	–	–
	20V 4000 M65L	3200	900 - 1800	3100	208	802	II/III	–	–	–

* emission stage has been superseded, therefore engine is not available with certificate, but compliant only. local exemptions may apply.
** fuel consumption values for IMO III on request
*** Continuous operation with variable speed / load
Only a selection of recommended variable speed gensets; Other versions on request. Variable speed gensets with Series 4000M55RN (natural gas) also available on request.
Rating definition: ICFN, temporary 10% overload capability for load steps

ENGINES AND GENSETS FOR OFFSHORE WIND AND EXPLORATION & PRODUCTION

Photo: Øyvind Hagen/Statoil



Engines and gensets for offshore power generation –
50 Hz @ 1500 rpm

1350 KW - 2600 KW
(1810 BHP - 3487 BHP)

Engine model	Rated power ICXN		Genset	Rated power	
	kW	bhp		kWe	kVA
12V 4000 P63	1350	1810	PP12V4000P63	1295	1620
12V 4000 P63	1560	2092	PP12V4000P63	1500	1875
16V 4000 P63	1800	2414	PP16V4000P63	1730	2160
16V 4000 P63	2080	2789	PP16V4000P63	2000	2500
20V 4000 P63	2245	3011	PP20V4000P63	2155	2695
20V 4000 P63	2600	3487	PP20V4000P63	2500	3120

Application group			Fuel consump. at 75%		at 100%		Emissions Optimization	
3A	3B	3C	g/kWh	l/h	g/kWh	l/h	IMO	EPA
■			204	248	204	331	II	–
	■	■	202	284	202	378	II	–
■			201	326	198	428	II	–
	■	■	199	373	197	492	II	–
■			210	425	207	558	II	–
	■	■	206	482	211	659	II	–

Engines and gensets for offshore power generation –
60 Hz @ 1800 rpm

1455 KW - 2800 KW
(1951 BHP - 3755 BHP)

Engine model	Rated power ICXN		Genset	Rated power	
	kW	bhp		kWe	kVA
12V 4000 P83	1455	1951	PP12V4000P83	1395	1745
12V 4000 P83	1680	2253	PP12V4000P83	1615	2015
16V 4000 P83	1940	2602	PP16V4000P83	1860	2330
16V 4000 P83	2240	3004	PP16V4000P83	2150	2690
20V 4000 P83	2425	3252	PP20V4000P83	2330	2910
20V 4000 P83	2800	3755	PP20V4000P83	2690	3360

Application group			Fuel consump. at 75%		at 100%		Emissions Optimization	
3A	3B	3C	g/kWh	l/h	g/kWh	l/h	IMO	EPA
■			211	276	203	355	II	T2NRMM*
	■	■	207	313	207	418	II	T2NRMM*
■			211	369	205	477	II	T2NRMM*
	■	■	205	413	204	549	II	T2NRMM*
■			211	461	209	608	II	T2NRMM*
	■	■	209	527	215	723	II	T2NRMM*

* emission stage has been superseded, therefore engine is not available with certificate, but compliant only. local exemptions may apply.

EMISSION REDUCTION TECHNOLOGIES

Emission reduction technologies

SCR SOLUTION

SCR solution

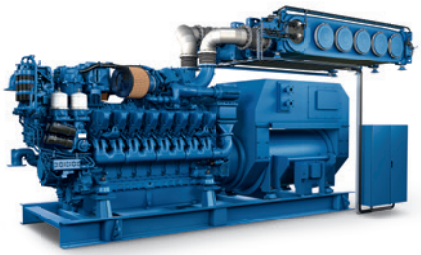
As installation space is always restricted inside the engine room, the inhouse developed airless SCR (Selective Catalytic Reduction) solution from ***mtu*** is compact and maintenance friendly. The system is designed and optimized for easy integration, and additional space to fit the exhaust gas aftertreatment is reduced to a bare minimum. Amonia slip is prevented under all operating conditions by a closed loop regulated control system. Besides the exhaust emissions related features, our SCR system also reduces noise.

SCR - the ideal solution for the marine world

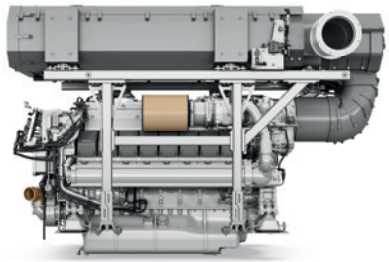
When using EGR (Exhaust Gas Recirculation) technology, the quality of the fuel is essential. Fuel with more than 15 ppm sulfur will lead to the formation of sulfur acid in the EGR cooling process. Sulfur acid will cause substantial engine failures over time. As many vessels operate worldwide, especially in the offshore service and supply business, we evaluate SCR as the preferred solution to maintain reliability of our engines and the safety of your vessel and crew. SCR technology allows operation with lower fuel quality. Developing all major key technologies inhouse like, SCR, EGR, turbocharging and common rail fuel injection, means we are able to shape the ideal solution to meet IMO III and EPA Tier 4 emissions regulations. At ***mtu*** we treat EGR as the ideal solution for applications like mining or oil&gas onshore, but within the marine world we are convinced that SCR technology grants much higher availability and component lifetime.

SCR cubical-box for high-power application

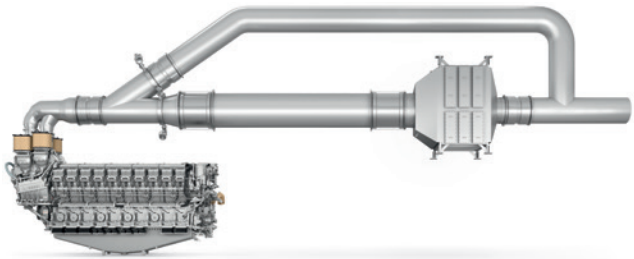
Generator set with SCR flat-box



mtu **16V 2000 M97 with SCR**



mtu **Series 8000 with SCR**

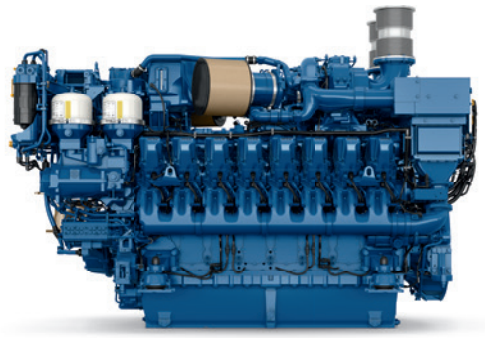


Emission reduction technologies

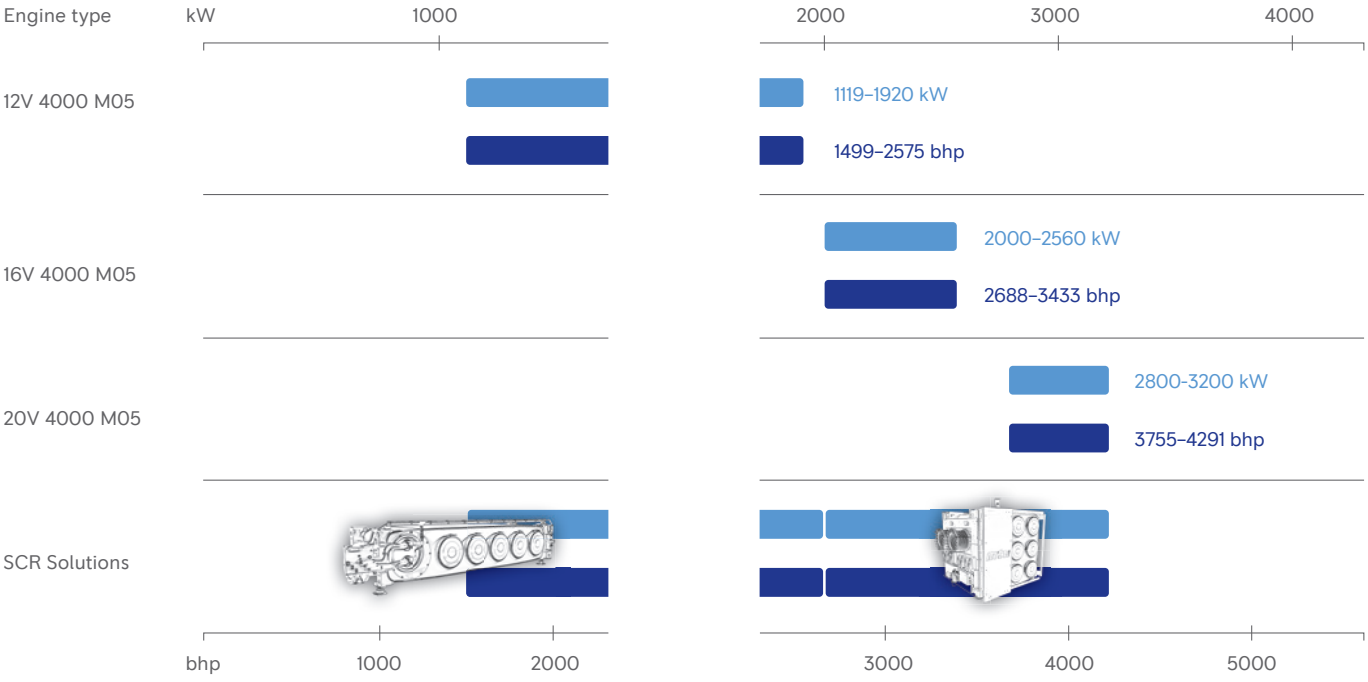
A LONGTIME PROVEN MARINE ENGINE - THE *mtu* SERIES 4000 M05.

