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	Displacement cm³/rev [in³/rev]	Max. flow l/min [U.S. gpm]	Max. pressure cont. bar [psi]
HD1	55 [3.35]	209 [55.2]	450 [6525]

The HD1 series variable piston pumps for closed loop circuits are axial pistons pumps with swash plate design and through drive shaft on option. These pumps have been specifically designed for use in closed circuit hydrostatic transmissions. The delivery is proportional to the rotation speed and the swash plate angle. The delivery increases when swash plate's angle of inclination increases from 0 to maximum position. Inverting the swash plate's angle, the flow direction is inverted. The technical choices allow the new unit to operate at pressures up to of 450 bar [6525 psi].



The series offers the following range of controls :

- HLR Manual lever with feed-back.
- HIR Hydraulic proportional with feed-back.
- HIN Hydraulic proportional without feed-back.
- HER Electric proportional with feed-back.
- HEN Electric proportional without feed-back.
- HFD Electric fun drive control.
- HE2 Electric on-off.
- HEH Electric proportional with hydraulic emergency override.
- Automotive

The pump has two built-in pressure relief valves to protect the circuit from pressure overloads. The charge pump circuit features a gerotor pump with different displacement on option.

The pump design allows the installation of many accessories, such as:

- Hydraulic pressure compensator standard.
- Electric cut-off valve.
- Combined electric cut-off – hydraulic pressure compensator.
- A wide range of through drive options.
- Charge pump delivery pressure filter.
- Electric or optical clogging sensor on the filter.

### Simbology:

<b>C</b>	N/bar [lbf/psi]	Load
<b>F<sub>ax max</sub></b>	N [lbf]	Axial pushing load
<b>F<sub>ax max</sub></b>	N [lbf]	Axial pulling load
<b>F<sub>q</sub></b>	N [lbf]	Radial load
<b>F<sub>q max</sub></b>	N [lbf]	Maximum permissible radial load
<b>J</b>	kg·m <sup>2</sup> [lbf·ft <sup>2</sup> ]	Moment of inertia
<b>m</b>	kg [lbs]	Weight
<b>n<sub>max</sub></b>	rpm	Maximum speed
<b>p<sub>nom</sub></b>	bar [psi]	Maximum cont. pressure
<b>p<sub>max</sub></b>	bar [psi]	Maximum pressure peak

<b>q<sub>max</sub></b>	l/min [U.S. gpm]	Maximum flow
<b>q<sub>d</sub></b>	l/min [U.S. gpm]	External drain flow
<b>T<sub>k</sub></b>	Nm/bar [lbf.ft/psi]	Torque costant
<b>T<sub>nom</sub></b>	Nm [lbf.ft]	Maximum torque at pressure cont.
<b>T<sub>max</sub></b>	Nm [lbf.ft]	Maximum torque at pressure peak
<b>Vg</b>	cm <sup>3</sup> /rev [in <sup>3</sup> /rev]	Displacement
<b>P<sub>max</sub></b>	kW [hp]	Maximum power at p <sub>nom</sub>
<b>η<sub>hm</sub></b>	%	Mech-hyd. efficiency
<b>η<sub>v</sub></b>	%	Volumetric efficiency
<b>I</b>	A	Current

### Fluids:

Use fluids with mineral oil basis and anticorrosive, antioxidant and wear preventing addition agents (HL or HM). Viscosity range at operating temperature must be of 15 ÷ 40 cSt. For short periods and upon cold start, a max.viscosity of 800 cSt is allowed. Viscosities less then 10 cSt are not allowed. A viscosity range of 10 ÷ 15 cSt is allowed for extreme operating conditions and for short periods only. For further information see at Fluids and Filtration section.

### Operating temperature:

The operating temperature of the oil must be within -25 °C ÷ 90 °C (-13 °F ÷ 194 °F). The running of the axial piston unit with oil temperature higher than 90 °C (194 °F) or lower than -25 °C (-13 °F) is not recommended. For further information see at Fluids and filtration section.

**Filtration:**

In the HD1 pump it is possible to provide a filter in the suction line but we recommend to use the optional pressure filter on the out-let line of the charge pump. The filter on the charge pump out-let line is supplied by Dana while if the filter assembled in the suction line is used the following recommendation applies:

Install the filter on the suction line of the auxiliary pump. We recommend to use filters with clogging indicator, no by-pass or with by-pass plugged and filter element rating of 10  $\mu\text{m}$  absolute. The maximum pressure drop on the filtration element must not exceed 0.2 bar [3 psi]. A correct filtration helps to extend the service life of axial piston units. In order to ensure a correct functioning of the unit, the maximum permissible contamination class is 20/18/15 according to ISO 4406:1999.

**Suction pressure:**

The minimum absolute pressure on the auxiliary pump suction must be of 0.8 bar [11.6 absolute psi]. On cold starting and for short periods an absolute pressure of 0.5 bar [7.25 psi] is allowed. In no case inlet pressure can be lower.

**Operating pressure:**

Main pump: The maximum permissible continuous pressure on pressure ports is 450 bar [6525 psi]. Peak pressure is 480 bar [6960 psi]. Charge pump: The nominal pressure is 22 bar [319 psi]. Maximum admissible pressure is 30 bar [435 psi].

**Case drain pressure:**

Maximum case drain pressure is 4 bar [58 psi]. On cold starting and for short-term a pressure of 6 bar [86 psi] is allowed. A higher pressure can damage the input shaft seal or reduce its life.

**Seals:**

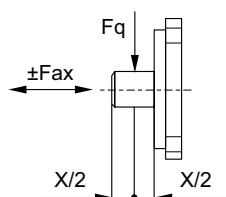
Standard seals used on HD1 pumps are of FKM (Fluoroelastomer). In case of use special fluids, contact Dana.

**Displacement limiting:**

The pump is equipped with the externally adjustable mechanical displacement limiting device. Displacement limitation is obtained by means of two setting screws which limit the control piston stroke.

**Input shaft Radial and Axial loads:**

The input shaft can stand both radial and axial loads. The maximum permissible loads are in the following table.



<b>Radial load</b>	<b><math>F_{q \max}</math></b>	N [lbf]	1900 [428]
<b>Axial load</b>	<b><math>F_{ax \max}</math></b>	N [lbf]	1500 [337]

**Installation:**

HD1 series pumps can be installed in every position or direction. For further details contact Dana.

<b>Displacement</b>	<b>V<sub>g max</sub></b>	cm <sup>3</sup> /rev [in <sup>3</sup> /rev]	55 [3.35]
<b>Displacement</b>	<b>V<sub>g min</sub></b>	cm <sup>3</sup> /rev [in <sup>3</sup> /rev]	0 [0]
<b>Pressure cont.</b>	<b>p<sub>nom</sub></b>	bar [psi]	450 [6525]
<b>Pressure peak</b>	<b>p<sub>max</sub></b>	bar [psi]	480 [6960]
<b>Max speed cont.</b>	<b>n<sub>0 max</sub></b>	rpm	3800
<b>Max speed int.</b>	<b>n<sub>0 max</sub></b>	rpm	4000
<b>Min speed</b>	<b>n<sub>min</sub></b>	rpm	500
<b>Max flow at n<sub>max</sub></b>	<b>q<sub>max</sub></b>	l/min [U.S.gpm]	209 [55.2]
<b>Maximum power cont.</b>	<b>P<sub>max</sub></b>	kW [hp]	157 [210]
<b>Maximum power int.</b>	<b>P<sub>max</sub></b>	kW [hp]	167 [224]
<b>Max torque cont. (p<sub>nom</sub>) at V<sub>g max</sub></b>	<b>T<sub>nom</sub></b>	Nm [lbf.ft]	394 [291]
<b>Max torque peak (p<sub>max</sub>) at V<sub>g max</sub></b>	<b>T<sub>max</sub></b>	Nm [lbf.ft]	420 [310]
<b>Moment of inertia<sup>(1)</sup></b>	<b>J</b>	kg·m <sup>2</sup> [lbf.ft <sup>2</sup> ]	0.0064 [0.156]
<b>Weight<sup>(1)</sup></b>	<b>m</b>	kg [lbs]	46 [101.4]

Charge pump technical data				
<b>Displacement charge pump</b>	cm <sup>3</sup> /rev [in <sup>3</sup> /rev]	11 [0.67]	14 [0.85]	18 [1.1]
<b>Charge pump setting pressure</b>	bar [psi]	22 [319]		
<b>Charge pump maximum pressure</b>	bar [psi]	40 [580]		
<b>Maximum Pressure in the housing cont.</b>	bar [psi]	4 [58]		
<b>Maximum Pressure in the housing int</b>	bar [psi]	6 [87]		

Theoretical values, without considering the efficiency; approximate values. Peak operations must not excide 1% of every minute. Avoid continuously working at simultaneously maximum pressure and maximum speed.

#### Notes:

(1) Approximate values.

The following alphanumeric codes system has been developed to identify all of the configuration options for the HD1 pumps. Use the model code below to specify the desired features.

**All alphanumeric digits system of the code must be present when ordering (as in the example below).**

We recommend to carefully read the catalogue before filling the ordering code.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Series	Pump	Size	Displacement limitation side A	Displacement limitation side B	Version	Mounting flange	Shaft end	Direction of rotation	Control	Control feature	Charge pump	Pressure relief valve side A	Pressure relief valve side B	Charge pressure relief valve	Pressure compensator valves	Pressure compensator feature	Filter	Through drive	Flushing valve	Pump feature	Painting
HD1	P	055	A55	B55	ME	06	13	DX	HIR	IH	00	25	25	AE	PC	000	XX	XX	XX	XXX	XX

1

## Series

HD1

Variable displacement axial piston pump for closed circuit

2

## Pump

P

Pump

3

## Size

055

55 cm<sup>3</sup>/rev [3.35 in<sup>3</sup>/rev]

4

## Displacement limitation side A

A0 ÷ A55

Stroke Limiter (From 0 cm<sup>3</sup>/rev to 55 cm<sup>3</sup>/rev [3.35 in<sup>3</sup>/rev])

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
HD1	P	055	A55	B55	ME	06	13	DX	HIR	IH	00	25	25	AE	PC	000	XX	XX	XX	XXX	XX

5

**Displacement limitation side B**

<b>B0 ÷ B55</b>	Stroke Limiter (From 0 cm <sup>3</sup> /rev to 55 cm <sup>3</sup> /rev [3.35 in <sup>3</sup> /rev])
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6

**Version**

<b>ME</b>	ISO
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<b>SE</b>	SAE
-----------	-----

7

**Mouting flange**

<b>06</b>	SAE-C 2/4 Bolts
-----------	-----------------

8

**Shaft end**

<b>13</b>	Splined 14T - 12/24 DP
-----------	------------------------

<b>AC</b>	Splined 21T - 16/32 DP
-----------	------------------------

**Note:**

For Tandem assembly check chapter "TANDEM COMBINATION DIMENSIONS"

9

**Direction of rotation (viewed from shaft side)**

<b>DX</b>	CW
-----------	----

<b>SX</b>	CCW
-----------	-----

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
HD1	P	055	A55	B55	ME	06	13	DX	HIR	IH	00	25	25	AE	PC	000	XX	XX	XX	XXX	XX

## 10

## Control

<b>HLR</b>	Manual lever with feed-back
<b>HIR</b>	Hydraulic proportional with feed-back
<b>HIN</b>	Hydraulic proportional without feed-back
<b>HER</b>	Electric proportional with feed-back
<b>HEN</b>	Electric proportional without feed-back
<b>HE2</b>	Electric on-off
<b>HEH</b>	Electric proportional with emergency hydraulic override
<b>HFD</b>	Electric fun drive control (minimum boost pressure 25 bar 363 PSI - Mandatory for feature 15 - AG)
<b>HME (*)</b>	Electric Automotive
<b>HMI (*)</b>	Hydraulic Automotive

(\*) Available for quantity.

## 11

## Control feature

## Control

				HLR	HIR	HIN	HER	HEN	HE2	HEH	HFD	HME	HMI
<b>IH</b>			Hydraulic inching	—	—	—	—	—	—	—	—	•	•
<b>IM</b>	Inching		Mechanical inching	—	—	—	—	—	—	—	—	—	—
<b>00</b>			Without inching	—	—	—	—	—	—	—	—	•	•
<b>12</b>		(V)	12 connector DIN 43650	—	—	—	•	—	•	•	—	•	—
<b>24</b>		(V)	24 connector DIN43650	—	—	—	•	—	•	•	—	•	—
<b>D2</b>	Voltage	(V)	12 - Deutsch DT04	—	—	—	•	—	•	•	—	•	—
<b>D4</b>		(V)	24 - Deutsch DT04	—	—	—	•	—	•	•	—	•	—
<b>N2</b>		(V)	12 AMP JUNIOR	—	—	—	—	•	—	—	•	—	—
<b>N4</b>		(V)	24 AMP JUNIOR	—	—	—	—	•	—	—	•	—	—
<b>00</b>		mm [in]	Without control orifices	S	•	—	•	•	—	—	•	—	—
<b>05</b>		mm [in]	Ø 0.5 [Ø 0.019]	—	—	•	—	—	—	—	—	—	—
<b>06</b>		mm [in]	Ø 0.6 [Ø 0.024]	—	•	—	•	—	—	—	—	—	—
<b>07</b>		mm [in]	Ø 0.7 [Ø 0.027]	—	•	•	•	—	—	—	—	—	—
<b>08</b>	Control orifices diameter (1)	mm [in]	Ø 0.8 [Ø 0.031]	—	S	S	S	—	—	S	—	—	—
<b>09</b>		mm [in]	Ø 0.9 [Ø 0.035]	—	•	•	—	—	—	—	—	—	—
<b>12</b>		mm [in]	Ø 1.2 [Ø 0.047]	—	•	—	—	—	S	—	—	S	S
<b>15</b>		mm [in]	Ø 1.5 [Ø 0.059]	—	—	—	—	—	—	—	—	•	•
<b>(*)</b>	Starting speed	(rpm)		—	—	—	—	—	—	—	—	•	•
<b>(*)</b>	Maximum torque speed	(rpm)		—	—	—	—	—	—	—	—	•	•
<b>(*)</b>	Maximum torque value	(Nm)		—	—	—	—	—	—	—	—	•	•

(\*) Supply the setting value.

