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"For All Your Hydraulic Needs"

Service Manual
Steering, OSPM

Contents

Chapter 1

Safety

Topics:

Safety precautions

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Warning:

Unintended Machine Movement

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To prevent unintended movement, secure the machine or disable / disconnect the mechanism while servicing.

Warning:

Flammable Cleaning Solvents

Some cleaning solvents are flammable. To eliminate the risk of fire, do not use cleaning solvents in an area where a source of ignition may be present.

Warning:

Fluid Under Pressure

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any othe rbody part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Warning:

Personal Safety

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

Warning:

Product Safety

Steering valves are safety components and therefore it is extremely important that the greatest care is taken when servicing these products. There is not much wear on a steering valve and therefore they normally outlast the application they are built into. Therefore the only recommended service work on steering valves is:

- Changing shaft seals and o-rings
- Disassemble, clean and assemble if contaminated
- Make hydraulic testing including valve setting.

Chapter 2

Versions

Topics:

OSPM versions

This service literature is valid for:

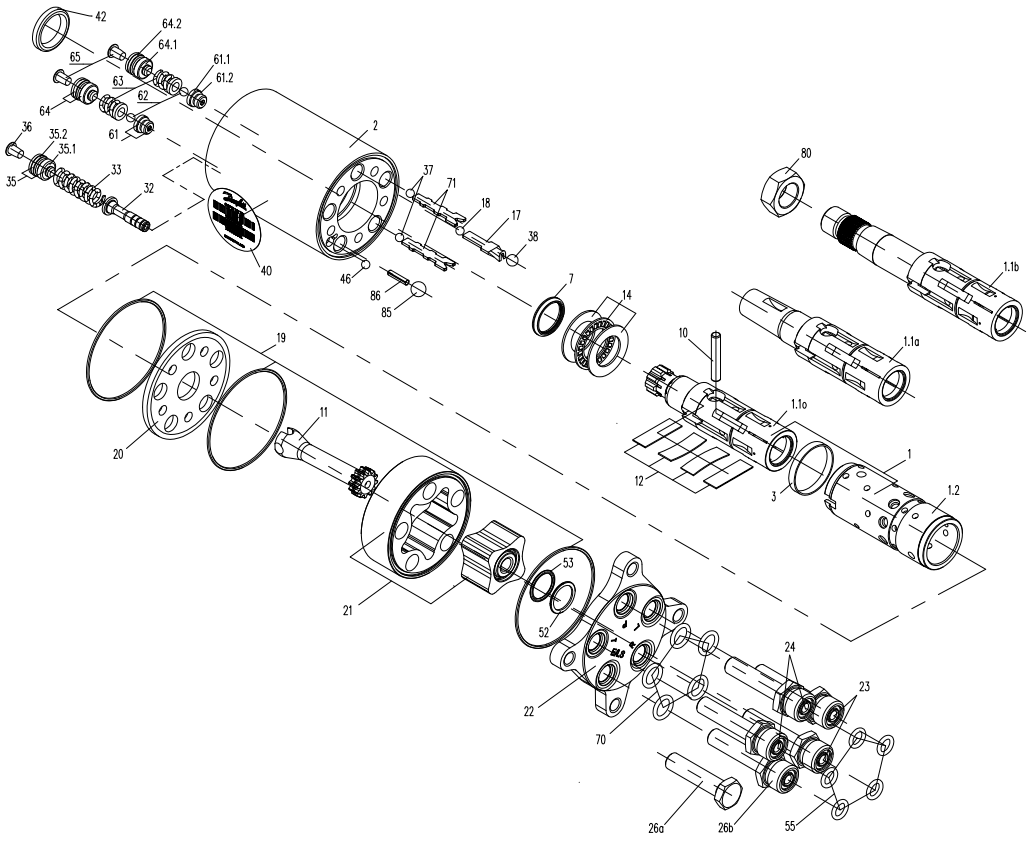
- OSPM, Mini steering unit with rear porting
- OSPMS, Mini steering unit with side porting
- OSPMC, Mini steering unit with rear porting and 12 teeth female shaft for standard column
- OSPMSC, Mini steering unit with side porting and 12 teeth female shaft for standard column

Chapter 3

Exploded views and seal kits

Topics:

OSPM exploded view



OSPM parts list

Item	Description	Number per unit	Tightening torque
1	Spool/sleeve set	1	-
1.1o	Spool for column mount	1	-
1.1a	Spool for steering wheel type A	1	-
1.1b	Spool for steering wheel type B	1	-
1.2	Sleeve	1	-
2	Housing	1	-
3	Ring	1	-
7	Shaft seal	1	-
10	Cross pin	1	-
11	Cardan shaft	1	-
12	Set of springs	1	-
14	Bearing assembly	1	-
17	Ball stop, emergency steer	1	-

Item	Description	Number per unit	Tightening torque
18	Ball, emergency steer, Ø3/16”	1	-
19	O-ring Ø60 x Ø1.5 mm	3	-
20	Distributor plate	1	-
21	Gearwheel set	1	-
22	End cover	1	-
23	Special hollow screw for L and R incl. O-ring (55)	2	30 ± 3 N•m [265 ± 26 lbf•in]
24	Special hollow screw for P and T incl. O-ring (55)	2	30 ± 3 N•m [265 ± 26 lbf•in]
26a	Special screw, for ON	1	30 ± 3 N•m [265 ± 26 lbf•in]
26b	Special hollow screw for LS/PB Included O-ring (55)	1	30 ± 3 N•m [265 ± 26 lbf•in]
32	Piston for relief valve	1	-
33	Spring for relief valve	1	-
35	Adjusting screw for relief valve with O-ring	1	-
35.1	Adjusting screw	1	-
35.2	O-ring Ø9 x Ø1,5 mm	1	-
36	Plug	1	-
37	Ball, suction valves, Ø3/16”	2	-
38	Ball, P-check Ø6,5 mm	1	-
40	Model/Code label	1	-
42	Dust seal ring	1	-
46	Ball, LS-check Ø3/16” (alternative to 85)	1	-
52	Seal ring	1	-
53	O-ring Ø15 x Ø1,60 mm	1	-
55	O-ring Ø7,65 x Ø1,78 mm for 9/16-18 UNF Ø9.25 x Ø1.78 mm for 11/16-16 UN	4 for ON 5 for LS/PB	-
61	Valve seat for shock valve with O-ring	2	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
61.1	Valve seat for shock valve	2	-
61.2	O-ring Ø6 x Ø1,5 mm	2	-
62	Ball Ø3/16”	2	-
63	Spring with thrust pad for shock valve	2	-

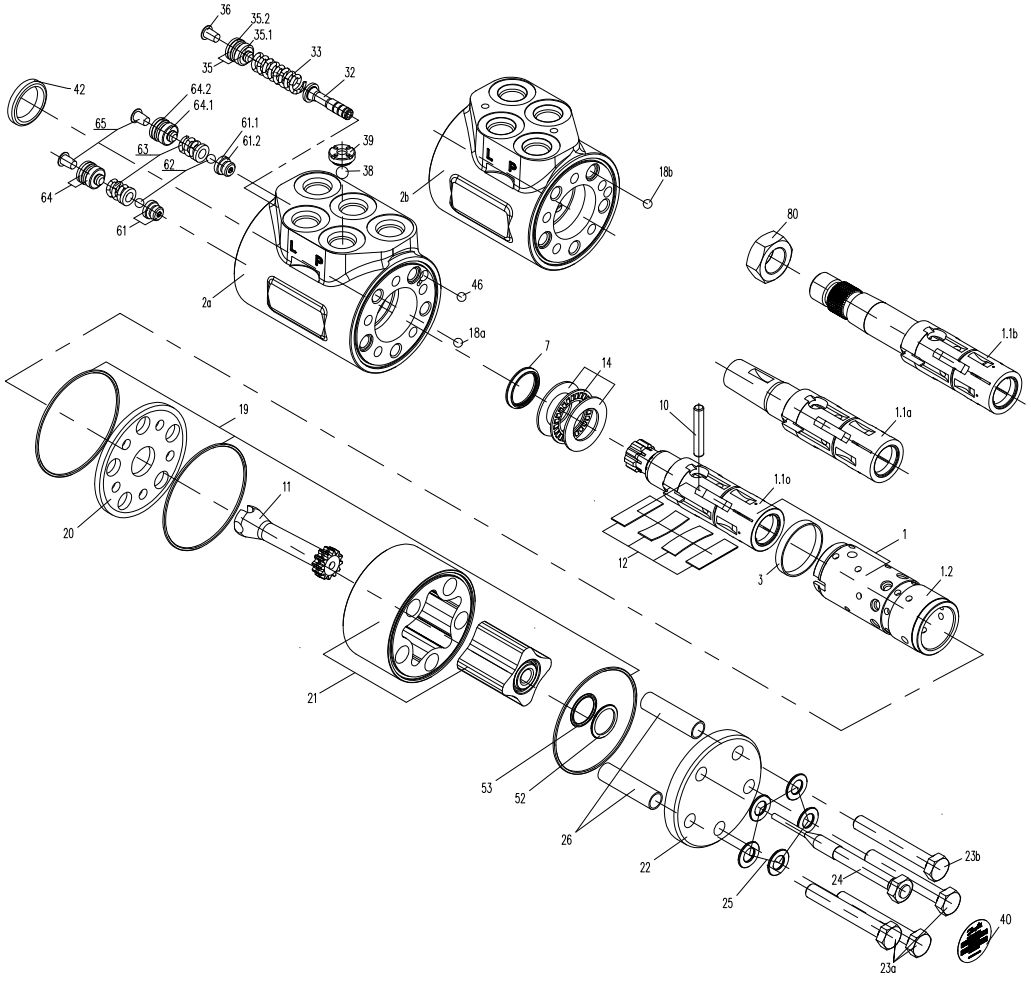
Item	Description	Number per unit	Tightening torque
64	Adjusting screw for shock valve with O-ring	2	-
64.1	Adjusting screw	2	-
64.2	O-ring Ø9 x Ø1,5 mm	2	-
65	Plug	2	-
70	O-ring Ø10 x Ø1,5 mm	5	-
71	Ball stop, suction valves	2	-
80	Nut, B-shaft	1	-
85	Ball, LS-check Ø6,5 mm (alternative to 46)	1	-
86	Pin for ball 85 (fixed into housing)	1	-

