Appendix B 15-03-002 Dome Drive Data 8-4-2010

Notes:

Data was collected by S.Bauman, I. Look, R. Taroma, C. Elizares, T. Arruda, and L. Roberts on 2-17-2010 at the CFHT Observatory. The data pressure readings for the supply and return sides of the hydraulic pump were taken by hand, one person per drive unit. The values were obtained from mechaincal gauges plumbed directly into the hydraulic motor manifold, see physical photos below and schematic layout. The flow was calculated using the Flow-Load characteriscs and rated flow of the Moog series 61-115 servo valve used to regulate the flow to the hydraulic motor, see pecification sheet page.

Valve sizing constant, K	0.474341649
Supply pressure(PSI),Ps	1000

Dome drive Pressure readings for Clockwise Rotation at full speed

						Drive Unit # 1				Dome drive unit # 1 hydraulic motor power
	time (minutes)	time (seconds)	Wind Speed (knots)	Wind Direction	Dome Position	Return Pressure reading to Hydraulic motor-Drive unit # 1 (PSI)	Supply Pressure reading to Hydraulic motor-Drive unit # 1 (PSI)	Pressure difference (drop) to Hydraulic motor-Drive unit # 1 (PSI)	Flow reading--Drive unit #1 (GPM)	Power (HP) Dirve unit 1 = Pressure(PSI) x flow(GPM) /1715
	static-both pumps on stopped waiting for a move command	0 sec				0	1550			
Test 1		30 sec	30	256.7	28.7	350	1000	650	8.874119675	3.363368973
	1 min	60 sec	34.3	234	58.4	350	1000	650	8.874119675	3.363368973
		90 sec	32.1	243	88.1	350	1100	750	7.5	3.279883382
	2 min	120 sec	28.9	259.9	118.7	350	1000	650	8.874119675	3.363368973
		150 sec	28.8	253.3	150.3	400	950	550	10.0623059	3.226978568
	3 min	180 sec	29.4	244.2	182.9	400	850	450	11.12429773	2.918911941
		210 sec	30.1	248.9	214.7	400	850	450	11.12429773	2.918911941
	4 min	240 sec	26.3	235.3	245.3	350	950	600	9.486832981	3.319008623
		270 sec	32.9	243	276.8	350	1000	650	8.874119675	3.363368973
	5 min	300 sec	33.1	233.9	307.5	350	1000	650	8.874119675	3.363368973
		330 sec	23.5	272.7	339	350	1000	650	8.874119675	3.363368973
	6 min	360 sec	28.4	239.3	0.1	400	900	500	10.60660172	3.092303708
	static-stopped					0	1450			
	static-both pumps on stopped waiting for a move command	0 sec				0	1450			
Test 3		30 sec	35.2	250	30	350	1000	650	8.874119675	3.363368973
	1 min	60 sec	30.2	234.8	59.4	350	1000	650	8.874119675	3.363368973
		90 sec	28.8	240.4	88.7	350	1050	700	8.215838363	3.353403413
	2 min	120 sec	39	267	118.7	350	1000	650	8.874119675	3.363368973
		150 sec	29.8	232.3	150.4	350	950	600	9.486832981	3.319008623
	3 min	180 sec	33.3	224.6	183.2	400	800	400	11.61895004	2.709959193
		210 sec	30.8	258.1	214.9	400	900	500	10.60660172	3.092303708
	4 min	240 sec	33.3	247.3	245	350	900	550	10.0623059	3.226978568
		270 sec	34.2	249.4	275.7	350	1000	650	8.874119675	3.363368973
	5 min	300 sec	29.8	214.9	305.9	350	950	600	9.486832981	3.319008623
		330 sec	29.2	237.6	337.3	400	900	500	10.60660172	3.092303708
	6 min	360 sec	38.1	245.2	359	350	850	500	10.60660172	3.092303708
	static-stopped					0	1550			
	Average					365	957.5	592.5	9.518732772	3.288541788
	Time to perform a full dome building rotation = 5 min, 55 sec								Full operating slew speed (velocity) = 60 deg/min or 1 deg/sec	

