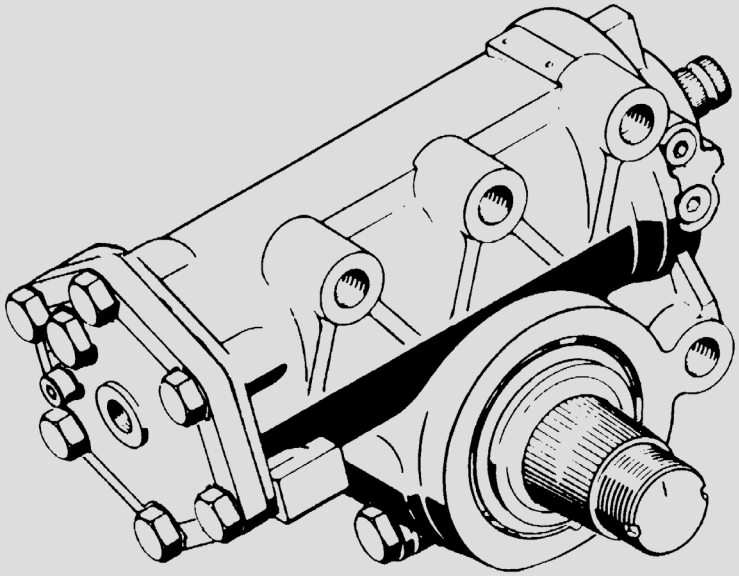
Service Manual

RB-Servocom®
Types 8090, 8095, 8097, 8098, 8118



Robert Bosch Automotive Steering GmbH
73522 Schwaebisch Gmuend
Germany
Telephone +49 7171 31-7936
global.service@bosch.com
https://steering-service.com

8090 S 2016-06 en V02 | Version 02 | 14.06.2016

Safety Instructions

- These instructions are to be referred to when carrying out necessary service work and repair on the Automotive Steering unit.
- Read these instructions first before starting the service work.
- Authorized, specialized staff must make sure that the product works perfectly again after the service work has been completed.
- **Automotive Steering units may only be repaired in workshops with**
  - **staff trained by Robert Bosch Automotive Steering GmbH**
  - **specified equipment and special tools corresponding to the work to be performed**
  - **original Bosch spare parts**
- This manual should only be used by technicians whose practical and theoretical training in our Global Service Training Centre is supplemented by this reference book and by service information.
- As a basic principle, only work listed in the instructions may be carried out on the steering gear. Additional changes or adaptations are not permitted and could cause a safety-critical deficiency. However, if in exceptional circumstances, other work should be necessary, then separate information which is only applicable for this case will be provided (e.g. service information).
- All work on Automotive Steering units must be carried out with great care and conscientiousness. This applies in particular to units and transmission parts from vehicles which have been involved in accidents.
- Before removing the hydraulic unit, any operating fluid (e.g. lubricant) must be drained without residue and must be routed through company-internal disposal.
- All metal parts which can no longer be used must be recycled in metal recycling. Other parts (e.g. seals) must be disposed of properly according to the respective applicable regulations.
- The manufacturer will not be held liable for damage and associated consequences caused by improper and/or unqualified repair.

The numbers indicated in round brackets refer to the picture numbers used in the figures.
The numbers indicated in square brackets refer to the used tools.

Important Notes

These instructions are not subject to the change management service.

Pay attention to further written service information.

List of Changes

Index	Date of Issue	Author	Chapter	Comment
01	04/2006	n.a.	-	Initial version
02	06/2016	NJ | OTG	All	Layout changed

Content

1 Symbols Used

Pictograms used in this document:

DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Application notes and other useful information.

2 Safety note for driver and workshop personnel

CAUTION

Stiff steering due to a failure of hydraulic assistance!

If the steering system is in a perfect working order, the steering efforts the driver has to exert on the steering wheel are low, e.g., 30 N corresponding to approx. 3 kg.

In the event of a failure of the hydraulic assistance (for example owing to lack of oil) the effort needed to carry out a steering motion will increase considerably, for example to 450 N corresponding to approx. 45 kg.

As this happens very seldom and unexpectedly, the driver may be led to believe, erroneously, that the steering system cannot be moved at all any longer.

However, even in the event of a failure of the hydraulic assistance, there is always a mechanical connection between the steering wheel and the road wheel ensuring that manual steering at increased steering efforts can take place.

- To avoid damages inside the steering gear and damages to the steering column, the steering effort at the steering wheel rim when steering motions are carried out without hydraulic assistance and at vehicle standstill must not exceed 700 N (approx. 70 kg) – based on a steering wheel diameter of 500 mm.

3 Design

The housing of the RB-Servocom steering gear houses the steering valve, the steering cylinder and a complete manual steering gear.

The oil flow and the pressure required by the steering gear is supplied by an engine-driven pump. To achieve this, the oil is taken in from the oil tank and fed back to the tank via the pump and the steering gear. The housing (A) - see Fig. 1- and the piston (B) have the function of a cylinder. The piston transforms the rotation of the steering input shaft (C) and of the worm (D) into an axial motion which it transmits to the sector shaft (F). The piston (B) and the worm (D) are positively connected with each other by means of a ball chain. As the worm rotates, the balls at one end of the chain are taken up by a recirculation tube and fed back to the other end so that an endless ball chain is formed. The teeth of the piston (B) and of the sector shaft (F) cause the sector shaft to rotate when the piston is displaced.

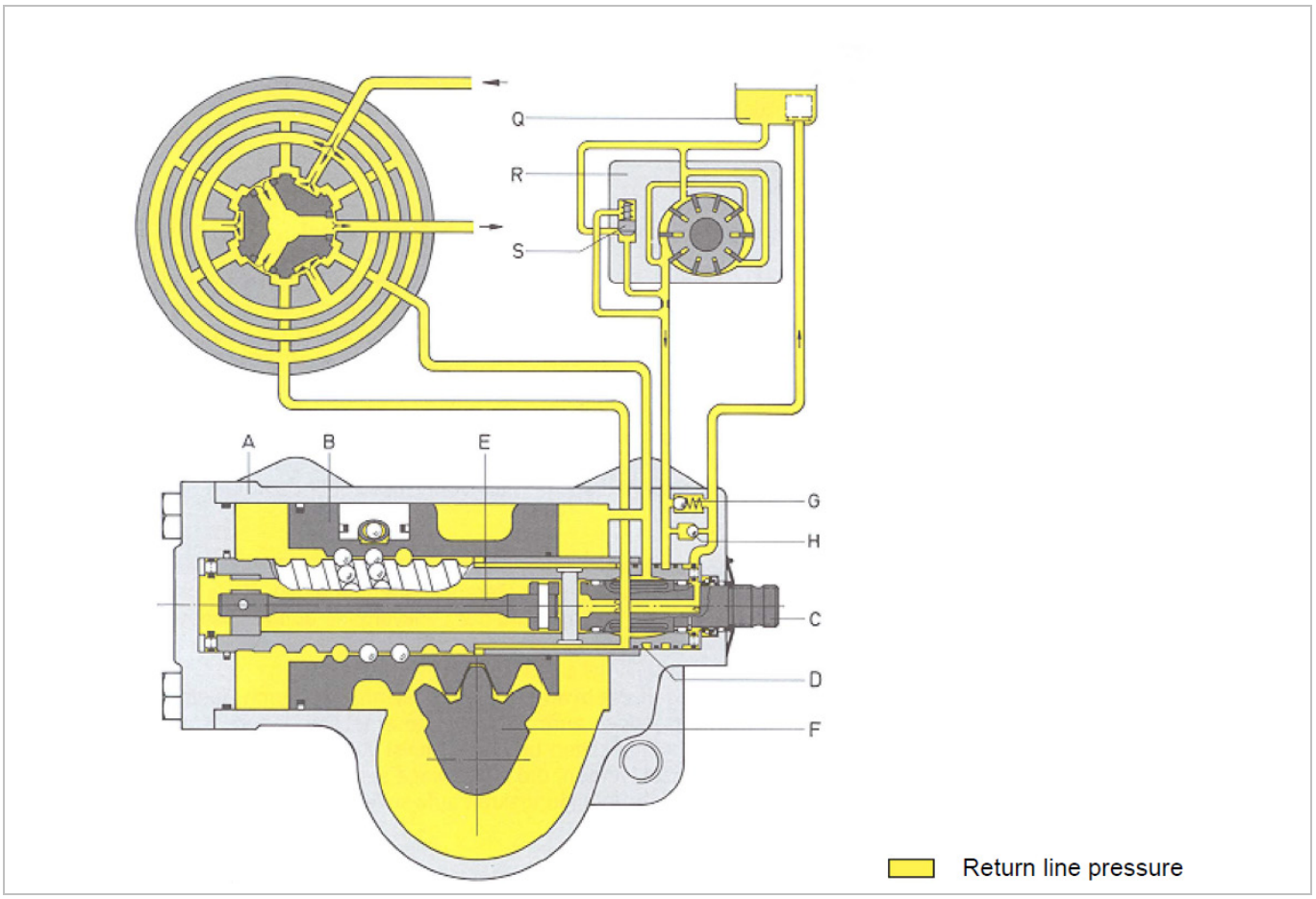


Fig. 1: Valve rotor in mid-position

Number	Description	Number	Description
A	Housing	B	Piston
C	Valve rotor/steering input shaft	D	Valve sleeve/worm
E	Torsion bar	F	Sector shaft
G	Pressure relief valve	H	Replenishment valve
Q	Oil tank	R	Vane pump
S	Flow limiting valve		

The steering valve consists of the valve rotor (C) which is carried in a needle bearing in the worm (D) and is provided with six control grooves on the circumference, and of the valve sleeve (D) on the worm (D). A torsion bar (E) pinned to the valve rotor (C) and the worm (D) keeps the steering valve in mid-position as long as no effort is exerted on the steering wheel. A pressure relief valve (G) limiting the maximum pressure within the steering system may be integrated in the steering gear housing. In addition, a replenishment valve (H) sucking oil from the return oil line when a steering motion without hydraulic assistance takes place can be fitted to the housing or to the steering valve.

In comparison with constant ratio steering gears, variable ratio steering gears are more direct around centre than outside the mid-position area, which has a favourable effect on the steering performance during straight ahead driving as minor steering corrections only, if any, are required. At the same time, in the static parking range requiring a wider steering wheel turning angle a higher hydraulic torque is available at the sector shaft owing to the more indirect steering ratio.

In the event of a failure of the hydraulic assistance the steering efforts at the steering wheel rim are lower in this range than they would be for a constant ratio steering gear.

The 3 functional drawings to Fig. 1 to Fig. 3 give a simplified representation of the steering valve and the oil flow. In addition, these figures give a cross-sectional view of the steering valve in order to schematically represent the connections from the steering valve to the cylinder chambers and the mode of operation of the valve.

4 Operation

When a torque is transmitted from the steering input shaft to the worm or vice-versa, the torsion bar is subjected to a deformation in the elastic area of its length, causing a torsion to occur between the valve rotor and the valve sleeve. Thus, to move the control grooves of the valve rotor away from the mid-position as compared with the position of the valve sleeve control grooves. When the steering wheel is released, the action of the torsion bar will make the steering valve return to the neutral (mid) position.

Through the bore in the housing, the oil flows into the annular groove of the valve sleeve and is fed to the arcuate control grooves of the inner valve rotor through three symmetrically-arranged radial bores. The position of the control grooves in the valve rotor and the valve sleeve is such that, in the mid-position of the steering valve, the oil can flow through the inlet slots (J and K) to the axial grooves (N and O) of the valve sleeve, which are also arcuate. From there, the oil can freely flow through radial bores to the cylinder chambers. As long as the steering valve is in the mid-position, the oil can flow to both cylinder chambers, and via the three return grooves (P) in the valve rotor it can also flow off to the oil tank.

4.1 Forward steering motion to the right

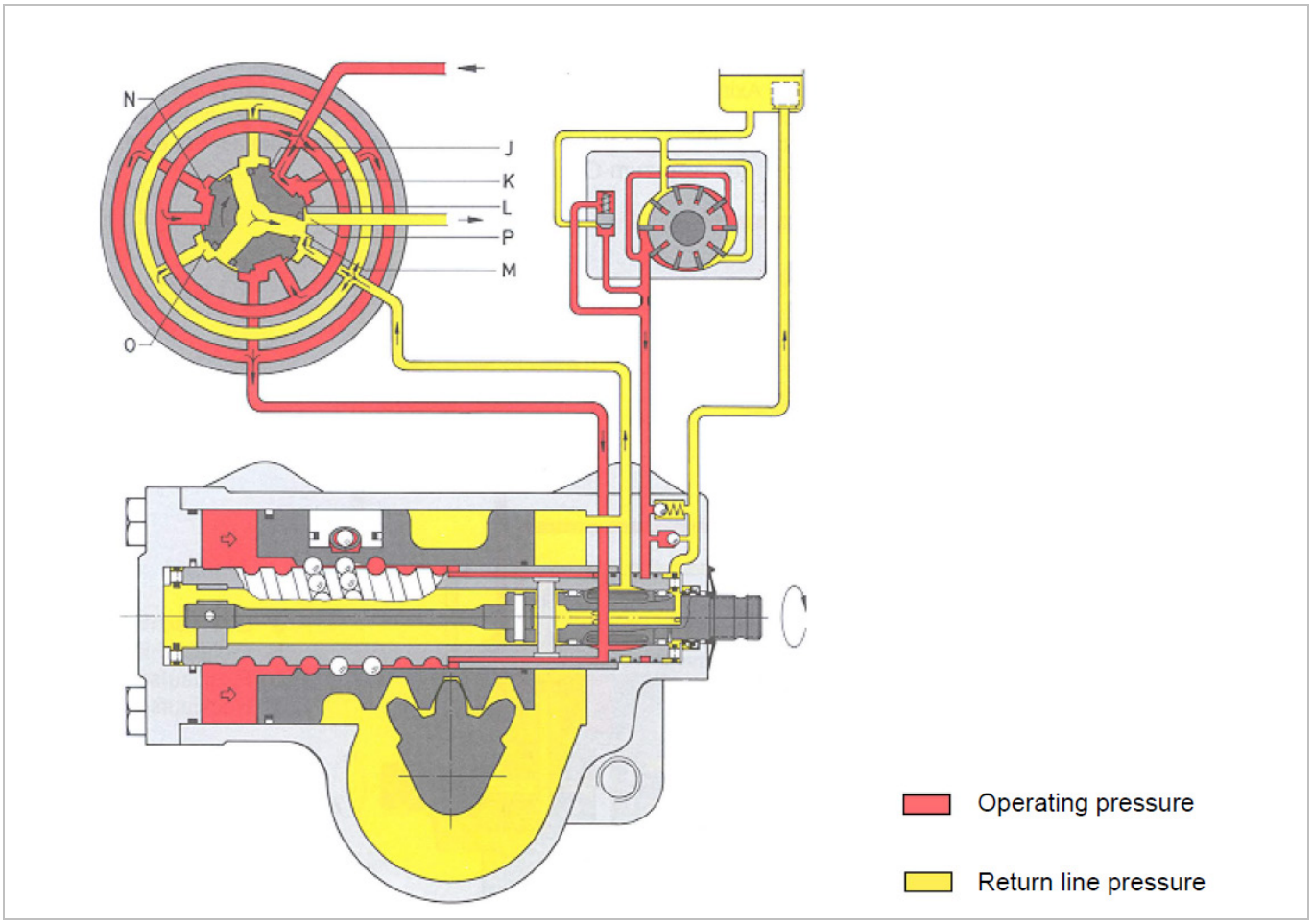


Fig. 2: Valve rotor in operating position, Steering wheel turned clockwise, piston with right-handed thread

Number	Description	Number	Description
J	Inlet slot	K	Inlet slot
L	Return slot	M	Return slot
N	Axial groove	O	Axial groove
P	Return groove		

When the steering wheel is turned to the right, the piston will shift to the right (Fig. 2). A pressure will now build up in the left-hand cylinder chamber which is a function of the steering effort required. To achieve this, the control grooves of the valve rotor are displaced clockwise and the inlet slots (K) are opened wider to admit the oil, while the inlet slots (J) are closed to the same extent and thus obstruct the feeding of oil to the axial grooves (O) of the valve sleeve. The oil will now flow through the inlet slots (K) to the axial grooves (N) of the valve sleeve and, from there, will pass through the ball screw thread and flow to the left-hand cylinder chamber. The closed inlet slots (J) prevent the oil from flowing off to the tank and, thus, cause a pressure to build up.

