



Operating Instructions for MAN Industrial Gas Engines

E 2842 E

Dear Customer,

these Operating Instructions are intended to familiarize you with your new MAN Otto-Cycle-Gas engine and how it operates.

The Publication "Fuels, Lubricants and Coolants for industrial and marine Diesel engines" supplements these Operating Instructions.

Note:

Both publications apply to the engine and must always be kept to hand in its vicinity in the engine room.

Comply in full with instructions relating to operation, prevention of accidents and environmental protection.

MAN Otto-Cycle-Gas engines are developed and manufactured in line with the latest state of the art. However, trouble-free operation and high performance can only be achieved if the specified maintenance intervals are observed and only approved fuels, lubricants and coolants are used.

It is imperative and in your own interest to entrust your MAN Local Service Centre with the removal of any disturbances and with the performance of checking, setting, and repair work.

Yours faithfully,
MAN Nutzfahrzeuge Aktiengesellschaft
Werk Nürnberg

Subject to change to keep abreast with technological progress.

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	Page
Declaration	3
Nameplates	4
Safety regulations	5
Technical information	
Engine views E 2842 E	10
Engine	12
Engine lubrication	14
Cooling	16
Air cleaner	16
Electrical equipment	17
Ignition system	18
Gas supply system	22
Commissioning and operation	28
Preparations	28
During operation	28
Starting	29
Shutting down	29
Temporary decommissioning of engines	30
Maintenance and care	31
Engine lubrication	31
Cooling	33
Air cleaner	36
Checking and setting	39
Ignition system	39
Spark plugs	42
To check and adjust valve clearance	42
Cylinder head bolts	42
V-belts	45
Technical data	48
Maintenance chart	50
Index	52

Declaration

In accordance with Article 4, paragraph 2, in conjunction with Appendix II, section B, of Directive 89/392/EEC, version 93/44/EEC

MAN Nutzfahrzeuge Aktiengesellschaft,

hereby declares that the engine described below is destined for installation in a machine as defined in the EC directive on machines.

Engine model:

Design:

For data see original declaration

Engine number:

If required this declaration is enclosed with the delivery note.

Rating / speed:

Note:

The manufacturer of the complete ready-to-use machine in which this engine is to be installed must take the further action necessary in the context of indirect safety-related engineering and provision of instructions to ensure that the ready-to-use machine complies with the requirements of the EC directive on machines.

The engine must not be put into operation until the complete machine satisfies the conditions laid down in the EC directive on machines 89/392/EEC, most recently amended by 93/44/EEC, or the latest amendment of said directive.

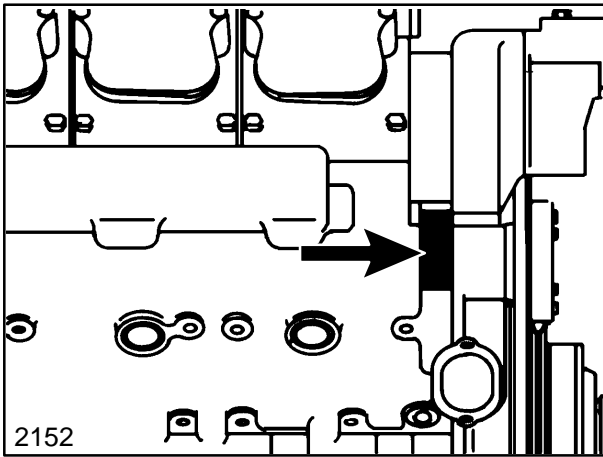
MAN Nutzfahrzeuge Aktiengesellschaft

Vogelweiherstraße 33

D-90441 Nürnberg



Nameplates



Model

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delivered on

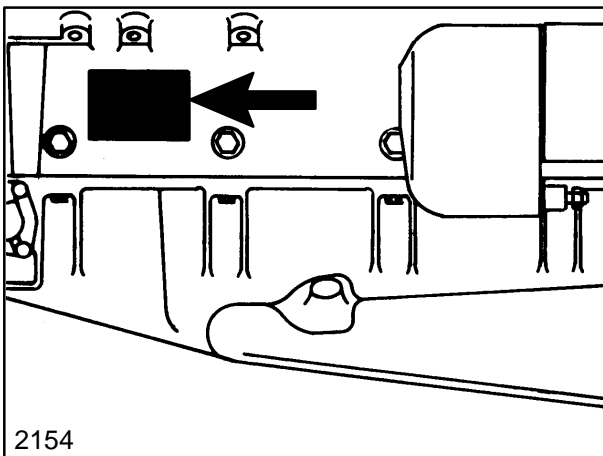
.....

installed on

.....

MAN Nutzfahrzeuge Aktiengesellschaft
 Typ
 Motor-Nr. / Engine No. NI/II
 E1 49 R-

Enter 14-digit serial number (is used in the spare parts catalog to distinguish between spare parts).



In all your correspondence please always quote engine model, serial number and job number (Order number).

MAN
 Nutzfahrzeuge Aktiengesellschaft
 Werk Nürnberg West Germany
GAS ENGINE

Bauj.	Year	Typ	Model	Motor-Nr.	Serial No
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Werk-Nr.	Job-No	Leistg. kW	Rating kW	Drehz. 1/min	Speed rpm
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Temp. °C	Leistg. PS	Rating BHP	Aufstellhöhe m ü.N.N	Altitude m	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	

Enter 14-digit engine serial number.

Enter 6-digit job number (Order number).

General notes

Day-to-day use of power engines and the service products necessary for running them presents no problems if the persons occupied with their operation, maintenance and care are given suitable training and think as they work.

This summary is a compilation of the most important regulations. These are broken down into main sections which contain the information necessary for preventing injury to persons, damage to property and pollution. In addition to these regulations those dictated by the type of engine and its site are to be observed also.

Important:

If, despite all precautions, an accident occurs, in particular through contact with caustic acids, scalding from hot oil, anti-freeze being splashed in the eyes etc., ***consult a doctor immediately.***

1. Regulations designed to prevent accidents with injury to persons

During commissioning, starting and operation

- Before putting the engine into operation for the first time, read the operating instructions carefully and familiarize yourself with the "critical" points. If you are unsure, ask your MAN representative.
- For reasons of safety we recommend you attach a notice to the door of the engine room prohibiting the access of unauthorized persons and that you draw the attention of the operating personal to the fact that they are responsible for the safety of persons who enter the engine room.
- The engine must be started and operated only by authorized personnel. Ensure that the engine cannot be started by unauthorized persons.
- When the engine is running, do not get too close to the rotating parts. Wear close-fitting clothing.
- Do not touch the engine with bare hands when it is warm from operation – risk of burns.
- Exhaust gases are toxic. Ensure that there is adequate ventilation and air extraction.
- Keep vicinity of engine, ladders and stairways free of oil and grease. Accidents caused by slipping can have serious consequences.

During maintenance and care

- Always carry out maintenance work when the engine is switched off.
- Change the oil when the engines is warm from operation.
Caution:
There is a risk of burns and scalding. Do not touch oil drain plugs or oil filters with bare hands.
- Take into account the amount of oil in the sump. Use a vessel of sufficient size to ensure that the oil will not overflow.
- Open the coolant circuit only when the engine has cooled down. If opening while the engine is still warm is unavoidable, comply with the instructions in the chapter entitled "Maintenance and Care".
- Neither tighten up nor open pipes and hoses (lube oil circuit, coolant circuit and any additional hydraulic oil circuit) during the operation. The fluids which flow out can cause injury.
- When using compressed air, e.g. for cleaning the radiator, wear goggles.
- Keep service products (anti-freeze) only in containers which can not be confused with drinks containers.
- Comply with the manufacturer's instructions when handling batteries.
Caution:
Accumulator acid is toxic and caustic. Battery gases are explosive.

When carrying out checking, setting and repair work

- Checking, setting and repair work must be carried out by authorized personnel only.
- Use only tools which are in satisfactory condition. Worn open-end wrench slip, which could lead to injury.
- When the engine is hanging on a crane, no-one must be allowed to stand or pass under it. Keep lifting gear in good condition.
- When working on parts which contain asbestos, comply with the notes at the end of this chapter.
- When working on the electrical system disconnect the battery earth cable first. Connect it up again last in order to prevent short circuits.

Comply with the safety rules for electronic ignition systems, see chapter "Checking and setting"

- When welding comply with the "Instructions for welders".

2. Regulations designed to prevent damage to engine and premature wear

Never demand more of the engine than it was designed to yield for its intended purpose. Detailed information on this can be found in the sales literature.

If faults occur, find the cause immediately and have it eliminated in order to prevent more serious damage.

Use only genuine MAN spare parts. MAN will accept no responsibility for damage resulting from the installation of other parts which are supposedly "just as good".

In addition to the above, note the following points:

- Never let the engine run when dry, i.e. without lube oil or coolant.
- Use only MAN-approved service products (engine oil, anti-freeze and anti-corrosion agent). Pay attention to cleanliness.
- Have the engine maintained at the specified intervals.
- Do not switch off the engine immediately when it is warm, but let it run without load for about 5 minutes so that temperature equalization can take place.
- Never put cold coolant into an overheated engine. See "Maintenance and care".
- ***Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Do not exceed the maximum permissible tilt of the engine.*** Serious damage to the engine may result if these instructions are not adhered to.
- Always ensure that the testing and monitoring equipment (for battery charge, oil pressure, coolant temperature) function satisfactorily.
- Comply with instructions for operation of the alternator. See "Commissioning and operation".

3. Regulations designed to prevent pollution

Engine oil, filter elements

- Take old oil only to an old oil collection point.
- Take strict precautions to ensure that oil does not get into the drains or into the ground. The drinking water supply could be contaminated.
- Filter elements are classed as dangerous waste and must be treated as such.

Coolant

- Treat undiluted anti-corrosion agent and / or antifreeze as dangerous waste.
- When disposing of spent coolant comply with the regulations of the relevant local authorities.

4. Notes on safety in handling used engine oil *

Prolonged or repeated contact between the skin and any kind of engine oil decreases the skin. Drying, irritation or inflammation of the skin may therefore occur. Used engine oil also contains dangerous substances which have caused skin cancer in animal experiments. If the basic rules of hygiene and health and safety at work are observed, health risks are not to the expected as a result of handling used engine oil.

Health precautions:

- Avoid prolonged or repeated skin contact with used engine oil.
- Protect your skin by means of suitable agents (creams etc.) or wear protective gloves.
- Clean skin which has been in contact with engine oil.
 - Wash thoroughly with soap and water. A nailbrush is an effective aid.
 - Certain products make it easier to clean your hands.
 - Do not use petrol, Diesel fuel, gas oil, thinners or solvents as washing agents.

- After washing apply a fatty skin cream to the skin.
- Change oil-soaked clothing and shoes.
- Do not put oily rags into your pockets.

**Ensure that used engine oil is disposed of properly
– Engine oil can endanger the water supply –**

For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations are punishable.

Collect and dispose of used engine oil carefully. For information on collection points please contact the seller, the supplier or the local authorities.

* Adapted from "Notes on handling used engine oil".

