Oilgear

PVWW

OPEN LOOP PUMPS

FOR FLUIDS CONTAINING WATER

Bulletin 47013

PERFORMANCE ASSURANCE IS STANDARD WITH EVERY OILGEAR COMPONENT

Every Oilgear pump manufactured is shipped with a corporate commitment to stay with the installation until it performs as specified.

This total dedication to performance is based upon experience gained since 1921 in matching fluid power system to a tremendous range of machines and applications.

Oilgear's Performance Assurance is made possible because of the many hydraulic techniques learned over the years in supplying machinery builders and users with unique solutions to hundreds of unusual fluid power problems.

Historically, Oilgear has concentrated its energies on hydraulic equipment and systems. Every Oilgear facility is staffed with factory trained and field experienced application engineers. These men are backed by a headquarters engineering staff who has access to the records and knowledge generated from these historically successful solutions.

Performance Assurance doesn't stop with the design of the system or the sale of the component. It guarantees that Oilgear engineers will be there— when they are needed— supplying the education, field service, parts and repairs, to make sure each runs smoothly— and keeps on running.

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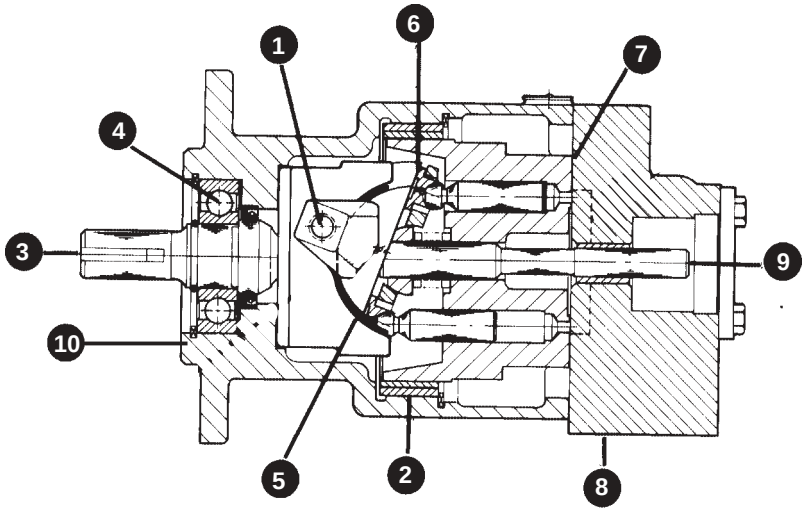


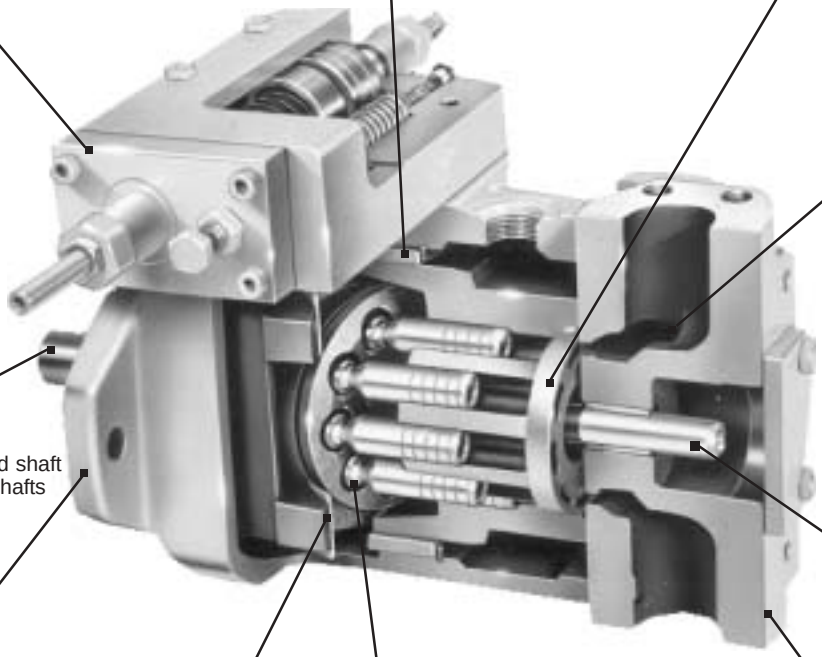
PVWW
OPEN LOOP PUMP

Cylinder mounted polymerous journal bearings
- Allows operation with water base, low viscosity or other special fluids
- Provides infinite bearing life
- Provides compact design

Hardened cylinder surface running on hardened valve plate ("hard-on-hard")
- Provides greater resistance to contamination
- Provides longer life
- Allows operation with water base, low viscosity or other special fluids

Large control selection
- 12 different types
- Field interchangeability without disconnecting from drive or system piping

Valve plate selections
- Rear or side port connections available



88050R

SAE keyed or SAE splined shaft
- Heavy duty belt drive shafts available

Thru-shaft availability
- Allows for multiple pump installation from a single drive shaft
- Allows pumps to drive auxiliary devices

Sealed front shaft bearings
- Allows operation with water base, low viscosity or other special fluids
- Allows side loading

Three frame sizes with seven capacity ranges allowing greater flexibility to selectively match pressure and capacity.
- Low flow/high pressure to low pressure/high flow from the same frame sizes.

Swashblock and saddle with special polymerous bearings
- Allows running on water base, low viscosity or other special fluids
- Permits consistent control reaction
- Eliminates troublesome yoke bearings
- Provides long life

Steel shoes with specially treated faces for increased fluid retention, running on hardened swashblock surface.
- Allows a higher degree of contaminate resistance
- Allows higher pressure operation with long life
- Allows operation with water base, viscosity or other special fluids
- Provides longer life

SPECIFICATIONS

27—30 SSU VISCOSITY FLUID

FRAME SIZE	UNIT SIZE	MAXIMUM DISPLACEMENT		RATED CONTINUOUS PRESSURE		MAXIMUM PRESSURE		FLOW RATE at 1800 rpm, rated continuous pressure & 14,7 psia (1 bar_{abs}) inlet condition		MAXIMUM SPEED at 1800 rpm and 14,7 psia inlet condition	POWER INPUT at rated continuous pressure and 1800 rpm	
		in^3/rev	ml/rev	psi	bar	psi	bar	gpm	l/min	rpm	hp	kw
A	06	0.86	14,1	3000	206,9	3500	241,4	5.5	20,8	1800	12.9	9,6
	10	1.35	22,1	2000	137,9	2500	172,5	9.0	34,1	1800	13.3	9,9
B	15	2.06	33,8	3000	206,9	3500	241,4	12.7	48,1	1800	30.4	22,7
	20	2.83	46,4	2000	137,9	2500	172,5	20.3	76,9	1800	27.8	20,7
C	34	4.67	76,5	3000	206,9	3500	241,4	32.6	123,6	1800	68.4	51,0
	45	6.00	98,3	2000	137,9	2500	172,5	42.8	162,2	1800	59.7	44,5
	60	7.94	130,2	1200	82,8	1500	103,4	56.5	214,2	1800	51.1	38,1

*Higher pressure available— consult factory.

