

# Danfoss Vane Pumps

## VVSL/VVPH Series

Variable Displacement,  
For Industrial Applications



ENGINEERING  
TOMORROW

BC446879547024en-000101

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# Vane Pump

VVSL / VVPH Series

## 1. Introduction

### Description

Maximum displacements 120 cm<sup>3</sup>/r (7.3in<sup>3</sup>/r).

Maximum pressures 250 bar (2300 psi).

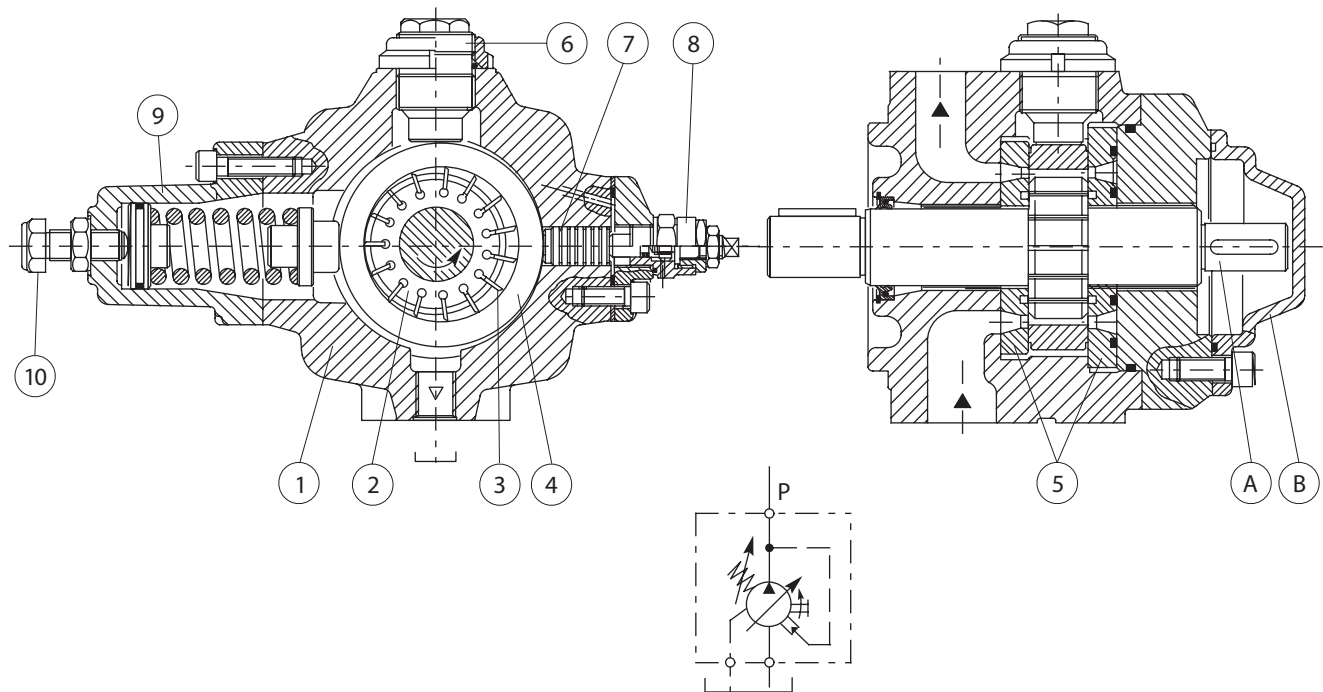
Vickers variable displacement vane pumps are available in four frame sizes (0-1-2-3) and size 0 has just one displacement. Sizes 1-2-3 are divided into three displacements. Each size, while retaining the same pump body, is available in two versions: low pressure VVSL (up to 120 bar) with mechanical pressure compensator, and VVPH (up to 250 bar) with hydraulic pressure compensator. The rotor shaft of Vickers pumps is pre-arranged for mounting an additional pump. By removing the rear cover, the secondary pump can be easily attached (see items A and B on page 5). Combining standard pumps eliminates the need for many "special application" pumps.

### Features and Benefits

- Long pump life resulting from manufacturing material characteristics, hydrodynamic lubrication of bearings, and hydrostatic balancing of distribution plates.
- Quiet pump operation from 58 to 80 db(A).
- Simplifies hydraulic circuit by eliminating maximum pressure relief valves and heat exchangers. Pumps can be supplied with various pressure compensators to control the maximum system pressure.
- Standard 4- hole flange (UNI ISO 3019/2)
- Combinations of standard pumps provide flexibility and cost effective pump packages.

## 2. Sectional Views and Functional Symbols

### VVSL Pump



As shown in the cross-sectional views, pumps consist of:

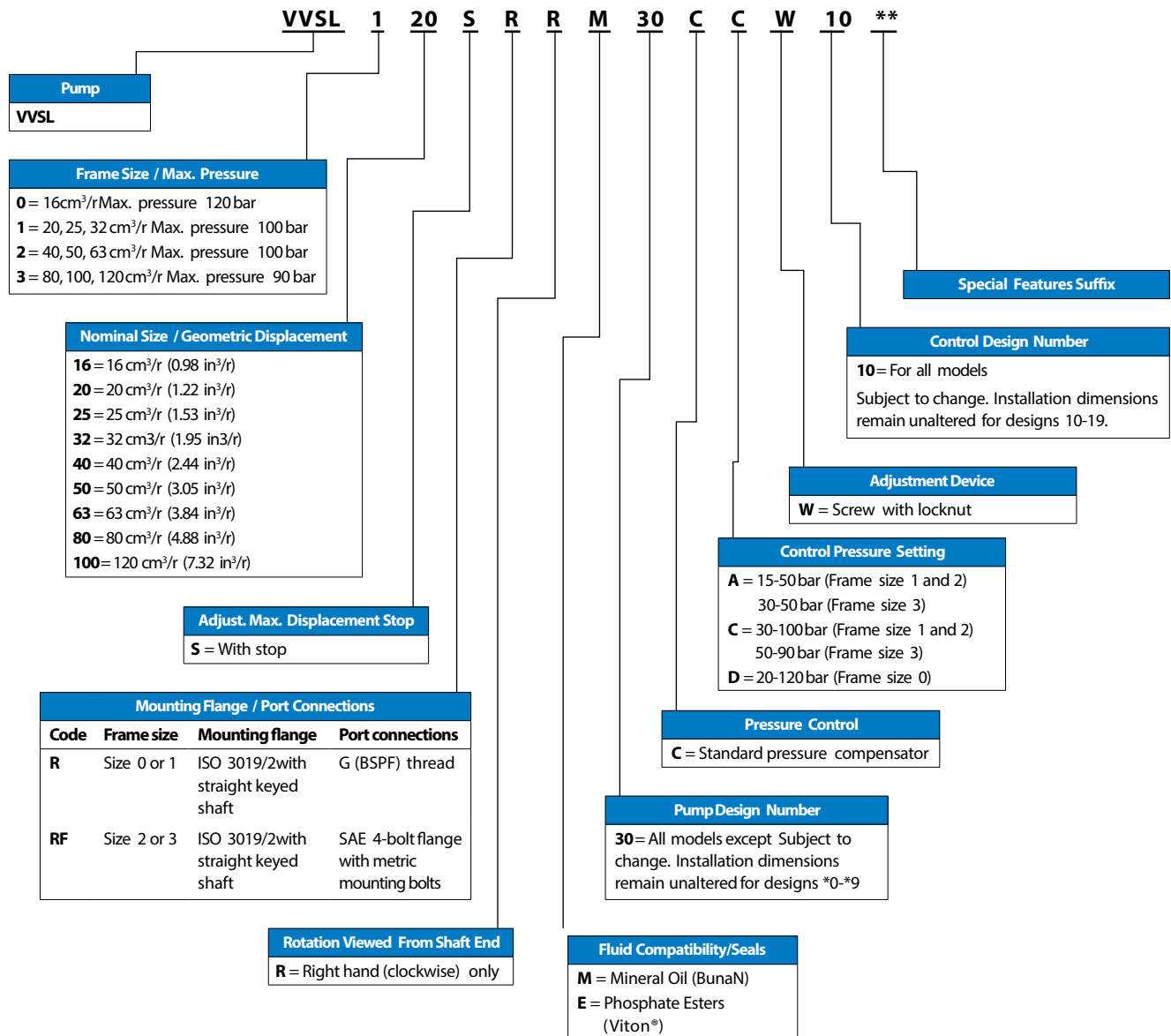
1. Body
2. One-piece shaft and rotor
3. Vanes
4. Pressure ring that changes the eccentricity and therefore the displacement of the pump, at hydrostatic axial compensation
5. Pressure plate stator to provide the passage of oil from the suction port to the pressure port
6. Guide block balancing adjustment screw (Do not tamper)
7. Displacement adjustment piston that regulates the maximum pressure compensated flow
8. Maximum volume adjustment screw
9. Pressure compensator
10. Pressure compensator adjustment

# Vane Pump

VVSL / VVPH Series

## 3. Series VVSL Pumps

### Model code



### Technical data

Nominal size		Size 0	Size 1			Size 2			Size 3		
<b>Geometric displacement according to UNI-ISO 3662 (cm³/ rev)</b>		16	20	25	32	40	50	63	80	100	120
<b>Actual displacement (cm3/rev)</b> Due to manufacturing tolerances, the value can vary by approx. ± 3%		17	21	26	33	42	51	63	80	100	123
<b>Maximum working pressure (bar)</b> Pressure peak exceeding 30% of the maximum operating pressure must be eliminated by adopting the appropriate measures		120	100						90		
<b>Pressure setting range (bar)</b>		D: 20-120	A: 15-50 C: 30-100						A: 30-50 C: 50-90		
<b>Permitted maximum drain port pressure (bar)</b>		1									
<b>Inlet pressure (bar)</b>		0.8 - 1.5 absolute									
<b>Speed range (rev/min)</b>		800 - 1800				800 - 1500					
<b>Rotation direction (viewed from shaft end)</b>		R - Right (clockwise)									
<b>Loads on drive shaft</b>		NO RADIAL OR AXIAL LOADS ALLOWED									
<b>Maximum torque on primary shaft (Nm)</b>	Tmax	110	250			586			900		
<b>Hydraulic fluid</b>		HM hydraulic oil according to ISO 6743/4 HLP according to DIN 5124/2									
<b>Viscosity range (cSt, mm²/s)</b>		22 - 68 at operating temperature									
<b>Starting viscosity under full flow conditions (cSt, mm²/s)</b>		400 max									
<b>Viscosity index according to ISO 2909</b>		100 min									
<b>Inlet fluid temperature range (°C)</b>		+15/ +60- pay attention to viscosity range									
<b>Maximum acceptable fluid contamination level</b>		20/18/15 according to ISO 4406/99, CLASS 9 according to NAS 1638									
<b>Recommended fluid contamination level for a longer pump working life</b>		18/16/13 according to ISO 4406/99, CLASS 7 according to NAS 1638									
<b>Moment of inertia (kgm²)</b>		0.00012	0.00050			0.00909			0,015		
<b>Weight (kg)</b>		7.4	18.3			43.8			56		
For further information and/or different operating conditions, please contact Danfoss Product Support											

# Vane Pump

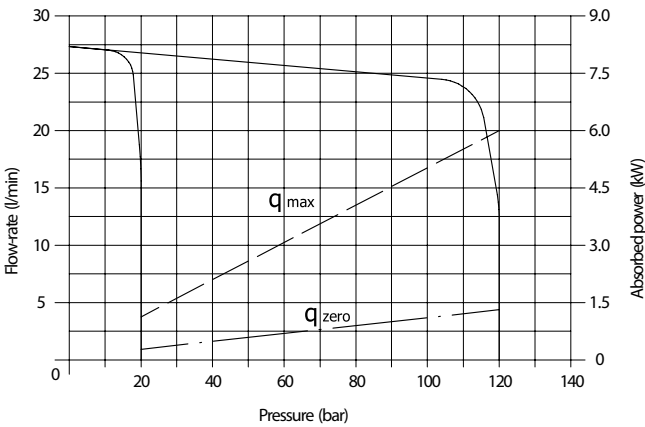
VVSL / VVPH Series

## Characteristic curves:

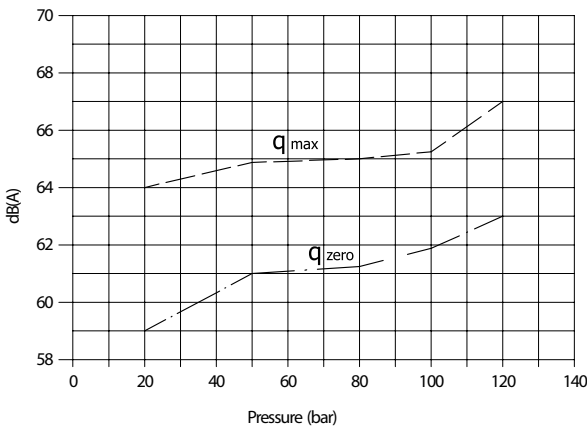
### VVSL0-16

Values displayed measured on test rig, referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40 °C .

#### Volumetric efficiency - zero flow setting curve

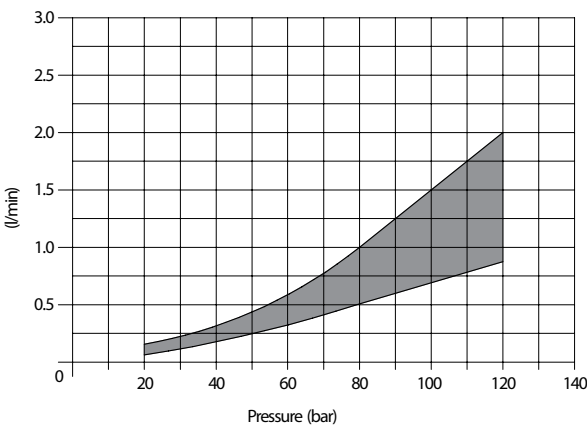


#### Noise level



Maximum noise level measured on test rig with sound-level meter placed 1 meter from the pump, with flexible coupling.

#### Case drain (leakage) flow-rate

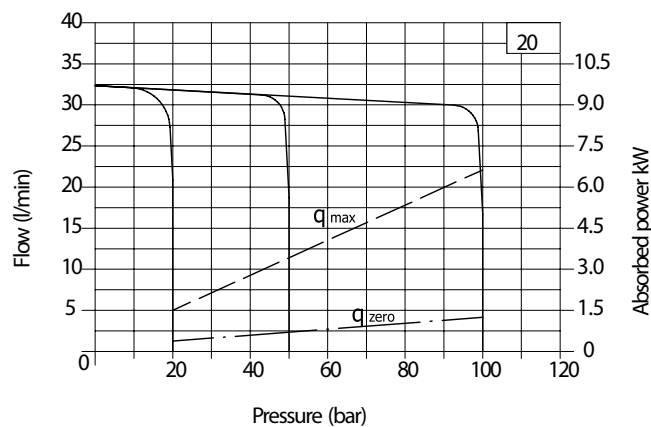


Pump under zero flow setting conditions

## VVSL1 20-25-32

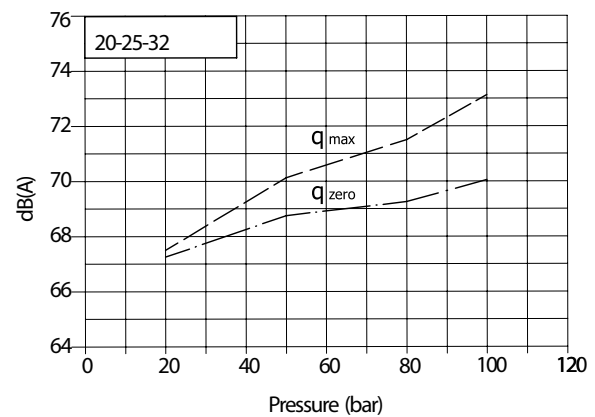
Values displayed measured on test rig, referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40 °C

### Volumetric efficiency - zero flow setting curve

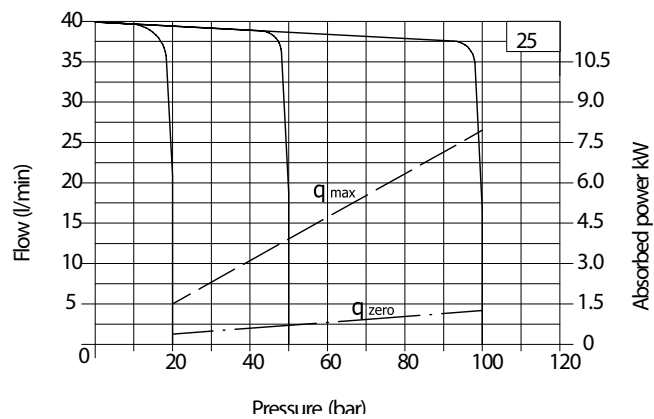


### Noise level

Maximum noise level measured on test rig with sound-level meter placed 1 meter from the pump, with flexible coupling.

