

Marine GenSets

from MAN Diesel & Turbo



Engineering the Future – since 1758.

MAN Diesel & Turbo





Safe and economical transportation of high value goods, critical cargoes and refrigerated or frozen perishables requires efficient, highly reliable and available auxiliary power. MAN GenSets have for decades earned a good reputation for delivering power to the world fleet.

History

Marine GenSets



MAN Diesel & Turbo has built auxiliary engines since 1929. First under the brand name “Holeby GenSets” and later under the “MAN GenSet” brand, and more than 20,000 GenSets, both from own production and from licensees, have been delivered over the years.

In 1965 the world famous L23/30 engine was launched, and in 1972 the larger L28/32 was introduced.

In the following period, up to the late 1990s, these engines were the benchmark for the whole industry as an example of reliability and userfriendliness. Today, our customers still choose this well-proven design, which has resulted in a production of more than 10,000 units, both from own and from licensee production.

Performance, Quality and Service

Marine GenSets

MAN Diesel & Turbo's approach to the design and production of GenSets is to lead the world market for GenSets in the 450-6,000 kW power range in terms of performance, quality and service.

The MAN Diesel & Turbo product development strategy is to design GenSet solutions that produce energy at the lowest possible cost per kWh without compromising on quality.

This strategy requires a resolution of the conflicts inherent in five key market requirements:

- operation on the cheapest fuel
- easiest possible daily maintenance procedures
- longest safe intervals between overhauls
- unlimited load patterns
- worldwide environmental regulations.

Over many years, MAN Diesel & Turbo has achieved the right balance between these requirements by applying an innovative approach to engine and generator design. This approach has ensured MAN GenSets a substantial global market share.

Indeed, we believe that our current product range described in this brochure is unsurpassed in terms of performance, reliability and economy.

Fuel economy

The basis for a superior operating economy is a low fuel consumption across the entire load range, combined with a uni-fuel concept.

The uni-fuel concept – the running of GenSets on the same heavy fuel oil as used by the vessel's propulsion engine – is the result of a continuous development programme. MAN Diesel & Turbo is an industry pioneer in this development area, and has therefore gained a unique market position.



Minimal daily maintenance

The control systems installed on today's merchant ships permit small crews to operate even the largest vessels, provided that ways can be found to reduce the hours spent on basic maintenance. For all MAN GenSets, the need for daily maintenance has been reduced to the absolute minimum necessary for a reliable and trouble-free operation – and the engine designers are constantly looking for ways to further reduce the maintenance requirements.

Long intervals between overhauls

Time between major overhauls is up to 20,000 hours, depending on the specific GenSet design, application and operating profile, and the quality of the daily maintenance.

Unlimited load pattern

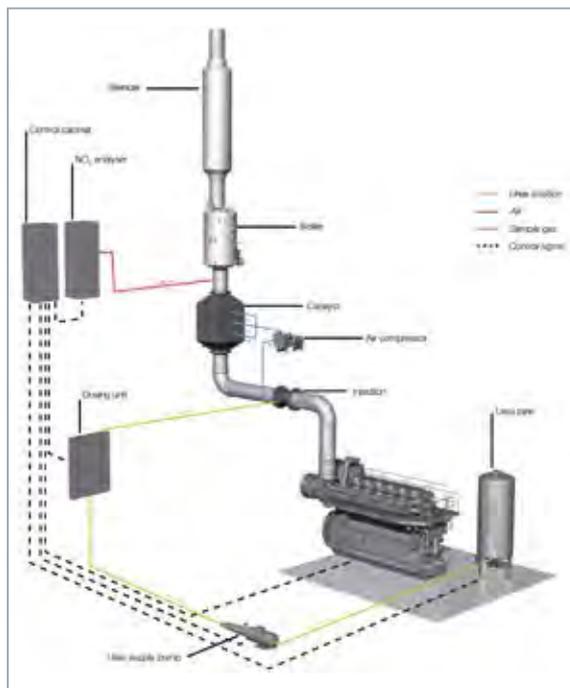
All MAN GenSets are capable of unrestricted operation in all load patterns – max. load/low load/no load combinations.



Environmental considerations

MAN Diesel & Turbo places a sharp focus on both the safety and the working environment of the ship crews as well as the potential effects of its products on the external environment. The GenSets operate at low vibration and noise levels to the benefit of the crew, and the current GenSet programme complies with the external environmental requirements defined by the IMO Tier II emission regulations – without requiring exhaust gas after-treatment.

Future emission requirements outlined in IMO Tier III (valid from January 2016) will require exhaust gas treatment in the form of a selective catalytic reduction (SCR) system.



The design and calculation of such equipment can be performed by MAN Diesel & Turbo



Operation on distillate fuels

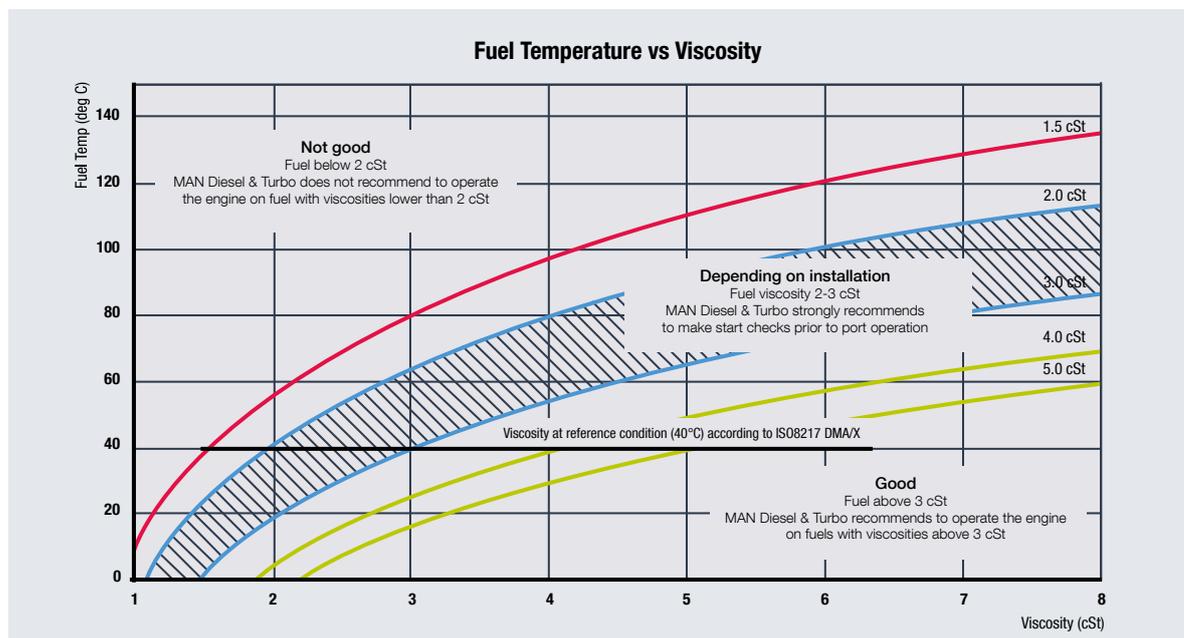
Exhaust emissions from marine diesel engines have been the focus of recent legislation. Apart from nitrous oxides (NO_x), sulphur oxides (SO_x) are considered to be the most important pollution factor. A range of new regulations has been implemented and others will follow (IMO, EU Directive, and CARB).

These regulations demand a reduction of SO_x emissions by restricting the sulphur content of the fuel. That is to say sulphur limits for HFO as well as mandatory use of low-sulphur distillate fuels for particular applications. This guideline covers the engine-related aspects of the use of such fuels.

Low-sulphur HFO

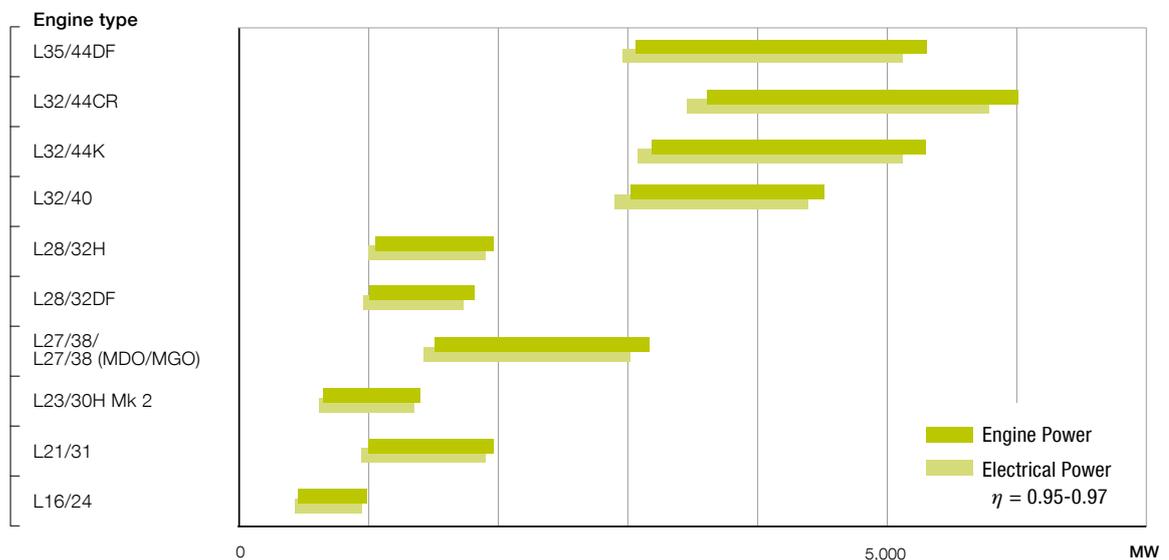
From an engine manufacturer's point of view, there is no lower limit for the sulphur content of HFO. We have not experienced any trouble with the currently available low-sulphur HFO that is related to the sulphur content or specific to low-sulphur HFO. This may change in the future if new methods are applied for the production of low-sulphur HFO (desulphurization, uncommon blending components).

MAN Diesel & Turbo will monitor developments and inform our customers if necessary. If the engine is not operated permanently on low-sulphur HFO, then the lubricating oil should be selected according to the highest sulphur content of the fuels in operation.



