

L+V51/60G

Four-Stroke gas engine



MAN Diesel





MAN Diesel

The responsible way in leading technology.

MAN Diesel is the world's leading designer and manufacturer of low and medium speed engines. Our involvement with electrical power generators goes back to 1904 when we supplied the first ever diesel generator sets to the Kiev Tram System.

Since those early days, MAN Diesel has never lost its technological pre-eminence in the large engine field. Likewise, our engines have never relinquished their status as the most efficient combustion engines available.

More than ever before, MAN Diesel's development focus is on 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.

With our absolute commitment to reducing emissions while increasing fuel efficiency and power density and, with our active partnership in the emissions law making process, we intend to be part of the global emissions solution.

L+V51/60G

A new class of large bore gas engine.

Based on their intrinsically clean combustion of gases containing methane, high efficiencies, comparatively low emissions of carbon dioxide, the traditionally favourable price of natural gas and the ability to burn renewable and weak gases like sewage, landfill, mine and pyrolysis gases, gas engines continue to claim an increasing share of the market for electrical power generation.

Modern and Innovative

With its newest gas engine, the 51/60G, MAN Diesel is now bringing the typical virtues of gas engines to power and co-generation plants with electrical outputs of 100 to 300 MW, a category previously dominated by gas turbines.

Highest Power Density

The 51/60G is offered in a 9 cylinder inline version and vee configuration versions with 12, 14, and 18 cylinders in a power range from 8,775 to 18,000 kW. These rated outputs – 1,000 kW per cylinder for 60 Hz power generation and 975 kW per cylinder for 50 Hz power generation – give the 51/60G market leading power densities in the gas engine sector.

Further major benefits of the 51/60G include:

- Largest, most powerful gas engine on the market
- The highest efficiencies in the combustion engine field
- Reliable combustion of lean air/gas mixtures
- High and stable ratings in hot and high locations
- Excellent load imposition and low following characteristics
- Low gas admission pressures
- Ease of maintenance

Co-generation or combined cycle

In addition to using thermal energy recovered from engine sources for heating or cooling in co-generation or tri-generation applications, the exhaust heat of the 51/60G engine can also be used to produce steam to drive a steam turbine generator. In this way the overall output and efficiency of the power plant can be increased without additional fuel costs.

Low emissions

At 500 mg NO_x/m³ at 5% O₂ on gaseous fuel, the 51/60G readily achieves emissions of oxides of nitrogen (NO_x), in compliance with Germany's TA Luft clean air regulations and undercuts the limits currently prescribed by the World Bank by a wide margin.

Advanced Ignition Technology

Derived from the extensively proven 48/60 diesel engine platform, the 51/60G uses distillate liquid fuel pilot injection to achieve reliable, low emissions ignition of lean air/gas mixtures in a large (510 mm) bore engine.



The pilot fuel quantity represents about 0,8% of the energy required to achieve the 51/60G engine's standard outputs, contributing to the engine's excellent NO_x emissions.

Gas delivery is via electronically controlled admission valves in the 51/60G's inlet ports.

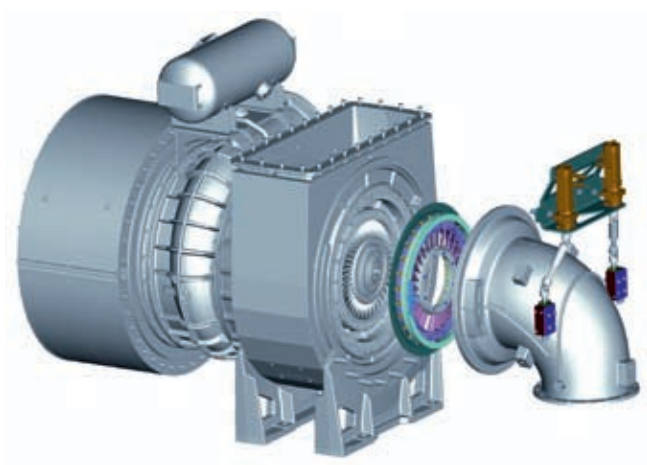
The 51/60G's pilot fuel injection equipment is an electronically controlled, electrically actuated common rail system which allows flexible setting of injection timing, duration and pressure for each cylinder.

This flexibility ensures the reliable ignition of lean air-fuel mixtures while allowing precise balancing of cylinder outputs and rapid response to combustion knock signals on a cylinder-by-cylinder basis.

