TEREXLIFT

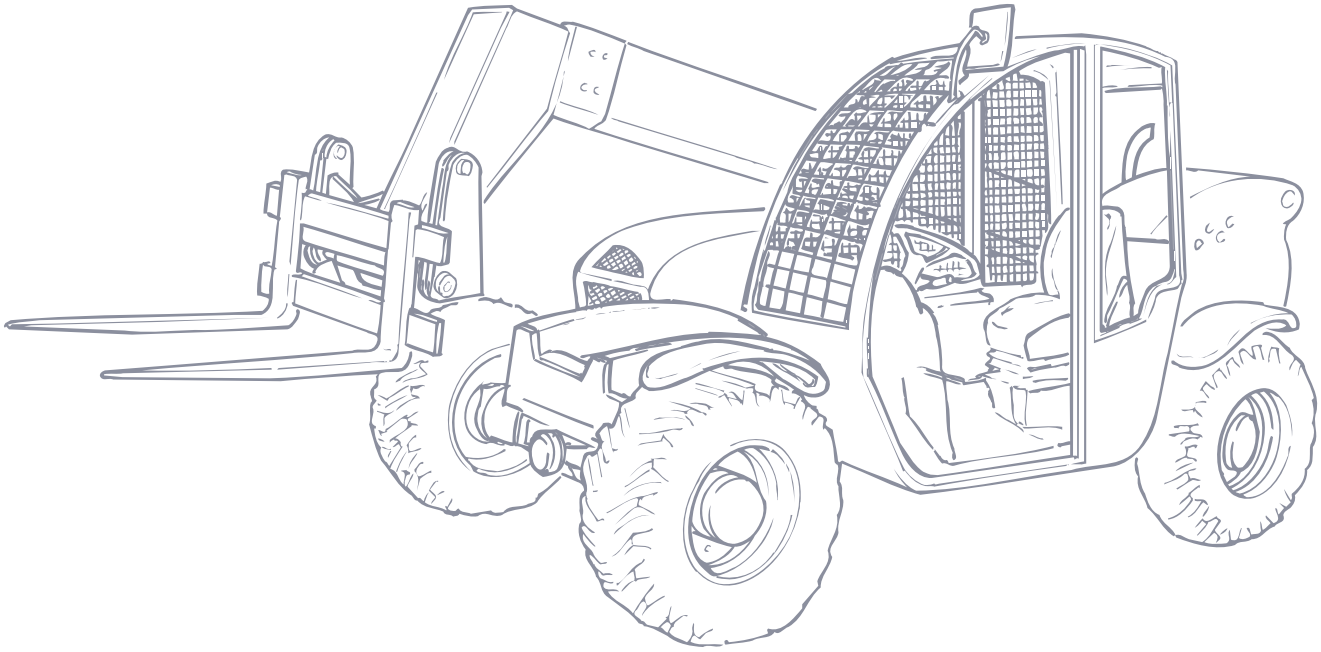
TEREXLIFT

WORKSHOP MANUAL

Code 57.4400.6200 - 1st Edition 02/2004

Handler with telescopic boom

TX 55-19



English
Edition

INDEX

WORKSHOP MANUAL

Code 57.4400.6200 - 1st Edition 02/2004

Number: .....

Consigned to: .....

DECLARATION

I, the undersigned.....

declare that I have received the ***Workshop manual for TEREXLIFT lifts series TX 55-19.***

Copies consigned: n° ..... on paper

n° ..... on CD-Rom

The undersigned is obliged to use the manual in their workshop, without disclosing the information in the same in any way, to unauthorised workshops and third parties in general, and not to photocopy or reproduce this manual or parts of the same in any way without the prior written authorisation of TEREXLIFT to do so.

If business relations between the undersigned and TEREXLIFT should come to an end, the undersigned is obliged to return the copies received without charges for TEREXLIFT.

Yours sincerely

date .....

For acceptance

The consignee

Company stamp
and signature of the Legal representative

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Copy to return stamped and signed for acceptance by the
Legal representative of the company receiving the copies of the manual.

WORKSHOP MANUAL

Code 57.4400.6200 - 1st Edition 02/2004

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LIST OF REVISED PAGES

Revision No.	Revision date	Revised pages	Notes	Issued by
1	02-2004		Publicated	
2				
3				
4				
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Sect. B SAFETY REGULATIONS

Sect. C TECHNICAL OPERATION DATA

Sect. D CHECKS AND ADJUSTMENTS

Sect. E DISMANTLING AND REASSEMBLY

Sect. F TROUBLESHOOTING

Sect. G DANA AXLE ASSEMBLY/DISMANTLING

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Sect. I REPAIR INSTRUCTIONS - REXROTH PUMP

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Section C
TECHNICAL OPERATING DATA

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C.02 HYDRAULIC SYMBOLS

ACTUATORS
- Emergency controls
- Pushbutton control
- Rotary control
- Pedal control
- Proximity control
- Lever control
- Timed control
- Mechanical/manual control
- Key control

RESISTANCES
- Resistance
- Resistor
- Potentiometer
- Variable resistance

SIGNALS
- Intermittent lamp
- Whistle
- Lamp
- Buzzer
- Siren
- Bell
- Horn

FUSES AND RELAYS
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- Relay

ACCUMULATORS
- Battery
- Thermocouple
- Element

TERMINALS AND GROUNDS
- Ring
- Ground
- Terminal
- Ground to frame
- Knot
- Protection ground
- Frame ground 2

COILS
- Coil
- Mechanical coupling coil
- Winding
- A/C coil
- Coil with diode
- Winding with diode

CONNECTORS
- Connector

STATIC APPLICATIONS
- Auto-transformer
- Transformer

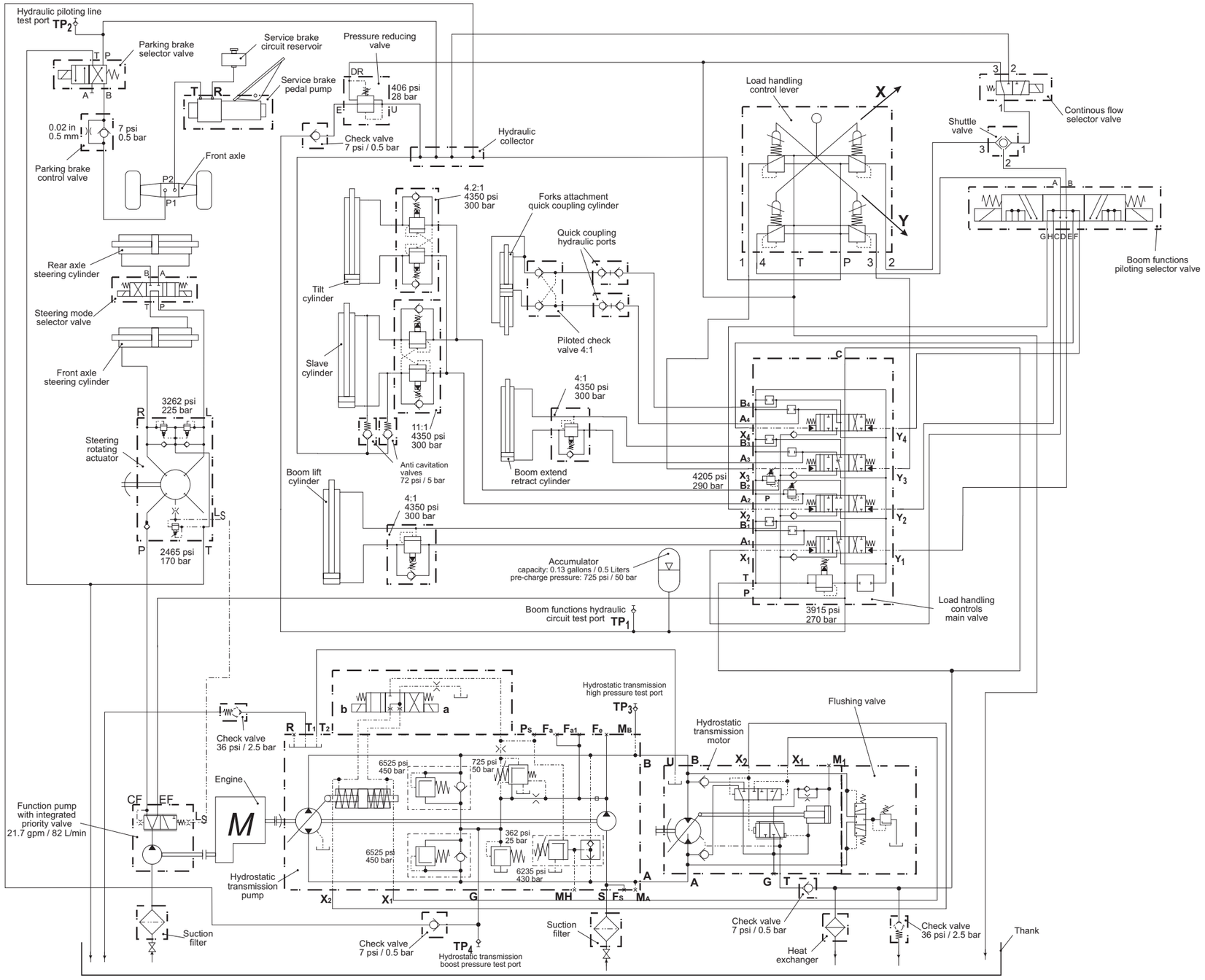
DYNAMIC APPLICATIONS
- Motor
- Generator
- As_3p_motor

ELECTRONIC PARTS
- Rectifier
- Light-emitting diode
- Diode
- Condenser

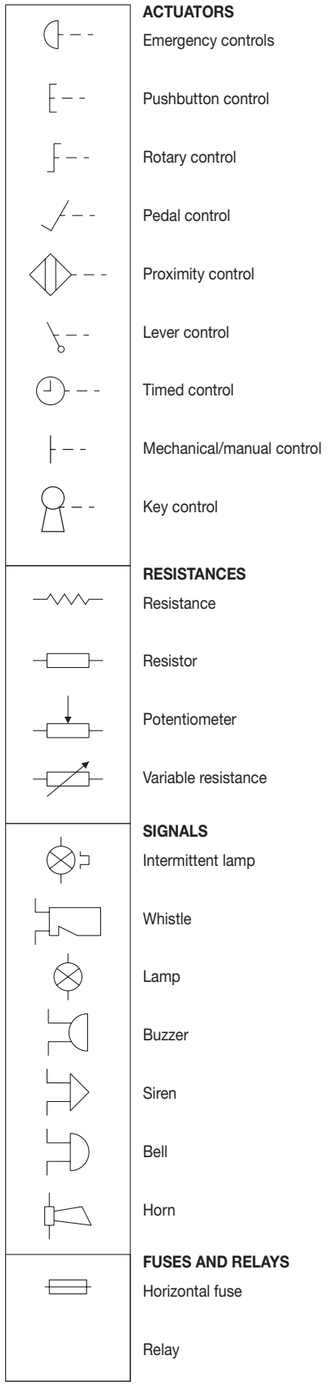
PUSHBUTTONS
- Manual NC contact
- Manual NO contact
- NC mushroom-head pushbutton
- NO mushroom-head pushbutton
- NC level
- NO level
- Pushbutton with NC return
- Pushbutton with NO return
- NC tie-rod
- NO tie-rod

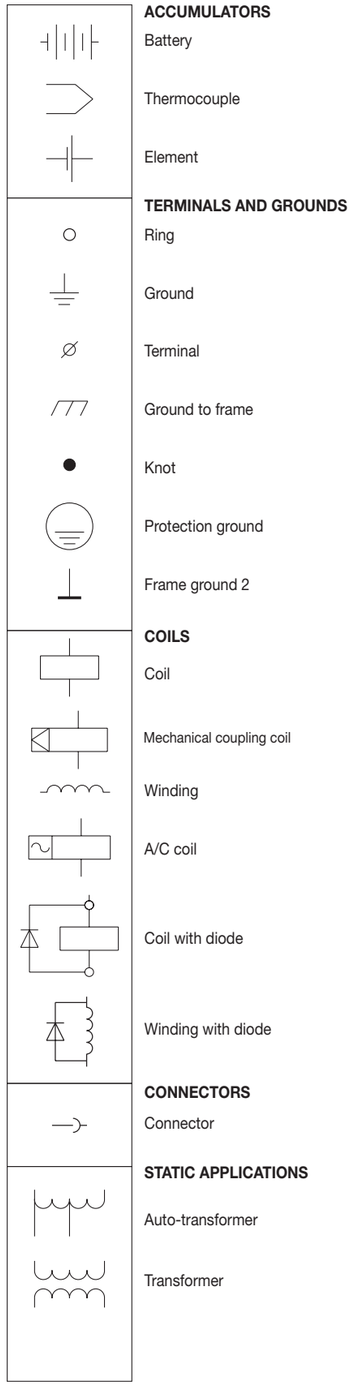
CONTACTS
- Thermal
- Normally open (NO)
- Normally closed (NC)
- NO limit switch
- NC limit switch
- Contactor
- Magneto-thermal closure
- Magneto-thermal opening
- Thermal closure
- Thermal opening
- Exchange
- NC proximity
- NO proximity
- NO mechanical
- NC mechanical
- Selector
- Selector2

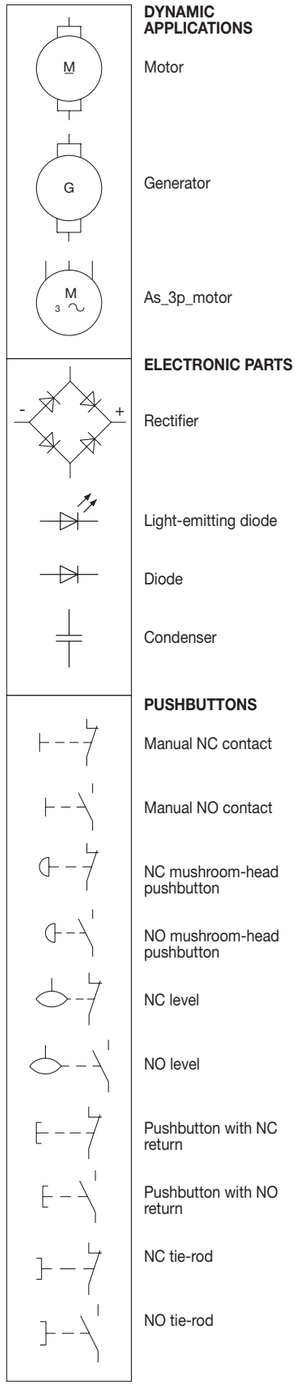
Operation: General hydraulic scheme	*Table:* **C.03**

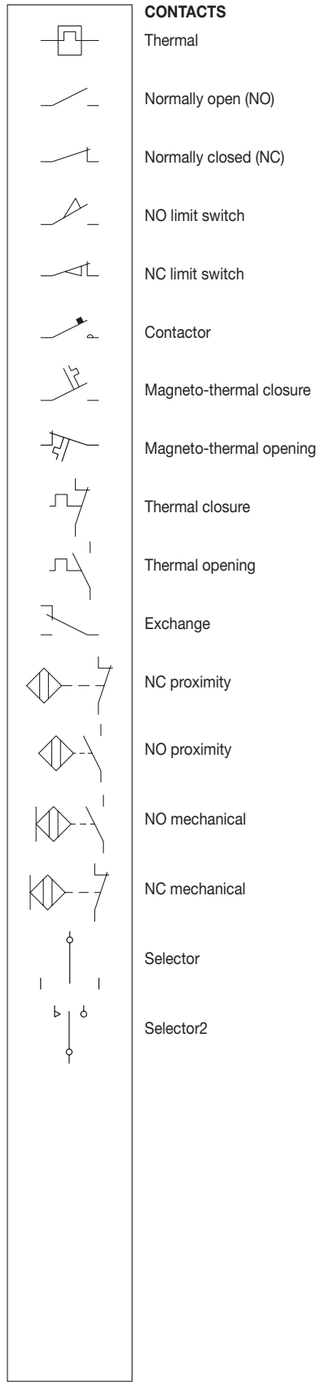


C.04 ELECTRICAL SYMBOLS

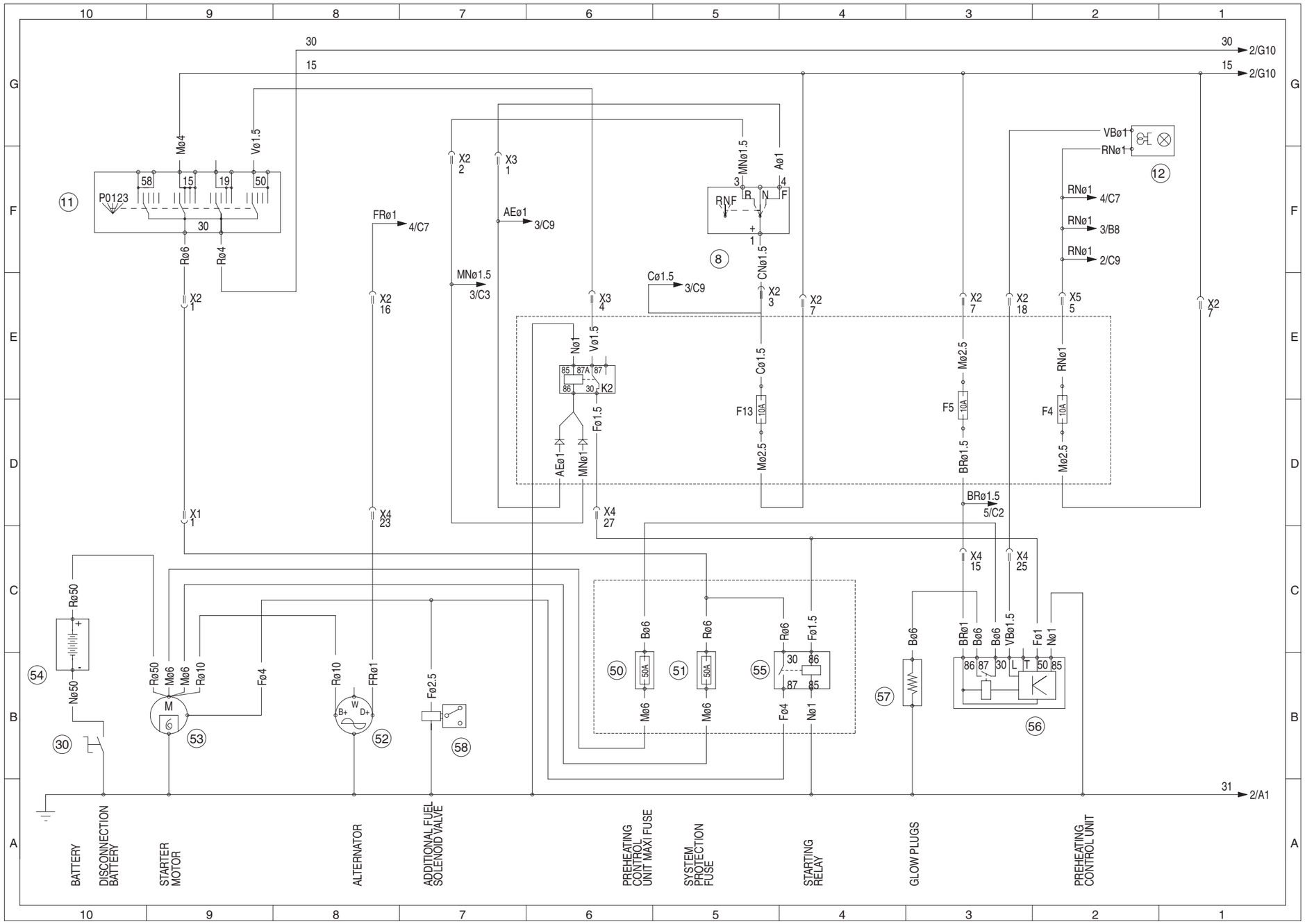




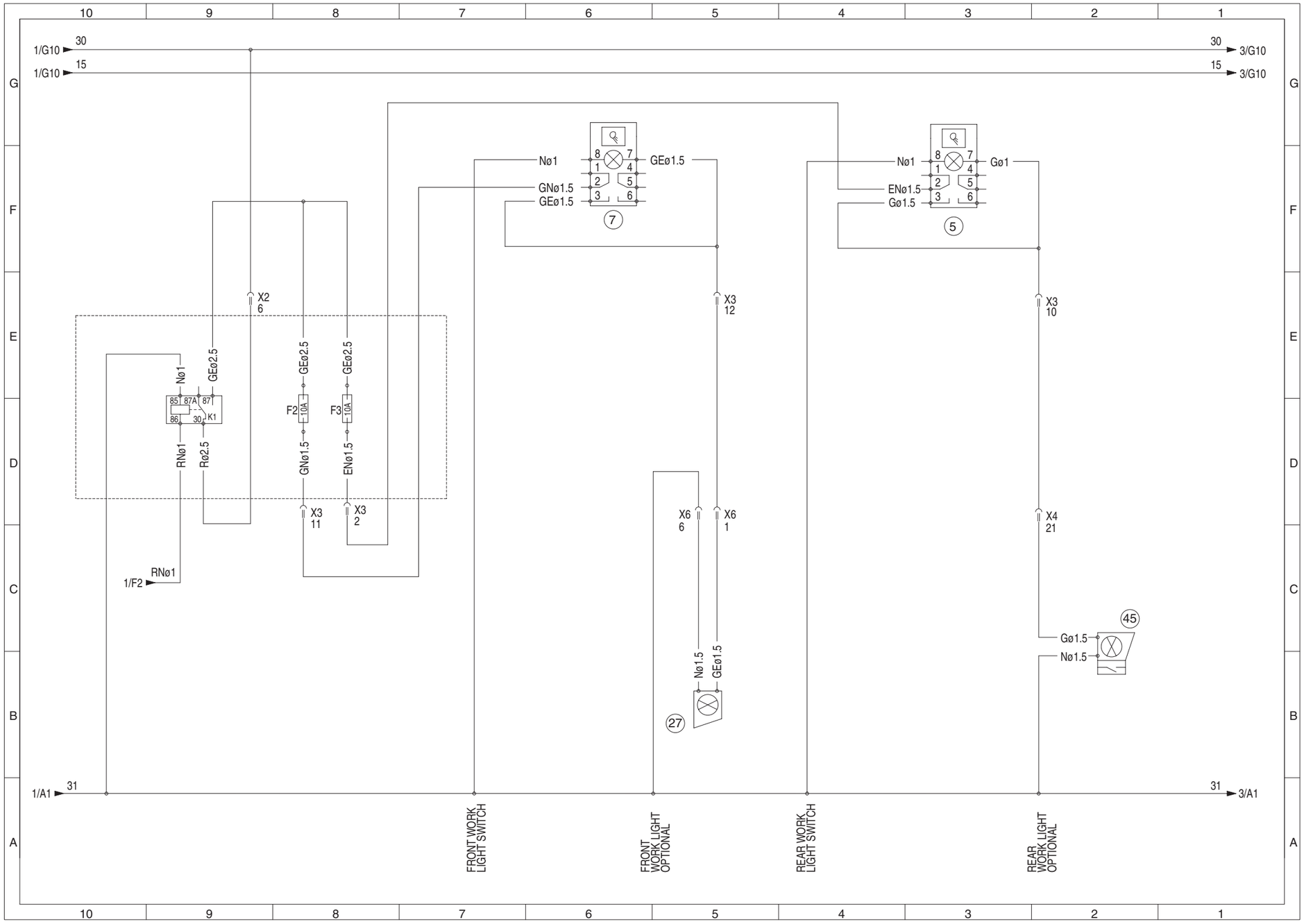




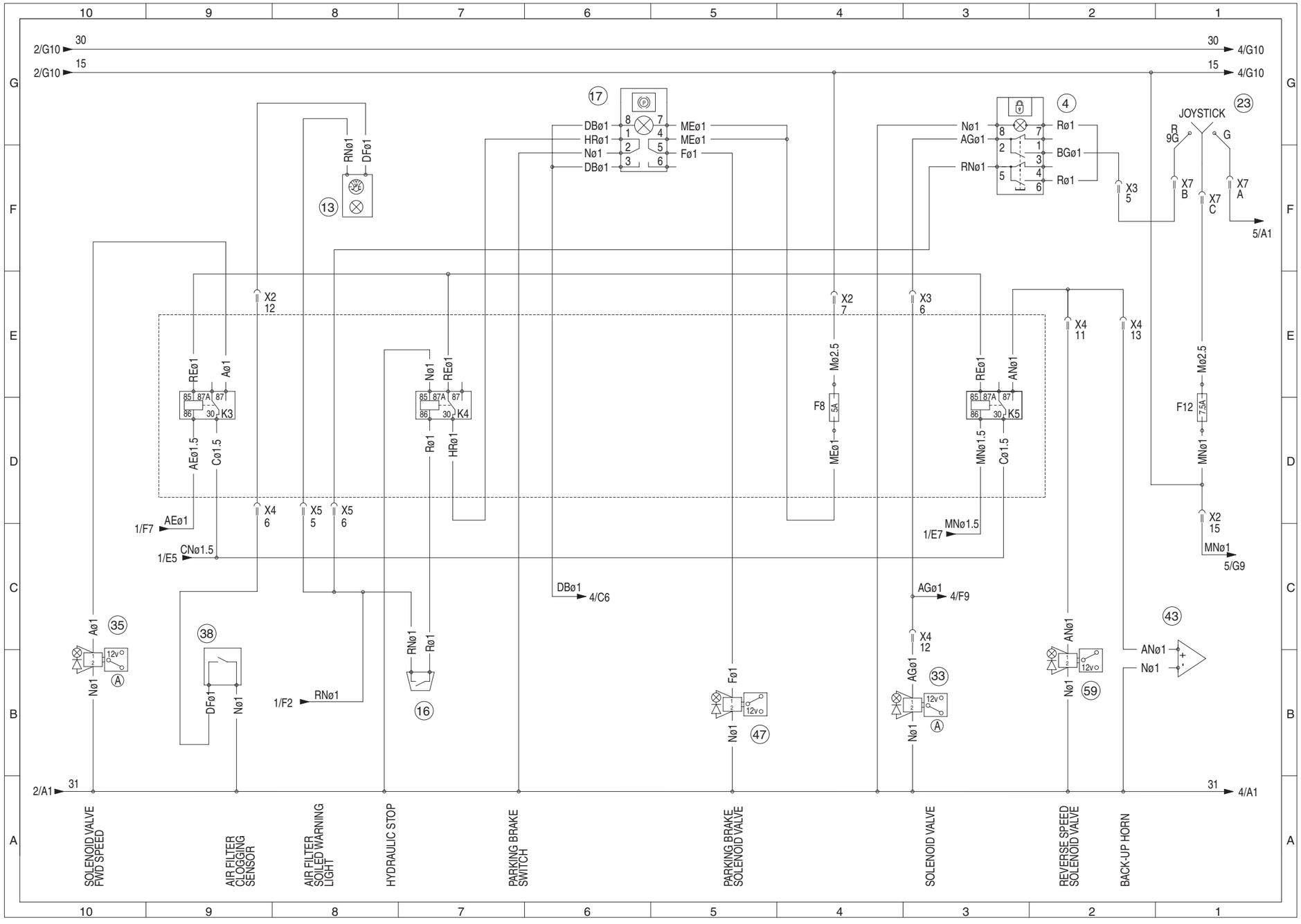
Operation: Wiring diagram - page 1 of 6	*Table:* **C.05.01**



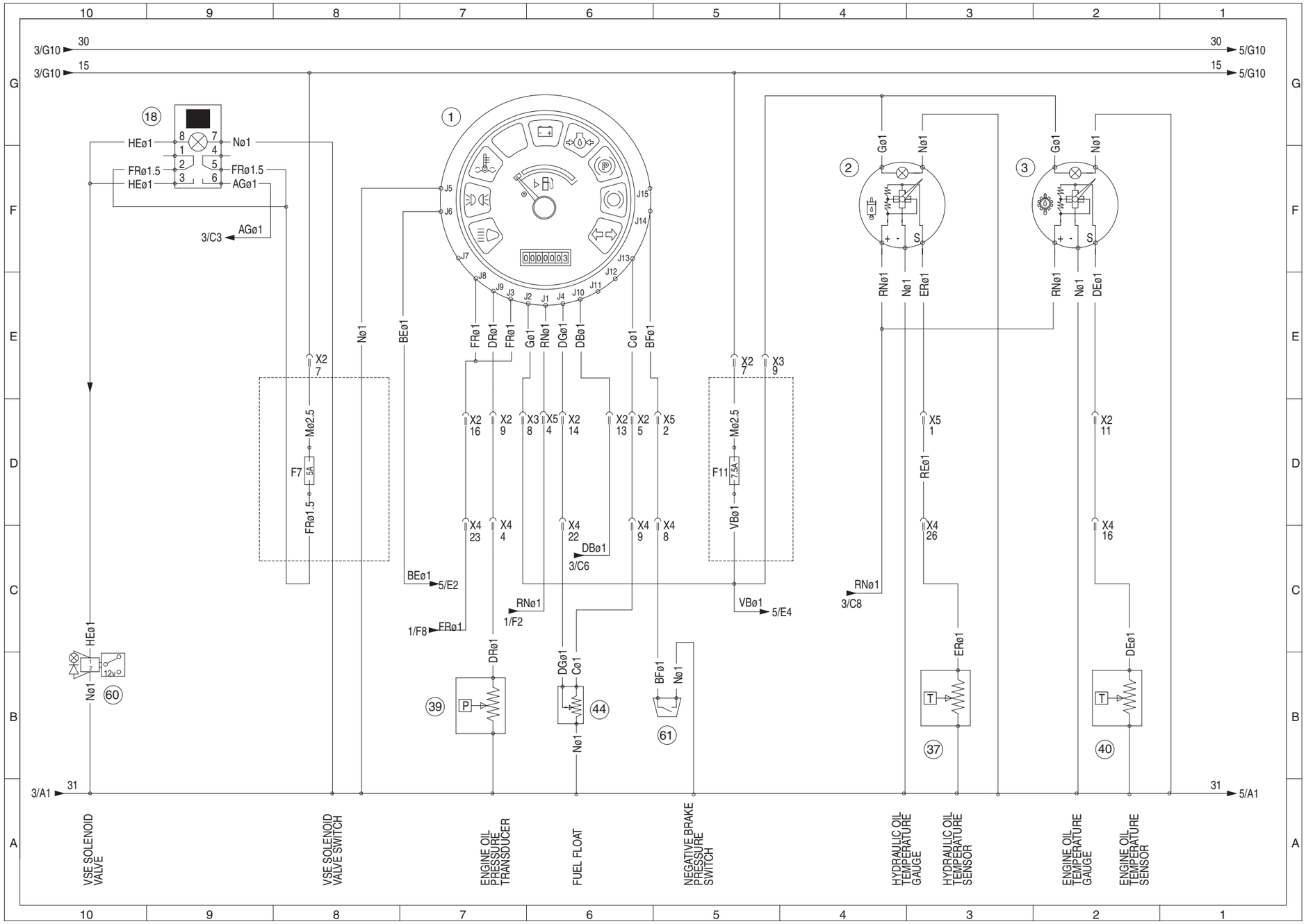
Operation: Wiring diagram - page 2 of 6	*Table:* **C.05.02**



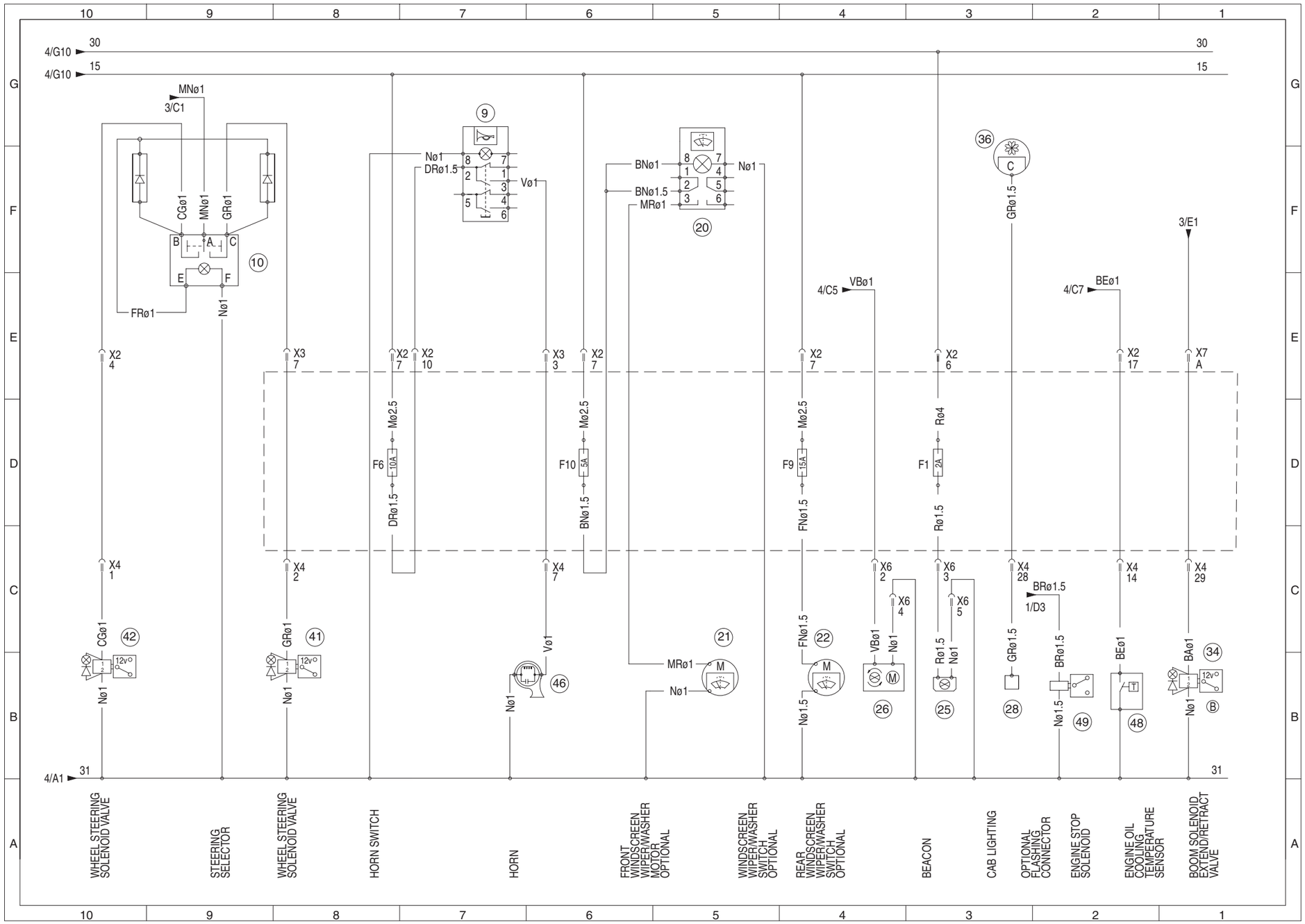
Operation: Wiring diagram - page 3 of 6	*Table:* **C.05.03**



Operation: Wiring diagram - page 4 of 6	*Table:* **C.05.04**

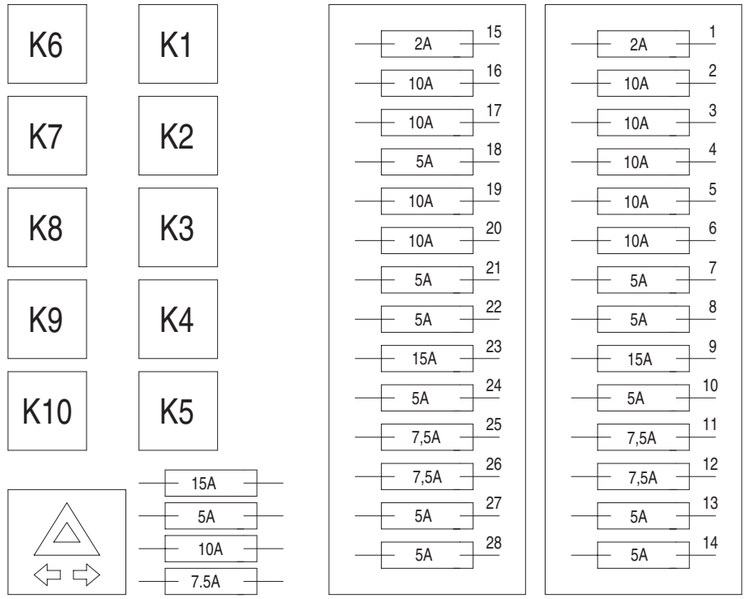


Operation: Wiring diagram - page 5 of 6	*Table:* **C.05.05**

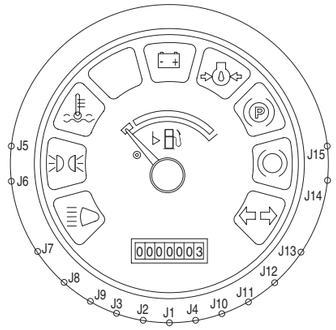


Operation: Wiring diagram - page 6 of 6	*Table:* **C.05.06**

WIRING DIAGRAM - FUSES AND RELAYS



Ref.	Circuit
J1	POWER SUPPLY
J2	FUEL GAUGE INSTRUMENT LIGHTING
J3	BATTERY LIGHT-POWER METER SIGNAL
J4	FUEL LEVEL
J5	GROUND
J6	HIGH TEMPERATURE
J7	
J8	BATTERY LIGHT-POWER METER SIGNAL
J9	ENGINE OIL PRESSURE
J10	PARKING BRAKE
J11	
J12	
J13	FUEL LOW LEVEL LIGHT
J14	BRAKE PRESSURE
J15	



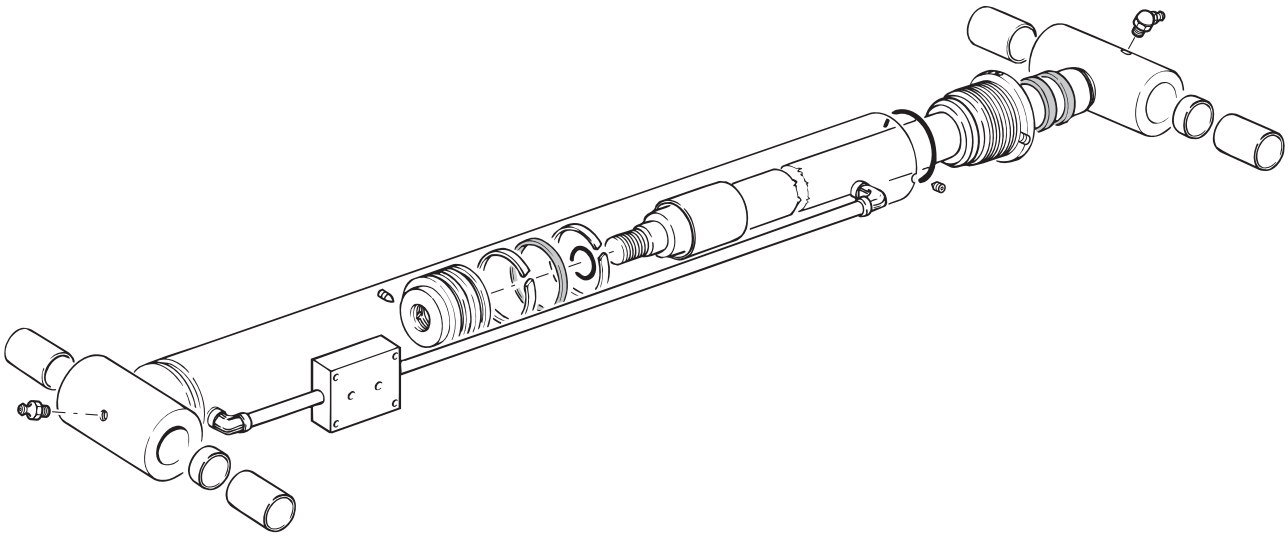
Ref.	RELAYS	Pag
K1	FRONT/REAR WORK LIGHTS OPTIONAL	2
K2	ENGINE START ENABLING COMMAND WITH SPEED LEVER IN NEUTER	1
K3	FORWARD SPEED	3
K4	FORWARD/REVERS SPEED ENABLING COMMAND	3
K5	REVERSE SPEED	3
K6		
K7		
K8		
K9		
K10		

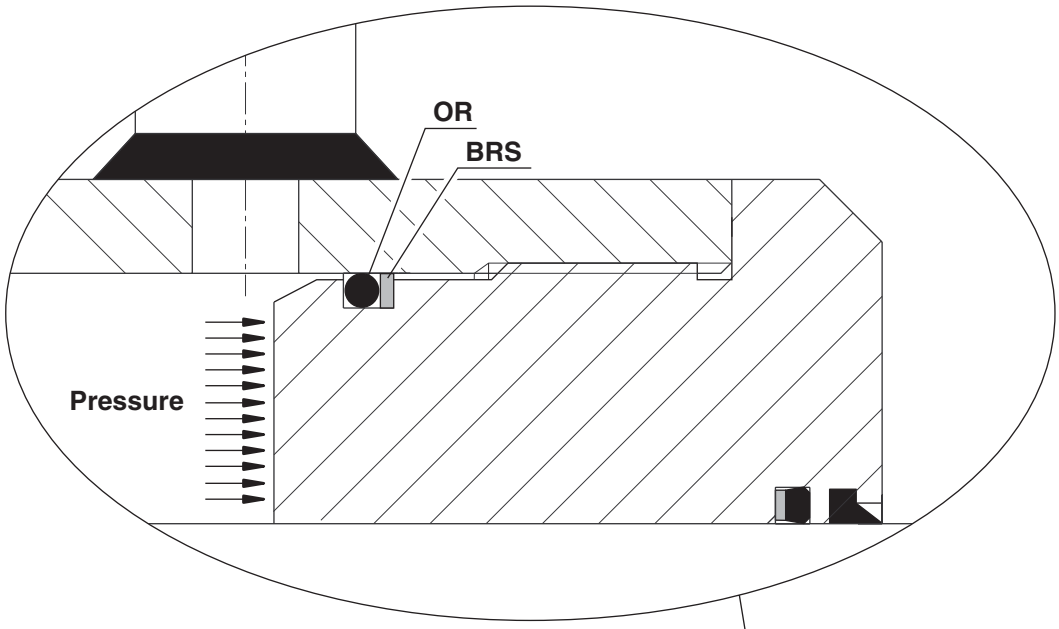
Ref.	FUSES	Pag
F1	INTERIOR LAMP POWER SUPPLY	5
F2	FRONTWORK LIGHT SWITCH POWER SUPPLY	2
F3	REAR WORK LIGHT SWITCH POWER SUPPLY	2
F4	K1 RELAY EXCITATION, HYDRAULIC STOP, FUEL GAUGE INSTRUMENT POWER SUPPLY, GLOWE LIGHT INSTRUMENT, AIR FILTER SOILED WARNING LIGHT, VSE SWITCH LIGHT	1
F5	POWER SUPPLY: ENGINE STOP SOLENOID, PREHEATING CONTROL UNIT	1
F6	HORN SWITCH POWER SUPPLY	5
F7	VSE SOLENOID VALVE SWITCH POWER SUPPLY, ATTACHMENT COUPLING/RELEASE SOLENOID VALVE POWER SUPPLY	4
F8	PARKING BRAKE SWITCH POWER SUPPLY, PARKING BRAKE SOLENOID VALVE POWER SUPPLY	3
F9	REAR WINDSCREEN WIPER/WASHER MOTOR POWER SUPPLY	5
F10	WINDSCREEN WIPER/WASHER SWITCH POWER SUPPLY	5
F11	BEACON POWER SUPPLY, LIGHTING: FUEL GAUGE WARNING LIGHT, HYDRAULIC OIL TEMPERATURE GAUGE ENGINE OIL TEMPERATURE GAUGE	4
F12	STEERING SELECTOR POWER SUPPLY, JOISTICK	3
F13	RELAY K3/RELAY K5 POWER SUPPLY	
F14		
F15		

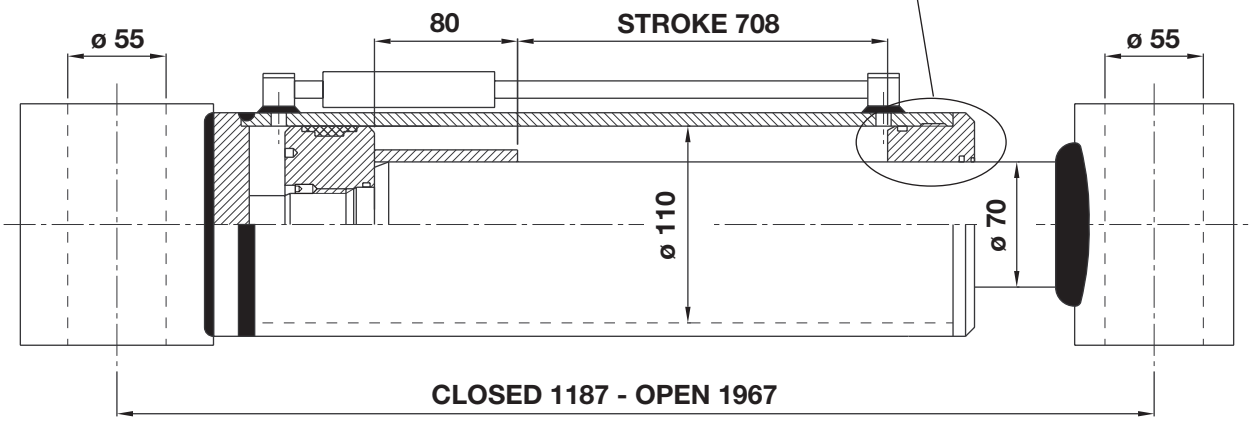
Operation: Legend wiring diagram	*Table:* **C.05.07**

Ref.	Description	Page	Cod.Supply	Ref.	Description	Page	Cod.Supply
1	WARNING LIGHTS-FUEL GAUGE	4		44	FUEL FLOAT	4	
2	HYDRAULIC OIL TEMPERATURE GAUGE	4		45	REAR WORK LIGHT OPTIONAL	2	
3	ENGINE OIL TEMPERATURE GAUGE	4		46	HORN	5	
4	ATTACHMENT COUPLING/RELEASE SWITCH	3		47	PARKING BRAKE SOLENOID VALVE	3	
5	REAR WORK LIGHT SWITCH OPTIONAL	2		48	ENGINE OIL COOLING TEMPERATURE SENSOR	5	
6				49	ENGINE STOP SOLENOID	5	
7	FRONT WORK LIGHT SWITCH OPTIONAL	2		50	PREHEATING CONTROL UNIT MAXIFUSE	1	
8	CHANGEOVER-OVER SWITCH	1		51	SYSTEM PROTECTION FUSE	1	
9	HORN SWITCH	5		52	ALTERNATOR	1	
10	STEERING SELECTOR	5		53	STARTER MOTOR	1	
11	IGNITION KEY SWITCH	1		54	12V BATTERY	1	
12	PREHEATING GLOW PLUGS WARNING LIGHT	1		55	STARTING RELAY	1	
13	AIR FILTER SOILED WARNING LIGHT	3		56	PREHEATING CONTROL UNIT	1	
14				57	GLOW PLUGS	1	
15				58	ADDITIONAL FUEL SOLENOID VALVE	1	
16	HYDRAULIC STOP	3		59	REVERSE SPEED SOLENOID VALVE	3	
17	PARKING BRAKE SWITCH	3		60	VSE SOLENOID VALVE	4	
18	VSE SOLENOID SWITCH	4		61	NEGATIVE BRAKE PRESSURE SWITCH	4	
19				62			
20	FRONT WINDSCREEN WIPER/WASHER SWITCH OPTIONAL	5		63			
21	FRONT WINDSCREEN WIPER/WASHER MOTOR OPTIONAL	5		64			
22	REAR WINDSCREEN WIPER/WASHER MOTOR OPTIONAL	5		65			
23	JOYSTICK	3		66			
24							
25	CAB LIGHTING	5					
26	BEACON	5					
27	FRONT WORK LIGHT OPTIONAL	2		X1	4-WAY CONNECTOR-FUSES LINE CONNECTION TO ENGINE LINE		
28	OPTIONAL FLASHING CONNECTOR	5		X2	18-WAY CONNECTOR-STEERING COLUMN LINE CONN. TO CAB LINE		
29				X3	12-WAY CONNECTOR-STEERING COLUMN LINE CONN. TO CAB LINE		
30	DISCONNECTION BATTERY	1		X4	31-WAY CONNECTOR-FUSES LINE CONNECTION TO ENGINE LINE		
31				X5	6-WAY CONNECTOR-STEERING COLUMN LINE CONN. TO CAB LINE		
32				X6	6-WAY CONNECTOR-FUSES LINE CONNECTOR TO CAB LINE		
33	ATTACHMENT COUPLING/RELEASE SOLENOID VALVE	3		X7	JOYSTICK CONNECTOR		
34	EXTEND/RETRACT BOOM SOLENOID VALVE	5					
35	SOLENOID VALVE-FWD SPEED	3					
36	AIR CONDITIONED COMPRESSOR OPTIONAL	5					
37	HYDRAULIC OIL TEMPERATURE SENSOR	4					
38	AIR FILTER CLOGGING SENSOR	3					
39	ENGINE OIL PRESSURE TRANSDUCER	4					
40	ENGINE OIL TEMPERATURE SENSOR	4					
41	WHEEL STEERING SOLENOID VALVE	5					
42	WHEEL STEERING SOLENOID VALVE	5					
43	BACK-UP HORN	3					

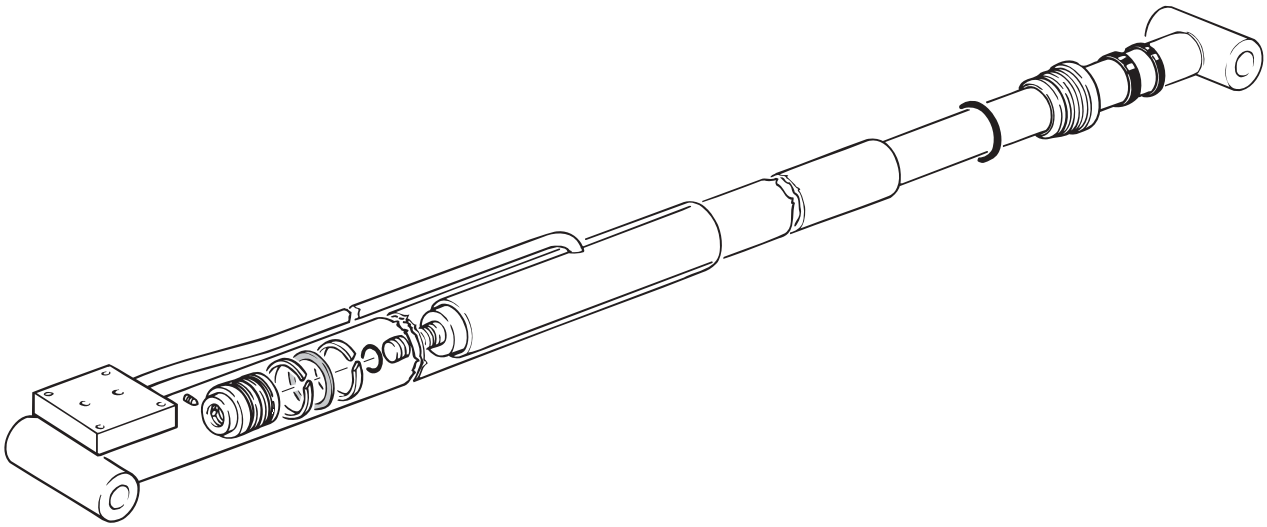
Operation: Boom raising cylinder	Table: C.06.01

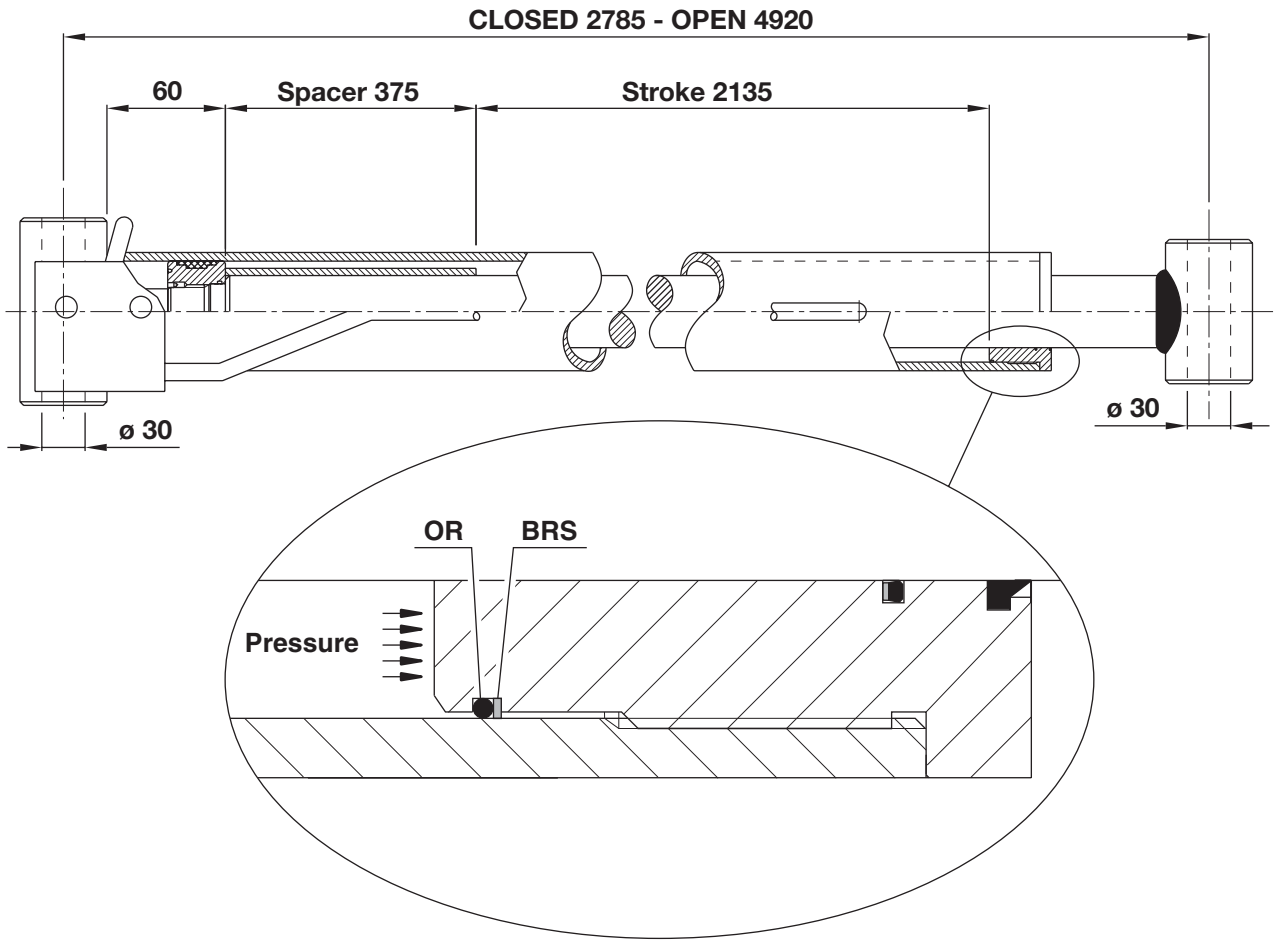




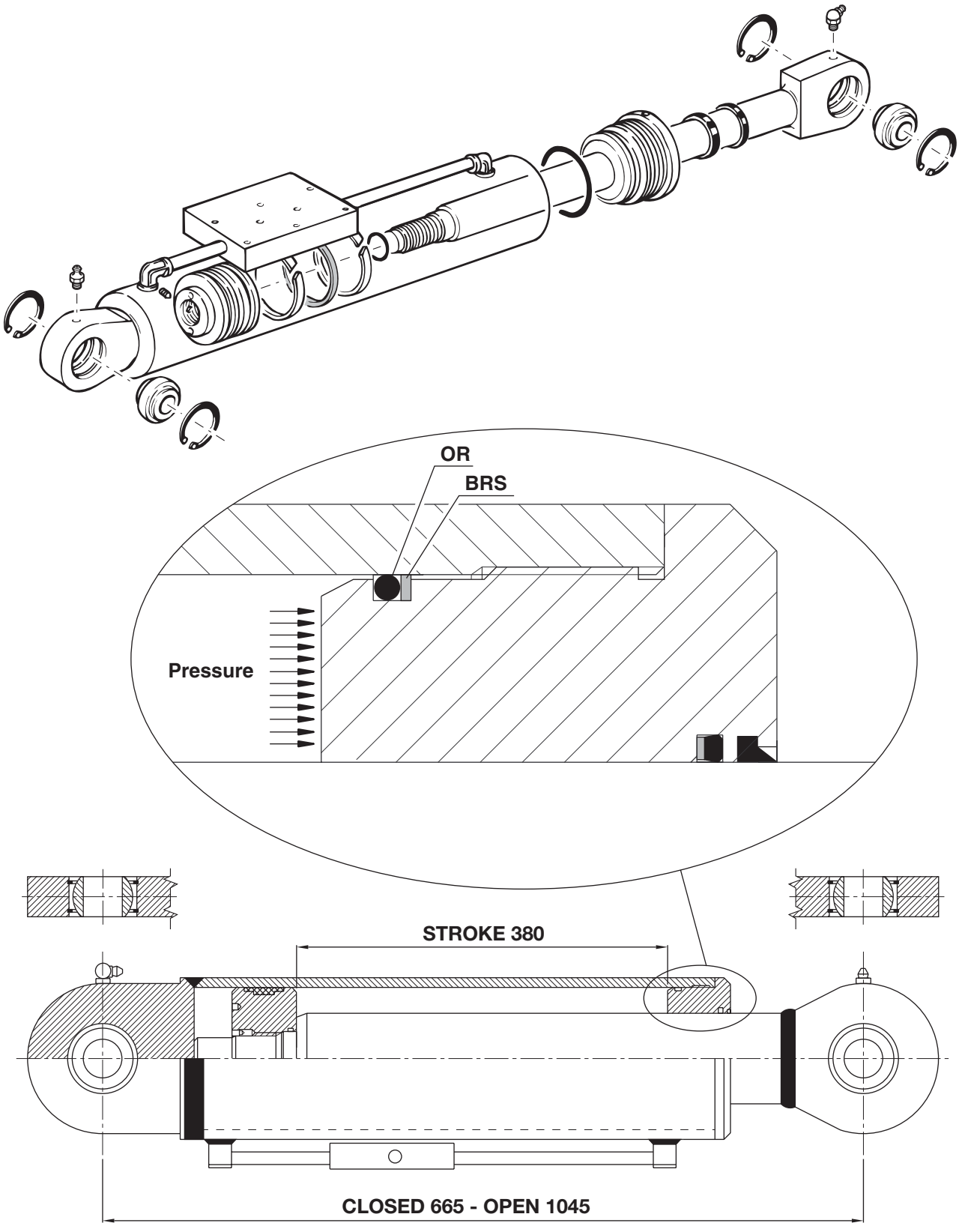


Operation: Boom extension cylinder	*Table:* **C.06.02**

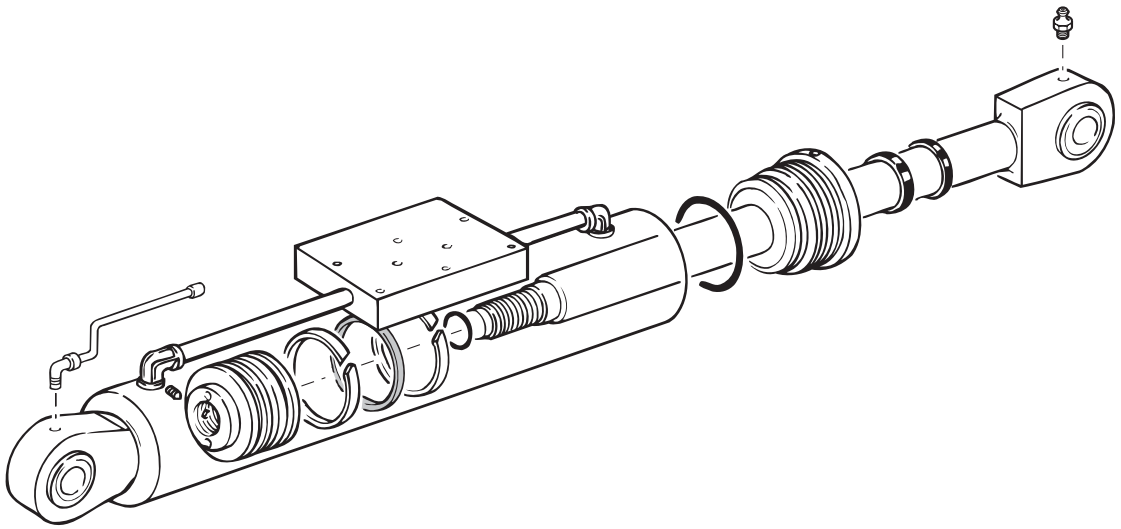


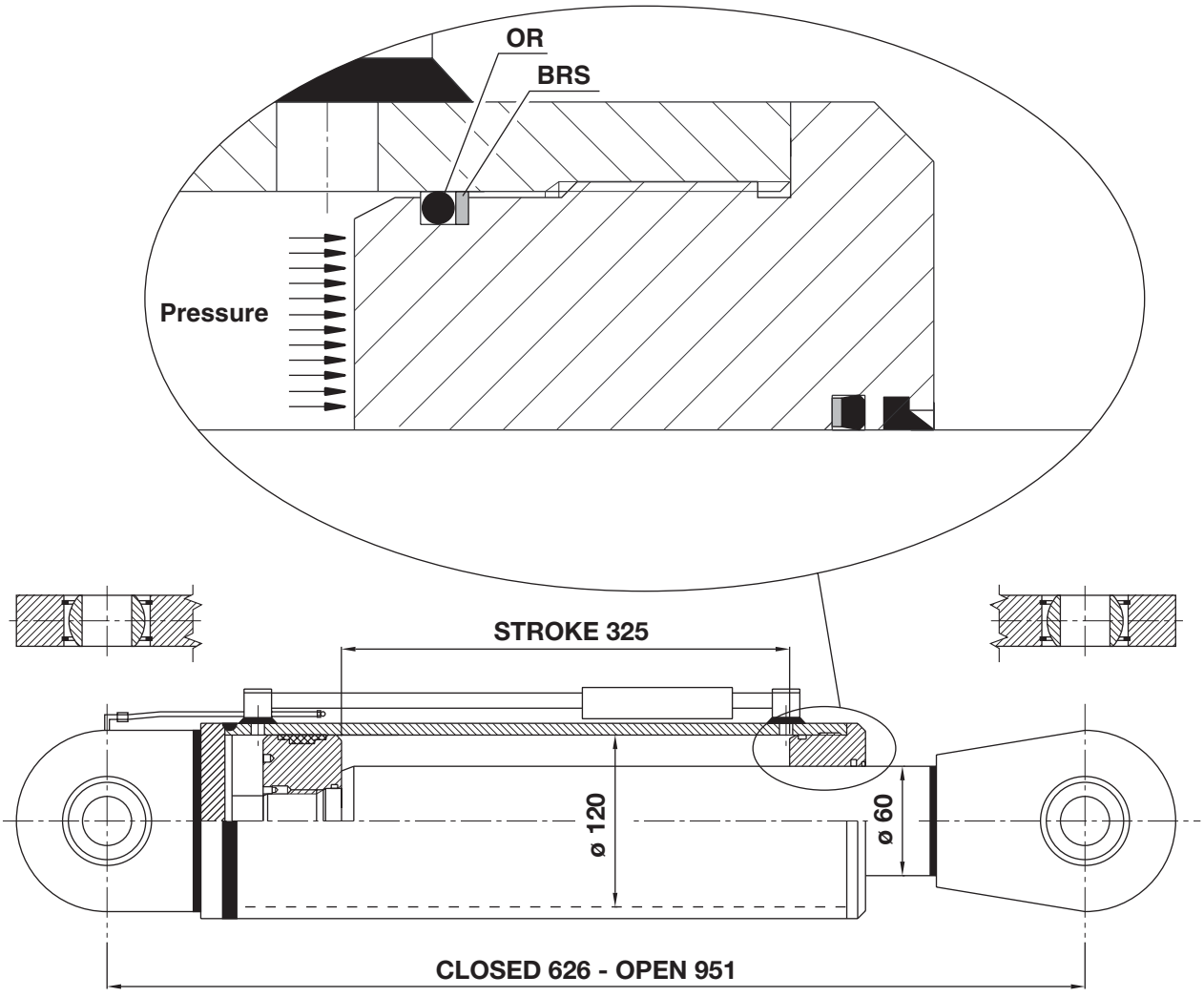


Operation: Balance cylinder	Table: C.06.03

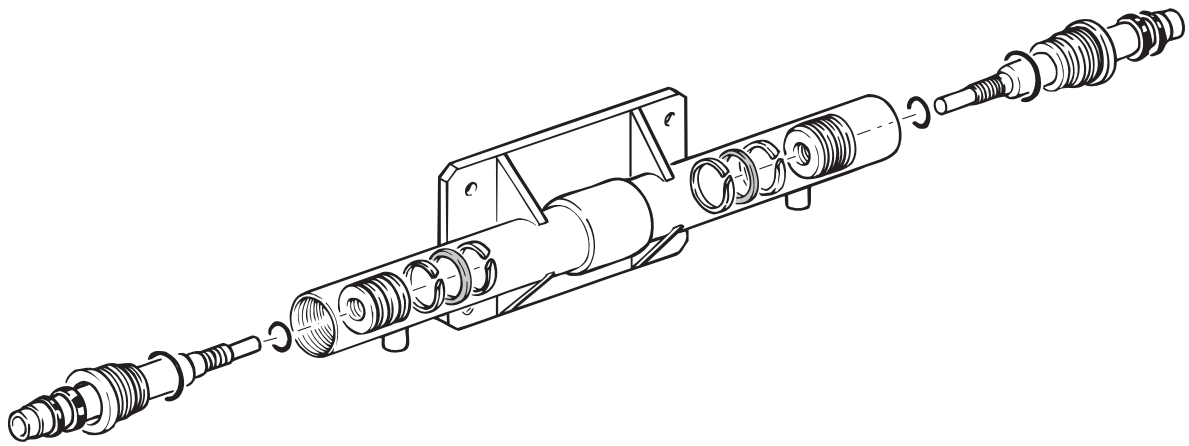


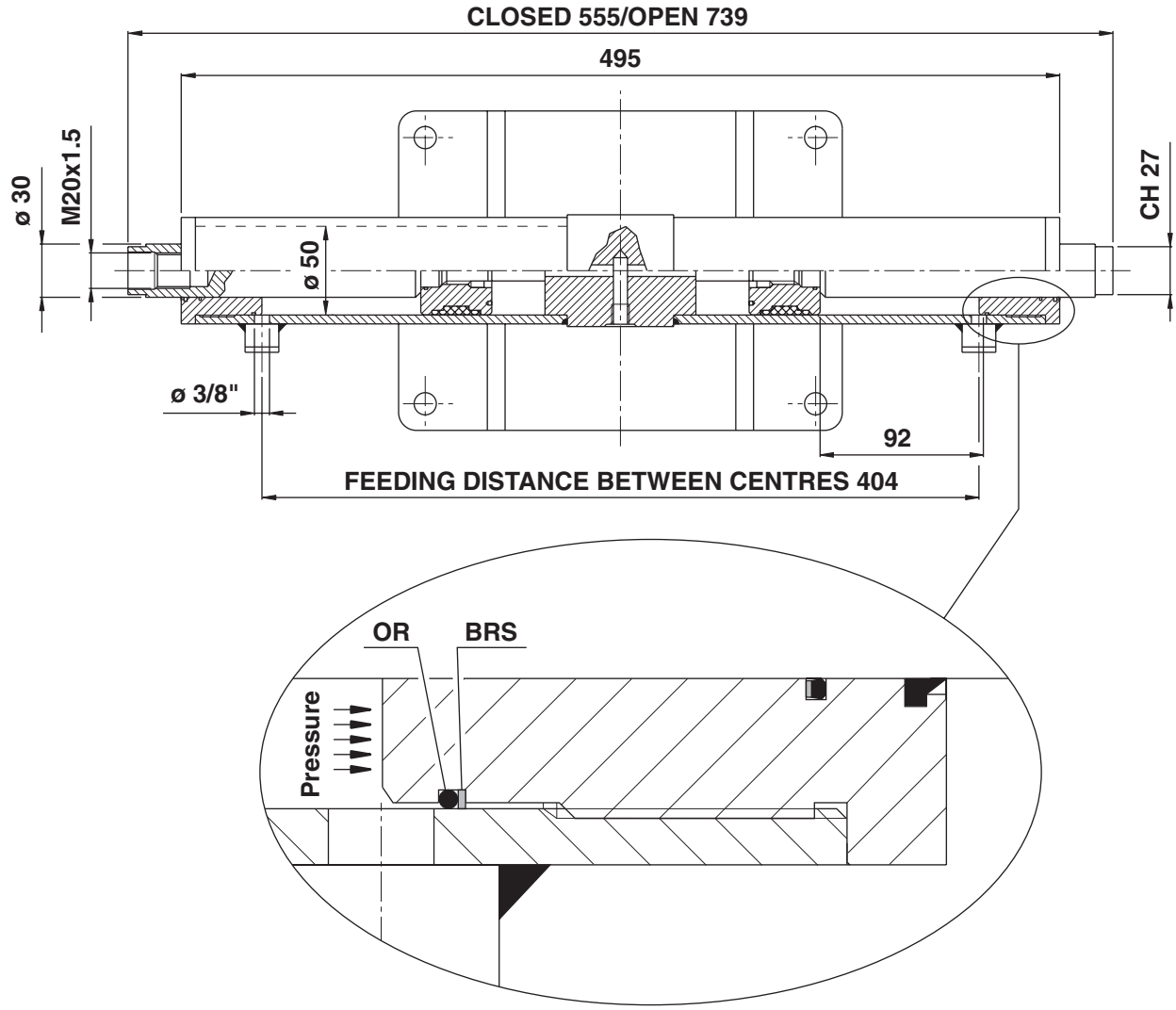
Operation: Fork movement cylinder	*Table:* **C.06.04**



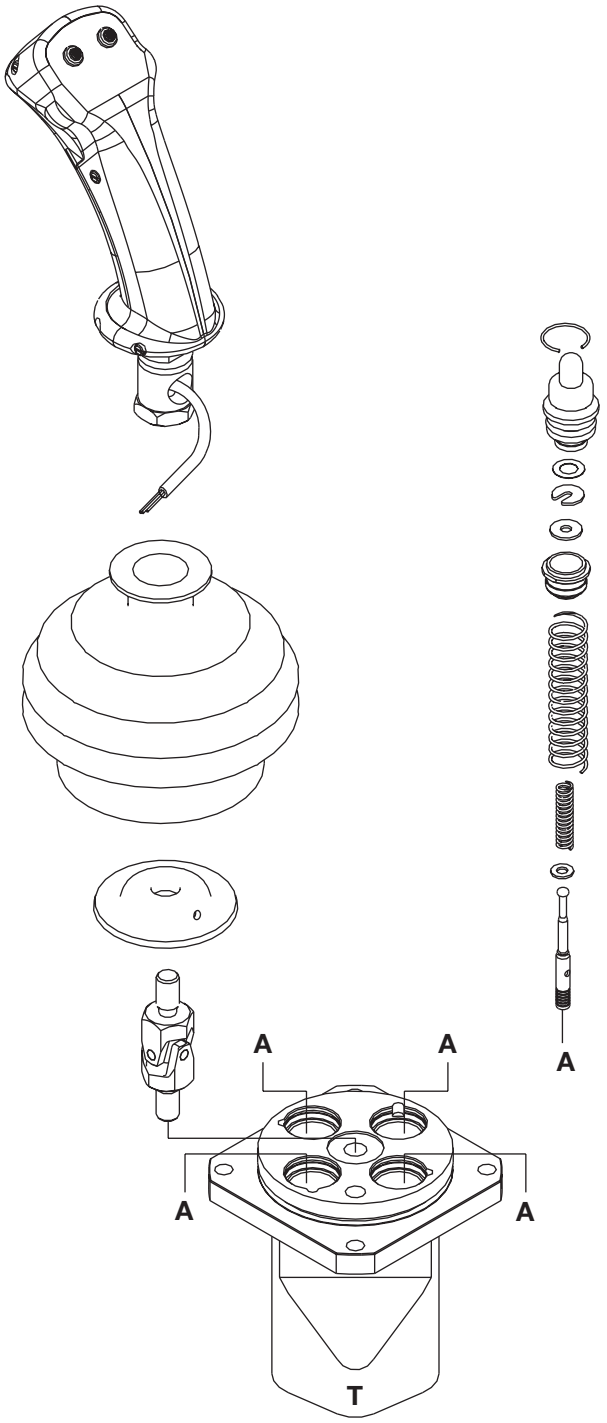


Operation: Attachment locking cylinder	Table: C.06.05



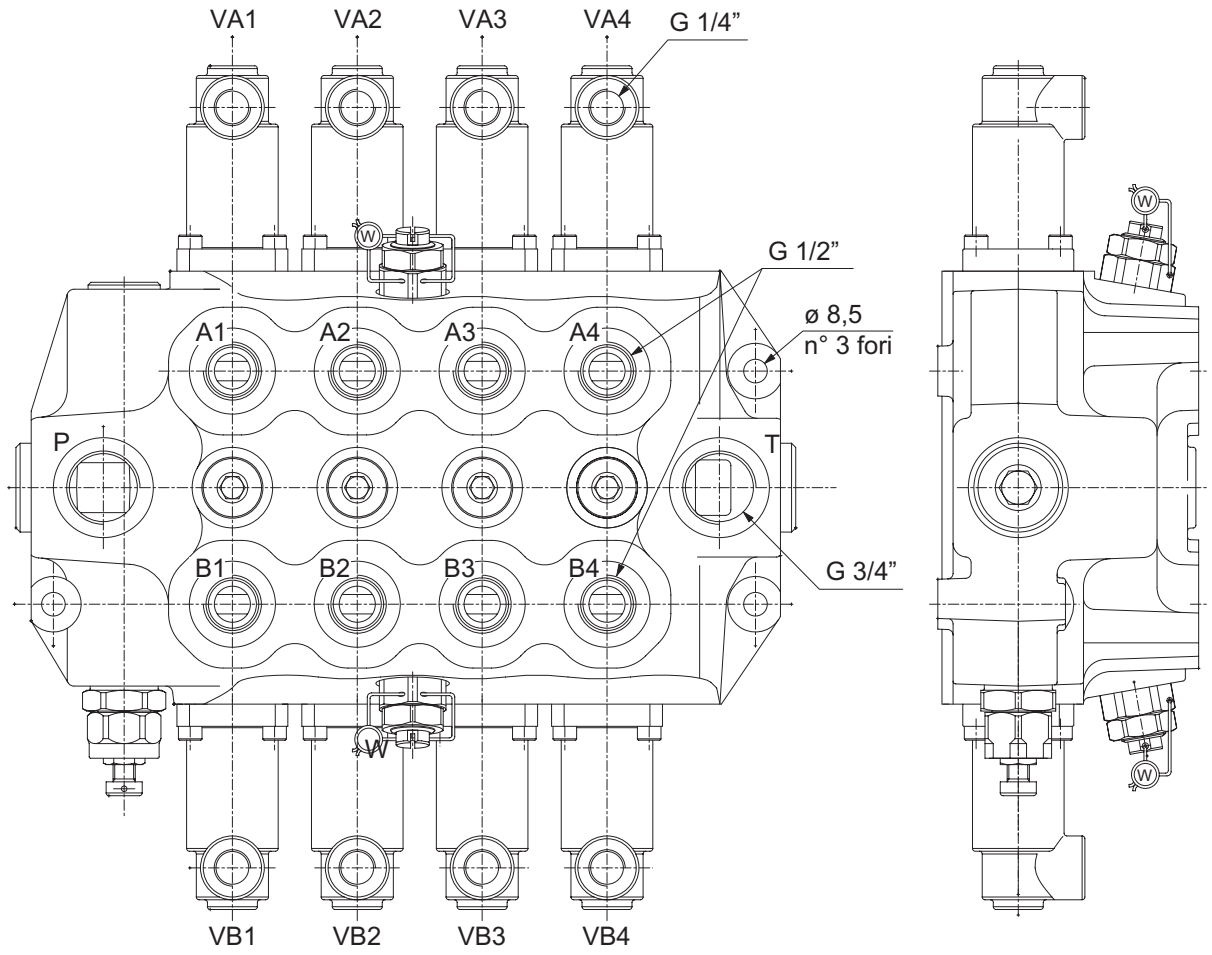


Operation: Hand-lever	*Table:* **C.07**



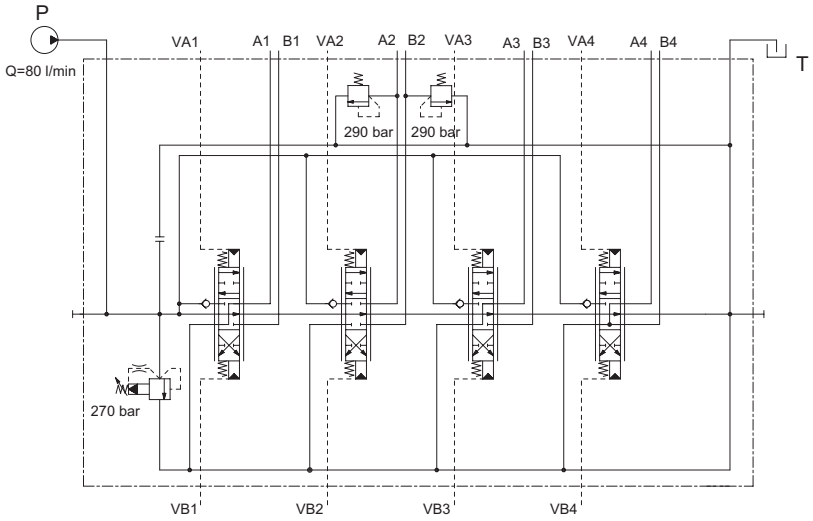


Operation: Hydraulic distributor	*Table:* **C.08**

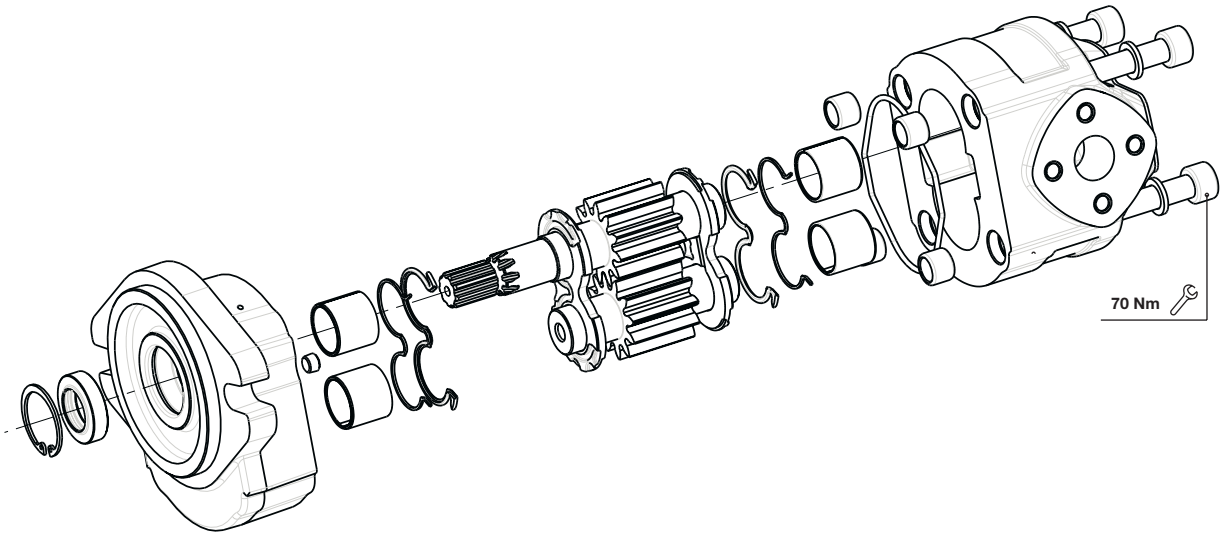


DATA	
Monobloc actuator with paralleled circuit	
Working elements	4
Slider diameter	18 mm
OPERATING CONDITIONS (mineral oil - viscosity 46 mm²/s @ 40|BC)	
Nominal flow	80 l/min
Nominal pressure	315 bar
Max pressure on V	50 bar
Max back-pressure to drain T	25 bar
Max internal leakage A(B)->T @ 100 bar:	3 cm³/min
Viscosity – working range	15 - 75 mm²/s
Viscosity – minimum	12 mm²/s
Viscosity – maximum	400 mm²/s
Ambient temperature	-40|B a +60|BC
Fluid temperature range	-20|B a +80|BC
Admissible contamination degree	19/16 - ISO 4406

HYDRAULIC SCHEME



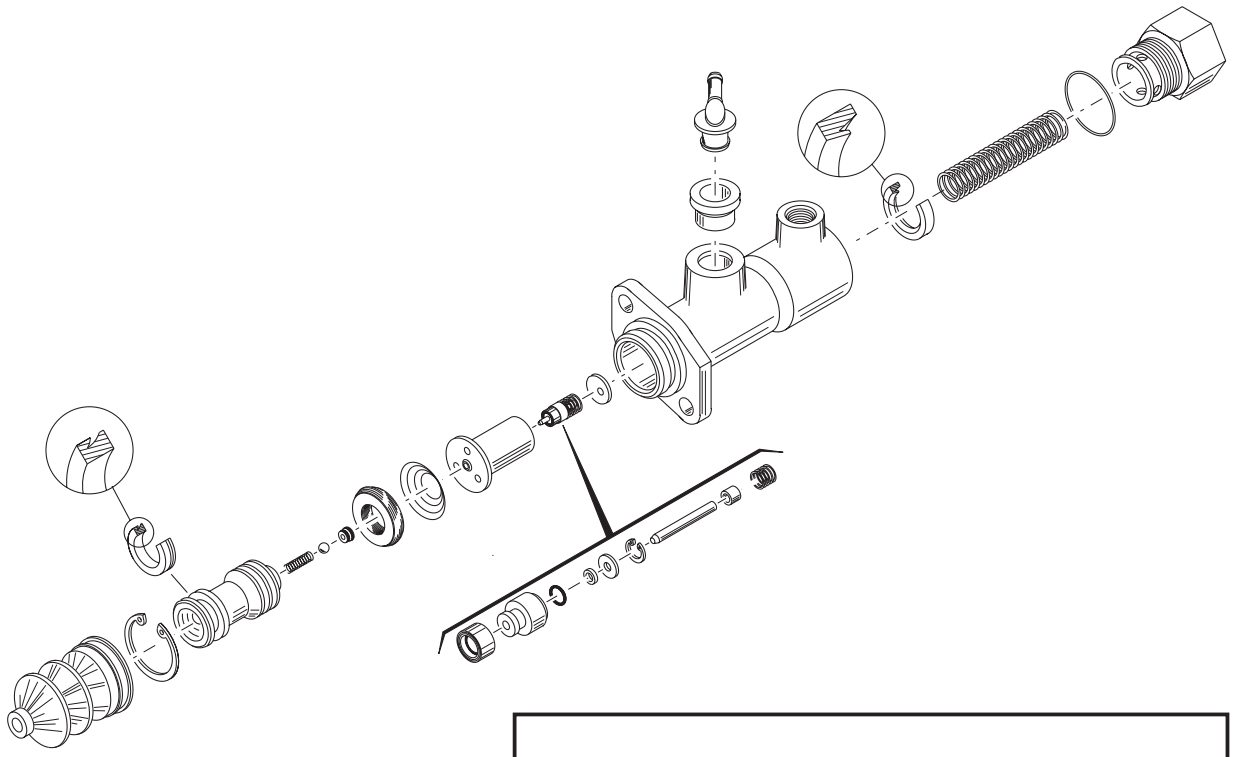
Operation: Hydraulic pump	*Table:* **C.09.01**

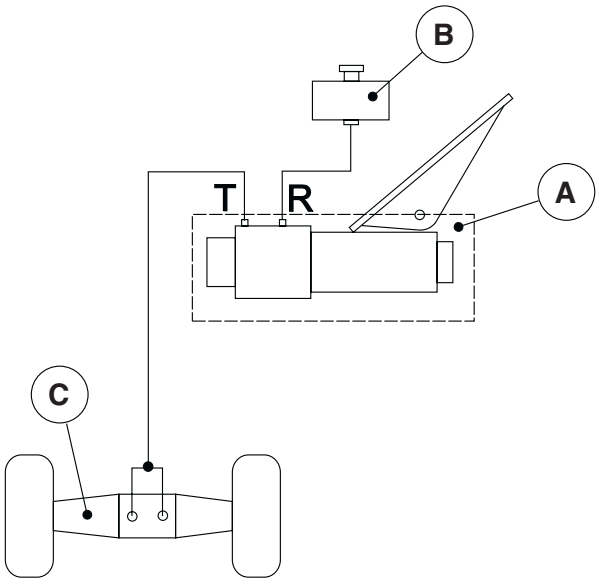


PUMP TECHNICAL DATA

- Rotation direction		left
- Displacement		21.14 cm^3
- Feeding pressure field for pumps		0.3 - 3 bar
- Max continuous pressure	P1	210 bar
- Max intermittent pressure	P2	230 bar
- Max peak pressure	P3	250 bar
- Speed	min P1	300 min^-1
	max P1	3000 min^-1
- Gaskets		NBR
- Working temperature		-25°C +80°C
- Viscosity field	recommended	12-100 mm^2/s
	admissible	max 750 mm^2/s
- Contamination class	ΔP > 200 bar	8 - Nas 1638
	βx = 75-10 μm	19/17/14 - ISO 4406
	ΔP < 200 bar	10 - Nas 1638
	βx = 75-25 μm	21/19/16 - ISO 4406

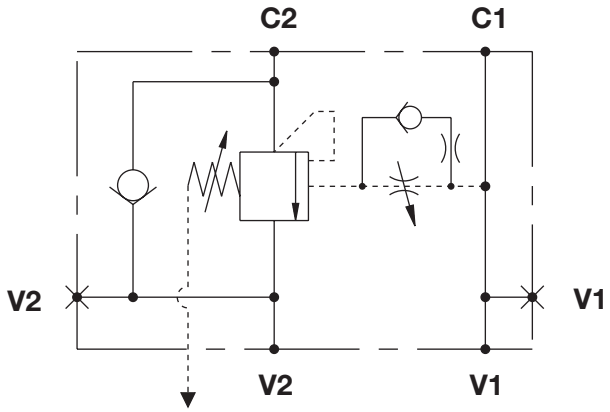
Operation: Brake pump	*Table:* **C.09.02**



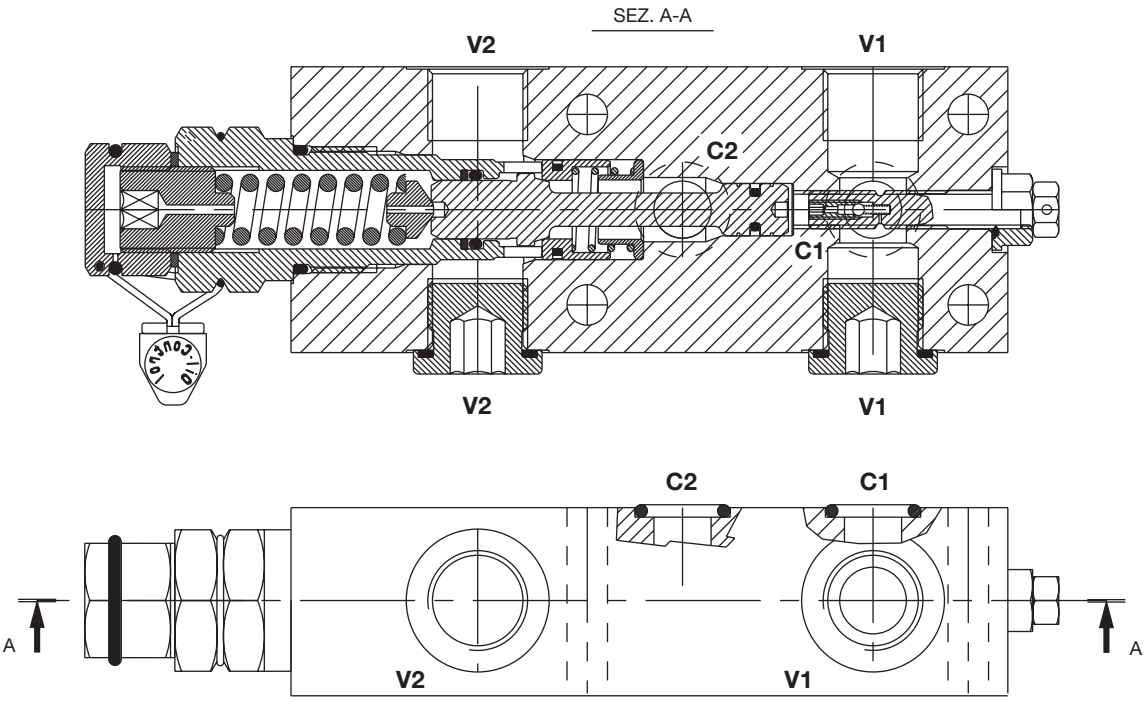


A BRAKE PUMP
B BRAKE OIL SUMP
C FRONT AXLE

Operation: Boom raising and extension cylinder blocking valve	*Table:* **C.10.01**



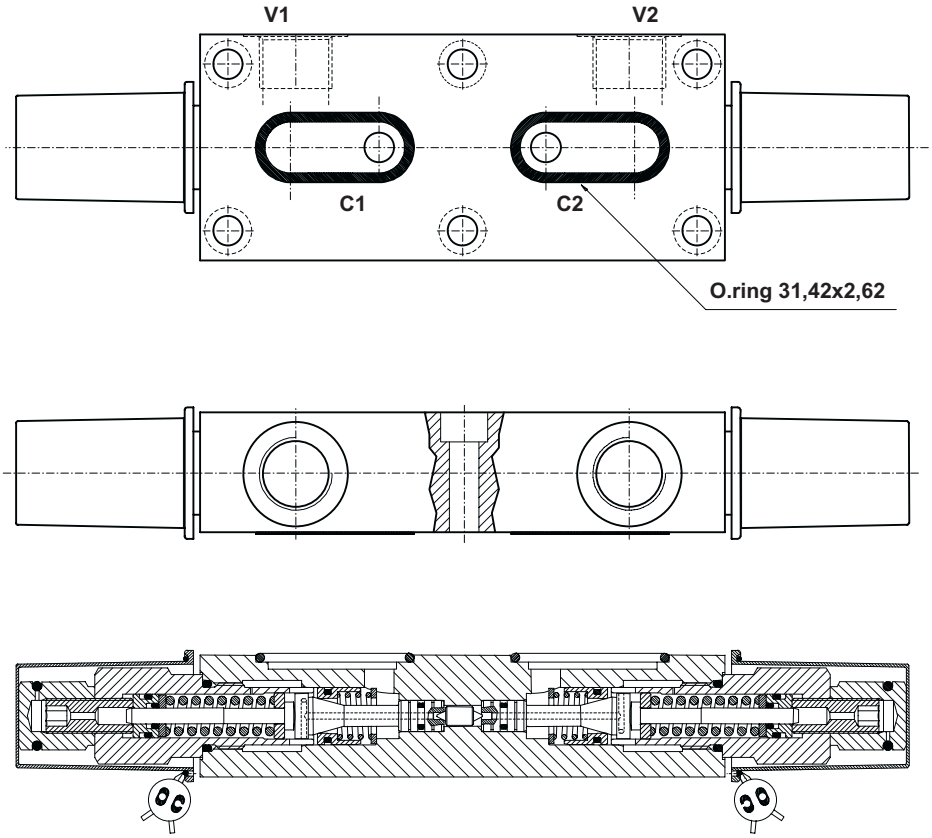
FITTINGS V1-V2: G 1/2”
C1-C2: ø12



TECHNICAL DATA

- Max working pressure = 350 bar
- Piloting ratio = 4:1
- Weight = 2.5 kg
- Valve setting = 1.3 times higher than the load induced pressure
- Steel manifold

Operation: Balance cylinder blocking valve	*Table:* **C.10.02**

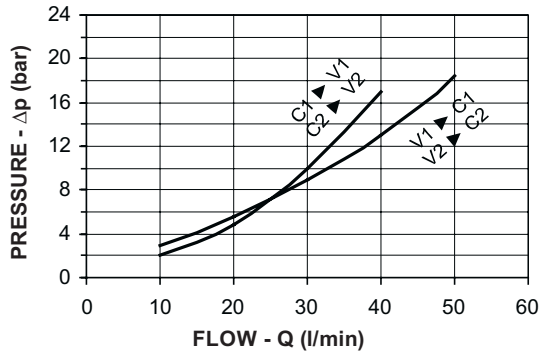


MATERIAL

Manifold: Steel

TECHNICAL DATA

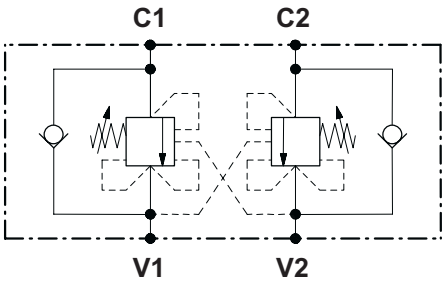
Max flow = see diagram
Max pressure = 350 Bar
Setting = 100 - 350 bar
Standard setting (Q=5 l/min) = 300 bar
Valve setting = 1.3 times higher than
the load induced pressure
Piloting ratio = 4,2:1
Weight = 2 kg



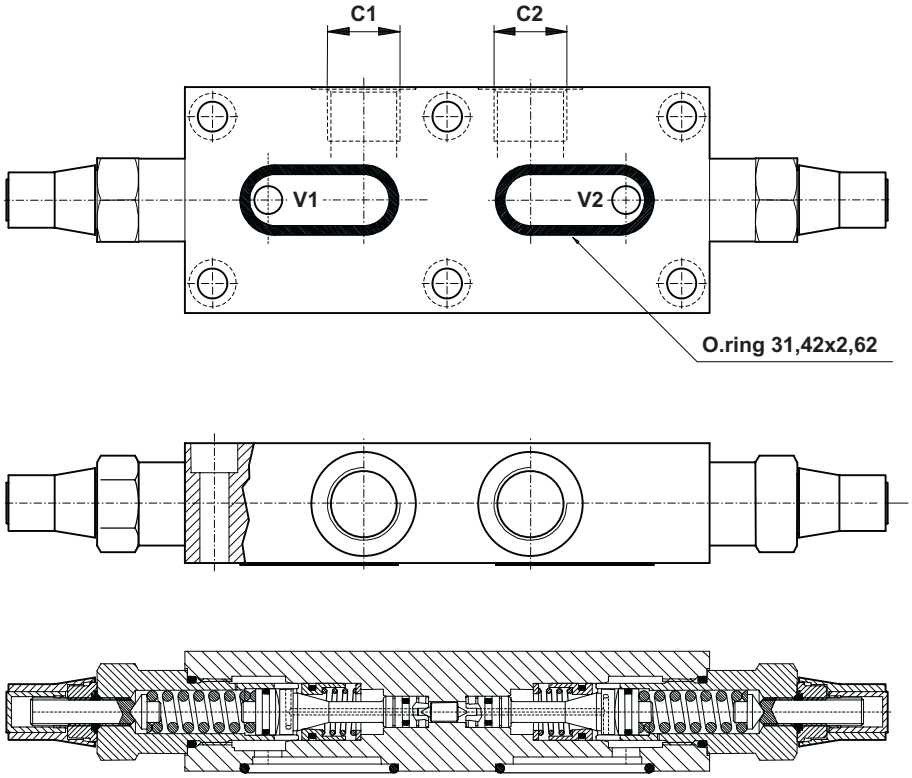
FITTINGS

C1-C2 = G 1/2”
V1-V2 = ø 8,5

INSTALLATION SCHEME



Operation: Fork movement cylinder blocking valve	*Table:* **C.10.03**

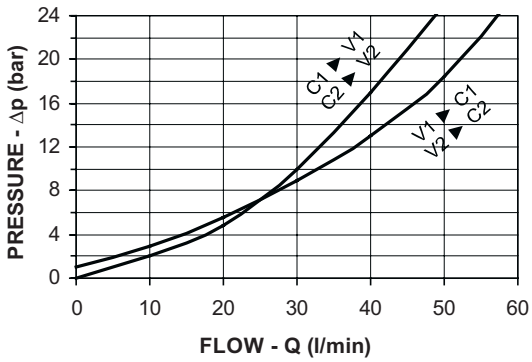


MATERIAL

Manifold: Steel

TECHNICAL DATA

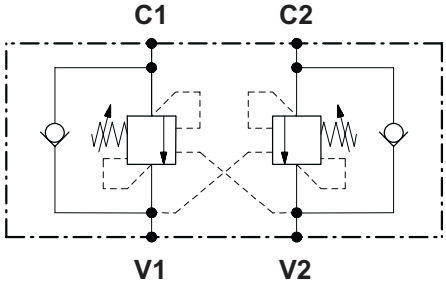
Max flow = see diagram
Max pressure = 350 Bar
Setting = 100 - 350 bar
Standard setting (Q=5 l/min) = 300 bar
Valve setting = 1.3 times higher than the load induced pressure
Piloting ratio = 11:1
Weight = 2 kg



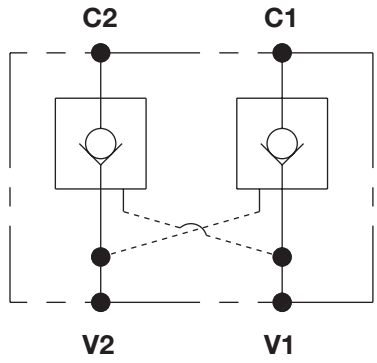
FITTINGS

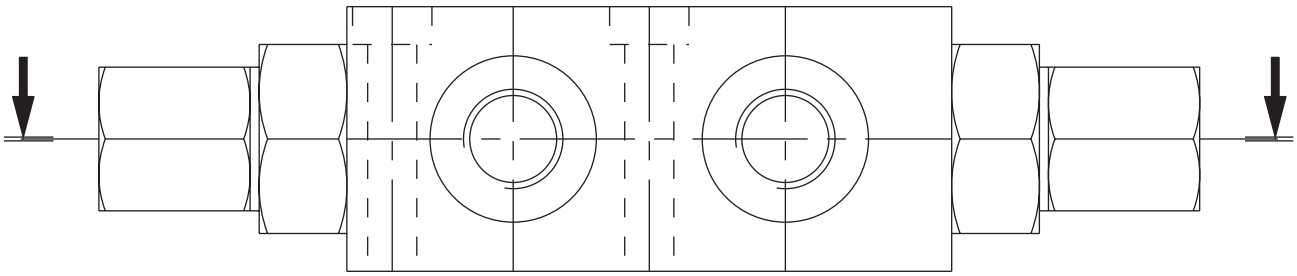
C1-C2 = G 1/2”
V1-V2 = ø 8,5

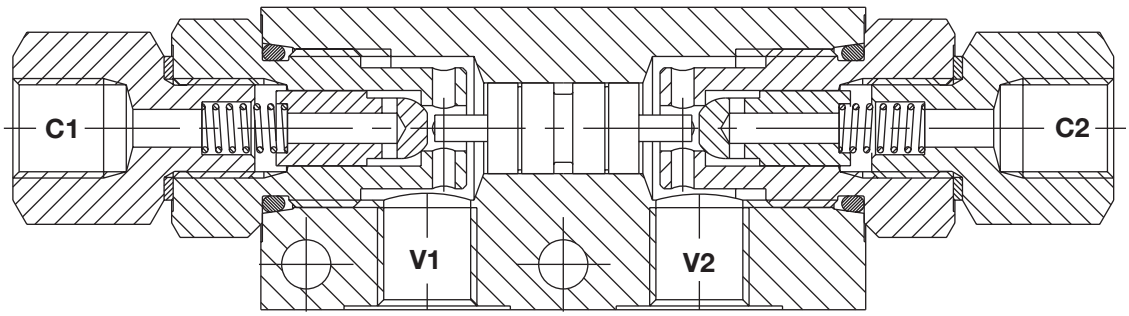
INSTALLATION SCHEME



Operation: Attachment cylinder blocking valve	*Table:* **C.10.04**



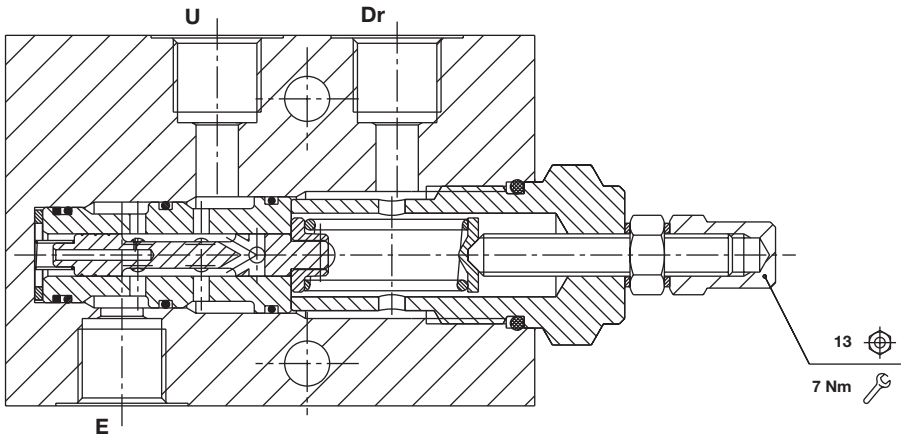




TECHNICAL DATA

- Max working pressure = 350 bar
- Opening pressure = 3 bar
- Max flow = 15 l/min
- Piloting ratio = 4:1
- Weight = 0.7 kg

Operation: Pressure reducing valve	*Table:* **C.10.05**



FILTRATION - OIL CONTAMINATION

TYPE OF SYSTEM TYPE OF VALVE	RECOMMENDED CONTAMINATION LEVEL - ISO 4406
- High performance systems - Systems with working pressures from 210 to 350 bar - Systems with proportional controls - Systems with high frequency cycles	16/13
- Systems with working pressures up to 210 bar - Spool valves - Valves with calibrated orifice	18/14
- Systems with low working pressures - Piloting systems - Systems with low frequency cycles	19/15

MATERIAL

Body: Aluminium 702 State T6
Internal parts: case-hardened and tempered steel

TECHNICAL DATA

Max flow = 20 l/min
Max pressure = 210 Bar
Setting = 5 - 50 bar
(test setting 40 bar with 5 l/min)
Piloting ratio = 1:7
Fluid: 20-200 cSt mineral oil
Ambient temperature = 0 +40 °C
Gaskets : BUNA N

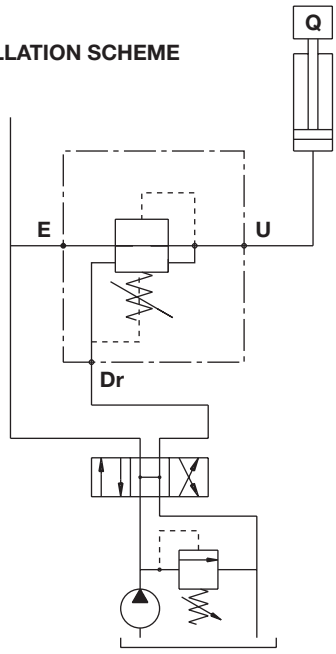
BLOW-BY
Blow-by in Dr: 20 cc/min at a pressure of 150 bar with oil with 46 cSt viscosity

FITTINGS

U - E - Dr = G 3\8”

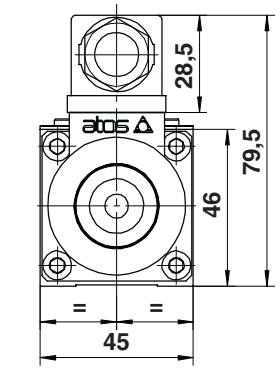
Cylindrical fitting tightening torque 0 60 Nm (do not use conical fittings)

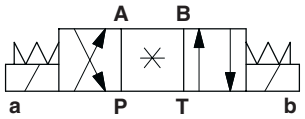
INSTALLATION SCHEME

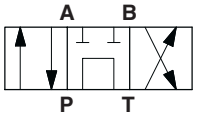


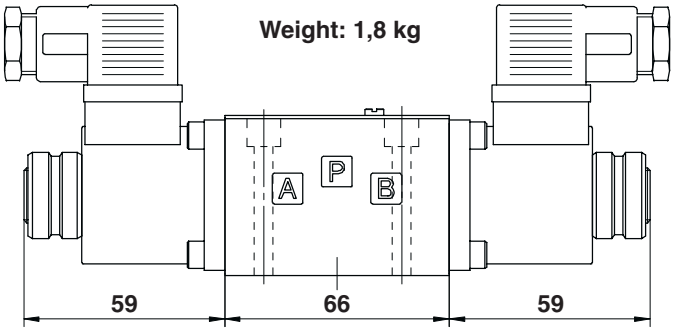
Operation: DHI solenoid valve

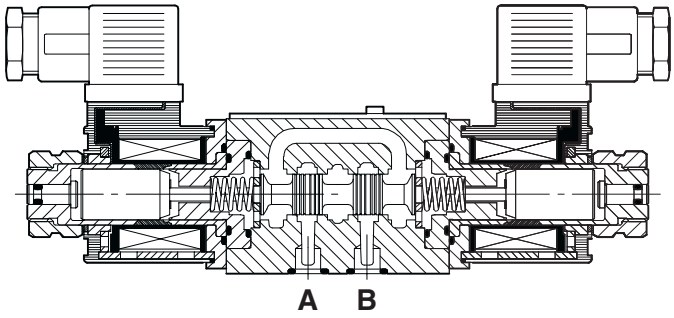
Table: **C.10.06**











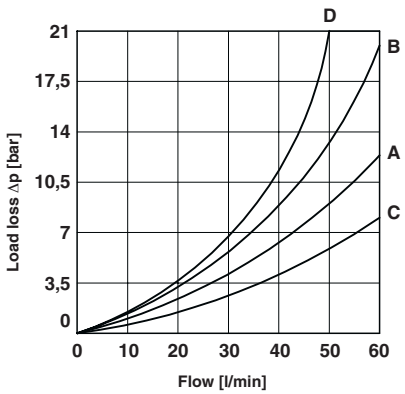
MAIN CHARACTERISTICS OF THE DHI SOLENOID VALVES

Installation position	Any
Coupling surface condition	Surface texture index $\sqrt{}^{0.4}$, flatness ratio 0.01/100 (ISO 1101)
Ambient temperature	-20 °C to +70 °C
Fluid	Hydraulic oil as per DIN 51524
Recommended viscosity	15÷100 mm²/s at 40 °C (ISO VG 15÷100)
Fluid contamination class	ISO 19/16, obtained through 25 μm and ß25≥ 75 line filters (recommended)
Fluid temperature	T ≤ 80 °C, if T ≤ 60 °C choose PE seals
Pressure limits	P, A, B ports: 350 bar – T port: 120 bar
Maximum flow	60 l/min for DI
Utilisation factor	100%
Voltage and power frequency	12 DC
Threshold tolerance	±10%

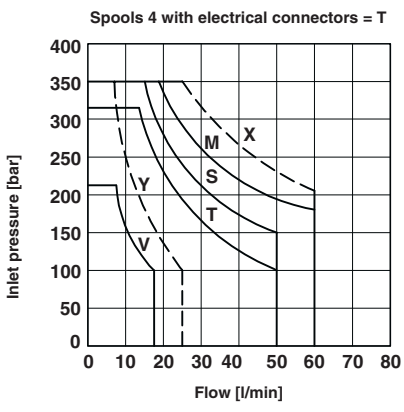
Q/Δp CHARTS

Port / Spool type	P-A	P-B	A-T	B-T	P-T
4	D	D	D	D	A

Tests done with fluid viscosity of 43 mm²/s at 40 °C



Spools 4 with electrical connectors = T



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Section D
CHECKS AND ADJUSTMENTS

SECTION INDEX

D.01 Speed check ..... page 2
D.02 Checking the max. current of the solenoid coils .....
D.03 Checking and calibrating the circuit pressure 4

Procedure: Checking the movement times of cylinders	Table: D.01

IMPORTANT

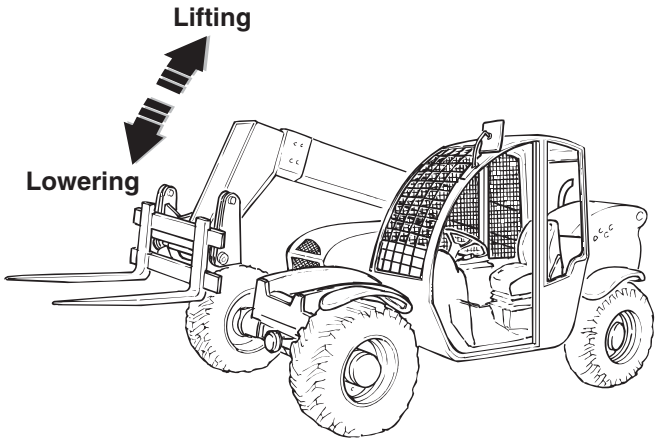
The check of the movement times of the cylinders shall be done with the hydraulic oil at a temperature of 60°.

IMPORTANT

To check the engine speed, the area easy to reach is the shaft of the CASAPPA pump.
Min engine speed = 950 rpm
Max engine speed = 2700 rpm

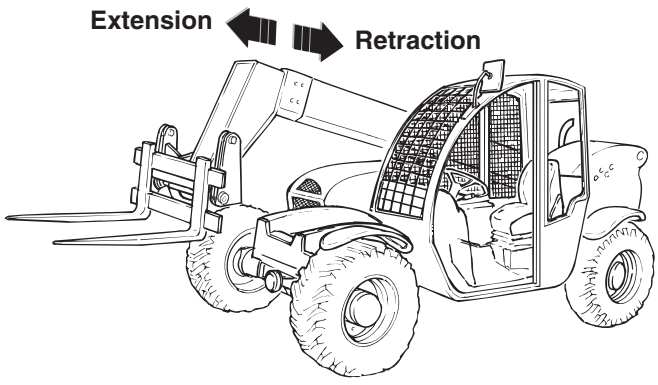
BOOM LIFTING/LOWERING

Time (s)	up	down
Max engine speed	7”	4”
Min. engine speed	18”	11”



BOOM EXTENSION/RETRACTION

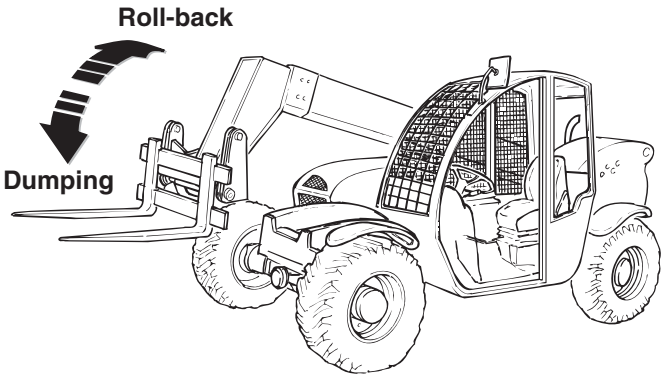
Time (s)	out	in
Max engine speed	7”	4”
Min. engine speed	19”	10”



Procedure: **Checking the movement times of cylinders**	*Table:* **D.01**

ATTACHMENT DUMPING

Time (s)	dumping	roll-back
T. Max	3”	4”
T. Min	10”	12”



IMPORTANT

The maximum speed that can be attained on a level ground is 24 km/h in both forward and reverse speed.

Procedure: **Checking and calibrating the circuit pressure**	*Table:* **D.03**

1. PRELIMINARY OPERATIONS

Warm up the hydraulic oil to 80°C by keeping one of the elements of the boom distributor to full stroke under pressure.
To reach this temperature in a faster way, cover the oil core of the radiator with a carton in the case of a water-oil combined cooler, or the oil radiator if the machine is equipped with a separate oil radiator.

2. SETTING THE BOOM DISTRIBUTOR

Find the mini-socket for the pressure gauge **ref. 2** on the **Walvoil** distributor (see **annex 1**).

2.1 SETTING THE DISTRIBUTOR PRESSURE CONTROL VALVE

Connect a 0-400 bar manometer to the mini-socket **ref. 2**. Fully raise the boom to stroke end by means of joystick **ref. 1**.
Calibrate valve **A** (see **annex 2**) to 270 bar with the Diesel engine at full speed.
To calibrate the safety valves **B** (see **annex 2**), proceed as follows:

- Connect a 0-400 bar manometer to the mini-socket **ref. 2**.
- Increase the pressure of valve **A** of the distributor to 290 bar moving the raising cylinder to stroke end (fully out).
- With the engine running at maximum speed, pitch the forks forward by means of the joystick and act on one of the two valves **B** until reaching a pressure of 280 bar.
- Proceed in adjusting the second valve **B** (280 bar) by pitching the forks back.
- When both fork inclination safety valves have been calibrated, reset the pressure control valve to 270 bar by adjusting the register **A**.

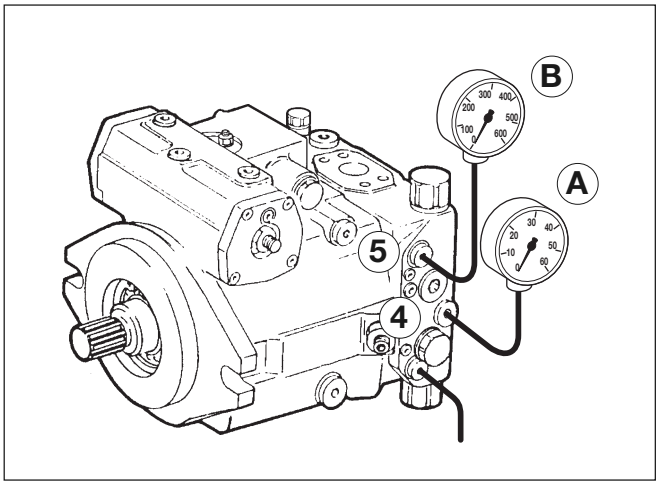
3. SETTING THE PRESSURE RELIEF VALVE

- Fit a fitting with mini-socket ref. **3** in the position shown in **annex 1**.
- Connect a 0-60 bar manometer to the mini-socket **ref. 3** (see **annex 1**), with the engine running at minimum speed moving any of the elements of the distributor to stroke end, then set valve **E** (see an**nex 1**) to 28 bar.
- Remove the manometer from the mini-socket and re-tighten the protection cap

4. SETTING THE HYDROMATIK PUMP HYDROSTATIC TRANSMISSION

Do the calibration of the hydrostatic transmission with the hydraulic oil at 80°C.

- Connect a 0-60 bar manometer **A** to the mini-socket **ref. 4** to read the boost pressure value.
- Connect a 0-600 bar manometer **B** to the mini-socket **ref. 5** to read the high-pressure value.



Procedure: **Checking and calibrating the circuit pressure**	*Table:* **D.03**

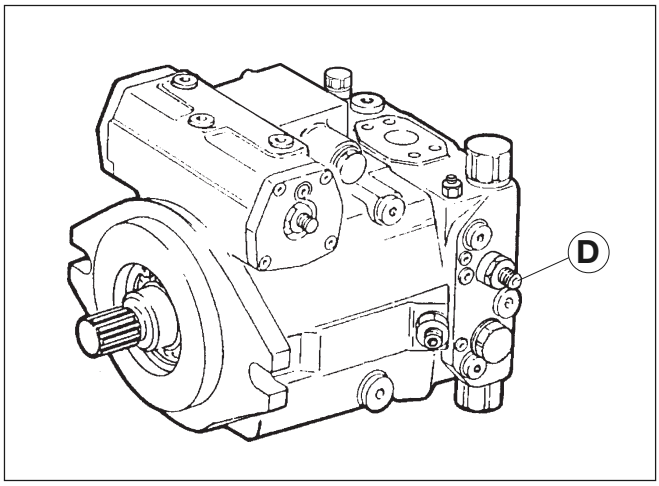
CAUTION

Do not fit the manometer to the application point corresponding to the reverse speed. This operation is extremely dangerous for the serviceman who is calibrating the transmission.

- Hold the selector to neutral position and make sure the maximum speed of the engine does not exceed 2800 rpm. The engine must run at a idle speed of 950 rpm. Otherwise, adjust the minimum speed.
- Read the boost pressure on manometer **A** and ensure it is about 26/28 bar with the engine running at idle speed.
  The boost pressure has not a fixed value but varies from pump to pump.
- Remove coil ref. **5** from solenoid valve ref. **6** (see **annex 3**) so the machine remains braked.

STARTING THE CALIBRATION

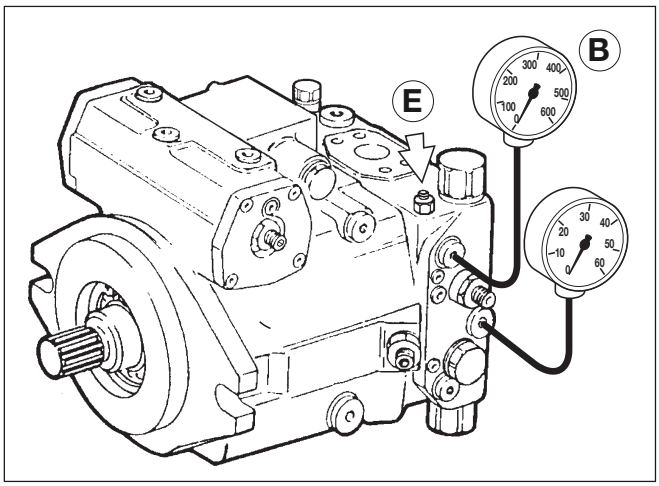
- Set the forward-neutral-reverse selector to the forward or backward position.
- Run the engine at 1200 rpm. Check the value on the tachometer.
- Adjust shutter **D** by means of the register until reading a value of 50 bar on the high-pressure manometer **B**.



4.1 CALIBRATION OF THE MAXIMUM PRESSURE

Do this operation with extreme caution. The proper functioning of pump and transmission depends on this calibration.

- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at maximum speed and check the high-pressure value. If this value is less than 420 bar, increase the pressure to 430 bar by means of the pressure cut-off valve **E**.
- Remove the manometers and do an attempt.

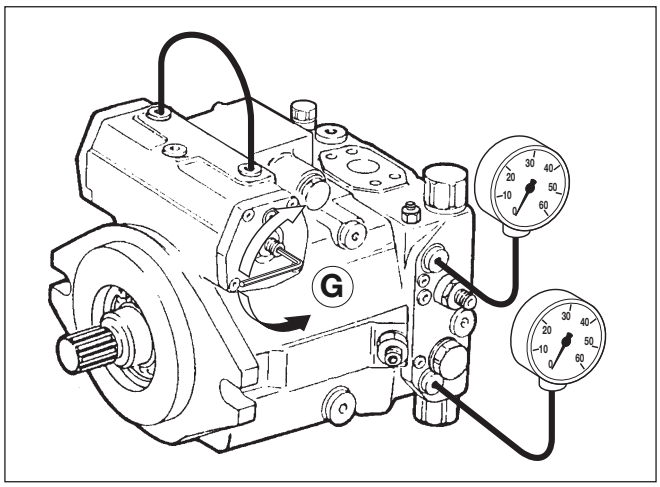


Procedure: **Checking and calibrating the circuit pressure**	*Table:* **D.03**

4.2 CALIBRATION OF THE MECHANICAL ZERO

The calibration of the mechanical zero **G** is required if the machine is set to neutral position with the forward-reverse speed lever.

- Set the forward-neutral-reverse selector to neutral position.
- With the engine running at idle speed, adjust the mechanical zero screw by rotating it until the high-pressure manometer reads the same value measured by the boost pressure manometer.



5. SETTING THE POWER STEERING

- Fit a fitting with mini-socket **Z** in the position shown in **annex 4**.
- Connect a 0-250 bar manometer to the mini-socket **Z**.
- Select the front axle steering mode.
- Move the steering cylinder to stroke end and make sure the value of the power steering **A** is 170 bar. If the value is less, tighten valve **X**; if the value is greater, loosen the valve.

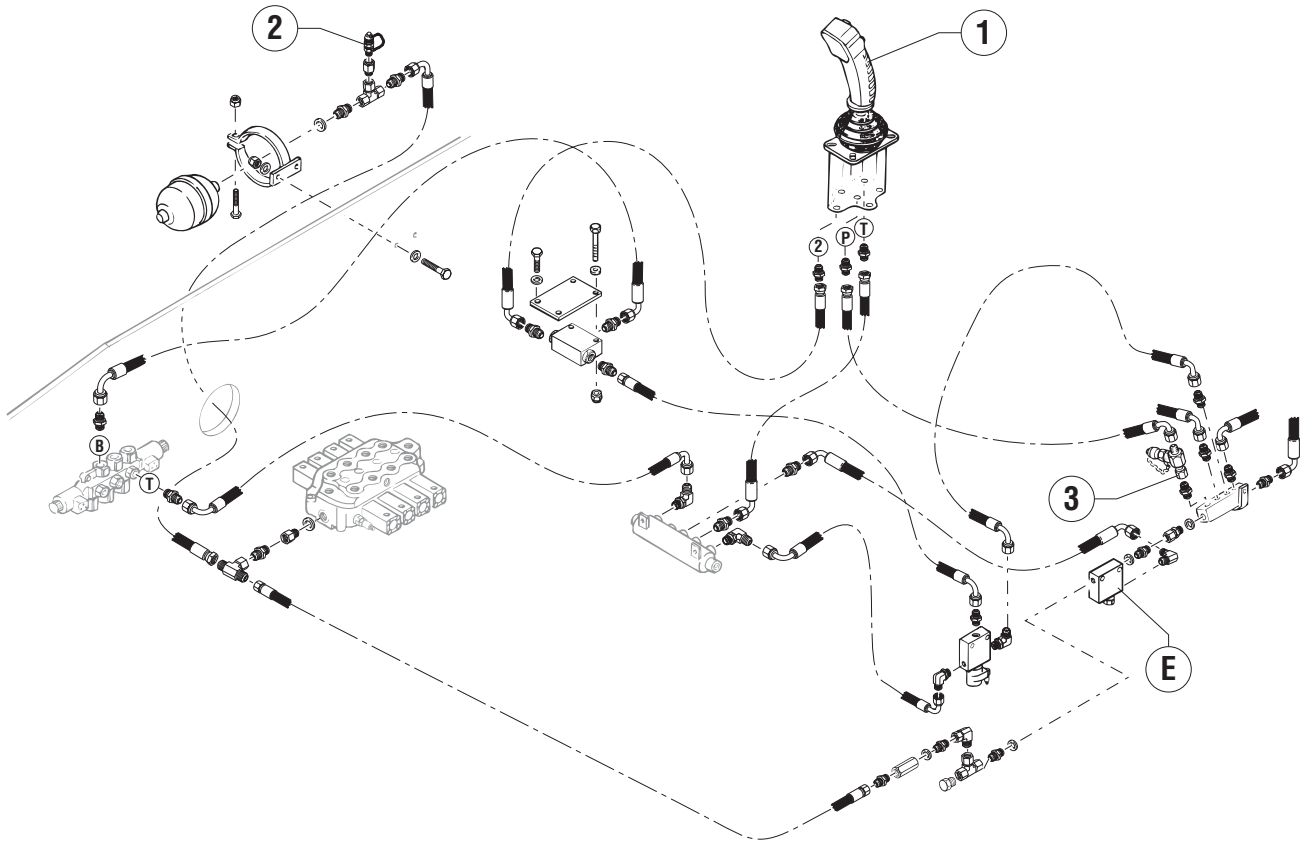
  Note: To gain access to valve **X**, remove the protection cap (see **annex 4**).

5.1 CHECKING THE NEGATIVE BRAKE PRESSURE

Fit a 0-60bar pressure gauge to mini-socket ref. **W** (see **annex 3**) to check the pressure acting on the parking brake of the front axle.
The brake is unlocked when the pressure value is 25 to 28 bar.

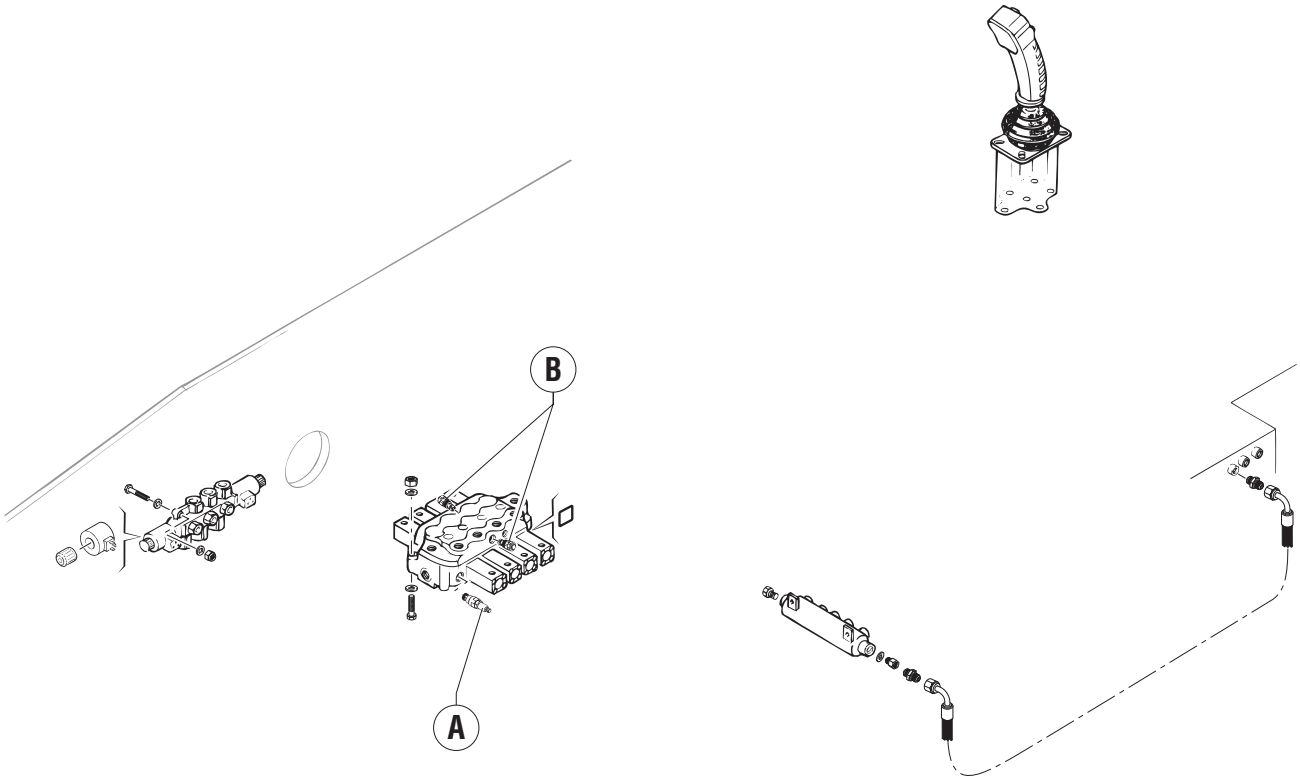
Procedure: **Checking and calibrating the circuit pressure**	*Table:* **D.03**

Annex 1



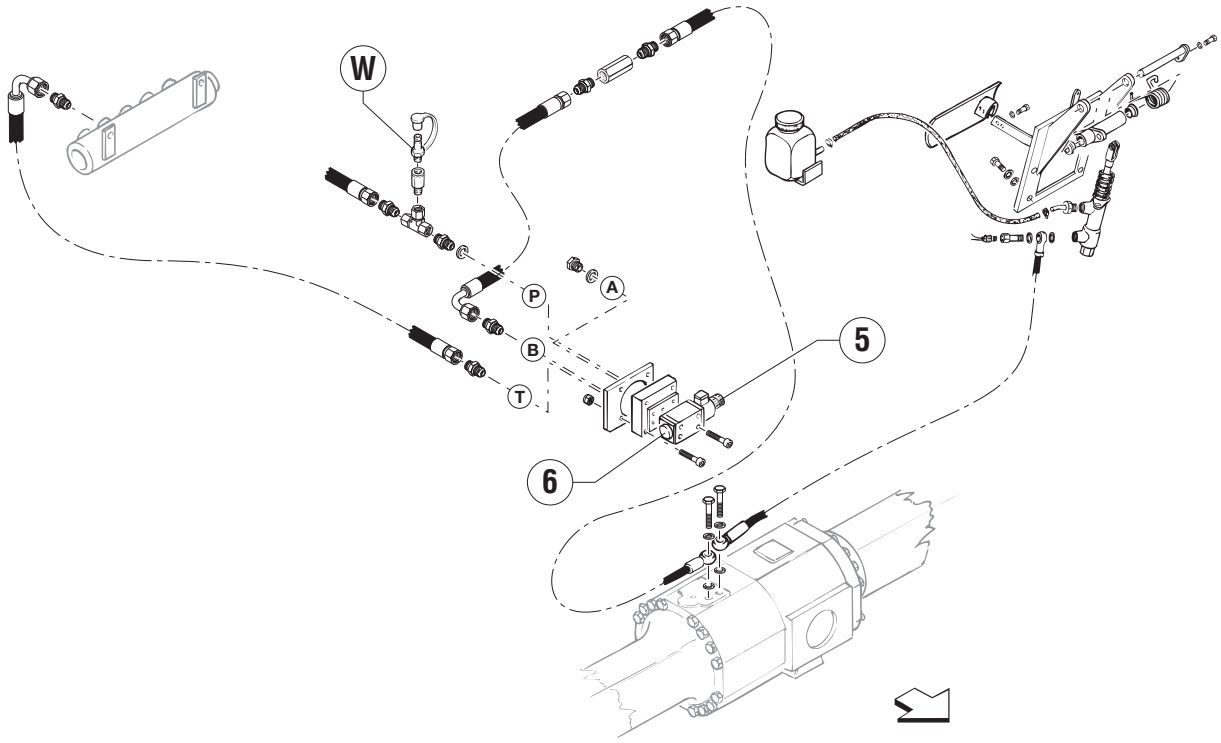
Procedure: **Checking and calibrating the circuit pressure**	*Table:* **D.03**

Annex 2



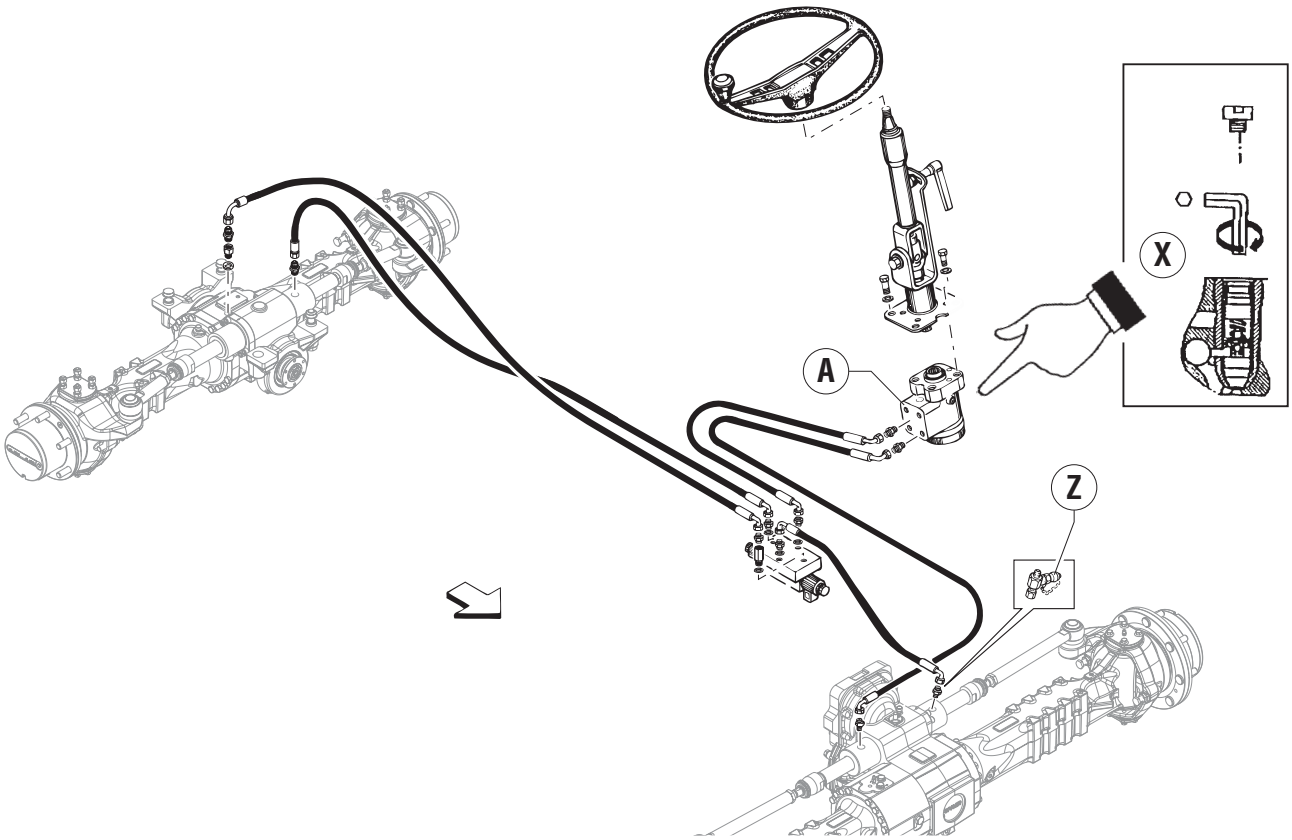
Procedure: **Checking and calibrating the circuit pressure**	Table: **D.03**

Annex 3



Procedure: **Checking and calibrating the circuit pressure**	*Table:* **D.03**

Annex 4



Section F
TROUBLESHOOTING

SECTION INDEX

Hydraulic faults ..... page 2
Electrical faults 5

DANGER

Any service, maintenance or troubleshooting must be carried out with the machine stopped, the boom in rest position lowered to the ground, and the transportation locking devices fitted.

Use the wiring diagrams enclosed for finding solenoid valves (EV), fuses (F), relays (E) or other electrical components in an easier way - see ***chapter C - Technical data*** of this manual.

Trouble	Cause	Solution
The boom does not move	• Low pressure	• Set the max pressure of the control block to 270 bar (see sec. D)
	• Hydraulic pump damaged	• Replace the pump
	• Load sensing valve defective	• Check the efficiency of the valve; replace if necessary
	• Leakage on the control block valve	• Dismantle the valve, check and eliminate any foreign matters
	• Pressure reducing valve maladjusted	• Check the efficiency and reset the correct pressure (28 bar) if necessary
	• Joystick damaged	• Check the efficiency of the joystick; replace if necessary
Wrong wheel shafting	• Leakage in the steering cylinders	• Check and replace the seals if necessary (see sec. G)
	• Leakage in the steer selection solenoid valve	• Check the efficiency of the solenoid valve
The steering wheel is hard (low force in the cylinders)	• Low pressure	• Check the pressure; in case, reset (170 bar)
	• Priority valve damaged	• Check the efficiency of the valve; replace if necessary

Trouble	Cause	Solution
When the engine is stopped, the lifting cylinder does not support the boom	• Block valves damaged or dirty • Cylinder seal defective	• Check the efficiency of the valves; replace if necessary • Replace the seal
When the engine is stopped, the cylinder does not support the forks	• Block valves damaged or dirty • Cylinder seal defective	• Check the efficiency of the valves; replace if necessary • Replace the seal
When the engine is stopped and the boom is high, the extension cylinder moves in	• Block valves damaged or dirty • Cylinder seal defective	• Check the efficiency of the valves; replace if necessary • Replace the seal
When the load is lifted, the fork cannot be levelled	• Seals of the levelling cylinder worn out • Shockproof valves of the control block dirty or maladjusted • One-way valves of the levelling cylinder dirty or damaged	• Dismantle the cylinder and replace the seals • Remove the valves, dry-clean or replace if damaged, and re-calibrate (see sec. D) • Remove the valves, dry-clean or replace if damaged, and replace in their seats
When the max load is applied, forks move down	• Seals, rod and liner of the fork tilting cylinder worn out • Leakage in the cylinder block valve • Low pressure in the hydraulic circuit	• Dismantle the cylinder and check and replace any defective parts • Check the leakage; remove the valve and rectify or replace • Re-calibrate the control block (see sec. D)
Operating the joystick no function is activated	• Joystick damaged • Control block valve damaged • Pressure reducing valve damaged	• Check the joystick efficiency; replace if necessary • Check the efficiency of the valve; replace if necessary • Check the calibration value of the valve; replace the valve if necessary
The steering wheel is slow and noisy	• Couplings damaged • Hydraulic drive damaged	• Replace the couplings • Replace the hydraulic drive
Differential noisy and high temperature on the body	• No oil • Bearings damaged	• Check the oil level and refill. If trouble cannot be rectified, dismantle the unit (see sec. G) • Replace the bearings (see sec. G)

Trouble	Cause	Solution
When moving out the second telescope, the boom tends to move right and left	• Sliding blocks worn out	• Check the play and replace any worn parts or place shims
When moving out the second telescope, the boom tends to jump	• Grease is insufficient or inadequate • Foreign matters on the sliding blocks and the relevant surfaces of the boom	• Check that the grease smeared on the boom is INTERFLON FIN GREASE LS2; smear the boom againwith grease • Check and eliminate any foreign matters
Low traction	• Drive pump defective	• Check the pressure values of the drive pump (see sec. D) and re-calibrate if necessary. If the overfeeding pressure drops down, replace the pump and clean the pump-motor couplings

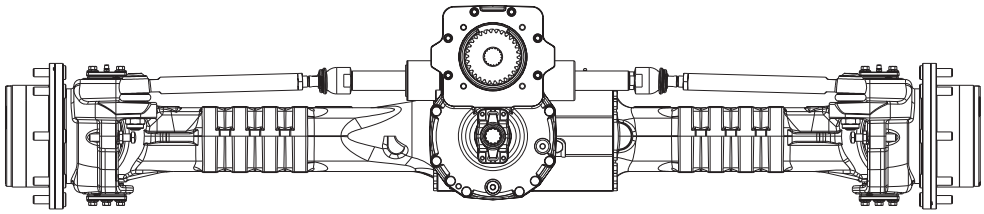
Trouble	Cause	Solution
No power to dashboard	• Battery switch off • Battery down • 50A fuse blown • Dashboard damaged • Broken or damaged wiring	• Turn on the switch • Check the battery efficiency; replace if necessary • Change the fuse • Check the dashboard and replace if necessary • Reconnect or replace the wiring
Engine does not start, starter does not run	• 50A fuse blown • Dashboard damaged • K2 relay damaged • Speed switch ruined • 70A engine start relay damaged • Starter defective	• Replace the fuse • Check the dashboard and replace if necessary • Change the relay • Check or replace the speed switch • Change the relay • Change the starter
Engine does not start - starter runs but engine does not start	• No fuel • Fuel filter clogged • Fuel ducts empty • Start aid solenoid damaged • Engine stop solenoid • Broken or damaged wiring	• Refuel • Clean or replace the filter • Eliminate any air • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary • Reconnect or replace the wiring
The machine does not move forward/back	• Speed switch damaged • 10A fuse F13 broken • Relays K3-K4-K5 damaged • Forward/reverse speed solenoid valves damaged • Parking brake micro-switch damaged • Parking brake switch • Broken or damaged wiring	• Check the efficiency or replace the switch if necessary • Change the fuse • Change the relays • Check the efficiency or replace • Check the efficiency or replace • Check the efficiency or replace • Reconnect or replace the wiring

Trouble	Cause	Solution
No steer selection	• 7.5A fuse F12 blown • Steer selector damaged • Coils of the steer selection solenoid valve damaged • Broken or damaged wiring	• Change the fuse • Check or replace the selector • Check the coils; replace if necessary • Reconnect or replace the wiring
Hydraulic oil thermometer defective	• 7.5A fuse F11 blown • Indicator damaged • Temperature sensor defective • Broken or damaged wiring	• Change the fuse • Change the part • Check or replace the sensor • Reconnect or replace the wiring
The parking brake lamp does not come on	• 10A fuse F4 blown • Dashboard instrument damaged • Broken or damaged wiring	• Change the fuse • Change • Reconnect or replace the wiring
The fuel gauge does not work	• 10A fuse F4 blown • Dashboard instrument damaged • Fuel sensor defective • Broken or damaged wiring	• Change the fuse • Change • Check and replace the sensor if necessary • Reconnect or replace the wiring
The engine coolant thermometer does not work	• 7.5A fuse F11 blown • Indicator defective • Temperature sensor defective • Broken or damaged wiring	• Change the fuse • Change the part • Check and replace the sensor if necessary • Reconnect or replace the wiring
High hydraulic oil temperature	• Hydraulic oil bulb damaged • Indicator defective • Radiador clogged	• Check or replace the bulb if necessary • Change the part • Check the radiator and eliminate any impurities from the fins

Trouble	Cause	Solution
The joystick does not pitch the forks	• 7.5A fuse F12 blown • Control block selection valve • Broken or damaged wiring	• Change the fuse • Check the efficiency of the electrical coils; replace the coils if damaged • Reconnect or replace the wiring
The joystick does not lock/ release the attachment	• 7.5A fuse F12 blown • Control block selection valve • Broken or damaged wiring • Operating pushbutton damaged	• Change the fuse • Check the efficiency of the electrical coils; replace the coils if damaged • Reconnect or replace the wiring • Check or replace the fuse

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Section G
DANA AXLE
ASSEMBLY - DISASSEMBLY



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INTRODUCTION

The efficiency and continued operation of mechanical units depend on constant, correct maintenance and also on efficient repair work, should there be a break-down or malfunction. The instructions contained in thismanual have been based on a complete overhaul of the unit. However, it is up to the mechanic to decide whether or not it is necessary to assemble only individual components, when partial repair work is needed. The manual provides a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows accurate work to be performed.
All the information needed for correct disassembly, checks and assembly of each individual component is set out below.
All the information needed for correct disassembly, checks and assembly of each individual component is set in the Chapter **E - Disassembly and Reassembly**.
In describing the following operations it is presumed that the unit has already been removed from the vehicle.

IMPORTANT

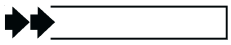
In order to facilitate work and protect both working surfaces and operators, it is advisable to use proper equipment such as: trestles or supporting benches, plastic or copper hammers, appropriate levers, extractors and specific spanners or wrenches.
Before going on to disassemble the parts and drain the oil, it is best to thoroughly clean the unit, removing any encrusted or accumulated grease.

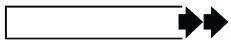
Introductory remarks

All the disassembled mechanical units should be thoroughly cleaned with appropriate products and restored or replaced if damage, wear, cracking or seizing have occurred.
In particular, thoroughly check the condition of all moving parts (bearings, gears, crown wheel and pinion, shafts) and sealing parts (O-rings, oil shields) which are subject to major stress and wear. In any case, it is advisable to replace the seals every time a component is overhauled or repaired. During assembly, the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one component requires the replacement of the other one. During assembly, the prescribed pre-loading, backlash and torque of parts must be maintained.

Classification

This manual classifies units according to part numbers. For a correct interpretation, classification is indicated as follows:


= up to the part number

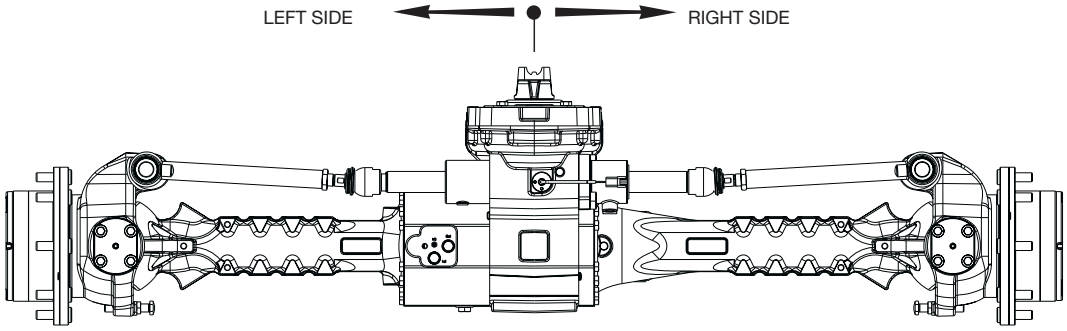

= from the part number on

When no classification is given, disassembly and assembly operations are the same for all versions.

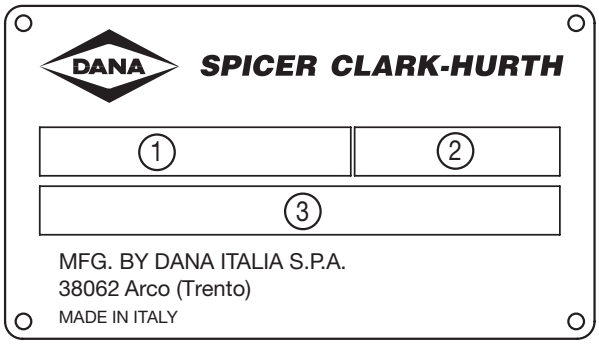
Specific equipment and spare parts

The drawings of all specific tools required for maintenance and repair work can be found at the end of this manual ; spare parts may be ordered either from the vehicle manufacturer or directly from the Service Centers or Authorised Distributors of DANA ITALIA S.p.A.

MAINTENANCE AND LUBRICANT
Definition of viewpoints

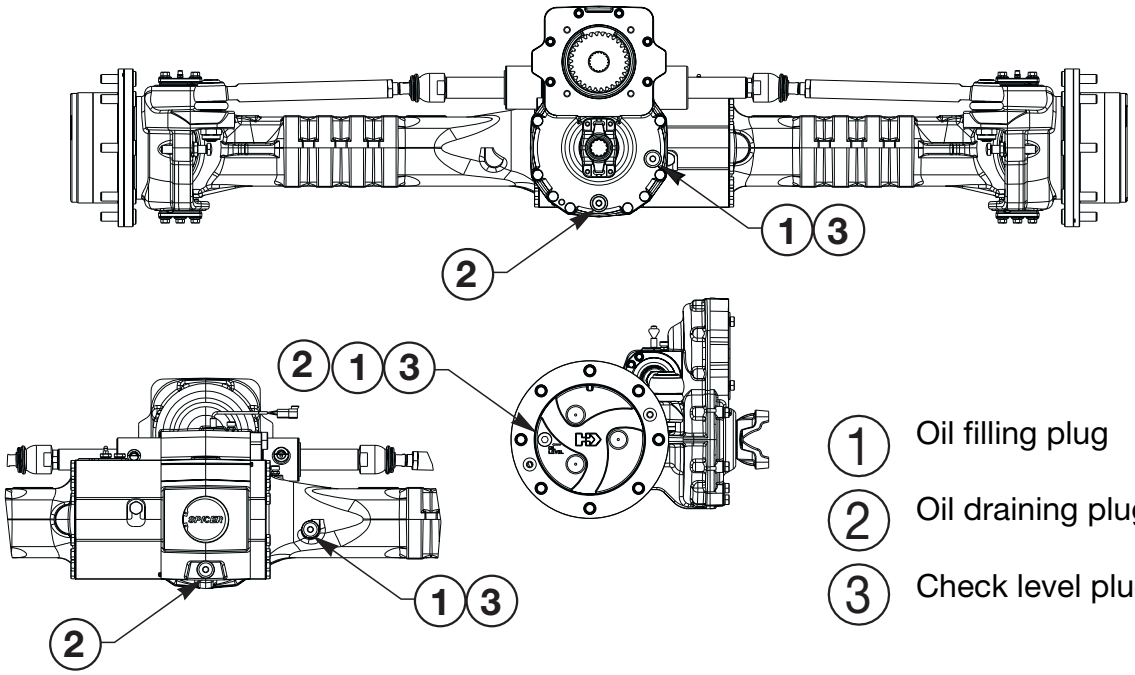


Data plate



1. Type and model unit - modification index
2. Serial number
3. Lubrificant

Maintenance points



1. Oil filling plug
2. Oil draining plug
3. Check level plug

Maintenance intervals

OPERATION		FREQUENCY	LUBRICANTS
• Check levels:	Differential	monthly	**SAE85W90 (API GL4 - MIL L-2105)** With additives for oil-bath brakes
	Planetary reduction	every 200 hours	
• Oil change:	Differential	every 800 hours (*)	**SAE85W90 (API GL5 - MIL 2105-B)** With additives for oil-bath brakes, for units presenting hypoid crown wheel and pinion and/or self-locking differential gear.
	Planetary reduction	every 1000 hours (*)	
	Self-locking differential gear	every 700 hours (*) (§)	

(*) Initially after 100 working hours

(§) When it starts sounding noisy

OPERATION	MEMBER	CONDITIONS	FREQUENCY	LUBRICANTS
Greasing	Articulations	Normal work	monthly	MOLIKOTE
		Awkward work	Weekly	MOLIKOTE

Adjustment and checks

UNIT	OPERATION	FREQUENCY	SERVICE BRAKE CIRCUIT
Negative brake	Adjustment	every 1000 hours (*)	Only for mineral oil use e.g. ATF Dexron II. Make sure that master cylinder seals are suitable for mineral oil.
Service brake	Adjustment	every 500 hours	
Wheel nuts	Tightening	every 200 hours	

(*) Initially after 100 working hours

CONVERSION TABLES

Units of pressure: 1 Atm = 1 bar = 10^5 PA = 14.4 PSi

Units of weight

	N	daN	kN	kg	lbs
1N	1	0,1	0,001	0,102	0,225
1daN	10	1	0,01	1,02	2,25
1kN	1000	100	1	102	225
1kg	9,81	0,981	0,00981	1	2,205

Units of torque

	Nm	daNm	kNm	kgm	lb-in
1Nm	1	0,1	0,001	0,102	8,854
1daNm	10	1	0,01	1,02	88,54
1kNm	1000	100	1	102	8854
1kgm	9,81	0,981	0,00981	1	86,8
1lb-in	0,1129	0,01129	0,0001129	0,01152	1

Tightening torques

Unit: Nm

SIZE OF BOLT		TYPE OF BOLT					
		8.8		10.9		12.9	
		Normali + Loctite 242	Normali + Loctite 270	Normali + Loctite 242	Normali + Loctite 270	Normali + Loctite 242	Normali + Loctite 270
COARSE PITCH	M6x1	9,5-10,5	10,5-11,5	14,3-15,7	15,2-16,8	16,2-17,8	18,1-20,0
	M8x1,25	23,8-26,2	25,6-28,4	34,2-37,8	36,7-40,5	39,0-43,0	43,7-48,3
	M10x1,5	48-53	52-58	68-75	73-81	80-88	88-97
	M12x1,75	82-91	90-100	116-128	126-139	139-153	152-168
	M14x2	129-143	143-158	182-202	200-221	221-244	238-263
	M16x2	200-221	219-242	283-312	309-341	337-373	371-410
	M18x2,5	276-305	299-331	390-431	428-473	466-515	509-562
	M20x2,5	390-431	428-473	553-611	603-667	660-730	722-798
	M22x2,5	523-578	575-635	746-824	817-903	893-987	974-1076
	M24x3	675-746	732-809	950-1050	1040-1150	1140-1260	1240-1370
	M27x3	998-1103	1088-1202	1411-1559	1539-1701	1710-1890	1838-2032
	M30x3,5	1378-1523	1473-1628	1914-2115	2085-2305	2280-2520	2494-2757
FINE PITCH	M8x1	25,7-28,3	27,5-30,5	36,2-39,8	40,0-44,0	42,8-47,2	47,5-52,5
	M10x1,25	49,4-54,6	55,2-61,0	71,5-78,5	78,0-86,0	86,0-94,0	93,0-103,0
	M12x1,25	90-100	98-109	128-142	139-154	152-168	166-184
	M12x1,5	86-95	94-104	120-132	133-147	143-158	159-175
	M14x1,5	143-158	157-173	200-222	219-242	238-263	261-289
	M16x1,5	214-236	233-257	302-334	333-368	361-399	394-436
	M18x1,5	312-345	342-378	442-489	485-536	527-583	580-641
	M20x1,5	437-483	475-525	613-677	674-745	736-814	808-893
	M22x1,5	581-642	637-704	822-908	903-998	998-1103	1078-1191
	M24x2	741-819	808-893	1045-1155	1140-1260	1235-1365	1363-1507
	M27x2	1083-1197	1178-1302	1520-1680	1672-1848	1834-2027	2000-2210
	M30x2	1511-1670	1648-1822	2138-2363	2332-2577	2565-2835	2788-3082

Screw-locking, sealing and lubricating materials

- Locking, sealing and lubricating materials referred to in this manual are the same used in the shop-floor.

- The table below gives an account of the typical applications of each single material, in order to facilitate replacement with similar products marketed by different brand names with different trade marks.

