

## Maintenance schedules

Information to Owners and Operators of  
Wärtsilä – Deutz D816 engines.

### For your information

**Reference**

99 Service information

**Introduction / Background**

The set up of the maintenance schedules  
has been changed.

For parts assignment a reference to the  
Service Calculation Office (SCO) is added.

**Validity / Issue**

Until further notice.

## Instruction

Replace the pages in the operation and / or workshop manual with enclosed pages.

## How to contact Wärtsilä

For questions about the content of this bulletin, or if you need Wärtsilä assistance, services, spare parts and/or tools, please contact your nearest Wärtsilä representative. If you don't have the contact details at hand, please follow the link "Contact us" – "24h Services" on the Wärtsilä webpage: [www.wartsila.com](http://www.wartsila.com)

## Feedback on the content of the bulletin

E-mail to: [service.sales.nl@wartsila.com](mailto:service.sales.nl@wartsila.com)

## Enclosures

Ch. 8 "Maintenance" of the operation manual

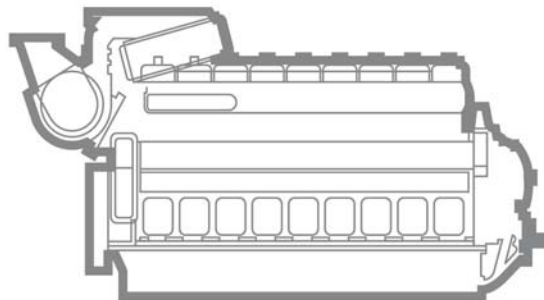
© 2013 Wärtsilä Netherlands B.V. – All rights reserved

No part of this publication may be reproduced or copied in any form or by any means (electronic, mechanical, graphic, photocopying, recording, taping or other information retrieval systems) without the prior written permission of the copyright holder. Wärtsilä Corporation makes no representation, warranty (express or implied) in this publication and assumes no responsibility for the correctness, errors or omissions for information contained herein. Information in this publication is subject to change without notice.

Unless otherwise expressly set forth, no recommendation contained in this document or any of its appendices is to be construed as provided due to a defect of the product, but merely as an improvement of the product and/or the maintenance procedures relating thereto. Any actions by the owner/operator as a result of the recommendations are not covered under any warranty provided by Wärtsilä and such actions will thus be at the owners/operators own cost and expense.

**NO LIABILITY WHETHER DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL, IS ASSUMED WITH RESPECT TO THE INFORMATION CONTAINED HEREIN. THIS PUBLICATION IS CONFIDENTIAL AND INTENDED FOR INFORMATION PURPOSES ONLY.**

- 8 Maintenance**
- 8.1 General**
- 8.2 Routine checks**
- 8.3 Maintenance schedule**
- 8.4 Maintenance parts**
- 8.5 Routine jobs & notes**
- 8.6 Bleeding**
- 8.7 Cleaning the engine**
- 8.8 Mounting the cylinder liners**
- 8.9 Fitting inlet and exhaust valves**
- 8.10 Setting the air starting control system**
- 8.11 Raw water pump**
- 8.12 Bilge pump**



This page is intentionally left blank.

## 8. Maintenance

### 8.1 General

The information given in the maintenance schedules are recommendations based on experience. No guarantee as to the useful life can be derived from this information. The maintenance intervals specified in the tables below apply to the operation of the engine under normal conditions. The following also applies:

- The use of fuels and consumables as stipulated in Section 4.
- Regular monitoring with duly installed and intact equipment.
- Proper and expert completion of all maintenance work.
- Exclusive use of original Wärtsilä Deutz parts. This also includes filters, seals and O-rings, etc.

Depending on the engine application, deviations from these prerequisites may shorten the maintenance intervals

After the maintenance work has been correctly carried out, the operating hours as indicated on the counter, date and signature or stamp must be recorded.

All the fuel system fittings, locking and regulating elements not named in the below tables, as well as those of the pneumatic system, must be maintained in accordance with the manufacturer's instructions.

Maintenance & service schedules		Max. maintenance intervals [hours]	Executed by
<b>E10</b>	After commissioning and 50 running hours after E60 & E70.	-	Technicians
<b>E20</b>	Daily check.	-	
<b>E23</b>	Periodic maintenance (small scope).	250	
<b>E25</b>	Periodic maintenance (small scope).	500	
<b>E30</b>	Periodic maintenance (small scope).	1,000	
<b>E40</b>	Periodic maintenance (medium scope).	1,500	Authorized specialists
<b>E50</b>	Periodic maintenance (extended scope).	2,500 hours	
<b>E60</b>	Intermediate overhaul.	7,500	
<b>E70</b>	Major overhaul.	15,000	

Definition of activities in the maintenance schedule	
<b>Adjust</b>	Adjust torques, dimensions, pressures etc.; extra work may be necessary to renew parts.
<b>Drain water</b>	Drain condensed water for example.
<b>Renew</b>	Renew parts, assembly groups and liquids.
<b>Recondition</b>	Machine material within the set tolerances to reinstate a nominal condition.

