

L+V48/60CR

Four-Stroke Diesel Engine



MAN Diesel



907



MAN Diesel – The Responsible Way in Leading Technology

MAN Diesel is the world's leading designer and manufacturer of low and medium speed engines – engines from MAN Diesel cover an estimated 50% of the power needed for all world trade. We develop two-stroke and four-stroke engines, auxiliary engines, turbochargers and propulsion packages that are manufactured both within the MAN Diesel Group and at our licensees.

More than ever before, MAN Diesel's development focus is the environmental performance of our engines.

Using our unrivalled grasp of large engine technology, we aim to make our engines progressively cleaner, more powerful and more efficient.

Our absolute commitment to reducing emissions while increasing fuel efficiency and power density starts with our active partnership in the emissions law making process and ends with the delivery of engines that achieve an ideal synthesis of prime mover characteristics.

Efficient, clean and compact



Core technologies in-house

As well as its expertise in engine design, development and manufacture MAN Diesel is also a leading manufacturer of the key technologies which determine the economic and ecological performance of a diesel engine:

- >> high-efficiency exhaust gas turbochargers
- >> advanced electronic fuel injection equipment
- >> electronic hardware and software for engine control, monitoring and diagnosis

Our impressive array of computer-aided design tools and one of the engine industry's largest, best-equipped foundries allow us decisively to shorten product development, and application engineering processes.

Our mastery of these engine technologies – and, the best brains in the large engine industry – are the firm foundation for

- >> low emissions
- >> low operating costs
- >> low life cycle costs
- >> long service life

The latest development in the MAN Diesel engine range is across-the-board compliance with the second stage of the NO_x emissions limits of the International Maritime Organisation – IMO Tier II – combined with optimized operating economy.

The range of technical measures employed comprises:

- >> Improved charge air cooling
- >> Enhanced turbocharging
- >> Miller valve timing
- >> Revised injection timing
- >> Higher compression ratios
- >> Low swirl inlet ports
- >> Variable valve timing (VVT)

Committed to the future

Technologies which promise compliance with the IMO Tier III round of emissions limits due in 2016 combined with further optimised fuel consumption and new levels of power and flexibility are already under development at MAN Diesel.

With this level of commitment MAN Diesel customers can plan with confidence.

Engine specifications

NO_x Reduction Measures L+V48/60CR

RI – Retarded Injection

Retarded injection timing delays combustion heat release and thus lowers combustion chamber temperature peaks.

New Piston for Increased Compression Ratio

The use of a new piston provides a higher compression ratio and gives a faster reduction in temperature after the ignition of the fuel, thus reducing NO_x formation. The increase in compression ratio also compensates the reduction in firing temperature due to retarded injection and hence the associated increase in SFOC.

VVT Variable Valve Timing

Variable valve timing enables variations in the opening and closing of the inlet and exhaust valves.

It can be used to compensate the increase in SFOC associated with lower NO_x emissions.

VVT is an enabling technology of variable Miller valve timing. A strong Miller effect under high load operation results in an improvement in the NO_x-SFOC trade-off.

At low load the Miller valve timings are reduced to attain higher combustion temperatures and thus lower soot emissions.

Miller Valve Timing

To reduce the temperature peaks which promote the formation of NO_x, early closure of the inlet valve causes the charge air to expand and cool before start of compression. The resulting reduction in combustion temperature reduces NO_x emissions.

High Pressure Ratio Turbocharger

The use of MAN Diesel turbochargers equipped with the latest high efficiency compressor wheels can alleviate the NO_x-SFOC trade off.

The higher pressure ratio increases the efficiency of the engine and thus compensates the increase in SFOC normally associated with lower NO_x emissions.

The higher pressure ratio also increases the scope for Miller valve timing.

