

Technical Information

Steering

VSP and VSPP Steering Units



Revision history

Table of revisions

Date	Changed	Rev
May 2019	First edition	0101

Contents

Overview

A wide range of steering components.....	4
Conversion factors.....	5
Survey of literature with technical data on Danfoss steering components.....	5

Steering unit type VSP and VSPP

General.....	6
--------------	---

Steering unit type VSP

Versions.....	7
VSP.....	7
VSP versions, overview.....	8
VSP circuits.....	9
Technical data, VSP ON/OR.....	11
Displacement, flow, and pressure.....	11
Valve functions.....	12
Pressure relief valve.....	13
Pressure drop in neutral.....	14
Technical data, VSP LS/LSR.....	15
Displacement, flow, and pressure.....	15
Valve functions.....	16
Pilot pressure relief valve; (P-T, Qp) characteristic.....	17
Check valve function in LS.....	17
Technical data, common all VSP types.....	18
Shock valves.....	18
Suction valves.....	18
Check valve in P.....	19
Weights.....	19
Port thread versions.....	20
Dimensions.....	21
VSP.....	21

Steering unit type VSPP

Versions.....	23
VSPP.....	23
VSPP versions, overview.....	24
VSPP circuits.....	25
Technical data, VSPP LS.....	26
Displacement, flow and pressure.....	26
Valve functions.....	27
Pilot pressure relief valve; (P-T, Qp) characteristic.....	28
Check valve function in LS.....	28
Pressure drop, P-EF.....	29
Shock valves.....	29
Suction valves.....	29
Check valve in P.....	29
Weights.....	30
Port thread versions.....	31
Dimensions.....	32
VSPP.....	32

VSP and VSPP: Variants and ordering specifications

VSP and VSPP MMC.....	34
Code numbers with catalog versions with specifications.....	34
Variants codes for VSP and VSPP MMC.....	35

Overview

A wide range of steering components



hfa1391605590092

Danfoss is one of the largest producers in the world of steering components for hydrostatic steering systems on off-road vehicles. Danfoss offers steering solutions both at component and system levels. Our product range makes it possible to cover applications of all types, ranging from ordinary 2 wheel steering (also known as Ackermann steering) to articulated steering, automatic steering (for example, by sensor) and remote controlled steering via satellite. We can offer more than 1,800 different steering units and 250 different priority valves categorized in types, variants and sizes.

For hydrostatic steering systems, Danfoss offers:

- Mini steering units with displacements from 32 to 100 cm³/rev [1.95 to 6.10 in³/rev], flow up to 20 l/min [5.28 US gal/min], steering pressure up to 140 bar [2030 psi].
- Steering units with displacements from 40 to 1200 cm³/rev [2.44 to 73.2 in³/rev], flow up to 100 l/min [26.4 US gal/min], steering pressure up to 240 bar [3481 psi].
- Priority valves for rated flows at 40, 80, 120, 160 and 320 l/min [10.6, 21.1, 31.7, 42.3 and 84.5 US gal/min], pressure up to 350 bar [5076 psi].
- Pilot operated flow-amplifiers with amplification factors of 4, 5, 8, 10 or 20 for rated oil flows of 240 and 400 l/min [63.4 and 105.7 US gal/min], steering pressure up to 240 bar [3480 psi].
- Pilot operated steering valve with steering flow up to 100 l/min [26.4 US gal/min], steering pressure up to 250 bar [3625 psi] and with integrated priority valve for pump flow up to 120 l/min [31.7 US gal/min].

For electrohydraulic steering systems Danfoss offers:

- Pilot operated steering valves (pilot operated by hydrostatic steering unit or by electrical signal) with steering flows up to 100 l/min [26.4 US gal/min], steering pressure up to 250 bar [3625 psi].
- Steering units with integrated electrical operated steering valve with steering flow up to 50 l/min [13.2 US gal/min], steering pressure up to 210 bar [3045 psi].
- Electrical operated steering valve with steering flow up to 70 l/min [18.5 US gal/min], steering pressure up to 210 bar [3045 psi].

Overview

Characteristic features for steering units:

- Low steering torque: From 0.5 N•m to 4 N•m in normal steering situations for VSP
- Low noise level
- Low pressure drop
- Many types available: Open center Non-reaction, Open center Reaction, Power Beyond, Closed center Non-reaction, Load Sensing, Load Sensing Reaction
- One or more built-in valve functions: relief valve, shock valves, suction valves, non-return valve in P-line and in LS-line
- Optional port connections (according to ISO, SAE or DIN standards)

Characteristic features for electrohydraulic steering systems with OSPE, EHPS, and EHi:

- Possibility of GPS, row sensor, variable steering ratio and joystick steering
- The possibility of manual steering even on very heavy vehicles
- EHPS: High steering pressure requiring smaller cylinders and flow
- EHPS: Low pilot pressure and flow giving extremely low noise in the cabin
- EHPS: Can be combined with Danfoss PVG 32 proportional valve

Conversion factors

- 1 N•m = [8.851 lbf•in]
- 1 N = [0.2248 lbf]
- 1 mm = [0.0394 in]
- 1 cm³ = [0.061 in³]
- 1 l = [0.264 US gal]
- 1 bar = [14.5 psi]
- °F = [1.8°C + 32]

Survey of literature with technical data on Danfoss steering components

Detailed data on all Danfoss steering components and accessories can be found in our steering component catalogues, which is divided into the following individual sub-catalogues:

General information	Steering components
Technical data on mini steering units	OSPM
Technical data on open center and closed center steering units	OSPB, OSPC, and OSPD
Technical data on load sensing steering units, priority valves and flow amplifiers	OSPB, OSPC, OSPF, OSPD, OSPL, OSPBX, OSPLX, OVPL, OLS, and OSQ
Technical data on load sensing steering unit with amplification	OSPU
Technical data on steering units	VSP and VSPP
Technical data on hydraulic and electrohydraulic pilot operated steering valves, electrical actuation modules and appropriate steering units	EHPS, EHPS w. OLS 320, PVE for EHPS and OSPCX
Technical data on combined steering unit/ electrohydraulic steering valves	OSPE
Technical data on electrohydraulic steering valves	EHi
Technical data on steering wheel sensors	SASA

For technical information on individual variants, please contact the Danfoss Sales Organization.

Steering unit type VSP and VSPP

General

The VSP steering unit program brings a competitive combination of attractive cost and good performance. Specifications are slightly lower than for other types of Danfoss steering units, however quality level of VSP's is on same high level as known from OSP steering products.

The VSPP is a steering unit with integrated priority valve inside the envelope of the standard VSP housing. This brings about a very compact solution minimizing installation space, cost and time.

All VSP and VSPP products are black painted as standard.

Steering unit type VSP

Versions



VSP

Two levels of specification are available:

- **Standard** for max steering pressure 170 bar [2466 psi].
- **High Spec.** for max steering pressure 190 bar [2756 psi].

Open Center

Open center steering units have open connection between pump and tank in the neutral position. In open center steering systems, pumps with fixed displacement are used.

VSP Open Center steering units are available with 2 different stages of spool/sleeve sets:

- Standard stage 2, typically to be used on machines without cabins
- Low Noise stage 3, recommended to be used on machines with cabins and/or demand for silent hydraulics.

Load Sensing

In load sensing steering systems both the steering system and the working hydraulic can be supplied from just one pump. In addition, LS steering systems make energy saving possible by the use of an LS pump.

Load sensing steering units have an extra connection for load sensing (LS) so that a load pressure signal can be directed via the steering unit to a Danfoss priority valve and/or an LS pump. The load sensing signal controls the oil flow from the priority valve (and/or the LS pump) to the steering unit. The LS connection is open to tank when the steering unit is in the neutral position.

VSP LS are all of load sensing dynamic type requiring dynamic type priority valves or variable displacement pumps with load sensing dynamic control. Load sensing dynamic steering systems have a constant oil flow in the LS connection in the direction of steering unit, also when the steering unit is in neutral position. Spool/sleeve sets for 2 levels of LS dynamic flow are available:

- Standard LS spool/sleeve set: 0.6 - 0.9 l/min [0.16 - 0.24 US gal/min]
- High dynamic LS spool/sleeve set: 1.0 - 1.3 l/min [0.26 - 0.34 US gal/min]

High dynamic is recommended, when extreme fast response is requested, e.g. when unloading working hydraulic load (EF) very rapidly during steering. Trade off with high dynamic is slightly higher energy consumption. All VSP LS steering units can withstand max. allowed P-port pressure also in neutral position. So VSP LS can be used also in constant pressure pump systems. However, this is not recommended due to energy consumption and noise aspects.

