

The Company

Everything began in the year 1904. Carl von Linde and Hugo Güldner founded the "Güldner Motorenwerke", the precursor of our company. No-one could imagine how dynamically this business would expand in the decades to follow. Today Linde Material Handling has over seven factories in Germany, France and Great Britain and a production site in China. More than 600 patents - many of them milestones in material handling engineering - attest to unrivalled innovative power, the basis for the success today and tomorrow.

Today, the Linde plant II in 63701 Aschaffenburg is one of the largest and most modern production facilities in the world. New assembly structures with only one direction of flow, trolleys without drivers, new supply systems, vacuum filling of the working hydraulics: The points were set correctly from the start to achieve maximum productivity and quality. The distances are short, as one might expect. In the entire assembly process, a Linde fork truck only travels approx. 2000 metres. It is therefore one of the fastest even before it sees the light of day.

People are always at the centre of our work, no matter what we plan, no matter what we do. On the one side are our employees, who receive a lot of room for development. On the other side are our customers. They measure us on the basis of productivity and quality, but also on the

basis of service and flexibility. We provide this worldwide in cooperation with our marketing and service organisations. With vehicles which, in the final analysis, are nothing else than the technical answer to their needs. Closeness to the customer is more than a word in this respect. It is lived reality.

Linde is one of the world's leaders in the sectors of material handling technology and hydraulics. The primary aim of our efforts is to offer our clients a convincing value for their money. Our decades of experience in material flow and the synergetic benefits of a large company allow us to tap new potential again and again. The most recent example is the Linde 39X with hydrostatic direct drive. A fork truck which links the fascination of technology and economy as no other forklift does.

We want to achieve a lot. We will give everything to achieve it. To be in a strong position in tomorrow's market you need more than yesterday's success. You need to be willing to work on yourself permanently. In research and development. In operations. And last, but not least, in service. In this respect, we have created the best conditions with our main plants in Aschaffenburg and the plants in Kahl, Weilbach and Ballenstedt.

Bruno Kulick
Management

Structure of the training document

This training document is based on the related seminar in the training centre and supplements it. The training document alone and without the accompanying training is not suited for self-study.

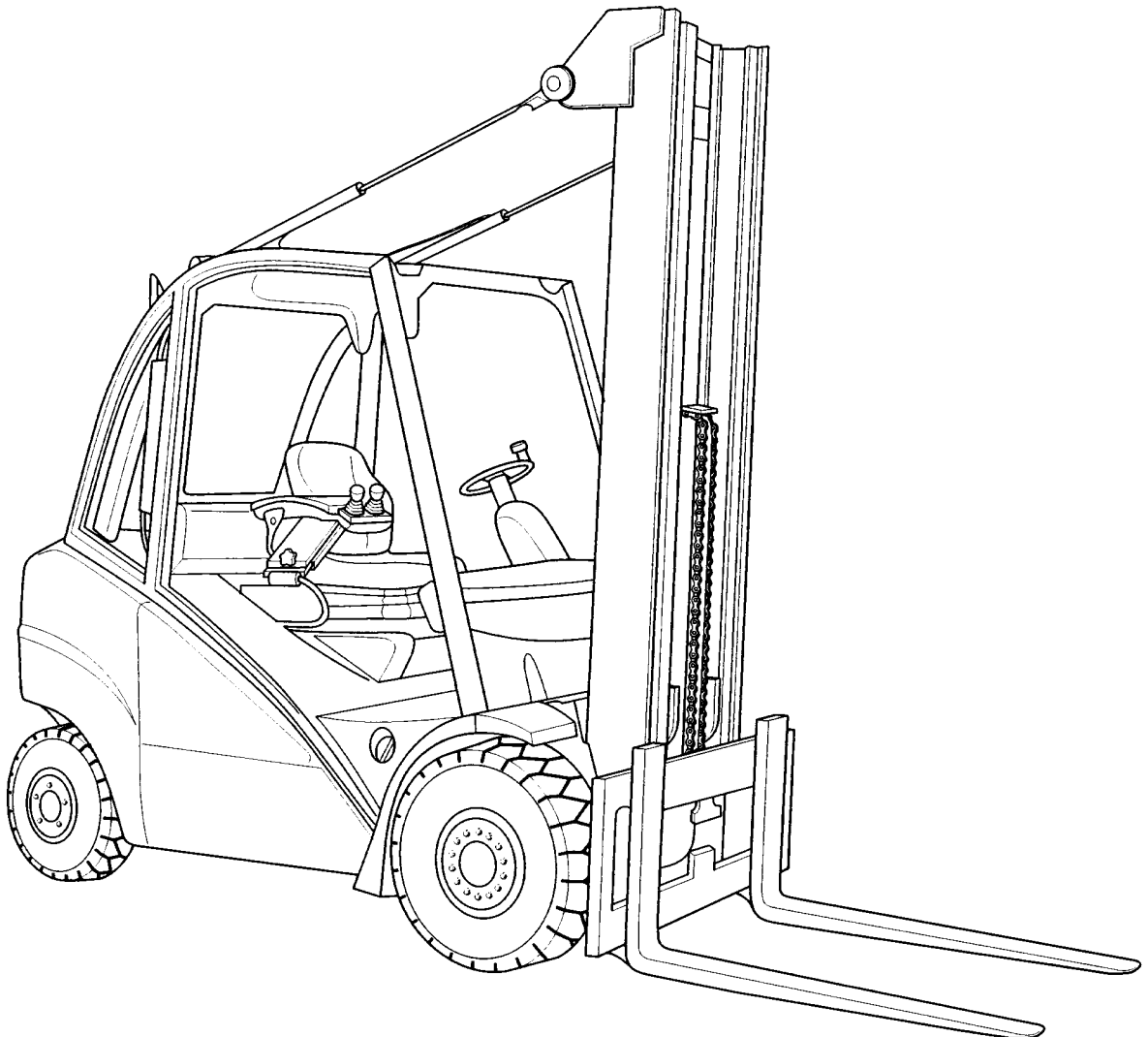
In order to allow you find the answer to problems at hand in the training document in case of a necessary repair, we want to give you some information on how and where you can find the desired information.