Note: Minimum speed 600 rpm.

For units to be run with conventional (oil) hydraulic fluids, please see Oilgear Bulletin 47014 (PVW Pumps) or Bulletin 47015 (PVWH Pumps).

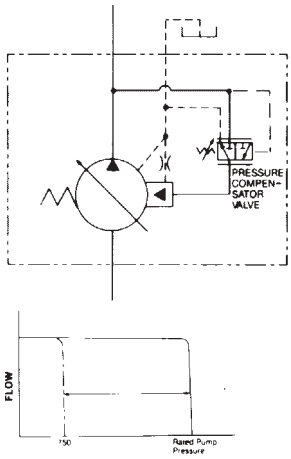
PUMP CONTROLS
PRESSURE*

Pressure Compensator "CN"

Ensures maximum pump flow until unit reaches preset control pressure setting then regulates output flow to match the requirements of the system while maintaining preset output pressure.

Can be adjusted from 750 psi working pressure up to the maximum pressure rating of applicable pump.

A remote control module "VSR" can be used to adjust the "CN" Control.



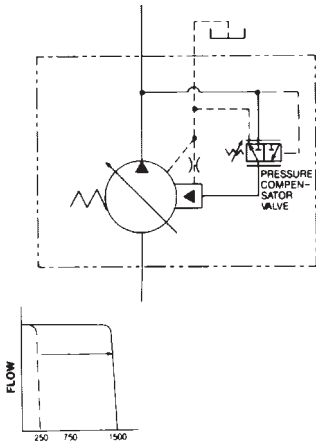
PRESSURE

509820

Low Pressure Compensator "CL"

Works the same as the "CN" control except it provides a lower minimum pressure. Can be adjusted from 250 psi working pressure up to a maximum of 1500 psi.

A remote control module "VSR" can be used to adjust the "CL" Control.

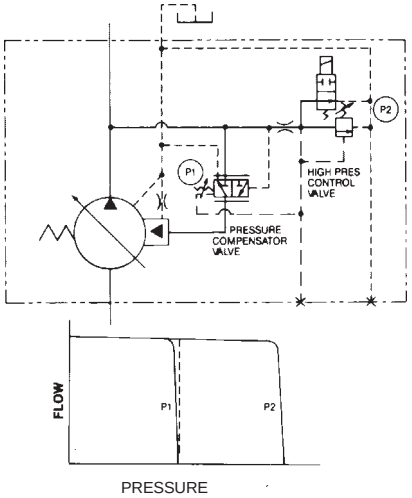


PRESSURE

509820

Dual Pressure Compensator "C2"

Provides two independently adjustable pressure compensated deliveries as selected by an integral solenoid.

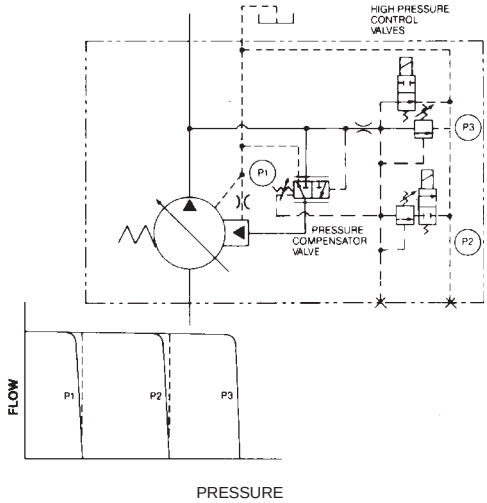


PRESSURE

509819

Triple Pressure Compensator "C3"

Provides three independently adjustable pressure compensated deliveries as selected by integral solenoids.



PRESSURE

509819

*Be sure system and pumps are protected against overloads with a high pressure relief valve.

PUMP CONTROLS

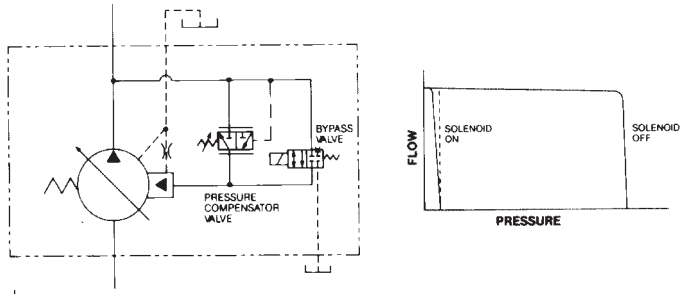
PRESSURE * (Cont'd)

VOLUME/PRESSURE SENSING*

Soft Start Pressure Compensator "CU"

Pump starts "softly" by going quickly at low pressure to a reduced flow setting, thereby reducing start up torque requirements.

While a standard compensator adjustor is supplied, a remote control module "VSR" can also be used to adjust the "CU" control.

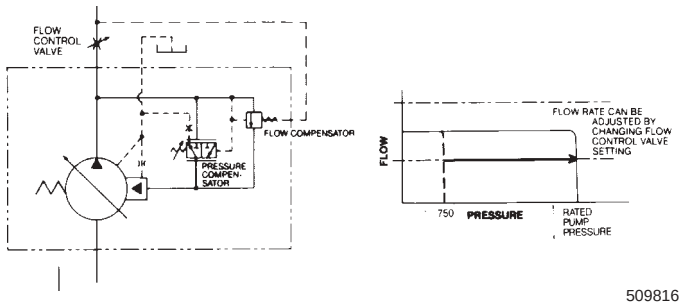


E51316

Load Sensing "CF"

A constant flow output is maintained for a given flow control valve setting regardless of changes in drive speed and/or working pressure.

Remote control module "VSR" can also be used to adjust the pressure compensator action of "CF" controlled pumps.