Steering unit type VSP

Non-reaction

With non-reaction steering units there is no movement of the steering wheel, when the driver is not steering the vehicle. The vehicle keeps the steering direction independent of forces on the steering cylinder.

Reaction

With reaction steering units any external forces acting on the steered wheels result in a corresponding movement of the steering wheel, when the driver is not steering the vehicle.

Gear set

The gear set meters the volume of oil per revolution in cm³/rev.

3 versions of gear set are available for VSP:

- Standard
- Low noise
- Seal star: reduces slippage, when steering cylinder is at end stroke. Seal star gear sets are available in 50, 70, 80, 100 and 125 cm³/rev. All seal star gear sets have standard profile

VSP versions, overview

The VSP's are available in the x-marked combinations:

Type	Base ¹		Spool/sleeve set ²			Gear set		
	Standard	High spec.	Standard	ON/OR: Low noise	LS: High dynamic ³	Standard	Low noise ⁴	Seal star
VSP ON: Open center Non-reaction	X		X			X		
		X	X			X		
		X	X					X
		X		X		X		
		X		X			X	
		X		X				X
VSP OR: Open center Reaction		X		X		X		
		X		X			X	
VSP LS: Load sensing Non-reaction		X	X			X		
		X	X				X	
		X	X					X
		X			X	X		
		X			X		X	
		X			X			X
VSP LSR: Load sensing Reaction		X	X			X		
		X	X				X	

¹ Base: High spec. adds an H in type designation, e.g. VSP 100 LSH

² Spool/sleeve set Open center adds a number: 2 (Standard) or 3 (Low noise) in the type designation

³ LS High dynamic flow, recommended LS flow range: 1 -1.3 l/min [0.26 - 0.34 US gal/min]

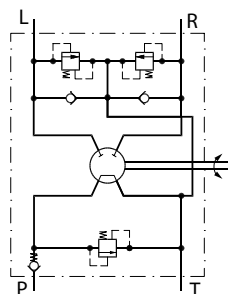
⁴ Gear set, Low noise: is available up to and including 250 cm³/rev

Steering unit type VSP

VSP circuits

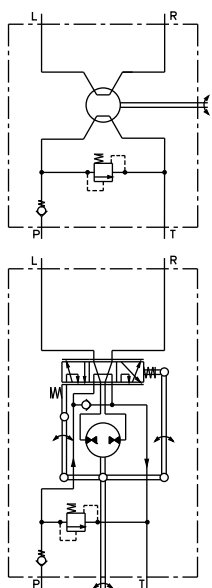
VSP Open Center, steering unit with integrated valve functions

VSP ON Open center Non-reaction



150-370.10

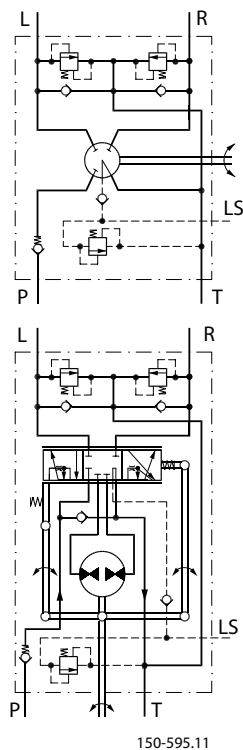
VSP OR Open center Reaction



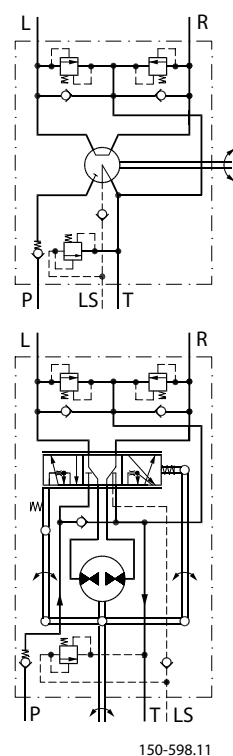
Steering unit type VSP

VSP Load Sensing dynamic steering unit with integrated valve functions

VSP LS Load Sensing Non-reaction



VSP LSR Load Sensing Reaction



Steering unit type VSP

Technical data, VSP ON/OR

Displacement, flow, and pressure

For common data, look in sub-catalog: "General Steering Components."

Steering unit	Displacement cm³/rev [in³/rev]	Recommended oil flow range from pump l/min [US gal/ min]	Max pressure, bar [psi]		
			System pressure/P-T port pressure¹	T, absolute port pressure	L-T/R-T port pressure
VSP 50 ON2	50 [3.05]	3-25 [0.79-6.60]	140 [2030]	20 [290]	250 [3625]
VSP 70 ON2	70 [4.27]		170 [2465]		
VSP 80 ON2	80 [4.88]				
VSP 100 ON2	100 [6.10]				
VSP 125 ON2	125 [7.63]				
VSP 160 ON2	160 [9.76]				
VSP 200 ON2	200 [12.20]	12-50 [3.17-13.21]			
VSP 250 ON2	250 [15.26]				
VSP 315 ON2	315 [19.22]				
VSP 400 ON2	400 [24.41]				
VSP 50 ON2H	50 [3.05]	3-25 [0.79-6.60]	140 [2030]	30 [435]	250 [3625]
VSP 70 ON2H	70 [4.27]		170 [2465]		
VSP 80 ON2H	80 [4.88]				
VSP 100 ON2H	100 [6.10]		190 [2755]		
VSP 125 ON2H	125 [7.63]				
VSP 160 ON2H	160 [9.76]				
VSP 200 ON2H	200 [12.20]	12-50 [3.17-13.21]			
VSP 250 ON2H	250 [15.26]				
VSP 315 ON2H	315 [19.22]				
VSP 400 ON2H	400 [24.41]				
VSP 50 ON3H	50 [3.05]	10-30 [145-435]	140 [2030]	30 [435]	250 [3625]
VSP 70 ON3H	70 [4.27]		170 [2465]		
VSP 80 ON3H	80 [4.88]				
VSP 100 ON3H	100 [6.10]		190 [2755]		
VSP 125 ON3H	125 [7.63]				
VSP 160 ON3H	160 [9.76]				
VSP 200 ON3H	200 [12.20]	20-50 [290-725]			
VSP 250 ON3H	250 [15.26]				
VSP 315 ON3H	315 [19.22]				
VSP 400 ON3H	400 [24.41]				

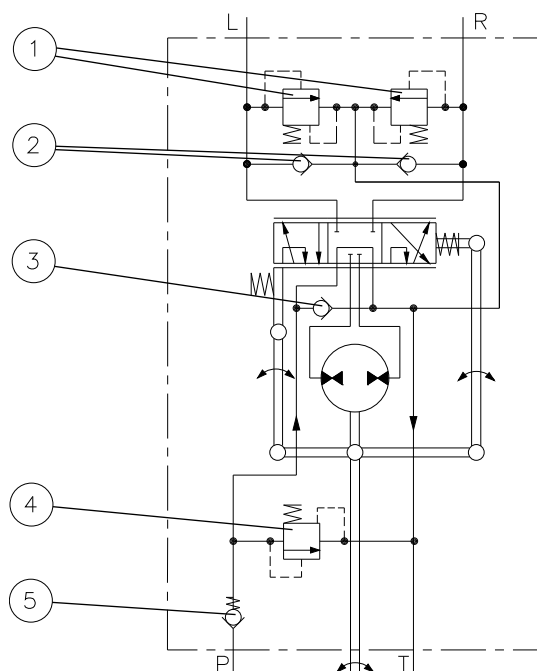
Steering unit type VSP

Steering unit	Displacement cm³/rev [in³/rev]	Recommended oil flow range from pump l/min [US gal/ min]	Max pressure, bar [psi]		
			System pressure/P-T port pressure¹	T, absolute port pressure	L-T/R-T port pressure
VSP 50 OR3H	50 [3.05]	10-30 [145-435]	140 [2030]	30 [435]	250 [3625]
VSP 70 OR3H	70 [4.27]		170 [2465]		
VSP 80 OR3H	80 [4.88]				
VSP 100 OR3H	100 [6.10]		190 [2755]		
VSP 125 OR3H	125 [7.63]				
VSP 160 OR3H	160 [9.76]				
VSP 200 OR3H	200 [12.20]	20-50 [290-725]			

¹ For VSP High Spec., absolute P-port pressure must not exceed 220 bar [3190 psi], so. w. max. allowed relief valve setting (P-T) 190-200 bar [2755-2900 psi], the absolute T pressure must not exceed 20 bar [290 psi]. With P-T setting 180-190 bar [2610-2755] or lower, T-pressure up to 30 bar [435 psi] can be allowed.

