Operating Instructions for MAN Industrial Gas Engines

E 0824 E 301 / 302
E 0826 E 301 / 302

Dear Customer,

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

Note:
This publication applies 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 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.

MTDA Technical status: 05.1998 51.99493-8466

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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

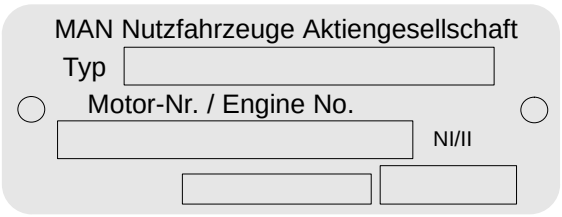
In all your correspondence please always quote engine model, serial number and job number (Order number).

For this reason it is advisable to read off the data from the engine type plates before putting the engine into operation and to enter them in the appropriate spaces.

The engine type plates are on the crankcase.

Model . . . . . .

Engine serial number . . . . . .



Gaseous fuels consist basically of methane, propane, butane, traces of higher–order hydrocarbons and of inert components such as carbon dioxide and nitrogen.

When commissioning, starting and operating the gas engine, observe the following without fail:

- Smoking or the use of a naked flame are prohibited.

- Leaks in the gas supply system represent an explosion risk and must be eliminated without delay.

- Fire extinguishers and other fire-fighting equipment must be kept close at hand.
- Inflammable material must not be stored in the engine room.

What must be done in the event of a gas leak?

- Close the shut-off tap for the gas supply.
- Turn off main switch for the electrical system.
- Cordon off danger area. Order unauthorised persons to leave the danger area.
- If gas is escaping, inform the relevant authorities without delay and make arrangements for repair work.

What must be done if fire breaks out?

- Alert the fire brigade.
- Assist any persons who may be in danger.
- If the fire is a pure gas fire, the escaping gas flame must not be extinguished.
  Cool the burning object if necessary.
  Burning gas = controlled gas!
- If the flames spread to the surrounding area, fight the fire with extinguishers.

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, fuel penetrating the skin, scalding from hot oil, anti-freeze being splashed in the eyes etc., ***consult a doctor immediately.***

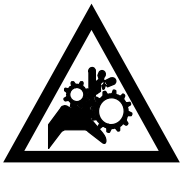
1. Regulations designed to prevent accidents with injury to persons

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. Comply with the instructions for the installation of MAN Diesel engines which are to be operated in enclosed spaces. 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. If the engine has to be maintained while it is running, e.g. changing the elements of change-over filters, remember that there is a risk of scalding. Do not get too close to rotating parts.

- 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 checking injectors do not put your hands under the jet of fuel. Do not inhale atomised fuel.
- When working on the electrical system disconnect the battery earth cable first. Connect it up again last in order to prevent short circuits.

- When welding comply with the “Instructions for welders”.

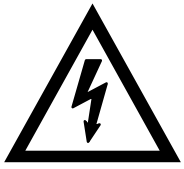
When working on the electronic ignition system

The firing power of electronic ignition systems is significantly higher than that of conventional, mechanically controlled systems.

As a result, electronic ignition systems work in a voltage range which in the event of physical contact with energised parts (of both primary and secondary circuits) may be extremely dangerous.

In this context we refer you to the relevant VDE instructions, particularly to VDE 0104/7.67, which must be complied with in all work on and checks of the ignition system.

- When working on the ignition system, always switch off the ignition. Such work comprises the installation of cable harnesses in commissioning procedures and the exchange of parts (spark plugs, ignition cables etc).



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

Do not demand more from the engine than it is able to supply in its intended application. Detailed information on this can be found in the sales literature. The injection pump must not be adjusted without prior written permission of MAN Nürnberg.

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.
- When starting do not use any additional starting aids (e.g. injection with starting pilot).
- 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.***
- Always ensure that the testing and monitoring equipment (for battery charge, oil pressure, coolant temperature) function satisfactorily.

3. Regulations designed to prevent pollution

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

- Take old oil only to an old oil collection point.
- Take strict precautions to ensure that no oil or Diesel fuel gets into the drains or 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 anti-freeze 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.

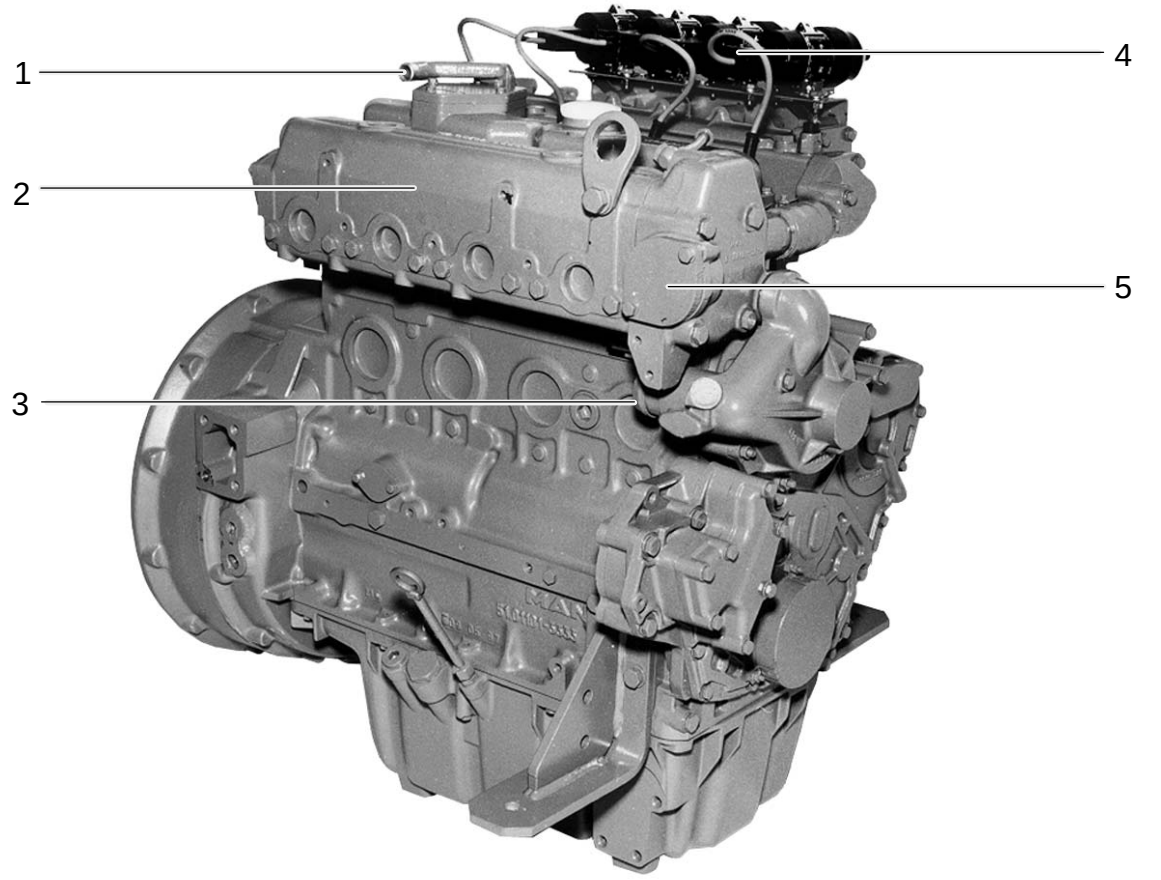
Ensure that used engine oil is disposed of properly
– Engine oil can endanger the water supply –

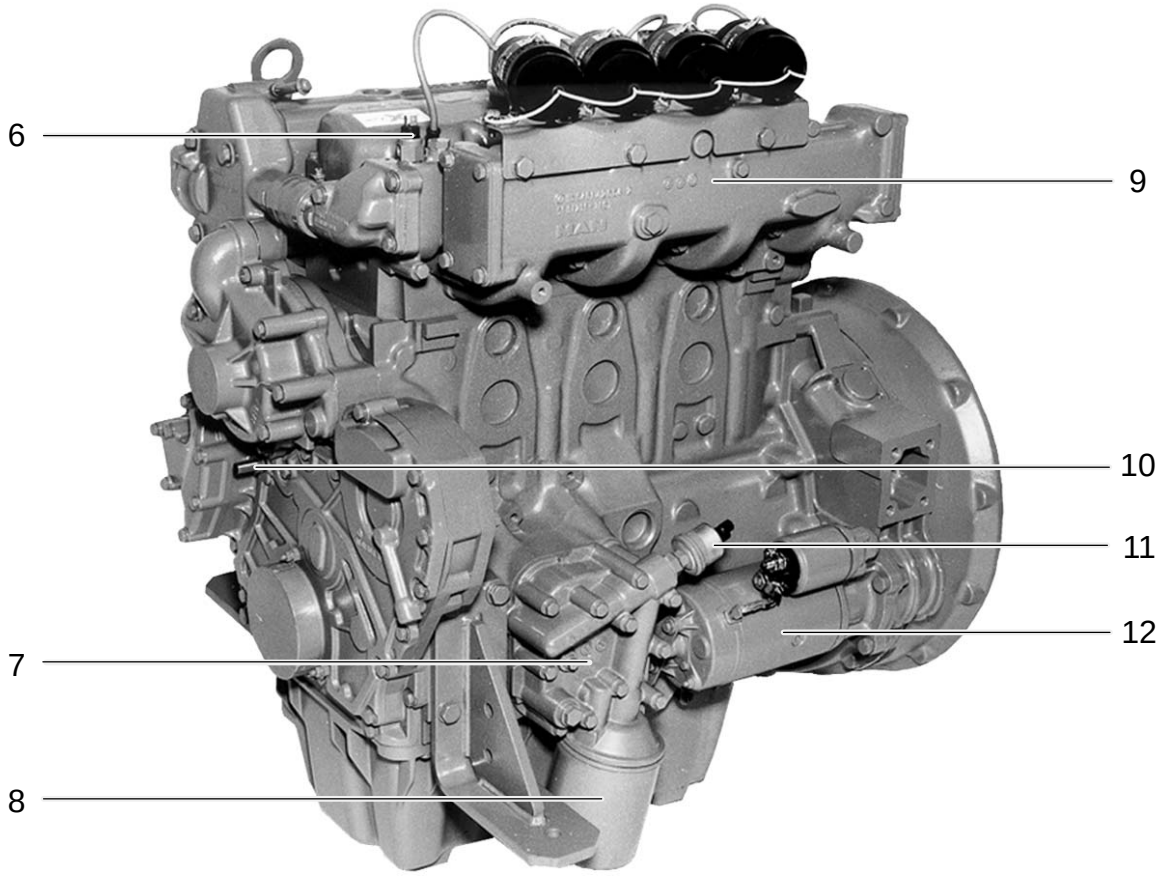
For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations are punishable.

