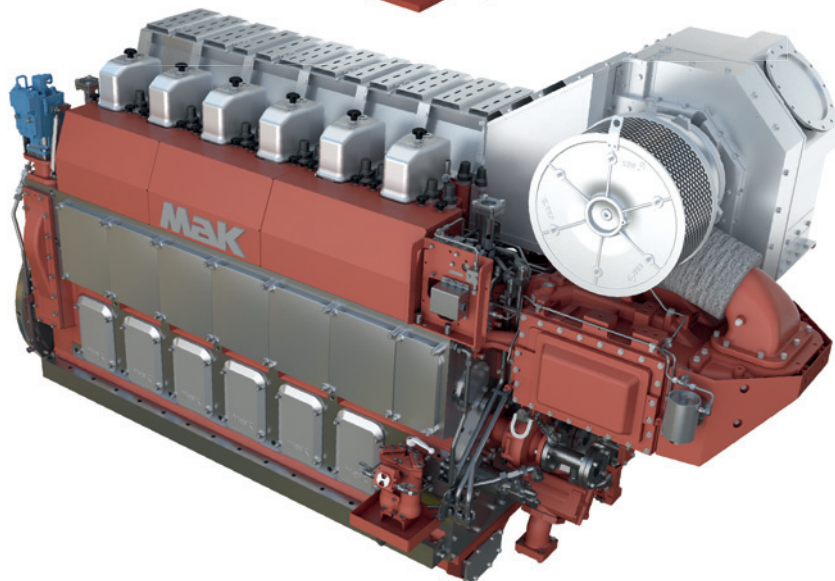
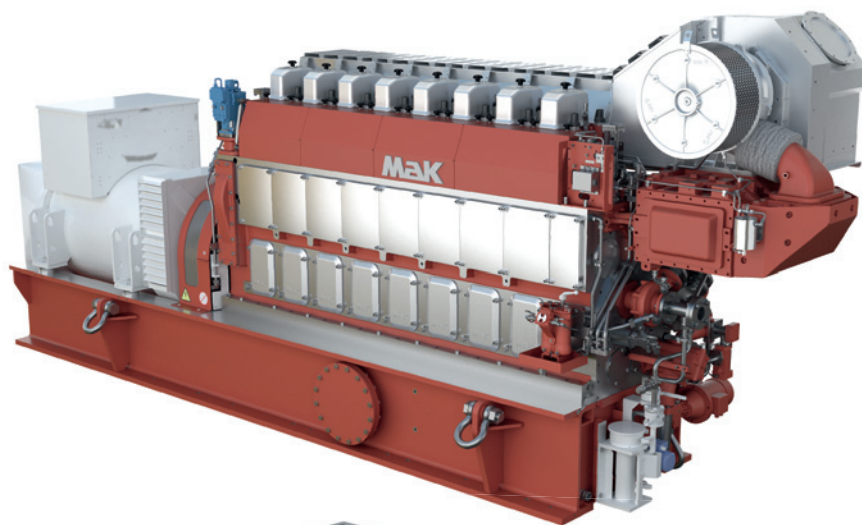


M 20 C

Main Engine and
Generator Solutions

6 • 8 • 9



M 20 C • The Compact Long-Stroke Diesel Engine with Heavy Fuel Capability

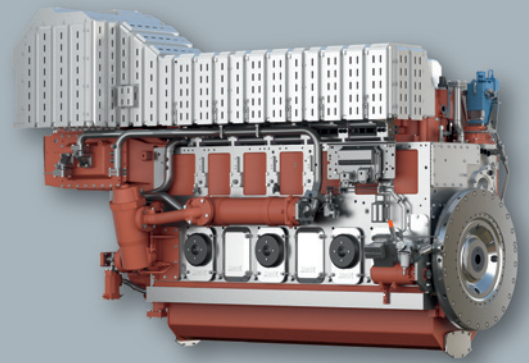
M 20 C engine series sets a milestone in MaK long-stroke engine technology.

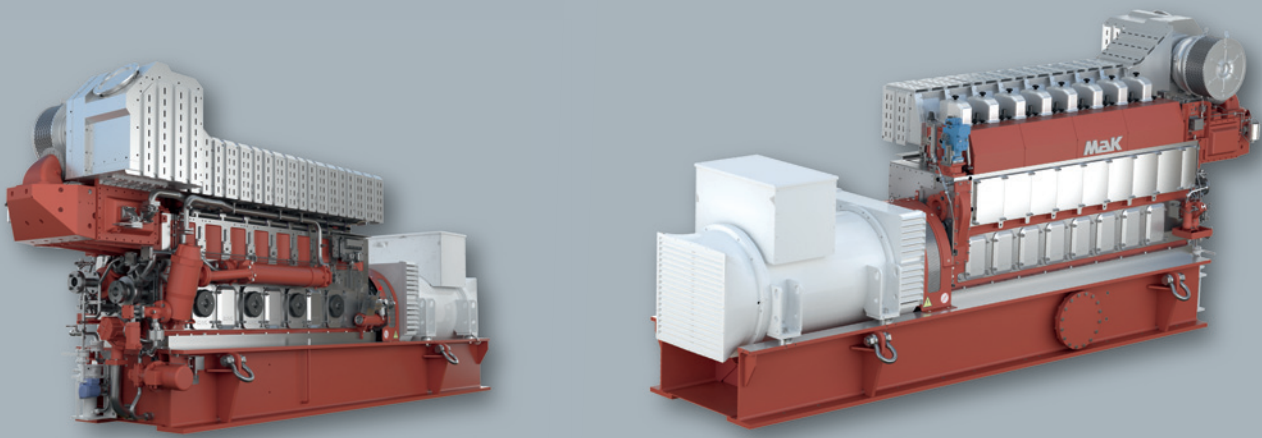
Developed and designed in response to the special requirements of marine applications, the most striking features of this engine are its high reliability and economy. These features help to explain the continued high market demand for the M 20 C as an engine for both marine propulsion and marine generator sets.