The oil from the right-hand cylinder chamber is displaced. Via the opened return slots (M), it flows to the return grooves (P) of the valve rotor. From there, it can at any time flow through the central oil bore in the valve rotor and the worm and off to the oil tank.

4.2 Forward steering motion to the left

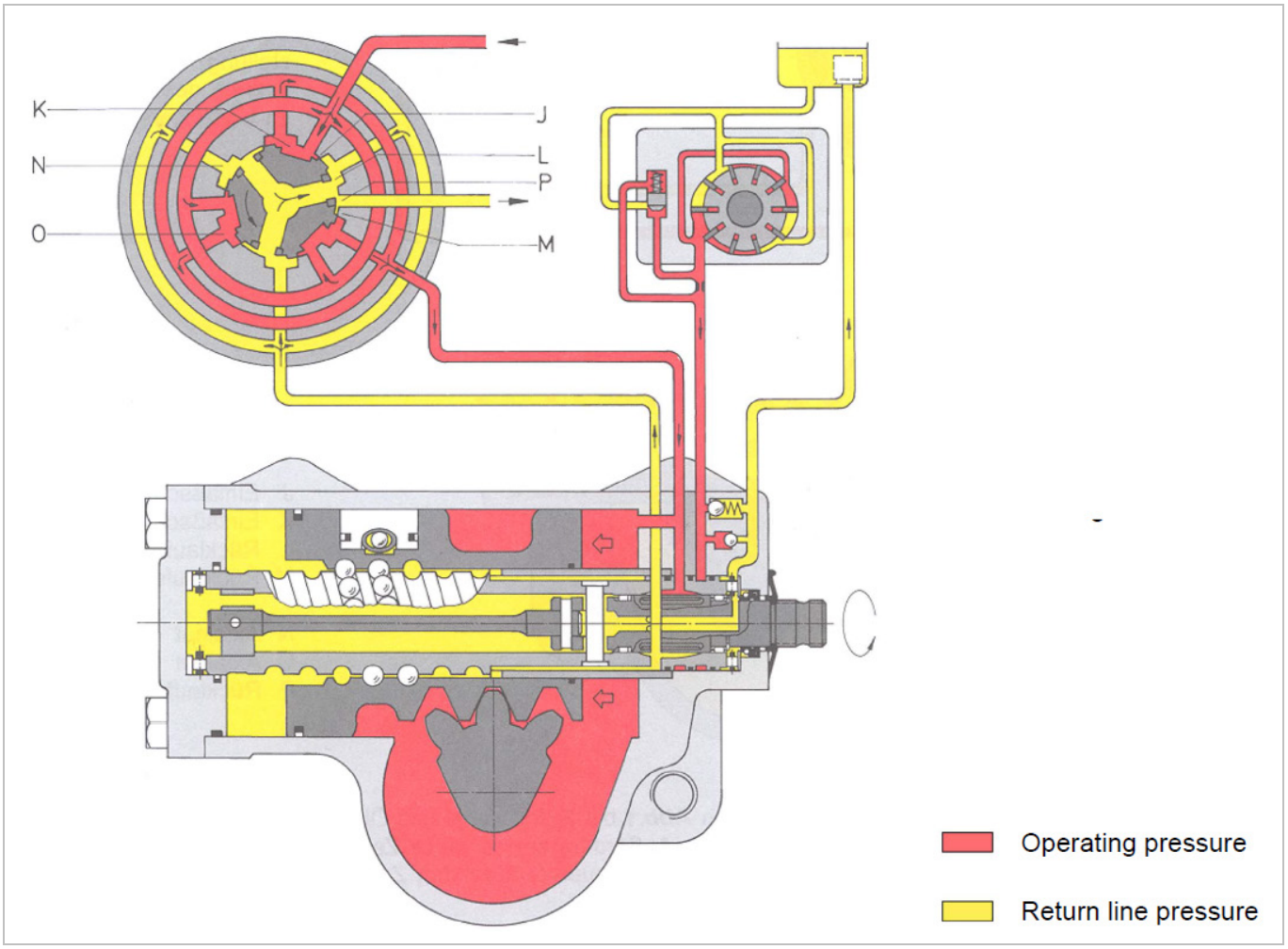


Fig. 3: Valve rotor in operating position; Steering wheel turned counter-clockwise, piston with right-handed thread

Number	Description	Number	Description
J	Inlet slot	K	Inlet slot
L	Return slot	M	Return slot
N	Axial groove	O	Axial groove
P	Return groove		

When the steering wheel is turned to the left, the piston will shift to the left (Fig. 3). Therefore, pressure build-up now takes place in the right-hand cylinder chamber. The control grooves of the valve rotor are displaced counter-clockwise and allow the oil to flow through the opened inlet slots (J) to the axial grooves (O) from where there is a connection to the right-hand cylinder chamber.

The oil from the left-hand cylinder chamber flows to the return grooves (P) of the valve rotor, via the ball screw thread and the opened return slots (L), and can then freely flow off to the oil tank through the central bore in the valve rotor and the worm.

4.3 Operation of the hydraulic steering limitation

The hydraulic steering limitation prevents a steering to the lock stops at full hydraulic pressure. It, thus, protects the pump and the steering linkage and prevents high oil temperatures. A double-acting steering limiting valve with spring-loaded valve pins (T and U) is arranged in the longitudinal direction in the piston (B). The valve pins project over the right-hand and the left-hand front faces of the piston (Fig. 4).

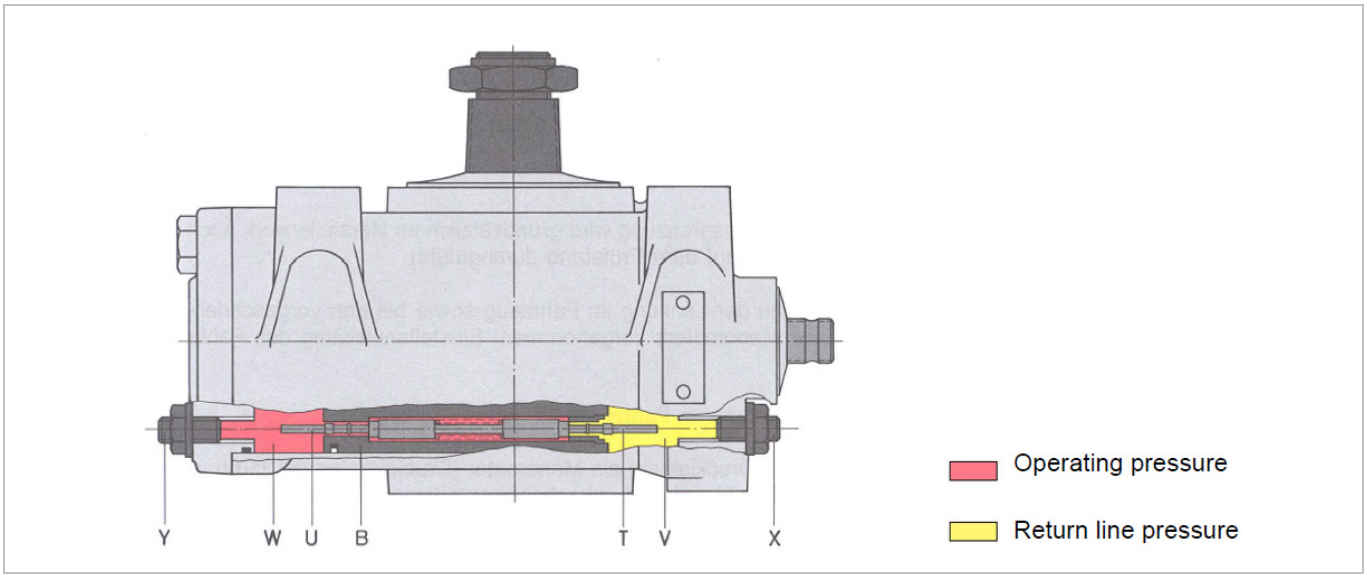


Fig. 4: Steering limiting valve closed

Number	Description	Number	Description
T	Right-hand valve pin of steering limiting valve	U	Left-hand valve pin of steering limiting valve
V	Right-hand cylinder chamber	W	Left-hand cylinder chamber
X	Right-hand adjusting screw	Y	Left-hand adjusting screw

If the piston is shifted to the right or to the left towards the lock stop, the valve pins (T and U) are actuated by the adjusting screws (X and Y) fastened in the housing and the cylinder cover, respectively. The steering limiting valve remains closed until one of the valve pins hits against an adjusting screw.

If for instance the piston is displaced to the right (Fig. 5), the right-hand valve pin will hit against the adjusting screw (X) before the piston end position is reached. Valve pin (U) is displaced by the oil pressure so that the oil can flow away from cylinder chamber (W) to cylinder chamber (V) and from there to the return line. When the piston is displaced to the left, the same sequence of operations as described above will take place by analogy.

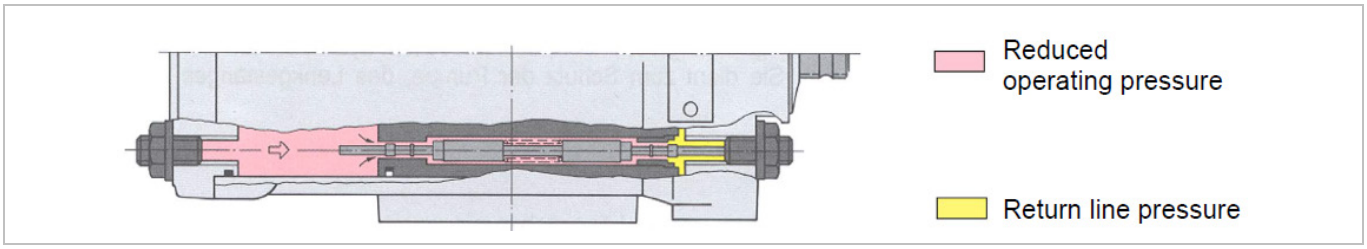


Fig. 5: Piston displacement to the right. Right-hand valve pin open. Oil pressure greatly reduced.

As soon as the steering limiting valve is open, the steering gear can be turned forward further at an increased steering effort and with greatly reduced hydraulic assistance until the lock stop is reached.

5 Servicing Work

5.1 Hints

In a number of countries a safety test (ST) is prescribed by law for vehicles with more than 8 passenger seats or a gross vehicle weight rating in excess of 7.5 t.

ATTENTION

On vehicles not subject to the safety test (ST), the work detailed in Chapter 5.3.5 – 5.3.10, has to be carried out in addition.

- Following a **test drive** and a subsequent visual inspection of the complete steering system (steering column, bevel box, steering gear, drag links, pump, and hydraulic lines) we recommend to carry out the following work.
- Within the scope of **maintenance** the proper functioning of the steering system is checked by a test drive and a visual inspection.
- During an **inspection**, safety-critical characteristics are tested.

5.2 Maintenance

Maintenance intervals

We recommend to carry out the following work within the scope of the general maintenance work (see vehicle manufacturer's instructions).

5.2.1 Test Driving

During the test drive, in particular look out for the following characteristics:

- return to neutral
- sticking
- increased friction
- play

5.2.2 Checking and inspecting for external leakproofness/damages

1. Check the steering gear (with bellows), the protecting caps, the pumps (engine-driven and grounddriven), the valves and the steering cylinders, the lines and the screwed connections for leakproofness and damages.
2. A thin oil film may cover the piston rod of the steering cylinder but there must not be any oil drops.

NOTICE

Malfunctions of the steering due to ingress of water and impurities!

When cleaning with a high-pressure cleaning machine, make sure not to direct the water jet directly towards the sealing elements of the steering system

5.2.3 Checking the oil level

Oil grade required: please refer to List of Lubricants TE-ML 09

- Prior to pulling out the oil dipstick, thoroughly clean the oil tank and its immediate vicinity to protect the hydraulic oil from being soiled by impurities.

NOTICE

Reduction of steering quality and steering performance!

A too low oil level may cause malfunctions, which can entail a failure of the hydraulic assistance of the steering system.

- Check the oil level regularly.

For vehicles with RB-Servocom RAS (Rear Axle Steering System)

1. Check the oil level in the straight ahead driving position.
   If the oil level is above the top mark, there may be a leakage in the master cylinder of the RB-Servocom RAS steering.
2. Check the RB-Servocom RAS as specified in the Instructions for the Functional Check, Maintenance and Inspection of RB-Servocom RAS steering gears.

Oil level check with the engine stopped

1. The oil must be topped up to the upper mark of the oil dipstick.

Oil level check with the engine running

1. When the engine is running, the oil level must be between the lower and the upper marks.
2. When the engine is stopped, the oil level may rise by 1 – 2 cm (depending on the capacity of the steering system). If the oil level rises by more than 2 cm, the steering system has to be bled.
3. Start the engine.
4. For vehicles equipped with an additional ground-driven emergency steering pump: jack up the drive axle of the emergency steering pump (see vehicle manufacturer's instructions) and engage a gear.

5.3 Inspection

- The inspection intervals depend on how the vehicle is used. Therefore, the table below distinguishes between different kinds of use which may, though, be overlapping.
- For the sake of increased traffic safety, we recommend to inspect the steering system in accordance with the inspection intervals listed below. Minor variations in inspection intervals are permissible if it is desirable to adjust these intervals to the vehicle-specific inspection intervals.
- The work listed below also includes work that has to be carried out within the scope of the safety test (ST). Such work is marked “(part of ST)”. Therefore, inspection steps bearing this mark can be omitted when vehicles subject to safety test (ST) are checked within the scope of the normal inspection.
- In addition, the safety test (ST) rules applying in the country of registration of the vehicle being inspected have to be complied with.

5.3.1 Inspection intervals

Up to date of manufacture 12/93

Kind of use	1st Inspection Inspection on the vehicle	2nd Inspection Inspection on the vehicle	3rd Inspection
Long-distance vehicles	100 000 km 60 000 miles	200 000 km 120 000 miles	300 000 km 180 000 miles
Vehicles in long and short distance use	100 000 km 60 000 miles	175 000 km 105 000 miles	250 000 km 150 000 miles
Construction site vehicles and vehicles in off-road use	80 000 km 50 000 miles 2 500 op.hrs	150 000 km 90 000 miles 4 500 op.hrs	200 000 km 120 000 miles 6 000 op.hrs

1. Additionally, at the time of the 3rd inspection, the mechanical transmission elements of the RB-Servocom steering gear have to be inspected.
2. To this effect, dismantle the steering gear and visually inspect and crack test all transmission elements (refer to Repair Manual).

Starting from date of manufacture/repair 1/94

Kind of use	1st Inspection Inspection on the vehicle	Further Inspections Inspection on the vehicle
▸ Long-distance vehicles ▸ Coaches with high mileages	600 000 km	after a further 300 000 km, ea.
▸ Buses ▸ Construction site vehicles ▸ Vehicles in short-distance use ▸ Vehicles subject to extreme loads	300 000 km 7 500 op.hrs	every 300 000 km 7 500 op.hrs

5.3.2 Test Driving

During test driving, in particular look out for the following characteristics:

- return to neutral
- sticking
- increased friction
- play

5.3.3 Visual inspection

1. Check the screws of the complete steering system (steering column, bevel box, steering gear, drag links and steering cylinder) for correct fastening.
2. Check whether the locking plate and the split pin are still perfectly secured.
3. By turning the steering wheel to both sides or by applying a load to it, check whether the fit of the drop arm on the sector shaft is still tight.
4. Check the steering column, bevel box, steering gear, axle stops, drag links and tie rods for damages, cracks and corrosion.
5. With the engine running, check the complete steering system for external leakproofness.

5.3.4 Replacing the oil filter

WARNING

Failure of the steering caused by impure oil!

Impurities in the hydraulic fluid may lead to failure of the pump and the steering. Before taking off the oil tank cover, thoroughly clean the oil tank and its immediate vicinity to prevent the ingress of impurities into the hydraulic fluid.

1. Pull the filter insert out of the oil tank.
2. Avoid any dripping of oil from the insert into the tank.
3. If heavily soiled, clean the oil tank.
4. Fit a new filter insert.

- Below is a list of all work that has to be carried out on the steering gear within the scope of the safety test (ST).
- This list represents the currently valid status and is not subject to the Updating Service.