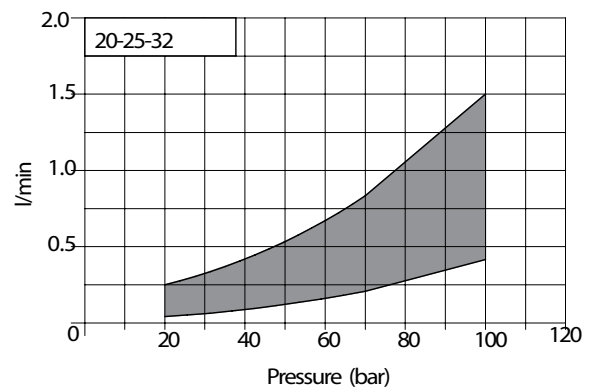


### Volumetric efficiency - zero flow setting curve

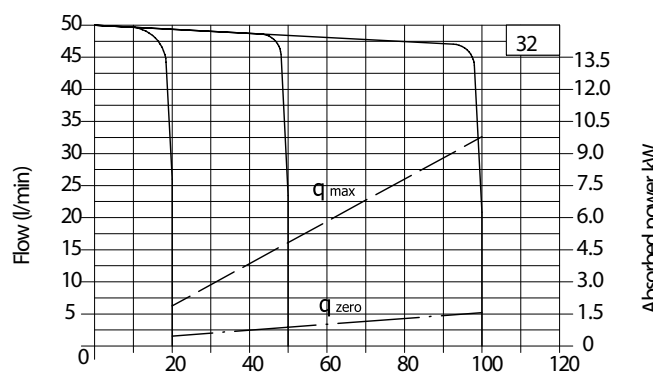


### Case drain (leakage) flow-rate

Data with pump under zero flow setting



### Volumetric efficiency - zero flow setting curve



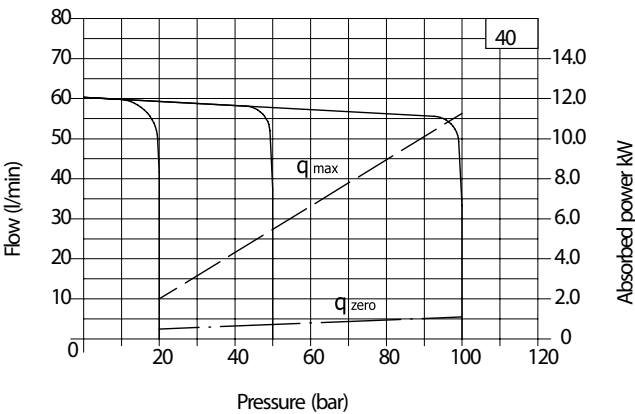
# Vane Pump

VVSL / VVPH Series

## VVSL2 40-50-63

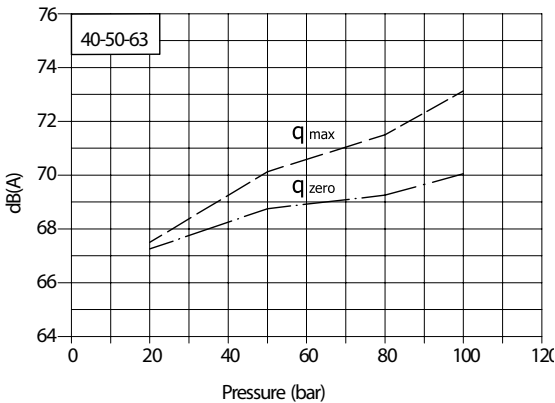
Values displayed measured on test rig, referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40 °C .

### Volumetric efficiency -zero flow setting curve

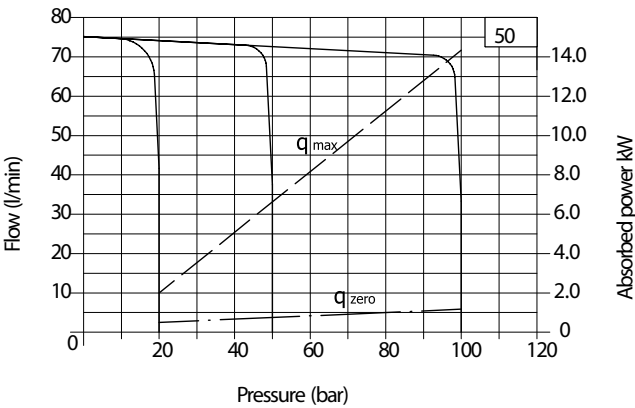


### Noise level

Maximum noise level measured on test rig with sound-level meter placed 1 meter from the pump, with flexible coupling.

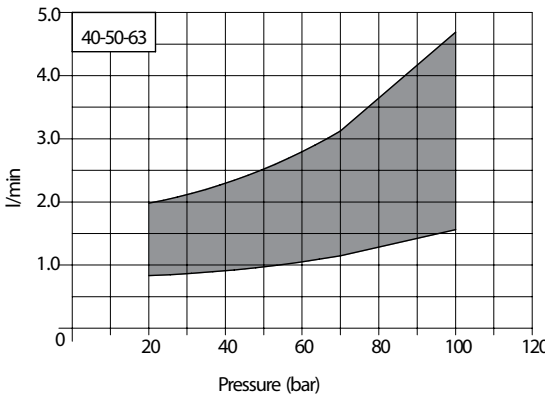


### Volumetric efficiency -zero flow setting curve

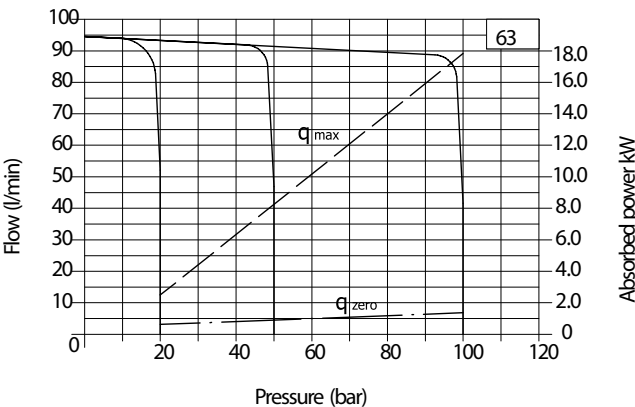


### Case drain (leakage) flow-rate

Data with pump under zero flow setting



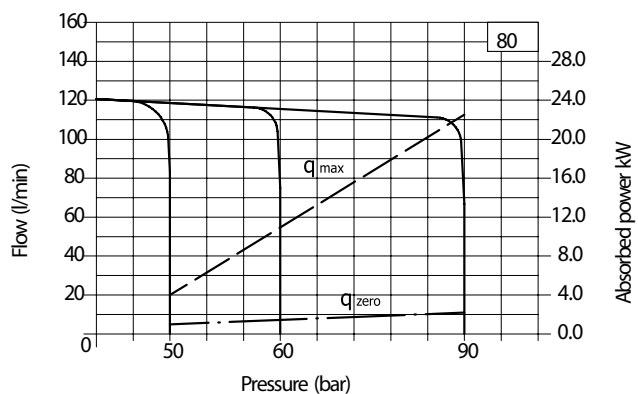
### Volumetric efficiency -zero flow setting curve



## VVSL3 80-100-120

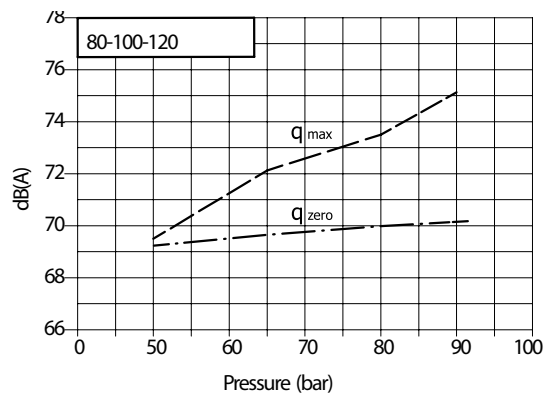
Values displayed measured on test rig, referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40 °C .

### Volumetric efficiency -zero flow setting curve

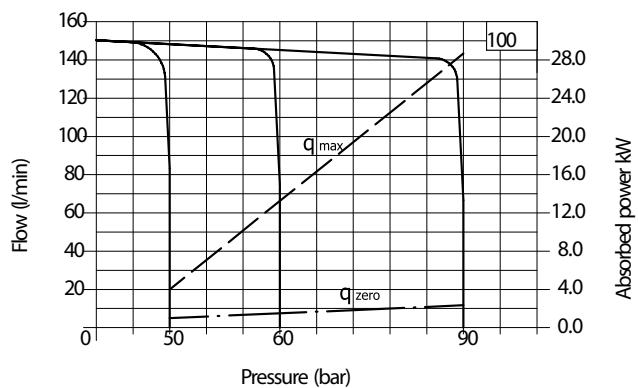


### Noise level

Maximum noise level measured on test rig with sound-level meter placed 1 meter from the pump, with flexible coupling.

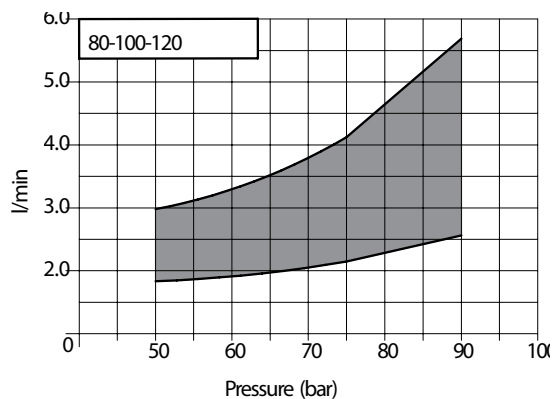


### Volumetric efficiency -zero flow setting curve

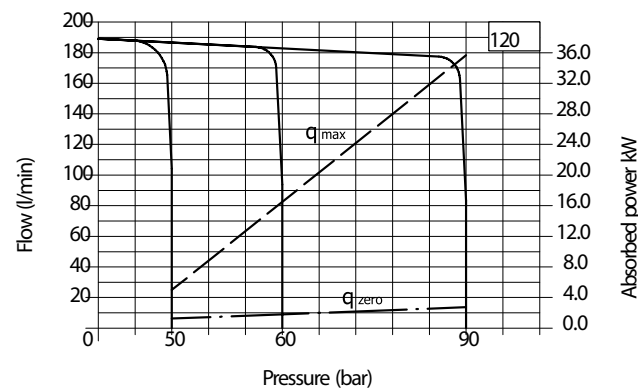


### Case drain (leakage) flow-rate

Data with pump under zero flow setting



### Volumetric efficiency -zero flow setting curve

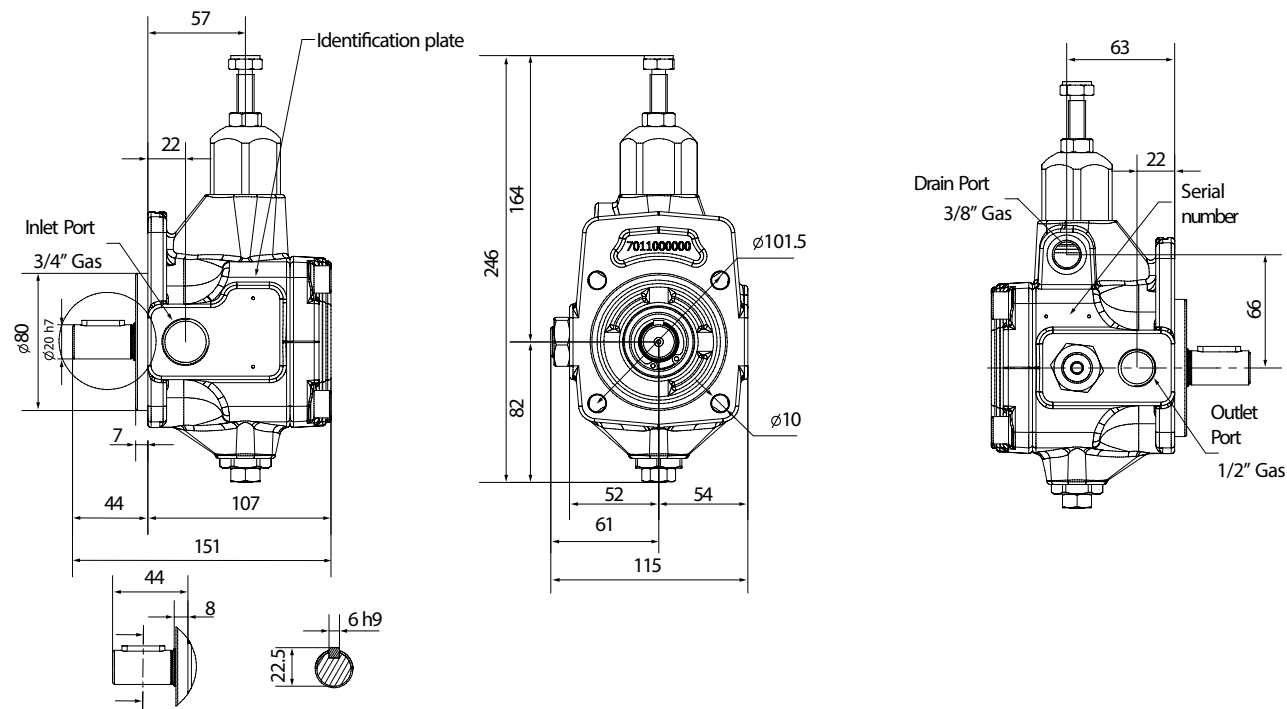


# Vane Pump

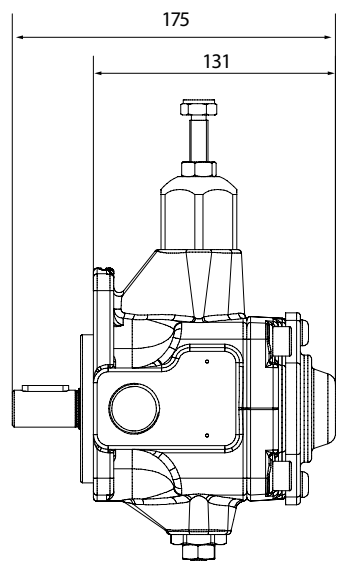
VVSL / VVPH Series

## Installation Dimensions

### VVSL0-16



Thru-drive shaft, covered (standard)



## VVSL / VVPH Series

Technical drawing of the 3000 Series Gas Valve, showing front, top, and side views with dimensions and labels.

**Front View Dimensions:**

- Overall width: 212
- Overall height: 113
- Inlet Port (1" Gas) diameter:  $\varnothing 100$
- Drain Port (1/2" Gas) diameter: 26
- Identification plate diameter: 46
- Serial number location: 86.5
- Bottom flange diameter:  $\varnothing 125$
- Bottom flange thickness: 28
- Bottom flange hole diameter:  $\varnothing 25$  h7
- Bottom flange hole offset: 9
- Bottom flange hole diameter: 46
- Bottom flange hole offset: 10
- Bottom flange hole diameter: 166
- Bottom flange hole offset: 212

**Top View Dimensions:**

- Overall width: 170.6
- Overall height: 315
- Bottom flange diameter:  $\varnothing 125$
- Bottom flange thickness: 28
- Bottom flange hole diameter:  $\varnothing 25$  h7
- Bottom flange hole offset: 9
- Bottom flange hole diameter: 46
- Bottom flange hole offset: 10
- Bottom flange hole diameter: 166
- Bottom flange hole offset: 212

**Side View Dimensions:**

- Overall width: 170.6
- Overall height: 315
- Bottom flange diameter:  $\varnothing 125$
- Bottom flange thickness: 28
- Bottom flange hole diameter:  $\varnothing 25$  h7
- Bottom flange hole offset: 9
- Bottom flange hole diameter: 46
- Bottom flange hole offset: 10
- Bottom flange hole diameter: 166
- Bottom flange hole offset: 212

**Labels:**

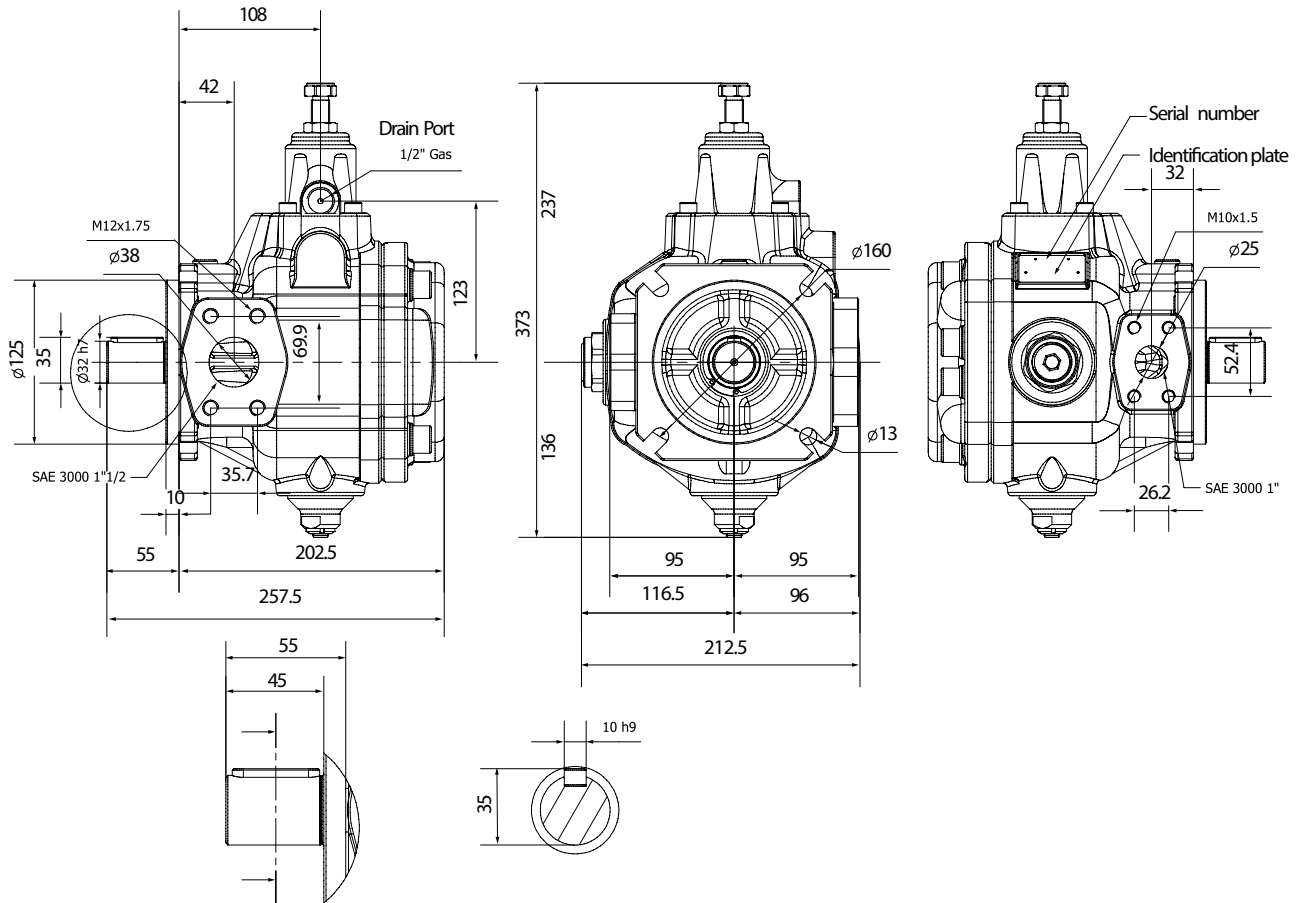
- Inlet Port 1" Gas
- Drain Port 1/2" Gas
- Serial number
- Identification plate
- Outlet Port 3/4" Gas

Technical drawing of a 3D printer nozzle assembly. The drawing shows a side view of the nozzle with two dimensions indicated: a total width of 236 and a distance of 190 from the left edge to the center of the nozzle tip.