Power Range

GenSet solutions for the 450-6,000 kW range

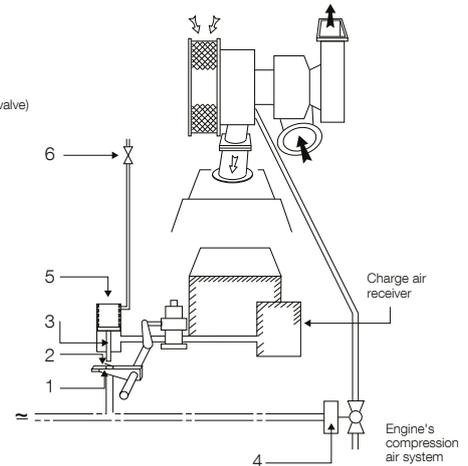


Classic Marine GenSets

Prepared for the requirements of tomorrow



1. Regulating arm
2. Switch (Pick-up)
3. Piston
4. Solenoid valve
5. Lambda controller
6. Overspeed device (mechanical activated 3/2 valve)



L23/30H Mk 2 and L28/32H are characterised by:

Constant pressure turbocharging

The constant pressure turbocharger system comprises an exhaust gas receiver, turbocharger, charge air cooler with water mist catcher, and a charge air receiver, the last two incorporated in the frame. The turbocharger is a high-efficiency design with a radial flow gas turbine and a radial flow compressor.

Lambda controller

A built-in lambda controller greatly increases the unit's load response ability and limits the fuel oil index during the start-up procedure and load changes. It reduces the formation of smoke and results in better fuel utilisation and cleaner exhaust. The engine operating system (mechanical governor) allows load steps of up to 50% in one step.

Environmentally friendly

In line with all MAN GenSets, the L23/30H Mk 2 and L28/32H series meet existing and adopted emission requirements. As well as low fuel oil and lubricating oil consumption, the engines meet the IMO Tier II requirements.

Tailor-made solutions

MAN GenSets are delivered as complete packages with the diesel engine and the alternator fitted on a common base frame. Any type and make of alternator can be specified, and the base frame can be adapted in each case.

Easy installation

Installation is easy, as the engine and the alternator are fitted on a single base frame, and connection to external systems is trouble-free. The GenSet is delivered in a ready-to-start state, speeding up the installation and commissioning process.

Established design

The popular L23/30H has been upgraded with regard to both the design and performance, and the L28/32H has been built in very large numbers. Their monoblock engine frame incorporates cylinder block, crankcase, charge air receiver, cooling water jacket, camshaft and camshaft drive. The underslung crankshaft keeps combustion and inertia forces within the same component, enhancing the engine's reliability, durability and availability.

MAN L23/30H Mk 2 GenSet

650-1,400 kW



Powered by 3 x L23/30H GenSets

The MAN L23/30H (Holeby) GenSet has been a treasured choice by customers since the first introduction in the mid-60s, and it has proven to be an extraordinarily reliable engine type. More than 10,000 GenSets have been installed, and the engine has served as the benchmark for the whole industry.

A classic has been upgraded

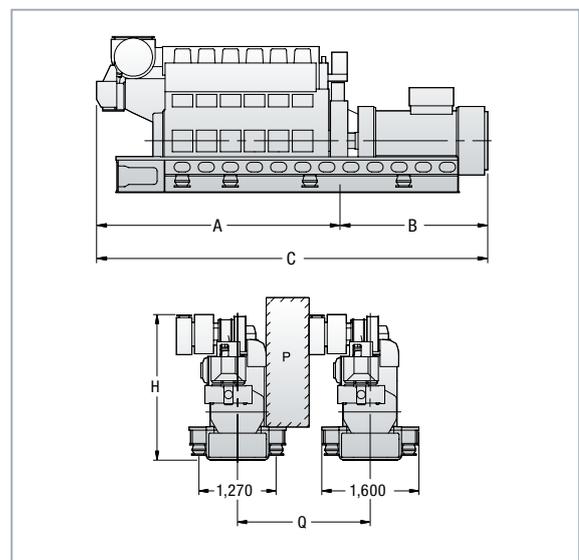
With the increased focus on both operational and economical measures, MAN Diesel & Turbo has decided to upgrade its most successful GenSet, i.e. the L23/30H. This upgrade offers a number of significant design changes leading to more benefits for the owner:

- weight reduction of 5-7% thanks to base frame design changes
- approximately 10% higher output per cylinder
- reduced fuel consumption (SFOC) of 1%.

The new GenSet, designated L23/30H Mk 2, has received positive feedback from the market, and the number of orders and the general interest indicate that the L23/30H engine is bound for more success. Just as with other MAN engines, quality in every component and comprehensive factory testing mean that

daily maintenance requirements are kept at a minimum and long intervals between overhauls are obtained.

The L23/30H Mk 2 engine has an additional environmental advantage – besides the IMO Tier II, it holds an EPA Tier 2 approval for the 900 r/min version.



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 2,250 mm

Main Data L23/30H Mk 2 – Bore: 225 mm, Stroke: 300 mm

| | | | |
|----------------|-----|-----|-----|
| Speed (r/min) | 720 | 750 | 900 |
| Frequency (Hz) | 60 | 50 | 60 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|-----------|---------|----------|---------|----------|---------|----------|
| 5 L23/30H | 650/710 | 618/675 | 675/740 | 641/703 | - | - |
| 6 L23/30H | 852 | 809 | 888 | 844 | 1,050 | 998 |
| 7 L23/30H | 994 | 944 | 1,036 | 984 | 1,225 | 1,164 |
| 8 L23/30H | 1,136 | 1,079 | 1,184 | 1,125 | 1,400 | 1,330 |

| Cyl. No. | 5 | 6 | 6 | 7 | 7 | 8 | 8 |
|--------------|---------|---------|-------|---------|-------|---------|-------|
| r/min | 720/750 | 720/750 | 900 | 720/750 | 900 | 720/750 | 900 |
| A (mm) | 3,369 | 3,738 | 3,738 | 4,109 | 4,109 | 4,475 | 4,475 |
| B (mm) | 2,155 | 2,265 | 2,265 | 2,395 | 2,395 | 2,480 | 2,340 |
| C (mm) | 5,524 | 6,004 | 6,004 | 6,504 | 6,504 | 6,959 | 6,815 |
| H (mm) | 2,402 | 2,402 | 2,466 | 2,466 | 2,466 | 2,466 | 2,466 |
| Dry Mass (t) | 17.0 | 18.5 | 19.8 | 20.0 | 21.4 | 21.9 | 22.9 |

* Based on nominal generator efficiencies of 95%
Weight and dimensions based on a standard alternator

Facts and figures

Performance

The L23/30H Mk 2 is a four-stroke in-line engine that can be delivered in 5 to 8-cylinder versions. Power output ranges from 650 to 1,400 kW.

Compact dimensions

With a length of 5.5 to 7.0 m, a width of 1.6 m, a height of 2.4 to 2.5 m (depending on the number of cylinders), and a dry weight of 17.0 to 22.9 tonnes, the L23/30H Mk 2 is compact. It also has a low dismantling height, making it suitable for areas in which vertical space is restricted.

Economical

Like all our units, the L23/30H Mk 2 is designed to achieve optimal performance on HFO. Lubricating oil consumption is minimal.

Long overhaul interval

With an interval of 16,000 hours between major overhauls and a short daily maintenance schedule, the L23/30H Mk 2 has a low maintenance requirement.

Extensive monitoring and control system

All media systems have thermometers and manometers providing input to alarm functions. There are standard shutdown functions for low lubricating oil pressure, high cooling water temperature and overspeed.

MAN L28/32H GenSet

1,050-1,980 kW

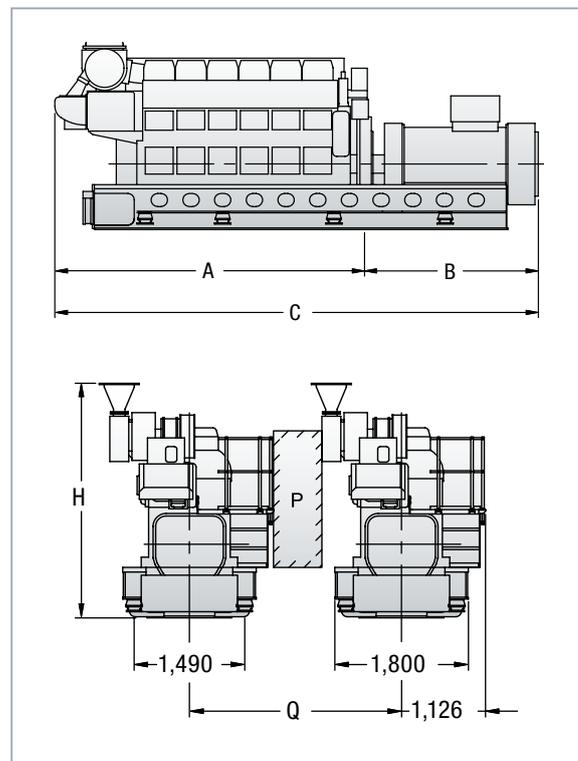


Powered by 2 x L28/32H GenSets

The classic L28/32H GenSet type series has a long proven record for reliability and durability. It comprises in-line engines from 5 to 9 cylinders, offering a power range from 1,050 to 1,980 kW.

The sturdy engine structure and amply dimensioned running gear ensure a low level of mechanical stress. Moving parts are optimised for good running properties and low wear rates, while the rigid engine structure gives a low deformation level.

The modular concept and dependable engine design, which has proven itself in many GenSet installations, offers the lowest routine maintenance schedule and up to 20,000 hours between overhaul when operated on HFO.



