ENGINEERING
TOMORROW

Service Manual

Steering Unit
OSPU

powersolutions.danfoss.com

Revision history

Table of revisions

Date	Changed	Rev
April 2017	Updated LS copy valve	0102
September 2014	First edition	AA

Contents

Safety

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 vehicle or machine movement hazard.

Unintended movement of the machine or mechanism may cause injury to the technican or bystanders. To prevent uintended 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.

Symbols

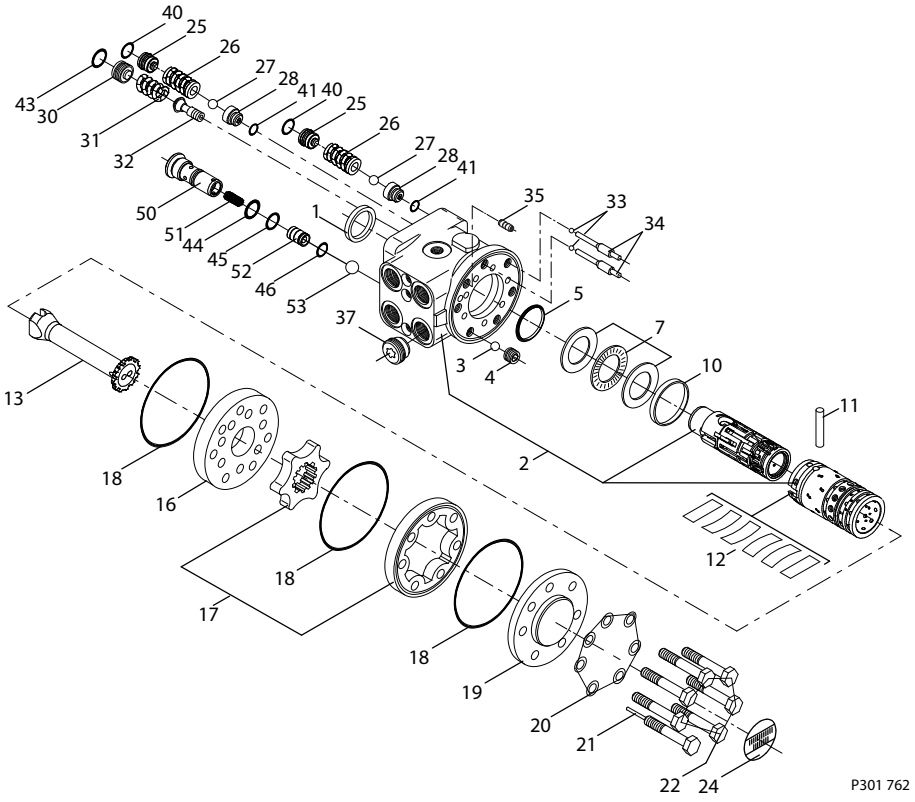
Symbols used in Danfoss Literature

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

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

Exploded view and seal kit

OSPU exploded view



OSPU parts list

OSPU parts list

Parts list	Num. per unit	Item	Tigtening torque
Dust seal ring	1	1	-
Housing & spool/sleeve set	1	2	-
Ball Ø8.5 mm	1	3	-
Threaded bushing (Screw below surface of housing)	1	4	-
Shaft seal	1	5	-
Bearing assembly	1	7	-
Ring	1	10	-
Cross pin	1	11	-
Set of springs	1	12	-
Cardan shaft	1	13	-
Distributor plate	1	16	-
Gearwheel set	1	17	-
O-ring ø79.4 x ø2.0 mm	3	18	-
End cover	1	19	-
Washer	7	20	-

Exploded view and seal kit

OSPU parts list (continued)

Parts list	Num. per unit	Item	Tigtening torque
Pin bolt screw	1	21	30±6 N•m
Screw	6	22	30±6 N•m
Model/Code label	1	24	-
Adjusting screw for shock valve	2	25	-
Spring with thrust pad for shock valve	2	26	-
Ball ø3/16 in for shock valve	2	27	-
Seat for shock valve	2	28	6+0/-1 N•m
Adjusting screw for relief valve	1	30	-
Spring for relief valve	1	31	-
Piston for relief valve	1	32	-
Ball Ø3/16 in for suction valve	2	33	-
Bushing with pin for suction valve	2	34	-
LS copy valve	1	35	-
Check valve	1	37	25±5 N•m
O-ring ø9.0 x ø1.5 mm	2	40	-
O-ring ø6.0 x ø1.5 mm	2	41	-
O-ring ø12.42 x ø1.78 mm	1	43	-
O-ring ø15.3 x ø2.2 mm	1	44	-
O-ring ø12.5 x ø1.8 mm	1	45	-
O-ring ø9.5 x ø1.0 mm	1	46	-
Torque compensator valve plug	1	50	-
Torque compensator valve spring	1	51	-
Torque compensator valve spool	1	52	-
Torque compensator valve ball, Ø13.0 mm	1	53	-

Seal kit for OSPU

Seal kit, Danfoss code 11140740 is valid for all codes of OSPU's.