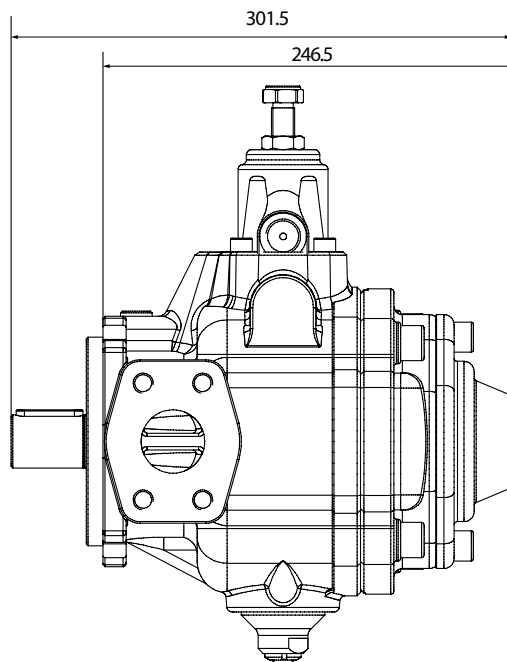
## Vane Pump

VVSL / VVPH Series

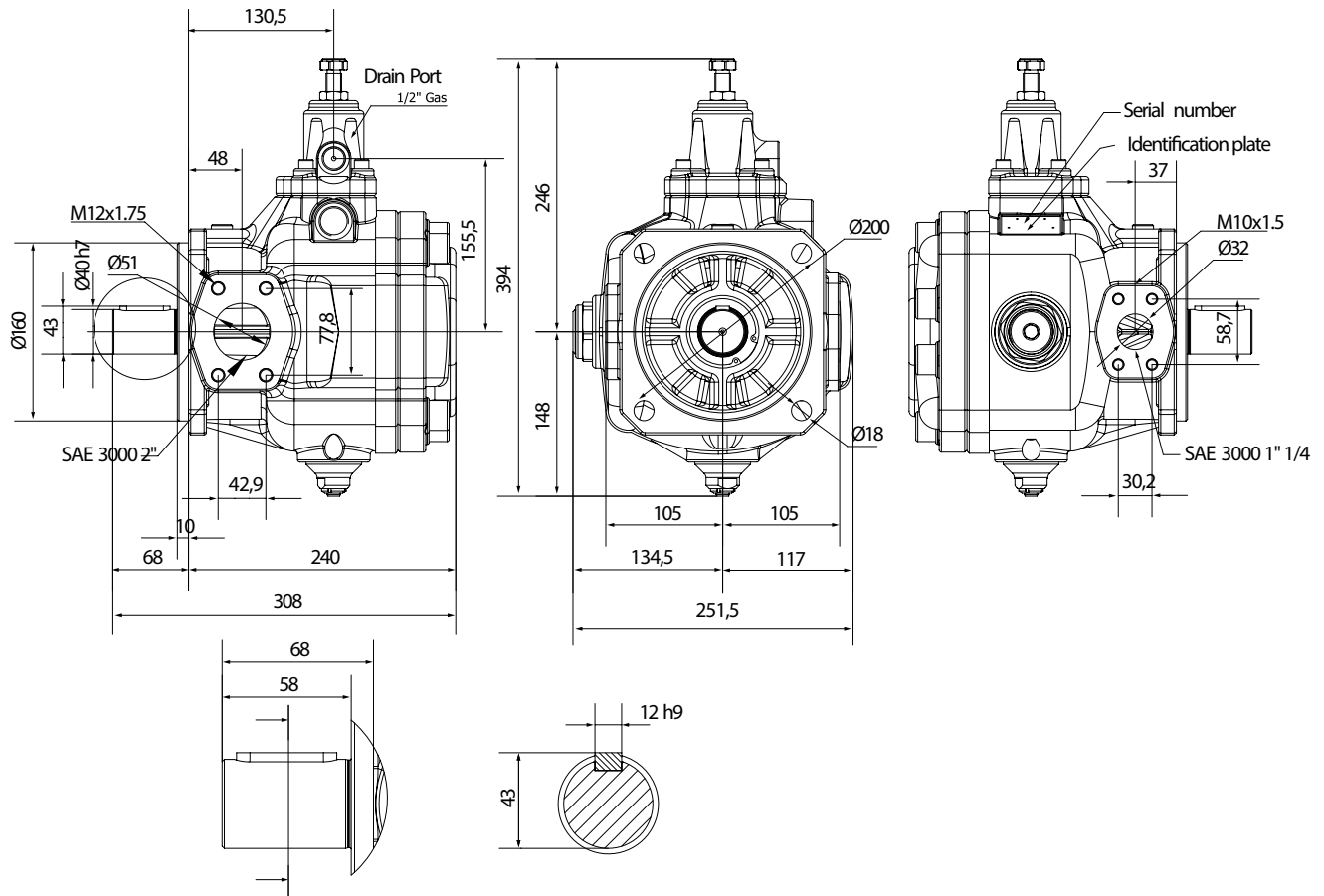
**VVSL2 40-50-63**



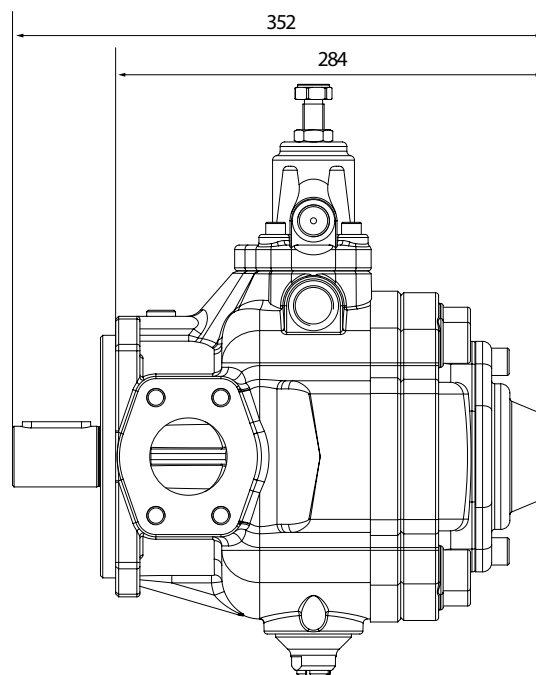
Thru-drive shaft, covered (standard)



## VVSL3 80-100-120



Thru-drive shaft, covered (standard)



# Vane Pump

VVSL / VVPH Series

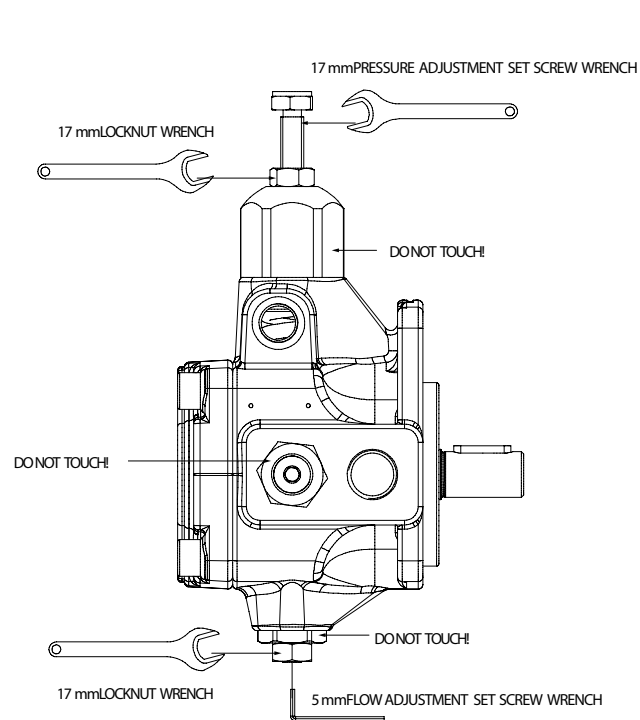
## Settings

### Pressure adjustment

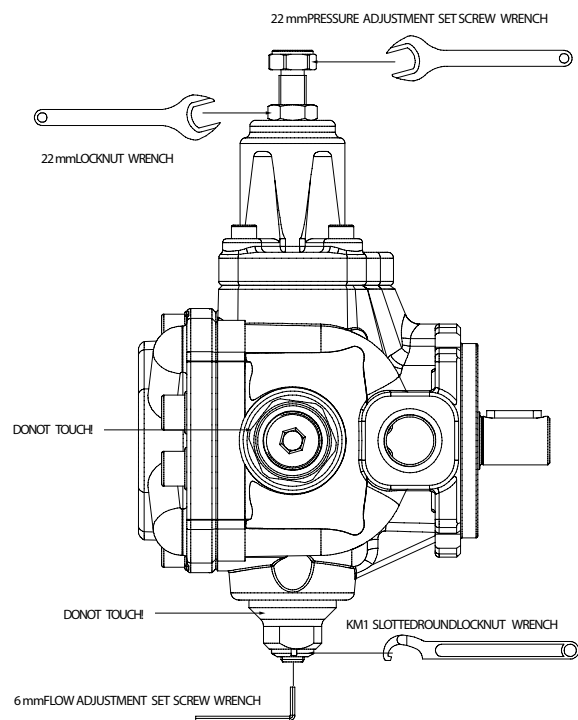
All VVSL series pumps are equipped with a mechanical pressure adjustment unit. This allows the pump pressure to be set at the zero-flow setting. Clockwise rotation increases pressure (pay attention to avoid going out of the pressure setting range specified (Technical Data)).

**Warning:** During the first run, make sure that the pressure adjustment screw is tightened enough to ensure the correct priming of the pump.

#### VVSL 0



#### VVSL 1-2-3



### Flow adjustment

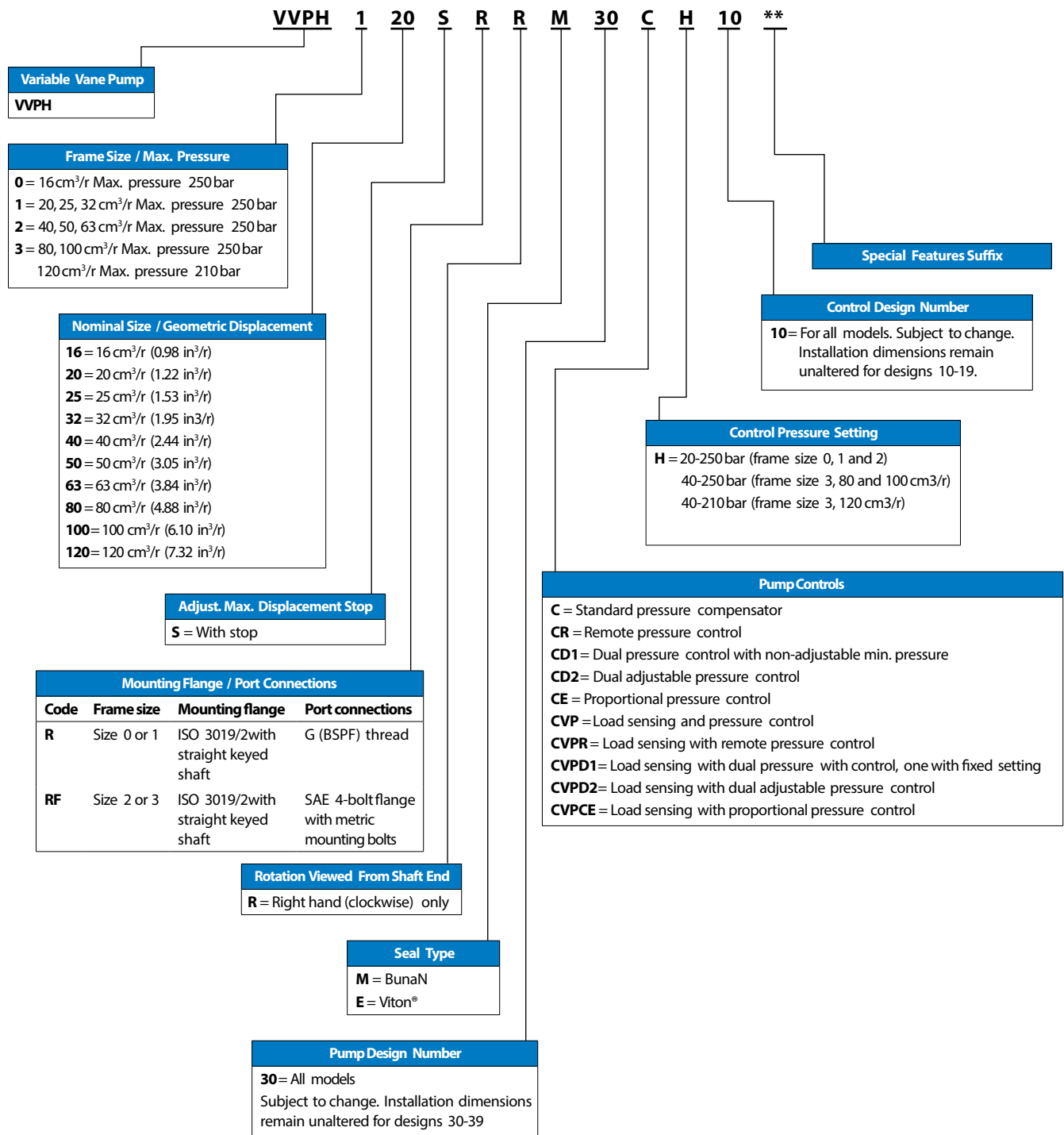
All VVSL series pumps are equipped with a displacement adjustment screw. This allows the mechanical reduction of the pump displacement in relation to the nominal value. Clockwise rotation decreases the pump displacement.

**Warning:** If the flow adjustment screw is set to less than 50% of the nominal displacement, the pump can only start on condition that the system and pump are completely filled with fluid.

Frame / Size (nominal)	Actual displacement	Reduced displacement by screw turn	Minimum achievable displacement
0-16	17 cm <sup>3</sup>	9,7 cm <sup>3</sup>	3.1 cm <sup>3</sup>
1-20	21 cm <sup>3</sup>	10 cm <sup>3</sup>	9.5 cm <sup>3</sup>
1-25	26 cm <sup>3</sup>	10 cm <sup>3</sup>	15 cm <sup>3</sup>
1-32	33 cm <sup>3</sup>	10 cm <sup>3</sup>	19 cm <sup>3</sup>
2-40	42 cm <sup>3</sup>	16 cm <sup>3</sup>	27.5 cm <sup>3</sup>
2-50	51 cm <sup>3</sup>	16 cm <sup>3</sup>	35.5 cm <sup>3</sup>
2-63	63 cm <sup>3</sup>	16 cm <sup>3</sup>	43.5 cm <sup>3</sup>
3-80	80 cm <sup>3</sup>	16 cm <sup>3</sup>	63 cm <sup>3</sup>
3-100	100 cm <sup>3</sup>	16 cm <sup>3</sup>	80 cm <sup>3</sup>
3-120	120 cm <sup>3</sup>	16 cm <sup>3</sup>	100 cm <sup>3</sup>
Stated values influenced by manufacturing tolerances.			