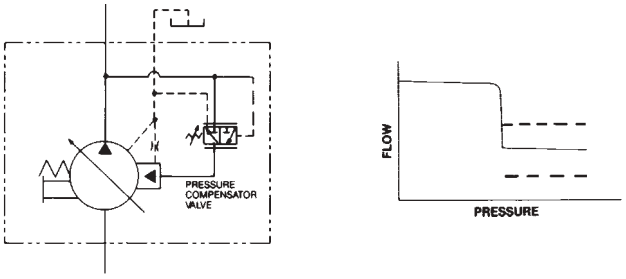


509816

High-Low Pressure Compensator "CH"

Ensures maximum pump flow until unit reaches preset control pressure setting, then partially de-strokes the pump to provide a minimum variable adjustment preset flow rate regardless of system pressure.

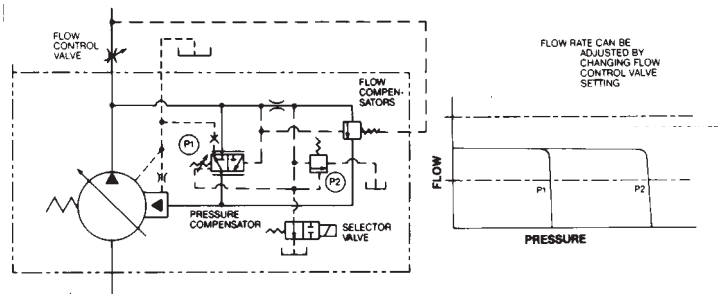
Remote control module "VSR" can also be used to adjust the pressure compensator action of "CH" controlled pumps



E51340

Dual Pressure Compensator with Load Sensing "2F"

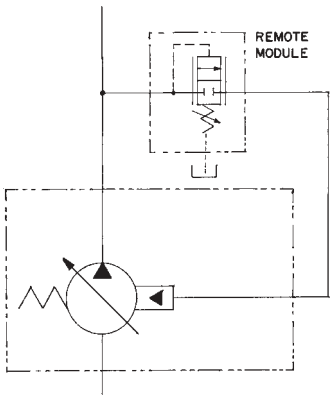
Maintains a constant flow rate at up to either of two independent adjustable pressures as selected by an integral solenoid.



E51215

Remote Operator "VSR"

Remote control module to adjust "CF", "CH", "CL" ,"CN", and "CU" controlled pumps. When system pressure reaches the setting of the remote control module, the control then regulates output to match the requirements of the system while maintaining preset output pressure.

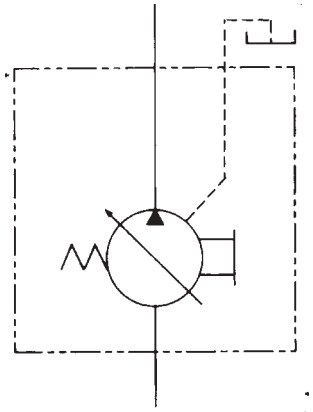


*Be sure system and pumps are protected against overloads with a high pressure relief valve.

VOLUME*

Handwheel "HN"

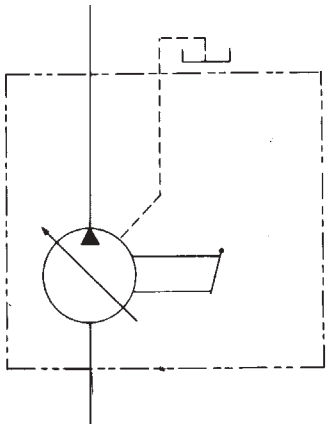
Provides simple manual handwheel adjustment of delivery.



509815

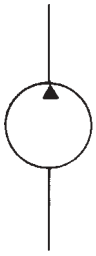
Lever Operated "MN"

Varies displacement proportional to the rotation of a pintle.



509818

Fixed Displacement "NN"

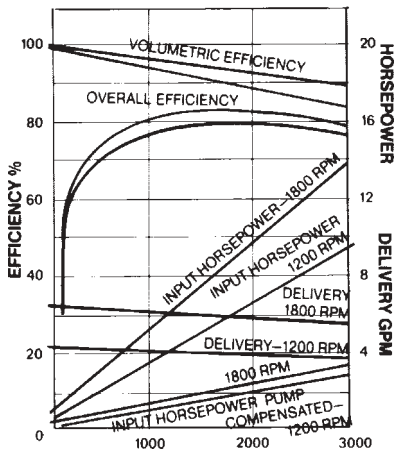


*Be sure system and pumps are protected against overloads with a high pressure relief valve.

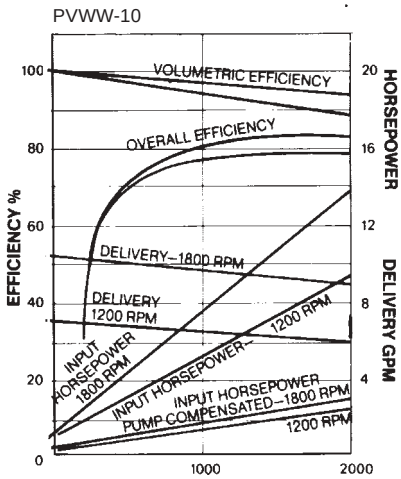
PERFORMANCE CURVES

The following single pump curves are based on a fluid temperature of 95°F (27 SSU) and flooded inlet.