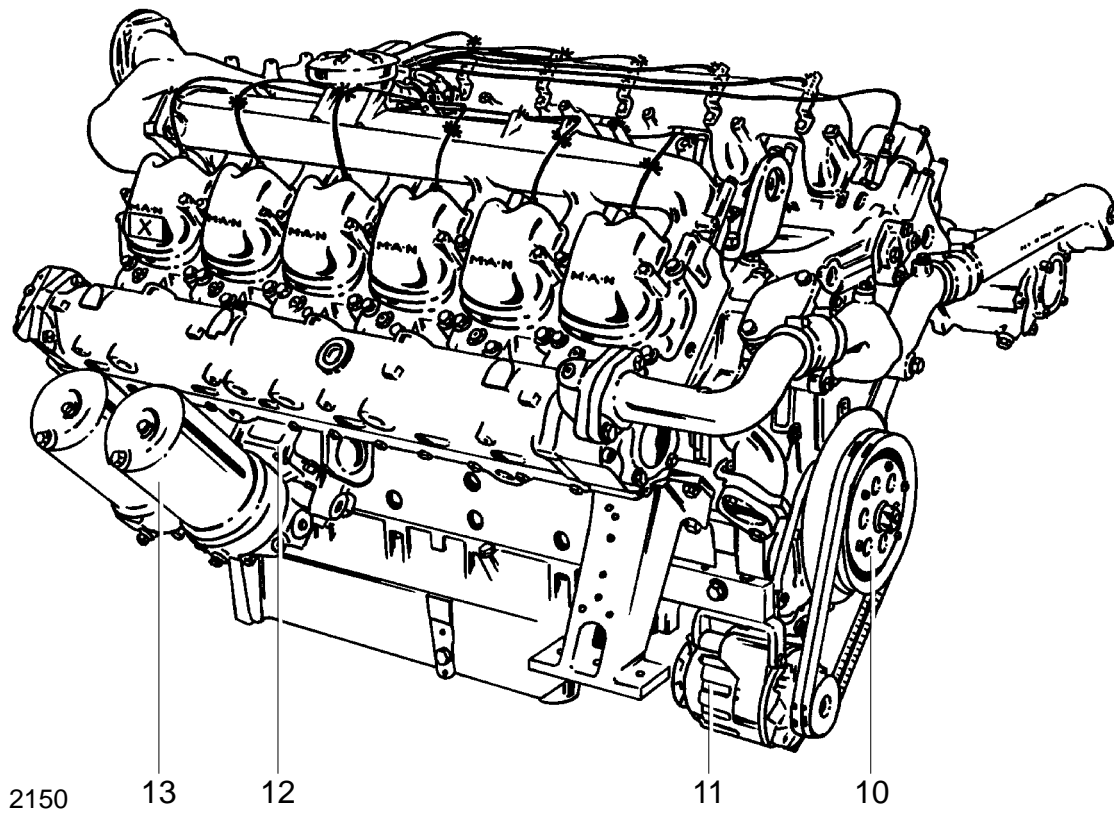
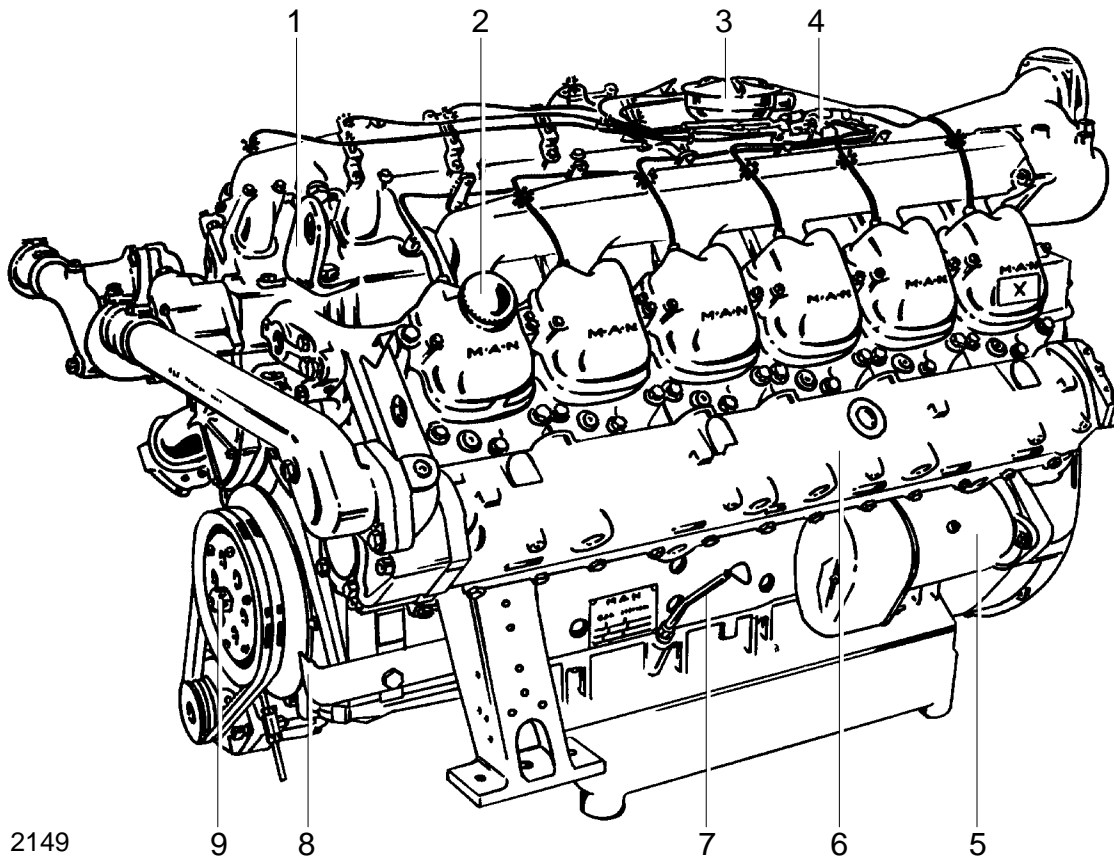
5. Note on parts containing asbestos

- Certain parts of the engine (gaskets) may contain asbestos. Spare parts and, where necessary, their packaging is marked accordingly, see illustration below.
- When parts that contain asbestos are machined fine asbestos dust may be released. To prevent possible damage to health please take appropriate safety precautions and follow the advice given below:
- Wherever possible work in the open air or in well ventilated rooms.
- If possible use hand-operated or slow-running machines, if necessary with a dust trap. If fast-running machines are used they ought always to have such a device.
- Wet the material before cutting or drilling it.
- Wet the dust, put it into a tightly closing container and have it disposed of as dangerous waste.



ACHTUNG ENTHÄLT ASBEST Gesundheits- gefährdung bei Einatmen von Asbeststaub Sicherheits- vorschriften beachten	ATENÇÃO CONTÉM AMIANTO Respirar po de amianto é perigoso para a saúde Consulte as normas de segurança	VAROITUS SISÄLTÄÄ ASBESTIA Asbestipölyn hengittäminen on terveydelle vaarallista Noudatettava turvaohjeita	VOORZICHTIG BEVAT ASBEST Het inademen van asbeststof is schadelijk voor de gezondheid Houd u aan de veiligheids- voorschriften
ATTENTION CONTIENT DE L'AMIANTE Respirer la poussière d'amiante est dangereux pour la santé Suivez les consignes de sécurité	ARTIKELN INNEHÄLLER ASBEST Dammet är farligt vid maskning Innehåller Asbest	ATTENZIONE CONTIENE AMIANTO Resirare polvere di amianto è pericoloso per la salute Seguire le norme di sicurezza	
INNEHOLDER ASBEST Inånding av støv fra dette materialet kan forårsake kreft Langvarig eller gjentatt påvirkning øker risikoen Bruk egnet verneutstyr	WARNING CONTAINS ASBESTOS Breathing asbestos dust is dangerous to health Follow safety instructions	PRECAUCIÓN :CONTIENE AMIANTO Evite la generación de polvo	

Engine views E 2842 E



-
- 1 Lifting eye, front
 - 2 Oil filler neck
 - 3 Oil separator for crankcase breather
 - 4 Distributor
 - 5 Starter motor
 - 6 Exhaust manifold, liquid cooled
 - 7 Oil dipstick
 - 8 Pointer, TDC mark
 - 9 Cranking device
 - 10 Torsional vibration damper
 - 11 Generator
 - 12 Oil cooler
 - 13 Oil filter

Engine

The E 2842 E is a liquid-cooled 12-cylinder Otto-Cycle-Gas engine. The cylinders are on a 90° V pattern.

Combustion system

The engine uses the Otto-Cycle-gas combustion system developed by MAN.

The outstanding design features of this system are a truncated combustion chamber located at the centre of the piston crown and the special shape of the intake port in the cylinder head (swirl). This port is formed to impart to the air/gas mixture entering the cylinder during the induction stroke a vigorous rotary movement about the axis of the cylinder. This swirling motion ensures intimate mixing of gas and air for well timed complete combustion.

Engine block

The cylinder block is a single piece of alloy cast iron. To increase its stiffness, it is designed with skirts extending to a level below the crankshaft centerline. The engine has replaceable wet cylinder liners and individual cylinder heads.

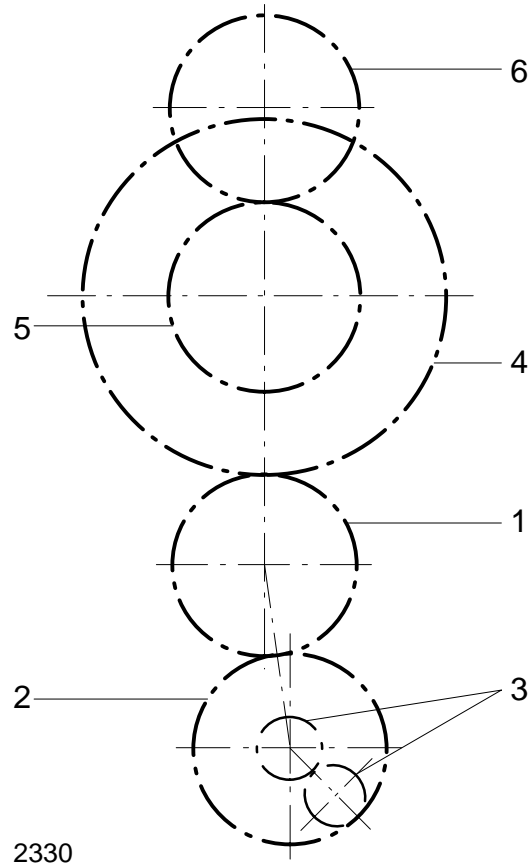
Piston / Conrod / Crank assembly

The forged crankshaft has screwed-on counterweights. Radial seals with replaceable wearing rings are provided to seal the crankcase penetrations.

The connecting rods are diagonally split and can be removed through the top of the cylinders together with the pistons. Big-end bearings and main bearings are of the steel-backed lead bronze ready-to-fit type.

Engine timing

Camshaft, oil pump and distributor are driven by a gear train arranged at the flywheel end.



- | | |
|---------------------------|-----------------------------|
| 1 Crankshaft gear | 4 Camshaft drive gear |
| 2 Oil pump drive gear | 5 Idler gear |
| 3 Oil pump impeller gears | 6 Injection pump drive gear |

The crankshaft gear and camshaft gear are match-marked by the digit "1" or "●".

Valves

The overhead valves are actuated via chilled cast-iron mushroom tappets, push and rocker arms from the camshaft.

Engine lubrication

The engine is equipped with force-feed lubrication.

The pressure is produced by a gear pump whose drive gear is in direct mesh with the crankshaft gear at the flywheel end.

The oil pump draws the oil from the sump and delivers it via the oil cooler and oil filter to the main distributor gallery and from there to the main bearings, big-end bearings and camshaft bearings as well as to the small-end bearings and locker arms.

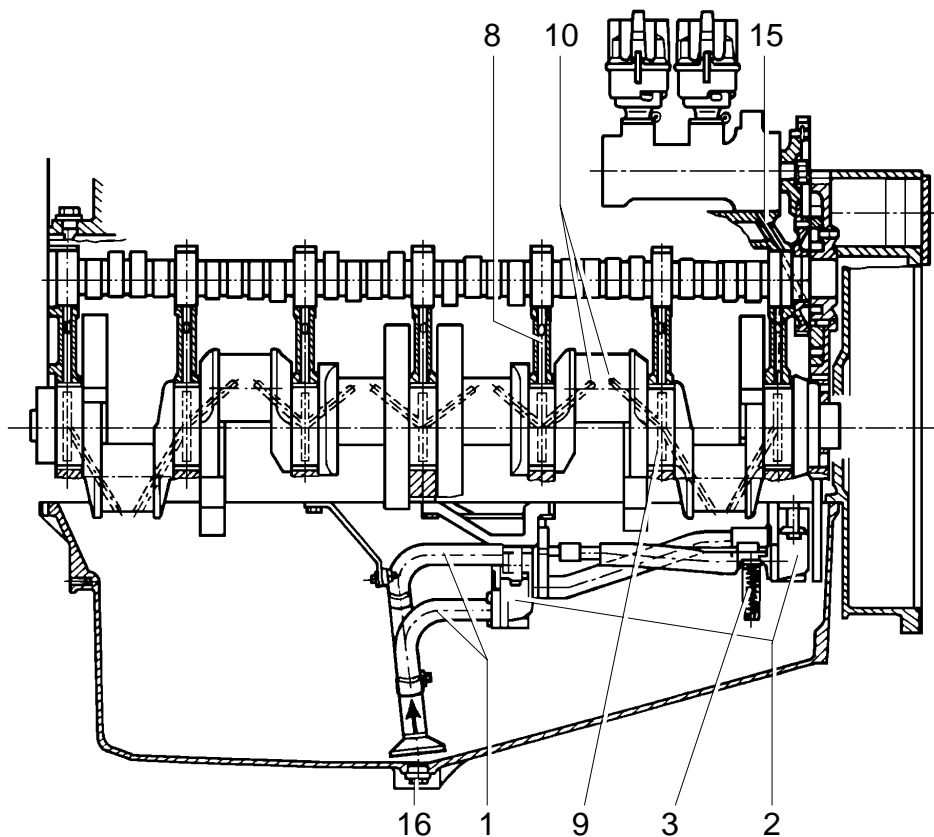
The drive of the distributor is also connected to the engine lubricating system.

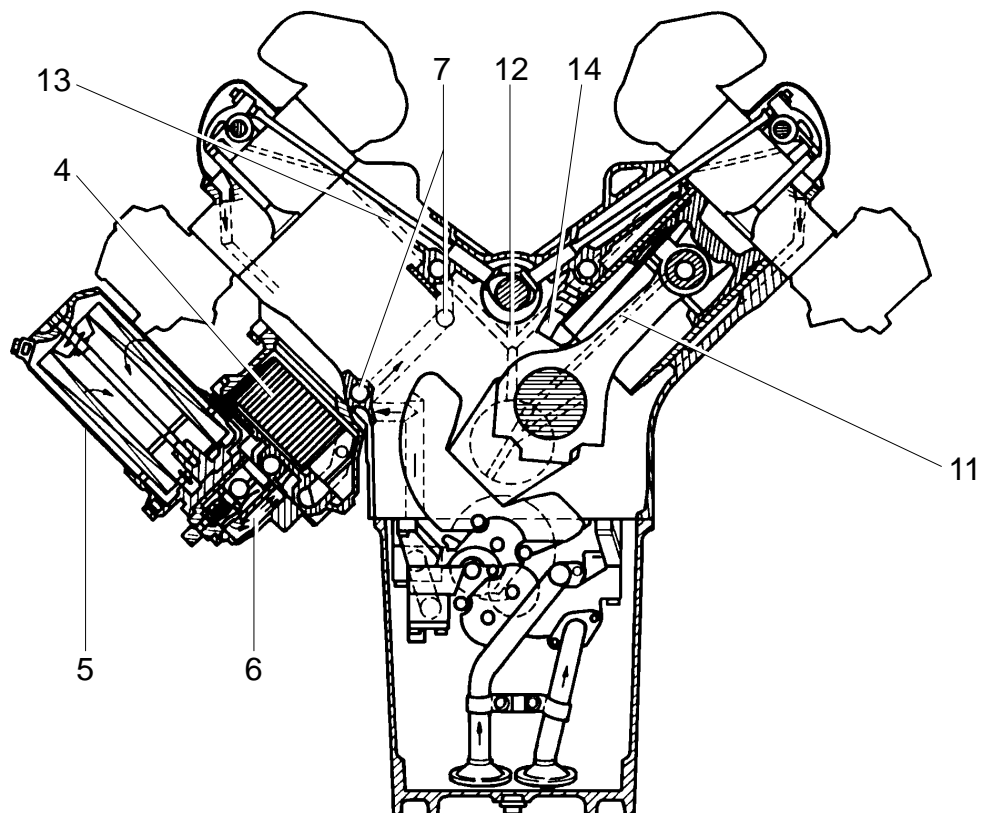
The cylinder walls and timing gears are splash-lubricated.