Appendix B 15-03-002 Dome Drive Data 8-4-2010

Drive Unit # 2				Dome drive unit # 2 hydraulic motor power
Return Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Supply Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Pressure difference (drop) to Hydraulic motor-Drive unit # 2 (PSI)	Flow reading--Drive unit #2 (GPM)	Power (HP) Dirve unit 2 = Pressure(PSI) x flow(GPM) /1715
500	1000			
400	1100	700	8.215838363	3.353403413
310	1050	740	7.64852927	3.300240035
400	950	550	10.0623059	3.226978568
400	900	500	10.60660172	3.092303708
410	800	390	11.71537451	2.664137645
400	725	325	12.32375754	2.335405949
400	900	500	10.60660172	3.092303708
400	975	575	9.778803608	3.278607624
400	900	500	10.60660172	3.092303708
410	900	490	10.71214264	3.060612184
400	800	400	11.61895004	2.709959193
425	1100	675	8.551315688	3.365678186
500	1000			
1000	500			
1100	350	750		
1000	350	650	8.874119675	3.363368973
1000	400	600	9.486832981	3.319008623
700	400	300	12.5499004	2.195317854
750	425	325	12.32375754	2.335405949
800	425	375	11.85854123	2.592975487
850	400	450	11.12429773	2.918911941
1000	400	600	9.486832981	3.319008623
925	400	525	10.33803656	3.164705071
825	350	475	10.86853256	3.010234965
825	400	425	11.37431317	2.818707344
800	400	400	11.61895004	2.709959193
1000	500			
630.25	642.5	484.75	10.69824167	3.023890759

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Drive Unit # 3				Dome drive unit # 3 hydraulic motor power
Return Pressure reading to Hydraulic motor-Drive unit # 3 (PSI)	Supply Pressure reading to Hydraulic motor-Drive unit # 3 (PSI)	Pressure difference (drop) to Hydraulic motor-Drive unit # 3 (PSI)	Flow reading--Drive unit #2 (GPM)	Power (HP) Dirve unit 2 = Pressure(PSI) x flow(GPM) /1715
900	900			
450	900	450	11.12429773	2.918911941
450	1000	550	10.0623059	3.226978568
450	900	450	11.12429773	2.918911941
450	900	450	11.12429773	2.918911941
450	800	350	12.09338662	2.468038086
450	750	300	12.5499004	2.195317854
450	900	450	11.12429773	2.918911941
450	950	500	10.60660172	3.092303708
450	900	450	11.12429773	2.918911941
450	900	450	11.12429773	2.918911941
450	800	350	12.09338662	2.468038086
400	800	400	11.61895004	2.709959193
800	800			
850	700			
450	900	450		
450	1000	550	10.0623059	3.226978568
450	950	500	10.60660172	3.092303708
450	850	400	11.61895004	2.709959193
450	750	300	12.5499004	2.195317854
450	700	250	12.99038106	1.893641553
450	900	450	11.12429773	2.918911941
450	950	500	10.60660172	3.092303708
450	900	450	11.12429773	2.918911941
450	900	450	11.12429773	2.918911941
450	800	350	12.09338662	2.468038086
450	800	350	12.09338662	2.468038086
850	800			
450	875	425	11.34640453	2.811791209

Average running hydraulic motor Power, HP	Maximim Running hydraulic motor power, HP	Minimum running hydraulic motor power, HP
3.041407919	3.365678186	1.893641553

