

# 575

# 615

# 825

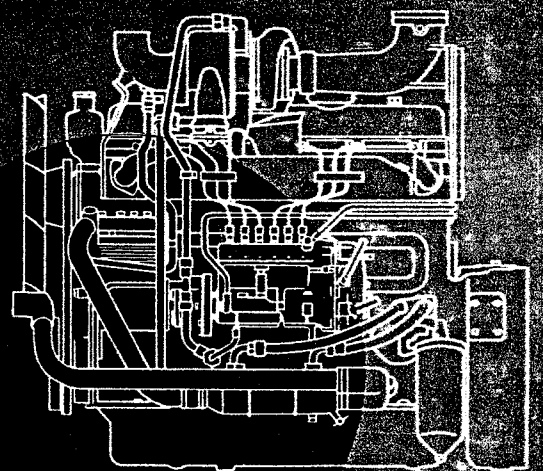
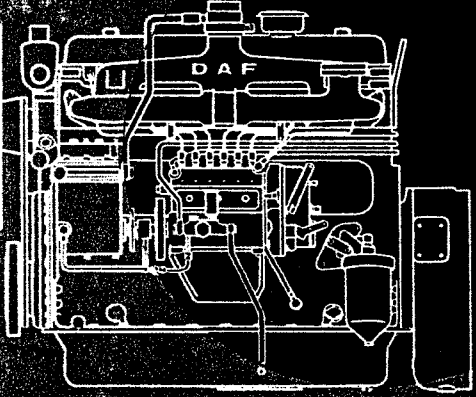
# 1160

DD

DF DT

DFD DTD DSD DTD DKS

operator's manual for marine engines



**DAF Diesel**

# **Operator's manual for marine engines**

**DD 575 M  
DF 615 M  
DT 615 M**

**DAF Diesel**

Town Seiny 0866 261111

Marine 9 Inoussine - Daimler Diesel

**ENGINE INFORMATION**

ENGINE TYPE ..... DAF DD575 .....  
ENGINE NUMBER.....  
SPECIFICATION NUMBER .. 401084 .....  
PUMP SETTING..... 11.6cc .....  
INJECTION TIMING..... 23° BTDC .....  
MAXIMUM SPEED UNDER LOAD .. 2400 .....

This manual deals with the operation and minor maintenance of DAF diesel engines for marine purposes.

The contents of this book is correct at the moment of going to press. DAF-Diesel, however, reserves the right of introducing modifications without previous advice.

Eindhoven, July 1980  
DAF-Diesel  
Service Promotion

## Introduction

This manual covers the DAF Diesel engines of the 575 and 615 series for marine purposes. The purpose of this manual is to instruct the operator on operation, maintenance and a few minor repairs of the diesel engine.

The maintenance and repair instructions have intentionally been restricted to such operations which the operator is able to perform without extended technical knowledge and without special equipment.

An accurate and punctually carried-out periodic maintenance is the best guarantee for a good and trouble-free operation of the engine. It is necessary, therefore, to carefully observe the instructions regarding preventive maintenance.

The accompanying directory lists the addresses of the DAF dealers specialised in the service to, and the maintenance of, DAF diesel engines.

Should you prefer to carry out the maintenance and repair yourself, then this manual will no doubt prove insufficient.

It is possible then to order a so-called workshop manual for which apply to your dealer. Make sure to observe the warranty conditions then.

It is to be recommended to carefully read this book before starting operation of the engine.

The illustrations do not always show the exact design of the engines as available for various purposes. Possible deviations are, however, of no real importance to the information.

We do hope that this manual will contribute to many years of trouble-free operation of your DAF Diesel engine.

DAF Diesel  
Service Promotion

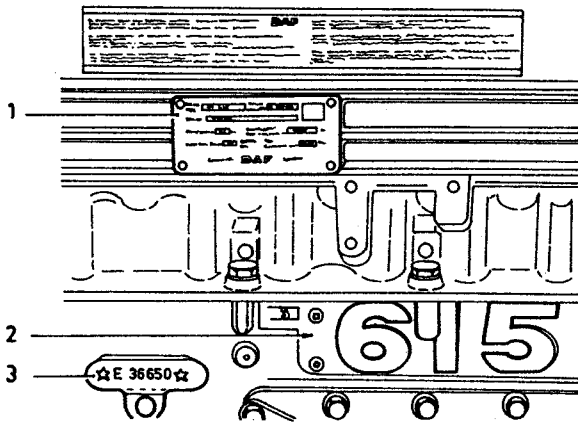
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## Engine Identification

Every DAF engine has an identity plate fitted to the valve cover with the following data:

Engine type	= e.g. DT 615
Engine number	= e.g. E 36650
Spec. no.	= specification number/production version number
Pump setting	= fuel injection pump output at a specified speed and a specified number of strokes
Smoke level free acceleration	= smoke level expressed in an absorption coefficient
Injection timing	= number of degrees before T.D.C. at which fuel is injected
Max. governed speed	= maximum speed under load.

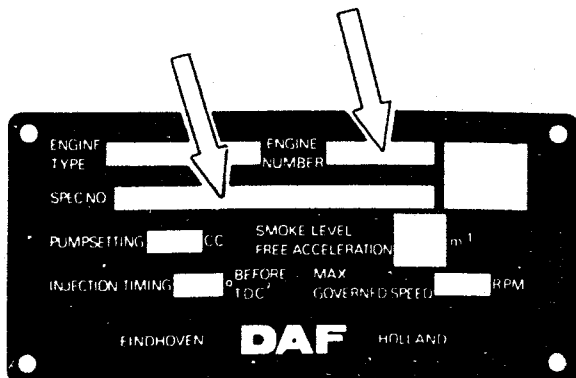


Location of engine number on engines of 575 and 615 series.

## Ordering of parts

When ordering parts make sure to mention not only the engine number but also the specification number as mentioned on the identity plate on the valve cover.

Without these data it is impossible to guarantee a correct supply.



## Conversion table

As from 1st January, 1978, the new system of units (S.I.) is operative, which entails the introduction of several new units, such as kW which substitute for h.p. to indicate power. In the present manual you will meet with several new units. The table below will help you, if necessary, to convert from old to new and reverse.

	<b>Nm</b>	<b>mkg</b>	<b>ft. lbs.</b>	<b>kWh</b>	
<b>ENERGY</b>	1	0,1019761	0,737607	0,0000002776	
	9,80665	1	7,233	0,000002723	
	1,356259695	0,1383	1	0,0000003765	
	3601001,88	367200	2656000	1	
	2647795,5	270000	1952900	0,7353	
	2684570,4375	273750	1980000	0,7455	
	4187,43955	427	3088	0,001163	
	<b>Nm</b>	<b>pkh (metr.)</b>	<b>HPH</b>	<b>kcal</b>	
	1	0,0000003776	0,0000003723	0,00023882	
	9,80665	0,0000037037	0,000003653	0,002342	
	1,356259695	0,0000051206	0,0000050505	0,0003238	
	3601001,88	1,3599	1,431	860	
	2647795,5	1	0,9863	632,4	
	2684570,4375	1,0139	1	641,1	
	4187,43955	0,001581	0,00156	1	
	<b>kW</b>	<b>pk (metr.)</b>	<b>mkg/sec</b>	<b>kcal/sec</b>	
<b>POWER</b>	1	1,36	102	0,2389	
	0,7355	1	75	0,1757	
	0,009804	0,01333	1	0,002342	
	4,186	5,693	427	1	
	0,7455	1,014	76,04	0,1781	
	0,001355	0,00184	0,1383	0,0003238	
	<b>kW</b>	<b>HP</b>	<b>ft. lbs./sec</b>		
	1	1,341	737,7		
	0,7355	0,9863	542,5		
	0,009804	0,01315	7,233		
	4,186	5,615	3088		
	0,7455	1	550		
	0,001355	0,00182	1		
	<b>Pa</b>	<b>bar</b>	<b>kg/cm<sup>2</sup> (p.s.i.)</b>	<b>lbs./sq. inch</b>	<b>atm.</b>
<b>PRESSURES</b>	1	0,00001	0,0000101	0,000145	0,0000987
	100000	1	1,0197162	14,500364	0,9868813
	98066,5	0,980665	1	14,22	0,9678
	6894,76	0,0689476	0,070307	1	0,068046
	101322,2	1,013223	1,0332	14,70	1
	133,32	0,0013332	0,0013595	0,01934	0,0013158
	3386,23	0,0338623	0,03453	0,4912	0,03342
	9797,82	0,0979782	0,09991	1,421	0,09668
	248,89	0,0024889	0,002538	0,02609	0,002456
			<b>Mercury column at 15°C and g = 980.665 cm/sec<sup>2</sup></b>	<b>Water column at 15°C and g = 980.665 cm/sec<sup>2</sup></b>	
	<b>Pa</b>	<b>mm</b>	<b>inches</b>	<b>m</b>	<b>inches</b>
1	0,0075007	0,00029653	0,0001021	0,0040187	
100000	750,06708	29,530981	10,207359	401,87015	
98066,5	735,56454	28,96	10,01	394,1	
6894,76	51,175	2,046	0,7037	27,70	
101322,3	760	29,92	10,337	407,2	
133,32	1	0,03937	0,01361	0,5358	
3386,23	25,40	1	0,3456	13,61	
9797,82	73,49	2,893	1	39,37	
248,89	1,876	0,07349	0,02540	1	

## Specifications

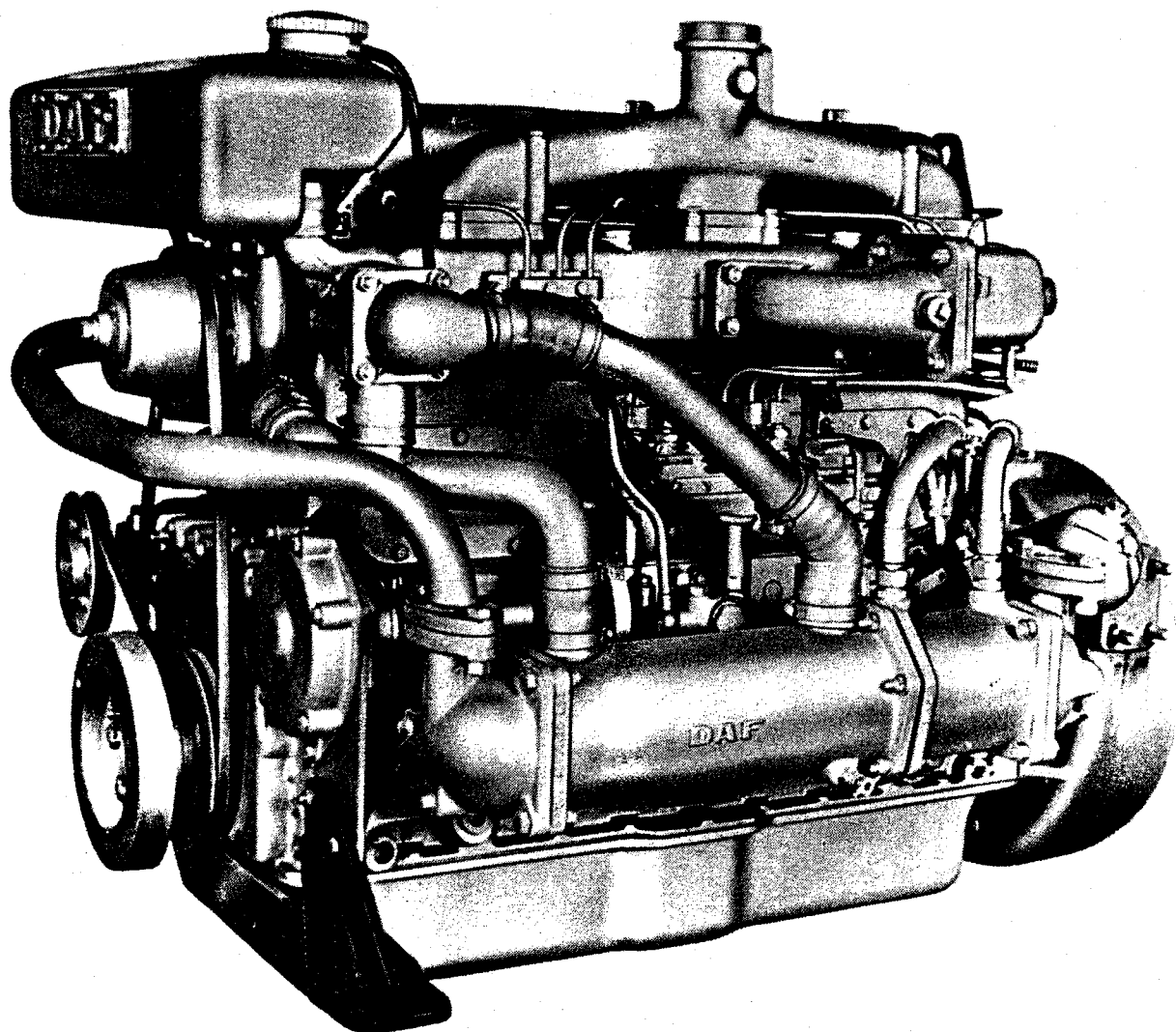
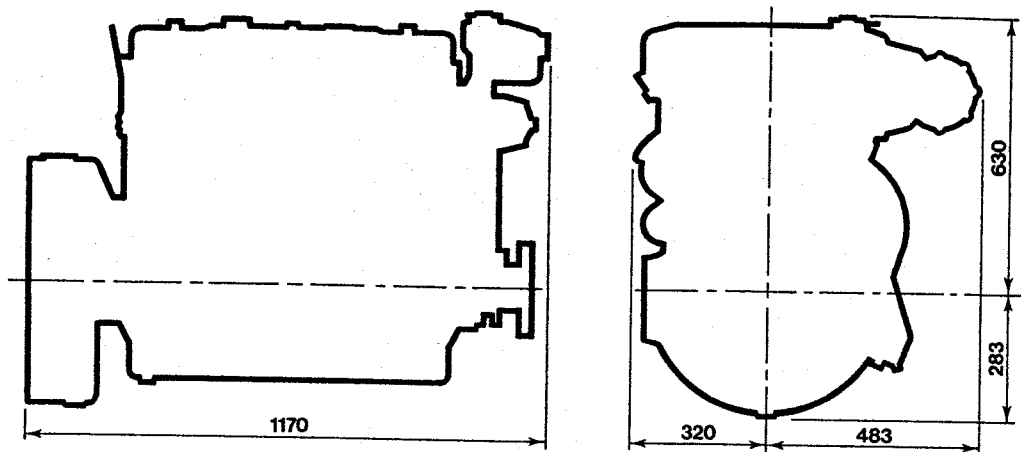
Make	DAF
Type	water-cooled diesel engine with direct injection; DT 615 equipped with turbocharger
Number of cylinders	6
Bore	DD 575: 100.6 mm, DF 615/DT 615: 104.2
Stroke	DD 575, DF 615, DT 615: 120.7 mm
Cubic capacity	DD 575: 5.76 litres DF 615/DT 615: 6.17 litres
Compression ratio	16 : 1
Idling speed	DD 575: 480-520 r.p.m. DT 615/DF 615: 450-500 r.p.m.
Maximum speed under no load (r.p.m.)	.....*)
Maximum speed under load (r.p.m.)	.....*)
Valve clearance (cold/warm)	0,5 mm
Applied thread	according to ISO standards
Engine weight, dry, including accessories but without clutch	DD 575: 530 kg, DF 615: 530 kg DT 615: 570 kg
Firing order	1-5-3-6-2-4
Injection timing	28° before T.D.C.: DD 575/DF 615 26° before T.D.C.: DT 615
Discharge pressure	DD 575/DF 615: 165-173 bar (bosch) 145-153 kg/cm <sup>2</sup> (CAV.) DT 615: 216-224 bar
Coolant operating temperature	75-80°C
Cooling system capacity	dependent on applied system
Lubricating system	
Lubricant	CC or CD
Viscosity, below 0°C	SAE 20
from -5°C to +30°C	SAE 30
above + 25°C	SAE 40
Oil pressure to be measured at a coolant temperature of	75-80°C
idling speed (new)	min. 1.0 bar
ditto (in case of wear)	min. 0.35 bar
at 2000 r.p.m. engine speed	3.5-4.2 bar
Capacity (incl. filter)	12 litres
ditto (including filter and cooler)	13 litres
ditto (in case of double room sump)	17 litres
Diesel fuel	minimum requirement: British Standard no. 2869-1970, Class A1**
Starting motor	bipolar, 24 V - 4 kW
Dynamo	various types of alternators
Tightening torques:	
Cylinder head nuts	DD and DF: 245-259 Nm (25-26 mkg) DT : 285-294 Nm (29-30 mkg)
Injector clamp nut	max. 50 Nm (5 mkg)
Injection line union nuts	max. 25 Nm (2.5 mkg)

\* Dependent on the application of the engine.  
The values applicable to your engine to be obtained from your DAF Diesel dealer.