Definition of activities in the maintenance schedule	
<b>Check</b>	Check acc. the criteria in the job card or on the measurement record. Rejection of the part, if not all criteria are fulfilled. Visual inspection or dimensional check, adjustment, reconditioning or replacement may be necessary.
<b>Clean</b>	Cleaning by hand or machine, renewal of cleaning parts (e.g. air filters) may be necessary.
<b>Visual Inspection</b>	Visual inspection according to Job Card. Rejection of the part, if not all criteria are fulfilled.
<b>Overhaul</b>	Check assembly groups, rework or renew parts.
<b>Maintain</b>	Maintain according to job card. Checking of functions; reworking or renewal of parts may be necessary.
<b>Change</b>	Change lubricating oil for example.
<b>Note 1:</b>	Cleaning should be done more frequently if increased contamination prevails.
<b>Note 2:</b>	In special (heavier) situations of engine application the maintenance intervals have to be shortened!

## 8.2 Routine jobs

Job number	10 hrs	125 hrs	Job description	To do	Job card	Construction group
1	x		Lubricating oil level	Check		14
2	x		Air filter cleanliness	Check		22
3	x		Cooling water level ( use cooling water additive if necessary)	Check		37
4		x	Concentration of cooling water additive (every 500 hrs when stabilised)	Check		37
5		x	Battery electrolyte level	Check		44

### Maintain logbook

**Intervals above are under normal engine operation conditions**

**8.3 Maintenance schedule**

CG	Job description	250 hrs	500 hrs	1,000 hrs	1,500 hrs	2,500 hrs	7,500 hrs	15,000 hrs	Workshop Manual DZ02911898	Workshop Manual DZ02911949
		E23	E25	E30	E40	E50	E60	E70		
1	Clean crankcase breather							X	3/18 - 3/19	3/23 - 3/26
4	Service cylinder liners							X	4/1	
5	Renew vibration damper							X	4/12 - 4/18, 4/21 - 4/26	3/27 - 3/33, 3/36 - 3/41, 4/27 - 4/33
5	Service crankshaft and main bearings							X	3/12 - 3/17	3/18 - 3/22
6	Service connecting rods and bearings							X	3/12 - 3/16	3/14 - 3/17, 4/8 - 4/11
7	Service pistons and rings							X	2/1	2/1 - 2/3
8	Check valve clearance		X	X	X	X	X	X	5-25	
8	Check compression					X	X		2/2	2/4 - 2/5
8	Service cyl. heads, valves, guides, seats, valve drive, starting air valves						X	X	3/1 - 3/11, 5/21	3/1 - 3/13, 4/1 - 4/7
10	Service camshaft							X	4/18 - 4/19, 4/26	3/28, 3/34 - 3/35, 4/31 - 4/33
9	Service distribution gear and crankshaft seals							X	4/1 - 4/11, 4/19 - 4/20	4/12 - 4/23, 4/24 - 4/26, 4/34 - 4/36
16	Renew engine lubricating oil		X	X	X	X	X	X	-	-
15	Clean lubricating oil cooler							X	6/13 - 6/17	3/42 - 3/50
14	Service lubricating oil pump							X	6/5 - 6/8	
16	Check valve seat lubricating system: Measure oil quantity					X	X	X	5/22 - 5/25	3/102 - 3/105
16	Renew valve seat lubricating pump							X	5/22 - 5/25	3/102 - 3/105
15	Renew lubricating oil filter		X	X	X	X	X			
15	Service lubricating oil filter housing changeover valve							X	6/8 - 6/10	3/82 - 3/85
15	Clean centrifugal lubricating oil filter	X	X	X	X	X	X		6/11	3/86 - 3/87
17	Check fuel injection pump coupling					X	X	X	5/1 - 5/8	2/6 - 2/7
17	Check fuel injection pump timing					X	X	X	2/6 - 2/7	2/8 - 2/11
17	Service fuel injection pump						X	X	5/1 - 5/4	3/106
27	Service governor + injection timer							X	5/9 - 5/19	3/98 - 3/101
18	Service fuel injection pump drive							X	5/22 - 5/25	3/102 - 3/105
19	Renew fuel injectors							X	2/8, 5/20	2/12 - 2/14, 3/107 - 3/109

