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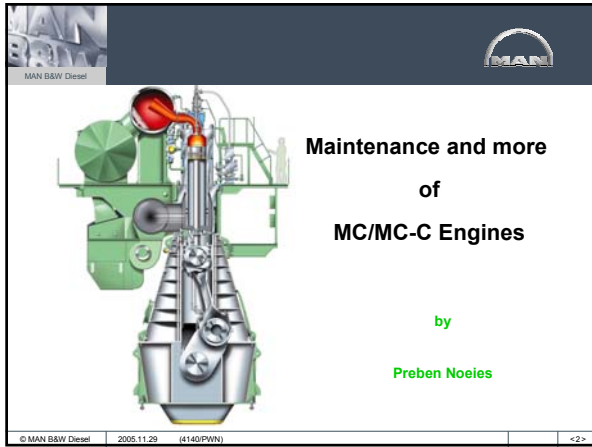
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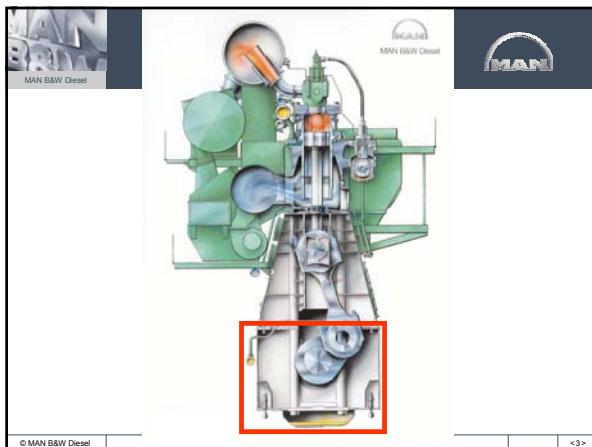
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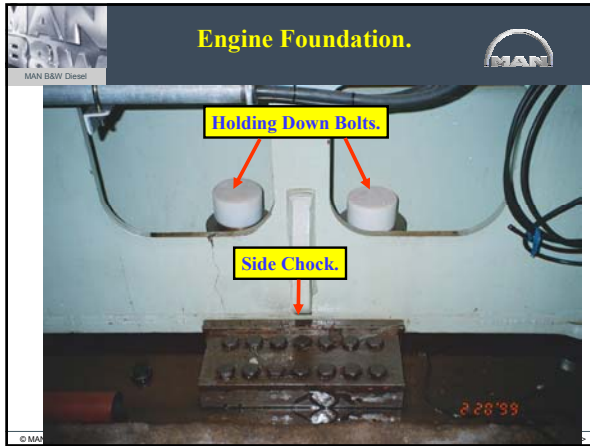
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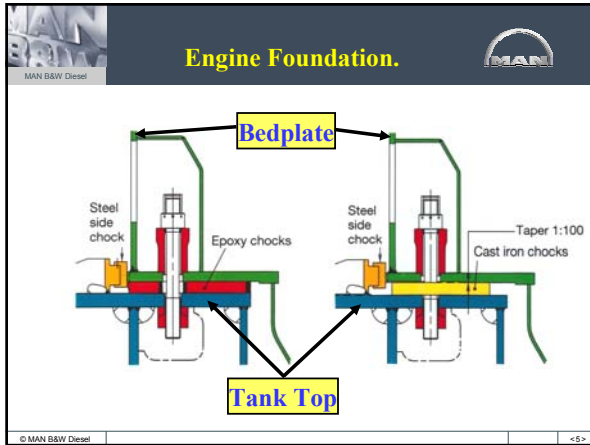
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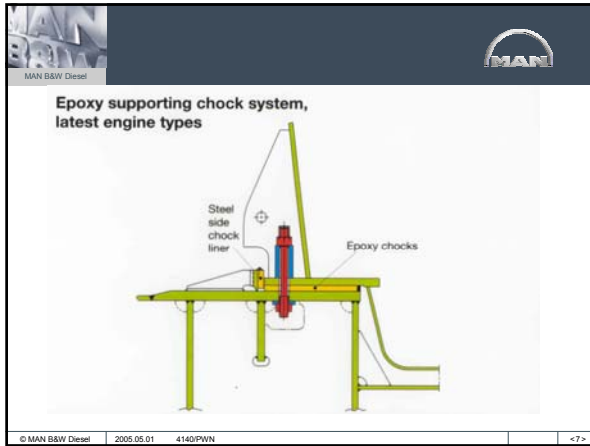
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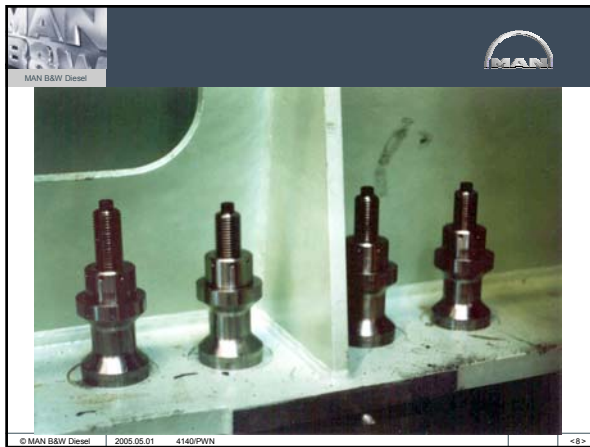
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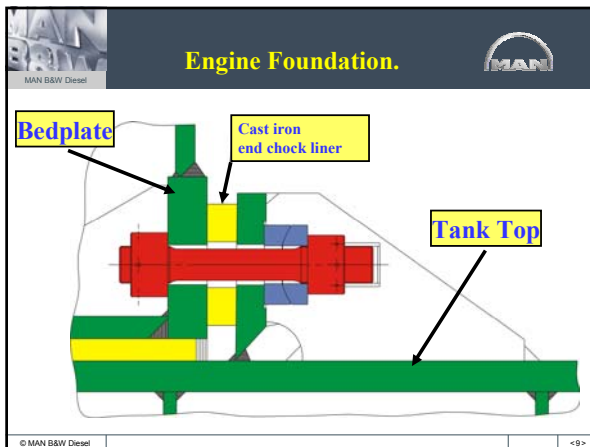
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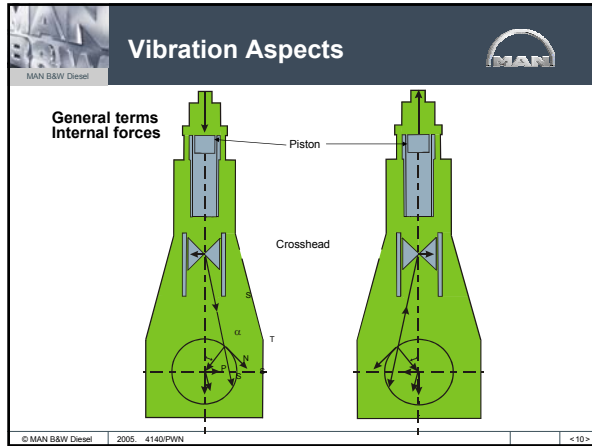
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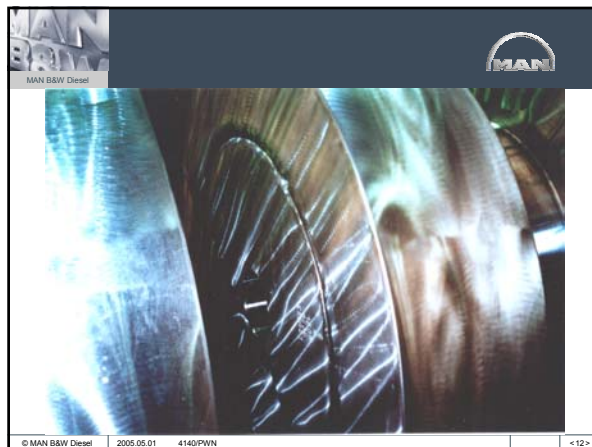
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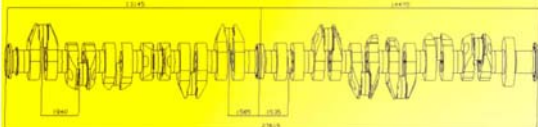
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MAN B&W Diesel

**MAN**

### Crankshaft



		12K98MC-C	12K108MC
Total	tons	412	542
Fore	tons	216	255
Aft	tons	196	287
Total length	mm	25,195	27,615

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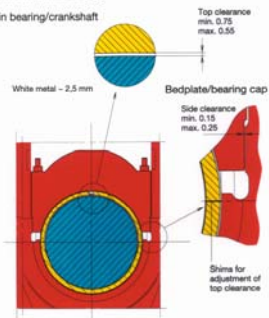
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MAN B&W Diesel

**MAN**

### S80MC Main bearing

Main bearing/crankshaft



White metal - 2.5 mm

Bedplate/bearing cap

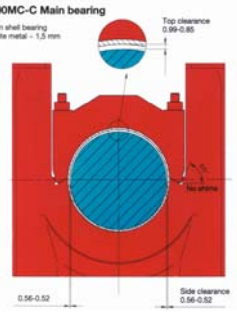
Side clearance min. 0.15 max. 0.25

Shims for adjustment of top clearance

Top clearance min. 0.25 max. 0.55

### K90MC-C Main bearing

Thin shell bearing white metal - 1.0 mm



Top clearance 0.99-0.85

Side clearance 0.56-0.52

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MAN B&W Diesel

**MAN**

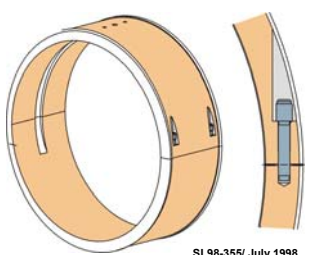
### Design Features

#### Main bearings

Thick shell design, vertical guide pins

Vertical guide pins introduced, avoiding misalignment and oil scraper edges

Future spare bearings will be of revised design and delivered as a set. The set is fully exchangeable with previous designs



SL98-355/ July 1998

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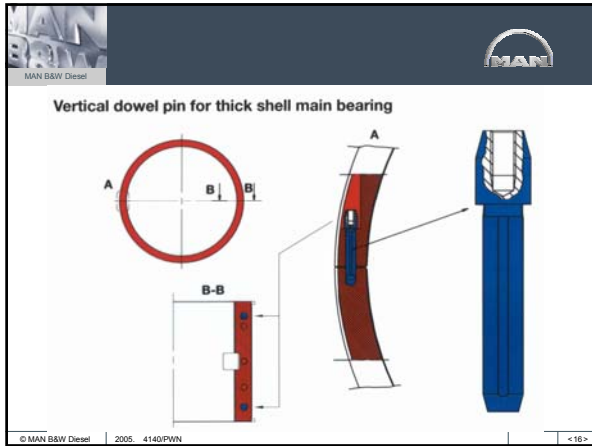
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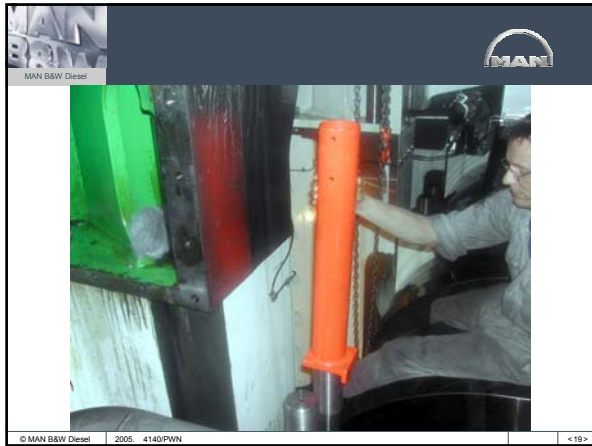
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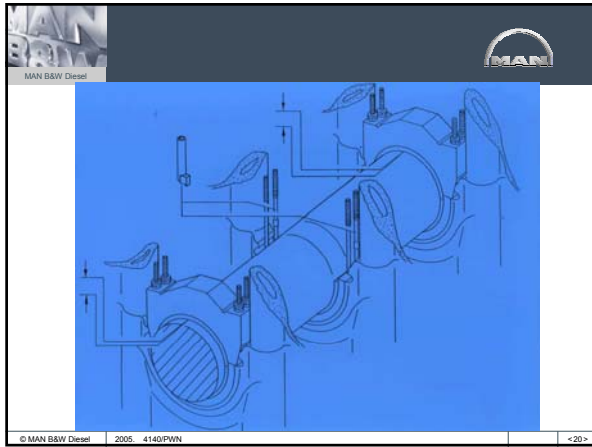
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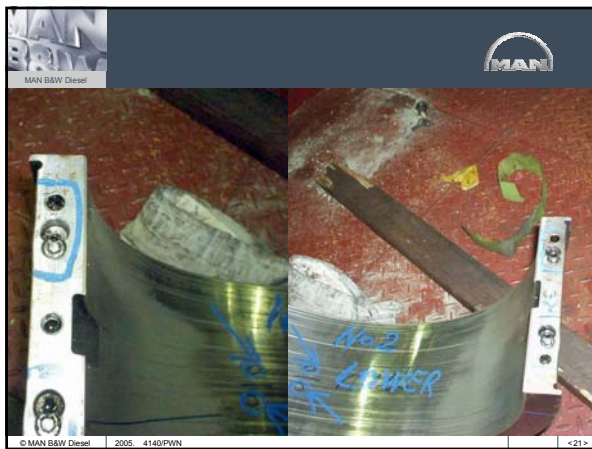
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**Main Bearing.**

MAN B&W Diesel

MAN

The Flex-Edge bearing is fully interchangeable with previous types and provides an increased margin against fatigue damage occurring in the edge area.

