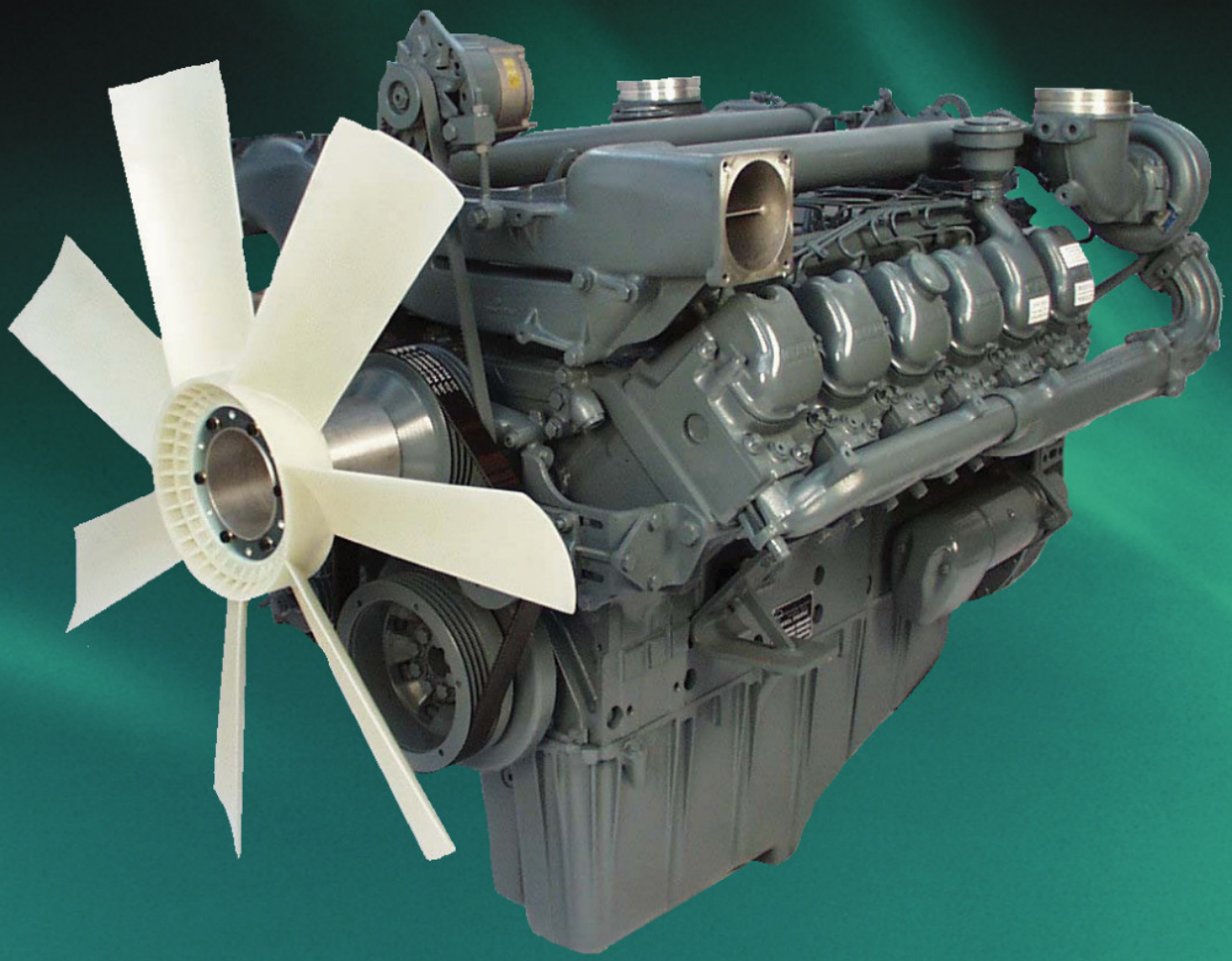
Repair manual

MAN-Industrial Diesel Engines

D 2848 LE 2..
D 2840 LE 2..
D 2842 LE 2..



This Repair Manual is designed to facilitate proper repair of the engines listed here.

The pictures and associated descriptions show typical work that may not always be applicable to the engine in hand, which nevertheless does not mean that they are not correct.
In such cases, the repair work is to be planned and carried out in a similar way.

It is compulsory that the engine be removed before performing any of the work described in this Repair Manual.

The expert knowledge necessary for handling diesel engines was taken for granted when this publication was compiled.

Note:
Only use fuel, coolants and lubricants in accordance with MAN regulations, otherwise the manufacturer's warranty will not apply!
For basic information on the fuels see the publication "Fuels, Lubricants and Coolants for MAN Diesel Engines".
You can find the approved products on the Internet at:
–**http://www.man-mn.com**/ → **Products & Solutions** → **E-Business**–

Any repair of components such as injection pump, alternator etc. ought to be left to our or the manufacturer's service department.

Best regards
MAN Nutzfahrzeuge Aktiengesellschaft
Nuremberg Plant

Since our products are in continuous development, we reserve the right to make technical modifications.

