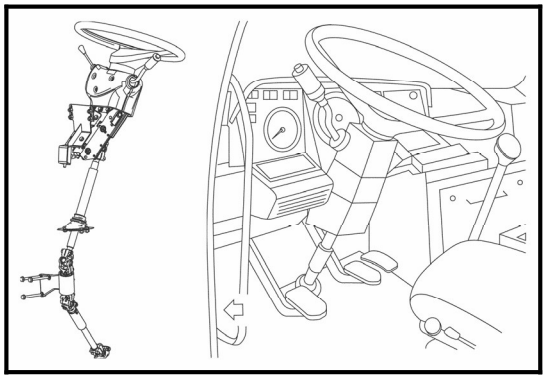


BEML - TATRA 815

26RR36 22 255 6x6.1R/50T, 51T

Workshop manual

Part 10 – STEERING

Publication numer: 03-0254-ENG/00

TATRA, a.s. **1-st Edition 28-2-2007**

10 STEERING

10.1 Description and Main Technical Specifications

The vehicles BEML - TATRA **T815 - 26RR36 22 255 6x6.1R/50T** and BEML - TATRA **T 815 - 26RR36 22 255 6x6.1R/51T** are fitted with a wheel controlled, right-hand drive, mechanical, power-assisted steering with the fluid-controlled working cylinder. Steered are wheels of the front axle.

The steering mechanism consists of three relatively independent components:

- Steering column
- Kingpin steering mechanism
- Power steering circuit

The arrangement of the steering column assembly is illustrated in the figure.

The assembly consists of steering wheel **1**, spindle cover **3** and spindle holder assy **4**, which is screwed to the cross girder on the cabin front panel, in which spindle **5** c/w cross-pin coupling **6** are mounted. The steering wheel **1** is attached with nut **2** to spindle **5**. The cross-pin coupling **6** is connected to fork of steering gear.

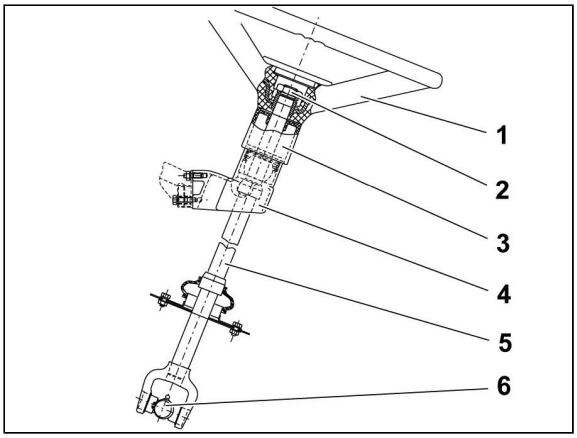


Fig. 10.1 Steering column

To the steering column assy the steering gear **2** and steering pitman arm **1** are linked.

The arrangement of the kingpin mechanism is illustrated in the figure. It consists of power cylinder pull rod c/w joint **3** and steering booster with joints **6** being anchored in the front cross-girder, double steering arm **8**, which is mounted in bearing **9** on central member frame, steering rods **7** and steering arms **5**. The individual steering arms and rods are interconnected by spherical ball joints **4**.

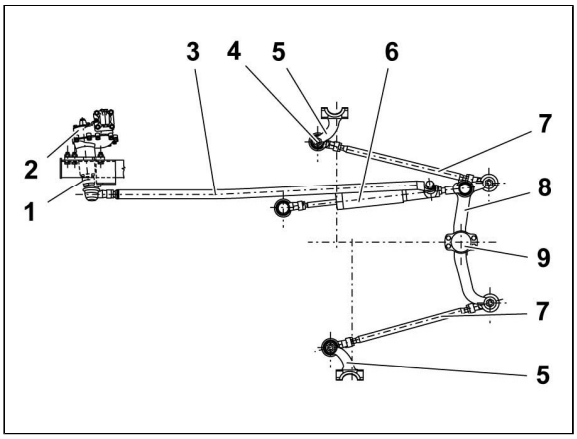


Fig. 10.2 Kingpin mechanism

The arrangement of power-steering circuit is illustrated in the figure.

From the power-steering tank **3** the hydraulic fluid is supplied through pipeline and hoses by means of power steering pump **1**, which is situated on engine, to the power-assisted steering **2** and then back to the power steering tank **3**.

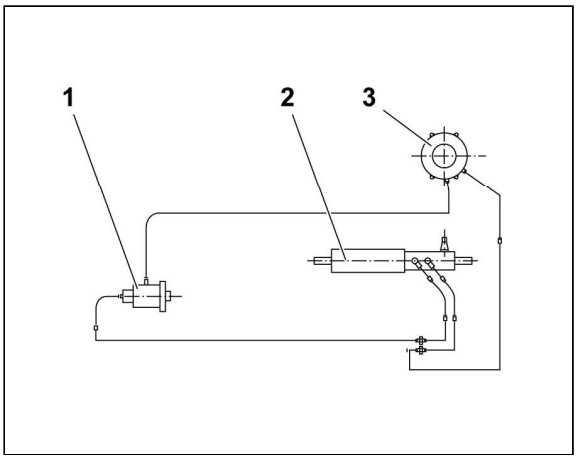


Fig. 10.3 Power steering circuit

The main technical specifications of the steering mechanism are mentioned in the table below.

Tab. 10.1 Main technical specifications of the steering mechanism

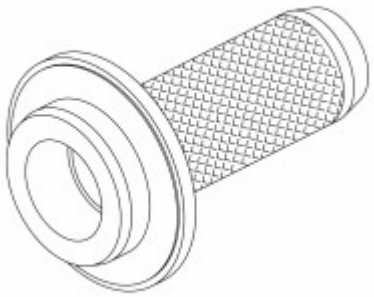
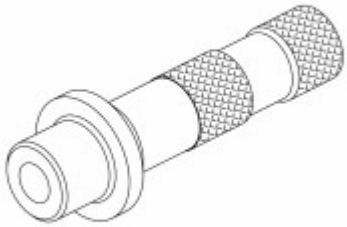
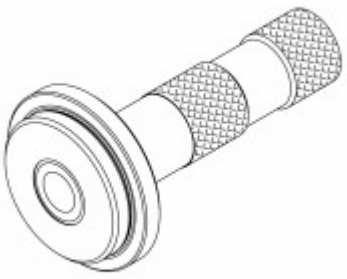
Data	Unit	Value
Kind		steering-wheel controlled, right-hand drive, mechanical, power-assisted steering with fluid working cylinder
Steering gear		with worm and one steering finger mounted on needles in bush
Type of working cylinder		RV 78 - 26311.42
Type of pump		UC 16 S.04
Sense of rotation		clockwise (viewed from flange)
Nominal overpressure	MPa	7
Maximum overpressure	MPa	11
Adjustment of relief valve	MPa	9.8 - 10.5
Total number of steering wheel turns to achieve the lock		$5\ ^{2}/_{3}$
Diameter of steering wheel crown	mm	500
Steering wheel backlash with engine running	°	max. 15
Front axle wheels camber (basic adjustment)		1°20' ± 40'
Front axle wheels toe-in at curb weight	mm	- 1.5 to + 2.5

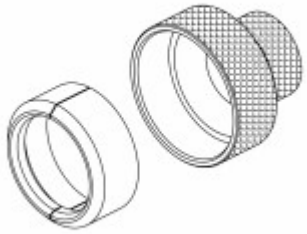
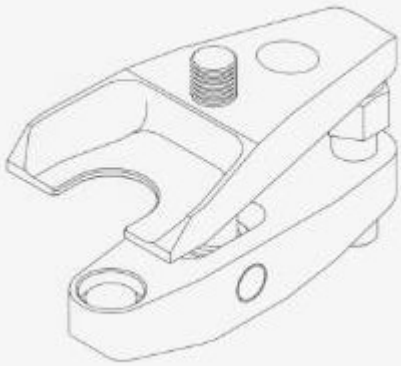
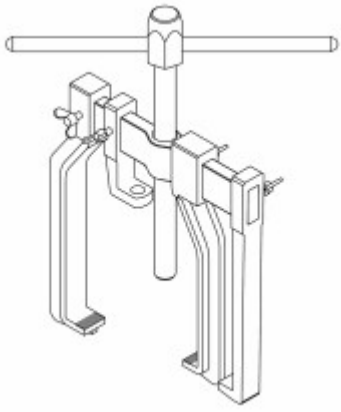
10.2 Faults Causes and Troubleshooting

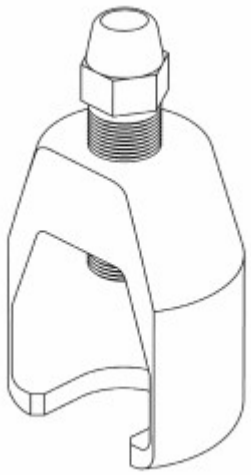
Fault	Cause	Remedy	Mentioned in:
The steering wheel is not functional	Mechanical or other damage to steering wheel	Replace the steering wheel	(See Subchapter **10.5.8**)
The steering wheel cannot be locked	The steering wheel lock is not functional	Replace the steering lock	(See Subchapter **10.5.9**)
The vehicle does not respond exactly to the steering wheel turning	Big steering shaft backlash	Replace the worn steering shaft components	(See Subchapter **10.5.10**)
	Big backlash in steering gear	Adjust the backlash in steering gear	(See Subchapter **10.5.7**)
	Big backlash in joints of connecting steering rods	Replace faulty components of the arm bearing	(See Subchapter **10.5.12**), (See Subchapter **10.5.15**)
	Backlash in the double steering arm bearing	Replace faulty components of the arm bearing	(See Subchapter **10.5.17**)
	Damaged steering gear	Replace the steering gear	(See Subchapter **10.5.11**)
The vehicle has the poor riding characteristics (it is “wandering”)	Wheels alignment out-of-specifications	Adjust the wheels alignment	(See Subchapter **10.5.6**)
Unequal tire wear	Wheels alignment out-of-specifications	Adjust the wheels alignment	(See Subchapter **10.5.6**)
Lubricant leaks from dust seal of ball joint	Damaged dust seal of spherical ball joint	Replace the dust seal of spherical ball joint	(See Subchapter **10.5.16**)
Abnormal hard steering (excessive effort required to turn the steering wheel)	Small backlash in steering gear	Adjust the backlash in steering gear	(See Subchapter **10.5.7**)
	Damaged power-assisted steering c/w joints	Replace the power-assisted steering	(See Subchapter **10.5.13**), (See Subchapter **10.5.14**)
	Fault in the power steering circuit not caused by defect in individual assemblies (hoses and pipes leakage, lack of oil, aeration, etc.).	Check hoses and pipes for leaks, check the oil levels, bleed the circuit, etc.	(See Chapter **10.5**)

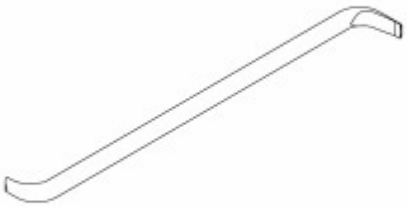
10.3 List of Special Tools

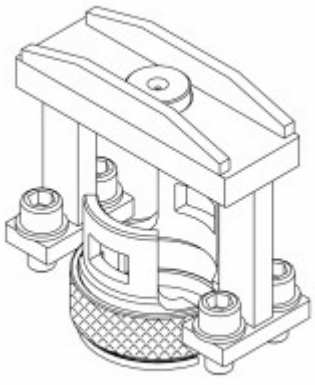
Tab. 10.2 Steering components removal and installation tools

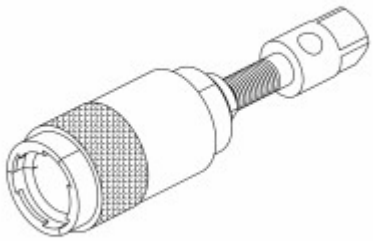
Name: Driver of shaft seal 70x100x13 of double arm steering lever seat *Tool number:* PRL 0619	
Name: Driver of bearing 442 0 5040 032 4 of double arm steering lever seat *Tool number:* PRL 0652	
Name: Driver of double arm steering lever seat 442 0 5040 031 4 bearing *Tool number:* PRL 0653	

Name: Driver of ball joint protective bag *Tool number:* PRL 0886	
Name: Ball joint puller *Tool number:* PRM 0412.2	
Name: Universal puller *Tool number:* PRM 0777	

Name: Puller of steering lever from steering gearbox *Tool number:* PRM 3094	

Name: Puller of bearing 442 0 5040 031 4 of double arm steering lever seat *Tool number:* PRM 3205	

Name: Puller of bearing 442 0 5040 032 4 of double arm steering lever seat *Tool number:* PRM 3254	

Name: Steering wheel puller *Tool number:* PRM 3285	

10.4 Survey of Torque Specifications

Tab. 10.3 Torque specifications

DATA	UNIT	VALUE
Locking screws nuts of steering booster ball joint	Nm	65 ± 10%
Locking nuts of steering rods ball joints (at bushes)		310 ± 10%
Steering arms screws at steering knuckles		370 ± 40
Steering wheel nuts		120 - 150
Fastening screws nuts fixing the spindle holder to cab		10 - 13
Fastening screw fixing the spindle holder to cab		10 - 13
Nuts fixing the power cylinder pull rod to steering booster		200 ± 10%
Fastening screws nuts of steering gear		150 ± 10%
Fastening nuts fixing the steering rod on steering gear		280 ± 10%
Fastening nuts of ball joints of steering rods, power cylinder pull rod, steering booster		280 ± 10%
Bolts of double steering arm bearing housing		250 - 300

10.5 Working Procedures

10.5.1 Oil Change in Steering Gear

a) Reason for Oil Change

1. Regular oil changes in accordance with the TDS classification (Service Booklet) after three years of operation at the latest.

b) Technical Conditions

1. Replace sealing ring with a new one.
2. Fill with oil according to manufacturer's specification.
3. No oil leakage through the drain plug after oil change is allowed.

c) Oil Change Procedure

1. Lift the driver's cabin.
2. Unscrew the plug **2** from bottom cover of steering gear.
3. Drain oil into a pan prepared.
4. After the oil change, screw the plug **2** c/w new sealing ring.