The training document is divided into numbered main sections. These main sections are again divided into subsections which in turn are also divided into more detailed subsections of the related section. The numbers and headings of the main sections and the subsections comply with internal guidelines and are retained for reasons of standardizations and continuity.

Overview of the main sections and (summarised) their content:

Section	Content
00	Product information Diagnosis
01	Motor Internal combustion engine Electric motor
02	Gearbox Hydrostatic drive axle Mechanical drive axle Drives
03	Body Chassis Operator's compartment
04	Running gear Steering system Mechanical guidance Inductive guidance Wheels and tyres Brake system

The truck



The H 30 and H 35 trucks represent the next generation of IC-engined Linde fork trucks. The truck is perfectly tailored to the driver. Its operating comfort ensures little fatigue when working, protects the driver's health, thus allowing high productivity. Its superior economy comes from its low fuel consumption, low service costs and high re-sale value at the end of its period of use. The low driving noise and pollutant emissions, which are well below the specified limits, make the truck environment-friendly and protect the driver and environment.

Other highlights are:

- Excellent operator's workplace for greatest possible performance of driver and truck.
- Unique shock-absorption system reduces roadway and load impacts before they are transmitted to the truck and driver.

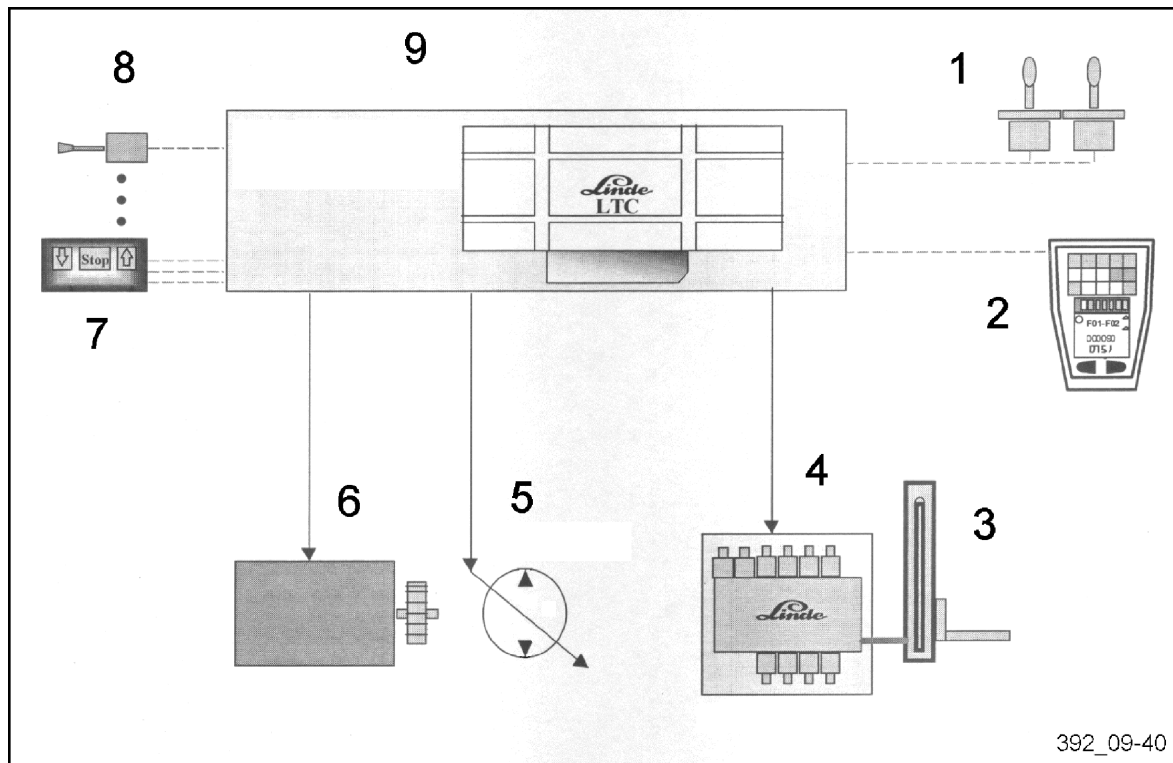
- Maintenance-free hydrostatic direct drive with a high degree of efficiency from Linde.
- Modern, economical engines with low emissions.
- Overhead tilt cylinder for higher residual load capacities and more precise load handling.
- Linde dual pedal for faster and safe working.

Design of operator's compartment

The operator's workplace is designed according to the latest findings in ergonomics. It has a low access, which can be viewed from above. The large cabin space with a generous footwell and a interior design corresponding to automotive standards imparts a pleasant spatial feeling. The Linde Load Control provides precise and relaxed operation of all mast functions consisting of two control levers, which are integrated in