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”.

Engine views E 0824 E 301 / 302





1 Crankcase breather

2 Fluid-cooled exhaust-gas collector pipe

3 Coolant inlet

4 Ignition coils (accessory)

5 Coolant outlet (In the picture it is closed up by a blind flange)

6 Coolant temperature transmitter

7 Oil cooler

8 Oil filter

9 Intake pipe

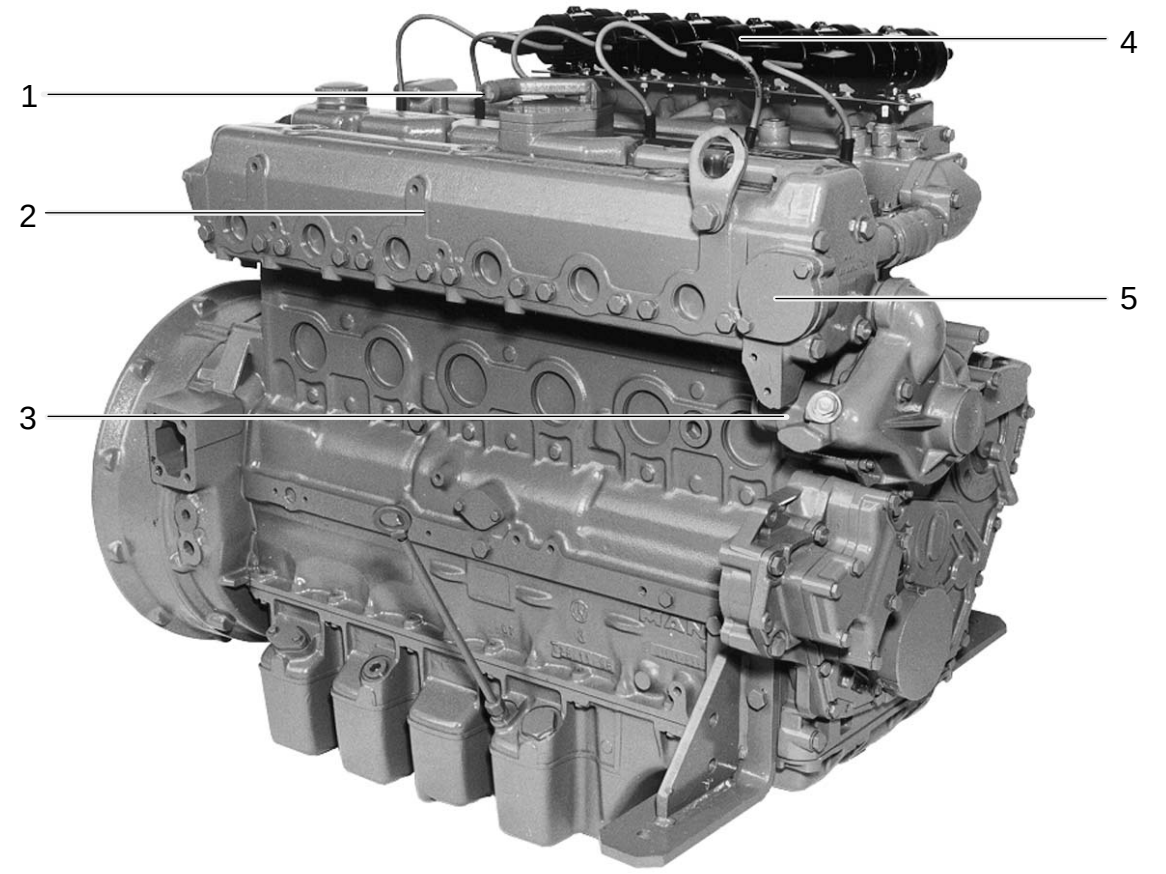
10 Pulse recorder for ignition system (accessory)

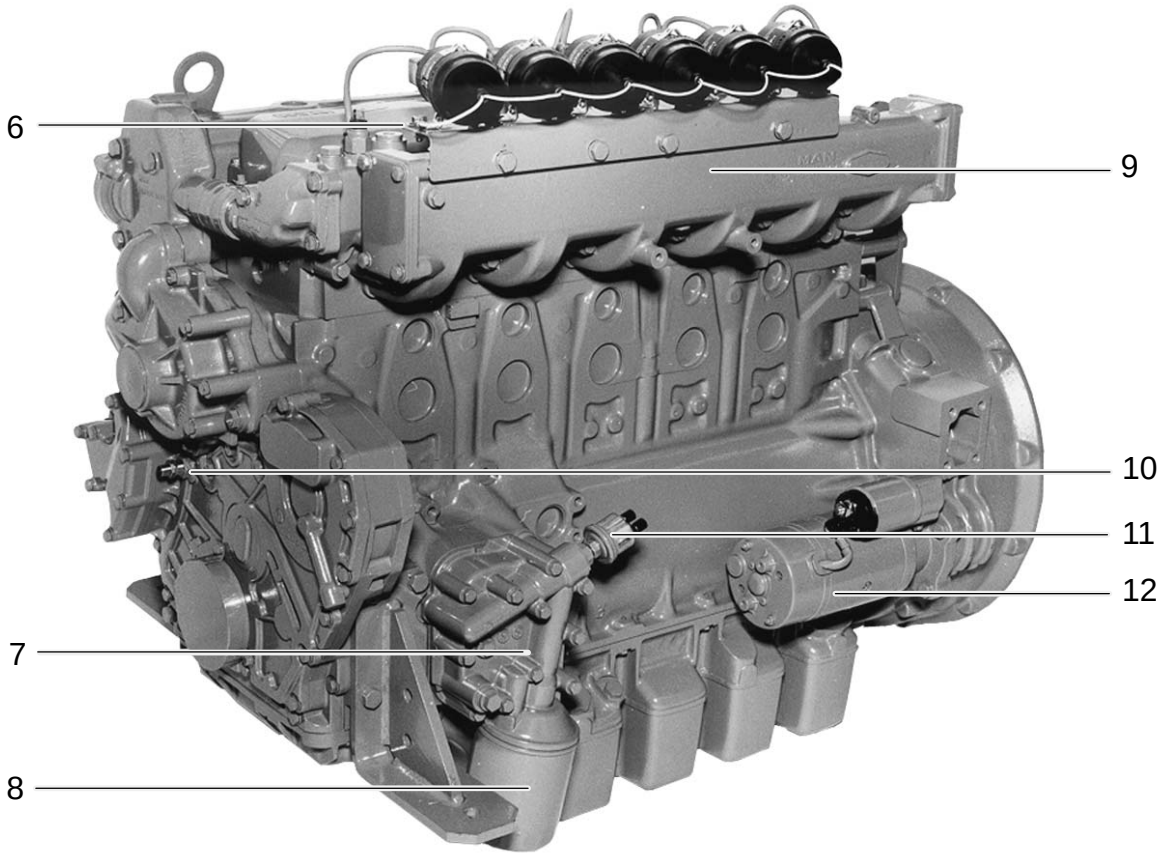
11 Oil pressure transmitter

12 Starter

Note:
The gas tract, which consists of ball valve, gas filter, solenoid valve, gas pressure governor, gas mixer and air filter, is not part of MAN's extent of delivery.

Engine views E 0826 E 301 / 302





1 Crankcase breather

2 Fluid-cooled exhaust-gas collector pipe

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Note:
The gas tract, which consists of ball valve, gas filter, solenoid valve, gas pressure governor, gas mixer and air filter, is not part of MAN's extent of delivery.

First commissioning

Filling-in of coolant

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 “Fuels, Lubricants and Coolants for MAN Industrial Gas Engines”).

