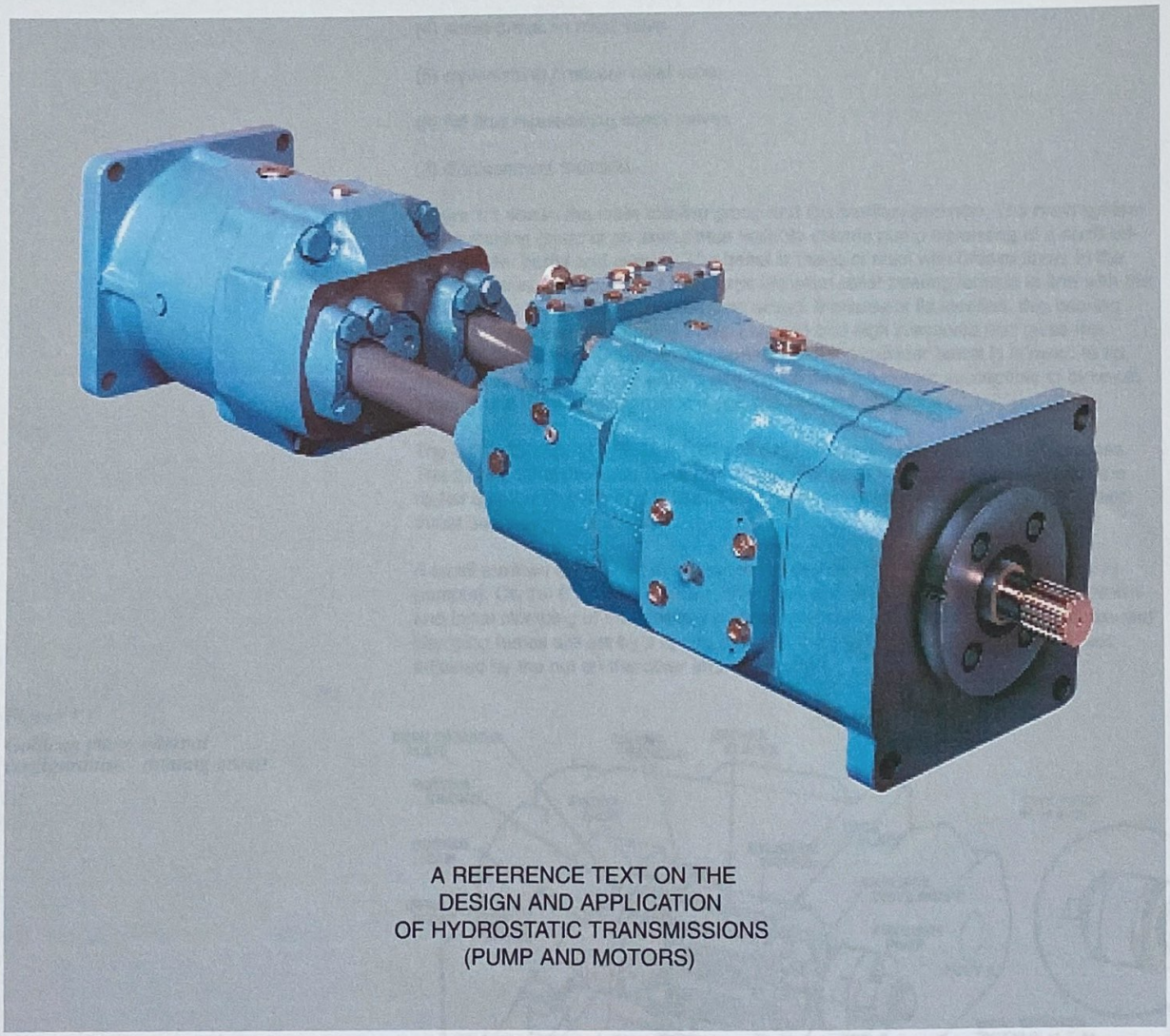
DENISON HYDRAULICS
Gold Cup series
Hydrostatic transmission Application manual



A REFERENCE TEXT ON THE
DESIGN AND APPLICATION
OF HYDROSTATIC TRANSMISSIONS
(PUMP AND MOTORS)

publ. LT3-00004-1 *replaces SP1-AM330-A*

DENISON Hydraulics

ISO 9001
DNV
DNV Certification, Inc.
REGISTERED FIRM

GOLDCUP PACKAGE PUMP AND MOTOR INTERNAL CONFIGURATION

Goldcup series package pumps and motors are equipped with all the components required by most hydrostatic transmission circuits. In the pump are the main system rotating group, the servo and replenishing pump(s), replenishing check valves, stroking mechanisms, and a valve block assembly containing the servo pressure relief valve, replenishing pressure relief valve and the pressure compensator override valving. The package motor contains the hot oil shuttle valve and the low pressure replenishing relief valve along with the main system motor rotating unit. The circuitry and operation of these valves are detailed in the Goldcup circuitry chapter of this manual.

PACKAGE PUMP INTERNAL CONFIGURATION

Goldcup hydrostatic transmission pumps are equipped with the following standard features:

(1) rotary servo displacement control

(2) pressure compensator override

(3) servo and replenishing pump(s)

(4) servo pressure relief valve

(5) replenishing pressure relief valve

(6) full flow replenishing check valves

(7) displacement indicator

Figure 1.1 shows the main rotating group and the auxiliary pump(s). The main system pump rotating group is an axial piston variable volume pump consisting of a shaft driven cylinder barrel and pistons. The barrel is made of steel with bronze liners in the cylinder bores. It is supported by a large diameter roller bearing located in line with the radial forces generated by the pumping action. Because of its location, this bearing prevents the barrel from tipping at high speeds and high pressures and gives the pump its high speed and pressure capabilities. If the cylinder barrel is allowed to tip, the balancing areas will be altered and the barrel will be more susceptible to blow-off. Tipping also increases internal leakage and reduces efficiency.

The 6.0, 7.25, 8.0, 11 and 14 in^3/rev units all have seven pistons with bronze shoes. The 24 and 30 in^3/rev units have nine. A retainer plate holds the piston shoes to the rocker cam creep plate and is itself held to the rocker cam snout by a snap ring and thrust bearing.

A small auxiliary drive shaft is splined to the cylinder barrel and drives the auxiliary pump(s). On the 6.0 thru 14 in^3/rev , this shaft also provides cylinder barrel holddown and initial clamping of the auxiliary pump(s) pressure loaded side plate. Holddown and clamping forces are set by a spring between the shaft and the cylinder barrel, and adjusted by the nut on the other end of the shaft.

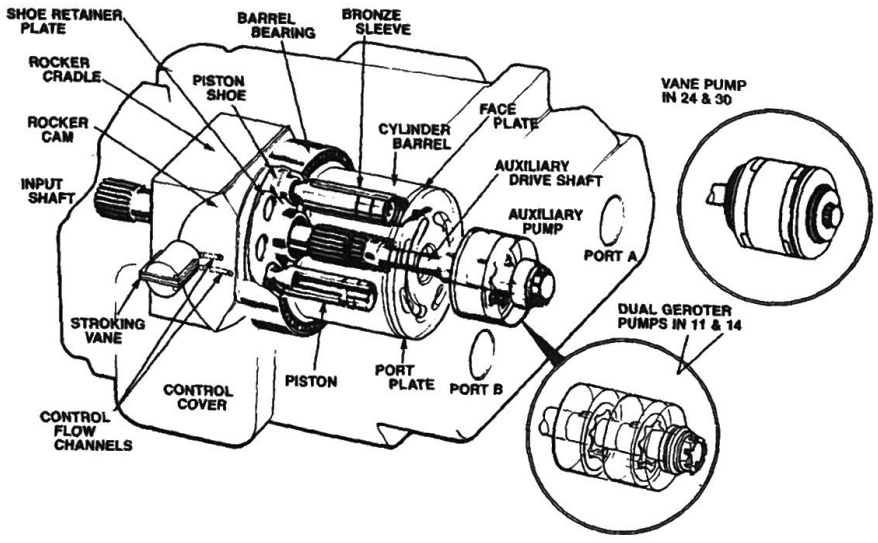


Figure 1.1
Goldcup pump internal configuration - rotating group

Variable displacement motors use the same rocker cam, cradle and stroking mechanisms as the package pumps (see Figure 1.11).

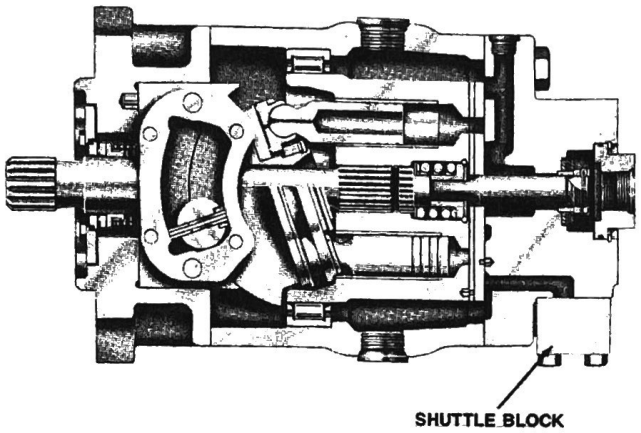
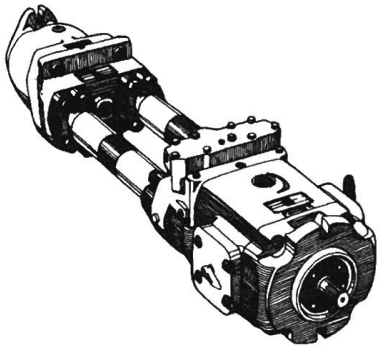


Figure 1.11
Variable displacement motor

The gerotor pump(s), valve block and ring checks are not included. Since there is no gerotor, servo flow must be plumbed to the motor from an external source such as the pump servo pressure.

In place of the pump valve block, the package motors have a small valve block containing the hot oil shuttle and low pressure replenishing relief valve. Non-package motors do not have this block.