Each cylinder has an oil jet provided for cooling the underside of the pistons.

Cleaning of the lubricating oil is in a full-flow filter.

Depending on the agreed extent of delivery and the design of the engine, the lube oil circuit can be equipped with oil pressure monitors (advance warning and cut-off function) which shut the engine down in the event of a sudden loss of pressure.





2337

- | | |
|------------------------------|---|
| 1 Oil suction pipes | 10 Ports for big-end bearing lube |
| 2 Oil pumps | 11 Small-end bearing lube |
| 3 Relief valve | 12 Camshaft bearing lube |
| 4 Oil cooler | 13 Rocker arm lube |
| 5 Oil filter | 14 Oil jets for piston cooling and cam lube |
| 6 Bypass valve | 15 Lube oil gallery for distributor drive |
| 7 Main oil galleries | 16 Oil drain plug |
| 8 Oil pipe to crankshaft | |
| 9 Port for main bearing lube | |

Oil cooler

An oil cooler is provided between the oil filter and the crankcase. This cooler is of the flat-tube type with turbulence inserts and operated by the engine coolant.

Cooling

The engine has a liquid cooling system.

The water pump is a maintenance-free impeller pump and is driven by V-belts from the crankshaft pulley.

Depending on the agreed extent of delivery and the design of the engine, the coolant circuit can be equipped with temperature and level monitors which, in the event of overheating, will trigger an advance warning system or, in the event of loss of coolant, shut the engine down.

Air cleaner

An air cleaner is installed on the engine to filter the air for combustion.

The intervals at which the cleaner should be serviced depend on the specific operating conditions. Clogged air filters may cause black smoke and reduce power.

The connecting elements between the air cleaner and the inlet manifold should be checked from time to time for tightness. The ingress of unfiltered air is liable to cause an increased rate of cylinder and piston wear.

Electrical equipment

Alternator

AC three-phase alternator with integral silicon rectifiers is installed.

A transistorized regulator mounted on the alternator limits the alternator voltage. The alternator should not be operated except with the regulator and battery connected in circuit to avoid damage to the rectifier and regulator.

The alternator is maintenance-free. Nevertheless, it must be protected against dust and, above all, against moisture.

Operate the alternator according to the instructions given in the chapter "Commissioning and operation".

Starter motor

The sliding-gear starter motor is flanged to the rear of the flywheel housing on the left-hand side.

As part of every engine overhaul, the starter pinion and ring gear should be cleaned with a brush dipped in fuel and then a coat of grease should be applied again.

Always protect starter motor against moisture.

Warning:

Always disconnect the battery earth cable before starting work on the electrical system. Connect up the earth cable last, as there is otherwise a risk of short-circuits.

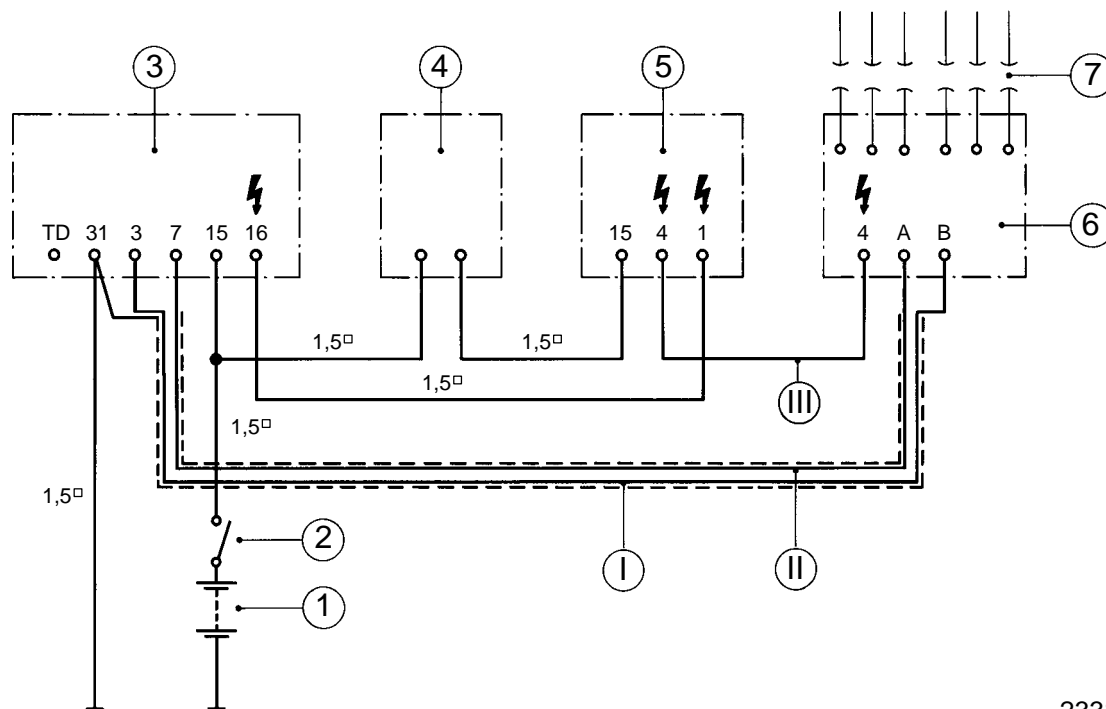
Ignition system

The engine is equipped with contactless transistorized ignition system (TSZ-i).

The main components of the ignition systems are:

- | | |
|---|--------------------|
| 2 Distributor with induction transmitter, | 2 Ignition coil, |
| 2 Control unit, | 2 Series resistor, |
| 12 Spark plugs. | |

The drive of the distributor is via a gear train from the timing idler gear.



2338

Circuit diagram

- 1 Battery
- 2 Ignition switch
- 3 Control unit
- 4 Series resistor
- 5 Ignition coil
- 6 Distributor with inductive transmitter
- 7 Spark plugs

- I yellow
- II black
- III ignition cable

Caution ⚡

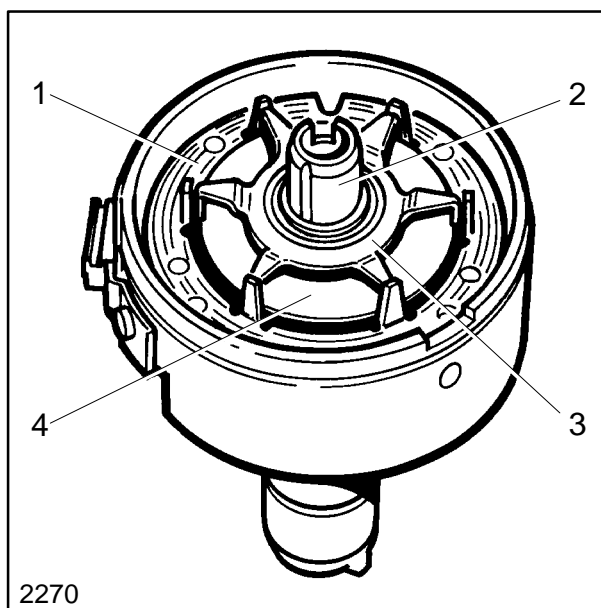
Dangerous primary and secondary voltages !

Refer to "CHECKING AND SETTING" for "Dangers of electronic ignition systems"

Distributor with induction transmitter

In the contactless transistorized coil ignition system with inductive transmitter (TSZ-i), the mechanical control switch is replaced by a pulse transmitter.

The inductive transmitter in the distributor casing consists of a moving part, the pulse transmitter wheel, and a fixed part, the disc with a permanent magnet, induction coil and core. The pulse transmitter wheel is mounted on the distributor shaft and as it rotates, produces an AC voltage in the induction coil whose frequency is proportionate to the speed and the number of cylinders of the engine. This AC voltage is passed as a control signal from the distributor via a two-wire transmitter line to the control unit.



Distributor with cap and rotor removed

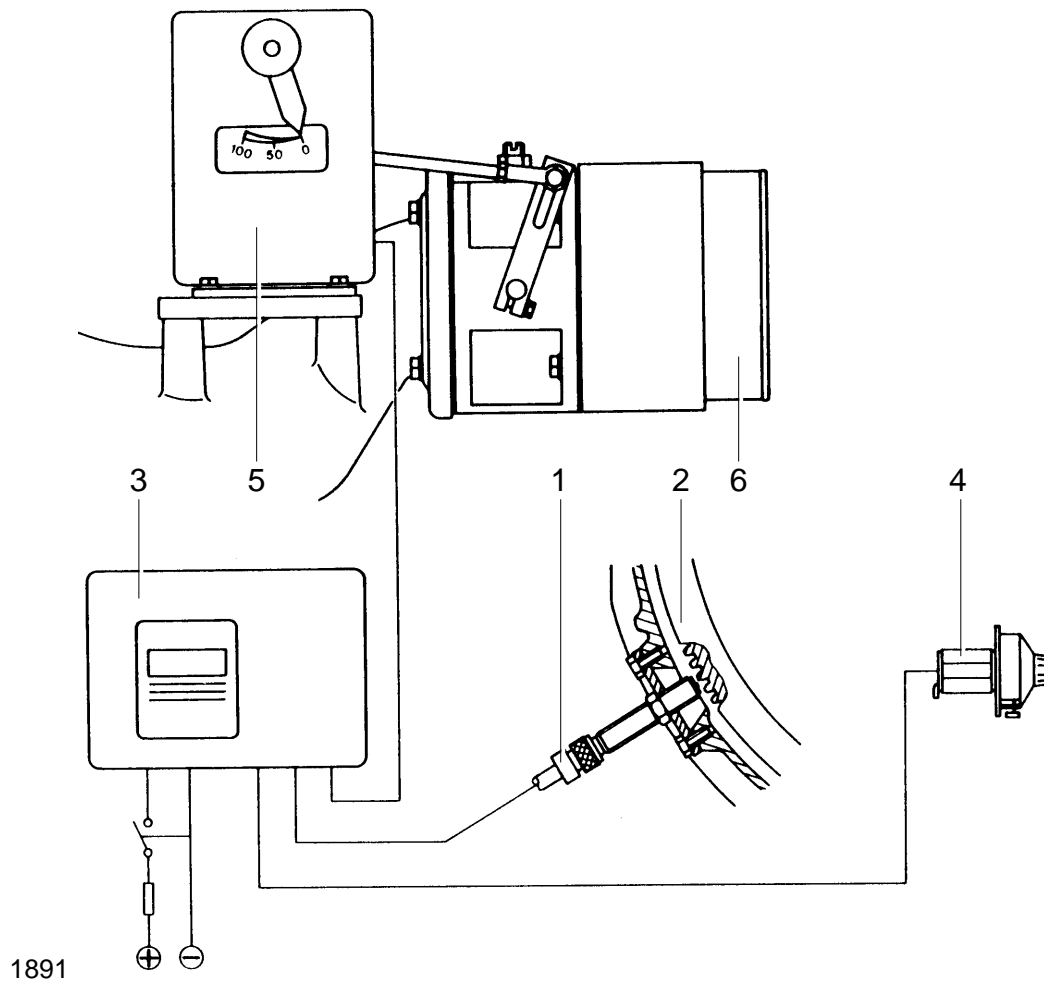
- 1 Pole disc
- 2 Distributor shaft (do not lubricate felt provided)
- 3 Pulse transmitter wheel
- 4 Coil carrier

The distributor rotor and distributor cap should be renewed after every 6000 hours operation.

Control unit

In the control unit, the signal from the inductive transmitter is converted and transformed by means of the ignition coil to a high voltage. The high voltage pulses are distributed same as in a non-transistorized coil ignition system via the distributor rotor and cap to the engine cylinders.

Electronic speed governor (for use with synchronous generator)



- 1 Pulse transducer
- 2 Starter ring gear
- 3 Control unit
- 4 Set point potentiometer
- 5 Indexer
- 6 Gas mixer

Operation:

A pulse transducer senses the engine speed on the starter ring gear and transmits the signal to the control unit.

In the control unit, the actual speed signal is compared to the value preset on the potentiometer. If any deviations exist of the speed from the set point, the current input of the actuator is varied. This causes a change in the actuator position and thereby a change in the flow through the gas mixer.

Note:

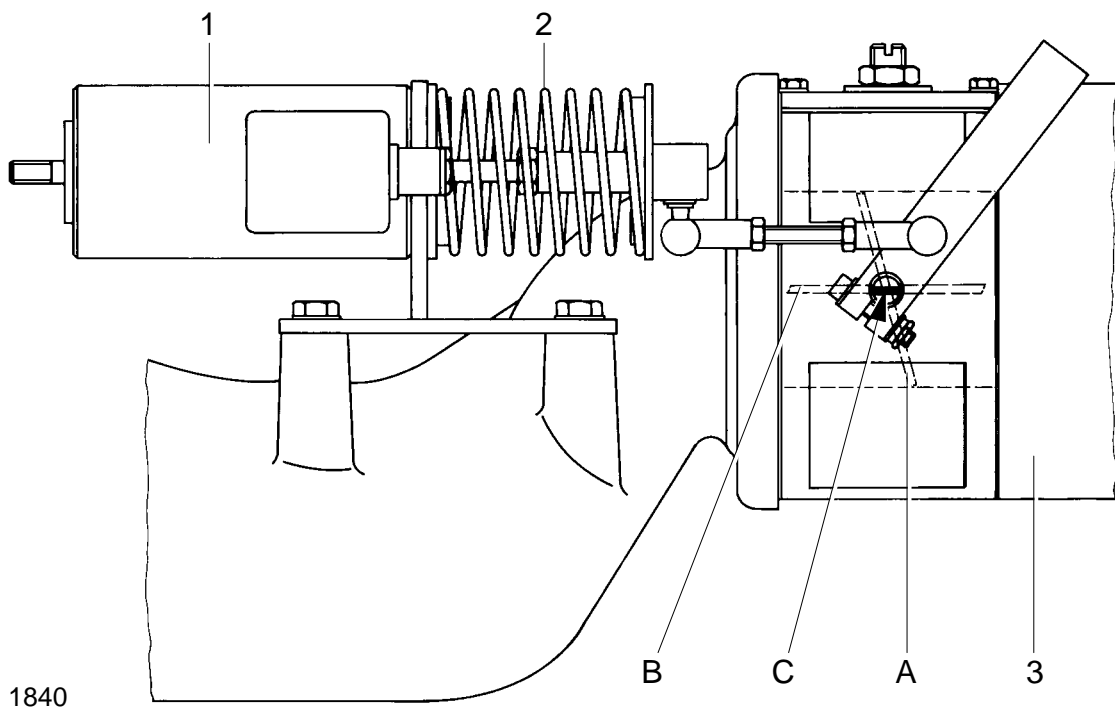
Install the transducer so that the gap between it and the tip of the ring gear tooth is 0.5 to 0.8 mm.