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 2,655 mm (without gallery) ~2,850 mm (with gallery)

Main Data L28/32H – Bore: 280 mm, Stroke: 320 mm

| | | |
|----------------|-----|-----|
| Speed (r/min) | 720 | 750 |
| Frequency (Hz) | 60 | 50 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|-----------|---------|----------|---------|----------|
| 5 L28/32H | 1,050 | 1,000 | 1,100 | 1,045 |
| 6 L28/32H | 1,260 | 1,200 | 1,320 | 1,255 |
| 7 L28/32H | 1,470 | 1,400 | 1,540 | 1,465 |
| 8 L28/32H | 1,680 | 1,600 | 1,760 | 1,670 |
| 9 L28/32H | 1,890 | 1,800 | 1,980 | 1,880 |

| Cyl. No. | 5 | 6 | 7 | 8 | 9 |
|--------------|---------|---------|---------|---------|---------|
| r/min | 720/750 | 720/750 | 720/750 | 720/750 | 720/750 |
| A (mm) | 4,279 | 4,759 | 5,499 | 5,979 | 6,199 |
| B (mm) | 2,400 | 2,510 | 2,680 | 2,770 | 2,690 |
| C (mm) | 6,679 | 7,269 | 8,179 | 8,749 | 8,889 |
| H (mm) | 3,184 | 3,184 | 3,374 | 3,374 | 3,534 |
| Dry Mass (t) | 32.6 | 36.3 | 39.4 | 40.7 | 47.1 |

* Based on nominal generator efficiencies of 95%
Weight and dimensions based on a standard alternator

Facts and figures

Economical HFO operation

L28/32H engines can operate on the same heavy fuel oil used for the ship's propulsion engine. Consumption of both fuel oil and lubricating oil is low. The total cost per kW produced is very low when operating the L28/32H GenSets on heavy fuel oil.

Low maintenance costs

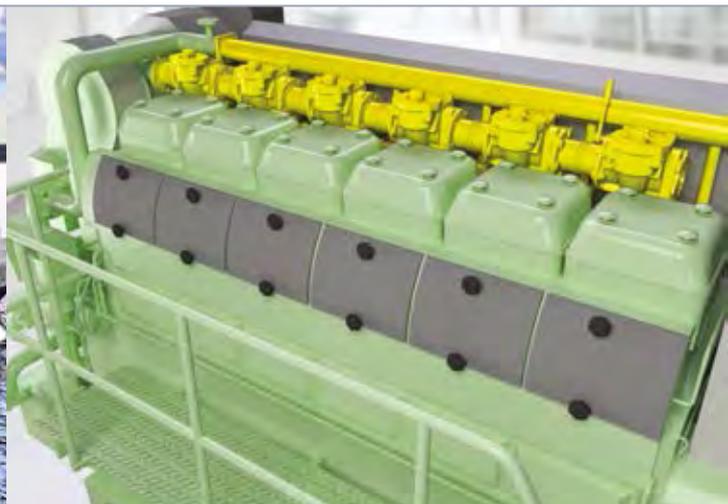
The L28/32H series requires only limited routine maintenance, and the time between the major overhauls is up to 20,000 hours.

Many configurations

The L28/32H range comprises in-line engines of 5 to 9 cylinders. Output ranges from 1,050 to 1,980 kW.

MAN L28/32DF GenSet

Dual fuel flexibility



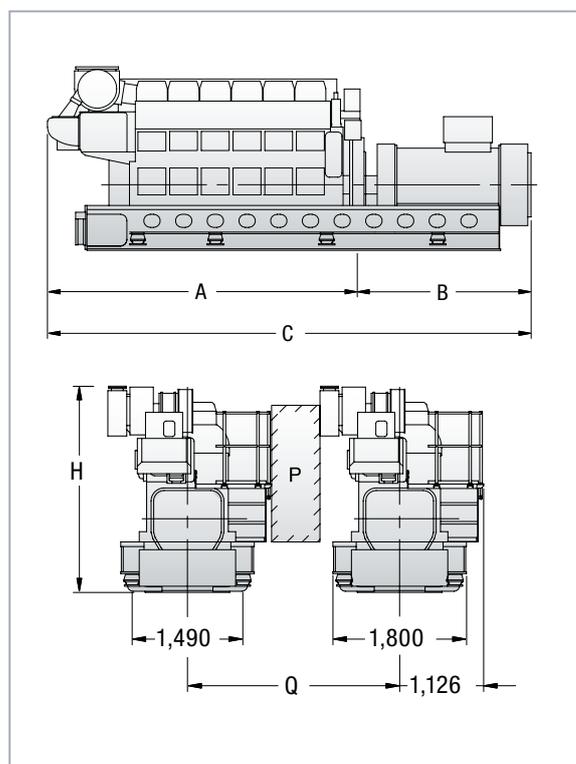
Powered by 3 x 9L28/32DF GenSets

The L28/32DF engine is based on the proven L28/32H workhorse, recognised worldwide as an ultra-reliable and robust GenSet with long TBOs.

MAN Diesel & Turbo's new L28/32DF generating set offers the ultimate in fuel flexibility and efficiency and forms part of a complete marine solution with the low-speed ME-GI main engine.

Dual-fuel engines using clean-burning liquefied natural gas (LNG) represent an excellent, operational option. Not only do these satisfy all emission requirements when running on gas, they also offer low operational and maintenance costs. Dual-fuel engines also have several advantages over engines that run on gas alone. Most importantly, should there be any problems with gas operation, or a shortage of fuel, the ship can simply switch to liquid fuel.

Powering engines by natural gas – with its little to no sulphur content – instead of HFO leads to a cleaner-system as traces of the SO_x sulphur oxides are accordingly found in only negligible amounts in the exhaust gas. Particulate amounts are also reduced considerably, as are NO_x and CO₂ totals.



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 2,655 mm (without gallery) ~2,850 mm (with gallery)

Main Data L28/32DF – Bore: 280 mm, Stroke: 320 mm

| | | | | | |
|----------------|--|----------------|-----------------|----------------|-----------------|
| Speed (r/min) | | 720 | | 750 | |
| Frequency (Hz) | | 60 | | 50 | |
| | | | | | |
| | | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
| 5 L28/32DF | | 1,000 | 950 | 1,000 | 950 |
| 6 L28/32DF | | 1,200 | 1,140 | 1,200 | 1,140 |
| 7 L28/32DF | | 1,400 | 1,330 | 1,400 | 1,330 |
| 8 L28/32DF | | 1,600 | 1,520 | 1,600 | 1,520 |
| 9 L28/32DF | | 1,800 | 1,710 | 1,800 | 1,710 |

Dimensions

| Cyl. No. | | 5 | 6 | 7 | 8 | 9 |
|----------|-------|---------|---------|---------|---------|---------|
| | r/min | 720/750 | 720/750 | 720/750 | 720/750 | 720/750 |
| A | mm | 4,321 | 4,801 | 5,281 | 5,761 | 6,241 |
| B | mm | 2,400 | 2,510 | 2,680 | 2,770 | 2,690 |
| C | mm | 6,721 | 7,311 | 7,961 | 8,531 | 8,931 |
| H | mm | 2,835 | 3,009 | 3,009 | 3,009 | 3,009 |
| Dry Mass | t | 32.6 | 36.3 | 39.4 | 40.7 | 47.1 |

* Based on nominal generator efficiencies of 95%

Weight and dimensions based on a standard alternator

Gas / fuel ratio:

- at load: 30-90% 90 / 10
- at full load 80 / 20

Gas methane number ≥ 80

Streamlined Modular GenSets

Designed for optimised service friendliness



The L16/24, L21/31 and L27/38 GenSets are characterised by:

Compact size

The engines are lower and shorter than other long-stroke engines in their power class, and they can be installed in restricted engine room areas without problems.

Pipeless design

The front-end box and cylinder units are linked to the engine's internal oil and water circuits without pipes. Overall, the number of components has been reduced by up to 60%. Fewer sensitive components mean even higher reliability.

Front-end concept

All support functions – oil and water pumps, coolers, filters, and safety and regulator valves – are housed in a single front-end box for easy access and maintenance.

Separate cylinder units

Each complete cylinder assembly – head, piston, liner and connecting rod – can be removed as a unit for easy maintenance or replacement.

Low bearing wear

The connecting rods for L21/31 and L27/38 are of the marine head type and are designed for low-pressure operation, resulting in lower wear and a longer life for bearings – for the higher combustion forces in these engines.

Reduced maintenance requirements

The engines require only minimal daily maintenance and are designed for 16-20,000 service hours between overhauls.

Operation on HFO

All engines operate efficiently on inexpensive heavy fuel oil across the whole power range. However, since the introduction of the L16/24 engine, HFO has generally decreased in quality and ignition properties. Combined with, in some cases, unexpected long intervals with low-load operation, this has generated some design updates so as to restore the operational safety margins.

Environmentally friendly

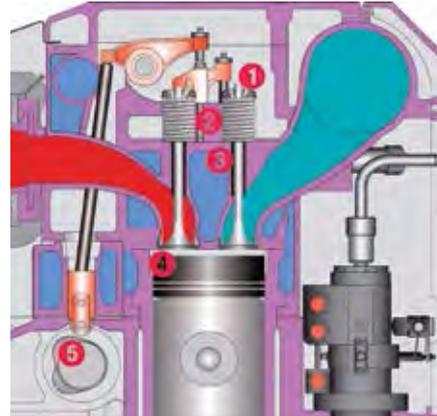
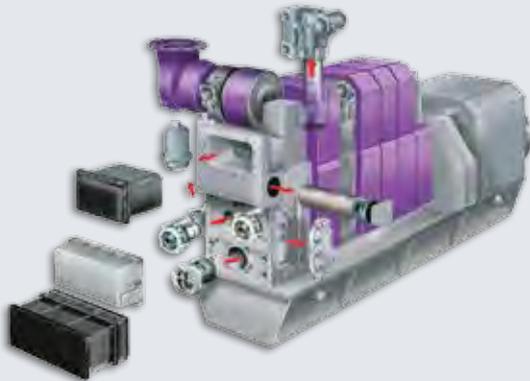
The streamlined generation of GenSet engines has high outputs, but low lube oil and fuel oil consumption figures. As standard, the engines meet the IMO Tier II emission limits.

Optimal operating temperature

The engine has an integrated cooling water system that ensures an optimal operating temperature across the range from idle to full load. In addition, the charge air cooler is equipped with a water mist catcher that reduces the amount of condensation in the cooler.