Seal kit for OSPM

Table 1: Seal kit code 150L4054

Item	Description	Dimension	Comments	Number per unit
7	Shaft seal	21,9x 17,5 x 3,1 mm	For OSPM with integrated column from before 2006	1
		26 x 19 x 4 mm	For OSPM and OSPMS	
19	O-ring	Ø60 x Ø1.5 mm		3
35.2	O-ring	Ø9 x Ø1,5 mm		1
42	Dust seal ring	26 x 18,2 x 3,5 mm	For OSPM and OSPMS	1
70	O-ring	Ø10 x Ø1.5 mm		5
61.2	O-ring	Ø6 x Ø1.5 mm		2
64.2	O-ring	Ø9 x Ø1,5 mm		2

OSPMS exploded view



OSPMS parts list

Item	Description	Number per unit	Tightening torque
1	Spool/sleeve set	1	-
1.1o	Spool for column mount	1	-
1.1a	Spool for steering wheel type A	1	-
1.1b	Spool for steering wheel type B	1	-
1.2	Sleeve	1	-
2	Housing. 2a for PB/LS. 2b for ON	1	-
3	Ring	1	-
7	Shaft seal	1	-
10	Cross pin	1	-

Item	Description	Number per unit	Tightening torque
11	Cardan shaft	1	-
12	Set of springs	1	-
14	Bearing assembly	1	-
18	Ball, emergency steer, Ø3/16”. Pos.18a for PB/LS. Pos. 18b for ON	1	-
19	O-ring Ø60 x Ø1.5 mm	3	-
20	Distributor plate	1	-
21	Gearwheel set	1	-
22	End cover	1	-
23a	Screw	3	30 ± 3 N•m [265 ± 26 lbf•in]
23b	Screw (position shown for PB/LS. For ON it has position as 24)	1	30 ± 3 N•m [265 ± 26 lbf•in]
24	Pin bolt screw (position shown for PB/LS. For ON it has position as 23b)	1	30 ± 3 N•m [265 ± 26 lbf•in]
25	Washers	5	-
26	Tubes	2	-
32	Piston for relief valve	1	-
33	Spring for relief valve	1	-
35	Adjusting screw for relief valve with O-ring	1	-
35.1	Adjusting screw	1	-
35.2	O-ring Ø9 x Ø1,5 mm	1	-
36	Plug	1	-
38	Ball, P-check Ø6,5 mm	1	-
39	Screw for P-check, special	1	-
40	Model/Code label	1	-
42	Dust seal ring	1	-
46	Ball, LS-check Ø3/16”	1	-
52	Seal ring	1	-
53	O-ring Ø15 x Ø1,60 mm	1	-
61	Valve seat for shock valve with O-ring	2	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
61.1	Valve seat for shock valve	2	-
61.2	O-ring Ø6 x Ø1,5 mm	2	-
62	Ball Ø3/16”	2	-

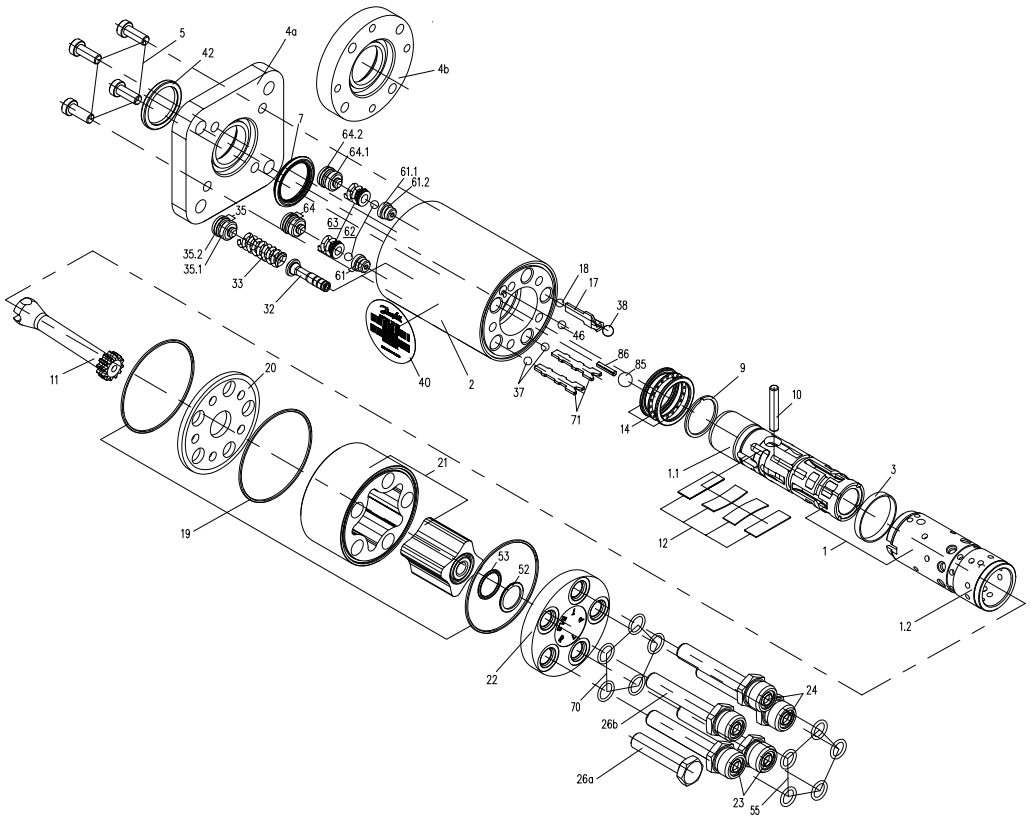
Item	Description	Number per unit	Tightening torque
63	Spring with thrust pad for shock valve	2	-
64	Adjusting screw for shock valve with O-ring	2	-
64.1	Adjusting screw	2	-
64.2	O-ring Ø9 x Ø1,5 mm	2	-
65	Plug	2	-
80	Nut, B-shaft	1	-

Seal kit for OSPMS

Table 2: Seal kit code 150L4054

Item	Description	Dimension	Comments	Number per unit
7	Shaft seal	26 x 19 x 4 mm	For OSPM and OSPMS	1
19	O-ring	Ø60 x Ø1.5 mm		3
25	Washer	15,2 x 8,2 x 1	For OSPMS	5
35.2	O-ring	Ø9 x Ø1,5 mm		1
42	Dust seal ring	26 x 18,2 x 3,5 mm	For OSPM and OSPMS	1
61.2	O-ring	Ø6 x Ø1.5 mm		2
64.2	O-ring	Ø9 x Ø1,5 mm		2

OSPMC exploded view



OSPMC parts list

Item	Description	Number per unit	Tightening torque
1	Spool/sleeve set	1	-
1.1	Spool	1	-
1.2	Sleeve	1	-
2	Housing	1	-
3	Ring	1	-
4a	Flange, square. M10 for column	1	-
4b	Flange, round. M6 for column	1	-
5	Screw	4	10 + 3/-0 N•m [88 + 27/-0 lbf•in]
7	Shaft seal	1	-
9	Locking ring	1	-
10	Cross pin	1	-
11	Cardan shaft	1	-
12	Set of springs	1	-
14	Bearing assembly	1	-

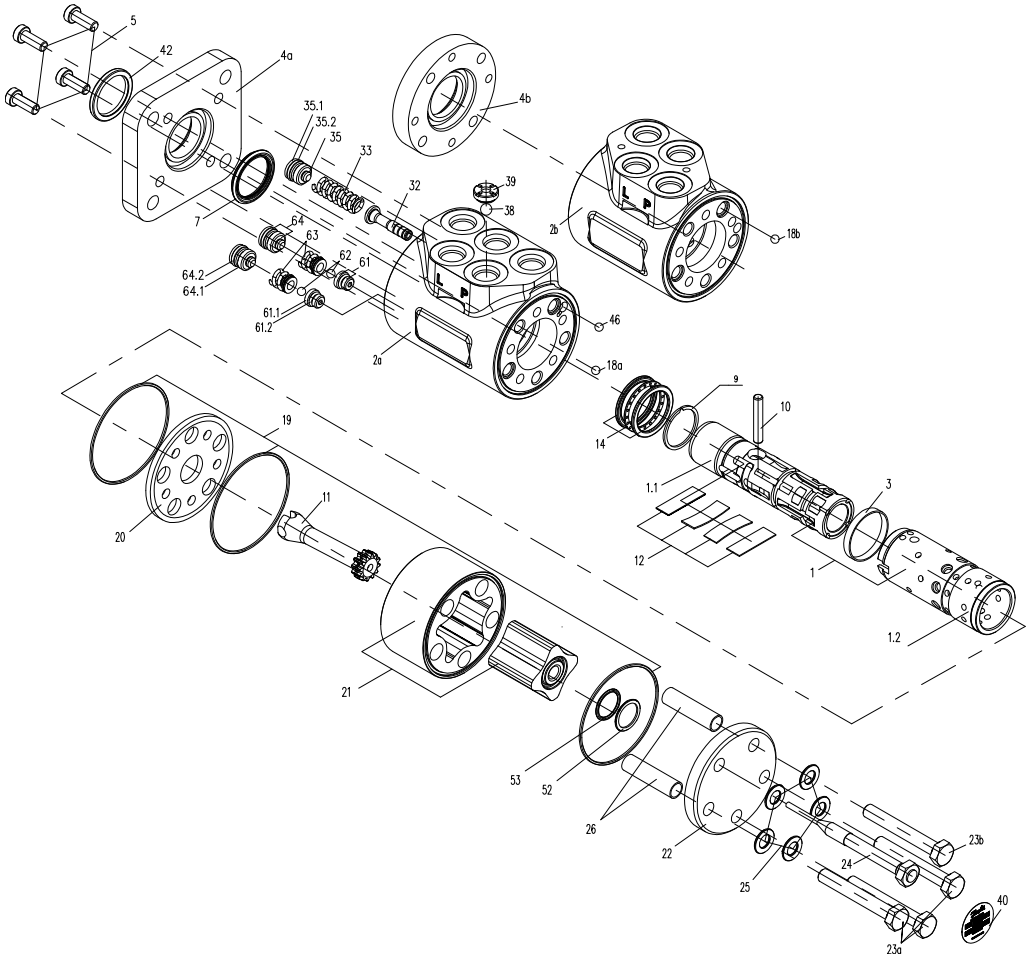
Item	Description	Number per unit	Tightening torque
17	Ball stop, emergency steer	1	-
18	Ball, emergency steer, Ø3/16”	1	-
19	O-ring Ø60 x Ø1.5 mm	3	-
20	Distributor plate	1	-
21	Gearwheel set	1	-
22	End cover	1	-
23	Special hollow screw for L and R incl. O-ring (55)	2	30 ± 3 N•m [265 ± 26 lbf•in]
24	Special hollow screw for P and T incl. O-ring (55)	2	30 ± 3 N•m [265 ± 26 lbf•in]
26a	Special screw, for ON	1	30 ± 3 N•m [265 ± 26 lbf•in]
26b	Special hollow screw for LS/PB Included O-ring (55)	1	30 ± 3 N•m [265 ± 26 lbf•in]
32	Piston for relief valve	1	-
33	Spring for relief valve	1	-
35	Adjusting screw for relief valve with O-ring	1	-
35.1	Adjusting screw	1	-
35.2	O-ring Ø9 x Ø1,5 mm	1	-
37	Ball, suction valves, Ø3/16”	2	-
38	Ball, P-check Ø6,5 mm	1	-
40	Model/Code label	1	-
42	Dust seal ring	1	-
46	Ball, LS-check Ø3/16” (alternative to 85)	1	-
52	Seal ring	1	-
53	O-ring Ø15 x Ø1,60 mm	1	-
55	O-ring Ø7,65 x Ø1,78 mm for 9/16-18 UNF Ø9.25 x Ø1.78 mm for 11/16-16 UN	4 for ON 5 for LS/PB	-
61	Valve seat for shock valve with O-ring	2	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
61.1	Valve seat for shock valve	2	-
61.2	O-ring Ø6 x Ø1,5 mm	2	-
62	Ball Ø3/16”	2	-
63	Spring with thrust pad for shock valve	2	-

