

# Hydraulic Motors

Series V12, V14, T12  
Variable Displacement

aerospace  
climate control  
electromechanical  
filtration  
fluid & gas handling  
**hydraulics**  
pneumatics  
process control  
sealing & shielding



ENGINEERING YOUR SUCCESS.

### Basic formulas for hydraulic motors

A) Displacement ( $D_{\alpha}$ )

$$D_{\alpha} = D_{35} \times \frac{\sin \alpha}{\sin 35^{\circ}} \text{ [cm}^3\text{/rev]}$$

$\alpha$  - displacement angle [°]  
 (between 35° and 6.5°)  
 $D_{35}$  - max displ. at 35° [cm<sup>3</sup>/rev]

B) Flow (q)

$$q = \frac{D \times n}{1000 \times \eta_v} \text{ [l/min]}$$

D - displacement [cm<sup>3</sup>/rev]  
 n - shaft speed [rpm]  
 $\eta_v$  - volumetric efficiency

C) Torque (M)

$$M = \frac{D \times \Delta p \times \eta_{hm}}{63} \text{ [Nm]}$$

$\Delta p$  - differential pressure [bar]  
 (between inlet and outlet)  
 $\eta_{hm}$  - mechanical efficiency

D) Power (P)

$$P = \frac{q \times \Delta p \times \eta_t}{600} \text{ [kW]}$$

$\eta_t$  - overall efficiency  
 ( $\eta_t = \eta_v \times \eta_{hm}$ )

### Conversion factors

1 bar .....	14.5 psi
1 cm <sup>3</sup> .....	0.061 cu in
1 kg .....	2.20 lb
1 kW .....	1.34 hp
1 l .....	0.264 US gallons
1 mm .....	0.039 in
1 N .....	0.225 lbf
1 Nm .....	0.738 lbf ft
1 °C .....	1.8 F° + 32

**Content**

**General information**

General information and design

**General information**

Pages 5 - 6

**1**

**Series V12**

Axial piston motor with variable displacement and bent-axis

**V12**

Pages 7 - 31

**2**

**Series V14**

Axial piston motor with variable displacement and bent-axis

**V14**

Pages 32 - 57

**3**

**Series T12**

Axial piston motor with two-displacement and bent-axis

**T12**

Pages 58 - 63

**4**

**Installation and start-up information**

V12, V14 and T12

**Installation information**

Pages 64 - 67

**5**





### Series V12

Series V12 is a bent-axis, variable displacement motor. It is intended for both open and closed circuits, mainly in mobile applications, but the V12 can also be utilized in a wide variety of other applications.

#### Features

- Max intermittent pressure to 480 bar and continuous operating pressure to 420 bar
- Thanks to low weight pistons with laminated piston rings and a compact design of the rotating parts, the V12 tolerates very high speeds
- High allowable speeds and operating pressures means high output power; the overall efficiency remains high throughout the entire displacement range
- The 9-piston design provides high start-up torque and smooth motor operation
- Wide displacement ratio (5:1)
- Broad range of controls and accessory valves for most applications
- Small envelop size and a high power-to-weight ratio
- ISO, cartridge and SAE versions
- Low noise levels due to a very compact and sturdy design with smooth fluid passages
- Positive piston locking, strong synchronizing shaft, heavy-duty bearings and small number of parts add up to a compact and robust motor with long service life and proven reliability.

### Series V14

Series V14 is a new generation of variable displacement, bent-axis motors, a further development of our well known V12 motor.

It is designed for both open and closed circuit transmissions with focus on high performance machines .

#### Applications

- Excavators
- Forestry machines
- Mining and drilling machines
- Wheel loaders
- Winch drives

#### Optional equipment

- Integrated sensors for speed and displacement
- Integrated flushing and pressure relief valves

#### Additional benefits (compared to those of the V12)

- Improved speed capability
- Improved control performance
- Reduced number of parts
- Stronger shaft bearing support.

(cont'd ...)



**Available motors**

Model	Frame size	Version	Chapter
V12	60	ISO	2
	"	Cartridge	"
	"	SAE	"
	80	ISO	"
V14	"	Cartridge	"
	"	SAE	"
	160	ISO	"
	"	SAE	"
T12	60	Cartridge	4
	80	"	"

**Series T12**

The T12 two-displacement motor is tailor-made for track drives. It allows a high ratio between high and low speed and installs as easily as a fixed displacement motor. Max speed ratio is 3.33-to-1.

The T12 is a cartridge motor based on the well proven V12 series. The specially designed end cap with dual ports permits a very short installation.

A simple setting device moves the cylinder barrel to the maximum or minimum displacement position. The setting is controlled by an external hydraulic pilot signal.

A brake valve can be fitted without increasing the axial length of the motor. The twin ports have the same mounting pattern as those of the F12 and V12 motors.

The F12/V12 accessory valve program also fits the T12 motor. As an option, integrated pressure relief valves can be included.



<b>Content</b>	<b>Page</b>
V12 cross section .....	8
Specifications .....	8
Efficiency diagrams .....	9
Ordering codes .....	10
Installation dimensions	
ISO version .....	14
Cartridge version .....	16
SAE version .....	18
Bearing life .....	20
Controls (general information) .....	21
AC pressure compensator .....	21
AH pressure compensator .....	22
AE pressure compensator with brake defeat .....	23
EO two-position control .....	24
EP proportional control .....	25
HO two-position control .....	26
HP proportional control .....	27
Control installation dimensions .....	28
Flushing valve .....	29
High speed operation .....	29
Accessory valve blocks .....	30
Speed sensor .....	31
Installation and start-up information .....	64





**Efficiency diagrams**

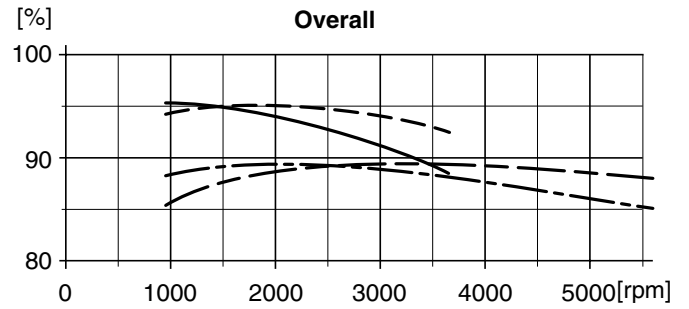
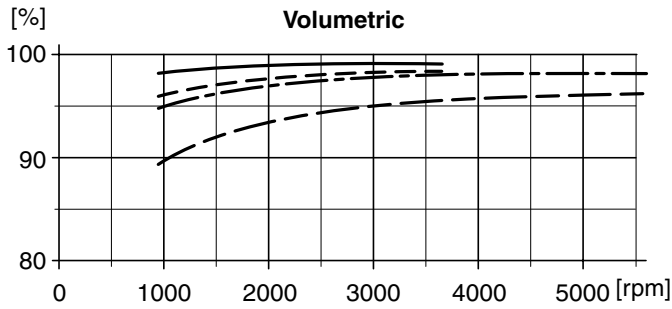
The following diagrams show volumetric and overall efficiencies versus shaft speed at 210 and 420 bar operating pressure, and at full (35°) and reduced (10°) displacements.

Information on efficiencies for a specific load condition can be made available from Parker Hannifin.

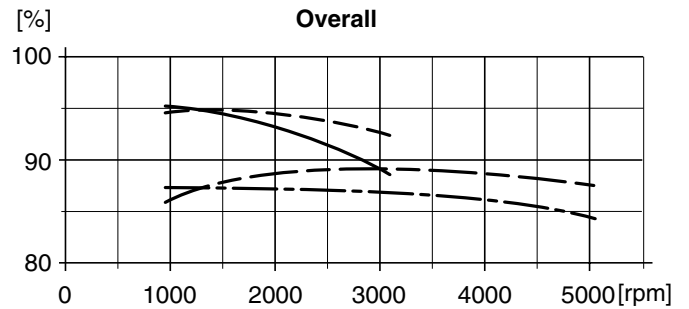
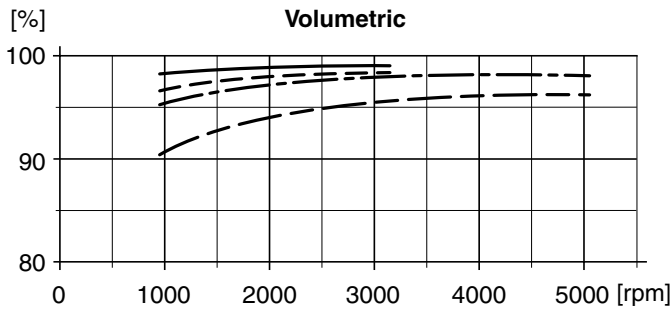
- 210 bar at full displacement
- - - - - 420 bar “ “ “ “
- - - - - 210 bar at reduced displacement
- - - - - 420 bar “ “ “ “



**V12-60**

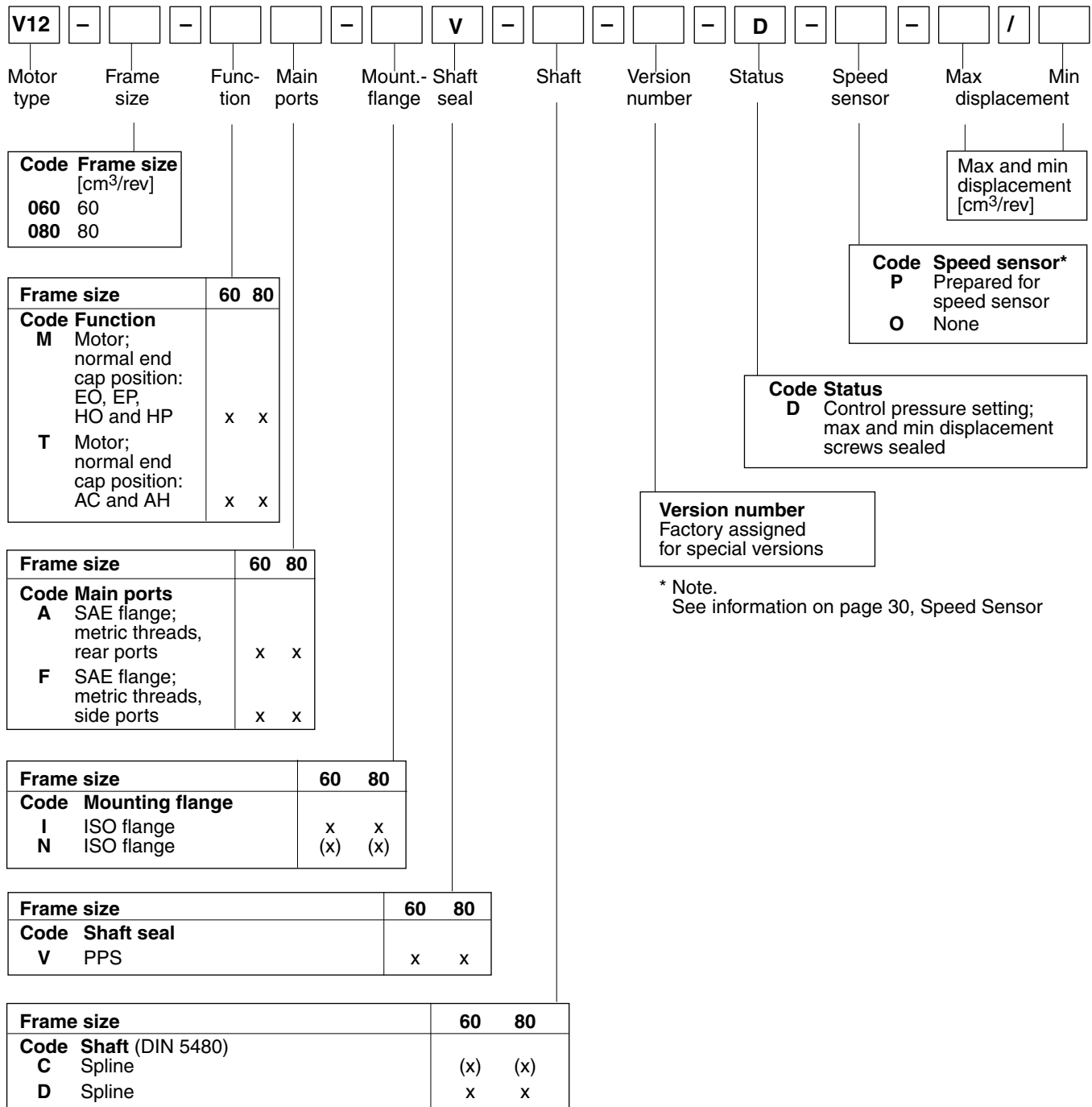


**V12-80**



Ordering codes

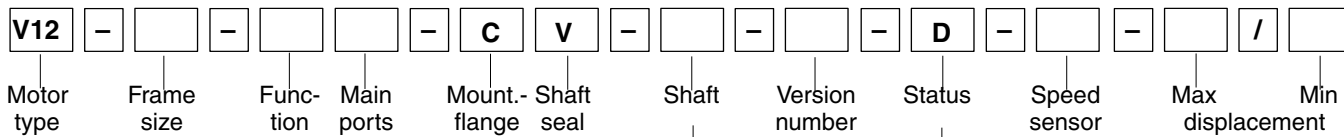
ISO version (basic configuration)



\* Note.  
See information on page 30, Speed Sensor

x: Available (x): Optional - : Not available

Cartridge version (basic configuration)



2

Code	Frame size [cm <sup>3</sup> /rev]
060	60
080	80

Max and min displacement [cm<sup>3</sup>/rev]

Frame size	60	80
<b>Code Function</b>		
<b>M</b> Motor; normal end cap position; EO, EP, HO and HP	x	x
<b>T</b> Motor; normal end cap position; AC and AH	x	x

Code	Speed sensor*
<b>P</b>	(Speed sensor only available for V12-60)
<b>O</b>	None

Code	Status
<b>D</b>	Control pressure setting; max and min displacement screws sealed

**Version number**  
Factory assigned for special versions

\* Note.  
See information on page 30, Speed Sensor

Frame size	60	80
<b>Code Main ports</b>		
<b>A</b> SAE flange; metric threads, rear ports	x	x
<b>F</b> SAE flange; metric threads, side ports	x	x

Frame size	60	80
<b>Code Mounting flange</b>		
<b>C</b> Cartridge flange	x	x

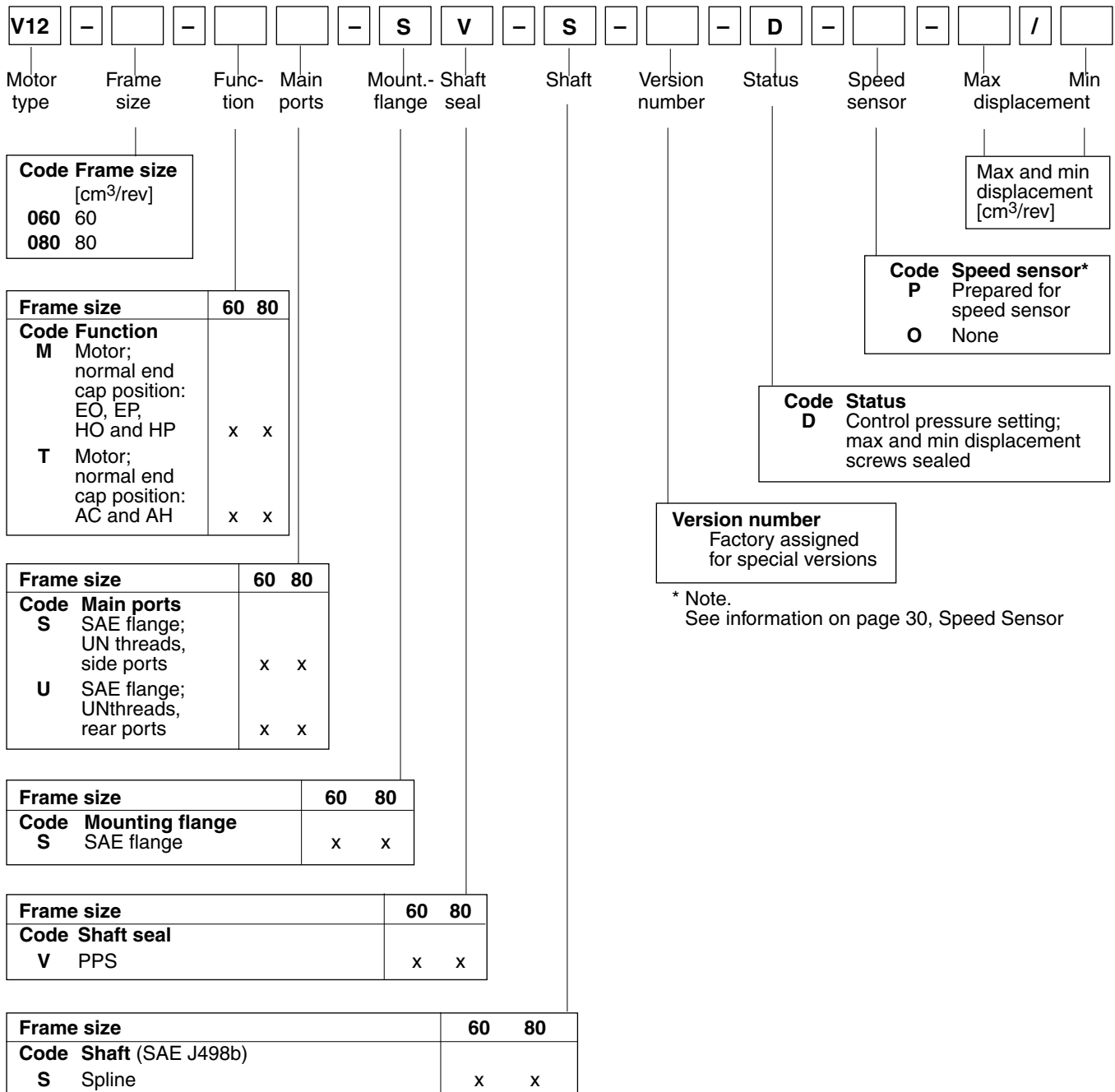
Frame size	60	80
<b>Code Shaft seal</b>		
<b>V</b> PPS	x	x

Frame size	60	80
<b>Code Shaft (DIN 5480)</b>		
<b>C</b> Spline	(x)	(x)
<b>D</b> Spline	x	x

x: Available    (x): Optional    - : Not available

**Ordering codes**

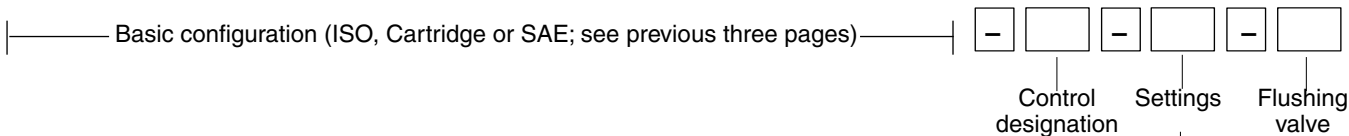
**SAE version (basic configuration)**



\* Note.  
See information on page 30, Speed Sensor

x: Available    (x): Optional    - : Not available

**Controls and flushing valve**



2

Frame size		60	80
Code	Control designation		
<b>AC I 01 I</b>	Pressure compensator, internal pilot pressure, internal servo supply	x	x
<b>AC E 01 I</b>	Pressure compensator, external pilot pressure, internal servo supply	(x)	(x)
<b>AH I 01 I</b>	Pressure compensator, hydraulic override, internal pilot pressure, internal servo supply	x	x
<b>AH E 01 I</b>	Pressure compensator, hydraulic override, external pilot pressure, internal servo supply	(x)	(x)
<b>AEL 01 B</b>	Pressure compensator electrohydraulic override, 12 VDC	-	x
<b>AEH 01 B</b>	Pressure compensator electrohydraulic override, 24 VDC	-	x
<b>EOL 01 I</b>	Electrohydraulic, two-position, 12 VDC, internal servo supply	x	x
<b>EOL 01 E</b>	Electrohydraulic, two-position, 12 VDC, external servo supply	(x)	(x)
<b>EOH 01 I</b>	Electrohydraulic, two-position, 24 VDC, internal servo supply	x	x
<b>EOH 01 E</b>	Electrohydraulic, two-position, 24 VDC, external servo supply	(x)	(x)
<b>EPL 01 I</b>	Electrohydraulic proportional, 12 VDC, internal servo supply	x	x
<b>EPL 01 E</b>	Electrohydraulic, proportional, 12 VDC, external servo supply	(x)	(x)
<b>EPH 01 I</b>	Electrohydraulic, proportional, 24 VDC, internal servo supply	x	x
<b>EPH 01 E</b>	Electrohydraulic, proportional, 24 VDC, external servo supply	(x)	(x)
<b>HOS 01 I</b>	Hydraulic two-position, standard version internal servo supply	x	x
<b>HOS 01 E</b>	Hydraulic two-position, standard version external servo supply	(x)	(x)
<b>HPS 01 I</b>	Hydraulic proportional, standard version internal servo supply	x	x
<b>HPS 01 E</b>	Hydraulic proportional, standard version external servo supply	(x)	(x)

**NOTE:** '01' - Standard nozzles      x: Available      (x): Optional      - : Not available  
 Brake defeat valve: Internal servo supply

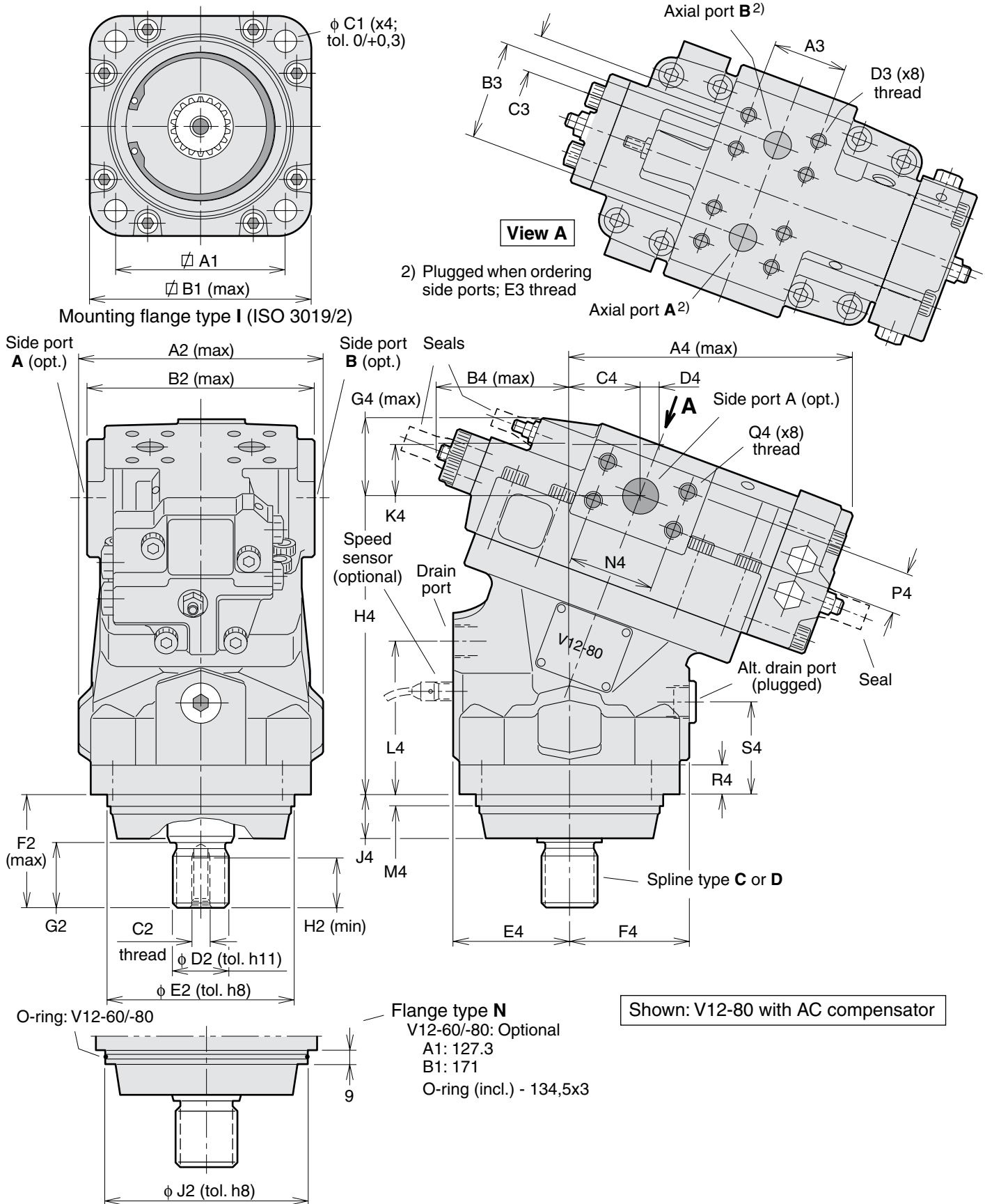
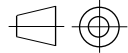
**Settings**

AC, AE, AH: Threshold pressure: **150 to 400 bar** / Modulating pressure: **015, 025 or 050 bar**  
 EO, EP: Threshold current: 12 VDC - **400 mA**; 24 VDC - **200 mA**  
 Modulating current: EO - **000**; EP, 12 VDC - **600 mA**; EP, 24 VDC - **300 mA**  
 HO, HP: Threshold pressure: **010 bar** / Modulating pressure: HO - **000**; HP - **015 or 025 bar**

**Code Flushing valve**

**L 01** Integrated flushing valve; 01 - std. nozzle 1.3 mm (option; refer to page 28).

**ISO version**



Size	V12-60	V12-80
A1	113.2	113.2
B1	151	151
C1	14	14
A2	159	165
B2	146	154
C2	M12	M12
D2*	34.6	39.6
E2	125	125
F2*	73	78
G2*	40	45
H2	28	24
J2	140	140
A3	50.8	50.8
B3	66	66
C3	23.8	23.8
D3 <sup>1)</sup>	M10x20	M10x20
E3 <sup>2)</sup>	M22x1.5	M22x1.5
A4	188	193
B4	87	90
C4	45	48.3
D4	13.4	13.1
E4	76	78
F4	77	80
G4	55	57
H4	188	199
J4	31.5	31.5
K4	35.5	34.6
L4	94	101
M4	9	9
N4	50.8	57.2
P4	23.8	27.8
Q4 <sup>1)</sup>	M10x20	M12x23
R4	20	20
S4	57.5	60.5

\* Dimension for shaft type **D**.  
Shaft type **C** dimensions are 5 mm shorter than those of type **D**.

- 1) Metric thread x depth in mm
- 2) Metric thread x pitch in mm
- 3) '30° involute spline, side fit'.