The long-stroke design principle is the backbone of an excellent combustion process with low fuel and lube oil consumption, as

well low NO_x emission. The M 20 C engine is SOLAS compliant. Its intelligent simplicity means the high functional integration of fewer components. Fewer components mean greater reliability and easier maintenance.

Overall, this leads to outstandingly low operating costs and rapid returns on investment. Reliability and ease of maintenance are convincing arguments in favour of the engines of this series.



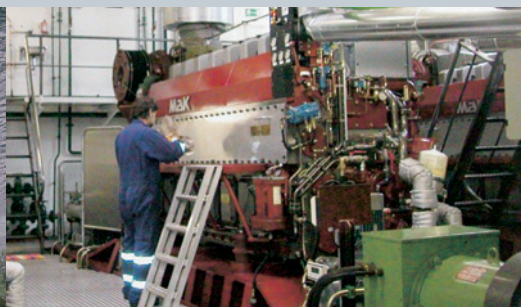


M 20 C – Marine Propulsion

M 20 C – Marine Generator Set

M 20 C – Diesel Electric Application

M 20 C – Caterpillar Propulsion Portfolio



M 20 C • Design Improvement

Customer Benefits

- **Turbocharging System**
with improved efficiency
- **Exhaust Pipe Design**
for greater simplicity
- **Exhaust System Cladding**
small, compact and easy to maintain
- **Dual Circuit Fresh Water Cooling System**
for easier installation with higher efficiency thanks to higher cooling water temperature up to 90 °C

- **Cylinder head**
Easy maintenance thanks to plug-in connections

- **New modular alarm and control system**
Basic- and advanced panel

- **Charging system**
with a high air excess

- **Camshaft**
Easy maintenance

- **Cylinder block**
Dimensional accuracy due to a foundry improvement

- **Double resilient mounting system**
in connection with deep oil pan available, also available for HFO operation



M 20 C • Safety First

Engine with high safety level

The M 20 C is an engine with a high safety level. This applies not only to those special internal design features which guarantee long component life and high availability but also to safety in the area around the engine. As a result, SOLAS regulations are strictly and consistently observed. Explosion protection cover for the cylinder/crankcase housing and cladding of the complete fuel and exhaust gas system in stainless steel are part of an overall SOLAS safety concept.

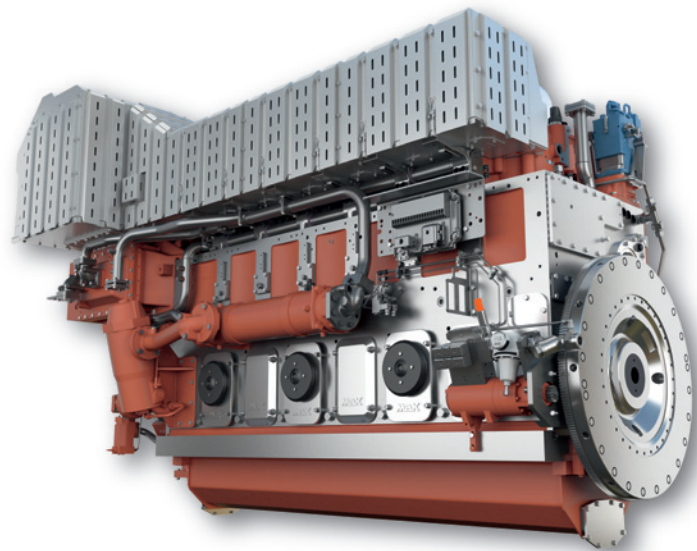
HFO/MDO – Long TBO and lifetime

Long maintenance intervals and the life of components are the basis for low operating costs.

	Lifetime x 1000 h
Piston	60
Piston rings	30
Cylinder liner	60 / 90*
Cylinder head	90
Inlet valve	30
Exhaust valve	30
Nozzle element	5 / 7.5*
Pump element	15
Main bearing	30
Big-end bearing	30

*MDO Operation

The above mentioned data are not binding. They only serve as standard values. These standard values can be attained if the MaK operating and maintenance specifications are strictly observed and only MaK spare parts are used. Please consider as well the negative effect of bad fuel qualities.



