The Electronically Controlled Engine

General Data

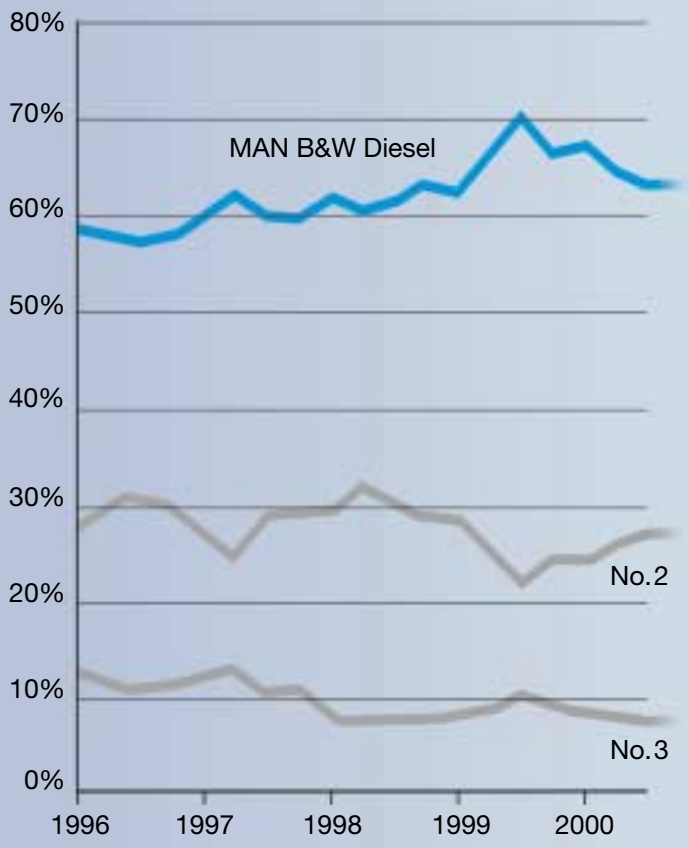
With the introduction of the electronically controlled engine (the **ME** engine), MAN B&W Diesel is offering an engine with reduced running costs, better emission characteristics and a high degree of flexibility in terms of operating modes.

The ME engine is based on the well-proven MC engine models developed over the last twenty years, and is the first electronically controlled engine design in service, having run since November 2000 with excellent results.

The ME engine secures better emission characteristics.

Low Speed Marine Propulsion

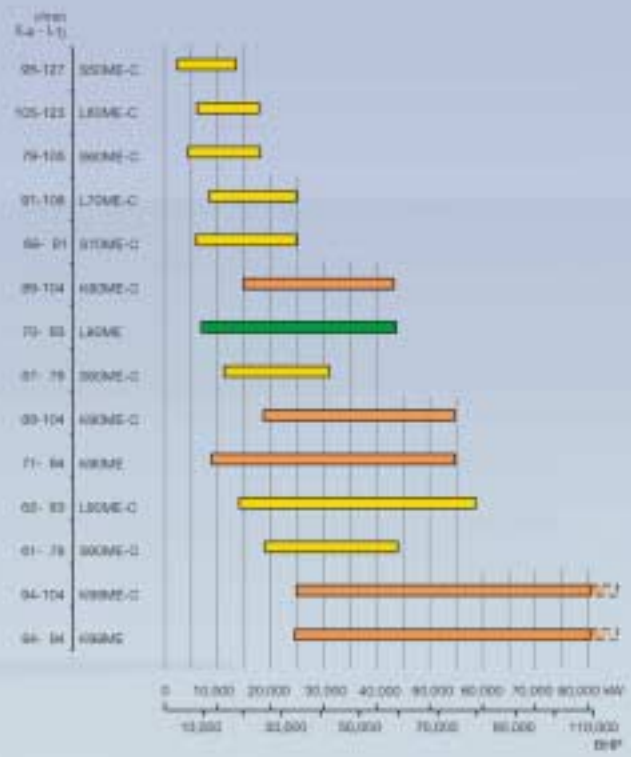
Worldwide market shares – Deliveries
% BHP