5.3.5 Steering gear play (part of ST)

1. Start the engine
2. Rotate the steering gear to the straight ahead driving position.
3. Slowly turn the steering wheel and, simultaneously, watch the front wheel to see how far the steering wheel has to be turned to make the front wheel move.
   - perm. total displacement (stg. wheel Ø 500 mm): max. 50 mm
   - for version with bevel box: max. 55 mm

5.3.6 Hydraulic steering limitation (part of ST)

The hydraulic steering limitation causes the pressure to drop in the area of the steering stop, thus protecting the steering pump and the steering linkage and preventing increased temperatures.

For a check of the setting please refer to Chapter 5.5.

5.3.7 Light operation of the steering gear (part of ST)

If the steering system has a hydraulic defect, this is indicated by increased steering efforts.

1. Start the engine.
2. At vehicle standstill, quickly rotate the steering gear twice from lock to lock and look out for stiff operation of the steering.

5.3.8 Points of stiff operation (part of ST)

Defective transmission elements (steering column, universal joints, ...) may cause a temporarily stiff operation of the steering gear.

1. Relieve the front axle (conform to vehicle manufacturer's instructions)
2. With the engine cut off, rotate the steering gear from lock to lock and look out for points of stiff operation.

5.3.9 Automatic return to neutral (part of ST)

The axle geometry ensures automatic return to neutral during driving.

1. Test drive the vehicle on a cordoned-off ground.
2. During the test drive, rotate the steering gear to full lock.
3. Release the steering wheel and find out whether the steering gear automatically returns to mid-position.

5.3.10 Steering wheel (part of ST)

1. Check whether the steering wheel is properly fastened.
2. Check the steering wheel for damages.

5.4 Oil change and bleeding

5.4.1 Oil change

Draining the oil

An oil change is only required if steering gear units were repaired or replaced.

NOTICE

Mechanical destruction of the pump or the steering caused by contaminated oil!

- Do not use any drained oil to refill the system.
- Avoid any blending of oils.

Draining the steering system

1. Jack the steered axle up (see vehicle manufacturer's instructions).
2. Unscrew the pressure and return lines from the steering gear.
3. Then have the engine run for a short time (maximum 10 seconds) to allow the oil to be sucked from the pump and the oil tank. Collect any escaping oil in a pan.
4. Screw in again all components unscrewed earlier.

Draining the steering gear

Even after unscrewing all components mentioned above, a residual oil quantity may be left over in the steering gear.

A complete draining of the steering gear may be necessary depending on the amount of impurities in the oil. To this effect the steering gear has to be removed from the vehicle and opened at a service partner.

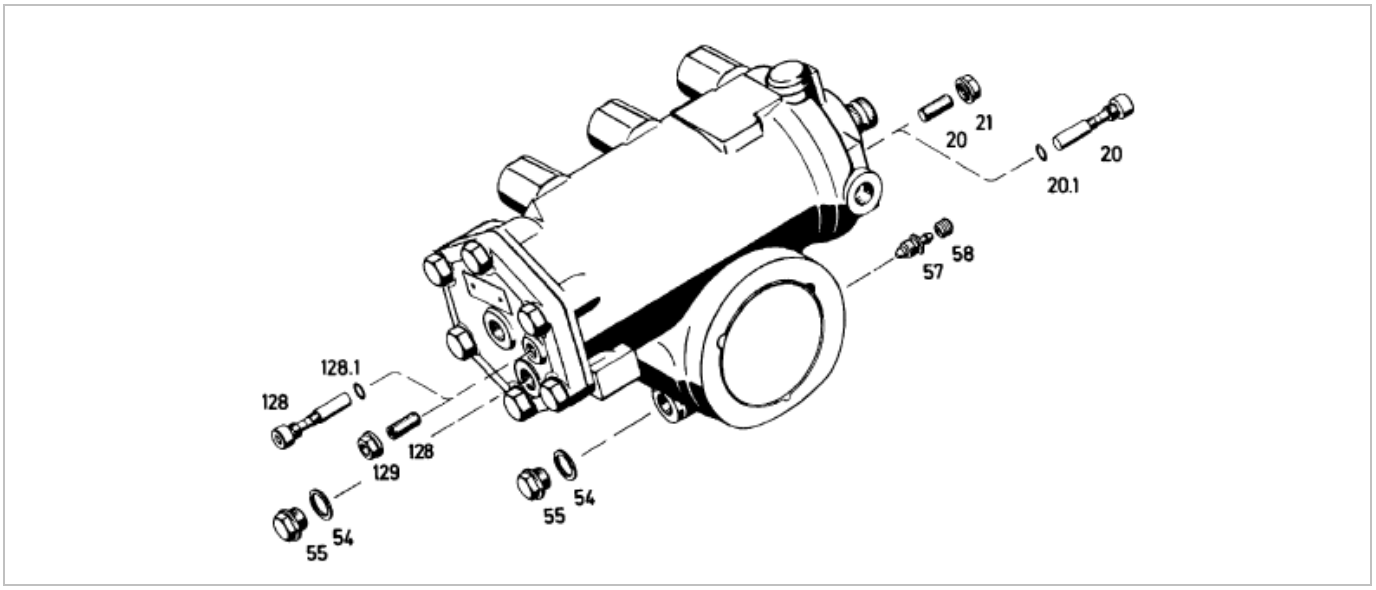


Fig. 6: Draining steering gear

1. If existing on the version inspected, unscrew
   - the screw plugs (55) from the cylinder cover or the housing
   - the set screw or the collar nut (20 or 128)
   - the screw (20 or 128)
   - the bleeder (57) (Fig. 6).
2. To achieve a quick draining, open the one among the components referred to above which is lowest in the installed position.
3. Rotate the steering gear manually from lock to lock until no more oil is draining.
4. Unscrewed components must be screwed in again at the following tightening torques:

Components	Anziehdrehmoment
Screw plug (55)	40 Nm (M 16 x 1.5) 50 Nm (M 18 x 1.5)
Collar nut (21 and 129)	20 + 10 Nm
Screw (20 and 128)	12 + 3 Nm
Bleeder (57)	30 Nm m

5.4.2 Oil filling

WARNING

Malfunctions of the steering caused by impure oil!

When the steering system is filled with oil, there is a risk of impurities getting into the steering oil circuit.

- To avoid malfunctions caused by foreign bodies in the system, maximum cleanliness is of paramount importance both at initial fill and when topping up with oil

For admitted oil grades, refer to the List of Lubricants TE-ML 09.

1. Fill the tank with oil to the rim.
2. Start the engine and have it run at idling speed to fill the steering system with oil. During this operation, the oil level in the tank will quickly drop. Therefore, to avoid any suction of air, the oil tank has to be topped up constantly.

In addition, for vehicles equipped with a ground-driven emergency steering pump

1. Jack up the drive axle (see vehicle manufacturer's instructions).
2. Select a gear and have the engine run at idling speed.
3. To avoid any suction of air, constantly top up with oil.

5.4.3 Bleeding

For steering gear versions with automatic bleeding

Steering gear versions with automatic bleeding do not have any bleed screws. These steering gears automatically bleed any air remaining within the steering system.

Automatic bleed valves operate in the idle pressure range only; therefore, any unnecessary pressure build-up should be avoided.

1. When the steering system is filled to an extent preventing the oil level from dropping below the upper mark of the oil dipstick: Have the engine run at low speed for 2 – 3 minutes.
2. Rotate the steering wheel several times from lock to lock and, while doing so, watch the oil level.
3. Top up with oil if required.

In addition, for vehicles equipped with a ground-driven emergency steering pump

1. Jack up the drive axle (see vehicle manufacturer's instructions).
2. With a gear selected and the engine running, bleed the emergency steering pump.
3. 2 – 3 minutes later rotate the steering wheel several times from lock to lock.
   NOTICE: In the end positions, do not pull heavier at the steering wheel than is necessary to rotate the steering gear.
4. Top up with oil if required.

Versions with additional steering cylinder

1. The line connections of the steering cylinder must point upward to allow for an escaping of the air in the cylinder.
2. If required turn the steering cylinder to a suitable position and mount it again in its original position after air bleeding.

Versions with bleeder

1. With the engine running, open the bleeder (57) until nothing but oil is coming out (Fig. 7).
2. Afterwards, close the bleeder again until it is oil-tight.

On versions without automatic bleeding (installed position horizontal, steering output shaft in the bottom position) the topmost screw/set screw (20 and 128, respectively) can be used for bleeding.

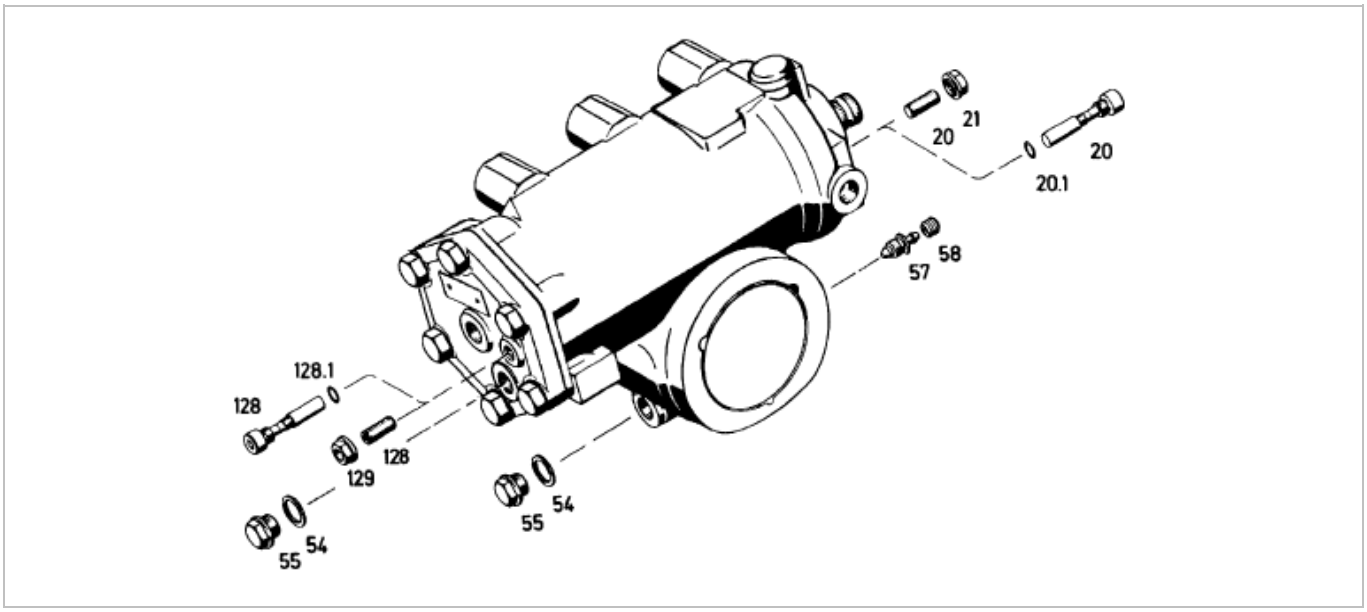


Fig. 7: Steering gear with bleeder

Versions with screw

1. Open the topmost screw (20 and 128, respectively) until nothing but oil is coming out.
2. Re-tighten the screw (20 or 128) using a torque of 12+3 Nm.

Versions with set screw

1. Slacken the collar nut (21 or 129) of the topmost set screw (20 or 128) until nothing but oil is coming out.
2. Re-tighten the collar nut (21 and 129) using a torque of 20+10 Nm.
3. The hydraulic steering limitation must be checked after bleeding.

For versions with flange, in addition

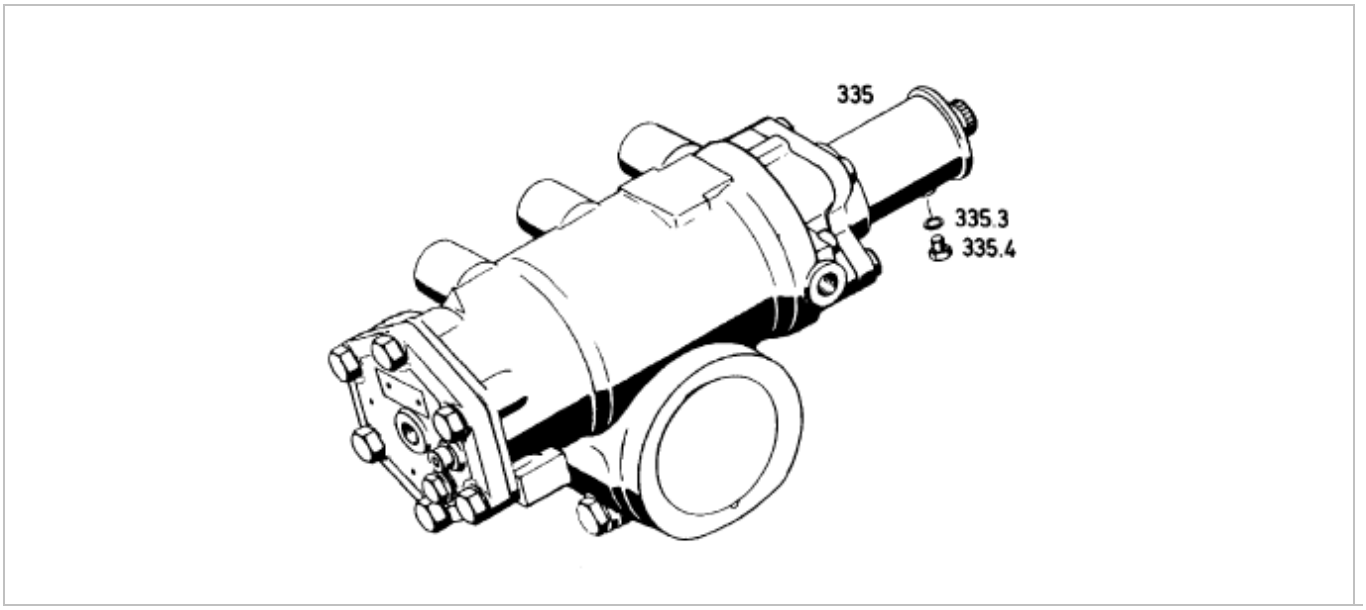


Fig. 8: Steering gear with flange

1. Open the screw plug (335.4) until nothing but oil is coming out (Fig. 8).
2. Then close the screw plug again.
   Tightening torque: 8+1 Nm (M8x1)
3. If bleeding was done correctly, the oil level in the tank must not rise by more than 1 to 2 cm when the engine is stopped.
4. Turn the engine off.
5. Lower the jacked-up steered axle or drive axle to the ground.

5.5 Setting the hydraulic steering limitation

A setting of the steering limitation is necessary if or when

- a new or repaired steering gear is fitted or
- new screws (20 and 128) were fitted to the automatically adjusting steering limitation or
- alterations to or adjustments of the front axle were carried out.

5.5.1 Hydraulic steering limitation with manual setting

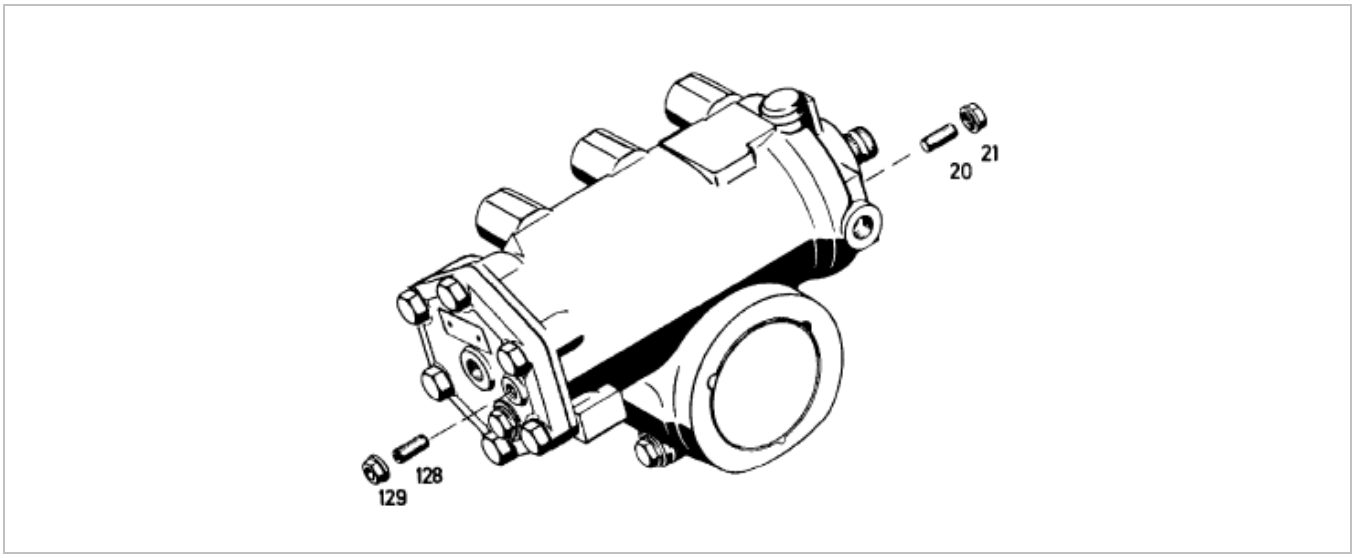


Fig. 9: Hydraulic steering limitation with manual setting

1. Fit a pressure gauge (pressure range up to 250 bar) or tool [1] (Servotest 600) to the pressure line between the pump and the steering gear (see Fig. 10).