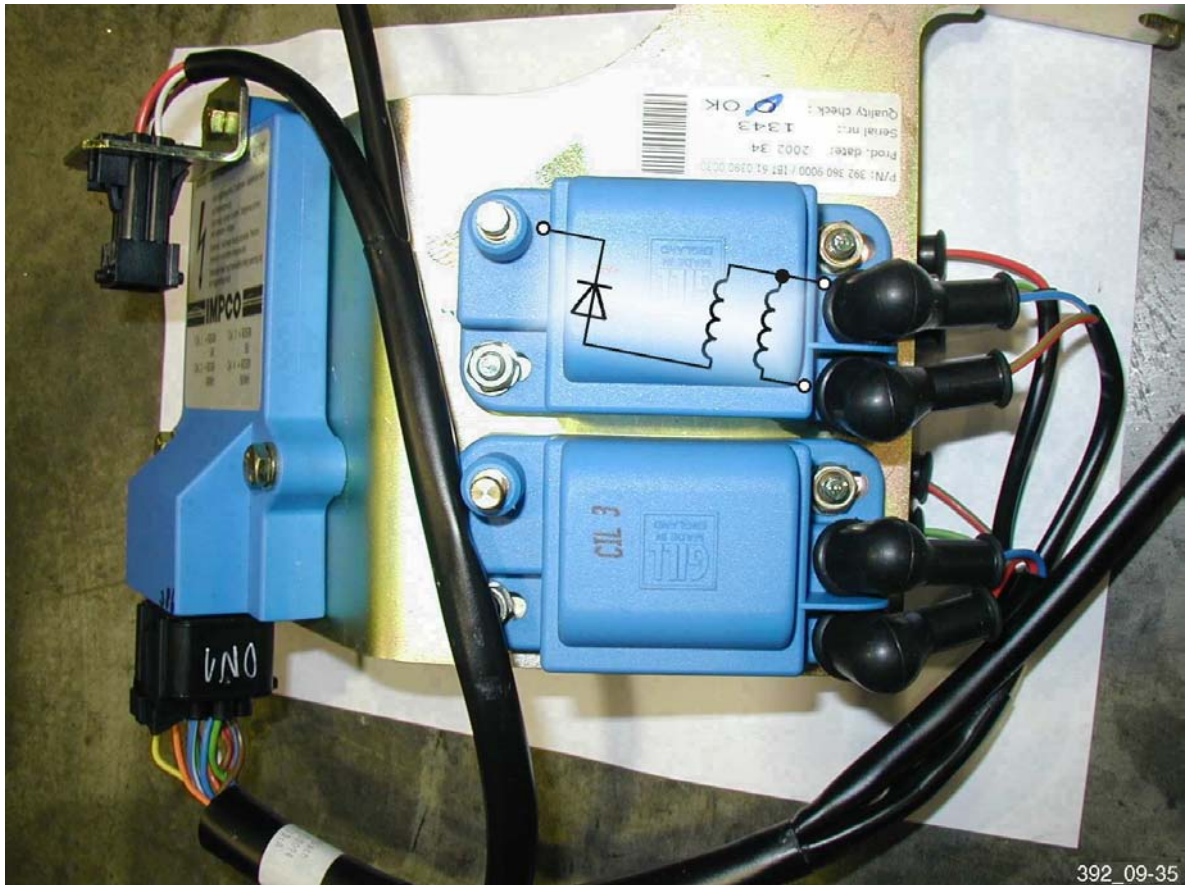
Diagnosis

LTC - basic structure



- | | | | |
|---|---------------------------------|---|----------------------------------|
| 1 | Joysticks | 6 | Internal combustion engine |
| 2 | Display | 7 | Pedal group |
| 3 | Mast | 8 | Directional control switch |
| 4 | Directional control valve block | 9 | Integrated traction/lift control |
| 5 | Traction pump | | |

Ignition coil



Design and function of the coil are largely identical with those of the coils in conventional ignition systems. Each cylinder has 1 coil, which can be replaced separately. Primary and secondary coil can be checked by measuring the resistance.

Primary coil resistance: 0.6 ?

Secondary coil resistance: max 35 kV

Ignition coil up to installation date Week 14 - check



CAUTION

*During the test, sparks arise at the spark plug.
If the spark plug gap is too wide, the ignition coil (diode) can be destroyed.
Be sure the spark plug gap is correct.*

- Testing of primary coil (1). Resistance measurement at positive and negative terminals.

Desired resistance: 0.5 - 1.4 ?

Check the diode (secondary coil (2). (diode symbol on multimeter).

Description of transmission

Technical data for BEU

Manufacturer	VW
Type of engine	BEU (SDI industrial engine)
Number of cylinders	4
Cubic capacity	1896 cm ³
Power	43 kW at 2600 rpm
max torque	173 Nm at 1800 rpm
Injection nozzle pressure	220 bar, wear limit 200 bar
Compression ratio	19.5 : 1
compression	25 - 31 bar, wear limit 19 bar
Max admissible pressure difference	5 bar
Lower idle speed	1000 rpm
Upper idle speed	2700 min when driving
	2800 rpm with working hydraulic system
Valve clearance	Self-adjusting
Firing order	1 - 3 - 4 - 2
Position of cylinder 1	Opposite power takeoff side
Thermostat	Thermostat start of opening: 87°C, fully open at 102°C
Fuel	Diesel fuel acc. to DIN EN 590, RME-based biodiesel possible
Number of teeth on flywheel	135
Oil pressure at 2000 rpm and an oil temperature of 80°C	at least 2 bar

Explanation of engine identification: The engine identification letter and the engine number are stamped on the left side of the cylinder block above the fuel pump. There is also a plate on the toothed belt cover.

Structure of engine number: Example: BEU / 002141 (type of engine / consecutive number)

- Using the circuit diagram, check the lines between test adapter and the connector for interruptions

- Contact 7 and socket 111
- Contact 4 and socket 103

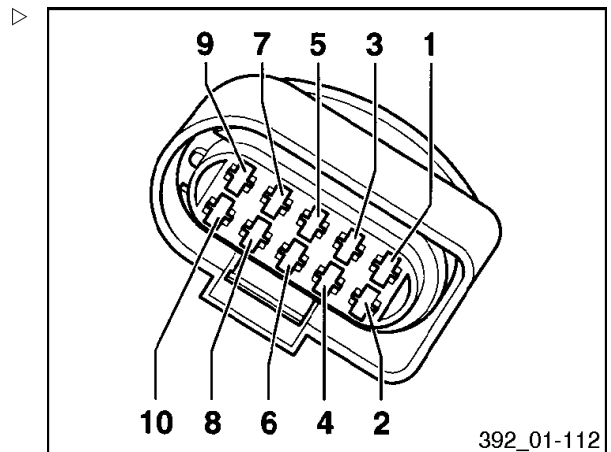
Line resistance: max 1.5 Ω

- Also check the lines for line-to-line shorts, short to battery earth/engine earth and to battery positive

Desired value: 8 Ω

If no fault is detected in the lines:

- Replace the control unit for direct injection system 0N1.