Item	Description	Number per unit	Tightening torque
64	Adjusting screw for shock valve with O-ring	2	-
64.1	Adjusting screw	2	-
64.2	O-ring Ø9 x Ø1,5 mm	2	-
70	O-ring Ø10 x Ø1,5 mm	5	-
71	Ball stop, suction valves	2	-
85	Ball, LS-check Ø6,5 mm (alternative to 46)	1	-
86	Pin for ball 85	1	-

Seal kit for OSPMC

Item	Description	Dimension	Comments	Number per unit
7	Shaft seal	31,6 x 25,3 x 3,5 mm	For OSPMC and OSPMSC	1
19	O-ring	Ø60 x Ø1.5 mm		3
35.2	O-ring	Ø9 x Ø1,5 mm		1
42	Dust seal ring	31,8 x 24,6 x 3 mm	For OSPMC and OSPMSC	1
70	O-ring	Ø10 x Ø1.5 mm		5
61.2	O-ring	Ø6 x Ø1.5 mm		2
64.2	O-ring	Ø9 x Ø1,5 mm		2

OSPMSC exploded view



OSPMSC parts list

Item	Description	Number per unit	Tightening torque
1	Spool/sleeve set	1	-
1.1	Spool	1	-
1.2	Sleeve	1	-
2	Housing. 2a for PB/LS. 2b for ON	1	-
3	Ring	1	-
4a	Flange, square. M10 for column	1	-
4b	Flange, round. M6 for column	1	-
5	Screw	4	10 + 3/-0 N•m [88 + 27/-0 lbf•in]
7	Shaft seal	1	-
9	Locking ring	1	-

Item	Description	Number per unit	Tightening torque
10	Cross pin	1	-
11	Cardan shaft	1	-
12	Set of springs	1	-
14	Bearing assembly	1	-
18	Ball, emergency steer, Ø3/16”. Pos.18a for PB/LS. Pos. 18b for ON	1	-
19	O-ring Ø60 x Ø1.5 mm	3	-
20	Distributor plate	1	-
21	Gearwheel set	1	-
22	End cover	1	-
23a	Screw	3	30 ± 3 N•m [265 ± 26 lbf•in]
23b	Screw (position shown for PB/LS. For ON it has position as 24)	1	30 ± 3 N•m [265 ± 26 lbf•in]
24	Pin bolt screw (position shown for PB/LS. For ON it has position as 23b)	1	30 ± 3 N•m [265 ± 26 lbf•in]
25	Washers	5	-
26	Tubes	2	-
32	Piston for relief valve	1	-
33	Spring for relief valve	1	-
35	Adjusting screw for relief valve with O-ring	1	-
35.1	Adjusting screw	1	-
35.2	O-ring Ø9 x Ø1,5 mm	1	-
38	Ball, P-check Ø6,5 mm	1	-
39	Screw for P-check, special	1	-
40	Model/Code label	1	-
42	Dust seal ring	1	-
46	Ball, LS-check Ø3/16”	1	-
52	Seal ring	1	-
53	O-ring Ø15 x Ø1,60 mm	1	-
61	Valve seat for shock valve with O-ring	2	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
61.1	Valve seat for shock valve	2	-
61.2	O-ring Ø6 x Ø1,5 mm	2	-
62	Ball Ø3/16”	2	-
63	Spring with thrust pad for shock valve	2	-

Item	Description	Number per unit	Tightening torque
64	Adjusting screw for shock valve with O-ring	2	-
64.1	Adjusting screw	2	-
64.2	O-ring Ø9 x Ø1,5 mm	2	-

Seal kit for OSPMSC

Table 3: Seal kit code 150L4054

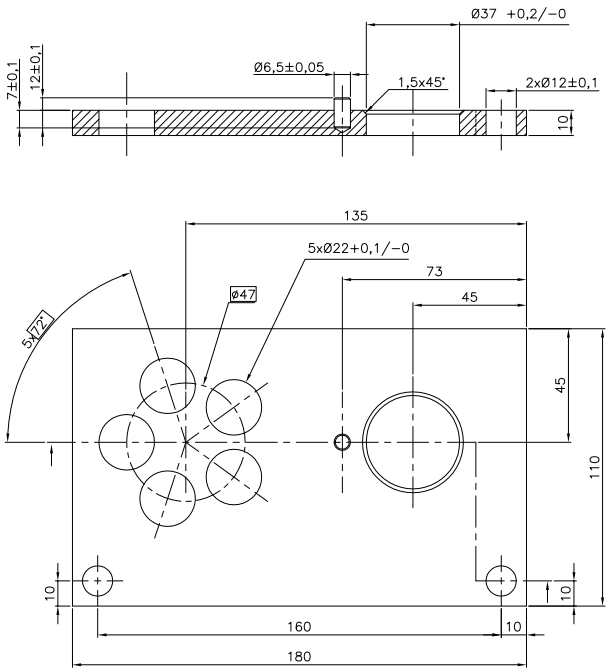
Item	Description	Dimension	Comments	Number per unit
7	Shaft seal	31,6 x 25,3 x 3,5 mm	For OSPMC and OSPMSC	1
19	O-ring	Ø60 x Ø1.5 mm		3
25	Washer	15,2 x 8,2 x 1	For OSPMS	5
35.2	O-ring	Ø9 x Ø1,5 mm		1
42	Dust seal ring	31,8 x 24,6 x 3 mm	For OSPMC and OSPMSC	1
61.2	O-ring	Ø6 x Ø1.5 mm		2
64.2	O-ring	Ø9 x Ø1,5 mm		2

Chapter 4

Required tools

Topics:

Holding tool for any OSPM type



- Material: appropriate metal
- The 2x Ø12 mm holes are for fixing the holding tool to work bench.
- There shall be a free space of min. 60 mm under Ø37 bore to have room for any shaft type.
- This tool is not available from Danfoss.

Figure 1: Holding tool

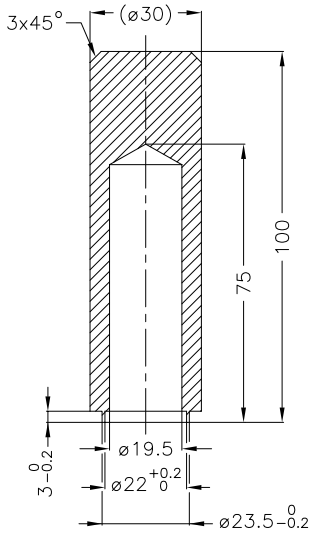
Note: No tool is needed to assemble shaft seal to housing of OSPMC and OSPMSC.

Assembly tool for shaft seal

- Tool, code 11230557 to be used for any OSPM from 2006 and on.
- Tool, code 11230556 only for OSPM with shaft for column from before 2006.

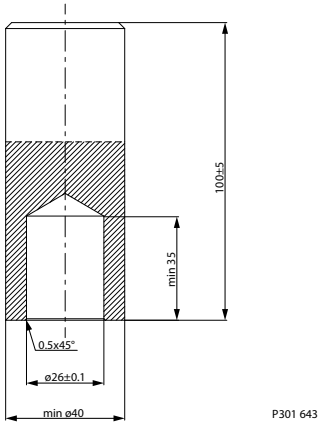
Figure 2: Assembly tool for shaft seal: O-ring / RotoGlyd type for OSPM and OSPMS

Assembly tools for dust seal



- Material: Free cutting steel.
- This tool is not available from Danfoss.

Figure 3: Assembly tool for dust seal for OSPM and OSPMS

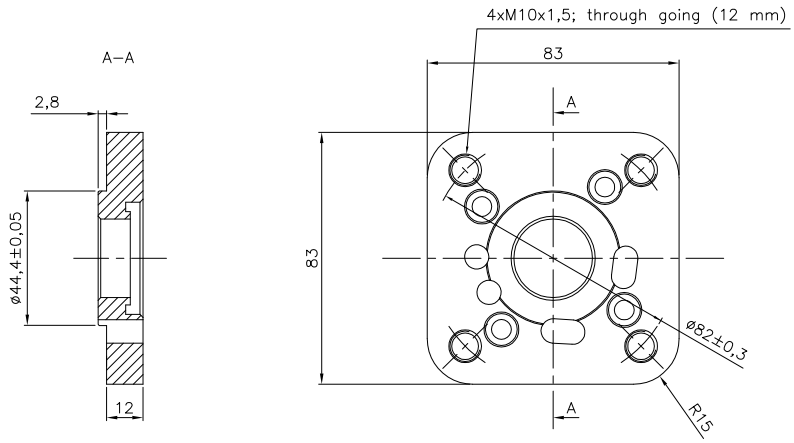


- Material: Free cutting steel.
- This tool also fit for other steering unit types: OSPB/OSPC/OSPE/OSPF/OSPD/OSPU and OSPL.
- This tool is not available from Danfoss.

