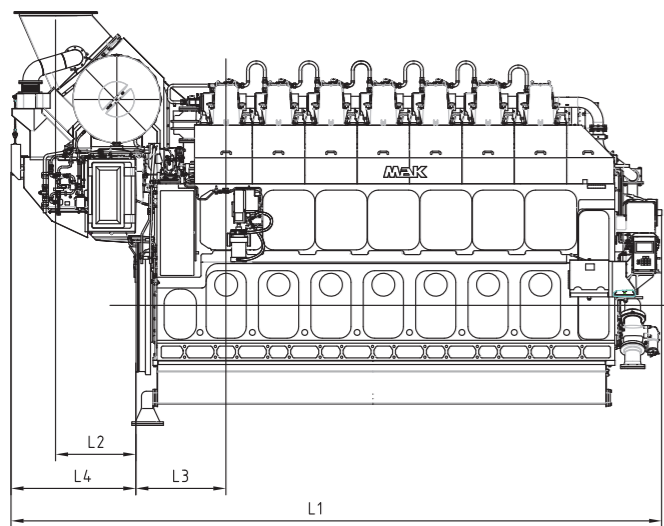


Technical Data

		Gas Mode	Gas Mode	Diesel Mode (HFO)	Diesel Mode (MDO only)
Emission		IMO III	IMO III	IMO II	IMO II
Bore	mm	460	460	460	460
Stroke	mm	610	610	610	610
Speed	rpm	500/514	500/514	500/514	500/514
Power	kW/cyl.	900	965	900	965
BMEP	bar	21.3/20.7	22.8/22.2	21.3/20.7	22.8/22.2
Liquid fuel consumption	g/kWh @100%	1.9	1.8	186	185
Gas fuel consumption	kJ/kWh @100%	7,200	7,275	—	—
Efficiency (development target)	%	50.0	49.5	45.3	45.6

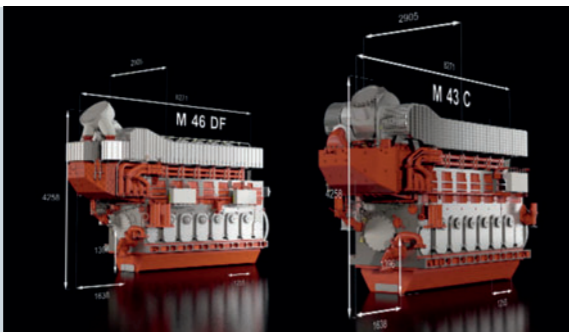
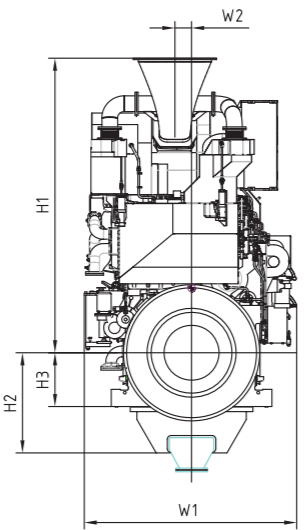
Without engine driven pumps. Tolerance for SFOC and efficiency +/- 5%.



Engine	L1	L2	L3	L4	H1	H2	H3	W1	W2	t*
6 M 46 DF	8330	1086	1255	1723	3734	1396	750	2961	215	94
7 M 46 DF	9068	1119	1255	1740	4105	1396	750	2961	232	107
8 M 46 DF	9798	1119	1255	1740	4105	1396	750	2961	232	114
9 M 46 DF	10768	1119	1255	1740	4105	1396	750	2961	232	127

- Operational simplicity and engine characteristics:**
- Key attributes of the M 46 DF are class leading efficiency and loading capacity as well as the operational simplicity which is supported by a fully automated engine control.
 - Fast service access as well as service and maintenance simplicity are supported by a modular engine design, concept and the monitoring and diagnostic system.
 - Operation on natural gas with min. methane number of 55 possible at reduced load.
 - Supports HFO operation according to CIMAC H55/K55 in diesel mode.

- Excellent support:**
- Global application and installation support for engine and gas system periphery.
 - Operator and technician training.
 - Strong, global product support network with Marine focus.



All mentioned data is preliminary!