- Screw down the transducer until it contacts the tip of the tooth
- Back off about one half turn
- Lock in this position

(For a description of the individual components and setting procedures, see publications E 80001 and E 80002 "Heinzmann Electronic Speed Governors").

Starting control

(for use with asynchronous generator)



- | | |
|----------------------|--|
| 1 Solenoid | A Starting position of throttle valve |
| 2 Compression spring | B Operating position of throttle valve |
| 3 Gas mixer | C Marking slot (indicates throttle plate position) |

Note:

With the solenoid de-energized, the marking slot should be horizontal (operating position).

The starting control device is designed for use with asynchronous generators in order to achieve satisfactory smooth loading of the generator.

On shutting down, the device will prevent the engine from being accelerated by trapped gas on unloading the generator

Gas supply system

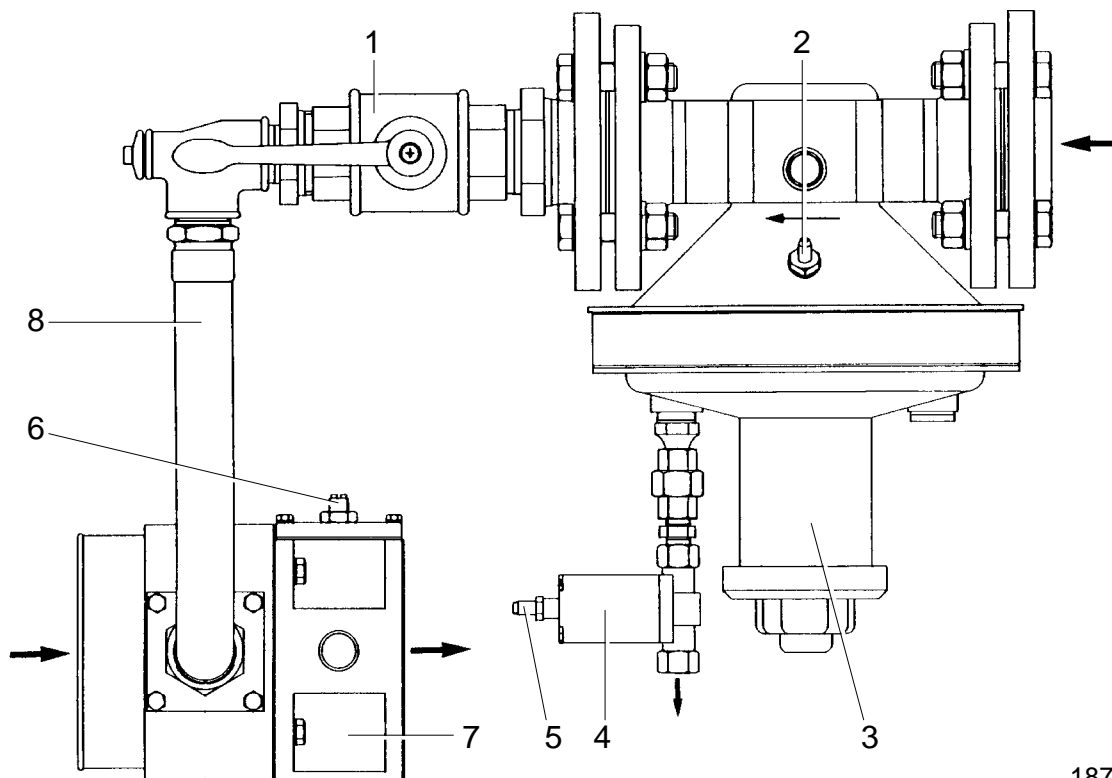
Note:

The gas supply system is not included in our scope of supply. Metal hose and zero-pressure regulator, however, can be supplied at request.

Always proceed according to Manufacturer's Operating Instructions when commissioning, operating and servicing the gas supply system.

A typical gas supply system which meets all requirements for trouble-free operation of the engine is described below.

Any manipulations or adjustments of the gas system should only be carried out by qualified personnel.



1879

- 1 Isolating cock
- 2 Gauge connection
- 3 Zero pressure regulator
- 4 3/2-way solenoid valve
- 5 Connection for air cleaner compensation
- 6 Idling adjustment screw
- 7 Gas mixer
- 8 Metal hose

Gas pressure regulator, zero pressure regulator, (3)

Function

Reducing the gas pressure (low pressure) fluctuating at the gas station inlet within acceptable limits to zero pressure.

Negative-pressure-controlled gas metering for the venturi in the gas mixer as a function of engine load, i.e. the gas/air mixture produced in the venturi is maintained practically constant at constant speed over the full load range (idling to full load).

Note:

Before installing the metal hose between the gas station and the gas mixer, adjust the main spring in the gas pressure regulator dome at the top so that, with the gas lock open and the engine stationary, the regulator valve will just remain closed.

Negative opening pressure of gas pressure regulator 0.5 mbar.

The equalizing line (compensating line) provided between the gas pressure regulator and the air inlet manifold (after paper air cleaner) serves to limit the gas flow admitted to the gas mixer, in spite of any increased negative pressure in the suction line due to clogging of the paper air cleaner, in order to prevent an increase in engine output above the safe limit.

3/2-way solenoid valve (4)

For reliable starting of the engine – especially under conditions where the starting speed has dropped due to aged starter batteries – we strongly recommend the use of the 3/2-way solenoid valve to bypass the air cleaner compensation during the starting phase and at idling (for synchronizing the generator).

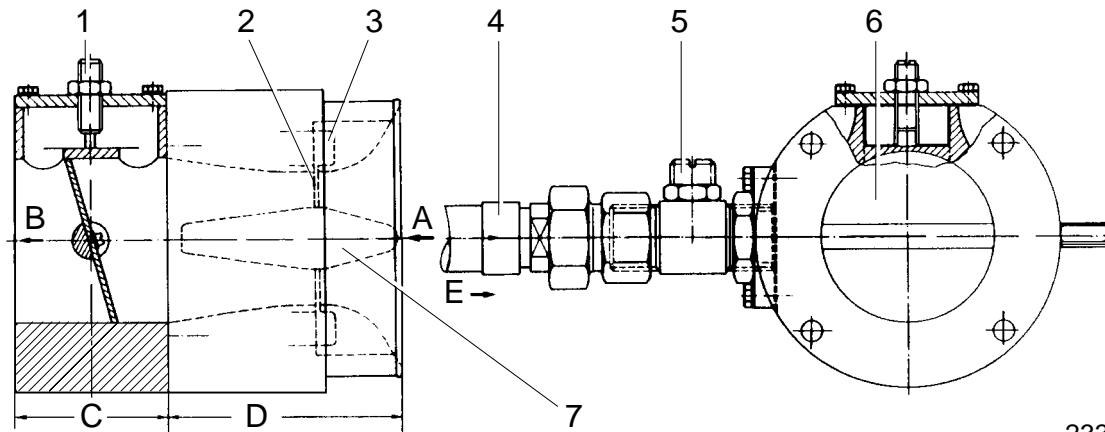
Metal hose with DVGW (German Association for Gas and Water) type test to connect the gas regulating station installed in the engine room with the gas mixer on the engine (5).

Installation:

Install metal hose without any twist.

The main directions of movements due to engine vibrations about the crankshaft axis and the 90° metal hose bend should be in one plane in order to prevent detrimental torsional stresses.

Gas mixer (7)



2339

- 1 Setting screw for regulating bypass gas for idling
- 2 Gas annulus
- 3 Gas passage
- 4 Metal hose
- 5 Setting screw for regulating max permissible gas flow
- 6 Throttle valve for regulating engine output
- 7 Bulb

- A Air inlet from air cleaner
- B Outlet of gas/air mixture to engine
- C Throttle valve casing
- D Venturi
- E Gas inlet from gas regulating station

Venturi casing

Function

The gas mixer arranged between the air cleaner and the engine block draws gas into the venturi throat at varying pressure up to about 1 mbar (i.e. pressure drop relative to air cleaner internal pressure) in proportion to the air flow velocity in the area of the restriction of the venturi.

In this annulus, gas and air are mixed. See also negative-pressure controlled gas metering in zero pressure regulator of gas regulating station.

With the throttle valve open (full load), the setting screw, (5), is used to limit the gas flow according to the value of the gas and the maximum permissible engine output as well as the desired air excess (λ).

The setting screw is factory set during the test run of the engine in the maker's works, but the engine output has to be tuned up again by trained personnel at destination before commissioning the set to allow for any differing operating conditions, especially with respect to gas quality.

After this final setting, no changes should be made and a seal should be applied to prevent unauthorized interference.

By no means must the maximum continuous engine rating permitted by the maker (see applicable engine performance characteristic of E 2842 E) be exceeded due to incorrect setting.

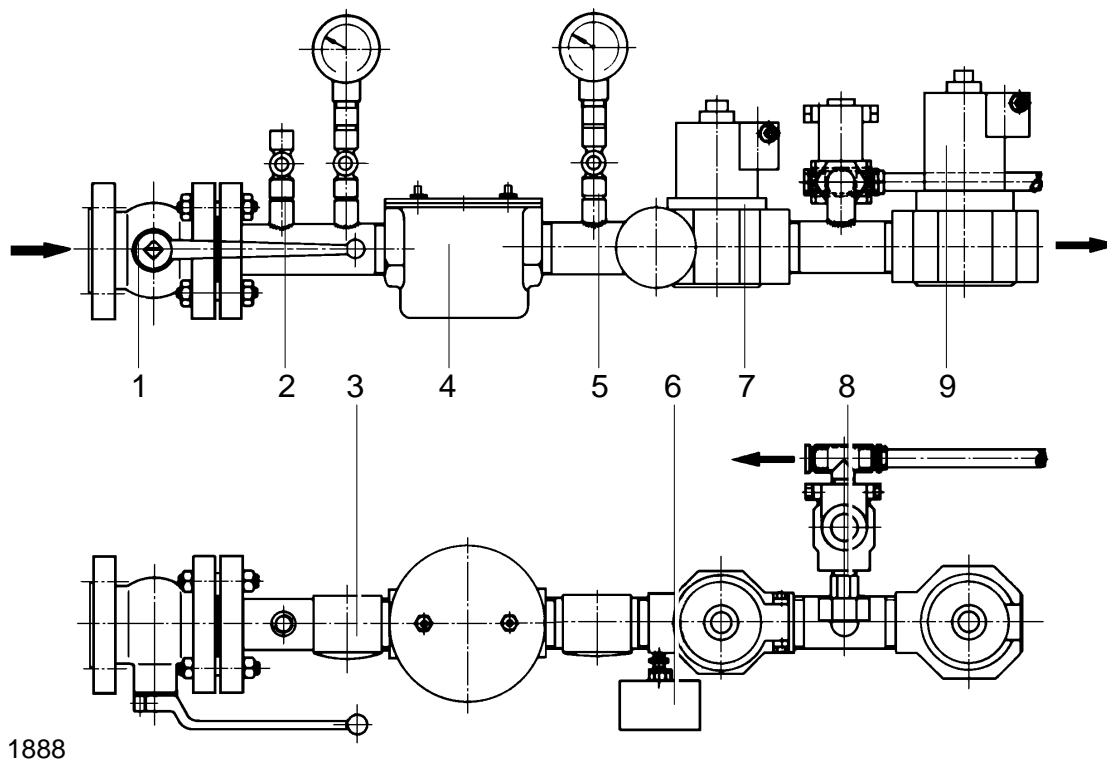
Any necessary readjustment of the gas flow, e.g. especially when a different gas quality with a higher heat value is used, must only be entrusted to trained personnel.

Throttle valve casing

By adjusting the throttle valve and, thereby varying the gas/air mixture flow, it is possible to set the desired engine speed as a function of the engine load.

To regulate the idling speed, the bypass gas flow is adjusted by turning the locked setting screw (5), with the throttle valve closed.

Notes on necessary gas plant components upstream of the zero pressure regulator



1888

- 1 Ball cock
- 2 Push button cock
- 3 Pressure gauge with push button cock
- 4 Gas filter
- 5 Pressure gauge with push button cock
- 6 Gas pressure monitor
- 7 Safety solenoid valve
- 8 Leak gas solenoid valve
- 9 Main gas solenoid valve

Gas lock consisting of

- main and safety solenoid valve (9 and 7)
(de-energized to close)
- leak gas solenoid valves (only if required)
- leak gas pipe between zero pressure regulator and connection behind leak gas solenoid valve (at request)

Gas pressure monitor (6) for minimum gas pressure 10 mbar.

Gas pressure gauge (2 and 5) with push button cock. Indication up to 100 mbar

Hand ball cock (1) flanged type

Vent cock (2) push-button type

Gas filter (4) cleaning efficiency better than 0.05 mm

Hand ball cock flanged type

Gas reserve tank at gas station inlet for sets with 100% load acceptance (only where required)

In order to prevent a drop in output at the moment of 100% load acceptance, a reserve tank with

about 400 litres capacity

is required for the E 2842 E in the gas supply line ahead of the gas station inlet, preferably in the main flow.

If connected in a bypass, the connecting pipe to the gas mains should be as short as possible and with at least 50 mm bore.