## 4. Series VVPH Pumps

### Model code



**Note:** See page 33-36 for detailed dimensional listing for mounting flanges, shafts and ports.

# Vane Pump

VVSL / VVPH Series

## Technical Data

### VVPH Series

NOMINAL SIZE		SIZE 0	SIZE 1			SIZE 2			SIZE 3		
Geometric displacement according to UN-ISO 3662 (cm3/r)		16	20	25	32	40	50	63	80	100	120
Actual displacement (cm3/rev) Due to manufacturing tolerances, the value can vary by approx. ± 3%		17	21	26	33	42	51	63	80	100	123
Maximum working pressure (bar) Pressure peak exceeding 30%(10% only for size 3) of the maximum operating pressure must be eliminated		250									210
Pressure setting range (bar)		H: 20 - 250							H: 40 - 250		H: 40 - 210
Permitted maximum drain port pressure (bar)		1									
Inlet pressure (bar)		0.8 - 1.5 absolute									
Speed range (rev/min)		800 - 1800				800 - 1500					
Rotation direction (viewed from shaft end)		R - Right (clockwise)									
Loads on drive shaft		NO RADIAL OR AXIAL LOADS ALLOWED									
Maximum torque on primary shaft (Nm)	Tmax	130	250			586			900		
Hydraulic fluid		HM hydraulic oil according to ISO 6743/4 HLP according to DIN 5124/2									
Viscosity range (cSt, mm²/s)		22 - 68 at operating temperature									
Starting viscosity under full flow conditions (cSt, mm2/s)		400 max									
Viscosity index according to ISO 2909		100 min									
Inlet fluid temperature range (°C)		+15/ +60 - pay attention to viscosity range									
Maximum acceptable fluid contamination level		20/18/15 according to ISO 4406/99, CLASS 9 according to NAS 1638									
Recommended fluid contamination level for a longer pump working life		18/16/13 according to ISO 4406/99, CLASS 7 according to NAS 1638									
Moment of inertia (kgm2)		0,00019	0,00050			0,00909			0,015		
		Single pump weight (kg)									
C - standard pressure compensator		16.5	18.5			43.7			57.2		
CR - remote pressure control		18.5	20.5			45.7			59.2		
CD1 - dual pressure control		18.0	20			45.2			58.7		
CD2 - dual adjustable pressure control		19.0	21.3			46.2			59.7		
CE - proportional pressure control		18.0	20			45.2			58.7		
CVP - load sensing compensator		19.0	21			46.2			59.7		
CVPR - load sensing with remote pressure control		19.5	21.3			46.7			60.2		
CVPD1 - load sensing with dual pressure control		19.0	21			46.2			59.7		
CVPD2 - load sensing with dual adjustable pressure control		20.0	22			47.2			60.7		
CVPCE - load sensing with proportional pressure control		19.0	21			46.2			59.7		
For further information and/or different operating conditions, please contact Danfoss Product Support											

### Controls

#### Standard Pressure Control "C"

##### Hydraulic single-stage pressure control

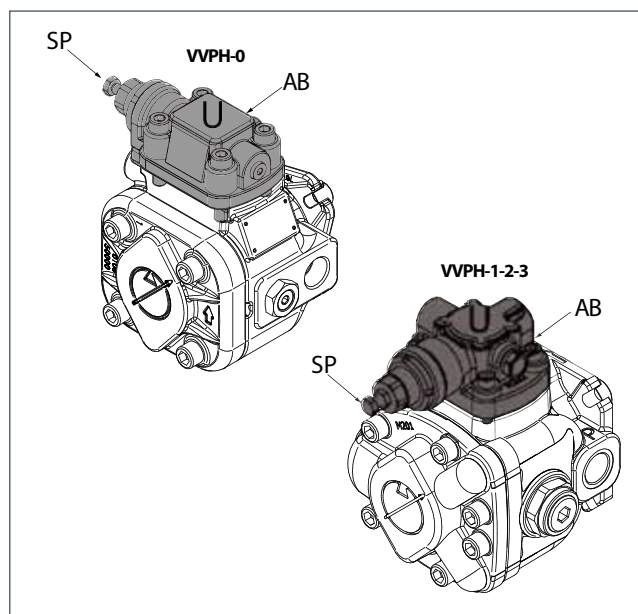
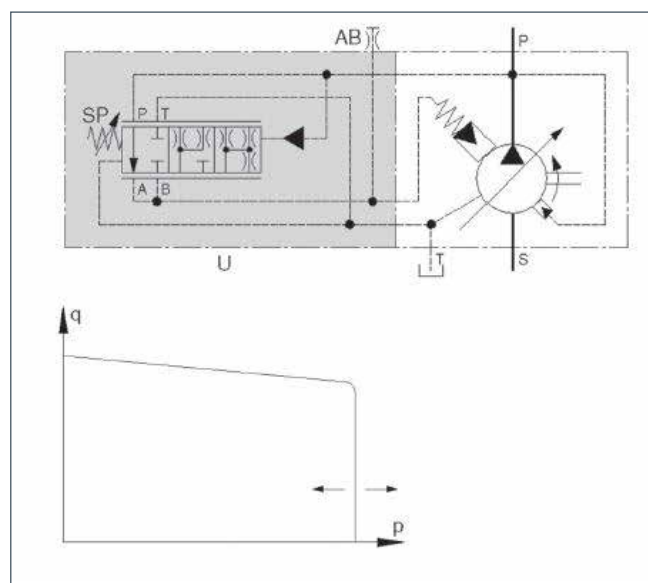
This standard control enables the pump displacement to be adjusted (until "zero flow setting" condition) according to the flow rate required by the hydraulic system, keeping the working pressure constant and equal to the value set on the compensator device.

The pressure setting of the compensator device is adjusted by means of the "SP" pressure setting screw and locked using the corresponding locknut.

Pressure setting	
Pressure setting screw	CH 13 mm HEX
Pressure setting locknut	CH 13 mm HEX
Clockwise rotation increases the pressure setting	

Control devices	
"U"	Standard pressure compensator device

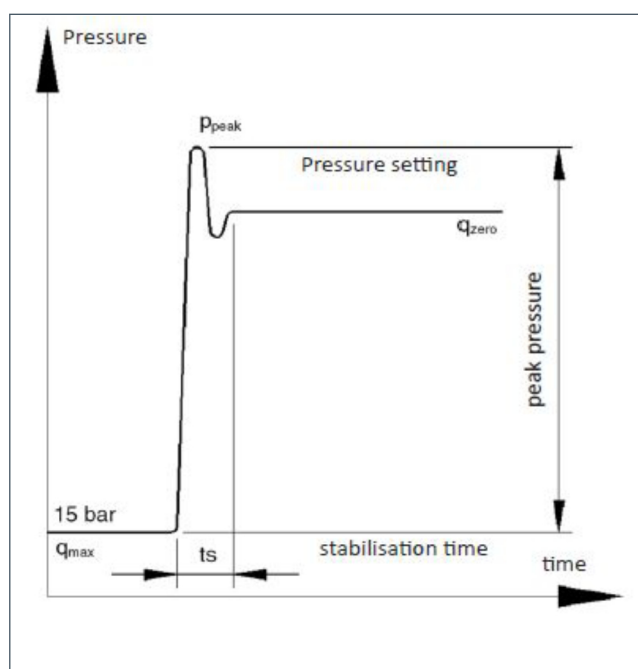
Connections	
"AB" - Air bleed	"1/4" Gas BSP ■
■	Supplied port closed



Dynamic characteristic of pressure compensator device		
Test: Full flow - zero flow setting condition		
Pump type	15 - 210 bar	15 - 250 bar
	ts	ts
VVPH0	50 ms	40 ms
VVPH1	80 ms	60 ms
VVPH2	100 ms	80 ms
VVPH3	120 ms	100 ms

Testing condition on:

- Dynamic response curves obtained by abruptly closing the pump outlet using a solenoid operated directional valve located around 0.5 m from the pump outlet port
- HM hydraulic fluid accordingly to ISO 6743/4, ISO VG46 according to ISO 3448, temperature 40°C, 1500 rpm
- Pressure peak exceeding 30% (10% only for size 3) of the maximum operating pressure must be eliminated**
- Indicate values. For further information please contact Danfoss



# Vane Pump

VVSL / VVPH Series

## Remote Pressure Control "CR"

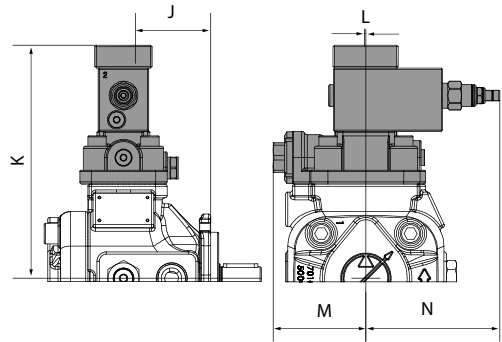
### Hydraulic control with remote pressure control

This function of this control is the same as the standard control function with the addition of the possibility of adjusting the working pressure by means of an additional maximum pressure relief valve "RV" installed in a remote position, far from the pump.

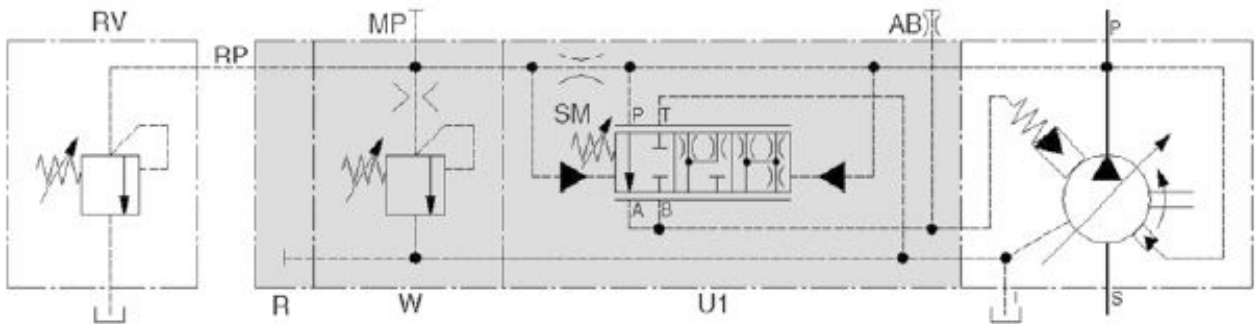
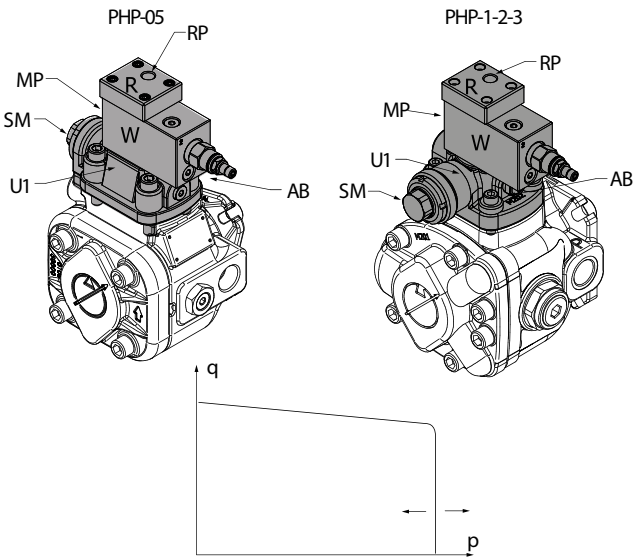
Control performances depends on the additional valve type and on its distance from the pump.

Control devices	
"U1"	Pressure compensator device for additional controls
"SM"	"Minimum pressure" spring adjustment (factory preset - do not tamper)
"W"	Maximum pressure relief valve (factory preset at maximum value)
"R"	Remote control block
"RV"	Additional remote maximum pressure relief valve (Properties: 0 - 51 /min(not supplied))

Connections	
"AB" - Air bleed	"1/4" Gas BSP <input checked="" type="checkbox"/>
"MP" - Pressure gauge	"1/4" Gas BSP <input checked="" type="checkbox"/>
"RP" - Remote control port	"1/4" Gas BSP <input type="checkbox"/>
The pilot pipe length between the pump and the additional valve "RV" must not exceed 5mm.	
<input type="checkbox"/>	Must be connected
<input checked="" type="checkbox"/>	Supplied port closed



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
J	66	76	97.7	120.2
K	203	204	237.5	246.5
L	1.3	1.3	1.3	1.3
M	81	-	-	-
N	117	117	117	117
Indicative dimensions. For further information please contact Danfoss.				



### Dual Pressure Control "CD1"

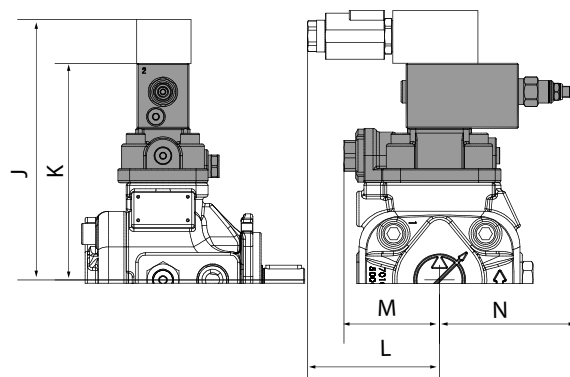
#### Hydraulic two-stage pressure control, one with fixed setting

This function of this control is the same as the standard control with the addition of the option to mount a directional control valve "EV" on the top of the compensator in order to switch between two working pressure level, one of which is fixed.

Control performances depends on the type of additional directional control valve.

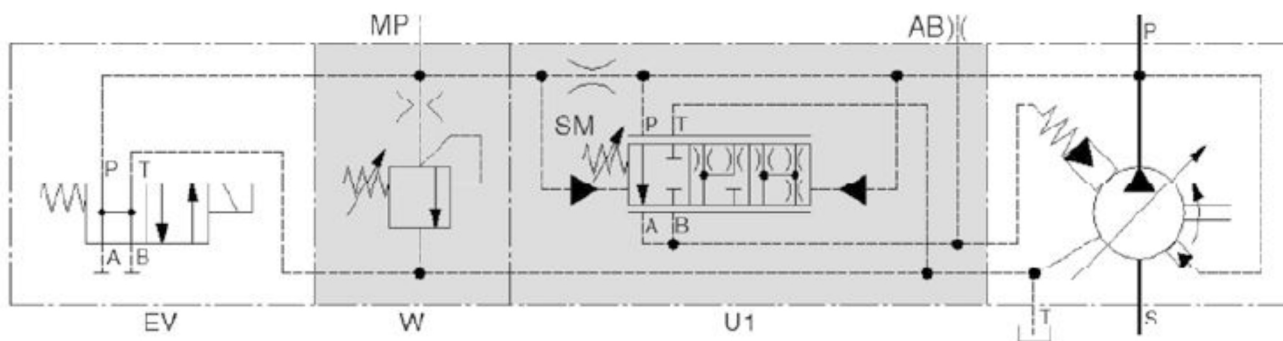
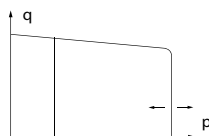
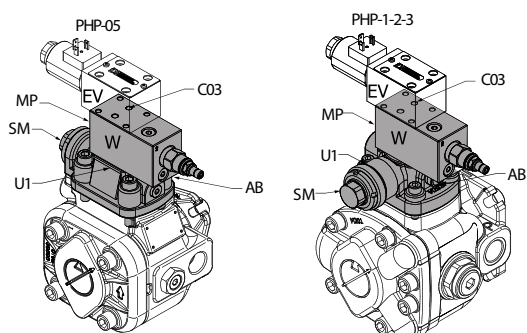
Control devices	
"U1"	Pressure compensator device for additional controls
"SM"	"Minimum pressure" spring adjustment (1st pressure level at fixed pressure setting do not tamper)
"W"	Maximum pressure relief valve (2nd adjustable pressure level)
"EV"	Directional control valve (supplied only on request). For information please contact Danfoss

Connections	
"AB" - Air bleed	"1/4" Gas BSP ■
"MP" - Pressure gauge	"1/4" Gas BSP ■
Surface - "C03" (see installation dimensions)	ISO 4401-03 (CETOP 03)
□	Must be connected
■	Supplied port closed



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
J	(*)	(*)	(*)	(*)
K	183	184	217.5	226.5
L	(*)	(*)	(*)	(*)
M	81	-	-	-
N	117	117	117	117

(\*): Please consult the directional control valve catalog. Indicative dimensions. For further information please contact Danfoss.



# Vane Pump

VVSL / VVPH Series

## Dual Pressure Control “CD2”

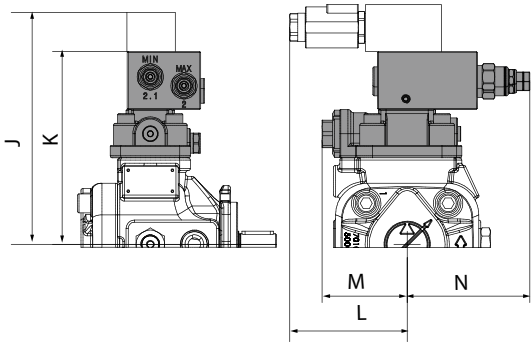
### Hydraulic two-stage pressure control, both adjustable

This function of this control is the same as the standard control with the addition of the option to mount a directional control valve “EV1” on the top of the compensator in order to switch between two adjustable working pressure levels.

Control performances depends on the type of additional directional control valve.

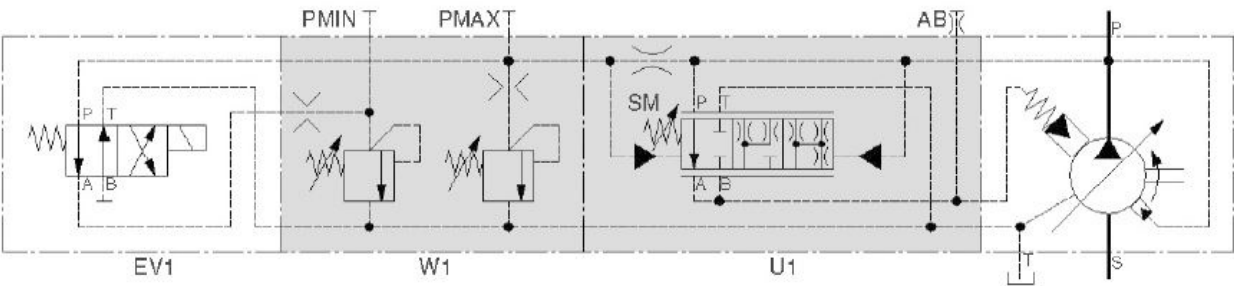
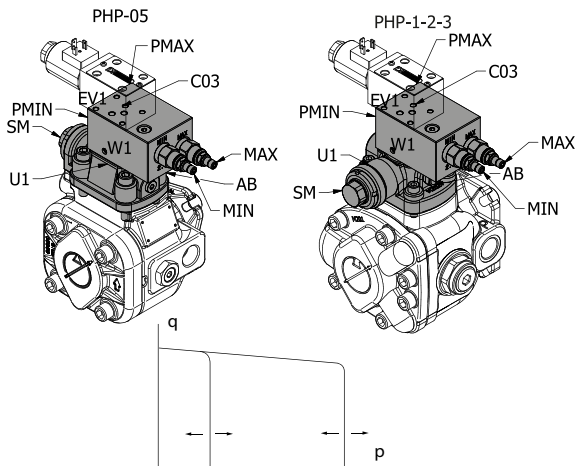
Control devices	
“U1”	Pressure compensator device for additional controls
“SM”	“Minimum pressure” spring adjustment (factory preset - do not tamper)
“W1”	Maximum pressure relief valve block “MIN” 1st adjustable pressure level “MAX” 2nd adjustable pressure level
“EV1”	Directional control valve (supplied only on request). For information please contact Danfoss

Connections		
“AB” - Air bleed		“1/4” Gas BSP <input checked="" type="checkbox"/>
Pressure gauge	“PMIN”	“1/4” Gas BSP <input checked="" type="checkbox"/>
	“PMAx”	
Surface - “C03” (see installation dimensions)		ISO 4401-03 (CETOP 03)
<input type="checkbox"/>	Must be connected	
<input checked="" type="checkbox"/>	Supplied port closed	



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
J	(*)	(*)	(*)	(*)
K	183	184	217.5	226.5
L	(*)	(*)	(*)	(*)
M	81	-	-	-
N	117	117	117	117

(\*): Please consult the directional control valve catalog. Indicative dimensions. For further information please contact Danfoss.



