Service Manual
Steering Unit
Type OSPD V2
### Revision History

**Table of Revisions**

<table>
<thead>
<tr>
<th>Date</th>
<th>Changed</th>
<th>Rev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 2014</td>
<td>Torque value under assembly corrected</td>
<td>AB</td>
</tr>
<tr>
<td>Dec 2013</td>
<td>First version - DITA CMS</td>
<td>AA</td>
</tr>
</tbody>
</table>
## Contents

### Safety Precautions
- Safety Precautions

### Service Literature
- Symbols Used in Danfoss Literature
- OSPD Versions, Belonging Service Literature

### Exploded View and Seal Kit
- Exploded View, OSPD V2/OSPD New Design
- Seal Kit for OSPD

### Tools
- Tools

### Disassembly
- Disassembling OSPD V2

### Assembly
- Assembling OSPD V2

### Tightening Torques
- Tightening Torques for Connections OSDP V2
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 other body 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 units 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 unit and therefore they normally outlast the application they are built into. Therefore the only recommended service work on steering units is:

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

Symbols Used in Danfoss Literature

- Non removable part, use a new part
- Note correct orientation
- External hex head
- Mark orientation for reinstallation
- Internal hex head
- Torque specification
- Lubricate with hydraulic fluid
- Press in - press fit
- Inspect for wear or damage
- Pull out tool - press fit

OSPD Versions, Belonging Service Literature

This service literature is valid for OSPD V2/OSPD in new design only.

If the OSPD in question is in “old” or “V2/new” design can be traced by the product code:

- OSPD’s with product code number higher than 11113069 are all in “new” design
- OSPD’s with product code number 150xxxxx (e.g. 150G4051) and with product code lower than 11113069 are all in “old” design

The outside shape differs between OSPD in “old” and “V2/new” design:

OSPD old design

OSPD V2 / New Design

For further explanations between OSPD in “old” and “new” design, see Product Information Bulletin ST2013-068.

Service literature HN.21.ZA.52 is valid for OSPD in “old” version.
Exploded View and Seal Kit

Exploded View, OSPD V2/OSPD New Design

OSPD V2 Parts List

<table>
<thead>
<tr>
<th>Parts list</th>
<th>Num. per unit</th>
<th>Item</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust seal ring</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Housing &amp; spool/sleeve</td>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Ball Ø8.5 mm</td>
<td>1</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Threaded bushing</td>
<td>1</td>
<td>4</td>
<td>Screw below surface of housing</td>
</tr>
<tr>
<td>Shaft seal</td>
<td>1</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Bearing assembly</td>
<td>1</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Ring</td>
<td>1</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Cross pin</td>
<td>1</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>Set of springs</td>
<td>1</td>
<td>12</td>
<td>-</td>
</tr>
</tbody>
</table>
### Exploded View and Seal Kit

