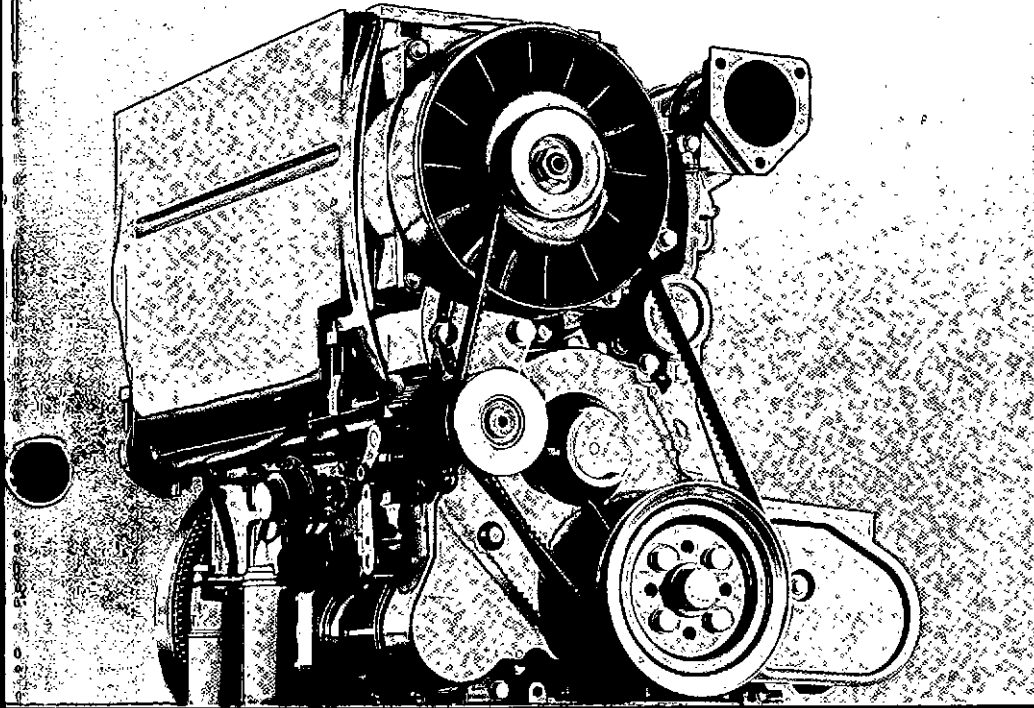
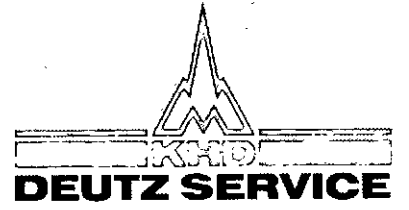


Operation Manual

FL 1011



- Please read and comply with the information given in this Operation Manual. Thus, you will prevent the occurrence of accidents, preserve the warranty granted by the manufacturer and keep an efficient engine ready for operation.
- This engine is exclusively built for the application provided in the scope of supply — and defined by the manufacturer — (use in accordance with regulations). Any use exceeding that scope is considered to be contrary to regulations. The manufacturer will not assume any responsibility for any damage resulting therefrom. The risks involved are to be borne solely by the operator.
- Use in accordance with regulations also implies compliance with the conditions laid down by the manufacturer for operation, maintenance and repairs. The engine may only be used, maintained and repaired by persons familiar with engines and informed about the risks involved.
- The relevant regulations for prevention of accidents as well as other general and legal rules regarding safety and industrial medicine are to be complied with.
- Unauthorized alterations on the engine will exclude any responsibility by the manufacturer for any resulting damage.

Operation Manual

FL 1011



0297 4706 en

**Engine Serial
Number:**

| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|

Please enter here the engine serial number. By quoting this number, you will help to facilitate dealing with questions concerning Customer Service, Repairs and Spare Parts (see Section 2.1).

All rights reserved. In view of the constant improvements to our engines, the specification data and other technical information included in this Operation Manual are subject to change. No part of this Manual may be reproduced in any form or by any means without our written permission.



Foreword

Dear Customer!

The air-cooled DEUTZ engines have been developed for a wide range of applications. Consequently, a correspondingly high number of variants are offered to meet the special requirements of each special case.

Your engine is appropriately equipped for the installation concerned, which means that not all of the components described in this Operation Manual are necessarily mounted to your engine.

We have taken pains to point out the differences, so that you can easily find the operating and maintenance instructions relevant to your engine.

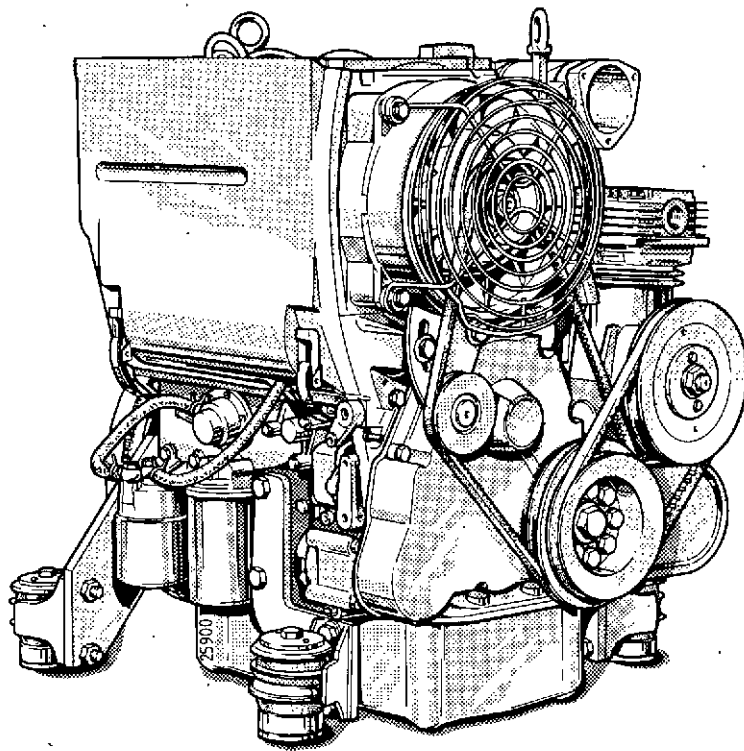
Please read these instructions before commissioning your engine and give them your due consideration.

Should you have further enquiries, please do not hesitate to contact the KHD-DEUTZ SERVICE, who gladly remain at your disposal.

Yours sincerely,

KLÖCKNER-HUMBOLDT-DEUTZ AG

| | | | |
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| 1. General | 4.1.2 Viscosity | 6.6.1 Checking/Adjusting Valve Clearances | 1 |
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| 3.5 Operating Conditions | 6.5.4 Retensioning or Renewing Air Compressor V-Belt | | |
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| 3.5.2 High Ambient Temperature, High Altitude | 6.6 Adjustments | | |
| 4. Operating Media | | | |
| 4.1 Lube Oil | | | |
| 4.1.1 Quality Grade | | | |



DEUTZ Diesel Engines

are the product of research and development ranging over many years. The know-how thereby gained, coupled with high demands with regard to quality, forms the guarantee for the manufacture of engines featuring long service-life, high reliability, and low fuel consumption.

It goes without saying that the high demands regarding protection of the environment are also fulfilled.

Beware of Running Engine

Always stop the engine before carrying out maintenance or repair work. After completing the work, refit any guards which had to be removed.

Closely-fitting work clothing should be worn when working on the running engine.

Always stop the engine before refuelling.

Never run the engine in an enclosed space — danger due to poisonous vapours.

Service and Maintenance

will also play a decisive role as to whether the engine fulfills to your satisfaction the demands you make on it. Observance of the prescribed maintenance intervals and careful carrying out of the service and maintenance jobs are therefore essential.

Particular attention must be given with regard to applications involving differing and harder operating conditions as compared with normal operation.

Safety



When reading through this Manual, you will find this symbol marking all safety instructions and proceed with special care. Pass on these safety instructions to your operating personnel.

In addition, it is also necessary to observe the official safety and accident prevention rules.

DEUTZ SERVICE

In case of operational troubles and queries concerning spare parts, please contact your DEUTZ agent. Where necessary, our trained specialists will ensure a quick and professional repair, using DEUTZ spare parts. Genuine DEUTZ spare parts are always manufactured to the latest technical standards. More information on DEUTZ SERVICE is to be found at the end of this Operation Manual.

Asbestos



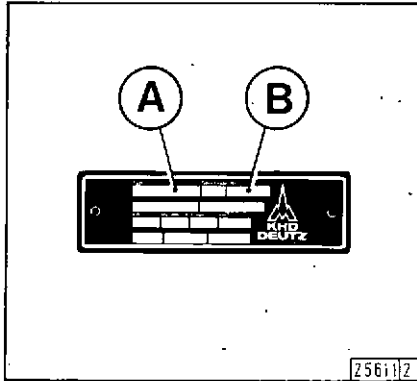
Gaskets used in this engine may contain asbestos.

When carrying out repair work, pay special attention to spare parts which are marked „a“.

- 2.1 Model Designation**
- 2.2 Engine Illustrations**
- 2.3 Lube Oil Circuit**
- 2.4 Layout of Fuel System**

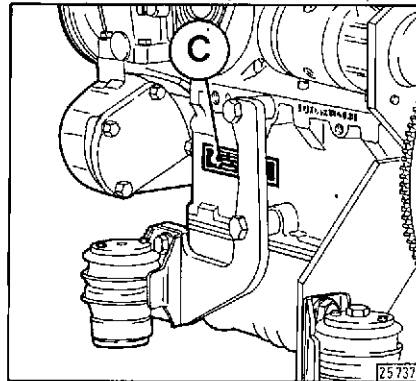
2

2.1.1 Rating Plate



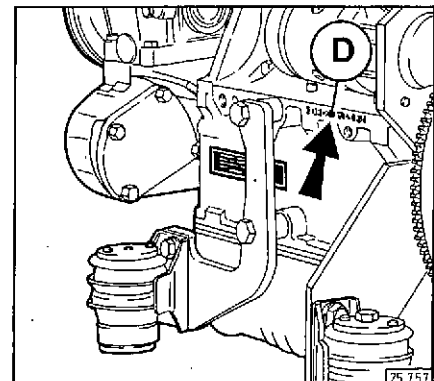
The model designation A, the engine serial number B and the performance data are stamped on the rating plate. When ordering spare parts, it is essential to quote the model designation and engine serial number.

2.1.2 Location of Rating Plate



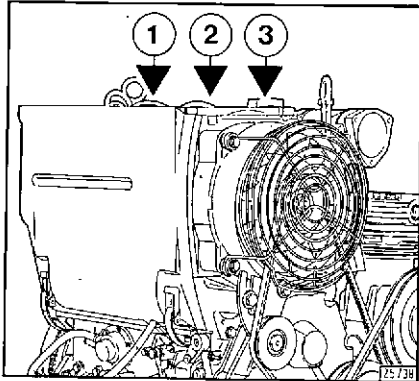
The rating plate C is attached to the crankcase; depending on the version, an additional rating plate may be attached to the air cowling.

2.1.3 Engine Serial Number



The engine serial number D is stamped into the crankcase as well as on the rating plate(s).