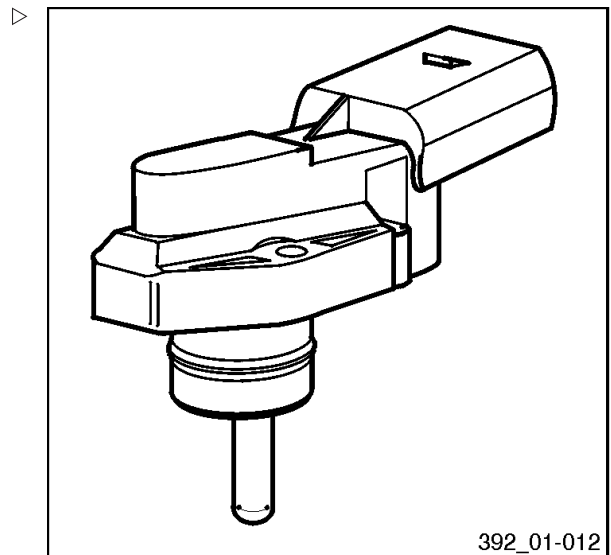
Intake pipe temperature and intake pipe pressure sending unit OB4

The sensor is located in the intake pipe. Its signal provides information on the air temperature in the intake manifold.

The signal of sensor OB4 is used for control purposes.

Intake pipe temperature and intake pipe pressure sending unit - substitute function

In case of a failure of sensor OB4, the electronic control unit specifies a constant value. In this case the electronic control unit takes a value of approx. 20°C as a basis for calculation.



Intake pipe temperature and intake pipe pressure sending unit - self-test

The control unit stores two possible malfunctions

- short circuit to earth
- Interruption/ short circuit

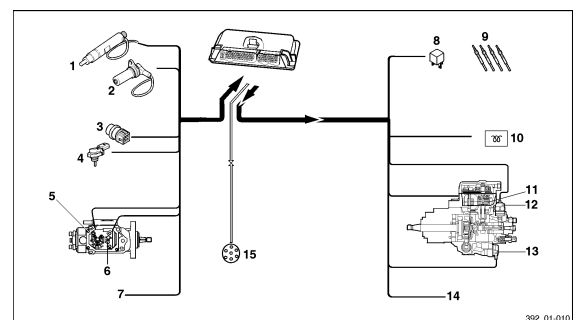
Required special tools for the test

- Laptop with software
- Test adapter 7 917 299 010
- Multimeter
- Wiring diagram

Prerequisites for the test

The engine must run at idle speed.

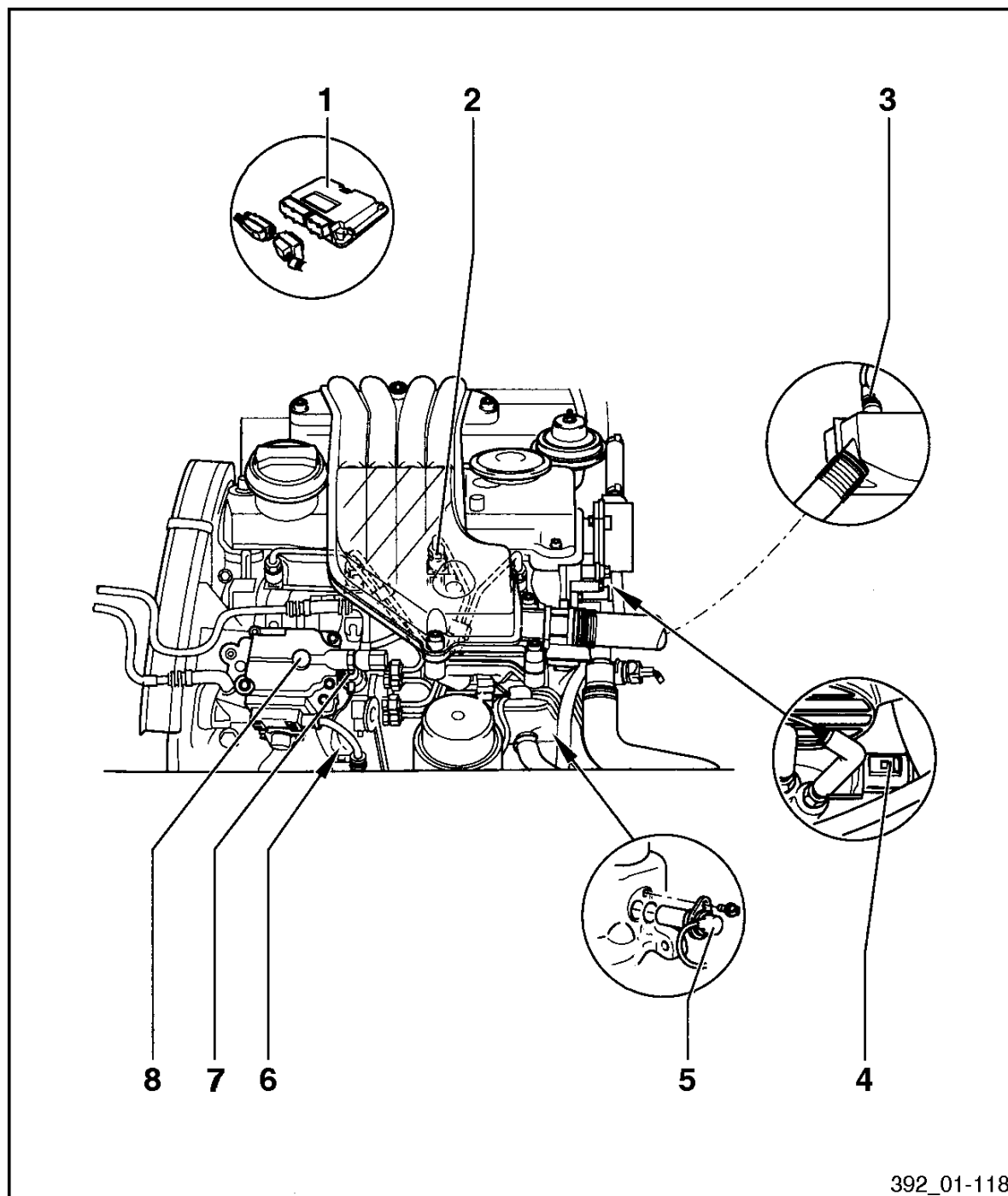
- Connect the Laptop
- Start the software