Appendix B 15-03-002 Dome Drive Data 8-4-2010

Dome drive Pressure readings for Counterclockwise Rotation at full speed

						Drive Unit # 1				Dome drive unit # 1 hydraulic motor power
	time (minutes)	time (seconds)	Wind Speed (knots)	Wind Direction	Dome Position	Supply Pressure reading to Hydraulic motor-Drive unit # 1 (PSI)	Return Pressure reading to Hydraulic motor-Drive unit # 1 (PSI)	Pressure difference (drop) to Hydraulic motor-Drive unit # 1 (PSI)	Flow reading--Drive unit #1 (GPM)	Power (HP) Dirve unit 1 = Pressure(PSI) x flow(GPM) /1715
	static-both pumps on stopped waiting for a move command	0 sec				0	1550			
Test 2		30 sec	32.8	246.3	335	900	400	500	10.60660172	3.092303708
	1 min	60 sec	29.3	270.6	307	975	400	575	9.778803608	3.278607624
		90 sec	31.1	226.8	276.6	850	400	450	11.12429773	2.918911941
	2 min	120 sec	31	251.2	245.1	800	400	400	11.61895004	2.709959193
		150 sec	25.2	252.2	214	750	400	350	12.09338662	2.468038086
	3 min	180 sec	28	244	182.2	800	400	400	11.61895004	2.709959193
		210 sec	29.4	230.8	155.5	900	400	500	10.60660172	3.092303708
	4 min	240 sec	34.9	243.6	126.7	950	400	550	10.0623059	3.226978568
		270 sec	30.3	265.1	95.8	850	400	450	11.12429773	2.918911941
	5 min	300 sec	33.3	249.3	63.1	750	400	350	12.09338662	2.468038086
		330 sec	37.2	248.5	29.4	700	400	300	12.5499004	2.195317854
	6 min	360 sec	38	248.5	0.8	750	400	350	12.09338662	2.468038086
	static-stopped					0	1450			
	static-both pumps on stopped waiting for a move command	0 sec				0	1550			
Test 4		30 sec	32.3	239.4	335.6	950	350	600	9.486832981	3.319008623
	1 min	60 sec	34.1	248.1	307	900	400	500	10.60660172	3.092303708
		90 sec	30.1	223.5	277.1	850	350	500	10.60660172	3.092303708
	2 min	120 sec	30.1	239.8	246	800	400	400	11.61895004	2.709959193
		150 sec	29	256.7	215.4	750	400	350	12.09338662	2.468038086
	3 min	180 sec	28	253.7	184.5	800	400	400	11.61895004	2.709959193
		210 sec	30.9	254.4	156.8	900	350	550	10.0623059	3.226978568
	4 min	240 sec	30	213.9	128.6	900	400	500	10.60660172	3.092303708
		270 sec	29.9	237.1	97.9	850	400	450	11.12429773	2.918911941
	5 min	300 sec	30.9	246.7	65.8	800	400	400	11.61895004	2.709959193
		330 sec	33.4	238.9	33.8	700	400	300	12.5499004	2.195317854
	6 min	360 sec	29.3	242.2	1.8	750	400	350	12.09338662	2.468038086
	static-stopped					0	1450			
	Average					828.75	395	433.75	11.25887132	2.847542527
	Time to perform a full dome building rotation = 5 min, 55 sec								Full operating slew speed (velocity) = 60 deg/min or 1 deg/sec	

Appendix B 15-03-002 Dome Drive Data 8-4-2010

Drive Unit # 2				Dome drive unit # 2 hydraulic motor power
Supply Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Return Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Pressure difference (drop) to Hydraulic motor-Drive unit # 2 (PSI)	Flow reading--Drive unit #2 (GPM)	Power (HP) Dirve unit 2 = Pressure(PSI) x flow(GPM) /1715
1100	500			
750	400	350	12.09338662	2.468038086
700	400	300	12.5499004	2.195317854
700	400	300	12.5499004	2.195317854
800	390	410	11.52171862	2.754463344
900	400	500	10.60660172	3.092303708
900	350	550	10.0623059	3.226978568
925	325	600	9.486832981	3.319008623
875	375	500	10.60660172	3.092303708
725	390	335	12.23212982	2.389366467
725	390	335	12.23212982	2.389366467
850	375	475	10.86853256	3.010234965
1150	500	650	8.874119675	3.363368973
1100	500			
1100	500			
900	400	500	10.60660172	3.092303708
900	390	510	10.5	3.12244898
800	390	410	11.52171862	2.754463344
800	375	425	11.37431317	2.818707344
850	350	500	10.60660172	3.092303708
900	300	600	9.486832981	3.319008623
1000	300	700	8.215838363	3.353403413
900	375	525	10.33803656	3.164705071
700	300	400	11.61895004	2.709959193
700	350	350	12.09338662	2.468038086
850	375	475	10.86853256	3.010234965
1000	500	500	10.60660172	3.092303708
1100	500			
825	365	460	10.96704323	2.941597601

