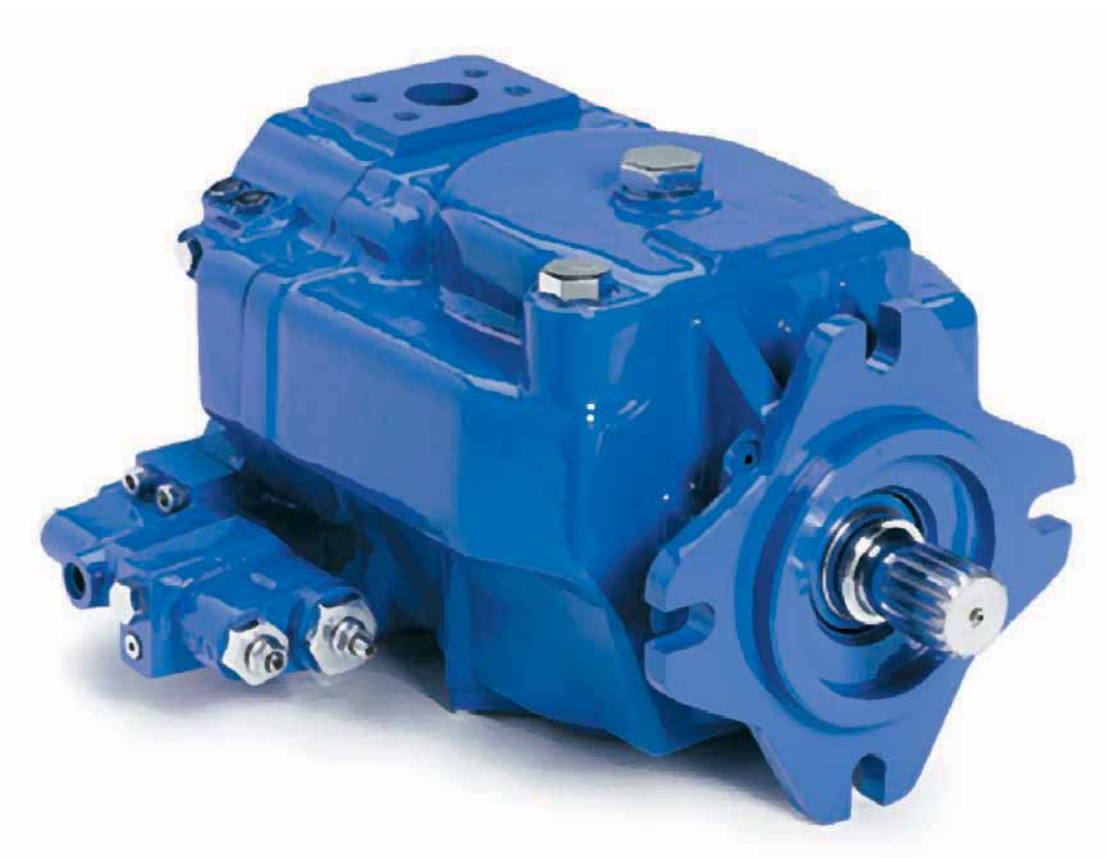
Eaton PVH Variable Displacement Piston Pumps
Vickers® Product Line

57-141 cc^3
(3.5-8.6 in^3)

H-Series
Industrial Variable
Displacement

H-Series
Mobile Variable
Displacement



EATON
Powering Business Worldwide

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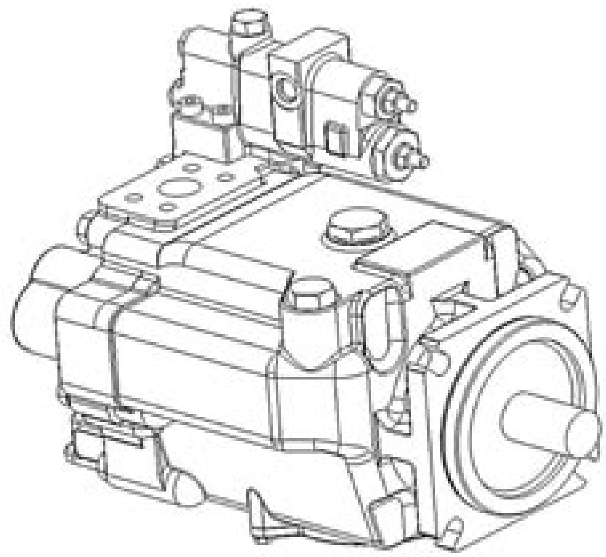
H Series Variable Displacement Piston Pumps

Introduction



Eaton's Vickers® PVH high flow, high performance pumps are a family of variable displacement, inline piston units that incorporate the proven design, quality manufacturing techniques and operating features of other Vickers piston pumps, but in a smaller, lighter package.

The PVH series has been specially designed to meet the 250 bar (3625 psi) continuous duty performance requirements of new generation equipment designs.

These are efficient, reliable pumps, with a selection of optional controls for maximum operational flexibility. Designed specifically for strenuous application, they provide the productivity gains and controllability improvements desired in earthmoving, construction, machine tool, plastics, and all other energy-conscious markets. As with all Eaton products, these pumps have been fully laboratory tested and field proven.

PVH Series Benefits

- Versatile design includes single pumps, thru-drive arrangements, and a variety of drive shaft and control options that will adapt to any application and provide the most cost effective installation.
- Proven components designed into a heavy duty, compact housing to provide 250 bar (3625 psi) continuous operating performance, and 280 bar (4050 psi) operating performance in a load sensing system. This design assures long life at the higher performance levels required of today's power-dense machinery.
- Compact and lightweight design to reduce the application weight, and provide better access for installation and servicing.
- Service kits developed for the most critical rotating and control components to simplify and assure successful pump servicing.
- Quiet designs available for noise-sensitive industrial applications, reducing sound levels further to provide a more acceptable environment.
- Designed for maximum efficiency in any type of application. A variety of compensators provide the most effective system control, and the 95%-plus volumetric efficiency means more flow, and more input energy, is directed to the work and not into heat and waste.
- Heavy duty bearings and shafts result in minimum internal deflections and wear, providing for longer life and maximum uptime.

Hydraulic System Design Calculations

Basic Formulas

Output Flow (Q)

$$\text{lpm} = \frac{\text{cm}^3/\text{r} \times \text{rpm}}{1000} \qquad \text{gpm} = \frac{\text{in}^3/\text{r} \times \text{rpm}}{231}$$

Input Power (P)

$$\text{kW} = \frac{\text{l/min} \times \text{bar}}{600} \qquad \text{hp} = \frac{\text{gpm} \times \text{psi}}{1714}$$

Shaft Torque (M)

$$\text{N-m} = \frac{\text{bar} \times \text{cm}^3/\text{r}}{62.8} \qquad \text{lb-in} = \frac{\text{psi} \times \text{in}^3/\text{r}}{6.28}$$

Shaft Speed (n)

$$\text{rpm} = \frac{1000 \times 1/\text{min}}{\text{cm}^3/\text{r}} \qquad \text{RPM} = \frac{231 \times \text{gpm}}{\text{in}^3/\text{r}}$$

Output Power (P)

$$\text{kW} = \frac{\text{N-m} \times \text{RPM}}{9549} \qquad \text{hp} = \frac{\text{lb-in} \times \text{rpm}}{63{,}025}$$

Volumetric Displacement

$$\text{cm}^3/\text{r} = \frac{\text{lpm} \times 1000}{\text{rpm}} \qquad \text{in}^3/\text{r} = \frac{\text{gpm} \times 231}{\text{rpm}}$$

Basic Formulas

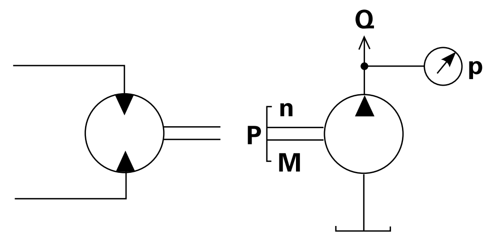
bar = 10 Newtons/cm^2
gpm = gallons per minute
hp = horsepower
lb-in = pound inch
lb-ft = pound feet
kW = kilowatt
kgf = kilograms force
l/min = liters per minute
N-m = Newton meters
psi = pounds per square inch
rpm = revolutions per minute

Efficiencies

$$\text{Volumetric Nv} = \frac{\text{gpm actual}}{\text{gpm theorectical}}$$

$$\text{Mechanical Nm} = \frac{\text{lb-in actual}}{\text{lb-in theorectical}}$$

Total Nt = Nv x Nm



Commonly Used Conversions

To Convert	Into	Multiply by
bar	psi	14.5
cm^3	in^3	0.06102
˚C	˚F	(˚C x 1.8) +32
gallons (US)	liters	3.785
kg	lbs	2.205
kgf/cm^2	psi	14.2
kW	hp	1.341
liters	US Gallons	0.2642
mm	inches	0.03937
N-m	lb-in	8.85
N-m	lb-ft	0.7375
˚F	˚C	(˚F-32)/1.8
hp	kW	0.7457
inch	mm	2.54
in^3	cm^3	16.39
lb-in	N-m	0.113
lb-ft	N-m	1.356
lbs	kg	0.4535
psi	bar	0.06896
psi	kgf/cm^2	.070307

Note: Performance charts can be found on subsequent pages.

Model Codes
PVH Piston Pump

PVH	063	R	01	AB	1	0	B	23	14	00	00	1	00	1	00	00	0	A
1, 2 ,3	4, 5, 6	7	8, 9	10, 11	12	13	14	15,16	17, 18	19, 20	21, 22	23	24, 25	26	27, 28	29, 30	31	32

1, 2, 3 Pump Series

PVH – PVH OC Piston Pump

4, 5, 6 Displacement

057 – 57.4 cm3/r [3.50 in3/r]
063 – 63.1 cm3/r [3.85 in3/r]
074 – 73.7 cm3/r [4.50 in3/r]
081 – 81.0 cm3/r [4.94 in3/r]
098 – 98.3 cm3/r [6.00 in3/r]
106 – 106.5 cm3/r [6.50 in3/r]
131 – 131.1 cm3/r [8.00 in3/r]
141 – 141.0 cm3/r [8.60 in3/r]

7 Rotation

R – Right-Hand Rotation (cw)
L – Left-Hand Rotation (ccw)

8, 9 Front Mounting and Input Shaft

01 – 4 Bolt C, 1-1/4 inch Dia. Keyed
02 – 4 Bolt C, 14T 12/24 DP Splined
03 – 4 Bolt C, 17T 12/24 DP Splined
04 – 4 Bolt C, 1-1/2 inch Tapered Shaft & Woodruff Keyway
05 – 4 Bolt C, 1-1/4 inch Dia. Tapered Keyed & 3/4-16 UNF-2A Ext Thread
08 – 2 Bolt B, 15T 16/32 DP Splined
0N – 4 Bolt M (ISO 125B4HW) with 32.1 (1.26) Dia Straight Keyed
10 – 4 Bolt C, 14T 12/24 DP Splined, 73.2 (2.88) Shaft Ext and 49.0 (1.93) Spline
13 – 4 Bolt C, 1-1/2 inch Dia Straight Keyed
16 – 4 Bolt C, 44.4 (1.75) Dia Straight Keyed
17 – 4 Bolt C, 1-1/4 in Dia Tapered Keyed & M20 x 1-1/2 in. Ext Thread
23 – 2 Bolt C, 17T 12/24 DP Splined Shaft
24 – 2 Bolt B 19T 24/48 DP Splined
30 – 4 Bolt C, 14T 12/24 DP Splined, 78.0 (3.07) Shaft Extension and 54.0 (2.12) Spline Length
51 – 2/4 Bolt C, 1-1/4 inch Dia Straight Keyed
52 – 2/4 Bolt C, 14T 12/24 DP Splined
53 – 2/4 Bolt C, 17T 12/24 DP Splined
58 – 2 Bolt B, 15T 16/32 DP Splined
60 – 2/4 Bolt C, 14T 12/24 DP Splined, 73.2 (2.88) Shaft Extension and 49.0 (1.93) Spline Length
62 – 2 Bolt C, 13T 8/16 DP Splined

10, 11 Main Ports Size & Location

AA – Side Ports; Suction 2 in. (Code 61) Pressure 1 in. (Code 61)
AB – Side Ports; Suction 2 in. (Code 61) - w/ M12 Threads; Pressure 1 in. (Code 61) - w/ M10 Threads
AC – Side Ports; Suction 2 in. (Code 61) - w/ M12 Threads; Pressure 1.25 in. (Code 61) - w/ M12 Threads
AD – Side Ports; Suction 2.5 in. (Code 61) w/ M12 Threads; Pressure 1 in. (Code 61) w/ M10 Threads
AE – Side Ports; Suction 2.5 (Code 61) w/ M12 Threads; Pressure 1.25 (Code 61) w/ M12 Threads
AF – Side Ports; Suction 2.5 in. (Code 61) ; Pressure - 1.25 in. (Code 62)
AG – Side Ports; Suction - 2.5 in. (Code 61) w/ M12 Threads; Pressure - 1.25 in. (Code 62) w/ M14 Threads
AH – Side Ports; Suction - 2.0 in. (Code 61) w/ M12 Threads; Pressure - 1.0 in. (Code 61) w/ M12 Threads
AJ – Side Ports; Suction 2.5 in. (Code 61); Pressure 1.0 in. (Code 61)
AL – Side Ports; Suction - 2.5 in. (Code 61); Pressure - 1.25 in. (Code 61)

12 Drain Ports Size & Location

1 – #8 SAE O-Ring Port - Bottom (Top Plugged)
2 – #8 SAE O-Ring Port - Top (Bottom Plugged)
3 – #10 SAE O-Ring Port - Bottom (Top Plugged)
4 – #10 O-Ring Port - Top (Bottom Plugged)
5 – #8 3/4-16 UNF-2B SAE O-Ring Port - Bottom (Top Plugged)
6 – #8 3/4-16 UNF-2B SAE O-Ring Port - Top (Bottom Plugged)
7 – #10 7/8-14 UNF-2B SAE O-Ring Port - Bottom (Top Plugged)
8 – #10 7/8-14 UNF-2B SAE O-Ring Port - Top (Bottom Plugged)
9 – #12 SAE O-Ring Port - Bottom (Top Plugged)
A – #12 SAE O-Ring Port - Top (Bottom Plugged)
B – M22 x 1.5 Metric O-Ring - Bottom (Top Plugged)
C – M22 X 1.5 Metric O-Ring - Top (Bottom Plugged)
F – Vertical Mount w/ G 1/2 BSPP - Bottom (Top Plugged)
G – Vertical Mount w/ G 1/2 BSPP - Top (Bottom Plugged)

13 Diagnostic Pressure Ports

0 – No Diagnostic Pressure Ports

14 Controller Type*

A – Pressure Compensator
B – Pressure And Flow Compensator
D – Pressure Compensator w/ Torque Sensing
E – Pressure And Flow Compensator w/ Torque Sensing
G – IC Pressure Compensator
H – IC Pressure and Flow Compensator
J – IC Pressure and Flow Compensator w/ Torque Sensing
N – Pressure and Flow Compensator w/ Unload Valve

** Torque control is not available with case-to-inlet check value. Specify "AA" Pump Special Features*

Model Codes
PVH Piston Pump

PVH	063	R	01	AB	1	0	B	23	14	00	00	1	00	1	00	00	0	A
1, 2 ,3	4, 5, 6	7	8, 9	10, 11	12	13	14	15, 16	17, 18	19, 20	21, 22	23	24, 25	26	27, 28	29, 30	31	32

15,16 Pressure Comp. Setting

07 – 66-74 bar [957-1073 psi]
23 – 226-234 bar [3278-3394 psi]
25 – 246-254 bar [3568-3684 psi]

Other Settings Available by Request

17,18 Flow Compensator Setting

00 – No Flow Comp. Setting
14 – 13-15 bar [189-218 psi]
24 – 23-25 bar [334-363 psi]
AA – Unload Valve Standby 39-41 bar [334-363 psi]

Other Settings Available by Request

19,20 Torque Setting/ Other Comp.

00 – None
04 – 36-44 bar [522-638 psi]
14 – 136-144 bar [1973-2089 psi]
AA – Unload Valve 186.2-193 bar [2700-2800 psi] Reset 157.8-164.6 bar [2288-2387 psi]
AB – Unload Valve 203.4-210.2 bar [2950-3050 psi] Reset 183-190 bar [2650-2748 psi]

21,22 Control Special Features

AB –** No Control Special Features
AA – Bleed Down Orifice 0.37 [.015] Ø
AR – Bleed Down Orifice 0.65 [.026] Ø
AV – 1.60 [.063] Ø Orifice (IC Control Only)
AW – 0.76 [.030] Ø Orifice (IC Control Only)

23 Maximum Displacement Option

1 – Standard Displacement (As given in code title)
2 – Adjustable Max Displacement (Set at Max)
F – Adjustable Max Displacement (Set at Max) w/ Extended Adjusting Screw

Other Settings Available by Request.

24,25 Auxiliary (Rear) Mount and Output Shaft

00 – No Auxiliary Mounting Features
AA – 2/4 Bolt C, 14T 12/24DP
AB – 2/4 Bolt B, 15T 16/32DP
AC – 2 Bolt A, 9T
AY – 2/4 Bolt B, 13T 16/32DP
AZ – 2/4 Bolt C, 17T 12/24DP
BA – 2 Bolt A, 11T 16/32DP

26 Shaft Seal

1 – Single, OneWay Shaft Seal, Viton®
3 – Single, OneWay Shaft Seal, Nitrile
5 – Double, TwoWay Shaft Seal, Viton® W/ VHO Filter
6 – Double, TwoWay Shaft Seal, Nitrile W/ VHO Filter

27,28 Pump Special Features

00 – No Pump Special Features
AA – No Case To Inlet Check
AE – Q250 Valve Plate, No Case To Inlet Check Valve
AF – Q140 Valve Plate, No Case To Inlet Check Valve
AP – Pressure Lube Swashplate
AR – Pressure Lube Swashplate, No Case To Inlet Check Valve
SC – Q250 Valve Plate, Grooved Saddle Bearings, No Case To Inlet Check Valve
BH – Q250 Valve Plate, Pressure Lube Swashplate
BM – Q250 Valve Plate, Pressure Lube Swashplate, No Case To Inlet Check Valve
BR – Q140 Valve Plate, Grooved Saddle Bearings, No Case To Inlet Check Valve

29,30 Paint

00 – No Paint
01 – Blue Primer

31 Identification

0 – Standard

32 Design Code

A – First Design

Performance Data

Performance data is typical with SAE 10W anti-wear hydraulic oil at 50°C (120°F) and at zero pump inlet pressure, except where otherwise indicated.

Rated Characteristics of PVH Industrial Pumps*

Parameters	PVH057	PVH063	PVH074	PVH081	PVH098	PVH106	PVH131	PVH141
Geometric displacement, max. cm^3/r	57,4	63,1	73,7	81,0	98,3	106,5	131,1	141,1
(in^3/r)	(3.5)	(3.85)	(4.5)	(4.94)	(6.0)	(6.50)	(8.0)	(8.60)
Rated pressure bar (psi)	250 (3625)†	230 (3300)†	250 (3625)†	230 (3300)†	250 (3625)†	230 (3300)†	250 (3625)†	230 (3300)†
Rated speeds in r/min at various inlet pressures								
127 mm Hg (5″ Hg)	1500	1500	1500	1500	1500	1500	1200	1200
Zero inlet pressure	1800	1800	1800	1800	1800	1800	1500	1500
0,48 bar (7 psi)	1800	1800	1800	1800	1800	1800	1800	1800
Typical effective flow in l/min (USgpm) Rated Pressure								
at 1500 r/min 83	102		140		186			
	(22)		(27)		(37)		(49)	
at 1800 r/min	98		125		170		223	
	(26)		(33)		(45)		(59)	

† In load sensing systems the compensator can be set at 280 bar (4060 psi).
* Industrial Valve Plates are specified in Pump Special Feature 'Q250' or 'Q140'

Ratings of PVH Industrial Pumps with Alternate Fluids

Parameters	Petroleum based	Polyol ester	Water glycol	HWBF(90–10) thickened
Max. pressure bar (psi)	250 (3625)	230 (3300)	172 (2500)	155 (2250)
Max. speed in r/min at:				
1,0 bar abs. (0 psi)	1800 ‡	1800	1800	1700
0,85 bar abs. (5″ Hg)	1500 □	1500	1500	1500
Max. inlet temp. deg. C (deg. F)	93 (200)	65 (150)	50 (120)	50 (120)

‡ 1500 rpm for PVH131/141 only. □ 1200 rpm for PVH131/141 only.

Rated Characteristics of PVH Mobile Pumps ◊

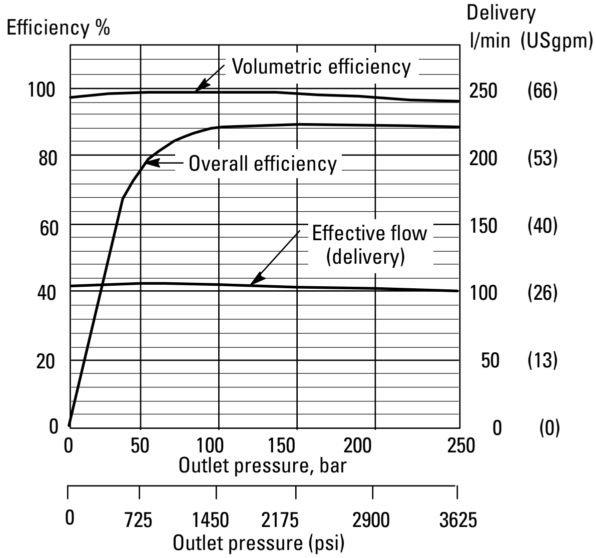
Parameters	PVH057	PVH063	PVH074	PVH081	PVH098	PVH106	PVH131	PVH141
Rated speeds in r/min at various inlet pressures								
127 mm Hg (5″ Hg)	2000	2000	1850	1850	1750	1750	1650	1500
Zero inlet pressure	2400	2400	2200	2200	2100	2100	2000	2000
0,48 bar (7 psi)	3000	3000	2750	2750	2600	2600	2500	2500
Typical effective flow in l/min (USgpm) at 250 bar (3625 psi) and rated speed @ zero inlet pressure	134 (35)	146 (38)	156 (41)	172 (45)	202 (53)	216 (57)	249 (66)	272 (72)

◊ Displacements & rated pressure are same as for PVH*** industrial pumps.

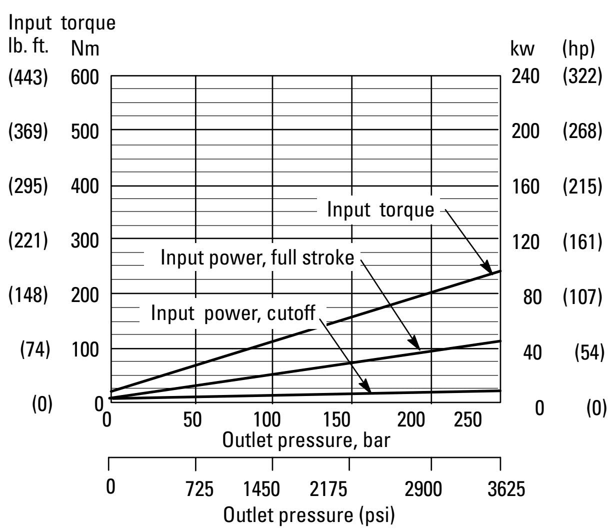
Performance Data

PVH057

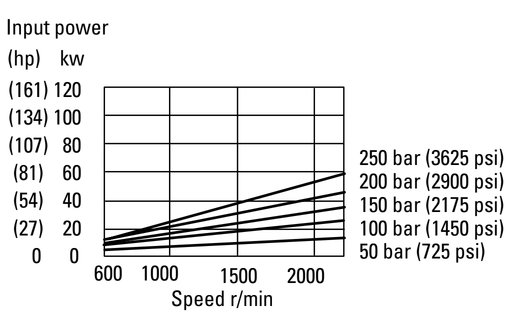
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min

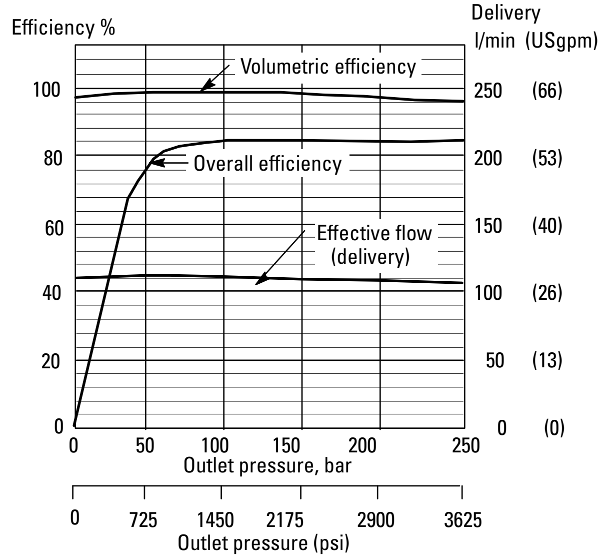


Input power versus speed

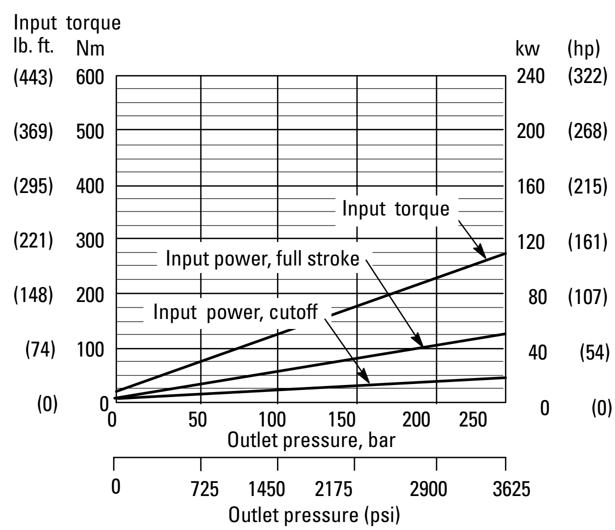


PVH063

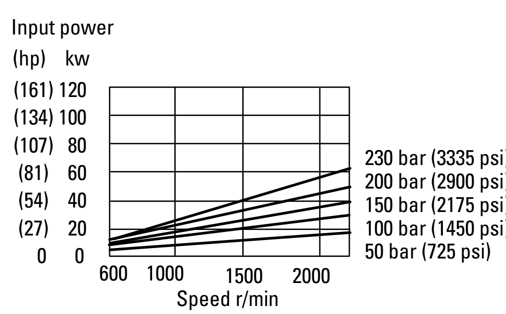
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min



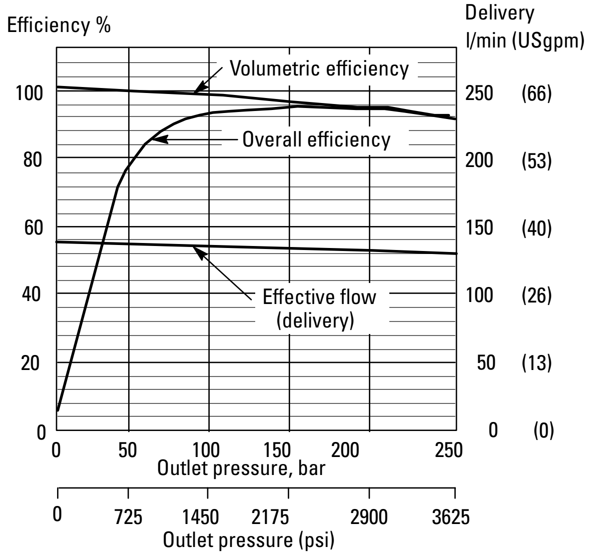
Input power versus speed



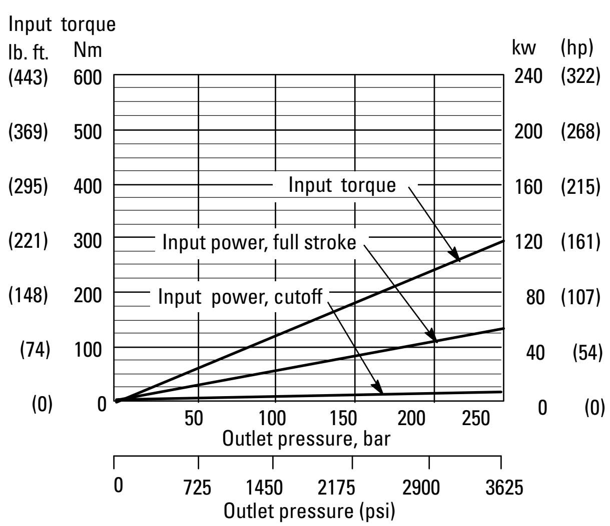
Performance Data

PVH074

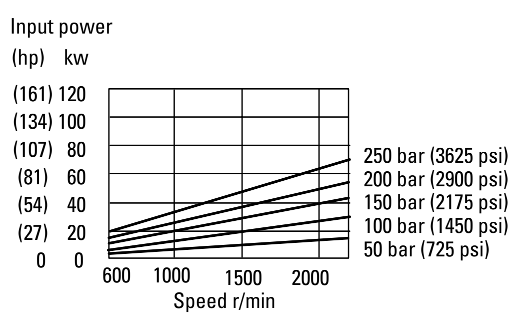
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min

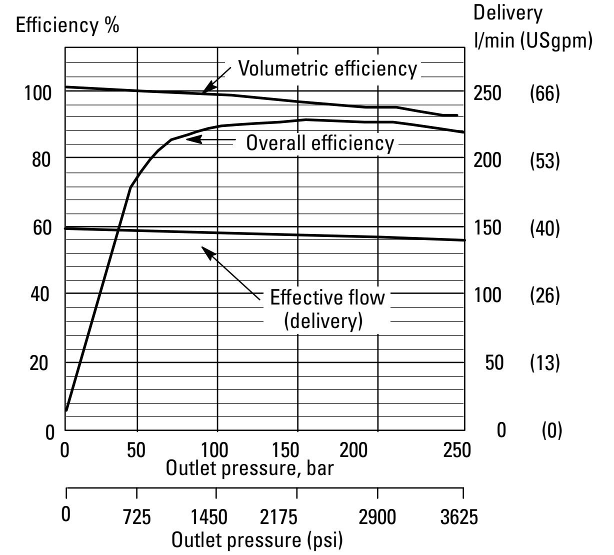


Input power versus speed

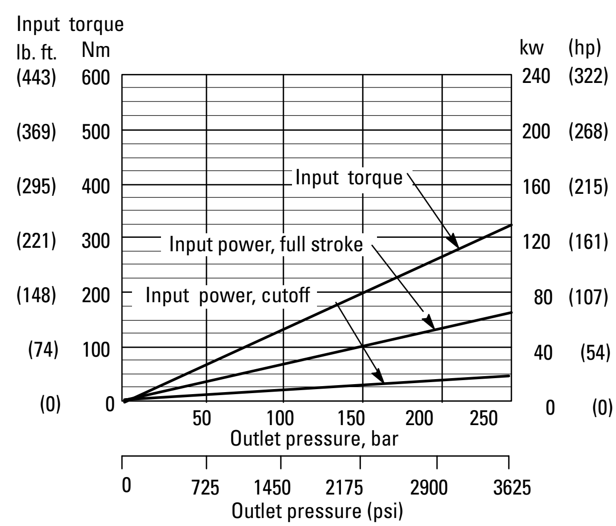


PVH081

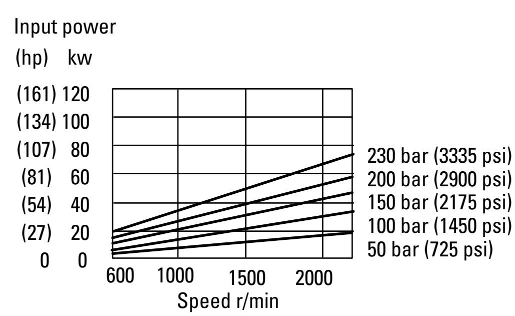
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min