Gas pressure monitor for maximum gas pressure upstream of gas regulating station (this is required in all cases)

Within the gas regulating station associated with each gas engine, only the minimum gas pressure downstream of the gas filter is automatically monitored by the control system. The necessary maximum gas pressure monitor is generally arranged ahead of the gas regulator station, but downstream of the initial pressure gas regulator, where one is provided. In the case of multiple engine plants, only one gas pressure monitor is required in the central gas supply for the complete plant.

Similar to the minimum gas pressure monitor, the control system closes the gas lock, but in this case when the maximum permissible gas pressure upstream of the gas regulator station is exceeded. In the case of multiple engine plants, all engines will be shut down simultaneously in this case.

Initial pressure gas regulator (only where required)

If natural gas is available at the site of the gas engine set only in the medium-pressure or high-pressure range, it is necessary to install an initial pressure regulator (two-stage type may be called for) in the central gas supply line to reduce the pressure of the gas to the permissible low pressure range upstream of the gas regulating station.

Points to be noted in selecting the initial pressure gas regulator:

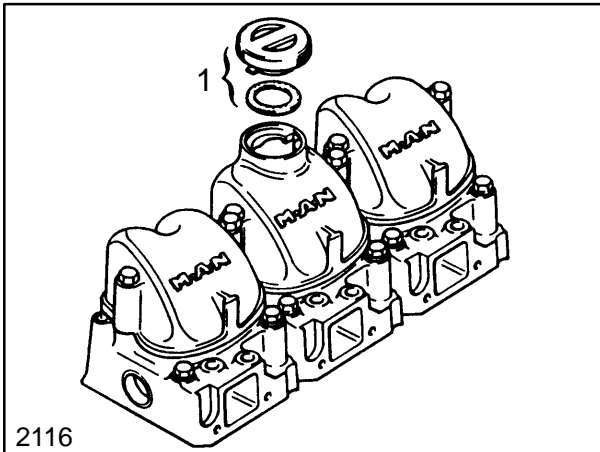
It is recommended that the contractor installing the generating set retain a gas equipment supplier to advise on the selection of the initial pressure regulator.

The gas flow must be large enough, in conjunction with the reserve gas tank described below, to avoid a drop in output at the moment of load acceptance, especially in the case of sets which are required to accept 100% load and multiple engine plants.

The valve opening characteristic of the initial pressure regulator must not be too slow and must ensure that, at the moment of load acceptance, sufficient gas is available for accelerating the engine.

Preparations

At the time of initial commissioning of a new or overhauled engine make sure to have observed the "Technical Information for the installation of MAN engines".



- 1 Oil filler neck on valve cover

Before daily starting the engine, check fuel level, coolant level and engine oil level and replenish, if necessary.

Engine oil level

The notches in the dipstick indicate the maximum permissible and the minimum permissible oil levels. Check oil level daily.

Caution:

Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.

The oil required in the sump is specified in the "Technical Data" at the end of these Instructions.

Ensure utmost cleanliness when handling fuels, lubricants and coolants.

Use approved fuels, lubricants and coolants (see Publication "Fuels, Lubricants and Coolants for industrial and marine Diesel engines") only, as otherwise the manufacturer's guarantee will be null and void.

During operation

During operation the oil pressure in the engine lubrication system must be monitored. If the monitoring devices register a drop in the lube oil pressure, switch off the engine immediately.

The minimum oil pressure with the engine at operating temperature (oil temperature > 80°C) is **2.5 bar** at 1500 rpm. If the pressure falls below this value, the engine must be shut down by the monitoring system.

Do not overload the engine. Do not exceed the maximum permissible engine tilt. If faults occur, find their cause immediately and have them eliminated in order to prevent more serious damage!

The *coolant temperature* should be approximately 80 to 85°C.

If the cooling water temperature exceeds 93°C, the engine must be shut down by the monitoring system.

Alternator

In order to avoid damage to the alternator, observe the following instructions:

While the engine is running

- Do not de-energize the main battery switch!
- Do not disconnect the battery or pole terminals or the cables!
- If, during operation, the battery charge lamp suddenly lights up, stop the engine immediately and remedy the fault in the electrical system!
- Do not run the engine unless the battery charge control is in satisfactory order!
- Do not short-circuit the connections of the alternator with those of the regulator or said connections with ground, not even by briefly bringing the connections into contact!
- Do not operate the alternator without battery connection!

A.Operation with asynchronous generator (E 2842 E - A)

Starting

- Operate starter to crank engine with gas supply shut off and without ignition for a few seconds (air purge)
- Starting control will close throttle valve in gas mixer
- Switch on ignition
- Gas lock will open
- Engine will start firing and run up to 1300 to 1400 rpm without generator load on idling gas flow
- As soon as this speed is reached, starting control will move the throttle valve into operating position. Simultaneously, the generator will be connected to the system

Shutting down

- Gas lock will close
- Simultaneously, generator will be separated from the system and solenoid will pull throttle valve closed (idling position). Instant closing of the throttle valve prevents engine from accelerating after generator load has been removed due to the gas trapped in the pipes up to the main gas solenoid valve
- Switch off ignition after about 5 seconds

Caution:

If the engine shutdown device is defective, never stop the engine by means of the ignition key.

- Close the main isolating cock
- Do not switch off ignition until the engine is at a standstill

B.Operation with synchronous generator (E 2842 E - S)

Starting

- Operate starter and crank engine with gas supply shut off and without ignition for a few seconds (air purge), (The electronic speed governor must be energized so that the throttle valve in the gas mixer is opened)
- Switch on ignition
- Gas lock will open
- Engine will start firing
- The electronic speed governor (Heinzmann governor) maintains the engine speed at the value set on the set-point potentiometer

Shutting down

- Gas lock will close
- Engine will run down
- Switch off ignition and electronic speed governor after about 5 seconds

Caution:

If the engine shutdown device is defective, never stop the engine by means of the ignition key.

- Close the main isolating cock
- Do not switch off ignition until the engine is at a standstill

Caution:

Ensure that the engine can not be started by unauthorized persons.

Temporary decommissioning of engines

Temporary anti-corrosion protection according to MAN works norm M 3069 is required for engines which are to be put out of service for fairly long periods.

The works norm can be obtained from our After-Sales Service department, VES-N, Nuremberg works.

Engine lubrication

Oil level

Check the oil level in the engine sump daily with a dipstick. The level should be between the two notches cut into the dipstick and should never be allowed to drop below the lower notch.

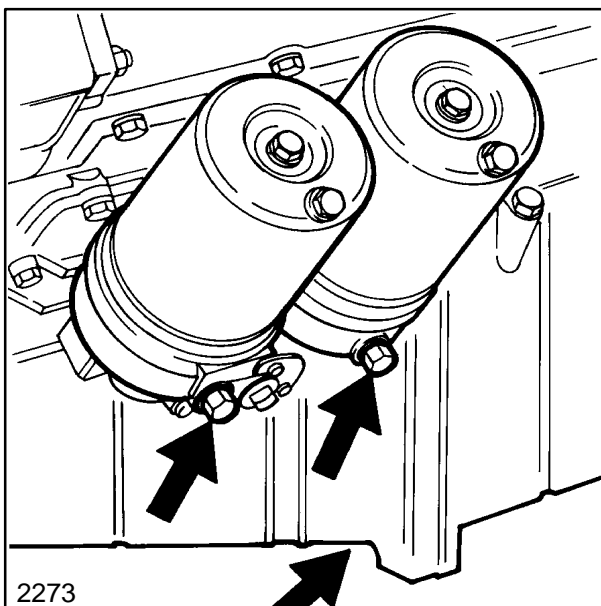
Caution:

Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.

The oil level should be checked with the engine horizontal and only after it has been shut down for about 20 minutes.

Oil drainage

With the engine at operating temperature, remove the oil drain plugs on the oil sump and the oil filter bowl and allow the old oil to drain off completely. Use a vessel of sufficient size to ensure that the oil does not overflow.



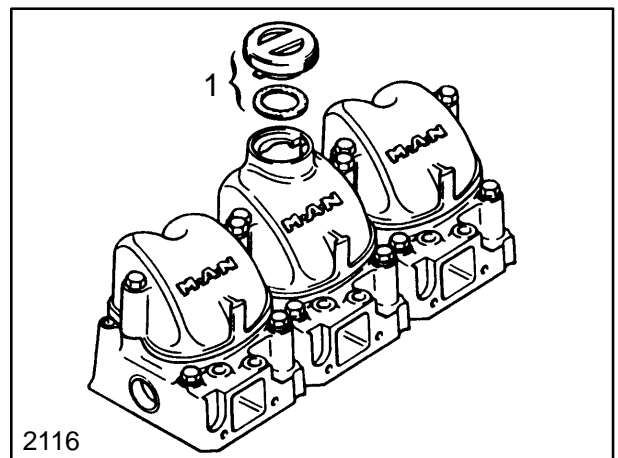
Refit the oil drain plugs with new gaskets.

Caution:

The oil is hot- risk of scalding. Do not touch the oil drain plug with bare fingers. Oil is an environmental hazard. Handle it with care!

Refilling with oil

Refill with fresh engine oil at the oil filler neck.



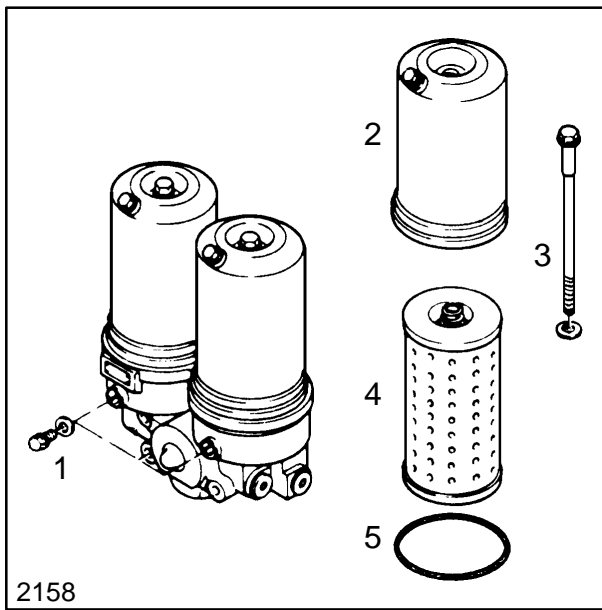
- 1 Oil filler neck on valve cover

After refilling with oil, rotate the engine with the starter with ignition "off" until the oil pressure warning light goes out and the oil pressure gauge shows a pressure. Then start the engine and allow it to run at medium speed for a few minutes. Check oil pressure and tightness of system.

Then shut down the engine. After about 20 minutes, check the oil level. The oil level should now be at the upper notch of the dipstick. Add any necessary oil.

Lubricating oil filter

Cleaning of the lubricating oil is effected in a full-flow oil filter with paper cartridges. A bypass valve ensures continuity of oil supply if the filter elements should be clogged.



- 1 Sludge drain plug
- 2 Oil filter bowl
- 3 Tie screw
- 4 Filter cartridge
- 5 Gasket

Renewal of filter cartridges

- Allow the filter content to run off along drain plugs. Hold a suitable vessel under hole

Caution:

Oil is hot and under pressure!

- After releasing the clamping bolts remove filter bowls
- Renew filter cartridges. Thoroughly clean all other parts in cleaning fluid (do not allow cleaning fluid to enter the oil circuit)
- Use new gaskets for reassembly of filter bowls

Note:

To prevent the seal (5) from twisting hold the filter bowl (2) firmly when tightening the tensioning screw (3)

Every time an oil change is made, the two oil filter cartridges should be renewed!

Caution:

Used oil filters are classed as dangerous waste and must be disposed of accordingly.

Cooling

Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene glycole basis or anti-corrosion agent.

See Publication "Fuels, Lubricants and Coolants for industrial and marine Diesel engines".

Filling-in of coolant (only when engine has cooled down)

- Fill in the coolant slowly
- Make sure that all air can escape from the cooling system
- Run the engine briefly and then check coolant level once more

If, in an **exceptional** case, the coolant level has to be checked in an engine that has reached operating temperature, first carefully turn the cap (large cap) with safety valve to the first stop, let off pressure, then open carefully.

Coolant must be added at the filler neck only. Do not put cold coolant into an engine which is warm from operation.

Ensure that the ratio of water to anti-freeze is correct. Find the cause of the loss of coolant and have it eliminated.

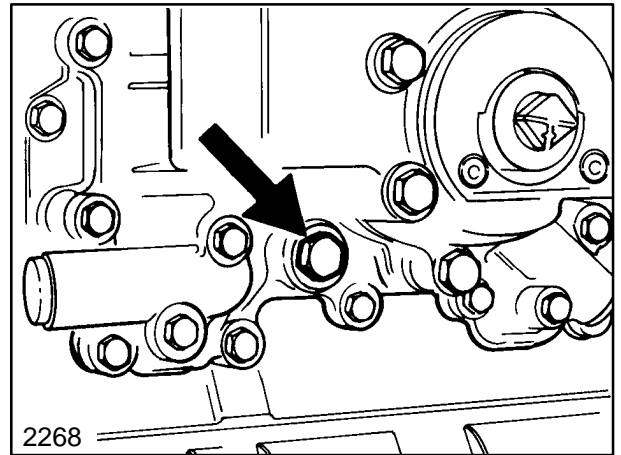
Warning:

If the cap with the working valves is opened, there is the risk that it will not close tightly again afterwards. The excess pressure required in the system will then no longer build up. Premature boiling occurs and coolant is lost. To prevent damage to the engine open this cap only in exceptional circumstances and fit a new one as soon as possible.

Draining of coolant

Drain coolant as follows when cooling system has cooled down:

- Remove cover from filler neck of surge tank
- Remove drain plug in crankcase and oil cooler housing



Drain plug in oil cooler housing

Improper mixing of anti-freeze and corrosion inhibitors may lead to lime and corrosion deposits in the engine cooling system which can jeopardize cooling efficiency.

In such cases it is necessary to clean the cooling system at suitable intervals.

