
# S60MC

EDITION 5

## VOLUME II
## MAINTENANCE

# Instructions for Main Engine

# Type S60MC

This book forms part of a set of books consisting of three volumes entitled:

Vol. I OPERATION
Vol. II MAINTENANCE
Vol. III COMPONENTS AND DESCRIPTIONS

The purpose of these books is to provide general guidance on operation and maintenance and to describe the constructional features of a standard version of the above engine type. Deviations may be found in a specific plant. In addition, the books can be used for reference purposes, for instance in correspondance and when ordering spare parts.

It is essential that the following data is stated in spare parts orders as it is used by us to ensure the supply of the correct parts for the individual engines:

1. Name of vessel
2. Engine No. built by
3. Plate No.
4. Part No.
5. Quantity required (and description)

Examble: M/S Nybo - 7730 B&W - 90201 - 00 - 059
10 off (piston ring)

If the parts list indicates a 'MAN B&W Standard No.', this should also appear in your order.

Furthermore, to ensure optimum efficiency, reliability and lifetime of the engine and its components, only original spare parts should be used.

The designation 'D' used in texts and illustrations refers to the information given on the data-sheets inserted in the respective books.

As reliable and economical operation of the diesel engines is conditional on correct operation and maintenance, it is essential that the engine-room personnel is fully acquainted with the contents of this book.



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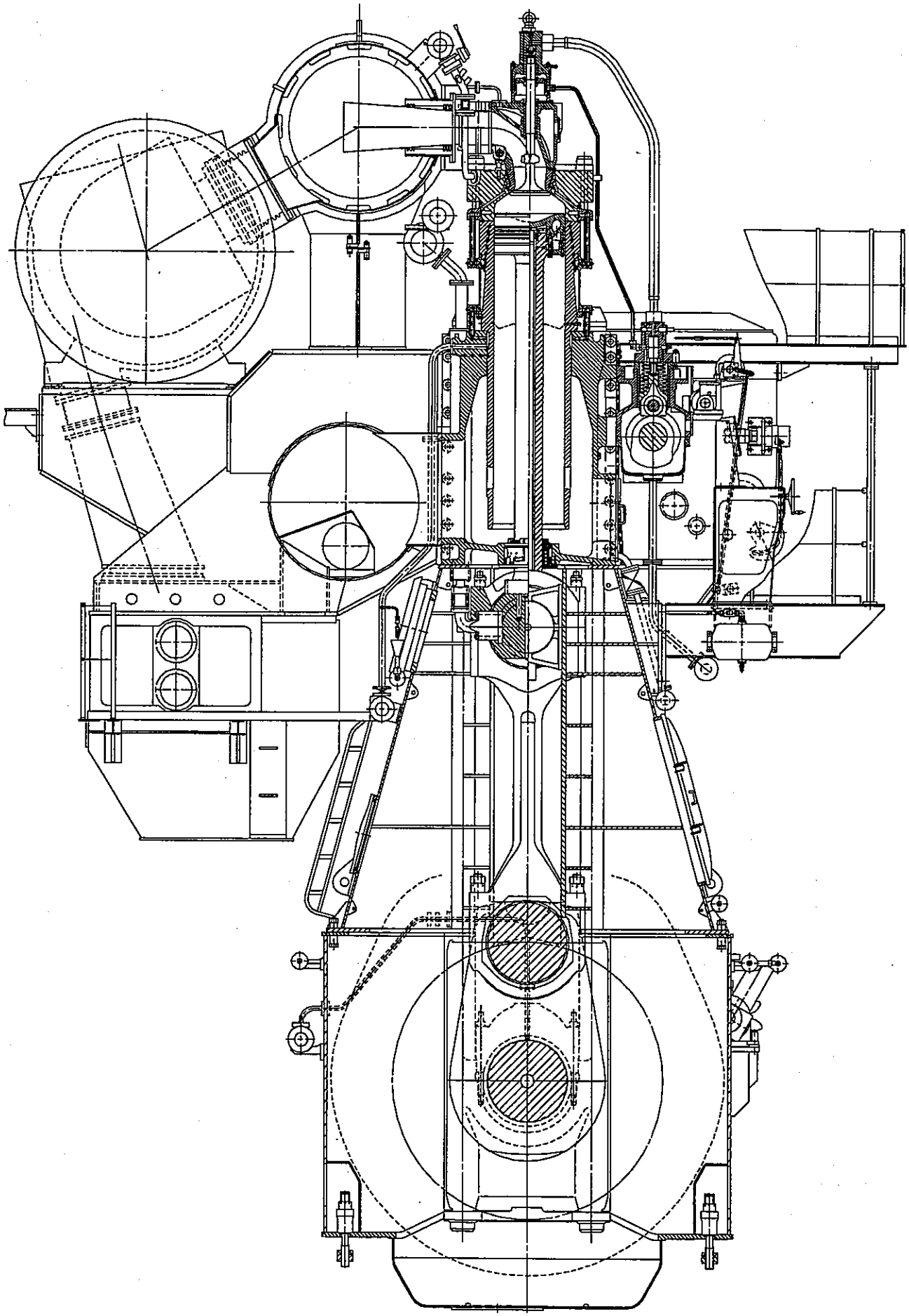
MAN B&W

# Cross Section through Engine

Plate 90001-35

S60MC



The Checking and Maintenance Programme indicates the intervals at which it is deemed appropriate to inspect the individual components of the engine and to carry out overhauls, if necessary, based on the engine condition or on time criteria.

The procedures contained in the instruction book are arranged in a logical order, and the following Checking and Maintenance Programme can be used as a table of contents.

The stated 'Normal hours of service' are only to be used as a guidance, as difference in the actual service conditions, the quality of the fuel oil, lubricating oil, treatment of cooling water, etc. will decisively influence the actual service results, and thus the intervals between necessary overhauling.

Design modifications may necessitate a revision of the instructions, and in that case the revised instructions and changed overhauling intervals, if any, will apply and supersede those originally issued (*see e.g our Service Letters*).

Under 'Procedure' the word 'Replacement' has been used also:

1. Where exchange to another ready-made spare part will shorten the stop time of the main engine considerably, for instance by mounting another piston complete with piston rings and stuffing box.

2. Where overhaul and replacement to a new spare part is the same procedure as, for instance, inside inspection of piston crown (*see procedure 902-4.1*).

Thus 'Replacement' to a new spare part usually only takes place due to wear or possible damage.

The procedures are divided into three categories:

**A. Condition checking procedures,**

marked under the heading 'Normal hours of service' by **C**, deal with the service condition of a number of engine components, and form the basis for estimating whether further overhauling is necessary. In a number of cases the condition checking procedures refer to Volume I, OPERATION, in which more detailed descriptions and working procedures can be found.

Where a procedure number is stated under the heading 'Related procedure', it will be appropriate to carry out this procedure at the same time.

**B. Condition-based overhauling procedures**

are those procedures which under the heading 'Normal hours of service' are marked by **O**, and opposite which, under the heading 'Overhaul to be based on procedure No.', a procedure number is stated.

This procedure number normally refers to one of the above condition checking procedures which form the basis of the overhaul. For this reason, the intervals stated are for guidance only.