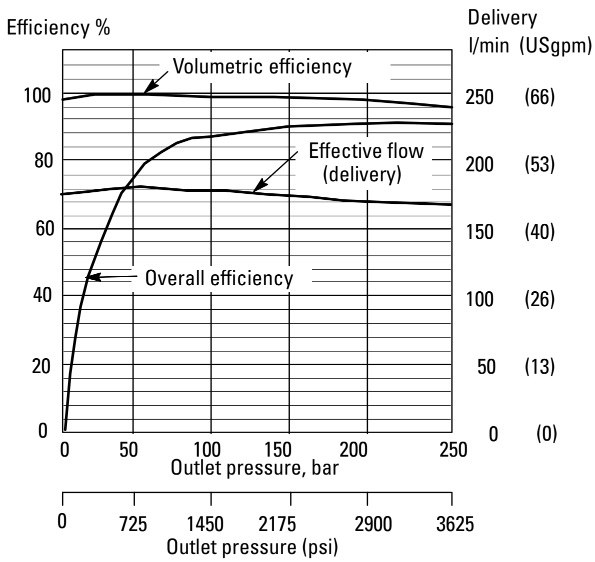
Input power versus speed



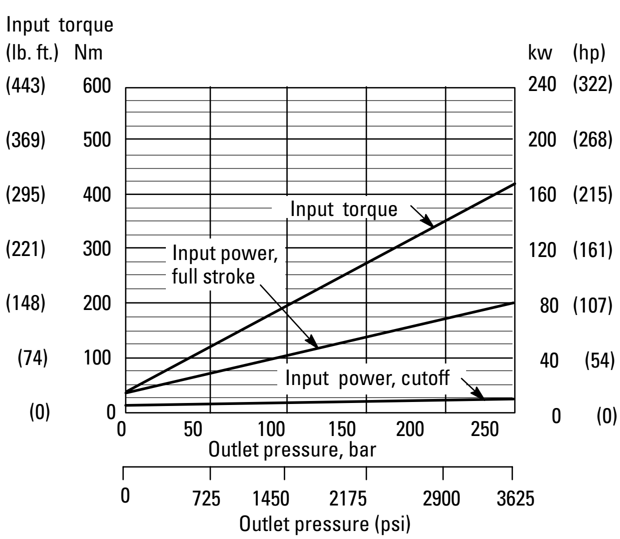
Performance Data

PVH098

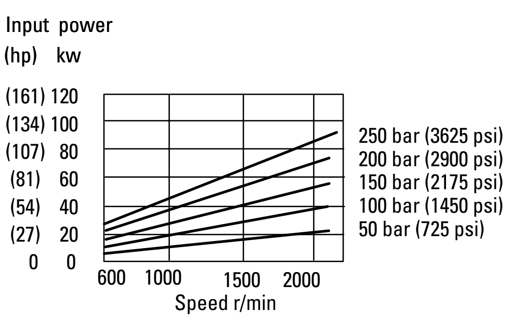
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min

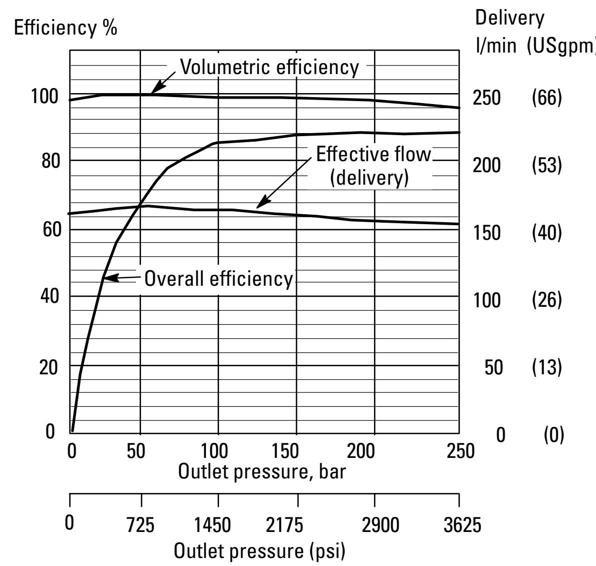


Input power versus speed

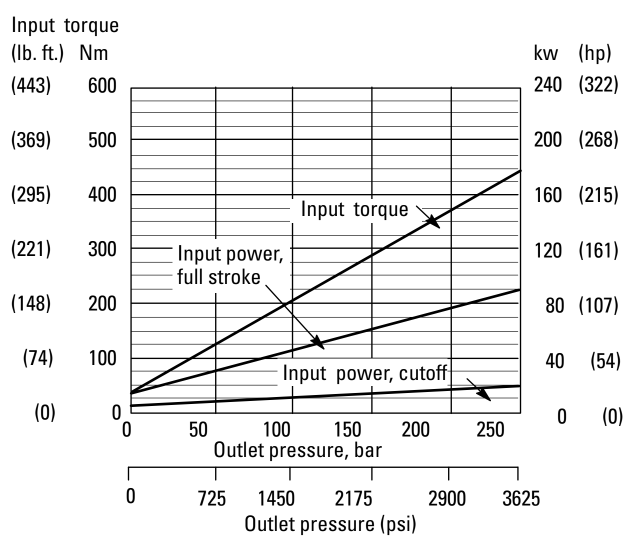


PVH106

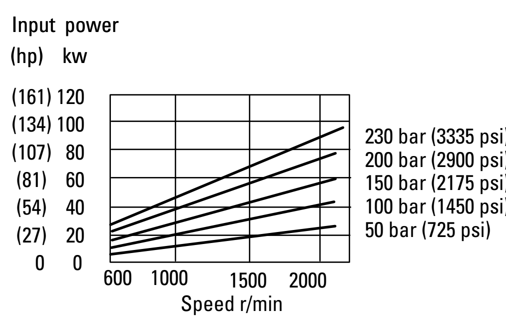
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min



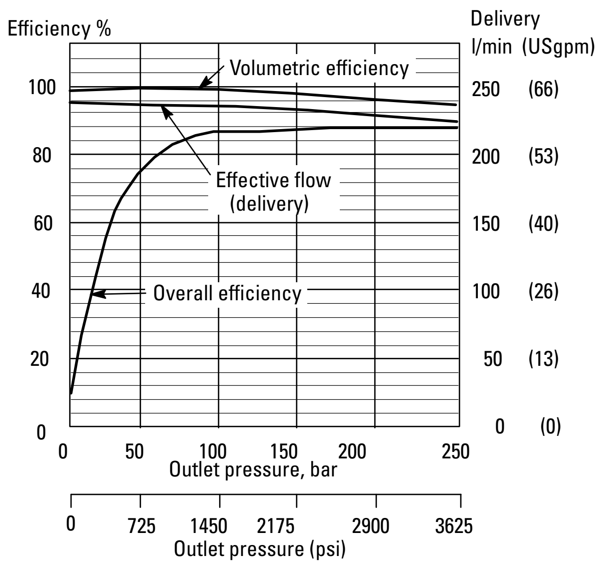
Input power versus speed



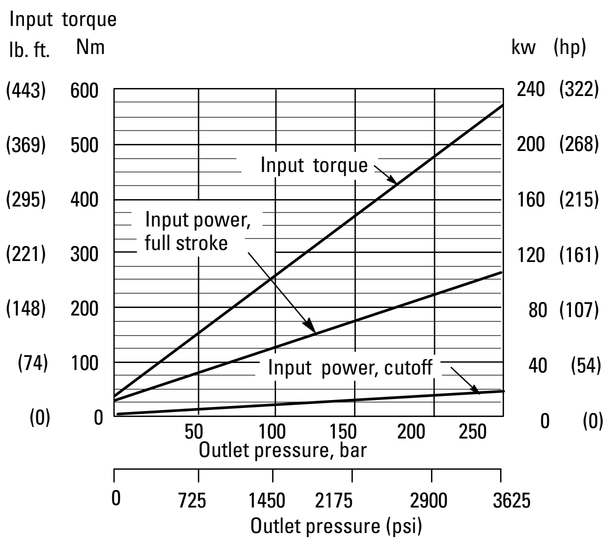
Performance Data

PVH131

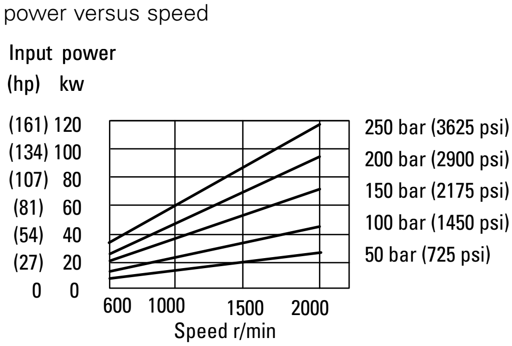
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min

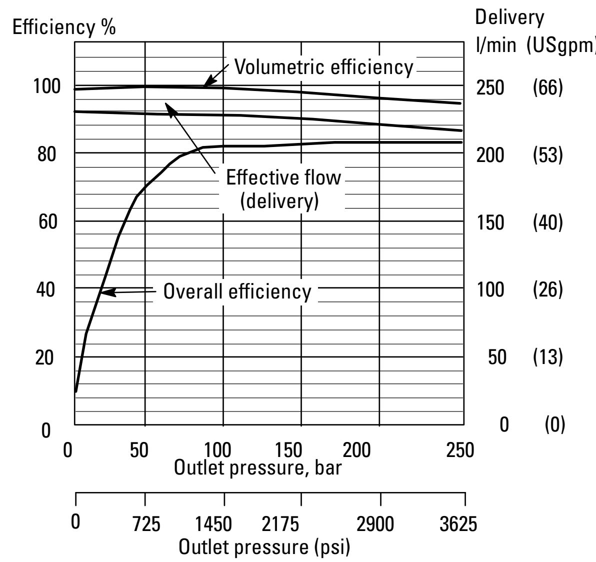


Input power versus speed

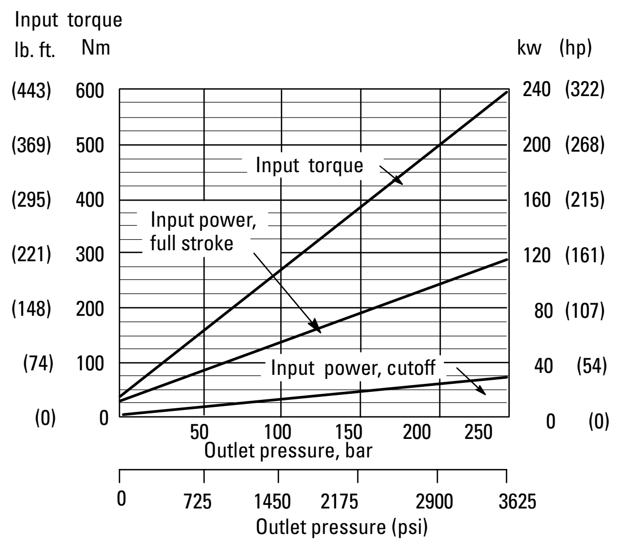


PVH141

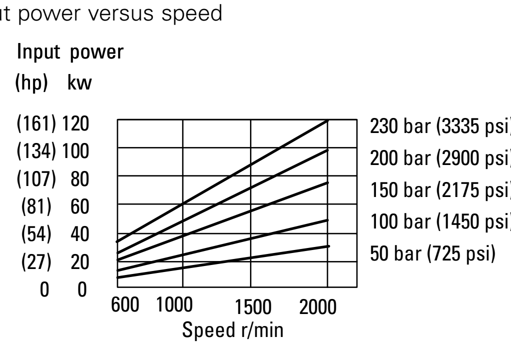
Delivery and efficiency versus outlet pressure at 1800 r/min



Input torque and power versus outlet pressure at 1800 r/min



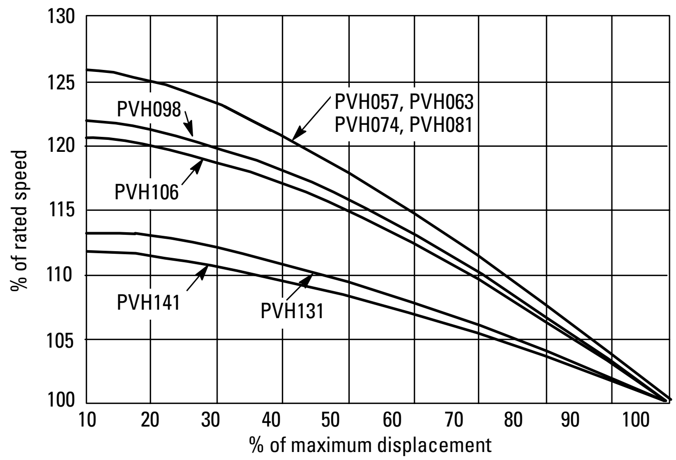
Input power versus speed



Performance Data

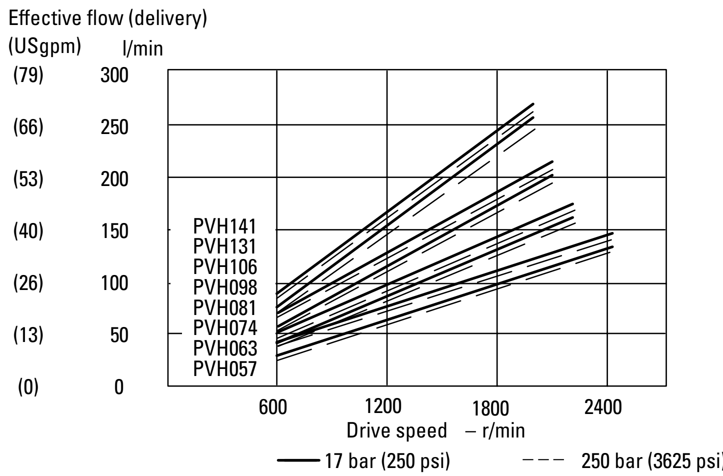
Performance data is typical with SAE 10W anti-wear hydraulic oil at 50°C (120°F) and at zero pump inlet pressure, except where otherwise indicated.

Rated Speed at Reduced Displacement and Zero Inlet Pressure

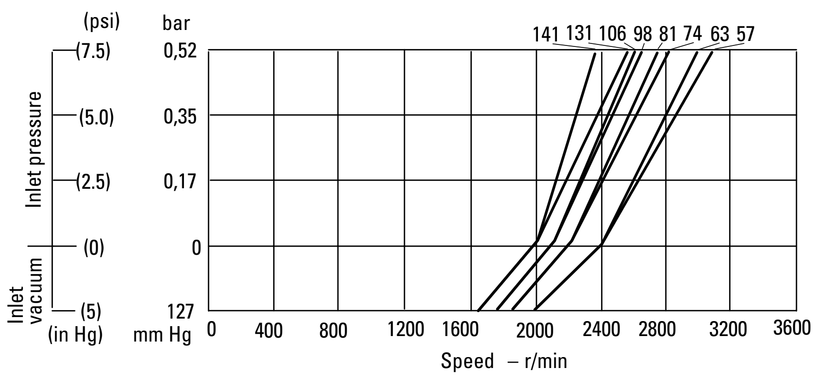


Note: Speeds at 10% displacement represent maximums at load-sense standby condition. These speeds must be reduced to rated speeds at 100% displacement before leaving standby condition, or pump damage may result.

Effective Flow at Maximum Torque



Inlet Pressure/Vacuum versus Speed, Mobile Pumps



Performance Data

Response Data

Model series/ Control type	Typical yoke response † On stroke	Off stroke
PVH057/A**	.101 sec.	.015 sec.
PVH057/B**	.080 sec.	.014 sec
PVH063	.101 sec.	.015 sec.
PVH063	.080 sec.	.014 sec
PVH074/A**	.097 sec.	.015 sec.
PVH074/B**	.088 sec.	.028 sec.
PVH081	.097 sec.	.015 sec.
PVH081	.088 sec.	.028 sec.
PVH098/A**	.134 sec.	.019 sec.
PVH098/B**	.118 sec.	.029 sec.
PVH106	.134 sec.	.019 sec.
PVH106	.118 sec.	.029 sec.
PVH131/A**	.139 sec.	.019 sec.
PVH131/B**	.118 sec.	.029 sec.
PVH141	.139 sec.	.019 sec.
PVH141	.118 sec.	.029 sec.

† Based on 6900 bar/sec (100,000 psi/sec) pressure rise at rated speed and pressure.

Sound Levels

Vickers PVH pumps are designed to provide the highest levels of system performance with noise levels within OSHA requirements. The standard models exhibit low sound levels across a wide range of operating speeds and pressures to accommodate the conditions necessary for high performance mobile vehicles. In addition, the quieter QI models provide even lower sound levels at typical in-plant conditions.

Sound is generated by a variety of factors associated with the system, machine, and environment. For more information concerning the causes and nature of noise in machinery, and methods to reduce sound levels, refer to Eaton's "More Sound Advice" bulletin 390 and "Noise Control in Hydraulic Systems" bulletin 510.

Mobile Version – Sound Level dB(a) DIN (NFPA) ‡

Pressure bar (psi)	PVH057 1200 r/min	PVH057 1800 r/min	PVH063 1800 r/min	PVH063 2300 r/min	PVH074 1200 r/min	PVH074 1800 r/min	PVH081 1800 r/min	PVH081 2100 r/min	PVH098 1200 r/min	PVH098 1800 r/min	PVH106 1800 r/min	PVH106 2000 r/min	PVH131 1200 r/min	PVH131 1800 r/min	PVH141 1800 r/min	PVH141 1900 r/min
70 (1015)	71	76	77	78	71	76	74	74	71	75	80	80	76	82	81	84
140 (2030)	76	76	77	80	76	78	75	77	74	78	84	82	81	87	86	86
210 (3025)	77	81	79	83	77	81	79	79	77	82	86	84	88	89	88	87
250 (3625)	77	81	80	84	77	81	79	79	78	84	86	85	83	90	89	88

Industrial Version* – Sound Level dB(a) DIN (NFPA) ‡

Pressure bar (psi)	PVH057 1200 r/min	PVH057 1800 r/min	PVH063 1200 r/min	PVH063 1800 r/min	PVH074 1200 r/min	PVH074 1800 r/min	PVH081 1500 r/min	PVH081 1800 r/min	PVH098 1200 r/min	PVH098 1800 r/min	PVH106 1500 r/min	PVH106 1800 r/min	PVH131 1200 r/min	PVH131 1800 r/min	PVH141 1200 r/min	PVH141 1500 r/min
70 (1015)	64	71	66	73	65	73	73	79	69	75	73	81	75	80	74	74
140 (2030)	68	73	70	72	69	74	72	78	70	76	75	84	77	84	76	78
210 (3025)	70	76	73	76	73	77	75	79	75	80	77	85	80	87	79	81
250 (3625)	71	78	73	77	73	78	76	79	77	82	78	85	82	89	79	82

‡ DIN: Computed semi-anechoic values per DIN 45635. NFPA: Recorded in a semi-anechoic chamber in accordance with NFPA Recommended Standard 13.9.70.12. All values shown are the higher of either maximum displacement or fully compensated conditions.

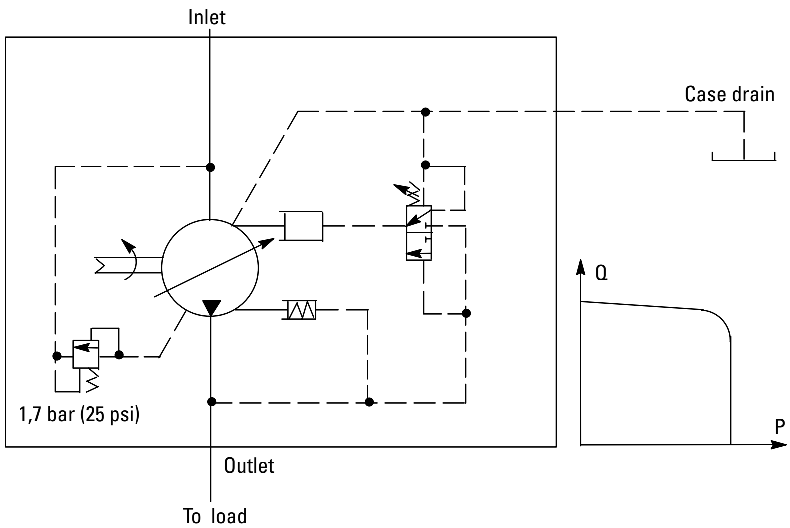
* Q250 Valve Plate

Due to the rounding of numbers during conversion, the difference between DIN and NFPA ratings may be one or two numbers; for example 69 (71) or 69 (72).

Control Options

Pressure Compensator Control (A)

The pump will provide a continuously modulated flow to meet changing load demands at a pre-adjusted compensator pressure. At pressures below the compensator setting, the pump will operate at maximum displacement. The compensator is available in two pressure ranges.



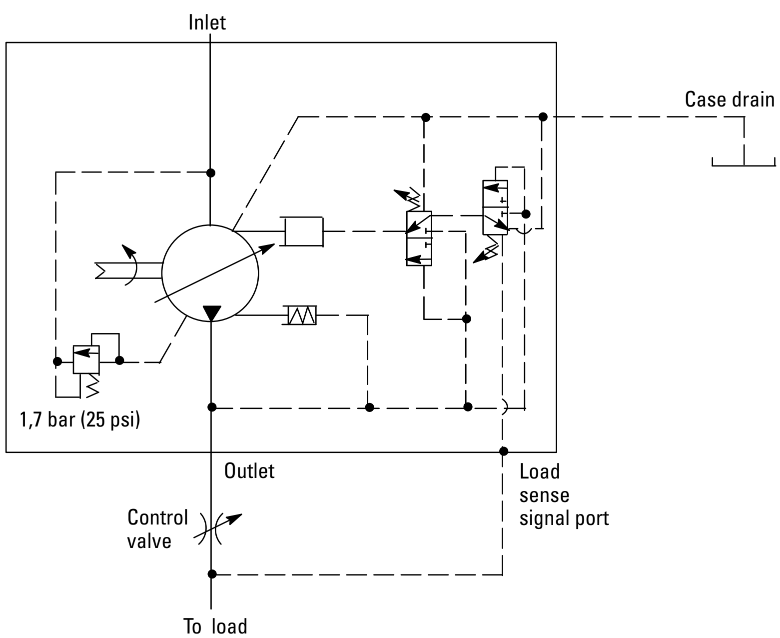
Load Sensing and Pressure Compensator Control (B)

The pump will provide power matching of pump output to system load demand, maximizing efficiency and improving load metering characteristics of any directional control valve installed between the pump and the load.

Load sensing ensures that the pump always provides only the amount of flow needed by the load. At the same time, the pump operating pressure adjusts to the actual load pressure plus a pressure differential required for the control action. When the system is not demanding power, the load sense control will operate in an energy-saving stand-by mode.

Typically, the differential pressure is that between the pressure inlet and service port of a proportionally controlled directional valve, or a load sensing directional control valve. The standard differential pressure setting for load sense is 20 bar (290 psi), but can be adjusted to between 17 and 30 bar (247 and 435 psi) on the pump.

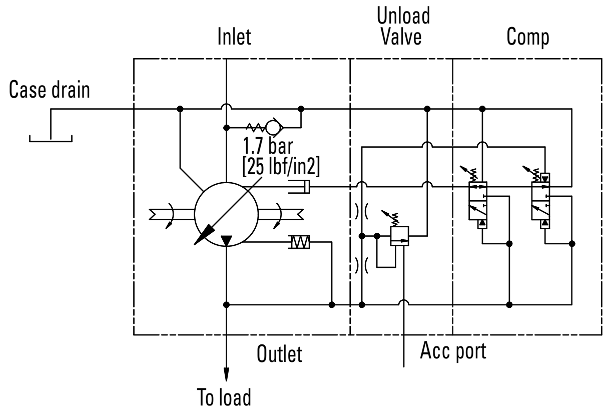
If the load pressure exceeds the system pressure setting, the pressure compensator destrokes the pump. The load sensing line must be as short as possible and can also be used for remote control or unloading of the pump pressure. For remote control purposes, it is recommended that you contact your Vickers representative for the correct configuration of the control.



Control Options

Pressure and Flow Compensator with Unloading Valve for Accumulator Circuit
This pump control functions as a load-sensing pressure compensator that unloads the pump at a preset pressure and loads the pump after preset pressure drop.

Unloading Valve Circuit (N)

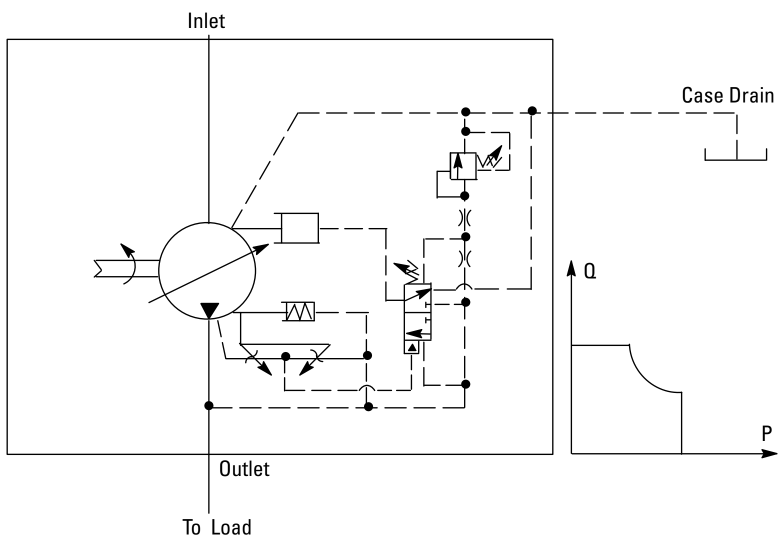


Pressure and Torque Limiter Control (D)

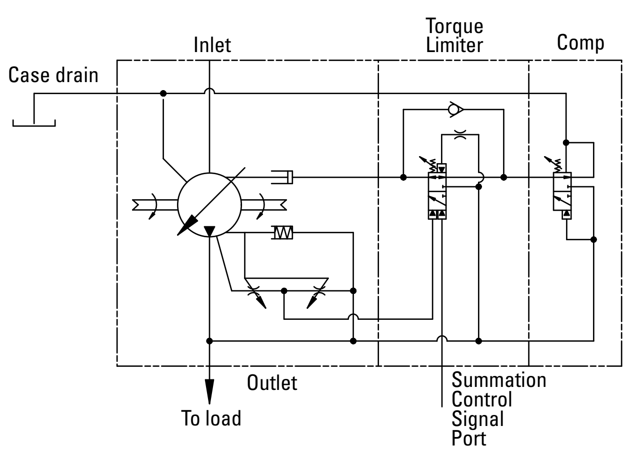
The pump senses pressure and flow and starts destroking at a predetermined input torque level. The rate of flow reduction is normally tailored to follow the maximum power capability curve of the prime mover. Input torque is limited while the pressure compensator limits the system pressure.

When the input speed remains constant (i.e. industrial drives), the torque limiter acts as an input power limiter. This allows a smaller electric motor to be used if maximum pressure and maximum flow are not required at the same time. At low load levels, the control permits high pump displacement and high load speeds. Under heavy loads, speed is reduced, preventing stalling of the prime mover. In the case of variable speed drives (I.C. engines), this function provides, in addition to pressure compensation or limiting, a torque limiting ability that can be adjusted to the torque/speed characteristics of the engine.

The start of torque limiting (pump-destroking) is pressure dependent. This pressure is selectable (see model code) and is factory preset to between 30% and 80% of the maximum pressure control setting. The minimum torque pressure setting is 40 bar (580 psi).



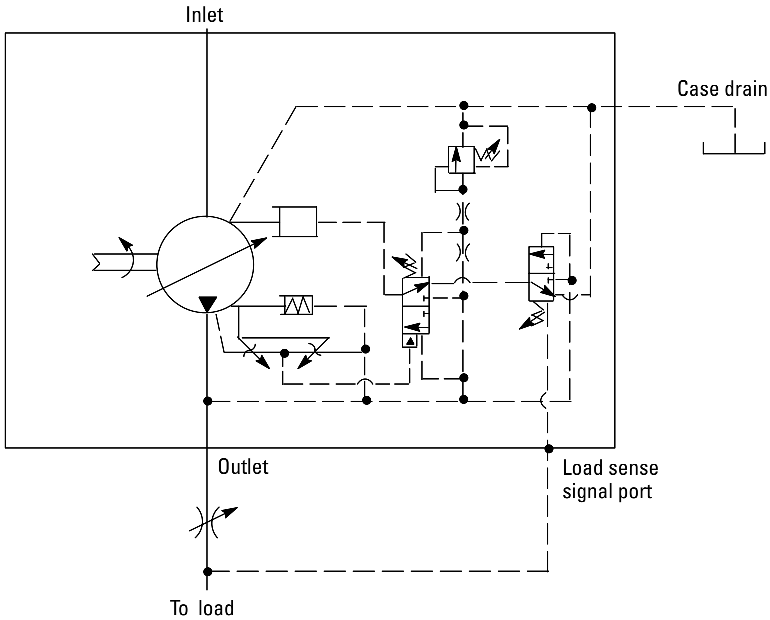
Summation Control (C)



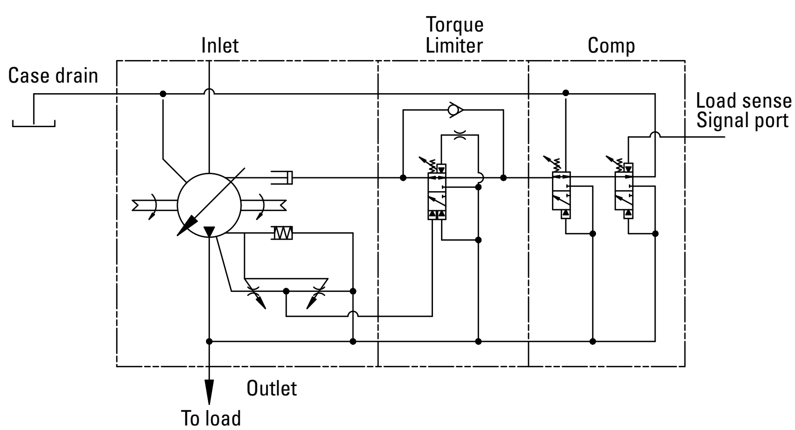
Pressure and Torque Limiting, Plus Load Sensing, Control (E)

The pump's control functions like a load sensing control, but with additional torque limiting tailored to the size of the drive motor selected. The limiting function is the same as for a pressure compensator with torque limiting (see D description, previous page). The combination of the two controls provides the following benefits:

1. The energy savings of a variable displacement load sensing control.
2. The pump pressure follows the load pressure.
3. The torque control allows smaller drive motors to be used.
4. The pressure compensator de-strokes the pump as maximum pressure is reached.
5. The pump pressure can also be remotely controlled using the load sense line. The E control allows complete control of flow and pressure, either mechanically or electrically, if used with proportional valves.