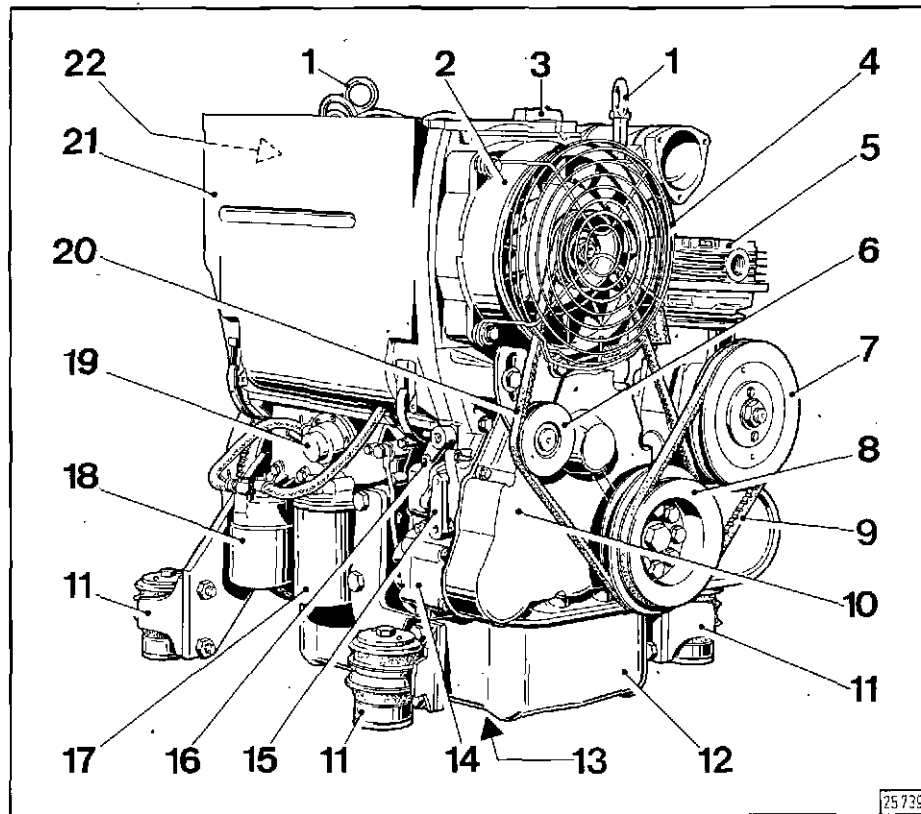
2.1.4 Numbering of Cylinders



The cylinders are numbered consecutively, beginning at the flywheel end.

2.2.1 Service Side

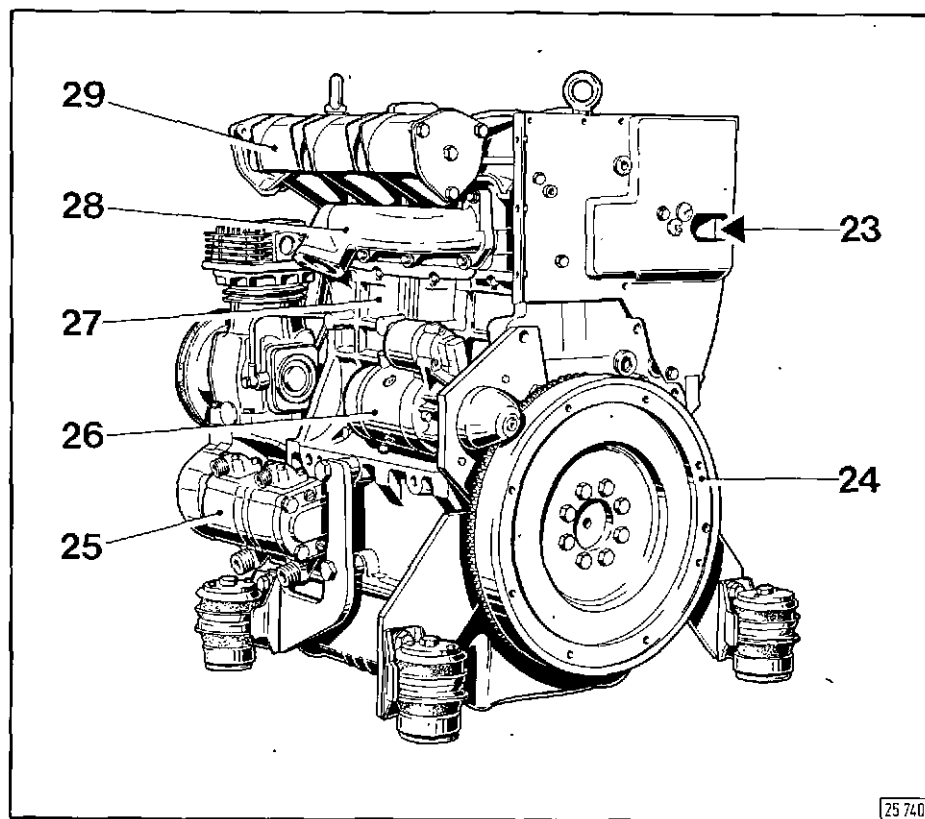
2



- 1 Lifting eyebolts
- 2 Cooling blower (with integrated alternator)
- 3 Oil filler neck
- 4 Guard
- 5 Air compressor
- 6 V-belt idler pulley
- 7 V-belt pulley (air compressor)
- 8 V-belt pulley (crankshaft)
- 9 Air compressor V-belt
- 10 Hood of toothed belt drive
- 11 Flexible engine mountings
- 12 Oil pan
- 13 Oil drain plug
- 14 Oil pump
- 15 Speed control lever
- 16 Shut-down lever
- 17 Oil filter
- 18 Fuel filter
- 19 Fuel pump
- 20 Cooling blower V-belt
- 21 Removable air cowling
- 22 Oil-cooler

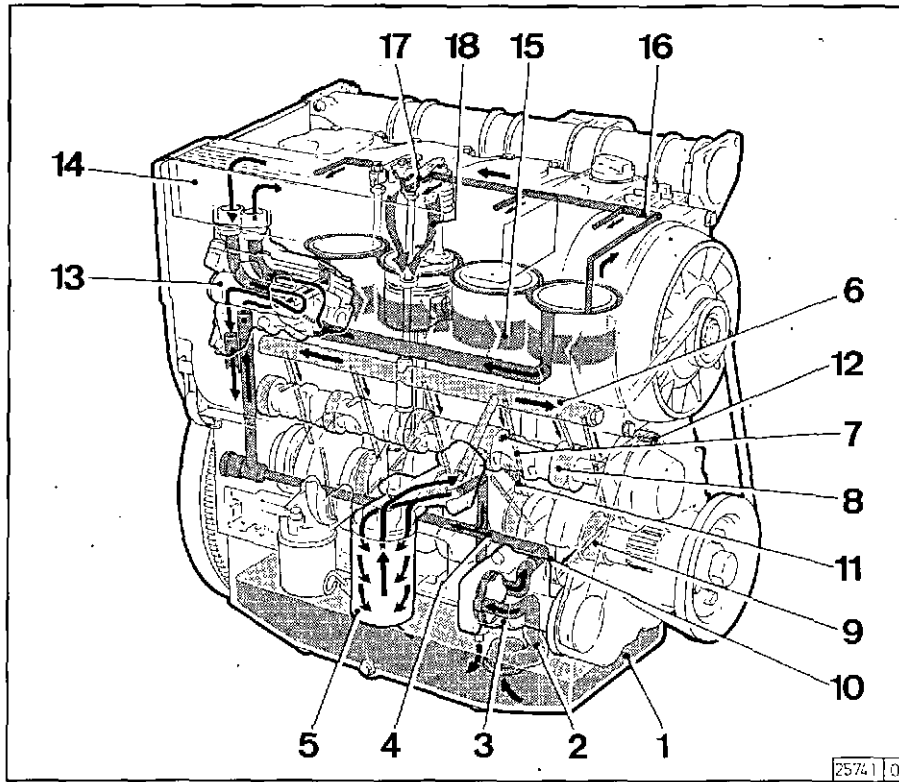
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2.2.2 Exhaust-Air Side



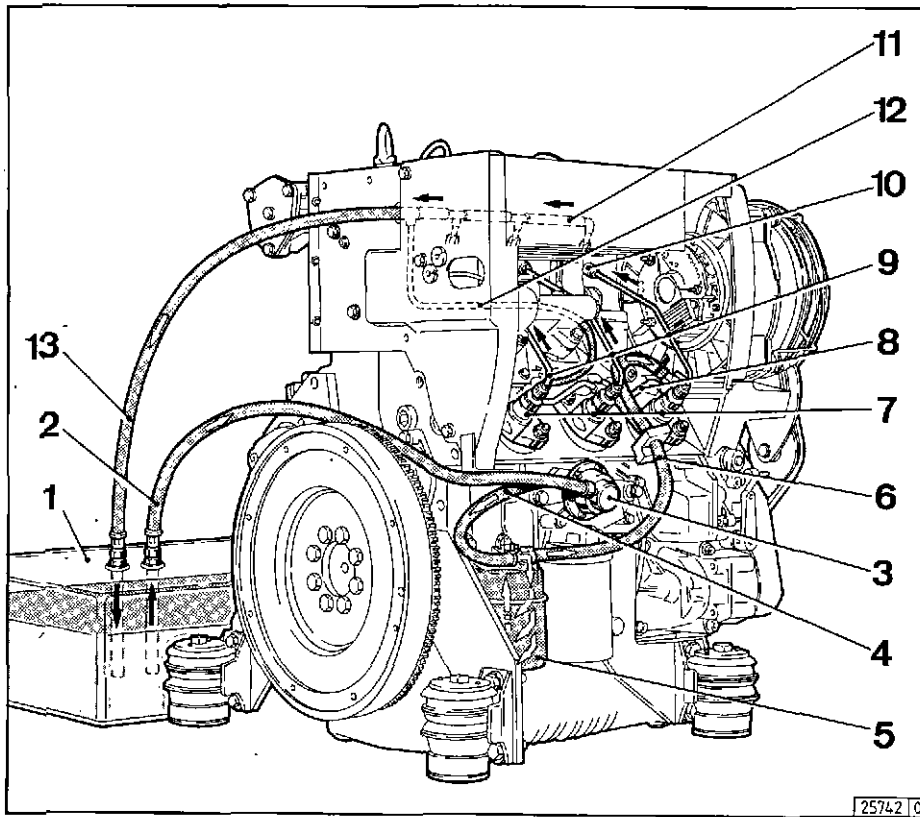
- 3 Cut-out for passage of lines
(in case of engine-oil cab heating system)
- 4 Flywheel
- 5 Hydraulic pump
- 6 Starter motor
- 7 Cylinder crankcase
- 8 Exhaust manifold
- 9 Air intake manifold

2



- 1 Oil pan
- 2 Suction pipe
- 3 Oil pump
- 4 Oil duct to oil filter and thermostat housing
- 5 Oil filter
- 6 Oil gallery
- 7 Oil bores to camshaft and main bearings
- 8 Camshaft bearing
- 9 Main bearing
- 10 Big-end bearing
- 11 Spray nozzle for piston cooling
- 12 Connection for air compressor lubrication
- 13 Thermostat housing
- 14 Oil cooler
- 15 Oil-cooled cylinder
- 16 Oil duct for lubrication of rocker arms
- 17 Rocker arm lubrication
- 18 Oil return via crankcase to oil pan

25741 | 0



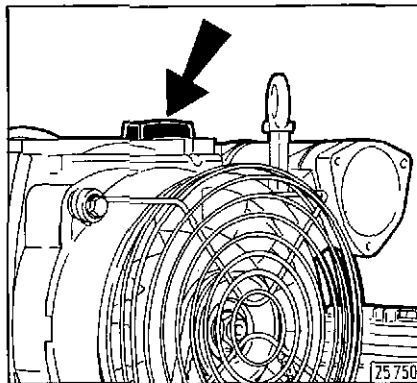
- 1 Fuel tank
- 2 Fuel line from tank to fuel feed pump
- 3 Fuel feed pump
- 4 Fuel line from feed pump to fuel filter
- 5 Fuel filter
- 6 Fuel line from filter to plug-in injection pump
- 7 Plug-in injection pumps
- 8 Fuel distribution line
- 9 Injection lines
- 10 Injectors
- 11 Fuel backleakage line
- 12 Fuel overflow line
- 13 Fuel return line to tank

25942 0

- 3.1 Commissioning**
- 3.2 Starting**
- 3.3 Monitoring Systems**
- 3.4 Stopping**
- 3.5 Operating Conditions**

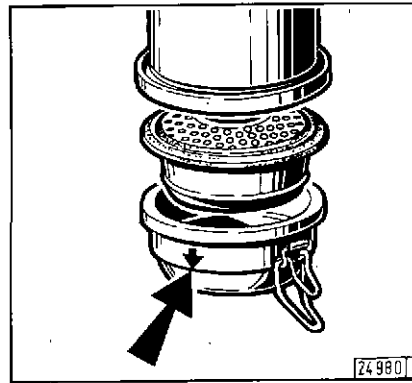
3

3.1.1 Filling in Engine Oil



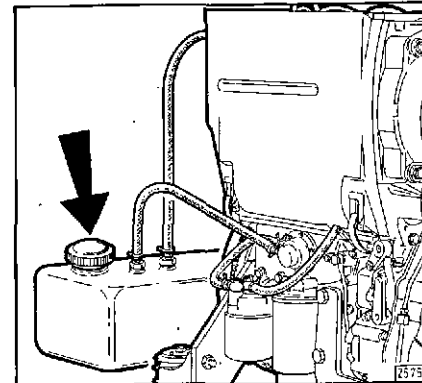
As a rule, the engines are delivered without oil filling.
Fill the engine with lube oil through the oil filler neck (arrow).
For oil filling volume, see 9.1
For oil quality grade and oil viscosity, see 4.1

3.1.2 Filling Oil Bath Air Cleaner with Engine Oil



Fill oil bath air cleaner (if mounted) with engine oil up to the arrow mark.

