48/60
Four-stroke diesel engine
MAN Diesel & Turbo 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 & Turbo 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 & Turbo’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 firm commitment to reducing emissions while increasing fuel efficiency and power density, and with our active partnership with environmental institutions and development banks, we intend to be part of the global emissions solution.
Both economical and environmentally friendly, the 48/60 is a prime mover in the truest sense. With a power output range of 9,450 to 18,900 kW, this reliable, high-output engine is the four-stroke heart of medium and large diesel power plants the world over.

Reliable power output
The 48/60 engine can be run on heavy oil with a viscosity up to 700 mm²/s (cSt) at 50°C. It is designed for fuel qualities up to the levels specified in CIMAC 2003 H/K700/DIN ISO 8217. In fact, the engine is capable of continuous operation on heavy oil in an output range of 20 per cent to 100 per cent. For brief periods, it can even operate below 20 per cent.

For engines driving a generator, in accordance with DIN ISO 8528-1, a 10 per cent overload is allowed for a brief period for governing purpose (e. g. suddenly applied load) to prevent frequency drop.

Rugged engine block
The engine is housed in a rigid monobloc frame, further strengthened by continuous tie rods. These run from the underslung main bearing to the top edge of the engine frame, and from the cylinder head through the intermediate plate.

Cylinder liner with fire ring
The thick-walled design provides high resistance to deformation, preventing cavitation. This leads to better piston performance and a longer service life. Cooling at the top of the liner ensures uniform temperature distribution over the entire surface.

Stepped piston
The forged dimensionally stable steel crown (with shaker cooling) is made from high-grade materials, while the skirt is constructed from spheroidal graphite cast iron (skirt also available in steel upon request), to provide superior durability.

Both the stepped piston and fire ring prevent combustion residue accumulating on the piston crown and cylinder liner. In combination with chromium ceramic coating of the first piston ring and chromium coating of the second and third piston rings, this minimises wear of the cylinder liner and reduces lubricating oil consumption.

Cylinder head and durable valves
Designed for safe, high ignition pressures, the cylinder head is equipped with effective bore cooling. All valves are armoured to reduce wear, and the exhaust valve seats are water-cooled. The exhaust valves have an exhaust-driven rotor, while the inlet valves are rotated using rotocaps, keeping the valve seat clean.

Sophisticated fuel injection
High-pressure injection with improved atomisation ensures good combustion with any fuel quality. The injection system has been designed for lower fuel consumption and lower emissions.

Connecting rod and bearing
The marine head design, with a joint in the upper shaft, allows piston overhaul without removal of the connecting rod bearing. A low piston height also makes overhaul easier. Optimised bearing shells in the connecting rod increase reliability.

Improved design
To make the 48/60 even better, the design has been enhanced. Improvements include better combustion chamber geometry, a higher density ratio, and more accurate injection and valve timing. All of these features reduce fuel consumption and improve ignition, even with poor fuel qualities.
Top turbochargers
The constant pressure turbocharging system uses state-of-the-art MAN Diesel & Turbo TCA series turbochargers, with long-bearing overhaul intervals. Their high efficiency at full and part loads ensures thorough combustion with low thermal stress and no residue.

48/60 V-engines are charged by a single TCA turbocharger, with the advantage that the cylinders share a single exhaust line. A new turbocharger module with integrated intercoolers significantly reduces the engine centres between two adjacent V-engines.

Service-friendly design
A number of features make servicing the 48/60 easy:
- Hydraulic tools for tightening and loosening cylinder head nuts, and for the crankshaft and big-end bearings;
- Clamps with quick-release fasteners and/or clamp and plug connectors;
- Generously sized access covers;
- A practically maintenance-free sleeve spring vibration damper.

SaCoS for enhanced safety
On request, all MAN Diesel & Turbo medium-speed engines, including the L48/60, can be equipped with the SaCoS safety and control system. This system is tested at the factory together with the engine, making fine tuning and functional testing easier and smoother when the power unit is commissioned.

Low exhaust emissions
As with all MAN Diesel & Turbo engines, 48/60 engines comply with World Bank guidelines for exhaust emissions. Even lower NOx emissions can be achieved to fulfill worldwide emission standards for specific plants. For example, engines can be equipped with MAN’s advanced selective catalytic reduction (SCR) technology.
The more thorough the combustion, the lower the particle emissions. MAN Diesel & Turbo’s highly efficient engines produce particle emission rates well below the World Bank guidelines, provided that fuel with low ash content is used.