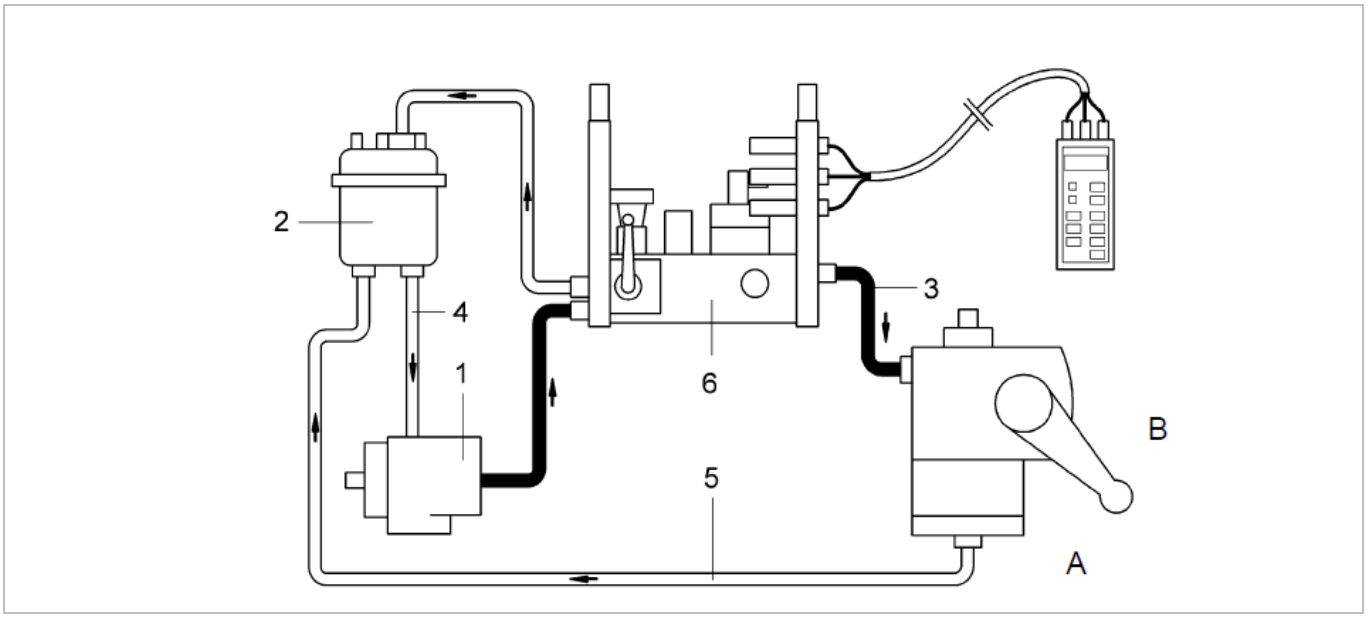


Fig. 10: Fit Tool [1]

Number	Description	Number	Description
1	Pump	2	Oil tank
3	Pressure line	4	Suction line
5	Return line	6	Servotest 600

- If the setting takes place at set screw (128) the drop arm will be caused to move in direction “B” (Fig. 10).
- If the setting takes place at set screw (20) the drop arm will be caused to move in direction “A”.

Test temperature: 50° C ± 10°

- **Rigid axle:** Relieve the axle by jacking it up or place it on swivel plates (see vehicle manufacturer's instructions).
- **Single-wheel suspension:** Place the steered wheels on swivel plates.

2. With the engine running at **idling speed**, rotate the steering gear to the lock stop.
3. Upon reaching the lock stop, overcome the return force of the steering valve by rotating the steering wheel further for a short time (5 sec. maximum) until a positive steering stop is reached.
4. Read the pressure at the pressure gauge or at tool [1] (Servotest 600).

Steering systems	Specified values
Up to 16 dm^3/min	40 – 50 bar
Up to 20 dm^3/min	50 – 60 bar
Above 20 dm^3/min	70 – 80 bar

NOTICE

Damage of the set screws because of insufficient thread overlap!

Because of insufficient thread overlap, the set screws would run the risk of being ejected when maximum pressure is built up in the steering gear.

- During the setting operation as well as in the built in condition, the set screws (20 and 128) must be screwed in at least 3 threads deep.

5. To correct, slacken the corresponding collar nut (21 or 129) and screw the set screw (20 or 128) Fig. 9 in or out.
   - **If a higher pressure is measured**, the corresponding set screw must be **screwed in** further.
   - **If a lower pressure is measured**, the corresponding set screw must be **screwed out** further.

   While doing so, release the steering wheel so that idle pressure only can build up during this work.
6. Then tighten the collar nut (21 or 129) using a torque of 20 + 10 Nm.
7. Proceed as described above for the setting of the second lock stop.

At variance with the setting described above, the vehicle manufacturer may specify a different way of adjustment, e.g. by inserting a spacer to ensure that, when the steering limitation responds, a distance dimension “C” can be kept (Fig. 11).

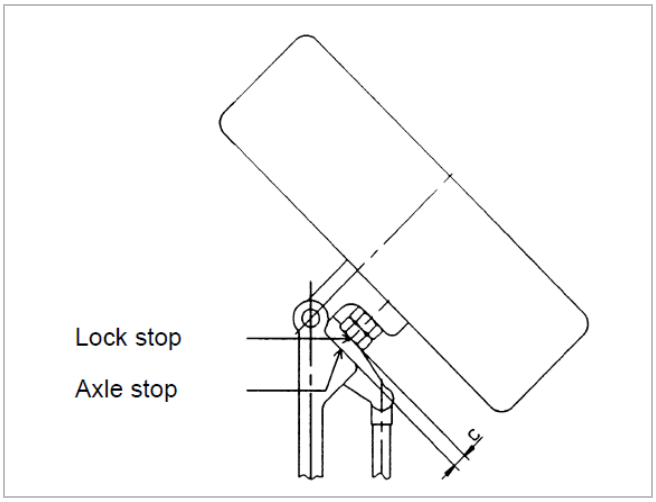


Fig. 11: Setting of the second lock stop

5.5.2 Automatically adjusting hydraulic steering limitation

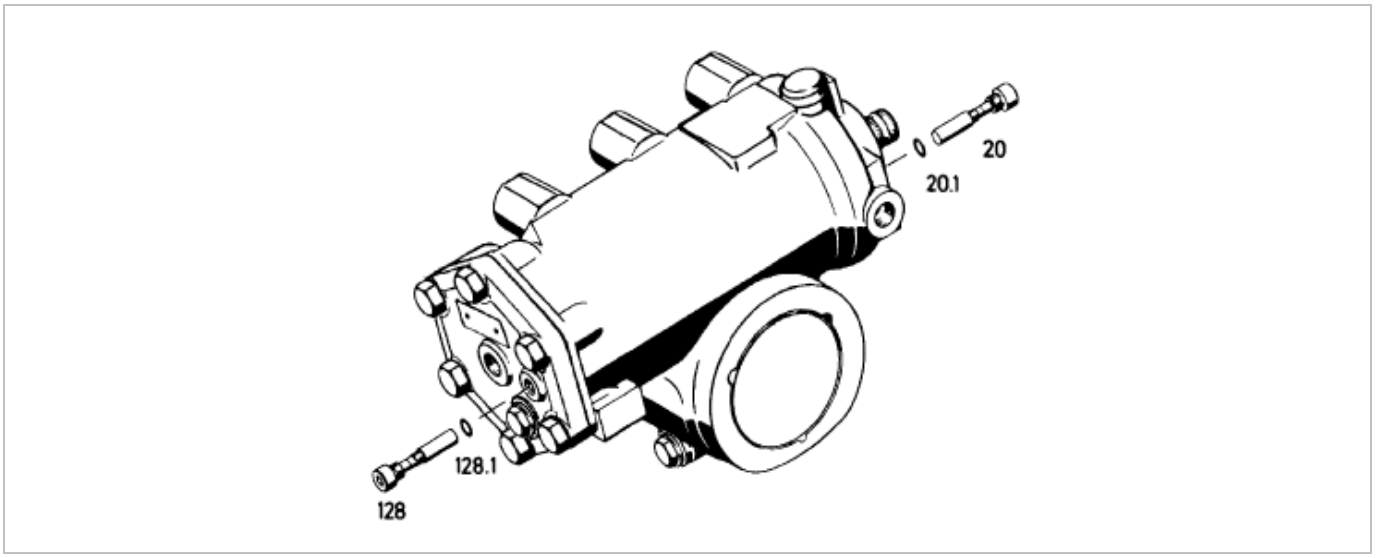


Fig. 12: Automatically adjusting hydraulic steering limitation

NOTICE

Damage to the steering system or the axle!

Steering gears with automatically adjusting steering limitations must not be rotated manually to the end positions when the steering linkage is removed or when the steering gear is removed from the vehicle. The sliding bushes of the screws (20 or 128) would, thereby, be shifted to the cut-off position that is at maximum possible, and an automatic adjustment on the vehicle would only be possible with **new** screws (20 and 128) (Fig. 12).

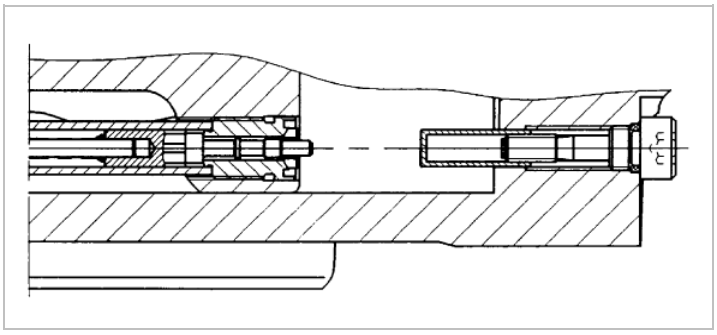


Fig. 13: Initial position Sliding bushes not yet adjusted

Operating mode of the automatically adjusting steering limitation

In the end positions, the valve piston tappets run up against the sliding bushes (20 and 128, respectively) and open the steering limiter valves (U and T, respectively).

The opening of the steering limiter valve is determined by the position of the sliding bushes on the screws (20 and 128).

Setting

NOTICE

This setting (Fig. 14) can only be carried out after the steering gear was fitted to the vehicle. To enable the setting, the steering linkage and the axle stops must be installed and set.

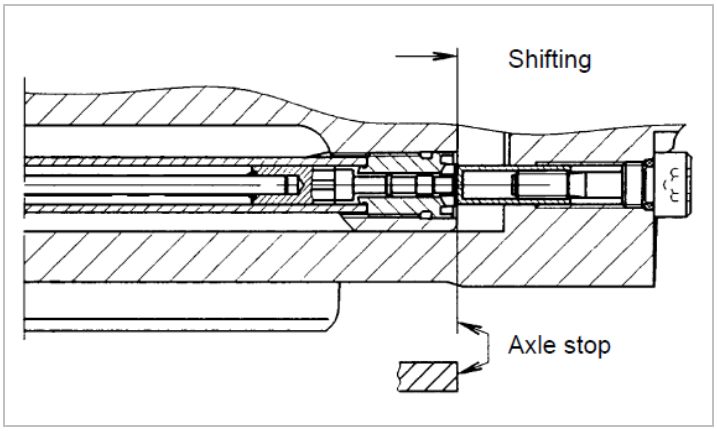


Fig. 14: Setting operation

Positioning of the sliding bushes

1. **For vehicles with a rigid axle**
   Relieve the steered axle by jacking it up (there must, however, still be a load on the steered axle) or place it on swivel plates (see vehicle manufacturer's instructions).
2. **For vehicles with single-wheel suspension**
   Place the wheels on swivel plates.
3. Rotate the steering wheel, with and without hydraulic assistance, to the maximum lock stop. This will cause the piston to push the sliding bush on the screw (20 and 128) up to the required cut-off position (Fig. 15).

NOTICE

During this setting operation the steering limiter valve is constantly open which means that, with as well as without hydraulic assistance, the steering wheel can only be rotated further at an increased effort.

4. Repeat the setting operation for the other direction of rotation.

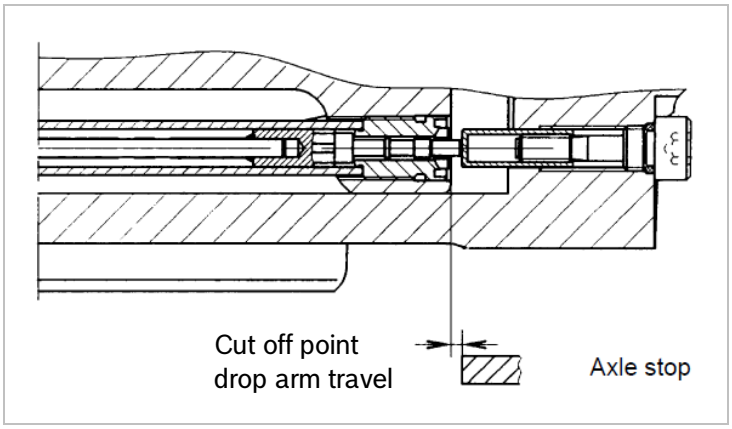


Fig. 15: Left-hand steering limiter valve open, oil pressure highly reduced

Correcting the drop arm travel

- **Increasing the drop arm travel**
  Carry out the setting as described above.
- **Reducing the drop arm travel**
  Fit new screws (20 and 128, respectively).
  Tightening torque for the screws (20 and 128, respectively): 12 + 3 Nm

NOTICE

Destruction of the screw by pulling bach the sliding bushes!

The sliding bushes on the screws (20 and 128) may not be pulled back. The screw is then no longer adjustable!

6 Repair of external leakages

Apart from the work detailed above, no further repair work may be carried out. Any repair work exceeding the extent described above has to be done by a service partner.

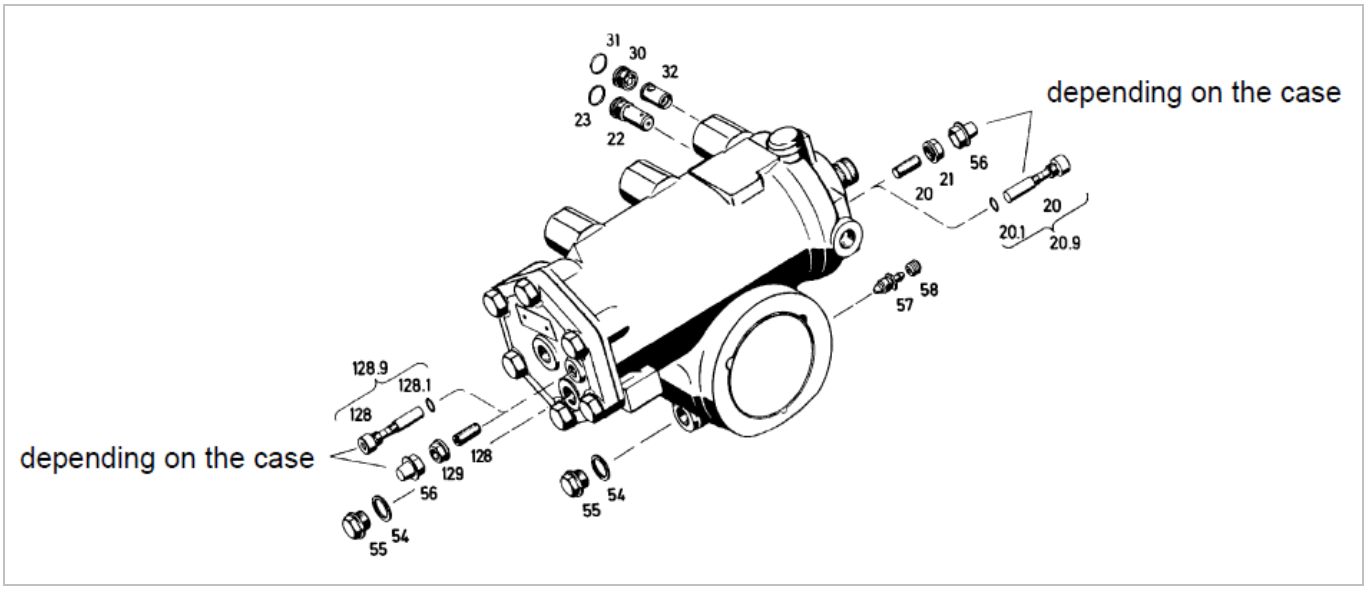


Fig. 16: Repair of external leakages

Valve insert: Pressure relief valve

1. Unscrew the valve insert (22) from the housing (Fig. 16)
2. Remove O-ring rests.
3. If the pressure does not conform to the specified value or if there is any leakage, replace the complete valve insert (22).
4. Fit a new greased O-ring (23) to the valve insert (22) and screw it in again.
   Tightening torque: 30 + 10 Nm

Valve insert: Replenishment valve

1. Unscrew the screw (30) and the valve insert (32).
2. Put the valve insert (32) into the housing bore.
3. Remove O-ring rests.
4. Fit a new greased O-ring (31) to the screw (30) and screw it in again.
   Tightening torque: 30 + 10 Nm

Screws

1. Screw in new screws (20 and 128)
   Tightening torque: 12 + 3 Nm
2. Setting the steering limitation (refer to Chapter 5.5).

