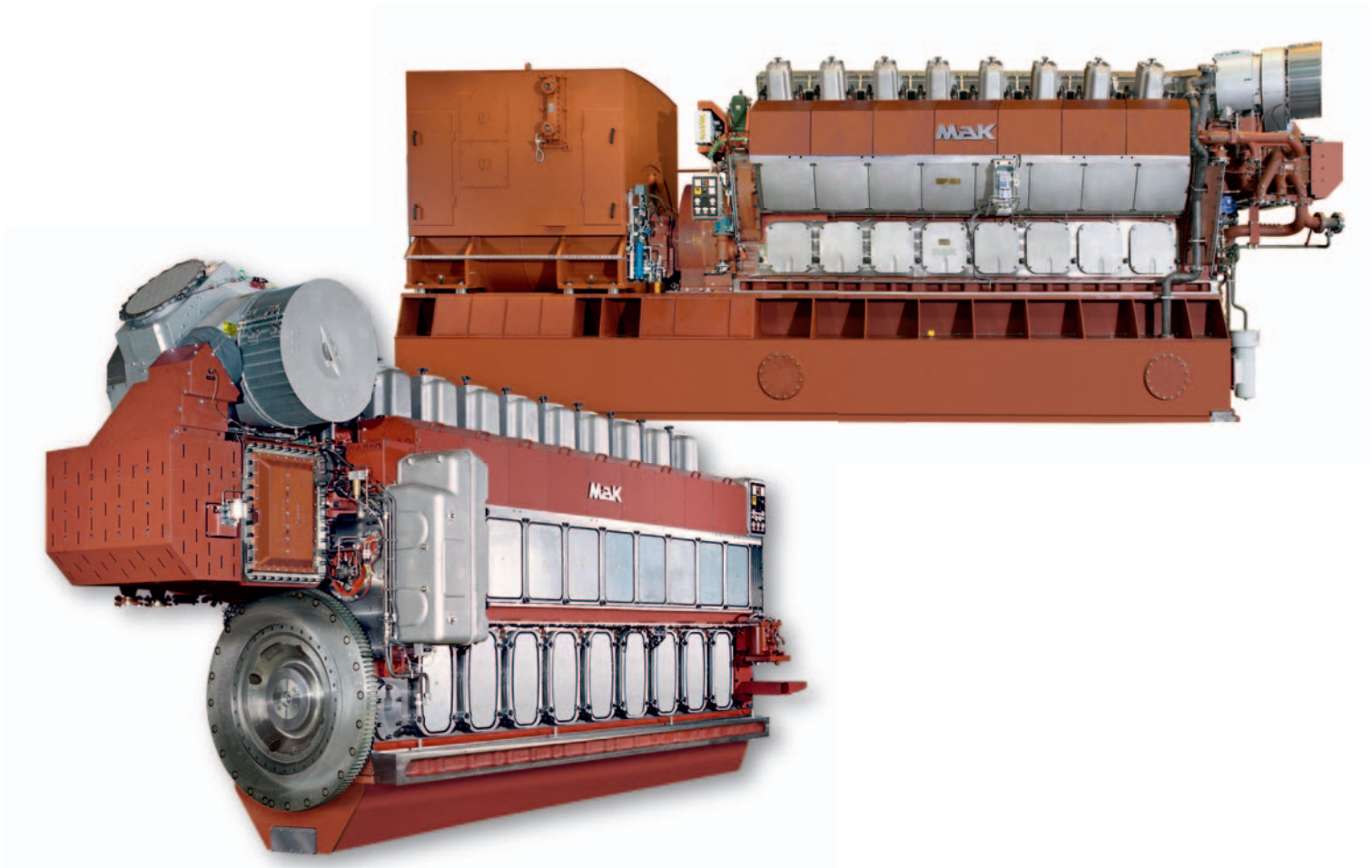
M 32 C

Long-Stroke Diesel Engines for Maximum Efficiency and High Reliability

6 • 8 • 9 In-line Engines

12 • 16 V-Type Engines



MaK

M 32 C – Powerful, Reliable and Economical

The acceptance of the M 32 C long-stroke engine series in the marine industry is a success story whose equal is hard to find in this power class.

Since its introduction in 1994, more than 1600 engines have been sold.

80% of those commissioned are marine propulsion engines and 20% are in electrical generator sets.

The M 32 C series is a genuine heavy fuel engine and 75% of all engines commissioned burn the economical heavy fuel oil.

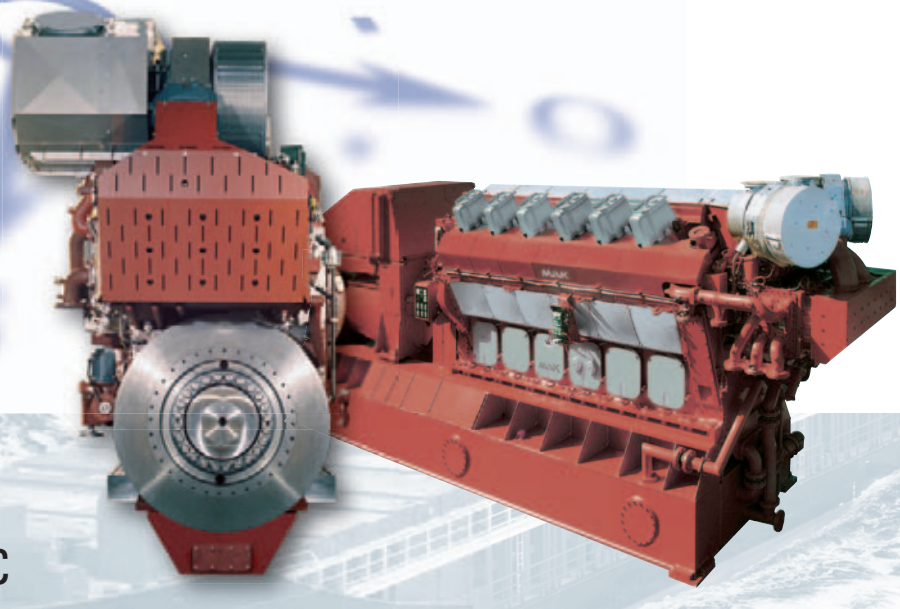
The M 32 C long-stroke series, with a bore of 320 mm, has continued the market success of its predecessor in this bore size.