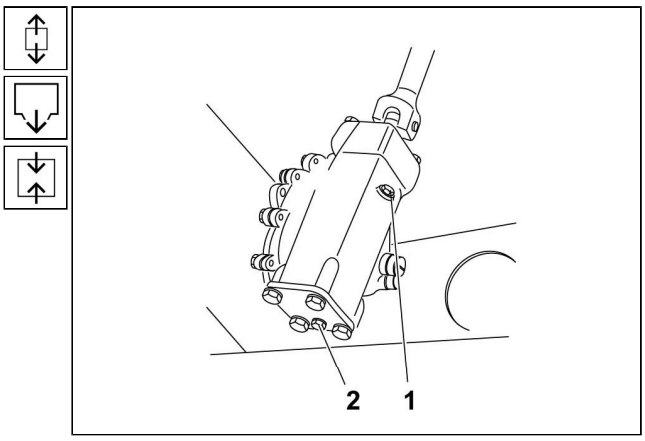


Fig. 10.4 Steering gear plugs

5. Unscrew the check plug **1** .
6. Fill pure oil through the check hole up to the edge.
7. Screw the check plug **1** .
8. Lower the driver's cabin.

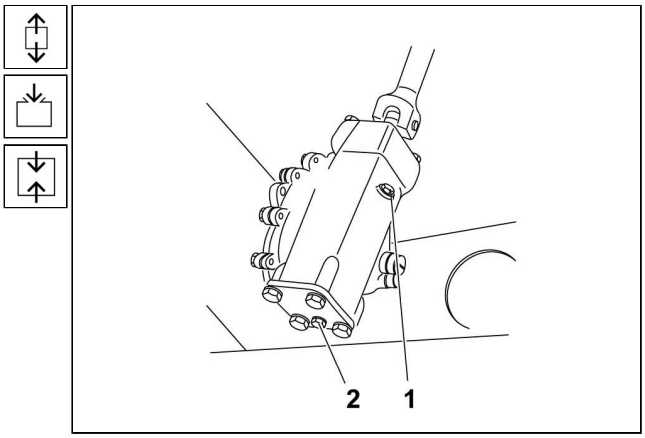


Fig. 10.5 Steering gear plugs

10.5.2 Oil Change in the Power Steering Circuit

a) Reason for Oil Change

1. The technical servicing after consuming every 36,000 ltr of fuel, after 2,700 eng. hrs or after covering 90,000 km, which occurs the first.

   CAUTION:
   If the prescribed number of kilometers has not been covered, change the oil after every one-year's operation.

b) Technical Conditions

1. Replace all sealing rings with new ones.
2. It is necessary to replace the filter cartridge in the power steering tank simultaneously with the oil change.

c) Oil change Procedure

1. Unscrew hollow screws **1** and **3** fixing the inlet **2** and outlet **4** oil manifolds to steering booster **5**.
2. Start the engine, leave it running at idle and drain oil into a prepared pan. After the power steering tank is empty, stop the engine **immediately**. The pump must not run "dry"!
3. By alternative steering wheel turning to right and left locks, discharge the oil also from steering booster.

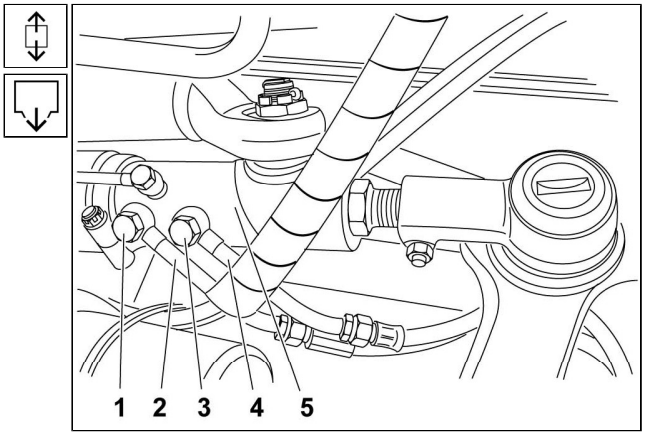


Fig. 10.6 Oil manifolds to steering booster - removal

4. Use hollow screws **1** and **3** to connect the inlet **2** and outlet **4** oil manifolds to steering booster **5**.

   CAUTION:
   Remember to fit 3 pcs of sealing rings 16 x 20 ČSN 02 9310.2 with the hollow screw 3 (2 pcs beneath line ring connection 4)

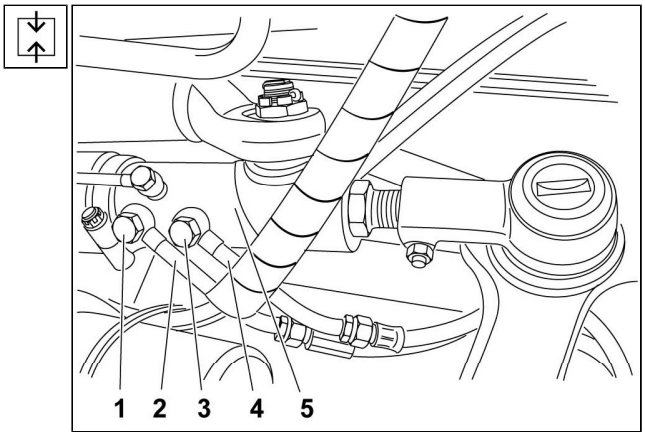


Fig. 10.7 Oil manifolds to steering booster - installation

5. Replace the filter cartridge in the power steering tank **2** with a new one in accordance with the procedure mentioned in: (See Subchapter **10.5.3**).
6. Fill the power steering tank with pure oil to 3/4 level.

   CAUTION:
   When filling the tank with oil, the oil dipstick 1 must be unscrewed from the tank cap.

7. Start the engine and turn the steering wheel alternatively to both steering locks to bleed the power steering circuit.

   Note:
   When bleeding the circuit, remember to top up the oil in the power steering tank all the time.

8. Shut the engine off and top up the oil to power steering tank **2** to mark on the oil dipstick **1** .
9. Visually check the whole hydraulic circuit for leaks.

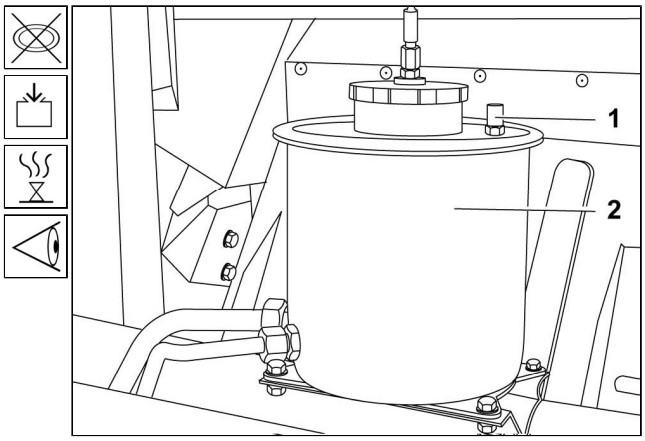


Fig. 10.8 Power steering tank

10.5.3 Replacement of the Filter Cartridge in the Power Steering Tank

a) Reason for Replacement

1. Technical servicing during the running-in period – after covering 2,500 to 3,000 km and during the oil change in the power steering circuit.

b) Technical Conditions

1. Replace the filter cartridge together with oil change in the power steering circuit.
2. The filter cartridge must fit on the attachment bolt so that the lower seal element comes as far as it goes, it means on the face of the reinforced part of attachment bolt.
3. The relief valve must fit slightly on the attachment bolt. The valve must run smoothly along the manifold.

c) Replacement Procedure

1. Unscrew the bleeding line **1** from neck **2**.
2. Unscrew the filler cap **3**.
3. Loosen and unscrew nut **4** from bolt **7**.
4. Withdraw cover **5** c/w washer **6**.
5. Withdraw valve **9** c/w spring **8**.
6. Remove the filter cartridge **10** from bolt **7**.
7. Slide a new filter cartridge **10** on bolt **7**.
8. Fit valve **9** c/w spring **8**.
9. Fit cover **5** c/w washer **6**.
10. Mount nut **4** on bolt **7** and tighten.

    CAUTION:
    After the tank is covered with cap 5, be sure to tighten the nut 4 as far as it goes - washer 6 must lean with edge of the hole on the bolt leading cone 7.

11. Mount the oil filler cap **3**.
12. Mount the bleeding line **1** on neck **2**.

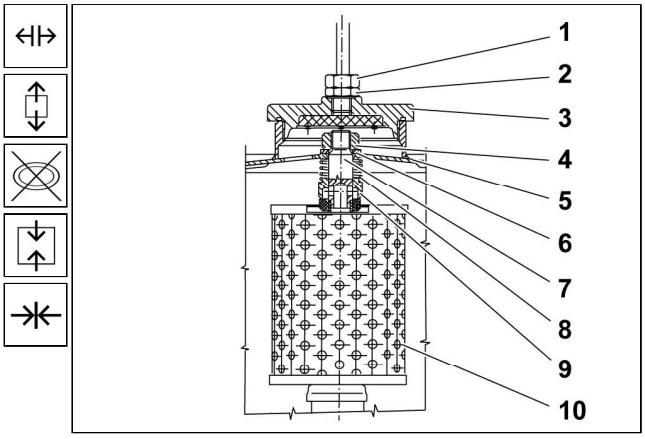


Fig. 10.9 Power steering tank components

10.5.4 Inspection of the Backlash in the Steering

a) Reasons for Inspection

1. Technical servicing after consuming every 8,000 ltr of fuel, after 600 engine hours and/or after covering 20,000 km, which occurs the first.
2. Inspection or adjustment of the front axle wheels alignment.

b) Technical Conditions

1. The maximum backlash in the steering makes **18°**.

c) Inspection Procedure

1. Set the vehicle wheels of the front axle into a straight-ahead direction.
2. Attach the angle gauge indicator of the steering backlash measuring instrument to the steering wheel.
3. Fix the angle gauge indicator with a suction pad to the window glass.

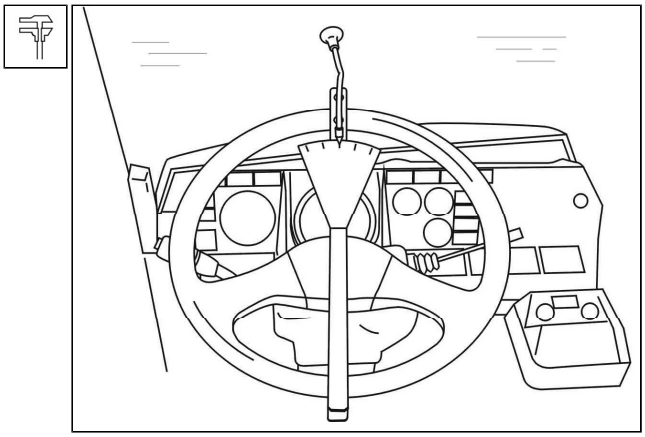


Fig. 10.10 Use of the angle gauge to check the backlash in the steering

4. Start the engine.
5. Turn the steering wheel to full RH and LH locks (without moving vehicle wheels forwards and rearwards). At the moment when vehicle wheels start to move to a full lock, read the total angular displacement on the angle gauge.
6. Should the measured value exceed the maximum allowable value of **18°**, it is necessary to check the bearing of steering ball joints, double steering arm, a correct tightening-up of steering rods lock screw connections, steering cross joints forks and to measure the backlash in the steering monoblock gearing (only authorized service station may perform it). Remove the found-out undesired backlashes in individual steering components and repeat the steering backlash measurement again.

10.5.5 Inspection of the Tightening-up of Steering Arms Fastening Screws at Steering Knuckles

a) Reason for Inspection

1. Technical servicing during the running-in period – after covering 2,500 to 3,000 km, and during technical servicing after consuming every 16,000 ltr of fuel, after 1,200 eng. hrs and/or after covering 40,000 km, which occurs the first.

b) Technical Condition

1. The torque specification is **370 ± 40 Nm**.

c) Inspection Procedure

1. Unscrew screws **5** c/w spring washers **4** fixing the brake cylinder bracket **1** to bolts **2** of steering arm **6** and steering knuckle and partially lift the brake cylinder bracket **1**.
2. Remove the binding wire **3** securing the screws **2** of steering arm **6**.
3. Fit the torque wrench on screw heads **2** and tighten them to check the correct torques. The torque specification should be **370 ± 40 Nm**.
4. After checking the tightening, secure screws **2** with binding wire **3** to protect them against loosening.
5. Use bolts **5** and spring washers **4** to attach the brake cylinder bracket **1** to bolts **2** and steering knuckle.

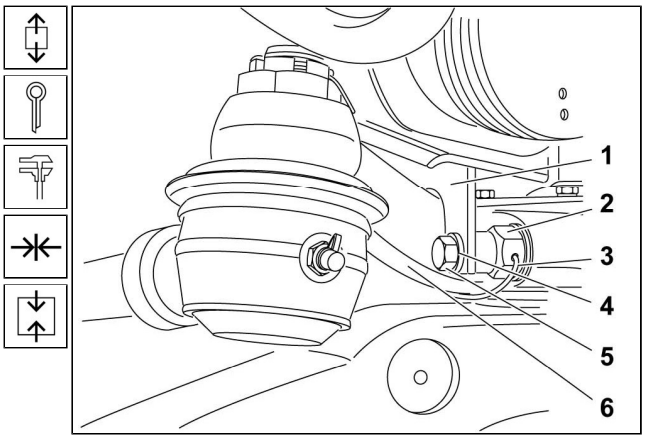


Fig. 10.11 Checking the tightening-up of steering arms screws at steering knuckles

10.5.6 Inspection and Adjustment of the Front Axle Wheels Alignment

a) Reasons for Inspection and Adjustment

1. Technical servicing during the running-in period – after covering 2,500 to 3,000 km and during technical servicing after consuming every 16,000 ltr of fuel, after 1,200 engine hours or after covering 40,000 km, which occurs the first.
2. Adjustment after removal and reinstallation of the steering kingpin mechanism.
3. Uneven wear of tire treads of the front axle.
4. Vehicle pulls to one side when driving on a level road.

b) Technical Conditions

1. The measuring surface must meet the requirement of the evenness of 1 mm per 1 m both in the longitudinal and transversal direction.
2. Thoroughly clean the vehicle undercarriage and wheels.
3. Inflate tires to specified pressures.
4. The steering backlash must be within the tolerance of max. **18°**.
5. The wheel units' bearings clearances must be within the tolerance and wheels must not be wobbling (the wheels run-out must not be excessive).
6. Wheel discs must not be deformed.
7. The wheels camber at curb weight should be within the range of **1° 20' ± 40'**.
8. The wheels toe-in should be within the range of **- 1.5** to **+ 2.5 mm**.
9. Should you need to apply the steering booster elements for the vehicle control (steering wheel turning, braking, etc.), start the engine. If the vehicle is parked in enclosed areas, take care that the inner space with exhaust gases is ventilated properly!
10. Use the suitable measuring equipment (e.g. optical instrument) to carry out inspection and adjustment.

c) Inspection and Adjustment Procedure

Inspection and adjustment of individual parameters of the front axle wheels alignment should be evaluated as a whole. It is not possible to change the adjustment of one parameter (except for the wheels toe-in) when leaving the other parameters unchanged. A change of one parameter can result in a change of other parameter.