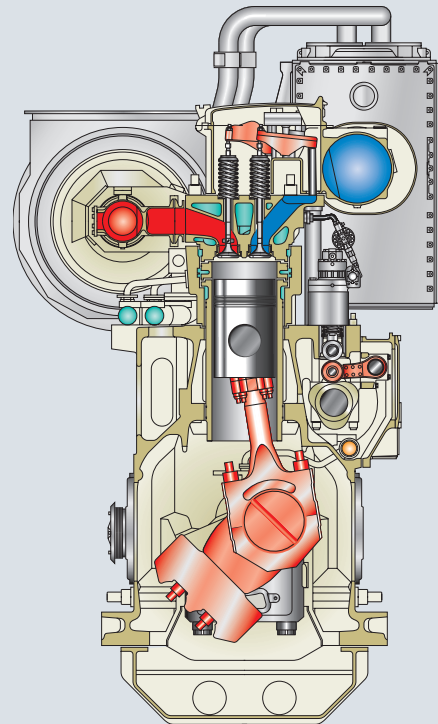
Common Rail Injection

The 48/60 common rail injection system uses the latest MAN Diesel common rail technology which allows flexible setting of injection timing, duration and pressure for each cylinder. This flexibility allows the fuel consumption and emissions of the 48/60CR to be optimised at any point on its operating profile.

L+V48/60CR technical data

L+V48/60CR four-stroke diesel engine

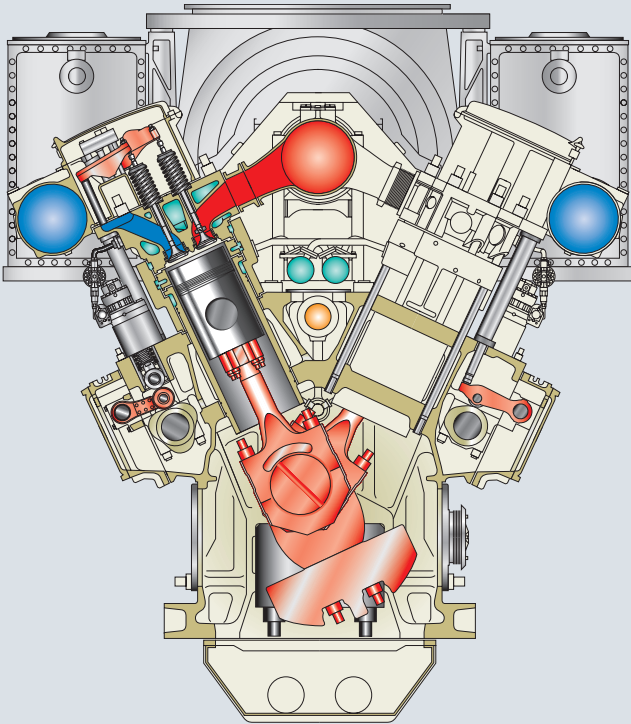
Engine cycle:	four-stroke
Turbocharging system:	constant-pressure
Number of cylinders, in-line engine:	6, 7, 8, 9
Number of cylinders, V-engine:	12, 14, 16, 18
Bore:	480 mm
Stroke:	600 mm
Swept volume per cyl:	108.6 dm ³
Power-to-weight ratio (MCR)	
In-line engine:	13.7 – 14.7 kg/kW
V-engine:	12.3 – 13.1 kg/kW
Cylinder output (MCR) at 514/500 rpm:	1,200 kW
Cooling	
Cylinder cooling (one-stage):	cooling water
Charge-air cooler (two-stage):	fresh water
Fuel injector cooling:	fresh water
Starting method:	compressed air



Power unit output (maximum continuous rating)

Engine speed	514 rpm	500 rpm
Mean piston speed	10.3 m/s	10.0 m/s
Mean effective pressure	25.8 bar	26.5 bar

		kW	kW
6L48/60CR	6 cyl.	7,200	7,200
7L48/60CR	7 cyl.	8,400	8,400
8L48/60CR	8 cyl.	9,600	9,600
9L48/60CR	9 cyl.	10,800	10,800
12V48/60CR	12 cyl.	14,400	14,400
14V48/60CR	14 cyl.	16,800	16,800
16V48/60CR	16 cyl.	19,200	19,200
18V48/60CR	18 cyl.	21,600	21,600



Norwegian Jewel, one engine retrofitted to 12V48/60CR

Specific fuel consumption

	100% P	85% P
L48/60CR	180 g/kWh	176 g/kWh
V48/60CR	178 g/kWh	174 g/kWh

The fuel consumption rates are based on a lower calorific value (LHV) of the fuel of 42,700 kJ/kg without engine driven pumps. Tolerance 5%.