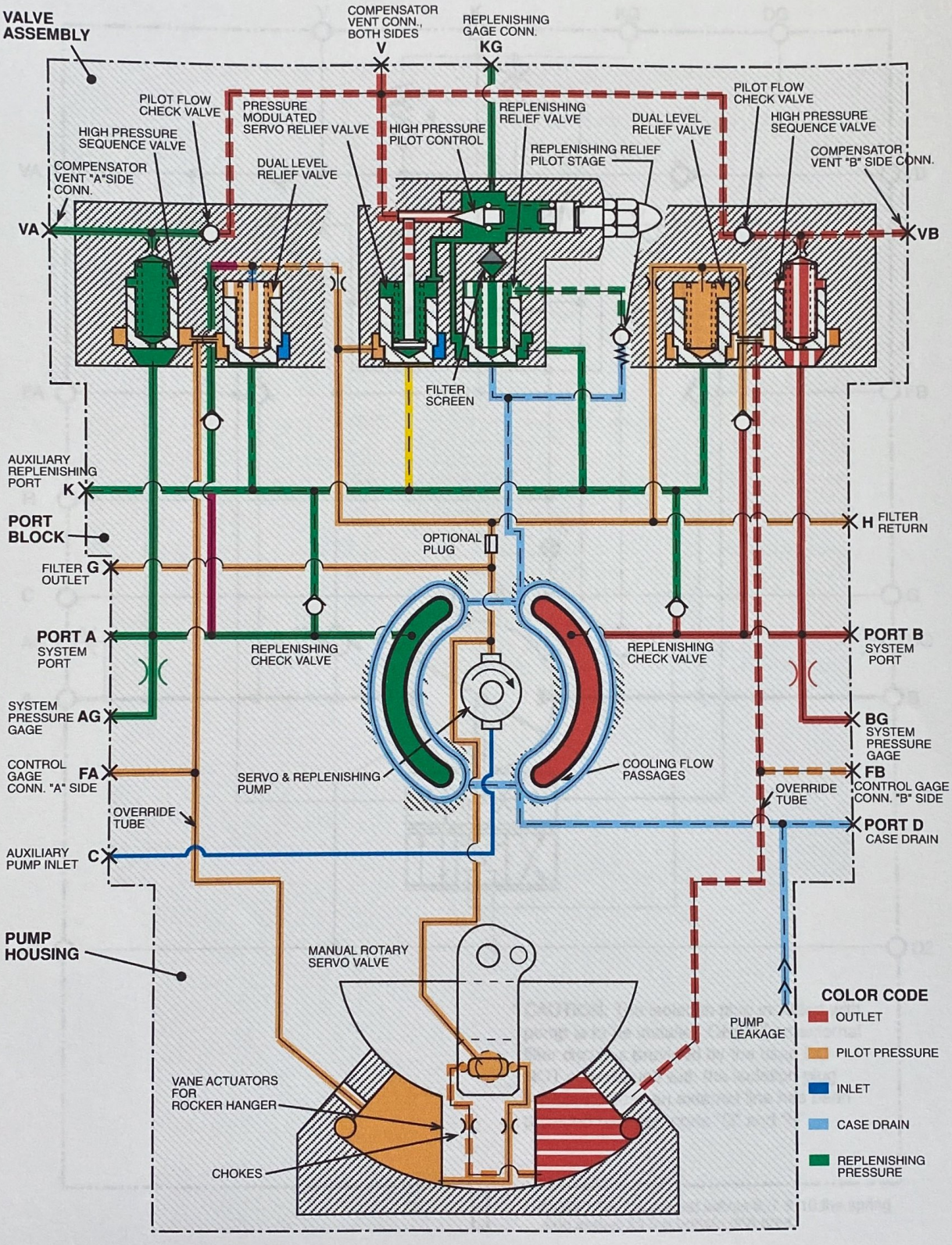


Figure 2.2
6.0, 7.25 and 8.0 in³/rev Pump circuit

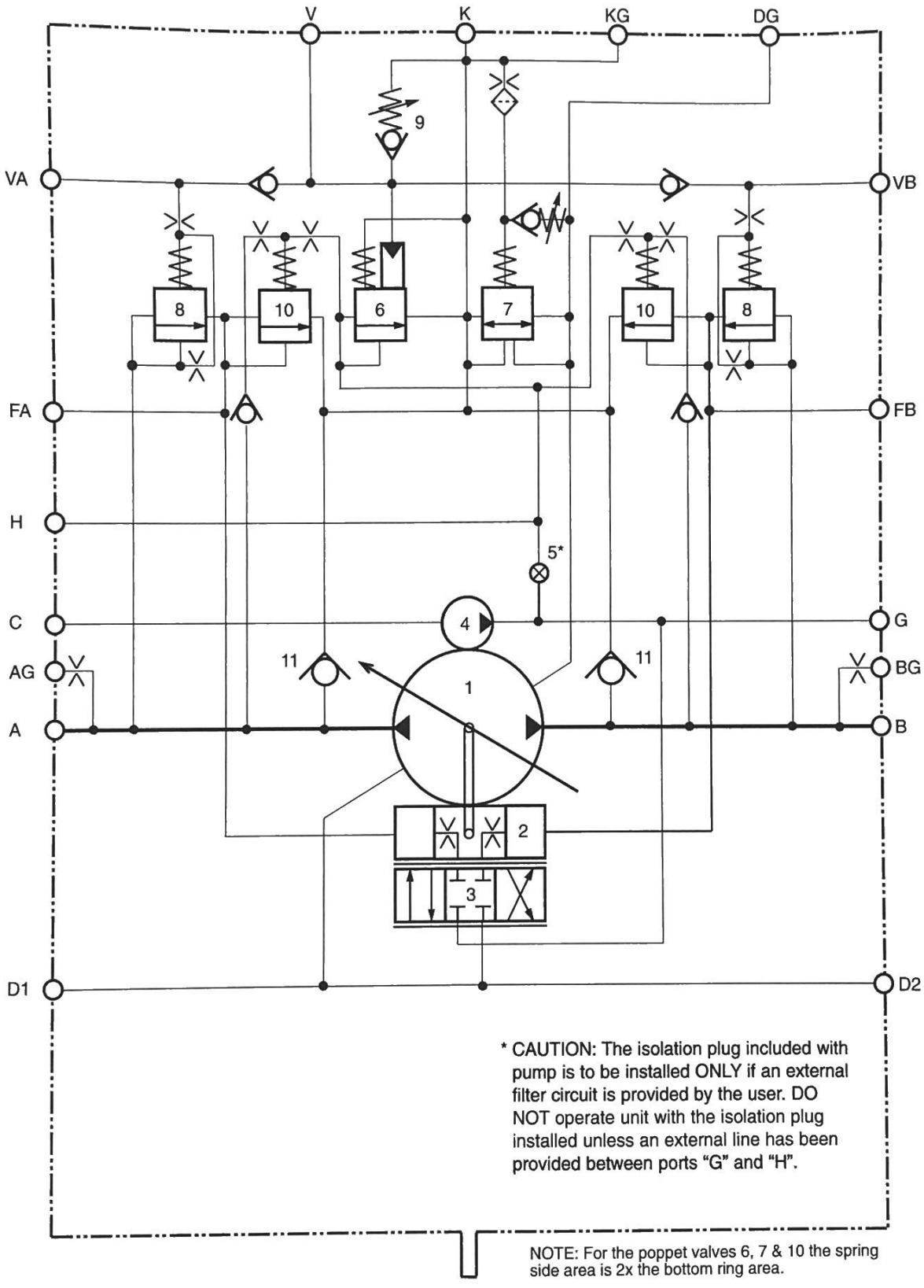


Figure 2.2.1
6.0, 7.25 and 8.0 in³/rev Pump circuit
(ISO Standard)

NOMENCLATURE

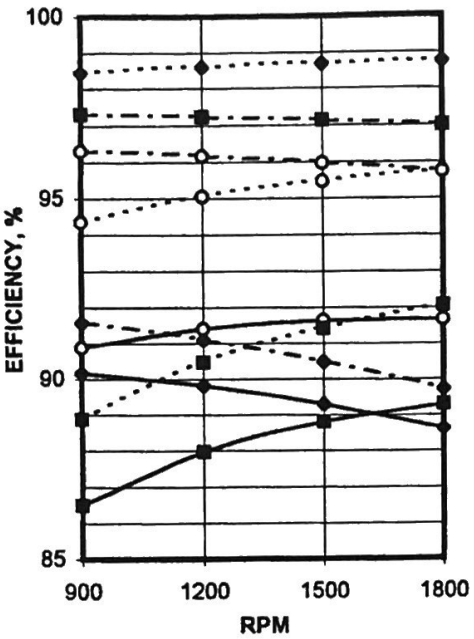
(For ISO circuit Figure 2.2.1)

ITEM	DESCRIPTION
1	Piston pump
2	Vane chambers
3	Rotary servo
4	Servo and replenishing pump
5	Plug optional
6	Servo relief valve (modulated by operating pressure)
7	Replenishing relief valve
8	High pressure sequence valve (2)
9	High pressure pilot control
10	Dual level relief valve (2)
11	Replenishing check valve

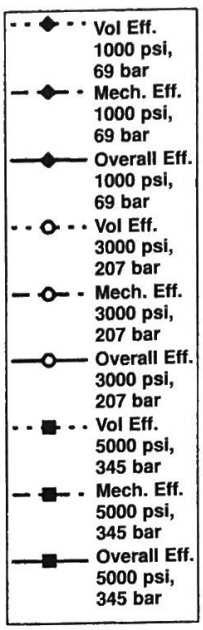
PORT CODE	CONNECTION FUNCTION	PORT SIZE OR THREAD
A,B	System power	4-bolt pad for SAE-1.5" 6000 psi, 414 bar
A	Open loop inlet	4-bolt pad for SAE-2" 3000 psi, 207 bar
AG,BG	System pressure gage, each side	SAE-6 straight thread
C	Auxiliary pump inlet	SAE-16 straight thread
DG	Case pressure gage	SAE-6 straight thread
D1,D2	Case drains	SAE-12 straight thread
G	Auxiliary pump outlet	SAE-8 straight thread
H	Auxiliary flow return servo pressure	SAE-8 straight thread
K	Replenishment inlet	SAE-16 straight thread
KG	Replenishing pressure gage	SAE-6 straight thread
FA	Control area, A side	1/4" NPTF Dryseal
FB	Control area, B side	1/4" NPTF Dryseal
V	Compensator vent, both sides	SAE-4 straight thread
VA	Compensator vent, A side	SAE-4 straight thread
VB	Compensator vent, B side	SAE-4 straight thread

