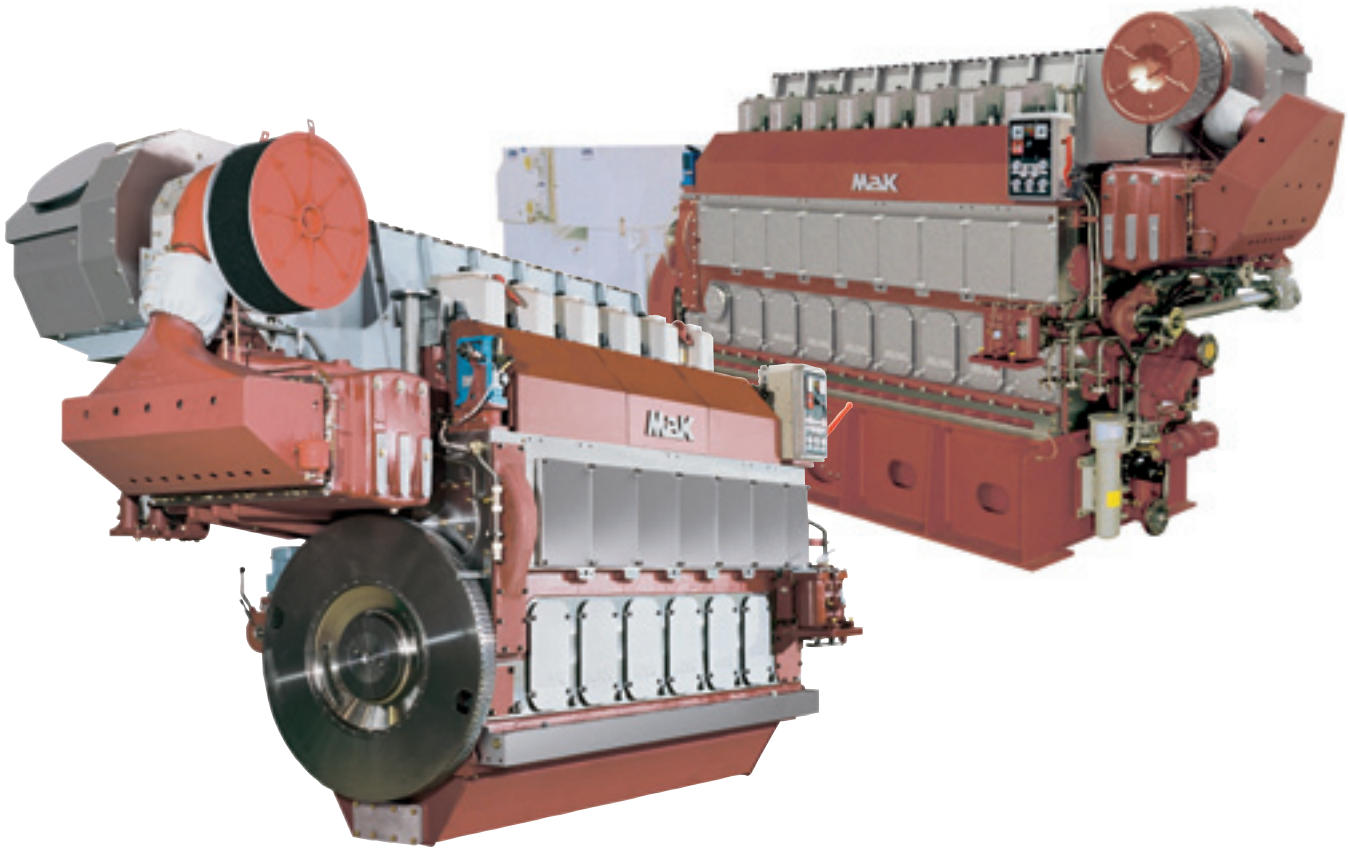
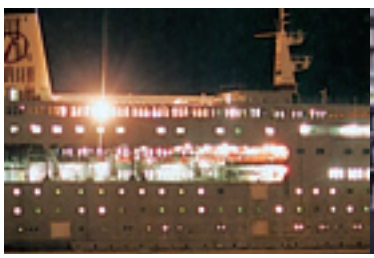
M 25 C