Specific lubricating oil consumption

L+V48/60CR	0.8 g/kWh
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The lube oil consumption is given with a tolerance of 20%.

Clean, efficient and powerful

General definition of diesel engine ratings according to ISO 30461/1-2002

ISO reference conditions:

Air temperature: 298 K (25°C)

Air pressure: 1 bar

Fresh water temperature upstream

of charge-air cooler: 298 K (25 °C)

Relative humidity: 30%

No power reduction required below:

Air temperature: 318 K (45°C)

Air pressure: 1 bar

Fresh water temperature upstream

of charge-air cooler: 311 K (38 °C)

IMO requirements:

The engine detailed herein will comply with the emission limits referred to as IMO Tier II.

The fuel consumption is based on a lower calorific value (LHV) of the fuel of 42,700 kJ/kg without engine driven pumps. Tolerance 5%. Lubricating oil consumption value is given with a tolerance of 20%.

L+V48/60CR – “The modern Powerhouse”

Synonymous with top performance and excellent flexibility. With the 48/60CR (Common Rail), MAN Diesel is embarking on a new era in modern diesel engine design. Based on the more than 600-fold well proven 48/60 engine, the 48/60CR was developed for use as a propulsion engine in cruise liners, tankers or container ships. By the use of electronic injection, variable valve timing, improved turbocharger and by improved combustion, increasingly stringent emission standards can be fulfilled and improved part load performance (smoke, SFOC) can be obtained without compromising on the engines high availability and specific power output. The 48/60CR thereby sets the new standard in this engine class and is therefore a true “prime mover” in every respect.