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MTDB Technical status: 07.2005 51.99493–8504

Important instructions concerning technical safety and personal protection are, as shown below, especially highlighted.

Danger:
This refers to working and operating procedures which must be complied with in order to rule out the risk to persons.

Caution:
This refers to working and operating procedures which must be complied with in order to prevent damage to or destruction of material.

Note:
Explanatory descriptions which help in understanding the relevant work or operating procedure to be carried out.

Assembly of pipes

Danger:
No pipes may be bent.
Risk of breakage!

Fitting flat seals / gaskets

Gaskets are frequently used with sealants or adhesives as an aid to assembly or to achieve a better seal. Above all when parts with different levels of thermal expansion (e.g. aluminium and cast iron) are bonded, this can mean that the gasket is shifted during operation by the so-called stitching or sewing machine effect and leaks occur.

Example: The cap of the front crankshaft seal. If a sealing agent or an adhesive is used here the flat seal will move inwards in the course of time as a result of the different expansion rates of the materials. Oil will be lost, for which the shaft seal may be thought to be responsible.

Perfect assembly of gaskets can only be achieved if the following instructions are adhered to:

- Use only genuine MAN seals / gaskets.
- The sealing faces must be undamaged and clean.
- Do not use any sealing agent or adhesive – as an aid to fitting the seals a little grease can be used if necessary so that the seal will stick to the part to be fitted.
- Tighten bolts evenly to the specified torque.

Assembly of round sealing rings

- Use only genuine MAN round sealing rings.
- The sealing faces must be undamaged and clean.
- Always wet round sealing rings with engine oil before fitting them.

Masking of fuel and lube oil pipe connections (for classified engines only)

The unions of pressurised oil and fuel pipes are masked with a protective tape.
If this tape is removed during a repair, the unions must be masked with protective tape again afterwards.

The following pipes are affected:

- Oil supply pipe to turbochargers
- Fuel pipes between supply pump, filter and injection pump
- Injection pipes protected against leaks

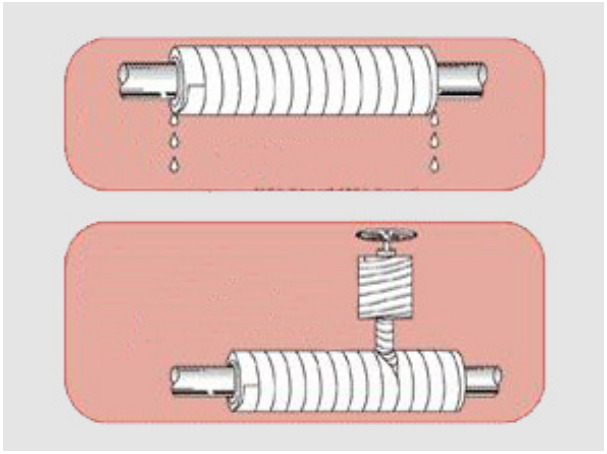

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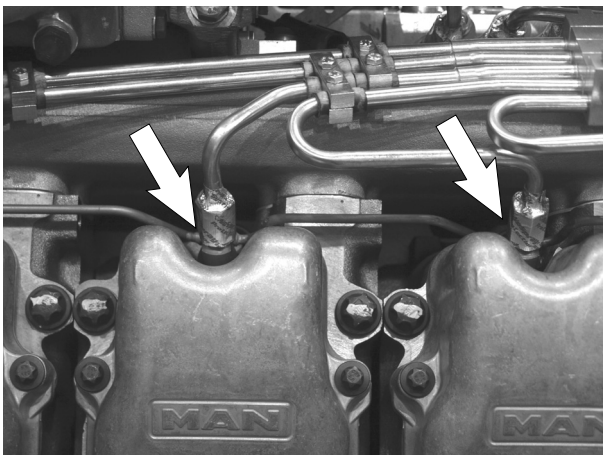
Fig. 1
A protective tape is wound around the unions. Ensure that there is 50 % overlap on every pass.



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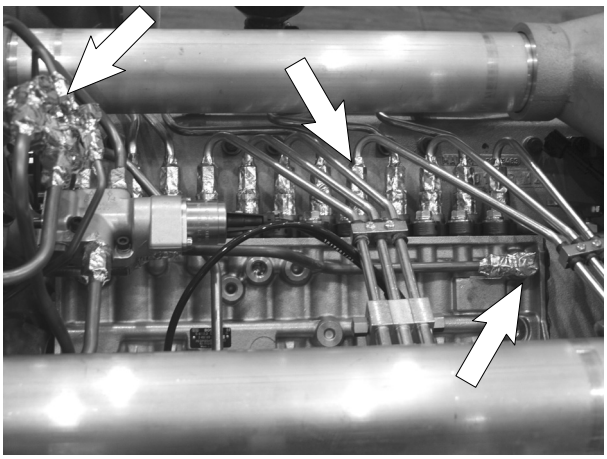
Figs. 2–4
The unions to be masked must be clean and free of oil and grease.
Do not apply the protective tape unless this is the case