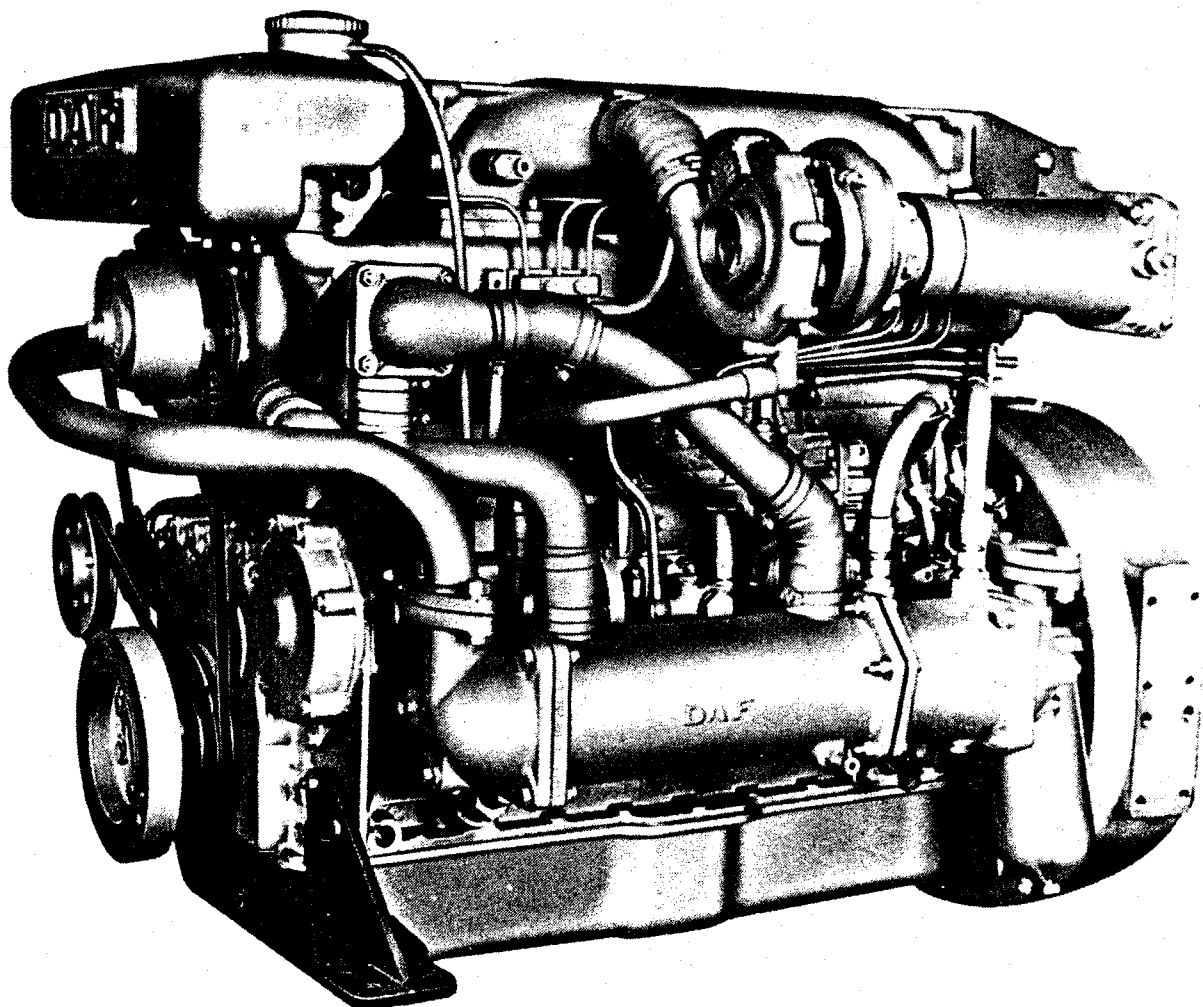
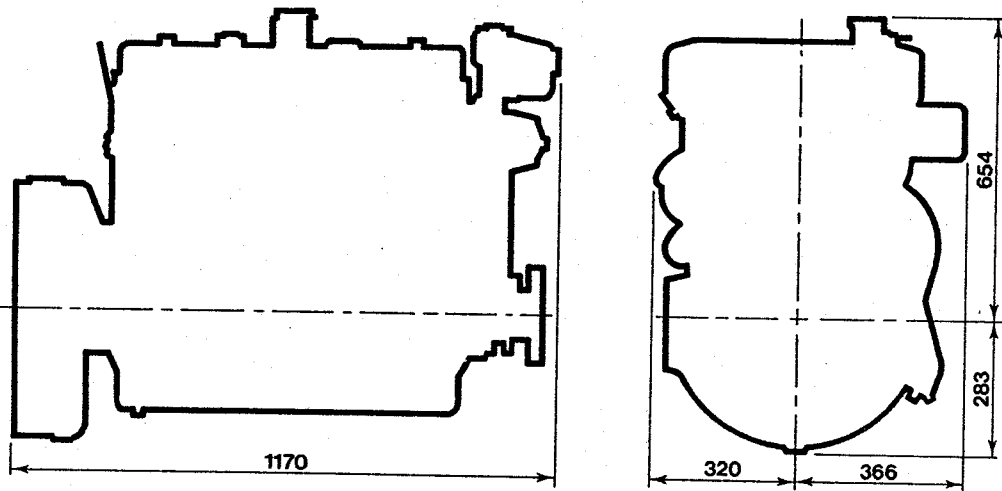
\*\* As for engines equipping vessels which must satisfy the requirements of Nederlandse Scheepvaart Inspectie (Dutch Navigation Inspectorate) and/or a shipping registry (Lloyd's, Veritas etc.) the minimum requirement of the diesel fuel is British Standard No. 2869-1970, class A2.



**DD 575 M**  
**DF 615 M**  
**Marine version**



**DT 615 M**  
**Marine version**

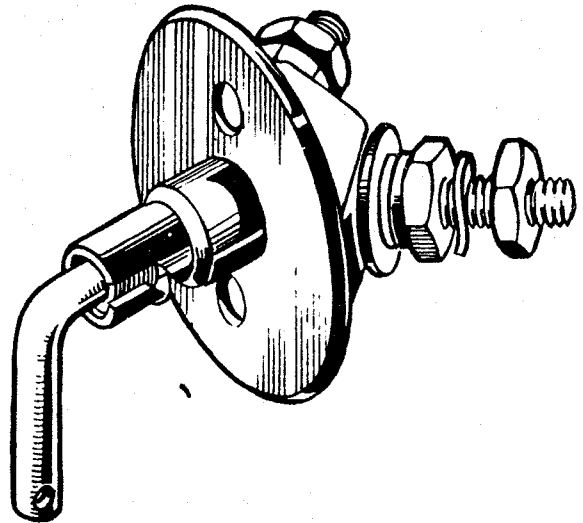


## Instruments and controls

The instruments and controls dealt with in this section are of a design as supplied by DAF, but a great many other versions are available, details of which may be obtained from the firm installing the engine.

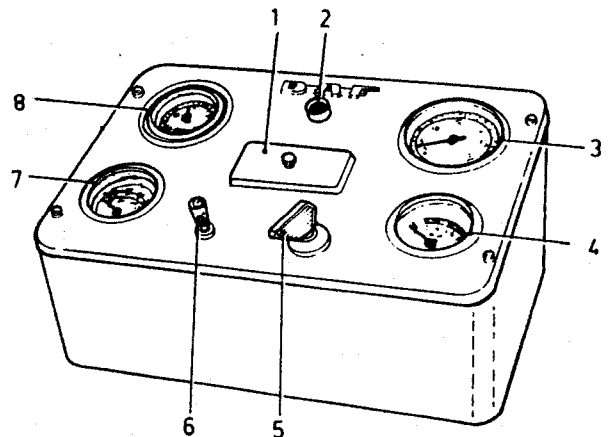
### Master switch

It is advisable to provide a master switch with removable key in the cable between battery and starting motor.



### Starter switch

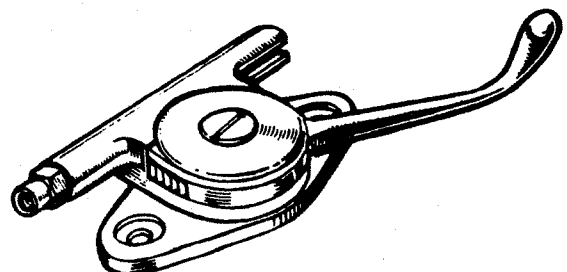
The starter switch has three positions: off - contact - starting. By inserting the key into the lock and turning it clockwise the contact is made. Turning the key further clockwise, against spring pressure, will operate the starting motor. Once the engine fires the key should be released; it returns automatically to the contact position then.

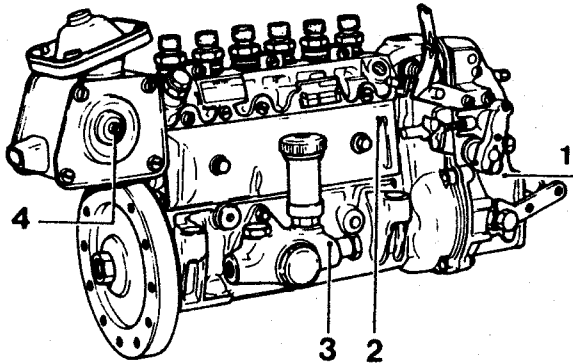


1. Fuse box
2. Battery charge warning lamp
3. Rev. counter
4. Temperature gauge
5. Starter switch
6. Switch
7. Oil pressure gauge
8. Operating hours counter

### Stop handle

A bowden cable connects the stop handle with the stop lever of the fuel injection pump. Operation of the stop handle will pull the stop lever to the non-delivery position, due to which the fuel injection is stopped. Before starting the engine, the stop handle must be returned to the original position.





1. Governor
2. Injection pump
3. Fuel feed pump
4. Cold starting lever

#### Fuel lever

The fuel lever is connected with the fuel injection pump control lever regulating the quantity of fuel to be injected. This lever often serves to operate the reversing gear.

#### Fuel injection pump

This pump consists of the injection pump, the governor and the fuel feed pump. The latter is provided with a knob which can be actuated by hand when fuel has to be delivered from the tank whilst the engine is out of operation and if the fuel system has to be bled.

#### Cold-starting device

Dependent on the use of the engine, cold-starting devices are available in different versions. In addition, the engine may be equipped with an electric glow plug in the inlet manifold which serves to warm up the incoming cold air during starting.

#### Oil pressure gauge

This gauge is connected to the engine lubrication system and indicates the prevailing pressure. The measuring element is next to or in the oil filter connecting piece.

At operating temperature the oil pressure should be:

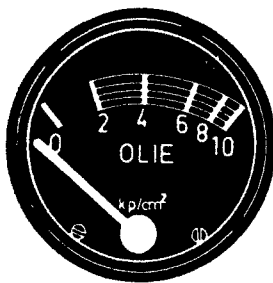
3.5-4.2 bar at 2,000 r.p.m.

With a cold engine the gauge reading will in general be 1-1.5 bar higher.

#### Attention:

If the oil pressure is too low, stop the engine immediately.

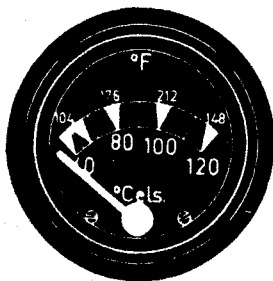
Min. 0.35 bar with idling engine.



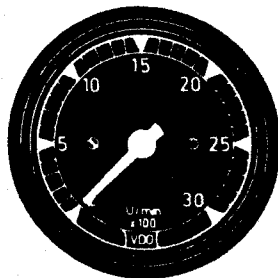
Oil pressure gauge



Ammeter



Coolant temperature



Revolution Counter

#### Ammeter/battery charge warning lamp

The ammeter indicates at what charging current the battery is being charged by the dynamo, or to what extent current is taken from the battery without the battery being recharged.

On a number of versions the ammeter has been replaced by a warning lamp, which extinguishes as soon as the dynamo starts recharging.

#### Coolant temperature

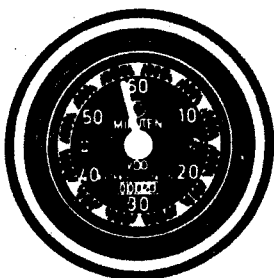
The most favourable operating temperature is 75-80°C.

#### Revolution counter

The revolution counter shows the number of revolutions per minute of the engine crankshaft.

#### Operating hours counter

The electric operating hours counter shows the number of operating hours of the engine. The counter starts operating from a dynamo voltage of 8 onwards which value has already been reached at engine idling speed.



Operating hours counter

## Operating instructions

### Running-in period

Before the engine leaves the plant it is first submitted to exhaustive tests by means of sophisticated modern instruments.

Make sure to use some caution during the initial 100 operating hours or 400 km.

Avoid operation under heavy load and, at any rate, continuous heavy operation.

Always (i.e. also after the running-in) allow the engine to reach its operating temperature under a not too heavy load and at a low engine speed. Oil must be changed after the initial 20 and 100 operating hours.

If, after a repair or an overhaul, the engine has been fitted with new cylinder liners and piston rings, the engine must be filled with a lubricant which answers the following requirements:

- API specification: CC;
- viscosity: SAE 20 (irrespective of the atmospheric temperature)

After 100 hours it must again be filled with the normally specified oil.

### Daily check before the first start

- a. Check oil level in the oil sump with the dipstick.