115 million bhp of MC/MC-C engines sold

A full programme of ME engines for every application

The ME* Programme



*) Electronically controlled

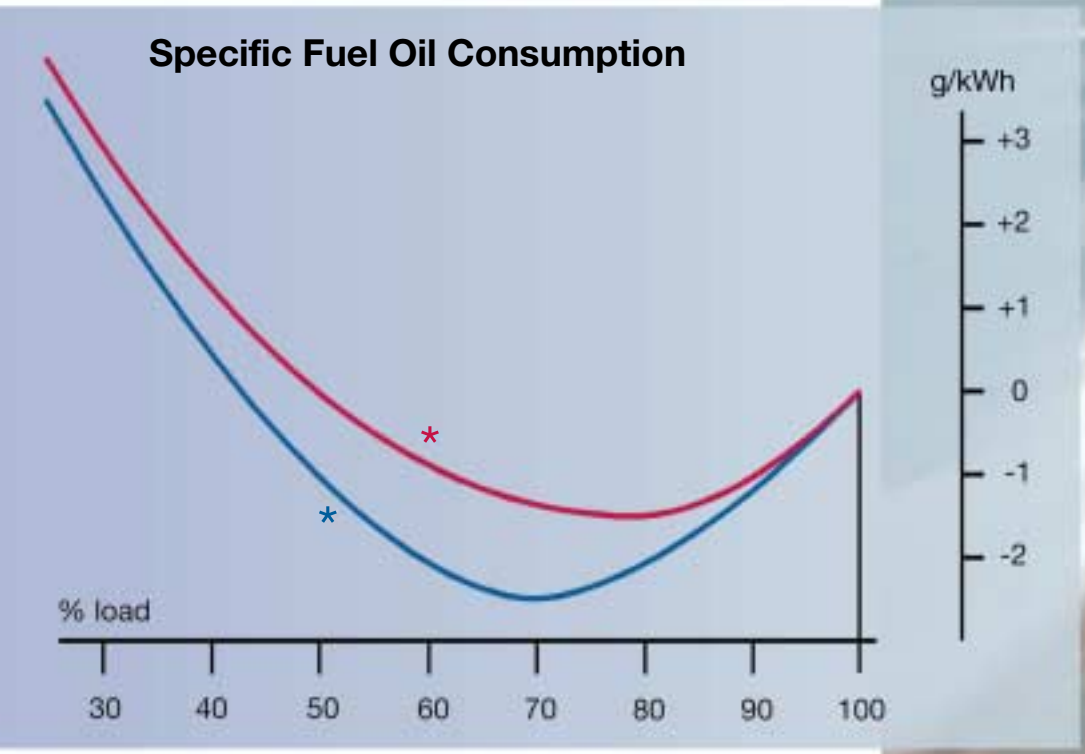
Advantages with the ME Concept

Power, speed and nominal Specific Fuel Oil Consumption (SFOC) are the same for the ME series as for their MC counterparts.

The SFOC has been reduced significantly at part load as the maximum pressure can be maintained down to 65-70 percent of the engine load.

- The ME series is available from 50 cm bore to 98 cm bore
- SFOC is the same as for the mechanically controlled engines at nominal output
- At lower load, the SFOC is lower for the electronically controlled engines
- The layout diagrams are the same for the MC and the ME versions
- Easy to change between various running modes.