- : Available
- : Not available
- S: standard

(1) in case of the different response times, please you contact sales office



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
HD1	P	055	A55	B55	ME	06	13	DX	HIR	IH	00	25	25	AE	PC	000	XX	XX	XX	XXX	XX

## 12

## Charge pump

00	Without charge pump	Not Available with Filter and Automotive control
18	Displacement 18 cm <sup>3</sup> /rev [1.098 in <sup>3</sup> /rev]	Standard

## 13

## Pressure relief valve side A

25	250 bar [3625 psi]	
30	300 bar [4350 psi]	
35	350 bar [5075 psi]	
42	420 bar [6090 psi]	Standard
45	450 bar [6527 psi]	

## 14

## Pressure relief valve side B

25	250 bar [3625 psi]	
30	300 bar [4350 psi]	
35	350 bar [5075 psi]	
42	420 bar [6090 psi]	Standard
45	450 bar [6527 psi]	

## 15

## Charge pressure relief valve

## Control

		HLR	HIR	HIN	HER	HEN	HE2	HEH	HFD	HME	HMI
AE	20 bar a 1000 rpm [290 psi at 1000 rpm]	•	•	•	•	•	•	•	—	•	•
AF	22 bar a 1000 rpm [319 psi at 1000 rpm]	•	•	•	•	•	•	•	—	•	•
AG	25 bar a 1000 rpm [363 psi at 1000 rpm]	•	•	•	•	•	•	•	•	•	•

• : Available

— : Not available



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
HD1	P	055	A55	B55	ME	06	13	DX	HIR	IH	00	25	25	AE	PC	000	XX	XX	XX	XXX	XX

## 16

		Control									
Pressure compensator valves		HLR	HIR	HIN	HER	HEN	HE2	HEH	HFD	HME	HMI
XX	Without Pressure Compensator	—	—	—	—	•	—	—	•	•	•
PC	Pressure compensator	•	•	•	•	—	•	•	—	—	—
EP	Electric Cut-Off + Pressure Compensator	•	•	•	•	—	•	•	—	—	—

- : Available
- : Not available

## 17

Pressure compensator feature			XX	Compensator	
				PC	EP
000	Feature not necessary		•	—	—
000	Pressure Setting (bar)	Locked	—	•	•
100 ÷ 430	Pressure Setting (bar)	100÷430 bar [1450÷6237 psi]	—	•	•
12	Voltage	12 V - Connector DIN 43650	—	—	—
24	Voltage	24 V - Connector DIN 43650	—	—	—
D2	Voltage	12 V - Deutsch DT04	—	—	—
D4	Voltage	24 V - Deutsch DT04	—	—	•

- : Available
- : Not available

## 18

			Control	
Filter			HLR - HIR - HIN - HER HEN- HE2 - HEH - HFD	HME - HMI
XX	Without Filter	Standard	•	•
M8	Optical clogging sensor (8 bar) [116 psi]		•	—
E9	Electric clogging sensor (8 bar) [116 psi]		•	—
E3	Electric clogging sensor (8 bar) [116 psi] + DIN 43650 connector		•	—
E2	Electric clogging sensor (8 bar) [116 psi] + DIN 43650 connector with LED 24V		•	—
E1	Electric clogging sensor (8 bar) [116 psi] + DIN 43650 connector with LED 12V		•	—
FR	Through drive remote filter		•	—
FP	Arranged for filter		•	—

Note:  
E9 feature as "Standard production" for electric clogging sensor

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
HD1	P	055	A55	B55	ME	06	13	DX	HIR	IH	00	25	25	AE	PC	000	XX	XX	XX	XXX	XX

## 19

## Through drive

Through drive for 2nd pump assembled by the customer

<b>XX</b>	Through drive for 2nd pump assembled by the customer	Standard
<b>SA</b>	SAE A = Z9 - 16/32 DP	
<b>AA</b>	SAE A = Z11 - 16/32 DP	
<b>SB</b>	SAE B = Z13 - 16/32 DP	
<b>BB</b>	SAE B-B = Z15 - 16/32 DP	
<b>SC</b>	SAE C = Z14 - 12/24 DP	

Through drive for 2nd pump assembled by Dana

<b>TA</b>	Tandem through drive with flange SAE A = 9T - 16/32 DP	
<b>TB</b>	Tandem through drive with flange SAE B = 13T - 16/32 DP	
<b>BT</b>	Tandem through drive with flange SAE B-B = 15T - 16/32 DP	
<b>TC</b>	Tandem through drive with flange SAE C = 14T - 12/24 DP	

## 20

## Additional feature

<b>XX</b>	Not Required	
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## 21

## Pump feature

<b>XXX</b>	Not Required	
<b>BPV</b>	By Pass valve	
<b>ASI (*)</b>	Angle swivel indicator	
<b>ASB (*)</b>	Angle swivel indicator + by-pass valve	

(\*) Available for quantity.

## 22

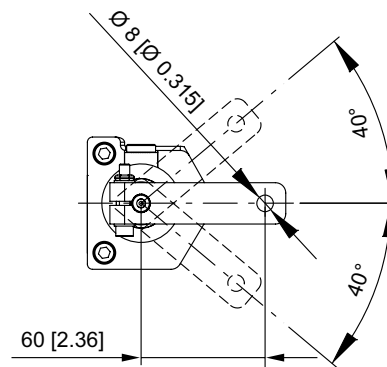
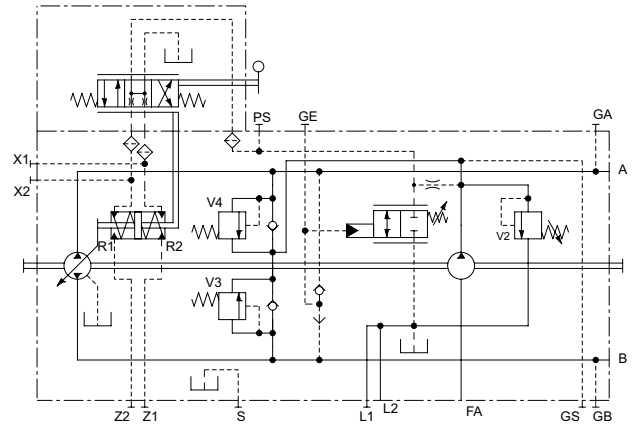
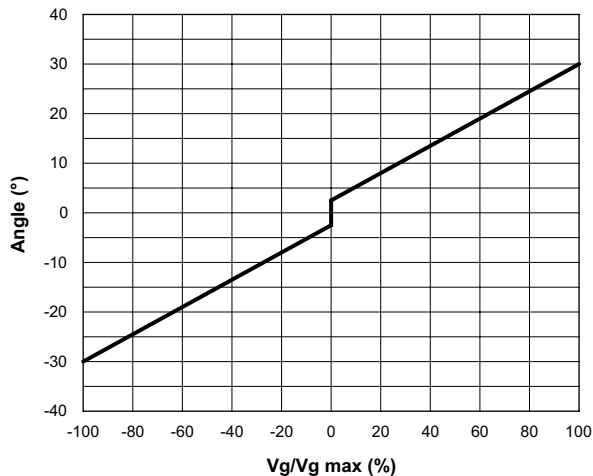
## Painting

<b>XX</b>	Not Required	
<b>01</b>	Black Painted RAL 9005	

## 10

## Control

The displacement of the pump is directly proportional to the angle of rotation of the lever. The feedback system feels the position of the swashplate and works automatically to compensate a positioning error. The diagram below shows the relationship between angle and displacement.



The torque necessary at the control lever is between 1 and 2.45 Nm [0.737 and 1.80 lbf·ft].

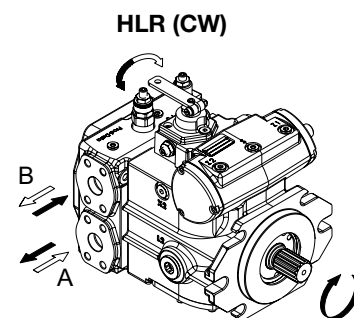
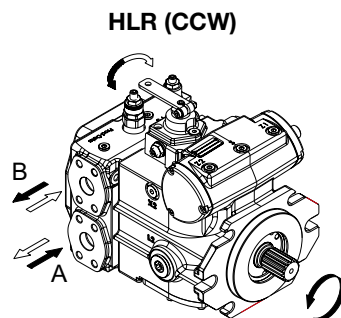
**Note:**

**The spring return feature in the control units is not a safety device.**

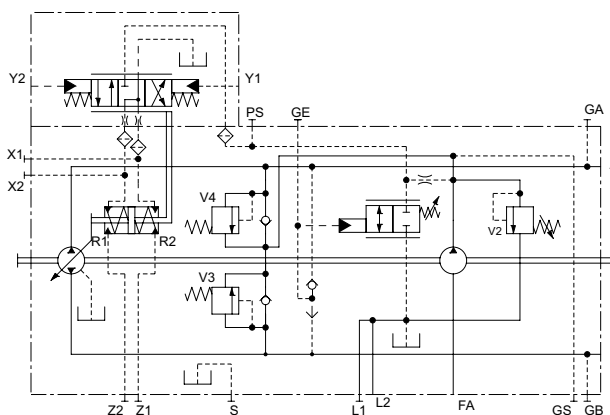
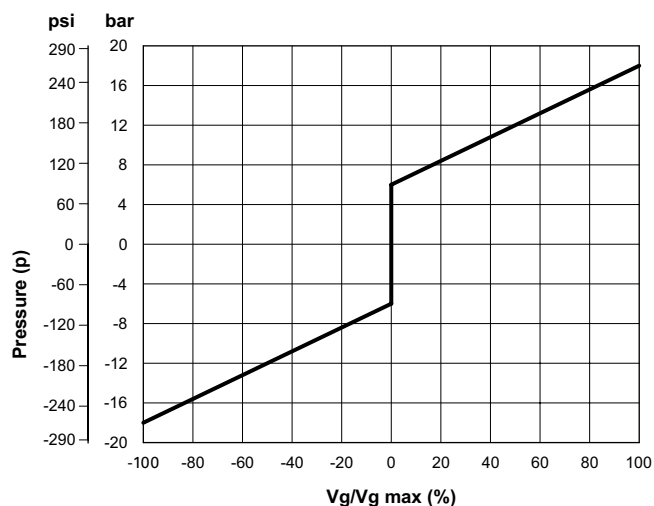
The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator. Check whether your application requires that remedial measures be taken on your machine in order to bring the driver consumer into a safe position (e.g. immediate stop).

**Flow direction:**

Correlation between direction of rotation (shaft view) control and direction of flow.



The pump displacement is proportional to the pilot pressure on Y1 or Y2 ports, which also affect flow direction. The feedback system feels the position of the swashplate and works automatically to compensate a positioning error. Piloting can be provided by boost pressure from GS port. The piloting pressure will have to be controlled then by a joystick or by a pressure reducing valve (not supplied).



Start of control = 6 bar [87 psi]  
End of control = 18 bar [261 psi] (Max displacement)

#### Note:

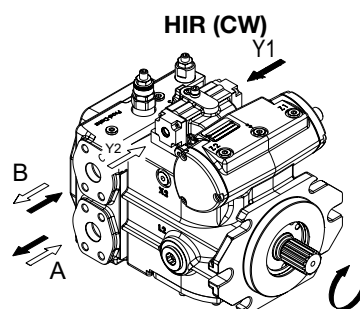
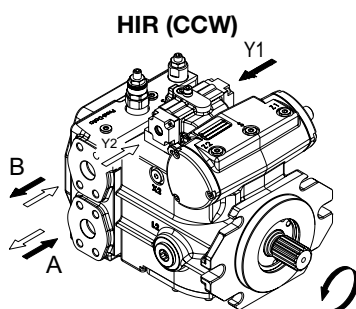
The tolerance on piloting pressure is  $\pm 10\%$  of maximum value.

#### The spring return feature in the control units is not a safety device.

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator. Check whether your application requires that remedial measures be taken on your machine in order to bring the driver consumer into a safe position (e.g. immediate stop).