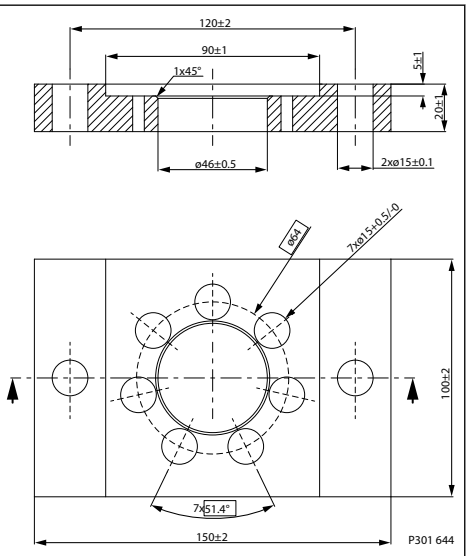
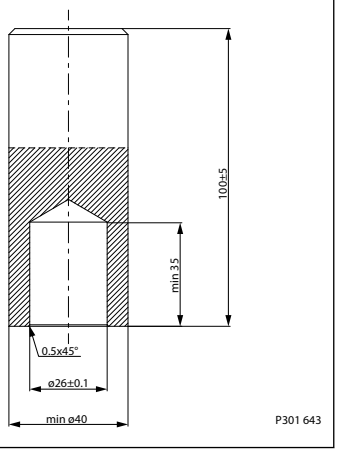
Spare part kit for OSPU, code no. 11140740

Parts list	Number per spare part kit	Item
Dust seal ring	1	1
Shaft seal	1	5
O-ring	3	18
Washer	7	20
O-ring	2	40
O-ring	2	41
O-ring	1	43
O-ring	1	44
O-ring	1	45
O-ring	1	46

Tools

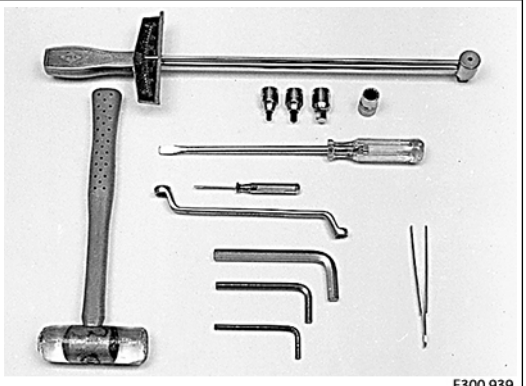
Tools for OSPU

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.	

Tools

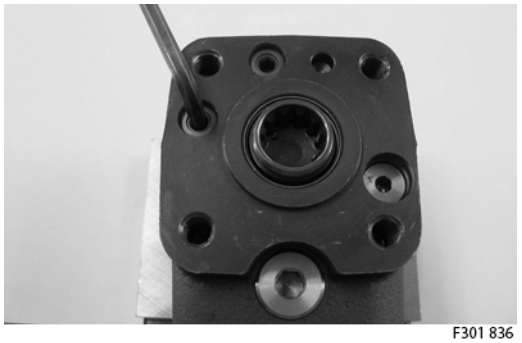
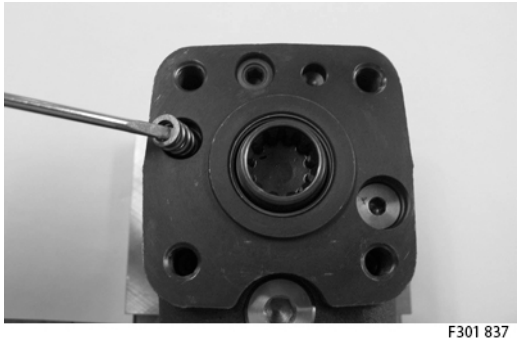
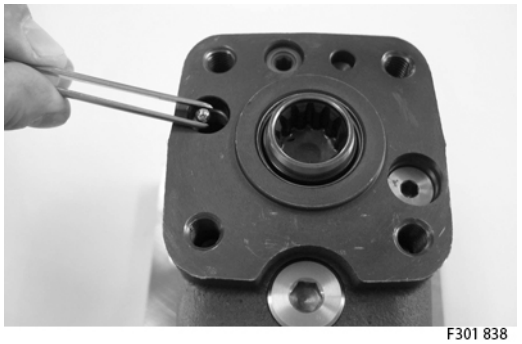
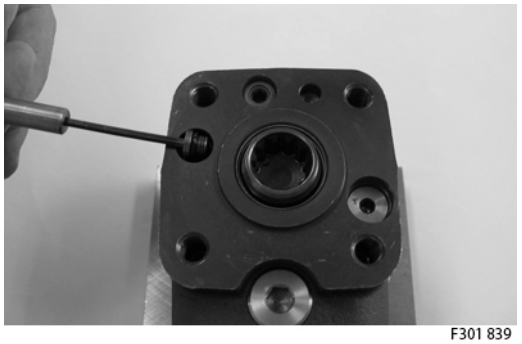
Tools (continued)