*MBD-C supply*

Ensures always latest design (flex-edge)

A → A →  
A-A

C → C →  
C-C

**New design**

**Previous design**

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**Flex Edge Main Bearing.**

MAN B&W Diesel

MAN

**Flex Edge Bearing Shell**

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**Flex Edge Main Bearing.**

MAN B&W Diesel

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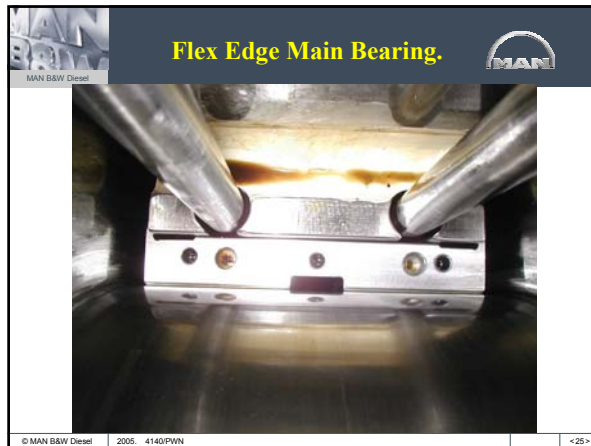
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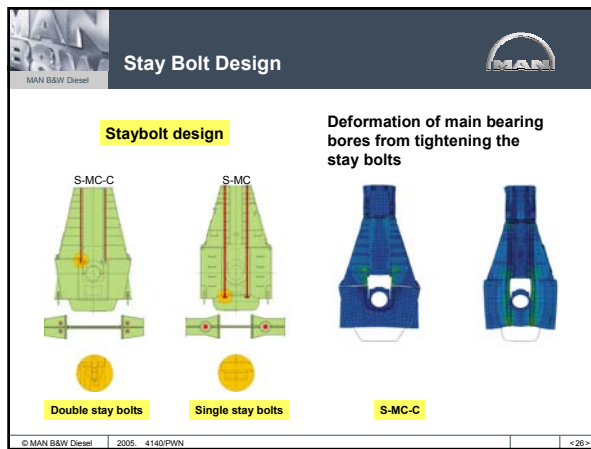
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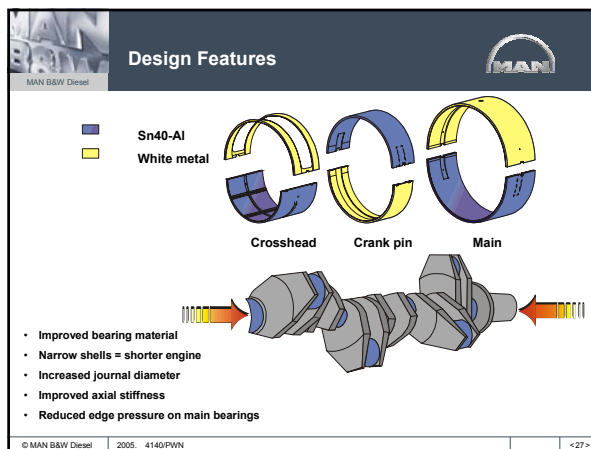
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MAN B&W Diesel

## Main Bearings

MAN

**A: Previous design**  
Original design for the MC engines  
(S50-80MC, L50-70MC, K90MC)

Design updates secure  
reliable performance

**B: Thin shell design**  
Introduced on the small bore MC,  
later on the MC-Compact and  
K98MC/MC-C, S80/90MC-C  
L90MC-C, K80/90MC-C  
L80MC engines

Good experience  
Reliable design

SL98-355/SBJ July 1998

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MAN B&W Diesel

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MAN B&W Diesel

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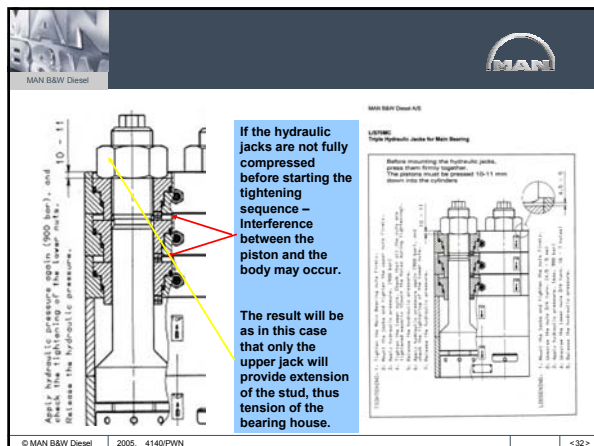
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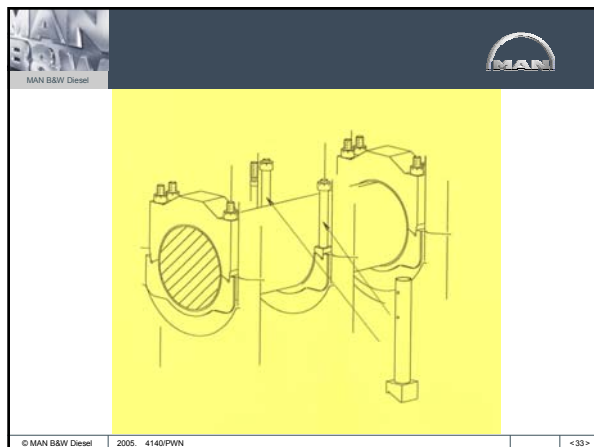
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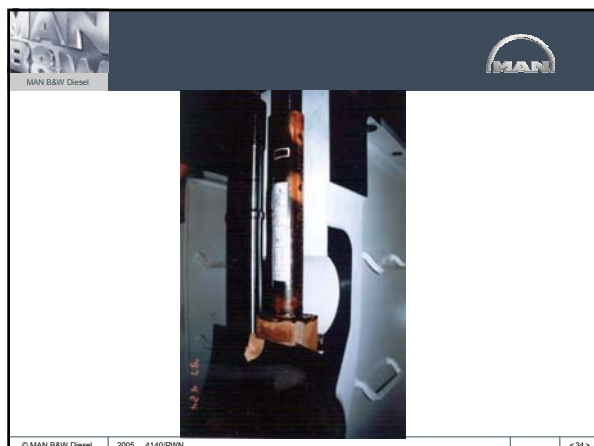
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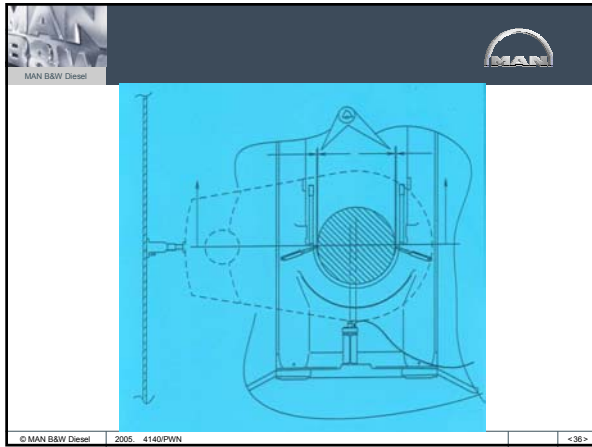
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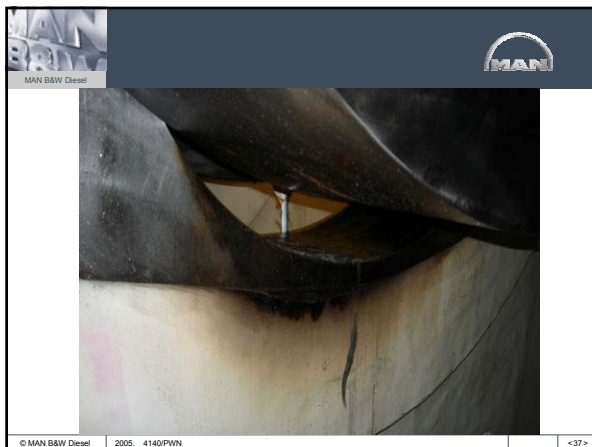
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**Earthing Device**

MAN B&W Diesel

**Spark erosion in main bearings**

Bronze: Propeller = +

Potential difference <math>< 50 \text{ mV}</math>

Main bearing

Current Earthing device

Steel: Hull  
= +  
Intermediate shaft  
Propeller shaft

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**Axial Vibration Damper.**

MAN B&W Diesel

**Traditional Excitation Technique**  
Axial vibration

Radial force

Equivalent forces

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**Axial Vibration Damper.**

MAN B&W Diesel

Damper House

Sealing rings

Front End.