DENOMINATION	APPLICATION
Loctite 242	Anaerobic product apt to prevent the loosening of screws, nuts and plugs. Used for medium-strength locking. Before using it, completely remove any lubricant by using the specific activator.
Loctite 243	The oleocompatible alternative to 242. Does not require the activation of lubricated surfaces.
Loctite 270	Anaerobic product for very-high strength locking of screws and nuts. Before using it, completely remove any lubricant by using the specific activator. To remove parts, it may be necessary to heat them at 80°C approx.
Loctite 275	Anaerobic product suitable for high-strength locking and sealing of large threaded parts, bolts and stud bolts, for pipe sealing and for protecting parts against tampering; suitable for sealing coupling surfaces with a max. diametrical clearance of 0,25 mm.
Loctite 510	Anaerobic product for the hermetic sealing of flanged units and screw holes communicating with fluids. Can seal clearances between flanges up to 0,2 mm.
Loctite 577	Quick anaerobic sealant for sealing threaded portions of conical or cylindrical unions up to M80. Before using it, remove any lubricant with the specific activator. After polymerisation, disassembly may result rather difficult, so heating may be necessary for larger diameters.
Loctite 638	Anaerobic adhesive for fast and high-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with clearance ranging between 0,1 and 0,25 mm.
Loctite 648	Anaerobic adhesive for fast and medium-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with radial clearance below 0,1 mm.
(AREXONS) Repositionable jointing compound for seals	Solvent-based sealing compound for elastic seals, drying through evaporation. Used for sealing the outer diameter of sealing rings for rotating shafts with outer metal reinforcement.

DENOMINATION	APPLICATION
Silicone	Semi-fluid adhesive material used for sealing and filling and to protect components from environmental and physical elements. Polymerises with non-corrosive dampness.
(TECNO LUPE/101) Silicone-based grease	Highly adhesive synthetic grease, with silicone compounds added. Applied to adjustment screws with hole communicating with oil-type fluids. Used when frequent adjusting is required.
Molikote	Lubricating compound containing molybdenum disulphide, used to lubricate articulation pins and to prevent sticking and oxidation of parts that are not lubricated on a regular basis.
(Lithium-based) Grease	Applied to bearings, sliding parts and used to lubricate seals or parts during assembly.

NOTES ON SAFETY PRECAUTIONS

1 - During all operations described in this manual, the axle should be fastened onto a trestle, while the other parts mentioned should rest on supporting benches.

2 - When removing one of the arms, an anti-tilting safety trestle should be placed under the other arm.

3 - When working on an arm that is fitted on the machine, make sure that the supporting trestles are correctly positioned and that the machine is locked lengthways.

4 - Do not admit any other person inside the work area; mark off the area, hang warning signs and remove the ignition key from the machine.

5 - Use only clean, quality tools; discard all worn, damaged, lowquality or improvised wrenches and tools. Ensure that all dynamometric wrenches have been checked and calibrated.

6 - Always wear gloves and non-slip rubber shoes when performing repair work.

7 - Should you stain a surface with oil, remove marks straight away.

8 - Dispose of all lubricants, seals, rags and solvents once work has been completed. Treat them as special waste and dispose of them according to the relative law provisions obtaining in the country where the axles are being overhauled.

9 - Make sure that only weak solvents are used for cleaning purposes; avoid using turpentine, dilutants and toluol-, xylolbased or similar solvents; use light solvents such as Kerosene, mineral spirits or water-based, environment friendly solvents.

10- For the sake of clarity, the parts that do not normally need to be removed have not been reproduced in some of the diagrams.

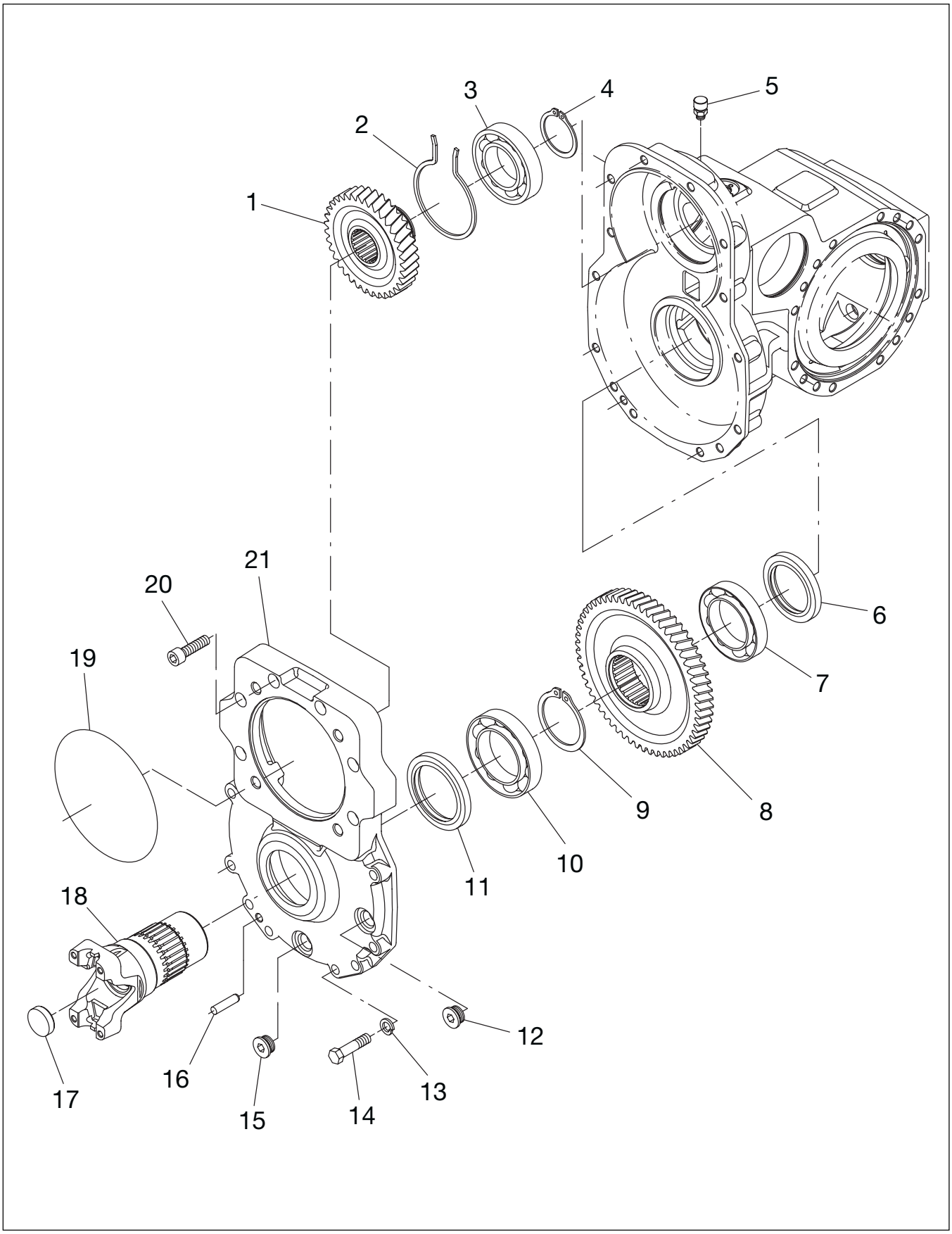
11- The terms RIGHT and LEFT in this manual refer to the position of the operator facing the axle from the side opposite the drive.

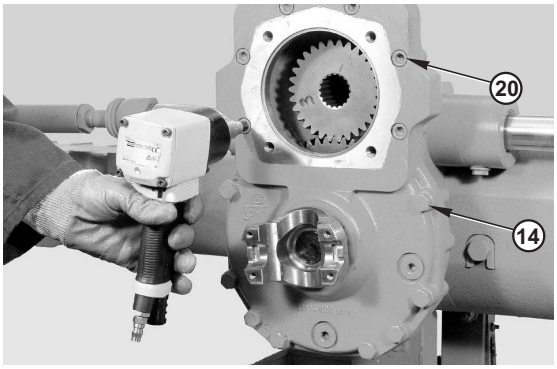
12- After repair work has been completed, accurately touch up any coated part that may have been damaged.

Symbols

	Disassembly of assembly groups
	Reassemble to from assembly groups
	Remove obstruction parts
	Reinstall-remount parts which had obstructed disassembly
	Attention ! Important notice
	Check - adjust e.g. torque, dimensions, pressures, etc.
	T=Special tool P=Page
	Note direction of installation
	Visual inspection
	Possibly still serviceable, renew if necessary
	Renew at each reassembly
	Unlock - lock e.g. split pin, locking plate, etc.
	Lock-adhere (liquid sealant)
	Guard against material damage, damage to parts
	Mark before disassembly, observe marks when reassembly
	Caricare - riempire (olio - lubrificante)
	Drain off oil, lubricant
	Tighten
	Apply pressure into hydraulic circuit
	To clean
	Lubricate - grease

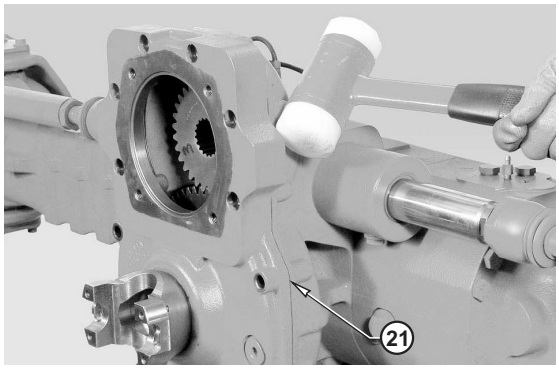
DISASSEMBLY FLANGED REDUCTION GEAR 603 TYPE: INTEGRAL 603 INPUT GEAR





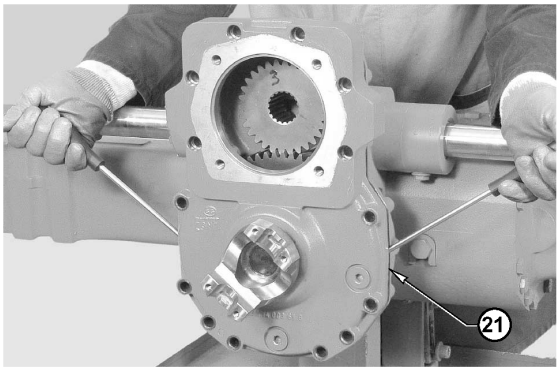
GB a

Remove screws (14)(20) of the drive side flange cover.



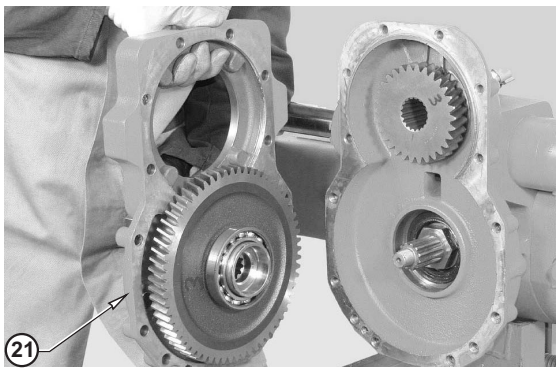
GB b

Take off the drive side flange cover (21).



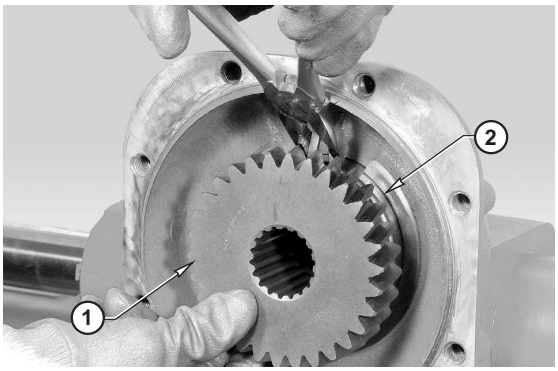
GB c

Place two levers into the appropriate slots.
NOTE: Look out not to damage the surfaces.



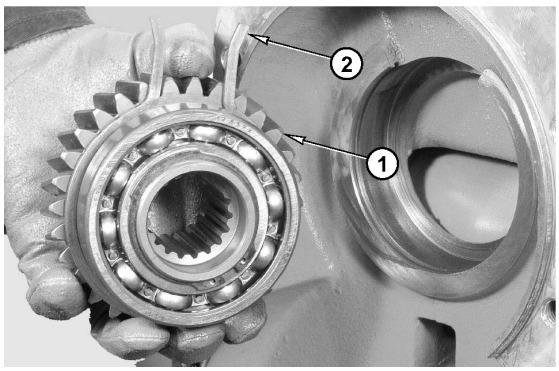
GB d

Lift off the cover (21).



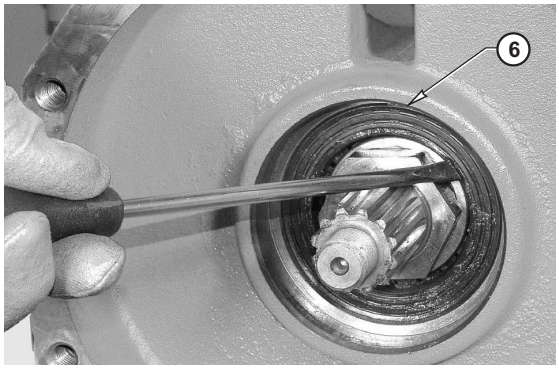
GB e

To remove the drive side shaft (1), hook off the snap ring (2).



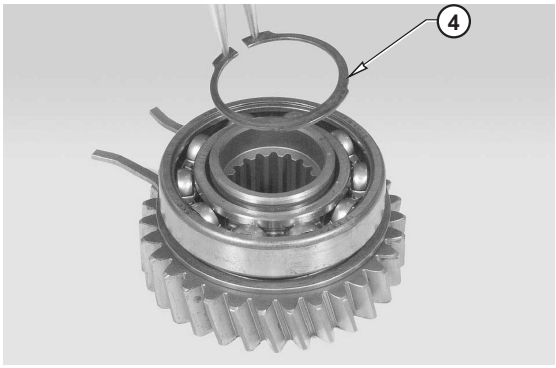
GB f

Using two levers, remove the drive side shaft (1).



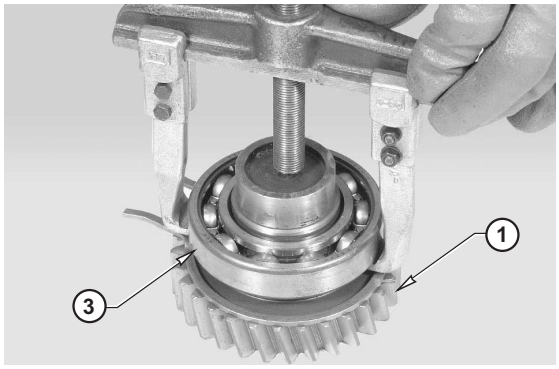
GB a

Using two levers, remove the flange sealing ring (6).



GB b

Remove the snap ring (4).



GB c

With a puller, remove the bearing (3) from the input shaft (1).

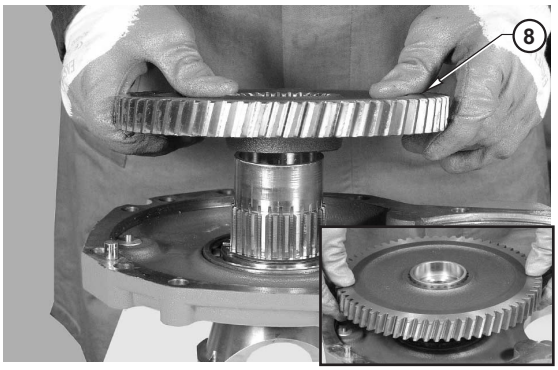


GB d



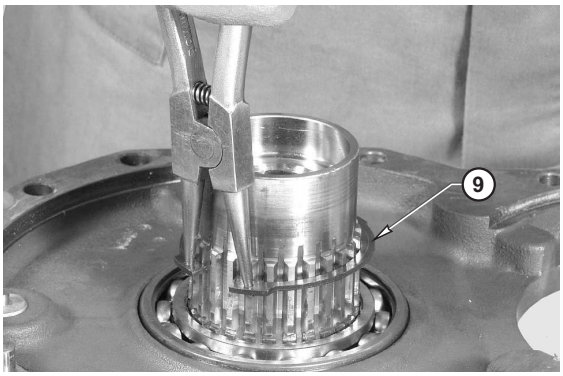
GB e

With a puller, remove the bearing (7) from the flange shaft (18).



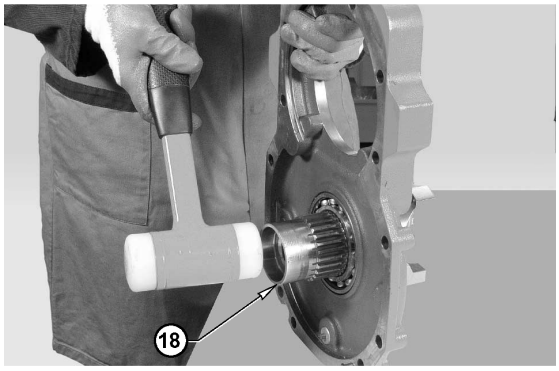
GB f

Remove the secondary gear wheel (8) using two levers.



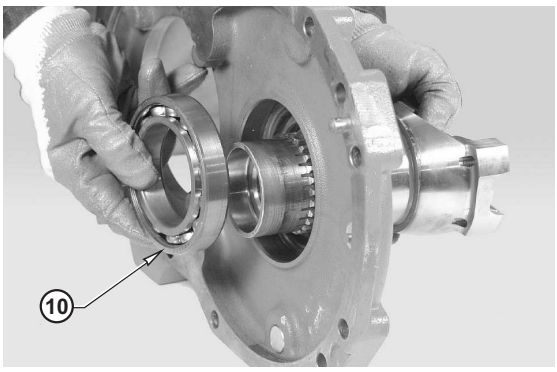
GB a

Remove the snap ring (9).



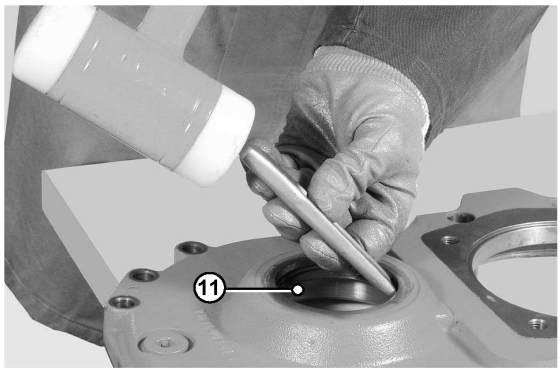
GB b

Remove the flange (18) by means of a plastic hammer.



GB c

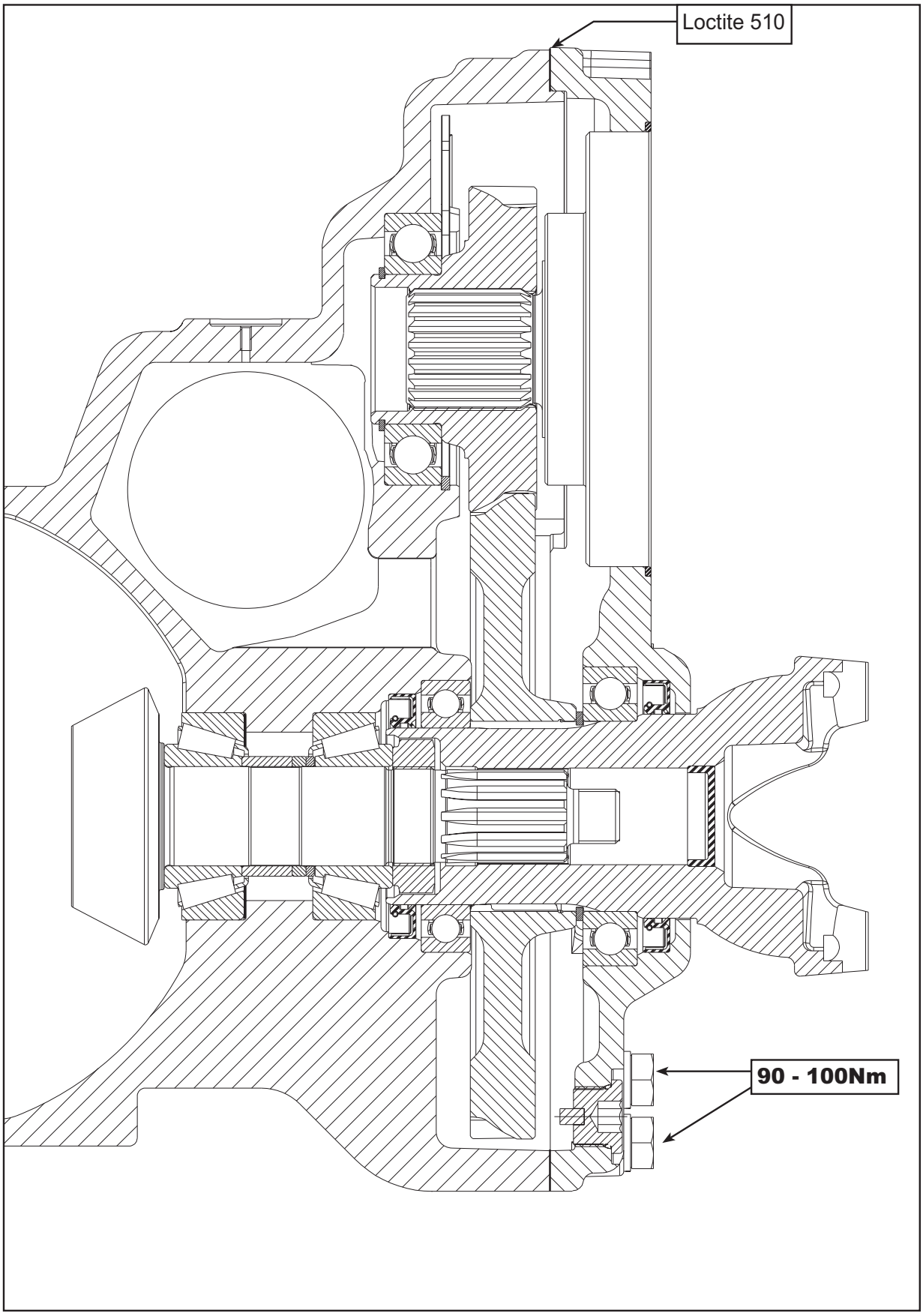
Remove the internal bearing (10).

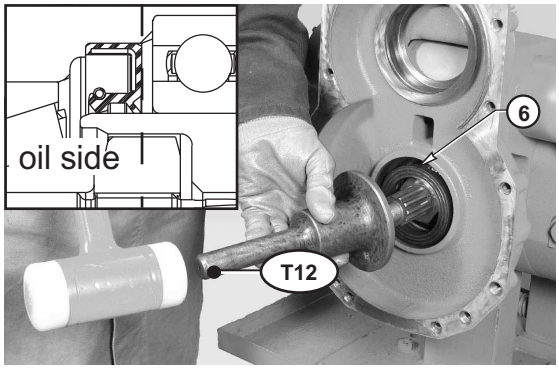


GB d

Pull out the cup of the sealing ring (11) by using drift.

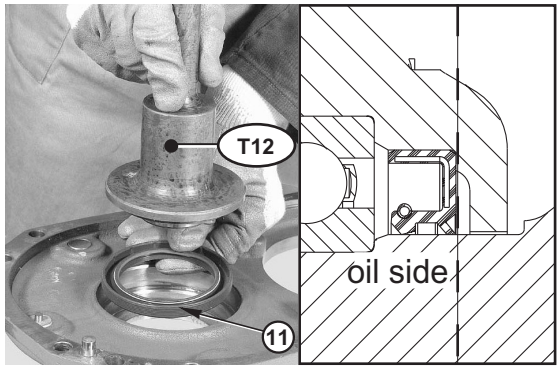
ASSEMBLY FLANGED REDUCTION GEAR 603 TYPE: INTEGRAL 603 INPUT GEAR





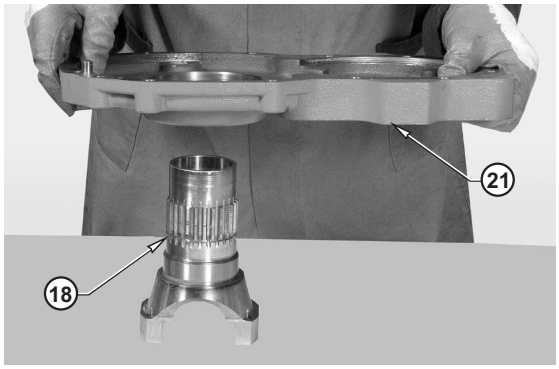
GB a

Insert the sealing ring (6) with a normal tool.
NOTE: Bring the sealing ring just to the end stop, apply grease to the sealing lips.



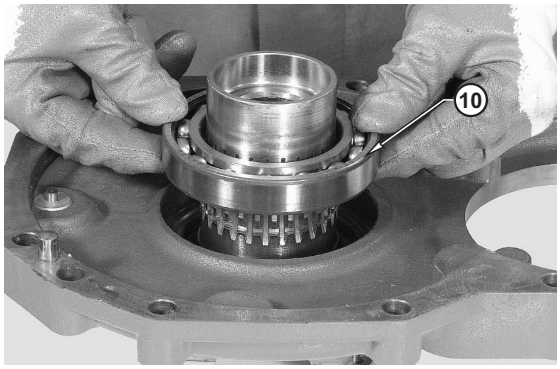
GB b

Insert the sealing ring (11) with a normal tool.
NOTE: Bring the sealing ring just to the end stop, apply grease to the sealing lips.



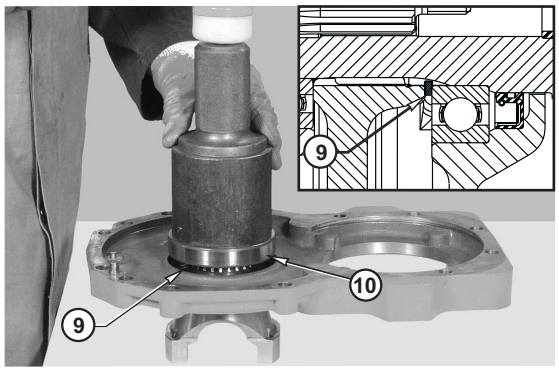
GB c

Fit the flange (18) and fasten it.
For keying the flange (18), use a plastic hammer if necessary.



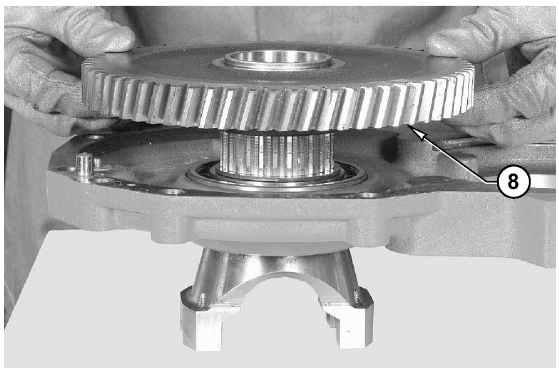
GB d

Insert the bearing (10).



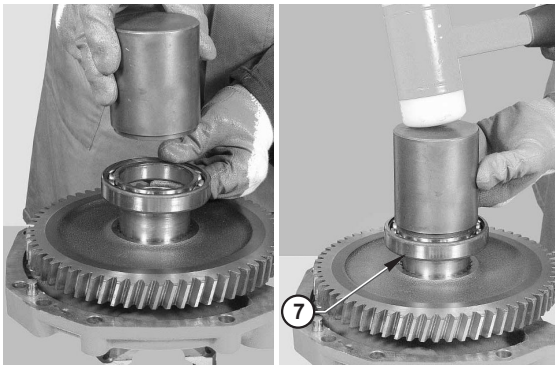
GB e

Using a normal tool insert the bearing (10) and snap ring (9).
oil side.



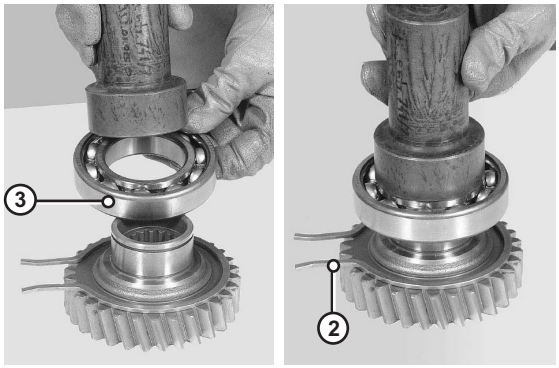
GB f

Install the secondary gear wheel (8) with a plastic hammer.



GB a

Using a normal tool insert the bearing (7).



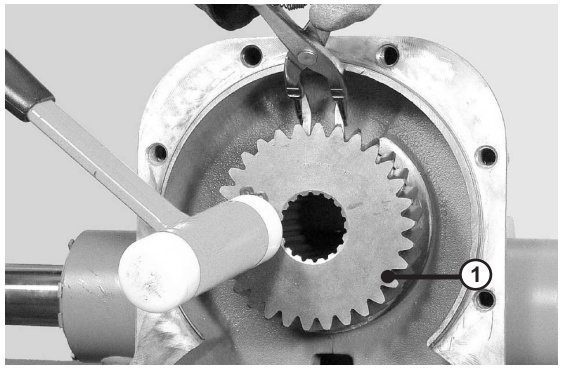
GB b

Insert the snap ring (2) and using a normal tool insert the bearing (3).



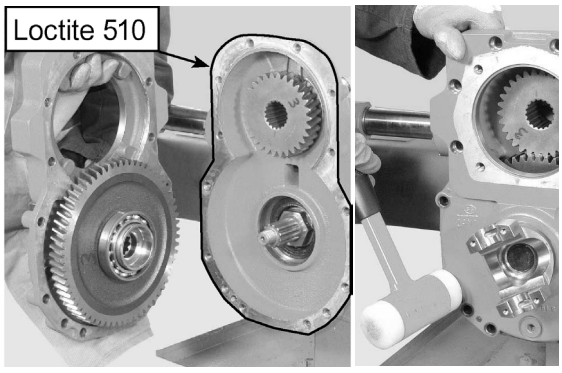
GB c

Fix the bearing with the snap ring (4).



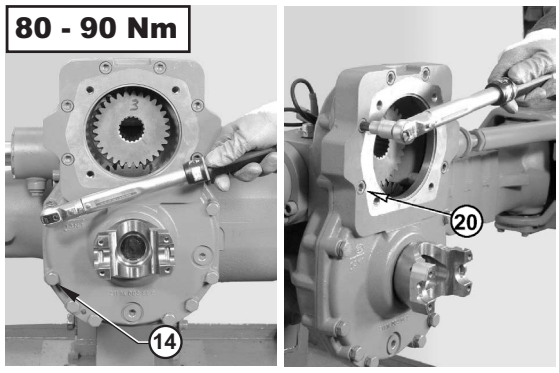
GB d

Install the drive side shaft (1) with a plastic hammer.



GB e

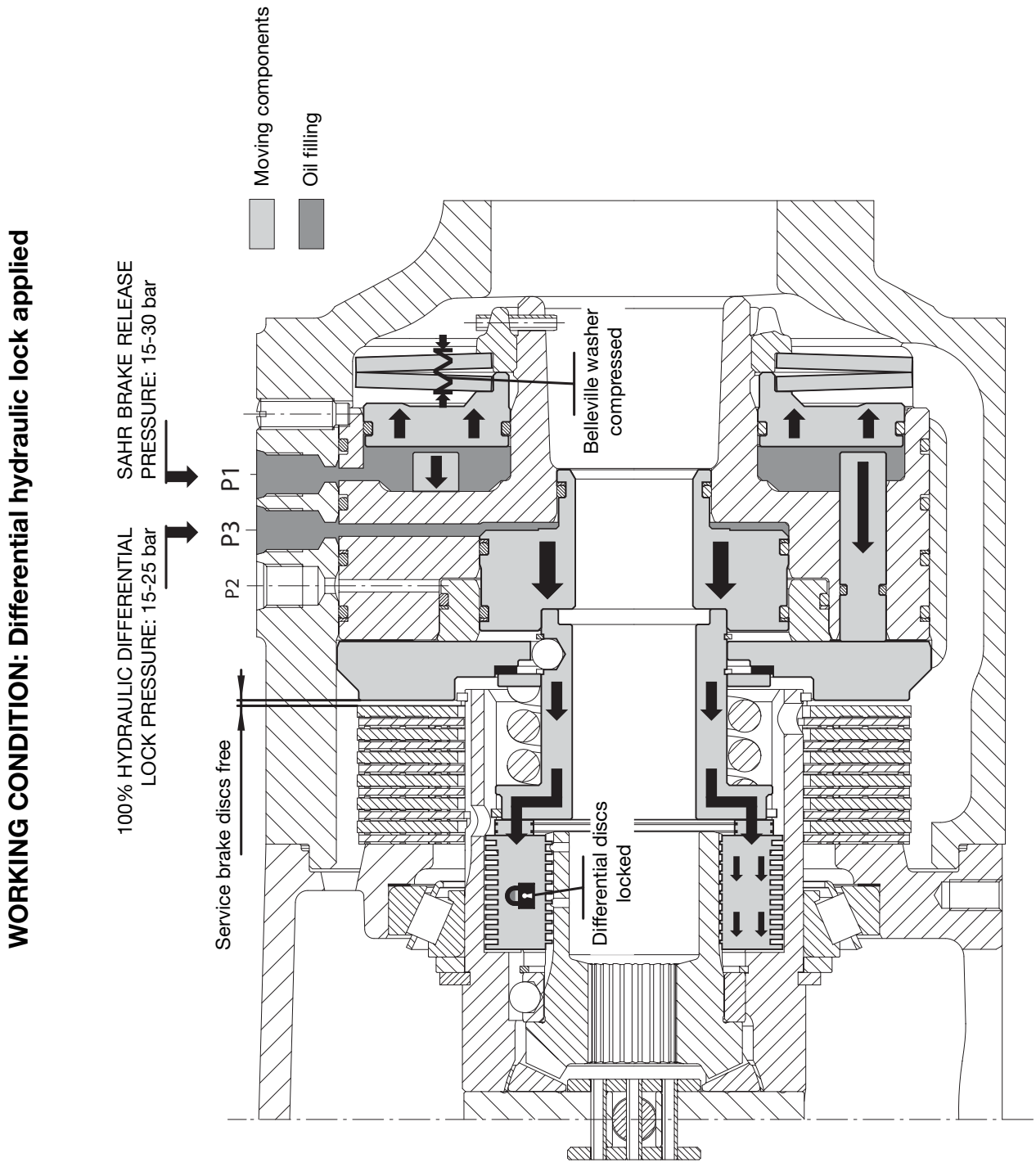
Install drive side flange cover, apply LOCTITE 510 to the short screws.

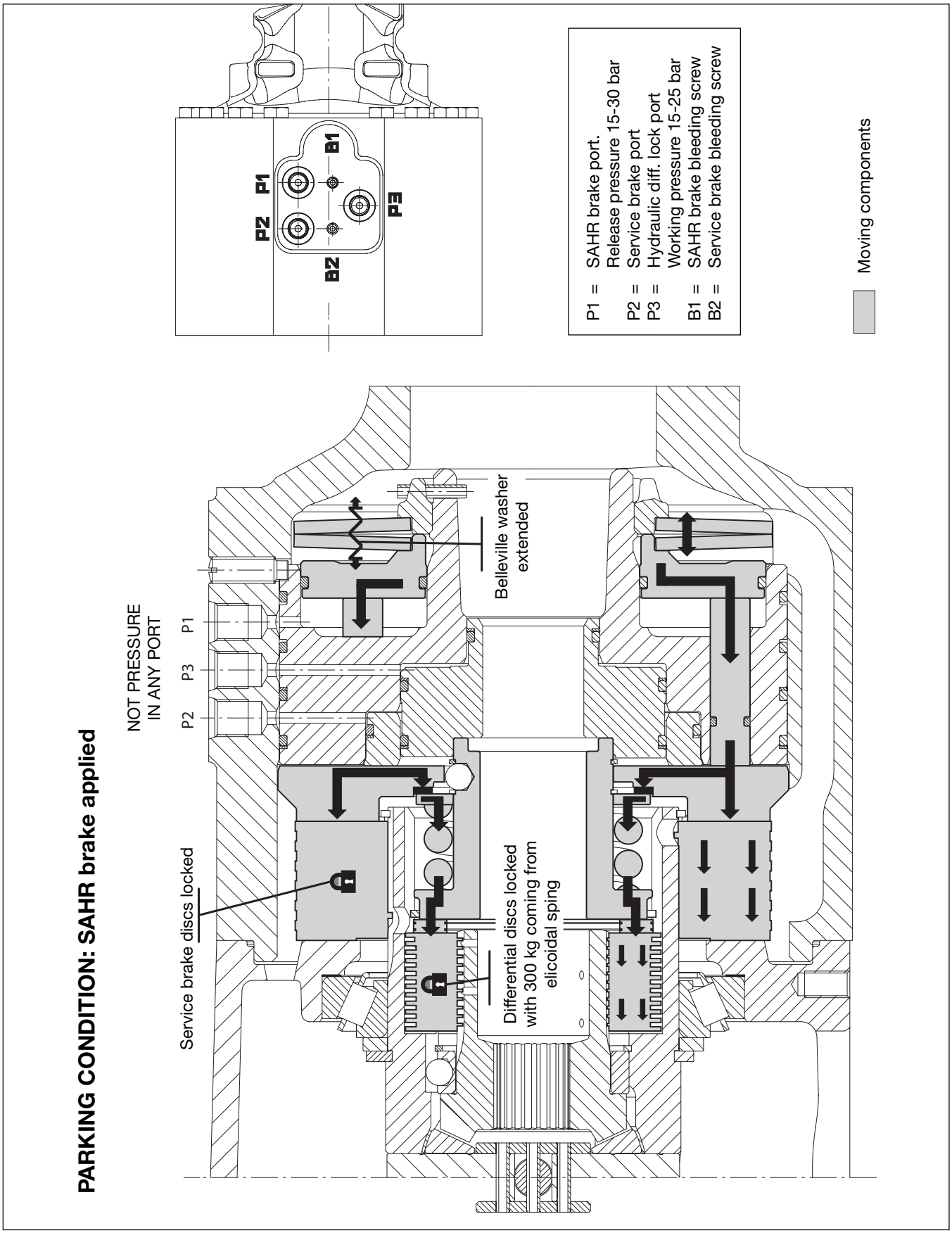


GB f

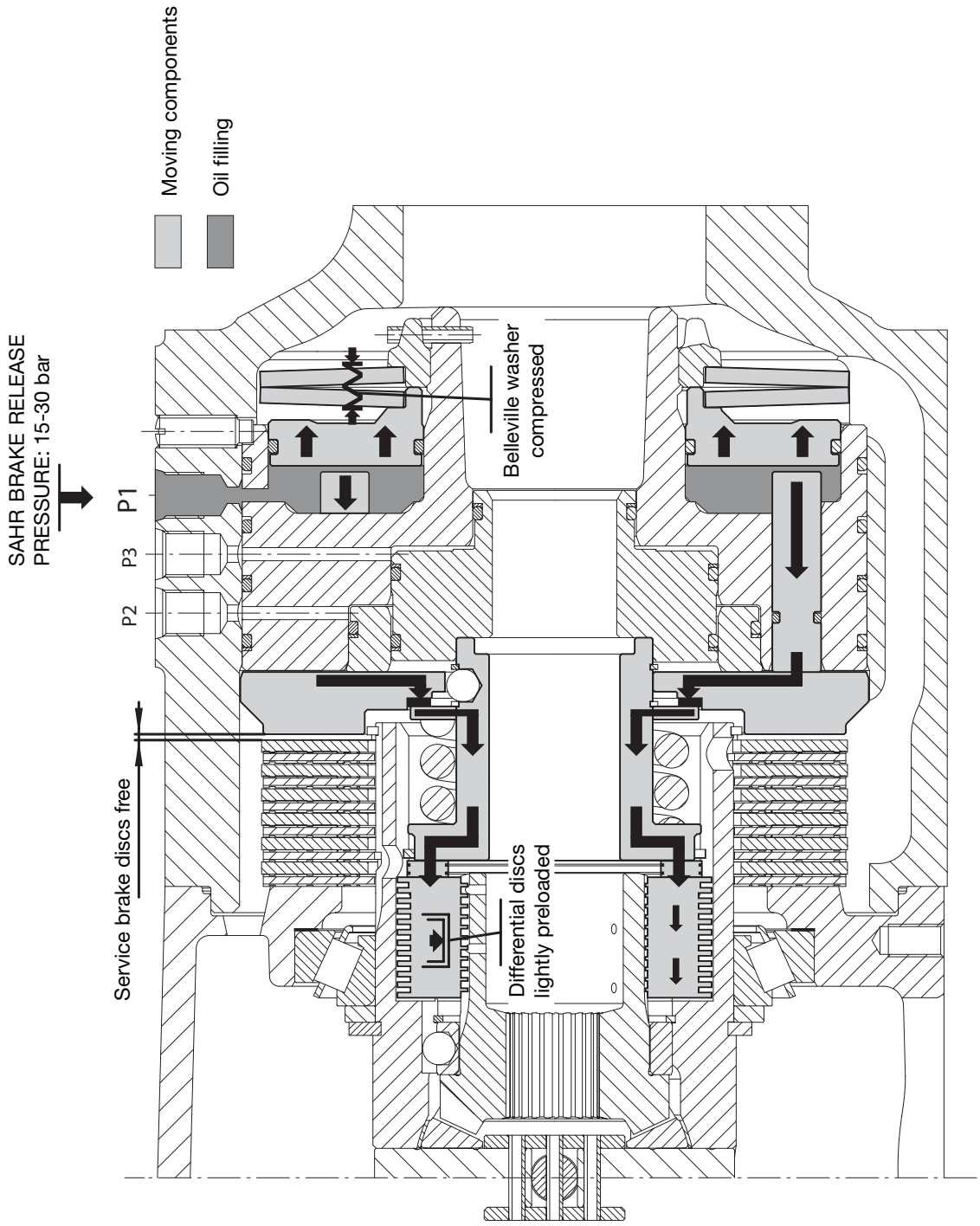
Tighten screws with a torque wrench setting of 80-90 Nm.

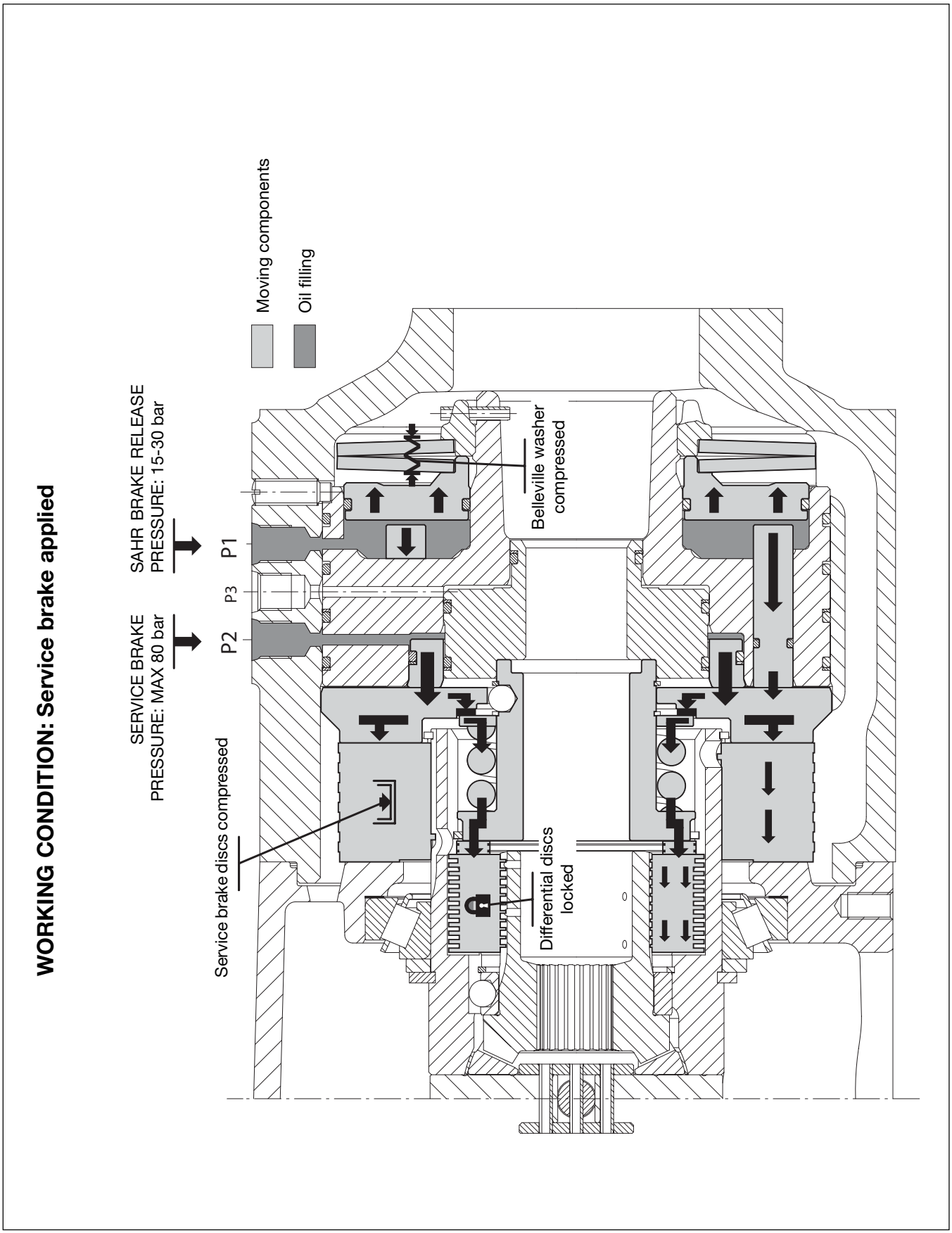
DISASSEMBLY BRAKE: NEGATIVE BRAKE 4 CUP SPRINGS

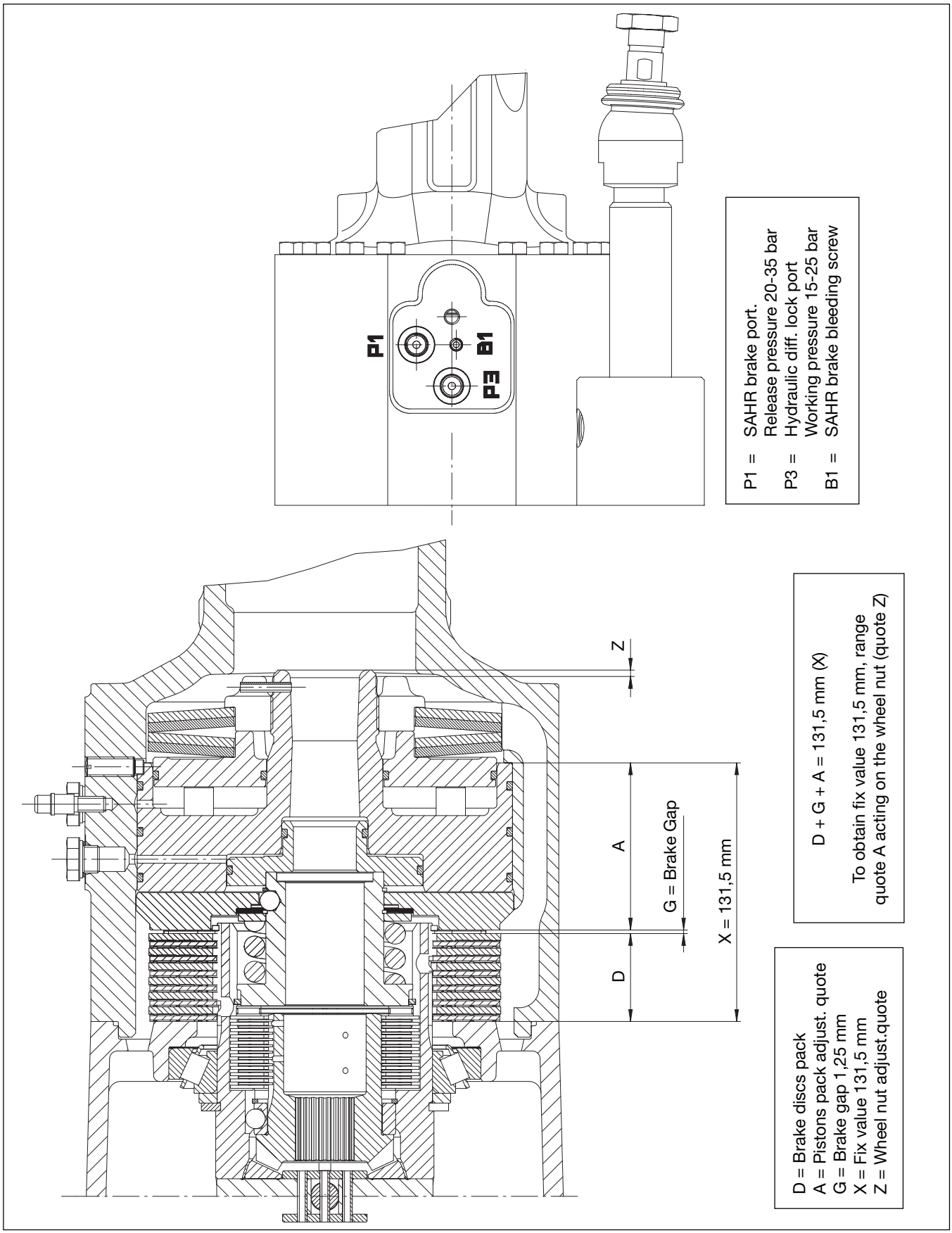


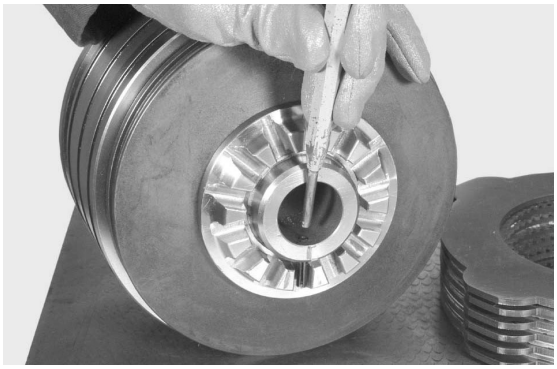

B1
P1
P3
P2
B2
P1 = SAHR brake port. Release pressure 15-30 bar
P2 = Service brake port
P3 = Hydraulic diff. lock port Working pressure 15-25 bar
B1 = SAHR brake bleeding screw
B2 = Service brake bleeding screw
Moving components
PARKING CONDITION: SAHR brake applied
NOT PRESSURE IN ANY PORT
P1
P3
P2
Belleville washer extended
Service brake discs locked
Differential discs locked with 300 kg coming from elicoidal sping

WORKING CONDITION: SAHR brake released




WORKING CONDITION: Service brake applied
Moving components
Oil filling
SAHR BRAKE RELEASE
PRESSURE: 15-30 bar
SERVICE BRAKE
PRESSURE: MAX 80 bar
P1
P3
P2
Belleville washer
compressed
Service brake discs compressed
Differential discs
locked


P1
B1
P3
P1 = SAHR brake port.
Release pressure 20-35 bar
P3 = Hydraulic diff. lock port
Working pressure 15-25 bar
B1 = SAHR brake bleeding screw
Z
A
G = Brake Gap
D
X = 131,5 mm
D + G + A = 131,5 mm (X)
To obtain fix value 131,5 mm, range
quote A acting on the wheel nut (quote Z)
D = Brake discs pack
A = Pistons pack adjust. quote
G = Brake gap 1,25 mm
X = Fix value 131,5 mm
Z = Wheel nut adjust.quote



GB a

For details, see «BRAKE: SERVICE BRAKE, NEGATIVE **BRAKE, 100% LOCKED».**Turn upside down the brake module and with a pin driver remove the locking pin of the slotted nut. Sign the position of the slotted nut.



GB b

Unscrew the slotted nut (26).



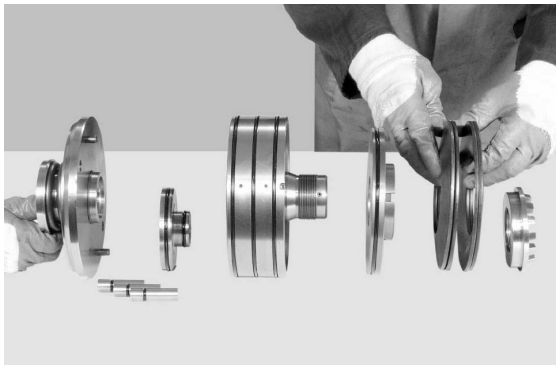
GB c

Remove the disc springs (28).



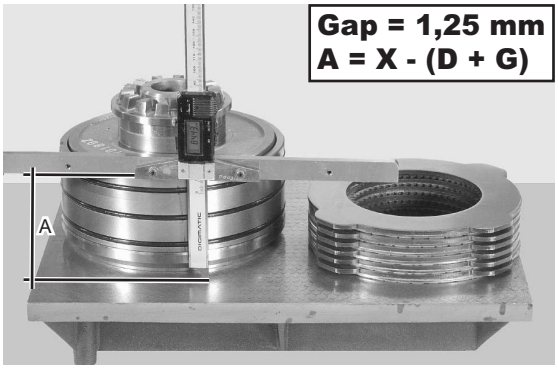
GB d

ASSEMBLY BRAKE: NEGATIVE BRAKE 4 CUP SPRINGS



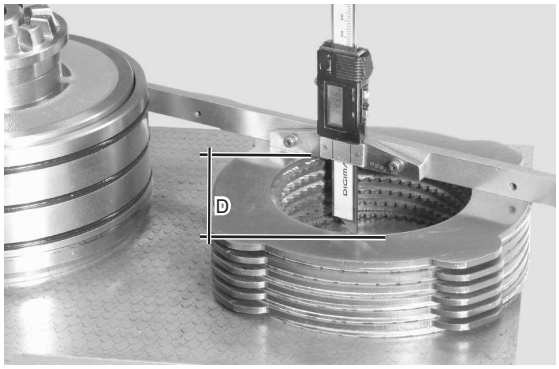
GB a

For details, see «BRAKE: SERVICE BRAKE, NEGATIVE BRAKE, 100% LOCKED».
Complete the O-rings and anti-extrusion rings on all pistons.
ATTENTION: The O-rings always have to be assembled from the pressure facing side.



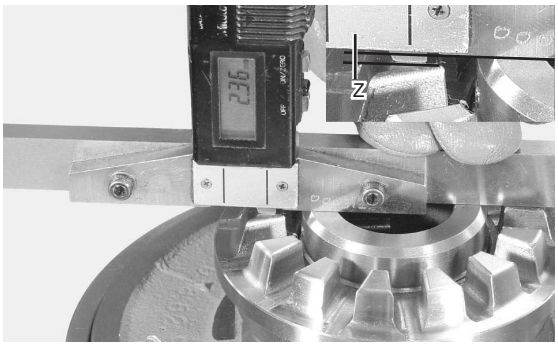
GB b

Determin the level “A” between external plane and the brake plate by the adjustment of the slotted nut. **NOTE**: To define the level A adjust the slotted nut always to the smaller value by driving to the closer notch.
A = 131,5 - (D+G) = 131,5 - (44,95 + 1,25) = 85,3 mm
X = constant value 131,5 mm



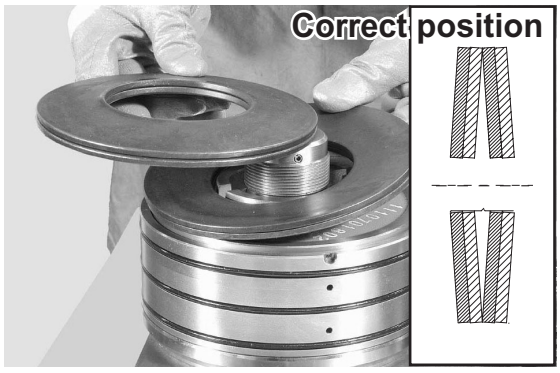
GB c

Find out the level of the brake discs “D”.
E.g. D=44.7 mm
Add to D the value G = brake clearance (e.g. 1,25 mm).
D + G = 44,9 + 1,25 = 46,2 mm



GB d

Before removing the slotted nut in order to insert the springs, note down the distance Z from the plane to the tooth near the pin.
NOTE: Sign.



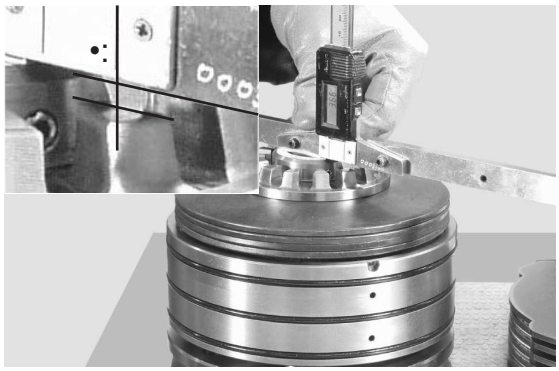
GB e

Insert the disc springs in the right position.



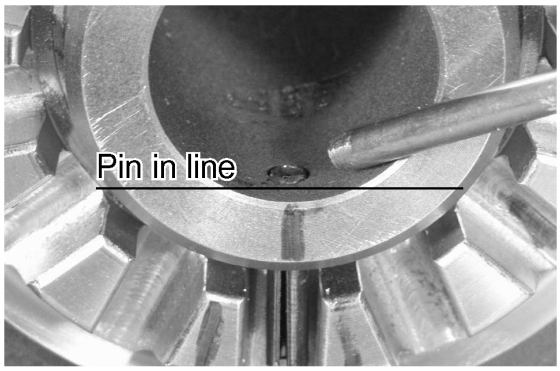
GB f

Screw up the slotted nut.



GB a

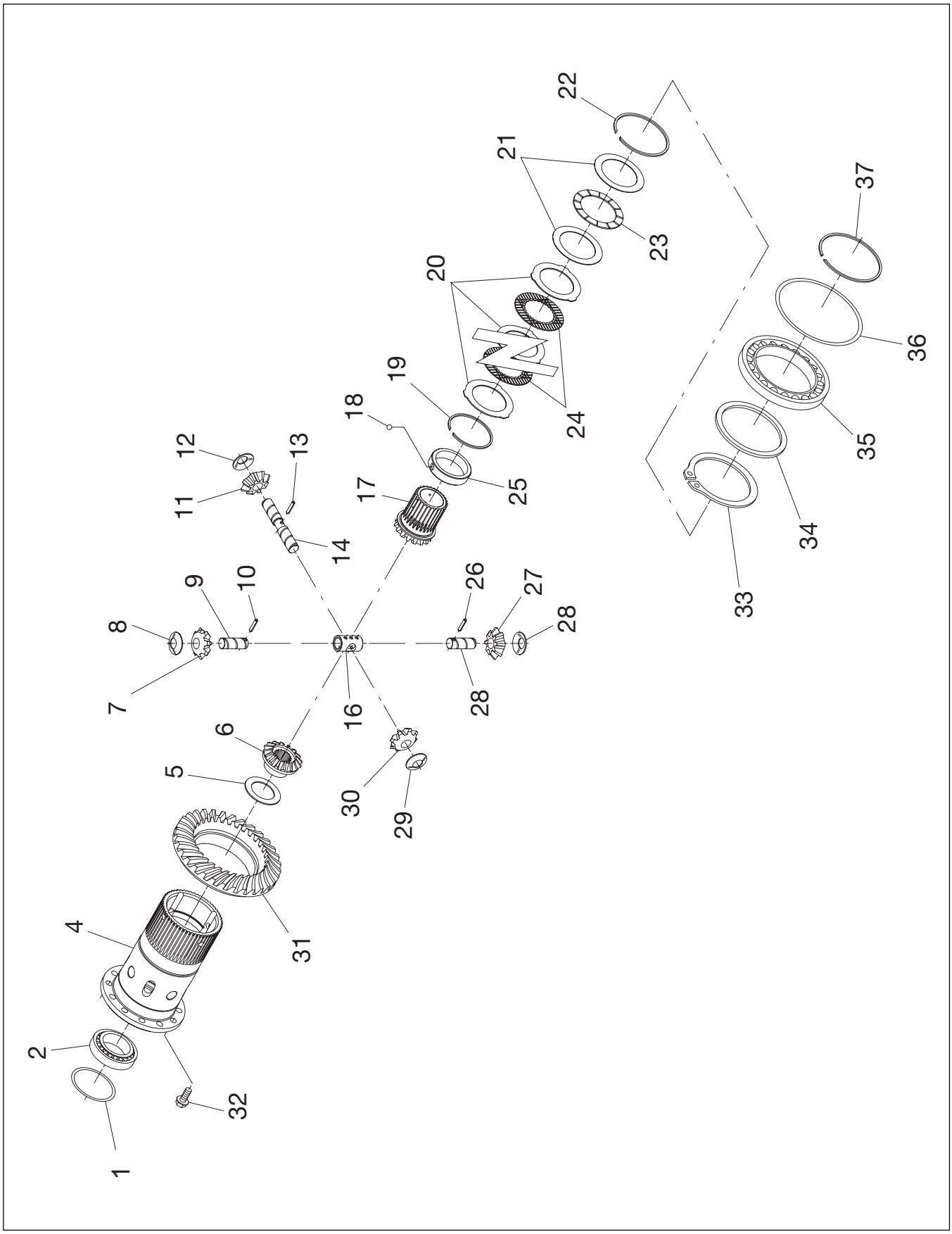
Check the earlier measured distance Z from the plane to the tooth next to the pin.

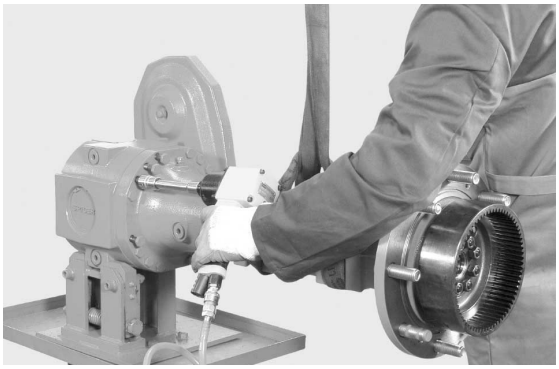


GB b

Put the pin in locking (21) position.

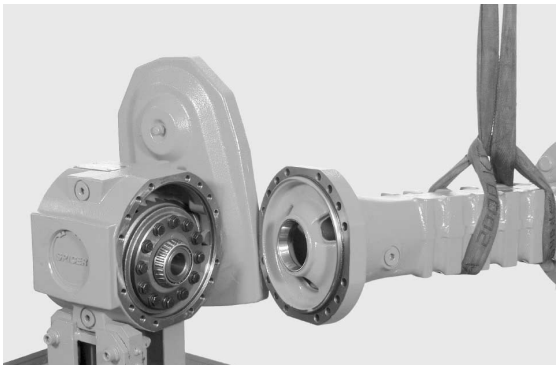
DISASSEMBLY NORMAL PRELOADED DIFFERENTIAL





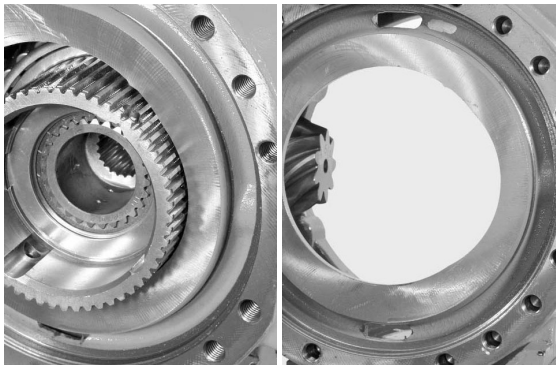
GB a

Remove the brake side arm and the brake discs pack.
Sling the arm to be removed and connect it to a hoist, remove screws of the crown wheel side arm.



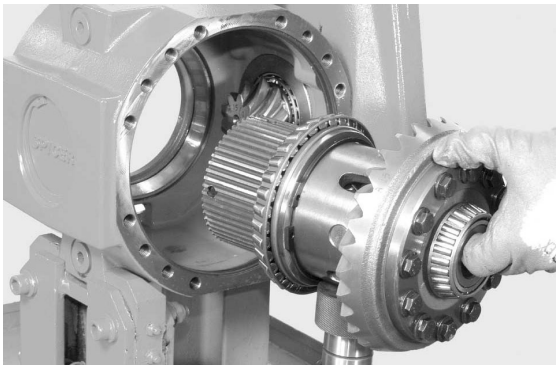
GB b

Remove the hydraulic block discs one after th other.



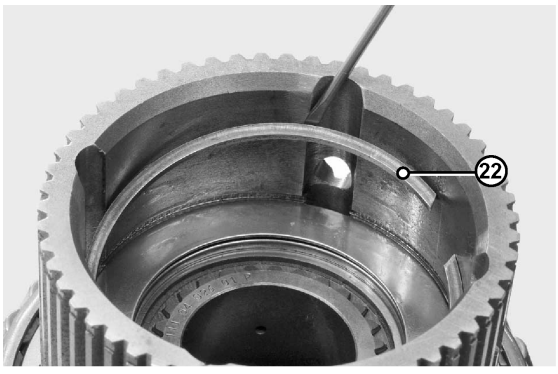
GB c

ATTENTION: Position the differential gear sideways into the recess in order to be able to pull it out.



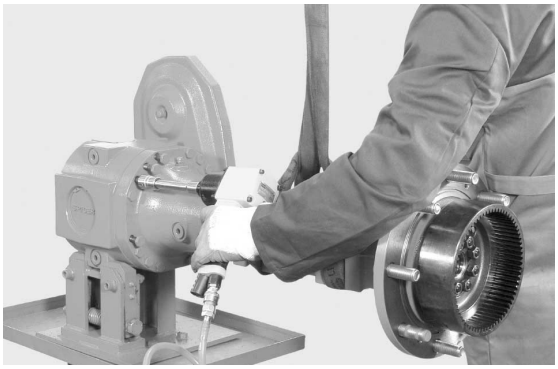
GB d

Pull out the differental.



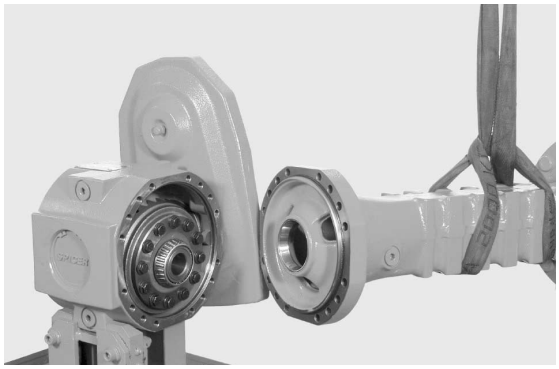
GB e

Remove the snap ring (22) that secures the thrust bearing.



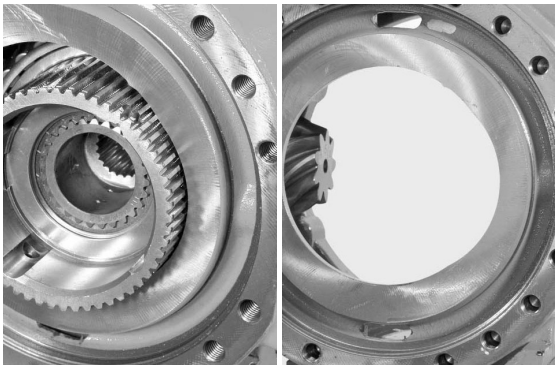
GB a

Remove the brake side arm and the brake discs pack.
Sling the arm to be removed and connect it to a hoist, remove screws of the crown wheel side arm.



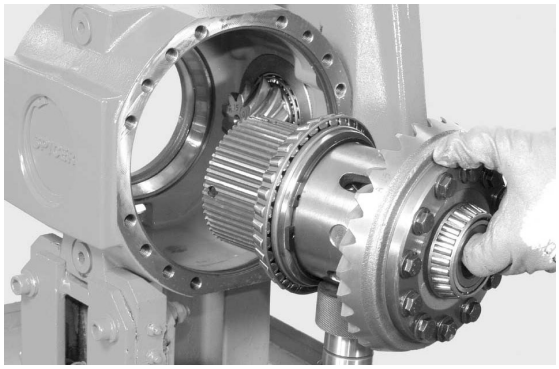
GB b

Remove the hydraulic block discs one after th other.



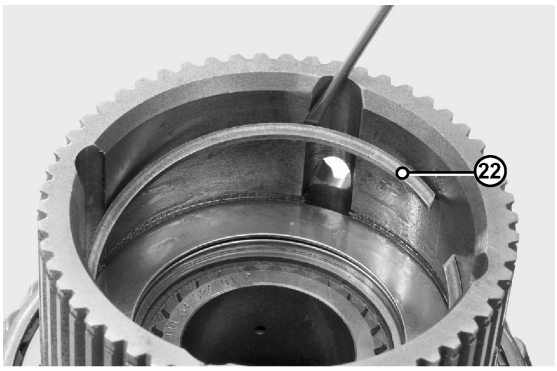
GB c

ATTENTION: Position the differential gear sideways into the recess in order to be able to pull it out.



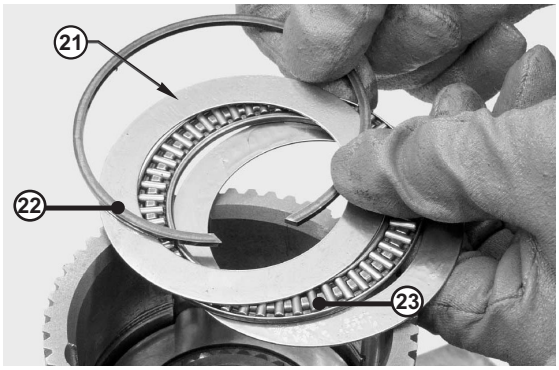
GB d

Pull out the differental.



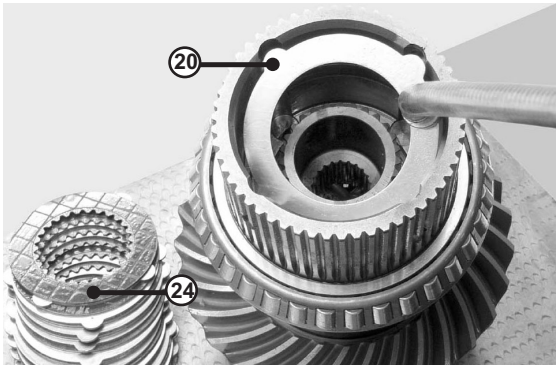
GB e

Remove the snap ring (22) that secures the thrust bearing.



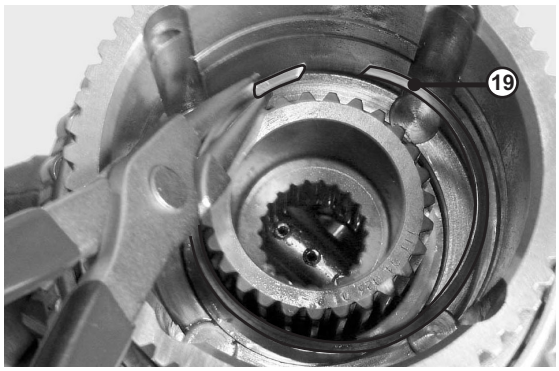
GB a

Remove the snap ring (22) and thrust bearing (23).



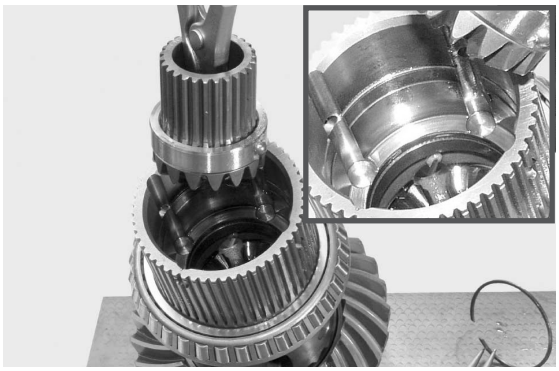
GB b

Remove the hydraulic block discs (20)(24) one after the other.



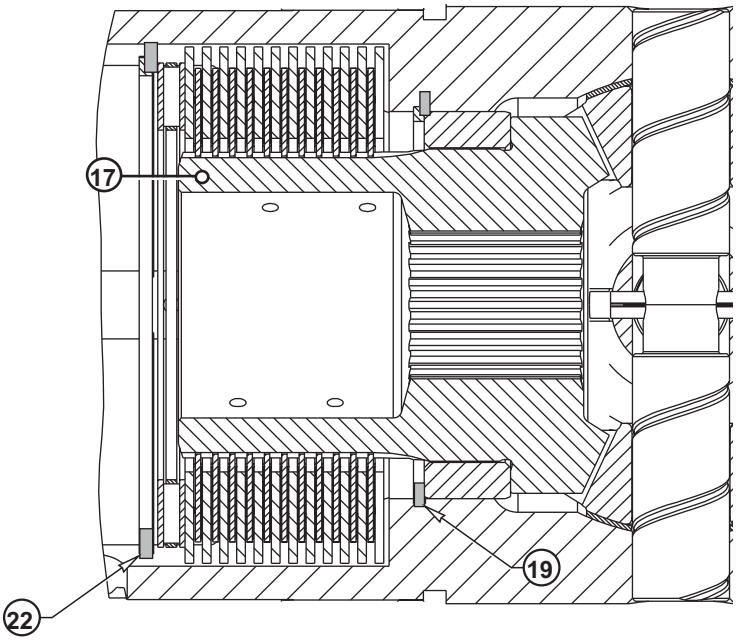
GB c

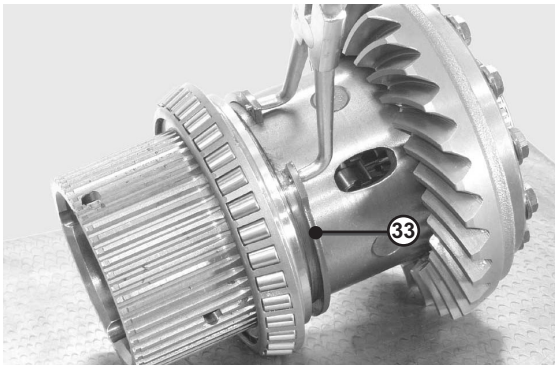
Remove the snap ring (19) that secures the planetary gear.



GB d

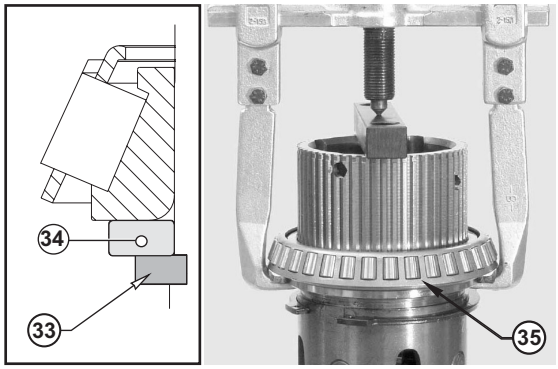
Remove the brake side planetary gear.





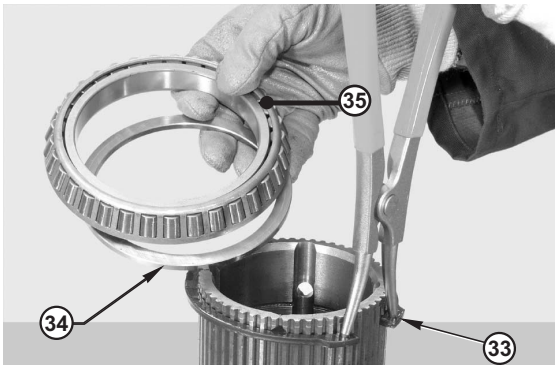
GB a

Remove the snap ring (33) out of it's seat by moving it sideways.



GB b

Using a puller, extract the bearing (35) and the washer (34).



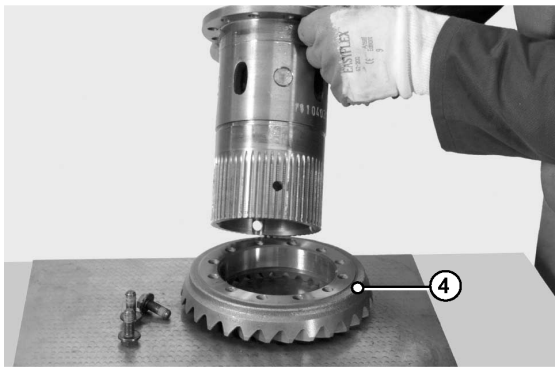
GB c

Remove completely bearing (35), washer (34) and snap ring (33).



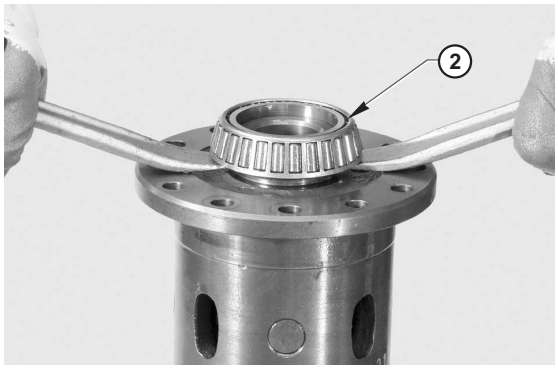
GB d

Remove fixing screws (32) of the crown wheel (31); exchange each time when removed.



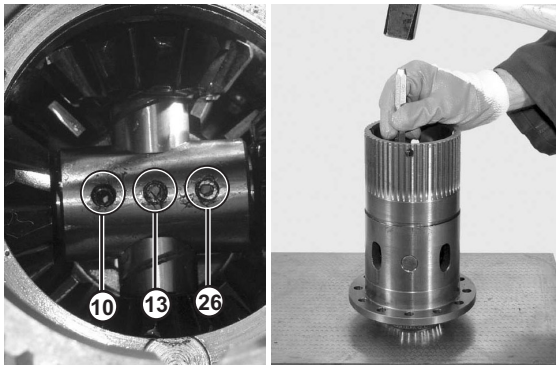
GB e

Extract the crown wheel (4).



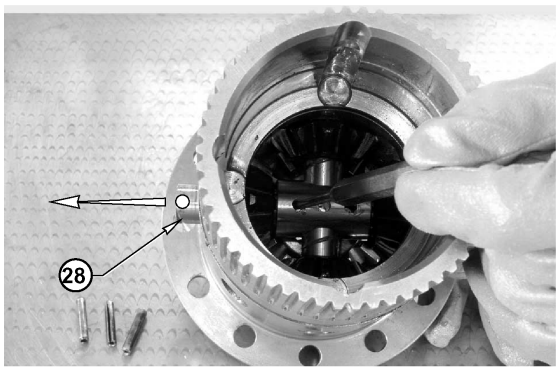
GB a

Remove the tapered roller bearing (2) of the crown wheel side, using two levers.



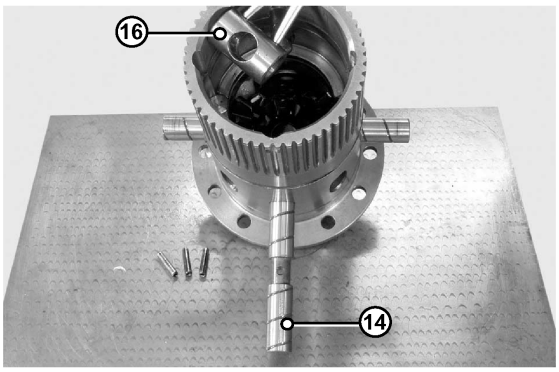
GB b

Remove the three spider blocking pins (10)(13)(26) by using a pin driver.



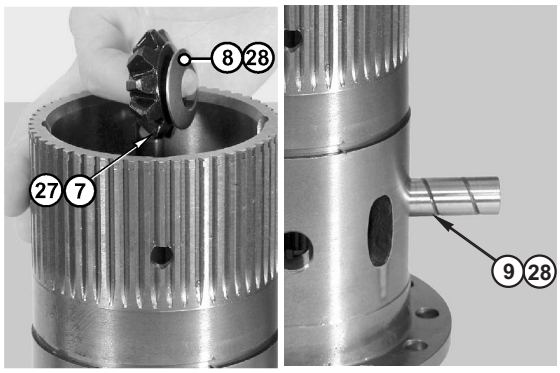
GB c

Move the two opposite mounted short bolts (9)(28) to the outside of the box using the same pin driver.



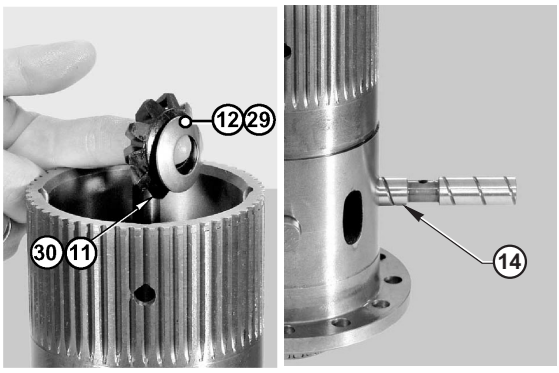
GB d

Drive out the long bolt (14) and pull out the spider (16) from the centre.



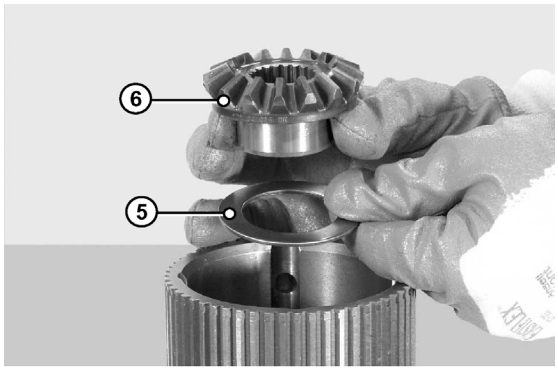
GB e

Remove the two half bolts (9)(28), spherical washers (8)(28) and satellite wheels (27)(7).



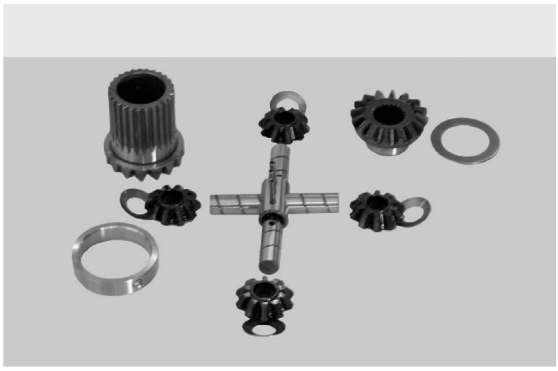
GB f

Remove long bolt (14), spherical washers (12)(29) and satellite wheels (30)(11).



GB a

Remove the planetary gear (6).



GB b

Arrangement of the differential.

ASSEMBLY NORMAL PRELOADED DIFFERENTIAL



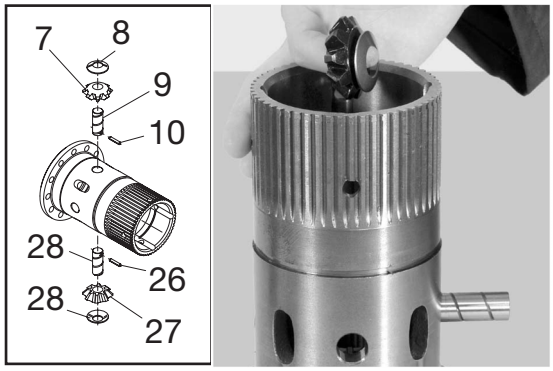
GB a

Differential module assembled.



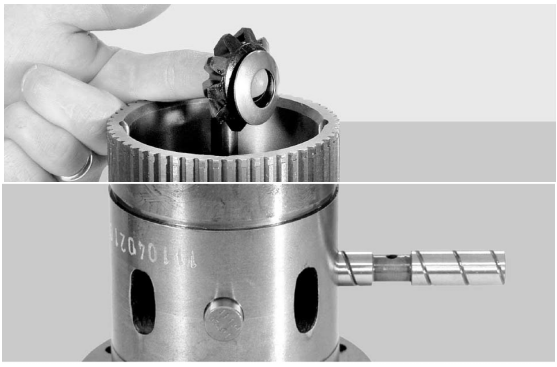
GB b

Lubricate and insert washer and plantary wheel.



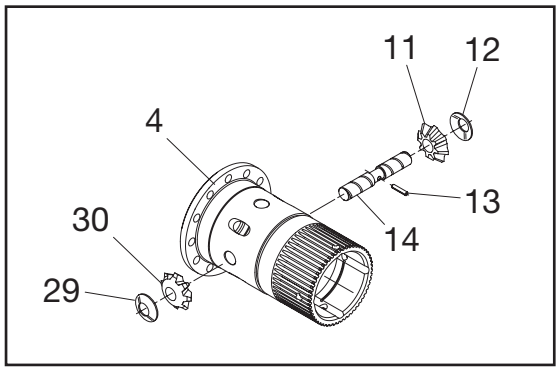
GB c

Insert the two half bolts (28)(9), spherical washers (8)(28) and satellite wheels (7)(27).

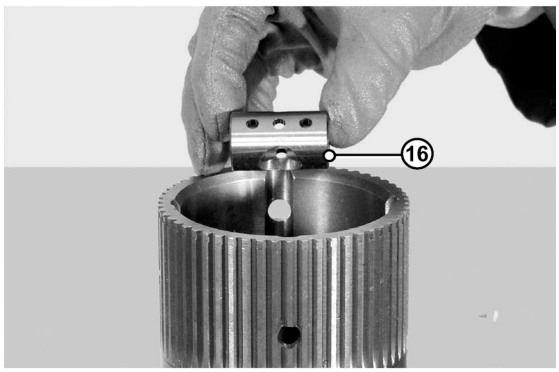


GB d

Partially insert the long bolt (14), satellite wheels (11)(30) and spherical washers (29)(12).

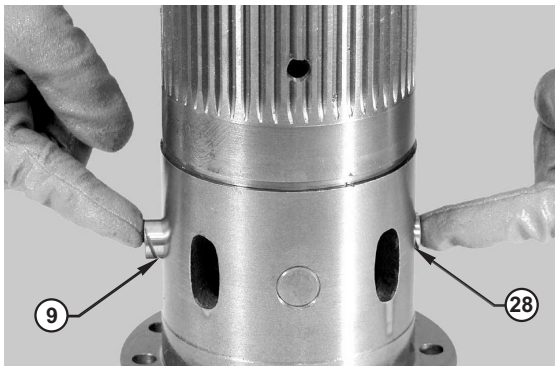


GB e



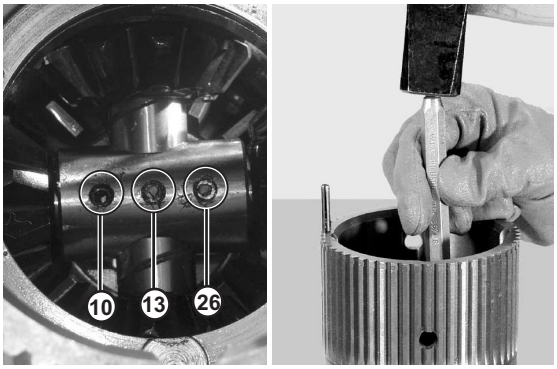
GB f

Insert spider (16) and completely insert the long bolt (14).



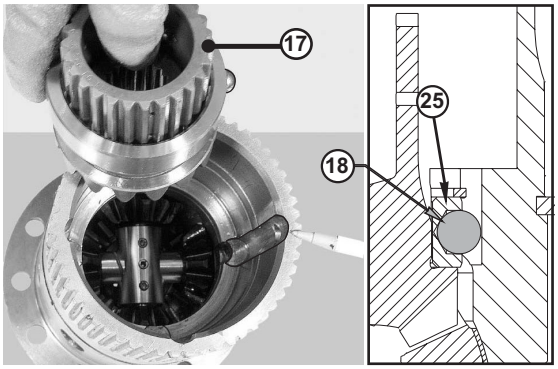
GB a

Insert completely the half bolts (9)(28).



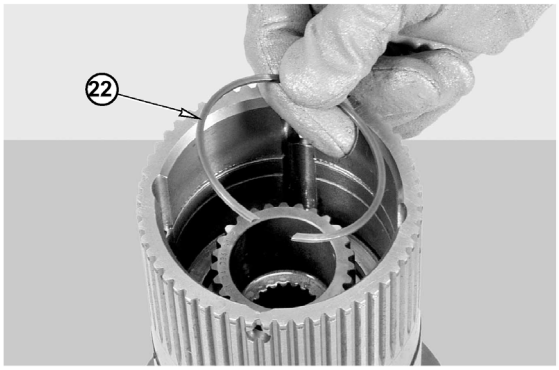
GB b

Centre the pin holes and insert the 3 pins (10)(13)(26).
NOTE: Check the free rotation of the satellite wheels on the bolts.



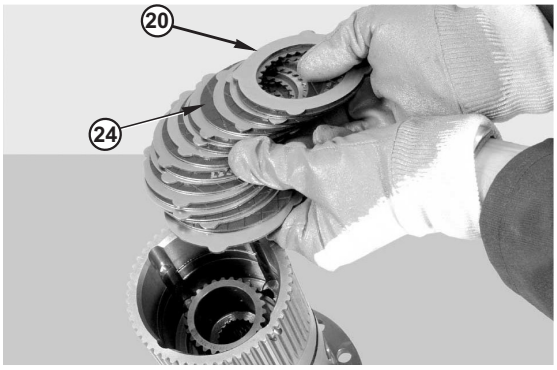
GB c

Insert the planetary wheel together (17) with the centering sleeve (25). **NOTE**: The centering sleeve must have the fixing ball (18) assembled.



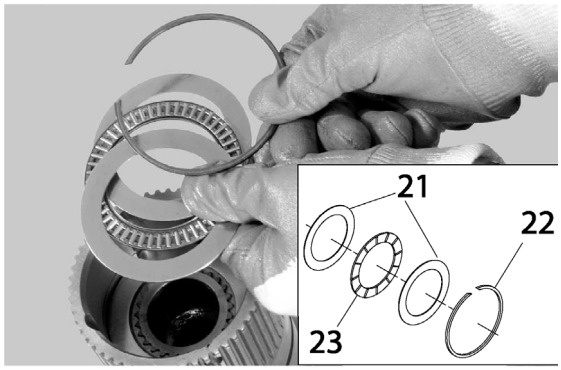
GB d

Insert snap ring (22) of the planetary wheel.



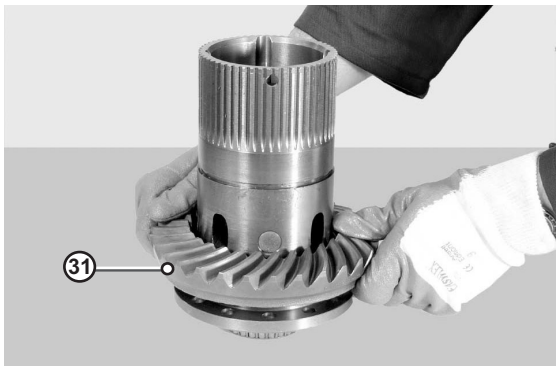
GB e

Insert and substitute, if necessary, the discs (20)(24) of the dif ferential lock. **ATTENTION**: First and last disc have to be of steel.



GB f

Insert thrust bearing (23) and snap ring (22).



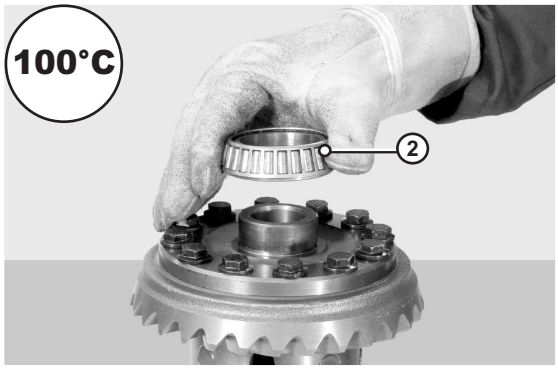
GB a

Insert crown wheel (31).



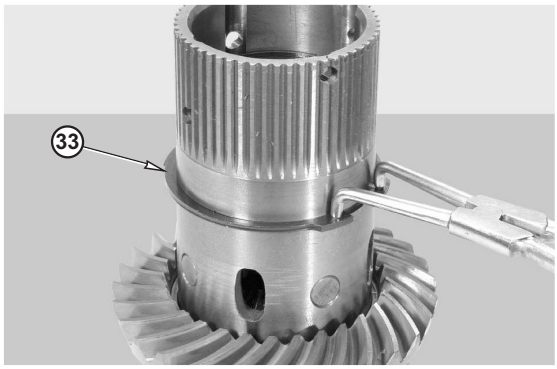
GB b

Insert the screws (32). Tighten screws with a torque wrench setting of 78-86 Nm.
NOTE: Always use new screws to fix the crown wheel. In case the screws are not thread locking pretreated, use Loctite 270.



GB c

Assemble the bearing (2). **NOTE**: Heat the bearing to 100°C before assembling.



GB d

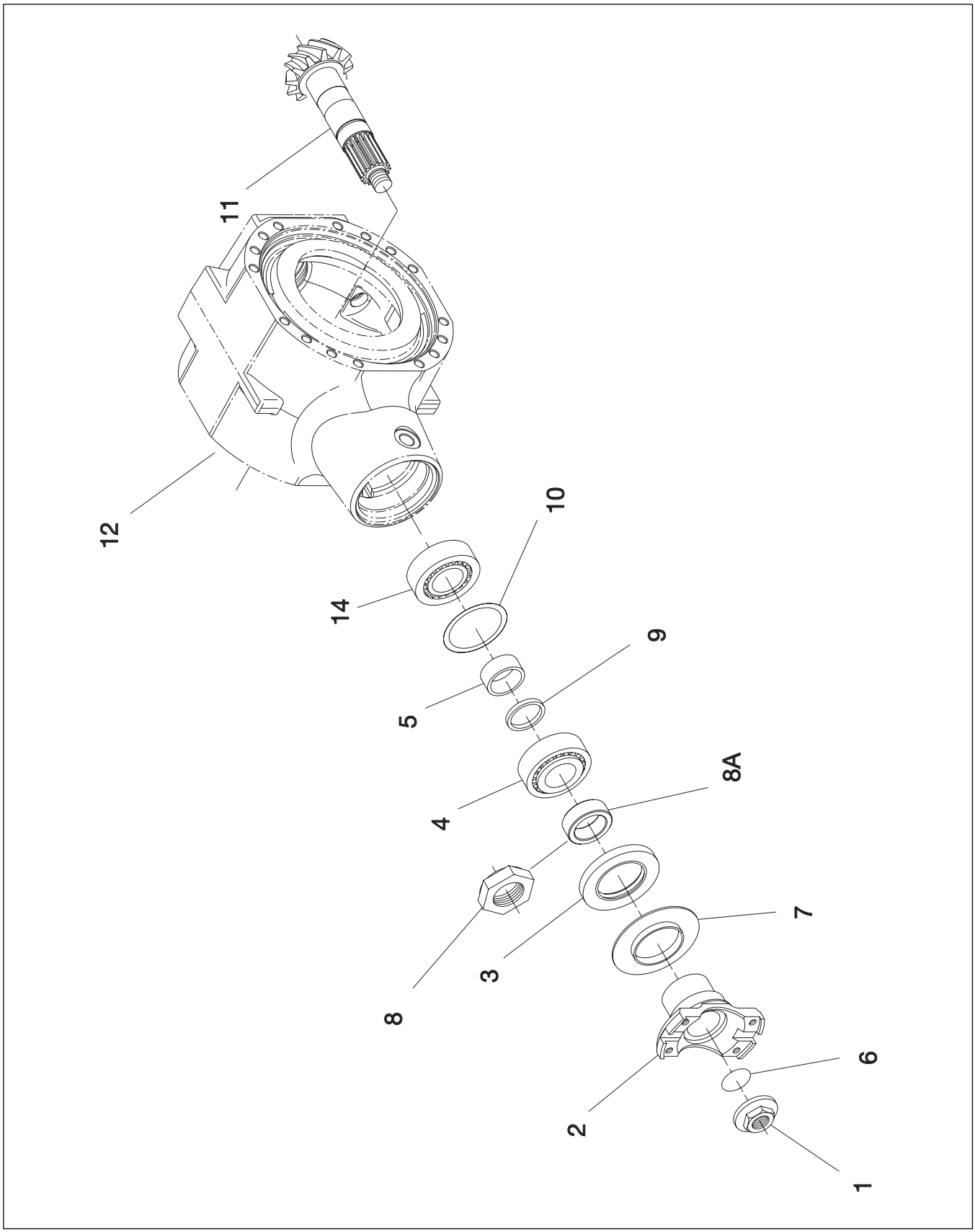
Assemble the snap ring (33) in it´s seat.

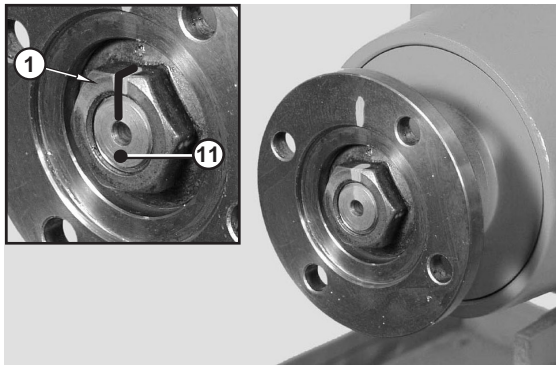


GB e

Assemble shim (34) and bearing (35).
NOTE: Heat the bearing as well as the shim to 100 °C before assembling.

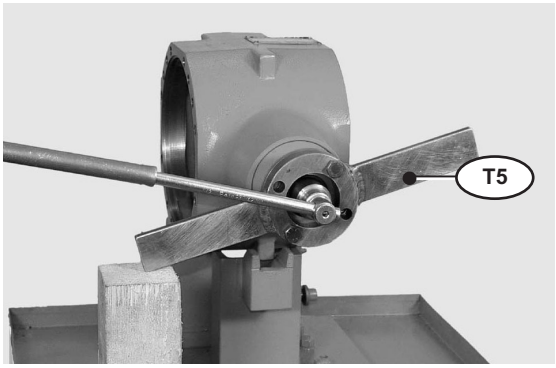
DISASSEMBLY BEVEL PINION: VERSION NORMAL FLANGE AND NUT REVOLUTION COUNTER VERSION





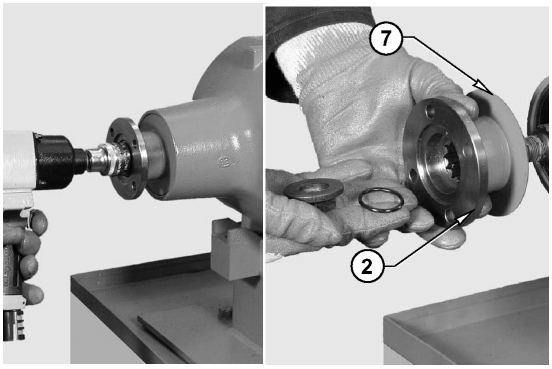
GB a

Make positional marks across nut (1) and pinion (11) tang; if disassembly is awkward, heat the check nut (1) of the flange (2) at 80C°.
NOTE: Heating is meant to unloose the setting of Loctite on the nut (1).



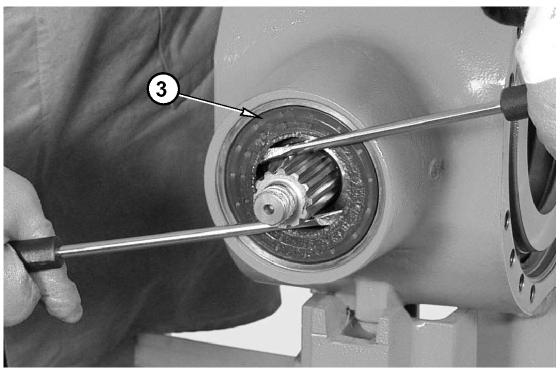
GB b

Position tool T5, so as to avoid pinion rotation.
Unloose and remove the nut (1); also remove the O-ring (6).



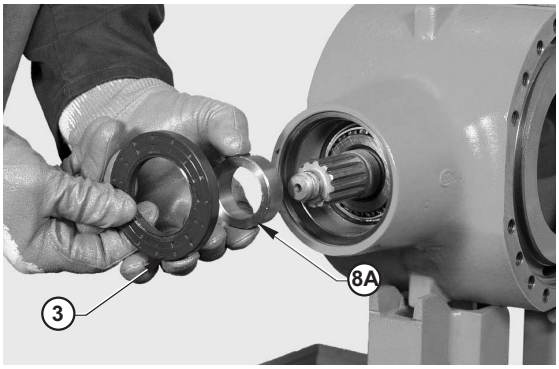
GB c

Remove the flange (2) complete with guard (7) by means of a puller.



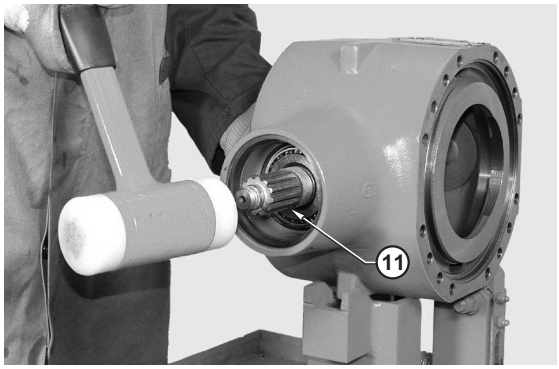
GB d

Remove the sealing ring (3).



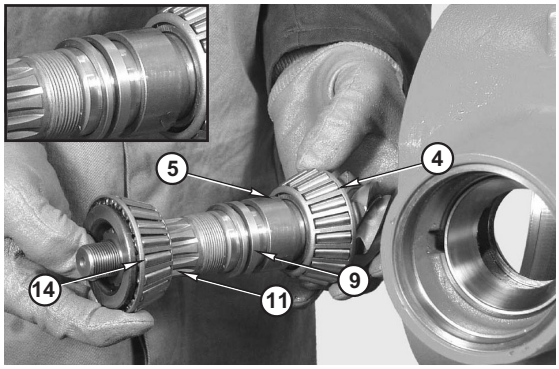
GB a

Remove the sealing ring (3) and spacer (8A).
NOTE: sealing rings (3) must be replaced each time the unit is disassembled.



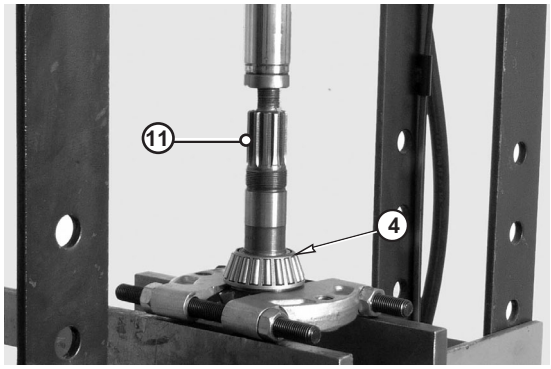
GB b

Remove the pinion (11), shims and distance piece.



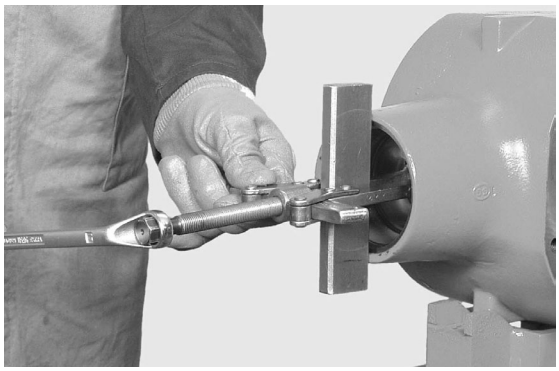
GB c

Refer and keep to the positions marked during disassembly.



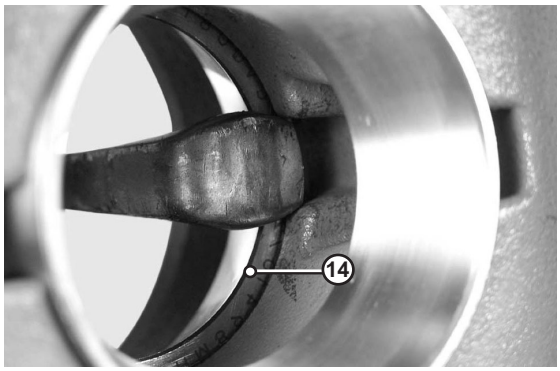
GB d

Using a puller and a press, remove the inner bearing (4) from the pinion (11).

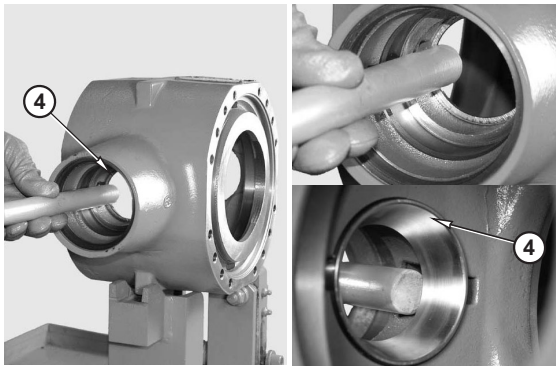


GB e

Remove the thrust block of the external bearing (14).



GB f



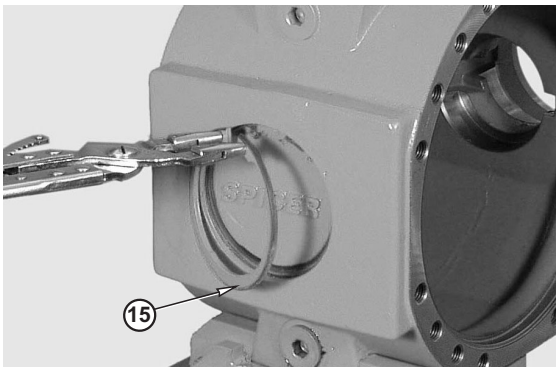
GB a

Insert a drift in the appropriate holes.



GB b

Remove the thrust block of the internal bearing (4) as well as the shim washers (10)(S).



GB c

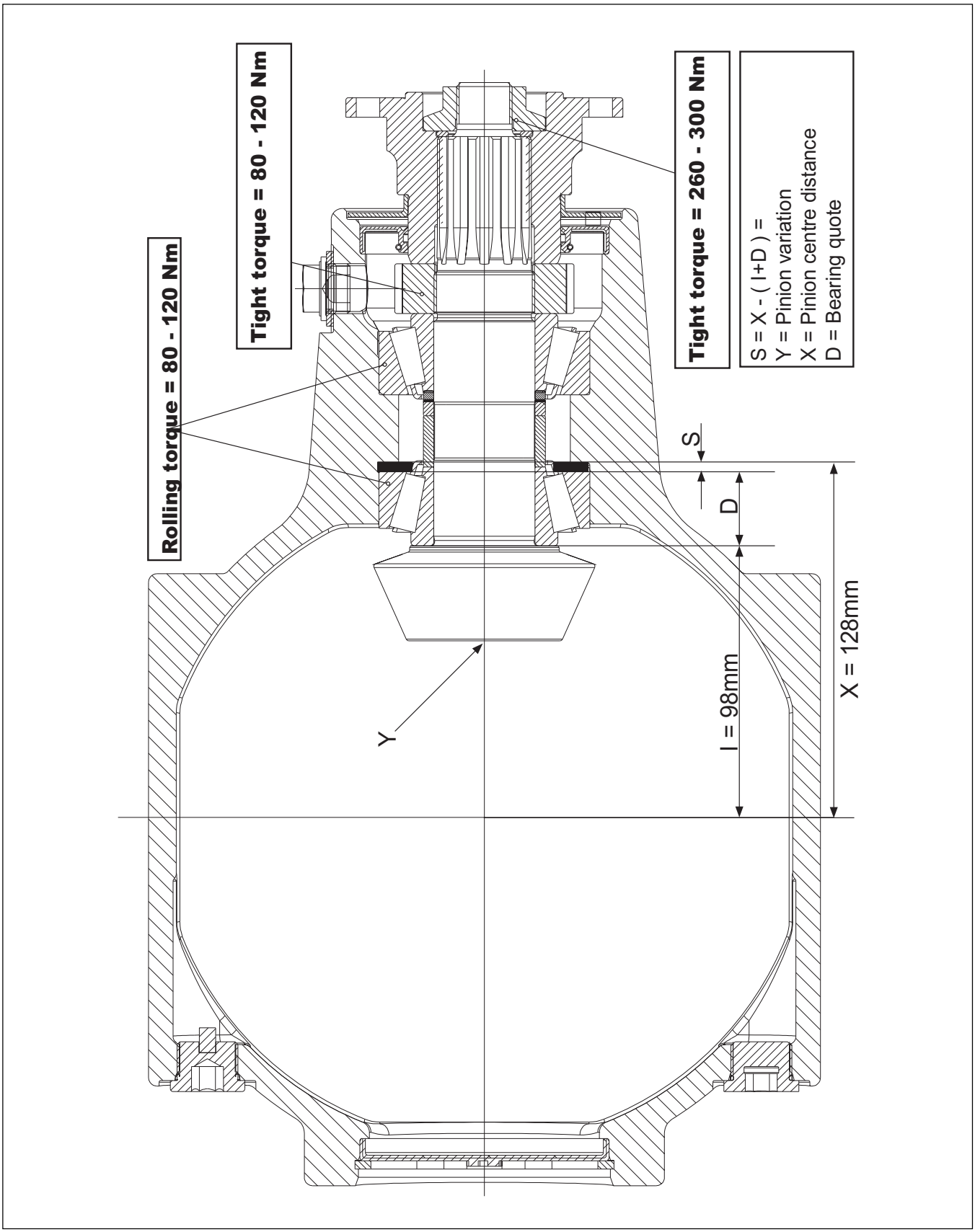
Remove the snap ring (15).

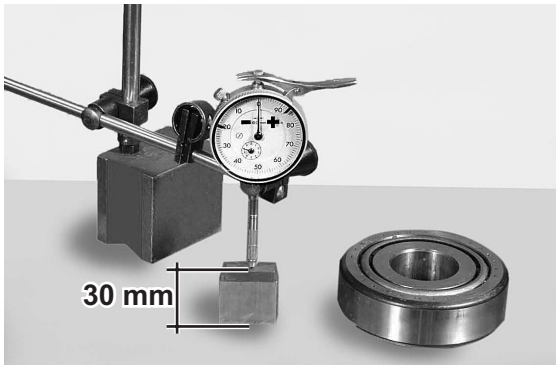


GB d

Remove the cap (14).

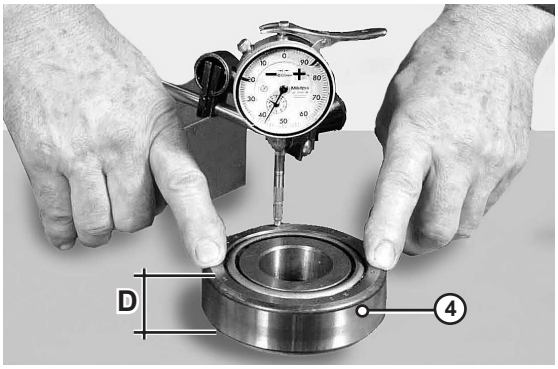
ASSEMBLY BEVEL PINION: VERSION NORMAL FLANGE AND NUT REVOLUTION COUNTER VERSION





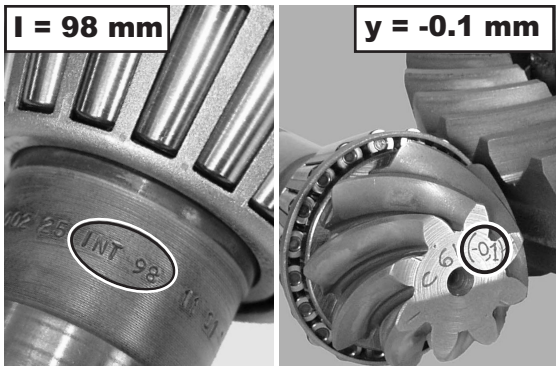
GB a

CALCULATING PINION CENTRE DISTANCE
Using a faceplate, reset a centesimal comparator “DG” on a calibrated block (whose known thickness is 30 mm.).
Preload the comparator by about 3 mm.



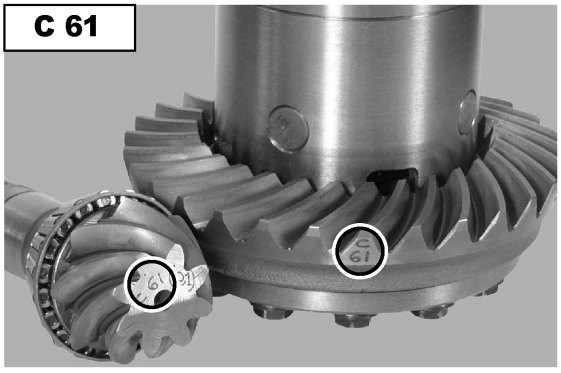
GB b

Bring inner bearing (4), complete with thrust block, under comparator “DG”.
ATTENTION: Press the thrust block centrally and carry out several measurements by rotating the thrust block.
EXAMPLE: 30 - 0,55 = 29,45 = “D”.



GB c

Check nominal dimension “I” as marked on the pinion. Add up to or subtract from “I” the variation indicated as “Y ” to obtain the actual centre distance “I”.
EXAMPLE:I =INT ± Y ==98-0,1=97,9mm
NOTE: C61 =Match part number



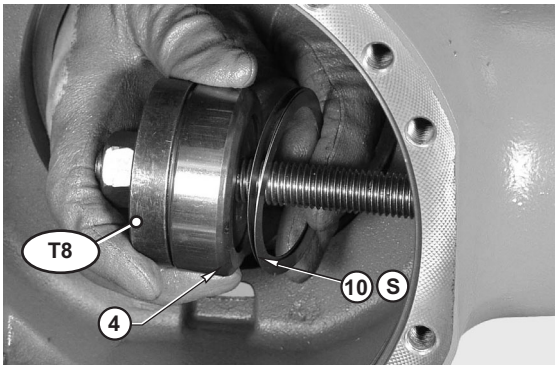
GB d

C61 =bevel gear set matching number
(-0,1)=Y variation from the theorical I =98



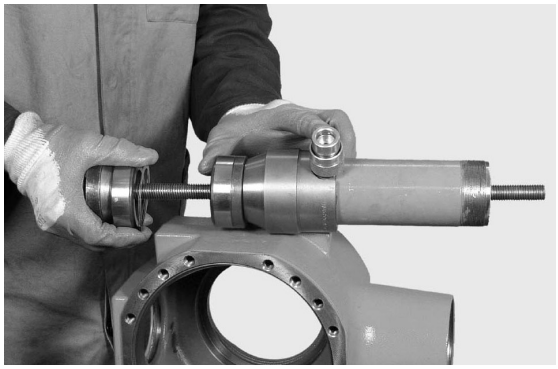
GB e

Calculate shims “S” for insertion under the thrust block of the inner bearing using the following formula:
S = X - (I + D) where: X = fixed dimension
I = actual pinion centre distance
D = Total bearing thickness;
EXAMPLE: S = 128 - (97,9+29,45) = 0,65 mm.

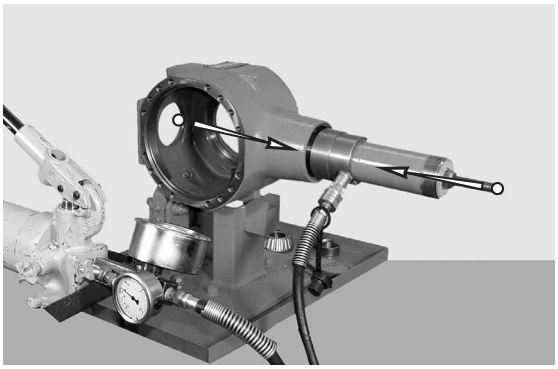


GB a

Using special tool T8.
Partially insert the thrust block of the bearings (4)and shims (10).

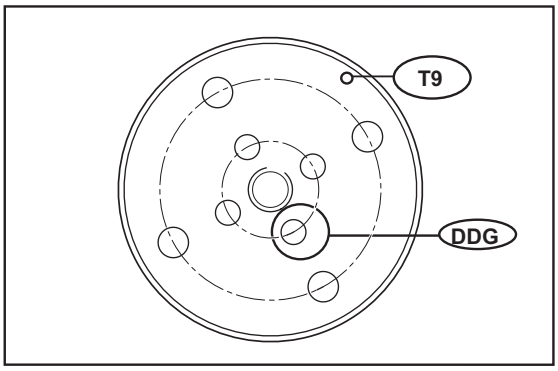


GB b

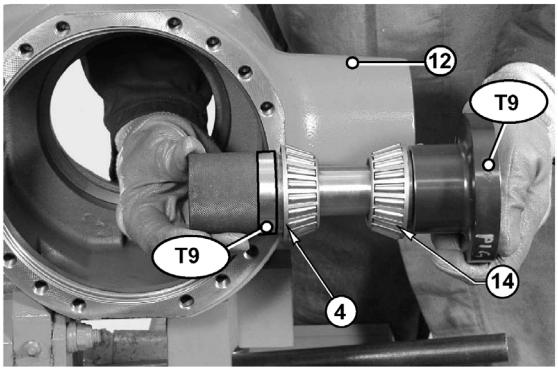


GB c

Connect the tension rod to the press and move the thrust block of bearings (4) (14) into the seats.
Disconnect the press and remove the tension rod.
NOTE. Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.

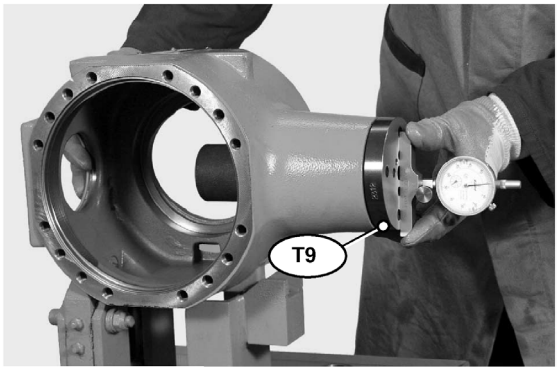


GB e



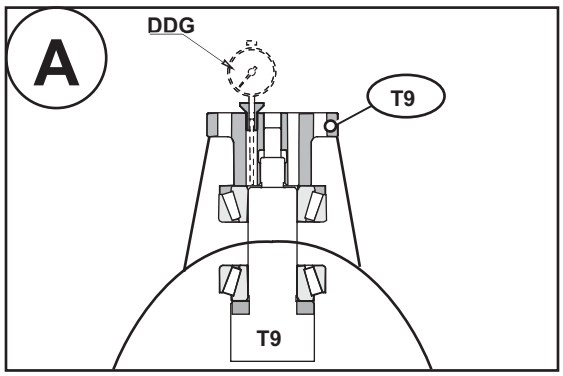
GB d

CALCULATING PINION BEARINGS ROLLING TORQUE
Introduce tool T9 complete with bearings (4) and (14) into the main body (12); tighten by hand until a rolling torque is definitely obtained.

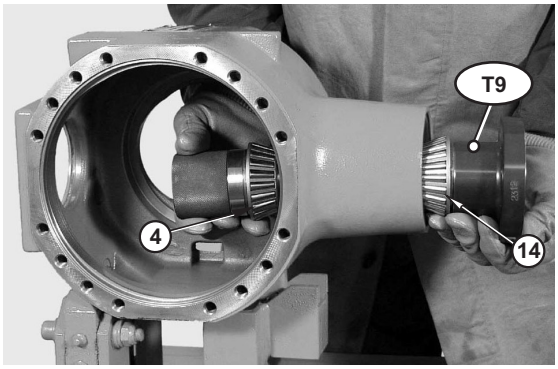


GB f

Introduce the tracer of a depth comparator “DDG” into either sidehole of tool T9.
Reset the comparator with a preload of about 3 mm.



GB a



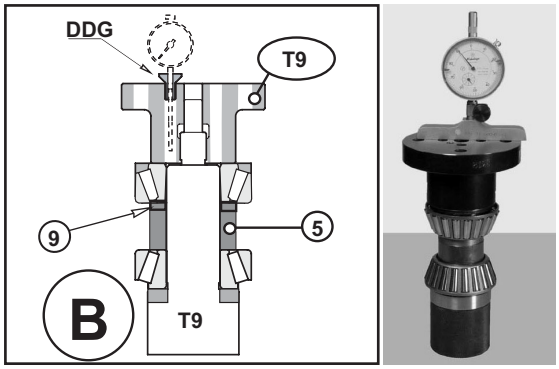
GB b

Remove the comparator and take out tool and bearing kits from the main body.
Reinstall every part, also introducing a distance piece between bearings (4) and (14). Tighten the entire pack by hand.



GB c

Assemble on top of the tool T9 and between the two bearings the shim (5) and the largest calibrated shim (9).



GB d

Measur the difference H using a dial gauge DDG
E.g. H = A - B = 2.93 mm



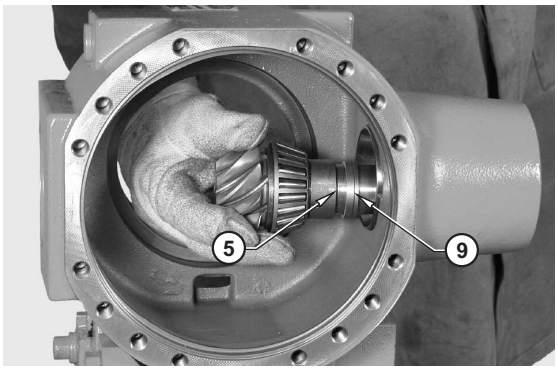
GB e

Calculate the shim S2 to be inserted.
E.g. S2 = H + X = 3.01 mm where X = fixed value to obtain = 0.07...0.08 mm



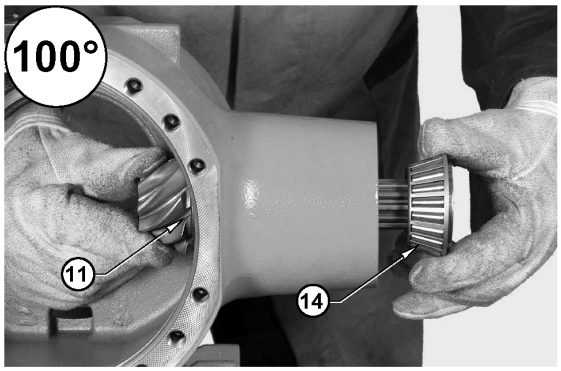
GB f

Measur the difference H using a dial gauge DDG
E.g. H = A - B = 2.93 mm



GB a

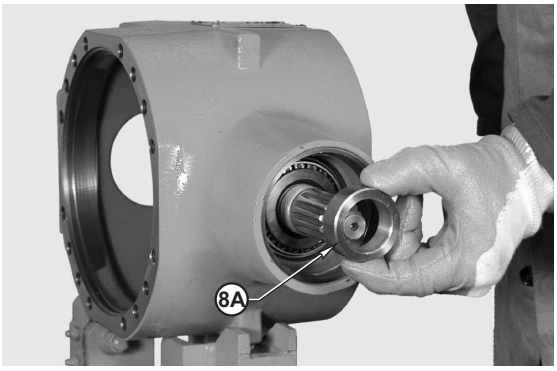
Fit the pinion (11), shim “S1” (10) and distance piece (5)(9) in the main body (12).
NOTE. The finer shims must be placed in- between the thicker ones.



GB b

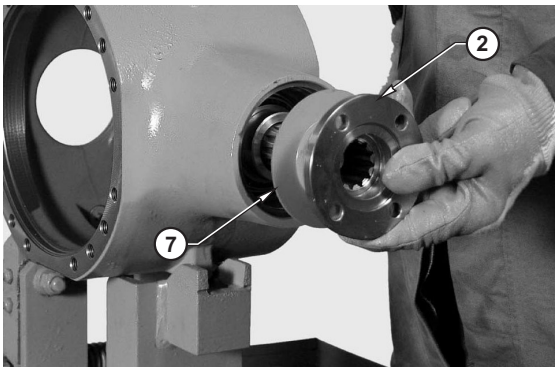
Heat the external bearing (14) to a temperature of about 100 C° and fit it on to the pinion (11) so as to complete the pack as shown in the figure.
NOTE. Lightly lubricate bearing with SAE85W90 oil.

NORMAL FLANGE VERSION



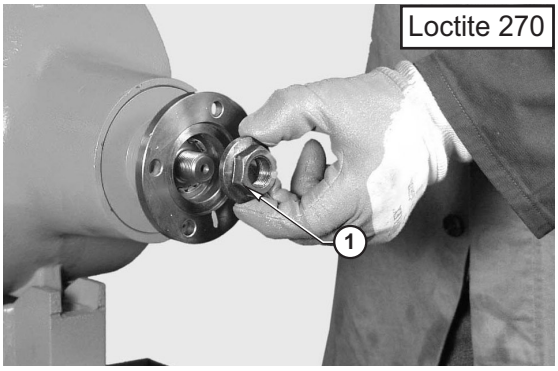
GB a

Insert the spacer (8A)
NOTE: Check the using of the friction washers.



GB b

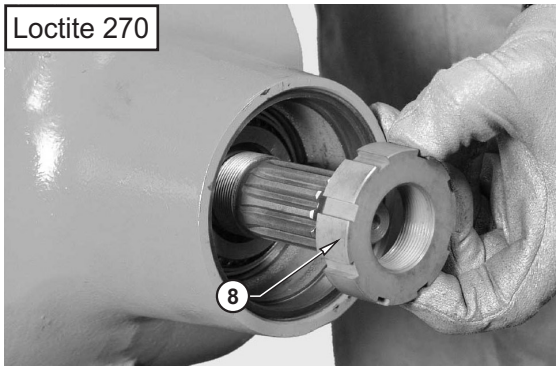
Install the flange (2) onto the pinion (11) without sealing ring.



GB c

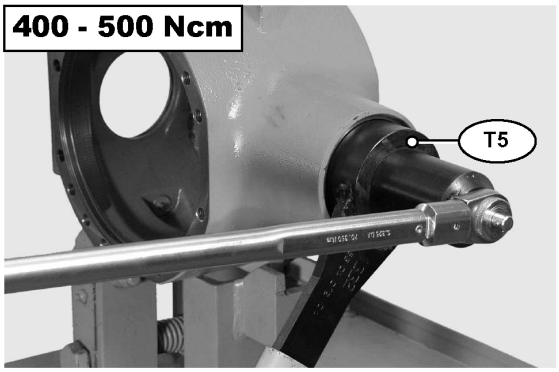
Install the nut (1) without LOCTITE 270.

REVOLUTION COUNTER VERSION



GB a

Apply Loctite 270 to the thread of the ring nut (8) and screw the nut onto the pinion.

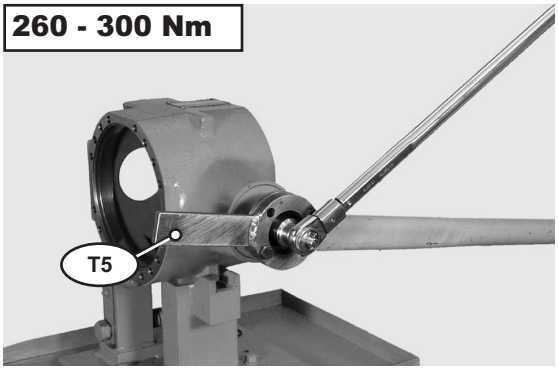


GB b

Apply onto the pinion (11) the bar-hol d and with the help of a torque metre, check the torque of the pinion (11).
Torque: 400 - 500 Ncm
CAUTION! If torque exceeds the maximum value, then the size of shim “S1 ” (4)between the bearing (9)and the distance piece (3) needs to be increased.
If torque does not reach the set value, increase the torque setting of the ring nut (10)in different stages to obtain a maximum value of 500 Nm.
CAUTION! If torque does not reach the minimum value, then the size of shim “S1 ” ((4)needs to be reduced.
CAUTION! When calculating the increase or decrease in size of shim “S1 ”, bear in mind that a variation of shim of 0.01 mm corresponds to a variation of 60 Ncm in the torque of the pinion (11).

NORMAL FLANGE VERSION

260 - 300 Nm

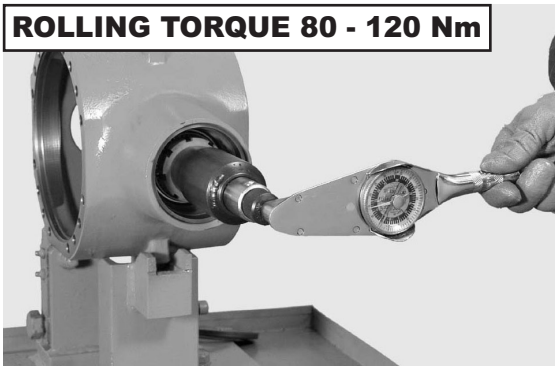


GB a

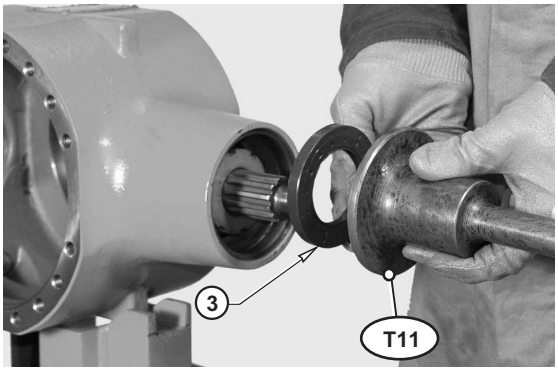
Lock the wrench T5, rotate the p ini on using a dynametric wrench, up to a minimum required torque setting of 260 - 300 Nm.

REVOLUTION COUNTER VERSION

ROLLING TORQUE 80 - 120 Nm



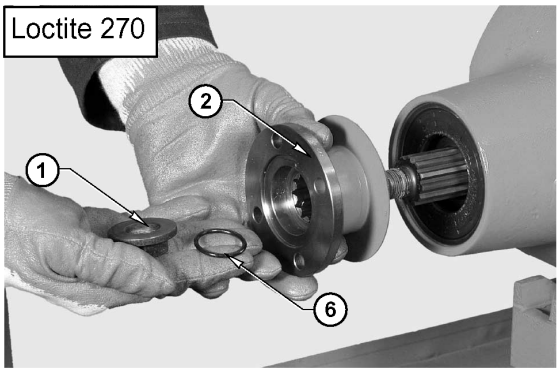
GB a



GB b

Apply Arexons rubber cement to the outer surface of the new seal ring (3) and fit ring in the main body (12) using driver T11.

Loctite 270



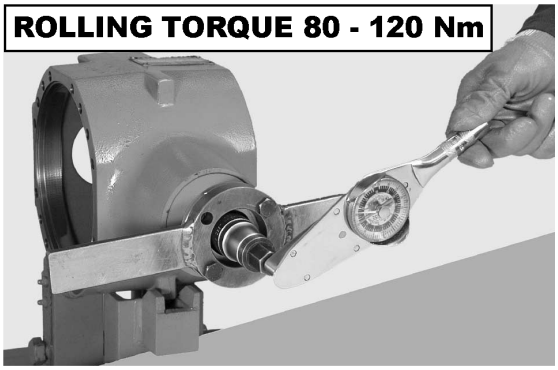
GB c

Oil seal ring lips and install flange (2).
Mount O-ring (6) and apply Loctite 270 to pinion tang; tighten nut (1).

NORMAL FLANGE VERSION

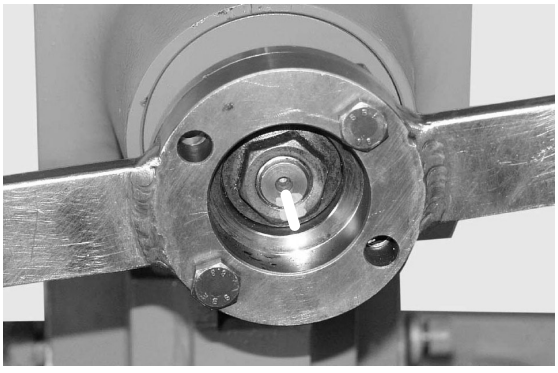
REVOLUTION COUNTER VERSION

ROLLING TORQUE 80 - 120 Nm



GB d

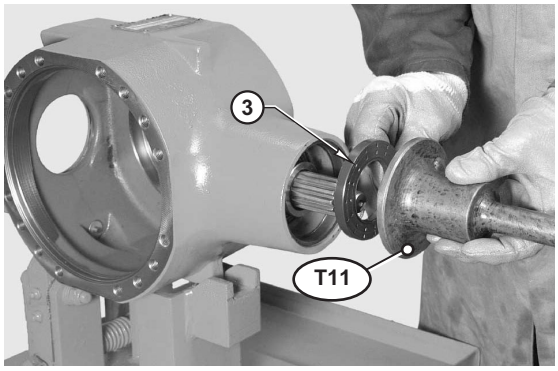
Apply onto the pinion (11) the bar-hol d and with the help of a torque metre, check the torque of the pinion (11).
Torque: 80-120 Ncm
CAUTION! If torque exceeds the maximum value, then the size of shim “S1 ” (4) between the bearing (9)and the distance piece (3) needs to be increased.
If torque does not reach the set value, increase the torque setting of the ring nut (10)in different stages to obtain a maximum value of 500 Nm.
CAUTION! If torque does not reach the minimum value, then the size of shim “S1” (4) needs to be reduced.
CAUTION! When calculating the increase or decrease in size of shim “S1”, bear in mind that a variation of shim of 0.01 mm corresponds to a variation of 60 Ncm in the torque of the pinion (1).



GB e

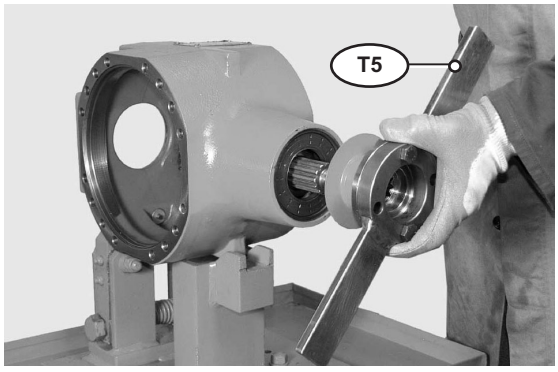
Make positional marks across nut (1) and pinion (11) tang; then remove nut and flange (2).

NORMAL FLANGE VERSION



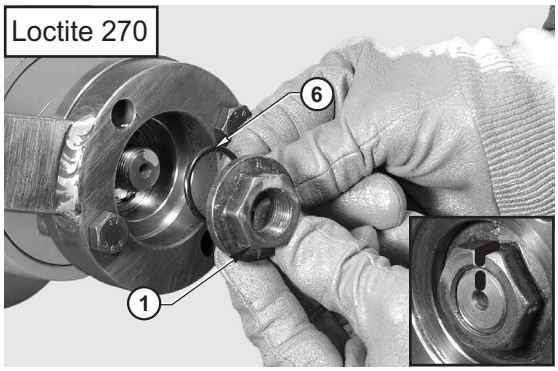
GB a

Apply Arexons rubber cement to the outer surface of the new seal ring (3) and fit ring in the main body (12) using driver T11.



GB b

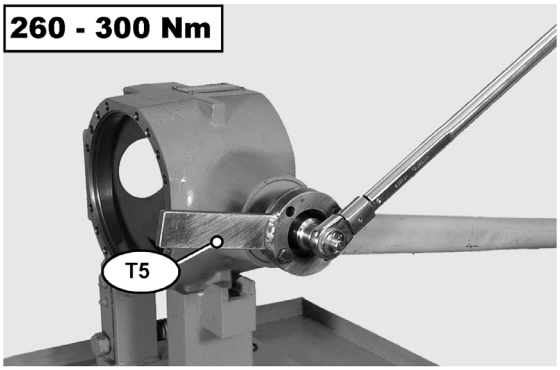
Oil seal ring lips and install flange (2).
Mount O-ring (6) and apply Loctite 270 to pinion tang; tighten nut (1).



GB c

Tighten the nut until the match marks made at stage “a” line up.

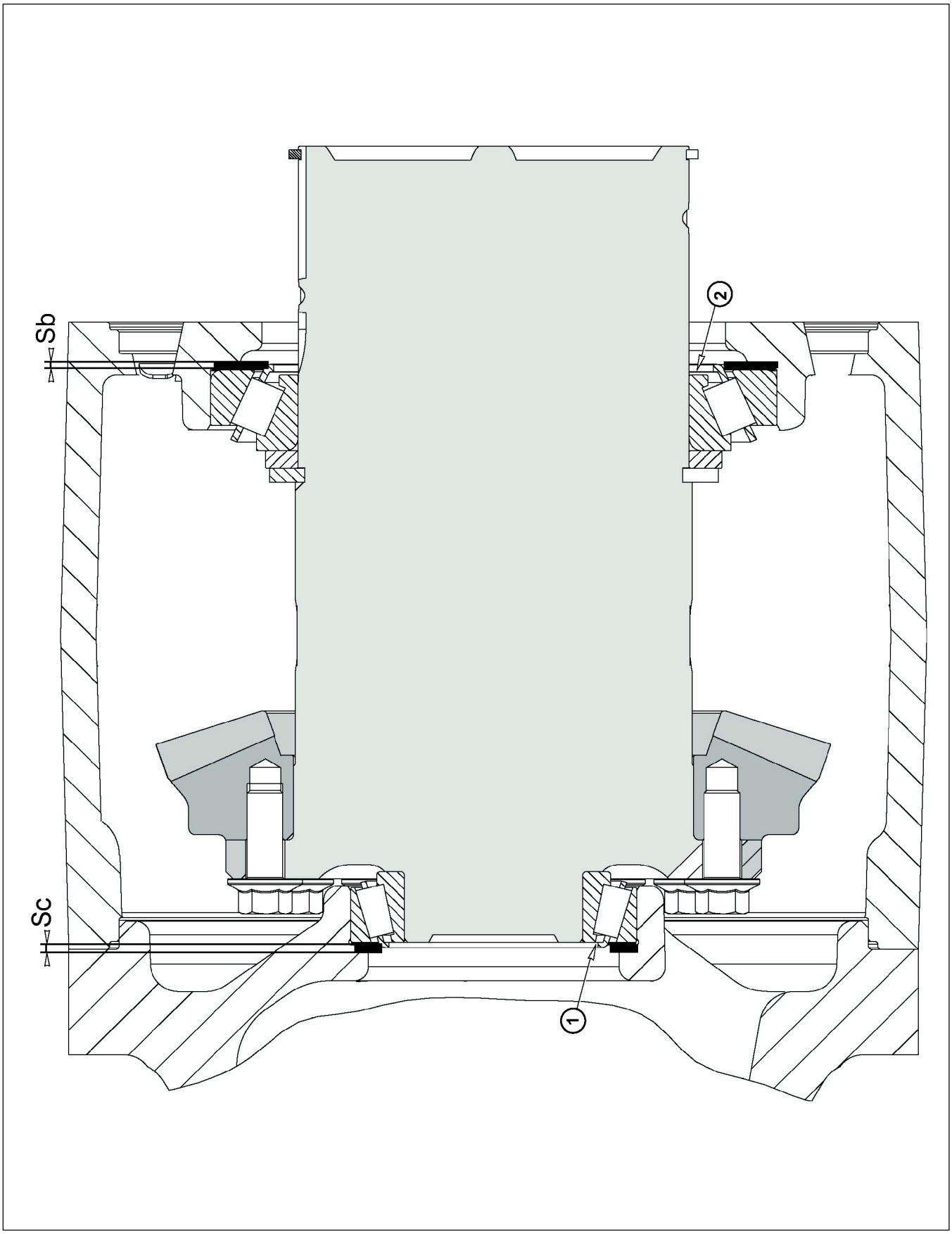
REVOLUTION COUNTER VERSION

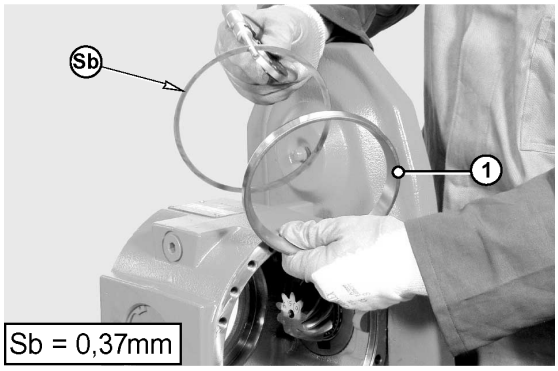


GB a

Lock the wrench T5, rotate the pinion using a dynamometric wrench,up to a minimum required torque setting of 260-300 Nm.

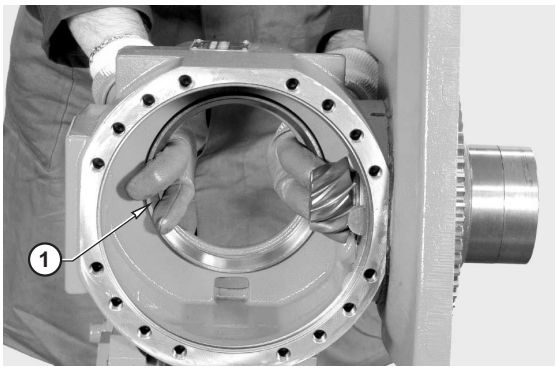
RING AND PINION ADJUSTING: STEP FOR PRELOADED DIFFERENTIAL





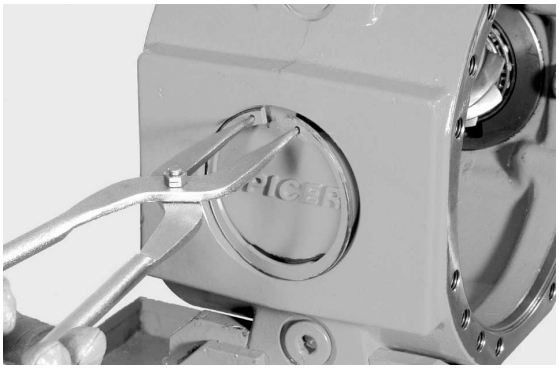
GB a

Choose a pack of shims Sb with an initial value of about 0.37 mm to place under the brake side bearing's cup.



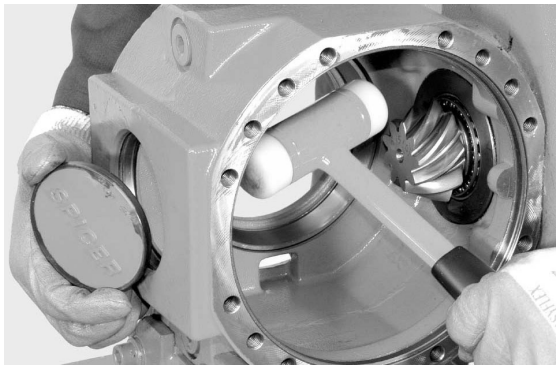
GB b

Assemble the shims Sb, the cup (1) and level.



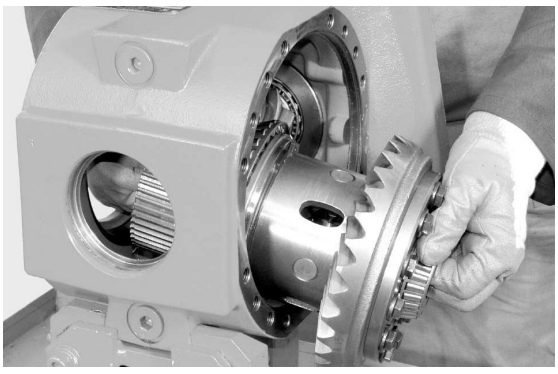
GB c

Remove the snap ring.



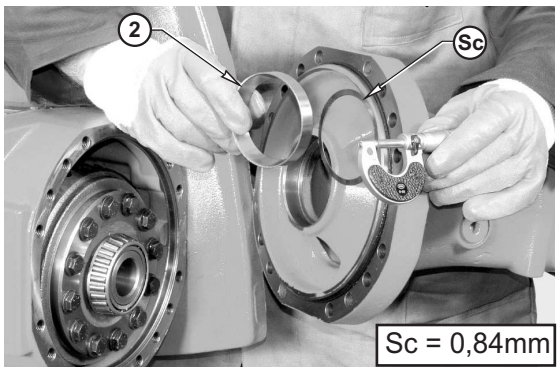
GB d

Remove cap.
ATTENTION: Do not bend the cap



GB e

Insert the complete differential
NOTE: Attention do not damage the sealing surface of the O-ring.



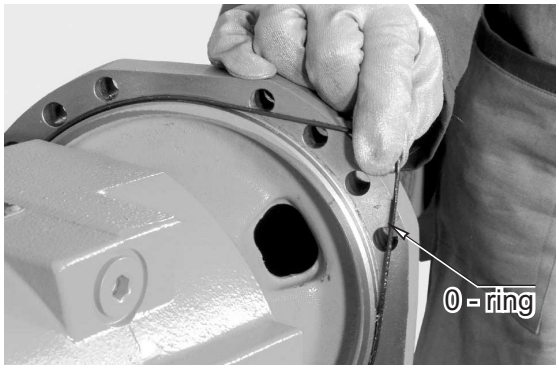
GB f

Choose a pack of shims Sc with an initial value of about 0.84 mm to place under the crown wheel side bearing's cup.



GB a

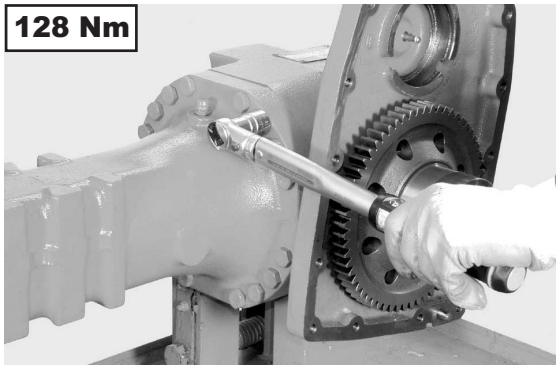
Assemble the shims Sc, the (1) cup and level.



GB b

Exchange always the O-ring of the arm.

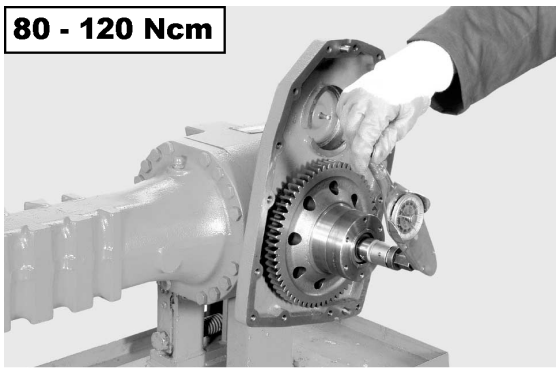
128 Nm



GB c

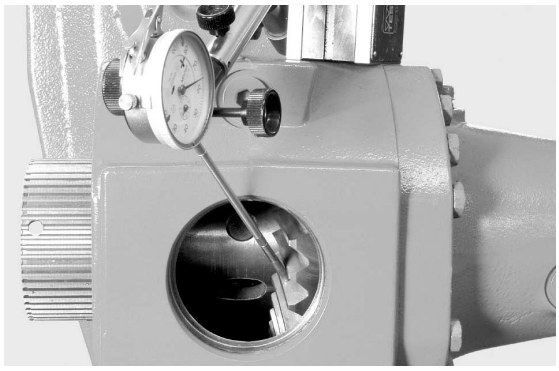
Assemble the arm and tighten provisionally with a torque wrench setting of 128Nm at least 6 screws equally distributed.

80 - 120 Ncm



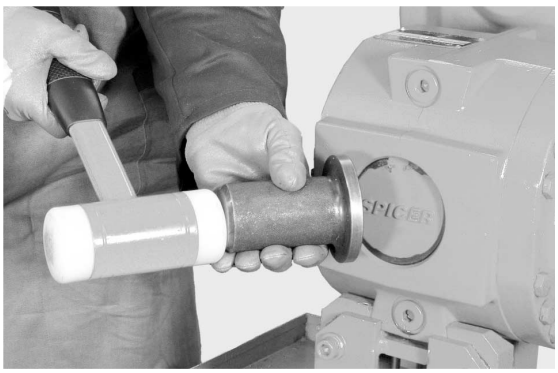
GB d

Apply torque meter TM to pinion nut and check that torque will increase by 40-60 Ncm as a result of differential bearing preload.
Example: pinion torque: 80-120 Ncm
Pinion + differential torque: 120-180 Ncm.



GB e

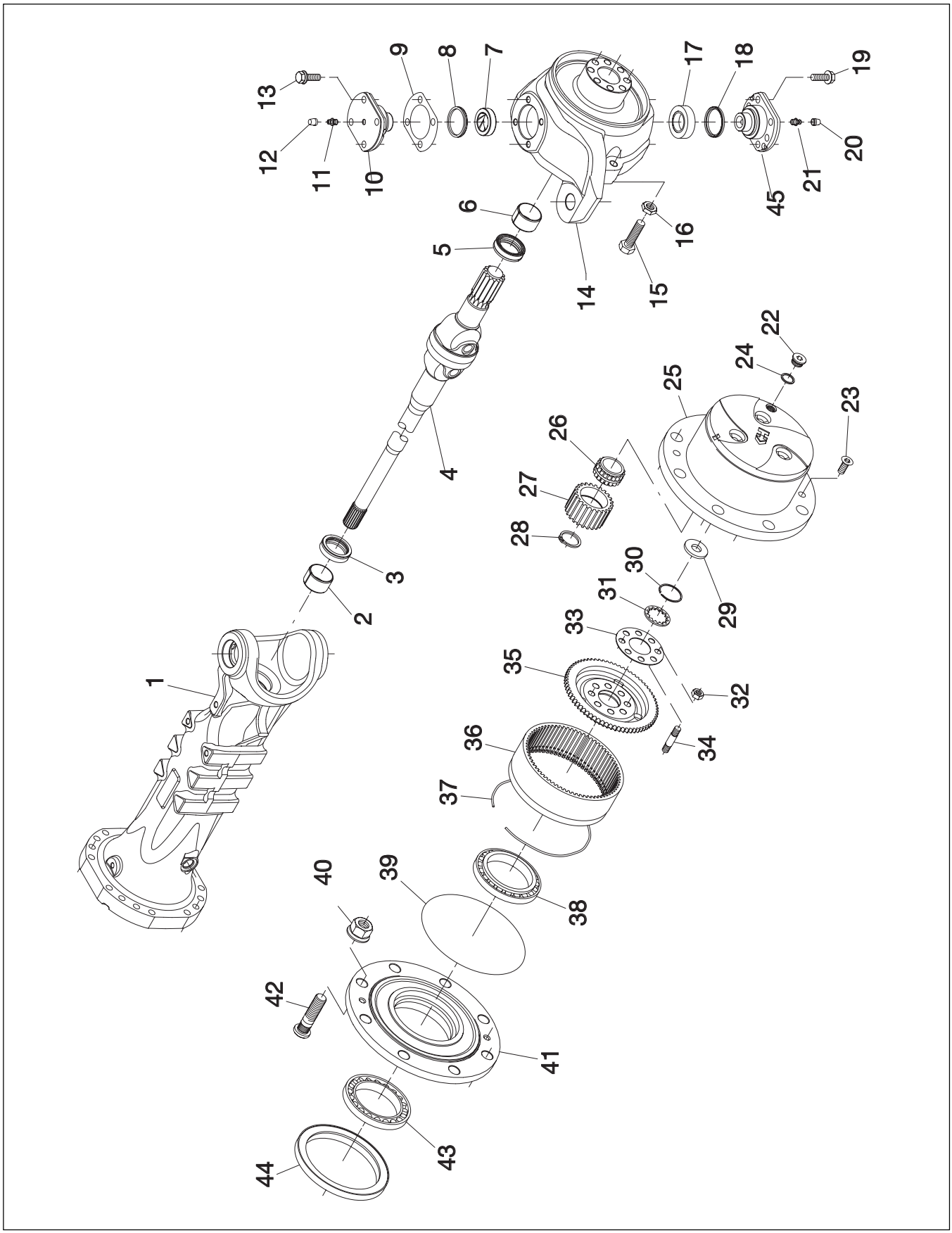
Position comparator on the centre of one of the crown teeth, preset it to 1 mm and reset it to zero. Manually move the crown in both directions to check the existing clearance between pinion and crown. Gap= 0,13-0,20 mm. In order to increase the gap while keeping the load on the bearing unchanged, take off shims from the crown wheel side and insert them on the opposit side. In order to decrease the gap, act the other way round. Introduce a comparator with rotary key through the rear cap hole.

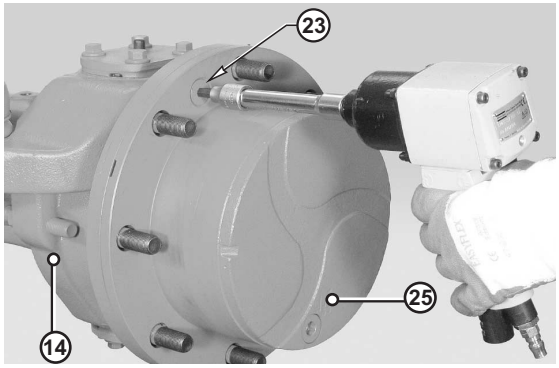


GB f

Assemble rubber cap and snap ring.