MAN L16/24 GenSet

450-990 kW



1. New rotocaps
2. New valve springs
3. New valve guides
4. Valve pockets in piston
5. Reduced cam/valve lift

The streamlined exterior of the award-winning L16/24, uncluttered by tubes and pipes, is an indication of its exceptional design. It is an engine which, although firmly based on almost a century of diesel engine design and manufacturing, overturns many of the accepted doctrines to provide both owners and shipyards with important benefits.

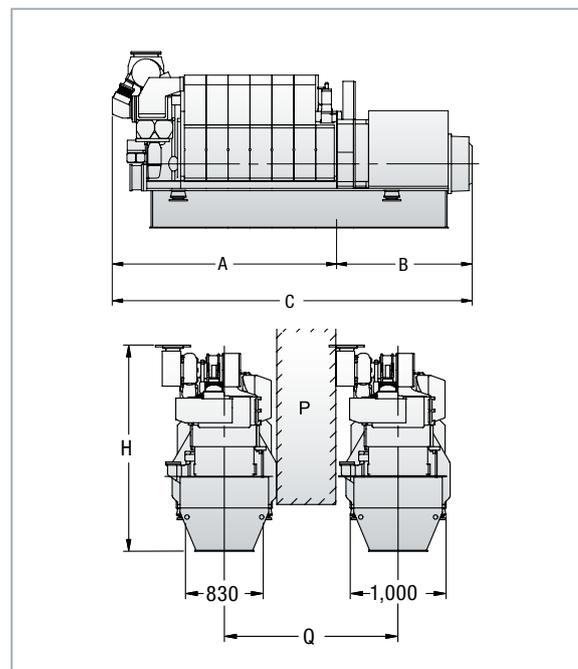
Our experience with the heavy fuel oil on the market has shown a tendency of decreasing ignition properties which, in general, may lead to operational problems, especially in the low-load area.

In order to improve the ability of low-load operation, it was decided to apply a charge air preheating system as a standard application. By further development of the valve train and cam system, it has been possible to reduce the risk of engine damage if a valve is sticking in the cylinder head, as no mechanical contact is possible in the updated design.

Benefits

The L16/24 engine family's 450-990 kW power range and cost-effectiveness, in terms of both capital investment and daily operation, combined with the latest updates to the original design, makes it the ideal GenSet solution for a large number of vessel types.

Suitable applications for the engine range from handy-size bulk carriers, tankers and general cargo vessels to small and medium-sized reefers, container vessels, ferries and cruise ships.



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 1,800 mm

Main Data L16/24 – Bore: 160 mm, Stroke: 240 mm

| | | |
|----------------|-------|-------|
| Speed (r/min) | 1,200 | 1,000 |
| Frequency (Hz) | 60 | 50 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|----------|---------|----------|---------|----------|
| 5 L16/24 | 500 | 475 | 450 | 428 |
| 6 L16/24 | 660 | 627 | 570 | 542 |
| 7 L16/24 | 770 | 732 | 665 | 632 |
| 8 L16/24 | 880 | 836 | 760 | 722 |
| 9 L16/24 | 990 | 941 | 855 | 812 |

| Cyl. No. | 5 | 6 | 7 | 8 | 9 |
|--------------|-----------|-----------|-------------|-----------|-----------|
| r/min | 1200/1000 | 1200/1000 | 1200/1000 | 1200/1000 | 1200/1000 |
| A (mm) | 2,807 | 3,082 | 3,557 | 3,832 | 4,107 |
| B (mm) | 1,400 | 1,490 | 1,585 | 1,680 | 1,680 |
| C (mm) | 4,207 | 4,572 | 5,142 | 5,512 | 5,787 |
| H (mm) | 2,337 | 2,337 | 2,415/2,337 | 2,415 | 2,415 |
| Dry Mass (t) | 9.5 | 10.5 | 11.4 | 12.4 | 13.1 |

* Based on nominal generator efficiencies of 95%
Weight and dimensions based on a standard alternator

Facts and figures

HFO operation

The L16/24 range operates efficiently on the most inexpensive fuel type (HFO) across the operating range, from idle to full load, including the start/stop phase.

Performance

The engine output at 1,000 and 1,200 r/min ranges from 450 kW (5 cyl.) to 990 kW (9 cyl.) – and every L16/24 engine is a class leader in terms of specific weight (kW/kg).

Compactness

At a width of 1 m, a height of 2.3 to 2.4 m, and a length between 4.2 and 5.8 m, it is the smallest engine in its power output class.

Light weight

These compact dimensions result in a substantial weight advantage compared with competitive products. The L16/24 range weighs between 9.5 and 13.1 tonnes.

Easy maintenance

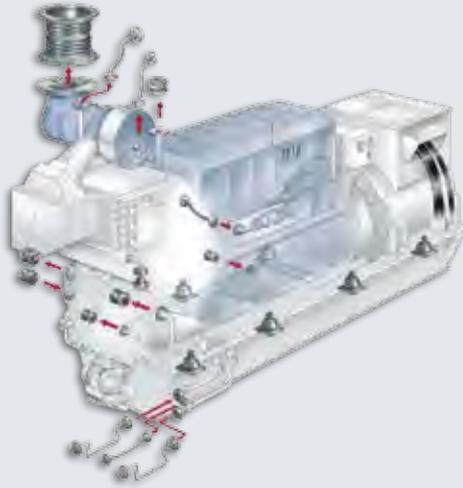
As with all MAN engines, only minimal daily maintenance is required.

Improved working conditions

The L16/24 operates with very little vibration and is fitted with sound insulation jackets which substantially reduce engine noise.

MAN L21/31 GenSet

1,000-1,980 kW



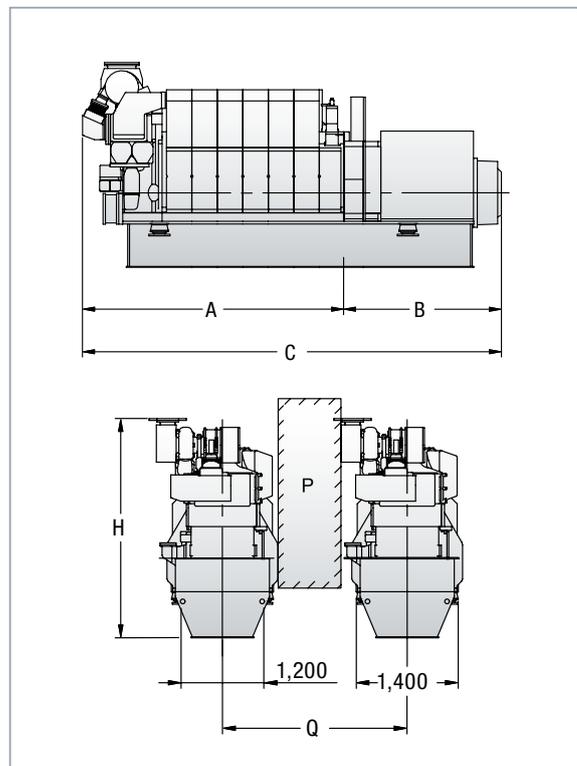
Powered by 3 x L21/31 GenSets

The development of the L21/31 engine completes the MAN GenSet programme. The engine covers the power range between the L16/24 and the L27/38 engines. All in all, a marine GenSet product programme for the 21st century.

Benefits

Producing 1,000-1,980 kW, the L21/31 is based on the same innovative, streamlined concept as the L16/24 and the L27/38: i.e. reduced size and weight, modular construction, simplified pipeless design, fewer components, reduced maintenance requirements, high power, low noise, economic operation and low emissions.

Engineered to be robust for reliable, long TBO service, it hides a wealth of advanced technology behind its smooth, uncluttered exterior. Its support systems permit an integrated approach to fuel oil supply, cooling water and starting air systems. The benefits are smooth installation, and simple operation and maintenance.



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 2,400 mm (without gallery) ~2,600 mm (with gallery)

Main Data L21/31 – Bore: 210 mm, Stroke: 310 mm

| | | |
|----------------|-----|-------|
| Speed (r/min) | 900 | 1,000 |
| Frequency (Hz) | 60 | 50 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|----------|---------|----------|---------|----------|
| 5 L21/31 | 1,000 | 950 | 1,000 | 950 |
| 6 L21/31 | 1,320 | 1,254 | 1,320 | 1,254 |
| 7 L21/31 | 1,540 | 1,463 | 1,540 | 1,463 |
| 8 L21/31 | 1,760 | 1,672 | 1,760 | 1,672 |
| 9 L21/31 | 1,980 | 1,881 | 1,980 | 1,881 |

| Cyl. No. | 5 | 6 | 7 | 8 | 9 |
|--------------|----------|----------|----------|----------|----------|
| r/min | 900/1000 | 900/1000 | 900/1000 | 900/1000 | 900/1000 |
| A (mm) | 3,959 | 4,314 | 4,669 | 5,572 | 5,927 |
| B (mm) | 1,870 | 2,000 | 1,970 | 2,110 | 2,135 |
| C (mm) | 5,829 | 6,314 | 6,639 | 7,682 | 8,062 |
| H (mm) | 3,183 | 3,183 | 3,289 | 3,289 | 3,289 |
| Dry Mass (t) | 22.5 | 26.0 | 29.5 | 33.0 | 36.5 |

* Based on nominal generator efficiencies of 95%
Weight and dimensions based on a standard alternator

Facts and figures

Flexible configuration

There is a choice of configuration from 5-9 cylinders, with power output ranging from 1,000-1,980 kW.

High reliability

The L21/31 is designed for long overhaul intervals and high reliability on heavy fuel oil.

Improved working conditions

Design features such as marine head connecting rods, cross flow cylinder heads sturdy engine block, water mist catcher and lambda controller provide the perfect working conditions.