Main Bearing #1

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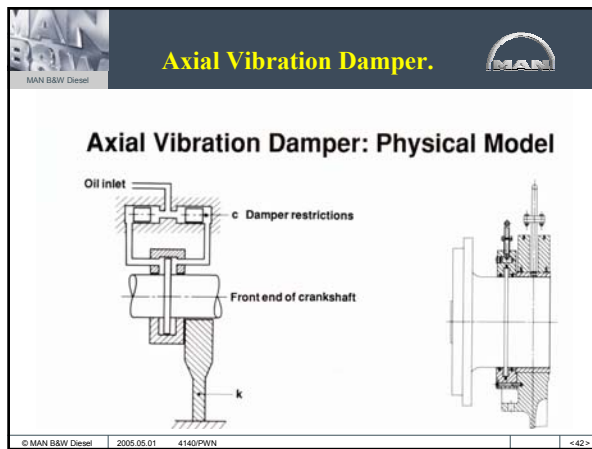
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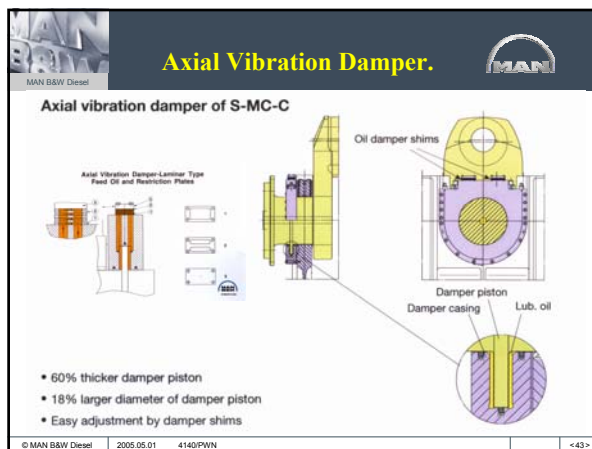
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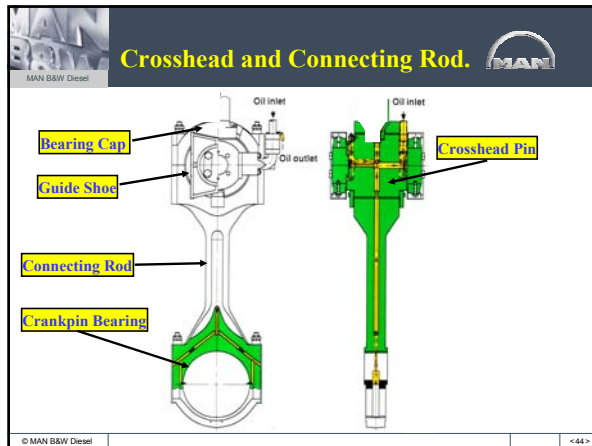
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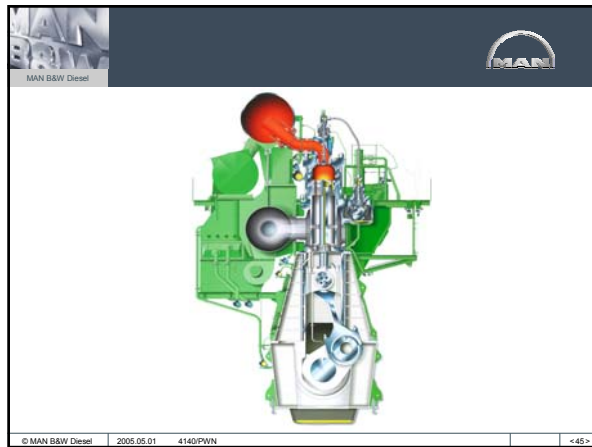
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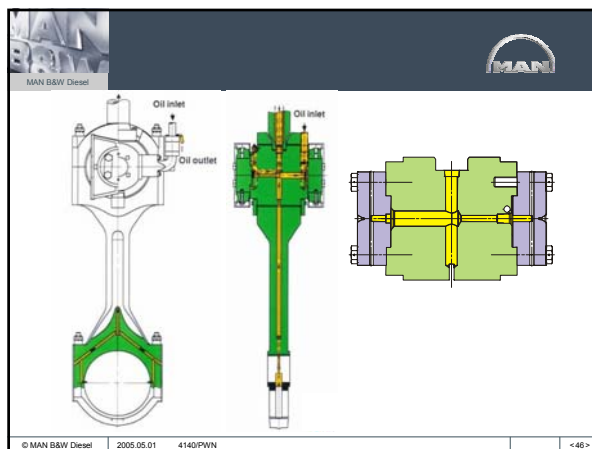
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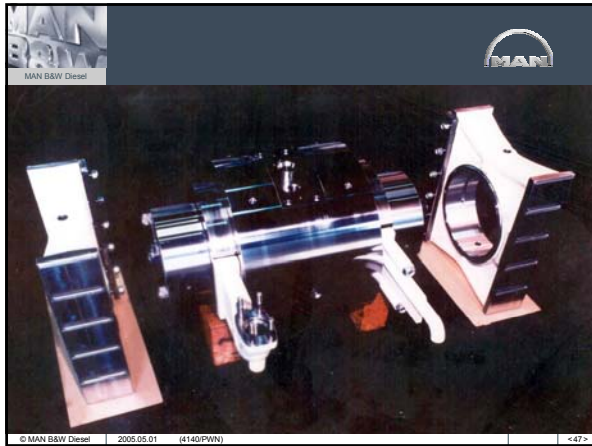
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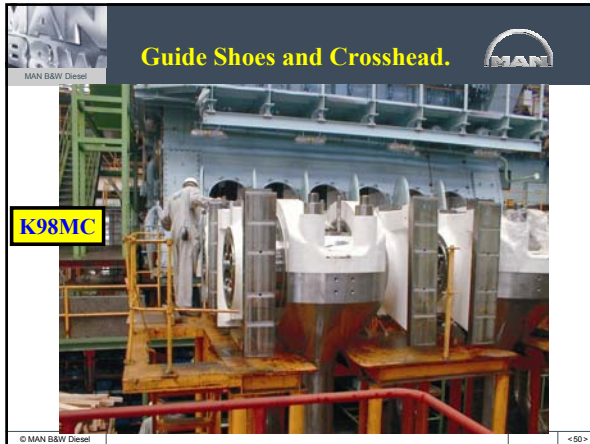
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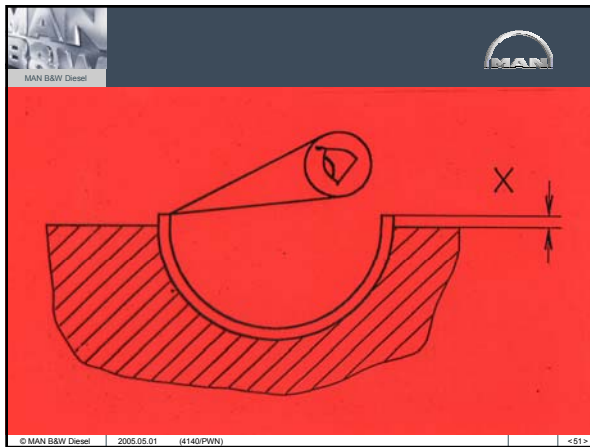
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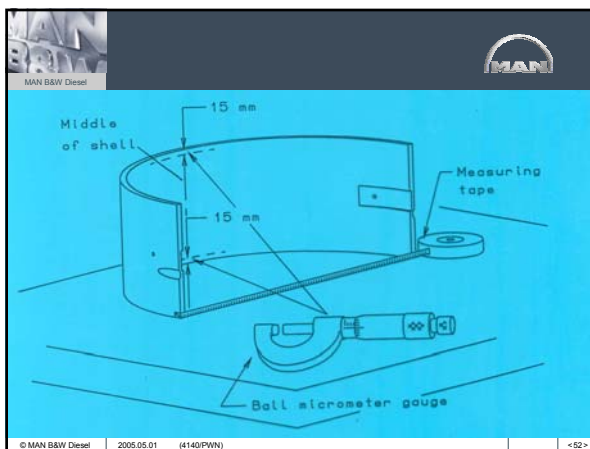
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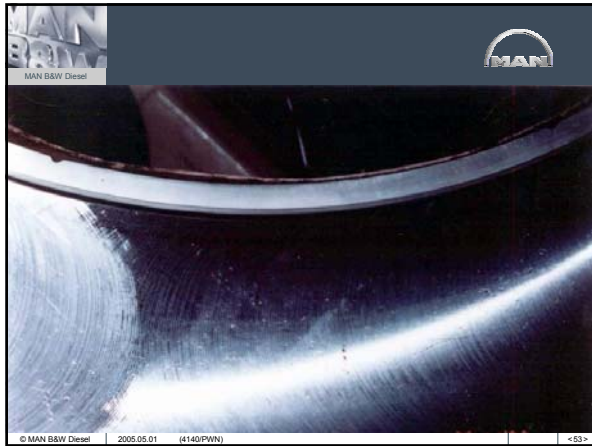
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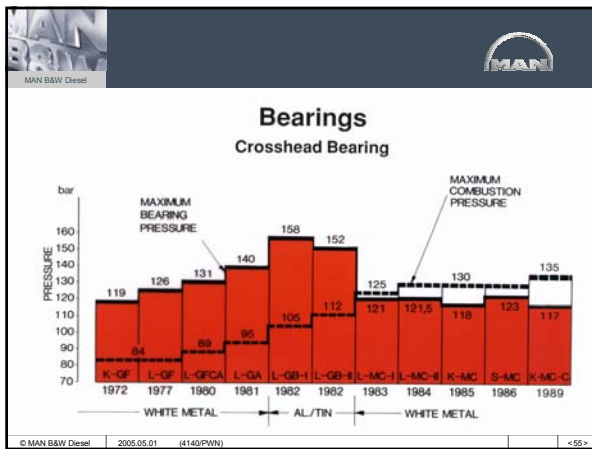
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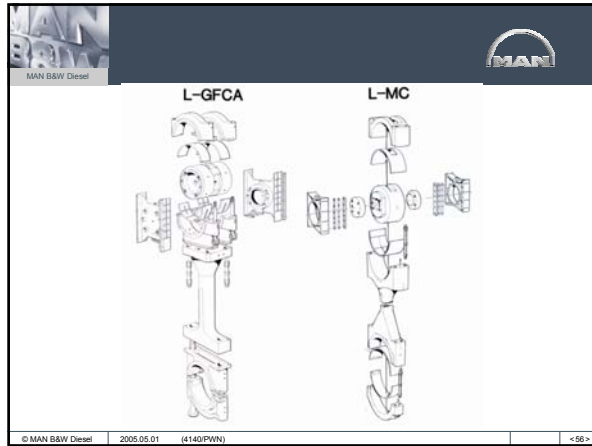
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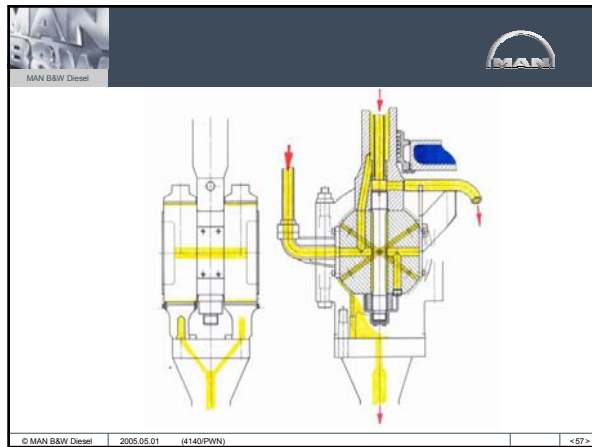
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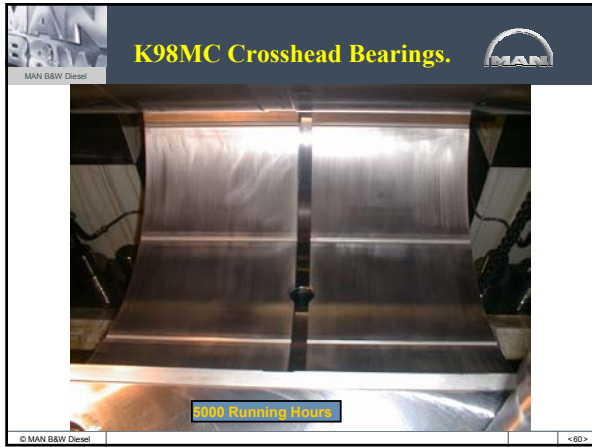
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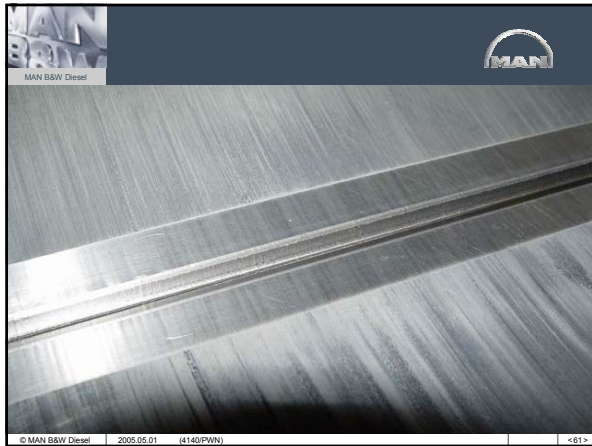
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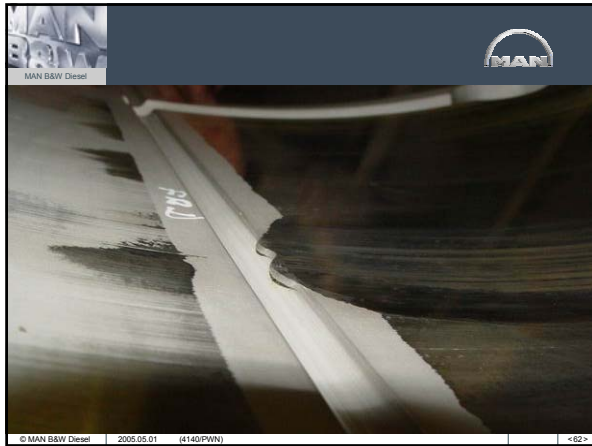
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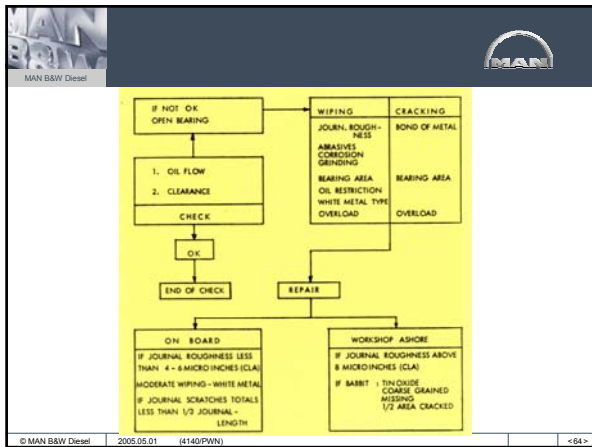
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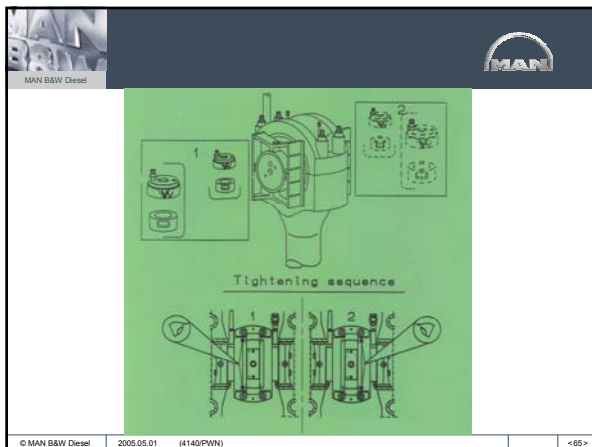
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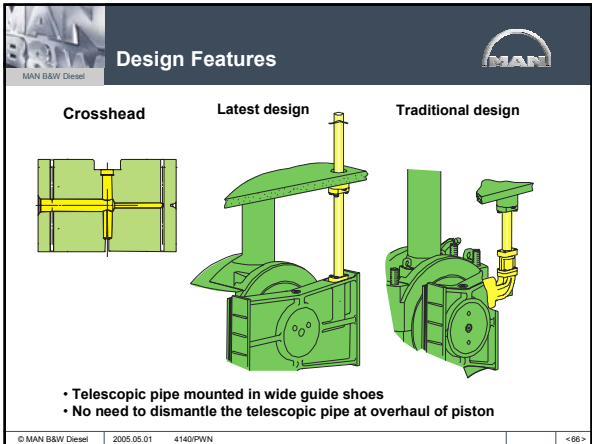
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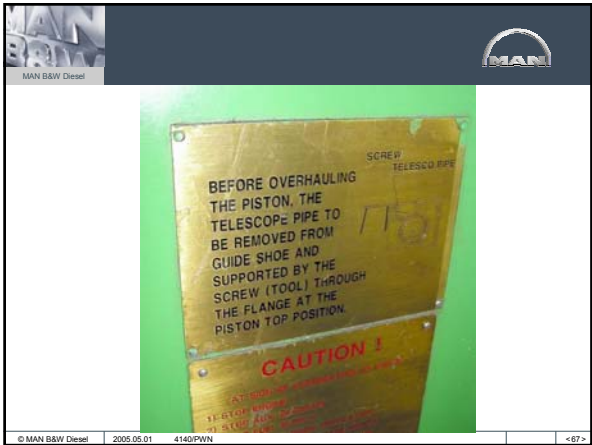
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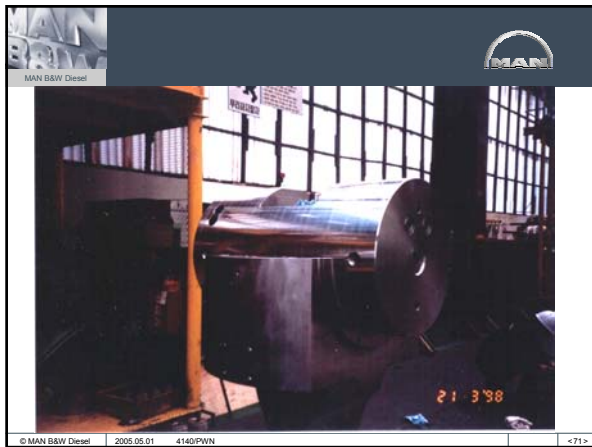
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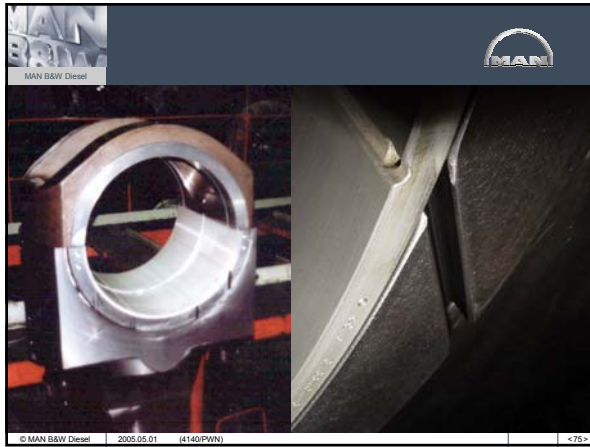
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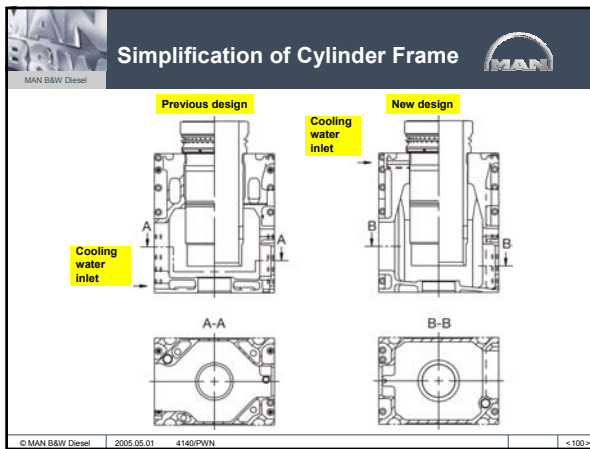
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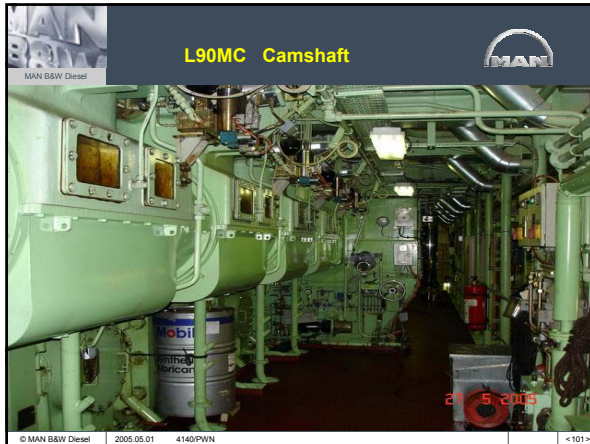
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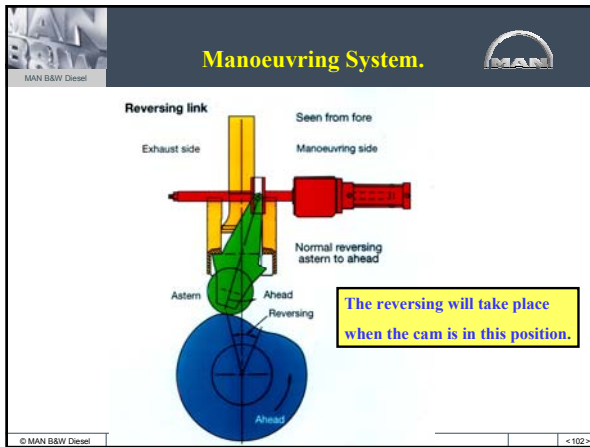
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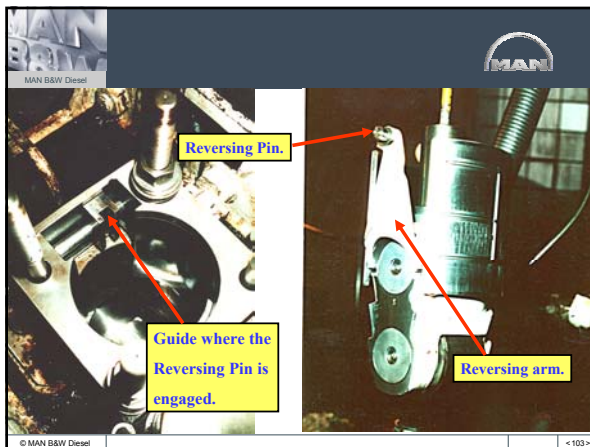
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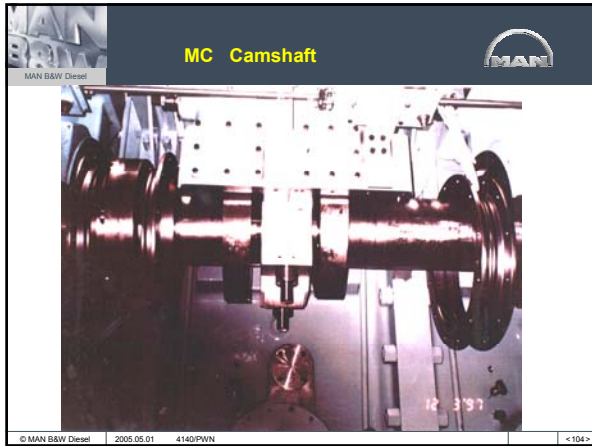
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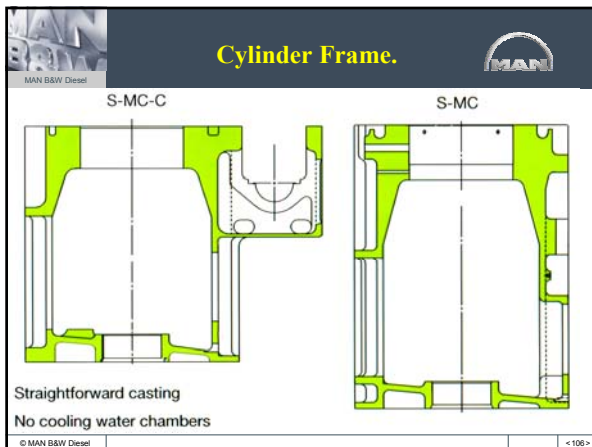
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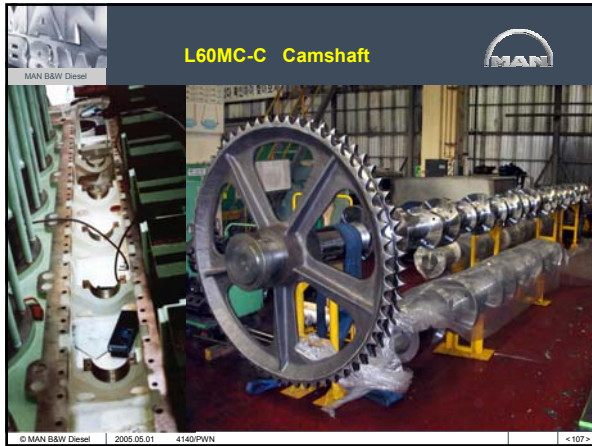
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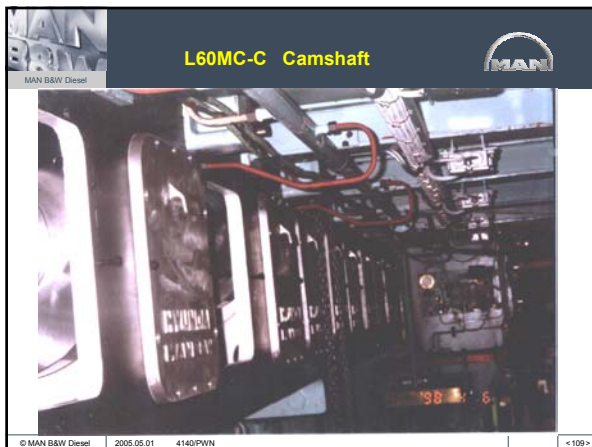
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MAN B&W Diesel