CG	Job description	250 hrs	500 hrs	1,000 hrs	1,500 hrs	2,500 hrs	7,500 hrs	15,000 hrs	Workshop Manual DZ02911898	Workshop Manual DZ02911949
		E23	E25	E30	E40	E50	E60	E70		
20	Clean fuel oil filter			X	X	X	X		2/8, 5/20	2/12 - 2/14
20	Renew fuel filter elements							X	-	-
20	Renew flexible hoses							X	-	-
21	Check fuel oil injection piping		X	X	X	X	X	X	-	-
21	Check lp fuel lines and leak-off lines					X	X	X	-	-
22	Clean air intake filter							X	-	-
8	Check heater plugs					X	X	X	-	-
30	Service starting air distribution						X	X	5/21	-
44	Service auxiliary drive							X	6/23 - 6/25	-
38	Check concentration of		X	X	X	X	X	X	6/18 - 6/19	3/91 - 3/94
37	Service fresh water circulation pump						X	X	7/1 - 7/4	3/57 - 3/60
37	Service raw cooling water pump						X	X	-	-
37	Lubricate bearings of raw		X	X	X	X	X	X	7/5 - 7/10	3/51 - 3/56
36	Renew cooling water thermostats							X	7/13 - 7/26	3: Steimel 1-5
44	Lubricate ball bearings in idler pulley (renew bearings if necessary)					X	X	X	-	-
41	Check exhaust piping tightness					X	X	X	6/13 - 6/17	3/42 - 3/50
41	Check fastenings of exhaust manifold						X	X	7/11 - 7/12	3/61 - 3/63
43	Service turbocharger						X	X	8/7	5/13 - 5/14
48	Check sensors of monitoring, safety and control system					X	X	X	-	-
27	Service tachometer, including drive							X	8/5, 8/8 - 8/14	5/1 - 5/5, 5/15 - 5/57
44	Check v-belt tension and condition	X	X	X	X	X	X	X	6/20	-
38	Check cooling water preheater						X	X	6/20	-
99	Check test run the engine at load							X	-	-
19	Service fuel injectors				X	X	X		-	3/95 - 3/96
15	Remove and refit centrifugal lube oil filter							X	7/35 - 7/39	3/77 - 3/81
44	Service generator and starter motor			X	X	X	X	X	8/5 - 8/6	5/5 - 5/8



CG	Job description	250 hrs	500 hrs	1,000 hrs	1,500 hrs	2,500 hrs	7,500 hrs	15,000 hrs	Workshop Manual DZ02911898	Workshop Manual DZ02911949
		E23	E25	E30	E40	E50	E60	E70		
36	Service cooling water heat exchanger			X	X	X	X	X	-	-
36	Check cooling water heat			X	X	X	X	X	-	-
58	Clean charge air cooler, air			X	X	X	X	X		
87	Remove and refit charge air pipe			X	X	X	X	X		

**Intervals above are under normal engine operation conditions**

- \* 250 running hours under heavy operation conditions.
- \*\* Check the tightness of bolts after 250 running hours, when the gaskets from the exhaust gas connection of cylinder head have been renewed.

This page is intentionally left blank

## **8.4 Maintenance parts**

For business activities it is necessary to make fast offers. For this purpose there is a calculation application in Wärtsilä's portal: Service Calculation Office (SCO). The function of SCO is to aid in the making of service agreements by calculating the maintenance work costs, spare parts cost, personnel cost and operations cost.

The BAM816 is one of the engines that is added to the SCO database. To obtain data from SCO access to the Wärtsilä portal is necessary. The Wärtsilä service units have this access.

The report from SCO is indicative! As soon as an order is assigned, it is absolutely necessary to have the indicative parts checked whether the parts can be used for the specific engine. The engine number should be used to confirm the engine configuration.

This page is intentionally left blank.

## 8.5 Routine jobs & notes

### 8.5.1 Engine oil level

Oil consumption of new engines is normally higher than that of older ones. Therefore the oil level has to be checked twice a day during the running-in period (appr. 200 running hours), after which one check a day will be sufficient. Check level daily or every 10 working hours respectively with the engine stopped and standing on a horizontal level. To do this, withdraw dipstick, wipe off with a non-fraying rag, reinsert as far as it will go and take out again: the level should have reached to somewhere between the upper and bottom marks, preferably up to the upper mark. (Where the dipstick is of the screwed type. It must nevertheless only be inserted for checking purposes.) If it reaches only to the lower mark, top up immediately, or serious damage to the engine may result.

### 8.5.2 Cooling water

Check level daily. In case of leakage loss top up in time with soft water as indicated in Section 6.3.

When refilling cooling water on versions having no venting pipe, the cooling system is to be vented through the drain plugs of the cooling water outlet pipes on the right and left hand sides. If temperatures are low, see Notes on Section 4.5.