Collar nuts

1. Screw in new collar nuts (21 and 129).
   Tightening torque: 20 + 10 Nm
2. Setting the steering limitation (refer to Chapter 5.5).

Screw plug

1. Unscrew the screw plug (55), fit a new sealing ring (54) and screw it in again.
   Tightening torque:
   40 Nm (M16x1.5)
   50 Nm (M18x1.5)

Bleeder

1. Screw in a new bleeder (57).
   Tightening torque: 30 Nm

7 Replacing switch and potentiometer

7.1 Replacing the switch

1. Unscrew the switch (222) and replace it by a new one (tightening torque: 50 Nm).
2. Starting from mid-position, rotate the steering gear to the left and to the right. The contact of the switch (222) must open after drop arm travels of 5^0 (± 10 %), each (110^0 ± 10 % drop arm travel corresponding to 0.3 steering wheel turns) (Fig. 17).
3. Make sure that the steer angles to the left and to the right are uniform.
4. If required, correct the symmetry of the switching range by rotating the cover (221).
   Tightening torque: Cap screws (223) 5.5 Nm
   Testing tool: Multimeter

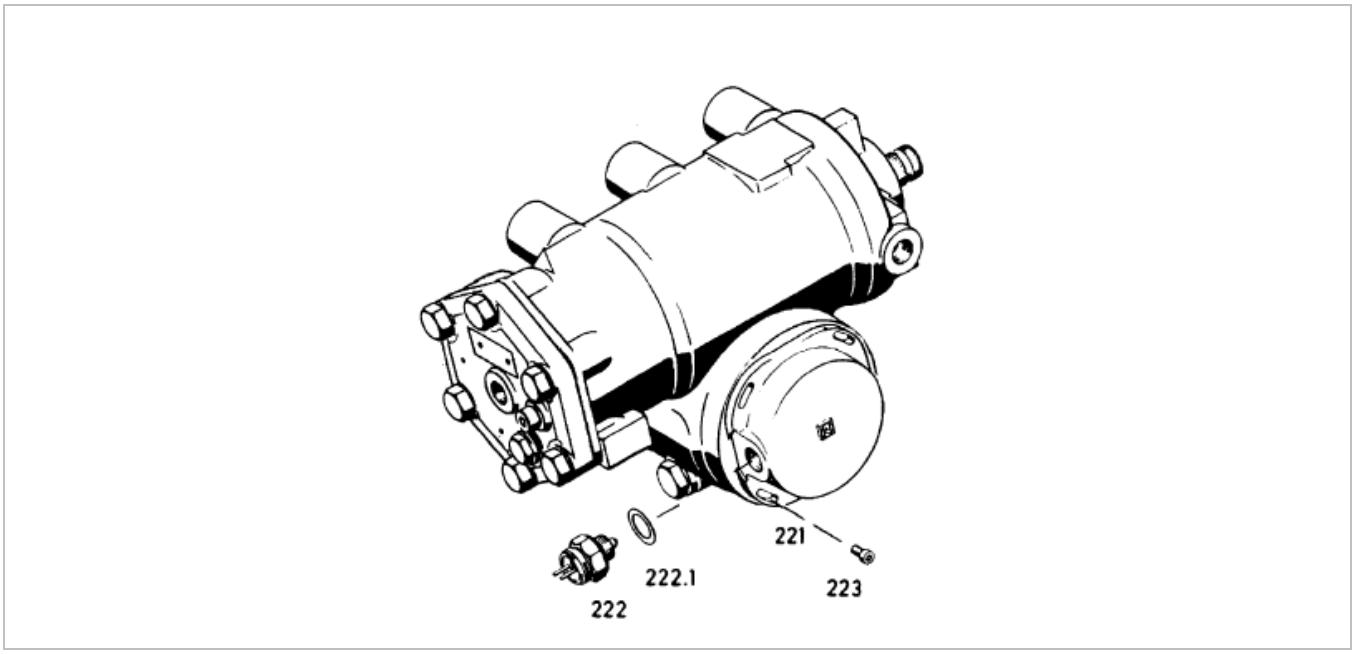


Fig. 17: Replacing the switch

5. The switching range is set by varying the screw-in depth of the switch (222). Washers (222.1) of different thicknesses are available to enable this setting.
6. Do not use more than three washers (222.1) for the setting operation. (A washer thickness of approx. 0.25 mm corresponds to a drop arm travel of 1° – 22° at the steering wheel).
7. The cover (221) must be filled with 50 cm^3 of oil (see list of lubricants TE-ML 09).

7.2 Replacing the potentiometer

7.2.1 Removing the potentiometer

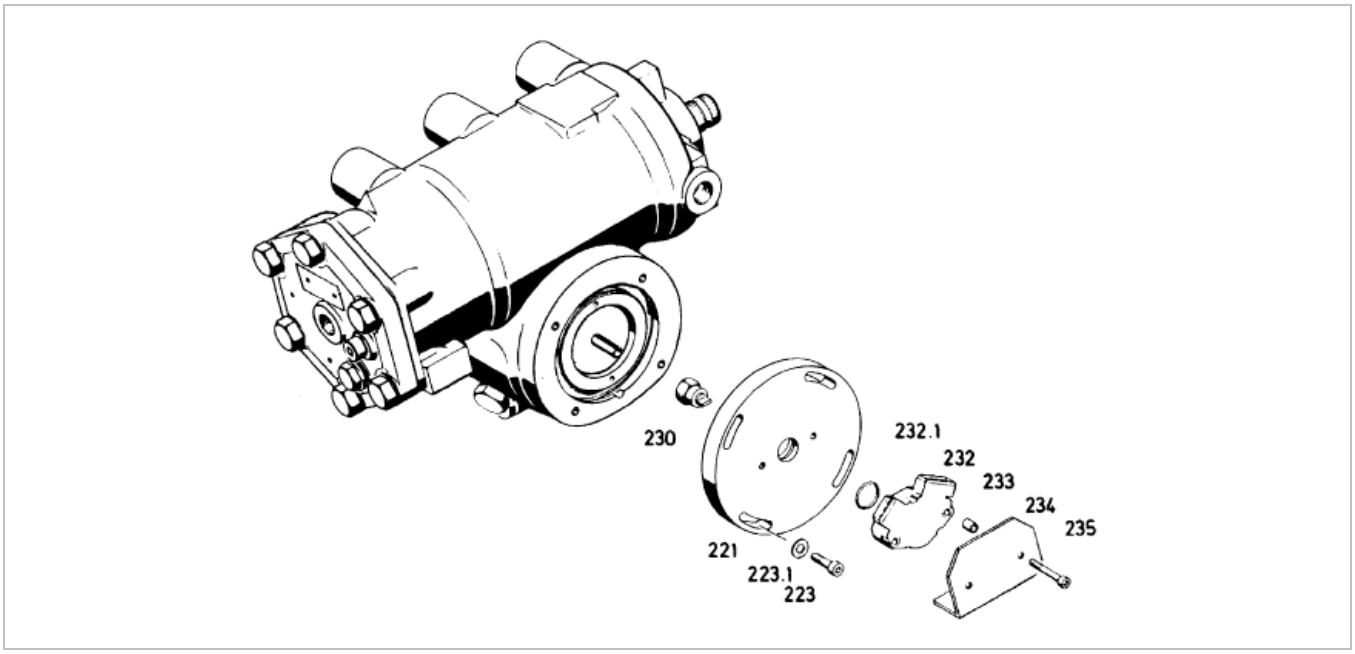


Fig. 18: Replacing the potentiometer

1. Rotate the steering gear to mid-position.
2. Clean the area surrounding the potentiometer (232) (Fig. 18).
3. Mark the position of the potentiometer (232).
4. Unscrew the cap screws (235).
5. Remove the potentiometer (232) along with the screening plate (234), the spacing sleeves (233) and the O-ring (232).

7.2.2 Fitting the potentiometer again

1. Check whether the steering gear is in mid-position.
2. Fit an O-ring (232.1) to the potentiometer (232).
3. Place the deep groove of the potentiometer (232) drive on the carrier (230).

The slider of the potentiometer (232) being spring-loaded, it will return to its initial position when disassembled.

4. Therefore, check whether the potentiometer (232) can be turned through 50° minimum to either side when the steering gear is in mid-position.
5. Fasten the potentiometer (232) along with the spacing sleeves (233), the screening plate (234) and the cap screws (235).
   Tightening torque 2.8 Nm
6. Check: The installed position of the potentiometer (232) must be identical with the position as marked during disassembly.

7.2.3 Setting the potentiometer

NOTICE

Destruction of the potentiometer!

A maximum value of 6 V must not be exceeded for otherwise the potentiometer (232) would be destroyed.

- The tumbler switch of the Servotronictest tester (tool [7]) must not be switched to speed position.

1. Rotate the steering gear to mid-position, therefore half the total number of steering wheel turns.

Setting a voltage of 5V

1. Connect tools [6] and [7] (or use a suitable transformer) and the Multimeter measuring instrument (shown in Fig. 19).
2. Switch the tumbler switch of the Servotronictest tester (tool [7]) to transducer position.
3. Continue adjusting the transducer regulator until the Multimeter measuring instrument reads 5 V.

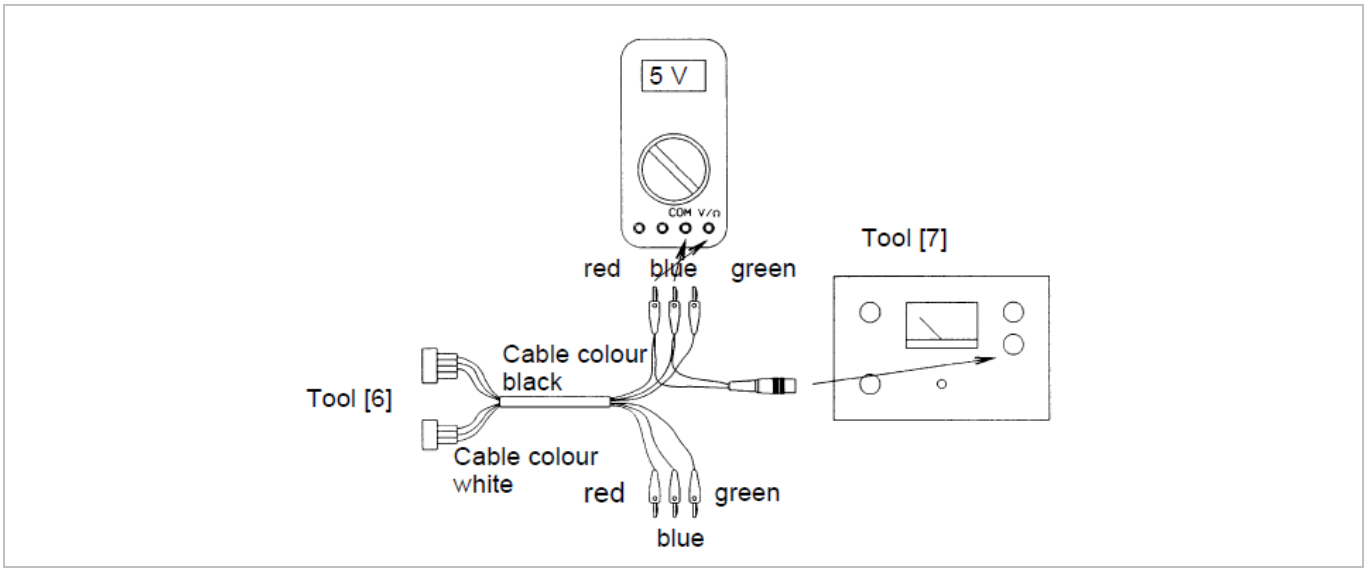


Fig. 19: Setting a voltage of 5V

Setting the potentiometer (232) to steering gear mid-position (setting path 2)

1. Connect tools [6] and [7] and the Multimeter measuring instrument (shown in Fig. 20).

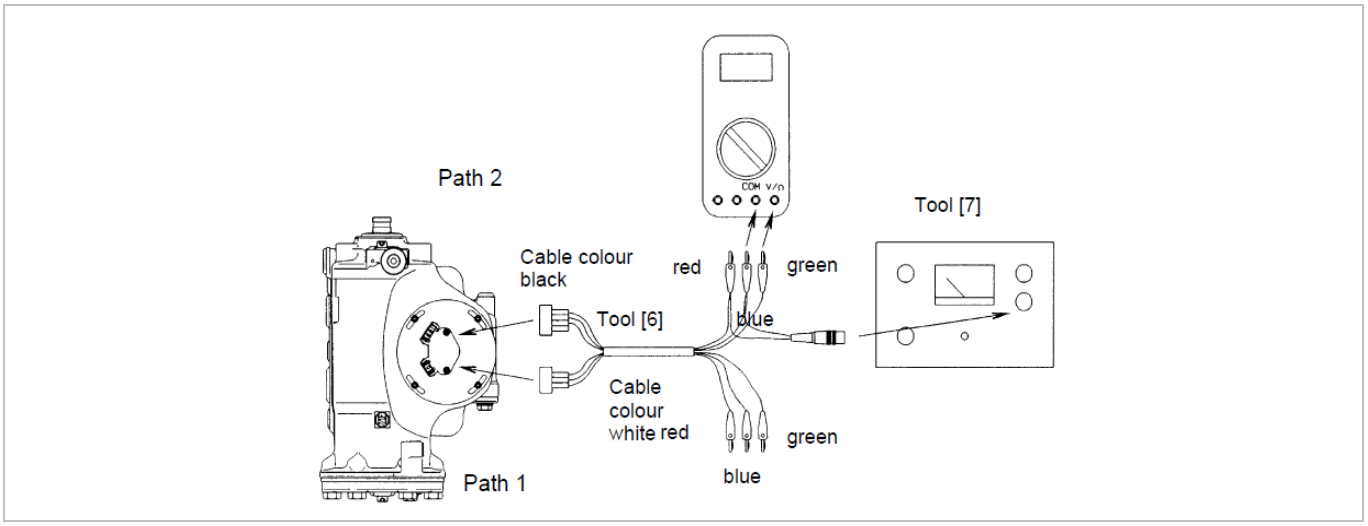


Fig. 20: Setting the potentiometer to steering gear mid-position

2. Rotate the potentiometer (232) together with the cover (221) until the Multimeter measuring instrument reads half the voltage applied, namely 2.5 V + 0.03 V.
3. In this position, tighten the cap screws (223) (tightening torque: 4+1.5 Nm).

Instructions on measurements, paths 1 and 2

- Measurement path 2; refer to Fig. 20
- Measurement path 1: refer to Fig. 20

Additionally:

- Plug in a jumper from blue to blue.
- Plug in a jumper from red to red.
- Unplug the green cable of path 2.

At variance:

- Plug the green cable of path 1 in the Multimeter.

