A. Steering gear 765.7 (LS 90)

1 Steering case .................................................. Clamp with special tool 123 589 03 59 00
2 Pitman shaft .................................................. Check for wear on bearing points and on tooth segment, as well as for distortion. Attention! Pay attention to toothing.
6 Control valve .................................................. Pay attention to different versions, do not disassemble!
8 Steering case cover with needle sleeve ............... Check needle sleeve for damage and quiet running. If needle sleeve is damaged, renew case cover.
10 Closing cap .................................................. Different diameters, according to steering gear model designation
12 Reaction bolt .................................................. Different diameters, according to steering gear model designation
15 Compression spring
16 Locking ring
18 Thrust washer
19 Compression spring
20 Locking ring
21 O-ring (closing cap) ........................................... Renew
22 Locking ring .................................................. Renew
23 O-ring ......................................................... Renew
47 Adjusting screw ............................................. Mount free of play
48 Thrust washer
49 Locking ring .................................................. Renew
50 Thrust ring
51 Locking ring .................................................. Renew
52 Needle sleeve .................................................. Check, renew case cover if required
53 Locking ring .................................................. Renew
54 O-ring ......................................................... Renew
55 O-ring ......................................................... Renew
56 Radial sealing ring .......................................... Renew, special tool 116 589 07 43 00
<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>Self-locking hex. nut</td>
<td>60–65 Nm</td>
</tr>
<tr>
<td>58</td>
<td>Needle bearing</td>
<td>Control valve 2nd version</td>
</tr>
<tr>
<td>92</td>
<td>Cover</td>
<td>Check for damage and quiet running</td>
</tr>
<tr>
<td>93</td>
<td>Compression spring</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>Spring bolt</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>Bushing</td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>O-ring</td>
<td>Renew</td>
</tr>
<tr>
<td>97</td>
<td>Locking ring</td>
<td>Renew</td>
</tr>
<tr>
<td>98</td>
<td>Thrust ring</td>
<td></td>
</tr>
<tr>
<td>99</td>
<td>Locking ring</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Hex. head screws</td>
<td>Renew, 30–35 Nm</td>
</tr>
</tbody>
</table>
1 Steering case ............... Check needle sleeve at top in steering case for damage and quiet running. If required, remove needle sleeve with a conventional puller and renew. Special tool for mounting 123 589 03 59 00
3 Steering worm ................ Check ball circuit for score marks. Pay attention to different version, according to steering model designation.
4 Steering nut .................. Special tool for friction torque
5 Working piston ....... Pay attention to toothing and version (with and without compensation for play) Special tool 201 589 02 59 00
7 Bearing cap .................. Pay attention to different version, according to steering model designation.
9 Bearing insert with needle sleeve Check needle sleeve for damage and quiet running. Renew bearing insert completely, if required. Special tool 000 589 00 05 00, 116 589 08 43 00, 123 589 01 16 00, 123 589 02 07 00
24 Axial washer
25 Needle sleeve ............... Renew
26 Radial sealing ring ........ Renew
27 Locking ring ............... Renew
28 O-ring ...................... Renew
31 Slot nut or hex. nut ........ 140–160 Nm Special tool 126 589 00 16 00, 123 589 01 07 00 or 123 589 09 09 00
32 Axial cyl. roller cage ...... Check for quiet running and damage
33 Axial angular ball bearing Check for quiet running and damage
34 Axial cyl. roller cage ....... Check for quiet running and damage
36 Screw cover (hex.) ........ Special tool depending on version
36a Screw cover (square) ........ 123 589 01 16 00, 123 589 05 09 00
                                                                     123 589 07 09 00, 123 589 06 09 00
<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Action</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>O-ring</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Sealing ring (teflon)</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Slot nut</td>
<td>Renew</td>
<td>200–240 Nm</td>
</tr>
<tr>
<td>39a</td>
<td>Hex. nut</td>
<td>Renew</td>
<td>Special tool 126 589 00 16 00 and 123 589 00 07 00 or 123 589 09 09 00</td>
</tr>
<tr>
<td>40</td>
<td>O-ring</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Sealing ring (teflon)</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Steel balls</td>
<td>24 each</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Ball guide half</td>
<td>Check for damage</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Fastening clamp</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Hex. head screw</td>
<td>12–16 Nm</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>O-ring</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Locking plate</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Axial washer</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>O-ring</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>Sealing ring (teflon) in bearing cap</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>O-ring in bearing cap</td>
<td>Renew</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>Stop ring</td>
<td>Different thickness according to steering model designation</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Hex. head screws</td>
<td>60–65 Nm</td>
<td></td>
</tr>
</tbody>
</table>
Special tools
Conventional tool

| Box wrench, plug-type 19 mm for torque wrench 001 589 67 21 00 | e.g. made by Wille, D-5600 Wuppertal Order No. 732/40 – 19 mm |