### 8.5.3 Air cleaner (with engine stopped)

#### - Oil bath air cleaner

Service the cleaner every 10 to 60 hours as determined by the dust content of the air drawn in. To do this, the engine must have been stationary for at least one hour permitting all oil to have dripped into the bowl at the bottom. On loosening the fasteners, the bowl can be easily removed. Next give the lower element a side blow hand so this too can be easily removed. Discard the contaminated oil and clean the two stripped components in diesel fuel.

When the fuel has dripped off thoroughly from the bowl, refill the latter with fresh motor oil and refit along with the cleaned element.

Where the dust content of the ambient air is not unduly high. remove oil bath air cleaner once a year and clean the upper metal wool element, which is a fixture in the cleaner, by dipping it several times in diesel fuel. Where the dust content is high do this twice a year.

#### **Be sure not to damage the rubber gasket!**

Where the engine has to operate in particularly dust-laden air, the oil bath air cleaner is usually fitted with a cyclone-type pre-cleaner, the dust trap of which should be emptied frequently. In no event must oil be poured into this trap.

**Failure to service the air cleaner properly will result in lower power output and higher wear and tear.**

- **Wet-type air cleaner**

When a deposit of dust is easily recognizable on the filter element, remove the element, clean it in clean diesel fuel and shake it off. Dip the element in a bath of oil and again vigorously shake it off. When reassembling, ensure perfect tightness.

- **Paper-type air cleaner**

Clean the dust collector daily according to the amount accumulated. (Be sure never to fill collector with oil!).

On the running engine the laterally mounted service gauge keeps displaying a red signal, although the paper element may be still clean. Therefore, servicing is only required once the red signal stays on when the engine is stopped

The cleaning procedure is as follows: Carefully blow air of less than 5 bar over element exterior and interior or carefully knock element front on all level base. A third alternative is washing the element in lukewarm water using a non-foaming detergent. Element replacement is due not later than after the element has been cleaned 5 times. A filter element soiled by exhaust gases drawn in cannot be cleaned and must be replaced.

**Be sure to re-use only elements that are perfectly intact.**

### **8.5.4 Intake pipe**

Check for freedom from leaks after commissioning.

### **8.5.5 Battery electrolyte**

Every 125 working hours, or every four weeks at the latest, unscrew the caps of the individual cells and introduce a clean wooden stick down to the lead plates; after withdrawal the stick must be moist over a length of 10-15 mm (0.4 to 0.6 in). If the electrolyte level is lower top up, but only with distilled water. If temperatures are low, see Section 4.5.

### **8.5.6 Valve clearance**

Every 500 working hours or at every motor oil change check the valve clearance. when the engine is cold (no sooner than 30-60 minutes following engine shutdown), with a feeler gauge of 0.30 mm (0.012 in) for inlet and 0.45 mm (0.018 in) for exhaust.

To do this, remove the cylinder head cover and turn the engine over with the lever included in the toolkit at the flywheel or clutch respectively until both valves of one cylinder are closed, and check that both respective pushrods can be easily rotated below the adjusting screws. Now insert the feeler gauge in the gap between the respective valve and the rocker arm pad and check that this involves a slight drag. If the gap is found too large or too small, release the lock nut and turn the adjusting screw in such a manner that - with the lock nut retightened - the gauge can now be withdrawn with a slight drag.

### 8.5.7 Motor oil change

Change oil according to Maintenance Schedule.

(Viscosity see Section 6.2).

In the case of engines not in regular service. e.g. engines on standby duty, change oil at least once a year.

Regarding new and overhauled engines see Section 4.6.

Be sure to drain old oil in hot condition, since oil will then run out more easily.

Proceed by removing drain plug on engine sump and oil filter.

After refitting drain plugs, fill in fresh oil through neck **up to top mark**, and following a brief test run add oil as required.

**Oil capacities at oil change see Section 3.1.**

### 8.5.8 Strainer with paper elements

Every 500 hours drain oil at the plugs of the filter body. Unscrew clamping bolts at filter top and take out bowls, strainer and paper elements. Brush strainers in clean diesel fuel and renew paper element in any case. When reassembling, ensure perfect tightness.

### 8.5.9 Centrifugal oil cleaner

Every 250 hours release outer fasteners and remove body top. Take rotor out of body and clamp down in a vise at the chuck faces of the rotor base. Release top nut by wrench, remove rotor cap and replace paper sleeve, where no sleeve is fitted, clean rotor cap inside. When reassembling, check that the internal cast-on circular segment of the cap engages in the large recess of the sleeve on the base. Check also that the O-seal is properly located.

### 8.5.10 Fuel filter

Clean tubular felt filter every 1000 hours or earlier as engine power falls off.