Decisive factors in its development have been the requirements for maximum benefit to the customer, i.e. economy and operational reliability. Environmental aspects however have also been important.

Operational results have fully confirmed the design objectives.

Further development, which led to the M 32 C version with 500 kW/cyl., has provided even more benefits to the customer.

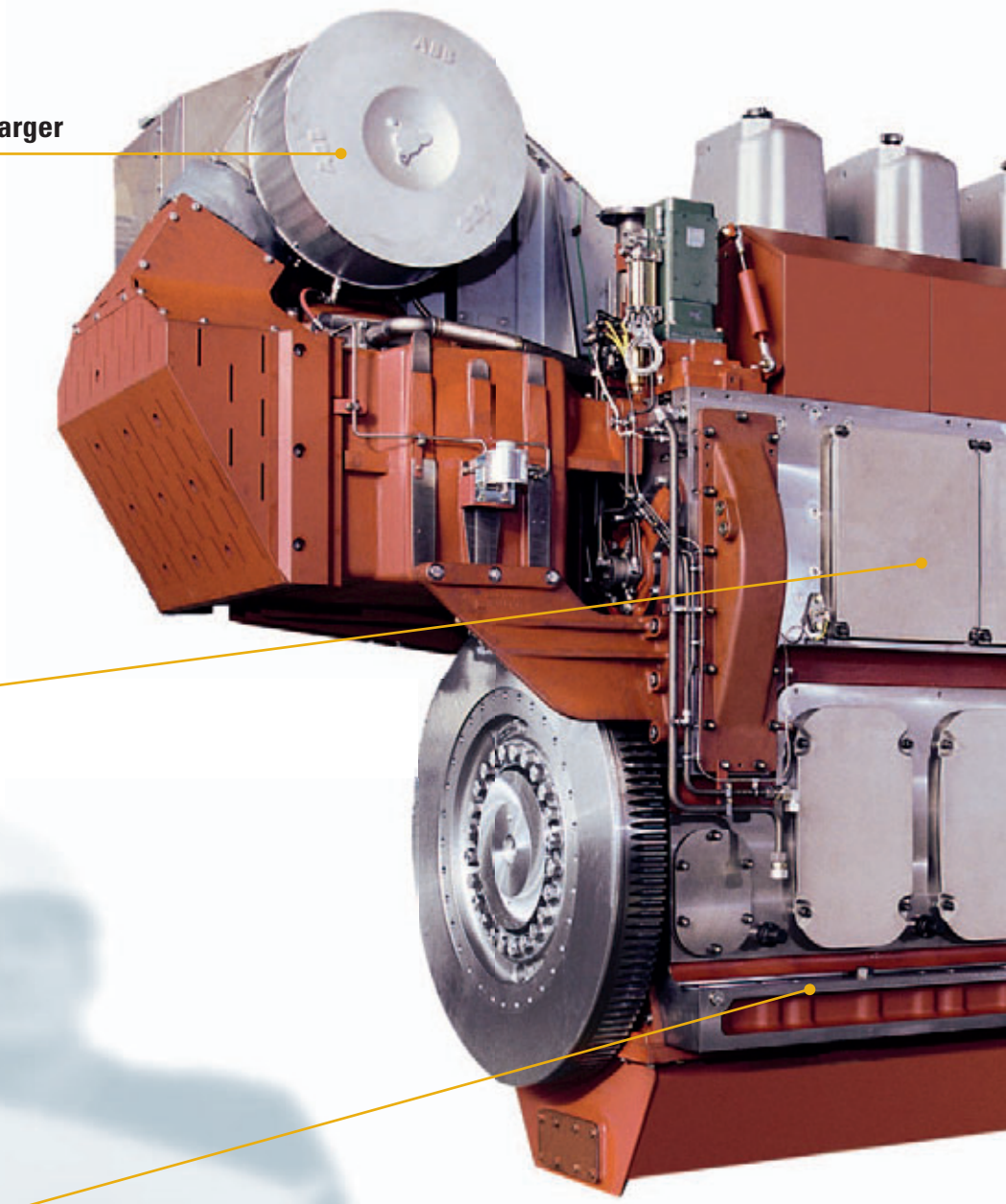
6, 8, 9,



- M 32 C
- VM 32 C
- M 32 C – On-Board Power
- MaK Propulsion Packages
- Emission Reduction Technology