### Camshaft arrangement for MC-C

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MAN B&W Diesel

### Camshaft

**Improvements:**

- Increased number of fitted bolts in coupling next to chaindrive
- Mounting of camshaft from top
- Two part spare cam and no need to remove the old cam completely

**Verification:**

- Specific loading as K90MC-C

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MAN B&W Diesel

### MC-C Camshaft

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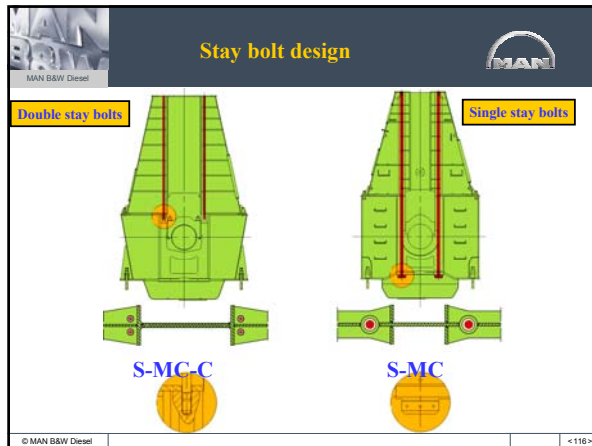
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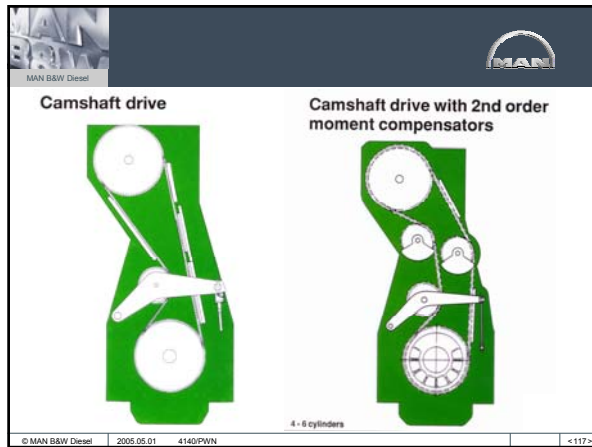
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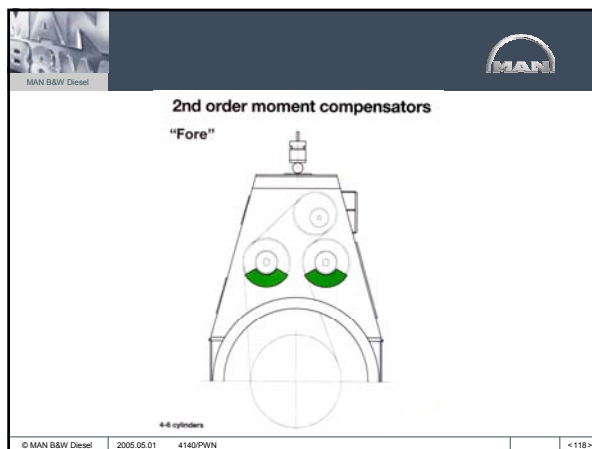
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**Chain Drive.**

**Check of Wear on Teeth**

MAN B&W Diesel

MAN

Visually Check  
Wear on Tooth Flanges

Measure Wear on Tooth flanges

2.5 mm

© MAN B&W Diesel <119>

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**Chain Drive.**

**Check of wear of Chain**

MAN B&W Diesel

MAN

NEW: 713.7 mm

Measurement over 10 Links

SCRAP: 720.8 mm

General Rule: 1% increase --> Scrap

© MAN B&W Diesel <120>

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**Chain Drive.**

**Replacement of Chain Link**

MAN B&W Diesel

MAN

Always use a New Chain Link!