Ports

Type	V12-60	V12-80
Axial	19 [ <sup>3</sup> / <sub>4</sub> "]	19 [ <sup>3</sup> / <sub>4</sub> "]
Side	19 [ <sup>3</sup> / <sub>4</sub> "]	25 [1"]
Drain <sup>2)</sup>	M22x1.5	M22x1.5

Main ports: ISO 6162, 41.5 MPa, type II (SAE J518c, 6000 psi)

Spline type **C**<sup>3)</sup> (DIN 5480)

Size	Dimension
V12-60	W30x2x14x9g
-80	W35x2x16x9g

Spline type **D**<sup>3)</sup> (DIN 5480)

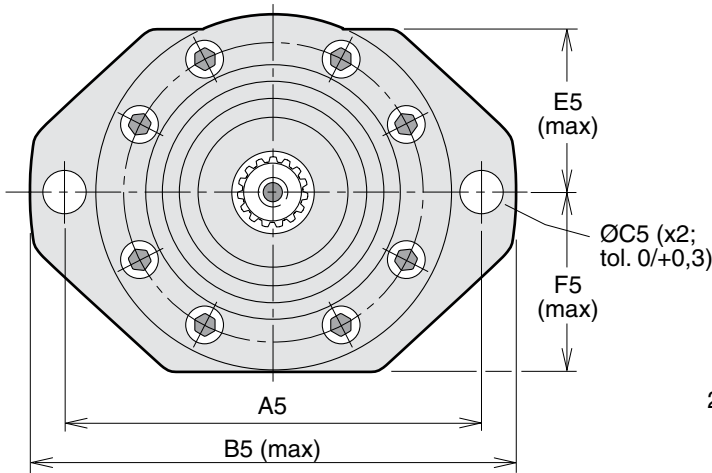
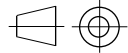
Size	Dimension
V12-60	W35x2x16x9g
-80	W40x2x18x9g

Flange

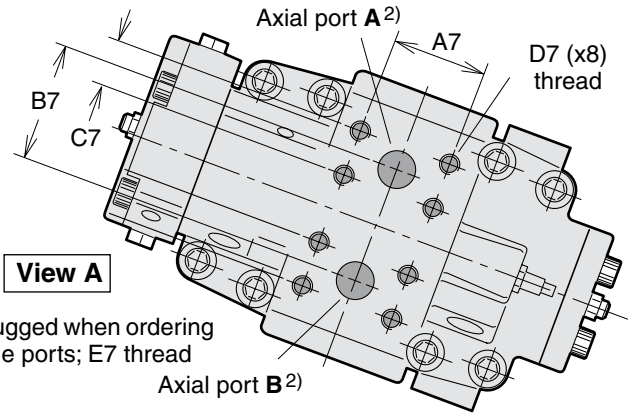
Size	I	N
V12-60	standard	optional
-80	standard	optional



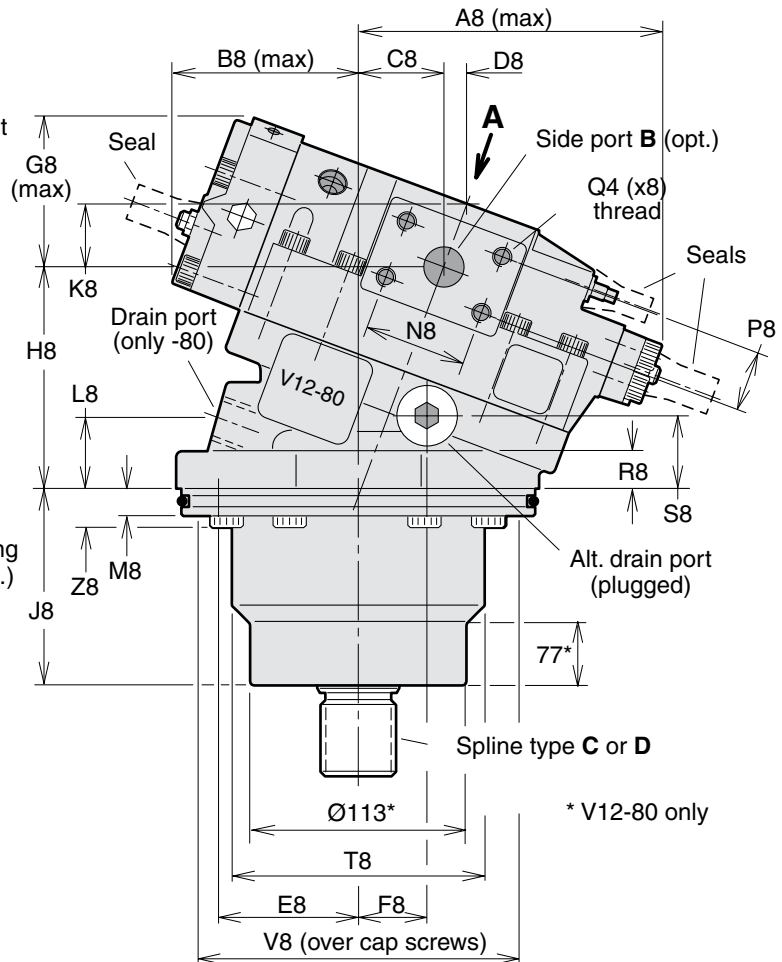
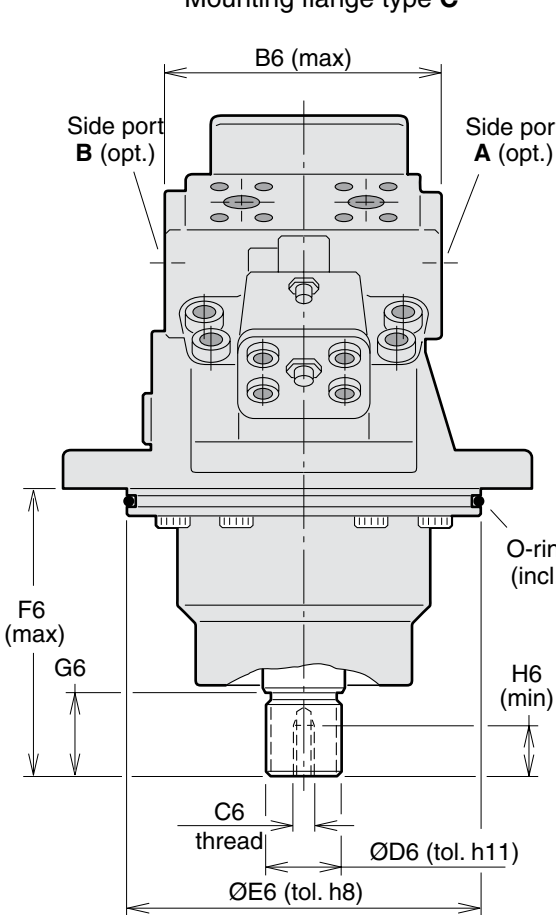
**Cartridge version**



**Mounting flange type C**



2) Plugged when ordering side ports; E7 thread



\* V12-80 only

Shown: V12-80 with HO control



Size	V12-60	V12-80
A5	200	224
B5	238	263
C5	18	22
E5	78.5	89.5
F5	83	99.5
B6	146	154
C6	M12	M12
D6*	34.6	39.6
E6	160	190
F6	133	156.5
G6*	40	45
H6	28	28
A7	50.8	50.8
B7	66	66
C7	23.8	23.8
D7 <sup>1)</sup>	M10x20	M10x22
E7 <sup>2)</sup>	M22x1.5	M22x1.5
A8	166	173
B8	108	108
C8	45	48.3
D8	13.4	13.1
E8	77	77.5
F8	39	38
G8	86	85
H8	127	120.5
J8	90	106
K8	35.5	34.6
L8	39	39
M8	15	15
N8	50.8	57.2
P8	23.8	27.8
Q8 <sup>1)</sup>	M10x20	M12x23
R8	20	20
S8	39	39
T8	121	139
V8	151	177
Z8	22	22

\* Dimension for shaft type **D**.  
 Shaft type **C** dimensions are 5 mm shorter than those of type **D**.

- 1) Metric thread x depth in mm
- 2) Metric thread x pitch in mm
- 3) '30° involute spline, side fit'.

Ports

Type	V12-60	V12-80
Axial	19 [3/4"]	19 [3/4"]
Side	19 [3/4"]	25 [1"]
Drain	-	M22x1.5
Alt. drain	M18x1.5	M18x1.5

Main ports: ISO 6162, 41.5 MPa, type II  
 [SAE J518c, 6000 psi]

Spline type **C**<sup>3)</sup> (DIN 5480)

Size	Dimension
V12-60	W30x2x14x9g
-80	W35x2x16x9g

Spline type **D**<sup>3)</sup> (DIN 5480)

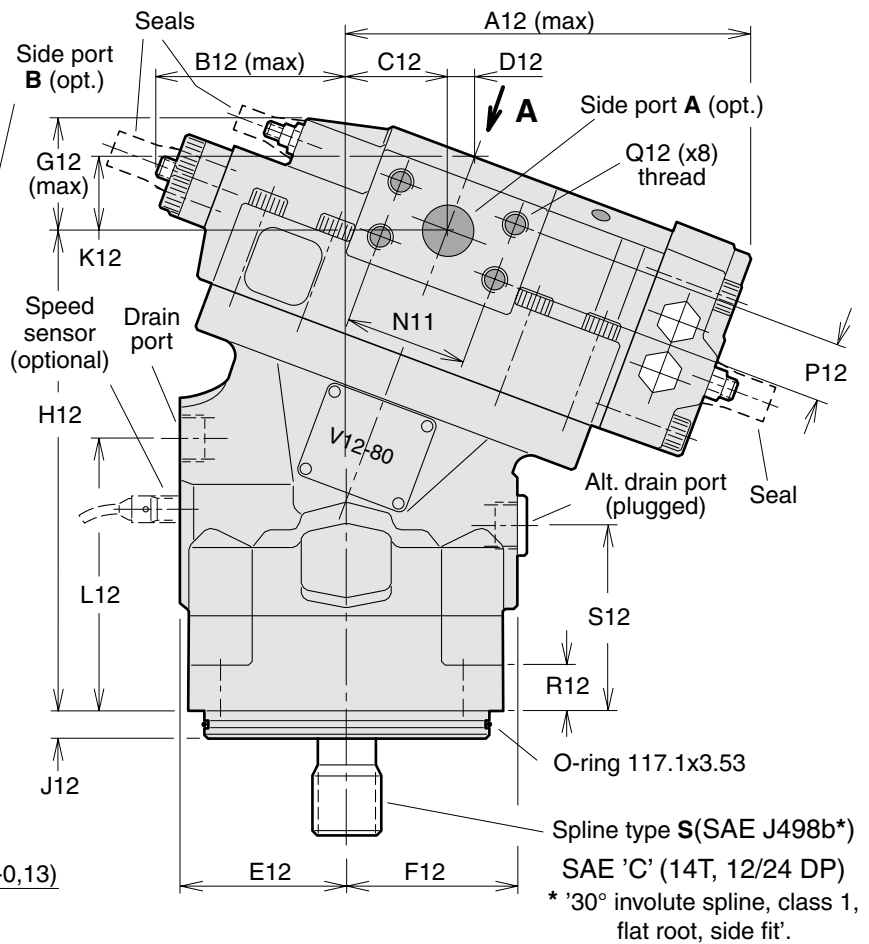
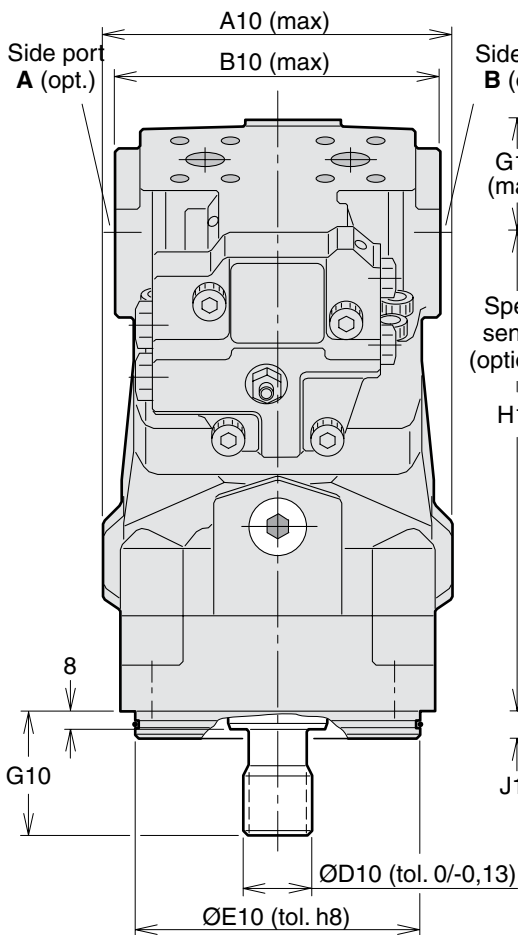
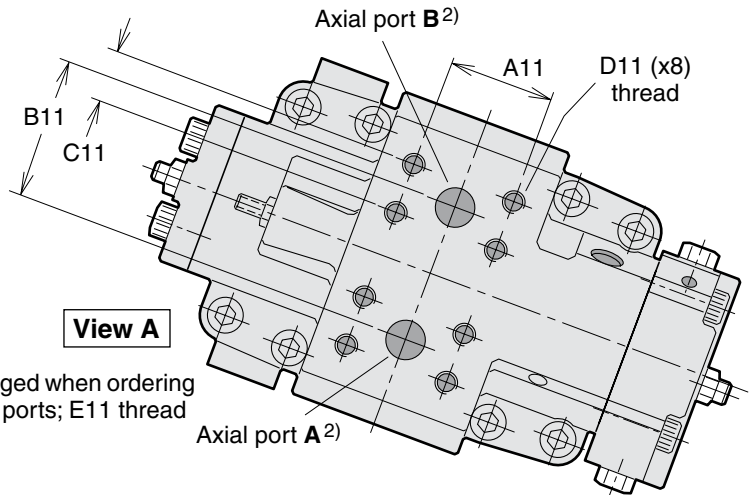
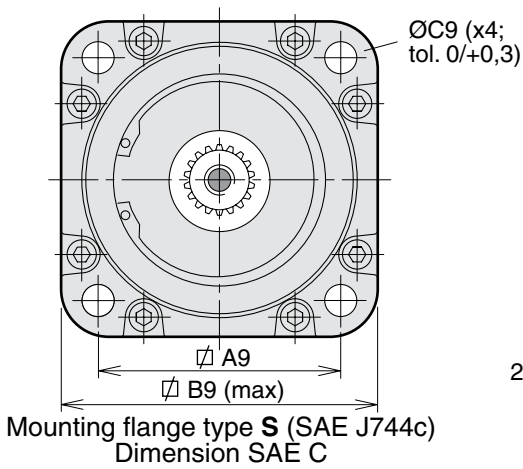
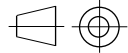
Size	Dimension
V12-60	W35x2x16x9g
-80	W40x2x18x9g

O-rings

Size	Dimension
V12-60	150x4
-80	180x4



**SAE version**



Shown: V12-80 with AC compensator

Size	V12-60 (inch)		V12-80 (inch)	
A9	114.5	4.51	114.5	4.51
B9	149	5.87	149	5.87
C9	14.3	0.56	14.3	0.56
A10	159	6.26	165	6.50
B10	146	5.75	154	6.06
D10	31.22	1.23	31.22	1.23
E10	127.00	5.00	127.00	5.00
G10	55.6	2.19	55.6	2.19
A11	50.8	2.00	50.8	2.00
B11	66	2.60	66	2.60
C11	23.8	0.98	23.8	0.98
D11 <sup>1)</sup>	3/8"-16 x20	3/8"-16 x0.79	3/8"-16 x20	3/8"-16 x0.79
E11 <sup>2)</sup>	M22x1.5	-	M22x1.5	-
A12	188	7.40	193	7.60
B12	87	3.43	90	3.54
C12	45	1.77	48.3	1.90
D12	13.4	0.53	13.1	0.52
E12	76	2.99	78	3.07
F12	77	3.03	80	3.15
G12	55	2.17	57	2.24
H12	212	8.35	223	8.78
J12	12.7	0.50	12.7	0.50
K12	35.5	1.40	34.6	1.36
L12	118	4.65	125	4.92
N12	50.8	2.00	57.2	2.25
P12	23.8	0.93	27.8	1.09
Q12*	3/8"-16 x20	3/8"-16 x0.79	7/16"-14 x23	7/16"-14 0.91
R12	20	0.79	20	0.79
S12	81.5	3.21	84.5	3.33

- 1) UNC thread x depth in mm
- 2) Metric thread x pitch in mm.

Ports

Type	V12-60	V12-80
Axial	3/4"	3/4"
Side	3/4"	1"
Drain	7/8"-14	7/8"-14

Main ports: 6000 psi (SAE J518c).

Drain ports: O-ring boss, UNF thread (SAE 514).



**Bearing life**

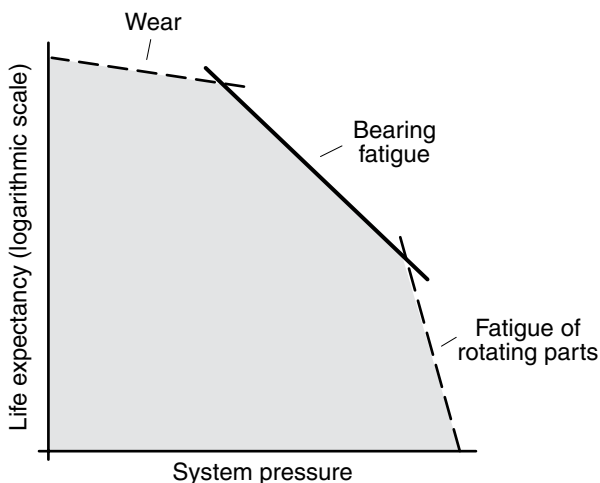
**General information**

Bearing life can be calculated for that part of the load/life curve (shown below) that is designated 'Bearing fatigue'. 'Fatigue of rotating parts' and 'Wear' caused by fluid contamination, etc., should also be taken into consideration when estimating the service life of a motor/pump in a specific application.

In reality, bearing life can vary considerably due to the quality of the hydraulic system (fluid condition, cleanliness, etc.)

Bearing life calculations are mainly used when comparing different motor frame sizes. Bearing life, designated  $B_{10}$  (or  $L_{10}$ ), depends of system pressure, operating speed, external shaft loads, fluid viscosity in the motor case, and fluid contamination level.

The  $B_{10}$  value means that 90% of the bearings survive at least the number of hours calculated. Statistically, 50% of the bearings will survive at least five times the  $B_{10}$  life.



Hydraulic motor life versus system pressure.

**Bearing life calculation**

An application is usually governed by a certain duty or work cycle where pressure, speed and displacement vary with time during the cycle.

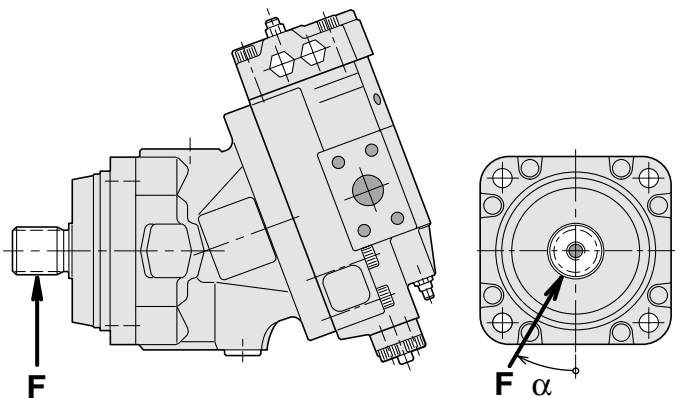
Bearing life is also dependent on external shaft loads, case fluid viscosity and fluid contamination.

Parker Hannifin has a computer program for bearing life calculation and will assist in determining life for specific V12 load conditions; refer to MI 170, 'V12 bearing life', available from Parker Hannifin.

**Required information**

When requesting a bearing life calculation from Parker Hannifin, the following information (where applicable) should be provided:

- A short presentation of the application
- V12 size and version
- Duty cycle (pressure and speed versus time at specified displacements)
- Low pressure
- Case fluid viscosity
- Life probability ( $B_{10}$ ,  $B_{20}$ , etc.)
- Direction of rotation (L or R)
- Axial load
- Fixed or rotating radial load
- Distance between flange and radial load
- Angle of attack ( $\alpha$ ) as defined below.



**Controls** (general information)

The following six V12 controls described below satisfy most application requirements:

- Pressure compensator (AC and AH)
- Two-position controls (EO and HO)
- Proportional controls (EP and HP).

All controls utilize a setting piston that connects to the valve segment (refer to the picture on page 8).

The built-in four-way servo valve acts on the setting piston and determines the displacement which can vary between 35° (max) and 6.5° (min).

**AC pressure compensator**

The AC compensator is used in off-road vehicle hydrostatic transmissions; it automatically adjusts motor displacement to the output torque requirement (up to max available system pressure).

Normally, the motor stays in the minimum displacement position. When there is a demand for additional torque, i.e. when the vehicle enters an upgrade, the displacement increases (providing more torque) while the motor shaft speed decreases proportionally.

The threshold pressure ('ps'; refer to the AC diagram) where displacement starts to increase, is adjustable between 150 and 400 bar.

To reach max displacement, an additional modulating pressure ( $\Delta p$ ) above the threshold pressure ( $p_s$ ) is required.

To satisfy specific hydraulic circuit requirements, a modulating pressure,  $\Delta p$ , of 15, 25 or 50 bar can be selected.

The AC compensator is available in two versions:

**ACI 01 I** - Internal pilot pressure

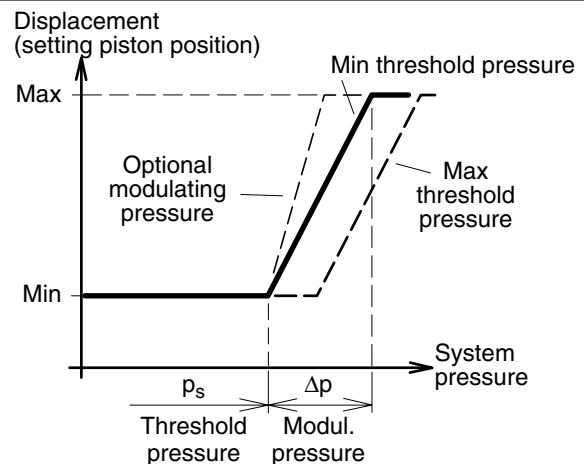
**ACE 01 I** - External pilot pressure; port X5 can, for example, be connected to the 'forward drive' pressure line of a vehicle transmission to prevent motor displacement increase when the vehicle is going downhill.

Servo supply pressure is usually obtained from the main high pressure port through the built-in shuttle valve.

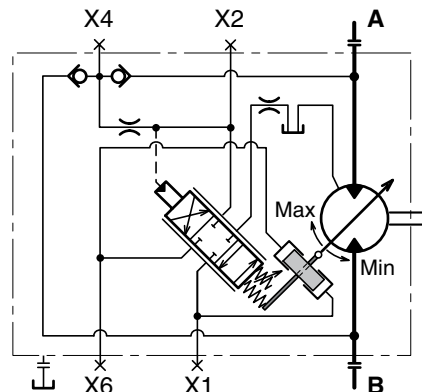
When using external servo supply, the servo pressure should be at least 30 bar.

The response time (i.e. from max to min displacement) is determined by orifices in the servo valve supply and return lines.

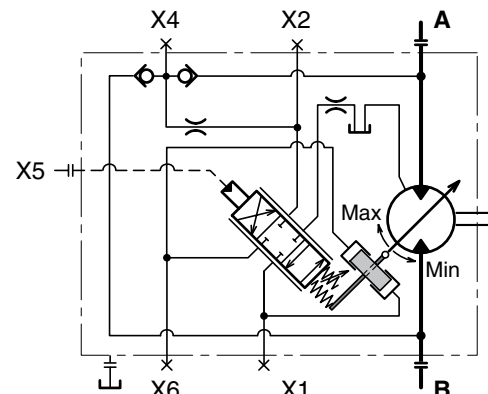
**NOTE:** The modulating pressure/current,  $\Delta p/\Delta I$  values are valid for motors that are not displacement limited.



AC diagram.



ACI 01 I schematic (spool in a balanced, mid-pos.).



ACE 01 I schematic (spool in a balanced, mid-pos.).

- Gauge/pilot ports (AC compensator):
- X1 Setting piston pressure (increasing displ.)
  - X2 Servo supply pressure (after orifice)
  - X4 Servo supply pressure (before orifice)
  - X5 External pilot pressure
  - X6 Setting piston pressure (decreasing displ.)
- Ports are:
- M14x1.5 (ISO and cartridge versions)
  - 9/16"-18 O-ring boss (SAE version).

**AH pressure compensator**

The AH compensator is similar to the AC (page 21) but incorporates an hydraulic override device. It is utilized in hydrostatic transmissions where a high degree of manoeuvrability at low vehicle speeds is desirable.

When the override is pressurized, the servo piston moves to the max displacement position irrespective of system pressure, provided the servo supply pressure is at least 30 bar.

The AH compensator is available in two versions:

**AHI 01 I** - Same as the ACI except for the override; internal pilot pressure.

**AHE 01 I** - External pilot pressure (port X5; compare (optional) ACE, page 21).

Required override pressure, port X7 (min 20 bar):

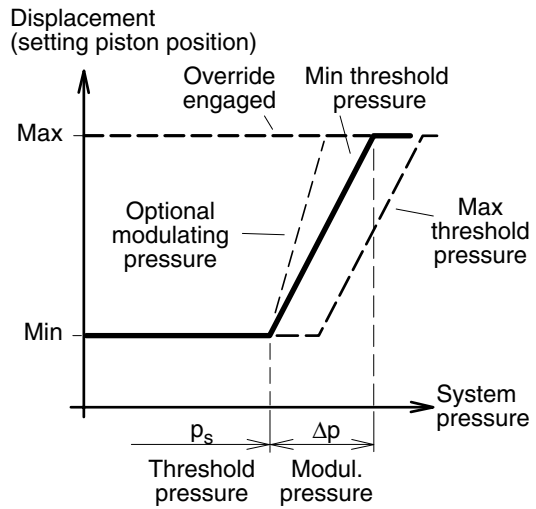
$$p_7 = \frac{p_s + \Delta p}{24} \text{ [bar]}$$

$p_7$  = Override pressure

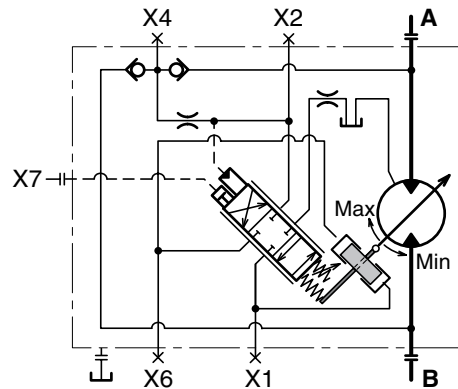
$p_s$  = System pressure

$\Delta p$  = Modulating pressure

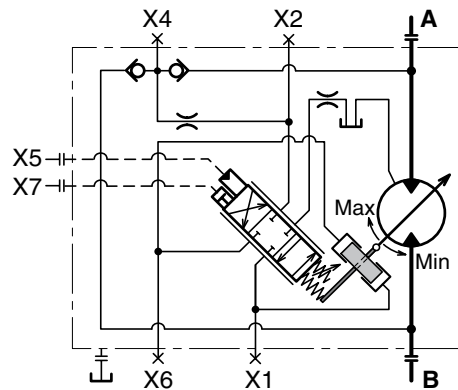
- Gauge/pilot ports (AH compensator):
- X1 Setting piston pressure (increasing displ.)
  - X2 Servo supply pressure (after orifice)
  - X4 Servo supply pressure (before orifice)
  - X5 External pilot pressure
  - X6 Setting piston pressure (decreasing displ.)
  - X7 Override pressure
- Ports are:
- M14x1.5 (ISO and cartridge versions)
  - 9/16"-18 O-ring boss (SAE version).