#### Flow direction:

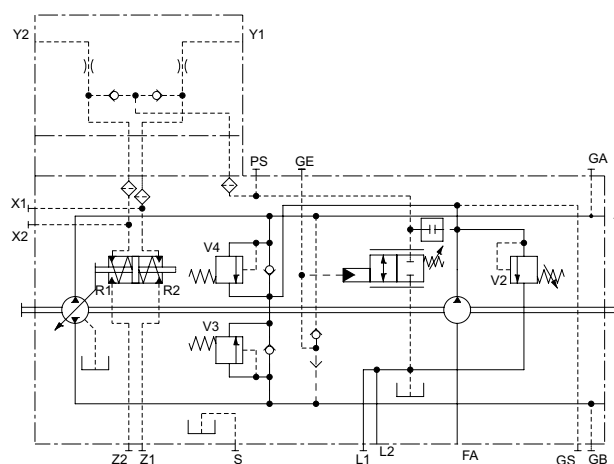
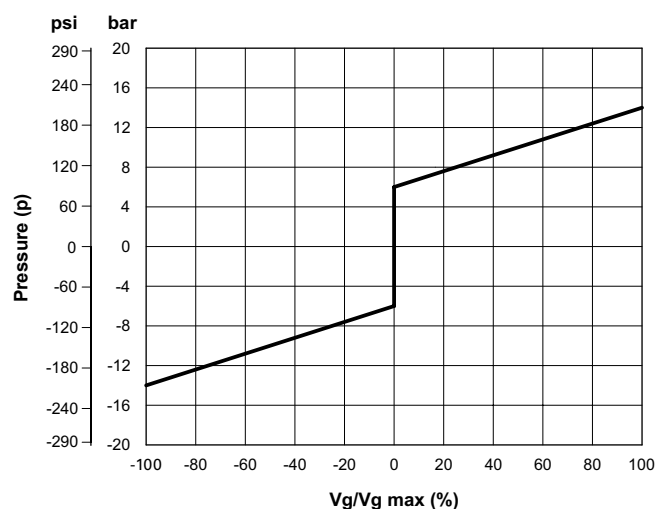
Correlation between direction of rotation (shaft view) control and direction of flow.



The pump displacement is proportional to the pilot pressure on Y1 or Y2 piloting ports, which also affect flow direction. The flow is also influenced by the working pressure and by the rotation speed of the pump. With a given input signal (piloting pressure) the pump can vary the displacement and the flow when working pressure or rotating speed change. Feeding pressure to the control joystick can be provided by charge pressure from GS port. The piloting pressure must then be controlled by said joystick or by a pressure reducing valve (not supplied). The orifice dimensions must be chosen in function of the response time required, see the table below.

## Warning:

**HIN control could require working parameters review. Please contact Dana technical service**



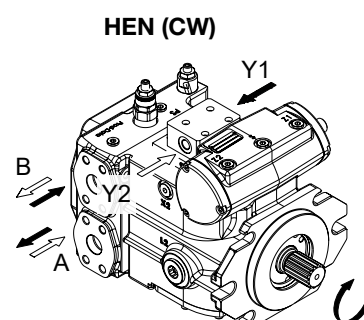
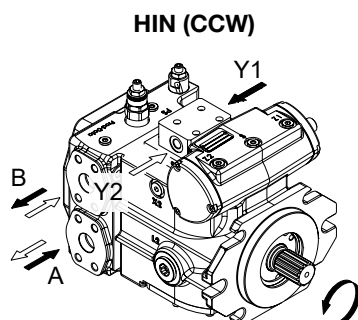
Maximum Pilot pressure = 30 bar [435 psi]  
 Start of control = 6 bar [87 psi]  
 End of control = 14 bar [203 psi](Max displacement)

## Note:

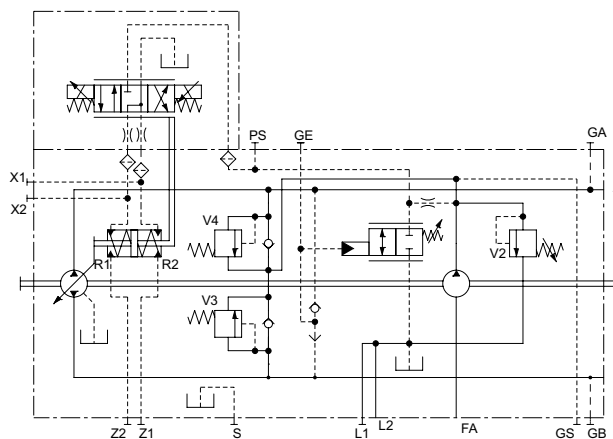
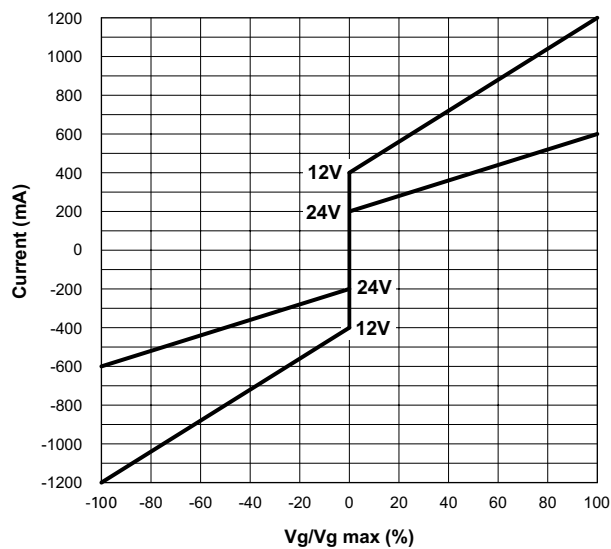
The tolerance on piloting pressure is  $\pm 10\%$  of maximum value.

## Flow direction:

Correlation between direction of rotation (shaft view) control and direction of flow.



The displacement of the pump is directly proportional to the input current of one of the two proportional solenoids. The feedback system feels the position of the swashplate and works automatically to compensate a positioning error. The input current of the two proportional solenoids must be controlled by an external amplifier card and it is recommended to use our amplifier specific for HD1. Flow direction depends on which solenoid is energized. Standard solenoids are proportional at 24V d.c. max. current 1A. (Optional solenoids 12V d.c. max. current 2A). For emergency operation only it is however possible to control solenoids directly with 24V d.c.voltage (or 12V d.c.), by-passing the amplifier.



Solenoid 24V:  
Current min. 200 mA max 600 mA  
Solenoid 12V:  
Current min. 400 mA max 1200 mA

**Note:**

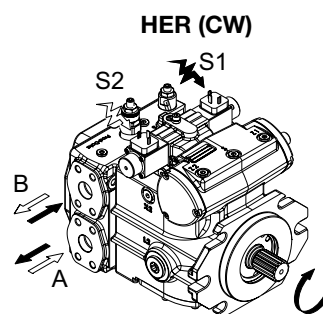
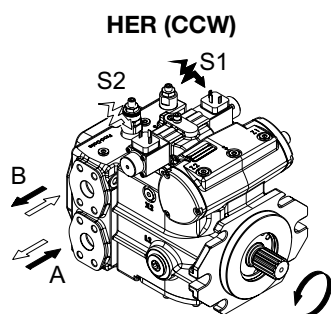
The tolerance on piloting current is  $\pm 10\%$  of maximum value.

**The spring return feature in the control units is not a safety device.**

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator. Check whether your application requires that remedial measures be taken on your machine in order to bring the driver consumer into a safe position (e.g. immediate stop).

**Flow direction:**

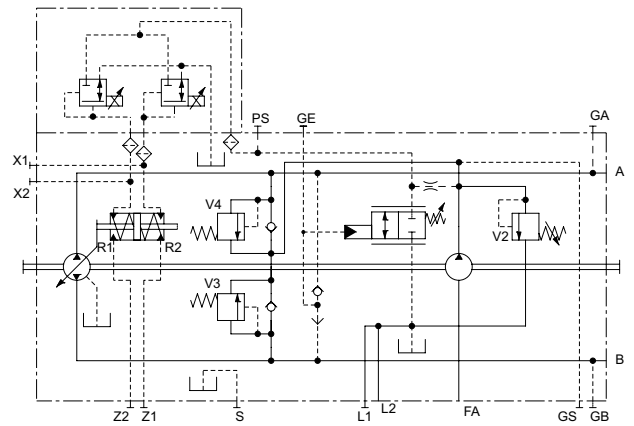
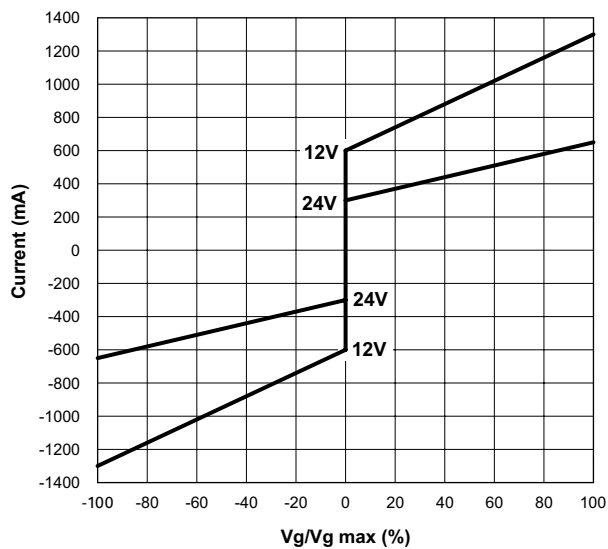
Correlation between direction of rotation (shaft view) control and direction of flow.



The displacement of the pump is directly proportional to the input current of one of the two proportional solenoids. The flow is also influenced by the working pressure and by the rotation speed of the pump. With a given input signal (piloting current) the pump can vary the displacement and the flow when working pressure or rotating speed change. The input current of the two proportional solenoids must be controlled by an external amplifier card and it is recommended to use our amplifier specific for HD1. Flow direction depends on which solenoid is energized. Standard solenoids are proportional 24V d.c. max. current 1A. (Optional solenoids 12V d.c. max. current 2A). For emergency operation only it is however possible to control solenoids directly with 24V d.c.voltage (or 12V d.c.), by-passing the amplifier.

**Warning:**

**HIN use could require working parameters review. Please contact Dana technical service**



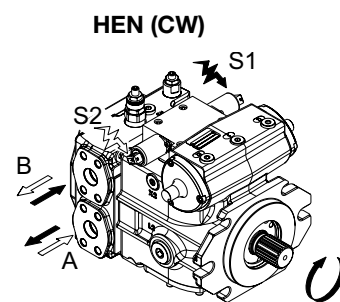
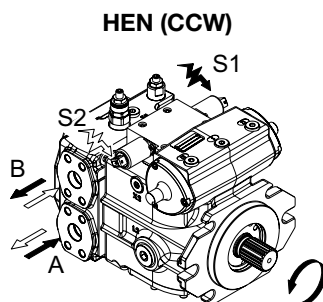
Solenoid 24V:  
Current min. 300 mA max 650 mA  
Solenoid 12V:  
Current min. 600 mA max 1300 mA

**Note:**

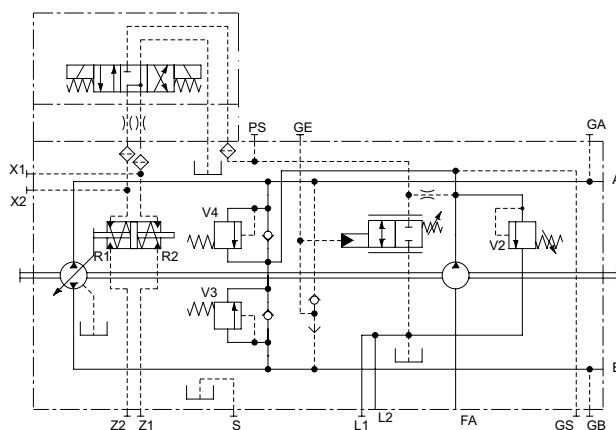
The tolerance on piloting current is  $\pm 10\%$  of maximum value.

**Flow direction:**

Correlation between direction of rotation (shaft view) control and direction of flow.

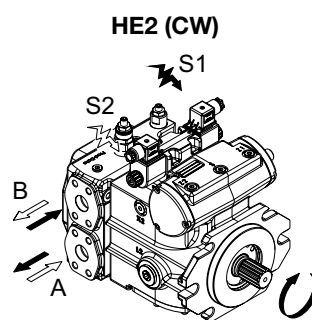
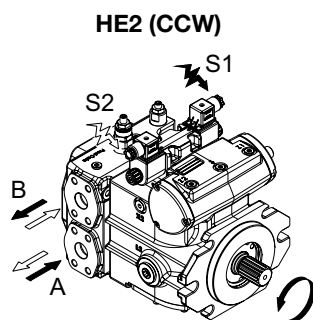


Switching one of the solenoids the pump swivels to maximum displacement in the corresponding output flow direction. Switching off the stated solenoid will result in swivelling back the pump to zero displacement position.

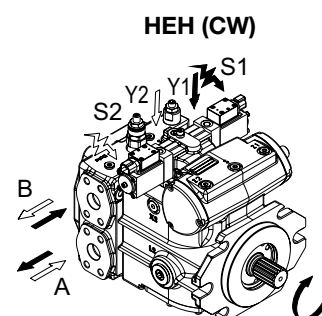


#### Flow direction:

Correlation between direction of rotation (shaft view) control and direction of flow.