Long-Stroke Diesel Engines for Maximum Efficiency and High Reliability 6 • 8 • 9

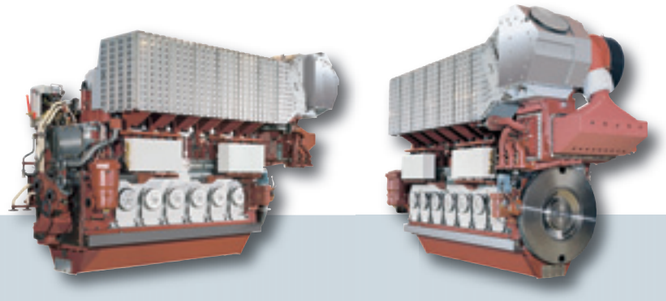




MaK

CATERPILLAR®

M 25 C – Simply intelligent



The M 25 C, part of the MaK long-stroke engine generation, is based on the proven design characteristics of the M 20 C, M 32 C and M 43 C engine series. In the development of this new engine generation, the objective was to achieve a high benefit level for the customer. In all design and development considerations, therefore, three criteria had maximum priority – reliability, economy and environmental compatibility.

Other important points of great significance in the engine's design and development work were ease of maintenance, long maintenance intervals, long component life and ease of installation.

The M 25 C series can now be supplied with different cylinder powers: 300 kW or 333 kW per cylinder. So a power range of between 1,800 and 3,000 kW is available. Main features of the series are their high levels of reliability and economy in both MDO and HFO operation. The series is available in 6, 8 and 9-cylinder variants.

With its modern design and high performance, the M 25 C offers its operators a wide range of applications and the certainty that they have bought a reliable and economic engine. Another feature of the series is its low emission levels, which are well within IMO regulatory limits.

- **M 25 C** – Propulsion
- **M 25 C** – On-Board Power
- **MaK** Propulsion Package

Marine Propulsion

M 25 C: The right solution for marine propulsion application

- for fishing vessels
- for tugs and for all the conditions of off-shore use
- for cargo vessels

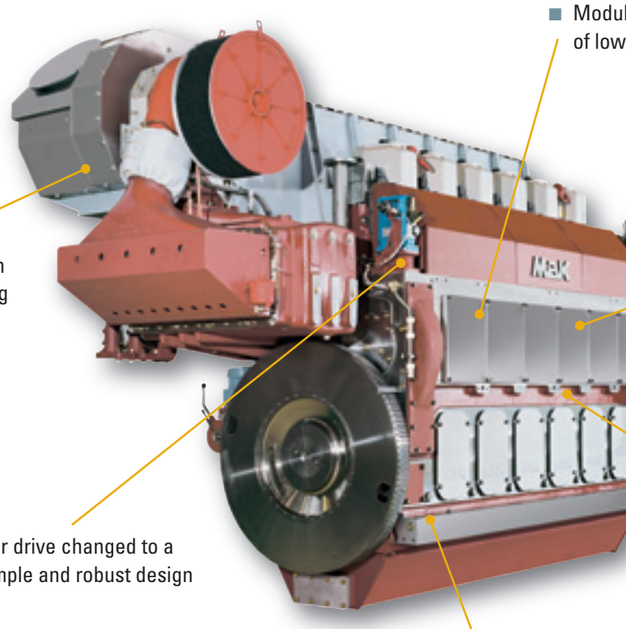
On-Board Power

M 25 C: The reliable generator drive for container reefer and on-board electricity generation

- the dependable solution
- on-board electricity for all types of ships

M 25 C – Design Improvement

- The new M 25 C was changed to meet the same design principles as M 20 C, M 32 C and M 43 C.
- All MaK engine series have the same nomenclature with the design status “C”.
- The power output of the M 25 C increased slightly.
- The engine development also considers a possible Caterpillar Common Rail introduction.
- The design changes of the new M 25 C cylinder block result in an improved way of founding with an increased dimensional accuracy.
- The new governor drive is of simple and robust design.
- The design of the lower valve drive was changed to modular pre-assembly.
- New camshaft cover design for improved handling.
- No change of connecting points.