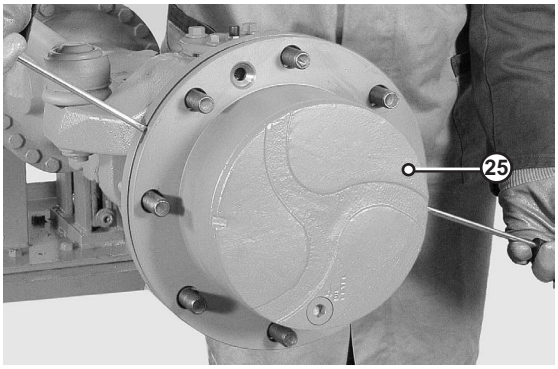
DISASSEMBLY THE PLANETARY REDUTION AND THE COMPLETE STEERING CASE





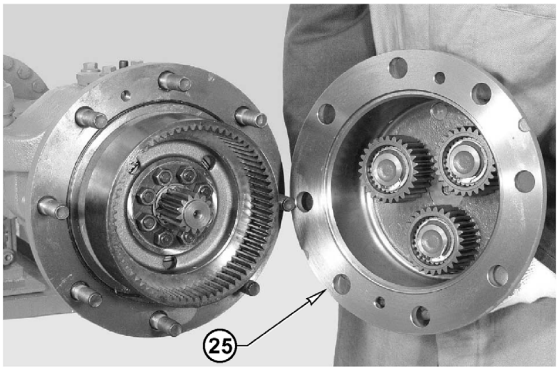
GB a

Remove the securing screws (23) from the planetary carrier cover (25).
Disconnect the steering bars from the steering case (14).



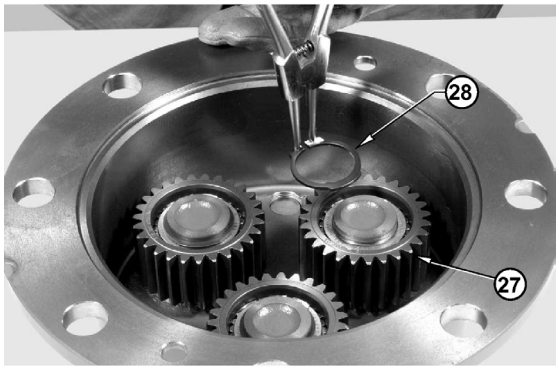
GB b

Disjoint the planetary carrier cover (25) from the steering case by alternatively forcing a screwdriver into the appropriate slots.



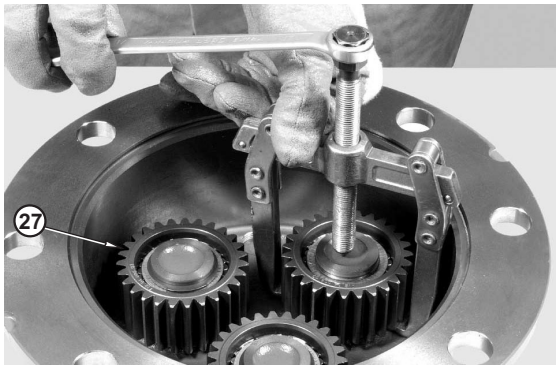
GB c

Remove the complete planetary carrier cover (25).



GB d

Remove the safety spring rings (28) of the planetary gears (27).



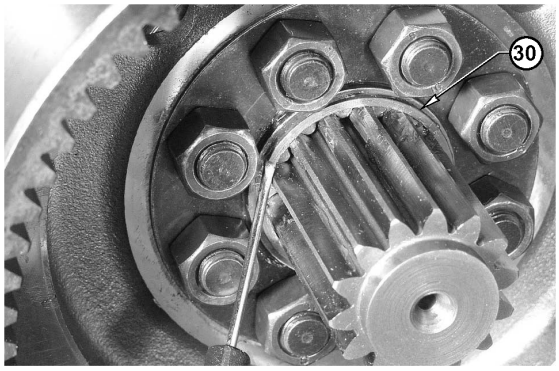
GB e

Remove the planetary gears (27).



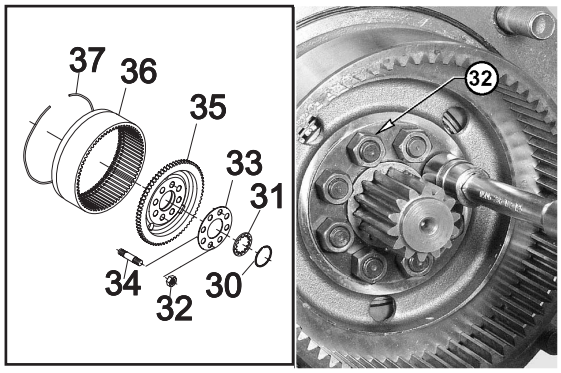
GB f

NOTE. Note down direction of assembly of planetary gears.



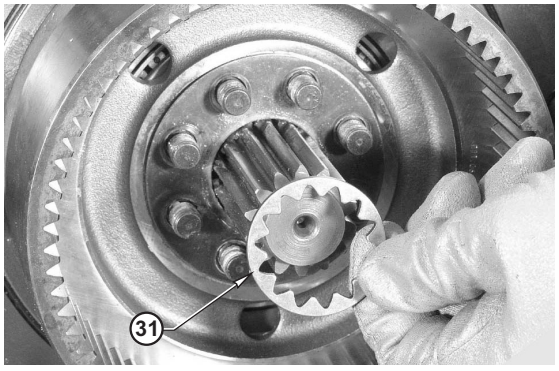
GB a

Remove the snap ring (30).



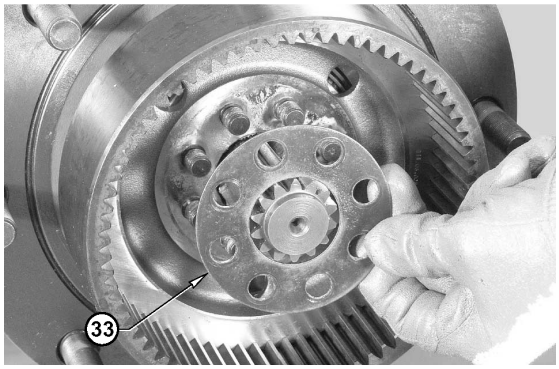
GB b

Unloose and remove the tightening nuts (32) from the crown flange (35).



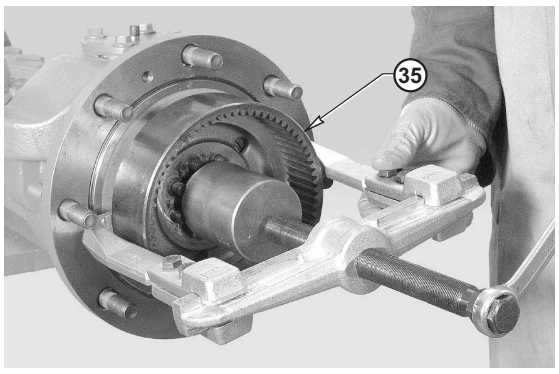
GB c

Remove the shim washer (31).



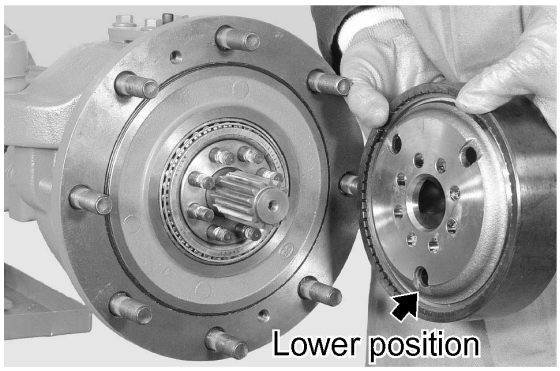
GB d

Remove the safety flange (33).

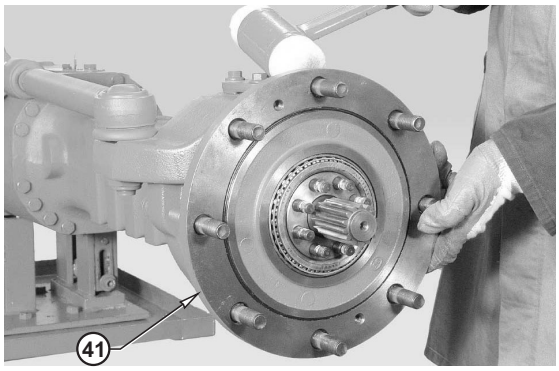


GB e

Using a puller, remove the complete crown flange (35) by acting on the stud bolts.

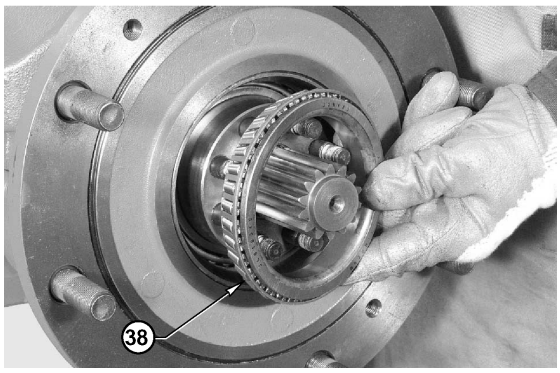


GB f



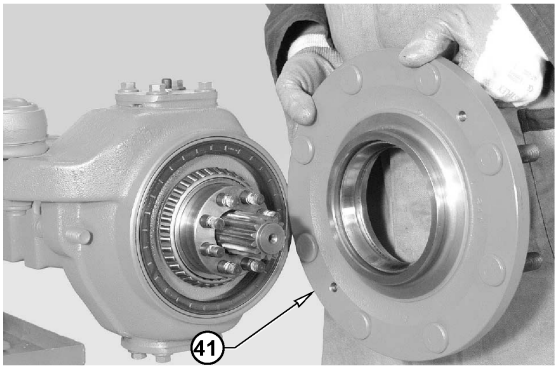
GB a

Partially extract the hub (41) using a plastic hammer.
NOTE. Alternately hammer on several equidistant points.



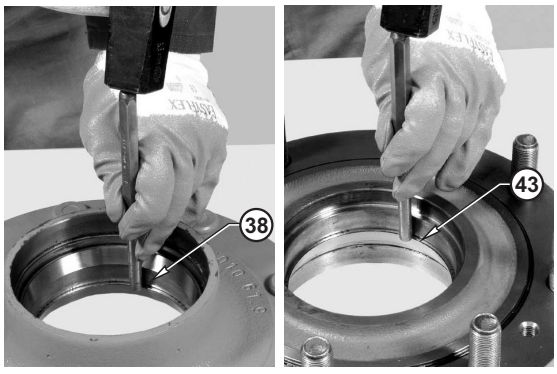
GB b

Remove the external bearing (38).



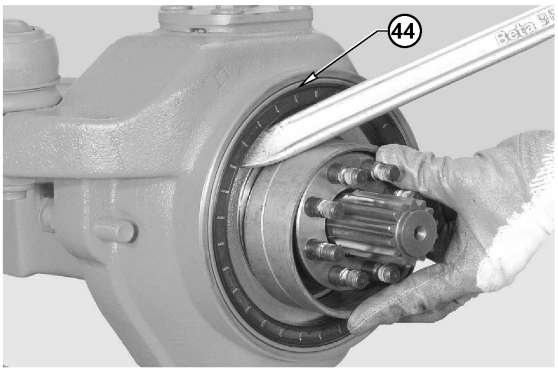
GB c

By hand remove the complete hub (41).



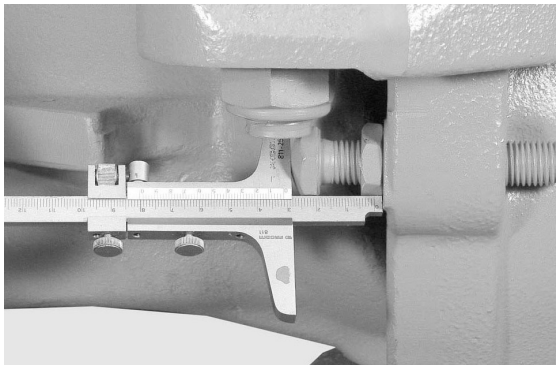
GB d

Remove the external thrust blocks of bearings, using a pindriver.
NOTE. Hammer in an alternate sequence to prevent crawling and deformation of the thrust blocks.



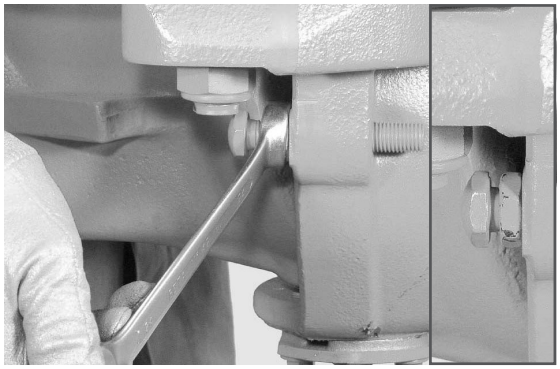
GB e

Remove the sealing ring from the steering case (44).
Pay due attention not to damage the seat of bearing.



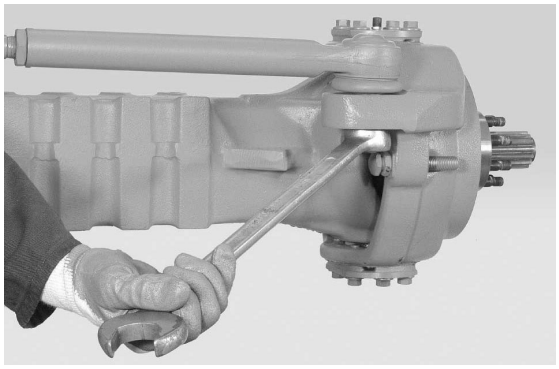
GB a

Note the measure of the screw of lock steering case.



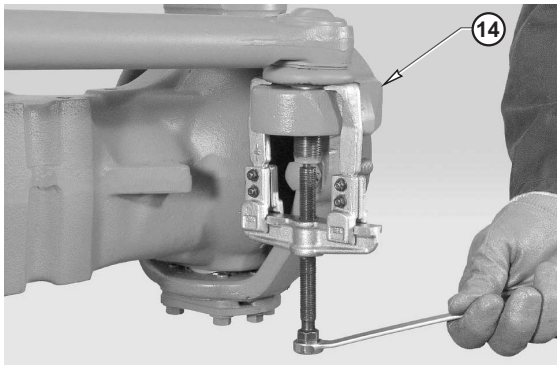
GB b

Loose the lockscrew and insert it to allow the passage of tool.



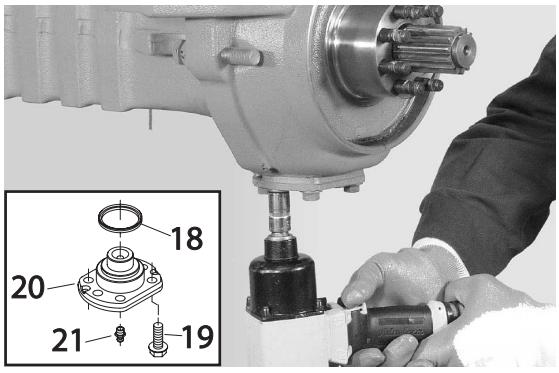
GB c

Remove the nuts that lock the articulation pins.



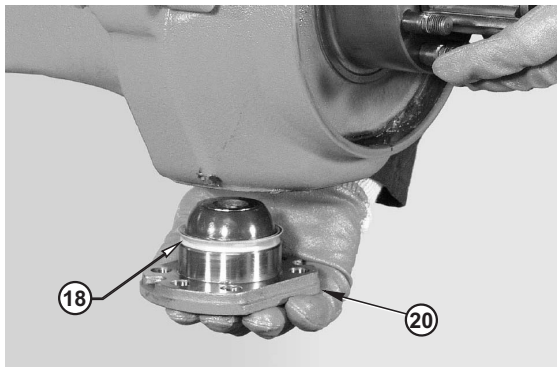
GB d

Disconnect the tapered pins of the articulation from the steering case (14) by means of a puller.



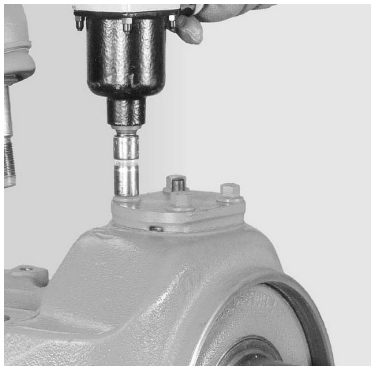
GB e

Unloose and remove the fittin screws (19) from the bottom articulation pin (20).
NOTE. Screws cannot be re-used.



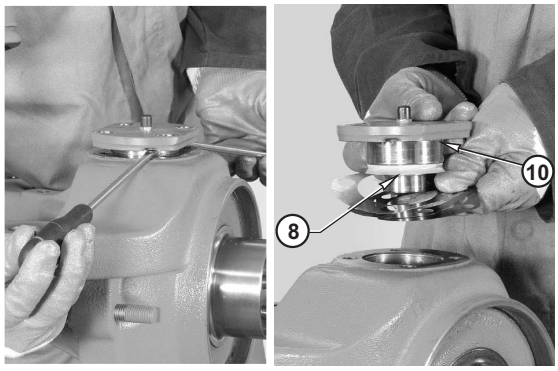
GB f

Remove the bottom articulation pin (18) complete with front sealing ring (20).



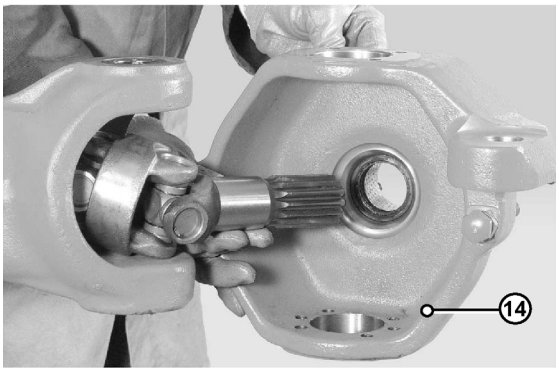
GB a

Unloose and remove the fittin screws (13) from the top articulation pin (10).



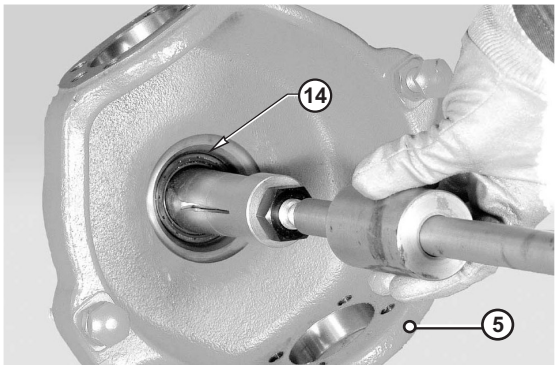
GB b

Using two levers, remove the top articulation pin (10) complete with front seal (8).
Pay attention not to damage the surfaces.



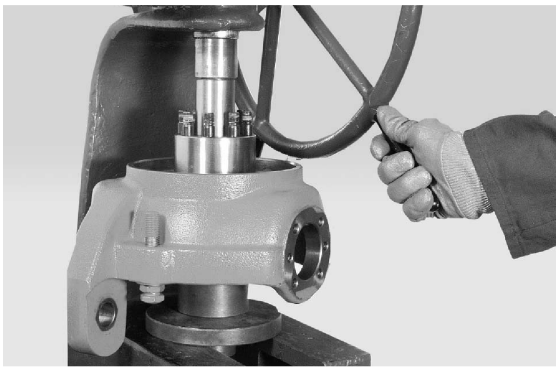
GB c

Remove the complete steering case (14).



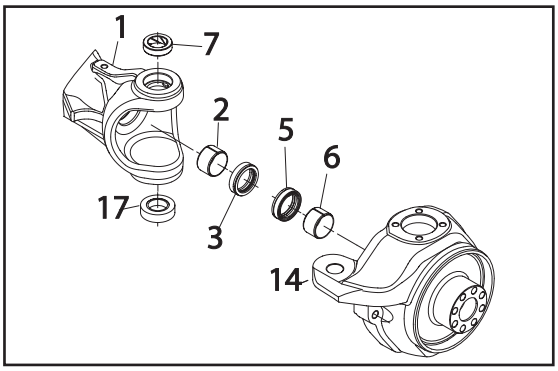
GB d

Use a puller to remove the sealing ring from the steering case (14).
NOTE. Note down the orientation of sealing ring (5).

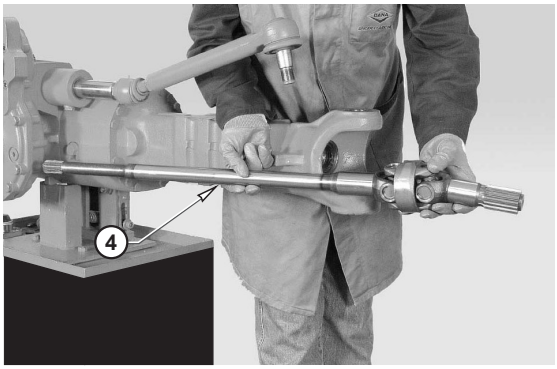


GB e

Remove the bushing (6) from the steering case (14).
NOTE. Note down the orientation of bushing.

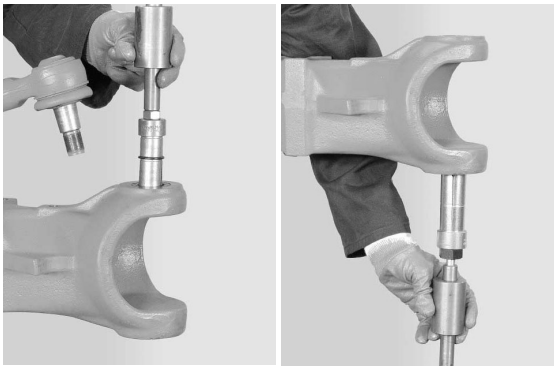


GB f



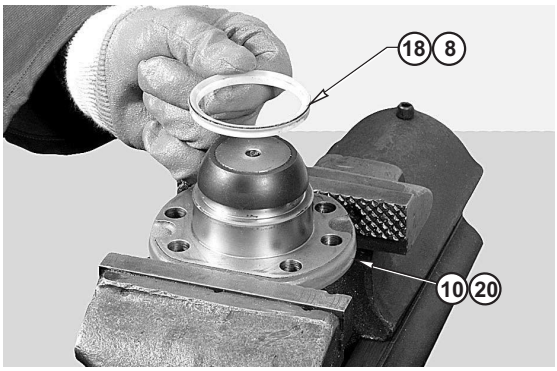
GB a

Remove the u-joint (4).
NOTE. To remove the u-joint use, if necessary, a plastic hammer or a lever.



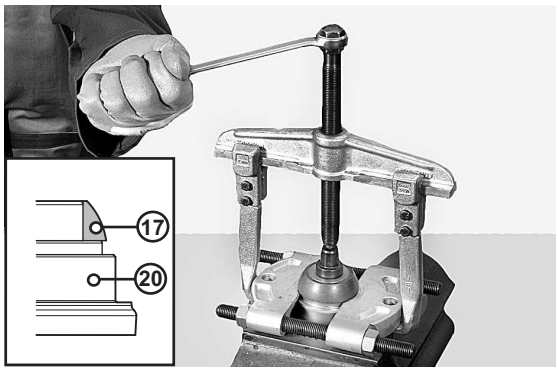
GB b

Using a puller for inner parts, remove the top bush (7) and the bottom ball-bush (17).



GB c

Remove the articulation pins (10)(20) and the front sealing rings (8)(18).
NOTE. Note down the side for assembly.



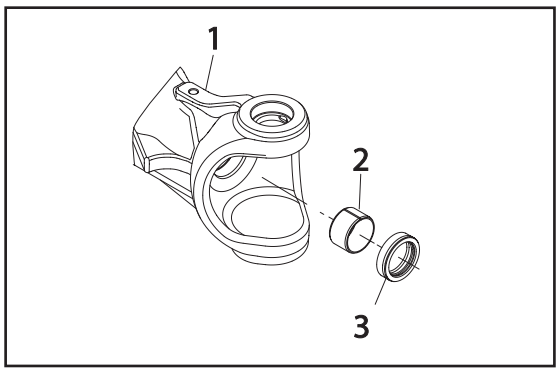
GB d

If the ball cover (17) needs replacing, remove it from the bottom articulation pin (20).



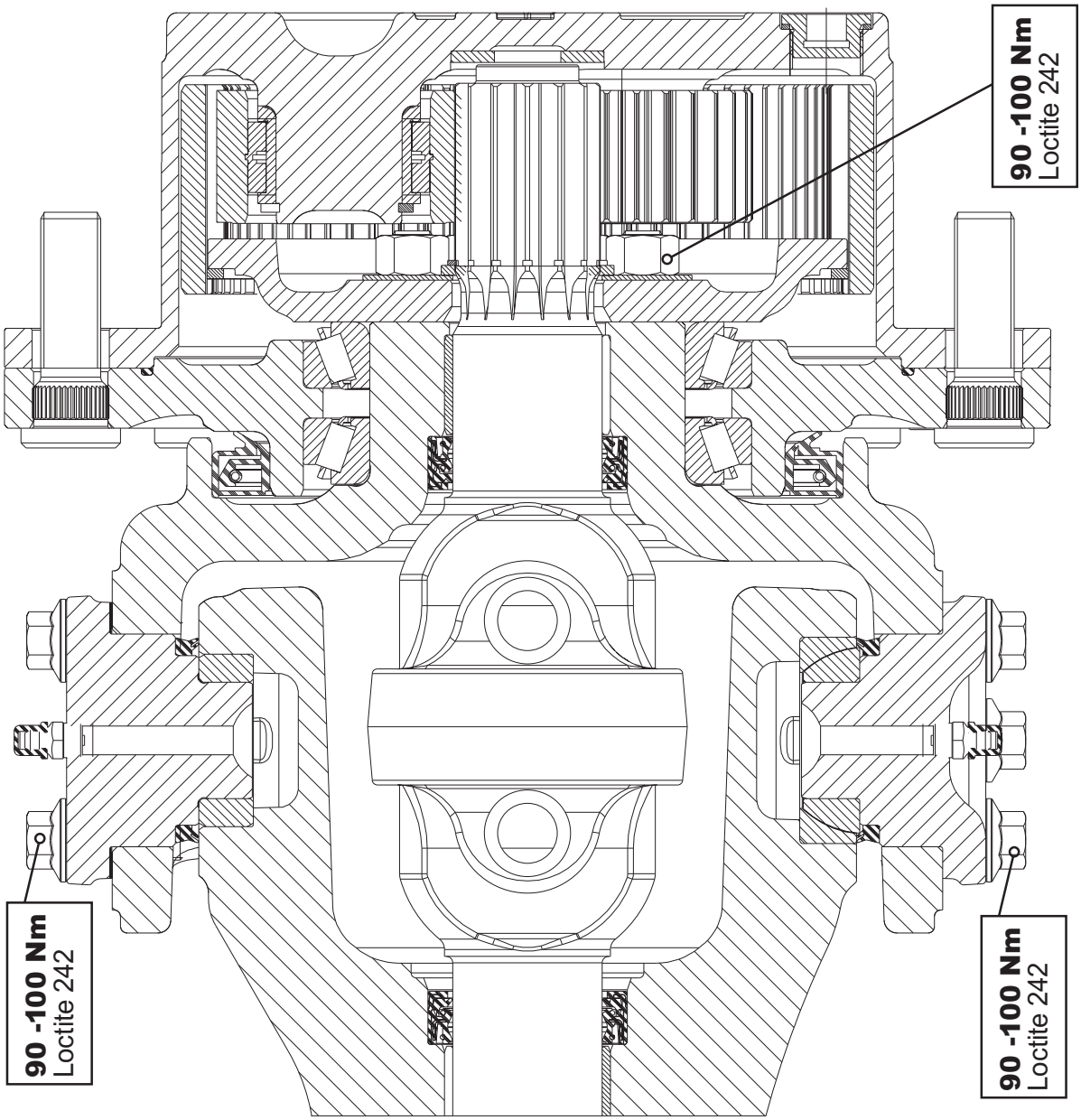
GB e

Remove seal ring (3) and the bushing (2) from the arm (1).

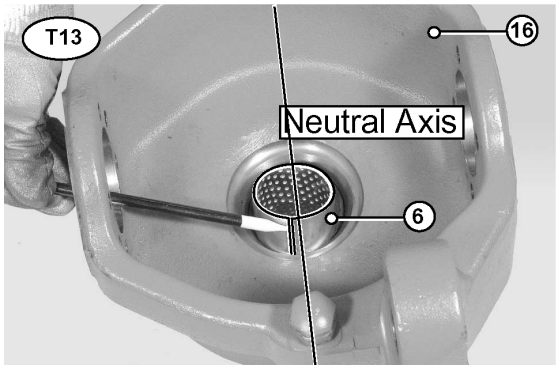


GB f

ASSEMBLY THE PLANETARY REDUTION AND THE COMPLETE STEERING CASE

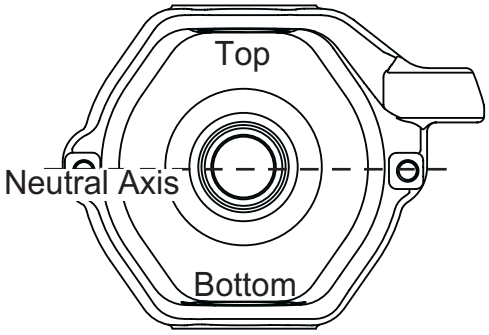


CONTINUOS ROLLING TORQUE without planetary gear cover **7 - 20 Nm**
PRELOAD STREARING CASE 40 - 80 Nm

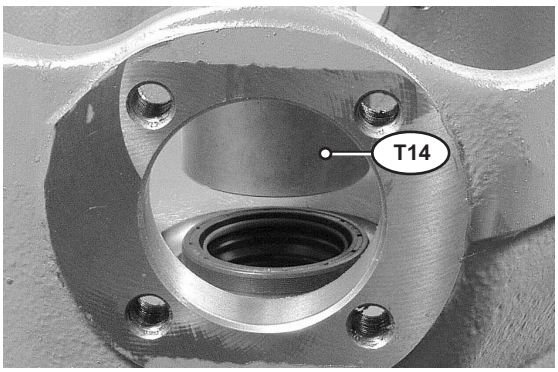


GB a

Lubricate the bushing (6) and the seat of the steering case (14).
Install the bushing (6), using tool T13.

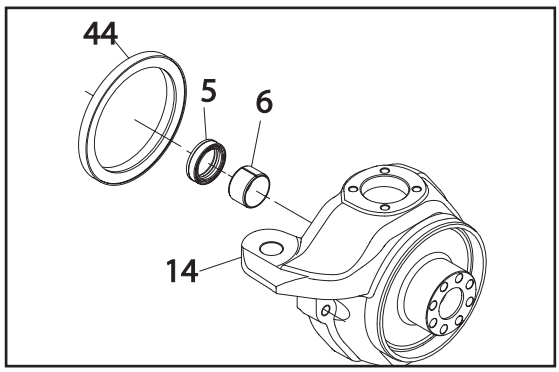


GB b

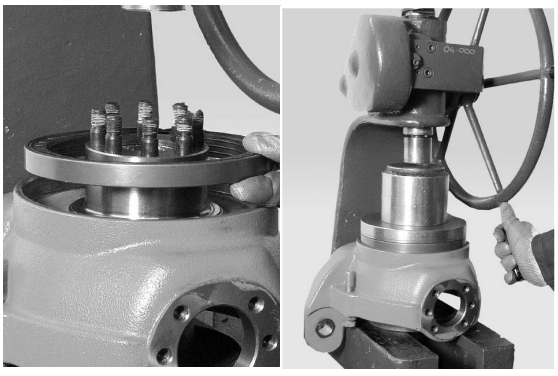


GB c

Lubricate the outer surface of the sealing ring (5); fit them into their seat using tool T14.

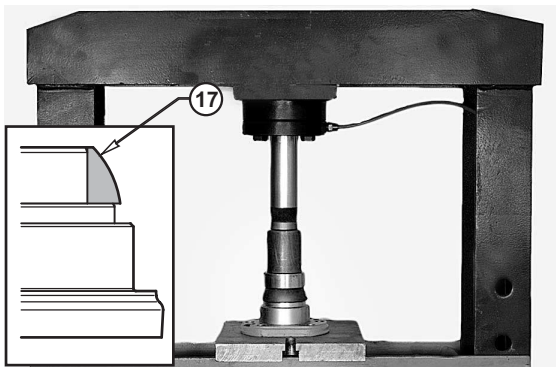


GB d



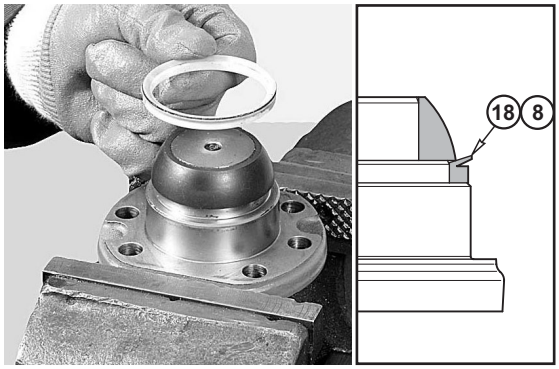
GB e

Using special tool T15 apply a repositionable jointing compound for seals to the outer surface of the sealing ring (44). Position the sealing ring (44) in the steering case (14).
NOTE. Check that the ring (44) is correctly oriented.



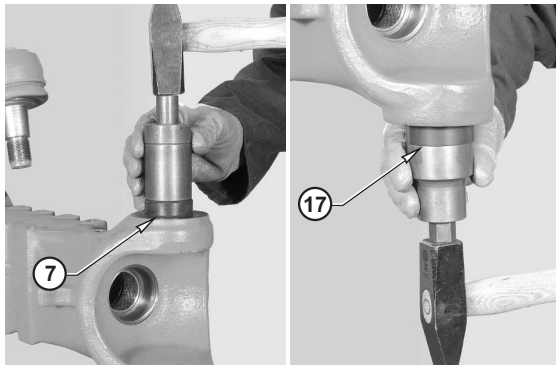
GB f

If the bottom articulation pin (17) has been extracted, position the pin under a press and fit the ball cover (20).



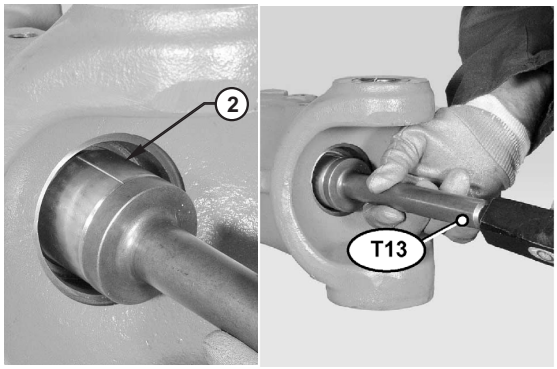
GB a

Fit the front sealing rings (18)(8)onto the articulation pins (4) and (6).
NOTE. Carefully check that the rings are properly oriented (18)(8).



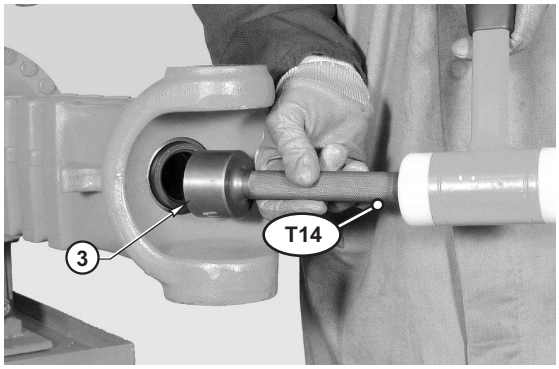
GB b

Lubricate the top bush (7) or the bottom ball bush (17) and fit them into the fulcrum holes of the arm.



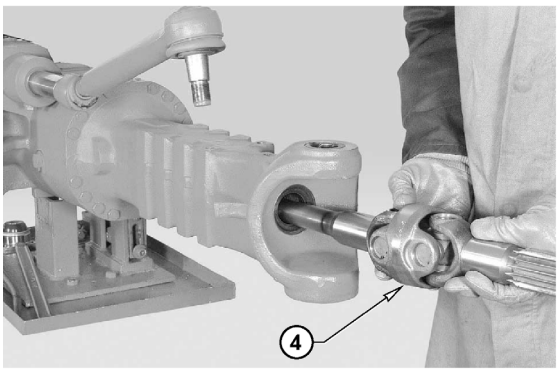
GB c

Lubricate the bushing (2) and the seat of the steering case (1). Install the bushing (2), using tool T13.



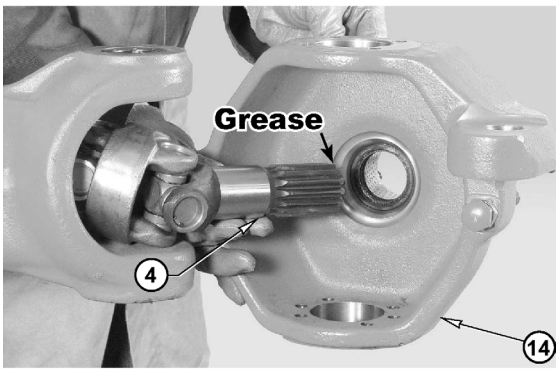
GB d

Lubricate and fit the sealing ring (3) onto tool T14; install the rings into the arm.
CAUTION! Pay particular attention to the direction of assembly of the rings.



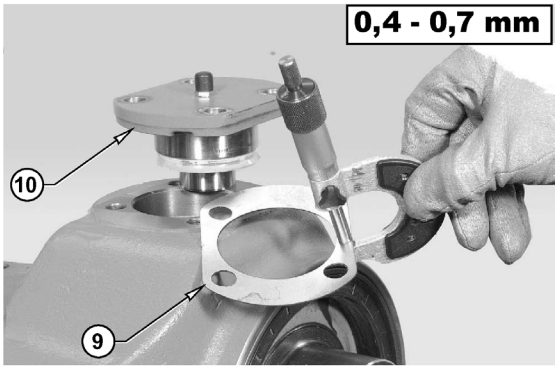
GB e

Insert the u-joint (4).



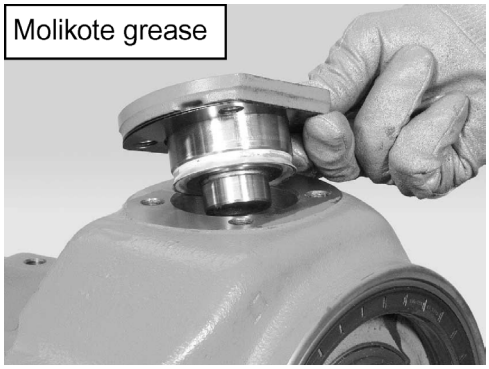
GB f

Lubricate the terminal of the u-joint (4) and install the steering case (14).
Pay due attention not to damage the dust cover rings and the sealing rings.



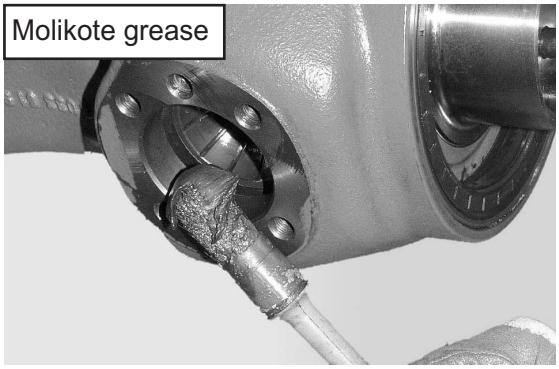
GB a

Prepare a series of shims (9) of 0,4 up to 0,7 mm.
To be assembled under the upper pin (10).



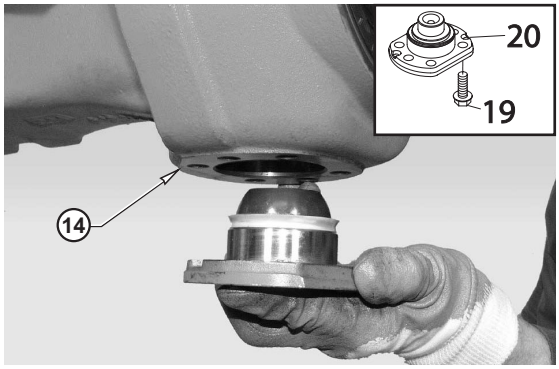
GB b

Lubricate and install the unit in the steering case.



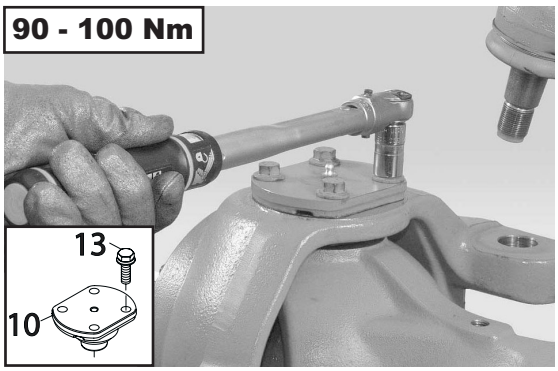
GB c

Lubricate the steering case.



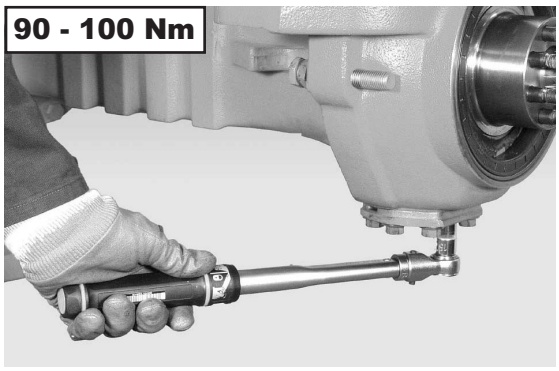
GB d

Fit the unit (20) in the steering case (14). Position the screws (19) and tightly tighten.



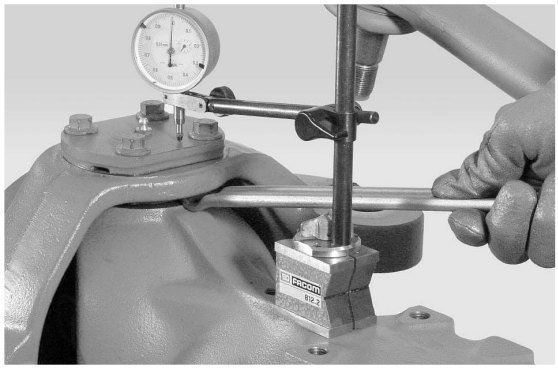
GB e

Tighten the new fittin screws (13) of top articulation pins in sequence using the cross tightening method.
Torque wrench setting: 90 - 100 Nm



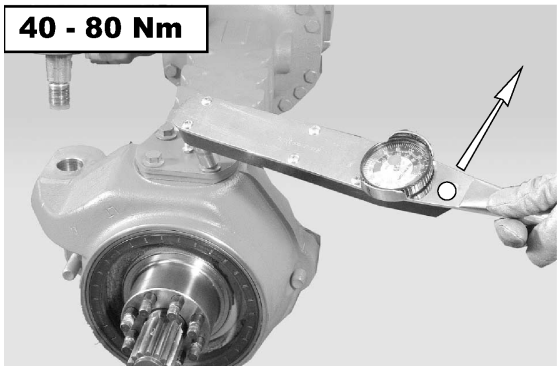
GB f

Tighten the new fittin screws (19) of bottom articulation pins in sequence using the cross tightening method.
Torque wrench setting: 90 - 100 Nm



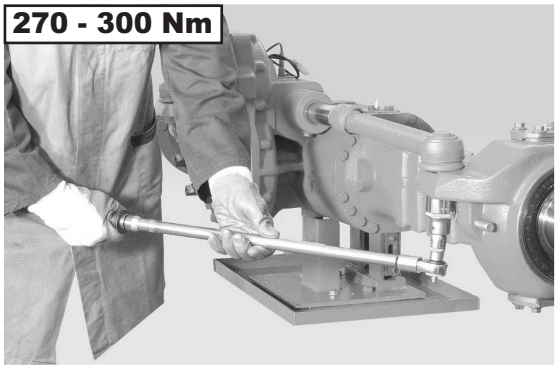
GB a

Check by means of a lever that there is no vertical gap.
In case there is any gap, determine the width and reduce it by removing shims.



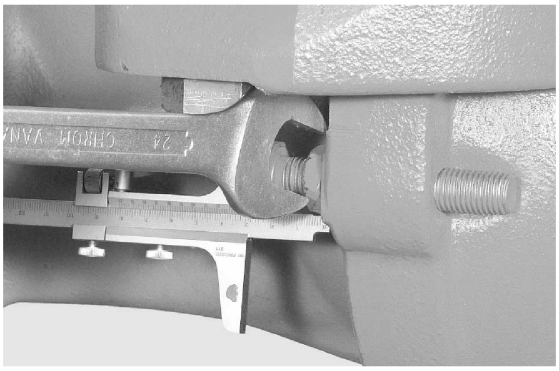
GB b

Check the torque of the pins, which has to be between 40 and 80 Nm. If the preliminary measured value is too high, the shims have to be increased.



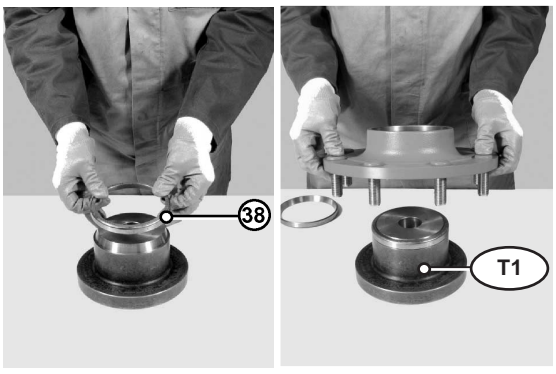
GB c

Look for the position of the notch regarding the safety cotter pin hole when the nut is finaly locked max 300 Nm.



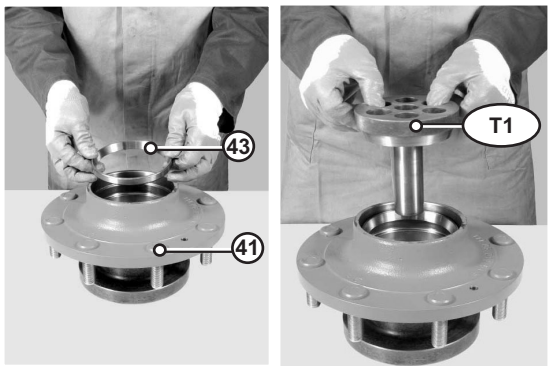
GB d

Bring the lockscrew to the quote at the measure previously survey.



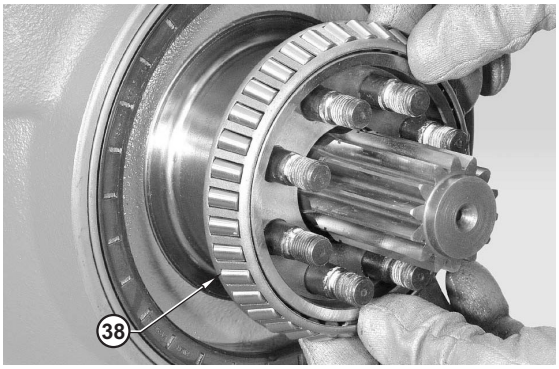
GB e

Position the lower part of tool T1 and the thrust block of the external bearing (38).



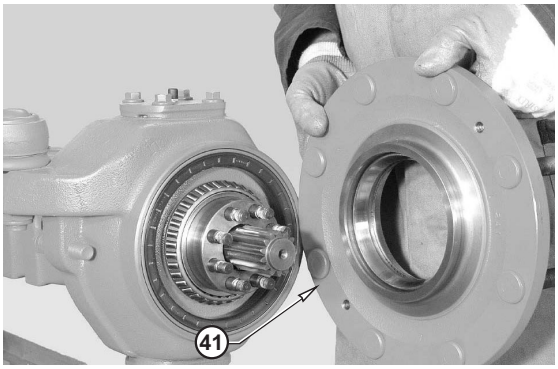
GB f

Lubricate the seats of the bearings and position the hub (41) on tool T1; position the thrust block of the internal bearing (43).
NOTE. Check that the thrust block is correctly oriented.



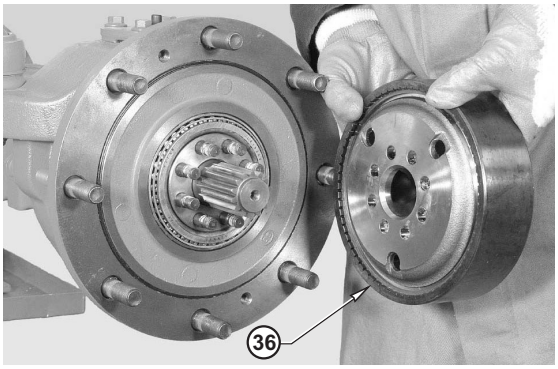
GB a

Install the external bearing (38).
NOTE. Move the bearing to the limit stop by hammering lightly all around the edge.



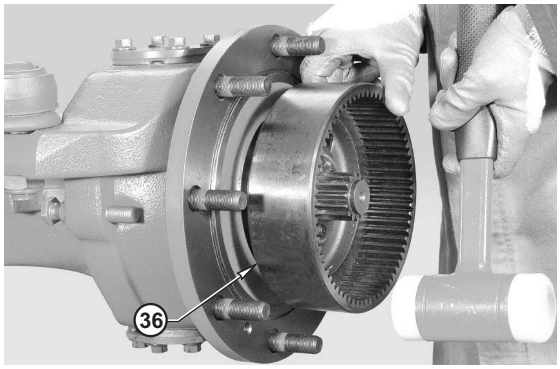
GB b

Install the wheel hub (41).



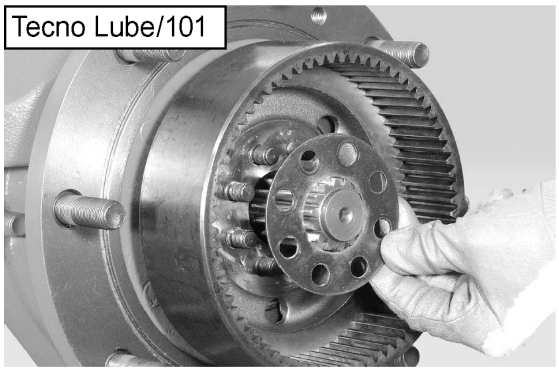
GB c

Install the crown wheel (36).



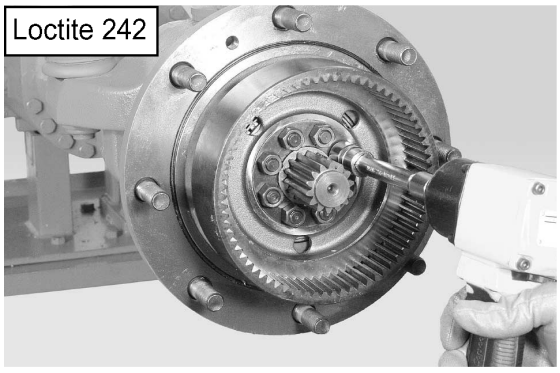
GB d

Fit the complete crown flange (36).
NOTE. In order to fasten the flange (36), use a plastic hammer and alternately hammer on several equidistant points.



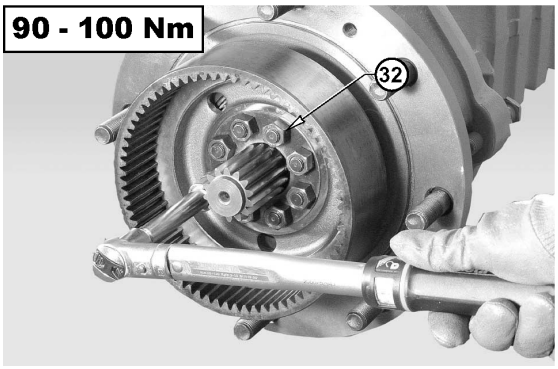
GB e

Install the security flange (33).
Using Tecno Lube /101, grease the surface of the safety flange (33) that touches the crown wheel.



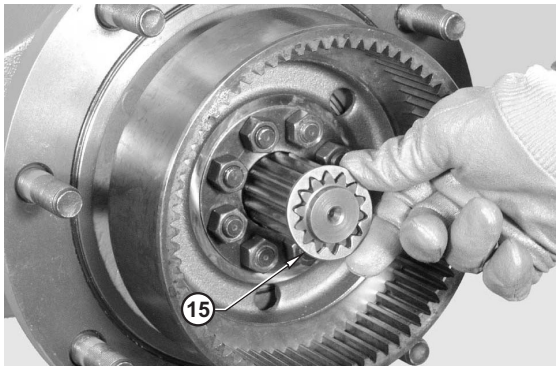
GB f

Coat the nuts (23) with Loctite 242 and screw them.



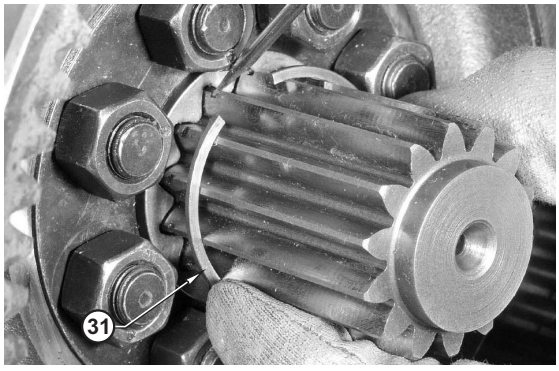
GB a

Tighten nuts (32) in two stages, using the criss-cross method.
Initial torque wrench setting: 90 Nm
Final torque wrench setting: 100 Nm



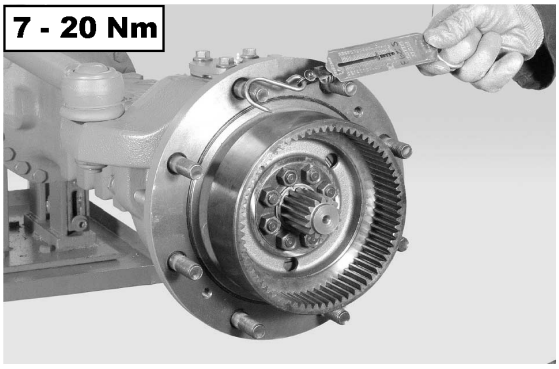
GB b

Install the distance piece (15)



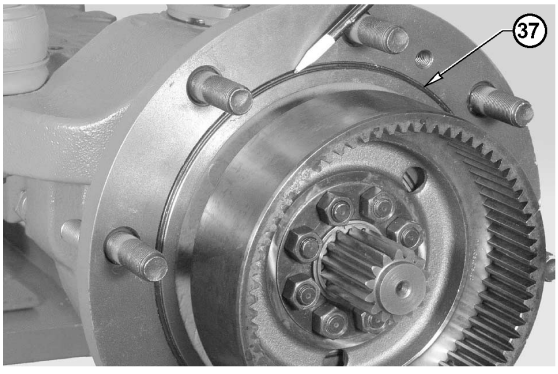
GB c

Install the snap ring (31).



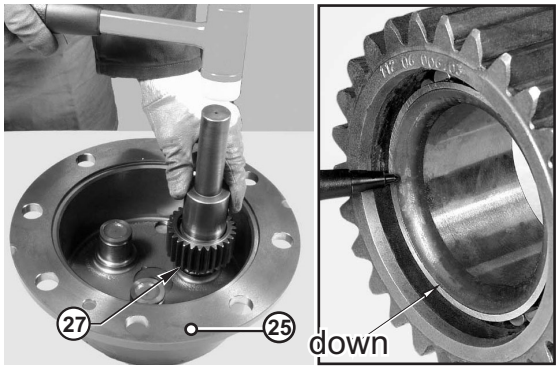
GB d

Check the continuous rolling torque on the hub.
Torque 7 - 20 Nm.



GB e

CAUTION!
Check the condition and position of the O-ring (37).



GB f

Fit the planetary gear (27) onto the planetary gear cover(25).
CAUTION! The jointed portion of the internal ring of the bearings must face the bottom of the pin.



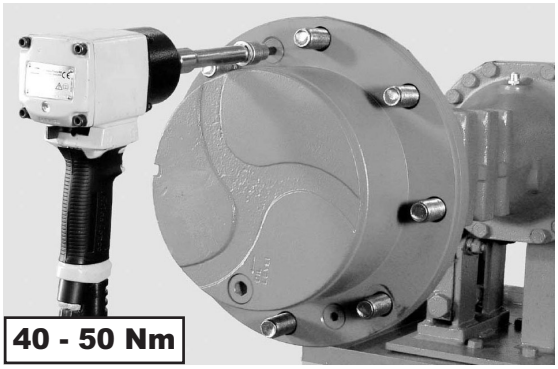
GB a

Lock into position the planetary gears (16) with the snap rings (15).



GB b

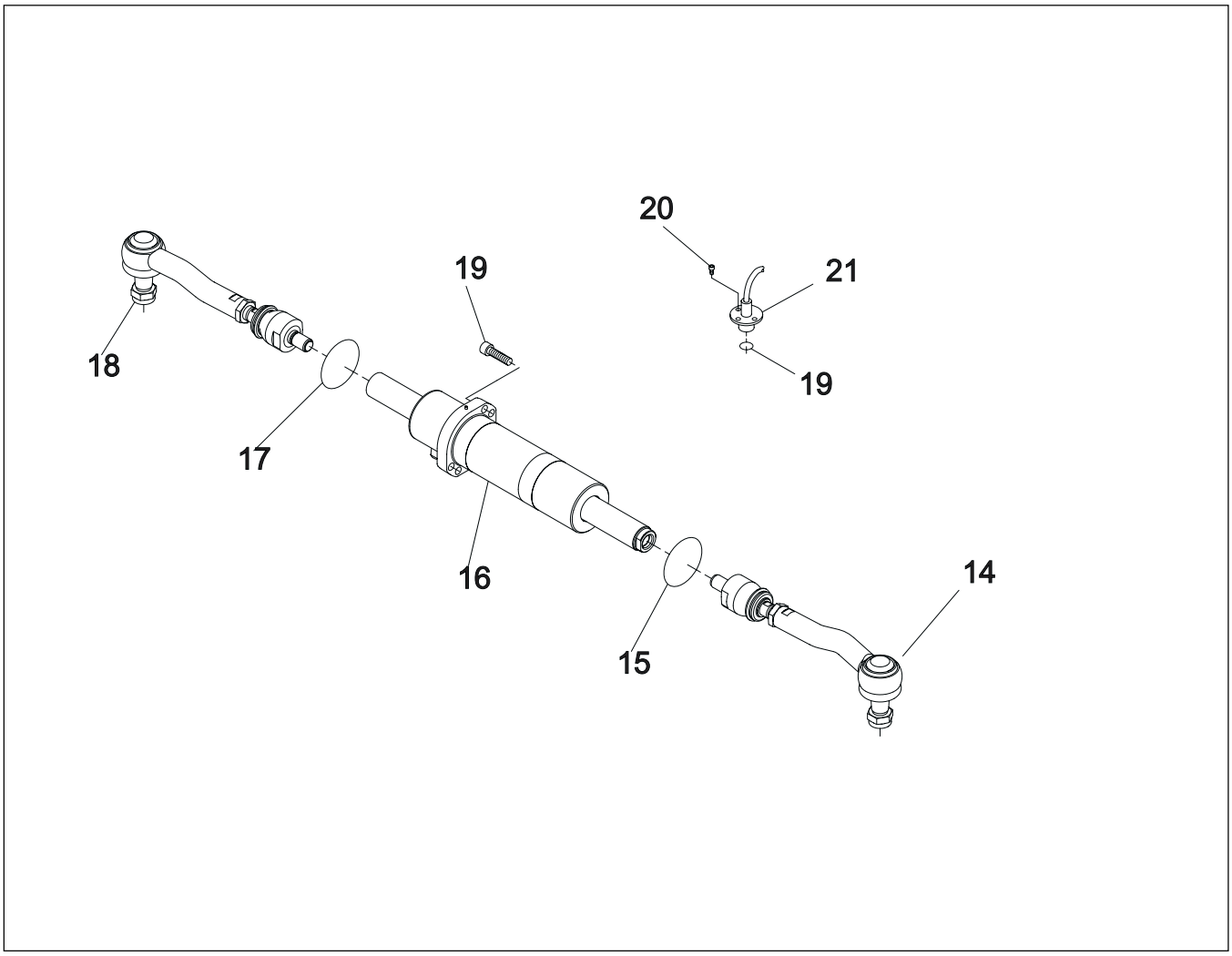
Fit the planetary gear cover (18) onto the wheel hub (4).

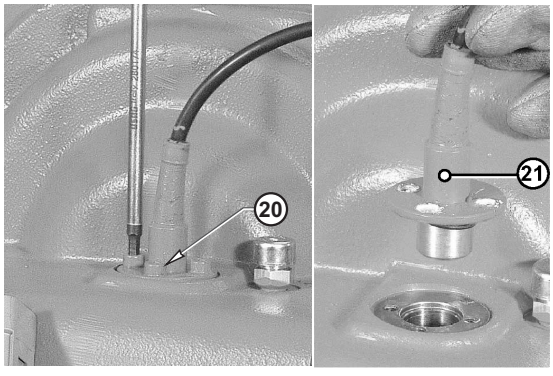


GB c

Torque wrench 40-50 Nm.

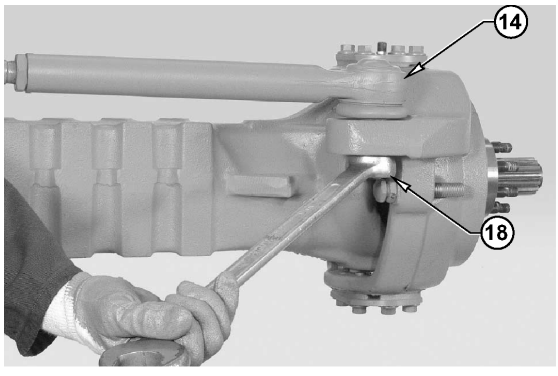
HOW TO DISASSEMBLE THE STEERING CYLINDER





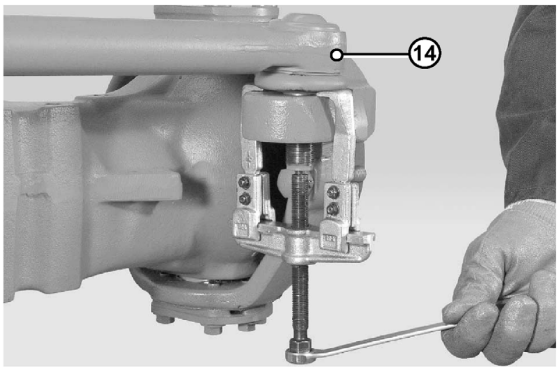
GB a

Remove the centring sensor (21) of the steering piston.



GB b

Remove the nuts (18) that lock the articulation pins (14).



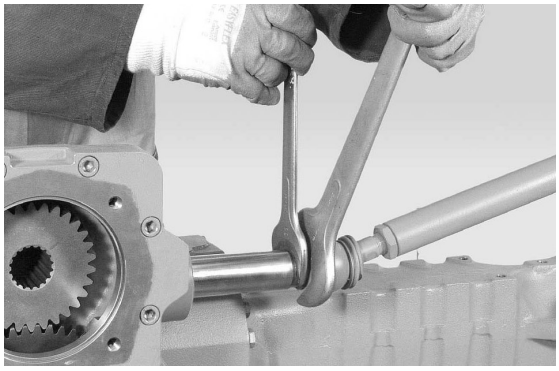
GB a

Disconnect the tapered pins of the articulation (14) from the steering case by means of a puller.



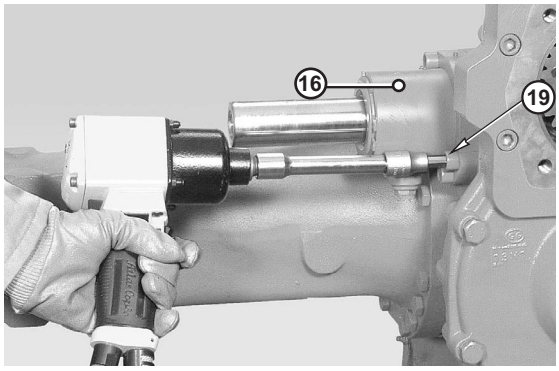
GB b

If the connection of the steering bars includes a safety collar, raise the border.



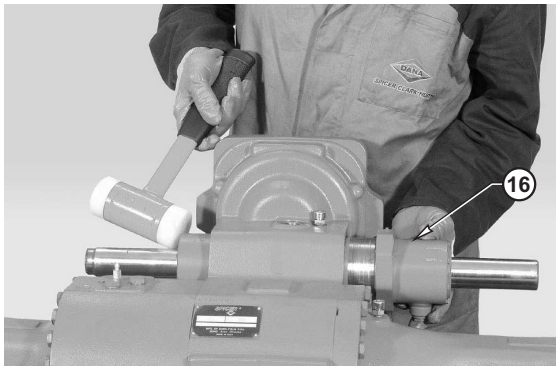
GB c

Disconnect left and right steering bars from the piston.



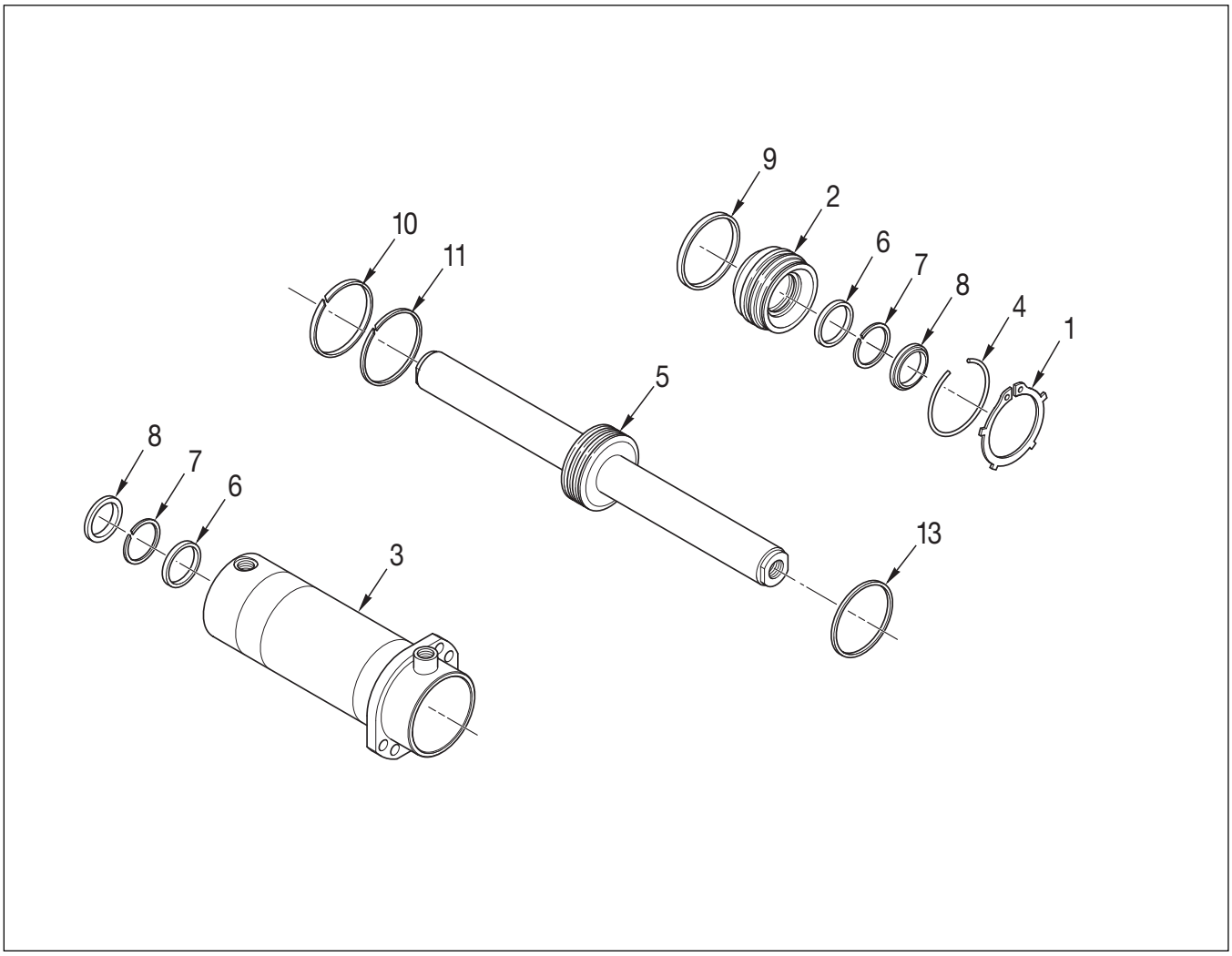
GB d

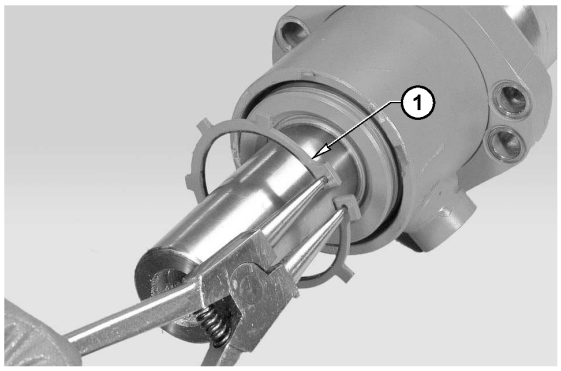
Remove the securing screws (19) from the steering cylinder (16).



GB e

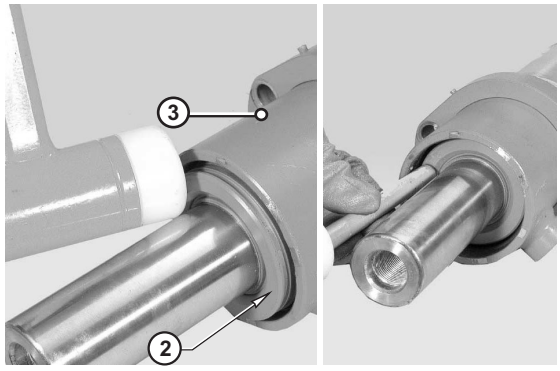
Extract the cylinder (16) using a plastic hammer.





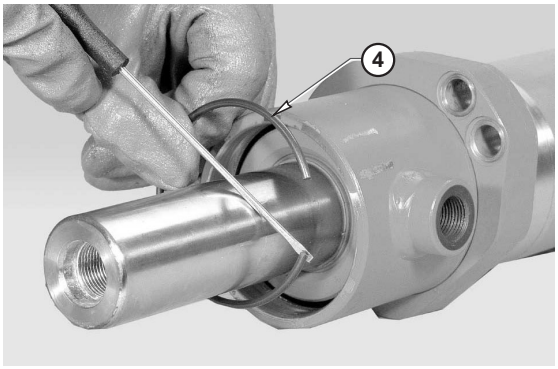
GB a

ATTENTION! Before attempting to disassemble the unit, drain the oil in the cylinder chambers completely.
Using a screwdriver, remove the snap ring (1) of the cylinder head.



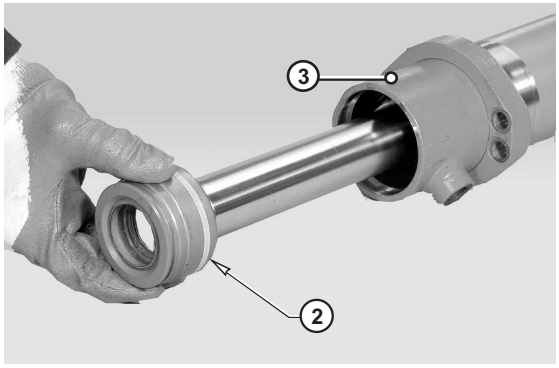
GB b

Lightly tap the cylinder head (2) with a plastic hammer so as to push it inside the cylinder (3).
NOTE. Insert the cylinder head so it is flush with the cylinder.



GB a

Using a punch, force the stop ring (4) located inside the cylinder (3) and extract ring using a screwdriver.



GB b

Take the cylinder unit a part by extracting the head first, followed by the piston.



GB c

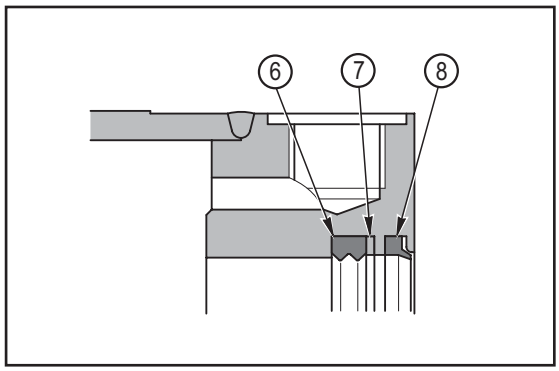
ATTENTION! Note down direction of installation of piston whose seal ring is oriented towards cylinder head.



GB d

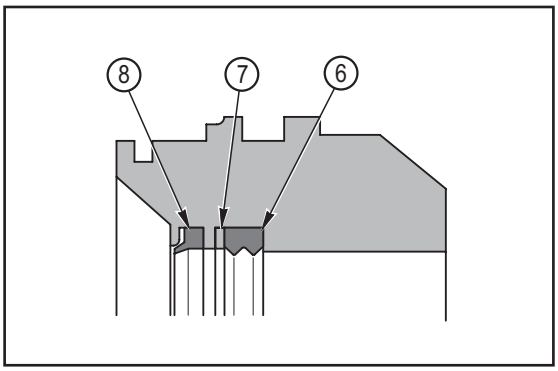
Remove all seals, anti-extrusion rings and scraper rings from head (2), cylinder (3) and piston (5).
NOTE. 1 - All seals must be replaced every time the unit is disassembled.
2 - Particular attention must be paid not to damage the seats of both seals and piston slide.

HOW TO ASSEMBLE THE STEERING CYLINDER



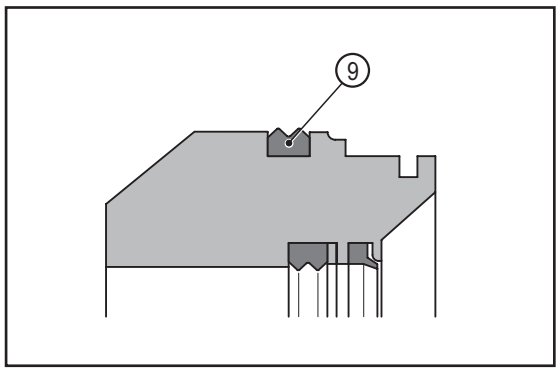
GB a

Grease and install the piston rod seal ring (6), rod wiper (8) and back up washer (7) into cylinder (3).



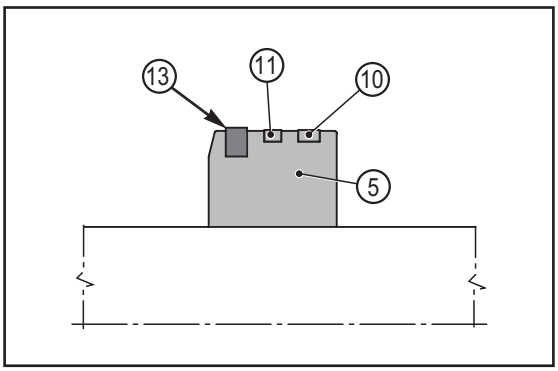
GB b

Grease and install the piston rod seal ring (6), rod wiper (8) and anti-extrusion ring (7) into the head (2).



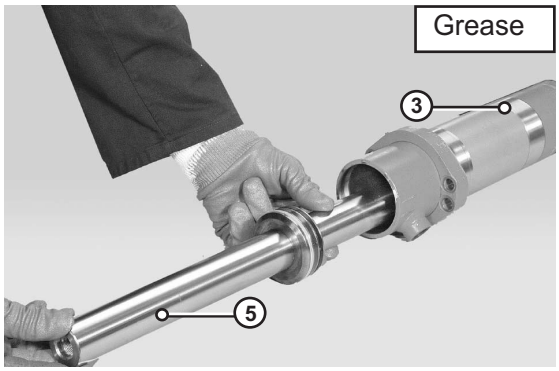
GB c

Fit seal (9) on the outside of the head (2).
ATTENTION!
1 - To ease installation, grease the outer surface of the piston
2 - Do not roll the seal (9).



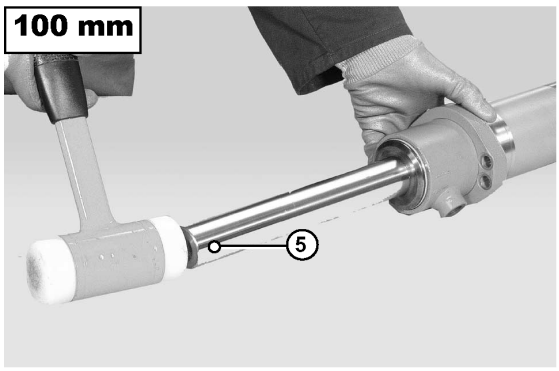
GB d

Prepare piston (5) by fitting it with magnetic ring (11) anti-extrusion ring (10) and piston seal (13).
ATTENTION! 1 - To ease installation, lubricate with grease.



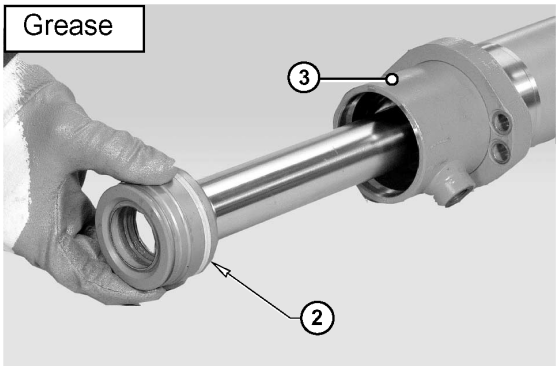
GB e

Centre the shaft on the cylinder (3) so that it fits into the piston (5).
NOTE. Apply a little grease to seals and cylinder.



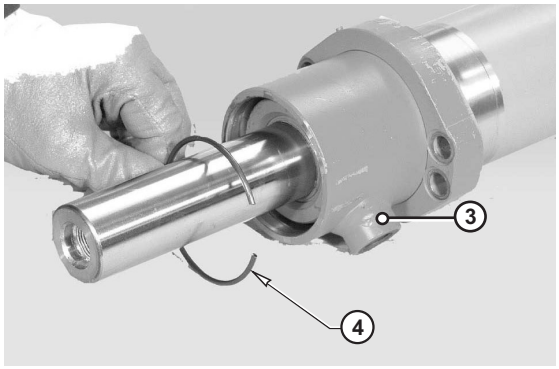
GB f

Push the piston (5) into the cylinder for 100 mm using a plastic hammer.



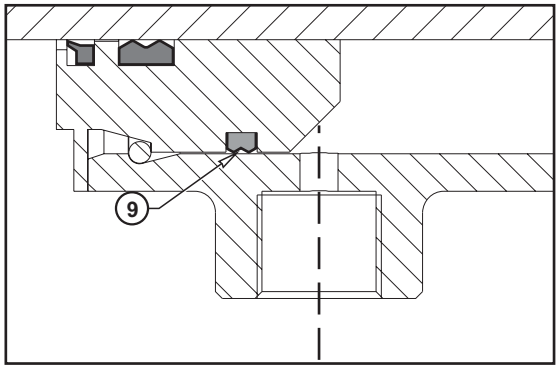
GB a

Apply grease to head (5) seals, fit the head onto the piston and push it into the cylinder (3) using a plastic hammer.
NOTE. Insert the head as to line it up with the edge of the cylinder.



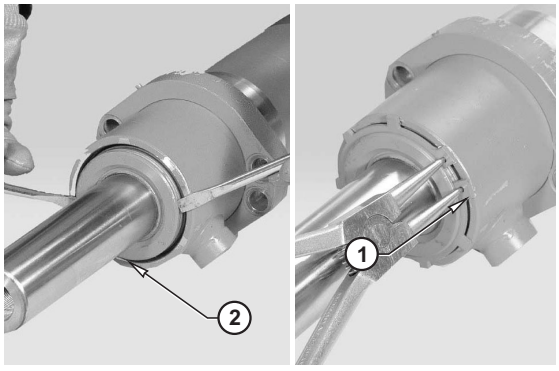
GB b

Introduce the stop ring (4) and ensure that it sets in the seat of cylinder (3).



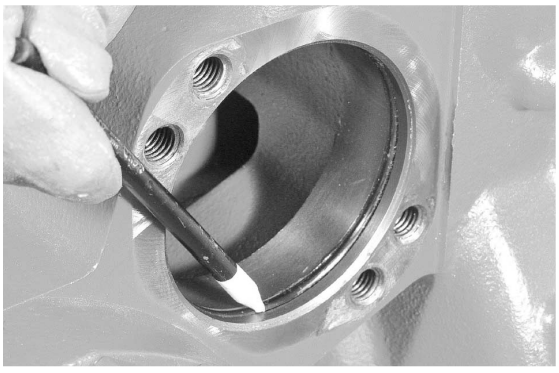
GB c

CAUTION! to insert the heading not to go beyond with the ring of gasket the hole of feeding because it could be cut.



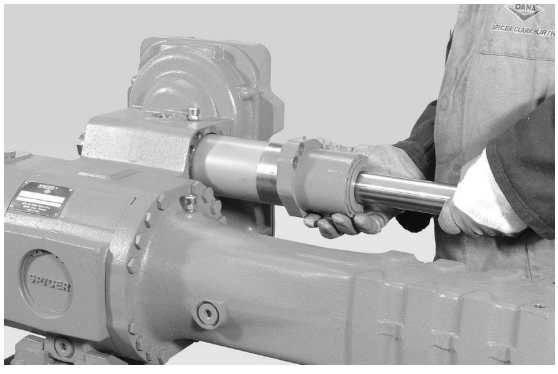
GB d

Using two screwdrivers or levers, force the head until it is seated against the stop ring (4).
Fit the snap ring (1) on the head (2).
CAUTION! Make sure that the snap ring (1) is securely fastened in its seat. If necessary, force it into its seat using a drift and a hammer.



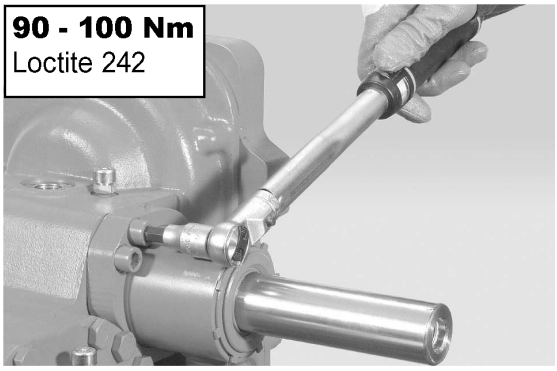
GB e

Renew at each reassembly.



GB f

Check that the O-rings (17)(15) of the axle unit are in good condition; lubricate the seats of the seals and fit the steering cylinder (3).



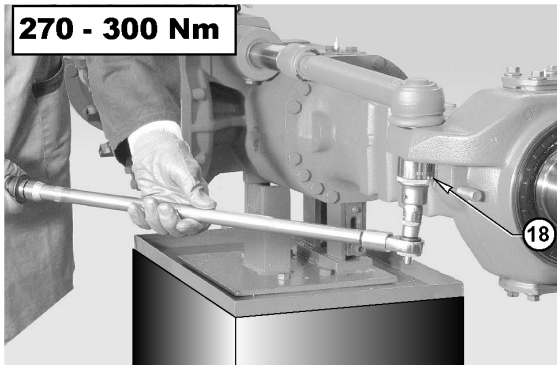
GB a

Lock the cylinder by cross- tightening the screws (3).
Torque wrench setting: 90-100 Nm



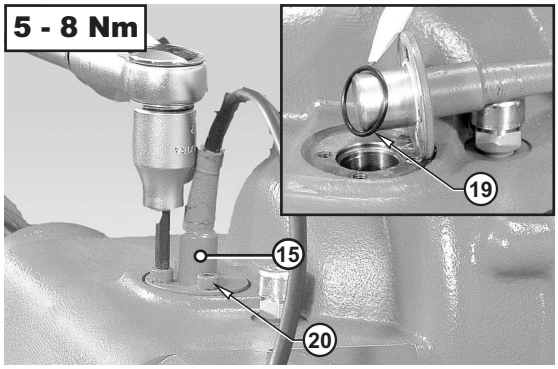
GB b

Apply Loctite 242 to the thread and connect the steering bars by screwing the terminals onto the piston stem.
Torque wrench setting: 240 - 270 Nm
NOTE. Versions with coupling require that the rim of the articulation is riveted onto the surfaces of the piston stem.



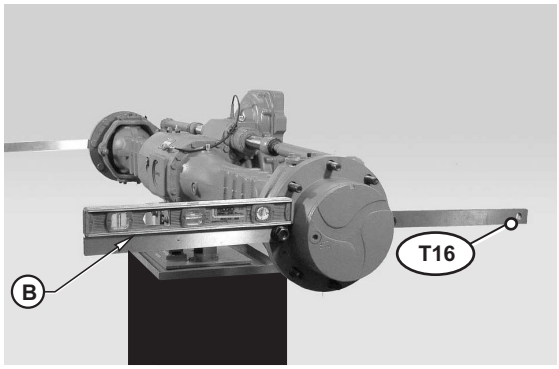
GB c

Insert the pins (18) in the steering case and lock into position using a torque wrench setting of 270 - 300 Nm.



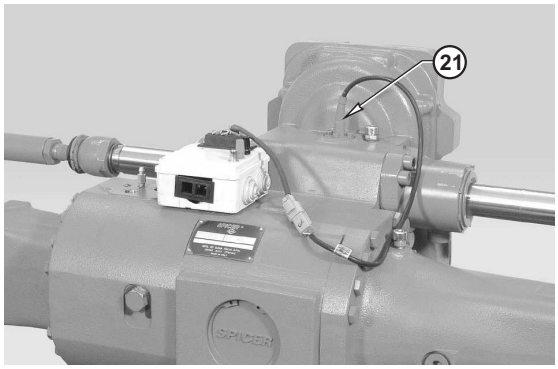
GB a

Install the proximity (21) for checking piston centring - if applicable -and tighten the screws (20).
Torque wrench setting: 5±8 Nm



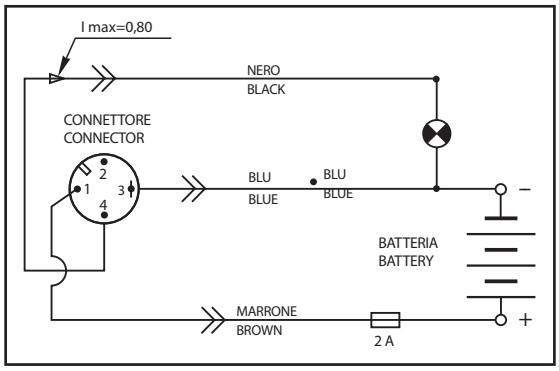
GB b

CAUTION. Eliminate the action of the negative brake, if fitted.
Apply tools T16 to the hubs and lock them.
Using a level “B”, check that tools are perfectly flat and parallel to each other.



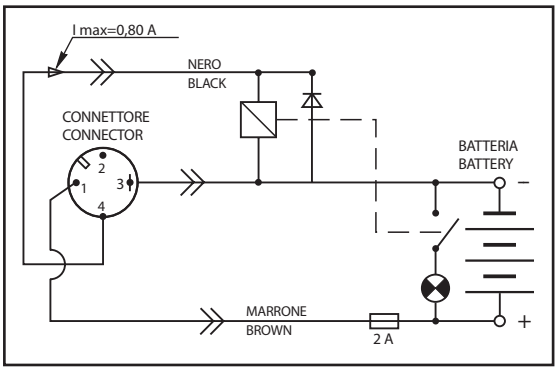
GB c

Connect the sensor (21) to the inspection device according to either diagram.



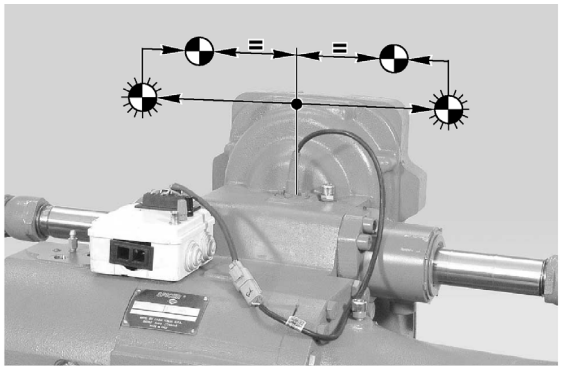
GB d

STANDARD version.



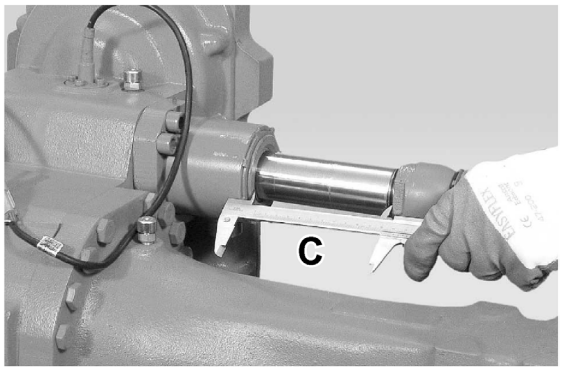
GB e

OPTIONAL version.



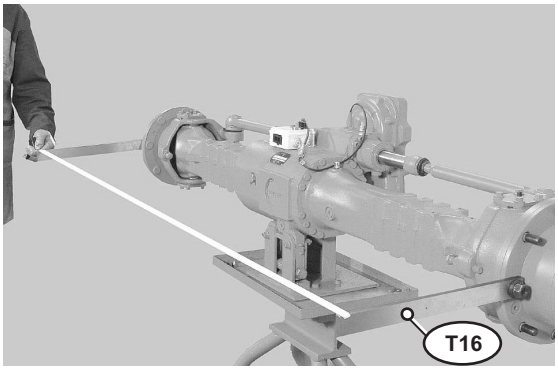
GB f

Centre the piston by slowly moving it first in one direction then in the other and position it half way on the stroke, which is determined by the switching on and off of the signal lamp of the inspection device in the reversal stage.



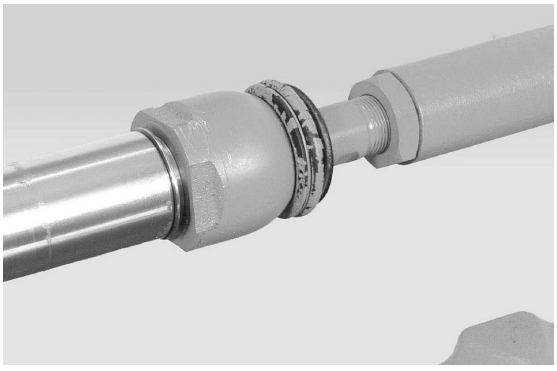
GB a

Inspect jut “C” on one side of the piston and note down the size for checking later adjustments.
NOTE. If cylinders come without a sensor, the centring of the piston must be carried out on the basis of the maximum stroke.



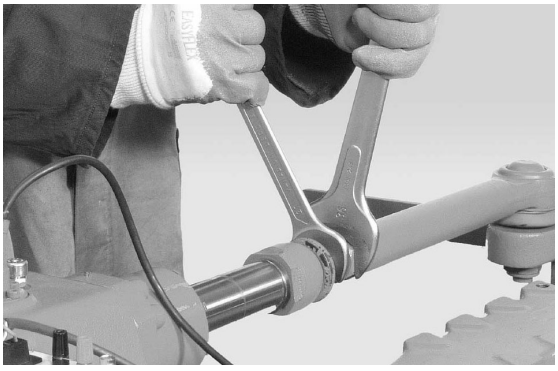
GB b

Without moving the piston, check front and rear size at the edge of tools T16.
Max. difference: 0.6-0.7 mm
NOTE. In order to check the rear size, rotate the bevel pinion and check that tools T16 are flat.



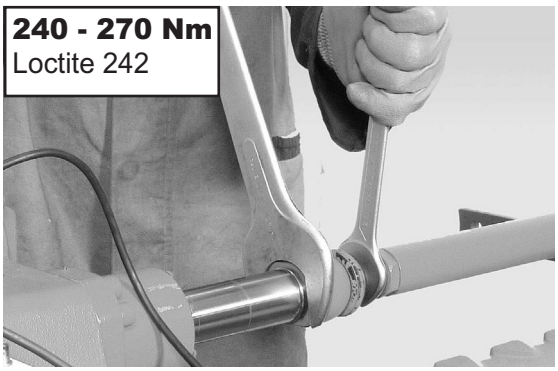
GB c

If necessary, adjust convergency without moving the centring of the piston and adjust the length of the steering bars (14).
NOTE. With a half turn of screw, the front size is reduced by about 3 mm, whereas the rear one is increased by about 3 mm.



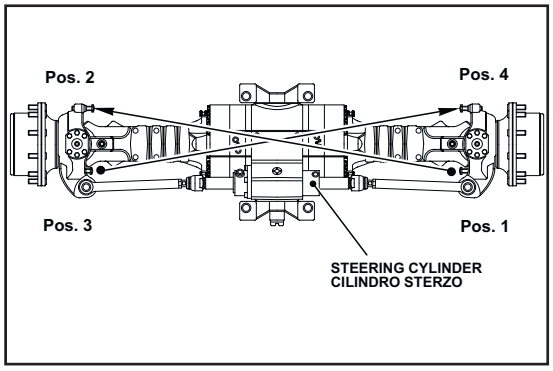
GB d

Unloose the nuts and screw them onto the ball-and-socket joints.



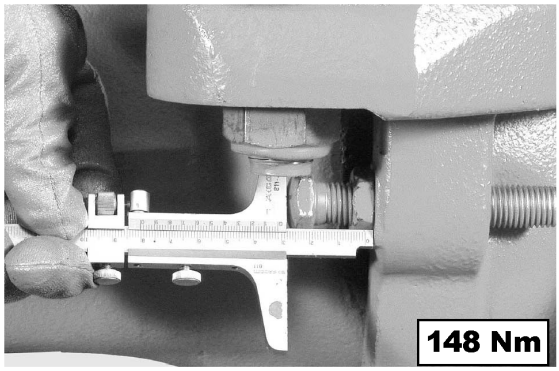
GB f

Hold the articulations still and rotate the ball-and-socket joints.
Once the convergency has been adjusted, lock the nuts.
Torque wrench setting for nuts: 240 - 270 Nm.



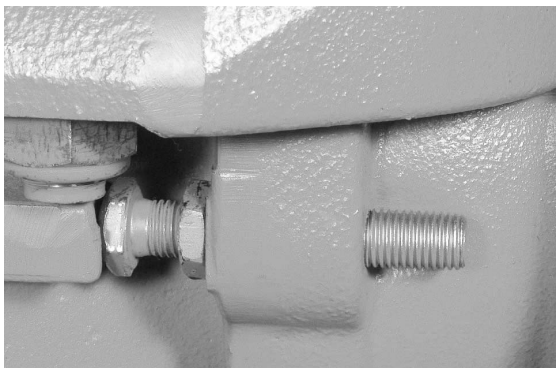
GB a

ADJUSTING THE STEERING ANGLE
NOTE. Perform the same operations on both sides (see diagram).
Loosen the nut of one of the adjusting srews on cylinder side.



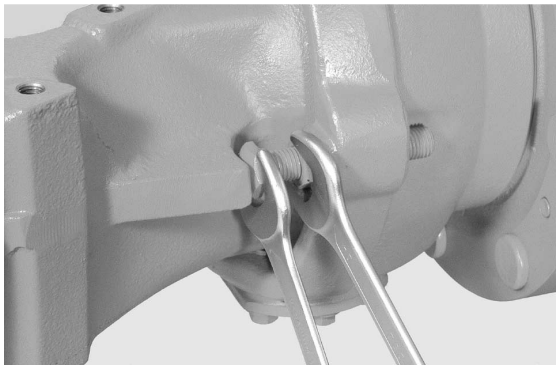
GB b

Adjust the jutting portion of the screw according to data shown in the table.
Lock into the position with nut tightened to max 148 Nm.



GB c

Perform one full steering operation until the adjusted screw leans against the arm stop.



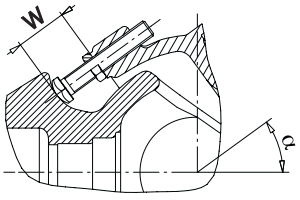
GB d

As you hold the adjusted screw in position against the arm stop, adjust the screw opposite, on non-cylinder side, until it leans against the arm stop.
IMPORTANT! The screws must lean against the respective arm stops all at the same time.

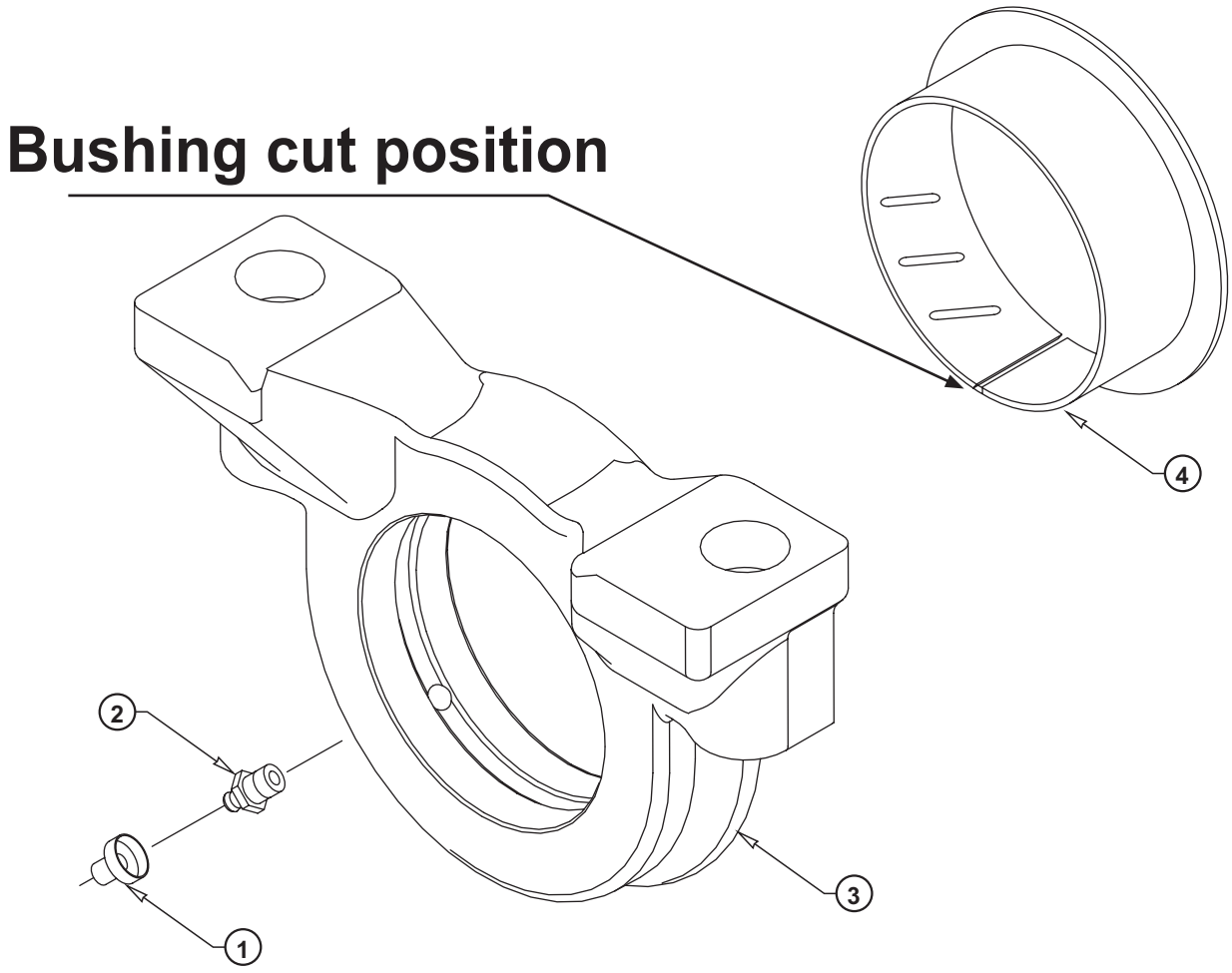
Requested steering angle value: α	25°	27°	30°	32°	35°	36°	40°	42°	45°
Steering cases version based on max. steering angle.	Value W = Adjustment of the steering stop screw, steering cylinder side [mm].								
35° max angle.	55.1	51.2	45.4	41.4	35.0				
45° max. angle.			57.4		47.0	44.7	35.8	31.2	24.6

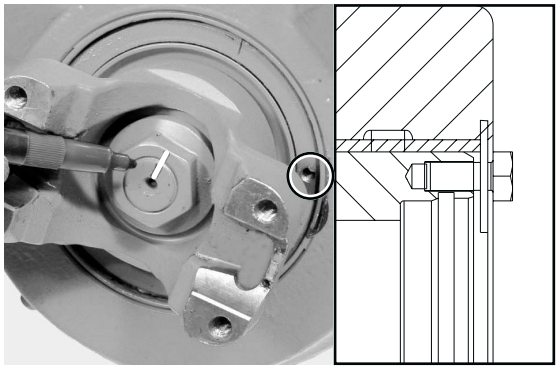
GB e

IMPORTANT! The screws must lean against the respective arm stops all at the same time.



DISASSEMBLE THE SWINGING SUPPORT





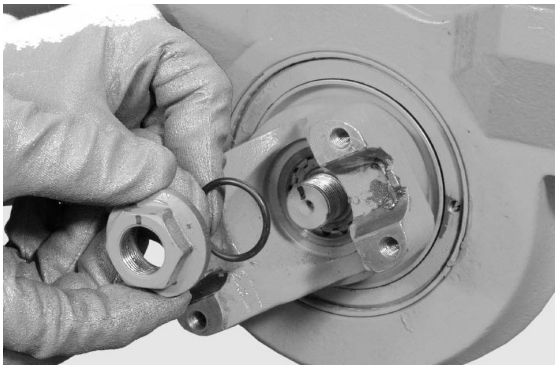
GB a

Make positional marks across nut and pinion tang.
If disassembly is awkward, heat the check nut of the flange at 80°C.
NOTE. Heating is meant to unloose the setting of Loctite on the nut.



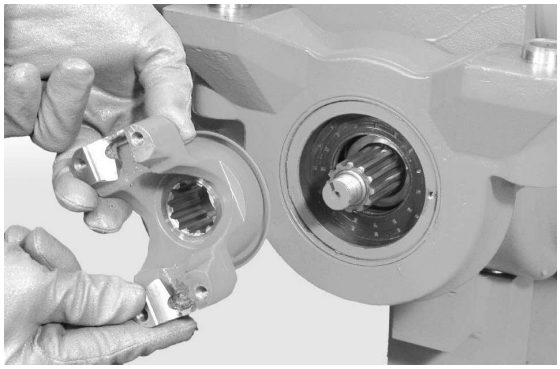
GB b

Unloose and remove the nut; also remove the O-ring.



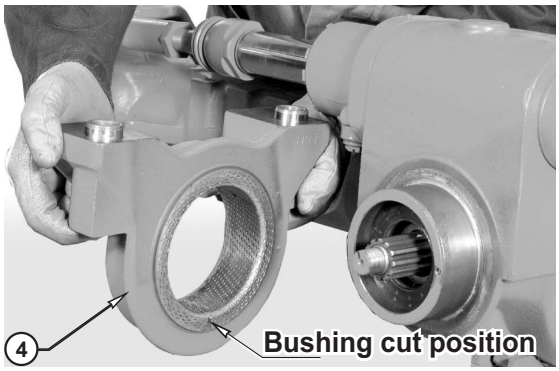
GB c

Remove the nut and the O-ring.



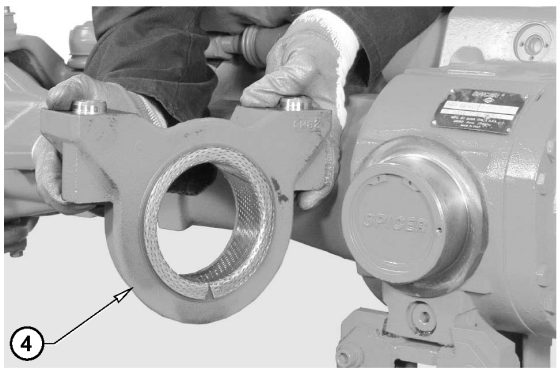
GB d

Remove the flange complete with guard by means of a puller.



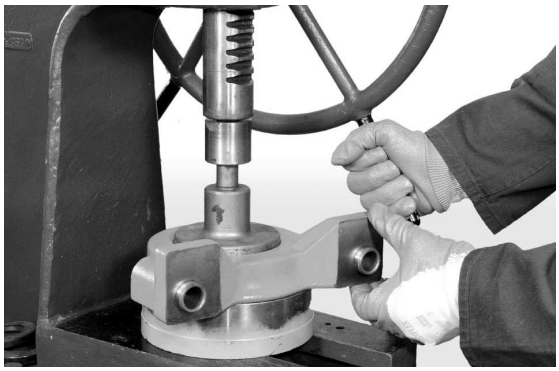
GB e

Remove the swinging support (4).

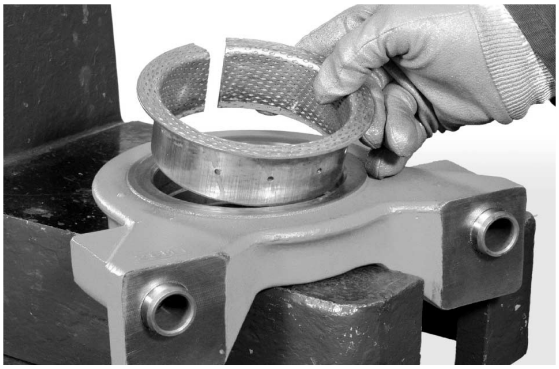


GB f

Remove the swinging support (4) on the side opposite the drive.

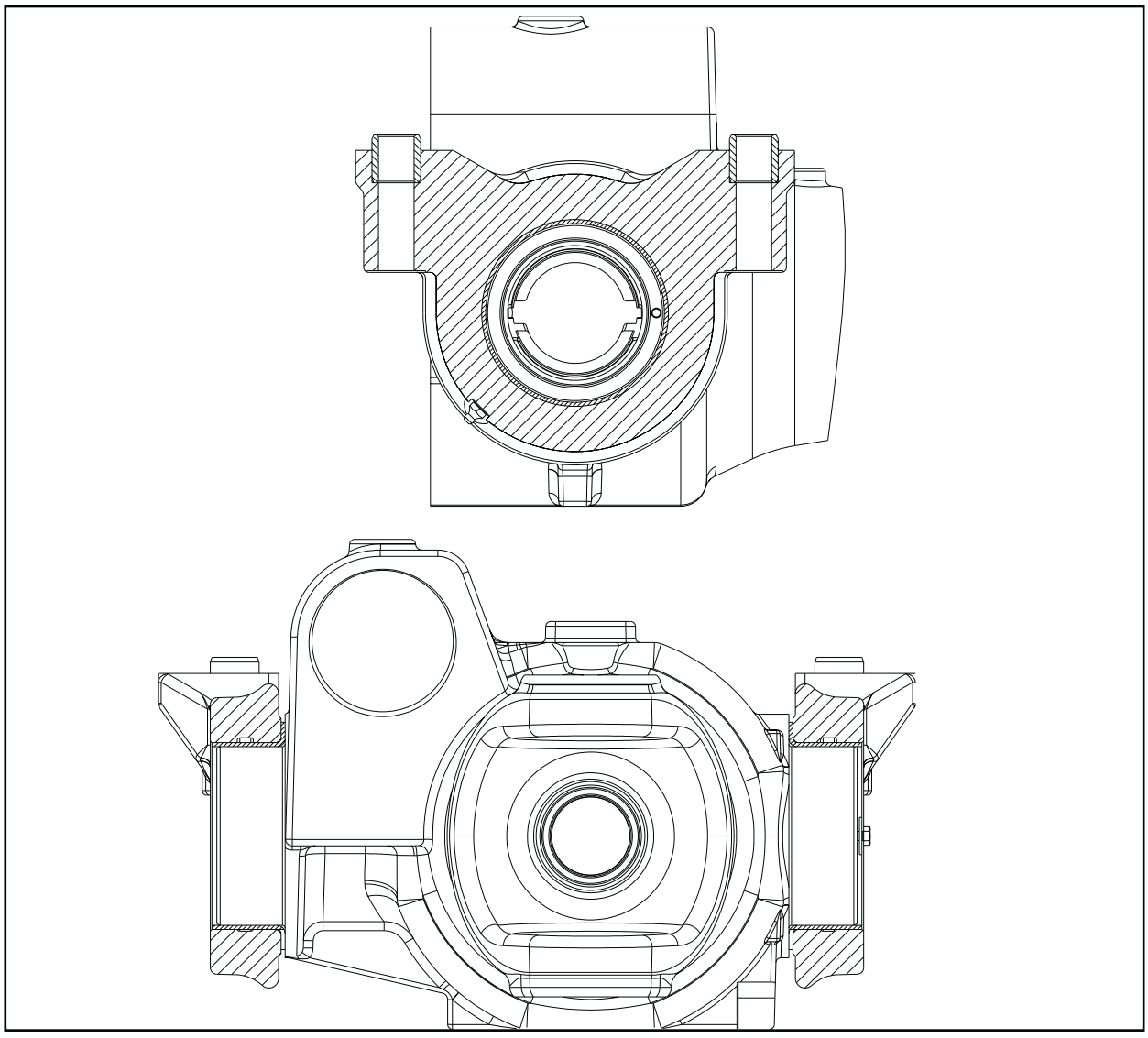


GB a

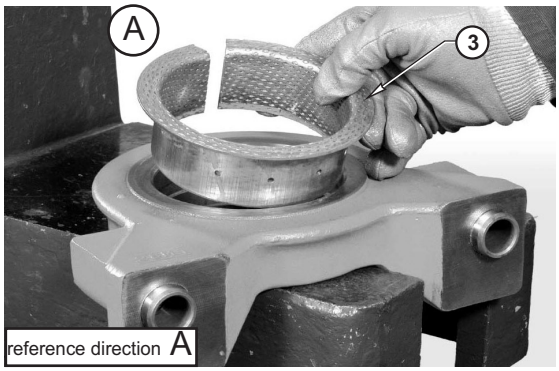


GB b

Position the swinging support (4) under a press and remove the complete bushing (3).

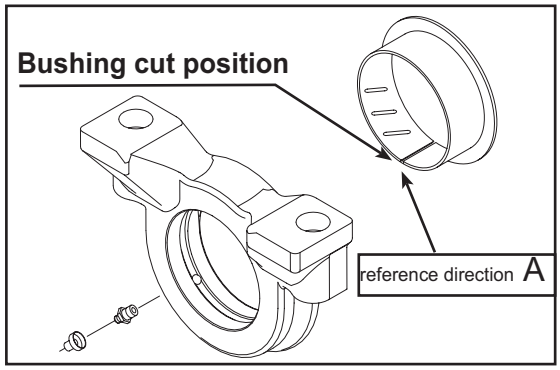


ASSEMBLY THE SWINGING SUPPORT

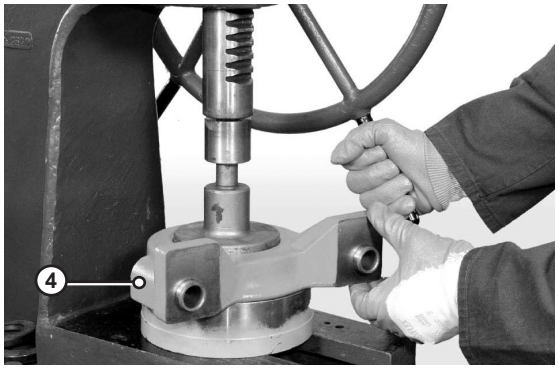


GB a

NOTE. If the bushing (3) is worn and needs replacing, note down the assembly side of the connection notch "A".

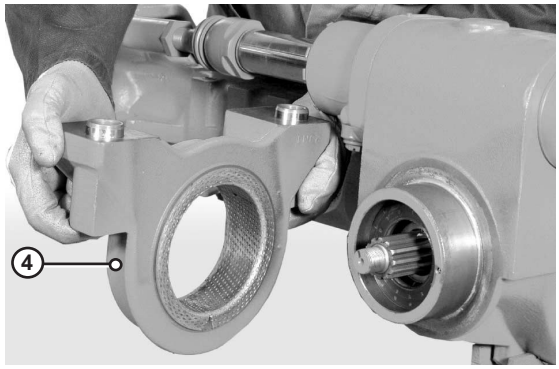


GB b



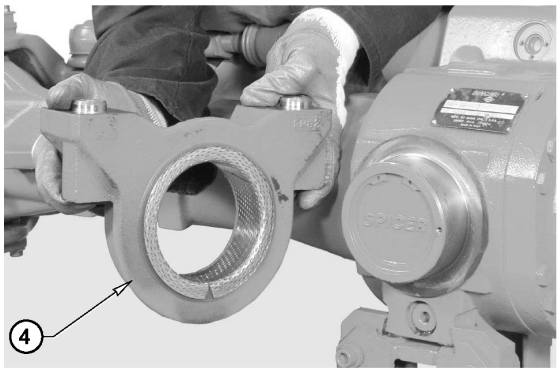
GB c

Position the swinging support (4) under a press and insert the complete bushing (3).



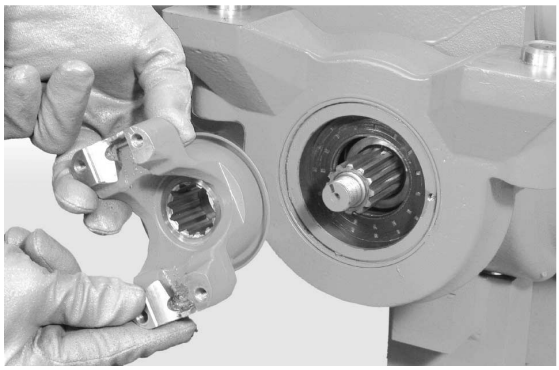
GB d

Install the swinging support (4).
NOTE. Check that it is properly oriented.



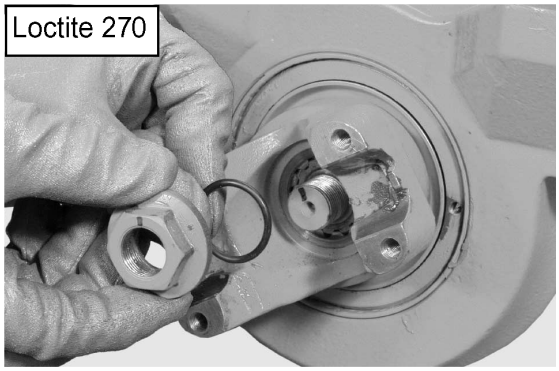
GB e

Install the swinging support (4) on the side opposite the drive.



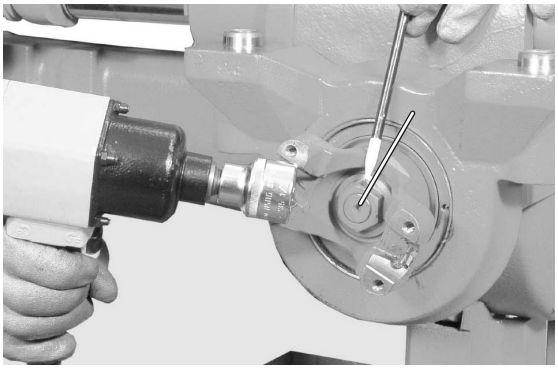
GB f

Fit the flange and fasten it.
For keying the flange, use a plastic hammer if necessary.



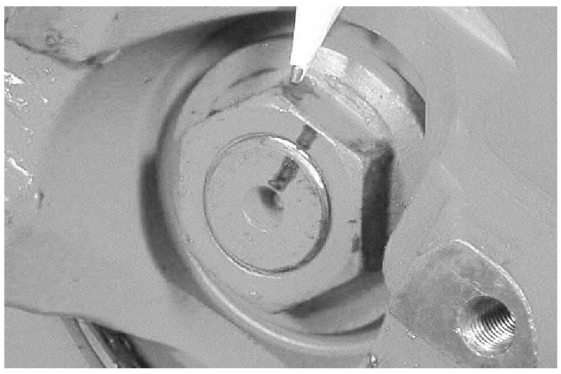
GB a

Install flange.
Mount O-ring and apply Loctite 270 to pinion tang; tighten nut.



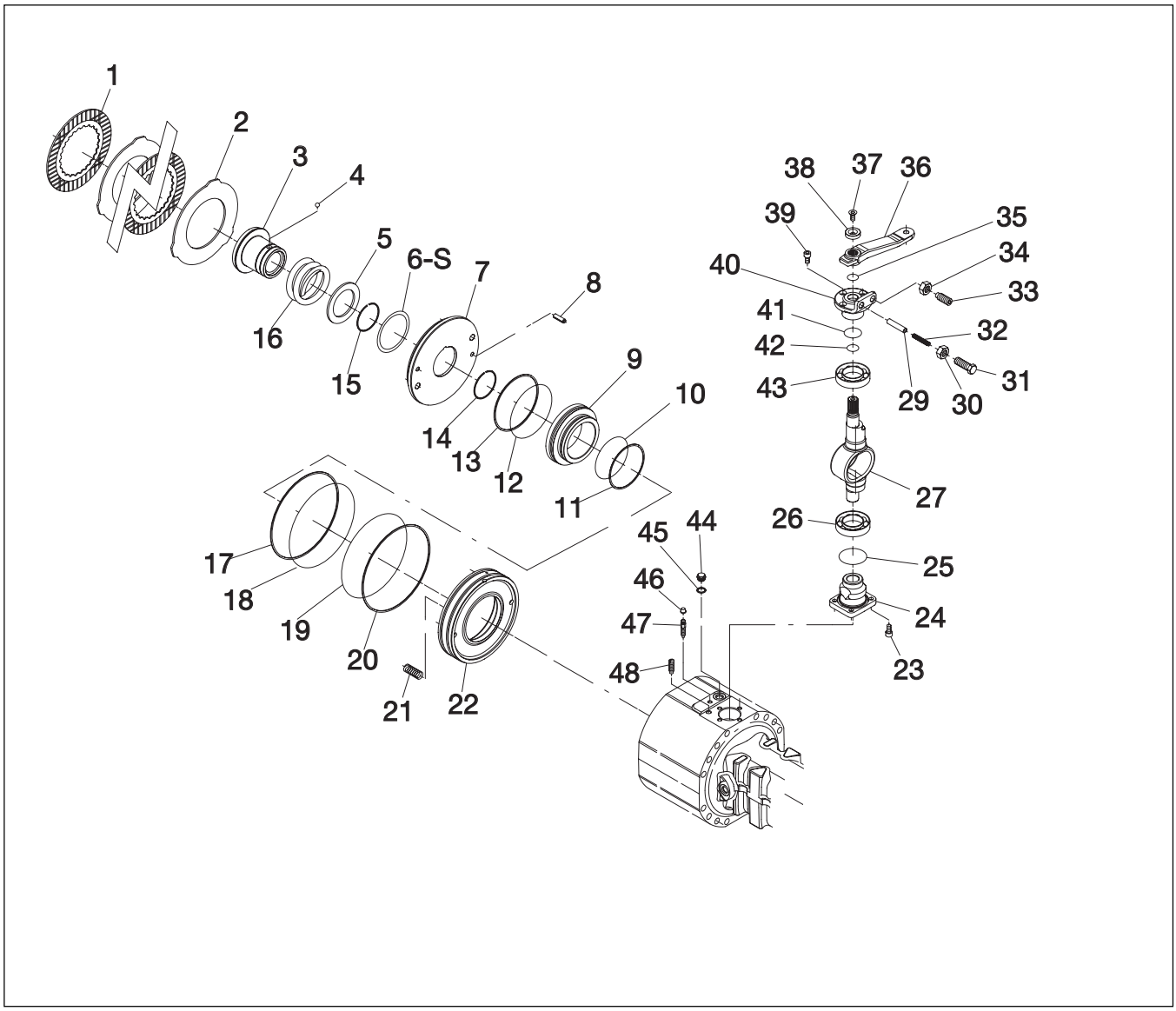
GB b

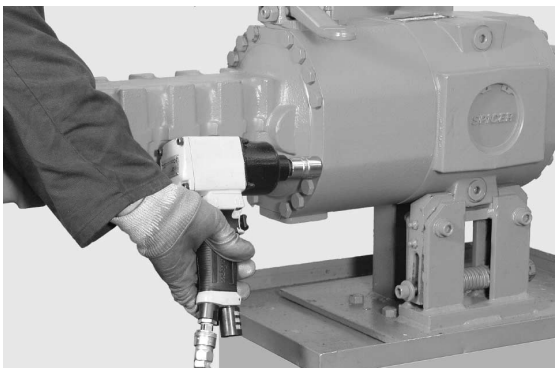
Tighten the nut until the match marks at line up.



GB c

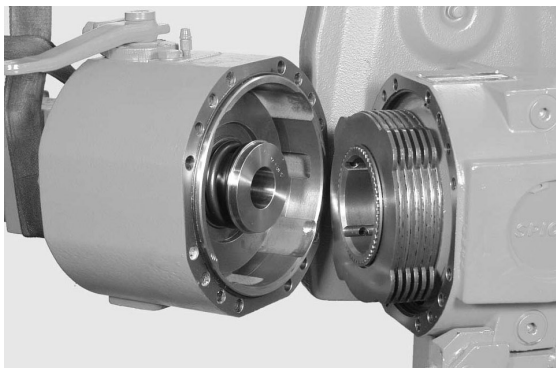
DISASSEMBLY BRAKE: SERVICE BRAKE AND MECHANIC PARKING BRAKE





GB a

Sling the arm to be removed and connect it to a hoist, remove screws.



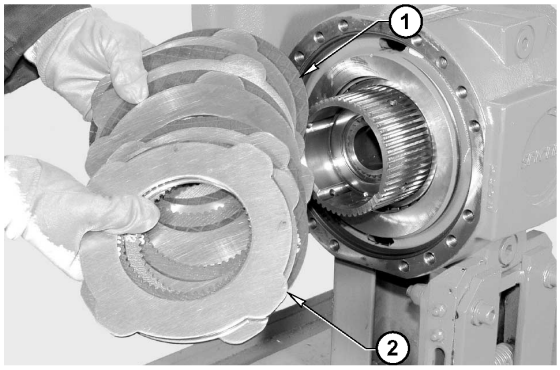
GB b

Take off the arm and lay it down vertically.



GB a

Remove the snap ring of the brake stack.



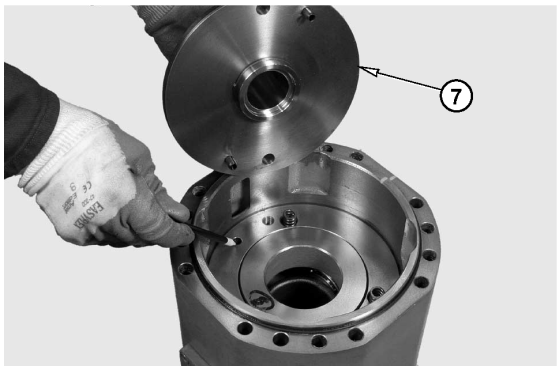
GB b

Remove the brake discs (1)(2) one after the other.
NOTE: If they are not to be substituted, do not mix up the sequence.



GB c

NOTE: Sign the assembly position.



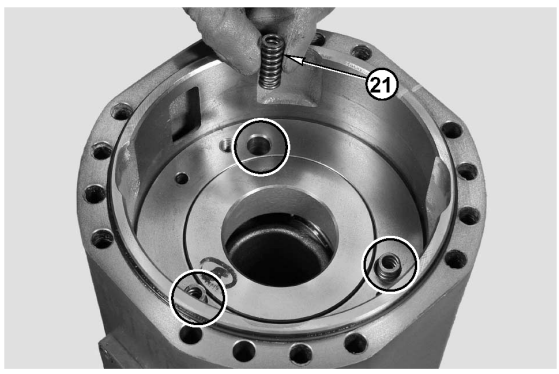
GB d

Remove intermediate disc (7).



GB e

NOTE: Sign the assembly position.



GB f

Remove the springs (21).



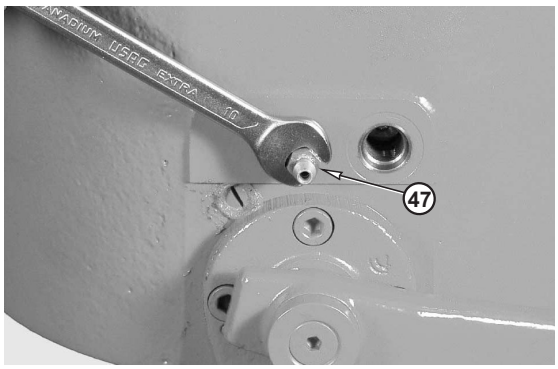
GB a

Insert the screws of the puller (M12) into the tapholes of the negative brake (22) and remove the pistons of the brake.



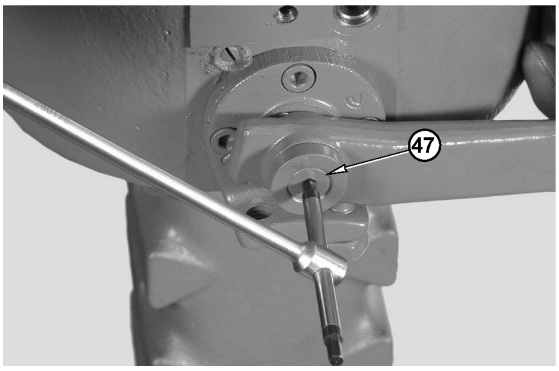
GB b

Pull out brake piston assembly module.



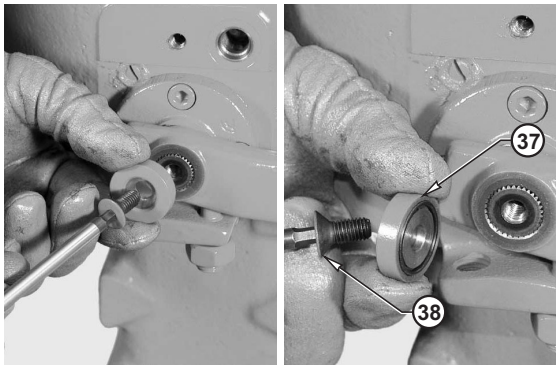
GB c

Remove the breather (47).



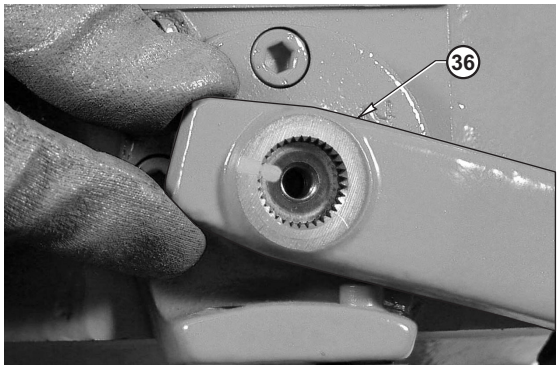
GB d

Remove the fixing screw of the lever brake.

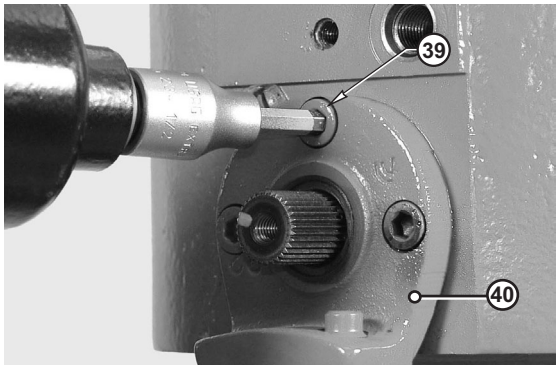


GB a

To remove the locking screw (37) lever brake completes of conic washer (38).

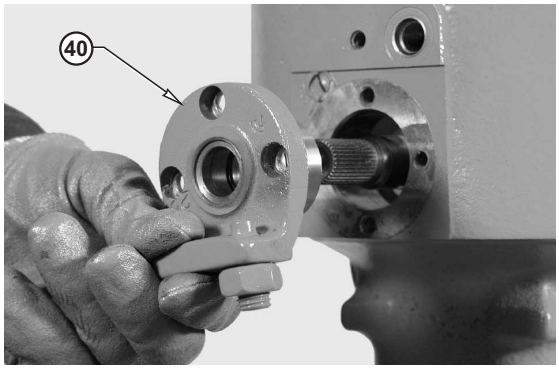


GB b



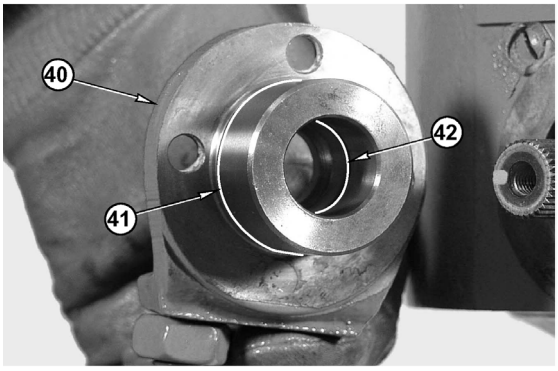
GB c

Remove the fixing screw (39) of the thrust bushing.

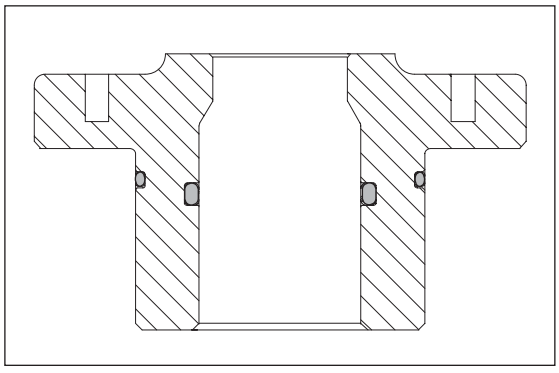


GB d

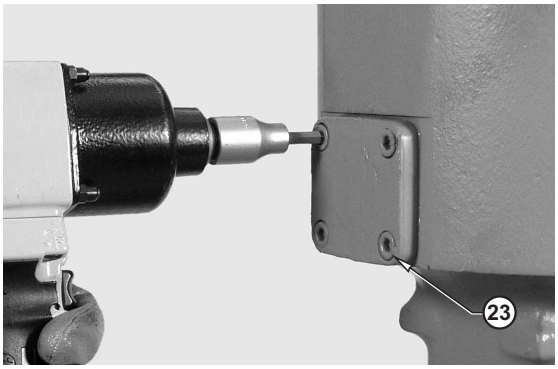
Remove the thrust bushing (40) complete the O-rings.



GB e

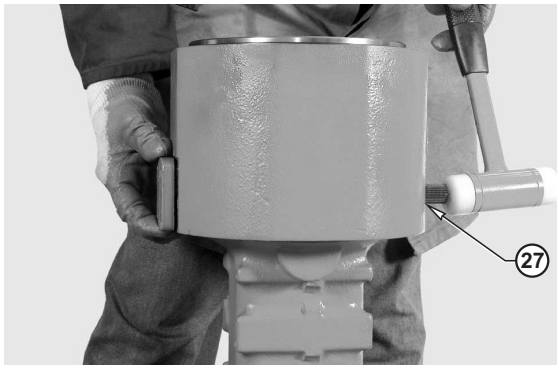


GB f



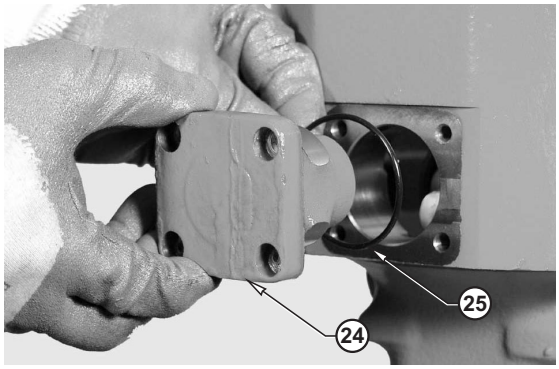
GB a

Remove the fixing screw (23) of the thrust bushing .



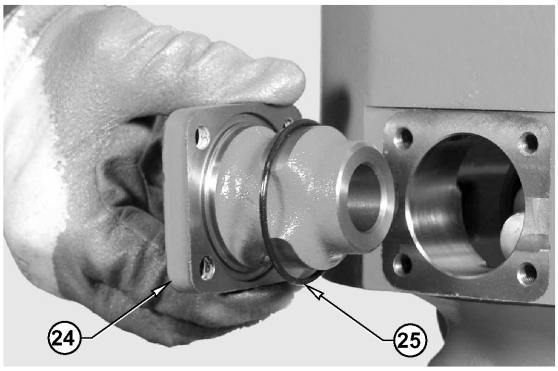
GB b

With a plastic hammer, hammer on the internal lever (27).



GB c

Remove the thrust bushing (24) complete the O-rings (24).

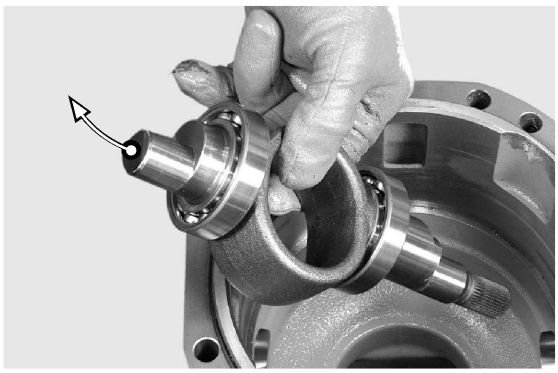


GB d

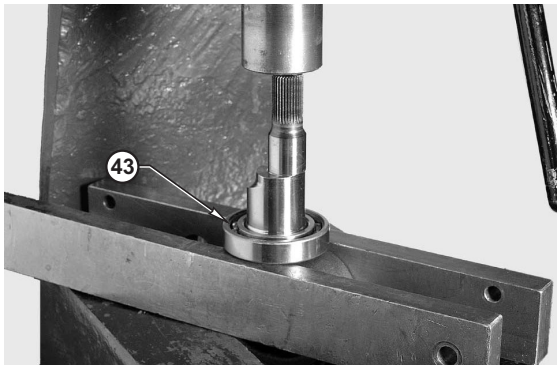


GB e

Remove the internal lever complete with bearings.

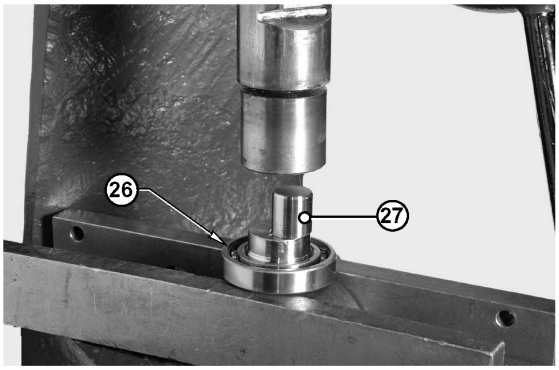


GB f



GB a

Place the lever (27) under a press and remove the bearings (43).



GB b

Place the lever under a press and remove the bearing (26).

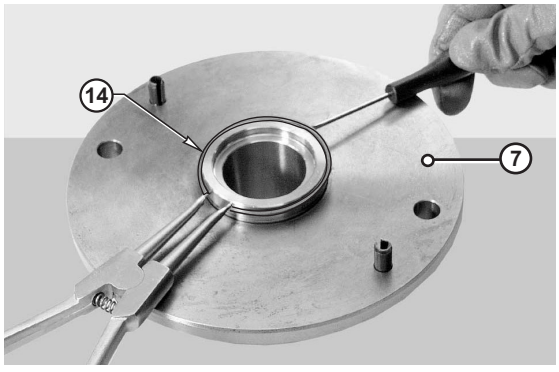


Bar GB c

Applying pressure to the hole, remove the hydraulic piston (9).

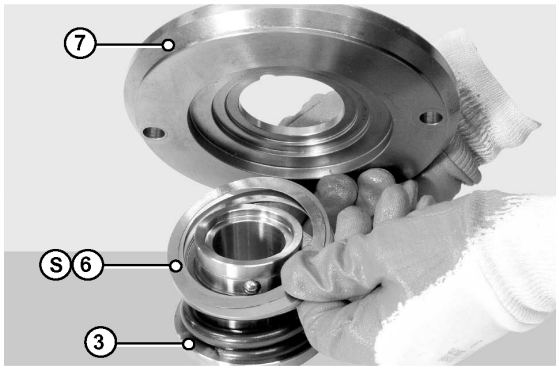


Bar GB d



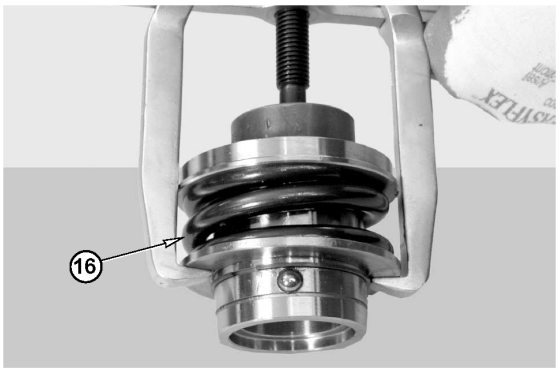
GB e

Remove the snap ring (14) from the intermediate disc (7).



GB f

Remove coupling (3) and washers (6).
NOTE: Build a stack of washers and check the measure.



GB a

Using a puller, preload the spring (16).



GB b

Remove the snap ring (15).
ATTENTION: Spring preloaded.



GB c

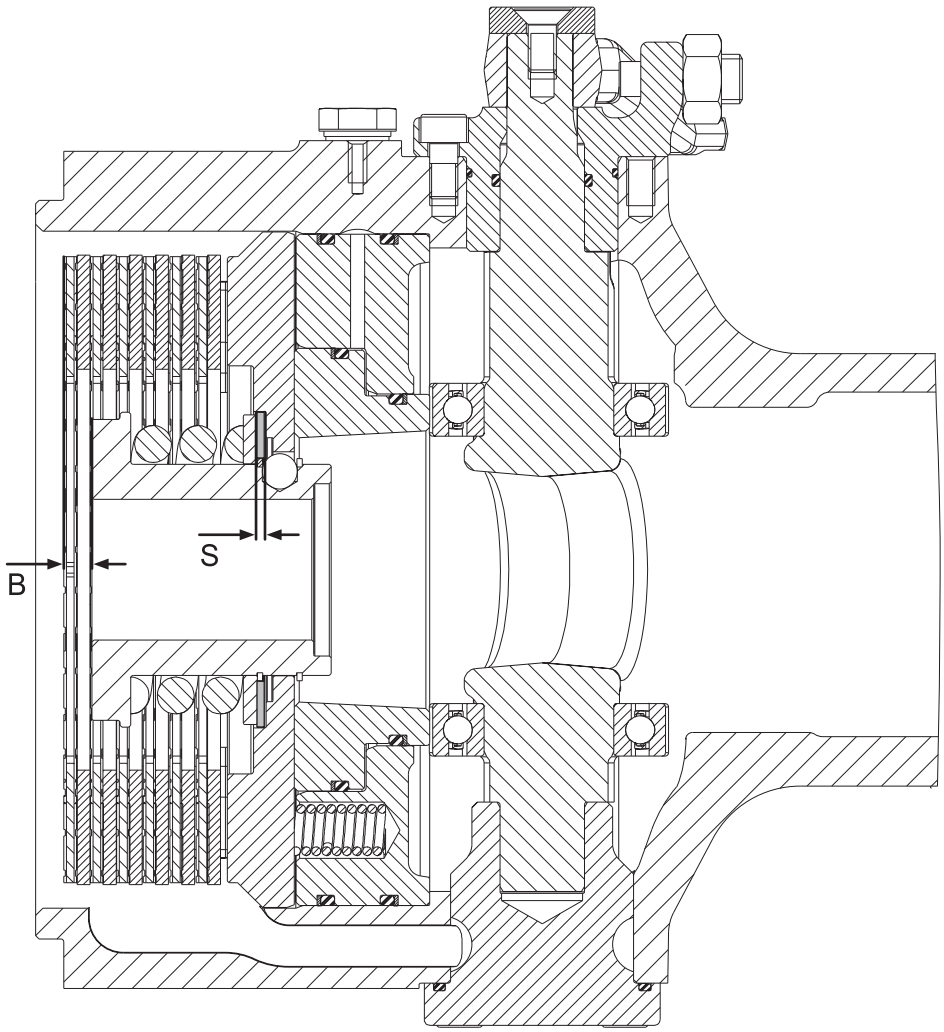
Remove the fixing ball (4).

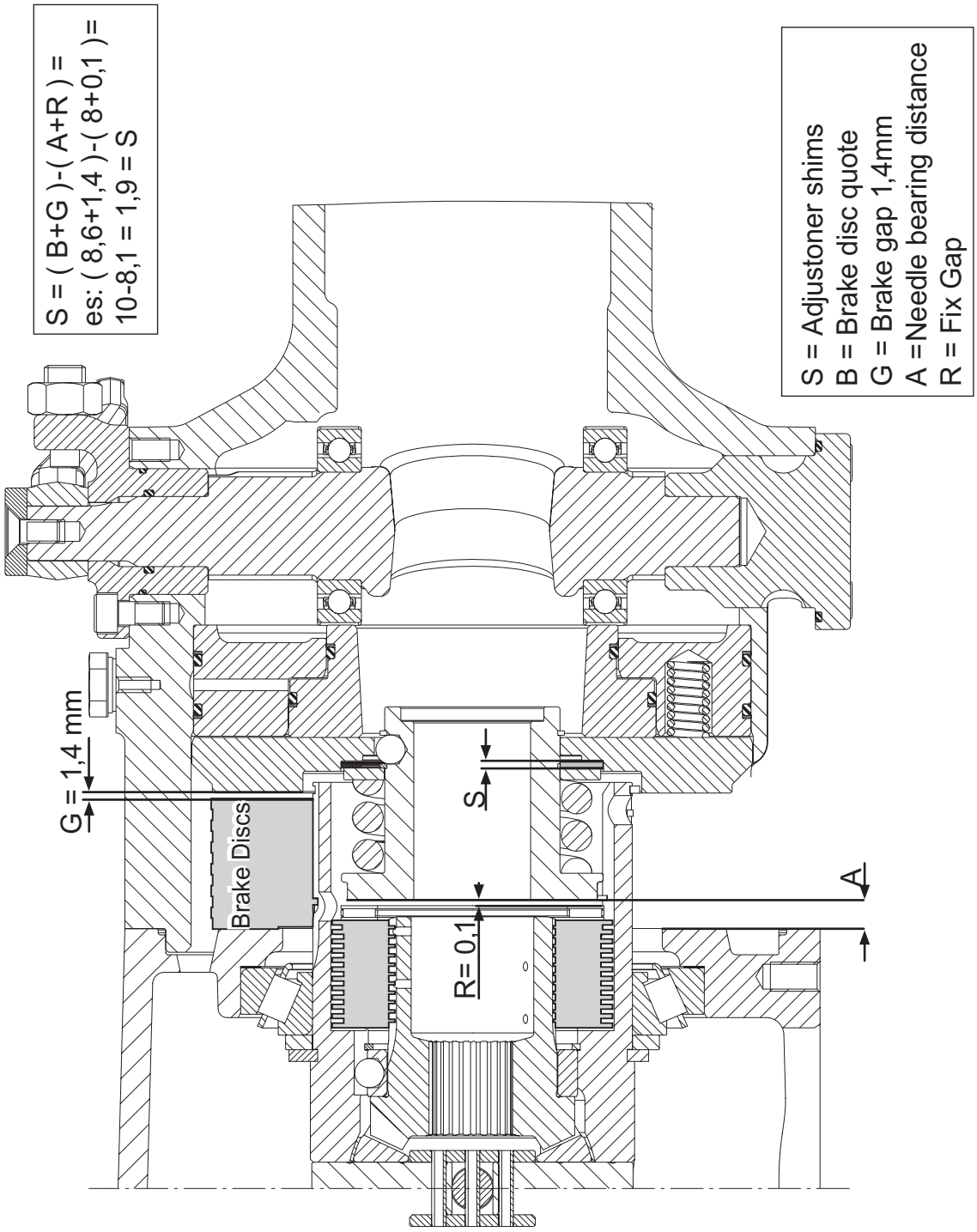


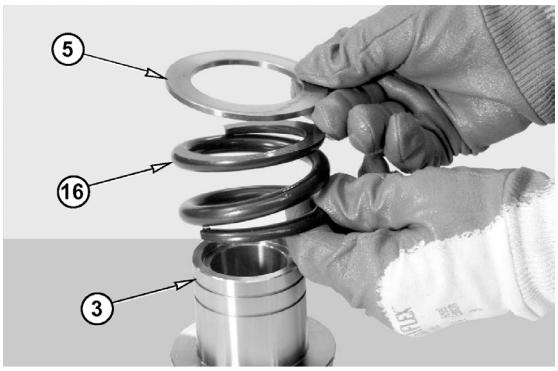
GB d

Remove washer (5) and spring (16).

ASSEMBLY BRAKE: SERVICE BRAKE AND MECHANIC PARKING BRAKE

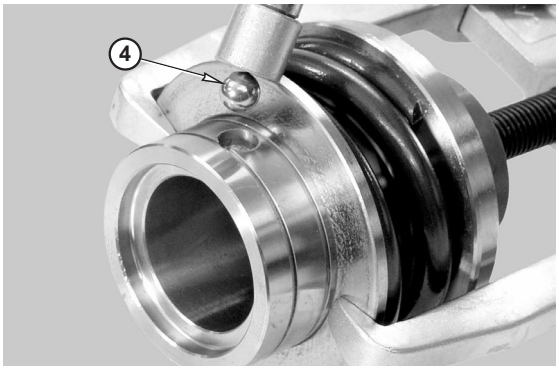



S = (B+G)-(A+R) =
es: (8,6+1,4)-(8+0,1) =
10-8,1 = 1,9 = S
S = Adjustoner shims
B = Brake disc quote
G = Brake gap 1,4mm
A = Needle bearing distance
R = Fix Gap
G = 1,4 mm
Brake Discs
S
A
R= 0,1



GB a

Insert spring (16) and washer (5) onto the hydraulic block coupling (3).



GB b

Preload the spring by using a puller acting on the washer. Insert the snap ring (15) and the fixing ball (4).

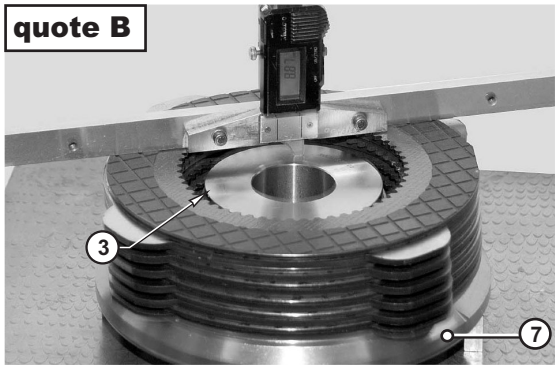


GB c

Shift the cut of the snap ring (15) according to the ball (4).
ATTENTION: The O-rings always have to be assembled from the pressure facing side.

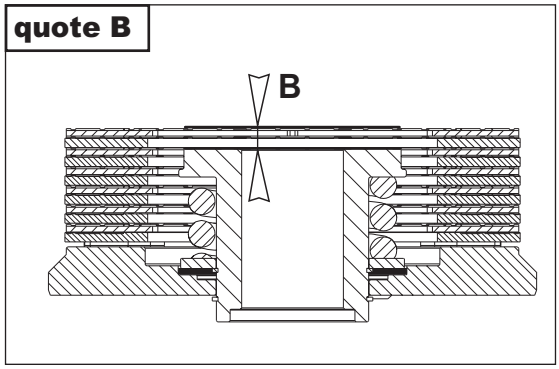


GB d



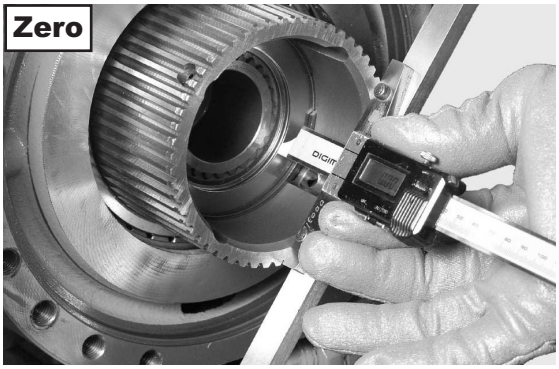
GB a

Using a surface plate, positioning disc (7), the coupling (3) and brake discs.



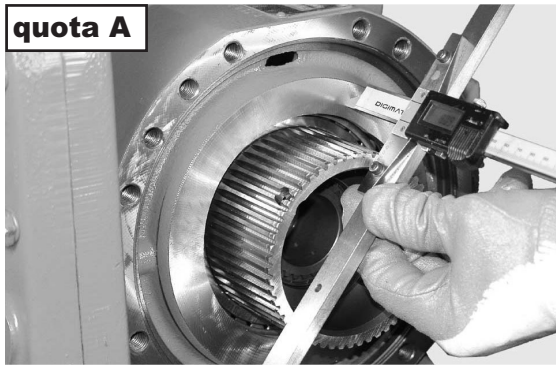
GB b

To notice the quote B between muff and first disk I brake.
Es: 8,6mm



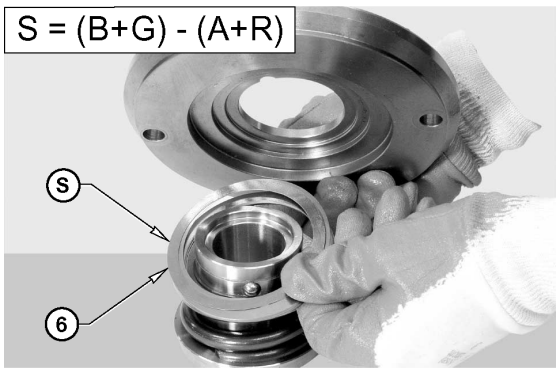
GB c

Zero the depth gage from the plane of the splined coupling to the surface of the brake discs.



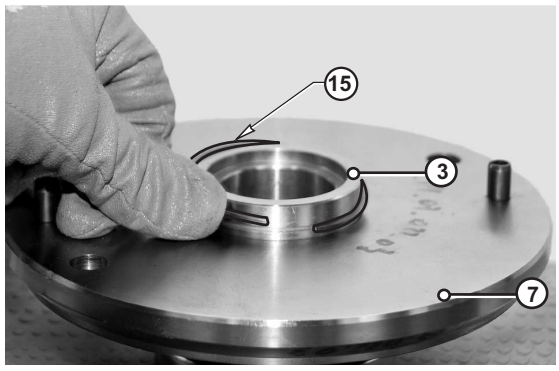
GB d

To relieve the quota A. that results between plain box and bearing.



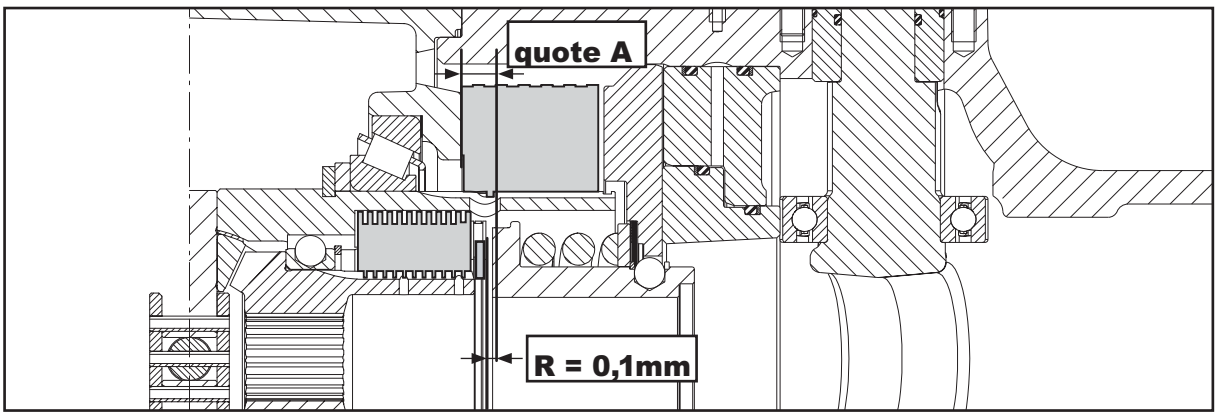
GB e

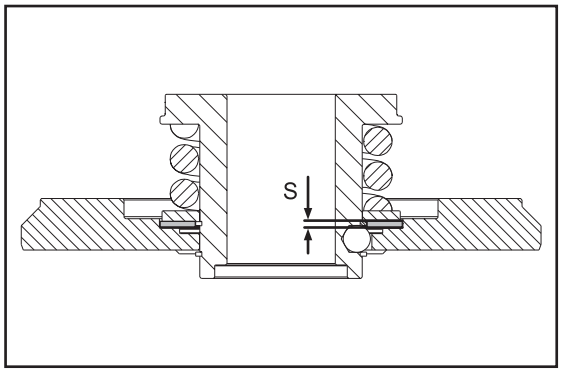
Calculation of shims S to be inserted.
S = (B+G)-(A+R)
G= o= 0,1 mm
R = fix gap = 1,4 m



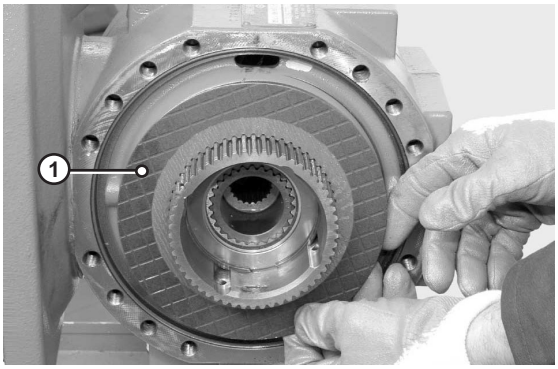
GB f

Insert and bring into position washers S (6) and coupling into the brake module.
Install the intermediary disk (7) on muff (3) staring it with the snap ring (15).



