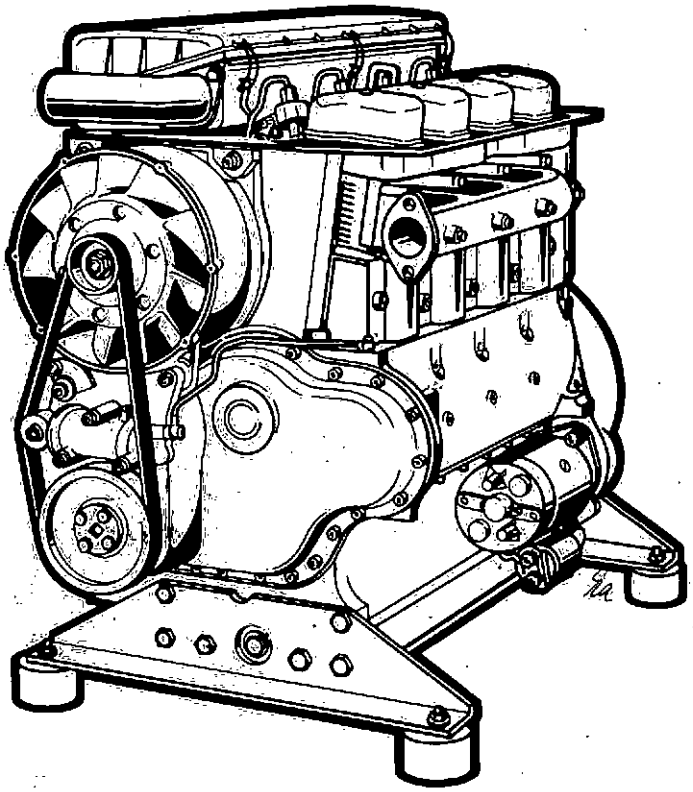
INSTRUCTION BOOK

HATZ DIESEL



2...4 M 31
2...4 M 40

FOR THE ACTUAL OPERATOR

A new HATZ Diesel engine is working for you.

Before leaving the factory, each engine is carefully tested and inspected including full load running and detailed examination.
This instruction book has been written to assist the owner / operator in the correct operating and maintenance procedure and to ensure continued engine reliability.
The „HATZ" worldwide service organisation is at your disposal for any repairs or problems.
Repairs or adjustments to your engine should be carried out by „HATZ" trained / qualified mechanics using genuine „HATZ" spare parts only to guarantee continued satisfaction.

The essential

HATZ DIESEL **genuine spare parts**

are listed in the corresponding spare parts list.

For further details contact your nearest HATZ agency as listed in the dealer network list or

MOTORENFABRIK HATZ GMBH +CO KG RUHSTORF a.d. ROTT

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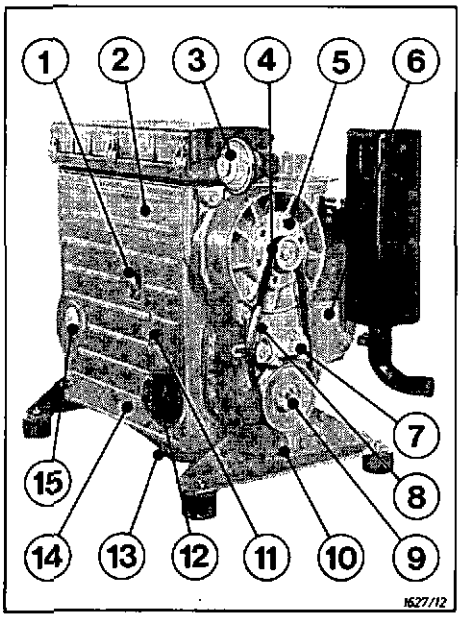
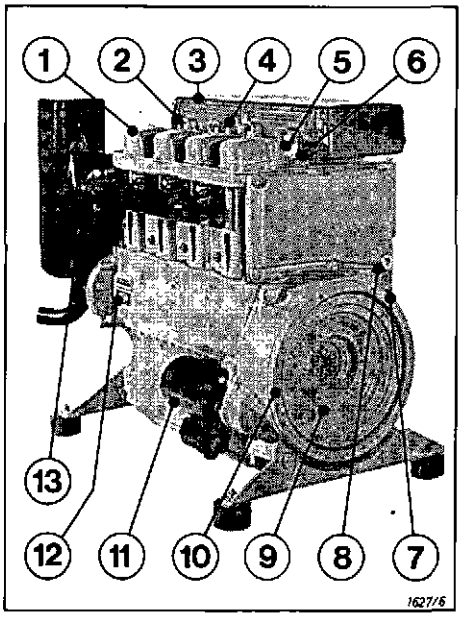
Removable maintenance chart between page 18 and 19.

1. Description

1. 1. Engine illustrations



1 Operator's side



2 Flywheel side

Engine 2...4 M 31, 2...4 M 40

1 Lub.-oil filling and dipstick
2 Side panel
3 Rain protection cap
4 Cooling fan drive belt
5 Cooling fan with incorp. alternator
6 Governor housing
7 Idler pulley, hydr. belt tensioner
8 Stop device
9 Belt pulley with $^1/_2$" internal square for cranking of engine
10 Oil drain plug
11 Speed control lever
12 Lubricating oil filter
13 Oil drain plug (Oilsump)
14 Cooling air duct for lub.-oil cooler
15 Access to fuel feed pump

1 Cylinder head cover
2 Fuel pressure pipe
3 Cover for air filter(s)
4 Eye-hook f. transport
Max. perm. load 500 kg / 1100 lbs
5 Injector
6 Fuel return line
7 Fuel supply line
8 Wiring harness duct
9 Flywheel
10 Engine flange
11 Starter
12 Type plate
13 Exhaust silencer

1. 2. Technical data

Typ	2 M 31	2 M 40	3 M 31	3 M 40	4 M 31	4 M 40
Mode of operation	4 stroke					
Combustion method	direct injection					
Number of cylinders	2	2	3	3	4	4
Bore/stroke mm	102/90	102/105	102/90	102/105	102/90	102/105
Cubic capacity cm^3	1470	1716	2205	2574	2940	3432
Compression ratio	18 : 1					
Ignition sequence No. 1 cylinder gov.-side	2 - 1		1 - 3 - 2		1 - 3 - 4 - 2	
Direction of rotation	anticlockwise (looking at the flywheel)					
Cooling air required at 3000 rpm. m^3/min.	25	29	35	39	46	49
Combust. air required at 3000 rpm. m^3/min.	2.1	2.6	3.2	3.9	4.2	5.2
Net weight approx. kg *	225..262	205..242	265..275	257..277	336..360	316..336
Lubricating oil pressure	at 800 rpm. min. 0.9 bar					
Lub.-oil consumption	max.: 1 % of fuel consumption at full load					
Injection pressure bar/psi	250^{+8} / 3600^{+115}					
Tappet clearance (cold engine) inlet/exhaust mm/in	0.10 / .004					
Starter motor	12 V 2.7 kW — 24 V 4.0 kW					
Alternator charging current at 3000/1500 rpm.	14 V : 50/42 A — 28 V : 40/28 A					
Battery capacity min./max.	12 V : 88/143 Ah — 24 V : 55/110 Ah					

Max. permissible permanent inclination in direction of:	**with** and **without** oil sump	**with** oil sump	**without** oil sump	**with** oil sump only
operator's side low	30°	30°	25°	25°
exhaust side low	30°	30°	30°	30°
governor side low	30°	25°	25°	15°
flywheel side low	30°	22°	25°	18°

* The weights vary depending on versions and variants.
For further details contact your nearest HATZ agency.

Torque wrench specifications

Engines M 31 - M 40	Nm	lbf. ft.	Comments:
Hexagon nut for cylinder head cover	10	7,5	
M 8 hexagon nuts, retaining injector	15	11	Tighten nuts evenly
Injector cap nut (nozzle retention)	85	62	
Collar nuts M 10 x 1,25 (Cylinderhead nuts)	65	48	Apply „Loctite 221" to thread and washer of stud which protrudes into rocker housing.
Allen screws on flywheel	200	146	

1. 3. Technical description

No. of cylinder	Type	Version	
2 ... 3 ... 4	... M 31 ... / ... M 40 ...	H = ≦ 2300 rpm.	Without capsule and balancing shaft(s).
2 ... 3 ... 4	... M 31 ... / ... M 40 ...	L = > 2300 rpm.	Without capsule and balancing shaft(s).

General design

Grey-cast-iron crankcase, horizontally split in axis of crankshaft.
Separate camshafts each for the operation of valves and the injection pumps.
Grey-cast-iron cylinders, light-alloy-cylinder-heads with shrunk-fitted valve seat rings.
Dry type air cleaner integrated to engine with maintenance indicator, with possibility to connect an externally fitted cyclon pre-cleaner.

Cooling system

Axial-type blower fan with integrated alternator, driven by a poly-V-belt with hydraulic belt tensioner and automatic shut-off-device in case of belt failure (alternativ: electric control switch).

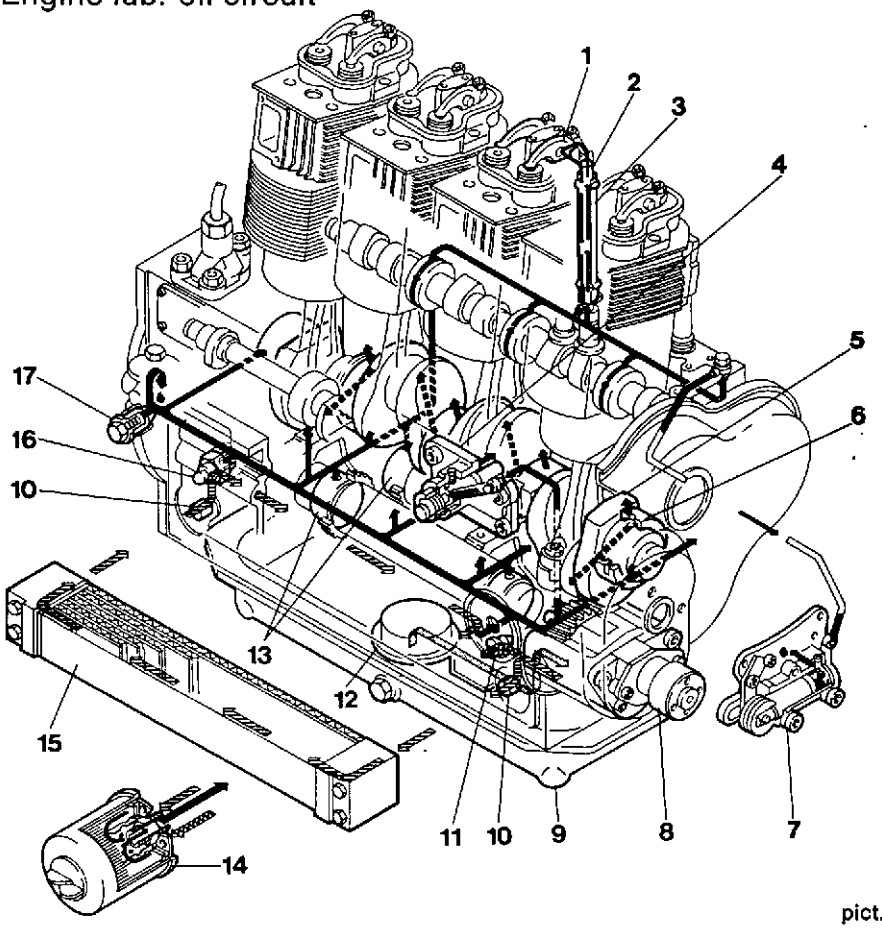
Fuel injection equipment

Direct injection with multi-hole-nozzle, separate injection pump for each cylinder, driven by a camshaft with incorporated timing advancer and speed governor.
Excessive fuel device and bleeding of fuel supply system operate automatically.