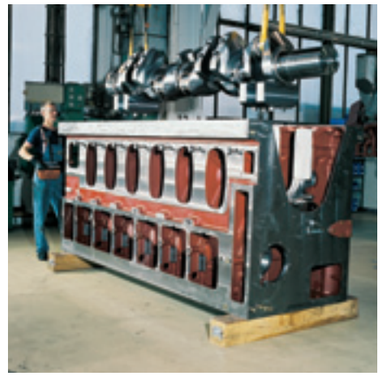
- Modular assembly of lower valve drive
- Turbocharger with improved cladding
- New camshaft cover design
- Governor drive changed to a more simple and robust design
- Cylinder block. Increased dimensional accuracy due to an improved casting process
- Resilient mounting system in connection with deep oil pan available. Also available for HFO operation

The Highlights

- Maximum operational reliability
- Maximum economy
- Low fuel consumption
- Low lubricating oil consumption
- Long maintenance intervals and component life
- Heavy fuel oil compatibility
- Robust and simple
- Reduction in the number of components
- Very maintenance-friendly
- Environmentally-friendly due to low NO_x and CO_2 emissions
- Ease of installation

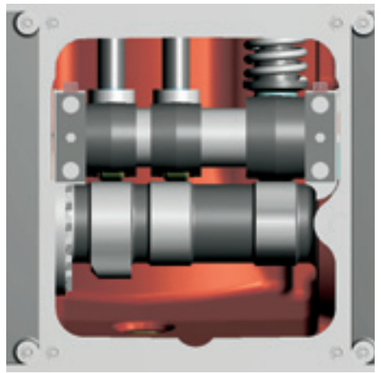
M 25 C – Design Features

Intelligent simplicity
This MaK design principle is most clearly reflected in the reduction in the number of components. About 40% of parts – in particular conduits – have been dispensed with and a high level of functional integration achieved among the remaining components. There are also about 40% fewer interfaces, – with their susceptibility to failure and associated maintenance requirements.
The remaining connections are plug-in connections, again reducing maintenance needs. All of this has resulted in a marked gain in operational reliability and a reduction in operating costs.



Crankshaft with thrust bearing

- Forged from one piece
- Generously sized trunnions
- Capable of bearing the single-part gearwheel for the control drive
- Linked to the flywheel via an oil-pressure connection
- Generously sized 100% mass counterweights



Camshaft

- Individual cylinder sections
- Integrated non-adjustable cams for injection and valve timing
- Low wear due to cam follower lever arm

Cylinder liner with calibration ring

- Robust
- Cooling only above the crankcase
- Cylinder liner protected from wear
- Longer oil change intervals thanks to reduced dirt intake

Multifunctional cooling water ring

- Centering action during assembly of cylinder liner and head
- Guides cooling water and charge air
- Concentrated cooling of cylinder liner and head
- Protects cylinder head bolts from corrosion

M 25 C – Design Features

Piston
- Piston with stable combustion chamber
- Hardened first ring groove
- First ring with chromium ceramic-plated running surface
- Piston rings have a long service life and high operational reliability

High-efficiency turbocharger
- Low temperature level of components surrounding the combustion chamber
- Two-stage design
- Corrosion-free turbocharger casing without water cooling

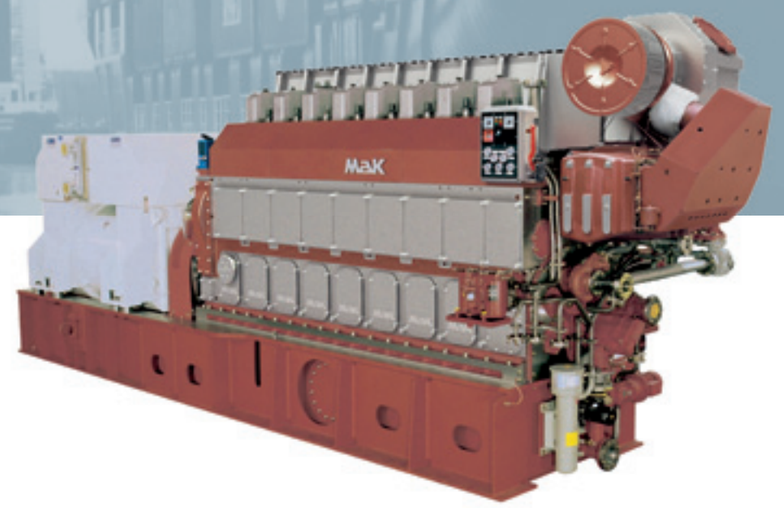
Cylinder head
- Intensive cooling by means of generously dimensioned radial openings
- Longitudinal holes for integrated media guidance
- Robust and form stable thanks to double-bottom construction in nodular cast iron

Injection pumps
- Secure mounting
- Monobloc design with constant-pressure valve
- Integrated low-pressure damping prevents high pressure pulses
- Integrated stop cylinder

M 25 C – Complete Diesel Generating Sets

Reliable energy supply
The complete diesel generating 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.