AH diagram.



AHI 01 I schematic (spool in a balanced, mid-pos.).



AHE 01 I schematic (spool in a balanced, mid-pos.).

**AE pressure compensator with brake defeat**

The **AE** control is similar to the ACI (internal pilot pressure supply; page 21) but incorporates a solenoid controlled override function.

In addition, the AE includes a brake defeat valve which prevents motor displacement increase in the braking mode.

The **override** consists of a piston built into the AE end cover and an external electrohydraulic solenoid valve. When the solenoid is energized, system pressure is directed to the piston which in turn pushes on the spool of the servo control valve.

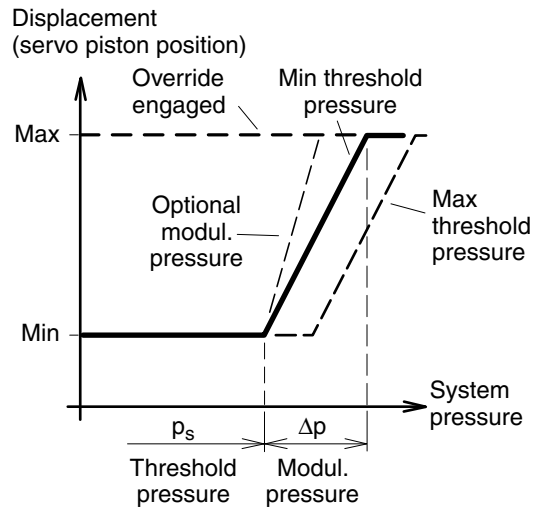
This causes the motor to lock in the max displacement position, irrespective of system pressure (min 30 bar).

Solenoids are available in 12 VDC (designated **L**) and 24 VDC (design. **H**); the required current is 2 and 1 A respectively.

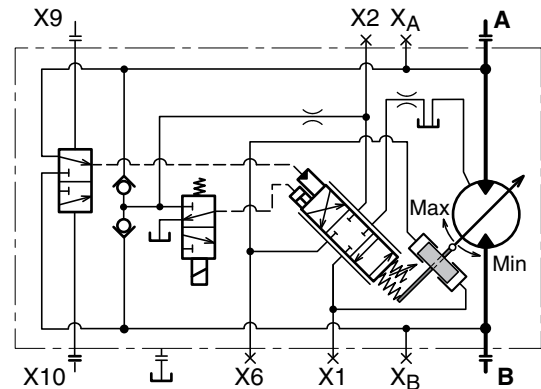
The **brake defeat** valve is also part of the AE end cover and consists of a two-position, three-way spool. The two ports, x9 and x10 (below) should be connected to the corresponding ports of the displacement control of the variable displacement pump.

The brake defeat function prevents the motor outlet port pressure to influence the pressure compensator. If, for example, port A is being pressurized when driving 'forward', pressure in port B during braking will not cause the motor to increase its displacement.

Likewise, when driving in 'reverse' (port B pressurized), any braking pressure in port A will not influence the control; refer to the schematic.

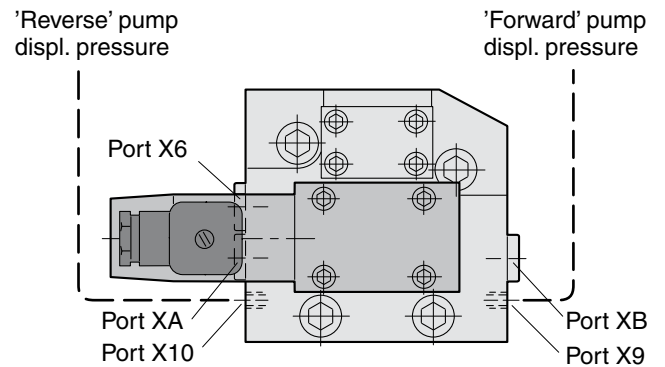


AE diagram.



AE schematic (spool in balanced, mid-position).

- Gauge/pilot ports (AE control):
- XA System pressure, port A
  - XB System pressure, port B
  - X1 Servo piston pressure (increasing displ.)
  - X2 Servo supply pressure (after orifice)
  - X6 Servo piston pressure (decreasing displ.)
  - X9 Brake defeat, port A
  - X10 Brake defeat, port B
- Ports are:
- M14x1.5 (ISO and Cartridge versions)
  - 9/16"-18 O-ring boss (SAE version).



AE end cover with solenoid valve and brake defeat.

**2**

**EO two-position control**

The EO is a two-position control, where max and min displacements are governed by a DC solenoid attached to the control cover (refer to the installation drawing on page 27).

The EO control is utilized in transmissions where only two operating modes are required: Low speed/high torque or high speed/low torque.

The servo piston, normally in the max displacement position, shifts to the min displacement position when the solenoid is activated. Intermediate displacements cannot be obtained with this control.

Servo pressure is supplied internally (through the shuttle valve from one of the main high pressure ports) or externally (port X4).

The solenoid is either 12 or 24 VDC, requiring 1.2 and 0.6 A respectively. An electrical connector is included (DIN 43650/IP54).

The EO two-position control is available in four versions:

**EOH 01 I** - Internal servo supply, 24 VDC

**EOL 01 I** - Internal servo supply, 12 VDC

**EOH 01 E** - External servo supply, 24 VDC

(optional)

**EOL 01 E** - External servo supply, 12 VDC

(optional)

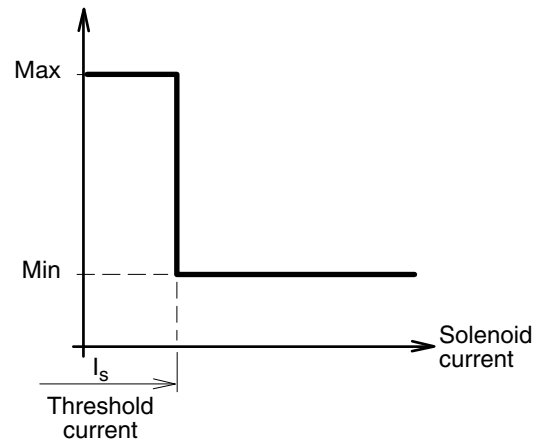
Gauge ports (EO control):

- X1 Setting piston pressure (max-to-min)
- X2 Servo supply pressure (after orifice)
- X4 Servo supply pressure (before orifice)
- X6 Setting piston pressure (min-to-max)

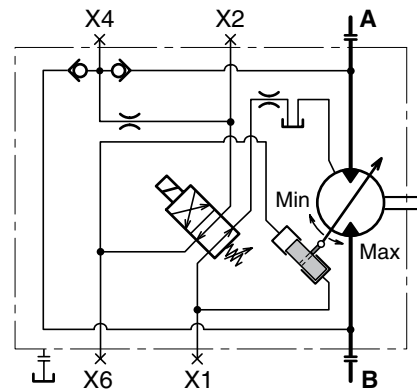
Ports are:

- M14x1.5 (ISO and cartridge versions)
- 9/16"-18 O-ring boss (SAE version).

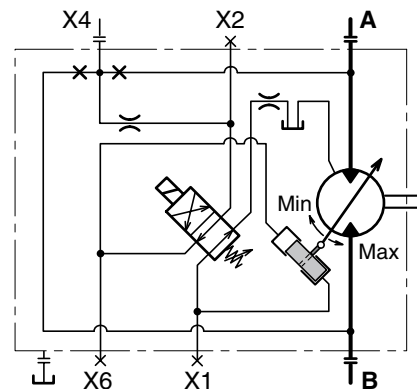
Displacement  
 (setting piston position)



EO diagram.



EO H 01 I schematic (non-activated solenoid).



EO H 01 E schematic (non-activated solenoid).



**EP proportional control**

The EP electrohydraulic proportional control is used in hydrostatic transmissions requiring a continuously variable shaft speed. The servo valve is governed by a DC solenoid attached to the control cover.

When the solenoid current increases above the threshold current, the servo piston starts to move from the max towards the min displacement position. The displacement vs. solenoid current is shown in the diagram to the right. Please note, that the shaft speed vs. current is non-linear; refer to the diagram below.

Solenoids are available in 12 and 24 VDC versions, requiring a max current of approx. 1.1 and 0.55 A respectively.

The threshold current ( $I_s$ ) is factory set (0.4 A at 12 VDC/0.2 A at 24 VDC) but is adjustable (12 VDC: 0.25–0.45 A; 24 VDC: 0.10–0.23 A).

When utilizing the full displacement range, the required modulating current ( $\Delta I$ ) is 0.6 and 0.3 A respectively. In order to minimize hysteresis, a pulse-width modulated control signal of 70 to 90 Hz should be utilized.

See also “Controls, Note” on page 21.

**NOTE:** The modulating current ( $\Delta I$ ) is not adjustable.

The EP control is available in four versions:

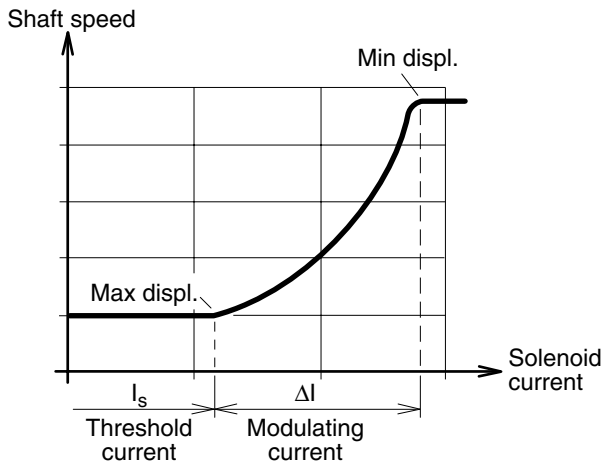
- EP H 01 I** - Internal servo supply, 24 VDC
- EP L 01 I** - Internal servo supply, 12 VDC
- EP H 01 E** - External servo supply, 24 VDC (optional)
- EP L 01 E** - External servo supply, 12 VDC (optional)

Gauge ports (EP control):

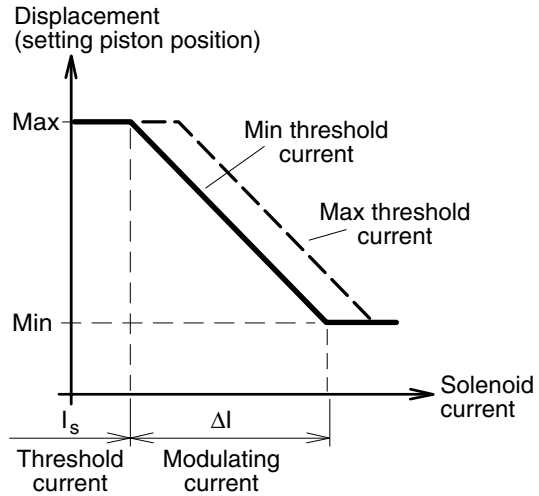
- X1 Setting piston pressure (decreasing displ.)
- X2 Servo supply pressure (after orifice)
- X4 Servo supply pressure (before orifice)
- X6 Setting piston pressure (increasing displ.)

Ports are:

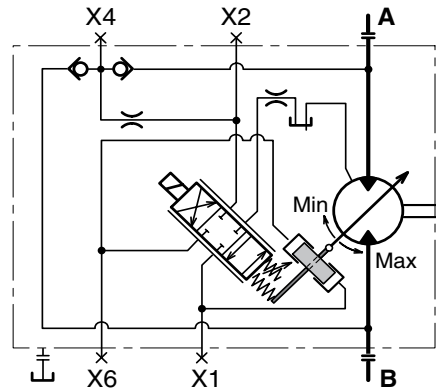
- M14x1.5 (ISO and cartridge versions)
- 9/16”-18 O-ring boss (SAE version).



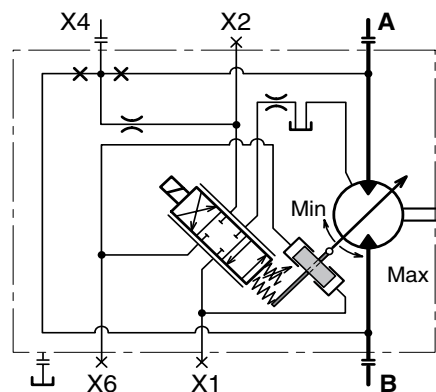
Shaft speed vs. solenoid current (EP control).



EP diagram.



EP H 01 I schematic (spool in a balanced, mid-pos.).



EP H 01 E schematic (spool in a balanced, mid-pos.).

**HO two-position control**

The two-position HO control is similar to the EO (page 23) but the pilot signal is hydraulic. The position of the setting piston is governed by the built-in servo valve (same on all compensators and controls).

When the applied pilot pressure (port X5) exceeds the pre-set threshold pressure, the piston moves from the max to the min displacement position.

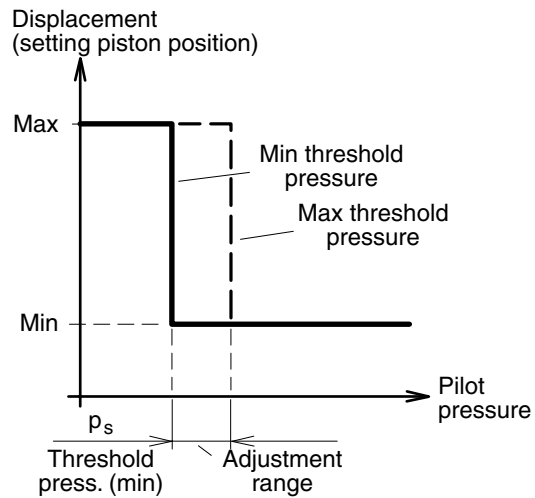
The threshold pressure is factory set at 10 bar but can be adjusted between 5 and 25 bar.

The HO two-position control is available in two versions:

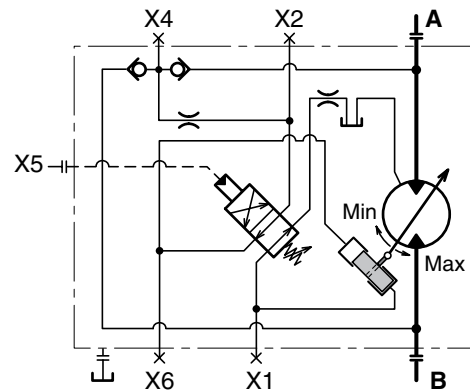
**HO S 01 I** - Internal servo supply

**HO S 01 E** - External servo supply (port X4) (optional)

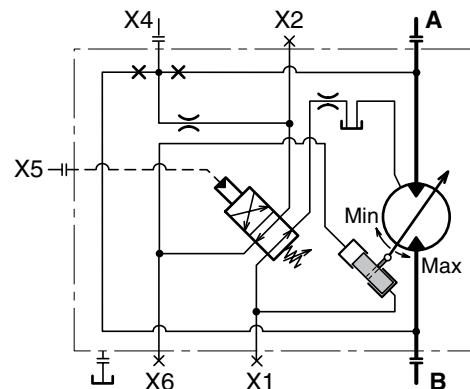
- Gauge/pilot ports (HO control):
- X1 Setting piston pressure (max-to-min)
  - X2 Servo supply pressure (after orifice)
  - X4 Servo supply pressure (before orifice)
  - X5 External pilot pressure (max 100 bar)
  - X6 Setting piston pressure (min-to-max)
- Ports are:
- M14x1.5 (ISO and cartridge versions)
  - 9/16"-18 O-ring boss (SAE version).



HO diagram.



HO S 01 I schematic (X5 not pressurized).



HO S 01 E schematic (X5 not pressurized).

**HP proportional control**

Like the EP control described on page 24, the HP proportional control offers continuously variable displacement, but the pilot signal is hydraulic.

Normally, the servo piston stays in the max displacement position. When a sufficiently high pilot pressure ( $p_s$ ) is applied to port X5, the piston starts to move towards the min displacement position.

As can be seen in the diagram to the right, the displacement changes in proportion to the applied modulating pressure.

In contrast, shaft speed vs. pilot pressure is non-linear; refer to the diagram below.

The following modulating pressures ( $\Delta p$ ) can be selected: 15 or 25 bar.

The threshold pressure ( $p_s$ ) is factory set at 10 bar but is adjustable between 5 and 25 bar.

See also "Controls, Note" on page 21.

Two versions of the HP control are available:

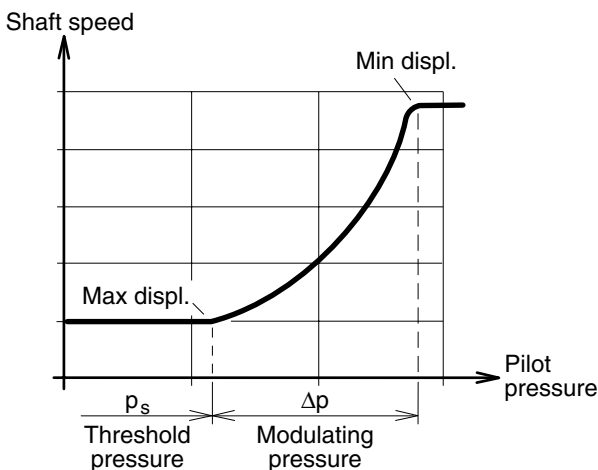
- HPS 01 I** - Internal servo supply
- HPS 01 E** - External servo supply (port X5) (optional)

Gauge/pilot ports (HP control):

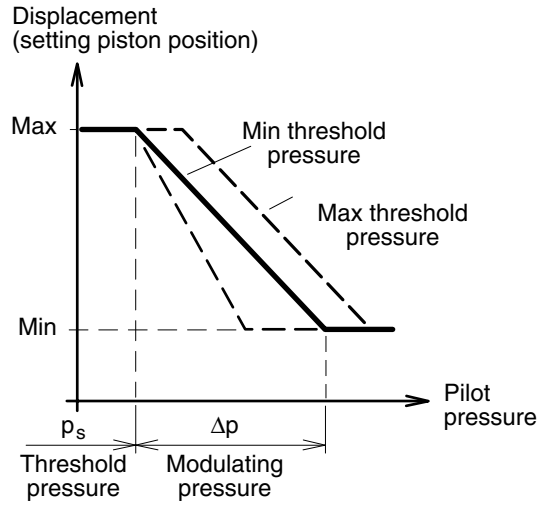
- X1 Servo piston pressure (decreasing displ.)
- X2 Servo supply pressure (after orifice)
- X4 Servo supply pressure (before orifice)
- X5 External pilot pressure (max 100 bar)
- X6 Servo piston pressure (increasing displ.)

Ports are:

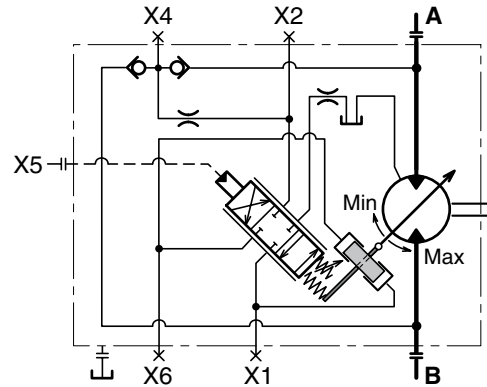
- M14x1.5 (ISO and Cartridge versions)
- 9/16"-18 O-ring boss (SAE version).



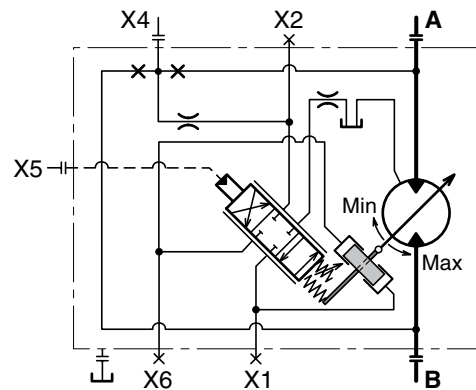
Shaft speed vs. pilot pressure (HP control).



HP diagram.



HP S 01 I schematic (spool in a balanced, mid-pos.).



HP S 01 E schematic (spool in a balanced, mid-pos.).

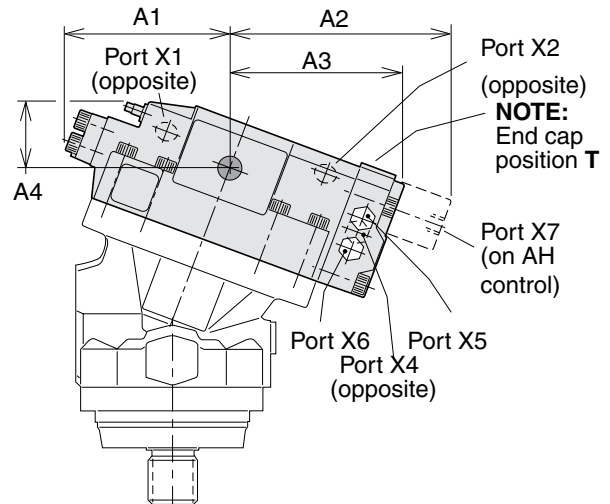
**Control installation dimensions**

**NOTE:** - The basic motor side port locations are shown on pages 14, 16 and 18.  
 - End cap position: Refer to the ordering codes, pages 10-12.

- Control/gauge ports are:
  - M14x1.5 (ISO and cartridge versions).
  - 9/16"-18 UNF (SAE version).
- All dimensions are max.

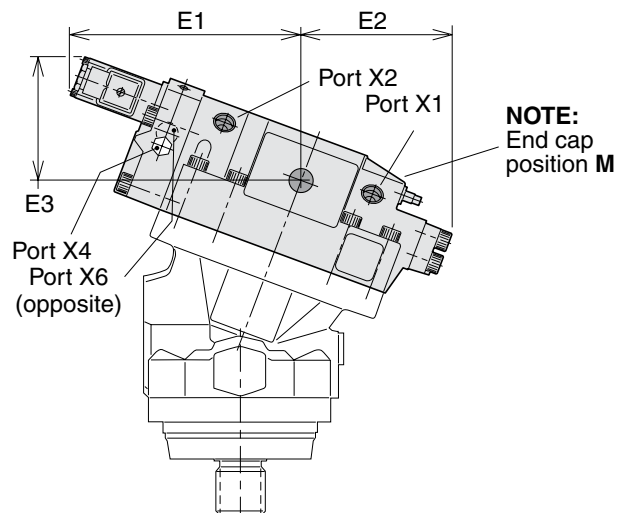
**AC and AH compensators**

Dim.	V12-60	(inch)	V12-80	(inch)
A1	132	5.20	138	5.43
A2	186	7.32	188	7.40
A3	143	5.63	145	5.71
A4	55	2.17	57	2.24



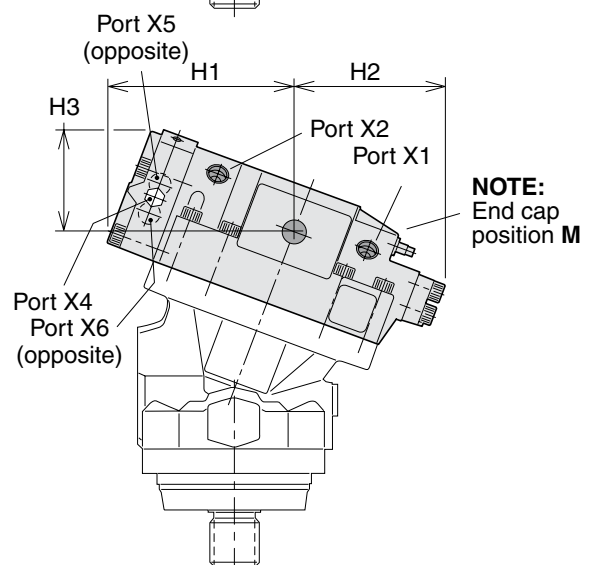
**EO and EP controls**

Dim.	V12-60	(inch)	V12-80	(inch)
E1	190	7.48	192	7.56
E2	121	4.76	125	4.92
E3	106	4.17	106	4.17



**HO and HP controls**

Dim.	V12-60	(inch)	V12-80	(inch)
H1	153	6.02	156	6.14
H2	121	4.76	125	4.92
H3	86	3.39	85	3.35



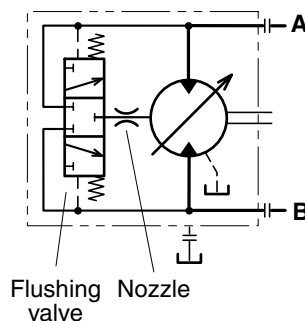
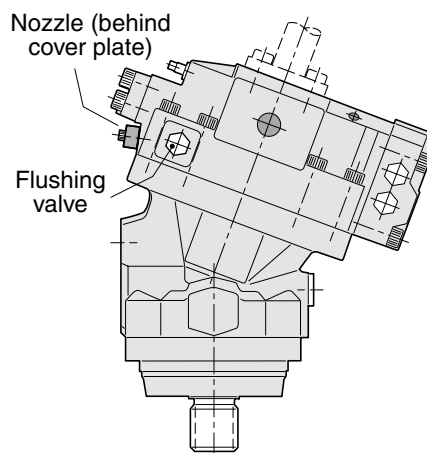
**Flushing valve**

As an option, **L**, the V12 is available with a flushing (or shuttle) valve that supplies the motor with a cooling flow through the case. Cooling the motor may be required when operating at high speeds and/or power levels.

The flushing valve consists of a three-position, three-way spool valve built into a special end cap. It connects the low pressure side of the main circuit to a nozzle (optional size) that empties fluid into the motor case.

In a closed circuit transmission, the flushing valve removes part of the fluid in the main loop. The removed fluid is continuously being replaced by cool, filtered fluid from the low pressure charge pump on the main pump.

**NOTE:** The flushing valve ordering code is shown on page 13 ('L 01').



**Available nozzles**

Nozzle design.	Orifice size [mm]	Status
<b>L 01</b>	<b>1.3</b>	<b>Standard</b>
L 02	0.8	Optional
L 03	1.0	"
L 04	1.2	"
L 05	1.5	"
L 06	1.7	"
L 07	2.0	"
L 08	3.0	"

**NOTE:** - '00' - no nozzle

**High speed operation**

Contact Parker Hannifin for additional information.