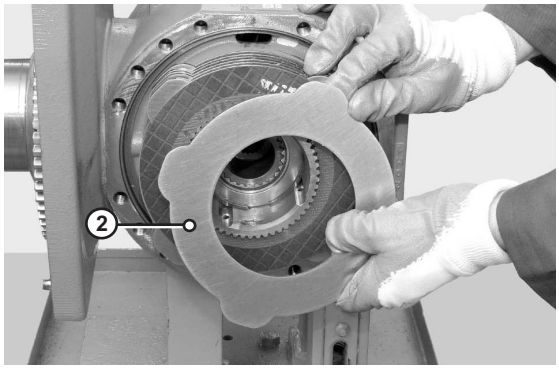


GB a



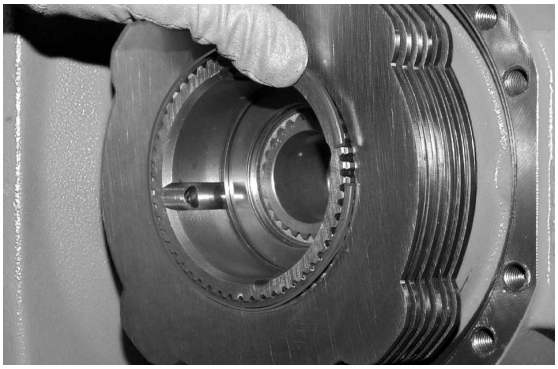
GB b

Install the first friction disc.



GB c

Install last disk brake in material metallic.



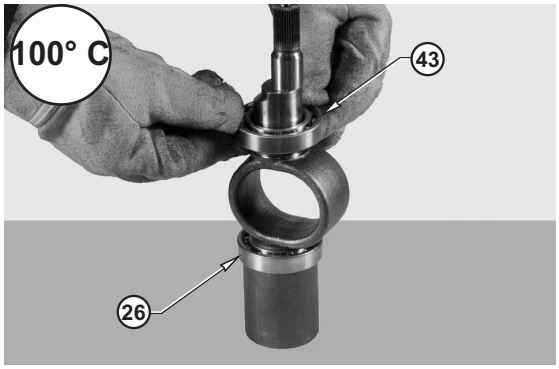
GB d

Install the snap ring of brake discs.

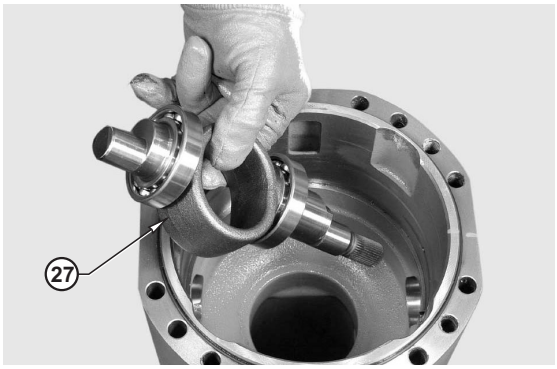


GB a

Insert the service brake piston (9) hammering alternately with a plastic hammer.

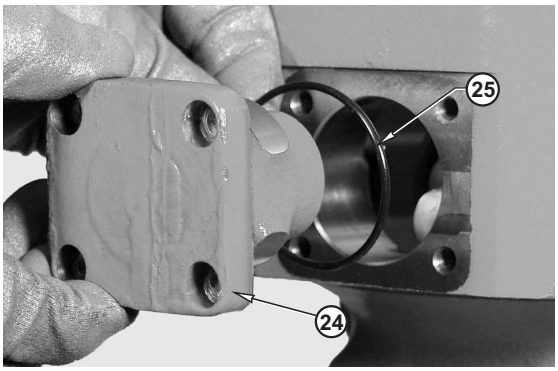


GB b



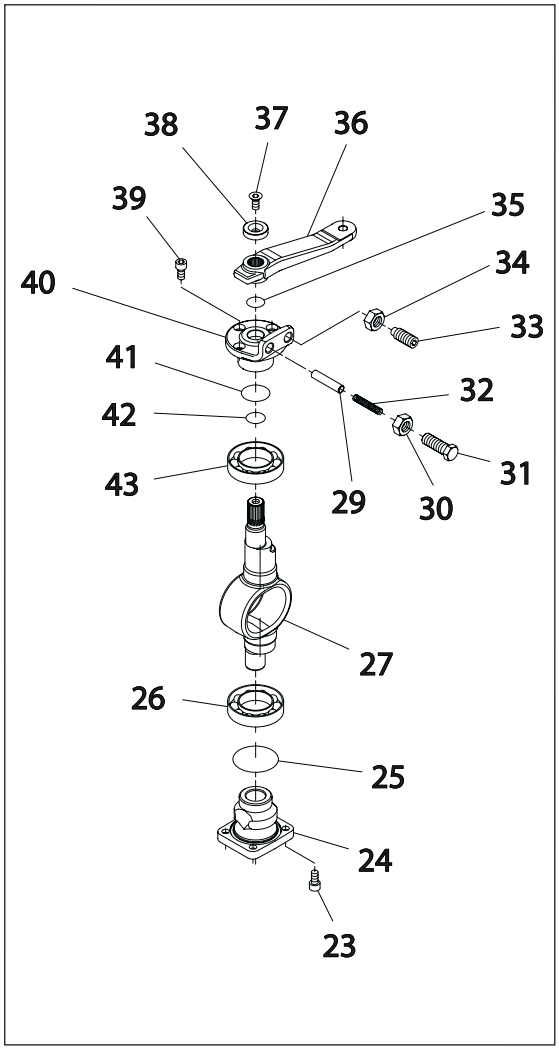
GB c

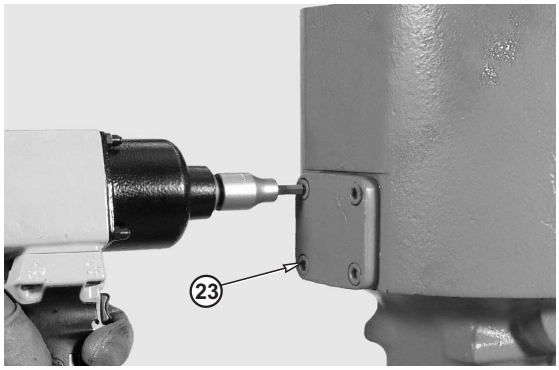
Insert the lever brake (27).



GB d

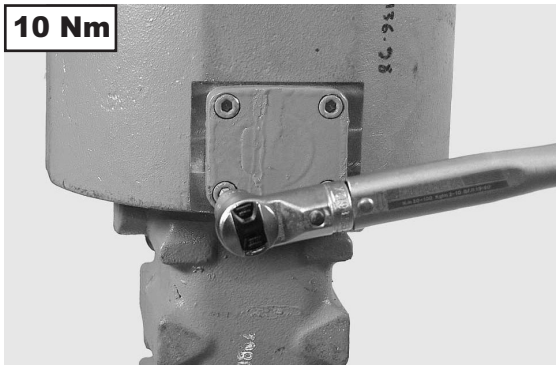
Install the thrust bushing (24) complete with new O-ring (25).





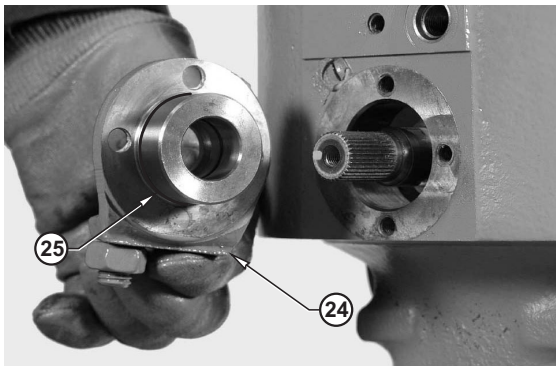
GB a

Insert screws (23).



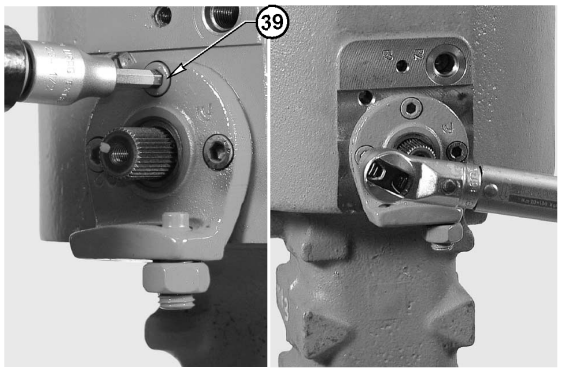
GB b

Tight the screws at 10 Nm.



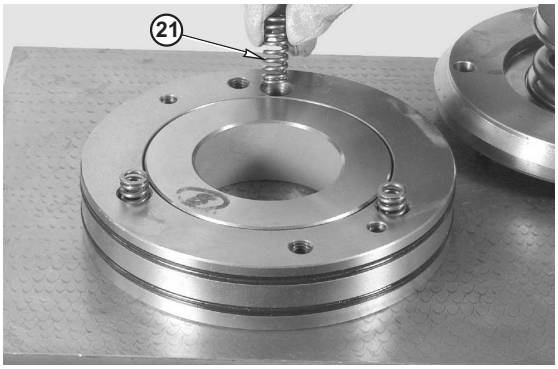
GB c

Insert the thrust bushing (24).



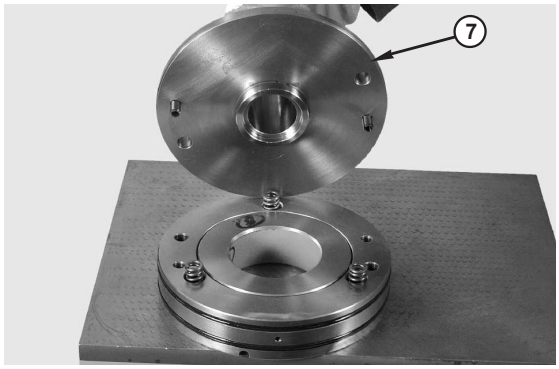
GB d

Insert screws (39).
Tight the screws at 10 Nm.



GB a

Insert the springs (21) in the piston.



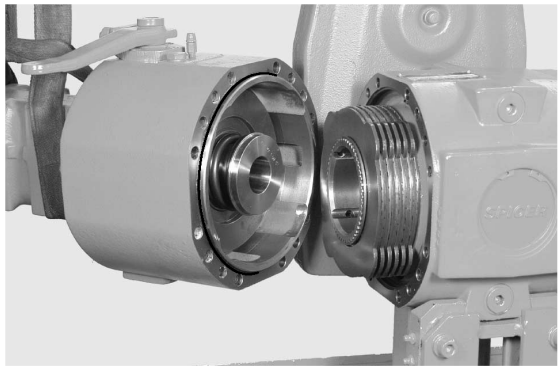
GB b

Install the intermediate brake disk on the piston.
Respect the position of assemblage.



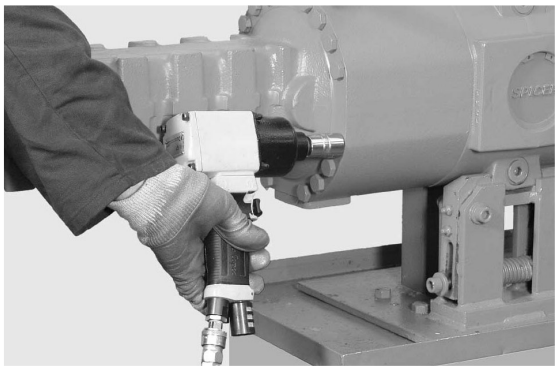
GB c

Install the piston pack

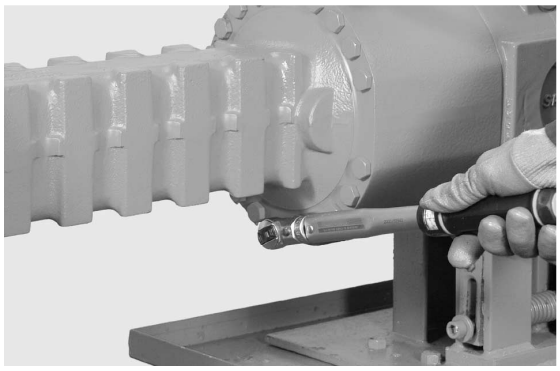


GB d

Exchange and lubricate the O-ring and insert the arm to the box.

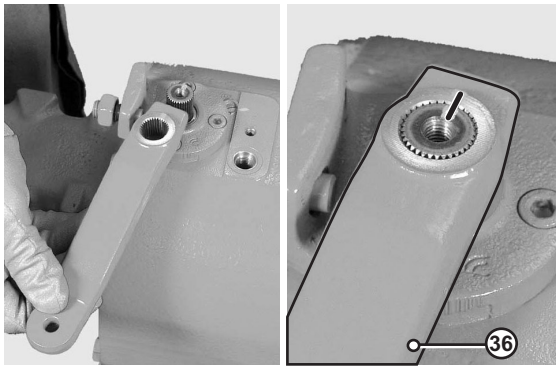


GB e



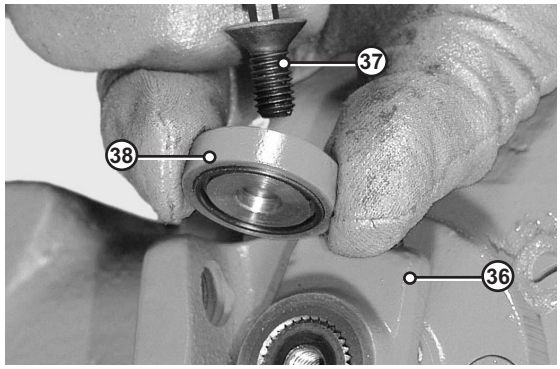
GB f

Insert the screws and tighten them alternately.



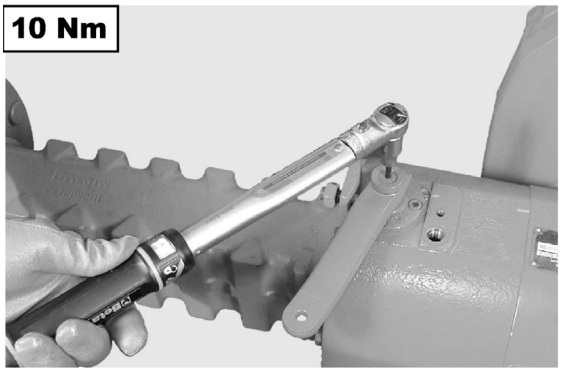
GB a

Install the brake lever (36).
Respect the position previously marked.



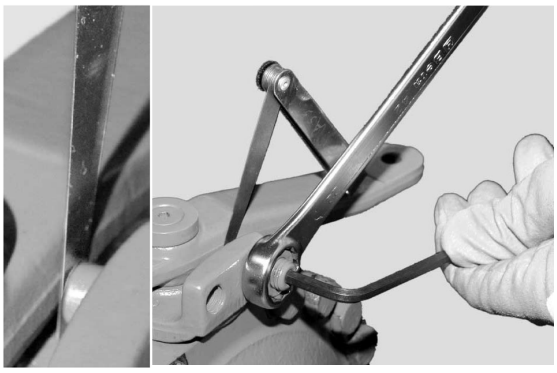
GB b

Lock the lever (36) with the screw (37) and washer (38).



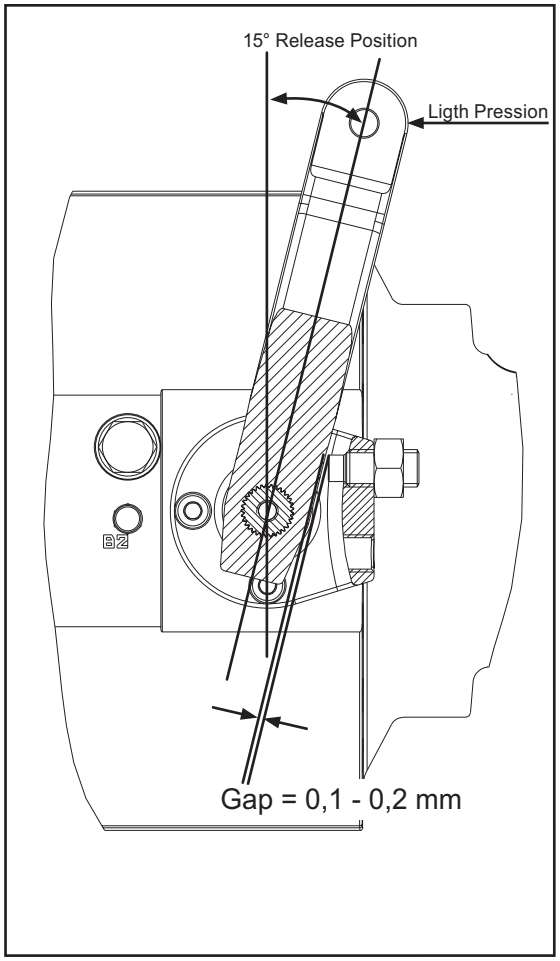
GB c

Torque wrench setting: 10 Nm



GB e

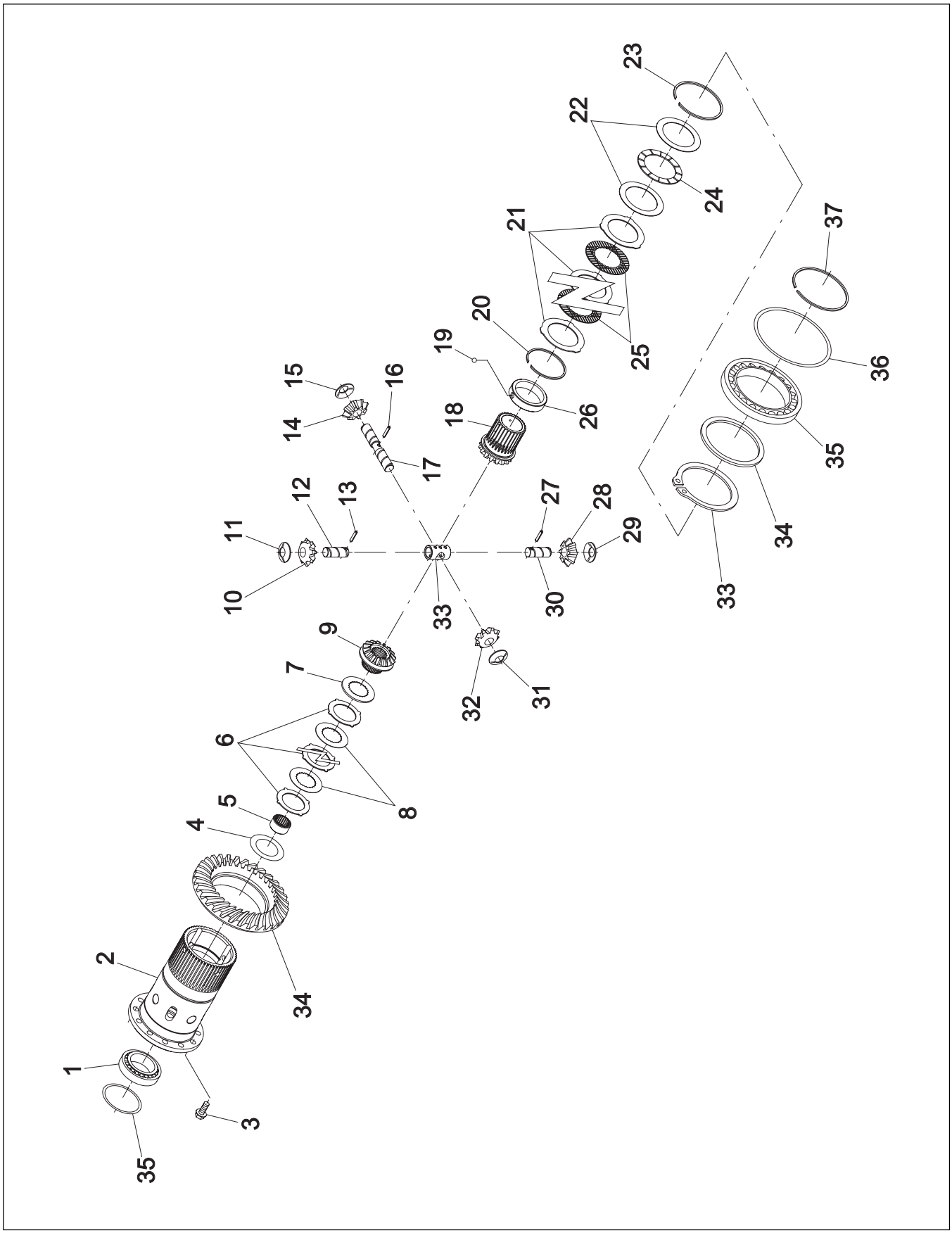
Applying a light pressure to bring in rest the lever brake to the piston, without preload the inside rubber band.

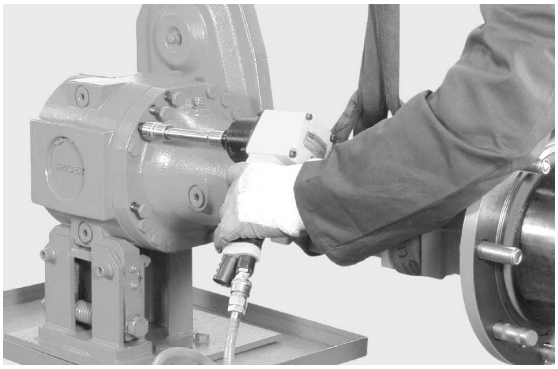


GB f

With the register screw (33) to draw near to the lever (36) leaving a gap of 0,1 - 0,2 mm.

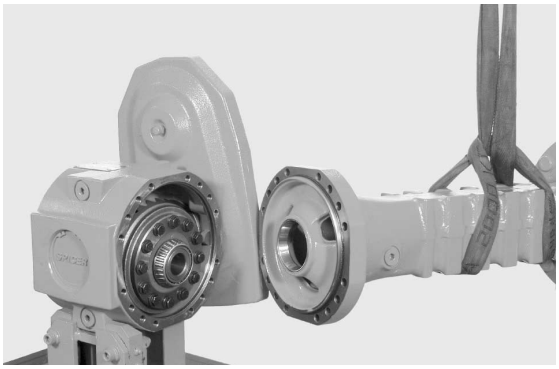
DISASSEMBLY PRELOADED LIMITED SLIP DIFFERENTIAL UNIT





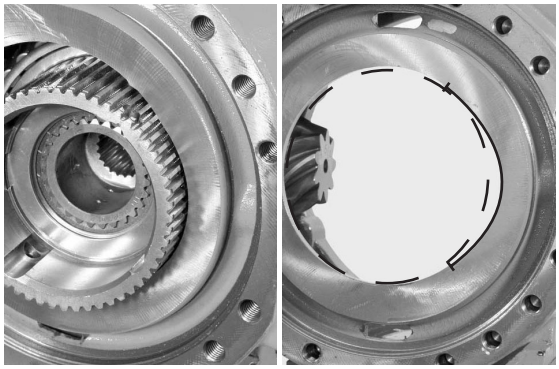
GB a

Remove the brake side arm and the brake discs pack.
Sling the arm to be removed and connect it to a hoist, remove screws of the crown wheel side arm.



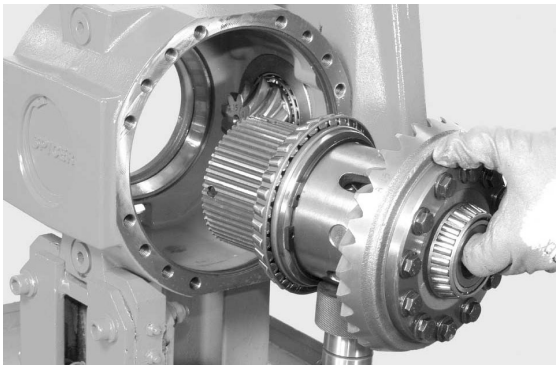
GB b

Place the arm on a bench.



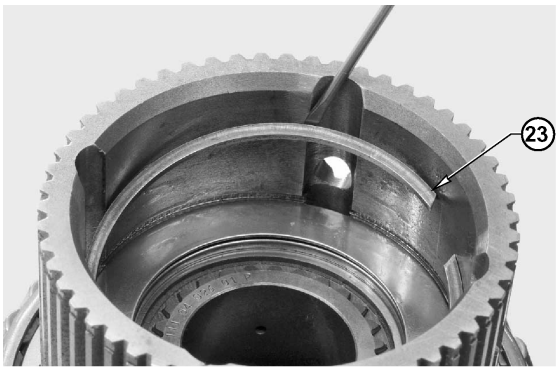
GB c

ATTENTION: Position the differential gear sideways into the recess in order to be able to pull it out.



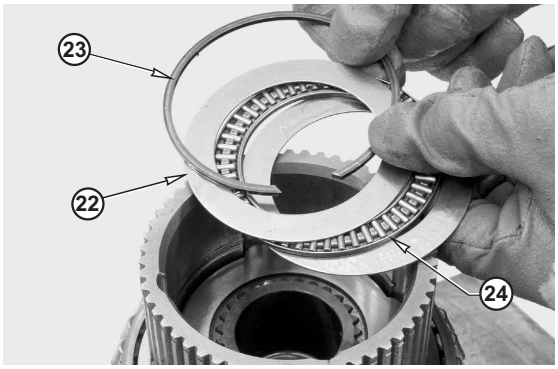
GB d

Pull out the differential.



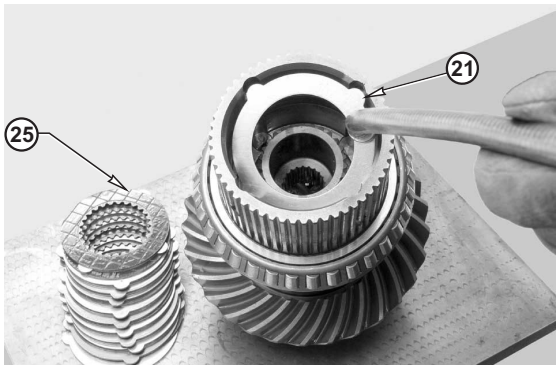
GB e

Remove the snap ring (23) that secures the thrust bearing.



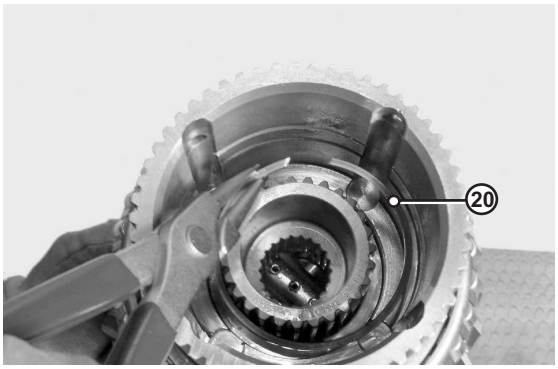
GB a

Remove the snap ring (23) and thrust bearing (24).



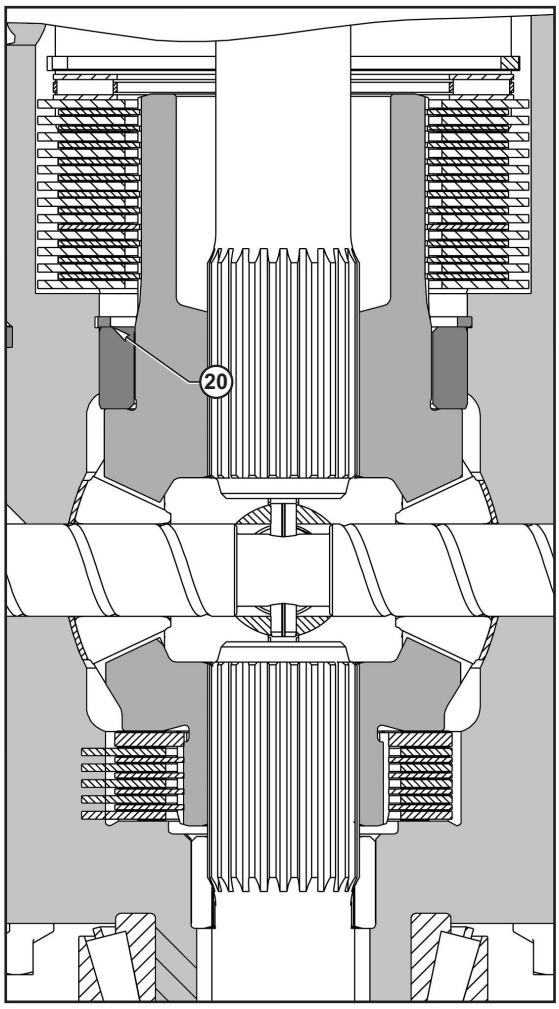
GB b

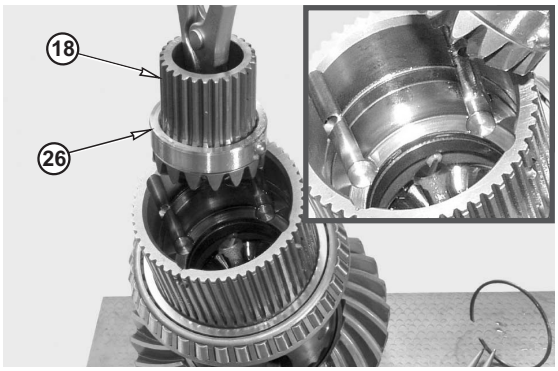
Remove the hydraulic block discs (21)(25) one after the other.



GB c

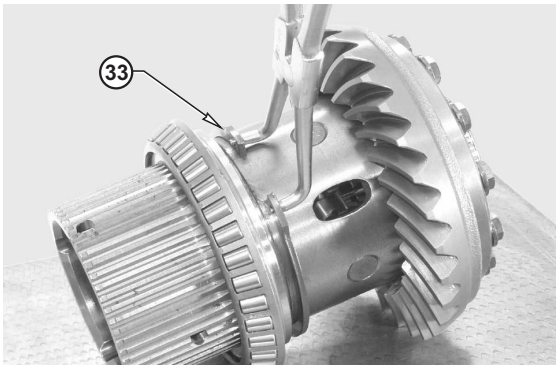
Remove the snap ring (20) that secures the planetary gear.





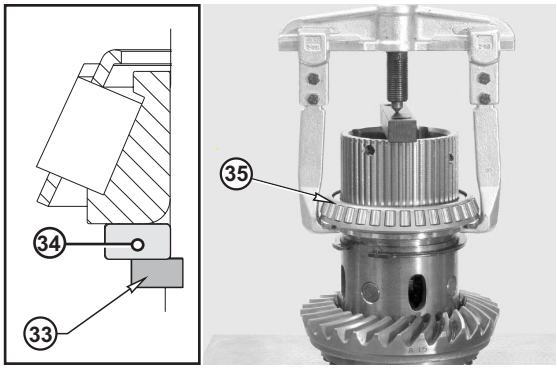
GB d

Remove the brake side planetary gear (18).



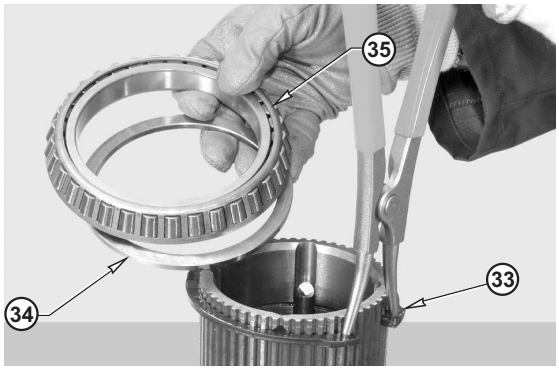
GB a

Remove the snap ring (33) out of it's seat by moving it sideways.



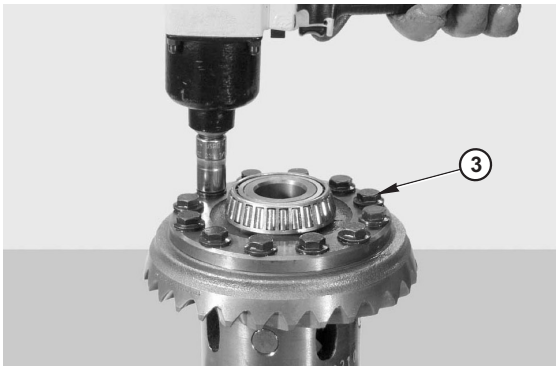
GB b

Using a puller, extract the bearing (35) and the washer (34).



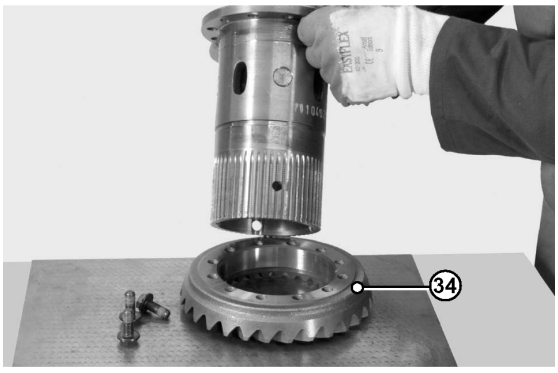
GB c

Remove completely bearing (35), washer (34) and snap ring (33).



GB d

Remove the fitting screws (3) of crown.
Renew the screws (3) at each reassembly.



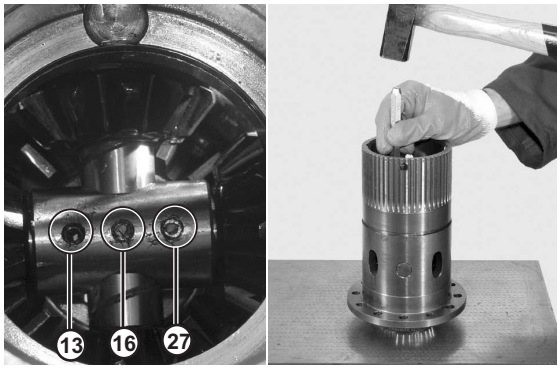
GB e

Extract the crown wheel (34).



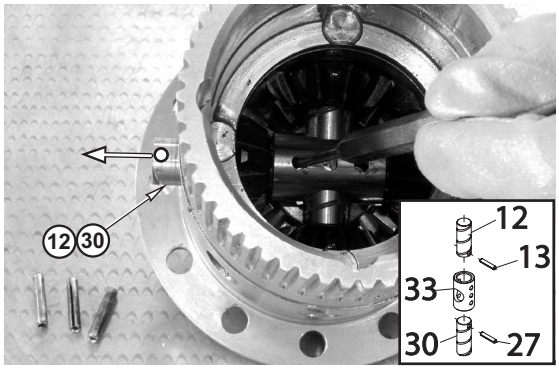
GB a

Remove the tapered roller bearing (1) of the crown wheel side, using two levers.



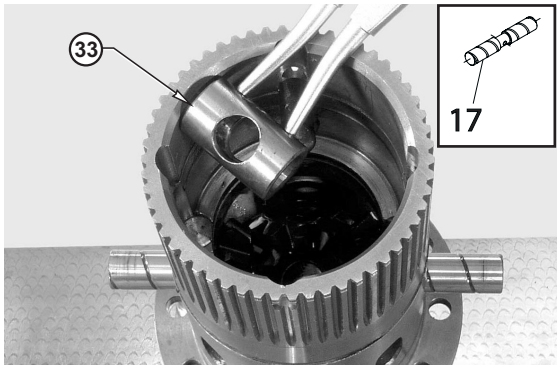
GB b

Remove the three spider blocking pins (13)(16)(27) by using a pin driver.



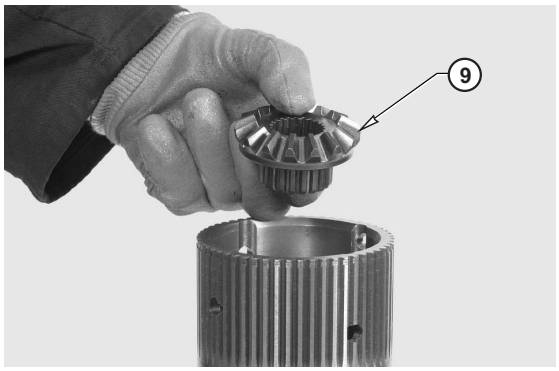
GB c

Move the two opposite mounted short bolts (12)(30) to the outside of the box using the same pin driver.



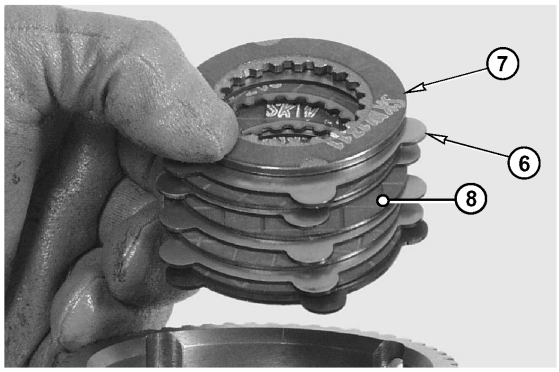
GB d

Drive out the long bolt (17) and pull out the spider (33) from the centre.



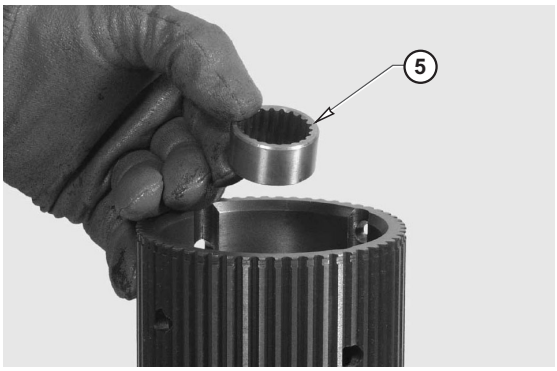
GB e

Remove the planetary gear (9).



GB f

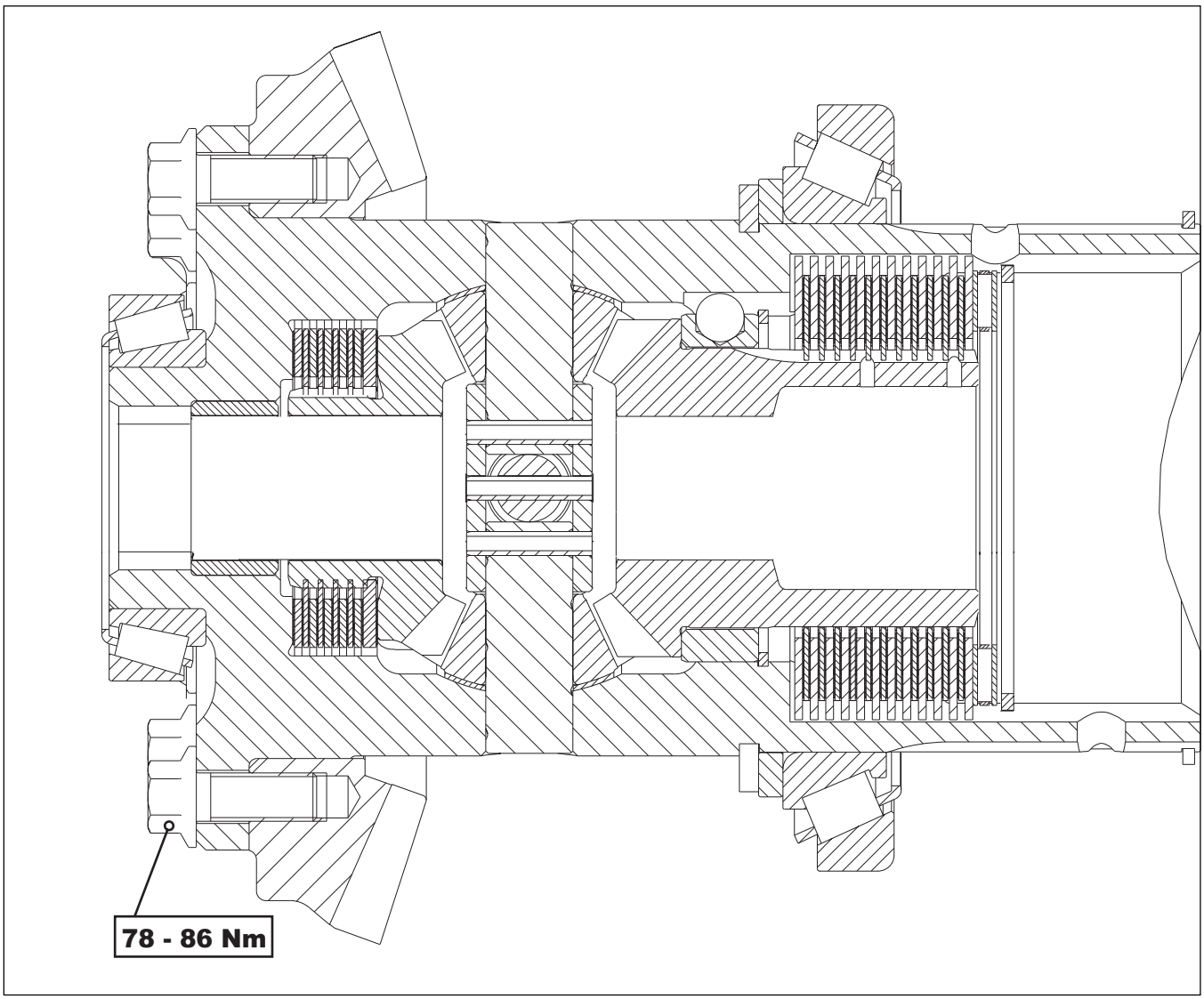
Remove the limited slip discs friction (6)(7)(8) .
CAUTION! 1 - Do not change the position of the disks forming the friction.



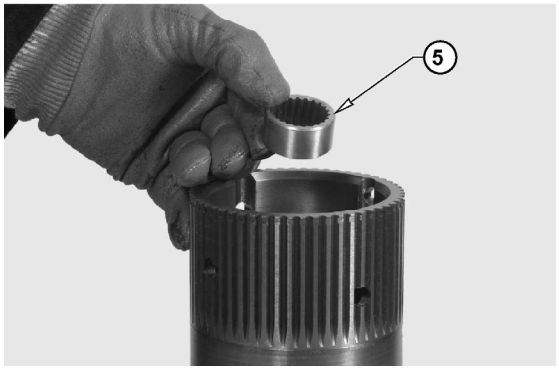
GB

a

Remove the half shaft bushing (5).

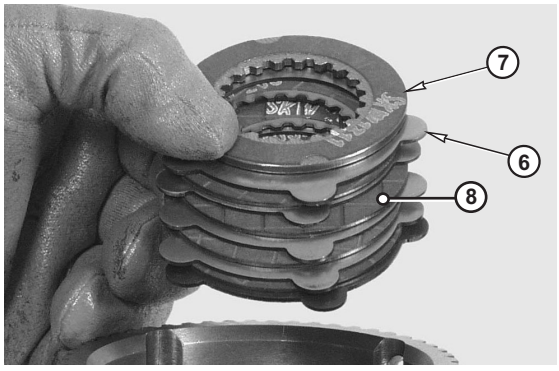


ASSEMBLY PRELOADED LIMITED SLIP DIFFERENTIAL UNIT



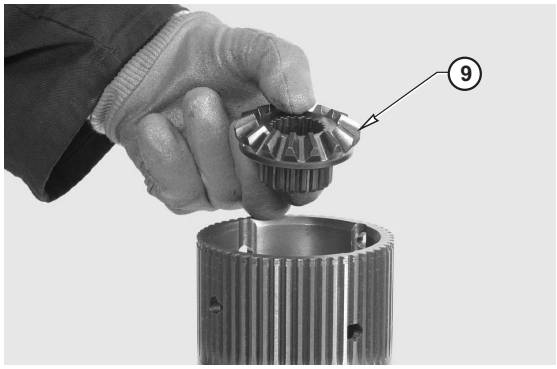
GB a

Install the half shaft bushing (5).



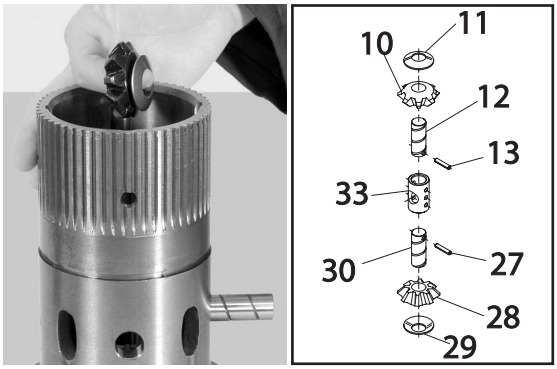
GB b

Insert in the body of the differential unit any required shims and the friction (6)(7)(8).



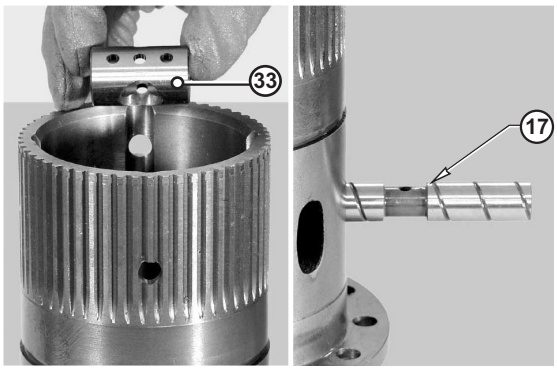
GB c

Install the planetary gear (9).



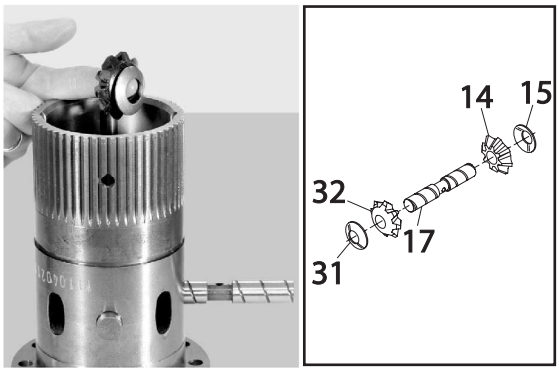
GB d

Install the planetary gears (10)(28) and spherical shoulder washers (11)(29) onto the shafts (12)(30).



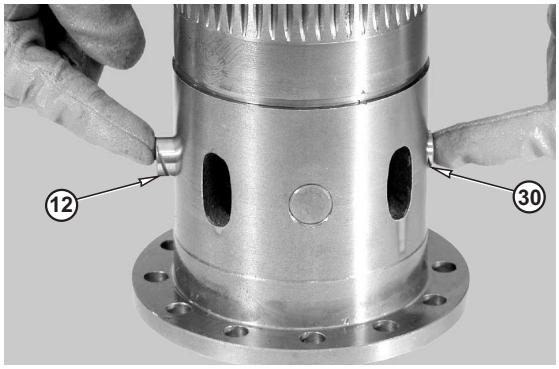
GB e

Insert spider (33) and partially insert the long bolt (17).



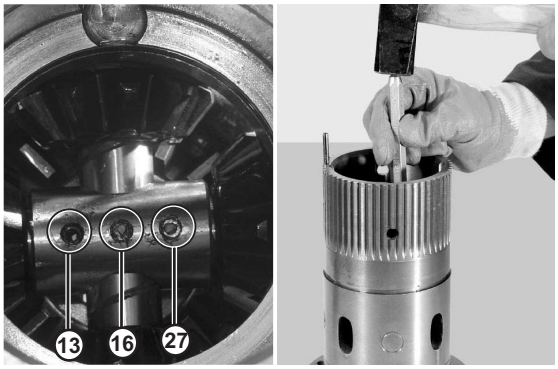
GB f

Satellite wheels (32)(14), spherical washers (15)(31) and completely insert the long bolt (17).



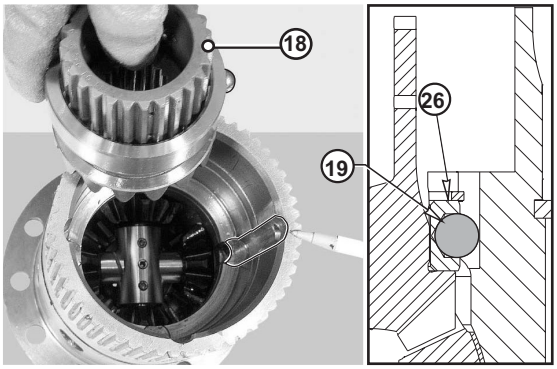
GB a

Insert completely the half bolts (30)(12).



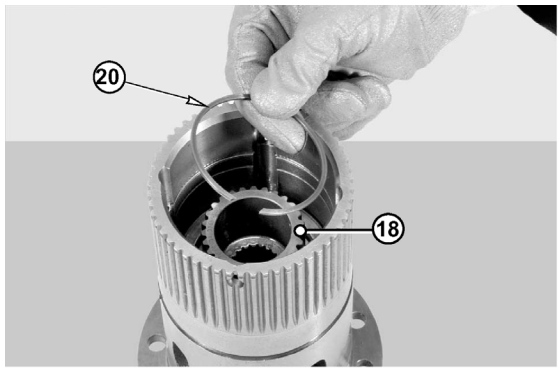
GB b

Centre the pin holes and insert the 3 pins (13)(16)(27).
NOTE: Check the free rotation of the satellite wheels on the bolts.



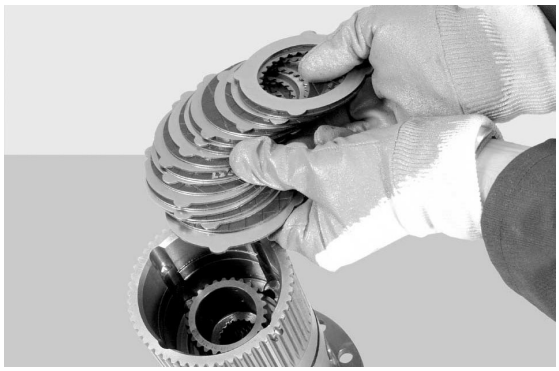
GB c

Insert the planetary wheel (18) together with the centering sleeve (26).
NOTE: The centering sleeve must have the fixing ball (19) assembled.



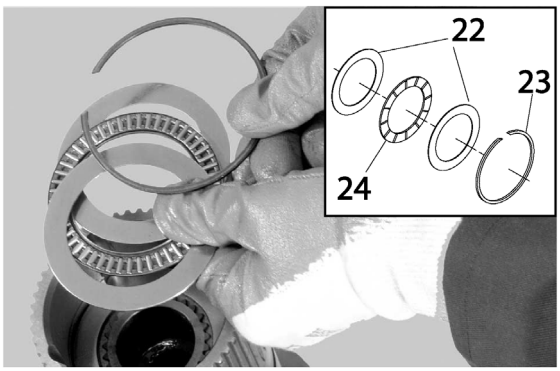
GB d

Insert snap ring (20) of the planetary wheel (18).



GB e

Insert and substitute, if necessary, the discs of the differential lock.
ATTENTION: First and last disc have to be of steel.



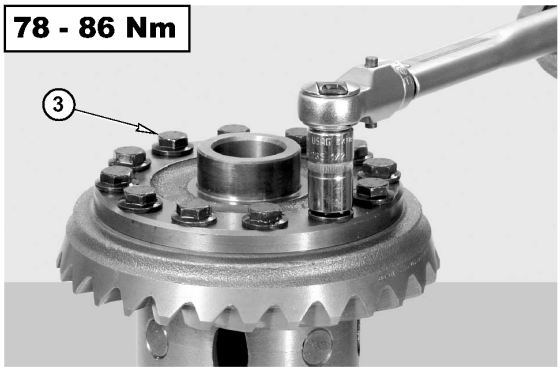
GB f

Insert thrust (24) bearing and snap ring (23).



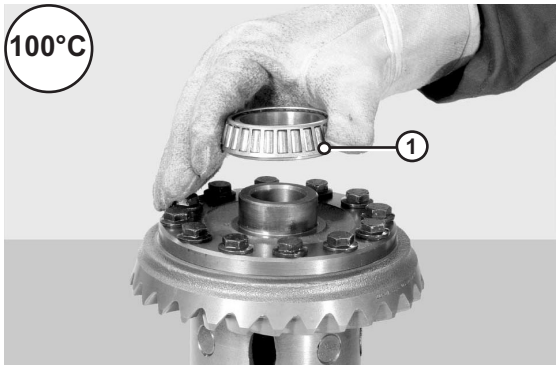
GB a

Insert crown wheel (34).



GB b

Insert the screws (3). Tighten screws with a torque wrench setting of 78-86 Nm.
NOTE: Always use new screws to fix the crown wheel. In case the screws are not thread locking pretreated, use Loctite 270.



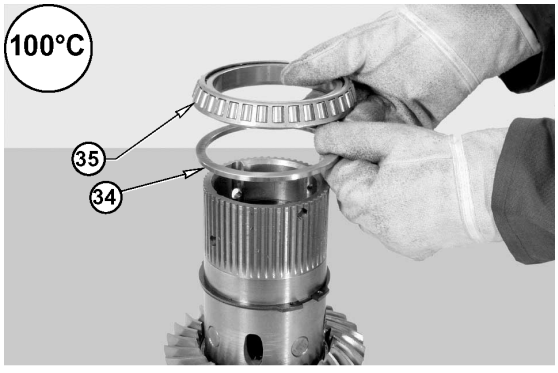
GB c

Assemble the bearing (1).
NOTE: Heat the bearing to 100 °C before assembling.



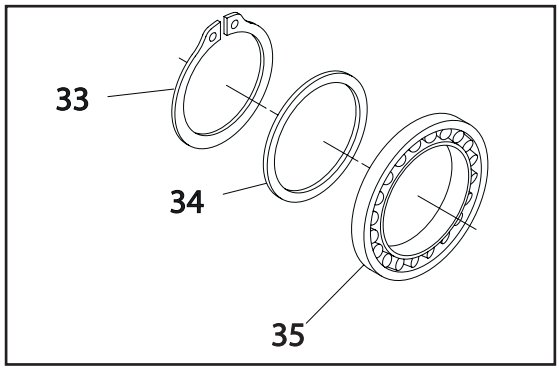
GB d

Assemble the snap ring (33) in it's seat.



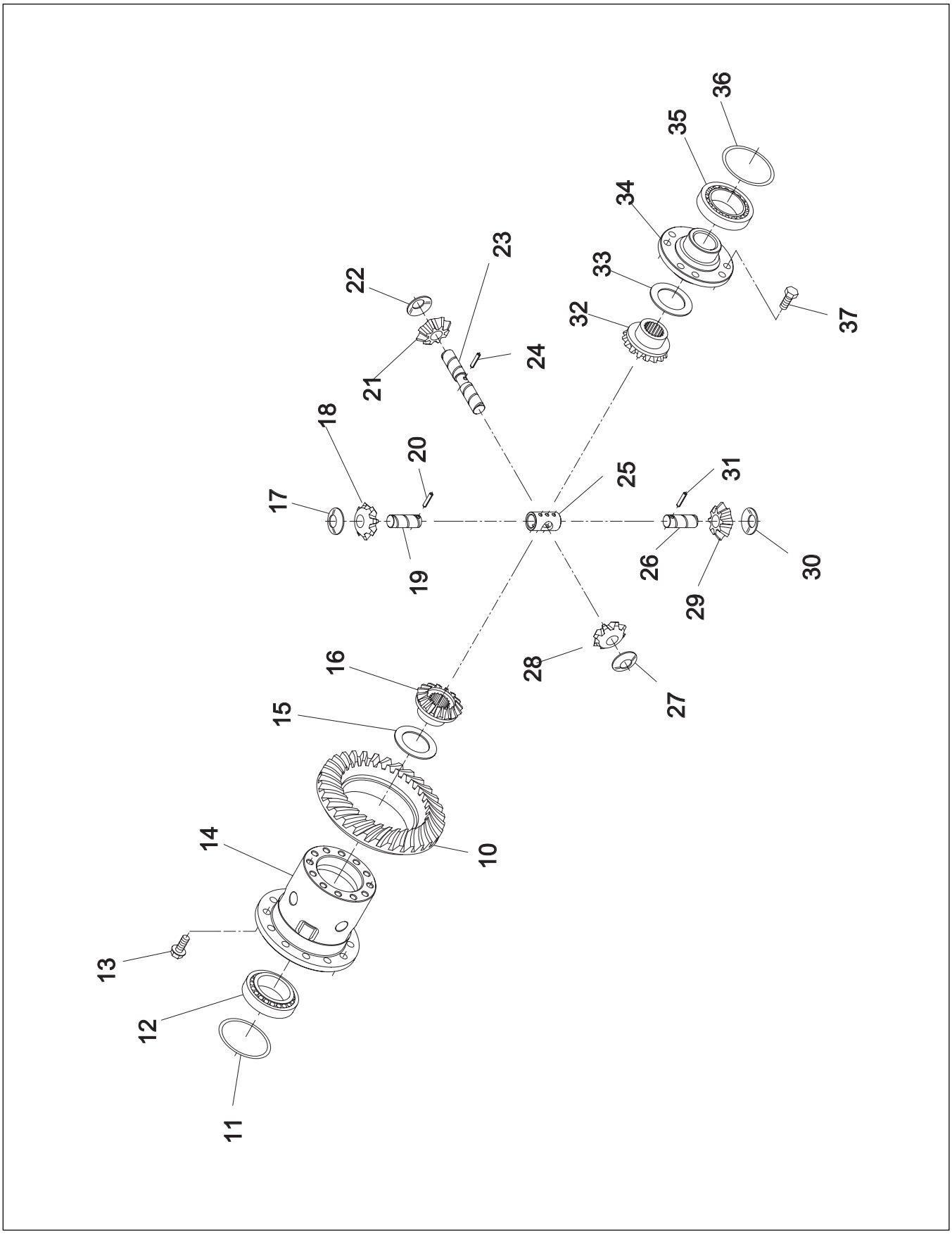
GB e

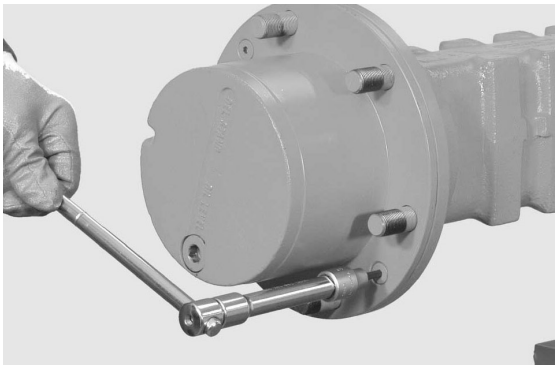
Assemble shim (34) and bearing (35).
NOTE: Heat the bearing as well as the shim to 100 °C before assembling.



GB f

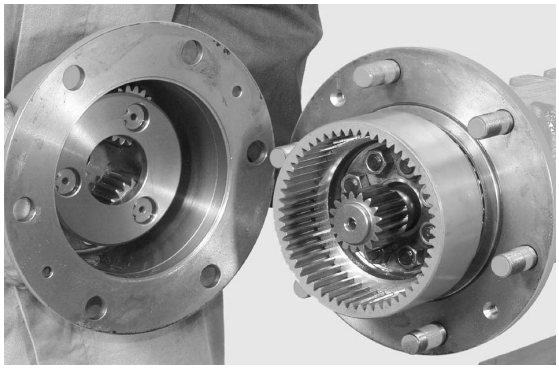
DISASSEMBLY NORMAL DIFFERENTIAL





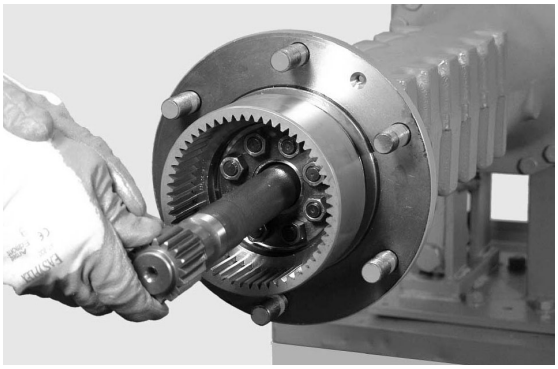
GB a

Remove the locking screws of planetary cover.



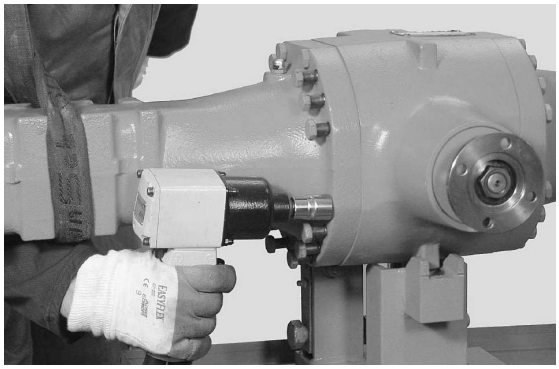
GB b

Remove the cover.



GB c

Remove the axle shaft.



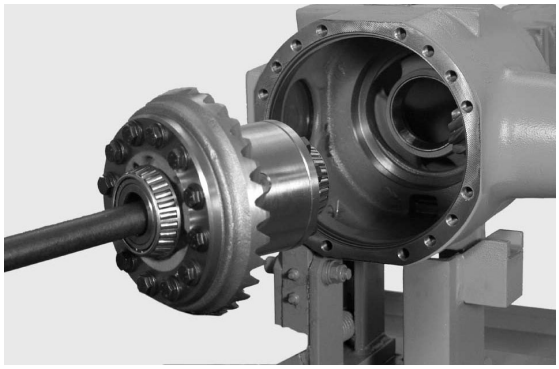
GB d

Sling the arm to be removed and connect it to a hoist.
Loosen and remove screws and nuts.



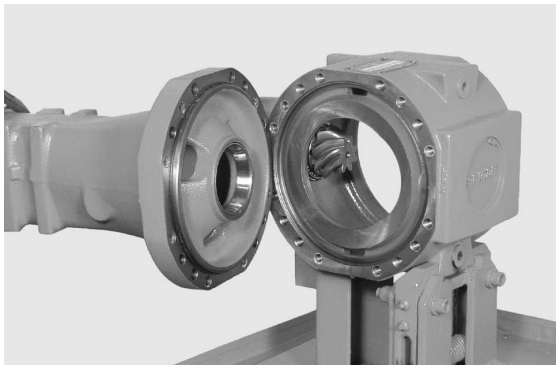
GB e

Remove arm together with brakes and axle shaf ts;lay down the arm ver tically.



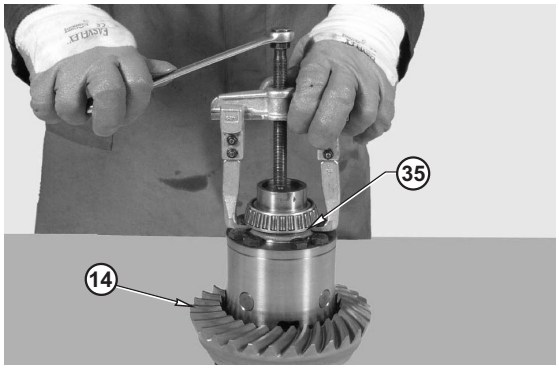
GB a

Extract the whole differential unit.



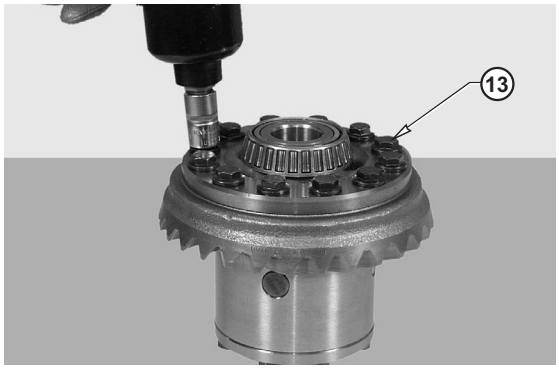
GB b

Remove the opposite side arm.



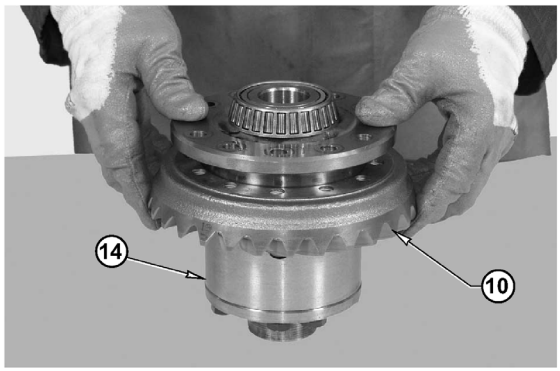
GB c

Extract the bearing (35) from the differential carrier (14).



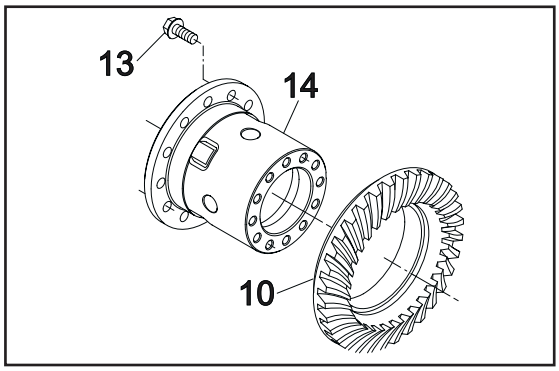
GB d

Remove the crown wheel fixing screws (13).

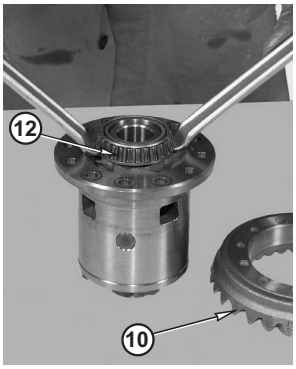


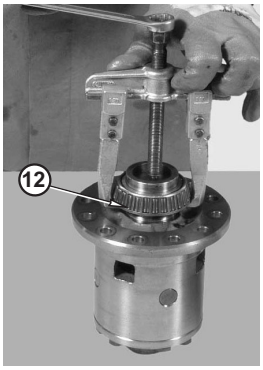
GB e

Separate the crown wheel (10) from the differential box (14).



GB f





GB a

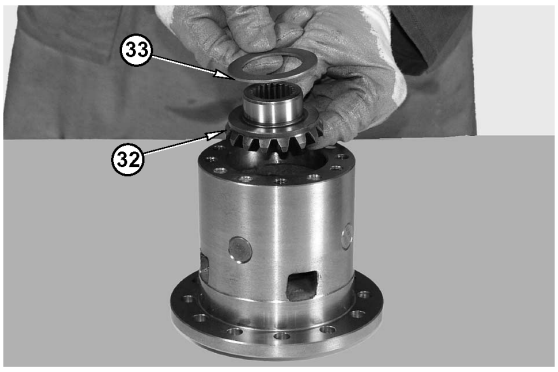
Extract the bearing (12) partially and using a puller, remove the bearing (12) of the crown wheel side (10).





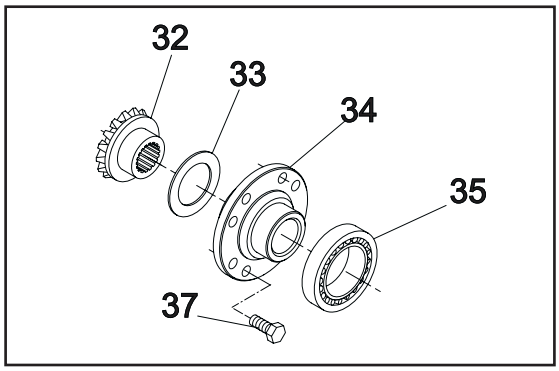
GB b

Remove the cover (34) from the blocking side of the differential unit.

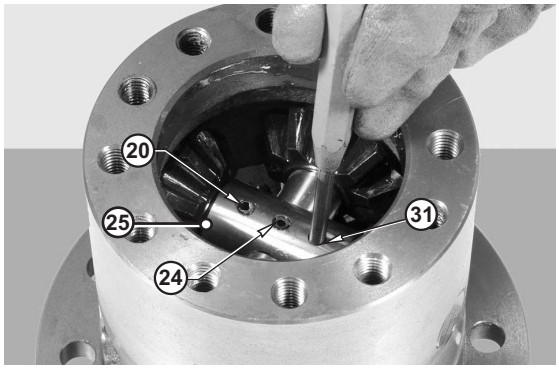


GB c

Remove the shim washer (33) and the planetary gear (32).

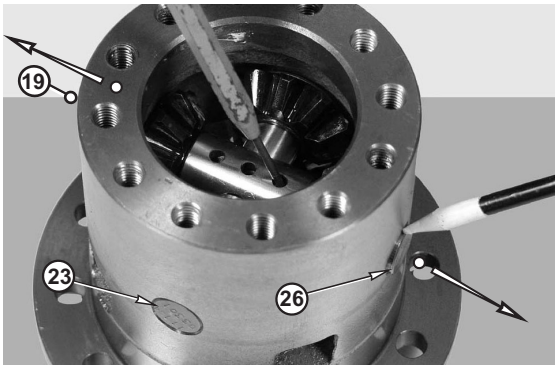


GB d



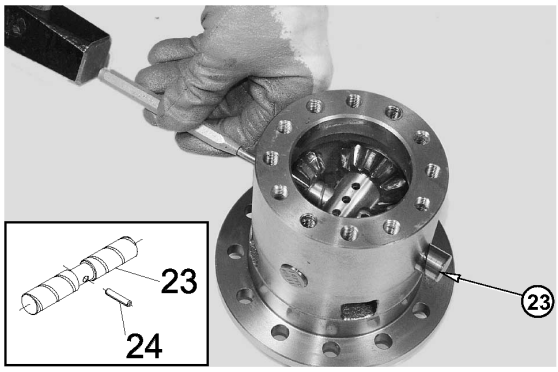
GB a

Remove the fixing pins (20)(24)(31) of the differential cross bolts (25).



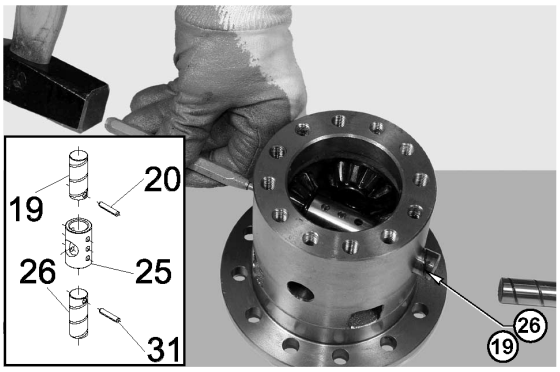
GB b

With a pin-driver push the two bolts (19)(26) to the outside.



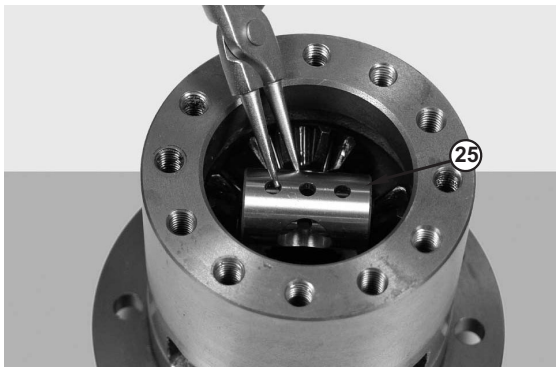
GB c

Remove the bolts with the help of a drift (23).



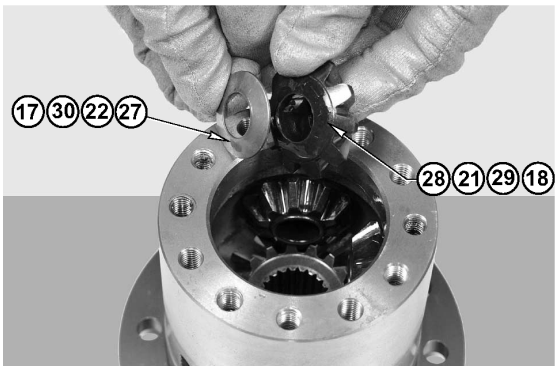
GB d

Remove the two halfes of the cross bolts (19)(26) with the help of a drift.



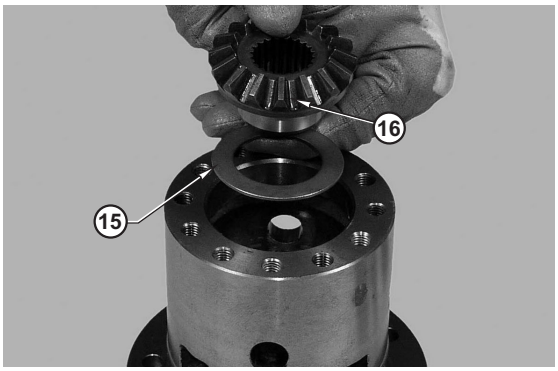
GB e

Remove the cross bolts (25).



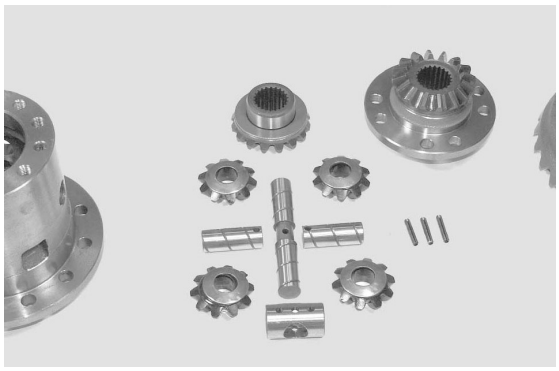
GB f

Remove the gear wheels (28)(21)(29)(18) and the spherical washers (17)(30)(22)(27).



GB a

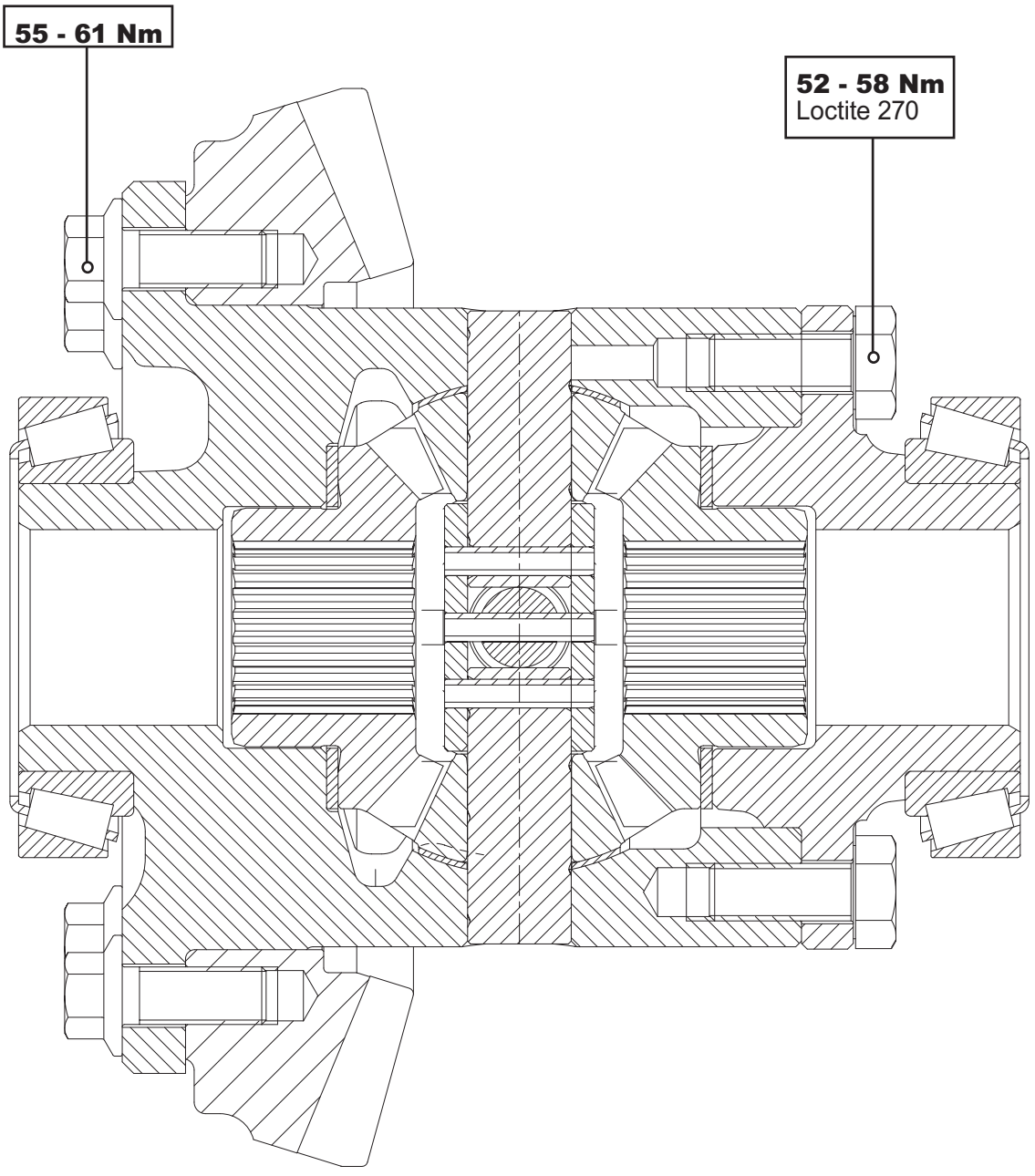
Remove the shim washer (15) and the planetary gear (16).

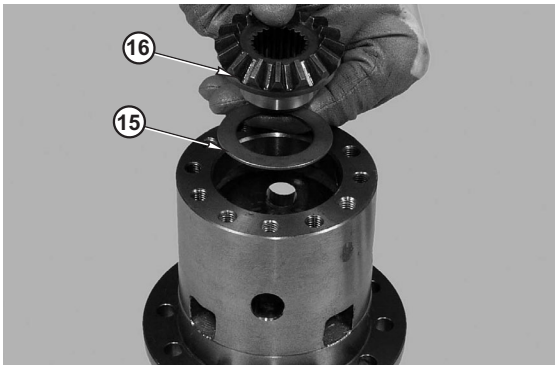


GB b

The components of the differential unit.

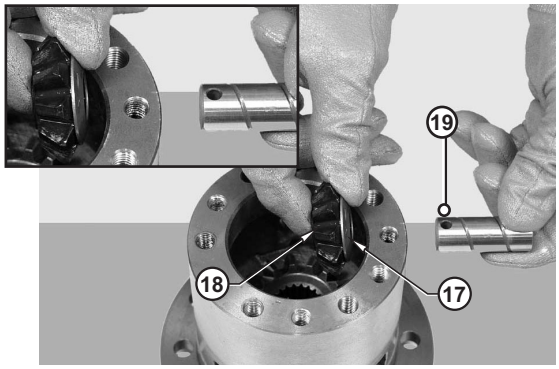
ASSEMBLY NORMAL DIFFERENTIAL





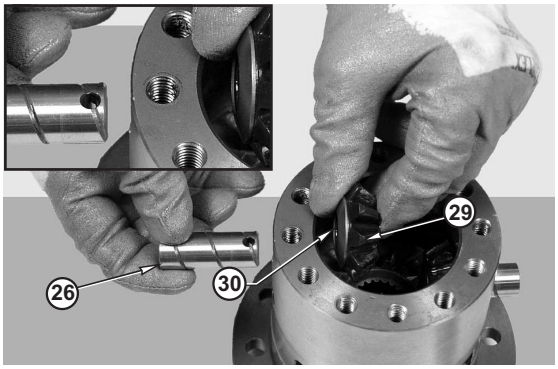
GB a

Insert the washer (15) and the gear wheel (16) on the crown wheel side.



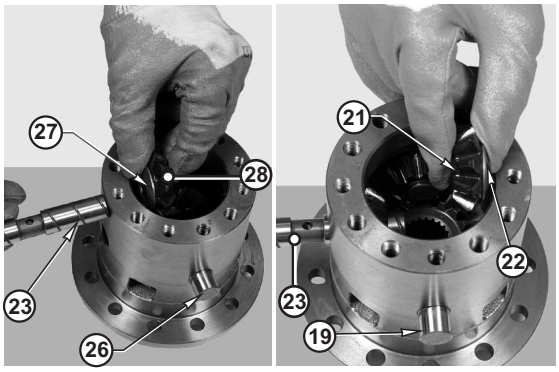
GB b

Insert the gear wheel (18) with the spherical washer (17) and the bolt (19) to keep them in position.



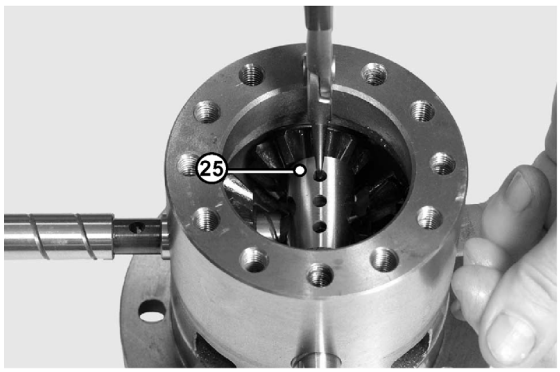
GB c

Insert the gear wheel (29) with the spherical washer (30) and the bolt (26) to keep them in position.



GB d

Insert the gear wheels (28)(21) with the spherical washers (27)(22) and the bolt (26)(19).



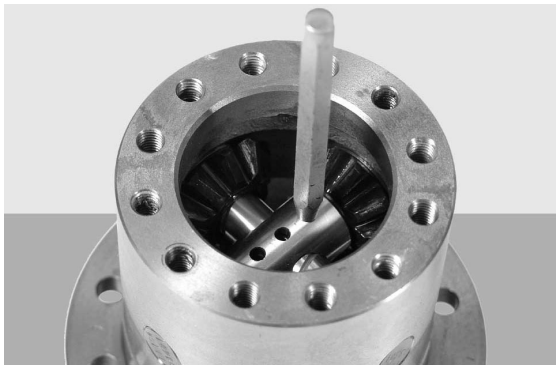
GB e

Insert the crossbolt (25) in the correct position.



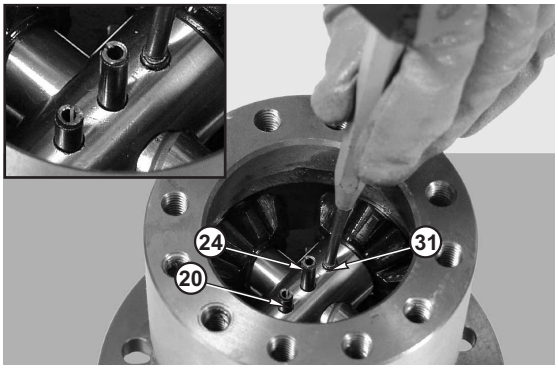
GB a

Insert the bolts in their position.



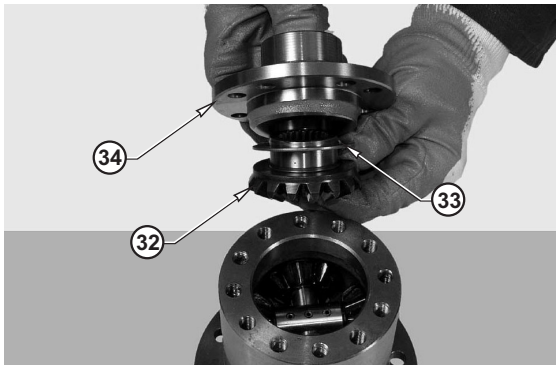
GB b

Bring the pin holes in line with the help of a pin-driver.



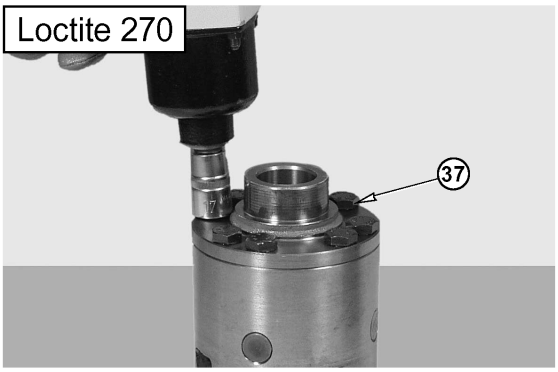
GB c

Insert pins (20)(24)(31) to end of stroke.



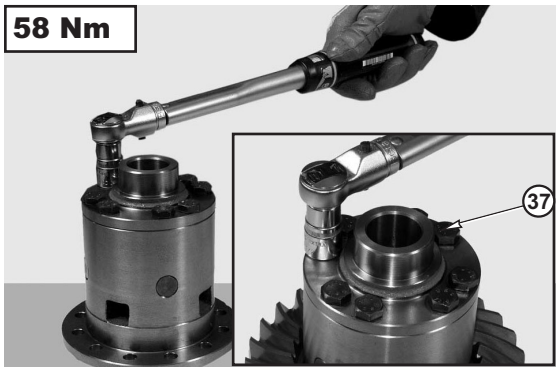
GB d

Insert planetary gear wheel (32) together with washer (33).



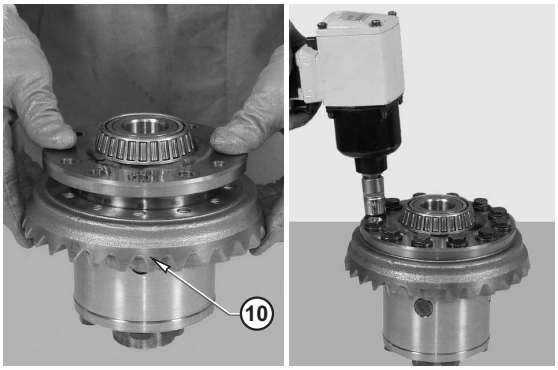
GB e

Coat the nuts (37) with Loctite 270 and screw them.



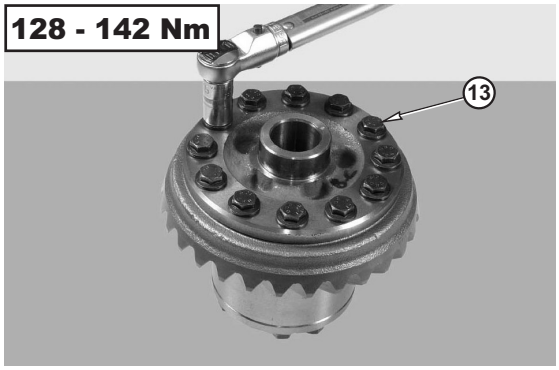
GB f

Torque wrench setting: 58 Nm.



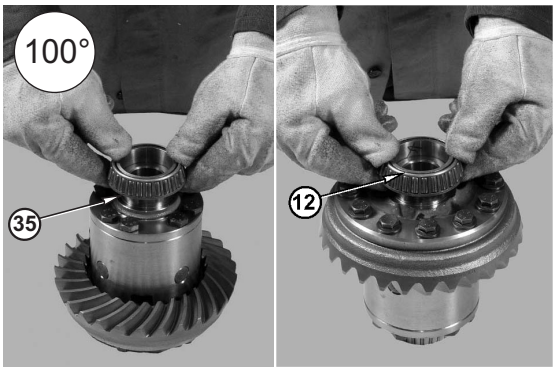
GB a

Install the crown wheel (10).
Fix the screws (13) of the crown wheel.
NOTE: use LOCTITE 270 on screws not treated with DRILOC.



GB b

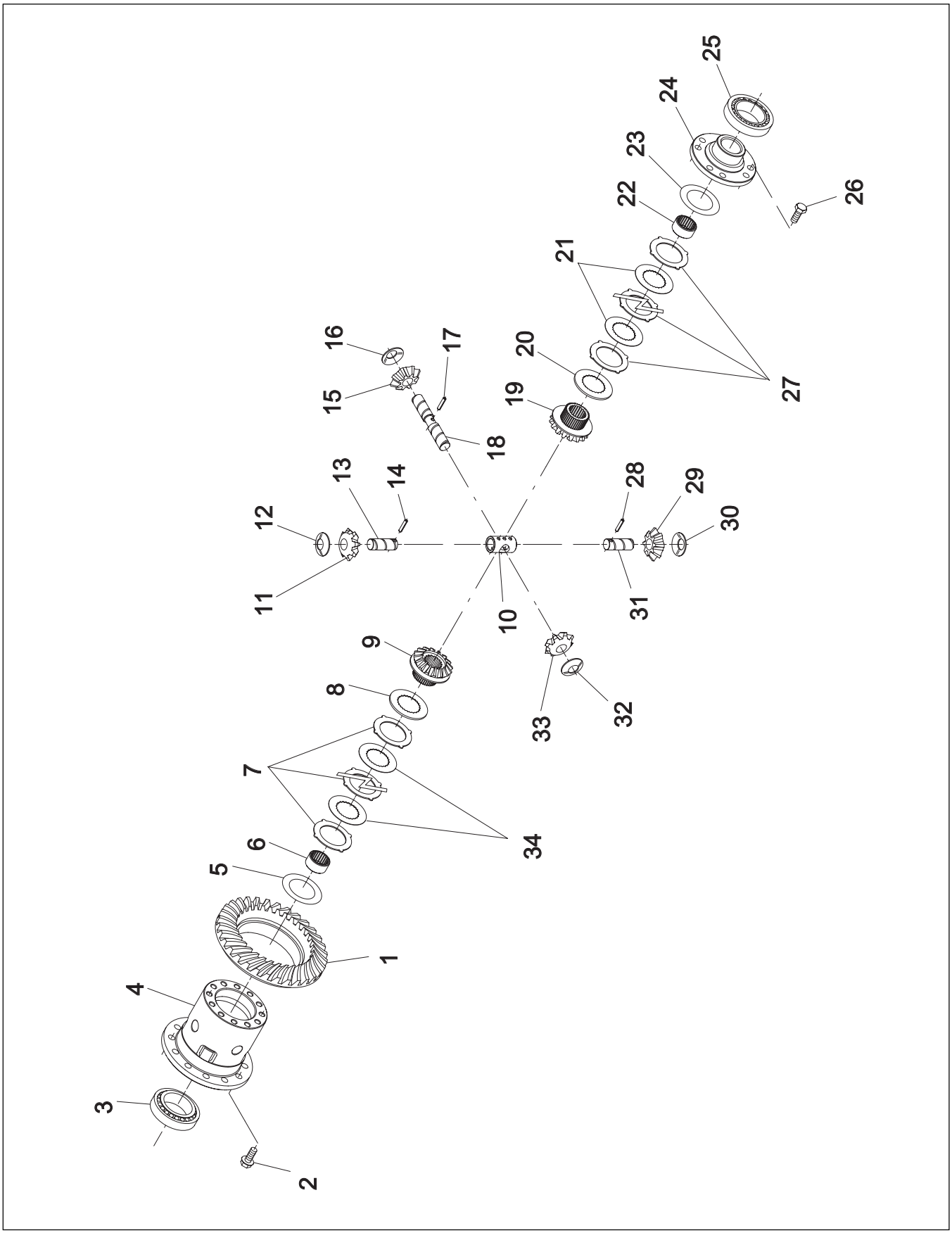
Tighten the screws of the crown wheel using the criss cross method.
Torque wrench setting: 128-142 Nm

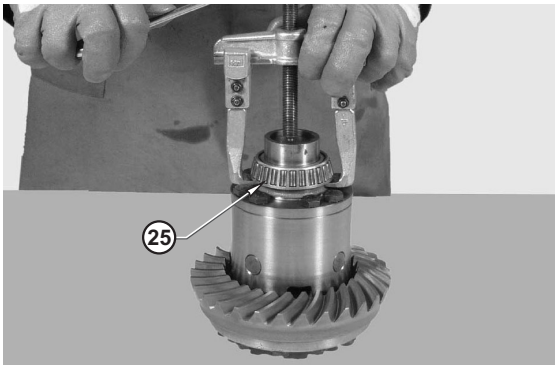


GB c

Heat up the roll bearings (12)(35) to 100°C and insert it onto the differential.

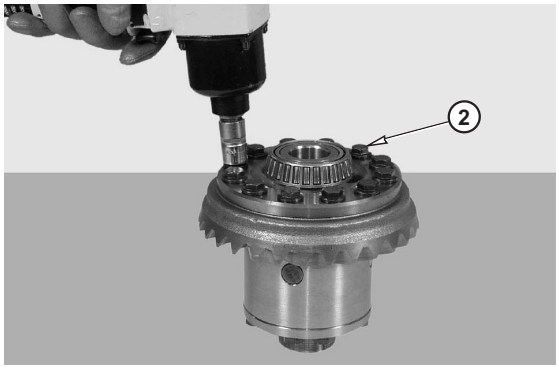
DISASSEMBLY LIMITED SLIP DIFFERENTIAL UNIT (45%)





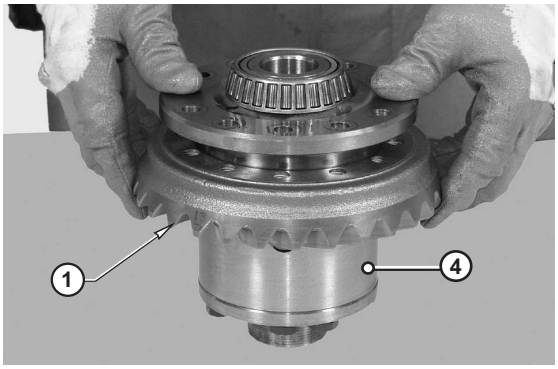
GB a

Extract the bearing (25) from the differential carrier.



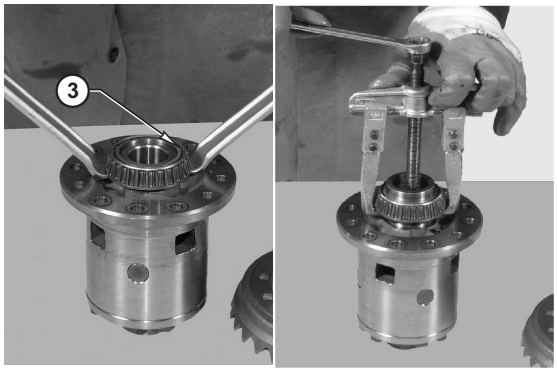
GB b

Remove the crown wheel fixing screws (2).



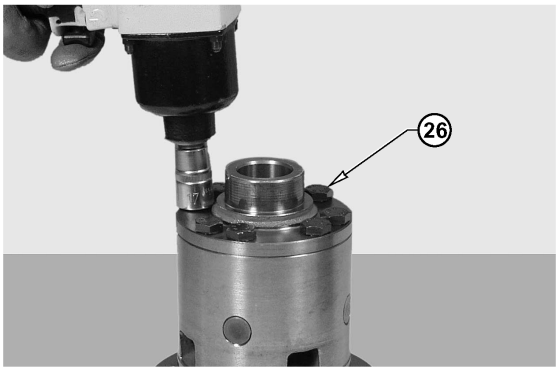
GB c

Separate the crown wheel (1) from the dif ferential box (4).



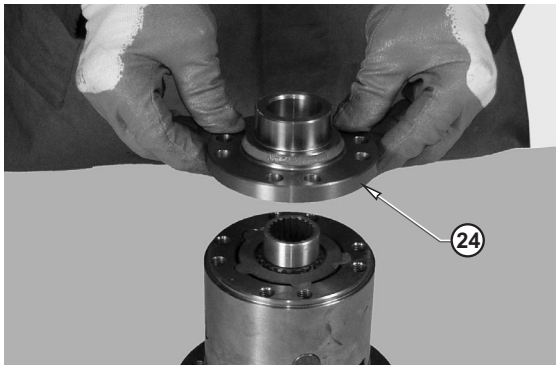
GB c

Extract the bearing (3) partially and using a puller, remove the bearing (3) of the crown wheel side (1).



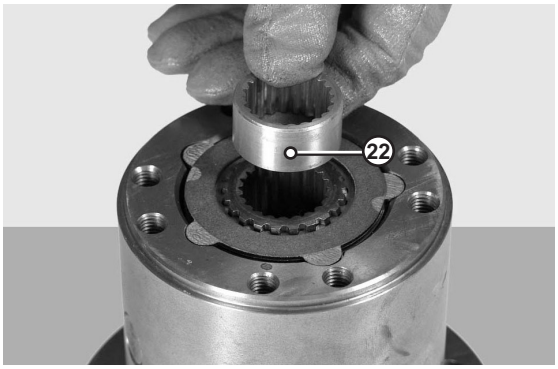
GB e

Remove the screws (26) jointing the differential unit.



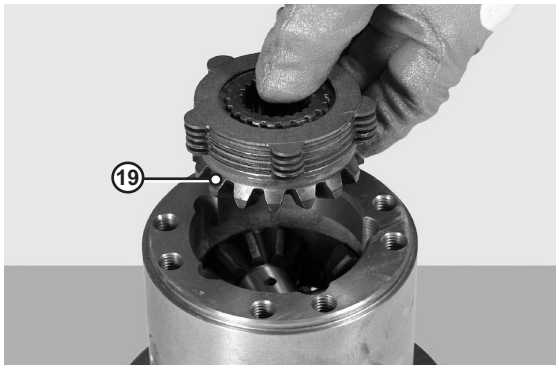
GB a

Remove the differential cover (24).



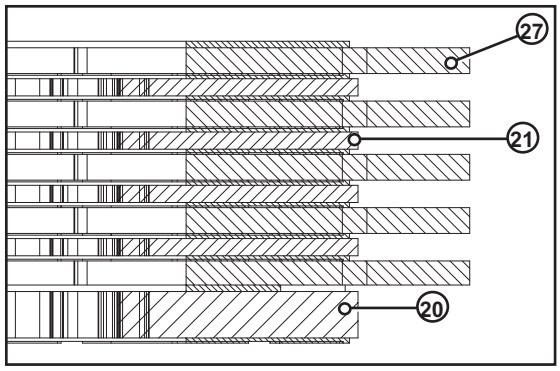
GB b

Remove the bushing (22).

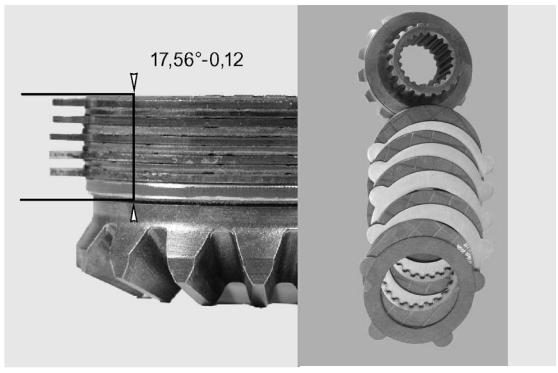


GB c

Remove the planetary gear (19) and the whole friction unit (20)(27)(21).

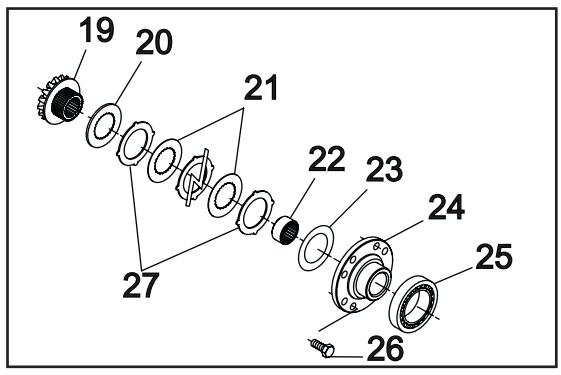


GB d

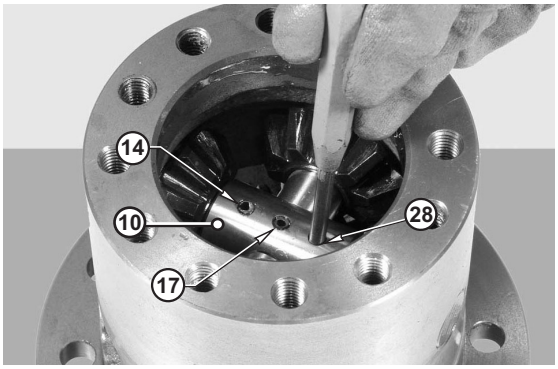


GB e

Replace the whole pack to 17,10 mm.

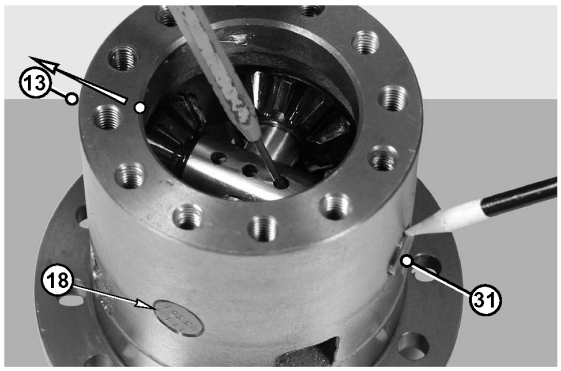


GB f



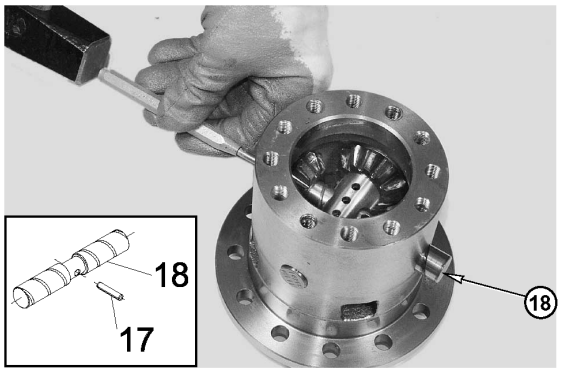
GB a

Remove the fixing pins (14)(17)(28) of the differential cross bolts (10).



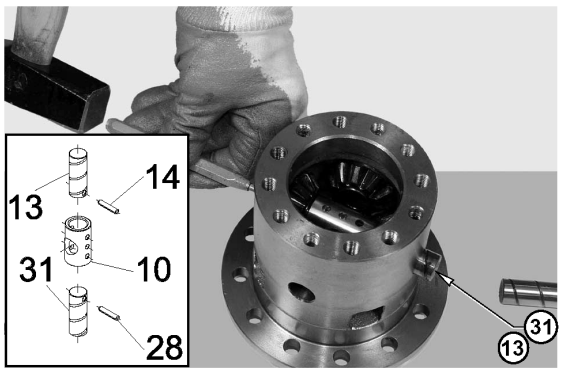
GB b

With a pin-driver push the two bolts (31)(13) to the outside.



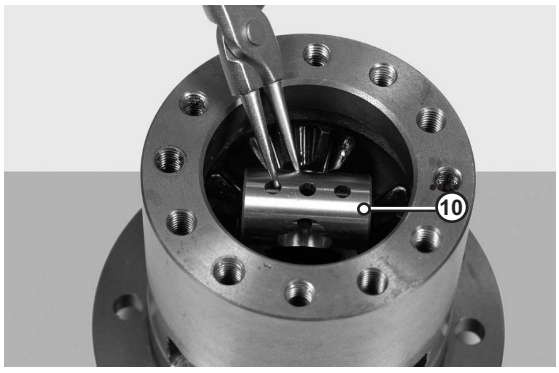
GB c

Remove the bolts with the help of a drift (18).



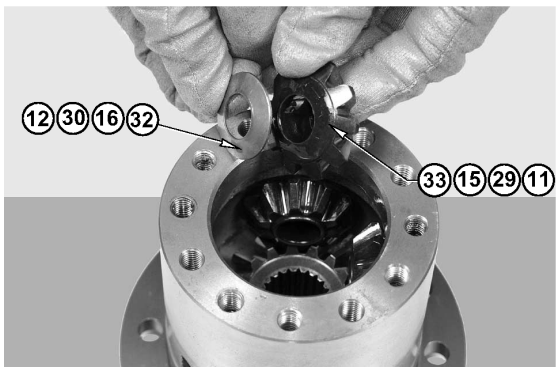
GB d

Remove the two halfes of the cross bolts (13)(31) with the help of a drift.



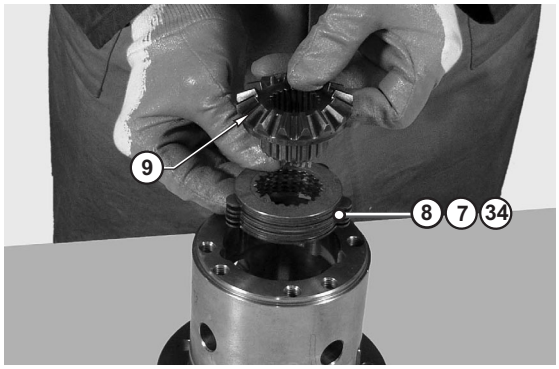
GB e

Remove the cross bolts (10).



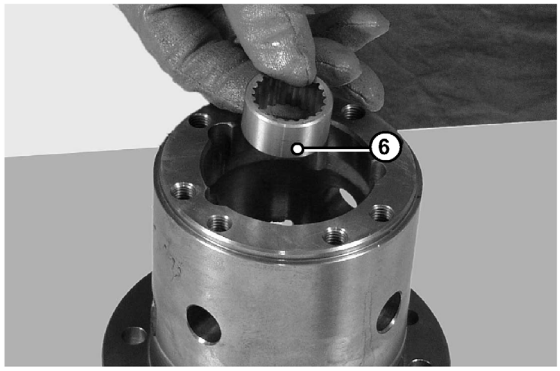
GB f

Remove the gear wheels (11)(29)(15)(33) and the spherical washers (32)(16)(30)(12).



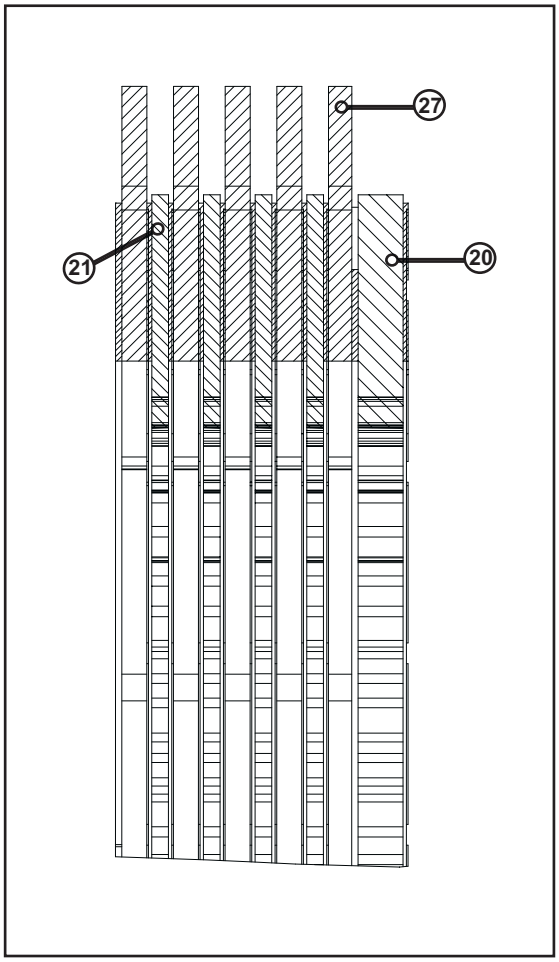
GB a

Remove the central gearwheel (9) and limited sipl packeg (8)(7)(34).



GB b

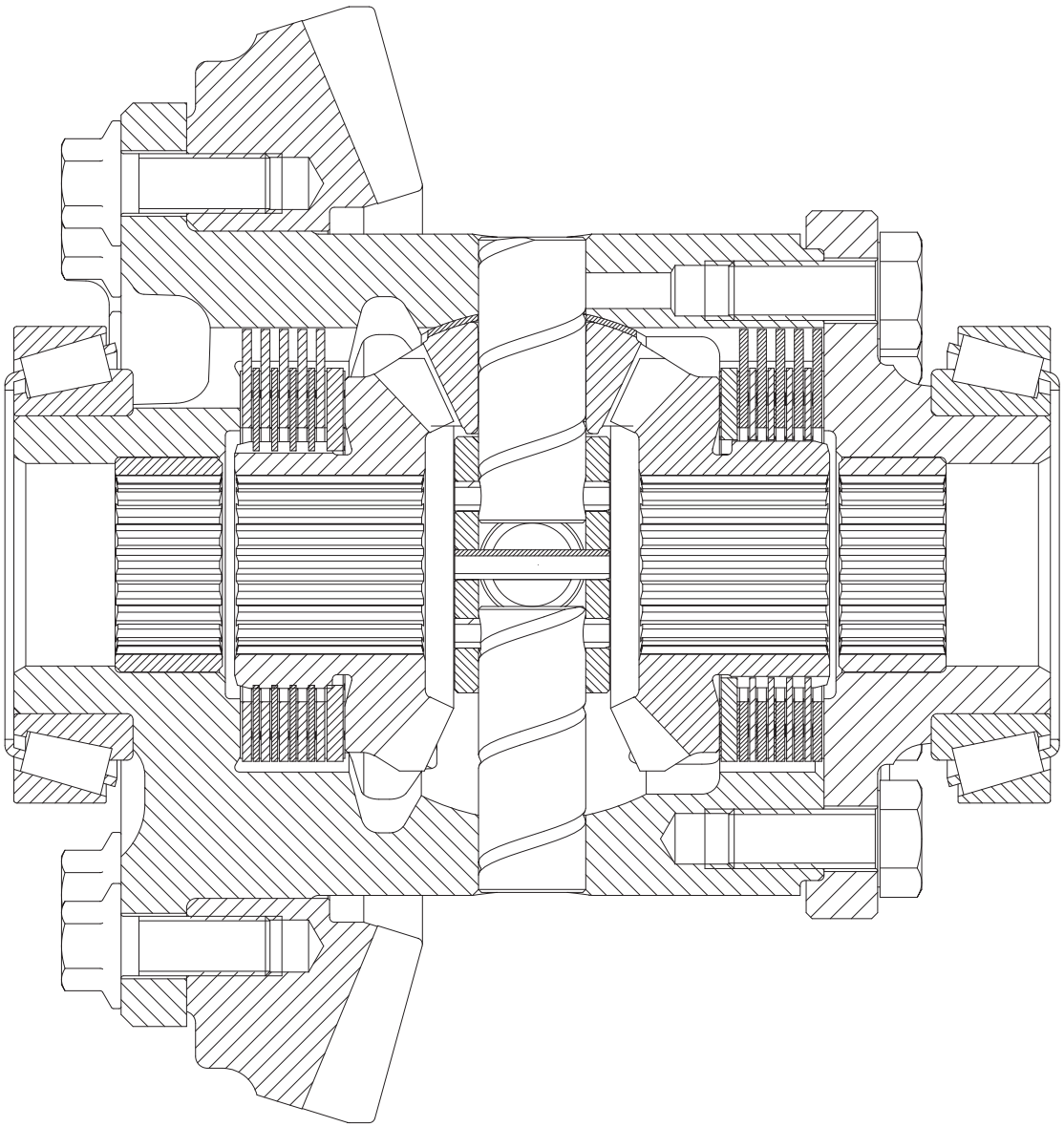
Remove the bushing (6).



GB c

Always check the thickness of braking discs (27)(20)(21) and eventualy replace the whole pack.
New limited sipl packeg = 17.56 mm
Replace pack = 16.90 m

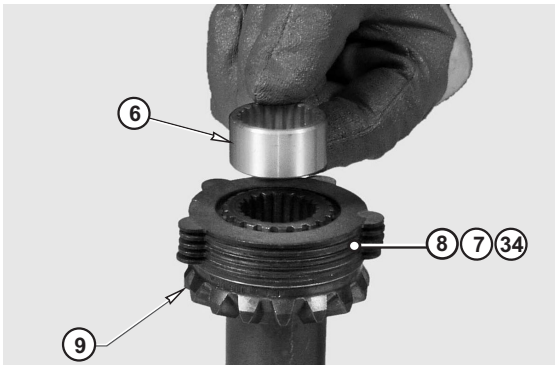
ASSEMBLY LIMITED SLIP DIFFERENTIAL UNIT (45%)





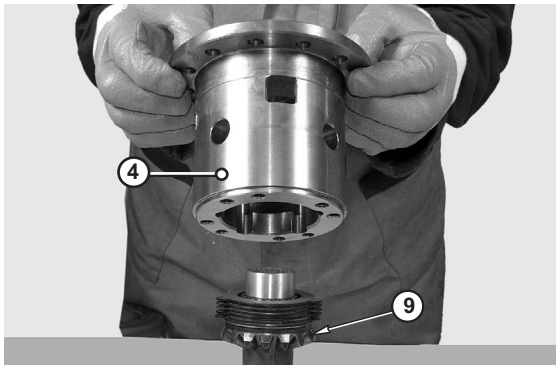
GB a

L.S. differential components.



GB b

Align disks (8)(7)(34) and bushing (6) on the planetary gear (9) in the correct position.



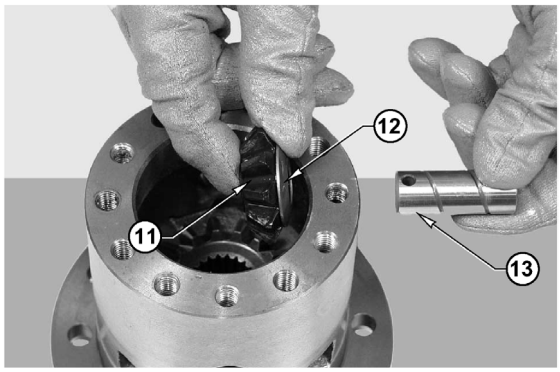
GB c

Insert the planetary gear (9) into the differential husing (4).



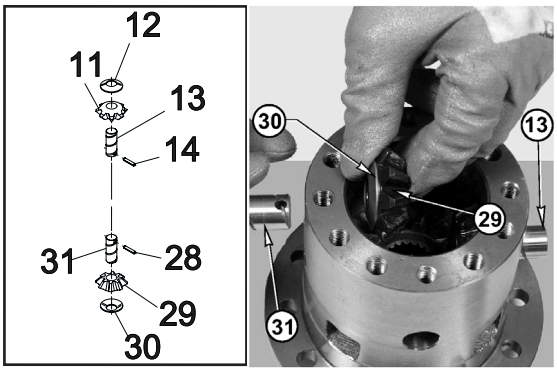
GB d

Check for correct position.



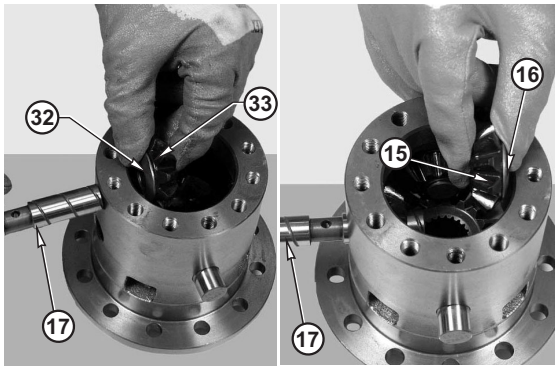
GB e

Insert the gear wheels (11)(29) with the spherical washers (12)(30) and the bolts (13)(31) to keep them in position.



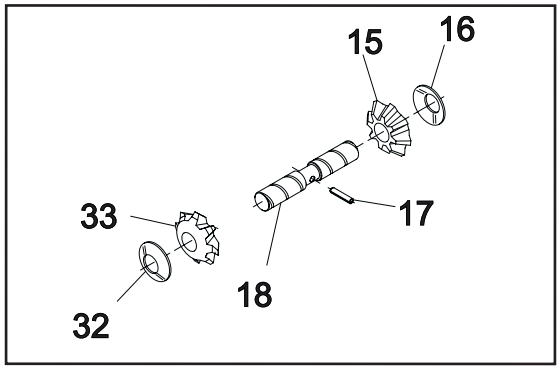
GB f

Insert the gear wheels (11)(29) with the spherical washers (12)(30) and the bolts (13)(31) to keep them in position.

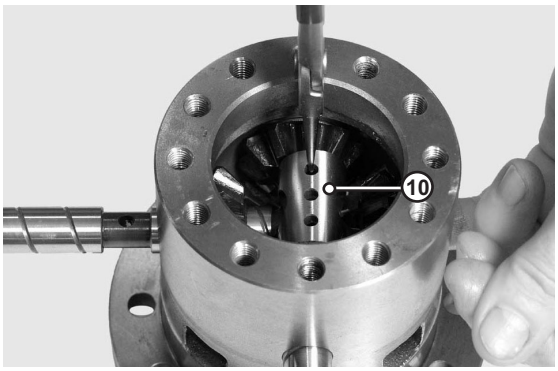


GB a

Insert the gear wheels (33)(15) with the spherical washers (32)(16) and the bolt (17).

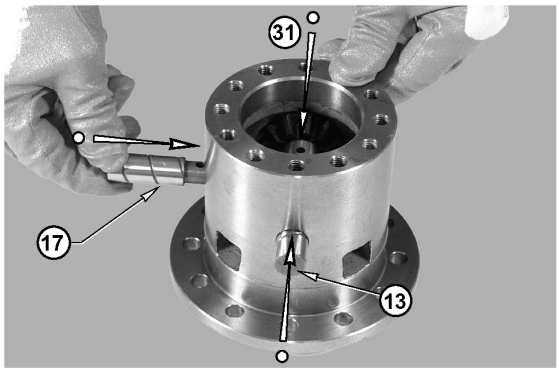


GB b



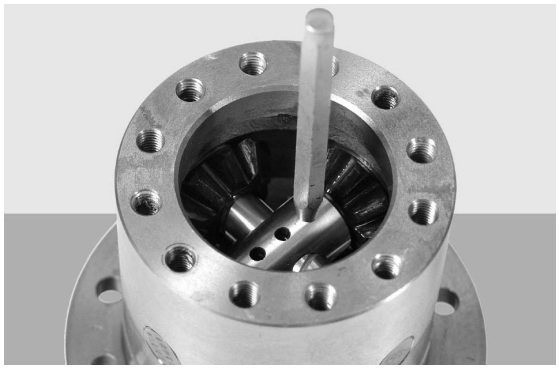
GB c

Insert the crossbolt (10) in the correct position.



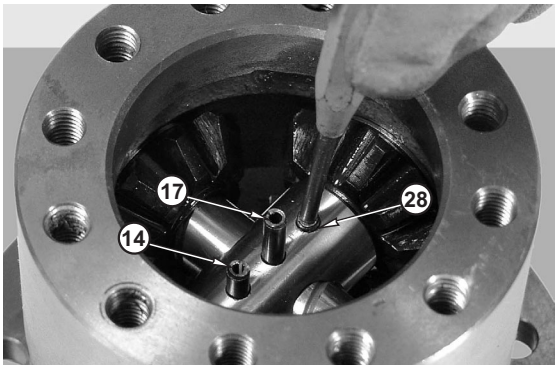
GB d

Insert the bolts in their position (17)(13)(31).



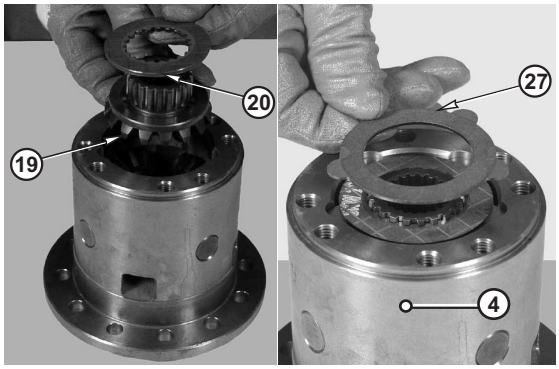
GB a

Bring the pin holes in line with the help of a pin-driver.



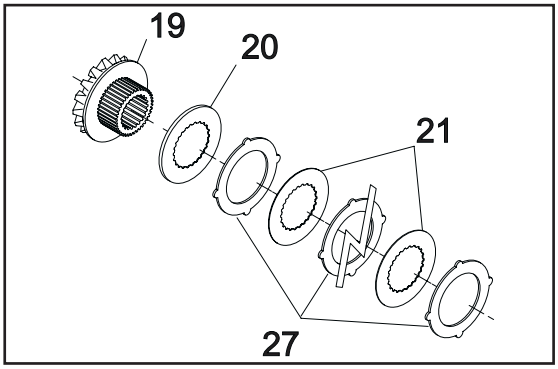
GB b

Insert pins to end of stroke (14)(17)(28).

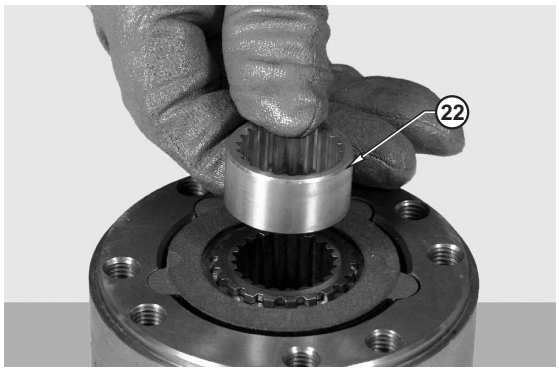


GB c

Insert the planetary gear (19) and the whole friction unit (20)(27)(21).

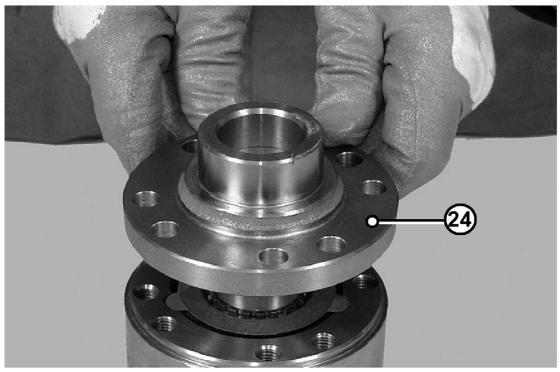


GB d



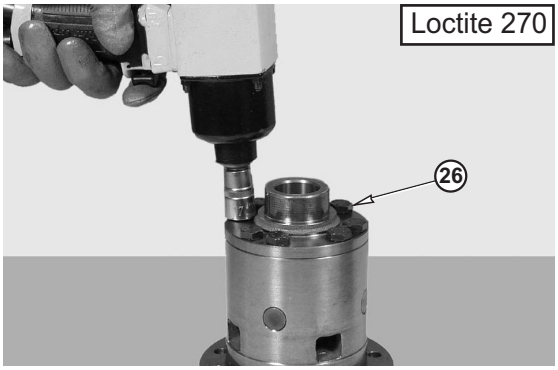
GB e

Install the busching (22).



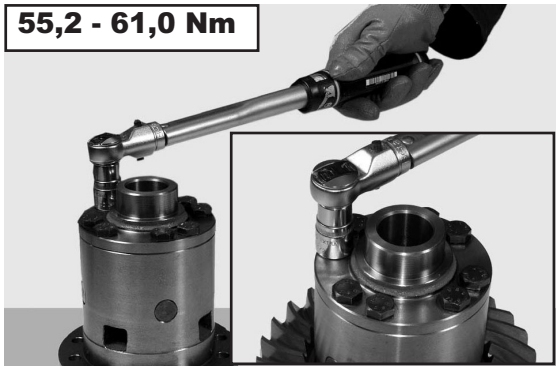
GB f

Install the differential cover (24).



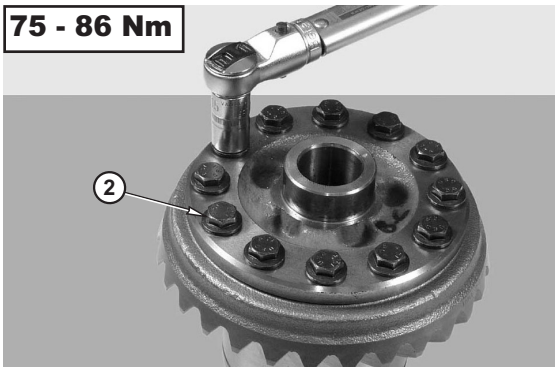
GB a

Apply Loctite 270 to the screws (26).



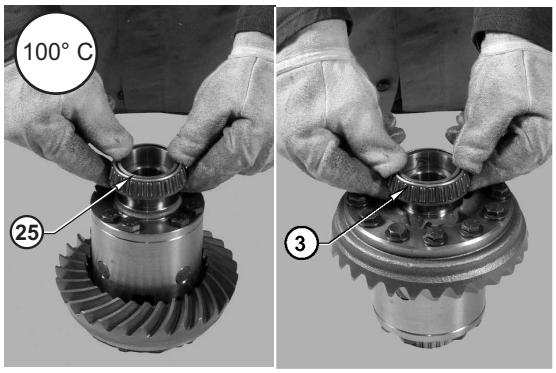
GB b

Torque wrench setting: 55,2 - 61,0 Nm.



GB c

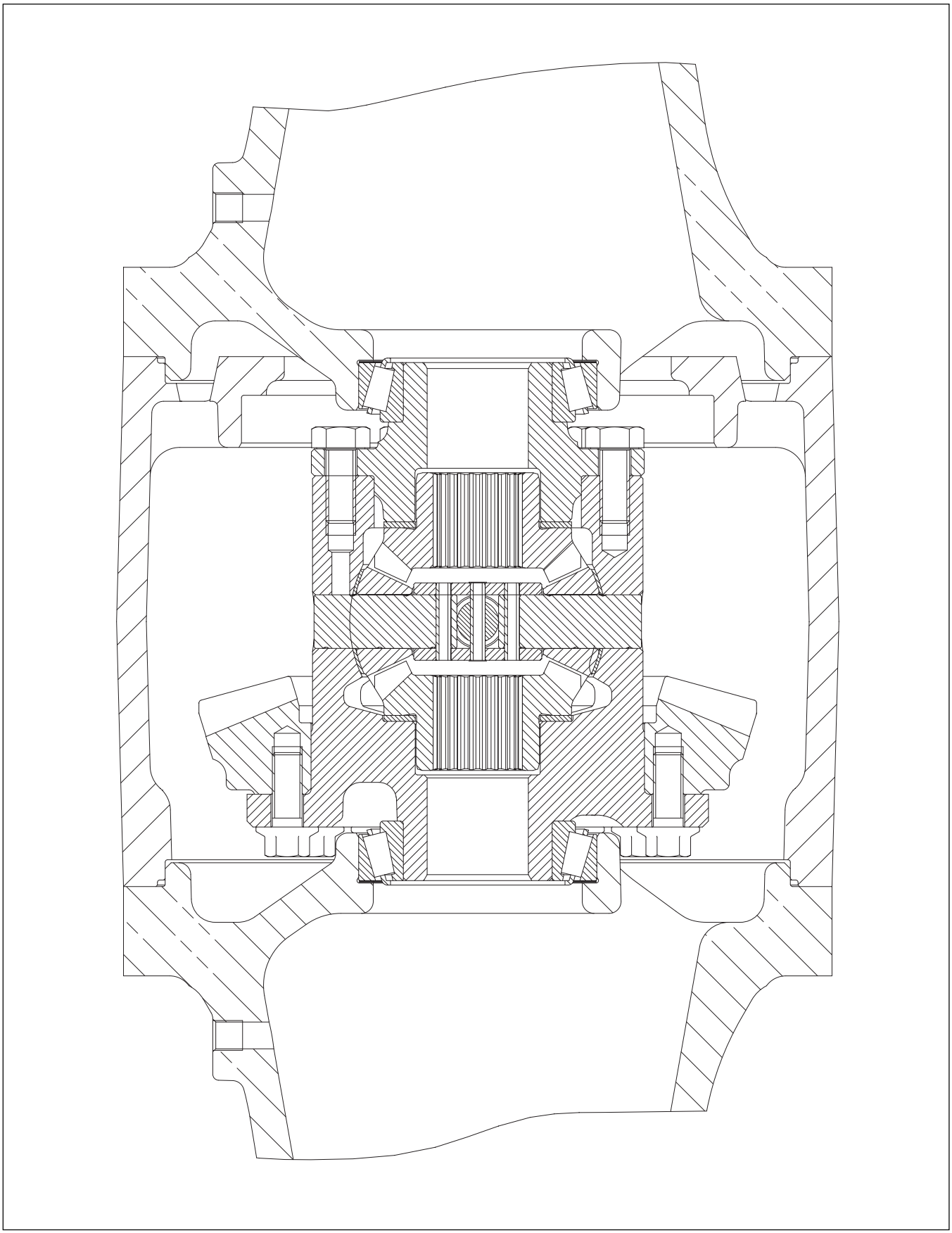
Fix the screws (2) of the crown wheel.
NOTE: use LOCTITE 270 on screws not treated with DRILOC.
Tighten the screws (2) of the crown wheel using the criss cross method.



GB d

Heat up the roll bearings (25)(3) to 100°C and insert it onto the differential.

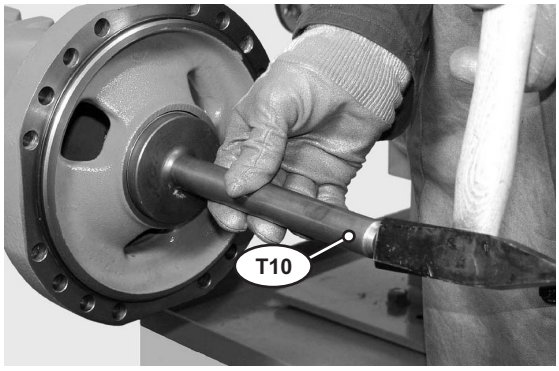
RING AND PINION ADJUSTING: PINION INTEGRAL VERSION AND DOUBLE ARM





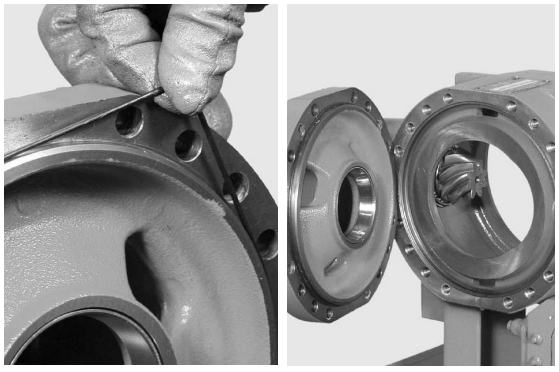
GB a

SETTING OF THE CROWN WHEEL AND PINION
Inser t the thrust block of the bearing (6)opposit side of the crown wheel shims (Sb)(7)of an initial thickness of about 0,55mm.



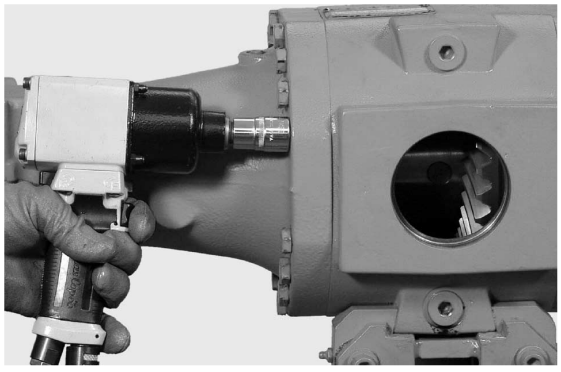
GB b

Insert the thrust block (6) and the shims (Sb)(7) into the arm.
NOTE: Check to be at end of stroke.



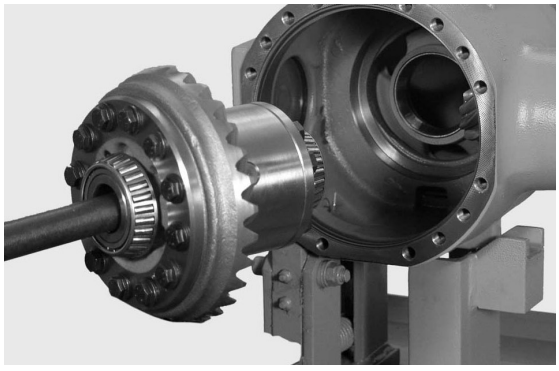
GB c

Check the O-Ring (2) and grease.



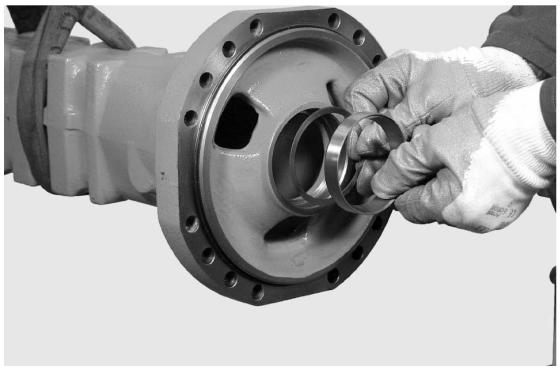
GB d

Temporarily insert all screws of the arm (18).



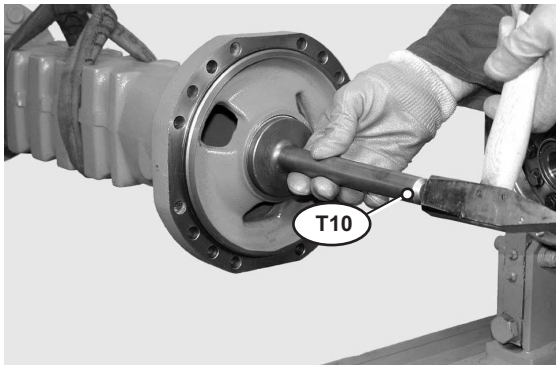
GB e

Insert complete differential (5).
ATTENTION! Do not damage the seat of the O-Ring with the gear wheel.



GB f

Inser t thrust block (4) of the bearing shims (Sc)(3) of an initial thickness of about 0,75mm.



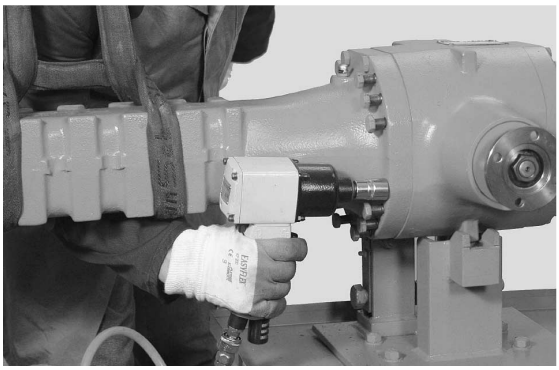
GB a

Insert the thrust block and the shims into the arm.
NOTE: Check to be at end of stroke.



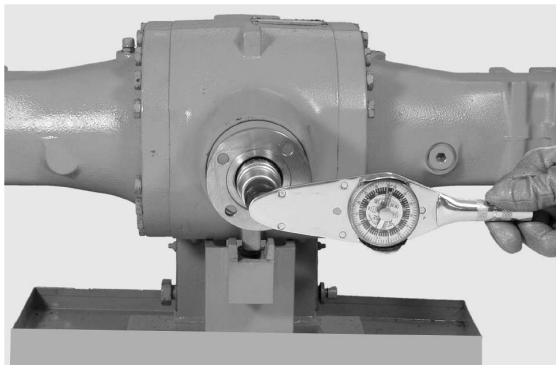
GB b

Install the crown wheel side arm (1)without half-axle.
NOTE:To check the torque of the dif ferential,neither of both half-axles must be installed.



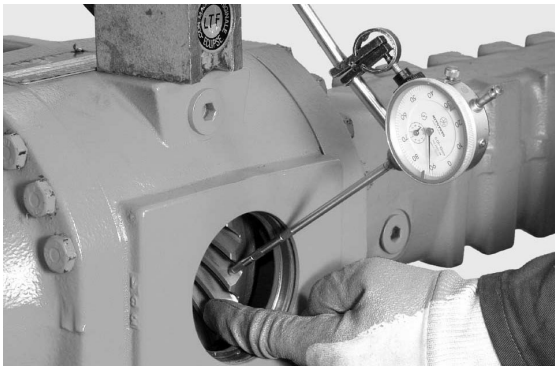
GB c

Temporarily insert all screws of the arm (18).



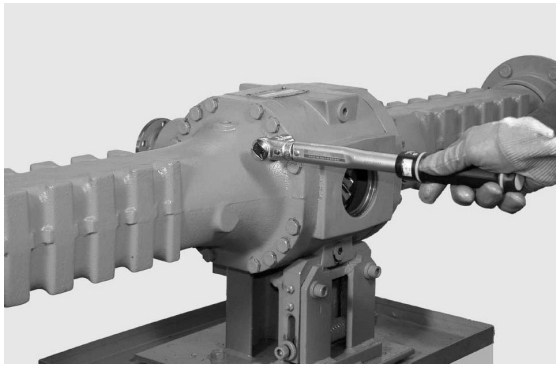
GB d

Apply torque meter TM to pinion nut and check that torque will increase by 40-60 Ncm as a result of dif ferential bearing preload.
Example:pinion torque:80-120 Ncm
Pinion + differential torque:120-180 Ncm.



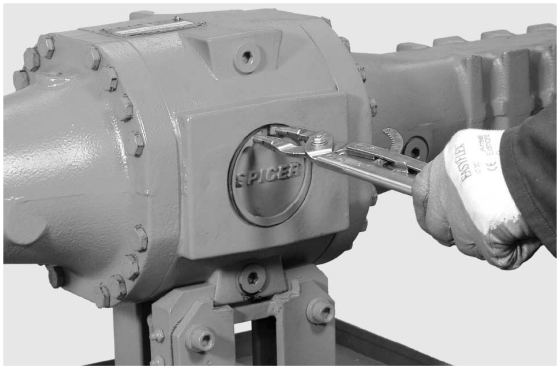
GB a

Position comparator on the centre of one of the crown teeth, preset it to 1 mm and reset it to zero.
Manually move the crown in both directions to check the existing clearance bet ween pinion and crown.
Gap =0,13-0,20mm
In order to increase the gap while keeping the load on the bearing unchanged,take of f shims from the crown wheel side and insert them on the opposit side.
In order to decrease the gap,act the other way round.
Introduce a comparator with rotar y key through the rear cap hole.



GB b

Torque wrench setting:130Nm
NOTE.Tighten using the criss-cross method.

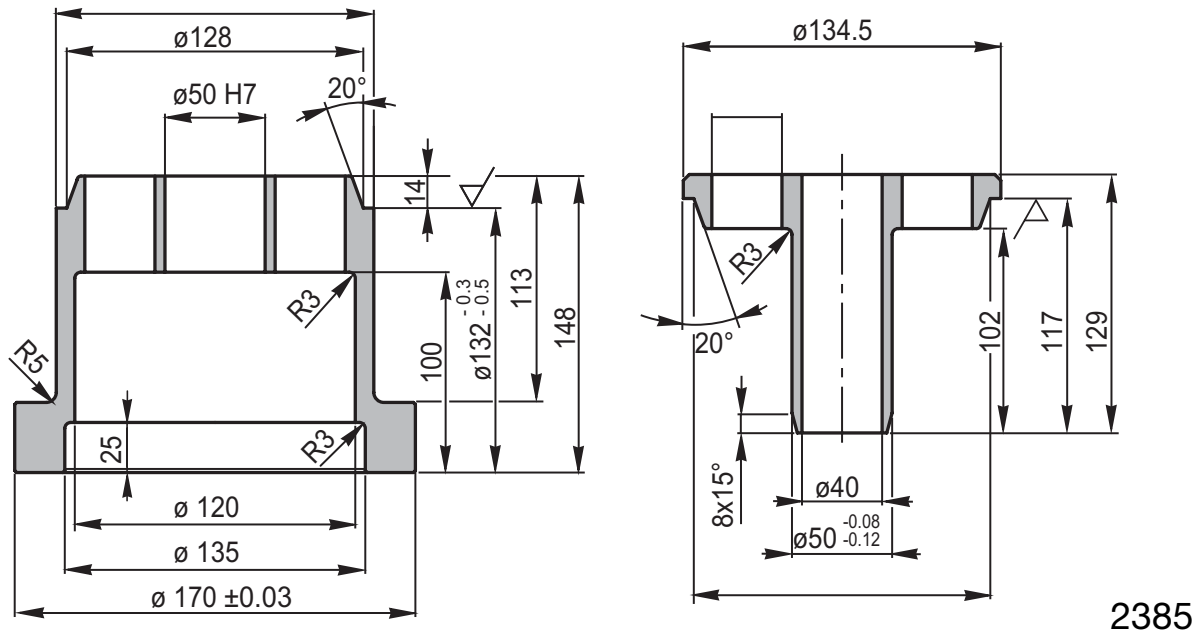


GB d

Using a driver,fit the cap and position it in its seat with the snap ring.