3.1.3 Filling the Fuel Tank



Use only commercial-grade diesel fuel. See 4.2 for fuel quality grade.
In accordance with ambient temperatures, summer or winter diesel fuel should be used.



Stop engine before filling fuel tank!
Observe strict cleanliness!
Do not spill any fuel!

3.1.4 Other Preparations

- Check battery and lead connections: see 6.7.1
- Remove lifting eyebolts, if mounted: see 6.7.2
- Trial Run

Upon completing the preparations, run the engine for a short trial period of about 10 minutes without load.

Steps to be taken during and after trial run:

- Check engine for leakages.
- Check oil level, top up with oil if necessary: see 3.1.1 and 6.1.2
- Retension V-belts: see 6.5

- Running In

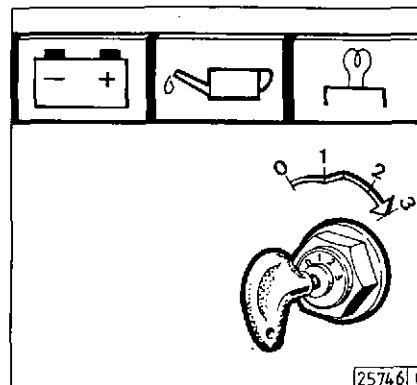
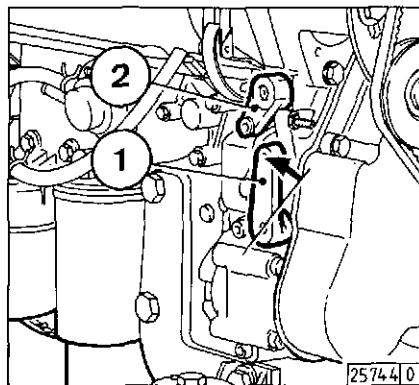
Normally, new engines have a higher oil consumption. During the running-in phase, approx. 200 running hours, it is recommended to check the oil level twice daily. After the running-in phase, checking once a day will be sufficient.

3.1.5 Additional Maintenance Jobs

After 50 running hours, the following maintenance jobs are to be carried out:

- Change lube oil: see 6.1.2
- Renew oil filter cartridge: see 6.1.3
- Renew fuel filter cartridge: see 6.2.1
- Check V-belt tension, retension if necessary: see 6.5
- Check valve clearances, readjust if necessary: see 6.6.1
- Check engine for leakages
- Check engine mountings, retighten if necessary: see 9.2

3.2.1 Electric Starting



- Disengage the clutch – where possible – to separate engine from driven equipment.
- Set speed control lever 1 to idling speed position.
- Set shut-down lever 2 to operating position.
- Insert key:
 - Position 0 = No operating voltage.
- Turn key clockwise:
 - Position 1 = Operating voltage.
 - Charging pilot lamp 3 lights up.
 - Oil pressure pilot lamp 4 lights up.

without Cold-Starting Aid

- Push key in deeper and turn further clockwise against spring pressure as far as detent.
 - Position 2 = No function.
 - Position 3 = Start.
- Release key as soon as engine starts firing.
 - Pilot lamps go out.

with Cold-Starting Aid (Heating Plug)

- Push key in deeper and turn further clockwise against spring pressure.
 - Position 2 = Preheating.
 - Hold in position 2 for about 1 minute for preheating.
- Turn key further as far as detent.
 - Position 3 = Start.
- Release key as soon as engine starts firing.
 - Pilot lamps go out.

Do not actuate starter for more than 20 seconds at a time. If engine does not start, wait 1 minute before repeating attempt.

If engine does not start after two attempts, trace the cause with aid of Diagnosis Chart (see 7.1).



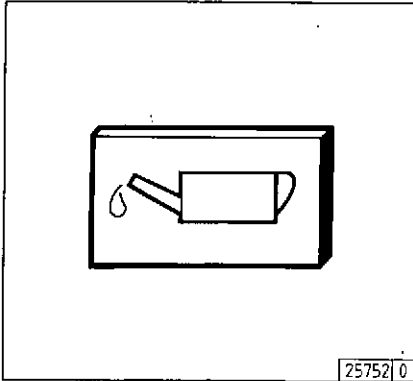
Before starting , make sure that no-one is standing in the close vicinity of the engine or driven machine.

After carrying out repairs: Check that all safety guards have been refitted and all tools have been removed from the engine.

When starting with heating plug, do not use any additional starting aids (e.g. spraying of start pilot). Danger of accident!

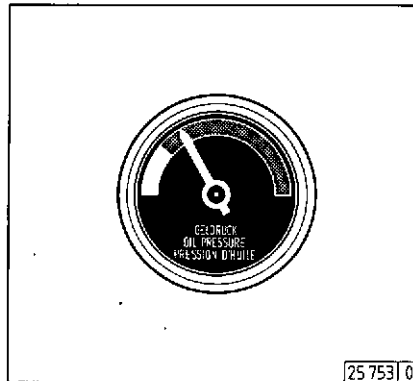
3.3.1 Engine Oil Pressure

Oil Pressure Pilot Lamp



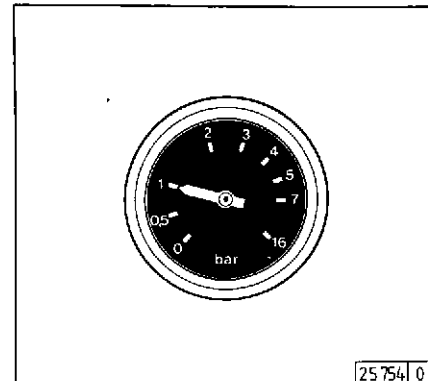
- The oil pressure pilot lamp lights up with operating voltage switched on but engine stopped.
- When the engine is running, the oil pressure pilot lamp must be out.

Oil Pressure Indicator



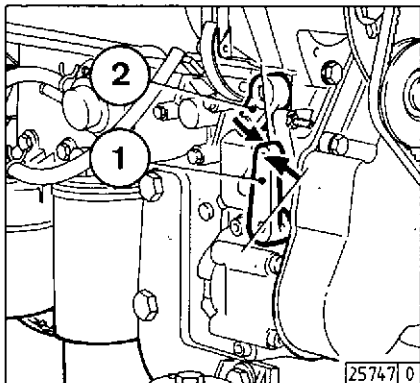
- The pointer of the oil pressure indicator must remain in the green sector over the entire operating range.

Oil Pressure Gauge



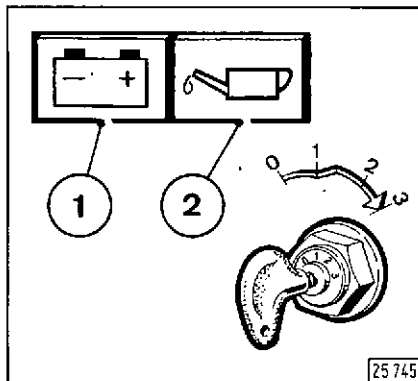
- The pointer of the oil pressure gauge must show the minimum oil pressure (see 9.1).

3.4.1 Mechanical Shut-Down



- Set speed control lever 1 to low speed position.
- Actuate shut-down lever 2 until engine stops, whereupon charging pilot lamp and oil pressure pilot lamp light up.
- Turn key counter-clockwise (to position 0) and withdraw. Pilot lamps go out.

3.4.2 Electrical Shut-Down (Ignition Key)



- Turn key counter-clockwise (to position 0) and withdraw. Pilot lamps 1 and 2 go out.

Do not shut engine down suddenly from full-load running.

3

3.5.1 Operation in Winter

● Lube Oil Viscosity

- Select viscosity (SAE-grade) as governed by the ambient temperature prevailing at the time of starting the engine; see 4.1.2.
- Note shorter periods between oil changes when operating below -10°C ($+14^{\circ}\text{F}$); see 6.6.1.

● Diesel Fuel

- Use winter-grade fuel for operation below 0°C ($+32^{\circ}\text{F}$); see 4.4.2.

● Additional Maintenance Jobs

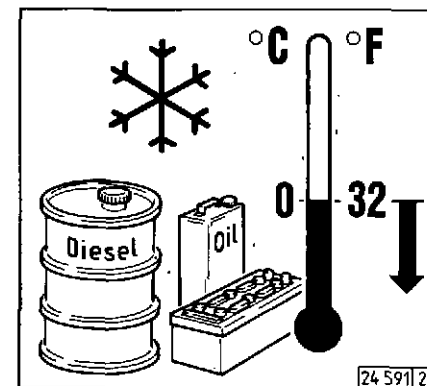
- Drain the thick sludge from fuel tank once a week (by undoing the sludge drain plug).
- Match the oil filling in oil bath air cleaner (if fitted) to ambient temperature, as in case of engine oil.
- At temperatures below -20°C (-4°F), lubricate the flywheel ring gear with low-temperature grease, e.g. Bosch FT 1 V 31, from time to time through the pinion hole (if necessary, remove starter).

● Cold-Starting Aids

- At temperatures near or below freezing point, start if necessary with heating plug; see 3.2.1.
- This not only lowers the starting limit temperature, but proves also useful at temperatures normally not requiring a starting aid.

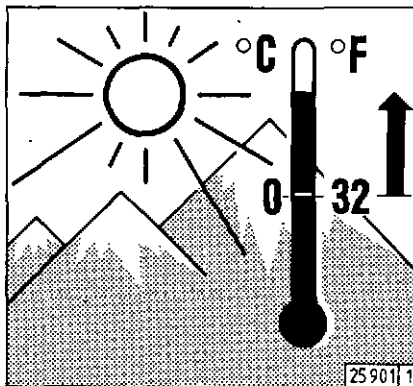
● Battery

- Cold starting requires a good state of charge of the battery; see 6.7.1.
- Lowering the limit temperatures by $4 - 5^{\circ}$ ($39 - 41^{\circ}\text{F}$) is possible by raising the battery temperature to about $+20^{\circ}\text{C}$ ($+68^{\circ}\text{F}$). This is achieved by removing the battery and storing it in a warm room.



3.5.2 High Ambient Temperature, High Altitude

- With increasing altitude and increasing ambient temperature, the density of the air tends to decrease. This has an effect on the maximum power output of the engine, the exhaust gas quality, the temperature level and, in the extreme case, the starting behaviour. For non-stationary engines, operation at altitudes up to 1000 metres is admissible (up to 30 °C [86 °F]). When operating under unfavourable conditions (higher altitude or higher temperature), a reduction in the amount of injected fuel, and therefore in the engine's power output, is necessary.
- In case of doubt concerning such engine applications, ask your engine or equipment supplier whether, in the interests of operational safety, service life and exhaust gas quality (smoke!), an engine derating had been considered necessary, or simply contact the DEUTZ SERVICE.