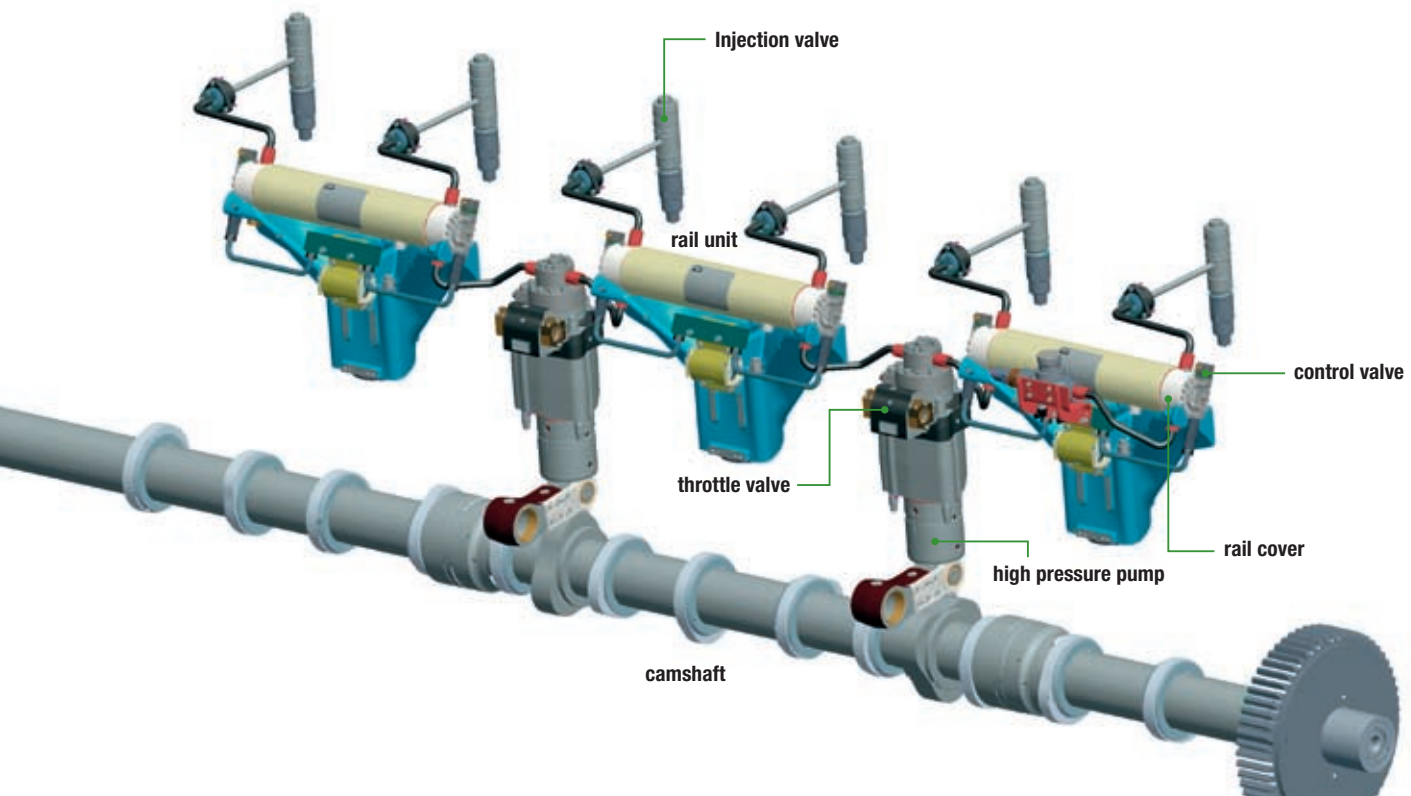
Fuels

The common rail injection system of the 48/60CR was designed for operation with heavy fuel oil (HFO) in accordance with specification DIN ISO 8217 (viscosities up to 700 cSt at 50 °C) and fuel temperatures up to 150 °C. The fuel oil system is designed to allow the engine to be started and stopped with HFO. In a load range from 100% to 20% load, the engine can be operated continuously, below 20% load for a limited time using HFO. Special attention was directed during development on the reliable functionality of all components during operation with all approved fuel qualities.

Injection

The patented injection system from MAN Diesel is based on the following principle: High pressure pumps compress the fuel to the required pressure and deliver it to the inline accumulator units (common rail). At the accumulator units are connections for the injection valves and also the components for fuel distribution and injection control. The common rail system achieves its high level of flexibility by consistent separation of pressure generation and injection control (i.e. injection pressure and timing for pre- and postinjection).

Modern and innovative technology



Common Rail System Layout

Features and advantages

As a matter of principle, MAN Diesel has kept the basic concept of its Common Rail Technology as simple as possible and has integrated technically proven components into the design. For example, in keeping with this philosophy, the design does not use a separate servo circuit for activating the injection valve. Less maintenance is one of the benefits as well as extremely quick and accurate reaction times of the injection system. The electronically controlled injection valves are on the rail outside the cylinder head, resulting in greater system reliability and very easy maintainability. Also, integrated into the

CR technology are well-proven components with long service experience, such as conventional injection nozzles. With the 48/60CR it has been possible to combine conflicting development specifications like “high power density with low wear” and “low emissions with low wear” in a revolutionary way. The engine represents the newest technology in the area of medium speed operated industrial sized diesel engines – technology that is ready for the future.

Electronics

The 48/60CR is equipped with the newest generation of proven MAN Diesel engine management system. For the first time, SaCoSone breaks down all functions of modern engine management into one complete system. Through integration on the engine, it forms one unit with the drive assembly. SaCoSone offers:

- >> Integrated self-diagnosis functions
- >> Maximum reliability and availability
- >> Simple use and diagnosis
- >> Quick exchange of modules (plug in)
- >> Trouble-free and time-saving commissioning

Technology for the future

Safety concept

The common rail system comprises an intelligent designed safety concept:

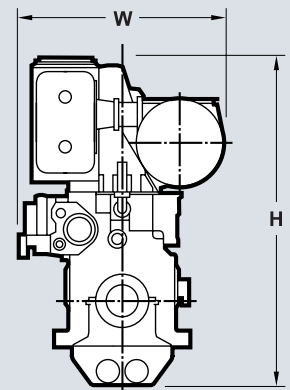
- >> All high pressure pipes are screened or have a double wall design.
- >> Flow limiting valves at each cylinder prevent uncontrolled injection.
- >> Redundant high pressure pumps guarantee further operation of the engine even in the event of high pressure pump malfunction.
- >> Twin type pressure sensors and speed sensors assure that the engine stays operational even in the event of failure of one of these elements. In case of single engine plants the ECUs (Electronic Control Units) are in double type as well.