48/60 Technical Data
Overview

Engine cycle: four-stroke
Turbocharging system: constant-pressure

Number of cylinders
In-line engine: 9
V-engine: 12, 14, 18
Bore: 480 mm
Stroke: 600 mm
Swept volume per cyl.: 108.6 dm³

Cylinder output (MCR)
at 514 rpm: 1,050 kW
at 500 rpm: 1,050 kW

Cooling
Cylinder cooling: cooling water
Charge-air cooler (two-stage): fresh water
Fuel injector cooling: fresh water

Starting method
compressed air

Emissions
The engines comply with the World Bank guidelines for thermal power plants.

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

Ambient conditions according to ISO 3046-1:2002
The stated consumption figures refer to the following reference conditions according to ISO 3046-1:
- Ambient air pressure: 1,000 mbar
- Ambient air temperature: 25°C (77°F)
- Charge air temperature: According to engine type, corresponding to 25°C cooling water temperature before charge air cooler.
The SFOC figures for engines in diesel operation are based on a lower calorific value of the fuel of 42,700 kJ/kg.

Figures are given with a tolerance of 5 per cent, except for the lubricating oil consumption, which is given with a tolerance of 20 per cent.
Dimensions and Weights

V48/60 four-stroke diesel engine

Power output (maximum continuous rating)

<table>
<thead>
<tr>
<th>Engine type</th>
<th>No. of cyl.</th>
<th>Engine (kW)</th>
<th>Generating set (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9L48/60</td>
<td>9 cyl.</td>
<td>9,450</td>
<td>9,191</td>
</tr>
<tr>
<td>12V48/60</td>
<td>12 cyl.</td>
<td>12,600</td>
<td>12,310</td>
</tr>
<tr>
<td>14V48/60</td>
<td>14 cyl.</td>
<td>14,700</td>
<td>14,362</td>
</tr>
<tr>
<td>18V48/60</td>
<td>18 cyl.</td>
<td>18,900</td>
<td>18,465</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Engine speed</th>
<th>50/60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean piston speed</td>
<td>10.0/10.3 m/s</td>
</tr>
<tr>
<td>Mean effective pressure</td>
<td>23.2/22.6 bar</td>
</tr>
</tbody>
</table>

Nominal generator efficiencies: L-type: 97.3%, V-type: 97.7%

Electric genset heat rate at 100% load

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Engine speed</th>
<th>Specific lubricating oil consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>L48/60 (WB 1998)</td>
<td>37 °C</td>
<td>gr/kWh: 0.5</td>
</tr>
</tbody>
</table>

Specific lubricating oil consumption

<table>
<thead>
<tr>
<th>Engine type</th>
<th>g/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>L48/60 (WB 1998)</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Dimensions and Weights

<table>
<thead>
<tr>
<th>Engine type</th>
<th>No. of cyl.</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>W (mm)</th>
<th>H (mm)</th>
<th>Wt. (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9L48/60</td>
<td>9</td>
<td>10,545</td>
<td>4,805</td>
<td>15,350</td>
<td>2,970</td>
<td>5,780</td>
<td>223</td>
</tr>
<tr>
<td>12V48/60</td>
<td>12</td>
<td>9,835</td>
<td>4,950</td>
<td>14,785</td>
<td>4,700</td>
<td>6,250</td>
<td>273</td>
</tr>
<tr>
<td>14V48/60</td>
<td>14</td>
<td>10,835</td>
<td>5,150</td>
<td>15,985</td>
<td>4,700</td>
<td>6,250</td>
<td>314</td>
</tr>
<tr>
<td>18V48/60</td>
<td>18</td>
<td>13,148</td>
<td>5,410</td>
<td>18,558</td>
<td>4,700</td>
<td>6,530</td>
<td>375</td>
</tr>
</tbody>
</table>

All weights and dimensions apply only to dry engines without a flywheel. More information available upon request.

L48/60 four-stroke diesel engine
World Class Service
Expert advice and assistance

PrimeServ – peace of mind for life
With more than 150 PrimeServ service stations and service partners worldwide and our growing network of PrimeServ Academies, MAN Diesel & Turbo 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 maximise the plant’s availability and viability
- Rapid, global availability of genuine, quality-assured MAN Diesel & Turbo spare parts via local outlets or our 24 hour hotline.

PowerManagement by MAN Diesel & Turbo
Complementing the PrimeServ after-sales offering is the MAN PowerManagement concept.

MAN PowerManagement packages provide integrated support solutions for all aspects of running 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. This gives the power plant operator comprehensive access to the technology, experience, best practices and professional resources of MAN Diesel & Turbo.

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