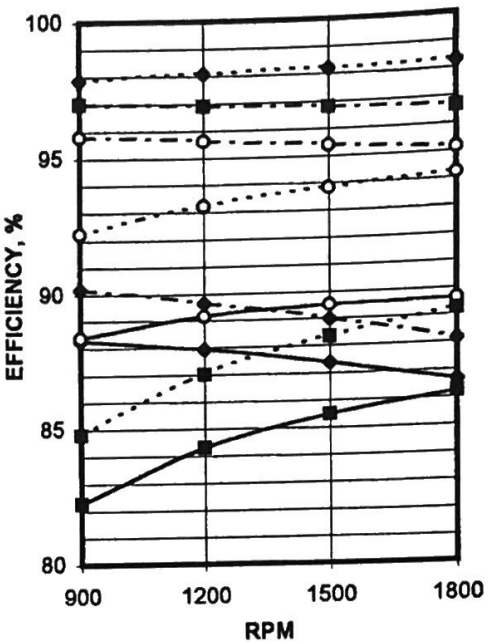
PERFORMANCE CURVES

Series 6
Variable volume pump with 1.07 in³/rev., 17,5 cm³/rev. auxiliary pump

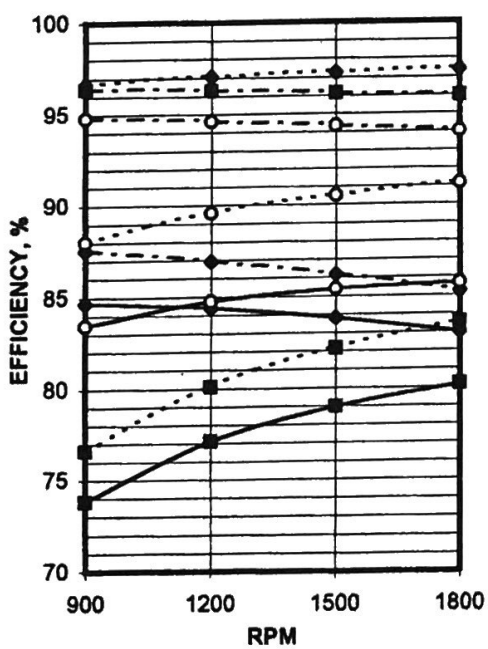


FULL STROKE 6.0 CIPR
98,3 CC/REV

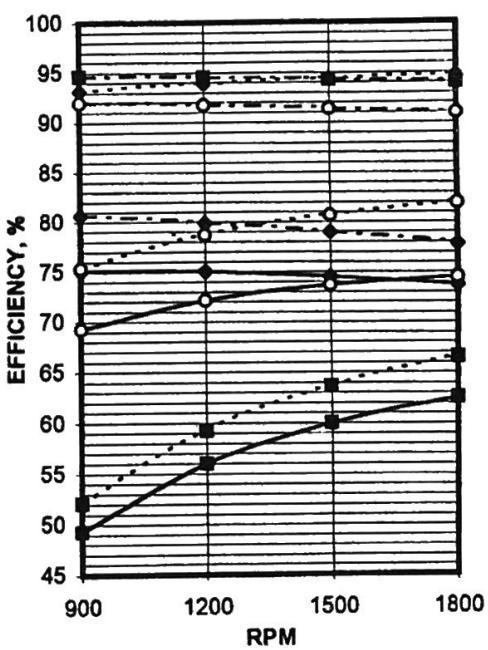




3/4 STROKE 4.5 CIPR
73,7 CC/REV



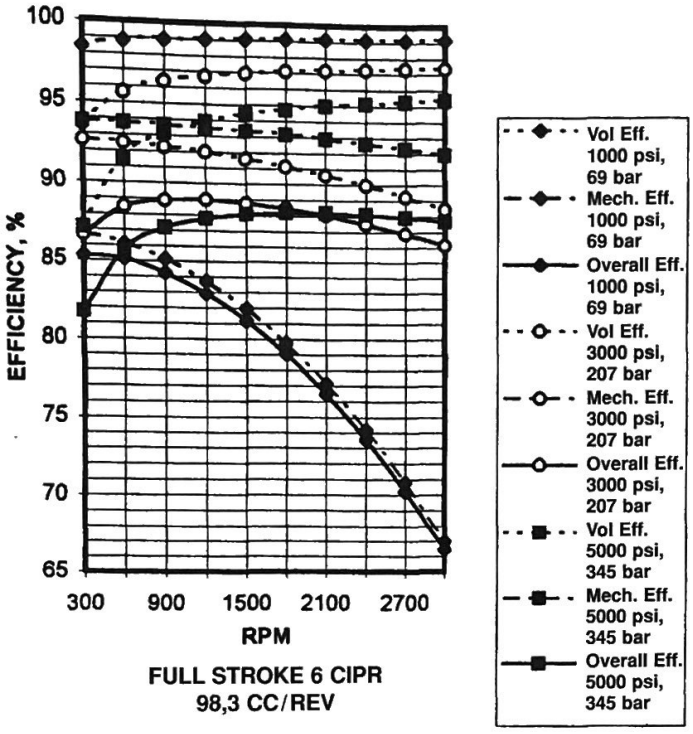
1/2 STROKE 3.0 CIPR
49,2 CC/REV



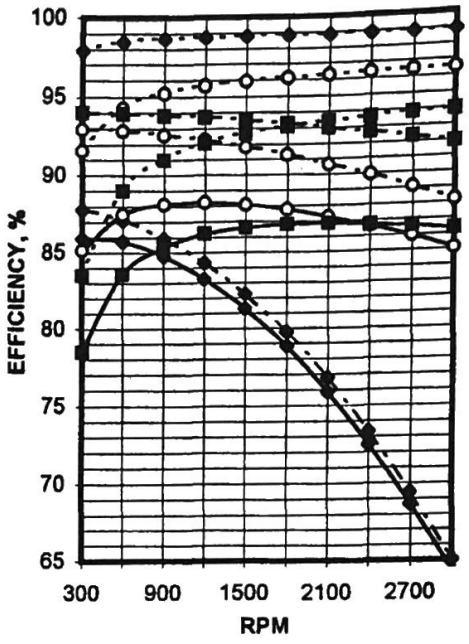
1/4 STROKE 1.5 CIPR
24,6 CC/REV

PERFORMANCE CURVES

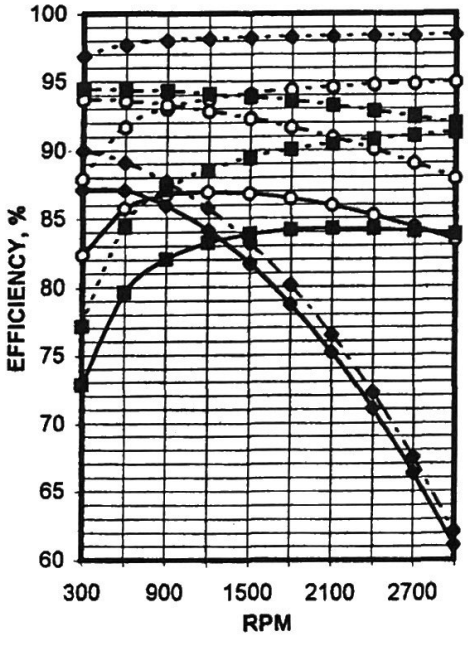
Series 6
Variable volume motor



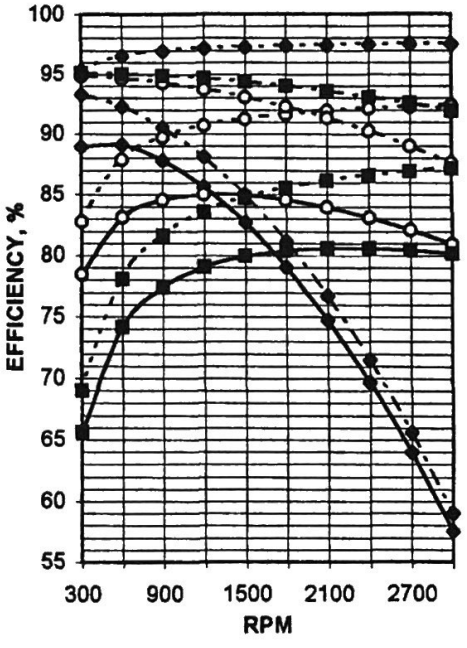
FULL STROKE 6 CIPR
98,3 CC/REV



3/4 STROKE 4.5 CIPR
73,7 CC/REV



1/2 STROKE 3.0 CIPR
49,2 CC/REV

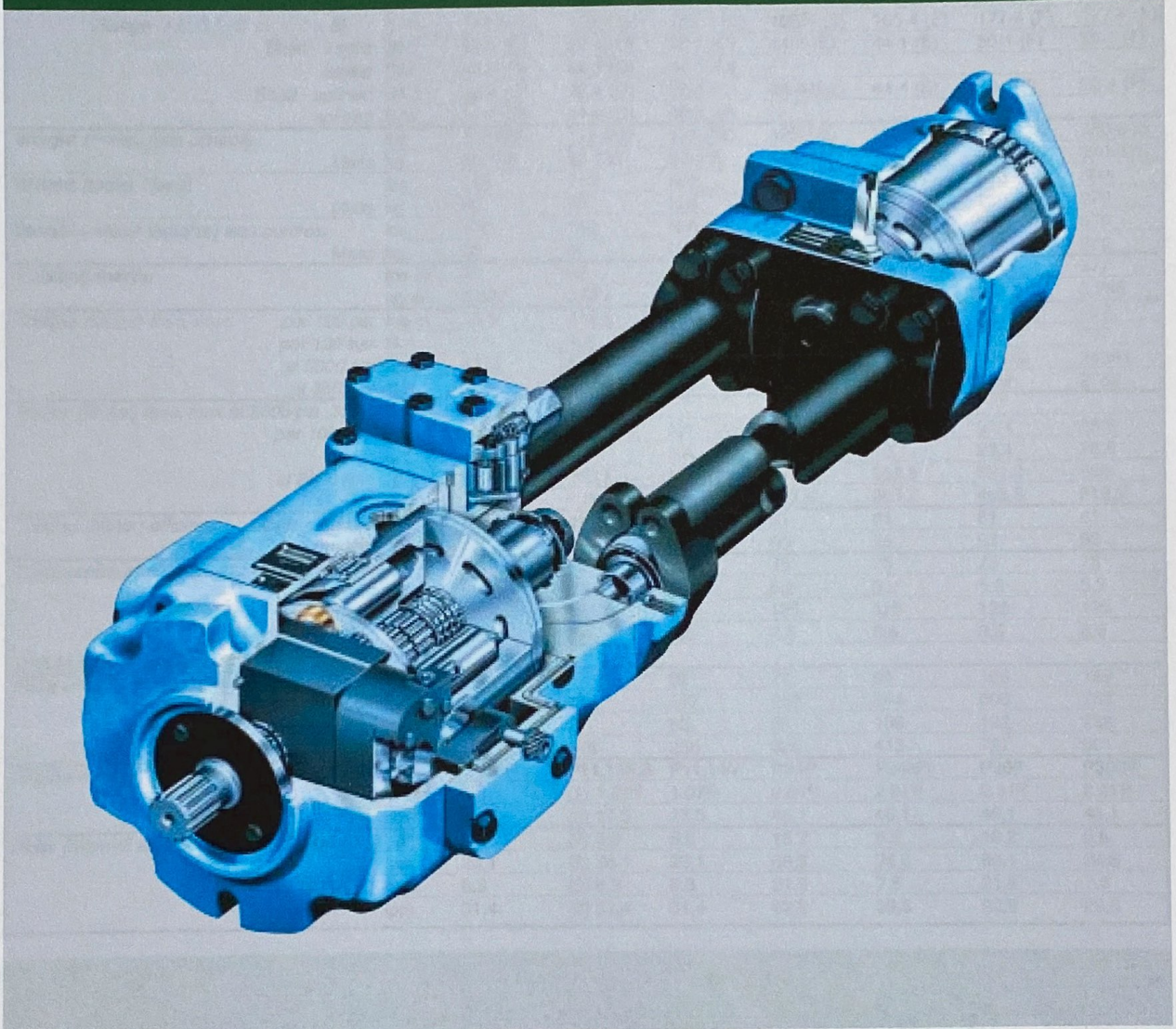


1/3 STROKE 2.0 CIPR
32,8 CC/REV

DENISON HYDRAULICS

Gold Cup Series

piston pumps for open & closed circuits



Publ.1 - LT3-00010-1-A 7/03

DENISON Hydraulics

ISO 9001 DNV DNV Certification, Inc. REGISTERED FIRM

Internet: http://www.denisonhydraulics.com E-mail: denison@denisonhydraulics.com

Series		Terms	P6	P7	P8	P11	P14	P24	P30
Displacement	*Max. displacement*	in^3/rev.	6.00	7.25	8.00	11.00	14.00	24.60	30.60
		cm^3/rev.	98,3	118,8	131,1	180,3	229,5	403,2	501,5
Pressure	*Continuous*	psi	5000	5000	3600	5000	5000	5000[1)]	5000[1)]
		bar	350	350	250	350	350	350[1)]	350[1)]
	Intermittent	psi	6000[7)]	6000[7)]	4500[7)]	6000[7)]	6000[7)]	5000[1)7)]	5000[1)7)]
		bar	420[7)]	420[7)]	310[7)]	420[7)]	420[7)]	350[1)7)]	350[1)7)]
Speed (*Pump*)	*max. @ full stroke*	rpm	3000	3000	2100	2400	2400	2100[2)]	1800
(*Motor*)	*max. @ full stroke*	rpm	3000	3000	NA	2400	2400	2100[2)]	1800
(*Motor*)	*max. @ 50% stroke*	rpm	3600	3600	NA	2800	2800	2100[2)]	1800
Mounting	*Flange -2 bolt*	SAE	127-2 (C)	127-2 (C)	127-2 (C)	-	-	-	-
Flange -4 bolt (opt. on 6,7 & 8)		SAE	152-4 (D)	152-4 (D)	152-4 (D)	165-4 (E)	165-4 (E)	177-4 (F)	177-4 (F)
	Shaft - keyed	SAE	32-1 (C)	32-1 (C)	32-1 (C)	44-1 (E)	44-1 (E)	50-1 (F)	50-1 (F)
	keyed	SAE	44-1 (D)	44-1 (D)	44-1 (D)	-	-	-	-
	Shaft - splined	SAE	32-4 (C)	32-4 (C)	32-4 (C)	44-4 (E)	44-4 (E)	50-4(F)	50-4 (F)
	splined	SAE	44-4 (D)	44-4 (D)	44-4 (D)	-	-	-	-
Weight (*Pump*) *less controls*		lbs	175-300	175-300	175-300	325-530	325-530	750-835	750-835
	Mass	kg.	80-135	80-135	80-135	145-240	145-240	340-375	340-375
Weight (*Motor Fixed*)		lbs	110	110	N/A	250	250	510	600
	Mass	kg.	50	50	N/A	110	110	230	270
Weight (*Motor Variable*) *less controls*		lbs	110	110	N/A	300	300	650	670
	Mass	kg.	50	50	N/A	135	135	290	300
Rotating inertia		$lbs\text{-}in^2$	92	92	92	290	290	821	977
		$kg.m^2$	0,027	0,027	0,027	0,085	0,085	0,240	0,286
Torque (*Motor*) *theo. max.*	*per 100 psi*	lbs-in	95.5	115.4	NA	175	222	392	487
	per 100 bar	Nm	157	189	NA	287	362	623	797
	at 5000 psi	lbs-in	4774	5769	NA	8750	11100	19576	24351
	at 350 bar	Nm	539,5	651,9	NA	990	1250	2158	2752
Power (*Motor*) *theo. max.at 5000 psi, 350 bar*									
	per 100 rpm	hp	7.6	9.2	NA	13.8	17.6	31.1	38.6
		kW	5,7	6,8	NA	10,3	13,1	23,1	28,8
	at 2000 rpm	hp	151.5	183.1	NA	277.8	353.5	621.3	695
		kW	113,0	136,6	NA	207,0	263,7	463,5	518,2
Torque (*Motor*) *efficiency*	*- approx. stalled*	% theo.	81	81	NA	81	81	81	81
	running	% theo.	93	93	NA	93	93	93	93
Case pressure:	*max. allowable continuous*	psi	75	75	75	75	75	75	75
		bar	5,2	5,2	5,2	5,2	5,2	5,2	5,2
	intermittent	psi	125	125	125	125	125	125	125
		bar	8,6	8,6	8,6	8,6	8,6	8,6	8,6
(Not to exceed 25 psi,1,7 bar above inlet in open circuit units)									
Flow (*Pump*) *theo.at max.displ.@1500 rpm*		gpm	39	47	52	71	91	160	199
		lpm	148	178	197	269	344	606	753
	@1800 rpm	gpm	47	57	62	86	109	192	238
		lpm	178	216	235	326	413	727	901
Displacement	*(Internal aux. pump)*		**P6,7,8P,S,V**	**P11,14P,S**	**P11,14V**	**P24P**	**P24S[3)]**	**P30P**	**P30S[3)]**
		in^3/rev.	1.07	(2) 1.07[4)]	1.07[5)]	2.81[6)]	2.81[6)]	2.81[6)]	2.81[6)]
		cm^3/rev.	17,5	(2) 17,5	17,5	46,1	46,1	46,1	46,1
Flow (*Internal aux. pump*)	*@1500 rpm*	gpm	6.9	(2) 6.9	6.9	18.2	6.5	18.2	6.5
		lpm	26,1	(2) 26,1	26,1	68,9	24,6	69,1	24,6
	@1800 rpm	gpm	8.3	(2) 8.3	8.3	21.9	7.8	21.9	7.8
		lpm	31,4	(2) 31,4	31,4	82,9	29,5	82,9	29,5

1) Max. pressure 5000 psi, (275 bar) for M24 and 30 series variable motors. Higher servo pressure may be required - consult Denison.

2) On HF-1 fluids, 1800 RPM Max. on HF-0 fluids.

3) Internal cartridge provides servo flow and must be supercharged from external replenishing flow, from external auxiliary pump.

4) One servo cartridge and one replenishing cartridge.

5) Servo cartridge only.

6) Standard, other sizes available, see ordering code.

7) 10% of operation time, not exceeding 6 successive seconds.

		P6,7,8,11,14,24P	P6,7,8,11,14,24S	P30P	P30S
Replenishing pressure *(Internal aux. pump)* *Replenish pressure minus case pressure*	psi	180-220	330-370	180-220	420-460
	bar	12,4-15,2	22,8-25,5	12,4-15,2	29,0-31,7
Servo pressure *(Internal aux. pump)* *Servo pressure minus case pressure at 0 psi, 0 bar discharge pressure*	psi	400-520	590-690	440-540	670-770
	bar	27,6-35,9	40,7-47,6	30,3-37,2	46,2-53,1
Servo pressure *(Internal aux. pump)* *Servo pressure minus case pressure at 5000 psi, 350 bar discharge pressure*	psi	600-720	790-890	740-840	970-1070
	bar	41,4-49,7	54,5-61,4	51,0-57,9	66,9-73,8
Servo pressure *(Internal aux. pump)* *for HI-IQ control units. Servo pressure minus case pressure at 5000 psi, 350 bar discharge pressure - at system pressure range 0 to 5000 psi, 350 bar.*	psi	500-600	500-600	500-600	500-600
	bar	37,2-44,1	37,2-44,1	37,2-44,1	37,2-44,1

Series		**Terms**	**P6**	**P7**	**P8**	**P11**	**P14**	**P24**	**P30**
Controls									
Compensator response	off-stroke	sec.	0.05	0.05	0.05	0.07	0.07	0.10	0.10
(per SAE J497 @ **5000 psi**, 350 bar)	on-stroke	sec.	0.9	0.9	0.9	1.5	1.5	1.8	1.8
Compensator adjustment		**psi/turn**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**
		bar/turn	138	138	138	138	138	138	138
Min. comp. override pressure at above listed min.		**psi**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
servo. (servo, electric & hydraulic stroker)		bar	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Servo shaft rotation, 0 to full stroke		degrees	19°	19°	19°	19°	19°	19°	19°
Torque to turn rotary servo shaft		**in.-lbs**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
		Nm	2,3	2,3	2,3	2,3	2,3	2,3	2,3

The maximum inlet at the auxiliary pump inlet is 200 psi. (13,8 bar)

Any inlet pressures above atmospheric will increase noise levels and decrease efficiencies noted in this literature. Exact measurements depend on each application and operating conditions. Please consult your nearest Denison Office for further details.

Minimum compensating pressure is 100 psi (6.9 bar) over servo.

For recommended fluids, temperature and fluid cleanliness, see Denison Hydraulics bulletin SPO-AM305 for more details.

REAR DRIVE TORQUE CAPACITY

SERIES	FRONT INPUT SHAFT TYPE	FRONT INPUT SHAFT TORQUE CAPACITY	REAR MOUNTINGS SAE A	B	C	D	E	F	REAR OUTPUT SHAFT TORQUE CAPACITY
P6,7,8 P,S,V	Keyed SAE 32-1(C) Spline SAE 32-4(C)	6920 in-lbs. (780 Nm)	● ●	● ●					1750 in-lbs. (195 Nm)
P6,7,8 P,S,V	Keyed SAE 44-1(D) Spline SAE 44-4(D)	6920 in-lbs. (780 Nm)	● ●	● ●					1750 in-lbs. (195 Nm)
P6,7,8 R,L only	Keyed SAE 32-1(C)* Spline SAE 32-4C	13,845 in-lbs. (1565 Nm)			● ●				6920 in-lbs. (780 Nm)
P11,14 P,S,V	Keyed SAE 44-1(E) Spline SAE 44-4(E)	13,370 in-lbs. (1510 Nm)	● ●	● ●					2400 in-lbs. (270 Nm)
P11,14 R,L only	Keyed SAE 44-1(E)* Spline SAE 44-4(E)	26735 in-lbs. (3020 Nm)			● ●	● ●	● ●		13,370 in-lbs. (1510 Nm)
P24,30 P,S,	Keyed SAE 50-1(F) Spline SAE 50-4(F)	24350 in-lbs. (2750 Nm)		● ●	● ●				2700 in-lbs. (305 Nm)
P24,30 R,L only	Keyed SAE 50-1(F) Spline SAE 50-4(F)	48,700* in-lbs. (5,500 Nm)				● ●	● ●	● ●	24,350 in-lbs (2750 Nm)

* Coupling for keyed shaft must be pressed fit for full torque capability.