Where several procedures are to be carried out on the same estimation basis, and these belong together with regard to the work, this is stated under the heading 'Related procedure'.

**C. Time-based overhauling procedures,**

also marked by **O** under the headings 'Normal hours of service' or 'Based on observations', are the procedures where an actual basis for estimation is lacking. It is recommended, therefore, to carry out these procedures at the overhauling intervals stated as a basis.

Where a symbol **O** or **C** is indicated under the heading 'Based on observations', this is due to the fact that special service conditions may make checking or overhauling necessary beyond the actual programme.

*) : See Vol. I Operation
**) : See special instructions
C : Check the condition
O : Overhaul to be carried out
A : Adjustment to be carried out

| No. | PROCEDURE | Overhaul to be based on procedure No.: or to refer to: | Check new/overhauled parts after 500-1500 hours | Normal hours of service: 2000 hours | 4000 hours | 6000 hours | 8000 hours | 16000 hours | 4 years (survey) | Based on observations | Related procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **901** | **CYLINDER COVER** | | | | | | | | | | |
| -1 | Replacement of cylinder cover | | | | | | O | | | | 902-2 |
| -1.1 | Dismantling | | | | | | | | | | |
| -1.2 | Mounting | | | | | | | | | | |
| -2 | Replacement of valves on cyl. cover | | | | | | | | | | 909-6 |
| -2.1 | Fuel valve | | | | C | | | | | | 909-7 |
| -2.2 | Starting valve | | | | | | O | | | | 907-4 |
| -2.3 | Exhaust valve | | | | | C | | O | | | 908-2 |
| -2.4 | Safety valve (see 911-1) | | | | | | C | | | | 908-1 |
| -3 | Overhaul of cylinder cover | | | | | | | | | | |
| -3.1 | Overhaul of cylinder cover | | | | | | | | | O | |
| -3.2 | Replacement of cooling jacket | | | | | | | | | O | |
| **902** | **PISTON WITH ROD AND STUFFING BOX** | | | | | | | | | | |
| -1 | Inspection of piston and rings through scavenge ports | *) | C | C | | | | | | | 903-1 |
| -2 | Replacement of piston complete with stuffing box | 902-1 | | | | | O | | | | 901-1 |
| -2.1 | Dismantling | | | | | | | | | | |
| -2.2 | Mounting | | | | | | | | | | |
| -2.3 | Tilting | | | | | | | | | | |
| -3 | Checking of piston and piston rings | | | | | | O | | | | |
| -4 | Overhaul of piston | | | | | | | O | | | |
| -4.1 | Replacement of sealing ring | | | | | | | | | | |
| -4.2 | Replacement of cooling oil pipe | | | | | | | | | | |
| -4.3 | Replacement of piston crown and pressure testing | | | | | | | | | | |
| -5 | Overhaul of piston rod stuffing box | | | | | | O | | | | |
| -5.1 | Outside the engine | | | | | | | | | | |
| -5.2 | Inside the engine | 902-1 | | | | | | | | O | |
| **903** | **CYLINDER LINER AND CYLINDER LUBRICATION** | | | | | | | | | | |
| -1 | Inspection of cylinder condition through scavenge ports | *) | C | C | | | | | | | 902-1 |
| | (Remove sludge from scavenge box and clean scavenge ports) | | C | O | | | | | | | |

*) : See Vol. I Operation
**) : See special instructions
C : Check the condition
O : Overhaul to be carried out
A : Adjustment to be carried out

| No. | PROCEDURE | Overhaul to be based on procedure No.: or to refer to: | Check new/overhauled parts after 500 - 1500 hours | Normal hours of service: 2000 hours | 4000 hours | 6000 hours | 8000 hours | 16000 hours | 4 years (survey) | Based on observations | Related procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -2 | Inspection, measuring and reconditioning of cylinder liner | | | | | | O | | | | 902-2 |
| -3 | Replacement of cylinder liner | 903-2 | | | | | | | | O | 901-1 |
| -3.1 | Replacement of cylinder liner | | | | | | | | | | |
| -3.2 | Replacement of cylinder liner (low lifting height) | | | | | | | | | | |
| -4 | Checking and adjustment of cylinder lubricators | *) | | | | | | | | O | |
| **904** | **CROSSHEAD WITH CONNECTING ROD** | | | | | | | | | | |
| -1 | Check oil drain from crosshead bearings | *) | C | | C | | | | | | |
| -2 | Crosshead bearings | | | | | | | | | | |
| -2.1 | Checking of crosshead bearing clearance | | | | | | C | | | | 904-6<br>905-2 |
| -2.2 | Inspection and replacement of crosshead journal and bearings | 904-1 | | | | | | | C | O | |
| -4 | Dismantling/mounting of crosshead | | | | | | | | | | |
| -5 | Checking of reciprocating parts | | | | | | | | | O | |
| -6 | Checking, inspection and replacement of crankpin bearing | | C | | | | C | | | | 904-2<br>905-2 |
| -7 | Dismantling/mounting of connecting rod | | | | | | | | | O | 904-4 |
| **905** | **CRANKSHAFT, THRUST BEARING AND TURNING GEAR** | | | | | | | | | | |
| -1 | Checking deflection of crankshaft | *) | C | | | | C | | | | |
| -2 | Checking and adjustment of clearance in main bearings | 905-1 | C | | | | C | | | A | 904-2<br>904-6 |
| -3 | Inspection of main bearings | 905-2 | | | | | | | C | | |
| -4 | Checking of clearance in thrust bearing | | C | | | | C | | | | |
| -5 | Replacement of thrust bearing segments | 905-4 | | | | | | | C | | |

| No. | PROCEDURE | Overhaul to be based on procedure No.: or to refer to: | Check new/overhauled parts after 500 - 1500 hours | Normal hours of service: 2000 hours | 4000 hours | 6000 hours | 8000 hours | 16000 hours | 4 years (survey) | Based on observations | Related procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -6 | Balancing arrangement fore and aft (where used) | | | | | | | | | | |
| -7 | Axial vibration damper (where used) | | | | | | | | | | |
| -7.1 | Mechanical check | | | | | | | | | C | |
| -7.2 | Monitoring check | | | | | | | | | C | |
| -7.3 | Overhaul | | | | | | | | | O | |
| **906** | **MECHANICAL CONTROL GEAR** | | | | | | | | | | |
| -1 | Checking of chain drive, guideways, bolt connections, and lubrication | *) | C | | | | C | | | | |
| -2 | Chain drive (4" and 1" chains) | | | | | | | | | | |
| -2.1 | Adjustment of chain tightener damper | | | | | | | | | A | |
| -2.2 | Blocking of chain tightener damper | | | | | | | | | | |
| -2.3 | Disassembling and assembling of chains (4" and 1" chains) | | | | | | | | | | |
| -3 | Inspection of running surfaces on cams | | | | | | C | | | | |
| -5 | Camshaft bearings | | | | | | | | | | |
| -5.1 | Checking clearance in camshaft bearing | | | | | | | C | | | 908-4 |
| -5.2 | Inspection of camshaft bearing | | | | | | | | C | | |
| -7 | Check adjustment (timing) of control gear | | C | | | | | | | C | |
| -8 | Adjustment of camshaft because of chain wear | 906-7 | | | | | | | | A | |
| -12 | Moment compensator | | | | | | | | | | 906-1 |
| -12.1 | Mounting of chains and adjustment of moment compensator | | | | | | | | | | |
| -12.2 | Tightening of foremost moment compensator chain | | | | | | | | | A | |
| **907** | **STARTING AIR SYSTEM** | | | | | | | | | | |
| -1 | Lubrication of all moving parts | *) | | | | | O | | | | |
| -2 | Inspection of starting air distributor | | C | | | | C | | | | |
| -4 | Overhaul of starting air valve | | | | | | O | | | | 901-2 |
| -5 | Governor, exchange of oil | **) | | | O | | | | | | |