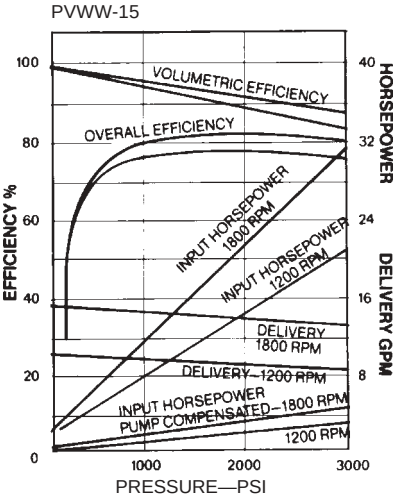
PVWW-06



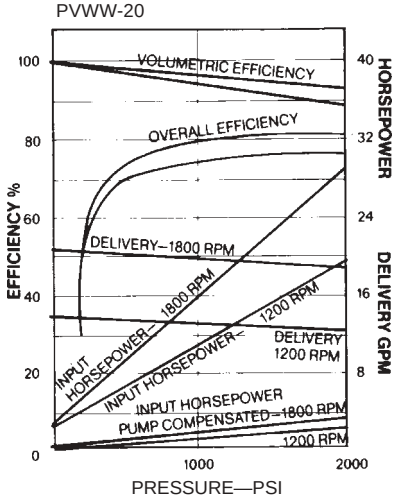
PVWW-10



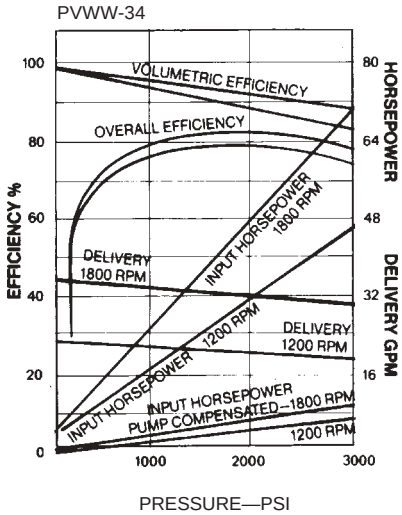
PVWW-15



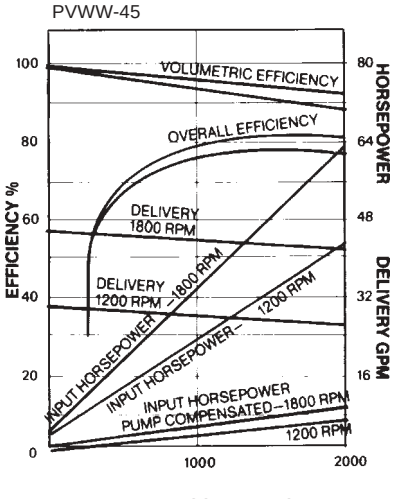
PVWW-20



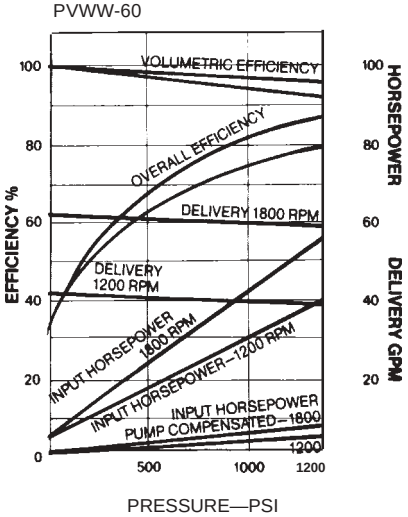
PVWW-34



PVWW-45



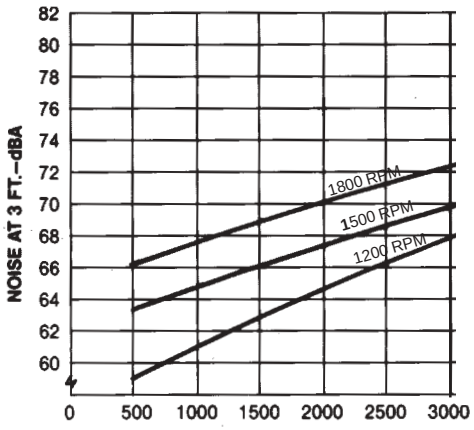
PVWW-60



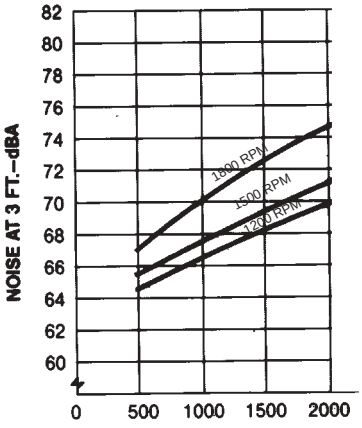
SOUND CURVES

All of the following sound curves are based on pump delivering full volume from port "A". Single microphone noise taken in semi-reverberant room at three feet from pump surface. Tolerance on curves is +3 dBa.

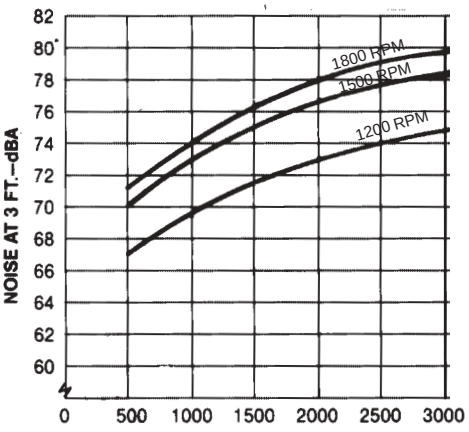
PVWW-06 —FULL STROKE



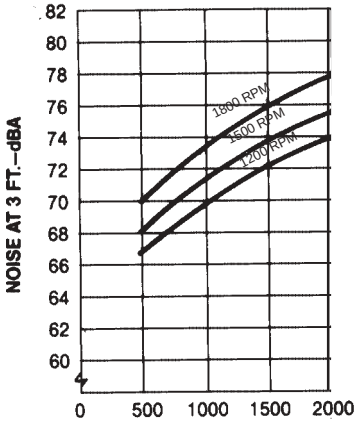
PVWW-10—FULL STROKE



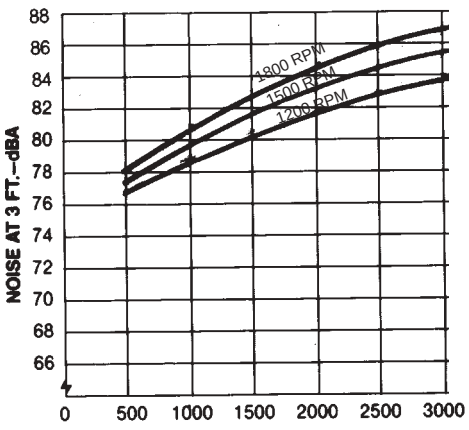
PVWW-15 —FULL STROKE



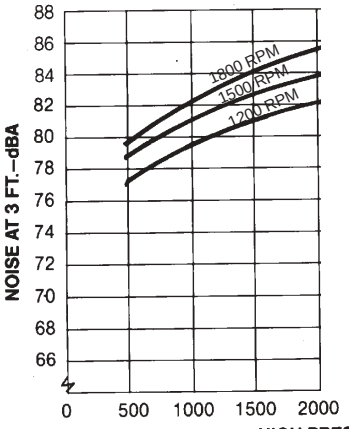
PVWW-20 —FULL STROKE



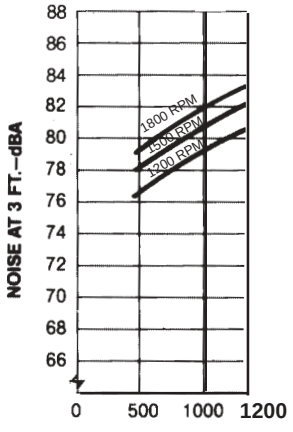
PVWW-34 —FULL STROKE



PVWW-45 —FULL STROKE



PVWW-60 —FULL STROKE



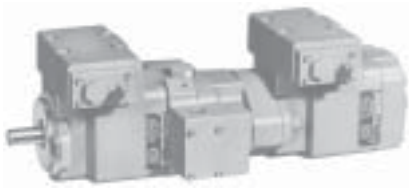
MULTIPLE PUMPS
PUMP COMBINATIONS

Two or more Oilgear axial piston variable delivery pumps can be integrally coupled together and driven from a single shaft.