Any VSP ON2 can withstand 170 bar [2465 psi] and any VSP ON2H/VSP ON3H/ VSP OR3H can withstand 190 bar [2755 psi] in max system pressure. However, VSP w. small gear set and high pressure will have relatively high slippage values.

Valve functions



All VSP ON/OR have the following valves built in as standard:

- Emergency steering check valve (3)
- P-check valve (5)
- Relief valve (4)

All VSP ON/OR can have the following valves built in:

- Shock valves (not needed in OR) (1)
- Suction valves (2)

Shock and suction are always combined.

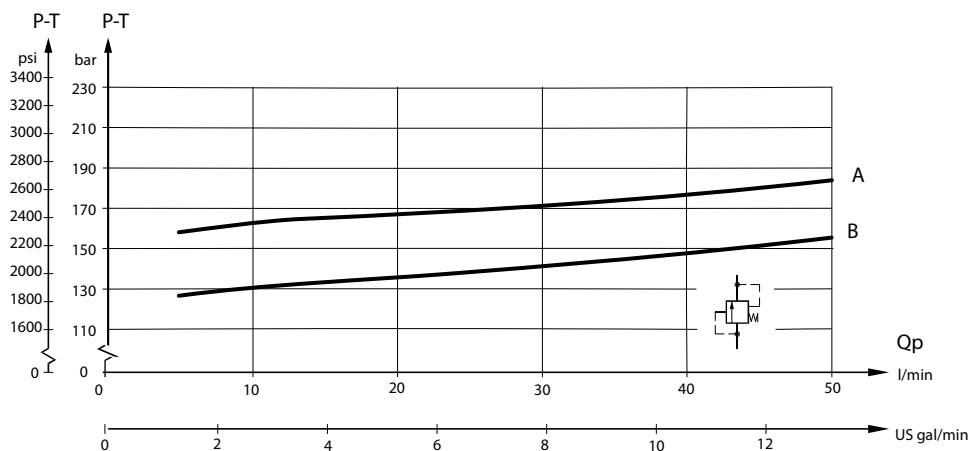
Steering unit type VSP

Pressure relief valve

The pressure relief valve protects pump and steering unit against excessive pressure and limits the system pressure while steering. The pressure relief valve is set at 25 l/min [6.60 US gal/min] flow.

Setting tolerances:

- 170 bar [2466 psi]: rated value +5 bar [+73 psi]
- > 170 bar [2466 psi]: rated value +10 bar [+145 psi]



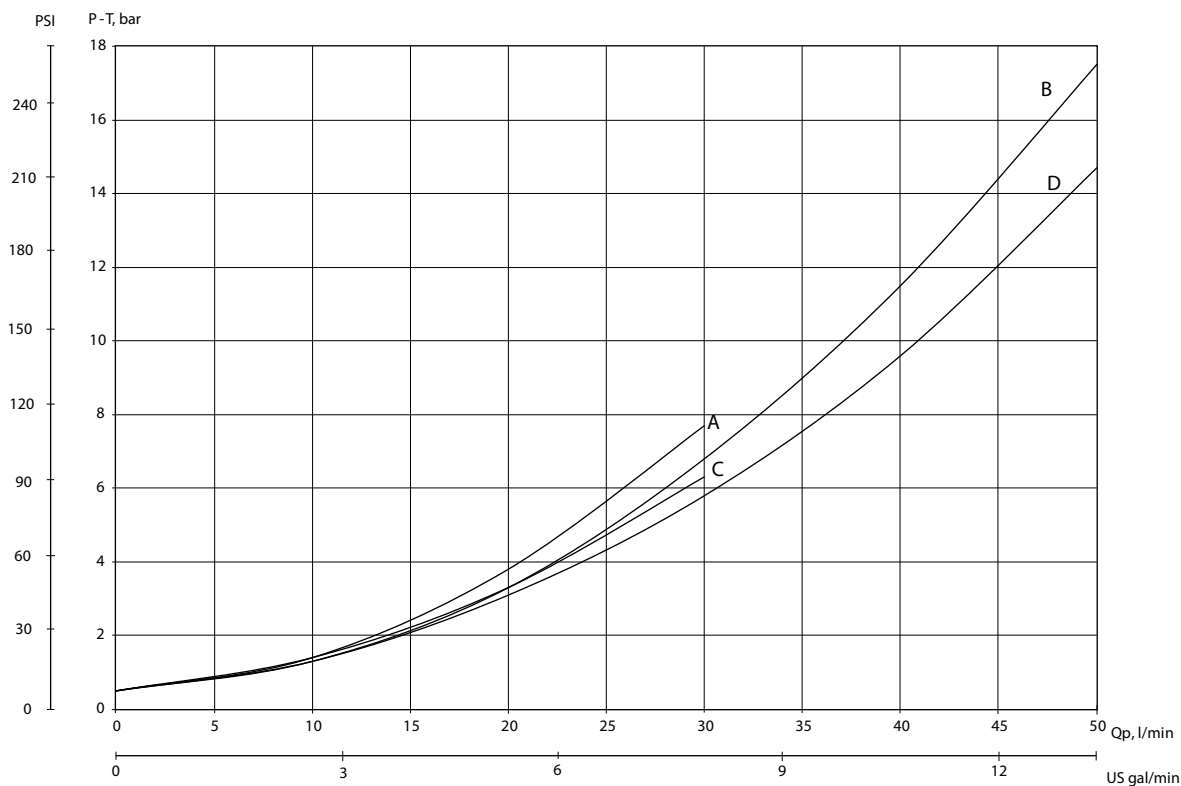
A 170 +5/-0 bar [2465 +73/-0 psi]

B 140 +5/-0 bar [2030 +73/-0 psi]

Steering unit type VSP

Pressure drop in neutral

The pressure drop is measured on Open Center steering units, and with the steering unit in neutral position. The pressure drop is measured from P to T. The values are valid at an oil temperature of 50°C [122°F] and a viscosity of 21 mm²/s (100 SUS).



- A** VSP ON2 low flow (for pump flow range 3-25 l/min [0.79-6.60 US gal/min])
- B** VSP ON2 high flow (for pump flow range 12-50 l/min [3.17-13.20 US gal/min])
- C** VSP ON3/OR3 low flow (for pump flow range 10-30 l/min [2.64-7.92 US gal/min])
- D** VSP ON3/OR3 high flow (for pump flow range 20-50 l/min [5.28-13.20 US gal/min])

Steering unit type VSP

Technical data, VSP LS/LSR

Displacement, flow, and pressure

For common data: Look in sub catalog "General, Steering Components"

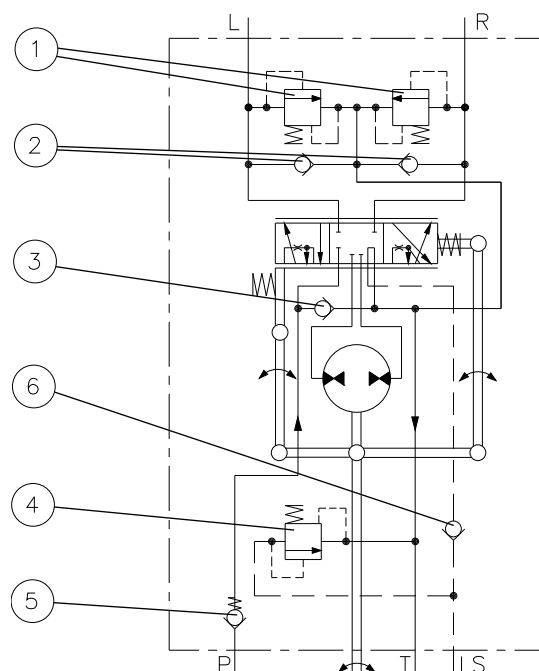
Steering unit	Displacement cm ³ /rev [in ³ /rev]	Rated oil flow @ 100 rpm l/min [US gal/ min]	Max. pressure, bar [psi]		
			System pressure/ P-T port pressure ¹	T, absolute port pressure	L-T/R-T port pressure
VSP 50 LSH	50 [3.05]	5 [1.32]	140 [2030]	30 [435]	250 [3625]
VSP 70 LSH	70 [4.27]	7 [1.85]	170 [2465]		
VSP 80 LSH	80 [4.88]	8 [2.11]			
VSP 100 LSH	100 [6.10]	10 [2.64]			
VSP 125 LSH	125 [7.63]	13 [3.43]	190 [2755]		
VSP 160 LSH	160 [9.76]	16 [4.23]			
VSP 200 LSH	200 [12.20]	20 [4.23]			
VSP 250 LSH	250 [15.26]	25 [6.60]			
VSP 315 LSH	315 [19.22]	32 [8.45]			
VSP 400 LSH	400 [24.41]	40 [10.57]			
VSP 50 LSRH	50 [3.05]	5 [1.32]	140 [2030]	30 [435]	250 [3625]
VSP 70 LSRH	70 [4.27]	7 [1.85]	170 [2465]		
VSP 80 LSRH	80 [4.88]	8 [2.11]			
VSP 100 LSRH	100 [6.10]	10 [2.64]			
VSP 125 LSRH	125 [7.63]	13 [3.43]	190 [2755]		
VSP 160 LSRH	160 [9.76]	16 [4.23]			
VSP 200 LSRH	200 [12.20]	20 [4.23]			

¹ For VSP High Spec., absolute P-port pressure must not exceed 220 bar [3190 psi], so. w. max. allowed pilot relief valve setting (P-T) 190-200 bar [2755-2900 psi], the absolute T pressure must not exceed 20 bar [290 psi]. With P-T setting 180-190 bar [2610-2755 psi] or lower, T-pressure up to 30 bar [435 psi] can be allowed.