Generation of electricity
In addition to its use as a marine propulsion unit, the M 25 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 25 C engine series as a generator unit is from 2,140 to 3,560 kVA.

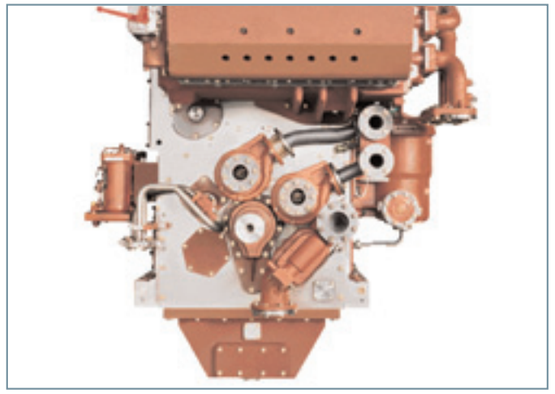


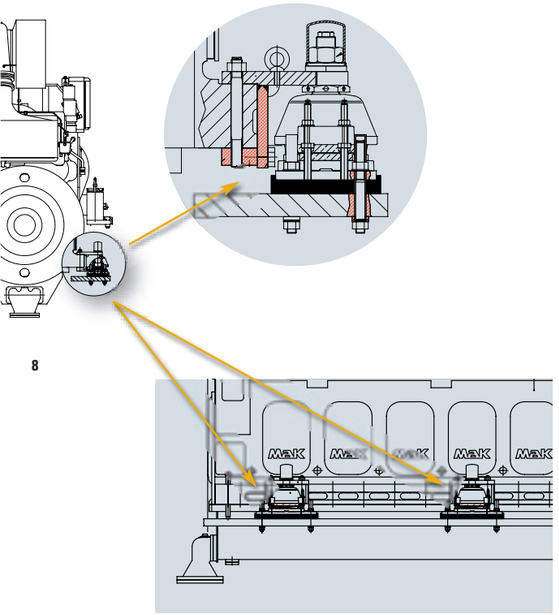
M 25 C – Ready for Installation

Complete
In addition to many outstanding technical features, the long-stroke M 25 C engine is also easy to install and provides good maintenance access to all component parts.

Installation-friendly
Further installation advantages are compact engine construction and the optimal position of interfaces for fuel, lubricating oil and cooling water systems. These are located at the opposite end to the coupling, making connection easier. All engine operating elements and remote switching are integrated into the operating panel, easily accessible to the engine.

Resilient mounting system
The resilient mounting system for vibration and structure-borne noise damping can be assembled safely and simply.





	TBO x 1000 h	Lifetime x 1000 h
Piston crown	30	90
Piston rings	-	30
Cylinder liner	-	60 / 90*
Cylinder head	15	-
Inlet valve	15	30
Exhaust valve	15	30
Nozzle element	-	7,5
Pump element	-	15 / 20*
Main bearing	-	30
Big-end bearing	-	30

*MDO Operation

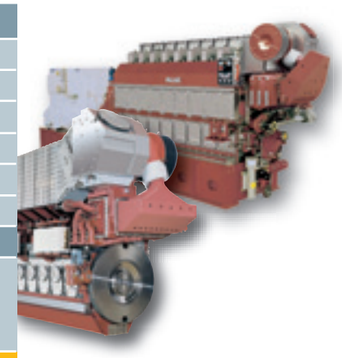
The above mentioned data are not binding. They only serve as standard values. These standard values can be attained if the MaK operating and maintenance specifications are strictly observed and only MaK spare parts are used. Please consider as well the negative effect of bad fuel qualities.

HFO/MDO – Long TBO and lifetime
Long maintenance intervals and the life of components are the basis for low operating costs.