**OSPD V2 Parts List (continued)**

<table>
<thead>
<tr>
<th>Parts list</th>
<th>Num. per unit</th>
<th>Item</th>
<th>Toughening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardan shaft</td>
<td>1</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>Distributor plate</td>
<td>3</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>Gearwheel set (GWS1)</td>
<td>1</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>Gearwheel set (GWS2)</td>
<td>1</td>
<td>17a</td>
<td>-</td>
</tr>
<tr>
<td>O-ring ø79.4 x ø2.0 mm</td>
<td>7</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>End cover</td>
<td>1</td>
<td>19</td>
<td>-</td>
</tr>
<tr>
<td>Washer</td>
<td>7</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Screw</td>
<td>1</td>
<td>21</td>
<td>30±6 Nm</td>
</tr>
<tr>
<td>Pin bolt screw</td>
<td>1</td>
<td>22</td>
<td>30±6 Nm</td>
</tr>
<tr>
<td>Screw</td>
<td>5</td>
<td>23</td>
<td>30±6 Nm</td>
</tr>
<tr>
<td>Model/Code label</td>
<td>1</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>Adjusting screw for shock valve</td>
<td>2</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>Spring with thrust pad for shock valve</td>
<td>2</td>
<td>26</td>
<td>-</td>
</tr>
<tr>
<td>Ball ø3/16 in for shock valve</td>
<td>2</td>
<td>27</td>
<td>-</td>
</tr>
<tr>
<td>Seat for shock valve</td>
<td>2</td>
<td>28</td>
<td>6+0/-1 Nm</td>
</tr>
<tr>
<td>Adjusting screw for relief valve</td>
<td>1</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Spring for relief valve</td>
<td>1</td>
<td>31</td>
<td>-</td>
</tr>
<tr>
<td>Piston for relief valve</td>
<td>1</td>
<td>32</td>
<td>-</td>
</tr>
<tr>
<td>Ball Ø3/16 in for suction valve</td>
<td>2</td>
<td>33</td>
<td>-</td>
</tr>
<tr>
<td>Bushing with pin for suction valve</td>
<td>2</td>
<td>34</td>
<td>-</td>
</tr>
<tr>
<td>Ball stop, threaded for LS check</td>
<td>1</td>
<td>35</td>
<td>1±0.1 Nm</td>
</tr>
<tr>
<td>Ball Ø3.0 mm for LS check</td>
<td>1</td>
<td>36</td>
<td>-</td>
</tr>
<tr>
<td>Check valve</td>
<td>1</td>
<td>37</td>
<td>25±5 Nm</td>
</tr>
<tr>
<td>O-ring ø9.0 x ø1.5 mm</td>
<td>2</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>O-ring ø6.0 x ø1.5 mm</td>
<td>2</td>
<td>41</td>
<td>-</td>
</tr>
<tr>
<td>Plug</td>
<td>1</td>
<td>42</td>
<td>-</td>
</tr>
<tr>
<td>O-ring ø14.3 x ø2.4 mm</td>
<td>1</td>
<td>43</td>
<td>-</td>
</tr>
<tr>
<td>Cardan shaft</td>
<td>1</td>
<td>51</td>
<td>-</td>
</tr>
<tr>
<td>Valve housing assembly</td>
<td>1</td>
<td>54</td>
<td>Do not disassembly</td>
</tr>
<tr>
<td>Spacer (present if GWS1 &gt;/= 100 cm³)</td>
<td>1</td>
<td>56</td>
<td>-</td>
</tr>
</tbody>
</table>

**Seal Kit for OSPD**

Seal kit, Danfoss code 150N4041 is valid for all OSPD’s, both in “old” and in “new” design.

<table>
<thead>
<tr>
<th>Parts list for 150N4041</th>
<th>Number per spare part kit</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust seal ring</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Shaft seal</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>O-ring</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Washer</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>O-ring</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Plug</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td>O-ring</td>
<td>1</td>
<td>43</td>
</tr>
</tbody>
</table>
Tools

Holding tool for the entire steering unit.
Material: Appropriate metal or hard plastic.
This tool is not available from Danfoss.

Assembly tool for dust seal.
Material: Free cutting steel.
This tool is not available from Danfoss.

Assembly tool for shaft seal, O-ring/Roto Glyd type:
Code number: 11092408.
Tools (continued)

- Torque wrench 0 - 70 Nm.
- 13 mm socket spanner.
- 2.75 - 5 and 6 mm Allan key.
- 12 mm screwdriver.
- 2 mm screwdriver.
- 13 mm ring spanner.
- Plastic hammer.
- Tweezers.

These tools are not available from Danfoss.
### Disassembly

#### Disassembling OSPD V2

**Disassembly**

Place the unit in the holding tool on gear set end. Screw out the adjusting screws for shock valves (25). O-ring (40) is fitted on adjusting screw (25).

Remove the springs with trust pads for shock valves (26).

Remove the balls for shock valves (27).
Disassembly (continued)

- Screw out the seats for shock valves (28). O-ring (41) is fitted on seat (28).