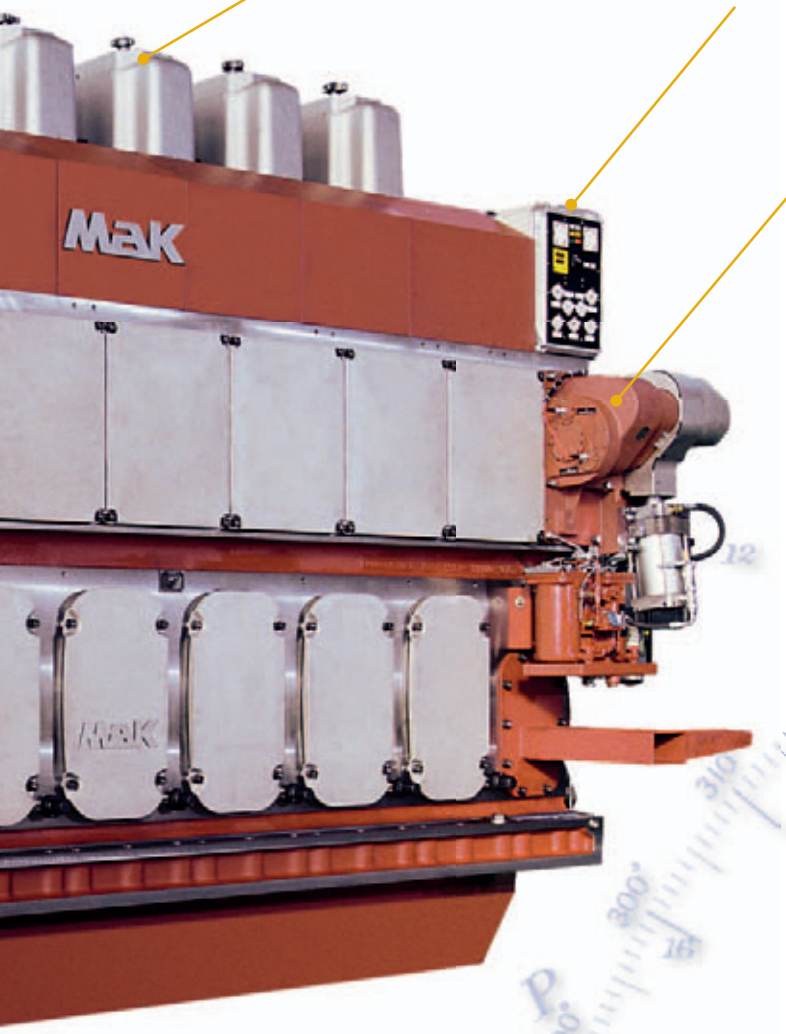
12, 16

M 32 C – Design Improvements



- High-efficiency turbocharger
- Segmental camshaft design
- Nodular cast-iron engine block

6, 8,

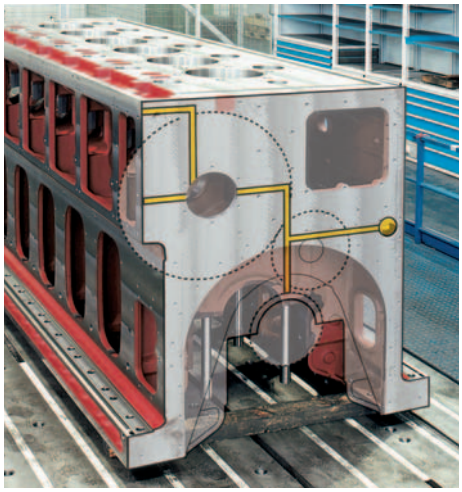


Customer Benefits:

- Nodular cast-iron engine block with integrated ducts for lubricating oil and charge air
- Cooling water system with simple plug-in connections
- Simplified parts spectrum by using single-pipe exhaust gas ducting
- Pulse charging system, available as an option, for all in-line engine variants
- High-efficiency turbocharger
- Engine control terminal with analog instrumentation in robust cast casing
- Segmental camshaft design
- Compact cylinder head design
- Cylinder liner, only cooled outside the engine block
- Installation-friendly, due to pumps and filters installed on the engine
- Connecting rod, split off design
- Compact module for lower valve drives and injection pump drives with cam followers
- Emission reduction technology
- Flexible Camshaft Technology (FCT), optional
- Cat® Common Rail fuel system, optional

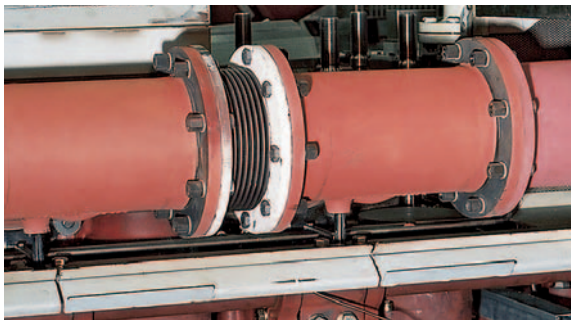
9, 12, 16

M 32 C – Design Features



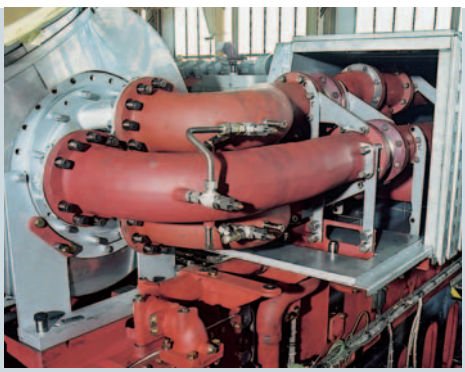
Nodular cast iron engine block and crankcase with integrated ducts for lubricating oil and charge air

- Lubricating oil supply to the crankshaft, camshaft control system and camshaft bearings through drilled ducts
- No piping
- No cooling water in the engine block
- Easy maintenance
- High level of operational safety



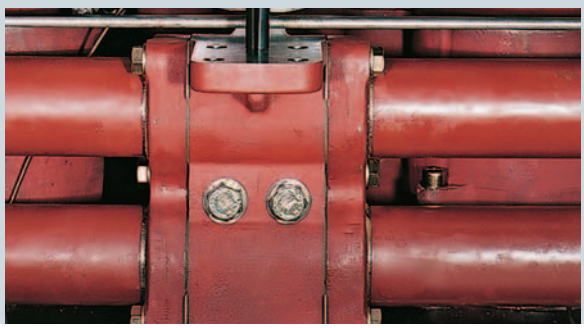
Simplified parts spectrum by using single-pipe exhaust gas ducting

- Identical cylinder parts
- Reduced component complexity
- Simple assembly/dismantling
- Low weight, low installation volume and low vibration level



Pulse charging system, available as an option, for all in-line engine variants

- Advantages in marine propulsion systems subject to frequent changes of load
- Optimum engine acceleration without special control system arrangements



Cooling water system with simple plug-in connections

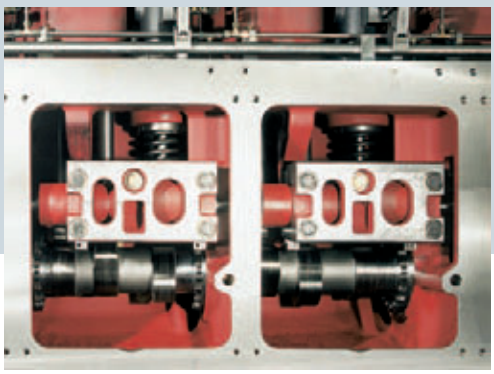
- Plug-in connections for the cooling water pipes with standard closure fittings
- Easy to fit, very maintenance-friendly
- Identical parts for each cylinder version
- Reduced number of components/parts
- Increased operational safety