Any VSP LSH/LSRH can withstand 190 bar [2755 psi] in max system pressure. However, VSP w. small gear set and high pressure will have relatively high slippage values.

Steering unit type VSP

Valve functions



All VSP LS/LSR have the following valves build in as standard:

- Emergency steering check valve (3)
- P-check valve (5)
- Pilot relief valve (4)

All VSP LS/LSR can have built in the following valves:

- Check valve in LS (6): recommended up to and including 200 cm³/rev
- Shock valves (1)
- Suction valves (2)

Shock and suction are always combined.

Steering unit type VSP

Pilot pressure relief valve; (P-T, Q_p) characteristic

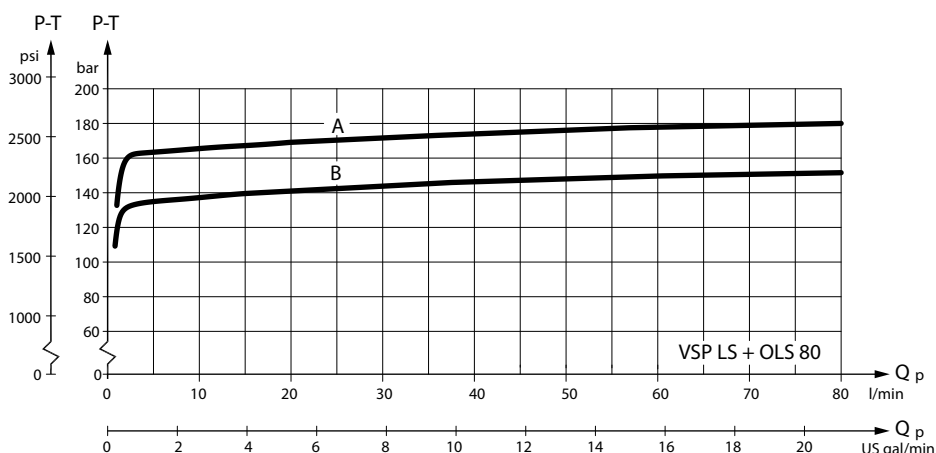
The pilot pressure relief valve protects the steering unit against excessive pressure. The pilot pressure relief valve in the VSP LS steering unit together with the priority valve limit the maximum steering pressure P-T. The pilot pressure relief valve is set at an oil flow to the priority valve of 25 l/min [6.60 US gal/min].

For VSP load sensing dynamic steering units with standard LS spool/sleeve set, the setting values are valid at a dynamic flow of 0.6 l/min [0.16 US gal/min].

For VSP load sensing high dynamic steering units with low noise/high dynamic spool/sleeve set, the setting values are valid at a dynamic flow of 1.1 l/min [0.29 US gal/min].

Setting tolerance:

- ≤ 170 bar [2465 psi]: rated value +5 bar [72.5 psi].
- > 170 bar [2465 psi]: rated value +10 bar [145 psi].



A 170 + 5/-0 bar [2465+ 73/-0 psi]

B 140 + 5/-0 bar [2030 + 73/-0 psi]

Check valve function in LS

The check valve in the LS line of VSP LS and VSPP LS dynamic steering units protects the driver against steering wheel jerks. The check valve prevents oil from flowing backwards into the LS line to the priority valve, when steering against a high pressure on the cylinder side. The need for the LS check valve is very system dependent. It is recommended to be included in VSP LS and VSPP LS up to and including 200 cm³/rev sizes.

Steering unit type VSP

Technical data, common all VSP types

Shock valves

The shock valves protect the steering unit and reduce external forces on the steering cylinder by limiting the pressure difference from L to T and from R to T.

The shock valves are set at 3 l/min [0.792 US gal/min]

At higher flow, pressure peaks may occur.

The shock valves are of the direct acting type, so they react very quickly.

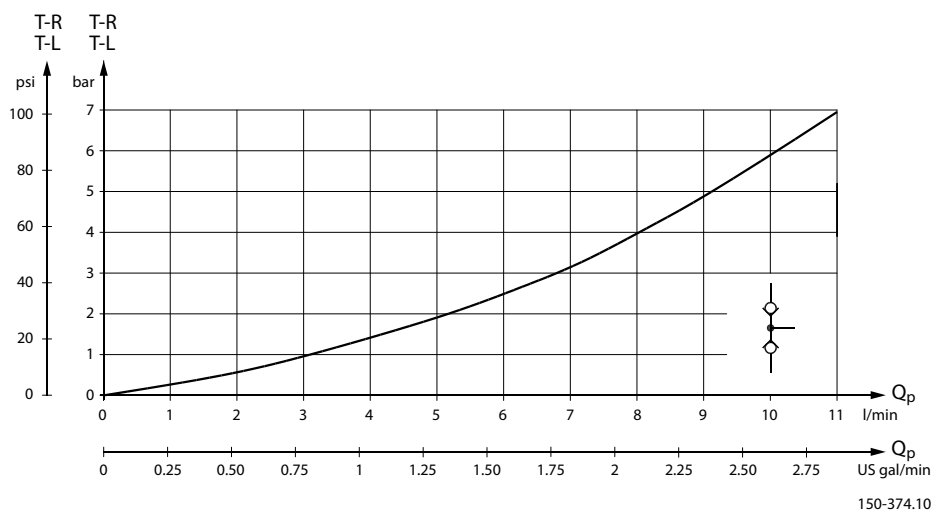
Setting tolerance: rated value +20 bar [290 psi].

Suction valves

The suction valves allow oil suction to avoid cavitation in the steering cylinder. To provide correct suction, a back pressure valve must be fitted in the tank line from the steering unit.

Generally Danfoss recommend a back pressure of 2 bar [29 psi], but on vehicles with strong self-straightening tendencies and on articulated steered vehicles, we recommend 5-10 bar [72.5 - 145 psi]. For further advice, please contact the Danfoss Sales Organisation.

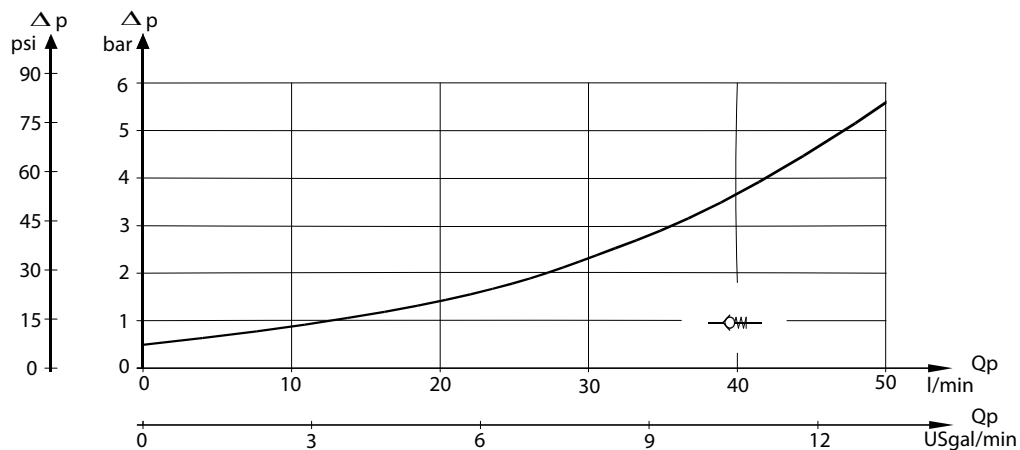
A connection which incorporates a check valve must be established to allow oil flow to by-pass the back pressure valve (and filter) from the tank to steering unit. See diagram examples in sub catalogue "General Steering Components" page 37 - 39.