The oil level must always be maintained between the two markings and must neither be below the lower nor above the upper marking. If required, top up with oil of the same type as that already contained in the engine.

- b. Check coolant level.

If required, top up with clean water.

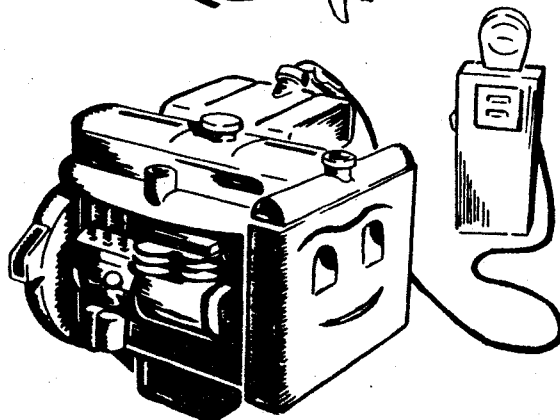
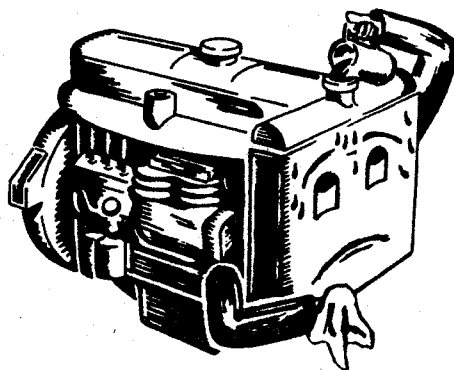
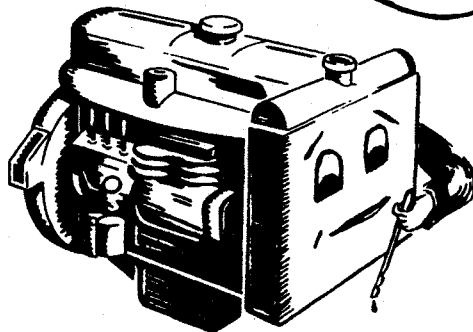
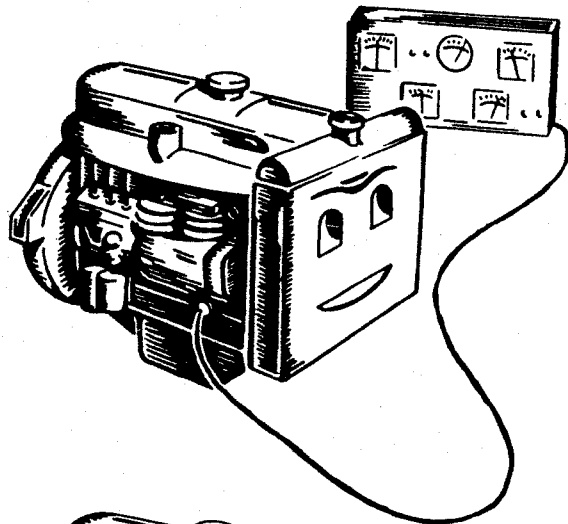
To protect the interior of the cooling system against corrosion an emulsifying oil (such as Donax C) must be added to the coolant. Mixing ratio 1%.

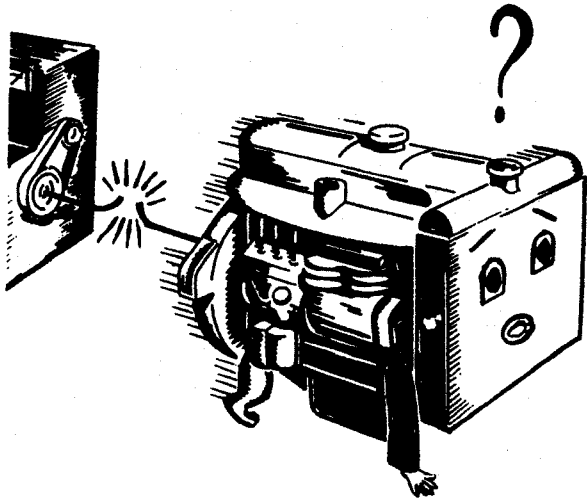
If the coolant contains an anti-freeze, it is as a rule not necessary to add an emulsifying oil as most anti-freeze brands already contain anti-corrosion additives.

**ALWAYS USE CAUTION WHEN UNSCREWING THE FILLING CAP OF A HOT ENGINE AS HOT WATER OR STEAM MIGHT ESCAPE.**

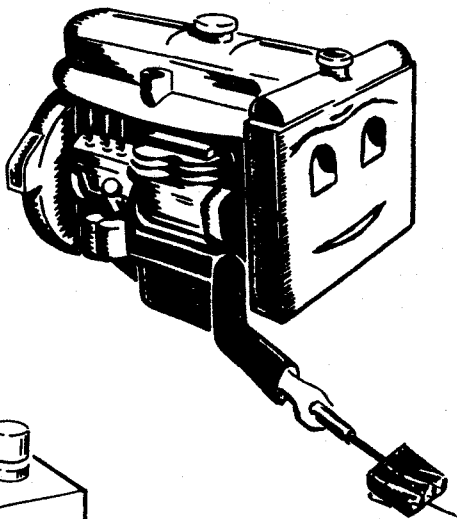
- c. Check the fuel level in the tank.

Too low a fuel level may result in air being sucked into the fuel system, which calls for bleeding of the entire system.



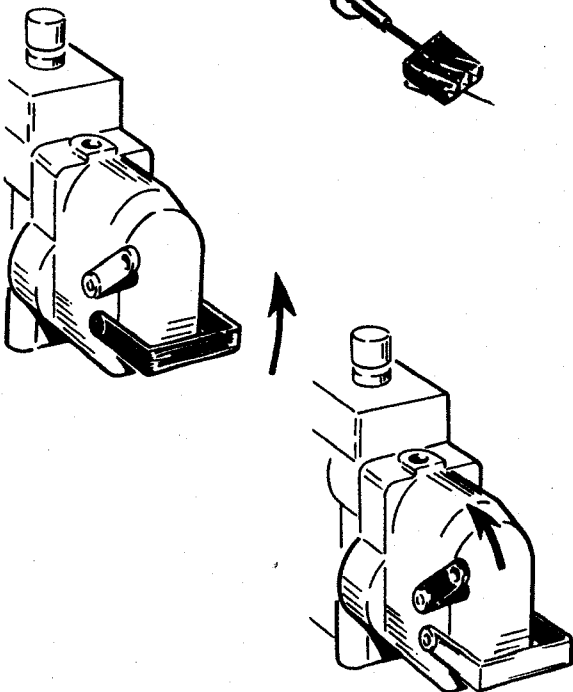


- d. Before starting the engine make sure that the reversing gear is in neutral position. A suddenly starting propeller might injure swimmers or cause the ship to move from its berth.



**Starting the engine**

1. Move the master switch, if fitted, to operating position.



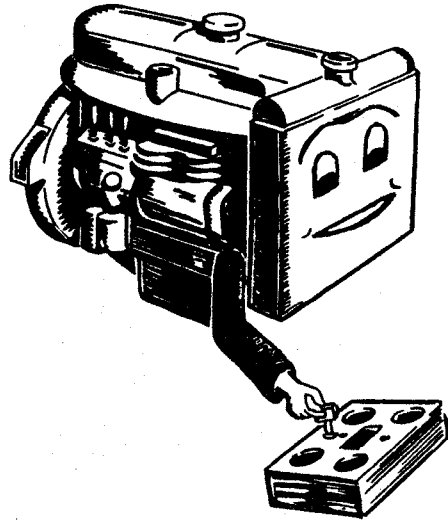
2. Move the stop handle to operating position.

3. Move the fuel handle to maximum position.

4. Start the engine by turning the starter key clockwise to stop.

**Note:**

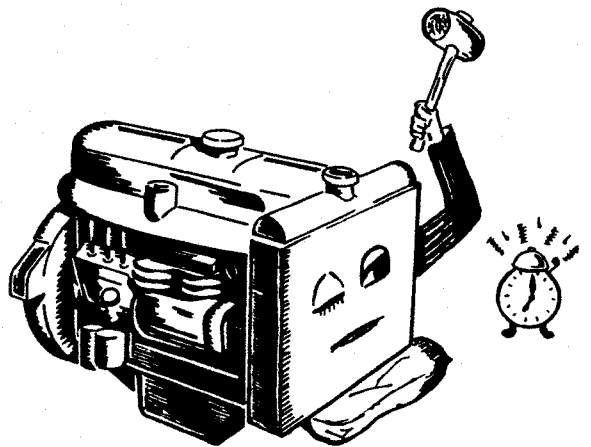
Avoid to run turbocharged engines at full speed immediately after starting (so-called "revving" with the accelerator).



5. If the engine fails to start after a few seconds, wait some ten seconds before starting again. This procedure may only be repeated a few times; then the cause of the failure has to be found first.

**Remark:**

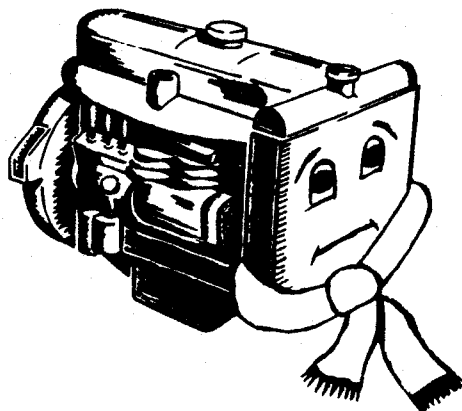
- I. Take care that after starting the key springs out of the "starting" position, since otherwise this would result in a burnt starting motor.
- II. If the engine fails to start immediately a fresh attempt must never be made before the engine and the starting motor are standing still, since otherwise the starter pinion and the flywheel ring gear may be seriously damaged.

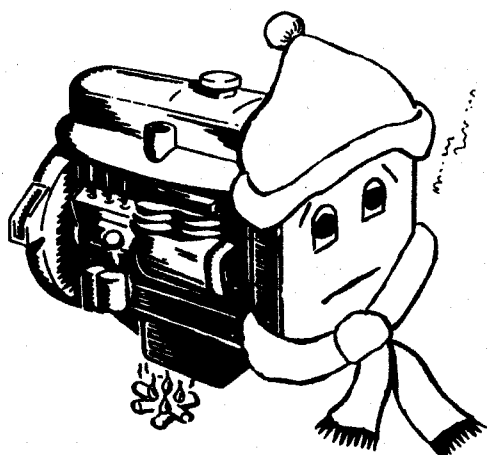


6. At low temperatures starting may be facilitated, if necessary, by using a cold-starting device, if fitted.

Pull out cold-starting button and move fuel handle to maximum position.

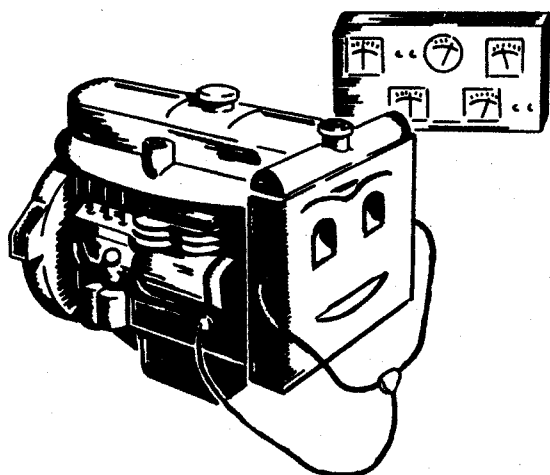
The cold-starting device will switch off automatically as soon as the engine makes a few revolutions. Therefore, after an unsuccessful starting attempt, the button must be depressed again.





7. At extremely low temperatures starting may be facilitated by using the glow plug (if fitted) in the intake manifold. If this is the case, the starter switch has two positions, the first position operating the glow plug and the second position switching on the starting motor.

The pre-glowing times are:  
between 0 and  $-10^{\circ}\text{C}$  20 seconds  
below  $-10^{\circ}\text{C}$  40 seconds.

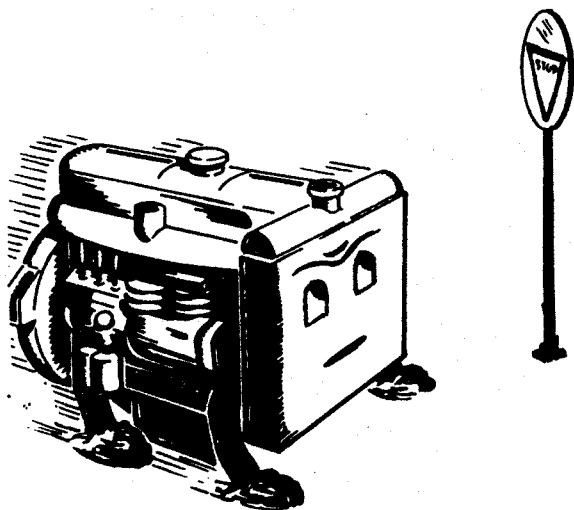


#### Checking during operation

It is very important to regularly check during operation the behaviour of the engine by means of the instruments on the instrument panel.

Also the sound produced by an engine may be indicative for the working.

Check the engine for oil and/or water leakage.

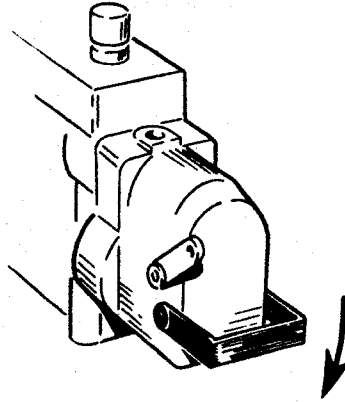


#### Stopping the engine

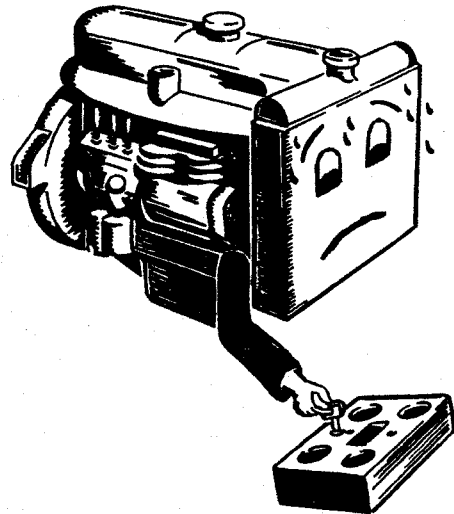
1. Reduce engine speed to idling.  
Allow the engine to run at tick-over for a few minutes. This will bring down engine temperature and avoid the risk of boiling of the coolant due to the rather high temperature of the engine. Also for a turbocharger, if fitted, cooling off is important.