Lubricating system

Pressurized lubricating system with in-line filter and cooler.
Automatic start blocking and engine shut-off in case of insufficient oil pressure are optionals.

Engine lub.-oil circuit



pict. 3

suction tube

way of pressurized oil between pump and filter (at engines **without oil-cooler)**

way of pressurized oil between pump and filter if engine is equipped **with oil-cooler**

way of pressurized oil after oil filter

1 Rockers
2 Pushrods
3 Pushrod tubes
4 HATZ auto-protection device with integrated excessive fuel device
5 Crankshaft
6 Main bearings
7 Hydraulic belt tensioner
8 Lub.-oil pump
9 Oil sump
10 Closing plugs (engines without oil cooler)
11 Closing screw (engines with oil cooler)
12 Oil suction sieve
13 Counter rotating balance shaft(s) L 31 . . . 40 only
14 Lub.-oil filter with bypass valve
15 Oil cooler
16 Oil pressure switch
17 Oil relieve valve

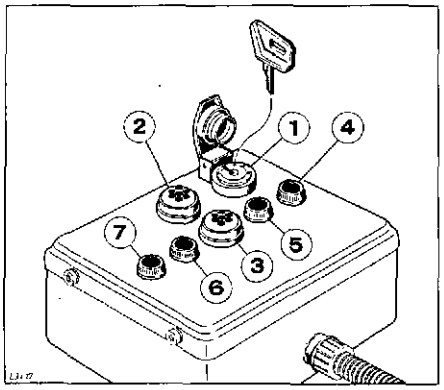
1. 4. Electric starting and control system

The engines are equipped with a fully wired 12 V or 24 V system.
The following versions of engine controls are available:

1. 4. 1. *Visual fault indication*

The engine is controlled from an instrument box or panel that holds the following components:

1 Mainswitch with key
2 Preglow-controller
3 Additional glow controller (with 4-cylinder engines only)
4 Charging indicator light
5 Indicator light for airfilter maintenance switch
6 Indicator light for low oil-pressure
7 Indicator light for excessive cylinder head temperature



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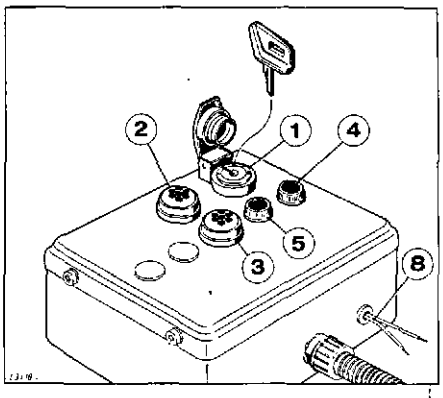
Note:
Pre-glow-equipment and cylinder head temperature indicator light are optionals.
Corresponding wiring diagram: Chapt. 8.

1. 4. 2. Automatic engine shut-off

The engine is controlled from an instrument box or panel which incorporates all components to automatically shut-off the engine in case of
– insufficient oil pressure
– failure of alternator
– clogged airfilters or
– excessive cylinder head temperature.
The system reacts only if failure signal lasts longer than approx. 3 sec.

The external components of the switch box are as follows:

1 Mainswitch with key
2 Preglow controller
3 Additional glow controller (with 4-cylinder engines only)
4 Charging indicator light
5 Indicator light for airfilter maintenance switch



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Note:
Pre-glow-equipment and cylinder head temperature indicator light are optionals.
Corresponding wiring diagram: Chapt. 8.

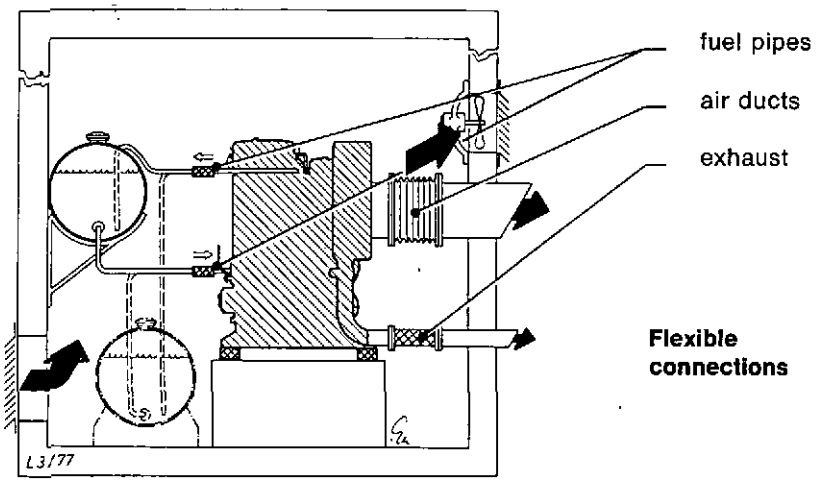
1. 5. Engine Installation

In case of engines installed in small engine rooms, containers etc. take care that the hot air discharge is not re-circulated.

The air intake (air supply) should be as close as possible to the cooling fan or air intake duct of the engine.

– Air intake, air outlet duct, ventilator and exhaust pipe are absolutely essential to operate engines or units in closed engine rooms or containers.

If necessary consult your nearest HATZ agency.



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– The fuel tank can be fitted either above or below the position of the fuel feed pump. In case of fuel tank fitted below feed pump pay attention to the following:

a) Suction height between minimum fuel level and fuel feed pump must not exceed 500 mm (20 in).

b) Lenght of the suction pipe max. 3000 mm (118 in).

c) In case the engine is equipped with a start-release device the gravity feed between fuel tank and fuel feed pump should not exceed 2 m (80 in).

Engine rating

New engines are normally adjusted to output rating according to DIN 6271 which refers to:

100 m above sea level
27° C ambient temperature
60 % relative humidity.

If your engine is operated under substantially different conditions consult your nearest HATZ agency to check whether a correction of rating is necessary.

2. Fuel and lubricants

2. 1. Fuel specifications

All Diesel fuels meeting the following specifications are suitable for these engines:

DIN 51601
BS 2869 A1/A2
ASTM D 975 - 2D/1D

Use of fuels which do not meet the specification figures
– especially with regard to sulphur contents – may require reduced oil change intervals.
Chapt. 4. 1.

Low temperature characteristics

Diesel fuels have a limited capability to stand extremely low temperatures. The border line figures for diesel fuels according to the above mentioned specifications are as follows:

Summer-Diesel: 0° C / 32° F
Winter-Diesel: – 12° C / 10° F

The low temperature-resistance can be improved by adding kerosene according to the the following table:

lowest ambient temperature	recommended proportion of kerosene	
	in summer fuel	in winter fuel
0 to –10° C / 32 to 14° F	20 %	–
–10 to –15° C / 14 to 5° F	30 %	–
–15 to –20° C / 5 to – 4° F	50 %	20 %
–20 to –30° C / – 4 to –22° F	–	50 %

On the market special additivies are available to improve the low-temperature resistance of the fuel. Application and efficency depend on the type of additive and the type of fuel, therefore it is recommended to ask the fuel supplier before using and relying on such products.

2. 2. Lub.-oil specifications

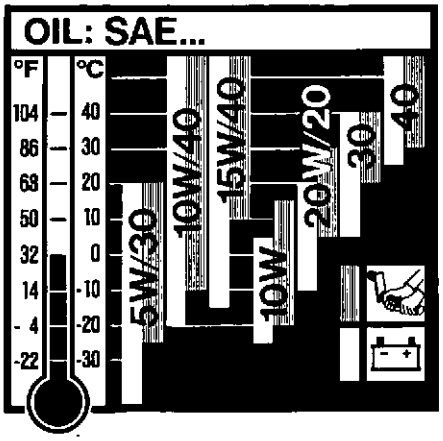
Grade of Lub.-oil equal to the following specifications:

API - CD
SHPD
CCMC - D2, – D3, – PD1

Remark:
The use of lub.-oil of classification API-CC or CCMC-D1 reduces the drain intervals.
Chapt. 4. 1.

Oil viscosity

Use the correct SAE-(viscosity) class depending on the ambient temperature during start of engine. Mind the difference for hand- and for electrically-started engines.



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2. 3. Lubricating oil capacities and type of dipstick

Engine	Oilsump	Lubricating oil capacity			Dipstick	
Type/Version		Ltr.	imp. gal	US gal	marked	Ordering No.
2 M 31 . . . 40 H/L	with	8,5	1,8	9	C	009 311 00
	without	5,5	1,2	5,8	A	007 397 02
3 M 31 . . . 40 H/L	with	11	2,4	11,6	D	009 308 00
	without	8,5	1,8	9	A	007 397 02
4 M 31 . . . 40 H/L	with	14	3,1	14,8	D	009 308 00
	without	–	–	–	–	–

Remark: Lub.-oil capacities are **approximate** figures and appertain to engines equipped with oil cooler as well as oil filter replaced during oil change procedure.

In certain cases engines are not equipped with oil coolers.
This reduces the lub.-oil capacity by approx. 0,2 - 0,5 ltrs.

Important is the max. mark on the dipstick.

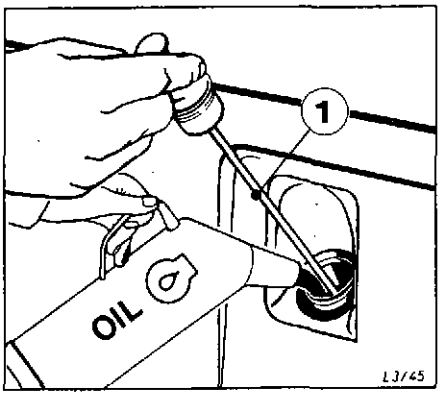
To obtain correct reading on dipstick, engine must be in a level operating position.

3. Operating instructions

3. 1.
Preparation for the first start

Lubricating oil

– Remove (pull out) oil dipstick "1". Fill with lub.-oil according to grade, viscosity and quantity as specified, see chapter 2. 2. and 2. 3.