Steering unit type VSP

Check valve in P

The check valve in the P connection of the steering unit protects the driver against steering wheel jerks. The check valve prevents oil from flowing backwards into the pump line when steering against a high pressure on the cylinder side. The pressure drop across the check valve is indicated on the following graph, which assumes the use of port adaptors with 11 mm [0.43 in] minimum bore.

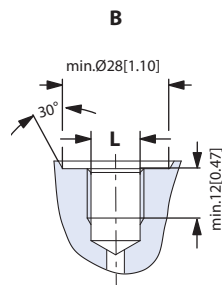


Weights

Type	Weight, kg [lb]
VSP 50	5.2 [11.46]
VSP 70	5.3 [11.68]
VSP 80	5.3 [11.68]
VSP 100	5.4 [11.90]
VSP 125	5.5 [12.13]
VSP 160	5.6 [12.35]
VSP 200	5.8 [12.79]
VSP 250	6.0 [13.23]
VSP 315	6.2 [13.67]
VSP 400	7.0 [15.43]

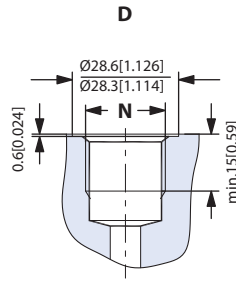
Steering unit type VSP

Port thread versions



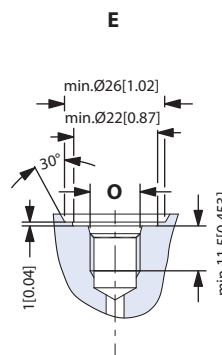
B G port w. spot face (LS)

L DIN 3852-2 – G1/4



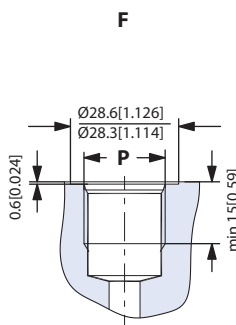
D G port w. spot face (P, T, L, R)

N DIN 3852-2 – G1/2



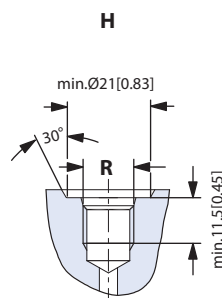
E Metric port w. spot face and O-ring chamfer (LS)

O ISO 6149-1 - M12 x 1.5



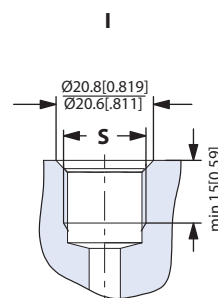
F Metric ports w. spot face and O-ring chamfer (P, T, L, R)

P ISO 6149-1 - M18 x 1.5



H UNF ports w. O-ring chamfer (LS)

R ISO 11926-1 7/16-20 UNF O-ring boss port



I UNF ports w. O-ring chamfer (P, T, L, R)

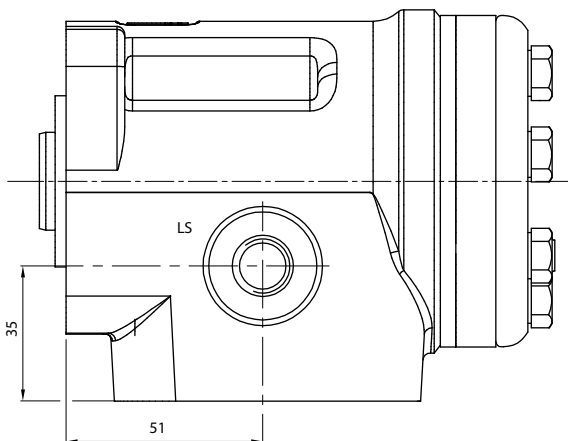
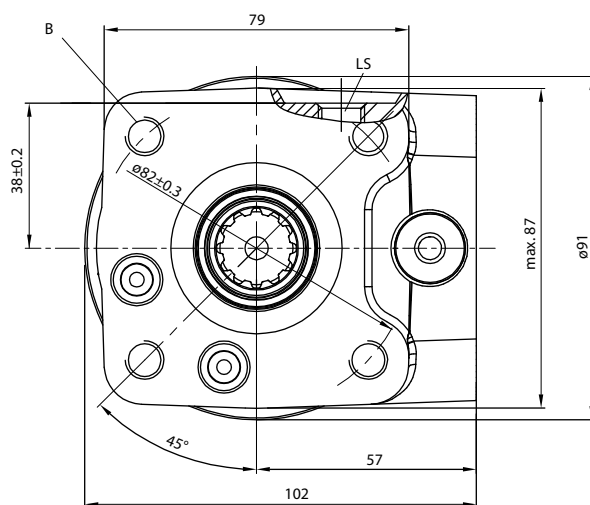
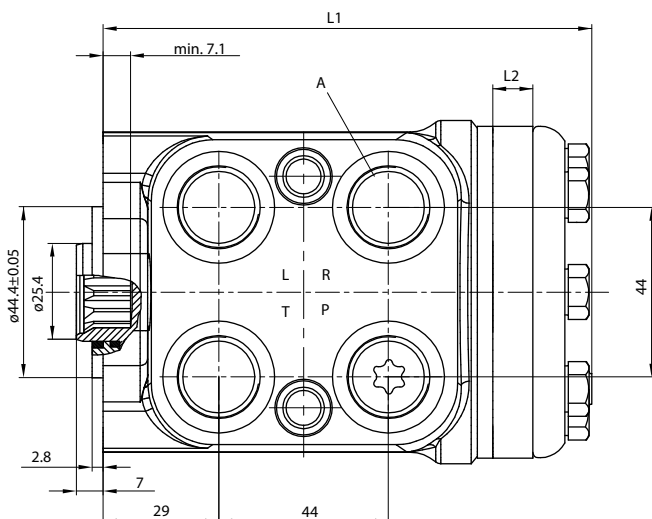
S ISO 11926-1 3/4-16UNF O-ring boss port

Steering unit type VSP

Dimensions

VSP

VSP ON/OR/LS/LSR



A (P, T, L, and R)

G ½ w. spot face, DIN 3852-2, 15 mm [0.59 in] deep

Or: M18 x 1.5, ISO 6149-1, 15 mm [0.59 in] deep

Or: 3/4 - 16 UNF O-ring boss, ISO 11926-1, 15 mm [0.59 in] deep

B

M10 x 1.5, 16 mm [0.63 in] deep

LS

G 1/4 w. spot face, DIN 3852-2, 12 mm [0.47 in] deep

Or: M12 x 1.5, ISO 6149-1, 11.5 mm [0.45 in] deep

Or: 7/16 - 20 UNF O-ring boss, ISO 11926-1, 11.5 mm [0.45 in] deep

Steering unit type VSP

VSP dimensions

Type	L1 mm [in]	L2 mm [in]
VSP 50	125 [4.92]	6.5 [0.26]
VSP 70	127 [4.99]	9.1 [0.36]
VSP 80	128 [5.04]	10.4 [0.41]
VSP 100	131 [5.16]	13.0 [0.51]
VSP 125	134 [5.28]	16.2 [0.64]
VSP 160	139 [5.47]	20.8 [0.82]
VSP 200	144 [5.67]	26.0 [1.02]
VSP 250	150 [5.91]	32.5 [1.28]
VSP 315	159 [6.26]	40.9 [1.61]
VSP 400	170 [6.69]	52.0 [2.05]

Steering unit type VSPP

Versions



VSPP

All VSPP's are **High Spec.** for maximum steering pressure 190 bar [2755 psi].

Load Sensing dynamic steering unit with built in priority valve, VSPP LS.

The VSPP is a steering unit with integrated priority valve inside the envelope of the standard VSP housing. VSPP LS are all of load sensing dynamic type and so the integrated priority valve is dynamic type.

Spool/sleeve sets for 2 levels of LS dynamic flow are available:

- Standard LS spool/sleeve set: 0.6 - 0.9 l/min [0.16 - 0.24 US gal/min]
- High dynamic LS spool/sleeve set: 1.0 - 1.3 l/min [0.26 - 0.34 US gal/min]

High dynamic is recommended, when extreme fast response is requested, e.g. when unloading working hydraulic load (EF) very rapidly during steering. Trade off with high dynamic is slightly higher energy consumption.

Non-reaction

VSPP's are non-reaction steering units, where there is no movement of the steering wheel, when the driver is not steering the vehicle. The vehicle keeps the steering direction independent of forces on the steering cylinder.