M 32 C – Design Features

High-efficiency turbocharger
- Moderate temperature level of components surrounding the combustion chamber
- Corrosion-free turbocharger casing without water cooling

Cylinder liner, only cooled outside the engine block
- Low wear rate due to calibration ring
- Low and constant lubricating oil consumption
- Long life

Engine control terminal with analog instrumentation in robust cast casing
- Securely mounted with vibration damping on the crankcase
- Direct and reliable display of all operating media pressures by robust pressure gauges
- Engine and turbocharger speed display by vibration-protected analog instruments



Segmental camshaft design
- Individual segments per cylinder
- Simple to assemble and dismantle

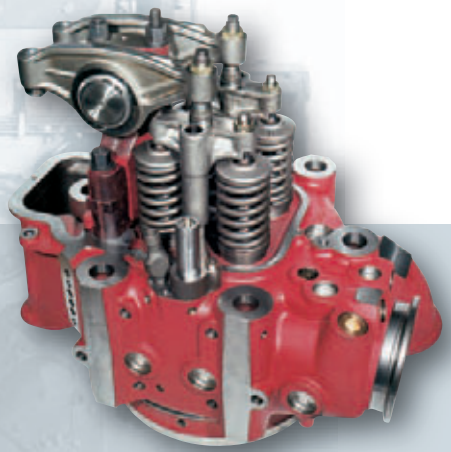
M 32 C – Design Features

Installation-friendly, because of pumps and filters installed on the engine

- Lubricating oil automatic filter fitted to the engine
- Replaces duplex filter and separate automatic filters
- Pumps and filters operate without any external power
- Reduces the parts requirements

Connecting rod, split off design

- High level of operational safety, the result of accurately preloaded bolts

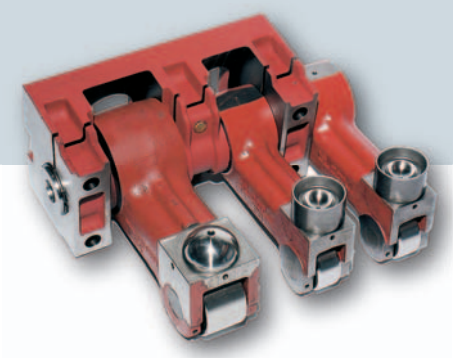


Compact cylinder head design

- Long intervals between overhauls
- Simple and fast assembly/ dismantling because of:
  – plug-in connections
  – integrated bores
  – self-centering

Compact module for lower valve drives and injection pump drives with cam followers

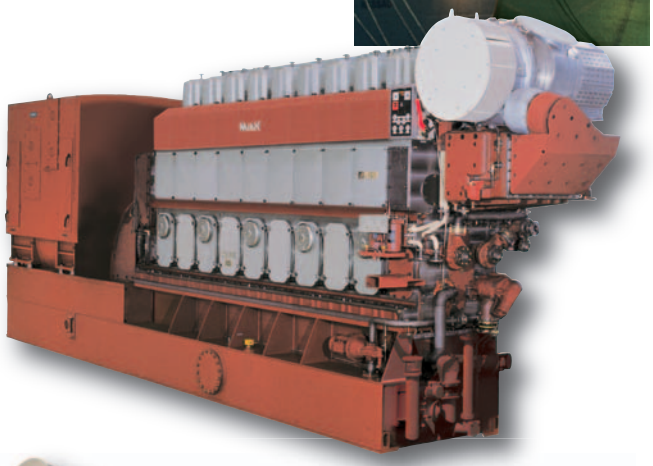
- Exact straight-line guidance for low-friction and low-wear operation

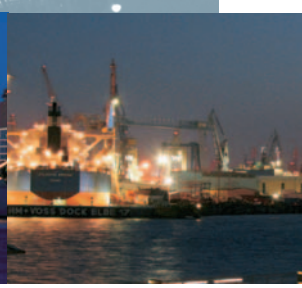


M 32 C – On-Board Electricity

M 32 C as a generator drive
The M 32 C was introduced in 1994 in 6, 8 and 9 cylinder versions and is outstandingly suitable as generator prime mover for electric power on ships. The robust design and moderate speed permits unlimited, continuous operation with heavy fuel oil. In-line engines – complete with generators – are mounted on a common base frame. Engine and electrics are tested prior to delivery. This ensures trouble-free installation and commissioning.

Economical operation with diesel-electric propulsion
Our engineers have extensive experience in the design of diesel-electric installations. This includes both pod propulsion systems and propulsion by fixed-pitch propellers driven by electric motors. The combination of up-to-date engine technology at the primary end of the propulsion train, and up-to-date diesel-electric technology at the secondary end, ensures low operation costs and better space utilization, which in turn means improved economy overall.





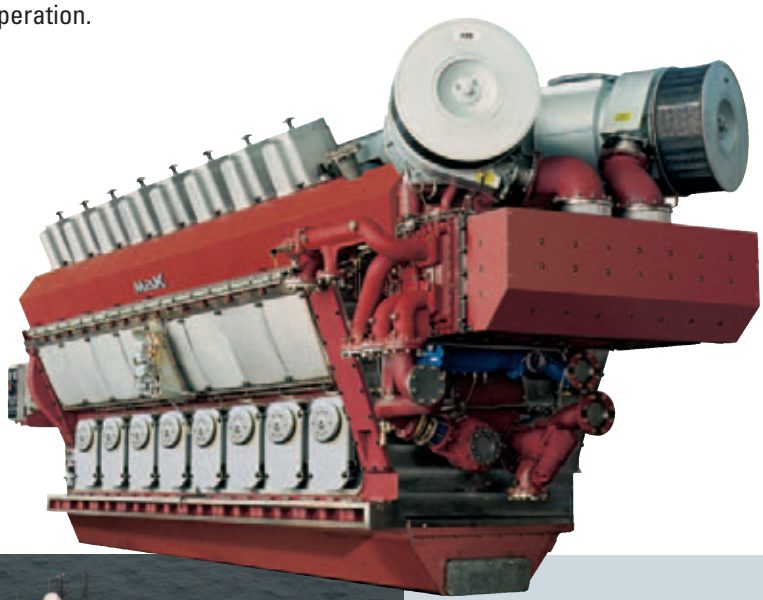
VM 32 C – Compact and Powerful!