Figure 4: Assembly tool for dust seal for OSPMC and OSPMSC

Test flange: OSPMC and OSPMSC

This flange is needed for OSPMC and OSPMSC with shock and/or relief valve. Only with this flange, the valves can be set in the steering unit. With this flange assembled to the OSPMC or OSPMSC, the connection picture for steering column will be identical to any OSPB/OSPC/OSPE/OSPF/OSPD/OSPU or OSPL steering unit types.



- Tool code number: 11249580

Additional tools needed

- Torque wrench 0 - 50 Nm.
- 13, 16 and 19 mm socket spanner.
- 5 and 6 mm Hex keys.
- 2 mm screwdriver.
- Magnet rod
- Tweezers

These tools are not available from Danfoss.

Chapter 5

Dismantling and Assembling

Topics:

OSPM disassembly

Remove shock and relief valves (if present)

Table 4: Wrench size and torque

Item	Description	Wrench size	Torque
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock valve	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end
2. Remove the plastic plugs (2x65) using a 2 mm flat screwdriver
3. Remove the adjusting screws (2x64) using a 5 mm Hex key

   O-rings (2x64.2) are fitted to the adjusting screws
4. Remove the springs with thrust pad (2x63) using a 2 mm flat head screwdriver
5. Remove the balls (2x62) using a magnet rod
6. Screw out the valve seat (2x61) using a 2.75 mm Hex key

   O-rings (2x61.2) are fitted to the valve seats
7. Remove the plastic plug (36) using a 2 mm flat screwdriver
8. Screw out the adjusting screw (35) using a 5 mm Hex key

   O-ring (35.2) is fitted to the adjusting screw
9. Remove the spring (33) using a 2 mm flat head screwdriver
10. Remove the piston (32) using a magnet rod

Remove end cover, gear set, cardan shaft, distributor plate, suction-, P- and LS-check- and emergency steer valves

Table 5: Wrench size and torque

Item	Description	Wrench size	Torque
23 + 24 + 26b	Special hollow screw for L, R, P, T and LS/PB	16 mm socket spanner for 9/16-18 UNF. 19 mm socket spanner 11/16-16 UN	30 ± 3 N•m [265 ± 26 lbf•in]
26a	Special screw, for ON	16 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place the steering unit on the holding tool on the steering column end
2. Screw off the 4 or 5 hollow screws (23, 24, 26b) using a 16mm (for 9/16-18 UNF) or 19mm socket spanner (for 11/16-16 UN). O-rings 55 and 70 are fitted to the screws. 26b is only present on LS and PB versions
3. Screw off the special screw (26a) using a 16mm socket spanner. Is only present on ON versions

   O-ring 70 is fitted to the screw
4. Remove the end cover (22) by sliding sideward

5. Lift the gear wheel set (21) off the unit
6. Remove the two O-rings (19) from the gear rim
7. Optional: Remove seal ring (52) and O-ring (53) from the gear wheel (if present)
8. Remove the cardan shaft (11)
9. Remove the distributor plate (20)
10. Remove the O-ring (19) from housing
11. Lift off unit from holding tool and shake out the following parts, use tweezers if necessary:
    - If P-check valve is present: Ball (38)
    - Pin (17) for emergency ball
    - Emergency steering ball (18)
    - If suction valves are present: Pins (2x 71)
    - If suction valves are present: Ball (2x 37)
    - LS-versions: Ball (46 or 85)

Remove spool/sleeve set from housing

1. Place the OSPM housing on the work bench with the center line horizontal
2. Determine if cross pin (10) in spool/sleeve set (1) is horizontal. If not, rotate housing (2) with spool/sleeve set (1) to be positioned with cross pin (10) horizontal.

   This is needed to make sure that cross pin (10) cannot fall into ring channels in housing (2) when pressing out the spool/sleeve set.
3. Press out the spool/sleeve set (1) from housing (2). Cross pin (10), ring (3), set of springs (12), and bearing assembly (14) will follow the spool/sleeve set.
4. Take off the bearing races and needle bearing (14) from the spool/sleeve set (1).

   The outer bearing (14) race can sometimes "stick" in the housing. Therefore check that it has come out.

Disassemble spool/sleeve set and remove dust and shaft seals from housing

1. Press out the cross pin (10).
2. Remove the ring (3)
3. Carefully press out the spool (1.1) of the sleeve (1.2).
4. Press the set of neutral springs (12) out of the slot of the spool
5. Remove the dust seal (42), and the shaft seal (7), carefully with a 2mm screw driver

   The OSPM steering unit is now completely dismantled.

Cleaning

Clean all parts carefully in Shellsol K or similar cleaning fluid.

Inspection and replacement

1. Replace all seals.
2. Place new O-rings from seal kit on plugs (35.1 and 64.1) and on seats (61.1).
3. Place new O-rings (70) from seal kit on screws (23, 24 and 26)
4. Check all parts carefully and make any replacements as necessary.

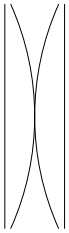
OSPM assembly

Assemble spool/spring set

1. Place the curved springs between the flat ones and press them into place. Press springs into place.

   Configuration of spring set (12):

   There can be different numbers of curved springs, 2 or 4, depending on configuration of spring set.



A150-517.10

Figure 5: Spring configuration

2. Guide the spool into the sleeve (1).

   Make sure the neutral springs (12) are placed into the slot.
3. Line up the spring set (12).

   Align the spring set by use of e.g. 2 screw drivers
4. Guide the ring (3) down over the sleeve.

   The ring should be able to move freely of the springs.
5. Fit the cross pin (10) into the spool/sleeve set.
6. Fit bearing races and needle bearing (14) as shown on the drawing below.

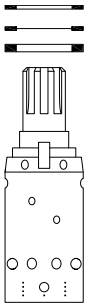


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Figure 6: Fit bearing races and needle bearing

Note: On units from before 2006, the races had different thickness: the thick race to be placed on chest of spool/sleeve set.

Assemble shaft seal and spool/sleeve set with springs, cross pin, ring and bearing assembly to the housing

1. Place the OSPM housing horizontally on the assembly table.
2. Insert the shaft seal into the housing with the assembly tool.

   Note: The small guide piece at the front of the tool must remain in the hole for the output shaft when the tool itself is drawn out of the housing.

Note: There are two different tools: Tool, code 11230557 to be used for any OSPM from 2006 and on, tool, code 11230556 only for OSPM with shaft for column from before 2006.

Grease the new shaft seal (7) with hydraulic oil and place it on the guide of the tool, the seal must be mounted as per drawing:

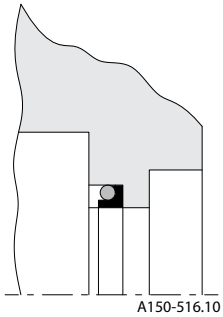

Figure 7: Shaft seal

3. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.
4. Press and turn on inner part of tool, the shaft seal (7) into position in the housing.
5. Draw the inner and outer parts of the assembly tool out of spool bore of the housing, leaving the guide from the inner part of the bore.
6. With the housing still horizontal on the assembly table, secure it with one hand.

   With the other hand take the assembled spool/sleeve set, making sure with two fingers hold the cross pin (10) in position.

   Guide the spool/sleeve set carefully into the housing with the cross pin (10) horizontal.

   Push the spool/sleeve set to the bottom of the spool bore of the housing.

   The spool/sleeve set will push out the assembly tool guide.
7. Place housing with spool/sleeve set In vertical position with gear set end pointing upwards on the fixing tool.

Assemble valve parts, O-rings, distributor plate, cardan shaft, gear set, end cover and screws to gear set end of housing

Table 6: Wrench size and torque

Item	Description	Wrench size	Torque
23+ 24+ 26b	Special hollow screw for L, R, P, T and LS/PB	16 mm socket spanner for 9/16-18 UNF. 19 mm socket spanner 11/16-16 UN	30 ± 3 N•m [265 ± 26 lbf•in]
26a	Special screw, for ON	16 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place balls and pins as illustrated in *OSPM exploded view* on page 10:
   a) Place ball (1x 18) Ø3/16” /Ø4,8 mm for emergency steering
   b) Place pin (1x 17) for emergency steering
   c) Place ball (1x 38) Ø6,5 mm for P-check (if present)
   d) Place ball (2x 37) Ø3/16” /Ø4,8 mm for suction valves (if present)

e) Place pin (2x 71) for suction valves (if present)
f) Place ball (1x 46) Ø3/16” /Ø4,8 mm or (1x 85) Ø6,5 mm for LS-check function

2. Insert the O-ring (19) in the groove of the housing.
3. Place the distributor plate (20) so that the outer holes match the tread holes in the housing.
4. Guide the cardan shaft (11) down into the bore so that the slot is parallel with the cross pin (10).
5. Place the two O-rings (19) in the two grooves in the gear rim.
6. Fit the gearwheel and rim (21) on the cardan shaft (11).

   Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in OSPM’s have timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.
7. Optional: Insert O-ring (53) and seal ring (52) in the gear wheel (if present)
8. Line up the gear rim holes to match the thread holes of the housing.
9. Place the end cover (22) into position: P-port must be lined up with thread hole with emergency steer ball (18) and pin (17).
10. Fit the special hollow screws (2x 23, 2x 24, 26b for LS/PB) and the special screw (26a for ON) with new O-rings (70) and place in the position as shown in the drawing page 6.
11. Cross tighten the 5 screws (23 + 24 + 26) using a 16 mm socket spanner (19mm for 23, 24 and 26b, when ports are 11/16-16 UN)

    Tightening torque: 30 ± 3 N•m [265 ± 26 lbf•in]
12. Assemble the O-rings (55) to the special hollow screws (2x 23, 2x 24, 26b for LS/PB), if they have been taken out during disassembly.