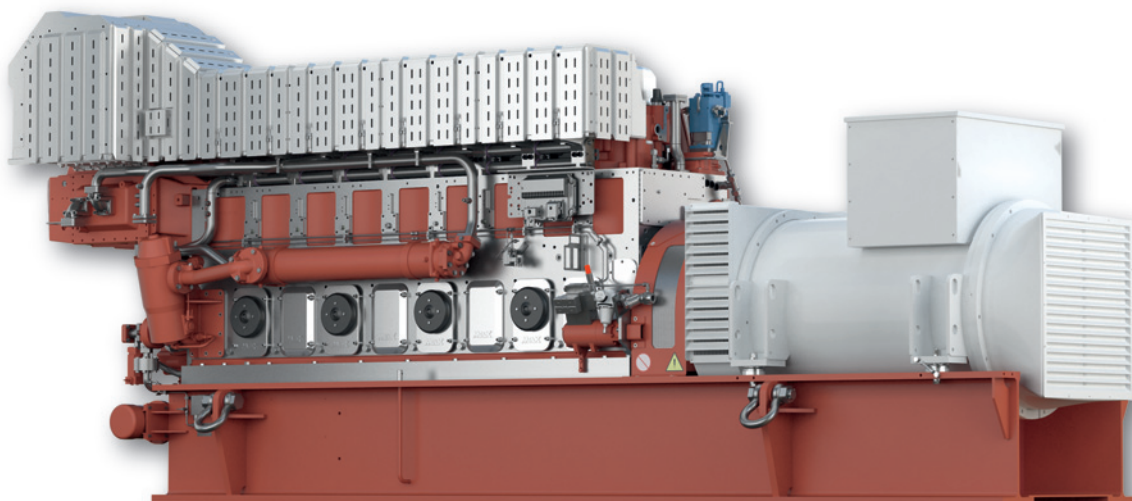
M 20 C • Complete Diesel Generator Sets

HFO and MDO operation

The main features of the diesel generator set are ease of installation, reliable operation, ease of maintenance and easy component accessibility. Its base is the rigid frame which forms a foundation for both the engine and the generator set and includes an integral, large-capacity oil sump and universal fuel supply equipment covering both HFO and MDO operation.

Generation of electricity

In addition to its use as a marine propulsion unit, the M 20 C has a wide range of application providing power for the continuous generation of electricity applications where a high level of reliability is always important. The power range of the M 20 C engine series as a generator unit is from 1,224 to 2,160 kVA.



M 20 C • EEDI (Energy Efficiency Design Index)

The Energy Efficiency Design Index (EEDI) was developed and implemented by the International Maritime Organization (IMO) in 2013. Its objective is to simulate/encourage the merchant fleet to reduce emissions by using innovative and more energy efficient propulsion concepts. The EEDI is based on technical design parameters. It is a calculated, specific figure for an individual ship design. It is uttered in grams of carbon dioxide per ship capacity-mile.

The CO₂ reduction level (grams of CO₂ per ton/mile) for the first phase is set to 10% and will be tightened every five years. Reduction rates have been established until 2030 when a 30% reduction is mandated for applicable ship types calculated from a reference line representing the average efficiency for ships built between 2000 and 2010.

Every defined and measured IMO group for each engine type has a specific EEDI value.

It was defined and agreed upon using the 75% MCR value for propulsion and the 50% MCR value for genset engines.

Caterpillar is continuously working on optimizing our engines to improve the Specific Fuel Oil Consumption.



The EEDI values for every defined and measured IMO group are specific.

For example: In propulsion application the M 20 C engine provides an EEDI fuel consumption value of 201.2 g/kWh*, based on one specific IMO group.

Please contact our sales teams, if you need more information about the EEDI SFOC for your engine and application.



* These values are subject to change without notice depending on engine group under which the engine is certified.

M 20 C • Technical Data

Propulsion

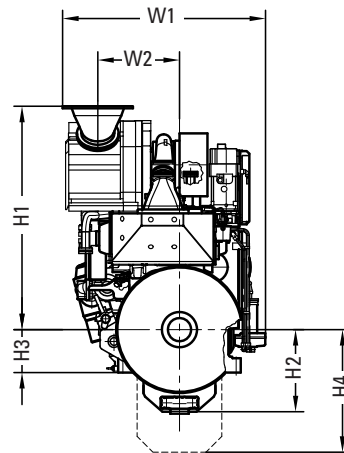
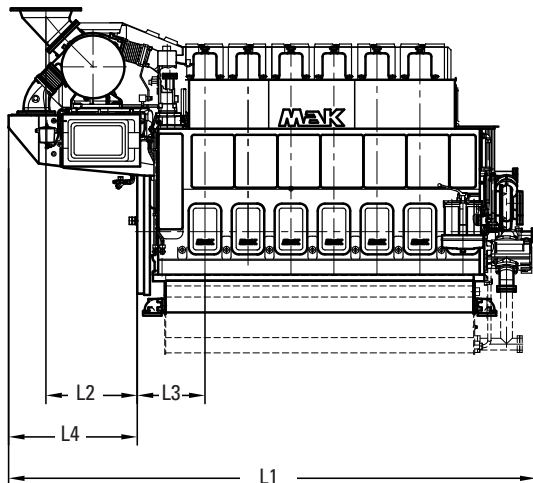
The engine is marketed with a standardized range of installed pumps and filters. Interfaces for fuel, lubricating oil and cooling water systems are located at the opposite end to the crankshaft coupling for ease of connection.