More than 25 years ago, in 1996 the first Series 4000 marine engine was presented at SMM exhibition in Hamburg. Since then, the Series 4000 is trusted in numerous applications.

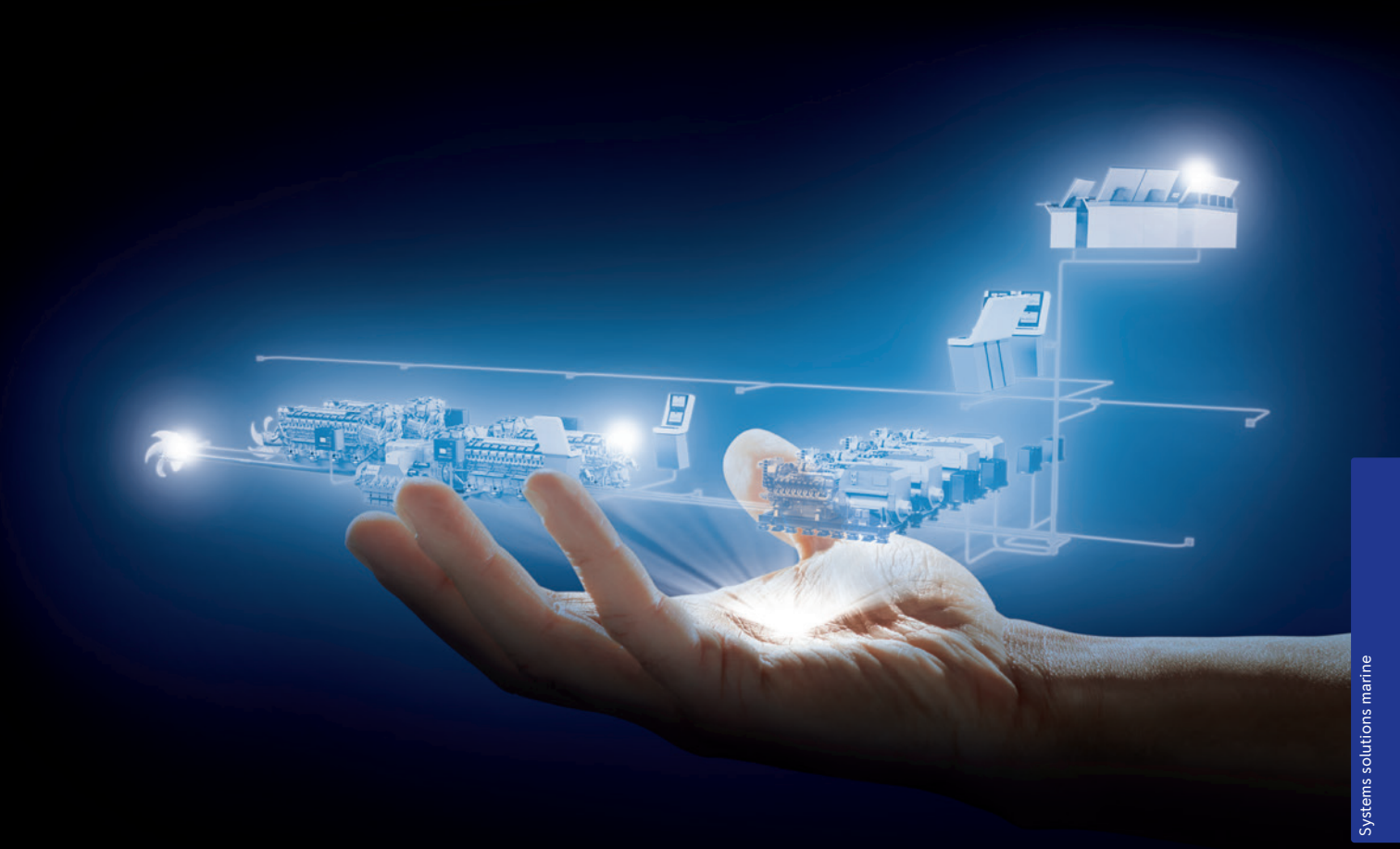
With more than 58,000 Series 4000 engines sold worldwide we gained experience from more than 345,000,000 operating hours which were directly fed into the development of the next generation of our marine workhorses. As an expert for tough applications like mining, oil&gas, rail and marine, we were always ready to go the next step - ahead of everyone else.



This is just as true today, as it was in 1996 when we introduced the first high speed diesel engine with common rail fuel injection. In 2016 we launched the only high-speed diesel enigne capable of up to 3200 kW (4291 bhp).



SYSTEMS SOLUTIONS



Systems solutions

SYSTEM EXPERTISE

We are one of the world's leading manufacturers of propulsion and power generation systems for marine applications: ***mtu*** products are used on all the world's oceans and in all marine areas.

For us, being a systems supplier means taking complete care of our customer's needs at any point of the life cycle. Our key technologies in diesel engine development and manufacturing comprising:
- Turbo charging units
- Fuel injection systems
- Engine management systems
- Automation systems

The key technologies are completed by validated and proven accessories like:
- Fuel treatment and filtration units
- Resilient engine mounts
- Resilient- and offset compensating couplings
- Gearboxes
- Exhaust silencers

Noise reduction technology

Double resilient mounting systems and active mounting systems are available for applications with the highest acoustic demands, such as comfort yachts or research vessels.

Emissions reduction technology

In addition to low emission diesel engines, we offer exhaust after treatment systems to meet the most stringent emissions requirements.
- Selective catalytic reduction (SCR) units:
  - Reduction of NOx emissions of diesel engines
  - Enables customers to achieve IMO Tier III emission levels with current Tier II engines.
- Diesel particulate filters (DPF):
  The new ***mtu*** engine generations, especially of the ***mtu*** Series 2000 & 4000 are exceeding emission regulation limits and are optimized to reduce soot also during transient operation.
  Therefore particulate filters (DPF) are requested for special applications only:
  - Active filter regeneration via burner
  - Enabled for low load operation
  - Optimum in system reliability
  - PM-reduction up to 99 %
  - Class certified: LR, GL

Gas-protected operation

In order to maintain a high level of safety in dangerous, explosive environments, some engines of the ***mtu*** Series 4000 and 8000 can be equipped for gas protection around flammable or explosive gases. Engines are equipped with a safety package that meets with the related operational conditions.

For further information, please contact your distributor or visit www.mtu-solutions.com/contact

Systems solutions

COMBINED PROPULSION SYSTEMS

Our engineering expertise and operating experience covers a large range of combined propulsion systems, such as:

- Combined Diesel and Diesel (CODAD)
- Combined Diesel and/or Gas Turbine (CODAG, CODOG)
- Combined Diesel-Electric and Gas Turbine (CODELAG)
- E-Drive Systems - Combined Diesel and/or Electric or Hybrid

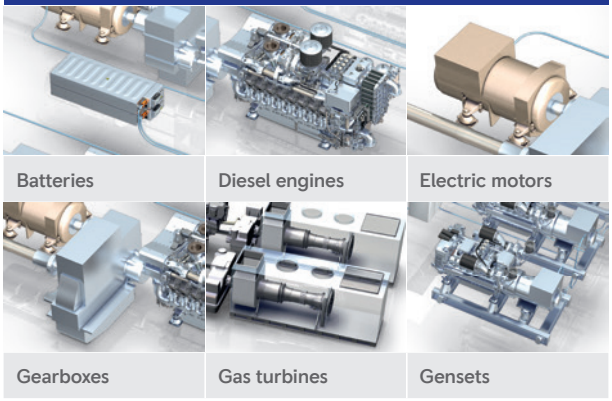
The intelligent combination of diesel engines, electric motors, gas turbines and batteries allows optimal adaptation of the propulsion system to the various operational requirements.

In order to reduce emissions and operating costs, combined systems e.g. diesel-electric propulsion systems are the preferred solution: The mechanical energy produced by the diesel engine is converted into electricity using a generator and then transmitted to the electric motors driving the ship's propellers.

By adding battery modules for energy storage we can also provide cutting edge hybrid propulsion systems.

On request, we will serve as the general contractor, taking complete technical and commercial responsibility for the entire propulsion and power generation system as well as the automation system. From project engineering and project management to support and service, we are your single source partner for complete solutions.