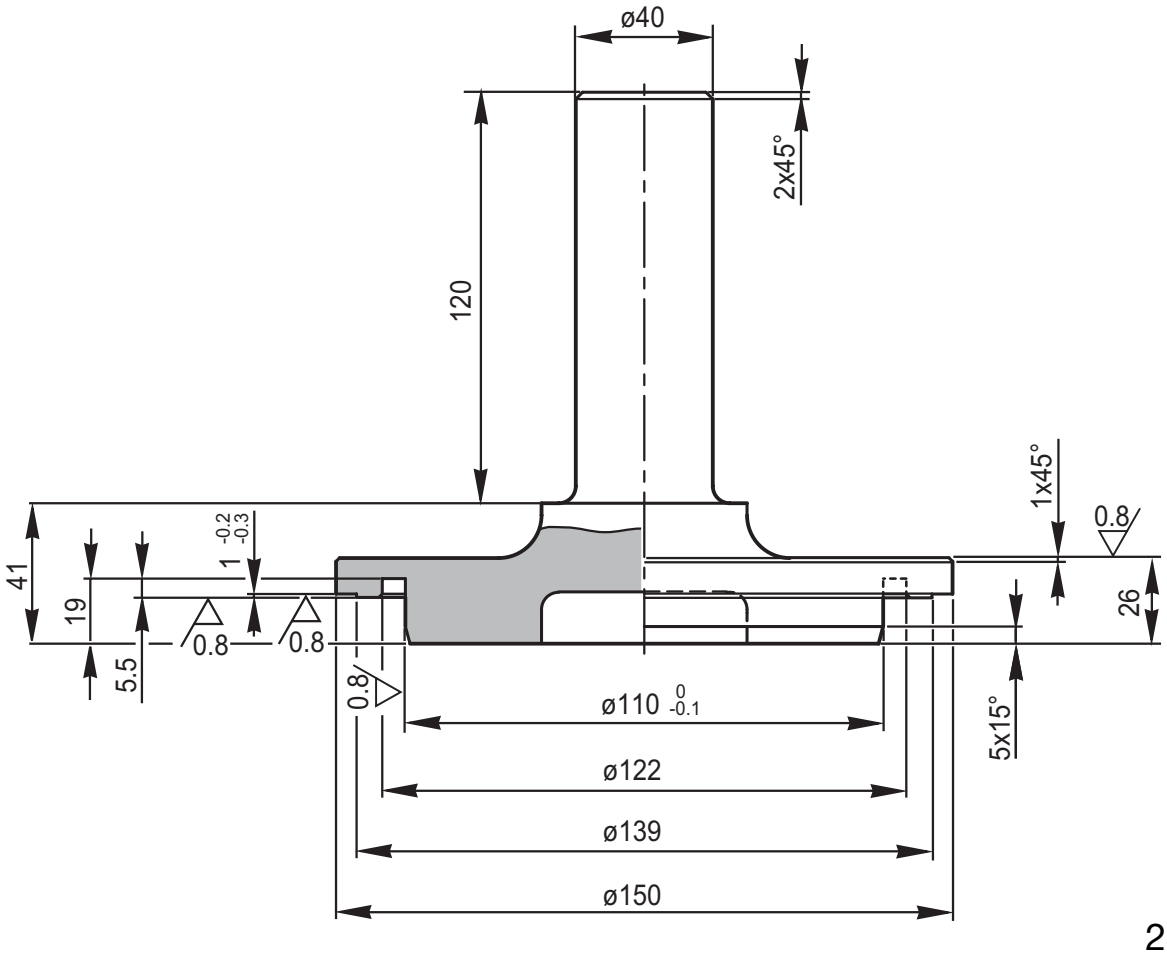
SPECIAL TOOL

T1



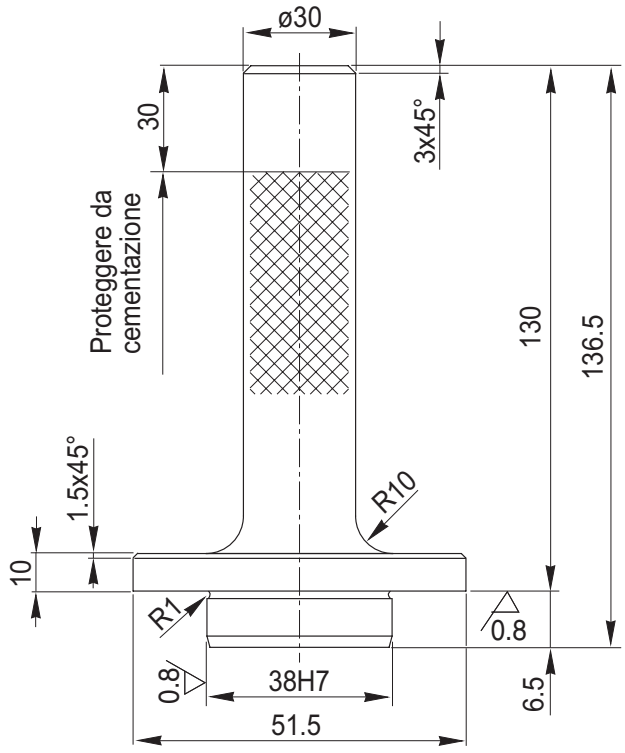
2385

T2



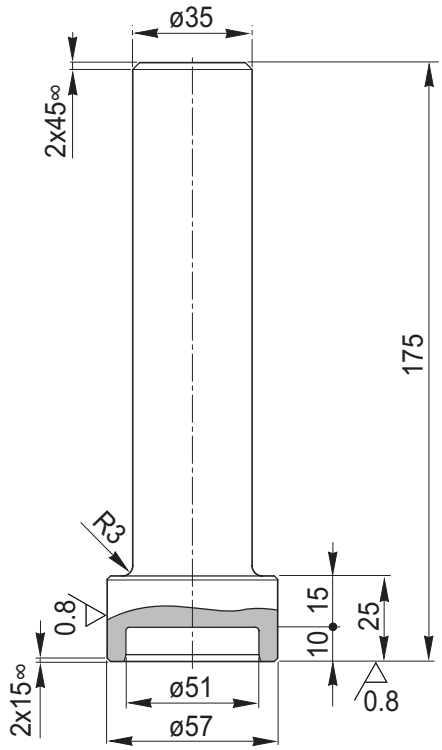
2384

T3



2387

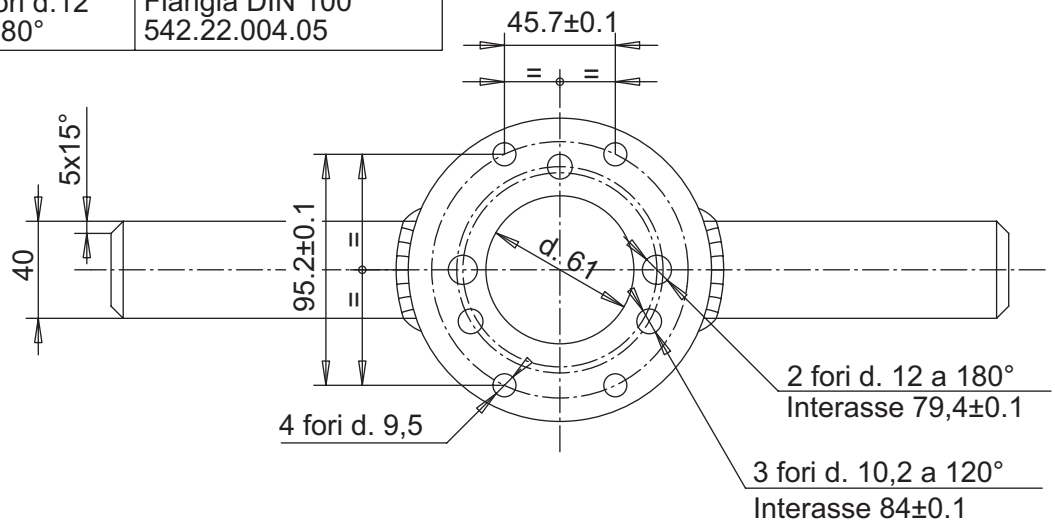
T4

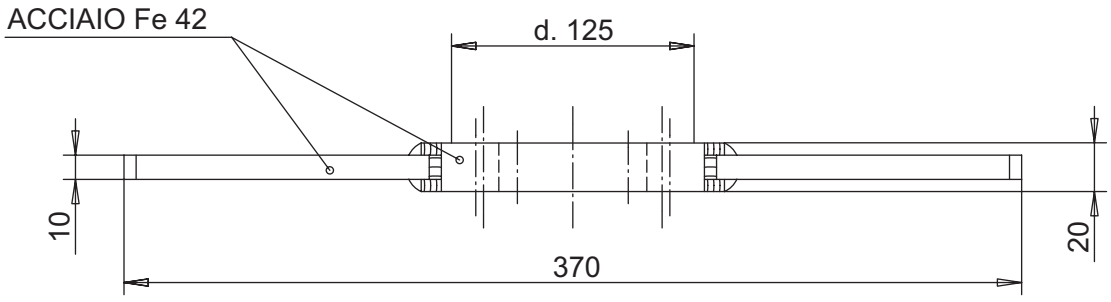


2388

T5

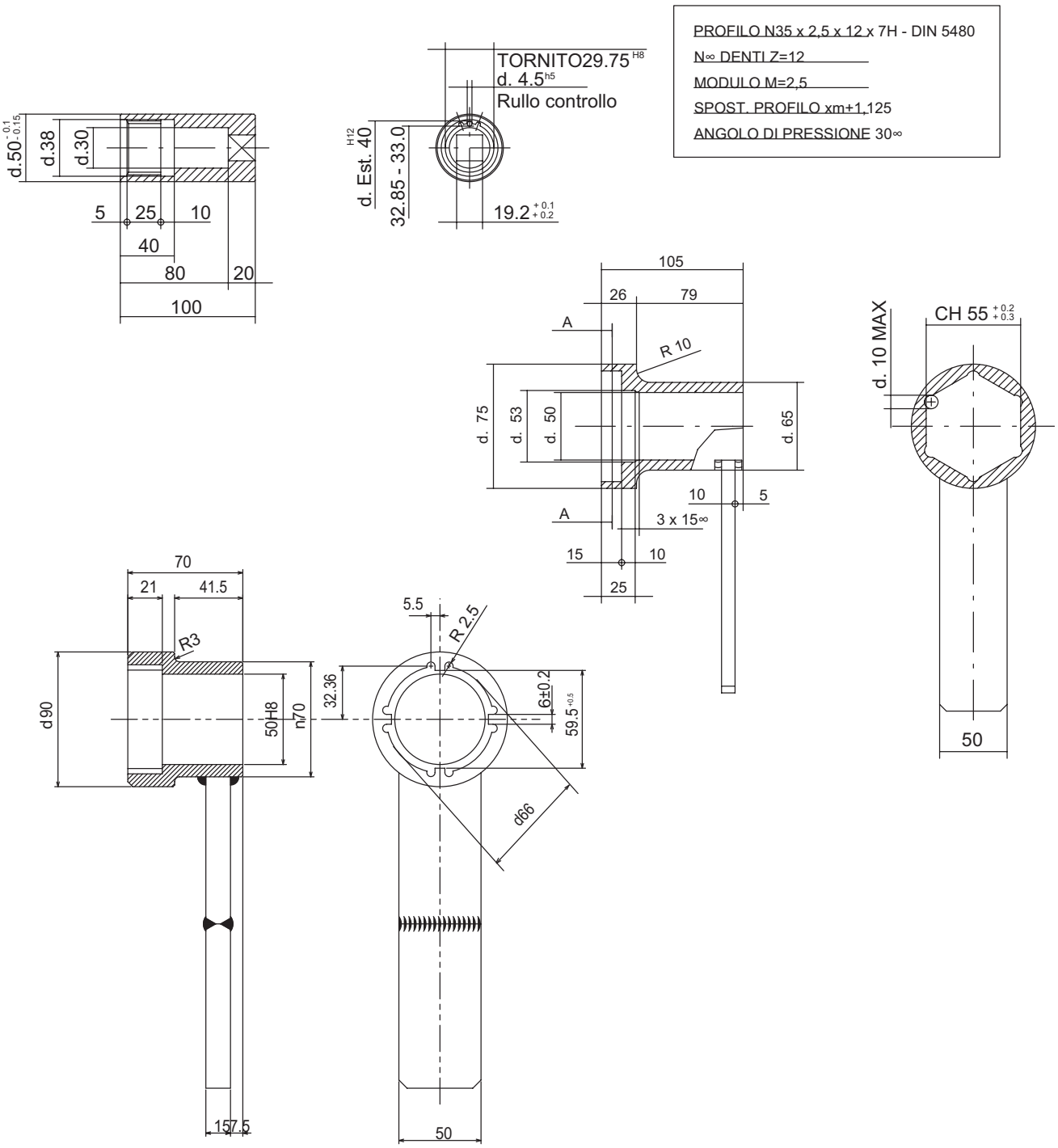
4 fori d. 9,5	Flangia END YOKE 315.14.011.02
3 fori d.10,2 a 120°	Flangia DIN 100 171.04.040.02
2 fori d.12 a 180°	Flangia DIN 100 542.22.004.05





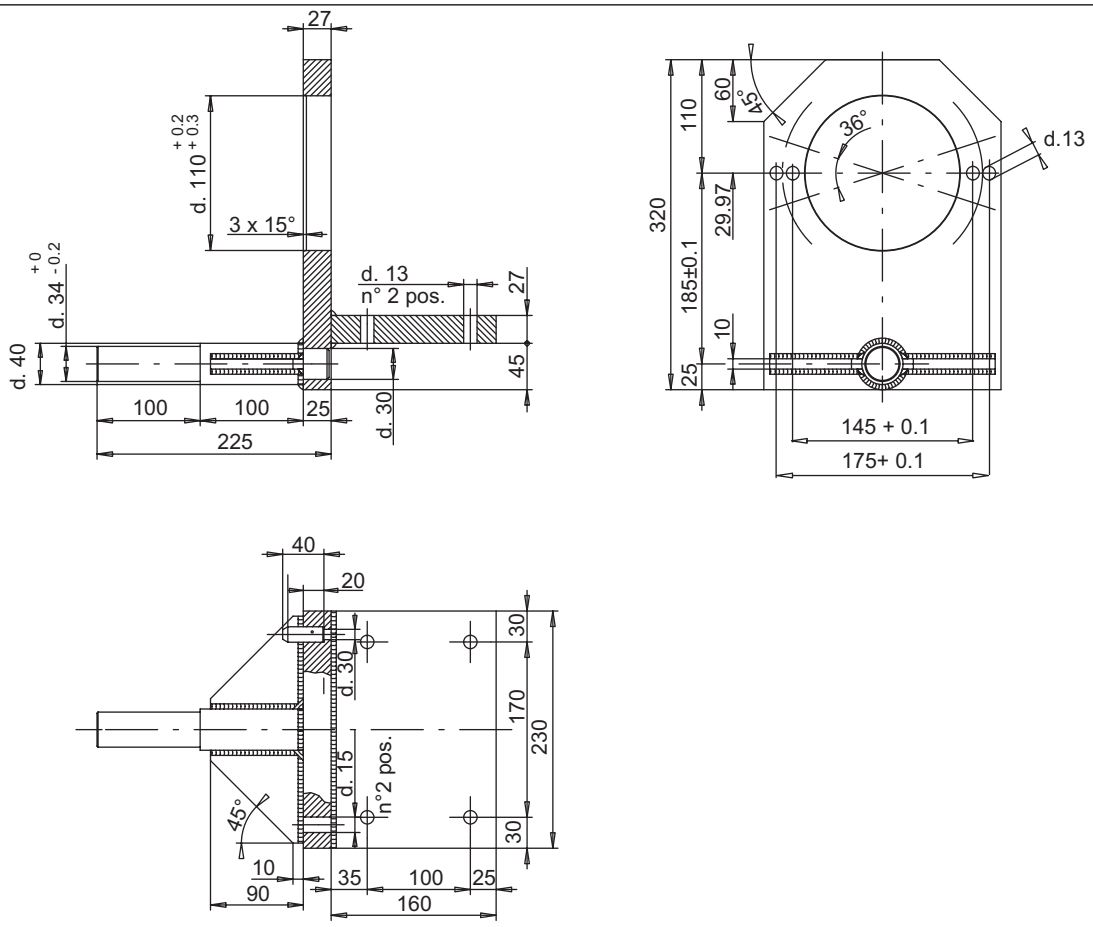
2386

T6


PROFILO N35 x 2,5 x 12 x 7H - DIN 5480
N∞ DENTI Z=12
MODULO M=2,5
SPOST. PROFILO xm+1,125
ANGOLO DI PRESSIONE 30∞
TORNITO29.75 H8
d. 4.5 h5
Rullo controllo
d.50 -0.1 -0.15
d.38
d.30
5
25
10
40
80
20
100
H12
d. Est. 40
32.85 - 33.0
19.2 +0.1 +0.2
105
26
79
A
R 10
d. 75
d. 53
d. 50
d. 65
10
5
3 x 15∞
15
10
25
d. 10 MAX
CH 55 +0.2 +0.3
50
70
21
41.5
R3
d90
50H8
n70
32.36
5.5
R 2.5
6±0.2
59.5 +0.5
d66
157.5
50

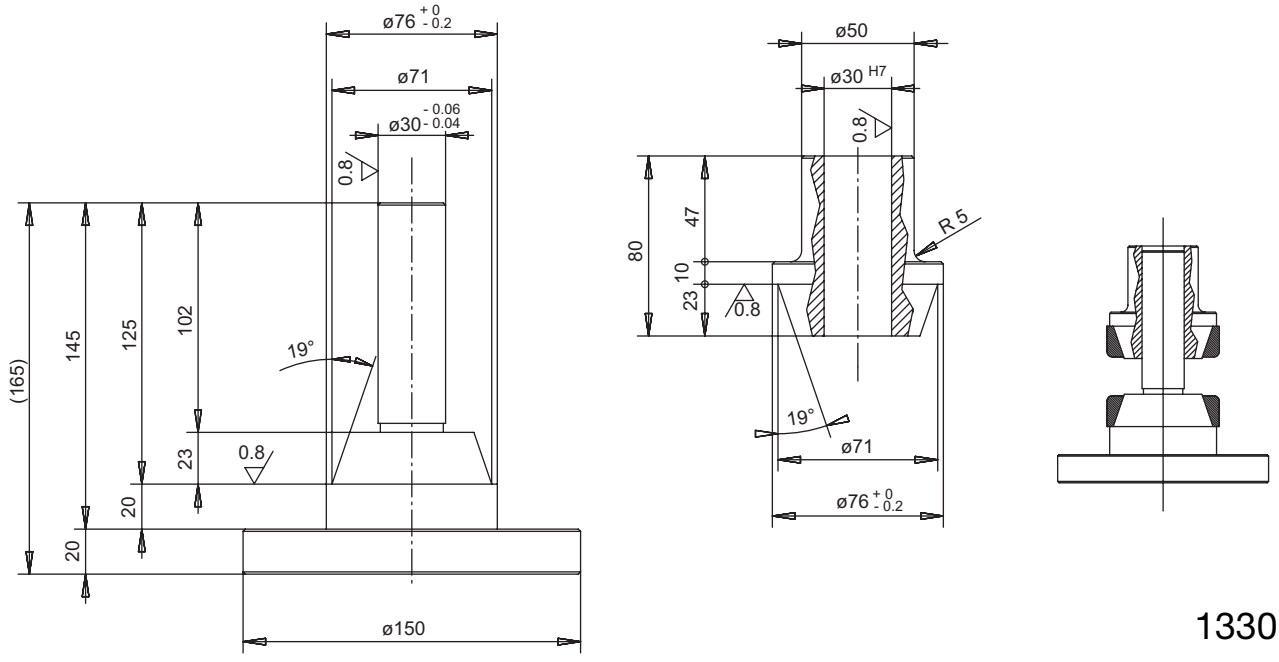
2386

T7



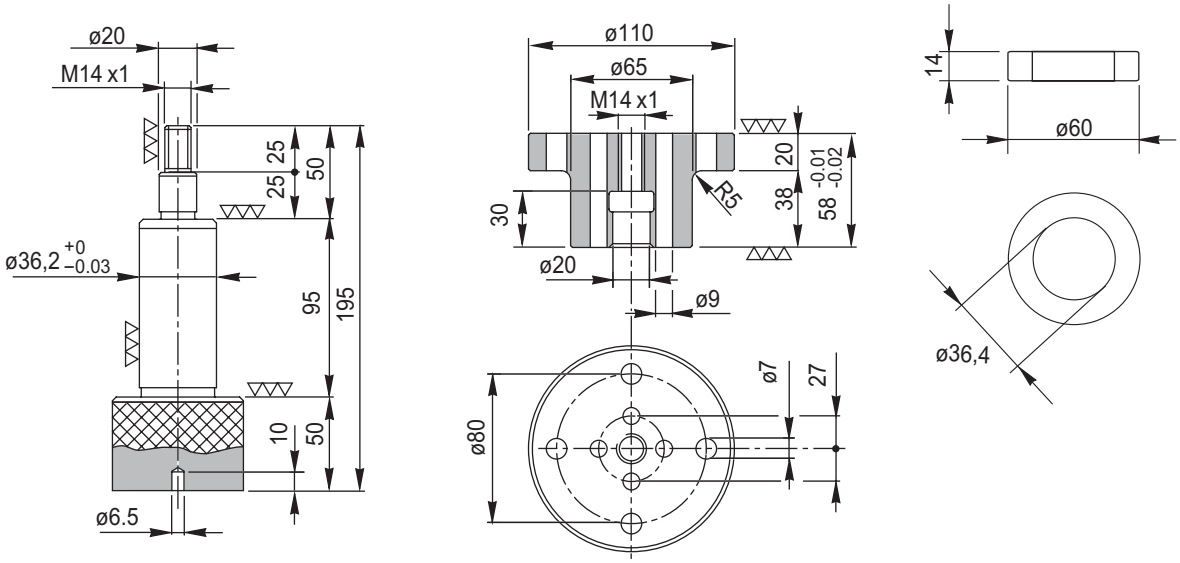
861

T8 2 PIECES



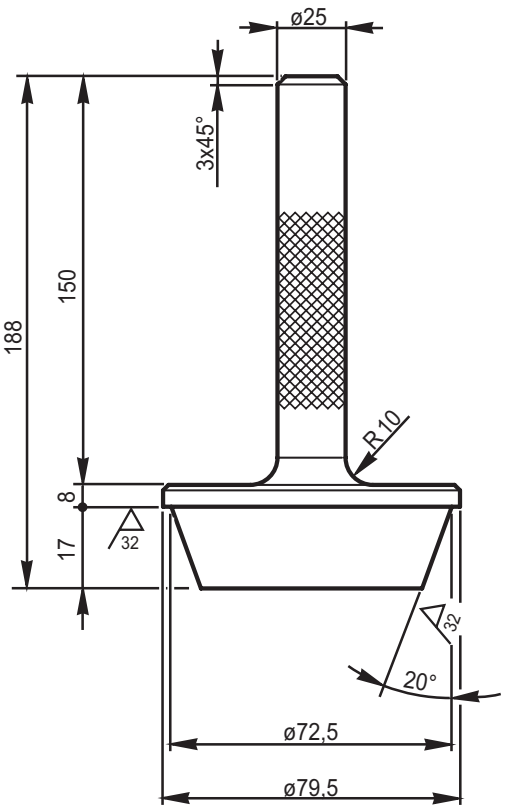
1330

T9



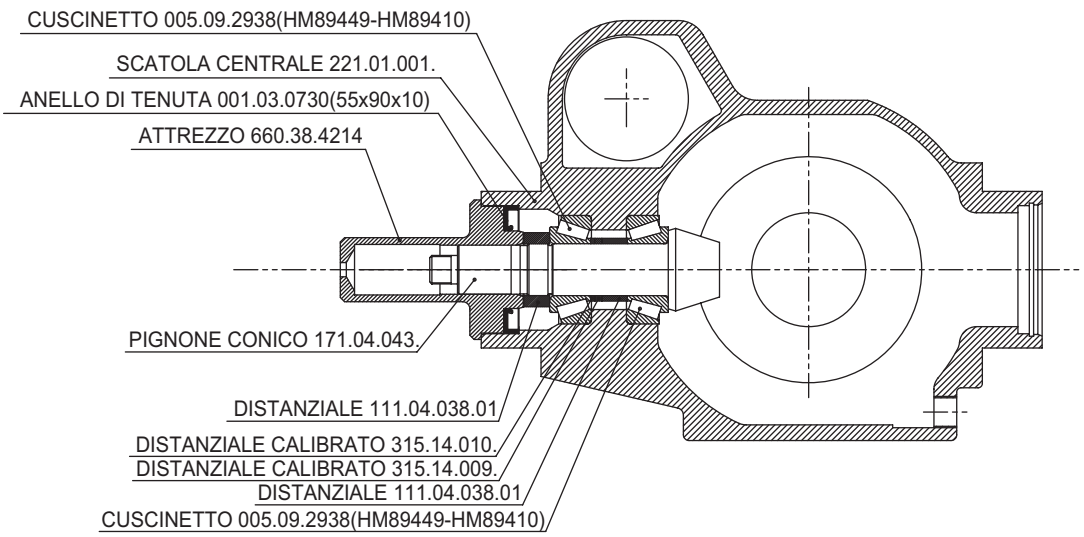
2389

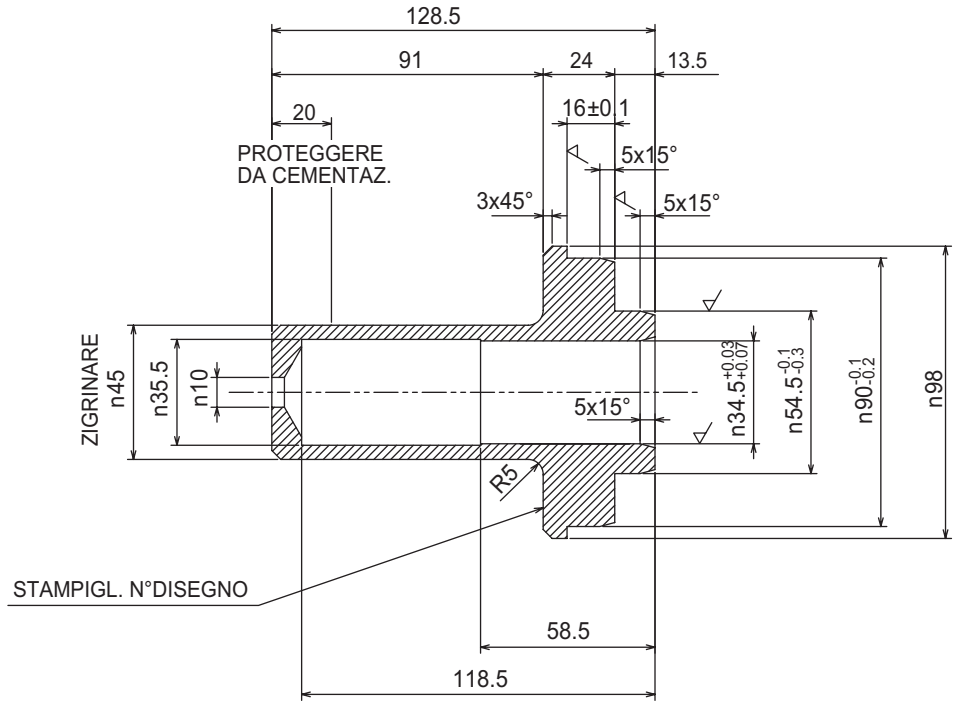
T10



2390

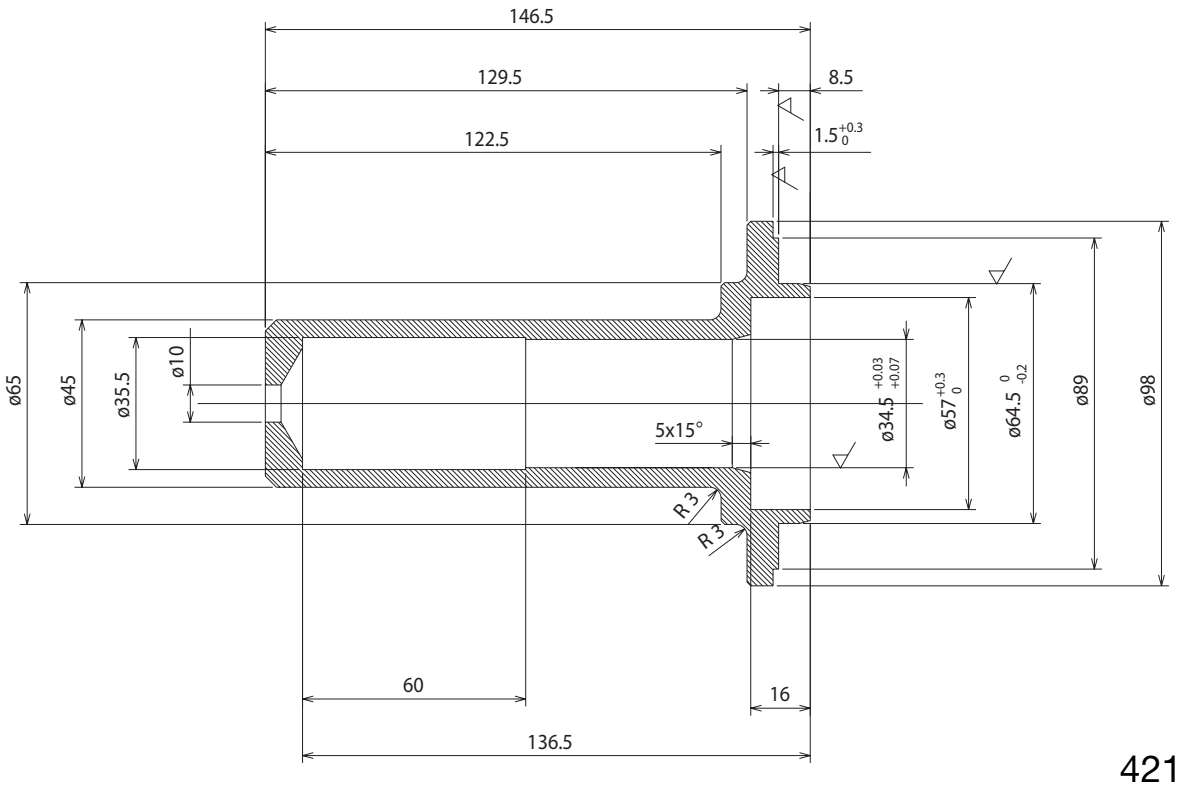
T11


CUSCINETTO 005.09.2938(HM89449-HM89410)
SCATOLA CENTRALE 221.01.001.
ANELLO DI TENUTA 001.03.0730(55x90x10)
ATTREZZO 660.38.4214
PIGNONE CONICO 171.04.043.
DISTANZIALE 111.04.038.01
DISTANZIALE CALIBRATO 315.14.010.
DISTANZIALE CALIBRATO 315.14.009.
DISTANZIALE 111.04.038.01
CUSCINETTO 005.09.2938(HM89449-HM89410)


128.5
91
24
13.5
20
16±0.1
PROTEGGERE
DA CEMENTAZ.
5x15°
3x45°
5x15°
ZIGRINARE
n45
n35.5
n10
5x15°
n34.5+0.03 +0.07
n54.5-0.1 -0.3
n90-0.1 -0.2
n98
R5
STAMPIGL. N°DISEGNO
58.5
118.5

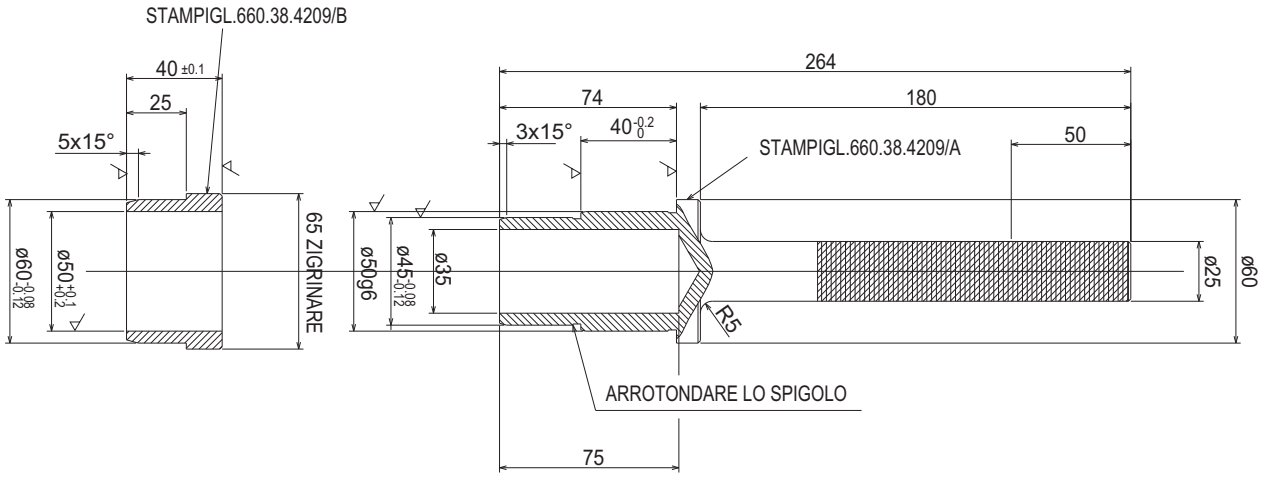
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T12



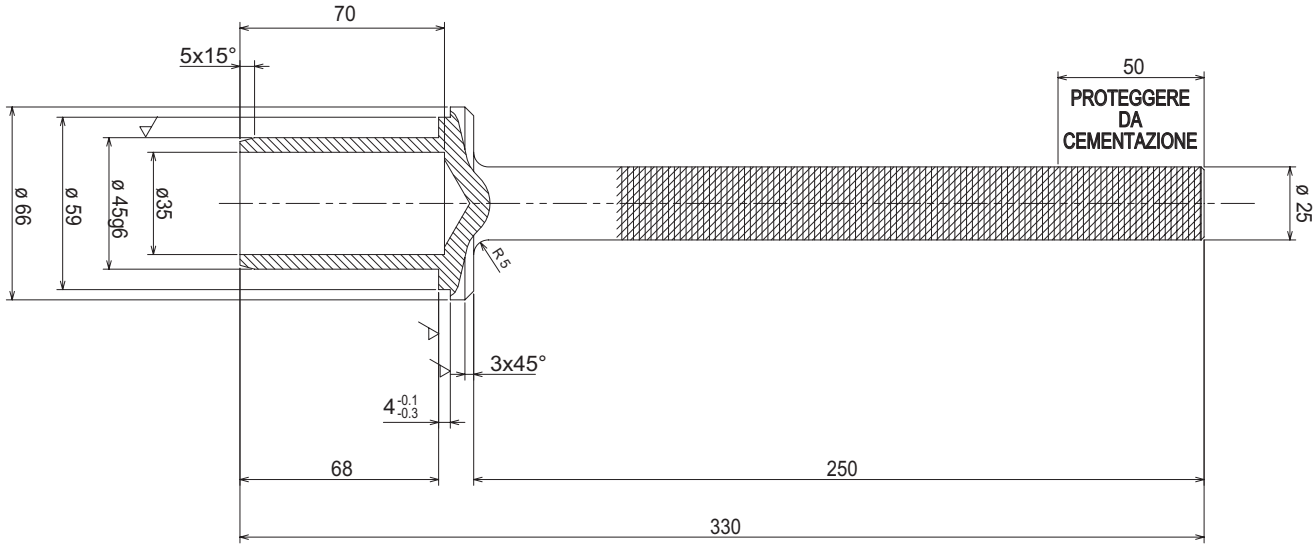
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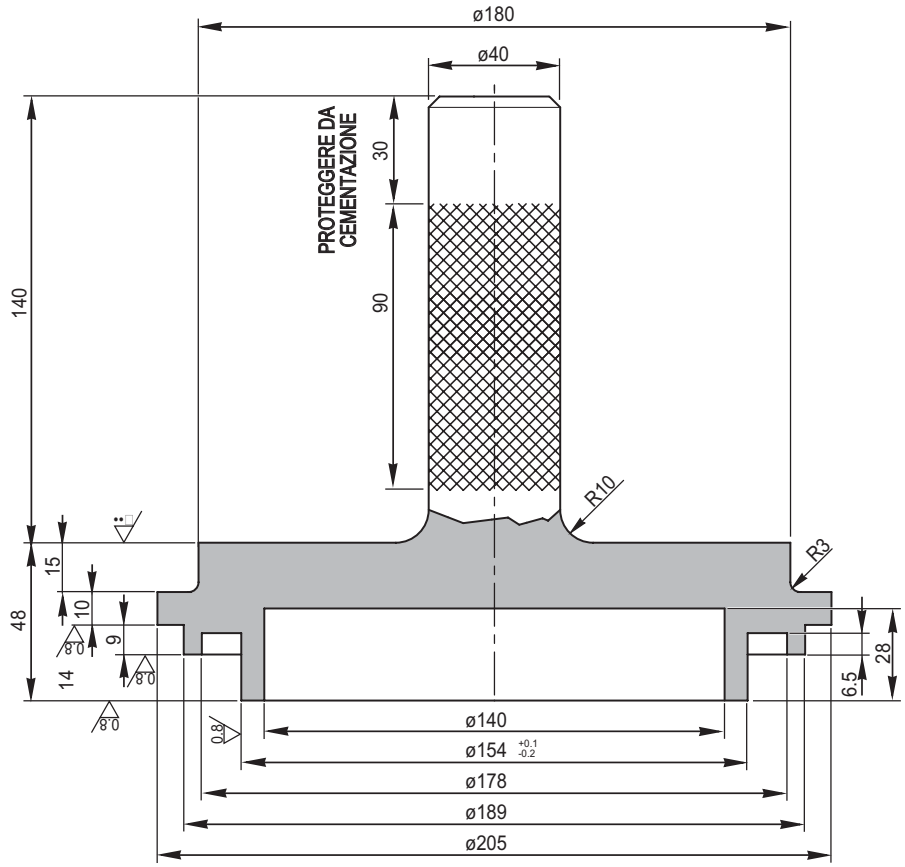
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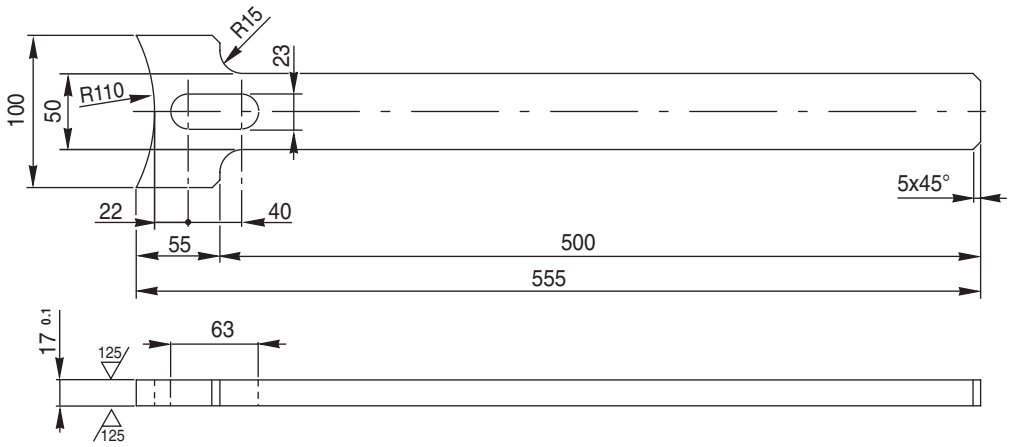
4210

T12



2366

T15



2387

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Section H
DEUTZ ENGINE MAINTENANCE

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- SPECIFICATION DATA 3
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FOREWORD

Reliable engine operation is dependent on properly executed repairs as well as adjustment work.
This Workshop Manual describes the appropriate operations for any repair and adjustment work on the engine and engine components. It is presumed that this work will be carried out by qualified personnel.
This operation manual has been designed for quick and easy understanding. Therefore the concise text passages are accompanied by pictographs to illustrate the relevant operation.
Aspects of operation and maintenance are dealt with in the respective Operation Manual.
For spare parts orders the respective spare parts catalogue should be referred to.
This Workshop Manual is not subject to engineering change service and is valid until next issue.
Therefore please refer to the information in our Technical Circulars when carrying out repairs.

General information:

- Please read carefully and observe the instructions given in this Workshop Manual to avoid accidents and ensure that your engine always functions properly and reliably.
- Make sure that this Workshop Manual is readily available for all those carrying out repairs or adjustments and that the contents are well understood.
- Non-compliance with these repair instructions may result in malfunction and engine damage as well as personal injuries for which the manufacturer shall not accept any liability.
- The accident prevention regulations and all other generally recognized regulations on safety and occupational medicine are to be observed.
- A prerequisite for successful repair is that all required equipment, hand and special tools are available and in perfect working order.
- Optimal operation economy, reliability and durability of the engine can only be ensured when genuine parts of DEUTZ AG are used.
- Engine components such as springs, clamps, snap rings, etc. may cause injury if not handled with care.
- Engine repairs must be carried out in accordance with intended use as defined by the equipment manufacturer. For conversions, only parts approved by DEUTZ AG for a specific purpose should be used.

SPECIFICATION DATA

Engine weight without starter, with generator:		
- with/without cooling system	F2L / F2M	175 / 169 kg
- with/without cooling system	F3L / F3M	217 / 210 kg
- with/without cooling system	F4L / F4M	256 / 248 kg
- with/without cooling system	BF3L / BF3M	222 / 215 kg
- with/without cooling system	BF4L / BF4M	257 / 250 kg
Engine swept volume:		
	F2L / F2M	1554 cm^3
	F3L / F3M	2331 cm^3
	F4L / F4M	3108 cm^3
	BF3L / BF3M	2331 cm^3
	BF4L / BF4M	3108 cm^3
Bore:		94 mm
Stroke:		112 mm
Direction of rotation:	when facing flywheel	counter-clockwise
Max. rated speed:		2800 rpm
Min. idle speed:		900 rpm
Working cycle:		Diesel 4 temps
Combustion system:		Direct injection
Compression ratio:		
	F2-3-4L / F2-3-4M	19
	BF3-4L / BF3-4M	17,5
Compression pressure:		
	F2-3-4L / F2-3-4M	25-30 bar
	BF3-4L / BF3-4M	22-27 bar
Dimensions:		
Max. lenght - Max. width - Max. heght	F2L	501-510-683 mm
Max. lenght - Max. width - Max. heght	F3L	612-509-678 mm
Max. lenght - Max. width - Max. heght	F4L	724-523-707 mm
Max. lenght - Max. width - Max. heght	F2M	508-510-683 mm
Max. lenght - Max. width - Max. heght	F3M	619-525-678 mm
Max. lenght - Max. width - Max. heght	F4M	731-523-707 mm
Max. lenght - Max. width - Max. heght	BF3L	612-569-695 mm
Max. lenght - Max. width - Max. heght	BF4L	724-556-707 mm
Max. lenght - Max. width - Max. heght	BF3M	619-631-695 mm
Max. lenght - Max. width - Max. heght	BF4M	731-556-707 mm
Inlet opens before TDC:		
	F2-3-4L / F2-3-4M	45°
	BF3-4L / BF3-4M	47°
Inlet closes after BDC:		
	F2-3-4L / F2-3-4M	65°
	BF3-4L / BF3-4M	63°

Exhaust opens before BDC:

F2-3-4L / F2-3-4M	76°
BF3-4L / BF3-4M	99,5°

Exhaust closes after TDC:

F2-3-4L / F2-3-4M	44°
BF3-4L / BF3-4M	51,5°

Minimum oil pressure during warm motor, oil temperature 110°C, oil SAE 20/20, during:

900/min (lower no-load)	1,4 bar (*)
1800/min	2,2 bar (*)
max. 2800/min	3 bar (*)

(*) Data related to motors without motor oil heating

Pressurestat:

F2-3L / F2-3M	6,5 bar
F4L / F4M	7 bar
BF3L / BF3M	6,5 bar
BF4L / BF4M	7 bar

SCHEMATIC FOR VALVE CLEARANCE ADJUSTMENT

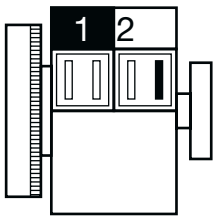
Crankshaft position **1**

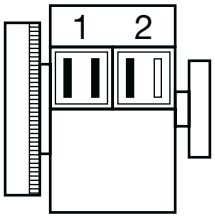
Turn engine until valves of cylinder No. 1 overlap

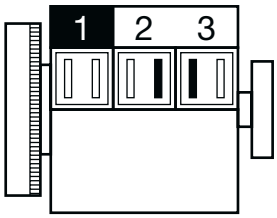
Crankshaft position **2**

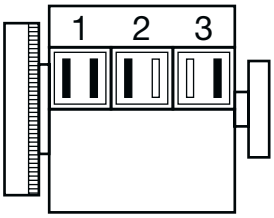
Turn engine further by one complete revolution (360°)

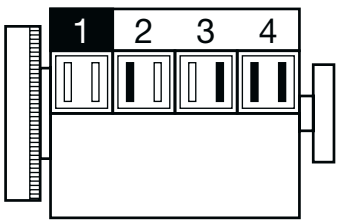
Not ready for adjustment.  Ready for adjustment.

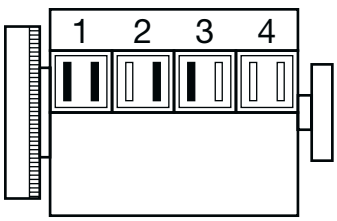




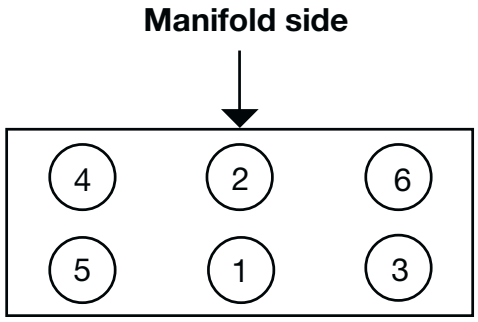




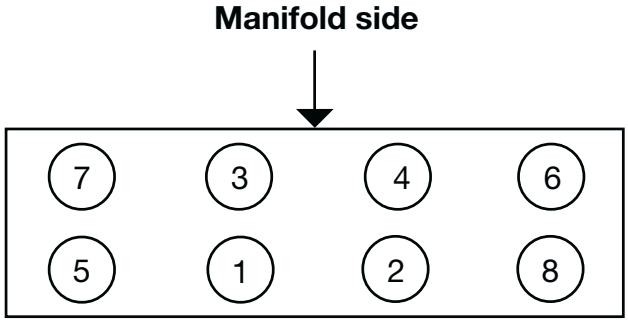




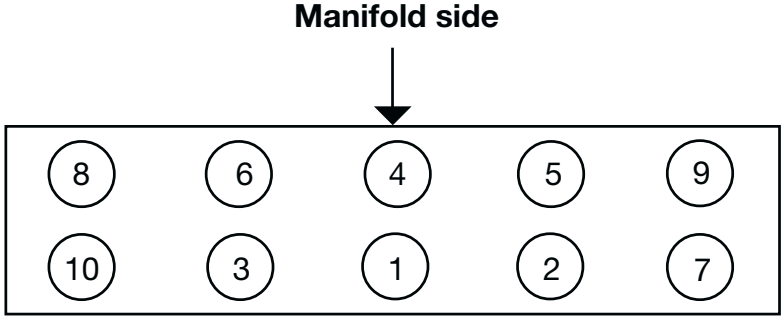
TIGHTENING ORDER FOR CYLINDER HEAD BOLTS



2-cylinder



3-cylinder



4-cylinder

KEY TO SYMBOLS

	Disassembly of assembly groups		Guard against personal injury Indication of hazard
	Reassembly to form assembly group		Guard against material damage Damage to parts
	Remove obstructing parts		Prop up - Support - Hold
	Reinstall - Remount parts which had obstructed disassembly		Oil
	Attention! Impartant notice!		Grease
	Check - Adjust e. g. torque dimensions, pressures, etc.		Mark before disassembly, observe marks when reassembling
	Special tool		Balance Eliminate any imbalance
	Note direction of installation		Filling - Topping up - Refilling e. g. oil, cooling water, etc.
	Visual inspection		Drain off e. g. oil, cooling water, etc.
	Possibly still serviceable Renew if necessary		Loosen - Release e. g. loosening a clamping device
	Renew at each reassembly		Tighten - Clamp e. g. tightening a clamping device
	Unlock - Lock e. g. split pin, locking plate, etc.		Vent
	Lock - Adhere e. g. with liquid sealant		Machining process

CHECKING AND ADJUSTING - VALVE CLEARANCE

The standard valve clearance can be adjusted:

with engine cold or warm after cooling down for at least 0.5 h.

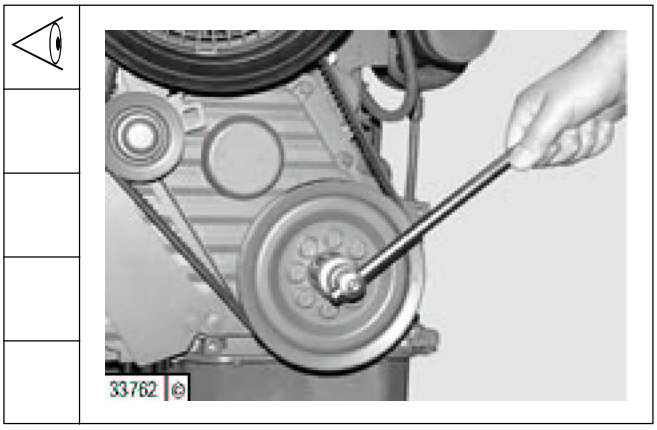
Oil temperature **80°C**.

Note: The valve clearance is to be increased by 0.1 mm at every cylinder head gasket renewal. After **1000 Bh** , the standard valve clearance is to be adjusted.

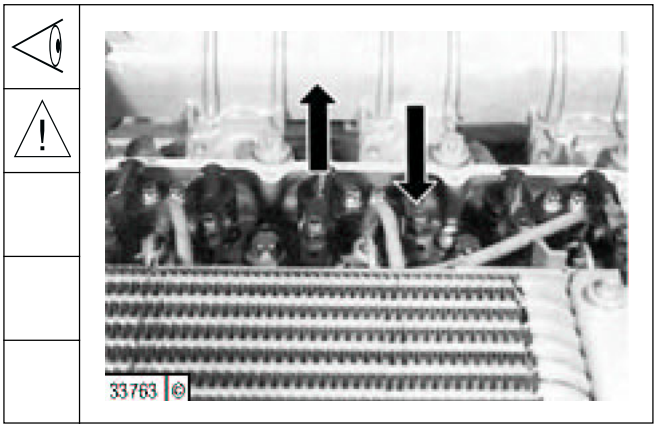
Cylinder head cover has been removed.

1. Turn engine until valves of cyl. No. 1 overlap.

For valve clearance adjustment schematic see Specification Data.



Note: Valves overlapping means:
Exhaust valve about to close.
Inlet valve about to open.
Neither pushrod can be turned in this position.



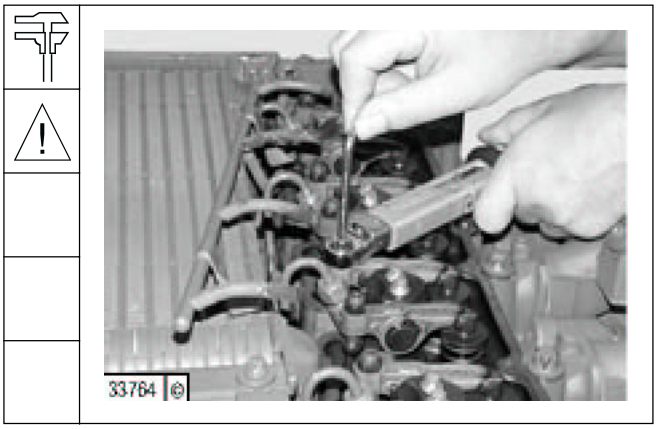
2. Adjust valve clearance on respective cylinder with feeler gauge.

Note: Inlet valve clearance: **0.3 mm**
Exhaust valve clearance: **0.5 mm**

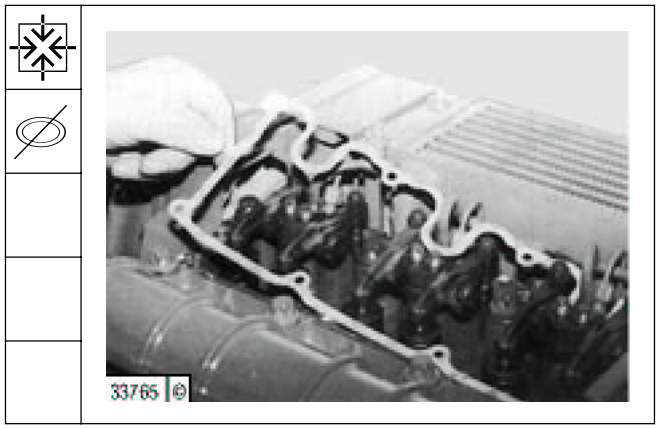
3. Tighten locknut.

   Tightening specification: **20 ± 2 Nm**

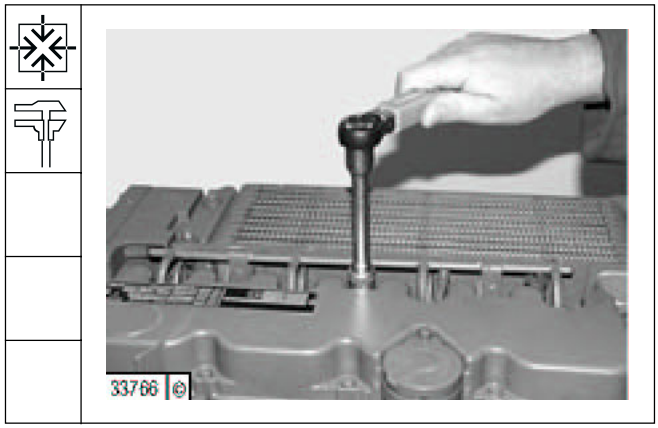
   Recheck the adjustment with feeler gauge.



4. Put gasket in place.



5. Insert **New** rubber tubes at the cross-over pipe and injection valves until the end stop.
Mount the cylinder head cover and the cross-over pipe. Tighten bolts.
Tightening specification: **8.5 Nm**



CHECKING AND ADJUSTING - COMPRESSION PRESSURE

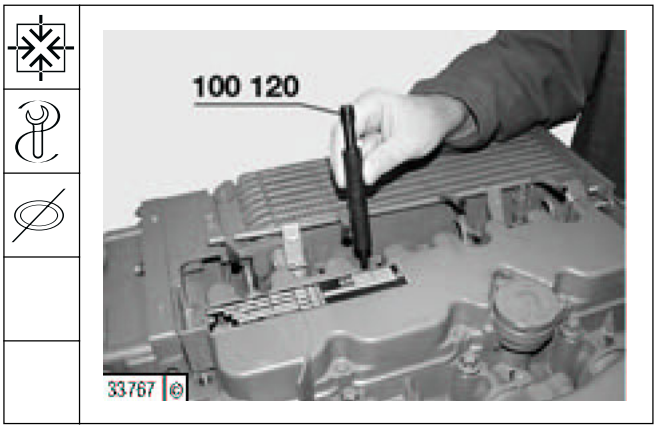
Commercial tools required:

Compression tester 8005
Glaw key 8018
Torx tool kit 8189

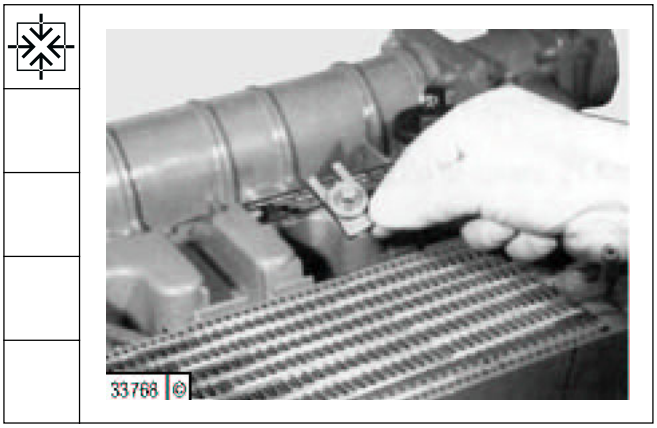
Special tools required:
Connector 100 120

Injectors have been removed, valve clearance has been checked.

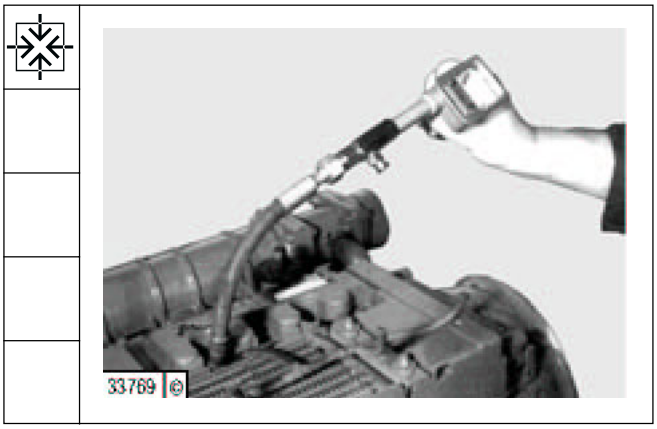
1. Insert connector with new special seal.



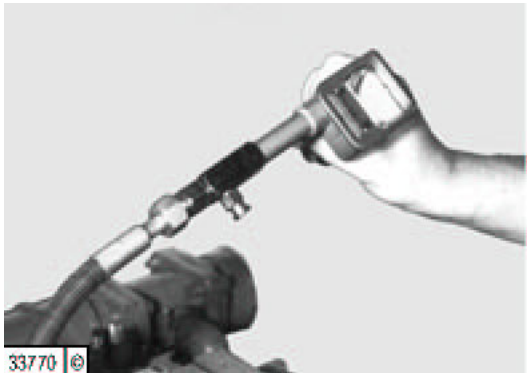
2. Fit clamping pad. Tighten bolt.



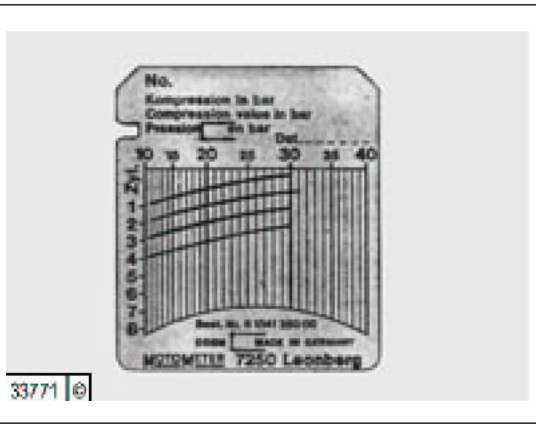
3. If necessary, screw on adapter for connector.



4. Connect compression tester. Turn engine with starter.
Compression pressure:
FI/M **25 - 30 bar**
BFL/M **22 - 27 bar**



The measured compression pressure is dependent on the starting speed during the measuring process and also on the altitude of the engine site. Therefore it is difficult to specify precise limit values. It is recommended to use the compression pressure measure-ment only for comparison of compression pressures of all cylinders in one engine. If a difference in pressure in excess of **15**% is determined, the cylinder unit concerned should be dismantled to establish the cause.



Note: Fit injector with new special seal and tighten.

Tightening specification: **21 Nm**

Attach the injection pipes and fix them firmly.

Tightening specification: **2 ± 2.5 Nm**

Insert **New** rubber tubes at the cross-over pipe and injection valves until the end stop.
Attach the cross-over pipe.

Tightening specification: **8.5 Nm**

CHECKING AND ADJUSTING - INJECTOR

Commercial tools required:

Nozzle tester 8008
Long socket a/flats 15 8021

Special tool required:

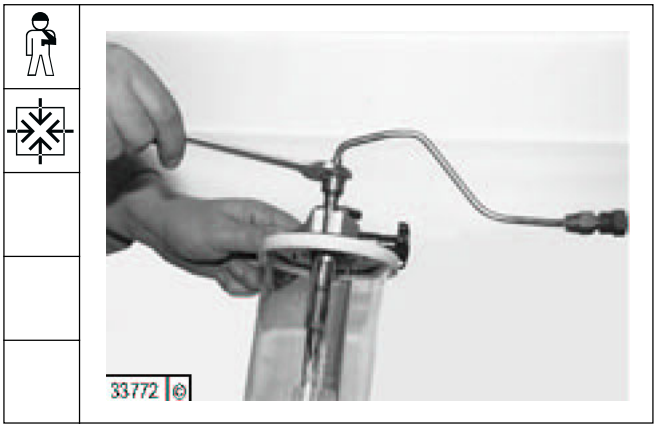
Retainer for injector 110 110

Note: Utmost cleanliness must be ensured when working on the injection equipment. For testing the injector use only pure test oil to ISO 4113 or clean diesel fuel.

Caution!

Beware of injection nozzle fuel jet. The fuel penetrates deeply into the skin tissue and may cause blood poisening.

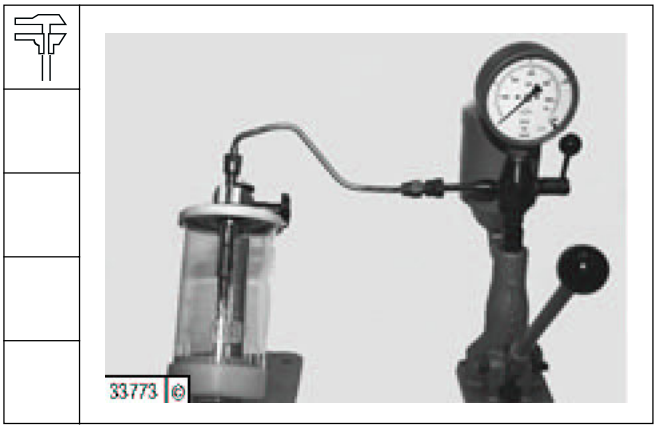
1. Connect injector to nozzle tester.



2. **Checking opening pressure**

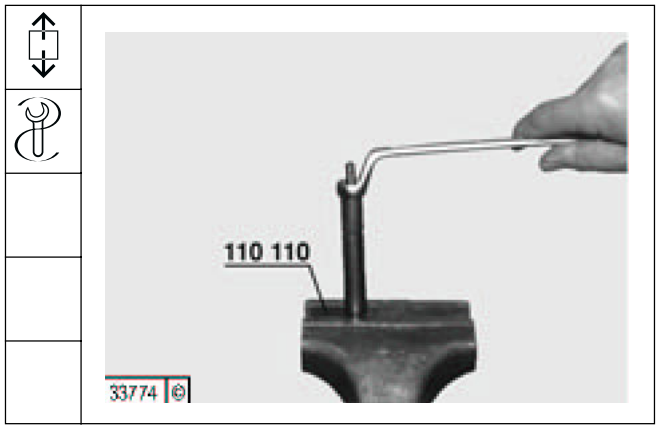
   With pressure gauge switched on, slowly press down lever of nozzle tester. The pressure at which the gauge pointer stops or suddenly drops, is the opening pressure.

   Opening pressure for initial setting:
   Genset engines **= 210 + 8 bar**



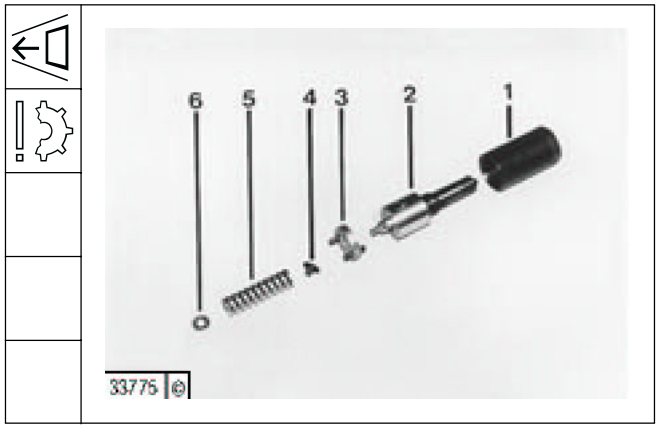
3. Adjusting the opening pressure on the injector

Unscrew cap nut and remove all parts



Sequence of parts disassembly

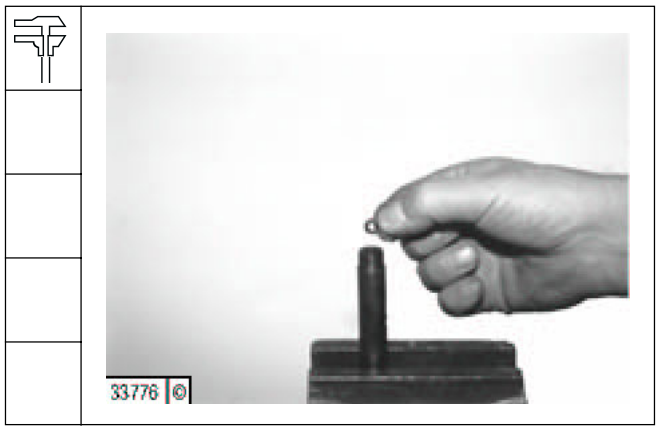
1. Cap nut
2. Injection nozzle
3. Adapter
4. Thrust pin
5. Compression spring
6. Shims



4. Adjust pressure by selecting appropriate shim. A thicker shim increases the opening pressure. Reassemble injector. Tighten cap nut.

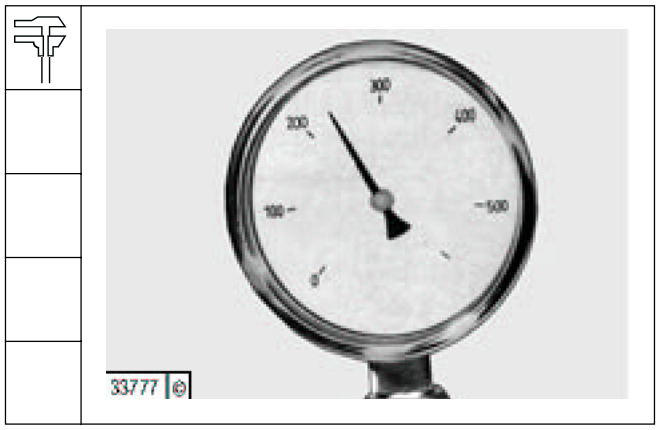
   Tightening specification: **45 ± 5 Nm**

   Recheck injector on nozzle tester.

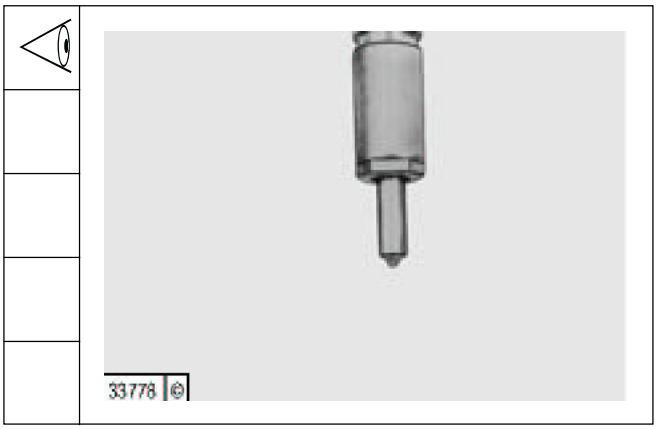


5. Checking for tightness

Dry nozzle and nozzle holder - blow out with compressed air. Press down handlever of nozzle tester slowly until a pressure of about **20 bar** below the previous opening pressure reading is attained.

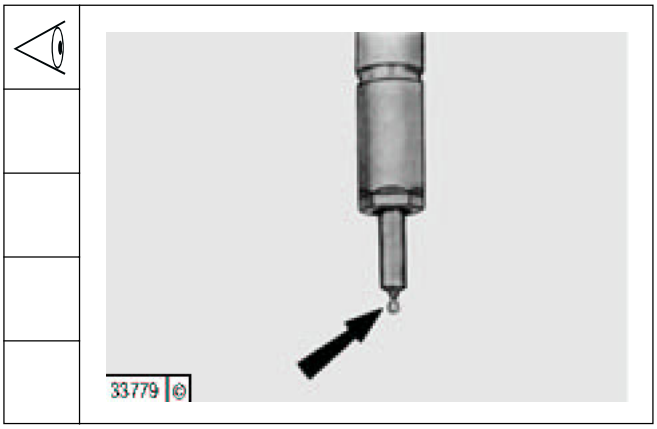


6. Nozzle is tight if there is no dripping within a period of **10** seconds.



7. In case of a drip, the injector must be dismantled and cleaned to remedy the leak. If this does not cure the leak, the injector must be replaced.

   Reworking is not permissible.

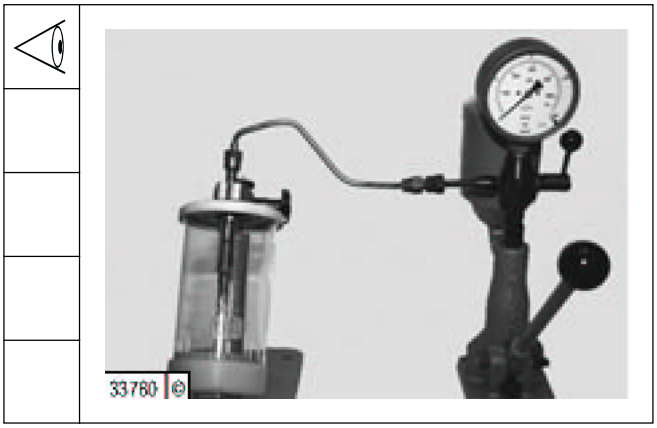


8. Buzzing and spray pattern test

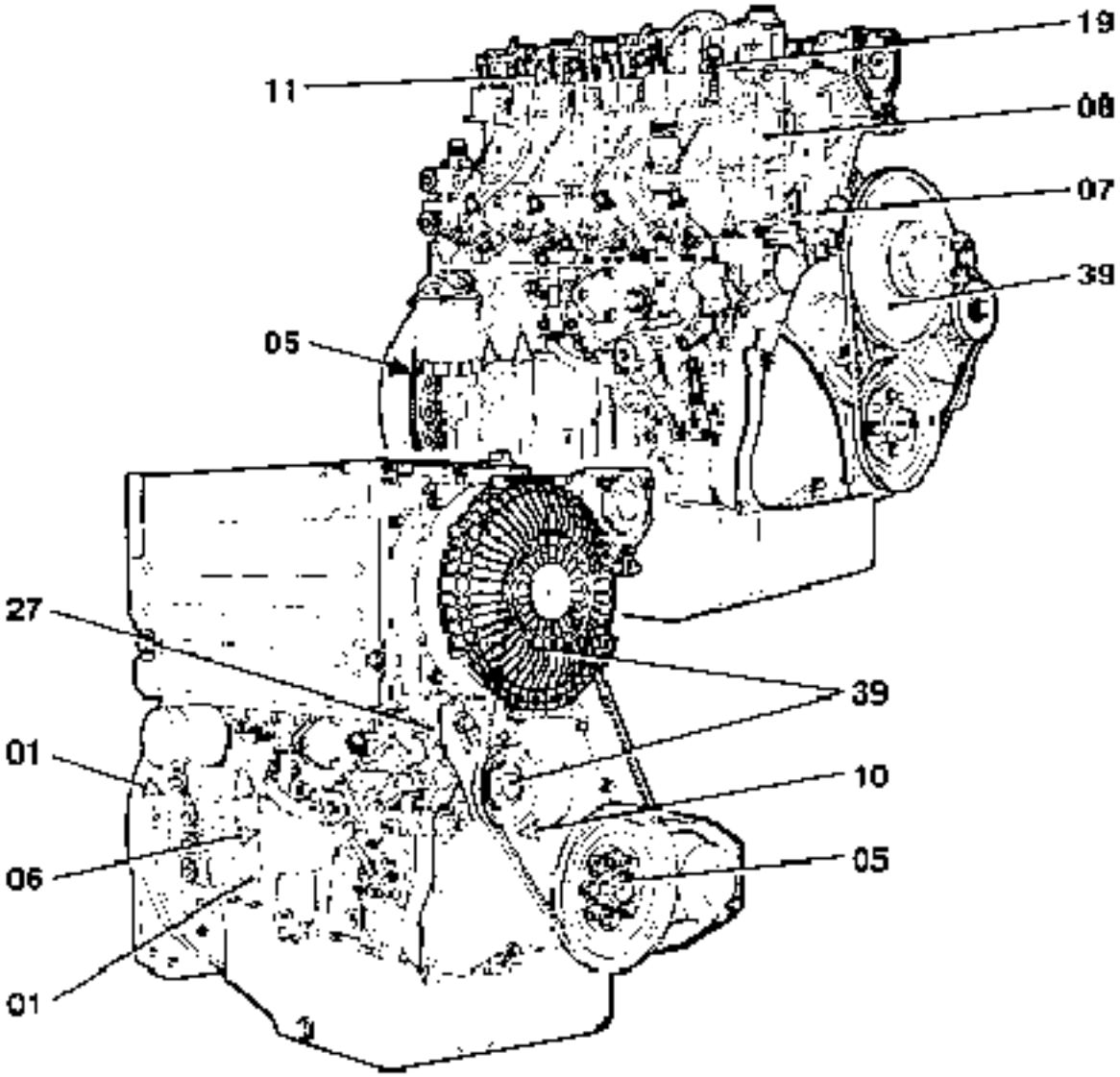
Switch off pressure gauge of tester.

The buzzing test permits an audible check of the ease of movement of the nozzle needle in the nozzle body. New injectors emit a different buzzing sound as compared to used injectors.
It deteriorates due to wear in the needle seat area. If an injection nozzle does not buzz despite cleaning, it must be renewed.

A used injector should buzz clearly during rapid actuation of the handlever, while exhibiting a well atomized spray pattern. The spray pattern may differ noticeably from that of a new injector.

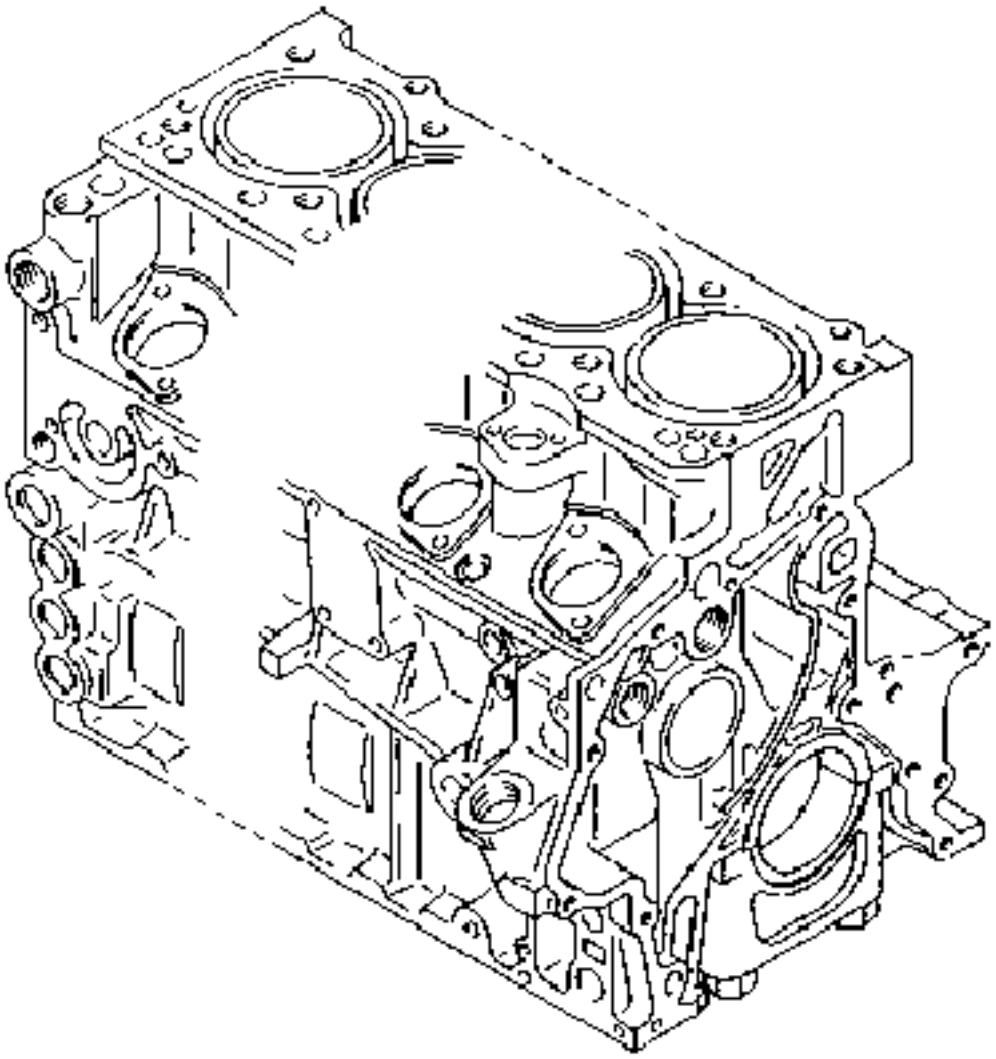


REPAIR OF COMPONENTS



Assembly Group	Description
01	Crankcase with integrated cylinder liners
01	Rear cover
05	Crankshaft
05	Starter ring gear / flywheel
06	Connecting rod
07	Piston
08	Cylinder head
10	Camshaft
11	Rocker arm bracket
19	Injector
27	Front cover
39	Blower
39	Idler pulley
39	Fan drive

• CRANKCASE WITH INTEGRATED CYLINDER LINERS



Commercial tools required:

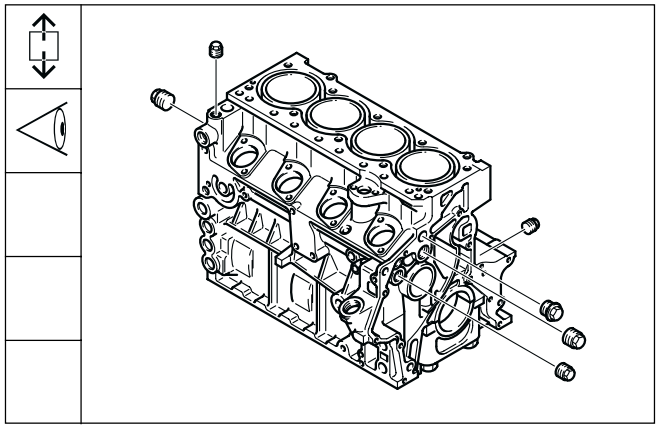
Screw driver socket 8112
Internal dial gauge

Special tools required:

Assembly tool for control rod bush 110 140
Assembly tool for camshaft bush 143 820
Puller for pipe 150 140
Assembly arbor for pipe 150 150

1. Clean the crankcase with integrated cylinder liners and carry out a visual check.

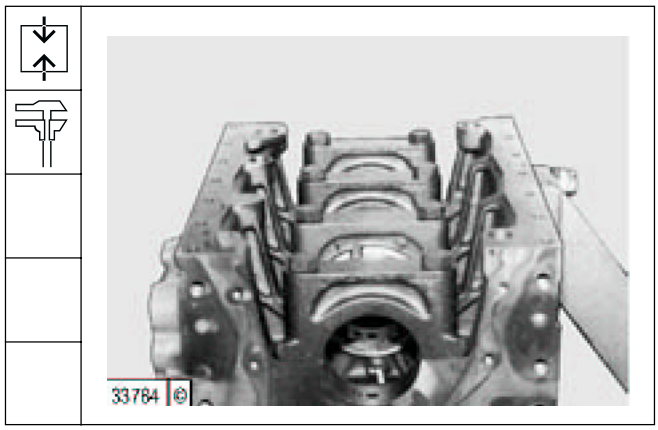
1.1 Remove the locking screws.
Clean the crankshaft casing and carry out a visual check for damage.
Check the oil channels for leakage.



2. Measure the main bearing bores / bearing shells (if necessary)

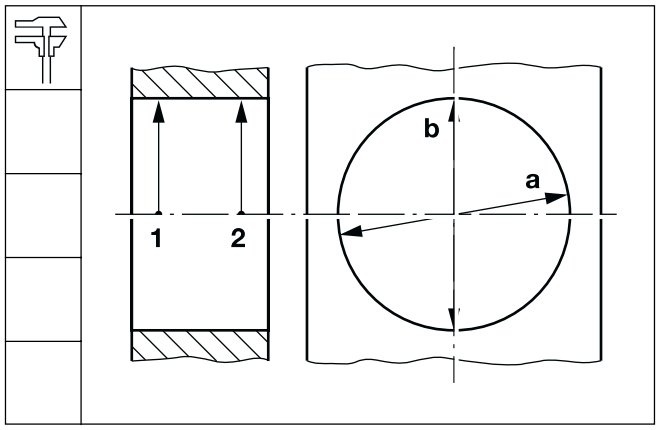
2.1 Mount on the crankshaft bearing cover / bearing shells and tighten the screws firmly.

Torque specification:
Pretension value **50 Nm**
Restress angle plate 1. stage **60°**
2. stage **45°**



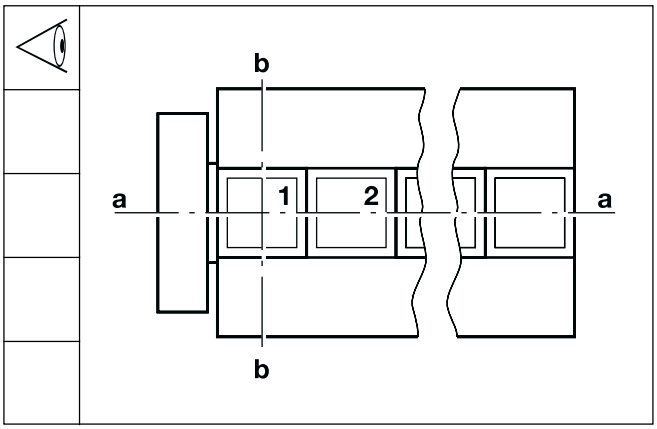
2.2 Measure the bearing bores / bearing shells at the positions 1 and 2 the level ”a“ and ”b“ with a measuring instrument.

Bearing bores nominal
dimension **75.0 - 75.019 mm**
Bearing shells nominal
dimension **70.02 - 70.055 mm**
Main bearing clearance nominal
dimension **0.03 - 0.085 mm**



3. Gauge cylinders

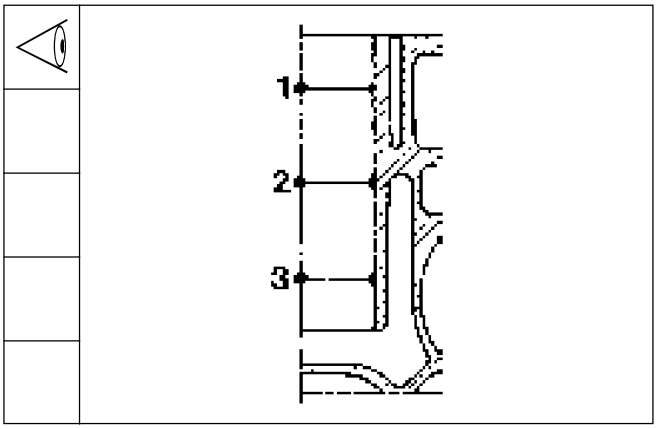
In order to measure the cylinder, the crankshaft bearing cover must be properly mounted.



3.1 Cylinder with a measuring instrument

- in the motor longitudinal axis "a" and motor transverse axis "b"

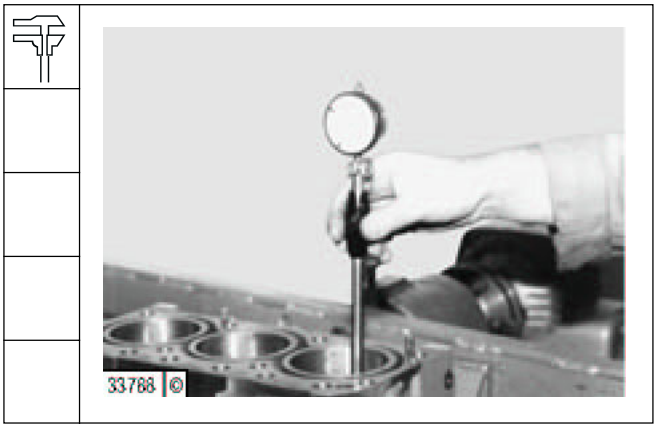
- and measure at the level 1-3.



3.2 Inside diameter of the cylinder:

Cylinder bore **94.0 - 94.02 mm**
Wear limit **94.1 mm**

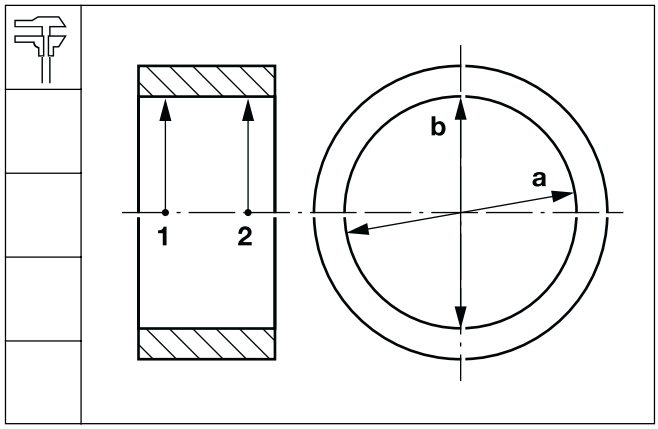
Oversized stage **94.5 - 94.52 mm**
Wear limit **94.6 mm**



If the measurements of the cylinders correspond to the indicated values, the crankcase with integrated cylinder liners.
In case of worn cylinders, the cylinder crankshaft casing can be grooved at our service center to an oversize cylinder ø 94,5 mm.

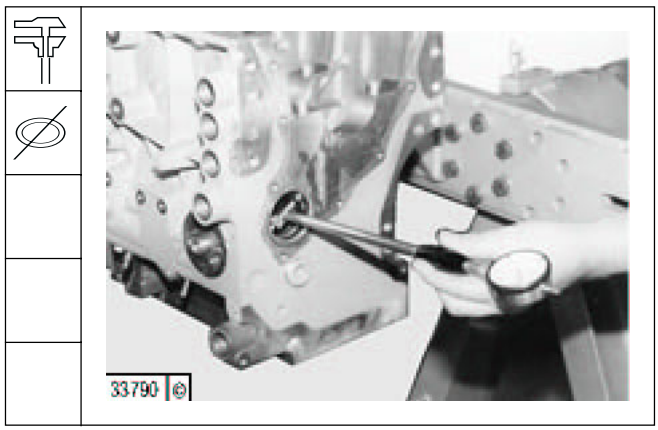
4. Measure the camshaft bearing bushes

4.1 Measure the camshaft bearing bushes with an internal measuring device at the points 1 and 2 at the level "a" and "b".



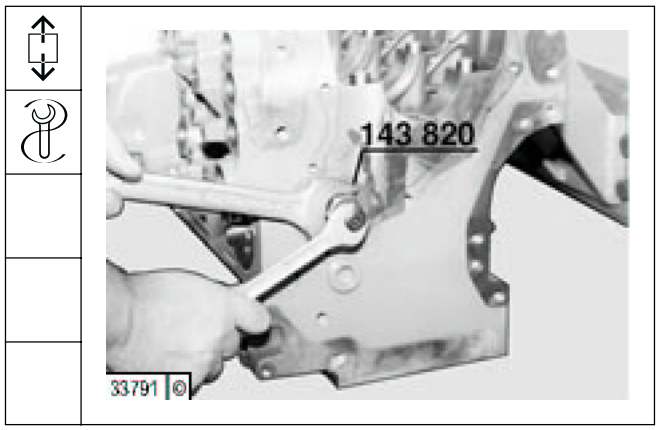
4.2 Inside diameter of the camshaft bearing bushes:

Cylinder bore **54.0 - 54.054 mm**
Wear limit **54.080 mm**



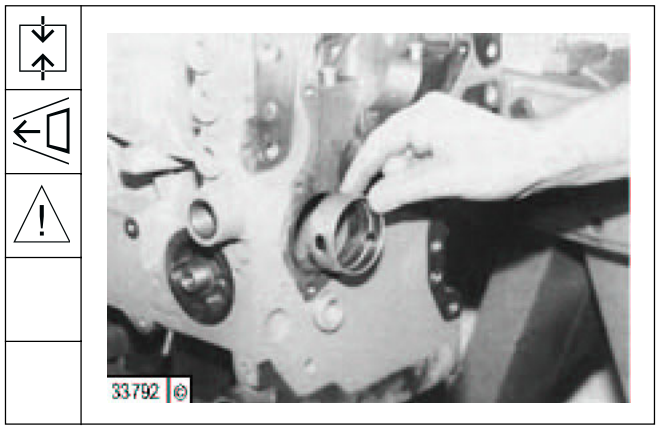
5. Exchange the camshaft bearing bushes

5.1 Remove the bearing bushings.

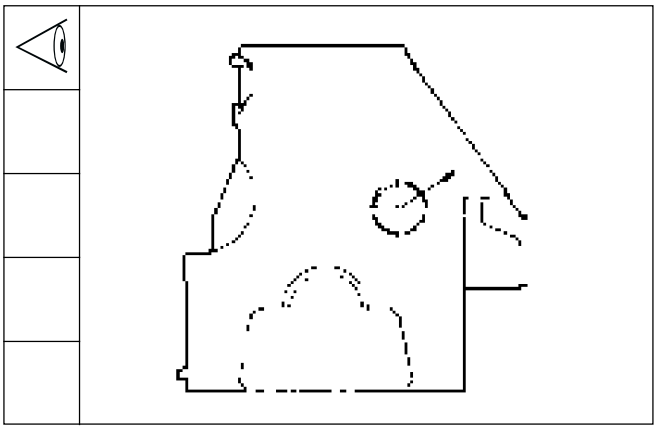


5.2 Place a new bearing bushing.

Note: Observe the fitting of the lubricating oil drillings.

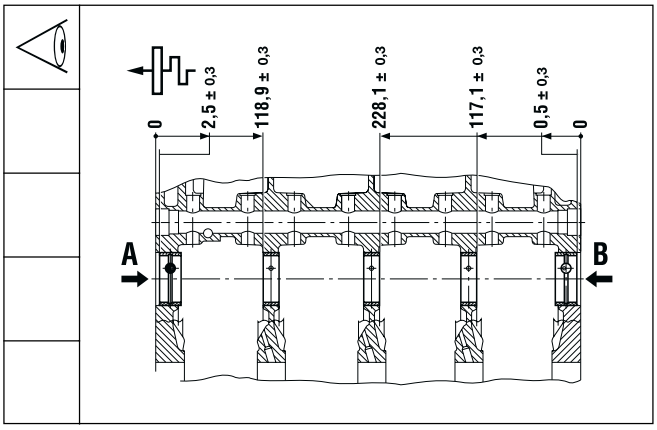


5.3 Schematic: Installation direction of joint in the bearing bush.

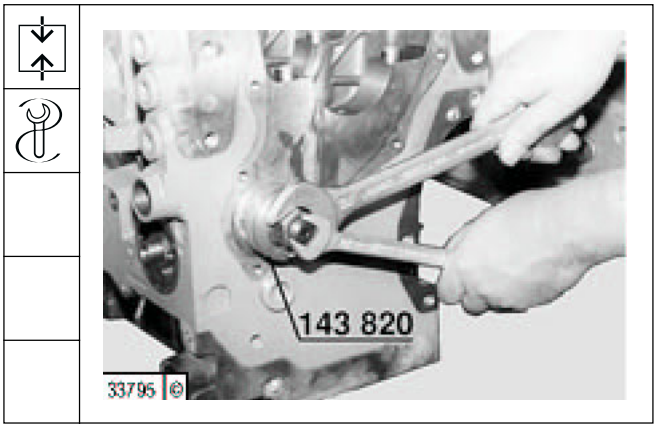


5.4 Schematic: Installation dimensions of bearing bushes.

	A	B
2-Cyl.	2.5 mm	0.5 mm 117.1 mm
3-Cyl.	2.5 mm 118.9 mm	0.5 mm 117.1 mm
4-Cyl.	2.5 mm 118.9 mm	0.5 mm 117.1 mm 228.1 mm

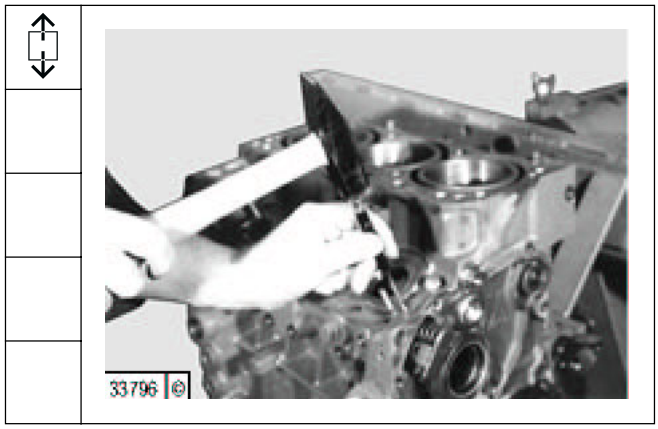


5.5 Insert bearing bush.

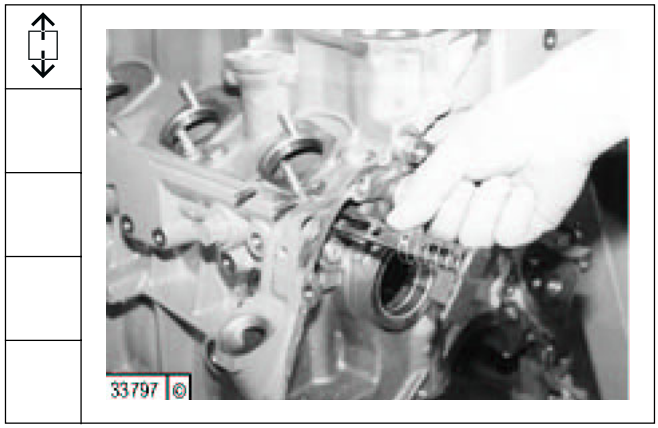


6. Exchange the adjusting rod and guide bushes

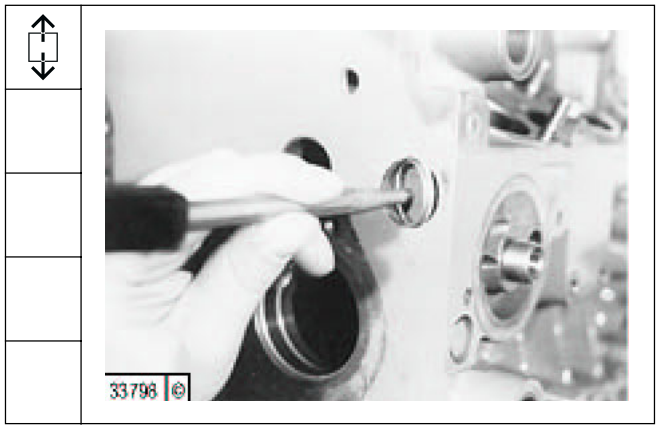
6.1. Drive out parallel pin.



6.2 Remove control rod together with spring.

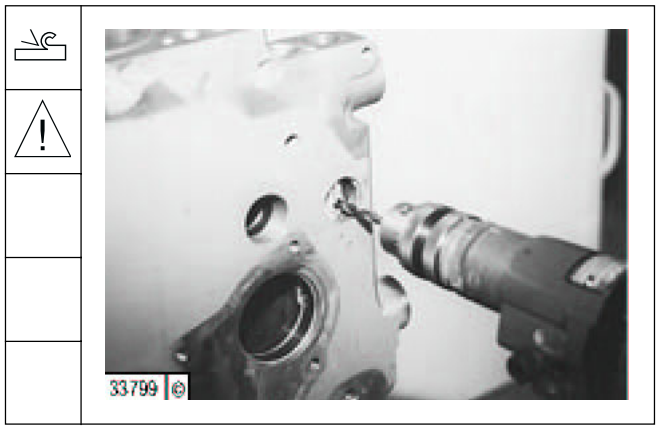


6.3 Remove cover.

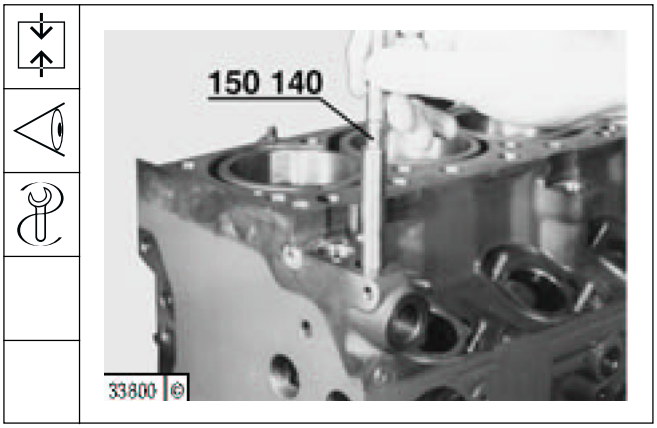


6.4 Pierce pipe on one side with a drill of 5.5 mm dia.

Note: Carefully clean crankcase after drilling.

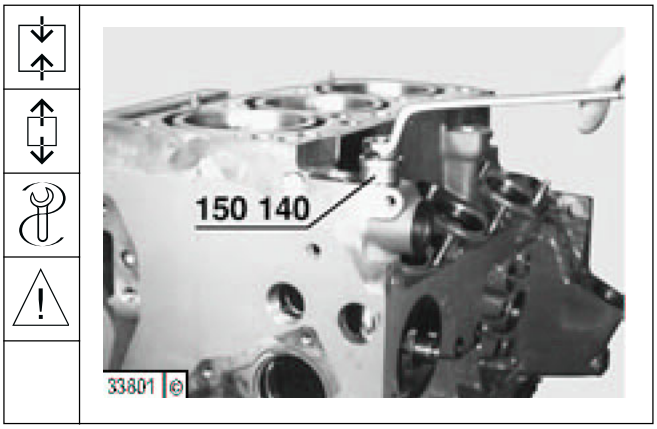


6.5 Insert puller until pin engages in bore.

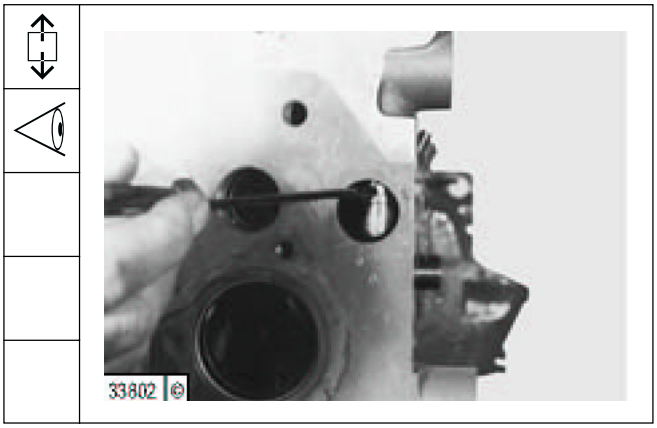


6.6 Position spacer bush in place. Pull out pipe from lower press fit.

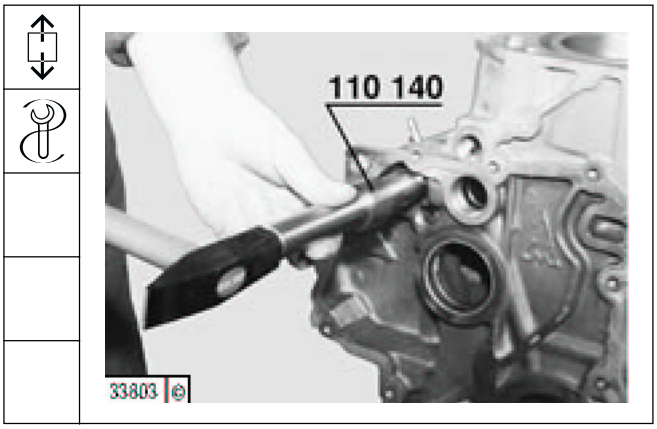
Note: Do not pull out pipe completely.



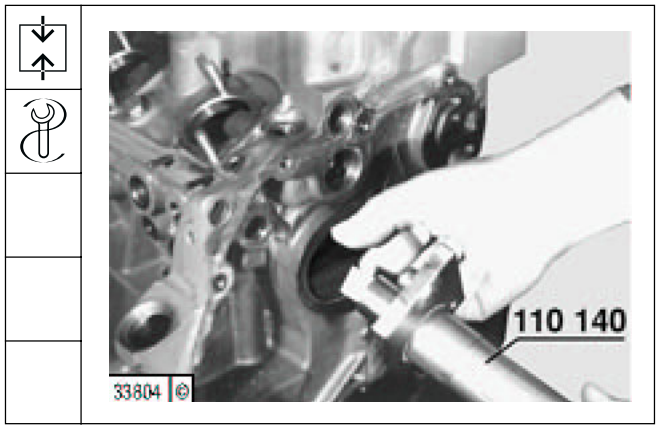
6.7 Press pin in until it does no longer project beyond the pipe. Now pull out pipe completely.



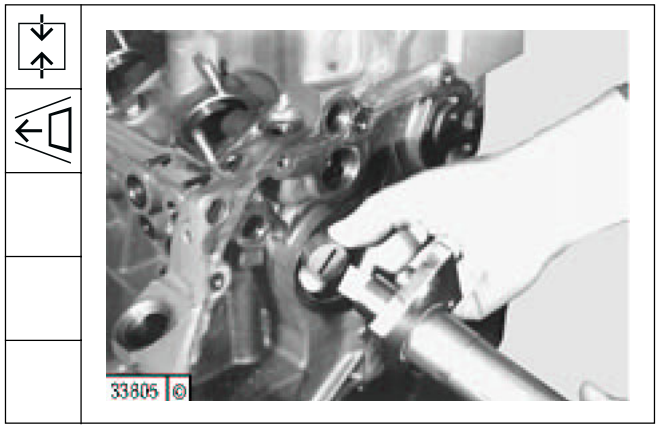
6.8 Drive out guide bush at front end.



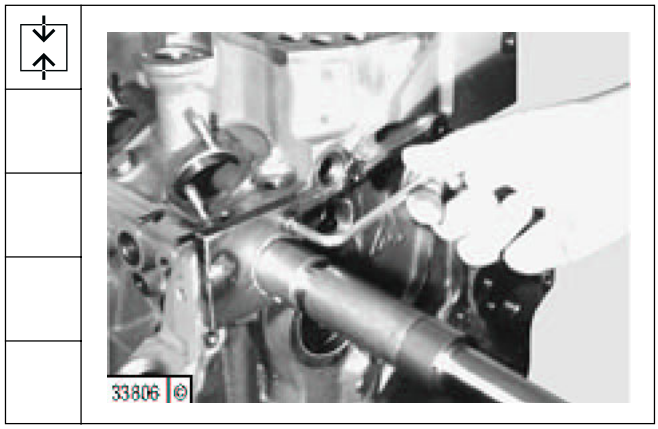
6.9 Introduce assembly arbor with spacer bush into centering.



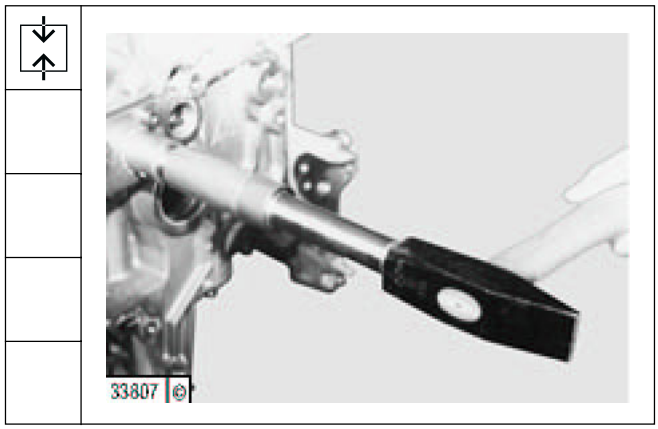
6.10 Position guide bush on assembly arbor with chamfer pointing towards crankcase.



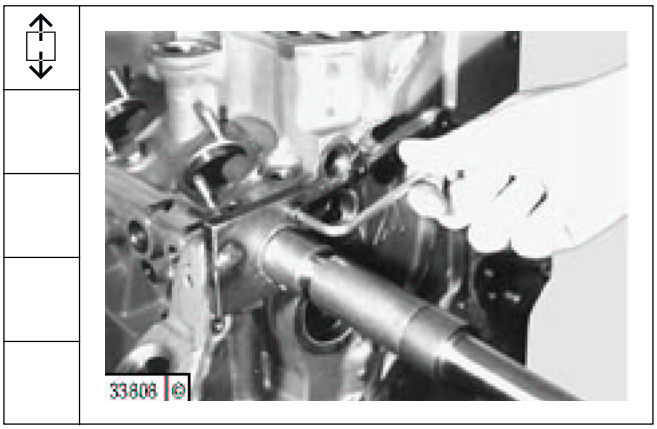
6.11 Secure centering with assembly arbor and guide bush on crankcase.



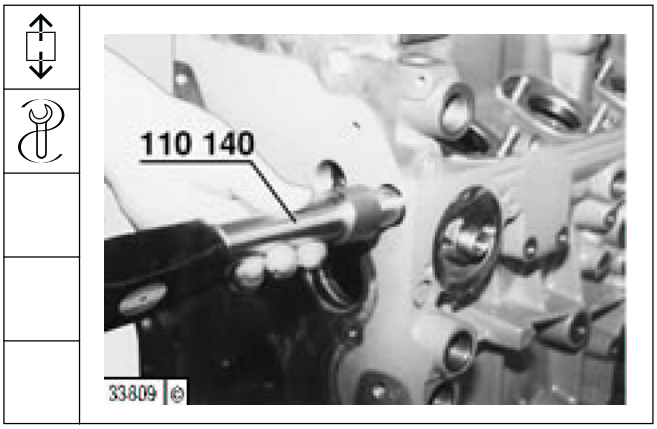
6.12 Drive in guide bush at front end as far as it will go.



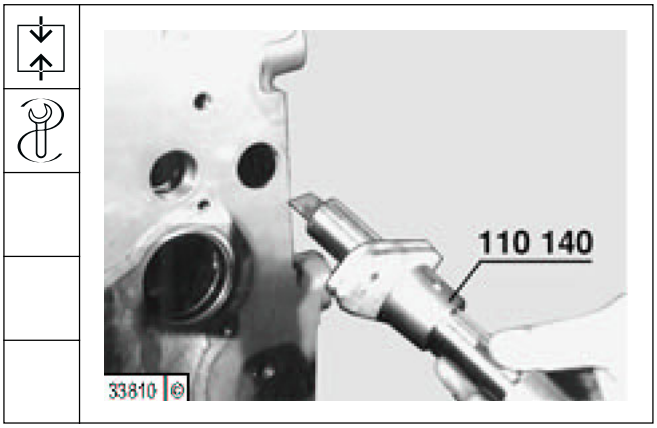
6.13 Remove centering.



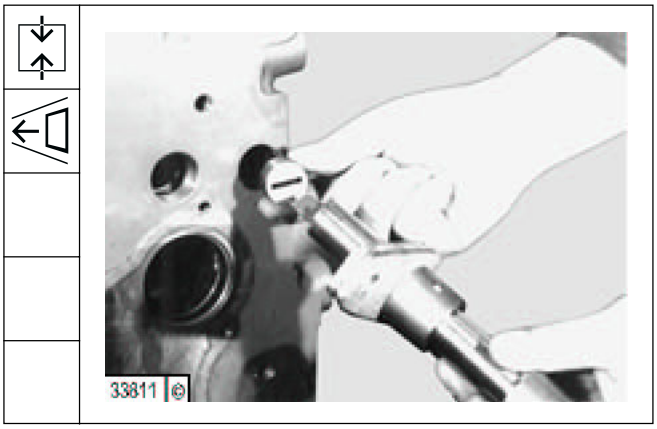
6.14 Drive out guide bush at flywheel end.



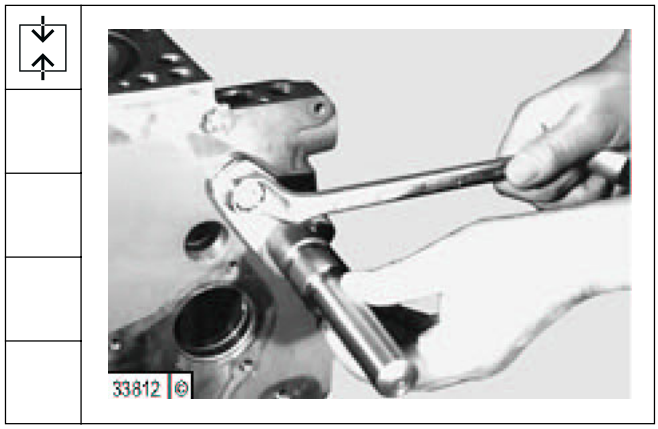
6.15 Introduce assembly arbor without spacer bush into centering.



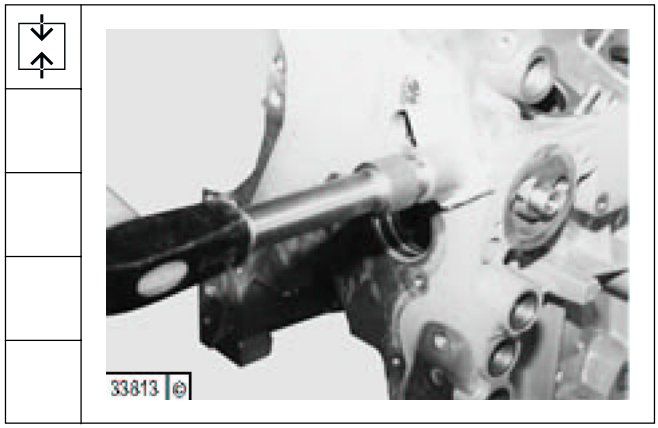
6.16 Position guide bush on assembly arbor with chamfer pointing towards crankcase.



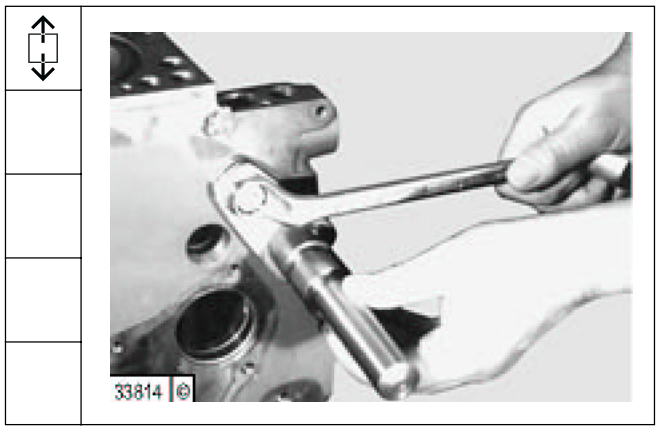
6.17 Secure centering with assembly arbor and guide bush on crankcase.



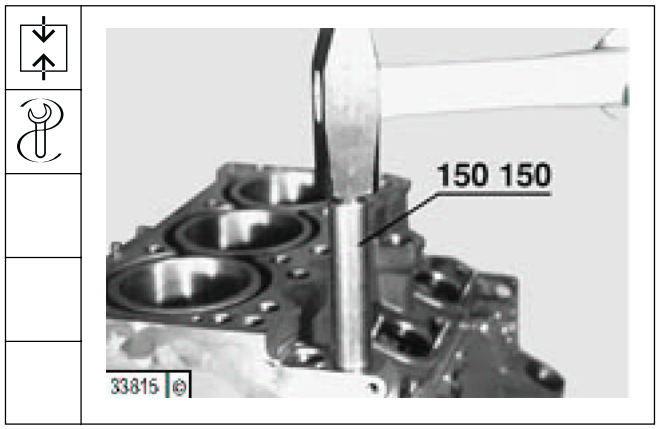
6.18 Drive in guide bush at flywheel end as far as it will go.



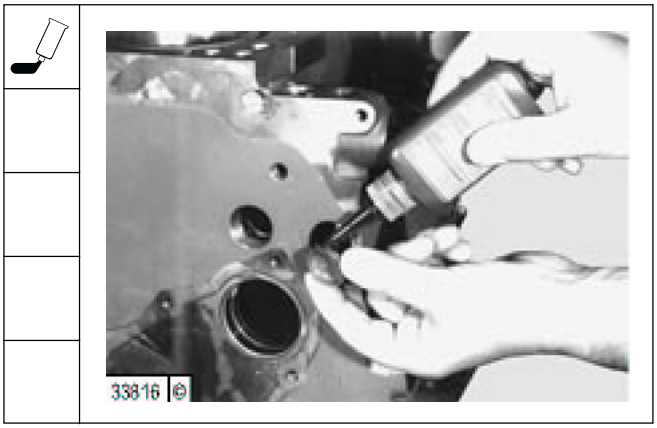
6.19 Remove centering.



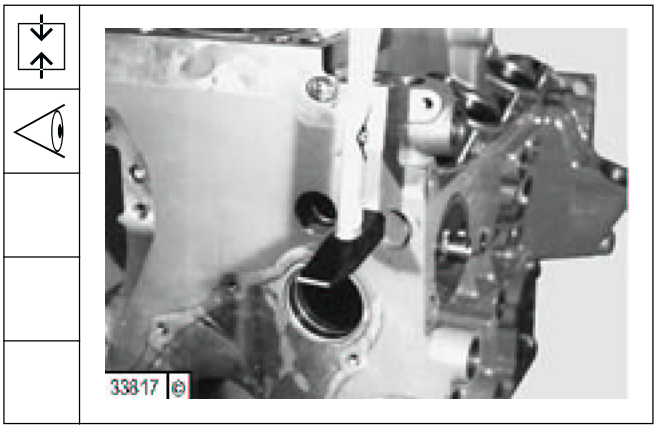
6.20 Press in new pipe with assembly arbor as far as it will go.



6.21 Apply locking compound **DEUTZ DW 72** to new cover.

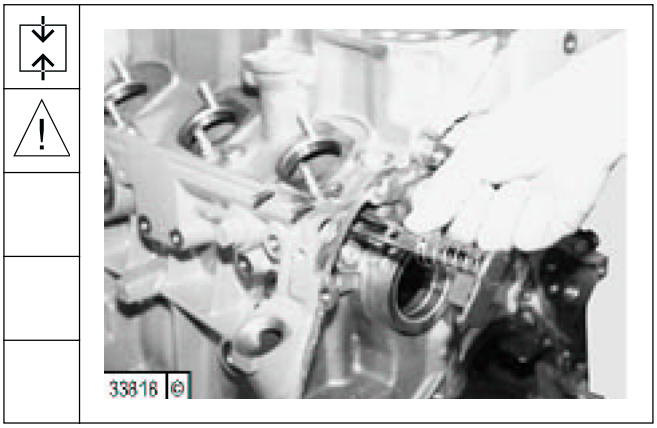


6.22 Drive in cover flush with crankcase.

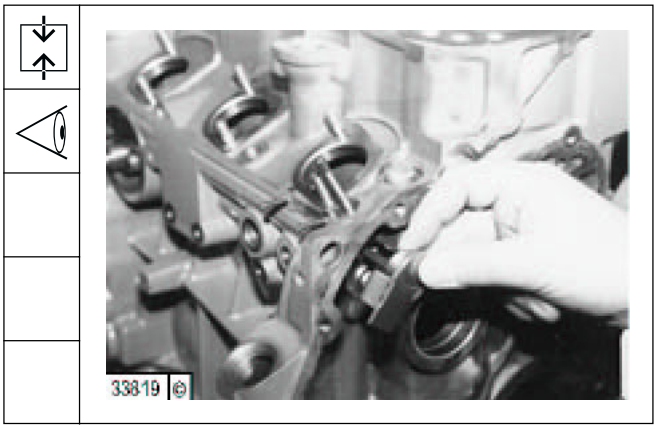


6.23 Insert control rod with starter spring into guide bushes.

Note: Check for free movement.



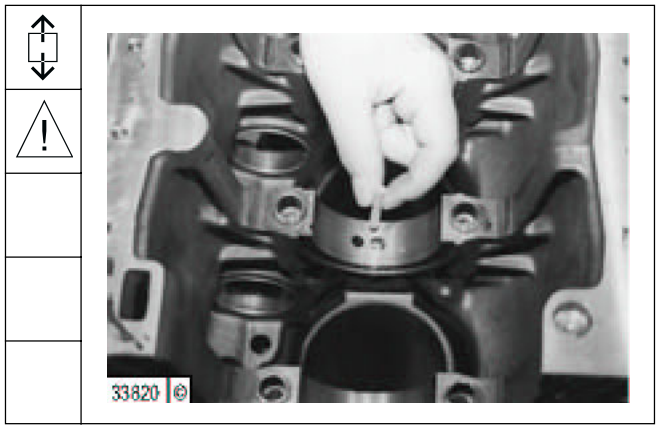
6.24 Compress starter spring. Drive parallel pin into recess for control rod travel limitation. Check that it is flush with surface.



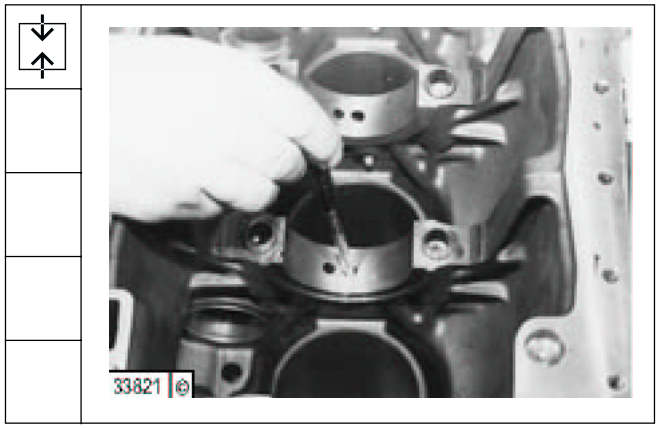
7. Exchange the piston cooling oil nozzles

7.1 Press out piston cooling oil nozzles.

Note: Before installing new piston cooling oil nozzles, check that the bores in the crankcase are clean and free of oil.



7.2 Press in new piston cooling oil nozzles as far as they will go.

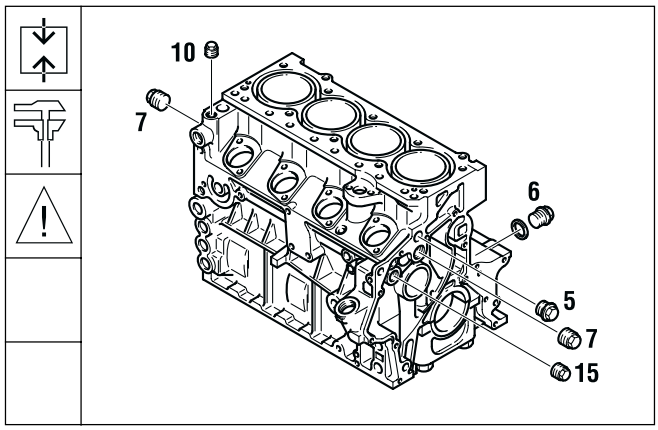


8. Mount the plug screws

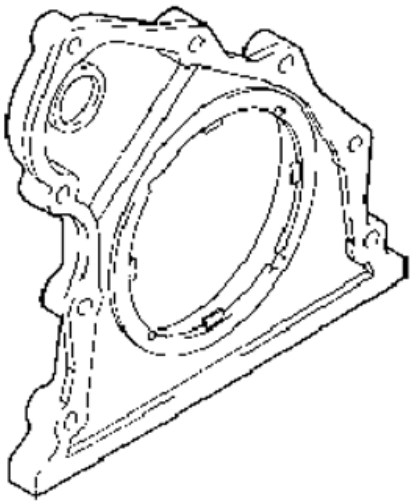
8.1 Screw in the locking screws and tighten them.

Tightening specification:
Item 5 = **50 Nm**
Item 7 = **95 Nm**
Item 10 = **56 Nm**
Item 15 = **50 Nm**
Item 17 = **26 Nm**

Note: After dismantling the position 5, 7, 10 and 17, these are to be basically renewed. Pos. 6 with new sealing ring.



• REAR COVER

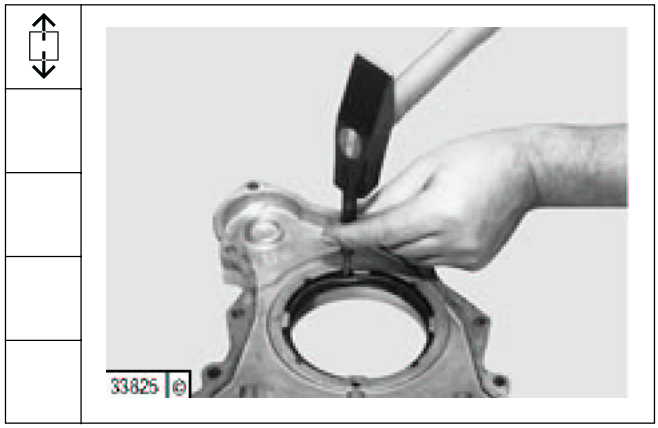


Special tools required:

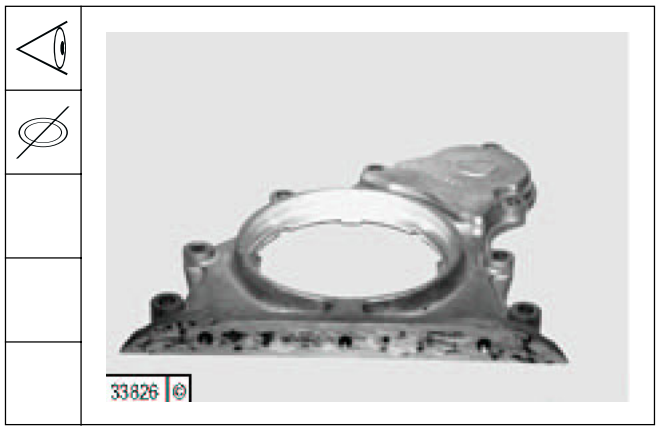
Assembly tool 142 860

If the crankshaft density has a lead-in spiral, a new shaft seal ring set, consisting of rotary shaft seal and a rotating ring is to be used instead of a new shaft seal ring.
For the assembly of the shaft seal ring set, see chapter 4.

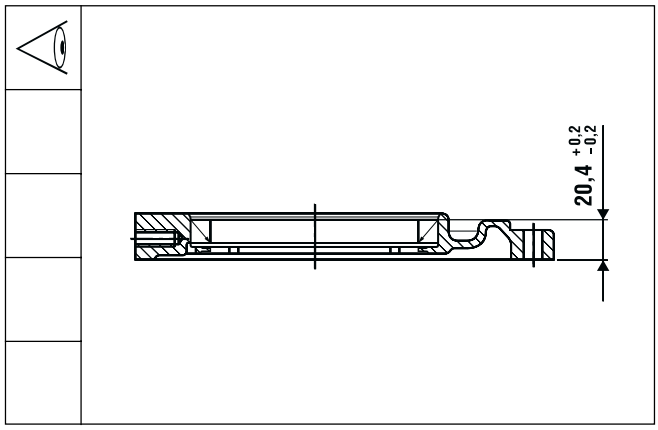
1. Drive out shaft seal.



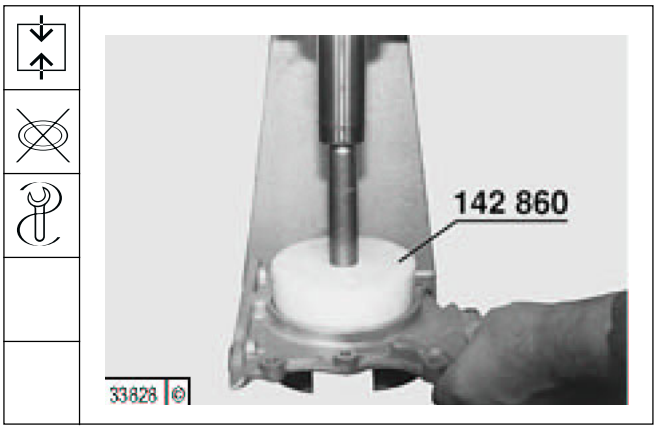
2. Inspect cover, replace if necessary.



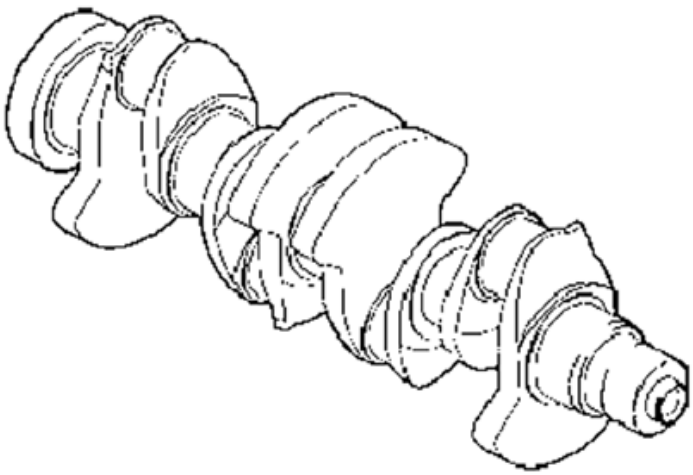
3. Installation depth of shaft seal.



4. Fit shaft seal with assembly tool without using oil.



• CRANKSHAFT

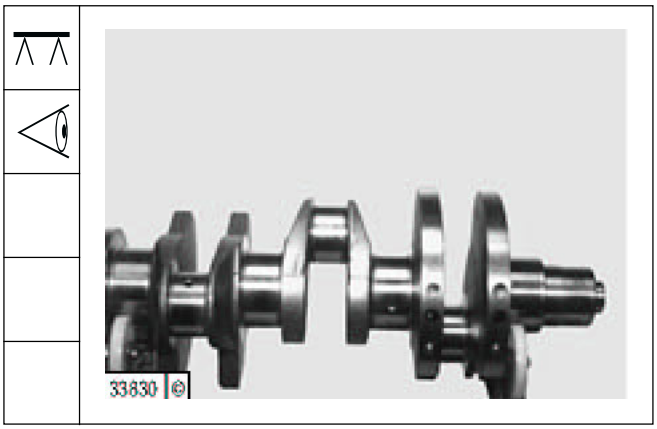


1. Measure the crankshaft

1.1 Chuck crankshaft up on prism stand.

Reworking sizes are marked on the outer contour of the cast-on counterweight at flywheel end.
H = ground main bearing journals
P = ground crankpins

If crankshaft is worn, it is possible to have it reconditioned at our Service Centers.



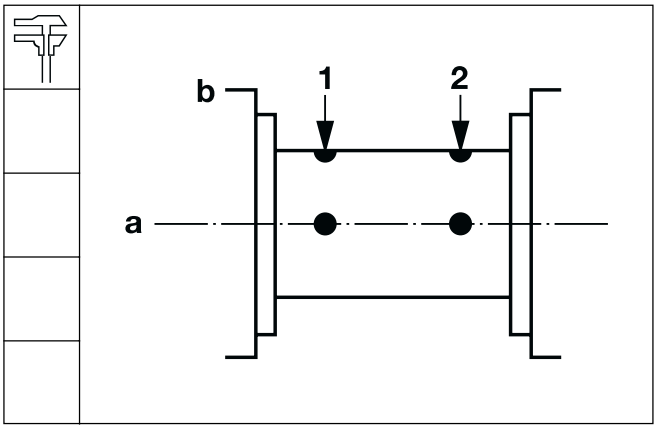
1.2 Measure the main bearing pins at the positions "1" and "2" at the level "a" and "b".

Nominal dimension **69.97 - 69.99 mm**

Each undersize **0.25 mm**

Limit for undersize **69.47 mm**

Wear limit:
Journal ovality **0.008 mm**

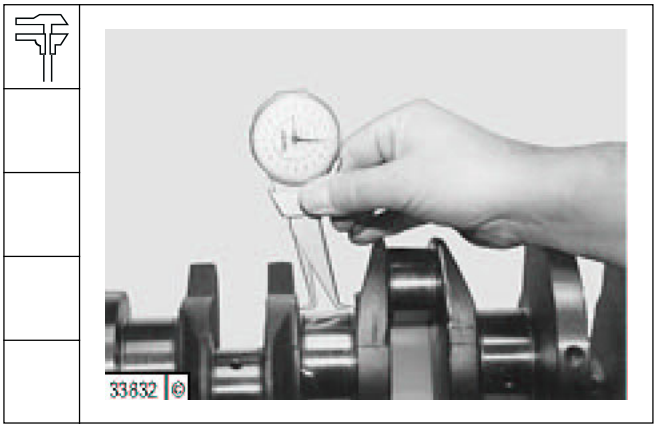


1.3 Gauge thrust bearing journal width.

Journal width **35.0 - 35.04 mm**

Each oversize **0.4 mm**

Limit for oversize **35.44 mm**



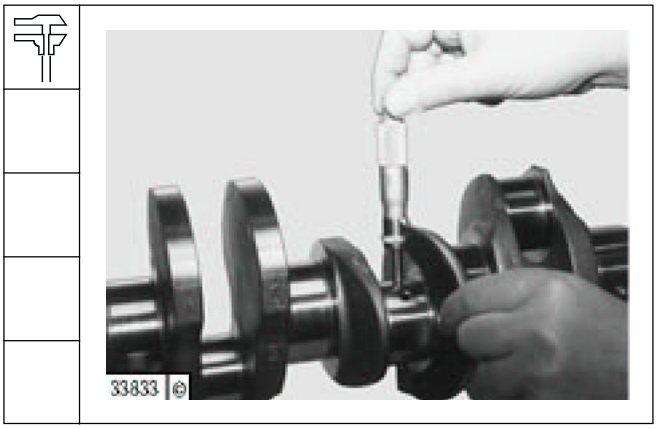
1.4 Gauge crankpins.

Pin diameter **54.97 - 54.99 mm**

Each undersize **0.25 mm**

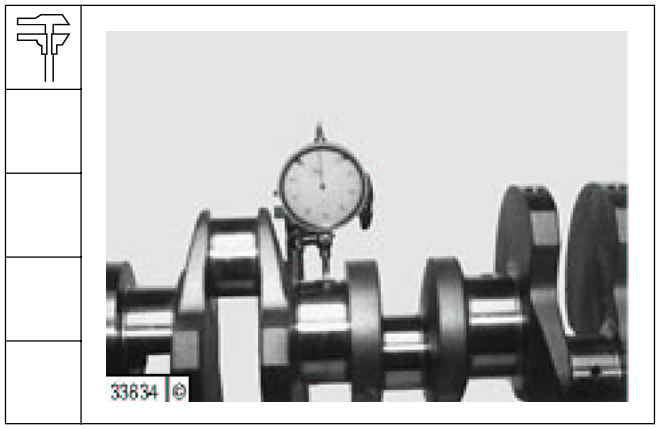
Limit for undersize **54.47 mm**

Wear limit:
Pin ovality **0,01 mm**



1.5 Check crankshaft for true running.

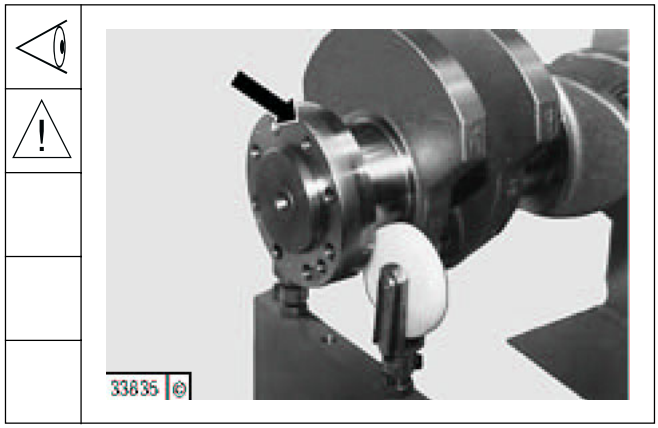
Out of roundness max. **0.05 mm**



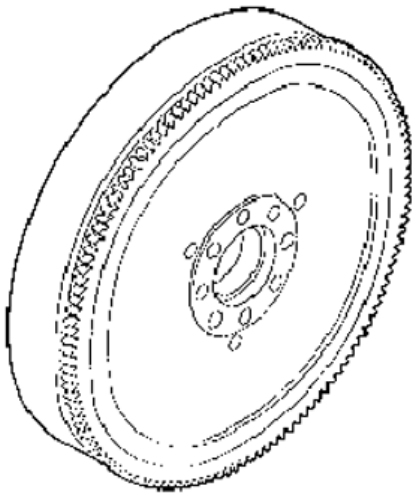
2. Check visually the sealing surfaces

2.1 Check visually the sealing surfaces of the shaft seal rings.

Note: If a lead-in spiral is placed on the sealing surfaces, a shaft seal ring set, consisting of a shaft seal ring and a rotating ring will be at the disposal of the crankshaft seal.
Assembly of the shaft seal ring set, see chapter 4.



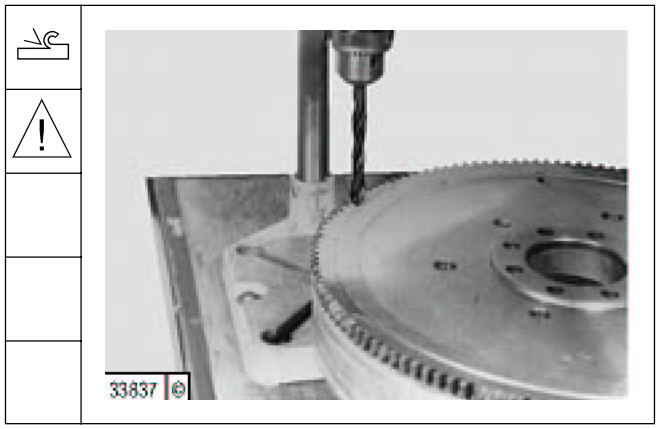
• STARTER RING GEAR / FLYWHEEL



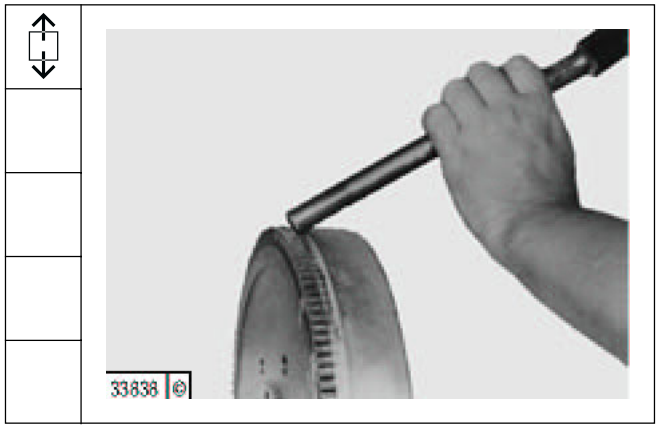
1. Exhange drill ring gear

1.1 Drill ring gear apart.

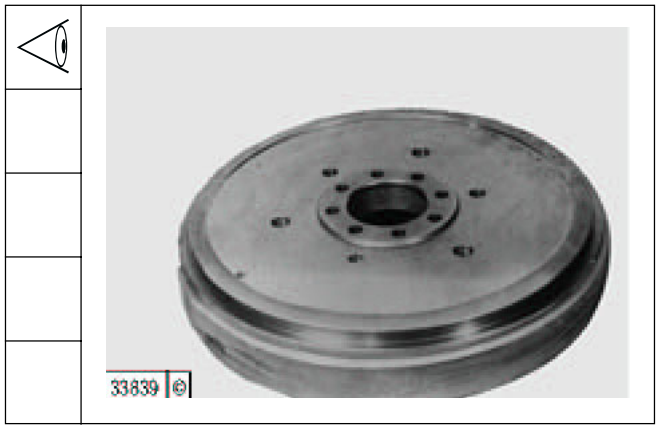
Note: Make sure not to damage flywheel.



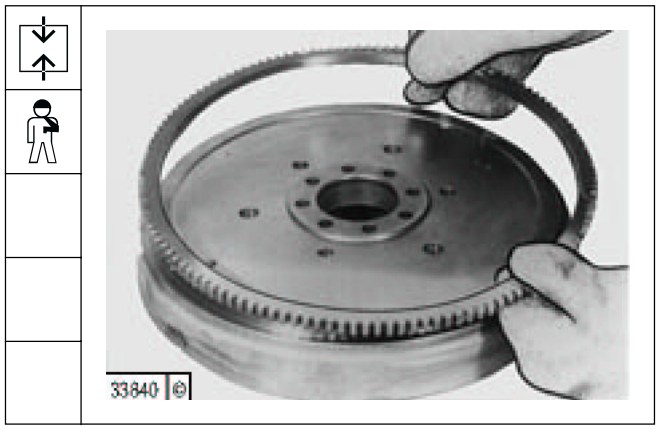
1.2 Remove ring gear.



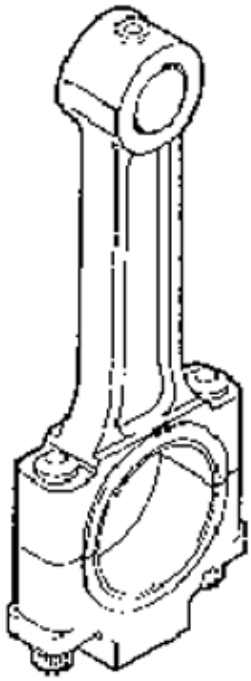
3. Clean flywheel and inspect at supporting flange.



4. Heat ring gear to max. 220 °C. Place ring gear in position and bring to stop at flange.



• CONNECTING ROD



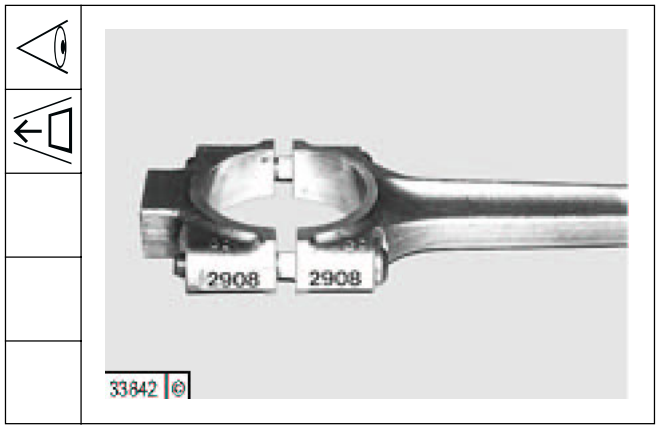
Special tools required:

Assembly tool for small end bush
26 mm dia. 131 340

Assembly tool for small end bush
30 mm dia. 131 350

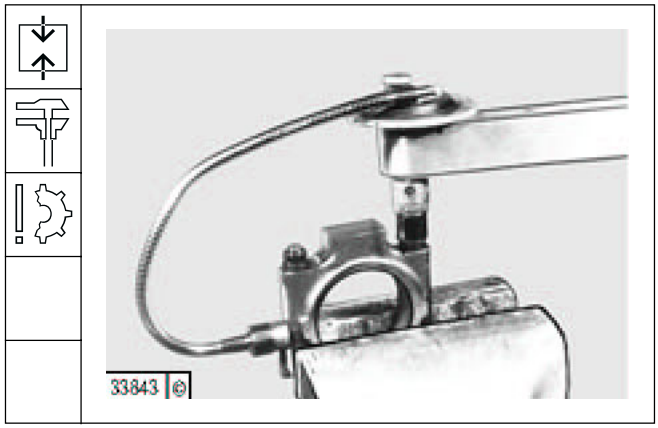
1. Measure the connecting rod bearing drilling

1.1 Make sure that cap mates with connecting rod.

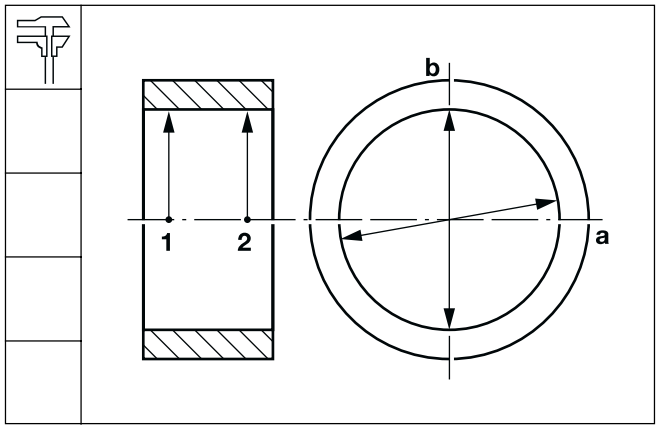


1.2 Fit bearing cap. Tighten nuts with **dodecagonal socket wrench**.

Tightening specification:
Initial tightening torque **30 Nm**
1st tightening angle **60°**
2nd tightening angle **60°**



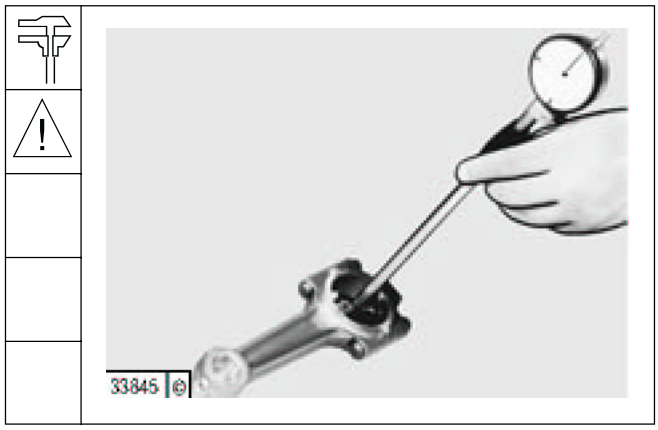
1.3 Connecting rod bearing drilling with a measuring instrument at the positions "1" and "2" of the level "a" and "b"



- Measure

Nominal dimension **58.5 - 58.52 mm**

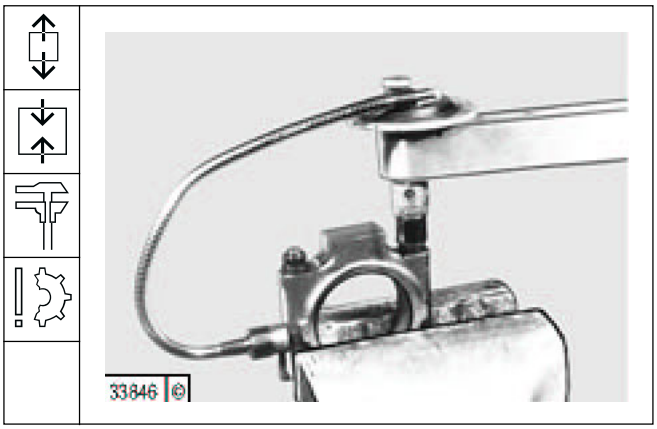
Note: If the gauge readings conform to the specified values, the necessary preload will be obtained after fitting the bearing shells.
If the measured values deviate only slightly, additional measurements are to be carried out with new bearing shells fitted.



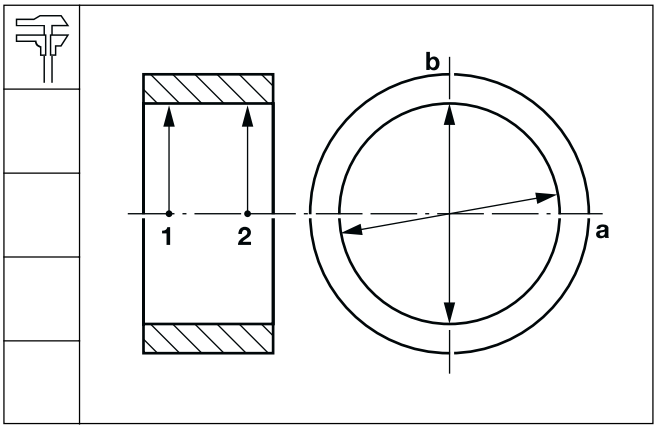
1.4 Remove bearing cap and fit new bearing shells. Refit bearing cap. Tighten nuts.

Tightening specification:

Initial tightening torque **30 Nm**
1st tightening angle **60°**
2nd tightening angle **60°**



1.5 Bearing shell with a measuring instrument at the positions "1" and "2" of the level "a" and "b"

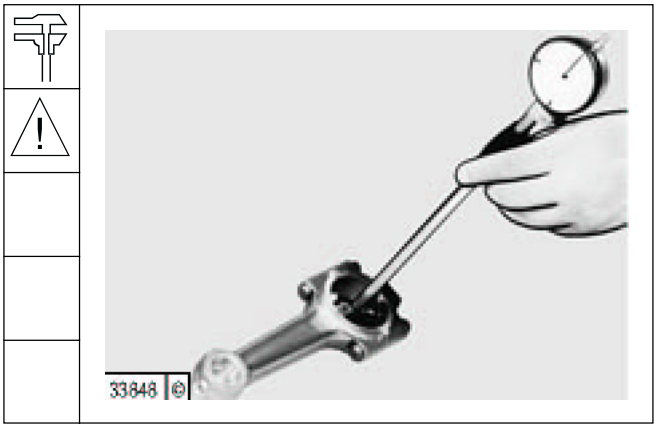


- Measure
Nominal dimension **55.024 - 55.055 mm**

Each undersize **0.25 mm**

Limit for undersize **54.524 - 54.555 mm**

Wear limit: Radial clearance
of big end bearing **0.12 mm**

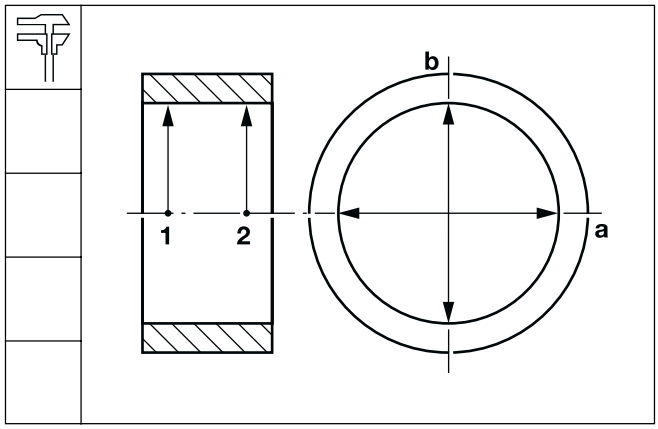


Note: If the readings do not exceed bearing tolerances by more than **0.015 mm** , the rod can be used further. If the limit value is exceeded, replace the connecting rod.

2. Measure the piston pin bushing

2.1 Piston pin bushing with a measuring instrument

- at the positions "1" and "2" of the level "a" and "b"



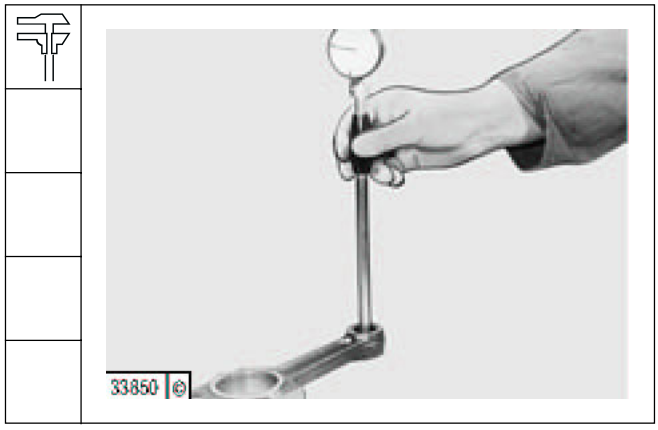
- Measure.

Nominal dimension

FL/M 2011 **26.025 - 26.035 mm**
BFL/M 2011 **30.025 - 20.035 mm**

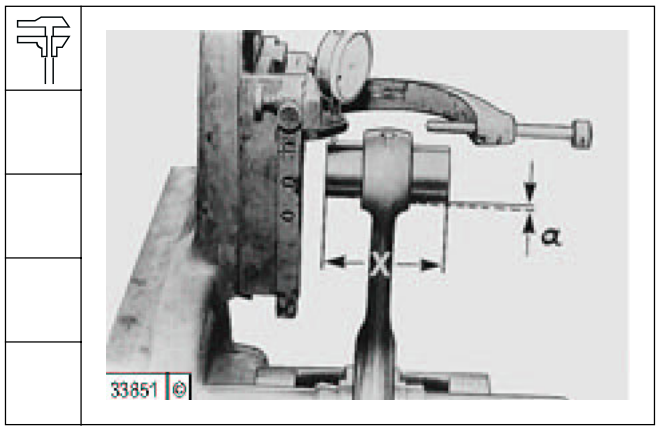
Wear limit:
Small end bush clearance **0.08 mm**

Replace small end bush if necessaray.



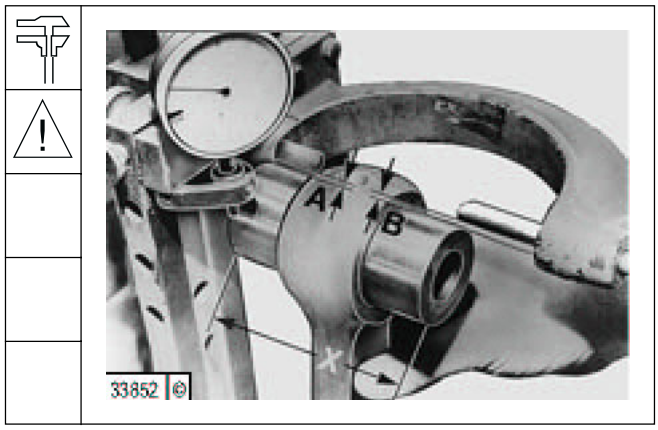
3. Measure the alignment of the bearing bores.

3.1 Permissible tolerance "a" = **0.03 mm**
over a distance of "x" = **100 mm**



3.2 Permissible tolerance "A" relative to "B" = **0.03 mm** over a distance of "x" = **100 mm**

Note: The adjustment of the connecting rod is not permissible.

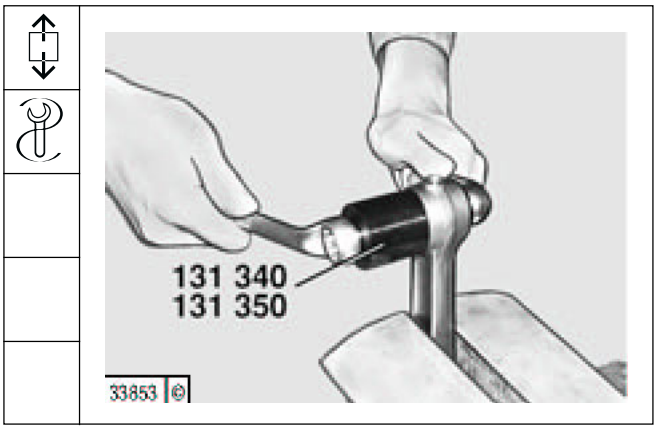


4. Exchange the piston pin bushing.

4.1 Withdraw the piston pin bushing.

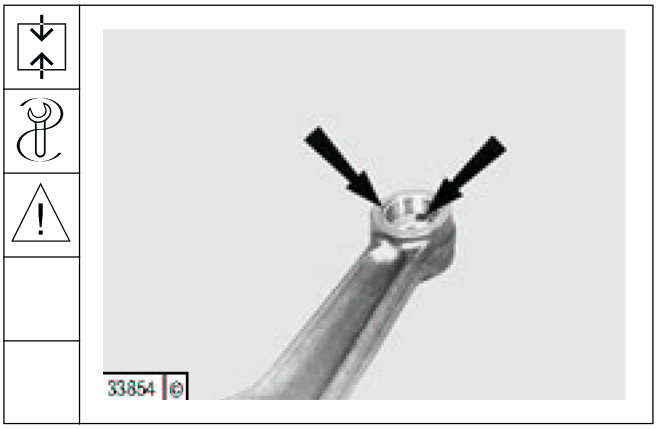
Bore for small end bush:
FL/M 2011 **29.0 - 29.02 mm**
BFL/M 2011 **33.0 - 33.02 mm**

Outer diameter of small end bush:
FL/M 2011 **29.06 - 29.10 mm**
BFL/M 2011 **33.07 - 33.11 mm**



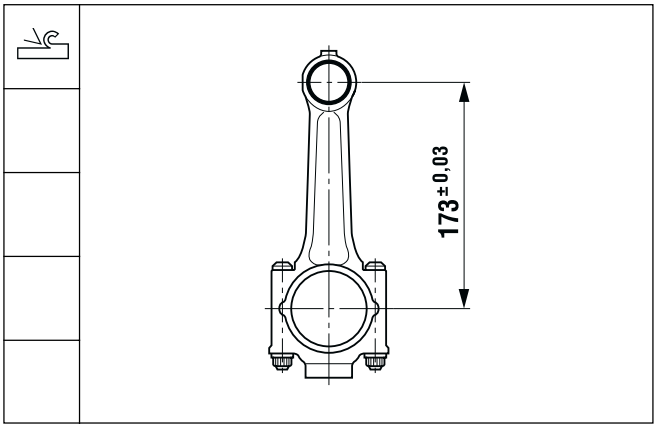
4.2 Pull in flush the piston pin bushing.

Note: Lube oil bores of small end bush and connecting rod must be in line.



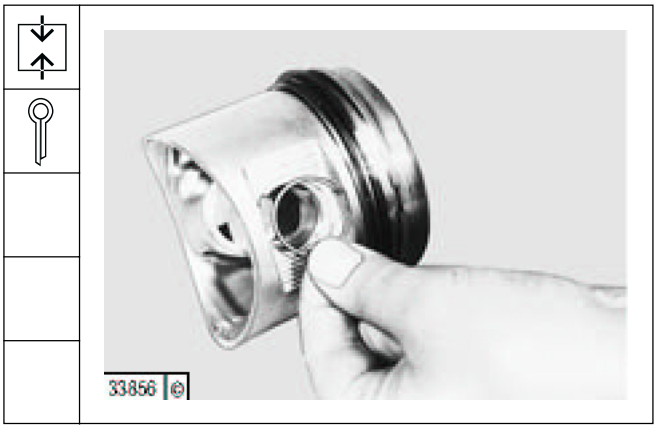
4.3 After pressing in, precision-bore small end bush on a fine boring.

Nominal dimension
FL/M 2011 **26.025 - 26.035 mm**
BFL/M 2011 **30.025 - 30.035 mm**

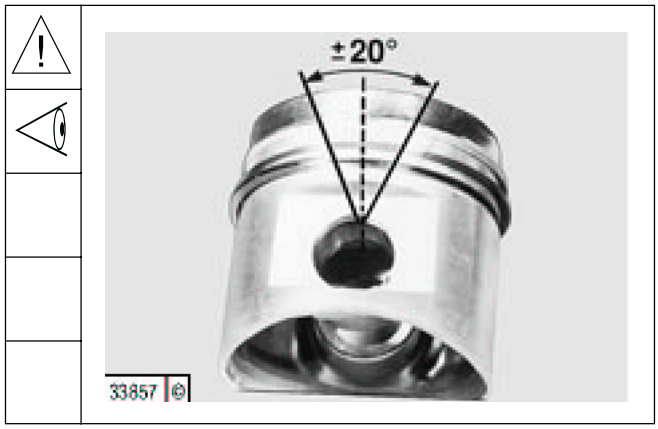


5. Assembling connecting rod with piston

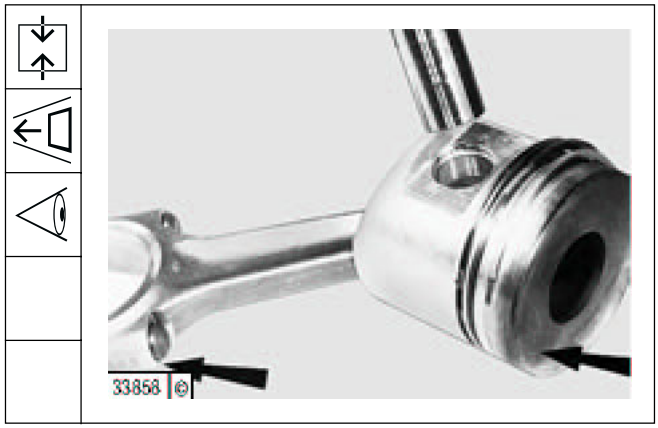
5.1 Put in place a spring ring.



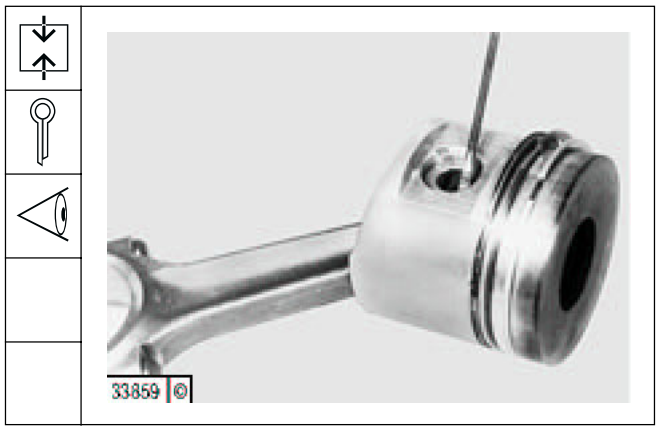
Note: Ring gaps of circlips must face piston crown.



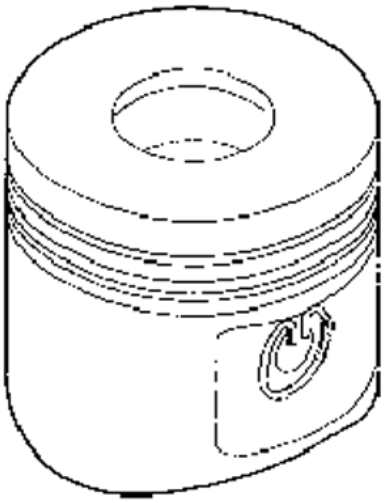
5.2 Install piston together with connecting rod. Flywheel symbol on the piston must point to the left and identification number on connecting rod must be visible.



5.3 Fit in and align a second spring ring.



• PISTON



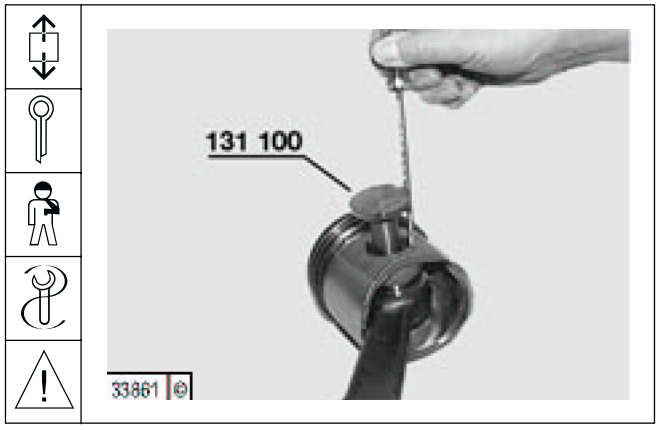
Special tools required:

Piston ring pliers 130 300
Trapezoidal slot wear gauge: 130 420
Disassembling tool for spring ring: 131 100

1. Completion connecting rod - disassembling piston

1.1 Fit the auxiliary tool into the piston pin. Remove the spring ring. Pull out the piston pin.

Note: Without auxiliary tools, there is a risk of injury due to a spring ring jumping off.

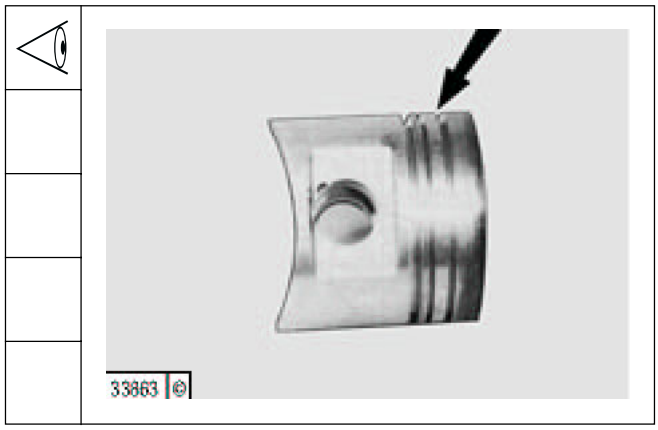


1.2 Adjust piston ring pliers to piston diameter. Remove piston rings.



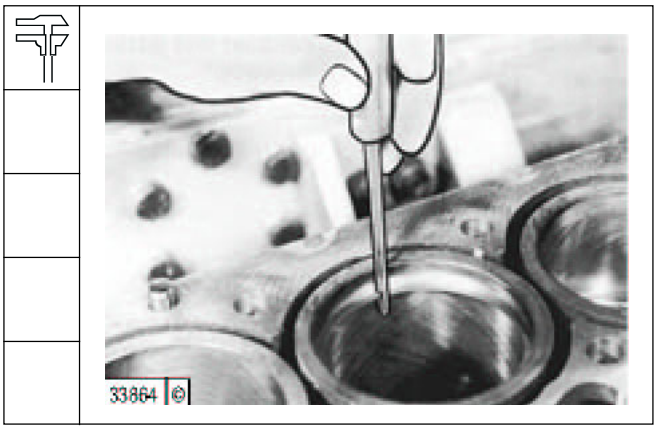
2. Check and measure the piston

2.1 Clean and inspect piston and ring grooves.



2.2 Measure ring gap with feeler gauge.

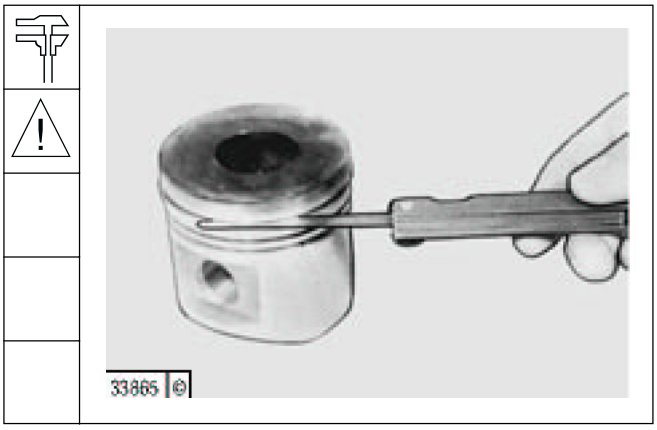
Wear limits:
1st ring gap **0.8 mm**
2nd ring gap **2.5 mm**
3rd ring gap FL/M 2011 **1.2 mm**
3rd ring gap BFL/M 2011 **1.1 mm**



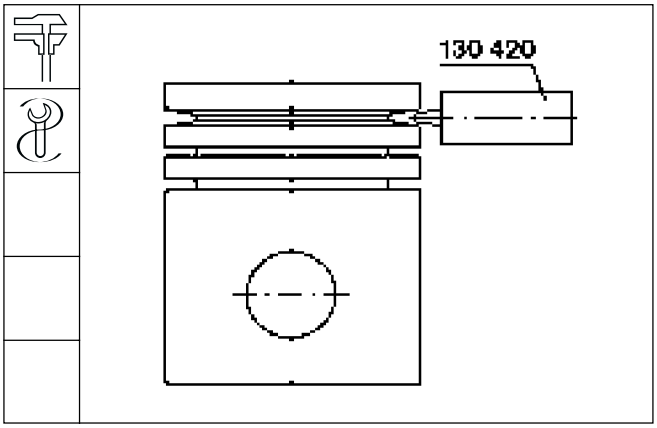
2.3 Measure the axial clearance of the piston rings in the piston ring grooves with a feeler gage.

Note: Carry out a measurement with new piston rings.

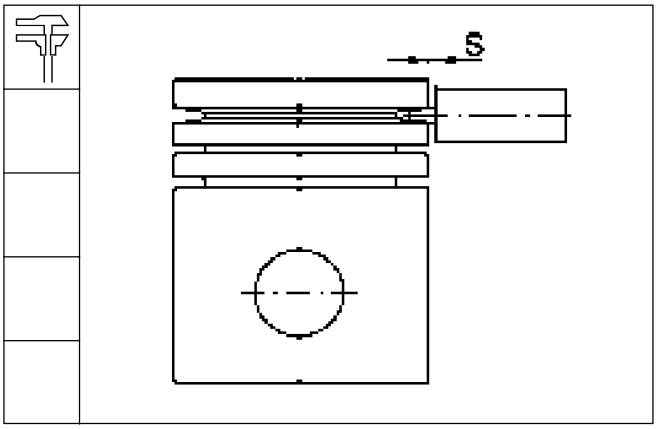
Wear limits:
1. Ring FL/M 2011 **0.20 mm**
1. Ring BFL/M 2011 Trapezoidal slot
2. Ring **0.20 mm**
3. Ring **0.15 mm**



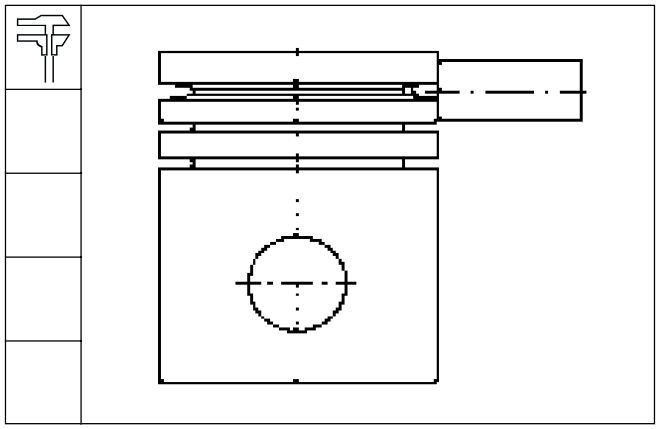
2.4 Measure the trapezoidal slot with trapezoidal slot wear gauge.