Advanced variable turbocharging

Contributing to the high efficiency of the 51/60G gas engine is the use of MAN Diesel's VTA Variable Turbine Area turbocharger technology for precise control of the air/fuel ratio.

The VTA system replaces the traditional method of air/fuel ratio control based on charge air by-passing. Where a by-pass system dissipates energy by expelling excess charge air to the atmosphere, the VTA system uses variable nozzle vanes ahead of the turbocharger turbine to precisely match the charge air output of the compressor to the engine's demand for intake air.



Technical illustration of VTA (Variable Turbine Area).

Synonymous with Highest Output

Which lies between 8,775 and 18,000 kW_m.

Basic Engine Features – MAN Diesel has all the major elements of engine technology in house. All engine parts are designed and constructed with the aim of achieving the highest reliability, ease of maintenance and longest possible TBOs*.

Engine frame

Rigid housing of single-cast monobloc construction, strengthened by tie bolts running from the suspended main bearing through to the top edge of the engine frame and from the cylinder head through to the intermediate bottom.

Cylinder liner

Thick-walled design isolated from external deformation, resulting in optimum running conditions for the piston.

Cylinder head

Combustion chamber geometry optimised for combustion of gas. Atomisation of the injection spray – without obstacles – promotes very good air-fuel ratio for optimum combustion.

Rocker arm casing

Weight-reduced design facilitating fast removal for overhaul and service of injection nozzles.

Stepped piston

Forged, dimensionally stable steel crown (with shaker cooling by oil), made from high-grade materials with skirt in nodular graphite iron. Chromium ceramic coating of the first piston ring with highly resistant ceramic particles in the ring surface, resulting in low wear of ring and liner.

Connecting rod and bearing

Optimised “marine head” design to allow piston overhaul without removal of the connecting rod bearing cap. Specially designed bearing shells in the connecting rod for increased reliability.

Valves

Exhaust gas valves with propellers on the shaft for self-turning effect in the exhaust gas stream and seating in armoured, water-cooled valve seats, resulting in low valve temperatures. The inlet valves are equipped with Rotocap mechanical rotators.

Service-friendly design

Hydraulic tools used for tightening and loosening cylinder head nuts; clamps with quick release fasteners and/or clamp and plug connectors; generously sized access covers; hydraulic tools for crankshaft bearings and big end bearings; sleeve spring vibration damper is practically maintenance-free.

SaCoS_one

The 51/60G engine is equipped with the safety and control system SaCoS_one. SaCoS_one guarantees reliable engine operation with an optimum operation range between knocking and misfiring. All cylinders are regulated individually.