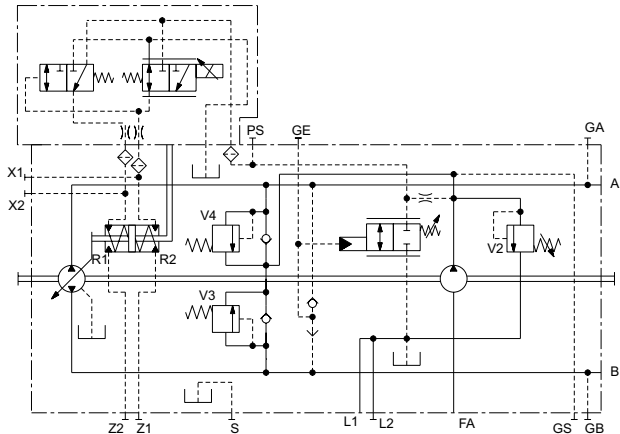
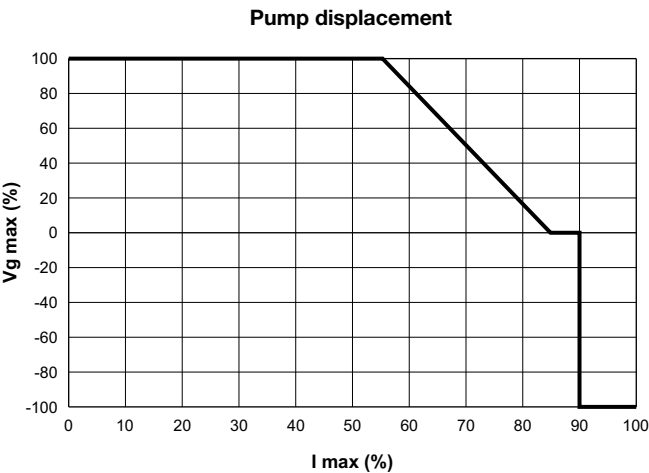




10

Control

Fan drive control (HFD) is a non-feedback control electrically operated. Pump displacement is proportional to the input current on the solenoid. Flow is also influenced by working pressure and rotation speed, with a given input signal pump can vary displacement and flow due to working pressure and speed rotation variation. Input current must be control by an external amplifier. Flow direction depends on pump direction of rotation and on input current (see below diagram).



Voltage	I max	Protection	Resistance	Connector
12 VDC	1.5 A	DIN VDE 0470 / EN 60 529 -IP65	3.85 Ohm	AMP Junior Timer
24 VDC	0.75 A		15.15 Ohm	

Minimum boost pressure 25 bar - 363 PSI.

**Flow direction:**  
Correlation between direction of rotation (shaft view) control and direction of flow.  
Flow direction depending to the I max current value.

Flow direction

	S1 < 85% I max
	S1 > 90% I max

HFD (CCW)

HFD (CW)

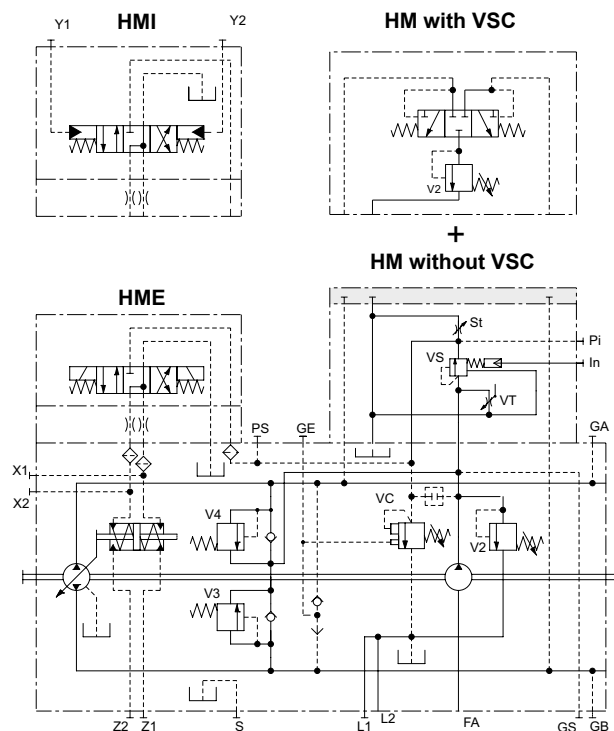
Click DANA button to return to Section Index

Click i button to return to main index

DC5A1G1\_0000000R2 - 03/24  
HD1/P - Section L

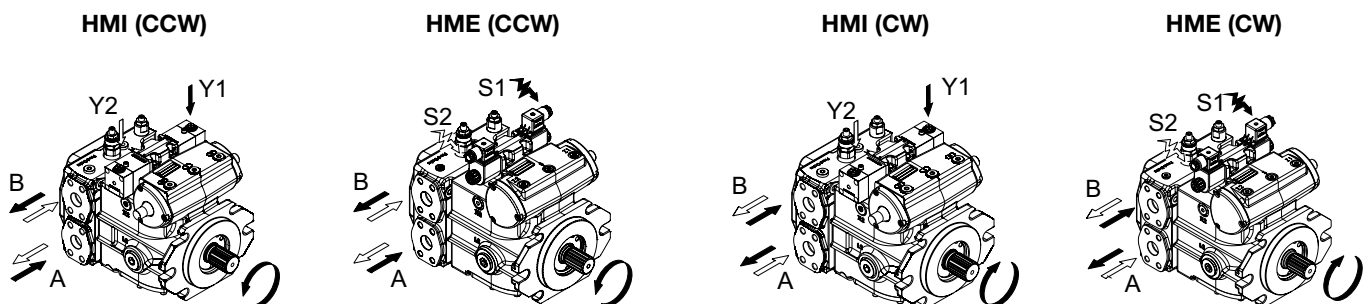
The "AUTOMOTIVE" (speed related) control, is used in hydrostatic transmissions with closed loop variable displacement pumps. This kind of controls allows to:

- Control of the vehicle translation speed;
- Limit the amount of Torque required from the Engine;
- Inching of the vehicle speed. The control of the Inching valve can be done with an hydraulic signal (Minimum 12 bar [174 psi] is required to swivel the pump to null displacement) or with a lever.
- Possibility to control the direction of flow electrically (HME) and hydraulically (HMI).



#### Flow direction:

Correlation between direction of rotation (shaft view) control and direction of flow.



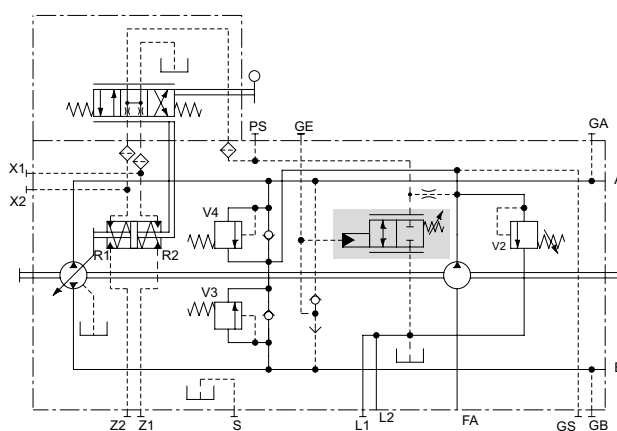
## PC

## Pressure compensator

The pressure compensator valve is meant to avoid opening of the relief valves: whenever working pressure reaches the PC valve setting, the swashplate is swivelled back reducing flow. The valve allows to maintain a constant pressure in the circuit at the setting value. It is advisable to fit the cut-off valve to all system where pressure peaks close to the relief valves setting value occur or in hydraulic systems engineered to the maximum pump pressure. It is recommended to set the pressure cut-off valve at 30 bar [435 psi] lower than the high pressure relief valve setting. Setting range: 100÷430 bar [1450÷6237 psi].

**Note:**

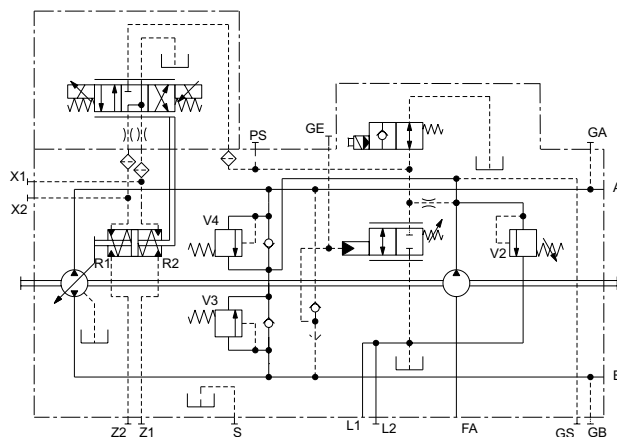
The pressure compensator valve is standard on HD1 pump and it can be combined with TE (EP) valve.



## EP

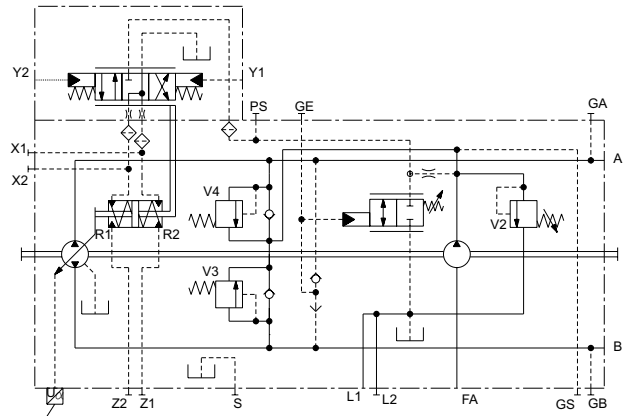
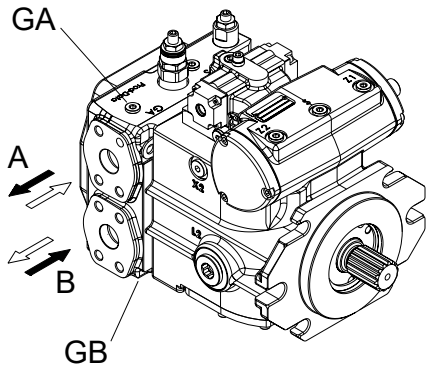
## Electric cut off valve

The electric cut-off valve swivels back to zero the pump flow when power supply to the ON/OFF solenoid is cut-off. This valve has been designed for applications subject to safety rules, which required stopping of the machine in case of no electric signal. Feed voltage is 24V d.c.



21 Pump feature

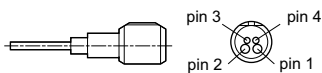
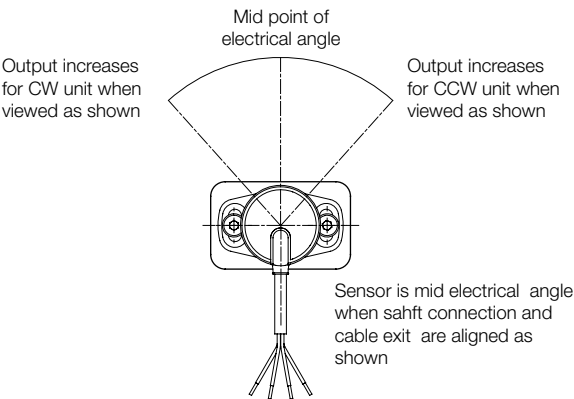
Pump swivel angle is measured by an electric swivel angle sensor. As an output parameter, the hall effect swivel angle sensor delivers a voltage proportional to the swivel angle (see table of output voltage).



Electric swivel angle sensor

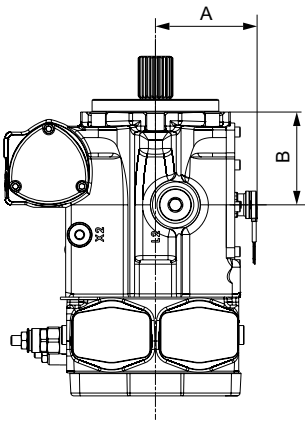
Output Voltage

		Flow direction	Operating Pressure	Output Voltage
Shaft direction of Rotation	CW	B to A	Gb	> 2.5
		A to B	Ga	< 2.5
	CCW	A to B	Ga	> 2.5
		B to A	Gb	< 2.5



pin	Description	Color
1	+V Supply	Red
2	0V Supply GND	Black
3	CH1 Output	Yellow
4	CH2 Output	White

Features	Range
Supply Voltage Ub	9 to 30 V DC
Output Voltage Ua	0.5 V (Vg max)    2.5 V (Vg 0)    4.5 V (-Vg max)
Reverse voltage protection	Short circuit-resistance
Operating temperature range	-40 °C to +140 °C
Vibration resistance Sinusoidal vibration EN 60068-2-6	BS EN 60068-2-64:1995 Sec 8.4(31.4gn rms) 20 to 2000Hz random
Shock resistance Continuous shock IEC 68-2-29	3m drop onto concrete And 2500g
Type of protection DIN/EN 60529	IP68 (to 2m depth for 1 hour) and IP69K



	mm [inch]
A	101.9 [4.01]
B	93 [3.66]



18

Filter

In order to guarantee an optimum fluid contamination level in the closed loop the HD1 can be equipped with a filter positioned on the delivery outlet of the charge pump. Only the flow necessary to reintegrate the lost oil due to leakage will pass through the filter, all the excess flow is not filtered and discharged through the pump drain line. In this way a longer life of the filter is achieved. The filter contains a composite fibre filtering element, with capacity of 12 micron absolute. The system uses sensors of clogging differential pressure of 8 bar [116 psi] in optical and electrical (Connector DIN43650/ISO4400) version.