### Proportional Pressure Control "CE"

#### Hydraulic control with proportional pressure adjustment

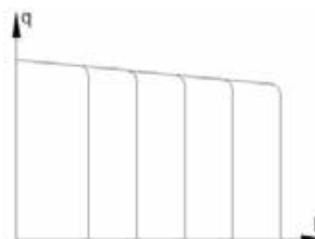
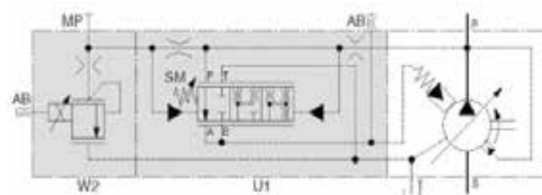
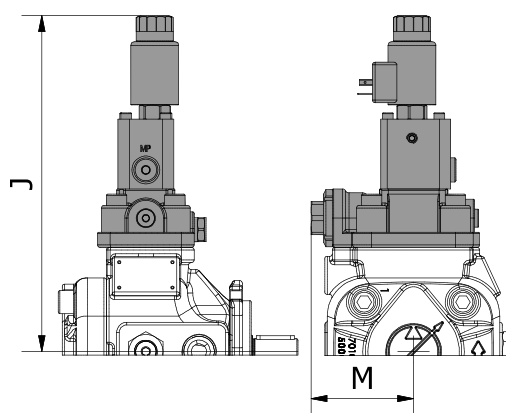
This control, with integrated proportional valve "W2" mounted on top of the compensator, enables the pump working pressure to be adjusted proportionally by means of an electrical signal.

Control performance depends on the type of electronic control unit for the proportional valve (**unit supplied on request only**).

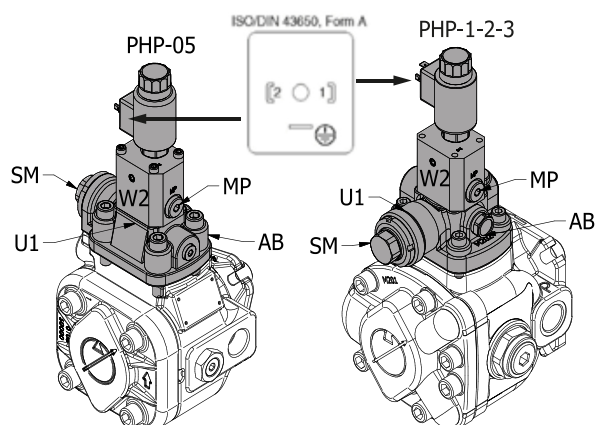
Electrical properties	
Voltage	24 VDC $\pm 10\%$
Maximum current	590 mA
Power consumption	22 watt
Nominal coil resistance at 50°C	37.2 $\Omega \pm 5\%$
Nominal coil resistance at 20°C	26.2 $\Omega \pm 5\%$
Maximum coil temperature at 20°C	105°C
Protection glass	IP65
Recommended dither frequency	160 - 200 Hz (*)
Linearity, Hysteresis, Repeatability	< 5% (*)
Connections	ISO/DIN 43650, Form A
(*): Depend on electronic control unit for the proportional valve. For available electronic control unit types, please contact Danfoss.	

Control devices	
"U1"	Pressure compensator device for additional controls
"SM"	"Minimum pressure" spring adjustment (factory preset - do not tamper)
"W2"	Proportional maximum pressure relief valve

Connections	
"AB" - Air bleed	"1/4" Gas BSP ■
"MP" - Pressure gauge	"1/4" Gas BSP ■
■	Supplied port closed



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
J	272	272	299	308
M	81	-	-	-
Indicative dimensions. For further information please contact Danfoss.				



# Vane Pump

VVSL / VVPH Series

## Load Sensing and Pressure Control “CVP”

### Hydraulic control with load sensing device and single-stage pressure control

The load sensing control system adds to the pressure setting adjustment system of the compensator device the option of regulating the pump flow-rate according difference  $\Delta p$  measured on either side of the throttle valve.

The pilot pressure of the load sensing compensator device is taken from the pump outlet line after throttle valve “Z” (manual or proportional) and before the actuators. Changing the position of the pump displacement independently of pressure variations that occur in the hydraulic system.

The load sensing control produces a notable reduction in displaced power and is recommended for use in applications where there are significant variations in torque (force) and speed.

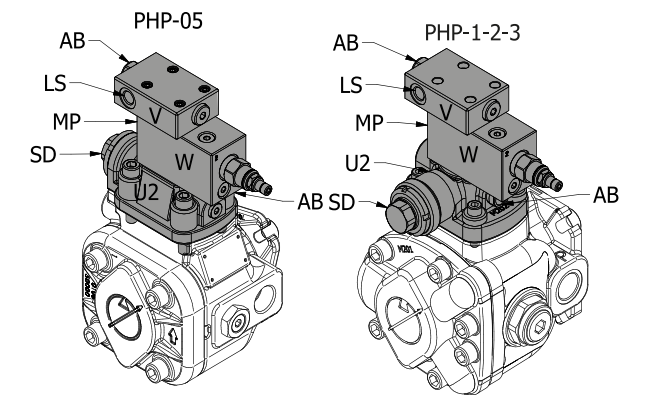
In the CVP control system, the adjustment of the single-stage pressure setting of the compensator device occurs by means of the maximum pressure relief valve “W”.

**Note:** When the throttle valve “Z” is completely closed, the pump will be in “zero flow setting condition”, keep the working pressure constant and equal to the “differential pressure  $\Delta p$ ” value.

Control performance depends on the type of throttle valve “Z” and on the length / dimensions of the load sensing pilot pressure line.

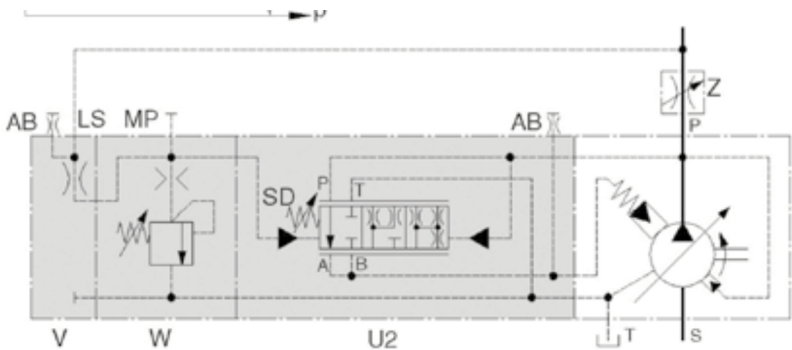
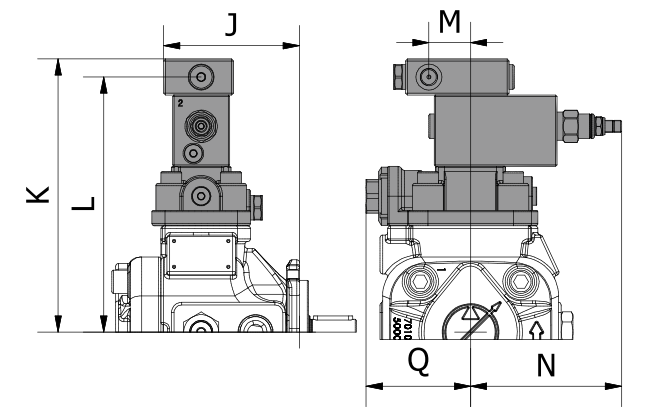
Connections		
“AB” - Air bleed	“1/4” Gas BSP	■
“MP” - Pressure gauge	“1/4” Gas BSP	■
“LS” - Load sensing port	“1/4” Gas BSP	□
The length between the throttle valve and the load sensing port must not exceed 5m.		
■	Supplied port closed	
□	Must be connected	

Control devices	
“U2”	Load sensing pressure compensator device
“SD”	Differential pressure $\Delta p$ adjustment
“W”	Maximum pressure relief valve
“V”	Load sensing valve
“Z”	Throttle valve (manual or proportional) ( <b>not supplied</b> )



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
J	105	115	137	159.5
K	211	212	245.5	254.5
L	197	198	234.5	240.5
M	32	32	32	32
N	117	117	117	117
Q	81	-	-	-

Indicative dimensions. For further information please contact Danfoss.



### Load Sensing with Remote Pressure Control "CVPR"

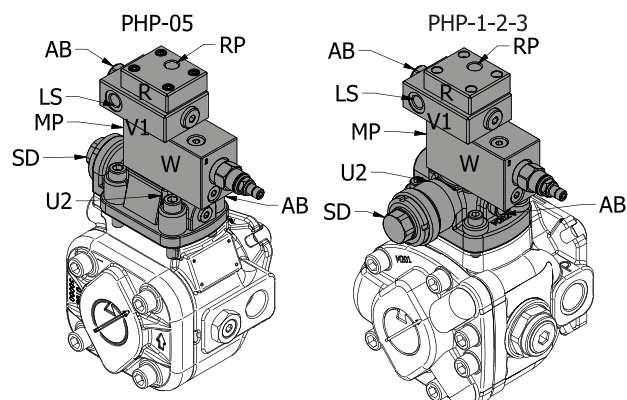
#### Hydraulic control with load sensing device and remote pressure control

The function of this control is the same as the standard control function with the addition of the possibility of adjusting the working pressure by means of an additional maximum pressure relief valve "RV" installed in a remote position, far from the pump.

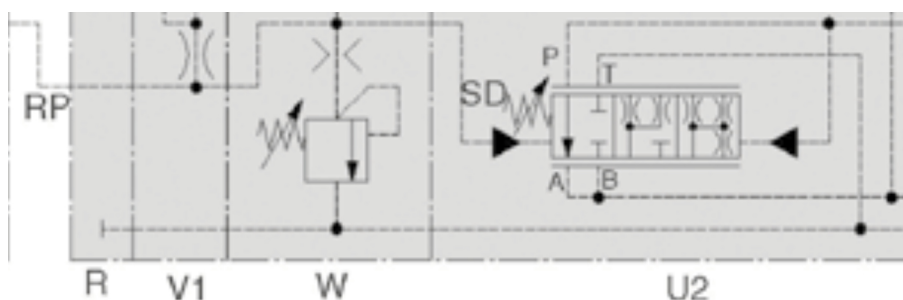
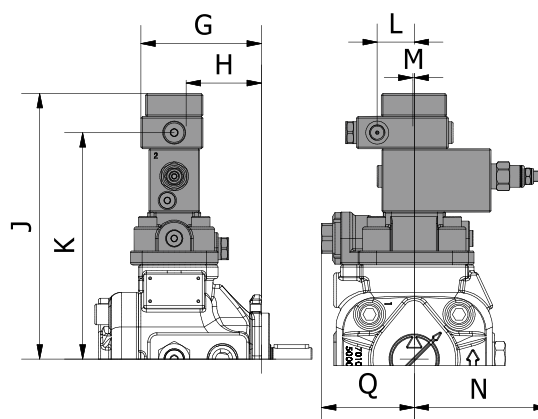
Control performance depends on type of throttle valve "Z", on the length / dimensions of the load sensing pilot pressure line, on the type of additional valve "RV", and on its distance from the pump.

Connections		
"AB" - Air bleed	"1/4" Gas BSP	■
"MP" - Pressure gauge	"1/4" Gas BSP	■
"LS" - Load sensing port	"1/4" Gas BSP	□
The length between the throttle valve and the load sensing port must not exceed 5m.		
■	Supplied port closed	
□	Must be connected	

Control devices	
"U2"	Load sensing pressure compensator device
"SD"	Differential pressure $\Delta p$ adjustment
"W"	Maximum pressure relief valve (factory preset at maximum value)
"V1"	Load sensing block for additional controls
"R"	Remote control block
"Z"	Throttle valve (manual or proportional) <b>(not supplied)</b>
"RV"	Additional remote maximum pressure relief valve (Properties: 0 - 5 l/min) <b>(not supplied)</b>



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
G	105	115	137	159.5
H	66	76	97.5	120
J	231	232	265.5	274.5
K	197	198	231.5	240.5
L	32	32	32	32
M	1.3	1.3	1.3	1.3
N	117	117	117	117
Q	81	-	-	-
Indicative dimensions. For further information please contact Danfoss.				



# Vane Pump

VVSL / VVPH Series

## Load Sensing with Dual Pressure Control “CVPD1”

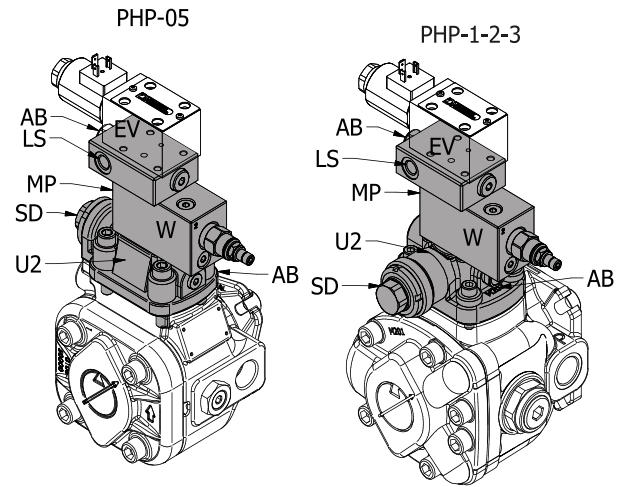
### Hydraulic control with load sensing device and two-stage pressure control, one with fixed setting

The function of this control is the same as the load sensing standard control with the addition of the option to mount a directional control valve “EV” on the top of the compensator in order to switch between two working pressure levels, one of which is fixed.

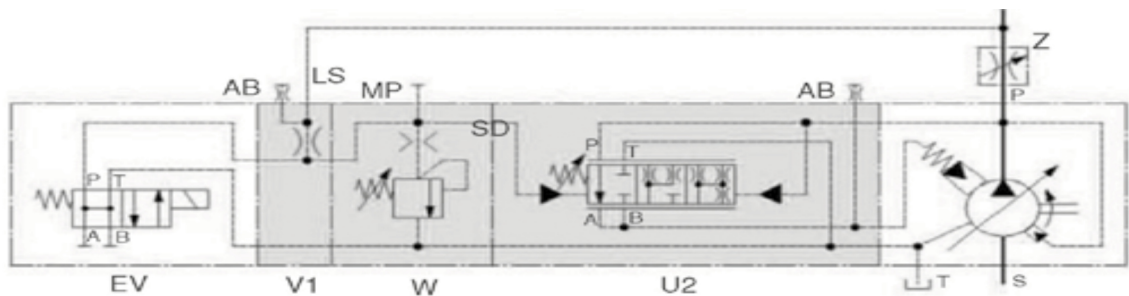
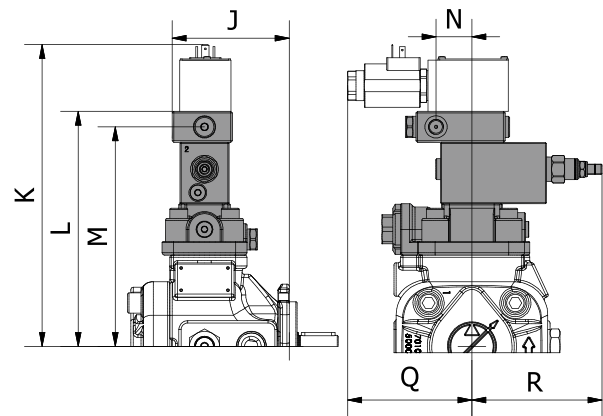
Control performance depends on the type of throttle valve “Z”, on the length / dimensions of the load sensing pilot pressure line, on the type of additional directional control valve.

Connections		
“AB” - Air bleed	“1/4” Gas BSP	■
“MP” - Pressure gauge	“1/4” Gas BSP	■
“LS” - Load sensing port	“1/4” Gas BSP	□
The length between the throttle valve and the load sensing port must not exceed 5m.		
Surface - “CO3” (See pages 10-12)	ISO 4401-03 (CETOP 03)	□
■	Supplied port closed	
□	Must be connected	

Control devices	
“U2”	Load sensing pressure compensator device
“SD”	Differential pressure $\Delta p$ adjustment (1st pressure level at fixed pressure setting)
“W”	Maximum pressure relief valve (factory preset at maximum value)
“V1”	Load sensing block for additional controls
“EV”	Directional control valve (supplied only on request) for information please contact Danfoss
“Z”	Throttle valve (manual or proportional) ( <b>not supplied</b> )



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
G	105	115	137	159.5
H	66	76	97.5	120
J	231	232	265.5	274.5
K	197	198	231.5	240.5
L	32	32	32	32
M	1.3	1.3	1.3	1.3
N	117	117	117	117
Q	81	-	-	-
Indicative dimensions. For further information please contact Danfoss.				



### Load Sensing with Dual Adjustable Pressure Control "CVPD2"

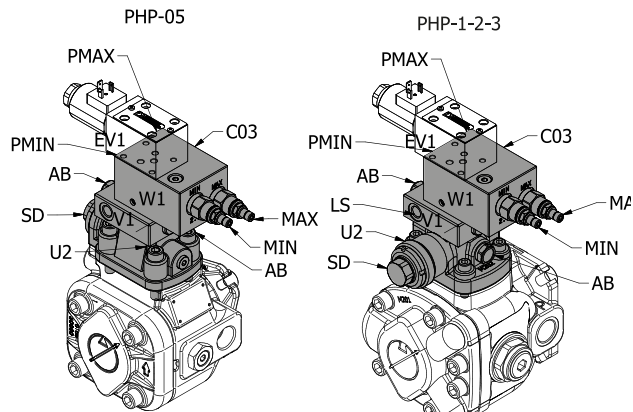
#### Hydraulic control with load sensing device and two-stage pressure control, one with fixed setting

The function of this control is the same as the load sensing standard control with the addition of the option to mount a directional control valve "EV" on the top of the compensator in order to switch between two working pressure levels, one of which is fixed.

Control performance depends on the type of throttle valve "Z", on the length / dimensions of the load sensing pilot pressure line, on the type of additional directional control valve.