- Comply with the filling instructions of the cogeneration–plant manufacturer
- Slowly fill up with coolant (max. 10 l/min.)

Filling with engine oil

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 engines are as a rule supplied without oil.

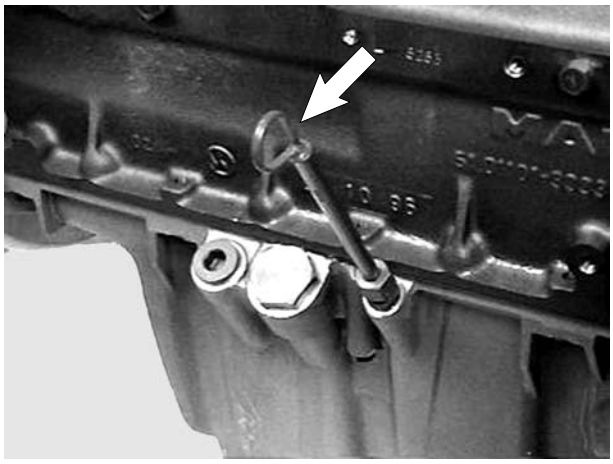
Pour oil into engine via filler neck.

For the quantity required see “Technical Data”.

Note:
Use approved service products only (see “Fuels, Lubricants and Coolants for MAN Industrial Gas Engines”); non-compliance renders warranty claims against manufacturer null and void.

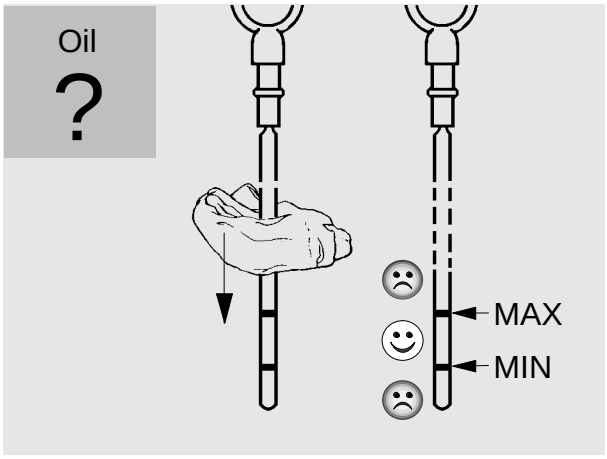
Ensure outmost cleanliness when handling lubricants and coolants.

Checking oil level



Check the oil level at least 5 minutes have passed since the machine was switched off.

- Pull out dipstick (arrow)
- wipe it with a clean, lintfree cloth
- and push it in again up to the stop
- Pull out dipstick again



The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary.

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.

Ensure outmost cleanliness when handling lubricants and coolants.

The control unit (option)

Purpose of the control unit

The control unit records the respective crank angle of the engine at very short intervals and calculates from these data the time for triggering the ignition pulse for each and every cylinder.

Positioning of the control unit

The control unit is arranged close to the engine so that the following conditions are met:

- Mounted on a stable support, with vibration damping by rubber elements if necessary
- Max. ambient temperature 70°C
- Earthing strip run from housing of control unit to the engine

> **Danger:**
> Disconnect battery before doing any work on electric cables or making adjustments to the control unit as described here!

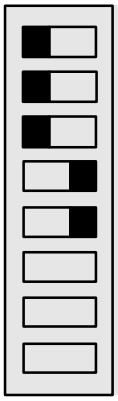
Adjusting ignition sequence and timing

The same control unit is used for the 4-cylinder and the 6-cylinder engine.

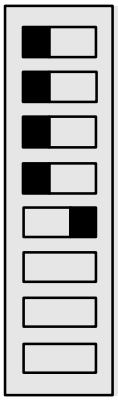
The ignition sequence and timing must therefore be set before the unit is used for the first time. To do this, unscrew the cover (see arrow in upper figure). You will now see 2 potentiometers and a switch panel with a total of 8 switches.

The first 5 switches are set to the positions shown on the right using a small screwdriver.

Switches 6, 7 and 8 are not required.



Control unit setting for the 4-cylinder E 0824 E engine



Control unit setting for the 6-cylinder E 0826 E engine

Connecting the control unit

Two cable harnesses are supplied with the engine:

- The cable harness for the input signals to the control unit
- The cable harness for the output signals from the control unit

The plugs (14-pin and 10-pin) are designed to prevent them from being inserted in the wrong socket.

The cable harness for the output signals from the control unit is already connected to the engine.

For circuit diagrams, see page 39.

Starting

> **Danger:**
> Before starting the engine, ensure that nobody is in the danger area around the engine.

Operation with asynchronous generator

- 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 (gas mixer is not part of MAN's extent of delivery).
- Switch on ignition.
- Solenoid valve for gas supply opens (not part of MAN's extent of delivery).
- Engine will start firing and run up to 1,300 to 1,400 rpm without generator load on idling gas flow.
- The starting control will move the throttle valve into operating position. Simultaneously, the generator will be connected to the system.

Operation with synchronous generator

- Operate starter and crank engine with gas supply shut off and without ignition for a few seconds (air purge). The electronic speed governor (not part of MAN's extent of delivery) has to be switched on at the same time.
- Switch on ignition.
- Solenoid valve for gas supply opens (not part of MAN's extent of delivery).
- Engine will start firing.
- The electronic speed governor (nicht Lieferumfang von MAN) maintains the engine speed at the value set on the set-point potentiometer.

> **Danger:**
> Ensure that the engine cannot be started by unauthorised persons.

System monitoring

Caution:
In the event of faults have their cause immediately ascertained and rectified so that no major damage will occur.

During operation the oil pressure of the engine lubrication and the coolant temperature are to be monitored.
If the monitoring devices indicate a drop in lube oil pressure or coolant excess temperature, the engine is to be switched off immediately.

Prolonged idling while engine is cold is to be avoided, because this, as is well known, exposes all internal combustion engines to increased wear through corrosion. Letting the engine idle over prolonged periods is detrimental to the environment.

Switching off

After operation at full load let engine idle for about 5 minutes.

- Solenoid valve for gas supply closes.
- Engine runs down.
- After about 5 seconds the ignition system and the electronic speed control are switched off.

Danger:
Chronologically speaking, the gas supply is always to be switched off before the ignition system, so that no unburned residual amounts of gas can get into the exhaust-gas pipe.

In the event of damage to the solenoid valve, **never switch off via the ignition system.**

- Shut main shut-off cock.
- Switch off ignition system only after engine has stopped.

Lubrication system

Draining of engine oil and changing of filters

Caution:
Used oil and oil filter cartridges are dangerous waste.
Observe safety regulations to prevent damage to the environment.

When engine is at operating temperature, remove oil drain plug from oil pan and let old oil drain out completely.

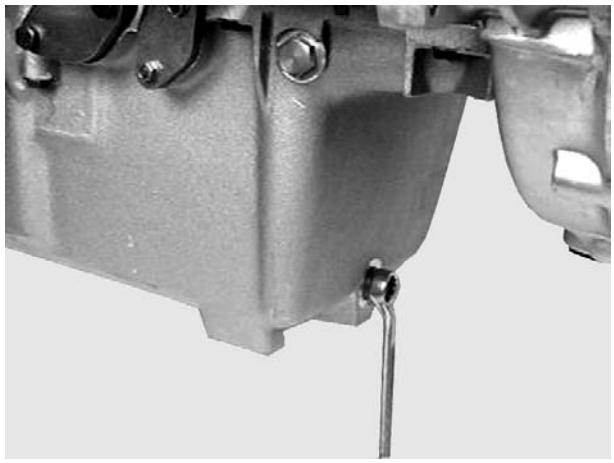
To catch emerging oil, use a container of sufficient capacity to prevent the oil from spilling over.

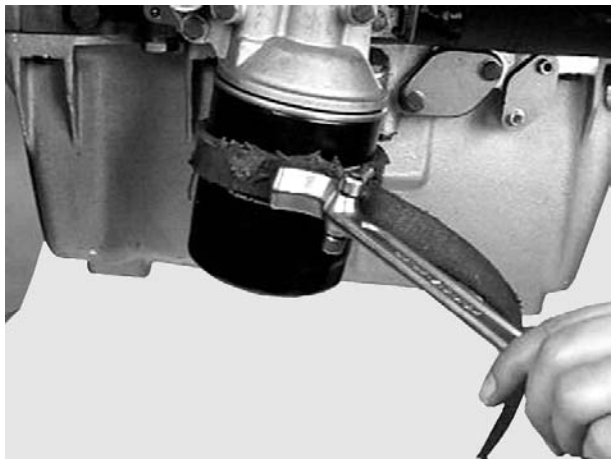
Loosen oil filter cartridge by means of a tape wrench and remove it. The oil filter cartridge is filled with oil even if the oil pan is empty.