1 Intake pipe temperature and intake pipe pressure sending unit (BEU engine)

Diesel engine

Injection system - overview



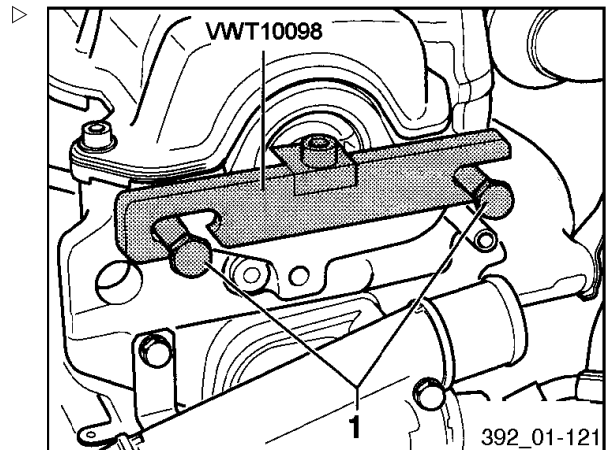
- | | | | |
|---|--|---|---|
| 1 | Control unit for injection system 0N1 | 6 | Start of injection valve 0Y2 |
| 2 | Injection nozzle with needle stroke sensor 0B5 | 7 | Fuel shut-off valve 0Y1 |
| 3 | Intake pipe temperature sending unit 0B4 | 8 | Fuel quantity regulating mechanism of the injection pump with fuel temperature sending unit 0B3 |
| 4 | Coolant temperature sending unit 0B1 | | |
| 5 | Engine speed sensor 0B2 | | |

The control unit of the direct injection unit is equipped with a fault history. The fault history

must be displayed and an actuator diagnosis

Camshaft position

The correct position is fixed with a new adjusting ruler. The exact camshaft position is very important for precise valve timing when installing the toothed belt.



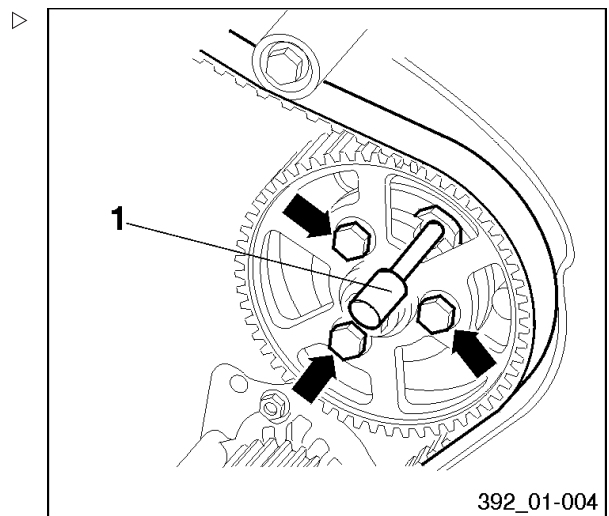
Injection pump sprocket

The injection pump is locked with the locating pin (1). The injection pump sprocket consists of two parts. A fine adjustment can be made by loosening the 3 screws (arrow).



Do not loosen the nut for the injection pump hub. This would change the basic setting of the injection pump. It can not be adjusted with workshop tools.

The exact procedure is described in the section "Injection pump - removal and installation, toothed belt replacement".