Cleaning the outside of the radiator (wear goggles)

Extreme dirt deposits can clog the honeycombs so that the remaining surface no longer ensures sufficient cooling. In such cases, the insects, dust etc. should be removed from the honeycomb system of the radiator block and the radiator itself then cleaned with the cleansing agent HENKEL P3-begesol. This cleansing agent is available from MAN in 10-kg cans under Part No. 09.21002-0164.

Procedure:

- Mix P3-begesol with water, ratio 1:1
- Using a spray gun, spray the mixture in as straight a jet as possible directly into the radiator fins
- Let the mixture work for 5 minutes
- Hose down the radiator with a straight jet of tap water directly from the front. In cases of stubborn dirt deposits remove the radiator and hose it down directly from behind. Do not use high-pressure cleaners (steam sprayers may be used)

Henkel P3-begesol contains no toxic or corrosive substances and, if handled properly, may be used without hesitation.

Cleaning the inside of the cooling system

(by authorized specialist personnel)

Investigations have shown that in many cases the poor condition of the coolant and / or the cooling system accounts for damage to the water pump mechanical seal. The poor condition of the cooling system is normally due to use of unsuitable or no anti-freezing agents and corrosion inhibitor or defect, not early enough replaced covers for filler neck and working valves.

If twice in a short time the water pump of an engine develops leaks or the coolant is heavily contaminated (dull, brown, mechanically contaminated, grey or black signs of a leakage on the water pump casing, after the defect on the oil cooler) clean the cooling system **prior to** removing that water pump as follows:

- a) Drain coolant
- b) Force the thermostats to open (by generating the relevant temperature) so that the entire coolant circuit will be

flushed through immediately during cleaning

- c) Fill coolant circuit with a mixture of hot water (min. 50°C) and Henkel P 3 neutral 5265 detergent (1.5% by volume) (-5266, -5225, Kluthe Hakopur 316), see Publication "Fuels, Lubricants ..."
- d) Warm up engine under load. After a temperature of 60°C is reached, run engine for a further 15 minutes
- e) Drain cleaning fluid
- f) Repeat steps c) and d)
- g) Flush cooling system. To this effect
- h) Replace drain plug by drain plug with a bore of 8 mm dia
- i) Fill cooling system with hot water
- k) Run engine at idle for 30 minutes. At the same time continuously replenish the water leaking from the bore in drain plug by adding fresh water

Repair water pump only now. Thereafter, fill the cooling system with approved cooling fluid. See Publication "Fuels, Lubricants ...".

Note:

Only sediments and suspended particles can be removed by this cleaning method. If corrosion and lime deposits are found, proceed according to the following section:

Removal of lime deposits in the cooling system

(by authorized specialist personnel)

Procedure:

- Drain the coolant
- Fill the system with undiluted original pickling fluid (Lithsolventsäure or engine pickling fluid RB-06), see sources of supply
- Let the engine run (also in normal operation) for approx. 8 hours with this filling in the cooling circuit

- Drain the pickling fluid and thoroughly flush the system with tap water
- If necessary, refill the circuit again with fresh pickling fluid and pickle the engine for another 8 hours
- Drain the pickling fluid, fill the system with tap water, and run the engine at idle for 5 minutes to flush out all fluid; then drain the water
- Fill the system with a 1% soda solution. Drain the soda solution after running the engine at idle for 5 minutes, and flush with tap water until the discharging water is clear
- Fill cooling circuit with a mixture of potable tap water and anti-freeze with at least 40% by volume, refer to Publication "Fuels, Lubricants ..."

Note:

Older radiators may develop leaks when such deposits are removed. The surge tank should be filled only up to the bottom edge as otherwise foaming will cause the pickling fluid to spill over.

Filler caps and working valves of cooling system

The rubber gaskets of the filler caps and working valves (negative pressure and positive pressure valves) of the cooling system are subject to natural aging.

To preclude leakages in the cooling system and tailing pressure drop and its consequences up to severe engine damage, renew the filler caps and working valves in line with the change of coolant (every two years at the latest).

Waste water treatment

Drained and spent cleaning and pickling fluid should be brought up to a pH value of 7.5 to 8.5 with the aid of caustic soda. Once the precipitation has settled to the bottom of the container the clear fluid above can be dumped into the sewer. The sludge at the bottom should be taken to a special waste dump. Anyway, it is recommended to consult the local authorities for more information about waste water rules or restrictions.

Sources of supply for pickling fluidsLithsolventsäure

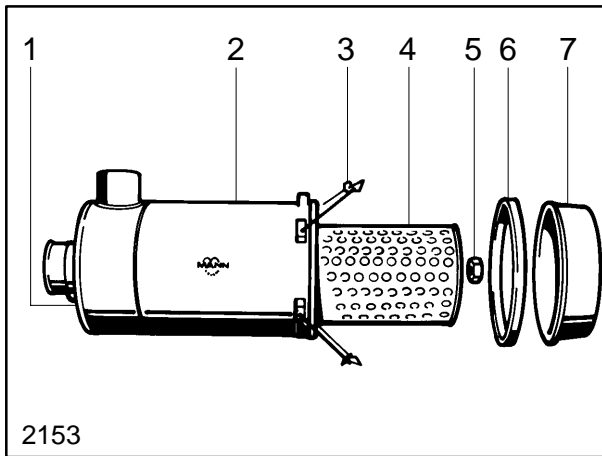
Keller & Bohacek
Liliencronstr. 54
D-40472 Düsseldorf
Phone: (02 11) 96 53 0

Motor pickling fluid RB-06

Reincolor-Chemie GmbH
Werkstr. 21
D-90518 Altdorf
Phone: (0 91 87) 97 03 0

Air cleaner

Dry air cleaner



- 1 Connection port, fouling indicator
- 2 Cleaner housing
- 3 Clamp
- 4 Element
- 5 Hexagon nut
- 6 Cover
- 7 Dust bowl

Service only when engine is switched off.

Dust collector

The dust collector must be emptied at regular intervals. The collector should never be more than half full of dust.

When the two retainers have been folded up the dust collector can be taken off.

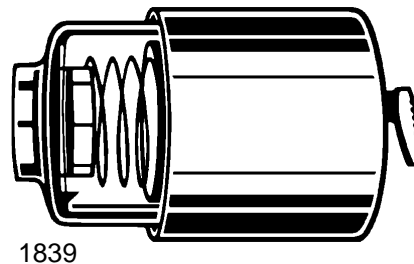
Remove the lid of the dust collector and empty the collector.

Ensure that the lid and the collector are reassembled correctly. A lug on the collector fits into a recess in the edge of the lid. If the filter is installed horizontally note the "oben" ("top") marking on the filter bowl.

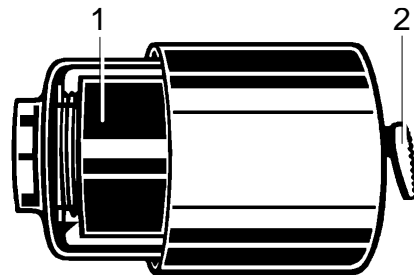
Fouling Indicator

As the degree of clogging increases the red indicator becomes more and more visible in the transparent section of the air cleaner.

If the fouling indicator remains engaged, i.e. it still shows completely red even with the engine shut down, the filter cartridge must be cleaned or replaced.



Filter operational



Filter must be serviced

- 1 Red indicator
- 2 Reset button

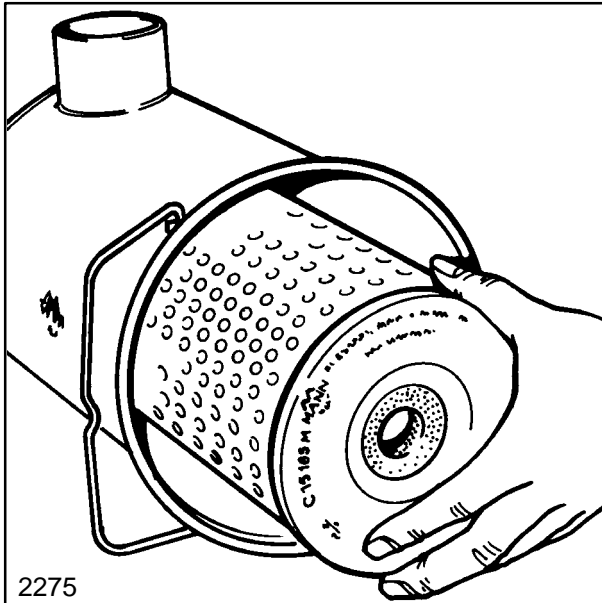
After servicing the cartridge, press the button to reset the fouling indicator.

Changing the filter cartridge

Caution:

No dust must get to the clear air end.

Remove the hex nut, take out the contaminated cartridge and fit a new one.



Clean the filter housing with a damp cloth, especially at the sealing face for the cartridge.

Caution:

The engine must not be run without a main cartridge.

Cleaning the cartridge

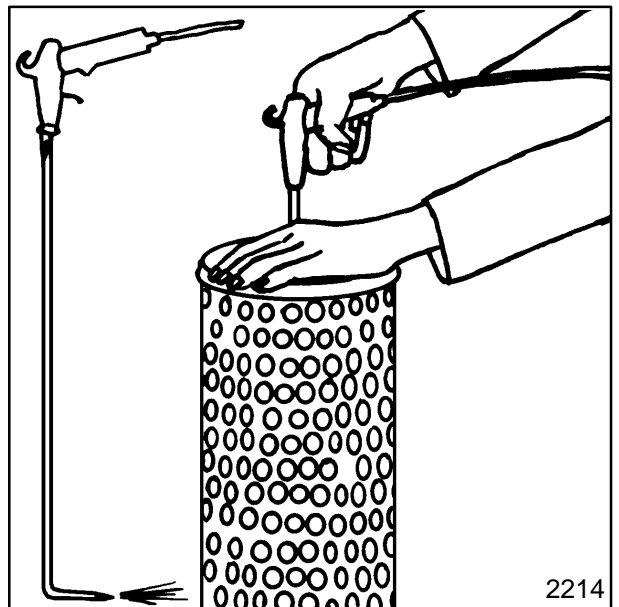
Caution:

The filter cartridge should normally be changed. Clean it only in emergencies (e.g. when no replacement is available).

Blowing out (wear goggles)

To do this fit a pipe to the compressed air gun. The end of the pipe should be bent by approx. 90°. The pipe must be long enough to reach the bottom of the cartridge.

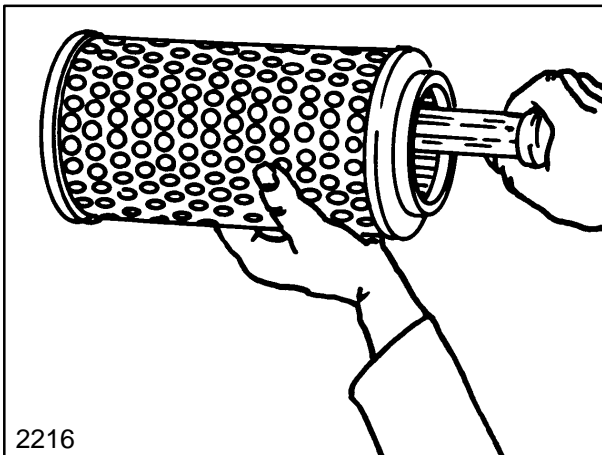
Blow the cartridge out from the inside with dry compressed air (max. 5 bar) by moving the pipe up and down inside the cartridge until no more dust is released.



Checking the cartridge

When a cartridge has been cleaned it must be examined for damage before it is refitted, e.g. damage to the paper bag and rubber seals. Check also for compression of or dents in the metal jacket.

Tears and holes in the paper bag can be found by shining a torch into the bag.



On no account re-use damaged cartridges. If in doubt fit a new cartridge.

Safety cartridge

When the main cartridge is being serviced the safety cartridge remains in the filter housing. The engine must not be run without the main cartridge.

Safety cartridges must be neither cleaned nor re-used.

Safety cartridges must be changed:

- at the latest after being in use for two years
- if, after the main cartridge has been serviced (changed), the contamination gauge responds again immediately
- if the main cartridge is defective

When the main cartridge has been removed the safety cartridge is accessible and can be removed also.

Remove the hex nut.

Pull out the safety cartridge.

Insert a new safety cartridge. Refit and tighten the hex nut.

Ignition system

Danger of electronic ignition systems

Safety rules

The voltages of electronic systems are much higher than those of conventional systems. As a result the power range of electronic ignition systems is so high that contact with live parts or terminals may be lethal (both on the primary and secondary sides).

In this connection, attention is drawn to the need to observe the VDE Regulations, particularly VDE 0104/7-67 when carrying out any work or tests on the ignition system.

It is mandatory that whenever any work is to be done on the ignition system, the ignition system must be de-energized (switch off ignition and / or power supply). Such work includes:

- Connecting up engine test devices (strobe, speed tester, ignition cables, etc.)
- Replacing of any parts of the ignition system (spark plug, ignition coil, distributors, ignition cables, etc.)

If testing of the ignition system or resetting work on the engine involves energizing the ignition system (switching on ignition and / or power supply), the dangerous voltage levels referred to will occur **in the complete system**.

The danger of accidents therefore exists on the individual components of the ignition system (such as distributors, ignition coil, control unit, ignition cables) as well as on the cable harness (such as tachometer connection, diagnosis plug), at connectors and the test devices.