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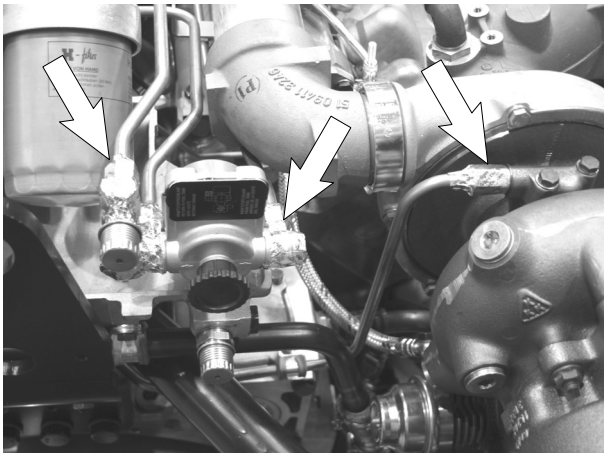

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Contents

All the engines dealt with here are related by design and together form a family.

The sequence of letters and numbers which make up the model designation reveal a number of characteristic properties of the engine in question to those familiar with the basic nomenclature.

We will explain the system using model D 2842 LE 201 as an example:

D The “D” at the beginning of the model designation stands for **“Diesel”**

28 The number “28” indicates that the engine has a 1**28** mm bore

4 The “4” means 1**4**2 mm stroke

2 The “2” shows that the engine has 12 cylinders. If there is a 0 here instead, the engine is a 10-cylinder model

L This letter stands for the German word “Ladeluftkühlung”, meaning **“intercooling”**

E “E” stands for the German word “Einbaumotor”, meaning **“installation engine”**, and distinguishes these engines from MAN vehicle engines

201/2.. This is a Works internal development number. This engine generation was introduced early 1994 with modified turbocharger, high-pressure injection and, fitted as standard, an electronically controlled quantity regulator.

General information

This brief overview summarises important instructions and is structured into areas of main concern in order to impart the knowledge necessary to prevent accidents involving injury to persons, damage to the engine or other property and harm to the environment. Additional notes are included in the operator's manual for the engine.

Important:
If despite all safety precautions an accident occurs as a result of contact with caustic acids, penetration of fuel into the skin, scalding with hot oil, anti-freeze splashes into the eyes etc, ***consult a doctor immediatel.***

1. Instructions for preventing accidents with injury to persons

Checks, setting jobs and repair work must be carried out by authorised skilled personnel only.

- When carrying out maintenance and repair work, ensure that the engine cannot be accidentally started from the bridge by unauthorised persons.
- The engine must be started and operated by authorised personnel only.
- When the engine is running, do not get too close to revolving components.
  Wear tight-fitting working clothes.

- Do not touch hot engine with bare hands: risk of burning yourself.

- Keep engine vicinity, ladder and steps free of oil and grease. Accidents resulting from slipping may have serious consequences.
- Work only with tools that are in good condition. Worn spanners slip: risk of injuries.
- Persons must not stand under an engine suspended from a crane hook.
  Keep lifting gear in good order.

- Open coolant circuit only after the engine has cooled down. If opening the coolant circuit while the engine is hot is unavoidable, observe the instructions in the chapter "Maintenance and care" in the Operator's Manual.
- Neither retighten nor open pressurised pipelines and hoses (lube oil circuit, coolant circuit and downstream hydraulic oil circuit if fitted): risk of injuries resulting from emerging fluids.

- When checking the injection nozzles, do not hold your hands in the fuel jet.
  Do not inhale fuel mist.

- When working on the electrical system, unplug earth cable from battery first and reconnect it last to avoid short-circuits.

- Observe the manufacturer's instructions for handling batteries.
  Caution:
  Battery acid is toxic and caustic. Battery gases are explosive.

- When carrying out welding work, observe the "Information sheets for welders".

2. Instructions for preventing damage to the engine and premature wear

- ***Prior to repairing the engine, clean it thoroughly. Ensure that dirt, sand or foreign matter will not get into the engine during repair work.***
- In the event of operational faults immediately identy the cause and rectify to prevent more serious damage.
- Always use genuine MAN parts only. Installation of "equally" good parts from other suppliers may cause severe damage for which the workshop carrying out the work is responsible.
- Never operate the engine while it is dry, i.e. without lubricant or coolant.
  Use a suitable label to mark engines not ready for operation.
- Only use operating materials (fuel, engine oil, antifreeze and anticorrosion agents) approved by MAN. Ensure that everything is kept clean. Diesel fuel must be free of water.
- ***Do not fill up with engine oil above the max. notch on the dipstick. Do not exceed the engine's maximum permissible operating inclination.***
  Non-compliance with these instructions may cause severe engine damage.
- Control and monitoring devices (charge check, oil pressure, coolant temperature) must work faultlessly.
- Observe the instructions for operating the alternator; see chapter "Maintenance and care" in the Operator's Manual.