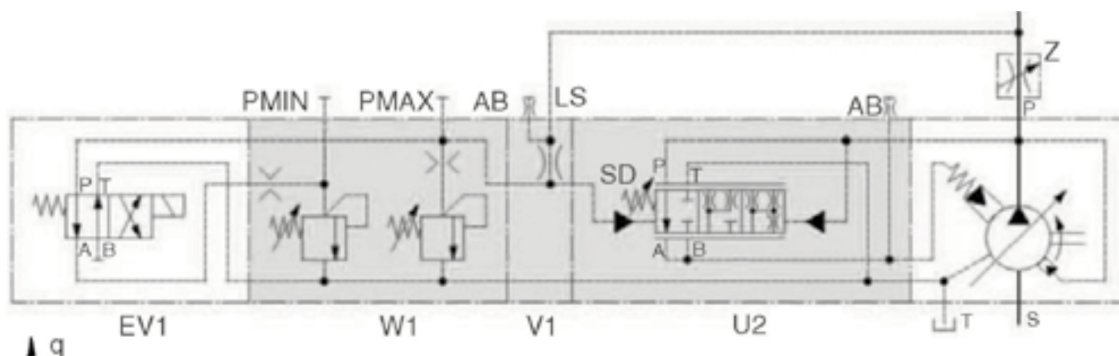
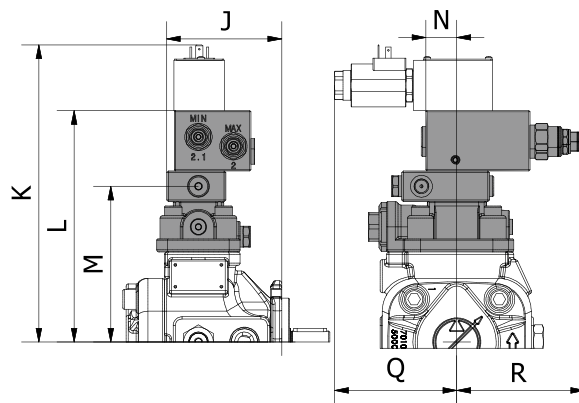
Connections			
"AB" - Air bleed		"1/4" Gas BSP	■
Pressure gauge	"PMIN"	"1/4" Gas BSP	■
	"PMAx"		
"LS" - Load sensing port		"1/4" Gas BSP	□
The length between the throttle valve and the load sensing port must not exceed 5m.			
Surface - "C03" (see pg 10-12)		ISO 4401-03 (CETOP 03)	□
□	Must be connected		
■	Supplied port closed		

Control devices	
"U2"	Load sensing pressure compensator device
"SD"	Differential pressure $\Delta p$ adjustment (1st pressure level at fixed pressure setting)
"W1"	Maximum pressure relief valve block "MIN" 1st adjustable pressure level "MAX" 2nd adjustable pressure level
"V1"	Load sensing block for additional controls
"EV1"	Directional control valve (supplied only on request) for information please contact Danfoss
"Z"	Throttle valve (manual or proportional) ( <b>not supplied</b> )



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
J	105	115	137	159.5
K	(*)	(*)	(*)	(*)
L	211	212	245.5	254.5
M	142	143	176.5	185.5
N	32	32	32	32
Q	(*)	(*)	(*)	(*)
R	117	117	117	117

(\*): Please consult the directional control valve catalog. Indicative dimensions. For further information please contact Danfoss.



## VVSL / VVPH Series

## 2 Hydraulic control with load sensing device and proportional pressure adjustment

This control, with integrated proportional valve "W2" on top of the compensator, adds to the adjustment of the pump flow-rate through the load sensing system the possibility of proportionally setting the pump working pressure by means of an electrical signal.

Control performance depends on the type of throttle valve "Z", on the length / dimensions of the load sensing pilot pressure line, and on the proportional valve electronic control unit **(unit supplied only on request)**

Electrical properties	
Voltage	24 VDC $\pm 10\%$
Maximum current	590 mA
Power consumption	22 watt
Nominal coil resistance at 50°C	37.2 $\Omega \pm 5\%$
Nominal coil resistance at 20°C	26.2 $\Omega \pm 5\%$
Maximum coil temperature at 20°C	105°C
Protection glass	IP65
Recommended dither frequency	160 - 200 Hz (*)
Linearity, Hysteresis, Repeatability	< 5% (*)
Connections	ISO/DIN 43650, FormA

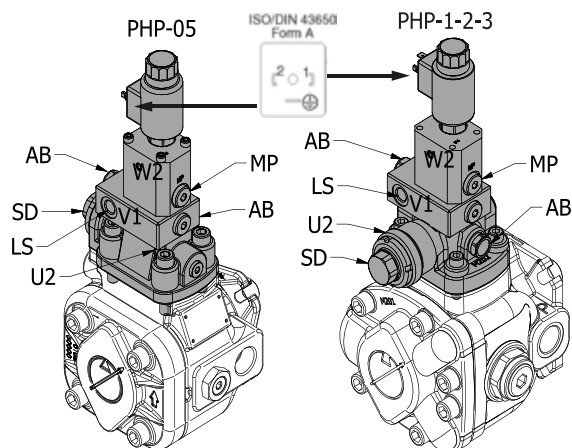
(\*): Depend on electronic control unit for the proportional valve. For available electronic control unit types, please contact Danfoss.

Control devices	
"U2"	Load sensing pressure compensator device
"SD"	Differential pressure $\Delta p$ adjustment
"W2"	Proportional maximum pressure relief valve
"V1"	Load sensing block for additional controls
"Z"	Throttle valve (manual or proportional) <b>(not supplied)</b>

Connections		
"AB" - Air bleed	"1/4" Gas BSP	■
"MP" - Pressure gauge	"1/4" Gas BSP	■
"LS" - Load sensing port	"1/4" Gas BSP	□

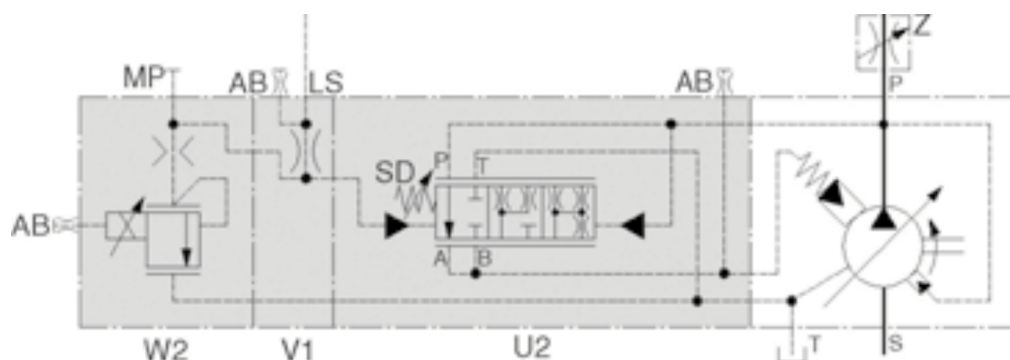
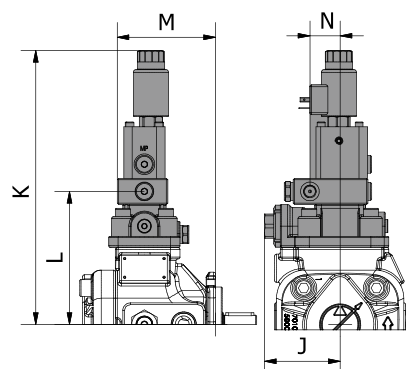
The length between the throttle valve and the load sensing port must not exceed 5m.

■	Supplied port closed
□	Must be connected



Designation	Dimensions			
	Size 0	Size 1	Size 2	Size 3
G	105	115	137	159.5
H	66	76	97.5	120
J	231	232	265.5	274.5
K	197	198	231.5	240.5
L	32	32	32	32
M	1.3	1.3	1.3	1.3
N	117	117	117	117
Q	81	-	-	-

Indicative dimensions. For further information please contact Danfoss.

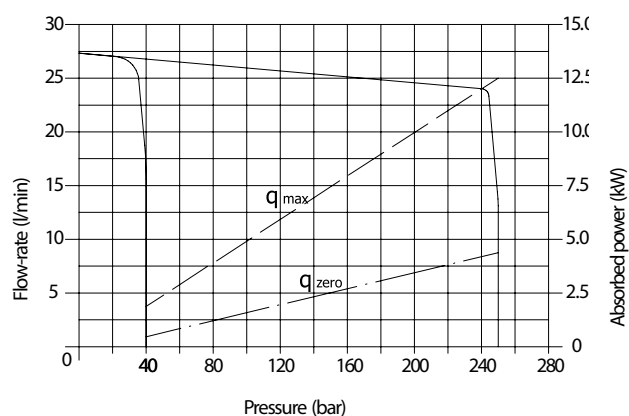


## VVPH Performance Characteristics

### VVPH 0 16

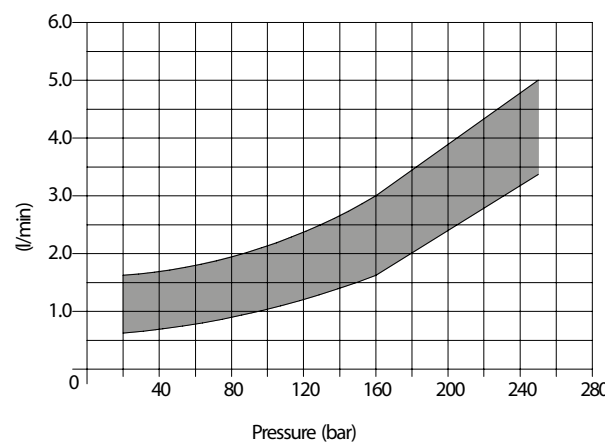
Below values are referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40°C.

### Volumetric efficiency - zero flow setting curve



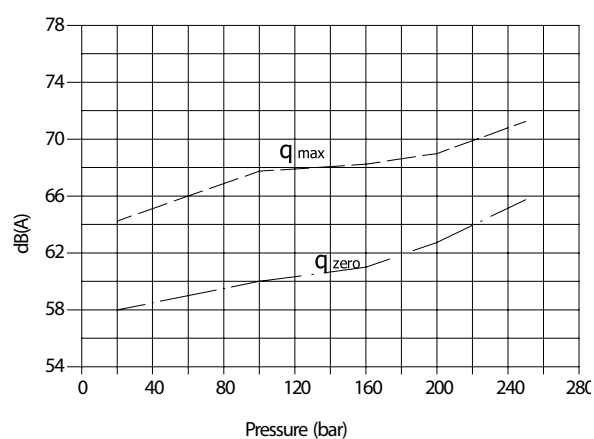
### Drainage (leakage) flow-rate

Pump under zero flow setting conditions.



### Noise level

Maximum noise level values measured with sound-level meter placed one meter from the pump, with flexible coupling.



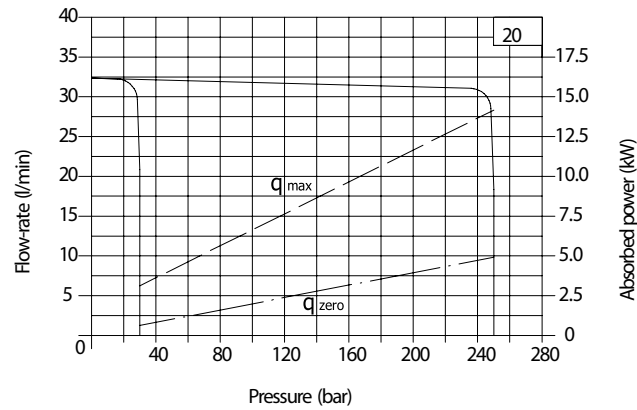
# Vane Pump

VVSL / VVPH Series

## VVPH 1 20-25-32

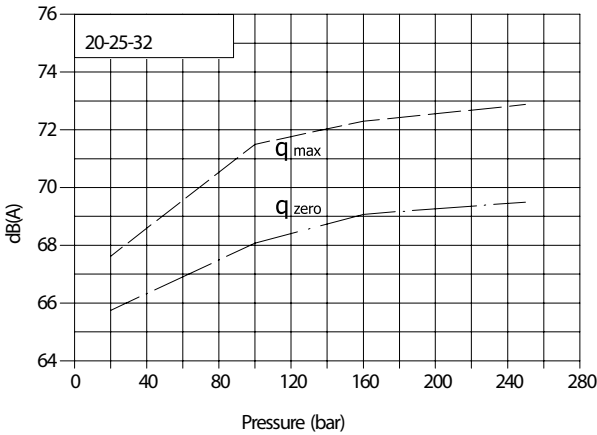
Below values are referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40°C .

### Volumetric efficiency - zero flow setting curve

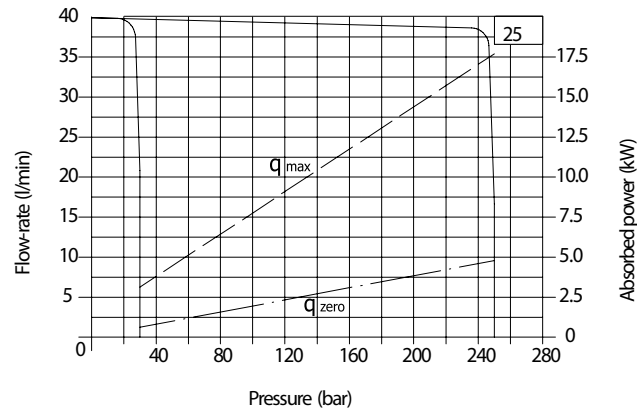


### Noise level

Maximum noise level values measured with sound-level meter placed one meter from the pump, with flexible coupling.

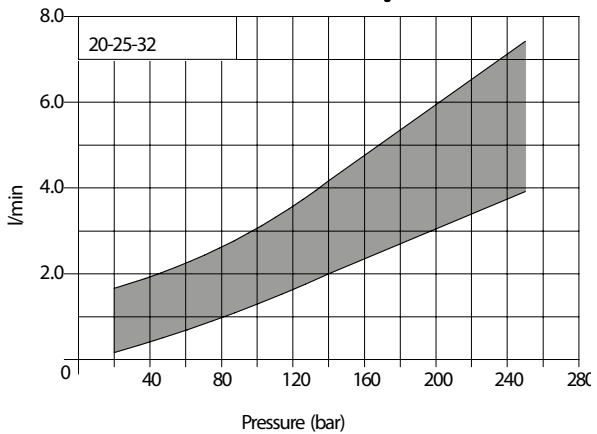


### Volumetric efficiency - zero flow setting curve

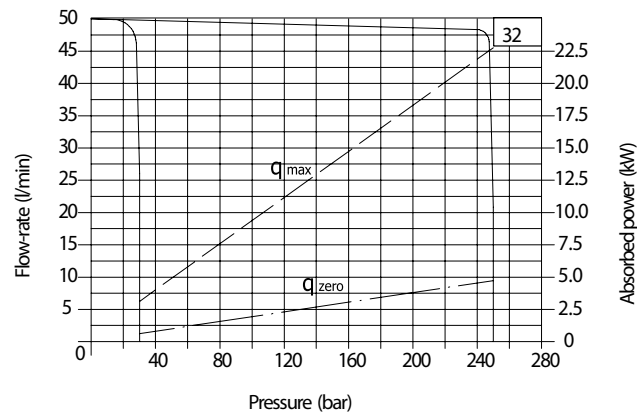


### Drainage (leakage) flow-rate

Pump under zero flow setting conditions.



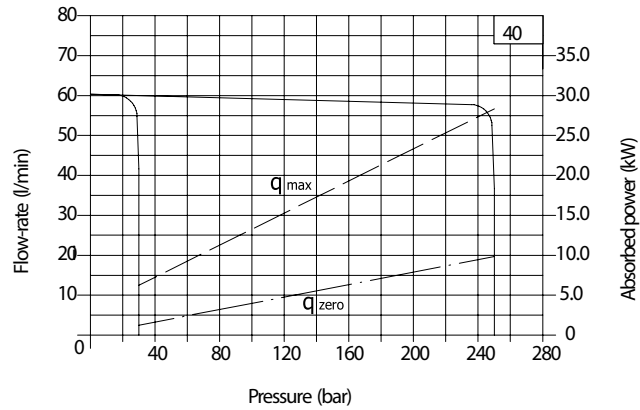
### Volumetric efficiency - zero flow setting curve



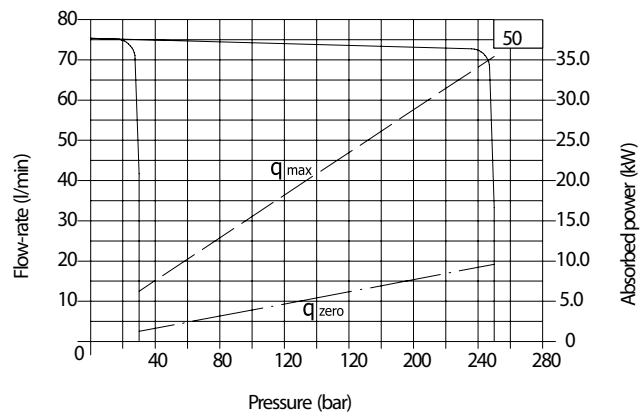
## VVPH 2 40-50-63

Below values are referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40°C.