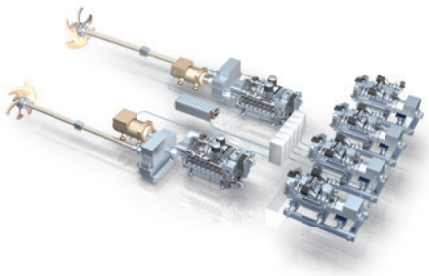
Propulsion systems



Batteries | Diesel engines | Electric motors

Gearboxes | Gas turbines | Gensets

Application example of complete propulsion system

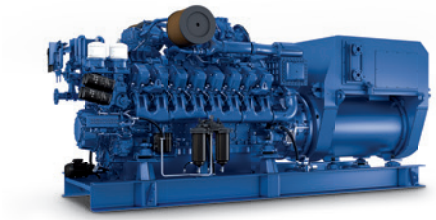


All systems can drive various kinds of propulsors, e.g. FPP, CPP, WJ, Voith Schneider, also in combination with CODAD, CODOG, CODAG, CODELAG or E-Drive propulsion systems.

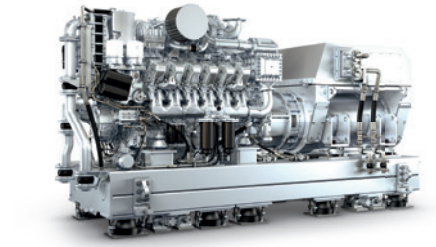
Systems solutions

MARINE GENSETS

Our gensets are based on *mtu* Series 4000 engines. Whether you are looking for onboard power, diesel-electric or hybrid propulsion, our gensets meet the full spectrum of requirements.



Standardized commercial generator set shown with *mtu* Series 4000



Our premium generator set. Here exemplarily shown with *mtu* Series 4000

Our gensets are available as a constant speed version in 50 or 60 Hz or as a variable speed configuration with added electronics. Our gensets are tailored to the specific needs of each application. Whether you are looking for a standradized cost-effective commercial genset or high-end yacht gensets.

We also provide emergency gensets for critical situations at sea, when absolute reliability is essential. In addition to gensets for main propulsion and onboard power, we also supply lower-power gensets which can be installed as separate power units in the engine room.

Your benefits are:

- Gensets based on proven ***mtu*** Series 4000 engines – of which over 58,000 have been sold worldwide
- Outstanding acoustic optimization for best-in-class comfort (noise and vibration levels can be contractually guaranteed, with all values proven on our test benches to minimize risk)
- Featuring special plug-and-play technology such as media plate and integrated piping for very easy installation
- All our gensets are classifiable according to e.g. DNV, LR
- Gensets with high quality finishing and painting dedicated for the yacht market

Systems solutions

OFFSHORE GENERATOR SETS

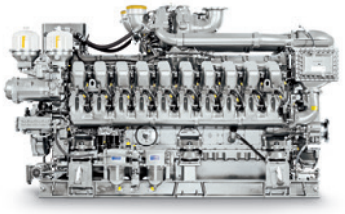
We offer complete solutions from a single supplier. All components are integrated, thoroughly tested and supported. Everything is designed to work together, which prolongs preventive maintenance and overhaul intervals. Decades of experience as an offshore specialist gives us the expertise and flexibility you need to keep your drilling operation productive and profitable.

Our offshore product range includes diesel engines and systems for:

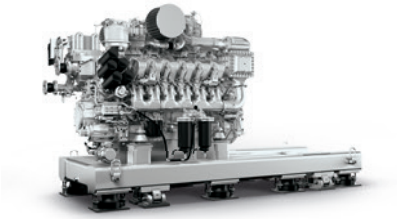
- Generator sets for emergency, essential, auxiliary and main power
- Fire pump drivers for mechanical/hydraulic/ electric installations
- Mud pump drivers
- Wellserve power packs
- Nitrogen units
- Cranes
- Cement pumps
- Hydraulic power packs
- Auxiliary/Emergency generator sets for offshore wind converter platforms

We also offer customized offshore documentation according to project specific requirements.

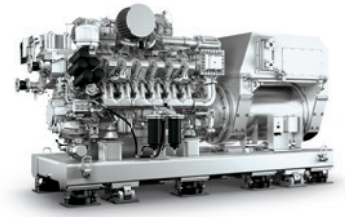
Our system solutions for offshore wind and exploration & production



Engine plus system



Modularized generator drive



Standardized generator set

Systems solutions

CONTROLLING THE POWER WITH *mtu* NautIQ SOLUTIONS

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*** NautIQ are designed to offer the ideal combination of performance and precision individually for your applications from a wide range of solutions.

Naval

Through years of partnership with navies worldwide, we have developed unique expertise and unparalleled focus on the expectations and needs of modern fleets. We provide customers with customized and complete propulsion, automation and intelligent control systems tailored to the sensitive marine sector.

Commercial Marine

The decision for our ship automation solutions is a decision for state-of-the-art reliability and individual, dedicated customer service. Our systems sail aboard cargo ships, barges, crew ships, ferries and many other types of vessels worldwide, and our experience has made us an indispensable partner to commercial shipping on the world's oceans.

Yachts

High standards of quality, innovation and maximum flexibility are the basis of our portfolio of solutions for megayachts. Our customized automation systems, developed with passion by our team of long-standing experts, ensure unprecedented reliability on board yachts large and small. Globally, we can support customers through strong partnerships in design, technical feasibility and comprehensive maintenance, while the custom-fit solutions of our ***mtu*** NautIQ suite answer the demands and challenges of modern yacht operations.

Systems solutions

FUTURE CONTROL

INTEGRATED SHIP AUTOMATION AND FLEET & HEALTH MANAGEMENT SOLUTIONS

mtu NautIQ Master
mtu NautIQ Core
mtu NautIQ Foresight

INTEGRATED BRIDGE SOLUTION

mtu NautIQ Bridge (only for Yachts)

PROPULSION AND GENSET MONITORING & CONTROL SOLUTIONS

mtu NautIQ BlueVision NG
mtu NautIQ Genoline NG

REMOTE & AUTONOMOUS CONTROL SOLUTIONS

mtu NautIQ CoDirect
mtu NautIQ CoOperate
mtu NautIQ CoPilot

DIGITAL SOLUTION

mtu Go

Systems solutions

mtu NautIQ MASTER

mtu NautIQ 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 naval and complex commercial projects.

- **Multiple operator workstations**
- **Integratable Propulsion Control System (PCS)**
- **Damage Control System (DCS)**
- **Integratable Automatic Power Management System (APMS)**
- **Equipment Health Monitoring and Dynamic Analysis**
- **Remote Data Collection and Control Units**
- **On Board Training Systems (OBTS)**

mtu **NautIQ Master sub-systems and plug in modules:**

- Navigation Bridge System
- Vessel Management System
- Communications
- Digital CCTV Surveillance
- Propulsion Control
- On Board Training System
- Power Management
- Condition Based Monitoring System
- Damage Control System

Systems solutions

mtu NautIQ CORE

mtu NautIQ Core Alarm, Monitoring and Control System (AMCS) is an entry- level system offering a reliable and highly cost-effective solution, designed using pre-engineered building blocks and specifically created to deliver COTS (Commercial Off-The-Shelf) solutions for all shipping sectors. The standard ***mtu*** NautIQ Core packages are future-proofed allowing for later integration of additional hardware, software and auxillary equipment through the vessels lifetime.

Key features:

Cost Efficient
- Placing Remote Terminal Units (RTU) near the process reduces cabling
- Pre-engineered solution reduces engineering costs
- Self-diagnostic features help to improve maintenance scheduling

Flexible
- Option to interface with external systems
- Modular design allows for customisation
- Up to 50% expansion available within each RTU

User-Friendly
- Unified interface across devices
- Intuitive HMI
- Simple modular design

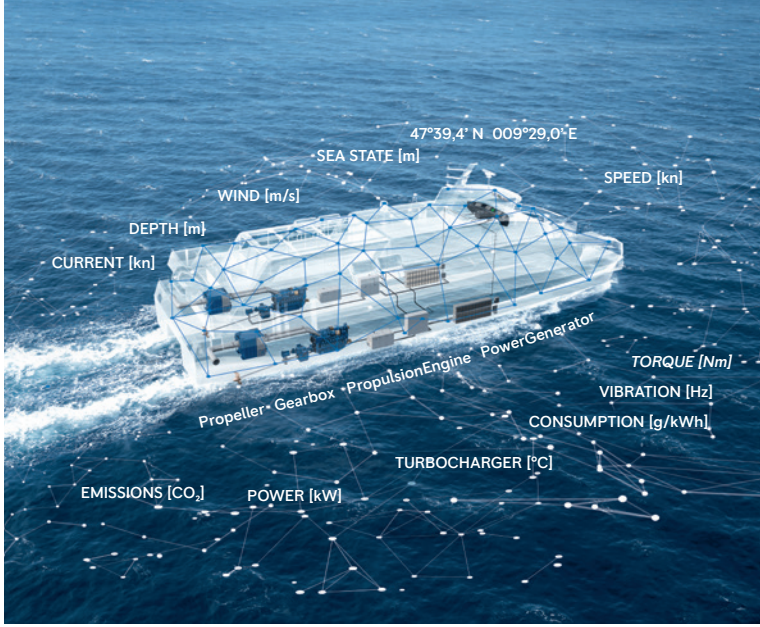
Safe and Reliable
- Multiple levels of redundancy
- BITE safeguards the network while our system safeguards the vessels systems
- COTS hardware with no moving parts

Systems solutions

mtu NautIQ FORESIGHT - FROM BRIDGE TO PROPELLER

mtu NautIQ Foresight is a Fleet & Health Management System. It allows you to monitor and have full control over the technical condition of your vessel from bridge to propeller. The system maximizes the availability of your vessel, and you can even use it to monitor a whole fleet. By providing system status at a click, ***mtu*** NautIQ Foresight makes availability management easier than ever before. It provides support for the maintenance and upkeep 24 hours a day, 7 days a week – and thus helps minimize vessel downtime.