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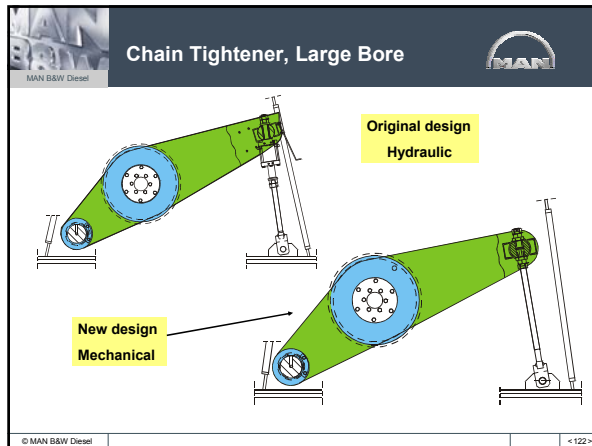
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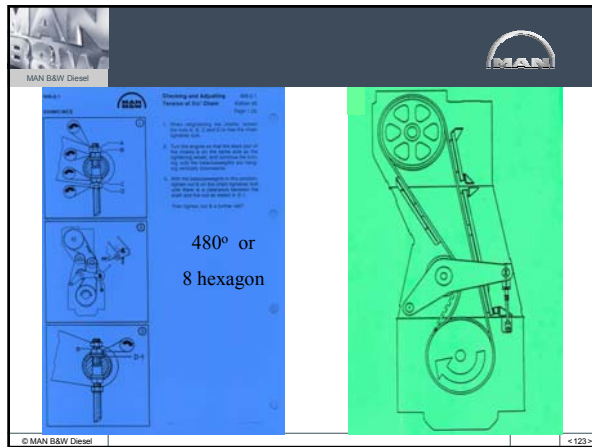
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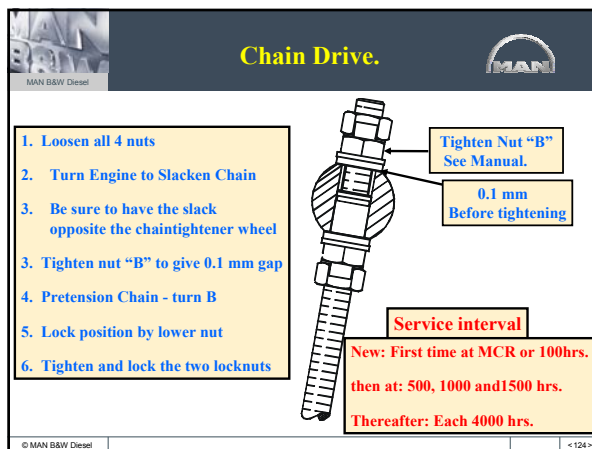
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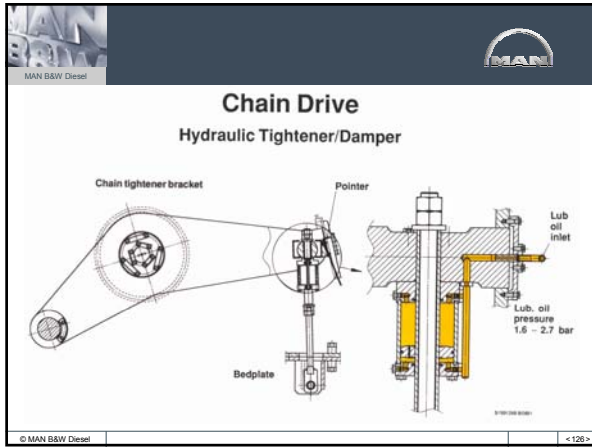
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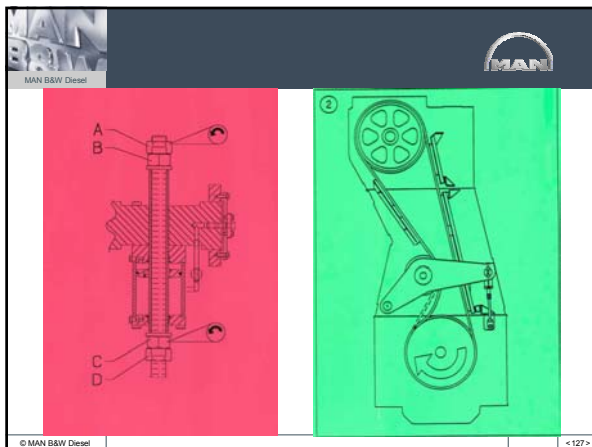
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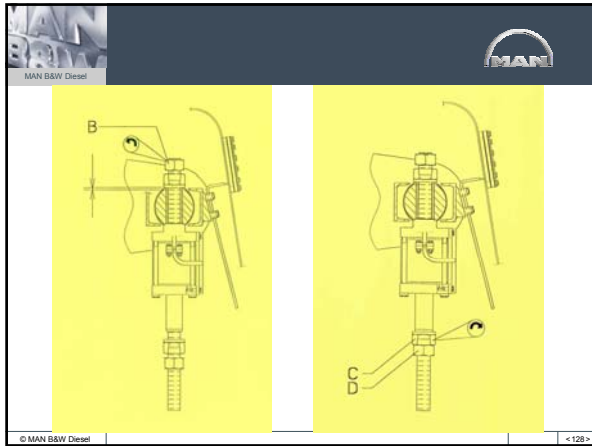
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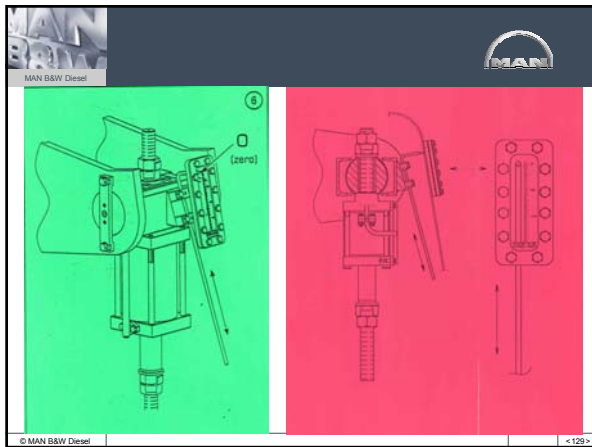
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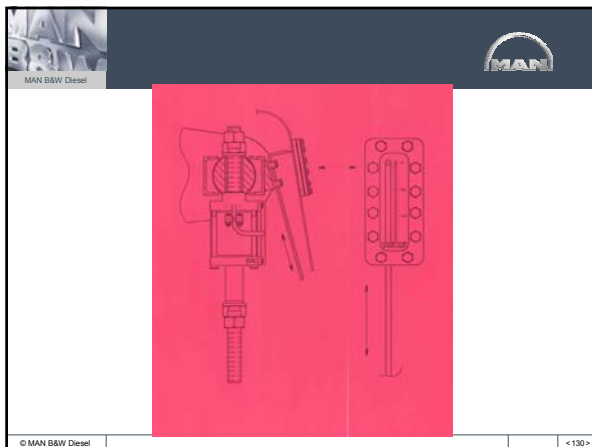
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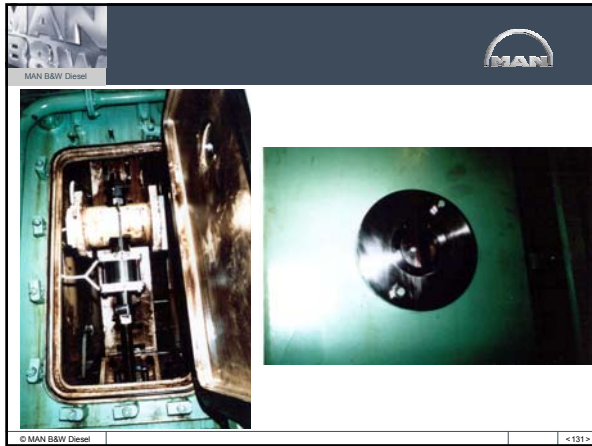
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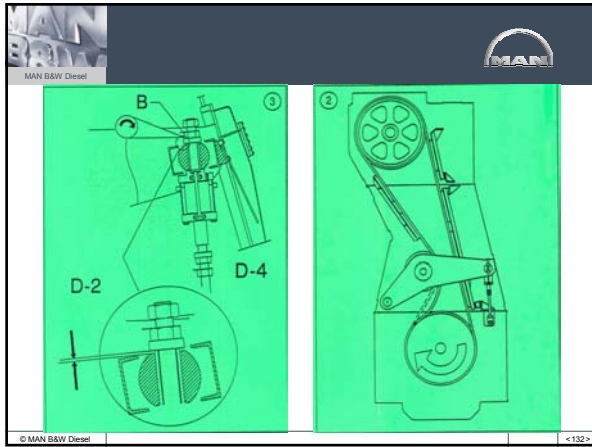
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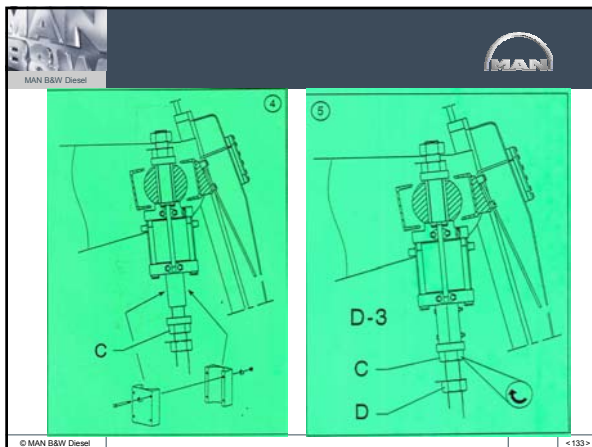
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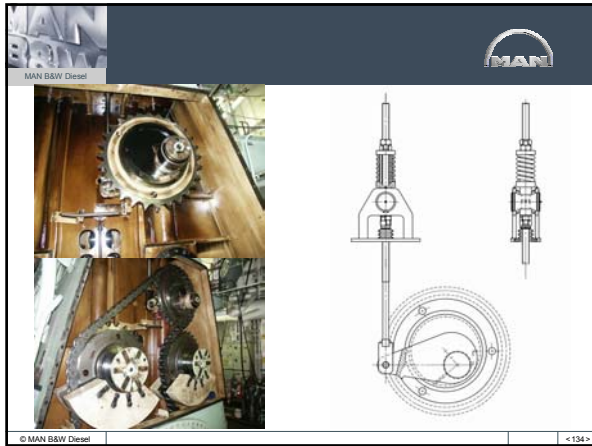
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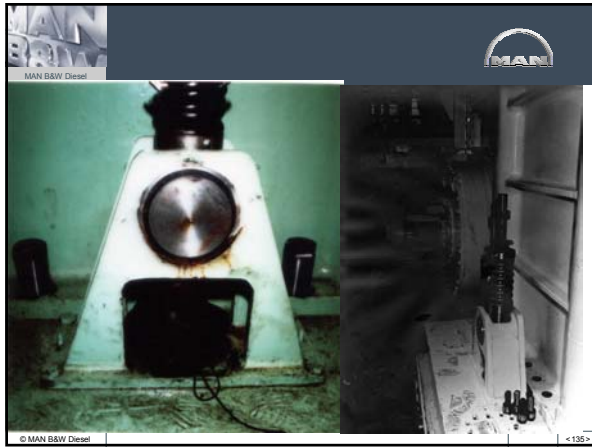
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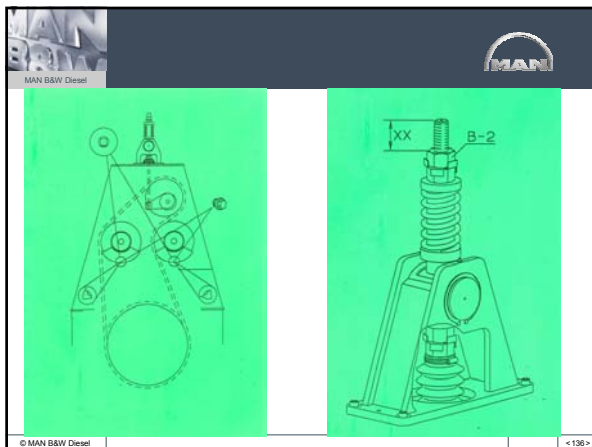
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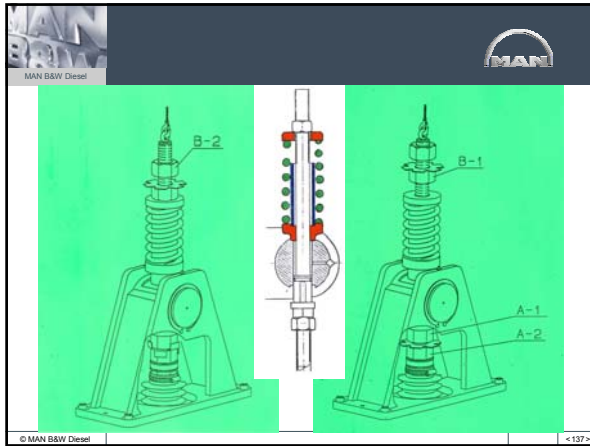
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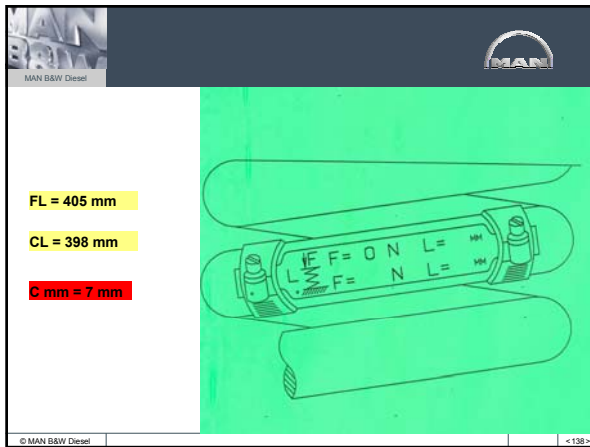
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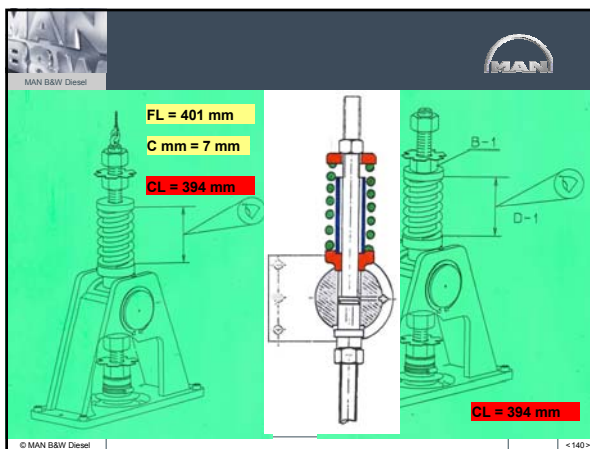
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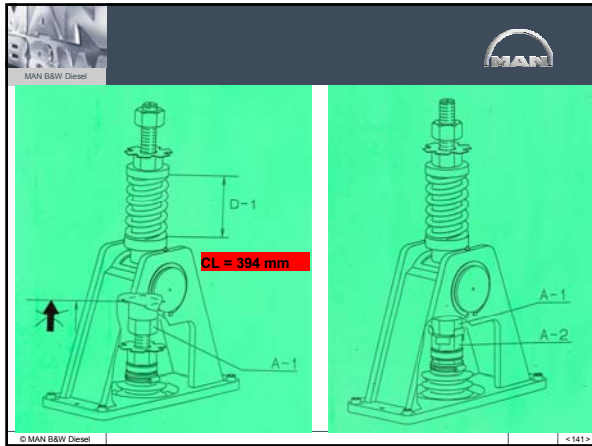
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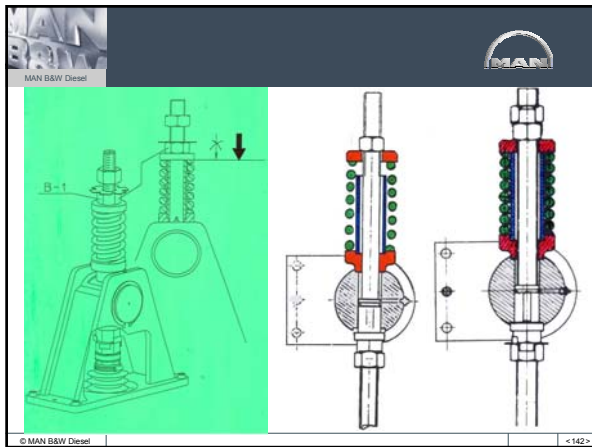
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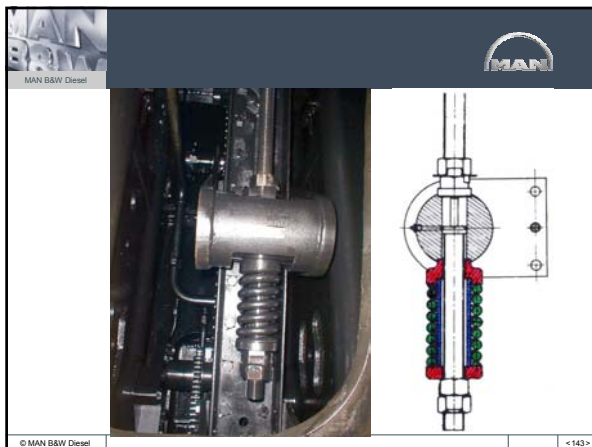
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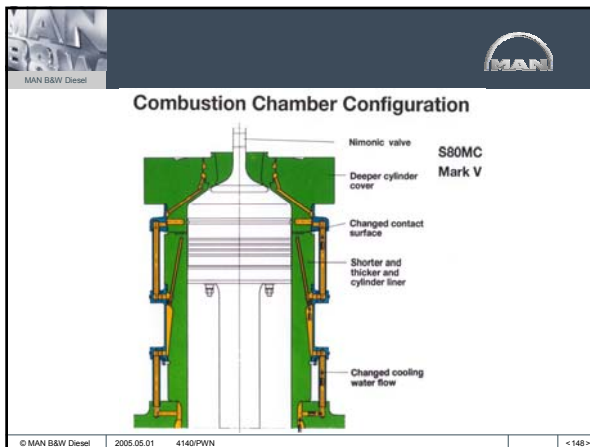
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MAN B&W Diesel

**MAN**

### Cylinder liner

**Principle of inserted pipe cooling**

The diagram illustrates two cooling methods for cylinder liners. The top part shows 'Pipe for high rated engines' with a 'Water chamber' above the liner and 'Heat flow' arrows pointing from the liner into the water. The bottom part shows 'Insulated pipe for low rated engines' with 'Insulation' between the liner and the 'Water chamber', and 'Heat flow' arrows pointing from the liner into the insulation.