<table>
<thead>
<tr>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of balls in ball circuit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjusting values</th>
<th>Ncm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friction torque of steering worm in bearing cap prior to preloading bearing insert</td>
<td>&lt; 12</td>
</tr>
<tr>
<td>Additional friction torque of steering worm after preloading bearing insert</td>
<td>4–7</td>
</tr>
<tr>
<td>Friction torque of steering nut in working piston</td>
<td>6–10</td>
</tr>
<tr>
<td>Friction torque of ball circuit steering worm – steering nut</td>
<td>30–50</td>
</tr>
<tr>
<td>Total friction torque</td>
<td>110–160</td>
</tr>
</tbody>
</table>

Note

The following description covers assembly and adjustment of the following steering gears:

Steering without and with inside stop

Steering with automatic compensation for play

The data valid for the individual models and steering gears with regard to pitch of ball circuit and diameters of reaction piston are shown in list "Differentiating characteristics of steering gears" 46–010.
1st version
Power steering without inside stop
(steering 765.700, 765.701, 765.702, 765.703)
1 Steer case
2 Pitman shaft
3 Steering worm
4 Steering nut
5 Working piston
7 Bearing cap
9 Bearing insert
36 Screw cap

2nd version
Power steering with inside stop
(steering 765.704, 765.706)
1 Steering case
2 Pitman shaft
3 Steering worm
4 Steering nut
5 Working piston
7 Bearing cap
9 Bearing insert
36 Screw cap
90 Stop ring
A Stop for working piston
Power steering without compensation for play
(steering 765.700, 765.701, 765.702, 765.703, 765.704)
1 Steering case
2 Pitman shaft
3 Steering worm
4 Steering nut
5 Working piston
6 Control valve
8 Case cover
23 O-ring
47 Adjusting screw

3rd version
Power steering with automatic compensation for play
(steering 765.706)
1 Steering case
2 Pitman shaft
3 Steering worm
4 Steering nut
5 Working piston
6 Control valve
8 Casing cap
23 O-ring
47 Adjusting screw
91 Automatic compensation for play
1. Fasten steering (1) to assembly device (0102).

Special tool 123 589 03 59 00

2. On steering 3rd version (with automatic compensation for play) turn steering worm until working piston is slightly in lefthand or righthand lock.

3. Remove locking ring (97) from cover (92), then remove thrust ring (98) from steering case.
   Remove locking ring (99) from steering case (1).
   Remove compression spring (93), spring bolt (94) and bushing (95).

4. Unscrew hex. screws for fastening casing cover (8) to steering case (1).
5 Unscrew self-locking hex. nut (57) from adjusting screw (47), while applying counterhold to adjusting screw.

6 In center position of steering, turn adjusting screw to the right, which will force pitman shaft including casing cover out of steering case.

7 Remove casing cover (8) from pitman shaft (2).

8 Remove O-rings (54 and 55) from casing cover.

9 Remove locking ring (53) and radial sealing ring (56) from casing cover (8).
10. Take locking ring (51) out of adjusting screw (47), then remove thrust ring (50).

11. Remove locking ring (49) from pitman shaft (2). Remove adjusting screw (47) including thrust washer (48).

12. Unscrew hex. screws for fastening bearing cap (7) to steering case (1).

13. Slip steering coupling on steering worm, turn steering worm to the left until bearing cap is pushed slightly out of steering case.

**Attention!**
Do not turn too far, since otherwise the balls may fall out of ball circuit.

14. Remove bearing cap together with steering worm and working piston out of steering case.
15 Place measuring device on splining of steering worm and measure friction torque of ball circuit. The friction torque steering nut — steering worm should amount to 5—50 Ncm (i.e. 50 g in notch "10" as lowest or 500 g in notch "6" to "12" as highest friction torque).