Pump deliveries can be combined for large volume circuits or deliveries can be used individually. See page 4 for individual pump ratings.

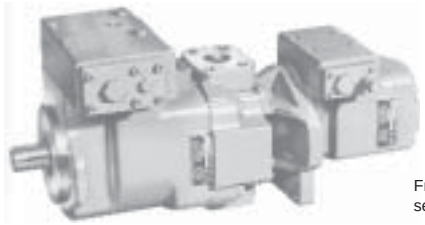
The front pump can be used at full rated output while the rear pumps are governed by the thru shaft torque listed in the table, on page 11.

89031



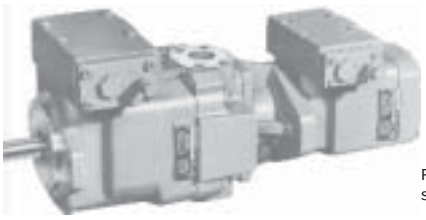
Front pump frame size A with second pump frame size A

55269



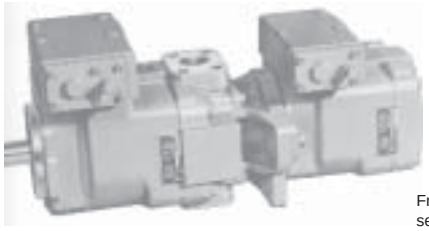
Front pump frame size C with second pump frame size A

55275



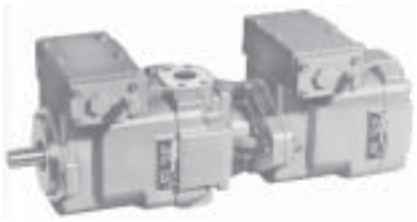
Front pump frame size B with second pump frame size A

55271



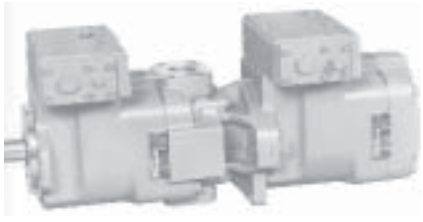
Front pump frame size C with second pump frame size B

55277



Front pump frame size B with second pump frame size B

55273



Front pump frame size C with second pump frame size C

55279

THRU SHAFT SIZING/COMPATIBILITY

PISTON PUMP FRAME SIZE	INPUT TORQUE									ALLOWABLE THRU SHAFT TORQUE	
	PUMP SIZE	RATED PRESSURE		INPUT TORQUE (T_R)@ RATED PRESSURE		PEAK PRESSURE		INPUT TORQUE @ PEAK PRESSURE		STANDARD SHAFT	
		psi	bar	in-lb.	Nm.	psi	bar	in-lb.	Nm.	in-lb.	Nm.
A	06	3000	206,9	452	50,9	3500	241,4	527	59,3	200	22,5
	10	2000	137,9	466	52,5	2500	172,5	588	66,2		
B	15	3000	206,9	1063	119,7	3500	241,4	1244	140,0	500	56,3
	20	2000	137,9	973	109,5	2500	172,5	1215	136,8		
C	34	3000	206,9	2395	269,6	3500	241,4	2795	314,7	900	101,4
	45	2000	137,9	2100	236,4	2500	172,5	2600	292,7		
	60	1200	82,8	1722	193,9	1500	103,4	2125	239,2		

ACTUAL INPUT TORQUE CALCULATION

$$T_A = T_R \times \frac{\text{ACTUAL OPERATING PRESSURE}}{\text{RATED PRESSURE}} \times \frac{\% \text{ FULL DELIVERY}}{100\%}$$

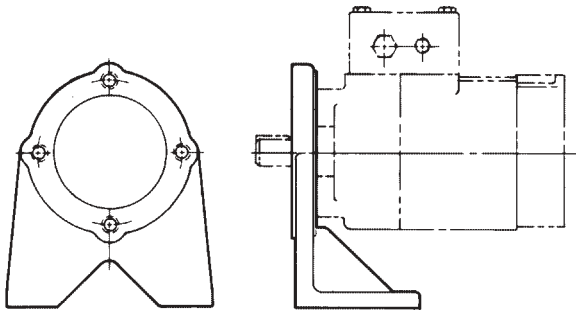
NOTE: When applying a thru shaft driven Oilgear pump or a thru shaft driven pump from other manufacturers, it must be determined that its actual input torque does not exceed the allowable thru shaft torque given in the table above. Use the formula given to determine actual input torque if the pump is applied at other than rated values.

NOTE: If more than one pump is to be thru shaft driven, their combined actual input torques must not exceed the above valves if their highest loads are experienced simultaneously.

