MC-C Engine Description

Please note that engines built by our licensees are in accordance with MAN Diesel & Turbo drawings and standards but, in certain cases, some local standards may be applied; however, all spare parts are interchangeable with MAN Diesel & Turbo designed parts.

Some components may differ from MAN Diesel & Turbo's design because of local production facilities or the application of local standard components.

In the following, reference is made to the item numbers specified in the 'Extent of Delivery' (EoD) forms, both for the 'Basic' delivery extent and for some 'Options'.

Bedplate and Main Bearing

The bedplate is made with the thrust bearing in the aft end of the engine. The bedplate consists of high, welded, longitudinal girders and welded cross girders with cast steel bearing supports.

For fitting to the engine seating in the ship, long, elastic holding-down bolts, and hydraulic tightening tools are used.

The bedplate is made without taper for engines mounted on epoxy chocks.

The oil pan, which is made of steel plate and is welded to the bedplate, collects the return oil from the forced lubricating and cooling oil system. The oil outlets from the oil pan are vertical as standard and provided with gratings.

Horizontal outlets at both ends can be arranged for some cylinder numbers, however, this must be confirmed by the engine builder.

The main bearings consist of thin walled steel shells lined with bearing metal. The main bearing bottom shell can be rotated out and in by means of special tools in combination with hydraulic tools for lifting the crankshaft. The shells are kept in position by a bearing cap.

Frame Box

The frame box is of triangular plate welded or rib design. On the exhaust side, it is provided with relief valves for each cylinder while, on the manoeuvring side, it is provided with a large hinged door for each cylinder. The crosshead guides are welded onto the frame box.

The frame box is bolted to the bedplate. The bedplate, frame box and cylinder frame are tightened together by stay bolts.

Cylinder Frame and Stuffing Box

The cylinder frame is either welded or cast and is provided with access covers for cleaning the scavenge air space, if required, and for inspection of scavenge ports and piston rings from the manoeuvring side. Together with the cylinder liner, it forms the scavenge air space.

The cylinder frame is fitted with pipes for the piston cooling oil inlet. The scavenge air receiver, turbocharger, air cooler box, lubricators and gallery brackets are located on the cylinder frame. At the bottom of the cylinder frame there is a piston rod stuffing box, provided with sealing rings for scavenge air. Oil scraper rings in the stuffing box prevent crankcase oil from coming up into the scavenge air space.

Drains from the scavenge air space and the piston rod stuffing box are located at the bottom of the cylinder frame.

Cylinder Liner

The cylinder liner is made of alloyed cast iron and is suspended in the cylinder frame with a low-situated flange. The top of the cylinder liner is fitted with a cooling jacket. The cylinder liner has scavenge ports and drilled holes for cylinder lubrication.

Cylinder liners prepared for installation of temperature sensors is basic execution on engines type 90 while an option on all other engines.

Cylinder Cover

The cylinder cover is of forged steel, made in one piece, and has bores for cooling water. It has a central bore for the exhaust valve, and bores for the fuel valves, a starting valve and an indicator valve.

The cylinder cover is attached to the cylinder frame with studs and nuts tightened with hydraulic jacks.

Crankshaft

The crankshaft is mainly of the semi-built type, made from forged or cast steel throws. In engines with 9 cylinders or more the crankshaft is supplied in two parts.

At the aft end, the crankshaft is provided with the collar for the thrust bearing, and the flange for the turning wheel and for the coupling bolts to an intermediate shaft.

At the front end, the crankshaft is fitted with the collar for the axial vibration damper and a flange for the fitting of a tuning wheel. The flange can also be used for a Power Take Off, if so desired.

Coupling bolts and nuts for joining the crankshaft together with the intermediate shaft are not normally supplied.

Thrust Bearing

The propeller thrust is transferred through the thrust collar, the segments, and the bedplate, to the end chocks and engine seating, and thus to the ship's hull.

The thrust bearing is located in the aft end of the engine. The thrust bearing is of the B&W-Michell type, and consists primarily of a thrust collar on the crankshaft, a bearing support, and segments of steel lined with white metal.