Special tool 116 589 03 21 00

If the friction torque is lower, the ball circuit has play; if it is higher, ball circuit is damaged. In both cases, replace the steering case.

16 The friction torque can also be measured with torque wrench in combination with respective socket.

Special tool 123 589 02 21 00 and 123 589 00 08 00

17 Screw steering worm (3) out of steering nut (4), making sure that no balls (42) are lost.

18 Remove O-ring from bearing cap (7) and fasten bearing cap in device (0100).

Special tool 123 589 02 59 00
19 Unscrew slot nut or hex. nut with tommy handle (0103) and unscrew pertinent insert (0104) from bearing insert.

Special tool 126 589 00 16 00 and 123 589 01 07 00 or 123 589 09 09 00

Layout bearing insert with slot nut

20 Unscrew bearing insert (9) with pin wrench from bearing cap (7).

Special tool 000 589 00 05 00

Note: Bearing insert can also be unscrewed by means of the adjustable pin wrench.
21. Remove steering worm (3) from bearing cap (7), remove axial cyl. roller cage (32) from steering worm.

22. On 1st version, remove bearing cap/steering worm sealing ring (30) and O-ring (29) from steering worm (3).

---

**Bearing cap and steering worm**

1st version:

- Bearing cap with neck, sealing ring (teflon) and O-ring on steering worm

- 3 Steering worm
- 7 Bearing cap
- 9 Bearing insert
- 24 Axial washer
- 25 Needle sleeve
- 26 Radial sealing ring
- 27 Locking ring
- 28 O-ring
- 29 O-ring
- 30 Sealing ring (teflon)
- 31 Slot or hex. nut
- 32 Axial cyl. roller cap
- 46 O-ring
- 61 Axial washer
23. On 2nd version bearing cap/steering worm remove sealing ring (89) and O-ring from bearing cap.

24. Remove axial washer (61) from bearing cap (7).

25. Unbend locking plate (59), unscrew hex. screws (45), remove locking plate, fastening clip (44) and both ball guide halves (43).

Special tool 201 589 02 59 00
26 Clamp working piston (5) into device (0100) and secure with plug (0100 a).

Special tool 123 589 02 59 00

Layout screw cover (36) with hexagon SW 36 or 46 and slot nut (39)

Layout screw cover (36 a) with square head and hex. nut (39 a)

27 Unscrew slot nur or hex. nut with pertinent insert (0104) including tommy handle (0103), then unscrew screw cover with pertinent insert.

Special tool for slot or hex. nut
126 589 00 16 00, 123 589 00 07 00, 123 589 09 09 00

Special tool for screw cover
123 589 01 16 00, 123 589 05 09 00, 123 589 06 09 00, 123 589 07 09 00

28 Take sealing ring (teflon) (38) and O-ring (37) from screw cover (36).

29 Remove axial cyl. roller cage (34) from steering nut (4) and steering nut from working piston (5).

30 Remove axial angular ball bearing (33) from working piston.
31. Remove locking ring (22) and closing cover (10) from steering case.

32. Remove control valve (6) from steering case (1), making sure that the springs on control valve 2nd, 3rd and 4th version are not falling out of reaction piston.

33. Remove O-ring (21) from closing cover.

---

a) Control valve 1st version

1 Steering case
6 Control valve
10 Closing cover
13 Supporting bolt
21 O-ring
22 Locking ring

---

b) Control valve 2nd version

1 Steering case
6 Control valve
10 Closing cover
12 Reaction piston
21 O-ring
22 Locking ring
65 Spring bolt
c) Control valve 3rd and 4th version
1 Steering case
6 Control valve
10 Closing cover
12 Reaction piston
16 Locking ring
21 O-ring
22 Locking ring
66 Compensating washer
67 Spring

Checkup

Apply strict standards when checking steering components. When in doubt, replace respective part on principle.

Note

The ball circuit, that is, the steering worm and the steering nut, are assembled free of play at factory.

To maintain the specified clearance of 0.006 to 0.01 mm between straightedge of steering nut and control valve, both parts are assembled by selection.

The same applies to steering case and the control valve mounted inside case. For this reason, except for gasket and bearing set, only the pitman shaft, the working piston and the case cover are available as spare parts.