Conversion of M 43 C to M 46 DF engines are supported by similar dimensions and system interfaces.

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, complete propulsion systems, controllable pitch propellers, transverse and azimuth thrusters, and controls. Cat and MaK products and technologies are proven reliable and are built to last in all marine applications, demonstrating superior productivity and the lowest lifecycle cost.

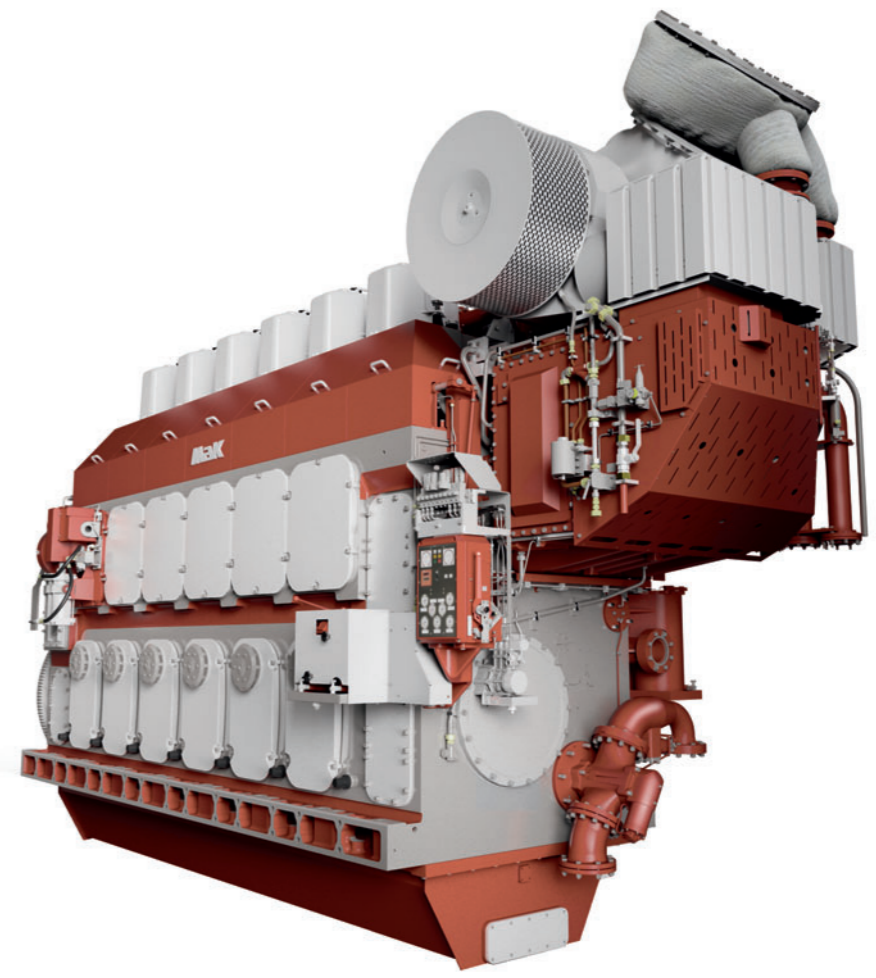
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M 46 DF

Dual Fuel Engine
for Operation on Liquid and Gaseous Fuels
6 • 7 • 8 • 9 Cylinder



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Fuel Flexibility and High Efficiency: A new Generation of Engines built by Caterpillar Motoren!

The Dual Fuel Engine Concept

Based on the successful M 43 C MaK medium speed engine, Caterpillar Motoren, Kiel designed the M 46 DF to meet and exceed the M 43 C reliability and life-time expectations, while maintaining its class leading position regarding operational efficiency and reliability.

Applying the same design philosophies, the M 46 DF will share the same footprint with the M 43 C providing the opportunity to retrofit M 43 C engines.