4. Check the voltage at path 1. In case the valve differs from the valve measured at path 2 then. Rotate the potentiometer (232) again along with the cover (221) until the same voltage (specified value: 2.3 – 2.7 V) is indicated for both paths.
5. In this position, tighten the cap screws (223) (tightening torque: 4+1.5Nm).
6. Rotate the steering gear to the right-hand lock and measure the voltages of paths 1 and 2 (specified value: 0.122 V – 4.88 V).
7. Rotate the steering gear to the left-hand lock and, again, measure the voltages of paths 1 and 2 (specified value: 0.122 V – 4.88 V).

If the specified values are not attained, a new potentiometer has to be used.

8 Removal of the steering gear

1. Thoroughly clean the steering gear and its immediate surroundings, in particular the pipe connections.
2. Drain the oil as described in Chapter 5.
3. Take a note of the pressure and return lines position.
4. Unscrew the pressure and return lines.
5. Obturate all oil pipes (**danger of soiling**).
6. Check whether the marks on the sector shaft and the drop arm coincide.

If the marks are offset from each other, prior to fitting the drop arm inquire with the vehicle manufacturer whether differing assembly instructions exist.

7. Screw out the locking screw (50).
8. Pull the drop arm off, using tool [5].

NOTICE

Changes to material or inner damages to the steering gear!

- Heating up the drop arm or driving in a wedge between the housing and the drop arm or removing the drop arm by means of hammer blows is not permitted.

Additionally, for vehicles with adjustable steering column

1. Adjust the driver's workplace to the topmost position to relieve the ball-track relay shaft as much as possible.
2. By means of a suitable tool, for instance a ratchet belt, relieve the ball-track relay shaft in such a way that no thrust force can act towards the steering gear.
   - When a ratchet belt is used, pass the belt through the yoke spaces if possible (see arrows in Fig. 21).
   - Tension the belt to an extent avoiding any damage to the sealing elements or the steering gear protection cap caused by a dislocation of the universal joints at the moment the clamping screws are unscrewed.

Remove universal joint

1. Unscrew the universal joint or the elastic coupling between the steering gear and the steering column or the separately mounted bevel box.
2. Unscrew the mounting screws and remove the steering gear.
3. If a fitting bolt was used, write its position down.

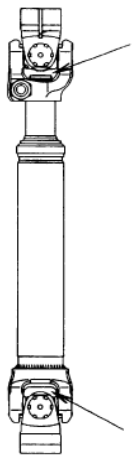


Fig. 21: Universal joint

9 Re-installing the steering gear

ATTENTION

Danger caused by failure of the steering gear!

- To guarantee a safe operation of the steering system, maximum cleanliness is an absolute must when re-installing all units that are part of the system.

NOTICE

Malfunctions caused by foreign bodies or impurities in the oil circuit!

- The plugs in the ports of the steering gear, the oil pump, the steering cylinder, the valves etc. ... should only be removed at the moment the lines are connected.
- Remove protecting sleeves in the installed position, only, if this is possible.
- Connecting lines and screwed connections must be thoroughly cleaned and deburred.

9.1 Prerequisites

1. Rotate the steering wheel to the straight ahead driving position.
2. Clean the locating surfaces of the mounting bracket and the steering gear.

Additionally, for vehicles with adjustable driver's workplace

1. Using a suitable tool, for example a ratchet belt, constrict the ball-track relay shaft until there is sufficient space for the steering gear to be built in without constricting the ball-track relay shaft any further (Fig. 22).

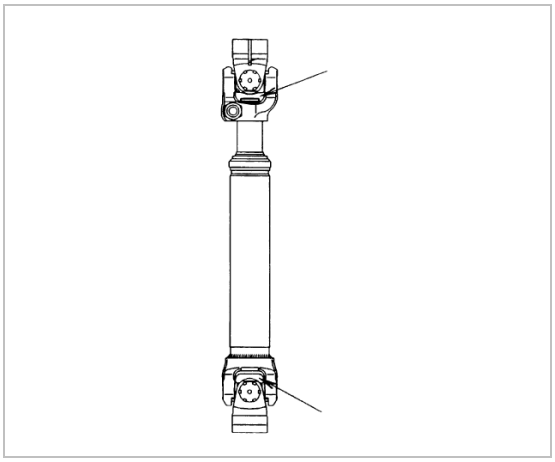


Fig. 22: Universal joint

2. Rotate the steering gear to mid-position by dividing the total number of steering wheel turns in two.
3. Then continue to rotate until the marks (see Fig. 23) on the input shaft, the protection cap and the housing coincide.

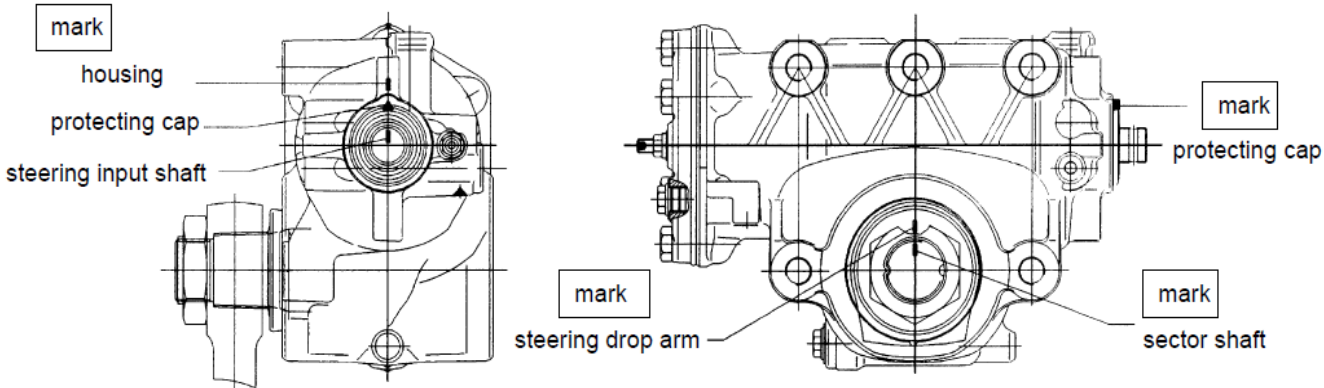


Fig. 23: Re-installing the steering gear

9.2 Place the steering gear into the mounting bracket

1. Place the steering gear into the mounting bracket and fasten it with screws. Make sure that the position of the fitting bolt is correct.

For the tightening torque, please refer to the technical cover sheet of the spare parts list. If no data is given in the list, the values below shall apply.
Conform to vehicle manufacturer's instructions.

2. Depending on the vehicle type, space restrictions may require a previous fitment of the drop arm.

Tightening torque:

Thread	Screw Grade	Tightening torque
M 18 x 1.5	10.9	410 + 10 % Nm
M 20 x 1.5	10.9	520 + 10 % Nm

9.3 Fit universal joint

1. Fit the universal joint or the elastic coupling between the steering column and the steering gear.
   The clamping slot in the universal joint must point towards the mark on the cover cap or on the input shaft.

Additionally, for vehicles with adjustable driver's workplace

1. Put the universal joint on without damaging the steering gear seal.
2. Tighten the clamping screw (M 10 x 1,25) applying a torque of 48+5 Nm.
3. Relieve the tool, e.g. the ratchet belt, **cautiously** and remove it (refer to Fig. 22).

9.4 Mount drop arm and locking nut

1. Move the steered wheels of the vehicle to the straight ahead driving position. This position is reached when the steered wheels are in line with or parallel to, respectively, the second pair of road wheels (place a graduated ruler against the front and rear wheels).
2. Put the drop arm on the serration, making sure that the marks on the drop arm and on the sector shaft coincide (refer to Fig. 23).
3. Screw the locking nut (50) on and tighten it, applying the torques specified below.

For versions with tapered serration

For the tightening torque, please refer to the technical data sheet of the spare parts list. If no data is given in the list, the following values shall apply.
If the vehicle manufacturer specifies different values, manufacturer's values shall apply.

Thread	Serration	Tightening Torque	Exception
M 30 x 1.5	1 3/8“x36	250 Nm + 10%	MAN/Neoplan: 850 Nm + 10%
M 30 x 1.5	1 1/2“x36	300 Nm + 10%	
M 30 x 1.5	1 5/8“x36	330 Nm + 10%	
M 35 x 1.5		400 Nm + 10%	
M 42 x 1.5		500 Nm + 10%	
M 45 x 1.5		700 Nm + 10%	

For versions with cylindrical serration and/or clamping screws
Apply the tightening torque specified by the vehicle manufacturer.

4. Peen the locking nut (50) (see vehicle manufacturer's instructions).

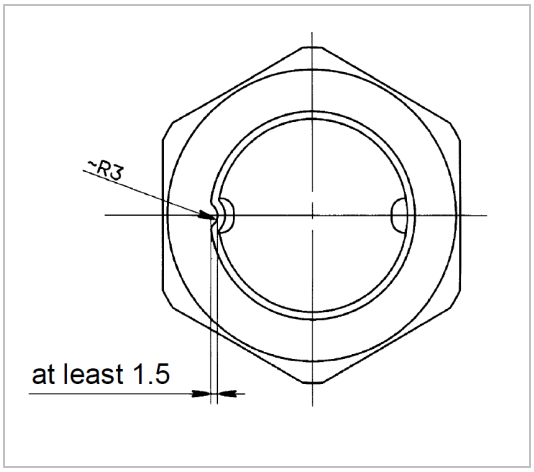


Fig. 24: Peen the locking nut

9.5 Mount drag link and tie rod

1. Put the drag link or the tie rod into place and tighten it (see vehicle manufacturer's instructions).
2. Rotate the steering gear to the left until reaching the stop.
3. Take off the drag link or the tie rod.

Additionally, for versions with automatically adjusting steering limitation

- Unscrew the screws (20 and 128).

4. Check at the steering wheel whether any further movement to the left is possible.
5. If the steering gear cannot be rotated any further to the left, the lock stop and the axle stop respectively, must be re-set.

NOTICE

Mechanical damage of steering gear and end stops!

- It must be guaranteed that the steering angle limitation takes place at the lock stops and the axle stops, respectively, and is not done by the steering gear.

6. Mount the drag link or the tie rod (see vehicle manufacturer's instructions).
7. Repeat the check for the right-hand side and, if required, re-set the lock stop and the axle stop, respectively.

Additionally, for versions with automatically adjusting steering limitation

- Screw in the screws (20 and 128).
  Tightening torque: 12 + 3 Nm

8. Mount the drag link or the tie rod (see vehicle manufacturer's instructions).

9.6 Connect lines and set steering system

1. Connect the pressure and return lines between the pump, the steering gear and the steering cylinder according to the notes taken on the removal.
2. Fill the steering system with oil and bleed it (refer to Chapter 5).
3. Set the hydraulic steering limitation (refer to Chapter 5).

9.7 Check the oil level

Oil grade required: please refer to List of Lubricants TE-ML 09

- Prior to pulling out the oil dipstick, thoroughly clean the oil tank and its immediate vicinity to protect the hydraulic oil from being soiled by impurities.

NOTICE

Reduction of steering quality and steering performance!

A too low oil level may cause malfunctions, which can entail a failure of the hydraulic assistance of the steering system.

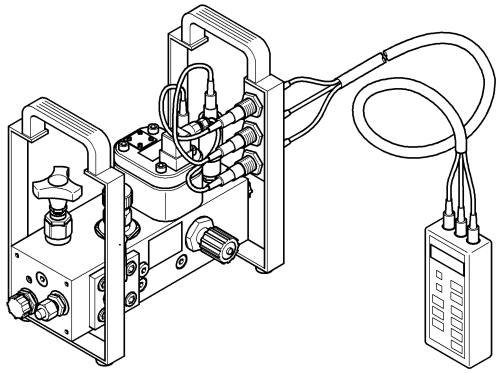
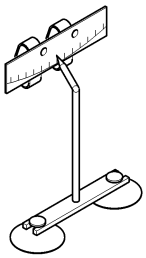
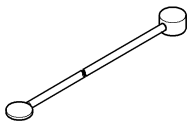
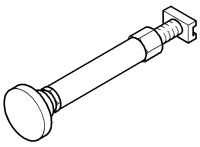
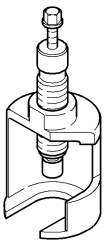
- Check the oil level regularly.

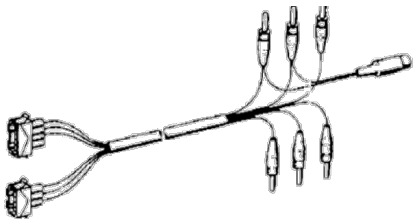
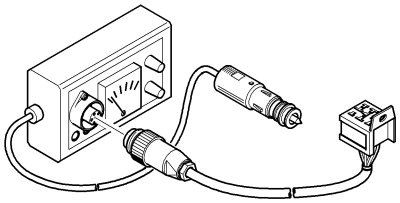
For vehicles with RB-Servocom RAS (Rear Axle Steering System)

- Check the oil level in the straight ahead driving position.
  If the oil level is above the top mark, there may be a leakage in the master cylinder of the RB-Servocom RAS steering.

10 Special tools

The tools described below are universal tools. For special applications, special tools recommended by the vehicle manufacturer may therefore be necessary.

Tool number and name	Figure	Order number
Tool [1] Servotest 600		7418 798 600
Tool [2] Dial with pointer		7418 798 452
Tool [3] Thrust pad		7418 798 556
Tool [4] Expanding device 2 pcs are required		1 pieces 7418 798 653
Tool [5] Extracting device		7418 798 219

Tool number and name	Figure	Order number
Tool [6] Adapter cable		7418 798 567
Tool [7] Servotronictest		7418 798 545

11 Troubleshooting

11.1 Troubleshooting on steering system

11.1.1 Checking the play

1. By moving (shaking) the steering wheel sideward back and forth, check whether there is any play in the input shaft bearing in the steering column.
2. If so, replace or repair the steering column/the bearing.

11.1.2 Checking for angular play or stiff operation

Play can be identified by the noticeable rattling noise occurring when the steering wheel is turned back and forth.

1. If play or stiff operation are ascertained in the universal joint, the telescopic shaft and the bevel box, replace the defective components.

11.1.3 Checking for leakage

When you replace hose lines or parts with externally visible damages, only use spare parts that are released or original Bosch spare parts.

1. Start the engine.
2. Check whether all screwed connections, lines and sealing elements of the complete steering system (bevel box, steering gear, pump and steering cylinder) are leakproof.
3. Check all hoses and lines, protecting caps and bellows for possible traces of chafing and embrittlement cracks.
4. Switch the engine off.

11.1.4 Checking the straight ahead driving position of steering gear and vehicle

NOTICE

Mechanical damage!

- Steering gears equipped with an automatically adjusting hydraulic steering limitation must not be rotated to the end positions if the steering linkage had been removed previously.

- **Vehicles with single-wheel suspension:** Place the wheels of the steered axle on swivel plates.
- **Vehicles with a rigid axle:** Jack the steered axle up (see vehicle manufacturer's instructions).

1. Rotate steering wheel from lock to lock to identify the total number of steering wheel turns.
2. Rotate the steering gear with the halved number to mid-position.
3. Rotate it further until the marks coincide (refer to Fig. 25).

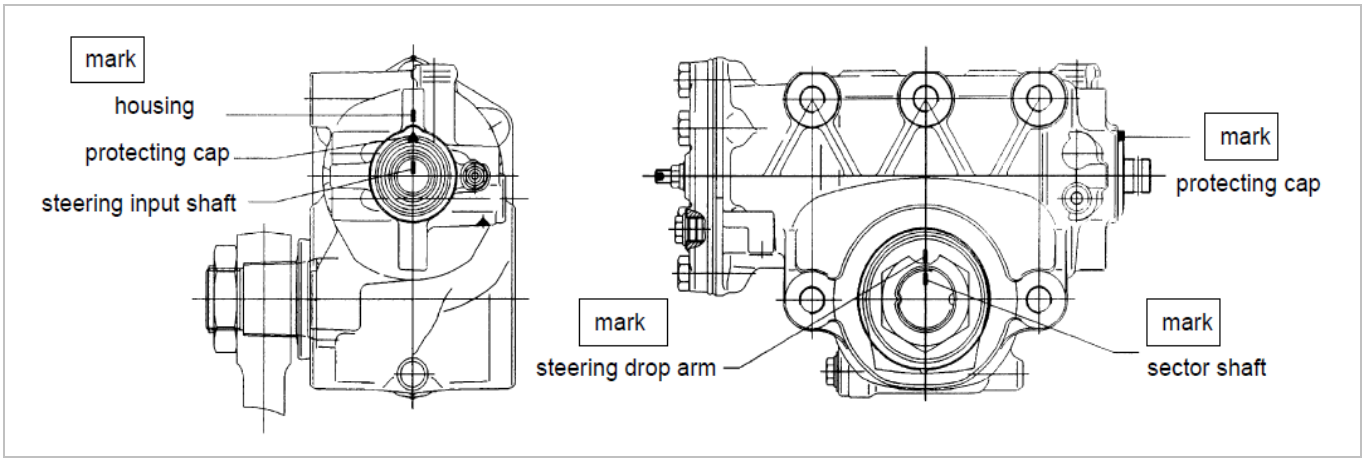


Fig. 25: Checking the straight ahead driving position of the steering gear

4. Turn the steered wheels to the straight ahead driving position.
5. Corrections can be made by screwing the ball joint on the drag link further in or out.