3. Instructions for preventing environmental damage

Engine oil and filter cartridges and elements, fuel / fuel filters

- Take old oil to an old oil disposal point only.
- Ensure without fail that oil and Diesel fuel will not get into the sewerage system or the ground.
  Caution:
  Danger of contaminating potable water!
- Treat filter elements and cartridges as special waste.

Coolant

- Treat undiluted anticorrosion and / or antifreeze agents as special waste.
- The regulations of the relevant local authorities are to be observed for the disposal of spent coolants.

4. Instructions for handling used engine oil *

Prolonged or repeated contact of any kind of engine oil with the skin causes the skin to degrease, which may result in dryness, irritation or inflammation. Old engine oil also contains hazardous substances which in animal experiments have caused skin cancer. Handling old engine oil does not pose any health hazard if the basic safety and hygiene related regulations are observed.

Health and safety regulations:

- Avoid prolonged, excessive or repeated contact of old engine oil with the skin.
- Use a suitable skin protection agent or wear protective gloves.
- Clean the skin that has been in contact with engine oil.
  - Wash yourself thoroughly with soap and water. A nailbrush is an effective aid.
  - Special hand cleaning agents facilitate cleaning soiled hands.
  - Do not use petrol, Diesel fuel, gas oil, fluxes or solvents as cleaning agents.
- After washing apply moisturising handcream to your skin.
- Change oil-soaked clothes and shoes.
- Do not put any oil-soaked cloths into pockets.

Pay meticulous attention to the proper disposal of old engine oil.
– Old oil is a water hazard –

Therefore, do not pour any old oil into the ground, the drains or the sewerage system. Any violation of this rule is punishable.

Collect and dispose of old engine oil properly. For information concerning collection points, contact seller, supplier or the local authorities.

* Based on the “Information sheed for handling used engine oil”
(Notes on how to handle old engine oil).

Faults and possible causes

We recommend

Repair work is to be considered complete only after the damage which has occurred and the possible causes have been eliminated. Ascertaining the causes of damage is frequently more difficult than eliminating the damage caused. For this reason we recommend you have the operational fault exactly described to you before removal or disassembly work is commenced. Then, track down the probable causes by asking specific questions, examining and eliminating these causes one by one with the aid of the table ***and your own experience.*** This helps to reduce repairs to those necessary and counter complaints about “premature” exchange of parts and expensive working and downtimes.

Remark:

The subsequent list is meant to be a memory aid so that no causes of damage will be overlooked in the elimination of faults. The precondition for this, however, is that you are familiar with the Repair Manual for the engine and the relevant Operator’s Manual as well as the publication “Fuels, Lubricants, Coolants for MAN Diesel Engines”.

1. Starter turns over engine only slowly or not at all																					
	2. Starter turns, engine does not start, engine does not start / difficult to start when cold																				
		3. Engine stalls (dies) during operation, no longer starts (starter turns), engine does not start / starts with difficulty when hot																			
			4. Sudden, temporary engine shutdown, engine does not reach full revs																		
				5. Engine only runs at idle speed, no throttle response																	
					6. Engine only runs at increased idle speed, no throttle response																
						7. Rated engine speed distinctly reduced (even under no load)															
							8. Reduced output in all ranges														
								9. Irregular engine operation, traction loss													
									10. Unstable idle speed, engine hunting, misfiring, knocking in engine												
										11. Engine judder											
											12. Unusual combustion noise										
												13. Excessive smoke emission: White smoke / blue smoke									
													14. Excessive smoke emission: Black smoke								
														15. Engine temperature too high (coolant loss)							
															16. Intermediate speed control cannot be activated / does not switch off; engine running at an excessively high speed						
																17. Fuel consumption too high						
																	18. Lubricating oil pressure too low				
																		19. Lubricating oil pressure too high			
																			20. Lubricating oil consumption too high		
																				21. Engine too “loud” / mechanical noise	
																					Possible causes
x	x																				Batteries discharged, battery lead connections loose or corroded, break in power circuit
x																					Crank gear blocked
x	x																				Starter solenoid switch sticks (clicks) / defective, cable connection loose or damaged
x	x																				Starter / starter interlock relay defective (carbon brushes worked loose / worn, winding defective, short to ground)
x																x	x	x			Engine oil viscosity unsuitable, not suitable for ambient temperature, lubricating oil quality does not correspond to specifications
						x												x			Oil level in sump too high
																x					Oil level in sump too low, oil in sump too thin (mixed with condensate or fuel)
																x					Engine temperature too high
																x					Oil filter clogged
																x	x				Oil pressure gauge defective
																x					Safety valve in oil circuit defective (does not close, spring fatigued or broken)
																x			x		Bearing wear
																x					Oil pump gears worn
																			x		Crankshaft timing gears worn, tooth flank backlash too great
							x		x								x				Engine cold
									x												Lubricating oil entering combustion chamber (piston rings worn, piston rings broken) – valve stem guide worn – overpressure in crankcase (crankcase vent clogged)
																	x				Relief valve in oil circuit defective (does not open), oil lines / oil galleries clogged
																		x			Leaks in lubricating oil circuit, particularly at turbocharger and oil cooler
							x											x			Piston rings heavily worn, broken
							x												x		Piston pin or crankshaft bearing loose
																		x			Valve stems worn, bent
	x						x												x		Valve clearance not correct
	x						x														Valves jam
	x	x				x	x														Compression deficient, or more than 3–4 bar pressure difference between individual cylinders
	x						x					x									Valve seats leaking
o			x									x									Increased power intake due to defective secondary consumers such as hydraulic pumps, fan etc., power take-off engaged
			x			x				x		x							x		Air cleaner soiled or clogged, turbo air system leaking, air inlet / exhaust line clogged / leaking
	x	x	x	x		x	x		x		x		x								Fuel low pressure system: Fuel tank, prefilter, water trap faulty / clogged / mould / fungal attack, fuel unsuitable / contaminated (paraffin added)
	x	x	x			x	x	x		x		x									Fuel low pressure system: Fuel lines leaking, broken, clogged