With ***mtu*** NautIQ Foresight you can collect and analyze data from ***mtu*** systems and third-party key components on the vessel, considering additional factors, such as navigational data.



Improved vessel availability

It's all about uptime. Real-time data analytics combined with artificial intelligence and machine learning techniques reduce unplanned downtime and maximize asset availability.
The real-time sensor data on vibration, pressure, and temperature is compared with long-term figures for the respective operating conditions and ideal characteristic curves. The results enable optimum operation.

Peaked performance

Monitoring fuel oil consumption and measuring torque is the first step to understanding the state of the vessel. This information, combined with the health monitoring data, allows you to analyze and improve the vessel's performance. Weather and navigational data let you draw conclusions about factors such as hull condition. Additionally, the optimal speed can be determined. This performance monitoring system enables fuel cost optimization and contributes to reduced emissions.

Optimized life cycle costs

Maximized availability and peaked performance optimize life cycle costs. Due to the improved plannability, downtimes are reduced to a minimum and unplanned maintenance is turned into planned maintenance.

Reduced emissions

mtu NautIQ Foresight bundles all operational data in one system. The combination of engine, power generation, navigational and weather data enable in-depth analytics of the vessel's movement and its performance. In the next step, the operation of the vessel can be adjusted to run in a more efficient and environment-friendly manner.

Systems solutions

mtu NAUTIQ BRIDGE
ONE PLATFORM. ONE DESIGN. ONE SOURCE.

mtu NautIQ Bridge is a fully integrated bridge solution. Created in partnership with yacht specialists Team Italia, this outstanding ensemble improves safety and offers a new level of customer experience.

One platform: Full integration

The navigation equipment and all the yacht subsystems necessary to monitor and control the entire vessel can be seamlessly integrated in one platform and controlled by a combination of touch screen displays and multicontrol devices. There is no need to modify third-party equipment or subsystems integrated into ***mtu*** NautIQ Bridge.

One design: Elegant, intuitive, user-optimized

All the information is presented in one elegant and user-optimized design.

- Total navigation control, simplified management
- Innovative design and functionality
- Safe and user-friendly thanks to consistent user interface
- Seamless user interface across all integrated subsystems

One source: Dependability for builders and owners

All the technology and services come from one source.

- One face to the customer for complete vessel operating system
- Global ***mtu*** service support, anytime, anywhere
- Seamless integration of product and technology
- Scalable, to integrate additional functions
- High flexibility for updates and upgrades

Systems solutions

STANDARDIZED PROPULSION AUTOMATION SYSTEMS ***mtu*** NautIQ BLUEVISION NG

For ***mtu*** Series 2000 and 4000

For decades, we have been offering sophisticated standard automation systems to control, regulate and monitor the propulsion system - always doing a perfect job! Our current standard automation solution ***mtu*** NautIQ BlueVision NG is more convenient than ever before: easy to customize, easy to integrate, easy to operate.

mtu NautIQ BlueVision NG is available in muliple versions to meeting different requirements according to boat design and customer budgets:

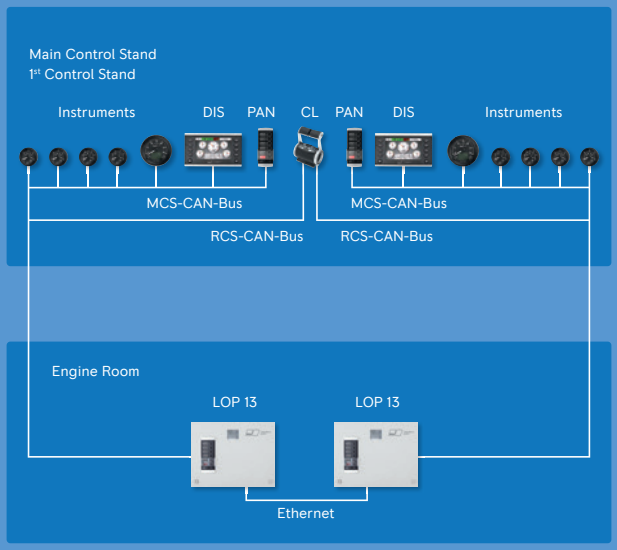
- straightforward non-classifiable version
  mtu NautIQ BlueVision NG_Basic
- cost effective classifiable version
  mtu NautIQ BlueVision NG_Advanced
- enhanced classifiable version
  mtu NautIQ BlueVision NG_Avantgarde

The modular system design allows a flexible configuration; intelligent data bus technology ensures reliable data exchange and reduces cable efforts. Optimized interfaces between the propulsion and automation systems result in ideal total solutions that guarantee you security, efficiency and reliability.

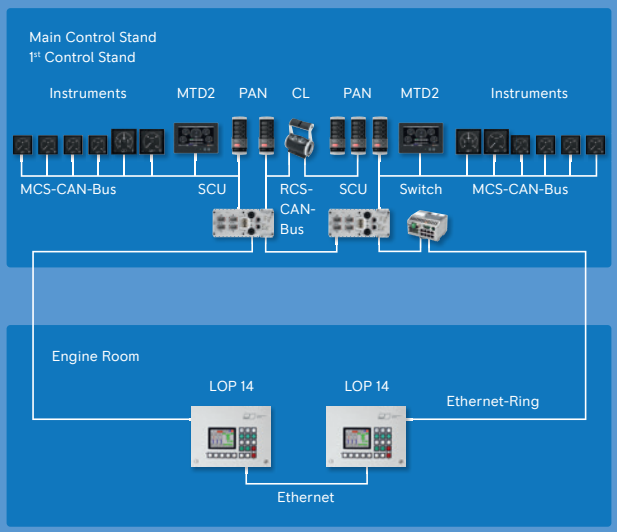
With ***mtu*** NautIQ BlueVision NG we offer you a complete and convenient system solution individually optimized for your ship, as well as comprehensive service – all from one source.

Thanks to “plug & play”, the system is as easily installed as it is operated.

mtu NautIQ BlueVision NG_Basic



mtu NautIQ BlueVision NG_Advanced



Systems solutions

STANDARDIZED PROPULSION AUTOMATION SYSTEMS ***mtu*** NautIQ BLUEVISION NG

Simple interfaces connect the monitoring & control system ***mtu*** NautIQ BlueVision NG with the ***mtu*** diesel engine and the gearbox.

All components are type-approved und type-examination tested in shake/vibration/stress tests.

Customer benefits

mtu NautIQ BlueVision NG is an automation system for propulsion plants in yachts and workboats with ***mtu*** Series 2000 or 4000 engines.

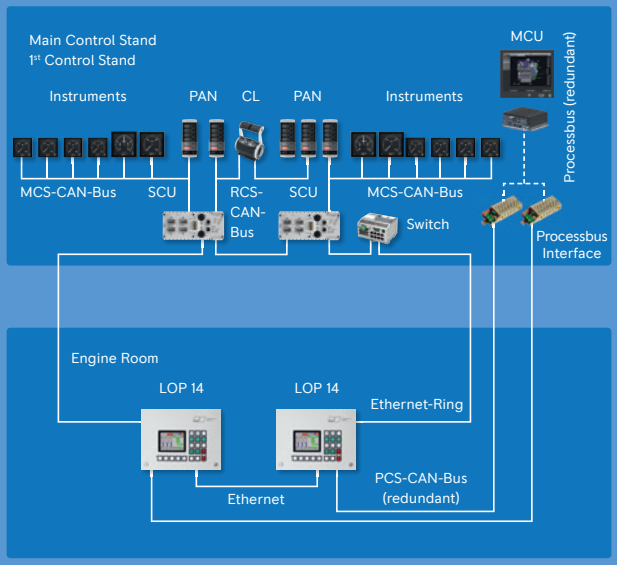
mtu NautIQ BlueVision NG offers the following benefits:

- High operational availability and reliability of the propulsion plant
- High flexibility thanks to modular system structure and open architecture
- Classifiable system in line with current directives
- Quicker and easier commissioning via structured user dialogue
- Type-tested components
- Development in accordance with current standards
- Optimized operation and visualization of the propulsion plant
- Uniform spare part concept across all ***mtu*** Series
- Global sales and service network
- Self-learning “Improved Crash-Stop” in order to stop the ship as quickly as possible

Aditional

- Available in different versions with a choice of HMIs interfaces such as small touch displays but also comprehensive operator stations (with ***mtu*** NautIQ BlueVision NG_Avantgarde).

mtu NautIQ BlueVision NG_Avantgarde



MTD2 (Multi Touch Display 2. Generation)

LOP 14 (Local Operating Panel)

Systems solutions

mtu NautIQ BLUEVISION NG JOYSTICK CONTROL

Visionary simple. Simply visionary.
As a system supplier, ***mtu*** not only provides you with the perfect yacht engine, but also with an automation system exactly adjusted to it. You get a complete package where everything is just right: not only powerful engine performance, but also maximum efficiency, uncompromising reliability and environmental compatibility.