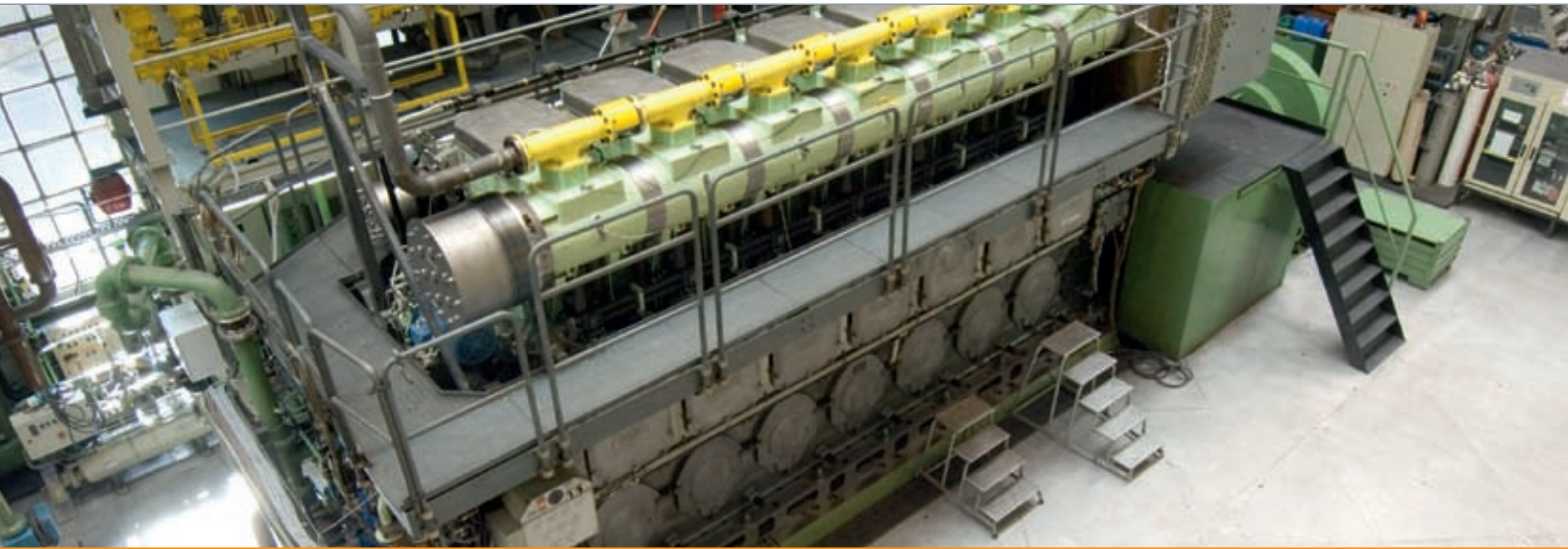
Cooling

The 51/60G features single-stage engine cooling, two-stage charge air cooling and intensive cooling of the pilot fuel injectors.

*TBO = Time Between Overhaul

L+V51/60G Technical Data

Overview.



Four-stroke gas engines V51/60G and L51/60G

General

Engine cycle: four-stroke

Turbocharging system: constant pressure

Number of cylinders, L-engine: 9

Number of cylinders, V-engines: 12, 14, 18

Bore: 510 mm

Stroke: 600 mm

Swept volume per cylinder: 122.6 dm³

Cylinder output (MCR)

at 514 rpm, 60 Hz: 1,000 kW_m

at 500 rpm, 50 Hz: 975 kW_m

Starting

Compressed air

General definition of gas 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%

Specific fuel consumption, GenSet (5% tolerance)

Gas plus liquid fuel pilot injection:

7,708 kJ/kWh_e / 7,500 kJ/kWh_m (NO_x optimised)

7,430 kJ/kWh_e / 7,230 kJ/kWh_m (Efficiency optimised)

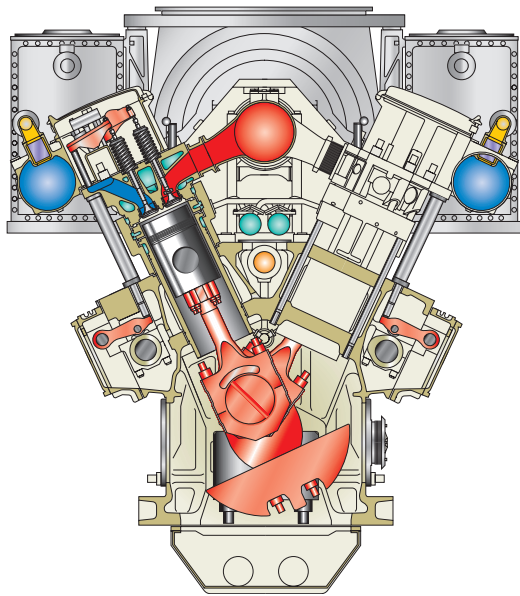
Lube oil consumption (20% tolerance)

9L51/60G: 4.5 kg/h

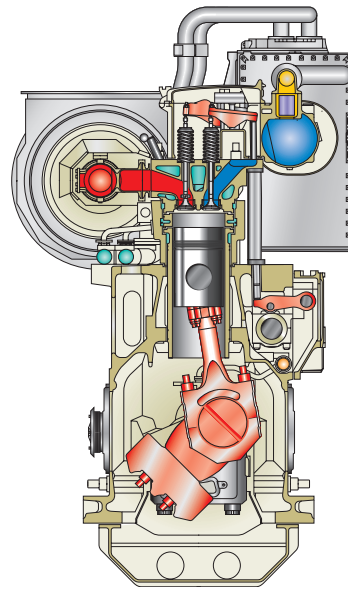
12V51/60G: 6.0 kg/h

14V51/60G: 7.0 kg/h

18V51/60G: 9.0 kg/h



Four-stroke engine V51/60G



Four-stroke engine L51/60G

GenSet output * (kW_e)

		500 1/min, 50 Hz kW _e	514 1/min, 60 Hz kW _e
9L51/60G	9 cyl.	8,538	8,757
12V51/60G	12 cyl.	11,384	11,676
14V51/60G	14 cyl.	13,282	13,622
18V51/60G	18 cyl.	17,076	17,514
Mean piston speed		10.0 m/s	10.3 m/s
Mean effective pressure		19.1 bar	19.1 bar

* Alternator Efficiency: 97.3%

Electrical power quoted depends on alternator make.
 Power and consumption may vary according to set-up conditions.
 Engines comply with the TA Luft guidelines for thermal power plants.
 The stated consumption figures refer to the above mentioned ISO reference conditions. The heat rate for gas operation refers to a LHV of 28 MJ/Nm³.