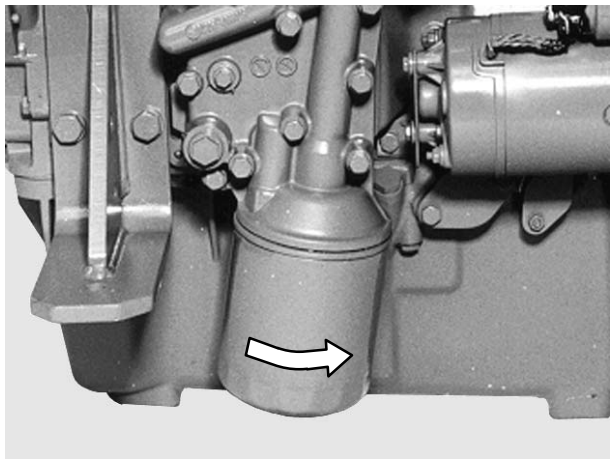
Danger:
The oil is hot- risk of scalding. Do not touch the oil drain plug with bare fingers. Oil is an environmental hazard. Handle it with care!

Fit new oil filter cartridge, lubricate seal lightly and tighten cartridge by hand.

Refit drain plugs with new seals.





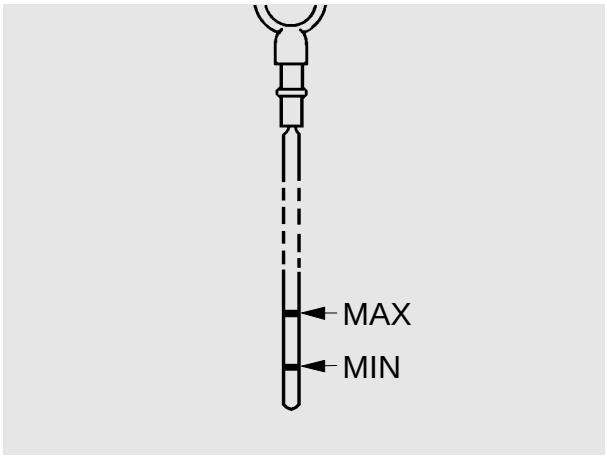


Refilling with oil

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.

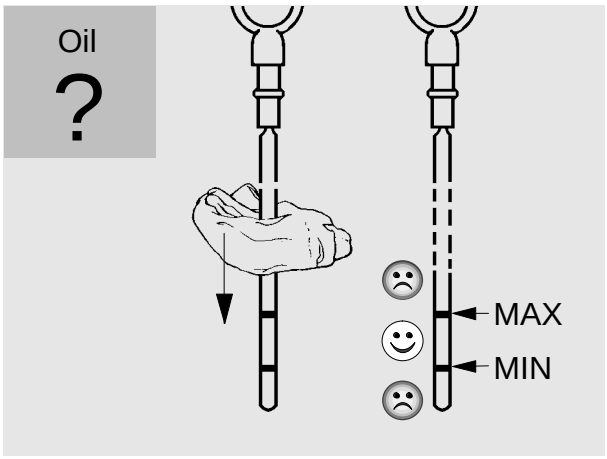
Fill up with fresh engine oil via oil filler neck on cylinder head cover.

After the filling operation start engine, let it idle for a few minutes and then check oil pressure and for leaks.
Switch off engine and check oil level after five minutes.



- Pull out dipstick
- wipe it with a clean, lintfree cloth
- and push it in again up to the stop
- Pull out dipstick again

The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary.



Note:
Use only approved engine oils for natural-gas engines (see “Fuels, Lubricants and Coolants for Industrial Gas Engines”); non-compliance renders warranty claims against manufacturer null and void.

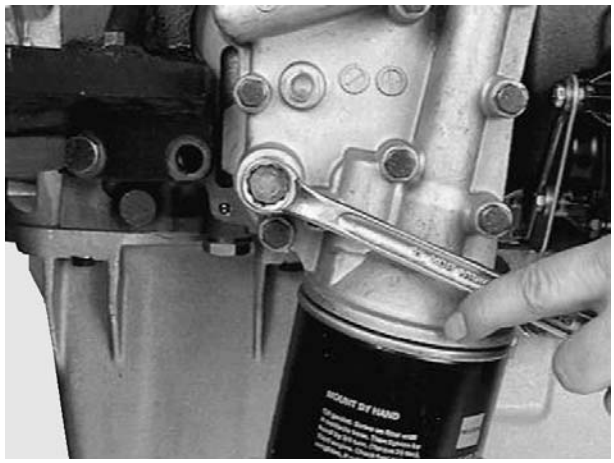
Cooling system

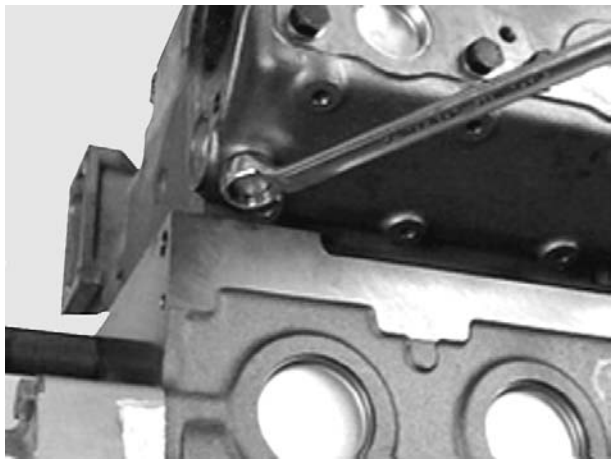
Danger of scalding
when draining hot coolant. Collect coolant as it is drained off and dispose of it correctly!

Draining coolant

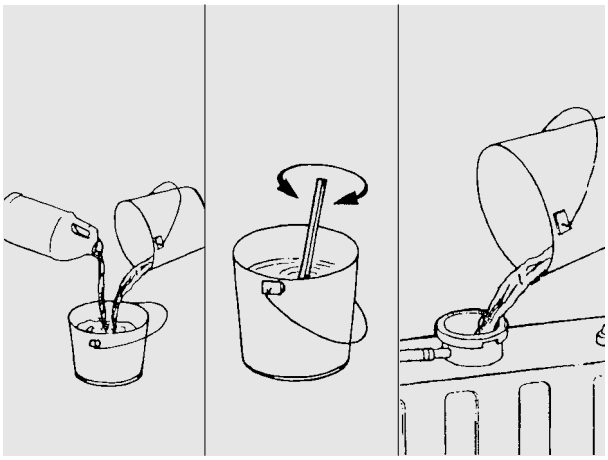
Make sure the engine has **cooled down**. Then drain the coolant as follows:

- Open filler cap of coolant reservoir (not supplied by MAN) to permit pressure equalisation.
- Unscrew drain plugs (see pictures, wrench fitted to drain plug) and take off caps.
- Drain coolant, using a container of sufficient capacity to catch emerging fluid.
- Refit drain plugs.
- Refill / bleed cooling system.



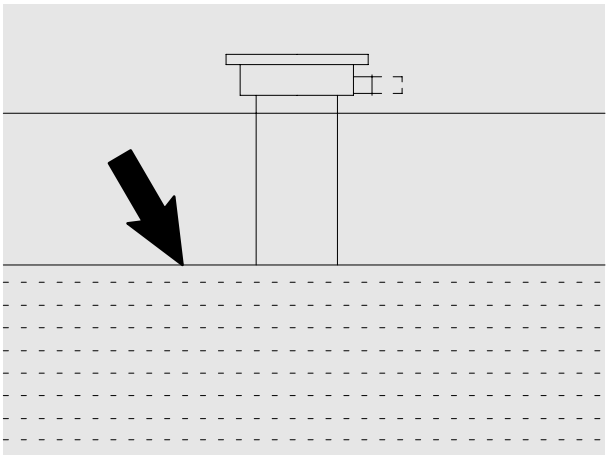


Adding coolant / Bleeding cooling system
(when engine has cooled down)



The engine cooling system should be filled with a mixture of potable tap water and antifreeze based on ethylene glycol and anti-corrosion agent (see “Fuel, Lubricants and Coolants for MAN Industrial Gas Engines”).

Coolant must be added in accordance with the filling instructions issued by the manufacturer of the block-type thermal power plant. Do not add cold coolant to a warm engine. Ensure that the water / antifreeze ratio is the same as before addition of the coolant.



- Unscrew cover
- Add coolant slowly
- Screw the cover back on
- Run the engine for a short time and then check the coolant level again.

Danger:
If in exceptional circumstances, it is necessary to check the coolant level when the engine is warm or to open the cooling circuit, the safety instructions of the manufacturer of the power plant must be followed.

Incorrect addition of antifreeze and anti-corrosion agent may lead to deposits of lime and rust in the engine coolant circuit, which impairs the cooling effect.
In such cases the coolant circuit must be cleaned at suitable intervals.

Removal of lime deposits in the cooling system

Procedure:

- Drain the coolant
- Fill the system with undiluted original pickling fluid (Lithsolventsäure or engine pickling fluid RB-06)
- 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 (see “Fuels, Lubricants and Coolants for MAN Industrial Gas Engines”)

Note:
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.

Spark plugs

Special spark plugs have been developed for industrial gas engines in continuous operation.

Use only the plugs specified in the ”Technical Data”.

We recommend that you do not adjust the spark gap on these special plugs (see “Technical Data”).

Fit new spark plugs every 2,000 hours of operation.

> **Danger:**
> High voltage! Do not remove spark plug connectors while engine is running.