2.5 If a distance "S" is present between the trapezoidal slot wear gauge and the piston, then the piston can be still used.

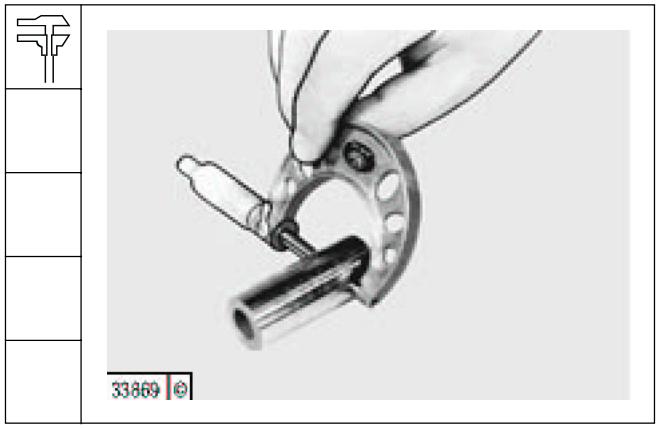


2.6 If the trapezoidal slot wear gauge rests against the piston, then the piston is to be exchanged.



2.7 Measure the outside diameter of the piston pin

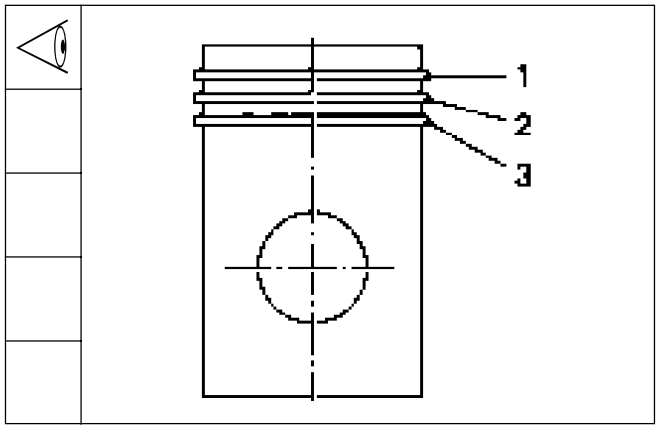
Nominal dimension:
FL/M 2011 **25.995 - 26.0 mm**
BFL/M 2011 **29.995 - 30.0 mm**



3. Complete the piston

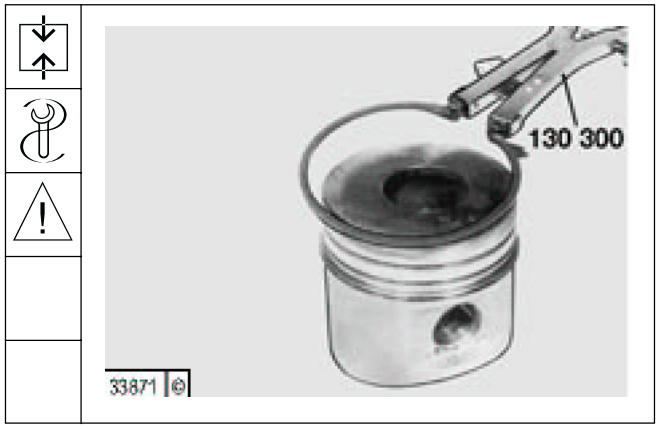
3.1 Order and position of piston rings:

1. Rectangular ring with FL/M 2011, top facing combustion chamber
1. Double trapezoidal washer with BFL/M 2011, top facing combustion chamber
2. tapered compression ring, top facing combustion chamber
3. bevelled-edge slotted oil control ring



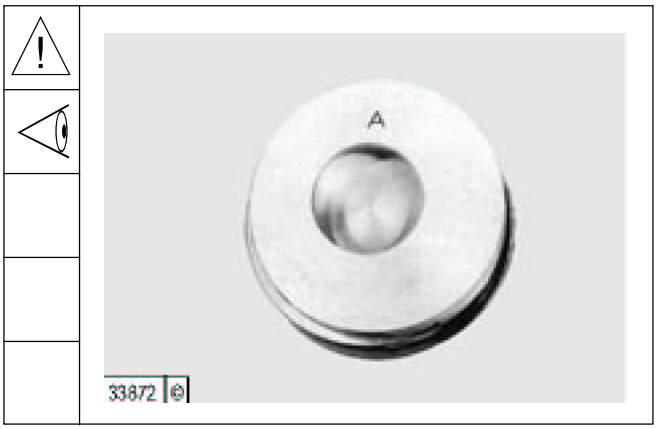
3.2 Fit piston rings

Note: Spring gap of bevelled-edge ring to be offset by **180**° relative to ring gap.



4. Note to the piston classes of the pistons

The pistons are grouped into different compression heights in piston classes. The piston classes are marked at the piston head.



4.1 **FL/M 2011**
For FL and FM motors, pistons with different compression heights are available.

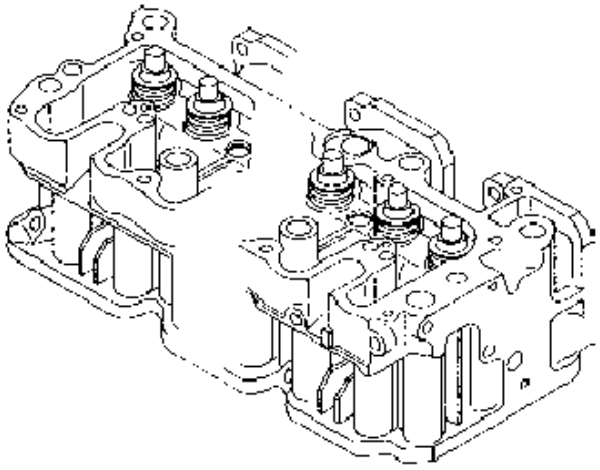
Piston class **A**
= Compression height **51.67 mm**
Piston class **B**
= Compression height **51.77 mm**

With each piston exchange, it must be ensured that the same piston class is again used.

With the exchange of the crankshaft or the crankcase with integrated cylinder liners, the distance "stroke tap upper edge TDC to cylinder head gasket support" must again be determined for the determination of the piston class.
See chapter 4.

4.2 **BFL/M 2011**
With the BFL and BFM motors, pistons excluding those of the piston class **A** are used.

• CYLINDER HEAD



Commercial tools required:

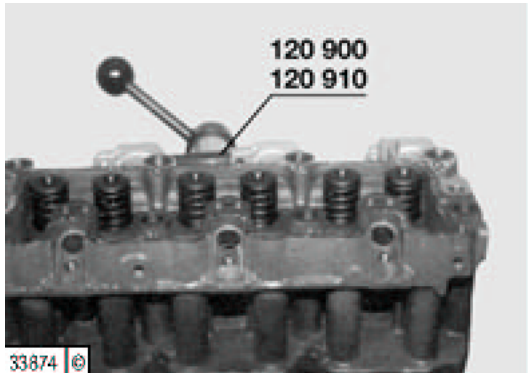
Magnetic measuring stand
Dial gauge
Valve stem gasket pliers 8024
Valve spring assembly lever 9017
Valve reseating tool

Special tools required:

Clamping stand 120 900
Clamping plate 120 910
Sleeve for fitting valve stem seal 121 410

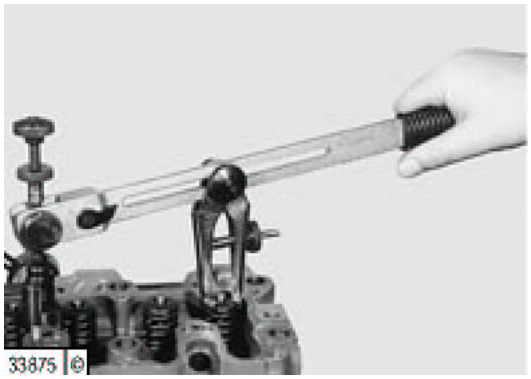
1. Preparation

1.1 Mount cylinder head on fixture



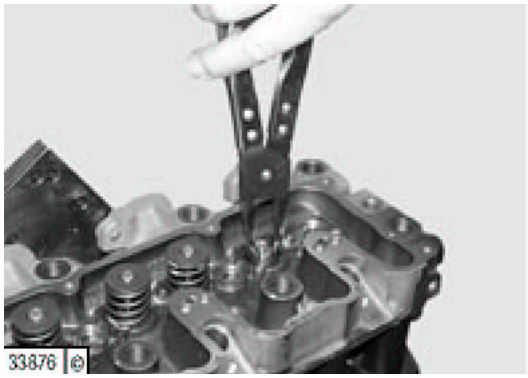
2. Remove the valves

2.1 Remove cone clamp, valve spring cap, valve springs and valves.



2.2 Remove valve stem seal.

Note: Use the valve stem gasket pliers 8024

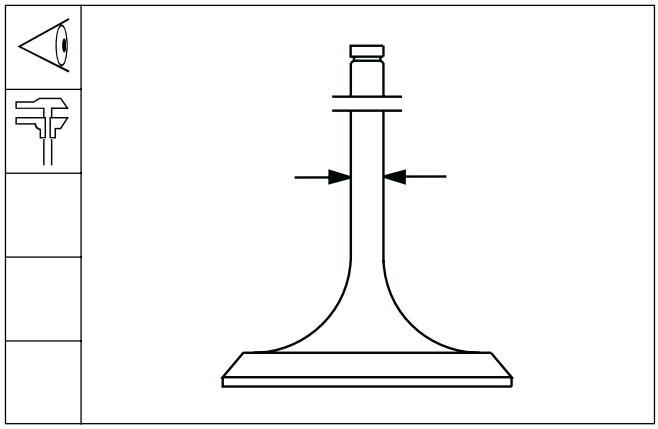


3. Check the valves

3.1 Clean the valves and carry out a visual inspection

3.2 Measure the valve stem diameter

Inlet valve **7.965 - 7.98 mm**
Exhaust valve **7.945 - 7.96 mm**



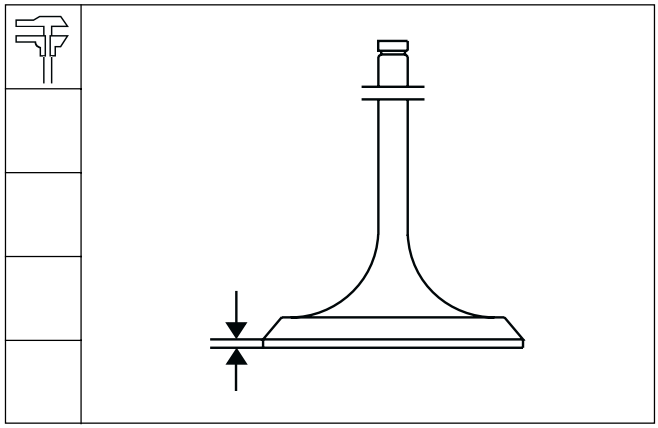
3.3. Measure the strength of the valve edge

Wear limits FL/M:

Inlet valve **0.8 mm**
Exhaust valve **1.2 mm**

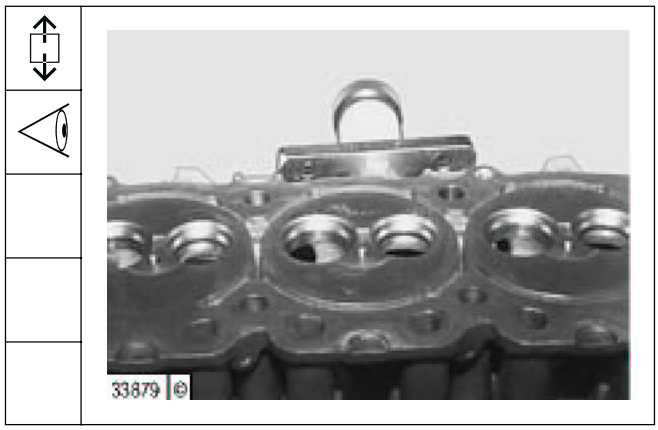
Wear limits BFL/M:

Inlet valve **1.4 mm**
Exhaust valve **1.2 mm**



4. Check the cylinder head

4.1 Clean cylinder head and inspect for damage.



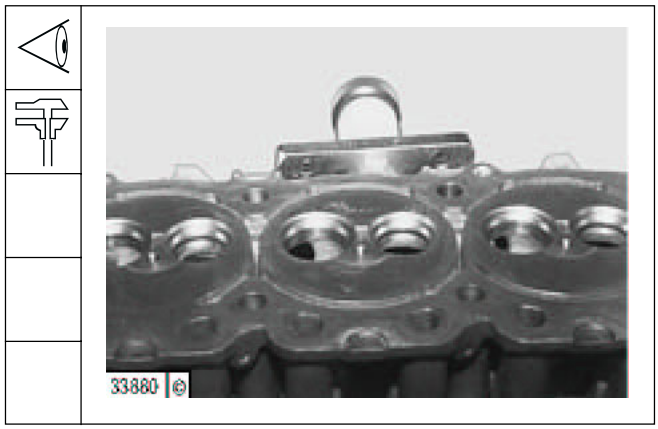
4.2 Check visually the valve seat rings.
Measure the valve seat width

FL/M:

Inlet valve **1.7 ± 0.4 mm**
Exhaust valve **1.7 ± 0.4 mm**

BFL/M:

Inlet valve **1.58 ± 0.4 mm**
Exhaust valve **1.7 ± 0.4 mm**

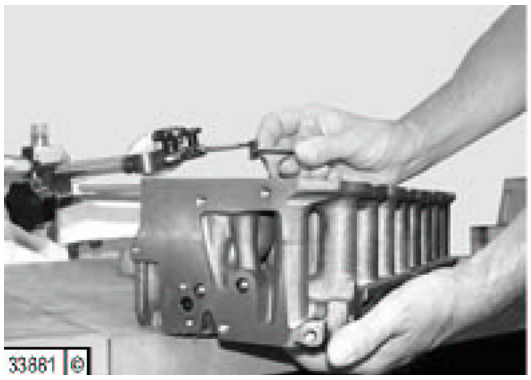


4.3 Fit in the valves and measure the valve stem clearance.

Wear limits:

Inlet valve **0.5 mm**
Exhaust valve **1.3 mm**

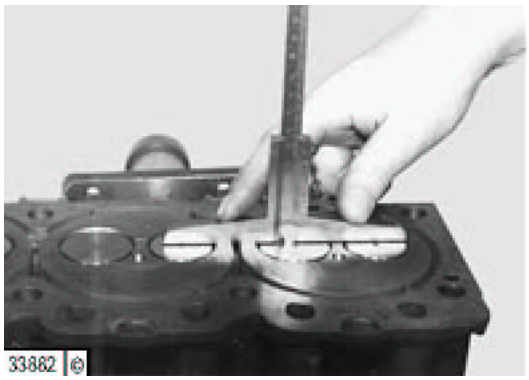
Note: For measuring the valve stem clearance, the valve shaft-end must close with the valve guide.



4.4 Measure the valve arrears from the valve disk to the cylinder head sealing surface.

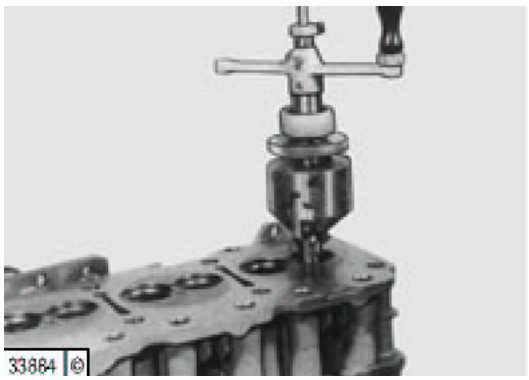
Wear limits:

FL/M **1.53 mm**
BFL/M **1.3 mm**



5. Check the cylinder head

5.1 If the wear dimension of the valve seat and the valve arrears are not yet reached, then work on the valve seat with the aid of a valve-seat grinding device.

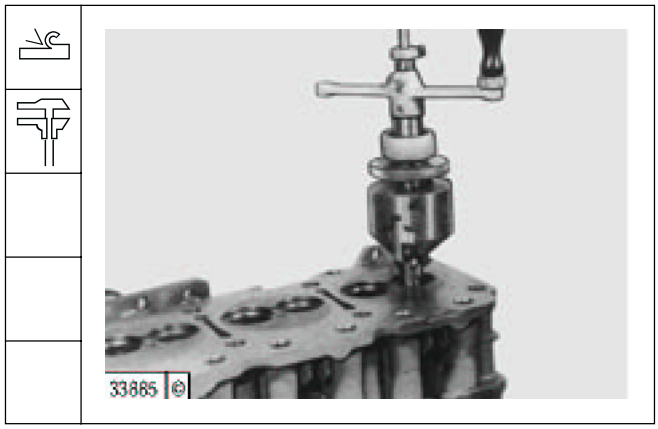


5.2 Reworking valve seat insert

Valve seat angle	Inlet	Exhaust
FL/M	**45°**	**45°**
BFL/M	**30°**	**45°**

Valve seat width:

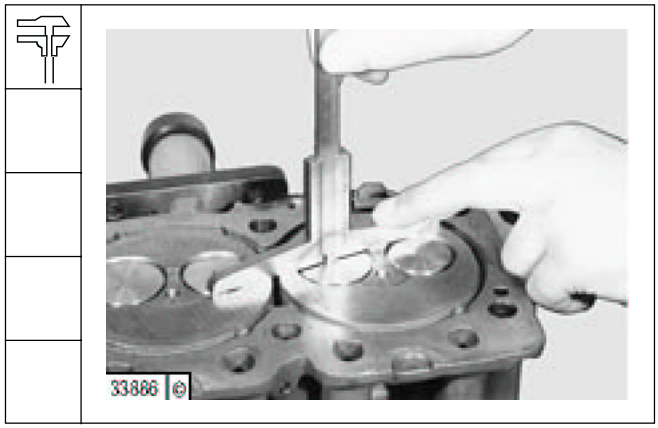
FL/M	**1.7 ± 0.4 mm**	
BFL/M	**1.58 ± 0.4**	**1.7 ± 0.4**



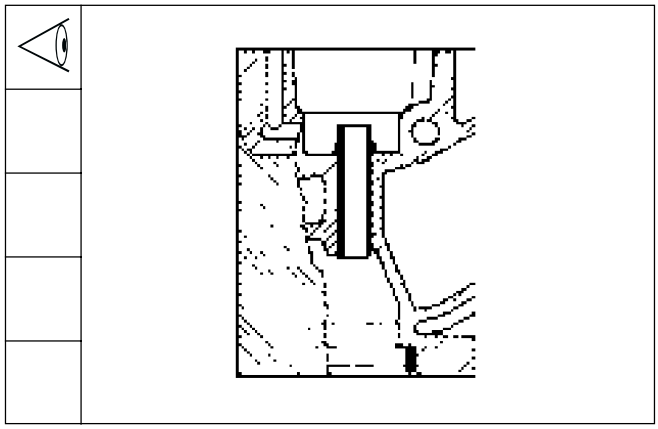
5.3 Measure the valve arrears from the valve disk to the cylinder head sealing surface.

Wear limits:

FL/M **1.53 mm**
BFL/M **1.3 mm**



5.4 If valve seats, valve guides are worn out or cylinder head sealing surface is damaged, it is possible to have the cylinder head reconditioned in our Service Centers.



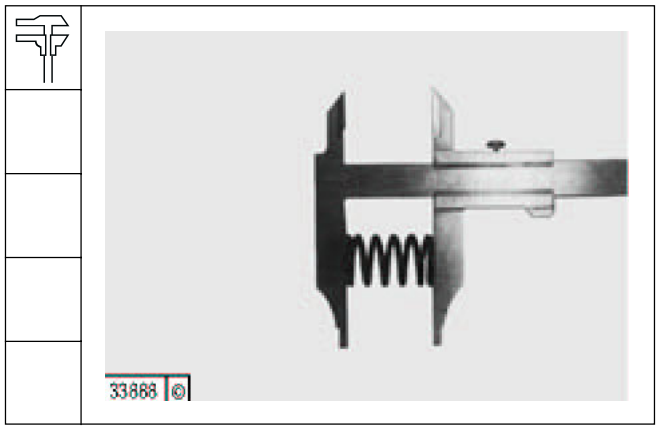
6. Check the valve springs

6.1 Gauge length of valve spring

Unloaded length,standard.

Valve spring wire dia. 3.35 mm **38.9 mm**
or
Valve spring wire dia. 3.40 mm **39.3 mm**

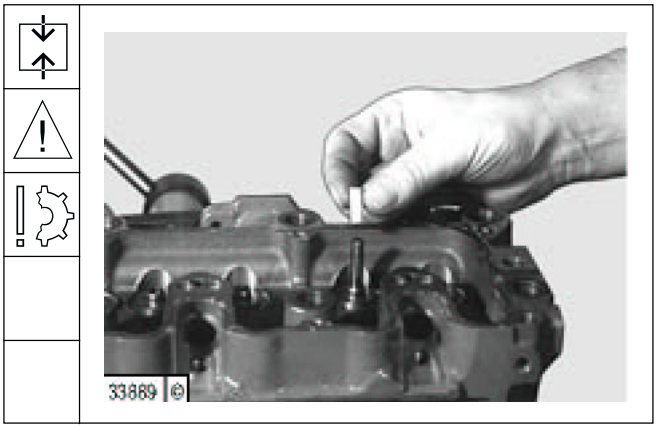
Mixed installation is permissible.



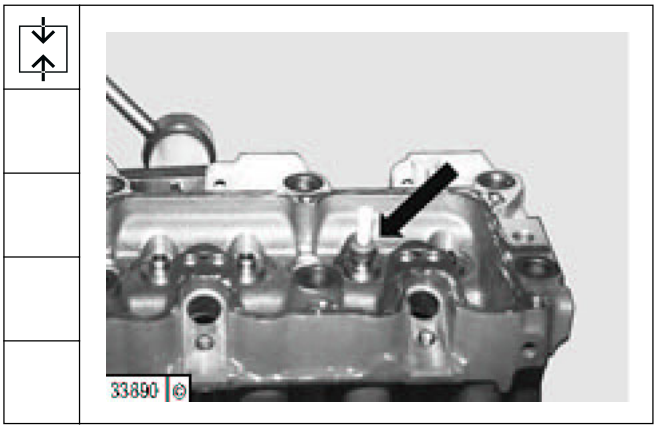
7 Install the valves

7.1 Insert and retain valve. Slide protective sleeve onto valve stem.

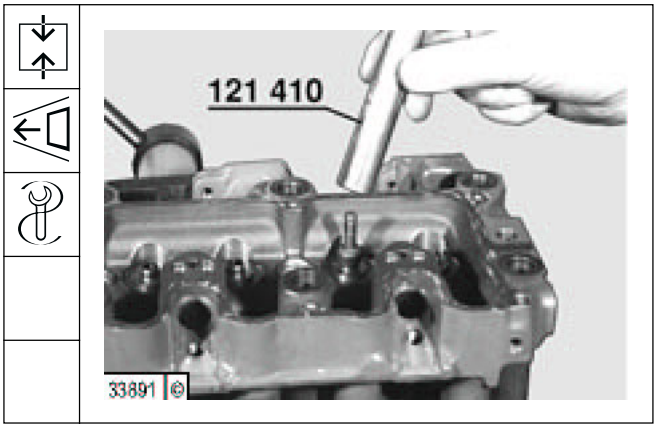
Note: Before fitting valve stem seal, valve splines must be covered by the protective sleeve or masking tape.



7.2 Insert a new valve stem gasket through the protective sleeve.

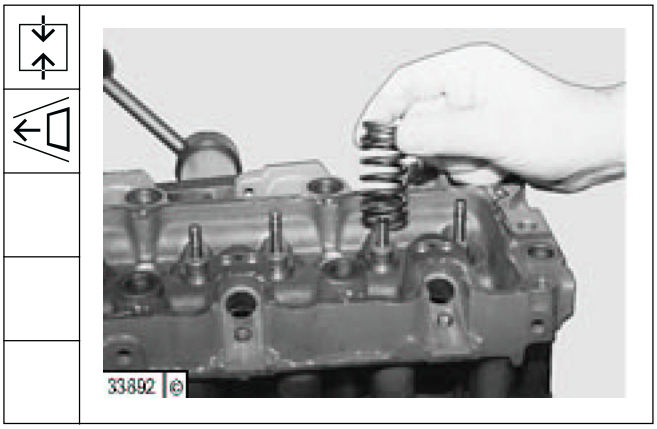


7.3 Remove protective sleeve. Press in valve stem seal as far as it will go.

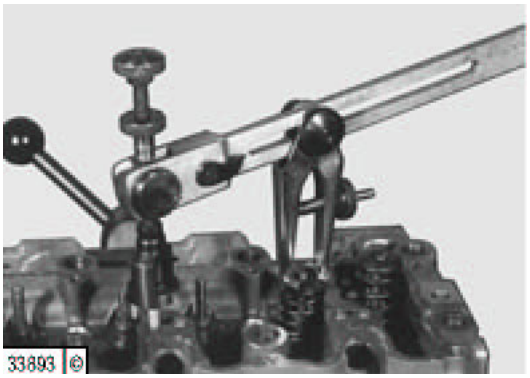


8. Dismount the front cover

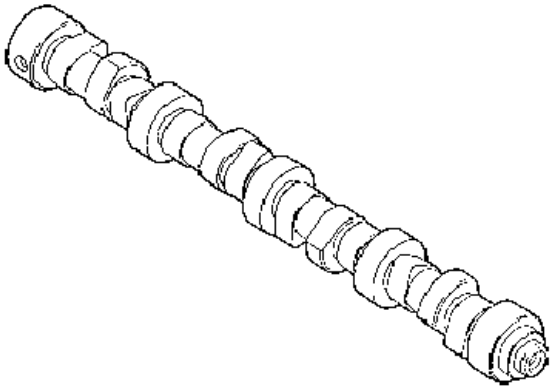
8.1 Assemble cylinder head:
Position valve spring and valve spring cap.



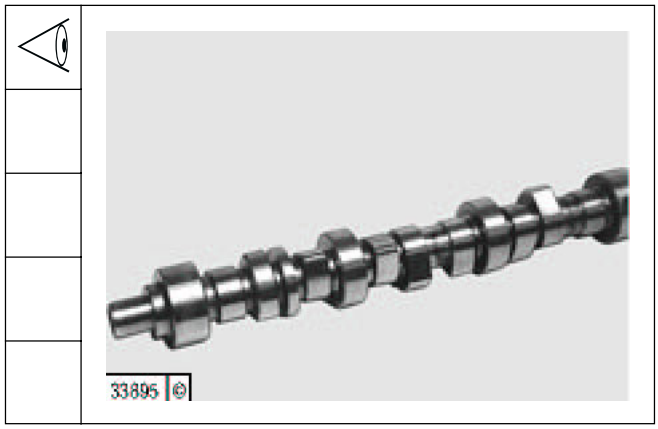
8.2 Fit valve assembly lever, insert cone clamp.



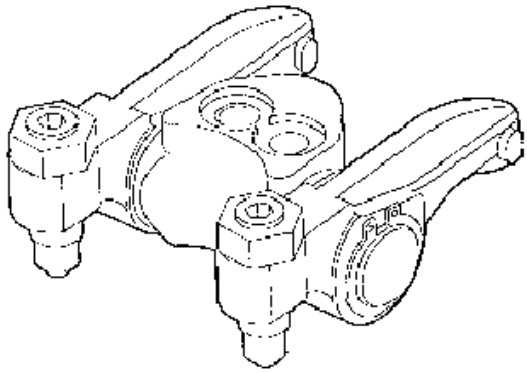
• CAMSHAFT



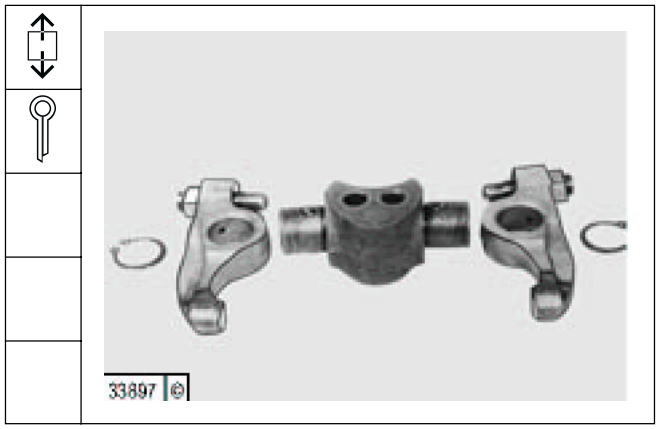
1. Inspect cams and bearing journals for wear.



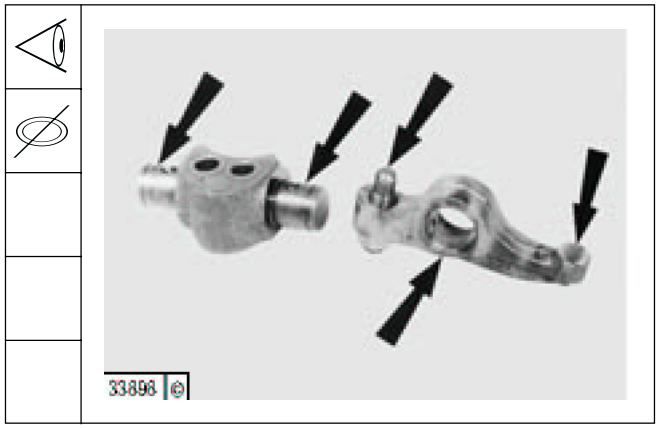
• ROCKER ARM BRACKET



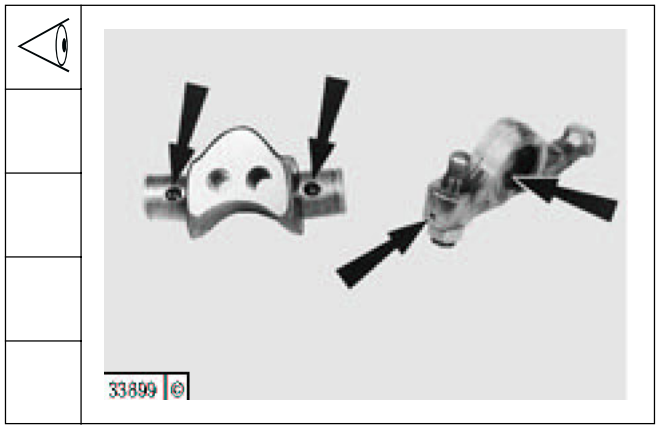
1. Dismantle rocker arm bracket.



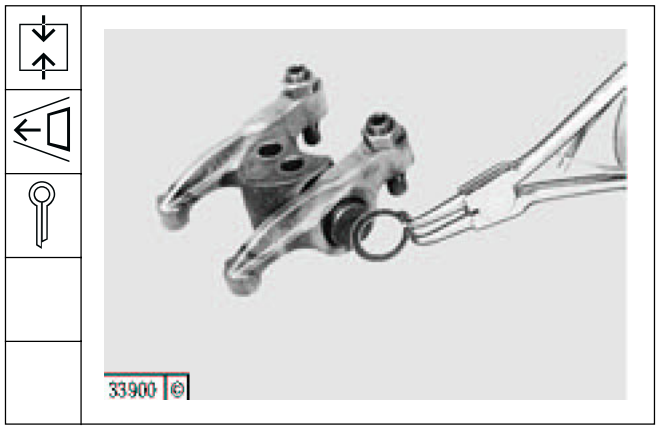
2. Check for wear and replace if nnecessary:
   Journals
   Adjusting screw
   Rocker arm contact face
   Bore



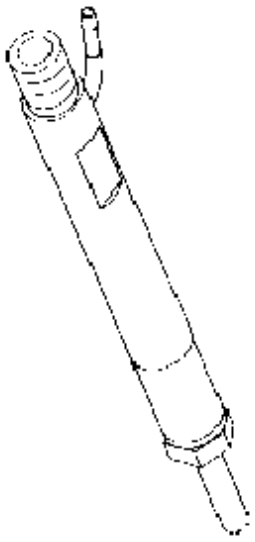
3. Check oil duct for free passage.



4. Reassemble rocker arm bracket.
   Fit circlips.



• INJECTOR



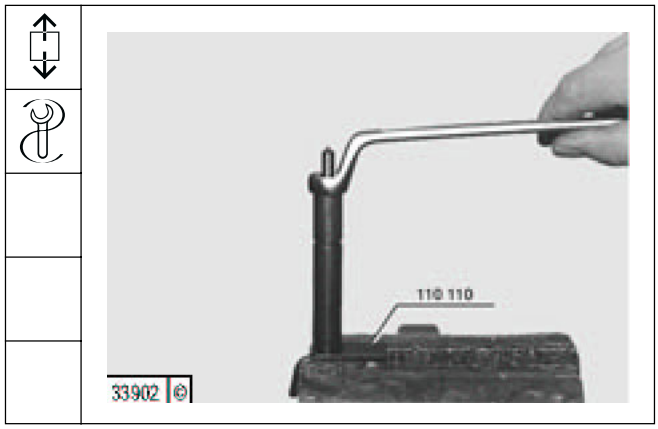
Commercial tool required:

Long socket a/flats 15 8021

Special tool required:

Retainer for injector 110 110

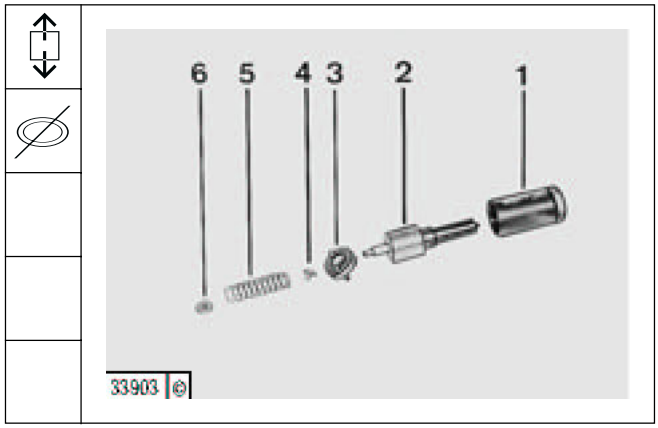
1. Unscrew cap nut.



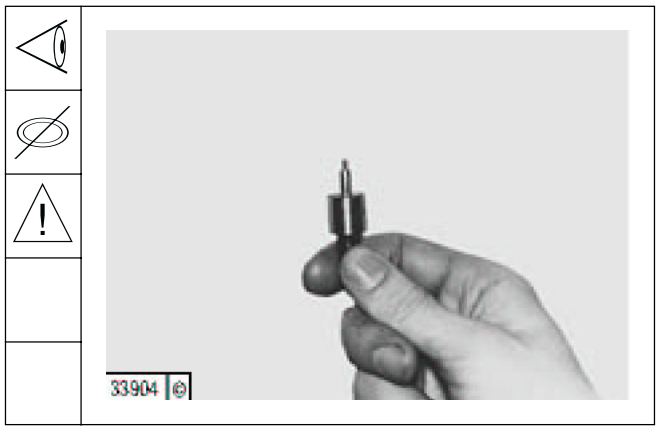
2. Sequence of parts disassembly:

   1. Cap nut
   2. Injection nozzle
   3. Adapter
   4. Thrust pin
   5. Compression spring
   6. Shim

   Wash all parts in clean diesel fuel and blow out with compressed air.

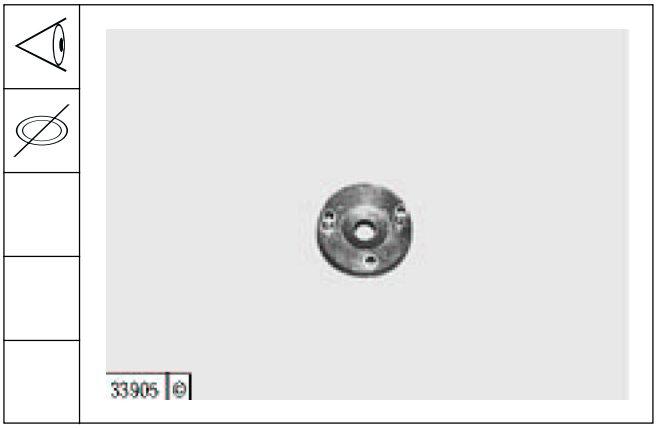


3. Nozzle needle and nozzle body are lapped together and may neither be confused nor exchanged individually.
   Do not touch nozzle needles with your fingers. When nozzle body is held in upright position, nozzle needle should by its own weight slide down slowly and smoothly on its seating.



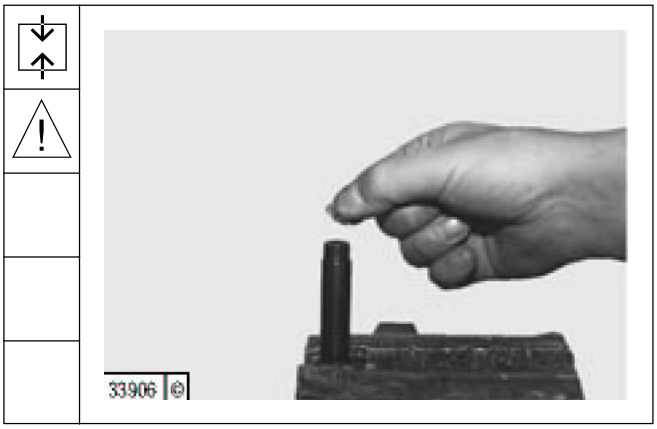
Note: If nozzle needle does not slide down smoothly, wash injection nozzle again in diesel fuel. Renew, if necessary. New injection nozzle must likewise be washed in clean diesel fuel.

4. Check seating faces of adapter for wear. Make sure that centering pins are fitted.

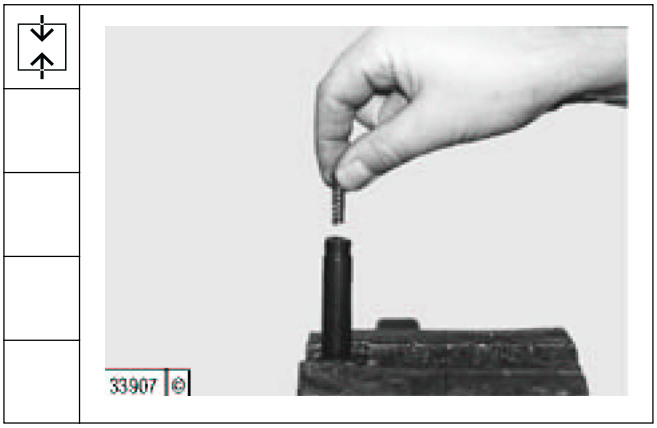


5. Insert shim.

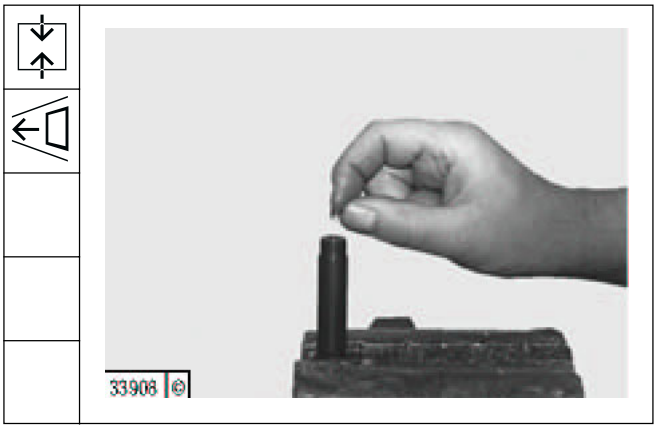
Note: The ejection pressure is dependent on the shim.



6. Insert compression spring.

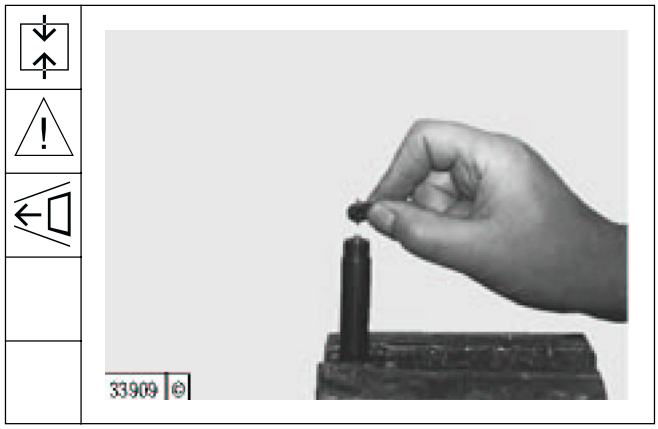


7. Insert thrust pin with centering collar facing towards compression spring.



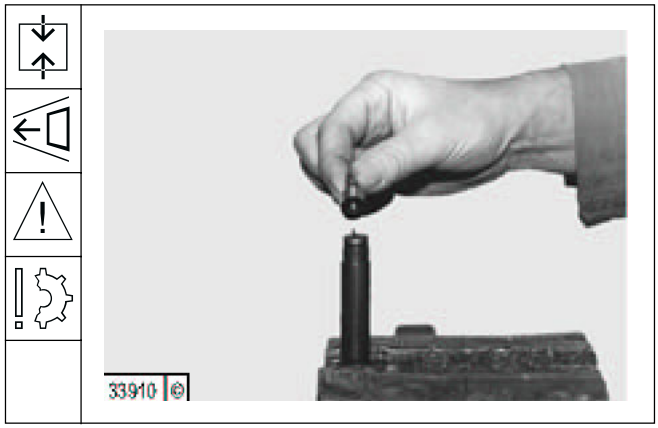
8. Insert adapter with centering pins into the bores of the nozzle holder.

Note: The spot facing points to the thrust pin.

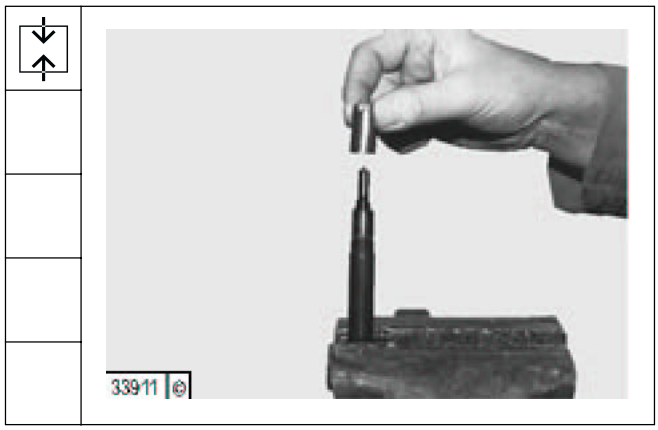


9. Fit injection nozzle with center bores mating with the centering pins of the adapter.

Note: Take care that nozzle needle does not fall out of nozzle body.



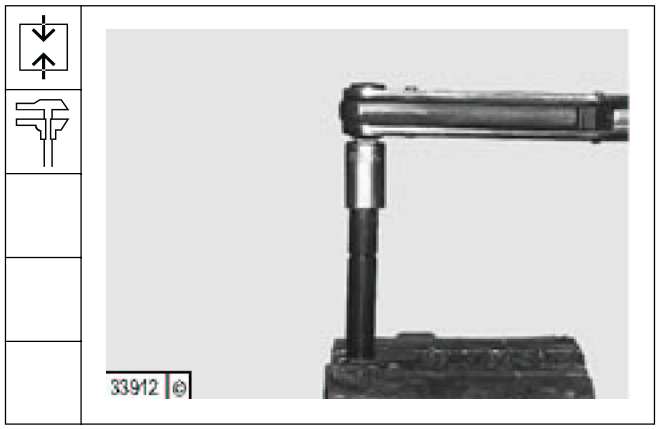
10. Screw on cap nut.



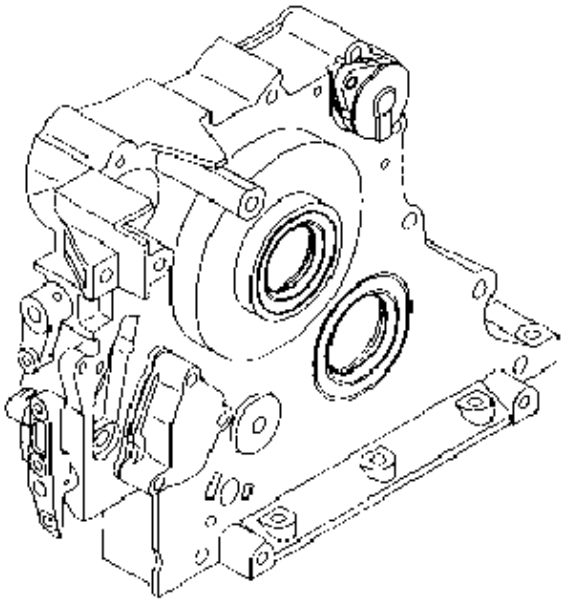
11. Tighten cap nut.

Tightening specification: **45 ± 5 Nm**

For testing and adjusting injector see Chapter 2.



• FRONT COVER

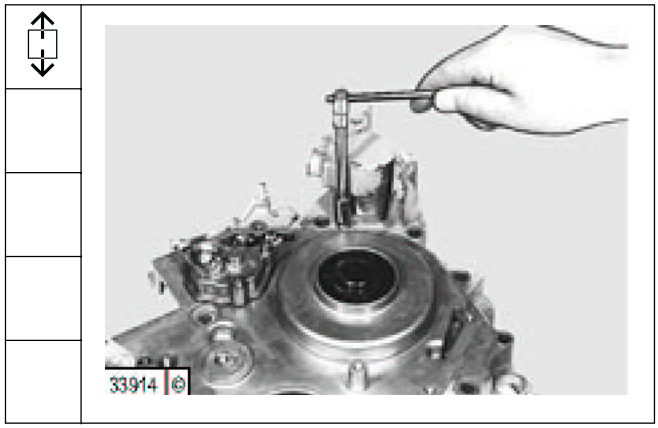


Special tools required:

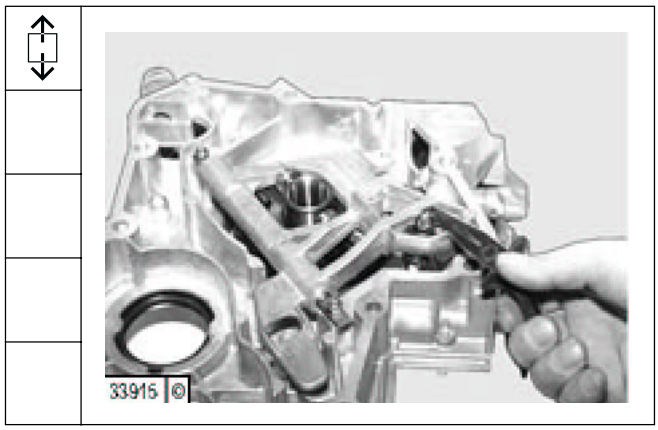
Assembly tool 142 850
Assembly tool 142 050
Measuring device for governor shaft
and piston protrusion 100 750

1. Dismount the front cover

1.1 Remove engine shutdown device, if any.

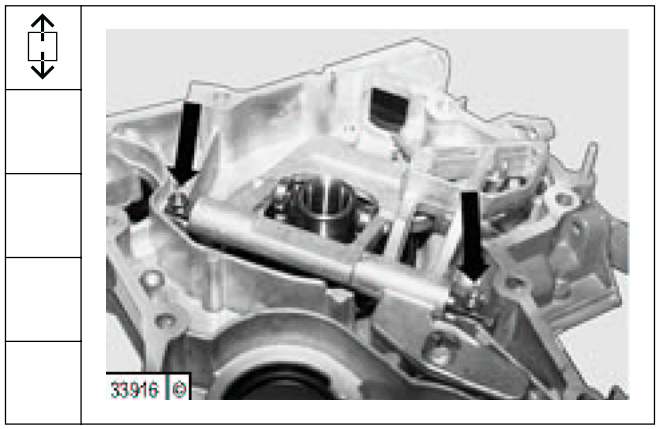


1.2 Detach governor spring.

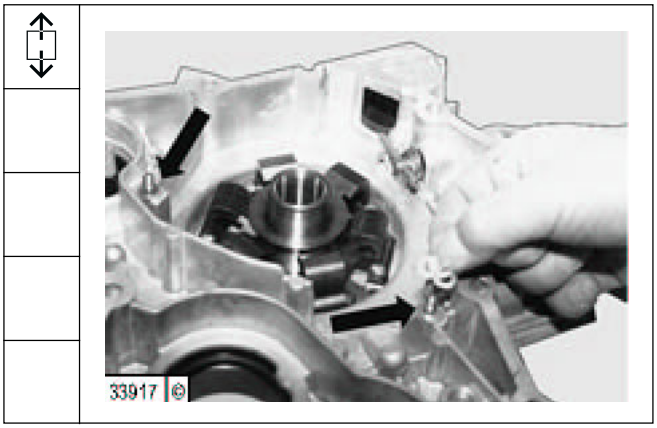


1.3 Remove governor lever shaft.

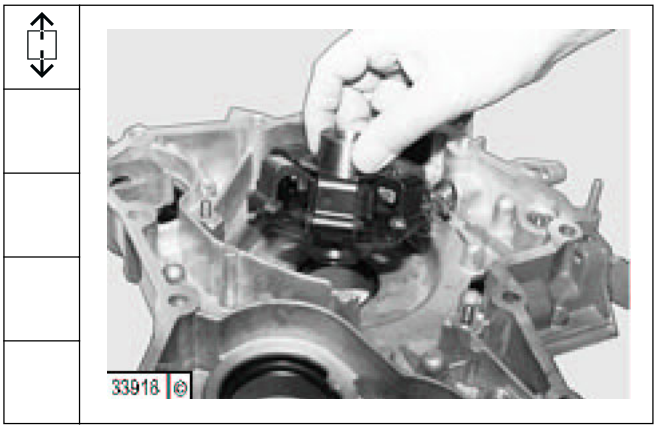
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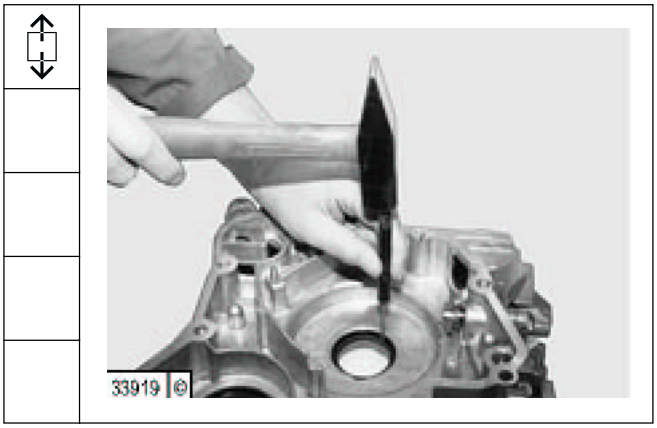
1.4 Take off shims below governor lever shaft.



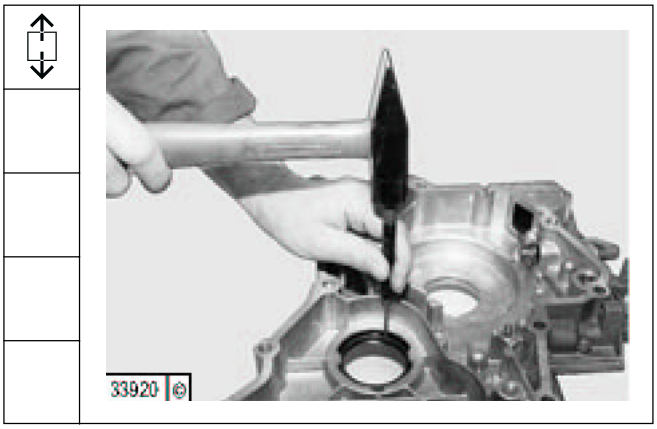
1.5 Remove the measuring element



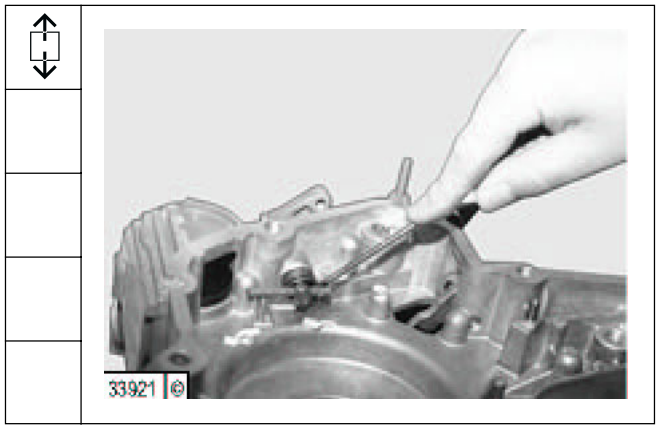
1.6 Drive out camshaft seal.



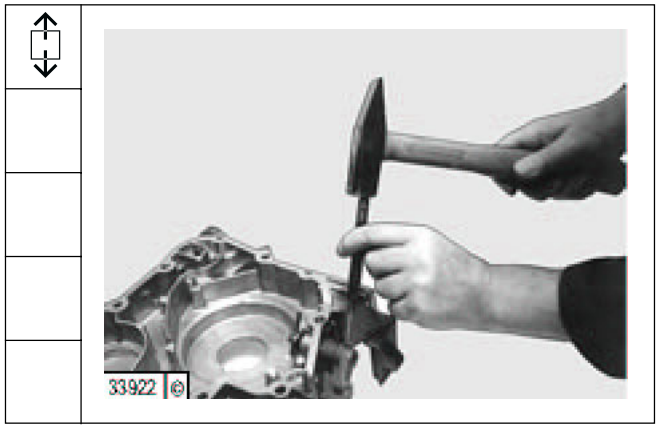
1.7 Drive out crankshaft seal.



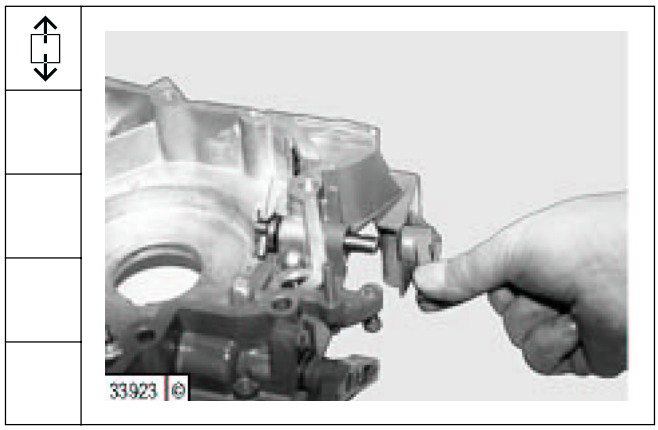
1.8 Detach spring.



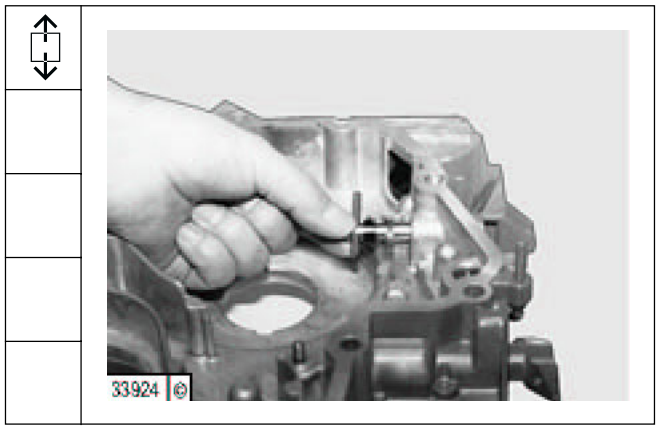
1.9 Drive out dowel sleeve.



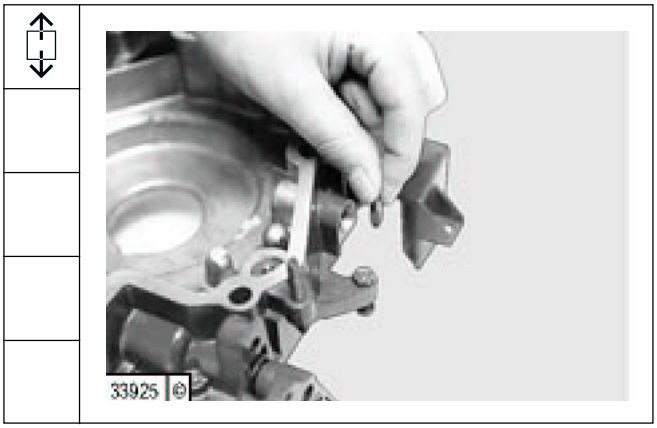
1.10 Remove shutdown lever together with spacer bushes.



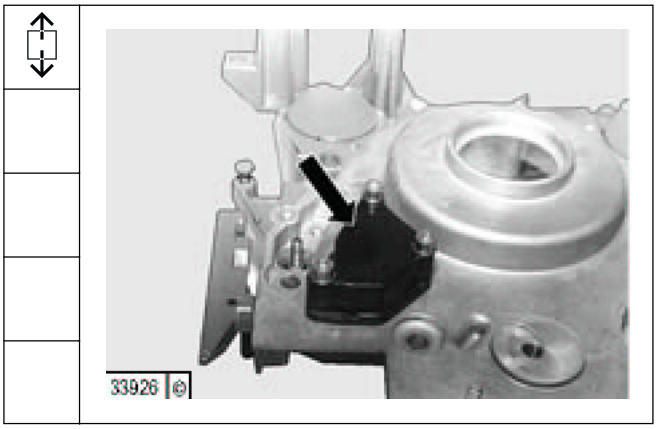
1.11 Remove shaft together with spacer bush and spring.



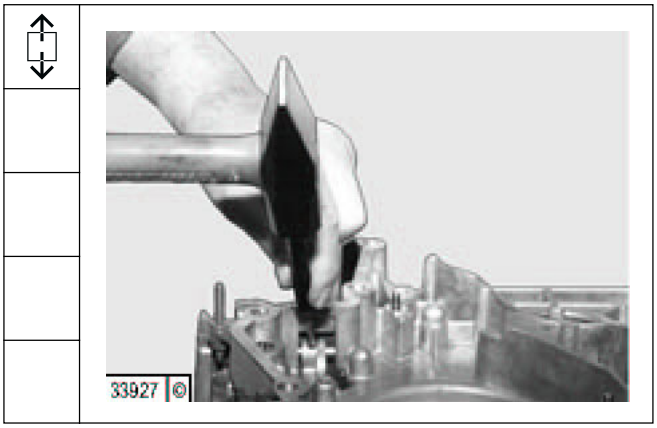
1.12 Take out O-seal.



1.13 Remove cover.

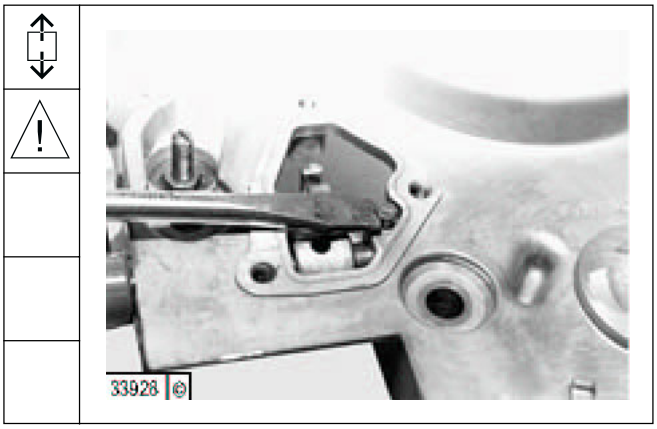


1.14 Drive out dowel sleeve.

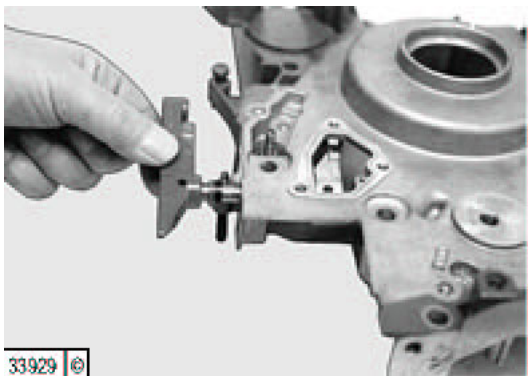


1.15 Lever out pin.

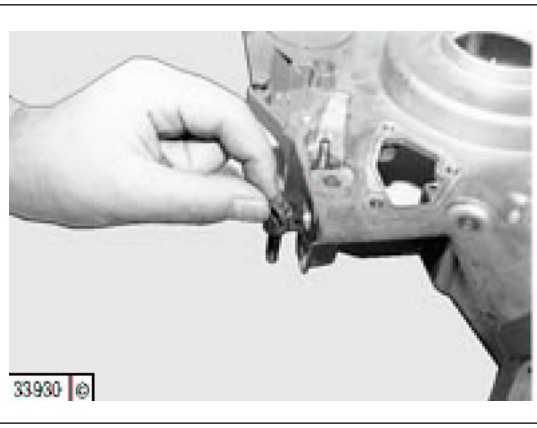
Note: Make sure not to damage sealing surface.



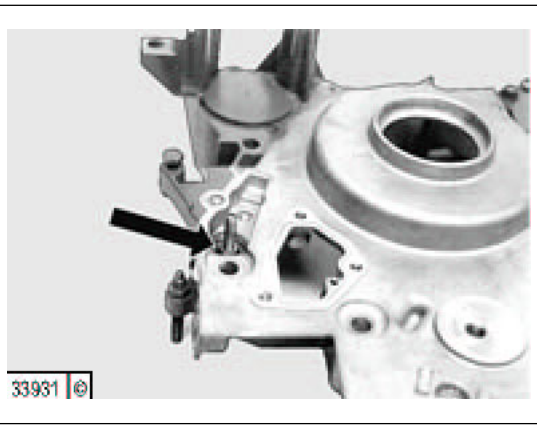
1.16 Remove speed control lever together with spacer bush.



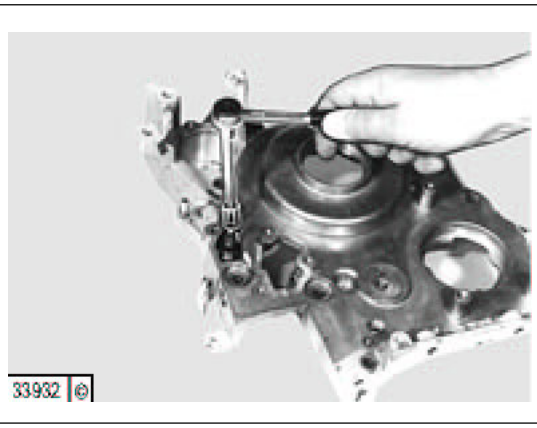
1.17 Take out O-seal.



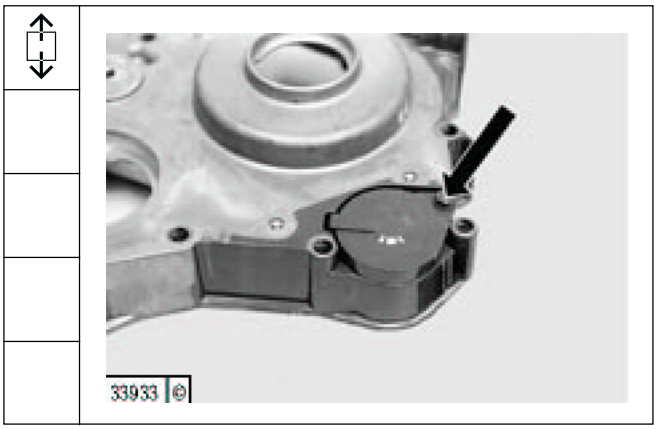
1.18 Remove full-load stop.



1.19 Remove clamping pad, if any.
Unscrew torque control.

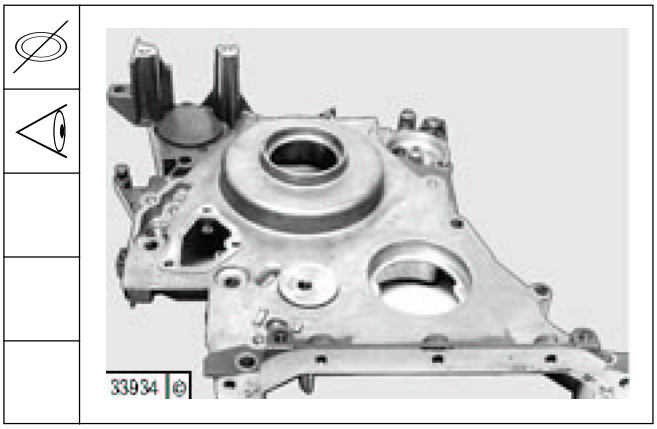


1.20 Remove vent valve.



2. Check visually the single components

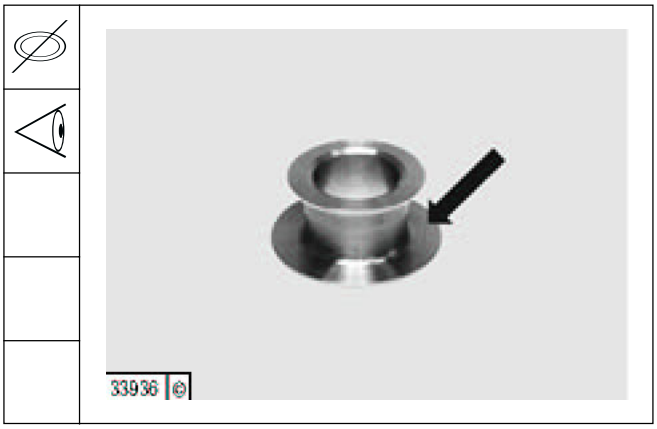
2.1 Inspect front cover and replace if necessary.



2.2 Check visually the measuring element for wear, exchange if necessary.



2.3 Check visually the pipe coupling, exchange if necessary.

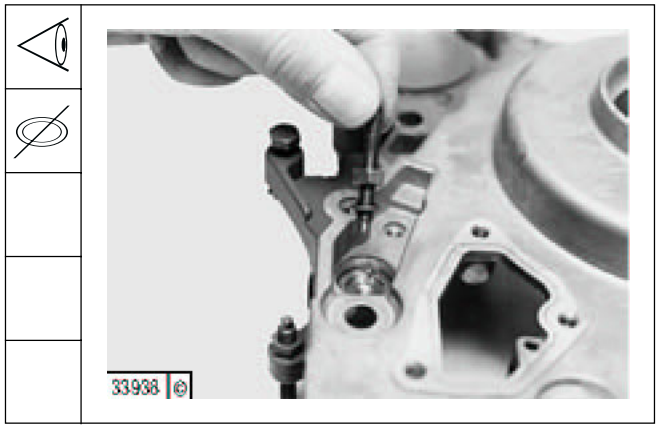


2.4 Carry out a visual check for the roller lever, shaft and and no-load operation lever, exchange if necessary.



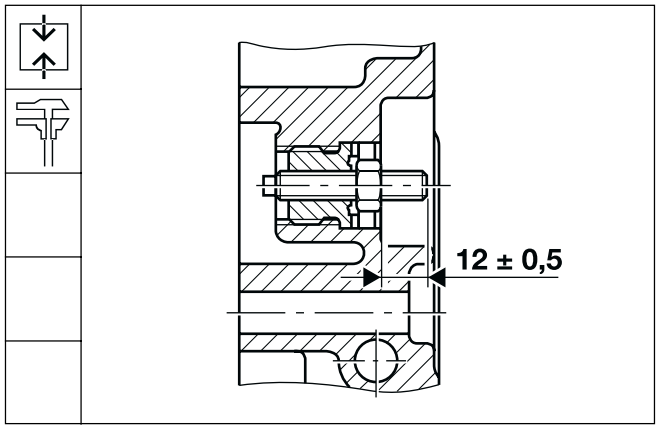
3. Complete the front cover

3.1 Install full-load stop together with O-seal.

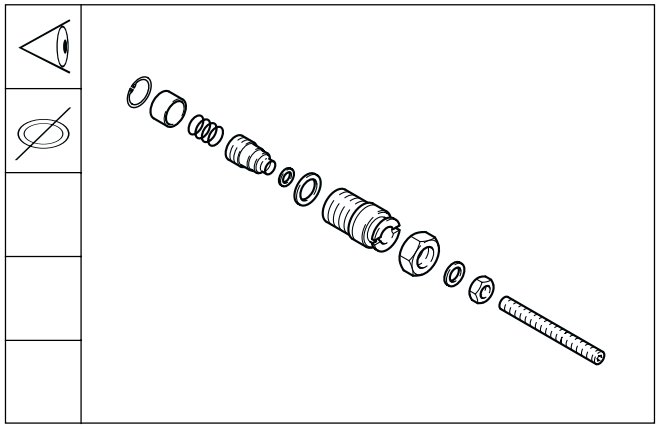


3.2 Adjust distance of full-load stop screw. Tighten locknut.

Tightening specification: **4.5 Nm**

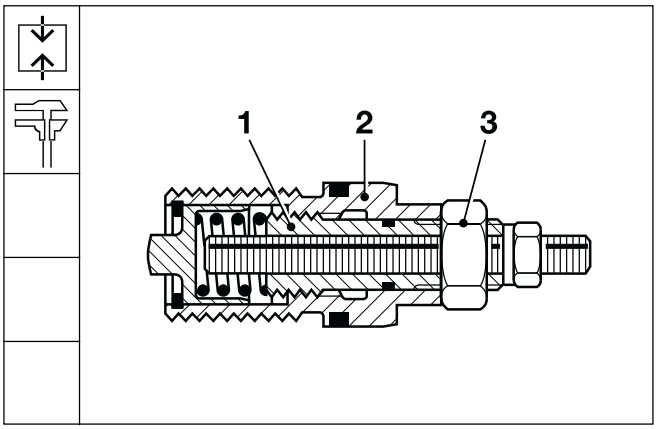


3.3 Inspect individual components of torque control, if any, and replace if necessary.



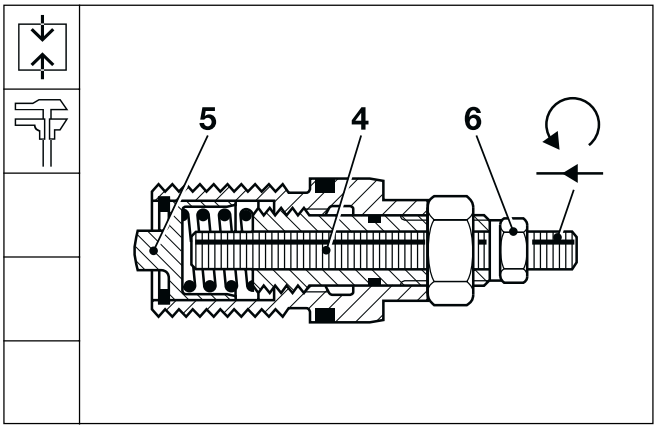
3.4 Preassemble torque control.
Pre-mount the adjustment. Turn Pos. 1 in Pos. 2 until the end stop with max. **1 Nm**. Then, turn out **1 + 0,5 rotations**.
Firmly tighten Pos. 3.

Tightening specification: **16** ± **1.6 Nm**

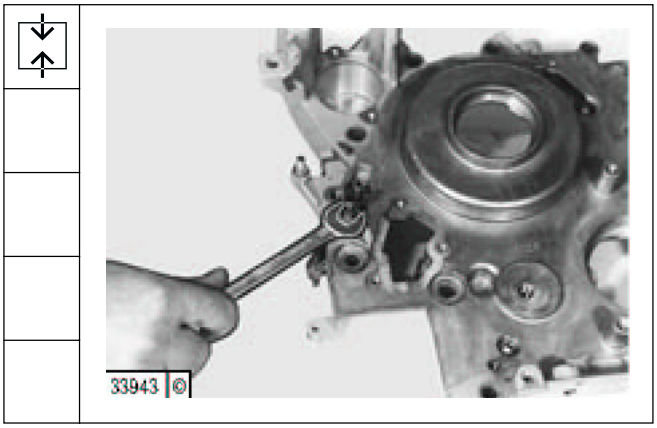


3.5 Turn item 4 as far as it will go into item 5. Then unscrew by **1 turn**.
Tighten item 6.

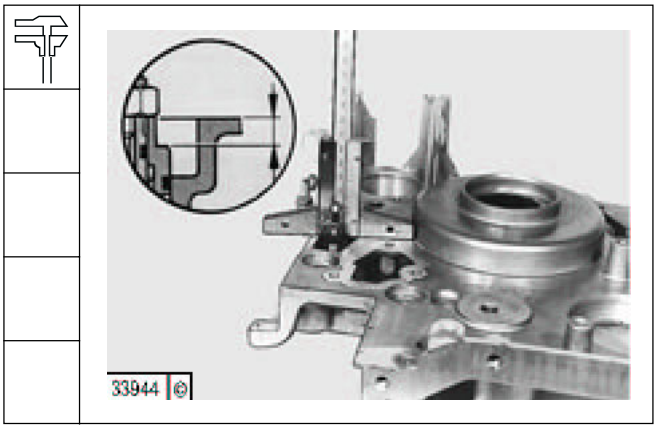
Tightening specification: **6** ± **0.6 Nm**



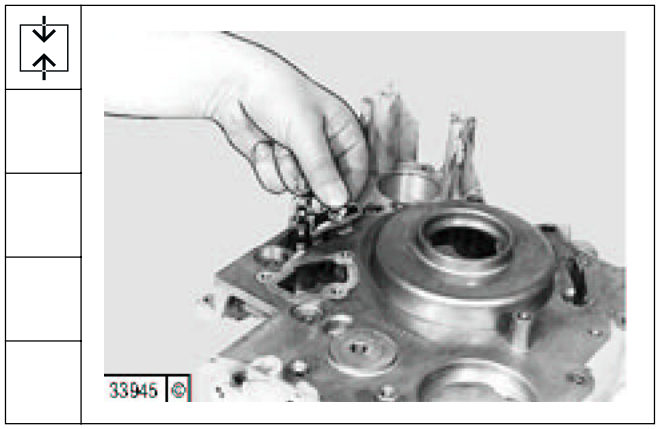
3.6 Turn in torque control.



3.7 Gauge thread reach:
6.4 ± **0.5 mm**



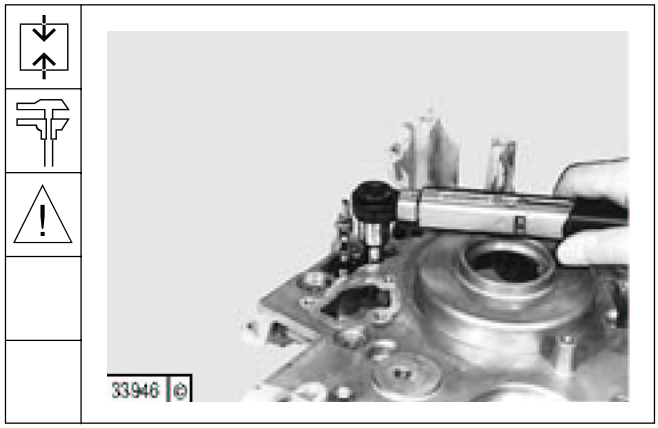
3.8 Position clamping pad.



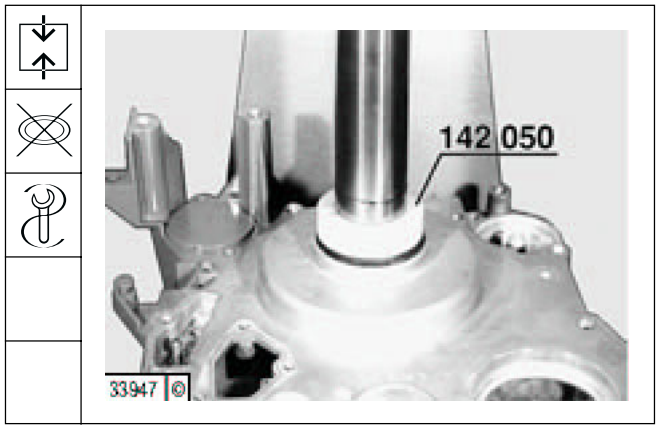
3.9 Tighten clamping nut.

Tightening specification: **10 ± 1 Nm**

Note: Bench test required for precise adjustment of torque control.

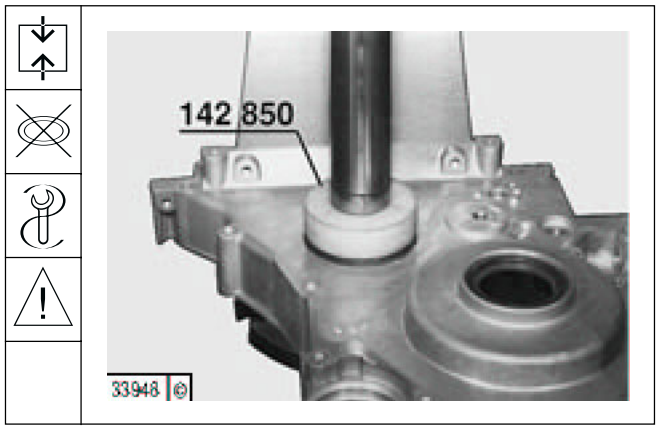


3.10 Press in unlubricated the new shaft seal ring for the cam shaft.



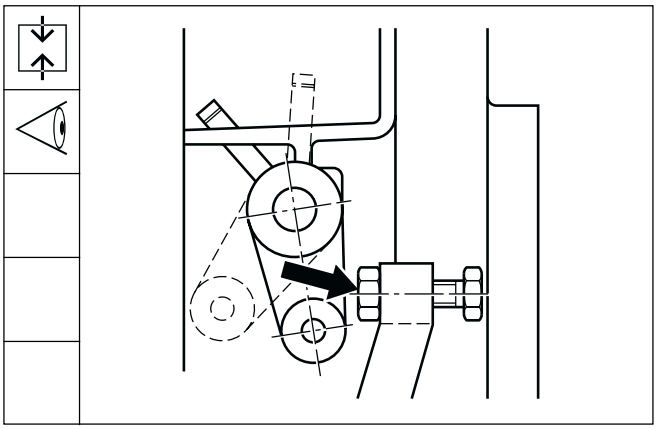
3.11 Press in crankshaft seal without using oil.

Note: If the crankshaft sealing surface has a lead-in spiral, a new shaft seal ring set, consisting of rotary shaft seal and a rotating ring is to be used instead of a new shaft seal ring. For the assembly of the shaft seal ring set, see chapter 4.



3.12 Screw in the stop screw in such a way that the counter nut closes flush fitting with the bolt end.

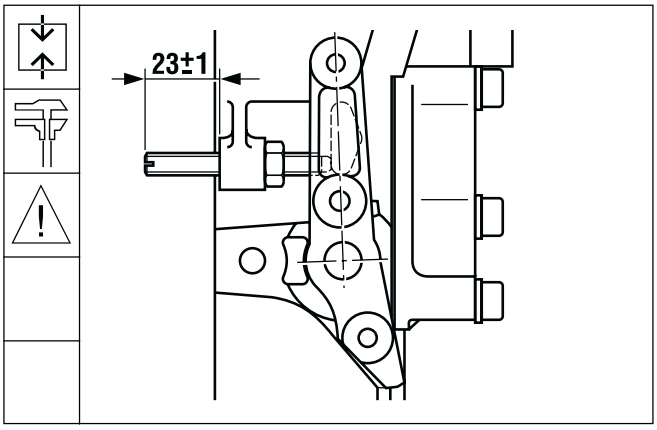
Tightening specification: **4.5 Nm**



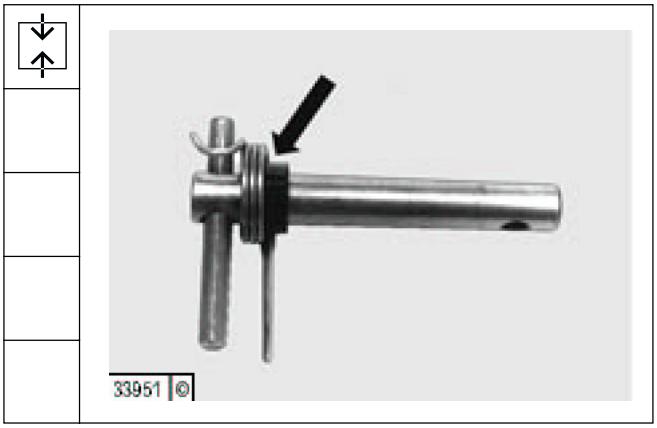
3.13 Adjust distance of min. speed setscrew and tighten.

Tightening specification: **4.5 Nm**

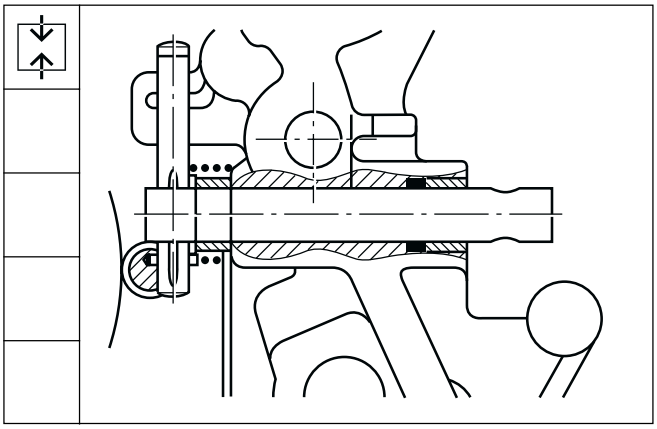
Note: The above adjustment data rep resent basic values. It is necessary to carry out a bench test for setting engine power and speed.



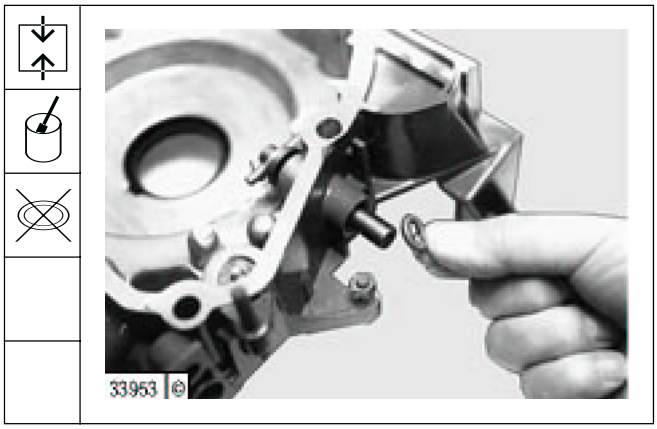
3.14 Push the sleeve and the spring onto storage shaft.



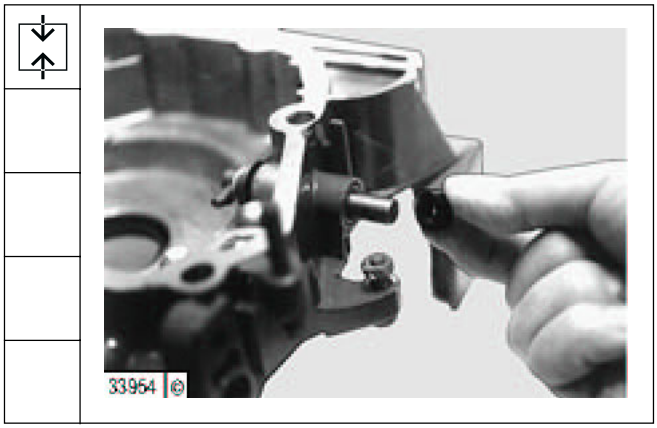
3.15 Install shutdown shaft.



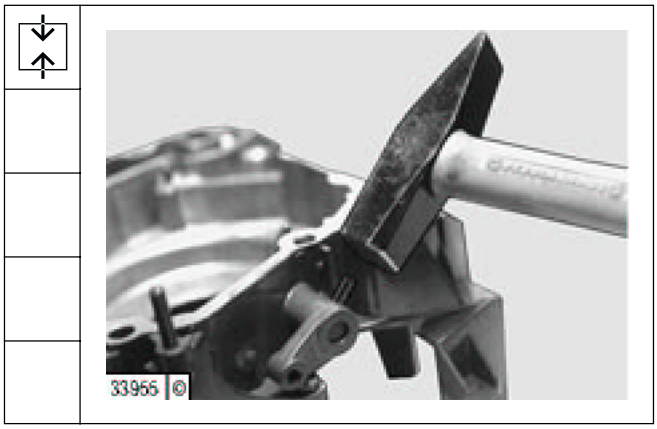
3.16 Slide greased O-seal onto shaft.



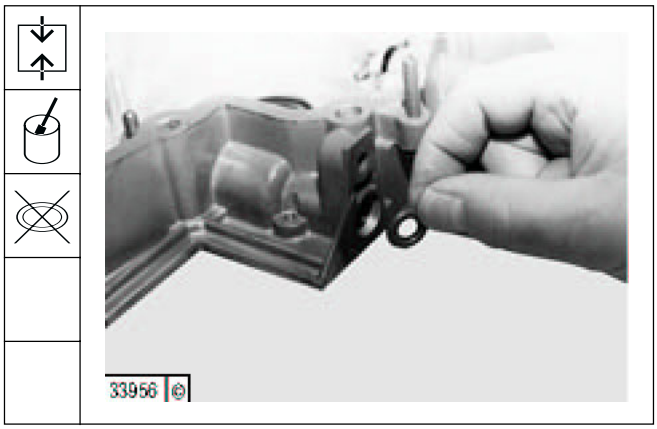
3.17 Insert the sleeve.



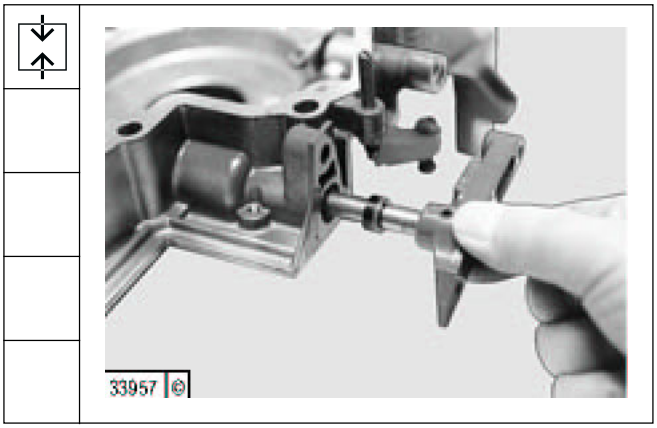
3.18 Assemble shutdown lever with dowel sleeve.



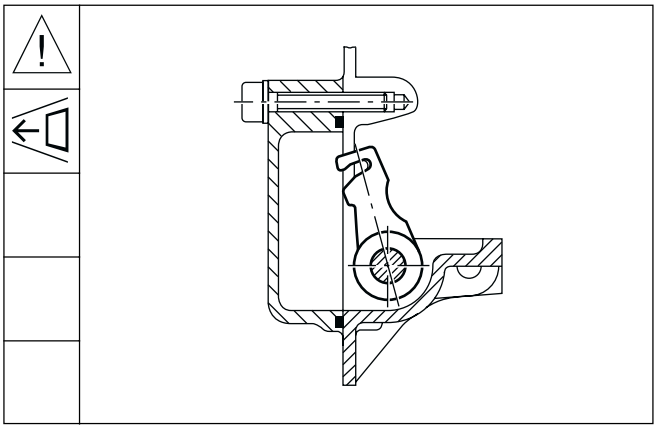
3.19 Fit greased O-seal.



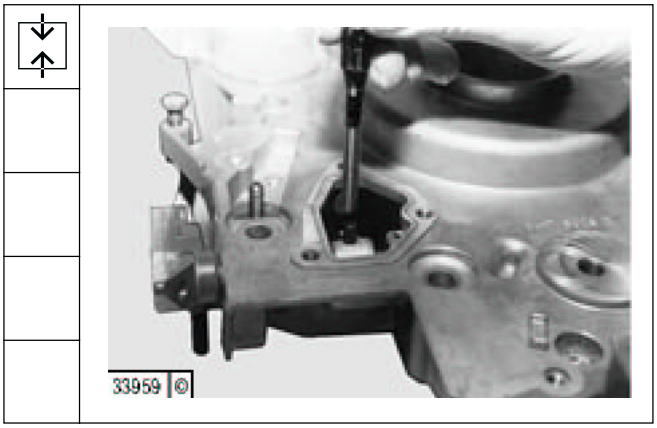
3.20 Mount and push in the sleeve on the rotational speed shaft.



Note: Watch direction of installation of speed control lever.

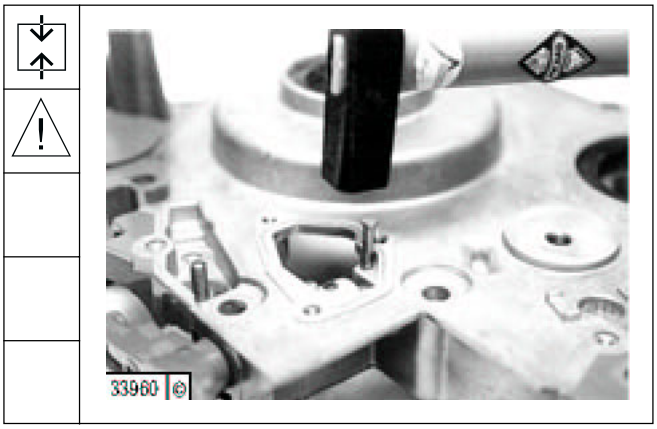


3.21 Assemble speed control lever with dowel sleeve.



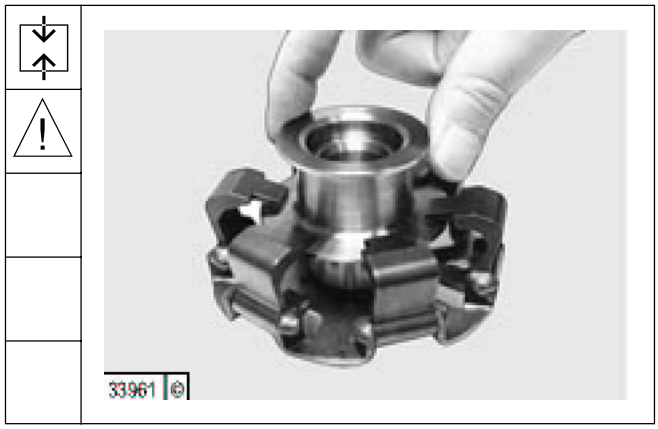
3.22 Drive in pin.

Note: Groove of speed control shaft must be in line with pin bore.



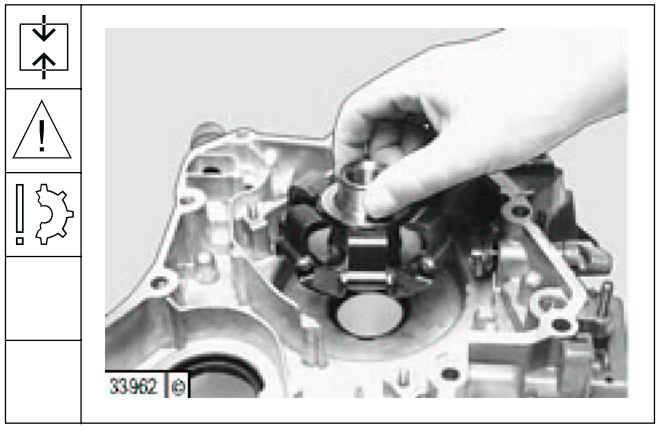
3.23 Complete the measuring element with the pipe coupling.

Note: Watch direction of installation.

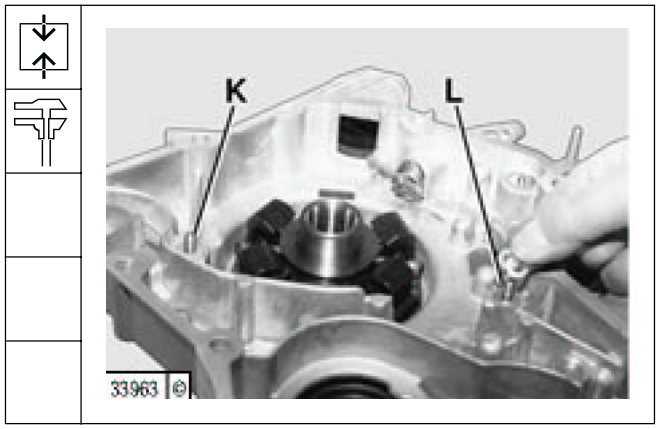


3.24 Fit the measuring element in the front cover.

Note: Be careful not to damage sealing lip of shaft seal.

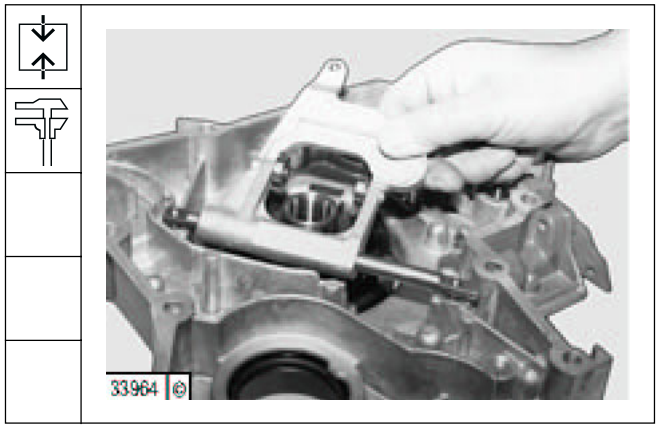


3.25 Support the compensating shim washer at the positions "K" and "L" using at least **0.3 mm**.



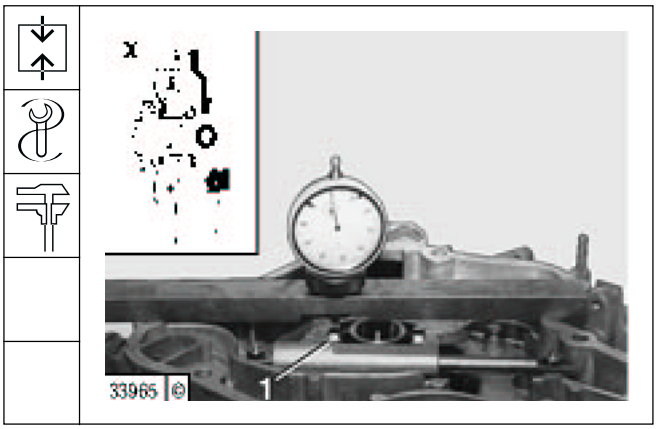
3.26 Install governor lever shaft without idling lever. Tighten bolts.

Tightening specification: **9.2 Nm**

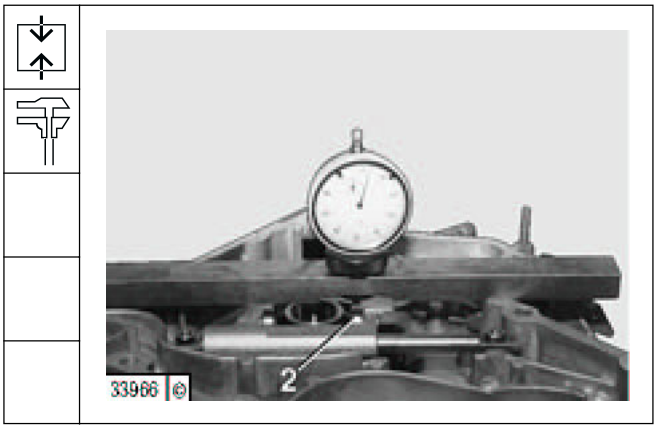


Measuring parallelism of roller lever:

3.27 Support the regulator levers at the position **x** in such a way that the ball bearings do not rest upon the pipe coupling.
It is measured under a light pressure of the roller lever against the regulator lever shaft.
Place the dial gauge on the ball bearing Pos. 1 and set the pointer to.

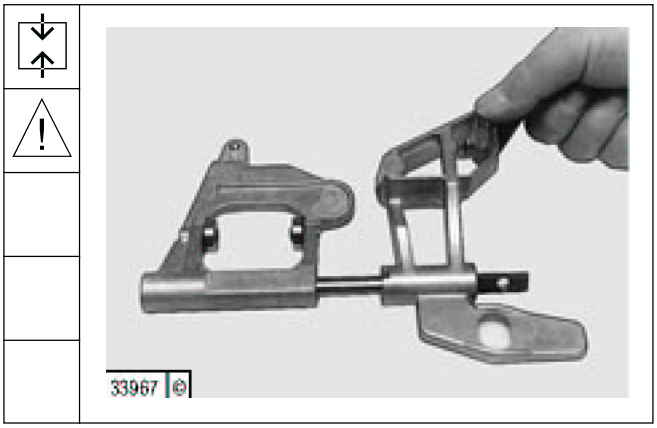


3.28 Place the dial gauge on the ball bearing Pos. 2.
Note the deviation to the ball bearing Pos. 1.
To attain the required tolerance of **0.05 mm**, it is possible to insert an additional shim of max. **0.5 mm** either at point ”K“ or ”L“.



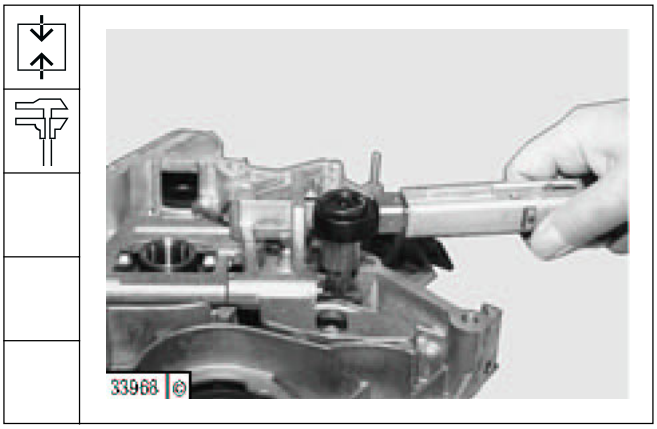
3.29 Assemble roller lever with idling lever and shaft.

Note: Watch direction of installation.

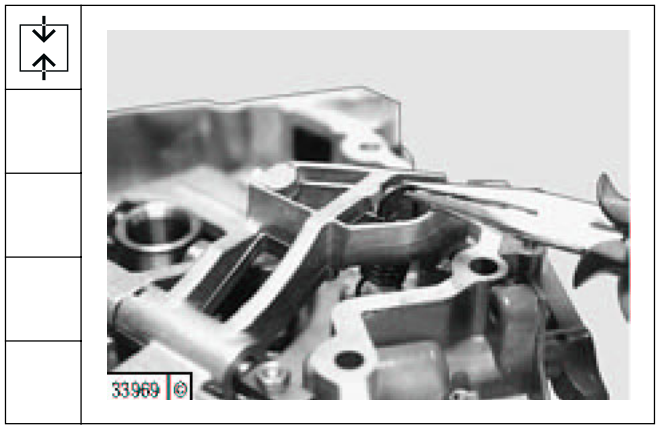


3.30 Install complete governor lever shaft in front cover.
Tighten bolts.

Tightening specification: **9.2 Nm**

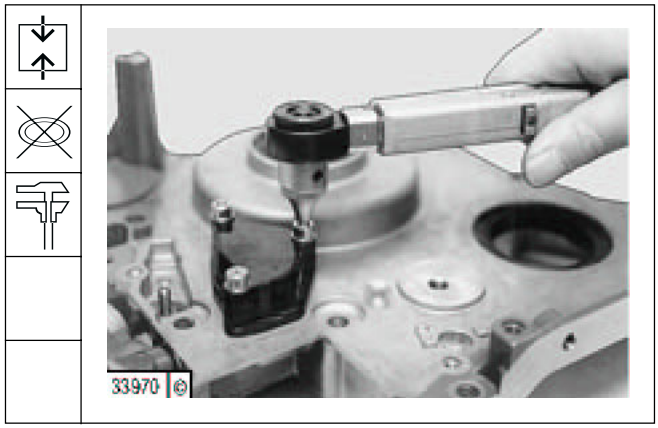


3.31 Hook up governor spring.

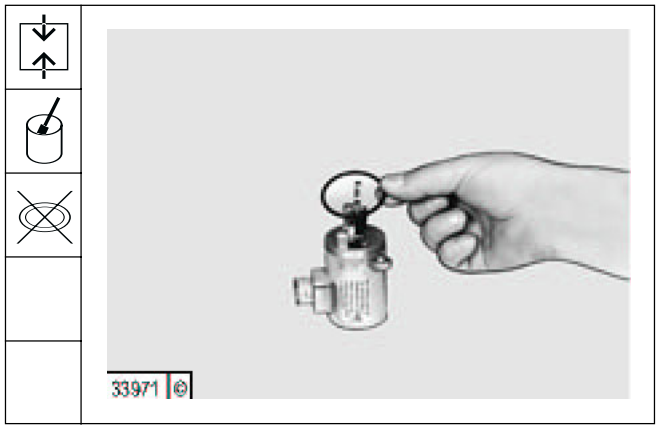


3.32 Mount cover with new gasket.
Tighten bolts.

Tightening specification: **4.5 Nm**



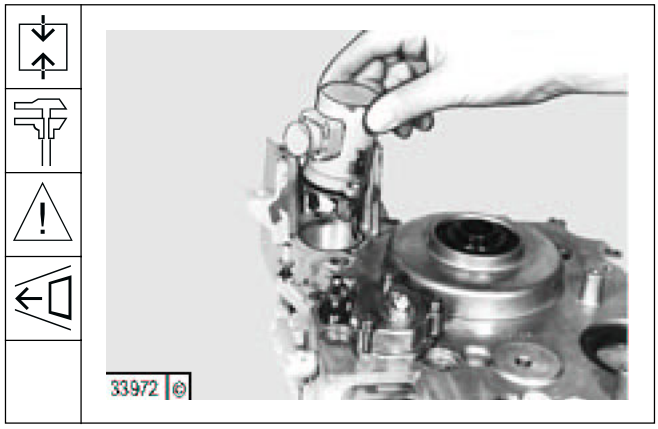
3.33 If engine shutdown device is provided, position O-seal and grease.



3.34 Install engine shutdown device and tighten bolts.

Tightening specification: **8.5 Nm**

Note: Watch direction of installation.

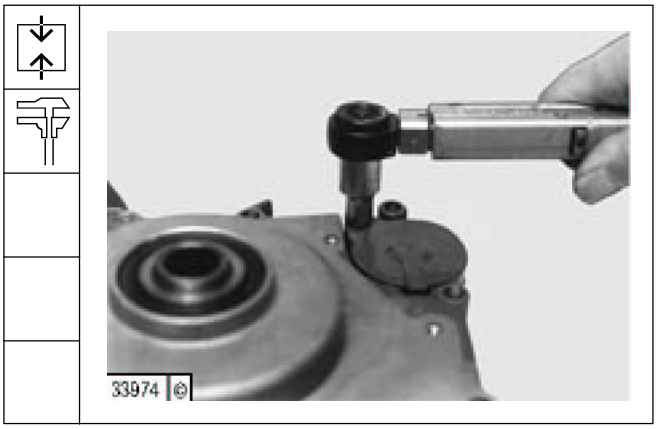


3.35 Position new O-seal.



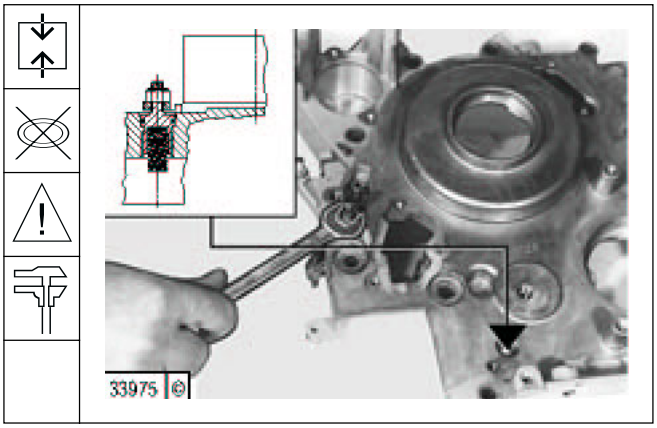
3.36 Fit crankcase breather.
Tighten bolts.

Tightening specification: **8.5 Nm**

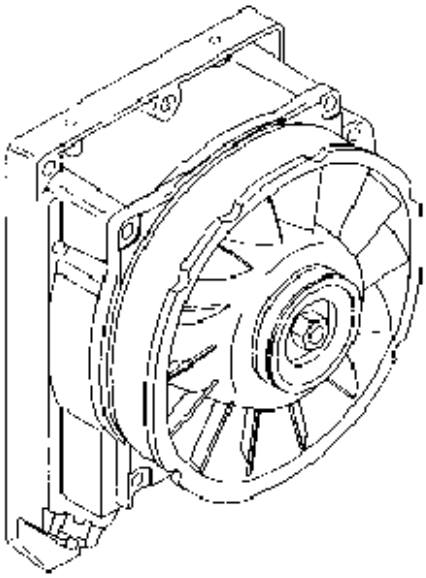


3.37 Screw in idle-speed casting, if any, with new O-seal flush with inner edge of front cover.
Tighten hex. bolt.

Tightening specification: **4.6 ± 0.4 Nm**



• BLOWER

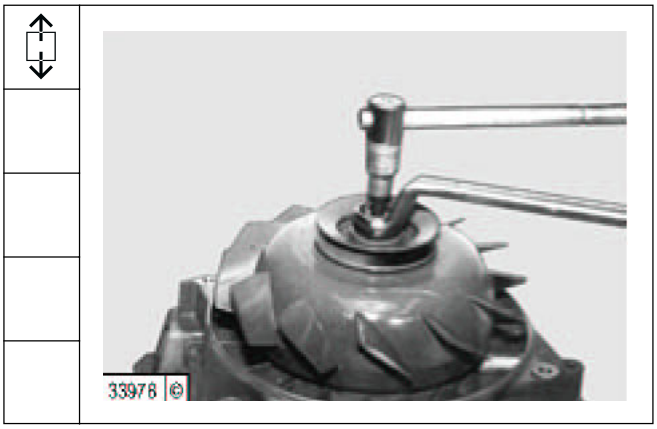


1. Dismount the cooling fan

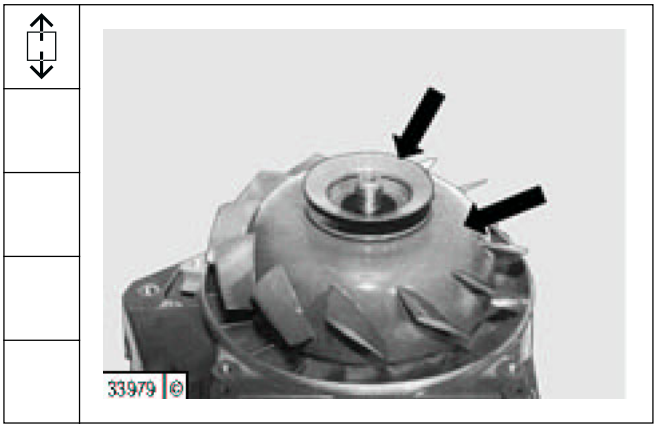
1.1 Remove blower jacket inlet.



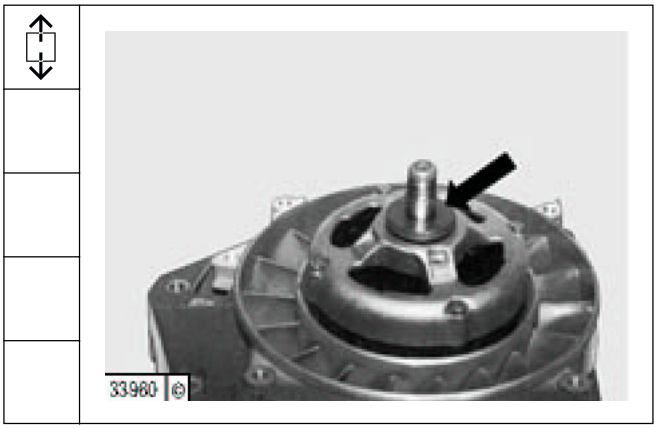
1.2 Remove air duct.



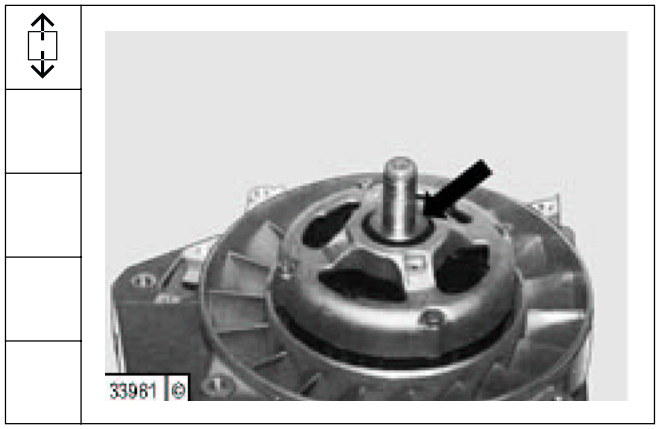
1.3 Unscrew fastening nut. Remove washer.



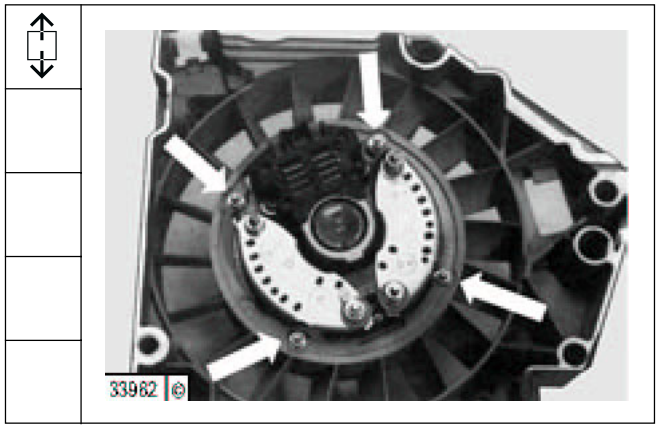
1.4 Remove V-belt pulley and rotor.



1.5 Remove guide disc.



1.6 Unscrew fastening nut.

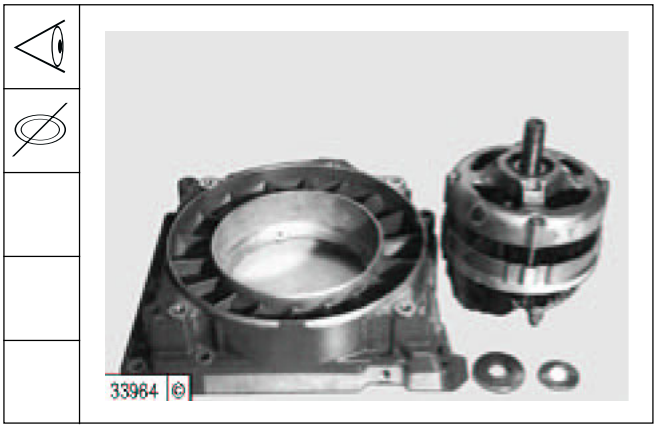


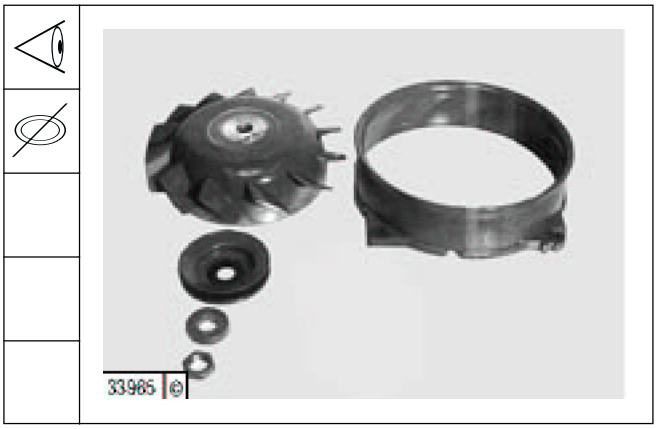
1.7 Press out alternator.



2. Check visually the single components

2.1 Inspect all single parts and replace if necessary.

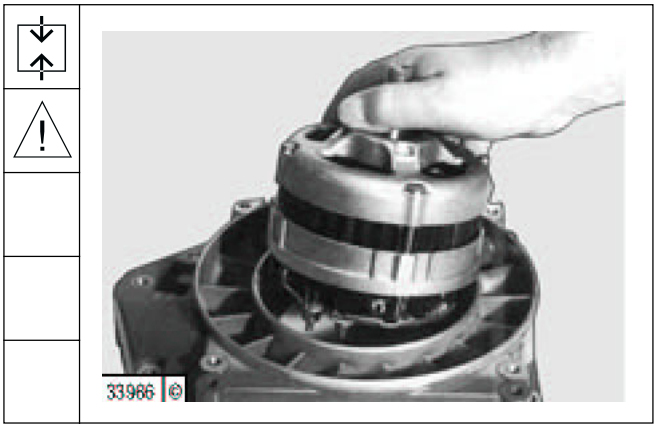




3. Complete the cooling fan

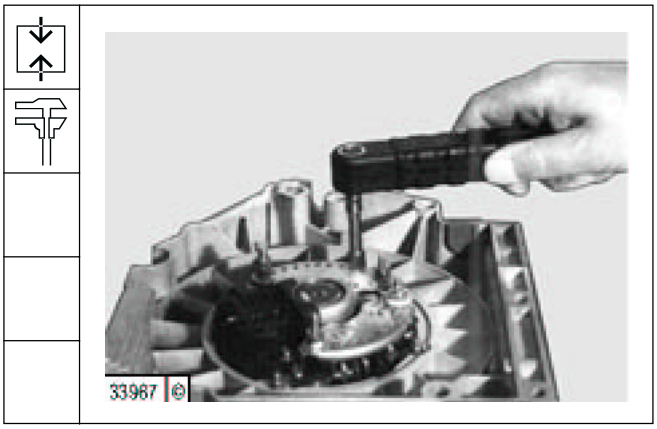
3.1 Introduce alternator into blower.

Note: Watch direction of installation.



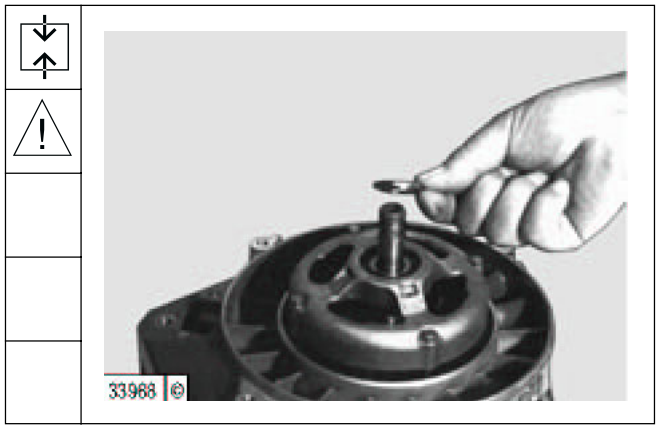
3.2 Position washers, tighten nuts.

Tightening specification: **4 Nm**

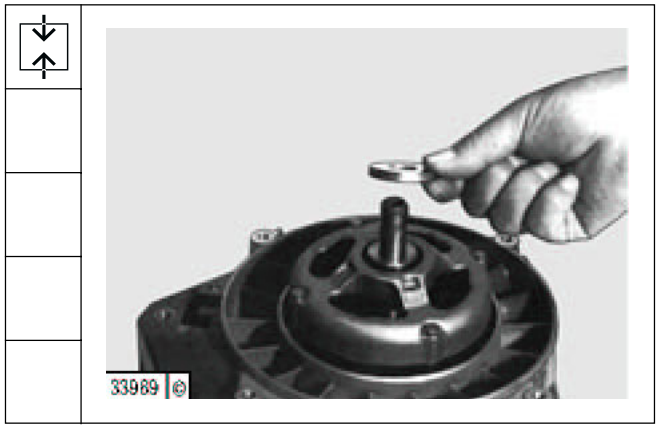


3.3 Position guide disc.

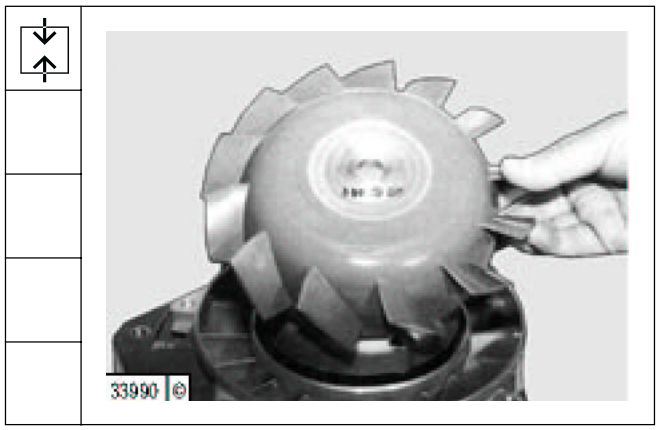
Note: Shouldered side must face alternator.



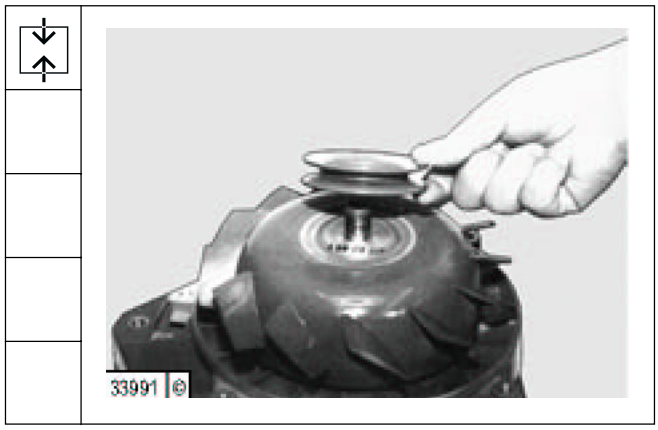
3.4 Position spacer.



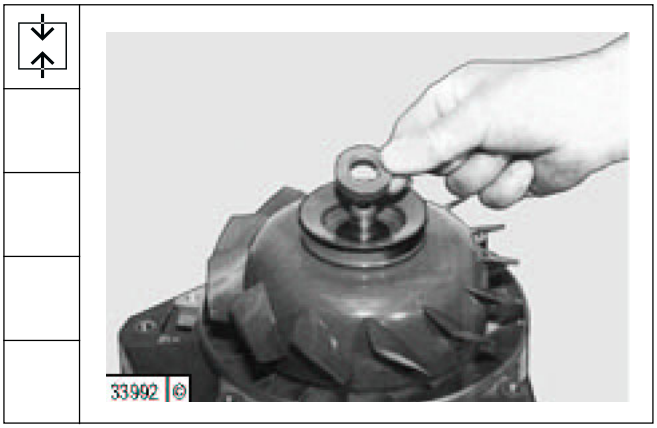
3.5 Install rotor.



3.6 Position V-belt pulley.

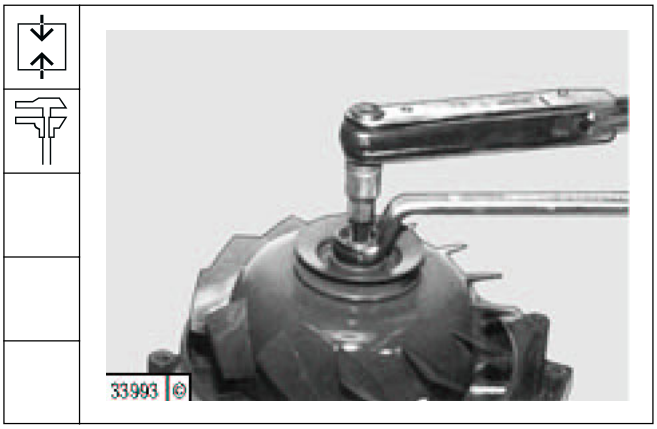


3.7 Position washer.

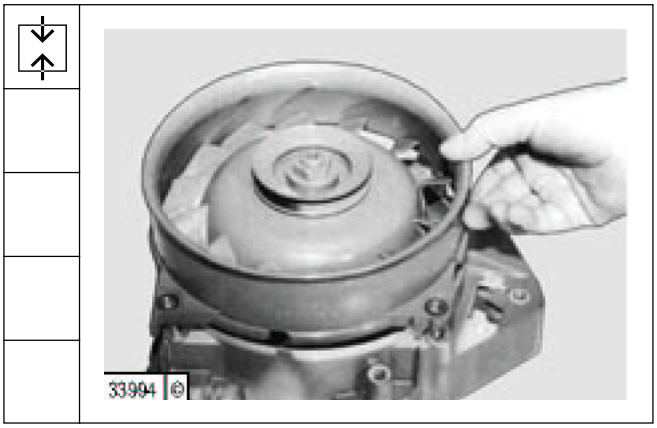


3.8 Screw on fastening nut and tighten.

Tightening specification: **50 Nm**

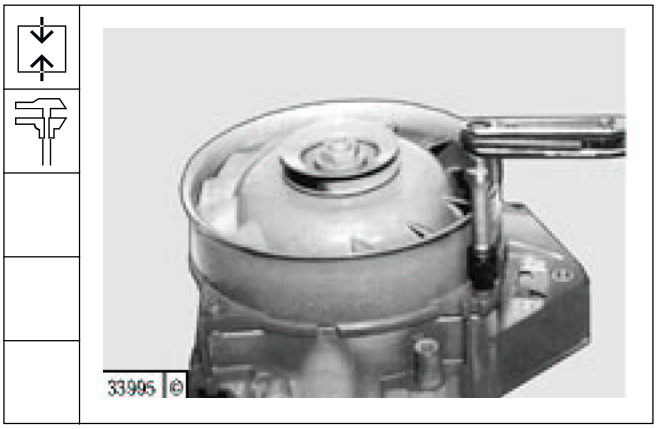


3.9 Position blower jacket inlet.



3.10 Tighten fastening bolts.

Tightening specification: **22 Nm**



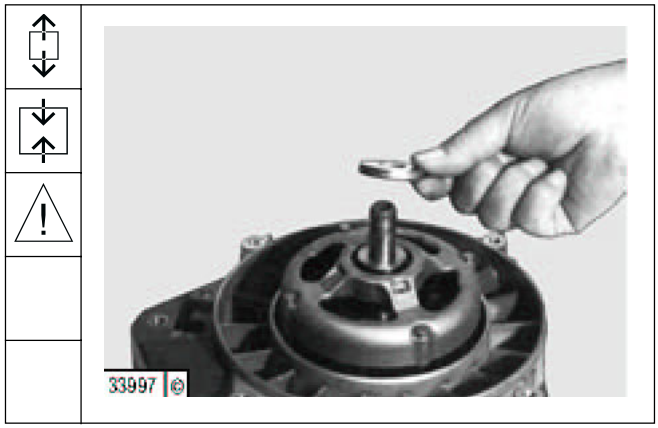
3.11 Gauge clearance between rotor and blower jacket inlet.

min. = **0.2 mm**
max. = **0.8 mm**

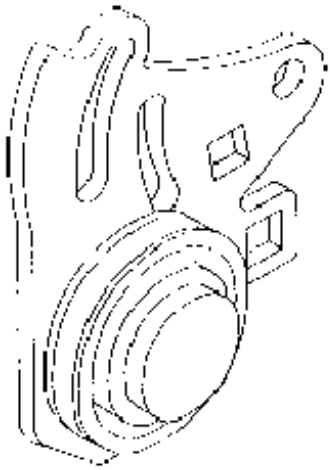


3.12 Use relevant spacer for correction.

Note: Spacers with 5.0 - 7.0 mm thickness are available.



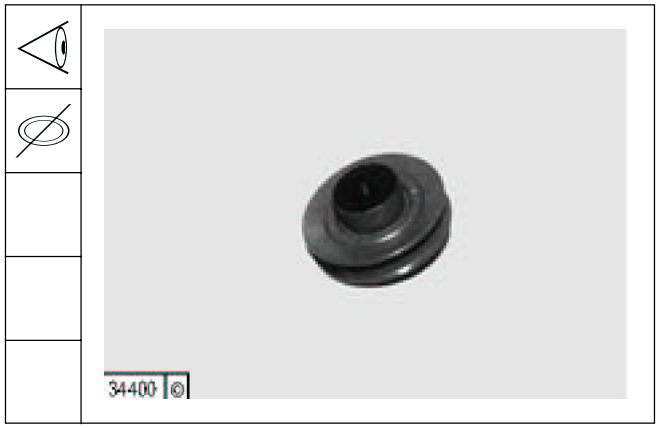
• IDLER PULLEY



1. Remove clamping plate.

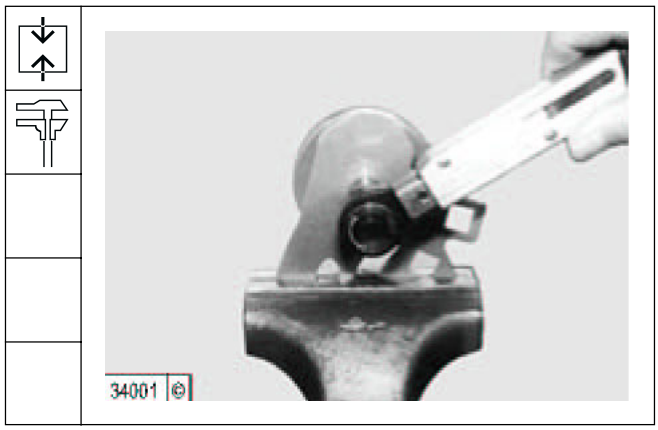


2. Replace damaged idler pulley.



3. Fit clamping plate, Tighten bolt.

   Tightening specification: **21 Nm**



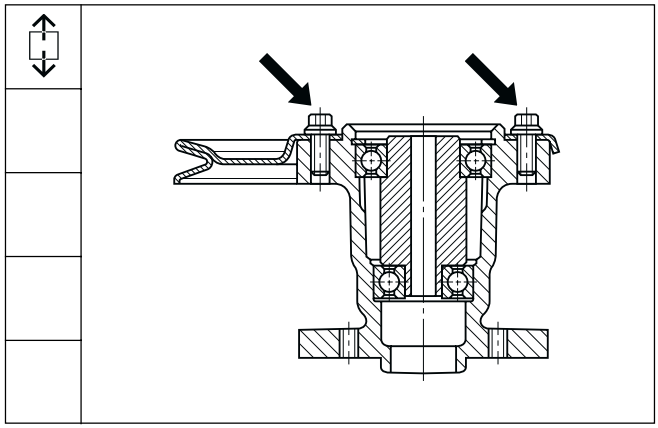
• FAN DRIVE



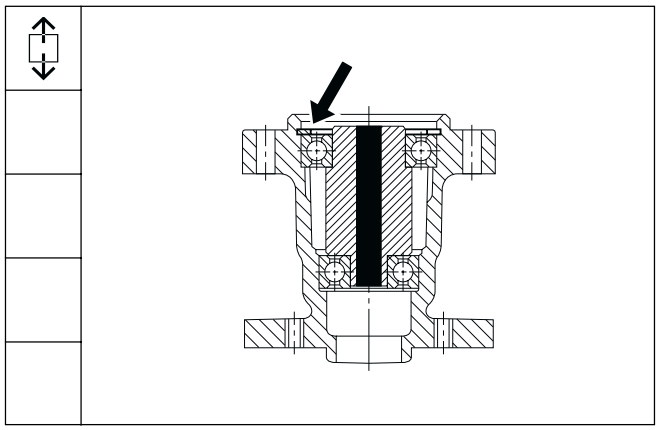
Commercial tools required:

Torx tool kit 8189

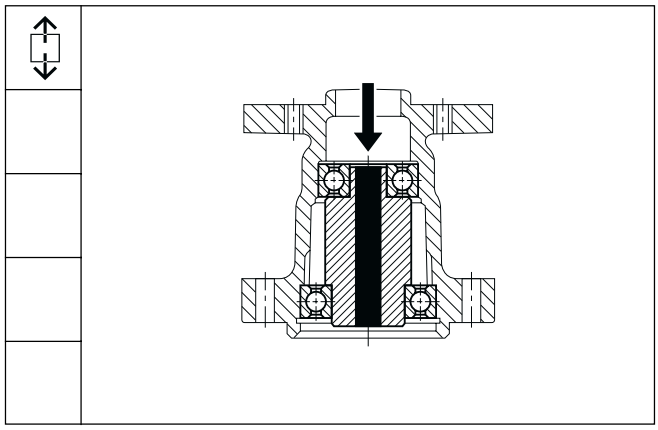
1. Remove V-belt pulley from drive hub.



2. Remove the locking ring.

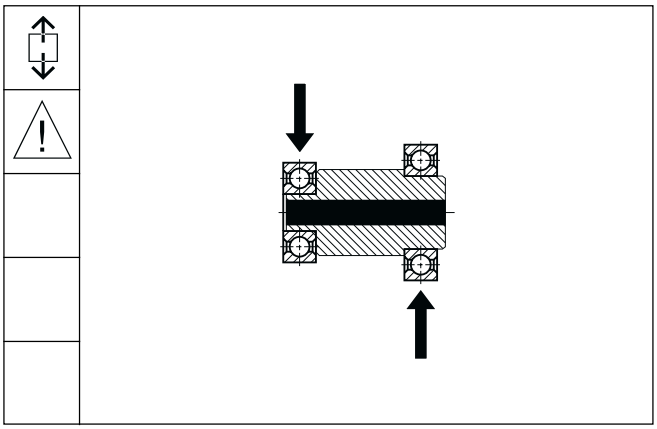


3. Press out the grooved ball bearing and the shaft.

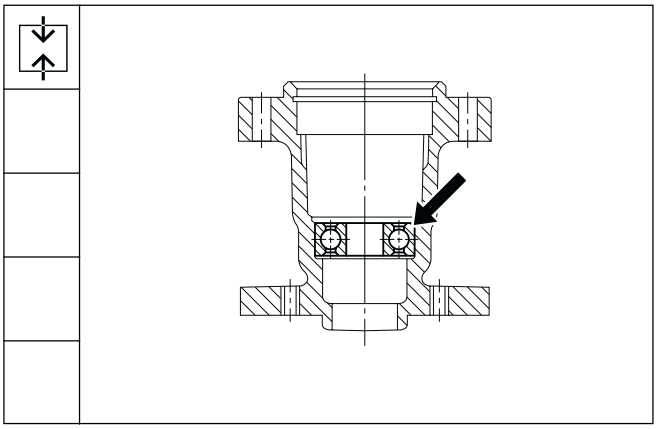


4. Pull off the grooved ball bearing

Note: Basically, the grooved ball bearings are to be renewed.

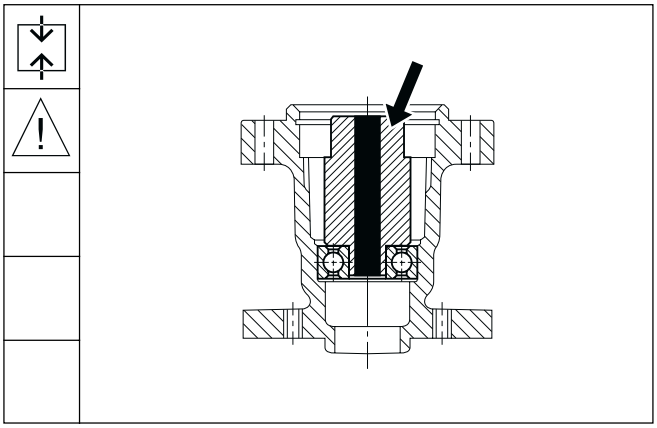


5. Press in inner grooved ball bearing via outer race as far as it will go.

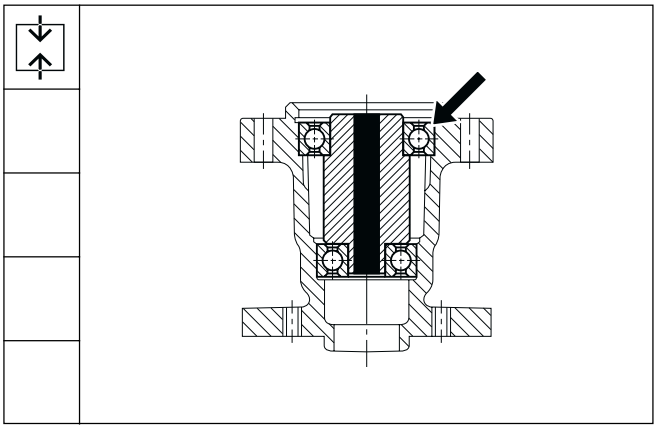


6. Push the shaft to unit into the grooved ball bearings.

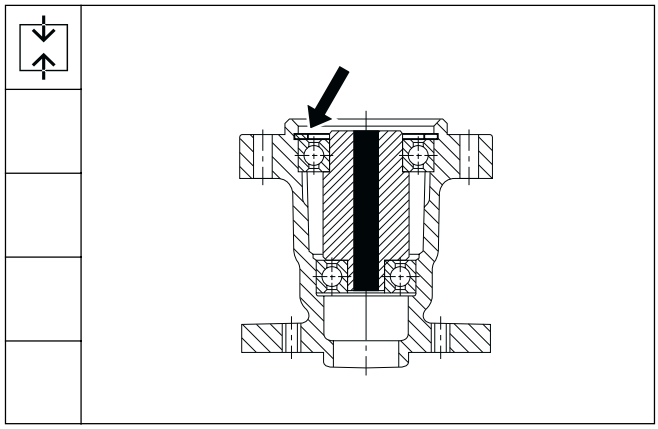
Note: Support the inner ring of the grooved ball bearing.



7. Press in outer grooved ball bearing via outer race as far as it will go.

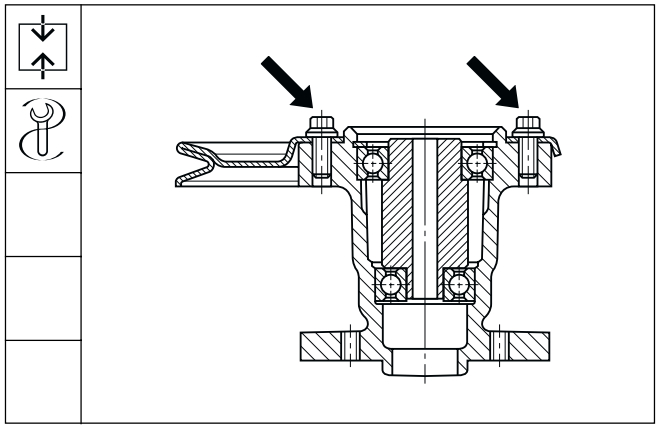


8. Insert circlip in drive hub.



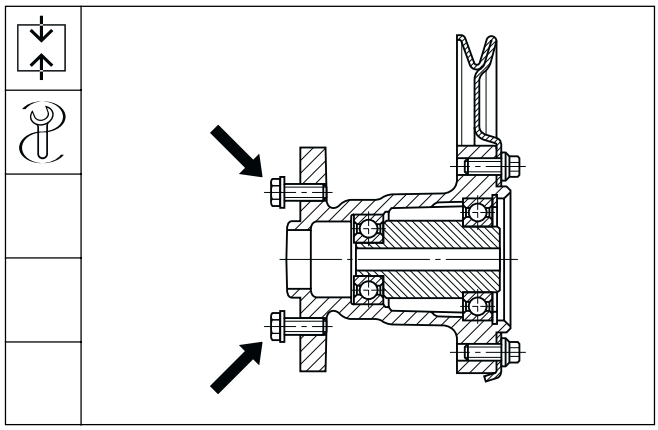
9. Fit V-belt pulley. Tighten bolts.

Tightening specification: **21 Nm**



10. With mounted fan:

Tightening regulations of the screws:
Screw 8.8 **22 Nm**
Screw 10.9 **30 Nm**



DISASSEMBLY AND REASSEMBLY OF COMPLETE ENGINE

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DISMANTLING ENGINE

Commercial tools required:

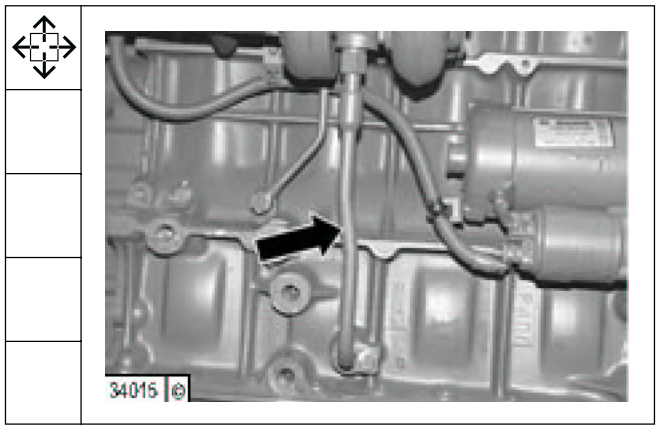
Torx tools 8189
Clip pliers 8011
Claw key 8018
Socket a/flats 32 8036
Multipower tool 8049
Hose clip pliers 9088
Spring clamp pliers 9090
Special bit ..... 9120 or 9122

Special tools required:

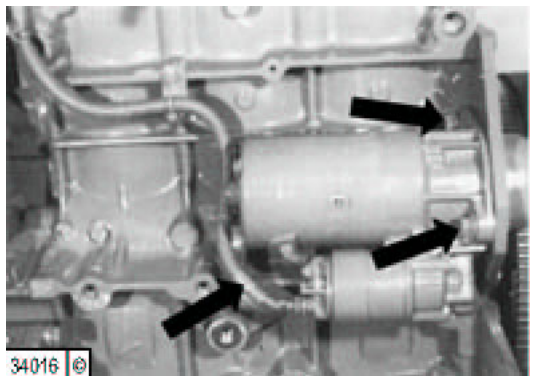
Engine assembly stand 6067
Angled clamping plate 6067/115
Adjusting pin 100 700
Puller 143 100
Dolly 143 420
Intermediate disc 143 430
Dolly for camshaft gear 144 130
Special wrench for filter cartridges 170 050
Special wrench for oil pressure sensor 170 110

The repair procedure outlined in this chapter refers to the standard specification, i.e. components for customizing the engine are not shown.

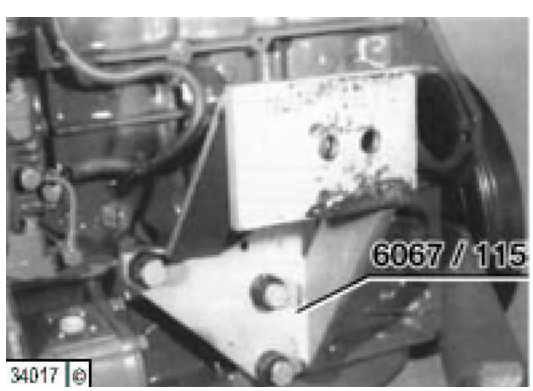
1. With BF motors.
Disassemble the oil-return pipe.



2. Remove charging current line and starter.

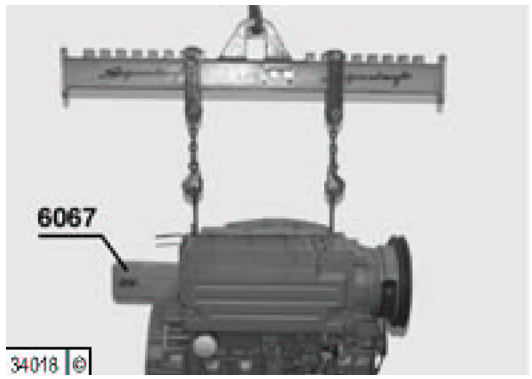


3. Mount angled clamping plate. Tighten bolts.

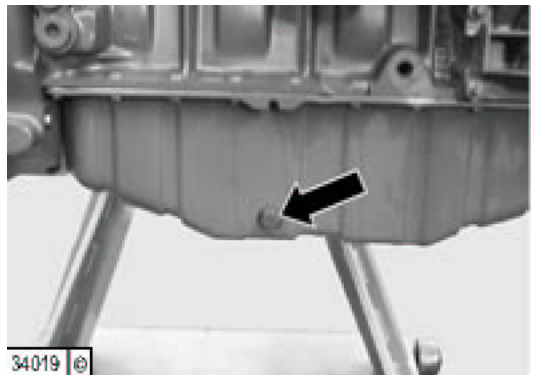


4. Mount engine to swivelling assembly stand.

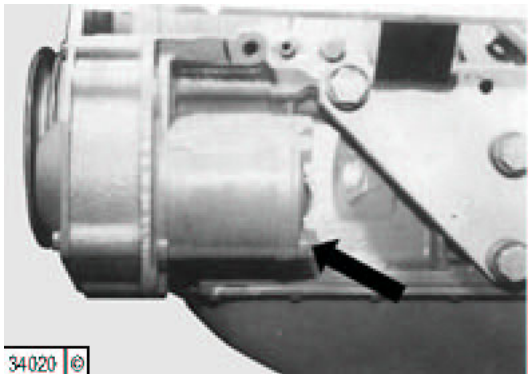
Note: Use proper suspension device.



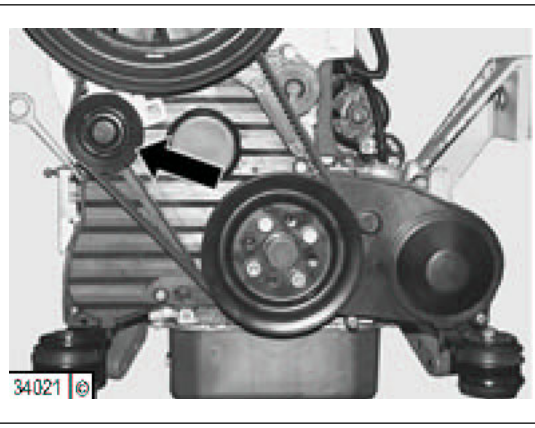
5. Drain, catch remaining oil and dispose of in accordance with antipollution regulations.



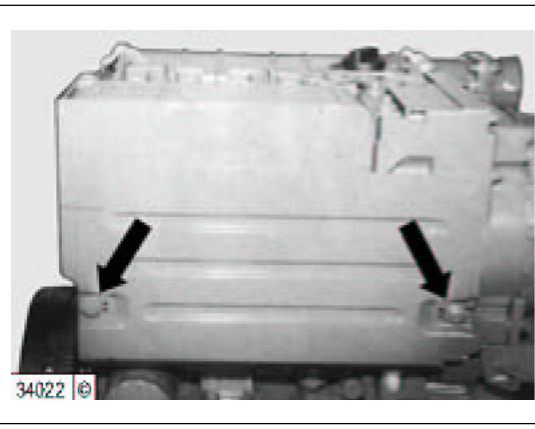
6. Remove hydraulic pump.



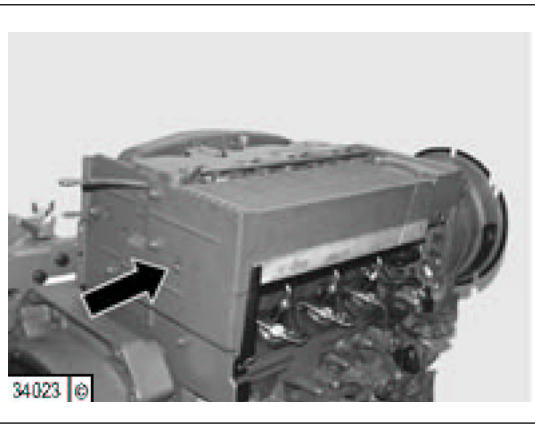
7. Remove V-belt idler pulley. Take off V-belt.



8. Remove air cowling.

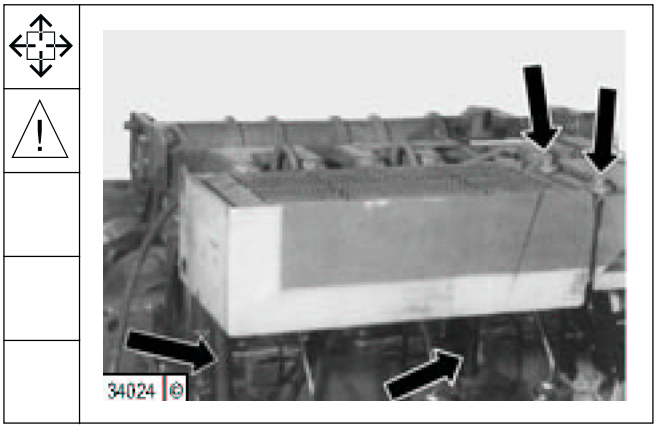


9. Remove stay plate.



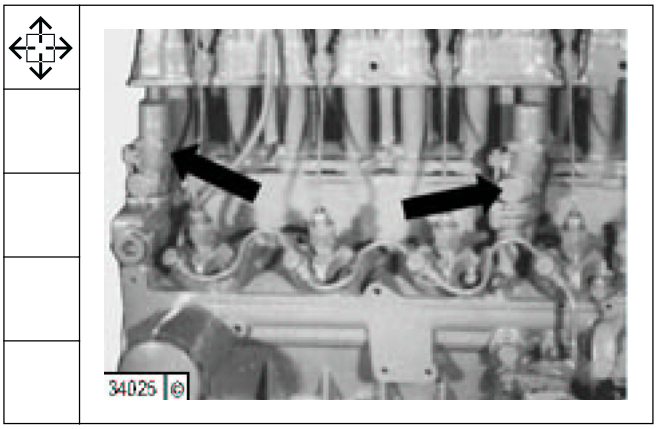
10. Remove oil cooler. If plug-in elements have remained in the crankcase, take them out.

Note: Catch any escaping oil and dispose of in accordance with anti-pollution regulations.

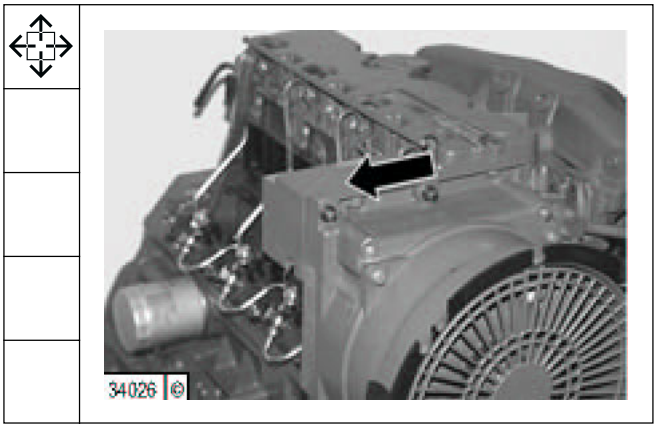


11. With B/FM engines:

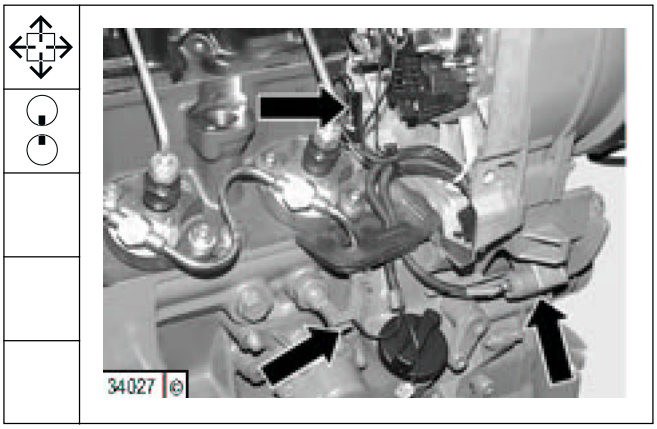
Remove oil cooler connections.



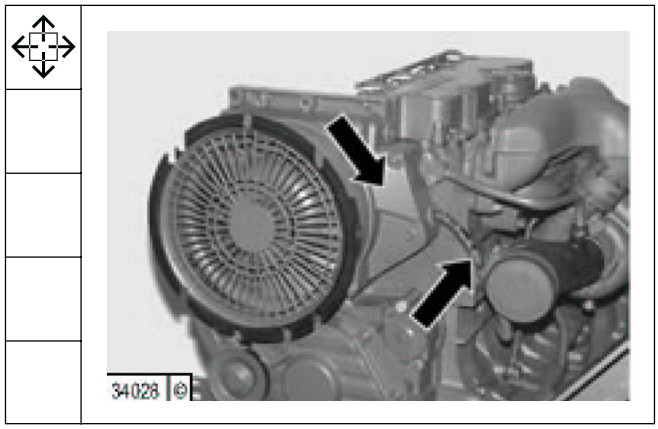
12. Remove air ducting.



13. Disassemble the plug-in connection.
Mark the lines and remove with the profile rubber.

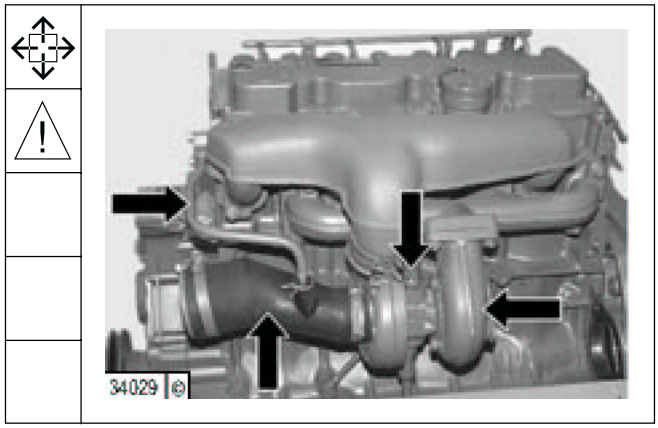


14. Disassemble the cooling fan with the generator, induction system and cable trunk.

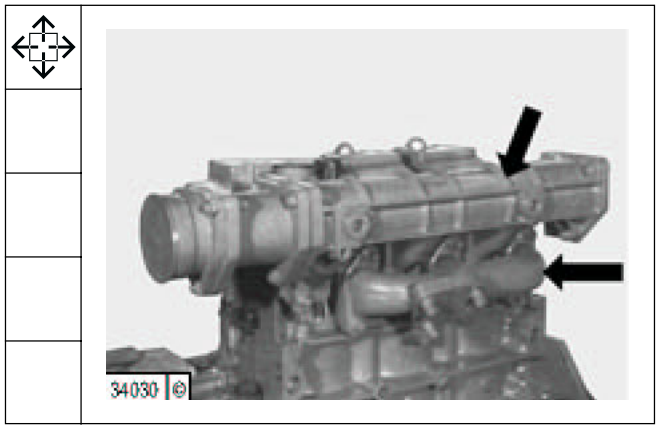


15. With BF motors.
Disassemble the vent pipe, reducer, lube oil line and the exhaust-driven turbosupercharger.

Note: Use the hose clip pliers 9088 and the spring clamp pliers 9090.

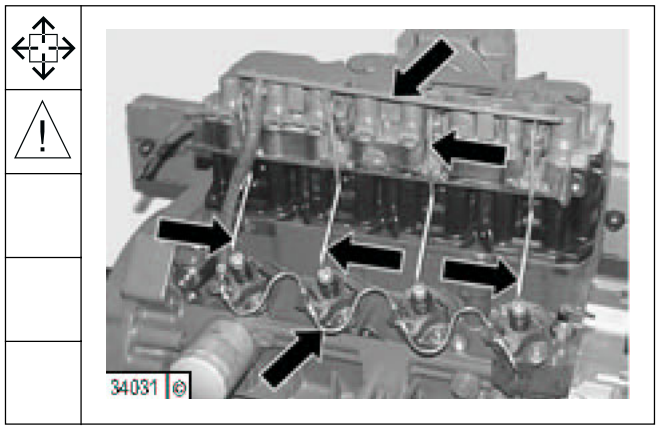


16. Remove exhaust manifold and air intake manifold.

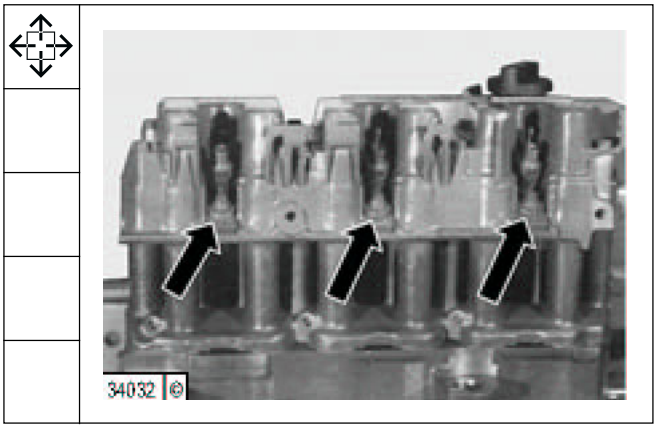


17. Disassemble the cross-over pipe, the fuel line and the injection lines.

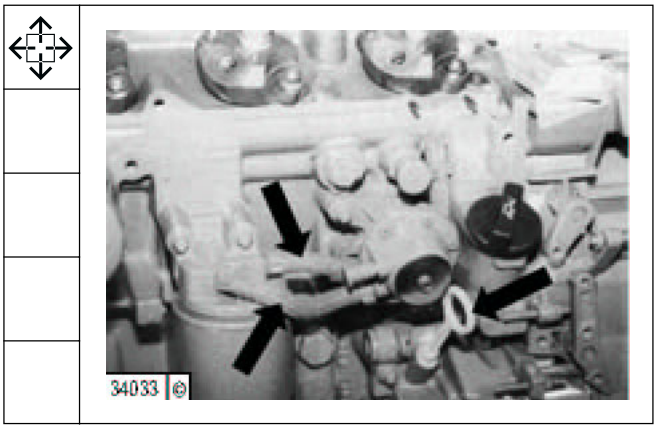
Note: Use the claw key 8018 for the injection lines. Close off the connections of the injection pumps and the injection valves.