Sumation Control (F)



Industrial Control Compensator

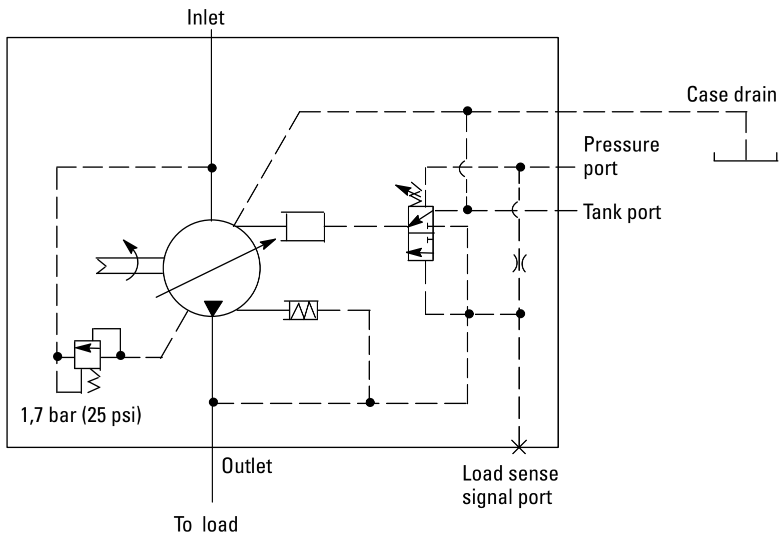
This pump is intended for use when multiple, remote, or electrically controlled compensating settings, with or without load sensing or, with or without torque control are desired.

Pressure compensation is obtained when an internal plug is removed, the load-sense signal port is kept plugged, and internal pilot pressure is applied to the spring chamber of the control spool. For pressure compensation with load sensing, the internal plug stays, the load-sense signal port is unplugged, and pilot pressure is externally applied.

An external relief valve (not supplied) controls spring chamber pressure. The externally adjustable spring determines the differential pressure setting of the control. Outlet pressure is limited to the value of the spring chamber (pressure port) pressure, plus control differential pressure.

(continued on next page)

Pressure Compensating Without Load Sensing (G)



Control Options

Industrial Control Compensator

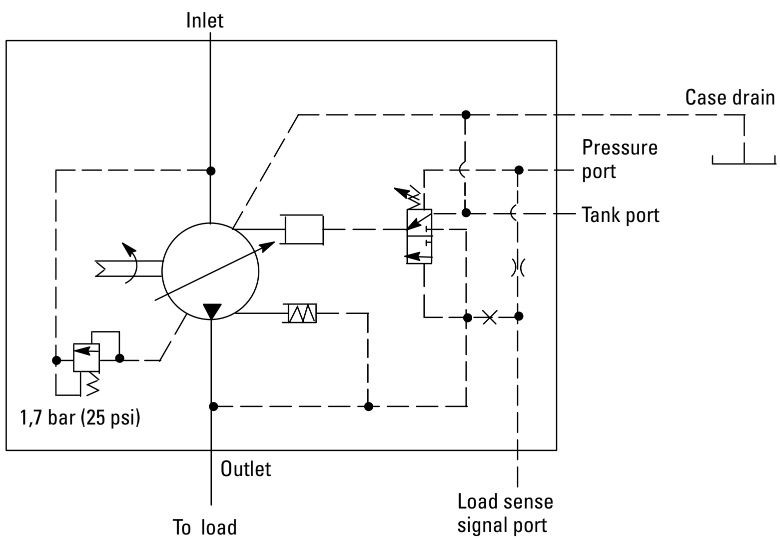
(continued)

Spring chamber (pilot) pressure is separated from outlet pressure by an internal orifice. Outlet pressure shifts the spool when pressure drop across the orifice reaches the differential pressure setting, and the pump de-strokes.

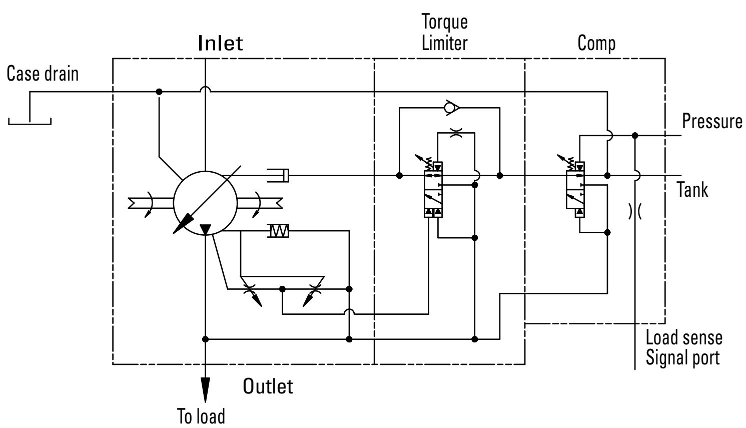
The relief valve can be mounted to an NFPA-D03/ISO 4401-03 pad on the pump control, or remotely located via tapping and blanking plates installed on the pad. See "Ordering Procedure", page 35, for more on valves and plates.

The standard factory-set differential pressure setting of the pump control is 20 bar (290 psi) and is not specified in the pump model number. Any other ordered differential pressure, within the control's adjustable pressure range of 17–35 bar (247–508 psi), will be specified in the model number.

Pressure Compensating with Load Sensing (H)



Pressure Compensating with Load Sensing and Torque Control (J)



Input Shaft Selection Data

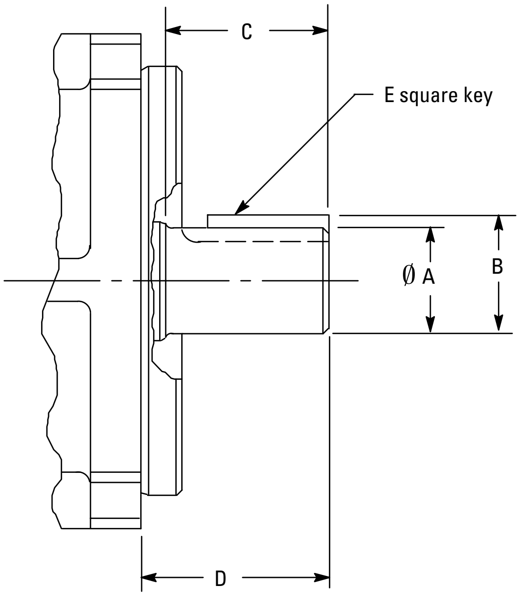
Multiple pump arrangements can be formed by a PVH thru-drive pump and any suitable pump (single or multiple) that can be installed on the SAE "A", "B", or "C" rear-mounting option available for the thru-drive pump.

It is important to check that maximum torque values for individual pump sections, or complete pumps, occurring in a specific application will not exceed the limits tabled below.

Shaft Code	Shaft Designation	Basic Pump Series	Thru-drive Pump Series	Maximum Input Torque Nm (lb. in.)	Maximum Thru-drive Output Torque Nm (lb. in.)
N	ISO 3019/2 – E32N	PVH057/063	–	450 (3,980)	–
	short straight keyed	PVH074/081	–	450 (3,980)	–
1	SAE "C" (J744-32-1)	PVH057/063	PVH057/063	450 (3,980)	335 (2,965)
	straight keyed	PVH074/081	–	450 (3,980)	–
		PVH098/106	–	450 (3,980)	–
2	SAE "C" (J744-32-4)	PVH057/063	PVH057/063	640 (5,660)	335 (2,965)
	14T 12/24 DP FRSF spline	PVH074/081	–	640 (5,660)	–
		PVH098/106	–	640 (5,660)	–
3	SAE "CC" (J744-38-4)	–	PVH074/081	1215 (10,750)	460 (4.070)
	17T 12/24 DP FRSF spline	–	PVH098/106	1215 (10,750)	640 (5,660)
		PVH131/141	PVH131/141	1215 (10,750)	640 (5,660)
12	SAE "D" (J744-44-4)	PVH131/141	PVH131/141	1215 (10,750)	640 (5,660)
	13T 8/16 DP FRSF spline				
13	SAE "CC" (J744-38-1)	–	PVH074/081	765 (6,770)	460 (4.070)
	straight keyed	–	PVH098/106	765 (6,770)	460 (4.070)
		PVH131/141	–	765 (6,770)	–
16	SAE "D" (J744-44-1)	–	PVH131/141	1200 (10,620)	640 (5,660)
	straight keyed				

Note: Any deviation from maximum input torques must be approved by Eaton. To assure developed thru-drive loads are within PVH pump limitations, actual torque values must not exceed values shown.

Input Shaft Dimensions



Straight Keyed Shafts*

Shaft Code	Shaft Designation	A	B	C	D	E
1	SAE “C” (J744-32-1)	31,75 (1.25)	35,32 (1.38)	48,0 (1.89)	56,0 (2.20)	7,93 (.312)
13	SAE “CC” (J744-38-1)	38,10 (1.50)	42,39 (1.67)	54,0 (2.12)	62,0 (2.44)	9,52 (.375)
16	SAE “D” (J744-44-1)	44,45 (1.75)	49,46 (1.95)	67,0 (2.64)	75,0 (2.95)	11,11 (.438)
N	ISO 3019/2–E32N	32,00 (1.26)	35,00 (1.38)	58,0 (2.28)	68,1 (2.68)	10,00 (.393)

* See torque limits on previous page.

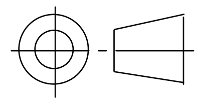
Spline Shafts*

Shaft code	Shaft designation	Number of teeth	C	D
2	SAE “C” (J744-32-4)	14	48,0 (1.89)	56,0 (2.20)
3	SAE “CC” (J744-38-4)	17	54,0 (2.13)	62,0 (2.44)
12	SAE “D“ (J744-44-4)	13	67,0 (2.64)	75,0 (2.95)

* See torque limits on previous page.

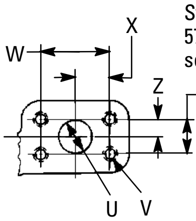
Installation Dimensions

Basic Pump with Pressure Compensator and Load Sense Controls

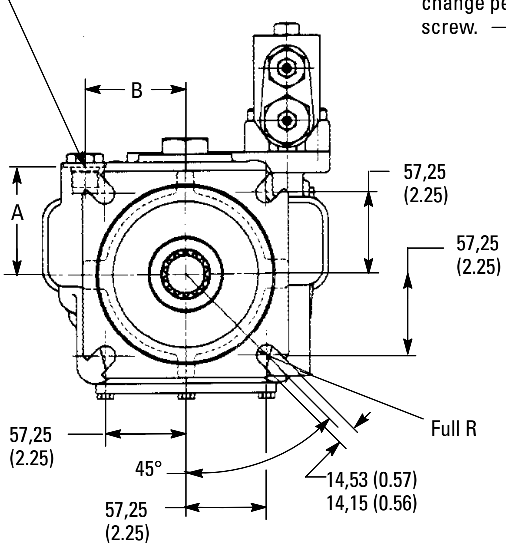


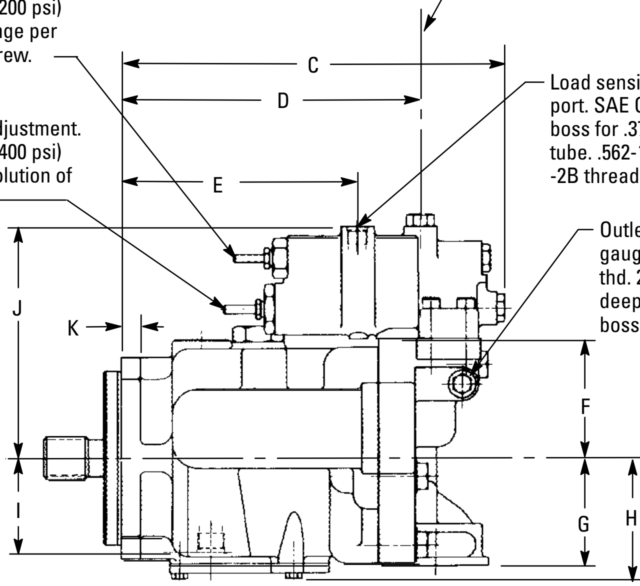
3rd angle projection

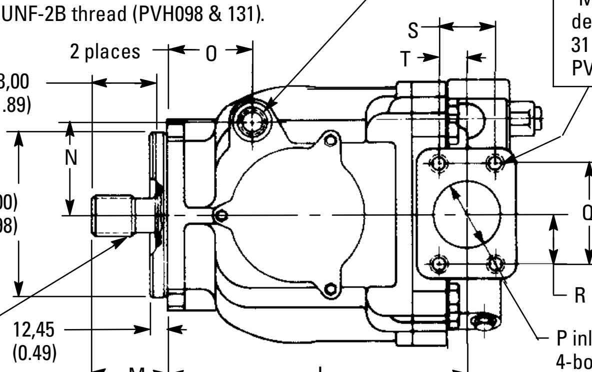
Dimensions in mm (inches)



View A-A







For shaft options and dimensions, see pages 16 and 17. Standard SAE pump mounting flange shown; see page 26 for optional SAE 2-bolt/4-bolt and ISO flanges. See page 29 for shaft-up mounting option.

Installation Dimensions

Basic Pump with Pressure Compensator and Load Sense Controls

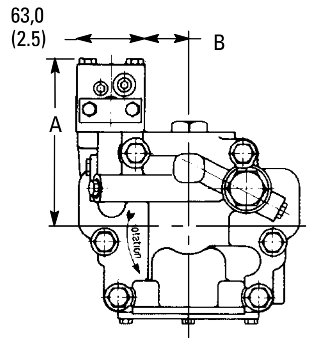
	A	B	C	D	E	F	G	H	I
PVH057	76,0	71,0	293,0	216,5	171,3	86,0	79,0	88,0	69,0
PVH063	(2.99)	(2.79)	(11.54)	(8.52)	(6.74)	(3.39)	(3.11)	(3.46)	(2.71)
PVH074	88,0	70,0	306,6	241,2	194,3	92,0	94,0	95,0	81,0
PVH081	(3.46)	(2.75)	(12.07)	(9.50)	(7.65)	(3.62)	(3.70)	(3.74)	(3.19)
PVH098	93,1	85,0	323,5	251,3	206,1	94,5	87,5	97,1	80,1
PVH106	(3.67)	(3.35)	(12.74)	(9.89)	(8.11)	(3.72)	(3.44)	(3.82)	(3.15)
PVH131	109,4	88,8	377,0	280,4	230,4	120,0	109,0	107,4	84,8
PVH141	(4.31)	(3.50)	(14.84)	(11.04)	(9.07)	(4.72)	(4.29)	(4.23)	(3.34)

	J	K	L	M	N	O	P	Q	R
PVH057	168,0	14,0	227,4	56,1	71,0	64,8	50,8	77,77	38,88
PVH063	(6.6)	(0.55)	(8.95)	(2.21)	(2.80)	(2.55)	(2.0)	(3.06)	(1.53)
PVH074	174.0	15,0	250,1	56,0	70,0	68,0	50,8	77,77	38,88
PVH081	(6.85)	(0.59)	(9.85)	(2.20)	(2.75)	(2.68)	(2.0)	(3.06)	(1.53)
PVH098	176,5	16,0	269,3	55,5	85,0	74,2	63,5	88,9	44,45
PVH106	(6.95)	(0.63)	(10.60)	(2.18)	(3.35)	(2.92)	(2.5)	(3.50)	(1.75)
PVH131	202,0	15,0	298,6	62,0	88,8	70,6	63,5	88,9	44,45
PVH141	(7.95)	(0.59)	(11.75)	(2.44)	(3.50)	(2.78)	(2.5)	(3.50)	(1.75)

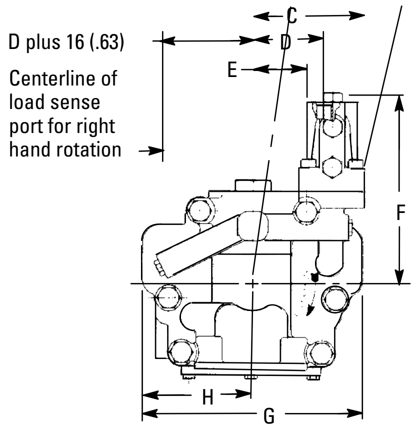
	S	T	U	V	W	X	Y	Z
PVH057	42,88	21,44	25,4	M10x1,5	52,37	26,18	26,19	13,10
PVH063	(1.69)	(0.84)	(1.0)	(.375-16)	(2.06)	(1.03)	(1.03)	(0.52)
PVH074	42,88	21,44	25,4	M10x1,5	52,37	26,18	26,19	13,10
PVH081	(1.69)	(0.84)	(1.0)	(.375-16)	(2.06)	(1.03)	(1.03)	(0.52)
PVH098	50,8	25,4	25,4	M10x15	52,37	26,19	26,19	13,10
PVH106	(2.0)	(1.0)	(1.0)	(.375-16)	(2.06)	(1.03)	(1.03)	(0.52)
PVH131	50,8	25,4	31,75	M14x2,0	66,68	33,34	31,75	15,88
PVH141	(2.0)	(1.0)	(1.25)	(.500-13) (2.63)	(1.31)	(1.25)	(0.63)	

Installation Dimensions

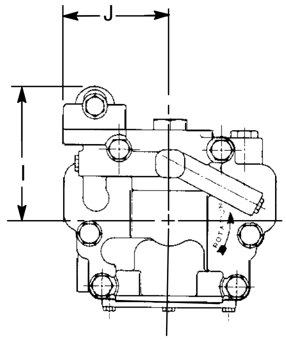
Basic Pump. Rear View with Various Controls



Right hand rotation, pressure compensated and torque limit model



Left hand rotation, pressure compensated and load sensing model

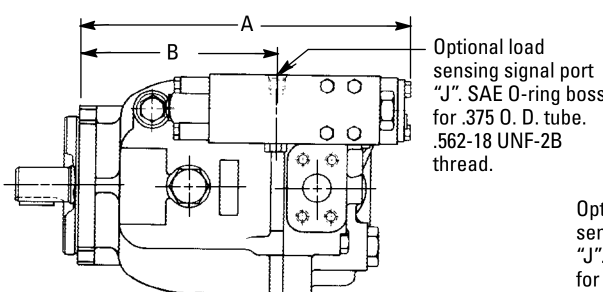


Right hand rotation, pressure compensated model

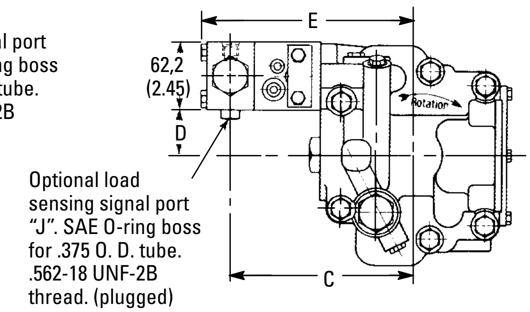
	A	B	C	D	E	F	G	H	I	J
PVH057	176,45	41,0	102,7	64,5	49,0	176,6	203,0	101,5	127,0	102,7
PVH063	(6.95)	(1.61)	(4.04)	(2.54)	(1.93)	(6.95)	(7.99)	(4.00)	(5.00)	(4.04)
PVH074	182,45	47,5	109,2	71,0	55,5	182,6	224,0	112,0	133,0	109,2
PVH081	(7.18)	(1.87)	(4.30)	(2.79)	(2.19)	(7.18)	(8.82)	(4.41)	(5.23)	(4.30)
PVH098	195.45	41,0	102,7	65,5	49,0	185,1	233,0	116,5	135,5	102,7
PVH106	(7.69)	(1.61)	(4.04)	(2.54)	(1.93)	(7.280)	(9.17)	(4.59)	(5.33)	(4.04)
PVH131	210,50	63,6	125,2	87,0	71,5	210,6	254,2	127,1	161,0	125,2
PVH141	(8.29)	(2.50)	(4.92)	(3.42)	(2.81)	(8.29)	(10.00)	(5.00)	(6.37)	(4.92)

*Add 16,0 (.63) to dimension D for right hand rotation model.

Pump with Pressure Compensation, Load Sense and Torque Limit Controls



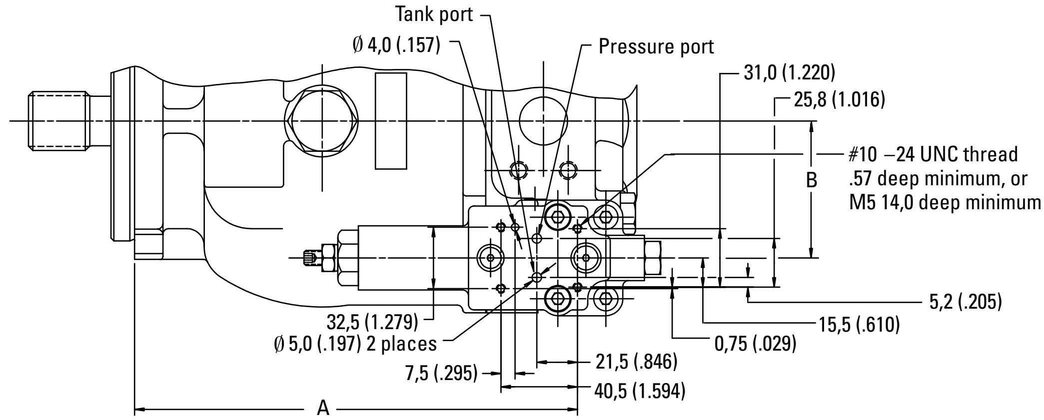
Left hand rotation, pressure compensated with load sense and torque limit model

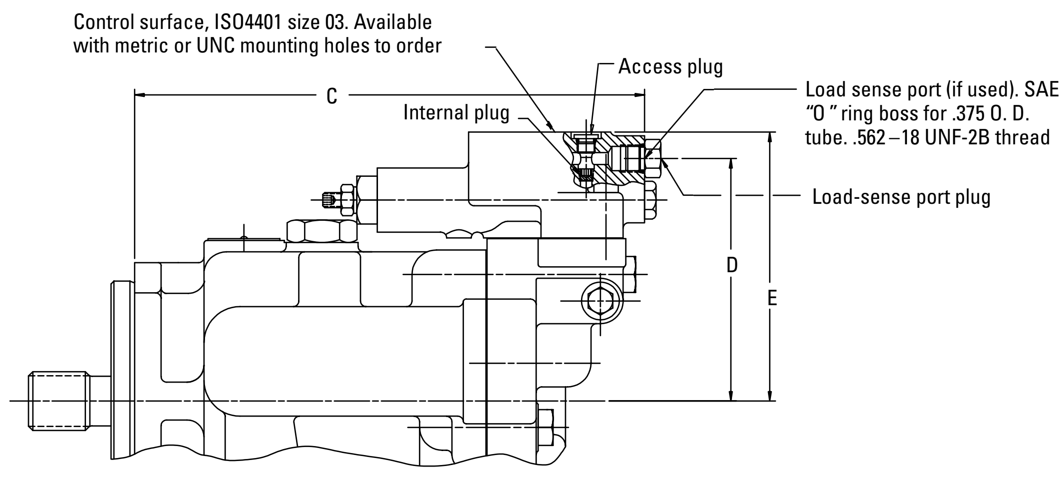


	A	B	C	D	E
PVH057	316,3	177,4	168,1	41,4	195,4
PVH063	(12.45)	(6.98)	(6.62)	(1.63)	(7.69)
PVH074	335,5	200,1	174,1	47,9	201,4
PVH081	(13.34)	(7.88)	(6.85)	(1.86)	(7.93)
PVH098	351,0	212,3	187,1	41,4	214,4
PVH106	(13.82)	(8.36)	(7.37)	(1.63)	(8.44)
PVH131	375,3	236,6	202,2	63,8	229,5
PVH141	(14.78)	(9.31)	(7.96)	(2.51)	(9.04)

Installation Dimensions

Pump with IC Compensator (Remotely Controllable Pressure Compensator, and Optional Load Sensing)





Pressure compensator:

Remove access plug, using 1/8 inch hex wrench. Remove internal plug, using 5/32 inch hex wrench. Replace access plug and torque to 12,1–12,4 Nm (107–110 lb. in.). Attach relief valve hardware (not supplied) to control surface. See page 15 for more details.

Pressure compensator with load sensing:

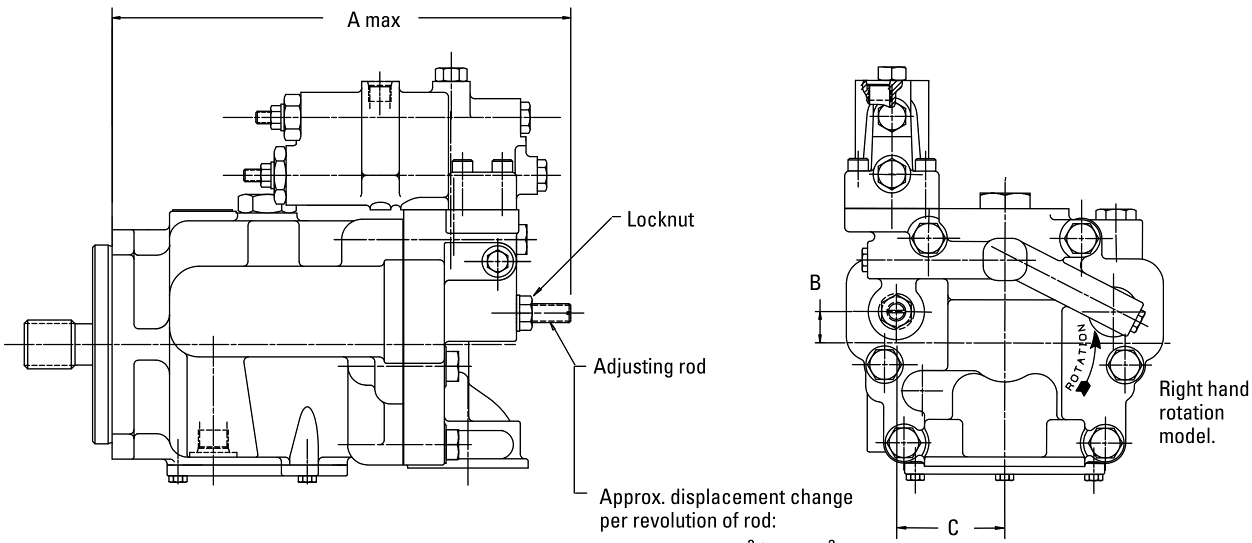
Remove load-sense port plug. (Internal plug must remain in place.) Attach line to load-sense port. Pressure decay rate of this line must not exceed 11 kbar/second (160 kpsi/second). Attach relief valve hardware (not supplied) to control surface. See page 15 for more details.

	A	B	C	D	E
PVH057	234,5	72,5	269,9	128,0	142,0
PVH063	(9.23)	(2.85)	(10.62)	(5.04)	(5.59)
PVH074	257,2	79,0	292,6	134,0	148,0
PVH081	(10.12)	(3.11)	(11.52)	(5.27)	(5.83)
PVH098	269,3	72,5	304,7	136,5	150,5
PVH106	(10.60)	(2.85)	(12.00)	(5.37)	(5.92)
PVH131	293,6	95,0	329,0	162,0	176,0
PVH141	(11.56)	(3.74)	(12.95)	(6.38)	(6.93)

Installation Dimensions

Pump with Adjustable Maximum Volume Stop

This option allows maximum pump delivery to be externally adjusted from 100 percent down to 25 percent. To assist initial priming, adjust stop to allow at least 40 percent of maximum delivery. Adjust by loosening locknut and turning adjusting rod clockwise to decrease maximum delivery, or counter-clockwise to increase maximum delivery. When desired setting is obtained, torque locknut to 25-50 Nm (18-36 lb. ft.).



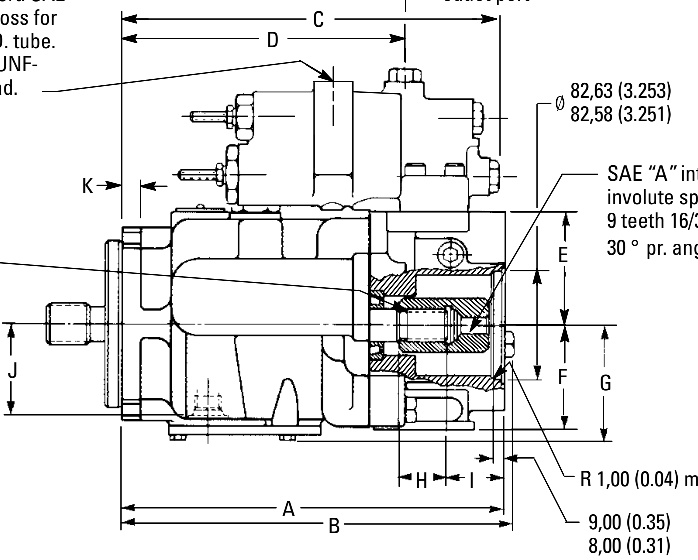
Approx. displacement change per revolution of rod:

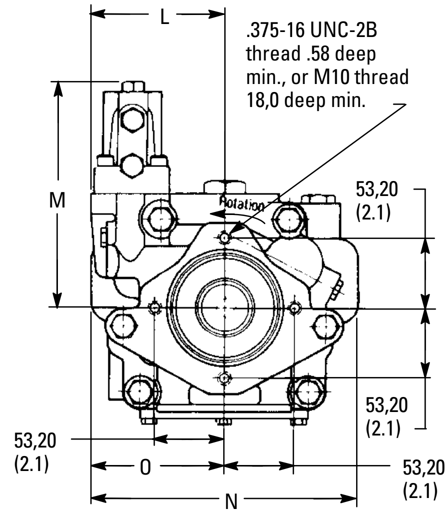
PVH057 – 4,25 cm^3 (0.259 in^3)
PVH063 – 4,70 cm^3 (0.287 in^3)
PVH074 – 5,00 cm^3 (0.305 in^3)
PVH081 – 5,47 cm^3 (0.334 in^3)
PVH098 – 6,25 cm^3 (0.381 in^3)
PVH106 – 6,76 cm^3 (0.413 in^3)
PVH131 – 8,50 cm^3 (0.519 in^3)
PVH141 – 9,15 cm^3 (0.559 in^3)

	A	B	C
PVH057	293,0	20,0	69.5
PVH063	(11.53)	(.79)	(2.74)
PVH074	306,6	22,0	76,0
PVH081	(12.07)	(.87)	(2.99)
PVH098	323,5	27,5	81,0
PVH106	(12.74)	(1.08)	(3.19)
PVH131	377,0	37,5	88,8
PVH141	(14.84)	(1.48)	(3.50)

Installation Dimensions

Thru-drive Pumps with SAE "A" Rear Pad





For shaft options and dimensions, see page 16 and 17. See page 26 for optional cover for rear pad.