Technical Data

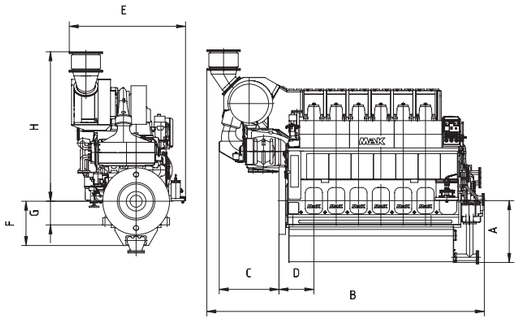
PROPULSION + GENERATOR SETS

Number of cylinders	in-line	6, 8, 9			
Bore	mm	255			
Stroke	mm	400			
Cylinder rating	kW	300	308	317	333
Speed	rpm	720	750	720	750
Mean piston speed	m/s	9.6	10.0	9.6	10.0
BME	bar	24.5	23.5/24.2	23.7/25.8	26.1
Engine rating:		**kW**	**kW**	**kW**	**kW**
	6 M 25 C	1,800	1,850	1,900	2,000
	8 M 25 C	2,320	2,400	2,540	2,660
	9 M 25 C	2,610	2,700	2,850	3,000
		60 Hz	**50 Hz**	**60 Hz**	**50 Hz**
Generator rating:*		**kWe** / **kVA**	**kWe** / **kVA**	**kWe** / **kVA**	**kWe** / **kVA**
	6 M 25 C	1,710 / 2,140	1,760 / 2,200	1,800 / 2,250	1,900 / 2,380
	8 M 25 C	2,200 / 2,750	2,280 / 2,850	2,400 / 3,000	2,530 / 3,160
	9 M 25 C	2,480 / 3,100	2,570 / 3,210	2,700 / 3,370	2,850 / 3,560
Specific fuel oil consumption (g/kWh) MCR 100% tolerance 5 %**		183	183	184	184
DNV Clean Design		185	185	186	186
Specific lub oil consumption:		0.6 g/kWh, tol. ± 0.3 g/kWh			
The engine fulfills MARPOL 73/78 Annex VI regulations.					

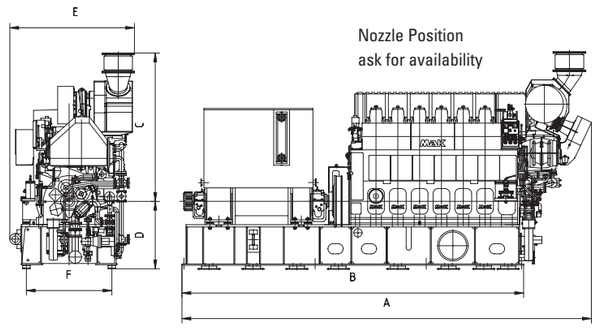


* Generator efficiency: 0.95, cos φ: 0.8 ** LCV = 42700 kJ/kg, without engine driven pumps

■ M 25 C Propulsion



■ M 25 C Generator Set



Propulsion Engine (Dimensions in mm)									
Engine	A	B	C	D	E	F	G	H	t
6 M 25 C	1191	5345	1151	672	2260	861	460	2906	21.0
8 M 25 C	1191	6289	1151	672	2315	861	460	3052	28.0
9 M 25 C	1191	6719	1151	672	2315	861	460	3052	29.6

Generator Set, Complete (Dimensions in mm)							
Engine	A	B	C	D	E	F	t
6 M 25 C	8070	6735	2951	1340	2479	1700	29.1
8 M 25 C	9130	7795	3097	1340	2534	1700	36.7
9 M 25 C	9560	8125	3097	1340	2534	1700	39.0

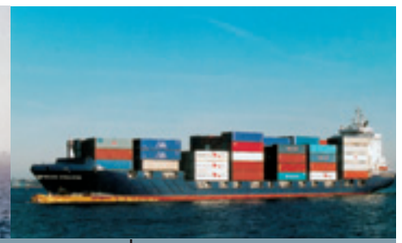
M 25 C – MaK Propulsion Package

Complete propulsion systems
The supply of complete propulsion systems is a market requirement which is becoming increasingly important.
We have comprehensive experience gathered during the design and execution of many successful propulsion plant installations and resulting from our close cooperation with competent partners.

We offer
- System responsibility and supply from a single source
- Accurately matched interfaces
- Coordinated delivery data control

A complete propulsion system usually consists of:
- MaK main propulsion engine with flexible coupling
- Reduction gearbox with or without installed clutch and gearbox PTO* with shaft generator
- Propeller and shaft installation
- Including remote control and monitoring equipment