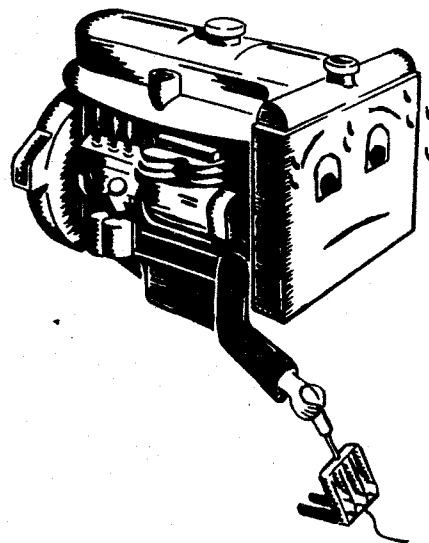
2. Stop the engine by means of the stop lever.



3. Turn the starter switch to OFF position.



4. Open the master switch



## Engine lubrication

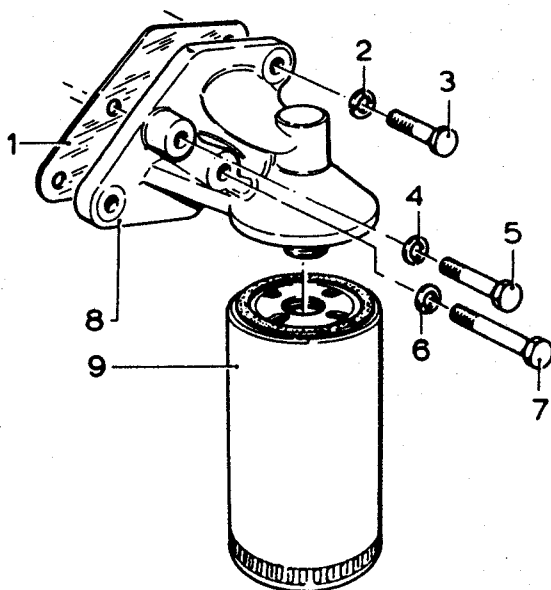
### Lubricating oil quality

The engine must be lubricated to keep the friction between the moving parts as low as possible. This is the most important task of the lubricant. There is, however, more to the lubricant than lubricating alone.

Together with the coolant the oil also ensures the cooling of the engine; in addition, it has a cleaning effect and thus, for example, sees to it that the piston rings will not stick in their grooves and maintain their sealing qualities. Chemical additives (so-called dopes) have been added to the oil to keep the combustion residues floating in the oil and to prevent aging (oxidisation). Notwithstanding the good operation of the filters it is unavoidable that impurities remain in the oil. These consist mainly of acidic condensates and fine carbon and metal particles which, between them, change the composition of the oil, cause wear and attach the metal surface by oxidation. The damage will become more serious as the contamination increases. Failure to change the oil in due time may have quite serious consequences therefore.

### Oil level

The oil level in the sump is read from the dipstick and should be checked daily after the engine has been standing still for at least 20 minutes. The level must always be between the two marks on the dipstick and must never drop below the lower mark. Prior to checking, the dipstick should be cleaned in order to avoid mistakes.



- |                  |                   |
|------------------|-------------------|
| 1. Gasket        | 6. Spring washer  |
| 2. Spring washer | 7. Screw          |
| 3. Screw         | 8. Filter head    |
| 4. Spring washer | 9. Filter element |
| 5. Screw         |                   |

### Oil change

In general, the lubricant should be changed every 400 operating hours at any rate once a year if the ship is laid up during the winter season, and at least twice a year if the ship is in operation throughout the year (also see the maintenance chart).

However, this interval should be reduced if the engine operates under unfavourable conditions, for example, if it often runs at idling speed, is often started from cold, etc. Consult your DAF dealer.

Draining the oil should be effected when the oil is warm and, hence, thin.

During the draining, the engine should occupy such a position that all oil can be drained through the drain opening. If necessary, use a sump draining pump.

**We must strongly advise against rinsing the engine with kerosene or a similar product, because it is not possible to completely drain the kerosene without removing the sump. The quantity of kerosene left will dilute the fresh oil.** Do not forget to always drain the oil filter and the oil cooler, if fitted.

Thoroughly clean the oil filler tube before fresh oil is poured in. The oil of a new or reconditioned engine has to be changed after 20, 100 and 200 operating hours.

Subsequently, the oil should be changed every 400 operating hours. The oil filter element has to be replaced or cleaned already after the first 20 operating hours and subsequently every 400 operating hours.

### Oil filter

The oil filter has to be provided with a new element whenever the oil is changed.

At present two different types of oil filters are fitted.

1. A so-called disposable filter: the filter element is completely renewed.  
Before fitting the new element moisten the sealing ring with some oil.  
Screw element hand-tight, run the engine for a short time and then check the filter for leakage.

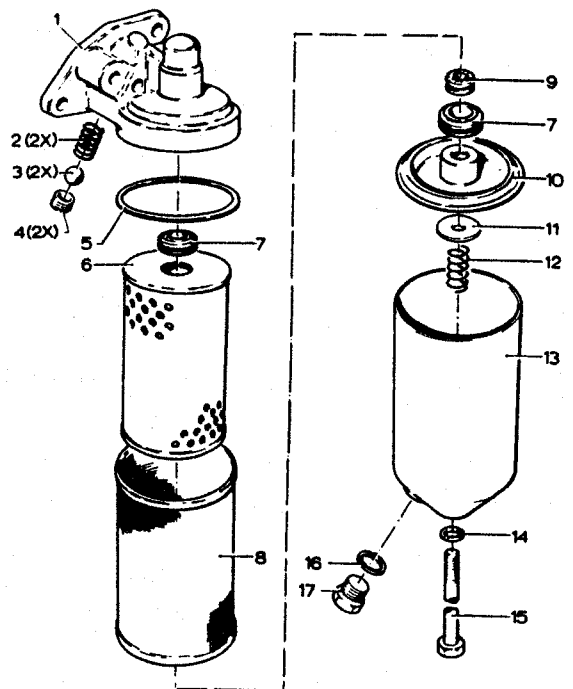
2. A lubricant oil filter of which only the filter element is renewed and the remaining parts are cleaned.

First drain the filter body and next take off the body by unscrewing the central bolt. The filter element can be taken out now. First thoroughly clean the body on the inside before installing the new element. After filling the engine with fresh oil, run the engine for a short time so that also the oil filter and the oil cooler are filled with oil.

Next, gauge the oil level and top up, if required.

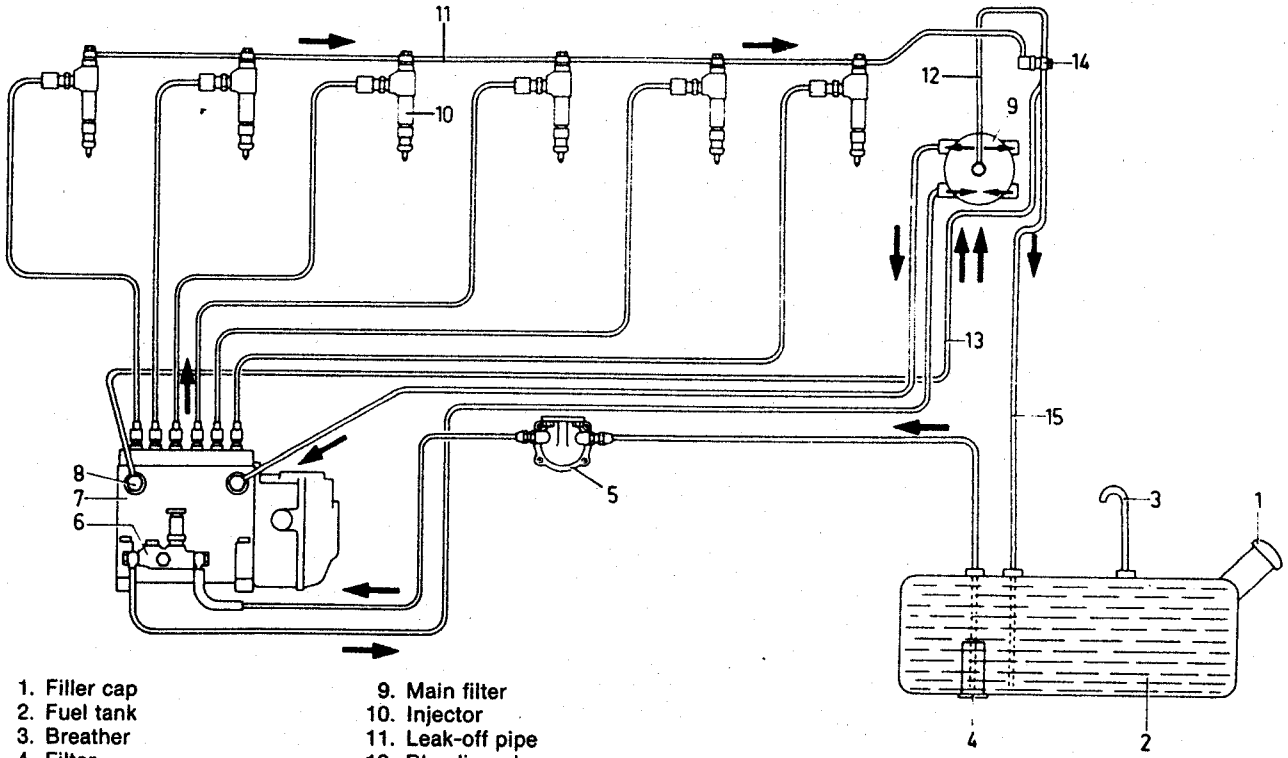
**Note:**

It is advisable to closely examine the impurities, because their nature may be indicative of a process of wear in the engine (e.g. particles of bearing material).

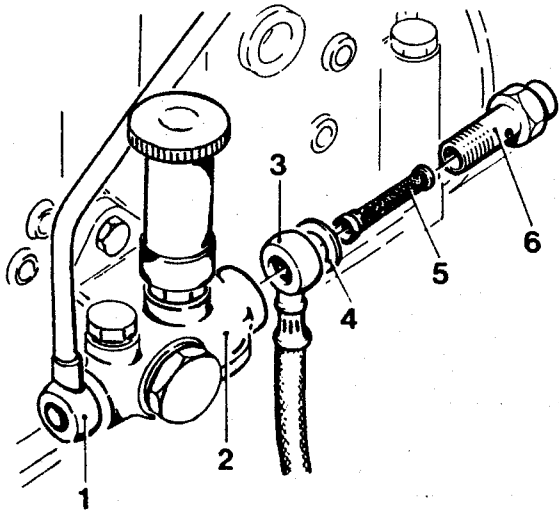


- 1. Filter head
  - 2. Spring
  - 3. Ball valve
  - 4. Valve seat
  - 5. Sealing ring
  - 6. Filter element
  - 7. Sealing rubber
  - 8. Strainer
  - 9. Cable grommet
  - 10. Lower cover
  - 11. Washer
  - 12. Spring
  - 13. Filter body
  - 14. Sealing ring
  - 15. Central bolt
  - 16. Sealing ring
  - 17. Drain plug
- } Discharge valve

# Fuel system



- |                              |                      |
|------------------------------|----------------------|
| 1. Filler cap                | 9. Main filter       |
| 2. Fuel tank                 | 10. Injector         |
| 3. Breather                  | 11. Leak-off pipe    |
| 4. Filter                    | 12. Bleeding pipe    |
| 5. Moisture separator        | 13. Overflow pipe    |
| 6. Fuel feed pump            | 14. Non-return valve |
| 7. Fuel injection pump       | 15. Return line      |
| 8. Pressure regulating valve |                      |



- |                       |
|-----------------------|
| 1. Fuel delivery line |
| 2. Fuel feed pump     |
| 3. Suction line       |
| 4. Ring               |
| 5. Fuel filter        |
| 6. Hollow screw       |

## Fuel system

In order to inject the exact quantity of fuel at the right moment into the cylinders a number of parts are required.

The fuel is stored in the fuel tank (2), and leaves the tank via a strainer (3) and passes through a moisture separator (4).

The fuel arrives at the suction side of the fuel feed pump (5) in the connection of which is a filter. Next, the feed pump pumps the fuel through the main filter (6). The inside of this filter is of a special kind of paper which will intercept almost any impurity.

The filtered fuel then continues to the fuel injection pump (7) where a fuel pressure of 1.5 bar is being maintained. Part of the fuel returns to the fuel tank via the pressure regulating valve (8). The fuel pump plungers force the remaining part of the fuel under a high pressure through the injection lines to the injectors (9) for injection into the cylinders. A small part of the fuel leaks away along the injector needle and is returned to the fuel tank via the leak-off pipe (10).

### Fuel quality

The minimum requirement for diesel fuel is: British Standard No. 2869-1970, class A1. As for engines equipping vessels which must satisfy the requirements of Nederlandse Scheepvaart Inspectie (Dutch Navigation Inspectorate) and/or a shipping registry (Lloyd's, Veritas etc.) the minimum requirement of the diesel fuel is British Standard No. 2869-1970, class A2, be it with the restriction that the sulphur contents in weight do not exceed 0.8%.

During the winter months diesel fuel suppliers generally use additives to prevent clogging due to paraffin deposits.

AT EXTREMELY LOW TEMPERATURES OR IF NO SO-CALLED WINTER FUEL IS AVAILABLE IT IS ALLOWED TO ADD UP TO 25% KEROSENE. If this is not permitted by law, up to 25% two-stroke petrol (a mixture of low octane petrol and lubricating oil) may be added. To prevent formation of ice maximum 0.5% methylated spirit may be added.

**It is not permitted to add to fuel or to lubricants any additive unless in such cases as prescribed by DAF**

### The main fuel filter

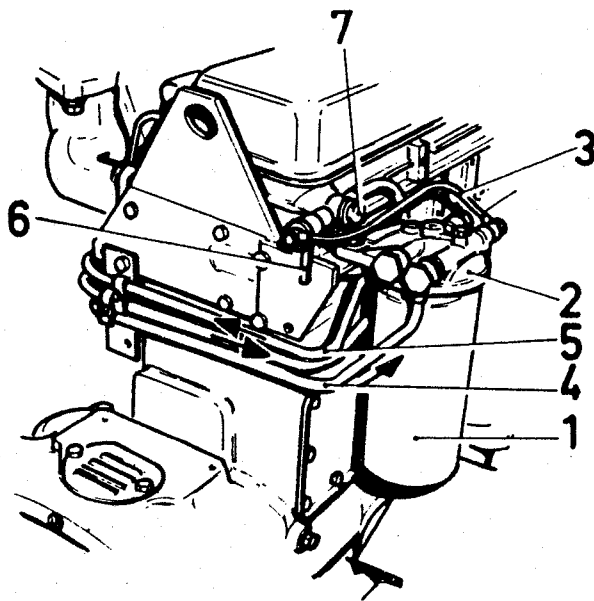
The main fuel filter is fitted in the fuel line between the fuel feed pump and the injection pump. Renew the element after the specified number of operating hours.

Unscrew the filter element and replace it completely by a new one. IT IS ON NO ACCOUNT PERMITTED TO CLEAN THE FILTER ELEMENT FOR RE-USE.

The sealing ring on the upper side of the filter element must be renewed at every filter change. Ensure that the joint face and the sealing ring are clean.