    Note: O-rings (5x 55) are not included in the seal kit code 150L4054

Assemble shock and relief valves, and dust seal to housing

Table 7: Wrench size and torque

Item	Description	Wrench size	Torque
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end.
2. Screw in the valve seat (61) using a 2.75 mm Hex key.

   O-rings (2x 61.2) is fitted to the valve seats.

   Tightening torque: 6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
3. Insert the balls (2x 62)
4. Insert the springs with thrust pad (2x 63)
5. Screw in the adjusting screws (2x 64) using a 5 mm Hex key.

   O-rings (64.2) are fitted to the adjusting screws.

   Screw in till head of screws are just below level of surface of housing. Shock valves shall be adjusted in hydraulic test, see section "Testing of OSPM."
6. Insert the piston (32)
7. Insert the spring (33)
8. Screw in the adjusting screw (35) using a 5 mm Hex key.

   O-ring (35.2) is fitted to the adjusting screw.

Screw in till head of screw is just below level of surface of housing. Relief valve shall be adjusted in hydraulic test, see section “Testing of OSPM”

9. Place the dust seal ring (42) in the housing.

   Fit the dust seal ring using tool for assembling dust seal ring, and a plastic hammer

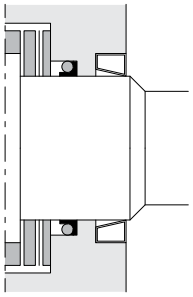

Figure 8: Dust seal

10. After testing, if shock and/or relief valves are present in the unit, insert plastic plugs (1x 36, 2x 65). Screw on plastic plugs to the connections to keep the ports clean during storage and transportation.

OSPMS disassembly

Remove all shock and relief valves (if present)

Table 8: Wrench size and torque

Item	Description	Wrench size	Torque
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock valve	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end
2. Remove the plastic plugs (2x 65) using a 2 mm flat screw driver
3. Screw off the adjusting screws (2x 64) using a 5 mm Hex key.
   O-rings (2x 64.2) are fitted to the adjusting screws
4. Remove the springs with thrust pad (2x 63) using a 2 mm flat head screwdriver.
5. Remove the balls (2x 62), using a magnet rod
6. Screw out the valve seat (2x 61) using a 2.75 mm Hex key.
   O-rings (2x 61.2) are fitted to the valve seats
7. Remove the plastic plug (36) using a 2 mm flat screw driver
8. Screw out the adjusting screw (35) using a 5 mm Hex key.
   O-ring (35.2) is fitted to the adjusting screw
9. Remove the spring (33) using a 2 mm flat head screwdriver.
10. Remove the piston (32) using a magnet rod

Remove end cover, gear set, cardan shaft, distributor plate, LS-check and emergency steer valves

Table 9: Wrench size and torque

Item	Description	Wrench size	Torque
23	Screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]
24	Pin bolt screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place the steering unit on the holding tool on the steering column end.
2. Screw off the 5 screws (23, 24) using a 13mm socket spanner.
3. Remove the 5 washers (25).
4. Remove the end cover (22) by sliding sideward.
5. Lift the gear wheel set (21) off the unit.
6. Remove the two O-rings (19) from the gear rim.
7. Remove the two tubes (26) from the gear rim.
8. Optional: Remove seal ring (52) and O-ring (53) from the gear wheel (if present).
9. Remove the cardan shaft (11).
10. Remove the distributor plate (20).
11. Remove the O-ring (19) from housing.
12. Lift off unit from holding tool and shake out the following parts, use tweezers if necessary:
    a) Emergency steering ball (18)
    b) LS-versions: Ball (46)

Remove spool/sleeve set from housing

1. Place the OSPMSC housing with the port face on the work bench. The center line must lay horizontal.
2. Determine if cross pin (10) in spool/sleeve set (1) is horizontal. If not, rotate the spool/sleeve set (1) to position cross pin (10) correctly.

   This is needed to make sure that cross pin (10) cannot fall into ring channels in housing (2) when pressing out the spool/sleeve set.
3. Press out the spool/sleeve set (1) from housing (2). Cross pin (10), ring (3), set of springs (12), and bearing assembly (14) will follow the spool/sleeve set.
4. Take off the bearing races and needle bearing (14) from the spool/sleeve set (1).

   The outer bearing (14) race can sometimes "stick" in the housing. Therefore check that it has come out.

Disassemble spool/sleeve set and remove dust and shaft seals from housing

1. Press out the cross pin (10).
2. Remove the ring (3).
3. Carefully press out the spool (1.1) of the sleeve (1.2).
4. Press the set of neutral springs (12) out of the slot of the spool.
5. Remove the dust seal (42), and the shaft seal (7), carefully with a 2mm screw driver.

   The OSPMS steering unit is now completely dismantled.

Cleaning

Clean all parts carefully in Shellsol K or similar cleaning fluid.

Inspection and replacement

1. Replace all seals.
2. Place new O-rings from seal kit on plugs (35.1 and 64.1) and on seats (61.1).
3. Place new washers (25) from seal kit on screws (23 and 24)
4. Check all parts carefully and make any replacements as necessary

OSPMS assembly

Assemble spool/sleeve set

1. Place the curved springs between the flat ones and press them into place. Press springs into place

   Configuration of spring set (12):

   There can be different numbers of curved springs, 2 or 4, depending on configuration of spring set.

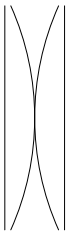

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Figure 9: Spring configuration

2. Guide the spool into the sleeve (1).
   Make sure the neutral springs (12) are placed into the slot.
3. Line up the spring set (12).
   Align the spring set by use of e.g. 2 screw drivers
4. Guide the ring (3) down over the sleeve.
   The ring should be able to move freely of the springs.
5. Fit the cross pin (10) into the spool/sleeve set.
6. Fit bearing races and needle bearing (14): one race, the needle bearing and the other bearing race. Both races have same thickness and symmetrical shape: they can be assembled randomly around the needle bearing.

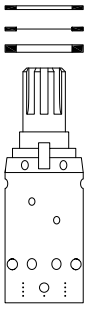

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Figure 10: Fit bearing races and needle bearing

Assemble shaft seal and spool/sleeve set with springs, cross pin, ring and bearing assembly to the housing

1. Place the OSPMS housing on the assembly table with port face pointing downwards.
2. With the assembly tool, code 11230557 the shaft seal must be inserted into the housing.

   Note: The small guide piece at the front of the tool must remain in the hole for the output shaft when the tool itself is drawn out of the housing.

   Grease the new shaft seal (7) with hydraulic oil and place it on the guide of the tool, the seal must be mounted as per drawing:

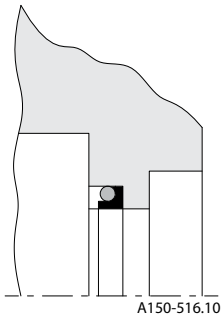


Figure 11: Shaft seal

3. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.
4. Press and turn on inner part of tool, the shaft seal (7) into position in the housing.
5. Draw the inner and outer parts of the assembly tool out of spool bore of the housing, leaving the guide from the inner part of the bore.
6. With the housing still horizontal on the assembly table, secure it with one hand.

   With the other hand take the assembled spool/sleeve set, making sure with two fingers hold the cross pin (10) in position.

   Guide the spool/sleeve set carefully into the housing with the cross pin (10) horizontal.

   Push the spool/sleeve set to the bottom of the spool bore of the housing.

   The spool/sleeve set will push out the assembly tool guide.
7. Place housing with spool/sleeve set In vertical position with gear set end pointing upwards on the fixing tool.

Assemble valve parts, O-rings, distributor plate, cardan shaft, gear set, end cover and screws to gear set end of housing

Item	Description	Wrench size	Torque
23	Screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]
24	Pin bolt screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place balls as illustrated in the drawing *OSPMS exploded view* on page 13:
   a) Place ball (1x 18) Ø3/16” /Ø4,8 mm for emergency steering
   b) Place ball (1x 46) Ø3/16” /Ø4,8 mm for LS-check function
2. Insert the O-ring (19) in the groove of the housing.
3. Place the distributor plate (20) so that the outer holes match the tread holes in the housing.

4. Guide the cardan shaft (11) down into the bore so that the slot is parallel with the cross pin (10).
5. Place the two O-rings (19) in the two grooves in the gear rim.
6. Fit the gearwheel and rim (21) on the cardan shaft (11).

   Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in OSPM's have timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.
7. Place the two tubes (26) in the two bolt holes of the gear rim as illustrated (*OSPMS exploded view* on page 13): the tubes only fits in 2 of the 5 thread holes of the housing.
8. Line up the gear rim holes to match the thread holes of the housing: the two tubes must drop into the two thread holes of the housing as illustrated on exploded view for OSPMS.
9. Optional: Insert O-ring (53) and seal ring (52) in the gear wheel (if present).
10. Place the end cover (22) into position: label text must be in parallel with the port face.
11. Fit pin bolt screw (24) with washer (25) in the bolt hole with emergency steer ball (18) in correct position: for ON versions: nearest to R-port, for LS and PB versions: nearest to P-port.
12. Fit the other 4 screws (24) with washers (25) in the remaining 4 bolt holes.
13. Cross tighten the 5 screws (23 + 24) using a 13 mm socket spanner.

    Tightening torque: 30 ± 3 N•m [265 ± 26 lbf•in]

Assemble shock and relief valves, and dust seal, to housing

Item	Description	Wrench size	Torque
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end.
2. Screw in the valve seat (61) using a 2.75 mm Hex key.

   O-rings (2x 61.2) is fitted to the valve seats.

   Tightening torque: 6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
3. Insert the balls (2x 62)
4. Insert the springs with thrust pad (2x 63)
5. Screw in the adjusting screws (2x 64) using a 5 mm Hex key.

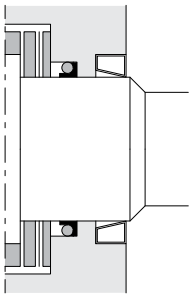
   O-rings (64.2) are fitted to the adjusting screws.