PROPULSION

Type	Output range kW	Speed rpm	Brake mean eff. pressure bar	Mean piston speed m/s	Bore mm	Stroke mm	Spec. fuel oil consumption	
							100% g/kWh	85% g/kWh
6 M 20 C	1,020	900	24.1	9.0	200	300	189	188
	1,080	900	25.5	9.0	200	300	191	189
	1,140	1,000	24.2	10.0	200	300	190	189
	1,200	1,000	25.5	10.0	200	300	192	190
8 M 20 C	1,360	900	24.1	9.0	200	300	189	188
	1,440	900	25.5	9.0	200	300	191	189
	1,520	1,000	24.2	10.0	200	300	190	189
	1,600	1,000	25.5	10.0	200	300	192	190
9 M 20 C	1,530	900	24.1	9.0	200	300	189	188
	1,620	900	25.5	9.0	200	300	191	189
	1,710	1,000	24.2	10.0	200	300	190	189
	1,800	1,000	25.5	10.0	200	300	192	190



Specific lubricating oil consumption 0.6 g/kWh, ± 0.3 g/kWh
LCV= 42700 kJ/kg, without engine-driven pumps, tolerance 5%



Engine center distance: 2010 mm

Propulsion engine (Dimensions in mm)

Engine	L1	L2	L3	L4	H1	H2	H3	H4	W1	W2	Weight (t)	
											wet sump	dry sump
6 M 20 C	4,049	702	520	988	1,714	630	330	941	1,591	627	11.5	10.9
8 M 20 C	4,846	802	520	1,125	1,856	630	330	941	1,727	710	14.5	13.8
9 M 20 C	5,176	802	520	1,125	1,856	630	330	941	1,727	710	16.0	15.0

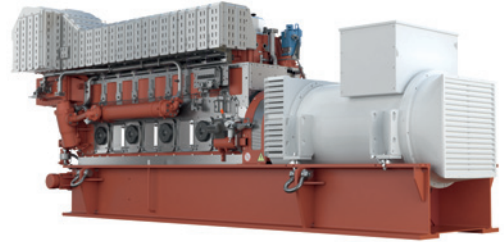
Wet sump (standard) Dry sump (special request)

Diesel-electric

The complete diesel generator set is notable for its ease of installation, reliable operation, ease of maintenance and good component accessibility. The basis is formed by the rigid base frame as foundation of the engine and alternator with integrated oil sump, large oil volume and universal equipment for both HFO and MDO operation.