- Remove the plastic plug (42).

- Screw out the adjusting screw for relief valve (30). O-ring (43) is fitted on adjusting screw (30).

- Remove the spring for relief valve (31).
Disassembly (continued)

Remove the piston for relief valve (32).

Replace the unit in the holding tool on steering column end.

Remove the screws (21, 22 and 23) with washers (20). Some versions have pin bolt screw (22), threaded bushing (4) and 5 pieces standard screws (23) as shown on exploded view page 5. Other versions (like this taken apart) has threaded bushing with ball stop (4) and 6 pieces standard screws (23). All versions have one piece short standard screw (21). Screw (21) is threaded in valve housing (54).

Remove the end cover (19), sideways.

Lift the gearwheel set (17a) off the unit. Remove the two O-rings (18).
Disassembly (continued)

Remove the rear distributor plate (16).

Remove valve housing assembly (54).
Remove the two O-rings (18).
Do not dismantle the entire valve (54)

Remove the middle distributor plate (16).

Remove the cardan shaft (51).
Disassembly (continued)

Remove spacer (56) if present.
Spacer is only present in OSPD with GSW1 (17) equal to 100 cm$^3$/rev or larger/height 13.0 mm or larger.

Lift the gearwheel set (17) off the unit. Remove the two O-rings (18).

Remove the cardan shaft (13).

Remove the distributor plate (16) from the housing.
Disassembly (continued)

Remove the threaded bushing/ball stop (4) from housing.

Remove the ball stop (35) from housing. Ball stop (35), and belonging ball (36) is only present in OSPD LS with check valve in LS line.

Remove the O-ring (18) from housing.

Shake out the check valve ball (3), suction valve pins (34), balls (33) and ball (36).
Disassembly (continued)

Place the housing with the ports facing down on the work bench. Ensure that the cross pin (11) in the spool and sleeve set (2) is in the horizontal position. The pin (11) can be observed through the open end of the spool.

Press the spool (2) inwards (from the housing mounting face end) and the sleeve (2), ring (7) and bearing assembly (6) will be pushed out of the housing together.

Take the ring (10), bearing races and needle bearing (7) from the spool and sleeve set (2). The outer bearing (7) race can sometimes “stick” in the housing, therefore check that it has come out.

Press out the cross pin (11).

Carefully press the spool out of the sleeve.
Disassembly

Disassembly (continued)

Press the neutral position springs (12) out of the slot of the spool.

Remove dust seal (1) and shaft seal (Roto Glyd) (5) carefully with a screwdriver or similar tool.

The steering unit OSPD is now completely dismantled.

Cleaning
Clean all parts carefully in Shellsol K or similar cleaner fluid.

Inspection and Replacement
Replace all seals and washers. Check all parts carefully and make any replacements as is necessary.
Assembling OSPD V2

Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into place.

Configuration of spring set (12). There can be different numbers of curved springs depending on configuration of spring set. There can be 2, 4 or 6 curved springs.

OSPD LSR
Spool and sleeve must be positioned correctly relatively to each other. Small marks are present on both spool and sleeve close to one of the slots for the spring set.

Guide the spool into the sleeve (2). If the spool and sleeve has marks as shown above, these must be placed on same side. Make sure the centering springs (12) are placed into the slot.
Assembly

Assembling OSPD V2 (continued)

Line up the spring set (12).

Guide the ring (10) down over the sleeve.
The ring should be able to move free of the springs.

Fit the cross pin (11) into the spool/sleeve.

Fit bearing races and needle bearing (7) as shown on the next drawing.
Assembling OSPD V2 (continued)

**Caution**
Assembly pattern for standard bearing
1. Outer bearing race
2. Needle bearing
3. Inner bearing race
4. Spool
5. Sleeve

*The inside chamfer on the inner bearing race must face the chest of the inner spool.

Place the steering unit housing with the port face down on the work bench. Guide the outer part of the assembly tool into the bore for the spool/sleeve set (2).