   Screw in till head of screws are just below level of surface of housing. Shock valves shall be adjusted in hydraulic test, see section "Testing of OSPM"
6. Insert the piston (32)
7. Insert the spring (33)
8. Screw in the adjusting screw (35) using a 5 mm Hex key.

   O-ring (35.2) is fitted to the adjusting screw.

   Screw in till head of screw is just below level of surface of housing. Relief valve shall be adjusted in hydraulic test, see section "Testing of OSPM"
9. Place the dust seal ring (42) in the housing.

   Fit the dust seal ring using tool for assembling dust seal ring, and a plastic hammer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10. After testing, if shock and/or relief valves are present in the unit, insert plastic plugs (1x 36, 2x 65). Screw in plastic plugs to the connections to keep the ports clean during storage and transportation.

OSPMC disassembly

Remove flange, dust seal, shock and relief valves

Item	Description	Wrench size	Torque
5	Screw for flange	5 mm Hex key	10 + 3/-0 N•m [88 + 27/-0 lbf•in]
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock valve	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end
2. Screw off the screws (4x 5) using a 5 mm Hex key.
3. Remove the flange (4).
4. Remove the dust seal (42) from flange carefully with a 2mm screw driver.
5. Screw off the adjusting screws (2x 64) using a 5 mm Hex key.
O-rings (2x 64.2) is fitted to the adjusting screws.
6. Remove the springs with thrust pad (2x 63) using a 2 mm flat head screwdriver.
7. Remove the balls (2x 62), using a magnet rod.
8. Screw out the valve seat (2x 61) using a 2.75 mm Hex key.
O-rings (2x 61.2) are fitted to the valve seats.
9. Screw out the adjusting screw (35) using a 5 mm Hex key.
O-ring (35.2) is fitted to the adjusting screw.
10. Remove the spring (33) using a 2 mm flat head screwdriver.
11. Remove the piston (32) using a magnet rod.

Remove end cover, gear set, cardan shaft, distributor plate, suction-, P-, LS-check-, and emergency steer valves

Item	Description	Wrench size	Torque
23 + **24** + **26b**	Special hollow screw for L, R, P, T and LS/PB	16 mm socket spanner for 9/16-18 UNF. 19 mm socket spanner 11/16-16 UN	30 ± 3 N•m [265 ± 26 lbf•in]
26a	Special screw, for ON	16 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place the steering unit on the holding tool on the steering column end.
2. Screw off the 4 or 5 hollow screws (23, 24, 26b) using a 16mm (for 9/16-18 UNF) or 19mm socket spanner (for 11/16-16 UN). O-rings 55 and 70 are fitted to the screws. 26b is only present on LS and PB versions
3. Screw off the special screw (26a) using a 16mm socket spanner. Is only present on ON versions.

   O-ring (70) is fitted to the screw
4. Remove the end cover (22) by sliding sideward.
5. Lift the gear wheel set (21) off the unit.
6. Remove the two O-rings (19) from the gear rim.
7. Optional: Remove seal ring (52) and O-ring (53) from the gear wheel (if present).
8. Remove the cardan shaft (11).
9. Remove the distributor plate (20).
10. Remove the O-ring (19) from housing.
11. Lift off unit from holding tool and shake out the following parts, use tweezers if necessary:
    a) If P-check valve is present: Ball (38)
    b) Pin (17) for emergency ball
    c) Emergency steering ball (18)
    d) If suction valves are present: Pins (2x 71)
    e) If suction valves are present: Ball (2x 37)
    f) LS-versions: Ball (46 or 85)

Remove spool/sleeve set from housing

1. Place the OSPMC housing on the work bench with the center line horizontal
2. Determine if cross pin (10) in spool/sleeve set (1) is horizontal. If not, rotate housing (2) with spool/sleeve set (1) to position of cross pin (10) is horizontal.

   This is needed to make sure that cross pin (10) cannot fall into ring channels in housing (2) when pressing out the spool/sleeve set.
3. Press out the spool/sleeve set (1) from housing (2). Cross pin (10), ring (3), set of springs (12), and bearing assembly (14) will follow the spool/sleeve set.
4. Take off the bearing races and ball bearing (14) from the spool/sleeve set (1).

   The outer bearing (14) race can sometimes "stick" in the housing. Therefore check that it has come out.

Disassemble spool/sleeve set and remove shaft seal from housing

1. Press out the cross pin (10).

2. Carefully press out the spool (1.1) of the sleeve (1.2).
3. Remove the ring (3).
4. Press the set of neutral springs (12) out of the slot of the spool.
5. Remove the shaft seal (7) from housing, carefully with a 2mm screw driver.

   The OSPMC steering unit is now completely dismantled.

   Note: Do not remove the locking ring (9) from spool (1.1)

Cleaning

Clean all parts carefully in Shellsol K or similar cleaning fluid.

Inspection and replacement

1. Replace all seals.
2. Place new O-rings from seal kit on plugs (35.1 and 64.1) and on seats (61.1).
3. Place new O-rings (70) from seal kit on screws (23, 24 and 26)
4. Check all parts carefully and make any replacements as necessary.

OSPMC assembly

Assemble spool/sleeve set

1. Place the curved springs between the flat ones and press them into place:

   Press the springs into the slot of the spool

   Configuration of spring set (12):

   There can be different numbers of curved springs, 2 or 4, depending on configuration of spring set.

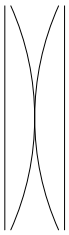

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Figure 12: Spring configuration

2. Line up the spring set (12).

   Align the spring set by use of e.g. 2 screw drivers
3. Guide the ring (3) down over the springs and the ring (3) must rest on the locking ring (9).
4. Guide the spool into the sleeve (1).

   The ring (3) must be able to move freely of the springs.
5. Fit the cross pin (10) into the spool/sleeve set.
6. Fit bearing races and ball bearing (14): one race with curved surface towards ball bearing, the ball bearing and the other bearing race also with curved surface towards the ball bearing.

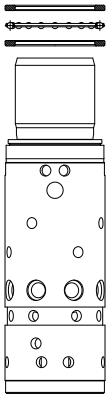


Figure 13: Fit bearing races and needle bearing

Assemble shaft seal and spool/sleeve set with springs, cross pin, ring and bearing assembly to the housing

1. Place the OSPMC housing vertically on the assembly table on gear set end.

   Grease the new shaft seal (7) with hydraulic oil and place it in the housing by hand, see drawing for orientation, O-ring side to point downwards:

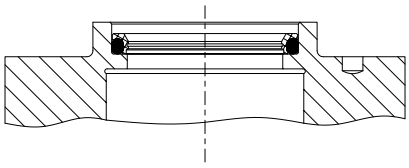


Figure 14: Shaft seal

2. Place the flange (4) on the steering column end, and screw it on with 2 screws (5) across each other using a 5 mm Hex key. Only tighten light until the flange (4) is in position. Purpose: to keep the shaft seal (7) in position during inserting the spool/sleeve set (1).
3. Place the OSPMC housing horizontally on the assembly table, and secure it with one hand.

   With the other hand take the assembled spool/sleeve set, making sure with two fingers hold the cross pin (10) in position.

   Guide the spool/sleeve set carefully into the housing with the cross pin (10) horizontal.

   Push the spool/sleeve set to the bottom of the spool bore of the housing.
4. Screw off the screws (2x5) using a 5 mm Hex key and remove the flange (4)
5. Place housing with spool/sleeve set on the fixing tool in vertical position with gear set end pointing upwards.

Assemble valve parts, O-rings, distributor plate, cardan shaft, gear set, aned cover and screws to the gear set end of housing

Item	Description	Wrench size	Torque
23 + 24 + 26b	Special hollow screw for L, R, P, T and LS/PB	16 mm socket spanner for 9/16-18 UNF. 19 mm socket spanner 11/16-16 UN	30 ± 3 N•m [265 ± 26 lbf•in]

Item	Description	Wrench size	Torque
26a	Special screw, for ON	16 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place balls and pins as illustrated in the drawing page 12:
   a) Place ball (1x 18) Ø3/16” /Ø4,8 mm for emergency steering
   b) Place pin (1x 17) for emergency steering
   c) Place ball (1x 38) Ø6,5 mm for P-check (if present)
   d) Place ball (2x 37) Ø3/16” /Ø4,8 mm for suction valves (if present)
   e) Place pin (2x 71) for suction valves (if present)
   f) Place ball (1x 46) Ø3/16” /Ø4,8 mm or (1x 85) Ø6,5 mm for LS-check function
2. Insert the O-ring (19) in the groove of the housing.
3. Place the distributor plate (20) so that the outer holes match the tread holes in the housing.
4. Guide the cardan shaft (11) down into the bore so that the slot is parallel with the cross pin (10).
5. Place the two O-rings (19) in the two grooves in the gear rim.
6. Fit the gearwheel and rim (21) on the cardan shaft (11).

   Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in OSPM’s have timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.
7. Optional: Iinsert O-ring (53) and seal ring (52) in the gear wheel (if present).
8. Line up the gear rim holes to match the thread holes of the housing.
9. Place the end cover (22) into position: P-port must be lined up with thread hole with emergency steer ball (18) and pin (17).
10. Fit the special hollow screws (2x 23, 2x 24, 26b for LS/PB) and the special screw (26a for ON) with new O-rings (70) and place in the position as shown in the drawing (*OSPMC exploded view* on page 16).
11. Cross tighten the 5 screws (23 + 24 + 26) using a 16 mm socket spanner (19mm for 23, 24 and 26b, when ports are 11/16-16 UN)

    Tightening torque: 30 ± 3 N•m [265 ± 26 lbf•in]
12. Assemble the O-rings (55) to the special hollow screws (2x 23, 2x 24, 26b for LS/PB), if they have been taken out during disassembly.

    Note: O-rings (5x 55) are not included in the seal kit code 150L4054

Assemble shock and relief valves, and flange with dust seal to housing

Item	Description	Wrench size	Torque
5	Screw for flange	5 mm Hex key	10 + 3/-0 N•m [88 + 27/-0 lbf•in]
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end.
2. Screw in the valve seat (61) using a 2.75 mm Hex key.

   O-rings (2x 61.2) are fitted to the valve seats.