| No. | PROCEDURE | Overhaul to be based on procedure No.: or to refer to: | Check new/overhauled parts after 500-1500 hours | Normal hours of service: 2000 hours | 4000 hours | 6000 hours | 8000 hours | 16000 hours | 4 years (survey) | Based on observations | Related procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -6 | Functional check of overspeed device | **) | | | | | C | | | | |
| -7 | Functional check of speed-setting system (engine with bridge control system) | **) | | | C | | | | | | |
| **908** | **EXHAUST VALVE** | | | | | | | | | | |
| -1 | Overhaul and adaptation of high-pressure pipe | | | | | | | | | C | |
| -2 | Overhaul of exhaust valve<br>*) When new exhaust valve is fitted | | | | | C*) | | O | | | 901-2 |
| -3 | Overhauling of hydraulic exhaust valve actuator | | | | | | | O | | | |
| -4 | Inspection of roller guides | | C | | | | | C | | | 908-5 |
| -5 | Lifting of roller guide for exhaust valve | *) | | | | | | | | O | |
| -6 | Emergency running with open exhaust valve | | | | | | | | | C | |
| -7 | Checking exhaust cam adjustment (Anticlockwise and clockwise) | | | | | | | | | C | |
| **909** | **FUEL OIL SYSTEM** | | | | | | | | | | |
| -1 | Checking and adjustment of fuel pump lead | *) | | | | | | | | C | |
| -1.1 | Checking | | | | | | | | | | |
| -1.2 | Adjustment | | | | | | | | | A | |
| -1.3 | Adjustment of pilot valve | | | | | | | | | A | |
| -2 | Adjustment of fuel pump cam | 909-1 | | | | | | | | A | |
| -3 | Overhaul of fuel pump | | | | | | | | | O | |
| -3.1 | Replacement of fuel pump barrel assembly | | | | | | | | | | |
| -3.2 | Replacement of sealing rings on pump barrel | | | | | | | | | | |
| -3.3 | Overhaul of top cover complete | | | | | | | | | O | |
| -4 | Inspection of fuel pump shock absorber | | | | | | C | | | | |
| -5 | Setting and testing lifting gear for fuel pump roller guide | | C | | | | C | | | | |

*) : See Vol. I Operation
**) : See special instructions
C : Check the condition
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A : Adjustment to be carried out

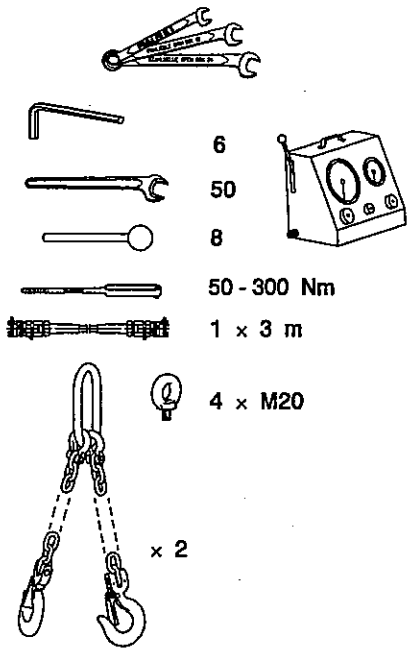
| No. | PROCEDURE | Overhaul to be based on procedure No.: or to refer to: | Check new/overhauled parts after 500 - 1500 hours | Normal hours of service: 2000 hours | 4000 hours | 6000 hours | 8000 hours | 16000 hours | 4 years (survey) | Based on observations | Related procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -6 | Overhaul of fuel valve (C means pressure test only) | | C | | C | | O | | | | 901-2 |
| -6.1 | Overhaul of fuel valve | | | | | | | | | | |
| -6.2 | Overhaul of spindle guides | | | | | | | | | | |
| -6.3 | Pressure testing of fuel valve | | | | | | | | | | |
| -7 | Overhaul of fuel oil high-pressure pipes | | | | | | | | | O | 901-1 |
| -8 | Overhaul of pneumatic reversing mechanism | | | | | | | | | O | |
| | *Inspection of fuel pump roller guide, see procedure 908-4.* | | | | | | | | | | |
| **910** | **TURBOCHARGER SYSTEM** | | | | | | | | | | |
| -1 | Replacement of filter elements in turbocharger inlet | *) | | | | | | | | O | |
| -2 | Overhaul of turbocharger | **) | | | | | O | | | | |
| -3 | Inspection and overhaul of protective grating for turbocharger gas inlet | *(**) | | | | | C | | | | |
| -4 | Cleaning of turbine side of turbocharger | *(**) | | | | | | | | O | |
| -5 | Air cooler | | | | | | | | | | |
| -5.1 | Cleaning of air cooler | *) | | | O | | | | | O | |
| -5.2 | Replacement of air cooler element (aft end & rear side) | | | | | | | | | O | |
| -5.3 | Dry cleaning of turbocharger turbine (aft end & exhaust side) | | | | | | | | | | |
| -6 | Replacement of non-return valve | | C | | | | | | | O | |
| -8 | Replacement of auxiliary blower | | | | | | | | | O | |
| -9 | Check of butterfly valves | | | | | | | | | O | |
| **911** | **SAFETY EQUIPMENT** | | | | | | | | | | |
| -1 | Overhaul and setting of safety valve | | | | | | C | | | | |
| -2 | Relief valve, functional test | | | | | | C | | | | |
| -3 | Functional test of alarm system for thrust bearing and slow down/shut down system | **) | C | C | | | | | | | |