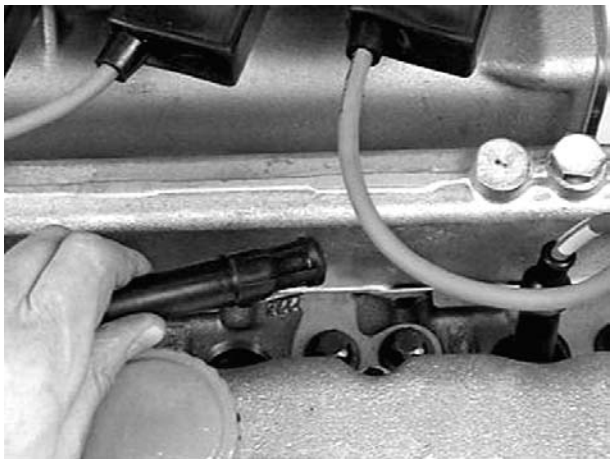
Fitting plugs when the engine is cold:

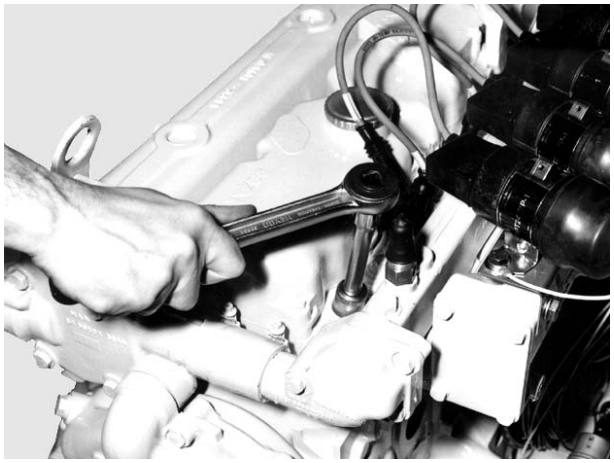
Tightening torque: 27 Nm

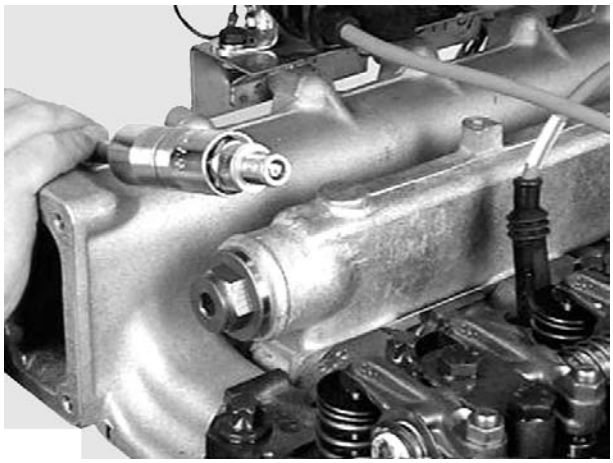
(do not grease spark plug thread)

Fitting plugs when the engine is warm:

- Insert spark plugs and tighten by hand.
- Wait until the plugs have reached the temperature of the engine (at least 2 minutes).
- Tighten with a torque wrench.







Air filter

The air filter is not part and parcel of MAN's extent of delivery. Concerning maintenance and cleaning work, the regulations of the cogeneration-plant manufacturer are to be heeded.

Starter motor

Check that the electric cables are properly fastened and that contacts and plug connections are secure.

Caution:
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.

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.

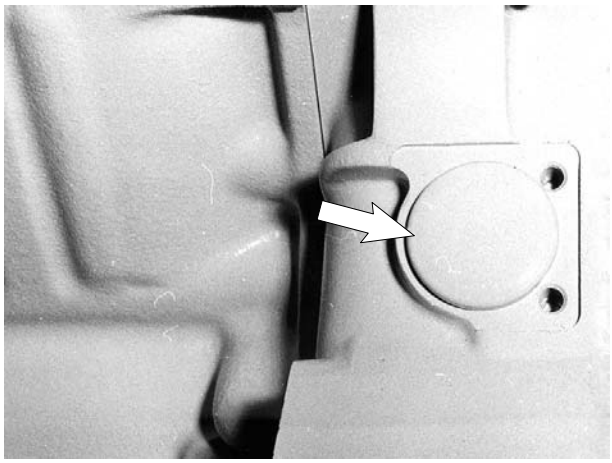
The works norm can be obtained from our After-Sales Service department, VEMS-N, Nuremberg works.

Adjusting ignition timing

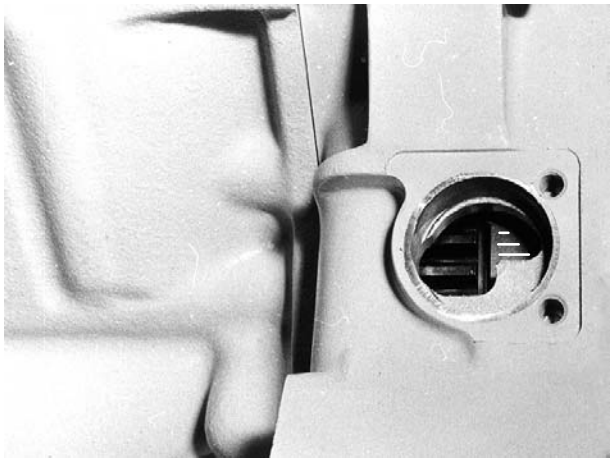
Checking ignition timing

Ignition timing should be checked every 2,000 hours of operation.

Open cover on flywheel housing (arrow). Before the first cylinder reaches TDC, you will see angle markings on the flywheel. These range from 40° before TDC to 0°. There is a reference edge on the flywheel housing to act as a corresponding marker.



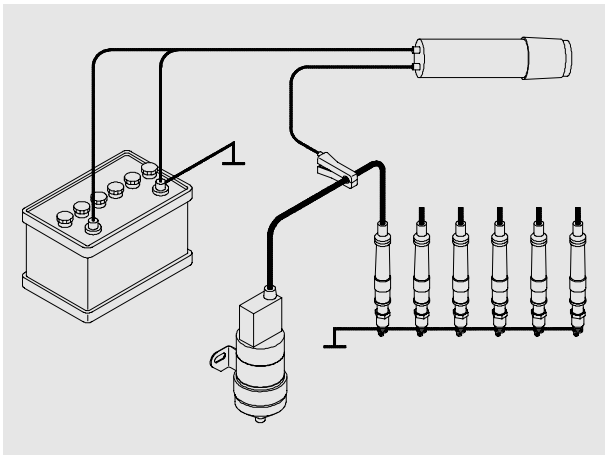
The ignition point depends on the air ratio λ at which the engine is being operated. The setting is correct when ignition in cylinder 1 takes place at 16° before TDC for λ = 1 or 8° before TDC for λ = 1.5.



Check and set the ignition point with a stroboscopic lamp. This must be done with the engine running.

Connect up the stroboscopic lamp as follows.

- Connect connecting cable to the battery terminals: red clamp to positive terminal, black clamp to negative terminal.
- Attach the inductive clamp transducer to the ignition cable of cylinder 1 (end remote from flywheel).

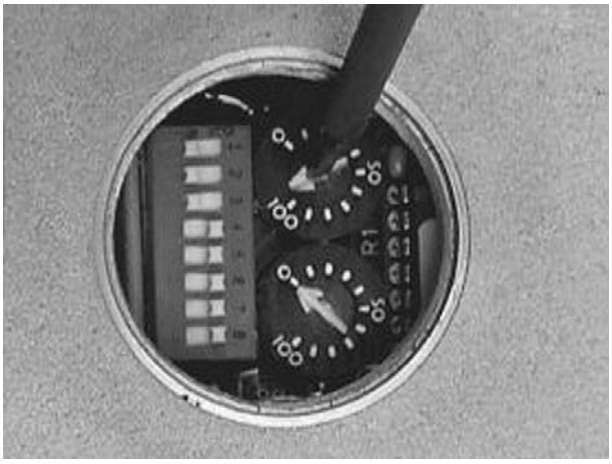


The clamp transducer senses the ignition pulse and transmits it to the stroboscopic lamp. The lamp flashes simultaneously with the ignition spark of cylinder 1.
If the stroboscopic lamp is pointed at the inspection hole, the selected ignition marking appears to be stationary.

Adjusting the ignition timing

The ignition point is adjusted at the control unit (accessories).

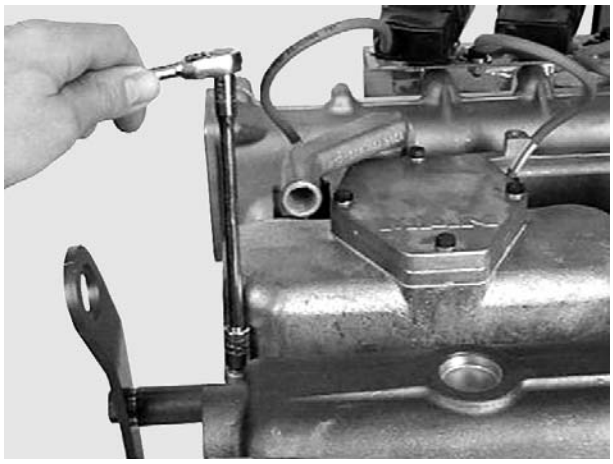
- Unscrew the cover from the control unit.
- Start engine.
- Point stroboscopic lamp at scale on flywheel and the corresponding marker.
- Adjust the control unit's upper potentiometer (screwdriver point in the upper figure) until the 12° marking on the flywheel and the edge in the inspection hole of the flywheel housing coincide.