Note:
The inspection and adjustment of the wheels alignment of the front axle depends on a type of the measuring instrument used. When checking individual parameters, abide by the manufacturer's instructions of the respective measuring equipment.

Follow the below-mentioned procedure during inspection and adjustment:

1. Inspection of steering components for a mechanical condition:

- check the backlash in steering spherical ball joints,
- check the backlash in the double steering arm bearing.

Note:
Should you find out the backlash in ball joints, replace them with new ones in accordance with the procedure mentioned in: (See Subchapter **10.5.14**), (See Subchapter **10.5.12**) and (See Subchapter **10.5.15**).

Should you find out the backlash in the double steering arm bearing, adjust it in accordance with the procedure mentioned in: (See Subchapter **10.5.17**)

Inspection of the wheels discs side run-out:

- lift one of front axle wheels,
- measure the disc wheel run-out while turning the wheel (heed the instructions of the measuring instrument manufacturer),
- carry out the same on the other wheel of the front axle

Note:
When you find out that the disc wheel run-out is excessive, repair the disc wheel or replace it with a new one and repeat the measurement.

3. Adjustment of front axle wheels into a straight-ahead direction:

- Heed the instructions of the measuring instrument manufacturer.

4. Inspection of front axle wheels locks:

- measure both front wheels locks while turning the wheels from the basic position to the maximum right and left locks,
- If the wheels RH and LH locks are different, continue to adjust it in accordance with further point, if OK, go on point 6.

5. Adjustment of steering mechanism into the basic position for the straight-ahead drive:

- adjust the steering gear into the basic position for the straight-ahead drive by distribution of steering wheel turns,
- remove the ball joint **5** of power cylinder pull rod **1** from steering arm **6** according to the procedure mentioned in: (See Subchapter **10.5.12**),
- unlock the lock washer **3**, loosen nut **2** and tap the bush **4** to release it from the ball joint housing **5**,
- Turn (screw) the ball joint **5** to adjust the length of power cylinder pull rod c/w joint so that the axis of holes for steering rod ball joints in the double steering arm is perpendicular to the vehicle longitudinal centerline after installation of the ball joint into steering arm.

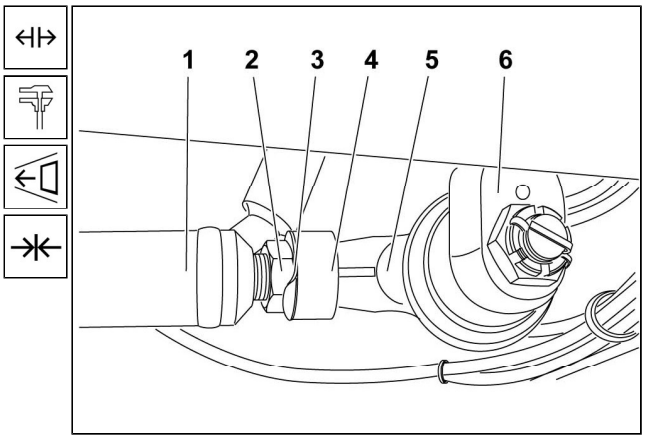


Fig. 10.12 Adjustment of the length of power cylinder pull rod c/w joint

CAUTION:
After adjustment of the length of power cylinder pull rod with joint, the position of

ball joint (20°) towards the contact surface of power cylinder pull rod must be kept (See Subchapter **10.5.12**)

- tighten the nut **2** to **310 ± 10% Nm** and secure it with bending of lock washer **3**.
- install the ball joint **5** of power cylinder pull rod **1** into steering arm **6** in accordance with the procedure mentioned in: (See Subchapter **10.5.12**),

- Carry out a visual inspection of the steering wheel adjustment in position on the steering column for the straight-ahead drive. In case that steering wheel arms are not perpendicular to the vehicle longitudinal centerline, remove the steering wheel and readjust it in accordance with the procedure mentioned in: (See Subchapter **10.5.8**).

6. Inspection of the front axle wheels camber:

- measure the wheels camber on both wheels of the front axle (abide by instructions of the used measuring equipment), if you find out that the camber is different from the specified value of **1° 20' ± 40'**, replace the torsion bars hinges and/or turn the torsion bar in grooves of location as per: (See Part **8**).
- repeat the inspection and measure the wheels camber.

7. Inspection of the front axle wheels toe-in:

- prior to start with the inspection, roll the vehicle forwards and backwards several times so that the wheels are turned by 360° at least,
- measure the wheels toe-in according to instructions of the respective measuring instrument manual,

- if you find out that the wheels toe-in differs from the specified value, i.e. **- 1.5** to **+ 2.5 mm**, unlock lock washers **3** on both sides of the RH and LH steering rod **1**, loosen nuts **2**, tap the bushes **4** to slacken them from ball joints housings **5** and turn (screw) both steering rods **1** to adjust the wheel toe-in.
- tighten nuts **2** to **310 ± 10% Nm** and secure by bending of lock washers **3**.

CAUTION:
Carry out the adjustment evenly by both steering tie-rods so that the wheels toe-in is symmetrical along the vehicle longitudinal vertical middle plane.

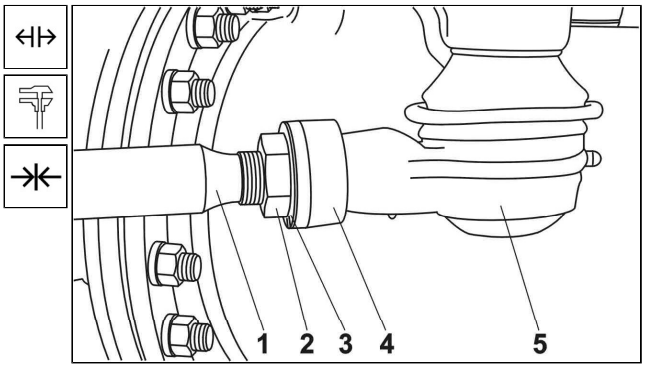


Fig. 10.13 Adjustment of the steering rod length - locking

10.5.7 Adjustment of the Backlash in Steering Gear

a) Reasons for Adjustment

1. Hard steering.
2. Wheels are wobbling during drive.

b) Technical Conditions

1. No ones have been stipulated.

c) Adjustment Procedure

1. Dismount the steering gear in accordance with the procedure mentioned in: (See Subchapter **10.5.11**).
2. Slacken the locking nut **2** of adjusting screw **1**.
3. Turn the adjusting screw **1** to set the mesh of steering finger c/w worm so that in the middle mesh position (straight-ahead drive) the finger has the minimum backlash in the worm slot and it is not dragging within the whole range of arm shaft swinging.
4. Secure the position of adjusting screw **1** with nut **2**.

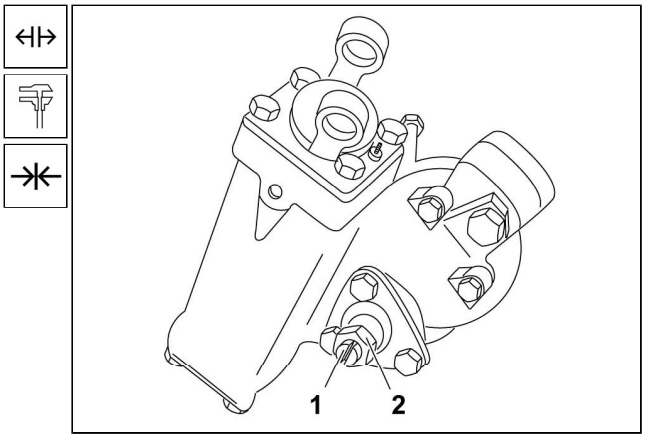


Fig. 10.14 Adjustment of backlash in steering gear

5. Install the steering gear in accordance with the procedure mentioned in: (See Subchapter **10.5.11**).

10.5.8 Removal and Installation of the Steering Wheel

a) Reasons for Removal

1. Damage to the steering wheel to such an extent, which prevents it from a correct function.
2. Performance of removal and installation works connected with repairs of the steering in cab.

b) Technical Conditions

1. To remove the steering wheel, use a special tool as per: (Tab. **10.2**).
2. Install the steering wheel so that its partition wall would be perpendicular to the vehicle longitudinal centreline for the straight-ahead vehicle drive.

c) Removal Procedure

1. Remove cover from the middle of the steering wheel **1**.
2. Unscrew nut **2**.
3. Use a puller **PRM 3285** to remove the steering wheel **1** from shaft **3**.

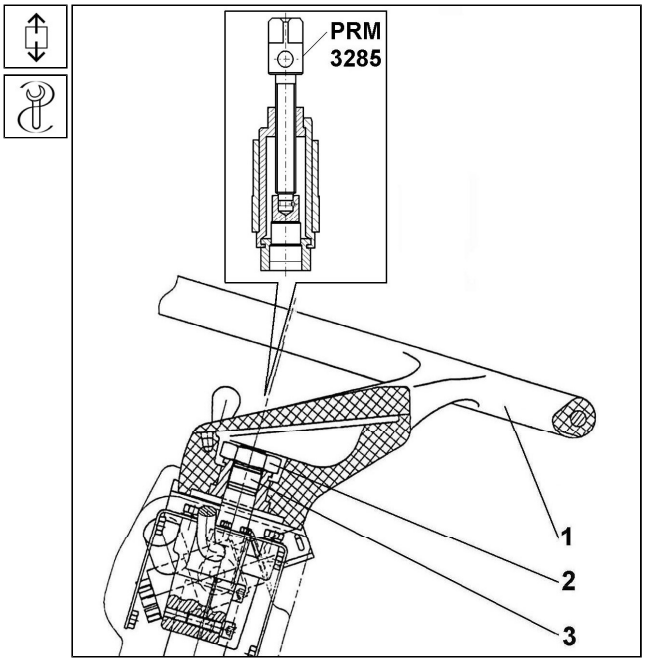


Fig. 10.15 Steering wheel removal

d) Installation Procedure

1. Install the steering wheel **1** on grooves of the shaft **3**.
2. Screw on nut **2** and tighten to the torque of **120** - **150 Nm**.
3. Fit the cover into the middle of the steering wheel **1**.

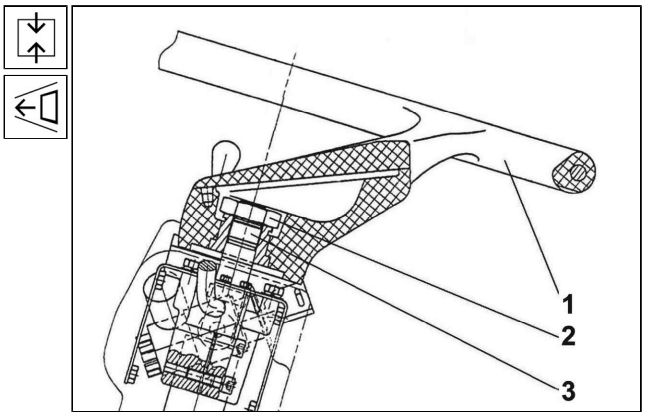


Fig. 10.16 Steering wheel installation

10.5.9 Removal and Installation of the Steering Lock

a) Reason for Removal

1. Damaged steering lock to the extent, which prevents it from a correct function.

b) Technical Conditions

1. Check the steering lock and ignition switch for function after installation.

c) Removal Procedure

1. Switch the batteries circuit breaker off.
2. Mark the wiring of electric leads in the steering lock ignition switch **1** not to confuse them during reinstallation.
3. Unplug cables from the ignition switch.
4. Remove or drill off the bolt **2** and use the puller for ruptured bolts to remove it.
5. Remove the steering lock from spindle holder **3**.

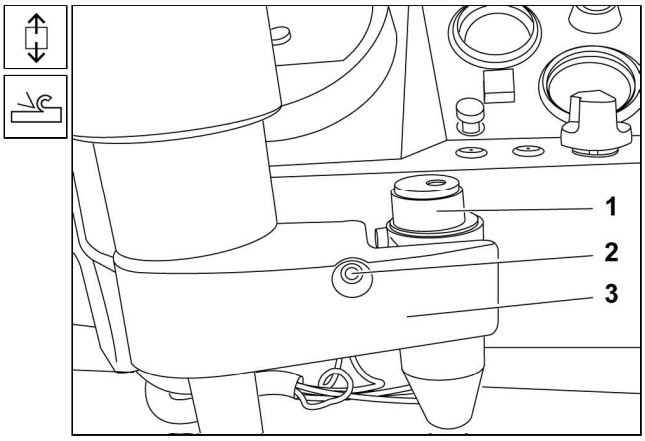


Fig. 10.17 Steering lock - removal

d) Installation Procedure

1. Fit new steering lock **1** into spindle holder **3** .
2. Screw and tighten the bolt **2** (part of steering lock assembly) till the bolt head tears off.
3. Plug electric cables to ignition switch of steering lock **1** .
4. Switch the batteries circuit breaker on.
5. Check the steering lock and ignition switch for function.

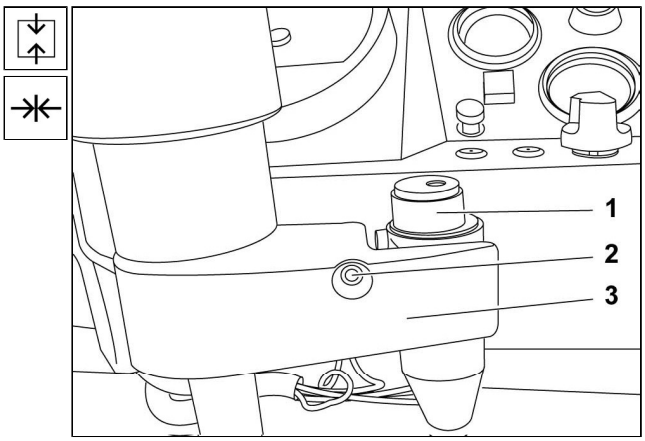


Fig. 10.18 Steering lock - installation

10.5.10 Removal and Installation of the Steering Spindle c/w Joint

a) Reason for Removal

1. Damage to the steering spindle c/w joint or spindle holder to such an extent preventing it from a proper function.

b) Technical Conditions

1. Install the steering wheel so that its cross member in the straight-ahead driving position is perpendicular to the vehicle longitudinal centerline.
2. Replace all sealing elements used in the procedure with new ones.

c) Removal Procedure

1. Switch the batteries circuit breaker off.
2. Remove the steering wheel **1** in accordance with the procedure mentioned in: (See Subchapter **10.5.8**).
3. Withdraw the steering spindle cover **2**.
4. Move the ignition **6** to position '1'. Mark the connection of electric cables in the ignition switch not to confuse them during reconnecting and unplug the cables.
5. Unscrew bolts **5** c/w spring washers and remove the combined change-over switch holder **3** from the complete steering spindle holder **4**.