x = trifft eher zu
o = trifft eventuell zu

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	Possible causes
x	x	x			x	x		x		x											Fuel low pressure system: Air in system (turn on ignition when bleeding system)
x	x	x			x	x	x	x		x			x								Fuel low pressure system: Fuel pump, overflow valve, main filter
x					x		x	x	x	o	x		x								Fuel high pressure system: Jets defective / clogged / leaking / coked
					x		x	x	x				o								Fuel high pressure system: Pressure lines – constriction, cavitation, leaking
	x				x		o	x	x	x	x		o								Fuel high pressure system: Injection pump worn / set incorrectly
					o			x	o				o								Fuel high pressure system: Injection pump constant-pressure control valve / return flow restrictor defective
x	x	x			o	x															EHAB defective, drive faulty
o	o				o		x		o	x	x		x								Injection pump-engine allocation: Start of delivery incorrect (basic installation), start of delivery set incorrectly
x	x	x						o													Both rpm sensors defective, line defective
					x		x			o	x										Exhaust turbocharger leaking or defective
																				x	Turbine and compressor rotor in turbocharger dirty (out-of-balance, irregular running)
											x										Intercooler leaking, defective
x										x											Flame starter defective
					x							x									Radiator dirty or failure of cooling system (temperatures too high)
												x									Coolant level too low, air in coolant circuit
												x									V-belt for water pump drive not tensioned correctly
												x								x	Incorrect V-belt tension
												x									Water pump leaking, defective / Thermostat defective, does not open
												x									Coolant lines leaking, clogged or twisted
											x										Coolant entering combustion chamber (cylinder head / gasket leaking)
									x												Engine bearings worn

x = trifft eher zu
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Very different factors have an influence on the life expectancy of an engine. For this reason it is not possible to give certain predetermined numbers of operating hours for basic overhauls.

In our opinion, opening an engine or carrying out a basic overhaul is not appropriate as long as the engine achieves good compression values and the following operating values measured and recorded and have not changed significantly since commissioning:

- Charge-air pressure
- Exhaust-gas temperature
- Coolant and lube-oil temperature
- Oil pressure and oil consumption
- Formation of smoke

The following criteria have a major influence on the life expectancy of an engine:

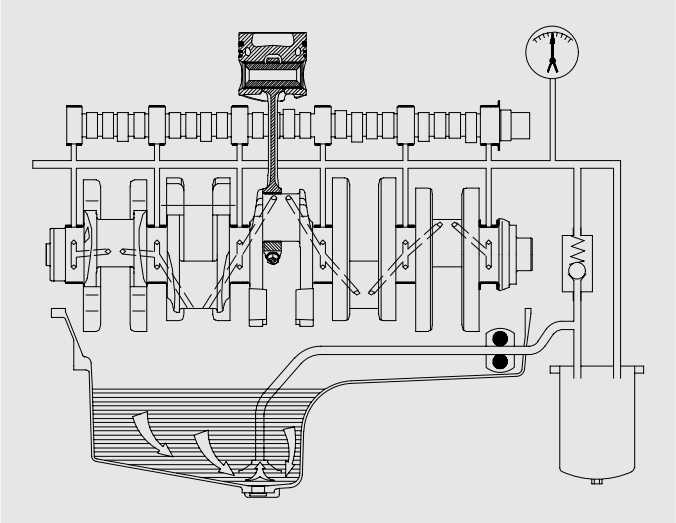
- Correct output setting according to the type of operation
- Expert installation in accordance with the installation instructions
- Inspection of the installation by authorized personnel
- Regular maintenance as per maintenance plan in the Operator's manual
- Selection and quality of lube oil, fuel and coolant as specified in the publication "Fuels, Lubricants, Coolants for MAN Diesel Engines"

Pressurisation

It is of utmost importance that after completion of repair work, ie in the dry condition, internal combustion engines be pressurised with lube oil before being recommissioned. This procedure may also be used for ascertaining damage and the cause of it.