4.1 Lube Oil

4.2 Fuel

4.1.1 Quality Grade

Lube oils are differentiated according to their efficiency and quality grade. Commonly used are the API-Specifications, named after the „American Petroleum Institute“.

Approved Oils:

Unturbocharged Engines API-Specific.
 CC/SE CC/SF
 CD/SE CD/SF

Turbocharged Engines API-Specific.
 CD/SE CD/SF
 SHPD*

* SHPD (Super High Performance Diesel) oils are approved by KHD by name only, since a valid Specification has not yet been laid down. Should you have any doubt, ask the DEUTZ SERVICE.

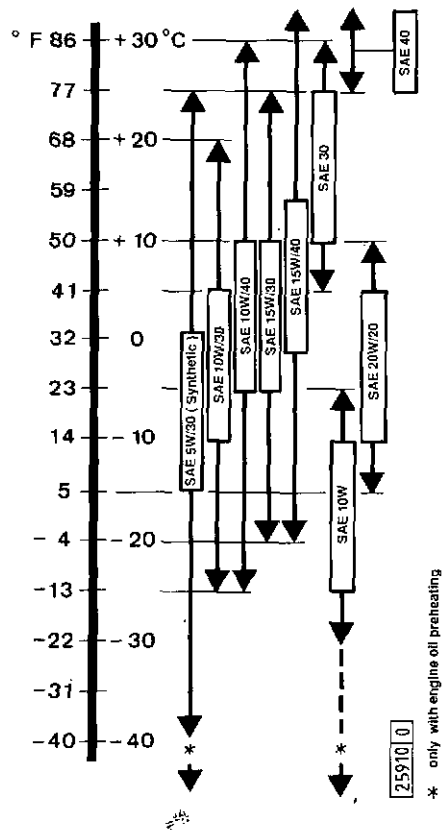
Oil change intervals: see 6.1.1
 Oil filling volumes: see 9.1.

4.1.2 Viscosity

As the viscosity of lube oil is greatly influenced by the temperature, the choice of SAE-grade should be governed by the ambient temperature at engine site. Optimum operating behaviour will be attained if you take as guide the oil viscosity diagram appearing alongside.

Should temperatures temporarily fall below the limits of the SAE-grade selected, this will merely affect the starting performance but cause no damage to the engine. Exceeding the application limits should not be over a prolonged period, in order to keep wear down to a minimum.

Oil changes dictated by the time of year can be avoided by using multi-grade oils. Multi-grade oils – particularly light-flowing oils – also tend to reduce fuel consumption.



4.2.1 Quality Grade

Always use branded grades of diesel fuel having a sulphur content of below 0.5 %. In the case of a higher sulphur content, the periods between oil changes must be shortened: see 6.1.1.

The following fuel specifications are approved:

- DIN 51 601
- NATO Codes F 54, F 75 and F 76
- BS 2869: A 1 and A 2
(in case of A 2, note sulphur content)
- ASTM D 975-81: 1-D and 2-D
- VV-F-800a: DF-A, DF-1 and DF-2.

4.2.2 Winter-Grade Fuel

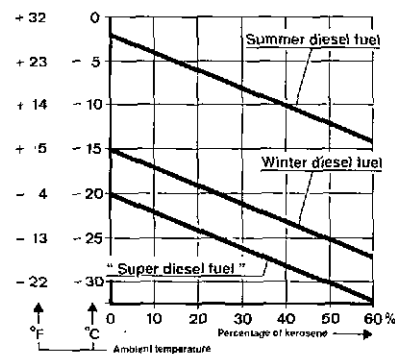
At low temperatures, waxing may occur and clog the fuel system, thus causing operational troubles. In the case of ambient temperatures below 0 °C (+ 32° F), use winter-grade diesel fuel (down to - 15 °C [+ 5 °F]). Normally, this is offered at filling stations in good time before the cold season starts. Diesel fuel with additives („Super diesel“) is frequently also on sale for use at temperatures down to - 20 °C (- 4 °F).

- At temperatures as low as - 15 °C (+ 5 °F) to - 20 °C (- 4 °F), kerosene should be mixed with the diesel fuel.

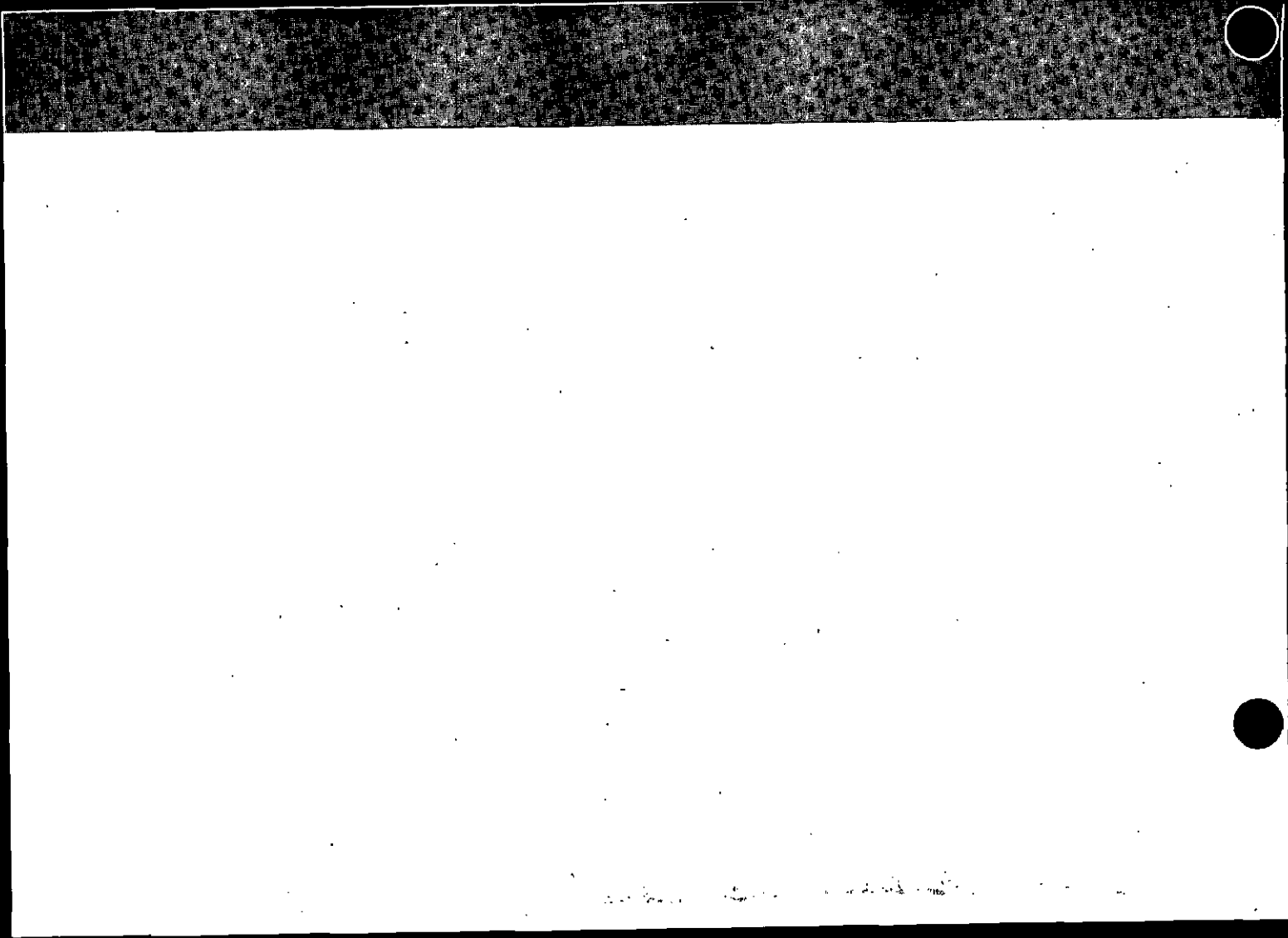
The necessary percentages for admixing are to be seen in the diagram at right.

If summer diesel fuel has to be used at temperatures below 0 °C (+ 32 °F), up to 60 % kerosene can be admixed (see diagram).

In most cases, adequate resistance to cold is also attained by adding a flow improver (fuel additive). Ask your DEUTZ SERVICE about this.



Prepare the blend in the tank itself!
Fill in the necessary amount of kerosene first, then add diesel fuel.



5.1 Maintenance Schedule

5.2 Maintenance Chart

5.3 Completed Maintenance Jobs

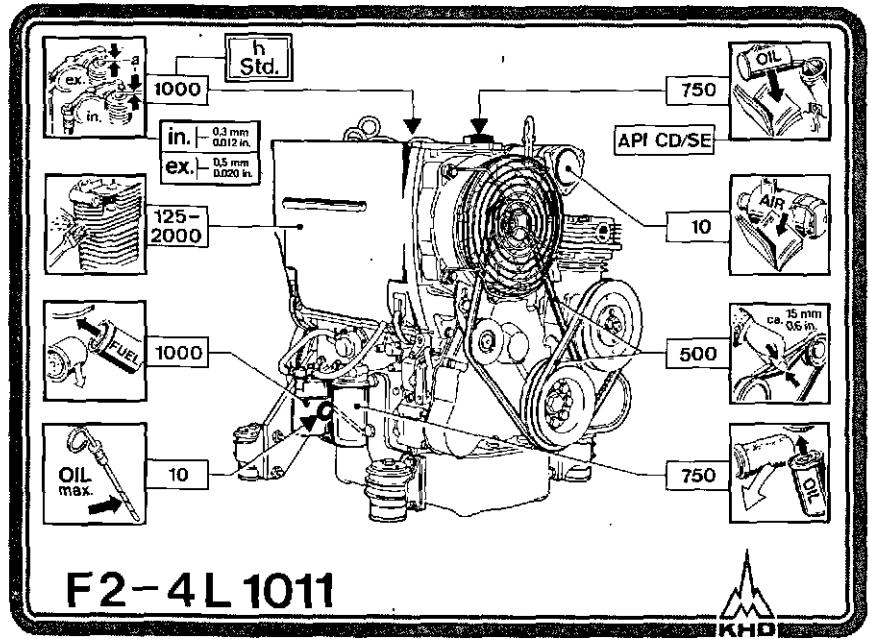
5.2 Maintenance Chart

Routine Maintenance

The Maintenance Chart displayed here is supplied as self-adhesive label along with each engine. Check that this label is stuck at a convenient location on the engine or driven equipment.

If necessary, ask for a fresh supply of labels.

Valid for routine maintenance work is the Maintenance Schedule: see 5.1



5



Stop engine before carrying out any maintenance work

Routine Maintenance

5.3 Completed Maintenance Jobs

5

| Hours | Date | Signature/Stamp | Hours | Date | Signature/Stamp |
|-------|------|-----------------|-------|------|-----------------|
| *50 | | | - | | |
| 125 | | | 250 | | |
| 375 | | | 500 | | |
| 625 | | | 750 | | |
| 875 | | | 1000 | | |
| 1125 | | | 1250 | | |
| 1375 | | | 1500 | | |
| 1625 | | | 1750 | | |
| 1875 | | | 2000 | | |
| 2125 | | | 2250 | | |
| 2375 | | | 2500 | | |
| 2625 | | | 2750 | | |

The maintenance jobs duly completed can be recorded in the above table.
* Commissioning new and overhauled engines.

5.3 Completed Maintenance Jobs

Routine Maintenance

| Hours | Date | Signature/Stamp | Hours | Date | Signature/Stamp |
|-------|------|-----------------|-------|------|-----------------|
| 2875 | | | 3000 | | |
| 3125 | | | 3250 | | |
| 3375 | | | 3500 | | |
| 3625 | | | 3750 | | |
| 3875 | | | 4000 | | |
| 4125 | | | 4250 | | |
| 4375 | | | 4500 | | |
| 4625 | | | 4750 | | |
| 4875 | | | 5000 | | |
| 5125 | | | 5250 | | |
| 5375 | | | 5500 | | |
| 5625 | | | 5750 | | |

The maintenance jobs duly completed can be recorded in the above table.