P6/7/8 SAE 127-2 Mtg., 32-1, 4 Shaft Bearing 230-82140 (6007)

Speed (rpm)	1000	1000	1000	1000	1200	1200	1200	1200	1500	1500	1500	1500	1800	1800	1800	1800
Shaft Load (lbs)	1	1	1000	1000	1	1	1000	1000	1	1	1000	1000	1	1	1000	1000
Shaft Load (N)	4	4	4448	4448	4	4	4448	4448	4	4	4448	4448	4	4	4448	4448
Case Pressure (psi)	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25
Case Pressure (bar)	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7
B-10 Life (hours x 1000)	**8E+08**	**1833**	**0.778**	**0.778**	**6E+08**	**1528**	**0.648**	**0.648**	**5E+08**	**1222**	**0.518**	**0.518**	**4E+08**	**1018**	**0.432**	**0.432**

P6/7/8 SAE 152-4 Mtg., 44-1, 4 Shaft Bearing 230-00207-0 (6207)

Speed (rpm)	1000	1000	1000	1000	1200	1200	1200	1200	1500	1500	1500	1500	1800	1800	1800	1800
Shaft Load (lbs)	1	1	1000	1000	1	1	1000	1000	1	1	1000	1000	1	1	1000	1000
Shaft Load (N)	4	4	4448	4448	4	4	4448	4448	4	4	4448	4448	4	4	4448	4448
Case Pressure (psi)	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25
Case Pressure (bar)	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7
B-10 Life (hours x 1000)	**3E+09**	**7394**	**3.136**	**3.136**	**3E+09**	**6161**	**2.613**	**2.613**	**2E+09**	**4929**	**2.09**	**2.09**	**2E+09**	**4170**	**1.742**	**1.742**

P11/14 SAE 165-4 Mtg., 44-1, 4 Shaft Bearing 230-82148-0 (6010)

Speed (rpm)	1000	1000	1000	1000	1200	1200	1200	1200	1500	1500	1500	1500	1800	1800	1800	1800
Shaft Load (lbs)	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000
Shaft Load (N)	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448
Case Pressure (psi)	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25
Case Pressure (bar)	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7
B-10 Life (hours x 1000)	**2E+09**	**535**	**1.907**	**1.907**	**2E+09**	**446**	**1.589**	**1.589**	**1E+09**	**356**	**1.272**	**1.272**	**1E+09**	**297**	**1.06**	**1.06**

P11/14 SAE 165-4 Mtg., 44-1, 4 Shaft Bearing 230-82214-0 (22208)

Speed (rpm)	1000	1000	1000	1000	1200	1200	1200	1200	1500	1500	1500	1500	1800	1800	1800	1800
Shaft Load (lbs)	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000
Shaft Load (N)	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448
Case Pressure (psi)	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25
Case Pressure (bar)	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7
B-10 Life (hours x 1000)	**16856**	**2452**	**275**	**172**	**14046**	**2043**	**230**	**143**	**11237**	**1635**	**184**	**114.8**	**9364**	**1363**	**153**	**95.7**

P24 SAE 177-4 Mtg., 50-1, 4 Shaft Bearing 230-82213-0 (22311)

Speed (rpm)	1000	1000	1000	1000	1200	1200	1200	1200	1500	1500	1500	1500	1800	1800	1800	1800
Shaft Load (lbs)	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000
Shaft Load (N)	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448
Case Pressure (psi)	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25
Case Pressure (bar)	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7
B-10 Life (hours x 1000)	**591.6**	**428.5**	**276.7**	**213.5**	**493**	**357**	**230.5**	**178**	**394.4**	**991.6**	**184.4**	**142.3**	**328.7**	**238**	**153.7**	**118.6**

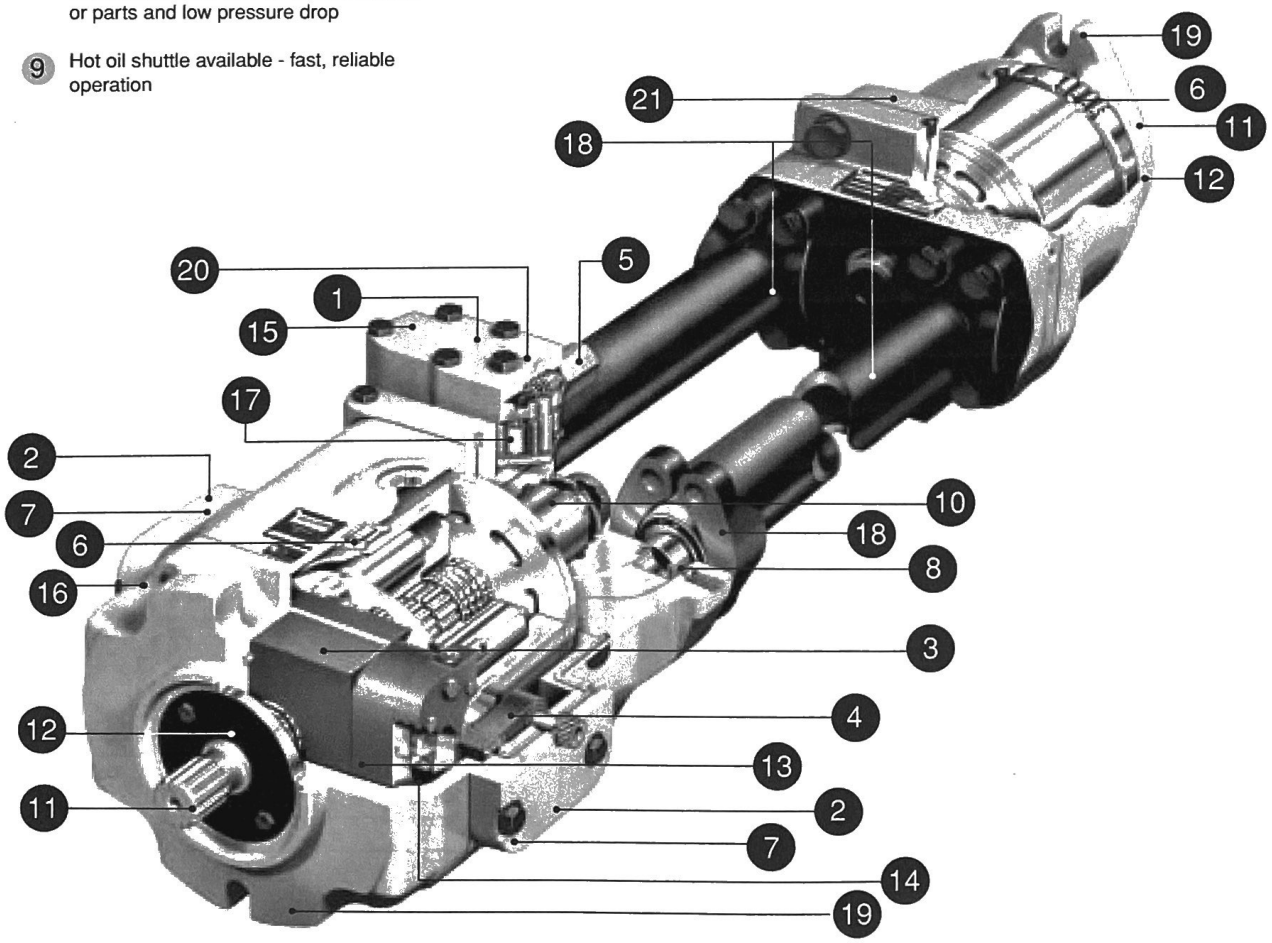
P30 SAE 177-4 Mtg., 50-1, 4 Shaft Bearing 230-82213-0 (22311)

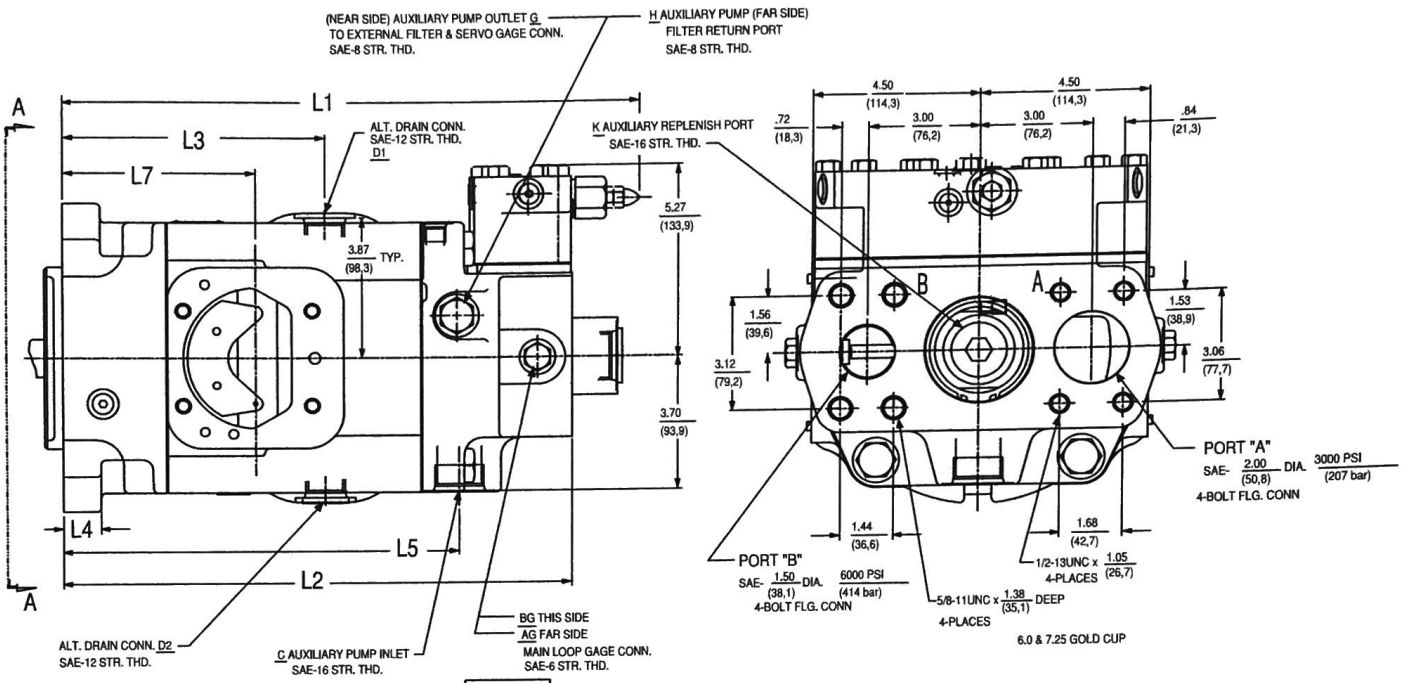
Speed (rpm)	1000	1000	1000	1000	1200	1200	1200	1200	1500	1500	1500	1500	1800	1800	1800	1800
Shaft Load (lbs)	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000	0	0	1000	1000
Shaft Load (N)	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448	0	0	4448	4448
Case Pressure (psi)	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25
Case Pressure (bar)	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7
B-10 Life (hours x 1000)	**227**	**177.7**	**126.4**	**102.8**	**189.2**	**148**	**105.3**	**85.6**	**151.3**	**118.4**	**84.2**	**68.5**	**126.1**	**98.7**	**70.2**	**57.1**

*radial load at center of key or spline

Note: Variation in life is due to variations in tolerances within the pump.
Contact DENISON Hydraulics for B-10 with other operating conditions and with other case pressure values.
Consult Denison Hydraulics for shaft side loads of P*R units.