MAN Diesel | PrimeServ

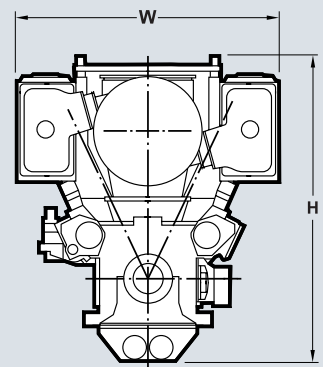
- >> Worldwide service organisation with more than 150 service stations
- >> Quick supply of high quality genuine spare parts
- >> Fast, reliable and competent support
- >> Ongoing information and training of service personnel
- >> Maintenance contracts
- >> Almost 110 years of service experience with maritime diesel engines

Online service

With the new MAN diesel online service, it is possible to transfer important engine and plant operating data in coded form. By quick and effective provision of information, it is possible to make the technical know-how of our specialists available throughout the world in a short space of time at low costs – a service that rounds off the performance profile of the new 48/60CR in an ideal way.



L48/60CR four-stroke diesel engine



V48/60BCR four-stroke diesel engine

Dimensions and weights

L+V48/60CR engine

Engine type	No. of cyl.	L mm	L1 mm	W mm	H mm	Wt. t
6L48/60CR	6	8,615	7,290	3,195	5,360	106
7L48/60CR	7	9,435	8,110	3,195	5,360	119
8L48/60CR	8	10,460	8,930	3,325	5,360	135
9L48/60CR	9	11,425	9,895	3,325	5,360	148
12V48/60CR	12	10,760	8,915	4,700	5,355	189
14V48/60CR	14	11,760	9,915	4,700	5,355	213
16V48/60CR	16	13,100	10,915	4,700	5,355	240
18V48/60CR	18	14,100	11,915	4,700	5,355	265

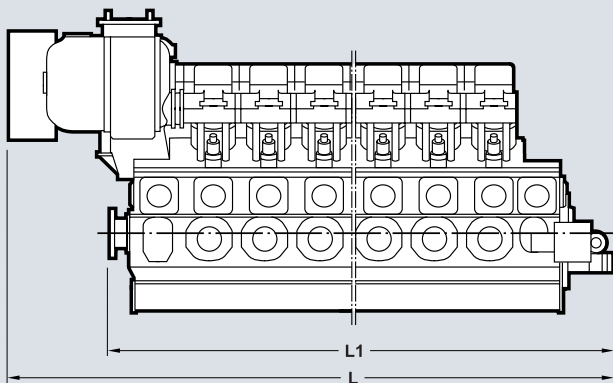
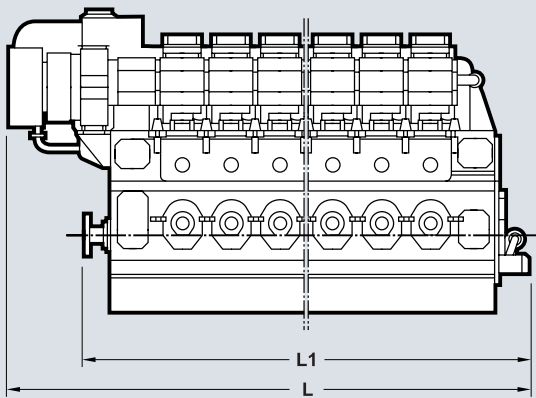
All weights and dimensions are for guidance only and apply to dry engines without flywheel.

Minimum centreline distance for twin engine installation:

– In-line engine: 3,200 mm

– V-type engine: 4,800 mm

More information available upon request.



Norwegian Jewel, one engine retrofitted to 12V48/60CR

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