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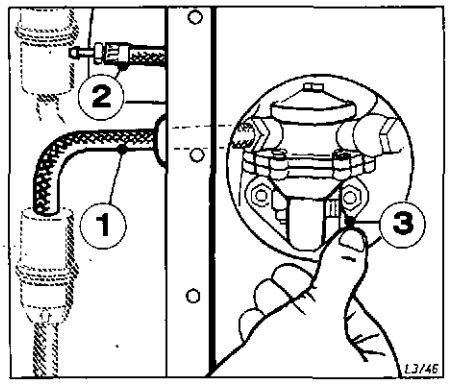
Diesel fuel

– Connect fuel supply "1" and fuel return line "2" to fuel tank.
– Fill with **clean diesel fuel** according to specification.
See chapter 2. 1.

Note:
Clean fuel is of the utmost importance. Use a clean fuel can and a funnel with strainer.
In general fuel must be free from foreign matter and water otherwise excessive wear takes place in the *fuel system*.



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All engines are equipped with an automatic venting system and bled during starting procedure via the fuel feed pump.
Priming is possible by means of the fuel feed pump hand priming lever „3" and only necessary before the first start or in case that fuel tank was totally emptied.
For this measure take off closing plug from panel of engine and actuate lever until fuel will emerge free of air bubbles from return hose "2".
Do not forget to fit closing cover to avoid any loss of cooling air during operation of engine.

Battery

The battery must be properly installed. Make sure terminal clamps marked + or – are attached in the right sequence (negative earth).
Fitting terminal clamps: Fit clamp + (positive) first and follow by clamp – (negative).
Removing terminal clamps: Remove clamp – (negative) first and follow by clamp + (positive). Apply a light coating of grease (petroleum jelly etc.) to terminals and clamps. Check the level of the electrolyte in each cell. The fluid level should be approx. 10 - 15 mm (½ in.) above the plates.

3. 2. Electric start

– Set speed control lever to full speed.
– Insert key into switchbox and turn key to position "I".
– Depending on version of electric equipment (see chapt. 1. 4.) indicator lamps for alternator function and oil pressure light up.
– Turn key into position "III", till engine fires and starts.

The armature box contains a relay which immediately after starting of engine switches off the starter motor even if starting key is held in position "III".
This relay also prevents from engaging the starter motor into the running engine to avoid any damage of starter motor and gearring in case of operation faults.

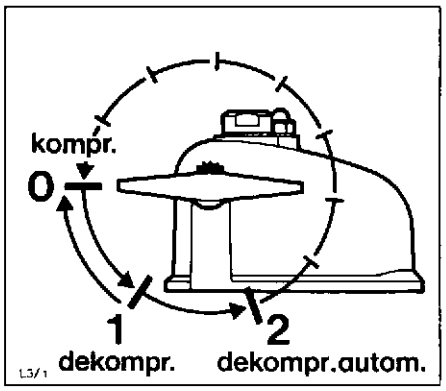
Note:
If engine is equipped with electrical automatic shut-off (identified by armature box having only two indicator lights) within 15 sec. after switching into position "I", the key has to be turned into pos. "II" (pre-glowing) or pos. "III" (start), otherwise the engine protection relay cuts off the fuel injection hence-no start of engine possible.
To reactivate the relay turn key back to pos. "0" and turn on as mentioned before.
– The indicator lamp for airfilter maintenance lights up only if the vacuum in the combustion air intake manifold is too high which is an indicator that the airfilters are clogged and have to be cleaned respect. replaced immediately (see chapt. 4. 2. 7.).
– The indicator lamp for excessive engine temperature (if installed) lights up as soon as the cylinderhead temperature exceeds the limit. In such cases immediately reduce the load of engine, stop engine and check the reason for overheating according to chapt. 6.

3. 3. Starting by hand

– If possible remove (disengage) the load from the engine.
– Set speed control lever to full speed.
– Turn decompression lever to position "2" or to the first position of ratched (first-click).

Position 0 = starting position/engine on compression
Position 1 = decompressed/automatic off
Position 2 = decompressed/automatic on

Compression is automatically on after approx. 8 turns of starting handle.



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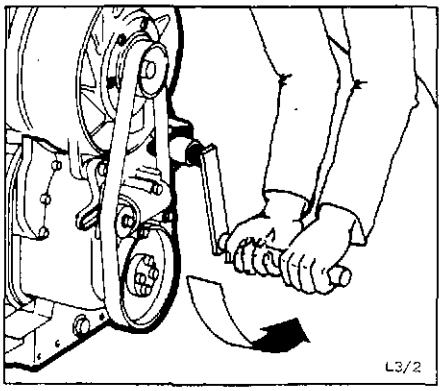
Important !

Turn decompression lever in direction of arrow (anti-clockwise) only, otherwise damage to mechanism will occur.

– Insert crank handle, take hold of crank handle with both hands and bring yourself in correct position in relation to engine.

– Turn crank handle with increasing speed until the decompression lever reaches after approx. 8 turns full compression at pos. "0" and keep on cranking until engine fires.



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Note:
When decompression lever reaches pos. "0" (compression) the highest possible speed/force has to be obtained.

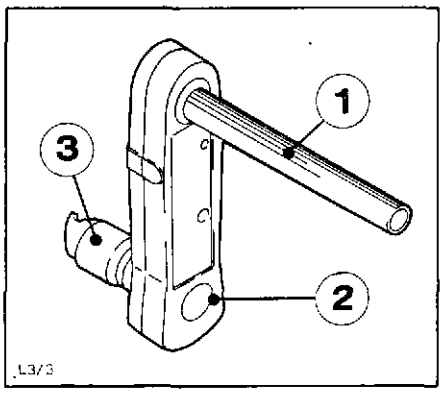
– Run engine at medium speed until engine runs smooth.

– Load can now be applied.

Starting with safety starting handle

– The complete safety mechanism is incorporated in the crank arm, interrupting the power transmission between crank jaw "3" and crank arm "2" in case excessive back-kicking occurs.

– Preparation as well as starting procedure has to be carried out in the same manner as for the standard type crank handle.



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Use both hands and pay attention to correct position of hands on grip "1".
A nonpositive mechanism engages the power transmission between crank jaw and crank arm i. e. the crank jaw remains in a fix position and the starting procedure can be carried out.

– In case a back-kick should occur while cranking the engine a short movement on the grip of the starting handle releases the safety mechanism and interrupts the power transmission between crank jaw and crank arm i. e. the crank jaw moves free in the crank arm.

– To repeat the starting procedure in case the safety mechanism has released simply turn the crank handle in cranking direction.

3. 4. Operation at very low temperatures

The engine has been designed and built for a cold start capability down to **–15° C without pre-glowing** (also refering to handstarted and spring-type-starter operated engines) and down to **–25° C with pre-glowing** equipment, but on the premises of the following details:

– Lub.-oil of the correct (low) viscosity class has to be chosen to enable easy cranking of engine during starting (see chapt. 2. 2.).

Note:

The cranking of engine is quite often restricted by directly flanged components (gear boxes, hydraulic pumps, etc.). Therefore attention should also be paid to the correct viscosity degree of the oil of these components; if any possible: disengage from engine.

– Use fuel with the appropriate low temperature resistance (see chapt. 2. 1.).

– Check condition of battery (level of electrolyte, charging level, clean terminals, etc.).

Starting under cold conditions with pre-glowing equipment

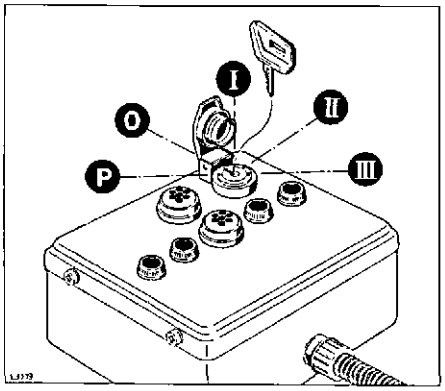
– Prepare for start (see chapt. 3. 2.)

– Turn start key into position "II" and hold for approx. 1 - 2 minutes. Glow-controller start and keeps glowing simultaneously to the glow plug inside combustion air intake manifold.

– Turn start key into pos. "III" until engine fires and starts.

Note:

Do not hold the starter motor for more than 15 - 20 sec. engaged. If engine does not start within this time check for, and cure the reason (see chapt. 6. 1.).



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Starting by hand

– If possible remove (disengage) the load from the engine.
– Set speed control lever to full speed.
– Turn decompressor lever to pos. "1".
– Insert crank handle and crank until engine is free to turn without obstruction.
– Start engine according to chapter 3. 3.

3. 5. Stopping of engine

If any possible do not stop engine under full load. Let the engine run under reduced load to cool down before stopping.

Depending on type of electrical equipment the engine is stopped with the speed control lever or by turning back the start key into position "0".

Don't stop the engine by means of the decompressor !

4. Regular maintenance

4. 1. Maintenance plan

Interval	Symbol	Maintenance work	Chapt.
Every 8 - 15 hrs.		– Check lub.-oil level – Check dust level in container of cyclon pre-cleaner	4. 2. 1. 4. 2. 2.
Every 250 hrs.		– Change lub.-oil – Replace oil filter – Check tappet clearance and adjust if necessary – Clean cooling system – Check condition of air filter(s) *(with dusty working conditions)* – Check all safety devices (indicator switches, shut-off-systems) for proper function. – Check fixing nuts and bolts holding external parts and components for tightness. Note: The cylinder head nuts must NOT be tightened.	4. 2. 3. 4. 2. 3. 4. 2. 4. 4. 2. 5. 4. 2. 7. 5. 1. - 5. 6.
Every 500 hrs.		– Replace fuel prefilter – Replace fuel filter – Maintain air filter(s)	4. 2. 6. 4. 2. 6. 4. 2. 7.

Important:
With new or major-overhauled engines after the first 25 hrs.:
– Change lub.-oil, replace oil filter
– Check tappets and adjust if necessary
– Check all nuts and bolts etc. for tightness.

If operating hours according to reference table are not obtained within 1 year, lub.-oil and -filter have to be changed **once a year.**
Special applications i. e. engines that are equipped with special oil supply systems may require different oil change intervals.

Reference-table of oil-change intervals dependent on lub.-oil - and fuel quality

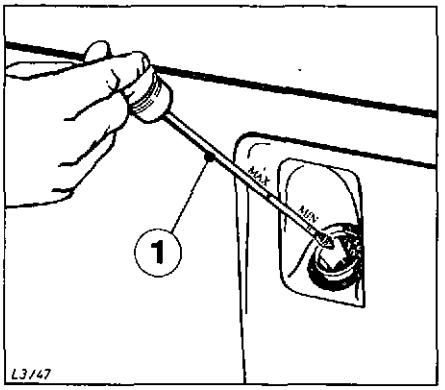
Oil-specification	Oil-change intervals with sulphur-contents of fuel below 0,5 %	above 0,5 %
API: "CD" SHPD CCMC: "D2" or "D3" or "PD1"	250 h	125 h
API: "CC" CCMC: "D1"	150 h	75 h

4. 2. Maintenance instructions

Maintenance after 8 - 15 operating hrs.