MOUNTING BRACKETS FOR PVWW PUMPS

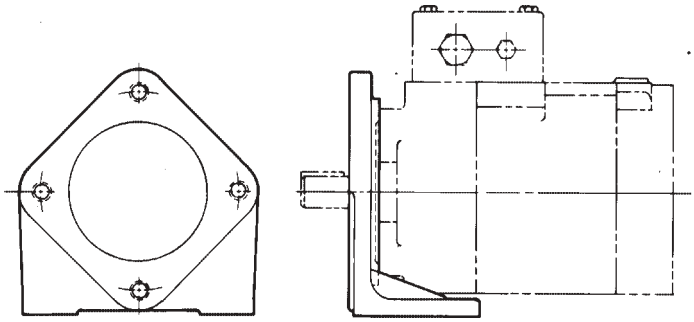
Piston Pump Frame Size

A



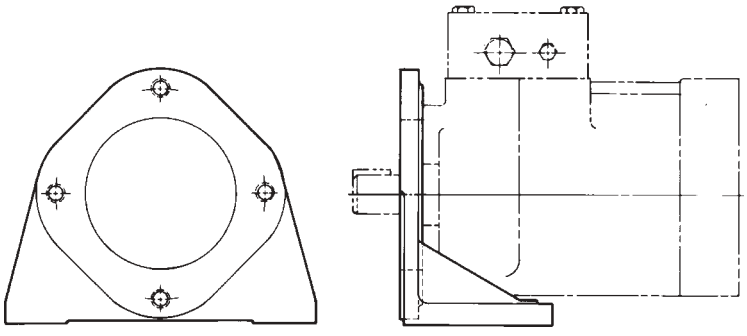
06, 10

B



15, 20

C

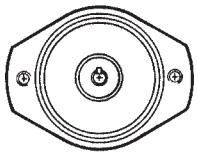
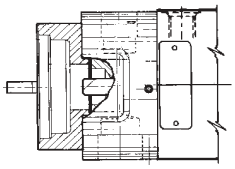
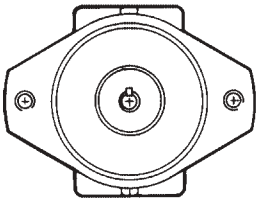
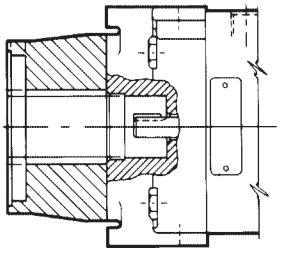
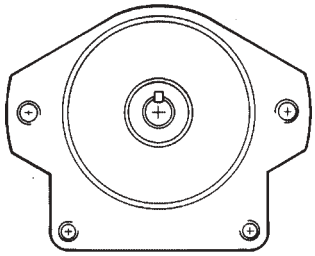
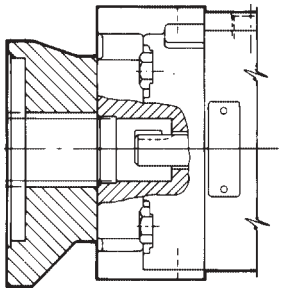


34, 45, 60

Contact your Oilgear Representative for detailed dimensions.

SAE ADAPTERS FOR PVWW PUMPS

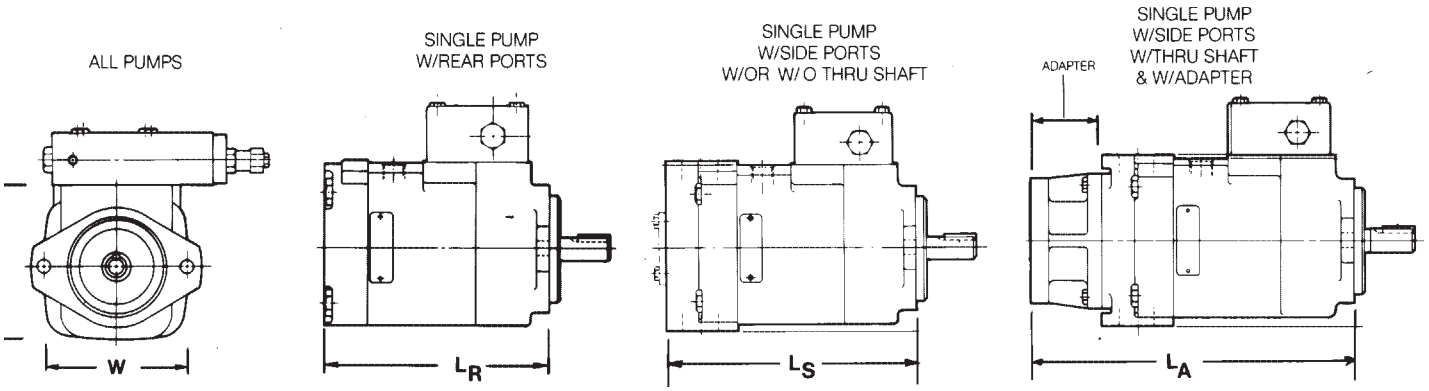
Installation adapters for single pumps with thru shaft and side ports. (E60240)

Piston Pump Frame Size		For Mounting The Following	To Piston Pump Size	Order Code No.
A				
		06, 10 Piston Pump	06, 10	AA
B				
		06, 10 Piston Pump	15, 20	AA
		15, 20 Piston Pump	15, 20	AB
C				
		06, 10 Piston Pump	34, 45, 60	AA
		15, 20 Piston Pump	34, 45, 60	AB
		34, 45, 60 Piston Pump	34, 45, 60	AC

(E60203)

Contact your Oilgear Representative for detailed dimensions.

SIZE AND WEIGHTS
SINGLE PUMPS



DIMENSIONS AND WEIGHTS

FRAME SIZE	PVWW PUMP SIZE	HEIGHT H		WIDTH W		LENGTH L_R		LENGTH L_S		LENGTH L_A W/PISTON PUMPS ADAPTER		WEIGHT SINGLE PUMP W/REAR PORTS	
		inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	lb	kg
A	06 & 10	4.50	114,3	4.32	109,7	7.20	182,9	8.07	205,0	9.39	238,5	32	14,5
B	15 & 20	6.11	155,2	5.80	147,3	8.50	215,9	9.63	244,6	12.36	313,9	68	30,9
C	34, 45 & 60	7.18	182,4	6.76	171,7	10.44	265,2	11.50	292,1	14.00	355,6	103	46,8

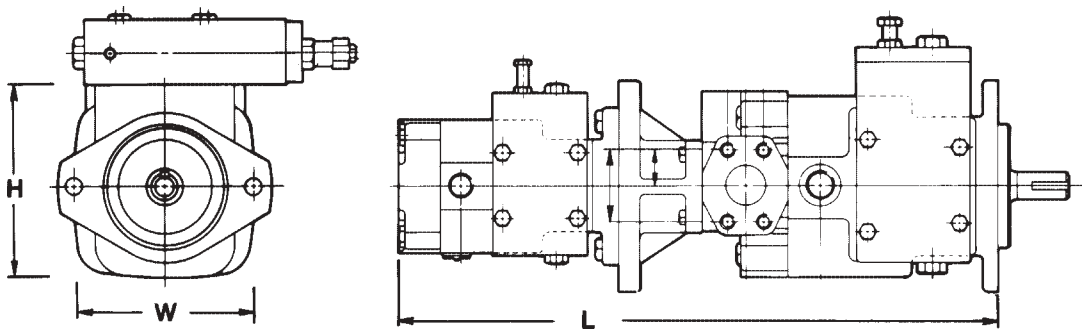
All dimensions are approximate, for detailed dimensions contact your Oilgear Representative.