The M 32 C V-engine was introduced in 2000 in 12- and 16-cylinder versions. With a bore of 320 mm and a stroke of 460 mm, it covers a power range of 6,000 – 8,000 kW in the 720 and 750 rpm ranges. The engine is designed to meet not only the demands of the marine market but also those of the stationary electric power generation and petroleum industry markets.

The consistent application of MaK long-stroke engine design and development, along with the incorporation of as many in-line engine components as possible, is clearly and impressively demonstrated in the external configuration: – a compact, simple and clean design.

The modular construction of the engine, the integration of various functions into a single component, the robust design and the utilization of already proven, in-line engine components, form the basis for the wide availability range of this engine.

Reliable heavy fuel oil operation, low fuel and lubricating oil consumption, together with easy maintenance and long maintenance intervals, mean outstanding economical operation.



M 32 C – Economical from Installation to Operation

	TBO x 1000 h	Lifetime x 1000 h
Piston crown	30	90
Piston skirt	-	60
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

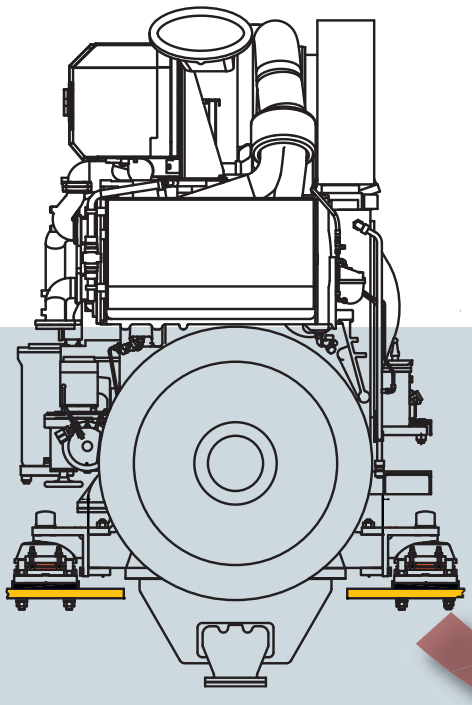
The above-mentioned data are not binding. They only serve as standard values. These standard values can be attained if the MaK operating and maintenance specifications are strictly observed and only MaK spare parts are used. Please consider as well the negative effect of bad fuel qualities.

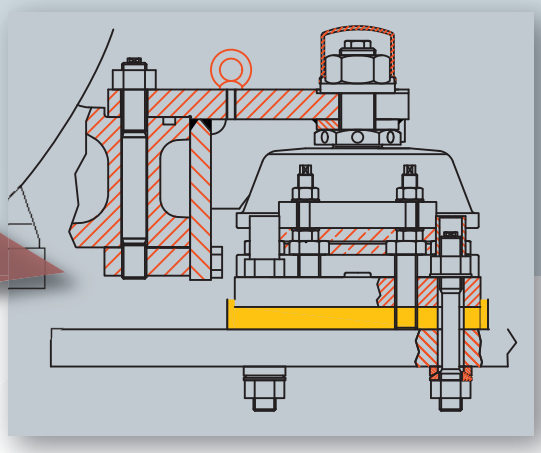
HFO/MDO
Anticipated TBO and life
Long maintenance intervals and extended life form the basis for low operating costs.

Complete engine
The engine is marketed with standardized pump and filter equipment. The interfaces for the fuel, lubricating oil and cooling water systems are located at the free end of the engine for ease of connection.

Lubricating oil system
Optional deep oil pan (wet sump).

Resilient foundation
The resilient foundation system can be assembled safely, simply and cheaply and ensures the damping of vibration and structure-borne noise.



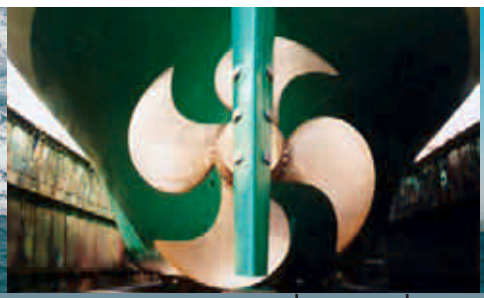


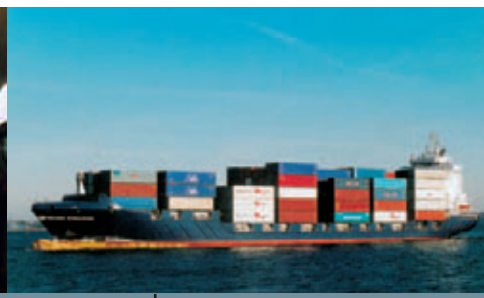
M 32 C – MaK Propulsion Package

Complete propulsion systems
The supply of complete propulsion systems is a market requirement which is becoming increasingly important. We have comprehensive experience through many completed installations and as a result or our close cooperation with competent partners.

We offer:
- System responsibility and supply – all from a single source
- Accurately matched interfaces
- Coordinated delivery date 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
- Matched remote control and monitoring equipment