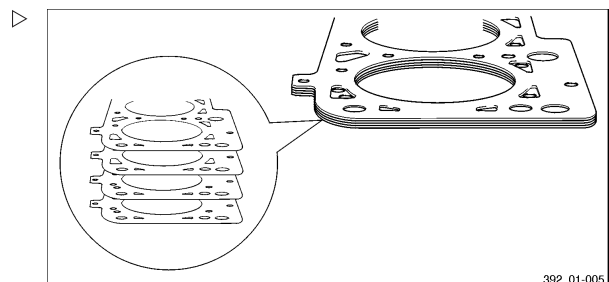


Cylinder head gasket

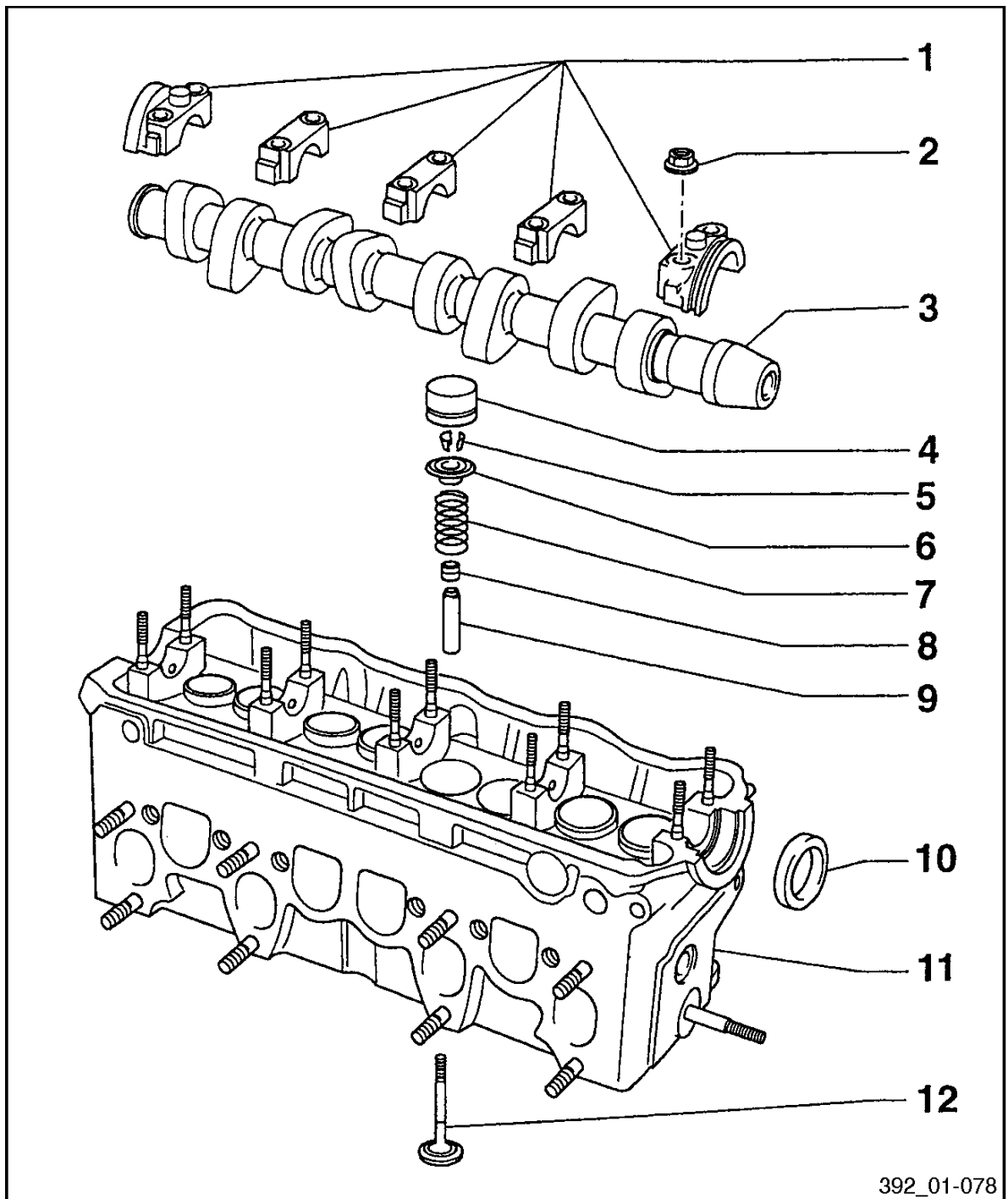
The cylinder head gasket is made of metal and is thus resistant to higher temperatures and pressures.



When installing new parts like pistons, crankshaft, etc. the tolerances must be taken into consideration with the appropriate thickness of the cylinder head gasket.



Valve gear



- 1 Bearing cap
- 2 Screw (tightening torque 20 Nm)
- 3 Camshaft
- 4 Tappet
- 5 Valve keepers
- 6 Valve spring seat

- 7 Valve spring
- 8 Valve stem seal
- 9 Valve guide
- 10 Sealing ring
- 11 Cylinder head
- 12 Valve

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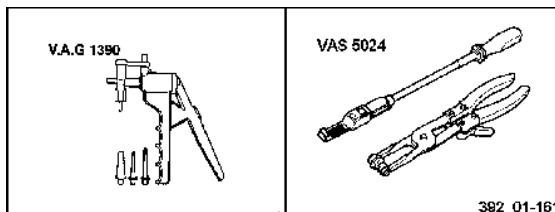
- 3 Intake air
- 4 Gasket
- 5 Torque: 25 Nm
- 6 Gasket
- 7 Holder for heat shield, item 9
- 8 Washer
- 9 Heat shield
- 10 Turbocharger
- 11 Load cell for charge pressure control
- 12 From air filter
- 13 Gasket
- 14 Gasket

- 15 Oil return line to cylinder block
- 16 Banjo bolt, torque 30 Nm
- 17 Torque: 15 Nm
- 18 Torque: 40 Nm
- 19 Bracket
- 20 Torque: 25 Nm
- 21 Gasket
- 22 Exhaust pipe, front
- 23 Union, torque 30 Nm
- 24 Torque: 10 Nm
- 25 Oil supply line, 22 Nm

- Item 4: Coating (bead) to intake pipe.
- Item 6: Observe mounting position.
- Item 10: Replace only together with exhaust manifold.
- Item 11: Part of turbocharger, cannot be replaced.
- Item 23: Apply "G 052 112 A3" to thread and head mating face.
- Item 25: Before installation, fill turbocharger at union of oil feeder line with engine oil.

Boost pressure control - check

Required special tools



- Manual vacuum pump VAG 1390
- Hose clamp pliers VAS 5024
- Multimeter
- Test adapter 7 917 299 010
- Wiring diagram
- Laptop with software

Prerequisites for testing

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electric loads must be switched off.
- Earth connections are OK.
- No leaks either on inlet side or on exhaust gas side.
- Engine oil temperature at least 80°C.

- No problems in engine/injection system such as start of injection, injection nozzles, compression.
- No fault should be stored in the fault history. Check the fault history

Test procedure

- Connect the laptop, start the software and select "Standardised data blocks". The engine must be idling.
- "Select Group 11".
- Increase the engine speed of approx. 1500 rpm under full load to maximum speed.
- Check the desired charge pressure (actual) in the Display field.

Desired pressure: 1650...2000 mbar.

- Terminate the communication between the vehicle and laptop.
- Turn off the ignition.

If the desired pressure is **not** obtained:

- Carry out an actuator diagnosis and activate the solenoid valve for charge pressure limitation.

The solenoid valve must click and the linkage of the load cell for charge pressure control at the turbocharger must move to and fro. The linkage must move to and fro at least 3 to 4 times, as long as a vacuum is present in the vacuum reservoir.



NOTE

The clicking of the valve cannot be heard due to the engine noise and can therefore only be checked by touch.

- Continue and finish the actuator test.
- Turn off the ignition.