4. 2. 1.
Check lub.-oil level and top up to upper mark of dipstick "1".

4. 2. 2.
Check cyclon pre-cleaner for dust level (see chapt. 4. 2. 7. for further details).



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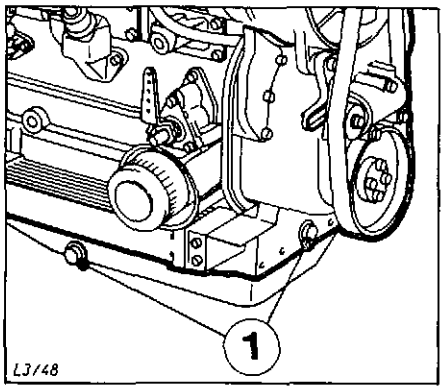
Maintenance after 250 operating hrs.

4. 2. 3.
Lub.-oil change

– Lub.-oil should be drained when the engine is warm.

– Remove oil drain plug "1" and drain off lub.-oil.

– Replace joint washer and tighten drain plug.



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– Remove oil filter cartridge by using screwdriver or strap wrench 620 307 01.

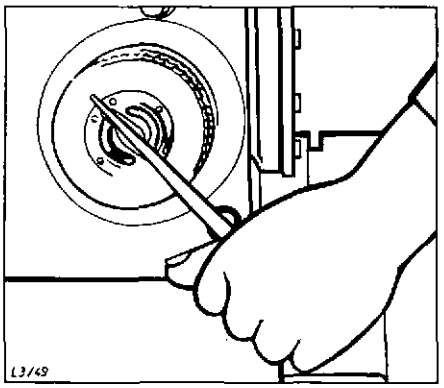
– Clean oil trap and sealing area on crankcase.

– Apply some oil to sealing ring of new oil filter cartridge.

– **Tighten** new oil filter cartridge **by hand only.**

– Fill with lub.-oil according to grade, viscosity and quantity as specified (see chapt. 2. 2. and 2. 3.).

– Check resp. top up oil level after a short-time run.



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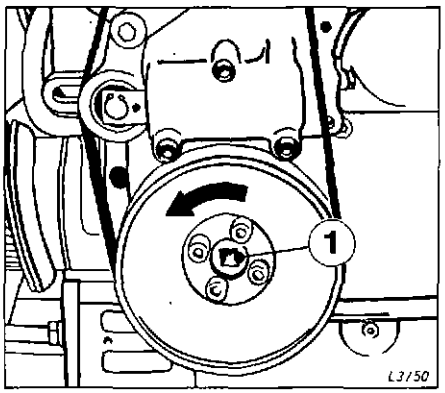
4. 2. 4.

Checking and adjusting of tappet clearance

– Remove hex.-nuts and cylinder head covers.

– In case of a fitted belt guard remove front cover to get access to belt pulley.

– Put ratchet or T-bar with ½" extension into the corresponding opening "1" in the pulley to enable cranking of engine.



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Note:
If your engine is not equipped with a V-pulley having the ½" opening, an adaptor flange with this opening is available as spare part.

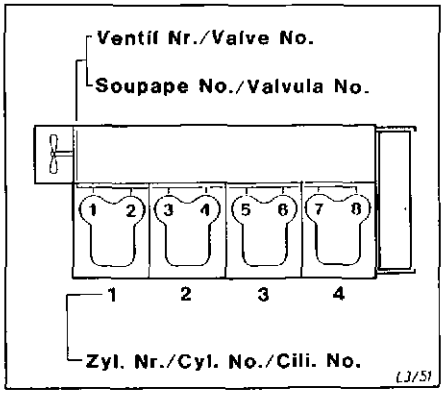
Important: Crank engine in direction of normal operation (anticlockwise facing both flywheel and drive pulley at blower side).

Adjusting sequence: ... with 2-cylinder engine

– Crank engine until valves of No. "1" cylinder are in rocking position.
– From this point crank engine for further 180°.
– Check resp. adjust tappet clearance on No. "2" cylinder.
– Crank for further 180° and check resp. adjust tappets on No. "1" cylinder.

... with 3- and 4-cylinder engine

Type	Valve No. full open	Check resp. adjust valves No. . . cyl.
3-cyl.	1	No. "3" cylinder
	5	No. "2" cylinder
	3	No. "1" cylinder
4-cyl.	1	No. "3" cylinder
	5	No. "4" cylinder
	7	No. "2" cylinder
	3	No. "1" cylinder



18

– Check tappet clearance of respective cylinder using a feeler gauge.

Cold engine –

all valves 0,10 mm / .004"

To adjust proceed as follows:

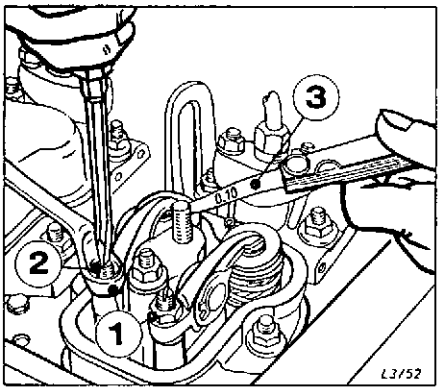
– Loosen hex. nuts "1"

– Place feeler gauge "3" between valve stem and rocker arm.

– Turn adjusting screw "2" until a smooth pull on the feeler gauge is obtained.

– Re-tighten hex. nut "1".

– Re-check tappet clearance.



19

– Check and adjust the remaining valves in the same manner.

– Replace O-ring and re-assemble cylinder head cover.

Note:

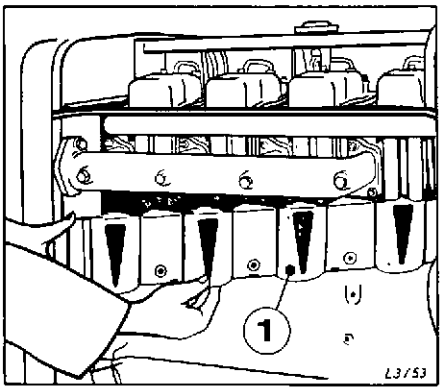
Hex. nuts (seal lock) should only be used twice before being replaced.
Check cylinder head cover for proper sealing after an initial engine run.

4. 2. 5.

Cleaning of cooling system

– Remove airducting parts so far that good access to all components in the cooling air flow is obtained.

– Remove air guide "1" and clean.

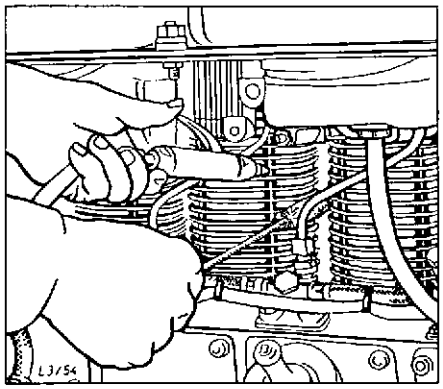


20

Cleaning – dry accumulated dirt

– Clean whole area (cooling fan, fins of cylinders, cylinder heads, air ducts) using a suitable bottle brush etc..

– Blow off loose dust by compressed air.

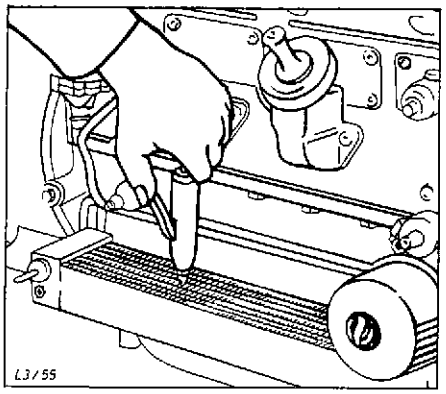


21

– Clean oil cooler using compressed air only.

Cleaning –
oil and dust contaminated

– Disconnect battery.
– Clean alternator and voltage regulator by hand.
– Protect alternator and regulator to avoid the ingress of water etc.
– Clean whole area (except alternator) with suitable cleaning fluids.
– Rinse off cleaner with water, preferably by using high-pressure steam- cleaner.



22

Note: Make sure alternator is properly protected.
– Dry off engine with compressed air.
– Check for oil leaks etc. and repair if needed (if necessary contact your nearest HATZ agency.
– Re-assemble all parts in reverse order.
– Immediately after cleaning run engine to dry off thus preventing rust formation.

Important: Under no circumstances may engines be operated without engine cover(s) as this will affect cooling.

250 **Check all nuts, bolts, etc. for tightness**

In connection with maintenance work a general checkover must be carried out including checking and if necessary re-tightening of all nuts and bolts fitted to engine brackets and fixation, covers, intake and exhaust manifold, air filter, exhaust silencer, fuel tank, starter and clutches, etc.

Note: The cylinder head nuts must NOT be re-tightened.

Air filter maintenance

See maintenance after 500 operating hrs.

500 **Maintenance after 500 operating hrs.**

4. 2. 6. **Maintenance of fuel supply system**

Replacing fuel filter cartridges
– Remove cooling air ducting to get access to the fuel filter cartridge.
– Place a suitable rag or waste wool etc. under the fuel filter cartridges to avoid fuel spilling over engine components.
– In case of fuel tank fitted above engine shut off fuel supply (see chapt. 1. 5.).