Economic operation

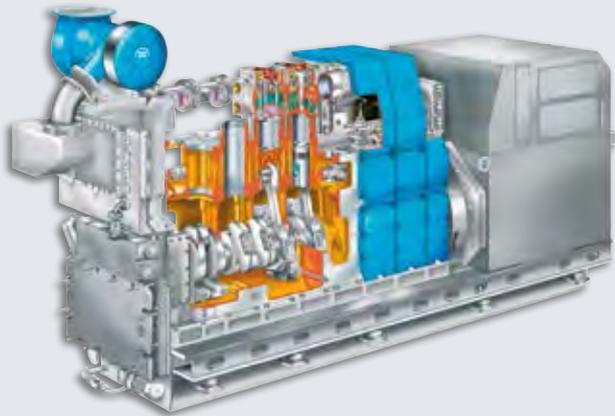
The L21/31 has been designed to produce high power at a low level of lube oil and fuel oil consumption.

Easy to maintain

Operating procedures are greatly simplified by pipe-less internal oil and water circuits, support functions collected in a single front-end box, fewer components and separate cylinder units.

MAN L27/38 GenSet

1,500-3,150 kW



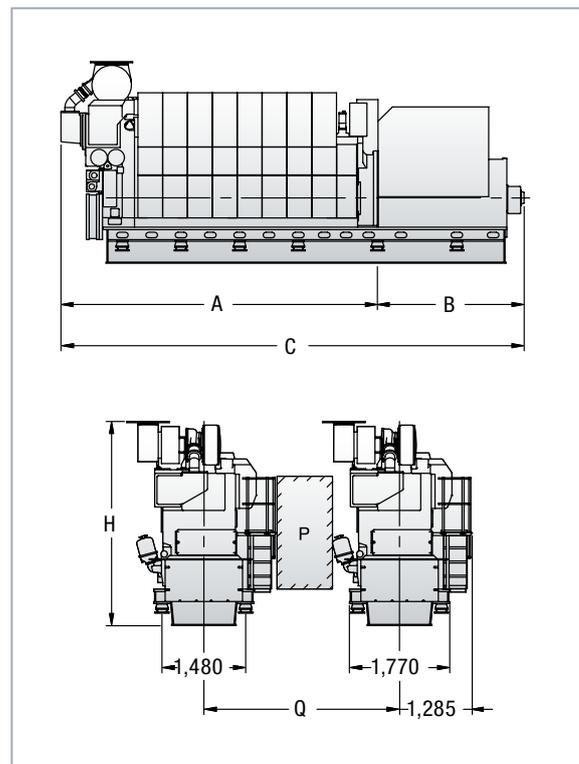
Powered by 4 x L27/38 GenSets

The development of the L27/38 for larger vessels was a logical continuation of the strategy initiated with the introduction of the L16/24 – the first of the new generation of MAN GenSets.

Benefits

Producing 1,500-3,150 kW, the L27/38 is based on the same innovative, streamlined concept as the L16/24; reduced size and weight, modular construction, a simplified pipeless design, fewer components, reduced maintenance requirement, high power, low noise, economic operation and a low level of emissions.

Engineered for reliable, long TBO service, it hides a wealth of advanced technology behind its smooth, uncluttered exterior. Its support systems permit an integrated approach to fuel oil supply and cooling water and starting air systems. The benefits are smooth installation and simple operation and maintenance.



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 2,900 mm (without gallery) ~3,100 mm (with gallery)

Main Data L27/38 – Bore: 270 mm, Stroke: 380 mm

| | | |
|----------------|---------|---------------------|
| Speed (r/min) | 720/750 | 720/750 (MDO**/MGO) |
| Frequency (Hz) | 60/50 | 60/50 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|----------|-------------|-------------|---------|----------|
| 5 L27/38 | 1,500/1,600 | 1,440/1,536 | - | - |
| 6 L27/38 | 1,980 | 1,900 | 2,100 | 2,016 |
| 7 L27/38 | 2,310 | 2,218 | 2,450 | 2,352 |
| 8 L27/38 | 2,640 | 2,534 | 2,800 | 2,688 |
| 9 L27/38 | 2,970 | 2,851 | 3,150 | 3,024 |

| Cyl. No. | 5 | 6 | 7 | 8 | 9 |
|--------------|---------|---------|---------|---------|---------|
| r/min | 720/750 | 720/750 | 720/750 | 720/750 | 720/750 |
| A (mm) | 4,346 | 4,791 | 5,236 | 5,681 | 6,126 |
| B (mm) | 2,486 | 2,766 | 2,766 | 2,986 | 2,986 |
| C (mm) | 6,832 | 7,557 | 8,002 | 8,667 | 9,112 |
| H (mm) | 3,712 | 3,712 | 3,899 | 3,899 | 3,899 |
| Dry Mass (t) | 40.0 | 44.5 | 50.4 | 58.2 | 64.7 |

* Based on nominal generator efficiencies of 96%

** MDO viscosity must not exceed 6 mm²/s = cSt @ 40 °C

Weight and dimensions based on a standard alternator

Facts and figures

Flexible configuration

There is a choice of configuration from 5-9 cylinders, with power outputs ranging from 1,500 to 3,150 kW.

High reliability

The L27/38 is designed for long overhaul intervals and high reliability on heavy fuel oil.

Improved working conditions

The sturdy engine block and carefully balanced rotating components provide a virtually vibration-free engine. Innovative insulation cuts noise substantially.

Economic operation

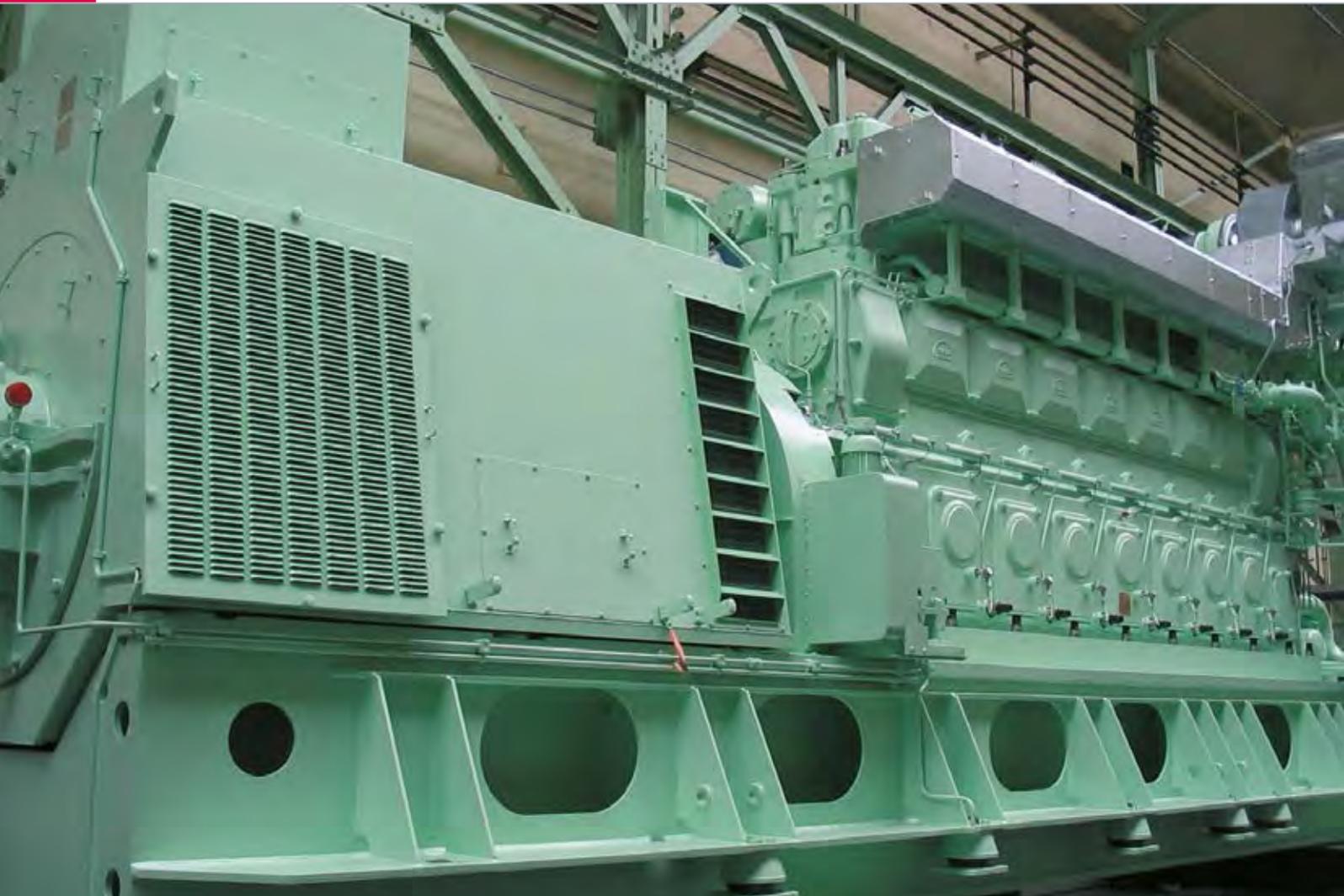
The L27/38 has been designed to produce high power at a low level of lube oil and fuel oil consumption.

Easy to maintain

Operating procedures are greatly simplified by pipe-less internal oil and water circuits, support functions collected in a single front-end box, fewer components and separate cylinder units.

High-Power GenSets

For efficient upper-range power coverage



Proven foundation with L32/40, 32/44K and L32/44CR

New ideas and technical features are based on MAN Diesel & Turbo's solid GenSet heritage. For generations, the MAN brand has maintained and developed its position as the leading HFO marine GenSet design. Many of the largest container vessels in the world have their massive electrical energy demands secured by MAN's high-power 32-cm bore GenSets.

The basic design of the 32/44CR engine is derived from the successful and very well-proven 32/40. This engine series has logged many reliable operating hours in a vast number of different applications – within auxiliary power generation and as main propulsion engines for ships, stationary power plant applications and for the offshore sector.

The L32/40, 32/44K and L32/44CR GenSet types are characterised by:

Efficient operation on HFO

The L32/40 and L32/44CR range of engines has been designed to run on heavy fuel oils with a viscosity of up to 700 cSt at 50°C.

Constant pressure turbocharger

The engine's turbocharger is a constant pressure system consisting of an exhaust gas receiver, turbocharger, charge air cooler and charge air receiver.