Diesel engine

fault: If a sporadic fault does not reoccur during 50 driving cycles (ignition is on for at least 2 seconds), it will be cleared. Before replacement of the components which have been detected to be defective, first check the lines and connectors to these components and the earth connections in accordance with the wiring diagram. Check the connectors for correct latching and correct seating on the relay plate.

Possible causes of faults



NOTE

Check the engine control unit before testing. If a test of the engine control unit is possible, it may be assumed that the lines and connections are okay.

Problem	Possible cause	Correction
Control unit does not respond	Supply voltage too low	Check supply voltage and correct, if necessary (terminal 15 to immobilizer and engine control)
	Short between the cables of 5-pin connector ("W" and "K" at the control unit for the immobilizer or short circuit to earth)	Check connector and correct the fault, if necessary, according to the wiring diagram.
Control unit does not respond	Cable defective	Check and replace the cable, if necessary
	Immobilizer defective	Replace the immobilizer
	Control unit defective	Replace the control unit

The control unit identification is automatically checked after ignition "ON".

Fault table

The fault table is arranged in the order of the 5-digit fault code number shown on the left (eg 16500). If components are indicated to be defective:

- Check the lines and connectors to these components.
- Check the earth connections according to the wiring diagram.

Only replace the component if this check does not reveal any faults. This applies in particular to faults reported as "sporadic".

- Then lock the slotted nut (4) again.
- If $iY3 = 440 - 460 \text{ mA}$, perform the same adjustment at adjustment ring (2).
- Release the blocked wheel.
- Fully depress the accelerator. A value of 1220 mA must be displayed via the tab "Currents" of the diagnostics software (preset by the control).
- Measure maximum wheel speed

Measure maximum wheel speed by taking the mean of the speed of both drive wheels.

Desired speed $n = 200 \text{ rpm}$.

Start of delivery - diagram



NOTE

If the electric values are correct but the full wheel speed is not reached, then check and adjust the stroke of the servopiston (swash angle of pump).

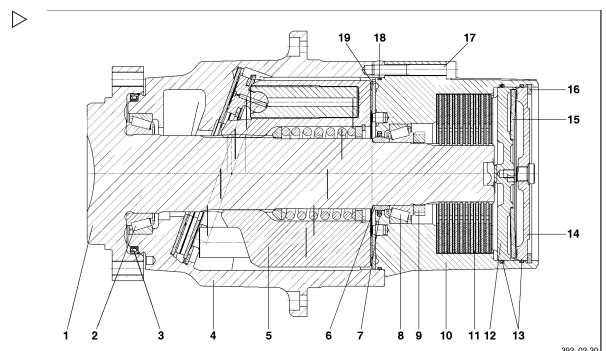
Swash angle - adjustment

- Jack up the truck and lock 1 wheel.
- Start the engine and release the brake pedal.
- Loosen the setscrew locknut (1) on the Y side of the control and turn in the setscrew (1)) until the free wheel just begins to turn.
- Then turn the setscrew (1) out for 12 turns and relock the locknut.
- Repeat the same procedure on side Z.

Hydraulic zero position - adjustment

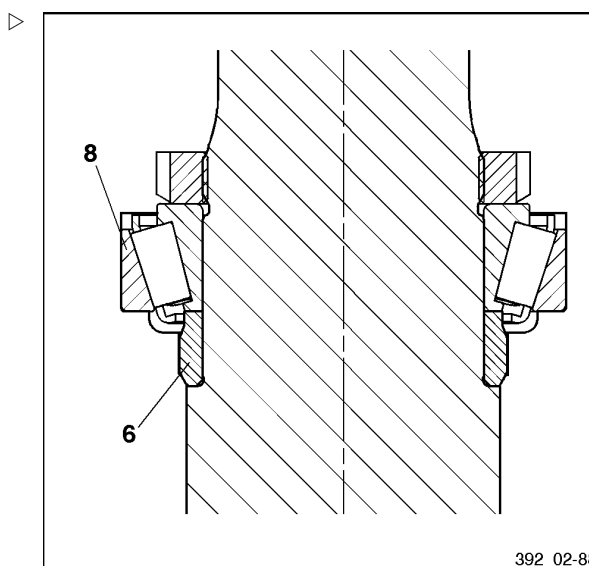
- Jack up the truck and lock 1 wheel.
- Start the engine and release the brake.
- Mediate the position of the pilot housing (7). Loosen the grooved nut (8) and turn the pilot housing (7)) to one side until the free wheel just begins to turn.
- Repeat the procedure in the opposite direction.
- Measure and halve the distance between both positions and turn the pilot housing (7) towards the centre exactly by this value.
- Lock the pilot housing (7) with the slotted nut (8).
- Release the locked wheel.

Repeat the adjustment if a drive wheel is still turning.

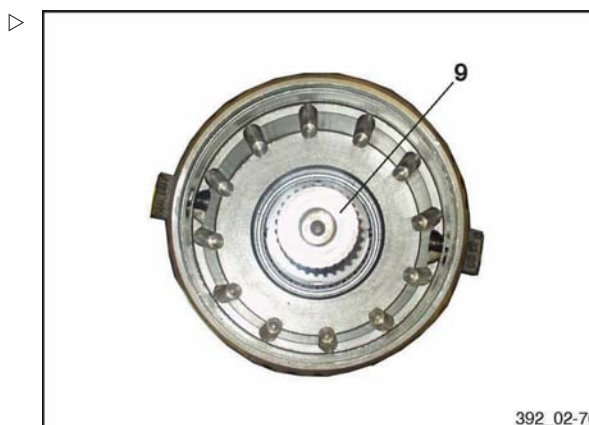


Q	Volume flow
S	Accelerator stroke
I	Release valve shifts
II	Drive wheels start to turn
II	Max speed of drive wheels

- Insert tapered roller bearing (8) and use slide hammer to drive it against the distance ring (6).