**Accessory valve blocks**

**SR pressure relief/check valve**

To protect the main hydraulic circuit from unwanted pressure peaks, an add-on valve block, type SR, with two independent pressure relief cartridges and two large capacity check valves can be ordered for series V12.

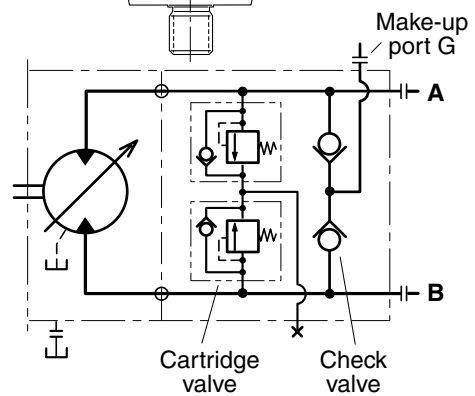
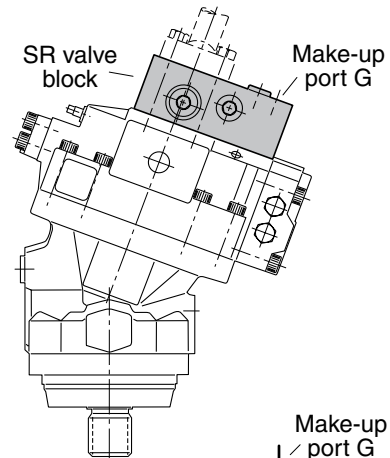
The valve block is mounted on the motor end cap as shown to the right. The individual cartridge has a fixed, factory-set opening pressure.

An external port for make-up fluid is provided. When sufficiently pressurized, it prevents motor cavitation due to pressure losses in the main circuit.

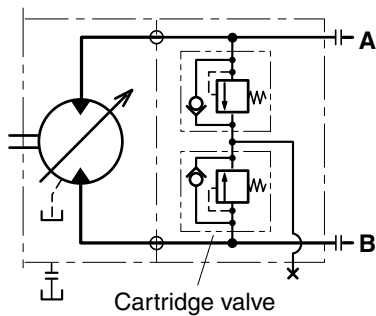
**SV pressure relief valves**

The SV relief valve block is an alternative to the SR valve block above.

The SV contains the same cartridge valves as the SR but lacks the two check valves; refer to the SV schematic, below.



*V12 with SR relief valve block.*



*V12 with SV relief valve block.*

**Note:**

Brake valves, please contact Parker Hannifin for additional information.

### Speed sensor

A speed sensor kit is available for the **ISO, Cartridge** and **SAE** versions of series V12, V12-80-Cartridge excepted.

The ferrostat differential (Hall-effect) sensor installs in a separate, threaded hole in the V12 bearing housing.

The speed sensor is directed towards the V12 shaft flange and outputs a 2 phase shifted square wave signal within a frequency range of 0 Hz to 15 kHz. Number of pulses per shaft rev is 36 which, at 5 Hz, corresponds to approx. 8 rpm.

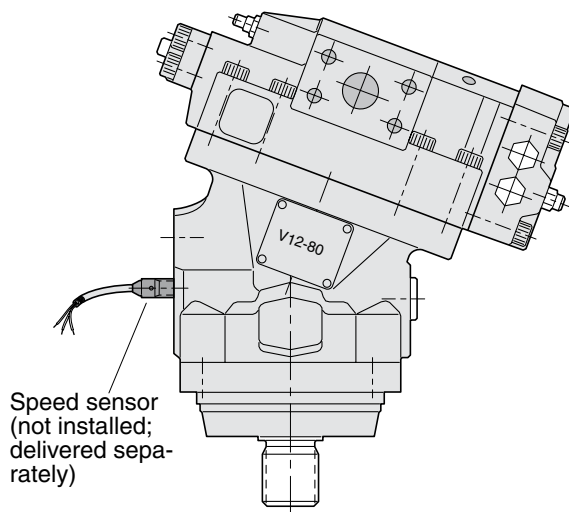
When a 'Speed sensor' is ordered (refer to the ordering codes on pages 10 and 12), the housing is machined with the threaded hole; the speed sensor kit is delivered in a separate bag.

- NOTE:**
- The motor bearing housing must be prepared for the speed pick-up; refer to the V12 ordering codes on pg. 10, 11 and 12 (Code P).
  - Additional information is provided in our publication HY30-8301/UK 'Speed sensor for series F11/F12 and V12/T12/V14'; available from Parker Hannifin.
  - The speed sensor is also shown in the illustrations on pg. 14 and 18.

#### How to order

Please order the speed sensor on a separate order line next to the product order line.

Part number for speed sensor is 3785190.



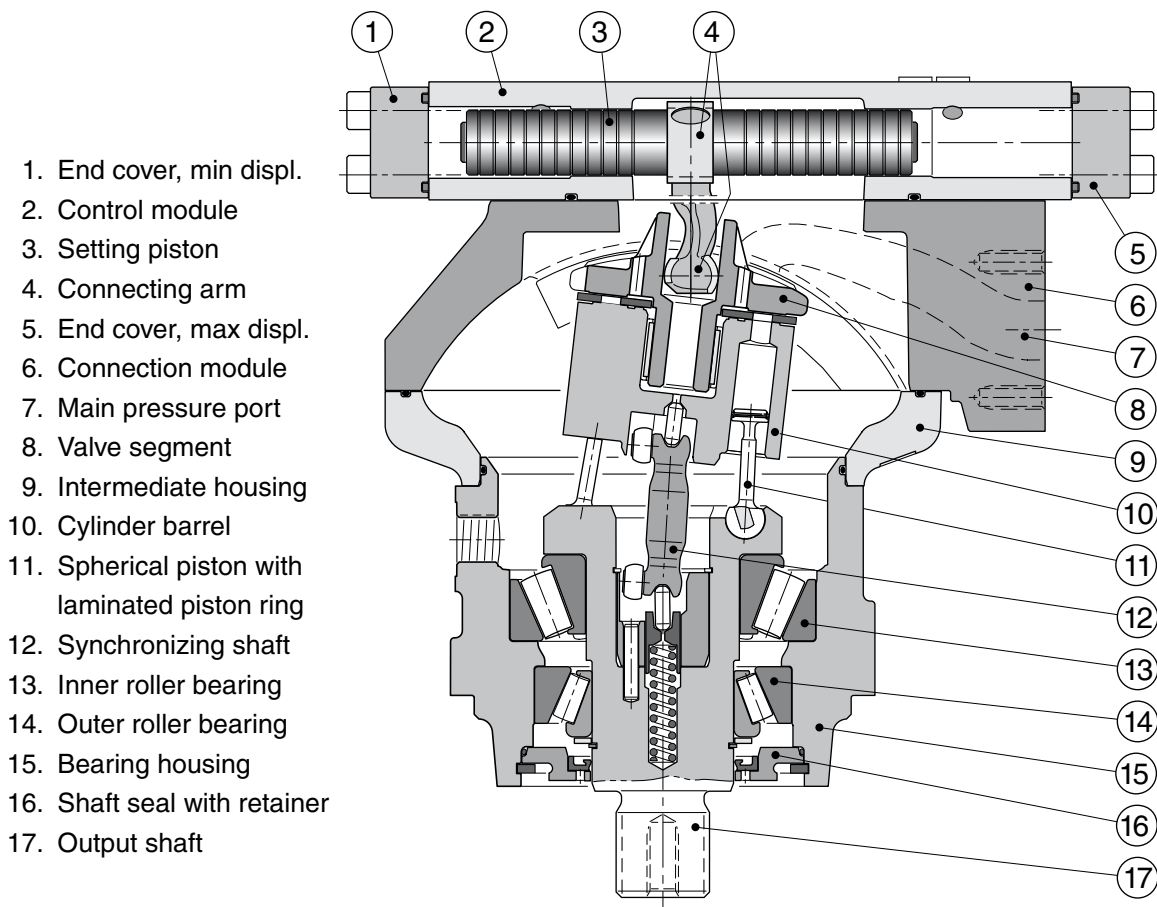
# V14



<b>Content</b>	<b>Page</b>
V14 cross section .....	33
Specifications .....	33
Efficiency diagrams .....	34
Ordering codes .....	35
Installation dimensions	
V14-110, ISO version .....	38
V14-110, Cartridge version .....	39
V14-110, SAE version .....	40
V14-160, ISO version .....	41
V14-160, SAE version .....	42
Controls - general information .....	43
AC pressure compensator .....	43
AD pressure compensator .....	46
AH pressure compensator .....	47
EO, EP, HO and HP controls (general information) ..	48
EO electric two-position control .....	50
EP electrohydraulic proportional control .....	51
HO hydraulic two-position control .....	52
HP hydraulic proportional control .....	53
Valve and sensor options (overview) .....	54
Flushing valve (option L) .....	54
Shaft speed sensor (option P) .....	55
Pressure relief valves (option P) .....	56
Setting piston position sensor (option L) .....	57
Installation and start-up information .....	64



**V14 cross section**



- 1. End cover, min displ.
- 2. Control module
- 3. Setting piston
- 4. Connecting arm
- 5. End cover, max displ.
- 6. Connection module
- 7. Main pressure port
- 8. Valve segment
- 9. Intermediate housing
- 10. Cylinder barrel
- 11. Spherical piston with laminated piston ring
- 12. Synchronizing shaft
- 13. Inner roller bearing
- 14. Outer roller bearing
- 15. Bearing housing
- 16. Shaft seal with retainer
- 17. Output shaft

**Specifications**

V14 frame size	110	160
<b>Displacement</b> [cm <sup>3</sup> /rev]		
- at 35° (max)	110	160
- at 6.5° (min)	22	32
<b>Operating pressure</b> [bar]		
- max intermittent <sup>1)</sup>	480	480
- max continuous	420	420
<b>Operating speed</b> [rpm]		
- max intermittent at 35° <sup>1)</sup>	3 900	3 400
- max continuous at 35°	3 400	3 000
- max intermittent at 6.5°-20° <sup>1)</sup>	6 500	5 700
- max continuous at 6.5°-20°	5 700	5 000
- min continuous	50	50

V14 frame size	110	160
<b>Flow</b> [l/min]		
- max intermittent <sup>1)</sup>	430	550
- max continuous	375	480
<b>Output torque</b> [Nm]		
at 100 bar (theor.)	175	255
<b>Max output power</b> <sup>1)</sup> [kW]	262	335
<b>Corner power</b> [kW]		
- intermittent <sup>1)</sup>	570	730
- continuous	440	560
<b>Weight</b> [kg]	54	68

1) Max 6 seconds in any one minute.

3

**Efficiency diagrams**

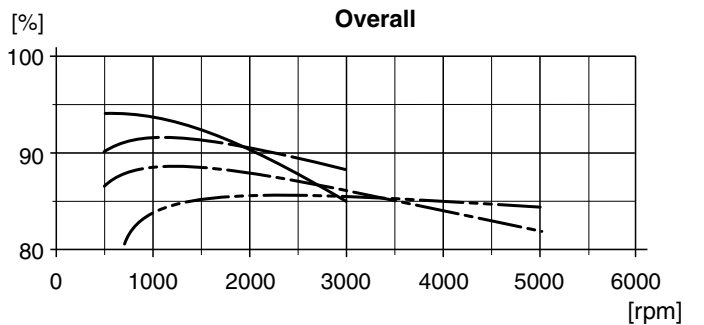
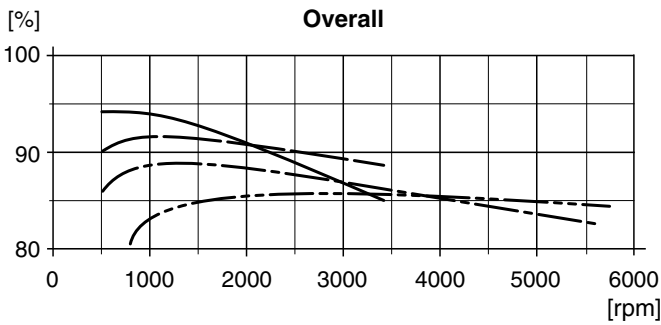
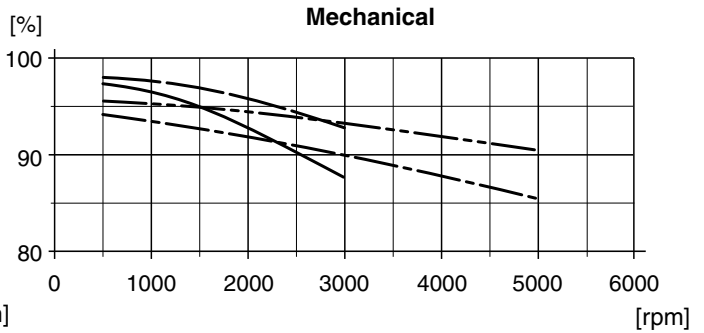
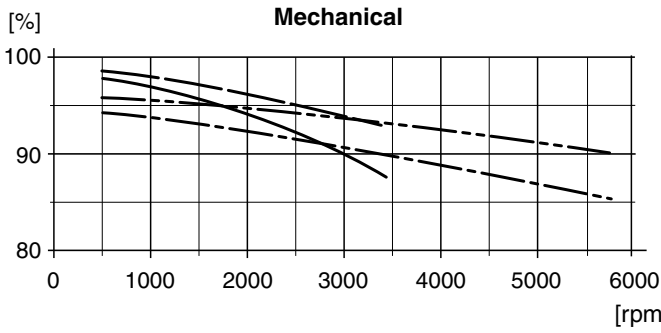
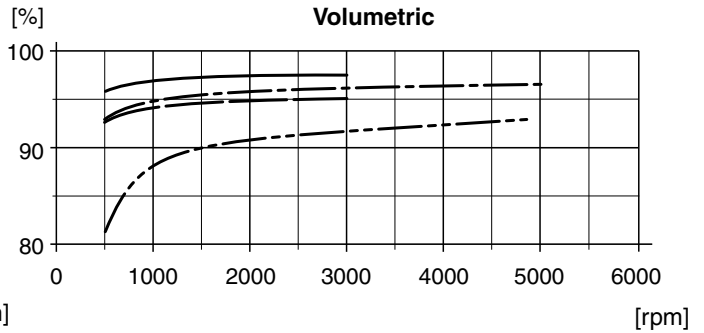
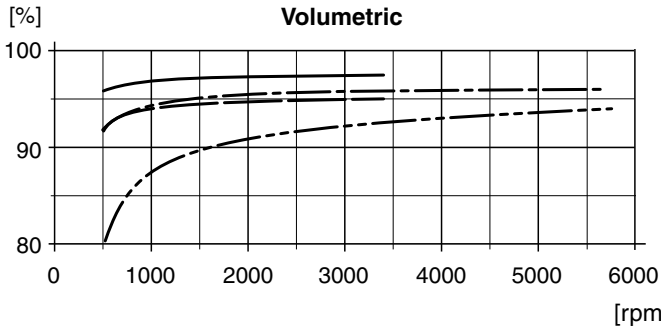
The following diagrams show volumetric, mechanical and overall efficiencies versus shaft speed at 210 and 420 bar operating pressure, and at full (35°) and reduced (10°) displacements.

Information on efficiencies for a specific load condition can be made available from Parker Hannifin.

- 210 bar at full displacement
- 420 bar “ “ “
- - - - - 210 bar at reduced displacement
- · - · - 420 bar “ “ “

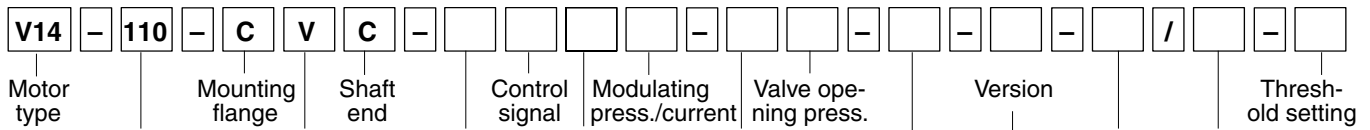
**V14-110**

**V14-160**





**Cartridge version**



**Code Frame size**  
 110 110 [cm<sup>3</sup>/rev]

**Code Mounting flange**  
 C Cartridge version

**Code Shaft seal**  
 V PPS

**Code Shaft end**  
 C DIN (ISO version)

**Code Control**  
**AC** Pressure compensator  
**AD** Press. compensator with electrohydraulic override and brake defeat valve  
**AH** Pressure compensator with hydraulic override  
**EO** Electrohydraulic, two-position  
**EP** Electrohydraulic, proportional  
**HO** Hydraulic, two-position  
**HP** Hydraulic, proportional

**Code Control signal**  
**E** External pressure (AH, HO, HP)  
**I** Internal pressure (AC, AH)  
**H** 24 [VDC] (AD, EO, EP)  
**L** 12 [VDC] (AD, EO, EP)

**Code Control restrictor set**  
 (orifice dia in mm)  
**1** 0.7  
**2** 0.8  
**3** **1.0 (standard)**  
**4** 1.2  
**X** Special

**Code Control modulating pressure/current**  
**N** AC, AD, AH, EO, HO: 0 bar;  
 EP: Non-selectible current  
**A** 15 [bar] (AC, AD, AH, HP)  
**B** 25 [bar] (AC, AD, AH, HP)  
**C** 50 [bar] (AC, AD, AH)

**Max and min displ. [cm<sup>3</sup>/rev]**

**Threshold setting**  
 AC, AD, AH:  
 Select pressure between 100 and 350 [bar]  
 EO, EP:  
**400** [mA] - 12 [VDC]  
**200** [mA] - 24 [VDC]  
 HO, HP:  
**10** [bar]

Factory issued for special versions

**Code Sensor options**  
 (pages 54-57)  
**N** None  
**C** Prepared for setting piston position sensor and shaft speed sensor (EP)  
**D** Setting piston position sensor and and prepared for shaft speed sensor (EP)  
**L** Setting piston position sensor (EP)  
**P** Prepared for speed sensor\*  
**T** Prepared for setting piston position sensor (EP)

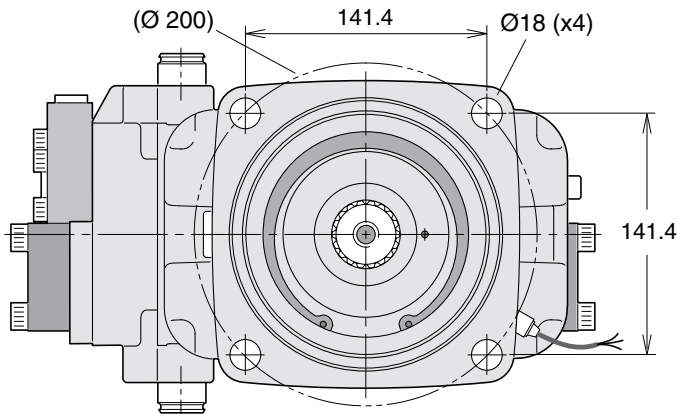
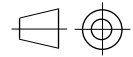
Pressure relief valve opening pressure [bar] (page 56)  
 Alternatively:  
 Flushing valve restrictor (page 54)

**Code Valve options** (pages 54-57)  
**N** None  
**(B)** Brake valve and pressure relief valves\*  
**L** Flushing valve  
**P** Pressure relief valves  
**R** Extra valve block (Contact Parker Hannifin)

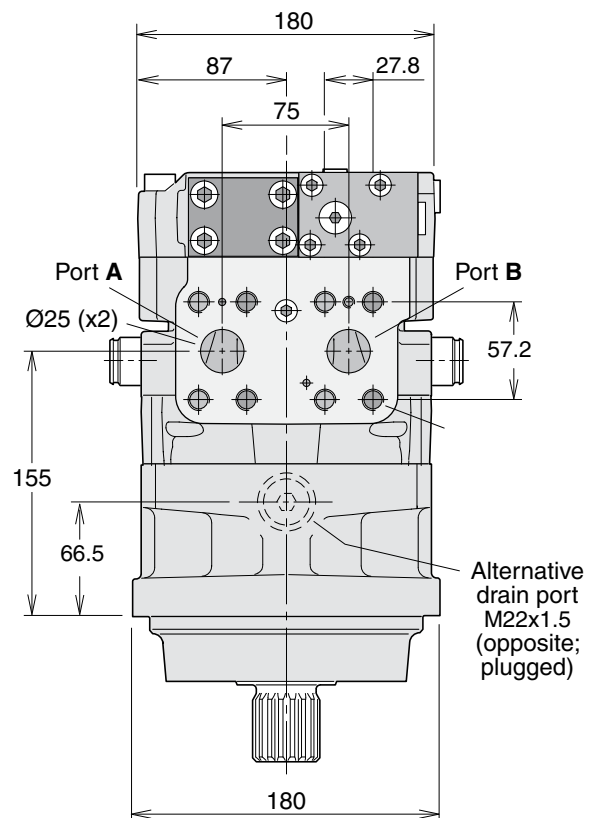
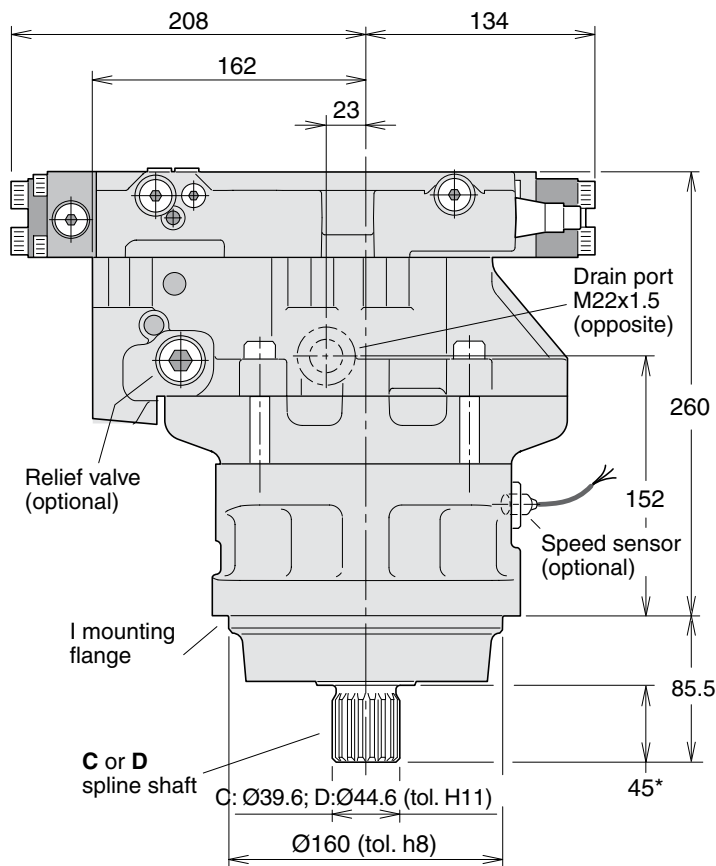
\* Note.  
 See information on page 55



**V14-110, ISO version**



Shown: V14-110-ISO with AC compensator



\* Measurement valid for spline type C.  
 Corresponding measurement for  
 spline type D is 5 mm longer.

Spline type <b>C</b> <sup>1)</sup> (DIN 5480)	
V14-110	W40x2x18x9g

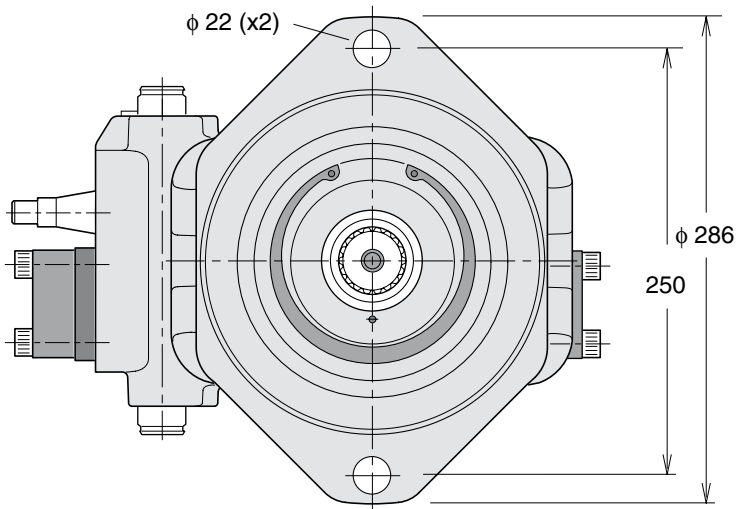
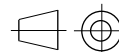
Spline type <b>D</b> <sup>1)</sup> (DIN 5480)	
V14-110	W45x2x21x9g

1) '30° involute spline, side fit'  
 C: Ø 39.6; D: Ø 44.6; tol. h11

Ports	V14-110
Main ports	25 [1"]
Drain ports	M22x1.5

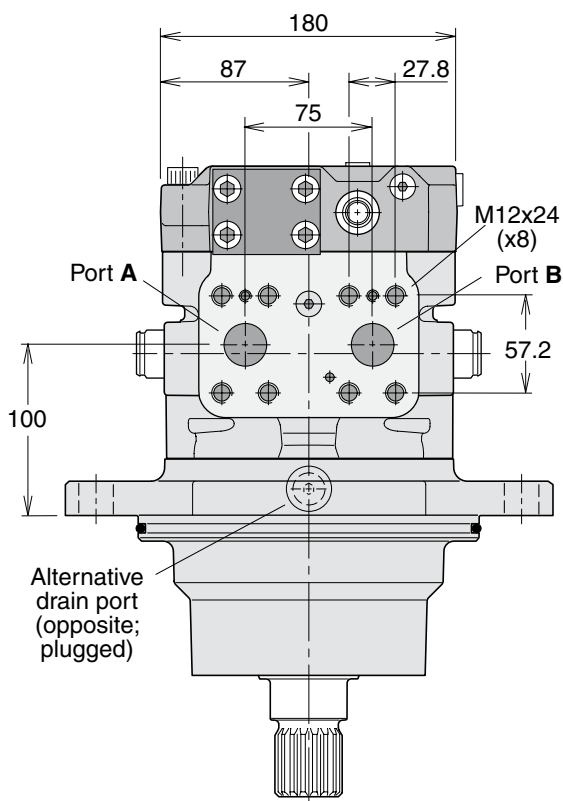
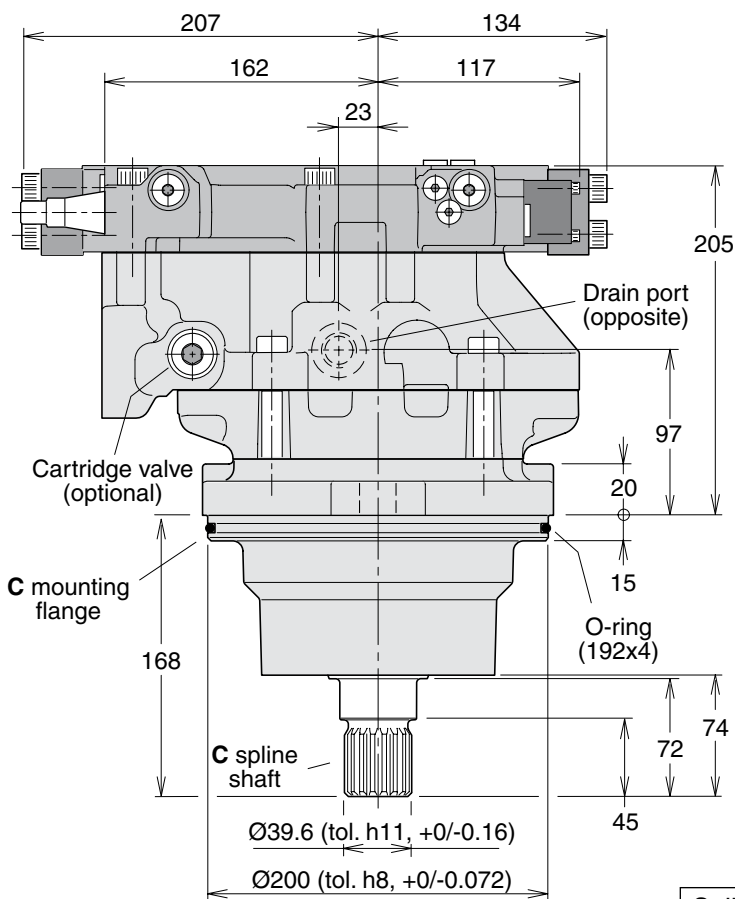
Main ports: ISO 6162, 41.5 MPa, type II

**V14-110, Cartridge version**



Shown: V14-110-SAE with HO/HP control

**3**



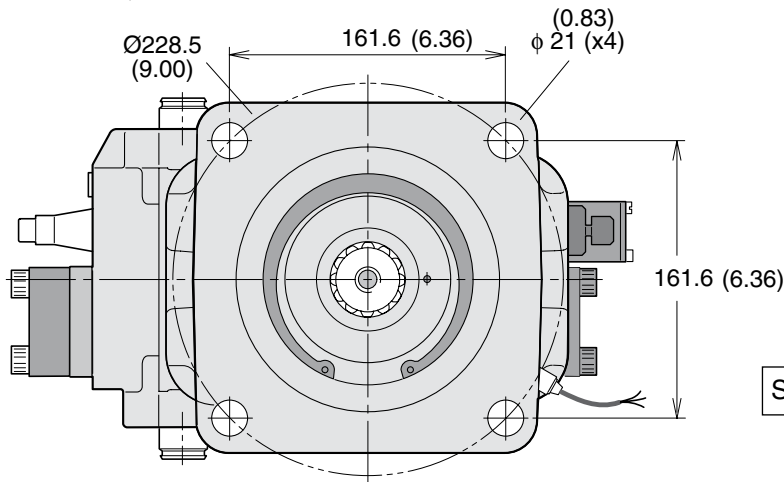
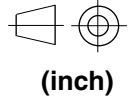
Spline type <b>C*</b> (DIN 5480)	
V14-110	W40x2x18x9g

\* '30° involute spline, side fit'.