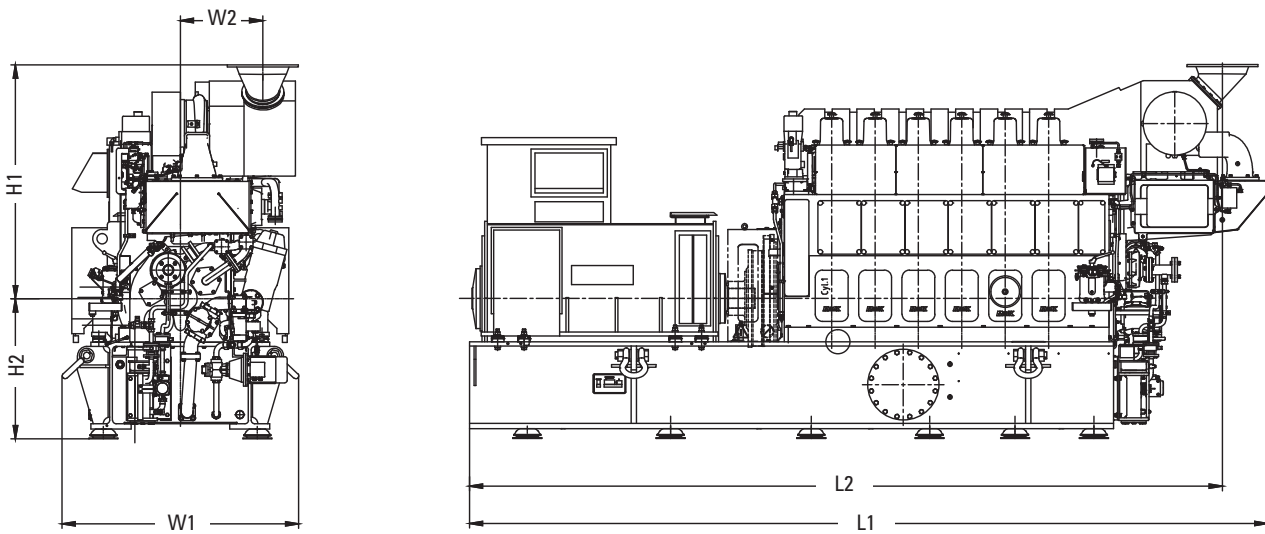
GENERATING SETS

Type	Engine rating		Output range		Frequency	Speed	Brake mean eff. pressure	Mean piston speed	Spec. fuel oil consumption	
	kW	kWe	kVA	Hz					rpm	bar
6 M 20 C	1,020	979	1,224	60	900	24.1	9.0	189	188	
	1,080	1,036	1,296	60	900	25.5	9.0	191	189	
	1,140	1,094	1,368	50	1,000	24.2	10.0	190	189	
	1,200	1,151	1,440	50	1,000	25.5	10.0	192	190	
8 M 20 C	1,360	1,306	1,632	60	900	24.1	9.0	189	188	
	1,440	1,381	1,728	60	900	25.5	9.0	191	189	
	1,520	1,459	1,824	50	1,000	24.2	10.0	190	189	
	1,600	1,534	1,920	50	1,000	25.5	10.0	192	190	
9 M 20 C	1,530	1,468	1,836	60	900	24.1	9.0	189	188	
	1,620	1,553	1,944	60	900	25.5	9.0	191	189	
	1,710	1,641	2,052	50	1,000	24.2	10.0	190	189	
	1,800	1,726	2,160	50	1,000	25.5	10.0	192	190	



Bore: 200 mm
Stroke: 300 mm

Specific lubricating oil consumption 0.6 g/kWh, \pm 0.3 g/kWh
LCV= 42700 kJ/kg, without engine-driven pumps, tolerance 5%
Generator efficiency: 0.96. $\cos\phi$: 0.8



Generator set center distance: 2010 mm

Generator set (Dimensions in mm)							
Engine	L1*	L2	H1	H2	W1	W2	Weight (t)*
6 M 20 C	6,073	5,727	1,779	1,065	1,800	627	21.2
8 M 20 C	6,243	5,897	1,955	1,065	1,800	710	23.1
9 M 20 C	7,438	7,116	1,955	1,065	1,800	710	26.0

*Dependent on generator make/type.

M 20 C • Cat® Propulsion Systems



The total package

Caterpillar Propulsion supplies complete, world-leading propulsion systems.

Custom-designed and optimized for uptime and cost-effective operations, our top-of-the-line controllable pitch propellers, thrusters, gearboxes, control systems, and hubs are all manufactured at our state-of-the-art production facilities in Sweden and Singapore.

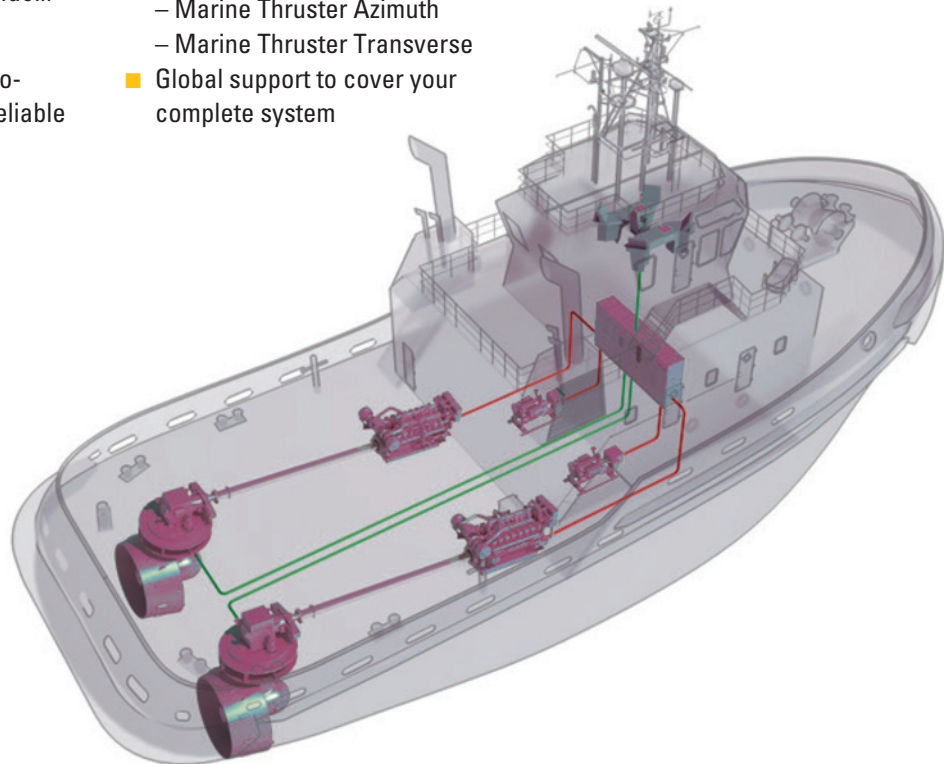
We are experts in innovative hydrodynamics to ensure heavy-duty, reliable performance for our customers.