If engines are not pressurised, the risk of premature damage to bearing surfaces is very high, because it takes a relatively long period of time until the lube oil sucked in from the oil pan via the oil pump has reached the individual bearing points.

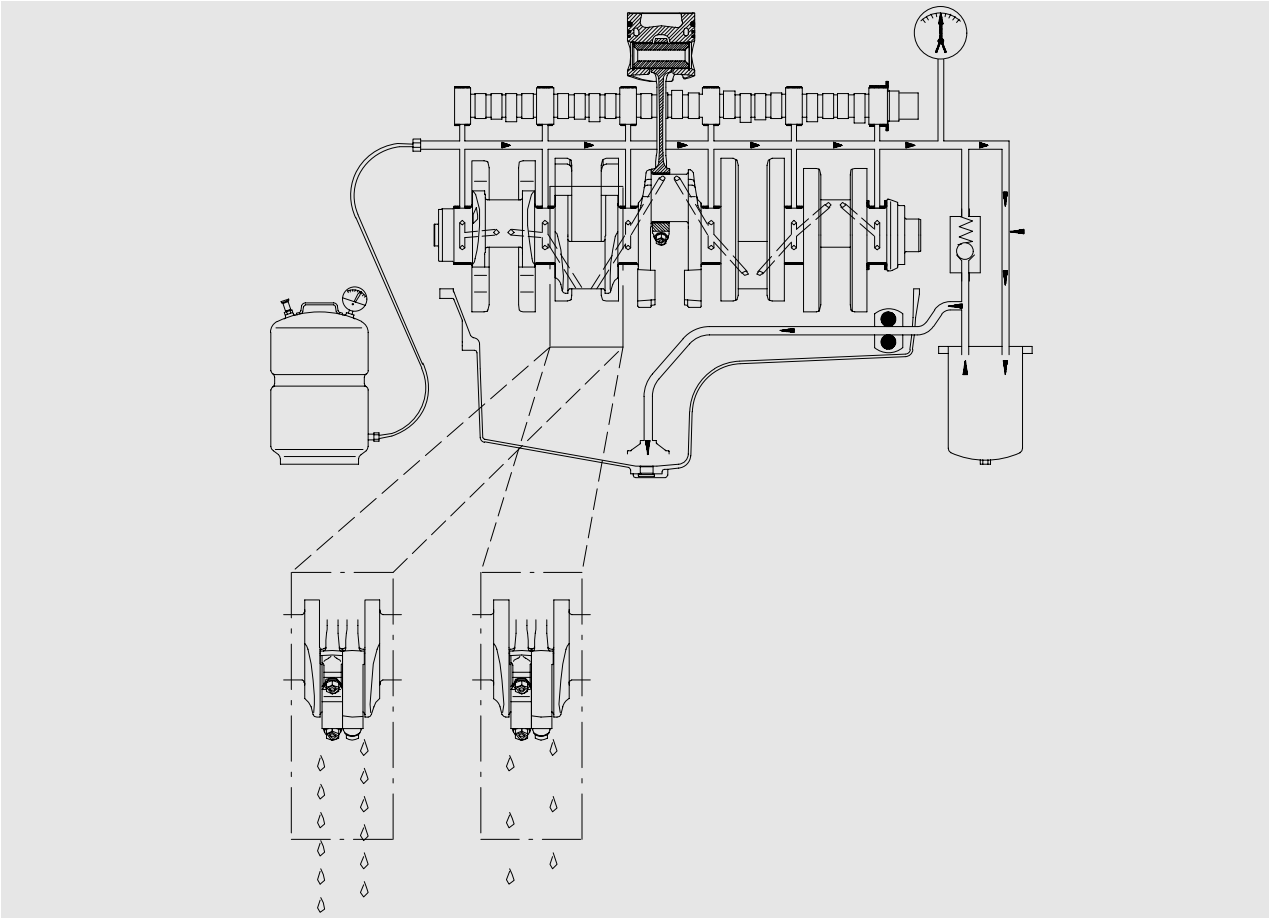
Such incipient damage need not necessarily lead to bearing failure, but may affect the functioning of bearings and shorten their service lives.



Schematic diagram of the flow of oil in non-pressurised engines.