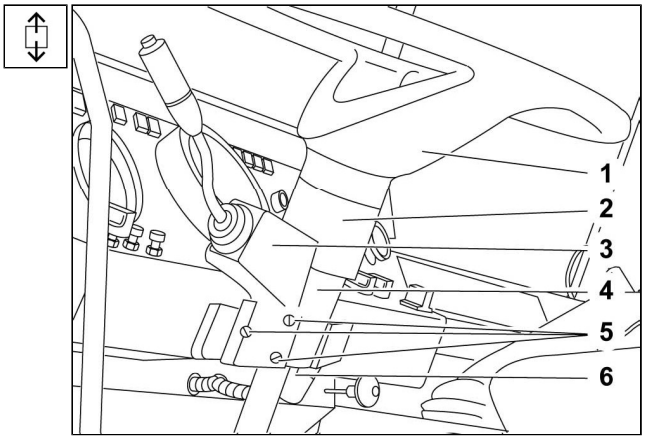


Fig. 10.19 Combined change-over switch holder - removal

6. Unscrew two bolts **5** c/w spring washers **5**.
7. Unscrew two nuts **1** and remove spring washers **2**.
8. Withdraw the complete steering spindle holder **3**, which was released from the cross member on the cabin face panel, from spindle c/w joint **4**.

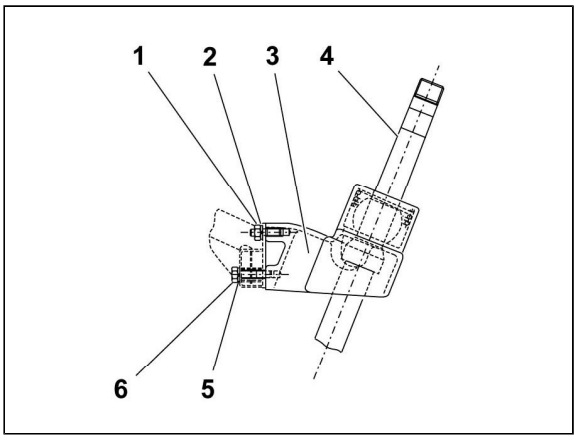


Fig. 10.20 Complete steering spindle holder - removal

9. Remove inner lock ring **2** from spindle holder **8**.
10. Remove ring **3** and spring **4**.
11. Withdraw upper ball cup **5** from ball socket **6**.
12. Remove ball socket **6** from lower ball cup **7**.
13. Press lower ball cup **7** out of spindle holder **8**.
14. Unscrew stud bolts **1** from spindle holder **8**.

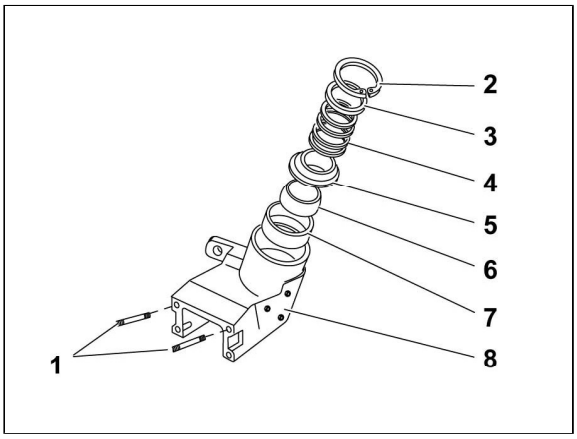


Fig. 10.21 Spindle holder assy - dismantling

15. Lift the driver's cabin.
16. Unlock outer lock rings **1** at bearings bushes **2**.
17. Withdraw bearings bushes **2** from arms of crosshead pin and remove them from fork of steering gear **3**.
18. Remove arms of crosshead pin from fork of steering gear **3** and move the spindle c/w joint **4** downwards out of cabin.

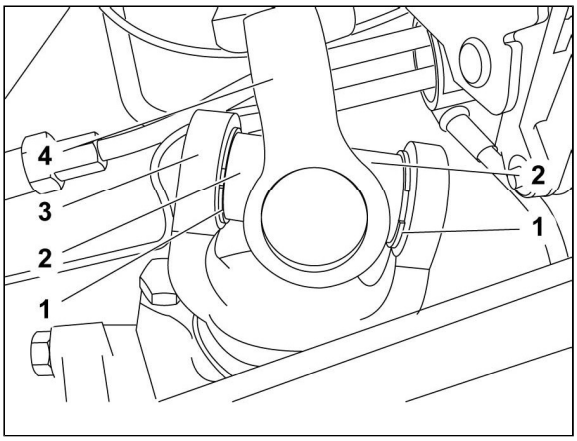


Fig. 10.22 Spindle c/w joint - removal

19. Unlock outer lock rings **4** at bearings bushes **5**.
20. Withdraw bearings bushes **5** from arms of crosshead pin **1** and remove from spindle fork **3**.
21. Remove crosshead pin **1** from spindle fork **3**.
22. Press bushes **7** out of bearings bushes **5**.
23. Remove rings **6** from bearings bushes **5**.
24. Withdraw shaped rings **8** from crosshead pin **1**.
25. Unscrew lubricating nipple **2** from crosshead pin **1**.

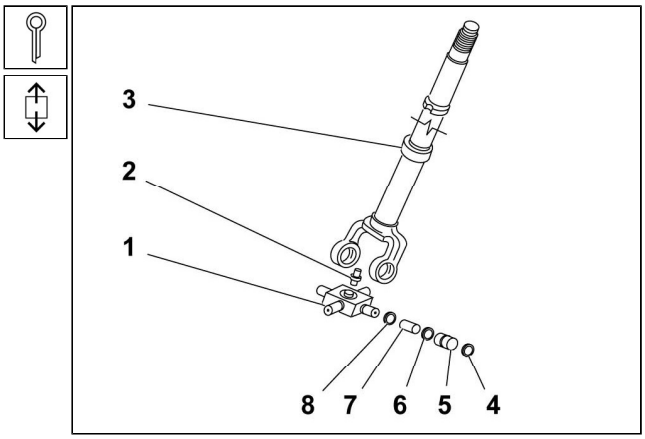


Fig. 10.23 Crosshead pin - removal

26. Unlock lock ring **2**.
27. Remove dust seal **3** from cover **1**.
28. Unscrew six bolts **4** c/w spring washers **5**.
29. Remove cover **1** from the cabin floor.

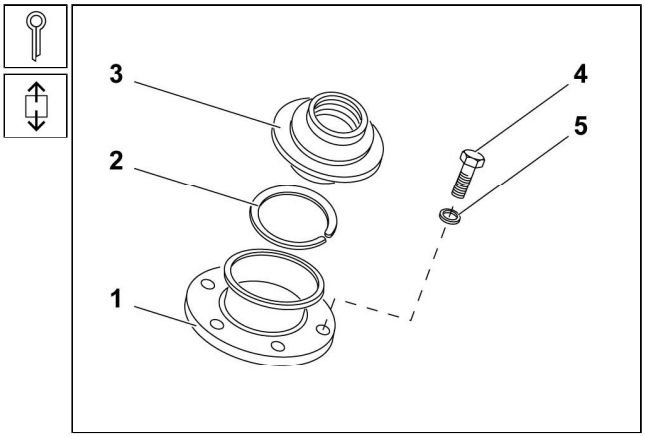


Fig. 10.24 Cover c/w dust seal - removal

d) Installation Procedure

1. Fit cover **1** on holes in the cabin floor and use six bolts **4** and spring washers **5** to mount it.
2. Fit the dust seal **3** on cover **1** and secure with lock ring **2**.
3. Fill inner grooves of dust seal **3** with plastic lubricant.

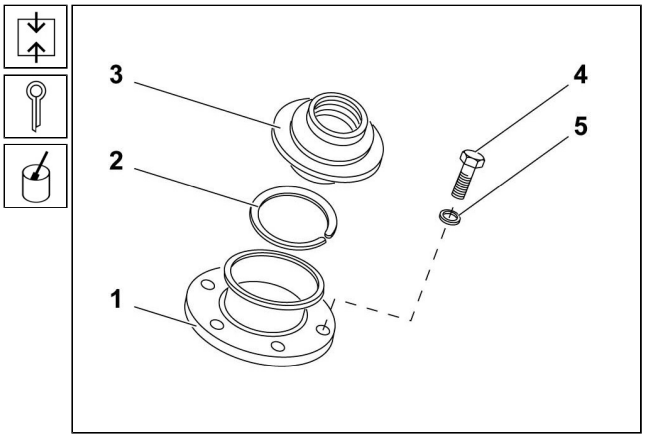


Fig. 10.25 Cover c/w dust seal - installation

4. Screw lubricating nipple **2** into crosshead pin **1**.
5. Fit shaped rings **8** on crosshead pin **1**.
6. Slide rings **6** into bearings bushes **5**.
7. Press bushes **7** out of bearings bushes **5**.
8. Insert arms of crosshead pin **1** into spindle fork **3** and slide on outer lock rings **4**.
9. Insert bearings bushes **5** into holes in the spindle fork **3** and slide on arms of crosshead pin **1**.
10. Secure bearings bushes **5** with outer lock rings **4** against fall.
11. Grease bushes **7** and rings **6** with plastic lubricant through lubricating nipple **2**.
12. From below of cabin, via hole with dust seal, slide spindle with joint **4** into cabin.
13. Insert arms of crosshead pin into fork of steering gear **3** and slide on outer lock rings **1**.
14. Insert bearings bushes **2** into holes in fork of steering gear **3** and slide on arms of crosshead pin.
15. Secure bearings bushes **2** with outer lock rings **1** against fall.

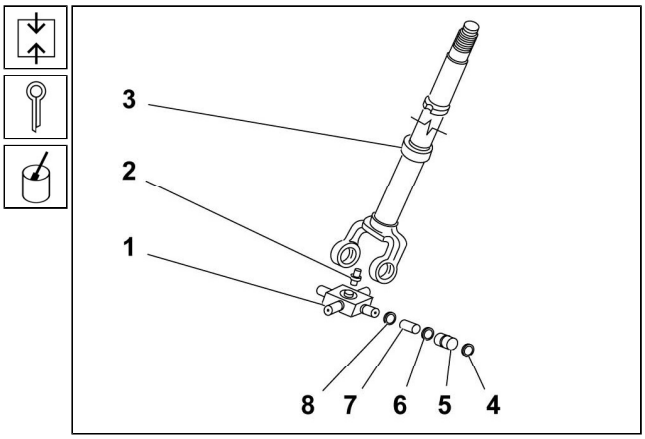


Fig. 10.26 Crosshead pin - installation

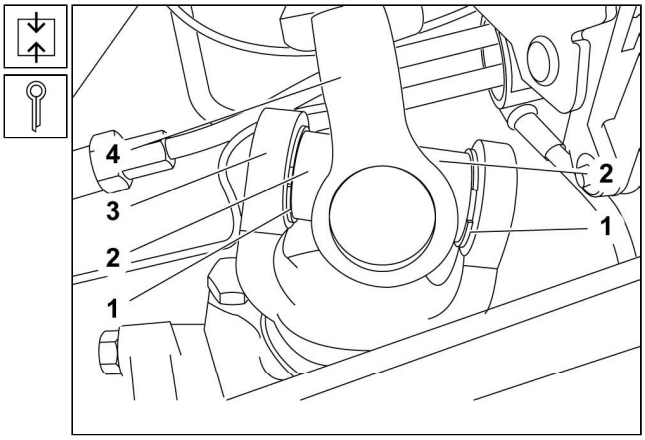


Fig. 10.27 Spindle c/w joint - installation

16. Screw stud bolts **1** into spindle holder **8**.
17. Press the lower ball cup **7** into spindle holder **8**.
18. Smear the ball socket **6** with plastic lubricant and slide into lower ball cup **7**.
19. Fit the upper ball cup **5** on ball socket **6**.
20. Insert spring **4** and press it.
21. Fit ring **3** and secure with inner lock ring **2**.

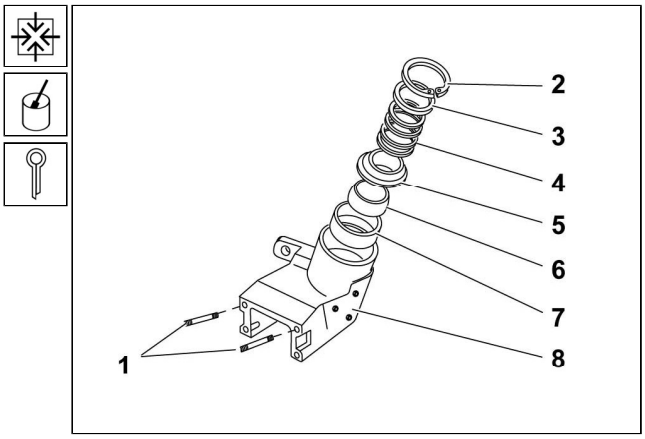


Fig. 10.28 Spindle holder assy - assembly

22. Smear the upper part of spindle c/w joint **4** with plastic lubricant and fit on complete spindle holder **3**.
23. Use nuts **1**, bolts **5** and spring washers **2** and **5** to attach the complete spindle holder **3** to cross member on the cabin face panel.
24. Tighten nuts **1** and bolts **5** to **10 - 13 Nm**.