Gear Set

The gear set meters the volume of oil/revolution on the steering wheel, cm³/rev. 2 versions of gear set are available for VSPP:

- Low Noise is default for VSPP up to and including 250 cm³/rev. VSPP 315 and VSPP 400 will have gear set with standard profile
- Seal star: reduces slippage, when steering cylinder is at end stroke. Seal star gear sets are available in 50, 70, 80, 100 and 125 cm³/rev.

All seal star gear sets have standard profile.

Steering unit type VSPP

VSPP versions, overview

The VSP's are available in the x-marked combinations:

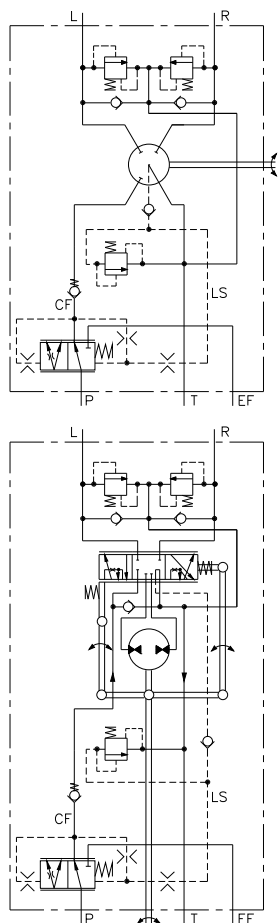
Type	Spool/sleeve set		Gear set	
	Standard	LS: High dynamic	Low Noise	Seal star
VSPP LS: Load Sensing non reaction w. int. Priority valve	X		X	
	X			X
		X	X	
		X		X

Steering unit type VSPP

VSPP circuits

VSPP Load Sensing dynamic, steering unit with integrated valve functions

VSPP LS Load Sensing Non-reaction



Steering unit type VSPP

Technical data, VSPP LS

Displacement, flow and pressure

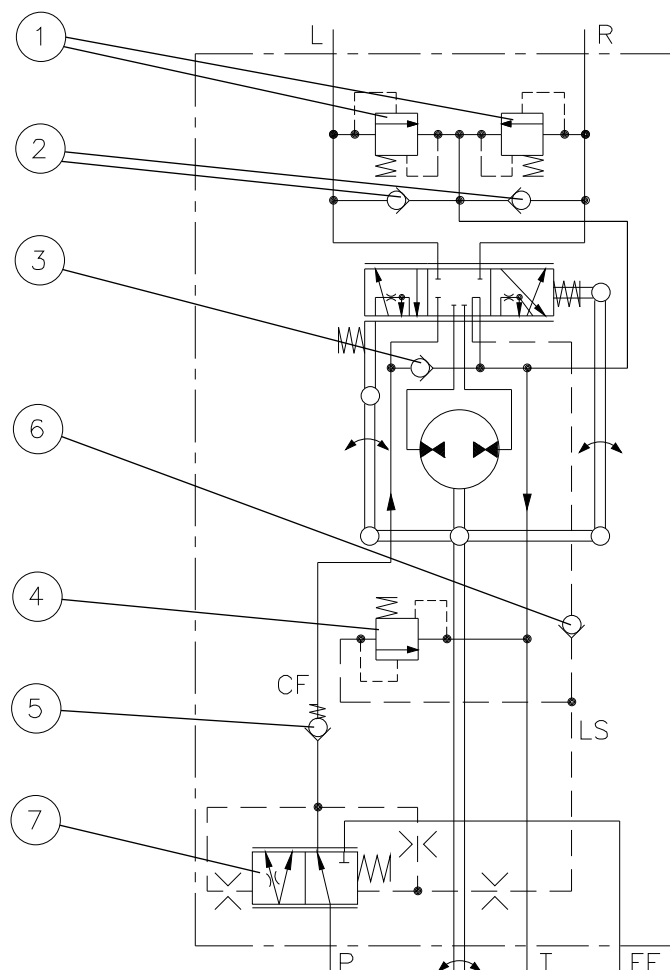
For common data: Look in sub catalog: "General Steering Components"

Steering unit	Displacement cm ³ /rev [in ³ /rev]	Rated oil flow for steering @ 100 rpm l/min [US gal/min]	Max. oil flow from pump l/min [US gal/min]	Max. pressure, bar [psi]			
				System pressure ¹ / P-T portpressure	T, absolute port pressure	L-T/R-T port pressure	P and EF, absolute port pressure
VSPP 50 LSH	50 [3.05]	5 [1.32]	80[1160]	140 [2030]	30 [435]	250 [3625]	230[3335]
VSPP 70 LSH	70 [4.27]	7 [1.85]		170 [2465]			
VSPP 80 LSH	80 [4.88]	8 [2.11]					
VSPP 100 LSH	100 [6.10]	10 [2.64]		190 [2755]			
VSPP 125 LSH	125 [7.63]	13 [3.43]					
VSPP 160 LSH	160 [9.76]	16 [4.23]					
VSPP 200 LSH	200 [12.20]	20 [4.23]					
VSPP 250 LSH	250 [15.26]	25 [6.60]					
VSPP 315 LSH	315 [19.22]	32 [8.45]					
VSPP 400 LSH	400 [24.41]	40 [10.57]					

¹ Any VSPP LSH can withstand 190 bar [2755 psi] in max steering system pressure. However, VSPP w small gear set and high pressure will have relatively high slippage values.

Steering unit type VSPP

Valve functions



All VSPP LS have the following valves built in:

- Priority valve (7)
- P-Check valve in CF line (5)
- Pilot relief valve (4)
- Check valve in LS (6)
- Emergency steering check valve (3)
- Suction valves (2)
- Shock valves (1)

Steering unit type VSPP

Pilot pressure relief valve; (P-T, Qp) characteristic

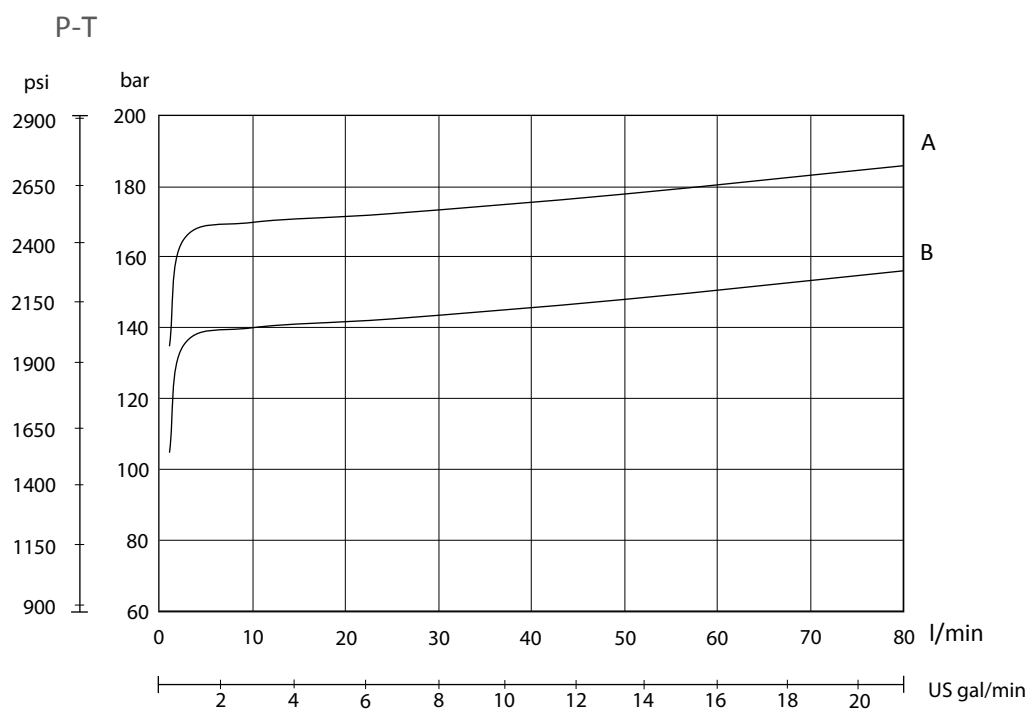
The pilot pressure relief valve protects the steering unit against excessive pressure. The pilot pressure relief valve in the VSPP LS steering unit together with the integrated priority valve spool, limits the maximum steering pressure P-T. The pilot pressure relief valve is set at an oil flow to the P-port of the VSPP valve of 25 l/min [6.60 US gal/min].

For VSPP load sensing dynamic steering units with standard LS spool/sleeve set, the setting values are valid at a dynamic flow of 0.6 l/min [0.16 US gal/min].