Length Example
SINGLE PUMP
*With rear ports.
PVWW-15-RSAY-CNN
Size 15 (L_R) length = 8.50 inches (215,9 mm)

*With side ports, w/wo thru shaft
PVWW-15-RDFY-CNNNTK
Size 15 (L_S) length = 9.63 inches (244,6 mm)

*With side ports, with thru shaft and adapter
PVWW-15-RDFY-CNNNTK-AG
Size 15 (L_A) length = 12.36 inches (313,9 mm)

MULTIPLE PUMPS



DIMENSIONS AND WEIGHTS

FRAME SIZE	PVWW DUAL PUMP SIZES	**W** WIDTH		**L** LENGTH		**H** HEIGHT		WEIGHT	
		inch	mm	inch	mm	inch	mm	lb.	kg
A/A	06 or 10 & 06 or 10	4-1/4	107	16 - 5/8	422	4-1/4	113	72	33
B/A	15 or 20 & 06 or 10	5-3/4	146	19 -1/2	495	6	155	108	49
B/B	15 or 20 & 15 or 20	5-3/4	146	21	533	6	155	144	66
C/A	34, 45 or 60 & 06 or 10	7-1/8	181	21-1/4	539	7-1/4	184	143	65
C/B	34, 45 or 60 & 15 or 20	7-1/8	181	22 -1/2	572	7-1/4	182	179	82
C/C	34, 45 or 60 & 34, 45 or 60	7-1/8	181	24 -1/2	622	7-1/4	182	214	97

All dimensions are approximate, for detailed dimensions of these or other multiple combinations including other types of auxiliary pumps, contact your Oilgear Representative.

Length Example:

DUAL PUMP
Two variable delivery pumps
PVWW-45-LDFS-CHSNTK-/PVWW-20-LSAY-CNSNNN
Size 45 pump (L_A) length = 14 inches (355,6 mm) plus
Size 20 pump (L_R) length = 8.50 inches (215,9 mm) =
22.50 inches (571,5 mm)

Three variable delivery pumps
PVWW-45-LDFS-CNSNTK-/PVWW-20-LDFY-CF
SNTK-/PVWW-10-LDAY-MNSNNN-CP
Size 45 pump (L_A) length = 14.00 inches (355,6 mm) plus
Size 20 pump (L_A) length = 12.36 inches (313,9 mm) plus
Size 10 pump (L_R) length = 7.20 inches (182,9 mm) =
33.56 inches (857,4 mm)

HOW TO ORDER

BLOCK NUMBER EXPLANATION	1	2	3		4		5	6	7		8	9	10		11
TRIPLE PUMP EXAMPLE	P	V	WW	—	45	—	L	DF	S	—	CN	SN	TK	—	/
DUAL PUMP EXAMPLE	P	V	WW	—	45	—	L	DF	S	—	CN	SN	TK	—	/
SINGLE PUMP W/THRU-SHAFT EXAMPLE	P	V	WW	—	34	—	R	DF	S	—	CN	NN	TK	—	AT
SINGLE PUMP WITH SIDE PORTS EXAMPLE	P	V	WW	—	10	—	L	DA	Y	—	CN	SN	TK	—	CP
SINGLE PUMP WITH REAR PORTS EXAMPLE	P	V	WW	—	06	—	L	SA	Y	—	CN	SN	NN		

1 = UNIT
- P = Pump

2 = TYPE
- F = Fixed
- V = Variable

3 = DESIGN SERIES
- WW = Water Base Series

4 = SIZE (1800 rpm)
- 06 = 6 gpm
- 10 = 10 gpm
- 15 = 15 gpm
- 20 = 20 gpm
- 34 = 34 gpm
- 45 = 45 gpm
- 60 = 60 gpm

5 = ROTATION (from shaft end)
- L = Left Hand (CCW)
- R = Right Hand (CW)

6 = PORT TYPE & LOCATIONS
- DA = Side Location w/SAE St. Thread Ports (for sizes 06, 10)
- DF = Side Location w/SAE Flanged Ports (for sizes 15, 20, 34, 45, 60)
- SA = Rear Location w/SAE St. Thread for sizes 06, 10, 15, 20; w/SAE St. Thread (Pressure Port) & w/SAE Flanged (Suction Port) for sizes 34, 45 & 60. Rear Ports can not be used with thru-shaft (multiple) units.
- DR = Flanged/Top & bottom with relief valve (for sizes 15, 20, 34 & 45). See Bulletin RV-I for dimensions.
- GA = Side Location w/SAE St. Thread Ports (for non-thru shafted size 06 & 10)
- TA = Side Location w/SAE St. Thread Ports (for thru shafted size 06 & 10).

7 = INPUT SHAFT END
- Y = Keyed (SAE)
- S = Splined (SAE), Mobile
- D = Splined (SAE), Industrial
- B = Keyed (belt driven, size 06 thru 20)
- C = Splined (belt driven, size 06 thru 20)

8 = CONTROL TYPES

Pressure
- *CN = Pressure Compensator
- *CL = Low Pressure Compensator
- C2 = Dual Pressure Compensator
- C3 = Triple Pressure Compensator
- *CU = Soft Start Pressure Compensator
- *CH = High-Low Pressure Compensator

Volume/Pressure Sensing
- *CF = Load Sensing
- 2F = Dual Pressure Compensator with Load Sensing

Volume
- HN = Handwheel
- MN = Lever Operator
- NN = Fixed Displacement

9 = VOLUME STOPS
- SA = Minimum Volume Stop (not available with CU, CF, 2F or HN controls)
- SB = Minimum & Maximum Volume Stop (not available with CU, HP, CF or 2F controls)
- SN = Maximum Volume Stop (Not available with CU, CH, CF, 2F or HF controls)
- NN = No stops

1	2	3		4		5	6	7		8	9	10		11	1	2	3		4		5	6	7		8	9	10		11
P	V	WW	—	20	—	L	DF	Y	—	C2	SN	TK	—	/	P	V	WW	—	10	—	L	DA	Y	—	CH	SN	TK	—	CP
P	V	WW	—	10	—	L	DA	Y	—	C2	SN	TK	—	CP															

10 = THRU SHAFT TYPE

- NN = None (Single units w/rear ports only)
- TK = Mounting for Key or Tang Driven Auxiliary Devices (not available for 06/10 sizes)
- TH = Mounting for Spline Driven Auxiliary w/high strength shaft Note: when using high strength shaft "TH", splined input shaft must be ordered.