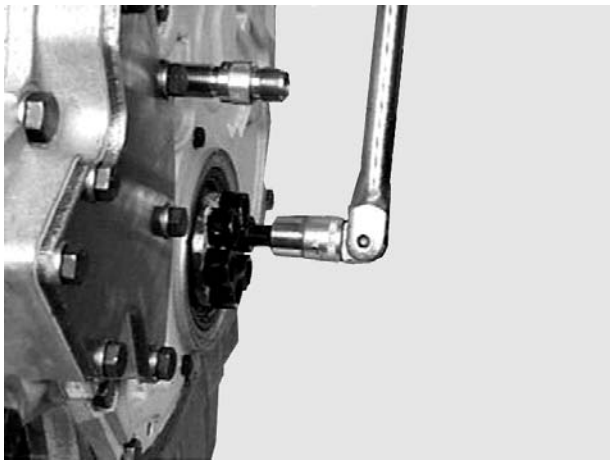


The timing adjustment range is limited by the left–hand and right-hand stops of the potentiometer. It corresponds to 16° of crank angle.

- Turning the potentiometer in the clockwise direction "retards" the ignition (adjustment towards TDC).
- Turning the potentiometer in the anticlockwise direction "advances" the ignition (adjustment away from TDC).

Adjusting the overspeed setting





To protect the engine from mechanical damage if the governor fails – which would allow an uncontrolled increase in engine speed – there is a facility for setting a maximum speed which cannot be exceeded.
The selected overspeed should be sufficiently above the rated speed but below the maximum speed allowed by the valve gear.

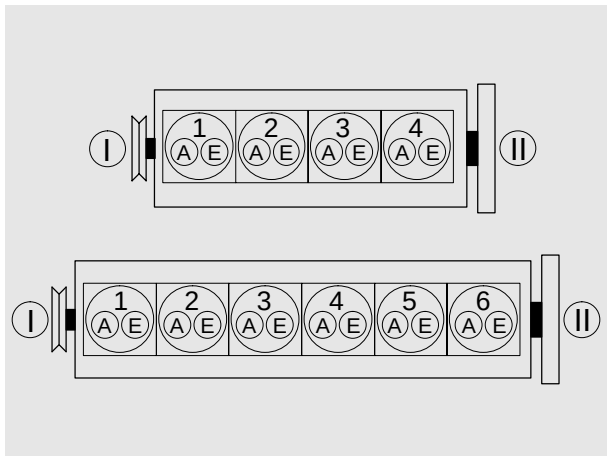
The rated speed is 1,500 rpm for driving alternators with a frequency of 50 Hz.
The maximum speed is 2,800 rpm.

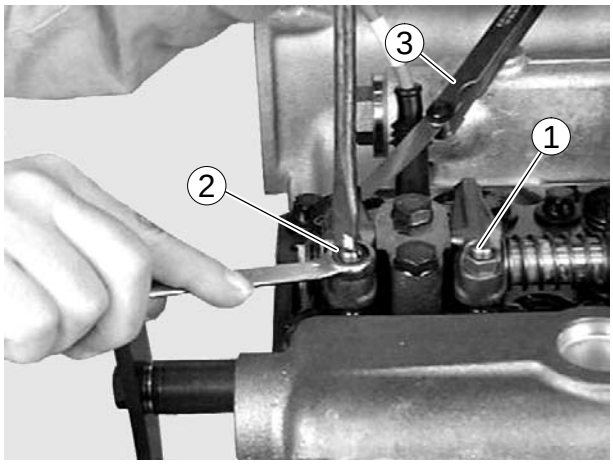
A safety speed of 2,000 rpm can therefore be set, for example.

Setting an overspeed of 2,000 rpm:

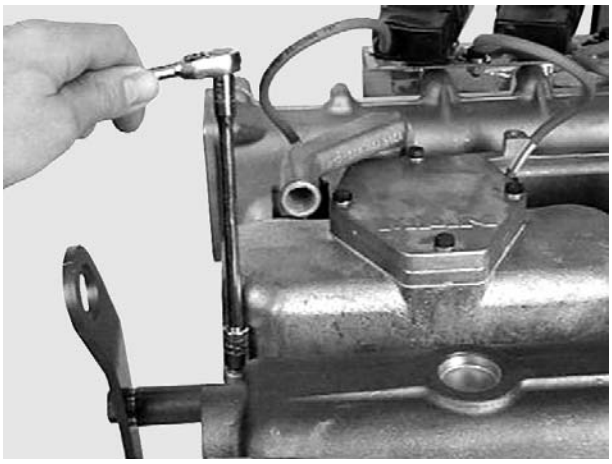
- Open cover on flywheel housing.
- Turn lower potentiometer (arrow) clockwise with a small screwdriver as far as the stop.
- Connect lead J at control unit input to earth. This halves the value set for the overspeed.
- Start engine and run at 1,000 rpm.
- Turn the potentiometer slowly in the anticlockwise direction until engine stalls.
- Disconnect lead J from earth.

If a fault occurs in the speed governing system, the engine is then switched off if its speed exceeds 2,000 rpm.



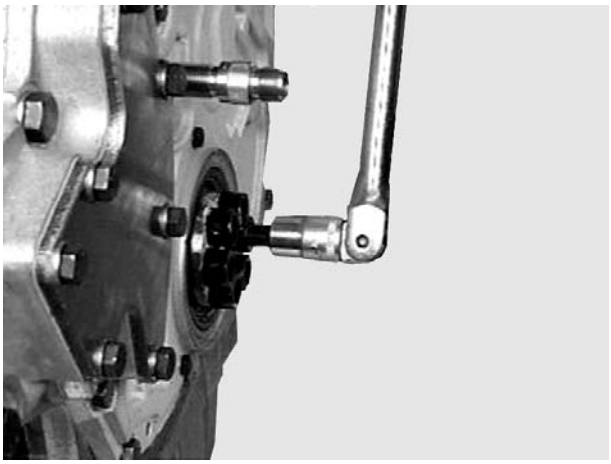


Adjusting valve clearances



Only adjust the valves when the engine is cold (maximum coolant temperature 50°C).
Remove cylinder head covers.

Turn the engine over until the piston of the cylinder to be adjusted is at ignition TDC and the rockers are relieved of load. The valves of the synchronous cylinder are then on overlap.



E 0824 E 301 / 302
Valves rocking on cylinder

1	3	4	2
4	2	1	3

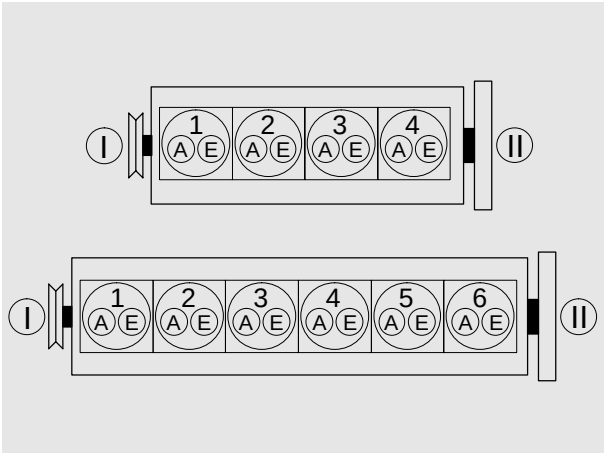
Adjust valves on cylinder

E 0826 E 301 / 302

Valves rocking on cylinder

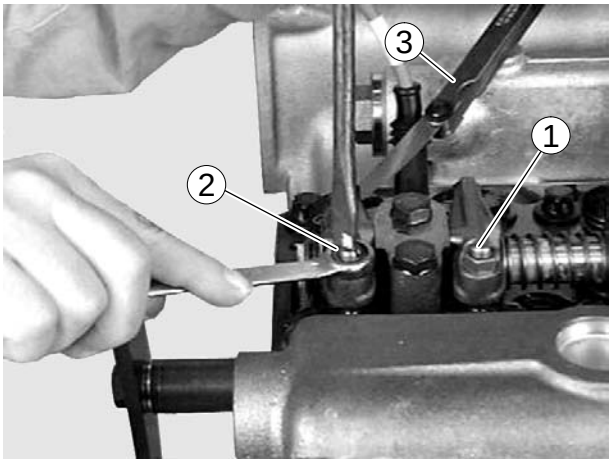
1	5	3	6	2	4
6	2	4	1	5	3

Adjust valves on cylinder



The valve clearance (see “Technical Data”) is to be set so that the feeler gauge can be moved between the valve stem and the rocker arm against slight resistance.

For adjustment, loosen counter nut and adjust setting screw.