ATTENTION

Damaged steering gear due to accident!

If the steering wheel position is not correct or if a length correction of the steering linkage turns out to be necessary, it may well be that this necessity originates in a preceding accident-like event.

- We recommend to check whether the serration of the sector shaft (30) is twisted, to do so, pull the drop arm off.
- We recommend to check whether the input shaft is installed in a twisted position and whether some or all further transmission elements are bent or have cracks.
- In addition, check the play as detailed in Chapter 5.3.
- Deformed components may not be re-bent to shape but must be replaced.

Additionally, for versions with automatically adjusting hydraulic steering limitation

1. If required, fit new screws (20 or 128).
2. Reset the steering limitation (refer to Chapter 5.5).

11.1.5 Checking the belt tension of the pump drive

1. Check the tension of the drive belt (see vehicle manufacturer's instructions).
   Even at maximum pump pressure, the drive belt must transmit the power without any slip.

11.2 Checking the hydraulic functioning of pump and steering gear

11.2.1 Checking the hydraulic functioning of pump and steering gear

Installing tool [1] (Servotest 600)

For the implementation of the pressure and leakage oil tests described below, it is necessary to distinguish 2 kinds (variants 1 and2) of steering systems.

Variant 1

Steering systems with the **pressure relief valve arranged in the pump or in the pressure line between the pump and tool [1] (Servotest 600)** (Fig. 26). This means that pressure relief takes place ahead of built-in tool [1].

On steering systems of this type the nameplate of the pump or of the pressure relief valve will indicate the maximum pressure, e.g. 130 bar.

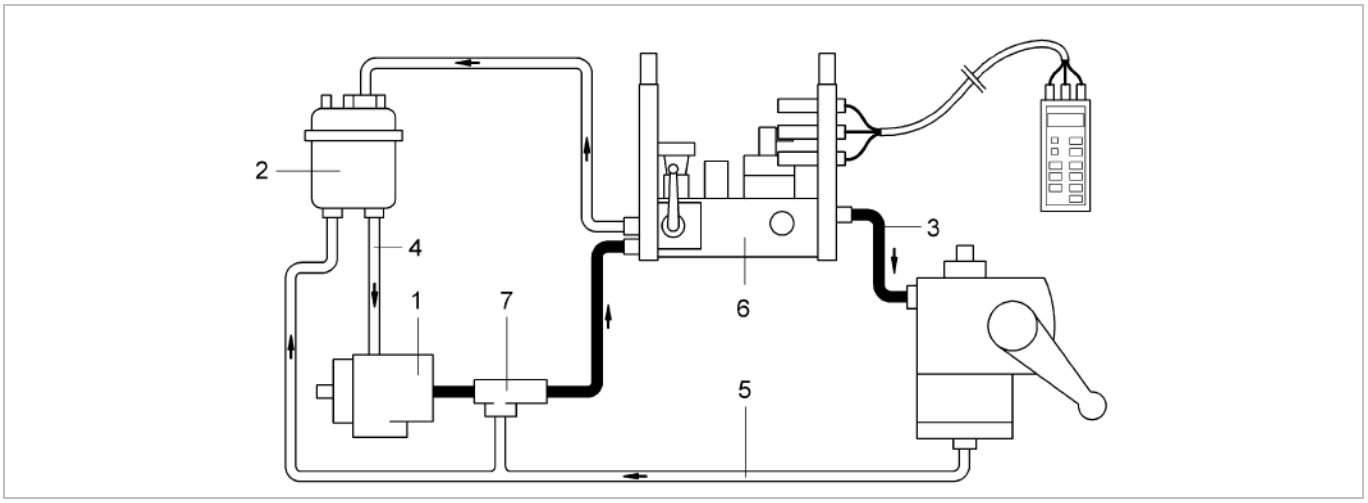


Fig. 26: Variant 1

Number	Description	Number	Description
1	Pump	2	Oil tank
3	Pressure line	4	Suction line
5	Return line	6	Tool [1] Servotest 600
7	Pressure relief valve		

Variant 2

Steering systems with the **pressure relief valve arranged in the steering gear or in the pressure line between tool [1] (Servotest 600) and the steering gear** (Fig. 27).

On steering systems of this type the nameplate of the steering gear or of the pressure relief valve will indicate the maximum pressure, e.g. 130 bar.

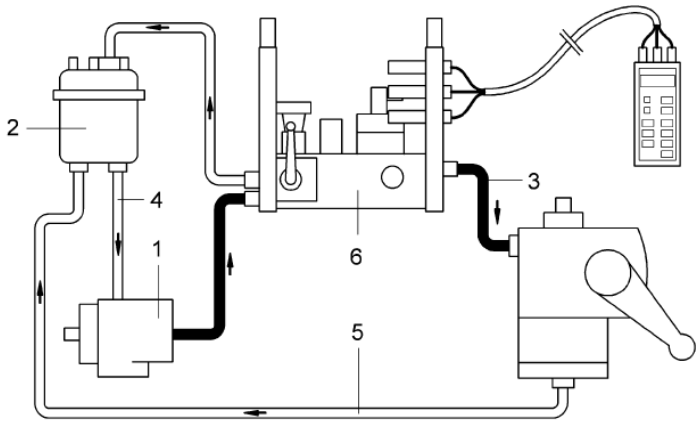


Fig. 27: Variant 2

Number	Description	Number	Description
1	Pump	2	Oil tank
3	Pressure line	4	Suction line
5	Return line	6	Tool [1] Servotest 600

1. Fit tool [1] (Servotest 600) to variants 1 or 2 in such a way that the readings can be seen from the driver's seat.
2. Check the oil level and bleed the steering system (refer to Chapter 5).
   Test conditions: oil temperature 50°C

Checking the maximum pressure of the pump

1. Read the maximum permissible pressure from the nameplate of the steering gear/the pump or of the separately arranged pressure relief valve.
2. Start the engine.
3. Set the pressure relief of tool [1] (Servotest 600) to a value excluding any damages to the steering system during the tests described below.

For steering systems with pressure relief ahead of tool [1]: Variant 1

NOTICE

Wear of the pump!

- Admit maximum pressure for a short time only (10 seconds maximum) to avoid an excessive heating-up of the inner parts of the pump and, in consequence, a premature wear of these parts.

1. Have the engine run at idling speed.
2. Close the shut-off valve of tool [1] (Servotest 600) and read the maximum pressure.
   NOTICE: Admit maximum pressure for only 10 seconds maximum!
3. Specified value: maximum pressure (see nameplate) + 10 %
4. Open the shut-off valve again.
5. If specified value is not reached the pump has to be replaced or repaired.

For steering systems with pressure relief aft of tool [1]: Variant 2

NOTICE

Damage of the pump!

If tool [1] is installed to variant 2 make absolutely sure that during the entire period of pressure testing the engine is running at idling speed, only. An increase in engine speed would entail an immediate and sharp rise in system pressure which could cause damage to the pressure line/the pump.

1. Have the engine run at idling speed.
2. While watching the pressure gauge of tool [1], slowly close the shut-off valve until the maximum pressure indicated is reached. Do not close the shut-off valve any further.
   NOTICE: Admit maximum pressure for a short time only (maximum 10 seconds) to avoid an excessive heating of the inner parts of the pump.
3. Have the shut-off valve return to its initial position.
4. If maximum pressure is not reached during this measurement, the pump has to be replaced or repaired.

11.2.2 Checking the flow rate of the pump

Specified values for flow rate, test pressure and test speed: see table below. Designations and operation of tool [1] (Servotest 600), see separate User Manual for Servotest 600.

Checking the controlled flow rate

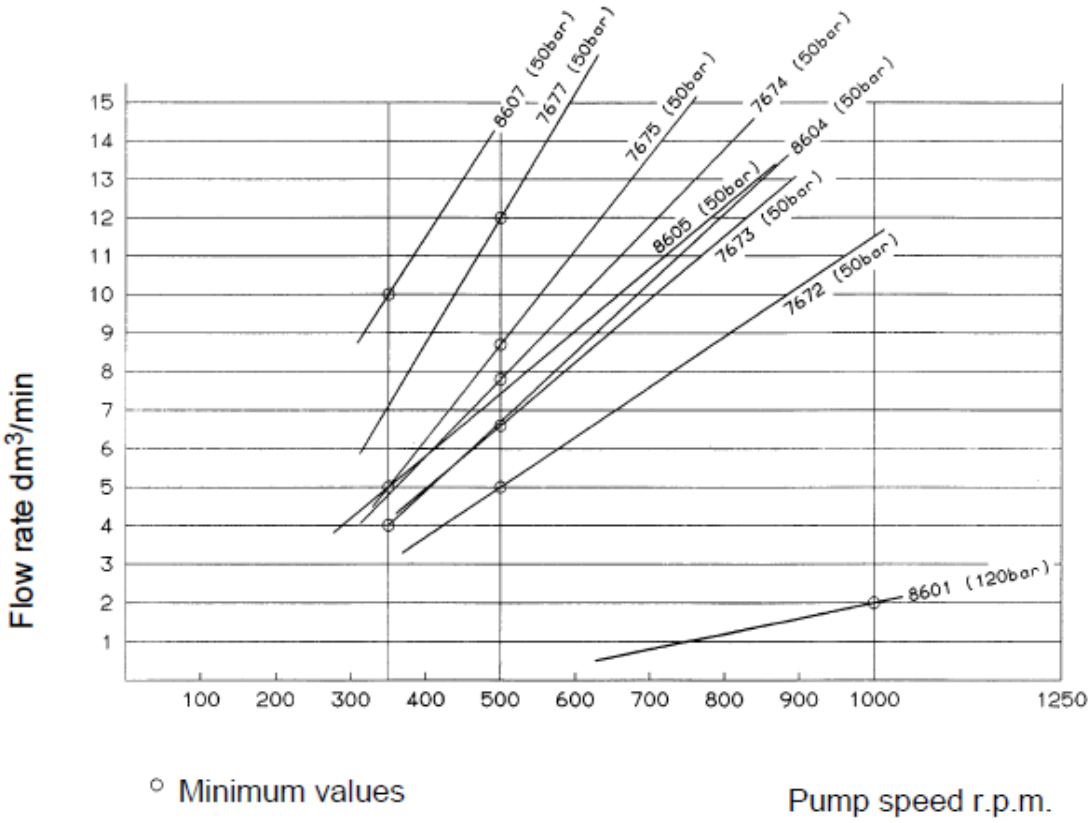
1. Raise the engine speed until the pump flow rate remains constant despite a further increase in speed (approx. 1300 r.p.m.)
2. The pump is now in the flow setting range.
   Specified value: see spare parts list.

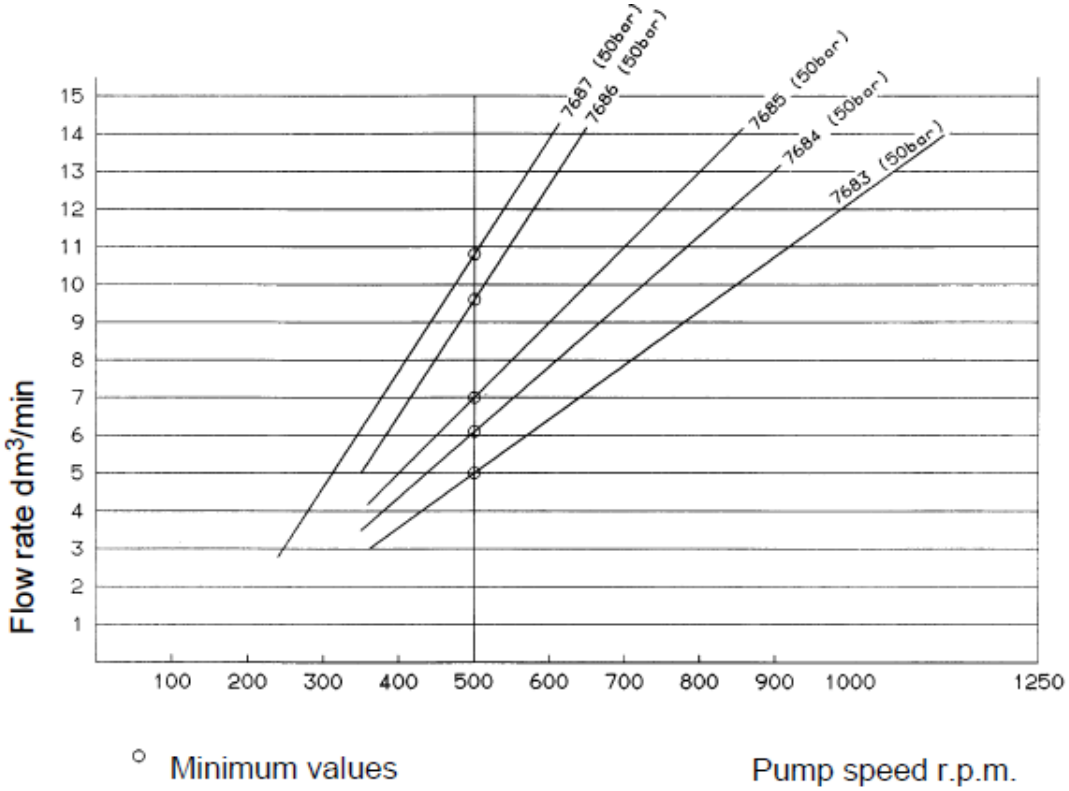
Checking the minimum flow rate

1. With the engine running at idling speed, progressively close the shut-off valve until the test pressure specified for the pump type in question is built up.
2. Read the flow rate.
3. Make sure the engine speed/pump speed ratio is correct.

Pump Type	Test Speed [r.p.m.]	Test Pressure [bar]	Minimum Flow Rate [dm3/min]
7672	500	50	5.0
7673	500	50	6.6
7674	500	50	7.8
7675	500	50	8.7
7677	500	50	12
7683	500	50	5.0
7684	500	50	6.1
7685	500	50	7.0
7686	500	50	9.6
7687	500	50	10.8
8601	1000	120	2.0
8604	350	50	4.0
8605	350	50	5.0
8607	350	50	5.0

Graphs see next page.


Flow rate dm³/min
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
100
200
300
400
500
600
700
800
900
1000
1250
8607 (50bar)
7677 (50bar)
7675 (50bar)
7674 (50bar)
8604 (50bar)
8605 (50bar)
7673 (50bar)
7672 (50bar)
8601 (120bar)
Minimum values
Pump speed r.p.m.


Flow rate dm³/min
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
100
200
300
400
500
600
700
800
900
1000
1250
7687 (50bar)
7686 (50bar)
7685 (50bar)
7684 (50bar)
7683 (50bar)
Minimum values
Pump speed r.p.m.

11.2.3 Checking the hydraulic steering limitation

Manually adjustable hydraulic steering limitation

- **Vehicles with a rigid axle:** Jack the steered axle up (see vehicle manufacturer's instructions).
- **Vehicles with single-wheel suspension:** Place the wheels of the steered axle on swivel plates.

1. Rotate the steering wheel clockwise.
2. When the axle stop or the lock stop, are reached, continue to rotate the steering wheel until a positive stop is reached.
3. In this position read the pressure at the pressure gauge:
   Specified values:

Steering systems	Specified Values
bis 16 dm^3/min	40 – 50 bar
bis 20 dm^3/min	50 – 60 bar
über 20 dm^3/min	70 – 80 bar

4. Repeat this test for the other direction of rotation.
5. Setting the steering limitation (refer to Chapter 5.5).

Automatically adjusting hydraulic steering limitation

1. Carry out the test (refer to Chapter 11.2.3 **Manually adjustable hydraulic steering limitation**.
2. If there is no more space left at the lock stop components or if the oil pressure does not drop to the specified value, fit new screws (20) or (128)
3. Reset the steering limitation (refer to Chapter 5.5).
   Specified values:

Steering systems	Specified Values
up to 16 dm^3/min	40 – 50 bar
up to 20 dm^3/min	50 – 60 bar
above 20 dm^3/min	70 – 80 bar

4. If there is too much space available at the lock stop components and if the oil pressure does not drop to the specified value, reset the steering limitation (refer to Chapter 5.5).
5. Repeat this test for the other direction of rotation.