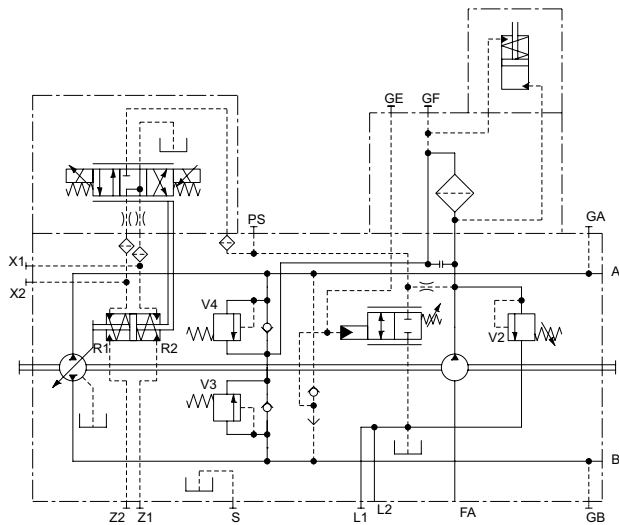
It is available a conversion cable from DIN43650/ISO4400 to Deutsch DT04 connector code M54050011. The filter is without by-pass.

It is available a version for filtering in filter pressure not mounted on the pump. It's available also version:

- FP arranged for filter
- FR with openings for external filter under pressure

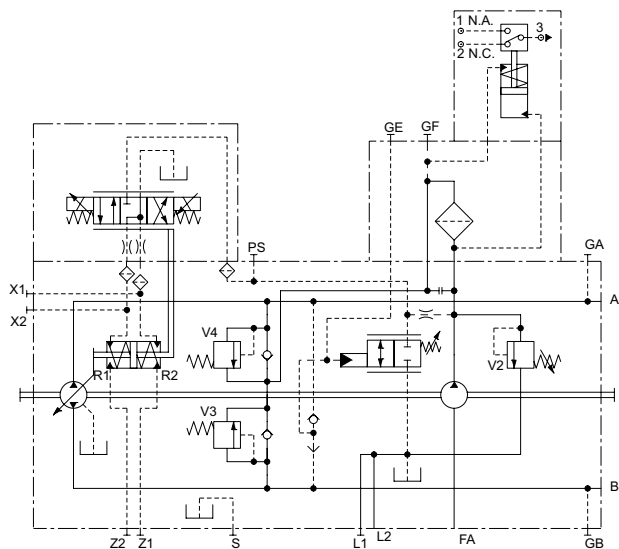
M8

With optical sensor



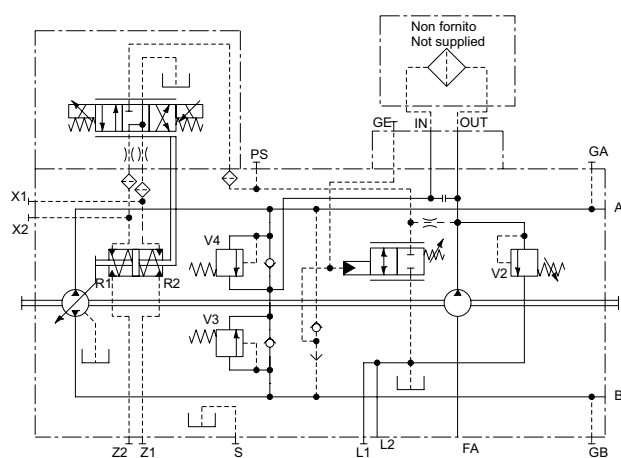
E1 - E2 - E3 - E9

With electric sensor

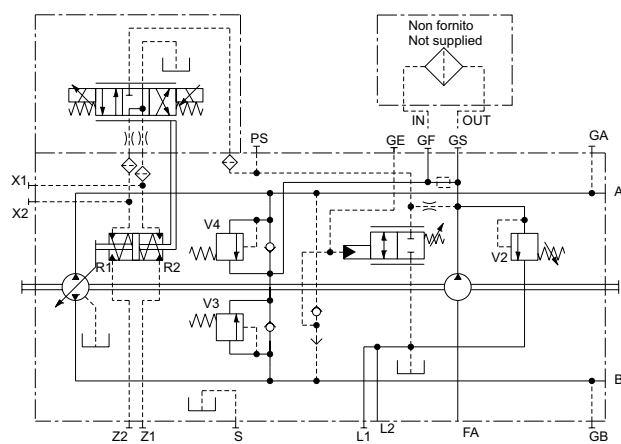


SPDT	Max resistive load	Max inductive load
258. C.A.\A.C. 125-250 V	1 A	1 A
C.C.\D.C. 30 V	2 A	2 A
C.C.\D.C. 50 V	0.5 A	0.5 A
C.C.\D.C. 75 V	0.25 A	0.25 A
C.C.\D.C. 125 V	0.2 A	0.03 A

## Remote filter



## Arranged for filter



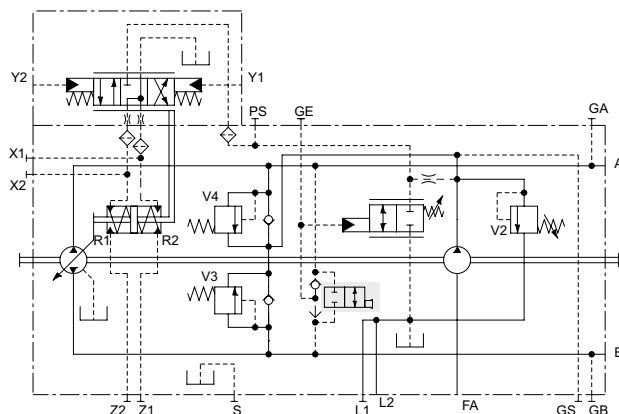
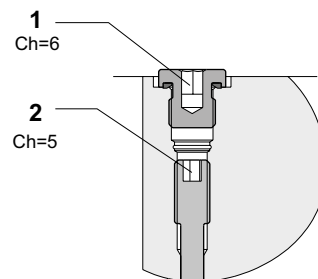
**BPV** By-pass valve

The By-pass valve allows, if necessary, to connect the pressure port line A and B.

By-pass function:

- Take out the cap **1**;
- Unscrew the valve **2** max 5 turns.

By-pass valve position and dimensions see page I35.





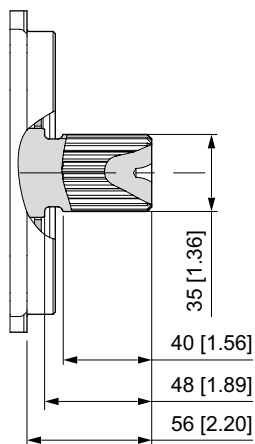
8

Shaft end

**AC**

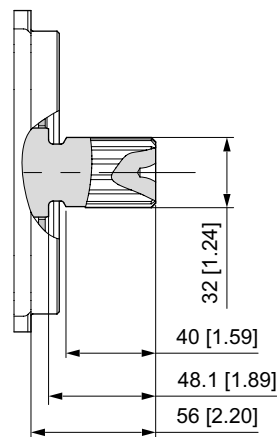
Splined

SAE 1-1/4" 21T 16/32 - FLAT ROOT CLASS 5 ANSI B92.1a - 1976

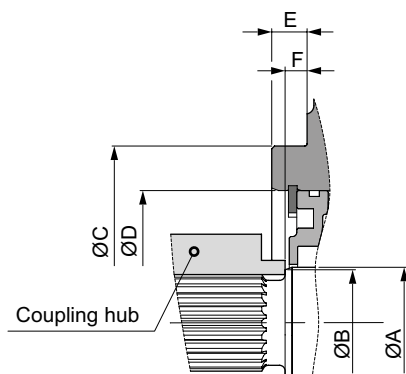

**13**

Splined

14T 12/24 DP - FLAT ROOT CLASS 5 ANSI B92.1a - 1976



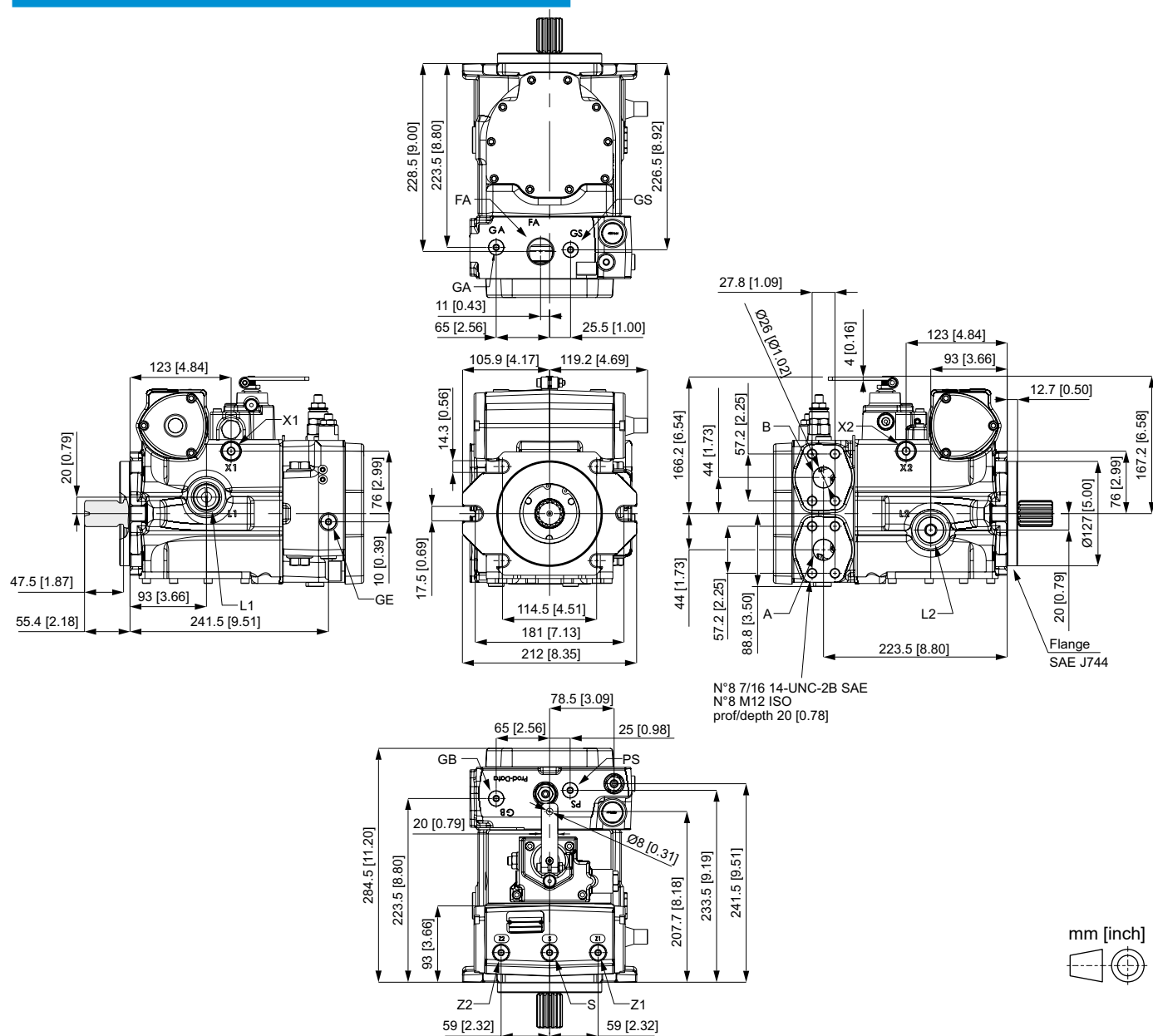
## Measures for installing the coupling hub



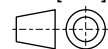
		mm [inch]					
Type		ØA	ØB	ØC	ØD	E	F
<b>AC</b>	21T 16/32" DP	35	34 [1.34]	127	72 [2.83]	12.7 [0.50]	7.9 [0.31]
<b>13</b>	14T 12/24" DP	35 [1.38]	32.9 [1.30]	5.08 [0.20]	2.83 [0.11]	0.50 [0.02]	0.31 [0.01]

To avoid dangerous contacts, the external diameter of the hub must be less than the diameter dimension "ØD" while the internal diameter must be less than the diameter "ØB".