Whith the new ***mtu*** Joystick System we offer a comprehensive system extension for the Remote Control System (RCS) of ***mtu*** NautIQ BlueVision NG. The ***mtu*** Joystick System makes complex maneuvers more convenient than ever before and allows the captain to perform every maneuver just moving the joystick lever in the preferred direction.

Benefits
- Manoeuvrability in an easy and intuitive way
- Easy docking, anchoring and manoeuvring
- Controls vessel direction and speed including rotations
- Simultaneous engine, transmission and thruster control or thruster only
- Single or multi stations possible
- Wide range of compatible thruster units

mtu Joystick lever

Systems solutions

mtu NautIQ CODIRECT

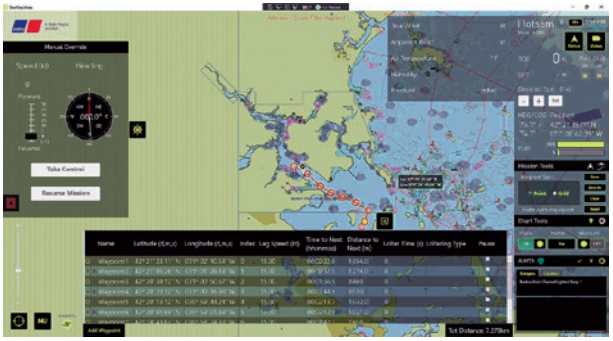
The wireless, remote-helm system that controls a vessel's engines, steering and transmission as well as payload functions like pumps, winches or cranes. It allows marine crews to operate a vessel from a distance of up to 1000 meters – from the safest vantage point.

Remote control applications
Remote helm control adds visibility, safety and efficiency to many types of marine operations:

- Tugboats
- Pushboats
- Tenders Response vessels
- Target boats
- Offshore daughter craft (LARS)

mtu NautIQ COOPERATE

mtu NautIQ CoOperate is an optionally self-piloting ship navigation and command system. It enables off-boat remote command, including all payloads on board, and offers situational awareness using cameras, sensors and other equipment, from a second location on another vessel or on shore.



mtu NautIQ COPILOT

(Coming soon)

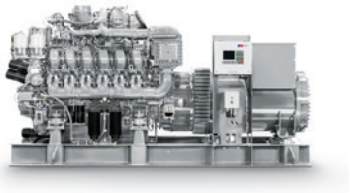
As an autonomous pilot assist system, ***mtu*** NautIQ CoPilot is our most advanced autonomous system, using digital marine sensors, embedded electronic charts, advanced autonomous algorithms and broad-area computer vision to support human-manual vessel operations with enhanced real-time understanding of objects, obstructions and traffic.

Systems solutions

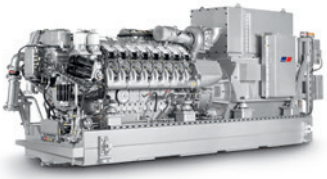
mtu NautIQ GENOLINE NG STANDARDIZED AND SYSTEM SOLUTION

mtu NautIQ Genoline NG is an non-classified and classified automation system for on-board power generation plants. The modular system design guarantees optimum adaptation of the diesel engine and generator to the diversity of operating conditions for the on board power generation. It is available for ***mtu*** Series 4000 engines.

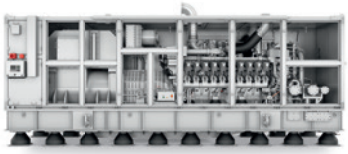
mtu NautIQ Genoline NG offers the following applications



On-board service power
non-classified and classified



Diesel-electric propulsion plant
non-classified and classified

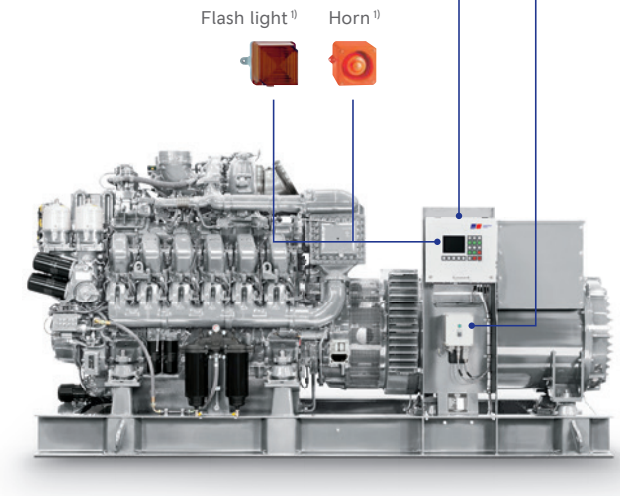


Special applications
- MIL
- Shock
- EMC etc.

mtu NautIQ Genoline NG automation system is an innovative high-end developed system with LOP (Local Operating Panel).

Customer interfaces

Interfaces	I/O signals	Power supply	Power supply
MODBus RTU MODBus TCP/IP - (only Genoline NG) J1939 CANopen	(hardwired) for monitoring and control	main and emergency (redundant) 24 VDC	230 - 440 VAC (50/60 Hz)



Priming pump and control 1)

1) Optional features

mtu AR technology

ENABLING SECURE AND RELIABLE NAVAL OPERATIONS IN A CHALLENGING ENVIRONMENT

Operators of naval vessels are faced with an ever-growing number of challenges: Vessels have to fulfil more demanding missions, staying at sea longer with smaller crews. At the same time, advancements in propulsion and energy conversion technologies also mean growing complexity of these systems. Our ***mtu*** AR technology could help to solve these challenges in the future.

It serves several purposes:

- Improving the understanding of system's functionalities
- Structured visual guidance for on-board maintenance tasks
- Enabling self-help (without the need for longstanding experience)
- Increasing safety on board

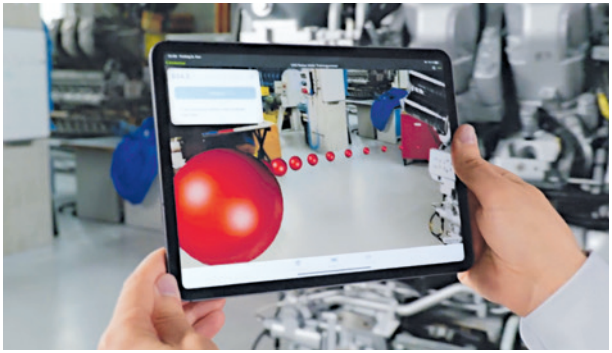
It does so by providing:

- Up-to-date and reliable information and documentation about the propulsion and energy conversion system anytime, anywhere
- Visual explanation of engine functions, e. g. of fluid systems
- Detailed step-by-step instructions for maintenance and repair
- Integrated guide for locating engine components

The ***mtu*** AR technology functions as a kind of "portable experienced engineer": It can illustrate system functionalities through a combination of text, animations and videos in a very clear and easily understandable way and aid the operator with the same guidance for maintenance and repair tasks as during training courses in our factory training centre. Unlike in a printed repair manual, the AR system projects information onto the real hardware, showing on the spot what steps have to be done how, using which parts and tools.

All information for the *mtu* AR technology is stored on the device and does not require any cloud connection. It can be used with different standard COTS hardware:

- Via head-mounted device:
  The virtual content (e. g. maintenance instructions) is projected via the glasses and added as an additional layer into the the user's normal view of reality
- Via mobile device (tablet or mobile phone):
  The camera shows a live view of reality, virtual content is laid over the live view shown on the display



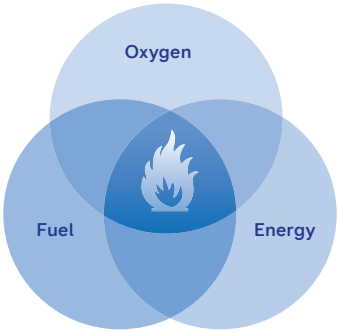
Guidance to locate components on the system

Virtual instructions on the actual hardware

Explosive problem. Integral solution.

ATEX ZONE 2 (IIB T3 GC)

Critical safety factors



Modifications of P-engines for ATEX zone 2

The combination of three factors makes an explosion possible:

- Oxygen
- Fuel/flammable substance (gas, vapors, mist, or dust)
- Energy/ignition source (devices, electrical plants, sparks, hot surfaces)

The exclusion of one of these three factors means the elimination of the risk. In order to guarantee safety in potentially explosive environments, a modification of factor 3 – the engine – is the most efficient solution both technically and economically. ***mtu*** engines are designed to minimize or even prevent the risk of high surface temperatures and spark generation.