1. Quick change valve block - easy to service or replace
2. Quick change controls - easy to service and change
3. Dampened low inertia rocker cam - more stable, quieter and faster than other designs
4. Exclusive zero-backlash rotary servo design - lifetime accuracy
5. Field adjustable compensator override - easily adjusted without removing from machinery
6. Precision barrel bearing, a distinctive Denison Hydraulics feature for over 30 years - permits high speeds, high pressure and provides long life
7. Versatile controls - can be located on either side of pump or motor for maximum freedom of design
8. Patented ring style replenishing checks fastest operation with no sliding poppets or parts and low pressure drop
9. Hot oil shuttle available - fast, reliable operation
10. Auxiliary pump can be changed without disassembling the transmission
11. Standard SAE keyed or splined drive shafts are available
12. High pressure mechanical shaft seals can be changed without disassembling the transmission. Double lip seals are also available
13. One piece stroking vane/cam means no lost motion, zero backlash, better control, and no linkages to wear out
14. Stroking vane seals are pressure loaded for longer life
15. Standard compensator vent ports allow for a wide variety of controls (See Applications Manual)
16. Rocker cam displacement indicator helps troubleshoot the system
17. Modulated servo pressure saves power
18. Standard Code 62 SAE split flange connections
19. Conforms to SAE mounting standards. These products are qualified to meet Military specifications MIL-P-17869A and MIL-S-901-C Grade A
20. Fastest compensator response: Gives maximum of 10% pressure overshoot at rated conditions (guaranteed times under all conditions faster response times possible depending upon application)
21. Variable motors available for multiple speed ranges or constant power





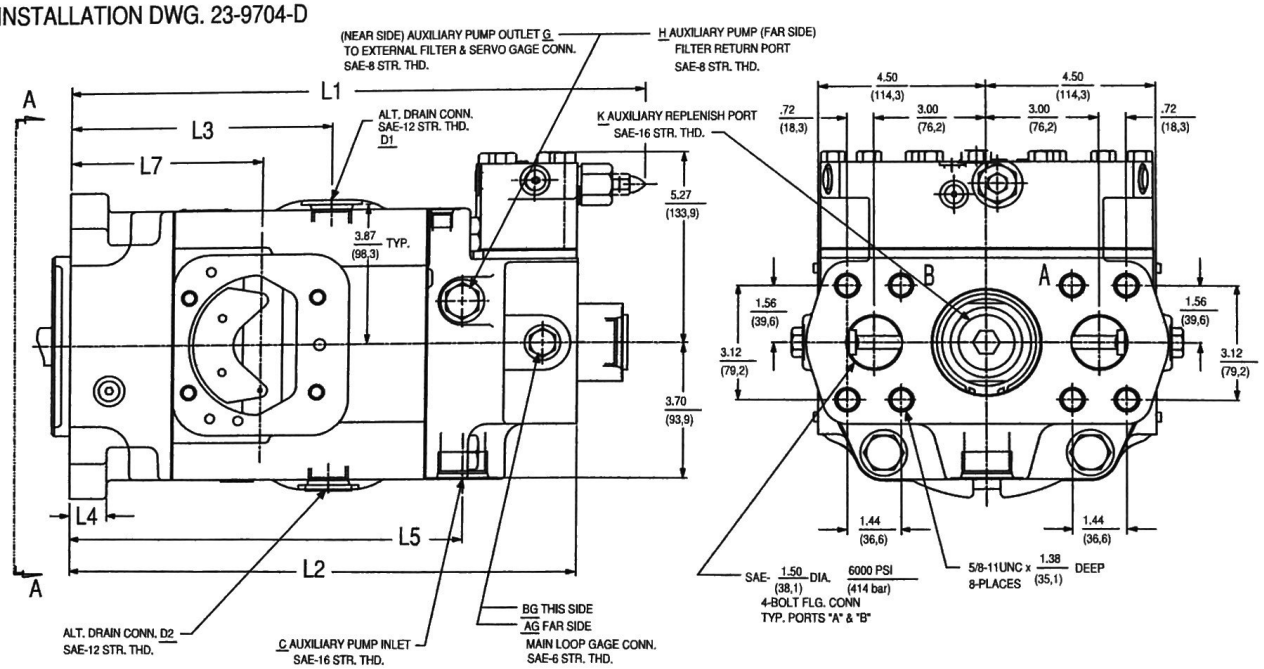
P*V

INSTALLATION DWG. 23-9704-D

TABLE 1						
MOUNTING	L1	L2	L3	L4	L5	L7
SAE 127-2 (SAE-C)	15.51 (393,9)	13.70 (348,0)	7.02 (178,3)	1.00 (25,4)	10.64 (270,3)	5.15 (130,9)
SAE 152-4 (SAE-D)	16.85 (427,9)	15.04 (382,1)	8.36 (212,3)	.86 (21,8)	11.98 (304,3)	6.49 (164,8)

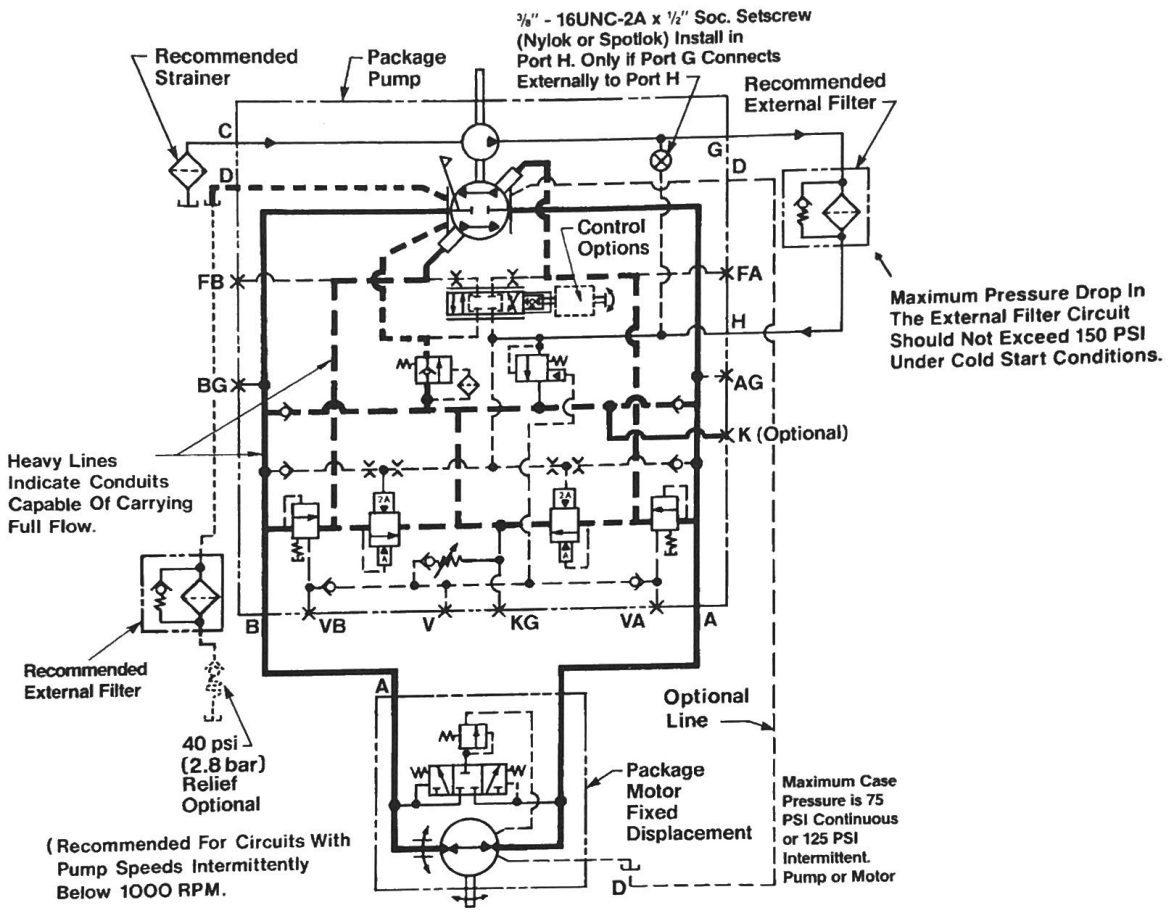
P*D & P*P

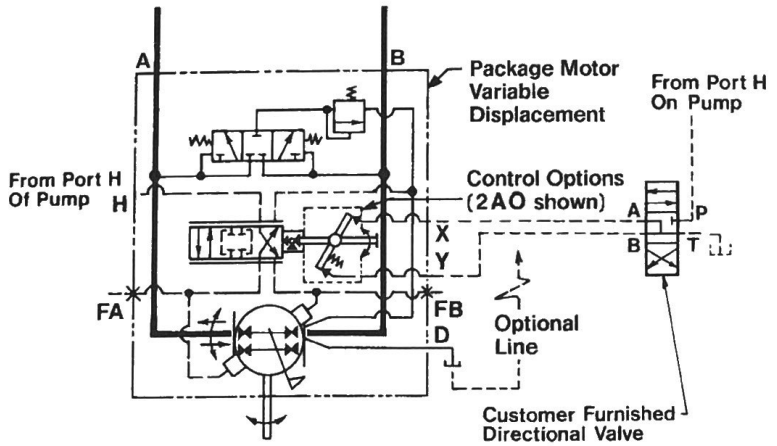
INSTALLATION DWG. 23-9704-D



NOTE: See page 16 for shaft information.
See appropriate controls mounting starting on page 34.

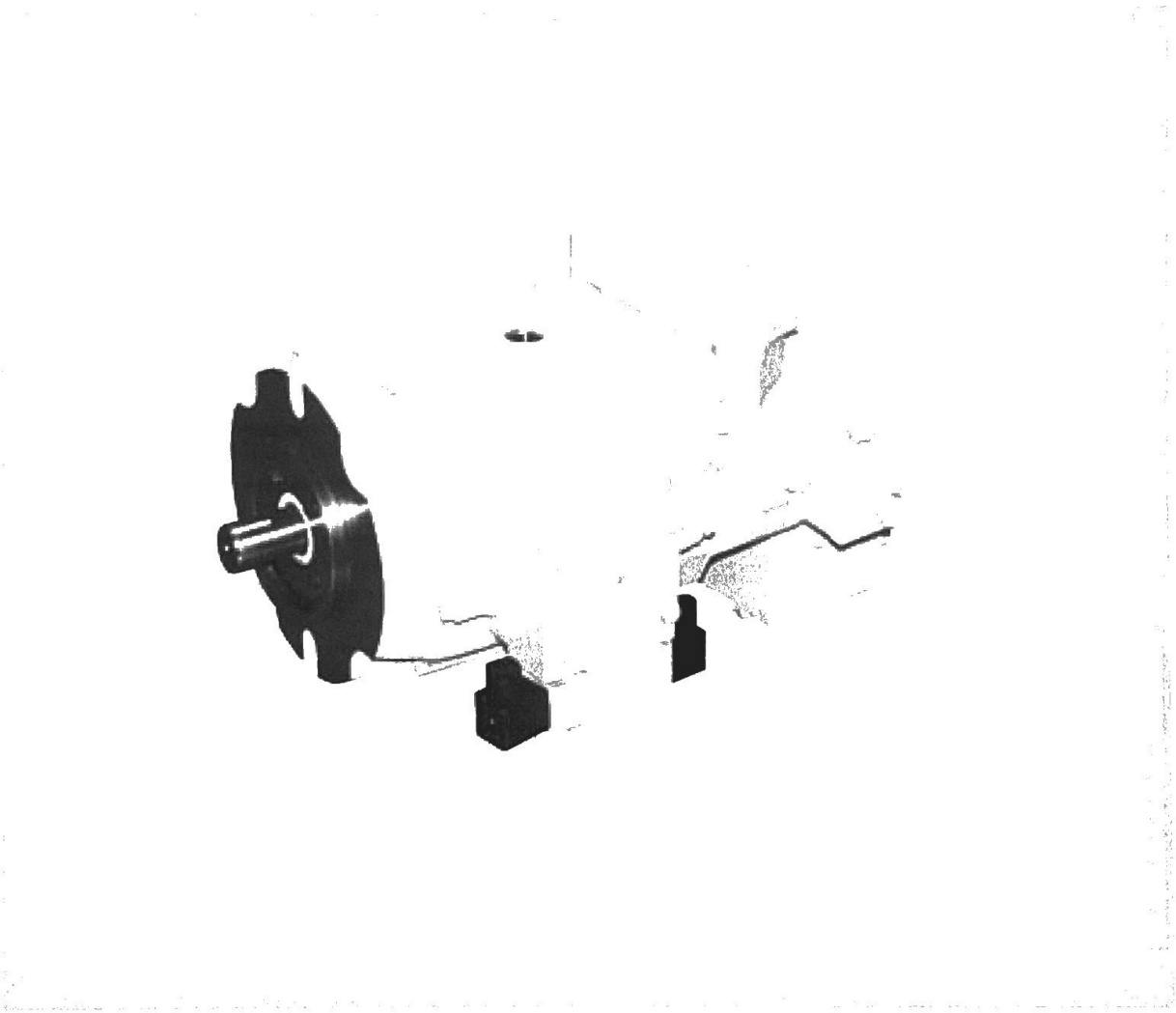
Series 6, 7 & 8 Information





DENISON HYDRAULICS
goldcup series
closed circuit piston pumps
P6, P7, P8S

service information



Publ. LT3-00058-2 Replaces S1-AM025-A

Revised 9/02

DENISON Hydraulics

E-Mail: denison@denisonhydraulics.com Internet: http://www.denisonhydraulics.com

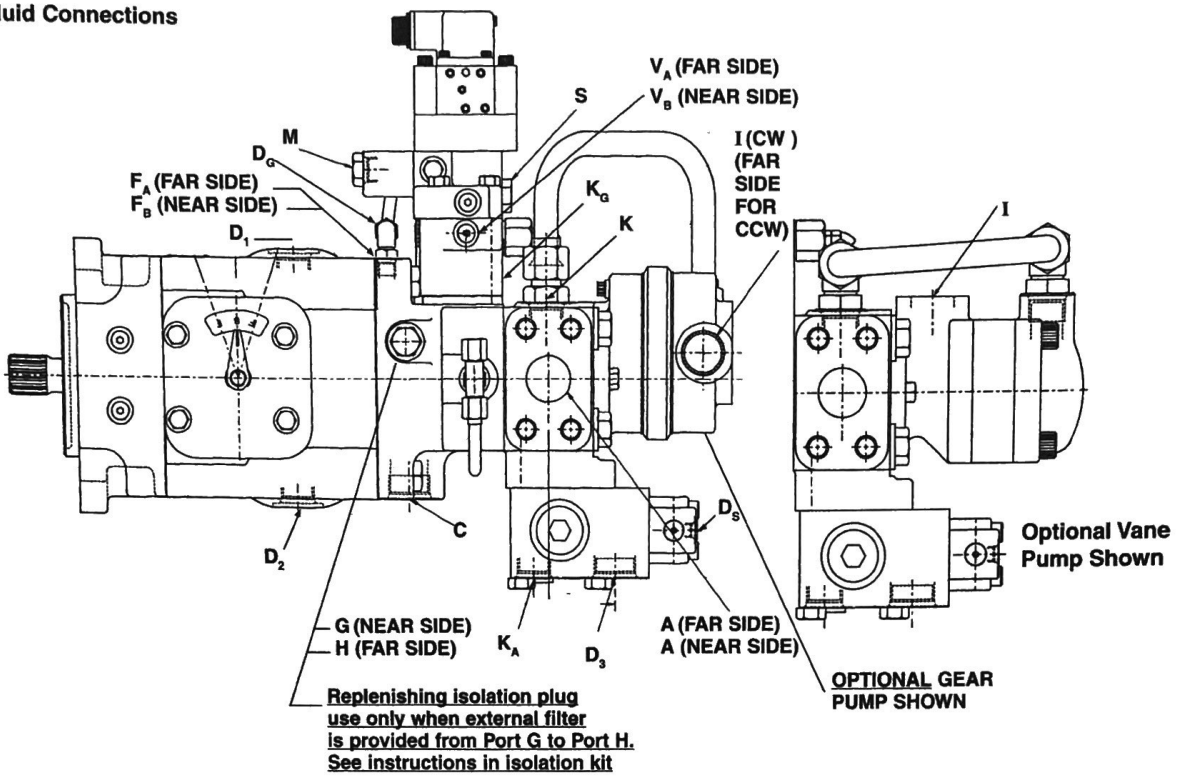
ISO 9001
DNV
DNV Certification, Inc.
REGISTERED FIRM