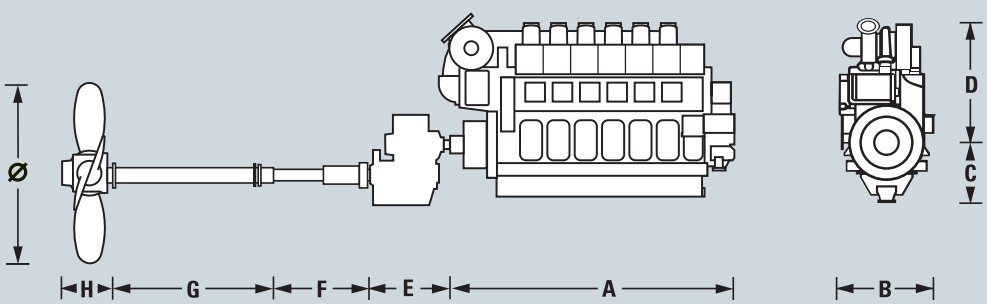




Engine							Gear	Shaft		Propeller		
Type	Rating	Speed										Speed
	kW	rpm	A	B	C	D	E	F	G	H	Ø	rpm
6 M 32 C	3000	600	5946	2369	1387	3258	1795	1600	3400	630	3500	195
8 M 32 C	4000	600	7309	2180	1387	3319	1795	2500	3500	735	4000	175
9 M 32 C	4500	600	7839	2180	1387	3513	2140	2400	3600	795	4200	170
12 M 32 C	6000	720/750	6956	2980	1205	3351	2140	5000	5000	867	4650	155
16 M 32 C	8000	720/750	8313	2980	1205	3351	2140	5000	5000	978	5050	157

Subject to be changed

Examples of complete propulsion systems



M 32 C – Emission Reduction Technology

Flexible Camshaft Technology (FCT) has been developed and put into production. The next milestone in emissions technology is a fully flexible fuel system suitable for DO, MDO and HFO, called the Cat® Common Rail (Cat CR) fuel system. Cat® Common Rail is considered the major building block towards low emissions, high performance and highest customer value. Caterpillar has chosen "inside the engine" measures as the technology with the highest customer value.

In combination with the long-stroke concept and high performance air systems the Cat Common Rail (Cat CR) fuel system is the most effective technology to meet emission regulations and customer expectations

With **Cat Common Rail**, the injection pressure is independent from load and speed. Utilizing injection maps the injection characteristics are optimized for every engine operating point. As a result, NO_x and soot emissions are reduced with the amount of reduction dependent on the actual engine operating condition.

For areas that are especially emissions-sensitive, soot emissions at low engine load remain well below the visibility limit. Furthermore, during normal load operation NO_x emissions can be reduced without sacrificing fuel consumption. In general, the Cat Common Rail fuel system enables vessel operation without visible soot throughout the whole operating range.

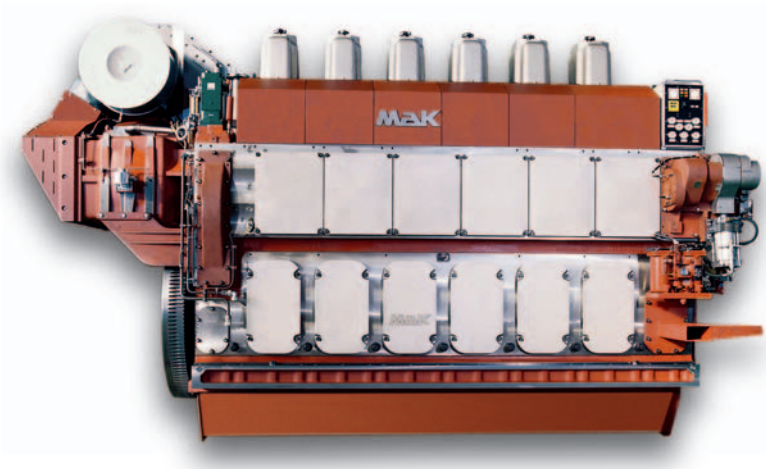
Key criteria are:

- 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 with minimum additional complexity.

High Pressure Pump



Control Device A4E4

Injector

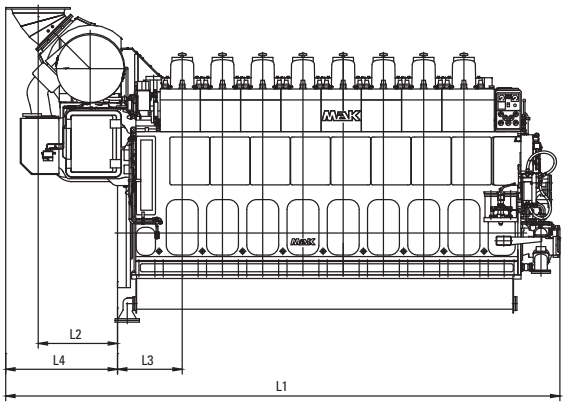
Rail Segment with Three Injectors

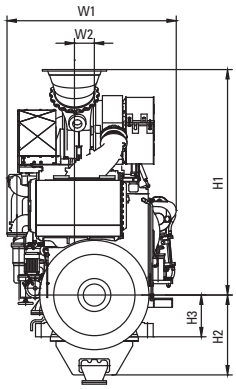
M 32 C – Technical Data

PROPULSION

Type	Output range		Speed	Mean eff. pressure	Mean piston speed	Bore	Stroke	Spec. fuel consumption 100%	Spec. fuel consumption 85%
	kW	mhp	rpm	bar	m/s	mm	mm	g/kWh	g/kWh
6 M 32 C	2880	3920	600	24.9	9.6	320	480	177	176
	3000	4080	600	25.9	9.6	320	480	177	176
8 M 32 C	3840	5220	600	24.9	9.6	320	480	177	176
	4000	5440	600	25.9	9.6	320	480	177	176
9 M 32 C	4320	5880	600	24.9	9.6	320	480	177	176
	4500	6120	600	25.9	9.6	320	480	177	176

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





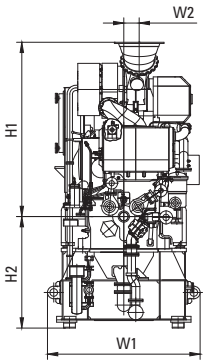
Propulsion Engine Dimensions (mm) and Weights (t)										
Engine	L1	L2	L3	L4	H1	H2	H3	W1	W2	t
6 M 32 C	5934	788	852	1168	2784	1052	550	2418	962	39,5
8 M 32 C	7298	1044	852	1472	2969	1052	550	2229	262	49,0
9 M 32 C	7828	1044	852	1472	2969	1052	550	2229	262	52,0