Routine Maintenance

5.3 Completed Maintenance Jobs

5

| Hours | Date | Signature/Stamp | Hours | Date | Signature/Stamp |
|-------|------|-----------------|-------|------|-----------------|
| 5875 | | | 6000 | | |
| 6125 | | | 6250 | | |
| 6375 | | | 6500 | | |
| 6625 | | | 6750 | | |
| 6875 | | | 7000 | | |
| 7125 | | | 7250 | | |
| 7375 | | | 7500 | | |
| 7625 | | | 7750 | | |
| 7875 | | | 8000 | | |
| 8125 | | | 8250 | | |
| 8375 | | | 8500 | | |
| 8625 | | | 8750 | | |

The maintenance jobs duly completed can be recorded in the above table.

- 6.1 Lubrication System**
- 6.2 Fuel System**
- 6.3 Cooling System**
- 6.4 Combustion Air Cleaner**
- 6.5 Belt Drives**
- 6.6 Adjustments**
- 6.7 Accessories**

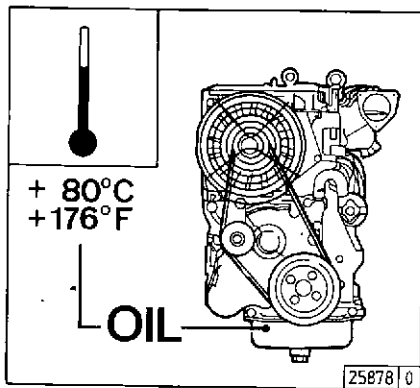
6.1.1 Oil Change Interval

- The oil change intervals are dependent on the engine application and on the quality of the lubrication oil.
- Should, within one year, the engine run less than the hours stated in the table, the oil must be changed at least once a year.
- The table is subject to the following conditions:
 - For diesel fuel, sulphur content max. 0.5 % b. w.
 - Prevailing ambient temperature above -10°C ($+14^{\circ}\text{F}$).
- In the case of sulphur content > 0.5 up to 1 %, or prevailing ambient temperatures being below -10°C ($+14^{\circ}\text{F}$), the intervals between oil changes are to be halved.
- In the case of fuels containing more than 1 up to 1.5 % sulphur, a lube oil with a TBN of 12 x % sulphur content must be used.

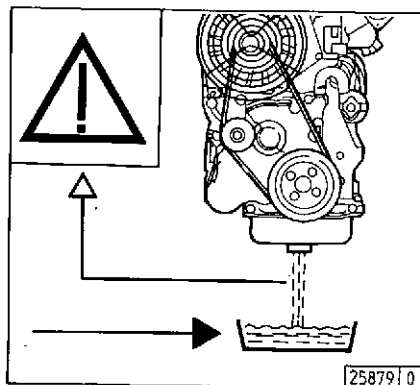
| Oil Grade | Naturally Aspirated Engines | |
|---|-----------------------------|----------------|
| | CC/SE CC/SF | CD/SE CD/SF |
| Equipment engines | Oil Change (running hours) | |
| Light duties, e.g.: Road vehicles, Tractors, Lift trucks, Cranes, Construction machinery, Rail traction units, Ships, Generating sets, Pumps | 500 | 750 |
| Heavy duties, e.g.: Combine harvesters, Underground mining, Road sweepers, Winter service, Emergency gensets, Emergency pumps | 250 | 375 |

TBN = „Total Base Number“: expresses the neutralising capacity of the oil. Ask your supplier to quote TBN.

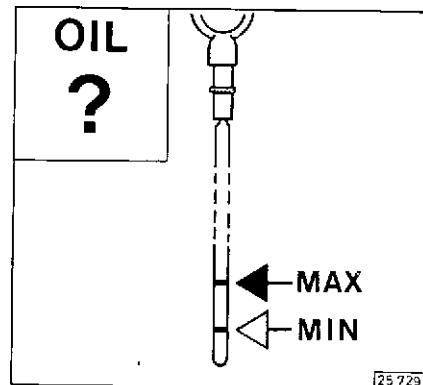
6.1.2 Changing Engine Oil Checking Oil Level



- Position engine or vehicle on level surface.
- Set cab heater actuating lever to maximum heating capacity (only in the case of vehicles with engine oil-operated cab heater system).
- Warm up engine
 - lube oil temperature approx. 80°C (+ 176°F).
- Stop engine.



- Place oil tray under engine.
- Screw out oil drain plug.
- Drain oil.
- Refit oil drain plug complete with new sealing ring and tighten firmly. (For tightening torque, see 9.2)
- Fill in fresh lube oil.
 - Oil grade/viscosity: see 4.1
 - Filling volumes: see 9.1
- Start engine and run at low idling speed (for about 2 min. in case of oil-operated heater system).



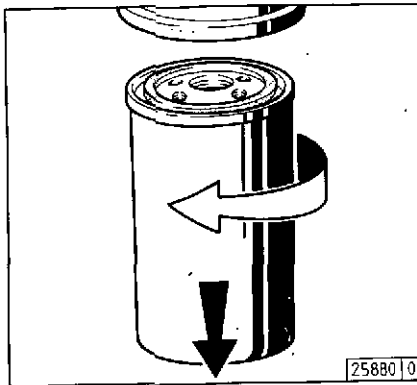
- Stop engine.
- Check oil level.
 - In case of oil dipsticks with double marking (● and –), the dash mark is applicable.
 - If necessary, top up with oil as far as the upper dash mark.



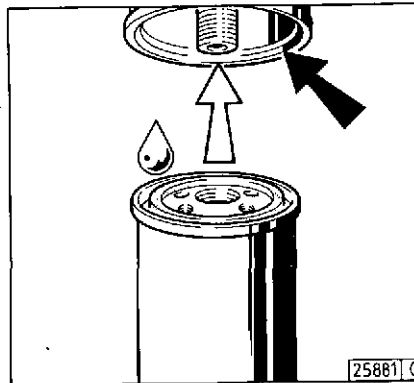
Take care when draining off hot oil: Danger of scalding!
Catch old oil in suitable receptacle ready for proper disposal to prevent environmental pollution!

6.1.3 Renewing Oil Filter

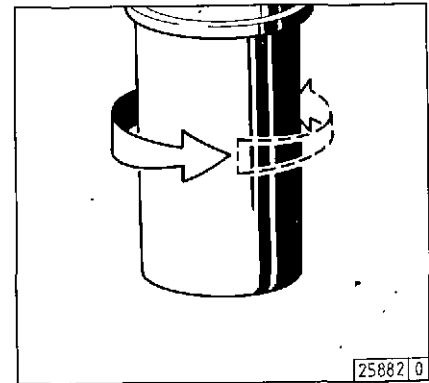
6



- Release lube oil filter cartridge with normal commercial tool and spin off.
- Catch any escaping oil in receptacle.



- Clean sealing surface of filter carrier.
- Apply light film of oil to rubber gasket of new lube oil filter cartridge.
- Screw cartridge into place by hand until gasket is evenly seated.

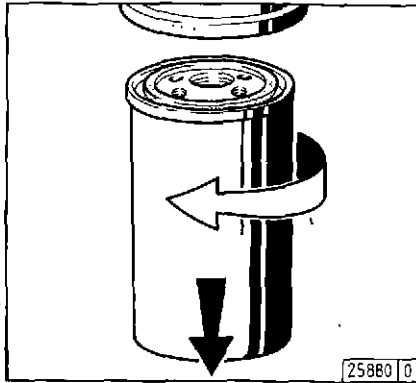


- Tighten lube oil filter cartridge firmly by giving a final half turn.
- Check oil level: see 6.1.2
- Check oil pressure: see 3.3.1
- Check sealing of lube oil filter cartridge for leaks.

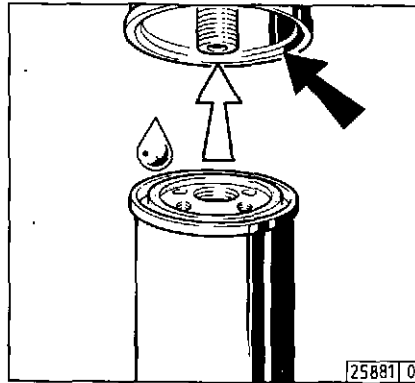


Beware of hot oil:
Danger of scalding!

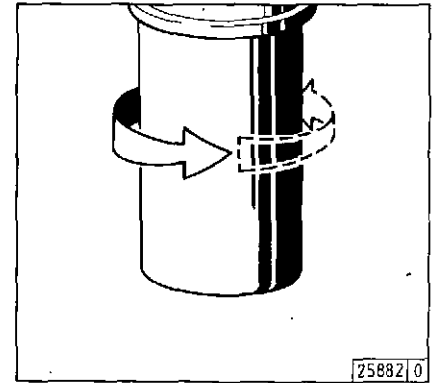
6.2.1 Renewing Fuel Filter



- Close fuel stopcock.
- Release fuel filter cartridge with normal commercial tool and spin off.
- Catch escaping fuel in receptacle.



- Clean sealing surface of filter carrier.
- Apply light film of oil or diesel fuel to rubber gasket of new fuel filter cartridge.
- Screw cartridge into place by hand until gasket is evenly seated.



- Tighten fuel filter cartridge firmly by giving a final half turn.
- Open fuel stopcock.
- Check sealing for leaks.



When working on the fuel system, keep naked lights away! Do not smoke!

Bleeding of the fuel system is not necessary.

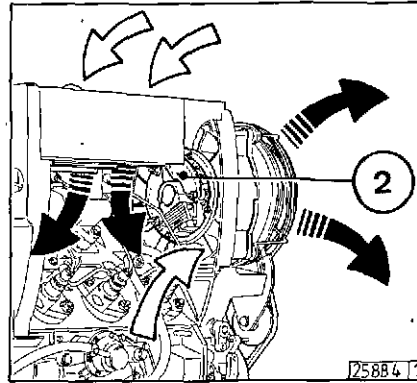
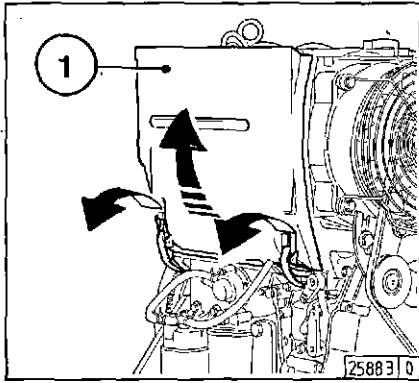
6.3.1 Cleaning Intervals

- The degree of soiling of the cooling system is dependent on the type of engine application.
- More severe contamination can occur, e.g. in case of:
 - Construction site application, due to heavily dust-laden air.
 - Harvesting work, due to the high proportion of chaff and chopped straw, for example, in the vicinity of the implement.
- The danger of contamination is increased due to residues of oil and fuel on the engine. Check extra carefully, therefore, for leakages when applications involve high dust fall-out.
- In view of the varying conditions of application, the cleaning intervals must be determined from case to case. The cleaning intervals stated in the table can be taken as guide values.

| Checking or Cleaning Intervals Guide Values (running hours) | Engine Application |
|---|---|
| 2000 | Ships, Generating sets in closed rooms, Pumps |
| 1000 | Vehicles on paved roads |
| 500 | Tractors, Lift trucks, Mobile gensets |
| 250 | Vehicles on construction sites and unpaved roads, Construction machinery, Compressors, Underground mine units |
| 125 | Farm equipment, Tractors doing harvesting work |

6.3.2 Cleaning the Cooling System

6



With Compressed Air

- Remove cooling-air cowling 1.
- Start blowing through the engine with compressed air from the exhaust-air side, paying particular attention to the cooling fins and oil cooler. Remove any dirt blown into the air cowling space.
- Remount cooling-air cowling 1.

With Cold Cleansing Agent

- Remove cooling-air cowling 1.
- Spray engine with a commercial cold cleansing agent and allow a soaking-in period of about 10 minutes.
- Wash engine clean with a powerful water jet (taking care to avoid direct contact of the water jet with sensitive engine components, e.g. alternator 2).
- Repeat procedure, if necessary.
- Remount cooling-air cowling 1.
- Run engine until warm, in order to prevent rust formation.