TYPICAL CHARACTERISTICS

Specification	Term	P 6	P7	P8
• displacement at max. angle	$in.^3$/rev. cm^3/rev	6.00 (98)	7.25 (119)	8.00 (131)
• pressure ports A & B max. continuous max. intermittent	psi bar psi bar	5000 (345) 6000 (414)	5000 (345) 6000 (414)	3600 (248) 4350 (300)
• speed, max. continuous	rpm	3000	3000	1800
• flow, ports A or B @ 1500 RPM (theoretical)	gpm L/min.	38.9 (147)	47.1 (178)	51.9 (196)
• flow, ports A or B @ 1800 RPM (theoretical)	gpm L/min.	46.8 (177)	56.9 (214)	62.3 (236)
• flow, internal replenishing pump @ 1800 RPM (theoretical)	gpm L/min.	6.9 (26.1)	6.9 (26.1)	6.9 (26.1)
• flow, auxiliary pump, external at 1800 RPM (theoretical) (see note)	gpm L/min.	9.3 (35.2)	9.3 (35.2)	9.3 (35.2)
• replenishing pressure	psi bar	200 (14)	200 (14)	200 (14)
• servo pressure	psi bar	335-535 (23-37)	335-535 (23-37)	335-535 (23-37)
• mounting-2 bolt flange	SAE	C	C	C
• shaft-spline keyed	SAE	C	C	C
• fluid connection ports A & B SAE-4 bolt pad for 6000 split flange	in mm	1-1/2 (38.1)	1-1/2 (38.1)	1-1/2 (38.1)
• weight w/rotary servo	lbs. kg.	335 (152)	335 (152)	335 (152)

Note: Any SAE-A or B mount pump may be used with the appropriate external drive

Fluid Connections



port	size	function
A	1 1/2" 4 bolt SAE 6000 psi	inlet/outlet
AG, BG	SAE - 6 straight thread	system pressure gage, ea. side
B	1 1/2" 4 bolt SAE 6000 psi	outlet/inlet
C	SAE - 16 straight thread	internal auxiliary pump inlet
D1, D2	SAE - 12 straight thread	case drain
D3	SAE - 16 straight thread	replenishing relief drain
DG	SAE - 6 straight thread	case pressure gage
DS	SAE - 4 straight thread	shuttle repl. pilot drain (ext.drain)
FA, FB	1/4 - 18 dryseal NPTF	control pressure gage, ea. side
G	SAE - 8 straight thread	int. aux. pump outlet to filter
H	SAE - 8 straight thread	filter return
I	SAE -16 straight thread	inlet to optional pump (gear pump)
	SAE - 1 1/4 3000 psi, 4-bolt pad	optional - vane pump
K	SAE -16 straight thread	aux. replenishing port
KA	SAE - 12 straight thread	aux. repl. inlet to shuttle
KG	SAE - 6 straight thread	replenishing pressure gage
M	SAE - 8 straight thread	auxiliary servovalve drain
S	SAE - 8 straight thread	servovalve inlet
VA/VB	SAE - 4 straight thread	individual compensator vent

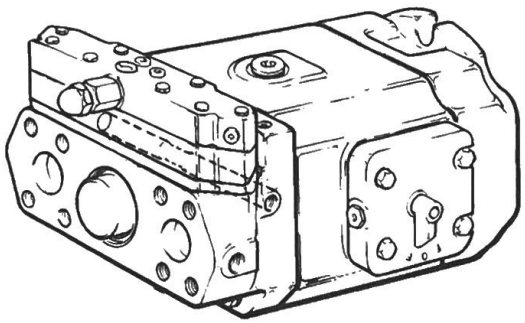
Conversion Adapter Kit "A" mount S23-12438-0
"B" mount S23-12669-0

TROUBLESHOOTING

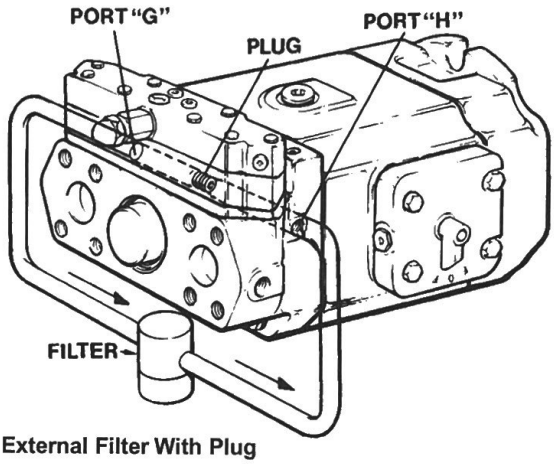
Component problems and circuit problems are often inter-related. An improper circuit may operate with apparent success but will cause failure of a particular component within it. The component failure is the effect, not the cause of the problem.

This general guide is offered to help in locating and eliminating the cause of problems by studying their effects:

effect of trouble	possible cause	fault which needs remedy
noisy pump	air in fluid	leak in suction line leak at shaft seal low fluid level turbulent fluid return lines above fluid level gas leak from accumulator excessive pressure drop in the inlet line from a pressurized reservoir suction line strainer acting as air trap
	cavitation in pump or motor rotating group	fluid too cold fluid too viscous fluid too heavy shaft speed too high suction line too small suction line collapsed suction strainer too small suction strainer too dirty operating altitude too high boost or replenishment pressure too low replenishment flow too small for dynamic conditions
	misaligned shaft	faulty installation distortion in mounting axial interference faulty coupling excessive overhung loads
	mechanical fault in pump	piston and shoe looseness or failure bearing failure incorrect port plate selection or index eroded or worn parts in the displacement control
erosion on barrel ports and port plate	air in fluid	see above
	cavitation	see above
high wear in pump and motor	excessive loads	reduce pressure settings reduce speeds
	contaminant particles in fluid	improper filter maintenance filters too coarse introduction of dirty fluid to system reservoir openings improper reservoir breather improper line replacement



Without Filter No Plug



External Filter With Plug

INSTRUCTIONS FOR REPLENISHING CIRCUIT ISOLATION PLUG

CAUTION: The isolation plug enclosed is to be used ONLY if an external filter circuit is provided. DO NOT operate this unit with the isolation plug installed unless an external line has been provided.

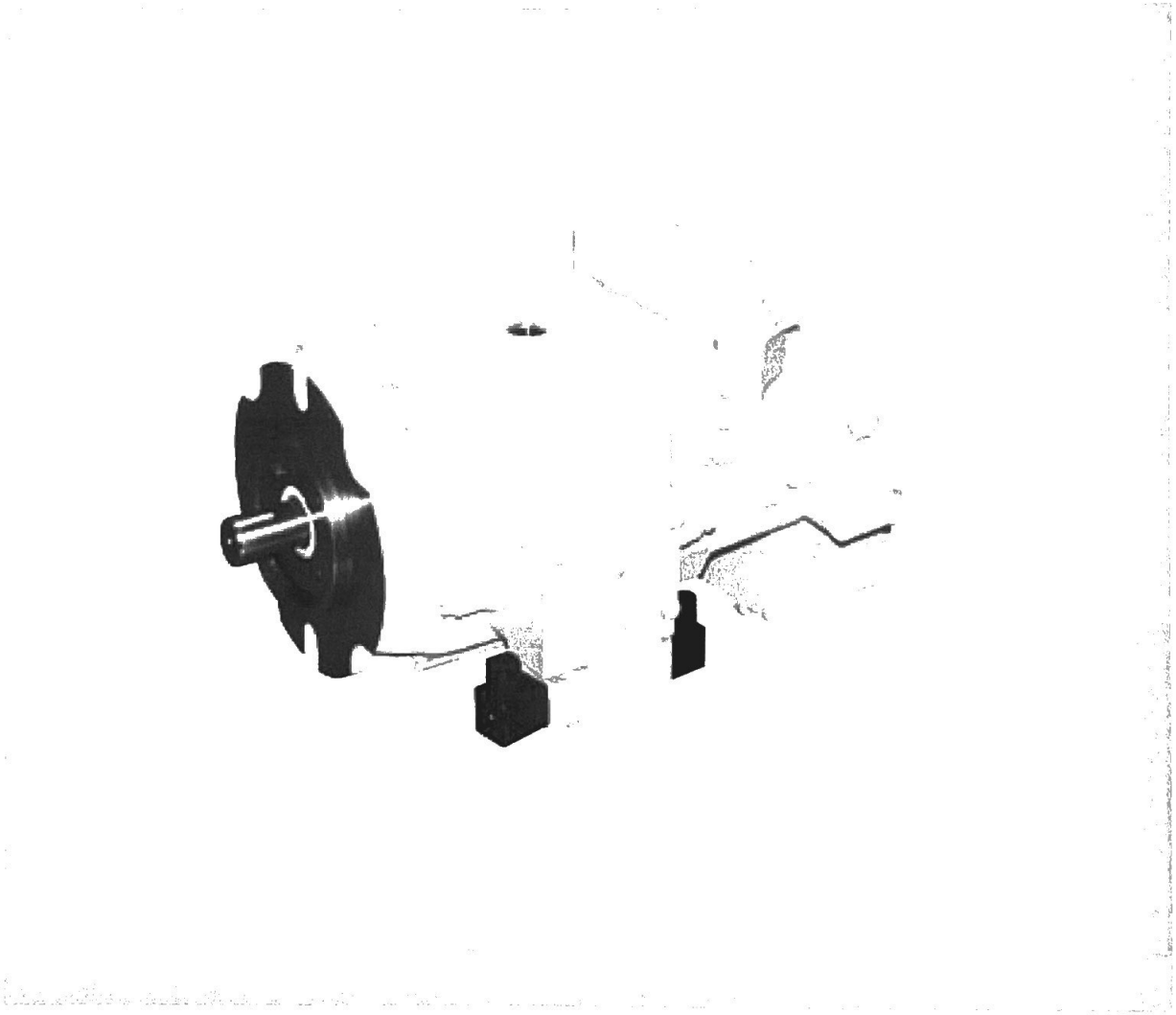
When the external filter circuit **IS NOT** used discard the isolation plug.

When the external filter circuit IS used install the isolation plug between port G and H (refer to appropriate installation drawing): use a 3/16 Hex. wrench by 4" minimum length **INSERTING THE ISOLATION PLUG INTO PORT H** and tighten to 80 - 120 in.-lb. torque. (9.04-13.56 Nm)

Isolation plug: Part No. 311-45032 (3/8-16 x 1/2 UNC Flat point set screw).

DENISON HYDRAULICS
goldcup series
closed circuit piston pumps
P6, P7, P8S

service information



Publ. LT3-00058-2 Replaces S1-AM025-A

Revised 9/02

DENISON Hydraulics

E-Mail: denison@denisonhydraulics.com Internet: http://www.denisonhydraulics.com

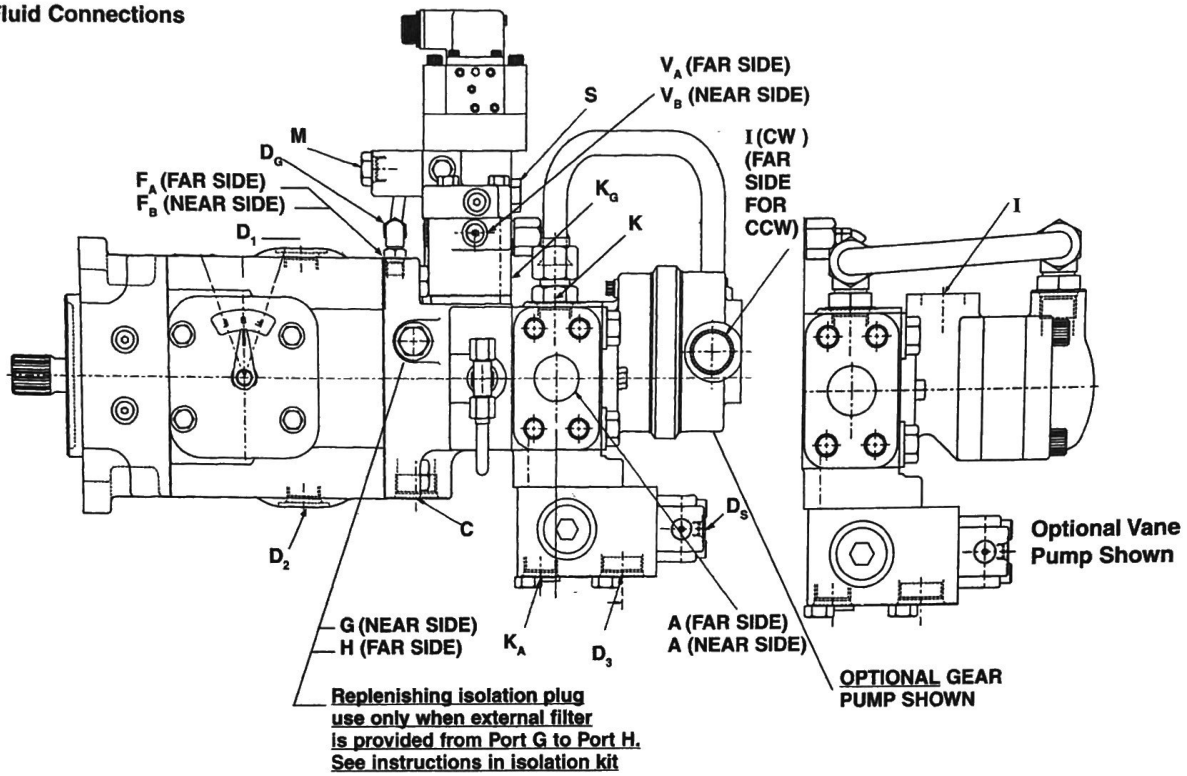
ISO 9001
DNV
DNV Certification, Inc.
REGISTERED FIRM