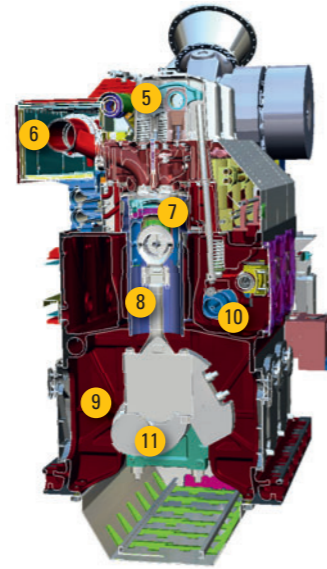
With its clean design the M 46 DF does allow fast and easy access to system and components, supporting the operation, service and maintenance simplicity MaK products are known for.

Designed to operate on gaseous- as well as liquid (MDO HFO) fuels the M 46 DF will meet IMO III emission limits while operating in gas mode, injecting a small amount of ignition fuel to control combustion.

The M 46 DF will comply with IMO II emission regulations while operating in diesel mode. (liquid fuels only)

Attention was paid to customers demand for a safe and reliable operation at varying engine loads and gas qualities.

- 1 Gas System**
 - Double walled gas piping to support an inherently safe engine room concept.
 - Leakage detection.
 - Segmented gas detection system on request.
- 2 Flexible Camshaft Technology (FCT) and lower valve train**
 - New eccentric profile.
 - Actuation linkage.
- 3 Turbocharger**
 - Optimized for gas mode operation and superior engine efficiency in gas- and diesel operation mode.
 - Blow off valve and waste gate technology for optimized air fuel ratio control.
- 4 Micro pilot fuel injection system**
 - Gear driven high pressure fuel pump and filter system with easy service access.
 - Reliability combined with service and maintenance simplicity, through individual ignition fuel injector and "in-cylinder head" integrated ignition fuel return pipes.



- 5 Cylinder Head**
 - Ignition fuel injector and integrated gas admission valve with easy service and maintenance access.
 - Cylinder pressure sensors for highest operational- reliability and efficiency, replacing conventional knocking sensor technology.
- 6 Exhaust Manifold & Cladding**
 - Explosion relief valves integrated.
- 7 Piston, Piston Rings and Liner**
 - Designed for operation on gas and diesel.
 - Bore increase.
- 8 Connecting Rod**
 - Marine head connecting rod for shortest piston removal height.
- 9 Engine Block**
 - M 43 C footprint and interface.
- 10 Camshaft**
 - Camshaft timing optimized for gas mode operation.
- 11 Crankshaft**
 - No dimensional change.
 - Advanced crankshaft material.

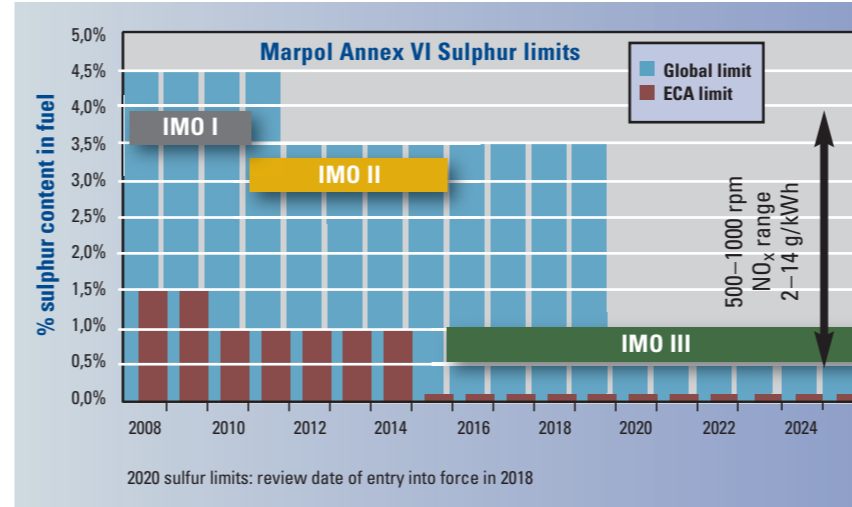
- Control & Monitoring Systems**
 - Control system for gas- and diesel mode operation.
 - Real time cylinder pressure monitoring for optimized cylinder balancing and higher efficiency.
 - Communication and interaction with engine system peripherals through data bus systems.
 - Auto change from gas- to diesel mode operation and vice versa without power interruption.
 - Remote monitoring and service diagnostics.