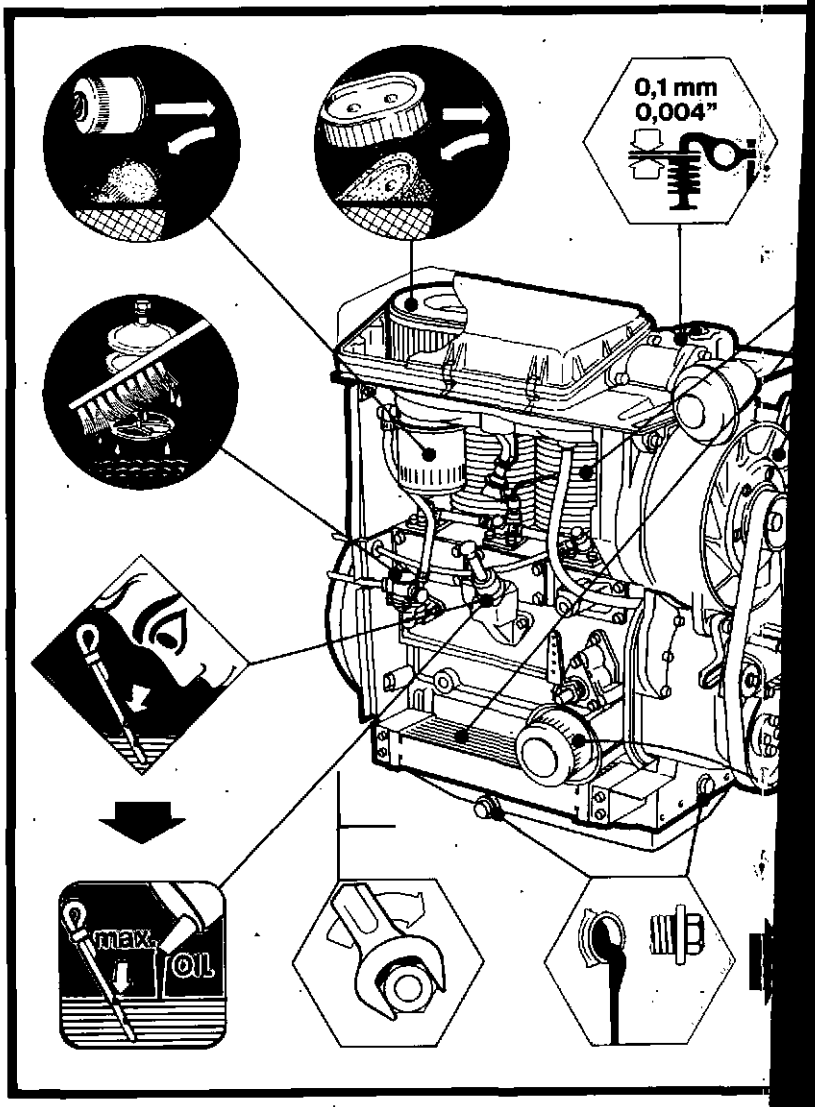
Removable maintenance chart →

MAINTENANCE guide for your H

Change fuel filter

Change air filter element

Adjust tappet clearance



Clean fuel feed pump screen

Check oil level

and...

top up with new oil to max. mark.

Check all nuts, bolts, etc., for tightness.

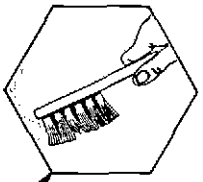
Note:
The cylinder head nuts must NOT be tightened.

Drain oil

an

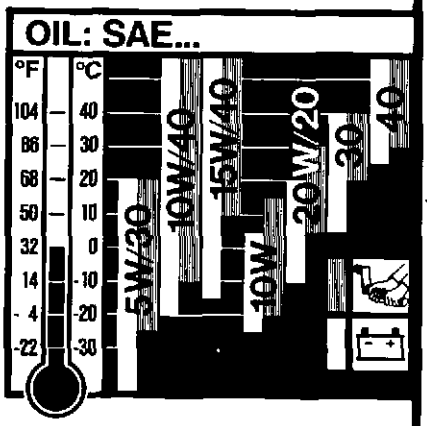
atz-Diesel-engine

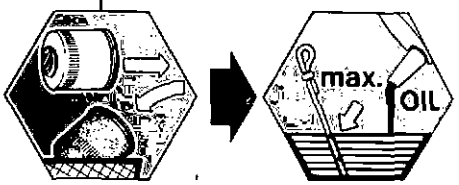
Clean cooling fins,
blower and oil cooler



Typ

.M31 .M40





Maintenance

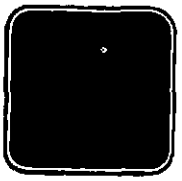
8 - 15 HOURS

250 HOURS

Choose oil viscosity according to temp. when starting

500 HOURS

IF NECESSARY



d... change oil filter

and... re-fill with new oil to max. mark.

Replacing fuel filter cartridges

Prefilter as well as fuel filter have to be replaced together !

– Detach fuel hoses „1" from prefilter „2".

– Fit new prefilter.

Note:

Pay attention to direction of flow (arrow).

The position should be vertical to avoid air locks in the system.

– Remove airducting parts to get access to the fuel filter.

– Place strap-wrench "1" over fuel filter cartridge.

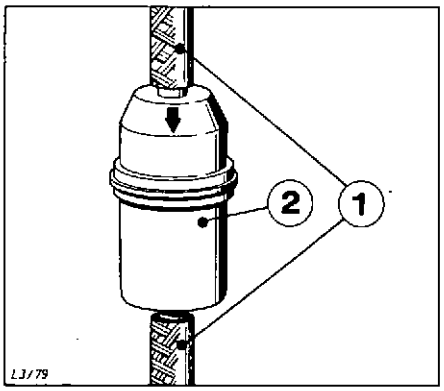
– Wind up wrench (anti-clockwise) to remove filter.

Strap wrench: HATZ-No. 62030701

– Apply some oil to sealing ring of new fuel filter cartridge.

– Replace fuel filter cartridge – **tighten by hand only.**

– Open fuel supply.



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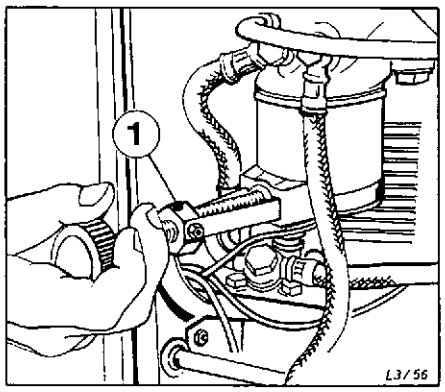

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Note:

To save the battery capacity (especially if drive units are directly flanged to the engine) it is adviseable to prime the fuel system by hand until fuel emerges bubble-free from the fuel return line.

– Re-assemble removed parts in reverse order.

– Check fuel filter cartridges for proper sealing after an initial engine run.

Note: The maintenance intervall concerning fuel filters is dependant on the cleanliness of diesel fuel used. This period can be as low as 250 operating hrs. or even less, or can be extended to more than 1000 hrs.

4. 2. 7. **Air filter maintenance**

– The intervall for the maintenance of the air filtration system is depending on the concentration of dust in the air, and the operating speed of the engine. It is heavily recommended to clean respect. change the airfilter elements only when the indicator for the air filter maintenance is giving the signal (indicator lamp is lighting up resp. the service indicator shows the red signal or the engine is stopped automatically).

The only daily routine maintenance should be to check the function of the maintenance indicator resp. indicator switch and control lamp by setting the engine to maximum speed shortly after start. If at full no load speed the air filter maintenance indicator light is not lighting up resp. no red signal is shown, most propably the engine will stand a full day of operation without the filters becoming totally clocked.

The best way to extend the maintenance interval for the filters is to reduce the dust load by using a cyclon precleaner and placing this where the dust load of the engine is at the lowest grade remote from the engine to a distance up to 4 m by using a flexible hose with same diameter as given on connection of engine.

Replacing of air filter element

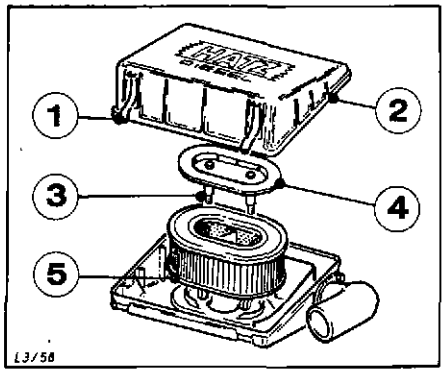
– Open fasteners "1" and remove cover over airfilter(s) "2".

– Clean area around airfilter(s).

– Remove bolts "3" together with cover "4".

– Slowly remove filter element(s) "5".

Put a clean cloth or any other cover *over the remaining opening to avoid* that dust or other foreign matters enter the air intake manifold.
The filter element itself is either replaced by a new one or cleaned in the appropriate way depending on the type of contamination.



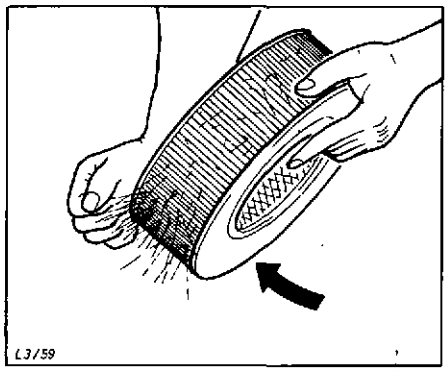
25

Cleaning of dry-dust

Improvised cleaning:

– Tap the side or end of the element carefully against the palm of your hand.

Note:
Do not tap the element against a hard surface.



26

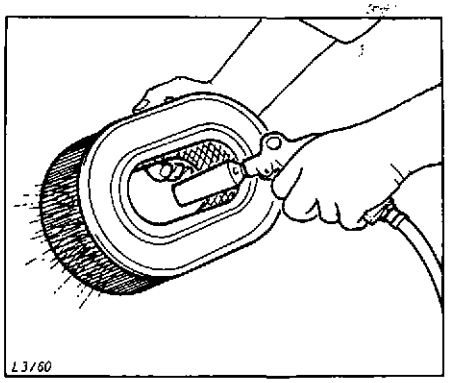
Intensive cleaning:

– Direct compressed air up and down the element (pleats) on the clean air side (inside) of the element.

– Clean suction side (outside) in the same manner.

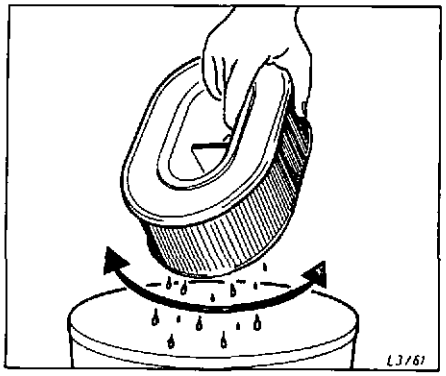
– Repeat several times.

Note:
Air pressure should not exceed 5 bar - 75 lbf/in².
Maintain reasonable distance (approx. 150 mm – 6 in) between nozzle and filter element.



27

Cleaning if contaminated by greasy dust or soot



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– Allow the element to soak in a suitable detergent (approx. 40° C - 105° F) for at least 10 minutes.

Note:
Use washing powder as used for woollens.
Do not use diesel fuel, petrol (gasoline), hot water, solvents or steam cleaners etc.

– Gently agitate element for approx. 5 minutes to remove loosened dirt.

– Rinse filter element thoroughly with clean water from hose until water runs clean.

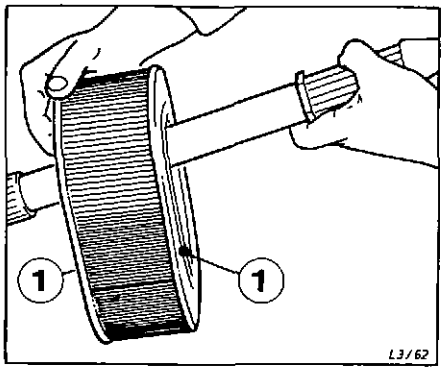
– Shake out excess water from element and allow to dry thoroughly.