Specific Fuel Oil Consumption

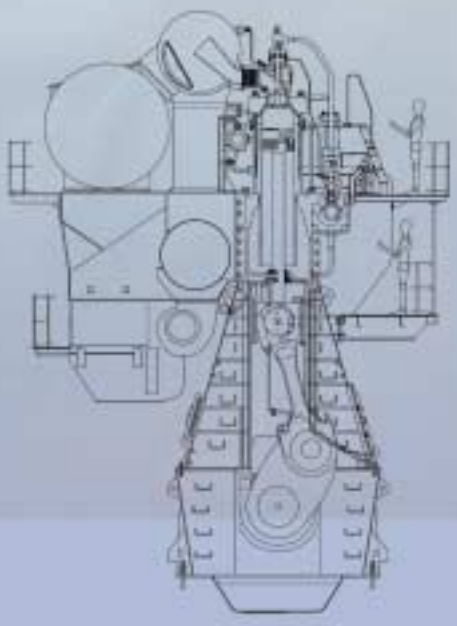


* MC-C optimized in L_1 with VIT
* ME-C

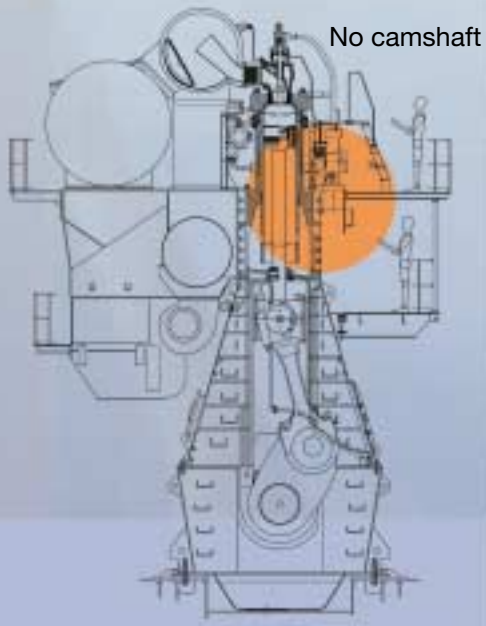
Exactly the same basis for MC and ME engines

Exactly the same basis

MC engine
Conventional engine



ME engine
With electronic control



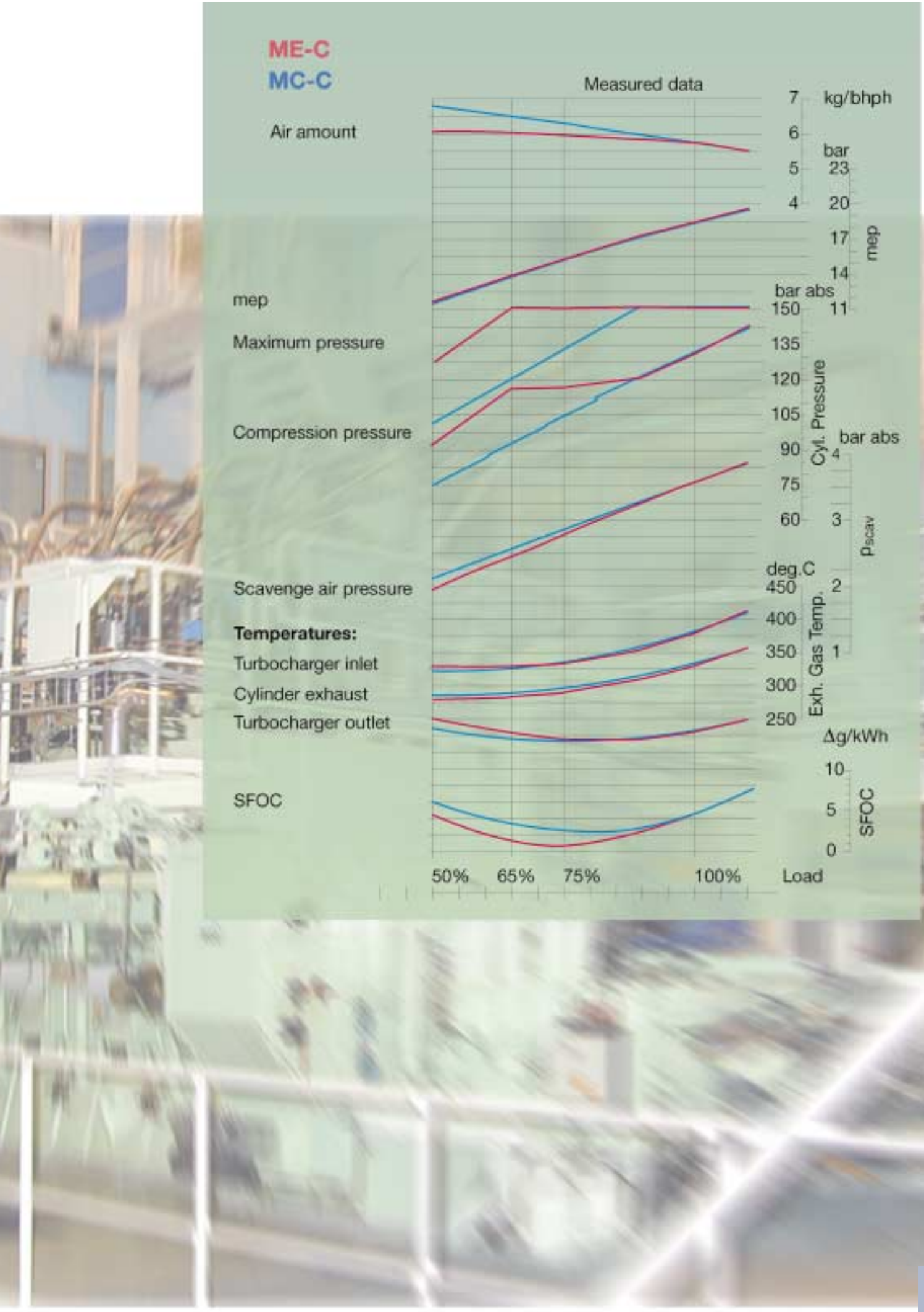
Functional Principles and Advantages of the ME Concept