Robust engine design

The cylinder head combines the low temperature on the combustion chamber side and the high mechanical strength, thus permitting the high firing pressure required for optimal fuel consumption to be absorbed safely. The main bearings, through bolts and cylinder head bolts, put the engine frame under compressive pre-stress. The result is an outstanding component reliability in spite of the high firing pressure.

Elimination of bore polishing

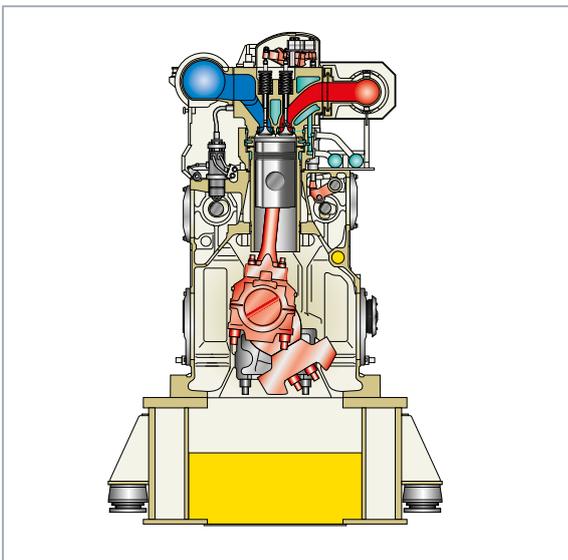
The liner is equipped with a separate, jet-bore-cooled fire ring. This ring and the top of the piston have been designed so that coke deposits cannot come in contact with the cylinder wall, effectively eliminating bore polishing.

Low consumption of lube oil

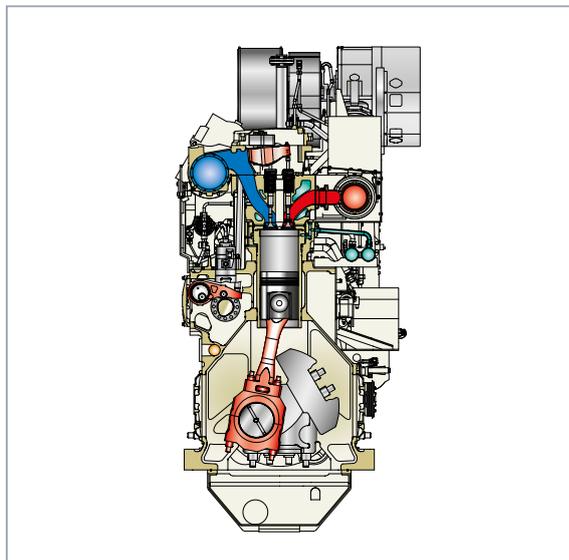
The piston is a composite with steel crown and cast-iron skirt. The mechanical strength of the skirt ensures optimal running of the piston rings. This, combined with the rigid cylinder liner, results in a low, constant consumption of lubricating oil.

Minimal maintenance

The need for daily maintenance has been reduced to a minimum. The standard recommended interval between major overhauls is 12,000 hours for cylinder heads and 24,000 hours for piston rings.



L32/40



L32/44CR

MAN L32/40 GenSet

3,000-4,500 kW



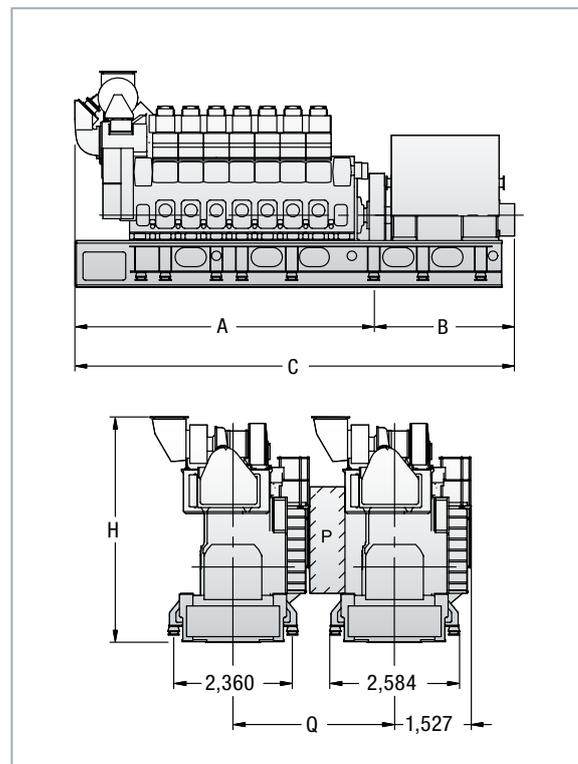
Powered by 4 x L32/40 GenSets

The L32/40 GenSet engine with an output of 500 kW per cylinder has an optimal combination of capital cost, performance and reliability.

Benefits

The L32/40 range run on inexpensive HFO from stand-by to full load. Twin camshafts provide unsurpassed flexibility – permitting a wide range of choices between optimal output/fuel ratio and minimised emissions. One camshaft drives the fuel injection pumps and operates the starting air pilot valves; the other operates the inlet and exhaust valves.

Supplied as an in-line engine with 6-9 cylinders, it is a perfectly balanced GenSet, designed to provide trouble-free operation for a quarter of a century or more in the largest vessels in the world fleet. Engines in the L32/40 family are in operation with some of the world's leading shipping lines.



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 2,835 mm (without gallery) ~3,220 mm (with gallery)

Main Data L32/40 – Bore: 320 mm, Stroke: 400 mm

| | | |
|----------------|-----|-----|
| Speed (r/min) | 720 | 750 |
| Frequency (Hz) | 60 | 50 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|----------|---------|----------|---------|----------|
| 6 L32/40 | 3,000 | 2,895 | 3,000 | 2,895 |
| 7 L32/40 | 3,500 | 3,380 | 3,500 | 3,380 |
| 8 L32/40 | 4,000 | 3,860 | 4,000 | 3,860 |
| 9 L32/40 | 4,500 | 4,345 | 4,500 | 4,345 |

| Cyl. No. | 6 | 7 | 8 | 9 |
|--------------|---------|---------|---------|---------|
| r/min | 720/750 | 720/750 | 720/750 | 720/750 |
| A (mm) | 6,340 | 6,870 | 7,400 | 7,930 |
| B (mm) | 3,415 | 3,415 | 3,635 | 3,635 |
| C (mm) | 9,755 | 10,285 | 11,035 | 11,565 |
| H (mm) | 4,622 | 4,622 | 4,840 | 4,840 |
| Dry Mass (t) | 75.0 | 79.0 | 87.0 | 91.0 |

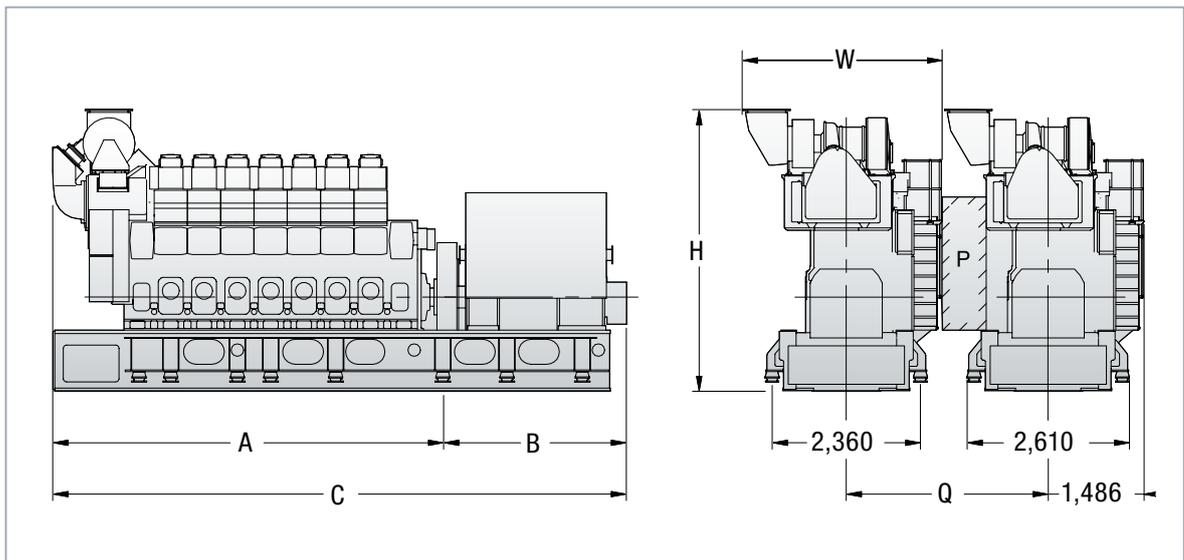
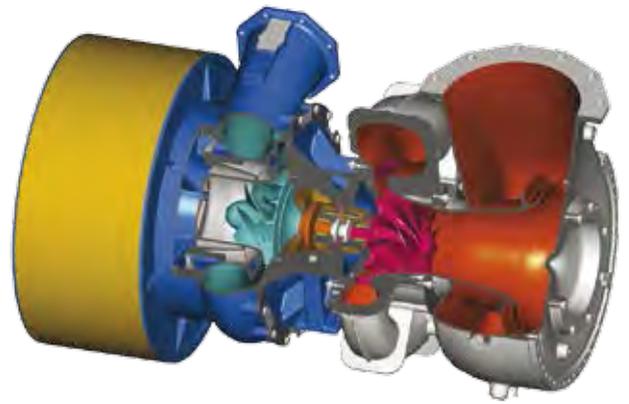
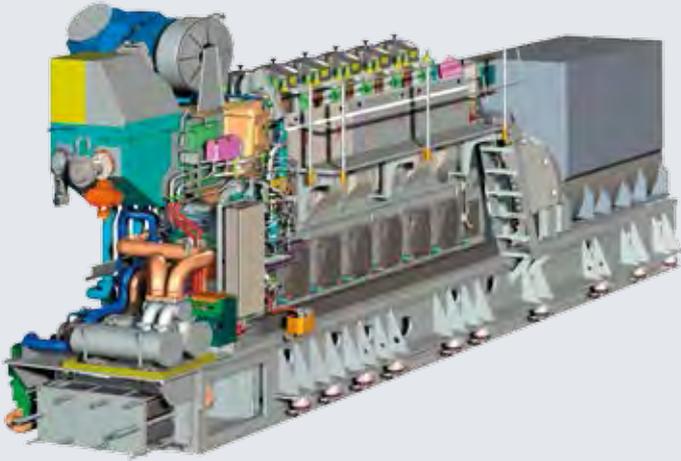
* Based on nominal generator efficiencies of 96.5%
Weight and dimensions based on a standard alternator

Facts and figures

- exhaust valves with rotators clean the valve seats for long TBOs and long lifetimes
- quick-acting connections at exhaust gas manifold
- highly efficient constant pressure turbocharging
- adjustable valve timing
- split connecting rod for easy maintenance
- dynamically balanced crankshaft with two counterweights per crank web
- stepped piston combined with a fire ring prevents bore polishing
- separate jacket for each cylinder ensures optimal piston running conditions
- no cooling water in the lower liner area and frame ensures an even temperature and eliminates the risk of cooling water contaminating the lube oil.