Assembly tool for shaft seal, O-ring/Roto Glyd type: Code number: 11092408.	 F301 732
Torque wrench 0 - 70 N•m. 13 mm socket spanner. 2.75 - 5 and 8 mm Allan key. 12 mm screwdriver. 2 mm screwdriver. 13 mm ring spanner. Plastic hammer. Tweezers. These tools are not available from Danfoss.	 F300 939

Dismantling

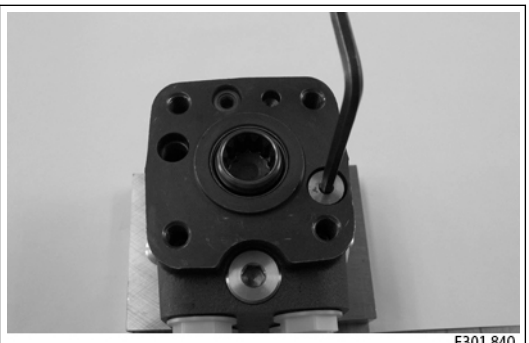
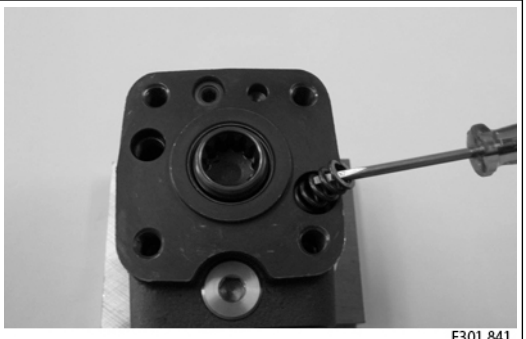
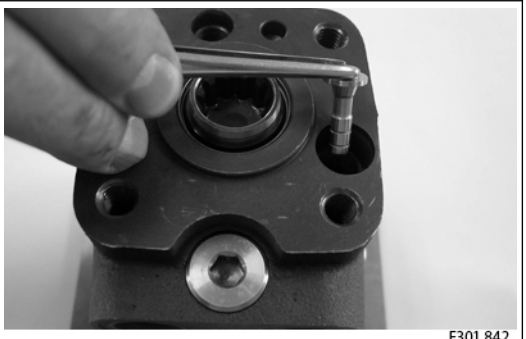
Dismantling OSPU

Dismantling OSPU

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).	 F301 836
Remove the springs with trust pads for shock valves (26).	 F301 837
Remove the balls for shock valves (27).	 F301 838
Screw out the seats for shock valves (28). O-ring (41) is fitted on seat (28).	 F301 839

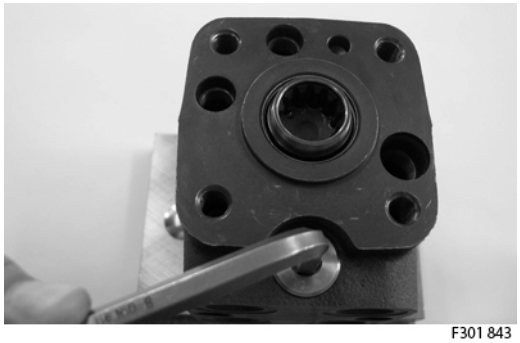
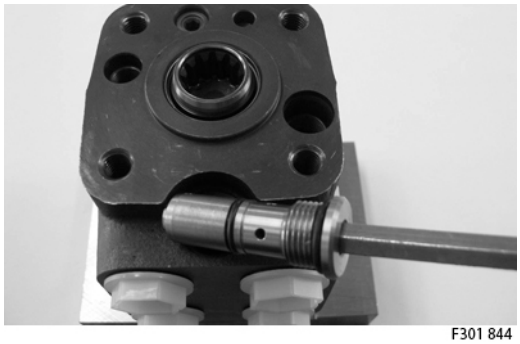
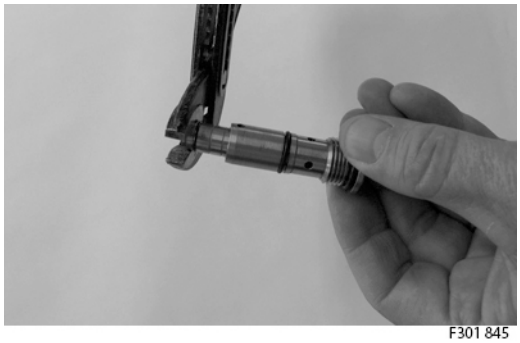
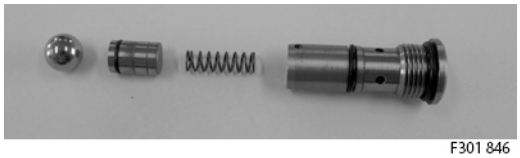
Dismantling

Dismantling OSPU (continued)