Grease the shaft seal (Roto Glyd, 5) with hydraulic oil and place them on the tool. Ensure that the Roto Glyd seal is placed on the insertion tool as per the photograph.
Assembly

Assembling OSPD V2 (continued)

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.

Press and turn the shaft seal (5) into position in the housing.

Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.

With a light turning movement, guide the spool and sleeve into the bore.

Fit the spool set holding the cross pin (11) horizontal.
Assembling OSPD V2 (continued)

The spool set will push out the assembly tool guide. The shaft seal (5) is now installed.

Place the steering unit housing on the holding tool on the steering column end. Put the check valve ball (3) into the hole indicated by the circle.

Screw the threaded bushing/ball stop (4) lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.

Put the check valve ball (36) into the hole indicated by the circle. Ball (36) is only present in OSPD LS with check valve in LS line.
Assembling OSPD V2 (continued)

Screw the ball stop (35) into the LS check valve bore. 1 +/-0.1 Nm [8.85 +/- 0.885 lbf.in].

Place a ball (33) in the two bolt holes indicated by the circles.

Place the pins (34) in the same two bolt holes.

Insert the o-ring (18) in the groove on the housing.
Assembling OSPD V2 (continued)

Place the distributor plate (16) so that the channel holes match the holes in the housing.

Guide the cardan shaft (13) down into the bore so that the slot is parallel with the connection flange ports and lines up with the cross pin (11).

Place the 2 o-rings (18) in the two groves in the gear rim. Fit the gearwheel and rim (17) on the cardan shaft (13). 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 OSPD V2 has timing securing; splines of gear wheel and cardan shaft can only be assembled with correct timing.

Place the spacer (56) if present. Spacer is only present in OSPD with GSW1 (17) equal to or larger than 100 cm³.
Assembling OSPD V2 (continued)

Place and rotate the cardan shaft (51) with the big diameter end until it moves in gear with gear wheel of gear set (17).

Place the middle distributor plate (16) so that the channel holes match the holes in the gear set.

Place the 2 o-rings (18) in the two groves in the valve housing assembly (54).
Place the valve housing assembly so that the one and only M8 thread whole points upwards and direction port face.
Make sure that channel holes match the holes in the distributor plate (16).
Assembling OSPD V2 (continued)

Place the rear distributor plate (16) so that the channel holes match the holes in valve housing assembly (54).

Place the 2 o-rings (18) in the two groves in the gear rim. Fit the gearwheel and rim (17a) on the cardan shaft (51). 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 OSPD V2 has timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.

Place the end cover (19) in position. Ensure that the bar codes and writing are parallel with port face.

Fit the short screw (22) with new washer (20) and place it in the hole shown.
Fit the six screws (23) with new washers (20) and insert them. In case the unit has pin bolt screw, this must be inserted where the circle is marked. Cross-tighten all the screws (22 and 23) with a torque of $30 \pm 6$ Nm [265.5 \pm 53 lbf•in]. Replace the unit in the holding tool on gear set end. The OSPD V2 can now be function tested manually: it must be possible to rotate input shaft with torque < 3.5 Nm [31.0 lbf•in].

Install the piston (32) to housing.

Install the spring (31) on top of the piston (32).

Place o-ring (43) on adjusting screw (30). Screw in the adjustment screw (30) with a 6 mm Allan key. Make the pressure setting on a test panel according to valve setting specification. Insert plastic protection plug (42) to the adjustment screw (30).
Assembling OSPD V2 (continued)

Place o-ring (41) on the shock valve seats (28). Screw in the seats (28) with a 2.75 mm Allan key into the cavities indicated by the circles.

Torque $6\pm1$ Nm [53.1 +/- 8.85 lbf-in].

Place one ball (27) in each of the shock valve cavities.

Place springs with trust pads (26) over the two balls.

Place o-rings (40) on adjusting screws (25). Screw in the two adjusting screws (25) using a 5 mm Allan key.