1. Filter element
2. Filter cover
3. Bleeding pipe
4. Delivery from fuel feed pump
5. Supply to fuel injection pump
6. Flexible leak-off pipe to tank
7. Non-return valve

**Diesel fuel at extremely low temperatures**

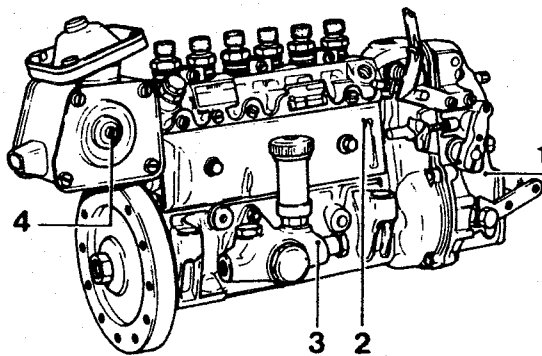


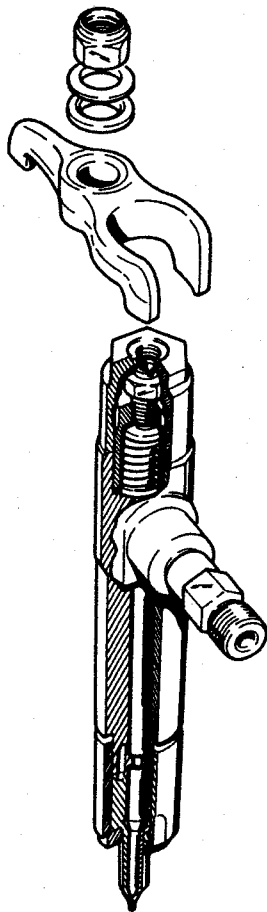
### Fuel injection pump

The fuel injection pump is a precision instrument to be handled only by specialists having the required tools at their disposal.

The fuel injection pump is connected to the lubricating oil system of the engine and needs no maintenance as far as the lubrication is concerned.

1. Governor
2. Fuel injection pump
3. Fuel feed pump
4. Cold-starting lever

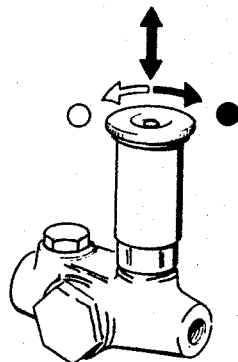




### Injectors

A satisfactory operation of the diesel engine requires that the injectors have been set to the correct discharge pressure. This setting must be done by a specialist with the required tools at his disposal.

Therefore, it is to be advised to always have some correctly set spare injectors at hand.

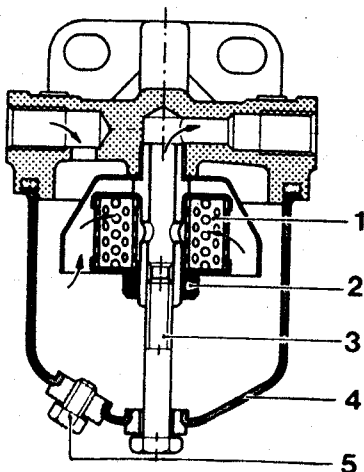


### Bleeding

If, despite all precautions, air is found to have penetrated into the fuel system, it should be bled. For this purpose the fuel feed pump has a milled knob for priming.

Unscrew the knob on the feed pump and move it up and down until a considerable resistance is felt.

Retighten the knob.



### The moisture separator

The moisture separator is included in the fuel line between tank and fuel feed pump.

The moisture separator ensures first of all the separation of water from the fuel. To remove this water, the bowl must be drained at regular intervals by opening the drain plug somewhat until the water has run out completely. Draining can best be effected when the engine has been off for a longer time so that any water is clearly separated from the fuel. During major servicings this sediment bowl must be cleaned.

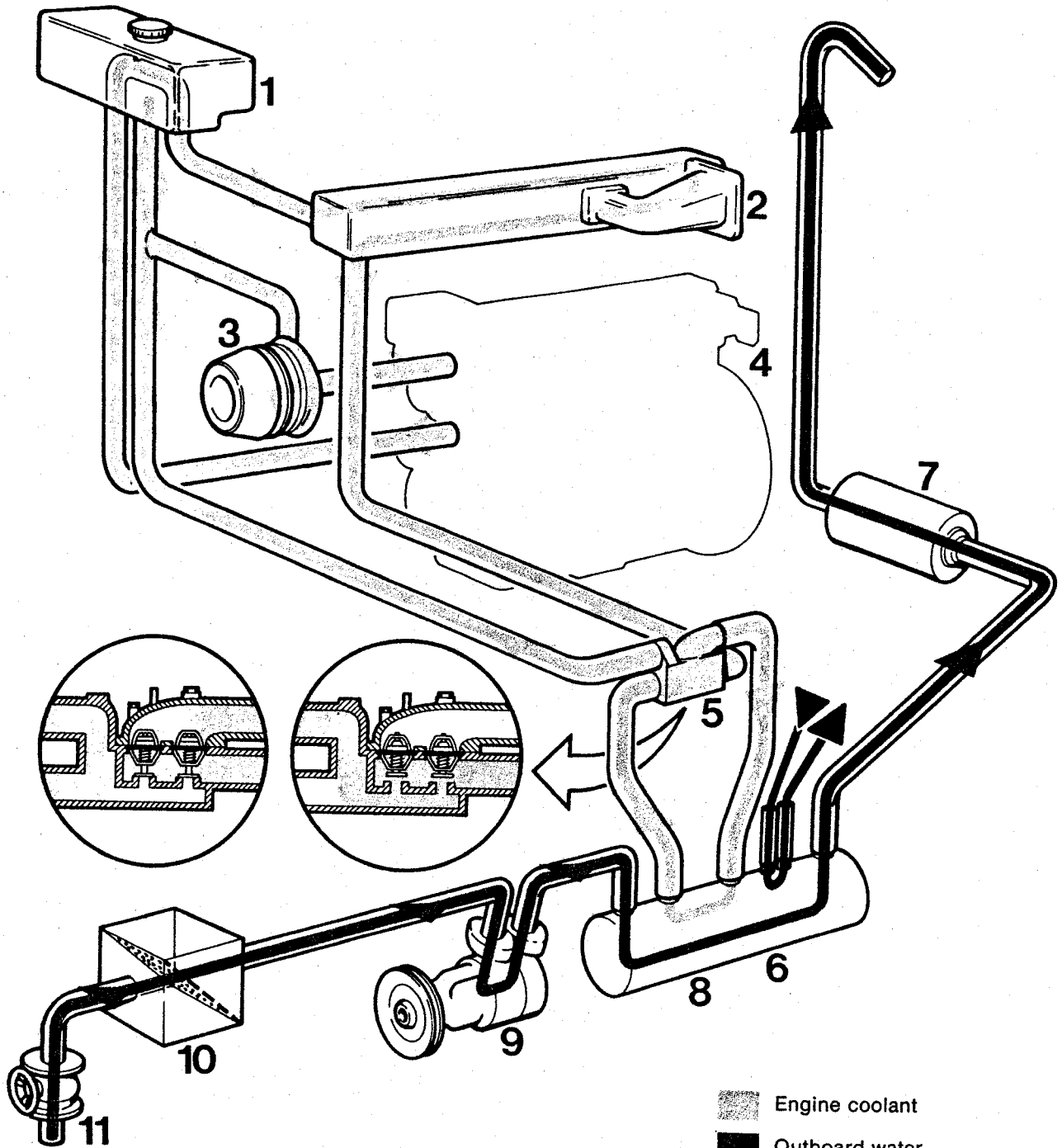
### Air cleaner

The air cleaner must be cleaned at regular intervals (also see maintenance chart).




1. Preliminary filter
2. Union nut
3. Screw

4. Bowl
5. Drain screw

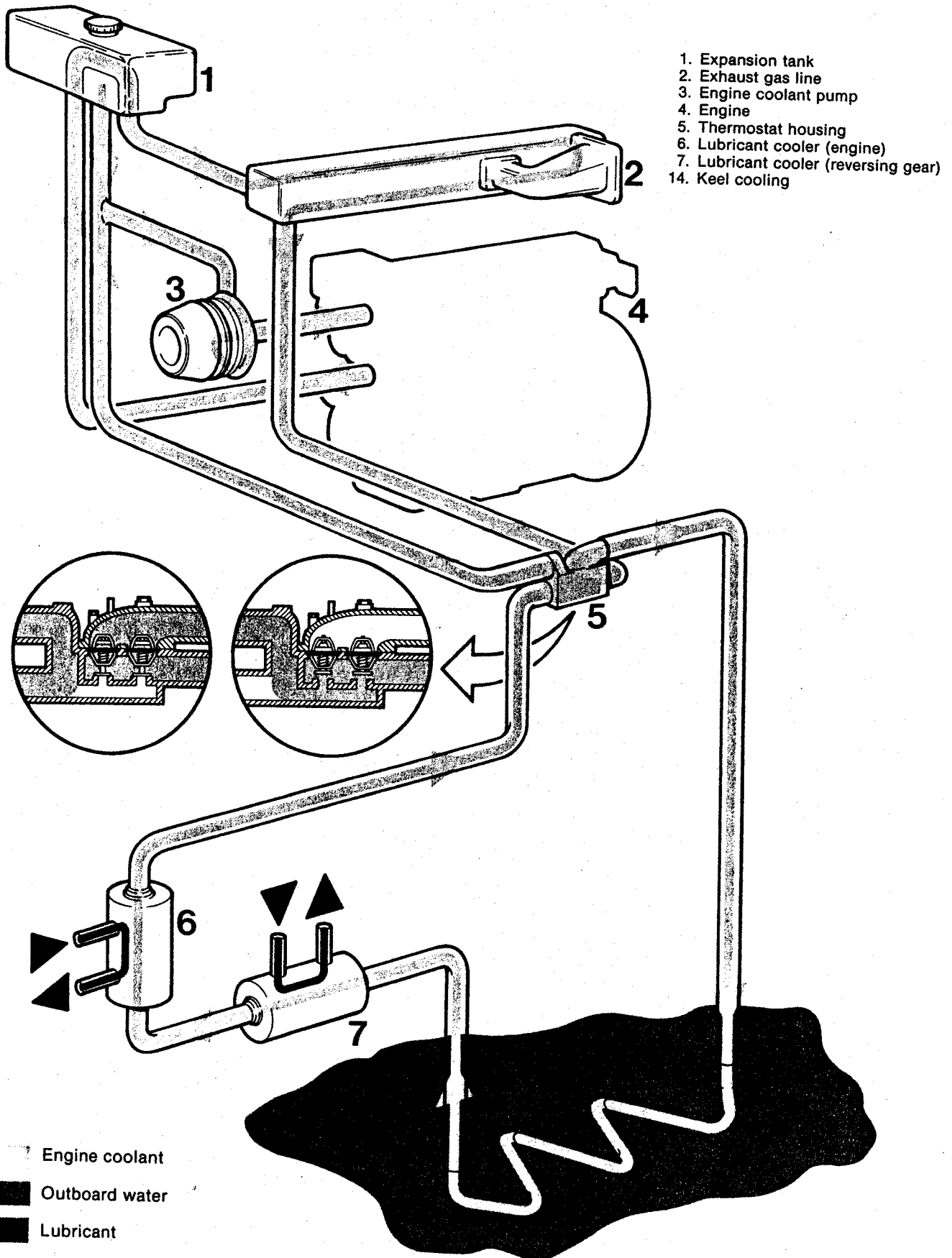
# COOLANT SYSTEM WITH INTERCOOLER



1. Expansion tank
2. Exhaust gas line
3. Engine coolant pump
4. Engine
5. Thermostat housing
6. Lubricating oil cooler (engine)
7. Lubricating oil cooler (reversing gear)
8. Engine coolant cooler,
9. Outboard cooling water pump
10. Filter tray
11. Cock

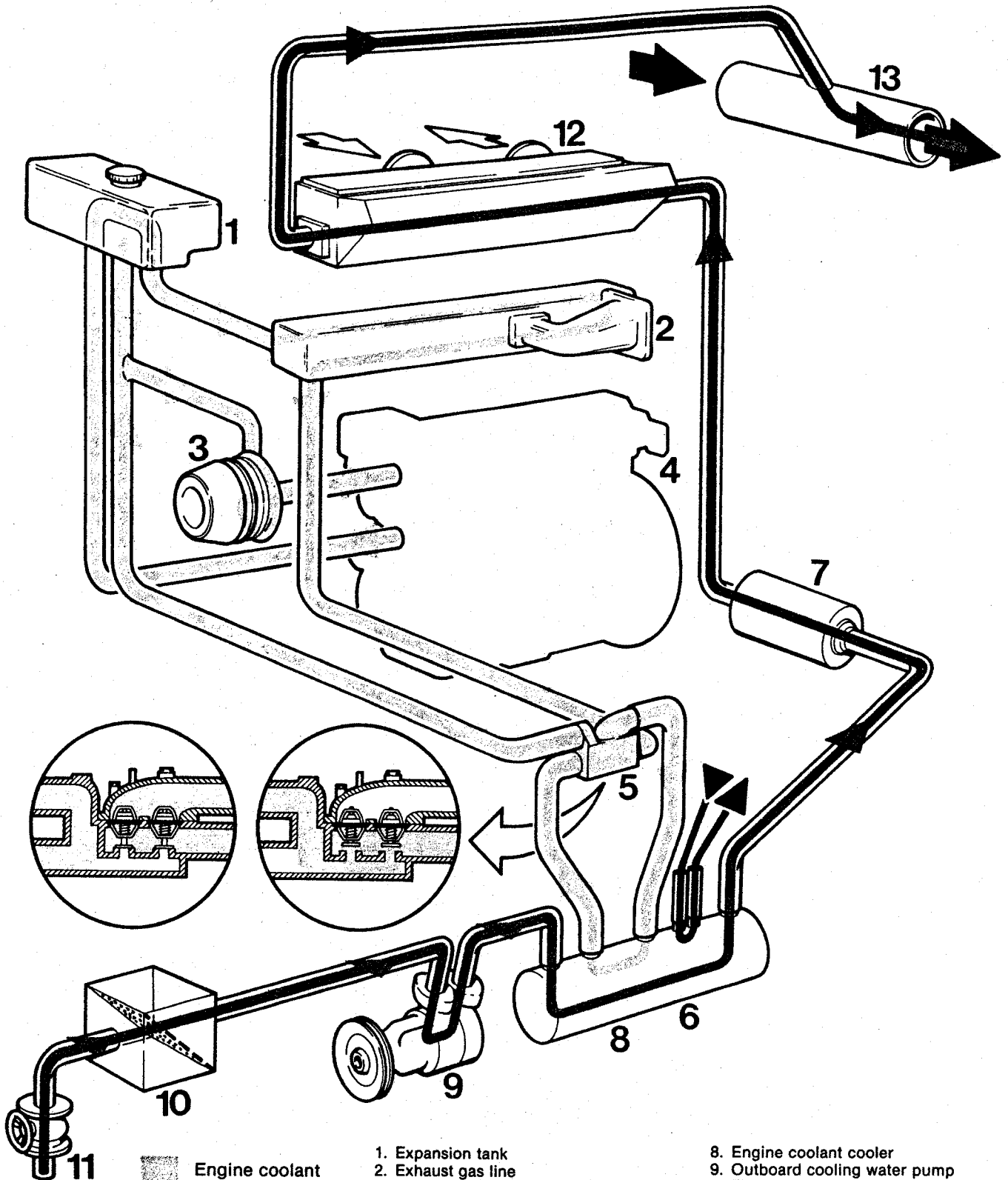
 Engine coolant  
 Outboard water  
 Lubricant




# COOLANT SYSTEM WITH KEEL COOLING





**COOLANT SYSTEM WITH INTERCOOLER  
AND INTAKE AIR COOLER**



 Engine coolant  
 Outboard water  
 Lubricant

1. Expansion tank
2. Exhaust gas line
3. Engine coolant pump
4. Engine
5. Thermostat housing
6. Lubricant cooler (engine)
7. Lubricant cooler (reversing gear)

8. Engine coolant cooler
9. Outboard cooling water pump
10. Filter tray
11. Cock
12. Intake air cooler
13. Cooling water/exhaust gas discharge pipe

## The cooling system

If the best possible engine performance is to be achieved, the engine cooling system must also be in the best possible condition. The following notes may help to avoid trouble with the cooling system and enable any faults to be remedied.