- Apply Loctite FK2 to the grooved nut (9) and push it over the wheel shaft. Install the

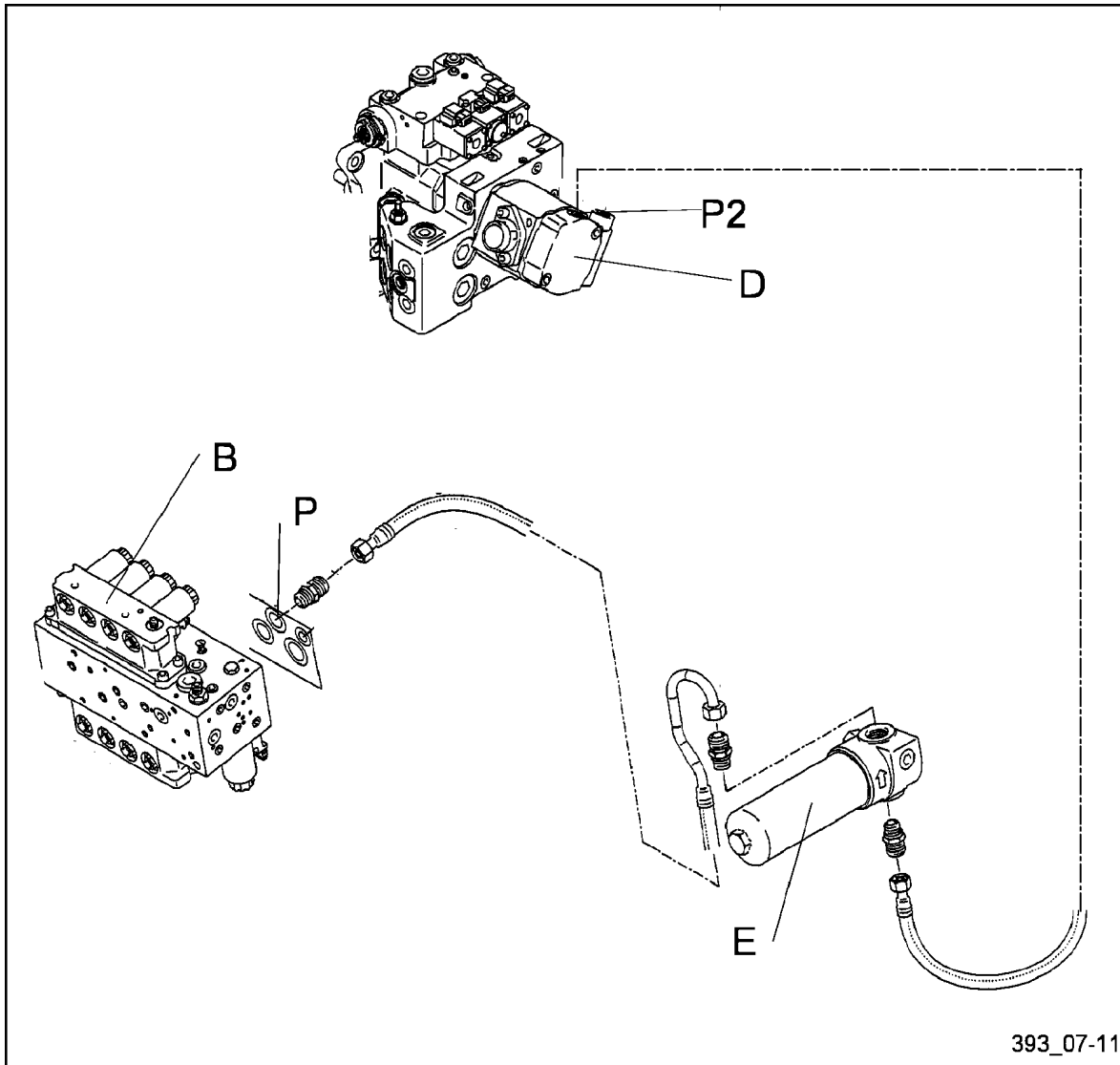


- slotted nut spanner 000 941 7000.
- The chamfer on the slotted nut faces the bearing.



Working hydraulics

Hose layout pump - control valve



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- B Working hydraulic valve
- D Gear pump
- E Filter working hydraulics
- P Pressure port - control valve
- P2 Working hydraulics port

Mast

- Remove the floor plate



CAUTION

The hose reel is prestressed by spring force. If the hose reel is removed without first securing it, the spring will relive spontaneously, which can lead to severe injuries.

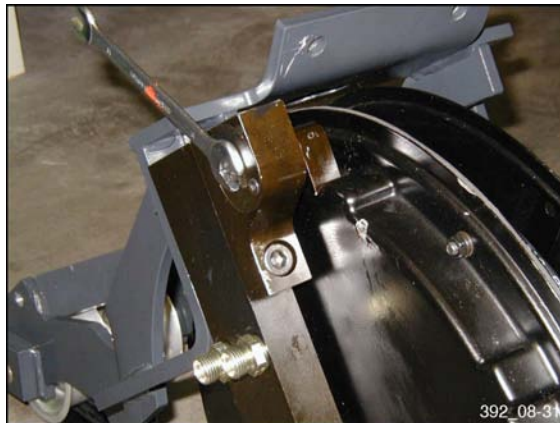
Make sure the pawl engages in one of the cams provided on the circumference of the hose reel so the hose reel does not unwind accidentally.

➤



- Lock the hose reel in the prestressed condition by pivoting the pawl in the direction of the hose reel. When doing so, unwind the hose reel a little. This keeps the hose loose in the locked condition.

➤



- Release the double hose at the connection to the mast.
- Disconnect the supply line from the control valve to the hose reel.
- Unscrew the front hexagon head screws (2 items) at the hose reel holder.

The hexagon head screws are located at the front part of the holder above the pulleys.

- Loosen the two hexagon head screws at the side of the hose reel holder.
- Unscrew the rear hexagon head screws (2 items) at the hose reel holder.

➤