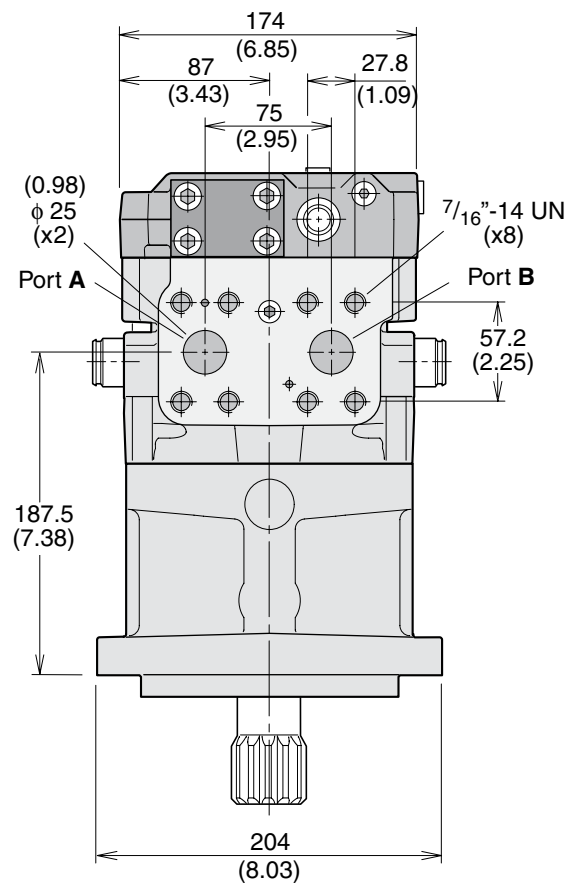
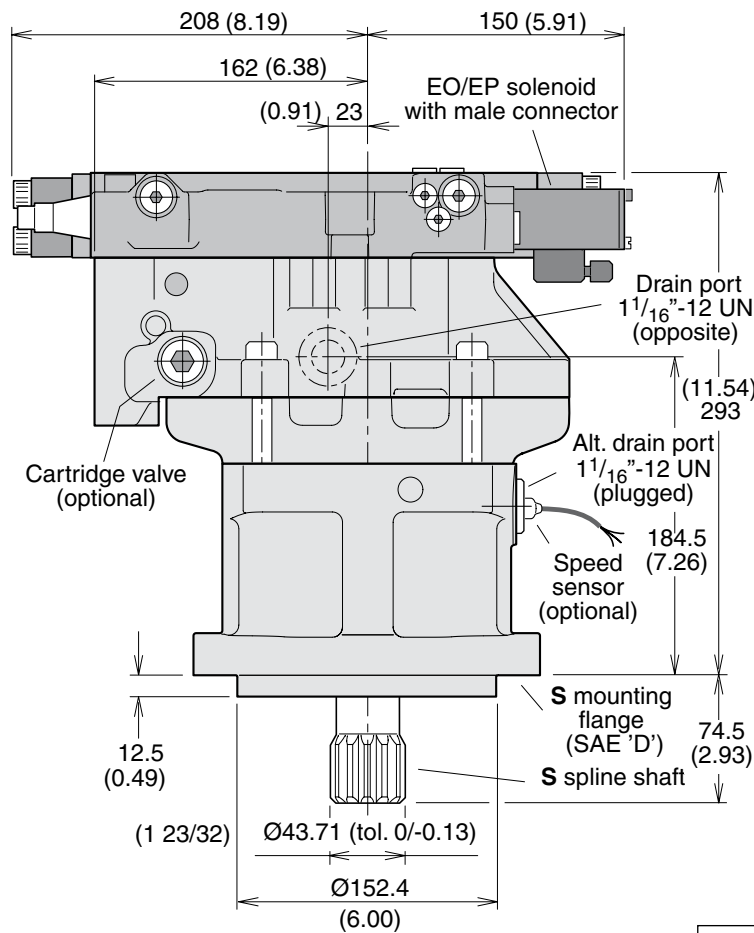
Ports	V14-110
Main ports	25 [1"]
Drain ports	M22x1.5

Main ports: ISO 6162, 41.5 MPa, type II

**V14-110, SAE version**



Shown: V14-110-SAE with EO/EP control



Spline type <b>S</b> (SAE J498b*)	
V14-110	SAE 'D' (13T, 8/16 DP)

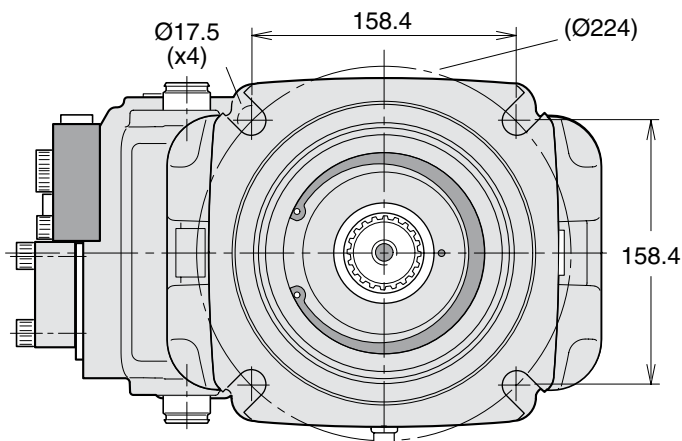
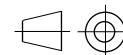
\* 30° involute spline, side fit

Ports	V14-110
Main ports	25 [1"]
Drain ports	1 1/16"-12 UN

Main ports: SAE J518c, 6000 psi

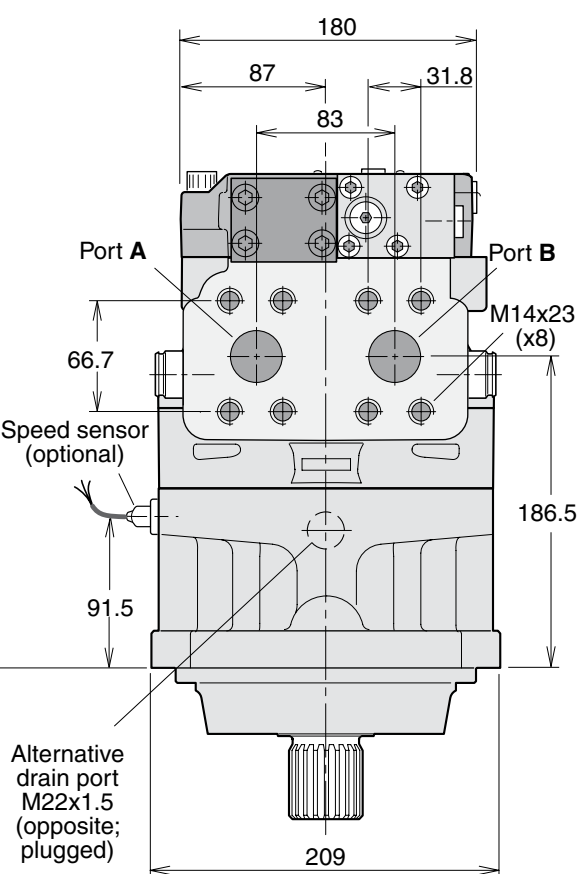
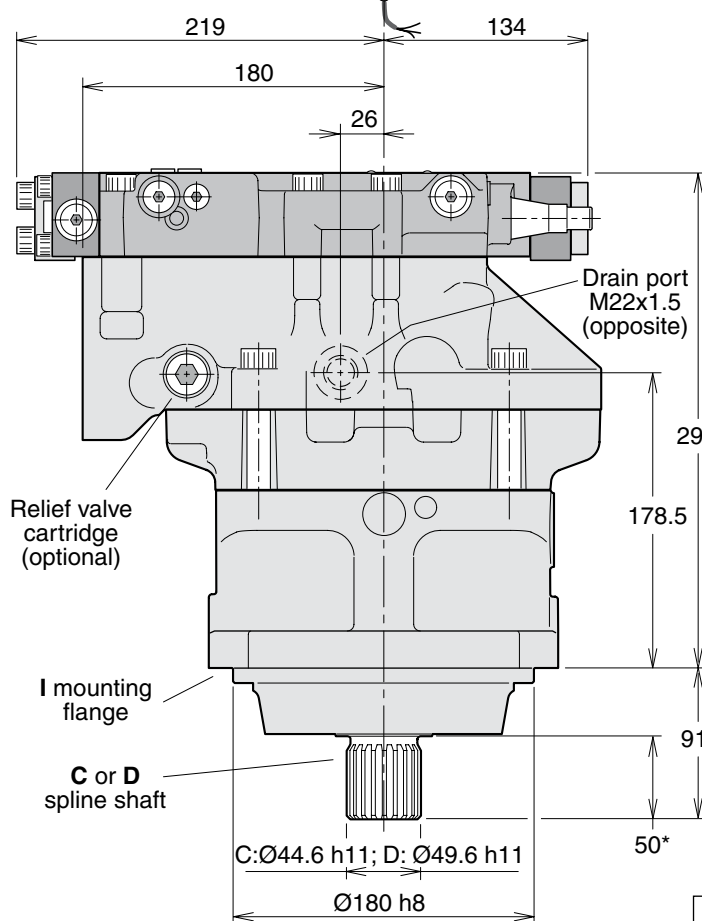


**V14-160, ISO version**



Shown: V14-160-ISO with AC compensator

**3**



\* Measurement valid for spline type C.  
 Corresponding measurement for spline type D is 5 mm longer.

Spline type <b>C</b> <sup>1)</sup> (DIN 5480)	
V14-160	W45x2x21x9g

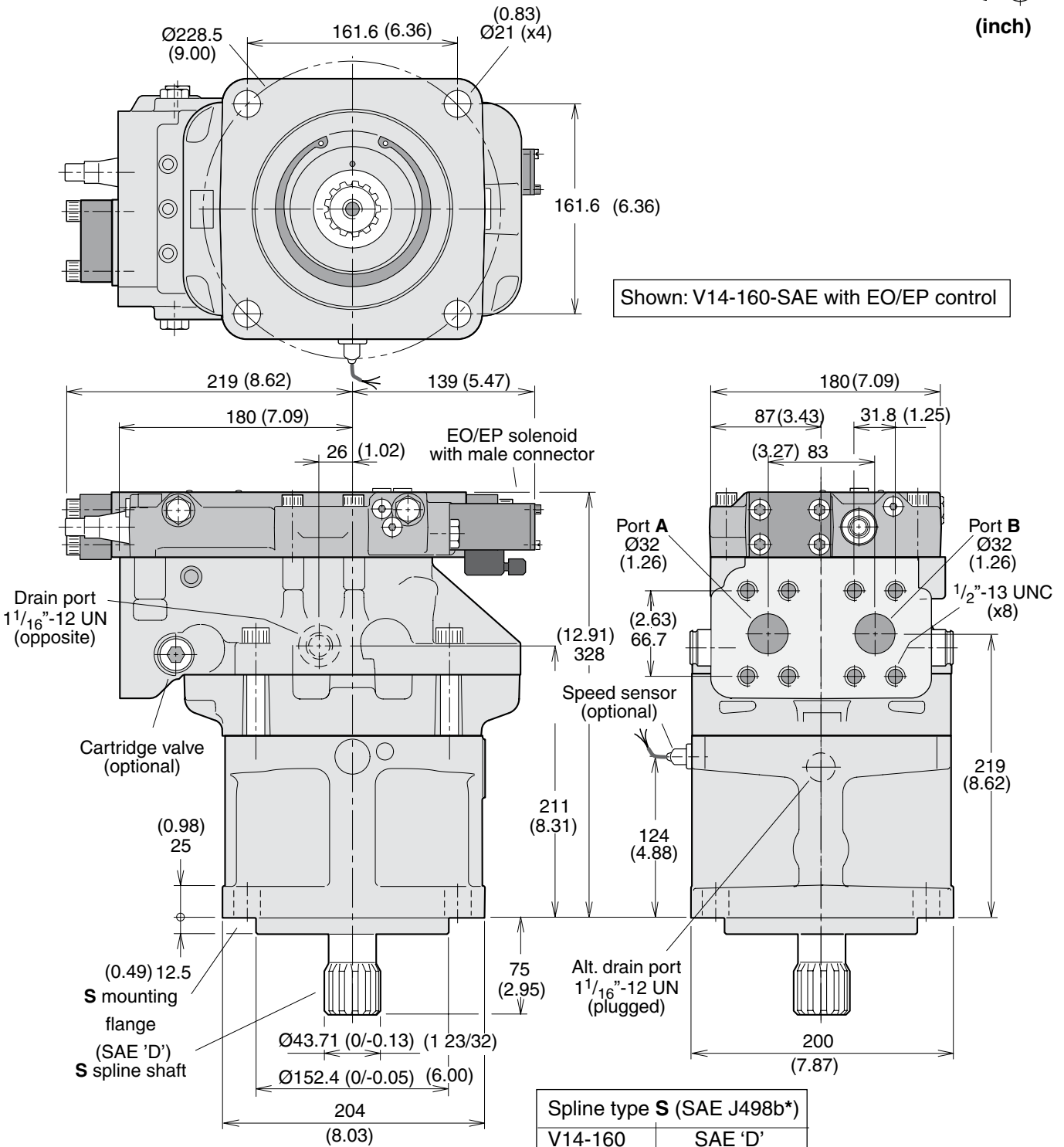
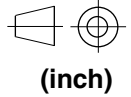
Spline type <b>D</b> * (DIN 5480)	
V14-160	W50x2x24x9g

1) '30° involute spline, side fit'.

Ports	V14-160
Main ports	32 [1 1/4"]
Drain ports	M22x1.5

Main ports: ISO 6162, 41.5 MPa, type II

**V14-160, SAE version**



Spline type <b>S</b> (SAE J498b*)	
V14-160	SAE 'D' (13T, 8/16 DP)

\* '30° involute spline, side fit'.

Ports	V14-160
Main ports	32 [1 1/4"]
Drain ports	1 1/16"-12 UN

Main ports: SAE J518c, 6000 psi

**Controls** - general information

The following V14 controls satisfy most application requirements:

- AC, AD and AH (automatic pressure compensators)
- EO and HO (two-position controls)
- EP and HP (proportional controls)

All controls utilize a servo piston that connects to the valve segment (refer to the illustration on page 32).

The built-in four-way servo valve determines the position of the servo piston and, in turn, the displacement.

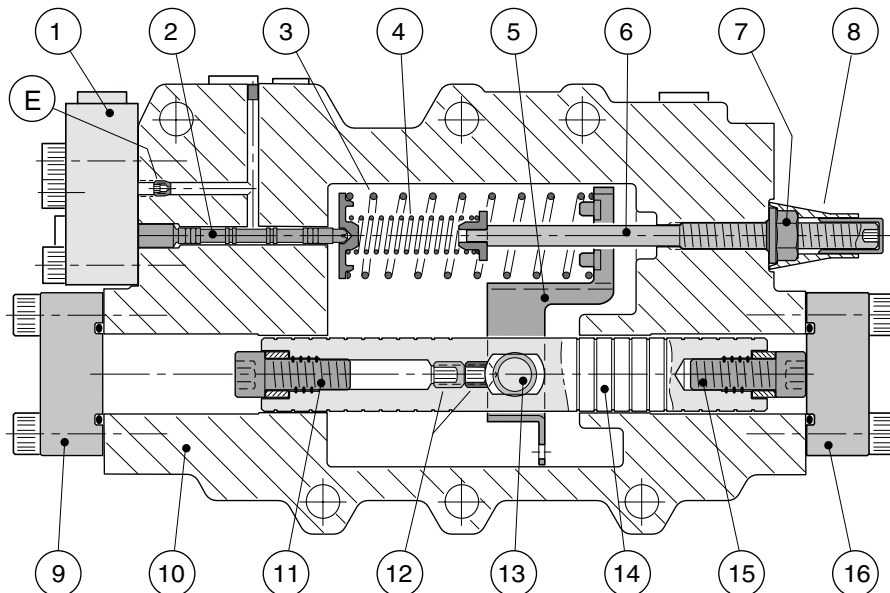
The displacement angle (between output shaft and cylinder barrel) ranges from 35° (max) to 6.5° (min).

Servo supply pressure is obtained from the pressurized, main port through the corresponding, built-in shuttle valve.

The response time (i.e. from max-to-min or from min-to-max displacement) is determined by restrictor nozzles in the servo valve supply and return lines; refer to the schematics.

**NOTE:** The modulating pressure/current,  $\Delta p/\Delta I$  values are valid for motors that are not displacement limited.

**AC pressure compensator**



*Cross section of the AC pressure compensator module.*

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>1. AC control cover</li> <li>2. Servo valve spool</li> <li>3. Modulating spring</li> <li>4. Threshold spring</li> <li>5. Feedback arm</li> <li>6. Threshold adjustment screw</li> <li>7. Seal nut</li> <li>8. Two-part seal (threshold adjustm't)</li> <li>9. End cover (max displ.)</li> </ul> | <ul style="list-style-type: none"> <li>10. Control module housing</li> <li>11. Max displ. limiting screw/bushing</li> <li>12. Set screws</li> <li>13. Connecting arm</li> <li>14. Setting piston</li> <li>15. Min displ. limiting screw/bushing</li> <li>16. End cover (min displ.).</li> <li>E. Nozzle location; refer to the hydraulic schematics, pag. 44-46.</li> </ul> |
|--|---|

**AC compensator function**

Refer to the illustration below (left):

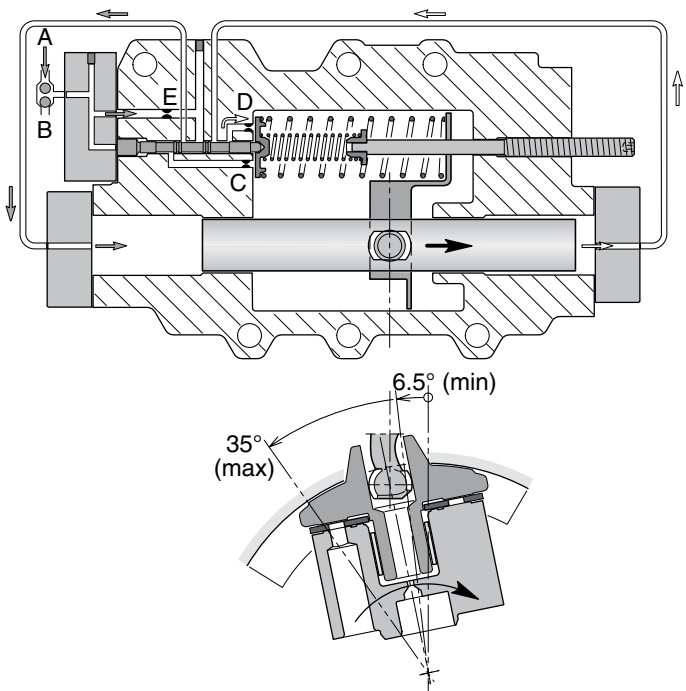
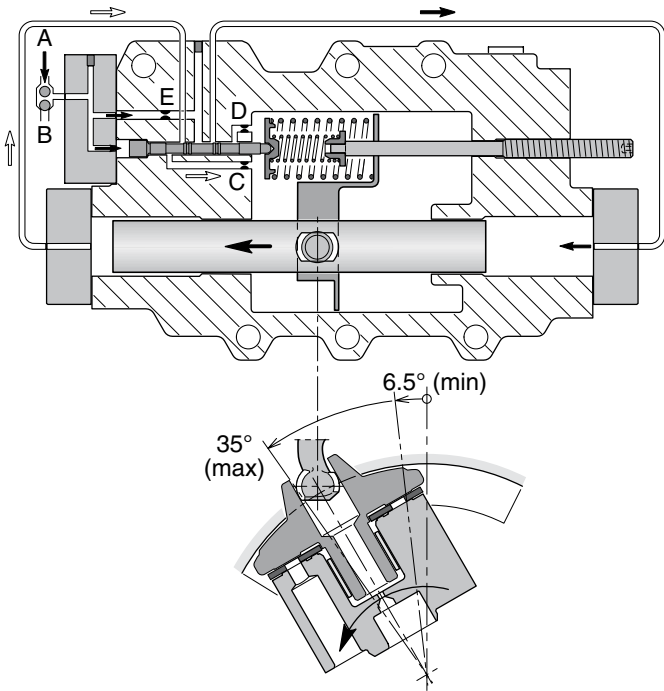
When pressure in port A (or B) increases, the servo valve spool is pushed to the right, directing flow to the right hand setting chamber - the setting piston moves to the left; displacement and output torque increases.

At the same time, the shaft speed decreases correspondingly (at a constant pump flow to the motor).

Refer to the illustration below (right):

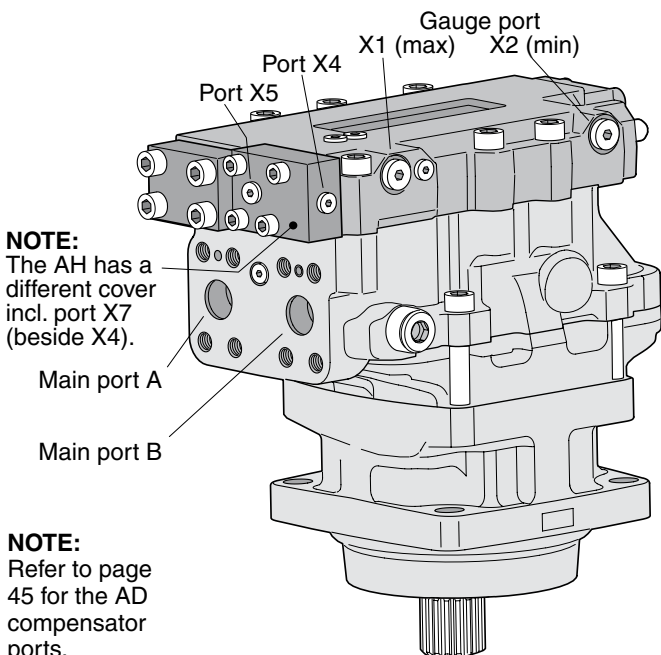
When pressure in port A (or B) decreases, the servo valve spool moves to the left, directing flow to the left hand setting chamber - the setting piston moves to the right; displacement and output torque decreases.

At the same time, the shaft speed increases correspondingly (at a constant pump flow to the motor).



AC function (displ. increases at increasing system pressure).

AC function (displ. decreases at decreasing system pressure).



**NOTE:**  
 Refer to page 45 for the AD compensator ports.

- Gauge/pilot ports (AC and AH compensators):
- X1 Setting piston pressure (decreasing displ.)
  - X2 Setting piston pressure (increasing displ.)
  - X4 Servo supply pressure (before orifice and filter)
  - X5 Pilot pressure
  - X7 Override pressure (on the AH)
- Port sizes:
- M14x1.5 (ISO and cartridge versions)
  - 9/16"-18 O-ring boss (SAE version)

Port locations - V14- with AC or AH compensator.

**AC compensator function (cont'd)**

The AC compensator is used in off-road vehicle hydrostatic propel transmissions. The compensator automatically adjusts motor displacement between available max and min to the output torque requirement (up to max available system pressure).

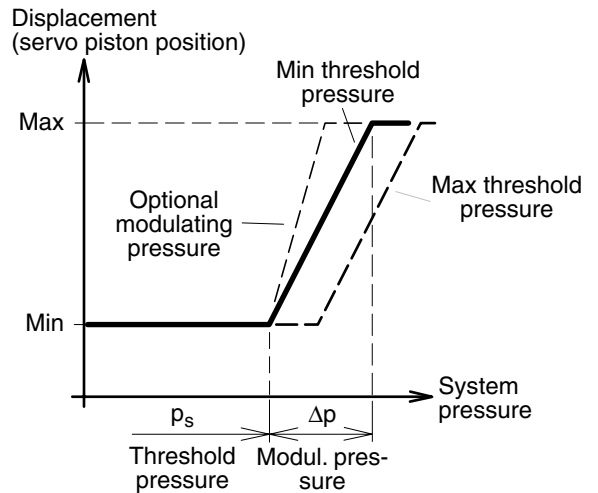
Normally, the motor stays in the minimum displacement position. When there is a demand for additional torque, e.g. when the vehicle enters an upgrade, the displacement increases (providing more torque) while the motor shaft speed decreases proportionally.