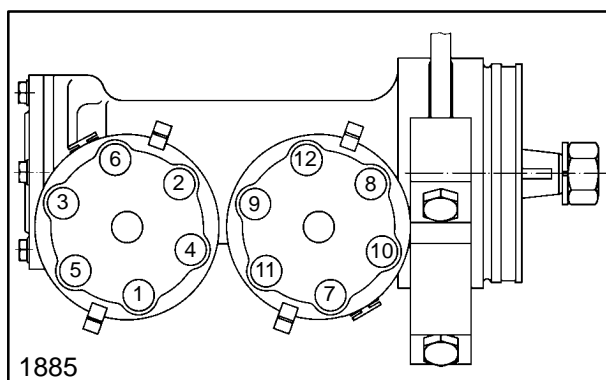
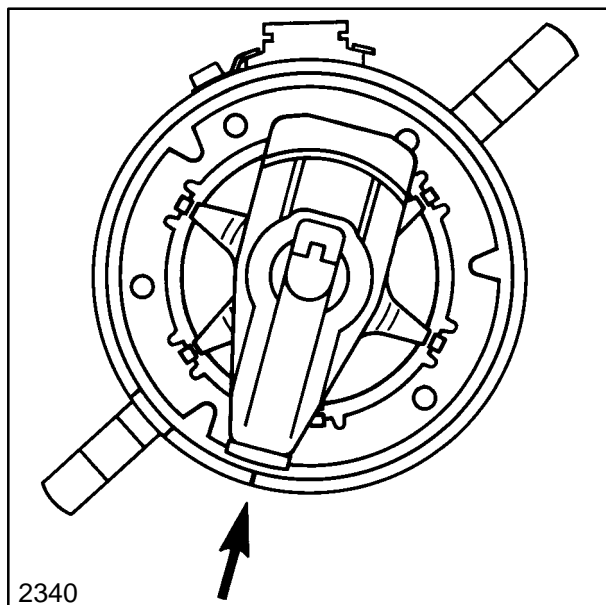
Installation of the distributor

(by authorized specialist personnel)

The engine has a separate distributor for each bank of 6 cylinders.

The following details are for the distributor of cylinders 1-6. If the distributor for cylinders 7-12 is to be installed, the data in brackets apply.

- Remove valve cover on cylinder No. 6, right hand bank at flywheel end (cylinder No. 7 left hand bank at front end)
- Rotate engine with ring spanner 32 mm between flats on the hexagon boss provided at the centre of the crankshaft pulley (barring device) so that the valves of cylinder No. 6 (cylinder 7) are rocking. The piston in cylinder No. 1 (cylinder 12) will now be at ignition TDC
- Turn back engine until the measuring edge of the pointer fitted to the crankcase is pointing at the 12° mark before TDC – cylinder 1 (12° before TDC – cylinder 12) on the marking disc on the front crankshaft end
- Remove distributor cap and position rotor so that the center of the high voltage bridge coincides with the notch cut into the edge of the distributor casing

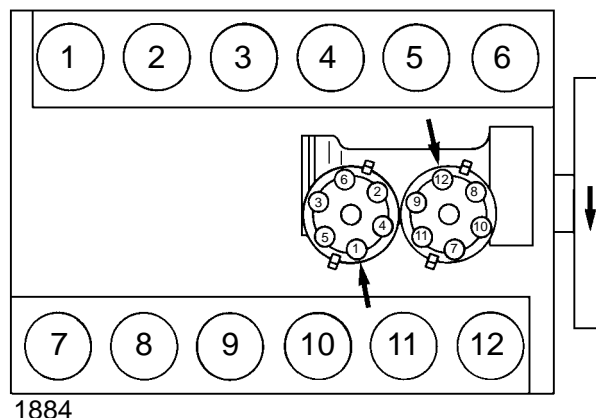


In this position of the distributor shaft, insert the distributor. Note the location of the spring clips for the distributor cap and the cable entry (see diagram).

Hold the rotor and turn the distributor slightly as it is being inserted so that the drive gears will mesh readily.

- Screw clamping lever to the bearing housing
- Transfer the position of the groove in the casing edge with paint or chalk to the outside of the distributor housing so that the "cylinder No. 1" (cylinder No. 12) mark remains visible with the distributor cap in place. Install dust cover, distributor rotor and cap

- Insert ignition cables. The paint mark applied earlier will point to the cable connection for cylinder No. 1 (cylinder No. 12). Insert the other cables in the sequence of the firing order shown in the diagram



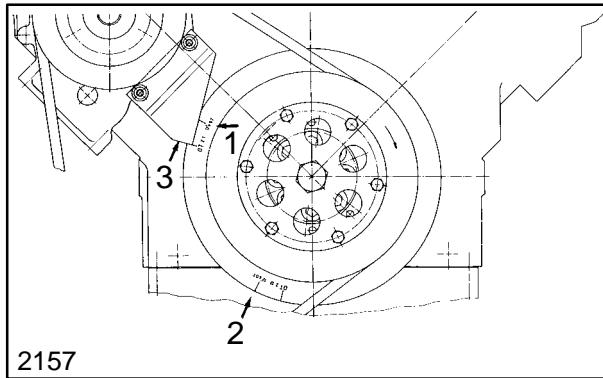
Set ignition timing by means of the stroboscope.

Adjusting the ignition timing (by authorized specialist personnel)

The ignition timing should be checked after every 2000 hours operation.

The adjustment or checking of the ignition timing can only be made with the engine running.

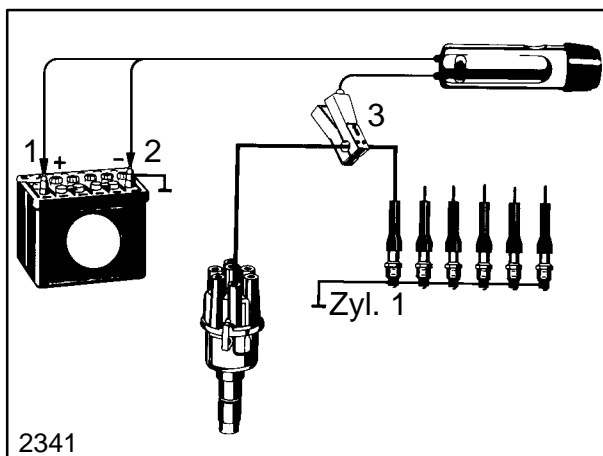
Check the engine timing by means of ignition timing stroboscope. Marks for the 12° before TDC of cylinder No. 1 and cylinder No. 12 are provided on a marking disc on the front crankshaft end. A pointer provides the mating mark.



- 1 12° before TDC, cylinder 1
- 2 12° before TDC, cylinder 12
- 3 Pointer

The ignition timing should be set for the two distributors one after the other.

Connect ignition timing stroboscope. Connect the cable to the battery to establish the power supply. Red clip is on positive pole, black clip on negative pole.



Connection of ignition timing stroboscope:

- 1 red clip to battery positive +
- 2 black clip to battery negative -
- 3 inductive prongs on ignition cable of No. 1 cylinder

Synchronous flashing of the stroboscope is effected with the spark in the No. 1 cylinder or respectively No. 12 cylinder. The inductive prongs are clamped on to the ignition cable to the No. 1 or No. 12 cylinder near the distributor. The prongs will pick up the ignition signal and pass it on to the strobe lamp.

- Start engine
- Direct flash lamp at vibration damper and pointer
- Rotate distributor by hand until the "12° before TDC" cylinder 1 or, respectively, "12° before TDC" cylinder 12 mark can be seen at the level of the pointer edge
- Lock distributor by tightening up the clamping screw
- Then make another check on the ignition timing

Note:

Whenever the marking disc and pointer have been taken off, they should be adjusted again on installation with the aid of the flywheel mark.

- Position engine at ignition TDC of cylinder No. 1
- Rotate engine by means of 32 mm size ring spanner applied to hexagon at centre of crankshaft pulley until the measuring edge of the sight hole in the flywheel housing is at "o.T." (TDC). At this point, the rotor of the distributor for cylinder 1-6 should be above the notch in the edge of the distributor casing and the valves in the No. 6 cylinder should be rocking
- Install hub with marking disc and pointer so that the pointer coincides with the "OTZ 1" (No. 1 cylinder TDC) mark

Spark plugs

The spark plugs should be renewed after every 2000 hours operation.

Only the spark plugs specified under "Technical Data" may be used.

Tightening torque:

- with thread grease 22 Nm
- without thread grease 27 Nm
- (the use of any grease is not recommended).

Installation of spark plugs in hot engine:

- Install spark plugs and tighten by hand without a spanner
- Wait until spark plugs are at the temperature of the engine (at least 2 minutes)
- Then tighten up with torque spanner

To check and adjust valve clearance

(by authorized specialist personnel)

The valve clearance for new and overhauled engines should be checked after the first 10 to 20 hours of operation.

The valve clearance (see "Technical Data") should be adjusted so that the feeler gauge can be moved between the valves stem and the rocker arm with a slight resistance being felt.

Adjustment is made with the adjusting screw after releasing the lock nut.

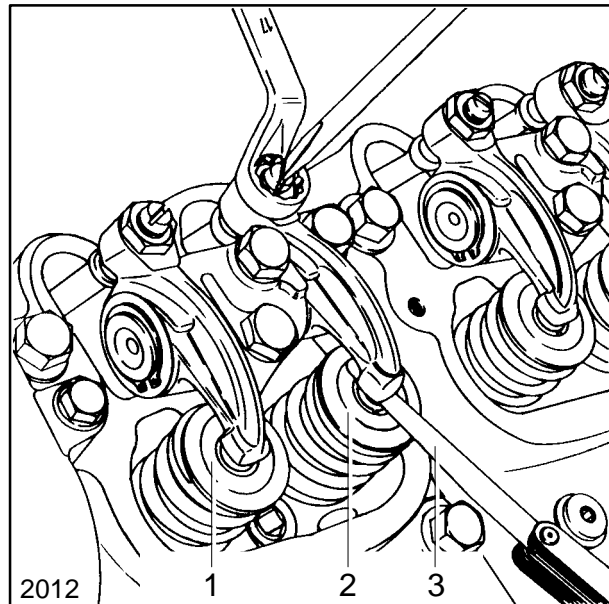
Rotate the crankshaft so that the piston of the cylinder to be adjusted is at firing TDC. This is the case when the valves of the synchronous pistons are just rocking.

Valve rocking on cylinder

1	12	5	8	3	10	6	7	2	11	4	9
6	7	2	11	4	9	1	12	5	8	3	10

Adjust valves on cylinder

To enable the engine to be cranked by hand for adjustments there is a plate fitted to the crankshaft V-belt pulley with a central hexagon driver (barring device).



- 1 Inlet valve
- 2 Exhaust valve
- 3 Feeler gauge

Cylinder head bolts

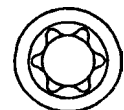
General notes

The engine may have either of the following two types of cylinder head bolt:

- Cylinder head bolts with hex head tightened by the angle-of-rotation method, socket size 19



- Cylinder head bolts with Torx head tightened by the angle-of-rotation method, Torx wrench size E18



Bolts to be used in event of repairs:

Bolts with hex head may be replaced by bolts with Torx head if all the bolts on the engine are to be changed.

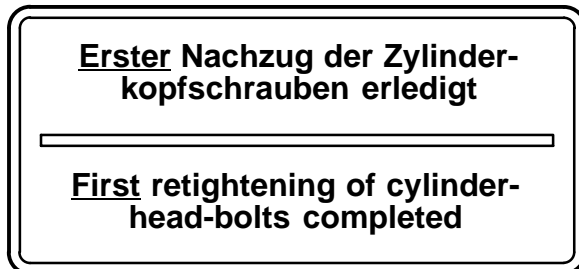
Do not use bolts with hex head and bolts with Torx head on the same engine.

Retightening cylinder head bolts on new engines

(engine cold or warm)

by authorized specialist personnel

The cylinder heads are mounted with cylinder head bolts which are tightened by the angle-of-rotation method. On new engines the cylinder head bolts are tightened up for the first time at the factory after the engine has been broken in. The sticker "**First retightening of cylinder head bolts ...**" is then attached to one of the cylinder head covers.



Spare part No. 51.97801-0211

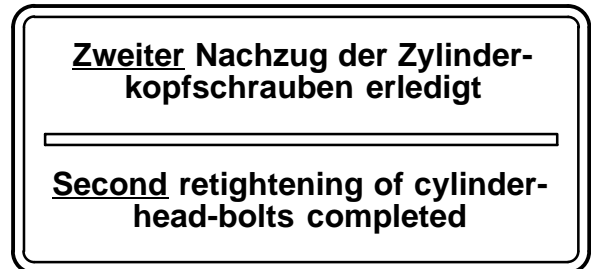
After the first 400 hours of operation retighten cylinder head bolts 1 to 4 in the order shown in Tightening diagram "1" by a further 90° (1/4 revolution).

The two outer screws (intake and exhaust sides) must not be retightened.

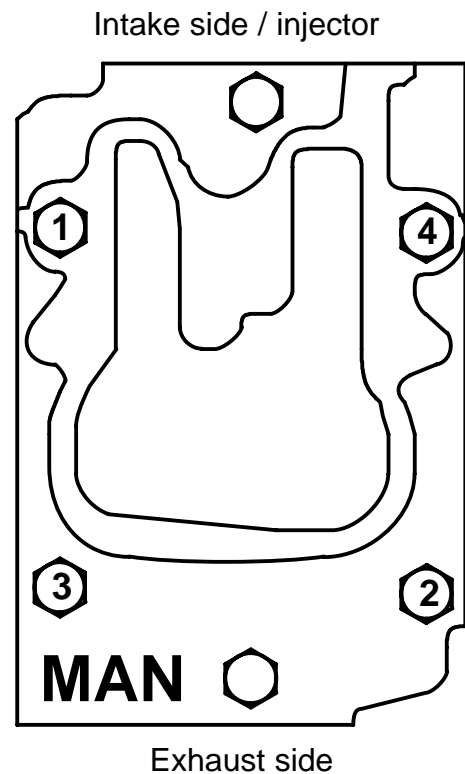
Note:

The cylinder head bolts to be retightened must not be loosened first, but simply tightened by a further 90° (1/4 revolution) from their actual position.

Remove the sticker "**First retightening of cylinder head bolts ...**" and attach the sticker "**Second retightening of cylinder head bolts ...**" to show that the cylinder head bolts have been retightened for the second time.