## HLR



mm [inch]

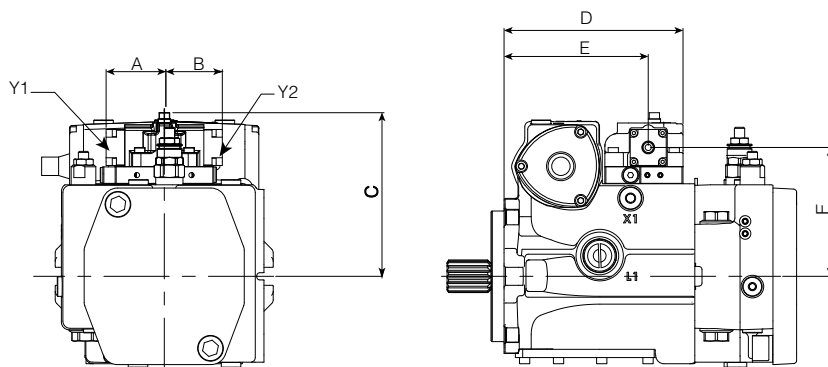


	Connections	ISO	SAE
<b>A-B</b>	Pressure ports	1" ISO 6162 - 6000 psi	1" SAE J 518 - 6000 psi
<b>L1-L2</b>	Case drain	3/4 G (BSPP) Depth 20 [0.59]	1-1/16"-12UN-2B Depth 20 [0.59]
<b>FA</b>	Suction	1 G (BSPP) Depth 19 [0.75]	1-5/16"-12UN-2B Depth 19 [0.75]
<b>GA-GB</b>	Gauge pressure A-B	1/4 G (BSPP) Depth 12 [0.47]	7/16"-20UNF-2B Depth 12 [0.47]
<b>GS</b>	Boost pressure	1/4 G (BSPP) Depth 12 [0.47]	7/16"-20UNF-2B Depth 12 [0.47]
<b>GE</b>	Working pressure	1/4 G (BSPP) Depth 12 [0.47]	7/16"-20UNF-2B Depth 12 [0.47]
<b>PS</b>	Control pressure	1/4 G (BSPP) Depth 12 [0.47]	7/16"-20UNF-2B Depth 12 [0.47]
<b>X1-X2</b>	Pressure stroking chamber	3/8 G (BSPP) Depth 13 [0.51]	9/16"-18UNF-2B Depth 13 [0.51]
<b>Z1-Z2</b>	Pressure stroking chamber	1/8 G (BSPP) Depth 12 [0.47]	7/16"-20UNF-2B Depth 12 [0.47]
<b>S</b>	Bleed	1/4 G (BSPP) Depth 12 [0.47]	7/16"-20UNF-2B Depth 12 [0.47]

10

Control

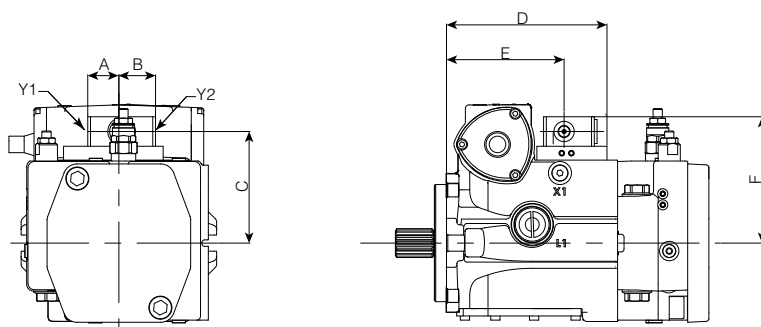
## HIR



	mm [inch]
<b>A</b>	56.5 [2.22]
<b>B</b>	56.5 [2.22]
<b>C</b>	159.1 [6.26]
<b>D</b>	174 [6.85]
<b>E</b>	140.2 [5.52]
<b>F</b>	123.3 [4.93]

Y1, Y2: control piloting pressure ports -1/4 G (BSPP) (ISO) - 7/16" - 20 UNF 2B (SAE)

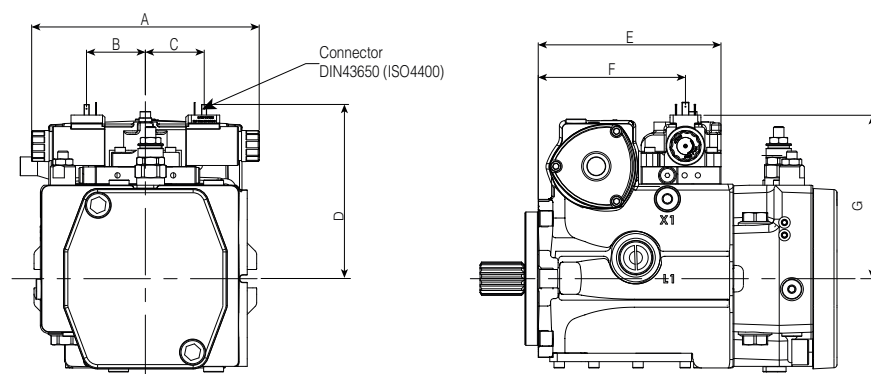
## HIN



	mm [inch]
<b>A</b>	33.8 [1.33]
<b>B</b>	39.7 [1.56]
<b>C</b>	137 [5.39]
<b>D</b>	174 [6.35]
<b>E</b>	127.5 [5.02]
<b>F</b>	121 [4.76]

Y1, Y2: control piloting pressure ports -1/4 G (BSPP) (ISO) - 7/16" - 20 UNF 2B (SAE)

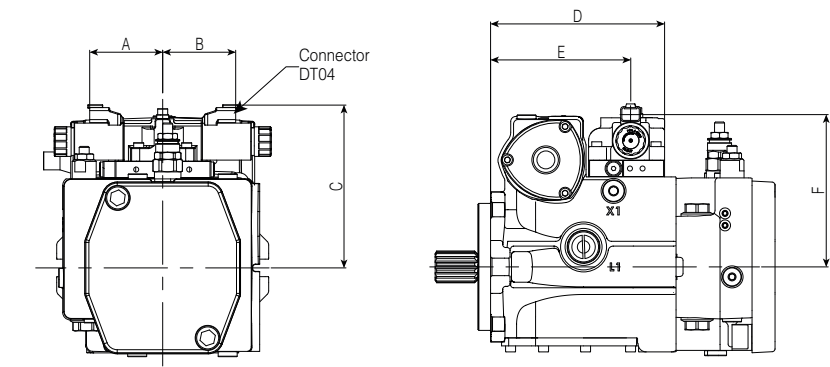
## HER - DIN 43650 (ISO 4400)



pump shape for reference only

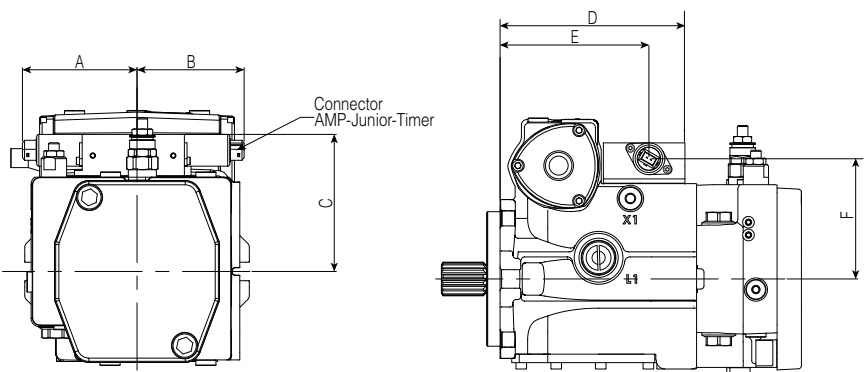
	mm [inch]
<b>A</b>	195 [7.63]
<b>B</b>	67.4 [2.65]
<b>C</b>	67.4 [2.65]
<b>D</b>	159.1 [6.26]
<b>E</b>	174 [6.85]
<b>F</b>	140.2 [5.52]
<b>G</b>	153.3 [6.04]

HER - DT04



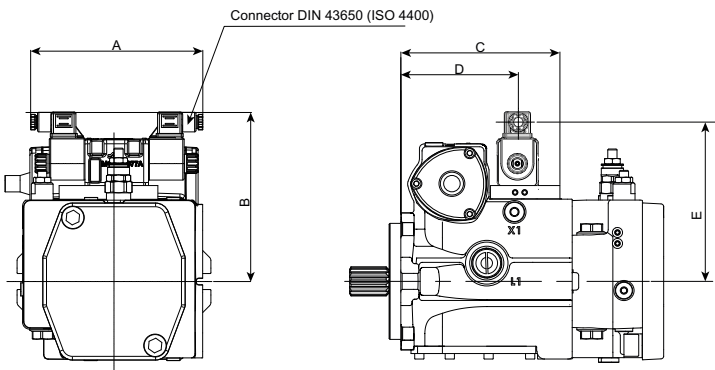
	mm [inch]
A	85.5 [3.37]
B	85.5 [3.37]
C	162.4 [6.33]
D	174 [6.85]
E	140.2 [5.52]
F	151.2 [3.95]

HEN



	mm [inch]
A	108.2 [4.26]
B	101.1 [3.98]
C	129.4 [5.09]
D	175 [6.89]
E	141 [5.55]
F	114.4 [4.50]

HE2



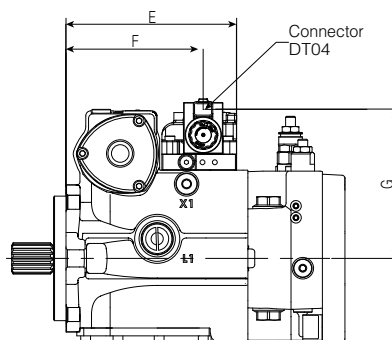
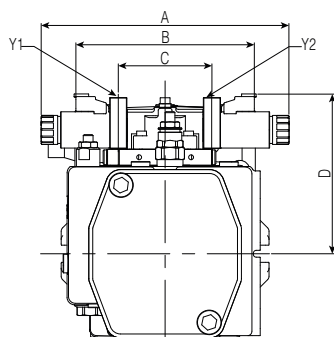
	mm [inch]
A	188.3 [7.41]
B	185.5 [7.30]
C	174 [6.85]
D	128.5 [5.06]
E	174.4 [6.87]

pump shape for reference only

10

Control

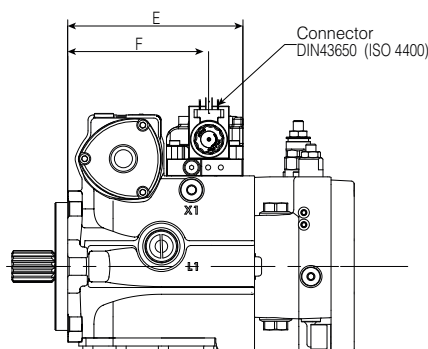
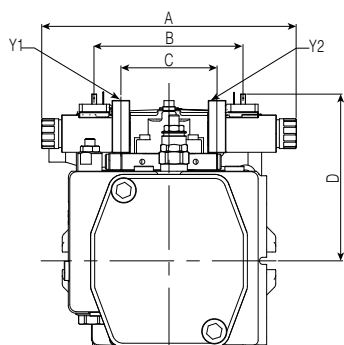
## HEH - DT04



	mm [inch]
<b>A</b>	241.8 [9.52]
<b>B</b>	207 [8.15]
<b>C</b>	95 [3.74]
<b>D</b>	162.6 [6.40]
<b>E</b>	174 [6.85]
<b>F</b>	140.2 [5.52]
<b>G</b>	151.2 [5.99]

Y1, Y2: control piloting pressure ports -1/8" G (BSPP) (ISO) - 5/16" - 24 UNF (SAE)

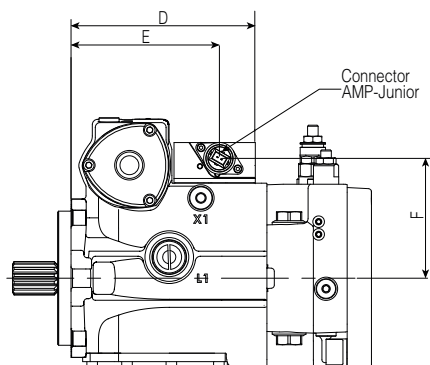
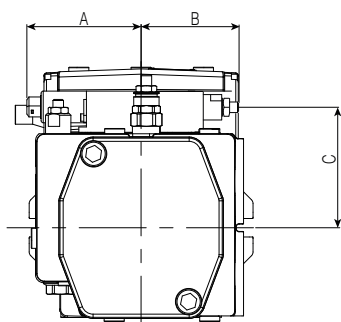
## HEH - DIN 43650 (ISO 4400)



	mm [inch]
<b>A</b>	239.8 [9.44]
<b>B</b>	171.7 [6.76]
<b>C</b>	95 [3.74]
<b>D</b>	152.9 [6.02]
<b>E</b>	174 [6.85]
<b>F</b>	140.2 [5.52]

Y1, Y2: control piloting pressure ports -1/8" G (BSPP) (ISO) - 5/16" - 24 UNF (SAE)