   Tightening torque: 6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
3. Insert the balls (2x 62)

4. Insert the springs with thrust pad (2x 63)
5. Screw in the adjusting screws (2x 64) using a 5 mm Hex key.

   O-rings (64.2) is fitted to the adjusting screws.

   Screw in till head of screws are just below level of surface of housing. Shock valves shall be adjusted in hydraulic test, see section “Testing of OSPM”
6. Insert the piston (32)
7. Insert the spring (33)
8. Screw in the adjusting screw (35) using a 5 mm Hex key.

   O-ring (35.2) is fitted to the adjusting screw.

   Screw in till head of screw is just below level of surface of housing. Relief valve shall be adjusted in hydraulic test, see section “Testing of OSPM”
9. If the OSPMSC has shock and/or relief valve: place the service flange, code 11249580 to the housing with bores for valve adjusting above the adjusting screws
10. Fit the screws (4x 5) to the screw holes of the service flange
11. Cross tighten the 4 screws (4x 5) using a 5 mm hex key.

    Tightening torque: 10 + 3/-0 N•m [88 + 27/-0 lbf•in]
12. Place the dust seal ring (42) in the original flange (4).

    Fit the dust seal ring using special tool for assembling dust seal and a plastic hammer

13. After testing, replace the service flange with the original flange with new dust seal.

    Screw on plastic plugs to the connections to keep the ports clean during storage and transportation.

OSPMSC disassembly

Remove flange, dust seal, shock and relief valves

Item	Description	Wrench size	Torque
5	Screw for flange	5 mm Hex key	10 + 3/-0 N•m [88 + 27/-0 lbf•in]
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock valve	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end
2. Screw off the screws (4x 5) using a 5 mm Hex key.
3. Remove the flange (4).
4. Remove the dust seal (42) from flange carefully with a 2mm screw driver.
5. Screw off the adjusting screws (2x 64) using a 5 mm Hex key.

   O-rings (2x 64.2) are fitted to the adjusting screws.
6. Remove the springs with thrust pad (2x 63) using a 2 mm flat head screwdriver.
7. Remove the balls (2x 62), using a magnet rod.

8. Screw out the valve seat (2x 61) using a 2.75 mm Hex key.
   O-rings (2x 61.2) are fitted to the valve seats.
9. Screw out the adjusting screw (35) using a 5 mm Hex key.
   O-ring (35.2) is fitted to the adjusting screw.
10. Remove the spring (33) using a 2 mm flat head screwdriver.
11. Remove the piston (32) using a magnet rod.

Remove end cover, gear set, cardan shaft, distributor plate, LS-check- and emergency steer valves

Item	Description	Wrench size	Torque
23	Screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]
24	Pin bolt screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place the steering unit on the holding tool on the steering column end.
2. Screw off the 5 screws (23, 24) using a 13mm socket spanner.
3. Remove the 5 washers (25)
4. Remove the end cover (22) by sliding sideward.
5. Lift the gear wheel set (21) off the unit.
6. Remove the two O-rings (19) from the gear rim.
7. Remove the two tubes (26) from the gear rim.
8. Optional: Remove seal ring (52) and O-ring (53) from the gear wheel (if present).
9. Remove the cardan shaft (11).
10. Remove the distributor plate (20).
11. Remove the O-ring (19) from housing.
12. Lift off unit from holding tool and shake out the following parts, use tweezers if necessary:

    Emergency steering ball (18)

    LS-versions: Ball (46)

Remove spool/sleeve set from housing

1. Place the OSPMSC housing with the port face on the work bench. The center line must lay horizontal.
2. Determine if cross pin (10) in spool/sleeve set (1) is horizontal. If not, rotate the spool/sleeve set (1) to position cross pin (10) correctly.
   This is needed to make sure that cross pin (10) cannot fall into ring channels in housing (2) when pressing out the spool/sleeve set.
3. Press out the spool/sleeve set (1) from housing (2). Cross pin (10), ring (3), set of springs (12), and bearing assembly (14) will follow the spool/sleeve set.
4. Take off the bearing races and ball bearing (14) from the spool/sleeve set (1).
   The outer bearing (14) race can sometimes "stick" in the housing. Therefore check that it has come out.

Disassemble spool/sleeve set and remove shaft seal from housing

1. Press out the cross pin (10).
2. Carefully press out the spool (1.1) of the sleeve (1.2).

3. Remove the ring (3).
4. Press the set of neutral springs (12) out of the slot of the spool.
5. Remove the shaft seal (7) from housing, carefully with a 2mm screw driver.

   The OSPMSC steering unit is now completely dismantled.

   Note: Do not remove the locking ring (9) from spool (1.1)

Cleaning

Clean all parts carefully in Shellsol K or similar cleaning fluid.

Inspection and replacement

1. Replace all seals.
2. Place new O-rings from seal kit on plugs (35.1 and 64.1) and on seats (61.1).
3. Place new washers (25) from seal kit on screws (23 and 24)
4. Check all parts carefully and make any replacements as necessary.

OSPMSC assembly

Assemble spool/sleeve set

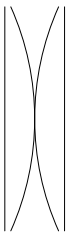
To assemble spool/sleeve set with springs, ring and cross pin, follow these steps.

1. Place the curved springs between the flat ones and press them into place:

   Press the springs into the slot of the spool.

   Configuration of spring set (12):

   There can be different numbers of curved springs, 2 or 4, depending on configuration of spring set.



A150-517.10

Figure 15: Spring configuration

2. Line up the spring set (12).

   Align the spring set by use of e.g. 2 screw drivers
3. Guide the ring (3) down over the springs and the ring (3) must rest on the locking ring (9).
4. Guide the spool into the sleeve (1).

   The ring (3) must be able to move freely of the springs.
5. Fit the cross pin (10) into the spool/sleeve set.
6. Fit bearing races and ball bearing (14): one race with curved surface towards ball bearing, the ball bearing and the other bearing race also with curved surface towards the ball bearing.

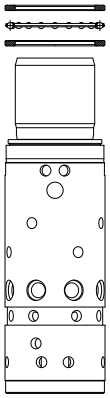


Figure 16: Fit bearing races and needle bearing

Assemble shaft seal and spool/sleeve set with springs, cross pin, ring and bearing assembly to the housing.

1. Place the OSPMSC housing vertically on the assembly table on gear set end.

   Grease the new shaft seal (7) with hydraulic oil and place it in the housing by hand, see drawing for orientation, O-ring side to point downwards:

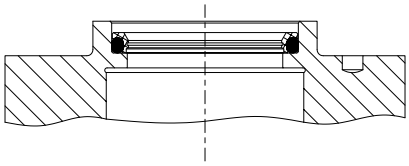


Figure 17: Shaft seal

2. Place the flange (4) on the steering column end, and screw it on with 2 screws (5) across each other using a 5 mm Hex key. Only tighten light until the flange (4) is in position. Purpose: to keep the shaft seal (7) in position during inserting the spool/sleeve set (1).
3. Place the OSPMSC housing horizontally on the port face on the assembly table, and secure it with one hand.

   With the other hand take the assembled spool/sleeve set, making sure with two fingers hold the cross pin (10) in position.

   Guide the spool/sleeve set carefully into the housing with the cross pin (10) horizontal.

   Push the spool/sleeve set to the bottom of the spool bore of the housing.
4. Screw off the screws (2x5) using a 5 mm Hex key and remove the flange (4)
5. Place housing with spool/sleeve set on the fixing tool in vertical position with gear set end pointing upwards.

Assemble valve parts, O-rings, distributor plate, cardan shaft, gear set, end cover and screws to gear set end of housing

Item	Description	Wrench size	Torque
23	Screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]
24	Pin bolt screw	13 mm socket spanner	30 ± 3 N•m [265 ± 26 lbf•in]

1. Place balls as illustrated in the drawing (*OSPMSC exploded view* on page 19):
   a) Place ball (1x 18) Ø3/16” /Ø4,8 mm for emergency steering

b) Place ball (1x 46) Ø3/16” /Ø4,8 mm for LS-check function

2. Insert the O-ring (19) in the groove of the housing.
3. Place the distributor plate (20) so that the outer holes match the tread holes in the housing.
4. Guide the cardan shaft (11) down into the bore so that the slot is parallel with the cross pin (10).
5. Place the two O-rings (19) in the two grooves in the gear rim.
6. Fit the gearwheel and rim (21) on the cardan shaft (11).

   Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in OSPM’s have timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.
7. Place the two tubes (26) in the two bolt holes of the gear rim as illustrated on drawing page 9: the tubes only fits in 2 of the 5 thread holes of the housing.
8. Line up the gear rim holes to match the thread holes of the housing: the two tubes must drop into the two thread holes of the housing as illustrated on exploded view for OSPMSC
9. If present: insert O-ring (53) and seal ring (52) in the gear wheel
10. Place the end cover (22) into position: label text must be in parallel with the port face.
11. Fit pin bolt screw (24) with washer (25) in the bolt hole with emergency steer ball (18) in correct position: for ON versions: nearest to R-port, for LS and PB versions: nearest to P-port.
12. Fit the other 4 screws (24) with washers (25) in the remaining 4 bolt holes
13. Cross tighten the 5 screws (23 + 24) using a 13 mm socket spanner

    Tightening torque: 30 ± 3 N•m [265 ± 26 lbf•in]

Assemble shock and relief valves, and flange with dust seal to housing

Item	Description	Wrench size	Torque
5	Screw for flange	5 mm Hex key	10 + 3/-0 N•m [88 + 27/-0 lbf•in]
64	Adjusting screw for shock valve	5 mm Hex key	-
61	Valve seat for shock	2.75 mm Hex key	6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
35	Adjusting screw for pilot relief valve	5 mm Hex key	-

1. Place the unit on the holding tool on the gear set end.
2. Screw in the valve seat (61) using a 2.75 mm Hex key.

   O-rings (2x 61.2) is fitted to the valve seats.

   Tightening torque: 6 +0/-1 N•m [59 +0/- 8.9 lbf•in]
3. Insert the balls (2x 62)
4. Insert the springs with thrust pad (2x 63)
5. Screw in the adjusting screws (2x 64) using a 5 mm Hex key.

   O-rings (64.2) is fitted to the adjusting screws.