Engines type 60 and larger with 9 cylinders or more will be specified with the 360° degree type thrust bearing, while the 240° degree type is used in all other engines. MAN Diesel & Turbo's flexible thrust cam design is used for the thrust collar on a range of engine types.

The thrust shaft is an integrated part of the crankshaft and lubricated by the engine's lubricating oil system.

Turning Gear and Turning Wheel

The turning wheel is fitted to the thrust shaft and driven by a pinion on the terminal shaft of the turning gear, which is mounted on the bedplate. The turning gear is driven by an electric motor with built-in gear with brake.

A blocking device prevents the main engine from starting when the turning gear is engaged. Engagement and disengagement of the turning gear is effected manually by an axial movement of the pinion.

The control device for the turning gear, consisting of starter and manual control box, can be ordered as an option.

Axial Vibration Damper

The engine is fitted with an axial vibration damper, mounted on the fore end of the crankshaft. The damper consists of a piston and a split-type housing located forward of the foremost main bearing.

The piston is made as an integrated collar on the main crank journal, and the housing is fixed to the main bearing support.

For functional check of the vibration damper, a mechanical guide is fitted, while an electronic vibration monitor can be supplied as an option.

Tuning Wheel/ Torsional Vibration Damper

A tuning wheel or torsional vibration damper may have to be ordered separately, depending on the final torsional vibration calculations.

Connecting Rod

The connecting rod is made of forged steel or cast and provided with bearing caps for the crosshead and crankpin bearings.

The crosshead and crankpin bearing caps are secured to the connecting rod with studs and nuts tightened by means of hydraulic jacks.

The crosshead bearing consists of a set of thin-walled steel shells, lined with bearing metal. The crosshead bearing cap is in one piece, with an angular cut-out for the piston rod.

The crankpin bearing is provided with thin-walled steel shells, lined with bearing metal. Lube oil is supplied through ducts in the crosshead and connecting rod.

Piston

The piston consists of a piston crown and piston skirt. The piston crown is made of heat-resistant steel. A piston cleaning ring located in the very top of the cylinder liner scrapes off excessive ash and carbon formations on the piston topland.

The piston has four ring grooves which are hard-chrome plated on both the upper and lower surfaces of the grooves. The uppermost piston ring is of the Controlled Pressure Relief type (CPR), whereas the other three piston rings all have an oblique cut. All four rings are alu-coated on the outer surface for running-in.

The piston skirt is made of cast iron with a bronze band or Mo coating.

Piston Rod

The piston rod is of forged steel and is surface-hardened on the running surface for the stuffing box. The piston rod is connected to the crosshead with four bolts. The piston rod has a central bore which, in conjunction with a cooling oil pipe, forms the inlet and outlet for cooling oil.

Crosshead

The crosshead is of forged steel and is provided with cast steel guide shoes of low-friction design with white metal on the running surface.

The telescopic pipe for oil inlet and the pipe for oil outlet are mounted on the guide shoes.

Scavenge Air System

The air intake to the turbocharger takes place directly from the engine room through the turbocharger intake silencer. From the turbocharger, the air is led via the charging air pipe, air cooler and scavenge air receiver to the scavenge ports of the cylinder liners, see Chapter 14. The scavenge air receiver on engines type 65 is of the D-shape design.

Scavenge Air Cooler

For each turbocharger a scavenge air cooler of the mono-block type is fitted. The cooler is designed as a central cooling system cooled by freshwater of maximum 4.5 bar working pressure. Alternatively, a seawater cooling system with up to 2.0 - 2.5 bar working pressure can be chosen.

The scavenge air cooler is so designed that the difference between the scavenge air temperature and the water inlet temperature at specified MCR can be kept at about 12 °C.

Auxiliary Blower

The engine is provided with electrically-driven scavenge air blowers. The suction side of the blowers is connected to the scavenge air space after the air cooler.

Between the air cooler and the scavenge air receiver, non-return valves are fitted which automatically close when the auxiliary blowers supply the air.

The auxiliary blowers will start operating consecutively before the engine is started in order to ensure sufficient scavenge air pressure to obtain a safe start.

Further information is given in Chapter 14.