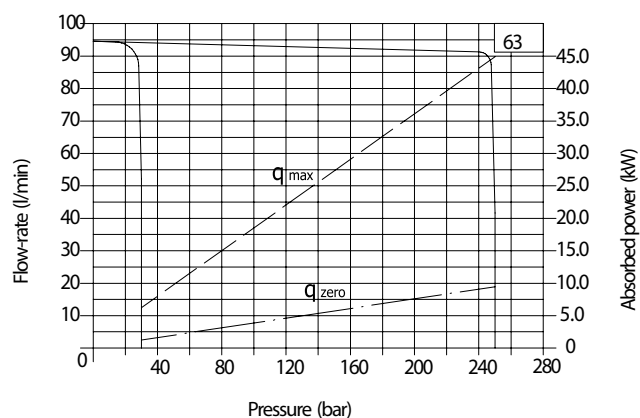
### Volumetric efficiency - zero flow setting curve



### Volumetric efficiency - zero flow setting curve

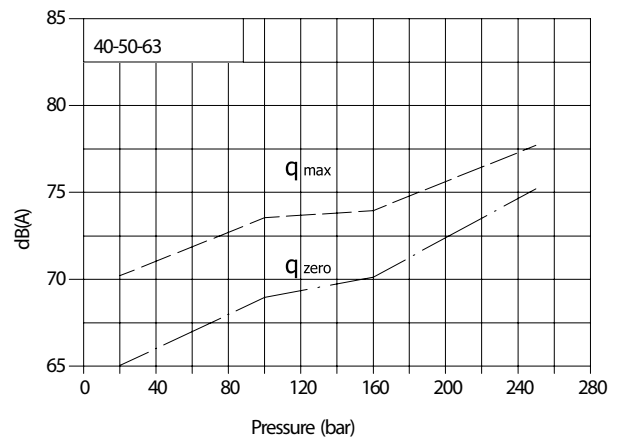


### Volumetric efficiency - zero flow setting curve



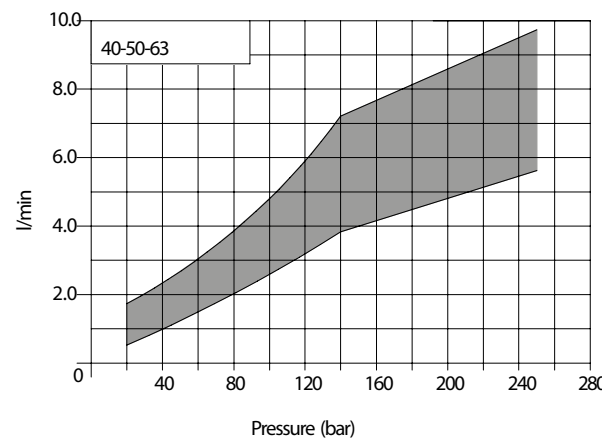
## Noise level

Maximum noise level values measured with sound-level meter placed one meter from the pump, with flexible coupling.



## Drainage (leakage) flow-rate

Pump under zero flow setting conditions.



1

2

3

4

5

6

7

8

9

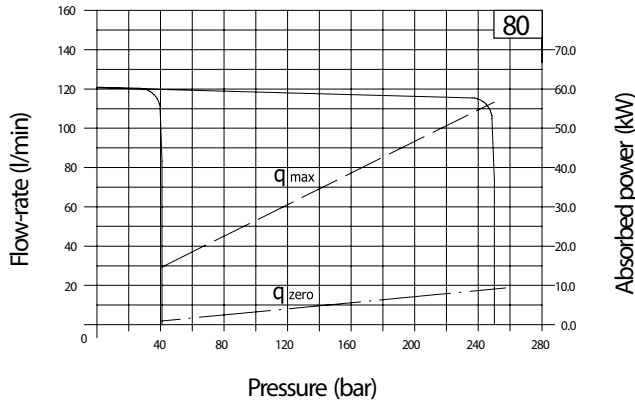
# Vane Pump

VVSL / VVPH Series

## VVPH 3 80-100-120

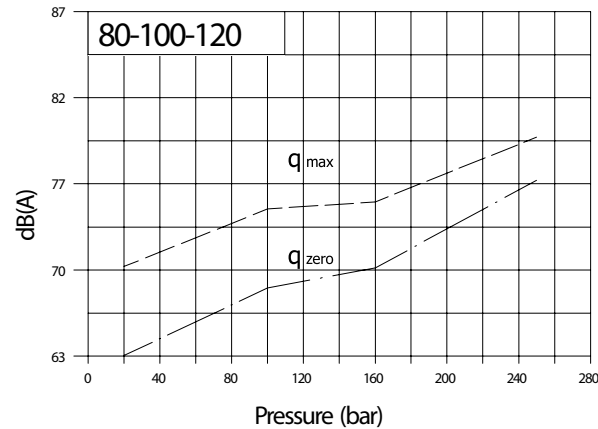
Below values are referring to 1500 rpm, with HM hydraulic oil according to ISO 6743/4, ISO VG 46 according to ISO 3448, temperature 40°C .

### Volumetric efficiency - zero flow setting curve

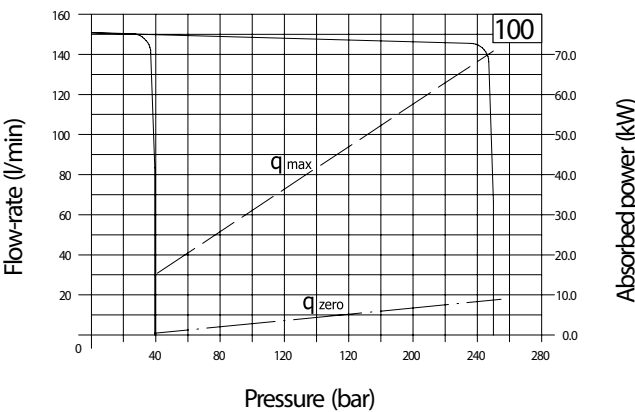


### Noise level

Maximum noise level values measured with sound-level meter placed one meter from the pump, with flexible coupling.

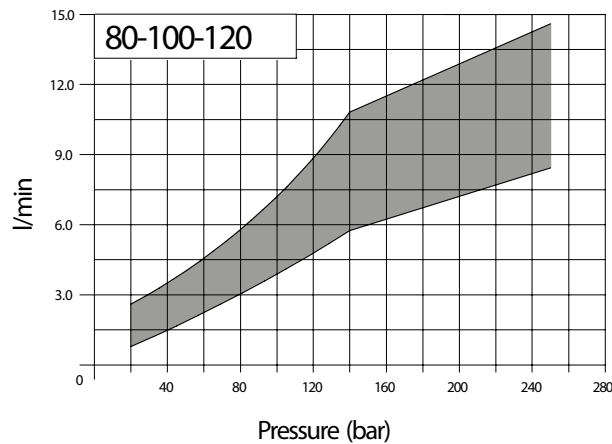


### Volumetric efficiency - zero flow setting curve

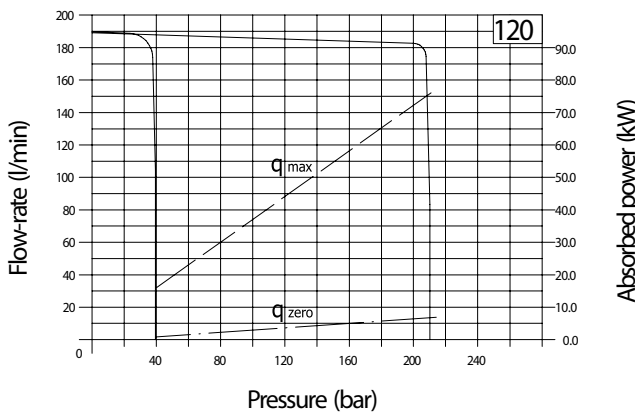


### Drainage (leakage) flow-rate

Pump under zero flow setting conditions.



### Volumetric efficiency - zero flow setting curve



**VVPH 0 16**

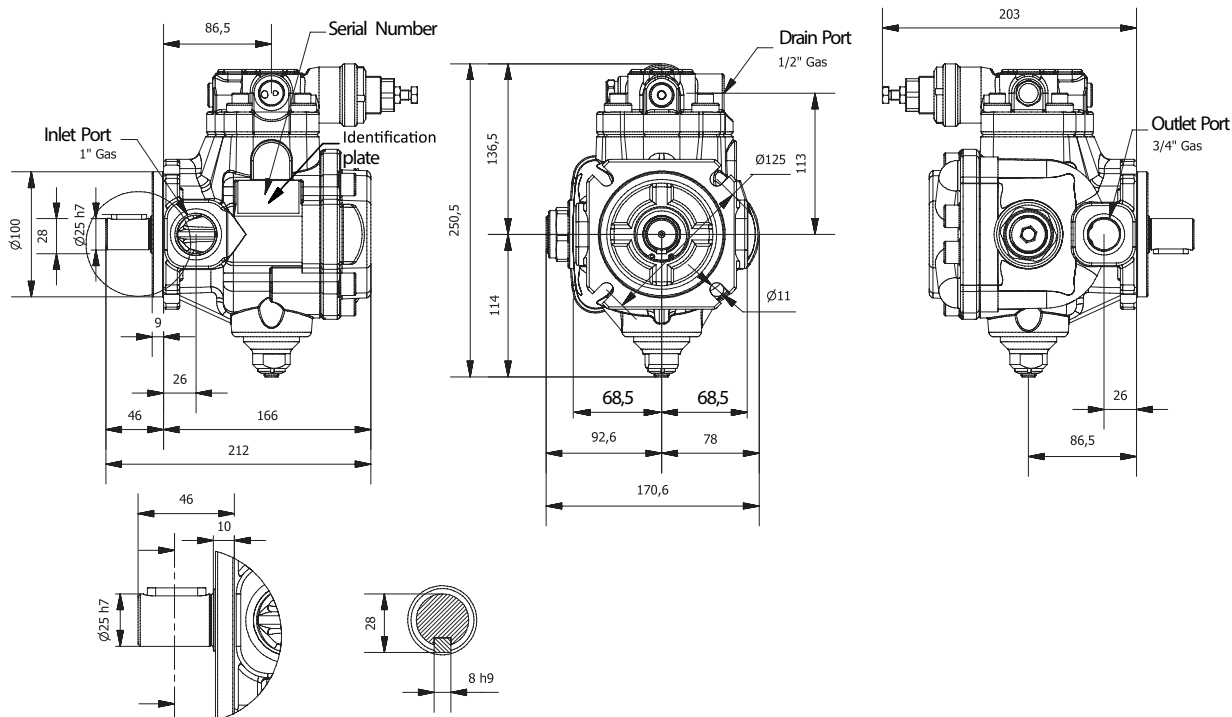


Designation	Dimension
C	40.5
D	21.5
E	12.7
F	0.75
G	5.1
H	15.5
J	25.9
K	31
L	31.75

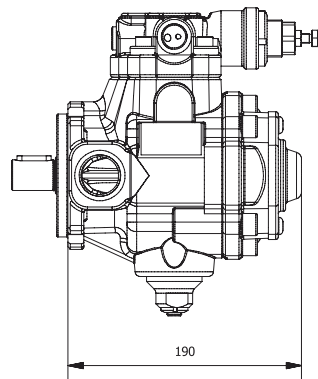
# Vane Pump

VVSL / VVPH Series

## VVPH 1 20-25-32



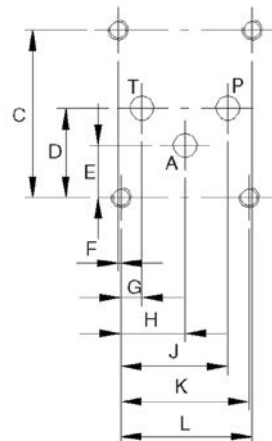
THRU-DRIVE SHAFT STANDARD



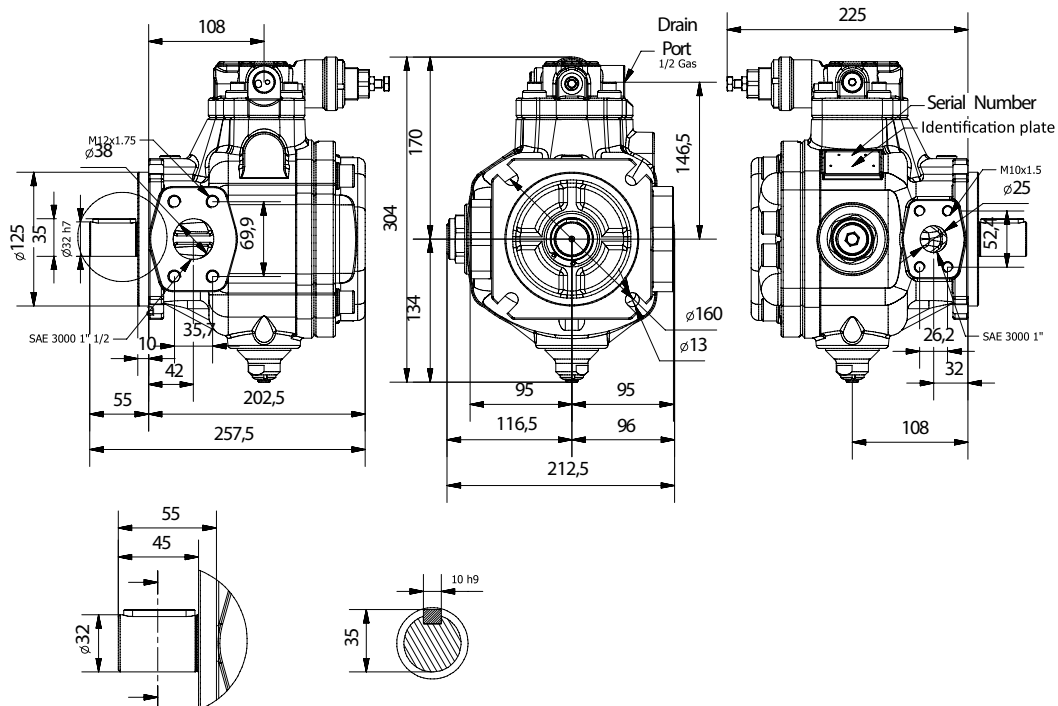
Mounting surface ISO 4401-03 (CETOP 03) for pressure/flow-rate controls CD1/CD2 and CVPD1/CVPD2

Designation	Dimension
C	40.5
D	21.5
E	12.7
F	0.75
G	5.1
H	15.5
J	25.9
K	31
L	31.75

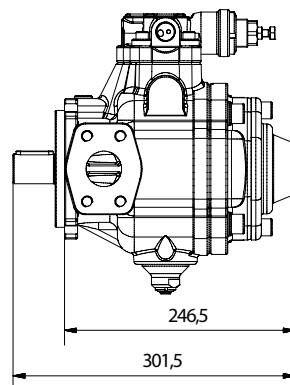
Note: "A" port is available only for CD2 and CVPD2 controls



**VVPH 2 40-50-63**



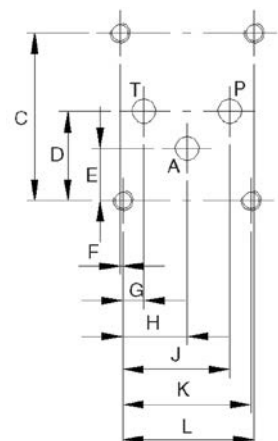
THRU-DRIVE SHAFT STANDARD



Mounting surface ISO 4401-03 (CETOP 03) for pressure/flow-rate controls CD1/CD2 and CVPD1/CVPD2

Designation	Dimension
C	40.5
D	21.5
E	12.7
F	0.75
G	5.1
H	15.5
J	25.9
K	31
L	31.75

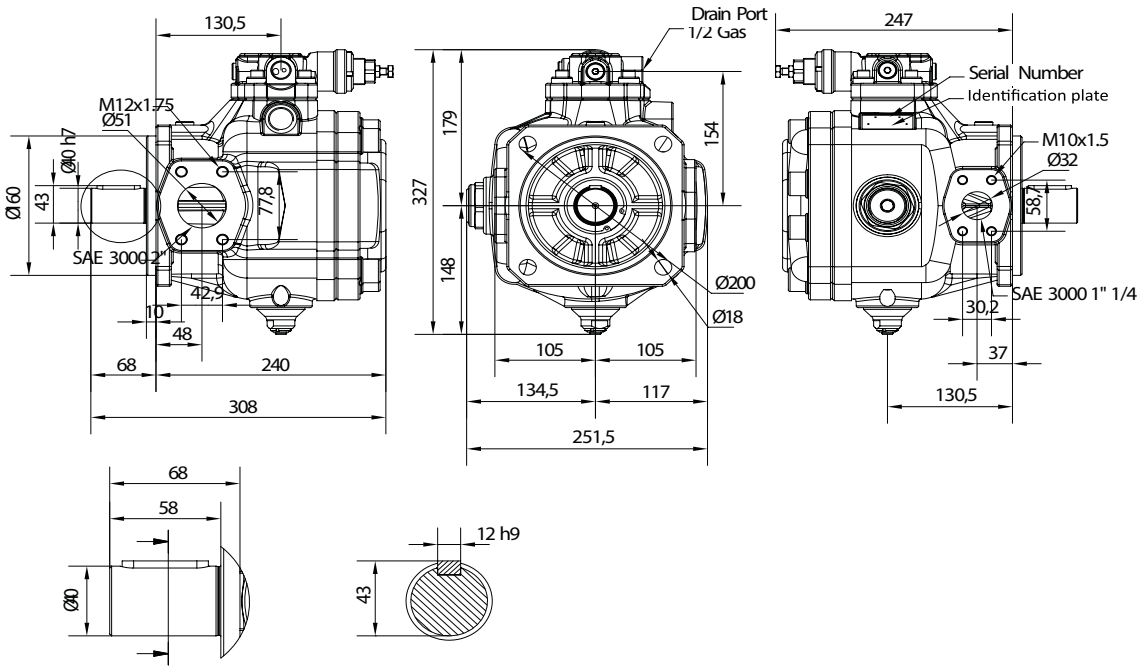
Note: "A" port is available only for CD2 and CVPD2 controls



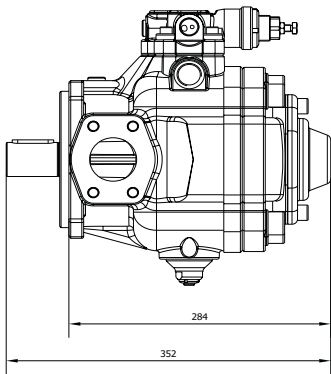
# Vane Pump

VVSL / VVPH Series

## VVPH 3 80-100-120



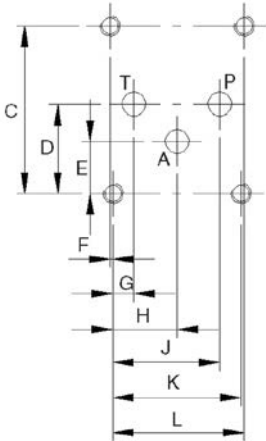
### THRU-DRIVE SHAFT STANDARD



Mountingsurface ISO 4401-03 (CETOP 03) for pressure/flow-rate controlsCD1/CD2 and CVPD1/CVPD2

Designation	Dimension
C	40.5
D	21.5
E	12.7
F	0.75
G	5.1
H	15.5
J	25.9
K	31
L	31.75

Note: "A" port is available only for CD2 and CVPD2 controls



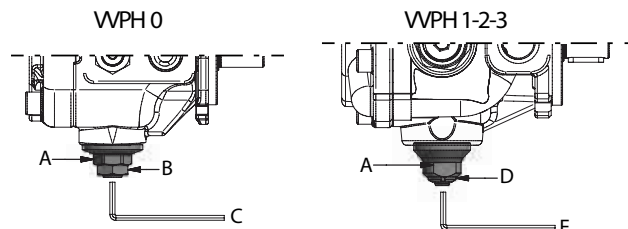
## Settings VVPH

### Flow adjustment

All VVPH series pumps are equipped with a displacement adjustment screw. This allows the mechanical reduction of the pump displacement in relation to the nominal value. Clockwise rotation decreases the pump displacement.