Note: The O-ring for sealing the rear mounting pad is furnished with the pump. The rear drive coupling shown must be ordered separately; see page 23.

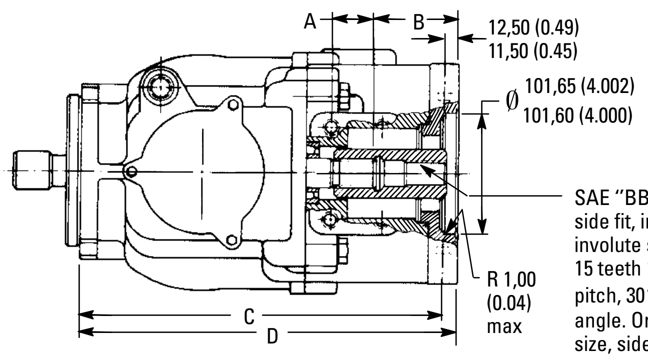
Right hand rotation, pressure compensated and load sensing model.

	A	B	C	D	E	F	G	H
PVH057	287,9	295,4	275.8	216,4	86,0	79,0	88,0	36,4
PVH063	(11.3)	(11.6)	(10.86)	(8.52)	(3.38)	(3.11)	(3.46)	(1.43)
PVH074	310,6	318,1	300,5	241,2	92,0	94,0	95,0	38,5
PVH081	(12.23)	(12.52)	(11.83)	(9.50)	(3.62)	(3.70)	(3.74)	(1.51)
PVH098	322,8	N/A	312,7	251,3	94,5	87,5	97,1	33,0
PVH106	(12.71)		(12.31)	(9.89)	(3.72)	(3.44)	(3.82)	(1.30)
PVH131	347,1	N/A	337,0	280,4	120,0	109,0	107,4	35,3
PVH141	(13.660)		(13.27)	(11.04)	(4.72)	(4.29)	(4.23)	(1.39)

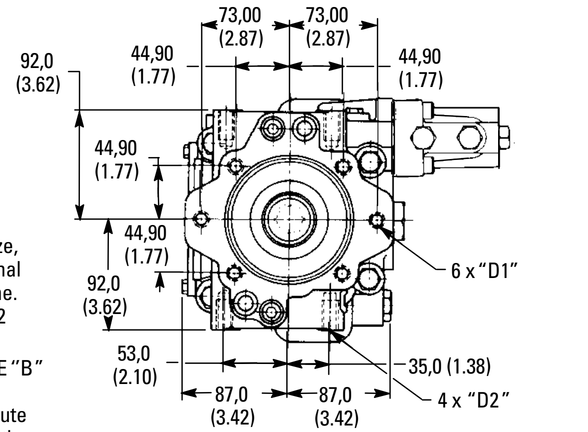
	I	J	K	L	M	N	O
PVH057	43,6	69,0	14,0	102,7	176,6	203,0	101,5
PVH063	(1.72)	(2.71)	(0.55)	(4.04)	(6.95)	(7.99)	(4.00)
PVH074	43,8	81,0	15,0	109,2	182,6	224,0	112,0
PVH081	(1.72)	(3.19)	(0.59)	(4.30)	(7.18)	(8.82)	(4.41)
PVH098	44,6	80,1	16,0	102,7	185,1	233,0	116,5
PVH106	(1.75)	(3.15)	(6.30)	(4.04)	(7.28)	(9.17)	(4.59)
PVH131	44,7	84,8	15,0	125,2	210,6	254,2	127,1
PVH141	(1.76)	(3.34)	(0.59)	(4.93)	(8.29)	(10.0)	(5.00)

Installation Dimensions

Thru-drive Pumps with SAE "B" Rear Pad Adapter

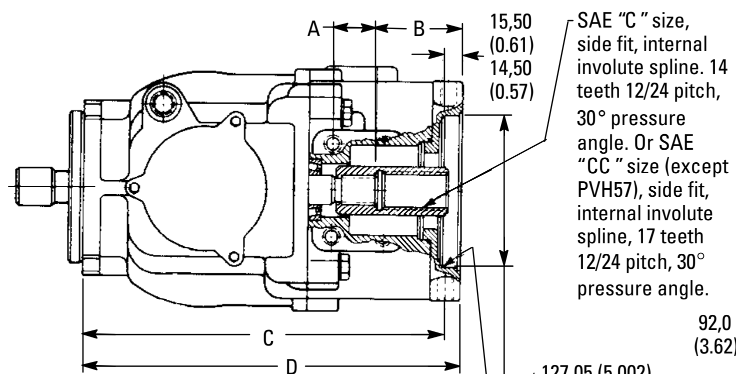


Thru-drive pumps must have support located by dimension "C."

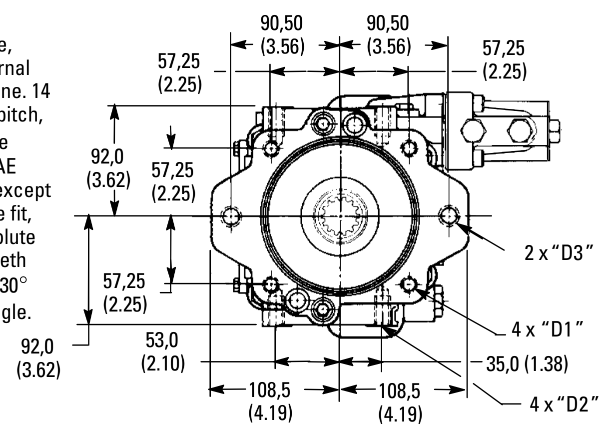


SAE "B" rear mounting. Mounting pad is machined to accept AS568-155 O-ring. Mounting pad is connected to pump case and must be sealed.

Thru-drive Pumps with SAE "C" Rear Pad Adapter



Thru-drive pumps must have support located by dimension "C."



SAE "C" rear mounting. Mounting pad is machined to accept AS568-159 O-ring. Mounting pad is connected to pump case and must be sealed.

Pump Model	A	B	C	D
PVH057	36,4	68,8	300,4	312,9
PVH063	(1.43)	(2.71)	(11.82)	(12.32)
PVH074	33,5	68,3	323,1	335,6
PVH081	(1.32)	(2.69)	(12.72)	(13.21)
PVH098	33,0	69,8	335,3	347,7
PVH106	(1.30)	(2.75)	(13.20)	(13.69)
PVH131	35,3	69,7	359,6	372,1
PVH141	(1.39)	(2.74)	(14.16)	(14.65)

	D1	D2	D3
Metric	M14x2,00	M12x1,75	M16x2,00
	25 deep	25 deep	25 deep
Inch	0,500-13 0.500-13 0.625-11		
	UNC-2B	UNC-2B	UNC-2B
	1.0 deep 1.0 deep 1.0 deep		

Note: The O-ring for sealing the rear mounting pad is furnished with the pump. The rear drive couplings shown must be ordered separately; see following page.

Installation Dimensions

Thru-drive Flange Kit and Shaft Coupling

Front Pump Model Series	SAE (J744) Mounting Flange for Rear Pump	Mounting Flange Adapter Kit Number* Metric Threads	Inch Threads	Coupling Part Number**
PVH057	A (J744-82-2)	None required	None required	526682
PVH063	B (J744-101-2/4)	876394	876390	526694
	BB (J744-101-2/4)	876394	876390	526695
	C (J744-127-2/4)	876392	876389	526696
PVH074	A (J744-82-2)	None required	None required	864460
PVH081	B (J744-101-2/4)	876394	876390	864457
	BB (J744-101-2/4)	876394	876390	864459
	C (J744-127-2/4)	876392	876389	864458
	CC (J744-127-2/4)	876392	876389	864461
PVH098	A (J744-82-2)	None required	None required	877039
PVH106	B (J744-101-2/4)	876394	876390	877040
PVH131	BB (J744-101-2/4)	876394	876390	877044
PVH141	C (J744-127-2/4)	876392	876389	877045
	CC (J744-127-2/4)	876392	876389	877046

*The basic PVH thru-drive pump has an SAE "A" pad on the rear. An SAE "B" or "C" pad rear mounting requires flange adapters. Required adapters can be provided if specified in the pump model code. The best combination of price, availability and flexibility is achieved by ordering a PVH SAE "A" thru-drive model and the applicable PVH mounting flange adapter separately. For example, a PVH074C-RCF-3S-10-C25-31 may also be ordered as a PVH074C-RAF-3S-10-C25-31 and a 876389 flange adapter.

** Thru-drive shaft couplings must be ordered separately to drive the second pump.

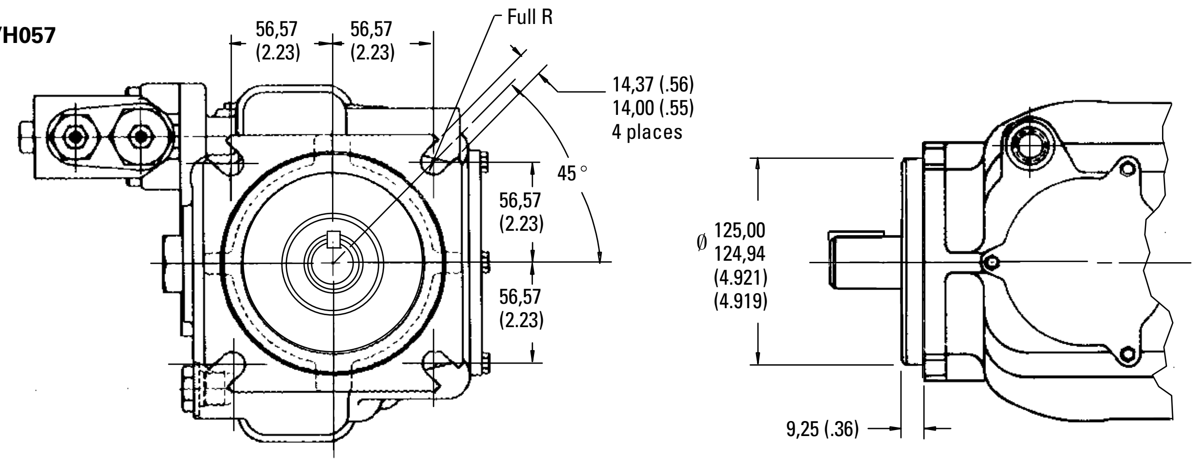
Typical Rear Pumps for Thru-drive Assemblies

Mounting	Piston pump Series	Shaft Code	Vane pump Series	Shaft Code
SAE A	PVQ10/13	3	V10	11
			V20	62
SAE B	PVQ20/32	3	20V	151
	PVQ40/45	3	25V	11
	PVE19/21	9	V2020	11
SAE BB	PVE19/21	2		
	TA19	2		
SAE C	PVH057/063	2	35V	11
	PVH074/081	2	352*V	11
	PVH098/106	2		
SAE CC	PVH131/141	3		

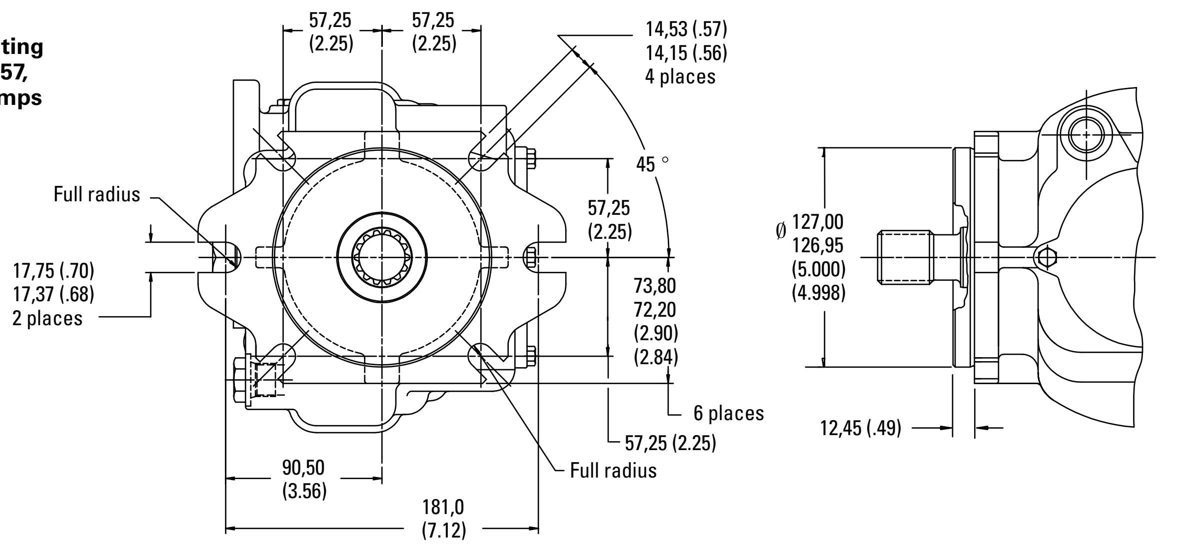
NOTE: The above Vickers pumps are examples of rear pumps for the thru-drive pumps dimensioned on pages 25 and 26. The thru-drive torque limits identified in the chart on page 16 must not be exceeded when applying these multiple pump systems.

Installation Dimensions

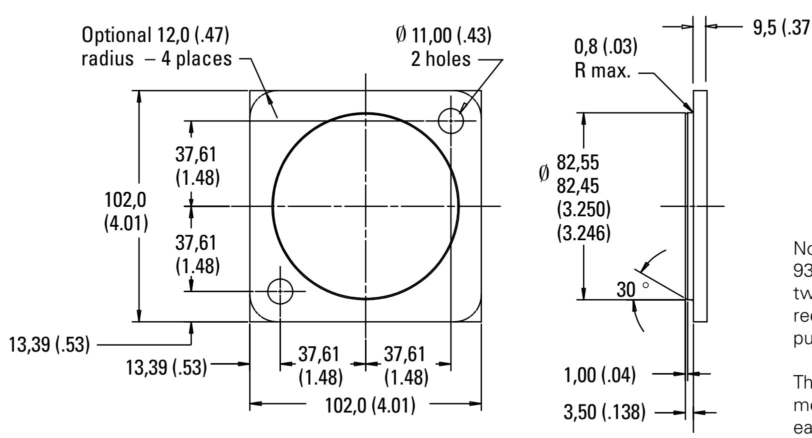
ISO 3019/2-125B4HW Mounting Flange for PVH057 and PVH074 Pumps



SAE 2–bolt/4-bolt Mounting (“027” Option) for PVH057, PVH074 and PVH098 Pumps



Cover (“031” Option) for Thru-drive SAE “A” Rear Mounting Flange



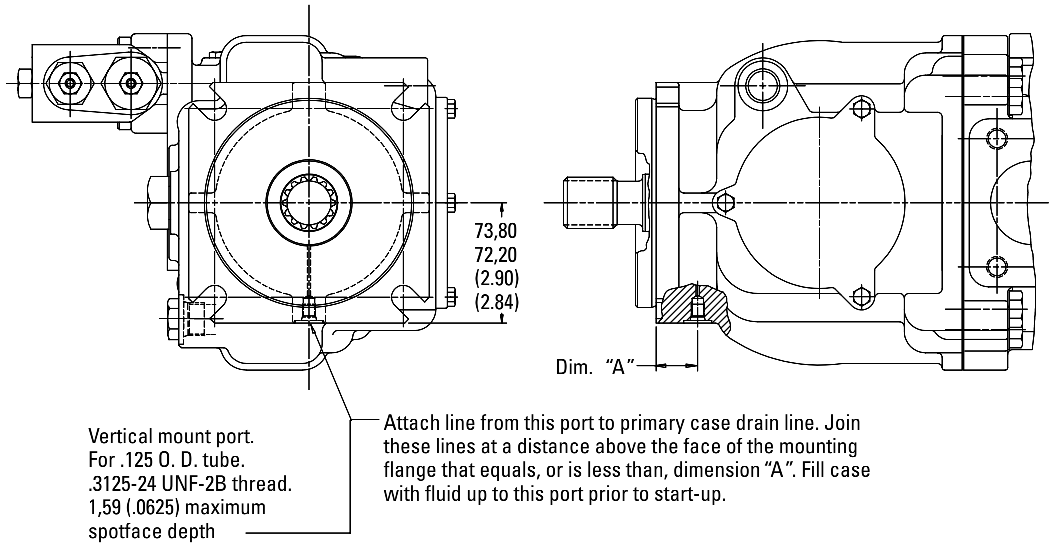
Note: When cover (part number 939790) is ordered as a separate part, two screws (part number 170177) are required to attach the cover to the pump’s rear mounting flange.

The O-ring for sealing the rear mounting flange is furnished with each thru-drive pump.

Installation Dimensions

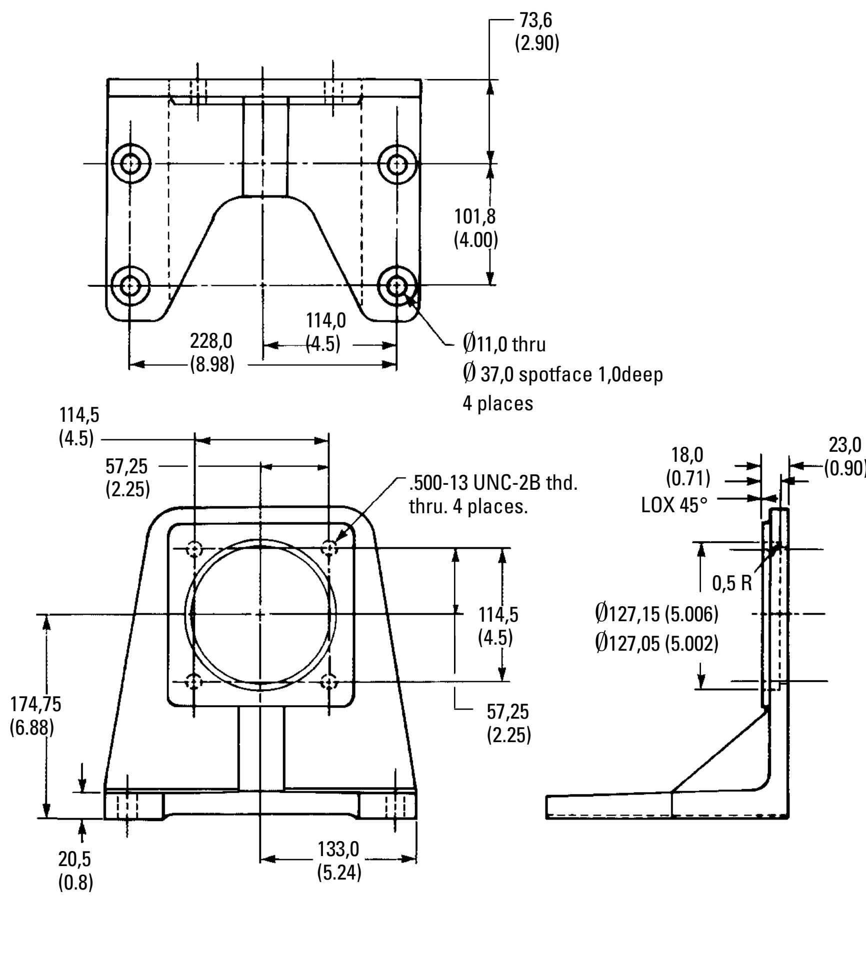
Pumps for Shaft-up Operation (Vertical Mount, "057" Option)

Model	Dim. "A"
PVH057	25,68/24.94
PVH063	(1.01/0.98)
PVH074	26,64/25,90
PVH081	(1.05/1.02)
PVH098	25,82/25,08
PVH106	(1.02/0.99)
PVH131	25,12/24,38
PVH141	(.99/0.96)



Model FB-C4-10 Foot Mounting Kit for All PVH Pumps

Each kit (part no. 02-143419) includes bracket shown and four screws for mounting to the pump. Kits are not included with pumps and must be ordered separately by model number.



Application Data

Hydraulic Fluids and Temperature Ranges

Use anti-wear hydraulic oil, or automotive type crankcase oil (designations SC, SD, SE or SF) per SAE J183 FEB80.

Select a viscosity grade that will allow optimum viscosity, between 40 cSt (180 SUS) and 16cSt (80 SUS), to be achieved.

Cold start capability at 5000 cSt. Max. intermittent temp. 104° C (220° F).

For further information, see 694.

Fluid Cleanliness

Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials and additives for protection against wear of components, elevated viscosity and inclusion of air.

Essential information on the correct methods for treating hydraulic fluid is included in Eaton publication 561; "Vickers Guide to Systemic Contamination Control," available from your local Eaton distributor or by contacting Eaton. Recommendations on filtration and the selection of products to control fluid condition are included in 561.

Recommended cleanliness levels, using petroleum oil under common conditions, are based on the highest fluid pressure levels in the system and are coded in the chart below. Fluids other than petroleum, severe service cycles or temperature extremes are cause for adjustment of these cleanliness codes. See Eaton publication 561 for exact details.

Eaton products, as any components, will operate with apparent satisfaction in fluids with higher cleanliness codes than those described. Other manufacturers will often recommend levels above those specified. Experience has shown, however, that life of any hydraulic components is shortened in fluids with higher cleanliness codes than those listed below. These codes have been proven to provide a long trouble-free service life for the products shown, regardless of the manufacturer.

Drive Data

Mounting attitude should be horizontal. See preceding page for vertical mount option. Consult your local Vickers representative if a different arrangement is required.

Direction of shaft rotation, viewed at the prime mover end, must be as indicated in the model designation on the pump. See "5" in Model Codes, page 6.

Drive arrangement should be by direct drive through a flexible coupling. Check pump installation drawing for concentricity and squareness tolerances.

Torque capability of shafts in basic (non-thru-drive) pumps is well in excess of that needed for operation at rated pressure and maximum displacement. Limitations for multiple pumps formed by PVH thru-drives as front-end sections are specified in the chart on page 18.

Moment of Inertia (Single Pump Rotating Group)

Model	Nm.sec^2	(lb.in.sec^2)
PVH057	0,0054	(0.0475)
PVH063	0,0054	(0.0447)
PVH074	0,0078	(0.0692)
PVH081	0,0073	(0.0643)
PVH098	0,0134	(0.1189)
PVH106	0,0123	(0.1086)
PVH131	0,0210	(0.1862)
PVH141	0,0210	(0.1856)

Cleanliness Codes For Petroleum Oil Usage

	System Pressure Level		
Product	**2000 psi**	**2000-3000 psi**	**3000+ psi**
Vane pumps, fixed	20/18/15	19/17/14	18/16/13
Vane pumps, variable	18/16/14	17/15/13	
Piston pumps, fixed	19/17/15	18/16/14	17/15/13
Piston pumps, variable	18/16/14	17/15/13	16/14/12
Directional valves	20/18/15	20/18/15	19/17/14
Proportional valves	17/15/12	17/15/12	15/13/11
Servo valves	16/14/11	16/14/11	15/13/10
Pressure/Flow controls	19/17/14	19/17/14	19/17/14
Cylinders	20/18/15	20/18/15	20/18/15
Vane motors	20/18/15	19/17/14	18/16/13
Axial piston motors	19/17/14	18/16/13	17/15/12
Radial piston motors	20/18/14	19/17/13	18/16/13

Weights, Ordering, Installation/Start-up

Weights in kg (lb)*

Pump Size	Basic Pump	Thru-drive Pump SAE "A"
PVH057	30–36	31-37
PVH063	(66-79)	(68-82)
PVH074	39-45	42-48
PVH081	(86-99)	(93-106)
PVH098	43-49	44-50
PVH106	(95-108)	(97-110)
PVH131	60-66	62-68
PVH141	(132-145)	(137-150)

*Approximate dry weights. Weight for a given model depends upon the type of pump control selected.

Ordering Procedure

Order PVH pumps by the full model designation. Pump displacement, mounting flange type, direction of rotation, pump configuration, shaft end type, shaft seals, pressure adjustment range, specific control functions, and torque limiter settings are all specified in the full model code.

Various Vickers® relief valves from Eaton are suitable for use with the "IC" compensator and must be ordered separately.

Examples include:

- DGMC2-3-AT-BT (plus DG4V-3-8C directional valve) for remotely and electrically controlled dual-pressure compensation, and standby no-flow pump operation in the load sensing mode.
- DGMC-3-PT-FW-30 crossline relief module (with DG4V3-8C directional valve) for electrical selection of dual pressure compensation.
- ECGF-02-9-21 proportional relief valve, with feedback, for remote control of pressure compensation.
- ECG-02-9-30 proportional relief valve for remote control of pressure compensation.
- DGMC-3-AT-BT (plus DG4V-3-0A directional valve) for remotely and electrically selected dual-pressure compensation.
- C175-F-20 (plus blanking plate DGMA-3-B-11 and tapping plate DGMA-T2-20-S) for remote control of pressure compensation.
- CVGC-3-S12 for non-remote control of pressure compensation.
- DGMC-3-PT-FW-30 crossline relief module (with blanking plate DGMA-3-B-11) for non-remote control of pressure compensation.

Contact your Vickers representative for additional information on the application and ordering of relief valves.

Installation and Start-up

The installation of PVH pumps must be in accord with the data on pages 16 and 27.

Before the pump is started, fill the case through the uppermost drain port with hydraulic fluid of the type to be used. The case drain line must be connected directly to the reservoir and terminate below the oil level.

If the pump has the vertical-mount option, attach a secondary drain line as noted on page 29.

Maximum continuous pressure at the case drain port must not exceed 0,5 bar (7 psi). For multiple pump arrangements that include non-PVH sections, the requirements of the non-PVH units must be considered.

Eaton
Hydraulics Business USA
14615 Lone Oak Road
Eden Prairie, MN 55344
USA
Tel: 952-937-9800
Fax: 952-294-7722
www.eaton.com/hydraulics

Eaton
Hydraulics Business Europe
Route de la Longeraie 7
1110 Morges
Switzerland
Tel: +41 (0) 21 811 4600
Fax: +41 (0) 21 811 4601

Eaton
Hydraulics Group Asia Pacific
Eaton Building
No.7 Lane 280 Linhong Road
Changning District, Shanghai
200335 China
Tel: (+86 21) 5200 0099
Fax: (+86 21) 2230 7240

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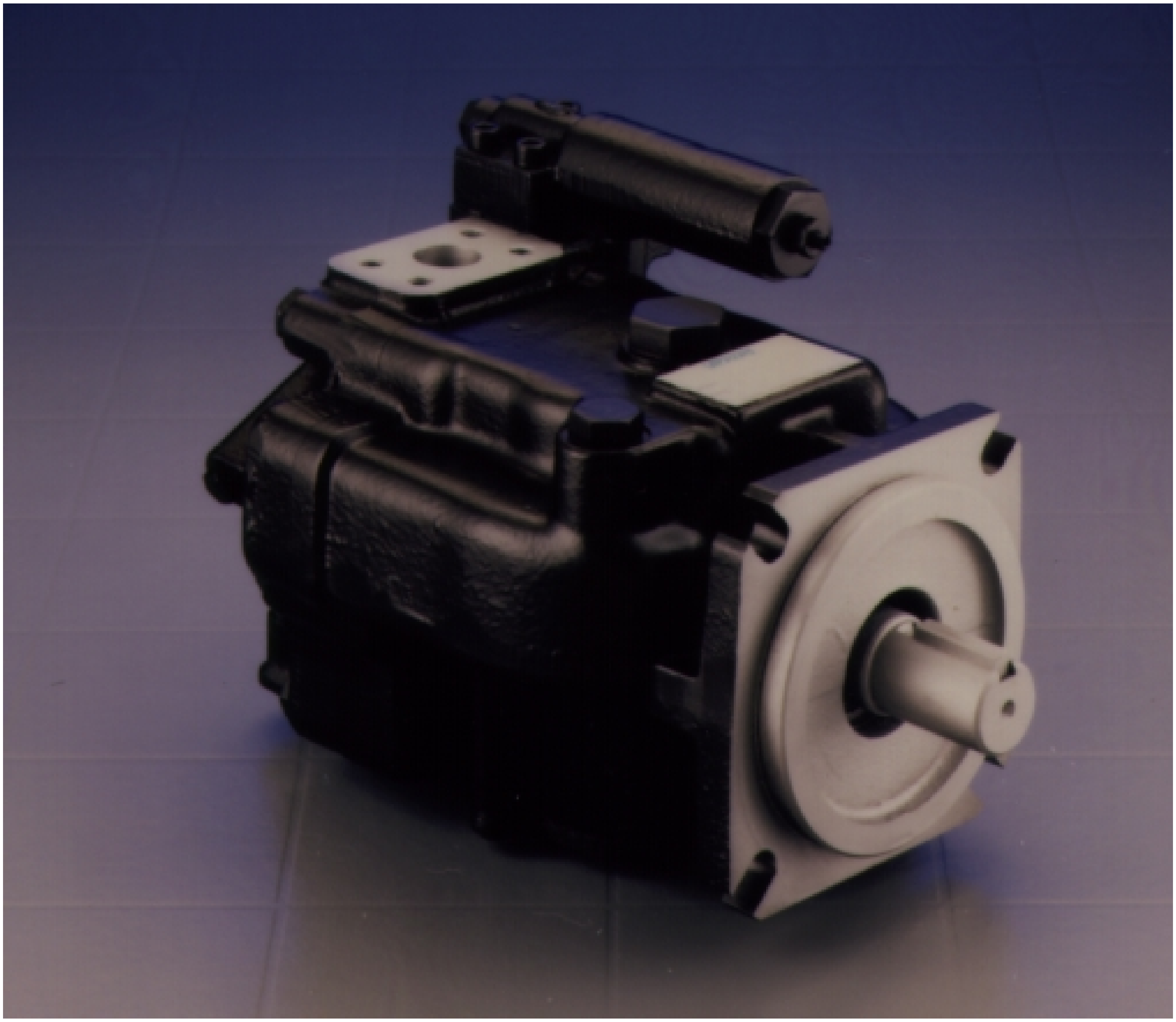
Vickers®

Overhaul Manual

Piston Pumps

PVH Piston Pumps

Including Controls



VICKERS

Rev. 2/93

M–2210–S

Section 1 – Introduction

A. Purpose of Manual

This manual describes basic operating characteristics and provides overhaul information for the Vickers PVH 57/74/98/131 series piston pumps. The information contained herein pertains to the latest design series as shown in the model code.

B. Related Publications

Installation dimensions for the PVH series pumps and controls are not included in this manual. Individual parts numbers for the basic pumps are also not included. Refer to the related publication list below for publications that include this type of information.

PVH57	Service drawing	M–2206–S
PVH74	Service drawing	M–2207–S
PVH98	Service drawing	M–2208–S
PVH131	Service drawing	M–2209–S
PVH	Series Application	GB–C–2010

C. Model Code Description

Variations within each basic model series are covered in the model code as shown on the next page. Service inquires should always include the complete unit model code number as stamped on the name plate, and the assembly number as stamped on the mounting flange.