The threshold pressure, where displacement starts to increase ( $p_s$ ; refer to the AC diagram), is adjustable between 100 and 400 bar.

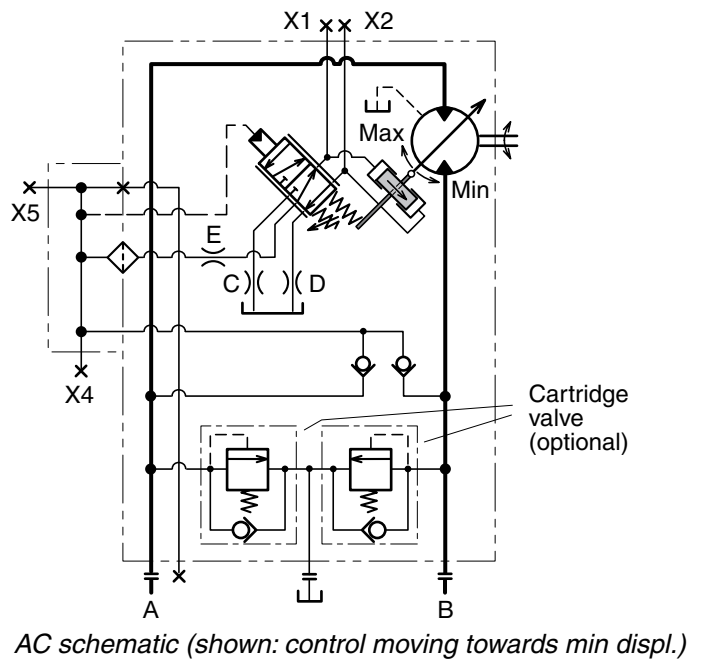
To reach max displacement, an additional modulating pressure ( $\Delta p$ ) above the threshold pressure is required.

To satisfy specific hydraulic circuit requirements, a modulating pressure of 15, 25 or 50 bar can be selected.

The pressure compensator is supplied with a small filter installed in the AC control cover (between ports X4 and X5); refer to the schematic below right.



AC diagram (displacement vs. system pressure).



AC schematic (shown: control moving towards min displ.)

**3**

Gauge/pilot ports (AC and AH compensators):

- X1 Setting piston pressure (decreasing displ.)
- X2 Setting piston pressure (increasing displ.)
- X4 Servo supply pressure (before orifice and filter)
- X5 Pilot pressure

Port sizes:

- M14x1.5 (ISO and cartridge versions)
- 9/16"-18 O-ring boss (SAE version)

**NOTE:** Port locations are shown in the illustration on page 43.

**AD pressure compensator**

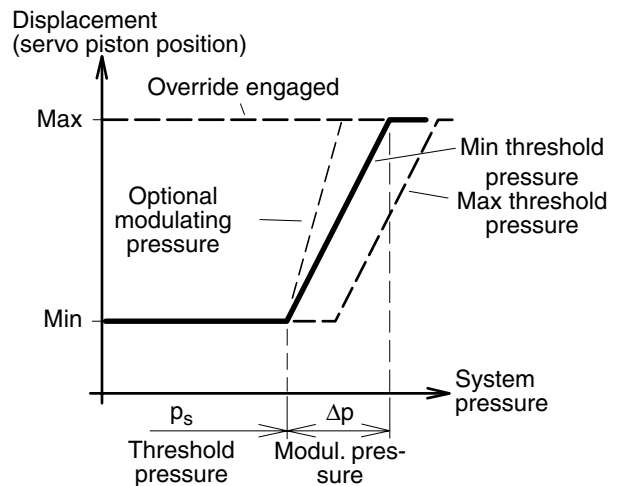
The AD control is similar to the AC (shown on previous pages) but incorporates a solenoid controlled override function and a brake defeat valve.

**Override**

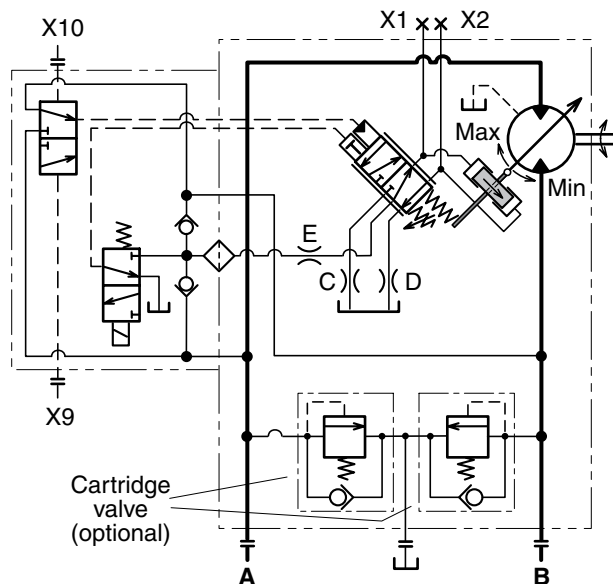
- The override consists of a piston built into a special end cover and an external solenoid.
- When the solenoid is energized, system pressure is directed to the piston which in turn pushes on the spool of the servo control valve. This causes the motor to lock in the max displacement position, irrespective of system pressure (min 30 bar).
- Solenoids are available in 12 VDC (designated **L**) and 24 VDC (design. **H**); the required current is 2 and 1 A respectively.

**Brake defeat valve**

- The brake defeat function, which is also built into the special end cover, consist of a two-position, three-way valve. Ports X9 and X10 (refer to the schematic) are connected to the corresponding ports of the pump displacement control.
- The function prevents any pressure in the motor return port to influence the pressure compensator. Say, e.g., that motor port A is pressurized to move the vehicle 'forward'. Thus, back pressure in return port B, which develops in the braking mode, will not cause the compensator to move towards the max displacement position and vehicle braking will be smooth.
- Likewise, when port B is pressurized when the vehicle moves 'backward', braking pressure in port A will not influence the compensator.



*AH diagram (displacement vs. system pressure).*



*AD schematic (shown: override solenoid not engaged; the compensator moves towards min displacement).*

**Gauge/pilot ports (AD compensator):**

- X2 Servo piston pressure (increasing displ.)
- X9 Pressure (from the pump control) to the brake defeat valve (for port A)
- X10 Pressure (from the pump control) to the brake defeat valve (for port B)

**Port sizes:**

- M14x1.5 (ISO version)
- X2 is M14x1.5 O-ring boss (SAE version)

**NOTE:** Some of the ports are shown in the illustration on page 43.

**AH pressure compensator**

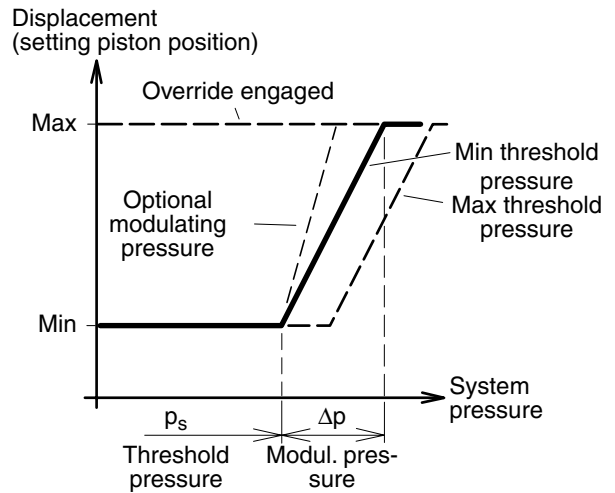
The AH compensator is similar to the AD (shown on previous page) but incorporates only an hydraulic override device. It is utilized in hydrostatic transmissions where a high degree of manoeuvrability at low vehicle speeds is desirable.

When the override is pressurized, the servo piston moves to the max displacement position irrespective of system pressure, provided the servo supply pressure is at least 30 bar.

Required override pressure, port X7 (min 20 bar):

$$p_7 = \frac{p_s + \Delta p}{24} \text{ [bar]}$$

- $p_7$  = Override pressure
- $p_s$  = System pressure
- $\Delta p$  = Modulating pressure



AH diagram (displacement vs. system pressure).

**3**

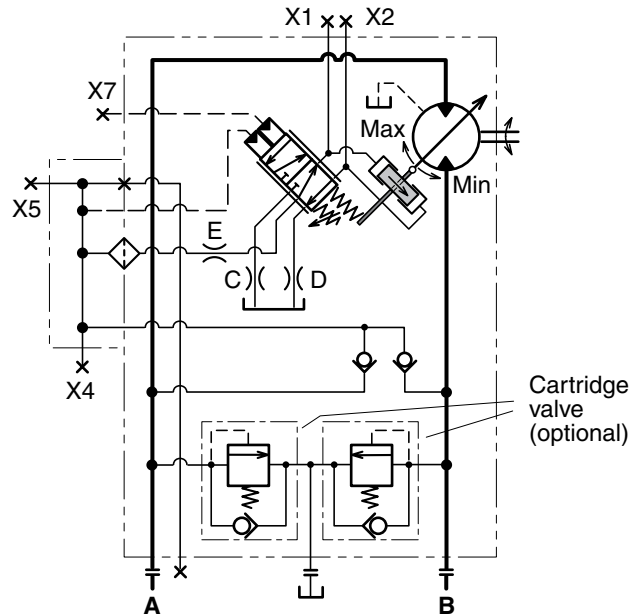
Gauge/pilot ports (AH compensator):

- X1 Servo piston pressure (decreasing displ.)
- X2 Servo piston pressure (increasing displ.)
- X4 Servo supply pressure (before orifice and filter)
- X5 Pilot pressure
- X7 Override pressure

Port sizes:

- M14x1.5 (ISO version)
- 9/16"-18 O-ring boss (SAE version)

**NOTE:** Port locations are shown in the illustration on page 43.



AH schematic (shown: override port X7 not pressurized; the compensator is moving towards min displacement).

**EO, EP, HO and HP controls** (general information)

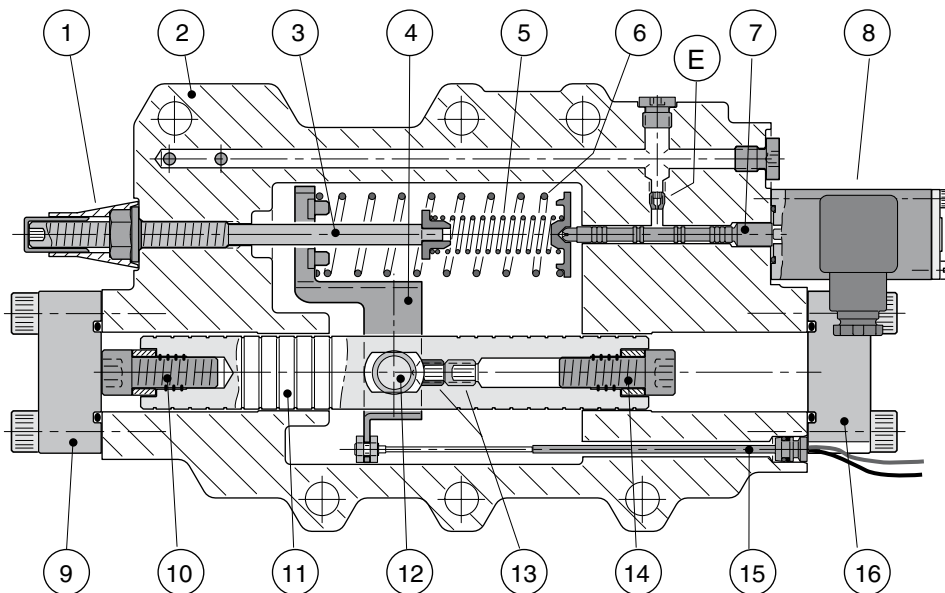
Basically, these controls function in a similar way.

At increasing solenoid current (EP) or increasing pilot pressure (HP) the control moves towards the min displacement position.

At decreasing current or pilot pressure, the control retracts towards max displacement.

In comparison with EP and HP, the EO and HO controls have no modulating spring; this means that only min and max displacements can be obtained with these controls.

Max and min displacements can be limited by a screw with spacer bushing as shown below.



*Cross section of the EP control module.*

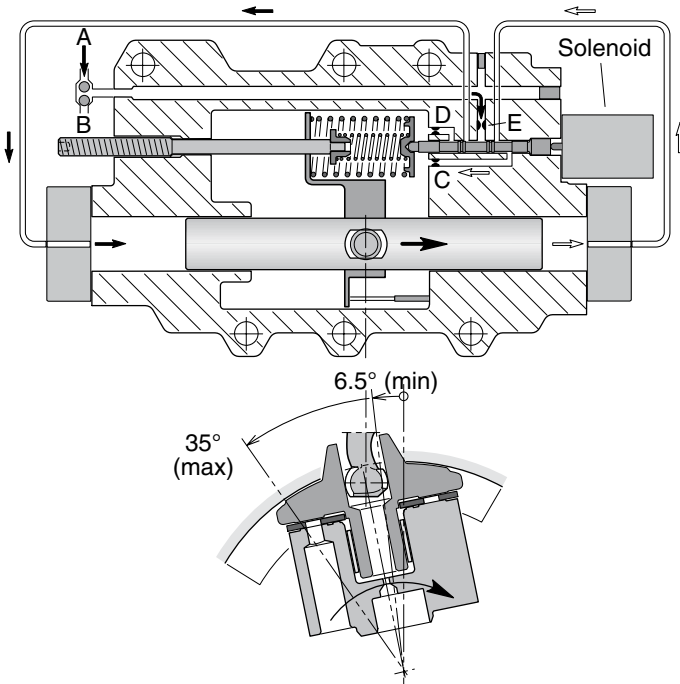
- |   |   |
|---|---|
| 1. Two-part seal (threshold adjustm't)        | 10. Max displ. limiting screw/bushing                     |
| 2. Control module housing                     | 11. Setting piston  |
| 3. Threshold adjustment screw                 | 12. Connecting arm  |
| 4. Feedback arm                               | 13. Set screws  |
| 5. Threshold spring                           | 14. Min displ. limiting screw/bushing                     |
| 6. Modulating spring (EP, HP only)            | 15. Setting piston position sensor                        |
| 7. Servo valve spool                          | 16. End cover (min displ. limit)                          |
| 8. Solenoid (EO, EP only);<br>cover on HO, HP | E. Nozzle location; refer to the<br>hydraulic schematics. |
| 9. End cover (max displ. limit)               |   |



**EP control function (solenoid current increasing)**

**NOTE:** Valid also for the HP at increasing pilot pressure.  
 Refer to the illustration below left:

At an increasing current (above the threshold value), the solenoid spool pushes left on the servo valve spool, and flow is directed to the left hand setting chamber - the setting piston moves to the right and the displacement decreases. This means, that the shaft speed in-creases while the output torque decreases correspondingly (at a constant pump flow and system pressure).

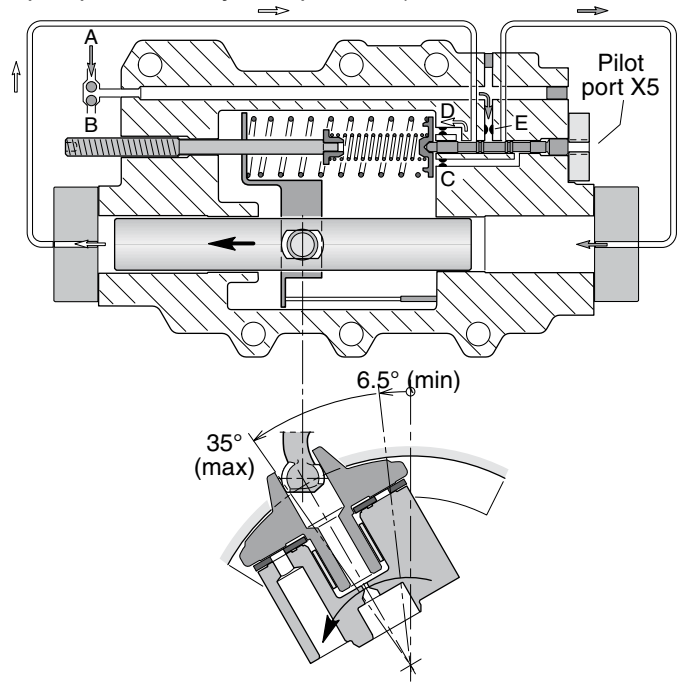


**HP control function (decreasing pilot pressure)**

**NOTE:** Valid also for the EP at decreasing current.  
 Refer to the illustration below right:

When the pilot pressure decreases, the servo valve spool moves to the right and flow is directed to the right hand setting chamber - the setting piston moves to the left and the displacement increases.

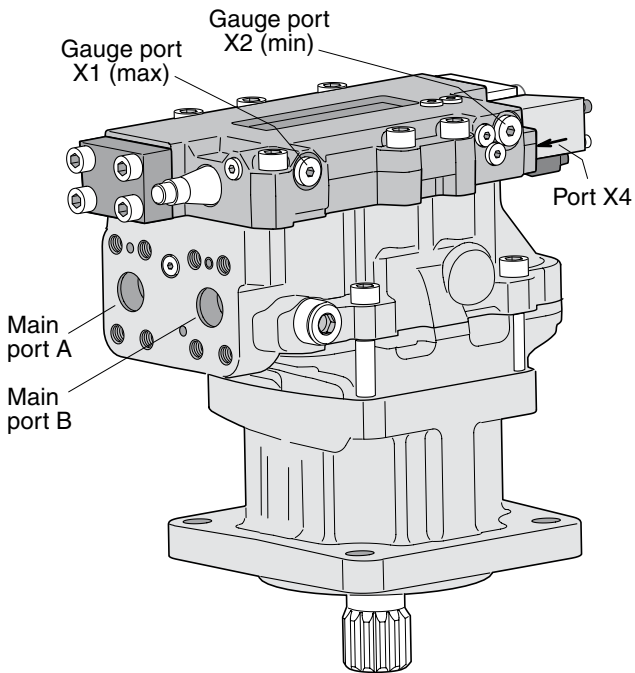
The shaft speed now decreases and the available output torque increases correspondingly (at a constant pump flow and system pressure).



**3**

*EP control function (displ. decrease at increasing current).*

*HP control function (displ. increase at decreasing pilot press.).*



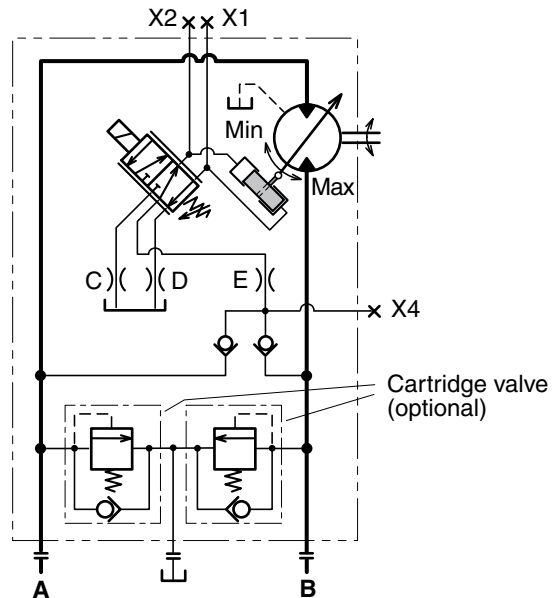
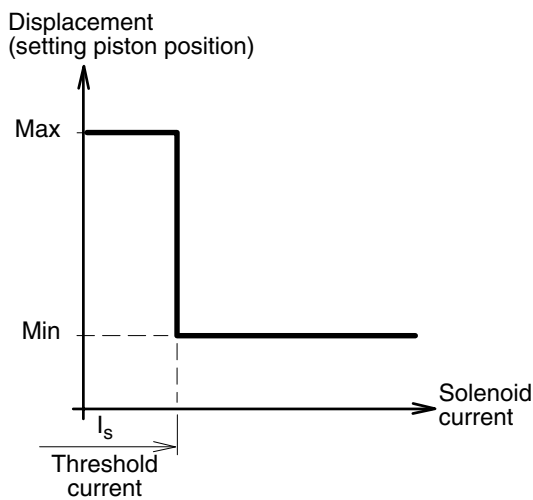
Gauge ports (EO and EP controls):  
 X1 Setting piston pressure (decreasing displ.)  
 X2 Setting piston pressure (increasing displ.)  
 X4 Servo supply pressure (before orifice)  
 Port sizes:  
 -M14x1.5 (ISO version)  
 -<sup>9</sup>/<sub>16</sub>"-18 O-ring boss (SAE version).

Port locations - V14- with EO or EP control.

**EO electric two-position control**

- The EO is a two-position control where the max and min displacements are governed by a DC solenoid (acting on the servo spool) which is attached to the control module (refer to the illustration on page 48).
- The EO is utilized in transmissions where only two operating modes are required - low speed/high torque and high speed/low torque.
- The servo piston, normally in the max displacement position, shifts to min displacement as soon as the solenoid is activated.
- Intermediate displacements cannot be obtained with this control.

- Servo pressure is supplied internally (through a check valve from the utilized high pressure port); refer to the schematic below.
- The solenoid is either 12 or 24 VDC, requiring 1.2 and 0.6 A respectively.
- The male connector (type 'Junior Timer') is permanently installed on the solenoid. The corresponding female connector is not included.  
**Note:** The female connector is available as spare part P-N 3781939.
- The threshold current of the 12 VDC solenoid is factory set at 400 mA; it is adjustable between 200 and 500 mA. The 24 VDC solenoid is factory set at 200 mA and is adjustable between 100 and 250 mA.



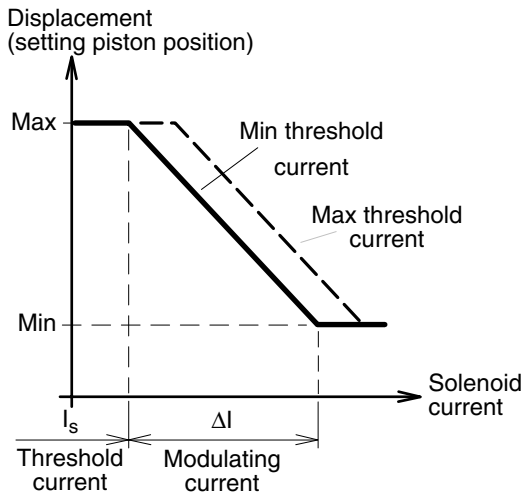
*EO schematic (shown: non-activated solenoid; control in max displacement position).*

Gauge ports (EO and EP controls):  
 X1 Setting piston pressure (decreasing displ.)  
 X2 Setting piston pressure (increasing displ.)  
 X4 Servo supply pressure (before orifice)  
 Port sizes:  
 - M14x1.5 (ISO version)  
 - 9/16"-18 O-ring boss (SAE version).  
**NOTE:** Port locations are shown in the illustration on page 49.

**EP electrohydraulic proportional control**

- The EP electrohydraulic proportional control is used in hydrostatic transmissions requiring a continuously variable shaft speed. The servo valve is governed by a DC solenoid (acting on the servo spool), attached to the control module (refer to the illustration on page 48).
- When the solenoid current increases above the threshold value, the servo piston starts to move from max towards min displacement. The displacement vs. solenoid current is shown in the diagram below.

**NOTE:** The shaft speed is **not** proportional to the solenoid current; refer to the bottom diagram.

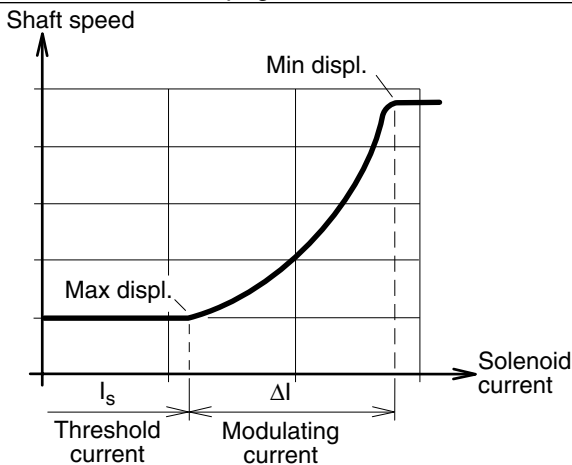


EP diagram (displacement vs. solenoid current).

Gauge ports (EP control):  
 X1 Setting piston pressure (decreasing displ.)  
 X2 Setting piston pressure (increasing displ.)  
 X4 Servo supply pressure (before orifice)

Port sizes:  
 - M14x1.5 (ISO version)  
 - 9/16"-18 O-ring boss (SAE version).

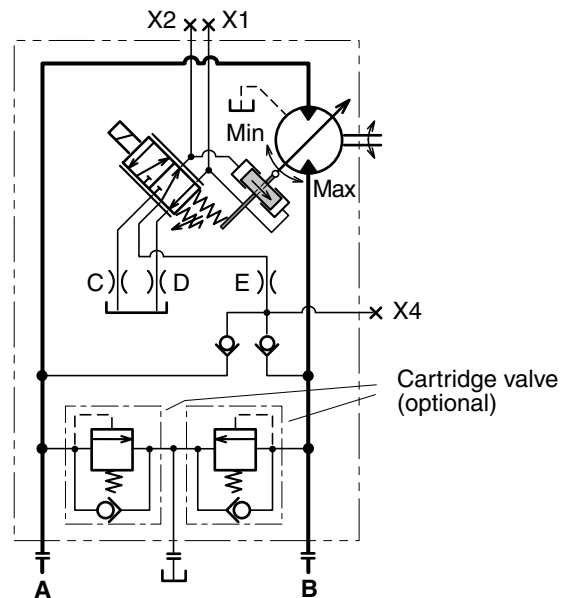
**NOTE:** Port locations are shown in the illustration on page 49.



**Please note:** The shaft speed is **not** proportional to the solenoid current.

- The solenoid (which is the same as the one used on the EO control) is either 12 or 24 VDC, requiring 1200 and 600 mA respectively.
- The male connector (type 'Junior Timer') is permanently installed on the solenoid. The corresponding female connector is not included.  
**Note:** The female connector is available as spare part P-N 3781939
- The threshold current of the 12 VDC solenoid is factory set at 400 mA; it is adjustable between 200 and 500 mA. The 24 VDC solenoid is factory set at 200 mA and is adjustable between 100 and 250 mA.
- When utilizing the full displacement range, the required modulating current ( $\Delta I$ ) is 0.6 and 0.3 A respectively. In order to minimize hysteresis, a pulse-width modulated control signal of 50 to 60 Hz should be provided.