MaK Dual Fuel Engines

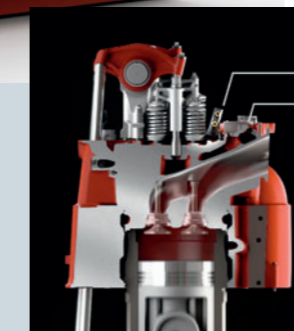
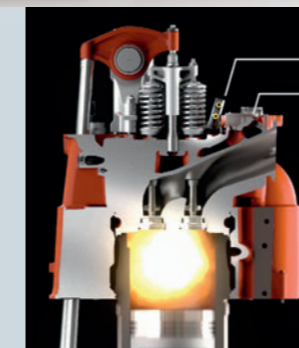
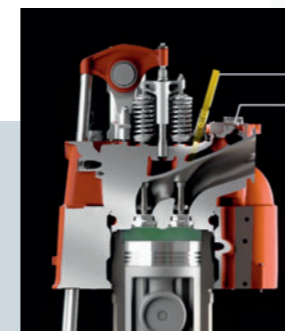
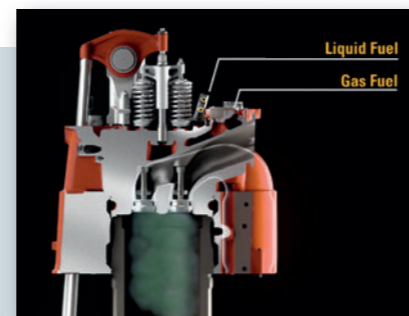
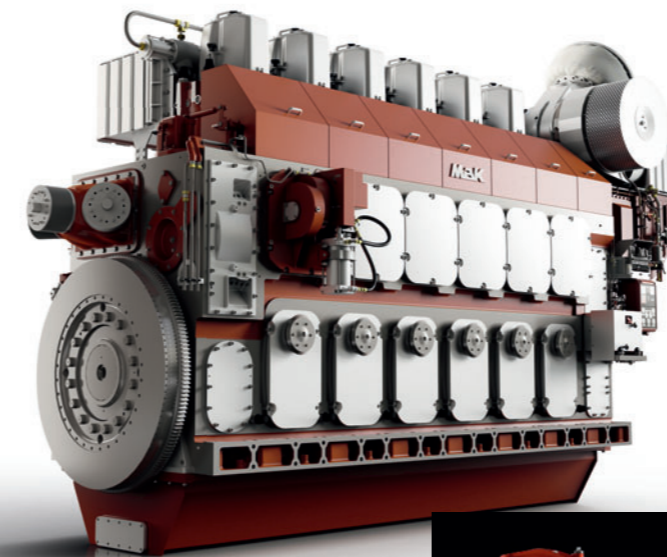
Building on its marine engine legacy Caterpillar Motoren designed the M 46 DF for a variety of marine applications without sacrificing the typical MaK marine engine attributes like operational reliability and efficiency as well as serviceability. Designed to meet the stringent conditions of upcoming emission- and fuel sulfur regulation the M 46 DF will provide maximum flexibility for vessel operating in regulated and/or lesser regulated areas without significant changes to engine room or the exhaust gas system, maintaining installation and certification simplicity at the same time.

The low emission footprint paired with high efficiency and reliability make the M 46 DF an ideal propulsion engine for operation, in- and outside of environmental protected areas as well as waters with fuel sulfur limitations.

Upcoming IMO III emission regulations, selected operation profiles and diesel fuel costs make the M 46 DF a preferred engine regarding lowest cost of operation.