   Screw in till head of screws are just below level of surface of housing. Shock valves shall be adjusted in hydraulic test, see section “Testing of OSPM”
6. Insert the piston (32)
7. Insert the spring (33)
8. Screw in the adjusting screw (35) using a 5 mm Hex key.

   O-ring (35.2) is fitted to the adjusting screw.

Screw in till head of screw is just below level of surface of housing. Relief valve shall be adjusted in hydraulic test, see section “Testing of OSPM”

9. If the OSPMSC has shock and/or relief valve: place the service flange, code 11249580 to the housing with bores for valve adjusting above the adjusting screws

10. Fit the screws (4x 5) to the screw holes of the service flange

11. Cross tighten the 4 screws (4x 5) using a 5 mm hex key.

Tightening torque: 10 + 3/-0 N•m [88 + 27/-0 lbf•in]

12. Place the dust seal ring (42) in the original flange (4).

Fit the dust seal ring using special tool for assembling dust seal and a plastic hammer

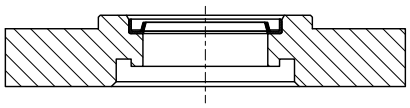


Figure 18: OSPMSC flange with dust seal

13. After testing, replace the service flange with the original flange with new dust seal.

Screw on plastic plugs to the connections to keep the ports clean during storage and transportation.

Chapter
6

Testing of OSPM

Topics:

This section describes minimum tests needed, when the OSPM steering unit has been disassembled and reassembled.

Example of system setup: OSPM ON steering unit with supply from gear pump:

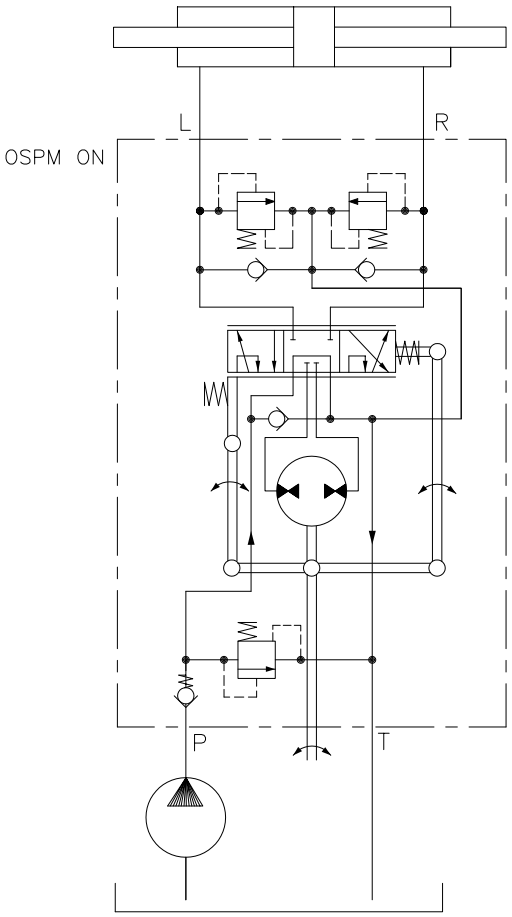


Figure 19: Example of system setup (OSPM ON in system)

With steering unit type OSPM PB: It must be supplied also direct from a gear pump. The E-port (Power Beyond port) has to be connected to tank like T-port.

Example of system setup: OSPM LS steering unit with supply from gear pump and priority valve:

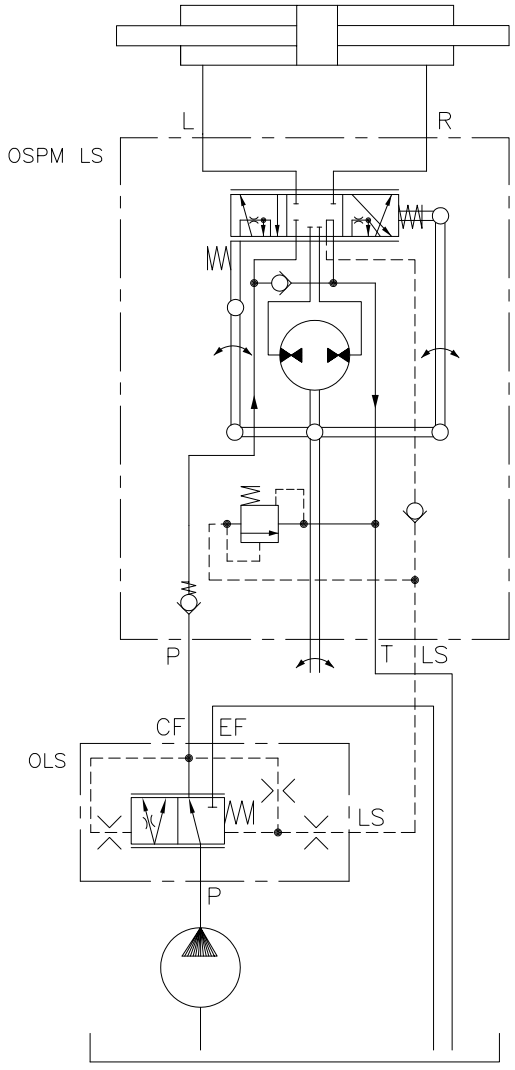


Figure 20: Example of system setup (OSPM LS in system)

Priority valve for testing OSPM LS should be OLS 40, Danfoss catalog code 152B8232 or similar OLS 40 priority valve with dynamic orifice size Ø0,6 mm, LS orifice size Ø0,8mm and spring force 7 bar.

Setup for testing

Use universal hydraulic work bench with pump capacity:

- 1 l/min and 230 bar for shock valve testing
- 20 l/min and up to 155 bar pressure for relief valve setting and steering test

The hydraulic oil must be with a viscosity of 21 cSt. at 50° and with max. degree of contamination according to ISO 4406: 21/19/16.

Shock valves

Description for setting of shock valves (if present in actual OSPM steering unit):

1. Connect T port of OSPM to tank of pump station.
2. Plug P-port of OSPM.
3. Connect P port from pump supply to one servo port at a time (L and R), plug opposite servo port.
4. Connect pressure gauge to the servo port connected to P of pump station and to T of pump station.
5. The shock valves are to be set at an oil flow of 1 l/min applied to one of the servo ports L and R at a time.
6. The shock valve (item 64, see Exploded view, OSPM) is set according to specification:

   Pressure (R-T/L-T), bar, for the code in question.

   Note:

   T pressure should not exceed ~5 bar. Max. allowed T pressure is 20 bar.

   Pump supply circuit must be adjusted not to exceed 230 bar P-T at shock valve setting.

Steering tests, setup

Description for system setup for steering tests:

1. Connect double rod cylinder to L and R ports of OSPM.
2. Connect T port of OSPM to tank of pump station.
3. Connect P port of OSPM:

   For ON and PB versions: to P port from pump.

   For LS versions: to CF of priority valve
4. For PB versions: E port of OSPM to tank of pump station.
5. For LS versions: LS port of OSPM to LS port of priority valve.
6. Connect steering column and steering wheel to OSPM surface for column.

   For OSPM with shaft type A or B, steering column is not needed.

   OSPMC and OSPMSC with relief and/or shock valves, these must be assembled with service flange code 11249580. After testing, the service flange must be replaced with the original flange.

   Column must allow access to the adjusting screw for pilot relief valve by cut-out in the foot plate.

   Note:

   T pressure should not exceed ~5 bar. Max allowed T pressure is 20 bar.

   Pump supply circuit must be adjusted not to exceed 155 bar P-T at steering test.

Start up test

During the testing, no disturbing vibrations, noise, or other irregularities must occur.

1. Start the pump.

   The pump flow is adjusted to approximately 12 l/min and pump pressure control must be set to approximately 70 bar.
2. Let the supplied oil flow through the steering unit for a few minutes.
3. Operate the steering wheel to move the steering cylinder from end stroke to end stroke for at least 5 cycles.

   Make sure pressure P-T, 70 bar can be achieved, when steering against end stroke.

   If this is not possible, the adjusting screw of the pilot relief valve (item 35, see Exploded views) must be turned clockwise until P-T, 70 bar is achievable.

Relief valve test

1. Adjust the pump flow to approximately 12 l/min and pressure to maximum 155 bar.
2. The steering wheel is actuated until the steering cylinder reaches one of its end strokes and the steering wheel is actuated in this cylinder position with steering torque 10 ±2 Nm.
3. The relief valve (item 35, see Exploded view, OSPM) is set according to specification:

   Maximum steering pressure (P-T), bar, for the code in question.

   The setting pressure is the pressure on the P-port minus the T-port of OSPM.

OSPMC and OSPMSC: replacement of service flange

If you have been servicing an OSPMC or and OSPMSC type steering unit with shock and/or relief valve, it has been assembled and tested with the service flange, code 11249580 to make the adjusting screws accessible.

1. The original flange must be assembled with new dust seal.
2. Remove the service flange
3. Assemble the original front flange to the steering unit.

   Tightening torque for fixing screws M6: 10 +3 -0 N•m [88 +27 -0 lbf•in]

Neutral positioning test

1. After adjusting the relief valve (and replacing to original flange for OSPMC and OSPMSC) , the steering wheel must be able to go to neutral position by itself no later than ~1 second after the activation of the steering wheel has been stopped.
2. The steering unit is in neutral position when the pressure drop (P-T) is no higher than 8 bar for ON and PB versions and no higher than 12 bar for LS versions.

Check for external leakage

1. After testing of the former items, the port connections are removed.
2. All ports except T port are to be plugged with steel plugs.

3. Oil pressure of 15 bar is supplied to the T-port for approximately 3 minutes:
   No leakage must be found in any assemblies.

Chapter 7

Tightening torques

Topics:

Tightening torques for connections on OSPM

Connections	Recommended tightening torque Nm [lbf.in]
	O-ring
9/16-18 UNF ORFS, ISO 8434-4	25 [221]. Fitting screws in OSPM must not be turned during assembly of hoses
11/16-16 UN ORFS, ISO 8434-4	27 [239]. Fitting screws in OSPM must not be turned during assembly of hoses
9/16-18 UNF, ISO 11926-1	30 [265]
M14 • 1.5, ISO 6149-1	30 [265]

Steering Components can withstand the tightening torques stated.

However, it is recommended to use torque levels stated by supplier of fittings, when those values are lower than stated above.

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