11 = COUPLING and ADAPTERS (Optional when not ordering multiple pump)

- AA = For mounting PVWW-06, 10 (SAE A 2-bolt)
- AB = For mounting PVWW-15, 20 (SAE B 2-bolt)
- AC = For mounting PVWW-34, 45, 60 (SAE C 2-bolt)
- CP = Cover plate
- VA = For mounting PVWW-06 or 10 (SAE A 2-bolt) to "TH" shaft
- VB = For mounting PVWW-15, or 20 (SAE B 2-bolt) to "TH" shaft
- VC = For mounting PVWW-34, 45 or 60 (SAE C 2-bolt) to "TH" shaft

* FOR REMOTE CONTROL ADJUSTMENT (optional)

Order line mounted sequence valve as a separate item.

For additional information on this module, see DS-82318.

Oilgear

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BULLETIN 47013
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Technical Bulletin

PVWW PUMPS

Application Guide Lines

The following information should be considered when applying Oilgear PVWW Pumps. These guide lines are to be used to help design systems for continuous duty. Please consult the Oilgear Technical Sales Department when application and/or system requirement vary (even) slightly from the following.

SPECIFICATIONS (Also see "Additional Notes")	**PVWW**		**PVWW**		**PVWW**		
	06	**10**	**15**	**20**	**34**	**45**	**60**
Drive							
Maximum rpm							
Flooded Inlet (suction)			1800				
Minimum rpm							
Flooded Inlet (suction)	600		600		600		
Torque to turn shaft (ft. lbs.)	1.7 - 2.1		2.9 - 3.3		7.9 - 8.3		
Inlet							
Pressure (psia)							
1800 rpm	6.4	7.0	8.4	9.0	9.6	9.8	14.5
1500 rpm	5.9	6.0	7.6	7.9	8.6	8.6	10.0
1200 rpm	5.5	5.5	7.0	7.2	8.0	7.6	8.0
Volume (See "Additional Notes")							
Output							
Pressure (psi)							
Maximum							
Intermittent	3500	2500	3500	2500	3500	2500	1500
Continuous	3000	2000	3000	2000	3000	2000	1200
Minimum	100	100	100	100	100	100	100
Volume @ 1800 rpm, rated pressure, and unit set for full displacement (to exceed) minimum gpm	5.21	9.19	13.74	18.75	31.9	41.94	55.72

(Continued)

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SPECIFICATIONS (Also see "Additional Notes")	PVWW 06	PVWW 10	PVWW 15	PVWW 20	PVWW 34	PVWW 45	PVWW 60
CASE Case pressure/inlet differentials take priority and must be followed.							
Maximum Pressure psi							
w/Std. Shaft Seal	25		25			25	
w/High Pressure Seal	100		100			100	
Minimum Drain Size (inch tube)	0.5	0.5	0.625	0.625	0.75	0.75	0.75
Average case slip (cipm) at							
1200 psi							390
2000 psi		152		230		345	
3000 psi	152		230		345		
Orientation See Oilgear Service Instruction Bulletin 947015 for horizontal mounting. See Service Instruction Bulletin 90014 for vertical mounting.							
Control							
Minimum Pilot Pressure (psi)							
Pressure Controls	200		400			600	
Volume Controls	350		350			350	
Control Piston Stroke (inches[1])	0.461		0.603			0.752	
Control Piston Area (inches[2])							
Pressure Controls							
On Stroke	Spring Operated						
Off Stroke	0.785		1.767			2.405	
Volume & Electronic Controls							
On & off sizes are equal	0.785		1.767			2.405	
Volume (inches[3])							
Pressure Controls							
On Stroke	N/A		N/A			N/A	

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SPECIFICATIONS (Also see "Additional Notes")	**PVWW**		**PVWW**		**PVWW**		
	06	**10**	**15**	**20**	**34**	**45**	**60**
Volume (inches^2) Continued							
Volume & Electronic Controls							
on & off are equal	0.362		1.066			1.809	
Swashblock Angle (degrees) max.	21.0		20.5			21.5	
Rated (msec.) at 1800 rpm & Rated Pressure							
Pressure Controls							
* Minimum to Full Stroke	100	100	100	100	200	200	200
** Full to Minimum Stroke	80	80	80	80	200	200	200
Volume & Electronic Control							
Min. to full stroke	Based on customers' control system pump						
Full to Minimum Stroke							

**The smaller the differential between delivery pressure and compensator setting, the slower the rate will be.*
*** Rate will be slower, if pressure is less than 500 psi above compensator setting.*

Fluid Also see "Additional notes" for filtration and contamination levels.

Viscosity SSU			
Minimum	27-30	27-30	27-30
Maximum	2000	2000	2000
Operating Temperature (F^0)*			
Inlet			
Maximum	150	150	150
Minimum	14	14	14
Minimum Starting	-40	-40	-40

** Minimum and maximum viscosities should be observed.*

ADDITIONAL NOTES

Inlet 1. Free sucking circuits must be arranged to ensure pump will "prime" when started.

Case 1. **Drain** (a) Fill case with fluid before starting (b) Arrange case drain line to keep case full of fluid. (c) Use a minimum of bends returning case drain line to reservoir below minimum fluid level.

2. **Orientation** (a) Pump orientation is not restricted. But, case drain must be arranged to **keep** case **full** of fluid at all times. *See Oilgear Service Instruction Bulletin 947015 for horizontal mounting. For vertically mounted units; see Bulletin 90014, "Service Instructions, Installation of Vertically Mounted Axial Piston Units".*

Control

1. Case bleed of 1 to 2 gpm is recommended for volume controlled pumps and/or pumps hydraulically remote controlled, especially if operated at neutral for long periods of time.

Fluid

1. **Filtration** (a) At least 1/3 of pump volume must be filtered with an element having a $B_{10} = 15$ (b). All fluid to servo valve controls must be through a $B_{10} = 75$ element.
2. **Contamination** level of ISO code 19/16 is maximum.

Start-up

1. **Priming** (a) Valves may be necessary to bleed air from high pressure lines.

2. **Horizontal mounted units** (a) Top of case must be level with (or below) minimum reservoir fluid level or (b) Free sucking horizontal units mounted on top of reservoir must be partially supercharged or dump full pump delivery into reservoir at 10 psi (or less) for 15 seconds to purge (burp) the inlet air.

3. **Vertically mounted units** – *See Bulletin 90014; "Service Instructions, Installation of Vertically Mounted Axial Piston Pumps".*

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