### General

The cooling system on DAF trucks operates at an overpressure of 0.28 bar (kg/cm<sup>2</sup>). This is achieved by fitting a relief filler cap on the radiator or on the expansion tank. The purpose of such a pressurised system is that the water will begin to boil only at a higher temperature than in a system under atmospheric pressure. To avoid accelerated cylinder and bearing wear it is essential for the engine to reach its operating temperature as soon as possible and for this temperature to be kept as constant as possible despite any changes in engine loading and/or ambient temperature. This can be achieved by fitting thermostats (in this case two parallel thermostats) in the cooling system, whether or not accompanied by a thermostatically operated electro-magnetic fan coupling.

DAF considers a temperature of about 80°C to be ideal for a diesel engine. It should be mentioned, however, that also due to the use of a pressurised system, there is no cause for alarm if for brief periods the temperature rises to 90-95°C.

### Temperature gauge and warning lamp

A temperature gauge, a temperature gauge and a warning lamp, or just a warning lamp may be provided on the instrument panel.

Both the gauge and the warning lamp are operated by a thermo-element. In the case of a temperature gauge the principle of the thermo-element is based on a change in resistance and is called a sensor then. If it is a warning lamp, this will only burn when a certain temperature is reached, the thermo-element acting as a switch then, whereby the driver is left in uncertainty as to the fluctuations in temperature. It is also possible that both functions are combined into one thermo-element, which may be recognised by the presence of two thermo-element terminals. This sensor must be located at the spot where the coolant reaches its highest temperature, i.e. ahead of the thermostat, but care should be taken that the thermo-element does not assume the surrounding temperature of much warmer metal engine parts.

This may occur if an incorrect type of thermo-element is used, which is located too near to warm metal parts, or if the specified sealing ring of the thermo-element has been omitted.

### Venting and filling

Air is a poor conductor of heat and the presence of air in the cooling system must therefore be avoided as much as possible. For this reason vent pipes are connected up to the highest positions in the cooling system, these pipes emerging either in the radiator header tank or the expansion tank. This, of course, implies that the header tank or

expansion tank must be at the highest point of the cooling system. In connection with the above it is important to proceed as follows when filling the cooling system.

- top up to the overflow pipe in the radiator header tank or expansion tank;
- run the engine for a few minutes;
- top up again.

### Draining

For completely draining the cooling system the filter cap has to be removed and all drain cocks i.e. in the engine block and — dependent on the version of the engine — those of the heat exchanger, the exhaust manifold, the oil cooler and the intercooler have to be opened.

It is furthermore advisable to run the engine at idling speed for a very short time (½ minute at most) in order to avoid water being left behind which might cause damage when freezing. It is furthermore recommendable to re-use the drained water to fill up the cooling system, since fresh water promotes the formation of scale.

### Winter season

Before the cold season sets in it is necessary to take the required precautions. The coolant of the system must not freeze as this would damage engine, fittings and lines. This can be prevented by adding anti-freeze to the coolant to bring down the freezing point.

Various products are marketed under the name of anti-freeze agents without, however, meeting the requirements and, although these lower the freezing point, they may cause serious damage to the cooling system.

**It is strongly advised therefore to use an ethylene-glycol based anti-freeze agent of a well-known, reliable brand.**

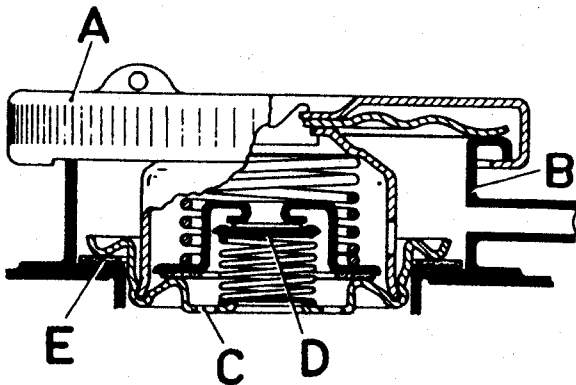
It is not possible to indicate here the desired mixing ratio of all good sorts of anti-freeze agents. Practically all quality brands are sold in cans on which mixing ratios are indicated.

Since the specific heat of an anti-freeze mixture is lower than that of water, the temperature of the coolant will rise more rapidly at the same development of heat by the engine. This results in the temperature gauge pointer deflecting faster than normal.

### Relief/filler cap

The filler cap on the radiator or expansion tank is a relief/filler cap with two valves. In normal conditions both valves are closed. If however, the pressure in the cooling system rises to 0.28 bar (kg/cm<sup>2</sup>) valve C opens. Surplus water escapes via the overflow pipe, the pressure is restored to 0.28 bar (kg/cm<sup>2</sup>) and valve C closes. Valve D opens as soon as an underpressure in the cooling system occurs due to the colder water having a smaller volume.

Removal of the vacuum avoids the possibility of the cooling system not being filled from the radiator header tank or expansion tank.



- A. Filler cap  
B. Filler opening  
C. Pressure relief valve  
D. Underpressure valve  
E. Gasket

### Rust inhibitor

In order to protect the interior of the cooling system against corrosion, an emulsifying oil, e.g. Shell Donax C, should be added to the coolant throughout the year.

The cooling system will thus be held in good condition and the risk of poor heat transfer or of clogging will be strongly reduced.

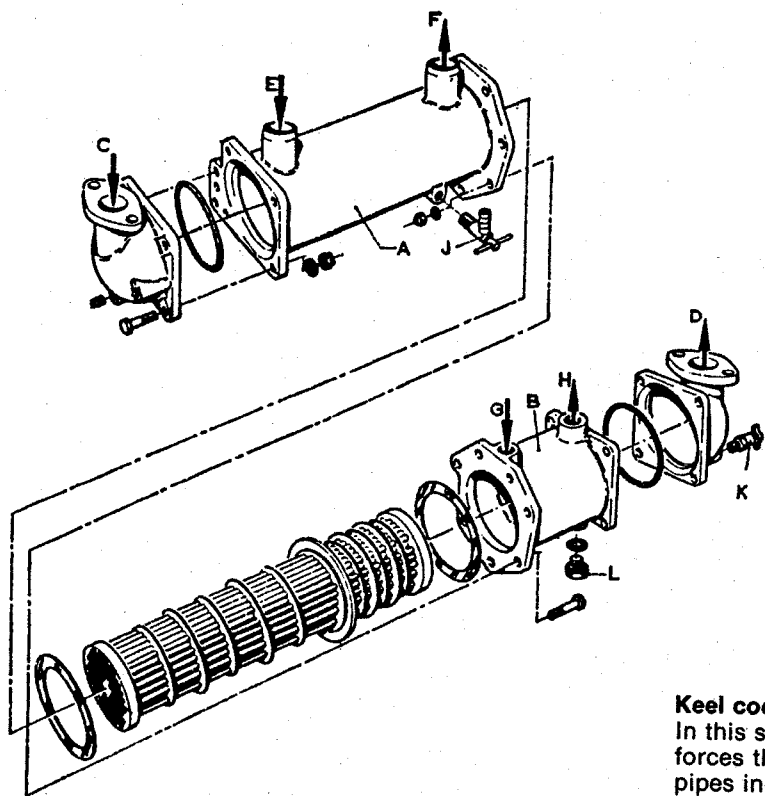
Emulsifying oil has to be added in the proportion of 1% to the coolant, which thus turns milky white. If during a regular inspection the coolant is found to be transparent, 100 cc may be added.

If an anti-freeze agent is used in the cooling system, it is not permitted to add an emulsifying oil, because most anti-freeze brands already contain a rust inhibitor.

### A few remarks:

1. Before using anti-freeze it is advisable to thoroughly clean the cooling system and to check the cylinder head gaskets for leaks (leakage of glycol in the engine results in sticking of parts). Also the water hoses should be checked and, if necessary, be renewed.
2. If the quantity of coolant has diminished after some time, a mixture of the same composition as the original one should be added. Water alone would raise the freezing point.
3. If the drained oil contains a sticky substance, it may be assumed that the anti-freeze has penetrated into the engine. Thorough inspection and cleaning are required then.

## Outboard water cooling systems



Intercooler (mercantile type)

- A. Engine coolant compartment
- B. Engine oil compartment
- C. Outboard water inlet
- D. Outboard water outlet
- E. Engine coolant inlet
- F. Engine coolant outlet
- G. Engine oil inlet
- H. Engine oil outlet
- J. Engine coolant drain cock
- K. Outboard water drain cock
- L. Engine oil drain plug

DAF Marine Diesel Engines are usually equipped with intercooling or keel cooling and in given cases skin cooling may be used.

### Intercooling

In this cooling system the cooling water of the engine is circulated in a conventional way by the water pump.

The water passes through the engine block, the cylinder head and the cooled exhaust manifold and subsequently arrives via the oil cooler at the thermostat housing.

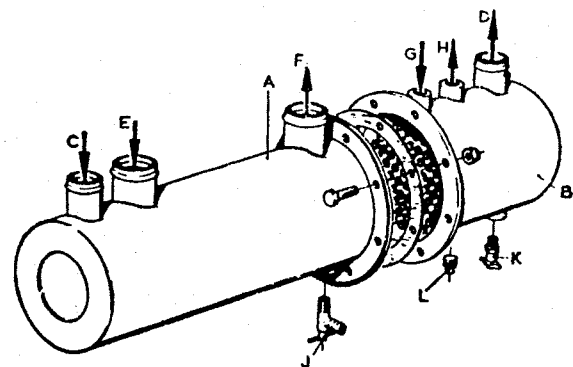
When the thermostat is closed because the coolant is not yet at the operating temperature, the water flows directly back to the water pump. When the thermostat is open, the coolant is first passed to the intercooler to deliver its heat to the outboard water, which is forced by a separate pump through the intercooler. If also the lubricating oil of the reversing gear has to be cooled, this is carried out in a separate cooler arranged between the intercooler and the water pump of the engine.

### Intake air cooling

For yachts there is a special intercooling version of the DT615-M engine, in which an intake manifold with outboard water cooling is applied. Due to the compression by the turbocharger the intake air has attained a high temperature and the above system serves to cool down this air to nearly its original temperature.

### Keel cooling

In this system the water pump of the engine forces the hot cooling water through a bunch of pipes included in the water circuit and arranged on or in the hull of the vessel. At this place water delivers heat to the outboard water flowing alongside. Therefore keel cooling dispenses with the outboard water pump and the inter cooler.



Intercooler (version for yachts)

This intercooler consists of two main parts for cooling, respectively the engine coolant and the engine oil by outboard water.

- A. Engine coolant compartment
- B. Engine oil compartment
- C. Outboard water inlet
- D. Outboard water outlet
- E. Engine coolant inlet
- F. Engine coolant outlet
- G. Engine oil inlet
- H. Engine oil outlet
- J. Engine coolant drain cock
- K. Outboard water drain cock
- L. Engine oil drain plug

### Skin cooling

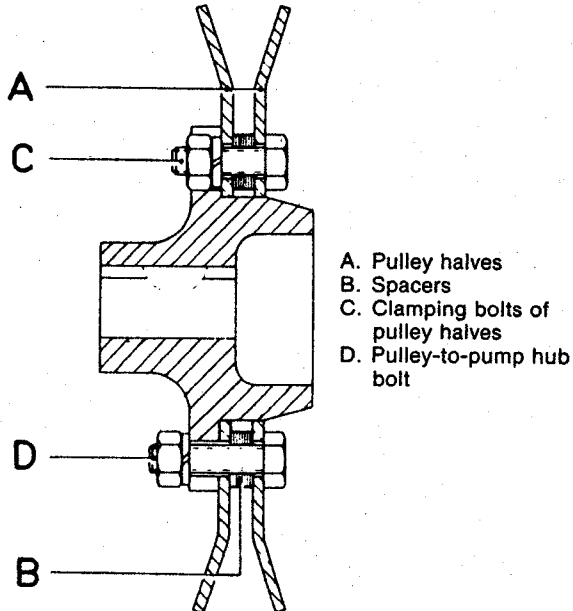
In principle, skin cooling is for a large part identical with keel cooling. The function of the bunch of pipes is performed here, however, by a comparatively large water tank, one or more surfaces of which are formed by the hull plates of the vessel so that they are in direct contact with the cold outboard water.

### Outboard water pump

For the data and instructions relating to the outboard water pumps used by DAF, reference is made to the respective chapters of this booklet. Since the outboard water pump is not adjustably fastened to the engine block, the V-belt tension has to be adjusted by changing the pulley. For this purpose the pulley consists of two separate halves with in between spacers B, bolted together by two bolts C. The assembly is attached to the pump hub with four bolts D.

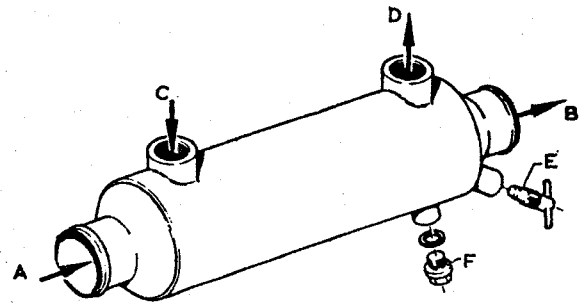
For tensioning the Vee-belt proceed as follows:

1. Unscrew the four bolts D and take the pulley off the pump.
2. Unscrew the two bolts C.
3. Remove two (or a multiple of two) spacers.
4. Re-assemble the two pulley halves.
5. **Important:** Put half the number of removed spacers between the inner pulley half and the pump hub and the remaining spacers under the head or the nut of the bolts D.



Adjustable Vee-belt pulley

When fitting a new Vee-belt insert eight spacers of 0.5 mm each between the pulley halves.



Engine oil cooler

- |                     |                      |
|---------------------|----------------------|
| A. Water inlet      | D. Engine oil outlet |
| B. Water outlet     | E. Water drain cock  |
| C. Engine oil inlet | F. Oil drain plug    |

### Maintenance of the cooling system

Since fouling of the sucked-in outboard water completely depends on the local conditions, no generally applicable intervals can be prescribed for cleaning the filter system. The same applies to the intervals of checking whether the degree of fouling is such that the cooling effect has become insufficient. However, if these checks are made regularly, the risk of difficulties with the outboard water cooling system is extremely small.