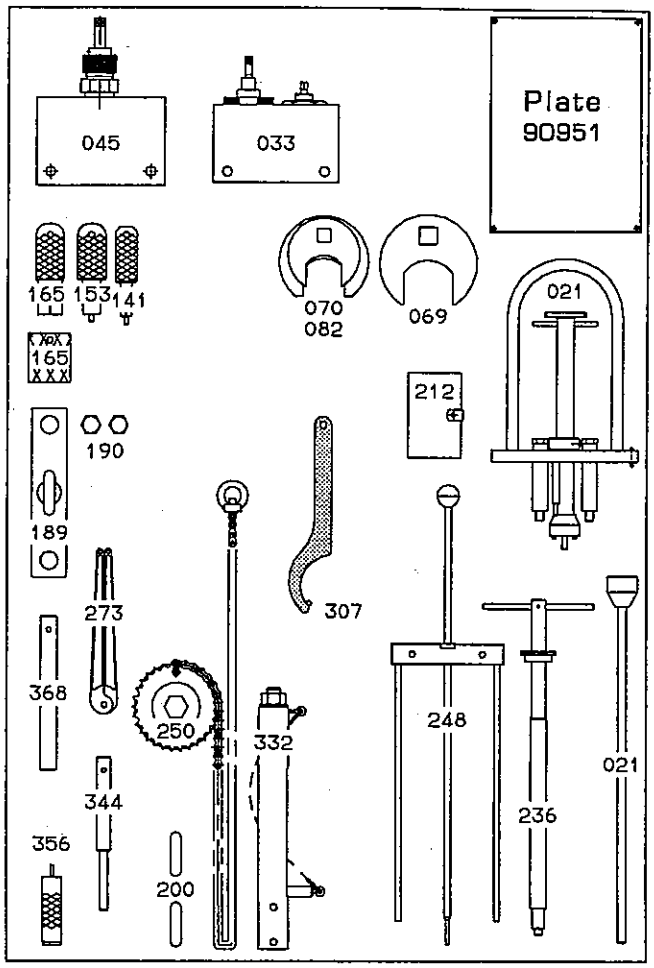
| No. | PROCEDURE | Overhaul to be based on procedure No.: or to refer to: | Check new/overhauled parts after 500 - 1500 hours | Normal hours of service: 2000 hours | 4000 hours | 6000 hours | 8000 hours | 16000 hours | 4 years (survey) | Based on observations | Related procedure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -4 | Checking and adjustment of pressure gauges | **) | | | | | C | | | | |
| -5 | Checking and adjustment of thermometers | **) | | | | | C | | | | |
| -6 | Checking and adjustment of thermostats | **) | | | | | C | | | | |
| -7 | Checking and adjustment of pressurestats | **) | | | | | C | | | | |
| -8 | Checking and adjustment of turning gear switch | **) | | | | | | | | | |
| **912** | **ASSEMBLY OF LARGE PARTS** | | | | | | | | | | |
| -1 | Retightening of holding down bolts, and end chock bolts | | C | | | | C | | | | |
| -1 | Retightening of holding down bolts, and end chock bolts (EPOXY) | | C | | | | C | | | | |
| -2 | Retightening of bolts for cylinder frame | | | | | | | C | | | |
| -3 | Retightening of stay bolts | | C | | | | C | | | | |
| **913** | **GENERAL TOOLS** | | | | | | | | | | |
| -1 | Application of hydraulic tools | | | | | | | | | | |
| -1.1 | Loosening of nut | | | | | | | | | | |
| -1.2 | Tightening of nut | | | | | | | | | | |
| -1.3 | Subsequent checking of bolt tightening | | | | | | | | | | |
| -1.4 | Hydraulic tools – Maintenance | | | | | | | | | | |
| -2 | Hydraulic nut | | | | | | | | | | |
| -5 | Tightening with torque spanner | | | | | | | | | | |
| -6 | Tightening according to tightening gauge | | | | | | | | | | |
| -7.1 | Locking of screws and nuts | | | | | | | | | | |
| -7.2 | Locking of screws and nuts with wire | | | | | | | | | | |
| -11 | Lubricating procedure | | | | | | | | | | |

SAFETY PRECAUTIONS

- [x] Stopped engine
- [x] Block the starting mechanism
- [x] Shut off starting air supply
- [x] Engage turning gear
- [x] Shut off cooling water
- [x] Shut off fuel oil
- [ ] Shut off lubrication oil
- [ ] Lock turbocharger rotors

Standard tools: see Section 913




DATA:

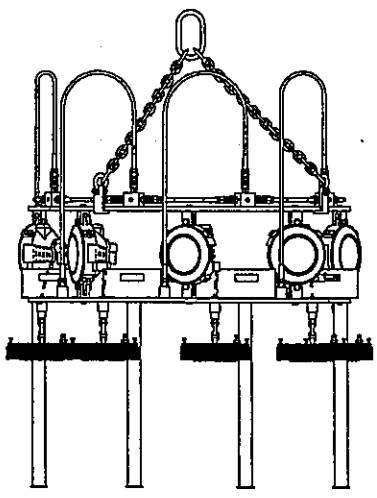
D-1 Hydraulic pressure
for cylinder cover:
– dismantling.....900-990 bar
– tightening..... 900 bar

D-2 Weight of high-pressure
pipe (exhaust valve)..... 18 kg

D-3 Weight of cylinder
cover complete..... 2810 kg

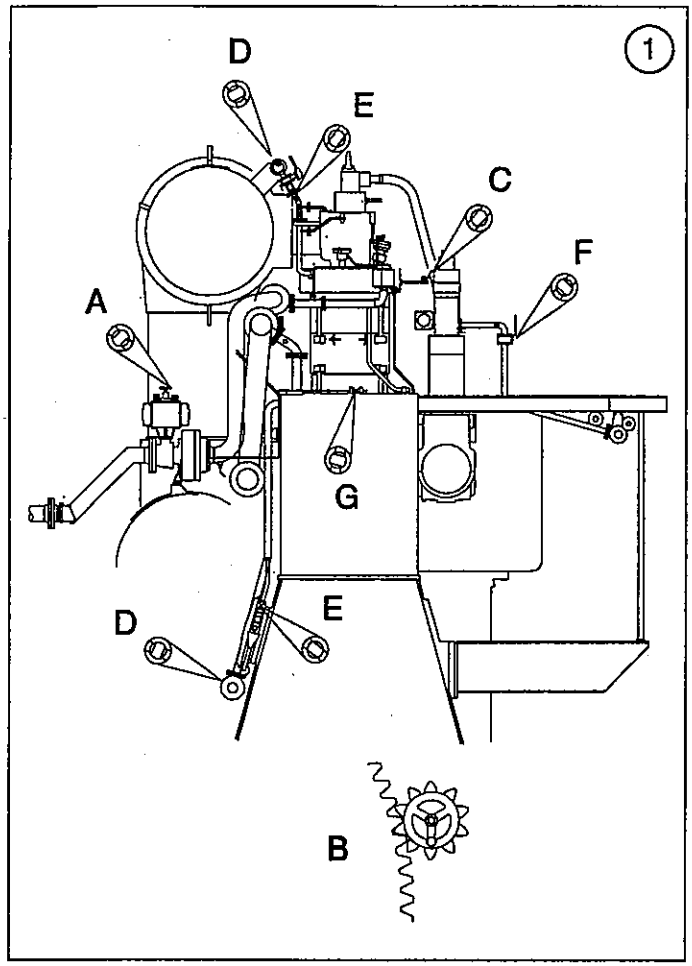
D-4 Tightening torque –
fuel oil high-pressure pipe
(fuel pump/fuel valve)..... 190 Nm

D-5 Tightening torque –
high-pressure pipe
(exhaust valve)..... 70 Nm



# Dismantling of Cylinder Cover






1. A. Set the blocking device on the main starting valve in the BLOCKED position.

   B. Engage the turning gear.

   C. Open the indicator cocks.

   D. Close the inlet and outlet valves for cooling water.

   E. Open the vent and drain cocks for cooling water. As soon as the cylinder cover has been emptied of water, close the drain cocks again.