Model Code

Industrial pumps

PVH * QI * – * (*) * – ** * – 10 – C(M) ** (**) (**) – *0 – *****

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Mobile pumps

PVH * - C – * (*) * – ** * – 10 – C ** (**) (**) – *0 – *****

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

1 Piston pump, variable displacement

2 Maximum geometric displacement

57 = 57.4 cm^3/r (3.5 in^3/r)
74 = 73.7 cm^3/r (4.5 in^3/r)
98 = 98.3 cm^3/r (6.0 in^3/r)
131 = 131.1 cm^3/r (8.0 in^3/r)

3 Industrial version

4 Mounting flange, prime mover end

C = SAE "C" 4–bolt type (SAE J744-127-4)
M = ISO 3019/2–125B4HW (Option for PVH57QI and PVH/74QI only)

5 Shaft rotation, viewed at prime mover end

R = Right hand, clockwise (Standard on QI models)
L = Left hand, counterclockwise (Optional on QI models)

6 Configuration

Blank = Non-thru-drive (single pump)
A = Thru-drive pump with SAE "A" 2-bolt rear flange mounting (SAE J744-82-2)
B = Thru- drive pump with SAE "B" 2- and 4-bolt rear flange mountings♦ (SAE J744-101-2/4)
C = Thru-drive pump with SAE "C" 2- and 4-bolt rear flange mountings♦(SAE J744-127-2/4)
S = Adjustable maximum volume stop (non-thru-drive and non-torque-control pumps only)

7 Main ports

F = SAE 4-bolt flange pads (standard)
M = SAE 4-bolt pads with metric mounting bolt threads (PVH57 & PVH74 only)

8 Shaft-end type, at prime mover end

N =	ISO 3014/2-E32N	Short straight keyed
1 =	SAE "C" (J744-32-1)	Straight keyed
2 =	SAE "C"▪ (J744-32-4)	Splined 14 tooth 12/24 D.P.
3 =	SAE "CC" (J744-38-4)	Splined 17 tooth 12/24 D.P.
12 =	SAE "D" (J744-44-4)	Splined 13 tooth 8/16 D.P.
13 =	SAE "C (J744-38-1)	Straight keyed
16 =	SAE "D" (J744-44-1)	Straight keyed

9 Shaft seal, prime mover end

S = Single, one-way (standard)
D = Double, two-way (optional) Recommended on second pump of tandem assembly (PVH**/ PVH**)

10 Pump design number

10 (Subject to change. Installation dimensions unaltered for design numbers 10 to 19 inclusive.)

11 Pressure compensator adjustment range

C = 70-250 bar (1015-3625 psi) (standard)
CM = 40-130 bar ((580-1885 psi) (optional QI version)
IC = Industrial control
UV = Unloading valve control for accumulator circuits

♦ Built from pump with SAE "A" rear pad to which suitable flange adapter is bolted. For best availability and flexibility, order PVH SAE "A" thru-drive pump and SAE "B" or "C" adapter kit separately.

12 Pressure compensator factory setting in tens of bar

25 = Normal factory setting of 250 bar for "C" models.
7 = Normal factory setting of 70 bar for "CM" models.

13 Additional control functions

Blank = No additional controls
V = Load sensing, 20 bar differential pressure setting
T = Torque limiter
VT = Load sensing and torque limiter

14 Torque limiter factory setting

** = Customer desired torque limiter setting specified in ten bar (145 psi) increments, e.g.:
8 = 80 bar (1160 psi);
18 = 180 bar (2610 psi).
The torque setting range is from 30–80% of the specified compensator setting.

15 Control design number

31 = C, CM, or C**V controls.
13 = C**T controls
14 = C**VT controls
10 = UV and IC controls

16 Special features suffix

027= Composite 2-bolt/4-bolt mounting conforming to SAE "C" (except PVH131)
031= Thru-drive SAE "A" pad cover
041= No case-to-inlet relief (for use with supercharged circuits)
057= Shaft-up operation (vertical mount)

▪ Torque restrictions apply to #2 shaft in PVH74 and 98 thru-drive, and PVH131 single and thru-drive, pumps. Vickers is not responsible for misapplied usage of these shafts. Please contact a Vickers representative for review of your application.

Section 2 – Description

A. Basic Pump

Figure 1 shows the basic construction of the PVH series piston pump. Major parts include the drive shaft, housing, yoke, rotating group, valve plate, control piston, bias piston, valve block and compensator control. The PVH series replaces the pintle bearing assembly with saddle bearings, which reduces weight and eliminates the roller bearings that added to maintenance time and overhaul costs.

B. Pump Controls

Two common pump control types are available. One type is the standard “C” compensator control that limits pump outlet pressure to a desired level. The other type is the “CV” pressure limiter/load sensing control. Now available is the “IC” (Industrial Control) which can be used as a load sensing compensator, remote compensator control and electrohydraulic control. These limit pump outlet pressure and also regulate pump displacement to match load requirements.

Section 3 – Principles of Operation

A. Pump Operation

Rotation of the pump drive shaft causes the cylinder block, shoe plate and pistons to rotate (See Figure 2). The piston shoes are held against the yoke face by the shoe plate. The angle of the yoke face creates a reciprocating motion to each piston within the cylinder block. Inlet and outlet ports connect to a kidney slotted wafer plate. As the pistons move out of the cylinder block, a vacuum is created and fluid is forced into the void by atmospheric pressure. The fluid moves with the cylinder block past the intake kidney slot. The motion of the piston reverses and fluid is pushed out of the cylinder block into the outlet port.

Warning

Before breaking a circuit connection, make certain that power is off and system pressure has been released. Lower all vertical cylinders, discharge accumulators, and block any load whose movement could generate pressure. Plug all removed units and cap all lines to prevent the entry of dirt into the system.

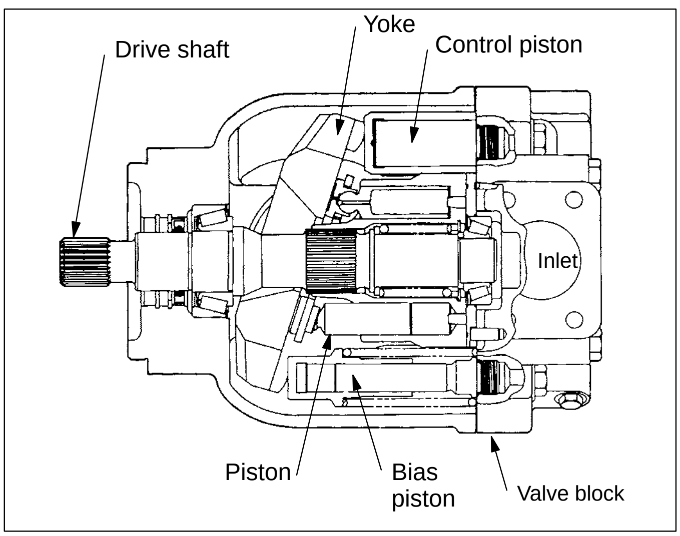


Figure 1. PVH Section View

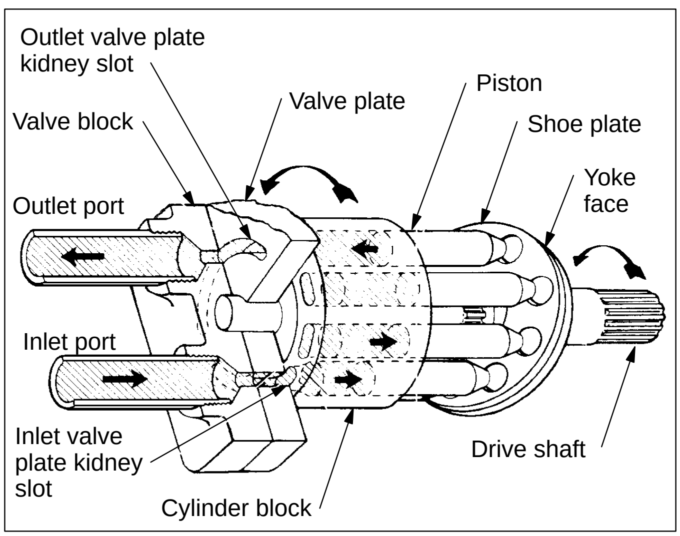


Figure 2. PVH Pump Operation

B. Pump Controls

Pressure Compensator Controls "C" & "CM"
(Figure 3)

The standard "C" and low pressure "CM" compensator controls are internally pilot operated, spring offset, 2-way valves. Their purpose is to limit system pressure to a desired level by varying pump displacement. These controls only provide the flow required to satisfy the load demand, while maintaining a constant preset pressure.

During operation, load or system pressure is continually fed to the bias piston. The function of the bias piston is to maintain the yoke at a full pump displacement position. Load or system pressure is also fed to the compensator spool chamber within the control. Pressure within the compensator spool chamber acts upon the spring force of the compensator spring.

When load or system pressure is below the pressure setting of the compensator spring, the compensator spool remains offset and the pump continues to operate at full displacement. When load or system pressure approaches the compensator pressure setting, the compensator spool will start to move and overcome the compensator spring force. Fluid will then meter into the control piston area. Since the control piston area is greater than that of the bias piston, the control piston pushes the yoke towards minimum pump displacement. The compensator control continues to meter fluid to the control piston, adjusting the pump displacement, and pumping only enough fluid to satisfy the load demand while holding the system at a constant pressure.

When load or system pressure exceeds the compensator setting, the compensator spool shifts towards the spring chamber area. A maximum amount of fluid is then metered to the control piston area, causing the yoke to shift to minimum pump displacement.

When system pressure decreases below the compensator pressure setting, the compensator spool returns to its original position and the yoke returns to maintain maximum pump displacement.

The compensator is available in two pressure ranges. The "C" spring has an adjustment range of 70–250 bar (1015–3625 psi). The "CM" spring has an adjustment range of 40–130 bar (580–1885 psi).

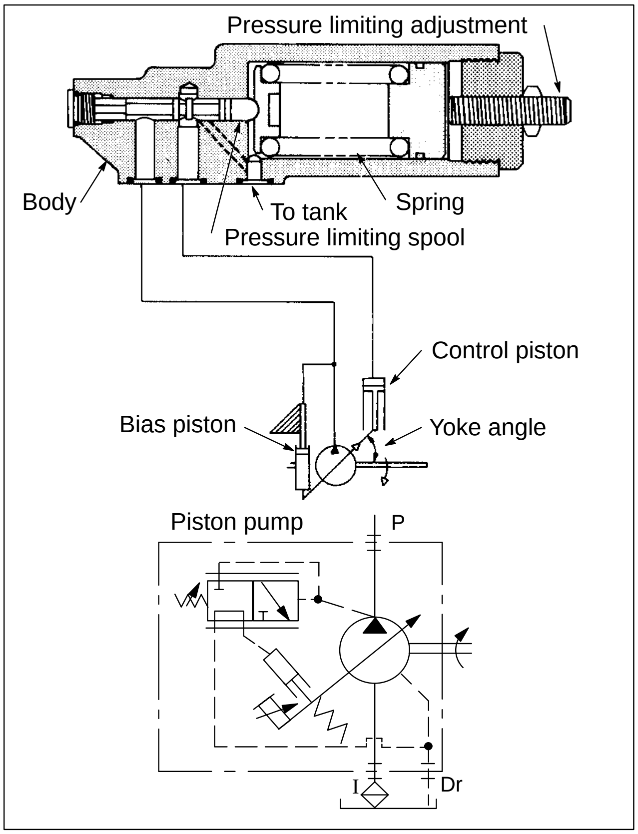


Figure 3. "C" & "CM" Controls

Load Sensing & Pressure Compensator Control C(M)*V
(Figure 4)

This pump will provide power matching of pump output to system load demand, maximizing efficiency and improving load metering characteristics of any directional control valve installed between the pump and the load.

Load sensing ensures that the pump always provides only the amount of flow needed by the load. At the same time, the pump operating pressure adjusts to the actual load pressure plus a pressure differential required for the control action. Typically, the differential pressure is that between the pressure inlet and service port of a proportionally controlled directional valve, or a load sensing directional control valve.

When the system is not demanding power, the load sense control can operate in an energy-saving stand-by mode. To achieve the low pressure, no flow, stand-by mode, the load sense signal line must be drained to the tank externally.

The standard differential pressure setting for load sense is 20 bar (290 psi), but can be adjusted to between 17 and 30 bar (247 and 435 psi) on the pump.

If the load pressure exceeds the system pressure setting, the pressure compensator de-strokes the pump. The load sensing line must be as short as possible and can also be used for remote control or unloading of the pump pressure. For remote control, it is recommended that you contact your Vickers representative for the correct configuration of the control.

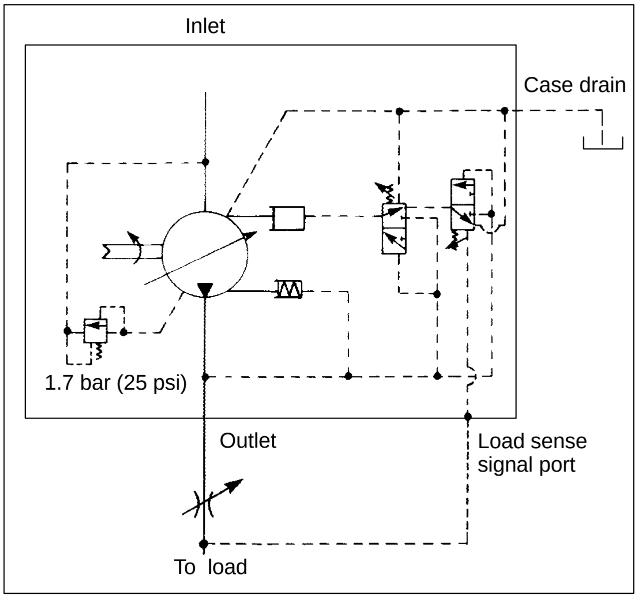


Figure 4: C(M)*V Control

PVH with UV Control for Accumulator Circuits
(Figure 5)

This pump control functions as a load- sensing pressure compensator that unloads the pump at a preset pressure and loads the pump after preset pressure drop.

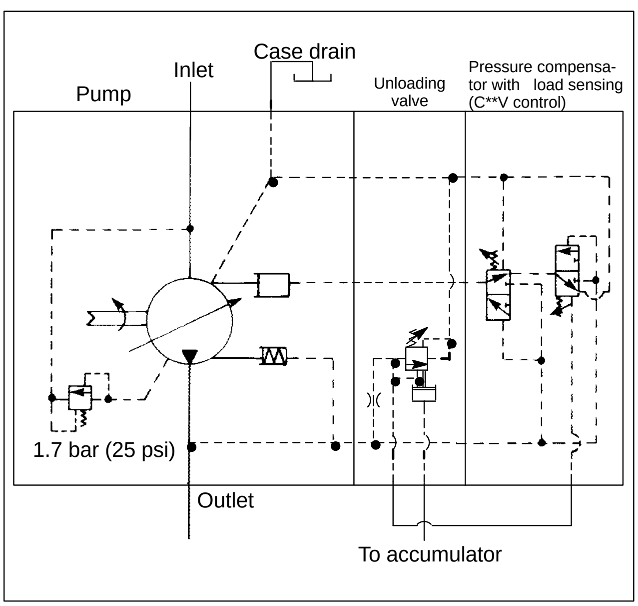


Figure 5: UV Control

Pressure & Torque Limiter Control CT**
(Figure 6)

This pump senses pressure and flow and starts destroking at a predetermined input torque level. The rate of flow reduction is normally tailored to follow the maximum power capability curve of the prime mover. Input torque is limited while the pressure compensator limits the system pressure.

When the input speed remains constant (i.e. industrial drives), the torque limiter acts as an input power limiter. This allows a smaller electric motor to be used if maximum pressure and maximum flow are not required at the same time. At low load levels, the control permits high pump displacement and high load speeds. Under heavy loads, speed is reduced, preventing stalling of the prime mover. In the case of variable speed drives (I.C. engines), this function provides, in addition to pressure compensation or limiting, a torque limiting ability that can be adjusted to the torque/speed characteristics of the engine.

The start of torque limiting (pump-destroking) is pressure dependent. The pressure is selectable (see model code) and is factory preset to between 30% and 80% of the maximum pressure control setting. The adjustment range for the “C” compensator is 80 to 200 bar (1160 to 2900 psi) in 10 bar (145 psi) increments. There is no “CM” spring option available with the torque limiting control.

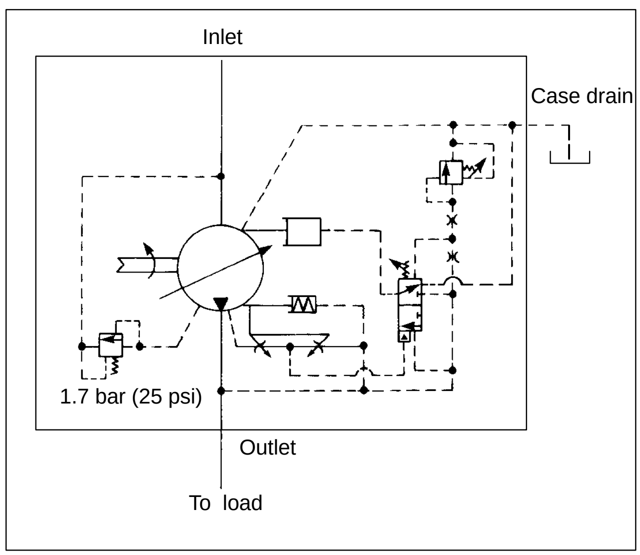


Figure 6: CT Control**

Torque Limiting Plus Load Sensing Control CVT**
(Figure 7)

This pump control option functions like a load sensing control, but with additional torque limiting tailored to the size of the drive motor selected. The limiting function is the same as for a pressure compensator with torque limiting. The combination of the two controls provides the following benefits:

Principles of Operation

1. The energy savings of a variable displacement load sensing control.
2. The pump pressure follows the load pressure.
3. The torque control allows smaller drive motors to be used.
4. The pressure compensator de-strokes the pump as maximum pressure is reached.
5. The pump pressure can also be remotely controlled using the load sense line. The C**VT control allows complete control of flow and pressure, either mechanically or electrically, if used with proportional valves.

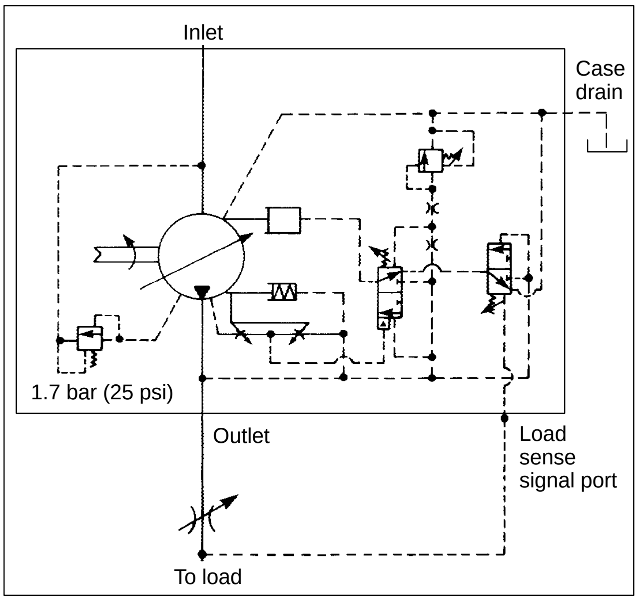


Figure 7: CVT Control**

Industrial Control
(Figures 8 & 9)

This pump control option is intended for use when multiple, remote, or electrically controlled compensating settings, with or without load sensing, are desired.

Pressure compensation is obtained by removing an internal plug, keeping the load-sense signal port plugged, and internally applying pilot pressure to the spring chamber of the pilot-operated control spool. For pressure compensation with load sensing, the internal plug stays, the load-sense signal port is unplugged, and pilot pressure is externally applied.

An external relief valve is used to set system pressure. The externally adjustable control-spool spring determines the differential pressure setting of the pump control. Pilot (spring chamber) pressure is separated from outlet pressure by an internal orifice. Outlet pressure shifts the spool when pressure drop across the orifice reaches the differential pressure setting, and the pump de-strokes.

The relief valve can be mounted to an NFPA-D03/ISO 4401-03 pad on the pump control, or remotely located via tapping and blanking plates installed on the pad.

The standard factory-set differential pressure setting of the pump control is 20 bar (290 psi) and is not specified in the pump model code. Any other ordered differential pressure, within the control's adjustable pressure range of 17–35 bar (247–508 psi), will be specified in the model code following the "IC" control code; for example, "-IC30-" for a 30 bar setting.

Application examples:

Mounting	Control Type
● EHST	Electrical control compensator
● DG valve w/DGMC	Double or triple compensator
● C–175	Remote control relief valve
● CGE–02	Electrical relief valve

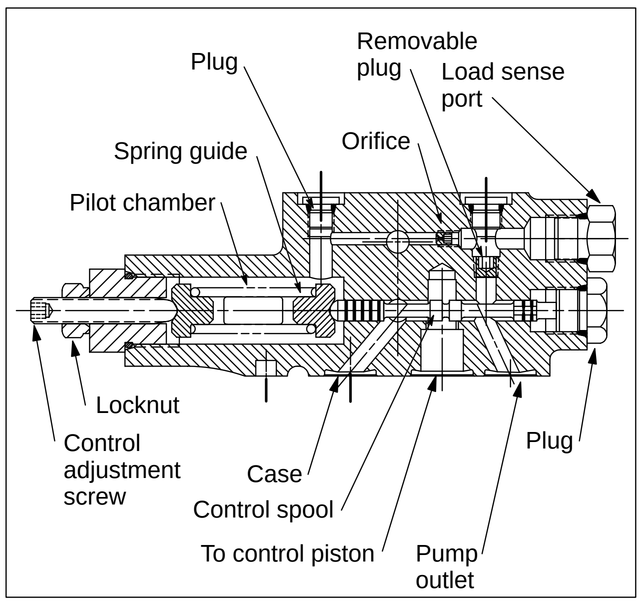


Figure 8: Industrial Control Section View

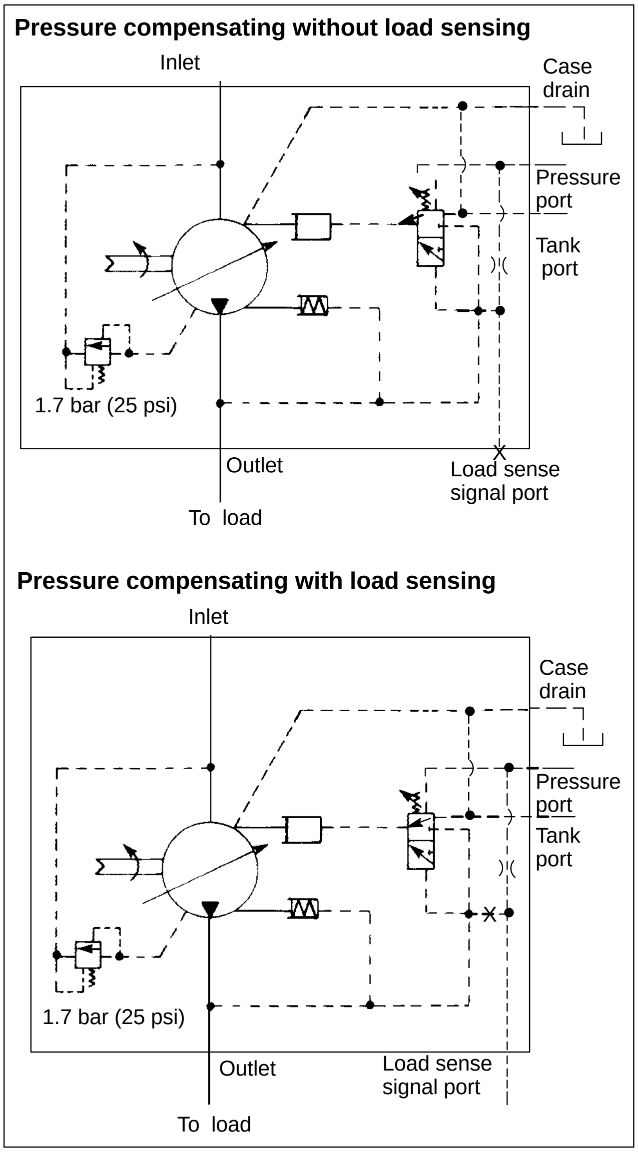


Figure 9: Industrial Control

C. Load Sensing/Pressure Limiting Operation

As one would expect from the title, this control is a combination of the features of both the pressure limiting and load sensing controls. Refer to Figure 10.

The load sensing spool senses the pressure difference (pressure drop ΔP) between pump outlet and load pressure across a series flow control or system directional valve which is inherent in its operation. This differential pressure causes the load sensing spool to move against its spring to the closed–center position. If the differential pressure (pressure drop ΔP) increases (greater flow through the series valve), the load sensing spool moves to the right. This opens discharge to the control piston. Outlet pressure at the control piston strokes the yoke toward a lower flow and when differential pressure again causes the load sensing spool to move to the closed-center position.

If differential pressure lowers (less flow through the series valve), the load sensing spool moves to the left, opening the control piston to tank. The bias piston then strokes the yoke toward a higher flow. When differential pressure (pressure drop), increases enough to move the load sensing spool to the closed-center position, yoke movement will stop and flow will remain constant.

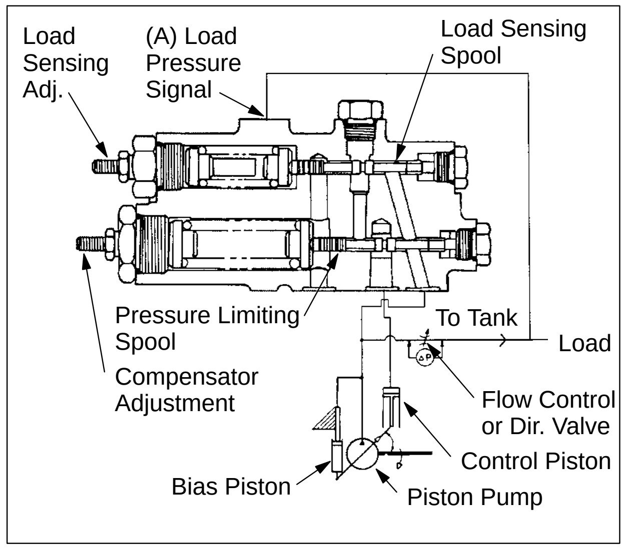


Figure 10: Load Sensing Control System

The load sensing portion of the control operates as a function of the pressure drop across the series valves (pressure drop ΔP), and is independent of system pressure. It establishes a constant flow characteristic from the pump based on the magnitude of the directional valve opening (operator controlled).

If outlet pressure increases to the maximum pressure limit setting, the pressure limiting spool meters fluid to the control piston. The control piston moves the yoke to reduce flow. If outlet pressure continues to rise, the spool will continue to meter fluid to the control piston and the pump will stroke to zero flow at maximum pressure.

Reduced horsepower standby feature

When the system flow control valve or directional valve is closed completely, the circuit is placed in standby.

Note

This feature assumes the system flow control valve or directional valve provides decompression of load sensing pressure in the standby, fully closed position. Pressure at point A (Figures 10 & 11) must decay toward zero through the system flow control or directional valve for standby to occur. Decompression of the load sensing pressure allows the pump to stroke to zero flow and minimum pressure. The circuit functions in the following manner.

Assume the flow control or directional valve is closed and there is no bleed of point A (Figure 10) to tank. The fluid is trapped and the load sensing spool is held to the left by the spring. The system pressure rises until the pressure limiting spool takes over. The yoke then stokes to zero flow and holds pressure at the maximum limiter setting.

If, in the closed condition, the flow control or system directional valve bleeds point A (Figures 10 & 11) to tank, the load sensing feedback pressure will decay. The load sensing spool will shift to the left. Fluid then meters through the pressure limiting spool and into the control piston. Outlet pressure decays through pump leakage following the decay of feedback pressure A (Figures 10 & 11) until minimum pressure drop is reached. The pump will operate in the standby mode (zero flow, minimum pressure) until the flow control or system directional valve demands flow from the pump. At this time, normal operation of the control will resume.

D. Adjustment procedure: Load Sensing Pressure Limiting Control

General

This procedure contains information on the PVH pressure limiting and load sensing control. Test and adjustment procedures are provided for standard units.

Note

Pressure gauges must be installed into the system before adjustment of the control can be performed. Complete field test adjustment procedures are included.

Set up

Make sure all machine controls are in the OFF or neutral position.

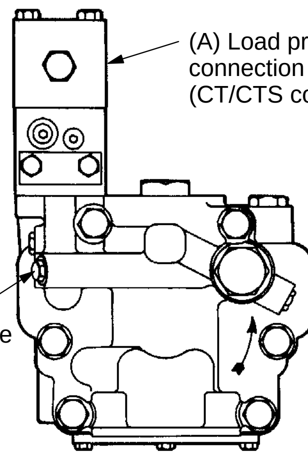


Figure 11: Gauge Connection

Connect a 5000 psi pressure gauge at the outlet of the piston pump and on load sensing models, in the load sensing line.

Check pump housing to verify that it is full of system fluid.

Jog the engine to prime the pump, then exercise the controls to eliminate entrained air in the system.

Pressure Limiter Adjustment

Move an appropriate cylinder on the machine until it bottoms out. From the center condition, crack the control valve lever toward the bottomed out position enough to allow pressure build up in the system. DO NOT exceed the maximum pressure limit noted in Table 1. If the maximum pressure limit does not correspond to Table 1, adjustment of the control is required.

Caution

DO NOT adjust control while machine is running.

Adjust the pressure limit set screw (clockwise to increase, counterclockwise to decrease) until the pressure noted in Table 3 is obtained.

Pump Model	Maximum Pressure Limit	
	bar	psi
–C18V–30	180	2610
–C19V–30	190	2755
–C20V–30	200	2900
–C25V–30	250	3625

Table 1. Control Pressure Specifications

Load Sensing Valve Adjustment

While slowly moving an actuator on the machine, observe pump pressure and load pressure. The difference between pump pressure and load pressure is the load sense pressure drop. To increase the load sensing pressure drop (ΔP), rotate load sensing adjusting screw clockwise. To decrease the setting, rotate the load sensing adjusting screw counterclockwise. The standard factory setting is 290 psi Δ. If this pressure drop is set too low, system instability can occur. Correct this by increasing pressure drop.

E. Overhaul of PVH Controls

Disassembly of C, CM Control (Refer to Figure 12)

Caution

DO NOT disassemble or remove control while engine is running. Make sure power is OFF and hydraulic cylinders are lowered. Discharge accumulators and block any load whose movement could generate pressure.

Note

In the following step if pump control is mounted at the 12 o'clock position, complete draining of the pump will not be required. Some draining will occur until fluid level reaches drain port level of the control.

1. Remove drain plug (47, see Figure 29) from pump housing and drain fluid from pump. Remove all tubing connected to the control.

2. Remove the control by loosening four screws (1b) that hold the control to the valve block. Remove o–rings and discard.

3. Install the control into a vise with the jaws resting on the outside of body (13b).

4. Remove nut (4b), with the associated o–ring (7b). Remove adjusting screw (5b), remove spring seat (6b), spring (8b) and spring guide (9b).