For VSPP load sensing high dynamic steering units with low noise/high dynamic spool/sleeve set, the setting values are valid at a dynamic flow of 1.1 l/min [0.29 US gal/min].

Setting tolerance:

- <= 170 bar [2465 psi]: rated value +5 bar [72.5 psi].
- > 170 bar [2465 psi]: rated value +10 bar [145 psi].



A 170 + 5/-0 bar [2465+ 73/-0 psi]

B 140 + 5/-0 bar [2030 + 73/-0 psi]

Check valve function in LS

See: Steering unit Type VSP, Technical data VSP LS/LSR, [Check valve function in LS](#) on page 17.

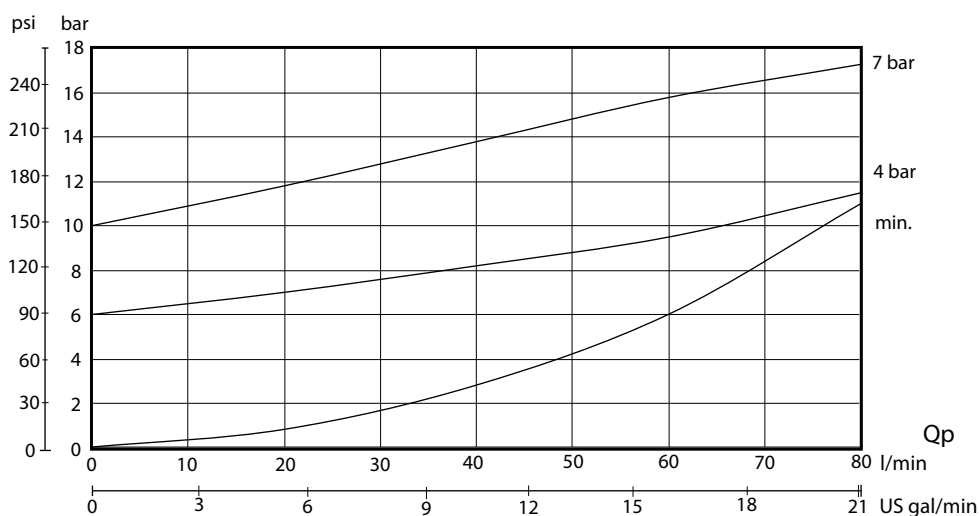
Steering unit type VSPP

Pressure drop, P-EF

This data comes from measurements on a representative sample of VSPP LS w. standard spool/sleeve set. Oil with viscosity of 21 mm²/s at 50 °C [102 SUS at 122 °F] was used during measuring. Measurement made when pressure on the LS connection is zero (steering unit in neutral position). The minimum curves apply when the pressure on the EF connection is higher than the actual control spring pressure. The curves for control spring pressure of 4 or 7 bar [58 or 101 psi] apply when pressure on the EF connection is zero.

Pressure drop, P-EF, for VSPP LS w. standard dynamic LS spool/sleeve set

P-EF, VSPP



Shock valves

See: Steering unit Type VSP, Technical data, common all VSP types, [Shock valves](#) on page 18.

Suction valves

See: Steering unit Type VSP, Technical data, common all VSP types, [Suction valves](#) on page 18.

Check valve in P

See: Steering unit Type VSP, Technical data, common all VSP types, [Check valve in P](#) on page 19.

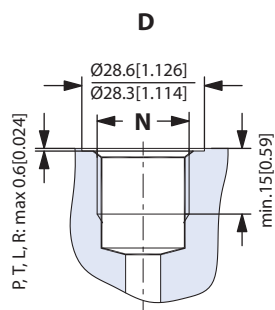
Steering unit type VSPP

Weights

Type	Weight, kg [lb]
VSPP 50 LS	5.2 [11.46]
VSPP 70 LS	5.3 [11.68]
VSPP 80 LS	5.3 [11.68]
VSPP 100 LS	5.4 [11.90]
VSPP 125 LS	5.5 [12.13]
VSPP 160 LS	5.6 [12.35]
VSPP 200 LS	5.8 [12.79]
VSPP 250 LS	6.0 [13.23]
VSPP 315 LS	6.2 [13.67]
VSPP 400 LS	7.0 [15.43]

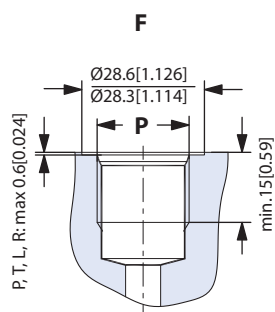
Steering unit type VSPP

Port thread versions



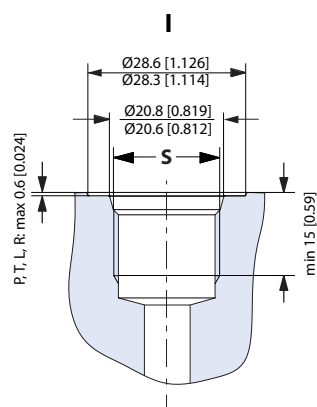
D G port w. spot face (P, T, L, R, EF)

N DIN 3852-2 – G1/2



F Metric ports w. spot face and O-ring chamfer (P, T, L, R, EF)

P ISO 6149-1 - M18 x 1.5



I UNF ports w. spot face and O-ring chamfer (P, T, L, R, EF)

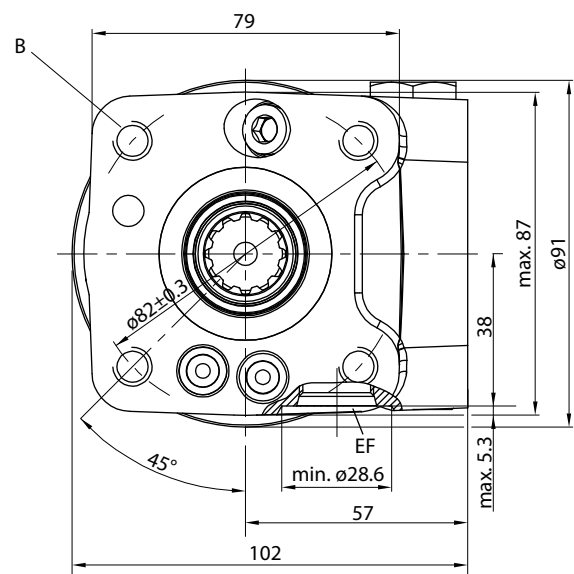
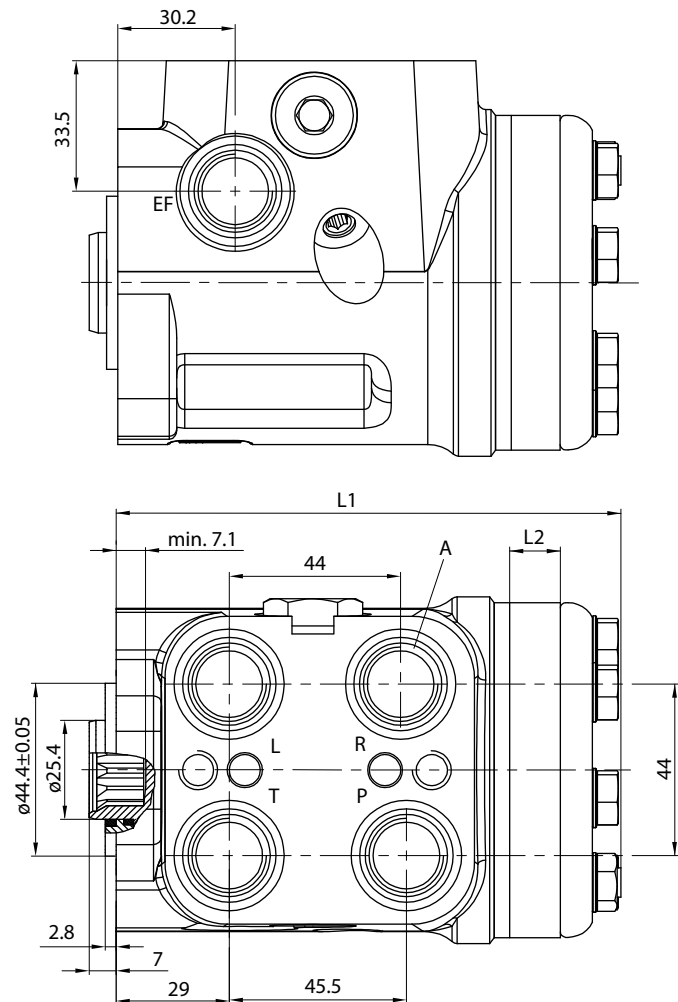
S ISO 11926-1 3/4-16UNF O-ring boss port