Make the pressure setting on a test panel according to valve setting specification.

Make test for external leakage:
Assembly

Assembling OSPD V2 (continued)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug all ports, established 35 bar, hydraulic pressure on T and check the unit is completely leak free.</td>
<td></td>
</tr>
<tr>
<td>Place the dust seal ring (1) in the housing.</td>
<td></td>
</tr>
<tr>
<td>Fit the dust seal ring in the housing using <strong>special tool for dust seal assembly</strong> and a plastic hammer.</td>
<td></td>
</tr>
<tr>
<td>Screw in the plastic plugs into the connection ports to keep the ports clean during storage and transportation.</td>
<td></td>
</tr>
</tbody>
</table>
## Tightening Torques for Connections OSDP V2

<table>
<thead>
<tr>
<th>Connections</th>
<th>Max. tightening torque Nm [lbf.in]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With cutting edge</td>
</tr>
<tr>
<td>G 1/4</td>
<td>35 [309]</td>
</tr>
<tr>
<td>G 3/8</td>
<td>70 [619]</td>
</tr>
<tr>
<td>G 1/2</td>
<td>100 [885]</td>
</tr>
<tr>
<td>G 3/4</td>
<td>180 [1593]</td>
</tr>
<tr>
<td>7/16-20 UNF</td>
<td>-</td>
</tr>
<tr>
<td>3/4-16 UNF</td>
<td>-</td>
</tr>
<tr>
<td>7/8-14 UNF</td>
<td>-</td>
</tr>
<tr>
<td>1 1/16-12 UNF</td>
<td>-</td>
</tr>
<tr>
<td>M12 • 1.5</td>
<td>30 [265]</td>
</tr>
<tr>
<td>M18 • 1.5</td>
<td>80 [708]</td>
</tr>
<tr>
<td>M22 • 1.5</td>
<td>100 [885]</td>
</tr>
<tr>
<td>9/16 - 18 UNF, ORFS</td>
<td>-</td>
</tr>
<tr>
<td>1 1/16 - 16 UN, ORFS</td>
<td>-</td>
</tr>
</tbody>
</table>
Danfoss Power Solutions is a global manufacturer and supplier of high-quality hydraulic and electronic components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway market. Building on our extensive applications expertise, we work closely with our customers to ensure exceptional performance for a broad range of off-highway vehicles.

We help OEMs around the world speed up system development, reduce costs and bring vehicles to market faster.

Danfoss – Your Strongest Partner in Mobile Hydraulics.

Go to www.powersolutions.danfoss.com for further product information.

Wherever off-highway vehicles are at work, so is Danfoss.

We offer expert worldwide support for our customers, ensuring the best possible solutions for outstanding performance. And with an extensive network of Global Service Partners, we also provide comprehensive global service for all of our components.

Please contact the Danfoss Power Solution representative nearest you.

Products we offer:
- Bent Axis Motors
- Closed Circuit Axial Piston Pumps and Motors
- Displays
- Electrohydraulic Power Steering
- Electrohydraulics
- Hydraulic Power Steering
- Integrated Systems
- Joysticks and Control Handles
- Microcontrollers and Software
- Open Circuit Axial Piston Pumps
- Orbital Motors
- PLUS+1® GUIDE
- Proportional Valves
- Sensors
- Steering
- Transit Mixer Drives

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed.

All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.

Danfoss Power Solutions US Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000

Danfoss Power Solutions GmbH & Co. OHG
Krokamp 35
D-24539 Neumünster, Germany
Phone: +49 4321 871 0

Danfoss Power Solutions ApS
Nordborgvej 81
DK-6430 Nordborg, Denmark
Phone: +45 7488 2222

Danfoss Power Solutions (Shanghai) Co. Ltd.
Building #22, No. 1000 Jin Hai Rd
Jin Qiao, Pudong New District
Shanghai, China 201206
Phone: +86 21 3418 5200

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed.

All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.