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MAN B&W Diesel

**MAN**

A black and white photograph showing a large industrial diesel engine. A long, horizontal cooling pipe is connected to the engine's cylinder block. The engine is mounted on a base, and various pipes and components are visible.

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**MAN**

### Alpha Lubricator System

#### Alpha lubricator

The diagram shows a cross-section of the Alpha Lubricator System. It includes an 'Injection plungers' assembly with an 'Inductive feedback sensor for control of piston movement'. A 'Signal for lubrication from control unit' is sent to a 'Solenoid valve'. The system also features 'Outlets for cylinder liner lub. oil injectors', a 'Spacer for basic setting of pump stroke', an 'Adjusting screw', an 'Actuator piston', a 'Cylinder Lub. oil outlet', and a 'Cylinder lube oil inlet'.

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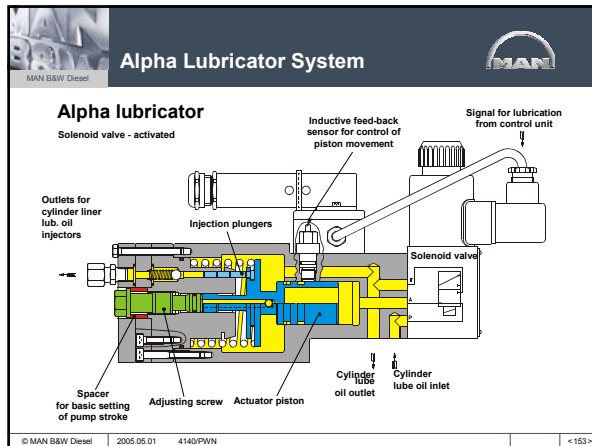
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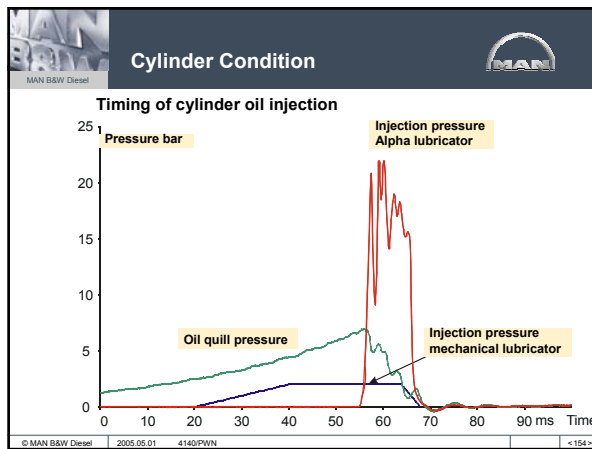
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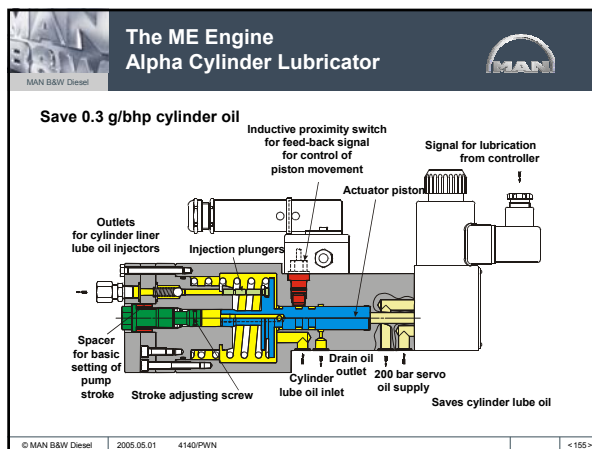
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MAN B&W Diesel

MAN

### Piston rod and stuffing box

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MAN

### Combustion Chamber Layout

#### Combustion chamber engines – Piston rings

- High 1<sup>st</sup> piston ring to accommodate CPR design
- Optimal pressure drop over the upper piston ring reduces the heat load on the second piston ring significantly
- All piston rings Alu-coat

Good performance of the piston ring pack means high reliability of the combustion chamber components and the cylinder condition

Controlled Pressure Relief (CPR) gaps

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MAN B&W Diesel Service

MAN

### Genuine spare parts

Piston ring with controlled pressure relief (CPR piston ring)

- Reduced differential pressure on piston ring No. 2
- Reduced temperature on piston ring No. 2

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**Cylinder Condition**

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**Controlled pressure relief piston ring (CPR)**  
90 and 98 bore engines

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**Alu-Coated Piston Ring**

MAN B&W Diesel

**Genuine spare parts**  
Developed at our Research Centre

- Reduced running-in time by more than 50%
- Thus saving cylinder oil
- Thickness: about 0.3 mm

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**Cylinder Condition**

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**Alu-coated Piston Ring**

**Ring pack**

- 1st ring: Type: CPR with Alu-Coat High
- 2nd ring: Type: RM5, oblique cut with Alu-Coat Low
- 3rd ring: Type: RM5, oblique cut with Alu-Coat Low
- 4th ring: Type: RM5, oblique cut with Alu-Coat Low

- High topland piston crown
- 1st piston ring with increased height
- Copper band on piston skirt

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**K90MC-C Design**

**Combustion chamber**

**Features:**

- High topland
- Oros shape of piston top
- CPR top piston ring
- Alu-coat piston rings
- Bore cooled, forged piston of heat resistant steel
- Piston cleaning ring

**Improvements:**

- Approx. 100 °C lower temperature on top compared with former type piston
- Elimination of inconel coating on piston top
- Increased chrome layer thickness in bottom of ring grooves
- Anti erosion bushing in oil outlet in piston rod foot

**Verification:**

- Extensive calculations
- Comprehensive tests on K90MC and K90MC-C
- Service test on K90MC