With High-Pressure Steam Jet

- Remove cooling-air cowling 1.
- Clean engine with steam jet (taking care to avoid direct contact of the steam jet with sensitive engine components, e.g. alternator 2).
- Remount cooling-air cowling 1.
- Run engine until warm, in order to prevent rust formation.



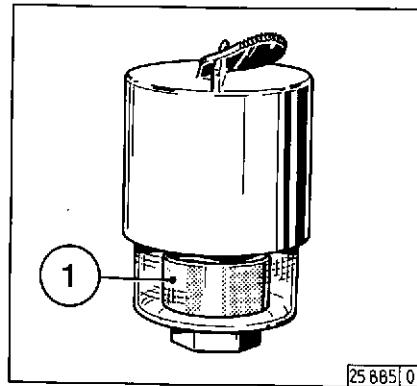
Engine must be stopped and cooled down prior to cleaning!

6.4.1 Cleaning Intervals

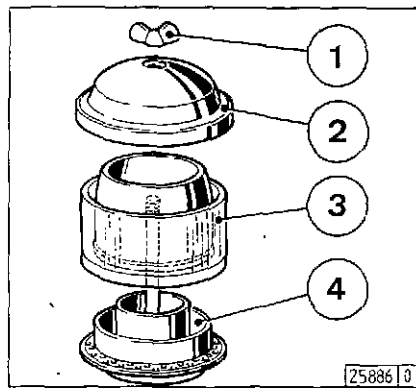
- The degree of soiling of the combustion air cleaner depends on the amount of dust in the air and the size of filter used. If very dusty air is to be expected, the combustion air cleaner can be preceded by a cyclone-type pre-cleaner.
- Consequently, the cleaning intervals cannot be laid down generally, but have to be determined from case to case.
- If dry-type air cleaners are used, cleaning should be carried out only when the service gauge indicates that servicing is due.
- Too frequent dismantling and refitting may damage the seal between filter cartridge and housing.

Servicing of the air cleaner becomes necessary if:

- with contamination indicator
 - the red flag 1 is fully visible with engine stopped.
- with filter service trip
 - the yellow warning lamp lights up with engine running.



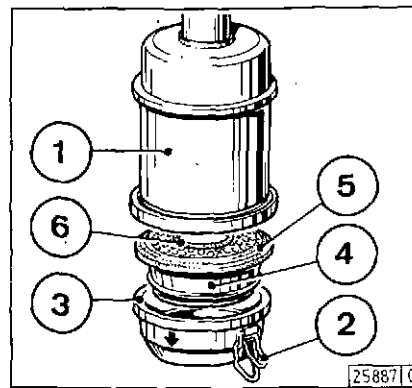
6.4.2 Emptying the Cyclone-Type Pre-Cleaner



- Undo wing nut 1 and take off housing cap 2.
- Lift dust collector 3 off cyclone base 4 and empty. Clean cyclone base by removing leaves, straw, etc.
- Reposition dust collector 3 onto base 4 and fasten housing cap 2 in place by tightening wing nut 1.

Never fill dust collector with oil!
Renew dust collector if damaged!

6.4.3 Cleaning the Oil Bath Air Cleaner



- Stop engine and wait about 10 minutes until the oil has run out of filter upper part 1.
- Release snap clips 2 and remove oil bowl 3 together with filter lower part 4, loosening filter element at joint by means of a screwdriver, if necessary. Do not damage rubber seal 5!
- After removing dirty oil and sludge, clean oil bowl.
- Rinse filter lower part 4 in diesel fuel and allow to drip-dry thoroughly.

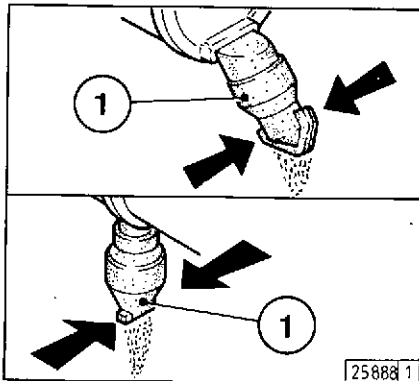
- Clean filter upper part 1, if necessary.
- Inspect rubber seals 5 and 6, renewing if necessary.
- Fill oil bowl with engine oil up to oil level mark (arrow). For oil viscosity, see 4.1.2.
- Refit oil bowl and filter element to filter upper part and fasten snap clips.



Never rinse filter in petrol (gasoline)!
Dispose of used oil in compliance with statutory provisions.

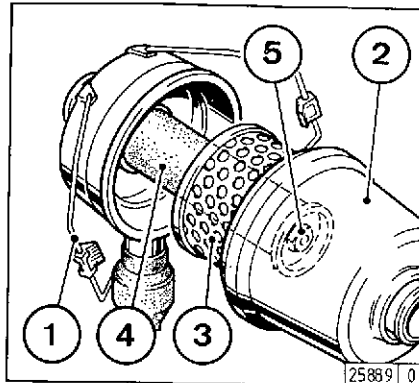
6.4.4 Dry-Type Air Cleaner

Dust Ejector Valve



- Discharge the dust ejector valve 1 by pressing apart the lips of the ejection slot, applying pressure as indicated by the arrows.
- Clean the ejection slot from time to time.
- Remove any cakes of dust by pressing together the upper part of the valve.

Filter Cartridges



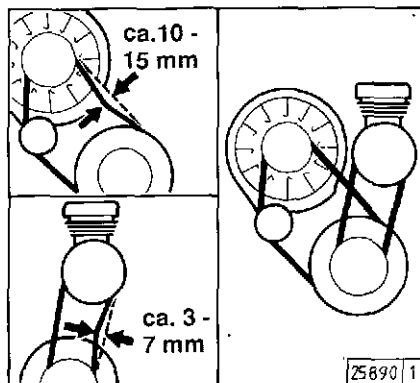
- Release fastening clamps 1.
- Take off filter hood 2 and pull out filter cartridge 3.
- Clean filter cartridge or renew after 1 year at latest.
- Clean filter cartridge 3:
 - With dry compressed air (max. 5 bar), applied from inside to outside, or
 - Tap out (emergency measure only), taking care not to damage cartridge, or
 - Wash out as per maker's instructions.
- Check cartridge for damage to filter paper (by introducing lighted lamp), and check seals. Renew, if necessary.

- After having serviced the filter cartridge five times, or after 2 years at the latest, renew safety cartridge 4 (never clean!).
Proceed as follows:
 - Undo hex. nut 5 and pull out cartridge 4.
 - Insert new cartridge and secure with hex. nut.
- Insert filter cartridge 3, place on hood 2 and fasten with clamps 1.

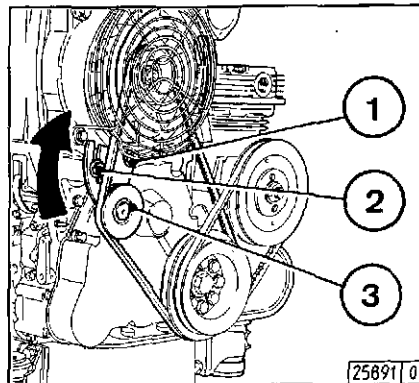


In no event use petrol (gasoline) or hot liquids for washing the filter cartridge!

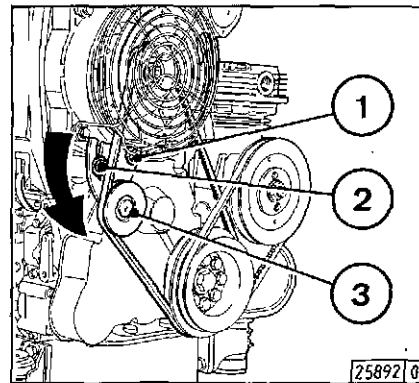
6.5.1 Checking V-Belts



6.5.2 Retensioning Blower V-Belt



6.5.3 Renewing Blower V-Belt



6

- Inspect V-belt over whole length for damage or cracks. Renew damaged or cracked V-belts.
- Check by pressing with the thumb midway between the pulleys to see whether the V-belt deflects inwards by not more than approx. 10-15 mm - cooling blower or 3-7 mm-air compressor.
- If necessary, retension V-belt: see 6.5.2 and 6.5.4.

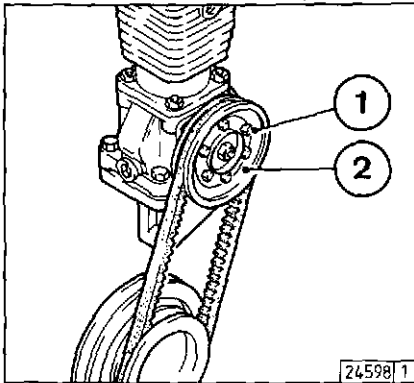
- Slacken hex. bolts 1 and 2.
- Push idler pulley 3 outwards until correct V-belt tension is attained.
- Retighten hex. bolts 1 and 2.

- If air compressor is mounted: First, remove compressor V-belt: see 6.5.4.
- Slacken hex. bolts 1 and 2.
- Push idler pulley 3 inwards.
- Remove V-belt and place on new belt.
- Push idler pulley 3 outwards until correct V-belt tension is attained.
- Retighten hex. bolts 1 and 2.
- If applicable, refit air compressor V-belt: see 6.5.4.

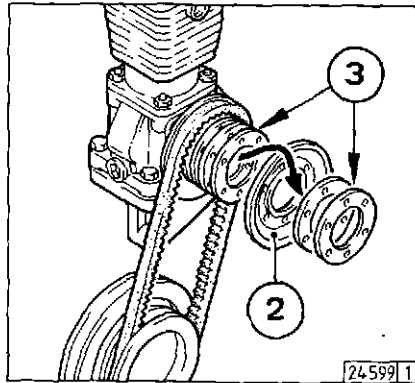


Stop engine before retensioning V-belts! If applicable, refit V-belt guard.

6.5.4 Retensioning or Renewing Air Compressor V-Belt



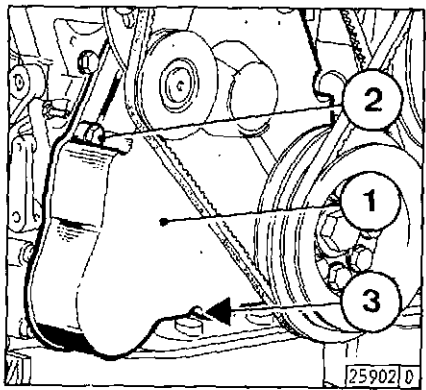
- Unscrew hex. bolts 1.
- Take off outer half-pulley 2.
- Renew V-belt if necessary
- To retension, remove one or more shims 3 — as may be required — from inside. Place removed shim(s) outside on removed half-pulley 2.



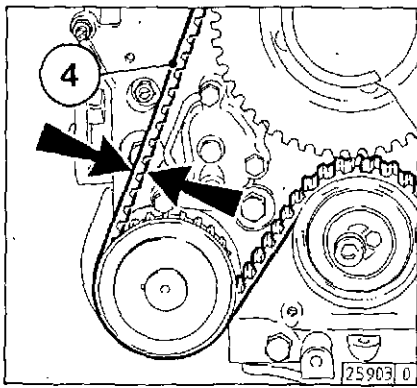
- Retighten bolts 1, while turning engine with turning tool to prevent the V-belt being squeezed.

In the case of new V-belts, recheck belt tension after running for 15 minutes.