Screw out the adjusting screw for relief valve (30). O-ring (43) is fitted on adjusting screw (30).	 F301 840
Remove the spring for relief valve (31).	 F301 841
Remove the piston for relief valve (32).	 F301 842

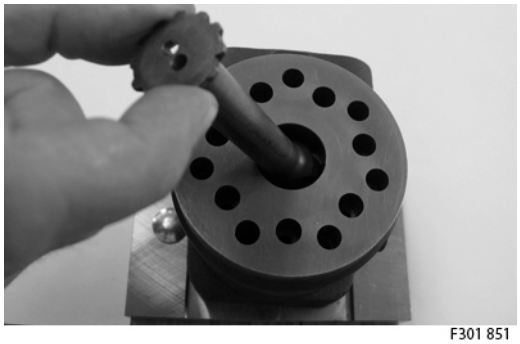
Dismantling

Dismantling OSPU (continued)

Screw out the plug for the torque compensator valve (50). Spring (51), spool (52) and O-rings (44, 45 and 46) is fitted to the plug (50).	 F301 843  F301 844
Remove the spool (52) and spring (51) from the plug (50).	 F301 845  F301 846
Remove the ball (53) from housing.	 F301 847
Replace the unit in the holding tool on steering column end.	

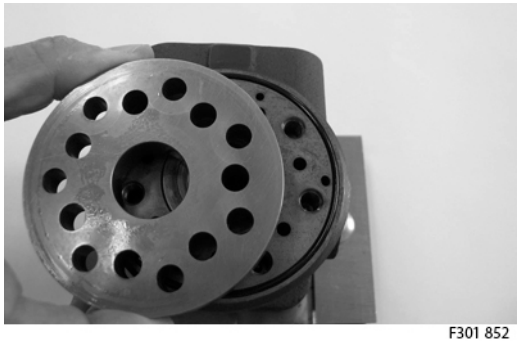
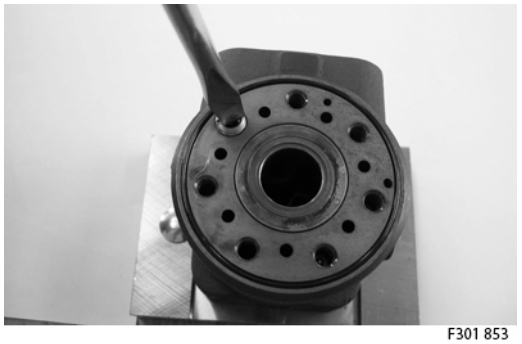
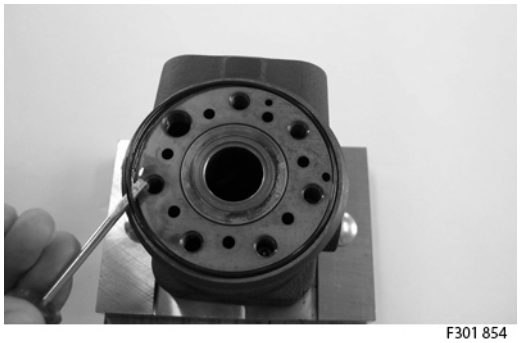
Dismantling

Dismantling OSPU (continued)

Remove the screws (21 and 22) with washers (20).	 F301 848
Remove the end cover (19), sideways.	 F301 849
Lift the gearwheel set (17) off the unit. Remove the two O-rings (18).	 F301 850
Remove the cardan shaft (13).	 F301 851

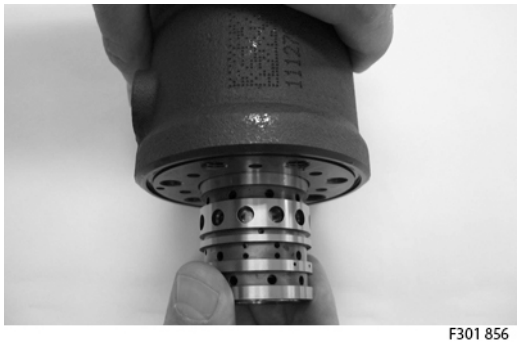
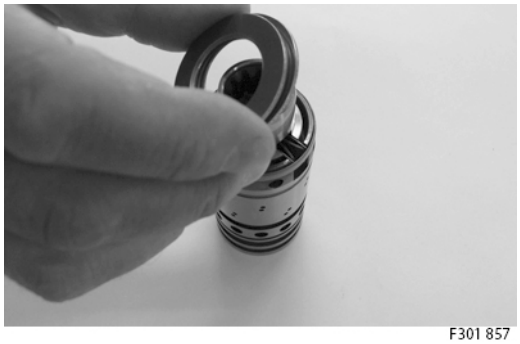
Dismantling

Dismantling OSPU (continued)

Remove the distributor plate (16).	 F301 852
Remove the threaded bushing (4) from housing.	 F301 853
Remove the O-ring (18) from housing.	 F301 854
Shake out the check valve ball (3), suction valve pins (34), balls (33) and LS copy valve (35).	 F301 855