### 8.5.11 Filter without tray

Push down selector lever toward filter section to be cleaned. Release bleed plug. Release clamping nut, remove cover and withdraw element. Close element by the two plugs of the cleaning attachment Included In the toolkit. Dip element into a vessel containing clean diesel fuel, seeing to it that the hose remains dry. When the felt is fully saturated, vigorously blow through the hose by tyre pump or air blast so as to produce air bubbles on the felt outside. Brush off the dirt emerging with the bubbles. Repeat this procedure with fresh cleaning fluid until the fluid is no longer contaminated. When reassembling, ensure perfect tightness. Air-venting see page For bleeding the cleaned chamber. open screw through one or two turns. With the engine running, slowly move lever to intermediate position (both chambers becoming operative) until air noticeably comes out through screw opening. Once fuel free from bubbles comes out, close screw.

### 8.5.12 Filter with tray

Release wing nut and remove tray cover. Then proceed as under 8.5.11.

### 8.5.13 Water coolers

Clean coolers every 1000 hours or earlier as the water temperature exceeds 90°C (see Section 6.3).

### 8.5.14 Flat-tubular heat exchanger

Drain water, remove cover after unscrewing bolts and withdraw nest of flat tubes. Immerse nest in a hot water solution (P 3) until the dissolved incrustations can be removed by water jet. Before refitting nest. check that sealing strips on both sides of the base are clean.

### 8.5.15 Radiator

Clean water side as under 8.5.13 and the-air side as governed by the degree of soiling, using water or compressed air.

On engines with mounted duplex-type cooling water pump and two-circuit cooling system (charge air and engine cooling), it will be necessary to install a pipe between the two separate expansion tanks, if provided.

For topping up cooling water. check that the level is 2 or 3 cm below the top edge of the filler hole.

### 8.5.16 Fan belt

Even if only one fan belt should have failed, be sure to replace the entire belt set. Check that all new belts are of equal length within  $\pm 0.15\%$ .

### 8.5.17 Raw water pump belt

When a new belt set has been fitted, check with 50 N pressure that slack between crankshaft gear and pump gear over the greater length is some 15 mm. After a 8.1.18 running-in period of some 30 min. check that slack is some 17 mm as for used belts, which must also be tested with 50 N.

### 8.5.18 Charge air cooler

Where engines are fitted with a charge air cooler in the raw water circuit, remove this cooler and clean as under 8.5.14 or when charge temperatures exceed 50 °C.

### 8.5.19 Raw water filler

On engines with mounted heat exchanger and raw water pump be sure to use raw water filters with a mesh of 4 mm dia. or 3 mm x 3 mm respectively.

Where auxiliary sets are primarily used in harbour waters, clean filter at sea and run engine briefly.

Where heat exchanger and raw water pump are not supplied by this company, read the instructions of the makers carefully. Also, if the charge air coolers are in this case embodied in the raw water circuit, the raw water filter mesh must again be 4 mm dia. If no change-over type duplex filter is provided, be sure to stop the engine for cleaning purposes, so that impurities from the filter elements will not enter the clean water side.



### 8.5.20 Temperature indicator

Every 1000 hours remove engine temperature indicator. Dip sensor in boiling water and check that the reading is 98 °C to 100 °C.

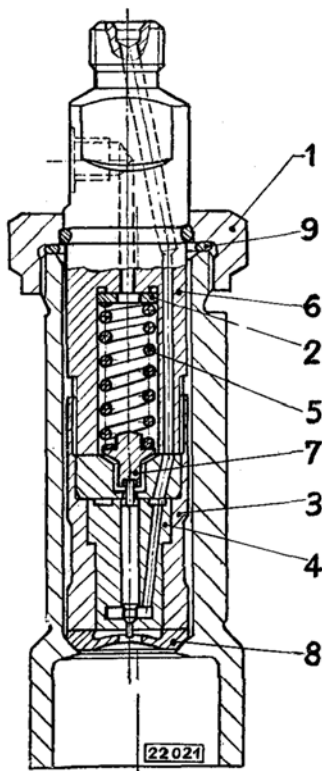
### 8.5.21 Generator

Every 1000 hours have the generator inspected.

### 8.5.22 Starter motor

Every 1000 hours have the starter motor inspected. At this stage the motor normally only needs lubrication. Every 2000 hours, however, have it thoroughly cleaned.

### 8.5.23 Injectors



Every 1500 working hours the injection nozzles should be removed and properly cleaned in diesel fuel. Make sure at the same time that the injection release pressure is according measurement record MR716/19/01.

To this end, unscrew union nut 1, remove nozzle holder and check pressure on the special testing outfit. If adjustment is required, unscrew nozzle clamping nut 3. take out nozzle 4 and spring 5 and fit shims 2 between holder body 6 and spring 5. When reassembling, check that plunger 7 is located with the drilled shoulder facing the nozzle needle.

Whenever assembling or testing a nozzle holder be sure to renew heat shield 8 and washer 9.