The ME series of engines have no camshaft. Instead, to provide power for fuel injection and exhaust valve lifting, they utilise a hydraulic oil loop with fine filtered oil from the main engine lubricating system at about 200 bar pressure.

The loop for heavy fuel oil is retained, as on mechanically controlled engines, i.e. individual plunger type fuel pumps with hydraulic activation. Hence, no fuel oil will enter the precision fast-acting control valves in the hydraulic oil control loop.

This system makes it possible to model any injection pattern (including the one used in common rail systems) for optimum rate shaping.

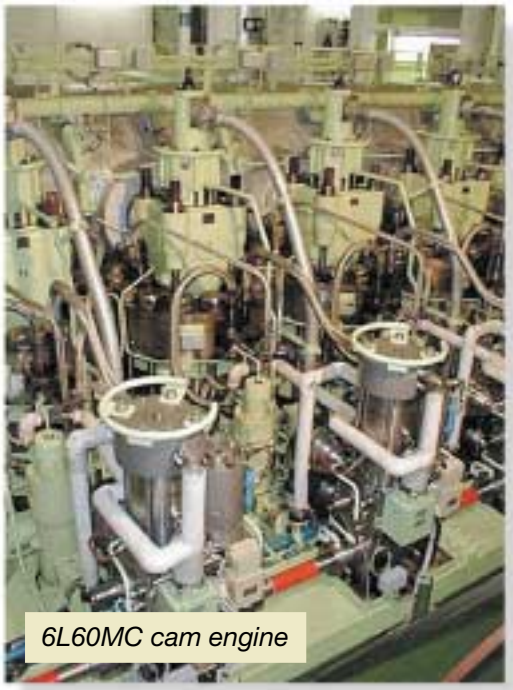
The advantages of the ME series of engines come from the fact that the timing and intensity of fuel oil injection and exhaust valve opening and closing is optimal at all steady and transient loads, thus giving lower part load fuel oil consumption, lower emissions and particularly smoother and better low load operation. The balance between cylinders will be easier to adjust for smoother operation. All this will eventually mean longer MTBO (Mean Time Between Overhauls).