A complete propulsion system usually consists of:

- MaK main propulsion engine
- Fully integrated control panel
- Controllable Pitch Propeller with or without feathering system
- Propeller with integrated hydraulic servo cylinder
- On request:
 - Marine Thruster Azimuth
 - Marine Thruster Transverse
- Global support to cover your complete system

Benefits include:

- Maximum efficiency
- Increased operating hours
- Reduced operating costs
- Maximum uptime
- Custom-designed



M 20 C • Cat® SCR System

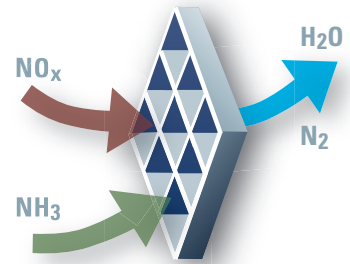
A sustainable solution to reduce NO_x emissions

The upcoming global and local regulations covering exhaust gas emissions for medium-speed marine diesel engines will be more stringent. While fulfilling IMO Tier II exhaust gas emissions is possible with engine internal solutions, IMO Tier III compliance will be achieved with exhaust gas after treatment solutions.

The Cat SCR System solution was designed by Caterpillar® especially for MaK medium-speed engines to meet future

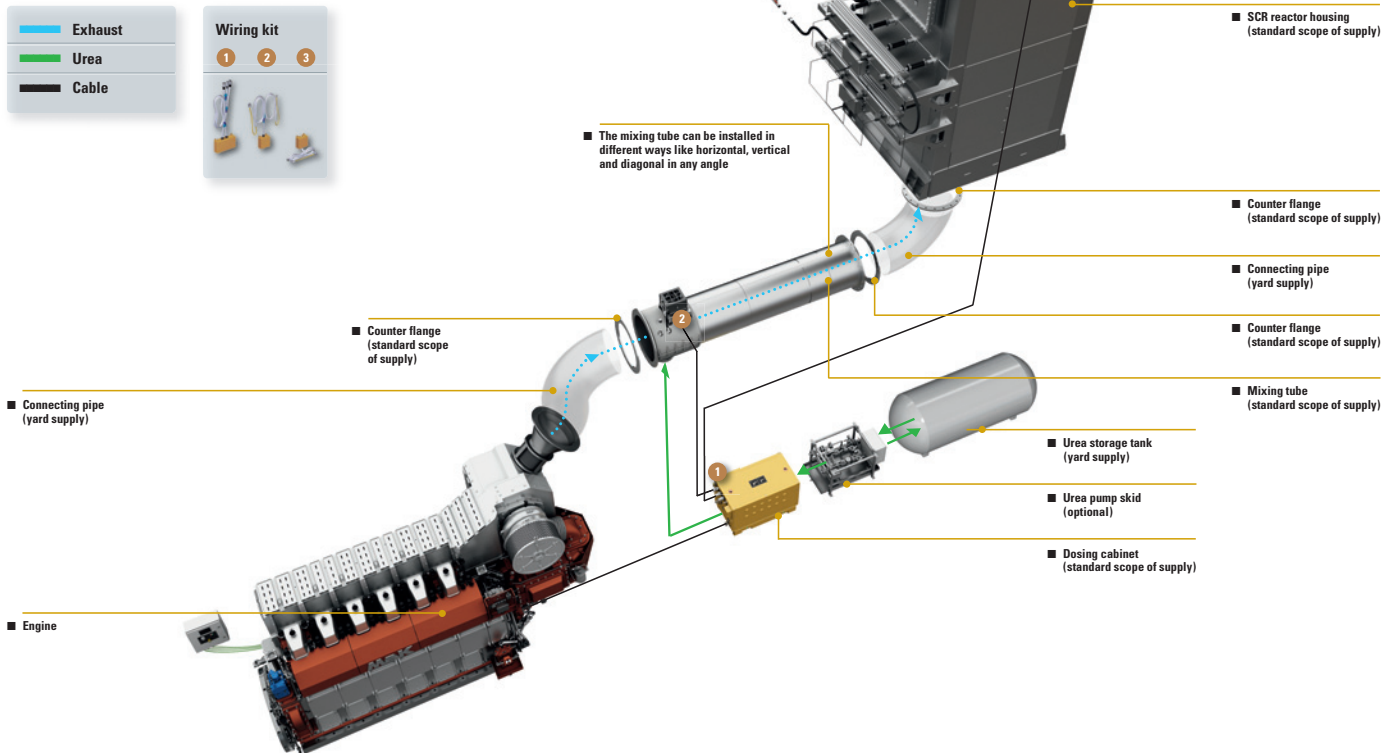
IMO Tier III emissions requirements. Installation and operation of the Cat SCR System is a sustainable solution to reduce NO_x emissions without sacrificing the typical MaK marine engine efficiency, durability and reliability that our customers are used to know.

The service- and maintenance-friendly design, remote condition monitoring and diagnostic capabilities, as well as our unmatched global product support respond to the industry's desire to lower operational costs and downtime beyond today's standards.



Available for 6, 8 and 9 M 20 C. Please feel free to ask us for more details and attend our SCR Systems leaflet.

■ Schematic drawing – Cat SCR System.



aMACS • advanced Modular Alarm and Control System

M 20 C is provided with an advanced Modular Alarm and Control System

For a faster on board installation, improved robustness and better service ability the engine control and monitoring system is separated into on- and off-engine component. The on-engine component contains all engine mounted sensors, actuators and control units. The second component is the off-engine control panel with customer interface.

Caterpillar Marine offers two control panel options to suit the requirements of your MaK brand medium-speed diesel engine application. These options are

The **Basic Panel** is the first panel option, currently available for M 20 C to VM 43 C propulsion engines and generator sets.