   F. Close the fuel oil inlet valve.

   G. Shut off the control air supply and safety air supply before venting the manoeuvring system through the ball valve.

   Also shut off the air supply on the reduction unit for the hydraulic/ pneumatic exhaust valve, and vent the system.

   H. Valve for checking of water level, when cooling water is drained during exchange of cylinder cover or piston.

2. Remove the cooling water outlet pipes from the exhaust valve and cylinder cover.

   Remove the screws which fasten the high-pressure pipe to the oil cylinder on the exhaust valve and the hydraulic activator, and lift away the high-pressure pipe.

   Dismount the drain oil pipe between the exhaust valve and the hydraulic activator.

3. Dismount the high-pressure fuel pipes between the fuel pump and the fuel valves.

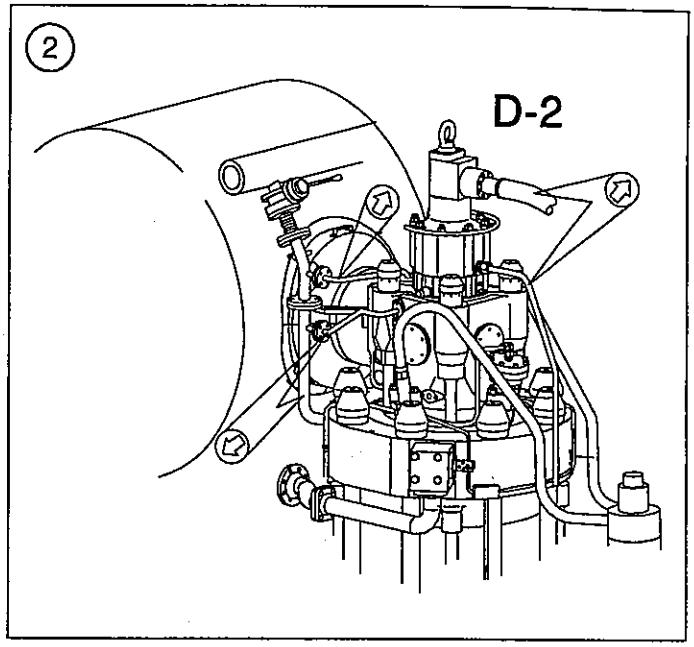
   Dismount the spring housings from the fuel valves.

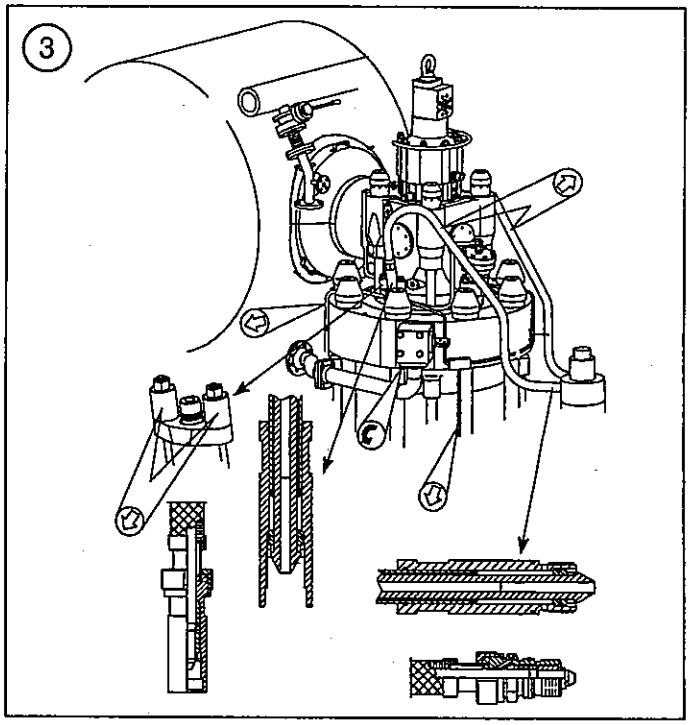
   Dismount the return oil connection from the fuel valves at the fuel pump.

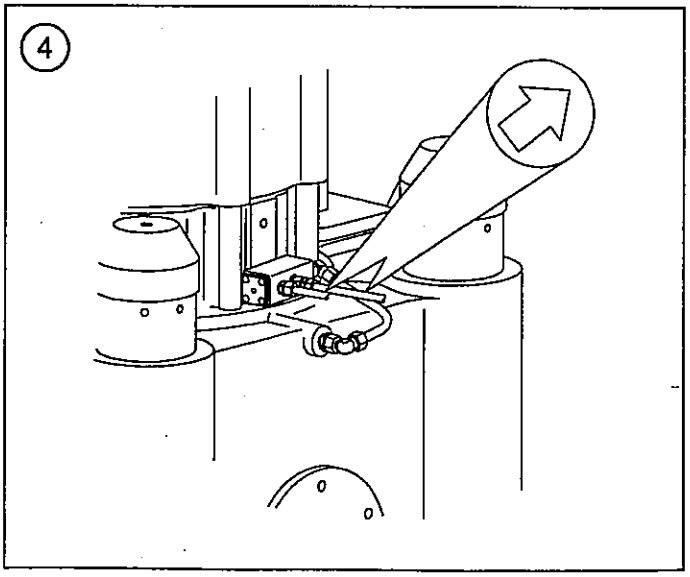
   Dismount the control air pipe from the starting valve.

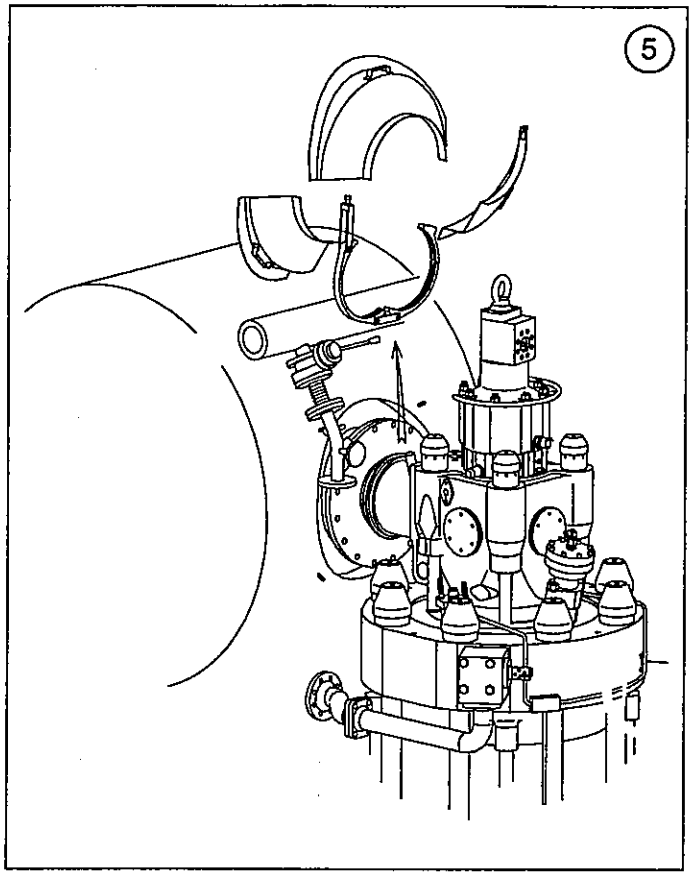
   Remove the screws in the flange connection for the starting air pipe.