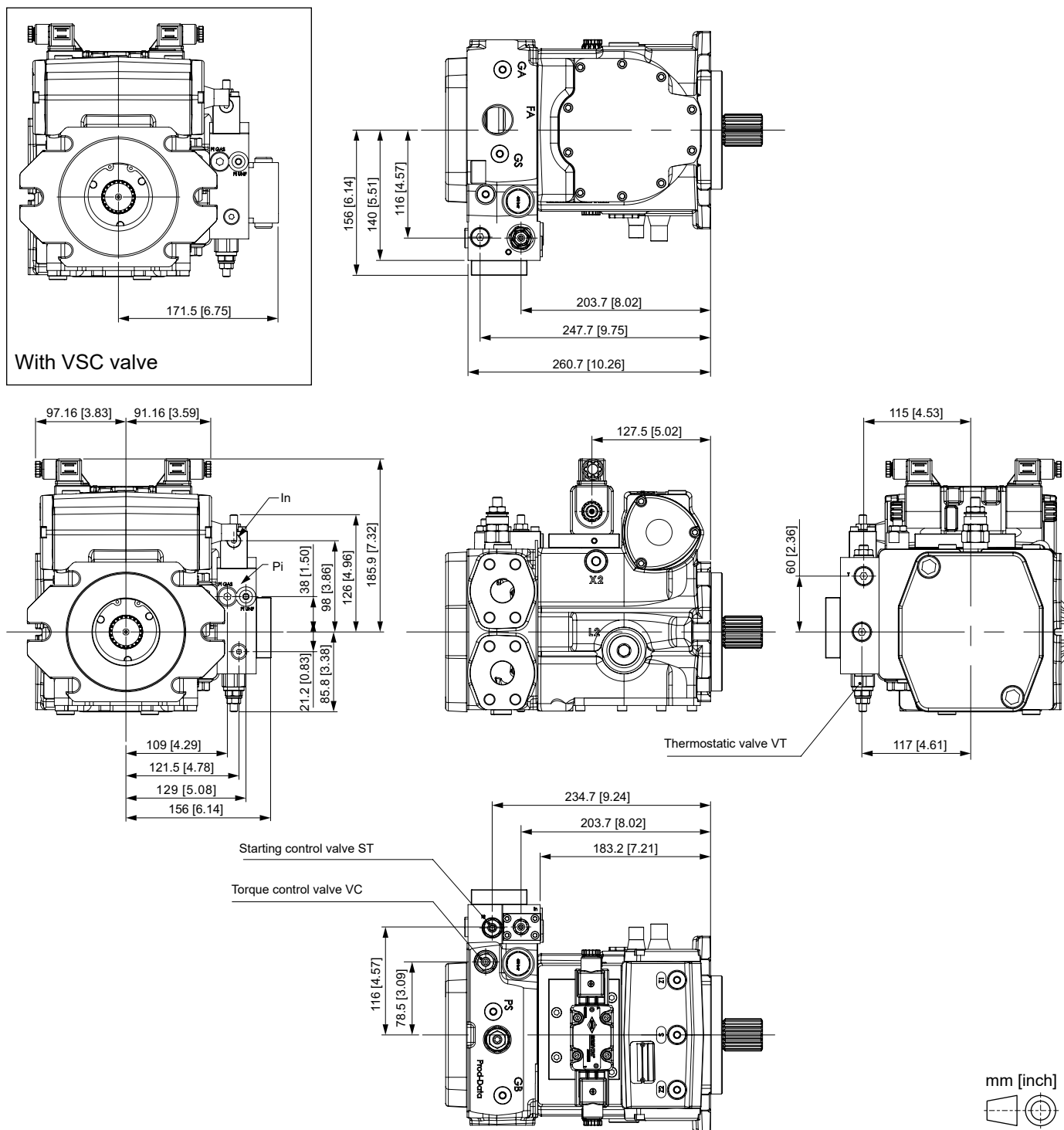
## HFD



pump shape for reference only

	mm [inch]
<b>A</b>	108.2 [4.26]
<b>B</b>	93.2 [3.67]
<b>C</b>	114.4 [4.50]
<b>D</b>	175 [6.83]
<b>E</b>	141 [5.55]
<b>F</b>	129.4 [5.09]

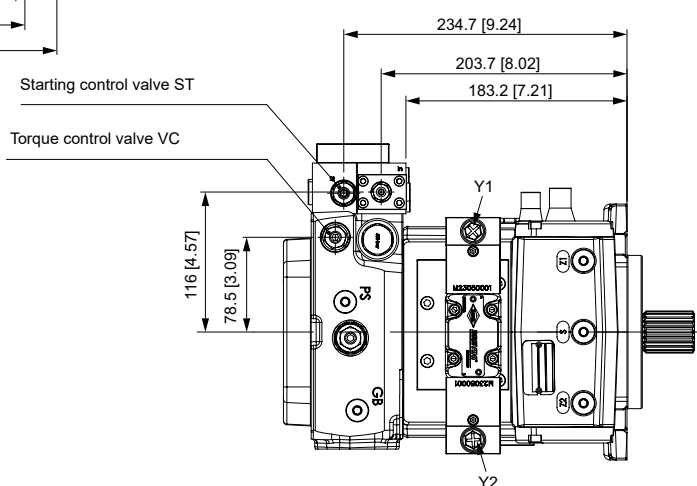
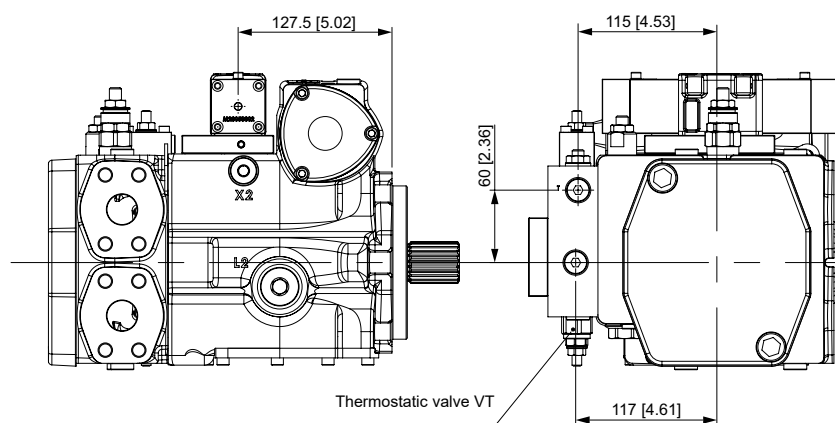
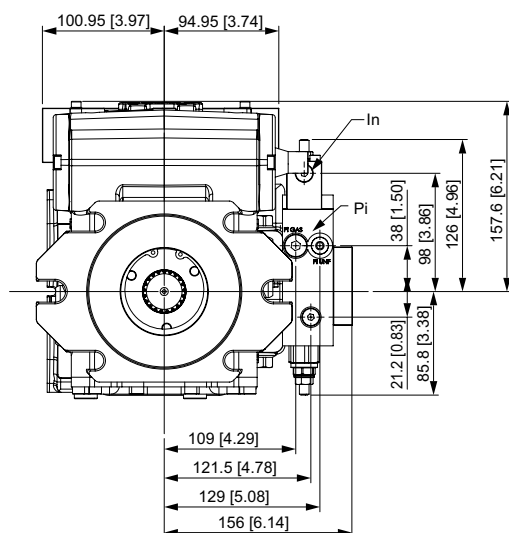
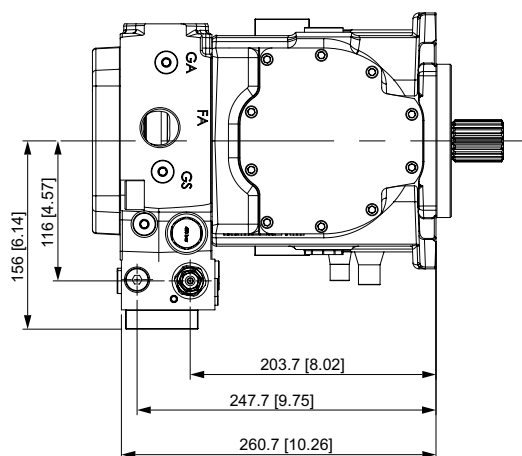
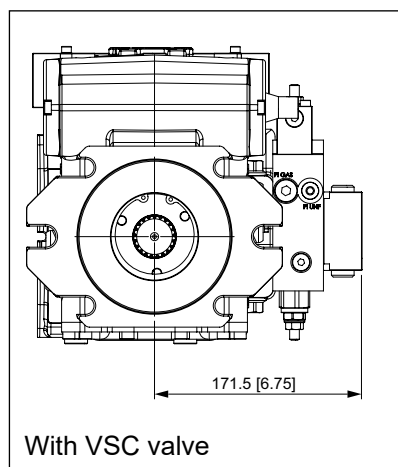
## HME Automotive



Pi Gas: Piloting pressure gauge port - 1/4 G (BSPP) (ISO)  
 Pi UNF: Piloting pressure gauge port - 7/16" - 20 UNF (SAE)  
 In: Piloting pressure Inching port - 1/8 G (BSPP) (ISO)

## HME

### Automotive



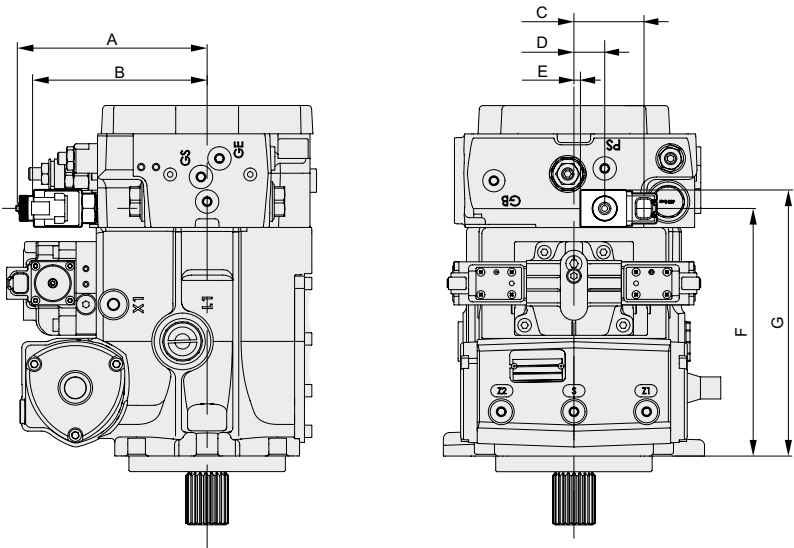
Pi Gas: Piloting pressure gauge port - 1/4 G (BSPP) (ISO)  
 Pi UNF: Piloting pressure gauge port - 7/16" - 20 UNF (SAE)  
 In: Piloting pressure Inching port - 1/8 G (BSPP) (ISO)  
 Y1, Y2: Control piloting pressure ports - 1/4 G (BSPP) (ISO) - 7/16" - 20 UNF with Nipple SAE

16

Pressure compensator valve

EP

Electric Cut-Off +  
Pressure Compensator valve



	mm [inch]
A	154.1 [6.07]
B	141.7 [5.58]
C	56.9 [2.24]
D	25 [0.98]
E	5.3 [0.21]
F	201 [7.91]
G	216 [8.50]

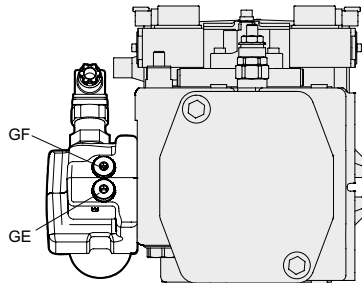




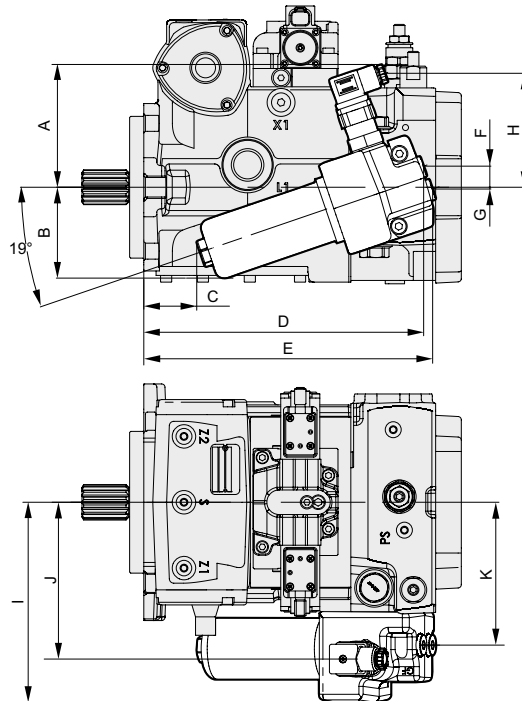
18

Filter

### E1/E2/E3/E9 Filter with electric clogging sensor



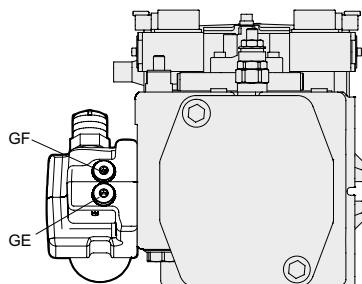
GF: Boost pressure  
GE: Working pressure



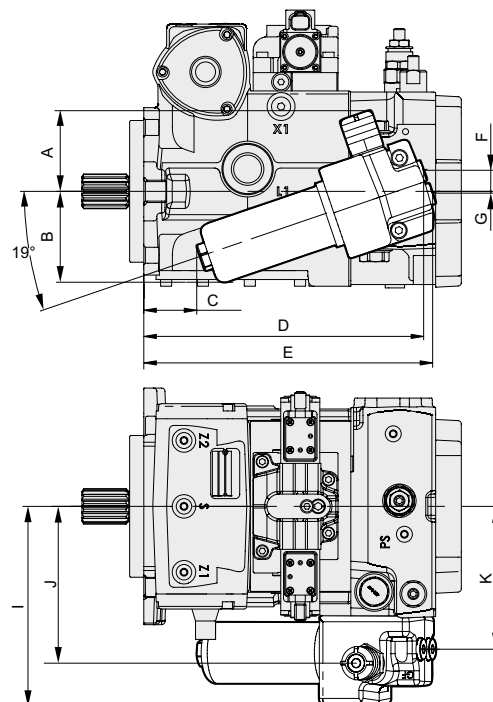
	mm [inch]
GF GE ISO	1/4" G (BSPP) UNI/ISO 228/1 Depth 12 [0.47]
GF GE SAE	7/16"-20 UNF-2B ISO 11926 Depth 12 [0.47]
A	110 [4.33]
B	81.4 [3.21]
C	47.4 [1.87]
D	250.8 [9.87]
E	258.8 [10.19]
F	18.9 [0.74]
G	1.6 [0.06]
H	102.1 [4.02]
I	179 [7.05]
J	140.5 [5.53]
K	128 [5.04]