Pressurising an engine affords the following advantages:

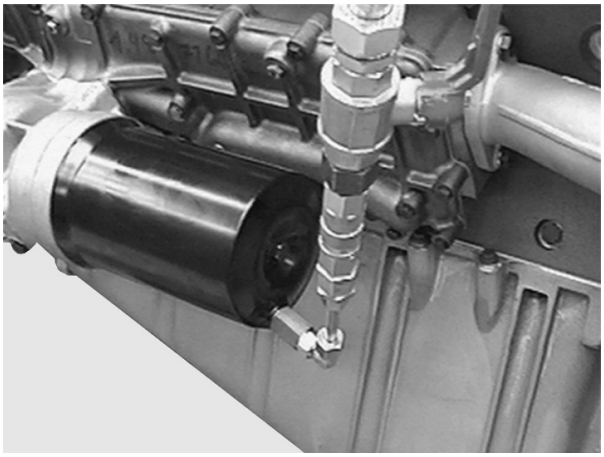
- All engine parts are lubricated before engine start; inside the bearings a lubricating film can build up as early as after the first few turns of the crankshaft, which prevents damage to the bearing races.
- Loss of oil, be it the result of excessively large bearing play or leaks from the crankcase or from crankcase bores which may not be plugged, can be recognised immediately. For this purpose mount the engine on a dolly, take off the oil pan and install a suitable oil collector under the crankcase in such a way that the bearings are visible.



Execution of pressurisation:

At least 30% of the overall oil quantity is pressed from the pressurisation container into the engine oil circuit. The operating pressure serves as a yardstick for the pressure to be injected. This must not be exceeded.

The pressurisation container is connected up to the engine's oil circuit at the oil filter head (screw plug).