**NOTE:** The modulating current ( $\Delta I$ ) is not adjustable.

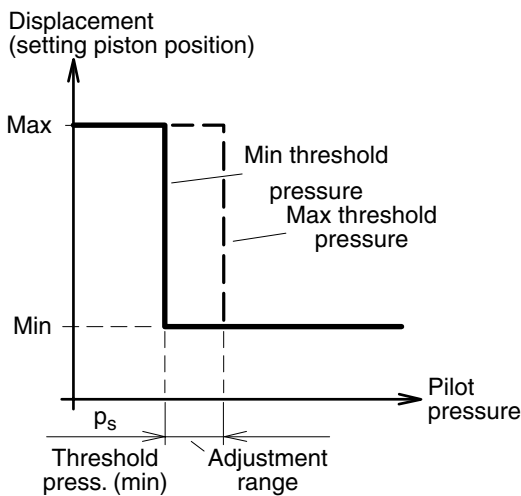


EP schematic (shown: non-activated solenoid; control moving towards max displacement).

**3**

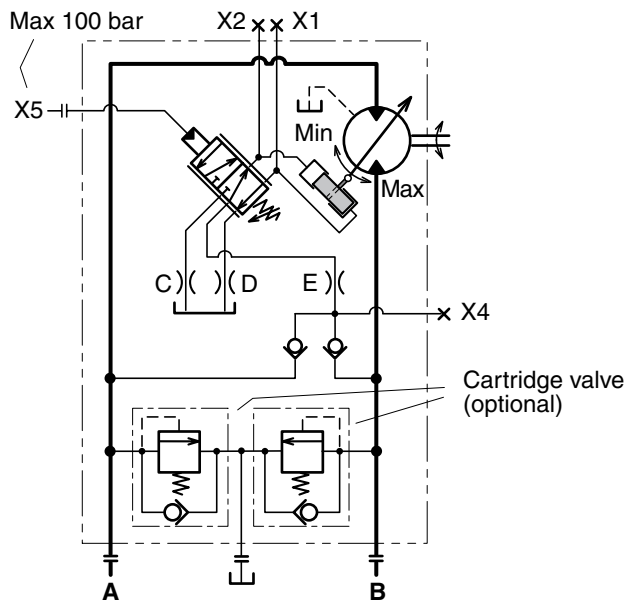
**HO hydraulic two-position control**

- The two-position HO control is similar to the EO (page 50) but the control signal is hydraulic. The position of the servo piston is governed by the built-in servo valve (same as on all controls).
- When the applied pilot pressure (port X5) exceeds the pre-set threshold value, the piston moves from the max to the min displacement position.
- Positions between max and min cannot be obtained with this control.
- The threshold pressure is factory set at 10 bar but is adjustable between 5 and 25 bar.

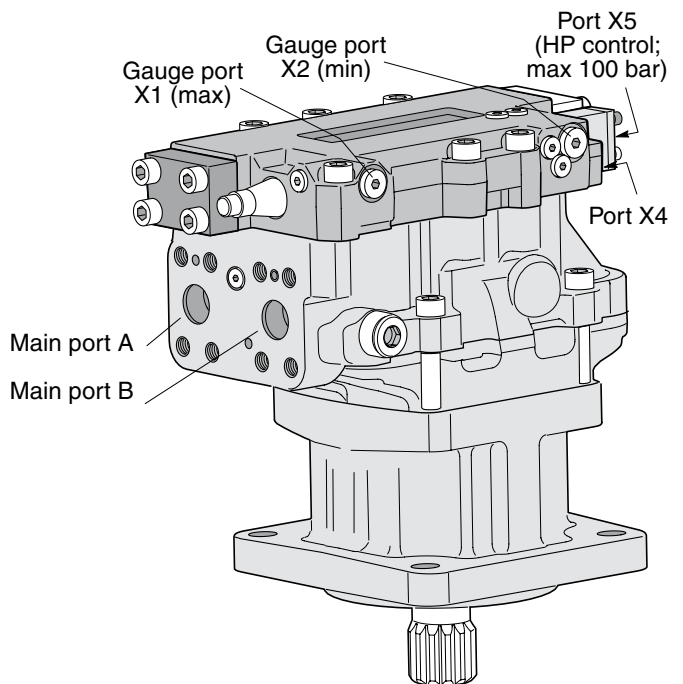


HO diagram (displacement vs. pilot pressure).

- Gauge ports (HO and HP controls):
- X1 Setting piston pressure (decreasing displ.)
  - X2 Setting piston pressure (increasing displ.)
  - X4 Servo supply pressure (before orifice)
  - X5 External pilot pressure (max 100 bar; HP control)
- Port sizes:
- M14x1.5 (ISO version)
  - 9/16"-18 O-ring boss (SAE version).



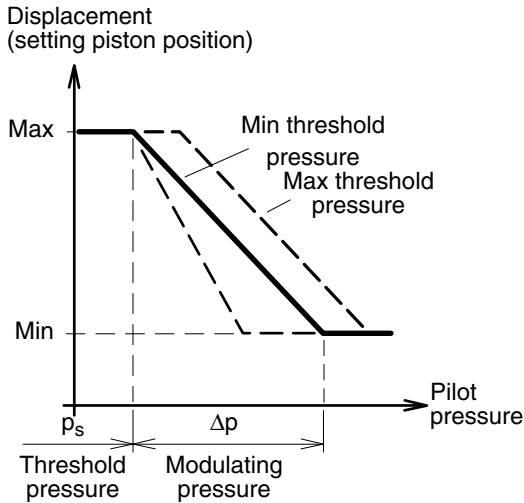
HO schematic (shown: port X5 not pressurized; control in max displ. position).



Port locations - V14-110 with HO or HP control.

**HP hydraulic proportional control**

- Like the EP described on page 50, the HP proportional control offers continuously variable displacement, but the controlling signal is hydraulic.
- Normally, the servo piston stays in the max displacement position. When a sufficiently high pilot pressure ( $p_s$ ) is applied to port X5, the piston starts to move towards the min displacement position.



HP diagram (displacement vs. pilot pressure).

Gauge/pilot ports (HP control):

- X1 Setting piston pressure (decreasing displ.)
- X2 Setting piston pressure (increasing displ.)
- X4 Servo supply pressure (before orifice)
- X5 External pilot pressure (max 100 bar)

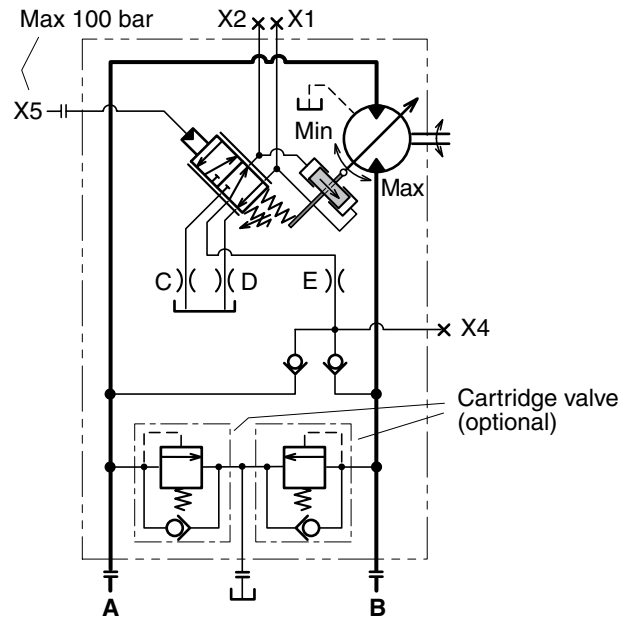
Port sizes:

- M14x1.5 (ISO version)
- 9/16"-18 O-ring boss (SAE version).

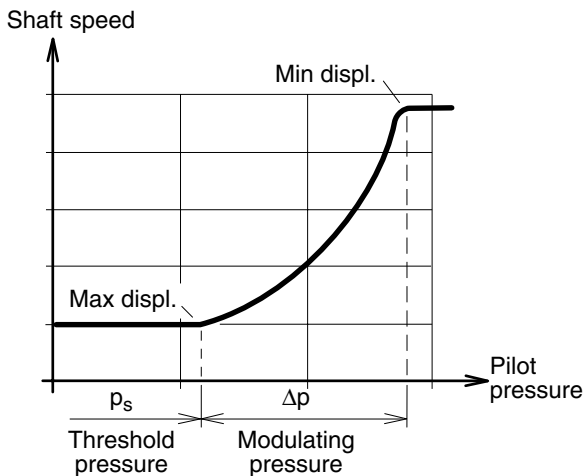
**NOTE:** Port locations are shown in the illustration on page 52.

- As can be seen from the pilot pressure/displacement diagram below, the displacement changes in proportion to the applied modulating pressure.
- In contrast, the shaft speed is not proportional to the pilot pressure; refer to the bottom left diagram.
- The modulating pressure ( $\Delta p$ ) is factory set at 15 bar; the threshold pressure ( $p_s$ ) is set at 10 bar but is adjustable between 5 and 25 bar.

See also "Controls, Note" on page 37.



HP schematic (shown: port X5 not pressurized; control moving towards max displacement).



**Please note:** The shaft speed is **not** proportional to the pilot pressure.

**3**

## V14-110/-160

### Valve options (overview)

- Brake valve and pressure relief valves (opt. **B**; )\*
- Flushing valve (option **L**; below)
- Pressure relief valves (option **P**; page 56)

### Sensor options (overview)

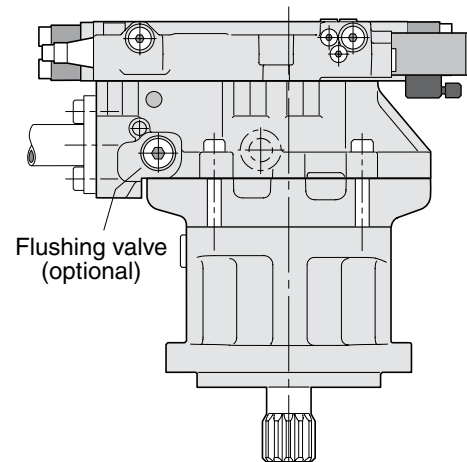
- Shaft speed sensor (option **P**; page 55)
- Setting piston position sensor (option **L**; page 57)

### Flushing valve (option L)

The V14 is available with a flushing (or shuttle) valve that supplies the motor with a cooling flow through the case. Cooling the motor may be required when operating at high speeds and/or power levels.

The flushing valve consists of a three-position, three-way spool valve built into the connection module. It connects the low pressure side of the main circuit to a nozzle (optional sizes below) that empties fluid into the motor case.

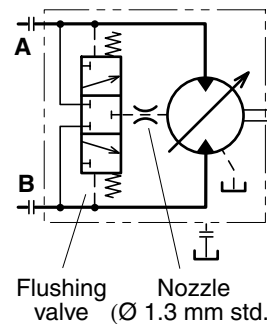
In a closed circuit transmission, the flushing valve re-moves part of the fluid in the main loop. The removed fluid is continuously being replaced by cool, filtered fluid from the low pressure charge pump on the main pump.



V14-110 (EP control) with built-in flushing valve.

### Available nozzles

Ordering code	Orifice size [mm]	Status
L 010	1.0	Optional
<b>L 013</b>	<b>1.3</b>	<b>Standard</b>
L 015	1.5	Optional
L 017	1.7	"
L 020	2.0	"
L030	3.0	"



Hydraulic schematic - V14 with built-in flushing valve.

\* Note.  
 See information on page 55

### Shaft speed sensor (option P)

A speed sensor kit is available for the V14.

The ferrostat differential (Hall-effect) sensor installs in a separate, threaded hole in the V14 bearing housing.

The speed sensor is directed towards the V14 shaft flange and outputs a 2 phase shifted square wave signal within a frequency range of 0 Hz to 15 kHz. Number of pulses per shaft rev is 36 which, at 5 Hz, corresponds to approx. 8 rpm.

### Ordering information

(refer to the ordering codes on pages 34-36)

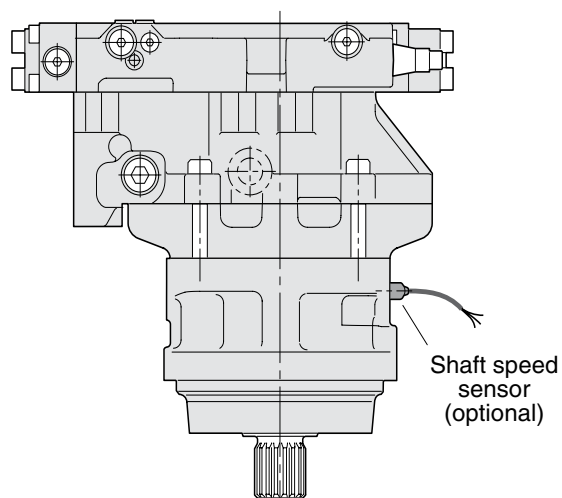
**N** - None

**C** - Prepared for setting piston position and shaft speed sensors. To be ordered separate.

**D** - Setting piston position sensors and prepared for shaft speed sensor.

**P** - Prepared for shaft speed sensor. To be ordered separate.

**NOTE:** Additional information is provided in our publication HY30-8301/UK, 'Speed sensor for series F11/F12 and V12/T12/V14', available from Parker Hannifin.



*V14-160 (AC control) with speed sensor.*

#### How to order

Please order the speed sensor on a separate order line next to the product order line.

Part number for speed sensor is 3785190.

### Brake valve

Contact Parker Hannifin for additional information

**Pressure relief valves (option P)**

To protect the motor (and the main hydraulic circuit) from unwanted, high pressure peaks, the V14 can be supplied with relief valve cartridges.

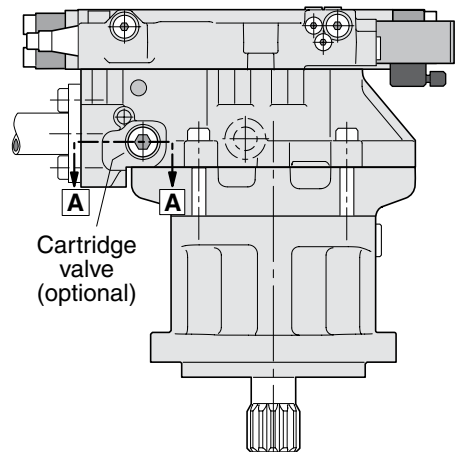
The individual cartridge (with integrated check valve function) has a non-adjustable, factory-set opening pressure, available in pressure settings shown below.

The cross section (below right) shows a situation, where the upper cartridge has opened because of high fluid pressure. This, in turn, forces the opposite cartridge to open to the low pressure area (this cartridge now acting as a check valve).

As shown, a small part of the flow may go directly to the reservoir.

**PLEASE NOTE:**

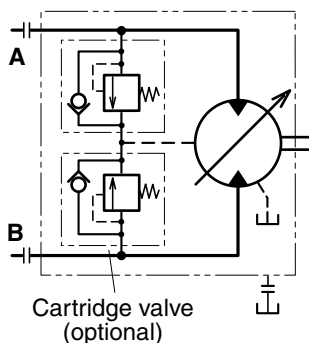
- The pressure relief cartridges should not be used as main pressure reliefs; in a motor application, they should only be relied on to limit short duration pressure peaks (or the temperature of the fluid which circulates through the motor will rapidly reach damaging high levels).
- The main pressure relief is usually installed in the main pump or in the directional control valve, or is line mounted between pump and motor.



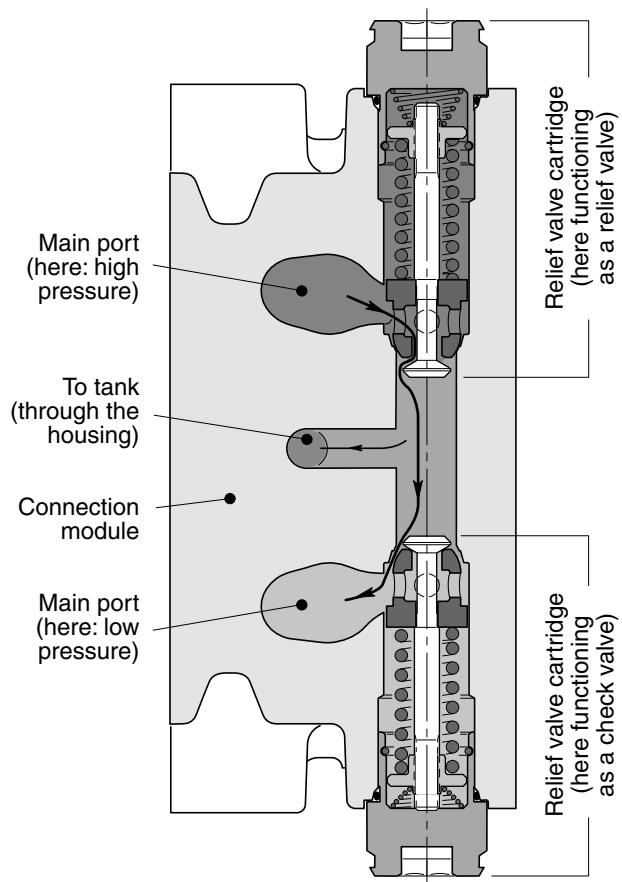
V14- 110 (EP control) with relief valve cartridges.

**Available cartridges**

Ordering code	Pressure setting [bar]	Part number
P250	250	3794614
P300	300	3794616
P350	350	3794618
P400	400	3794620
P420	420	3793529
P450	450	3794622



Hydraulic schematic - V14 with cartridge valves.



Section A-A (showing pressure relief cartridges).



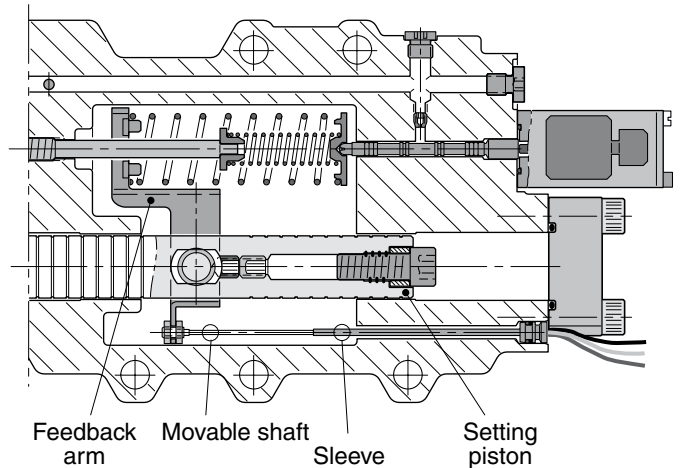
**Setting piston position sensor** (option L)

The setting piston position sensor, also referred to as a 'Sub-Miniature In-Cylinder Transducer', combines the best features associated with LVDT's (Linear Variable Differential Transformer) and potentiometers into one rugged, contactless, highly reliable position sensor.

The stationary part of the sensor, the sleeve, is provided with a flange that fits in a specially machined boring in the control module housing.

The movable shaft of the sensor is attached to the feedback arm as shown in the illustration to the right. When the sensor is properly connected to the electronic module (packed separately with an installation sheet), the produced output signal is proportional to the position of the setting piston.

In order to obtain the correct electrical max and min position settings, as determined by the utilized max and min displacements, the programming module (part of the electronic module, illustrated below right) must be adjusted; for further information please contact Parker Hannifin.



EP control section with setting piston position sensor.

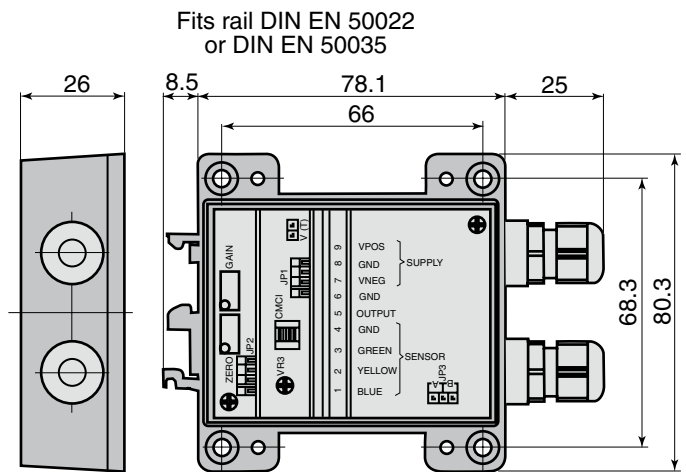
**3**

**Specifications**

Supply voltage	10 to 60 VDC
Supply current	max 10 mA
Output voltage	0.5 to 4.5 VDC*
Output load	max 10 kΩ
Output current - shaft retracted	0.020 mA
- shaft extended	0.5 mA
Linearity	≤ 1% of stroke
Operational temperature	0 °C to +70 °C
Distance between sensor and electronic module	Max 30 m
Electrical wiring	PTFE insulated, heat shrink sleeved, 500 mm long leads
Weight	100 g

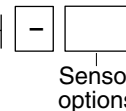
\* Other voltages can be selected; contact Parker Hannifin.

**Ordering information** (refer to 'Sensor options' in the ordering codes on pages 34-36)



Electronic module (incl. internal programming module).

———— Basic V14 configuration (ISO, cartridge or SAE; see pages 34-36) ————



Code	Sensor options
N	None
C	Prepared for setting piston position and shaft speed sensors
D	Setting piston position sensors and prepared for shaft speed sensor.
L	Setting piston position sensor
P	Prepared for shaft speed sensor
T	Prepared for setting piston position sensor

# T12



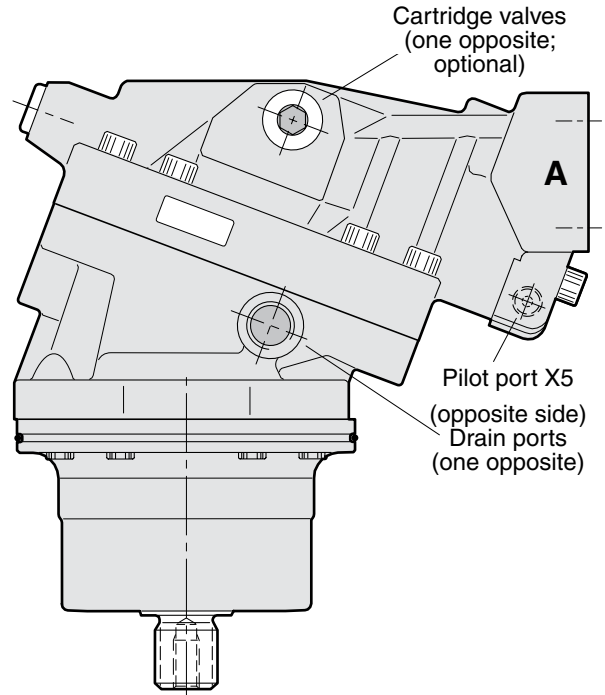
<b>Content</b>	<b>Page</b>
Specifications .....	59
Efficiency diagrams .....	59
Port and relief valve locations .....	59
Ordering codes .....	60
T12-60, Installation dimensions.....	61
T12-80, Installation dimensions.....	62
Technical Information.....	63
Two-position control (HO T _ _ I).....	63
Pressure relief valves (optional) .....	63
FV flushing valve block (optional) .....	63
Installation and start-up information .....	64

**Specifications**

T12 frame size	60	80
<b>Displacement</b> [cm <sup>3</sup> /rev]		
- at 35° (max)	60	80
- at 10° (min)	18	24
<b>Operating pressure</b> [bar]		
- max intermittent <sup>1)</sup>	480	480
- max continuous	420	420
<b>Operating speed</b> [rpm]		
- max intermittent at 35° <sup>1)</sup>	4400	4000
- max continuous at 35°	3600	3100
- max intermittent at 10° <sup>1)</sup>	7000	6250
- max continuous at 10°	5600	5000
- min continuous	50	50
<b>Flow</b> [l/min]		
- max intermittent <sup>1)</sup>	265	320
- max continuous	215	250
<b>Output torque</b> [Nm] at 100 bar (theor.)	95.2	127.0
<b>Output power</b> [kW]		
- max intermittent <sup>1)</sup>	150	175
- max continuous	95	105
<b>Corner power</b> [kW]		
- intermittent <sup>1)</sup>	335	400
- continuous	235	280
<b>Weight</b> [kg]	26	30.5

1) Max 6 sec's in any one minute

**Port and relief valve locations**



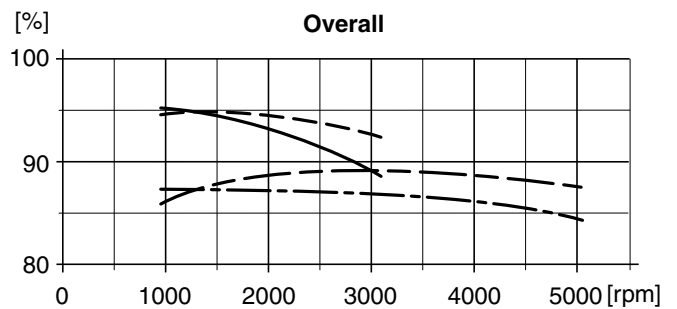
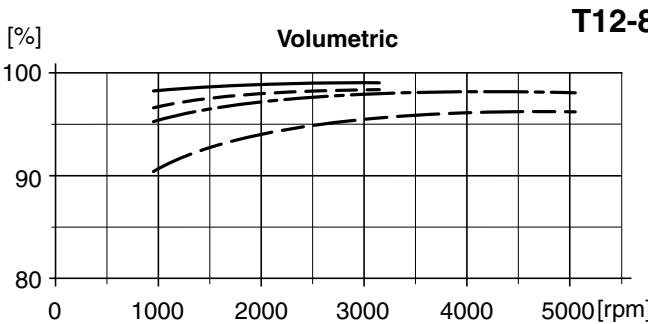
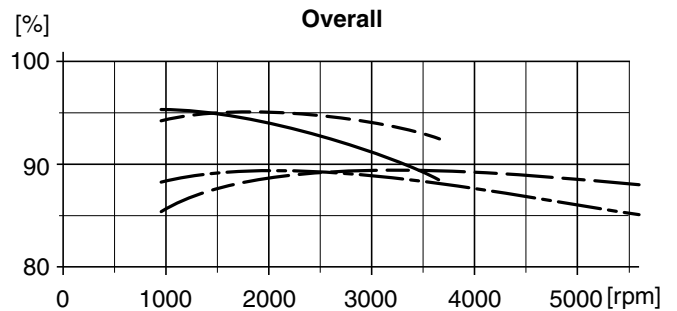
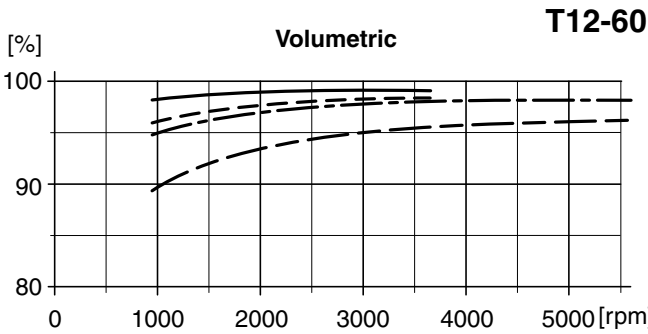
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**Efficiency diagrams**

The following diagrams show volumetric and overall efficiencies versus shaft speed at 210 and 420 bar operating pressure, and at full (35°) and reduced (10°) displacements.