### M8

Filter with optical clogging sensor



GF: Boost pressure  
GE: Working pressure



	mm [inch]
GF GE ISO	1/4" G (BSPP) UNI/ISO 228/1 Depth 12 [0.47]
GF GE SAE	7/16"-20 UNF-2B ISO 11926 Depth 12 [0.47]
A	72 [2.83]
B	81.4 [3.21]
C	47.4 [1.87]
D	250.8 [9.87]
E	258.8 [10.19]
F	18.9 [0.74]
G	1.6 [0.06]
I	179 [7.05]
J	140.5 [5.53]
K	128 [5.04]

pump shape for reference only

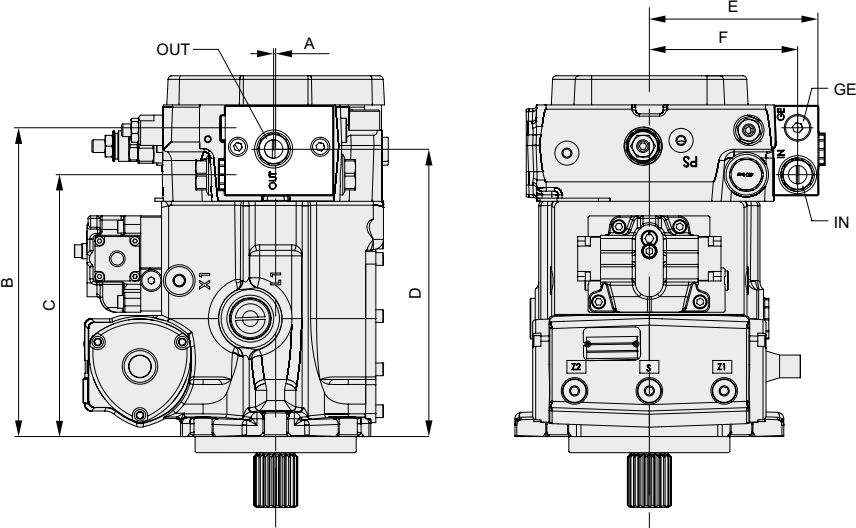
[Click i button to return to main index](#)

[Click Dana button to return to Section index](#)



FR

Remote filter option

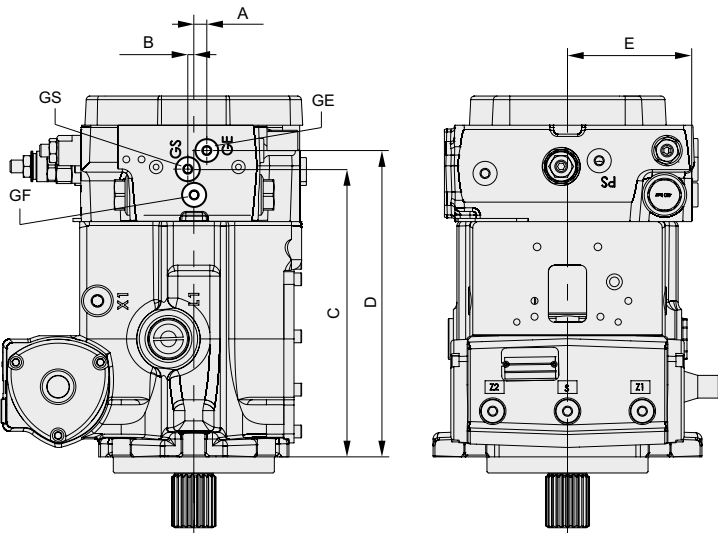


IN: Return from the filter  
OUT: Flow to the filter  
GE: Working pressure

mm [inch]	
IN OUT ISO	1/2" G (BSPP) UNI/ISO 228/1 Depth 18 [0.71]
IN OUT SAE	3/4" - 16 UNF-2B ISO R725 Depth 15 [0.59]
GE ISO	1/4" G (BSPP) UNI/ISO 228/1 Depth 12 [0.47]
GE SAE	7/16"-20 UNF-2B ISO 11926 Depth 12 [0.47]
A	-0.2 [-0.01]
B	243.5 [9.59]
C	206.5 [8.13]
D	226.5 [8.92]
E	132.9 [5.23]
F	116.9 [4.60]

FP

Arranged for filter

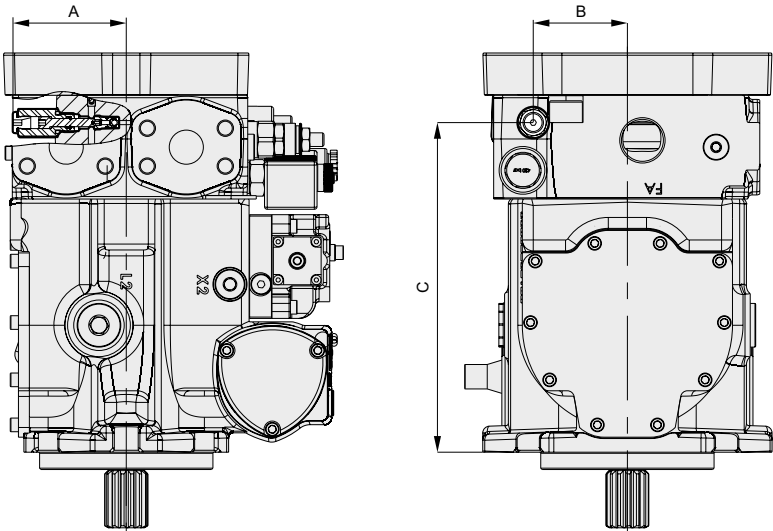


GF/GS: Boost pressure  
GE: Working pressure

mm [inch]	
GS GE GF ISO	1/4" G (BSPP) UNI/ISO 228/1 Depth 12 [0.47]
GS GE GF SAE	7/16"-20 UNF-2B ISO 11926 Depth 12 [0.47]
A	10 [0.39]
B	5 [0.20]
C	226.8 [8.93]
D	241.5 [9.51]
E	98 [3.86]

21 Pump feature

BPV By-pass valve



	mm [inch]
<b>A</b>	83 [3.27]
<b>B</b>	69 [2.72]
<b>C</b>	241.5 [9.51]

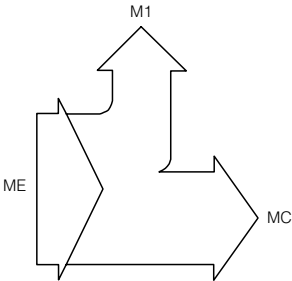
HD1 pump can be supplied with through drive. The through drive can driving with a second HD1 or a pump of other kind.

Available flanges are:

- SAE A, SAE B, SAE C, SAE B-B and SAE C-C flange
- TANDEM flange

The maximum permissible torques on drive shaft of the first pump and the maximum through drive torques are listed in the table below.

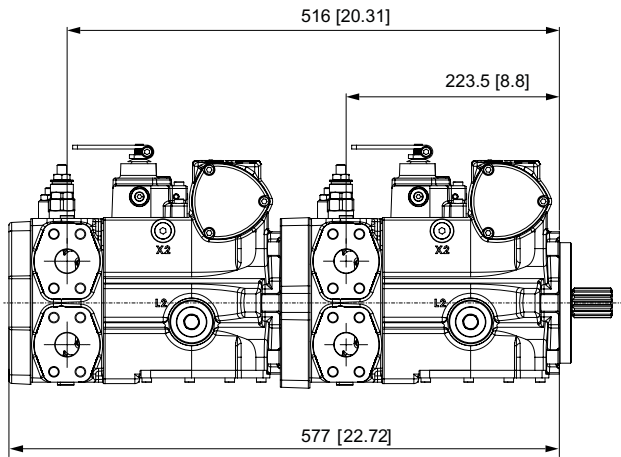
**Warning:**  
The effective torque value on the shaft of first pump is given by the sum of the torques required from each pump making the system.



			Drive shaft	
			AC (Z21 16/32 DP)	13 (Z14 12/24 DP)
Drive shaft max torque	ME	Nm [lbf·ft]	950 [700]	620 [457]
Through drive max torque	MC	Nm [lbf·ft]	522 [385]	522 [385]

19 Through drives

TC - TX Tandem through drive



Shafts for combination pumps		
	Front Pump	Rear Pump
Shafts	AC	13
	13	13

Warning: the TC-TX through drives must be used in the configuration of the first pump in the following cases:

1. Tandem pump combination.
2. Dana second pump

Example:

- If it is needed to purchase a single pump for Tandem pump combination, the pump will must have the TC through drive.

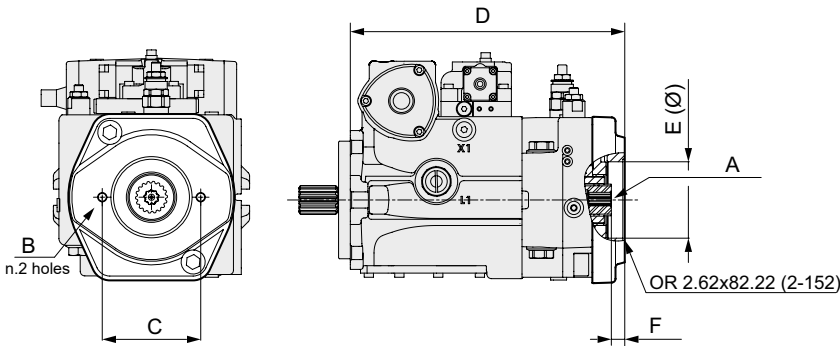


19

Through drives

SA-AA

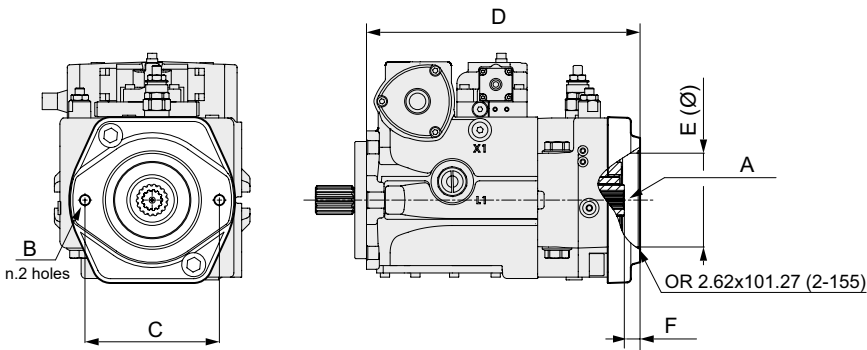
SAE A / SAE A-A - Flange



	Type	mm [inch]
A	SA	SAE A - 5/8" - 9T 16/32 DP
	AA	SAE AA - 3/4" - 11T 16/32 DP
B	ISO	M10 Dept 16 [0.63]
	SAE	3/8" 16 UNC-2B Dept 16 [0.63]
C		106.4 [4.19]
D		296.5 [11.67]
E		82.55 [3.25]
F	SA	14.5 [0.57]
	AA	14.5 [0.57]

SB/BB

SAE B / SAE B-B Flange

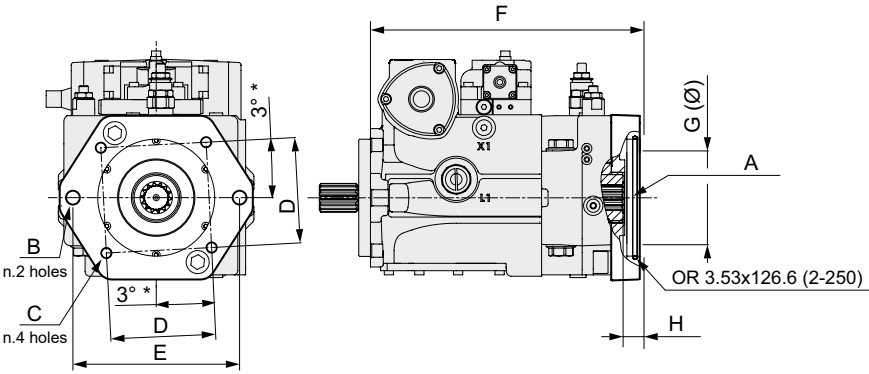


	Type	mm [inch]
A	SB	SAE B - 7/8" - 13T 16/32 DP
	BB	SAE BB - 1" - 15T 16/32 DP
B	ISO	M12 Dept 19 [0.75]
	SAE	1/2" 13 UNC-2B Dept 19 [0.75]
C		146 [5.75]
D		296.5 [11.67]
E		101.6 [4.00]
F	SB	17.1 [0.67]
	BB	15.1 [0.59]

pump shape for reference only

19 Through drives

SC SAE C Flange



	Type	mm [inch]
A		SAE - C 1 1/4" - 14T 12/24 DP
B	ISO	M16 Dept 30 [1.18]
	SAE	5/8" 11 UNC-2B Dept 30 [1.18]
C	ISO	M12 Dept 21 [0.83]
	SAE	1/2" 13 UNC-2B Dept 21 [0.83]
D		114.5 [4.51]
E		181 [7.13]
F		292.5 [11.52]
G		127 [5.00]
H		18.1 [0.71]

pump shape for reference only





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