**For disconnecting injection lines from the associated injectors, be sure to remove all pipe clips!**

### 8.5.24 Special notes on exhaust piping

After the first 20-50 working hours. retighten bolts of manifold sections and expansion joints. Unscrew expansion joints before removing cylinder heads. Align heads with a steel rule before fitting the piping.

If expansion joints of the metallic bellows type are provided, check that the flared bore of the Inner tube points in the direction of flow.

Wet all bolts with molybdic disulphide. e.g. Molykote or Never-Seez.

## 8.6 Bleeding

The fuel system must be vented if the fuel tank has run dry, if the fuel filter has been removed or if injection lines have been dismantled. Proceed as follows:

### 8.6.1 Venting the fuel filter

Slacken both vent plugs on the built-on fuel filter for 2 or 3 turns and wait until fuel issues free from air bubbles. Where a feed pump is mounted, operate the priming pump.

### 8.6.2 Venting the injection pump and injection lines

To vent the injection pump, slacken the overflow valve for 2 or 3 turns. Loosen knurled handle of priming pump by a few turns to the left and operate pump by pulling and pushing until fuel emerges free from air bubbles at the overflow valve. Retighten overflow valve and be sure to **retighten also the priming handle**.

To vent the injection lines, slacken union nut at the respective line end on the injector for 2 or 3 turns and operate starter motor until fuel free from bubbles appears here too.

## 8.7 Cleaning the engine

The exhaust manifolds are packed in Insulation material. On no account must this insulation material come into contact with Inflammable agents (such as fuel etc.) used for cleaning the engine, otherwise the agent will soak into the insulation material and subsequent running of the engine will cause an acute danger of fire.

## 8.8 Mounting the cylinder liners

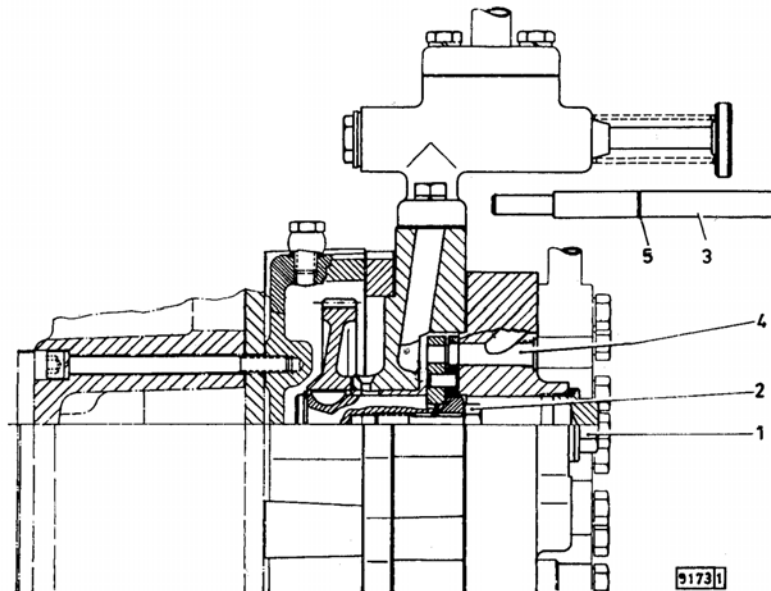
Whenever fitting a liner, be sure to renew O-seals and gaskets.

## 8.9 Fitting inlet and exhaust valves

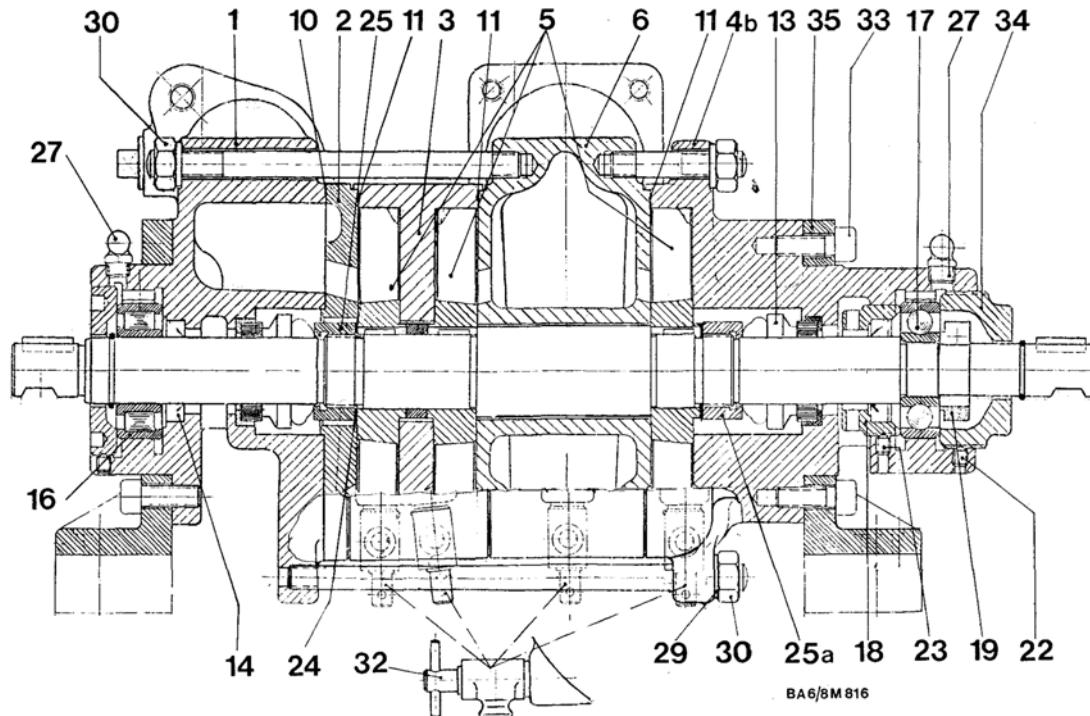
Never interchange valves, or leaks may occur. If necessary, regrind valves. Apply oil to stems before fitment.