On request ***mtu*** P-engines fulfill the requirements of ATEX Zone 2 IIB T3 Gc according to directive 2014/34/EU. This means that they deliver an extremely high standard of safety in conjunction with superior cost efficiency.

Meaning of the ATEX marking.

- Zone 2:
  An area in which an explosive mixture of gas is not likely to occur in normal operation and if it occurs it will exist only for a short time

- Explosion group IIB:
  Explosive mixture of various types of gas, i.e. ethylene, whereas hydrogen and acetylene is excluded and air

- T3:
  Surface temperature < 200°C
  equivalent to class I division 2 (North America)

- Gc:
  Equipment protection level (according to Zone 2 for gas hazard, former marking: 3G)

For further detailed explanation please refere to the ATEX directive.

Safety is good. Redundancy is better.

REDUNDANT CONTROLLER FOR FIRE PUMP DRIVE SYSTEMS (NFPA 20)

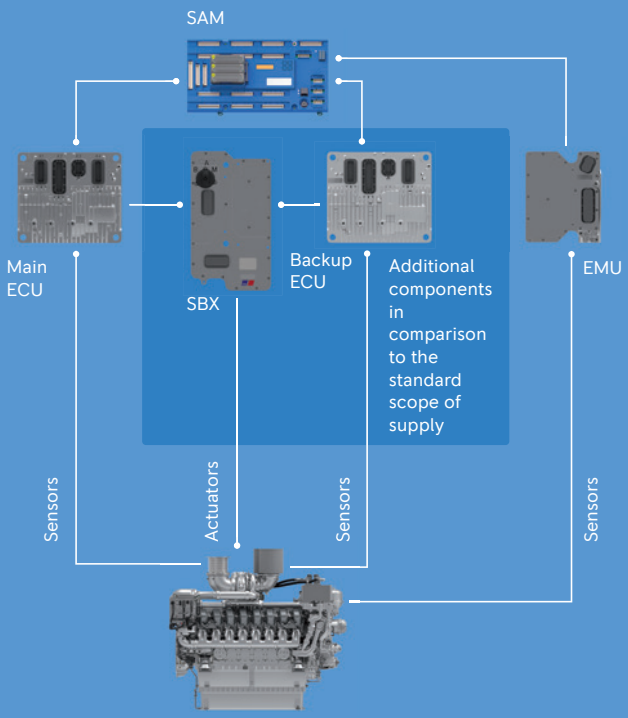
The NFPA-20 standard requires redundant engine controllers on fire-pump drive systems in order to prevent interruptions in the fire-pump water jet during an emergency. We are the first manufacturer in the world to offer redundant controllers for engines with common rail injection.
In accordance with this standard, the second controller must be installed on the engine and permanently wired. In the event of a fault on the first (main) controller, the second (backup) controller must take over the engine control automatically without interrupting the water jet. This measure increases the availability of your fire pumps and consequently the entire system.
The redundant controllers developed by us can be used in direct, hydraulic, and diesel-electric drive systems. To redundantly record all engine data required for controlling, a second sensor set is installed on the engine. The ECU7 engine control unit is used as a main and backup controller. Because the injectors and high-pressure fuel control block are not installed redundantly, triggering of these actuators must be switchable between the two controllers: and so the new SBX1 switch box forms the heart of this system.

Switching

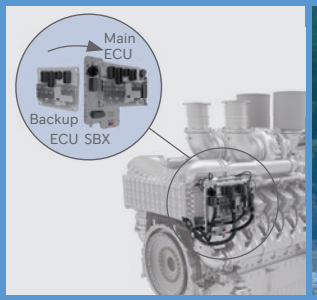
The ***mtu*** engine controller offers the option of manual switching, whereby the controller active at any given moment is displayed optically (via LED). The switching process is designed to guarantee the greatest possible redundancy of the system. Optimal use is made of the ECU7 plugs for logic switching and for supplying the new unit. This results in extremely simple wiring.If switching is necessary, drops in speed and excessively high rail pressure must be prevented. Our system guarantees that these demands are met for all types of applications (direct, diesel-electric, or diesel-hydraulic pump drive), all engine cylinder variants (12V, 16V, or 20V), and for every engine base speed (1,500 rpm for 4000 P63 or 1,800 rpm for 4000 P83).

Benefits:

- Achieving the NFPA20 norm for ***mtu*** Series 4000 P-engines
- Specifically designed for common rail injection
- Increased availability thanks to redundancy
- Simple retrofitting due to plug-and-play
- All components are developed to work together seamlessly
- All from one trusted source and in the quality you expect from us

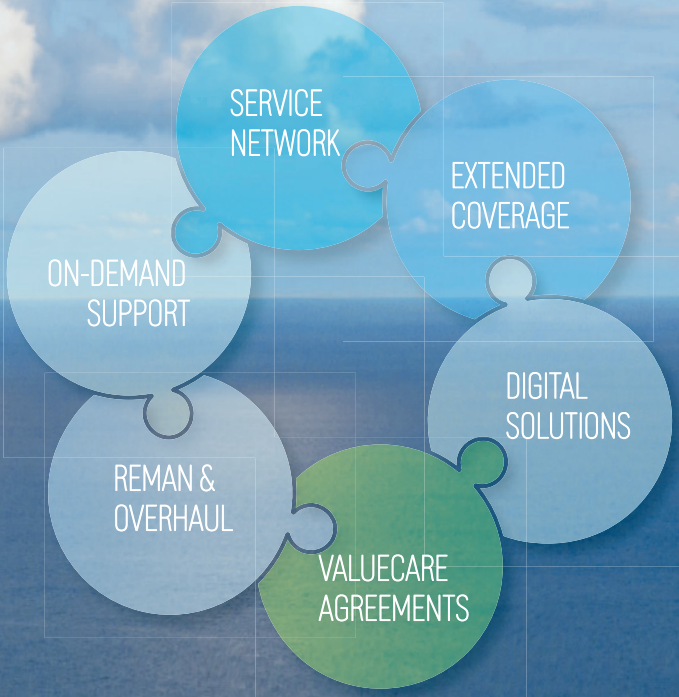


mtu Series 4000 P03



mtu Service solutions

SOLUTIONS THROUGHOUT THE ENTIRE LIFECYCLE



YOUR ***mtu*** SERVICE

Everywhere. Anytime. Just the way you need it.

Commercial Marine
While you take care of your business, we take care of the availability of your fleet; with extended coverage that exceeds the market average; and with ***mtu*** overhaul solutions – in our factories or directly on the ship – adapted specifically to your needs (condition-based to standard).

Yachts
Choosing ***mtu*** means joining an elite class of yacht owners, designers, builders and marine engineers that demand only the most powerful, reliable and sophisticated systems. In addition to assuring optimal engine performance for years to come, your purchase includes a best-in-class warranty and several complimentary ***mtu*** ValueCare products and services.

Extended coverage
Protect yourself against unexpected costs with ***mtu*** extended coverage.

Digital solution
Make better decisions faster with digitally-enhanced tools.

ValueCare Agreements
mtu ValueCare Agreements make it easy to keep your business running smoothly, reduce total cost of ownership, and helping you avoid equipment-related business disruptions through preventive maintenance.

On-demand support
Improve system performance and extend equipment life with on-demand support.

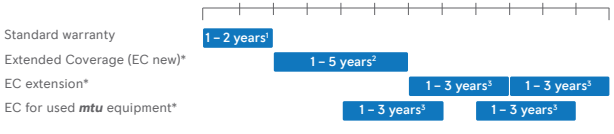
Reman & overhaul portfolio
Keep a good thing going with ***mtu*** reman and overhaul solutions.

Upgrades and refit solutions
Maximize the value of your equipment with custom upgrades for changing needs.

Extended coverage

BEST-IN-CLASS WARRANTY OPTIONS

Equipment lifecycle (years) from handover



* See your EC terms & conditions for details
[1] for Commercial Marine applications: 1 year standard warranty
for Yachts applications: 2 years standard warranty
[2] for Commercial Marine applications: 1 - 5 years EC new
for Yachts applications: 1 - 3 years EC new
[3] only Yachts applications

Costs covered

In case of a corrective claim: material, labor, travel cost (if applicable)

Exclusions: e.g. Removal & reinstallation of engine, gearbox etc. and all preventive maintenance

Covered equipment

Engine and on-engine electronics (only ***mtu*** Scope of Supply)

Optional: Gearbox & Automation

Place of performance

Nearest authorized ***mtu*** service center, defined place or other locations as advised by ***mtu***

Deductible

No deductible or optional 500 EUR per repair visit and propulsion line

Protection
against unexpected repair costs (corrective maintenance)

100% genuine
Exclusive use of original parts and components

EC card
for easy engine identification and fast service

Professional repair
by ***mtu***-certified technicians

Enhanced resale value
when coverage is transferred to a new owner

Flexible packages
to suit your needs (e.g. 1-5 years duration*)

Digital solutions

DELIVERING ACTIONABLE INSIGHTS THROUGH DIGITAL SOLUTIONS

mtu Go

Connect all your equipment
Data collection from your fleet, asset, system and engine

Connectivity is the basis for all the advantages of digitally supported service. Using our edge software connected to the control unit, you and your service network can monitor relevant deviations from the optimum conditions remotely. We offer several ways to collecting data, including the creation of interfaces to already existing data sets. In doing so, we always adhere to the highest data privacy and security standards of our industry.