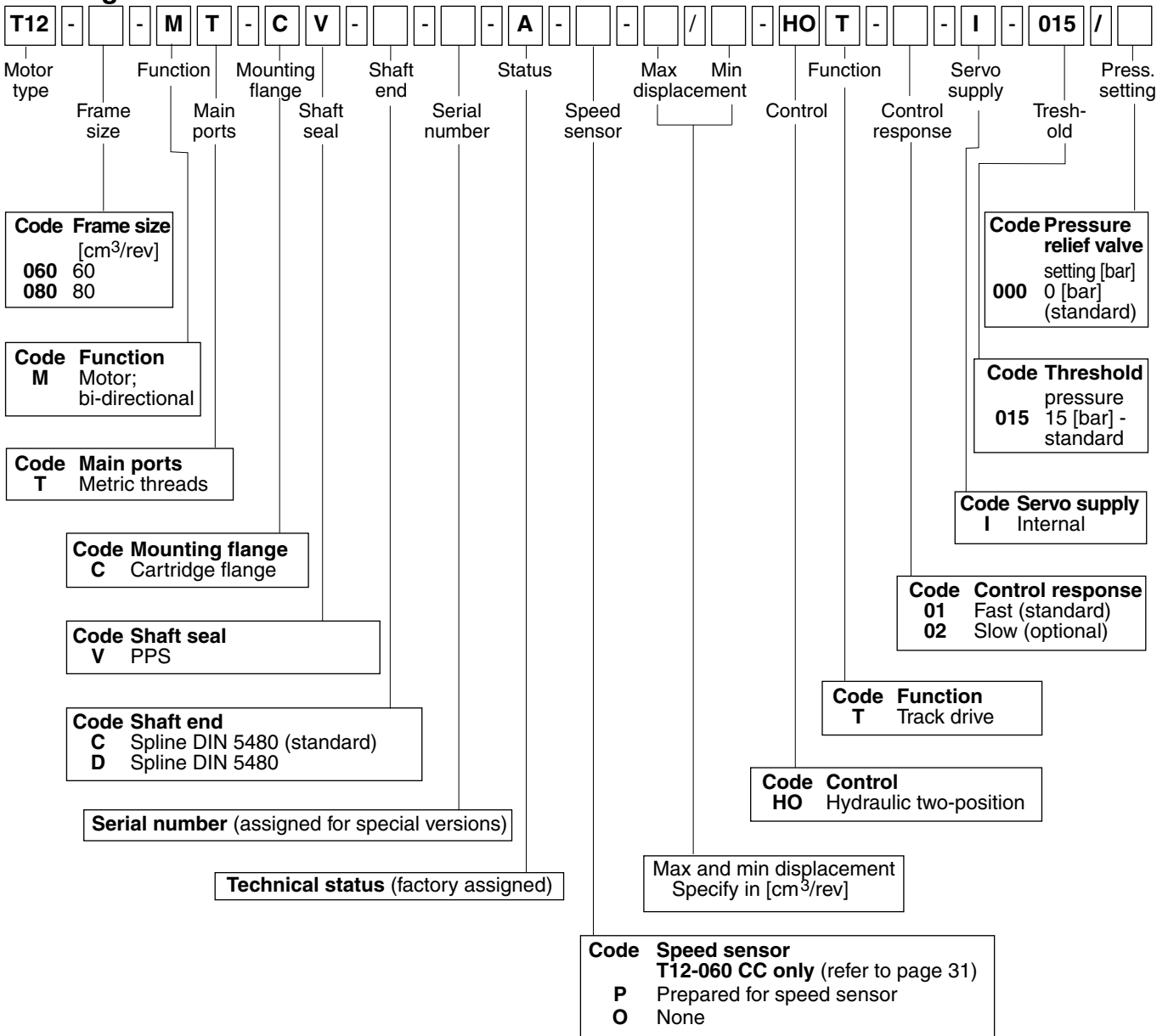
Information on efficiencies for a specific load condition can be made available from Parker Hannifin.

- 210 bar at full displacement
- - - - 420 bar “ “ “
- 210 bar at reduced displacement
- - - - 420 bar “ “ “

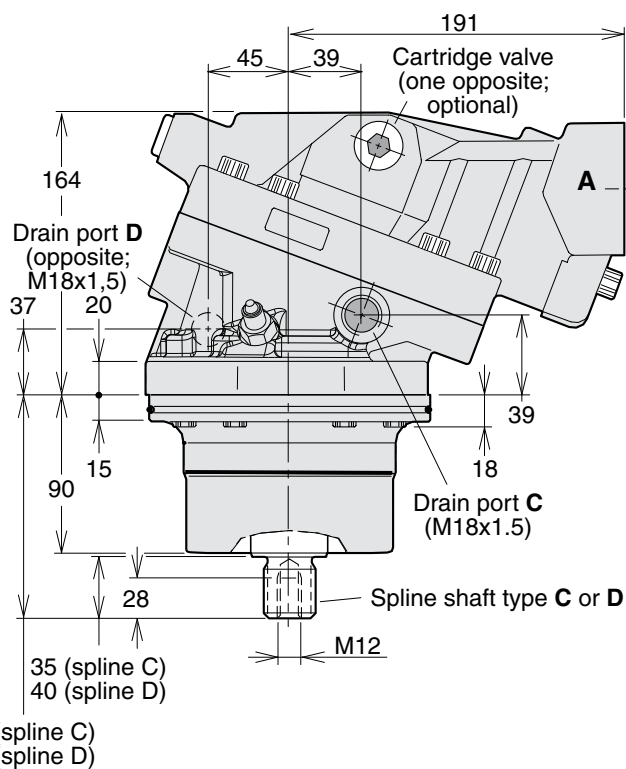
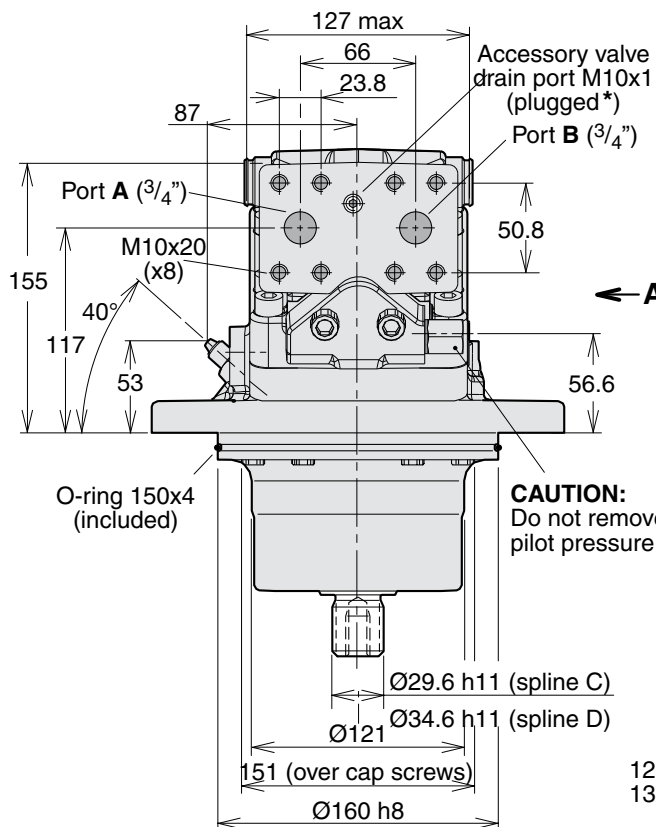
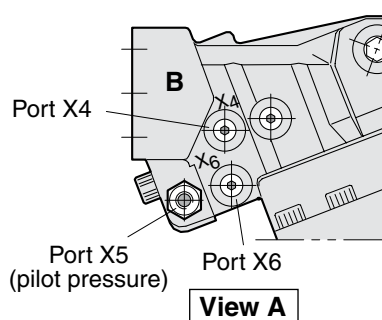
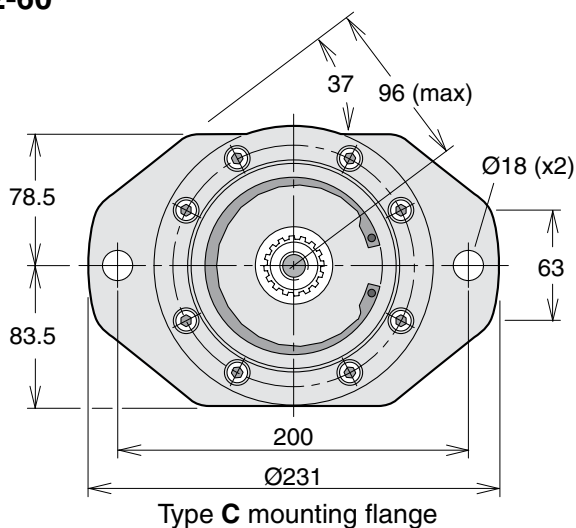
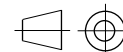


Ordering codes

Ordering code



**T12-60**



**\* NOTE:**

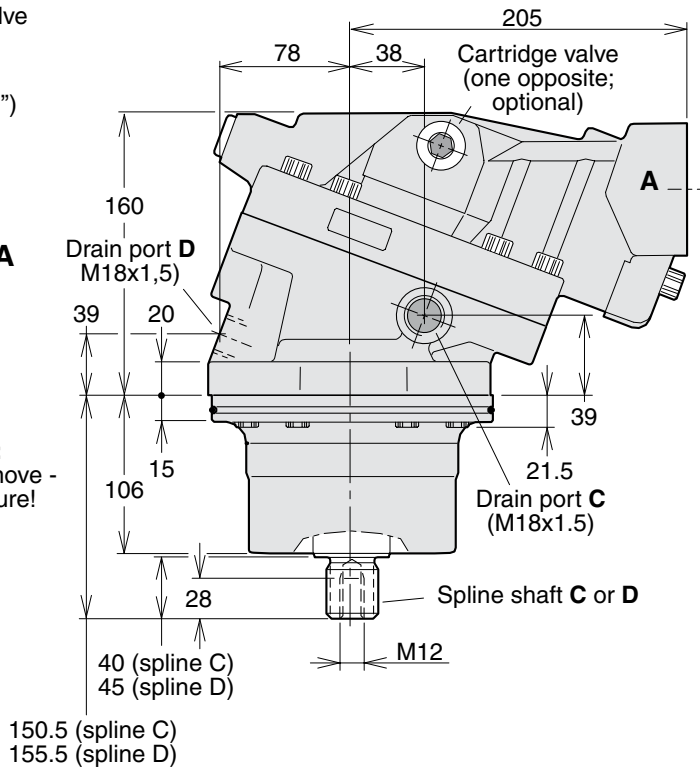
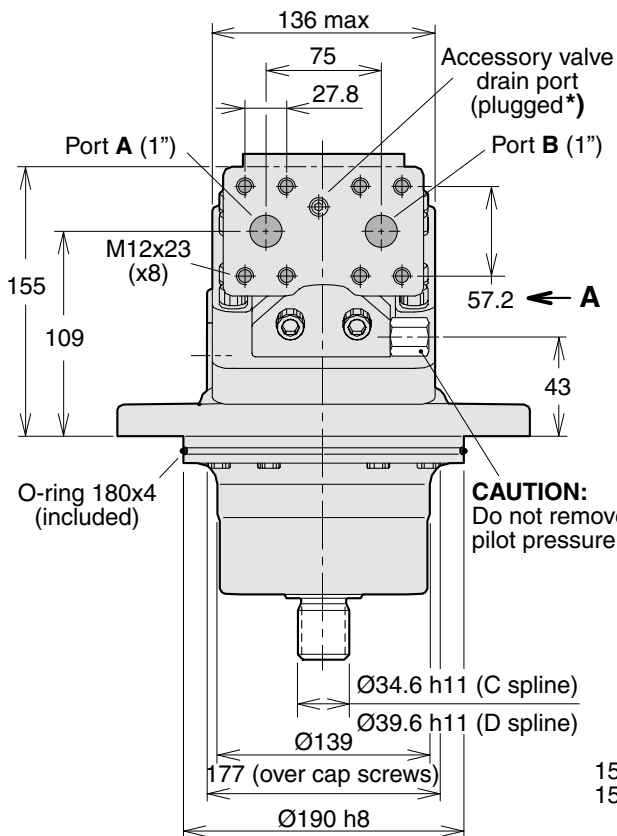
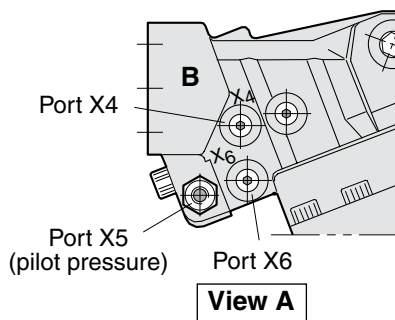
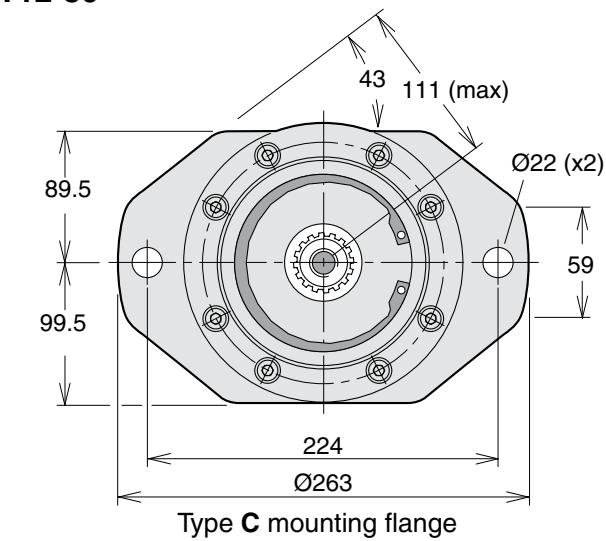
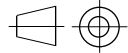
The accessory valve drain port plug **must be removed** before installing the following valve:  
 - **FV** flushing valve.

Spline <sup>1)</sup>	C (standard)	D (optional)
T12-60	W30x2x14x9g	W35x2x16x9g

1) DIN 5480 ('30° involute spline, side fit').

4

**T12-80**



**\* NOTE:**

The accessory valve drain port plug **must be removed** before installing the following valve:  
 - FV flushing valve.

Spline <sup>1)</sup>	C (standard)	D (optional)
T12-80	W35x2x16x9g	W40x2x18x9g

1) DIN 5480 ('30° involute spline, side fit').

**Two-position control (HOT \_\_ I)**

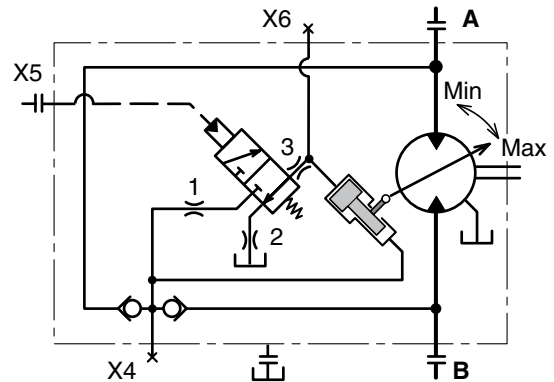
The displacement is controlled by means of pilot pressure in port X5. When this pressure exceeds the threshold pressure, 15 bar, the displacement is switched to min.

The T12 motor can be ordered with max and/or min displacement limiters.

The control is available in two versions:

- **HOT 01 I** (with standard nozzles) provides a 'fast' control response (max-to-min and min-to-max)
- **HOT 02 I** (optional) with 'slow' control response.

Gauge and pilot ports  
 X4 Servo supply (before nozzle)  
 X5 Pilot pressure (min 15 bar; standard)  
 X6 Setting piston pressure (decreasing displ.)  
 Port size  
 - M14x1.5 (all)  
**NOTE:** '1', '2' and '3' are nozzles.

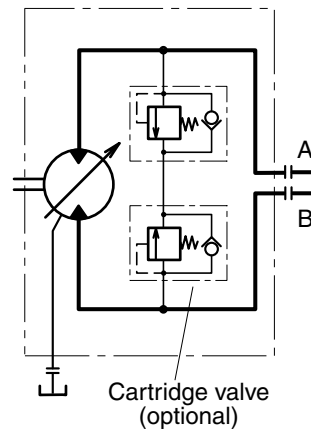


*T12 schematic (no pilot pressure; the control is in max displacement position).*

**Pressure relief valves (optional)**

As an option, T12 motors can be ordered with pressure relief valves, designed to protect the motor and the main hydraulic system from short duration pressure peaks.

The non-adjustable cartridge valves are integrated in the motor end cap and available with the following pressure settings:



*T12 with cartridge valves.*

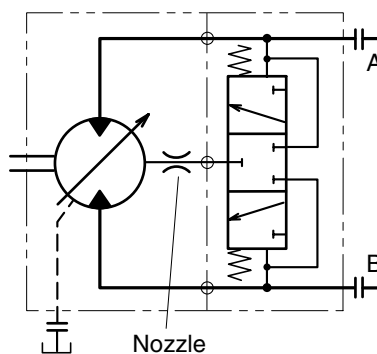
**Available cartridges**

Ordering code	Pressure setting [bar]	Part number
P250	250	3794614
P300	300	3794616
P350	350	3794618
P400	400	3794620
P420	420	3793529
P450	450	3794622

**FV flushing valve block (optional)**

The FV flushing valve supplies the T12 motor with a cooling flow usually required when the motor is operating at high speeds and/or high power levels.

The valve block mounts directly on the main port flange.



*T12 with flushing valve block type FV.*

**Brake valve**

Contact parker Hannifin for additional information



<b>Content</b>	<b>Page</b>
Installation and start-up information .....	65
Direction of rotation versus flow.....	65
Filtration.....	65
Case pressure .....	65
Required inlet pressure .....	65
Operating temperatures.....	65
Drain ports.....	66
Hydraulic fluids .....	66
Before start-up.....	66
Split-flange kits .....	67



**Direction of rotation versus flow**

**NOTE:** The V12, V14 and T12 motors are bi-directional.

**V12 rotation:**

- End cap position T (AC, AD and AH controls):  
When port B (open arrow) is pressurized, the motor rotates clockwise (right hand; R), and when port A (black arrow) is pressurized, the motor turns counter clockwise (left hand; L)
- End cap position M (EO, EP, HO and HP controls): A and B port positions interchange (A-to-B, B-to-A).

**V14 rotation:**

- Refer to the V14 illustration below right (valid for all compensators and controls).

**T12 rotation:**

- Refer to the V14 illustration below right.

**NOTE:** Before installing a V12, V14 or T12 motor in series (when both A and B ports can be subject to high pressures simultaneously) contact Parker Hannifin.

**Filtration**

Maximum motor service life is obtained when the fluid cleanliness meets or exceeds ISO code 18/13 (ISO 4406).

A 10 µm (absolute) filter is recommended.

**Case pressure**

The lowest and highest recommended case pressure shaft seal type V at selected shaft speeds is shown in the table below.

The min pressure secures sufficient lubrication, and the max pressure nominal seal life.

Case pressure should be measured in the drain port.

**NOTE:** Contact Parker Hannifin for information when operating at high speeds.

Frame size	1500	3000	4000	5000	6000
V12-60	max 12	0.5-7	1-5.5	1.5-5	2-5
V12-80	max 12	0.5-7	1-5.5	1.5-5	2.5-5
V14-110	max 10	1-6	1.5-5	2-4.5	3-5
V14-160	max 10	1-6	2-5.5	2.5-5.5	-

*Min and max case pressure [bar] vs. shaft speed [rpm].*

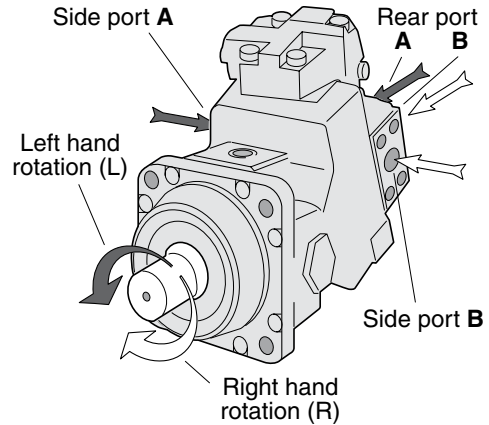
**NOTE:** Contact Parker Hannifin for information on other shaft seals.

**Required inlet pressure**

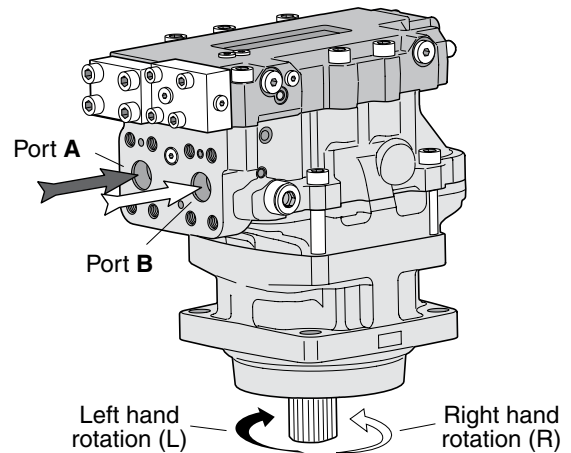
The motor may operate as a pump under certain conditions. When this occurs, a minimum pressure must be maintained at the inlet port; increased noise and gradually deteriorating performance due to cavitation may otherwise be experienced.

A 15 bar inlet pressure, measured at the motor inlet port, satisfies most operating conditions.

Contact Parker Hannifin for more specific information on inlet pressure requirements.



*Direction of rotation vs. flow for the V12 motor (here shown with AC-compensator; end cap position T).*



*Direction of rotation vs. flow for the V14 motor (shown with AC-compensator).*

**Operating temperatures**

The following temperatures should not be exceeded

Main circuit: 80 °C.

Drain fluid: 115 °C.

Continuous operation at high power levels usually requires case flushing in order for the fluid to stay above the minimum viscosity requirement. A flushing valve and restricting nozzle, available as an option, provide the necessary main circuit flushing flow.

Refer to fig. 1 (next page), and to:

- V12: 'Flushing valve', page 29.
- V14: 'Flushing valve', page 54.
- T12: 'Flushing valve block', page 61.

**Drain ports**

There are two drain ports on the V12, V14 and T12 motors. The uppermost drain port should always be utilized (see illustrations on the previous page).

In order to avoid excessively high case pressure, the drain line should be connected directly to the reservoir.

When the motor is operating, the case must be filled with fluid to at least 50%.

**NOTE:** - A spring loaded check valve in the drain line (shown in the V14 illustrations to the right) may have to be installed in order to prevent oil from being siphoned out of the motor case. This can otherwise happen if, e.g., the reservoir is located below the utilized motor drain port.

- 'High speed operation' available from Parker Hannifin.

**Hydraulic fluids**

Ratings and performance data for the motors are valid when a good quality, contamination-free, petroleum-based fluid is used in the hydraulic system.

Hydraulic fluids type HLP (DIN 51524), automatic trans-mission fluids type A, or API CD engine oils can be used.

When the hydraulic system has reached full operating temperature, the motor drain oil viscosity should be above 8 mm<sup>2</sup>/s (cSt).

At start-up, the viscosity should not exceed 1500 mm<sup>2</sup>/s.

The ideal operating range for the motor is 15 to 30 mm<sup>2</sup>/s.

Fire resistant fluids, when used under modified operating conditions, and synthetic fluids are also suitable.

Contact Parker Hannifin for additional information about:

- Hydraulic fluid specifications
- Fire resistant fluids.

**Before start-up**

Make sure the motor case as well as the entire hydraulic system is filled with hydraulic fluid.

The internal leakage, especially at low operating pressures, is not sufficient to provide lubrication at start-up.

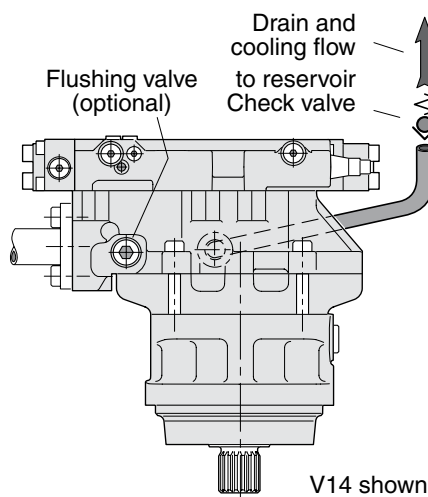


Fig. 1.

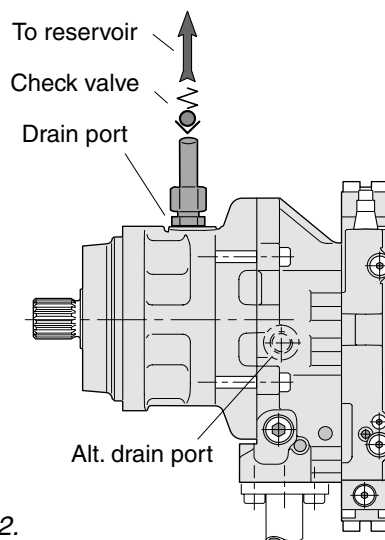


Fig. 2.

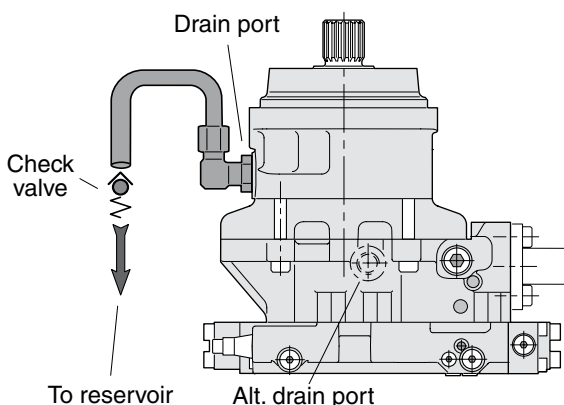
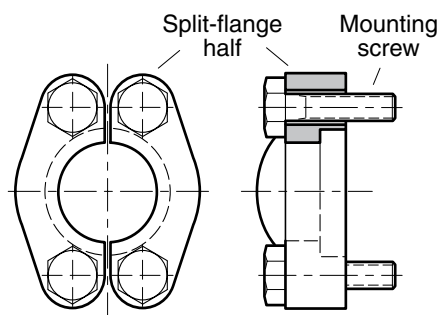


Fig. 3.

**Split-flange kits**

Metric split-flange kits, consisting of two split-flange halves and four mounting screws for use on V12 ISO and cartridge versions, are available from Parker Hannifin.

Part no.	SAE size	For	Screw size
3794405	3/4"	V12-60/-80	M10x35
3704329	1"	V14-110	M12x40
3704330	1 1/4"	V14-160	M14x45
3794405	3/4"	T12-60/-80	M10x35



**WARNING**

**FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.**

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The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

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