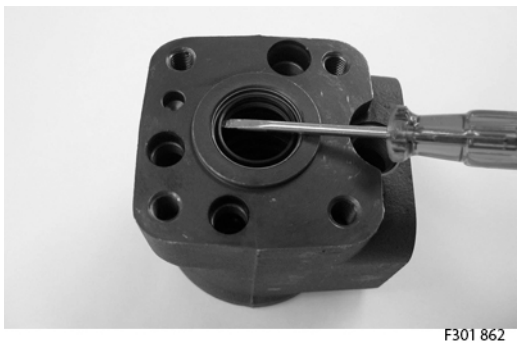
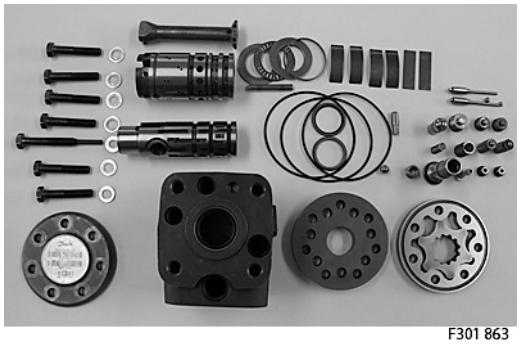
Dismantling

Dismantling OSPU (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.	 F301 856
Take 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.	 F301 857
Press out the cross pin (11).	 F301 858
Remove the ring (10).	 F301 859

Dismantling

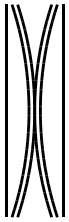
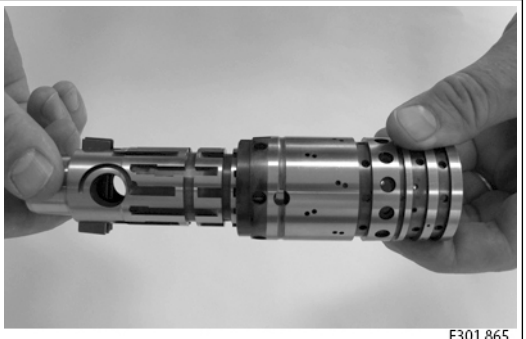
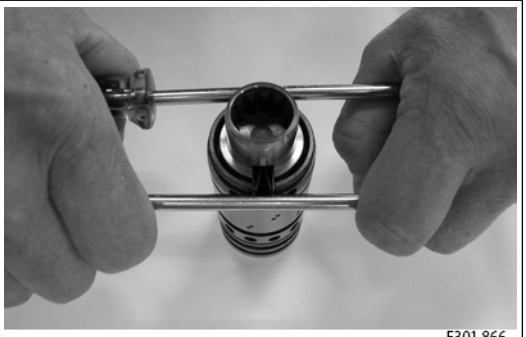
Dismantling OSPU (continued)

Carefully press the spool out of the sleeve.	 F301 860
Press the neutral position springs (12) out of the slot of the spool.	 F301 861
Remove dust seal (1) and shaft seal (Roto Glyd) (5) carefully with a screw driver or similar tool.	 F301 862
The steering unit OSPU is now completely dismantled.	 F301 863
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

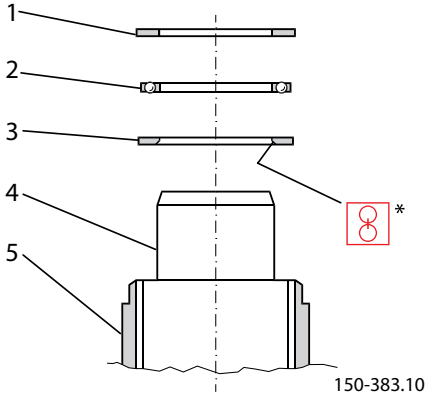
Assembling OSPU

Assembling

Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into place.	 F301 864
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.	 150-386.10
OSPU Spool and sleeve can be positioned relatively to each other in 2 positions. Both positions possible are valid due to symmetry of the OSPU spool/sleeve sets.	
Guide the spool into the sleeve (2). Make sure the centering springs (12) are placed into the slot.	 F301 865
Line up the spring set (12).	 F301 866

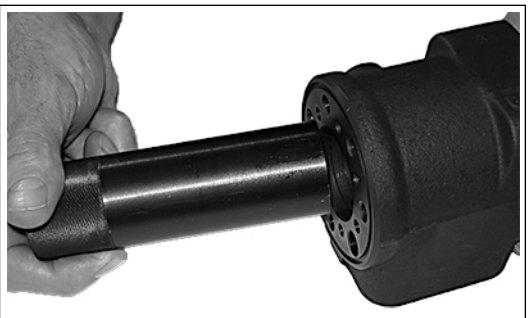
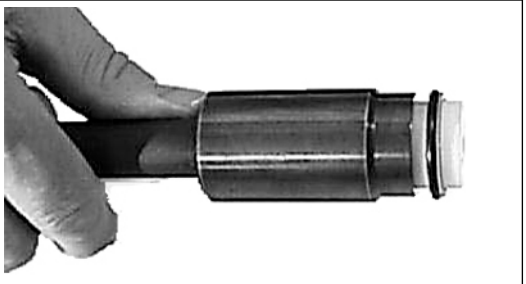
Assembling