Steering unit type VSPP

Dimensions

VSPP

VSPP LS



A (P, T, L, R, and EF)

G ½ w. **spot face** (G, DIN 3852-2) 15 mm [0.59 in] deep

Or: M18 x 1.5 ISO 6149-1, 15 mm [0.59 in] deep

Or: 3/4 - 16 UNF O-ring boss ISO 11926-1 15 mm [0.59 in] deep

B

M10 x 1.5, 16 mm [0.63 in] deep

VSPP dimensions

Type	L1 mm [in]	L2 mm [in]
VSPP 50	125 [4.92]	6.5 [0.26]
VSPP 70	127 [4.99]	9.1 [0.36]

Steering unit type VSPP

VSPP dimensions (continued)

Type	L1 mm [in]	L2 mm [in]
VSPP 80	128 [5.04]	10.4 [0.41]
VSPP 100	131 [5.16]	13.0 [0.51]
VSPP 125	134 [5.28]	16.2 [0.64]
VSPP 160	139 [5.47]	20.8 [0.82]
VSPP 200	144 [5.67]	26.0 [1.02]
VSPP 250	150 [5.91]	32.5 [1.28]
VSPP 315	159 [6.26]	40.9 [1.61]
VSPP 400	170 [6.69]	52.0 [2.05]

VSP and VSPP: Variants and ordering specifications

VSP and VSPP MMC

Determine Master Model Code (MMC). Fill in with codes from [Variants codes for VSP and VSPP MMC](#) on page 35, to specify VSP steering unit.

MMC-pos.	1	2	3	4	5	6	7
	Type1	Displ.	Type2	Housing, thread	Relief valve setting	Shock valve setting	Check valves
Your VSP							
Example	VSP	100	LSH	U11	170	230	CV4

MMC-pos.	8	9	10	11	12	13	14
	Neutral Springs	Spool/sleeve set, details	Gear set, details	Painting	Special feature visible	Special feature, non visible	Name Tag
Your VSP							
Example	N02	S07	G01	PB	NNN	NNN	NN

Code numbers with catalog versions with specifications

MMC-pos.	1	2	3	4	5	6	7
Code	Type1	Displ.	Type2	Housing, thread	Relief valve setting	Shock valve setting	Check valves
11198710	VSP	100	ON2H	U01	140	200	CV1
11198709	VSP	100	LSH	U11	170	230	CV4
11189283	VSPP	100	LSH	U21	180	240	CV4

MMC-pos.	8	9	10	11	12	13	14
Code	Neutral Springs	Spool/sleeve set, details	Gear set, details	Painting	Special feature visible	Special feature, non visible	Name Tag
11198710	N01	S01	G01	PB	NNN	NNN	NN
11198709	N02	S07	G01	PB	NNN	NNN	NN
11189283	N02	S07	G02*	PB	NNN	NNN	NN

VSP and VSPP: Variants and ordering specifications

Variants codes for VSP and VSPP MMC

MMC pos. 1	Main steering product Type1
VSP	VSP Steering units
VSPP	VSP Steering units w. integrated priority valve

MMC pos. 2	Displacement, cm ³ /rev
50	50
70	70
80	80
100	100
125	125
160	160
200	200
250	250
315	315
400	400

MMC pos. 3	Type2
ON2	Open center Non reaction, standard
ON2H	Open center Non reaction, High spec.
ON3H	Open center Non reaction, High spec., low noise
OR3H	Open center Reaction, High spec., low noise
LSH	Load Sensing non reaction, High spec.
LSRH	Load Sensing Reaction, High spec.

MMC pos. 4	Housing, thread
G01	DIN 3852-2: P, T, L, R: G1/2 w. spot face Column thread: M10x1.5
G11	DIN 3852-2: P, T, L, R: G1/2 w. spot face LS: G1/4 w. spot face, on side. Column thread: M10x1.5
G21	DIN 3852-2: P, T, L, R, EF: G1/2 w. spot face Column thread: M10x1.5
M01	ISO 6149-1: P, T, L, R: M18x1.5 w. spot face and O-ring chamfer Column thread: M10x1.5
M11	ISO 6149-1: P, T, L, R: M18x1.5 w. spot face and O-ring chamfer LS: M12x1.5 w. spot face and O-ring chamfer, on side Column thread: M10x1.5
M21	ISO 6149-1: P, T, L, R, EF: M18x1.5 w. spot face and O-ring chamfer Column thread: M10x1.5
U01	ISO 11926-1: P, T, L, R: 3/4-16UNF w. O-ring chamfer Column thread: M10x1.5
U11	ISO 11926-1: P, T, L, R: 3/4-16UNF w. O-ring chamfer LS: 7/16-20UNF w. spot face and O-ring chamfer, on side Column thread: M10x1.5
U21	ISO 11926-1: P, T, L, R, EF: 3/4-16UNF w. spot face and O-ring chamfer Column thread: M10x1,5

VSP and VSPP: Variants and ordering specifications

MMC pos. 5	Relief valve setting
140	Value for setting (140 bar), P-T. All VSP's and VSPP's have relief valve Range VSP: 50 - 170 bar Range VSP High Spec. and VSPP: 50 - 190 bar
MMC pos. 6	Shock and suction valves
NNN	No shock and suction valves
200	Value for setting (200 bar), R-T/L-T. All VSPP's have shock valves Shock and suction valves are belonging Range: 110 - 250 bar
MMC pos. 7	Check valves
CV1	Check valve in P (standard)
CV4	Check valve in P and in LS (standard in LS up to and included 200 cm ³ /rev)
MMC pos. 8	Neutral Springs
N01	150-4209, torque 0.8-4 Nm*. Standard. Only Neutral Spring kit for VSP ON/OR
N02	150N4019, torque 0.6-2.5 Nm*. Medium
N03	11124634, torque 0.7-1.7 Nm*. Soft
MMC pos. 9	Spool/ sleeve set, details
S01	ON2/ON2H low flow: Open Center, 15°, stage II For pump flow range 3-25 l/min
S02	ON2/ON2H high flow: Open Center, 15°, stage II For pump flow range 12-50 l/min
S03	ON3H low flow: Open Center, 15°, stage III - noise reduced For pump flow range 10-30 l/min
S04	ON3H high flow: Open Center, 15°, stage III - noise reduced For pump flow range 20-50 l/min
S05	OR3H low flow: Open Center, 15°, stage III - noise reduced For pump flow range 10-30 l/min
S06	OR3H high flow: Open Center, 15°, stage III - noise reduced For pump flow range 20-50 l/min
S07	LSH standard: Dynamic flow recommended 0.6-0.9 l/min, 15°, constant pressure
S08	LSH High dynamic: Dynamic flow recommended 1.0-1.3 l/min, 15°, constant pressure
S09	LSRH standard: Dynamic flow recommended 0.6-0.9 l/min, 15°, constant pressure
MMC pos. 10	Gear set
G01	Gear set, Standard cross grinded
G02	Gear set, Low Noise/profile grinded, available up to and including 250 cm ³ /rev
G03	Gear set, Standard cross grinded, with Seal Star (for low slippage) Available in 50, 70, 80, 100 and 125 cm ³ /rev
MMC pos. 11	Paint
PB	Black, RAL 9005 ; Corrosion class C3 ; Standard covering

VSP and VSPP: Variants and ordering specifications

MMC pos. 12	Special features visible
NNN	None
VXX	Special feature visible
MMC pos. 13	Special feature non visible
NNN	None
NXX	Special feature non visible
MMC pos. 14	Name tags - Steering unit and Box
NN	Danfoss name tag
CS	Customer specific

Products we offer:

- DCV directional control valves
- Electric converters
- Electric machines
- Electric motors
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
- PLUS+1® controllers
- PLUS+1® displays
- PLUS+1® joysticks and pedals
- PLUS+1® operator interfaces
- PLUS+1® sensors
- PLUS+1® software
- PLUS+1® software services, support and training
- Position controls and sensors
- PVG proportional valves
- Steering components and systems
- Telematics

Danfoss Power Solutions is a global manufacturer and supplier of high-quality hydraulic and electric 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 as well as the marine sector. Building on our extensive applications expertise, we work closely with you to ensure exceptional performance for a broad range of applications. We help you and other customers around the world speed up system development, reduce costs and bring vehicles and vessels to market faster.

Danfoss Power Solutions – your strongest partner in mobile hydraulics and mobile electrification.

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

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

Hydro-Gear

www.hydro-gear.com

Daikin-Sauer-Danfoss

www.daikin-sauer-danfoss.com

Local address:

**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 Trading
(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 subsequent 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.