Access your data

- Remote monitoring, available for individual assets, as well as complete fleets worldwide
- Different device and software options ensure optimal connectivity
- Data privacy and security to the highest industry standards

Monitor your fleet
Visualization of data for a quick and accurate overview of your fleet

With the ***mtu*** Go platform, predefined users, such as on-site technicians or managers, can view the system data and perform initial analyses by using diagnostic tools. By accessing the same information, your service network can provide fast support in handling alarms and planning necessary maintenance together with you. Open APIs allow you to interface directly to your existing dashboards or systems.

Keep track of your data

- All important data and alarms available at a glance for efficient fleet monitoring
- Intuitive and clear design for easy operation
- Visual comparison of data using the diagnostic tools for initial analyses

Manage your fleet
Digital solutions for your detailed data analysis on necessary actions

Supported by ***mtu*** Go your Service Network is able to analyze all relevant data from your equipment and compare it with data sets from other systems. From this we together can proactively derive recommendations for action.
In future, the analysis can be enriched with additional external data sets, such as environmental influences or time schedules. Cross-linking data will create new opportunities for optimizing business processes.

Learn from your data (under development)

- Algorithms for proactive early detection of deviations
- Troubleshooting based on large amounts of data with artificial intelligence
- Comparison with data outside own fleet leads for faster knowledge transfer and optimum service tool for initial analyses

Digital solutions

HOW DIGITAL SOLUTIONS OPTIMIZE YOUR BUSINESS.

Streamline your service requirements

We offer you the best possible service for your equipment by incorporating digitalization in a holistic approach. This helps improve our service to you and helps you operate your equipment more effectively.

Monitor and manage your equipment

Our digital platform ***mtu*** Go offers you the opportunity to analyze system data quickly, determine important action steps, and plan them optimally, either independently or together with our service department.

Maintain your data security

We always adhere to the highest data privacy and security standards of our industry. Because we understand and value the trust you put in us by having us analyze your data to create the best possible service solutions for your equipment.

An onboard connectivity device transmits vital equipment data in near real-time to your screen.

mtu ValueCare Agreements

PROTECT YOUR INVESTMENT

You've got a tough job. Get the power, performance and peace of mind to get it done right with ***mtu*** ValueCare Agreements—tailored support throughout the life of your equipment.

In your world, every second counts. Our digitally connected propulsion systems, wrapped in ValueCare Agreements, make it easy to keep your business running smoothly and reduce total cost of ownership by maximizing uptime, optimizing lifecycle costs and helping you avoid equipment-related business disruptions through preventive maintenance. That's why it pays to plan ahead by investing in a superior ***mtu*** system and protecting it with a ValueCare Agreement.

Tailored solutions to move your business forward:

Bronze

Covers preventive maintenance and ensures parts availability and price stability

Silver

Covers preventive and corrective maintenance to avoid unexpected costs

Gold

Includes preventive and corrective maintenance and more to maximize uptime

mtu ValueCare Agreements helps you

- Increase operational uptime
- Guarantee parts availability and service quality
- Predict equipment-related costs
- Optimize maintenance planning
- Connect to us, 24/7
- Attain peace of mind

Reman and overhaul solutions

WHATEVER YOUR CIRCUMSTANCE – WE'VE GOT YOU COVERED

mtu engines are built to last thanks to high engineering standards and an unwavering commitment to service and support. We also provide solutions that enable your engine to run even longer after its productive service life.

Provided by the same experts that originally built your engine, ***mtu*** reman and overhaul solutions make it run like new again. How? By delivering the same high standards of performance, service life and quality as with new ***mtu*** products. What's more, we offer fixed pricing and turnaround times up front along with a full factory warranty. Choose your solution from a wide reman and overhaul portfolio:

In-situ overhaul
Performed inside the ship

Condition based in-situ overhaul
Engine overhaul based on your engine's condition performed inside the ship.

Standard in-situ overhaul
A full overhaul of your engine performed inside the ship.

Factory overhauls

A full overhaul of your engine performed inside an ***mtu*** workshop.

Reman engine

Replace your existing engine and system with a remanufactured unit.

New exchange engine

A new engine from our series production.

Reman and overhaul solutions

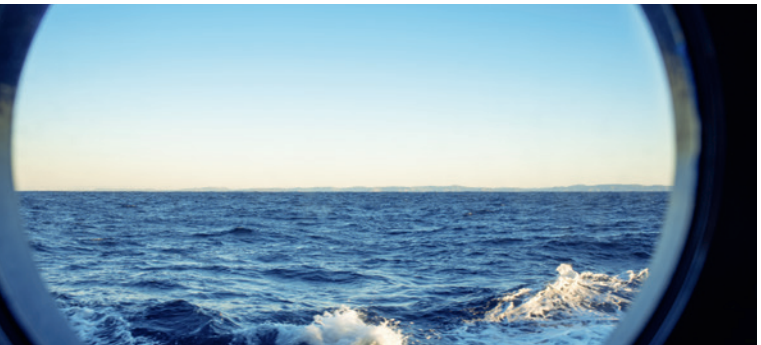
KEEP A GOOD THING GOING

Turn back the clock with factory overhauls

Completely restore your original equipment with an overhaul in our factory. This solution is ideal for classic and specialized engines such as ***mtu*** Series 183, 396, 493, 538, 595, 652, 956, 1163 and others (e.g. 2000 and 4000) that require greater customization during the restoration and validation process. As a result, your equipment delivers same-as-new performance that only we can offer.

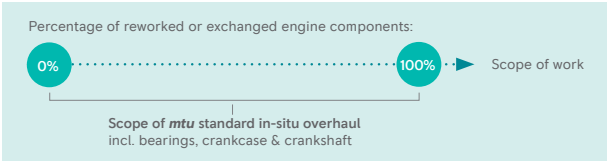
Save time and money with in-situ overhauls

Our in-situ overhauls directly inside the ship are ideal when the engine can't be removed from the vessel. We offer both comprehensive standard overhauls and a more cost-optimized, condition-based solution.



mtu standard in-situ overhaul

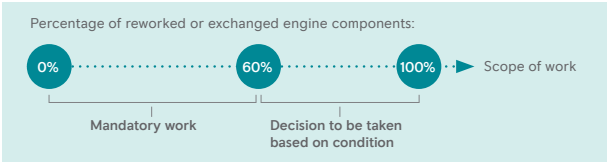
This comprehensive offer covers the replacement, overhaul and/or reconditioning of all engine components. The work performed fully complies with overhaul manual and maintenance specifications. The engine's service life is extended by a full cycle before the next scheduled overhaul.



mtu condition-based in-situ overhaul

This is a more cost-optimized in-situ overhaul offer that covers the replacement and overhaul of a defined scope of parts and components. Further measures depend on the condition of the engine.

A list of other parts and components are also examined to determine whether to overhaul, exchange or continue using them. This option can potentially reduce the work scope, downtime and costs.



Exchange and save with a reman solution

The reman solution we offer for ***mtu*** Series 2000 and 4000 involves replacing your existing engine and system with a remanufactured unit provided by your ***mtu*** service partner. At the same time, you receive credit for your original core based on its technical condition. With our core exchange program, we essentially assume the total costs and time for replacing your product up front. In addition to allowing you to avoid unplanned costs, our reman solution greatly minimizes downtime.

Service network

YOUR LOCAL SUPPORT – WORLDWIDE

The most important part of your propulsion system isn't a part at all – it's your local service team. With more than 1,200 service locations worldwide – backed by regional Parts Logistics Centers in Europe, Asia and America – you can count on responsive support by expert technicians, wherever work takes you. To find your local service partner, visit **www.mtu-solutions.com.**

Protect your assets with on-demand support
On-Demand Support—including professional inspections and preventive maintenance recommendations from us—helps you identify and address problems early, save on repairs or unexpected downtime, and optimize your equipment's performance and longevity. Inspections include visual assessment, test run and leak check, on-site oil and coolant analysis, diagnostic evaluation and reporting.

Always on call, 24/7
Whether it's connecting you with a local service partner or assigning an urgent problem to a dedicated team of our experts, we're ready to assist you—wherever you are, whatever you need.

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EXHAUST EMISSIONS

Many countries have implemented environmental legislation to protect people from consequences of polluted air. For this reason an increasing number of countries regulate emissions from specific mobile and stationary sources. Emission standards may apply internationally, nationally and/or for specific areas. The enforcement of an emission legislation may depend for example on the area where the equipment is used and the way it is operated.

The emission legislations may be categorized by power range and/or cylinder capacity. Emission legislations generally require a certificate which states compliance. Stationary applications may require on-site approvals (on-site emission test) depending on the particular emission legislation.