Spare part No. 51.97801-0212

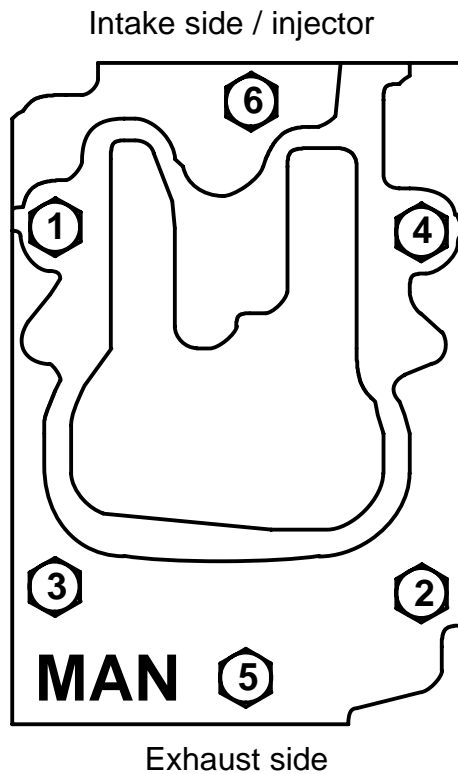


Tightening diagram "1"

Tightening cylinder head bolts after a repair (engine cold)

by authorized specialist personnel

Before inserting the cylinder head bolts oil them with engine oil on the thread (not to the bore) and coat the contact face of the bolt head with "Optimoly White T" assembly paste. Do not use any oils or oil additives that contain MoS₂. The bolts must be tightened by the angle-of-rotation method as shown in Tightening diagram "2".



Tightening diagram "2"

- 1st pretightening step = to 10 Nm
- 2nd pretightening step = to 80 Nm
- 3rd pretightening step = to 150 Nm
- 4th pretightening step = turn by 90°
- Final tightening = turn by 90°

Adjust valve clearance

Retightening cylinder head bolts after repairs (engine cold or warm)

by authorized specialist personnel

After the first 10 to 20 hours of operation after a repair turn the cylinder head bolts by a further 90° (1/4 revolution) in the order shown in Tightening diagram "2".

The cylinder head bolts to be retightened must not be loosened first, but simply tightened by a further 90° (1/4 revolution) from their actual position.

Attach the sticker "**First retightening of cylinder head bolts ...**" (Remove any other stickers which may already be attached).

After the first 400 hours of operation after a repair tighten cylinder head bolts 1 to 4 in the order shown in Tightening diagram "1" again by a further 90° (1/4 revolution).

The two outside screws (intake and exhaust side) must not be retightened.

Attach the sticker "**Second retightening of cylinder head bolts ...**".

Note:

When a cylinder head has been removed the cylinder head gasket must always be changed.

Re-using old cylinder head bolts

Checking

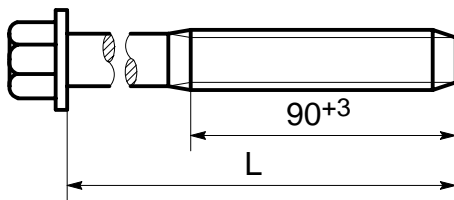
Before re-using old cylinder head bolts check them as follows:

Length

During tightening the bolts are intentionally stressed beyond the yield point and therefore subjected to some permanent elongation each time they are tightened.

The shank lengths "L" of new bolts are 109, 144 and 168 mm.

Permissible maximum lengths are 111, 146 and 170 mm respectively.



A = Angle-of-rotation symbol
L = Shank length

Surface

The surface of the bolts must be in satisfactory condition, i.e. the phosphate coating must be intact and there must be no rust.

Rusted or damaged bolts or bolts elongated beyond the maximum permissible length must immediately be made unusable – e.g. by destroying the threads with a hammer – and scrapped.

V-belts

The tension of the V-belts should be checked after every 200 hours of operation.

Change the V-belts if necessary

If, in the case of a multiple belt drive, wear or differing tensions are found, always replace the complete set of belts.

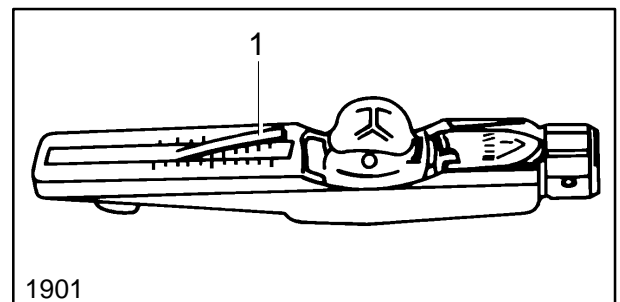
Checking condition

Check V-belts for cracks, oil, overheating and wear.
 Change damaged V-belts.

Testing by hand

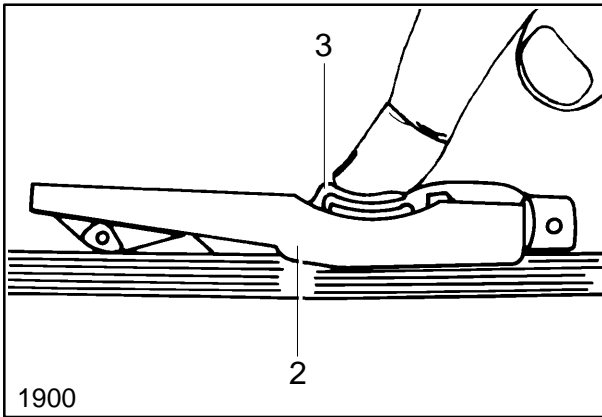
A more precise check of the V-belt tension is possible only by using a V-belt tension tester.

Check with V-belt tension tester



Measuring tension

- Lower indicator arm (1) into the scale
- Apply tester to belt at a point midway between two pulleys so that edge of contact surface (2) is flush with the V-belt



- Slowly depress pad (3) until the spring can be heard to disengage. This will cause the indicator to move upwards

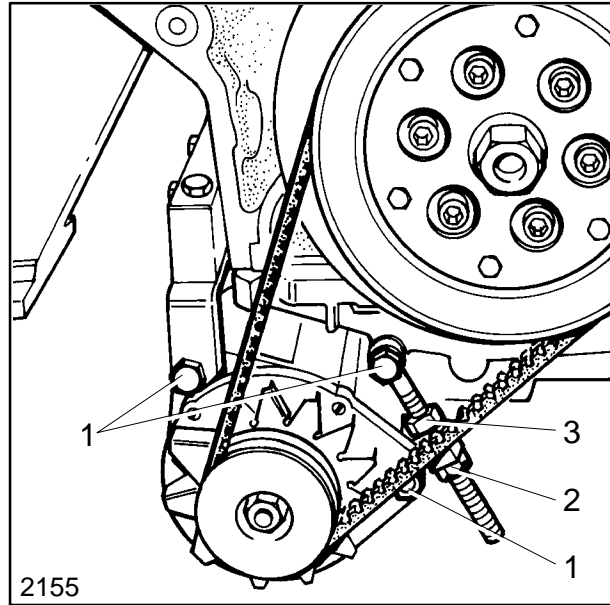
If pressure is maintained after the spring has disengaged a false reading will be obtained!

Reading of tension

- Read of the tensioning force of the belt at the point where the top surface of the indicator arm (1) intersects with the scale
- Before taking readings make ensure that the indicator arm remains in its position

Drive belt width	Tensioning forces according to the kg graduation on the tester		
	New installation		When servicing after long running time
	Installation	After 10 min. running time	
9.5	45–50	40–45	30
10.0	45–50	35–40	30
12.5	50–55	45–50	35
13.0	50–55	40–45	35
20.0	75	70	60
22.0	75	70	60
2/3VX	90–100	70–80	60
3/3VX	135–150	105–120	90

Tension and / or replace V-belts



Alternator

- Remove fixing bolts (1)
- Remove lock-nut (2)
- Adjust nut (3) until V-belts have correct tensions
- Retighten lock-nut and fixing bolts

To replace the V-belts loosen lock-nut and swing alternator inwards.



A series of horizontal dotted lines for writing notes, spanning the width of the page.



Technical data

Model	E 2842 E
Design	V-90°
Cycle	4-stroke Otto-cycle
Number of cylinders	12
Bore	128 mm
Stroke	142 mm
Swept volume	21 930 cm ³
Compression ratio	12.5 : 1
Rating	see engine nameplate
<p>The performance data are for operation on natural gas having a heat value of not less than 36.350 kJ/m³ NTP. If gas with a higher heat value is used, the engine setting should be corrected so that the specified output is not exceeded. If the heat value is lower, there will be a reduction in engine output.</p>	
Firing order	1 - 12 - 5 - 8 - 3 - 10 - 6 - 7 - 2 - 11 - 4 - 9
Valve clearance (cold engine)	
Intake	0.25 mm
Exhaust	0.40 mm
Valve timing	
Intake opens	12° before TDC
Intake closes	48° after BDC
Exhaust opens	61° before BDC
Exhaust closes	11° after TDC
Ignition timing	12° crank angle before TDC
Compression	16 bar minimum (with 130-150 /min starting speed)

Technical data



Engine lubrication	Force feed lubrication
Oil pressure at rated speed	3.5 ... 5.0 bar
at 1500 rpm	2.5 ... 3.5 bar
at no load	1.2 ... 1.5 bar
Lube oil filter	full-flow type with paper element
Oil capacity in oil sump (litres)	min. max.
Shallow	14 l 20 l
Deep	12 l 18 l
Engine cooling system	Liquid cooling
Speed governor	
Make	Heinzmann
Type	electronic
Model	E 6
Ignition system	
Make	Bosch
Type	transistorized contactless (TSZ-i)
Spark plugs	
Make	Champion
Type	RN 79 G
Electrical equipment	
Starter	24 V; 5.4 kW
Alternator	K1; 28 V; 35 A

ALWAYS COMPLY WITH SAFETY REGULATIONS !

Maintenance jobs	Maintenance cycles *								
	1	2	3	4	5	6	7	8	9
Check coolant level and oil level in engine	•								
Change engine oil in oil sump (see also page 51)		•		•					
Change oil filter cartridge (see also page 51)		•		•					
Check and if necessary correct V-belt tension		•		•					
1st retightening of cylinder head bolts (with overhauled engine)		•							
Check and if necessary adjust valve clearance		•	•	•					
Check that removable unions (bolts, hose clips, pipe fittings) are firmly in position and, if necessary, retighten		•							
2nd retightening of cylinder head bolts (with new or overhauled engine)			•						
Service the air cleaner (earlier if severe operating conditions demand it)				•					
Change spark plugs					•				
Check ignition timing					•				
Check compression pressure					•				
Change distributor rotor and cap						•			
Check throttle valve shaft bearings in gas mixer for leakages						•			
Check anti-freeze concentration							•		
Check pressure drop through gas filter, clean elements, if necessary								•	
Check complete gas regulating station and metal hose connection to gas mixer for gas leakages								•	
Change coolant, renew filler cap and working valve of cooling system									•
Check gas pressure monitor, isolating valves of gas lock and gas pressure regulator									•

- * 1 – Daily
 2 – After the first 10 to 20 hours of operation (with new or overhauled engine)
 3 – After the first 400 hours of operation
 4 – Every 600 hours of operation *)
 5 – Every 2000 hours of operation
 6 – Every 6000 hours of operation
 7 – Every 3 months
 8 – Every 6 months
 9 – Yearly

*) Interval to be reviewed on the strength of practical experience.

Approved Engine Oils

Oil quality

The following brands of engine oils should be used

1. Special gas engine oils

AVIA AG	AVILUB Gasmotorenöl E 30	SAE 30
	AVILUP Gasmotorenöl E 40	SAE 40
Deutsche Shell AG	SHELL V-OEL 7078	SAE 30
	SHELL V-OEL 7107	SAE 40
	SHELL MYSELLA T ÖL	SAE 30
ESSO AG	ESSOLUBE P 30	SAE 30
	ESSOLUBE PX 30	SAE 30
	ESSOLUBE PC 40	SAE 40
FINA Deutschland GmbH	FINA Gasmotorenöl D 1148	SAE 30
MOBIL OIL AG	MOBIL Gasmotorenöl DM 30	SAE 30

2. Synthetic gas engine oils

Deutsche Shell AG	SHELL-OEL G 758 S	SAE 30W-40
ESSO AG	GASMOTORENÖL PS	SAE 20W-40
MOBIL OIL AG	MOBIL Gasmotorenöl S	SAE 5W-30

Other oils upon request

Note:

If cold starts, i.e., starts at ambient temperatures below +10 deg C are excluded, SAE 40 may also be used.



Index

A			
Adjusting the ignition timing	40		
Air cleaner	16, 36–38		
Alternator	17, 28		
Approved Engine Oils	51		
C			
Checking and setting	39–46		
Combustion system	12		
Commissioning and operation	28–30		
Cooling	16, 33–35		
Cooling circuit			
Cleaning outside of radiator	33		
Descaling	34		
Filler caps and working valves	35		
Internal cleaning	34		
Cylinder head bolts	42–45		
D			
Declaration	3		
Draining of coolant	33		
During operation	28		
E			
Electrical equipment	17		
Engine	12		
Engine block	12		
Engine lubrication	14, 31		
Engine oil level	28		
Engine timing	13		
Engine views	10		
F			
Filling-in of coolant	33		
G			
Gas supply system	22		
I			
Gas supply system	22		
L			
Lubricating oil filter	32		
M			
Maintenance and care	31–38		
Maintenance chart	50–51		
N			
Nameplates	4		
O			
Oil cooler	15		
Oil drainage	31		
Oil level	31		
P			
Piston / Conrod / Crank assembly	12		
Preparations	28		
R			
Refilling with oil	31		
S			
Safety regulations	5–9		
Safety regulations: Summary			
Handling parts containing asbestos	9		
Handling used engine oil	8		
Preventing accidents with injury to persons	5		
Preventing damage to engine and premature wear	7		
Preventing environmental damage	8		
Shutting down	29		
Sources of supply for pickling fluids	35		
Spark plugs	42		
Starter motor	17		
Starting	29		
T			
Technical data	48–49		
Technical information	10–27		
Temporary decommissioning	30		
Tightening up cylinder head bolts	43		
To check and adjust valve clearance	42		
V			
V-belts	45		
Valves	13		
W			
Waste water treatment	35		



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