11.2.4 Checking the maximum pressure and the leakage oil of the steering gear

For steering systems with pressure relief ahead of tool [1]: Variant 1

WARNING

Danger of accidents by squeezing!

A tool under pressure may be ejected

- Avoid any direct visual contact with the tool.

1. Between the lock stops, insert tool [3] or approx. 15 mm thick thrust pads (Fig. 28) ensuring that the steering motion is stopped ½ to ¾ steering wheel turn before reaching the axle stop/lock stop.
2. The restriction of the steering motion must take place at tool [3] or at the said thrust pads and must not be done by the piston in the steering gear.

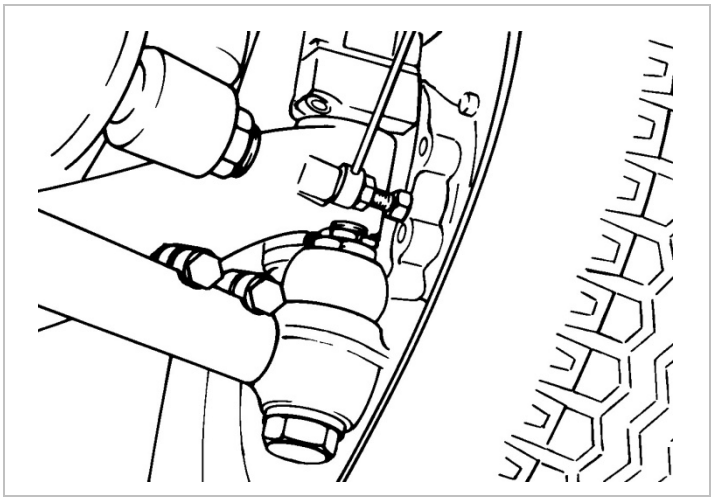


Fig. 28: Insert thrust pads between lock stops

3. Use the special tool specified by the vehicle manufacturer for the axle version in question.
4. At engine idling speed, rotate the steering wheel to the stop and continue to turn for abt. 5 seconds with an effort of 100 – 200 N at the steering wheel. Read the maximum pressure and the leakage oil.
5. Repeat this test in the opposite direction of rotation.
   Maximum permissible leakage oil values:

Type	Maximum permissible leakage oil values
8090	2.0 dm^3/min
8095 – 8098/8118	2.5 dm^3/min

Checking the leakage oil at a reduced flow rate

1. Set tool [1] (Servotest 600) to a flow rate which is 0.5 dm^3/min higher than the maximum permissible leakage oil value.
2. Repeat the leakage oil test as described above.
3. The leakage oil value measured in this repetition test must not exceed the value measured previously.

Cause of insufficient maximum pressure/too much leakage oil:

- Pressure relief valve and/or replenishment valve defective.
- Pressure cut-off of steering limitation valve comes too early. Refer to Chapter 5.5 for setting the steering limitation valfe.
- Seals in the steering gear defective.

For steering systems with pressure relief aft of tool [1]: Variant 2

1. The shut-off valve (4) must be closed completely and the throttle valve (5) must be closed progressively until a pressure is achieved that is 30 bar lower than maximum pressure.
2. Re-open the shut-off valve (4).
3. Repeat this test as described above.

11.2.5 Checking the return to neutral of the valve

Make sure the steering column has sufficient clearance (floor carpets, coverings).

1. By rotating the steering wheel, close the steering valve, thus causing maximum pressure to build up.
2. Rotate the steering wheel back until idle pressure is available.
3. Raise the pressure to idle pressure + 10 bar.
4. Release the steering wheel and watch the pressure, which must drop to idle pressure (at maximum 0.5 bar higher) within 1 second.
   Example:
   - Idle pressure: 4.0 bar
   - Maximum permissible value: 4.5 bar

11.2.6 Checking the steering gear play

Prerequisite for the test described below:

The transmission parts between the steering wheel and the road wheel must be free from play.

Versions with leaf spring

1. Lock the LH front wheel (the RH front wheel if the vehicle is RH steered) in the straight ahead driving position by fitting tool [4] between the wheel rim (rear and front) and the front spring.

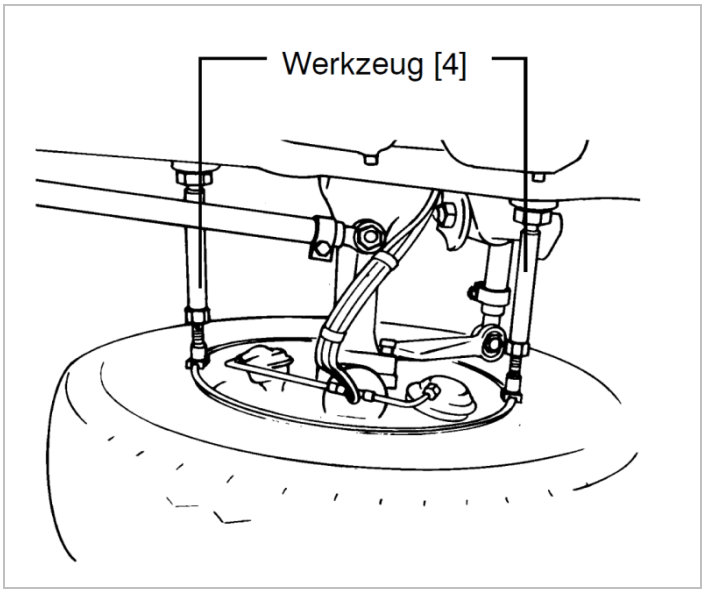


Fig. 29: Fitting tool [4]

NOTICE

Damages of the wheel rim due to high pressures!

- Do not exert any pressures in excess of those mentioned below on the tools and the wheel rim in order to avoid damages to the wheel rim.

Versions with single-wheel suspension

1. Lock the LH front wheel (the RH front wheel if the vehicle is RH steered) as per vehicle manufacturer's instructions.
2. Put tool [2] on the steering wheel and attach the pointer to the dashboard or to the windscreen.

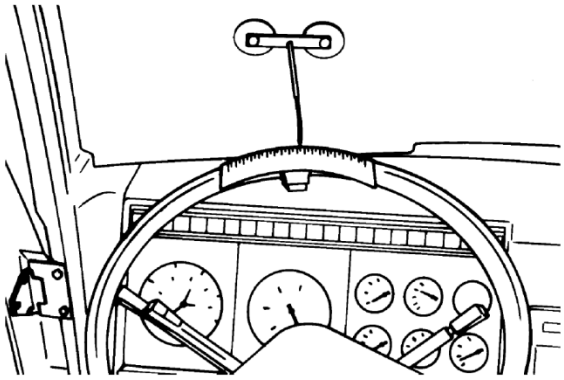


Fig. 30: Fitting tool [1]

3. Raise the engine speed to approx. 1000 r.p.m..
4. Read the idle pressure at tool [1] (Servotest 600/pressure gauge).
5. Rotate the steering wheel to the left until a pressure of 1 bar above idle pressure is indicated. On tool [2] read the dial value.
6. Rotate the steering wheel to the right until a pressure of 1 bar above idle pressure is indicated. On tool [2] read the dial value.
7. Calculate the total travel covered.
   Specified value: max. 50 mm (steering wheel Ø 500 mm)
   For versions with bevel box: Specified value: max. 55 mm (steering wheel Ø 500 mm)
8. If the maximum value is exceeded, check the play of the steering column and, if required, repair or replace the steering gear.
9. Remove tool [1] (Servotest 600)/the pressure gauge.
10. Check the oil level and bleed the steering system - see Chapter 5.

11.3 Troubleshooting aid

Fault	Cause	Remedial Action
Noise	▸ Air in the oil ▸ Oil level too low	▸ Bleed steering system (see Chapter 5) ▸ Top up with oil
	Pump defective	▸ Repair (contact service partner) ▸ Replace (contact service partner)
Stiff operation to either side	Oil level too low	▸ Repair leakage ▸ Top up with oil (refer to Chapter 5)
	Steering system is sucking in air (Suction area)	▸ Repair leakage ▸ Top up with oil (refer to Chapter 5) ▸ Bleed steering system (refer to Chapter 7)
	Universal joints/steering column Stiff operation	▸ Check ▸ Replace (see vehicle manufacturer's instructions)
	Oil filter soiled	▸ Replace (refer to Chapter 5)
	Steering gear defective	▸ Repair (contact service partner) ▸ Replace (contact service partner)
	Pump defective	▸ Repair (contact service partner) ▸ Replace (contact service partner)
	Used wrong oil	▸ Change oil (refer to Chapter 5) ▸ Fill steering gear with correct oil (refer to Chapter 5)
	Oil temperature too high	▸ Add oil-cooling actions (refer to Chapter 5)
Stiff operation in one direction	Incorrect setting of steering limitation	▸ Set (refer to Chapter 5)
	Steering gear defective	▸ Repair (contact service partner) ▸ Replace
Stiff operation during fast steering motion	Steering system is sucking in air (suction area)	▸ Repair leakage ▸ Top up with oil ▸ Bleed steering system (refer to Chapter 5)
	Pump defective or wrong version	▸ Replace pump (contact service partner)
Self-centering hampered	Stiff operation of axle/axle guide components	▸ Repair (see vehicle manufacturer's instructions)
	Steering gear/steering column fitted in twisted position	▸ Eliminate twisting (see vehicle manufacturer's instructions)
	Excessive flow pressure	▸ Wrong hose cross-section ▸ hose bent / narrowed ▸ orifice / wrong orifice fixed (see vehicle manufacturer's instructions)
	Stiff operation of steering column	▸ Eliminate stiff operation (see vehicle manufacturer's instructions)
	Steering gear defective	▸ Repair (contact service partner) ▸ Replace (contact service partner)

Fault	Cause	Remedial Action
Exact straight ahead driving impossible	Oil level too low	▸ Repair leakage ▸ Top up with oil (refer to Chapter 5) ▸ Bleed steering system (refer to Chapter 5)
	Axle/axle guide components/steering column not play-free	▸ Check (see vehicle manufacturer's instructions) ▸ Replace (see vehicle manufacturer's instructions)
	Steering gear not play-free	▸ Check (refer to Chapter 5) ▸ Replace (contact service partner)

Additionally, for versions with potentiometer

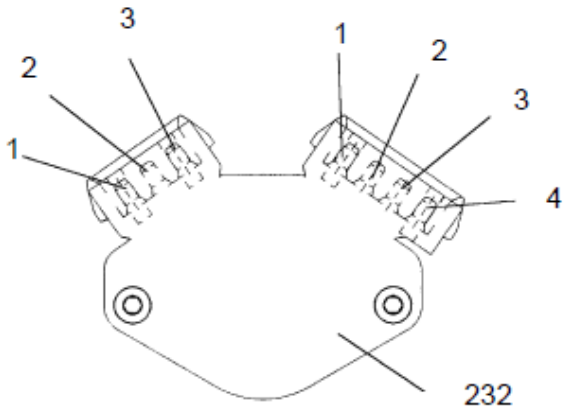


Fig. 31: Pin assignment at potentiometer (232) or plug (vehicle electrical system)

Fault	Cause	Remedial Action
Potentiometer (232) does not work	No operating voltage	At plug (vehicle electrical system) measure between pins 1-3 Specified value: operating voltage (see vehicle manufacturer's instructions)
	Contact problems	Remove dirt and/or corrosion
	Internal malfunction	Check potentiometer (see below)
	No tripping of potentiometer (232)	Replace steering gear (contact service partner)
Wrong operation of potentiometer (232)	Wrong setting	Set potentiometer (refer to Chapter 7)
	Wrong cabling	Check cabling (refer to Chapter 7)
	Cap screws (223 and 235) loose	Check and tighten (refer to Chapter 7)
	Potentiometer (232) mounted incorrectly	Check (refer to Chapter 7)

12 Key to numbers in figures and exploded drawing

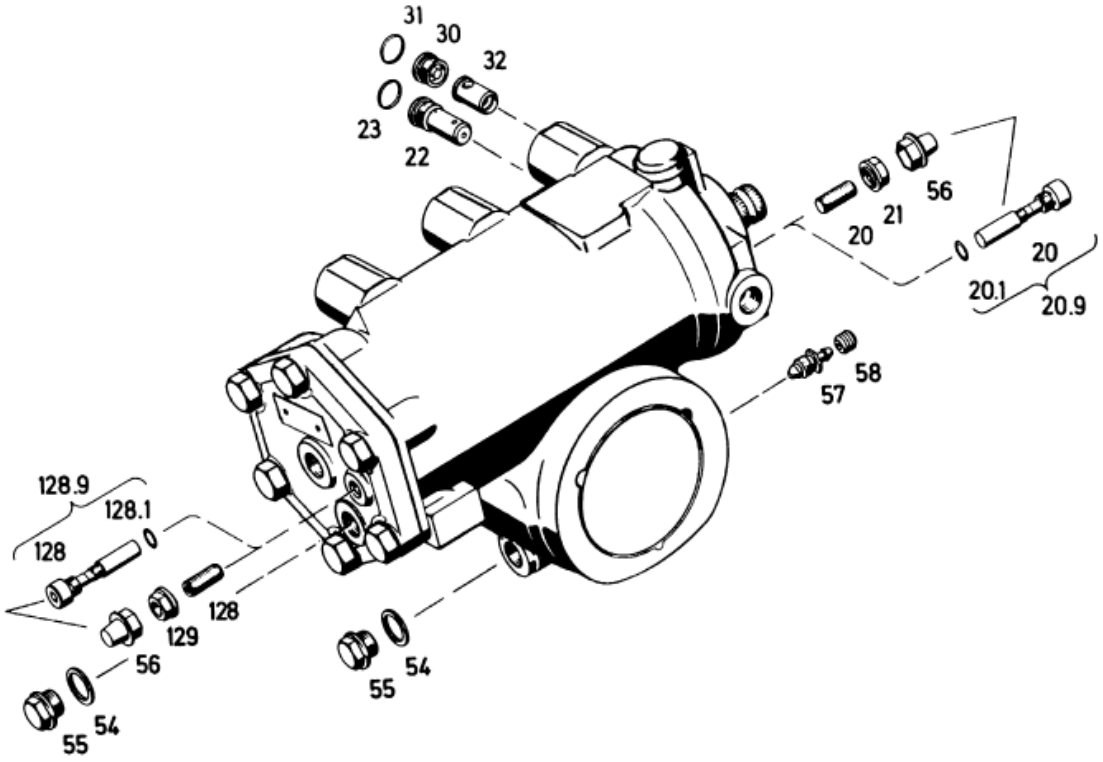


Fig. 32: Exploded drawing

Number	Description	Number	Description
20	Set screw/screw	20.1	O-ring
20.9	Screw	21	Collar nut
22	Valve insert	23	O-ring
30	Screw	31	O-ring
32	Valve insert	54	Sealing ring
55	Screw plug	57	Bleeder
128	Set screw/screw	128.1	O-ring
128.9	Screw	129	Collar nut

13 Maintenance Report RB-Servocom

Customer: _____ Steering gear version: _____

Vehicle manufacturer: _____ Pump manufacturer: _____

Vehicle type (or model): _____ Pump version: _____

Mileage: _____ Emergency steering pump: _____

Maintenance Work

	O.K.	Not O.K.
Test drive carried out?	☐	☐
Tested or checked for external leakproofness / damages?	☐	☐
Oil level checked?	☐	☐

Remarks:

Original for duplication

Inspected by (name): _____ Date: _____

14 Inspection Report RB-Servocom

Customer: _____ Steering gear version: _____

Vehicle manufacturer: _____ Pump manufacturer: _____

Vehicle type (or model): _____ Pump version: _____

Mileage: _____ Emergency steering pump: _____

Inspection intervals
Refer to Chapter 5

Inspection Work

	O.K.	Not O.K.
Test drive carried out?	☐	☐
Visual inspection carried out?	☐	☐
Oil filter replaced?	☐	☐
Steering gear play checked?	☐	☐

Specified value: max. 50 mm
max. 55 mm (for versions with bevel box

Measured value: _____ mm

	O.K.	Not O.K.
Safety test (ST) checks carried out?	☐	☐

Remarks:

Inspected by (name): _____ Date: _____

15 Notes