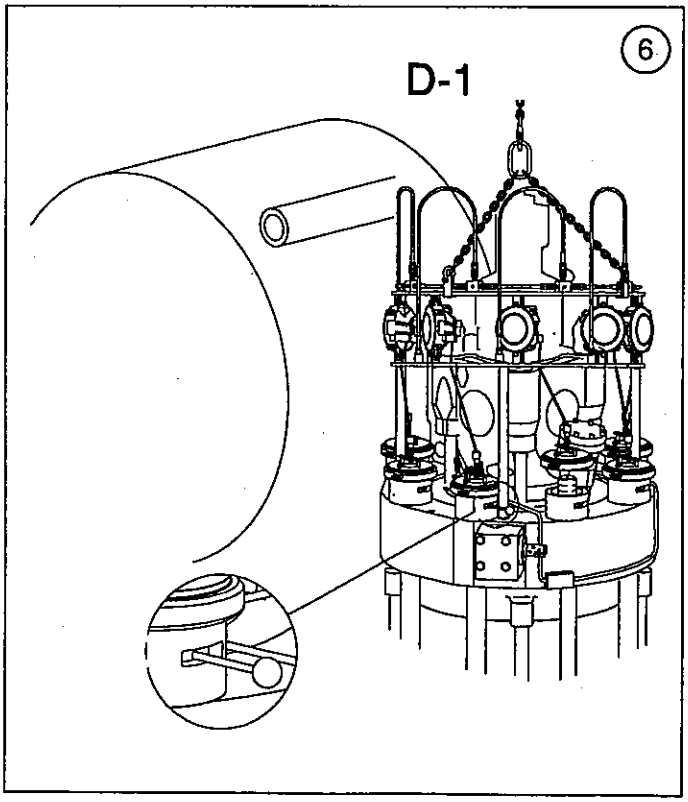
4. Dismount the air pipes for the sealing air control unit.






5. Remove the plate cover and the insulating material from the exhaust receiver and intermediate pipe.

   Dismount the clamp from the exhaust pipe/intermediate pipe flanges.

   Remove the caps from the cylinder cover nuts.

6. Position the cylinder cover tightening tool over the cylinder cover.

   Place the spacer rings over the nuts.

   Pull down the hydraulic jacks of the tightening tool and screw the jacks on to the studs.

   Connect the hydraulic hoses to the jacks and raise the pressure to the level stated in Data. Loosen the nuts with a tommy bar.

   Release the pressure.

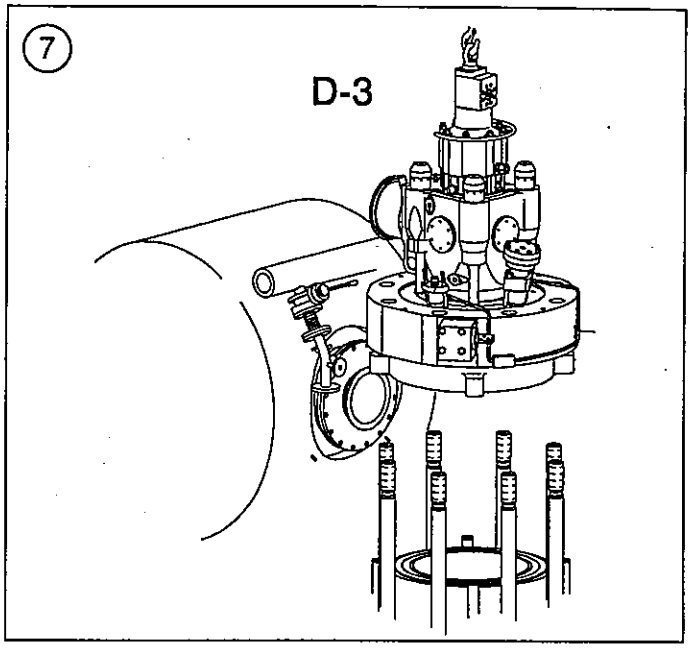
   Remove the hydraulic jacks, the spacer rings and the nuts.

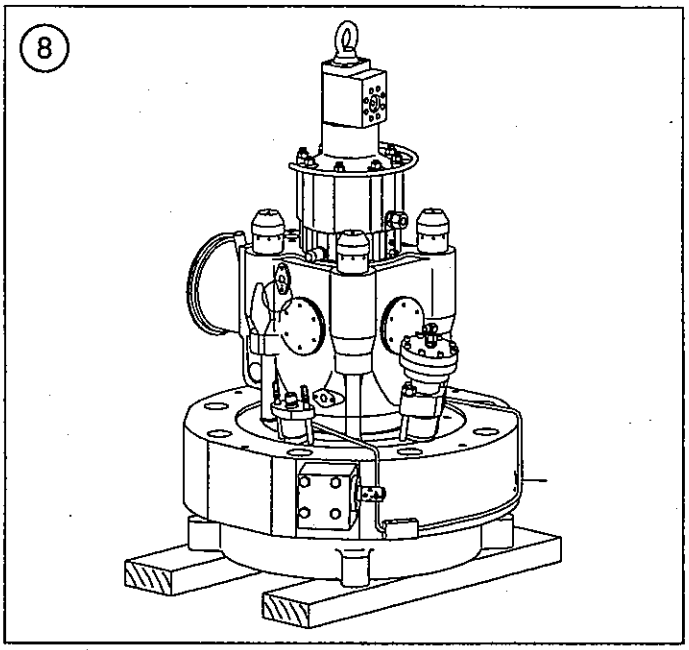
7. Hook the engine room crane on to the lifting attachment on top of the exhaust valve.

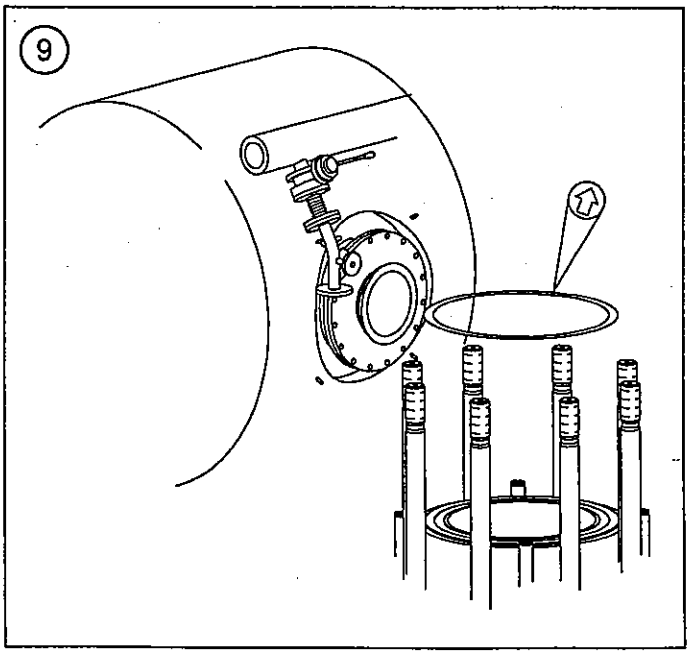
8. Lift away the cylinder cover complete and land it on, for instance, a couple of wooden planks.