MAN 32/44K GenSet

Part-load optimised – Better fuel efficiency



P: Free passage between the engines, width 600 mm and height 2,000 mm

Q: ~Min. distance between centre of engines: 3,400 mm (with gallery)

Main Data L32/44K – Bore: 320 mm, Stroke: 440 mm

| | | |
|----------------|-----|-----|
| Speed (r/min) | 750 | 720 |
| Frequency (Hz) | 50 | 60 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|------------|---------|----------|---------|----------|
| 6 L32/44K | 3,180 | 3,069 | 3,180 | 3,069 |
| 7 L32/44K | 3,710 | 3,580 | 3,710 | 3,580 |
| 8 L32/44K | 4,240 | 4,092 | 4,240 | 4,092 |
| 9 L32/44K | 4,770 | 4,603 | 4,770 | 4,603 |
| 10 L32/44K | 5,300 | 5,115 | 5,300 | 5,115 |

| Cyl. No. | 6 | 7 | 8 | 9 | 10 |
|--------------|-------|--------|--------|--------|--------|
| A (mm) | 6,340 | 6,870 | 7,495 | 8,025 | 8,580 |
| B (mm) | 3,300 | 3,520 | 3,740 | 3,960 | 4,180 |
| C (mm) | 9,640 | 10,390 | 11,235 | 11,985 | 12,760 |
| W | 2,903 | 2,903 | 3,109 | 3,109 | 3,109 |
| H (mm) | 4,688 | 4,688 | 4,894 | 4,894 | 4,894 |
| Dry Mass (t) | 71 | 78 | 84 | 91 | 97 |

* Based on nominal generator efficiencies of 96.5%
Weight and dimensions based on a standard alternator

First GenSet optimised for part-load operation

- improved fuel oil consumption at part load, compared to traditional GenSets – 7 to 9 g/kWh in the 40-60% load range
- engine rigidly mounted on common base frame with alternator
- alternator rigidly mounted
- base frame resiliently mounted
- auxiliaries at front-end conventionally piped on base frame
- base frame with integrated oil service tank
- conventional injection system.

MAN L32/44CR GenSet

3,360-6,000 kW



Powered by L32/44CR GenSet

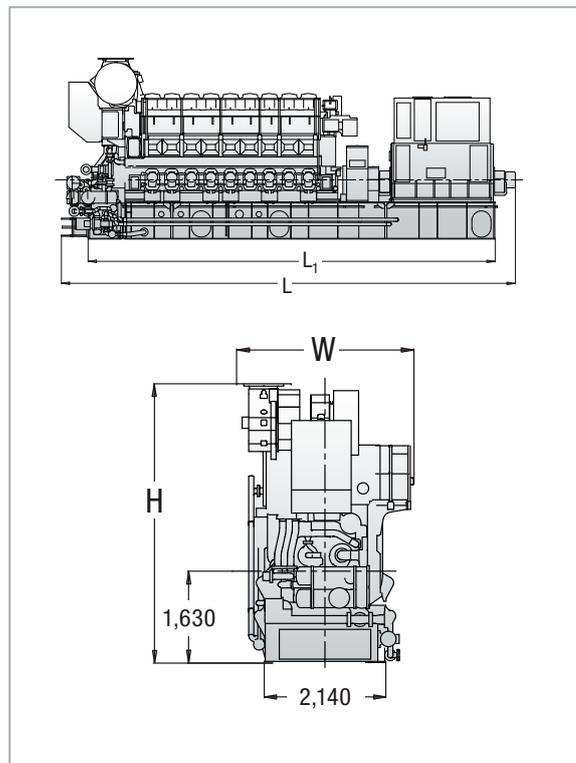
With the L32/44CR GenSet, new standards for efficient power generation are available based on state-of-the-art common rail technology.

Benefits

The L32/44CR GenSet offers unsurpassed operational efficiency and flexibility, high electrical power output, low fuel oil consumption, reduced exhaust gas emissions, and invisible smoke across the entire load range.

A clean, compact and powerful unit

The GenSet is designed as one unit on a tailored base frame, complete with alternator and engine with built-on auxiliary systems. The L32/44CR engine is resiliently seated on the base frame. It is vibration-analysed and balanced together with the rigidly seated alternator, which is driven via a highly flexible coupling.



Main Data L32/44CR – Bore: 320 mm, Stroke: 440 mm

| | | |
|----------------|-----|-----|
| Speed (r/min) | 750 | 720 |
| Frequency (Hz) | 50 | 60 |

| | Eng. kW | Gen. kW* | Eng. kW | Gen. kW* |
|--------------|---------|----------|---------|----------|
| 6 L32/44CR | 3,600 | 3,474 | 3,600 | 3,474 |
| 7 L32/44CR** | 3,920 | 3,783 | 3,920 | 3,783 |
| 8 L32/44CR | 4,800 | 4,623 | 4,800 | 4,623 |
| 9 L32/44CR | 5,400 | 5,211 | 5,400 | 5,211 |
| 10 L32/44CR | 6,000 | 5,790 | 6,000 | 5,790 |

| Cyl. No. | 6 | 7 | 8 | 9 | 10 |
|--------------|--------|--------|--------|--------|--------|
| L (mm) | 10,738 | 11,268 | 11,798 | 12,328 | 12,858 |
| L1 (mm) | 10,150 | 10,693 | 11,236 | 11,779 | 12,309 |
| W (mm) | 2,490 | 2,490 | 2,573 | 2,573 | 2,573 |
| H (mm) | 4,768 | 4,768 | 4,955 | 4,955 | 4,955 |
| Dry Mass (t) | 71 | 78 | 84 | 91 | 97 |

* Based on nominal generator efficiencies of 96.5%

** TC under development

Weight and dimensions based on a standard alternator

Weights and dimensions

For auxiliary engines (GenSets), the weights correspond to the unit (including alternator). The weight of the GenSets may vary depending on the alternator make. All weights given are without lube oil and cooling water. The length of the GenSet unit depends on the alternator make.

For a twin engine installation, the centreline distance is stated for each engine type. The center line distance for twin engine installation is given as a minimum value. Specific requirements to the passageway (e.g. from classification societies or flag state authorities), the kind of seating, or if a gallery is mounted can lead to higher values.

Facts and figures

By the use of the latest engine technology features, combined with electronically controlled common rail injection, the L32/44CR sets new class benchmarks, such as:

- high output, with a cylinder rating of 600 kW at 750 and 720 r/min
- low specific fuel oil and lube oil consumption
- user-friendly engine management via the SaCoS_{one} system
- injection flexibility of heavy fuel oils up to 700 cSt
- low NO_x, CO₂ and soot emissions
- invisible smoke emissions for engine loads ≥10% load.

Emergency & Harbour GenSet

450-990 kW

Combined emergency & harbour GenSet

Based on requests from many of our customers, we have developed a variant of our L16/24 marine GenSet (other engines are available on request) that complies with the classification requirements for engines functioning as both an emergency GenSet and a harbour GenSet.

Advantages for the customer

Emergency operating mode:

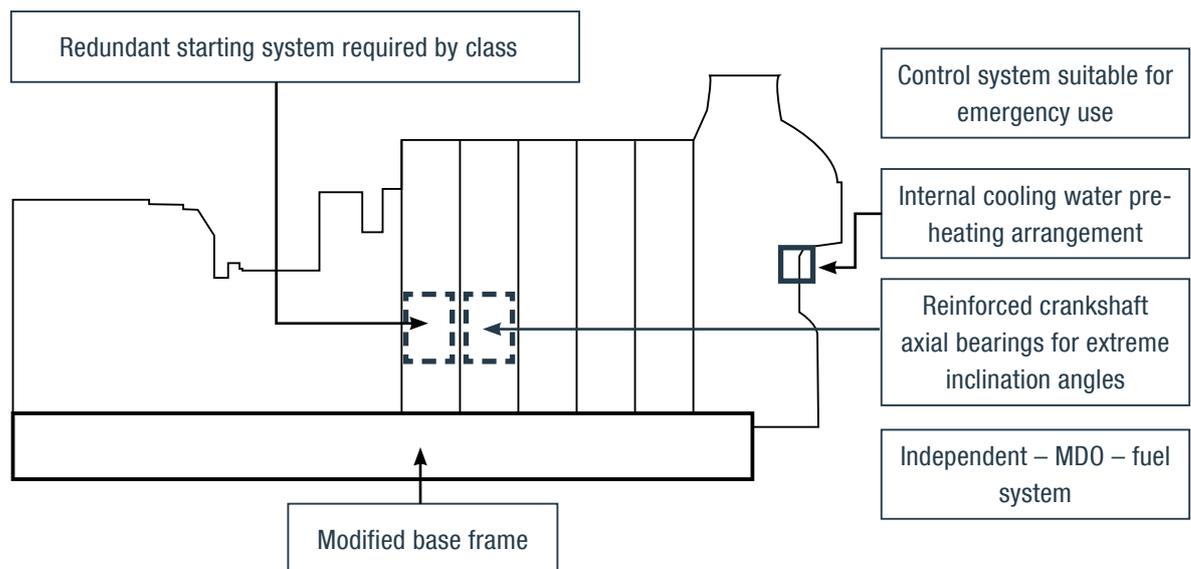
- one GenSet for two purposes; purchasing and service/maintenance cost savings
- both MDO and HFO possible in “harbour” mode
- fewer spare parts
- no need for separate emergency GenSet.