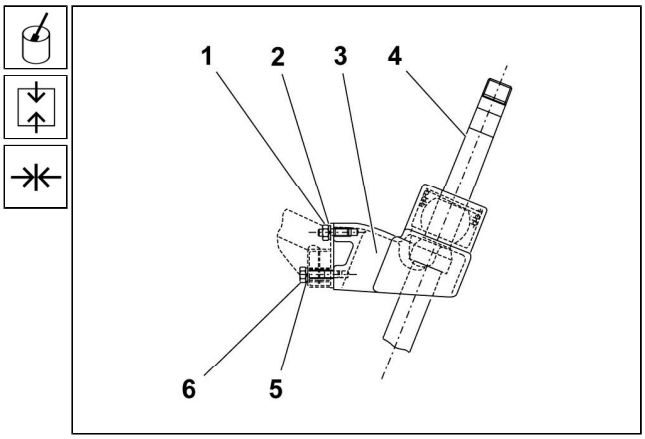


Fig. 10.29 Spindle holder assy - installation

25. Fit the holder of combined change-over switch **3** to complete spindle holder **4** and mount it using bolts **5** and spring washers.
26. Plug electric cables into ignition switch **6**.
27. Fit the spindle cover **2**.
28. Install the steering wheel **1**in accordance with the procedure mentioned in: (See Subchapter **10.5.8**).

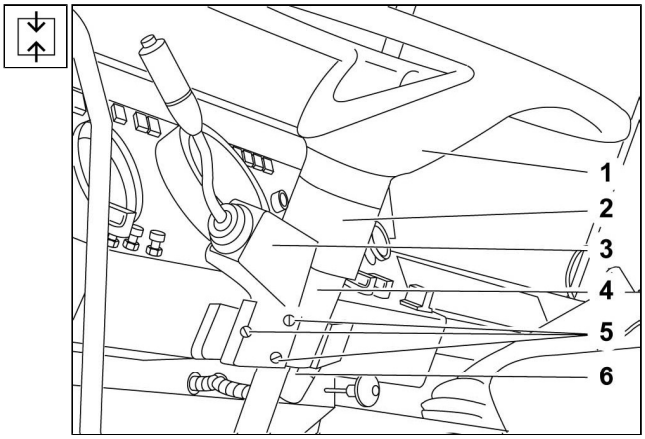


Fig. 10.30 Combined change-over switch - installation

29. Switch the batteries circuit breaker on.
30. Check the steering lock, ignition switch and combined change-over switch for function and check the adjustment of steering wheel.

10.5.11 Removal and Installation of the Steering Gear

a) Reasons for Removal

1. The steering gear has been damaged to such an extent preventing it from a proper function.
2. Because of removal of the auxiliary ladder-type frame.

b) Technical Conditions

1. Chock the wheels to secure the vehicle in spot during repair.
2. Use special tools as per: (See Tab. **10.2**) for removal and installation.

c) Removal Procedure

1. Dismount the ball joint **5** of power cylinder pull rod from steering arm **4** as per procedure mentioned in: (See Subchapter **10.5.12**).
2. Remove split pin **2** of crown nut **3**.
3. Unscrew nut **3**.
4. Use the puller **PRM 3094** to withdraw the steering arm **4** from conical grooves of steering gear arm shaft **1**.

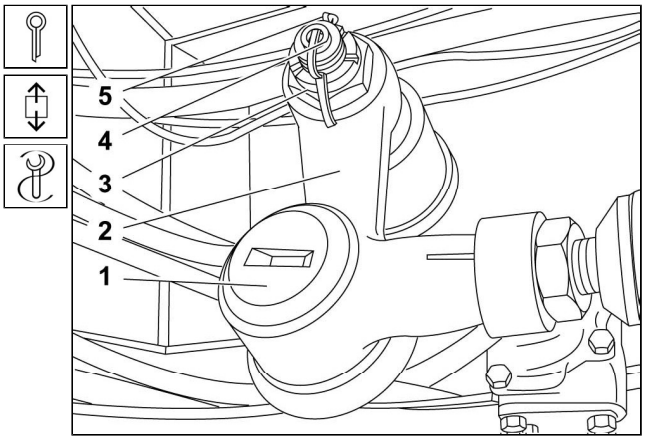


Fig. 10.31 Steering arm - removal

5. Detach spindle c/w joint **7** from steering gear **9** as per procedure mentioned in: (See Subchapter **10.5.10**).
6. Remove bleeding hose **8** from steering gear **9**.
7. Unscrew bolt **3** c/w spring washer **2** and withdraw holder **1** from steering gear **9**.
8. Remove split pins **6** of crown nuts **5**.
9. Loosen and unscrew four crown nuts **5**.
10. Remove bolts **4**.
11. Slide steering gear **9** out of hole in the longitudinal beam of the auxiliary frame.

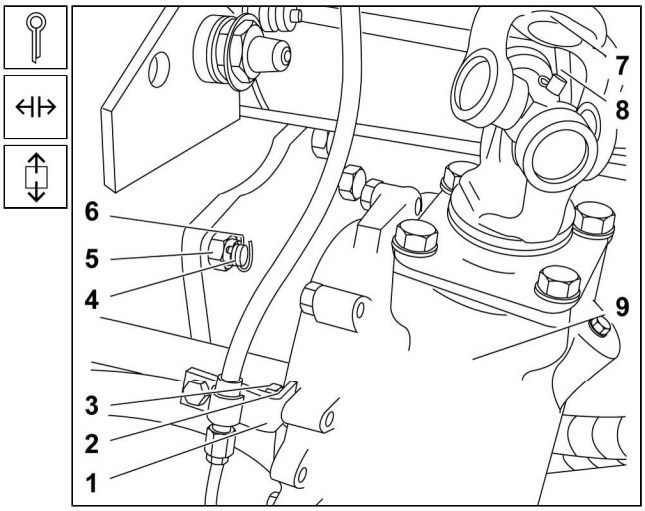


Fig. 10.32 Steering gear - removal

d) Installation Procedure

1. Slide steering gear **9** into hole in the longitudinal beam of the auxiliary frame.
2. Use four bolts **4** c/w crown nuts **5** to mount the steering gear **9** to the longitudinal beam of auxiliary frame. Tighten the nuts to **150 ± 10% Nm**.
3. Tighten the nuts **5** with the nearest slot into thread and secure with split pins **6**.
4. Use bolt **3** c/w spring washer **2** to attach the holder **1** to steering gear **9**.
5. Slide the bleeding hose **8** on steering gear **9**.
6. Attach spindle c/w joint **7** to steering gear **9** according to procedure mentioned in: (See Subchapter **10.5.10**).

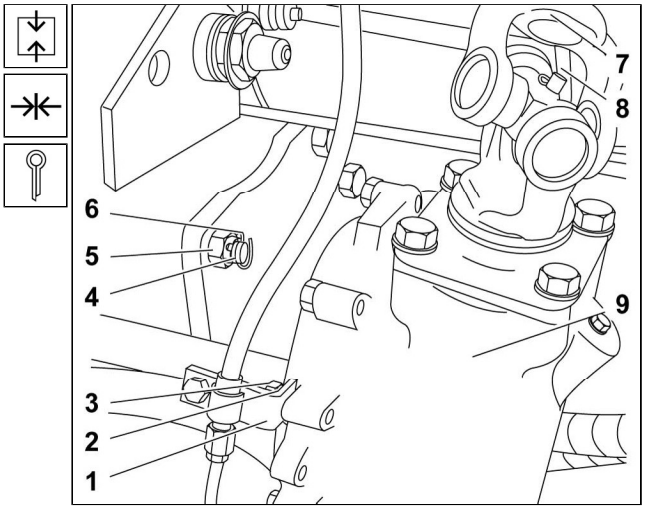


Fig. 10.33 Steering gear - installation

7. Fit steering arm **2** on conical grooves of the arm shaft **4** of steering gear so that the missing groove of the arm shaft and steering arm is in one spot.
8. Mount the crown nut **3** and tighten to **280 ± 10% Nm**.
9. Tighten the nut **3** with the nearest slot into hole in the thread and secure with split pin **5**.
10. Connect the ball joint **1** of power cylinder pull rod with steering arm **2** according to procedure mentioned in: (See Subchapter **10.5.12**).

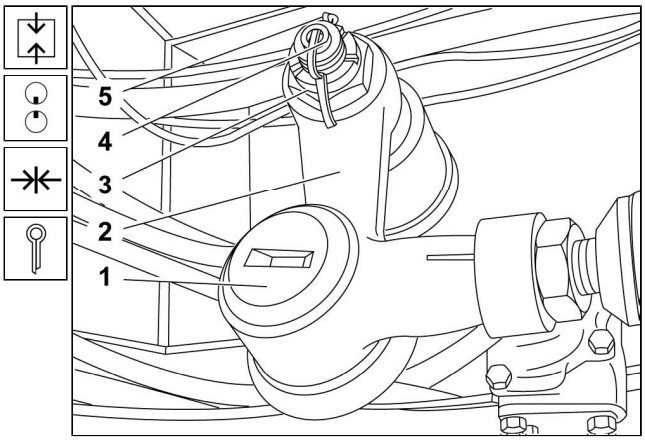


Fig. 10.34 Steering arm - installation

10.5.12 Removal and Installation of the Power Cylinder Pull Rod c/w Joint

a) Reason for Removal

1. The part of pull rod, especially the ball joint, has been damaged or worn.

b) Technical Conditions

1. It is necessary to check and adjust the front axle wheels alignment after removal and installation of the power cylinder pull rod.
2. Use special tools as per (See Tab. **10.2**) for removal and installation of the power cylinder pull rod c/w joint.

c) Removal Procedure

1. Remove split pin **4** of crown nut **3** fixing the ball joint **2** of power cylinder pull rod **1** to steering arm **5**.
2. Unscrew nut **3**.
3. Use the tool **PRM 0412.2** to press the cone of ball joint **2** out of hole in the steering arm **5**.

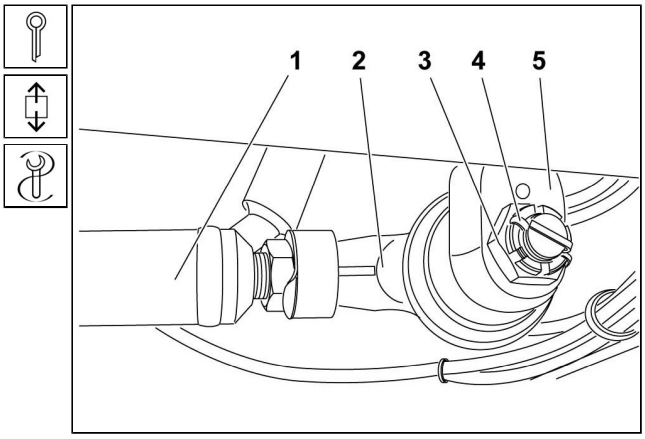


Fig. 10.35 Connection of power cylinder pull rod joint c/w steering arm - removal

4. Remove split pin **4** of crown nut **3**.
5. Unscrew nut **3.**
6. Use the tool **PRM 0412.2** to withdraw the power cylinder pull rod c/w joint **2** from the conical stem of steering booster **1** and remove the power cylinder pull rod with joint.

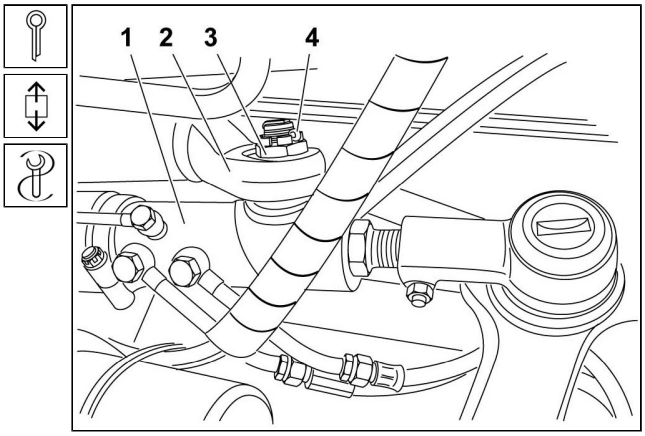


Fig. 10.36 Connection of power cylinder pull rod with booster - removal

7. Unlock lock washer **3** of nut **4**.
8. Loosen nut **4**.
9. Tap the bush **2** to slacken it.
10. Unscrew ball joint **1** from power cylinder pull rod **5**.
11. Withdraw bush **2** from power cylinder pull rod **5**.
12. Withdraw lock washer **3** from power cylinder pull rod **5**.
13. Unscrew nut **4** from power cylinder pull rod **5**.

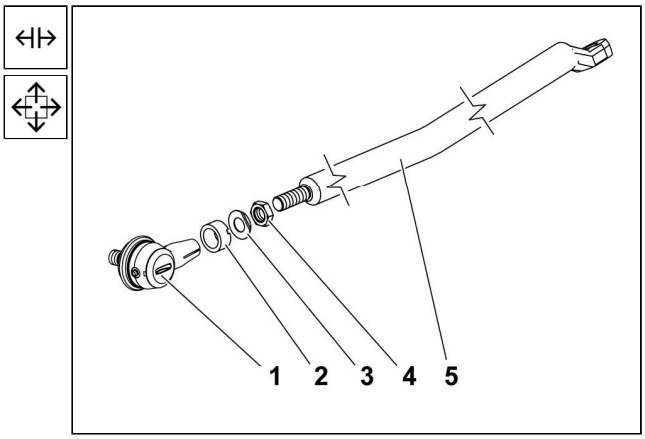


Fig. 10.37 Power cylinder pull rod with joint - dismantling

d) Installation Procedure

1. Screw nut **4** on power cylinder pull rod **5**.
2. Fit lock washer **3** on power cylinder pull rod **5**.
3. Fit bush **2** on power cylinder pull rod **5**.
4. Screw ball joint **1** on power cylinder pull rod **5**.
5. Adjust the length of power cylinder pull rod c/w joint (**1,964 mm**) and position of the ball joint (**20°**) towards the contact surface of power cylinder pull rod on steering booster.
6. Tighten the nut **4** to **40** - **80 Nm**.

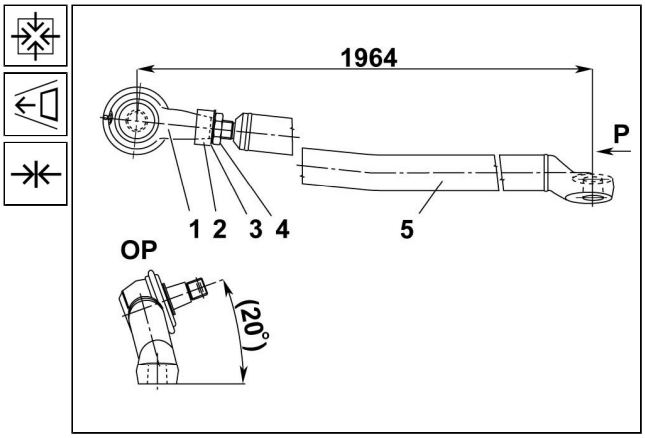


Fig. 10.38 Power cylinder pull rod with joint - assembly

7. Fit the conical hole in the power cylinder pull rod c/w joint **2** on conical stem of steering booster **1**.
8. Mount the nut **3** and tighten to **200 ± 10% Nm**.
9. Tighten the nut **3** with the nearest slot to hole in the thread and secure with split pin **4**.