Note:
Do not use electric bulb or source of heat over 60° C (140° F).

Never fit a wet element!

– Check for possible reason of oily contamination and repair if necessary.

Checking of air filter elements



29

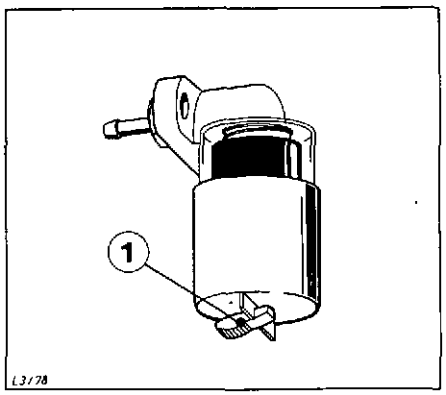
After any cleaning measures of the element it should be checked for its condition, i. e. thin spots, holes or other damage of paper element, and for deformation that could result in improper sealing "1" against the contact surface on bottom or upper side.

Check filter paper by placing a bright light inside the filter and looking through the element.

Never use a filter element that shows even minor damages, otherwise heavy wear of engine will occur within a few operating hours.

When putting back the airfilter(s) place all items separately by taking care that filter element "5" cover "4" and cover "2" are exactly in their seat and sealing properly.
(pict. 25).

After the filter element has been cleaned or replaced, depress the reset button to release the red signal from view.

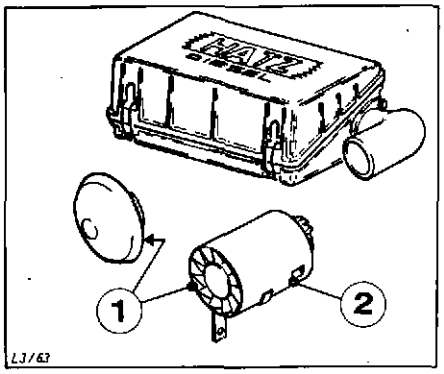


30

Cleaning of rain protection cap resp. cyclon pre-cleaner

Cyclon pre-cleaner can be mounted either directly to engine or remote from engine by means of flexible hose.

Check air inlet "1" for free opening. With precleaner directly fitted to engine check outlet opening "2" for free opening.

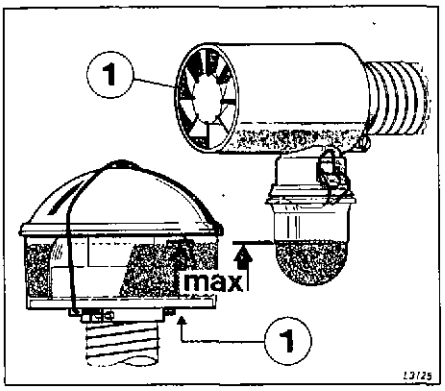


30a

Check air inlet "1" for free opening. The dust container should be emptied and cleaned when dust level has reached the "max."-mark indicated on the container.

Note:
Never fill dust trap with oil.
– Check condition of flexible hose between pre-cleaner and engine.

Note:
Pay special attention to hose clips and their conditions to avoid ingress of dusty air.



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5. Testing and failure-remedy measures

5. 1. Testing of airfilter maintenance-indicator

As already mentioned, the maintenance of the air filter elements should be carried out when the indicator lamp is lighting up or the service indicator *shows the red signal.*

The only regular operation in this respect is to check the function of the maintenance indicator and the indicator lamp whenever a maintenance job (i. e. oil change) is carried out with the engine.

The switching point of the maintenance indicator is not only influenced by the degree of clogging of air filter elements but also from the engine speed.

Therefore set engine to max. possible no-load-speed. If indicator switch does not react try to partically close the air inlet opening to increase the vacuum in combustion air inlet manifold until the switch resp. service indicator reacts.

An other way to check the function of the vacuum indicator and the in-line components i. e. indicator lamp and/or shut-off-relay and-magnet) is to pull off the end of hose connection at air inlet manifold and to suck on this end. It is easily possible to obtain a vacuum which makes the indicator reacting.

As long as a proper function of these control components is guaranteed there is not need to open the filter housing and check the contamination-degree of filters regularily.

5. 2. Replacement of cooling fan belt and performance test of automatic shut-off

Remove belt guard if fitted.

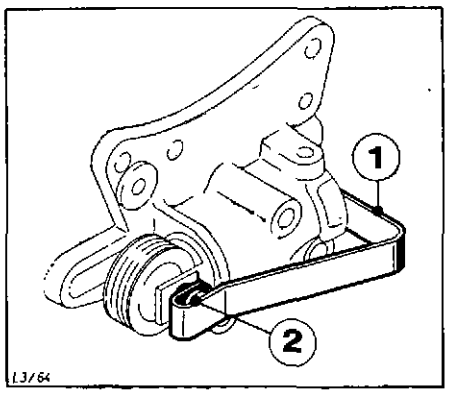
– Place retaining tool 623954 00 "1" onto allen screw "2".

– Press belt tensioner firmly into housing until catch is reached, and hook retaining tool in.

– Remove fan belt and check pulleys for possible damage.

Note:

In the event of broken or damaged grooves replace pulley, otherwise heavy wear of belt is caused.



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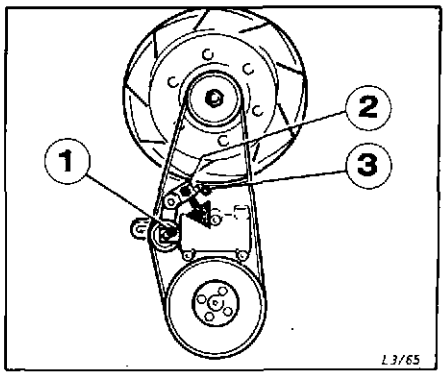
Functional-test of automatic shut-down

In connection with cooling fan belt replacement check automatic shut-down for proper function.

– Remove retaining tool from belt tensioner.

– Spring loaded tensioner piston "1" has to reach outer end-position.

– Same time stop lever "2" is pulled downwards to release spring loaded stop rod "3".



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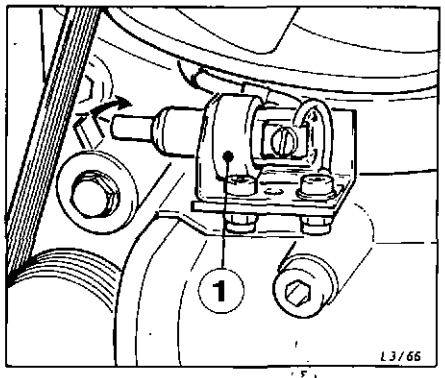
Engines driving vehicles are equipped with an electric switch "1" that actuates a control lamp on the operating panel of the vehicle.

In those cases the function of the electric switch respect. the one of the indicator lamp has to be checked only.



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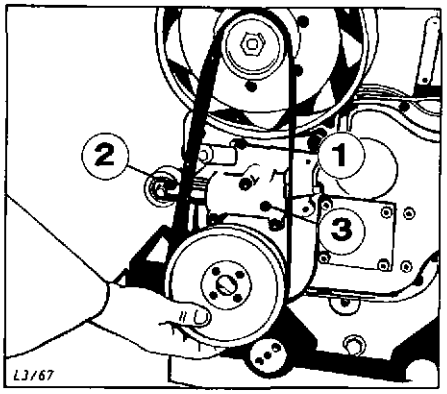
Fitting of cooling fan belt

It is absolutely essential to take off the belt drive pulley to facilitate fitting and proper alignment of belt without danger of damaging both belt and grooves of pulleys.

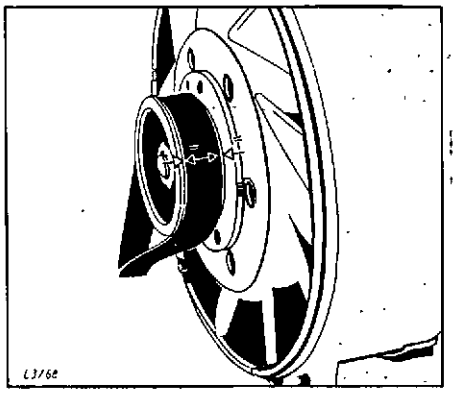
Sequence

Push stop rod "1" into housing to allow tension piston "2" to be pressed into inner end-position and locked with retainer clamp "1" (pict. 32).



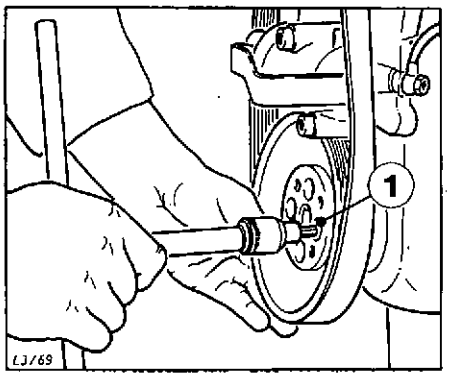
35

Hook drive pulley into bottom sloop of belt, and put belt over tensioner pulley by taking utmost care for proper alignment with all pulleys.



36

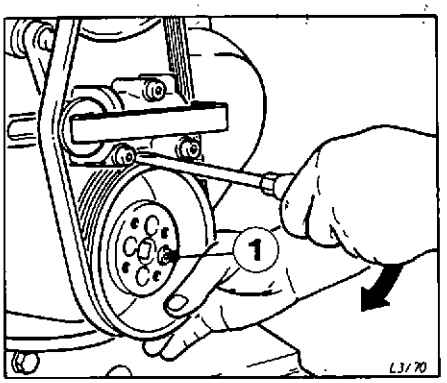
Fit one fixing bolt "1" to one of the horizontally-positioned bores and pre-tighten without having the pulley already centered on shaft.



37

Use heavy screw driver, hook under housing of belt tensioner and press pulley downwards until it „jumps" into its centering. Fix by tightening the bolts "1" step by step.

Do not forget to take off retaining clamp from belt-tensioner.



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Selecting of correct belt

Poly-v-belts are used according to the following table:

Belt specification		
Type and engine version	Ident-Nr.	Length mm
2...4 M 31 H 2...4 M 31 L 2...4 M 40 H 2...4 M 40 L	501 415 00	910

5. 3. Function, and functional test of the oil-pressure operated HATZ auto-protection device.

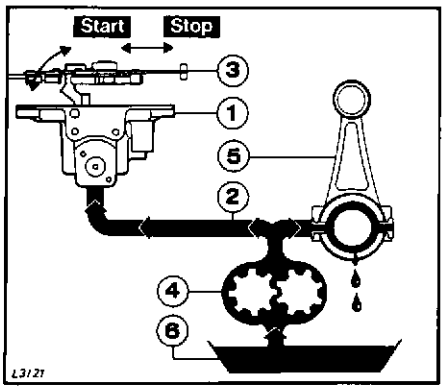
General function:

With no oil pressure the governor rod "3" is held in stop-position by means of a spring loaded lever inside of the control block "1". As soon as an oil pressure of approx. 0.3 . . . 0.5 bar is built during cranking of engine this lever is moved backwards hence releasing the injection pump control rod "3" into "start"-position.