5. Remove plug (10b) and o–ring (11b), remove spool (12b).

Follow the same inspection, repair and replacement procedure as outlined for the Industrial Control.

Assembly

Note

Obtain seal kit for the control (check service drawing for part number). Replace all seals and back up rings with new ones from the kit. Refer to Figure 12 during assembly. Special assembly procedures will be noted in the step–by–step procedure.

Note

Lubricate all parts with system fluid at assembly. O–rings and back up rings require a viscosity improver to facilitate assembly.

1. Assemble spool (12b) into valve body (13b) with rounded end of spool pointing toward adjustment plug end of valve. Assemble o–ring (11b) on plug (10b) thread plug (10b) into body (13b). Torque plug to 9.8–10.2 N.m. (7–7.5 lb.ft.).

2. Install parts (9b, 8b, 6b, 5b) in the order shown in exploded view.

3. Install plug (4b) and o–ring over spring seat (6b). Make sure adjusting screw (5b) is threaded through plug (4b). Make sure adjusting screw (5b) is lubricated. Thread on nut (3b).

C Control (b)

Item	Description	Qty	Item	Description	Qty
1b	Screw	4	7b	O–Ring	1
2b	O–Ring	3	8b	Spring	1
3b	Nut	1	9b	Spring guide	1
4b	Plug	1	10b	Plug	1
5b	Adjusting screw	1	11b	O–Ring	1
6b	Spring seat	1	12b	Pressure comp. spool	1
			13b	Control body	1

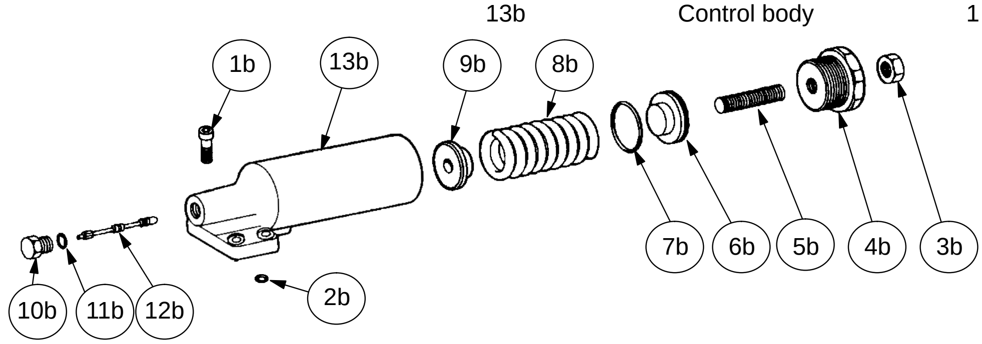


Figure 12: C, CM Control Exploded View

Disassembly of CV Control (Refer to Figure 13)

Caution

DO NOT disassemble or remove control while engine is running. Make sure power is OFF and hydraulic cylinders are lowered. Discharge accumulators and block any load whose movement could generate pressure.

Note

In the following step if pump control is mounted at the 12 o'clock position, complete draining of the pump will not be required. Some draining will occur until fluid level reaches drain port level of the control.

1. Remove drain plug (47, see Figure 29) from pump housing and drain fluid from pump. Remove all tubing connected to the control.

2. Remove the control by loosening four screws (1a) that hold the control to the valve block. Remove o–rings and discard.

3. Install the control into a vise with the jaws resting on the outside of body (7a).

4. Remove nuts (14a), then remove plugs (15a and 13a) with their associated o–rings (12a and 16a). Remove adjusting screws (11a), remove spring seats (10a), springs (9a and 18a) and spring guides (8a).

5. Remove plugs (4a) and associated o–rings (3a), remove spools (2a and 5a).

Follow the same inspection, repair and replacement procedure as outlined for the Industrial Control.

Assembly

Note

Obtain seal kit for the control (check service drawing for part number). Replace all seals and back up rings with new ones from the kit. Refer to Figure 13 during assembly. Special assembly procedures will be noted in the step–by–step procedure.

Lubricate all parts with system fluid at assembly. O–rings and back up rings require a viscosity improver to facilitate assembly.

1. Assemble spools (2a and 5a) into valve body (7a) with rounded end of spool pointing toward adjustment plug end of valve. Pressure compensating spool (5a) has five grooves versus three on the load sensing spool (2a). Make sure to note this distinction for proper assembly. Assemble o–rings (3a) on plugs (4a) and on plugs (15a and 13a) then thread plugs (4a) into body (7a). Torque plugs to 9.8–10.2 N.m. (7–7.5 lb.ft.).

2. Install parts (8a, 9a, 10a, 11a, 17a and 18a) in the order shown in exploded view.

3. Install plugs (13a and 15a) with their o–rings over spring guides (10a). Make sure adjusting screws (11a) are threaded through plugs (13a and 15a). Make sure adjusting screws (11a) are lubricated. Thread on nuts (14a).

CV Control (a)

Item	Description	Qty	Item	Description	Qty
1a	Screw	4	11a	Adjusting screw	2
2a	Load sensing spool	1	12a	O–Ring	1
3a	O–Ring	3	13a	Plug	1
4a	Plug	2	14a	Nut	2
5a	Pressure comp. spool	1	15a	Plug	1
6a	O–Ring	3	16a	O–Ring	1
7a	Control body	1	17a	Spring stop	1
8a	Spring guide	2	18a	Spring	1
9a	Spring	1	19a	Plug	1
10a	Spring Seat	2			

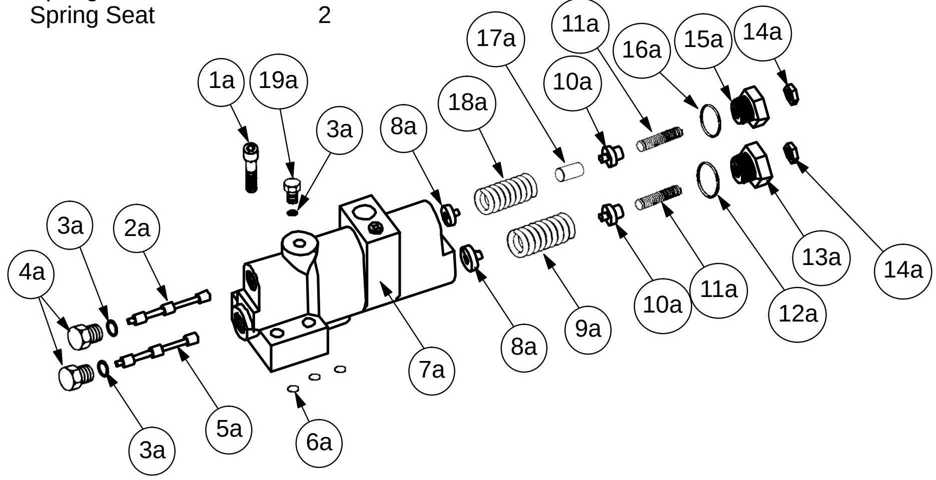


Figure 13: CV Control Exploded View

PVH with pressure compensation, load sensing and unloading valve

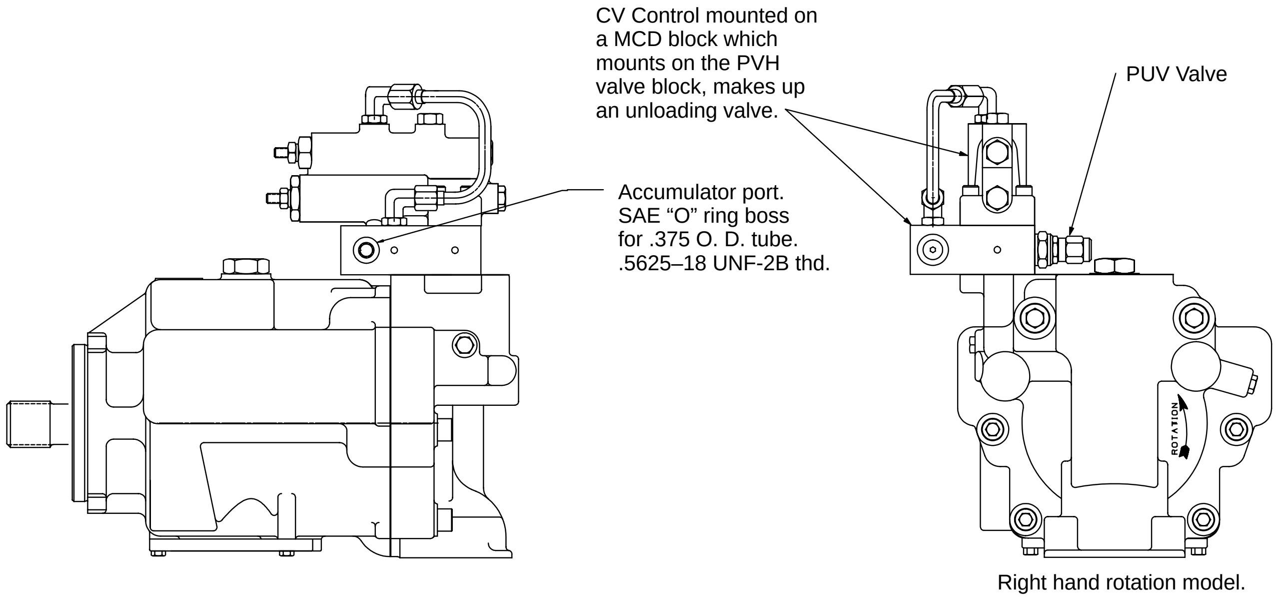


Figure 14: UV Unloading Control

Unloading Valve

Refer to Figure 14.

Refer to the overhaul procedure for the CV control. The MCD block and screw–in cartridge cannot be overhauled, replace if necessary.

Disassembly of Industrial Control

Refer to Figure 15.

Caution

DO NOT disassemble or remove control while engine is running. Make sure power is OFF and hydraulic cylinders are lowered. Discharge accumulators and block any load whose movement could generate pressure.

Note

In the following step if pump control is mounted at the 12 o'clock position, complete draining of the pump will not be required. Some draining will occur until fluid level reaches drain port level of the control.

1. Remove drain plug (47, see Figure 28) from pump housing and drain fluid from pump. Remove all tubing connected to the control.

2. Remove the control by loosening four screws (19) that hold the control to the valve block. Remove o–rings and discard.

3. Install the control into a vise with the jaws resting on the outside of body (17).

4. Remove nut (1) and adjusting screw (2), then remove nut (3) and associated o–ring (4). Remove spring guides, pin (not on PVH131), and spring (parts 5, 6, & 7). Discard o–rings.

5. Remove plugs (13 and14), remove and discard o–rings (12 and 15). Remove orifice plug (11) if necessary, and slide out spool (16).

Inspection, Repair & Replacement

Note

All parts must be thoroughly cleaned and kept clean during inspection and assembly. Clean all removed parts with a solvent that is compatible with system fluid. Compressed air may be used in cleaning, but must be filtered to remove water and contamination. Clean compressed air is especially useful in cleaning body passages.

Note

Replace all parts that do not meet the following specifications:

1. Inspect the threads and o–ring grooves and adjustment screw (2). If threads are worn, replace. If o–ring grooves have burrs, remove the burrs with an India stone.

2. Inspect spring (7) for wear on the outside edge of the spring. Check spring ends for squareness. The spring ends must be parallel within (3°). If spring is bent or worn, replace the spring.

3. Check spring guides (5) for burrs. Clean up with an India stone if burrs are present.

4. Check spool (16) for erosion, burrs, and scratches. If the spool is eroded or scratched across a land, check body (17) for the same problem. If erosion is heavy in both parts, replace the valve. If the spool is scratched and the scratch cannot be removed by light polishing with 500 grit paper or crocus cloth, replace both the body and spool. Clean up burrs with an India stone.

Note

Reliable operation throughout the specified operating range is assured only if genuine Vickers parts are used. Sophisticated design processes and materials are used in the manufacture of our parts. Substitutions may result in early failure.

Assembly

Note

Obtain seal kit for the control (check service drawing for part number). Replace all seals and back–up rings with new ones from the kit. Refer to Figure 15 during assembly. Special assembly procedures will be noted in the step–by–step procedure.

Lubricate all parts with system fluid at assembly. O–rings and back–up rings require a viscosity improver to facilitate assembly.

1. Assemble spool (16) into valve body (17) with rounded end of spool pointing toward adjustment plug end of valve. Assemble O–rings (12 and 15) on plugs (13 and 14), (install orifice plug 11 if removed) then, thread plugs (13 and 14) into body (17). Torque plugs (13 and 14) to 9.8–10.2 N.m. (7–7.5 lb.ft.).

2. Install spring guides (5), spring (7) and pin (6) into body (17). Install o–ring (4) over plug (3) and thread screw into body (17). Install adjusting screw (2) and nut (1).

Note

Reassemble the control to the pump and connect all tubing and applicable relief valves. Perform the final adjustment of control assembly.

IC Control

Item	Description	Qty	Item	Description	Qty
1	Nut	1	10	Plug	1
2	Adjusting screw	1	11	Orifice plug	1
3	Plug	1	12	O–ring	1
4	O–ring	1	13	Plug	1
5	Spring guide	2	14	Plug	1
6*	Pin (not used on PVH131)	3	15	O–ring	1
7	Spring	1	16	Spool	1
8	Plugs & O–rings	3	17	Body	1
9	Plug & O–ring	1	18	O–rings	3
			19	Screw	4

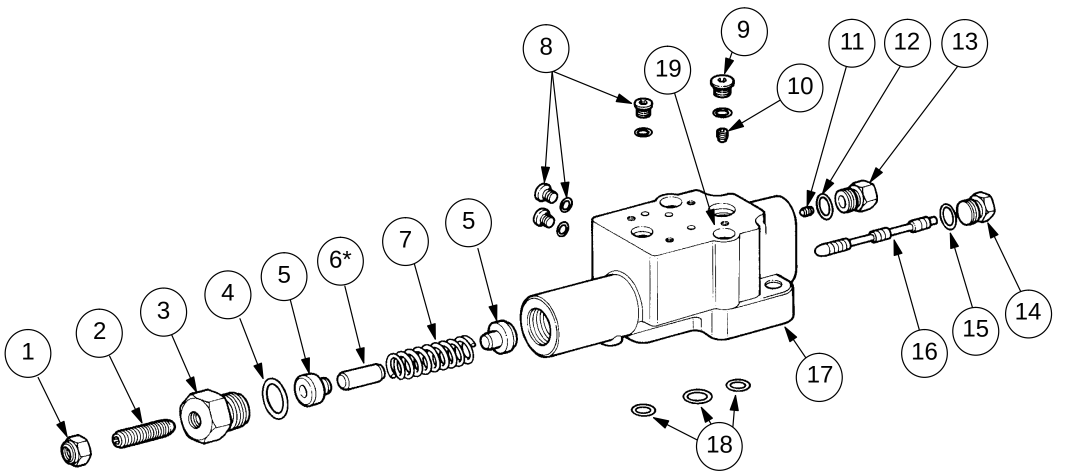


Figure 15: Industrial Control Exploded View

Disassembly CT Control

Refer to Figure 16.

Caution

DO NOT disassemble or remove control while engine is running. Make sure power is OFF and hydraulic cylinders are lowered. Discharge accumulators and block any load whose movement could generate pressure.

Note

In the following step if pump control is mounted at the 12 o'clock position, complete draining of the pump will not be required. Some draining will occur until fluid level reaches drain port level of the control.

1. Remove drain plug from pump housing and drain fluid from pump. Remove all tubing connected to the control.

2. Remove the control by loosening four screws (1d) that hold the control to the valve block. Remove the associated o–rings and discard.

3. Install the control into a vise with the jaws resting on the outside of body (4d).

Note

DO NOT remove adjusting screw (7d) and plug (6d) from cover unless a problem is found.

4. Remove screws (8d) and cover (9d) from body S/A (4d). Try not to rotate cover (9d) back and fourth during removal.

5. If spring guide (10d) is still located in cover (9d), pull the spring guide from the cover. Remove seals (11d and 12d) from the spring guide and seals (14d and 15d) from the cover. Discard the seals.

6. Tap cover (9d) against the work bench to remove pin (13d). If pin is stubborn, remove adjustment screw (7d), then, use a small brass rod and tap the pin from the cover. Insert 1/8" brass rod through the threaded hole of adjustment screw (7d).

7. Remove spring (16d) and spring seat (17d) from body S/A (4d).

8. Remove the torque limit parts as follows:

   a. Remove two screws (18d) and strap (19d) from body S/A (4d).

   b. Remove plug (20d) and slide pin (21d) from the end of plug. (NOTE: Tap end of spool with a brass rod to start plug out of body.) Remove seals (22d through 25d) and discard.

Follow the same inspection, repair and replacement procedure as outlined for the Industrial Control.

Assembly

Note

Obtain seal kit for the control (check service drawing for part number). Replace all seals and back up rings with new ones from the kit. Refer to Figure 16 during assembly. Special assembly procedures will be noted in the step–by–step procedure.

Note

Lubricate all parts with system fluid at assembly. O–rings and back up rings require a viscosity improver to facilitate assembly.

1. Place cover (9d) in a vise with o–ring groove pointing up and adjustment screw hole (7d) toward the technician.

2. Install o–ring (14d) and back-up ring (15d) on cover (9d) within the o–ring groove.

3. Install o–ring (12d) and back-up ring (11d) on plug (10d) and lubricate seals.

4. Insert pin (13d) into cover (9d). Make sure the plug is completely down into its bore. It may hang up on a ledge in the cover.

5. Place the end of spring guide (10d) into cover and slide down against the pin.

6. Place spring (16d) over the end of spring guide (10d) and set spring seat (17d) on top of the spring.

7. Pick up body (4d) and orient it with bottom interface up. Push spool toward the cover end opening to engage spring seat (17d). Gently slide body (4d) over the plug and spring parts and up against the cover. Install the four screws hand tight, then, test the spool for proper engagement with the spring guide. Use a length of brass rod for movement of the spool against the spring. The spool must bounce back or the spring seat is not in proper position. When the spring seat and spool are in position, place the body in the horizontal position and torque screws to 14.7–16 N.m. (11–12 lb.ft.).

8. If screw (7d) was removed, thread adjustment screw (7d) into cover (9d) until it is flush with cover. Install cover plug (6d).

9. Install o–rings (23d and 25d) and back-up rings (24d and 22d) on plug (20d). Back-up rings will be placed toward the ends of plug (20d).

10. Lubricate pin (21d) with petroleum jelly and insert into torque limiting plug (20d). Lubricate seals with a viscosity improver and insert the torque limiting plug into body S/A (4d). Make sure the pin does not fall out of torque limiting plug. (The plug must be held in the horizontal position during assembly.)

11. Assemble strap (19d) behind the plug and thread screws (18d) through strap into body S/A (4d). NOTE: Holes in strap are off center. Widest portion of strap from center holes will be placed toward the mounting face of body S/A (4d). Torque the screws to 30–38 N.m. (22–28 lb.ft.).

12. Install o–rings (5d) into body S/A (4d). Place cover (2d) over body S/A (4d) and insert screws (1d) through cover and into body S/A (4d). Place control in position on the pump valve body. Thread screws (1d) into pump and torque to 21–27 N.m. (15–20 lb.ft.). Make sure cover o–ring seals are located in-line with body openings.

CT Control (d)

Item	Description	Qty	Item	Description	Qty
1d	Screw	4	14d	O–Ring	1
2d	Cover	1	15d	Back–up ring	1
3d	O–Ring	4	16d	Spring	1
4d	Body S/A	1	17d	Spring seat	1
5d	O–Ring	5	18d	Screw	2
6d	Plug	1	19d	Strap	1
7d	Adjusting screw	1	20d	Plug	1
8d	Screw	4	21d	Pin	1
9d	Cover S/A	1	22d	Back–up ring	1
10d	Spring guide	1	23d	O–Ring	1
11d	Back–up ring	1	24d	Back–up ring	1
12d	O–Ring	1	25d	O–Ring	1
13d	Pin	1	26d	Pressure limiter screw	1

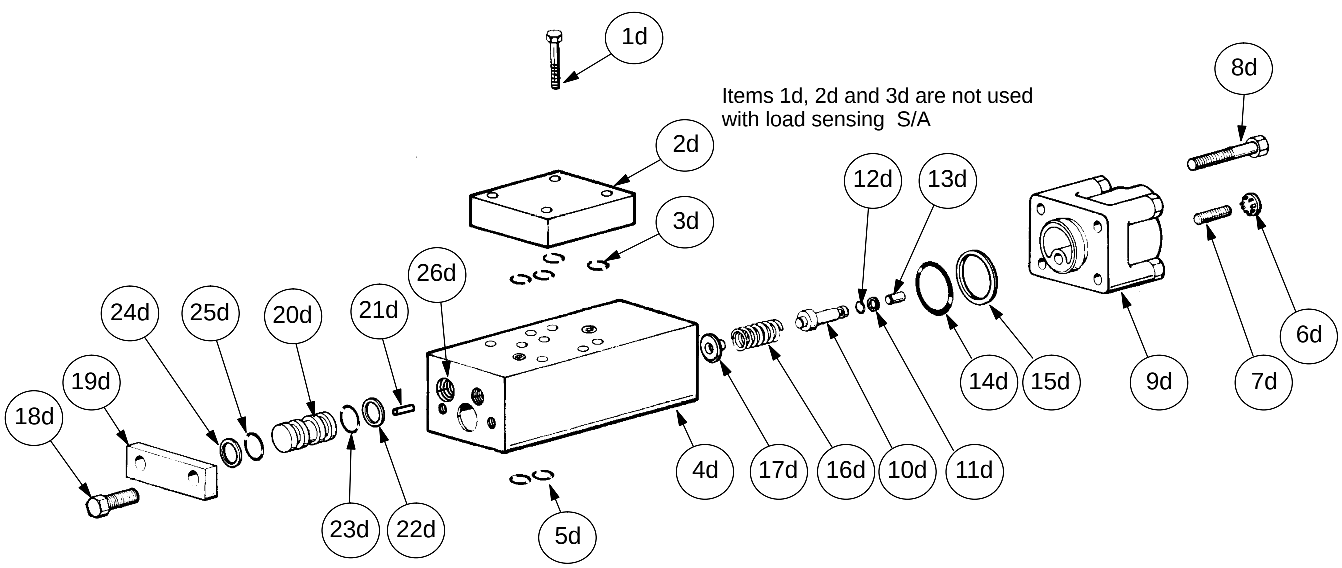


Figure 16: CT Control Exploded View

Disassembly Load Sensing Control (Refer to Figure 17)

Caution

DO NOT disassemble or remove control while engine is running. Make sure power is OFF and hydraulic cylinders are lowered. Discharge accumulators and block any load whose movement could generate pressure.

Note

In the following step if pump control is mounted at the 12 o'clock position, complete draining of the pump will not be required. Some draining will occur until fluid level reaches drain port level of the control.

1. Remove drain plug from pump housing and drain fluid from pump. Remove all tubing connected to the control.

2. Remove the control by loosening four screws (1c) that hold the control to the valve block. Remove the associated o–rings and discard.

3. Install the control into a vise with the jaws resting on the outside of body (2c).

4. Remove parts (4c through 9c), then remove plugs (10c and 13c) with their associated o–rings. Slide spool (12c) from the body and discard o–rings.

Follow the same inspection, repair and replacement procedure as outlined for the Industrial Control.

Assembly

Note

Obtain seal kit for the control (check service drawing for part number). Replace all seals and back up rings with new ones from the kit. Refer to Figure 17 during assembly. Special assembly procedures will be noted in the step–by–step procedure.

Lubricate all parts with system fluid at assembly. O–rings and back up rings require a viscosity improver to facilitate assembly.

1. Assemble spool (12c) into valve body (2c) with rounded end of spool pointing toward adjustment plug end of valve. Assemble o–rings (11c and 14c) on plugs (10c and 13c), then, thread plug (10c) into body (2c). Torque plug (10c) to 9.8–10.2 N.m. (7–7.5 lb.ft.).

2. Thread plug (13c) into body (2c) and torque to 29–32 N.m. (21–23 lb.ft.). Check RH/LH assembly position. Control position shown is for RH rotation.

3. Install spring (8c) over seat (9c) and insert spring and seat into valve body (2c).

4. Install back-up ring (7c) and o–ring (6c) on adjustment plug (5c or 5cc). Lubricate and thread adjustment plug (5c) into body (2c) until it is flush with face of body (-13 design). Adjust plug (5cc) full in then back off four turns (-14 design).

5. Insert cover (4c) over adjustment screw (5c, -13 design only). Thread nut (4cc) on adjustment screw (-14 design).

Torque Control/Load Sensing S/A (c)

Item	Description	Qty	Item	Description	Qty
1c	Screw	4	8c	Spring	1
2c	Body	1	9c	Spring seat	1
3c	O–Ring	4	10c	Plug	1
4c	Nut (–14 design)	1	11c	O–Ring	1
5c	Adj. Plug (–14 design)	1	12c	Spool	1
6c	O–Ring	1	13c	Plug	1
7c	Back–up ring	1	14c	O–Ring	1

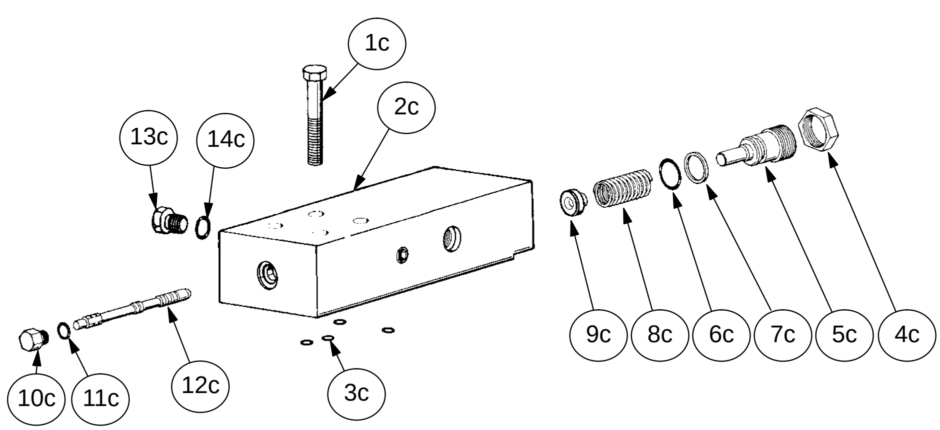


Figure 17: Torque Control/Load Sense S/A Exploded View

Section 4 – Installation

A. Lubrication

Internal lubrication is provided by the fluid in the system. Lubrication of shaft couplings should be as specified by their manufacturers. Coat shaft splines with a dry lubricant (Molycoat or equivalent) to prevent wear.

B. Mounting & Drive Connections

Caution

Pump shafts are designed to be installed in couplings with a slip fit. Pounding can damage the bearings.

1. Direct Mounting – A pilot on the pump mounting flange assures correct mounting and shaft alignment. Make sure the pilot is firmly seated in the accessory pad of the power source. Care should be taken in tightening the mounting screws to prevent misalignment.

2. Indirect drive is not recommended for these pumps without engineering approval.

C. Shaft Rotation

Shaft rotation (R or L) is specified by position 8 (page 4) of the model code which is stamped on the pump mounting flange.

Caution

Never drive a pump in the wrong direction of rotation. Seizure will result and cause expensive repairs.

D. Piping & Tubing

1. All pipes and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sandblasting, wire brushing, pickling, and power flushing with a clean solvent to remove loose particles.

Note

For information on pickling, refer to instruction sheet 1221–S.

2. To minimize flow resistance and the possibility of leakage use only as many fittings and connections as necessary for proper installation.

3. The number of bends in tubing should be kept to a minimum to prevent excessive turbulence and friction of oil flow. Tubing must not be bent too sharply. The recommended minimum radius for bends is three times the inside diameter of the tube.

Section 5 – Service Maintenance

A. Inspection

All parts within the unit must be kept clean during the overhaul process. Handle each part with care and always work in a clean area.

The close tolerance of pump parts makes cleanliness very important. Clean all parts that are removed with a commercial solvent that is compatible with system fluid. Compressed air may be used in the cleaning process, however, it must be filtered to remove any water and any other contamination.

DO NOT remove retaining ring on the cylinder block (refer to Figure 19) because the cylinder block spring is under high compression. Bodily harm may result if the retaining ring is removed without adequate caution. In most cases, the parts inside the cylinder block will not require removal.

Inspect roller bearings for pitting and cracks. Turn roller bearings in their associated bearing race and check for roughness and binding. The roller bearings must turn freely within the bearing race with no signs of bind. If a roller bearing shows evidence of bind, wash the bearing in clean solvent and recheck. If binding persists, replace the roller bearing and bearing race.

Check each cylinder block bore for excessive wear. Use the piston and shoe subassembly for this purpose. The pistons should be a very close fit and slide in and out of the cylinder block bores. *NO BINDING CAN BE TOLERATED*. If binding occurs, clean the cylinder block and pistons. Lubricate the cylinder block bores with clean fluid and try again. Even minor contamination of the fluid may cause a piston to seize up in a cylinder bore.

Periodic inspection of the fluid condition and tube or piping connections can save time consuming breakdowns and unnecessary parts replacement. The following should be checked regularly:

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the pump can result. In suction or return lines, loose connections permit air to be drawn into the system resulting in noisy and/or erratic operation.

2. Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt or other contaminants. If the fluid becomes contaminated, the system should be drained and the reservoir cleaned before new fluid is added.

3. Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

4. Air bubbles in the reservoir can ruin the pump and other components. If bubbles are seen, locate the source of the air and seal the leak. (See IV in Table 2.)

B. Cleanliness

Thorough precautions should always be observed to insure the hydraulic system is clean:

1. Clean (flush) entire new system to remove paint, metal chips, welding shot, etc.

2. Filter each change of oil to prevent introduction of contaminants into the system.

3. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.

4. Provide continuous protection of system from entry of airborne contamination by sealing the system and/or by proper filtration of the air.

5. During usage, proper oil filling and servicing of filter, breathers, reservoirs, etc., cannot be over emphasized.

6. Thorough precautions should be taken by proper system and reservoir design, to insure that aeration of the oil will be kept to a minimum.

Vickers supports and recommends the hydraulic Systems Standards for Stationary Industrial Machinery advanced by the American National Standards Institute; ANSI/(NFPA/JIC) T2.24.1–1991. Key elements of this Standard as well as other vital information on the correct methods for treating hydraulic fluid are included in Vickers publication #561; “Vickers Guide to Systemic Contamination Control,” available from your local Vickers distributor or by contacting Vickers, Incorporated. Recommendations on filtration and the selection of products to control fluid condition are included in this publication.

C. Sound Level

Noise is only indirectly affected by the fluid selection, but the condition of the fluid is of paramount importance in obtaining optimum reduction of system sound levels.

Some of the major factors affecting the fluid conditions that cause the loudest noises in a hydraulic system are:

1. Very high viscosities at start–up temperature can cause pump noises due to cavitation.

2. Running with a moderately high viscosity fluid will slow the release of air captured in the fluid. The fluid will not be completely purged of such air in the time it remains in the reservoir before recycling through the system.

3. Aerated fluid can be caused by ingestion of air through the pipe joints of inlet lines, high velocity discharge lines, cylinder rod packings or by fluid discharging above the fluid level in the reservoir. Air in the fluid causes a noise similar to cavitation.