The **Advanced Panel** is the top-of-the-line panel option and offers additional features.

designed to provide the appropriate level of monitoring and protection and to fit the constraints of your installation project.

The advanced Modular Alarm and Control System is fully Marine Classification Society (MCS) type approved for manned and unmanned engine rooms.

Please feel free to ask us for more details and attend our aMACS leaflet.

Benefits:

- Common control and monitoring system for all Cat® and MaK brand marine engines
- Complete engine control system
- Fully configured and tested engine alarm system
- Control panel with flexible mounting position
- Exhaust gas after treatment (IMO III/Selective Catalytic Reduction [SCR] capability)
- Integrated isochronous load sharing function
- Configurable input and outputs
- Standard customer interface
- Interconnection harness between engine and control panel for simple on board installation
- Full text alarm and diagnostic indication
- Common spare parts



6 M 20 C with advanced Modular Alarm and Control System



Dimensions (in mm)				
	Height	Width	Depth	Weight (approx. in kg)
Basic Panel	800	600	210	60
Advanced Panel	1200	600	300	80

Cat Financial • World-Class Financing Solutions



You specify Cat or MaK power solutions, because you believe in the power of Caterpillar engines to keep you and your vessel safely on course. Cat Financial has the same commitment to your success – whether you need construction, term or repower financing.

We know how to support customers in one country, construction in a second country and registration in a third. We understand the marine industry – we've been lending to marine customers for more than 20 years. And, as it has been since 1986, our service commitment is powered by Caterpillar and Cat and MaK dealers everywhere.

Global Coverage

Whether you're a German operator building at a Chinese shipyard or a U.S. citizen building a yacht in Italy, Cat Financial can help. Our customers do business around the world, and we support them wherever they go.

Our service commitment extends to all marine sectors. From production and custom yachts to workboats and tankers – we have you covered.

Local Presence

Need a local expert? We know local markets and how to navigate the legal and regulatory environments.

Cat Financial has offices in the Americas, Europe and Asia, and financing representatives all over the world. Put our knowledge to work to power the deal.

Get your project moving anywhere in the world with Cat Financial – backed by the power of Caterpillar and our unmatched dealer network.

Visit us online at CatPowerFinance.com



One Strong Line of World-Class Engines Perfect Solutions for Main Propulsion and On-Board Power Supply

The Program: Quality is our Motto

For more than 80 years we have developed, built, supplied and serviced diesel engines – worldwide. Today Caterpillar Marine with its brands Cat and MaK offer high-speed and medium-speed engines with power ratings from 11 kW to 18,000 kW. Many different engine families are available to meet your specific application needs.

The current MaK product line is comprised of six medium-speed four-stroke diesel and dual fuel engine models.

Cat and MaK diesel engines are distinguished by high reliability, extremely low operational costs, simple installation and maintenance and compliance with IMO environmental regulations.

The application of engines in main and auxiliary marine power systems varies greatly and extends from high-speed boats and yachts, through tugs, trawlers and offshore vessels to freighters, ferries and cruise liners.

Caterpillar Marine Sales and Service Organization

Caterpillar has combined the sales and service activities and responsibility of their Cat and MaK brand marine engine business into Caterpillar Marine with headquarters in Hamburg/Germany.

In setting-up this worldwide structure, we have concentrated on integrating the Cat and MaK brand groups into a single, united marine team, which utilises the particular expertise of each group.

Commercial marine engine business is split into three geographic regions,

- Europe, Africa, Middle East
- Americas ■ Asia-Pacific,

Onboard Power Supply



Propulsion Engines



Caterpillar Marine Production Facilities

which manage all sales and product support activities. They have direct responsibility for achieving the ambitious growth targets set for the Cat and MaK brands and for providing our customers and dealers with complete marine solutions.

Caterpillar's global dealer network provides a key competitive edge – customers deal with people they know and trust.

Cat dealers strive to form a strong working relationship with their customers, offering comprehensive and competent advice from project support to repair work.

Some of the most advanced manufacturing concepts are used at Caterpillar locations throughout the world to produce engines in which reliability, economy and performance are second-to-none.

From the production of core components to the assembly of complete engines, quality is always the top priority.

Comprehensive, recognized analysis systems, test procedures and measuring methods ensure that quality requirements

are met throughout all the individual manufacturing phases. All of our production facilities are certified under 1:2000 ISO 9001 EN, the international benchmark that is helping to set new quality standards worldwide.

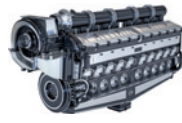
In addition to product quality, our customers expect comprehensive service which includes the supply of spare parts throughout the life of the engine.