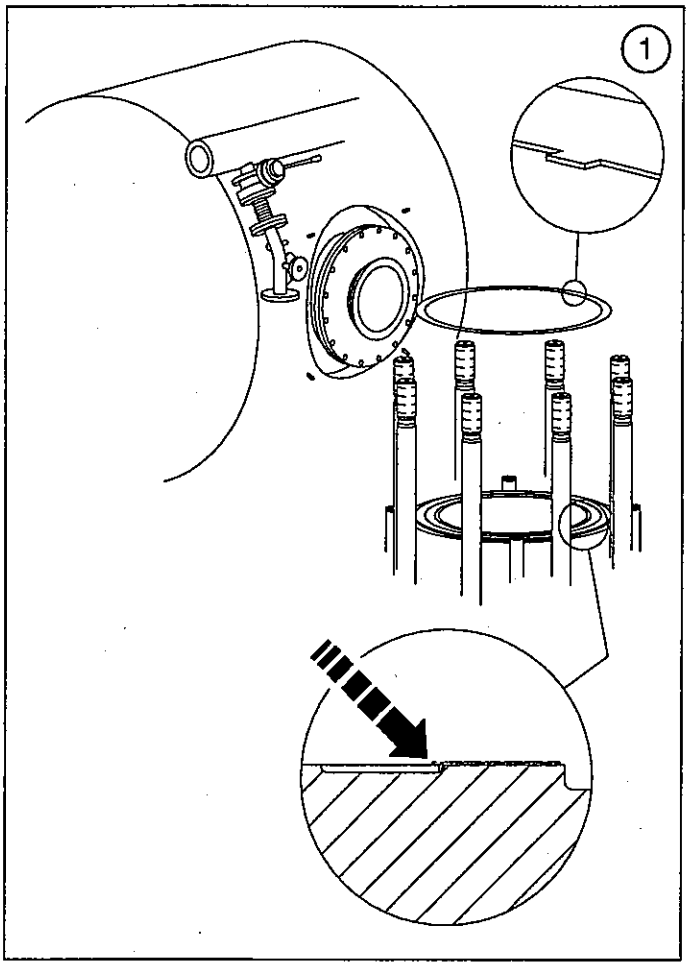
9. Remove and discard the sealing ring between cylinder cover and cylinder liner.

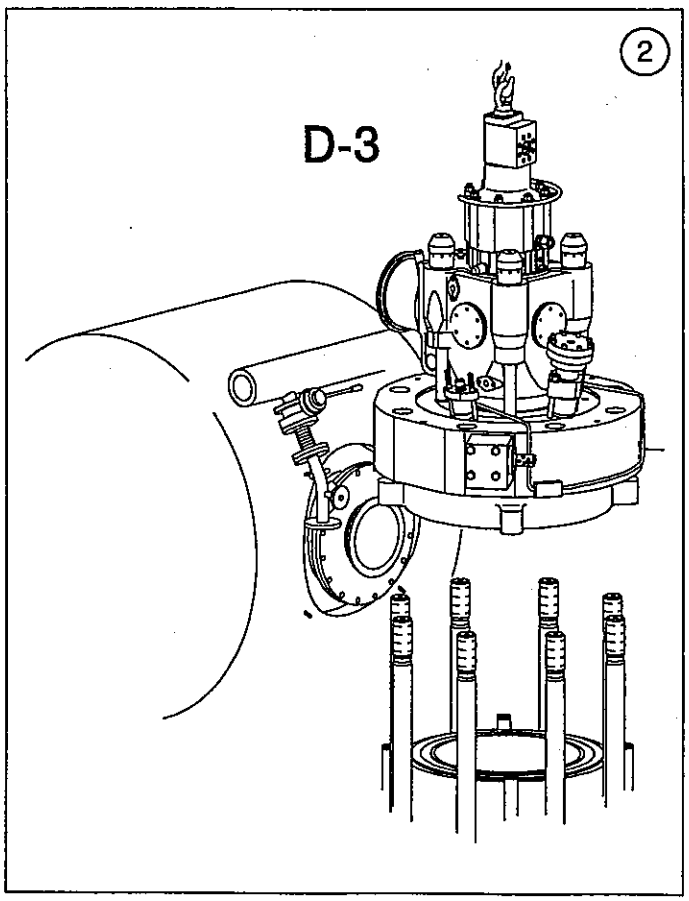
*For overhaul of cylinder cover, see Procedure 901-3.*






1. Place a new sealing ring on top of the cylinder liner and bend the three tabs on the sealing ring by means of a lead hammer.

2. Lift the cylinder cover by means of the crane and carefully wipe the contact surface which faces the cylinder liner.

   Provide the cooling water connecting pipes with new O-rings, lubricating them with grease or soft soap.

   Lower the cover **carefully** into position.

   During the landing, **carefully** check that the cooling water connecting pipes engage correctly with the cooling water connections.

| **Note !** |
| --- |
| To facilitate mounting and dismantling of the flange clamps, and to prevent seizure on account of heating, apply a coat of 'Never Seez NS 160' or a corresponding preparation to:<br>– the contact faces of the flanges (exhaust pipe/intermediate pipe),<br>– the inside of the clamp,<br>– the thread of the clamp screw,<br>– the screws of intermediate pipe/ exhaust valve |

3. Mount all eight nuts on the studs and screw them down to the cylinder cover.

   Place the eight spacer rings over the nuts.

   Position the cylinder cover tightening tool over the cylinder cover.

   Pull down the hydraulic jacks of the tightening tool and screw the jacks on to the studs.
   *For operation of hydraulic jacks, see Procedure 913-1.*

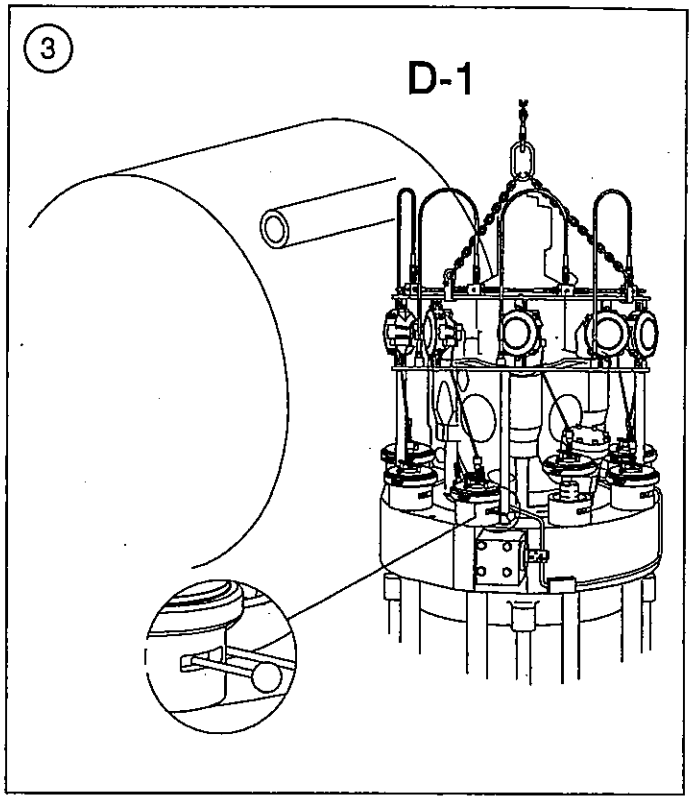
   Connect the hydraulic hoses to the jacks and raise the pressure to the level stated in Data. Tighten the nuts with a tommy bar.