Assembling (continued)

Guide the ring (10) down over the sleeve. The ring should be able to move free of the springs.	 F301 867
Fit the cross pin (11) into the spool/sleeve.	 F301 868
Fit bearing races and needle bearing (7) as shown on the drawing below.	 F301 869
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.	 1 2 3 4 5 * 150-383.10

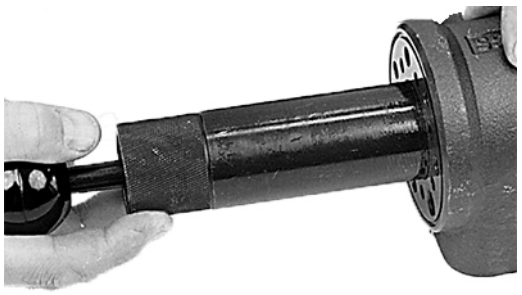
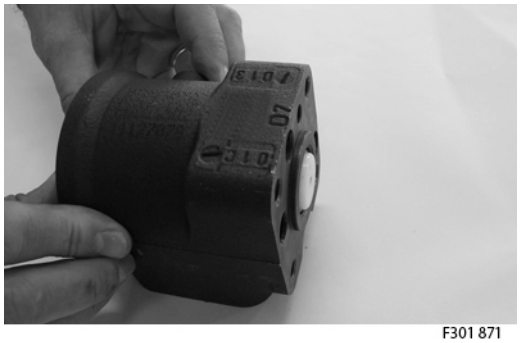
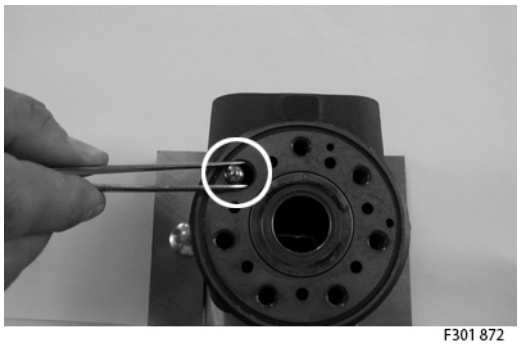
Assembling

Assembling (continued)

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).	 F301 703
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.	 F300 985
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.	 F300 986
Press and turn the shaft seal (5) into position in the housing.	 F301 987

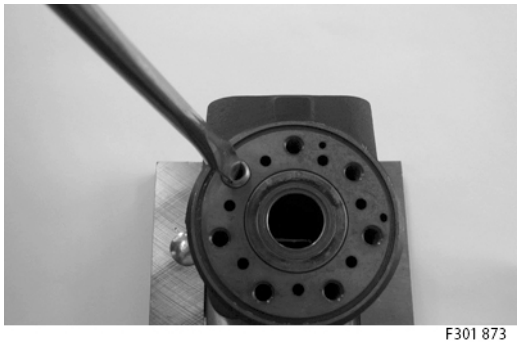
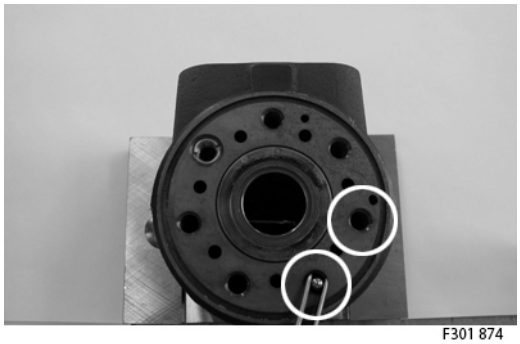
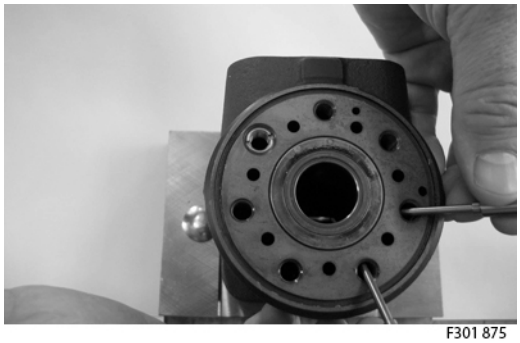
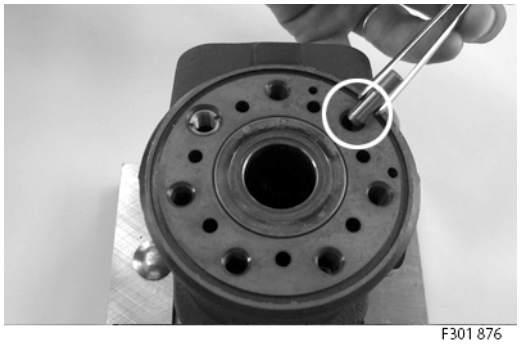
Assembling