Exhaust Gas System

From the exhaust valves, exhaust gas is led to the exhaust gas receiver where the fluctuating pressure from the individual cylinders is equalised, and the total volume of gas is led further on to the turbocharger(s). After the turbocharger(s), the gas is led to the external exhaust pipe system.

Compensators are fitted between the exhaust valves and the receiver, and between the receiver and the turbocharger(s).

The exhaust gas receiver and exhaust pipes are provided with insulation, covered by galvanised steel plating.

A protective grating is installed between the exhaust gas receiver and the turbocharger.

Exhaust Turbocharger

The engines can be fitted with either MAN, ABB or MHI turbochargers. As an option, MAN TCA turbochargers can be delivered with variable nozzle technology that reduces the fuel consumption at part load by controlling the scavenge air pressure.

The turbocharger selection is described in Chapter 3, and the exhaust gas system in Chapter 15.

Camshaft and Cams

The camshaft consists of a number of sections each having a shaft piece with exhaust cams, fuel cams, coupling parts and indicator drive cams.

The exhaust cams and fuel cams are made of steel, with a hardened roller race, and are shrunk onto the shaft. They can be adjusted and dismantled hydraulically.

The cam for the indicator drive can be adjusted mechanically. The coupling parts are shrunk onto the shaft and can be adjusted and dismantled hydraulically.

The camshaft bearings consist of one lower half-shell fitted in a bearing support. The camshaft is lubricated by the main lubricating oil system.

Chain Drive

The camshaft is driven from the crankshaft by a chain drive, which is kept running tight by a manually adjusted chain tightener. The long free lengths of chain are supported by rubber-clad guidebars and the chain is lubricated through oil spray pipes fitted at the chain wheels and guidebars.

The mechanical cylinder lubricators, if fitted, are driven from the camshaft by a separate chain.

Indicator Drive

As separate options, the engine can be supplied with either an indicator drive, a mechanical indicator system, or the so-called PMI system, a pressure analyser system, described in section 18.02.

The indicator drive consists of a cam fitted on the camshaft and a spring-loaded spindle with a roller which moves up and down in accordance with the movement of the piston within the engine cylinder. At the top, the spindle has an eye to which the indicator cord is fastened after the indicator has been installed on the indicator valve.

Governor

The engine is to be provided with a governor of a make approved by MAN Diesel & Turbo, controlling the fuel pump through an actuator. The governor must meet the ISO 3046 standard, part IV, 1997.

The speed setting of the actuator is determined by an electronic signal from the electronic governor based on the position of the main engine regulating handle. The actuator is connected to the fuel regulating shaft by means of a mechanical linkage. Alternatively for engines type 46 without PTO, a mechanical/hydraulic Woodward governor for pneumatic speed setting could be provided.

Fuel Oil Pump and Fuel Oil High Pressure Pipes

The engine is provided with one fuel pump for each cylinder. The fuel pump consists of a pump housing of nodular cast iron, a centrally placed pump barrel, and a plunger of nitrated steel. In order to prevent fuel oil from mixing with the lubricating oil, the pump actuator is provided with a sealing arrangement.

The pump is placed on the roller guide housing and activated by the fuel cam. The volume injected is controlled by turning the plunger by means of a toothed rack connected to the regulating shaft.

For optimal combination of NO_x and SFOC, the fuel pumps incorporate Variable Injection Timing (VIT). The VIT uses the governor fuel setting as the controlling parameter.

The fuel oil pump is provided with a puncture valve, which prevents high pressure from building up during normal stopping and shut down.

The roller guide housing is provided with a semi-automatic (optional on engines type 70, 60 and 50) lifting device which, during rotation of the engine, can lift the roller guide free of the cam. On 46 types, a separate tool is used to lift the roller guide.

The fuel oil high-pressure pipes are either double-walled or of the hose type.

Further information is given in Section 7.01.

Fuel Valves and Starting Air Valve

Each cylinder cover is equipped with two or three fuel valves, starting air valve (SAV), and indicator valve.

The opening of the fuel valves is controlled by the high fuel oil pressure created by the fuel oil pump, and the valves are closed by a spring. The fuel valves are cooled by the fuel.