Please find as follows examples of emission standards which apply to the marine industry. For details please consult the applicable legislation and/or permitting authority.

IMO - International Maritime Organization
MARPOL Annex VI Regulation 13 (NOx) and NOx Technical Code 2008: Marine diesel engines > 130 kW for ships engaged on international voyages to which MARPOL Annex VI applies (= flying the flag of a signatory, or entering waters of the jurisdiction of a signatory to the Annex. Signatory overview see IMO webpage, „Status of Conventions“). Fixed & floating platforms, including drilling rigs and similar structures, are considered as ships. For those structures IMO regulations are in addition to any controls imposed by the government which has jurisdiction over the waters in which they operate.

Applicability of tiers:
For new ships date of construction of the ship, for engine replacement with non-identical engine or installation of additional engine date of installation. Exemption rules are in place.

Currently applicable emission stages:
- IMO Tier II outside of NOx Emission Control Areas (NOx ECA)
- IMO Tier III is applicable in NOx Emission Control Areas (NOx ECA) only

Emission Control Areas (ECA):
- An ECA may limit NOx, SOx and particulate matter (PM) emissions, or both. MARPOL Annex VI Regulation 14 (SOx and PM emission compliance) requires fuels with less than 1000 ppm (0.1 %) sulphur (since January 1st, 2015).
- The enforcement dates of an ECA will be specified for each ECA individually. For the North American & US Caribbean ECA this has been January 1st, 2016 with regard to NOx.
- Additionally to the North American & US Caribbean the North Sea and the Baltic Sea are astablished as ECA for SOx and PM as well as NOx emissions.

We provide for IMO Tier III certified marine engines with SCR aftertreatment a NOx-conformity document, which is mandatory by IMO's 2017 SCR guidelines and the NOx technical code 2008.

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US EPA - United States Environmental Protection Agency
40CFR1042: Marine diesel engines > 8 kW for vessels registered (flagged) in the United States.

Applicability of tiers:
Date of engine manufacture. Specific replacement engine rules are in place. Exemption rules are in place.

Currently applicable emission stages:
- < 600 kW EPA Tier 3
- > 600 kW EPA Tier 4
- Recreational engines: EPA Tier 3r

China - China Emission Regulation for Marine Engines (Stage I, II)
GB 15097-2016 defines the regulatory requirements of Stage I and II.
GD05-2018 adds some operational detailed rules by CCS.
Currently applicable emission stages:
- C2

EU - European Union: Commercial Marine
EU Regulation 2016/1628 has replaced the previously existing EU Nonroad Directives 97/68/EC amended by 2012/46/EC and the corresponding CCNR limits.
It defines, in addition to many other categories of off-highway engines, the requirements for engines used in inland waterway vessels.
EU V applies for engines which have been placed into the market after 01/2019 respectively 01/2020 for engines > 300 kW. Due to BREXIT, a GBTA type approval, provisional or full, is applicable for UK market (inland marine) starting from 2023.

EU - European Union: Recreational Marine
EU Recreational Craft Directive (RCD) 2013/53/EU has replaced the previously existing 94/25/EC as amended by 2003/44/EC. It defines the requirements for propulsion engines for recreational crafts from 2.5 to 24 m hull length operating within EU territories.

Applicability of stages:
Date of placing the engine/boat into the market.
Exemption rules are in place.

Currently applicable emission stages:
- EU V
- RCD 2

Due to BREXIT, a UKCA marking, declaring conformity with UKs recreational craft standards is applicable for UK market starting from 2023.

Additional to afore mentioned emission regulations we are able to deliver engines also for regional emission standards such as BSO (Lake Constance) or SAV (Switzerland) on request.

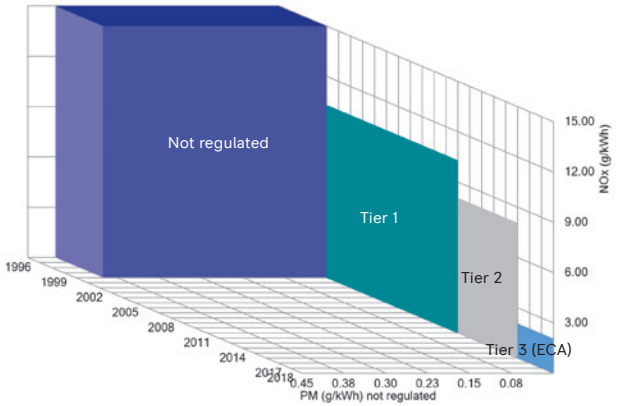
Besides current emission standards we are able to deliver also replacement engines with outdated emission standards. Replacement engine rules need to be observed.

EXHAUST EMISSIONS

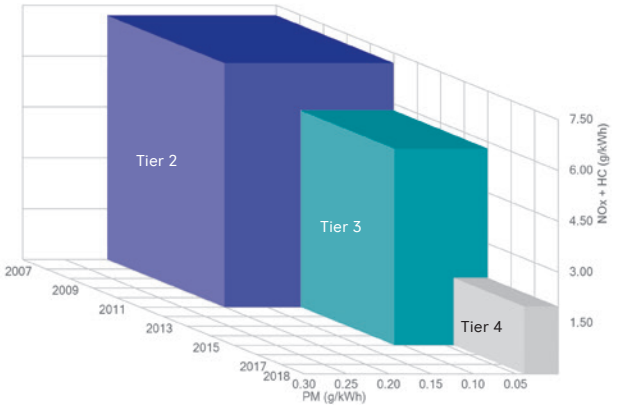
Samples for emission stages in marine industry:

IMO

IMO Seagoing ships



EPA



Abbreviations

T3c	EPA Tier 3 for commercial use
T3r	EPA Tier 3 solely for recreational use
T4c	EPA Tier 4 for commercial use
T1NRMM	EPA Tier 1 - Nonroad Mobile Machinery
T2NRMM	EPA Tier 2 - Nonroad Mobile Machinery
CCNR II	European commercial inland waterway transport - mutual recognition with EU IIIA
EU IIIA	European commercial inland waterway transport - mutual recognition with CCNR II
RCD 2	European recreational craft directive
EU V	EU Tier V as per (EU) 2016/1628
IMO I	International Maritime Organization Stage I (beginning form January 2000)
IMO II	International emission standard outside of emission control areas (ECA)
IMO III	International emission standard within emission control areas (ECA)
C1	China emission regulation for marine engines (Stage I)
C2	China emission regulation for marine engines (Stage II)

Please note

that the engines and systems (only) comply with country or region specific emission requirements and have appropriate emission certification(s) which are explicitly stated in respective technical specifications. Any Export/Import/Operation of the engine in countries or regions with different applicable emission law requirements is at the customers responsibility.

NOTES

Further special solution guides

- Rail
- PowerGen
- C&I, Agricultural, Mining
- Oil & Gas Industry
- Gendrive

CONVERSION TABLE

1 kW	= 1.360 PS	g	= 9.80665 m/s²
1 kW	= 1.341 bhp	Л	= 3.14159
1 bhp	= 1.014 PS	e	= 2.71828
1 oz	= 28.35 g	e	= 2.71828
1 lb	= 453.59 g	1 lb	= 16 oz
1 short ton	= 907.18 kg	1 short ton	= 2000 lbs
1 lb/bhp	= 447.3 g/PSh	1 ft lb	= 1.356 Nm
1 lb/bhp	= 608.3 g/kWh	1 ft/min	= 0.00508 m/s
1 gal/bhp (US)	= 4264 g/kWh	pDiesel	= 0.83 kg/l
1 kWh	= 860 kcal	1 lb/sqin	= 0.069 bar (1 psi)
1 cal	= 4.187 J	1 mm Hg	= 1.333 mbar (133.3 Pa)
1 BTU	= 1.055 kJ	1 mm H_2O	= 0.0981 mbar (9.81 Pa)
1 inch	= 2.540 cm	T (K)	= t (°C) + 273.15
1 sq. inch	= 6.542 cm²	t (°C)	= 5/9 x (t (°F) -32)
1 cu. inch	= 16.387 cm³	t (°C)	= 5/4 x t (°R)
1 foot	= 3.048 dm	1 foot	= 12 inches
1 sq. foot	= 9.290 dm²	1 yard	= 3 feet
1 mile	= 1.609 km	1 mile	= 5280 feet
1 naut. mile	= 1.853 km	1 naut. mile	= 6080 feet
1 UK Gallon	= 4.546 l	1 US Barrel	= 0.159 m³
1 US Gallon	= 3.785 l		= 42 US Gallons
Energy:	1 J = 1 Ws = 1 VAs = 1 Nm		
Power:	1 W = 1 VA = 1 Nm/s		
Force:	1 N = 1 kgm/s²		
Pressure:	1 Pa = 1 N/m² (1 bar = 10^5 Pa)		
MEP (bar)	$= \frac{P_{cyl}(kW) \times 1200}{n(1/min) \times V_{cyl}(l)}$		
Torque (Nm	$= \frac{P_{ges}(kW) \times 30000}{n(1/min) \times \pi}$		

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