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**Combustion Chamber.**

**Narrow combustion volume**

**Large combustion volume**

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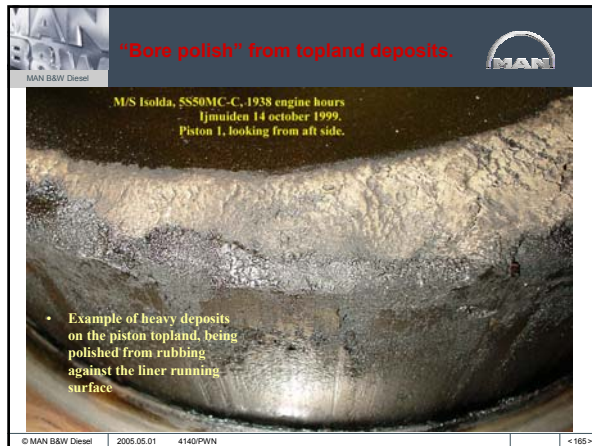
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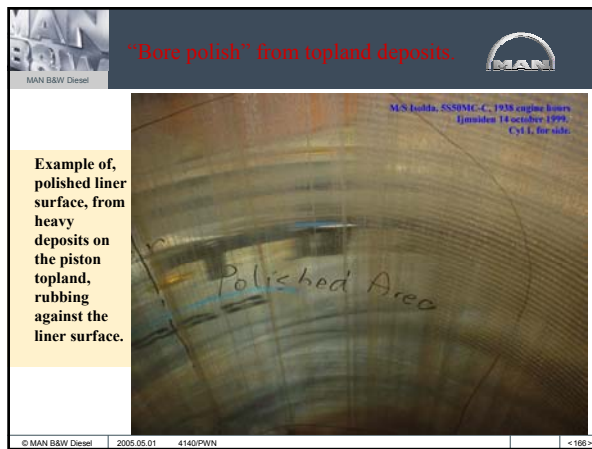
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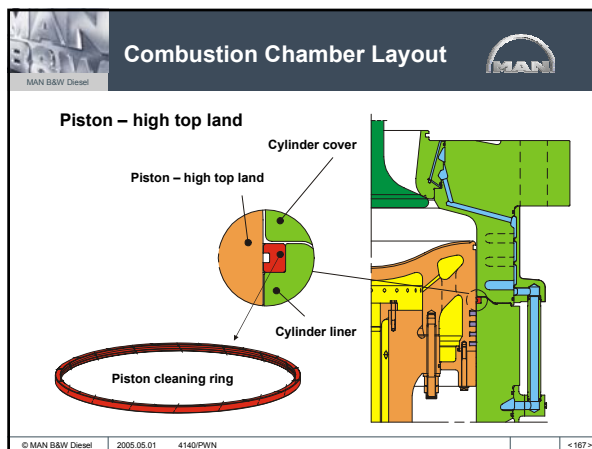
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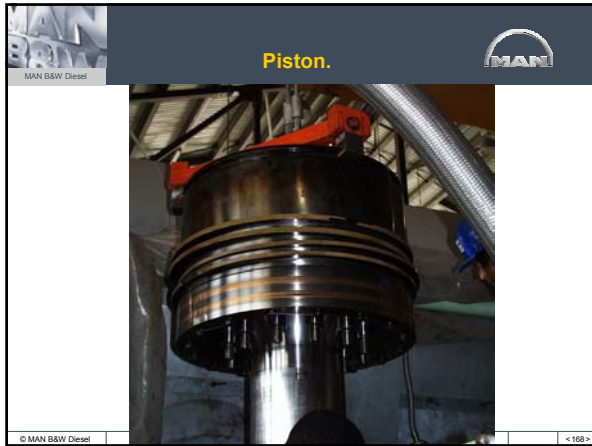
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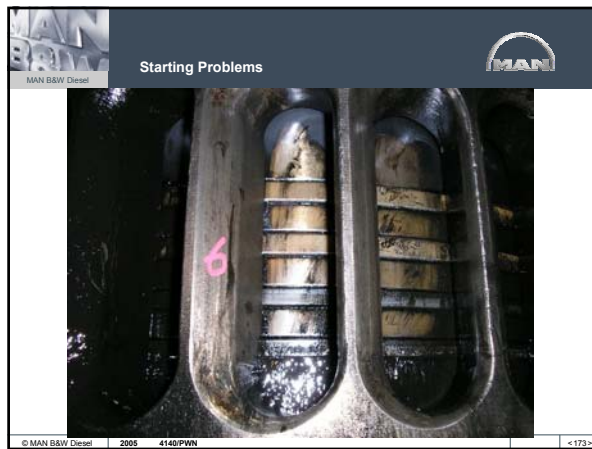
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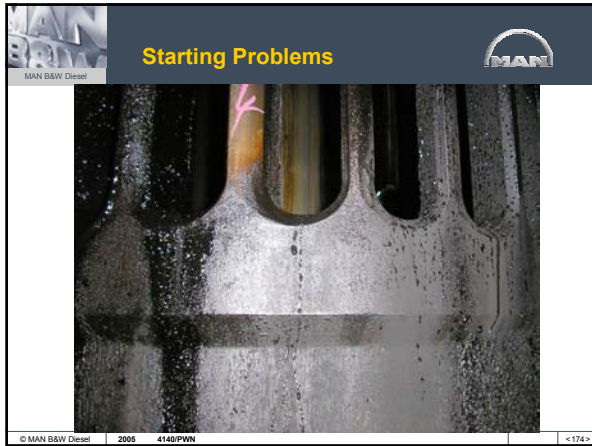
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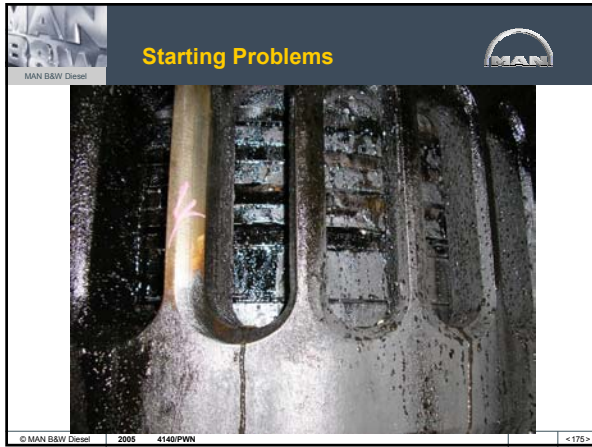
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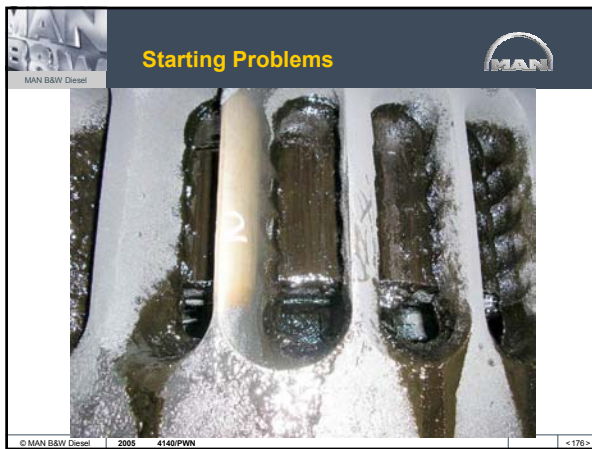
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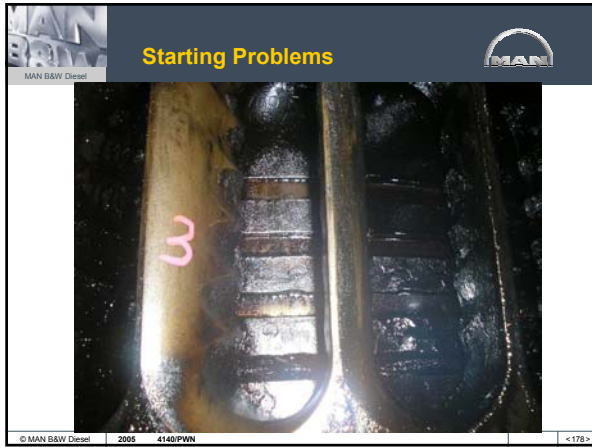
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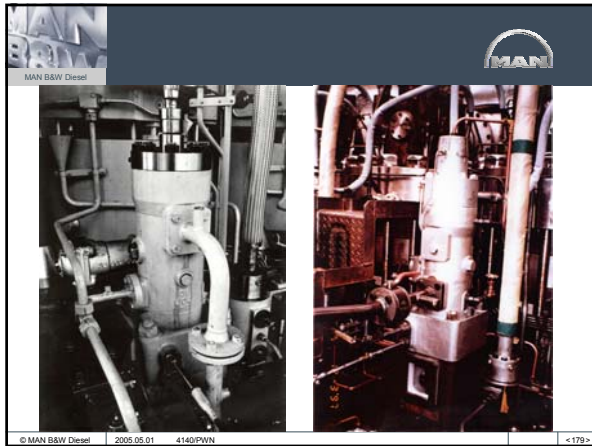
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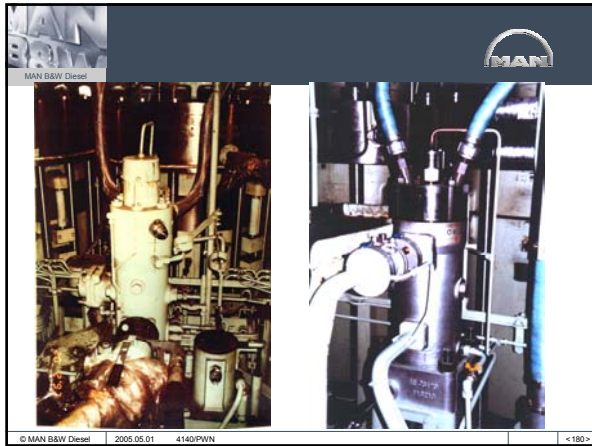
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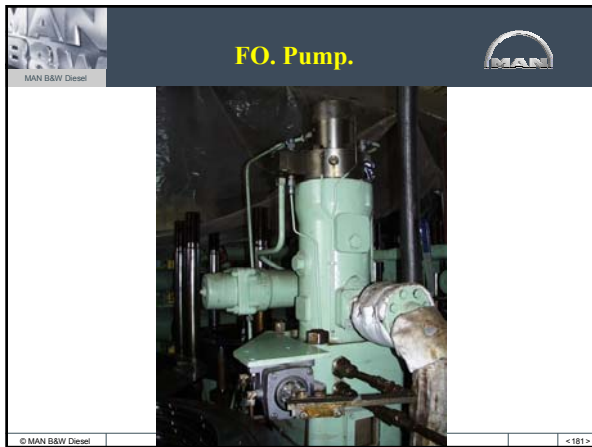
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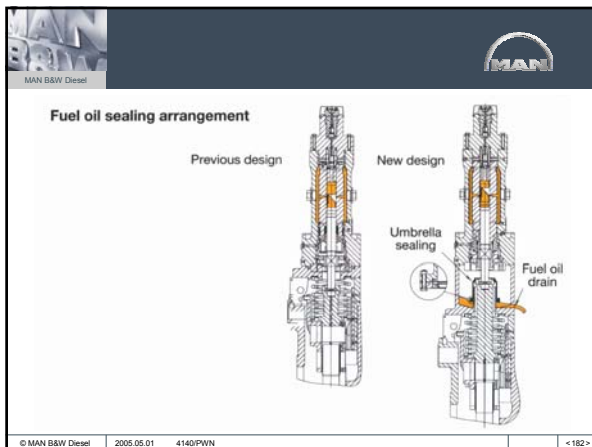
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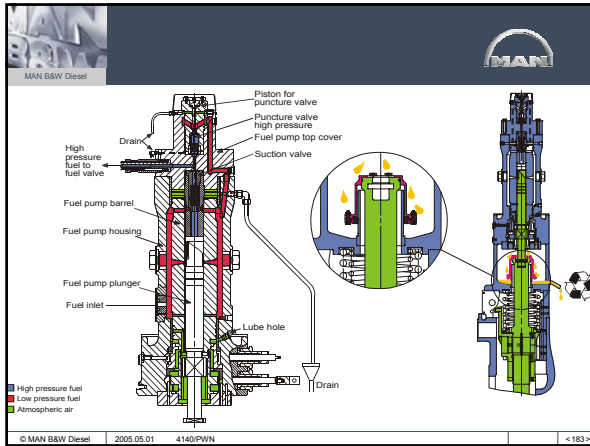
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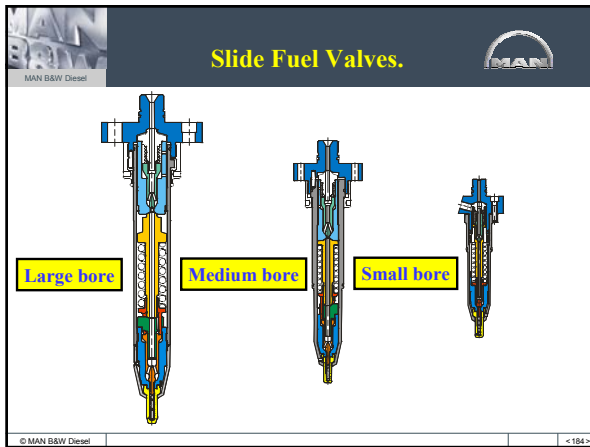
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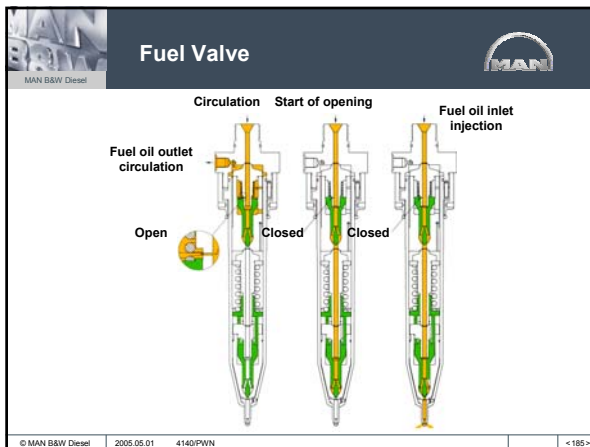
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**Performance**

MAN B&W Diesel

**Fuel Valves**

Conventional fuel valve  
Sac volume 1690 mm<sup>3</sup>

Mini-sac valve  
Sac volume 520 mm<sup>3</sup>

Slide-type fuel valve  
Sac volume 0 mm<sup>3</sup>

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**Slide-type Fuel Valve**

MAN B&W Diesel

Conventional fuel valve  
Sac volume 1690 mm<sup>3</sup>

Slide-type fuel valve  
Sac volume 0 mm<sup>3</sup>

Now used as standard

Possibility for retrofit

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**Fuel Valve Spindel Guide and Nozzle.**