Steering worm

34 Check ball circuit on steering worm (3). If impact dents are showing up, replace steering.

Bearing insert

35 Check needle sleeve for wear. If needle sleeve is damaged, renew complete bearing insert (9).
Working piston and steering nut

36  Remove sealing ring (41) and O-ring (40) from working piston (5). Press outer race of axial angular ball bearing (33) out of working piston.

37  Remove sealing ring (38) and O-ring (37) from screw cover (36).

38  Check ball circuit in steering nut (4). If impact dents are showing up, replace steering.

4  Steering nut
4a Straightedge on steering nut
5  Working piston
33 Axial angular ball bearing
34 Axial cyl. roller cage
36 Screw cover
39 Slot or hex. nut
41 Sealing ring (teflon)

Pitman shaft

39  Check pitman shaft (2) for wear at bearing points and on tooth segment, as well as for distortion or other damage. Renew pitman shaft, if required.

2  Pitman shaft
47 Adjusting screw
48 Thrust washer
49 Locking ring
50 Thrust ring
51 Locking ring

Case cover

40  Check needle sleeve (52) for wear. If needle sleeve is damaged, renew complete case cover.

Steering case

41  Check needle sleeve in steering case for wear. If required, pull out needle sleeve with a conventional puller.
Control valve

Note: On 1st version of control valve the reaction pistons have a diameter of 11 mm and the supporting pistons (13) are secured in reaction pistons by means of locking rings (14). On 2nd version (production starting middle of 1972) the diameter of the reaction pistons is 10 mm. Two spring bolts (65) are inserted in reaction pistons. On control valve 3rd version (production starting end of 1973) the reaction pistons have a diameter of 11 mm. Inside reaction pistons are compensating washer (66) and spring (67). Starting at the beginning of 1976 the control valve 4th version is installed, with a reaction piston diameter of 11.5 mm.

1st version

42 Check reaction piston (12) and supporting piston (13) in control valve (6) for easy operation. If required, remove and clean reaction piston after removing locking ring (16).

Note: Do not remove supporting bolts (13) from reaction pistons (12), since the spring load of compression spring (15) is adjusted by means of compensation washers (17).

2nd version

43 Check reaction piston (12) in control valve (6) for easy operation.
**Note:** Do not disassemble spring bolts (65), since the spring preload is adjusted with compensating washers (17).

- 6 Control valve
- 12 Reaction piston (10 mm dia.)
- 15 Compression spring
- 16 Locking ring
- 17 Compensating washer
- 18 Thrust washer
- 19 Compression spring
- 20 Locking ring
- 65 Spring bolt

**3rd and 4th version**

44 Check reaction piston (12) in control valve (6) for easy operation.

**Note:** Do not mix up springs (15) and compensating washers (17) of both reaction pistons.

- 6 Control valve
- 12 Reaction piston (11 or 11.5 mm dia.)
- 15 Compression spring
- 16 Locking ring
- 17 Compensating washer
- 18 Thrust washer
- 19 Compression spring
- 20 Locking ring

**Steering worm for steering without inside stop**

45 Place lower axial cyl. roller cage (32) on steering worm (3).

46 Slip assembly sleeve (84) on steering worm (3) and mount O-ring (29) first, then sealing ring (30).

**Bearing cap for steering without inside stop**

47 Fasten bearing cap (7) in device (0100), insert axial washer (61) into bearing cap, then steering worm (3).
Bearing cap and steering worm for steering without inside stop:

Bearing cap with neck, sealing ring (teflon) and O-ring on steering worm

3 Steering worm
7 Bearing cap
9 Bearing insert
24 Axial washer
25 Needle sleeve
26 Radial sealing ring
27 Locking ring
28 O-ring
29 O-ring
30 Sealing ring (teflon)
31 Slot or hex. nut
32 Axial cyl. roller cage
46 O-ring
61 Axial washer

Bearing cap and steering worm for steering with inside stop:

Bearing cap without neck, sealing ring (teflon) and O-ring in bearing cap

3 Steering worm
7 Bearing cap
9 Bearing insert
24 Axial washer
25 Needle sleeve
26 Radial sealing ring
27 Locking ring
28 O-ring
31 Slot or hex. nut
32 Axial cyl. roller cage
46 O-ring
61 Axial washer
88 Sealing ring (teflon)
89 O-ring