After some time sediments will be formed in the intercooling pipes so that the outboard water cooling will no longer be effective. This will become apparent from the coolant temperature gauge reading exceeding the standard value. In such a case the intercooling flanges should be removed and the tubes pierced. Use a rattan stick or copper wire of largest thickness, with a rounded-off end in order to prevent the tubes being damaged.

### Draining

With frosty weather, water not mixed with anti-freeze must not be left anywhere in the cooling system. This applies particularly to the outboard water. For a complete removal of the outboard water, drain plugs are provided in the outboard water pump and in the intercooler.

**It is absolutely required for all drain plugs to be removed in order to ensure that no water is left.**

# Electrical system

## GENERAL MAINTENANCE

### Batteries

The batteries must be checked at least every 100 hours.

The liquid (electrolyte) must always be about 5 mm above the plates. When the level has dropped, only distilled water must be added.

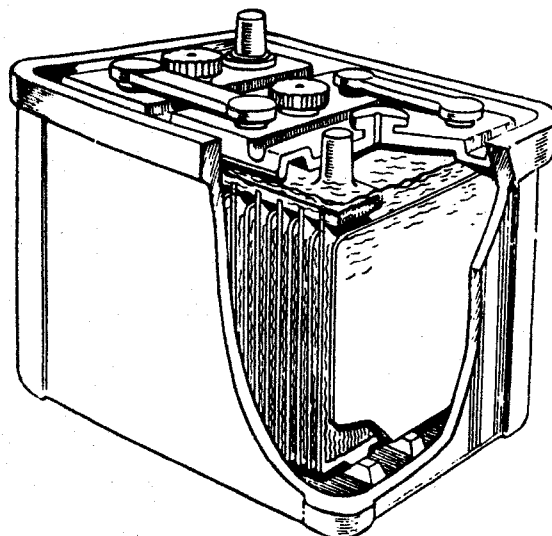
The battery terminals and terminal posts must be kept clean and free from oxidation. The clamps must be provided with a coating of acid-free petroleum gel. The outer side of the battery and especially the top must be kept clean and free of grease.

To keep the vent holes in the filler caps open these must be pierced with a piece of wire. Ensure that the batteries are closed with the filler caps when it is necessary to work on or near the batteries, because a spark or an open fire is likely to easily ignite the explosive hydrogen gas developed in the battery. It is advisable to check the condition of the battery from time to time by measuring the specific mass (sm) of the electrolyte. The sm will increase during the charge and decrease during the discharge. Specific mass (charged) at +20°C: 1280 kg/m<sup>3</sup>. Specific mass (discharged) at +20°C: 1120 kg/m<sup>3</sup>.

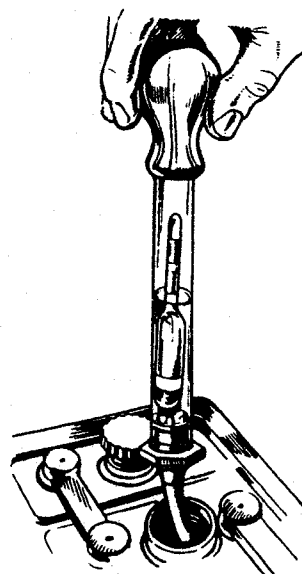
The batteries must never be left unused in a discharged condition. Before storing the batteries must be fully charged, thereafter slowly discharged (e.g. by a 15 W lamp) and then again slowly charged (10A). Once this has been done it suffices to recharge the battery every three months. The plates are thus prevented from reacting with sulphur.

### Alternator

1. Ensure there is a good electric contact of the various connection cables with the starting motor and the alternator, as well as a good earth connection between engine and earth.
2. Alternators may only be combined with the specified regulator and battery.
3. Regulators must be safeguarded against excessive temperatures (80°C).
4. To prevent damaging of diodes and regulator, it is not permitted to use the alternator if it is not connected with the regulator and the battery.
5. Never loosen connections between alternator, regulator and battery nor open the master switch when the alternator is operating.
6. It is absolutely inadmissible to test the alternator by connecting the B+ cable with the earth, not even for a short moment, because this would produce a short-circuit.
7. Drawing sparks from the earth by means of a conductor with the purpose to see if it is energised, must be omitted.
8. Make sure that the battery has been correctly connected. An incorrectly connected battery destroys the diodes.
9. Pre-excitation of the field is effected via the battery charge warning lamp. When replacing the lamp, make sure that the new lamp is of the correct type (24 Volts, 3 Watts).
10. When installing additional electrical systems of which the wiring includes coils (such as a relay), care must be taken to avoid inductive voltage peaks (e.g. with a diode or varistor).
11. During "quick-charging" it is to be advised to disconnect both the positive and the negative battery clamps, whereas during electric welding the connection between alternator, regulator and batteries must be interrupted.
12. Make sure that the belt is properly tensioned. Excessive belt tension may shorten the life of the alternator bearing, while an unduly low tension might lead to slipping of the belt(s).



Electrolyte (liquid) must be approx. 5 mm above the plates



Acidimeter

13. In the event of interference with radio reception:

- a. make sure that the regulator has a good contact with the negative battery terminal
- b. a capacitor can be inserted between the B+ terminal of the alternator and again the negative battery terminal. The value of this capacitor will depend on many factors such as the type of the radio, the electrical wiring system, the interference area etc. Generally speaking, this value may vary between 5 and 50 microFarads.

## Fault tracing

The fault finding table given below is not exhaustive and may only be taken as a guide to trace general failures.

In the case of complaints try to find a simple solution: most engine problems are small and can easily be solved.

Complaints regarding "lack of power" are often due to a fouled fuel filter.

A "high lubricant consumption" often simply indicates leakage at flanges or connections in lines.

Try to find the most likely solution of a complaint before looking further, this will save time and money.

## Fault finding table

Defect	Possible cause
1. Starting motor fails to operate	a. Discharged or defective batteries b. Loose or corroded battery cables c. Defective starter switch d. Defective starting motor
2. Engine fails to run when started	a. Defective starter pinion or flywheel gear ring b. Engine seized
3. Engine is running slowly	a. Bad cable connections of batteries and/or starting motor (corrosion) b. Bad charging condition of batteries
4. Engine fails to start up	a. Air in fuel system b. Moisture separator full of water c. Fuel feed pump defective d. Injection pump defective or incorrectly set e. Main fuel filter clogged f. Fuel filter clogged (at fuel feed pump) g. No fuel supply h. Throttle control sticking or incorrectly set i. Injectors fouled or deranged
5. Engine has insufficient power, runs badly and/or often cuts out	a. Air intake partly or completely blocked (black smoke from the exhaust pipe) b. Fuel filter clogged (see point 4, e and f) c. Loose or defective fuel pipes. d. Air in the injection system e. Injectors defective or deranged f. Throttle control deranged
6. Excessive oil consumption of engine	a. External oil leakage b. Internal oil leakage c. Sump breather filter on cover and in vent pipe clogged
7. Engine smoking at the exhaust	a. Fouled air cleaner or air intake system (black smoke) b. Injectors fouled or deranged c. Water in compression chamber or in exhaust system (white smoke)
8. Unduly low oil pressure	a. Oil level too low b. Defective oil pressure sensor c. Defective oil pump d. Oil filter clogged
<b>STOP ENGINE IMMEDIATELY</b>	
9. Engine remains too cold	a. Wrong type of thermostat
10. Engine is getting too hot	a. Too low coolant level b. Slipping or defective V-belt c. Defective thermostat d. Defective coolant pump e. Defective temperature gauge



## Repairs

### GENERAL INSTRUCTIONS

#### Cleanliness

A foreign particle penetrating during repair may cause more damage than the original defect did.

- if anywhere possible work with clean hands;
- clean the surroundings of a part before removal;
- cover an unprotected access by winding a cloth or a paper around it;
- put the removed parts on a clean sheet of paper.

#### Position marks

If parts are removed which must afterwards reoccupy their original positions, their relative positions must be marked prior to removal.

#### Gaskets

Even if it is not compulsory specified, it is in general to be preferred to always fit a new gasket. Gaskets - as well all the enclosing joint faces - have to be thoroughly clean since otherwise a perfect sealing would be impossible.

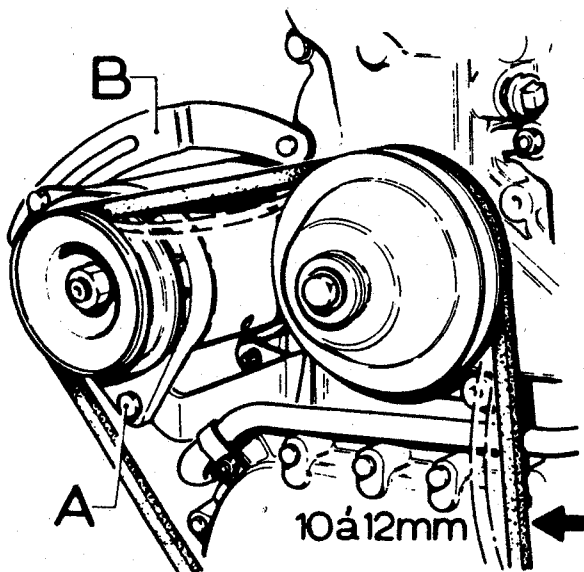
Observe the instructions with respect to the use of a liquid sealing compound.

In general only sparingly use liquid sealing compound.

#### Bolts and nuts

Make sure to always tighten bolts and nuts to the specified torque. In many cases, this is even an **ABSOLUTE REQUIREMENT**.

Even if not expressly stated, bolts and nuts should be tightened in crosswise order (never tighten two adjacent bolts in direct order of succession). Tightening should be carried out in at least two or three steps (never tighten the bolt and the nut at one go to the prescribed torque).



A. Attaching bolt B. Adjusting strip

#### Locking

Take care to always lock bolts or nuts which were locked before.

#### Renewing a Vee-belt

Always use caution when renewing a Vee-belt, avoid expanding and twisting. Slackening the dynamo attachment will enable to fit and to retension the belt(s) without much trouble.

A Vee-belt has the correct tension if it can be depressed approx. 10 to 12 mm between two pulleys.

If there is more than one belt on a pulley then all belts must be renewed simultaneously.

After renewing the Vee-belts check the tension after approx. two operating hours and again after twenty operating hours.

Thereafter check the tension at regular intervals.

#### Valve clearance

Irrespective of whether the engine is hot or cold, the clearance of the inlet valve and exhaust valve is 0.5 mm.

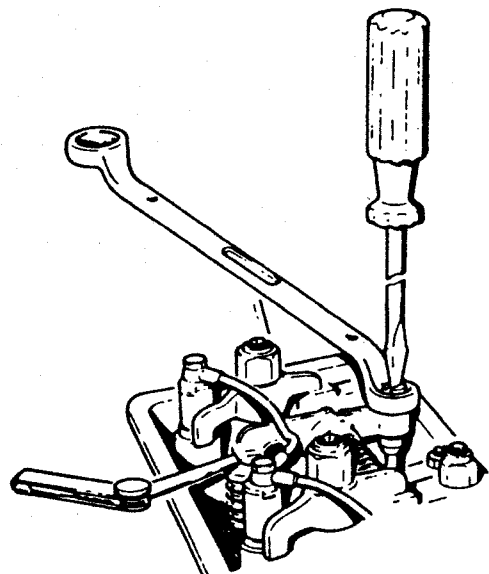
The valve clearance is measured with a feeler gauge between the rocker and the valve stem. In order to set the clearance of both valves these must be closed. This can easiest be done by proceeding as follows:

When, for instance, of cylinder no. 6 the exhaust valve closes and the inlet valve opens, the valves of cylinder no. 1 are in the correct position (closed) to enable the valve clearance to be set. The reverse is also true: when of cylinder no. 1 the exhaust valve closes and the inlet valve opens, the valve clearance of cylinder no. 6 allows to be set.

In the same way the remaining valves can be set: cylinders no. 2 and 5 and cylinders no. 3 and 4 correspond with each other.

#### Replacing an injector

To prevent dirt from falling into the injector hole,



Setting the valve clearance

first clean the surface around the injector which is to be renewed. After fitting the new injector it is connected to the injection pipe (also see: Renewing of injection pipes).

We must strongly advise against testing the operation of a loose injector with the engine running. The escaping fuel jet is sufficiently strong to cause the fuel oil to deeply penetrate into the flesh of the body which may cause to very dangerous infections.

#### **Air cleaner**

For cleaning a dry air cleaner with replaceable filter element proceed as follows:

- with compressed air (max. 3 bar) blow from the inside to the outside.
- after three cleanings renew the filter element
- in an emergency clean by cautiously tapping against a soft object.

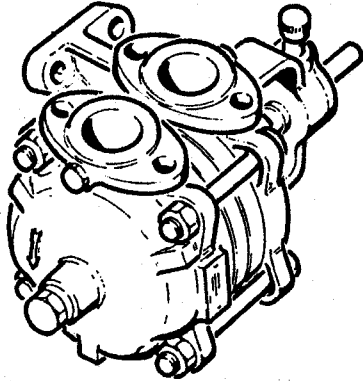
#### **Renewing of injection pipes**

A defective injection pipe must always be replaced by a genuine DAF spare part.

When fitting the new pipe make sure that the pipe exactly and stressfree connects to the pump and the injector and that the union nuts are not forced during tightening. It is furthermore very important to secure the pipes with the clamping blocks.

New lines must be blown through with compressed air prior to fitting.

## SIHI outboard water pump



SIHI outboard water pump

### General

The SIHI outboard water pump is a self-priming pump consisting of five main components. The bronze impeller with rubber-coated blades rotates in a chamber bounded by two bronze partitions clamped tight between two cast iron flanges. On the driven side the pump shaft is supported in a ball bearing which requires regular lubrication by means of a grease cup.

The non-driven side is supported in a water-lubricated plain bronze bearing.

The pump shaft is sealed in the usual way by means of a stuffing box. A slinger arranged on the pump-shaft prevents any water leaking along the shaft from reaching the ball bearing.

### Maintenance

#### Priming instructions

Before the pump is operated for the first time, the following operations have to be carried out:

1. Check whether the pump shaft can be turned by hand.
2. Completely fill the pump with water via the plug holes in the two flanges. This has to be repeated every time the pump has been drained.
3. Check the temperature of bearings and stuffing box after the pump has run for some time (at the most handwarm).

#### Lubrication

Lubricate the ball bearing every 300 working hours by one turn of the grease cup.

### Draining

If there is danger of frost the pump has to be drained completely by removing the plugs in the inlet flange and in the delivery flange. During draining turn the shaft by hand until water escapes no longer.

### Running dry

The pump must never run without water!

### V-belt

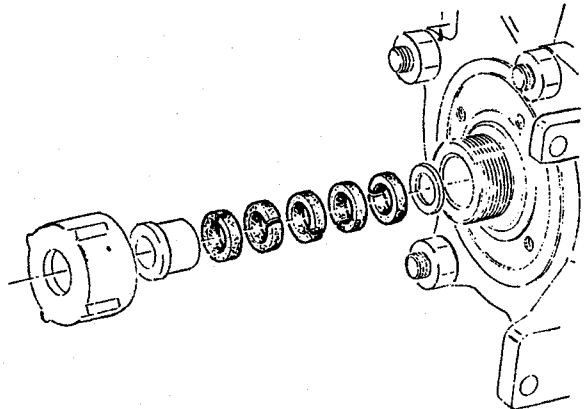
Check the tension of the V-belt every 100 working hours.