Assembling (continued)

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.	 F301 988
With a light turning movement, guide the spool and sleeve into the bore. Fit the spool set holding the cross pin (11) horizontal.	 F301 870
The spool set will push out the assembly tool guide. The shaft seal (5) are now installed.	 F301 871
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.	 F301 872

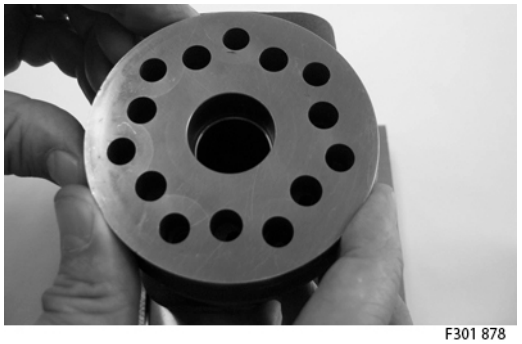
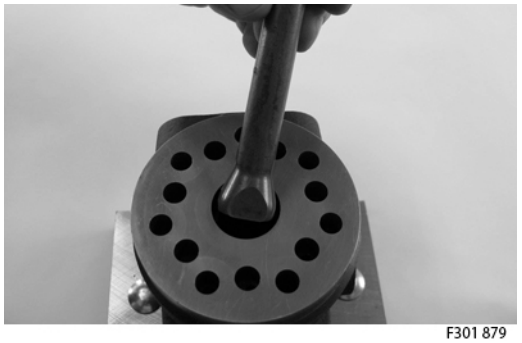
Assembling

Assembling (continued)

Screw the threaded bushing (4) lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.	 F301 873
Place a ball (33) in the two bolt holes indicated by the circles.	 F301 874
Place the pins (34) in the same two bolt holes.	 F301 875
Place the LS copy valve (35) into the hole indicated by the circle. The conical end must point downwards.	 F301 876

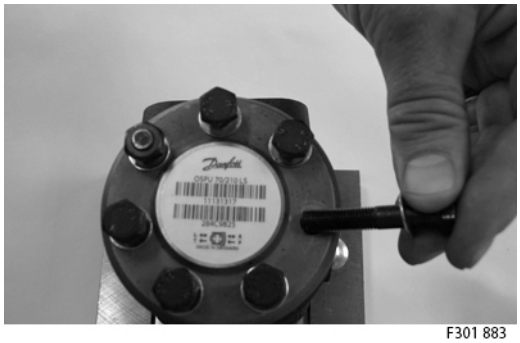
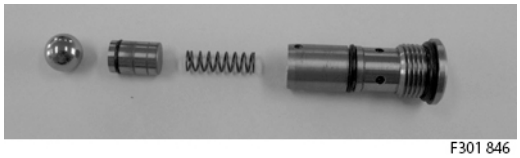
Assembling

Assembling (continued)

Insert the o-ring (18) in the grove on the housing.	 F301 877
Place the distributor plate (16) so that the channel holes match the holes in the housing.	 F301 878
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).	 F301 879
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 OSPU has timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.	 F301 880

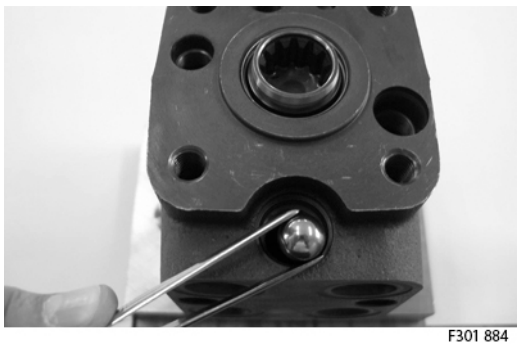
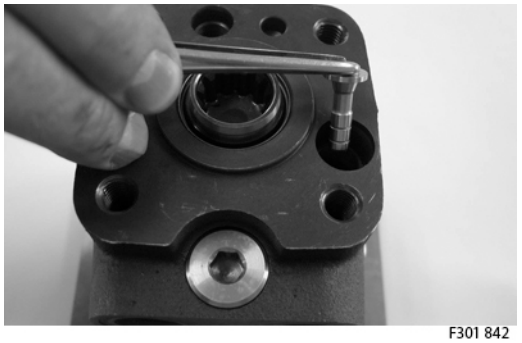
Assembling

Assembling (continued)

Place the end cover (19) in position. Ensure that the bar codes and writing are parallel with port face.	 F301 881
Fit the pin bolt screw (21) with washer (20) and place it in the hole shown.	 F301 882
Fit the six screws (22) with new washers (20) and insert them. Cross-tighten all the screws (22 and 23) with a torque of 30 ±-6 N•m [265.5 ± 53 lbf•in].	 F301 883
Replace the unit in the holding tool on gear set end.	
The OSPU can now be function tested manually: it must be possible to rotate input shaft with torque < 3.5 N•m [31 lbf•in].	
Assemble the torque compensator valve: new O-rings (46) in spool (52), (44 and 45) on plug (50), spring (51) and spool (52) to be pressed into plug (50).	 F301 846