**Warning:** If the flow adjustment screw is set to less than 50% of the nominal displacement, the pump can only start on condition that the system and pump are completely filled with fluid.

Frame / Size (nominal)	Actual displacement	Reduced displacement by screw turn	Minimum achievable displacement
0-16	17 cm <sup>3</sup>	11 cm <sup>3</sup>	3,3 cm <sup>3</sup>
1-20	21 cm <sup>3</sup>	10 cm <sup>3</sup>	9,5 cm <sup>3</sup>
1-25	26 cm <sup>3</sup>	10 cm <sup>3</sup>	15 cm <sup>3</sup>
1-32	33 cm <sup>3</sup>	10 cm <sup>3</sup>	19 cm <sup>3</sup>
2-40	42 cm <sup>3</sup>	16 cm <sup>3</sup>	27,5 cm <sup>3</sup>
2-50	51 cm <sup>3</sup>	16 cm <sup>3</sup>	35,5 cm <sup>3</sup>
2-63	63 cm <sup>3</sup>	16 cm <sup>3</sup>	43,5 cm <sup>3</sup>
3-80	80 cm <sup>3</sup>	16 cm <sup>3</sup>	63 cm <sup>3</sup>
3-100	100 cm <sup>3</sup>	16 cm <sup>3</sup>	80 cm <sup>3</sup>
3-120	120 cm <sup>3</sup>	16 cm <sup>3</sup>	100 cm <sup>3</sup>
Stated values influenced by manufacturing tolerances			



A - DO NOT TOUCH

B - LOCKNUT: 24 mm WRENCH

C - ADJUSTMENT: 8 mm WRENCH

D - KM1 SLOTTED ROUND LOCKNUT

E - ADJUSTMENT: 6 mm WRENCH

Standard pressure compensator C		
1	Pressure setting screw Clockwise rotation increases pressure setting	CH 13 mm HEX
2	Pressure setting locknut	CH 13 mm HEX
3	Slotted round locknut - Do not tamper	5 mm slot

The diagram shows a side view of the standard pressure compensator C. It is a cylindrical component with a hexagonal base. Three components are labeled: 1 is the pressure setting screw, 2 is the pressure setting locknut, and 3 is the slotted round locknut.

Pressure compensator device for additional controls Load Sensing pressure compensator device		
4	Controls CR, CD1, CD2, CE Minimum pressure spring adjustment - Do not tamper Controls CVP, CVPR, CVPD1, CVPD2, CVPCE Differential pressure $\Delta p$ adjustment	CH 26 mm HEX
5	Slotted round locknut	5 mm slot
6	Maximum pressure relief valve Pressure setting screw Clockwise rotation increases pressure setting	CH 5/32" HEX
7	Pressure setting locknut	CH 9/16" HEX
8	Do not tamper	CH 7/8" HEX

The diagram shows a side view of the pressure compensator device for additional controls. It is a cylindrical component with a hexagonal base. Five components are labeled: 4 is the controls assembly, 5 is the slotted round locknut, 6 is the maximum pressure relief valve, 7 is the pressure setting locknut, and 8 is the do not tamper component.

# Vane Pump

VVSL / VVPH Series

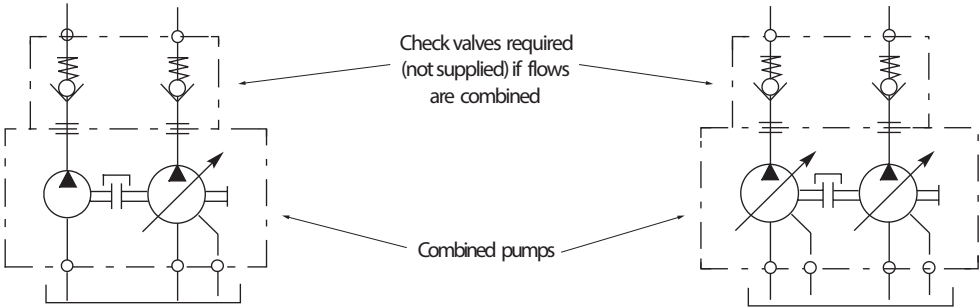
## 5. Combined Pumps

The rotor shaft of VVSL/VVPH variable vane pumps is prearranged for mounting an additional pump. Simply take off the rear cover to easily attach the secondary pump.

VVSL/VVPH combined standard pumps (see table below) eliminate the need for many "special application" pumps.

For solutions other than those shown in the table, contact your Danfoss representative.

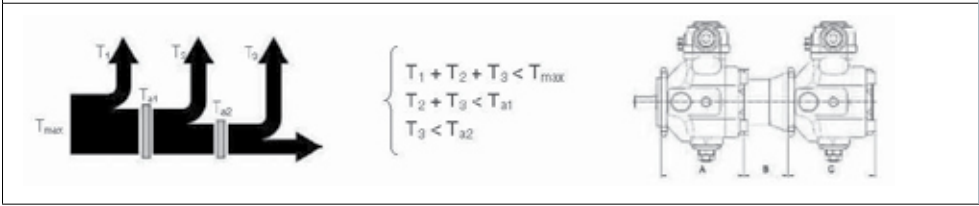
### Typical Pump Combinations

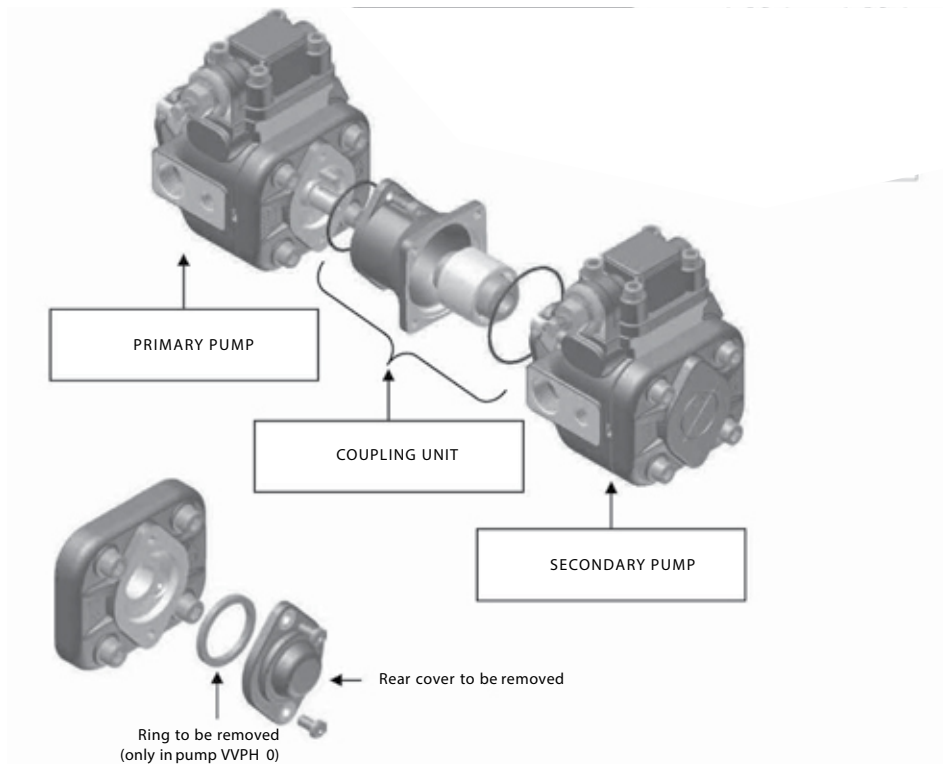


Primary Pump		Secondary Pump		Coupling Unit	
Pump type	A	Pumptype	C	Part Number	B Max. thru-drive torque Ta
VVSL 0-16	104	VVSL 0-16	107	02-358847	73
VVPH 0-16	139	VVPH 0-16	145	02-358847	73
		SAE "A"	(*)	02-358851	88.5
VV** 1	163	VVSL 0-16	107	02-358847	73
		VVPH 0-16	145	02-358847	73
		SAE "A"	(*)	02-358851	88.5
		VVSL 1 (20-25-32)	166	02-358849	75
		VVPH 1 (20-25-32)	166	02-358849	75
VV** 2 VV** 3	199.5 237	VVSL 0-16	107	02-358852	85
		VVPH 0-16	145	02-358852	85
		VVSL 1 (20-25-32)	166	02-358717	87
		VVPH 1 (20-25-32)	166	02-358717	87
		VVSL 2 (40-50-63)	202.5	02-358855	102
		VVPH 2 (40-50-63)	202.5	02-358855	102
		SAE "A"	(*)	02-358856	100.5
		SAE "B"	(*)	02-358857	126.5
VV** 3	237	VVSL 3 (80-100-120)	240	02-358858	117
		VVPH 3 (80-100-120)	240	02-358858	117

(\*) For the secondary pump flange requirement see next page. To find out the secondary pump dimensions please see the manufacturer's catalog.

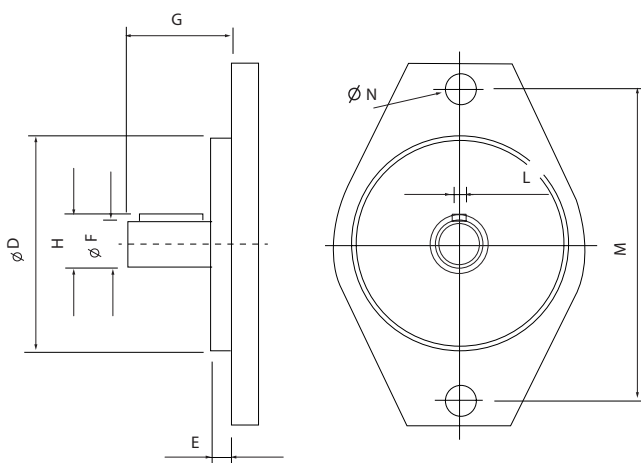
- The sum of individual torques of all pumps in the complete pump combination must not exceed the maximum permissible torque value applicable to the primary pump shaft.
- Secondary pump torque (or sum of torques for more than one secondary pump) must not exceed the coupling unit maximum thru drive torque.





Combined pumps should be mounted in decreasing order of absorbed power, paying attention to the maximum acceptable torque (see diagram on the previous page).

## SAE FLANGE DIMENSIONS FOR COUPLING KIT



Secondary pump	Secondary pump with SAE flange should conform to the dimensions below								
	$\varnothing D$	E	$\varnothing F$	G		H	L	M	$\varnothing N$
				min	max				
SAE "A"	$\varnothing 82.5$	7	$\varnothing 19.05$	32	59	21.1	4.8	106.4	11.1
SAE "B"	$\varnothing 101.6$	9.5	$\varnothing 22.2$	41	71	25.1	6.375	146	14.3
						25.5	4.8		

# Vane Pump

VVSL / VVPH Series

## 6. Seal Kits

Product	Standard (BunaN)	Special (Viton®)
VVSL 0	6044544-001	6044544-002
VVPH 0	6044544-003	6044544-004
VVSL 1	6044544-005	6044544-006
VVPH 1	6044544-007	6044544-008
VVSL 2	6044544-009	6044544-010
VVPH 2	6044544-011	6044544-012
VVSL 3	6044544-013	6044544-014
VVPH 3	6044544-015	6044544-016

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## 7. Installation Instructions

Pumps from the VVSL 0/1 and VVPH 0/1 series can be mounted in any position.

Pump type VVSL 2/3 and VVPH 2/3 must be mounted with the shaft HORIZONTAL and the compensator device upward (see figure).

When the pump is installed over the reservoir fluid level, pay attention to the inlet pressure.

### Cleanliness is essential during assembly!

Motor-pump coupling must be made with a self-aligning flexible coupling with convex teeth and a polyamide cam. When assembling make sure that:

- the distance between the half-couplings strictly falls within the specified values (see next page);
- the pump shaft and the motor shaft are accurately aligned: concentricity within 0.05 mm, angular displacement within 0.2° (see drawing);
- strictly no radial or axial loads on the pump shaft.

Other types of motor-pump couplings are not permitted.

The fluid tank must be suitably sized in order to exchange the thermal power generated by the various system components and to provide a low recycle rate (tank capacity approximately 4 times the flow rate per minute of the pump). In systems where the pump runs for a long time under zero flow setting conditions, the installation of a heat exchanger in the drain line is recommended. The pressure on the drain port must never exceed the value specified. Maximum operating temperature must not exceed 60°C under any circumstances.

To ensure the maximum pump working life, the inlet fluid temperature must never be above 50°C.

**Suction pipe.** The suction pipe should be as short as possible, with a small number of bends and without internal section changes. The pipe-end inside the tank should be cut at 45°, should have a minimum distance from the tank bottom of not less than 50 mm, and there should always be a minimum height of suction of 100 mm. Select the clear width of the pipes according to the pump inlet ports. The suction pipe should be completely airtight in order to avoid air intake which could be extremely damaging to the pump.

**Drain pipe.** The drain pipe must always be independent from the other return lines, connected directly to the tank, and extended sufficiently inside the tank so as to be below the minimum fluid level to avoid generating foam and to prevent emptying when the pump is not running. Moreover, the drain pipe must also be at the highest possible position in relation to the pump in order to always prevent fluid emptying from the pump, and must be free of restrictions. The drain pipe should be as far as possible from the suction pipe to prevent hot fluid being circulated.

**Pressure line.** Ensure that the pressure line is strong enough. It is recommended that a non-return valve (check valve) is installed on the pump pressure line as well as an automatic air bleed valve, for trouble free operation.

Ensure that any valves, taps and gate valves on the suction and pressure pipes are fully opened and all protective caps removed. Fill the pump through the case drain port and replace the drain pipework. Check that the reservoir is full of fluid.

Ensure that the pump shaft can be rotated manually without any resistance.

Check that the motor rotation direction is the same as the pump rotation direction: right-hand rotation (clockwise) viewed from shaft end of the pump.

# Vane Pump

## VVSL / VVPH Series

Start the motor (in jogging mode), allowing free circulation of fluid to the tank in order to facilitate priming.

The pump should prime within 5 seconds . If it does not, switch it off and investigate the cause . The pump should not run empty.

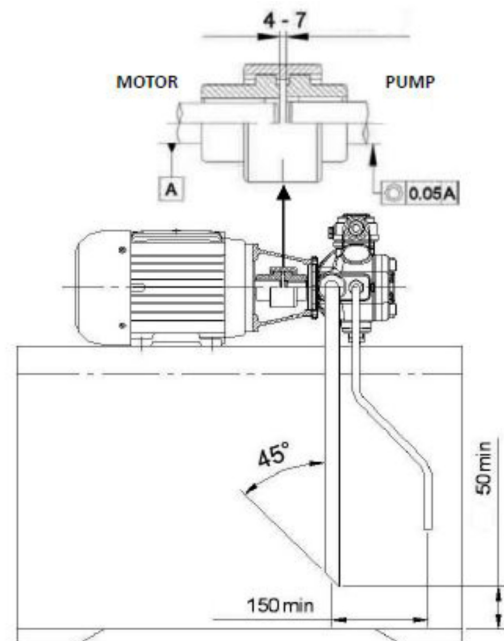
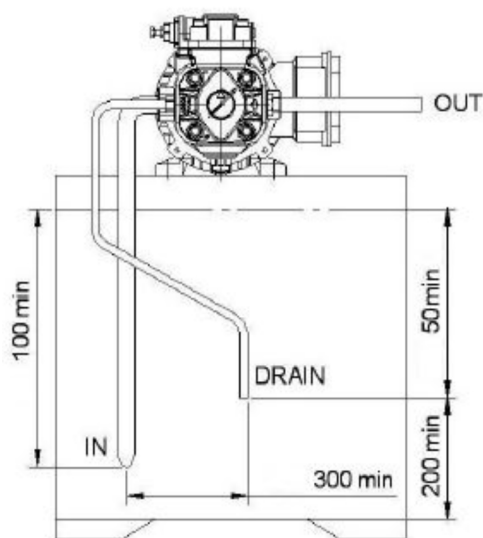
During INITIAL INSTALLATION, the pump must run under maximum flow conditions (P connected to T), with the fluid flowing directly into the tank, without pressure for several minutes . Care should be taken to eliminate all the air from the system during this process . To facilitate this operation, there is an air bleed port on the pressure compensator (only on VVPH): unscrew the cap to bleed the air and then close the cap.

Subsequent start-ups under zero flow setting conditions are admissible only with pressure not exceeding 30 bar, and with the system and pump completely filled with fluid.

If the flow limiter unit is set to less than 50% of the nominal flow-rate, the pump can only start on condition that the system and the pump are completely filled with fluid.

During the initial and subsequent starting operations, it is necessary that the pump (ambient) and fluid temperature do not differ by more than 20°C . If this is the case, the pump should be switched on only for short intervals of approximately 1-2 seconds (start/stop mode) without pressure, until the temperatures are balanced.

For further information, please contact Danfoss Product Support .



# Vane Pump

WVSL / WVP Series

**Products we offer:**

- Cartridge valves
- DCV directional control valves
- Electric converters
- Electric machines
- Electric motors
- Gear motors
- Gear pumps
- Hydraulic integrated circuits (HICs)
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
- PLUS+1® controllers
- PLUS+1® displays
- PLUS+1® joysticks and pedals
- PLUS+1® operator interfaces
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- PLUS+1® software
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- Position controls and sensors
- PVG proportional valves
- Steering components and systems
- Telematics

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