6.5.5 Checking Toothed Belt

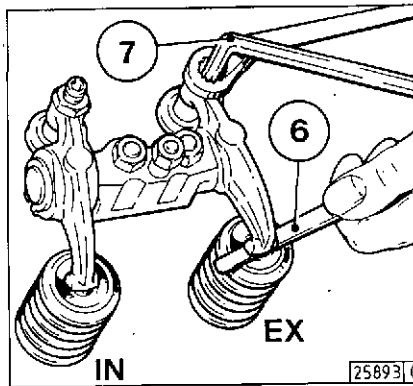
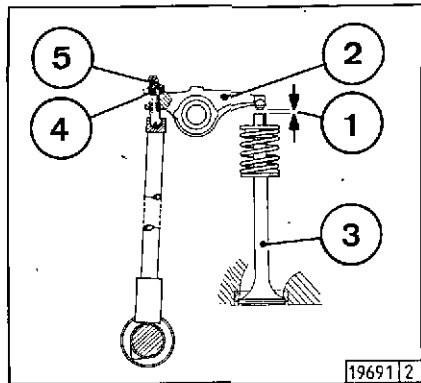


- Take off left-hand covering hood 1 of the toothed belt drive, after undoing hex. bolts 2 and 3.
- Check toothed belt 4 over whole length at tooth roots and tooth backs for cracks (see arrows).
- To do this, turn engine four revolutions with turning tool.



- If cracks are found, renew toothed belt (see Workshop Manual).
- Replace hood 1 and secure with hex. bolts 2 and 3.

6.6.1 Checking/ Adjusting Valve Clearances

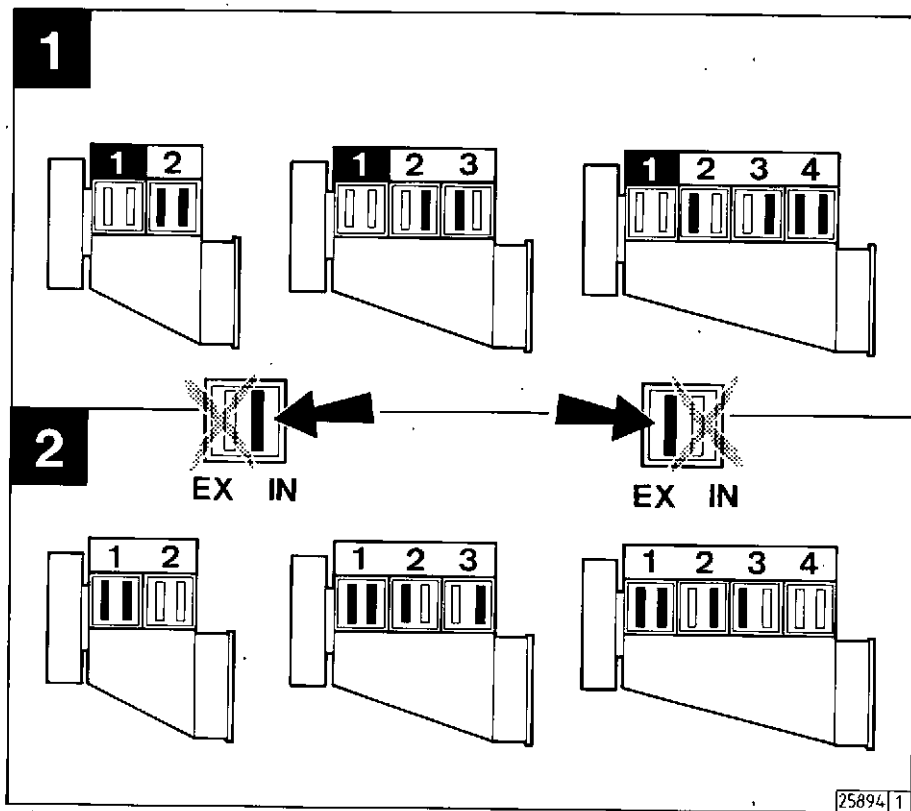


6

- Remove rocker cover.
 - Position crankshaft as per setting schematic: see 6.6.1.1.
 - Before adjusting valve clearance: Allow engine to cool down for at least 30 minutes (oil temperature below 80 °C (176 °F)).
 - Check valve clearance 1 between pad of rocker arm 2 and valve 3 with feeler blade 6 (clearance is correct if feeler blade can be inserted in gap with a slight drag).
- For permissible valve clearance, see 9.1.

- If necessary, adjust valve clearance as follows:
 - Loosen locknut 4 by 2 - 3 turns.
 - With Allen key 7 adjust setscrew 5 so that, when locknut 4 is retightened, the correct valve clearance is attained.
- Check the valve clearances at each of the remaining cylinders and adjust if necessary.
- Refit rocker cover with new seal.

6.6.1.1 Setting Schematic for Adjusting Valve Clearances

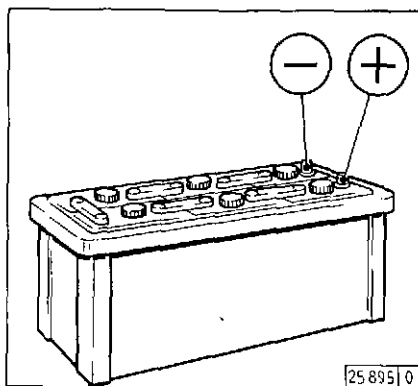


- Crankshaft Position 1:
Turn the crankshaft until both valves at cylinder 1 are on „overlap“ (i.e. exhaust valve about to close, inlet valve about to open). The valves marked black can now be adjusted. Mark each adjusted valve with chalk to show that it has been done.

- Crankshaft Position 2:
Turn the crankshaft further by one rotation (360°). The valves marked black can now be adjusted.

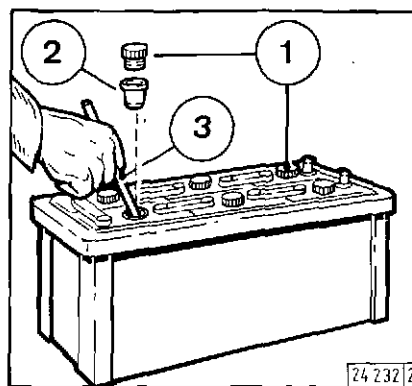
6.7.1 Battery

6.7.1.1 Checking Battery and Lead Connections



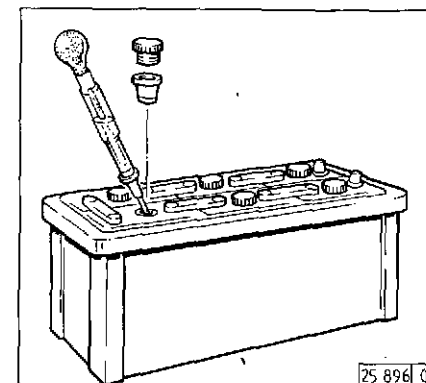
- Keep battery clean and dry.
- Undo soiled terminal clamps.
- Clean battery terminal posts (+ and -) and clamps, and treat with an acid-free and acid-resistant grease.
- When reconnecting, ensure good contact of the terminal clamps. Tighten clamping bolts firmly.

6.7.1.2 Checking Electrolyte Level



- Remove cell caps 1.
- If electrolyte level testers 2 are provided: the level should be high enough to wet the bottom of these.
- An alternative method is to insert a wooden stick 3 into the cell until it touches the top of the plates. The electrolyte should wet the stick over a length of about 10 - 15 mm.
- If the electrolyte level is low, top up with distilled water.
- Replace cell caps.

6.7.1.3 Checking Specific Gravity of Electrolyte



- Measure the specific gravity of the individual cells with a hydrometer.

The measured values (see table alongside) indicate the state of charge of the battery. During the measurement, the temperature of the electrolyte should preferably read 20 °C (68 °F).

| Specific Gravity | | | | |
|------------------|---------|------------------|---------|-----------------------------------|
| in kg/l | | in °Bé (°Baumé)* | | State of Charge |
| Normal | Tropics | Normal | Tropics | |
| 1,28 | 1,23 | 32° | 27° | Fully charged |
| 1,20 | 1,12 | 24° | 16° | Half charged: Recharge |
| 1,12 | 1,08 | 16° | 11° | Discharged: Charge up immediately |

* Measurement of the specific gravity in °Bé (°Baumé) is obsolete and rarely used today.



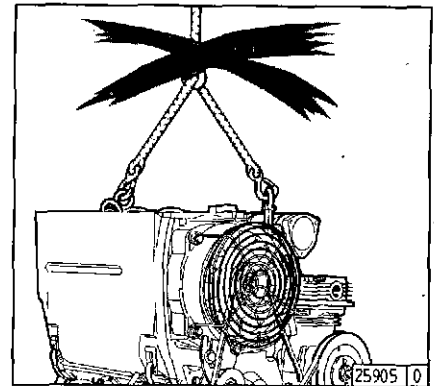
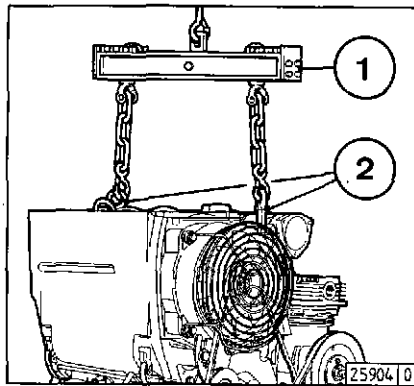
The gases emitted by the battery are explosive! Avoid formation of sparks in vicinity of battery, keep naked lights away!

Do not allow acid to come into contact with the skin or clothing! Wear protective goggles!
Do not place tools on battery!

6.7.2 Notes on three-phase system:

- When the engine is **running**, never disconnect the leads between battery, alternator and regulator. Where it is however necessary to operate the engine without battery, disconnect, before starting, the regulator from the alternator.
- Be sure not to confuse the battery terminals.
- Renew a defective charging pilot light bulb immediately.
- Before washing the engine, fit covers to protect the alternator and regulator.
- The common practice on a DC-system of touching a lead against frame for checking whether the lead is live must under no circumstances be adopted on a three-phase current system.
- In case of electric welding, connect the earth terminal of the welding unit direct to the part to be welded.

6.7.3 Lifting Tackle



- For transporting the engine, always use the correct lifting tackle 1.
- Upon completion of transporting manoeuvres, prior to recommissioning the engine: Remove lifting eyeboots 2.



Always use the correct lifting tackle!

7.1 Diagnosis Chart

- If engine problems occur, they will frequently be caused by improper operation or maintenance of the engine.
- In case of any trouble, always check whether the operating and maintenance instructions have been observed.
- An appropriate Diagnosis Chart appears on the page opposite.
- If you cannot identify the cause of the trouble or are unable to put it right yourself, contact your DEUTZ SERVICE.

| Trouble | | | | | | | | | | Remedial Measure | | |
|---|---|---|---|---|---|--|--|--|---|--|----------------|------|
| Engine fails (or difficult) to start | | | | | | | | | | Check | CH | |
| Engine starts, but runs unevenly or stalls | | | | | | | | | | Adjust | A | |
| Engine becomes too hot, temperature monitor gives warning | | | | | | | | | | Renew | R | |
| Engine gives poor performance | | | | | | | | | | Clean | CL | |
| Engine not working on all cylinders | | | | | | | | | | Top up | TU | |
| Engine has little or no oil pressure | | | | | | | | | | Lower level | LL | |
| Engine oil consumption excessive | | | | | | | | | | | | |
| Engine smokes - blue | | | | | | | | | | | | |
| - white | | | | | | | | | | | | |
| - black | | | | | | | | | | | | |
| Cause | | | | | | | | | | Section | | |
| • | | | | | | | | | | Not declutched (where possible) | Operation | CH |
| • | | | | | | | | | • | Below start limit temperature | | CH |
| | • | | | | | | | | | Oil level too low | | TU |
| | | • | | | | | | | | Oil level too high | | LL |
| | | | • | | | | | | | Excessive inclination of engine | | CH |
| • | | | | | | | | | | Wrong SAE-grade of engine oil and oil quality | Op. Media | R |
| • | • | | | | | | | | • | Fuel quality not as quoted in Op. Manual | | R |
| | | • | | | | | | | • | Air cleaner: Filter soiled | Combustion Air | R |
| | | • | | | | | | | • | Air cleaner: Contamination indicator/Filter service trip defective | | R |
| | | | • | | | | | | | Cooling fins soiled | Cooling System | CL |
| | | | | • | | | | | | Cooling blower faulty, V-belt broken/loose | | CH/R |
| | | | | | • | | | | | Heating-up of cooling air/Recycling of heat | | CH |
| • | | | | | | | | | | Battery defective or flat | Electrics | CH |
| • | | | | | | | | | | Connections of starter circuit loose/oxidized | | CH |
| • | | | | | | | | | | Starter faulty or pinion does not engage | | CH |
| • | • | | | | | | | | • | Valve clearances incorrect | Engine | A |
| • | • | | | | | | | | • | Injection line leaky | | CH |
| • | • | | | | | | | | • | Injector defective | | CH/R |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

8.1 Preservation

8.1 Preservation

If the engine is to be shut down for a major period, it is necessary to take preservative measures to prevent rust formation. The preservative measures described here will protect the shut-down engine for a period of up to about 6 months. Before re-using the engine, the preservatives must be removed, except from the oil and fuel.