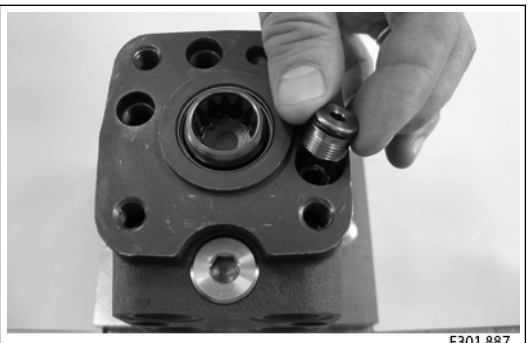
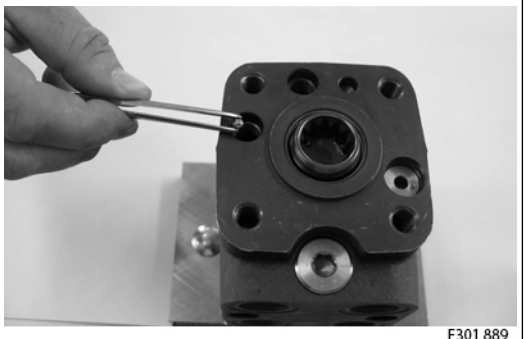
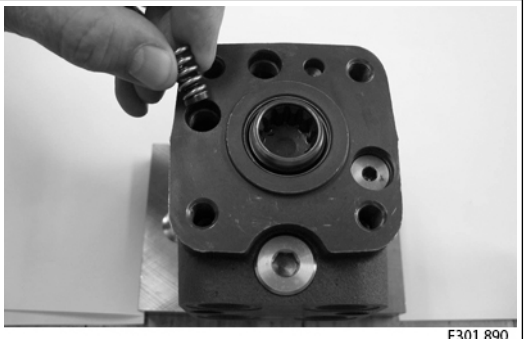
Assembling

Assembling (continued)

Install the ball (53) in the housing.	 F301 884
Screw in the entire torque compensator plug w. parts (50) with an 8 mm Allan key into the cavity indicated by the arrow. Torque 30 +10/-0 N•m [265 +88/-0 lbf•in].	 F301 885
Install the piston (32) to housing.	 F301 842
Install the spring (31) on top of the piston (32).	 F301 886

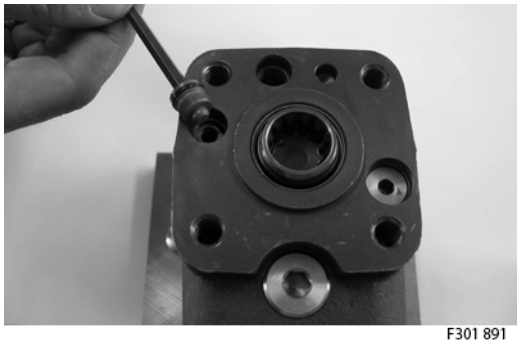
Assembling

Assembling (continued)

Place o-ring (43) on adjusting screw (30). Screw in the adjustment screw (30) with an 5 mm Allan key. Make the pressure setting on a test panel according to valve setting specification.	 F301 887
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 ±1 N•m [53 ±9 lbf•in].	 F301 888
Place one ball (27) in each of the shock valve cavities.	 F301 889
Place springs with trust pads (26) over the two balls.	 F301 890

Assembling

Assembling (continued)

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.	 F301 891
Place the dust seal ring (1) in the housing.	 F301 729
Fit the dust seal ring in the housing using special tool for dust seal assembly (see page 7) and a plastic hammer.	 F301 730
Screw in the plastic plugs into the connection ports to keep the ports clean during storage and transportation.	 F301 892

Tightening torques for connections

Tightening torques

Connections	Recommended tightening torque N•m [lbf•in]			
	With cutting edge	With copper washer	With alum. washer	O-ring
G 1/4	35 [309]	35 [309]	35 [309]	-
G 3/8	70 [619]	45 [398]	50 [442]	-
G 1/2	100 [885]	55 [486]	80 [708]	-
G 3/4	180 [1593]	90 [796]	130 [1150]	-
7/16-20 UNF	-	-	-	20 [177]
3/4-16 UNF	-	-	-	60 [531]
7/8-14 UNF	-	-	-	90 [796]
1 1/16-12 UN	-	-	-	120 [1062]
M12 • 1.5	30 [265]	20 [177]	30 [265]	25 [221]
M18 • 1.5	80 [708]	55 [486]	70 [619]	50 [442]
M22 • 1.5	100 [885]	65 [575]	80 [708]	60 [531]
9/16 - 18 UNF, ORFS	-	-	-	25 [221]
11/16 - 16 UN, ORFS	-	-	-	27 [239]

Danfoss Steering Components can withstand the tightening torques stated. However it is recommended to use torque levels stated by supplier of fittings.

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