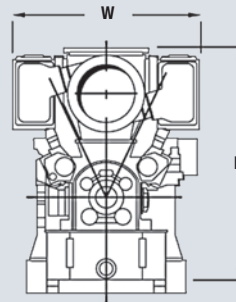
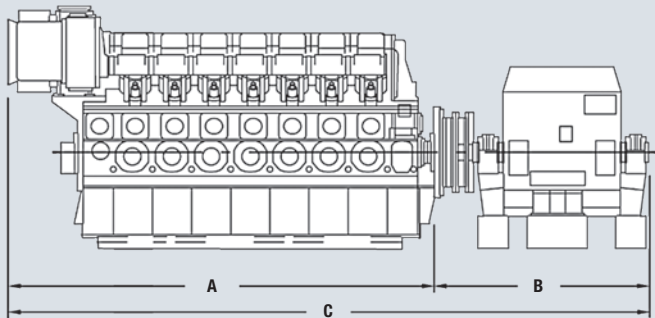
Ratings are given with a tolerance of +5% and without engine-driven pumps. Figures for gas engines refer to natural gas with a methane number higher than 80.

The specific lube oil consumption is specified at MCR with a tolerance of 20%.

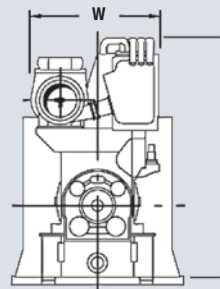
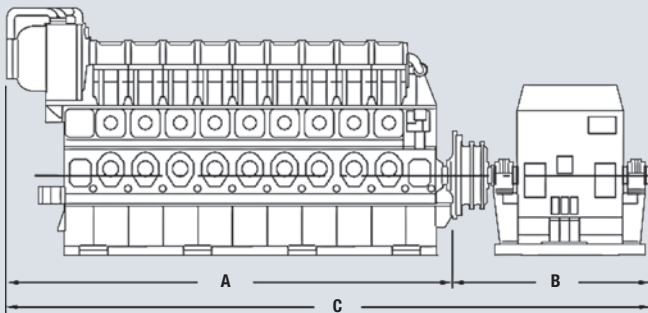
Dimensions and Weights

All cylinder numbers.

V51/60G



L51/60G



Engine L+V51/60G

Engine type	No. of cyl.	A mm	B mm	C mm	W mm	H mm	Dry mass* t
9L51/60G	9	10,545	4,805	15,350	2,970	6,030	221
12V51/60G	12	9,835	4,950	14,785	4,700	6,530	271
14V51/60G	14	10,835	5,150	15,985	4,700	6,530	312
18V51/60G	18	13,148	5,410	18,558	4,700	6,530	373

World Class Service

Our eyes on your plant.



PrimeServ – peace of mind for life

With more than 100 PrimeServ service stations and service partners worldwide and our growing network of PrimeServ Academies, the MAN Diesel after-sales organisation is committed to maintaining the most efficient, accessible after-sales organisation in the business. PrimeServ's aim is to provide:

- Prompt, OEM-standard service for the complete life cycle of an installation
- Tuition and qualification of service personnel at our PrimeServ Academies to maximize the availability and viability of a plant
- Rapid, global availability of genuine, 100% quality-assured MAN Diesel spare parts via local outlets or our 24 hour hotline.

Power Management by MAN Diesel

Complementing the PrimeServ after-sales offering is the MAN Diesel Power Management concept.

Power Management packages provide integrated support solutions for all aspects of the running of a power or co-generation plant. Individually negotiated agreements can cover assistance with – or delegation of – the management of all mechanical, electrical and thermal equipment. In this way the power plant operator gains comprehensive access to the technology, experience, best practices and professional resources of MAN Diesel.

In short: Power Management by MAN Diesel allows you to benefit from our specialist expertise in running a power plant while you concentrate on your own core business.



MAN Diesel SE

86224 Augsburg, Germany

Phone +49 821 322-3897

Fax +49 821 322-1460

powerplant@mandiesel.com

www.mandiesel.com