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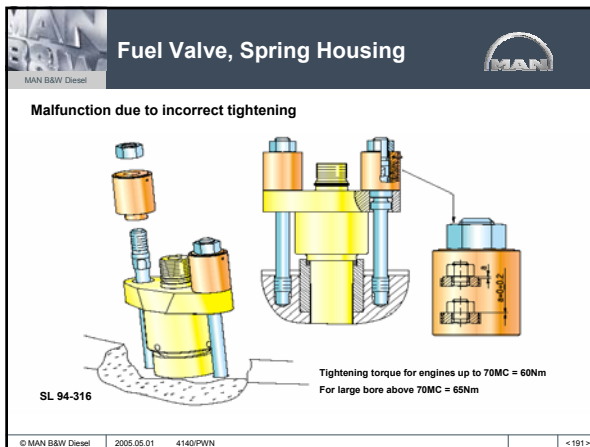
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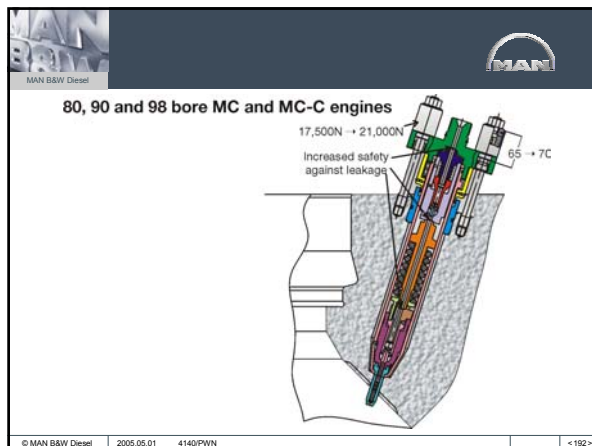
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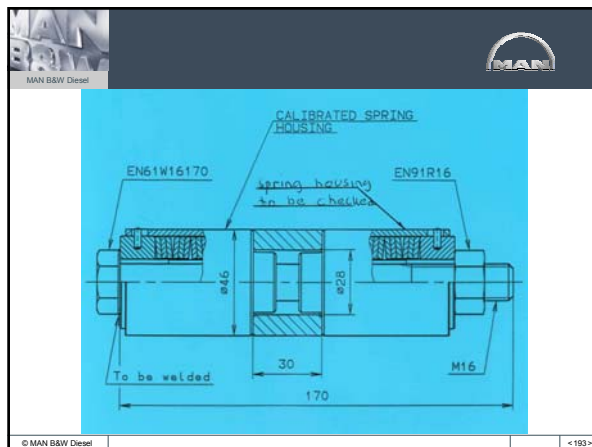
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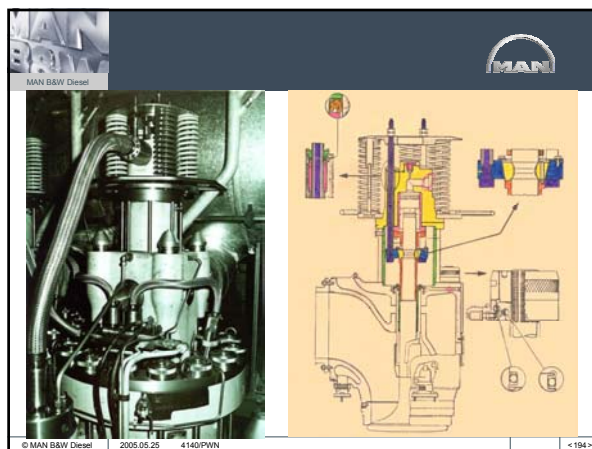
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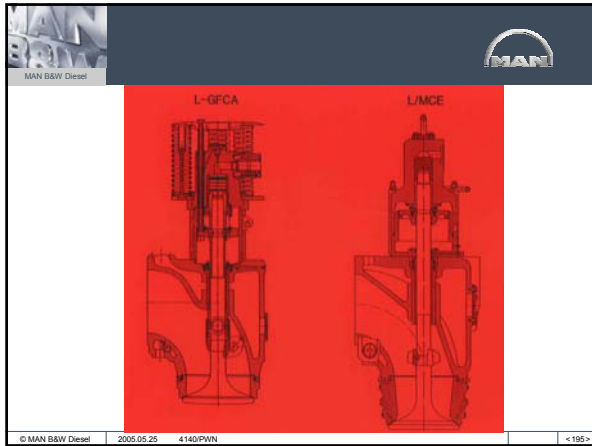
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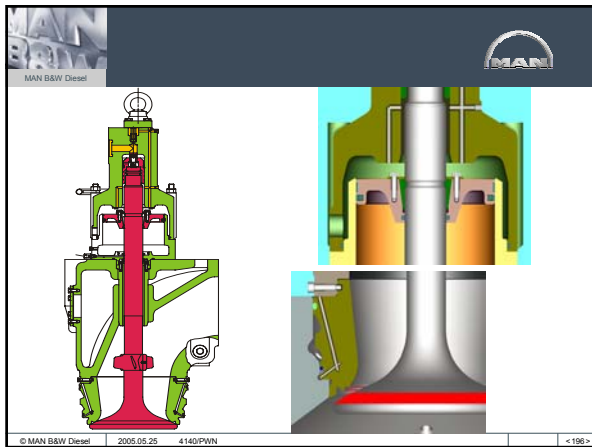
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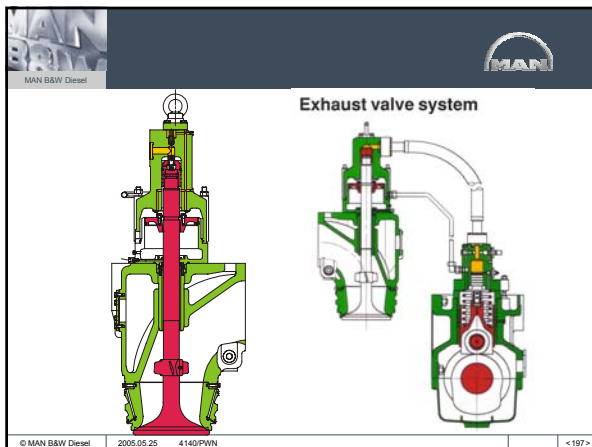
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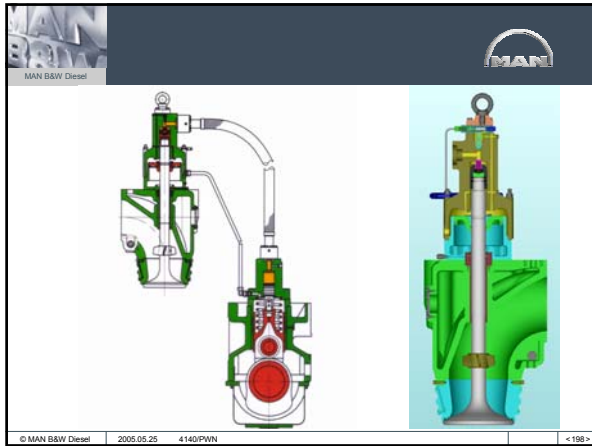
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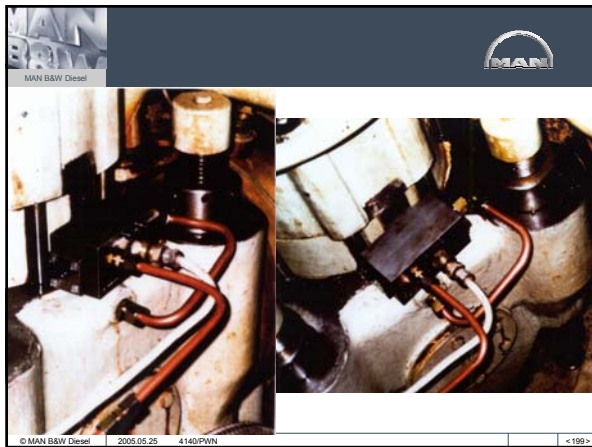
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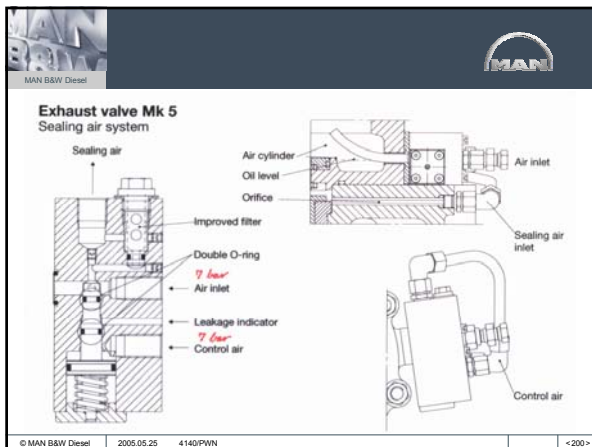
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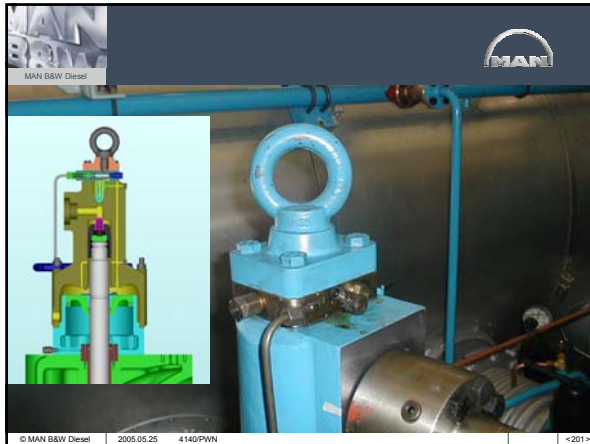
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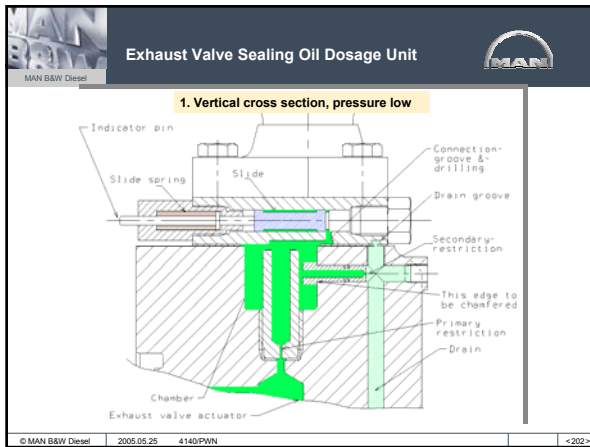
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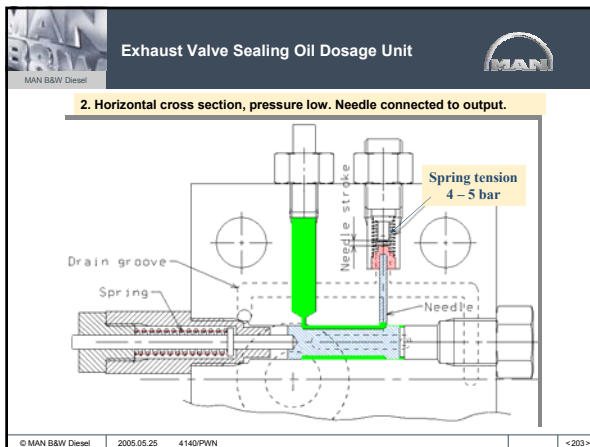
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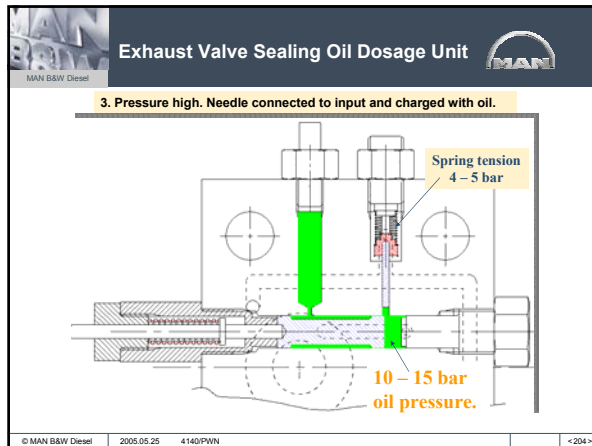
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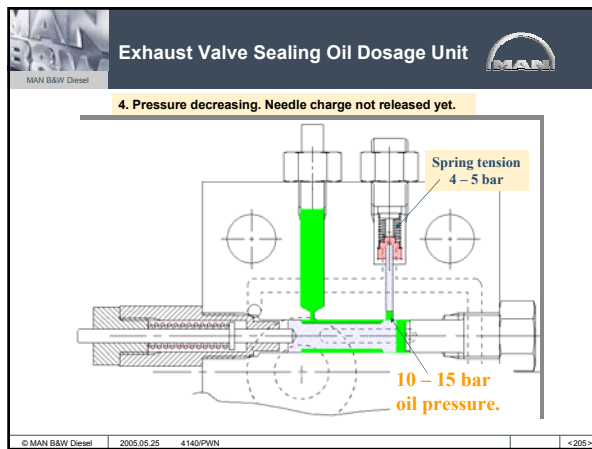
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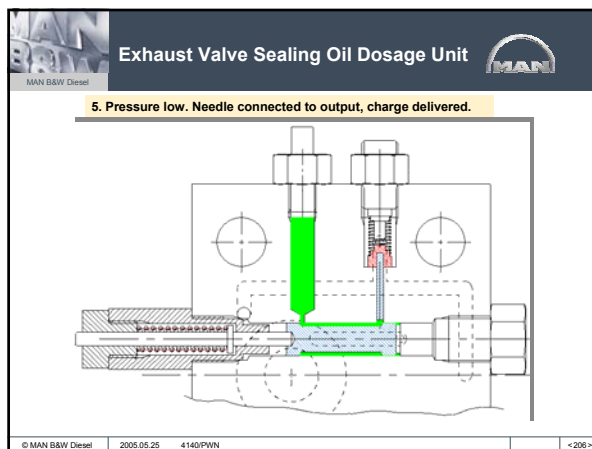
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### Exhaust valve Reasons for knocking

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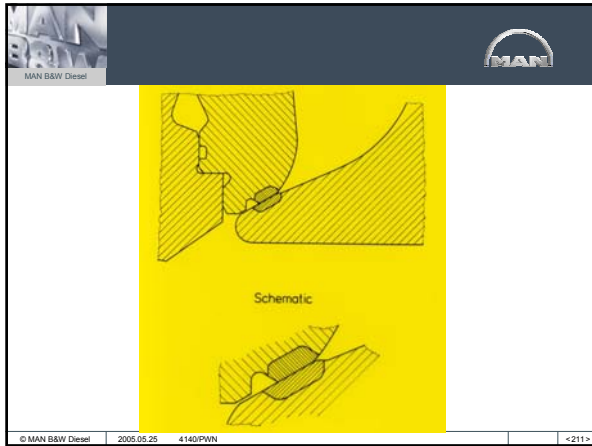
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**MC EXHAUST VALVE**

**Bottom piece for engine types: K/L/S-MC/C-/S**

Original design	Modified design	Cooled steel (Hardened W-seat)	1983 - 1992: 26 - 50 MC 60 - 90 MC	Cooled Alloy 50 Cooled Stellite 6
Alloy 50 Hard facing		Semi cooled steel (Hardened W-seat)	1992 - 1997: 26 - 50 MC 60 - 90 MC	Cooled Alloy 50 Semi-cooled hard. steel
Hardening zone			1997 - 2000: 26 - 42 MC 46 - 98 MC	Cooled hard. steel Semi-cooled hard. steel
			2000 - : 26 - 42 MC 46 - 98 MC	Cooled W-seat Semi-cooled W-seat

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**MC EXHAUST VALVE**

**Chamber seat**

**W-seat**

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### Exhaust Valve Spindle & Bottom Piece 98MC/MC-C – 26MC

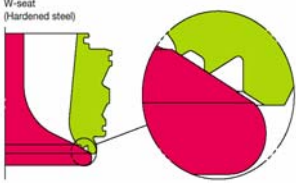
**MAN**

The longer lifetime on the seat area is achieved with the new geometry of the W-seat, which retains the temperature reducing features of the chamber seat and combines them with the benefit of the two narrow concentric contact areas.

The effect is that all carbon particles which are trapped between the spindle and bottom piece are crushed and squeezed out and therefore eliminated without giving rise to any appreciable risk dents.

The spindle and seat are fit for further use provided that:

- There is contact along the entire inner circumference of the seat.
- There are no blow-by tracks across the inner part of the seats.



**16,000 h between overhauls**  
**60-100,000 h lifetime for spindle**  
**> 30,000 h lifetime for bottom piece**

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**Bottom Piece W-Seat**

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**Bottom Piece**

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References of W-seats running for more than 36000 hours without any grinding and only very small dent marks

Hole for indication of cooling water leakage from the lowermost sealing ring or gas leakage from the combustion chamber

U-type sealing ring (Teflon with a spring back-up)

Connect compressed air to the air spring to keep the exhaust valve closed during mounting

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**MC EXHAUST VALVE**

Valve spindle for engine types: K/L/S-MC/C/-S

1983 - 1992:	Alloy 50
26 - 50 MC	Stellite 6
60 - 90 MC	
1992 - 2002:	Alloy 50
26 - 50 MC	Nimonic
S50MC / 60 - 98 MC	
2002 - :	DuraSpindle
26 - 50 MC	Nimonic
S50MC / 60 - 98 MC	
1983 - 1996:	Cr stem coating
1996 - :	HVOF stem coating

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**Exhaust Valve Nimonic Spindle**

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Formation of dent marks is an inevitable consequence of service on heavy fuel oil.

Dent marks may appear harmful, but will in general have no influence on the performance of the exhaust valve seat.

If indications of blow-by are found, then the seat must be ground.

HVOF-coating

Vane wheel for gas driven spindle rotation

Base Material: Nimonic 80A

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**Exhaust Valve Nimonic Spindle**

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- Applied on the exhaust valve stem only
- High Velocity Oxygen Fuel (HVOF) process
- Highly wear-resistant mixture of metalcarbide and superalloy
- Thermally sprayed coating
- Thickness about 0.2-5 mm

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**Maintenance.**

**Auxiliary Systems**

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Cooling and air system  
 Fuel oil system  
 Starting and control air system  
 Cylinder lubricating oil system  
 Scavenge box drain system  
 Lubricating and cooling oil system  
 Air cooler cleaning system  
 Demohull lubricating oil system  
 Fire extinguishing system  
 Bluffing box drain oil cleaning system

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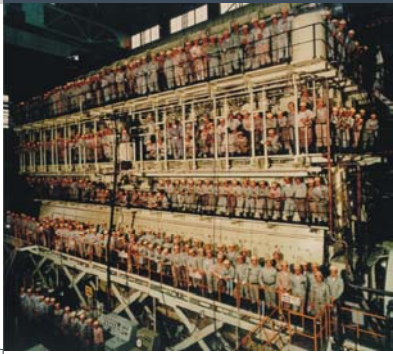
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# "Finish with Engine"



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# Thank you!

# For your attention

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