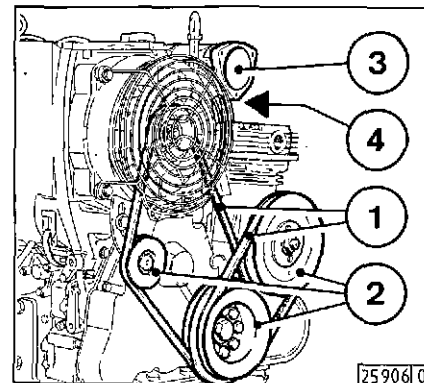
- Anti-corrosive oils to Specification:
 - MIL-L-21260B
 - TL 9150-037/2
 - NATO Code C 640 / 642
- Anti-corrosive agent to Specification:
 - NATO Code C 632
- Recommended cleansing agent for removing preservatives:
 - Benzine
(dangerous materials class A 3)

Preserving Engine:

- Clean engine with high-pressure steam jet (in case of need, cold cleansing agent): see 6.3.2.
- Warm up engine and stop.
- Drain engine oil: see Chapter 6, and fill in anti-corrosive oil.
- Clean oil bath air cleaner (if provided): see 6.4.3, and fill in anti-corrosive oil.
- Drain fuel out of tank.
- Prepare fuel mixture of 90 % diesel fuel and 10 % anti-corrosive oil and fill up tank.
- Run engine for about 10 minutes.
- Stop engine.
- Turn engine over several times by hand.
- Remove V-belts 1 and store in wrapped condition.
- Spray grooves of V-belt pulleys 2 with anti-corrosive agent, which must be wiped off before re-using engine.
- Close intake opening 3 and exhaust opening 4.

Removing Engine Preservatives:

- Remove anti-corrosive agent from the grooves of the V-belt pulleys 2.
- Fit V-belts 1. Retension later, if necessary, after short period of operation: see 6.5.
- Remove closures of intake opening 3 and exhaust opening 4.
- Engine now ready for operation.



9.1 Engine Specifications and Settings
9.2 Torque Wrench Settings

| Model | | F2L 1011 | F3L 1011 | F4L 1011 |
|--|--------------------|-------------------|--|-------------------|
| Number of cylinders | | 2 | 3 | 4 |
| Cylinder arrangement | | | vertical, in-line | |
| Bore | mm | 91 | 91 | 91 |
| Stroke | mm | 105 | 105 | 105 |
| Piston displacement | cm ³ | 1366 | 2049 | 2732 |
| Compression ratio | | 18.5 | 18.5 | 18.5 |
| Working principle | | | 4-stroke diesel | |
| Combustion system | | | direct injection | |
| Direction of rotation (facing flywheel) | | | counter-clockwise | |
| Weight incl. integrated cooling system (excl. starter, incl. alternator), approx. | kg | 162 | 202 | 242 |
| Power | kW (HP) | ¹⁾ | ¹⁾ | ¹⁾ |
| Speed | rpm | ¹⁾ | ¹⁾ | ¹⁾ |
| Lubrication system | | | forced-feed lubrication | |
| Min. oil pressure (engine warm, oil temp. ~ 100 °C [212 °F]), at: 900 rpm (low idling speed) | bar | 1.8 | 1.8 | 1.8 |
| 1800 rpm | bar | 2.6 | 2.6 | 2.6 |
| 3600 rpm | bar | 4.3 | 4.3 | 4.3 |
| Oil capacity (initial filling), approx. | ltr. ²⁾ | 8.0 | 8.0 | 13.0 |
| Oil capacity with filter renewal (standard 0.5 ltr.), approx. | ltr. ²⁾ | 6.5 | 6.0 | 10.5 |
| Valve clearance (engine left to cool down for at least 30 min.: oil temperature below 80 °C/176 °F) | mm (in.) | | inlet valve 0.3 (0.012) exhaust valve 0.5 (0.020) | |
| Injector working pressure | bar | 250 ⁺⁸ | 250 ⁺⁸ | 250 ⁺⁸ |
| Commencement of delivery | crank angle bTDC | ¹⁾ | ¹⁾ | ¹⁾ |
| Firing order | | 1-2 | 1-2-3 | 1-3-4-2 |

¹⁾ Engine power, speed and commencement of delivery are stamped on the rating plate (see also 2.1).

²⁾ Approximate values, can vary depending on design. Decisive is always the upper oil dipstick mark. For engines with heating system, add about 1 ltr.

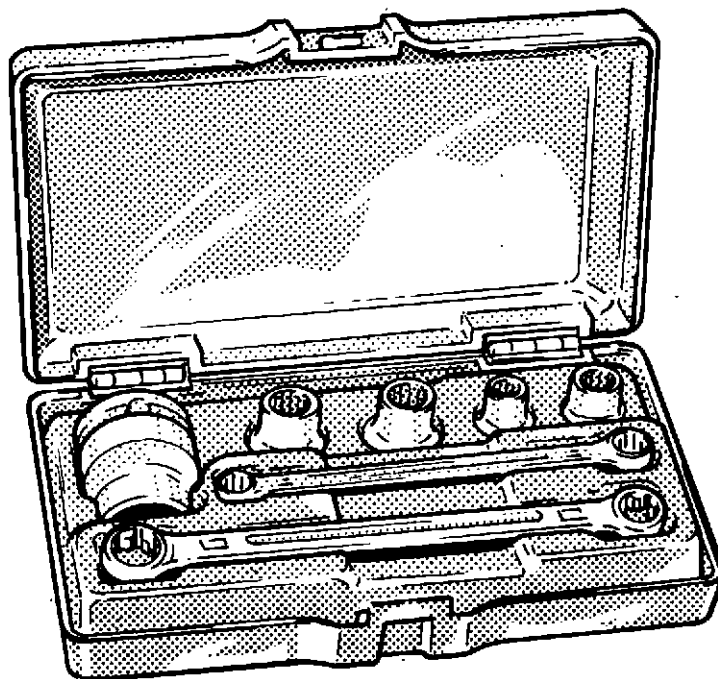
| Location | Preloading (Nm) | Tightening Nm | | | | Total (Nm) | Note |
|------------------------------------|--------------------|---------------|-----------|-----------|-----------|---------------|-----------------------|
| | | 1st Stage | 2nd Stage | 3rd Stage | 4th Stage | | |
| Idler pulley/V-belt pulley | - | - | - | - | - | 40 ± 4 | |
| Rocker cover | - | - | - | - | - | 9 ± 1 | |
| Rocker arm setscrew | - | - | - | - | - | 20 ± 2 | |
| Mounting foot, rear (flywheel end) | - | - | - | - | - | 106 | |
| Mounting foot, front (blower end) | - | - | - | - | - | 168 | |
| Intake manifold | - | - | - | - | - | 22 ± 2 | TORX |
| Exhaust manifold | - | - | - | - | - | 40 ± 4 | TORX + Never Seize |
| Oil drain plug | - | - | - | - | - | 55 ± 5 | |
| Injector fastening | - | - | - | - | - | 20 ± 2 | TORX |
| Injector union nut | - | - | - | - | - | 45 ± 5 | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

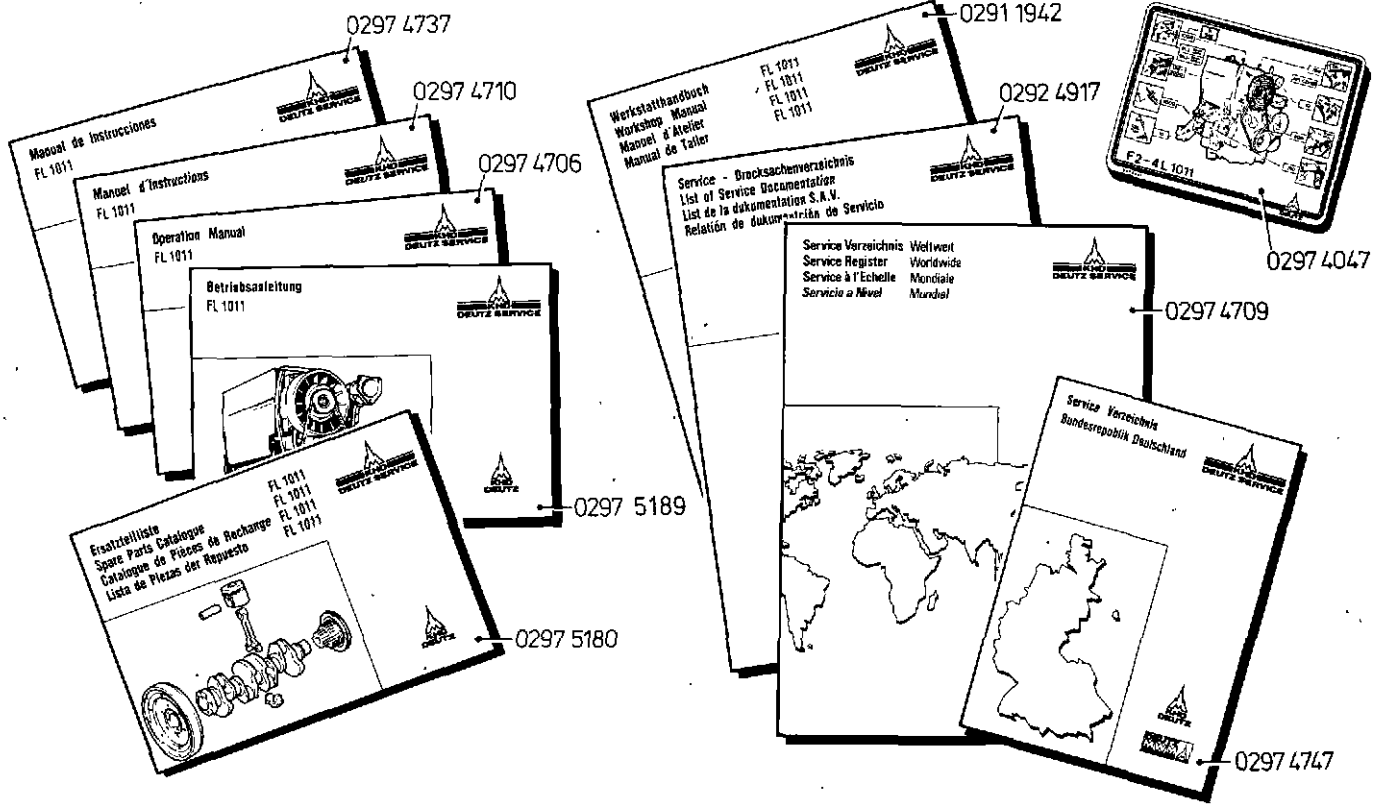
The TORX bolt/screw fastening system, among others, is used on the engines FL 1011. This system was introduced in view of its many advantages:

- Excellent access to the bolts/screws.
- Highly efficient torque transmission when loosening or tightening.
- Slipping or breaking of the wrench, and the danger of injury thereby involved, is practically ruled out.

TORX tools are obtainable as set under the Order No. 8189 from:

Messrs. WILBÄR
Postfach 140580
D-5630 Remscheid 1





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Printed in Germany (West)
Contents: AZ-MD
Layout: AZ-MD
Distribution: AZ-WA

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2nd Edition, 03/1989
Circulation 2100, E

Order No. 0297 4706