An automatic vent slide allows circulation of fuel oil through the valve and high pressure pipes when the engine is stopped. The vent slide also prevents the compression chamber from being filled up with fuel oil in the event that the valve spindle sticks. Oil from the vent slide and other drains is led away in a closed system.

The starting air valve is opened by control air from the starting air distributor and is closed by a spring. The control air supply is regulated so that the starting valves deliver starting air to the cylinders in the correct firing order.

Starting Air System

The starting air system comprises a main starting valve, one or two starting air distributors (one only on 46 types) and a non-return valve, a bursting disc for the branch pipe and a starting valve on each cylinder. The main starting valve is connected with the manoeuvring system, which controls the start of the engine.

A slow turning valve can be ordered as an option. The slow-turning function is actuated manually from the manoeuvring console.

The starting air system is described in detail in Section 13.01.

Exhaust Valve

The exhaust valve consists of the valve housing and the valve spindle. The valve housing is made of cast iron and is arranged for water cooling. The housing is provided with a water cooled bottom piece of steel with a flame-hardened seat of the W-seat design.

The exhaust valve spindle is a DuraSpindle or made of Nimonic. The housing is provided with a spindle guide.

The exhaust valve is tightened to the cylinder cover with studs and nuts. It is opened hydraulically and closed by means of air pressure. The hydraulic system consists of a piston actuator placed on the roller guide housing, a high-pressure pipe, and a working cylinder on the exhaust valve. The piston actuator is activated by a cam on the camshaft.

In operation, the valve spindle slowly rotates, driven by the exhaust gas acting on small vanes fixed to the spindle.

Sealing of the exhaust valve spindle guide is provided by means of Controlled Oil Level (COL), an oil bath in the bottom of the air cylinder, above the sealing ring. This oil bath lubricates the exhaust valve spindle guide and sealing ring as well.

Cylinder Lubrication

The cylinder lubrication system can be of either the electronic MAN B&W Alpha cylinder lubrication system or a mechanical type.

The cylinder lubrication systems are described in detail in Chapter 9.

Manoeuvring System

The engine is provided with a pneumatic/electric manoeuvring and fuel oil regulating system. The system transmits orders from the separate manoeuvring consoles to the engine.

The regulating system makes it possible to start, stop, reverse the engine and control the engine speed. The speed control on the manoeuvring console gives a speed-setting signal to the governor, dependent on the desired number of revolutions.

At shut-down, the fuel injection is stopped by the puncture valves in the fuel pumps being activated, independently of the speed control. At reversing**,** the displaceable rollers in the driving mechanism for the fuel pumps are moved to the 'Astern' position by air cylinders controlled by the starting air distributor.

The engine is provided with an engine side mounted console and instrument panel.

Reversing

On reversible engines (with Fixed Pitch Propellers mainly), reversing of the engine is performed by means of an angular displaceable roller in the driving mechanism for the fuel pump of each engine cylinder. The reversing mechanism is activated and controlled by compressed air supplied to the engine.

The exhaust valve gear is not to be reversed.

Gallery Arrangement

The engine is provided with gallery brackets, stanchions, railings, platforms (exclusive of ladders). The brackets are placed at such a height as to provide the best possible overhauling and inspection conditions.

The engine is prepared for top bracings on the exhaust side, or on the manoeuvring side.

Piping Arrangements

The engine is delivered with piping arrangements for:

- Fuel oil
- Heating of fuel oil pipes
- Lubricating oil, piston cooling oil and camshaft lubrication
- Cylinder lubricating oil
- Cooling water to scavenge air cooler
- Jacket and turbocharger cooling water
- Cleaning of scavenge air cooler
- Cleaning of turbocharger
- Fire extinguishing in scavenge air space
- Starting air
- Control air
- Safety air
- Oil mist detector (required only for make Schaller Automation)
- Various drain pipes.

All piping arrangements are made of steel piping, except the control air, safety air and steam heating of fuel pipes, which are made of copper.

The pipes are provided with sockets for local instruments, alarm and safety equipment and, furthermore, with a number of sockets for supplementary signal equipment. Chapter 18 deals with the instrumentation.