If an additional stop magnet ("7" — pict. 40, "181" chapt. 8) is installed, this magnet needs to be powered.

The function of this control block can be controlled at the end of shaft "1" on the upper side of the block pict. 41.

This shaft turns approx. 60° (1/6 turn) in anti-clockwise direction for opening the control rod, and backwards when oil pressure is reduced to stop the engine.



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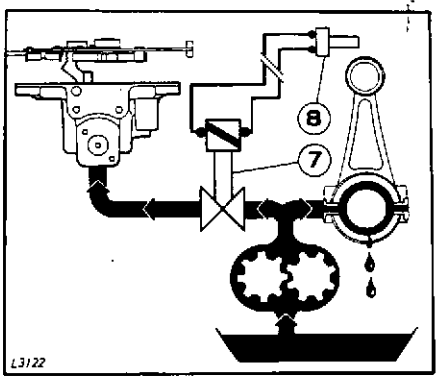
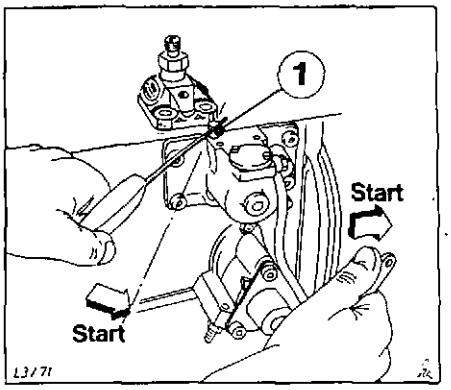


40

If this shaft does not turn (which means that the engine will not start), it can be manually operated by means of a suitable tool.

Hold shaft in start-position for approx. 5 sec.

Do not lock it in this position otherwise the engine cannot react on any failure signals (i. e. low oil pressure, etc.).



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Possible reasons for no turning of the shaft during cranking

– No, or too low oil pressure (lack of lub.-oil in sump, wrong viscosity of oil, cranking speed too low for building up sufficient oil pressure).

– Valve magnet (if installed) does not open, see chapt. 5. 5.

– Improper function of the **engine control block**; contact a service-dealer in *such cases because* ***with this block*** *also the* ***power adjustment*** *of the engine* **is controlled** and fixed.

Uncontrolled dismantling and assembling of this block can result in insufficient operation of engine and even in engine failures.

5. 4. Functional test of the electric engine shut-off-system as described in chapt. 1.4.2.

Whenever a maintenance job is carried out with the engine the function of this electric shut-off system should be checked.

For this purpose just connect the cable connection on failure sensors (oil pressure switch, cylinder head temperature switch, maintenance indicator of air filter and terminal D + of alternator) to ground.

After the failure signal has lasted at least 3 sec. the control relay "177" reacts and cuts off power from the valve magnet "181" (chapter 8) which makes the **engine stopping** immediately.

Restart of engine is possible only after turning the switch key back to O-position before turning on into position I - II - III.

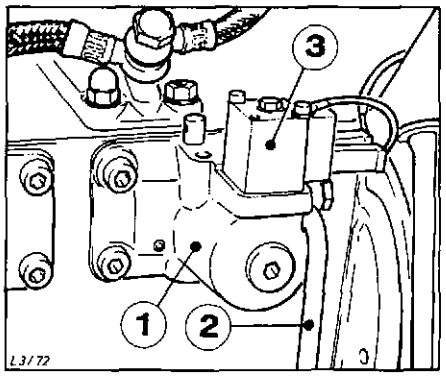
5. 5. Functional test of valve magnet on engine control block

The function of this valve magnet can primarily be checked acoustically with the engine not running. If switch key is turned into pos. "I" the magnet "3" has *to open which is indicated by an internal "klick". This indicates that the valve* solenoid has opened and allows the oil which is supplied from the crankcase via the pipe "2" to get into the block "1" and to open the injection pump control rod into "start" position, chapt. 5. 3.

If the magnet valve does not open, the reason can be either no power supply to the + − terminal or no internal function.

To sort this detail out connect the positive terminal of magnet valve "3" directly to B+ of battery and check again for function.

If the test is positive now, the reason of improper function is caused by the complete electrical system of the engine, probably the control relay "177".



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Functional test with the engine running:

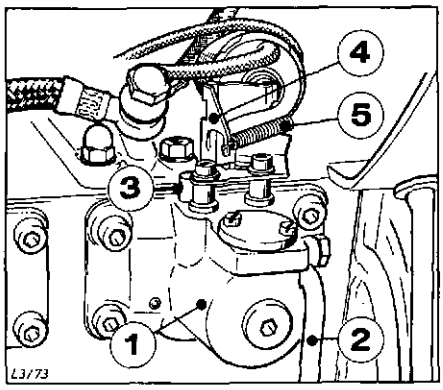
Turn switch key back to "0" (stop) or simulate a stop-signal (chapt. 5.4.). The valve magnet has to close the oil supply to the inner side of the control block and to stop the engine immediately.

5. 6. Function and functional test of the hydraulically operated start-release-device

This device is additionally fitted and used in cases where due to several reasons (i. e. extremely high oil temperature or very low cranking speed during starting) the minimum oil pressure of approx. 0.3 bar is not obtained during cranking of engine to open the governor rod (39/3) into start position. This device is operated from the pressure of the fuel feed pump.

Function:

With the engine stopped the spring "5" via the lever "4" turns the shaft "3" into start-position. As soon as the fuel supply system has been built up, the lever "4" from the force of the cylinder and against the force of the spring "5" is turned into stop-position of shaft "3". Due to the fact that immediately after starting of the engine oil pressure is built up the shaft "3" is held in start-position by the oil pressure inside of housing "1".



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If due to several reasons the oil pressure inside of housing "1" decreases below a minimum figure of about 0.5 bar, the engine can be stopped from the engine control block as described under 5. 3.

After the engine has stopped, the pressure inside of the fuel supply system decreases too, which allows the spring "5" to again turning the lever "4" into start-position.

Important note:

If the engine stops immediately after the start, insufficient oil pressure inside of control block "1" is indicated. Before it is tried again and again to start the engine, the reason for the lack of oil pressure should be checked for and cured. Otherwise the engine can get damaged !

5. 7. Functional test, and replacing of injector nozzle.

An improper function of injector can cause:

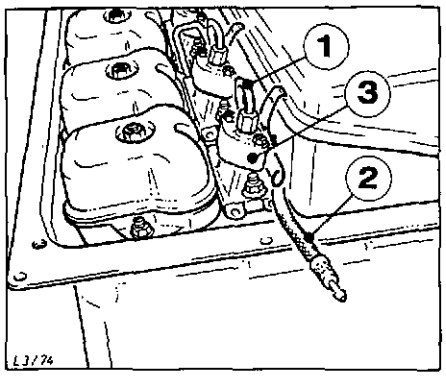
– reduced power output

– black smoke from exhaust, and generally high exhaustgas pollution figures

– overheating of cylinder head

– starting problems at low temperature

– Remove fuel pressure and return pipe "1" + "2".



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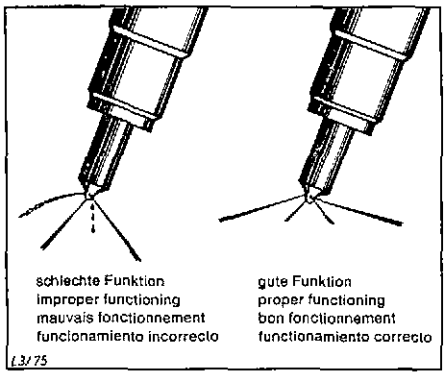
Injector can be tested only after removing from engine. Injectors are *held down and radially positioned* by clamp "3".

To pull out injectors from their seat, refit fuel pressure pipe and pull upwards, together with turning the injector with open-end spanner.

– Check for correct spray pattern and -pressure either by re-connecting injector to injection pump of *engine together with* HATZ-equipment 604 628 00 or by means of a special injector tester (HATZ-No. 625 010 00) on work bench.



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If spray pattern is unsatisfying

– different spray-jets and -angles from each of the four holes

– dropping of fuel

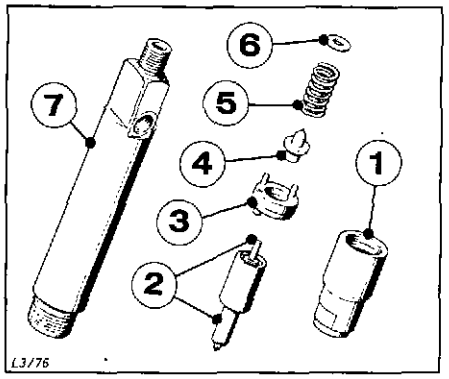
The nozzle "2" itself has to be checked for its condition, and properly cleaned or replaced by a new one.

If injection pressure is not matching the nominal value it can be corrected by using shims "6" with different thickness.

Note:
Any testing and repair job with injectors should be left with an authorized HATZ-Dealer or other specialized workshops, if the required knowledge and equipment is not given.

When re-assembling the injector take care for utmost cleanliness and correct positioning of parts.

Use new sealing shim "1" between injector and its seat in cylinder head, the **non-metallic** (asbestos-) **-side** contacting the injector body to isolate it from excessive heat transfer from cylinder head.