Selecting the right power rating

- start-load on emergency switchboard is the critical factor for GenSet size choice
- emergency GenSet must be able to take emergency switchboard load immediately within standard class requirements.

Harbour operating mode:

- when the emergency power requirement is fulfilled, the harbour power requirement becomes the main factor
- full standard GenSet rating can be utilised in the harbour power mode.



For emergency GenSet operation, a number of alterations/reinforcements need to be implemented

| Installation Type | Angle of inclination | |
|---|----------------------|--------------|
| | Athwart ship | Fore and aft |
| STD GenSet-STATIC | 15° | 5° |
| STD GenSet-DYNAMIC | 22.5° | 7.5° |
| Ship safety equipment – STATIC | 22.5° | 10° |
| Ship safety equipment – DYNAMIC | 22.5° | 10° |
| Ships with liquefied gases and chemicals – STATIC | 30° | 10° |

Major differences

Starting system with redundancy

- two air starters, one on engine and one near by as a spare
- air starter can be replaced within 15 min.
- two starting air systems with start capacity in accordance with class rules.

Approved by DNV, GL and BV.

Conclusion

With only a few changes, compared with the standard, our GenSet can function both as an emergency GenSet at sea and as a harbour GenSet in port. Thus, great savings are achieved compared with establishing and maintaining a separate emergency GenSet.

Base frame allowing large inclination

- to avoid oil/crankshaft collision at high inclination, base frame height is increased
- cost-effective solution with only small difference to standard
- good service experience with this solution
- increase of base frame height by 50 mm (5L) up to 125 mm (9L) allows inclinations up to 10° pitch and 30° roll.

For further information please contact your MAN partner.

Safety and Control

Marine GenSets

Due to higher environmental standards paired with increased safety requirements, and the increased engine functionality and complexity, a new generation of engine automation and control system was developed.

Our product portfolio of SaCoS_{one} safety and control systems, including the standard product SaCoS_{one} GENSET system introduced in 2010, currently with more than 2000 systems in operation worldwide, offers a future-proof, reliable and cost-optimised product line that covers the needs of the genset engine market.

Characteristics of the SaCoS_{one} GENSET system:

- supports the following applications:
 - a. auxiliary
 - b. diesel-electric propulsion
 - c. stationary
- integrated speed control system with electronic governor
- integrated complete automation system (engines marked with *)
- one standard interface connection (reduced integration effort)
- various customised configurations with standardised optional settings possible
- prepared for isochronous load-sharing with additional equipment
- type approved by the following class societies:
 - a. GL
 - b. DNV
 - c. LR
 - d. CCS
 - e. ABS
 - f. RINA
 - g. KR
 - h. CRS

The engine types listed in the table below will be delivered with our innovative SaCoS_{one} GENSET safety and control system:

| Low to mid-power engines | High-power engines |
|--------------------------|--------------------|
| L16/24* | L32/40* |
| L21/31* | L32/44 K |
| L27/38* | |
| L28/32 DF | |

For other high-power GenSet engines, like the L35/44 DF and the L32/44 CR, the more flexible SaCoS_{one} Large system is used.

The system control unit includes the control module S for engine control, monitoring and alarm system. The Control Module S logs engine measurements and converts them into data that is fed to the ship's alarm system via a modbus interface.

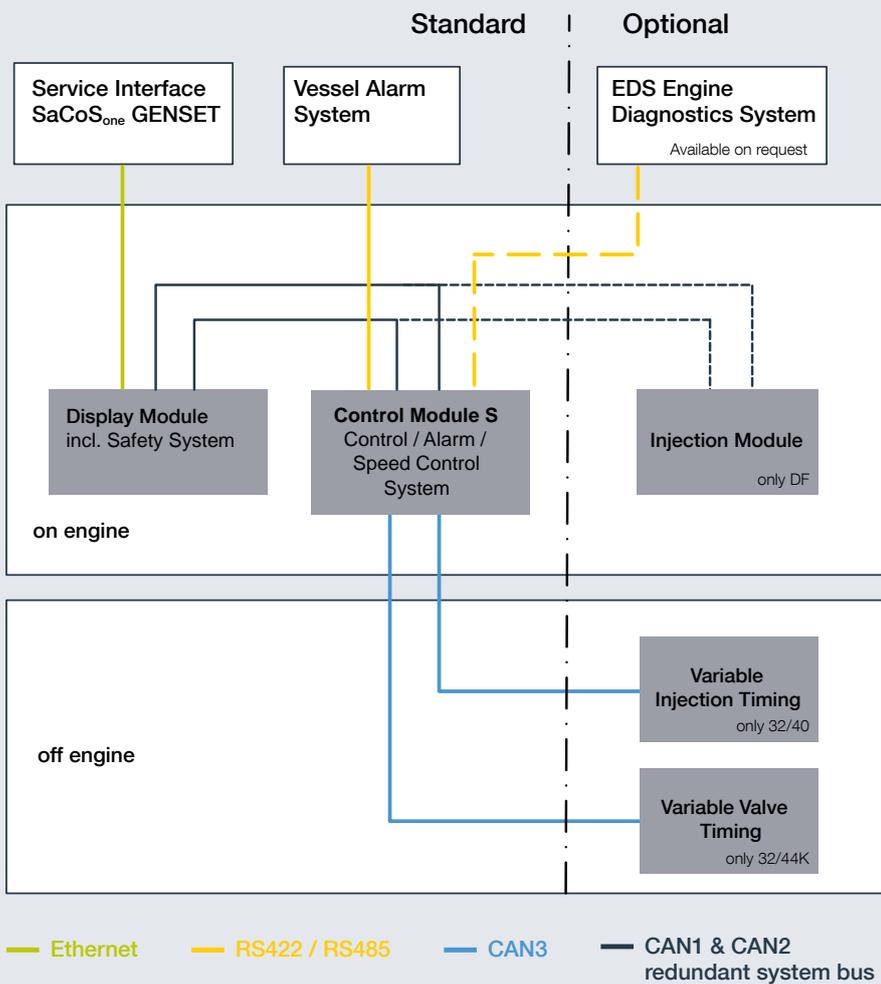
Furthermore, the control unit is equipped with a display module with a touchscreen and an integrated PLC for the safety system.

The display module provides the following functions:

- safety system
- visualisation of measured data and operating values
- engine operation via touchscreen
- engine control panel.

The safety system is electrically separated from the control system due to classification requirements. The system provides a central connection and distributing point for the 24 VDC power supply of the entire system.

SaCoS_{one} GENSET



It also connects the control unit to the GenSet, the ship's alarm system and the optional crankcase monitoring system.

Improvements of current version

With the new SaCoS_{one} GENSET version, the system

is reaching a higher level of system safety protection through, for example, integrated fuses and through a fully integrated redundant power distribution module. Further on, output signals up to 250 VAC can be processed within the system directly.

Quality Agreements

Production support



Quality support

Occasionally, MAN Diesel & Turbo has been contacted by owners requesting MAN Diesel & Turbo to do quality inspections of key components on their behalf at the engine builder and their sub-suppliers. To do this, MAN Diesel & Turbo must be appointed inspection partner together with/or on behalf of the owner.

To avoid any doubts and possible misunderstandings, we have introduced quality agreements, previously known as inspection agreements, clearly defining the responsibilities of each party. The quality agreement is often a four-party agreement signed by the owner, shipyard, engine builder and MAN Diesel & Turbo.

The standard quality agreement may cover:

- production
- shop trial/Factory Acceptance Test (FAT)
- installation (alignment on board the vessel)
- sea trial/Site Acceptance Test (SAT).

The agreements can be customised from case to case depending on the requests from the owner. The number and/or intensity of the inspection of the components can be changed depending on the result, experience and quality of earlier inspected components.

For further information, please contact us or visit our website www.mandieselturbo.com



World Class GenSet Service

Wherever you are operating



PrimeServ's worldwide service support

With more than 150 PrimeServ service stations and service partners worldwide, plus our growing network of PrimeServ Academies, the MAN Diesel & Turbo after-sales organisation is committed to maintaining the most efficient and accessible after-sales organisation in the business.

PrimeServ's aim is to provide:

- prompt delivery of high-demand OEM spare parts within 24 hours
- fast, reliable and competent customer support
- tailored O&M and EMC-pit stop contracts
- ongoing training/qualification of service personnel
- global service 24/7, 365 days a year
- diagnosis and troubleshooting, e.g. via our Online Service concept.

Repair and reconditioning

We carry out repair and reconditioning services on all MAN Diesel & Turbo products at a price negotiated on a case-by-case basis. All work is carried out on the same production facilities as new components, and the resulting quality matches that of new components.

Exchange service

MAN PrimeServ's exchange service has been designed to facilitate the servicing of today's diesel engines. The service is based on the replacement of used units with renovated units during major overhauls. The financial and operational benefits using the service include:

- high level of engine reliability
- sustained high performance
- reduced running costs.

Worldwide Production Network

A strong GenSet market presence

While MAN Diesel & Turbo has its own production capacity at its own plants in Europe, the company also benefits on many fronts from maintaining and developing a large network of licensees.

Cooperation, development and flexibility

A large licensee family offers the extra capacity, enabling MAN Diesel & Turbo to meet market demands it would otherwise be unable to satisfy alone.

The licensees give the products a broader geographical spread, bringing the company and its products and services closer to the customers. Many of these licensed manufacturers are located by the shipyards building the vessels for which the prime movers are destined, facilitating the logistics of transport and installation.

A progressive licensee family also leads to mutual sharing and developing of knowledge and manufacturing experience that ultimately help MAN Diesel & Turbo to adapt and continuously improve its designs. MAN Diesel & Turbo works closely with its licensees and supports them with technical advice, quality assurance and application support.

A number of licensees for MAN Diesel & Turbo's medium speed marine GenSets are located in the following countries and major shipbuilding nations:



China



Croatia



Korea



Poland

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