4. A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper operation corrected.

D. Hydraulic Fluid Recommendations

Oil in a hydraulic system performs the dual function of lubrication and transmission of power. It constitutes a vital factor in a hydraulic system, and careful selection of it should be made with the assistance of a reputable supplier. Proper selection of oil assures satisfactory life and operation of system components with particular emphasis on hydraulic pumps. Any oil selected for use with pumps is acceptable for use with valves or motors.

Data sheet M–2950–S for oil selection is available from Vickers Communications Department, Troy, Michigan.

Oil recommendations noted in the data sheet are based on our over 70 years experience in the industry as a hydraulic component manufacturer. Where special considerations indicate a need to depart from the recommended oils or operating conditions, contact your distributor or Vickers sales representative.

E. Adding Fluid to the System

When hydraulic fluid is added to the system, it should be pumped through a 10 micron absolute filter. The use of a porta–filter transfer unit (PFTU) to filter clean fluid into the system is recommended. For further information on the porta–filter transfer unit, obtain service drawing I–3952–S.

It is important that the fluid be kept clean and free from any substance that may cause improper operation or wear to the pump and other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint from entering the system.

F. Replacement Parts

Reliable operation throughout the specified operating range is assured only if genuine parts are used. Sophisticated design process and material are used in the manufacture of our parts. Substitutes may result in early failure. Part numbers are shown in the service parts drawings listed on page 3.

G. Product Life

The service life of these products is dependent upon environment, duty cycle, operating parameters and system cleanliness. Since these parameters vary from application to application, the ultimate user must determine and establish the periodic maintenance required to maximize life and detect component failure.

H. Fluid Cleanliness

Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials and additives for protection against wear of components, elevated viscosity and inclusion of air.

Essential information on the correct methods for treating hydraulic fluid is included in Vickers publication 561; “Vickers Guide to Systemic Contamination control,” available from your local Vickers distributor or by contacting Vickers, Incorporated.

Recommendation of filtration and the selection of products to control fluid condition are included in 561.

Recommended cleanliness levels using petroleum oil under common conditions is based on the highest fluid pressure levels in the system.

Piston pumps, regardless of manufacturer, will operate with fluids showing a higher cleanliness code. The operating life of the pump, and other components in the system, will be less however. For maximum life and best system performance, cleanliness codes as defined below should be achieved.

Fluids other than petroleum, severe service cycles or temperature extremes are cause for adjustment of these cleanliness codes. See Vickers Publication 561 for exact details.

System Pressure Level

Product	1000psi	2000 psi	3000+ psi
Vane pumps, fixed	20/18/15	19/17/14	18/16/13
Vane pumps, variable	18/16/14	17/15/13	
Piston pumps, fixed	19/17/15	18/16/14	17/15/13
Piston pumps, variable	18/16/14	17/15/13	16/14/12
Directional valves		20/18/15	19/17/14
Proportional valves		17/15/12	15/13/11
Pressure/Flow controls		19/17/14	19/17/14
Cylinders	20/18/15	20/18/15	20/18/15
Vane motors	20/18/15	19/17/14	18/16/13
Axial piston motors	19/17/14	18/16/13	17/15/12
Radial piston motors	20/18/14	19/17/13	18/16/13

Section 6 – Troubleshooting

The troubleshooting chart (Table 2 below) lists common difficulties experienced with pumps and hydraulic systems. The chart indicates probable causes and remedies for each of the troubles listed.

Trouble	Probable Cause	Remedy
I. Excessive noise in pump.	Low oil level in reservoir.	Fill reservoir to proper level with the recommended fluid. **DO NOT** over fill or damage may result.
	Air in the system.	1. Open reservoir cap and operate hydraulic system until purged. 2. “Bleed” hydraulic lines at highest point downstream of pump while system is under pressure.
	Vacuum condition.	Check inlet (suction) lines and fittings for leaks.
	Oil too thick.	Be certain correct type of oil is used for refilling or adding to the system.
	Cold weather.	Run hydraulic system until unit is warm to the touch and noise disappears.
II. Hydraulic pump overheating.	Internal leakage.	If established that excessive internal leakage exists within the pump, return to maintenance shop for evaluation and repair.
	Heat exchanger not functioning.	Locate trouble and repair or replace.
	Fluid level low.	Add oil to proper operating level.
III. System not developing pressure.	Compensator malfunction	Replace or repair.
	Loss of fluid internally (slippage).	Return to maintenance shop for evaluation and repair.
IV. Loss of fluid	Ruptured hydraulic line.	Check all external connections, tubing and hoses. Tighten connections, replace ruptured tube or hose.
	Leaking gaskets or seals in the system.	Observe mating section of pump for leaks. Replace seals or gaskets if possible. Check all system components for leaks.
V. Miscellaneous.	Broken or misadjusted pump control.	Adjust or replace pump control.
	Disconnected or broken drive mechanism.	Locate and repair.

Table 2. Troubleshooting Chart

Section 7 – Pump Overhaul

A. General

In most cases, the pump will not require a complete overhaul as described within this section. If the pump needs a complete overhaul, use the service tools listed below. Repair of this unit is intricate and should not be attempted without proper tools.

B. Required Tools

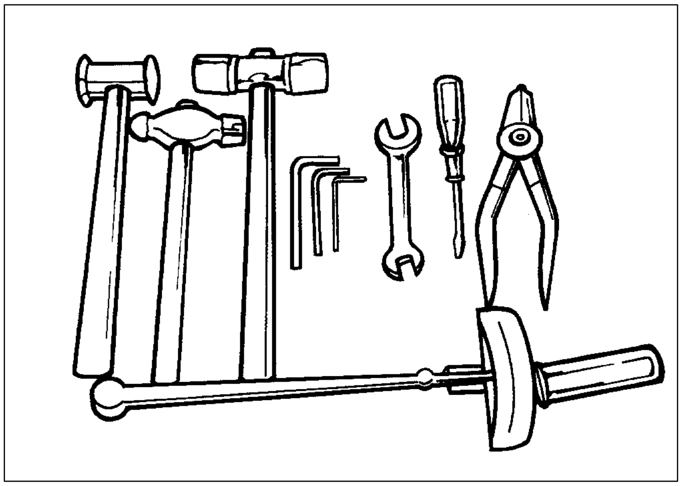


Figure 18: Standard Tools

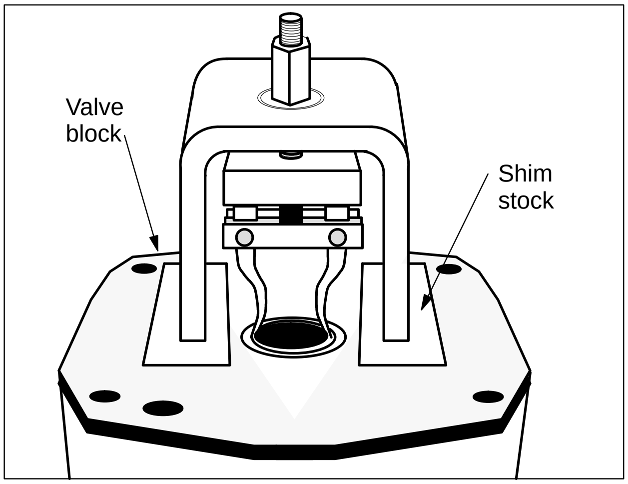


Figure 20: Valve Block Bearing Race Removal Tool w/shim stock

Standard tools for disassembly.
- Ball peen hammer
- Plastic tip hammer
- Hex (Allen) wrenches
- Wrenches
- Flat tip screw driver
- Lock ring pliers
- Torque wrench
- Rubber tip hammer
- Petroleum jelly
- Cleaning solvent

Special tools.
- Dial indicator and accessories
- Bearing race removal tool and shim stock (see Figure 20)
- Cylinder block spring decompression tool (see below)
- Shaft seal assembly tool (see Figure 22)
- Force indicator tool
- Bearing race installation tool (see Figure 23)
- Shim stock or teflon material 8” x 3” x .003”
- 2 Studs (8” long x 0.437–14 dia./C1–2A thd. class)

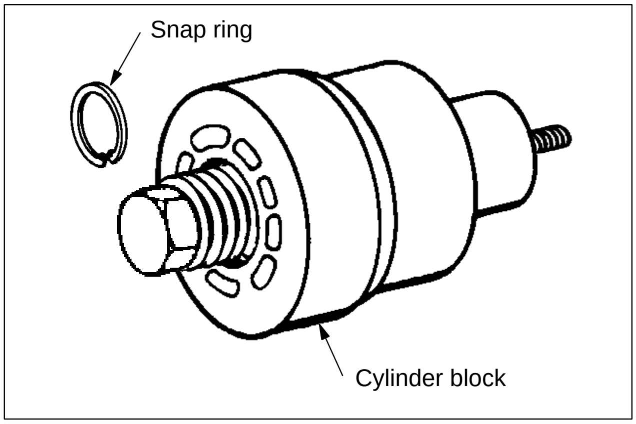


Figure 19: Cylinder Block Disassembly Tool. (Tighten nut, remove snap ring, loosen nut to relieve spring tension.)

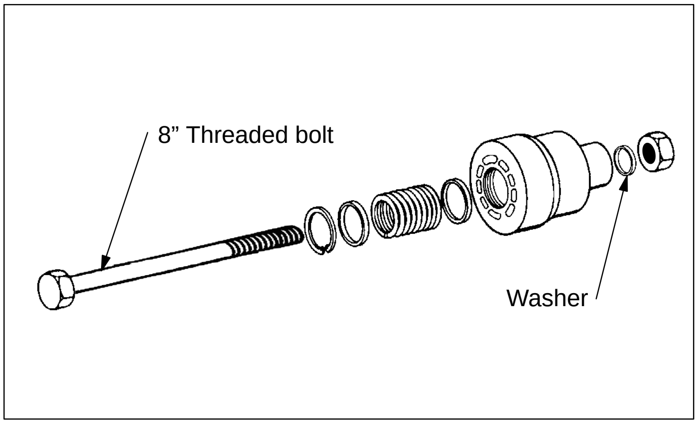
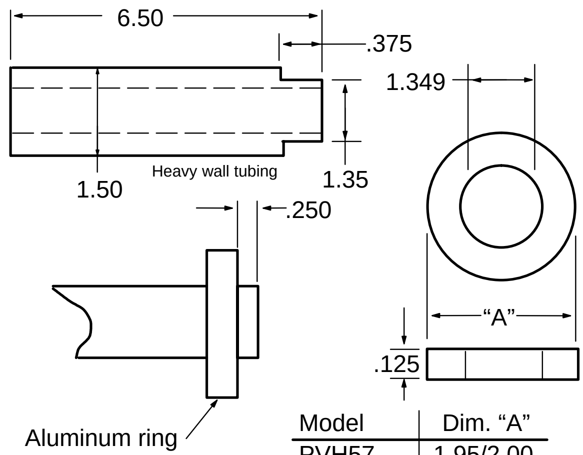


Figure 21: Cylinder Block Subassembly Parts

Required Tools (con't.)



Model	Dim. "A"
PVH57	1.95/2.00
PVH74/98	2.15/2.20
PVH131	2.40/2.45

Figure 22: Shaft Seal Driver

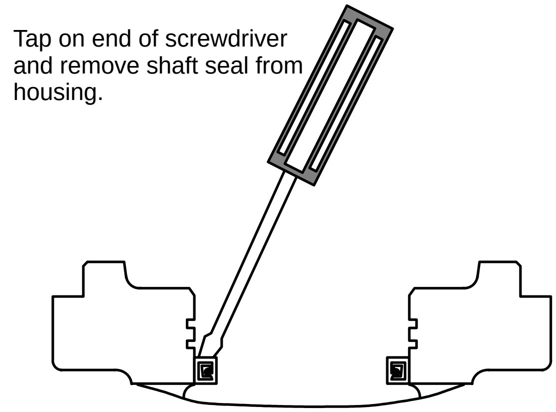


Figure 24: Shaft Seal Removal.

Refer to Figure 29.

Model	Bearing Race Item #	Dim. "A"	Dim. "B"	Dim. "C"
PVH57	23	4.00	1.98/2.00	0.98/0.99
	44		2.70/2.80	1.50/1.60
PVH74	23	4.00	2.10/2.20	1.00/1.10
	44		2.75/2.85	1.45/1.55
PVH98	23	4.00	2.30/2.40	1.00/1.10
	44		3.15/3.25	1.65/1.75
PVH131	23	4.00	2.50/2.60	1.20/1.30
	44		3.40/3.50	1.80/1.90

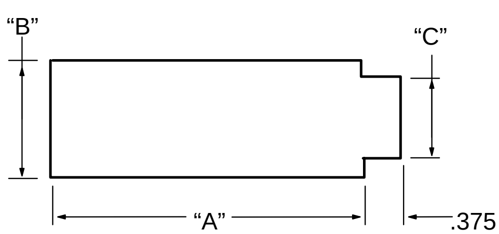


Figure 23: Bearing Race Installation Tool

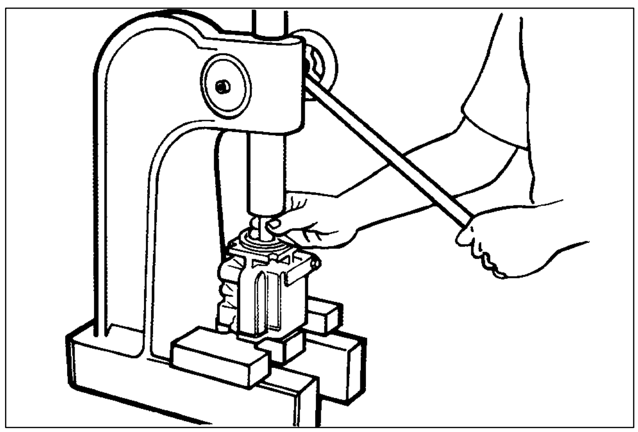


Figure 25: Removal of Front Bearing Race

C. Unit Removal

Refer to Figure 29.

1. Block the machine to prevent uncontrolled movement.

Caution

Before breaking the circuit connection, make sure power is OFF and system pressure is released. Lower all vertical cylinders, discharge accumulators, and block any load that could generate pressure.

2. Drain the fluid from the system.

3. Remove drain plug (1) from the pump's valve block (8) and drain the fluid from the pump.

4. Before breaking any circuit connections at the pump, clean the pump exterior to prevent dirt from entering the system.

5. Disconnect all hydraulic lines at the pump.

6. Remove the unit from the machine.

7. Put the unit on a clean, work bench that will support the unit's weight.

8. Before unit disassembly, cap or plug all open circuit connections on the machine so dirt does not enter the system.

D. Unit Disassembly

Note

All parts within the unit must be kept clean during the overhaul process. Handle each part with great care. The close tolerance of the parts makes this requirement very important. Clean all parts that are removed from the unit with a commercial solvent that is compatible with the system fluid. Compressed air may be used in the cleaning process, however, it must be filtered to remove water and other contamination.

Valve Block Disassembly

Note

Refer to Figure 29, PVH exploded view, for the following disassembly procedure.

1. Remove plug (3) and o–ring (4) from valve block (8).

2. Loosen six screws (5, 6, 7) that attach the valve block to the pump housing (51).

3. At this time, remove two screws (6 and 7) that are opposite of each other and replace these screws with two eight inch studs. The studs are referenced under Special Tools at the beginning of this section.

4. Remove the remaining four screws from the valve block.

5. Remove the valve block from the pump housing.

Note

To dislodge valve block (8) from pump housing (51), tap on side of valve block with a rubber hammer. Slowly remove the valve block away from the housing. The studs will act as a guide during this procedure. (Note: The valve plate (21) may stick to cylinder block (29) or valve block (8) during removal of the valve block.) Be careful not to damage the valve plate or valve block during this operation. Once the valve block moves away, do not allow the valve block to move back against the pump housing (51) because the valve plate may get damaged.

6. Remove valve plate (21).

7. Remove and discard housing gasket (20).

8. Remove pins (19) from valve block (8).

9. Remove control piston (9), bias piston (12), and bias spring (13). *DO NOT* remove control rod (10), o–ring (11), bias rod (14), and o–ring (15) from valve block (8) unless they are damaged.

Note

If control rod (10) or bias rod (14) need to be removed from valve block (8), secure the valve block in a sturdy vise. Make sure the vise jaws do not damage the valve block face. Insert a hex key wrench into the stem and turn the wrench counterclockwise. It may be necessary to use an extension on the wrench because the control and bias stem are secured to the valve block with Loctite 270 cement. Remove o–ring (11) and o–ring (15) from the rods.

10. Take a blunt screwdriver and push down on poppet (17). The poppet is located in the valve block face underneath seat (16).

Release the screw driver from the poppet and check to see if the poppet returns against seat (17). *DO NOT* remove seat (16), poppet (17), and spring (18) from valve block (8) if the poppet returns against the seat.

11. Remove tail roller bearing (23) and shim (22) from ends of shaft (39).

Maximum Displacement Stop Removal

Refer to Figure 29.

1. Remove lock nut (52).

2. Slide control piston (9) off control rod (10).

3. Unscrew adjusting screw (54) from valve block (8a).

Feedback Control Removal

Refer to Figure 29.

1. Unscrew feedback plug (67) from valve block (8b).

2. Remove screw (57) and retaining ring (58), slide spool seat (59) off bias piston (56).

3. Remove spring (55) and bias rod (14). (Refer to Note on page 26).

4. Remove feedback spool (61), and slide out sleeve (66).

Rotating Group Removal

1. Remove the three screws (26) that hold the lower bearing cover (27) to pump housing (51). Remove lower bearing cover and o–ring (28). Discard o–ring (28). Rotating group cannot be removed with the yoke. Remove screws first and then remove rotating group.

2. Reach in with both hands and remove the complete rotating group from housing (51). The complete rotating group consists of items 29 through 40.

3. Remove four screws (34) and limiter plates (35) to remove the rotating group from yoke (40).
(yoke assy. consists of 2 limiter plates, 2 spacers and 4 screws)

Warning

DO NOT remove retaining ring (30) from cylinder block (29) because spring (32) is under high compression. Bodily harm may result if the retaining ring is removed without adequate caution. In most cases, the parts inside the cylinder block will not require removal. However, if spring (32) is damaged, the parts within the cylinder block must be removed. See Figure 19 for disassembly instructions.

Shaft and Yoke Removal

Note

Shaft (39) removal is necessary if any of the following conditions are noticed:
a) Damage at bearing surface or spline area of shaft (39).
b) Yoke (40) bind (i.e. yoke does not move freely back and forth within the pump housing.
c) Yoke shows evidence of heavy wear or cracks.
d) Yoke saddle bearing (42 and 43) surfaces are worn, scored or defective.
e) Shaft seal (46) leakage during operation.

Note

If any of the above conditions are noted, perform the following steps.

1. Remove three screws (26) from lower bearing cover (27), then remove cover and upper bearing plug (24).

2. Remove four screws (34) and limiter plates (35) so that the rotating group can be separated from yoke (40).

3. Secure housing (51) in a vise so that shaft (39) is in a horizontal position.

4. Remove shaft (39) from housing (51) by tapping on spline end of shaft with a rubber hammer.

5. Remove yoke (40) from housing (51).

6. Wash yoke (40) with clean solvent.

Bearing and Shaft Seal Removal

1. Remove roller bearing (46) from housing (51). Also remove saddle bearings (42 & 43) and inspect for wear.

2. Inspect roller bearings (23 and 44) for pitting and cracks. Turn roller bearings in their associated bearing race and check for roughness and bind. The roller bearings must turn freely within the bearing race with no signs of bind. If a roller bearing shows evidence of bind, wash the bearing in a clean solvent and recheck for bind. If binding persists, replace the roller bearing and race. Refer to Figures 19 and 24 for the bearing race removal procedure.

3. Remove retaining ring (45) from housing (51) with Truarc pliers.

4. Remove shaft seal (46) from housing (51). Refer to Figure 24 for instructions.

E. Inspection, Repair & Part Replacement

Note
Before inspection of parts, clean with a solvent that is compatible with system fluid.

Rotating Group Parts (Refer to Figure 29)

1. Inspect cylinder block face (8) for wear, scratches, and/or erosion. If cylinder block condition is questionable, replace the entire rotating group.

2. Check each cylinder block bore for excessive wear. Use the piston and shoe S/A (37) for this purpose. The pistons should be a very close fit and slide in and out of the cylinder block bores. *NO BINDING CAN BE TOLERATED*. If binding occurs, clean the cylinder block and pistons. Lubricate the cylinder block bores with clean fluid and try again. Even minor contamination of the fluid may cause a piston to freeze up in a cylinder bore.

3. Inspect each of the nine piston and shoe subassemblies (31) for a maximum end play of 0.005 inch between the piston and shoe. Also check the face dimension of each shoe. The face dimension must be within 0.001 inch. See Figure 26.

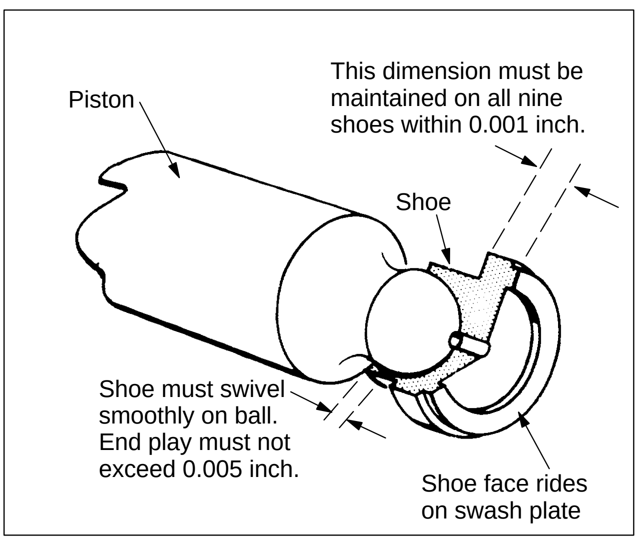


Figure 26: Piston S/A Tolerances

4. Inspect the shoe plate (36) for heavy wear and cracks. If heavy wear and/or cracks are found, replace the shoe plate.

Valve Block & Associated Parts

1. Inspect valve block (8) for erosion, cracks, and burrs. Clean up minor burrs with an India stone. If erosion or cracks are found, replace the valve block.

2. Inspect roller bearing and bearing race (23) for nicks and pitting. Make sure the roller bearing turns freely within the bearing race. If the roller bearing needs replacement, both the roller bearing and the bearing race must be replaced. To remove bearing race from valve block, refer to Figure 25.

3. Inspect valve plate (21) for erosion, excessive wear, heavy scratches, and cracks. If any of the above conditions are found, replace the valve plate.

4. Inspect control and bias piston parts (9 through 15), feedback control parts (55 thru 68), and maximum displacement stop parts (52, 53, 54, 9, 10) for burrs, scratches and cracks. Clean up minor scratches with 500 grit paper. Remove burrs with an India stone. The control and bias piston (9, 12 and 55) should move freely over the respective control stem and bias rods (10 and 14.)

Yoke Parts

1. Inspect yoke (40) face for wear, roughness or scoring. Check the yoke hubs and bearing surfaces for wear and cracks. Replace yoke, if defective.

2. Inspect limiter plate (35) and spacers (38) for heavy ware and cracks. Replace if defective.

3. Inspect saddle bearing surfaces (42 and 43) for wear, pitting, and smooth operation. Replace if necessary.

Shaft/Housing Parts

1. Inspect drive shaft (39) for wear, stripped splines, and burrs. Remove burrs with an India stone. Inspect the contact area of bearing (44) and shaft seal (46). Replace the drive shaft if wear or scoring is greater than 0.005 T.I.R. (total indicator reading).

2. Inspect drive shaft bearing (44) for roughness, pitting of rollers, and excessive end play. Replace, if defective. If the bearing needs to be replaced, the bearing race inside housing (51) also requires replacement. To remove the bearing race from the housing, refer to Figure 25.

3. Inspect housing (51) mounting flange for nicks and burrs. Remove minor nicks and burrs with an India stone. Also check the housing for damaged or stripped threads. If any thread is damaged, replace the housing.

4. Check remaining pump parts for excessive wear, damaged threads, burrs, cracks and erosion. Replace any part that is in questionable condition.

F. Assembly

Assembly is generally performed in the reverse order of disassembly. Refer to Figure 29 during the following assembly procedure.

Note

Obtain a new seal kit. Refer to the appropriate part drawing as listed on page 4 for the seal kit part number. Apply a light film of clean hydraulic fluid to the new seals. This will make assembly easier and also provide initial lubrication of moving parts.

Model	Plug #	Torque (Nm)	Torque (lb.ft.)
PVH57/74	1	54–59	40–43
	3	15–16	11–12
PVH98	1	75–83	55–61
	3	15–16	11–12
PVH131	1	41–49	30–36
	3	14–19	10–14

Table 3: Plug Torque
(refer to Figure 29)

Assemble the piston pump as follows:

1. If shaft seal (46) was removed, install a new shaft seal into housing (51). Lubricate the shaft seal and housing bore with petroleum jelly before assembly. Use an arbor press and the shaft seal assembly tool. The shaft seal assembly tool is shown in Figure 22. Make sure the spring member of the shaft seal is face up during assembly.

2. Install retaining ring (45) into the second groove within the housing bore next the shaft seal. Use Truarc pliers for this operation.

Note

Bearing (race and rollers) are to be treated as one part. Therefore, when replacing bearings, install new rollers and race. Do not try to use old races over again.

3. If bearing race was removed from housing (51) install a new bearing race into housing with an arbor press. Make sure the bearing race is face up to accommodate the matching roller bearing. Press the bearing race until it rests at bottom of housing. Use the bearing race tool as shown in Figure 27. After the bearing race is installed, apply a liberal amount of petroleum jelly to the matching roller bearing. Install the roller bearing into the bearing race.

4. Apply a thin coat of clean hydraulic fluid to limiter plate (35), spacers (38) and piston/shoe S/A (36 and 37). Align piston/shoe S/A (36 and 37) with yoke (40) and install using screws (34).

Note

The following step describes the assembly of shaft (39) into housing (51). Refer to Figure 28 during this process.

5. If yoke (40) was removed from housing (51), assemble the yoke into housing as follows:

a. Place the pump housing on its side with saddle bearing surface (42 and 43) area of the housing face up.

b. Insert yoke (40) into housing (51).

c. Lubricate yoke bearing surfaces (42 and 43) with clean hydraulic fluid. Orient the bearing to match the bearing race. Next, carefully insert the yoke into the pump housing. *DO NOT* force the yoke into place if it does not fit properly. Align the yoke bearing surfaces with the saddle bearings.

6. Install shaft (39) as follows:

a. Lubricate roller bearing (44) and shaft (39). Assemble roller bearing (44) on shaft (39).

b. Take a piece of shim stock or Teflon material (8” x 3” x .003”) and roll it into a funnel shape. Insert the Teflon material into the shaft seal (46) as shown in Figure 28.

c. Install shaft (39) into housing (51). (Note: The Teflon material will be forced out of shaft during this process.)

Note

The following step describes the shaft and end play procedure. Final shaft end play must be 0.001–0.004. This must be done without the rotating group installed.

7. Obtain a shaft spacer kit as noted in the parts drawing.

Perform the following steps:

a. If bias and control parts (9 through 15 – except 10 & 14) are attached to valve block (8), remove parts.

Note

The bias and control rods must be bonded to the valve block during assembly, using a suitable bonding compound.

b. If pins (19) were removed, install two new pins into valve block (8).

c. Install housing gasket (20) against valve block (8).

d. Install tail bearing (23) on end shaft (39) so the bearing rollers match up with bearing race within valve block (8).

Note

If bearing race was removed from valve block, install a new bearing race into valve block. *DO NOT* reuse bearing races with new rollers. Refer to Figure 27 for instructions.

e. Position valve block (8) on the two studs and carefully slide the valve block against housing (51). Make sure mounting pins (19) engage properly into valve block.

f. Apply a small amount of hydraulic fluid to screws (5 through 7) threads. Secure the valve block (8) to housing (51) with six screws (5 through 7). Tighten screws to 63.8 – 77.8 Nm.

g. Set the pump on the work bench so that shaft (39) is straight up (vertical). Push down on shaft to insure bearings (23 and 44) are seated.

h. Place a dial indicator at end of shaft (39). Set the dial indicator to 0.00.

i. Place vise grip pliers underneath shaft spline and lift up on shaft (39).

j. Observe the dial indicator reading to determine the amount of shaft movement. For example, if the dial indicator needle reads 0.040, a 0.036-0.039 shim (22) must be added to the end of shaft to obtain a 0.001-0.004 shaft end play (0.040 minus 0.036-0.039 = 0.001-0.004). Repeat this step two times to insure proper measurement.

k. Remove valve block (8) from housing (51). Remove tail bearing (23) from end of shaft (39).

l. Install shim (22) to end of shaft (39) according to the measurement obtained in step “j”.

m. Install tail bearing (23) on end of shaft (39) next to shim (22).

n. Repeat steps “a” through “j”. If 0.001-0.004 shaft end play is obtained, proceed to step “o”.

o. Remove valve block (8), tail bearing (23), and shim (22) from pump. Set these aside for final assembly.

8. Remove lower bearing cover (27) and upper bearing plug (24) from housing (51).

9. If required, assemble rotating group parts 29 through 40 into cylinder block (29). Use the spring compression tool as shown in Figure 21.

10. Lubricate cylinder block (29) with clean hydraulic fluid. Install the nine piston subassemblies (37) into shoe plate (36) as shown in Figure 26.

11. Feed nine pistons (37) into the cylinder block bores. Then install rotating parts 29 through 40.

12. Align rotating group with the yoke (40) subassembly. Add spacers (38) and limiter plates (35) and attach to yoke (40) with four screws (34). Seat yoke (40) on saddle bearings (42 and 43).

13. Install upper bearing plug (24) and lower bearing cover (27) and tighten three screws (26) to 7.5-9.5 Nm.

14. Install tail bearing (23) on shaft (39) next to shim (22).

15. If required, assemble o-ring (15) on bias rod (14) and o–ring (11) or control rod (10). Apply one drop of Loctite 270 cement to bias rod and control rod threads. Install the bias and control rods into valve block (8). Secure the stems with a hex key wrench.

16. Assemble adjusting screw (54) with o–ring (53) into valve block. Slide control piston (56) on control rod (55). Install lock nut (52).

17. Assemble spring (13) and piston (12) on bias rod (14). Install piston (9) on control rod (10).

18. Insert pins (19) into valve block (8).

19. Lubricate valve block face with a light film of clean hydraulic fluid.

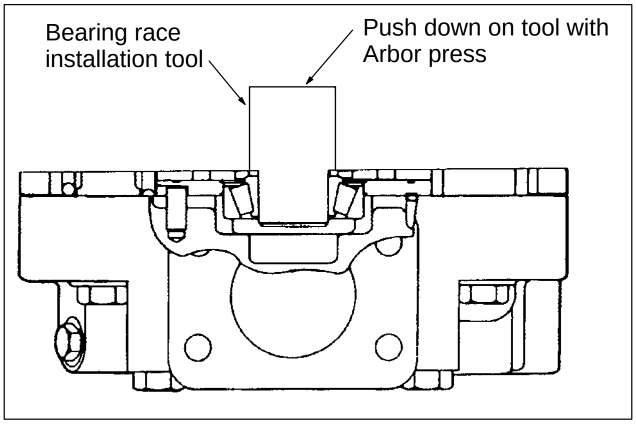


Figure 27: Installation of Bearing Race into Valve Block

20. Place valve plate (21) on valve block face with bronze side face up.

21. Carefully assemble valve block (8) onto housing (51). Make sure the bias spring (13) and bias piston (12) are in place against the yoke subassembly during the assembly process. If the spring or piston falls off bias rod (14), apply a liberal amount of petroleum jelly to the spring and piston to hold them in place.