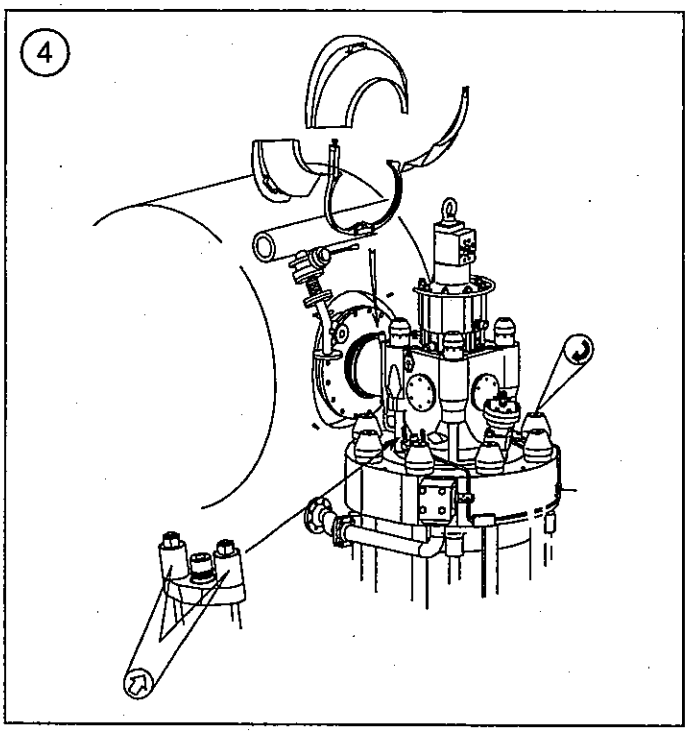
   Release the pressure. Remove the hydraulic jacks and the spacer rings.

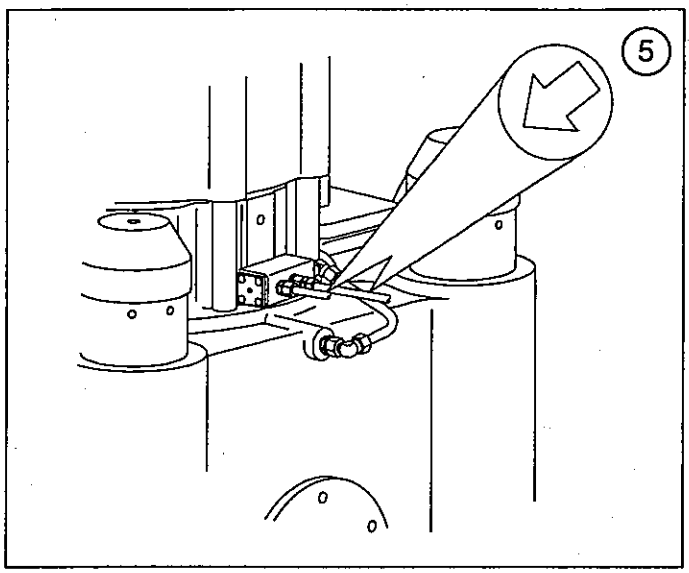
4. Mount the insulating material and the cover plate on the intermediate pipe.

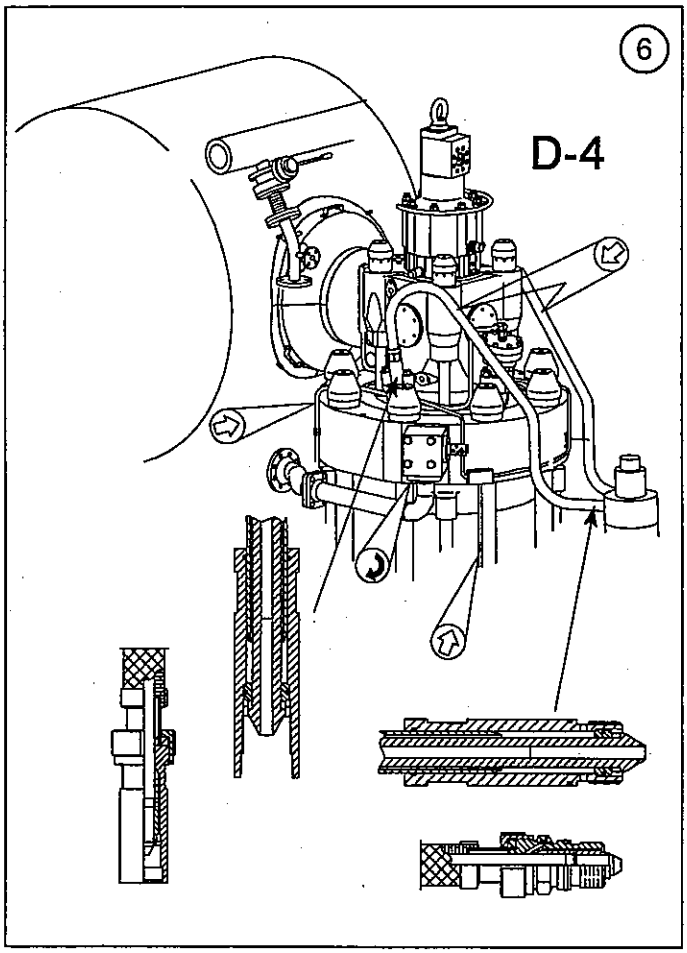
   Mount the caps on the cylinder cover nuts.

   *For tightening of fuel valve, see Procedure 901-2.1.*






5. Mount the air pipes for the sealing air control unit on the exhaust valve. Open the air supply.

| Warning ! |
| --- |
| The air supply to the exhaust valve must always be connected **before** starting the camshaft oil pumps.<br>This is **very** important, because otherwise the valve will open more than intended. |

6. Mount the fuel oil high-pressure pipes between the fuel pump and the fuel valves. Check that the pipes fit properly at the seats and that all parts are clean and provided with new O-rings.

   Lift up the union nuts on the pipes and tighten the coupling pieces with the special spanner head and the torque spanner (*see Data*).

   Lower the union nut and screw it on to the coupling piece by means of the hook spanner.

   Connect the outlet pipes for the return oil connection on the fuel valves.

   Connect the air hoses and outlet pipes to the fuel oil alarm system.

   Mount the control air pipe for the starting valve and fasten the starting air pipe.

7. Mount the high-pressure pipe for the hydraulic valve gear. *See Procedure 908-1.*

   Mount the return oil pipe between the exhaust valve and the hydraulic actuator.

   Mount the cooling water outlet pipes.

8. Shut the drain valves and open the cooling water inlet.

   After venting the cylinder section, shut the vent cocks and open the cooling water outlet valve.

   Open the fuel oil, lubricating oil and air valves.