1 Exhaust valve
2 Inlet valve
3 Feeler gauge

Model	**E 0824 E 301 / 302**
Design	in-line, vertical
Cycle	4-stroke Otto-cycle
Number of cylinders	4
Bore	108 mm
Stroke	125 mm
Swept volume	4,580 cm^3
Compression ratio	12,5 : 1
Speed	1,500 rpm
Rating	45 kW
Blocked ISO standard output as per ISO 3046 / part 7 Standard reference conditions: air temperature 298 K, air pressure 1,000 mbar, humidity 30% for operation with natural gas (group H) with calorific value H_u of 10 kWh/m^3_N methane number $\geq$ 80	
Firing order	1 - 3 - 4 - 2
Valve clearance (cold engine)	
Intake	0,50 mm
Exhaust	0,50 mm
Valve timing	
Intake opens	6° before TDC
Intake closes	38° after BDC
Exhaust opens	56° before BDC
Exhaust closes	12° after TDC
Engine lubrication	Force feed
Oil capacity in oil sump (litres)	min. max. 9 l 13 l
Oil change quantity (with filter)	14 l
Oil pressure during operation (depending on oil temperature, oil visvosity class and engine rpm)	must be monitored by oil pressure monitors / gauges
Oil filter	Full-flow filter with paper filter elements
Engine cooling system	Liquid cooling
Operating temperature	80 / 88°C engine inlet / -outlet
Electrical equipment	
Starter	24 V; 4 kW

Ignition system	
System	Elektronic ignition system with static ignition timing
Make	Fairbanks Morse
Type	IQ 250 A
Ignition time	
at λ = 1	Crank angle: 16° before TDC
at λ = 1,5	Crank angle: 8° before TDC
Spark plugs	GE 3–1
Electrode gap (when new)	0,23 – 0,33 mm

Model	**E 0826 E 301 / 302**
Design	in-line, vertical
Cycle	4-stroke Otto-cycle
Number of cylinders	6
Bore	108 mm
Stroke	125 mm
Swept volume	6,870 cm^3
Compression ratio	12,5 : 1
Speed	1,500 rpm
Rating	70 kW
Blocked ISO standard output as per ISO 3046 / part 7 Standard reference conditions: air temperature 298 K, air pressure 1,000 mbar, humidity 30% for operation with natural gas (group H) with calorific value H_u of 10 kWh/m^3_N methane number $\geq$ 80	
Firing order	1 - 5 - 3 - 6 - 2 - 4
Valve clearance (cold engine)	
Intake	0,50 mm
Exhaust	0,50 mm
Valve timing	
Intake opens	6° before TDC
Intake closes	38° after BDC
Exhaust opens	56° before BDC
Exhaust closes	12° after TDC
Engine lubrication	Force feed
Oil capacity in oil sump (litres)	min. max. 16 l 20 l
Oil change quantity (with filter)	21 l
Oil pressure during operation (depending on oil temperature, oil visvosity class and engine rpm)	must be monitored by oil pressure monitors / gauges
Oil filter	Full-flow filter with paper filter elements
Engine cooling system	Liquid cooling
Operating temperature	80 / 88°C engine inlet / -outlet
Electrical equipment	
Starter	24 V; 4 kW

Ignition system	
System	Elektronic ignition system with static ignition timing
Make	Fairbanks Morse
Type	IQ 250 A
Ignition time	
at λ = 1	Crank angle: 16° before TDC
at λ = 1,5	Crank angle: 8° before TDC
Spark plugs	GE 3–1
Electrode gap (when new)	0,23 – 0,33 mm

ALWAYS COMPLY WITH SAFETY REGULATIONS!

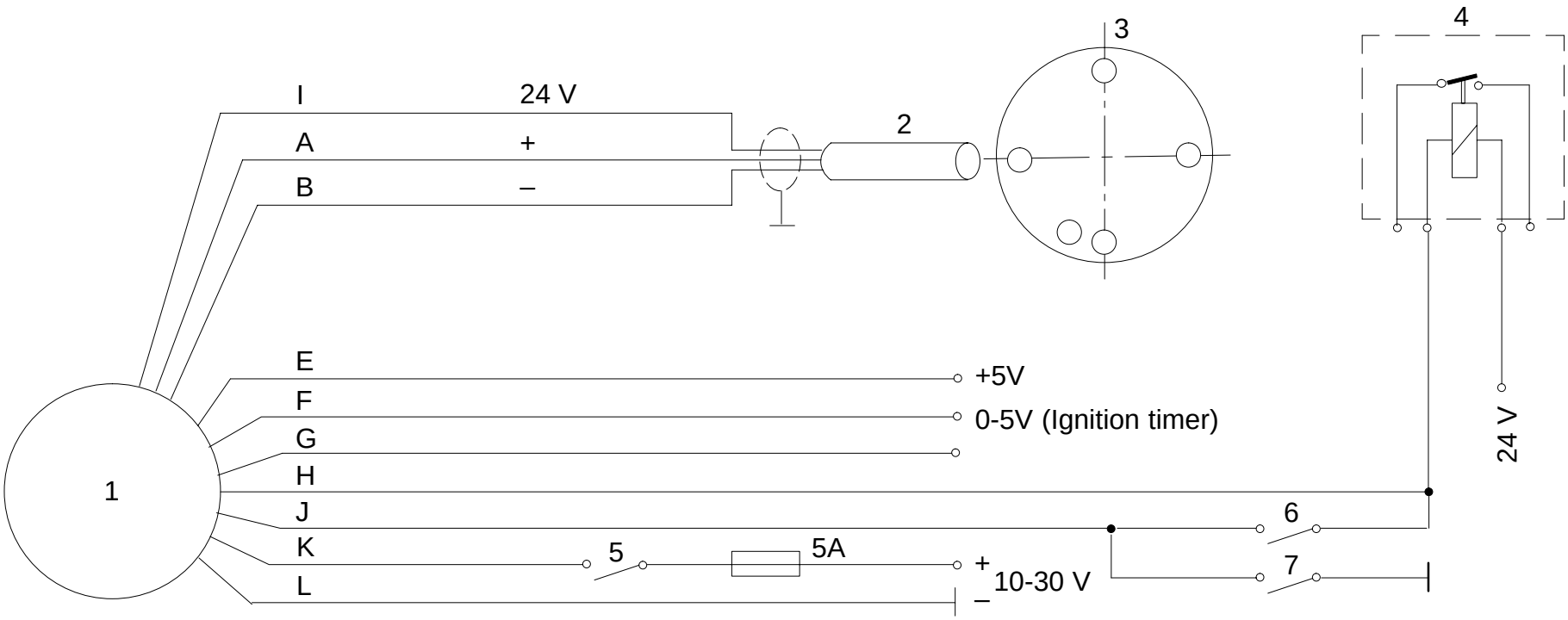
Maintenance jobs	Maintenance cycles *							
	1	2	3	4	5	6	7	8
Check coolant level and oil level in engine	●							
Change engine oil in sump		●		●				
Change oil filter cartridge		●		●				
Check that removable unions (bolts, hose clips, pipe fittings) are firmly in position and, if necessary, retighten		●						
Service the air cleaner (earlier if severe operating conditions demand it)				●				
Check and if neccessary adjust valve clearance		●	●	●				
Change spark plugs					●			
Check ignition timing					●			
Check comprssion pressure					●			
Check anti-freeze concentration						●		
Change both valve caps on expansion tank							●	
Change coolant								●

1 – Daily
2 – At the first 10 to 20 hours of operation (with new or overhauled engine)
3 – After the first 400 hours of operation
4 – Every 800 hours of operation *)
5 – Every 2000 hours of operation
6 – Every 3 months
7 – Yearly
8 – Every 2 years

* Interval to be reviewed on the strengh of practical experience

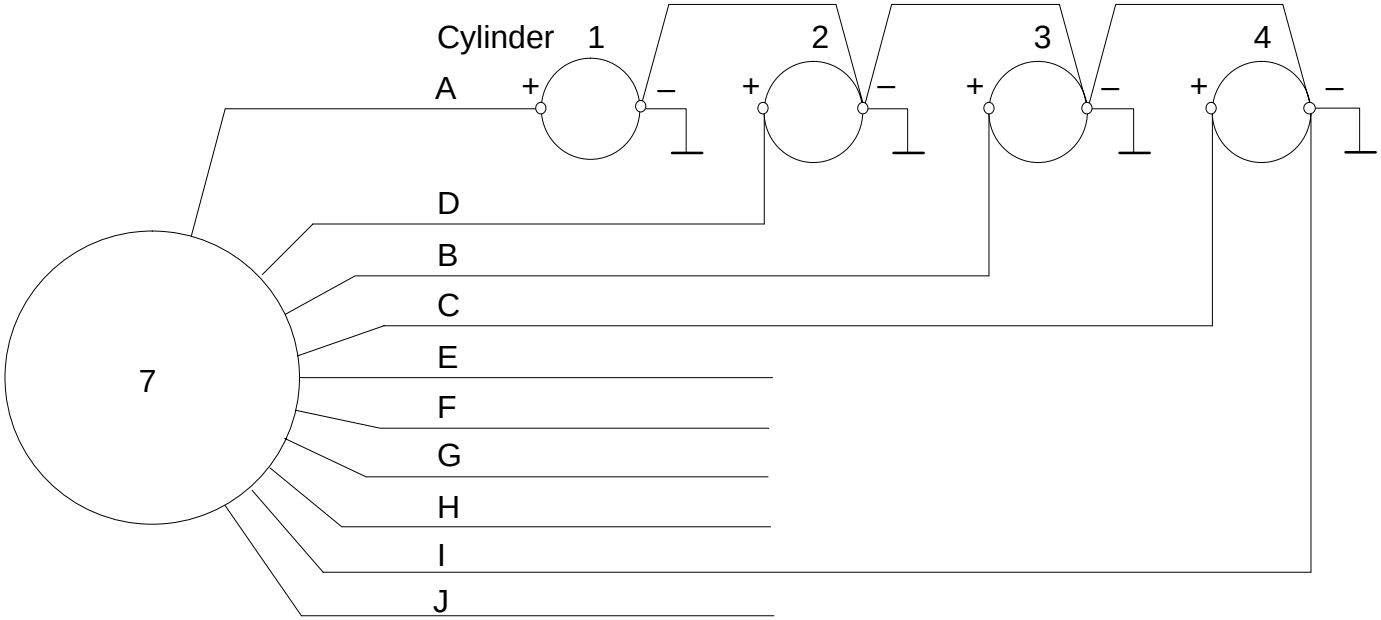
Circuit diagrams

Cable harness for the input signals to the control unit for E 0824 E and E 0826 E engines