18. Remove clamping pads.
Remove injectors.

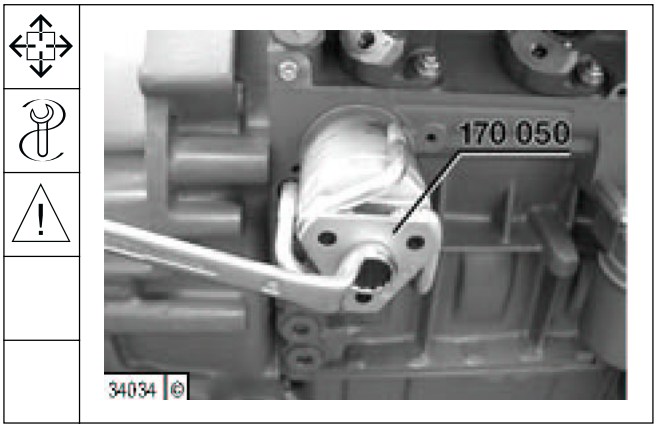


19. Remove fuel lines. Remove oil dipstick.



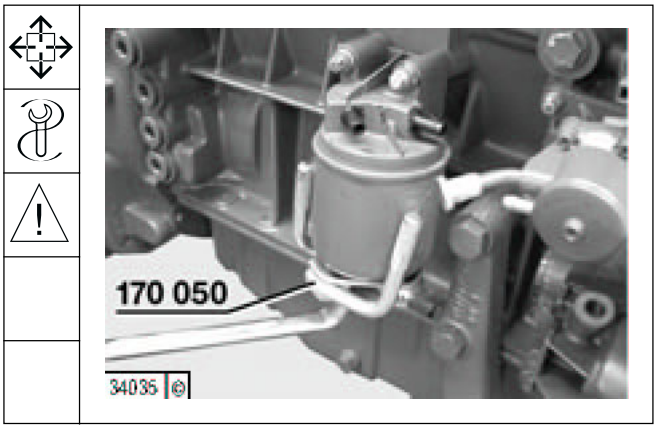
20. Remove oil filter.

Note: Catch any escaping oil and dispose of in accordance with anti-pollution regulations.

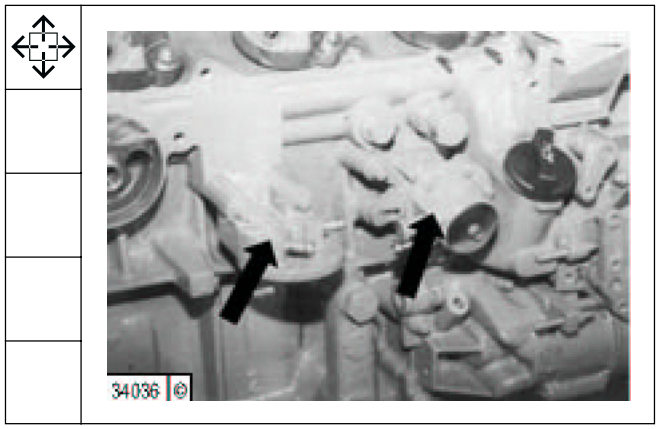


21. Remove fuel filter.

Note: Catch any escaping fuel and dispose of in accordance with anti-pollution regulations.

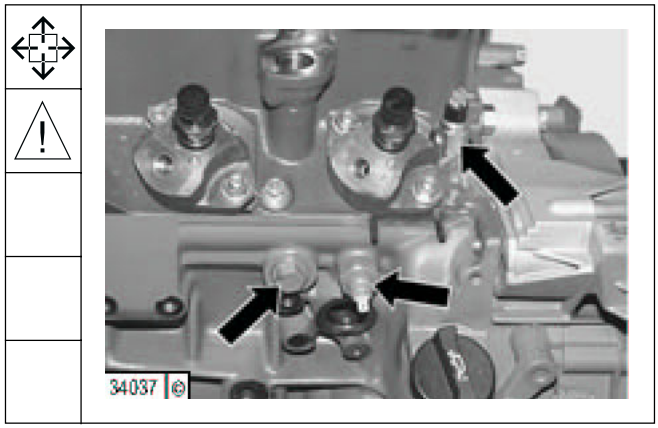


22. Remove fuel filter bracket and fuel feed pump.

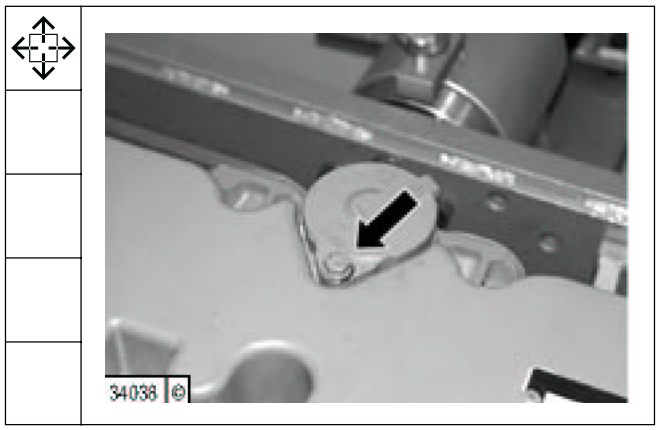


23. Remove the temperature transmitter, the oil pressure switch and the locking screw or the oil pressure transmitter.

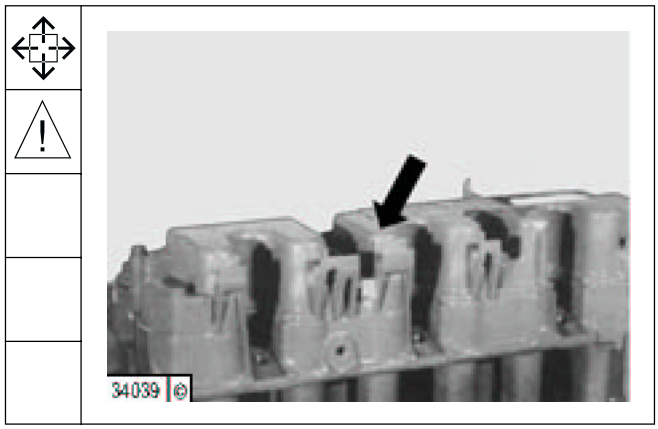
Note: Use a special key for the oil pressure transmitter.



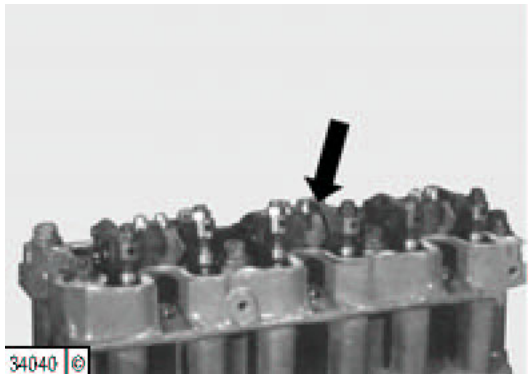
24. Disassemble the vent valve.
(With BF4L/M motors)



25. Remove cylinder head cover.



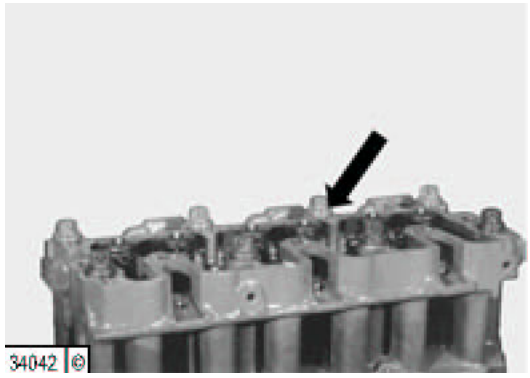
26. Remove rocker arm brackets.



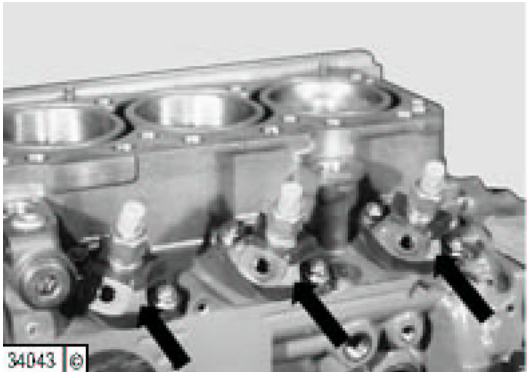
27. Take out pushrods.



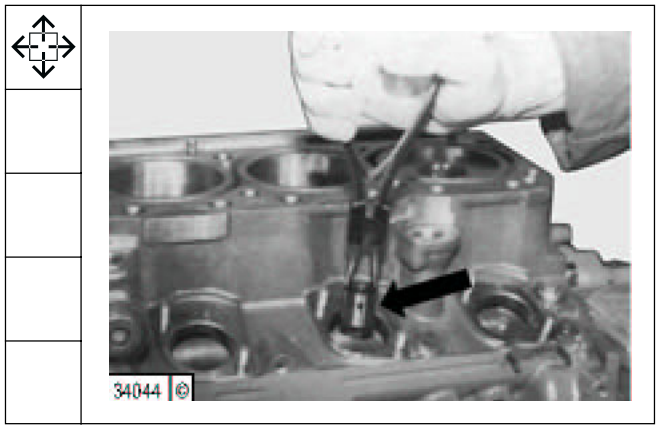
28. Remove cylinder head.



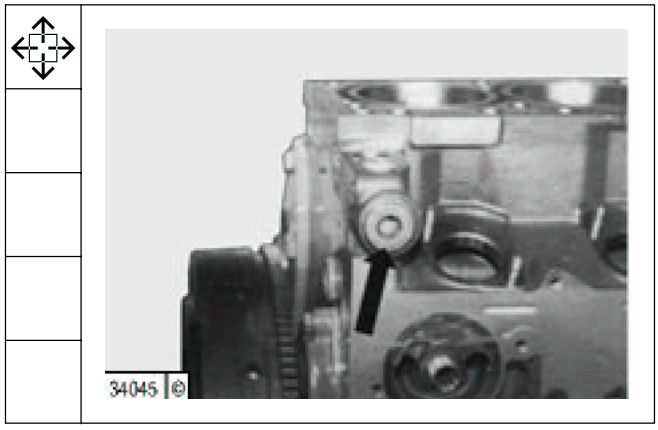
29. Remove injection pumps.



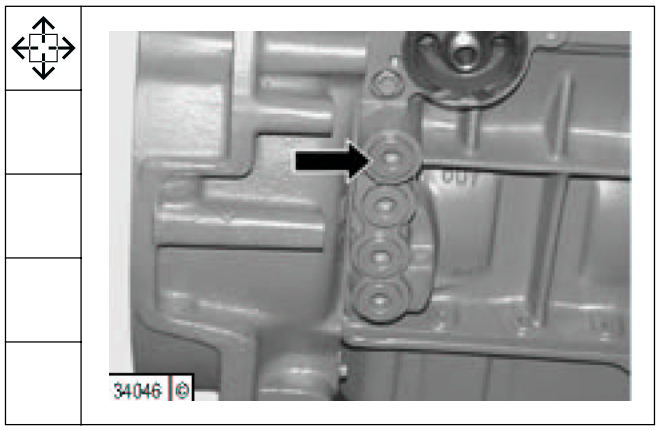
30. Take out roller tappets for injection pump (using outer circlip pliers).



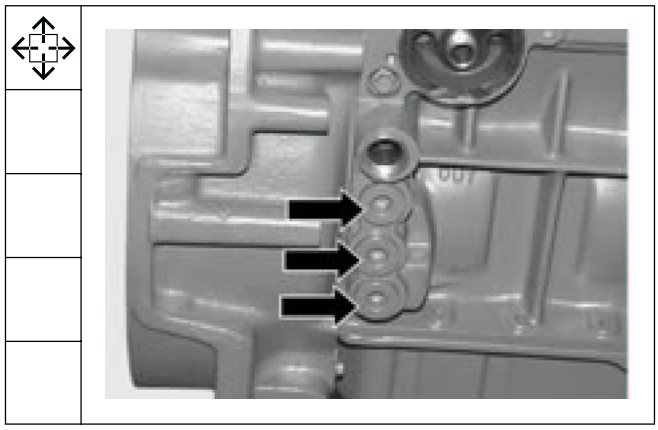
31. Remove thermostat.



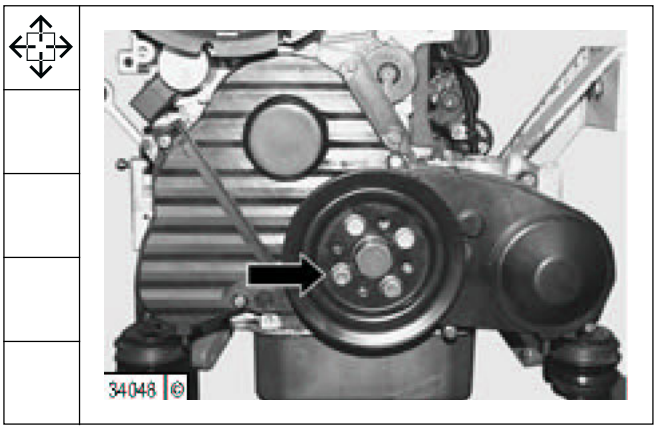
32. Remove oil pressure control valve.



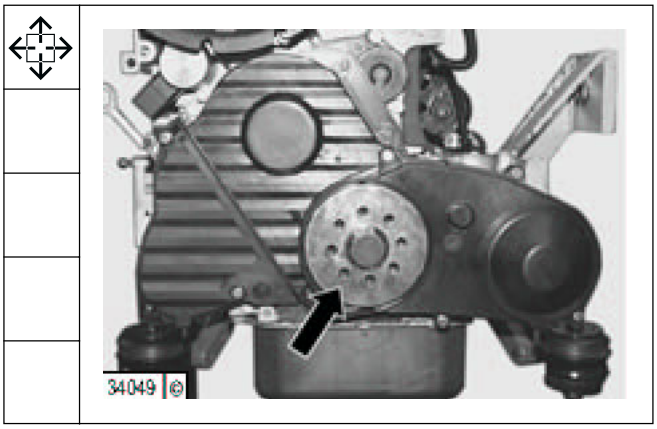
33. Unscrew screw plugs. If heater connection is provided, take out oil pressure control valves.



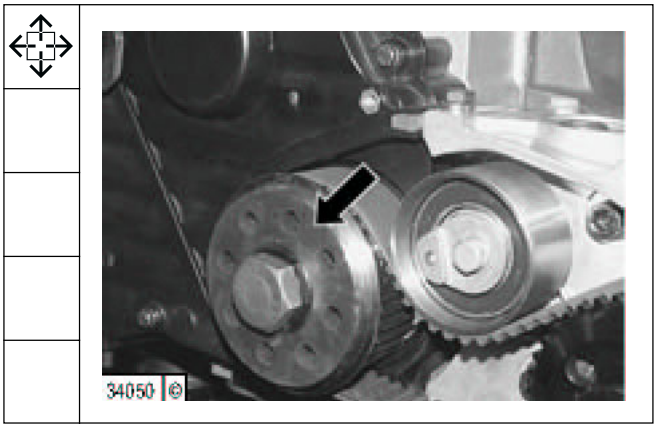
34. Remove belt pulley.



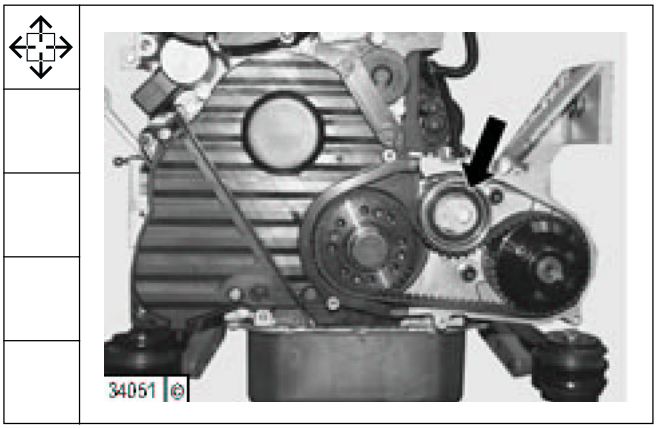
35. Remove the centrifuge disk. Disassemble the protective cover.



36. Take off intermediate disc.

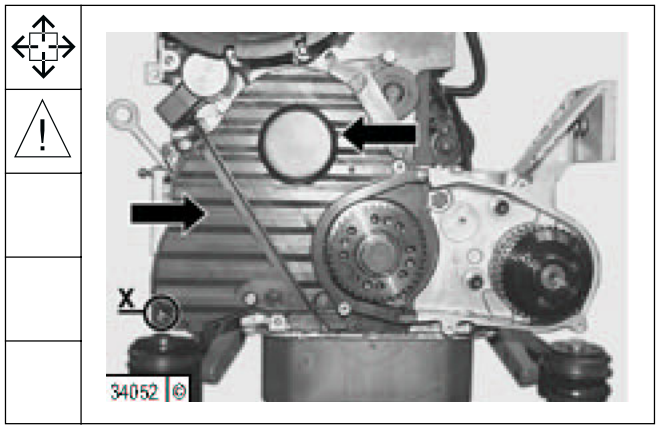


37. Remove idler pulley. Remove toothed belt.

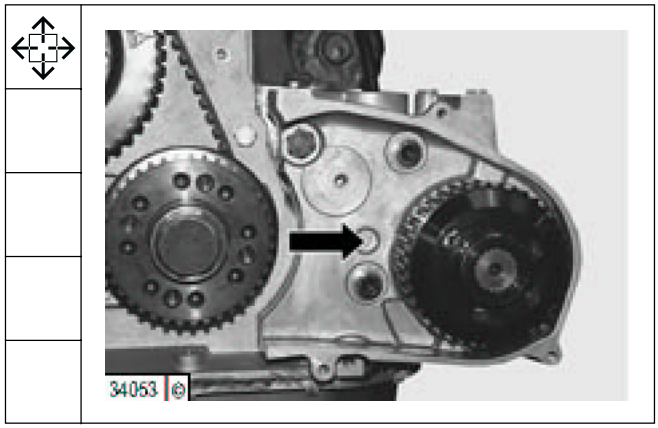


38. Disassemble the protective cover.

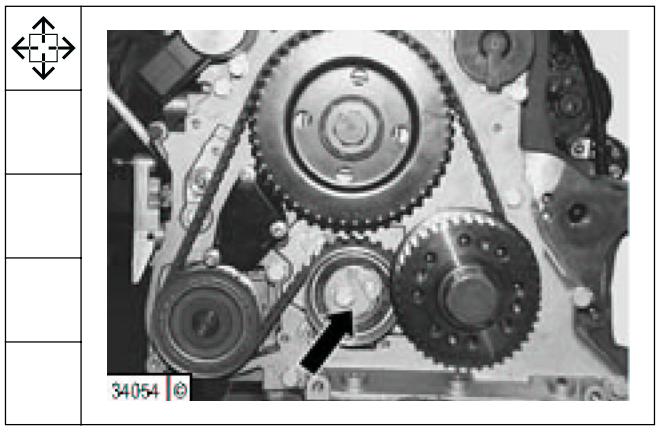
Note: For the locking screw (Pos. X), use the special bit 9120 or 9122.



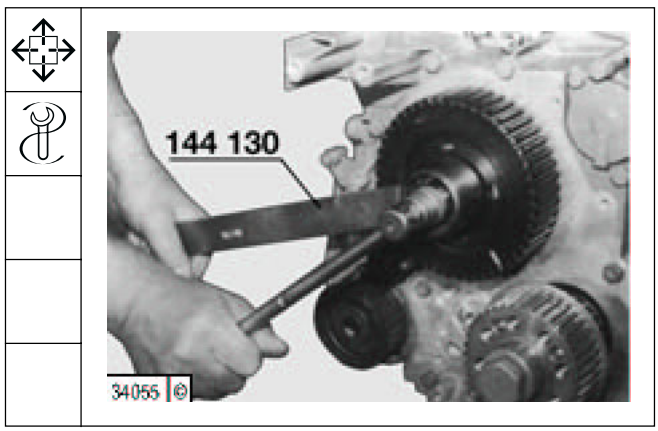
39. Remove the hydraulic pump console.



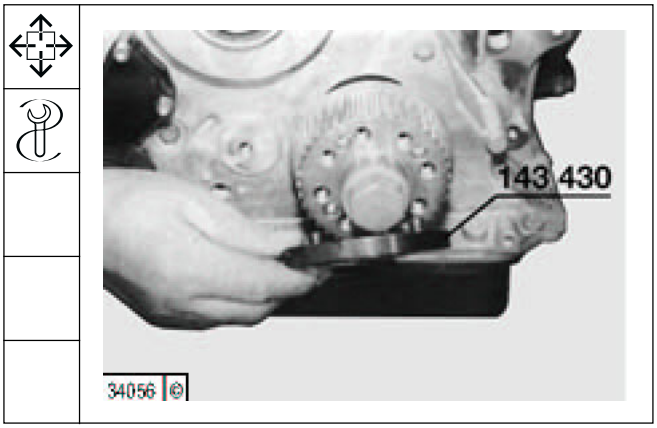
40. Remove idler pulley. Remove toothedbelt.



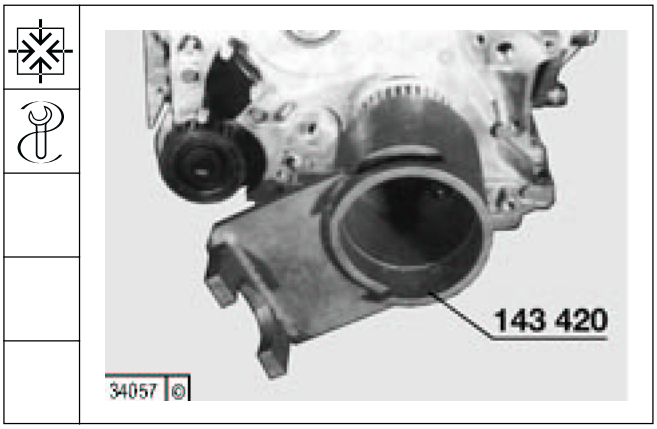
41. Remove camshaft gear.



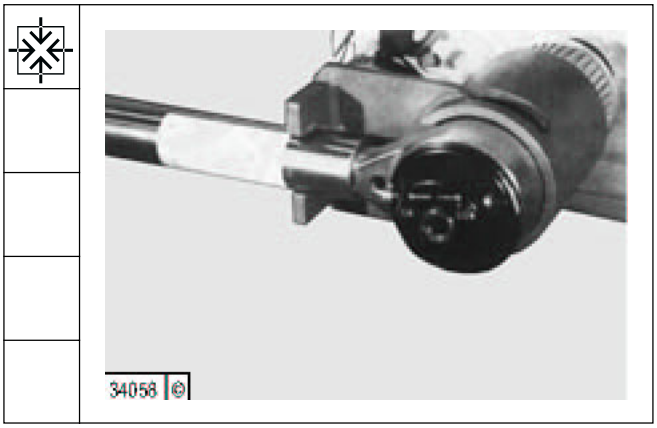
42. Position intermediate disc.



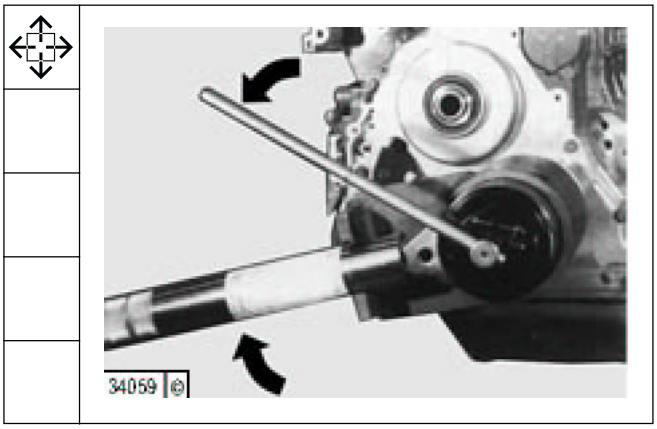
43. Fit dolly for crankshaft gear and tighten bolts.



44. Position multipower tool with socket (8036).

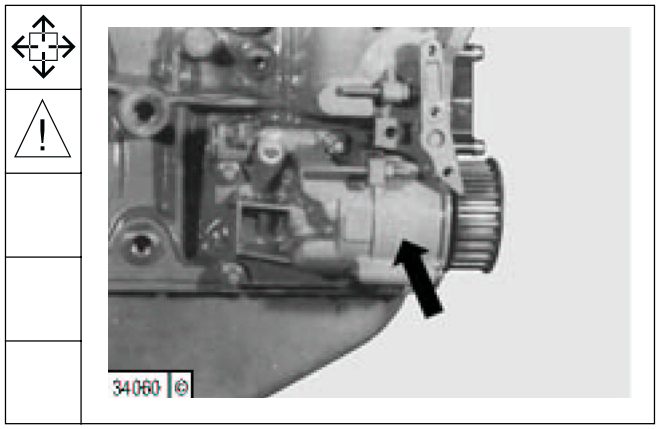


45. Retain multipower tool and loosen central bolt. Take off gears.

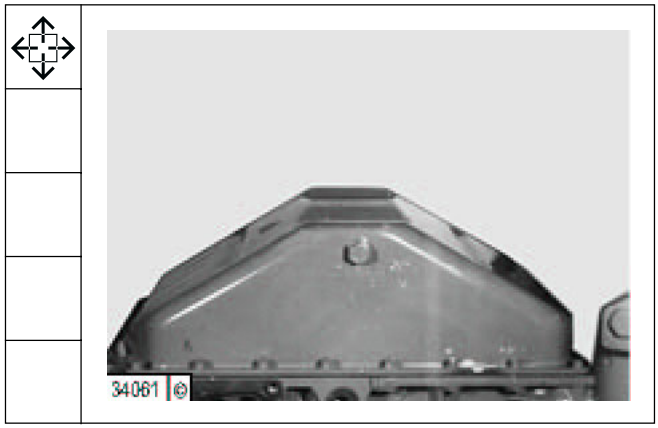


46. Remove lube oil pump.

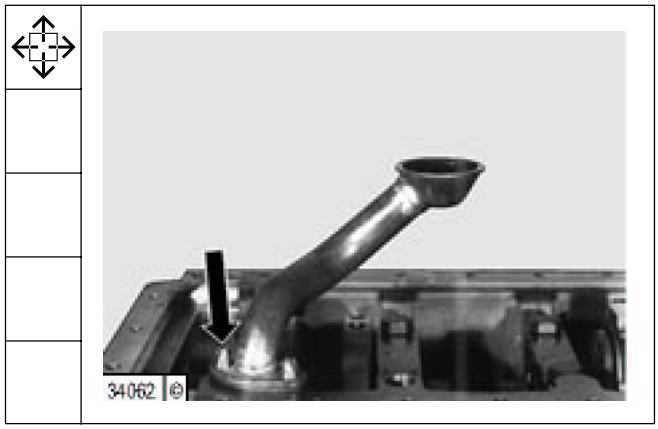
Note: Catch any escaping oil and dispose of in accordance with anti-pollution regulations.



47. Turn engine by 180°. Take off oil pan.

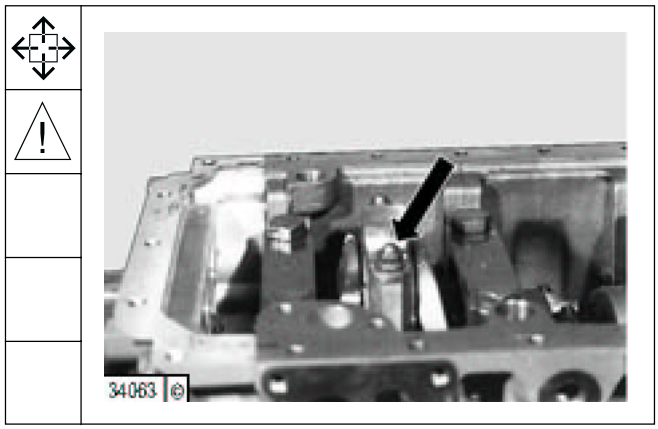


48. Remove oil suction pipe.

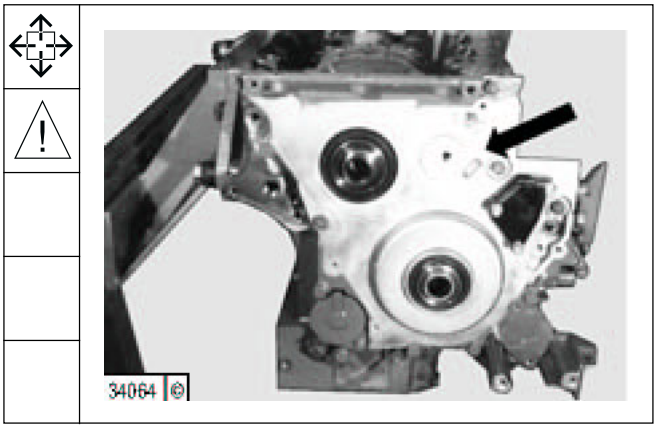


49. Remove piston complete with connecting rod.

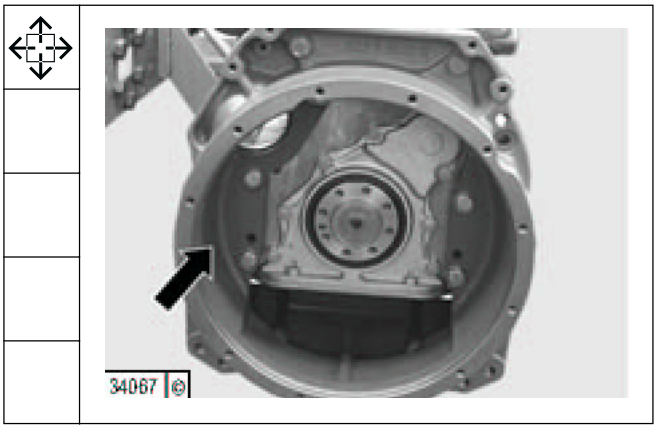
Note: Loosen conrod nut with **dodecagonal** socket wrench.



50. Take off front cover.

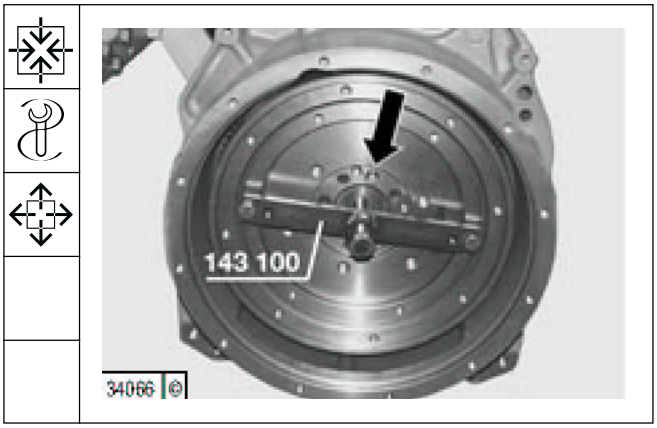


51. Loosen the flywheel screws and remove them.

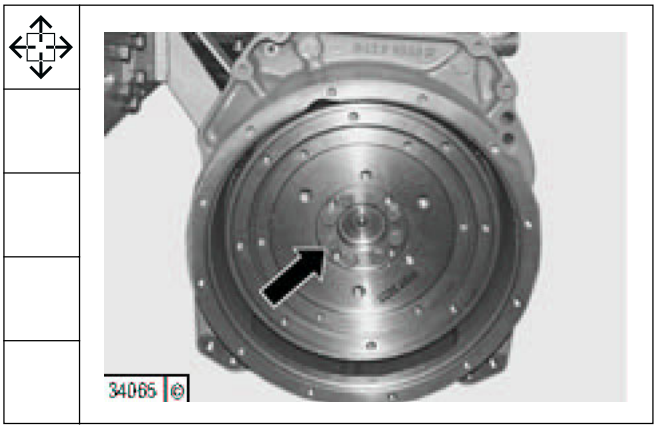


52. Remove the flywheel.
If flywheel is stuck, fit flywheel puller.
Press off flywheel.

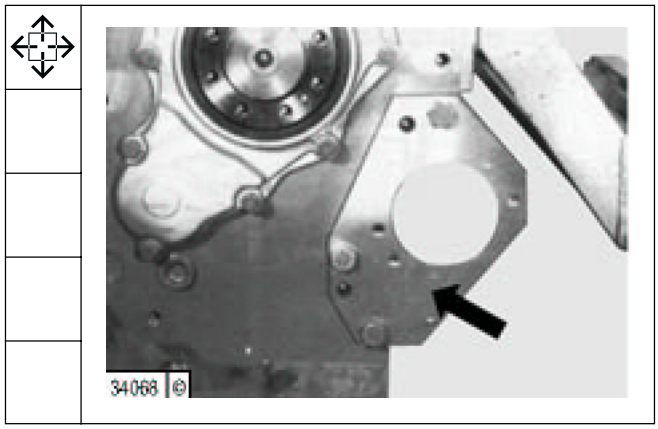
Note: Use self-made pilot bar.



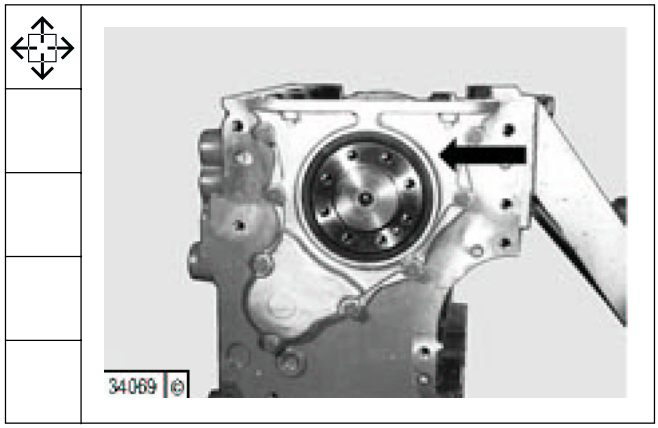
53. Disassemble the connection housing.



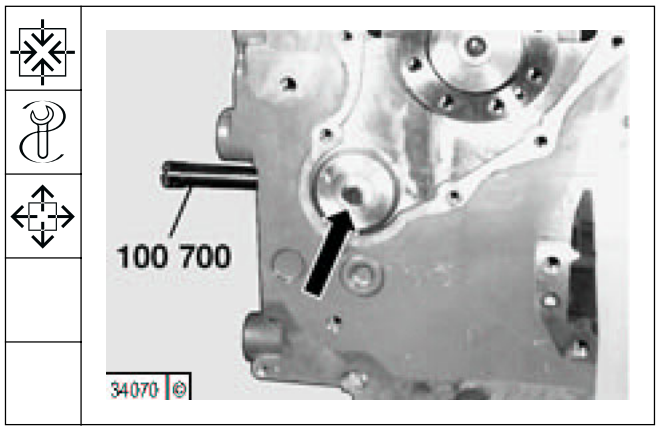
54. n the case of motors without a connection housing, remove the console for the starter.



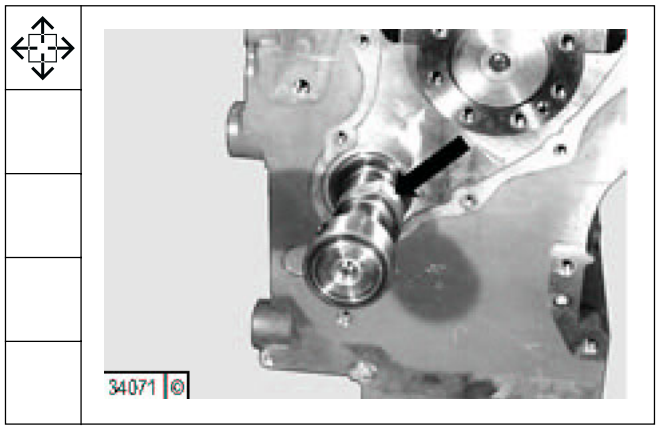
55. Take off rear cover.



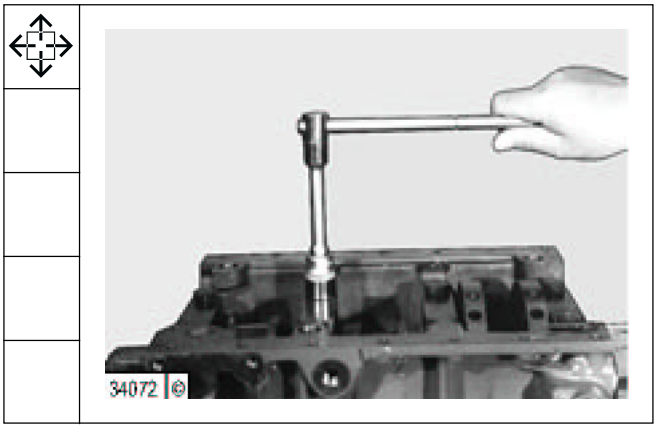
56. Screw in adjusting pin for camshaft.
Take off thrust washer for camshaft.



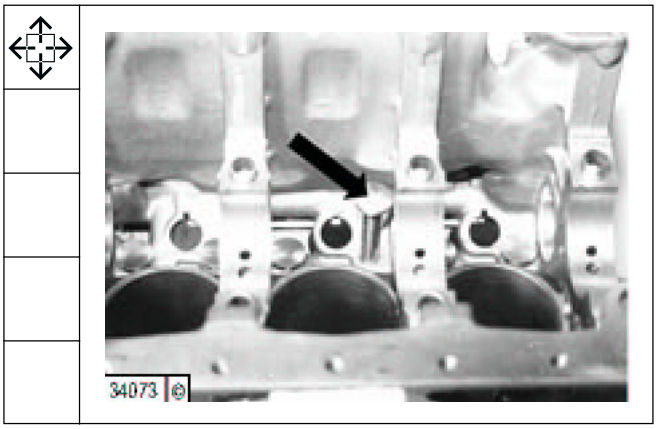
57. Remove camshaft.



58. Remove main bearing caps.
Lift out crankshaft.



59. Take out tappets.



REASSEMBLING ENGINE

Commercial tools required:

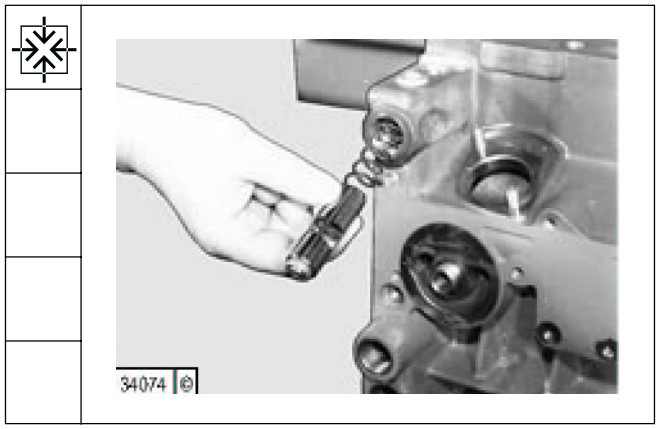
Torx tools 8189
Hose clip pliers 9088
Cobra clamp pliers 8011
V-belt tension gauge 8115
Multipower tool 8049
Socket a/flats 32 8036
Spring clamp pliers 9090
Special bit ..... 9120 or 9122

Special tools required:

Engine assembly stand 6067
Adjusting pin 100 700
Adjusting pin 100 710
Gauge 100 750
Locking wire for injection pump 100 880
Test template for I.P. gasket 103 020
Piston ring compressor 130 630
Dolly 143 420
Intermediate disc 143 430
Dolly for camshaft gear 144 130
Special wrench for oil pressure sensor 170 110

Thermostat

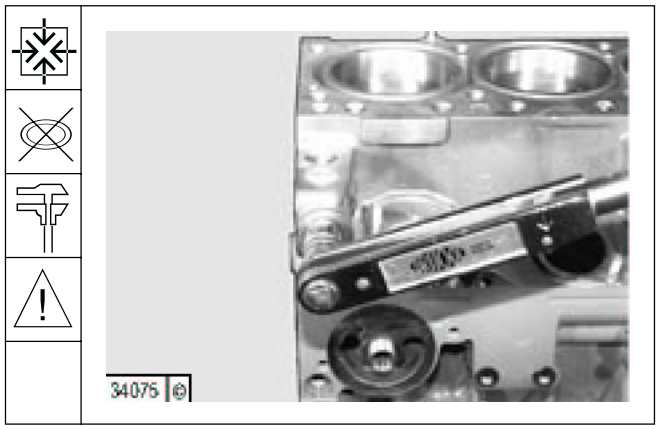
1. Fit thermostat with compression spring.



2. Tighten screw plug with new O-seal.

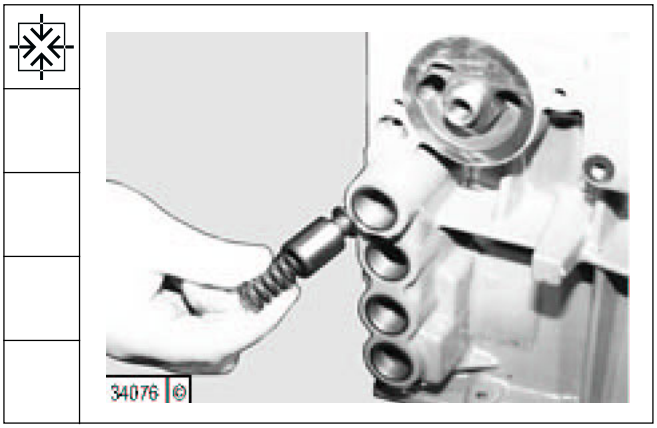
   Tightening specification: **75 Nm**

Note: For fitting the O-seal cover thread with assembly sleeve.



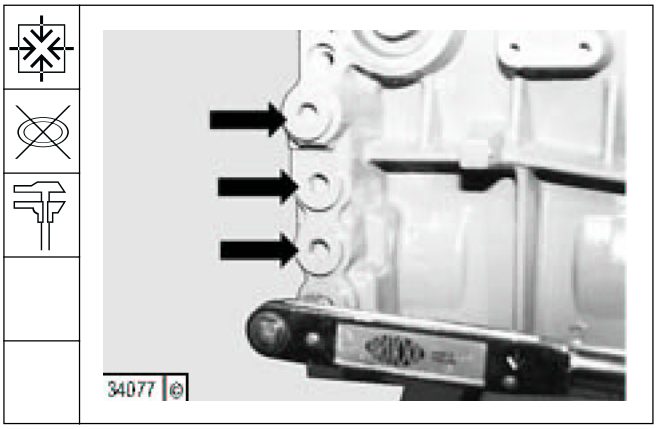
Oil pressure control valve (without heater connection)

3. Fit oil pressure control valve with compression spring (3 bar, green colour marking).



4. Tighten screw plugs with new Cu seals.

   Tightening specification: **111 Nm**

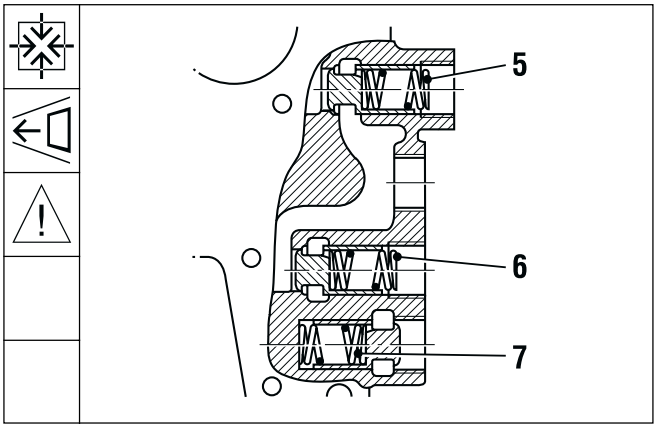


Oil pressure control valve with heater connection (if any)

5. Fit oil pressure control valves with compression springs.

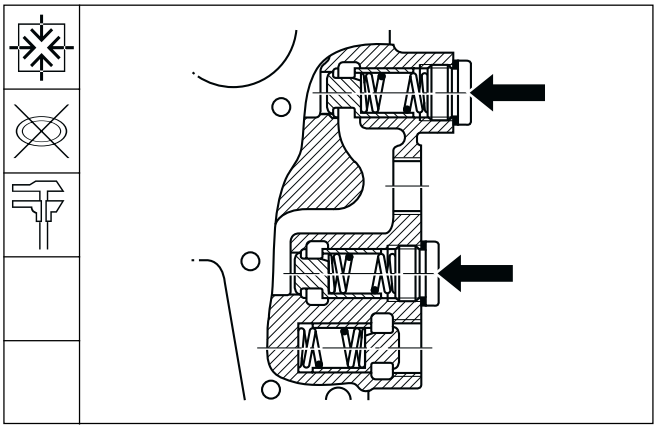
Note: Watch direction of installation of valves and different compression springs.

Item 5, compr. spring 1.0 bar, yellow colour marking
Item 6, compr. spring 1.7 bar, red colour marking
Item 7, compr. spring 0.3 bar, blue colour marking



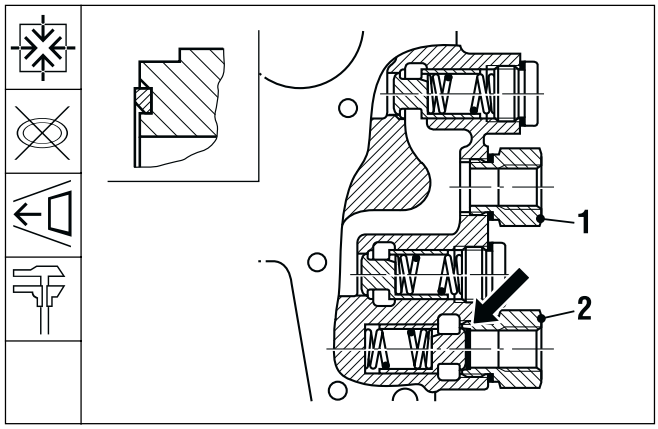
6. Tighten screw plugs with new Cu seals.

   Tightening specification: **111 Nm**



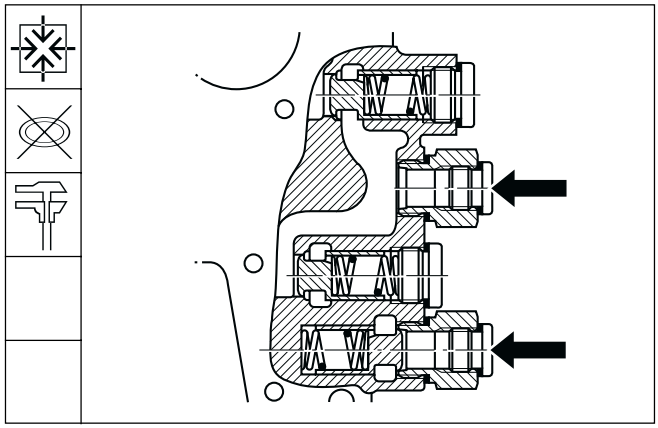
7. Fit O-seals in such a manner to swadged nipples that the spot facing points towards the crankcase. Tighten swadged nipple, item 1, and swadged nipple with valve seat, item 2.

   Tightening specification: **111 Nm ± 11 Nm**



8. Tighten screw plugs with new Cu seals.

   Tightening specification: **50 Nm**

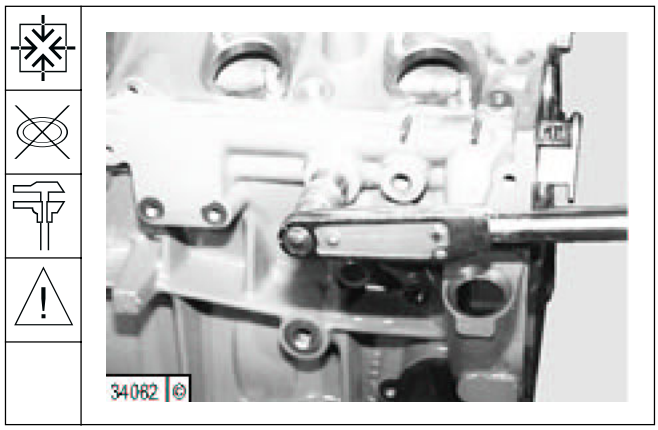


Oil pressure transmitter /-switch

9. Tighten screw plug with new Cu seal.

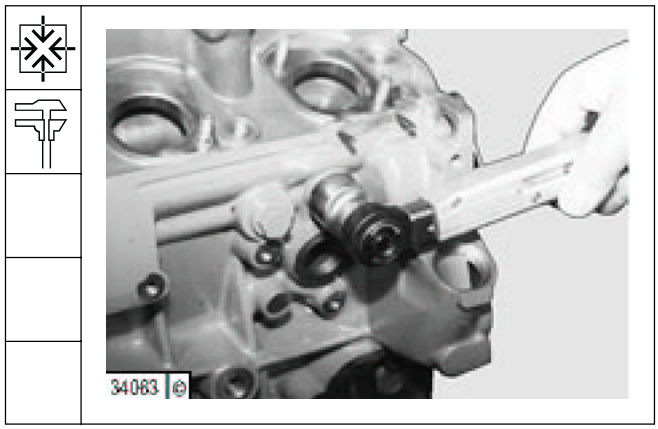
   Tightening specification **50 Nm**

Note: If the oil pressure transmitter is installed: firmly tighten the oil pressure transmitter with a special key.
Tightening regulations **20 ± 2 Nm**



9.1 Tighten oil pressure switch.

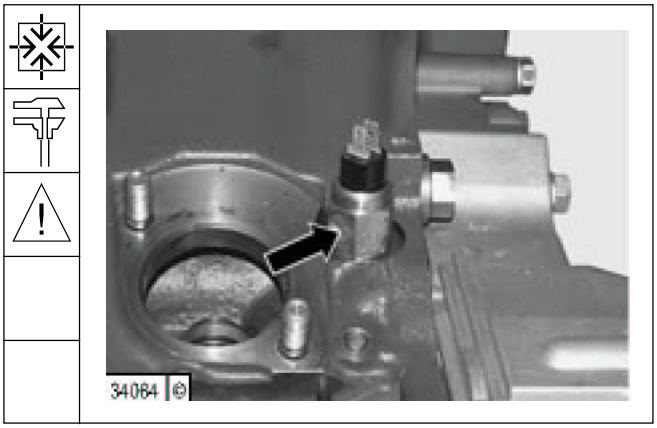
   Tightening specification **13 ± 1.5 Nm**



10. Fit and tighten oil temperature regulator.

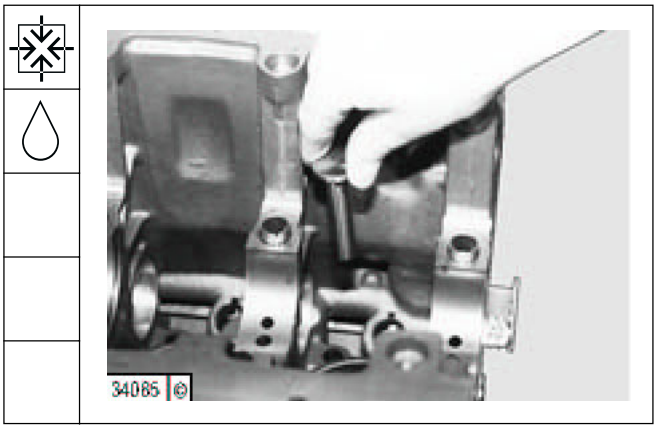
Tightening specification: **25 ± 2.5 Nm**

Note: In the case of motors without oil temperature regulator. Firmly tighten the locking screw with a new Cu seal ring.
Tightening specification: **28 Nm**

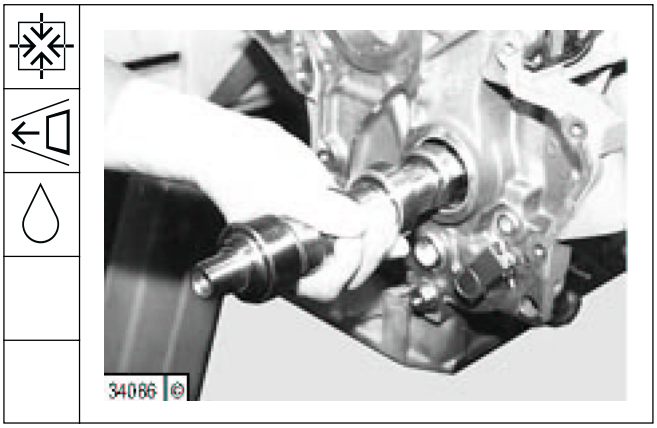


Tappets/camshaft

11. Insert tappets.

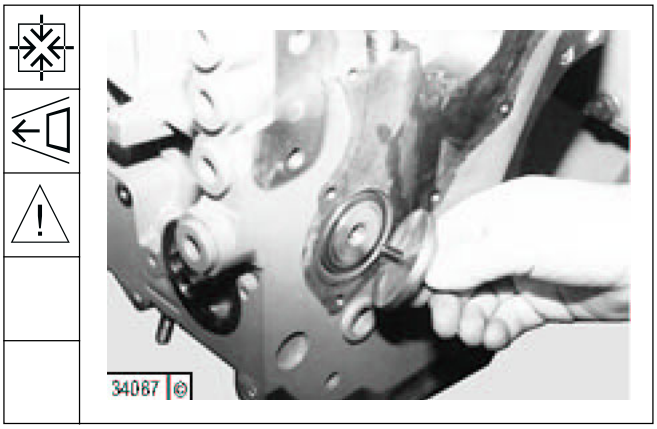


12. Introduce camshaft.



13. Fit thrust washer.

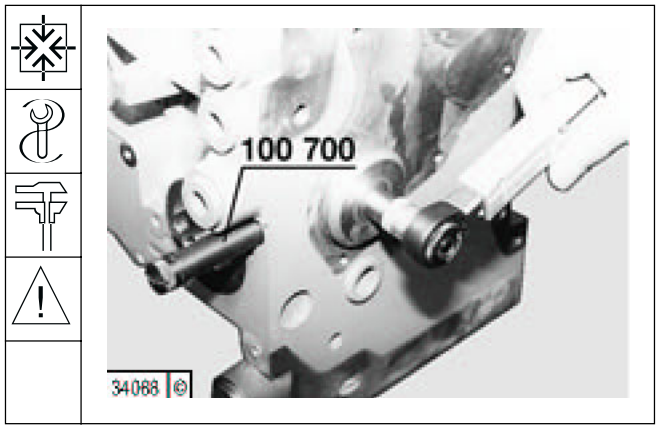
Note: Lubricating groove of thrust washer must face crankcase.



14. Screw in adjusting pin for camshaft.
Tighten bolt.

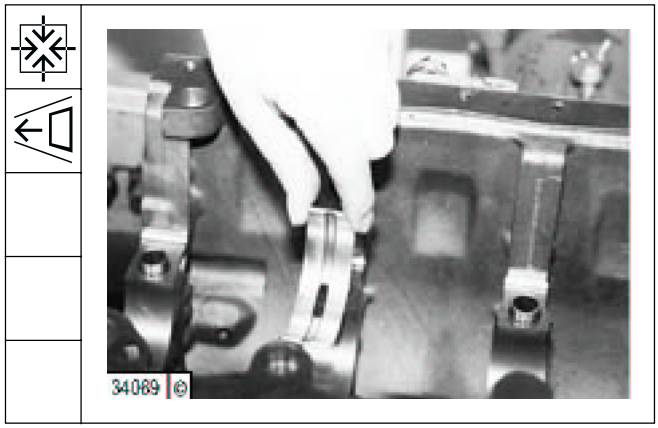
Tightening specification: **21 Nm**

Note: Unscrew adjusting pin again.

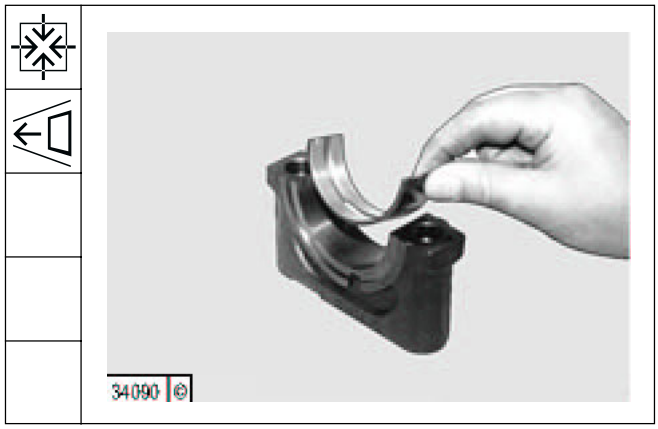


Crankshaft bearings

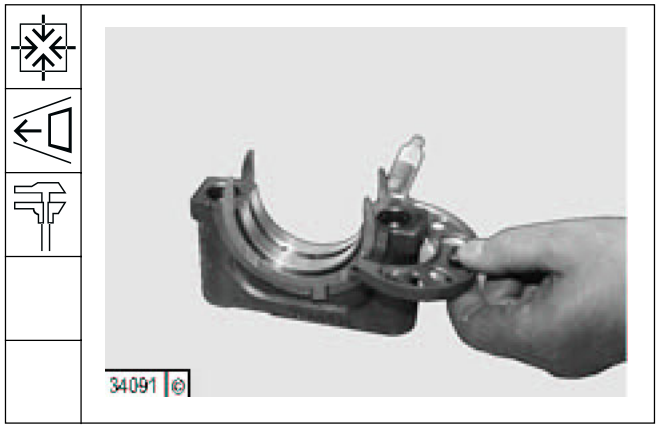
15. Insert bearing shells.



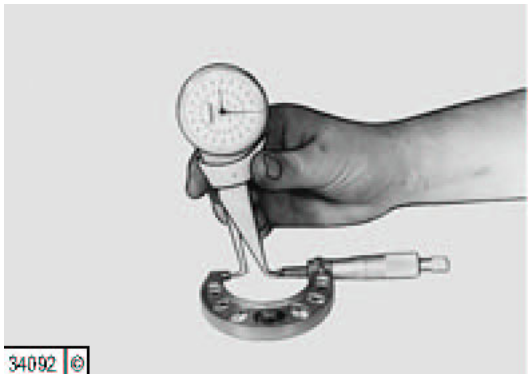
16. Insert bearing shells in main bearing cap.



17. Fit thrust washers to thrust bearing cap and gauge width.



18. Set internal dial gauge to 35 mm.



19. Gauge thrust bearing journal width of crankshaft.

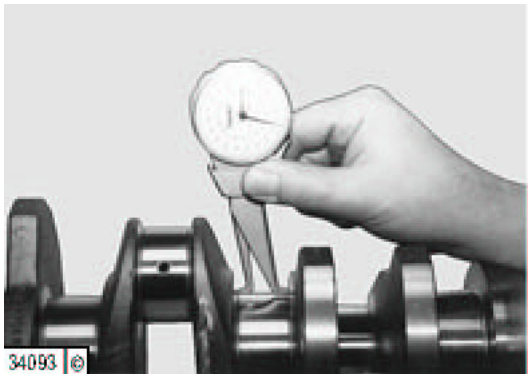
Determine axial play.

Journal width standard: **35 + 0.04 mm**

Each oversize: **0.40 mm**

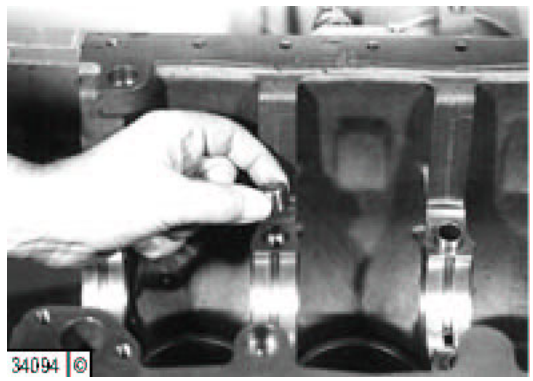
Limit for oversize: **35.44 mm**

Axial play:
standard: **0.1 - 0.273 mm**
wear limit: **0.4 mm**

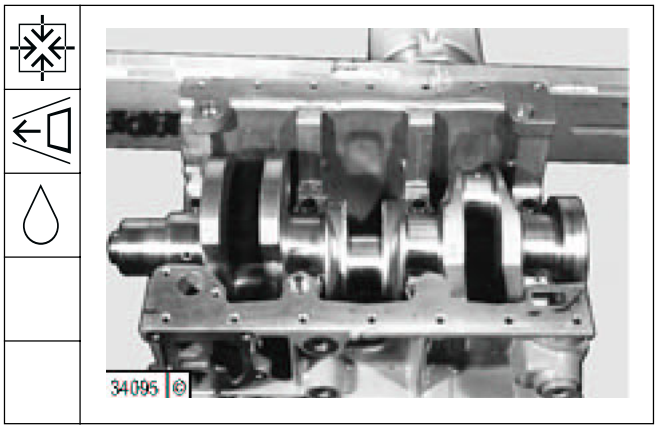


Note: Use new thrust washers if necessary.

20. Insert locating sleeves.

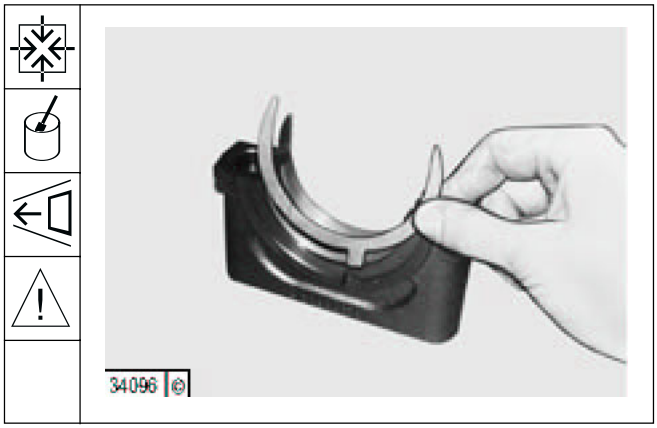


21. Introduce crankshaft.



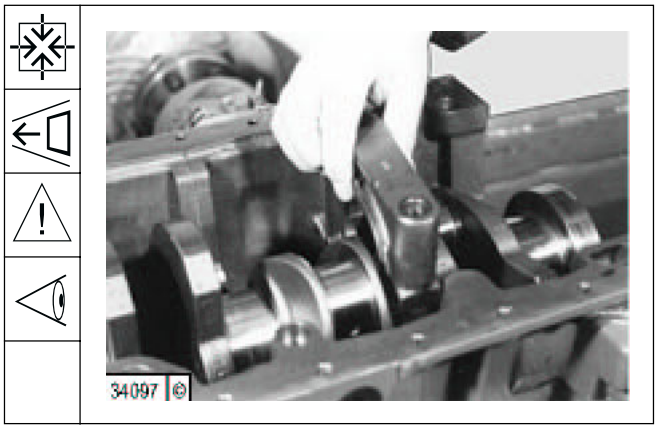
22. Stick half thrust washers with lug to thrust bearing cap using some grease.

Note: Running layer of thrust washers must face crankweb.

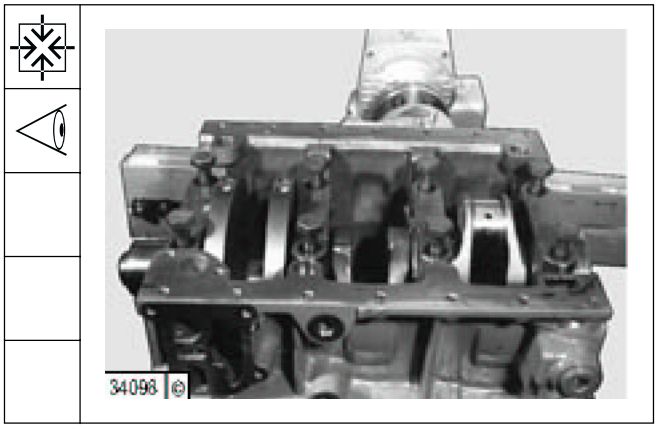


23. Mount thrust bearing cap.

Note: Bearing cap No. 1 at flywheel end. Chamfer must point towards flywheel end.

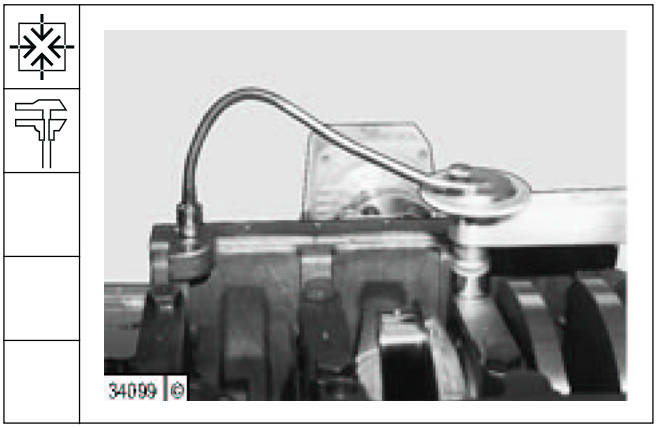


24. Mount bearing caps, paying attention mto the numbering.



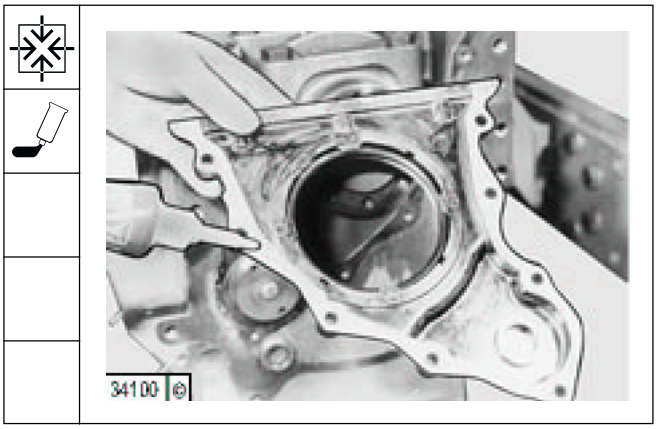
25. Tighten main bearing bolts.

Tightening specification:
Initial tightening torque **50 Nm**
1st tightening angle **60°**
2nd tightening angle **45°**



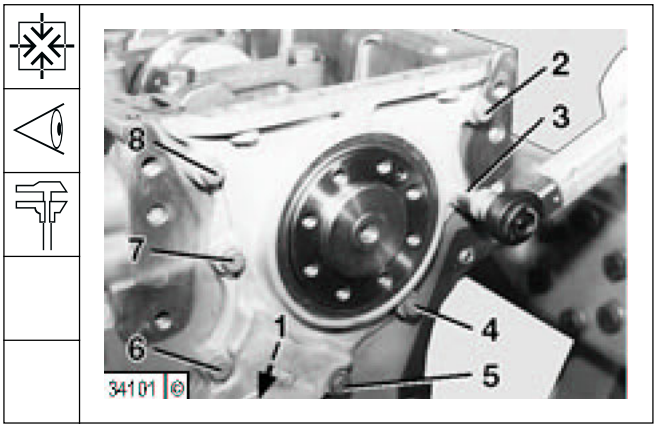
Rear cover

26. Apply sealing compound DEUTZ **DW 67** to rear cover.



27. Remove the cover completely with unlubricated shaft seal ring.
Align cover relative to oil pan sealing surface. Firmly tighten the srews in the tightening sequence 1 to 8.

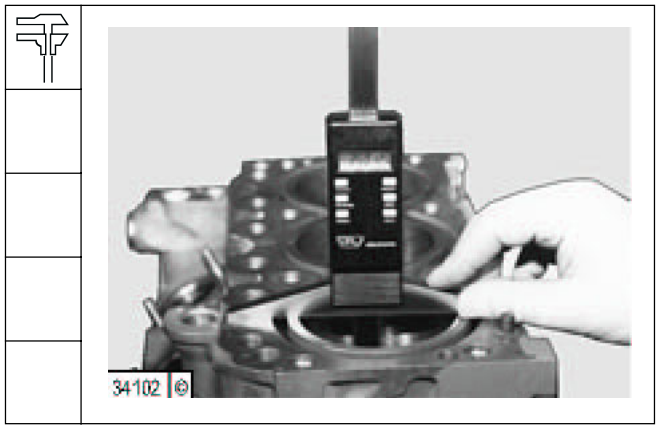
Tightening specification: **21 Nm**



Determine the piston class.
(Only FL and FM engines)

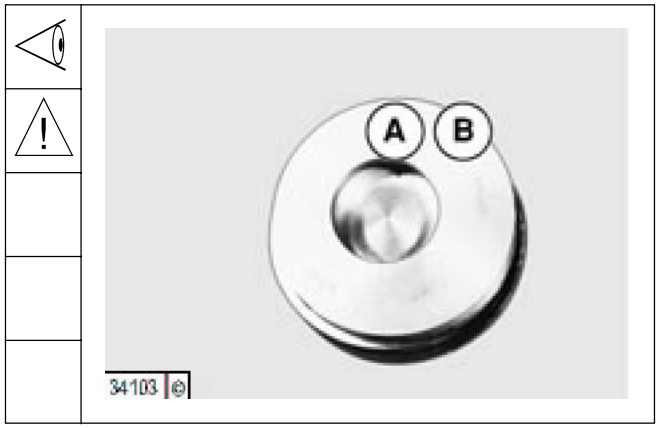
28. Gauge on every cylinder distance between top edge of crankpin in TDC and cylinder head sealing surface.

FL/M 2011	Piston
specified dimension x	class
x1 = **196.390 - 196.49**	A
x2 = **196.491 - 196.69**	B



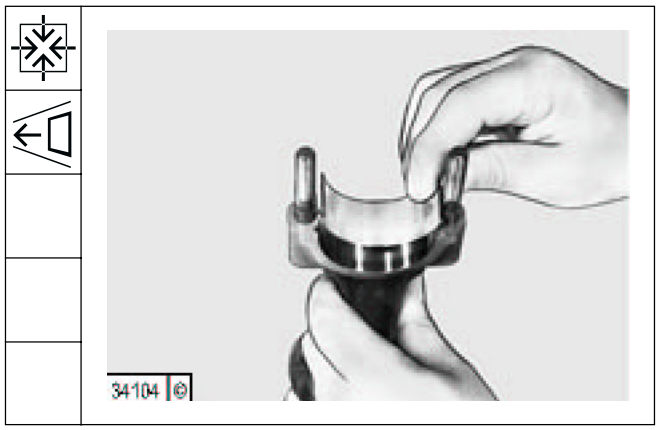
28.1 Compare actual dimension with the specified dimensions in the table.
Select piston class per cylinder. See Chapter. 3.

Note: In the case of crankshaft undersizes, **0.125 mm** must be added to the dimension indicated in the table.

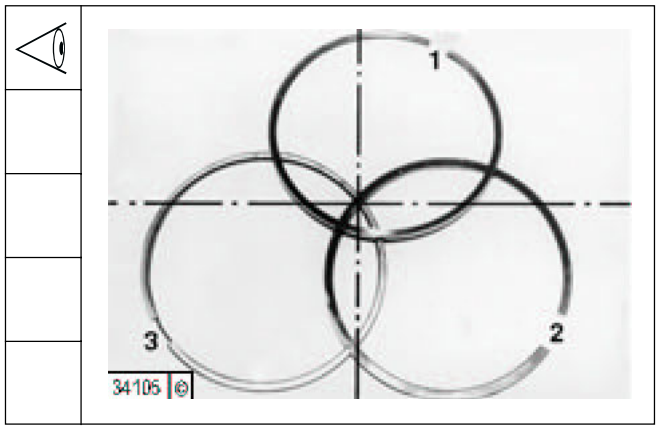


Piston with a connecting rod

29. Insert bearing shells into connecting rod.

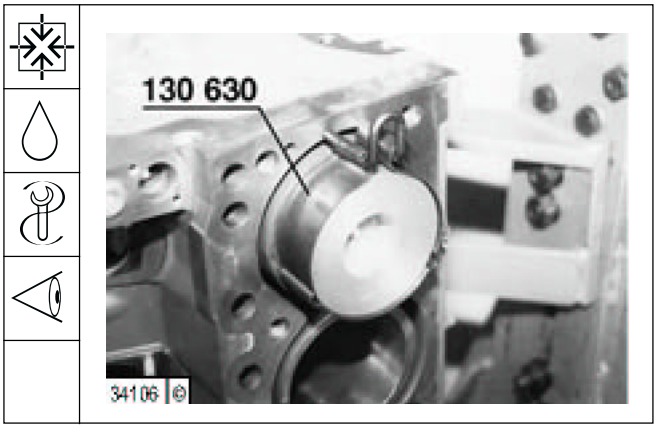


30. Piston ring gaps must be staggered.



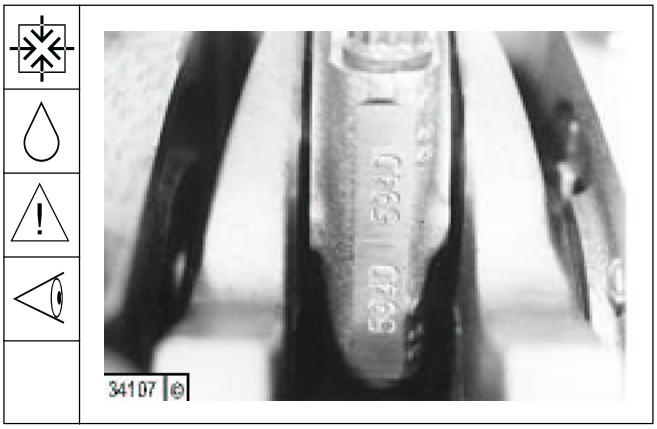
31. Introduce piston complete with connecting rod into crankcase with integrated cylinders.

Note: Flywheel symbol must point towards flywheel.



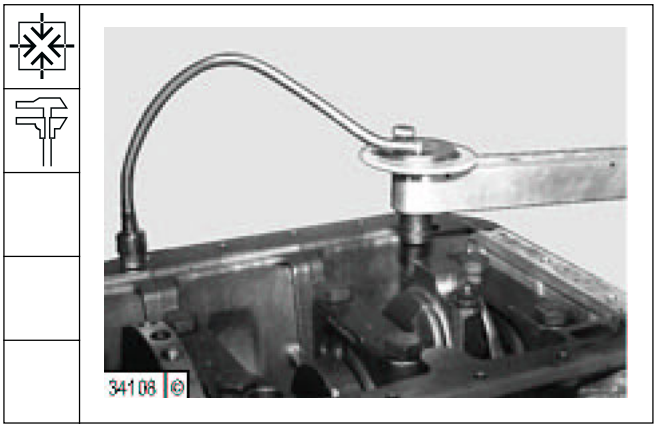
32. Press connecting rod against crankpin. Fit pertinent big end bearing cap.

Note: Conrod bolts may be used max. **5 x** if evidence can be provided concerning their use.



33 Tighten conrod nuts with **dodecagonal socket wrench**.

Tightening specification:
Intitial tightening torque **30 Nm**
1st tightening angle **60°**
2nd tightening angle **60°**



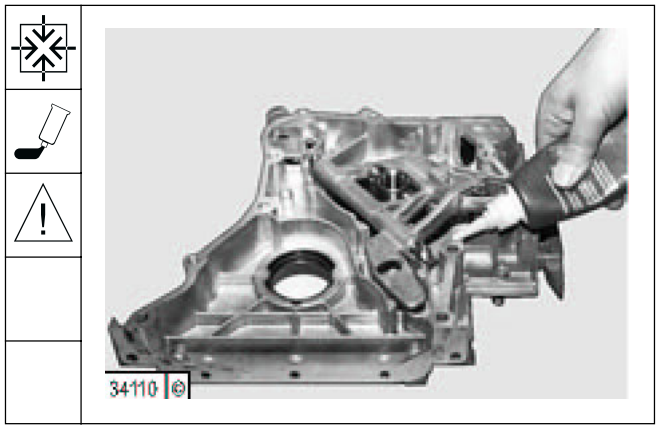
34. Check that connecting rods can be easily moved back and forth on the crankpin.



Front cover

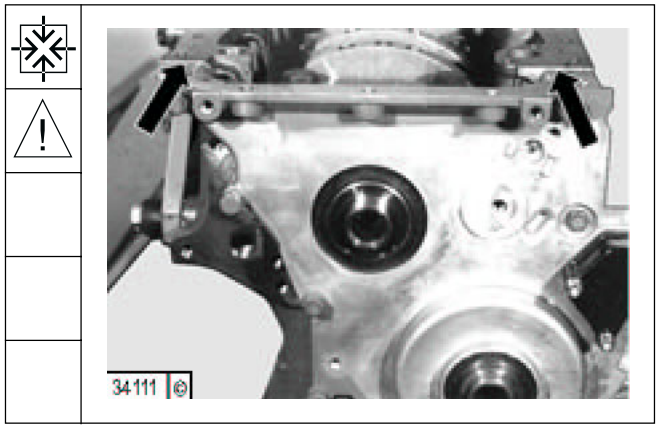
35. Apply sealing compound DEUTZ **DW 67** to front cover sealing surface.

Note: Camshaft/centrifugal governor connection must be clean and free of oil.



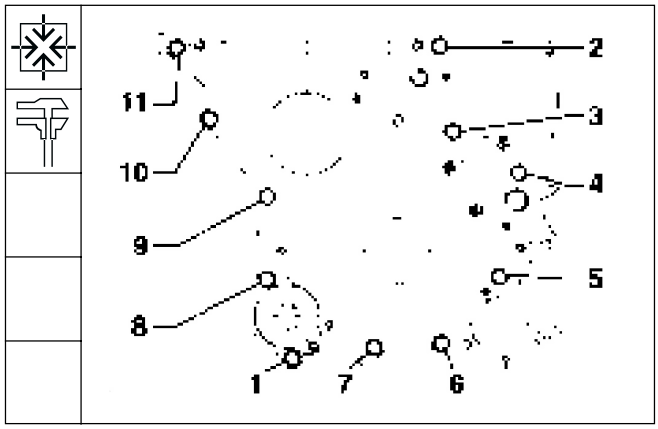
36. Mount completely the front cover with unlubricated shaft seal rings and align it to the oil trough sealing surface.

Note: When fitting cover pay attention to crankshaft seal.



37. Firmly tighten the screws in the tightening sequence 1 to 11.

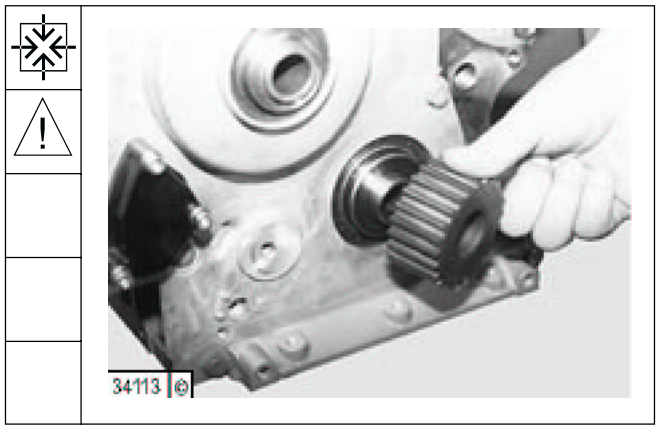
Tightening specification: **21 Nm**



Crankshaft toothed belt gear

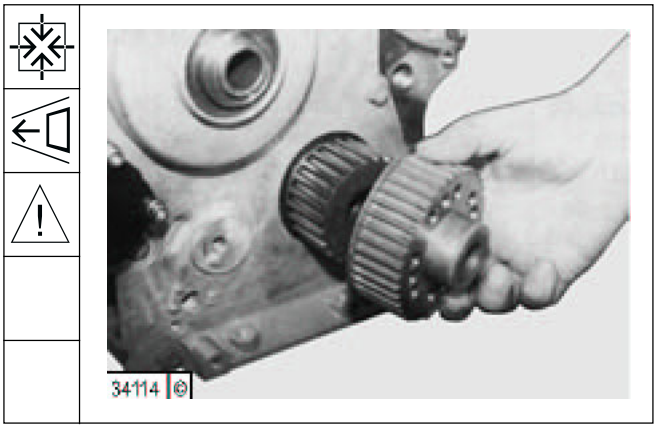
38. Slide on crankshaft toothed belt gear.

Note: All connecting surfaces must be clean and free of oil.

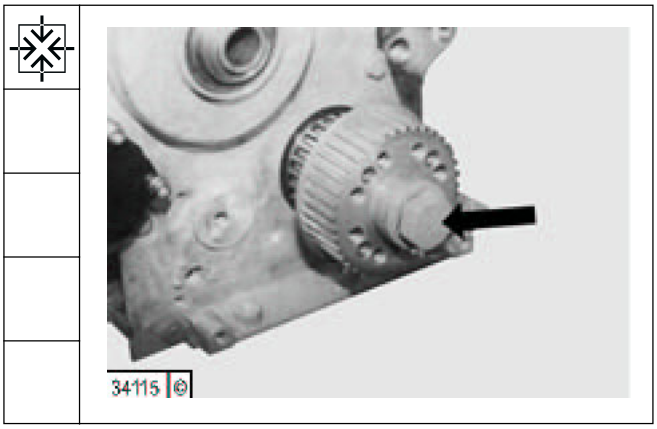


39. Insert crankshaft toothed belt gear for hydraulic pump, if any, in centering.

Note: If no hydraulic pump is mounted, a spacer is used instead of the gear.

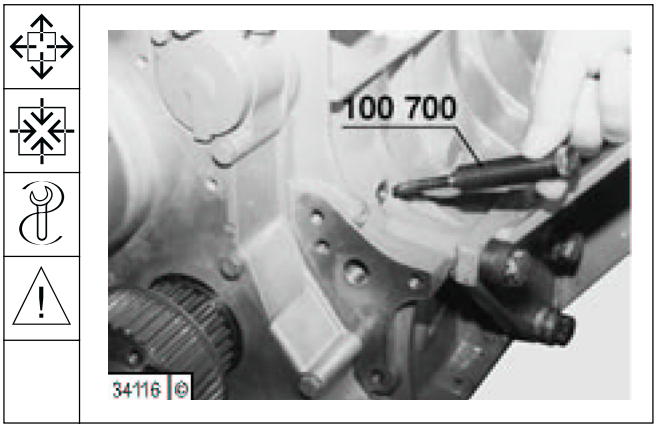


40. Start central bolt.



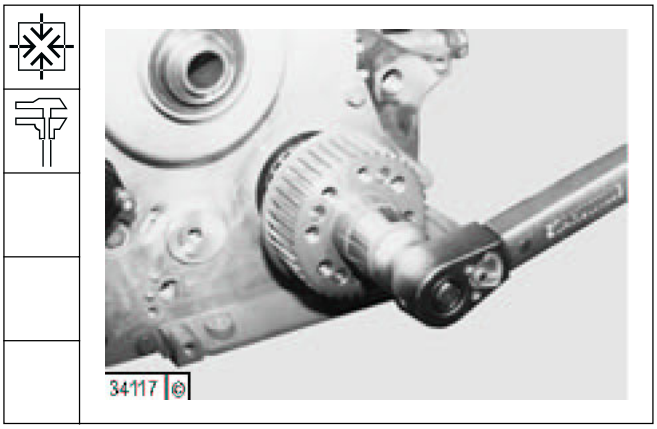
41. Undo screw plug. Screw in adjusting pin for crankshaft as far as it will go.
Turn crankshaft in clockwise direction against stop.

Note: Piston at front cover is in TDC.



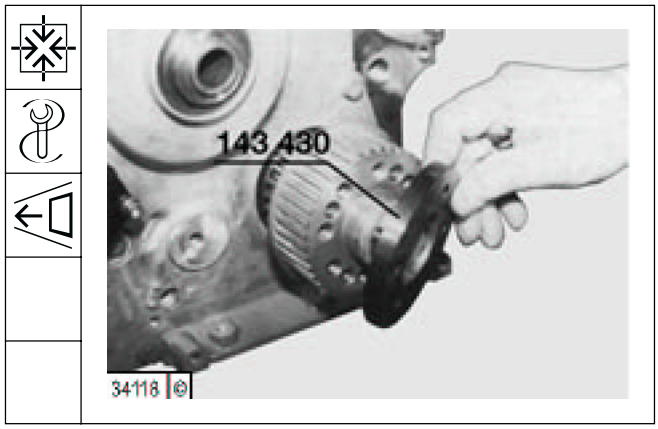
42. Initially tighten central bolt.

Tightening specification: **130 Nm**

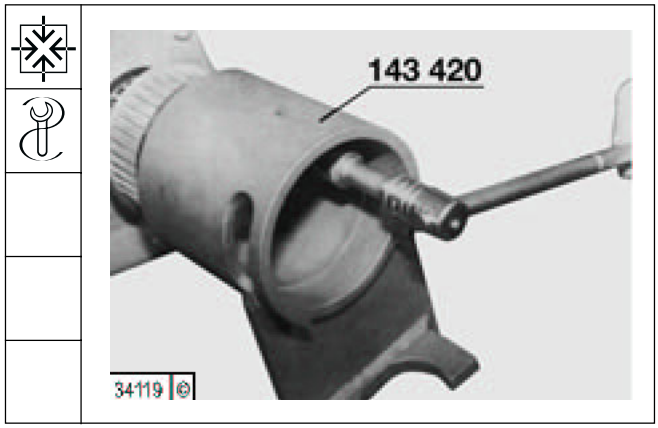


43. Position intermediate disc.

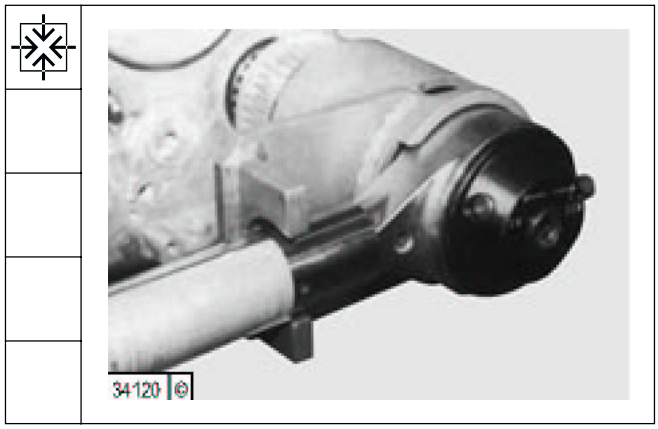
Note: Remove adjusting pin for crankshaft.



44. Fit dolly and tighten.

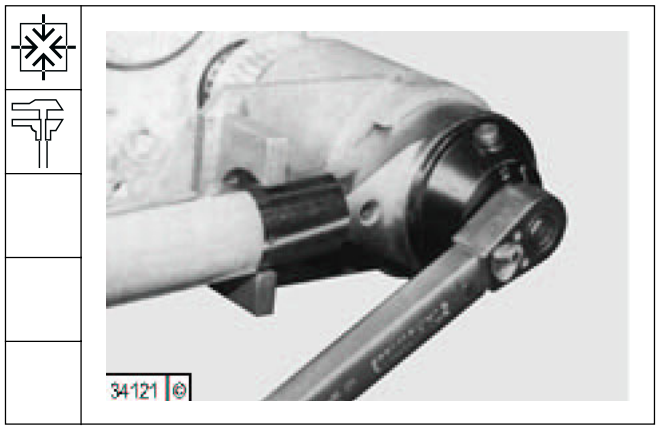


45. Insert multipower tool with socket in dolly.



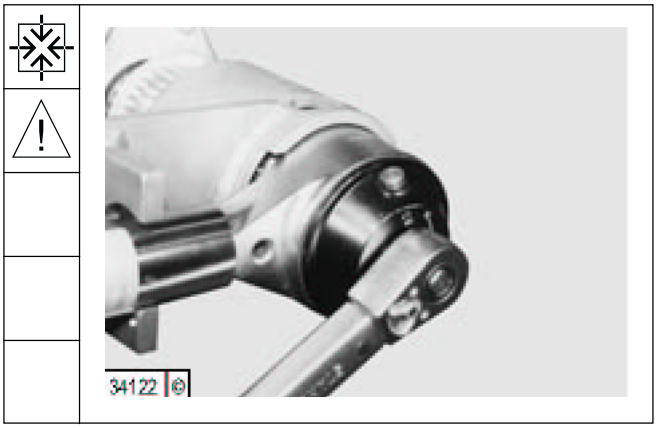
46. Retain multipower tool and tighten central bolt.

Tightening specification: **210**°



47. Depress detent knob. Unload multipower tool. Remove multipower tool, dolly and intermediate disc.

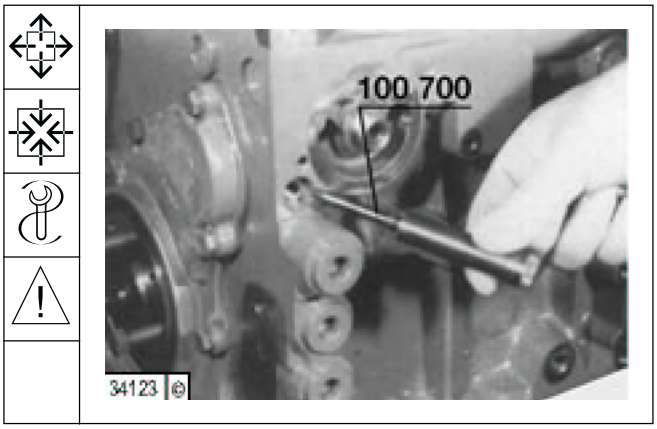
Note: Screw adjusting pin for crankshaft back in again as far as it will go.
Turn crankshaft in clockwise direction against stop. Piston at front cover is in TDC.



Camshaft toothed belt gear

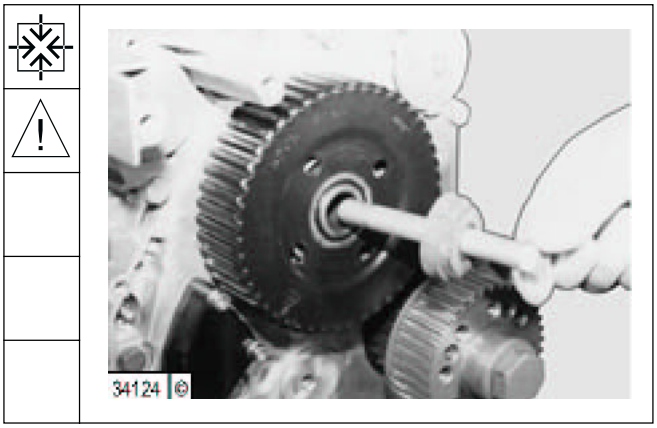
48. Undo screw plug. Screw camshaft adjusting pin into crankcase as far as it will go.

Note: Bore of camshaft must overlap with bore in crankcase.



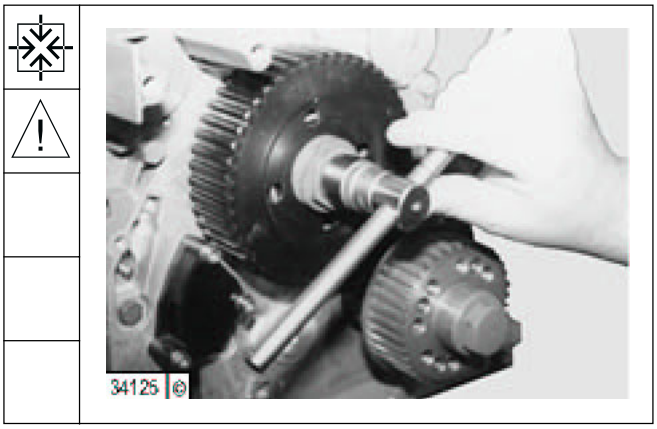
49. Position toothed belt gear, washer and bolt.

Note: All connecting surfaces must be clean and free of oil.



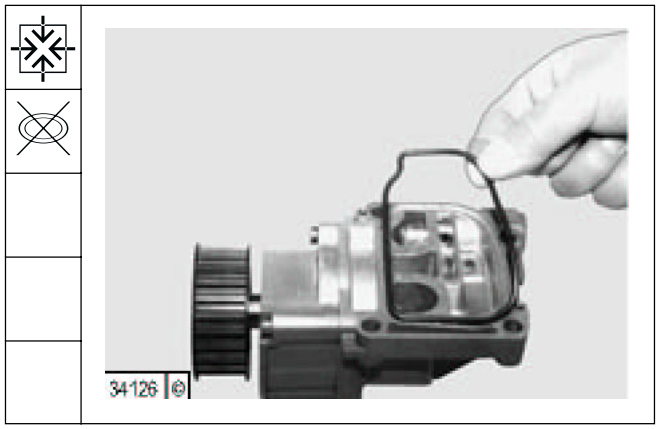
50. Secure camshaft central bolt fingertight.

Note: Camshaft gear must still turn freely.



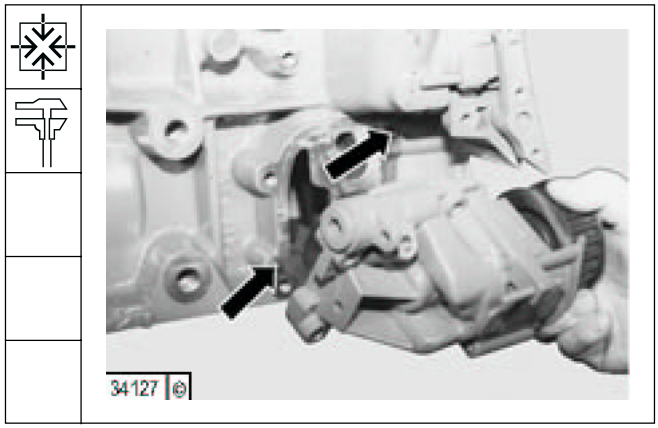
Lube oil pump

51. Position gasket.



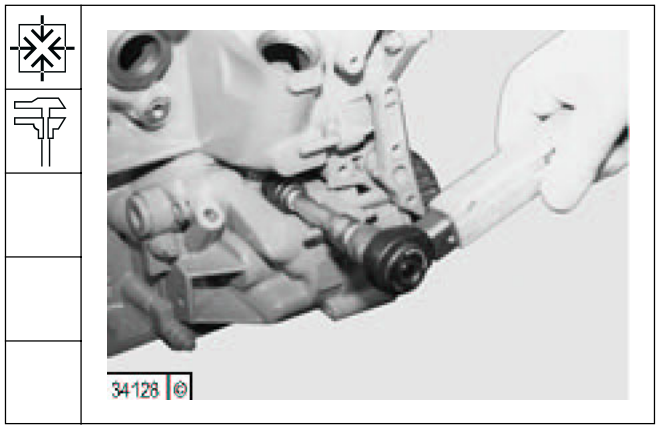
52. Mount oil pump.

Note: Pay attention to dowel sleeves.



53. Tighten bolts.

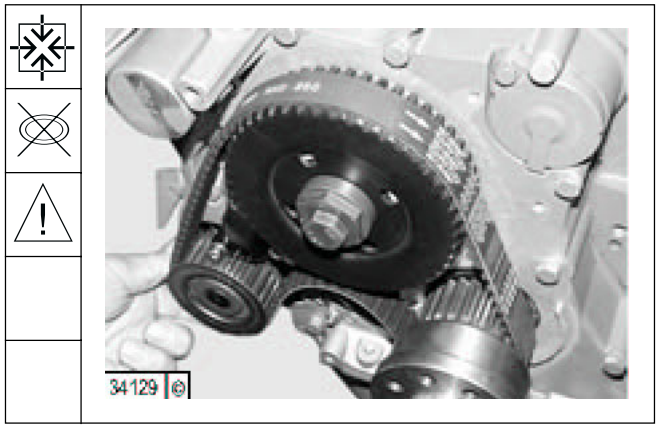
Tightening specification: **21 ± 2.1 Nm**



Toothed belt adjustment

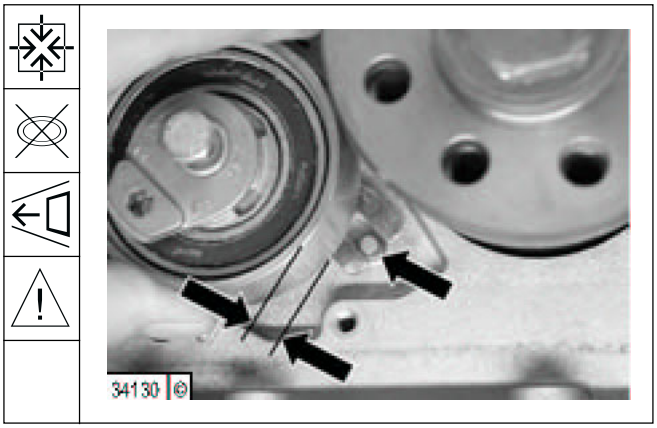
54. Position new toothed belt.

Note: Hold crankshaft against stop while adjusting toothed belt.

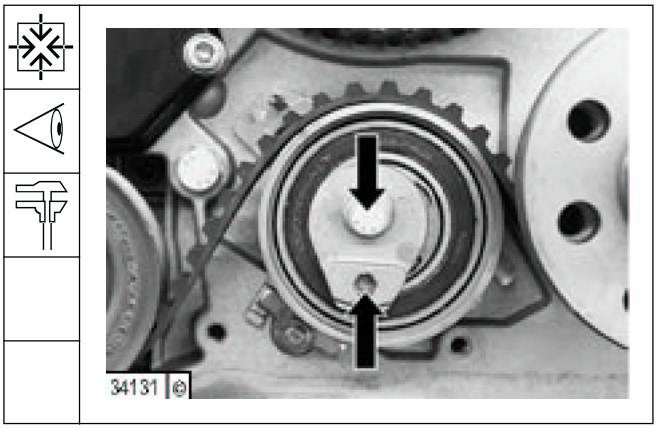


55. Place the new tension roller with the base plate guide clevis onto the guide pin.

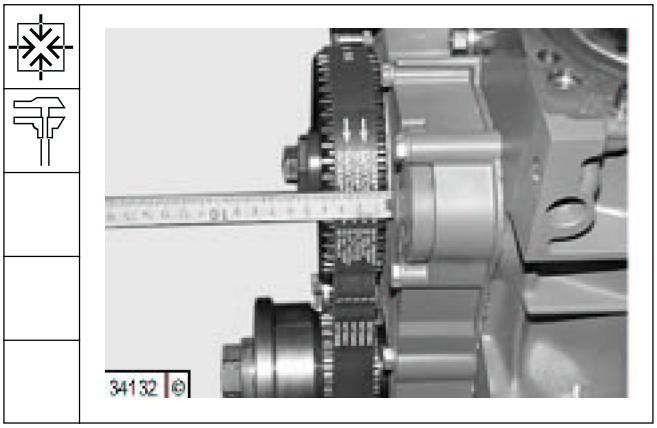
Note: Pay attention to the various tension rollers. Width of the roller for the camshaft drive 30 mm. Width of the roller for the hydraulic pump drive 35 mm.



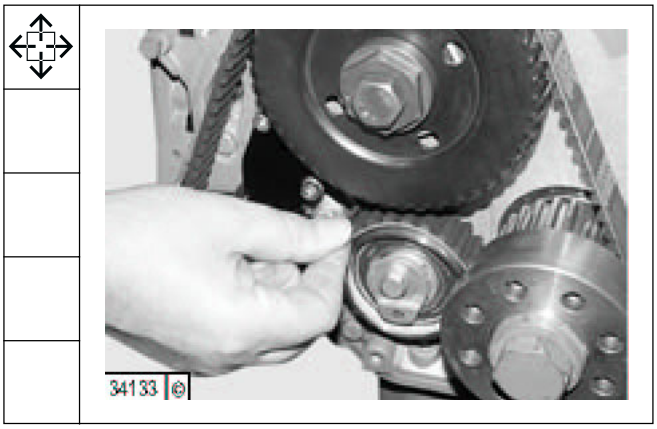
56. Set the eccentric cam arrangement with the hex socket to 6:00 hour position and mount on the tension roller. Pretension the screw with **8 + 2 Nm**.



57. Align toothed belt so as to ensure an equal distance from cover between **8 and 9 mm.**

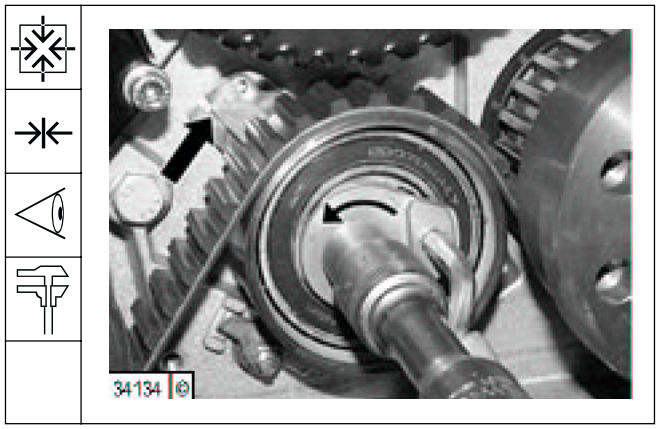


58. Remove the locking pin.



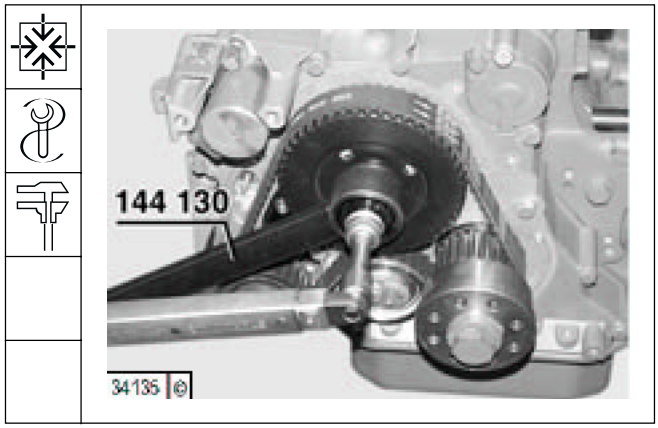
59. Rotate the eccentric cam arrangement with the aid of an Allen key in arrow direction until the pointer corresponds with the groove in the base plate. Firmly tighten the screw.

Tightening specification: **21 ± 2 Nm**



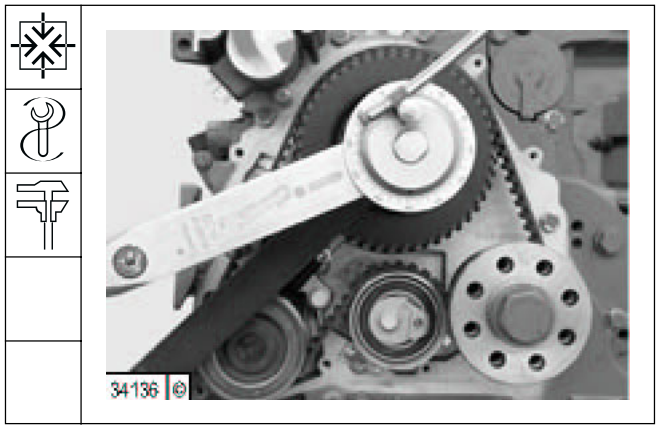
60. Retain centering washer. Initially tighten camshaft central bolt.

Tightening specification: **30 Nm**

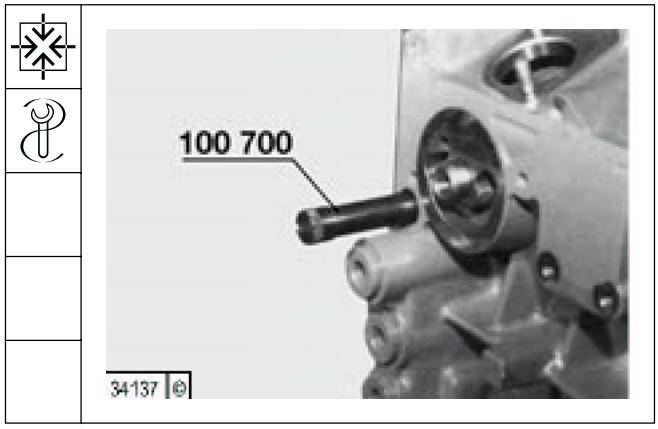


61. Back-up the centering disc, firmly tighten the camshaft central screw.

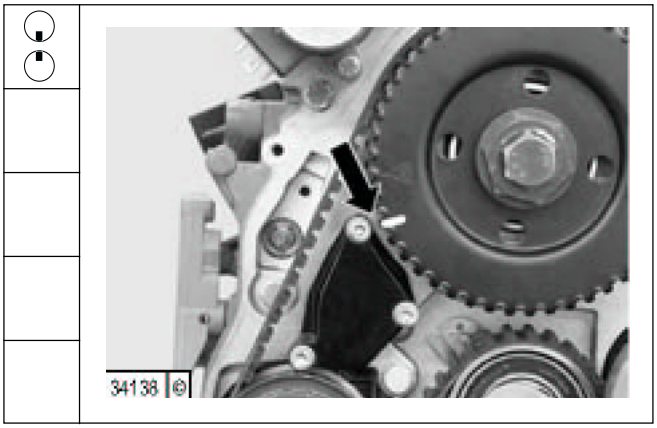
Tightening specification:
Tightening angle **210**°



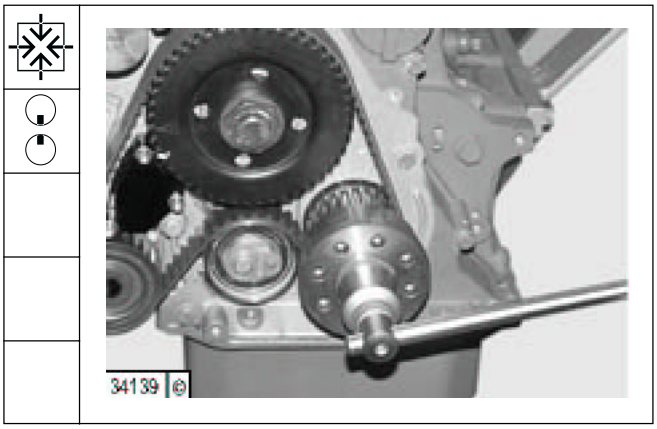
62. Unscrew the adjusting pins for the cam and crankshaft.



63. Mark camshaft gear and opposite bolt.



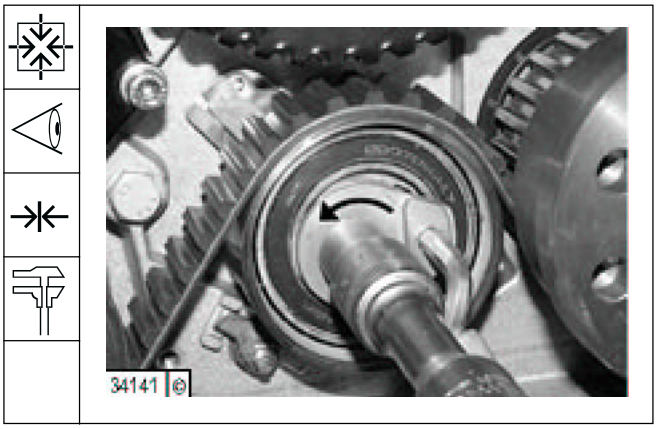
64. Make two complete crankshaft revolutions in direction of engine rotation until marks coincide.



65. Check the position of the pointer.



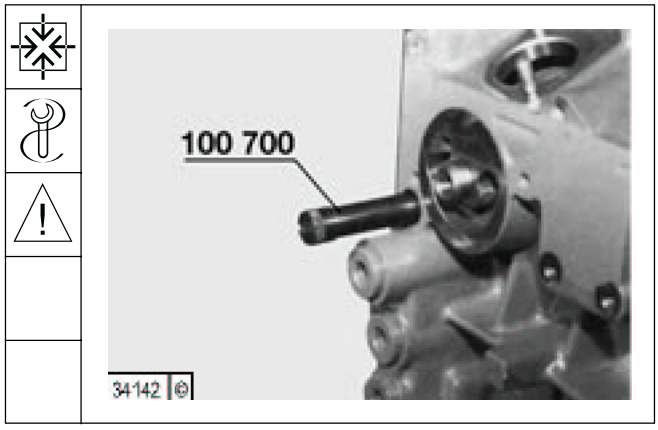
Note: If the pointer does not correspond with the groove, it must be corrected with the eccentric cam arrangement. Loosen the screw and pretension again with **8 + 2 Nm**. Rotate the eccentric cam arrangement with the aid of an Allen key in arrow mdirection until the pointer corresponds mwith the groove in the base plate. Firmly tighten the screw with **21 + 2 Nm**.



Valve timing check

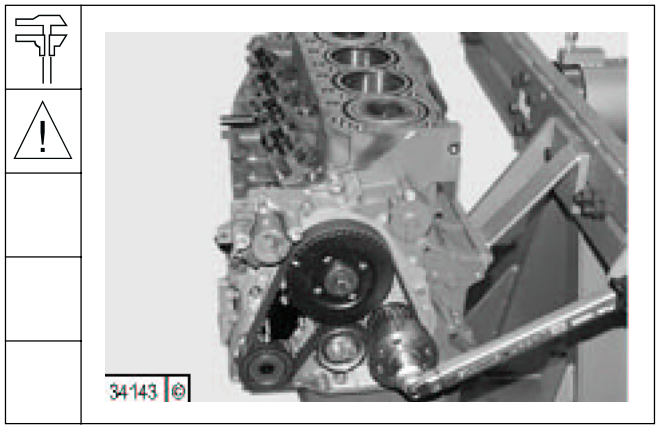
66. Screw camshaft adjusting pin into crankcase as far as it will go.

Note: Bore for camshaft must overlap with bore in crankcase.



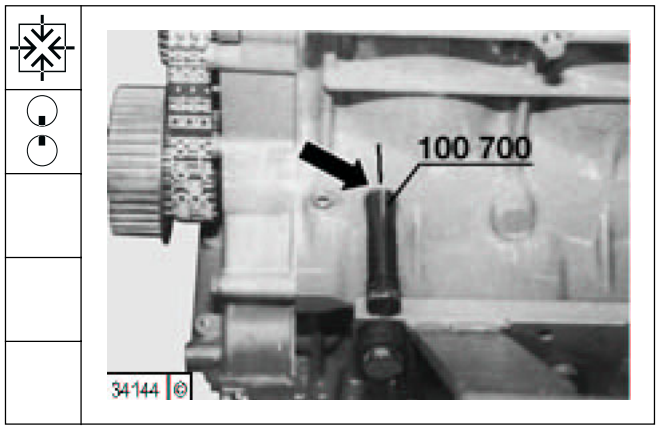
67. Tension the central bolt with the torque spanner in motor direction of rotation with **40 Nm**. Release evenly the torque spanner again, but not abruptly.

Note: Do not change crankshaft position anymore.

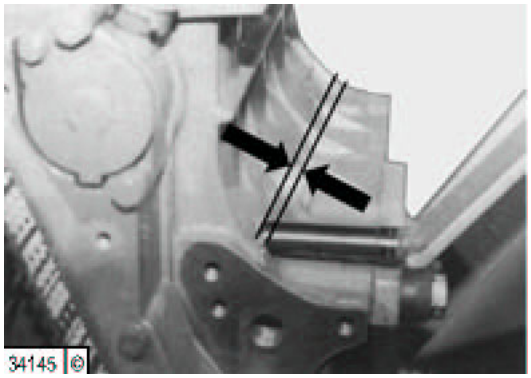


68. Screw in crankshaft adjusting pin until it has slight contact with crankshaft.

Mark position of adjusting pin.

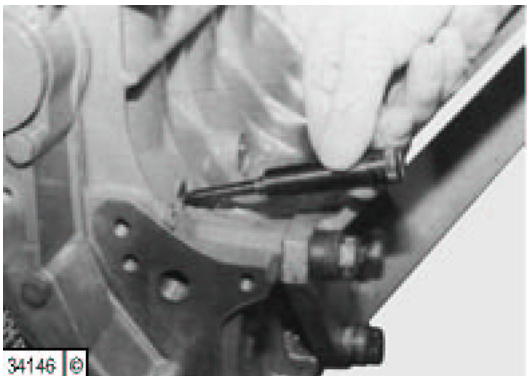


69. The setting is correct when the adjusting pin can still be screwed into the crankcase another **0.75 to 2.25** turns until stop.



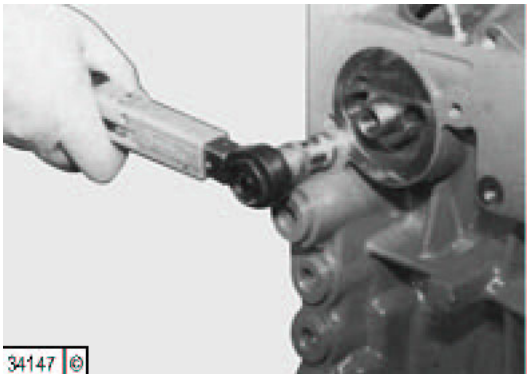
Note: If the adjusting pin cannot be screwed into crankcase over its full effective length, the basic camshaft setting has to be redone. Release camshaft toothed belt gear again for this purpose. Repeat procedure as from point 56.

70. Remove adjusting pins for cam-shaft and crankshaft.



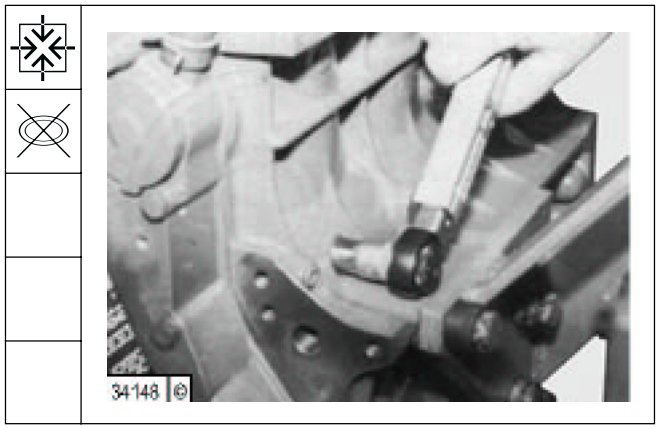
70.1 Tighten screw plug with new Cu seal.

Tightening specification: **18 ± 2 Nm**



70.2 Tighten screw plug with new Cu seal.

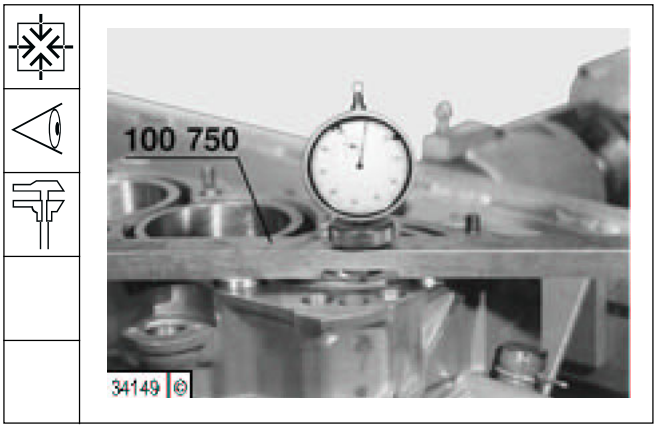
Tightening specification: **18 ± 2 Nm**



Cylinder head

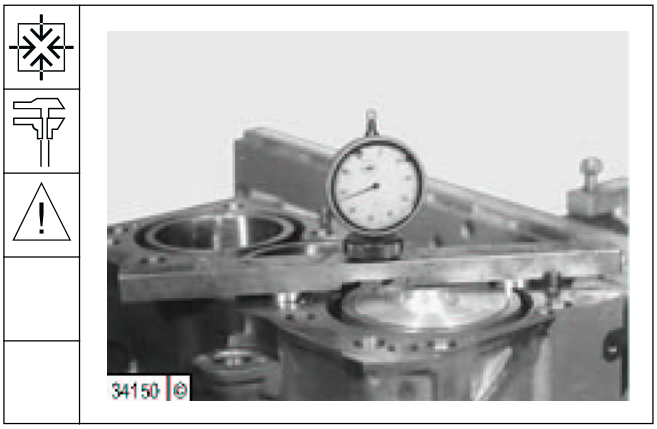
71. Determine cylinder head gasket.

71.1 Place spacers on sealing surface of crankcase with integrated liners and set dial gauge to “0”.

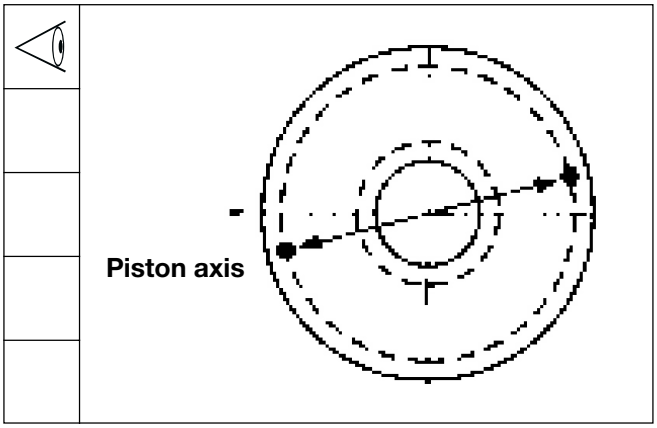


71.2 Position dial gauge on piston at gauge points and determine max. piston projection.

Note: All pistons must be gauged.

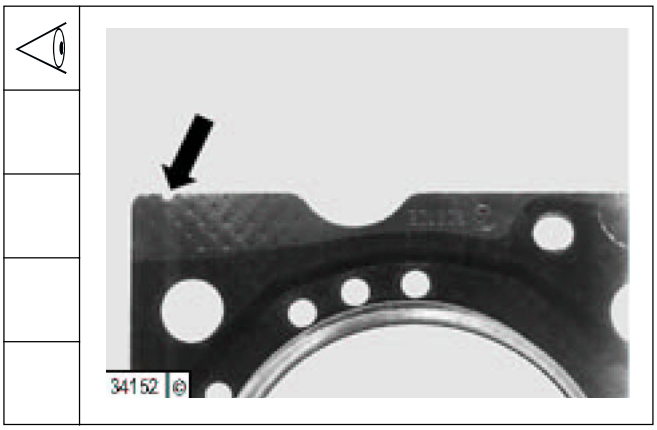


71.3 Pay attention to gauge points.

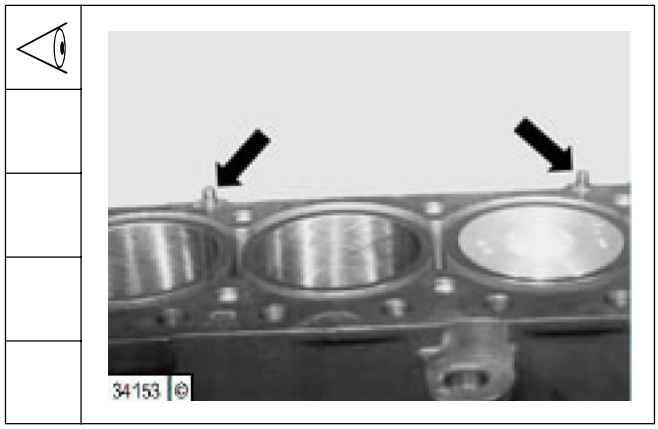


72. Compare max. value with table and determine appropriate cylinder head gasket.

Piston projection	Marking of cylinder head gasket
0.530 - 0.69 mm	1 notch
0.691 - 0.76 mm	2 notches
0.761 - 0.83 mm	3 notches

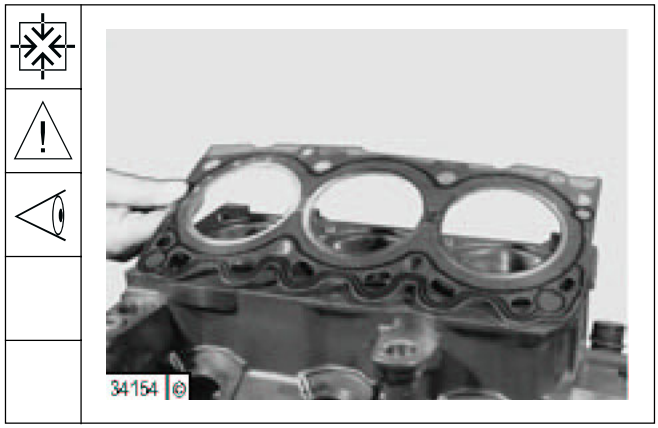


73. Make sure that dowel pins are fitted.



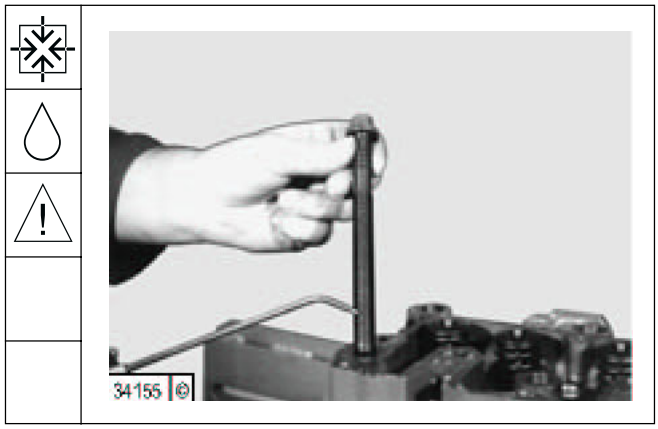
74. Position cylinder head gasket.

Note: Sealing surfaces for cylinder head gasket must be free of oil.



75. Install cylinder head. Oil cylinder head bolts lightly.

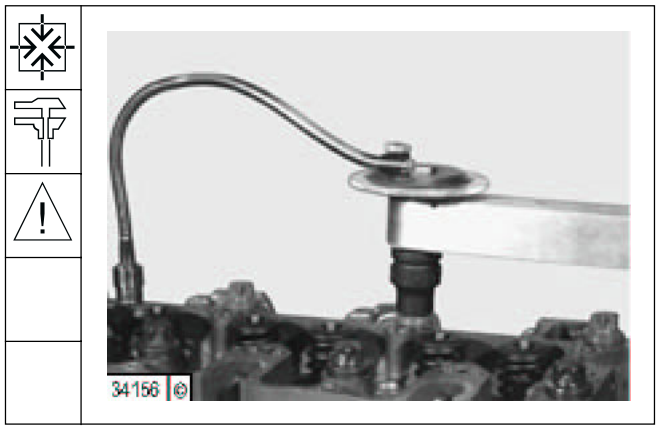
Note: Standard length of cylinder head bolt: **150 ± 0.8 mm**



75.1 Tighten cylinder head bolts.

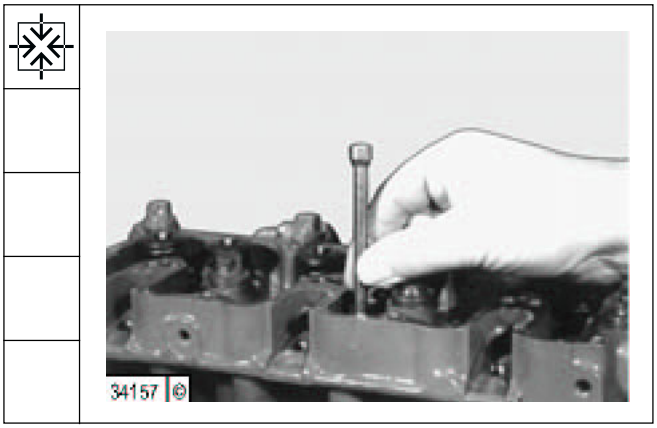
Tightening specification:
Initial tightening torque:
1st stage **30 Nm**
2nd stage **80 Nm**
3rd stage **160 Nm**
Tightening angle: **90°**

Note: Observe tightening order for cylinder head bolts. See Specification Data.

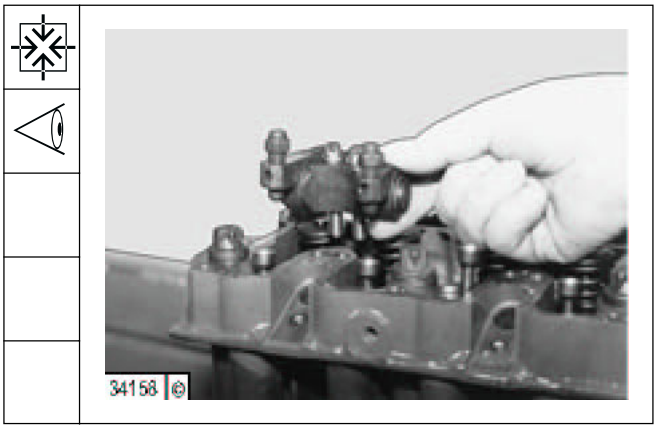


Valve gear

76. Insert pushrods.



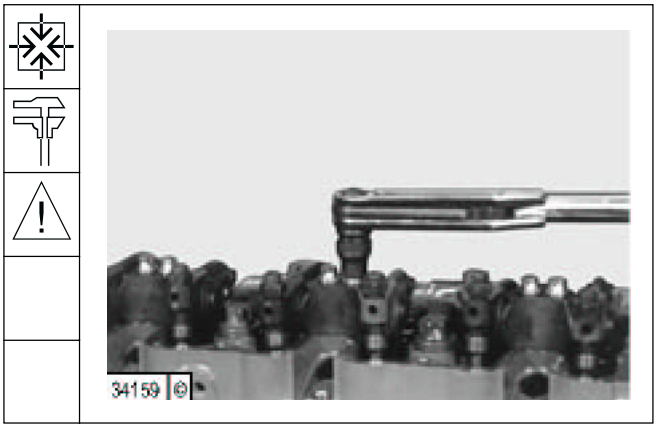
77. Fit rocker arm bracket and align relative to pushrods/valves.



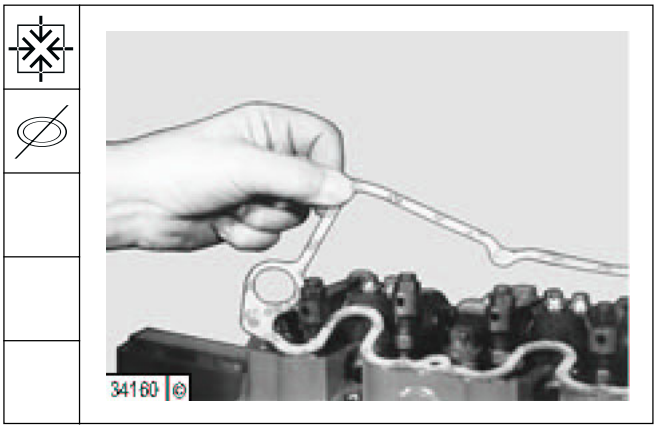
78. Tighten bolts.

Tightening specification: **21 Nm**

Note: Adjust valve clearance - see Chapter 2.

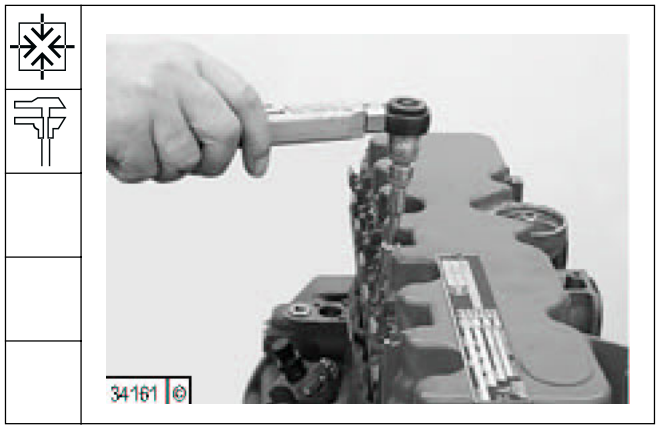


79. Place on gasket.



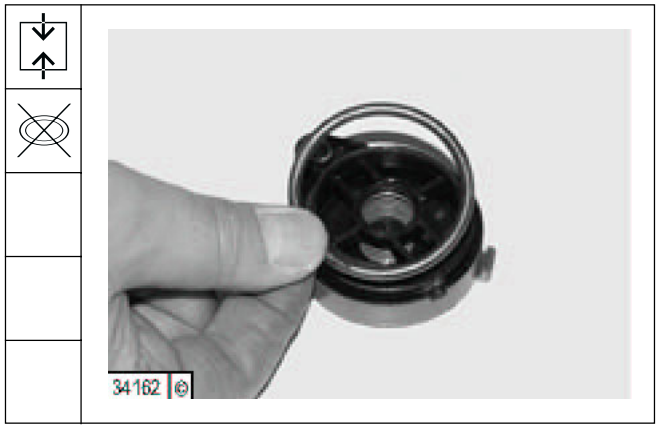
80. Fit cylinder head cover.

Tighten bolts.
Tightening specification: **8.5 Nm**



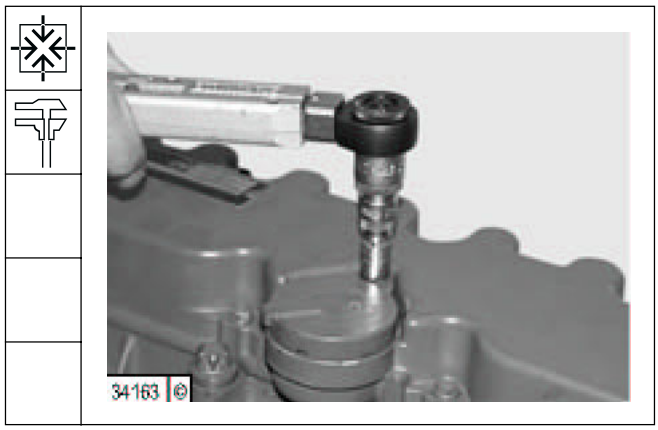
Vent valve
(With BF4L/M motors)

81. Clean the vent valve and mount a new O-ring type sealing ring.



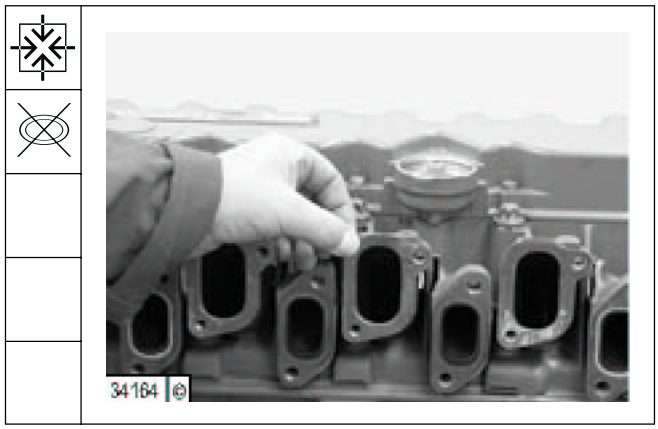
82. Attach a vent valve. Firmly tighten the screw.

Tightening specification: **8.5 Nm**



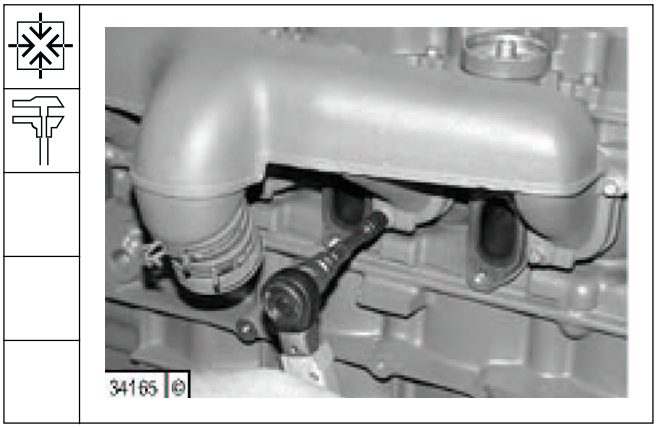
Air intake manifold / exhaust manifold

83. Mount air intake manifold with new gaskets.

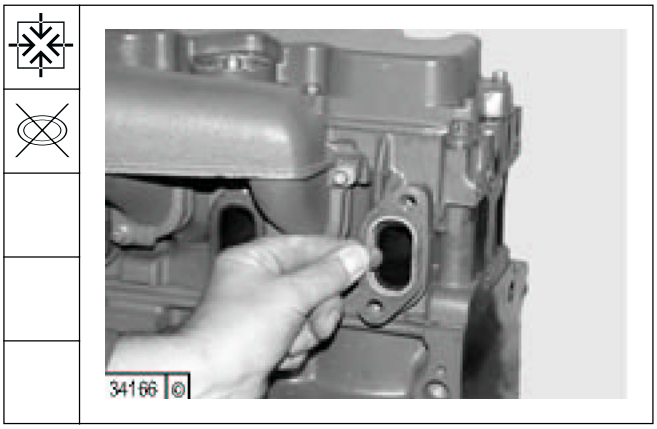


83.1 Tighten bolts.

Tightening specification: **21 Nm**

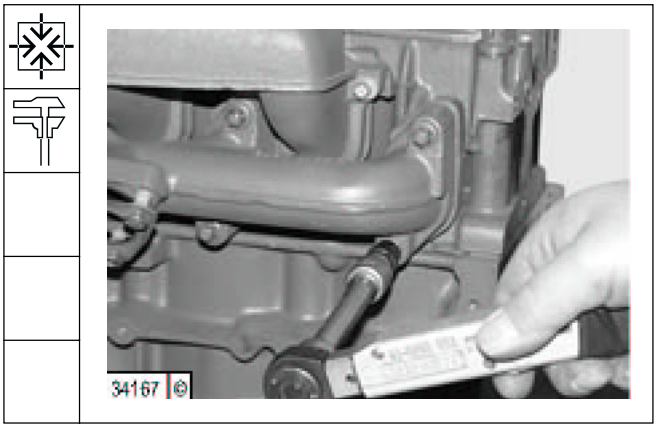


83.2 Mount exhaust manifold with new gaskets.



84. Tighten bolts.

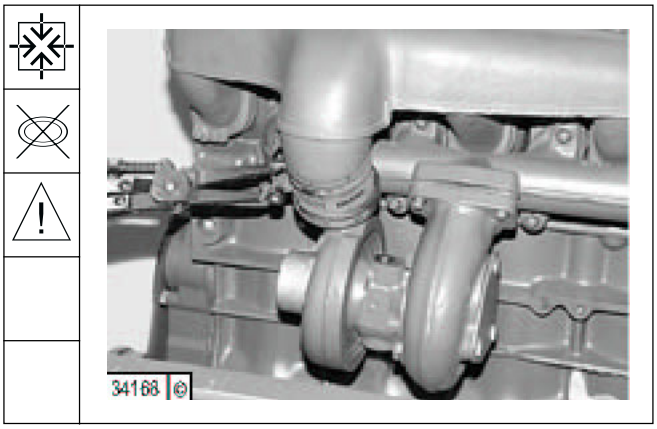
Tightening specification: **55 Nm**



Exhaust-driven turbosupercharger

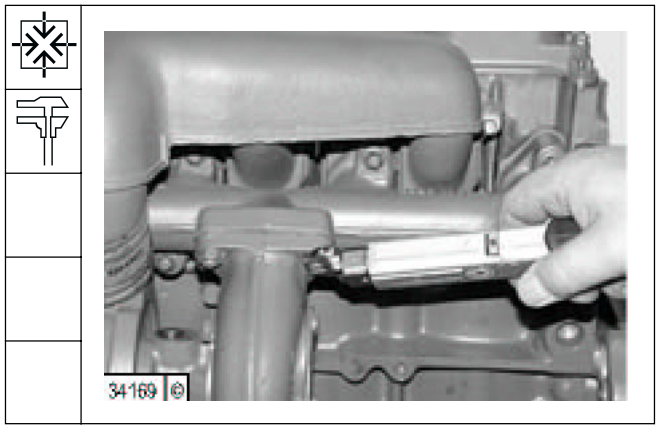
85. Attach an exhaust-driven turbosupercharger with a rubber sleeve, spring steel clips and a new seal

Note: Use a spring clamp pliers 9090.

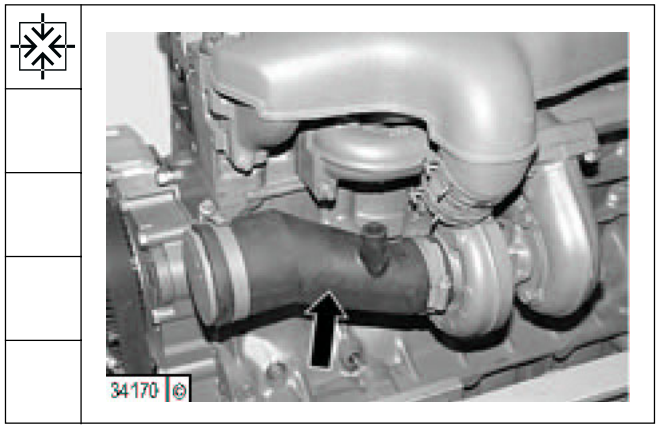


86. Tighten bolts.

Tightening specification: **21 Nm**



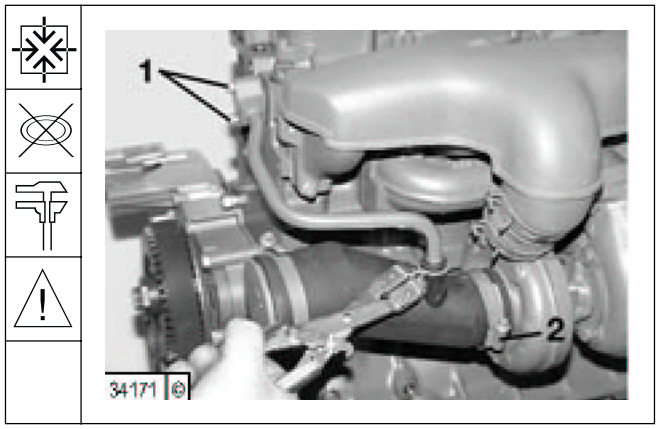
87. Mount on a reducer loosely.



88. Adjust the reducer and mount on the vent pipe with a new seal. Firmly tighten the screws and the hose clip.

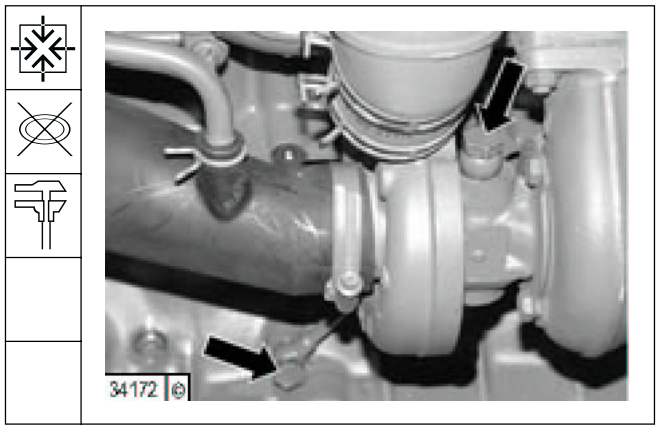
Tightening regulations: Pos. 1 **8.5 Nm**
Pos. 2 **4 ± 1 Nm**

Note: Use the hose clip pliers 9088.



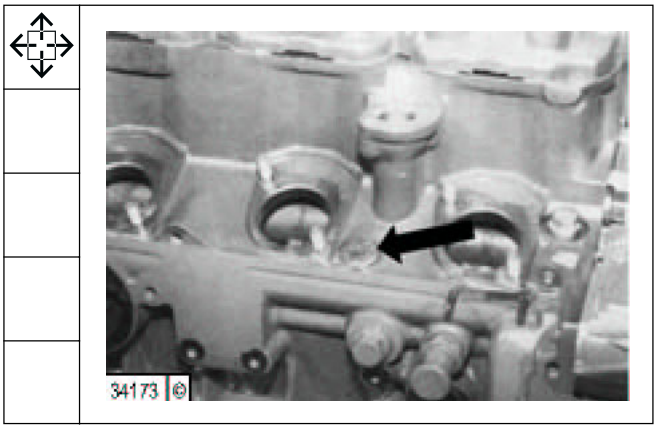
89. Mount on the lube oil line with new seal rings. Firmly tighten the hollow screws.

Tightening specification: **29 Nm**

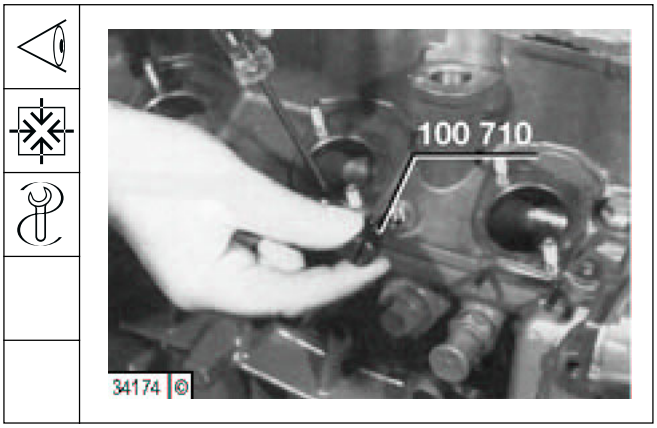


Injection pump

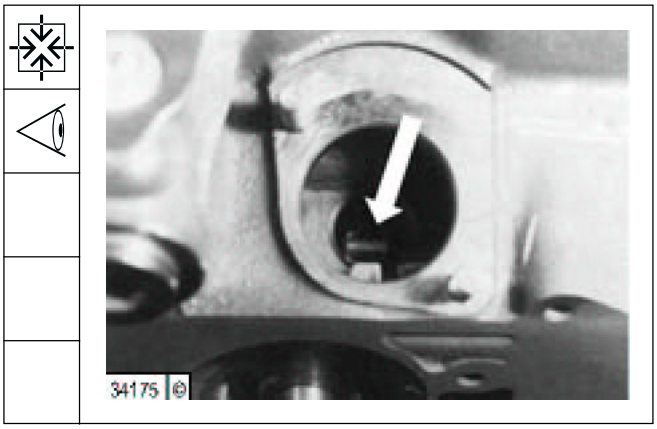
90. Undo screw plug on crankcase.



91. Bring control rod in central position.
Screw adjusting pin for control rod into crankcase as far as it will go.

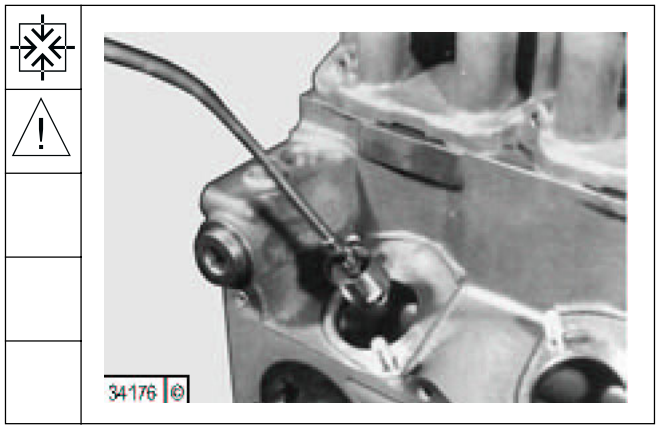


92. Rotate camshaft until tappet stroke of respective cylinder is at BDC.

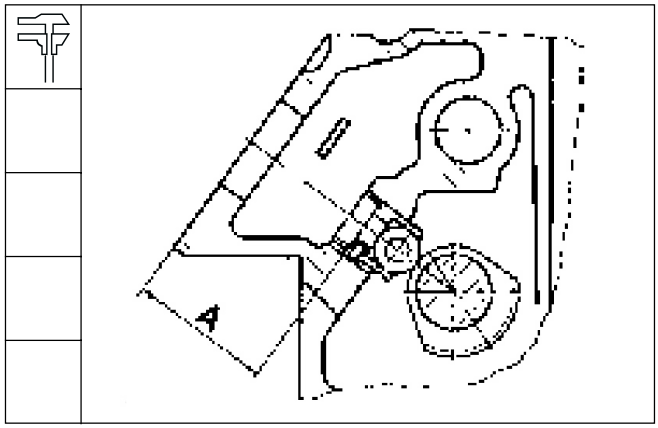


93. Fit injection pump tappet.

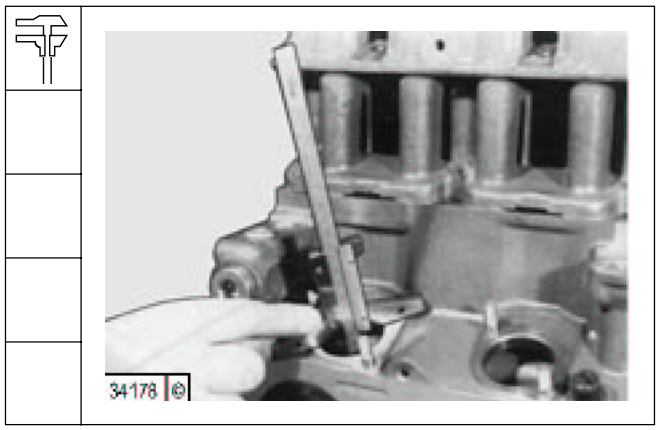
Note: Use flexible magnetic lifter.



94. Determining compensating gasket.

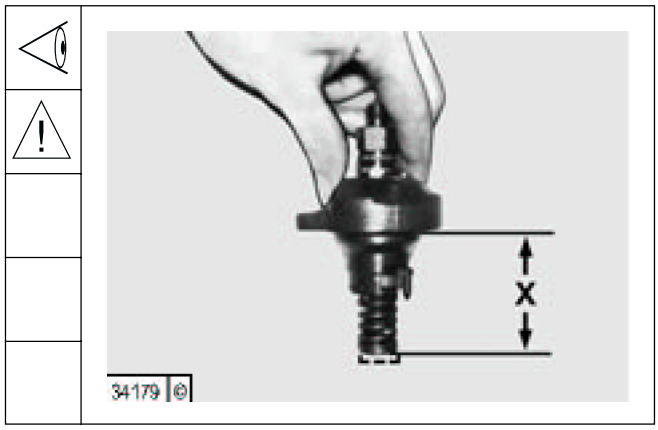


94.1 Gauge depth dimension "A" between crankcase contact surface and spring plate contact surface of tappet.



95. Installation dimension "X" of injection pump = **60 mm**.

Note: The fitting dimension "X" serves only for the calculation of compensating shim washers and cannot not be measure at the disassembled injection pump.

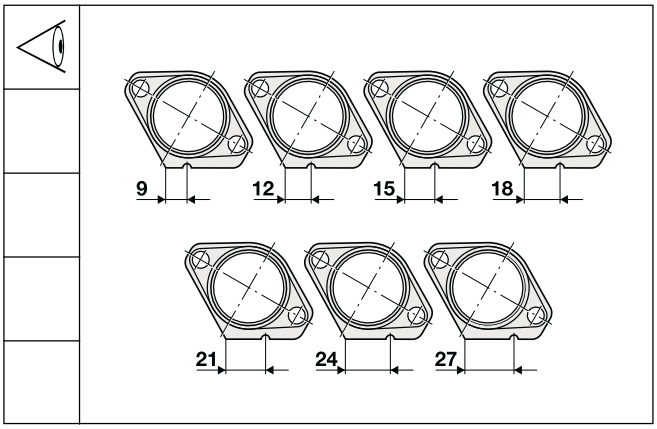


96. Determine difference between installation dimension "X" and depth dimension "A".

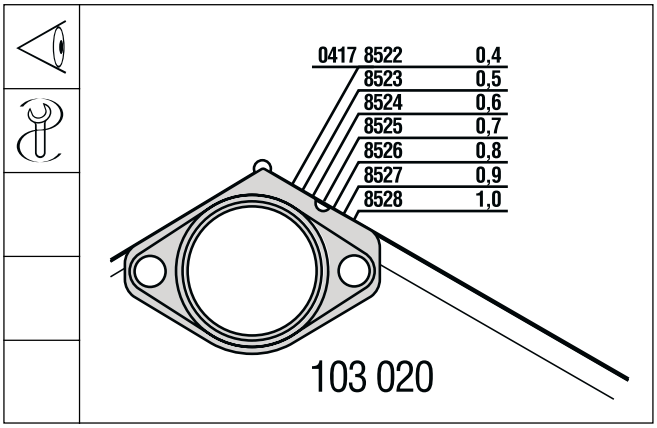
Example:
Installation dimension "X" = 60.00 mm
- Depth dimension "A" = 59.35 mm
Difference = **0.65 mm**

97. Select compensating gasket from table according to marking.

Determined difference	Marked dimension
up to 0.4 mm	9 mm
0.401 - 0.5 mm	12 mm
0.501 - 0.6 mm	15 mm
0.601 - 0.7 mm	18 mm
0.701 - 0.8 mm	21 mm
0.801 - 0.9 mm	24 mm
0.901 - 1.0 mm	27 mm

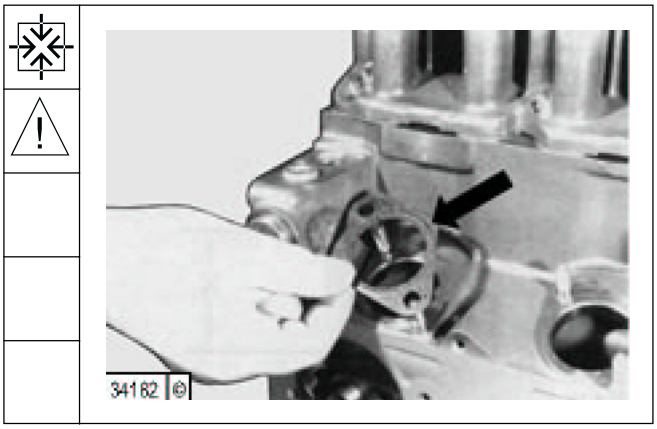


97.1 As the part No. and gasket thickness are not indicated on the compensating gasket the gasket thickness can be rechecked with the tool.

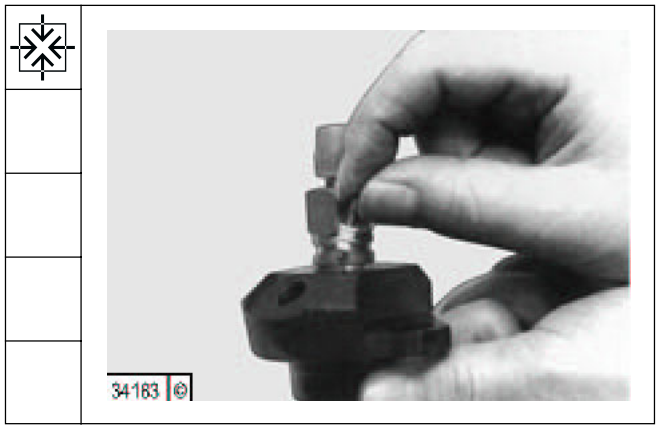


98. Place on appropriate compensating gasket.

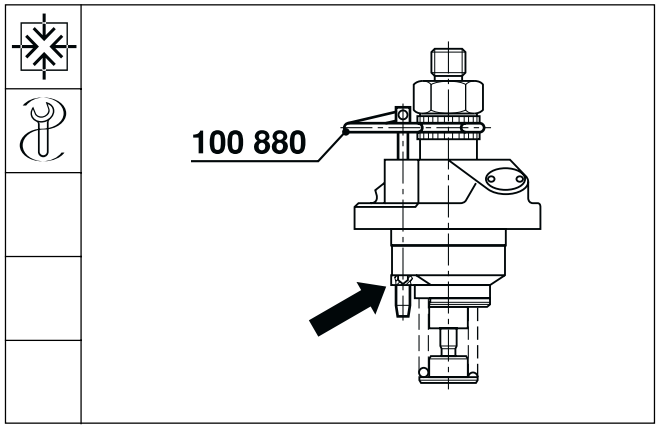
Note: Watch installation position.



99. Remove blanking pin from injection pump.

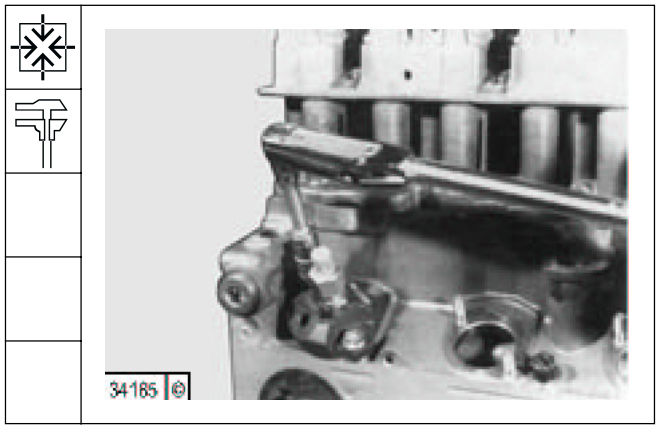


100. Before fitting injection pump, make sure that locking wire is eng†ged in control lever.

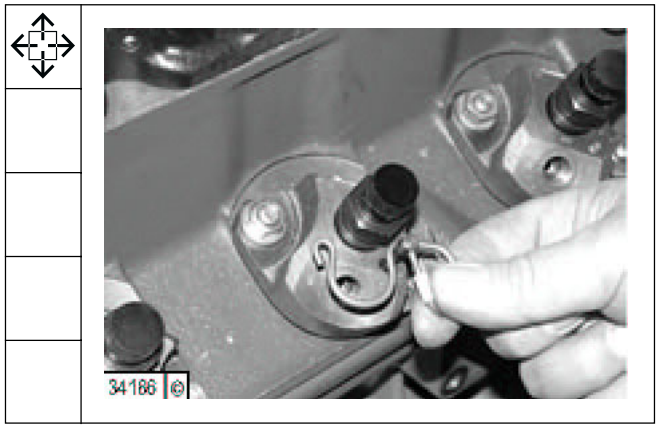


101. Fit injection pump in place. Then press pump down to its seat, taking care that it is accurately centered.
Tighten nuts.