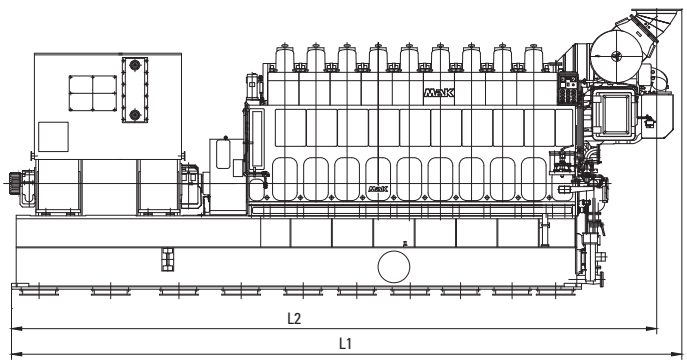
GENERATOR SETS

Type	Engine rating	Generator rating 50/60 Hz Speed: 600 rpm		Mean eff. pressure	Mean piston speed	Spec. fuel consumption 100%	Spec. fuel consumption 85%
	kW	kWe	kVA	bar	m/s	g/kWh	g/kWh
6 M 32 C	2880	2765	3456	24.9	9.6	177	176
	3000	2880	3600	25.9	9.6	177	176
8 M 32 C	3840	3686	4608	24.9	9.6	177	176
	4000	3840	4800	25.9	9.6	177	176
9 M 32 C	4320	4147	5184	24.9	9.6	177	176
	4500	4320	5400	25.9	9.6	177	176

Bore: 320 mm
Stroke: 480 mm

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





Generator Set, Complete Dimensions (mm) and Weights (t)							
Engine	L1*	L2	H1	H2	W1	W2	t*
6 M 32 C	9302	8869	2901	1900	962	2639	73.0
8 M 32 C	10886	10461	2969	1900	262	2600	92.0
9 M 32 C	11419	10991	2969	1900	262	2600	98.0

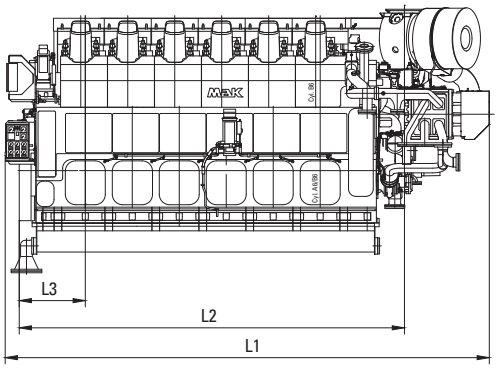
* dependent on generator make/type

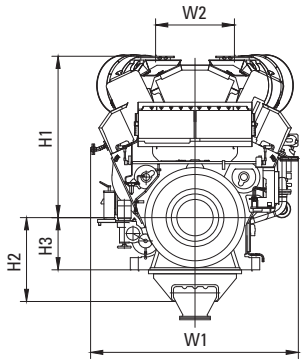
VM 32 C – Technical Data

PROPULSION

Type	Output range		Speed	Mean eff. pressure	Mean piston speed	Bore	Stroke	Spec. fuel consumption 100%	Spec. fuel consumption 85%
	kW	mhp	rpm	bar	m/s	mm	mm	g/kWh	g/kWh
12 M 32 C	6000	8160	720	22.5	11.0	320	460	178	177
	6000	8160	750	21.6	11.5	320	460	179	179
16 M 32 C	8000	10880	720	22.5	11.0	320	460	178	177
	8000	10880	750	21.6	11.5	320	460	179	179

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



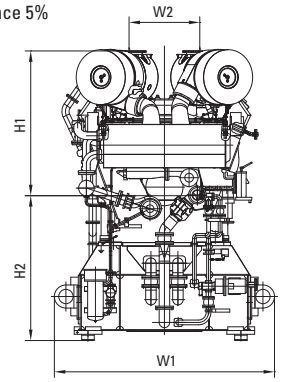


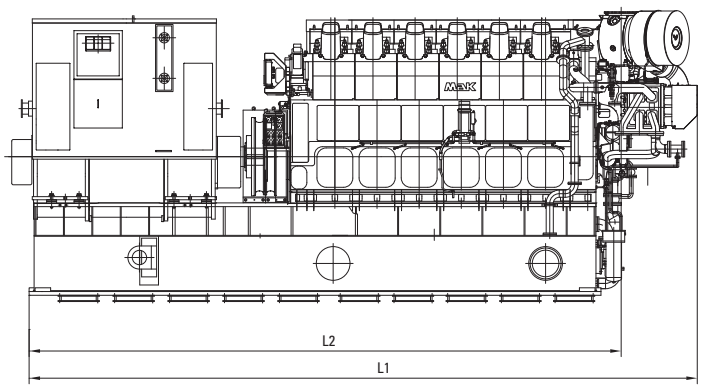
Propulsion Engine Dimensions (mm) and Weights (t)									
Engine	L1	L2	L3	H1	H2	H3	W1	W2	t
12 M 32 C	6956	5535	949	2319	1205	750	2985	1133	65.0
16 M 32 C	8328	6885	949	2319	1205	750	2985	1133	82.0

GENERATOR SETS

Type	Engine rating	Generator rating 50 Hz Speed: 750 rpm		Generator rating 60 Hz Speed: 720 rpm		Mean eff. pressure	Mean piston speed	Spec. fuel consumption 100 %	Spec. fuel consumption 85%
	kW	kWe	kVA	kWe	kVA	bar	m/s	g/kWh	g/kWh
12 M 32 C	6000			5760	7200	22.5	11.0	178	177
	6000	5760	7200			21.6	11.8	179	179
	6600			6336	7920	24.8	11.0	183	180
	6600	6336	7920			23.8	11.8	184	181
16 M 32 C	8000			7680	9600	22.5	11.0	178	177
	8000	7680	9600			21.6	11.8	179	179
	8800			8448	10560	24.8	11.0	183	180
	8800	8448	10560			23.8	11.8	184	181

Bore : 320 mm
Stroke: 460 mm
Specific lubricating oil consumption 0.6 g/kWh, ± 0.3 g/kWh
LCV = 42700 kJ/kg, without engine-driven pumps, tolerance 5%
Generator efficiency: 0.96, cos φ: 0.8





Generator Set, Complete Dimensions (mm) and Weights (t)							
Engine	L1*	L2	H1	H2	W1	W2	t*
12 M 32 C	10703	9484	2319	2320	1133	3526	120.0
16 M 32 C	10930	12149	2319	2320	1133	3526	140.0

* dependent on generator make/type

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 1987, 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.