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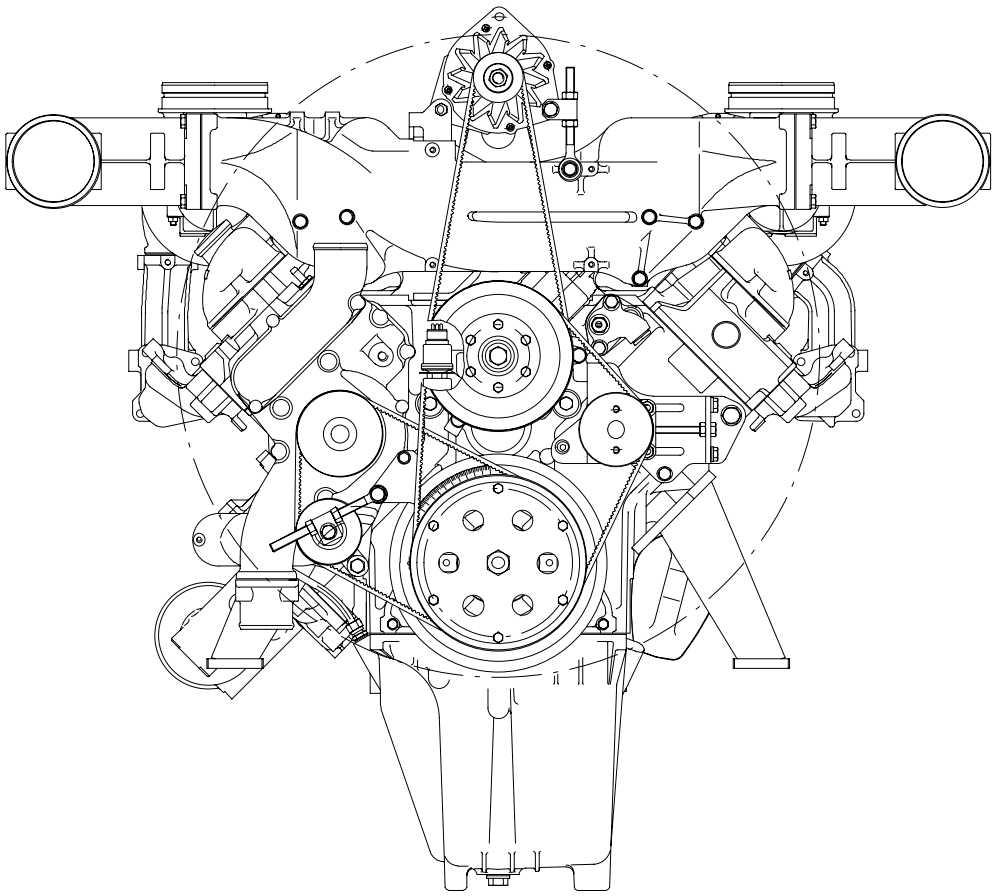
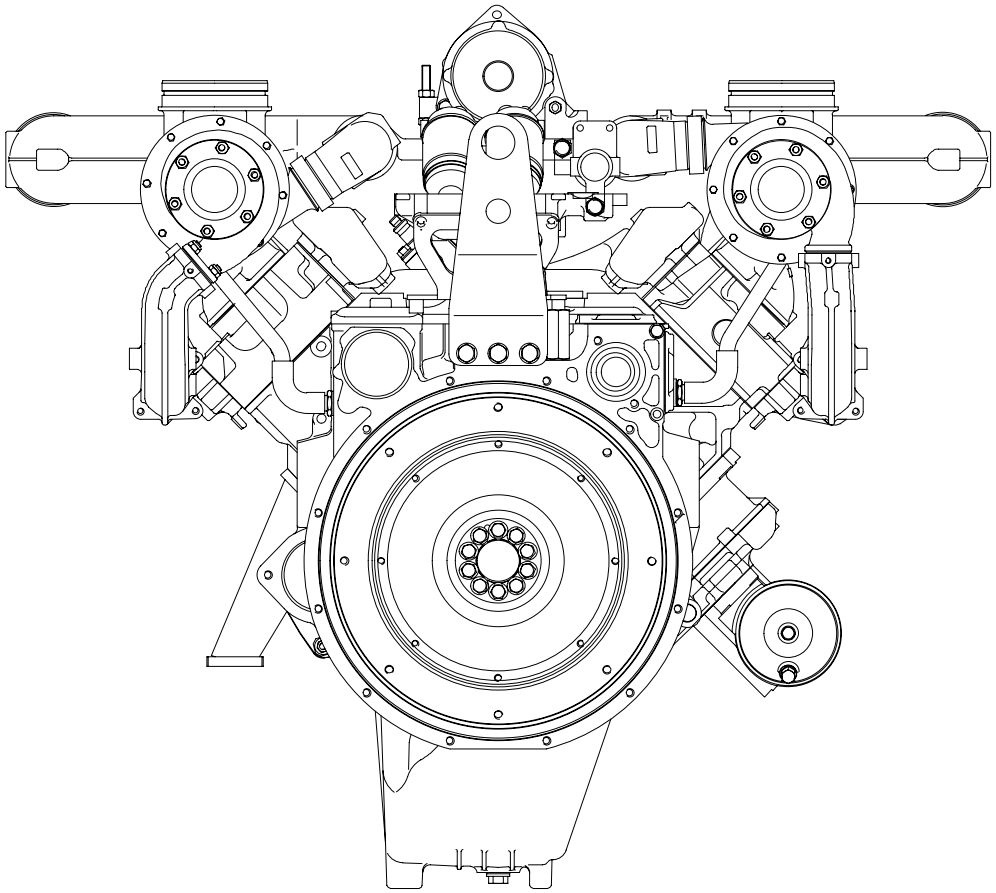
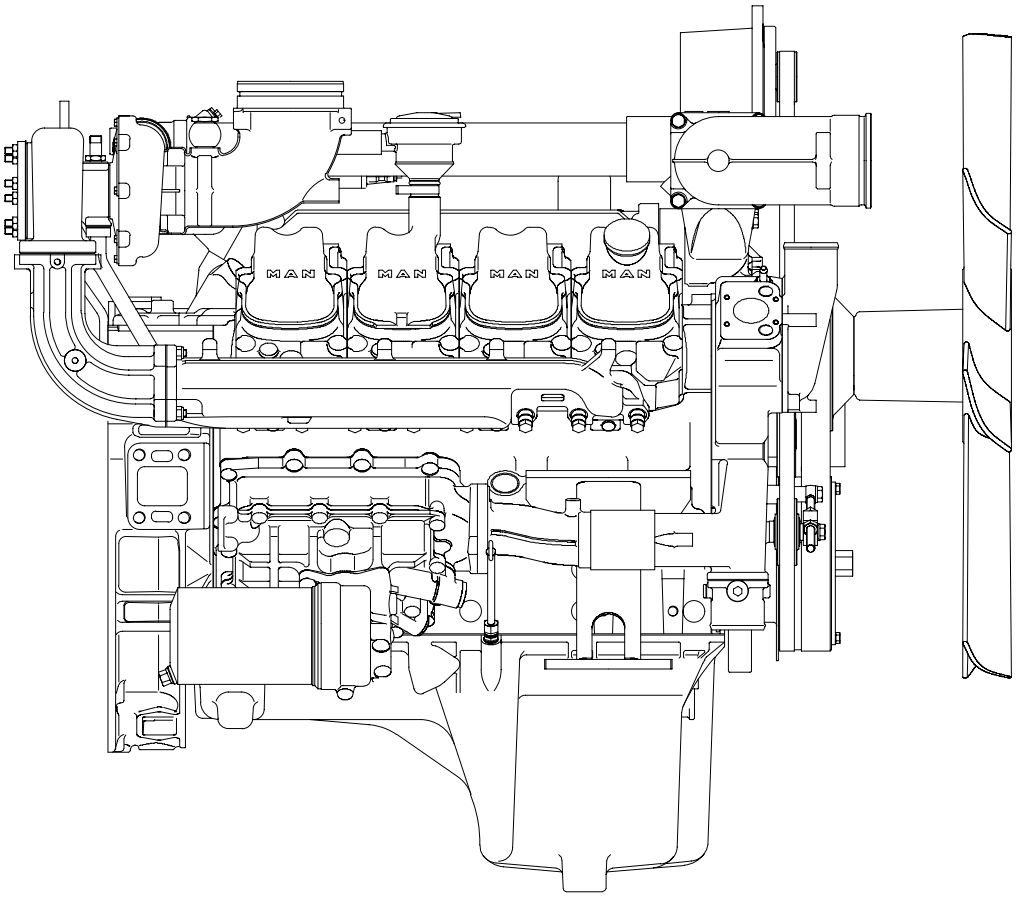
Front view of engine



Rear view of engine



View of engine from right-hand side



View of engine from left-hand side