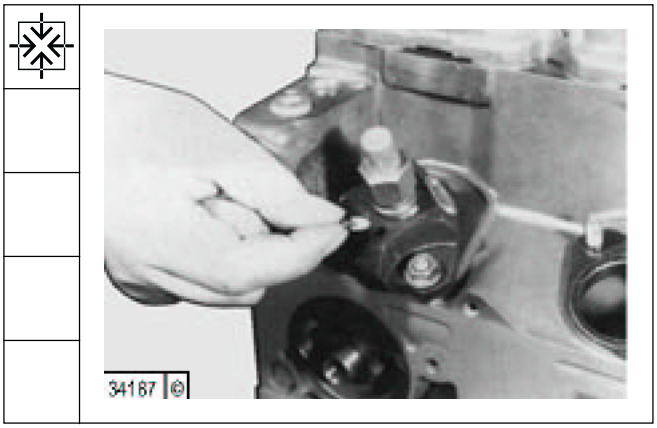
Tightening specification: **21 Nm**



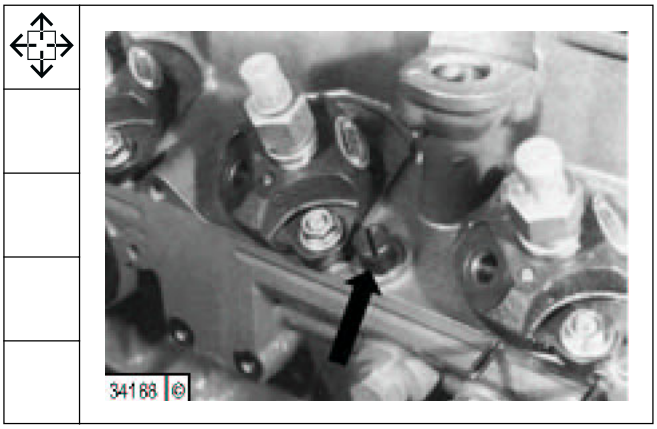
102. Take locking wire out.



103. Blank bore with pin.



104. Remove adjusting pin for control rod.



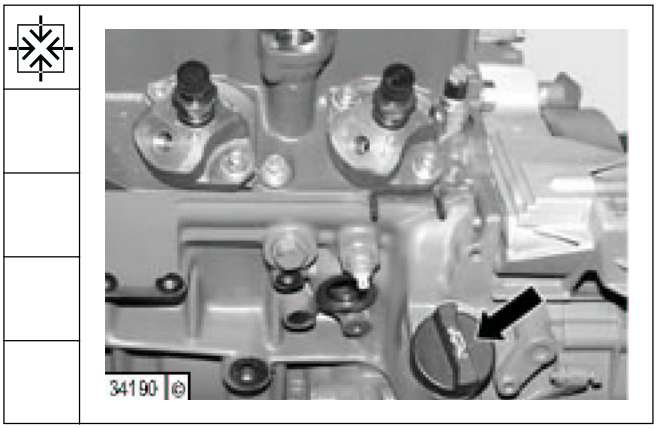
105. Tighten screw plug with new Cu seal.

Tightening specification: **18 Nm**



Oil filling

106. Fit in the closure cover for oil filling.



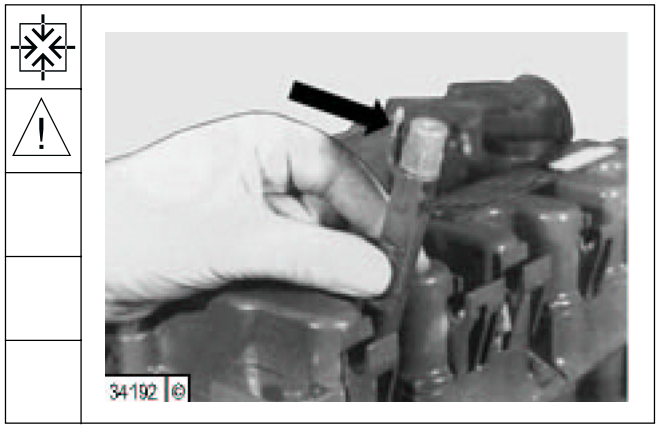
Injectors

107. Slide sealing ring over injector using some grease.



108. Insert injector.

Note: Leakage fuel connection must point towards exhaust side.



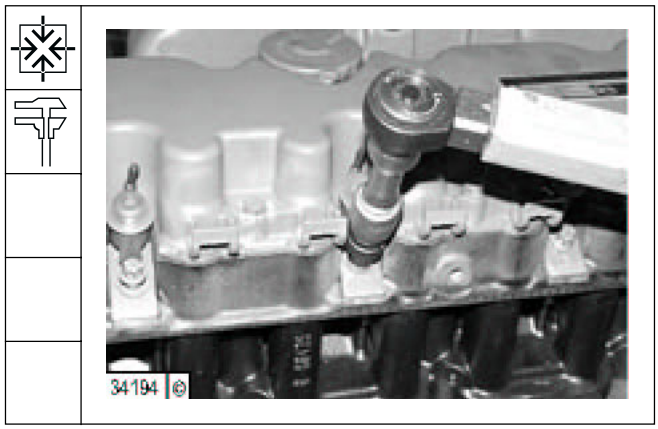
109. Fit clamping pad.

Note: Watch installation position of clamping pad.



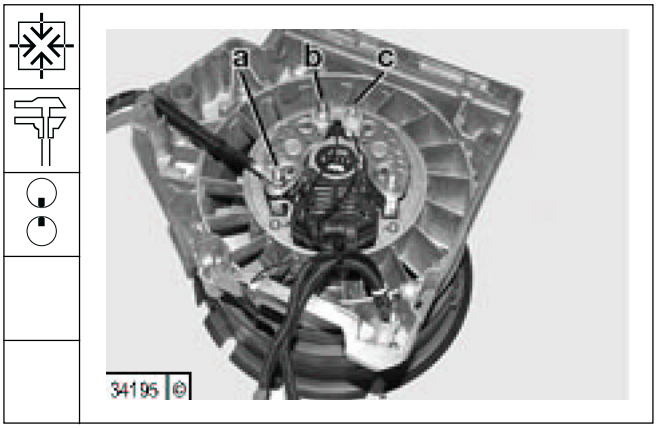
110. Tighten bolt.

Tightening specification: **21 Nm**



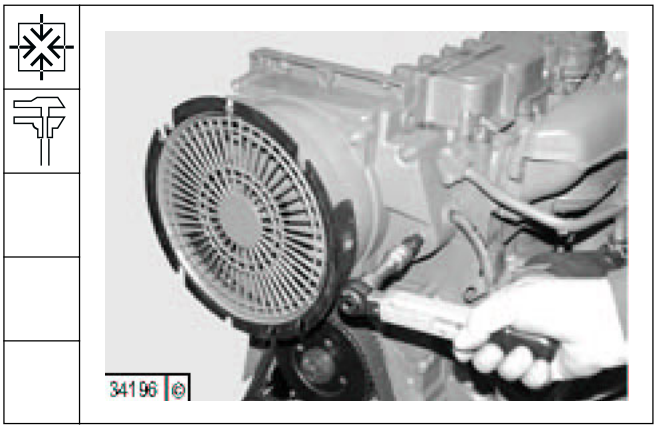
Cooling fan / cable trunk

111. Fit the plug casing of the cable trunk into the blower shell. Mount the lines as indicated.
   a) Induction system B+ firmly tighten the hex nut with **5.5 - 7 Nm**.
   Fit in the rubber sleeve
   b) Line G1.D+ firmly tighten the hex nut with **4.5 ± 0,8 Nm**
   c) Line G1.W



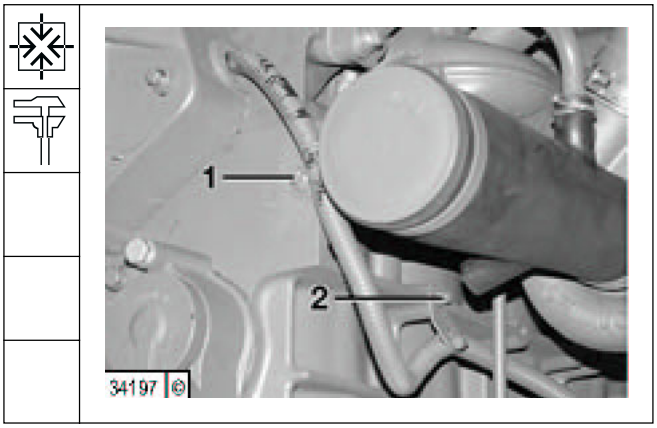
112. Mount blower. Tighten bolts.

   Tightening specification: **22 Nm**



113. Load the induction system. Tighten the screws firmly.

Tightening specification:
Pos. 1 **14 Nm**
Pos. 2 **8.5 Nm**

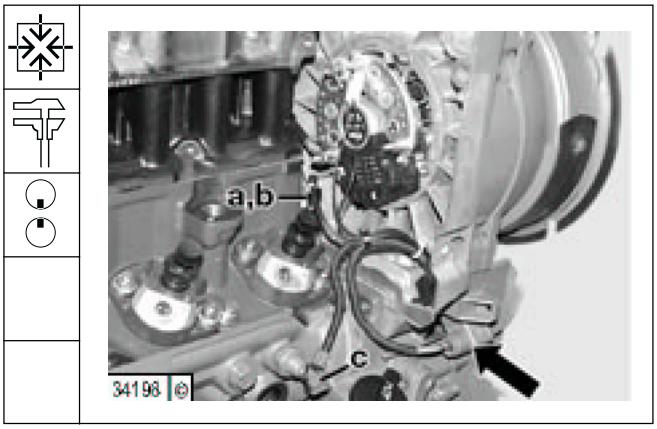


114. Mount on the plug-in connection at motor disconnection. Firmly tighten the screw.

   Tightening specification: **0.5 + 0.1 Nm**

Mount the lines as indicated.
a) Line B3. G Temperature transmitter
b) Line B3. WK Temperature transmitter
c) Line F1/B6 WK Pressure switch/transducer

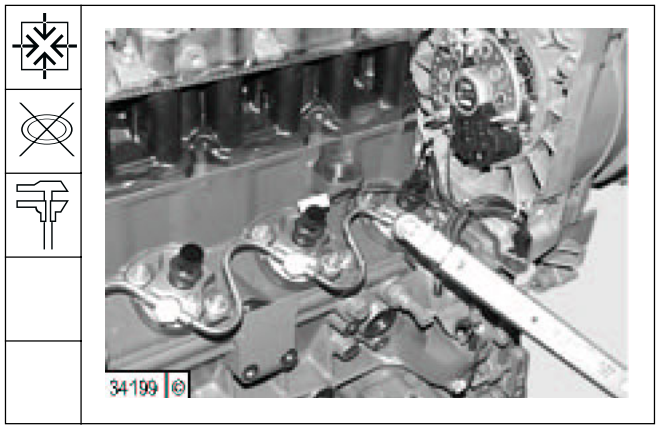
   Line B6. G Pressure transducer (if installed)



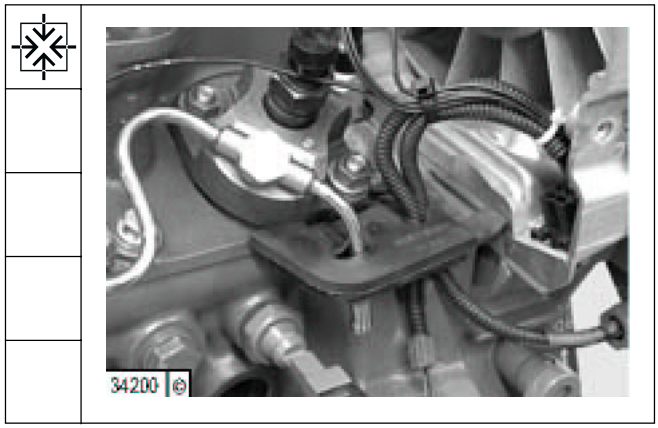
Fuel line/injection lines

115. Mount fuel line with new Cu seals. Tighten banjo bolts.

Tightening specification: **29 ± 2 Nm**



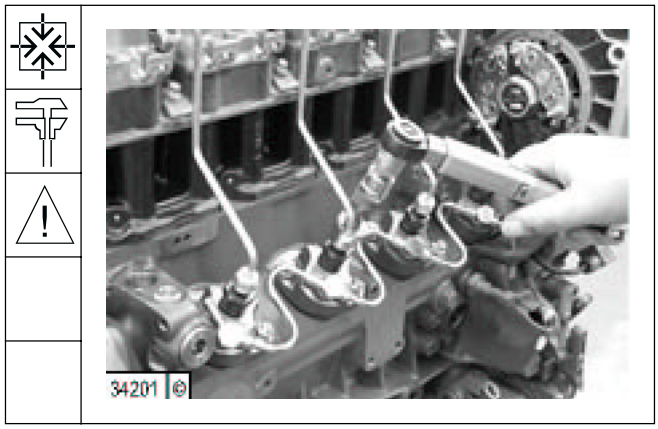
116. Guide the cable trunk and the fuel piping through the profile rubber and push the profile rubber onto the split pins.



117. Mount injection lines and tighten.

Tightening specification: **25 ± 2.5 Nm**

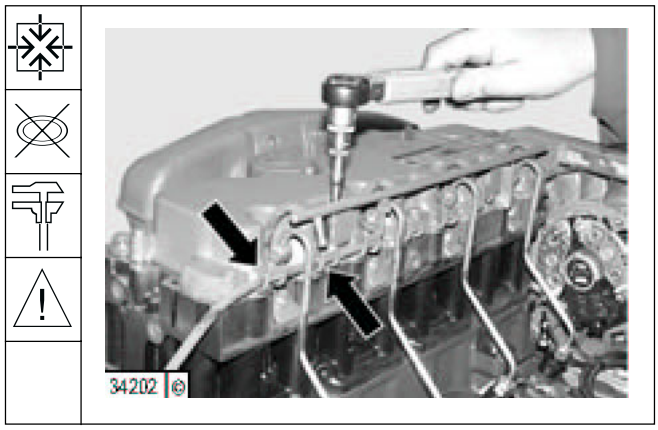
Note: Use the claw key 8018.



118. Mount on the cross-over pipe with new rubber tubes. Fasten the holder with the screws of the cylinder head cover. Engage the drain pipe into the mounting slots of the cylinder head cover.

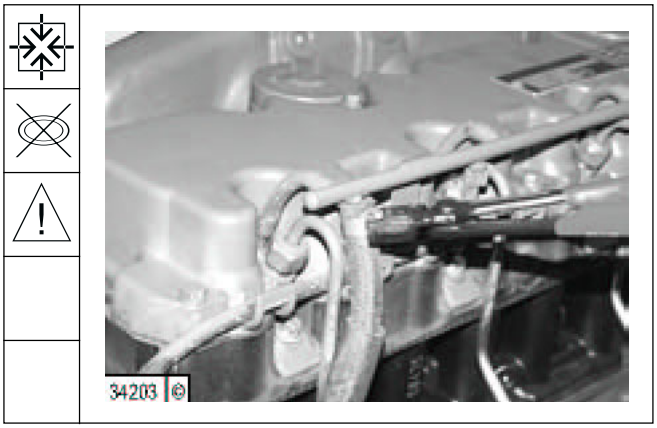
Tightening specification: **8.5 Nm**

Note: Basically, the rubber tubes are to be renewed.



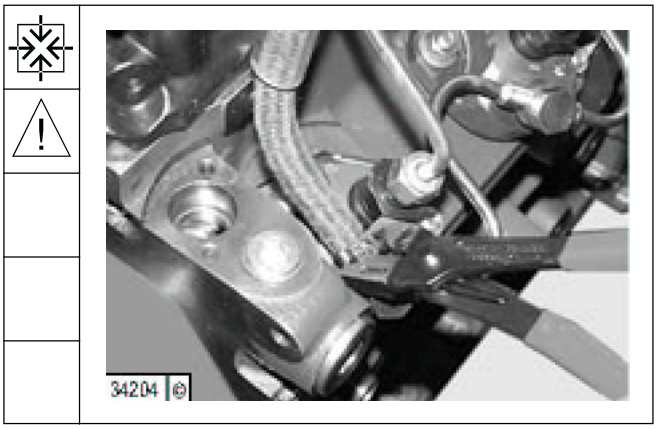
119. Mount a new rubber tube onto the fuel line with a hose clip. Put a protecting cover on the rubber tube.

Note: Use a clamp 8011.



120. Attach a rubber tube to the mcross-over pipe with a hose clip and a fastening strip.

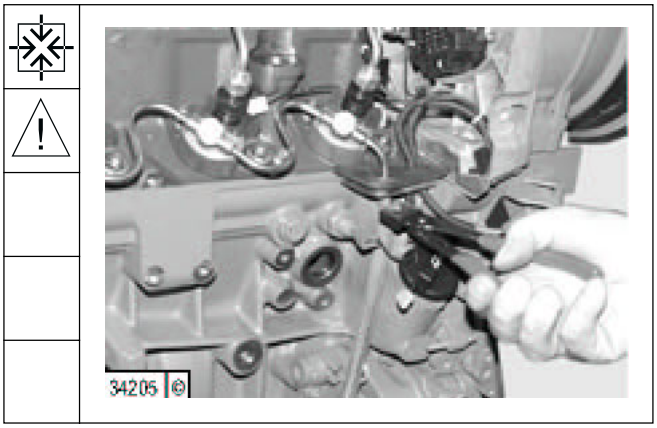
Note: Use a clamp 8011.



Fuel feed pump / fuel filter

121. Mount a rubber tube onto the fuel line with the hose clip.

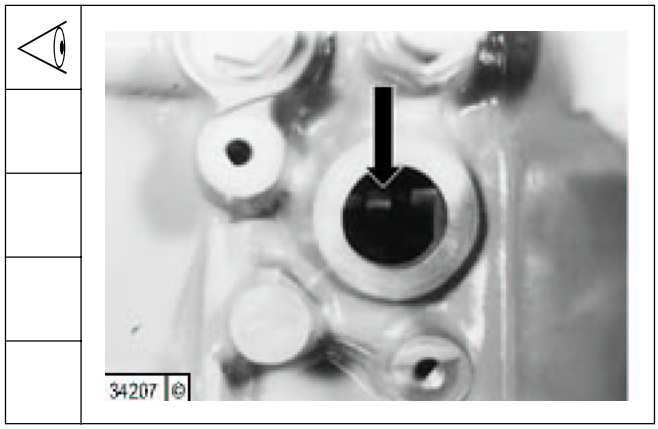
Note: Use a clamp 8011.



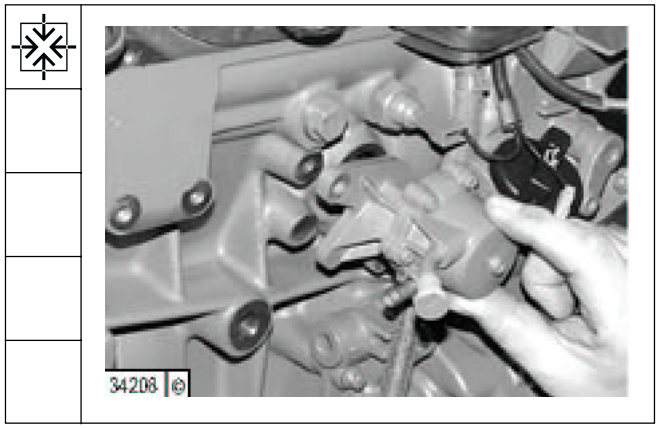
122. Position new O-seal.



123. Set camshaft eccentric for fuel feed pump to BDC.

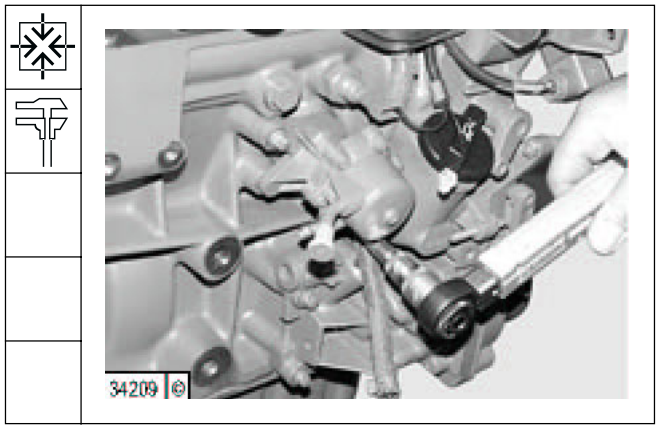


124. Mount fuel feed pump. Fit in alternately the screws up to the unit.



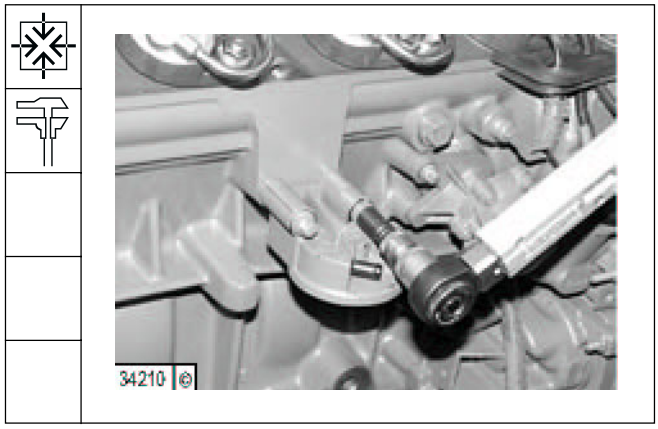
124.1 Tighten bolts.

Tightening specification: **21 Nm**



125. Fit fuel filter bracket.
Tighten bolts.

Tightening specification: **21 Nm**

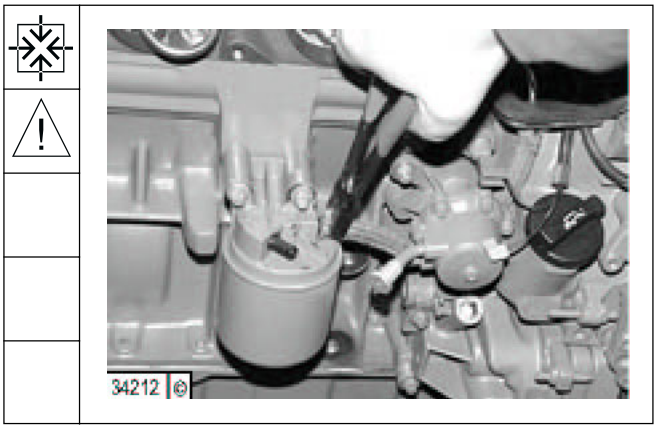


126. Lightly oil fuel filter gasket. Turn on manually a new fuel filter cartridge.



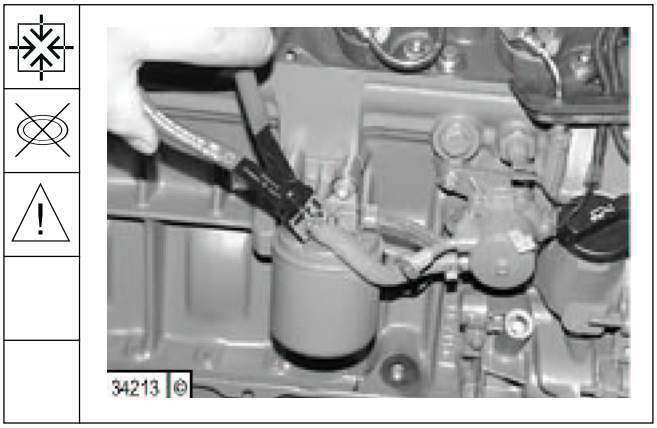
127. Mount on a rubber tube of the fuel line onto the fuel filter with the hose clip.

Note: Use a clamp 8011.



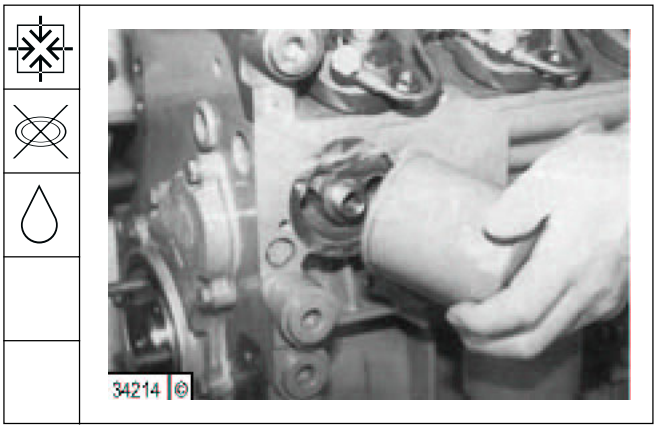
128. Mount on a new rubber tube of the fuel transfer pump to the fuel filter with the hose clips.

Note: Use a clamp 8011.



Oil filter

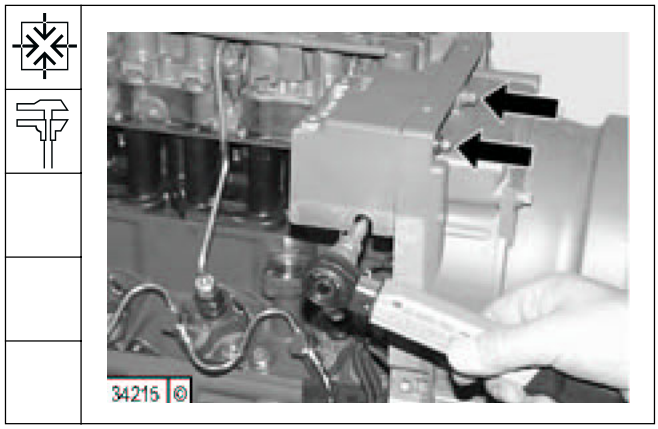
129. Lightly oil oil filter gasket. Secure new oil filter cartridge fingertight.



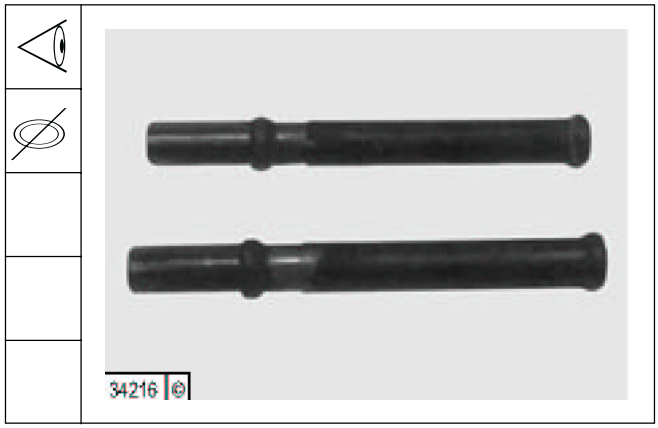
Air ducting/oil cooler

130. Mount on an air guide. First, pretension the screw at the cylinder head with **3 Nm**, then tighten firmly the screws at the cooling fan and the cylinder head.

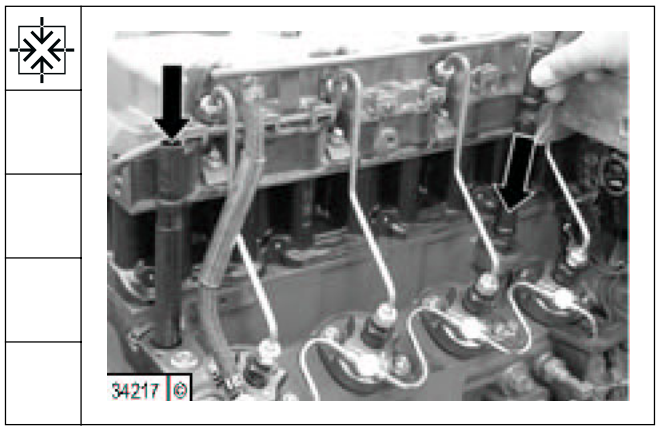
Tightening specification: **21 Nm**



131. Inspect plug-in element for visual damage.

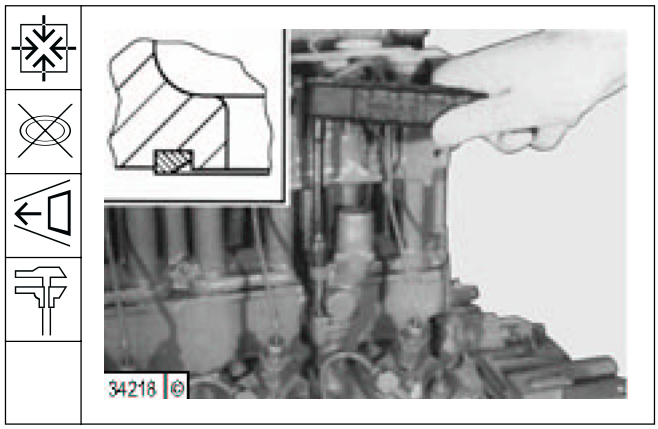


132. Press in plug-in elements as far as they will go.



132.1 **With B/FM motors:**
Fit new O-seals to oil cooler connections to that spot facing points towards crankcase.
See illustration.
Fit oil cooler connections.
Tighten bolts.

Tightening specification: **13 Nm**



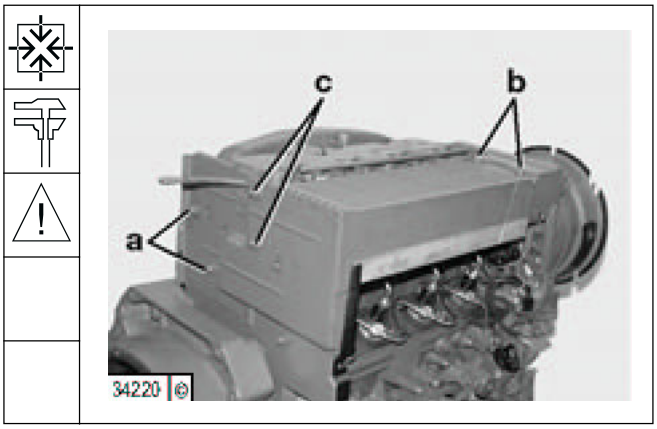
133. Mount on loosely the oil cooler.



134. Mount on the cooling air cowling.
Firmly tighten the screws in the order a, b and c.

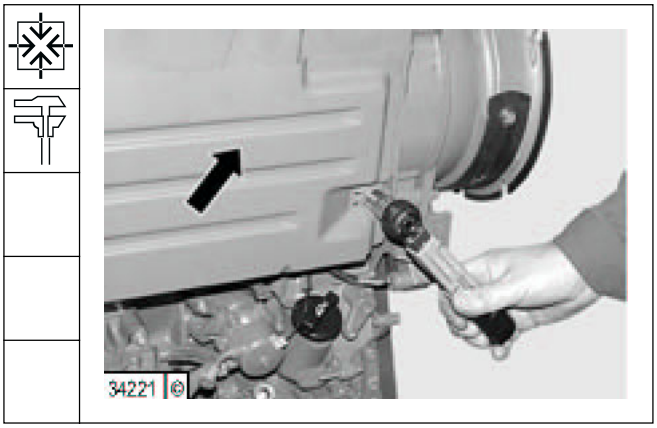
Tightening specification: **21 Nm**

Note: Pay attention to the length of the screws.



135. Mount air cowling. Tighten bolts.

Tightening specification: **21 Nm**

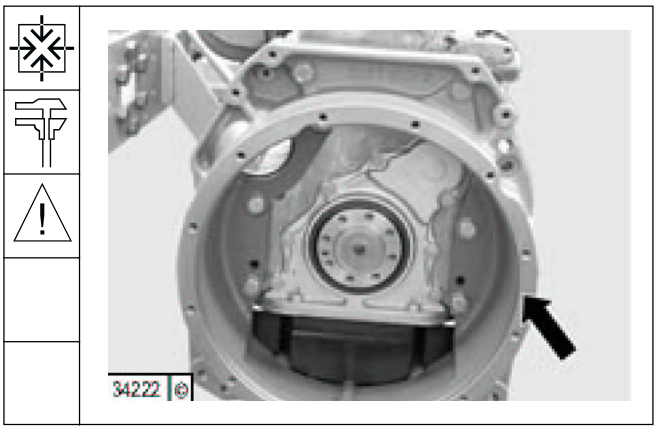


Connection housing / console

136. Mount on the connection housing.
Tighten bolts.

Tightening specification:
bolts M 12 **106 Nm**
bolts M 14 **180 Nm**

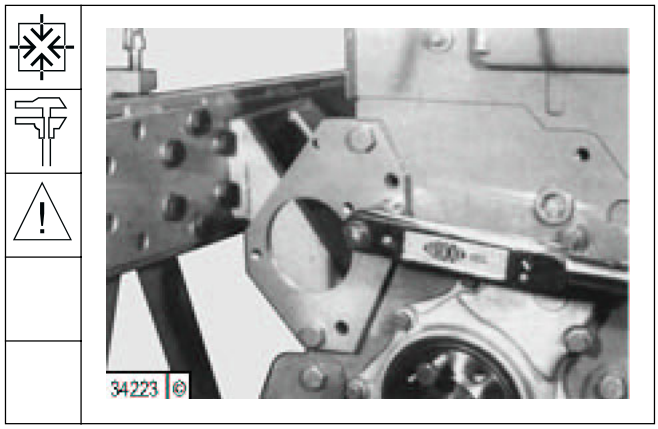
Note: Make sure that the collets are available.



137. In the case of motors without connection housing.
Mount on the console for the starter.
Tighten the screws firmly.

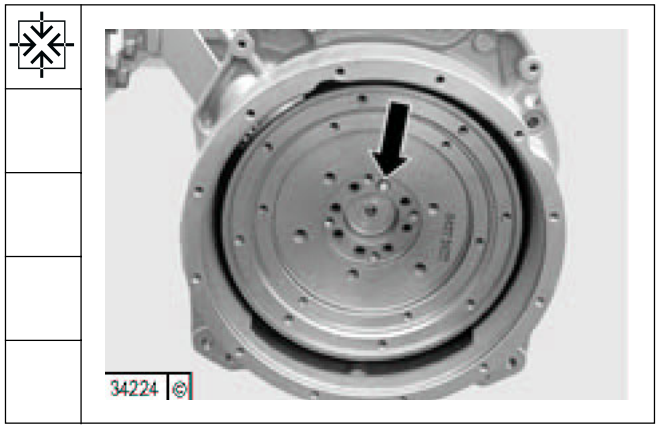
Tightening specification: **75** ± **7 Nm**

Note: Make sure that the collets are available.



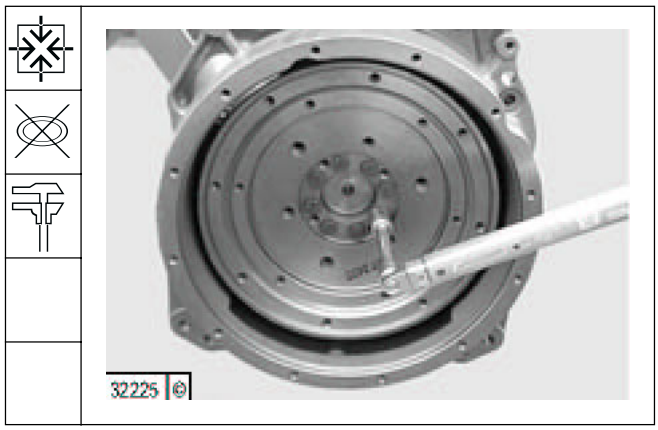
Flywheel

138. Position flywheel, using a self-made pilot bar.



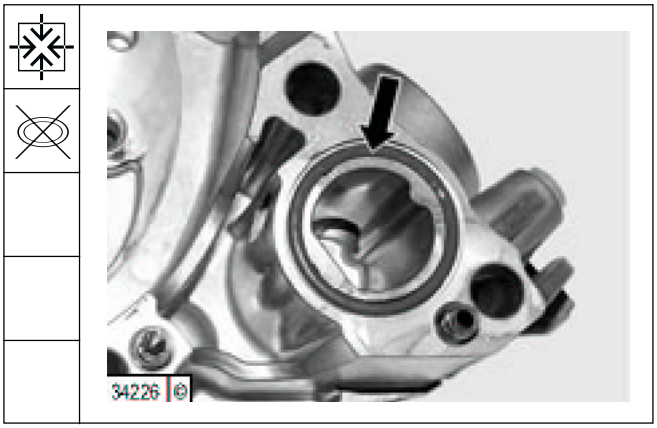
139. Fit in **new** screws. Back-up the flywheel and firmly tighten the screws.

Tightening specification:
Initial tightening torque **30 Nm**
Tightening angle **60**°
Tightening angle **30**°



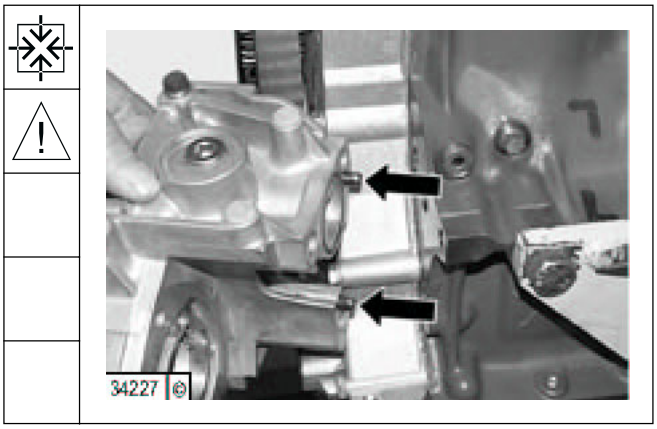
Hydraulic pump bracket / protective cover

140. Insert new O-seal.



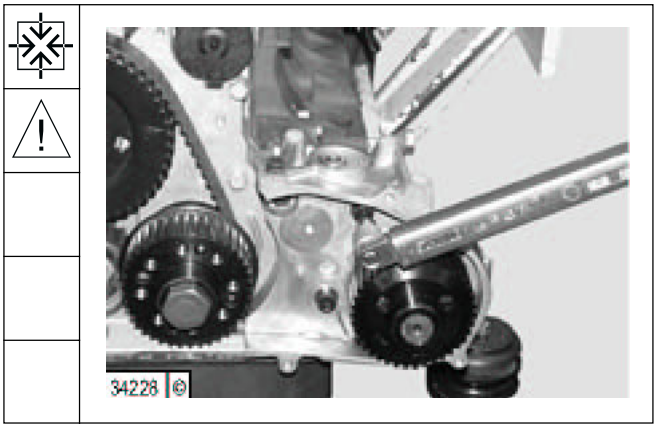
141. Mount hydraulic pump bracket. Start fastening bolts.

Note: Make sure that the split pins are available.



142. Firmly tighten the screws of the hydraulic pump console.

Tightening specification: **57 Nm**

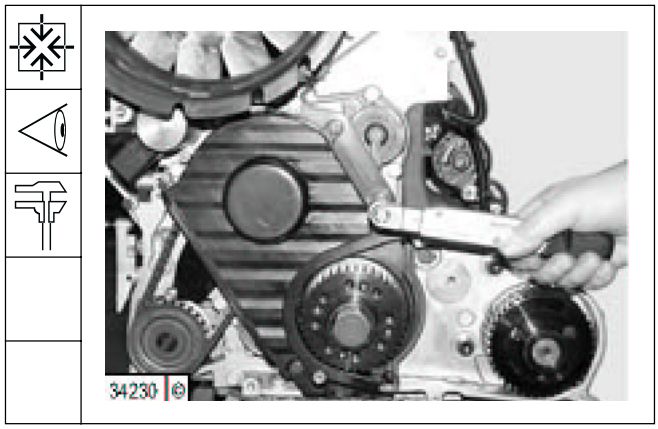


143. Check visually the protective covers, replace the sealing profiles, if necessary.



144. Mount on and align the protective cover and firmly tighten the screws.

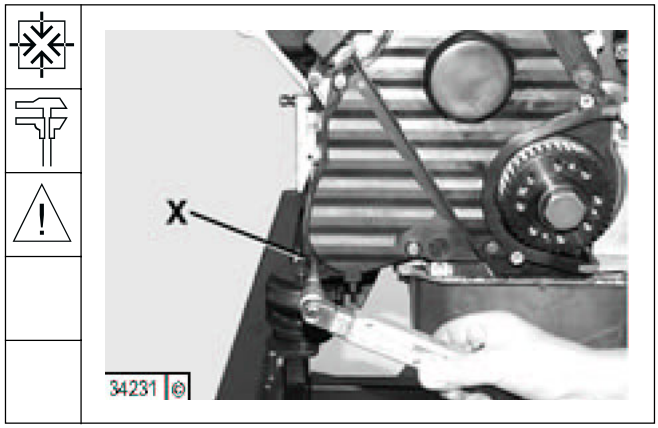
Tightening specification: **7 Nm**



145. Mount on the protective cover and firmly tighten the screws.

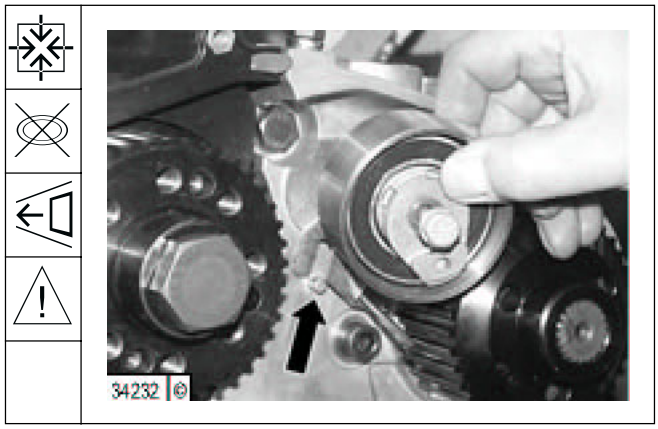
Tightening specification: **7 Nm**

Note: For the locking screw (Pos. x), use the special bit 9120 or 9122.

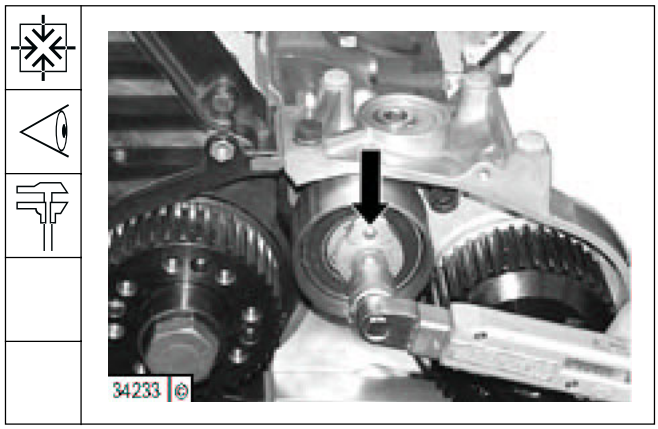


146. Place the new tension roller with mthe base plate guide clevis onto the guide pin.

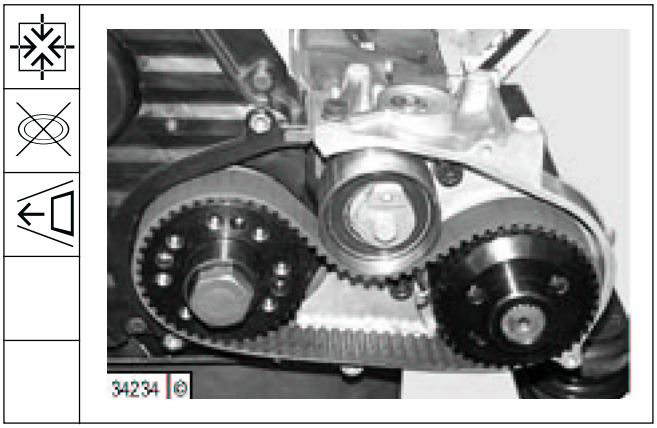
Note: Pay attention to the various tension rollers. Width of the roller for the hydraulic pump drive 35 mm.
Width of the roller for the camshaft drive 30 mm



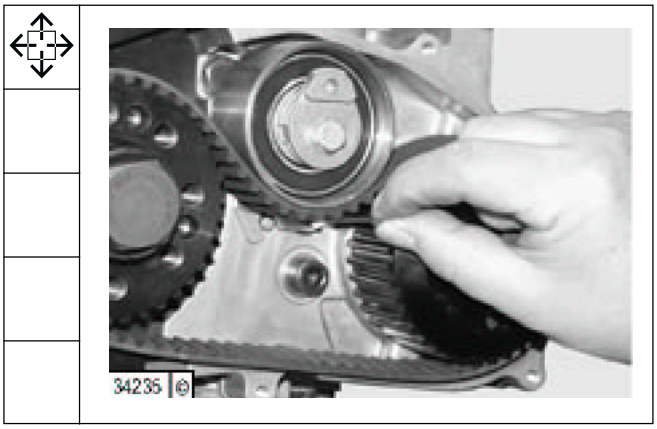
147. Set the eccentric cam arrangement with the hex socket to 12:00 hour position and mount on the tension roller.
Pretension the screw with **8 + 2 Nm**.



148. Place and adjust a new toothed belt.
On crankshaft gear as far as rear guide plate and on hydraulic pump gear with approx. 4 mm distance from front edge.

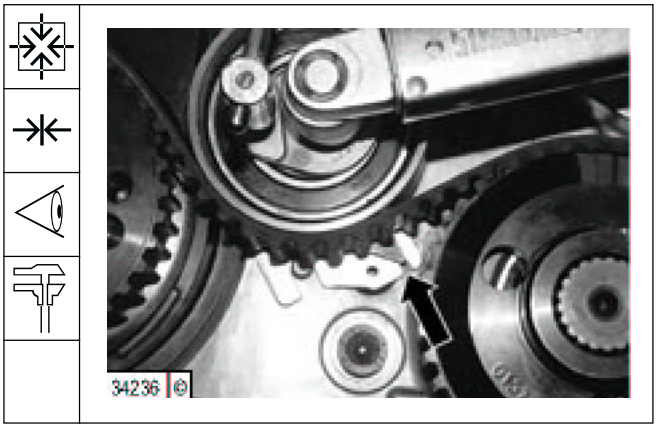


149. Remove the locking pin



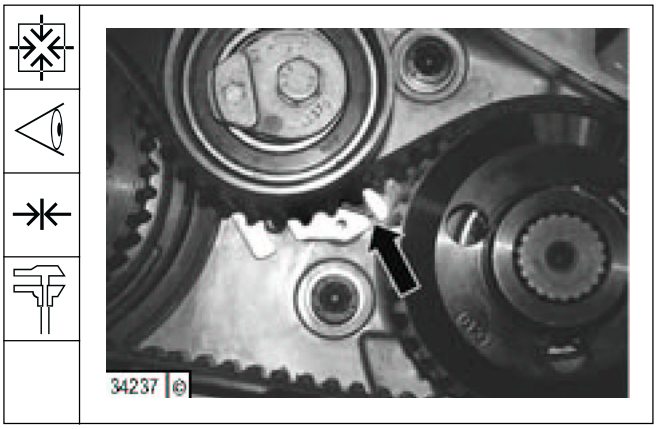
150. Rotate the eccentric cam arrangement with the aid of an Allen key in arrow direction until the pointer corresponds with the groove in the base plate. Firmly tighten the screw.

Tightening specification: **21 ± 2 Nm**

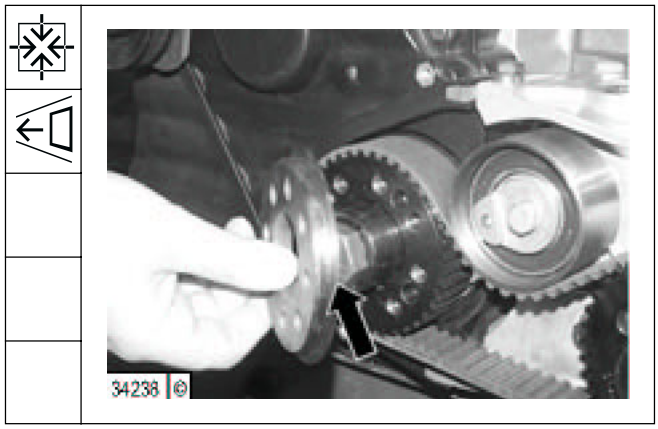


151. Turn the crankshaft 2 rotations in motor direction of rotation. Check the position of the pointer.

Note: If the pointer does not correspond with the groove, it must be corrected with the eccentric cam arrangement.
Loosen the screw and pretension again with **8 + 2 Nm**. Rotate the eccentric cam arrangement with the aid of an Allen key in arrow direction until the pointer corresponds with the groove in the base plate. Firmly tighten the screw with **21 + 2 Nm**.

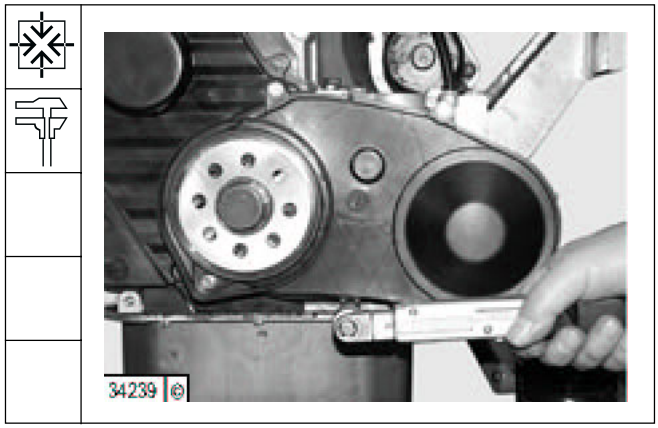


152. Put on the intermediate piece with the flattened side pointing to the toothed belt.



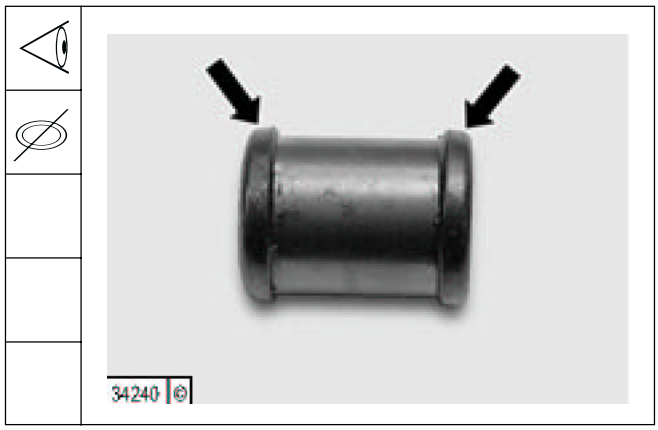
153. Mount on the protective cover and firmly tighten the screws.

Tightening specification: **8.5 Nm**

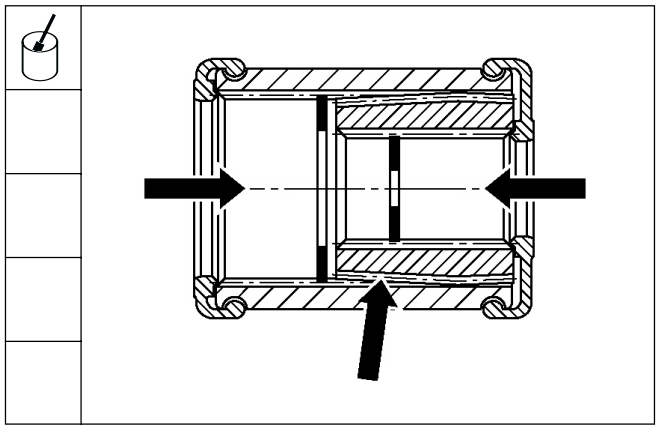


Hydraulic pump

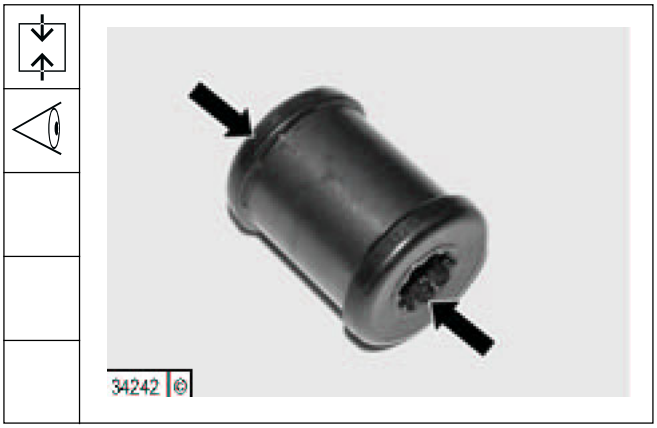
154. Check visually the coupling sleeve and the collars for damage, exchange completely, if necessary.



155. During further use of the coupling sleeve, fill the teeth area with graphite grease **G 500** (20 gram of tube).



156. Bring in cover the toothing of the collars with the toothing of the coupling sleeve.

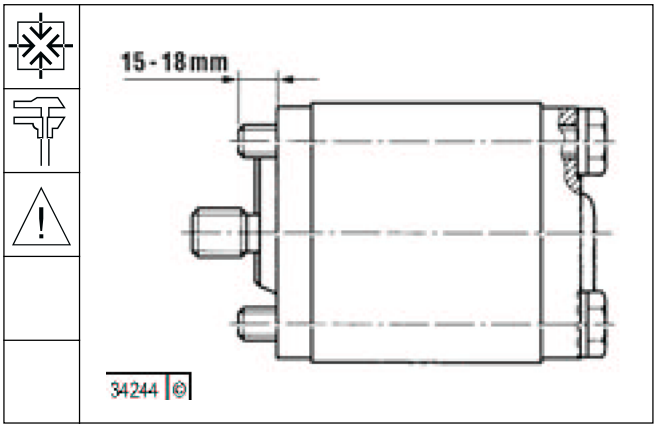


157. Grease the tooth shaft with graphite grease **G 500**. Push the coupling sleeve onto the tooth shaft.

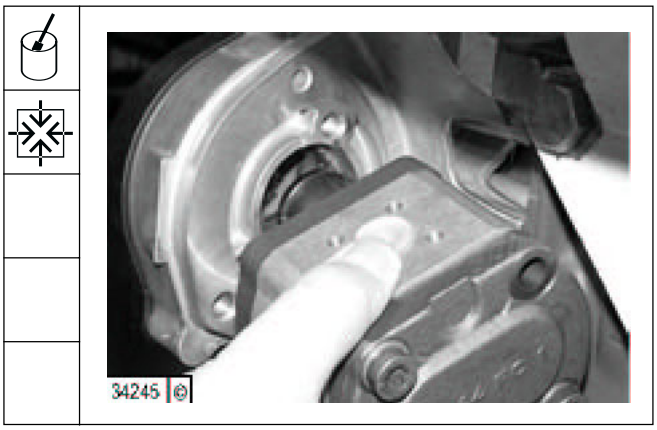


158. Fit in the screws with washers and measure the foregoing dimension of the screws.

Note: The max. dimension of 18 mm may not be exceeded.

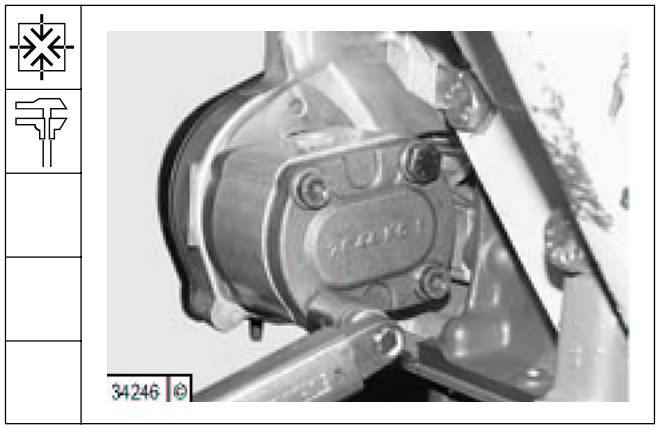


159. Grease the tooth shaft of the hydraulic pump drive with graphite grease DEUTZ **G 500**. Attach the hydraulic pump.



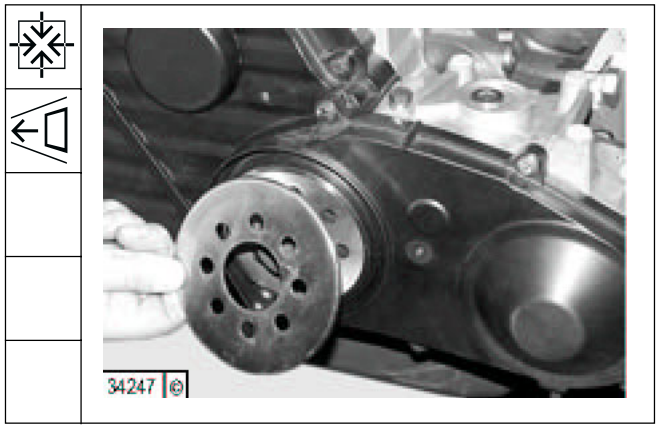
160. Tighten bolts.

Tightening specification: **57 Nm**



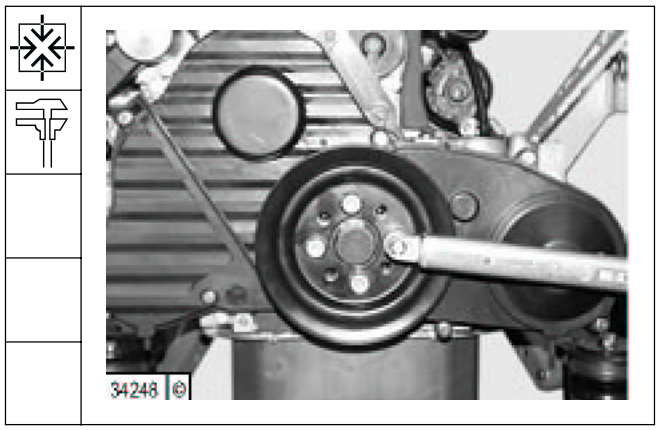
V belt pulley / idler pulley / V belt

161. Put on the centrifuge disk.



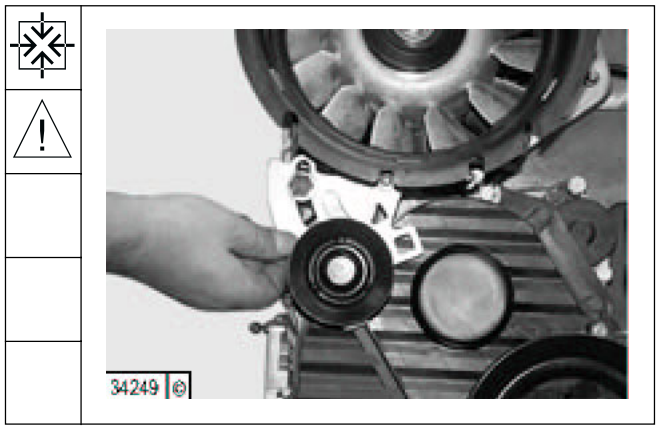
162. Fit V-belt pulley. Tighten bolts.

Tightening specification: **42 ± 4 Nm**

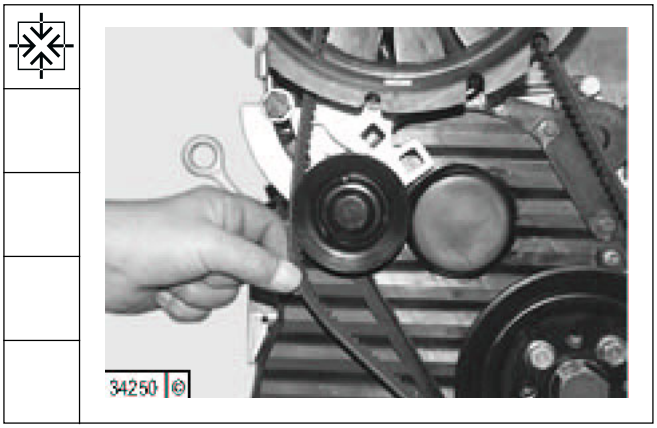


163. Fit V-belt idler pulley.

Note: Start bolts.

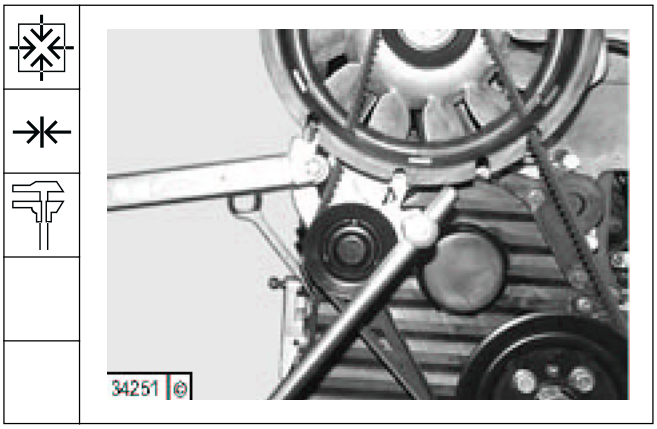


164. Position V-belt.



165. Tension V-belt. Tighten bolts.

Tightening specification: **45 Nm**

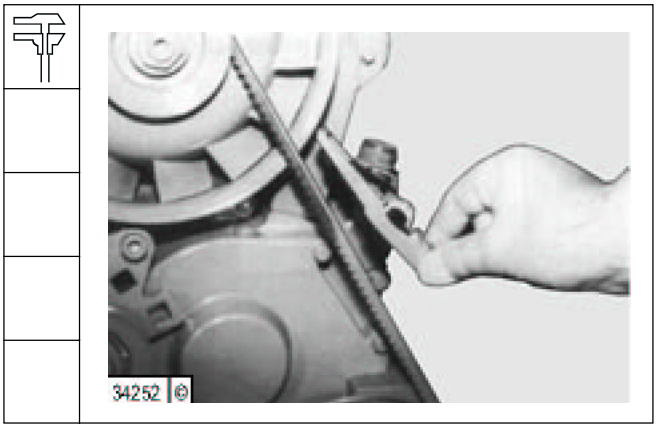


166. Check V-belt tension with tension gauge 8115.

Initial assembly: **450 ± 50 N**

Check value after 15 min. operation under load: **300 ± 20 N**

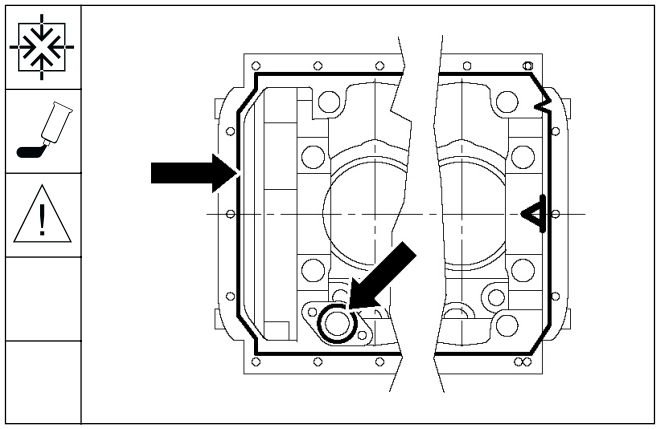
If specified scale reading is not attained, repeat procedure.



Oil suction pipe / oil trough
Rotate the motor by 180°.

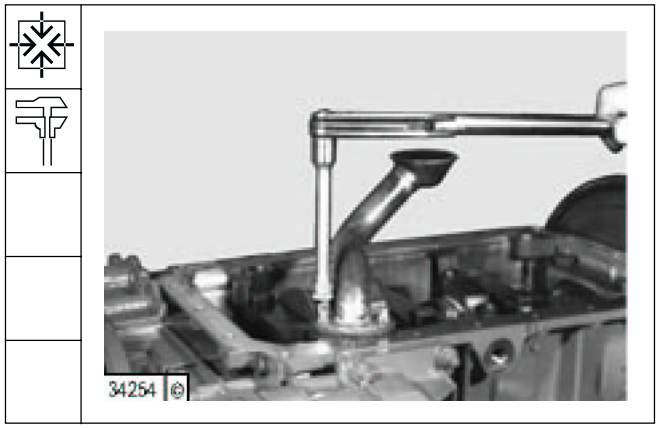
167. Apply the sealant DEUTZ **DW 74** for the oil suction pipe and the oil trough to the crankcase with integrated cylinder liners.

Note: Make sure that no sealing compound penetrates into the oil suction pipe.

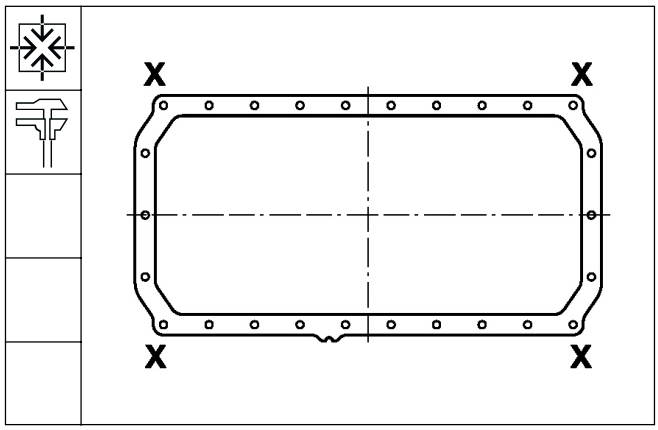


168. Attach the oil suction pipe. Firmly tighten the screws.

Tightening specification: **21 Nm**



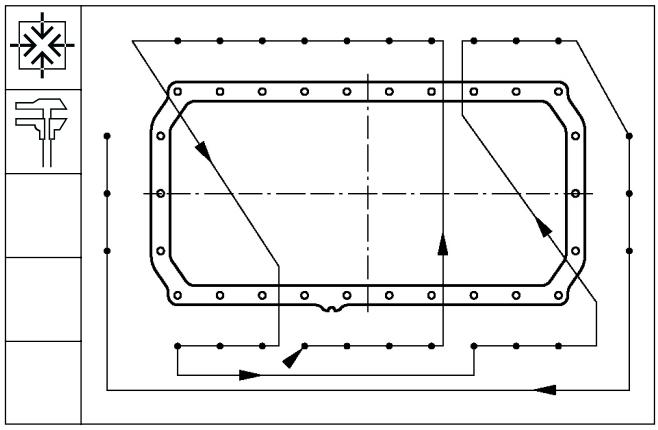
169. Mount on the oil trough. Pretension the corner screws "X" with **0,5 Nm** in each case. Firmly tighten all screws according to the tightening sequence, see sketches.



169.1 Tightening sequence 4-cylinder

Tightening specification:
Sheet metal oil pan
Bolts M 8 x 16 mm -8.8 **21 Nm**

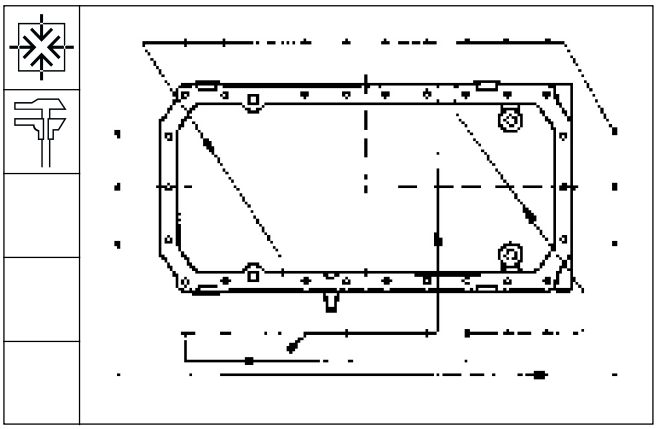
Cast oil pan
Bolts M 8 x 30 mm -10.9 **31 Nm**
Bolts M 8 x 55 mm -10.9 **21 Nm**



169.2 Tightening sequence 4-cylinder
Casting oil pan with cylinder head bolts

Tightening specification:

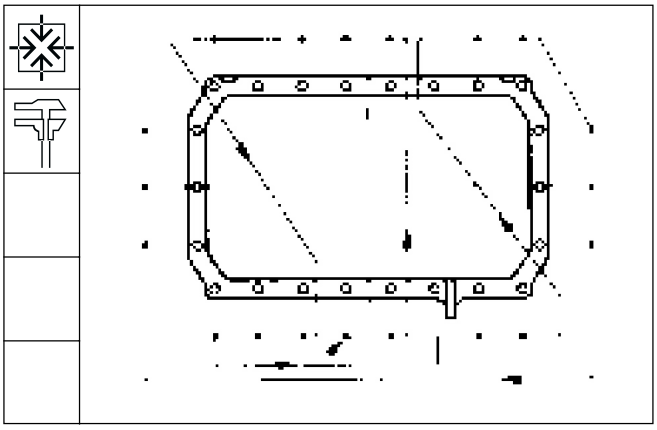
Casting oil pan with cylinder head bolts
Bolts M 8 x 30 mm -8.8 **21 Nm**
Bolts M 8 x 55 mm -10.9 **21 Nm**
Cylinder head bolts **180 Nm**



169.3 Tightening sequence 3-cylinder

Tightening specification:

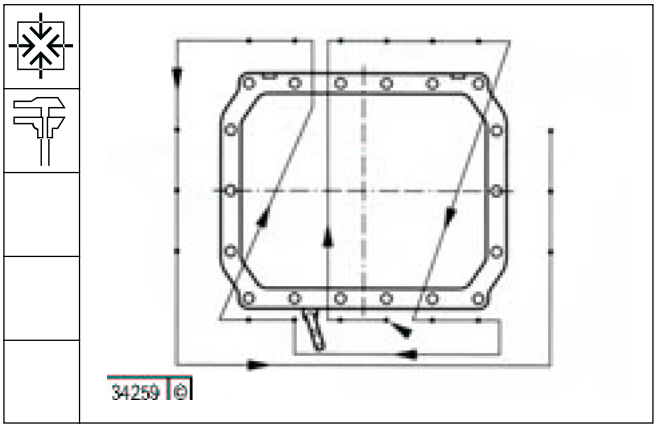
Sheet metal oil pan
Bolts M 8 x 16 mm -8.8 **21 Nm**



169.4 Tightening sequence 2-cylinder

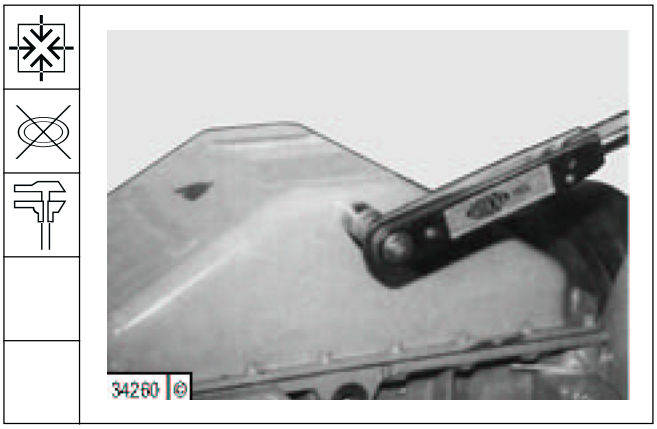
Tightening specification:

Sheet metal oil pan
Bolts M 8 x 16 mm -8.8 **21 Nm**



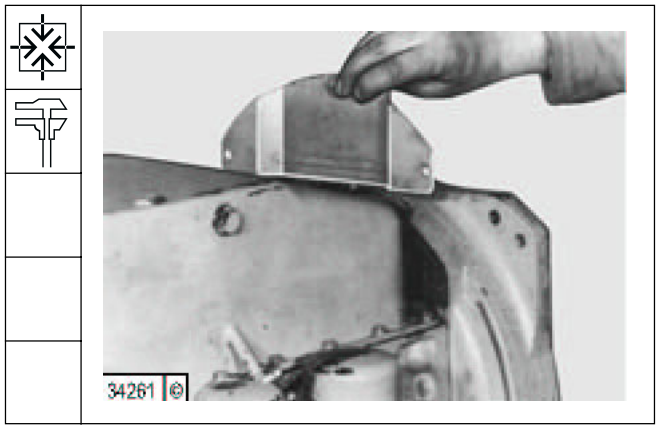
170. Screw oil drain plug back in with new Cu seal and tighten.

Tightening specification: **55 ± 5 Nm**



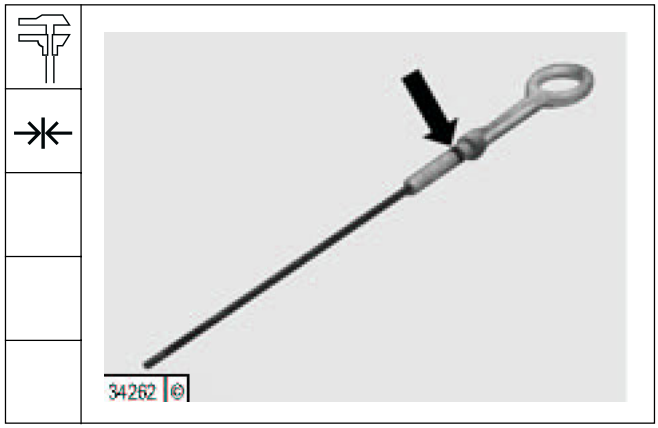
171. In case of motors with a connection housing, mount on a cover plate.
Tighten bolts.

Tightening specification: **9 Nm**

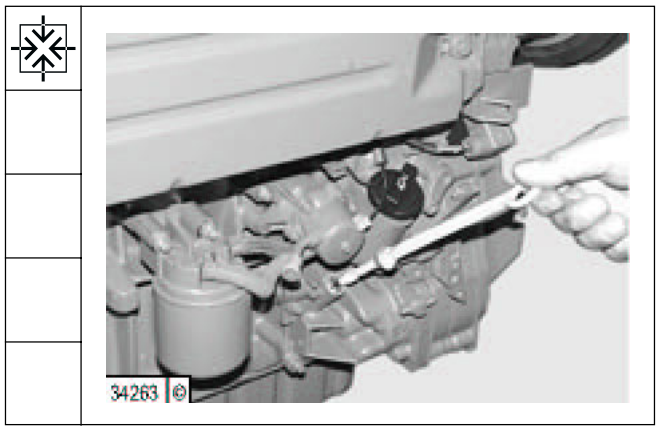


Oil measuring stick
Rotate the motor by 180°.

172. Fit new O-seal.



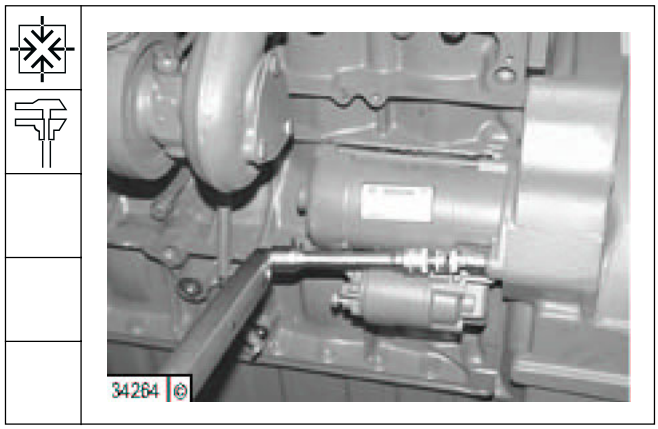
173. Press in oil dipstick as far as it will go.



Starter
Remove engine from assembly stand and angled clamping plate.

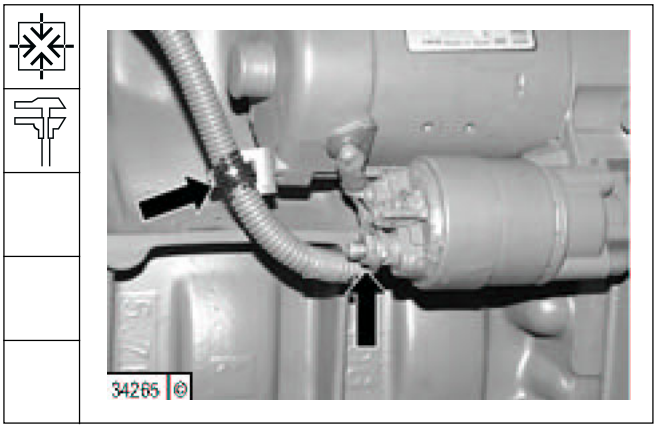
174. Mount starter
Tighten bolts.

Tightening specification: **43.5 Nm**



175. Mount on and load the induction system at the starter. Firmly tighten the hex nut.

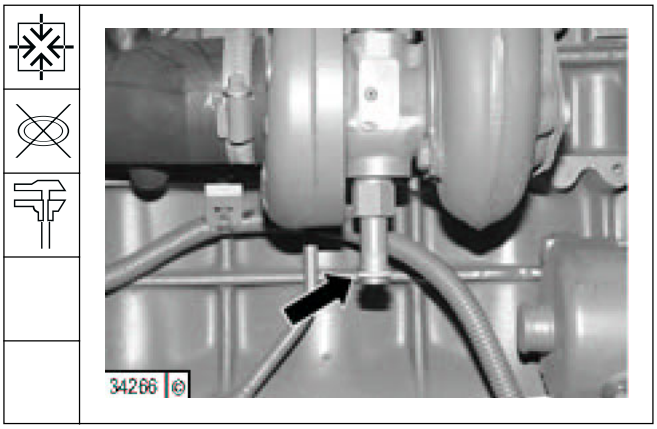
Tightening specification: **15 Nm** max.



Return pipe
(with BF motors)

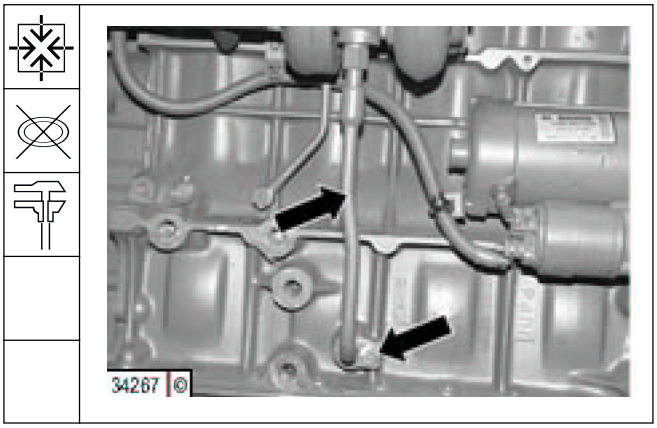
176. Fit in the threaded connections with new Cu-sealing ring and tighten firmly. Attach a new O-ring type sealing ring.

Tightening specification: **40 Nm**



177. Attach an oil return pipe with a new O-ring type sealing ring. Mount on a locking plate and tighten the screw firmly.

Tightening specification: **8.5 Nm**



Exchanging the shaft seal rings at the entire engine

Special tools required:

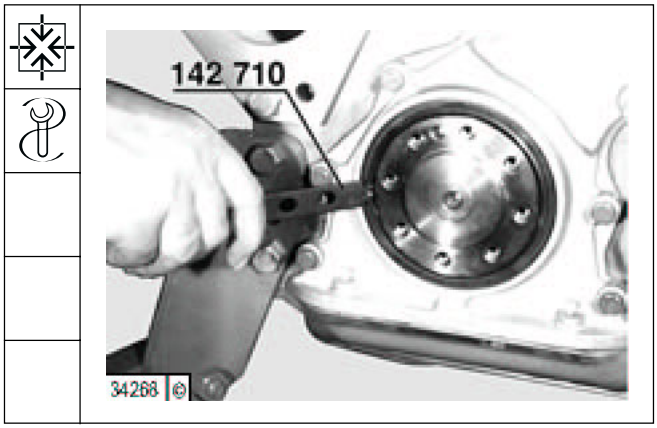
Puller for shaft seals 142 710
Assembly tools front 142 050
Assembly tools front 142 680
Assembly tools rear 142 690
Assembly tools front 142 850
Assembly tools rear 142 860

- Cover flywheel end -

Flywheel has been removed.

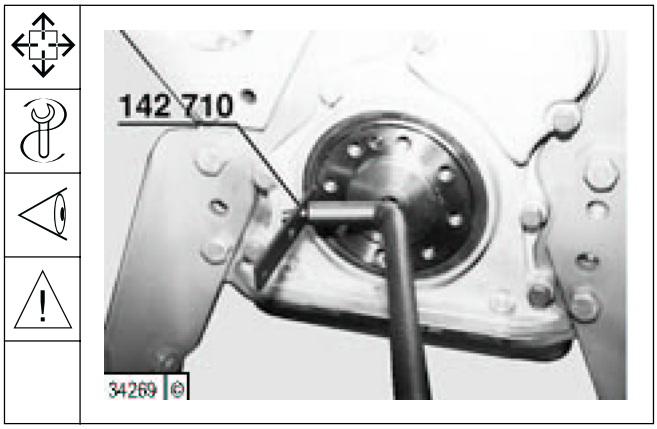
1. Remove shaft seal

1.1 Press angle hook into shaft seal.



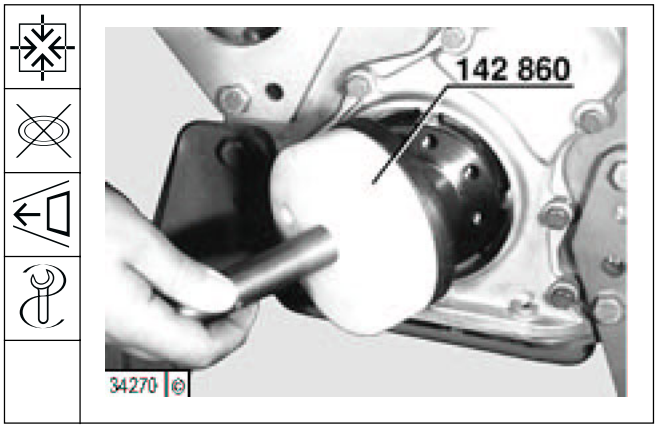
1.2 Pull the shaft seal ring with a withdrawal device out of the cover.
Check visually the contact surface of the shaft seal ring on the crankshaft.

Note: If the contact surface does not yet have a lead-in spiral, a new shaft seal ring can be built in.
If a lead-in spiral is available, a new shaft seal ring must be built in with a rotating ring.



2. Fit new shaft seal

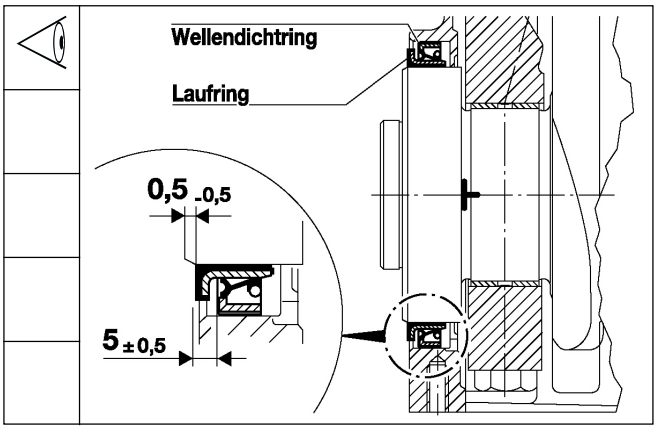
2.1 Fit new shaft seal with assembly tool without using oil. Sealing lip points towards crankshaft.



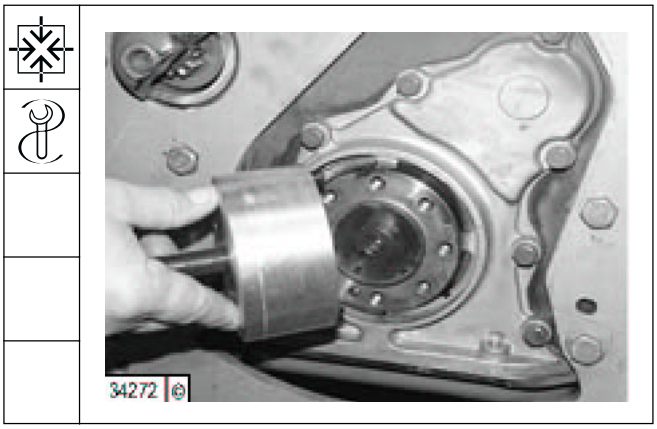
3. Mount a new shaft seal ring with a rotating ring

3.1 Fitting dimension of the shaft seal ring set

Wellendichtring = shaft seal ring
Laufring = rotating ring



3.2 Attach the guide at the crankshaft.
Turn the screws slightly.

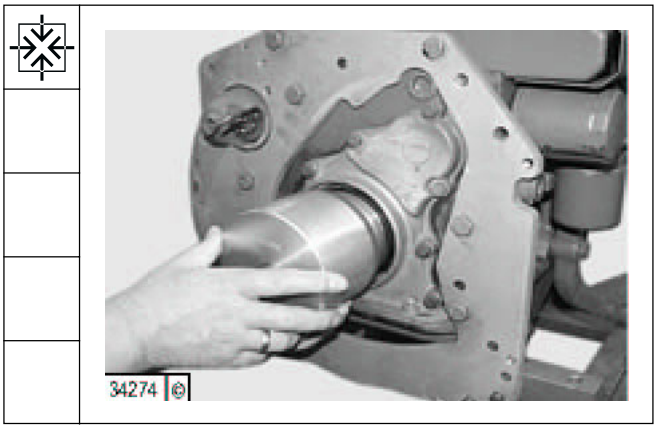


3.3 Insert a new shaft seal ring together with a rotating ring into the centering of the mounting sleeve.

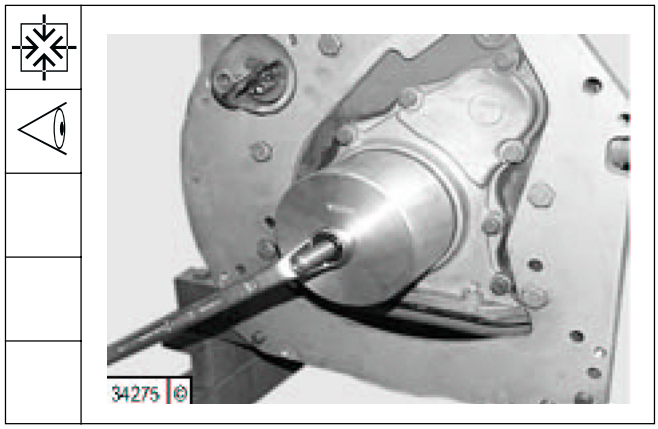
Note: Lubricate slightly the outer Ø of the shaft seal ring and inner Ø of the rotating ring.



3.4 Insert the shaft seal ring set with the mounting sleeve over the guide.



3.5 Push in the mounting sleeve up to the unit. The shaft seal ring and the rotating ring are then in their correct position.

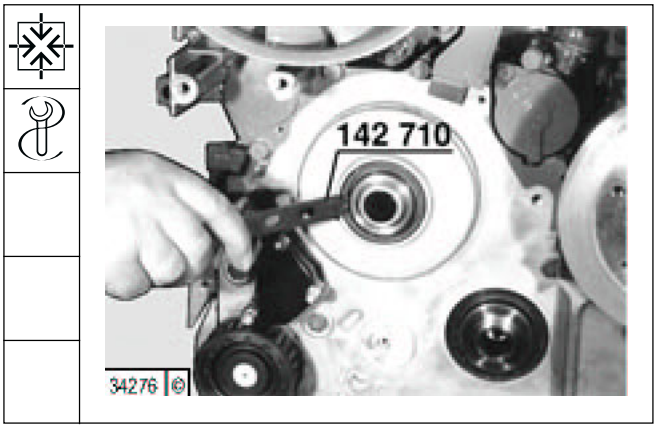


- Front cover -

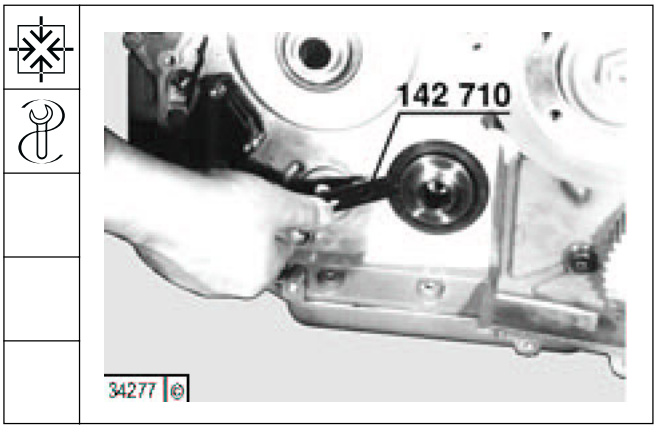
Toothed belt guard/camshaft and crankshaft gears have been removed. After having fitted shaft seals basic setting of “camshaft relative to crankshaft” has to be carried out.

1. Remove shaft seals

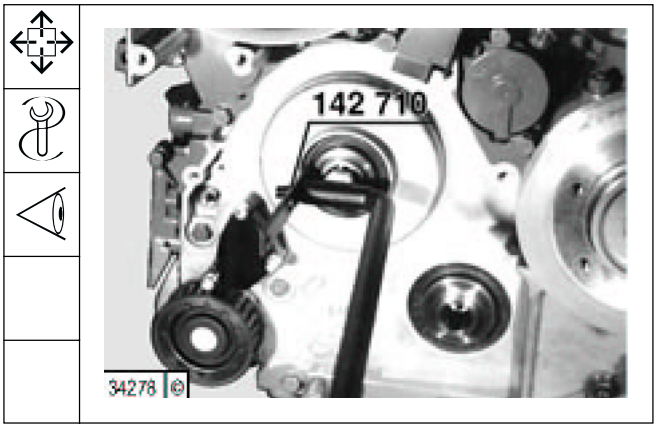
1.1 Press angle hook into seal of camshaft



- crankshaft -



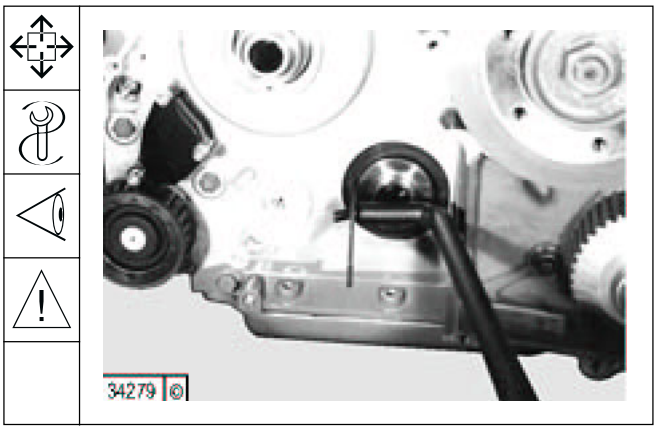
1.2 Withdraw the shaft seal ring for the cam shaft



- and the crankshaft with the aid of a withdrawal device.

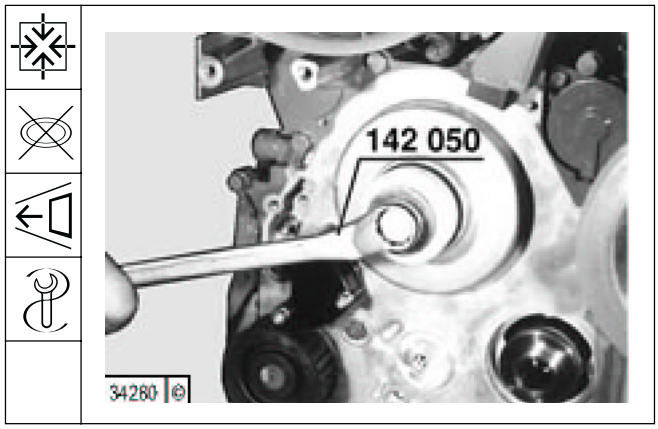
- Check visually the contact surface of the shaft seal rings on the crankshaft.

Note: If the contact surface does not yet have a lead-in spiral on the crankshaft, a new shaft seal ring can be built in.
If a lead-in spiral is available, a new shaft seal ring must be built in with a rotating ring.

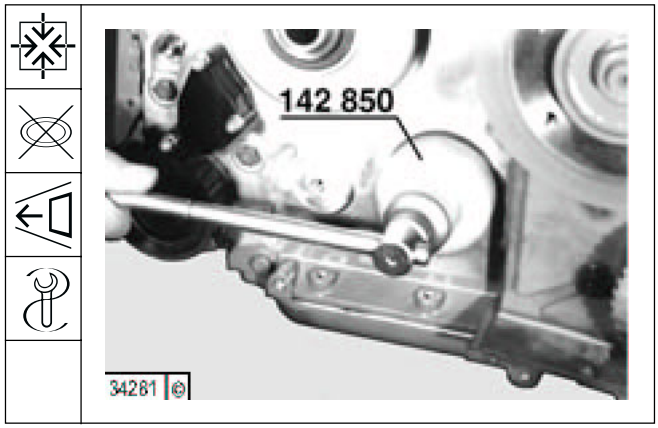


2. Fit in new shaft seal rings

2.1 Fit new seal for camshaft with assembly tool without using oil.
Sealing lip points towards camshaft.



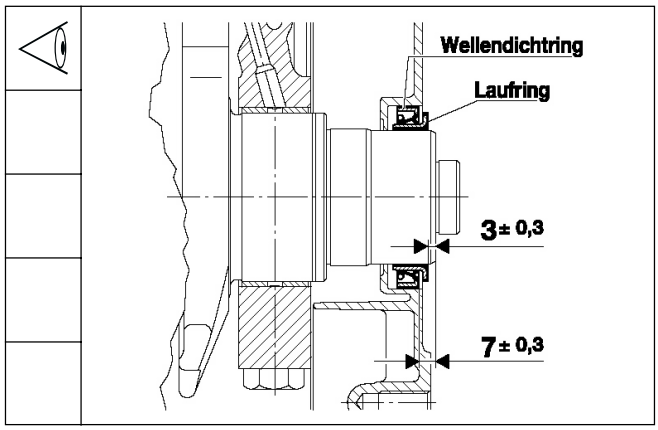
2.2. Fit new seal for crankshaft with assembly tool without using oil.
Sealing lip points towards crankshaft.



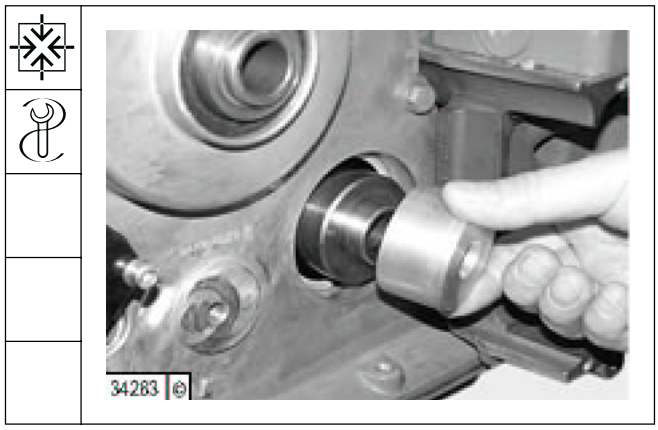
3. Mount on a new shaft seal ring with a rotating ring for the crankshaft

3.1 Fitting dimension of the shaft seal ring set

Wellendichtring = shaft seal ring
Laufring = rotating ring

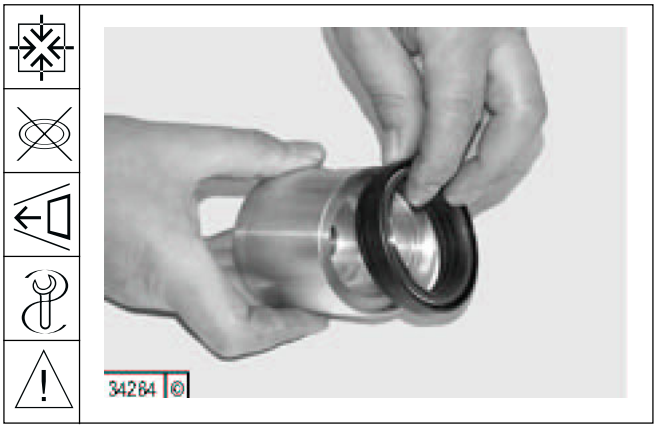


3.2 Place a guide onto the crankshaft.

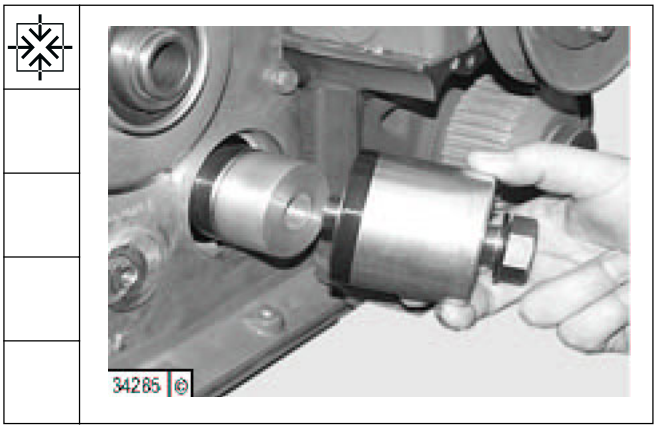


3.3 Insert a new shaft seal ring together with a rotating ring into the centering of the mounting sleeve.

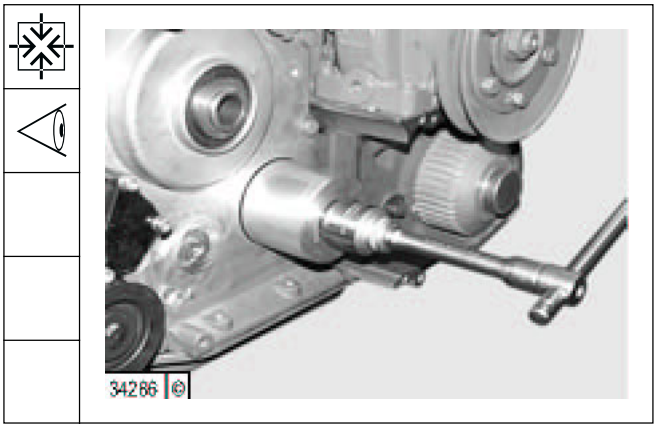
Note: Lubricate slightly the outer Ø of the shaft seal ring and inner Ø of the rotating ring.



3.4 Insert the shaft seal ring set with the mounting sleeve over the guide.



3.5 Push in the mounting sleeve up to the unit.
The shaft seal ring and the rotating ring are then in their correct position.

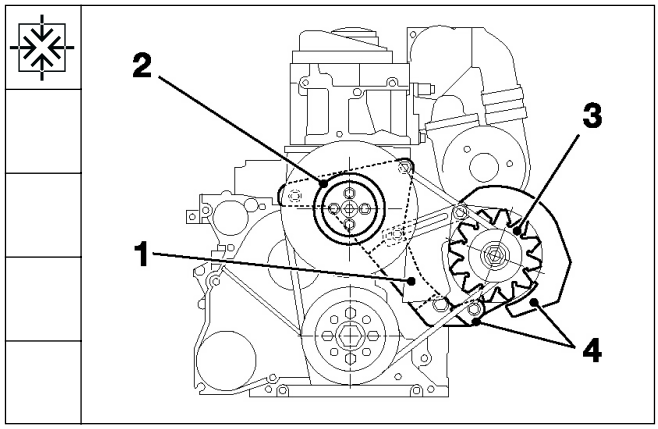


Different fan drive attachments

1. **High-built fan drive**
(aggregate design)

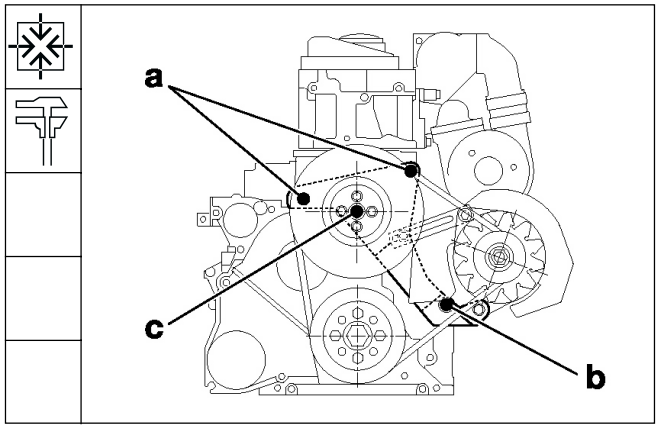
Commercial tool required:
V-belt tension measuring instrument 8115

1.1 Mount on the console (1), fan drive (2), generator (3) and guard plates (4).



1.2 Tighten bolts.

Tightening specification: a = **34 Nm**
b = Pretension **30 Nm**
Restress angle plate **49**°
c = Pretension **30 Nm**
Restress angle plate **120**°

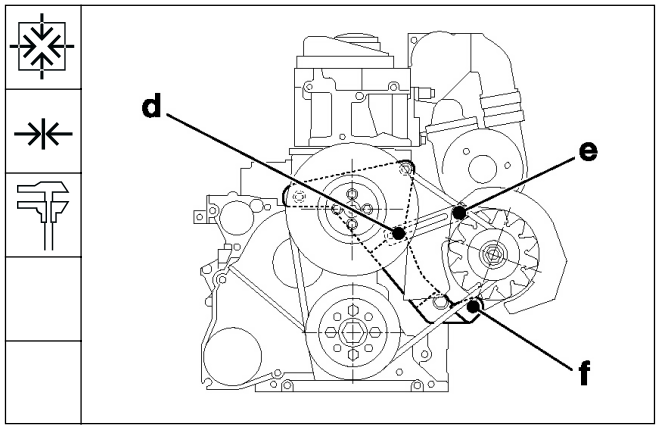


1.3 Place and tighten the V-belt. Firmly tighten the screws.

Tightening specification: d = **22 Nm**
e = **22 Nm**
f = **34 Nm**

Check the V-belt tensioning with a stress measuring instrument 8115.

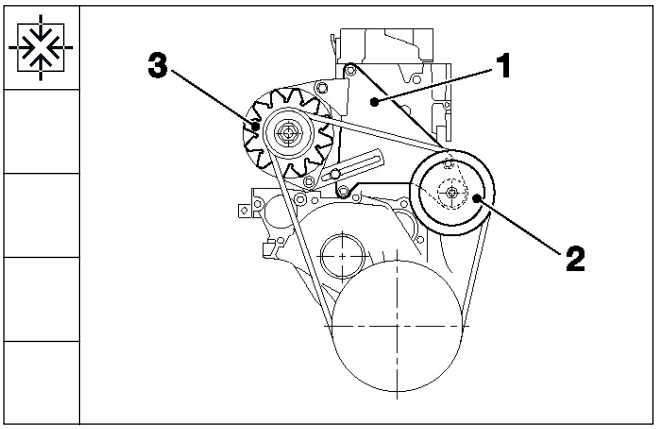
Initial assembly: **450** ± **50 Nm**
Control value after after 15 minutes running on load: **300** ± **20 Nm**
If the set value is not reached, repeat the tightening operation.



2. **High-built fan drive**
(construction machine design)

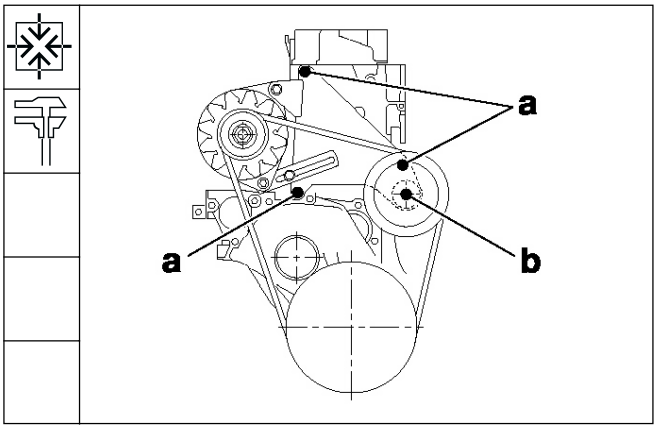
Commercial tool required:
V-belt tension measuring instrument 8115

2.1 Mount on the console (1), fan drive (2) and generator (3).



2.2 Tighten bolts.

Tightening specification: a = **30 Nm**
b = Pretension **30 Nm**
Restress angle plate **120**°



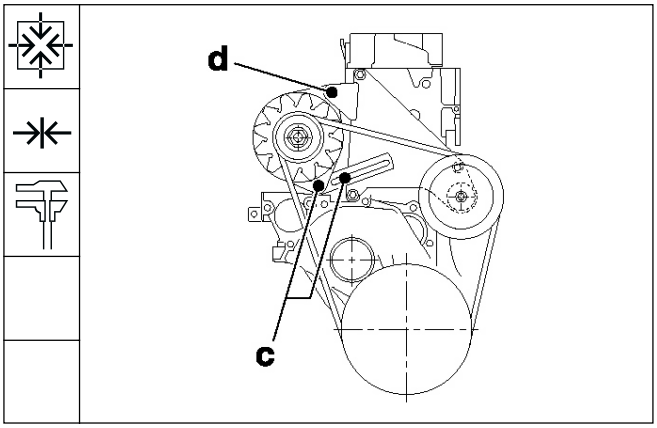
2.3 Place and tighten the V-belt. Firmly tighten the screws.

Tightening specification: c = **21 Nm**
d = **30 Nm**

Check the V-belt tensioning with a stress measuring instrument 8115.

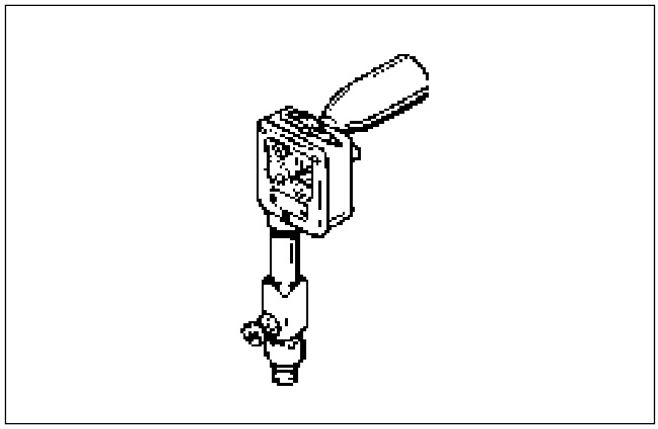
Initial assembly: **450** ± **50 Nm**
Control value after after 15 minutes running on load: **300** ± **20 Nm**

If the set value is not reached, repeat the tightening operation.

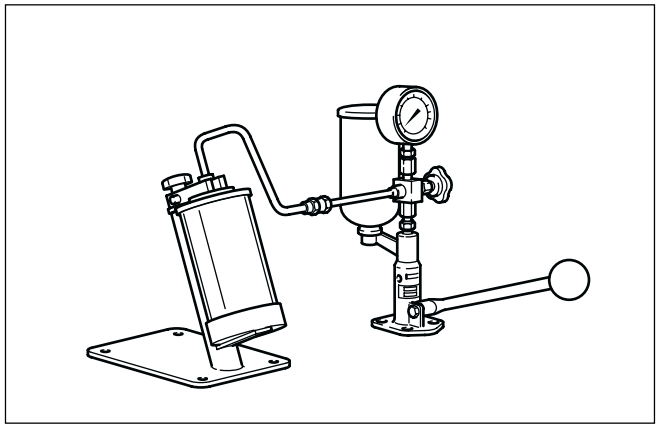


TOOLS

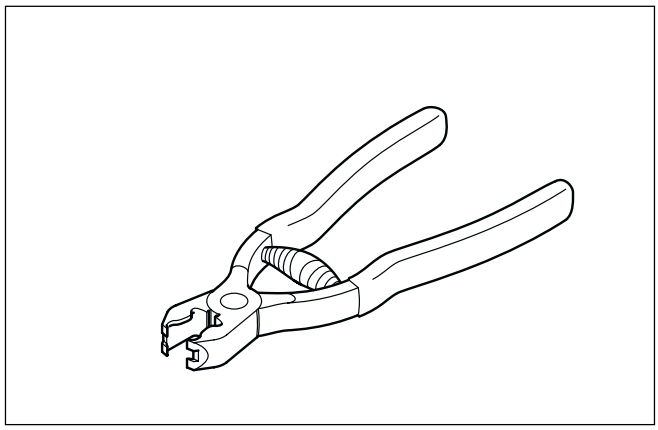
Description	Code
• Compression tester	8005



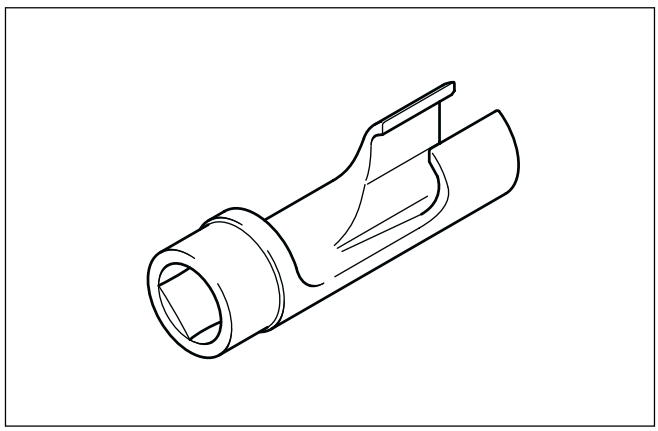
• Nozzle tester	8008



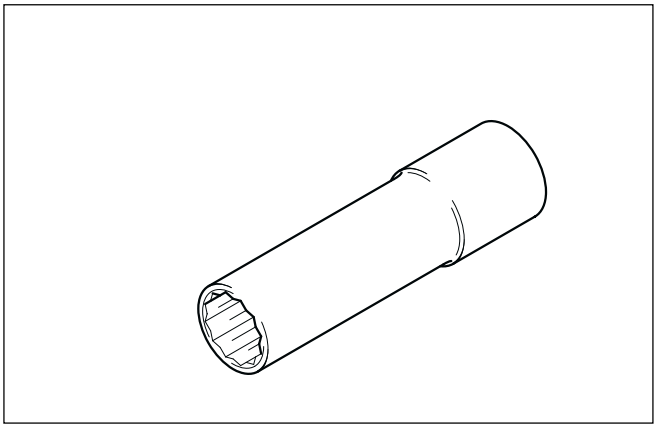
• Clip pliers	8011



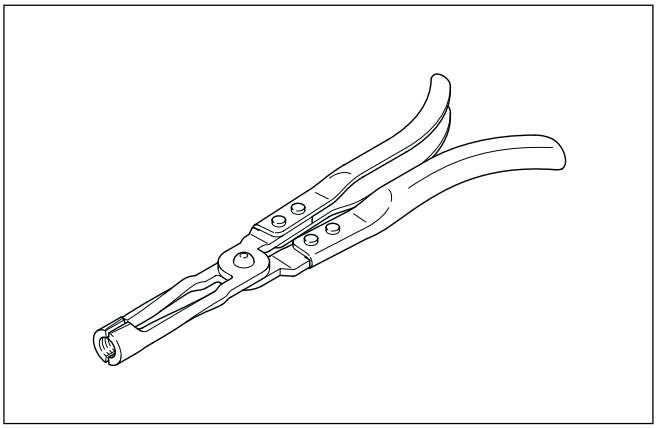
• Claw key	8018



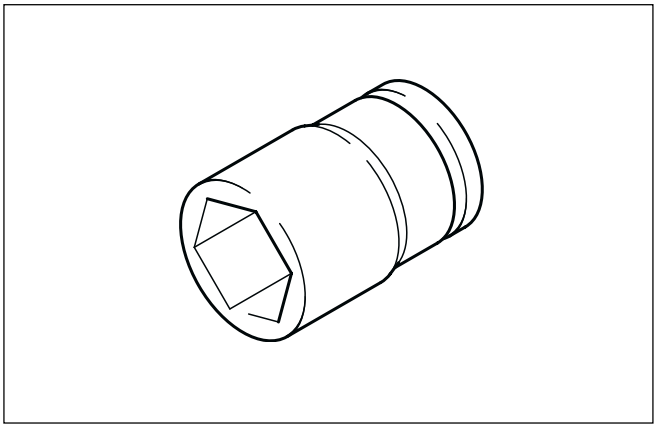
Description	Code
• Long socket a/flats 15	8021



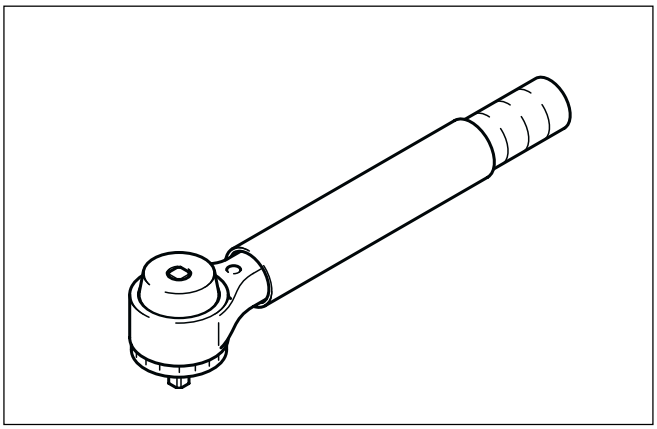
• Valve stem gasket pliers	8024



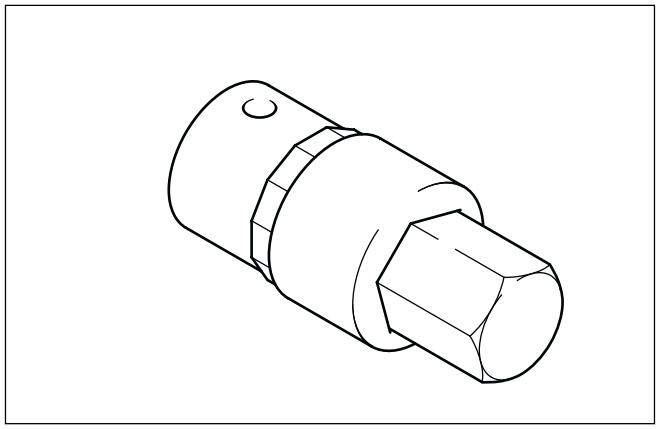
• Socket a/flats 32	8036



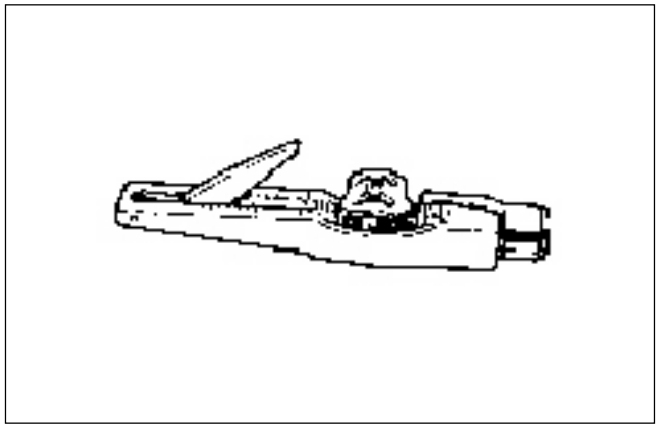
• Multipower tool for central bolt	8049



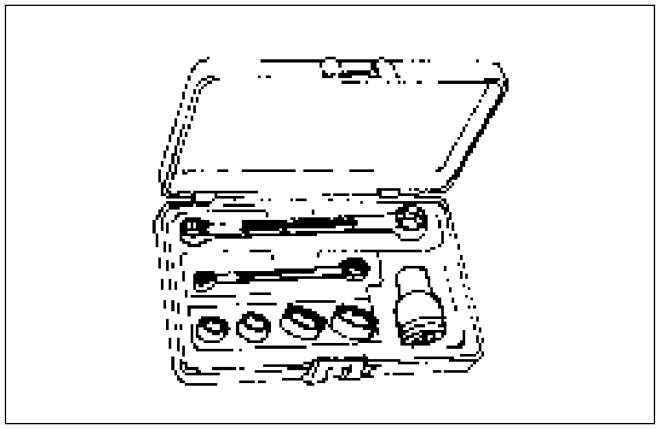
Description	Code
• Screw driver socket 1/2" a/flats 17	8112



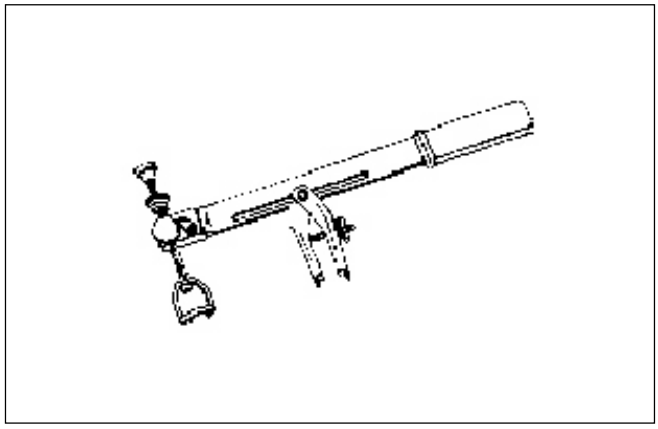
• V-belt tension gauge	8115

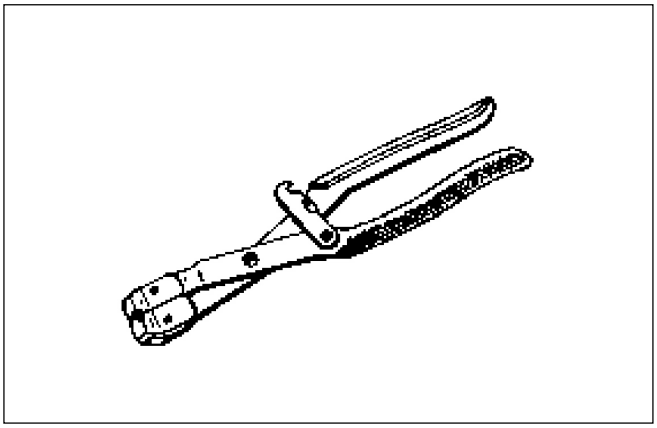
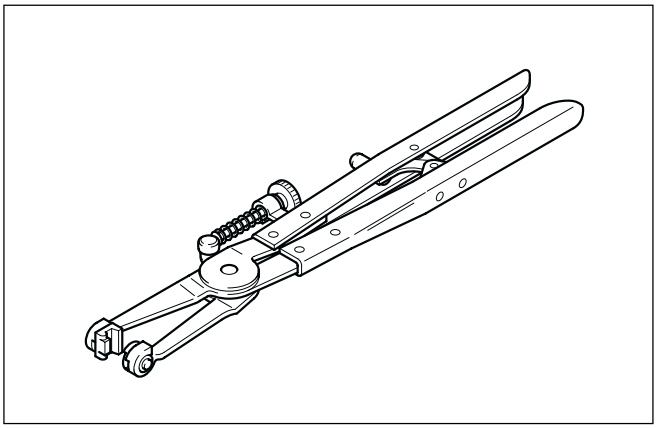
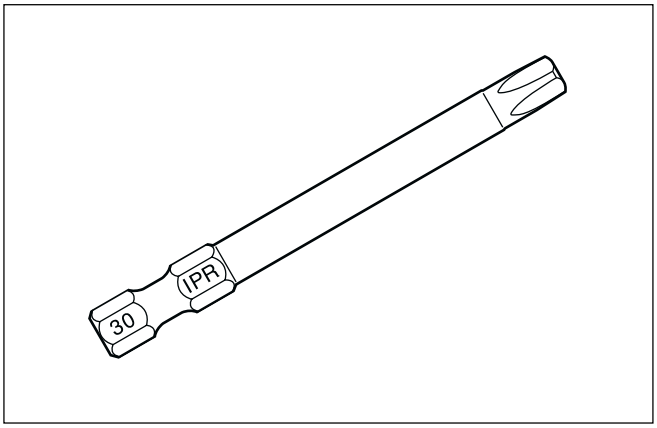
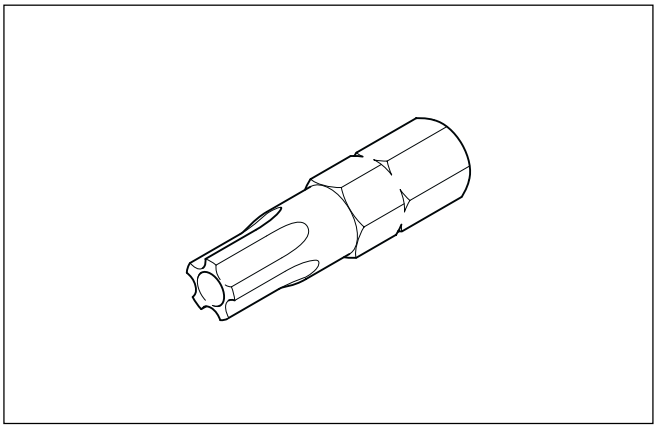


• Torx tool kit	8189

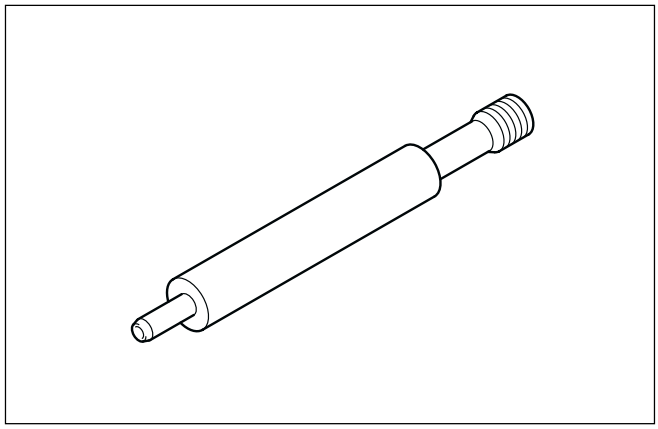


• Valve spring assembly lever	9017

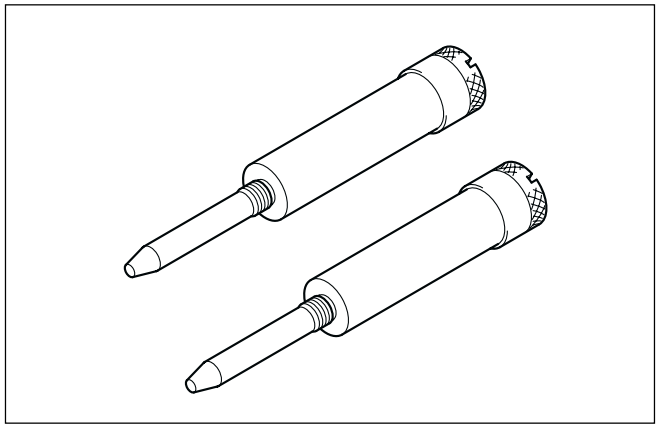


Description	Code	
• Hose clip pliers	9088	
• Spring clamp pliers	9090	
• Torx special bit 70 mm long	9120	
• Torx special bit 25 mm long	9122	

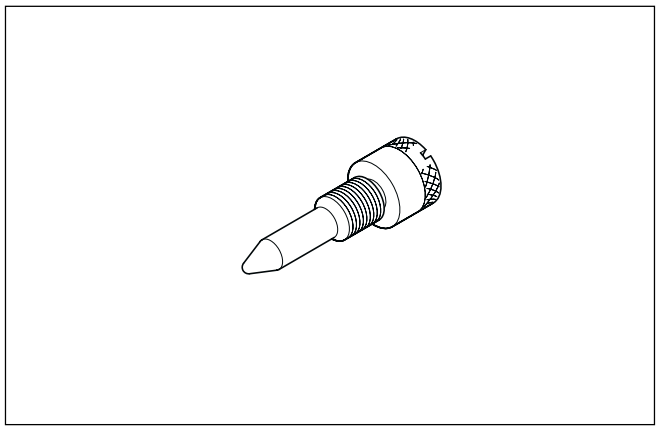
Description	Code
• Adapter for compression tester	100 120



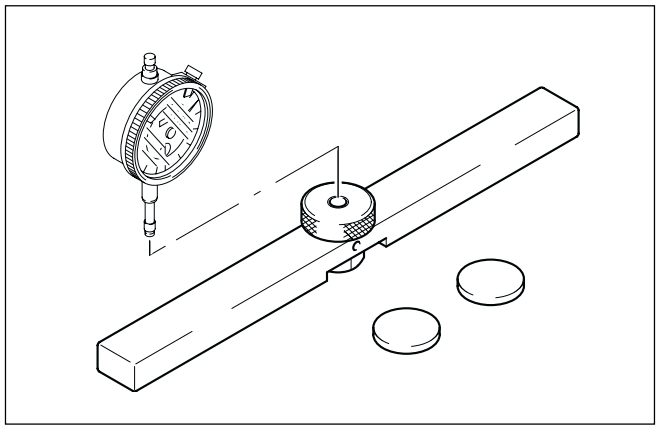
Description	Code
• Adjusting pin for crankshaft and camshaft	100 700



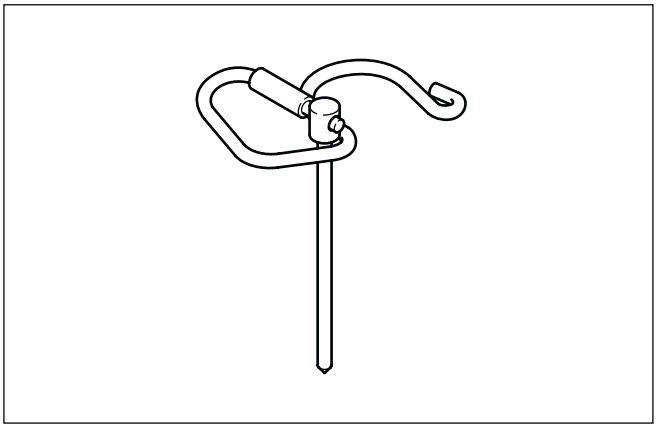
Description	Code
• Adjusting pin for injection pump control rod	100 710



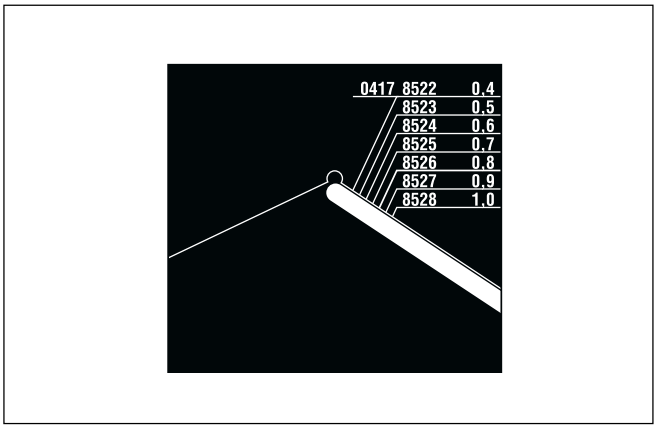
Description	Code
• Gauge with spacers for piston projection and front cover	100 750



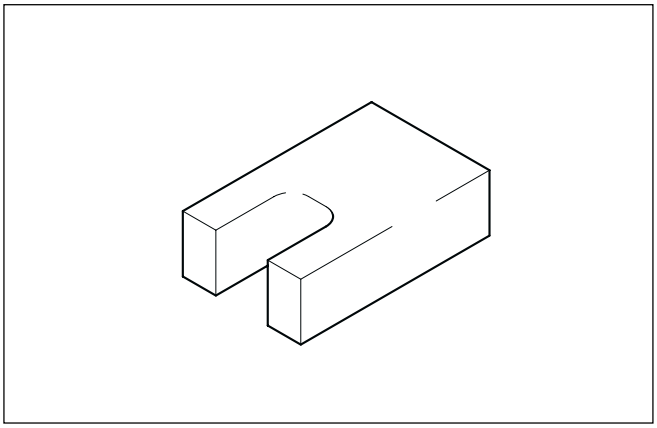
Description	Code
• Locking wire for control lever, injection pump	100 880



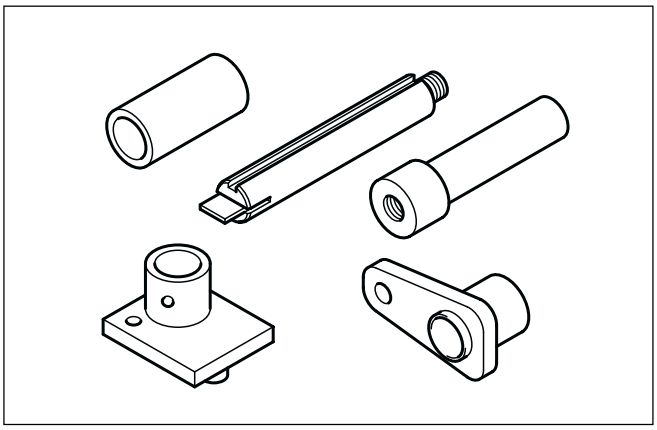
• Test template for I.P. gasket	103 020



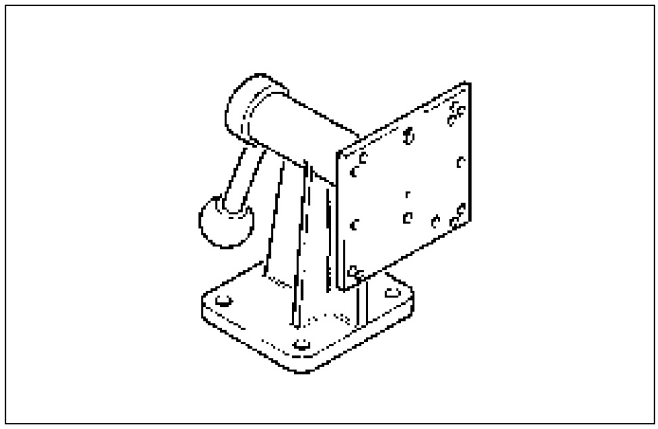
• Retainer for injector	110 110



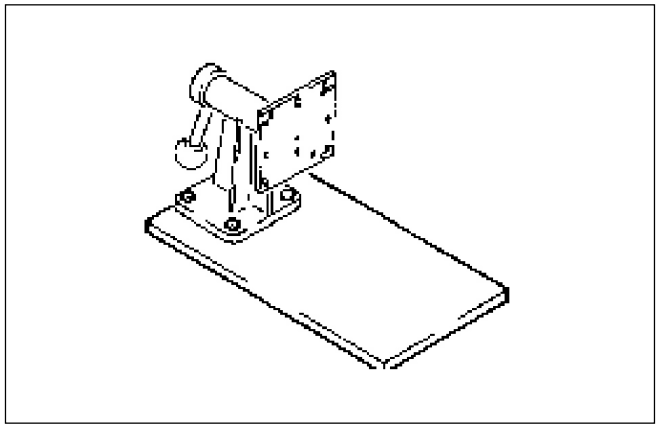
• Assembly tool for control rod bush	100 140



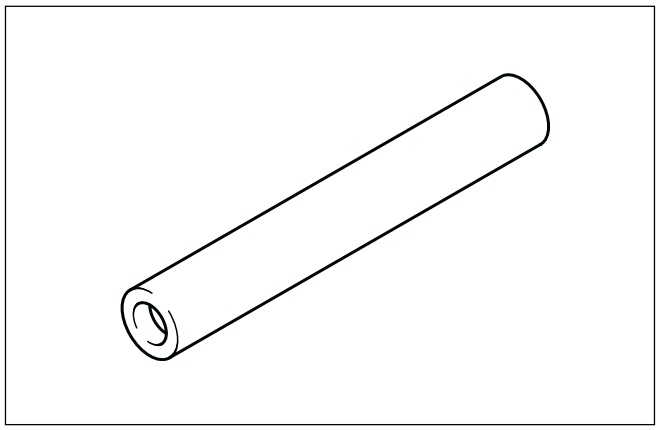
Description	Code
• Clamping stand for cylinder heads	120 900



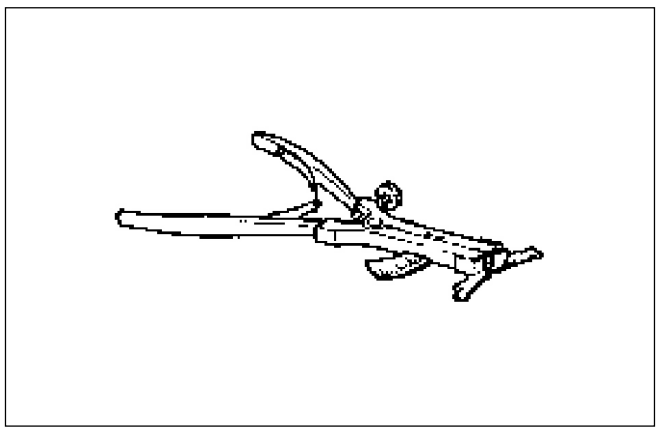
Description	Code
• Clamping plate for 120 900	120 910



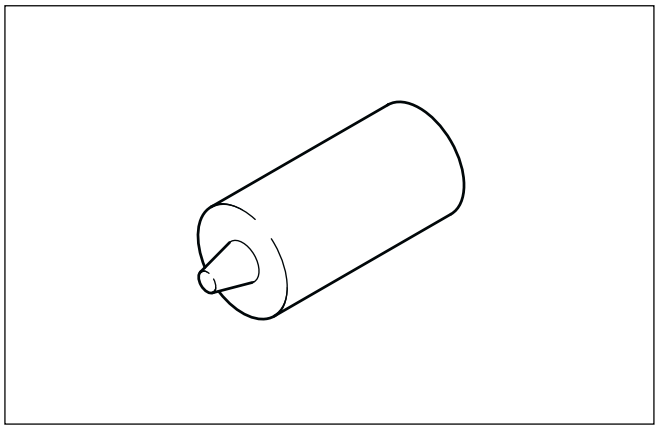
Description	Code
• Sleeve for fitting valve stem seal	121 410



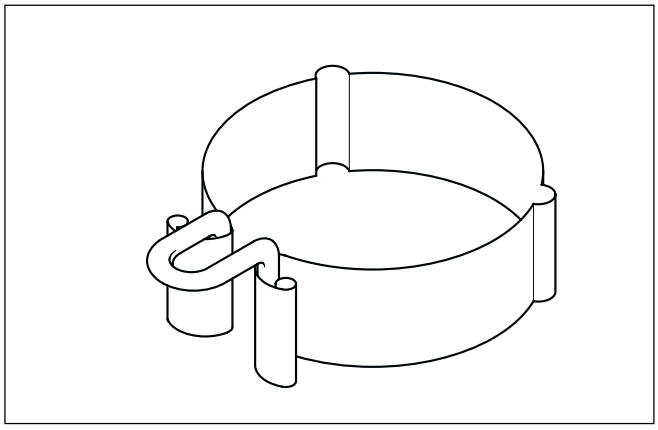
Description	Code
• Universal piston ring pliers	130 300



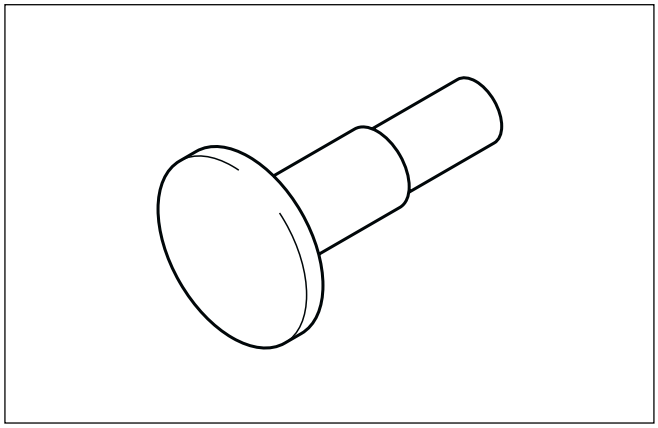
Description	Code
• Trapezoidal groove wear gauge	130 420



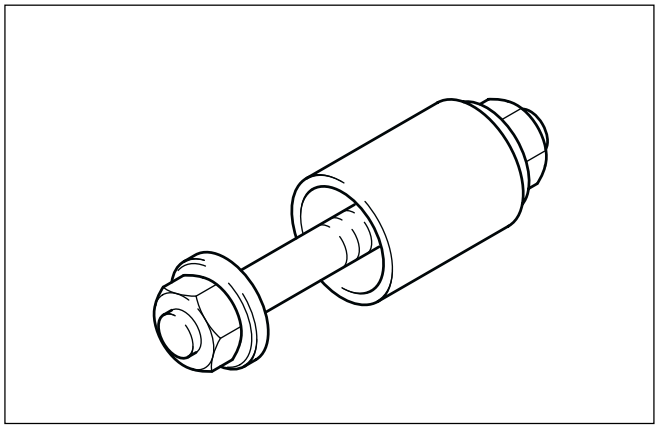
Description	Code
• Piston ring compressor	130 630



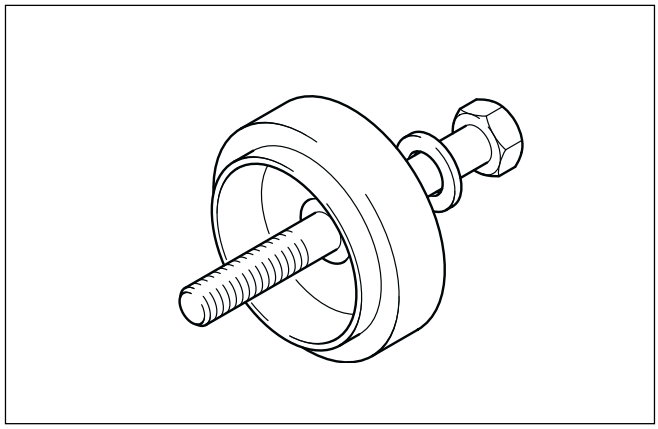
Description	Code
• Disassembling tool for spring ring	131 100



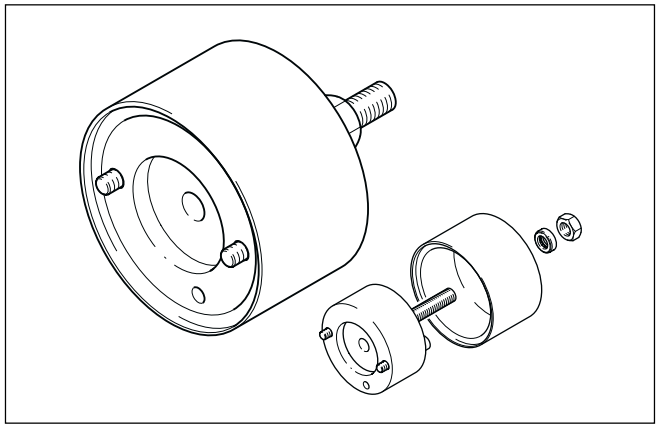
Description	Code
• Assembly tool for small end bush	131 340 131 350



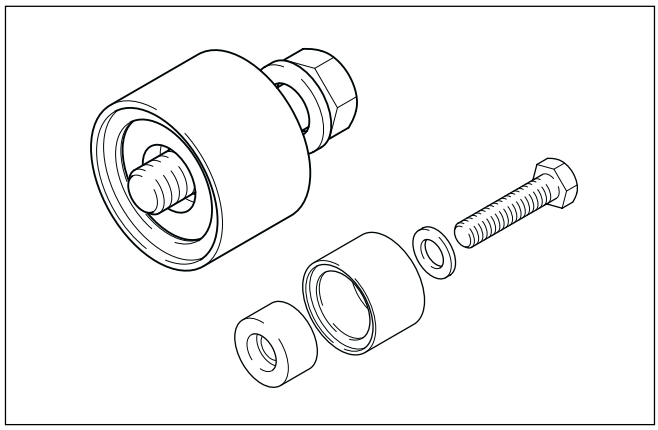
Description	Code
• Assembly tool for camshaft seals	142 050



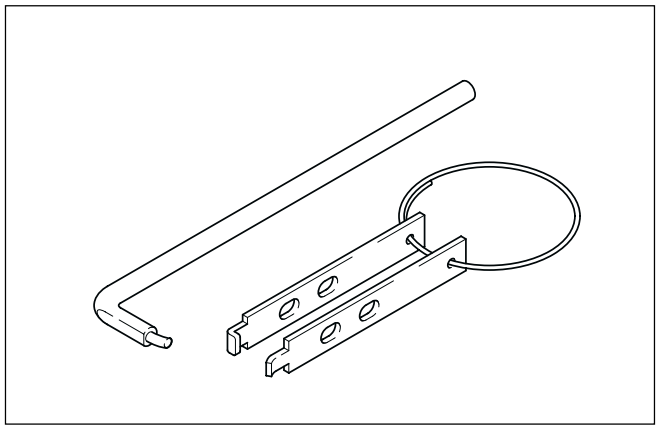
• Assembly tools for the sealing ring set, rear	142 680



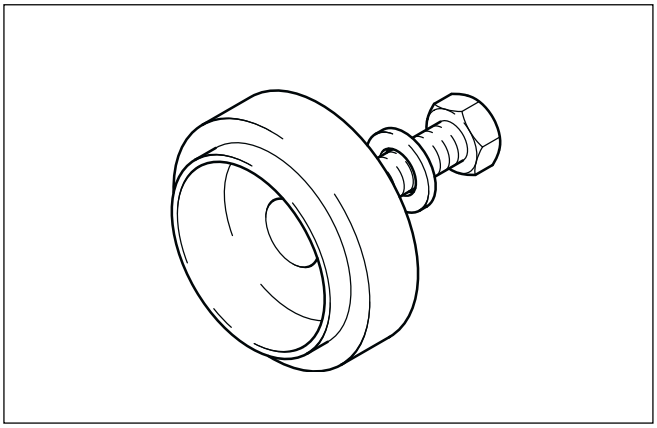
• Assembly tools for the sealing ring set, front	142 690



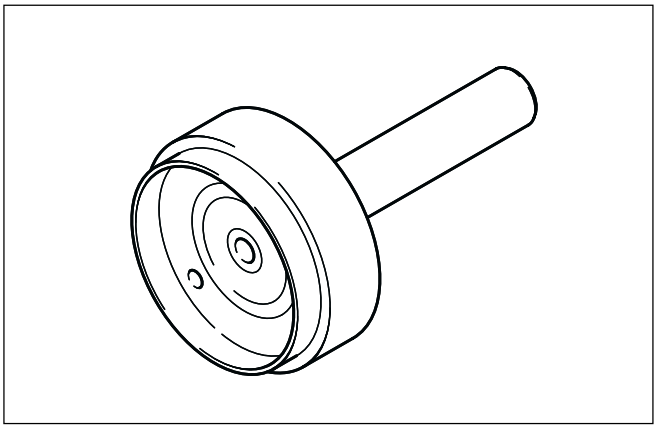
• Puller for crankshaft seals	142 710



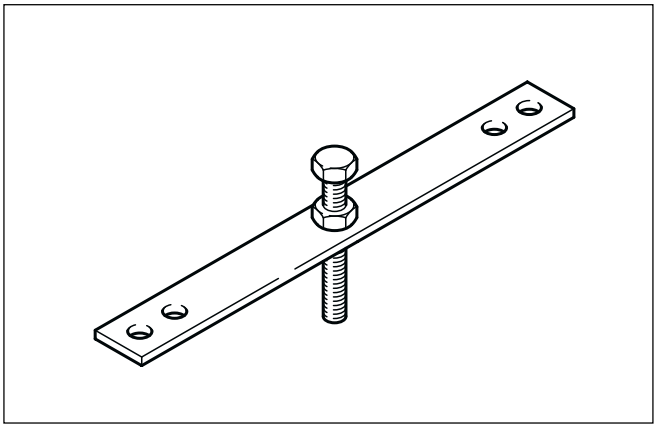
Description	Code
• Assembly tool for crankshaft seals, front	142 850



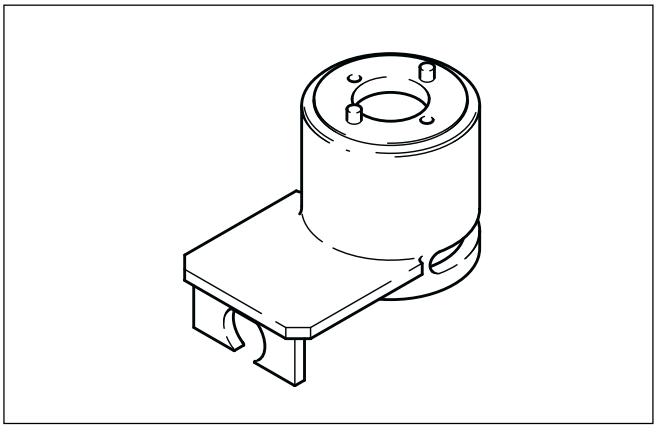
• Assembly tool for crankshaft seals, rear	142 860



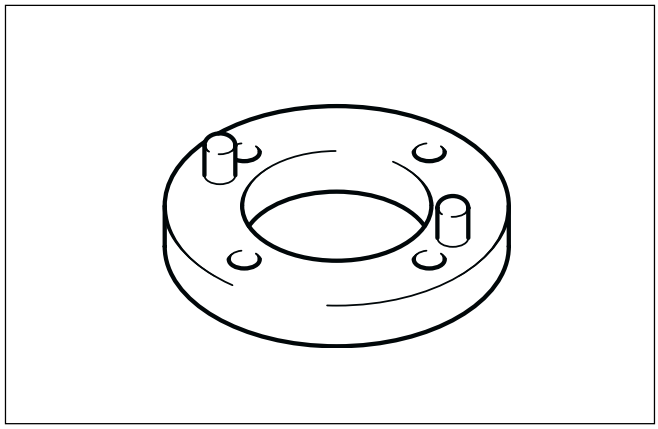
• Puller for flywheel	143 100



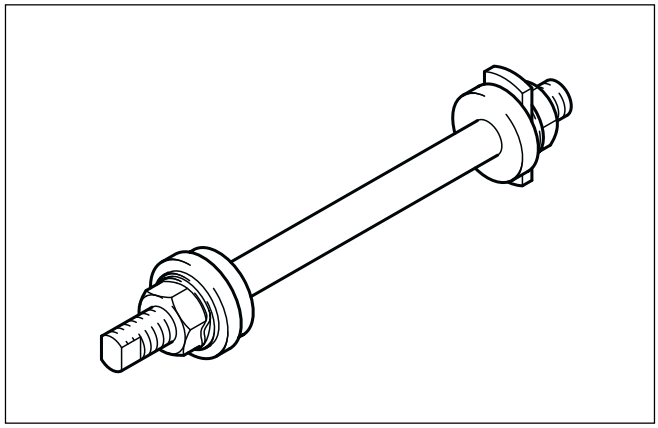
• Dolly for multipower tool	143 420



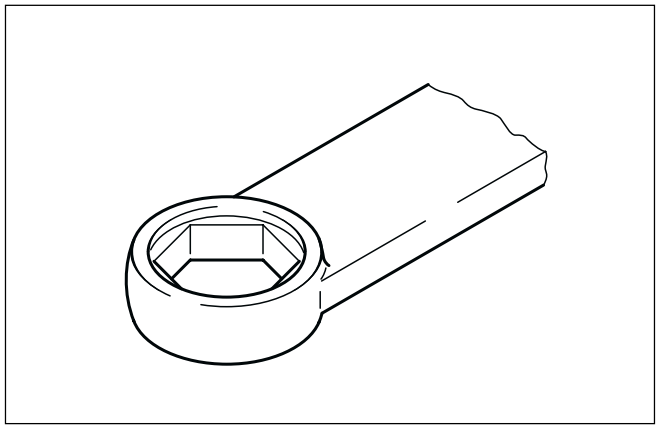
Description	Code
• Intermediate disc for dolly 143 420	143 430



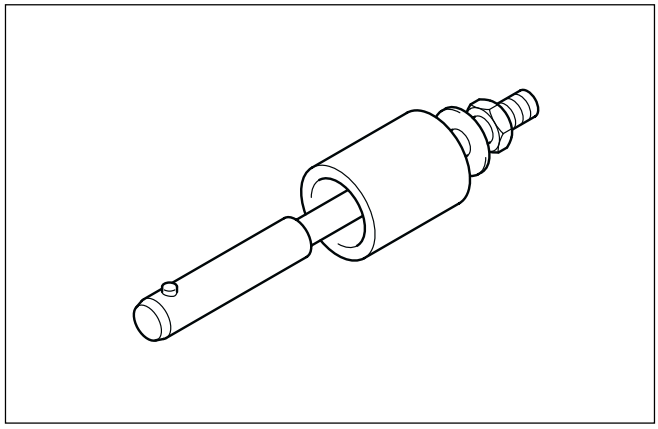
• Assembly tool for camshaft bush	143 820



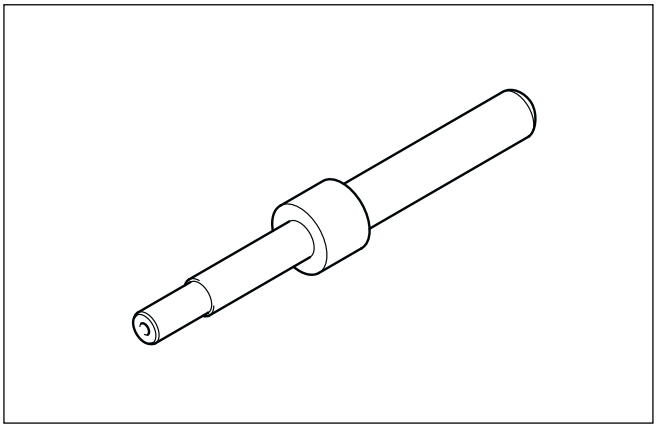
• Dolly for camshaft gear	144 130



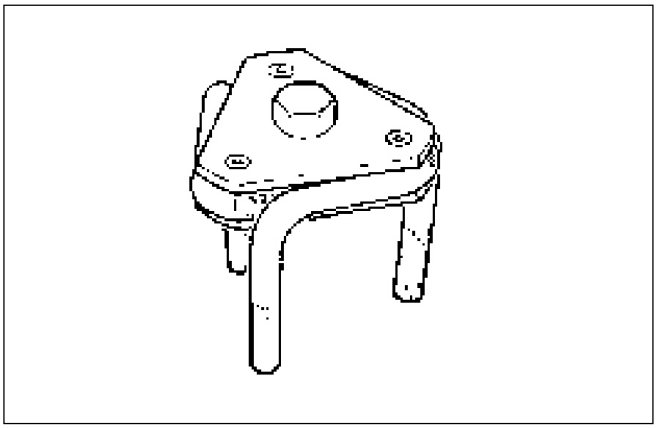
• Puller for pipe	150 140



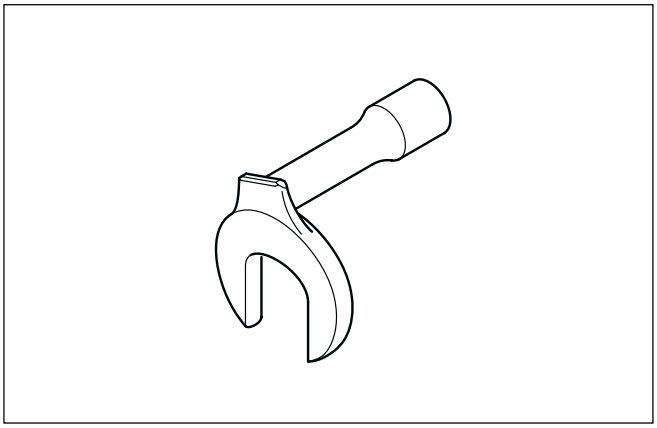
Description	Code
• Assembly arbor for pipe	150 150



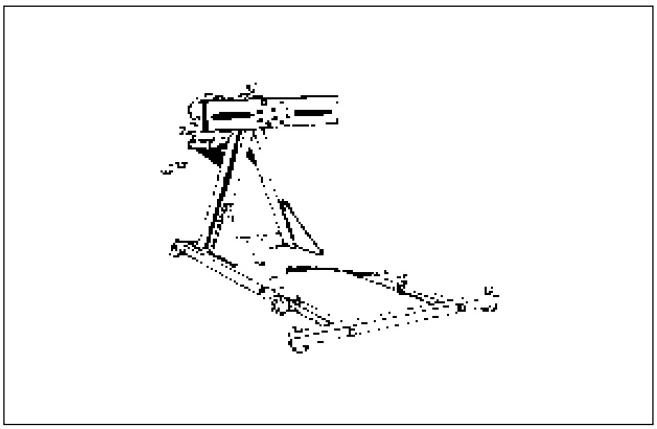
• Special key for filter cartridges	170 050



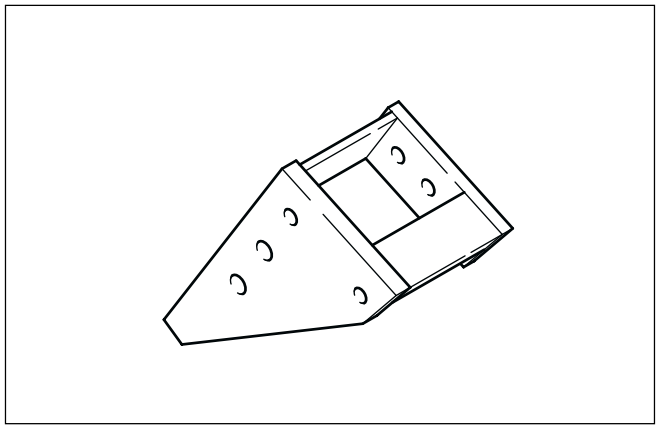
• Special wrench for oil pressure sensor	170 110



• Engine assembly stand	6067



Description	Code
• Angled clamping plate	6067/115



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