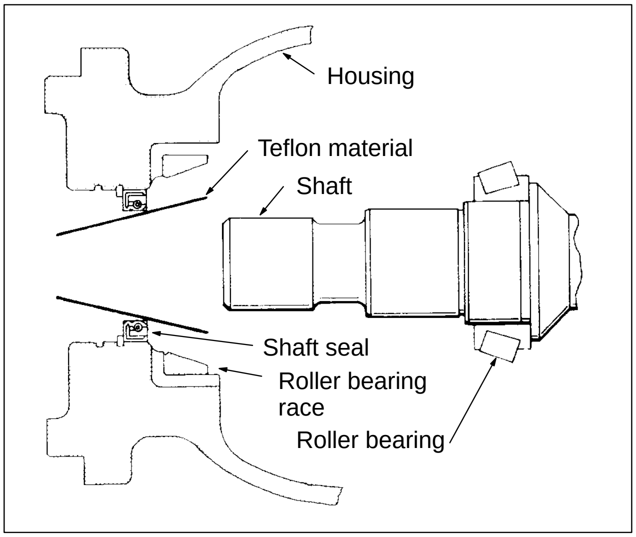


Figure 28: Shaft Installation

22. Install screws (6 and 7) hand tight. Remove the two 8" alignment studs from housing (51) and install the remaining two screws (5). Cross tighten the screws to 63.8-77.8 Nm.

23. Assemble o–rings (2 and 4) on plugs (1 and 3). Install the plugs into valve block (8). Tighten the plugs to valve noted in Table 3.

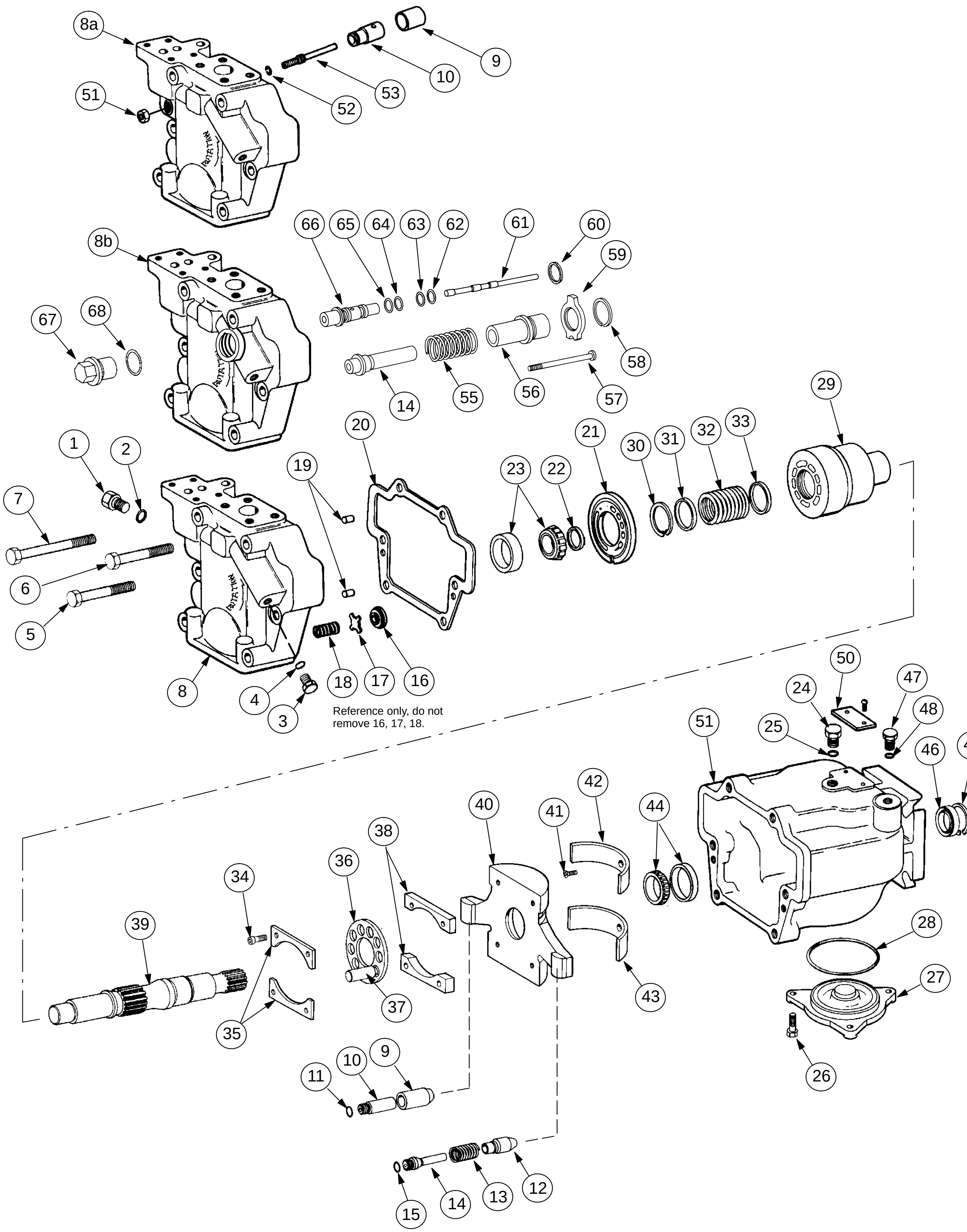


Figure 29: Exploded View of PVH Pump

Section 8 – Test

A. Test Conditions

1. Fluid entering the pump inlet must be filtered to meet an ISO cleanliness code of 14/12 or cleaner. Selections from OFP, OFR and OFRS series filters are recommended. For recommended fluid types, refer to bulletin M–2950–S.

2. Pump inlet pressure must be maintained between 1.15 bar and 0.85 bar absolute pressure (2 PSIG, 5 inches HG.)

3. Operate the pump at a fluid temperature of 120°F ±10°F.

4. PVH operating parameters are listed in Table 4.

Pump Model	Rated Pressure bar (psi)	Rated Speed (rpm)	Rated Displacement ml/rev (CIR)
PVH57	250 (3600)	2400	57 (3.5)
PVH57QI	250 (3600)	1800	57 (3.5)
PVH74	250 (3600)	2200	74 (4.5)
PVH74QI	250 (3600)	2200	74 (4.5)
PVH98	250 (3600)	2100	98 (6.0)
PVH98QI	250 (3600)	1800	98 (6.0)
PVH131	250 (3600)	2000	131 (8.0)
PVH131QI	250 (3600)	1500	131 (8.0)

Table 4: PVH Operating Parameters

B. Preliminary Set–up

1. If a hydraulic test stand is available with adequate horsepower capabilities, mount the pump on the test stand. If a test stand is not available, mount the pump on the vehicle and proceed to connect the hydraulic lines to the pump. Refer to page 22, Section 4 for pump installation instructions.

2. Connect the case line, inlet and outlet line, load sensing line (if required), pressure gauges, and other equipment as described in Figure 30. Make sure all connections are tight.

3. Remove drain plug (1) from valve block (8) and fill the pump with clean hydraulic fluid. Reinstall the plug and torque to value noted in Table 3.

Note

The following step describes the preliminary setting of the PVH control adjustment screws prior to test. Refer to Figures 12 thru 17 for screw locations.

4. Turn the control adjustment screws as follows:

For C Control, turn pressure compensating adjusting screw (5b, Figure 12) until bottomed.

For CV Control, turn load sensing and pressure compensator adjusting screw (11a, Figure 13) in until bottomed.

For UV Control, turn load sensing and pressure compensator adjusting screw (11a, Figure 13) in until bottomed. DO NOT adjust unloading valve, it is preset from the factory.

For Industrial Control, turn adjusting screw (2, Figure 15) in until bottomed.

For load sensing, torque limit and pressure limit controls, turn torque limiting adjusting screw (7d, Figure 16) and load sensing adjusting screw (5c, Figure 17) in until bottomed.

C. Operating Tests & Calibration

C Control: (refer to Figure 30)

1. Fully open load valve A.

2. Operate unit at rated speed as specified in Table 5 and adjust outlet pressure to 28 bar (400 psi) until all air is removed from the circuit.

3. Increase unit outlet pressure to 150 bar (2175 psi) and hold for 1 minute followed by 15 seconds at 28 bar (400 psi). Increase the outlet pressure to 250 bar (3625 psi) for 1 minute. Unit must be able to meet flow and flow loss requirements as specified in Table 5 at both conditions unless unit is at reduced stroke.

Pressure limiting and case–to–inlet check valve calibration.

1. With valve A closed, adjust the pressure limiting setting to the pressure specified by the model code ±4.0 bar (58 psi). If no pressure is specified, set the pressure compensator to 250 ±4.0 bar (3625 ±58 psi) at zero outlet flow.

2. With pump at rated speed, maximum flow, and outlet pressure of 28 bar (400 psi), close valve a rapidly. There should be no indication of yoke hunting or pump instability. Instability is evidenced by sustained pump outlet pressure oscillations greater than ±3.5 bar (50 psi) about nominal pressure limiting setting. With valve A closed, the pressure should be within ±4.0 bar (58 psi) of initial setting mentioned in paragraph 1.

3. Operate pump at rated speed with valve A closed and unit operating at pressure limiter setting. Block off case drain flow by closing valve c. The case pressure should be maintained at 0.9-1.7 bar (13-25 psi) above inlet pressure.

4. Plug all ports and apply air to case at a pressure of 3.5 bar (50 psi) while unit si immersed in a non-corrosive fluid. No external leakage is permitted.

CV Control: (refer to Figure 30)

1. Fully open valve G and V.

2. Fully open valve B and set valve A to minimum pressing setting.

3. Start the test stand or vehicle engine. Operate the pump at 600 rpm and at minimum outlet pressure. Check the system for leaks and unusual noise. Increase rpm's to 1200 until all the air is purged out of the system.

Caution

If unusual noise is noted, shut down the system immediately to avoid pump damage. Refer to the Troubleshooting chart (Table 2) for possible repair solution.

4. Increase the pump to the rated speed (rpm) as specified in Table 6. Adjust valve A until 28 bar (400 psig) outlet pressure is obtained at P2. Hold this condition until air is purged out of the system.

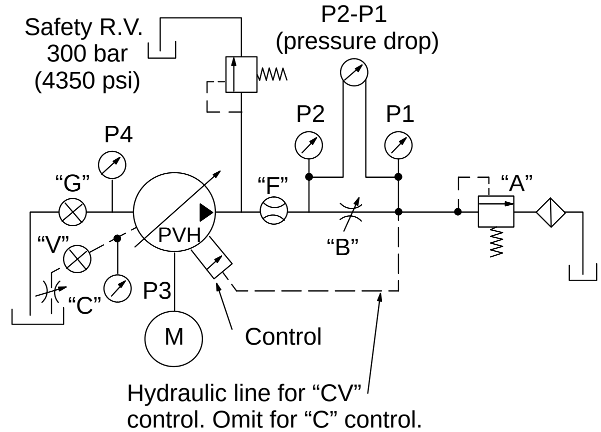
5. Increase the outlet pressure to 150 bar (2175 psig). Hold this condition for one minute. Reduce the outlet pressure to 28 bar (400 psig) and observe the pump flow from flowmeter F. Pump flow must meet the requirement as stated in Table 5 when the fluid temperature at pump outlet is 120°F ±10°F.

6. Increase the pump outlet pressure to 250 bar (3625 psig). The pump must be able to meet the flow loss requirement as shown in Table 5. Hold this condition for one minute.

7. Visually inspect shaft seal (46) for leakage throughout the performance test.

"A" = Load Valve
"B" = Flow Control or Load Sensing Valve
"C" = Internal Check Valve
"G" = Globe Valve Inlet
"V" = Needle Valve
"F" = Flow Meter

P1 = Pressure Gauges (5000 psi)
P2 = Pressure Gauge
P3 = Case Drain Pressure Gauge
P4 = Inlet Pressure Gauge



Note: Valve "B" and pressure gauge P1 not required for PVH with C control.

Figure 30: C, CV Control Test Circuit

Pump Model	Rated Speed (rpm)	Flow @28 bar (400 psi)	Max. Flow Loss @250 bar (3625 psi)
PVH57	2400	130 - 144 l/min (34.3 - 38 USgpm)	12 l/min (3.2 USgpm)
PVH57QI	1800	95.8 - 10.9 l/min (25.3 - 29.3 USgpm)	12 l/min (3.2 USgpm)
PVH74	2200	154.1 - 171 l/min (40.7 - 45.2 USgpm)	13 l/min (3.4 USgpm)
PVH74Q	2100	145 - 160 l/min (38 - 42 USgpm)	13 l/min (3.4 USgpm)
PVH74QI	1800	126.1 - 139.2 l/min (33.3 - 36.8 USgpm)	13 l/min (3.4 USgpm)
PVH98	2100	196 - 216 l/min (51.8 - 57.1 USgpm)	17.5 l/min (4.6 USgpm)
PVH98QI	1800	167.5 - 186.4 l/min (44.2 - 49.2 USgpm)	17.5 l/min (4.6 USgpm)
PVH131	2000	249 - 275 l/min (65.8 - 72.6 USgpm)	22 l/min (5.8 USgpm)
PVH131QI	1500	187 - 207 l/min (49.4 - 54.7 USgpm)	22 l/min (5.8 USgpm)

Table 5: Flow Specifications

CV Control calibration, stability & internal check valve test.

Note

To adjust the “CV” control, perform steps 1 through 7. Refer to Figures 13 and 30 during the adjustment procedure. Turn the adjusting screws clockwise to increase pressure and counterclockwise to decrease pressure.

1. Perform the preliminary set–up procedure.

2. Set the pump to rated rpm as shown in Table 6.

3. Adjust valve A to obtain 250 bar (3625 psig) at P2.

4. Adjust valve B to obtain an outlet flow that is specified in Table 6.

5. Turn load sensing screw (15) until 20 ($\pm$1 bar) (290 $\pm$14.5 psid) pressure differential is obtained between P2 and P1. Tighten nut (14).

6. Open valve B and adjust valve A to obtain 250 bar (3625 psig) at P2.

7. Turn pressure compensator screw (4) until pressure at P2 starts to decay below 3626 psi. Adjust screw (4) to a desired pressure level. If a pressure level is not specified, adjust the screw to 250 bar (3625 psi).

Pump Model	Rated Speed (rpm)	Pump Outlet Flow for Setting ΔP
PVH57	2400	70 l/min (18.5 USgpm)
PVH57QI	1800	50 l/min (13.2 USgpm)
PVH74	2200	80 l/min (21.0 USgpm)
PVH74QI	2100	75 l/min (19.8 USgpm)
PVH74QI	1800	65 l/min (17.2 USgpm)
PVH98	2100	105 l/min (27.7 USgpm)
PVH98QI	1800	90 l/min (23.8 USgpm)
PVH131	2000	130 l/min (34.0 USgpm)
PVH131QI	1500	144 l/min (38.0 USgpm)

Table 6: Outlet Flow Setting

Note

Refer to Figure 30 during the following procedure.

1. Adjust valve A to 28 bar (400 psig) outlet pressure at P2. Operate the pump at a rated speed (rpm) as stated in Table 4.

2. Close valve A rapidly. There should be no indication of pump instability. (Note: Pump instability is when outlet pressure oscillations exceed ±3.5 bar (50 psi) around control pressure setting of 250 bar (3625 psi). When valve A is closed, the pressure at P2 should be within ±4.0 bar (58 psi) of the initial pressure setting.

3. Close needle valve V. The differential pressure between P3 and P4 must be 0.9-1.7 bar (13–25 psid). Open needle valve V.

Unloading Valve: (refer to Figure 31)

NOTE

Testing for a pump with unloading valve requires an external pressure source of 207 bar (3000 psi).

1. Install unit in the test circuit and fill pump case.

2. Fully open load valve A.

3. Operate unit at rated speed as specified in Table 5 and adjust outlet pressure to 28 bar (400 psi) until all air is removed from the circuit.

4. Increase unit outlet pressure P1 to 150 bar (2175 psi) by adjusting valve A and hold for 1 minute followed by 15 seconds at 28 bar (400 psi). Increase the outlet pressure to 250 bar (3625 psi) for 1 minute. Unit must be able to meet flow and flow loss requirements as specified in Table 5 at both conditions.

Pressure limiting and case-to-inlet check valve calibration

1. With valve A closed, adjust the pressure limiting setting (P1) to the pressure specified by model code ±4.0 bar (58 psi).

2. With pump at rated speed, maximum flow, and outlet pressure (P1) of 28 bar (400 psi), close valve A rapidly. There should be no indication of yoke hunting or pump instability. Instability is evidenced by sustained pump outlet pressure oscillations greater than ±3.5 bar (50 psi) about nominal pressure limiting setting. With valve A closed, the pressure should be within ±4.0 bar (58 psi) if initial setting in paragraph 1.

3. Operate pump at rated speed with valve A closed and unit operating at pressure limiter setting. Block off case drain flow by closing valve C. The case pressure should be maintained at 0.9-1.7 bar (13-25 psi) above inlet pressure.

Unloading valve standby pressure & leakage

1. Apply 207 ±2 bar (3000 ±30 psi) from external supply to the accumulator port of unloading valve (Pe). Close valve A and adjust the load sensing screw on the control so the pump operates at zero flow and at the outlet pressure (P1) as listed in Table 7:

Unit	Model Code Suffix	Outlet Pressure P1
PVH74	083	440 ±15 psi
PVH131	072	440 ±15 psi
PVH131	077	440 ±15 psi

Table 7

2. Plug all ports and apply air to case at a pressure of 3.5 bar (50 psi) while unit is immersed in a non-corrosive fluid. No external leakage is permitted.

Alternate testing method, if no external pressure source is available:

1. Assemble pump without unloading valve and tubing attached but with CV control attached directly to the valve block. Complete test steps for the CV control.

2. Shut off test stand and assemble unloading valve and tubing onto the pump.

3. Install pump onto stand and run at rated speed and at 35 bar (500 psi) below compensator setting. Testing is complete if no oil leaks are observed.

4. Plug all ports and apply air to case at a pressure of 3.5 bar (50 psi) while unit is immersed in a non-corrosive fluid. No external leakage is permitted.

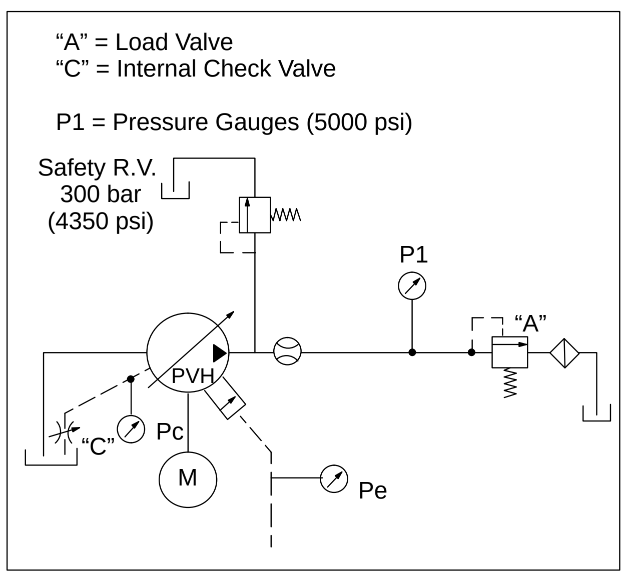


Figure 31: Unloading Test Circuit

Industrial Control: (refer to Figure 32)
PVH**QI

1. Install unit in the test circuit and fill pump case.

2. Fully open load valve A, throttle valves B and C, while keeping throttle valve D closed.

3. Operate unit at rated speed as specified in Table 5 and adjust outlet pressure using load valve A to 28 bar (400 psi) until all air is removed from the circuit.

4. Using load valve A, increase unit outlet pressure to 150 bar (2175 psi) and hold for 1 minute followed by 15 seconds at 28 bar (400 psi). Increase the outlet pressure to 250 bar (3625 psi) for 1 minute. Unit must be able to meet flow and flow loss requirements as specified in Table 5 at both conditions unless the pump is at reduced stroke.

Industrial Control valve calibration and testing

1. Adjust industrial control valve to obtain a pressure differential P2-P1 per chart below when throttle valve B is adjusted to obtain pump outlet flow as specified in Table 6 and with P2 at 150 bar (2175 psi). Change in differential pressure P2-P1 cannot exceed 5.0 bar (72.5 psi) when pressure P1 is varied between 150 bar (2175 psi) and 220 bar (3190 psi). The control is now set.

2. Fully open throttle valve B. Vary pump outlet flow from maximum flow (Table 5) to 7.5 l/min (2.0 USgpm) flow by closing valve B. The change in pressure differential between 90% maximum flow and 10% minimum flow should be within limits specified in Table 8, about nominal setting.

3. Cycle the pump outlet flow from maximum to minimum flow with throttle valve B. Pump outlet pressure must be stable. With valve B closed and P1 at zero pressure, the outlet pressure must not increase over the setting in Table 8 by more than the value in Table 5.

4. With throttle valve B open and load valve A set for 150 bar (2175 psi), open throttle valve D. Pump will go to zero flow. The outlet pressure must be less than setting in Table 8 plus maximum increase defined in Table 5. (This is done to assure that the orifice is assembled into the control. If it is not, flow through throttle valve D will be high.)

The industrial control pressure differential is incorporated in the model code. The value is listed immediately after the IC in the model code. When no value is present in the model code, the pressure differential is 20 bar (290 psi). The tolerance for all settings is ±1.0 bar (±14.5 psi).

Unit	Pressure Differential (P2-P1) @ Specified Flow
PVH*QI**IC	20.0 ±1.0 bar (290.0 ±15.5 psi)
PVH*QI**IC17	17.0 ±1.0 bar (247.0 ±14.5 psi)
PVH*QI**IC35	35.0 ±1.0 bar (508.0 ±14.5 psi)

Table 8

Inlet check valve testing

1. With pump at rated speed, valve A set for pump outlet pressure of 250 bar (3625 psi), throttle valve B open, and throttle valve D closed, close throttle valve C. Case to inlet pressure differential must be 0.9-1.7 bar (13-25 psi).

Plug all ports and apply air to case at a pressure of 3.5 bar (50 psi) while unit is immersed in a non-corrosive fluid. No external leakage is permitted.

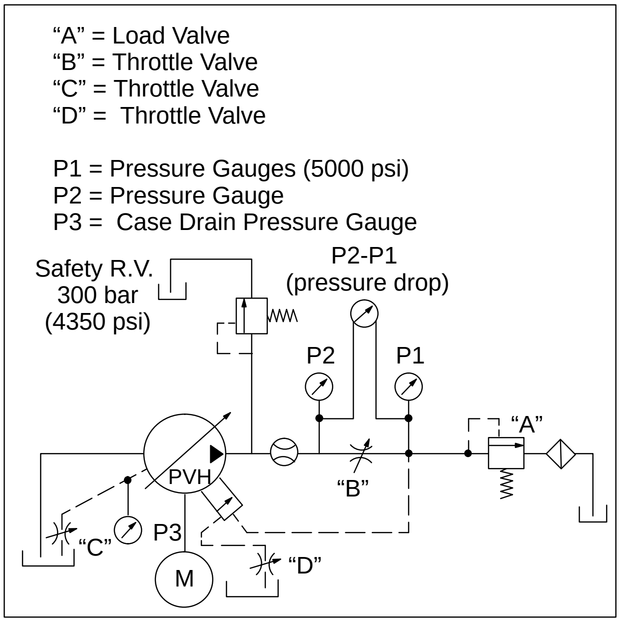


Figure 32: Industrial Control Test Circuit

Load Sensing, Torque Limit and Pressure Limit Controls (refer to Figure 33)

1. Install unit in the test circuit and fill pump case.

2. Fully open load valve A and throttle valve B.

3. Operate unit at rated speed as specified in Table 5 and adjust outlet pressure to 28 bar (400 psi) until all air is removed from the circuit.

4. Increase unit outlet pressure to 150 bar (2175 psi) and hold for 1 minute followed by 15 seconds at 28 bar (400 psi). Increase the outlet pressure to 250 bar (3625 psi) for 1 minute. The pump must be able to meet flow and flow loss requirements as specified in Table 5 at both conditions unless unit is at reduced stroke.

Load Sensing valve calibration and testing

1. Adjust load sensing valve to obtain a pressure differential P2-P1 per Table 9 when throttle valve B is adjusted to obtain pump outlet flow as specified in Table 6 and with P2 at 150 bar (2175 psi). Change in differential pressure P2-P1 cannot exceed 5.0 bar (72.5 psi) when pressure P1 is varied between 150 bar (2175 psi) and 220 bar (3190 psi). The load sensing valve is now set.

2. Fully open throttle valve B. Vary pump outlet flow from maximum flow (Table 5) to 7.5 l/min (2.0 USgpm) flow by closing valve B. The change in pressure differential between 90% maximum flow and 10% minimum flow should be within limits specified in Table 9 about nominal setting.

3. Cycle the pump outlet flow from maximum to minimum pump flow with throttle valve B closed and P1 at zero pressure, the outlet pressure must not increase over the setting in Table 9 by more than the value in Table 6.

Load sensing differential pressure is incorporated in the model code. The value is listed immediately after the "V" in the model code. Pressure is in bar. Tolerance is as listed. When no value is present in the model code, 20 bar (290 psi) is to be used.

Unit	Pressure Differential (P2-P1) @ Specified Flow
C**V17	17.0 ± 1.0 bar (247.0 ± 14.5 psi)
C**V21	21.0 ± 1.0 bar (305.0 ± 14.5 psi)

Table 9

Setting Torque Limit Feedback Control (CT)

Remove plug (1, Figure 29) from valve block and install a pressure gauge. Operate the pump at rated rpm as specified in Table 5 and increase outlet pressure to 140 bar (2000 psi). The differential pressure between outlet pressure and feedback pressure should be 14.5 bar (210 ± 10 psi). Adjust with shims (60, Figure 29) under the head of the feedback sleeve (66, Figure 29) to suit. Pressure differential will change approximately .1 bar (1.5 psi) per .001" of shim.

Setting Torque Limiter

Operate pump at rated speed. Slowly close valve A until the outlet pressure P1 is the nominal model setting ± 1.5%. Back out slowly the torque limiting screw (7d, Figure 16) CCW until a drop in flow is noted. Check this setting by opening valve A until pressure drops 34.5 bar (500 psi). Slowly close valve A until the pump destrokes. This will be noted by a sharp reduction of output flow.

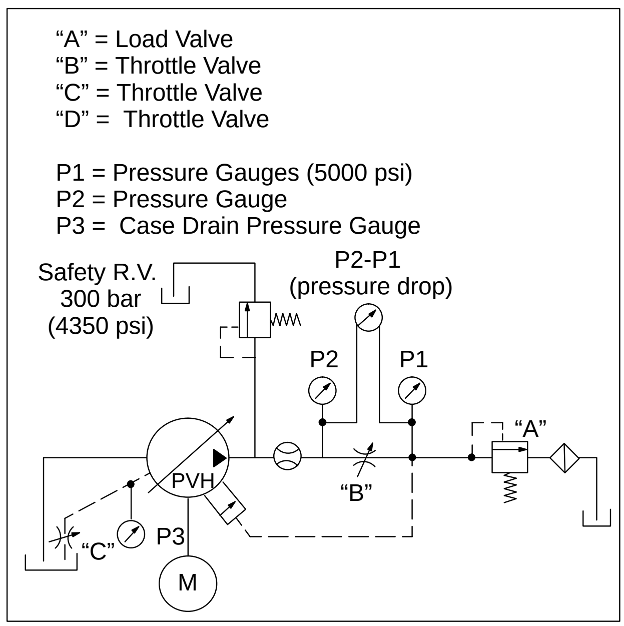


Figure 33: Load Sensing, Torque/Pressure Limit Test Circuit

Setting Pressure Limiter

1. Back out pressure limiter screw (26d, Figure 16) 4.5 turns CCW. With the pump operating at rated speed, close valve A. Raise pressure limiter setting by adjusting pressure limiter screw (26d, Figure 16) CW until the nominal specified model setting is reached ± 1.7%. Pressure will change about 2.7 bar (40 psi) for each 10° of rotation.

2. After pressure limiter is set, recheck that the torque limiter set point occurs at specified setting ± 5% when the pump begins to destroke (significant reduced output flow). Readjust torque limiting screw (7d, Figure 16) if necessary.

Stability Test

With pump at rated speed, maximum flow, and outlet pressure of 28 bar (400 psi), close load valve A rapidly. There should be no indication of yoke hunting or pump instability. Instability is evidenced by sustained pump outlet pressure oscillations greater than $\pm$3.5 bar (50 psi) about nominal pressure limiting setting. With valve A closed, the pressure should be within $\pm$4.0 bar (58 psi) of initial setting.

Internal case relief valve functional test

1. Operate pump at rated speed with valve A closed and pump operating at pressure limiter setting. Block off case drain flow by closing valve C. The case pressure should be at 0.9-1.7 bar (13-15 psi) above inlet pressure.

2. Plug all ports and apply air to case at a pressure of 3.5 bar (50 psi) while unit is immersed in a non-corrosive fluid. No external leakage is permitted.

D. Start–up Procedure

Make sure the reservoir and circuit are clean and free of dirt/debris prior to filling with hydraulic fluid.

Fill the reservoir with filtered oil to a level sufficient to prevent vortexing at suction connection to pump inlet. It is good practice to clean the system by flushing and filtering using an external slave pump.

Before starting the pump, fill with fluid through one of the ports. This is particularly important if the pump is above the fluid level of the reservoir.

When initially starting the pump, remove all trapped air from the system. This can be accomplished by loosening the pump outlet fittings or connections before starting the pump or by using an air bleed valve. All inlet connections must be tight to prevent air leaks.

Once the pump is started it should prime within a few seconds. If the pump does not prime, check to make sure that there are no restrictions between the reservoir and the inlet to the pump, and there are no air leaks in the inlet line and connections. Also check to make sure that trapped air can escape at the pump outlet.

After the pump is primed, tighten the loose outlet connections, then operate for five to ten minutes (unloaded) to remove all trapped air from the circuit.

If reservoir has a sight gage, make sure the fluid is clear -- not milky.

Add fluid to the reservoir up to the proper fill level.

Eaton Hydraulics
15151 Highway 5
Eden Prairie, MN 55344
Telephone: 612 937-7254
Fax: 612 937-7130
www.eatonhydraulics.com

46 New Lane, Havant
Hampshire PO9 2NB
England
Telephone: (44) 170-548-6451
Fax: (44) 170-548-7110