It must be possible to depress the V-belts 12-15 mm between the pulleys. An excessively taut V-belt results in excessive wear of the bearings. A slack V-belt is likely to cause slipping.

### Renewal of packing rings

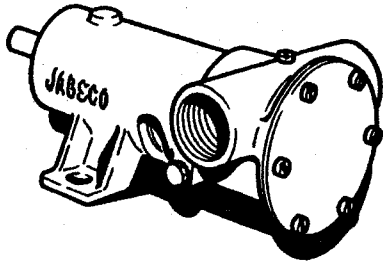
Only use genuine DAF packing rings. Carefully remove all old packing material. Make sure that the ring joints are staggered. Firmly tighten the gland nut so that the shaft can only just be turned by hand. Slacken the gland nut and retighten it by hand, after which the shaft should revolve without undue binding. It is advisable to allow the gland nut to leak **slightly** because this will lengthen the life of the shaft. Excessive tightening of the gland nut may result in destruction of the pump shaft and the packing.

**The gland nut has to be tightened when the engine is standing still. Only if this is not possible, it is allowed to do otherwise.**



When fitting the packing rings the ring joints must be staggered.

## JABSCO marine pump



View of Jabsco marine pump

### General

The Jabsco marine pump comprises two main components, viz.: a bronze pump body and a cast iron bearing housing, clamped together by means of a bolt.

The plastic impeller rotates within the pump body. Owing to the configuration of the flexible impeller vanes water is drawn in and is forced along under pressure.

The bearing housing is sealed at either end by a grease seal. Sealing between pump body and bearing housing is effected by means of a carbon water seal. Any water which might seep past this seal is deflected by the slinger mounted on the shaft and is thus prevented from entering the bearing housing.

### Maintenance

#### V-belt

Check the tension of the V-belt every 100 hours of operation. It must be possible to depress the V-belt 12 to 15 mm between the pulleys. An overtight V-belt reduces bearing life. A loose belt on the other hand allows slipping.

#### Draining

If there is danger of frost the pump has to be drained by loosening the end-cover screws and allowing all the water in the pump to flow out.

### Running dry

Do not allow the pump to run dry for more than 10 seconds.

### Operating temperature

The operating temperature of the pump may not exceed approx. 45°C.

### Laying up the vessel

If the vessel is to be laid up for a longer time it is recommended to remove the impeller from the pump body. Store the impeller in a dry, cool and frostproof place.

### Impeller replacement

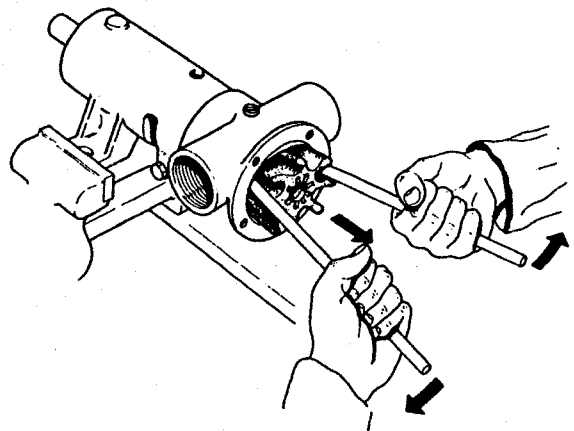
Fig. 2 shows how the impeller can be prised out of the pump body by means of two rods slightly curved at the ends.

Moisten the new impeller with water and introduce it into the pump body bore with a rotary motion until its splines engage with the splines of the pump shaft.

Push impeller fully into pump bore.

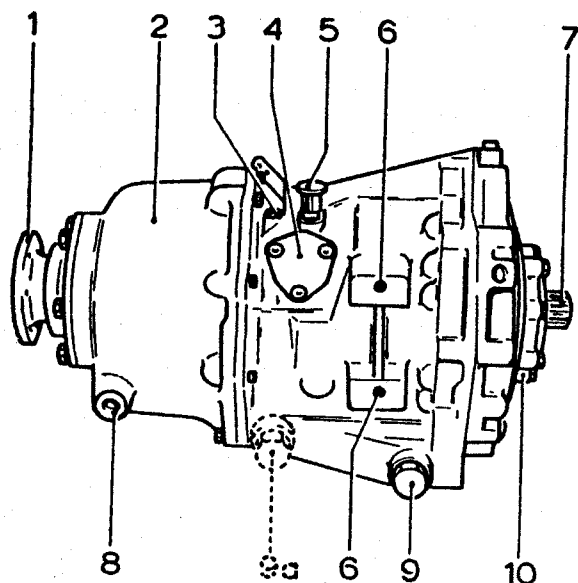
If the vanes of a used impeller do not regain their starting position, the impeller should be installed reversely to ensure that the full pump capacity is maintained.

Use a standard 0.010" (0.25 mm) thick end-cover gasket. A thicker gasket will reduce the pump capacity while a thinner one will damage the impeller beyond repair.

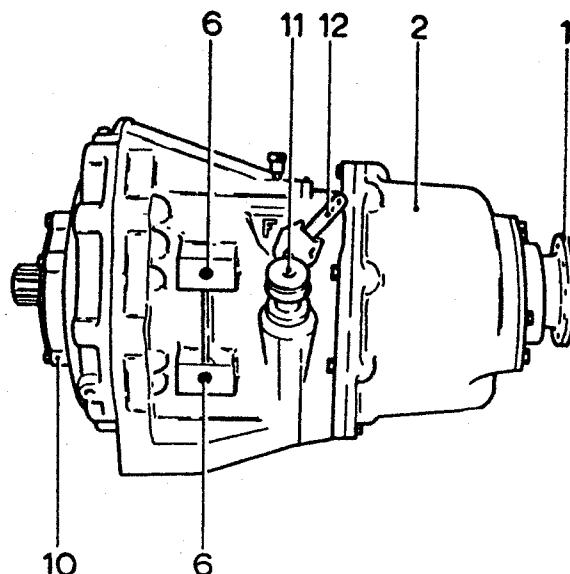


Impeller removal

## VELVET-marine gear



1. Output flange
2. Reduction casing
3. Outlet port to oil cooler
4. Control valve cover
5. Breather
6. Mounting holes
7. Input shaft
8. Oil cooler return port (former version)
9. Oil drain plug; also opening for oil cooler return port (type 72C)
- 9a. Location of plug for type 71C
10. Oil pump



8. Oil cooler return port (former version)
9. Oil drain plug; also opening for oil cooler return port (type 72C)
- 9a. Location of plug for type 71C
10. Oil pump
11. Oil filler cap
12. Control valve selector lever

### GENERAL

The Velvet hydraulic marine gear comprises two main units viz:

- a. the reversing gear, driven directly from the engine;
- b. the reduction gear attached to the rear of the reversing gear casing.

The reversing gear incorporates a planetary gear set which enables the direction of rotation of the output shaft to be reversed through application of one of the two hydraulically operated clutches.

This is accomplished by means of a shift control valve which directs oil delivered under pressure by the oil pump, to the respective clutch.

If no reduction in output shaft speed is required, the reversing gear alone is mounted and is then coupled directly to the propeller shaft.

Should a reduction be required, however, this is achieved by attaching a reduction gear to the reversing gear, the two units then forming a single

drive with the same lubrication system supplying oil to both units. The speed reduction is obtained through a planetary gear set in the reduction gear. The reversing gear and reduction gear output shafts are coaxial and rotate in the same direction\*.

The oil for applying the clutches and for lubrication of all moving parts of the marine gear is water-cooled by means of an oil cooler connected with the reversing gear and reduction gear units. The arrangement must be such that the oil will flow to the oil cooler from the outlet port (3) and after having passed through the cooler, will flow back to the reversing gear (9) or to the reduction gear (8) in the case of former versions.

\* With a 1.91 to 1 ratio reduction gear: in opposite direction.

### OPERATION

Except for emergency cases, never move the selector lever from ahead to astern position or reverse when engine speed is above 1000 r.p.m.

### LUBRICATION

Remove the filler cap before draining the oil. The oil is drained via the drain plug opening (9). After removing the drain plug the oil strainer becomes accessible. The strainer should be thoroughly cleaned at the same time the oil is changed. Former versions have this filter located behind oil cooler return port (8). The unit should be filled to the full mark on the dipstick and then run the engine at idling speed for a short while in order to fill all circuits. The oil level should be checked immediately following engine shut-off and sufficient oil should be topped up until the full mark is reached.

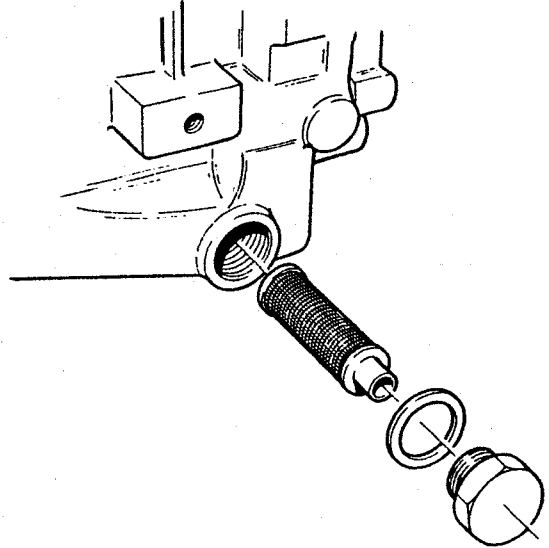
For reading the oil level insert dipstick only to thread but do not screw it down.

Where the arrangement is such that the oil in the cooler can flow back to the reversing gear unit when the engine is standing still the oil level should reach above the full mark on the dipstick after the engine has been off for some time. For this reason the daily oil level check should be

Recommended oil type :  
Check oil level :  
Change oil :

Clean oil strainer :  
Max. oil temperature :

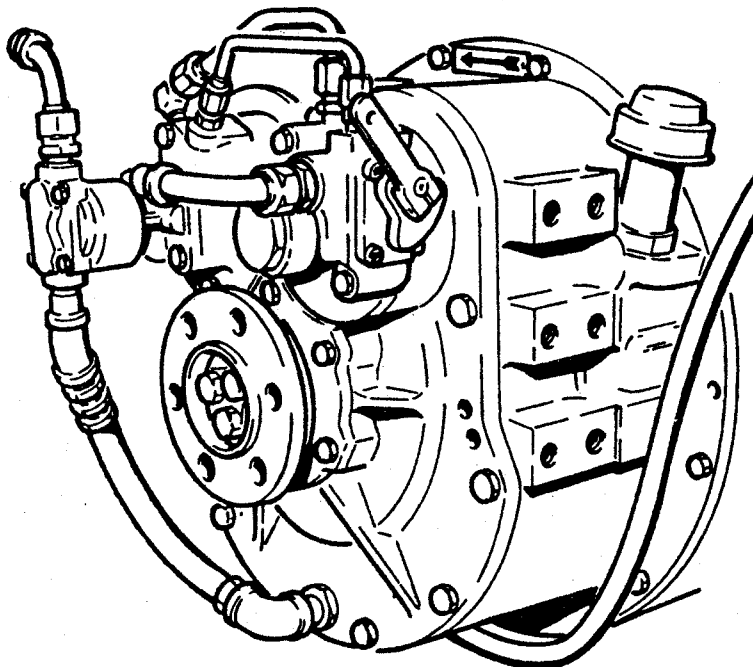
made immediately after engine shut-off and oil added, if necessary, till full mark.



Oil drain opening, strainer and drain plug

automatic transmission fluid, type 'A'  
daily  
simultaneously with the changing of the engine  
lubricant  
when oil is changed  
approx. 185°F (85°C)

## TWIN DISC reversing gear MG-506



Twin Disc reversing gear MG-506

### Technical data

Make	Twin-Disc
Model	MG-506
Type	hydraulically operated multiple plate reversing gear
Oil	
quantity including cooler and lines	4.5-5 litres
quality and viscosity	as prescribed for the engine lubricant
operating temperature	normal 60 to 83°C min. 60°C max. 107°C
operating pressure (engaged)	21-22 kg/cm <sup>2</sup> at 1800 rev/min and 83°C
ditto (minimum)	19 kg/cm <sup>2</sup> at 1800 rev/min and 83°C
lubricating and cooling oil pressure	0.5 kg/cm <sup>2</sup> at 1800 rev/min and 83°C
pump capacity	8.5 litres/min at 1800 rev/min

### Description

In the Twin-Disc reversing gear the transmission of the engine power to the propeller shaft is achieved by means of two gear sets. Dependent on the required direction of rotation of the propeller shaft, one of these gear sets is engaged by means of one of the two hydraulic multiple plate clutches. At the same time the engine speed is reduced.

Oil pressurised by a pump is forced through a control valve to one the plate clutches and

provides the required pressure on the friction plates. The oil serves in addition as a lubricant and coolant. In order to keep the temperature of the oil within permissible limits, an oil cooler is included in the circuit, where the oil is cooled by means of the engine cooling water. In the forward direction of navigation the propeller shaft rotates in the same direction as the engine crankshaft. In the reverse direction the directions of rotation of the propeller shaft and the engine crankshaft are opposite to each other.

### Operation

If operation of engine and reversing gear is not automatically effected simultaneously, the following shifting instructions must be observed.

1. Shifting from neutral to ahead or astern must not be carried out at engine speeds higher than 1900 r.p.m.
2. Shifting directly from ahead to astern or vice versa should not be carried out at engine speeds exceeding 1200 r.p.m.

### Maintenance

**Oil level check.** This check must be carried out with the engine idling. The oil level should be maintained between the 'low' and 'full' marks on the dipstick.

**Oil filling.** The oil should be poured into the oil sump through the breather pipe. After filling the engine should be started and the oil level has to be rechecked at idling speed.

**Oil change.** The oil should be changed after the initial 20 and 200 working hours and subsequently after every 1000 working hours. When the ship has been laid up for more than three months, the oil should be changed before service is resumed.

Oil of the same type and viscosity can be used for engine and reversing gear.

The oil is drained by means of the pump also used for emptying the engine sump. Draining should be carried out whilst oil is still warm and after it has returned to the oil sump (after 15 to 20 minutes). Do not forget to drain the oil from the oil cooler as well.

**Oil strainer.** The oil strainer in the clutch cover must be cleaned after the initial 20 and 200 working hours and subsequently after every 1000 working hours.

Cleaning must be done in pure fuel oil. The strainer is then blown to dryness. Always use a new gasket when re-installing the strainer in the clutch cover.

**Breather filter.** The breather filter should be cleaned at every oil change by flushing it thoroughly in clean fuel oil.

## FAULT FINDING

### Symptom

Oil pressure too low  
No oil pressure

Oil temperature too high

Excessive noise  
Clutch not engaging smoothly

### Cause

partially clogged oil strainer  
no oil or insufficient quantity in sump  
clogged oil strainer  
damaged oil supply lines  
too much oil in sump  
wrong type of oil  
air leakage on suction side of oil system  
air leakage on suction side of oil system