TYPICAL CHARACTERISTICS

Specification	Term	P 6	P7	P8
• displacement at max. angle	$in.^3/rev.$ cm^3/rev	6.00 (98)	7.25 (119)	8.00 (131)
• pressure ports A & B max. continuous max. intermittent	psi bar psi bar	5000 (345) 6000 (414)	5000 (345) 6000 (414)	3600 (248) 4350 (300)
• speed, max. continuous	rpm	3000	3000	1800
• flow, ports A or B @ 1500 RPM (theoretical)	gpm L/min.	38.9 (147)	47.1 (178)	51.9 (196)
• flow, ports A or B @ 1800 RPM (theoretical)	gpm L/min.	46.8 (177)	56.9 (214)	62.3 (236)
• flow, internal replenishing pump @ 1800 RPM (theoretical)	gpm L/min.	6.9 (26.1)	6.9 (26.1)	6.9 (26.1)
• flow, auxiliary pump, external at 1800 RPM (theoretical) (see note)	gpm L/min.	9.3 (35.2)	9.3 (35.2)	9.3 (35.2)
• replenishing pressure	psi bar	200 (14)	200 (14)	200 (14)
• servo pressure	psi bar	335-535 (23-37)	335-535 (23-37)	335-535 (23-37)
• mounting-2 bolt flange	SAE	C	C	C
• shaft-spline keyed	SAE	C	C	C
• fluid connection ports A & B SAE-4 bolt pad for 6000 split flange	in mm	1-1/2 (38.1)	1-1/2 (38.1)	1-1/2 (38.1)
• weight w/rotary servo	lbs. kg.	335 (152)	335 (152)	335 (152)

Note: Any SAE-A or B mount pump may be used with the appropriate external drive

Fluid Connections



port	size	function
A	1 1/2" 4 bolt SAE 6000 psi	inlet/outlet
AG, BG	SAE - 6 straight thread	system pressure gage, ea. side
B	1 1/2" 4 bolt SAE 6000 psi	outlet/inlet
C	SAE - 16 straight thread	internal auxiliary pump inlet
D1, D2	SAE - 12 straight thread	case drain
D3	SAE - 16 straight thread	replenishing relief drain
DG	SAE - 6 straight thread	case pressure gage
DS	SAE - 4 straight thread	shuttle repl. pilot drain (ext.drain)
FA, FB	1/4 - 18 dryseal NPTF	control pressure gage, ea. side
G	SAE - 8 straight thread	int. aux. pump outlet to filter
H	SAE - 8 straight thread	filter return
I	SAE -16 straight thread	inlet to optional pump (gear pump)
	SAE - 1 1/4 3000 psi, 4-bolt pad	optional - vane pump
K	SAE -16 straight thread	aux. replenishing port
KA	SAE - 12 straight thread	aux. repl. inlet to shuttle
KG	SAE - 6 straight thread	replenishing pressure gage
M	SAE - 8 straight thread	auxiliary servovalve drain
S	SAE - 8 straight thread	servovalve inlet
VA/VB	SAE - 4 straight thread	individual compensator vent

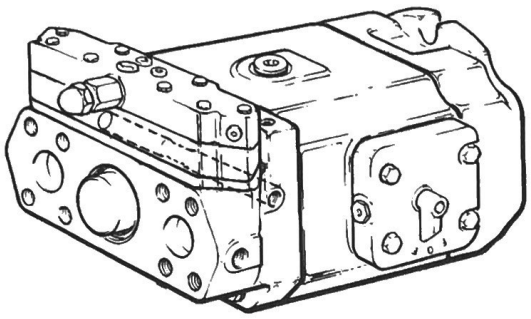
Conversion Adapter Kit "A" mount S23-12438-0
"B" mount S23-12669-0

TROUBLESHOOTING

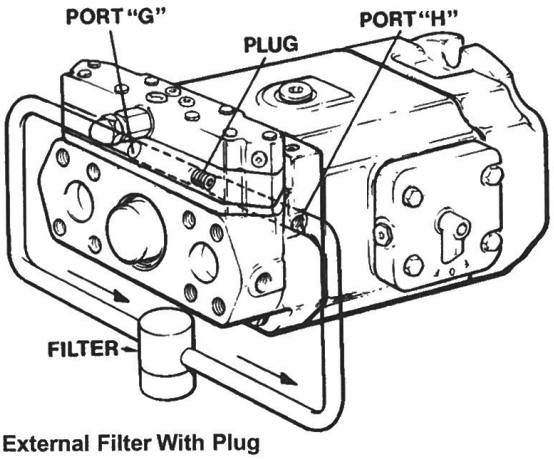
Component problems and circuit problems are often inter-related. An improper circuit may operate with apparent success but will cause failure of a particular component within it. The component failure is the effect, not the cause of the problem.

This general guide is offered to help in locating and eliminating the cause of problems by studying their effects:

effect of trouble	possible cause	fault which needs remedy
noisy pump	air in fluid	leak in suction line leak at shaft seal low fluid level turbulent fluid return lines above fluid level gas leak from accumulator excessive pressure drop in the inlet line from a pressurized reservoir suction line strainer acting as air trap
	cavitation in pump or motor rotating group	fluid too cold fluid too viscous fluid too heavy shaft speed too high suction line too small suction line collapsed suction strainer too small suction strainer too dirty operating altitude too high boost or replenishment pressure too low replenishment flow too small for dynamic conditions
	misaligned shaft	faulty installation distortion in mounting axial interference faulty coupling excessive overhung loads
	mechanical fault in pump	piston and shoe looseness or failure bearing failure incorrect port plate selection or index eroded or worn parts in the displacement control
erosion on barrel ports and port plate	air in fluid	see above
	cavitation	see above
high wear in pump and motor	excessive loads	reduce pressure settings reduce speeds
	contaminant particles in fluid	improper filter maintenance filters too coarse introduction of dirty fluid to system reservoir openings improper reservoir breather improper line replacement



Without Filter No Plug



External Filter With Plug

INSTRUCTIONS FOR REPLENISHING CIRCUIT ISOLATION PLUG

CAUTION: The isolation plug enclosed is to be used ONLY if an external filter circuit is provided. DO NOT operate this unit with the isolation plug installed unless an external line has been provided.

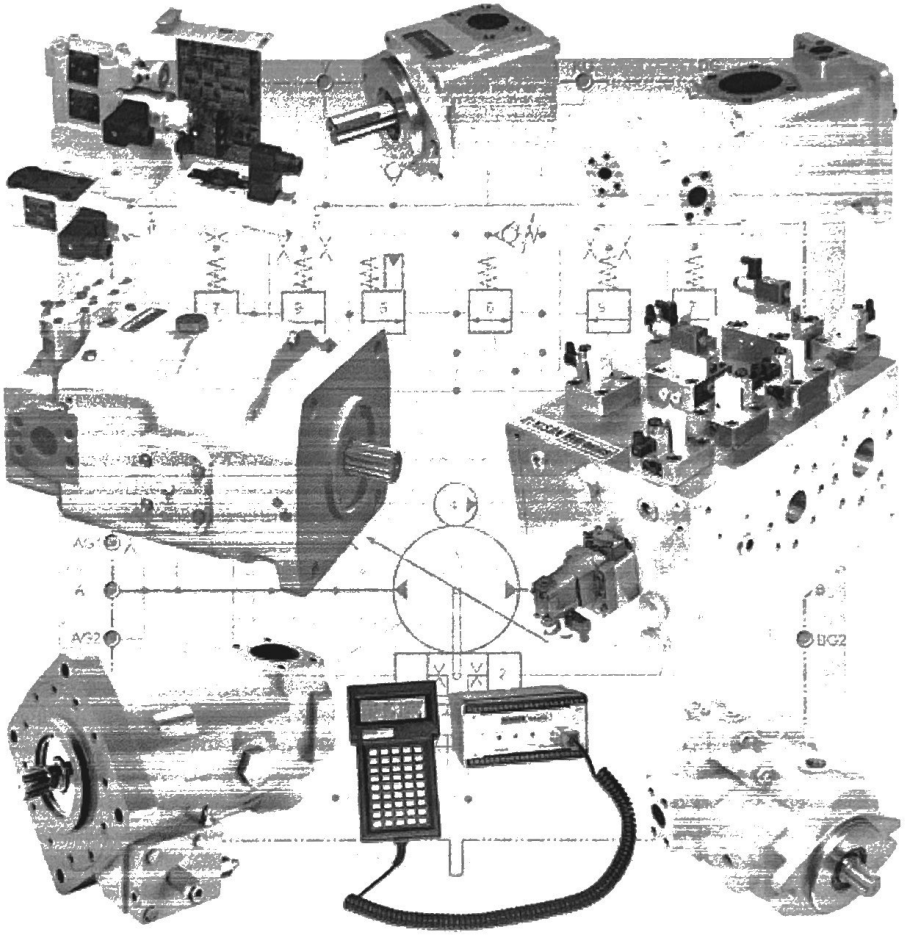
When the external filter circuit **IS NOT** used discard the isolation plug.

When the external filter circuit IS used install the isolation plug between port G and H (refer to appropriate installation drawing): use a 3/16 Hex. wrench by 4" minimum length **INSERTING THE ISOLATION PLUG INTO PORT H** and tighten to 80 - 120 in.-lb. torque. (9.04-13.56 Nm)

Isolation plug: Part No. 311-45032 (3/8-16 x 1/2 UNC Flat point set screw).

Hydraulic Fluids Information

For Piston, Vane, and Valve Products



SP0-AM305 (LTZ-00019-1)(replaces 2002-1)

Revised 1/03

DENISON Hydraulics

The product information, specifications, and descriptions contained in this publication have been compiled for the use and convenience of our customers from information furnished by the manufacturer; and we can not, and do not, accept any responsibility for the accuracy or correctness of any description, calculation, specification, or information contained herein. No such description, calculation, specification, or information regarding the products being sold has been made part of the basis of the bargain, nor has same created or amounted to an express warranty that the products would conform thereto. **We are selling the goods and merchandise illustrated and described on this publication on an "as is" basis, and disclaim any implied warranty, including any warranty of merchantability or warranty of fitness for any particular purpose whatsoever, with respect to the goods and merchandise sold.** All manufacturer warranties shall be passed on to our customers, but we shall not be responsible for special, indirect, incidental, or consequential damages resulting from the use of any of the products or information contained or described on this publication. Further, we reserve the right to revise or otherwise make product improvements at any time without notification.

General Discussion

The purpose of this bulletin is to present general information concerning hydraulic fluids and their use in hydraulic systems. Denison Hydraulics, Inc. does not sell these fluids, but recognizes that customers must use them in hydraulic systems. The information presented herein is not intended to be used as a specific recommendation, but as a general guideline. For specific recommendations or warranties concerning the use of specific hydraulic fluids, please, contact the manufacturer of that fluid.

This bulletin assumes the reader has a basic knowledge of hydraulic fluids so that a "definition of terms" is not necessary.

Our past experience with fluids has shown that some fluid types work better than others in Denison Hydraulics, Inc. pumps and motors. Due to the enormous number of fluids and fluid types available today, it is impossible for us to test our products on each and every one. Because of the vast number of fluids available, Denison Hydraulics, Inc. has written hydraulic fluid standards HF-0 through HF-5, which describe characteristics of some of the different fluids. These standards have been sent to many of the hydraulic fluids manufacturers, and they have tested many of their fluids to these specifications. The manufacturers of these fluids can make the results of these tests available. The new generation of environmentally acceptable hydraulic fluids, also called biodegradable fluids, can be used with Denison Hydraulics, Inc. pumps, motors, and valves. Those fluids and recommendations are included in the Denison Hydraulics, Inc. SK-30320 specification.

General Recommendations

Viscosity Limits (piston and vane only)

Viscosity - SUS (cSt)		
	Piston	Vane
Maximum at cold start*	7500 (1618)	4000 (862)
Maximum at full power	750 (162)	500 (108)
Optimum at operating temperature	140 (30)	140 (30)
Minimum at full power**	60 (10)	60 (10)

* Cold start is defined as the lowest temperature the oil will see prior to the startup of the equipment. At cold start we recommend operating at low pressure, low volume, and low speed, until the fluid warms up to where the maximum viscosity at full power will not be exceeded. Too high viscosity grade fluid and medium temperature can cause fluid aeration or cavitation, which leads to pump damage.

** Consult Denison Hydraulics, Inc. for applications where fluid viscosity at full power is less than these figures.

Viscosity Index

Viscosity index (V.I.) is a measure of a fluid's viscosity change with changes in temperature. The higher the index the smaller the change in viscosity with a given temperature change. Denison Hydraulics, Inc. requires a minimum V.I. of 90 for all fluids. Higher values extend the range of operating temperature but may reduce the life of the fluid.

Temperature Limits

Temperature limits for each product line are listed in the individual product bulletins. Temperature range is a function of fluid viscosity, fluid type, and seal limitations. Rapeseed based oil minimum temperature should not be below –4 degrees Fahrenheit (-20 degrees Celsius).

Cold Weather Applications

Operating hydraulic equipment in cold climates requires special considerations. If suitable multi-viscosity fluids are not available, it may be necessary to either change fluids so thatthe appropriate viscosity limits are maintained or modify the system to maintain viscosity within appropriate limits.