1 Plug (14 polig)
2 Speed governor
3 Camshaft gear (unit in picture: 4-cylinder engine)
4 Interference relay (eg for switching off gas tract) (not part of extent of delivery)
5 Ignition ON / OFF
6 Self-test ON / OFF
7 Overspeed adjustment

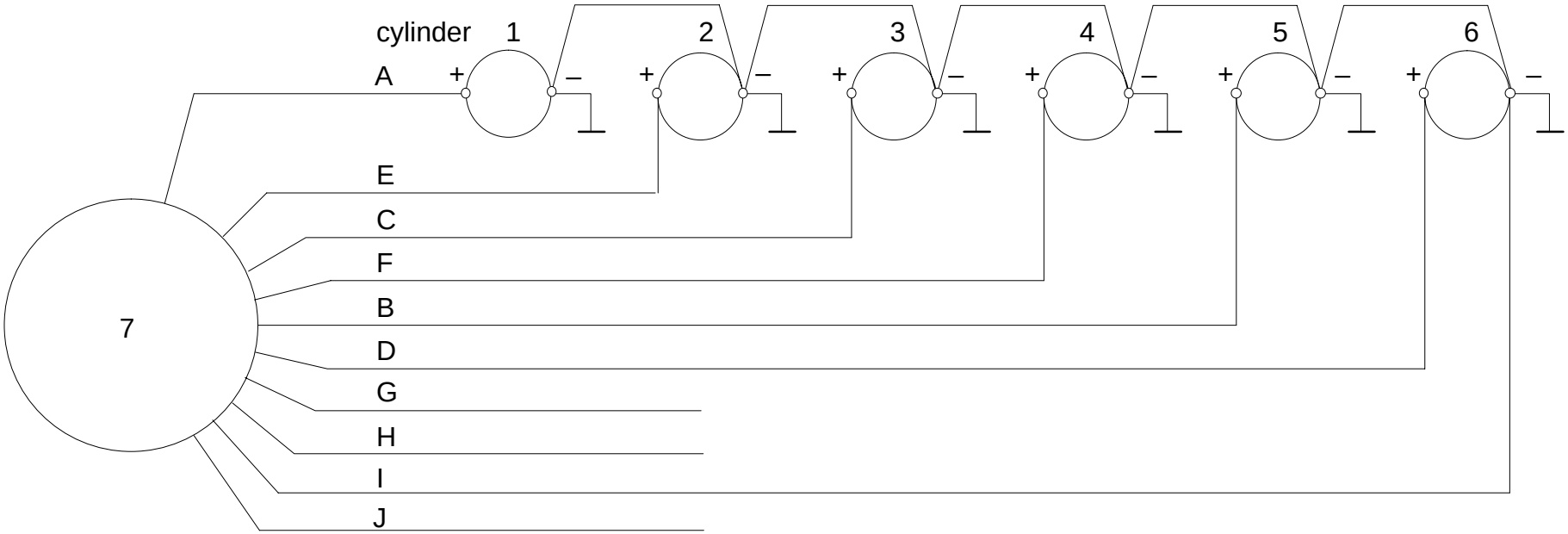
Cable harness for the output signals from the control unit for E 0824 E engines



1, 2, 3, 4 Ignition coils of the respective cylinders
(the 1st cylinder is located at the non-flywheel end)

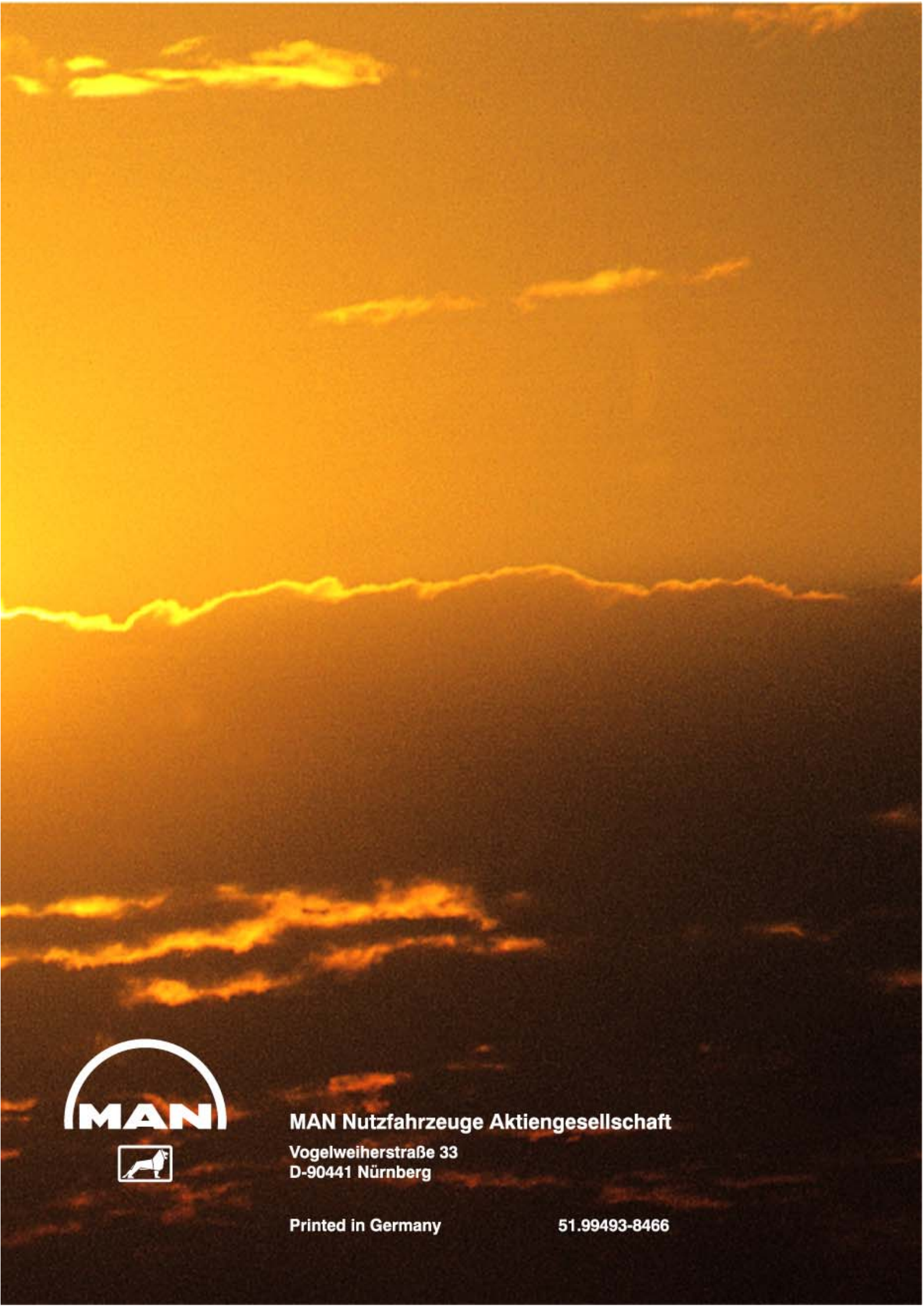
7 Plug
A red (cylinder 1)
B yellow (cylinder 3)
C green (cylinder 4)
D brown (cylinder 2)
E blue (not required in 4-cyl. engine)
F orange (not required in 4-cyl. engine)
G white / green (not used)
H white / orange (not used)
I white (minus)
J grey (rev counter)

Cable harness for the output signals from the control unit for E 0826 E engines



1, 2, 3, 4, 5, 6 Ignition coils of the respective cylinders (the 1st cylinder is located at the non-flywheel end)

7 Plug
A red (cylinder 1)
B yellow (cylinder 5)
C green (cylinder 3)
D brown (cylinder 6)
E blue (cylinder 2)
F orange (cylinder 4)
G white / green (not used)
H white / orange (not used)
I white (minus)
J grey (rev counter)



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Printed in Germany 51.99493-8466