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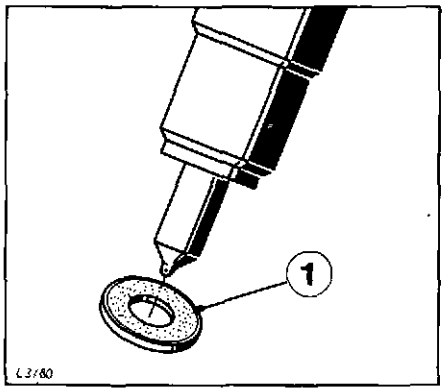

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6. Trouble shooting chart

Kind of trouble	Possibly caused by	Recommended remedy measure	chapt.
6.1. Engine doesn't start, although it is cranked correctly by the starter motor resp.crank handle.	No fuel supply to injection pumps	Check fuel supply by disconnecting fuel return hose and actuating fuel feed pump until fuel emerges free of bubbles at end of return hose.	3.1.
		If no success: check ...	
		– Fuel supply to engine	
		– Fuel prefilter	4.2.6.
		– Fuel filter	4.2.6.
		– General function of fuel feed pump	
	If fuel tank is below level off fuel feed pump: Check the whole fuel system for proper execution.		chapt.1.5.
	No injection, although fuel supply to injection pumps is given		
	a) Speed control lever not in start-position	Move lever into start-position and check whether it halts. If engine is equipped with electrical (solenoid-or motor-) adjustment; check function of electr. components	
	b) Insufficient lub.-oil-*pressure* at *engine* control block due to:		
	– improper oil level in crankcase	Fill up lub.-oil to top mark on dipstick	3.1.
	– too low viscosity of lub.-oil to obtain proper oil pressure during cranking of engine	Check function of control block	5.3.
	c) Magnet valve at control block doesn't open	Check function of valve magnet	5.5.
	Drive belt for blower fan broken	Replace	5.2.
	Insufficient compression due to		
	Incorrect tappet clearance	check resp. adjust tappet clearance	4.2.4.
	Automatic decompressor defective.	Contact HATZ-SERVICE	

Kind of trouble	Possibly caused by	Recommended remedy measure	chapt.
At extremely low temperatures additionally possible	Too low cranking speed due to		
	– too high viscosity of oil	change lub.-oil to correct viscosity class	2.2.
	– too low battery capacity	have battery checked and recharged	3.1.
	Fuel waxed up due to insufficient low temperature resistance	to be checked by disconnecting fuel return hose and manually actuating of feed pump	3.1.
		Warm up engine carefully or drain the complete fuel system and use fuel with sufficient resistance to low temperatures	2.1.
	Pre-glow-equipment defective (counts only at temperatures below –10 to –15° C as at higher temp. no pre-glowing-necessary for start	Check electrical system	7/8
	improper function of nozzle	check injector nozzle	5.7.
6.2.			
Engine fires a few times, but suddenly stops	Fuel filter or filter sieve of feed pump clogged	Replace filter resp. clean the sieve insert	4.2.6.
	No oil pressure	Check and correct oil level in crankcase.	4.2.1.
		In case of correct oil level check function of all components involved	5.3./4/5/6
	Stop-signal from other failure sensor (if engine is equipped with electric shut-off-system)	Sort out the refered sensor and the reason for the signal	5.4./5
6.3.			
Engine stops by itself during operation	Insufficient fuel supply due to	Check systematically the whole fuel supply system.	1.5. 4.2.6.
	– empty tank – Fuel prefilter and fuel filter glogged	As a result fuel has to emerge from the disconnected return hose free of bubbles when fuel feed pump is actuated by hand or by cranking of engine (approx. 5 cm^3 per lift)	3.1.

Kind of trouble	Possibly caused by	Recommended remedy measure	chapt.
	Blower fan belt broken	Replace, thereby carefully checking the belt-pulleys for good condition	5.2.
	Drop of oil pressure due to – improper oil level in crankcase – mechanical defects – too high oil temperature level	Check and correct oil level to upper mark on dipstick. Have oil pressure checked. Check cooling system, spec. with regard to sufficient supply of fresh air and unrestricted exhaust of cooling air. Eventually contact HATZ-SERVICE.	4.2.1.
Other possible reasons with engines equipped with electr. shut-off-system	Irregularities in the electr. system, such as – improper contacts with cable connectors – defective alternator	Check electr. system and all components systematically. Eventually contact HATZ-SERVICE.	7/8
	– defective control relay		5.4.
	– defective valve magnet		5.5.
	Failure sensor for excessive cylinder head temperature, or air filter maintenance switch reacts	Check engine for all possible reasons for insufficient cooling (cooling air flow, contamination of cylinder fins and oil cooler).	1.5. 4.2.5.
		Clean respect. replace air filter elements	4.2.7.
6.4. Engine lacks power, but **no black smoke from exhaust**	Insufficient fuel supply due to		
	– empty tank	– Refill tank	4.2.6.
	– clogged fuel prefilter and fuel filter	– change fuel filters	4.2.6.
	– insufficient venting of fuel tank	– check venting of tank	1.5.
	– hose connections leaking (air is sucked into fuel system)	– check hose connections for good sealing	1.5.

Kind of trouble	Possibly caused by	Recommended remedy measure	chapt.
6. 5.			
Engine lacks power **with black smoke from exhaust**	– Air filters clogged, and maintenance indicator switch and the electr. components have improper function	Clean respect. replace air filters; check maintenance indicator switch and the electr. system for proper function	4. 2. 7. 5. 1.
	poor function of nozzles	Check injector nozzle for function	5. 7.
6. 6.			
Engine overheats (indicator lamp for excessive cyl.-head temp. lights up), and is difficult to start immediately after being stopped	Too high oil level in crankcase	Reduce oil level to top-mark of dipstick.	3. 1.
	Restricted cooling due to	– Cooling air inlet to engine	1. 5.
	– contamination in the whole area of cooling air flow	– Blower fan, cylinder and heads	4. 2. 5.
		– Lub.-oil cooler	
		– Space between crankcase bottom and -part of capsule	
	– incompletely closed air ducting parts.	Check all air ducting parts for correct seat.	

7. Special notes for the electrical equipment

In order to avoid damage to the electrical system, especially alternator, regulator, and other electronic components pay attention to the following points:

– Never reverse polarity of battery connections.

– Never disconnect battery whilst engine is running.

– Never allow live cables to ground.

– In case of arc welding on engine or driven unit attach earth terminal of welding set as near as possible to the area of welding and disconnect alternator from circuit at terminals "B+" and "D–".

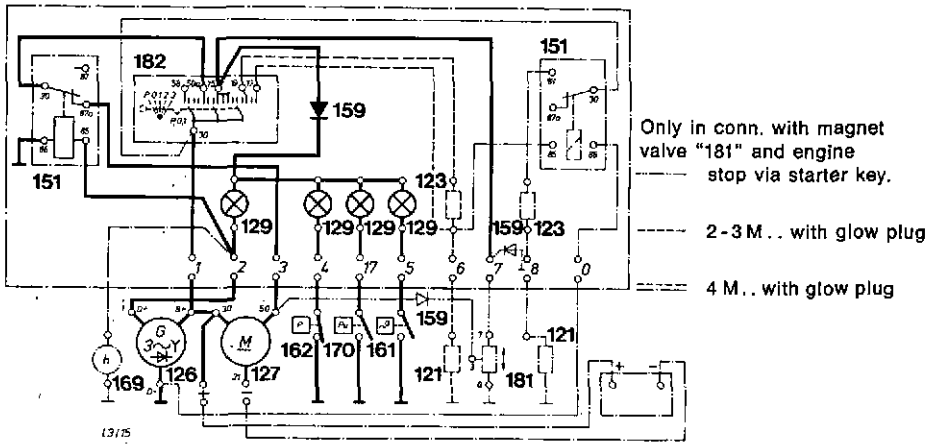
– When cleaning the engine do not directly spray onto alternator or electrical equipment with water or unsuitable cleaners.

If unavoidable disconnect battery and protect the alternator and electrical components from ingress of water. Dry off carefully (with compressed air) before connecting the battery terminals, etc.

– In case of irregularities (i. e. insufficient battery charging, lighting up of charging indicator lamp, etc.) before closer checks look for proper contacts on all cable connecting points within the electrical system first.

8. Wiring diagram

8. 1. Wiring diagram for 12 V electrical system with visual fault indication and glow plug(s).



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121	Glow plug	159	Diode
123	Glow plug indicator	161	Temperature switch
126	Alternator	162	Oil pressure switch
127	Starter	169	Hourmeter
129	Indicator lights	170	Maintenance switch for air filter
151	Control relais	181	Magnet valve
		182	Glow-start-switch

The magnet valve "181" with this type of electrical system is installed only if starting and stopping of engine is done with key-switch on operating panel of engine.

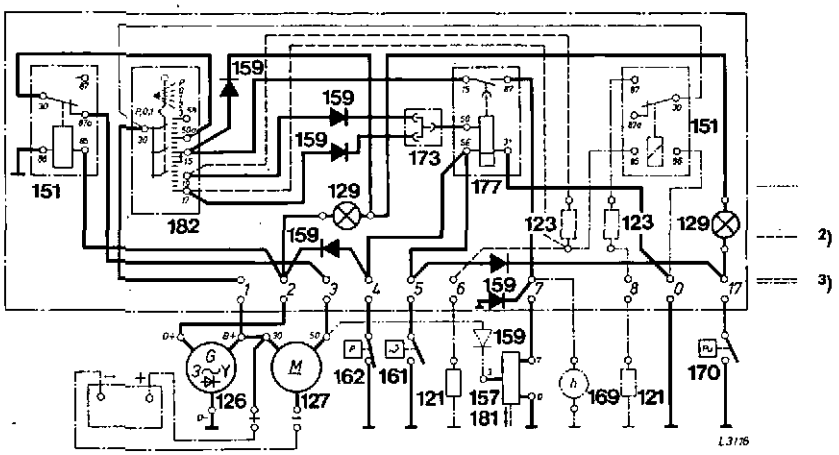
Note: concerning 24 V-System:

The corresponding 24 V-System in the following details is different from the one shown above:

a) with 2- and 3-cylinder engines:
between "123" and "121" an additional resistor is installed

b) with 4-cylinder engines:
one relais "151" only
one glow indicator "123" only;
two glow plugs connected in line instead of in parallel.

8. 2. Wiring diagram for 12 V with electric shut-off and glow plugs.



2) 2-3 M.. with glow plug

3) 4 M.. with glow plug

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121	Glow plug	161	Temperature switch
123	Glow plug indicator	162	Oil pressure switch
126	Alternator	169	Hourmeter
127	Starter	170	Maintenance switch for air filter
129	Indicator lights	173	Multi-connector
151	Control relais	177	Engine protection relay
159	Diode	181	Magnet valve
		182	Glow-start-switch

Note: concerning 24 V-System:
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b) with 4-cylinder engines:
one relais "151" only
one glow indicator "123" only;
two glow plugs connected in line instead of in parallel.

9. Preservation of engine

In case that engines are withdrawn from service for more than 6 months, the following preservation measures are recommended that keep the engine protected for the duration of at least 2 years.

– Drain lub.-oil, change lub.-oil filter and fill up with special anti-corrosion lubricating oil.

– Mix oil into the fuel in a ratio of approx. 1 : 4

– Operate engine for approx. 10 - 15 minutes (if any possible under load) to obtain a total circulation of preservation oil and of preservation oil-added fuel.

– After engine has cooled down to normal ambient temperature close openings on the combustion air inlet and exhaust side.

– Partially open cooling air ducting.

– Do not enclose engine in plastic film or similar materials to allow steady exchange of air around engine.
Otherwise corrosion due to moisture will occur.

Note:
We do not recommend to run the engine during storage from time to time. The operating temperature might not be obtained and thereby harm the original preservation.

Returning the engine to service

The engine can be operated with the preservation oil in the sump and with a certain percentage of preservation oil in the fuel, provided that long periodes of full load are avoided.

All engine control devices (i. e. mechanical shut-off-system in case of belt failure, indicator switches for lub.-oil pressure and air filter maintenance should be checked for proper function before engine is started.

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