ME-C
MC-C
Measured data
Air amount
kg/bhph
7
6
5
4
bar
23
20
17
14
mep
mep
bar abs
Maximum pressure
150
135
120
105
90
75
60
Cyl. Pressure
Compression pressure
bar abs
4
3
2
1
Pscav
Scavenge air pressure
deg.C
450
400
350
300
250
Exh. Gas Temp.
Temperatures:
Turbocharger inlet
Cylinder exhaust
Turbocharger outlet
Δg/kWh
10
5
0
SFOC
SFOC
50%
65%
75%
100%
Load

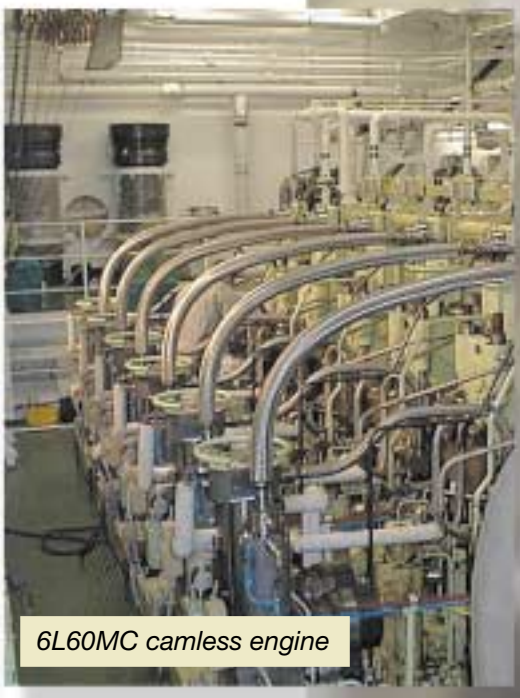
Verification Test of the ME Engines

After a number of years of preparation, system development and testing, MAN B&W started tests at sea late in year 2000 by rebuilding an existing engine, a 6L60MC originally built by Hitachi, to electronic/hydraulic control of fuel pump timing, injection intensity and opening and closing the exhaust valves.

The camshaft was left in place, but with the roller guides lifted. A parallel bank of fuel pumps and exhaust valve actuators with hydraulic activation was installed.



6L60MC cam engine



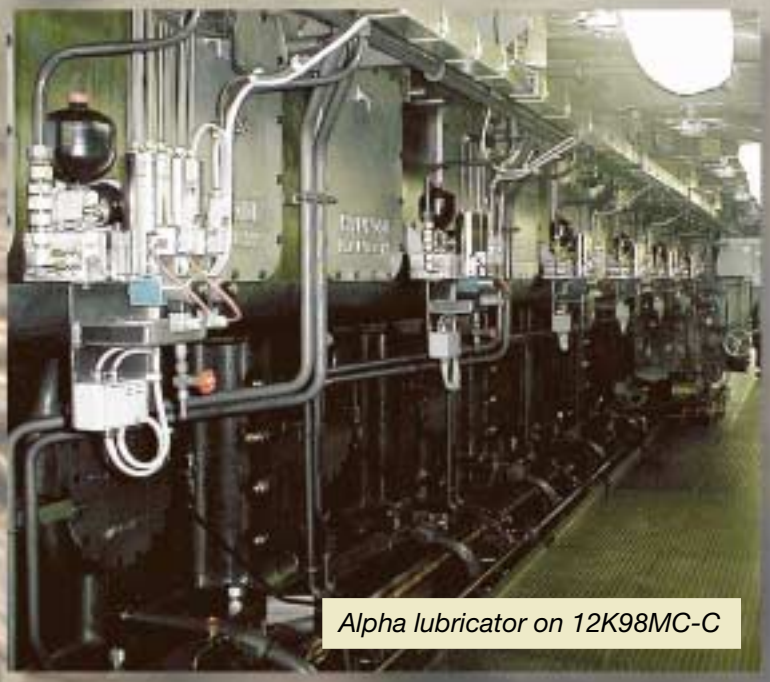
6L60MC camless engine

Advantages and Flexibility regarding Exhaust Gas Emissions:

- The engine can be changed over to different 'low emission modes' where its NO_x exhaust emission can be reduced below the IMO limits if desirable due to local emission regulations

- Typical smoke values for the most recent generation of MAN B&W engines are so low that the exhaust plume will be invisible, unless water vapour condenses in the plume, producing a gray or white colour. However, the NO_2 may give the plume a yellowish appearance.

  The cylinder oil feed rate also has an impact on the particulate emission. Tests show that when the cylinder oil feed rate is reduced, the particulate emission is also reduced. As an example, on a power plant in Puerto Rico, the cylinder lube oil feed rate was reduced to meet the local EPA rules on emission.



Alpha lubricator on 12K98MC-C

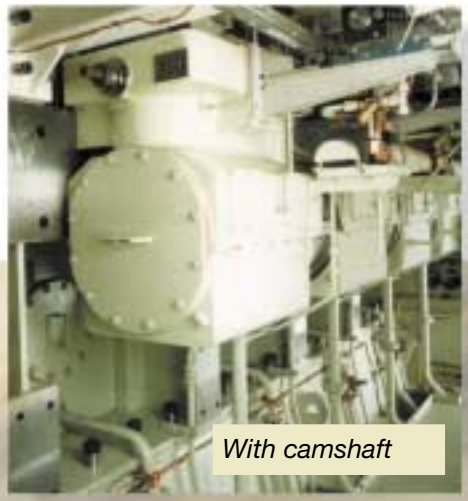
Benefits and Advantages of the ME Concept

The electronic control of the fuel injection system and the exhaust valve operation, together with the fact that ME engines are normally delivered with on-line cylinder pressure measurement equipment and the engine diagnosis system CoCoS-EDS, provides a number of benefits:

- Well-proven conventional fuel injection pattern and technology
- Adjustable injection intensity by electronically variable cam “angle” and cam “length”
- The control system offers more precise timing and thereby better engine balance with equalized thermal load in and between cylinders
- Uniform combustion and heat load at any load
- Lower rpm possible for manoeuvring
- Sequential cylinder cut-off at low load
- High injection pressure at low load
- Slide type zero-sack-volume fuel valves
- Improved emission characteristics, i.e. lower NO_x and less visible smoke at any load
- System comprising performance monitoring for longer time between overhauls.

Operational safety and flexibility:

- Monitoring of the engine (based on CoCoS-EDS) identifies running conditions which could lead to performance problems
- The Overload Protection System ensures compliance with the load diagram and ensures that the engine is not overloaded
- Since “as new” running conditions for the engine are maintained, maintenance costs will be lower (and maintenance easier). The engine diagnosis system indicates faults at an early time
- Optimum crash stop and reverse running performance
- “Engine braking” may be obtained, reducing the stopping distance of the vessel
- Faster acceleration of the engine by opening the exhaust valves earlier during acceleration
- Significantly improved dead slow running with low minimum rpm and stable operation together with improved combustion due to the electronic control of fuel injection



With camshaft

Without camshaft

- Low specific fuel oil consumption: 114 g/bhph of ME engines
- Layout flexibility, and revolutions down to 12 r/min. (6L60ME – Bow Cecil)
- Optimal combination of cylinder wear and cylinder oil consumption
- Competitive first cost. High value for the investment
- Reliable maintenance cost with well-proven key components

MAN B&W Diesel A/S

Teglholmsgade 41
DK-2450 Copenhagen SV
Telephone: +45 33 85 11 00
Telex: 16592 manbw dk
Telefax: +45 33 85 10 30
E-mail: manbw@manbw.dk
www.manbw.dk

MAN B&W Diesel A/S
Reg. No.: 39 66 13 14
P.387- 02.01