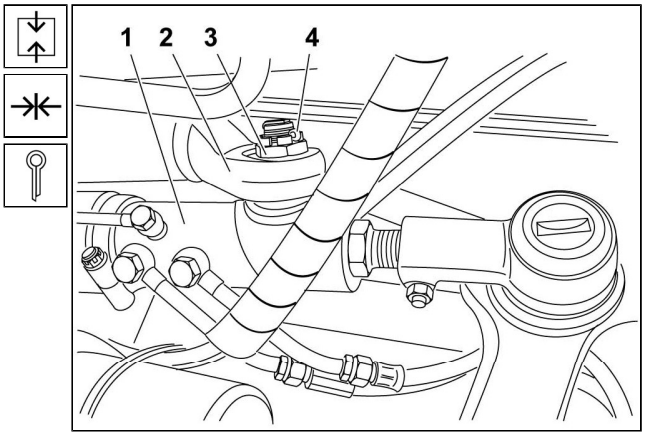


Fig. 10.39 Connection of power cylinder pull rod with booster - installation

10. Slide the cone of ball joint **2** of power cylinder pull rod **1** into hole in the steering arm **5**.
11. Mount the nut **3** and tighten to **280 ± 10% Nm**.
12. Tighten the nut **3** with the nearest slot into hole in the thread and secure with split pin **4**.

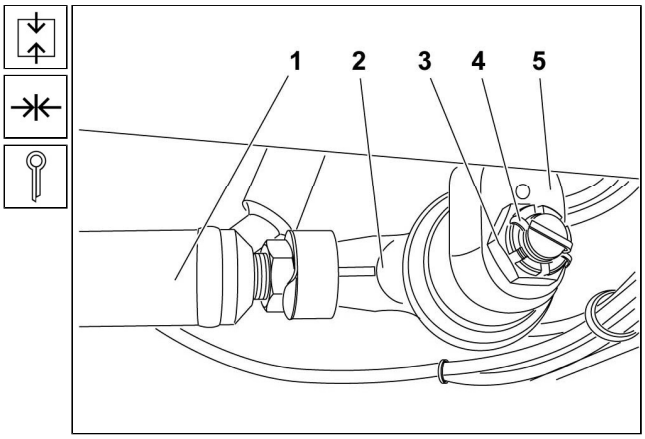


Fig. 10.40 Connection of power cylinder pull rod with steering arm - installation

13. Check and/or adjust the front axle wheels toe-in in accordance with procedure mentioned in: (See Subchapter **10.5.6**)

10.5.13 Removal and Installation of the Steering Booster c/w Joints

a) Reason for Removal

1. The steering booster with joints has been damaged to such an extent preventing it from a proper function.

b) Technical Conditions

1. Use special tools as per (See Tab. **10.2**) for removal and installation of the steering booster with joints.

c) Removal Procedure

1. Drain oil from the power steering circuit according to procedure mentioned in: (See Subchapter **10.5.2**).
2. Dismount the power cylinder pull rod with joint from conical stem of steering booster as per procedure mentioned in: (See Subchapter **10.5.12**).
3. Remove split pin **4** of crown nut **5** fixing the ball joint **2** of steering booster **1** to double steering arm **3**.
4. Unscrew nut **5**.
5. Use the tool **PRM 0412.2** to press the cone of ball joint **2** out of hole in the double steering arm **3**.

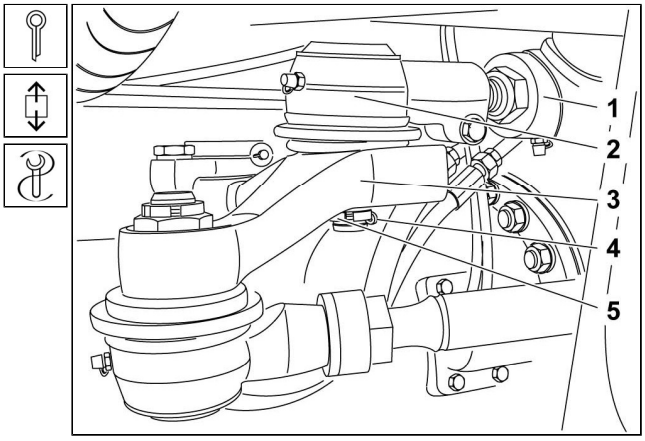


Fig. 10.41 Connection of steering booster with the double steering arm - removal

6. Remove split pin **2** of crown nut **3** fixing the ball joint **4** of steering booster to the front cross girder **1**.
7. Unscrew nut **3**.
8. Use the tool **PRM 0412.2** to press the cone of ball joint **4** out of hole in the front cross girder **1** and remove steering booster with joints.

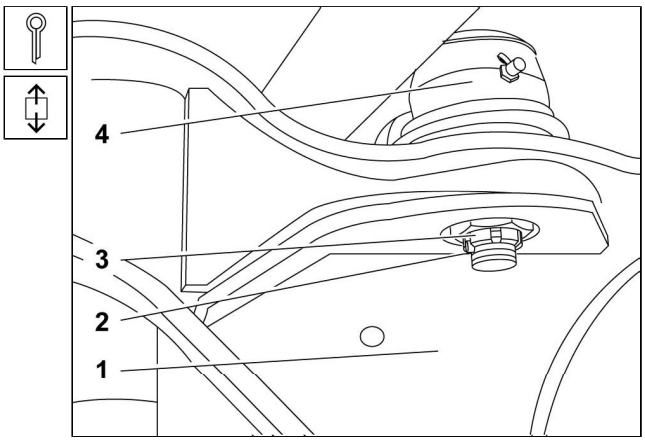


Fig. 10.42 Connection of steering booster joint with the front cross girder - removal

d) Installation Procedure

1. Fit the cone of ball joint **4** of steering booster into hole in the front cross girder **1**.
2. Mount the nut **3** and tighten to **280 ± 10% Nm**.
3. Tighten the nut **3** with the nearest slot into hole in the thread and secure with split pin **2**.

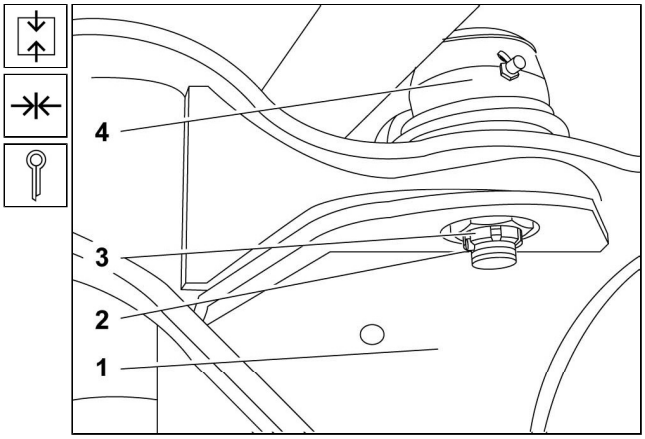


Fig. 10.43 Connection of steering booster joint with the front cross girder - installation

4. Fit the cone of ball joint **2** of steering booster **1** into hole in the double steering arm **3**.
5. Mount the nut **5** and tighten to **280 ± 10% Nm**.
6. Tighten the nut **5** with the nearest slot to hole in the thread and secure with split pin **4**.

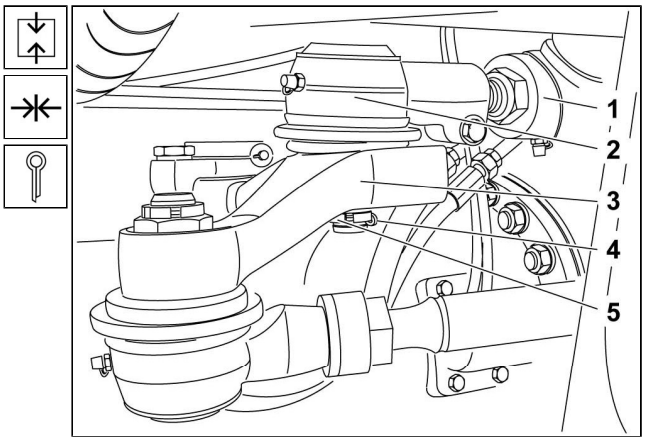


Fig. 10.44 Connection of steering booster with the double steering arm - installation

7. Mount the power cylinder pull rod with joint on the conical stem of steering booster in accordance with the procedure mentioned in: (See Subchapter **10.5.12**).
8. Fill the power steering circuit with oil in accordance with the procedure mentioned in: (See Subchapter **10.5.2**).

10.5.14 Removal and Installation of Steering Booster Joints

a) Reason for Removal

1. The steering spherical ball joint has been damaged to such an extent preventing it from proper function.

   Note:
   There are two versions of sphericalball joints:
   - **Version A** - to be installed into front cross girder
   - **Version B** - to be installed into double steering arm.

b) Technical Conditions

1. Use the self-locking nut to secure the ball joint housing **B** on steering booster in position.

c) Removal Procedure

1. Dismount the steering booster with joints as per: (See Subchapter **10.5.13**).

Version A

2. Unlock lock washer **5** of nut **4**.
3. Loosen nut **4**.
4. Tap the bush **6** to release it.
5. Unscrew the ball joint **A** from steering booster **1**.

Version B

2. Loosen and unscrew nut **2** from locking screw **3**.
3. Remove screw **3** from ball joint housing **B**.
4. Unscrew the ball joint **B** from steering booster **1**.

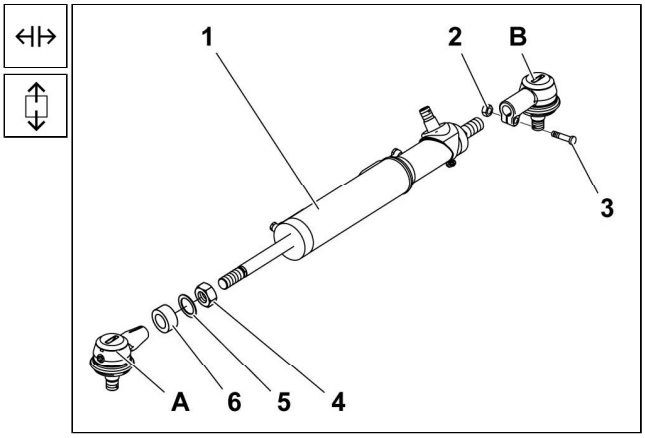


Fig. 10.45 Mounting of joints on booster - removal

Version B

1. Screw the ball joint **B** on thread of steering booster **1**.

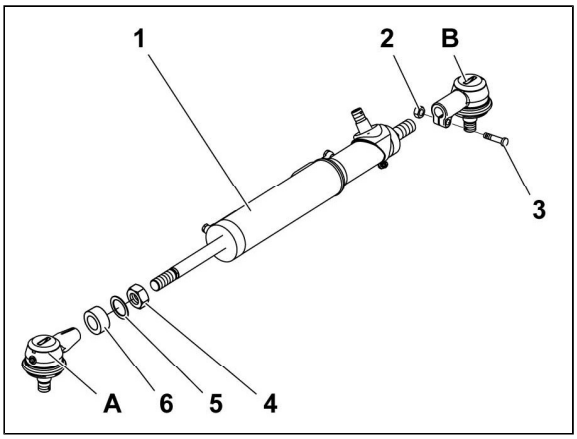


Fig. 10.46 Mounting of joints on booster - installation

2. Adjust the position (**33° ± 1°**) and length of ball joint as per values mentioned in: (See Fig. **10.47**).
3. Insert locking screw **3** (See Fig. **10.46**) into ball joint housing.
4. Mount the nut **2** and tighten to **65 ± 10% Nm**.

CAUTION:
Hold the booster by hexagon only when tightening the joint.

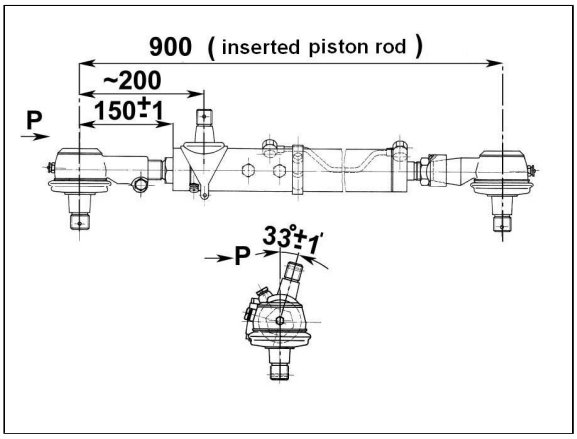


Fig. 10.47 Position of the ball joint head on booster

Version A

CAUTION:
When replacing the steering booster with a new one, first mount the nut 4, (See Fig. 10.46) slide lock washer 5 and bush 6. Then proceed as per points 1 through 5.

1. Screw the ball joint **A** (See Fig. **10.46**) onto thread of steering booster piston rod **1**.
2. Adjust the length of steering booster with joints with the piston rod retracted (**900 mm**), as per: (See Fig. **10.47**).
3. Tighten nut **4** (See Fig. **10.46**) to **310 ± 10% Nm**.
4. Secure nut **4** by bending of lock washer **5**.
5. Install the steering booster with joints as per: (See Subchapter **10.5.13**).

10.5.15 Removal and Installation of Steering Rods

a) Reason for Removal

1. The part of steering rod, especially spherical ball joints, has been damaged.

b) Technical Conditions

1. It is necessary to check and adjust the front axle wheels alignment after removal and installation of steering rods.
2. Use special tools for removal of steering rods as per: (See Tab. **10.2.**).

c) Removal Procedure

1. Remove split pin **4** of crown nut **3 fixing the** ball joint **2** of steering rod **1** to steering arm **5**.
2. Unscrew nut **3**.
3. Use the tool **PRM 0412.2** to press the cone of ball joint **2** out of hole in steering arm **5**.