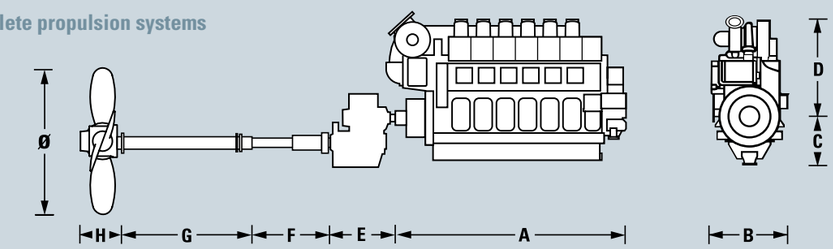
*Power Take Off



Engine							Gear	Shaft		Propeller		
aType	Rating	Speed										Speed
	kW	rpm	A	B	C	D	E	F	G	H	Ø	rpm
6 M 25 C	2,000	750	5,345	2,260	861/1,191	2,906	1,904	2,000	3,000	617	3,000	220
8 M 25 C	2,640	750	6,289	2,315	861/1,191	3,052	1,837	2,000	3,000	617	3,300	205
9 M 25 C	3,000	750	6,719	2,315	861/1,191	3,052	1,795	2,000	3,000	630	3,450	200

Subject to be change

Examples of complete propulsion systems



M 25 C – Clean Solution

The long-stroke concept for ecological operation
Environmental protection is also becoming increasingly important for seagoing shipping. Caterpillar Motoren recognized this trend in good time and, with the design and development of the modern long-stroke engine concept, created the conditions for engine operation at reduced emission levels. The NO_x emissions of the M 20 C engine lies well below the International Maritime Organisation`s limiting curve.

The long-stroke concept for engine operation at reduced emission levels
The following features characterise the concept which ensures, in addition to smooth running, maximum operational reliability and also permits operation on heavy fuel oil up to 700 cSt/50°C.
- Long piston stroke
- Large stroke/bore ratio
- Intensive injection
- Shaped injection curve
- Optimised control times
- High ignition pressure

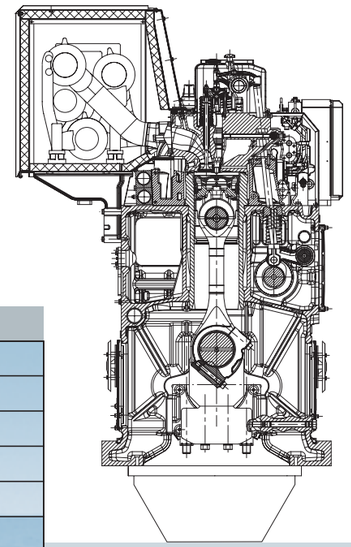
For MDO operation the engine is also available with less NO_x emission: Det Norske Veritas DNV "Clean Design" and Federal Ministry of Environment "Blue Angel".

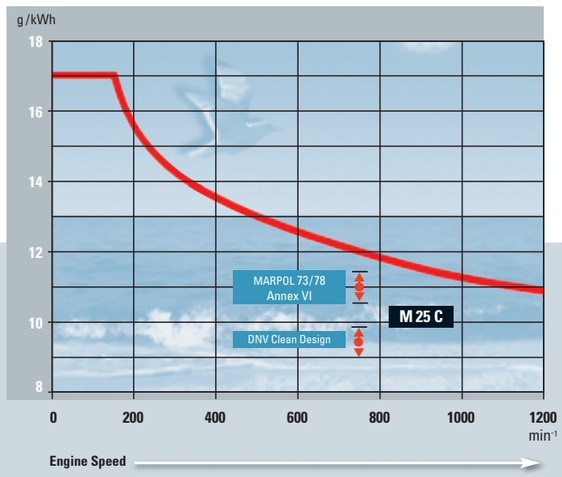
A further step to reduce soot emissions is the introduction of **Caterpillar Common Rail**, where the injection pressure is independent from load and speed. Utilizing several maps the injection characteristics are optimized for every engine operating point.

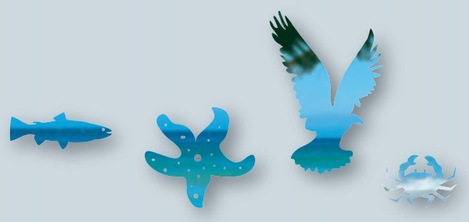
In general, the Caterpillar Common Rail fuel system enables vessel operation without visible soot throughout the whole operating range.