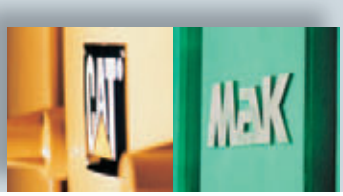
Get your project moving anywhere in the world with Cat Financial – backed by the power of Caterpillar and our unmatched dealer network.

Visit us online at
MARINE.CAT.COM/finance

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:
MARINE.CAT.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 18,000 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,

● **C1.5**
3 cylinder
10–14.5 kWe
10–18.0 kVA

● **C2.2**
4 cylinder
16–30 kWe
16–37.5 kVA

● **C4.4**
4 cylinder
36–99 kWe
45–123 kVA

● **C6.6 ACERT**
6 cylinder
93–170 kWe
116–212 kVA

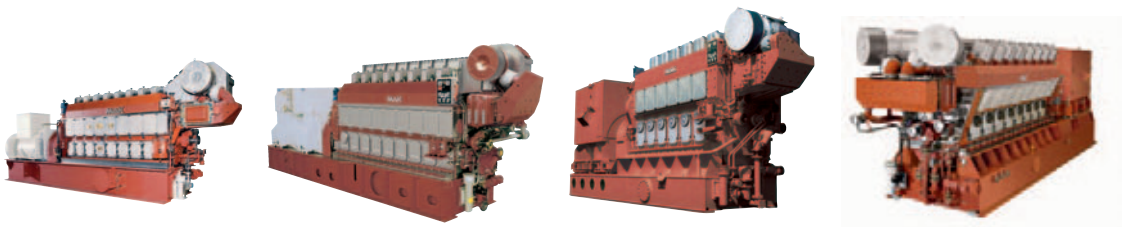
● **C9**
6 cylinder
142–250 kWe
178–313 kVA

● **C18 ACERT**
6 cylinder
275–550 kWe
344–688 kVA

● **C32 ACERT**
12 cylinder
715–940 kWe
675–1,138 kVA

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

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



● **M 20 C**
6, 8, 9 cylinder
979–1,641 kWe
1,224–2,052 kVA

● **M 25 C**
6, 8, 9 cylinder
1,920–2,880 kWe
2,400–3,600 kVA

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

● **VM 32 C**
12, 16 cylinder
5,760–8,448 kWe
7,200–10,560 kVA

GENSETS

● **3056**
6 cylinder
93–153 kW

● **C7**
6 cylinder
187–276 kW

● **C7 ACERT**
6 cylinder
339 kW

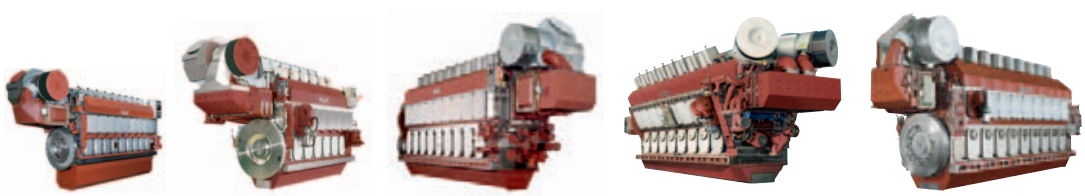
● **C9 ACERT**
6 cylinder
375–423 kW

● **C12**
6 cylinder
254–448 kW

● **C12 ACERT**
6 cylinder
492–526 kW

● **C18 ACERT**
6 cylinder
339–847 kW

Propulsion Engines



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

● **M 25 C**
6, 8, 9 cylinder
1,900–3,000 kW

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

● **VM 32 C**
12, 16 cylinder
6,000–8,000 kW

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

MAIN PROPULSION

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.

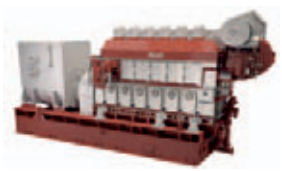
From the production of core components to the assembly of complete engines, quality is always the top priority.

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.

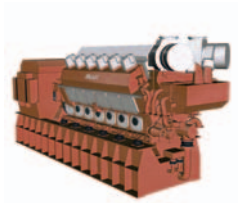
In addition to product quality, our customers expect comprehensive service which includes the supply of spare parts throughout the life of the engine.

Onboard Power Supply

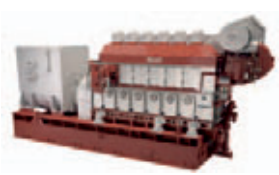
- High-Speed Engines
- Medium-Speed Engines



● **M 43 C**
6, 7, 8, 9 cylinder
5,760–8,640 kWe
7,200–10,800 kVA



● **VM 43 C**
12, 16 cylinder
11,520–15,360 kWe
14,400–19,200 kVA



● **M 46 DF**
6, 7, 8, 9 cylinder
5,148–7,776 kWe
6,480–9,720 kVA

● **VM 46 DF**
12, 16, 20 cylinder
10,368–17,280 kWe
12,960–21,600 kVA

● **C32 ACERT**
12 cylinder
492–1,417 kW

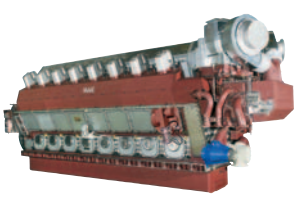
● **3500**
8, 12, 16 cylinder
526–2,525 kW

● **C175**
16 cylinder
2,001–2,168 kW

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

- High-Speed Engines
- Medium-Speed Engines

● **M 46 DF**
6, 7, 8, 9 cylinder
5,400–8,100 kW



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

● **VM 46 DF**
12, 16, 20 cylinder
10,800–18,000 kW

Caterpillar Marine Power Systems

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For more information please visit our website:
MARINE.CAT.COM

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Caterpillar Marine Power Systems is committed to sustainability. This document is printed on PEFC certificated paper.