### 8.10 Setting the air starting control system

- Unscrew plug 1 and square socket-head plug, loosen hex. bolt 2 and slightly retighten.
- Insert setting pin 3 into aperture 4 and turn engine over with bar until pin 3 can be pushed into marking groove 5.
- In this position loosen hex. bolt 2 still more and turn engine over until No.1 piston is in compression TDC.
- Then continue turning in accordance with the following instructions:
  - Rotate anti-clockwise 92° (392 mm on ring gear periphery) after cyl. No.1 TDC
  - Rotate clockwise 34° (177 mm on ring gear periphery) after cyl. No.1 TDC
- Preload bolt 2 through 20-30 Nm, tighten through 60° and refit screw plug 1 with washer.
- Pull out setting pin 3 and refit square socket-head plug with washer.



## 8.11 Raw water pump



Since all self-priming centrifugal pumps are sensitive to foreign particles, they should never be used without a filter.

Also, when fitting pumps keep the connection bores covered up until the pipes are actually connected. Should foreign matter such as residues from welding operations find its way into the pump interior, impellers are liable to break right on starting up for the first time. To permit self-priming, the pump must be filled before such start-up or whenever the pump has been completely drained.

Complete draining is also essential when frost is imminent. To do this, open valves 32 located at the lowermost point of the duct.

The pump shaft is carried in bearings 16 and 17; which must be serviced with a high quality ball bearing grease through nipples 27 at intervals of 500 working hours. No further maintenance is required.

If after a major service period, water leaks out heavily through the leak water slots, the packing is defective and should be renewed at the next opportunity. If for any reason the packing cannot be replaced immediately, the water can be drained through the slots provided for this purpose. The slots must never be closed up, otherwise water will find its way into the bearings and destroy them soon.

### 8.11.1 Dismantling

Dismantling is started on the setting side (part 4b) and carried out in the following sequence:

Loosen grub screw 22, unscrew cap 34, unscrew clamping nut 19, withdraw ball bearing from shaft.

Following this remove hex. socket-head screws 33 and base ring 35. Unscrew nuts 30 and take down locks 29. Withdraw cover 4b or housing 1, leaving shaft seals 14 and the drive-side roller bearing 16 in place.

Slip ring packings 13 can also be replaced without further dismantling the pump. For replacing defective impellers, remove packings 13 on both sides, gaskets 10, adapter 2 and gaskets 11. Finally unscrew threaded rings 25 and 25a, enabling impellers 5 and centre piece 3 to be taken down.

### 8.11.2 Refitting

For reassembling the pump be sure to start in the middle. I.e. fit impellers 5, centre piece 3 and adapter 6 plus gasket 11 on the shaft and securely tighten locking plate 24 by threaded ring 25. There upon place rotor-side gasket 11 slightly saturated with oil and fit adapter 2 in recess. Before putting housings 1 or covers 4b respectively in place, slip packings 13 on both sides onto the shaft and add gaskets 10. After fitting lock-washers 3, pull housing components together by hex. nuts 30.

Following this insert circlip 37, slip ball bearing 17 on the shaft, screw clamping nut 19 in place.