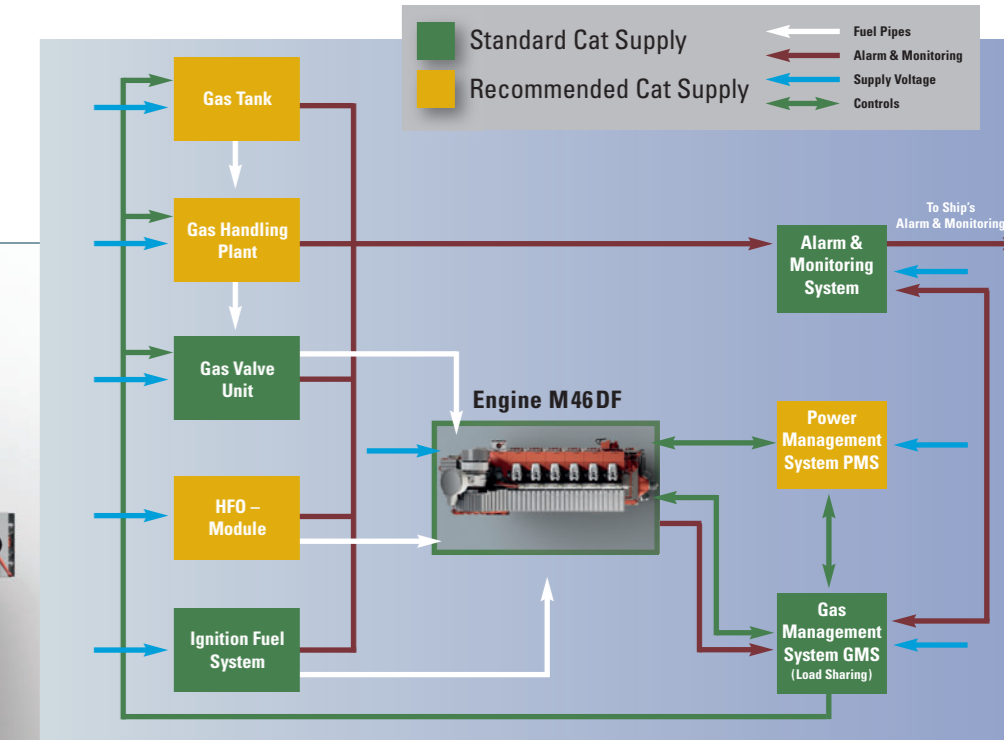
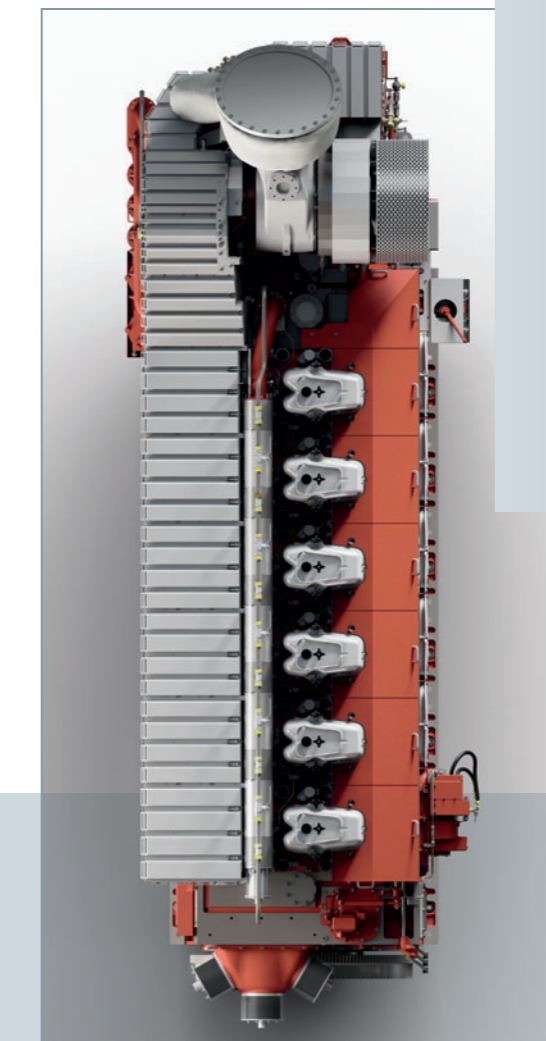
IMO III



Designed for Reliable Operation

- The operator-friendly service and maintenance concept is supported by the modular engine design.
- State-of-the-art material ensures long life of components.
- Flexibility to switch in-between diesel and gas mode while allowing operation on a variety of different diesel- and gas qualities.

- Into the lubricating oil system integrated injector cooling, intensive cooling of exhaust valves and exhaust valves seats do ensure reliable operation and long component life time in gas and diesel mode.



Reliable

All mentioned data is preliminary!