Fluid Type	Piston/Vane/Valve Products
Antiwear fluids covered by HF-0 standard	Fluids of this type generally have antiwear additives, but the quantity and chemistry is such that the equipment can be used at the full catalog ratings.
Non-antiwear R & O fluids covered by HF-1 standard	These are the preferred fluids for our piston equipment. All catalog ratings and performance data are based on operation with this type of fluid. Full catalog performance capability and maximum life can be expected.
Antiwear fluids covered by HF-2 standard	The fluids meeting this specification are compatible with vane products, and can be used at maximum catalog ratings. Some of these fluids may not be suitable for use with piston equipment. Consult fluid's manufacturer for specific fluid recommendations.
Water-in-oil invert emulsion covered by HF-3 standard	The fluids meeting this specification are acceptable for use with the following limitations: Due to the higher specific gravity of these fluids, catalog **absolute** inlet ratings must be raised 25%; in no case, however, should the pump inlet pressure be less than 13.0 psia (approximately 3 in. –Hg vacuum at sea level) as cavitation may occur due to the low vapor pressure of the water in the fluid. Since these fluids have less lubricity than petroleum fluids, piston equipment should be operated at no more than 3,500 psi (2,000 psi on PV6 through PV29 units). Consult Denison Hydraulics, Inc. for operation above 3,500 psi. Maximum speed is 1,800 rpm.
Water glycol solution covered by HF-4 standard	The fluids meeting this specification are acceptable for use with the following limitations: Due to the higher specific gravity of these fluids, catalog **absolute** inlet ratings must be raised 25%; in no case, however, should the pump inlet pressure be less than 13.0 psia (approximately 3 in. –Hg vacuum at sea level) as cavitation may occur due to the low vapor pressure of the water in the fluid. Since these fluids have less lubricity than petroleum fluids, piston equipment should be operated at no more than 3,500 psi (2,000 psi on PV6 through PV29 units). Consult Denison Hydraulics, Inc. for operation above 3,500 psi. Maximum speed is 1,800 rpm.
Phosphate ester fluids covered by HF-5 standard	Use of these fluids requires the catalog **absolute** inlet rating be raised 35% to assure that cavitation does not occur. Lubricating properties of these fluids are generally comparable to petroleum fluids; so, catalog speed and pressure ratings still apply.
Biodegradable fluids covered by SK-30320 specification	Fluids of either ester base, rapeseed base, or polyglycol base can be used at full catalog pressure. Catalog ratings per HF-0, HF-1, & HF-2. Speed limits should be determined by using catalog absolute inlet ratings raised by 10%. Since water contamination has affected thermal stability, a water decantation fitting should be installed in the circuit.

Comparison of Solid Contamination Classification Systems (refer to "Particle Contamination" on page 5)

National Aerospace Standard (NAS) 1638															
		Class													
		00	0	1	2	3	4	5	6	7	8	9	10	11	12
Particle Size Range	5-15 µm	125	250	500	1,000	2,000	4,000	8,000	16,000	32,000	64,000	128,000	256,000	512,000	1,024,000
	15-25 µm	22	44	89	178	356	712	1,425	2,850	5,700	11,400	22,800	45,600	91,200	182,400
	25-50 µm	4	3	16	32	63	126	253	506	1,012	2,025	4,050	8,100	16,200	32,400
	50-100 µm	1	2	3	6	11	22	45	90	180	360	720	1,440	2,880	5,760
	>100 µm	0	0	1	1	2	4	8	16	32	64	128	256	512	1,024
Maximum Particles	>5 µm	152	304	609	1,217	2,432	4,864	9,731	19,462	38,924	77,849	155,698	311,396	622,792	1,245,584
	>15 µm	27	54	109	217	432	864	1,731	3,462	6,924	13,849	27,698	55,396	110,792	221,584

ISO: DIS 4406; SAE J1165															
		ISO Solid Contaminant Code													
		8/5	9/6	10/7	11/8	12/9	13/10	14/11	15/12	16/13	17/14	18/15	19/16	20/17	21/18	22/19
Maximum Particles	>5 µm	250	500	1,000	2,000	4,000	8,000	16,000	32,000	64,000	130,000	250,000	500,000	1,000,000	2,000,000	4,000,000
	>15 µm	32	64	130	250	500	1,000	2,000	4,000	8,000	16,000	32,000	64,000	130,000	250,000	500,000

Note: All measurements are for a 100 ml sample size.

Fluid Type	General Comments
Antiwear fluids covered by HF-0 standard	These types of fluids are intended for systems in which both piston and vane products are used, as both products can be operated at full catalog ratings. Recommended seals: Nitrile (Buna N)(Denison Hydraulics, Inc. S-1) Alternate seals: Flourocarbon (Viton) (Denison Hydraulics, Inc. S-5) Temperature range: see product bulletin*
Non-antiwear R & O fluids covered by HF-1 standard	A typical example of this type of fluid is turbine oil. Recommended seals: Nitrile (Buna N)(Denison Hydraulics, Inc. S-1) Alternate seals: Flourocarbon (Viton) (Denison Hydraulics, Inc. S-5) Temperature range: see product bulletin*
Water-in-oil invert emulsion covered by HF-3 standard (45% maximum water content) (95-5 fluids are not acceptable)	In general, this fluid is equal in performance to water glycol fluid. Recommended seals: Nitrile (Buna N)(Denison Hydraulics, Inc. S-1). Flourocarbon seals are recommended for use with polyglycol base fluids. Alternate seals: Flourocarbon (Viton) (Denison Hydraulics, Inc. S-5) Temperature range: see product bulletin*
Water glycol solution covered by HF-4 standard	In general, this fluid is equal in performance to water-in-oil invert emulsion. Recommended seals: Nitrile (Buna N)(Denison Hydraulics, Inc. S-1). Flourocarbon seals are recommended for use with polyglycol base fluids. Alternate seals: Flourocarbon (Viton) (Denison Hydraulics, Inc. S-5) Temperature range: see product bulletin*
Phosphate ester fluids covered by HF-5 standard	Because of the variety of phosphate ester fluids available, each application should be considered individually. Consult Denison Hydraulics, Inc. for information. Recommended seals: Flourocarbon (Viton)(Denison Hydraulics, Inc. S-5). Some exceptions known to be incompatible with flourocarbon are: Monsanto, Stauffer Blend G, Skydrol 500B, Skydrol 500C, Skydrol 7000, Skydrol LD, Pydraul 60, Pydraul 10E, and Pyrogard 53. These fluids require EPR seals (Denison Hydraulics, Inc. S-4). For other phosphate ester fluids, check with the fluid's manufacturer for seal compatibility. Temperature range: see product bulletin*
Biodegradable fluids covered by SK-30320 specification	Recommended seals: Nitrile (Buna N)(Denison Hydraulics, Inc. S-1) for ester and rapeseed base fluids. Flourocarbon (Viton) (Denison Hydraulics, Inc. S-5) for polyglycol base fluids.

* Refer to "Temperature Limits" on page 2 and "Oxidation" on page 5, as well as the product bulletins. Contact Denison Hydraulics, Inc. for fluids not lis ted in this bulletin.

Fluid Maintenance

Optimum life from Denison Hydraulics, Inc. equipment can only be obtained with proper hydraulic fluid maintenance. This includes checking the fluid at the time of installation and an average of every three to six months, thereafter. The fluid should be checked for viscosity, oxidation, water content, additive depletion, and contamination. A record should be kept of each check to detect signs of progressive deterioration. For best results, fluid samples should be taken with the system operating at normal operating temperature. Most fluid suppliers will provide assistance in analyzing your fluid sample.

Viscosity

Many hydraulic fluids will shear or thin out with use. The viscosity at each check should be compared to the viscosity when new. At no time should the viscosity be outside the minimum and maximum operating limits. Check the specific product bulletin for these viscosity limits. If viscosity is outside these limits, proper corrective action should be taken. High VI improved fluids are particularly susceptible to viscosity breakdown, and should be checked more frequently. Consult your fluid supplier for a recommendation.

Oxidation

Fluid oxidation will occur with temperature changes and use, and is evidenced by a change in color and/or odor, increased acidity, formation of sludge, formation of gum, or formation of varnish in the system. The rate of oxidation increases significantly with operation at temperatures over 140-degrees Fahrenheit (60-degrees Celsius). The fluid should be checked more often if operation is at high temperatures. The oxidation process increases the acidity of a fluid, and is measured by a neutralization number. The oxidation process is typically slow at first, then incre ases sharply in the final stages of complete oxidation. A sharp increase (by a factor of 2-3) in the neutralization number is a good indication the fluid is reaching the limit of its oxidation life, and should be replaced.

Water Content

Contamination of petroleum, biodegradable, and synthetic fluids by water can usually be detected by sampling the fluid at the bottom of the reservoir. Most hydraulic fluids readily separate the water, which will settle to the bottom of the reservoir. For biodegradable fluids, a water drain-off fitting is recommended to be installed at the lowest decantation point of the circuit. This water should be drained. Certain fluids (crankcase oil, transmission fluid, etc.) emulsify the water, but there is usually a detectable reaction such as coating on filters, a color change in the fluid, or some formation of particulate matter. Consult your fluid supplier for the proper corrective action in this case. For water-in-oil emulsions and water glycol solutions, it is essential that the proper percentage of water be maintained. With these fluids, the water can evaporate, with a resultant reduction in fire resistant properties. If the water content increases through condensation or other means, the fluid's lubrication properties are diminished. The fluid viscosity will usually change with a change in water content. A viscosity check of these fluids is a good way of detecting a change in water content. Consult your fluid supplier for the acceptable limits on water content, and the necessary corrective action, if needed, for your particular fluid.

Additive Depletion

Most hydraulic fluids contain additives to give better performance properties. These additives are used up in the system with use. Thus, the presence of adequate amounts of the necessary additives should be checked regularly, especially after repair or replacement of a component. Your fluid supplier should be consulted for information on maintaining the proper additive level.

Fluid De-aeration Properties

When pumps are operated at high working pressure with fast pressure cycle change, it is recommended to select fluids having the best de-aeration properties. Air in oil generates circuit temperature increase, pressure spikes, accelerated fluid aging, and component wear.

Particle Contamination

The NAS 1638 Class 8 specification defines the maximum contamination level recommended by Denison Hydraulics, Inc. for its equipment. This corresponds approximately to ISO 17/14. Refer to the NAS/ISO chart on page 3. Component life will be improved if you maintain an even cleaner system.

In most applications, a filter with a 10-micron (nominal) rating is adequate. It will not, however, guarantee the above standards for particle sizes smaller than 25-micron, due to the difference between nominal and absolute ratings. Applications with a highly contaminated environment may require the use of absolute ratings rather than nominal ratings on the filters. **New hydraulic fluid, as received by the user, is generally not in a satisfactory cleanliness condition for long component life. The fluid should be filtered through a 10-micron (nominal) filter prior to it entering the hydraulic system.** System filters should be checked on a regular basis, and elements changed as required. Filters with a dirt alarm are recommended. Inspect filter elements that have been removed for evidence of fluid deterioration and metallic deposits, indicating excessive component wear. Do not return system fluid that has leaked out.

FLUID BRAND NAME	Fluid Type	PAVC Acceptability	PVP Acceptability	Restrictions/Comments
Mobil DTE-11	Mineral Base	AF	AF	
Mobil DTE-13M	Mineral Base	AF	AF	
Mobil DTE-20 Series	Mineral Base	AF	AF	
Shell Tellus 32	Mineral Based	AF	EC	
Ashland Hy-Tran	Hydraulic Transmission	AF	EC	
Kendall Hy-Ken-052	Hydraulic Transmission	AF	EC	
A.T.F. Dexron Type II	Automatic Transmission Fluid	AF	AF	
Mil-H-5606	Military Spec. Mineral Based High VI	AF	AF	
Mil-H-83282B	Military Spec. Synthetic High VI	AF	AF	
Royal Purple Syndraulic 46	Synthetic	EC	AF	
Mobil EAL 224H	Vegetable Oil Biodegradable	AF	AF	See Note 4
Mobil EAL (Syndraulic) 32	Synthetic Esther Biodegradable	AF	EC	See Note 4. Syndraulic name no longer used. Now called "Mobil EAL Envirosyn H"
Texaco Syn-Star	Biodegradable	EC	AF	See Note 4
Chevron 32X	FDA Approved	AF	AF	See Note 4
Union Carbide FDC300	FDA Approved	AF	AF	See Note 4
Quintolubric 822	Synthetic Fire Resistant	AF	EC	See Note 4
Houghto-Safe 250	Water Glycol	AR	ER	See Notes 1, 2, (and 3 for PVP Pumps)
Houghto Safe 419R	Water Glycol	AR	ER	See Notes 1, 2, (and 3 for PVP Pumps)
Houghto-Safe 620	Water Glycol	AR	AR	See Notes 1, 2, (and 3 for PVP Pumps)
Union Carbide HP5046	Water Glycol	AR	ER	See Notes 1, 2, (and 3 for PVP Pumps)
Aquacent Light	Invert Emulsion	AR	ER	See Notes 1 and 2. Note 3 could be assumed for PVP pumps, however no testing conducted.
Industrial Phosphate Esther	Phosphate Esther	NR	ER	Some compatibility with Viton seals. Check further restrictions with fluid manufacturer.
Skydrol 500, LD4, etc.	Phosphate Esther	NR	NR	Requires EPR seals, not available

Rev. Date: 1/5/99

Codes:
AF = Acceptable at Full Ratings
AR = Acceptable but De-Rated with Restrictions (See Notes)
EC = Not Specifically Tested, Expected Compatibility if Tested
ER = Not Specifically Tested, Expected Restrictions and De-Ratings if Tested
NR = Not Recommended

Notes:

1. Water based fluids are much more likely to cause cavitation problems. A flooded inlet and reduced speed is recommended to minimize cavitation effects when using water based fluids.
2. Some reduction in life to be expected. The amount of life reduction is highly dependent on the operating conditions, however the lubricating properties of this fluid are not as good as a premium mineral based hydraulic fluid.
3. PVP Pressure ratings on water glycol fluids are reduced in order to obtain acceptable bearing life. We have found little correlation between a B_{10} rating on mineral based fluids vs. the life observed on water glycol. The ratings given here are based on test results and should be used conservatively. PVP16; 1000 psi.‡. PVP23; 2000 psi. PVP33; 1500 psi. PVP41; 3000 psi. PVP48; 2500 psi. PVP60; 3000 psi. PVP76; 2500 psi. PFVI(H) 1200 RPM & 2000 psi **The PVP100/140 and PE105/145 are not recommended for use on water glycol fluids.**
4. Biodegradable and synthetic esther fluids usually break down and turn acidic in the presence of relatively small amounts of water. Use caution in applying this fluid if contamination by water (liquid or airborne) is possible.
5. Exclusion of any fluid does not imply that it is not recommended. Likewise, many fluids may be incompatible which have not been tested. Whenever possible, compare properties of an untested fluid with one in this chart to estimate compatibility. In all cases of fluid selection, the operating viscosity must be within our recommended range (17-180 cSt for PAVC and PVP Series).

‡If PVP16 is destroked to 12cc/rev, 1500PSI is OK.

This information is subject to change without notice.

Parker Fluids Approval List doc