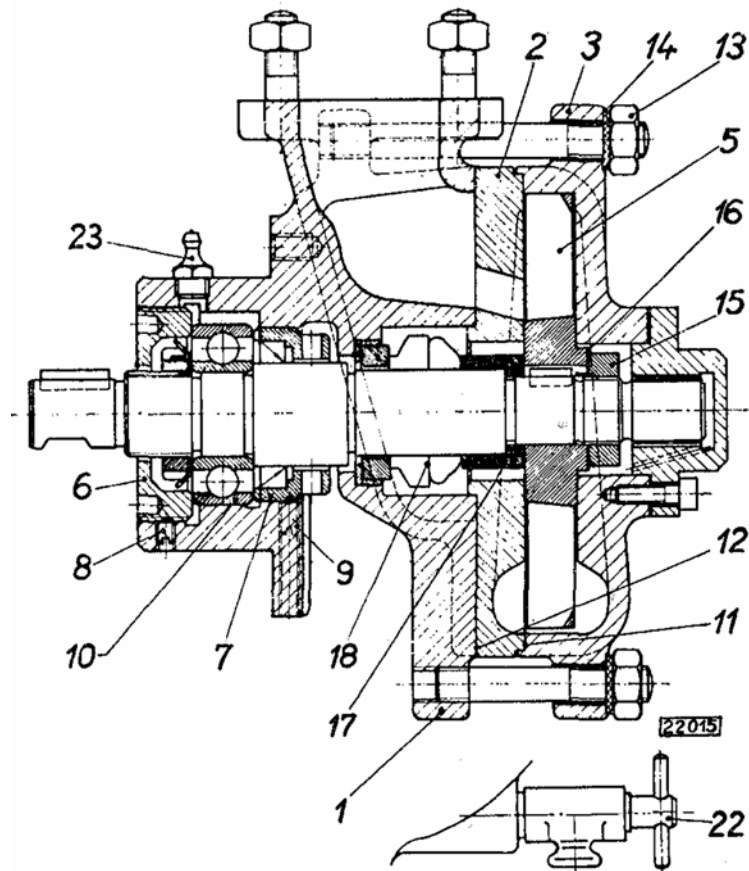
Reassembly is completed by screwing cap 34 in place and securing it with grub screw 22.

Output-side ball bearing 17 is adjustable to prevent side contact of the impellers. Bearing adjustment is not necessary where the previous dismantling procedure does not involve adjustment of setting ring 18 nor releasing the grub screw which locks the ring. Bearing adjustment is however required for balancing tolerances after a new shaft has been installed.

Adjustment is made by means of a piece of 5 mm dia. rod through the leak water slot, while cap 34 is unscrewed. Pull shaft in for ward direction by tightening setting ring 18 until the impellers bind laterally so the pump cannot be turned by hand. Screw cap 34 tightly in place and mark this position by centre punch or chisel. Release cap 34 and repeat the same procedure in the other direction. Turn back setting ring 18 and tighten cap 34 until it is located mid-way between the two markings. Now tighten setting ring 18 securely, enabling the Impellers to rotate freely. Lock position of setting ring and cap by tightening grub screws 22 and 23.

Impeller clearance with new pumps should be max. 0.1 mm each side.

## 8.12 Bilge pump



The bilge pump, too, is of the self-priming type that must not be operated without a filter. When frost is imminent with the engine stationary, the pump must be drained by opening valve 22. After complete draining as well as for first starting up, the pump must be filled.

At one end, the pump is carried in a ball bearing, and at the other end in a water-lubricated friction bearing. While the latter needs no servicing, the ball bearing must be lubricated by applying high-grade ball bearing grease to nipple 23 at intervals of 500 hours or so. No further maintenance is required by this pump. (See also Raw Water Pump as described heretofore.)

### 8.12.1 Dismantling

Dismantling of the bilge pump is much easier than that of the raw water pump. By merely pulling off cover 3, unscrewing nuts 13 and taking down locks 14 it is possible to gain access to impeller 5. After unscrewing nut 15 and taking down lock 16 the impeller can be withdrawn from the shaft and replaced, if necessary. Likewise, after removing impeller 5, adapter 2 and thrust ring 17, the slip ring packing 18 can be renewed.

### **8.12.2 Refitting**

Bilge pump reassembly is likewise comparatively simple. It is performed in the reversed order to the dismantling procedure. Be sure, however, to renew paper gaskets 11 and 12 after wetting them somewhat with oil.

Unlike the raw water pump, it is here the drive-side ball bearing 1 that is adjustable in order to provide impeller 5 with the correct clearance on either side. No bearing resetting is necessary even following pump dismantling, provided the two grub screws 8 and 9 as well as threaded rings 6 and 7 have not been put out of adjustment. Resetting is only required for balancing tolerances where the shaft itself has been replaced.

Setting is made again with a piece of 5 mm dia. rod through the leak water aperture. Impeller 5 is brought into contact with both sides, both fore and aft, while tightening the ball bearing and marking both settings on the outer threaded ring 6. Now turn ring 6 to mid-way between both marks and pull inner threaded ring 7 again tighten against ball bearing 10. Secure both rings by grub screws 8 and 9, so impeller 5 can run freely.

Impeller clearance on either side in new condition is again max. 0.1 mm.

This page is intentionally left blank.