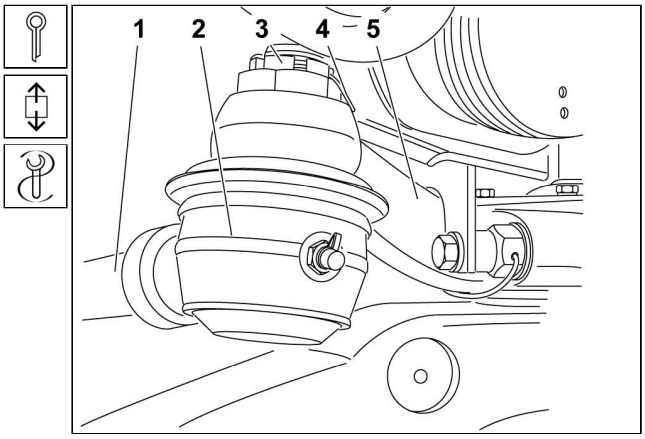


Fig. 10.48 Connection of steering rod with steering arm - removal

4. Remove split pin **5** of crown nut **4** fixing the ball joint **1** of steering rod **2** to double steering arm **3**.
5. Unscrew nut **4**.
6. Use the tool **PRM 0412.2** to press the cone of ball joint **1** out of holes in the double steering arm **3** and withdraw the complete rod.

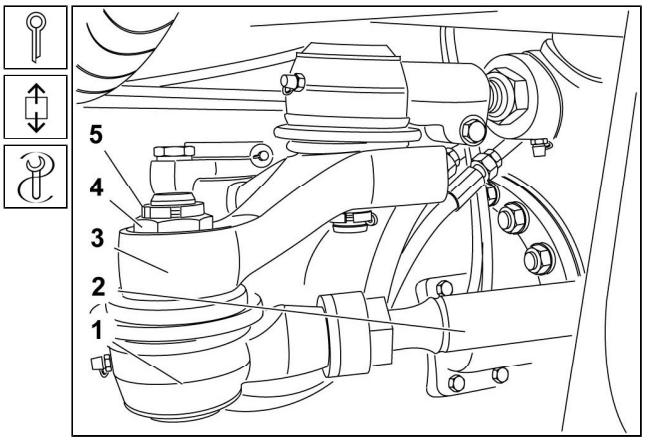


Fig. 10.49 Connection of steering rod with double steering arm - removal

7. Unlock lock washers **3** of nuts **4**.
8. Loosen nuts **4**.
9. Tap the bushes **2** to release them from position.
10. Unscrew ball joints **1** from steering rod **5**.
11. Withdraw bushes **2** from steering rod **5**.
12. Withdraw lock washers **3** from steering rod **5**.
13. Unscrew nuts **4** from steering rod **5**.
14. Repeat the procedure for the other steering rod.

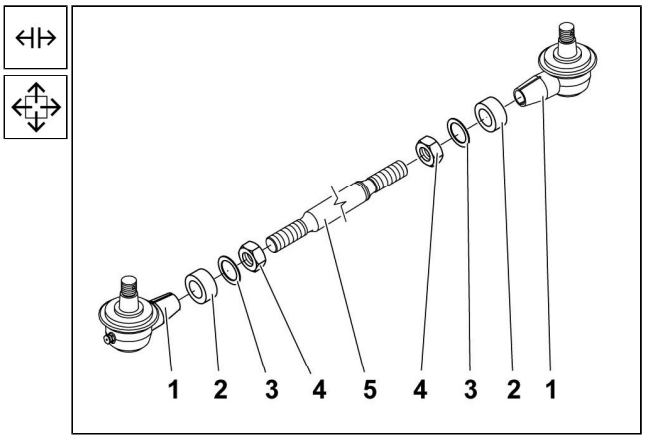


Fig. 10.50 Steering rod assy - dismantling

d) Installation Procedure

1. Mount nut **4** (LH thread) on steering rod **5** on the side with a recess.
2. Mount nut **6** (RH thread) on steering rod **5**.
3. Fit lock washers **3** on steering rod **5**.
4. Fit bushes **2** on steering rod **5**.
5. Screw the ball joint **7** (RH thread) and ball joint **1** (LH thread) evenly onto steering rod **5**. The joint with LH thread is marked with the transversal groove in the upper part of the joint housing as shown by arrow in the figure (See Fig. **10.52**).

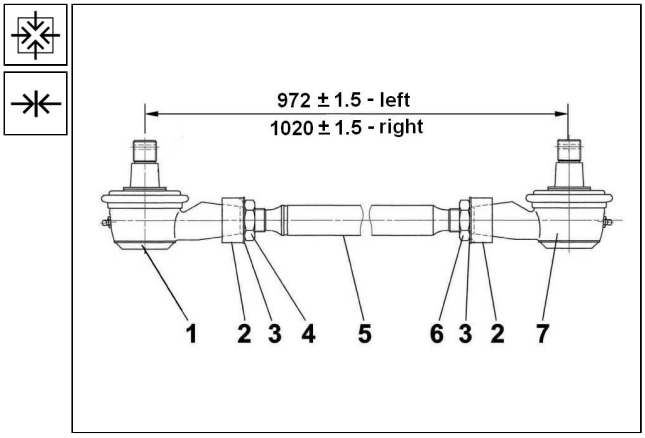


Fig. 10.51 Steering rod assy - assembly

6. Adjust the length of RH and LH steering rods and position of ball joints as per (See Fig. **10.51**).
7. Tighten nuts **4** and **6** to **40** - **80 Nm**.

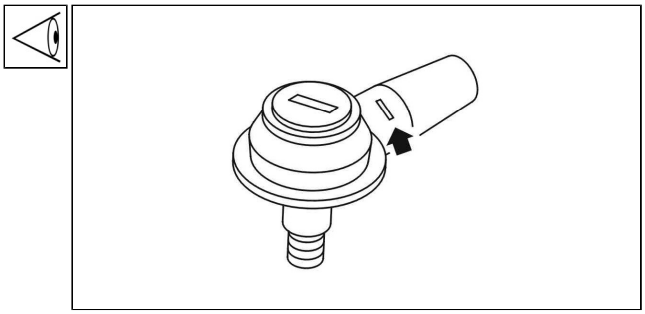


Fig. 10.52 Marking of LH thread joint

8. Fit the cone of ball joint **1** of steering rod **2** into hole in the double steering arm **3**.
9. Mount nut **4** and tighten to **280 ± 10% Nm.**
10. Tighten the nut with the nearest slot to hole in the thread and secure with split pin **5**.

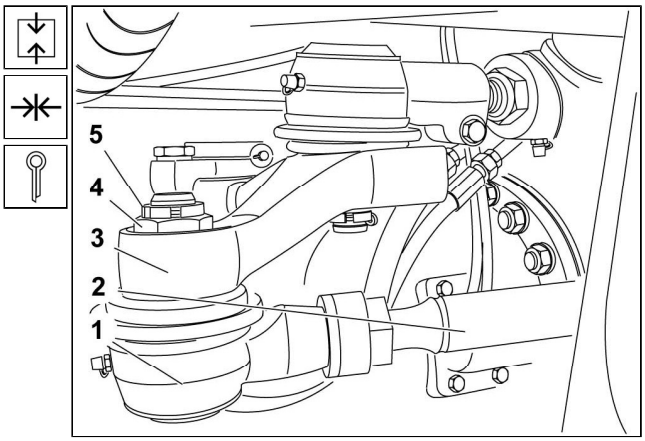


Fig. 10.53 Connection of steering rod with the double steering arm - installation

11. Fit the cone of ball joint **2** of steering rod **1** into hole in steering arm **5**.
12. Mount nut **3** and tighten to **280 ± 10% Nm.**
13. Tighten the nut with the nearest slot to hole in the thread and secure with split pin **4**.

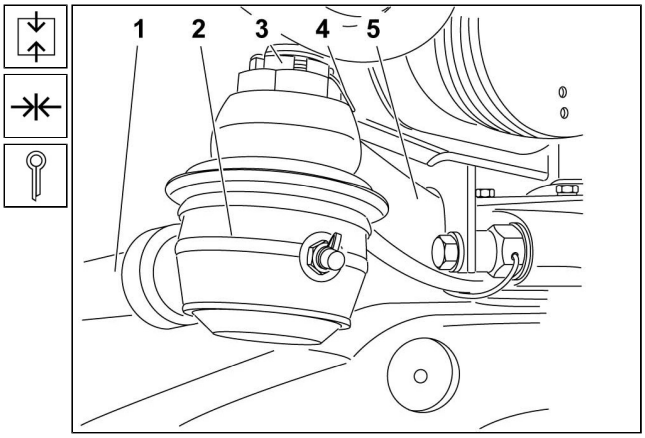


Fig. 10.54 Connection of steering rod with steering arm - installation

14. Repeat the procedure for the other steering rod.
15. Check and/or adjust the front axle wheels toe-in in accordance with the procedure mentioned in: (See Subchapter **10.5.6**).
16. Tighten nuts **4** and **6** (See Fig. **10.51**) to **310** ± **10% Nm** and secure by bending of lock washers **3** over nuts.

10.5.16 Removal and Installation of the Spherical Ball Joint Dust Seal

a) Reasons for Removal

1. Damaged (broken, burst) dust seal.
2. If rubber ageing is visible and the surface cracks occur.

b) Technical Conditions

1. Replace the locking ring if need be.
2. Fill the dust seal with the specified plastic lubricant.

c) Removal Procedure

1. Remove the locking ring **3** from dust seal **2**.
2. Withdraw the sheet collar of dust seal **2** from the joint housing **1**.
3. Withdraw the dust seal **2** from ball pin **4**.

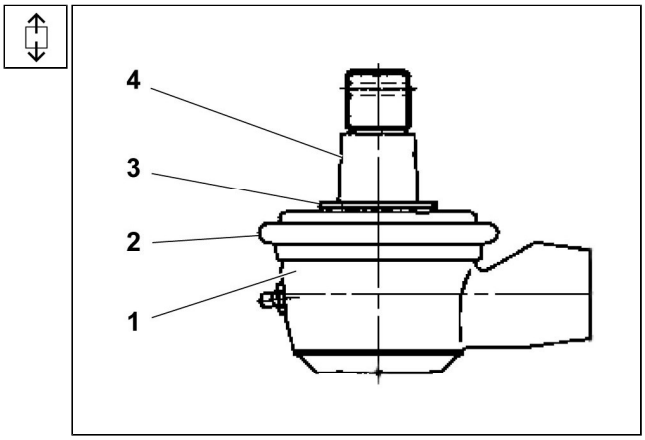


Fig. 10.55 Dust seal - removal

d) Installation Procedure

1. Fit the dust seal **2** on ball pin **4**.
2. Use the tool **PRL 0886** to press the sheet collar of dust seal **2** on the joint housing **1**.
3. Fit the locking ring **3** on dust seal **2**.
4. Fill the dust seal **2** with the specified plastic lubricant.

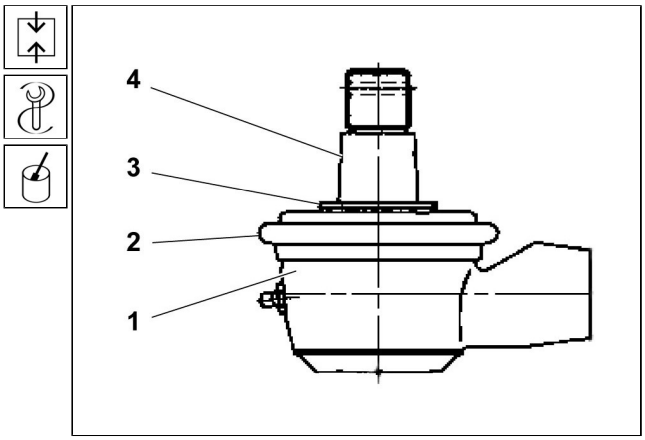


Fig. 10.56 Dust seal - installation

10.5.17 Removal and Installation of the Double Steering Arm

a) Reasons for Removal

1. Damage to the double steering arm or to the arm bearing to such an extent, which prevents it from a proper function.
2. The double steering arm bearing shows an excessive clearance.

b) Technical Conditions

1. The clearance in the double steering arm bearing should be **0.1- 0.2 mm**.
2. Replace the shaped ring and the shaft seal with new ones.
3. Fill the space under bearings of the steering arm in the lower and in the upper part of the steering bearing housing and the shaft seal with the plastic lubricant **MOBILITH SHC 220**.
4. To remove and to install the double steering arm, use special tools as per: (See Tab **10.2**).

c) Removal Procedure

1. Press the complete right steering rod ball joint out of the hole **B**, press the complete left steering rod ball joint out of the hole **C** and press the ball joint of the complete rod to the steering arm out of the hole **D** in accordance with procedures mentioned in: (See Subchapter **10.5.15**) and (See Subchapter **10.5.13**).
2. Loosen and unscrew screws **3** and remove spring washers **4**.
3. Withdraw the upper steering bearing housing **1** including grease nipple **2**, pin **5**, spacer washers **6**, shaped ring **7** and the upper bearing **8**.
4. Remove the double steering arm **11** including pin **9**, sealing ring **10** and thrust ring **12** from the steering bearing housing in the backbone tube **A**.
5. Use a suitable technological tool to push the pin **9** under press out of the thrust ring **12**, double steering arm **11** and sealing ring **10**.
6. Remove shaft seal **13** from the steering bearing housing **A**.

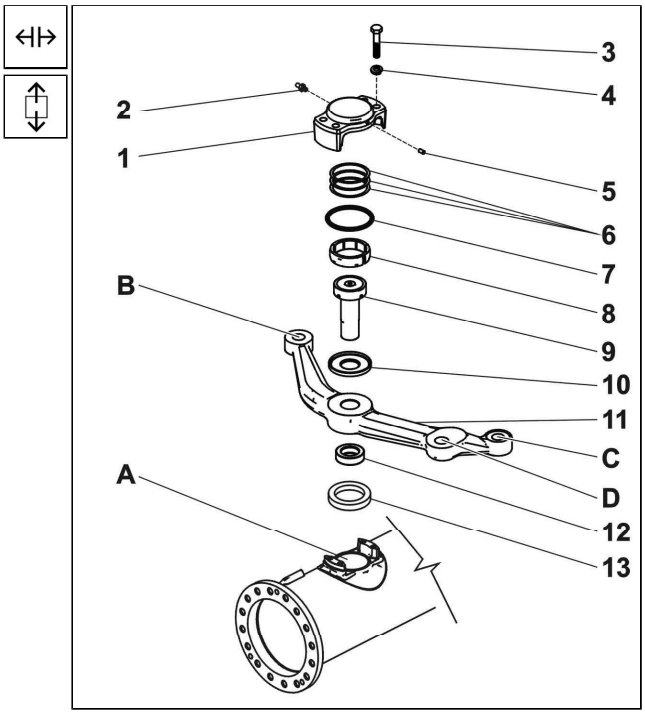


Fig. 10.57 Double steering arm bearing

7. Use tools **PRM 3254** and **PRM 0777** to remove the lower bearing **2** from the steering bearing housing in the backbone tube **1**.