Key criteria are:
- Compliance with current and future required emission limits for the respective power ranges
- Customer expectations in terms of engine performance, maintenance practices, fuel quality and mode of operation

By adopting well proven elements of this technology for medium-speed engines, it is our goal to meet and exceed customer expectations by maximizing product value through:
- Superior reliability in heavy fuel operation
- Best fuel efficiency in its class
- Lowest engine emissions without additional equipment







Cat Financial – Our World-Class Financial Support

Marine Financing Guidelines

Power:	Cat and MaK.
Financial Products:	Construction, term and repower financing.
Repayment:	Loan terms up to 10 years, with longer amortizations available.
Financed Amount:	Up to 80 % of your vessel cost.
Rates:	Fixed or variable.
Currency:	US Dollars, Euros and other widely traded currencies.

Global Resource from One Source

When you select Cat Marine Power for your vessel, look to Cat Financial for world-class financial support. With marine lending offices in Europe, Asia and the US supporting Caterpillar's worldwide marine distribution network, Cat Financial is anchored in your homeport. We also have over 20 years of marine lending experience, so we understand your unique commercial marine business needs. Whether you're in the offshore support, cargo, ship assist, towing, fishing or passenger vessel industry, you can count on Cat Financial for the same high standard you expect from Caterpillar.

www.CAT.com/CatMarineFinance

Visit our web-site or see your local Cat dealer to learn how our marine financing plans and options can help your business succeed.

Ocean-Going Vessels

Pleasure Craft

Commercial Vessels

Integrated Solutions – Customer Support Portfolio

Providing integrated solutions for your power system means much more than just supplying your engines. Beyond complete auxiliary and propulsion power systems, we offer a broad portfolio of customer support solutions and financing options. Our global dealer network takes care of you wherever you are – worldwide. Localized dealers offer on-site technical expertise through marine specialists and an extensive inventory of all the spare parts you might need.

To find your nearest dealer, simply go to:
www.cat-marine.com or www.mak-global.com

One Strong Line of World-Class Diesel 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 16,000 kW. Many different engine families are available to meet your specific application needs.

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 Power Systems

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 Power Systems 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,

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.

Caterpillar Marine Power Systems

Production Facilities

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.

Caterpillar Logistics Services, Inc., located in Morton, Illinois, is the largest parts distribution facility within the Cat Logistics network and is also the headquarters for all the worldwide distribution centres. Morton utilises sophisticated material handling, storage and retrieval systems to support Caterpillar's customer service goals.

Onboard Power Supply

C1.5
10–14.5 kWe
10–18 kVA

C2.2
16–30 kWe
16–37.5 kVA

C4.4
36–99 kWe
45–123 kVA

3056
84–99 kWe
105–124 kVA

C9
142–250 kWe
178–313 kVA

C18
275–550 kWe
344–688 kVA

3400
6, 8, 12 cylinder
200–590 kWe
250–738 kVA

3500
8, 12, 16 cylinder
590–1,825 kWe
738–2,281 kVA

3600/C280
6, 8, 12, 16 cylinder
1,650–5,200 kWe
2,063–6,500 kVA

M 20 C
6, 8, 9 cylinder
970–1,625 kWe
1,210–2,030 kVA

M 25 C
6, 8, 9 cylinder
1,710–2,850 kWe
2,140–3,560 kVA

M 32 C
6, 8, 9 cylinder
2,765–4,320 kWe
3,456–5,400 kVA

VM 32 C
12, 16 cylinder
5,530–7,680 kWe
6,912–9,600 kVA

GENSETS

Propulsion Engines

High-Speed Engines

3056
6 cylinder
93–153 kW

C7
6 cylinder
187–339 kW

C9
6 cylinder
375–423 kW

C12
6 cylinder
254–526 kW

C15
6 cylinder
597–636 kW

C18
6 cylinder
339–747 kW

3400
6, 8, 12 cylinder
187–1,044 kW

C32
12 cylinder
492–1,342 kW

3500
8, 12, 16 cylinder
526–2,525 kW

Medium-Speed Engines

3600/C280
6, 8, 12, 16 cylinder
1,730–5,650 kW

M 20 C
6, 8, 9 cylinder
1,020–1,710 kW

M 25 C
6, 8, 9 cylinder
1,800–3,000 kW

M 32 C
6, 8, 9 cylinder
2,880–4,500 kW

VM 32 C
12, 16 cylinder
5,760–8,000 kW

M 43 C
6, 7, 8, 9 cylinder
5,400–9,000 kW

VM 43 C
12, 16 cylinder
10,800–16,000 kW

MAIN PROPULSION

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www.cat-marine.com or www.mak-global.com

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