● **C18**
6 cylinder
260–565 kW
325–706 kVA

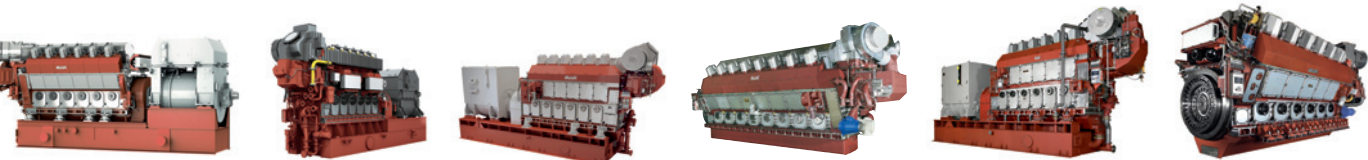
● **C32 ACERT**
12 cylinder
525–940 kW
656–1,175 kVA

● **C280**
6, 8, 12, 16 cylinder
1,650–5,200 kW
2,063–6,500 kVA



● **EMD E 23 (710 Series)**
8, 12, 16, 20 cylinder

- High-Speed Engines
- Medium-Speed Engines



● **VM 32 E**
12, 16 cylinder
6,099–8,593 kW
7,632–10,752 kVA

● **M 34 DF**
6, 8, 9 cylinder
2,934–4,574 kW
3,672–5,724 kVA

● **M 43 C**
6, 7, 8, 9 cylinder
5,754–9,063 kW
7,200–11,340 kVA

● **VM 43 C**
12, 16 cylinder
11,508–16,111 kW
14,400–20,160 kVA

● **M 46 DF**
6, 7, 8, 9 cylinder
5,179–8,329 kW
6,480–10,422 kVA

● **VM 46 DF**
12, 16, cylinder
10,357–14,807 kW
12,960–18,528 kVA



● **3500**
8, 12, 16 cylinder
578–2,525 kW

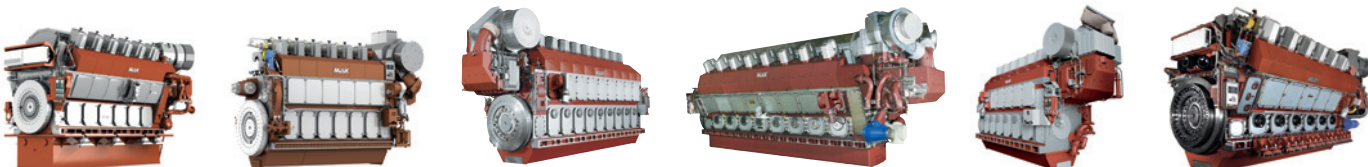
● **C175-16**
16 cylinder
2,001–2,550 kW

● **C280**
6, 8, 12, 16 cylinder
1,730–5,650 kW



● **EMD E23 (710 Series)**
8, 12, 16, 20 cylinder
1,491–4,101 kW

- High-Speed Engines
- Medium-Speed Engines



● **VM 32 E**
12, 16 cylinder
6,360–9,280 kW

● **M 34 DF**
6, 8, 9 cylinder
3,060–4,770 kW

● **M 43 C**
6, 7, 8, 9 cylinder
6,000–9,450 kW

● **VM 43 C**
12, 16 cylinder
12,000–16,800 kW

● **M 46 DF**
6, 7, 8, 9 cylinder
5,400–8,685 kW

● **VM 46 DF**
12, 16 cylinder
10,800–15,440 kW

The Power You Need.

The Cat® and MaK™ brands of Caterpillar Marine offer premier high- and medium-speed propulsion, auxiliary, and generator set solutions, as well as optional dual fuel, diesel-electric, and hybrid system configurations. With the launch of Caterpillar Propulsion our comprehensive and evolving product line gives customers one source for the most extensive engine power range available, as well as for complete propulsion systems, controllable pitch propellers, transverse and azimuth thrusters, and controls. Cat and MaK products and technologies have proven reliability and are built to last in all marine applications, demonstrating superior productivity and the lowest lifecycle cost.

The Cat Global Dealer Network, more than 2,200 global service locations strong, ensures that you will have local expertise, highly-trained technicians, rapid parts delivery, and the proper equipment and services to keep you working – anytime, anywhere.

Construction, term, or repower financing through Cat Financial will help you make Cat and MaK power a reality. With our knowledge of customer needs, local markets, and legal and regulatory requirements, we have been providing tailored financing solutions and exceeding expectations since 1986.

For more information or to find your local dealer, visit our website: www.cat.com/marine

Visit Cat Financial at: www.CatPowerFinance.com

Caterpillar Marine

Europe, Africa, Middle East

Caterpillar Marine
A Division of
Caterpillar Motoren GmbH & Co.KG
Neumühlen 9
22763 Hamburg
Germany

Phone: +49 40 2380 3000
Telefax: +49 40 2380 3535

Americas

MaK Americas Inc.
3450 Executive Way
Miramar Park of Commerce
Miramar, FL 33025/USA

Phone: +1 954 885 3200
Telefax: +1 954 885 3131

Asia Pacific

**Caterpillar Marine Trading
(Shanghai) Co., Ltd.**
19/F, 1319 Yan'an West Road
Shanghai 200050, China

Phone: +86 21 2216 0600
Telefax: +86 21 6226 4500

**Caterpillar Marine Asia
Pacific Pte Ltd**
No. 5 Tukang
Innovation Grove
Singapore 618304
Republic of Singapore

Phone: +65 68287 600
Telefax: +65 68287 625

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by scanning the QR code