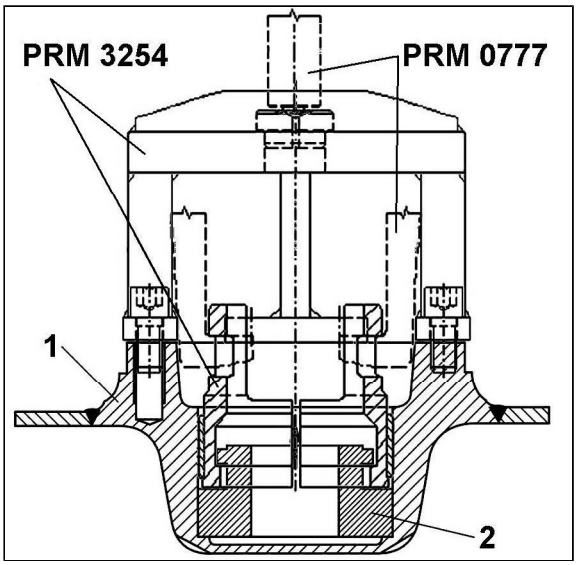


Fig. 10.58 Use of tools PRM 3254 and PRM 0777

8. Drill off the pin **3** connecting the upper bearing **4** with the upper steering bearing housing **1**.
9. Unscrew the grease nipple **2**.

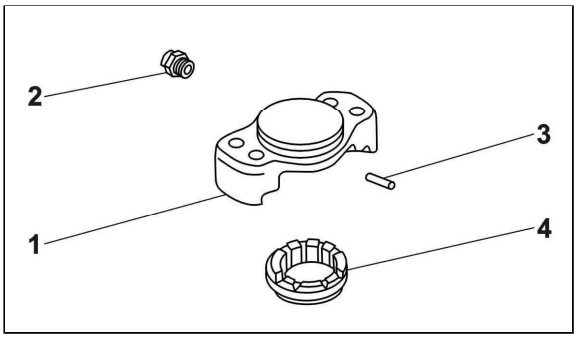


Fig. 10.59 Bearing locking – disassembly

10. Use the tool **PRM 3205** to remove the upper bearing **2** from the upper steering bearing housing **4**.
11. Remove the shaped ring **1**.
12. Remove spacer washers **3**.

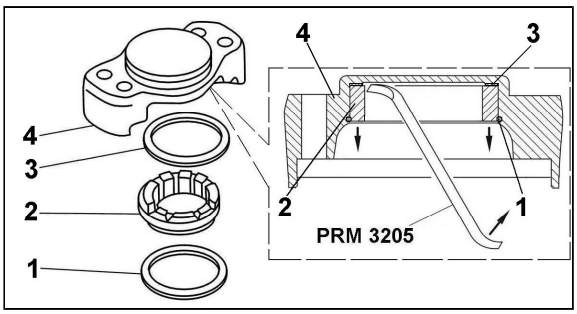


Fig. 10.60 Fit of the bearing in the upper steering bearing housing

d) Installation Procedure

1. Fit the sealing ring **3** on the pin **2**.
2. Press the pin **2** into the double steering arm **4** and thrust ring **5**.

- **CAUTION:**
  The sealing ring 3 must not rotate after pressing.

3. Install the upper bearing **1** and the lower bearing **6** on the pin **2**.

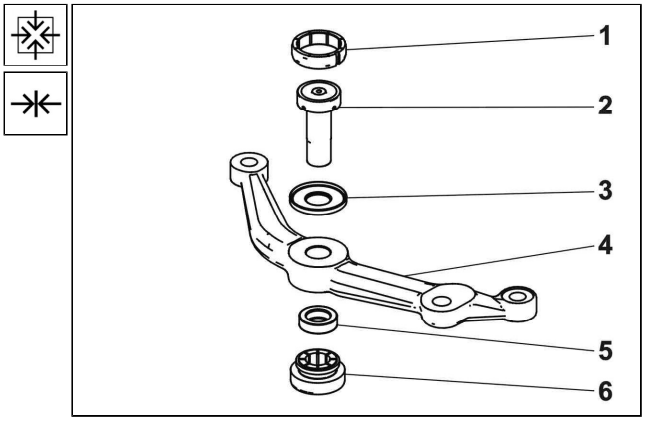


Fig. 10.61 Double steering arm - assembly

4. Measure the distance **A**.

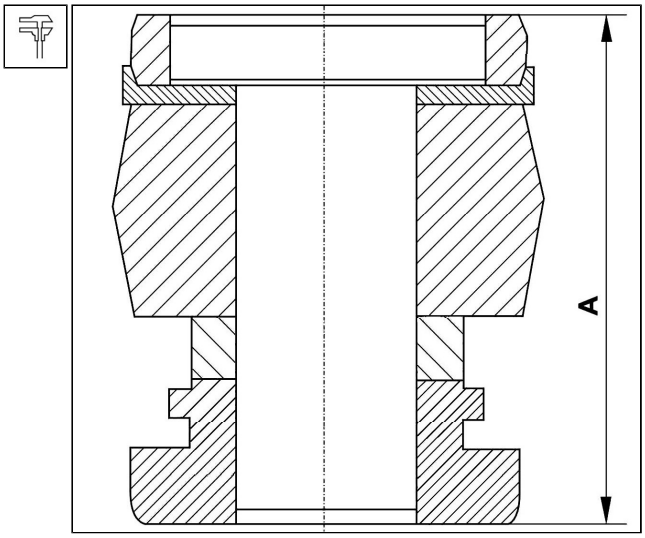


Fig. 10.62 Adjustment of the double steering arm

5. Withdraw the upper bearing **1** (See Fig. **10.61**) and the lower bearing **6** from the pin **2**.

6. Measure the depth **B** in the upper steering bearing housing from the contact surface to the upper contact surface of the bearing.

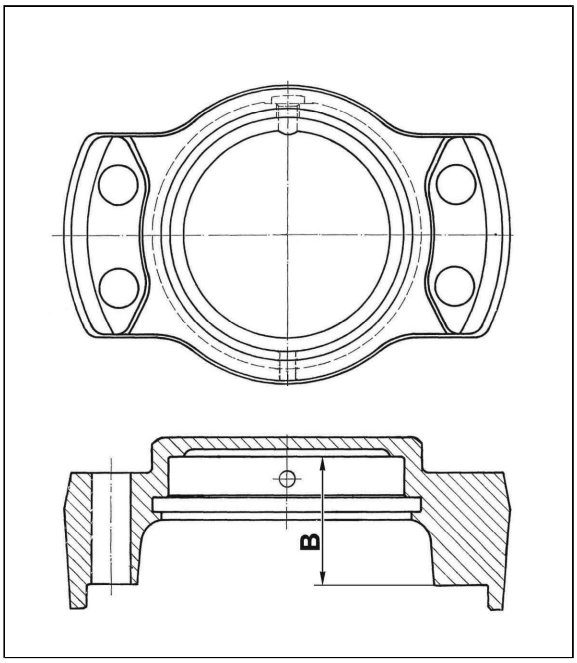


Fig. 10.63 Upper steering bearing housing

7. Measure the depth **C** in the steering bearing housing on the backbone tube from the contact surface to the lower contact surface of the lower bearing.

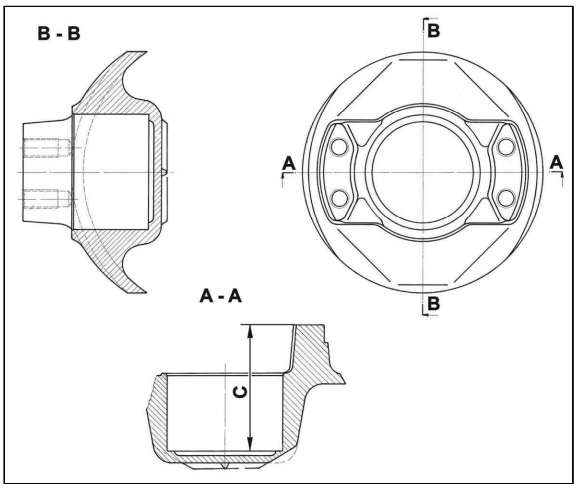


Fig. 10.64 Steering bearing housing

8. Add the measured values for the upper steering bearing housing **B** and for the steering bearing housing **C** and compare the sum with the measured value **A**. Use spacer washers **6** to take up the difference found out between both values **X**, i.e. **B + C - A = X** during installation (See Fig. **10.55**) so that the bearing clearance would be **0.1 - 0.2 mm**.

9. Install respective spacer washers **2** into the upper steering bearing housing **1**.
10. Install the shaped ring **3**.
11. Smear the interior of the housing **1** with oil and use the tool **PRL 0653** to press the upper bearing **4**.
12. Fill the space under the bearing **4** with the specified plastic lubricant.

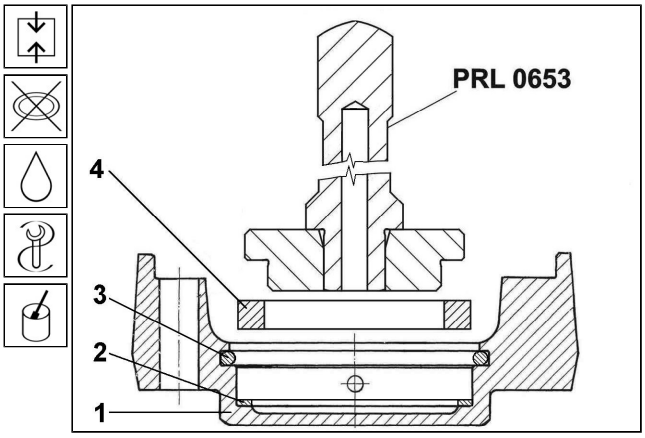


Fig. 10.65 Use of the tool PRL 0653

13. Lock the upper bearing **4** in the upper steering bearing housing **1** with pin **3**.
14. Knock the pin **3** to lock it in position.
15. Screw on the grease nipple **4**.

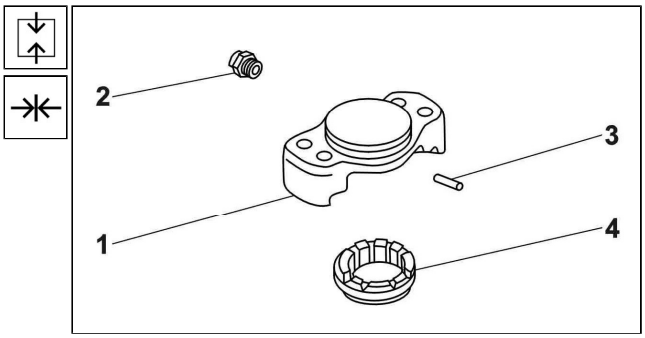


Fig. 10.66 Bearing locking - assembly

16. Smear the steering bearing housing **1** on the backbone tube with oil and use the tool **PRL 0652** to press the lower bearing **2** .
17. Fill the space with the specified plastic lubricant.

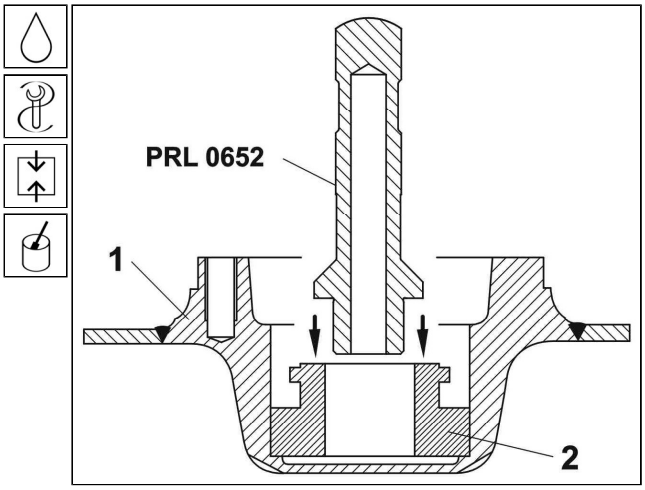


Fig. 10.67 Use of the tool PRL 0652

18. Fill the interior of the shaft seal **1** with the specified plastic lubricant.
19. Use the tool **PRL 0619** to press the shaft seal **1** into the steering bearing housing on the backbone tube **2**.

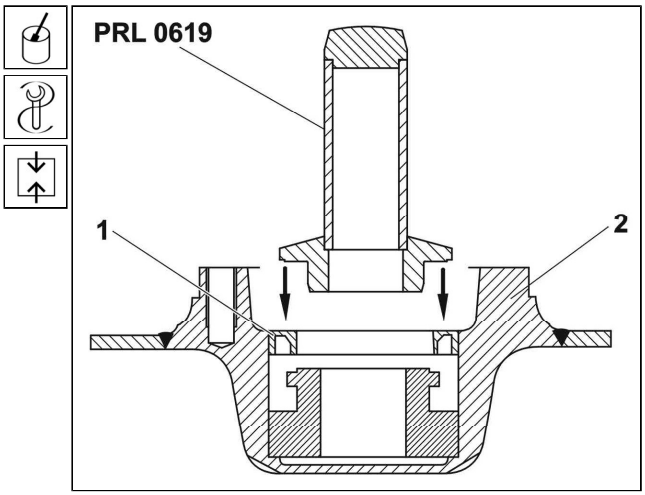


Fig. 10.68 Use of the tool PRL 0619

20. Install the assembled double steering arm (as per point 4 of the installation procedure) into the steering bearing housing **A** (See Fig. **10.55**).
21. Smear the shaped ring **7** in the upper steering bearing housing 1 with oil, fit the housing **1** on pin **9** and use screws **3** c/w spring washers **4** to fix it to the steering bearing housing **A**.
22. Tighten screws **3** to the torque of **250 - 300 Nm**.
23. Make sure that the double steering arm **11** is turning without dragging.
24. Connect the double steering arm **11** to the complete steering rod, RH and LH and to the rod c/w joints as per procedures mentioned in: (See Subchapter **10.5.10**) and (See Subchapter **10.5.11**).
25. Install the engine according to a procedure mentioned in: (See Part **1**).
26. Check the adjustment of the front axle wheels alignment in accordance with a procedure mentioned in: (See Subchapter **10.5.4**).