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Drive Unit # 3				Dome drive unit # 3 hydraulic motor power
Supply Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Return Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Pressure difference (drop) to Hydraulic motor-Drive unit # 2 (PSI)	Flow reading--Drive unit #2 (GPM)	Power (HP) Dirve unit 2 = Pressure(PSI) x flow(GPM) /1715
800	800			
900	400	500	10.60660172	3.092303708
850	400	450	11.12429773	2.918911941
800	400	400	11.61895004	2.709959193
750	400	350	12.09338662	2.468038086
800	400	400	11.61895004	2.709959193
900	400	500	10.60660172	3.092303708
900	400	500	10.60660172	3.092303708
850	400	450	11.12429773	2.918911941
750	400	350	12.09338662	2.468038086
700	400	300	12.5499004	2.195317854
750	400	350	12.09338662	2.468038086
900	700	200	13.41640786	1.564595669
800	800			
850	750			
850	400	450	11.12429773	2.918911941
850	400	450	11.12429773	2.918911941
750	400	350	12.09338662	2.468038086
750	400	350	12.09338662	2.468038086
750	400	350	12.09338662	2.468038086
850	400	450	11.12429773	2.918911941
900	400	500	10.60660172	3.092303708
800	400	400	11.61895004	2.709959193
750	400	350	12.09338662	2.468038086
700	400	300	12.5499004	2.195317854
700	400	300	12.5499004	2.195317854
850	400	450	11.12429773	2.918911941
850	750			
792.5	400	392.5	11.67386269	2.67171493

Average running hydraulic motor Power, HP	Maximim Running hydraulic motor power, HP	Minimum running hydraulic motor power, HP
2.820285019	3.363368973	1.564595669

Appendix B 15-03-002 Dome Drive Data 8-4-2010

Notes: Data was collected by S.Bauman, C. Elizares, T. Arruda, and L. Roberts on 8-4-2010 at the CFHT Observatory. The data pressure readings for the supply and return sides of the hydraulic pump were taken by hand, one person at the drive unit. The values were obtained from mechaincal gauges plumbed directly into the hydraulic motor manifold, see physical photos below and schematic layout. The flow was calculated using the Flow-Load characteriscs and rated flow of the Moog series 61-115 servo valve used to regulate the flow to the hydraulic motor, see pecification sheet page.

	one pump
Valve sizing constant, K	0.063245553
Supply pressure(PSI),Ps	1000

Dome drive Pressure readings for Clockwise Rotation at slow speed

Drive Unit # 2

	time (minutes)	time (seconds)	Dome Position	Return Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Supply Pressure reading to Hydraulic motor-Drive unit # 2 (PSI)	Pressure difference (drop) to Hydraulic motor-Drive unit # 2 (PSI)	Flow reading--Drive unit #2 (GPM)	Dome drive unit # 2 hydraulic motor power: Power (HP) Dirve unit 1 = Pressure(PSI) x flow(GPM) /1715
Test 1	from static-**one pump** on stopped waiting for a move command	0 sec	0	800	900	100	1.897366596	0.110633621
		46 sec	10	750	850	100	1.897366596	0.110633621
		96 sec	20	800	950	150	1.843908891	0.16127483
	static-stopped							
Test 2	from static-**one pump** on stopped waiting for a move command	0 sec	320	800	1050	250	1.732050808	0.25248554
		45 sec	330	800	1000	200	1.788854382	0.208612756
		97 sec	340	800	800	0	2	0
		151 sec	350	800	800	0	2	0
	static-stopped							
Test 3	from static-**two pumps** on stopped waiting for a move command							
		0 sec	350	800	800	0	2	0
		47 sec	0	800	800	0	2	0
		104 sec	10	700	900	200	1.788854382	0.208612756
		159 sec	20	800	800	0	2	0
	Time to perform a full dome building rotation = 27 min, 36 sec						Slow slew speed (velocity) = 13 deg/min or 0.216 deg/sec	

Dome drive Pressure readings for Clockwise Rotation at ~1/2 speed

Test 4	from static-**two pumps** on stopped waiting for a move command							
		0 sec	20	200	1200	1000	0	0
		17 sec	30	700	1000	300	5.019960159	0.878127142
		34 sec	40	700	900	200	5.366563146	0.625838268
		49 sec	50	700	700	0	6	0
	static-stopped							
	Average			730	896.6666667	166.6666667	2.419391656	0.235120666
	Time to perform a full dome building rotation = 10 min,12 sec						1/2 slew speed (velocity) = 35.3 deg/min or 0.59 deg/sec	

Two pumps @ 1/2 speed
0.18973666
1000

Average running hydraulic motor Power, HP	Maximim Running hydraulic motor power, HP	Minimum running hydraulic motor power, HP
0.095659375	0.25248554	0.110633621

Average running hydraulic motor Power, HP	Maximim Running hydraulic motor power, HP	Minimum running hydraulic motor power, HP
0.375991352	0.878127142	0.625838268

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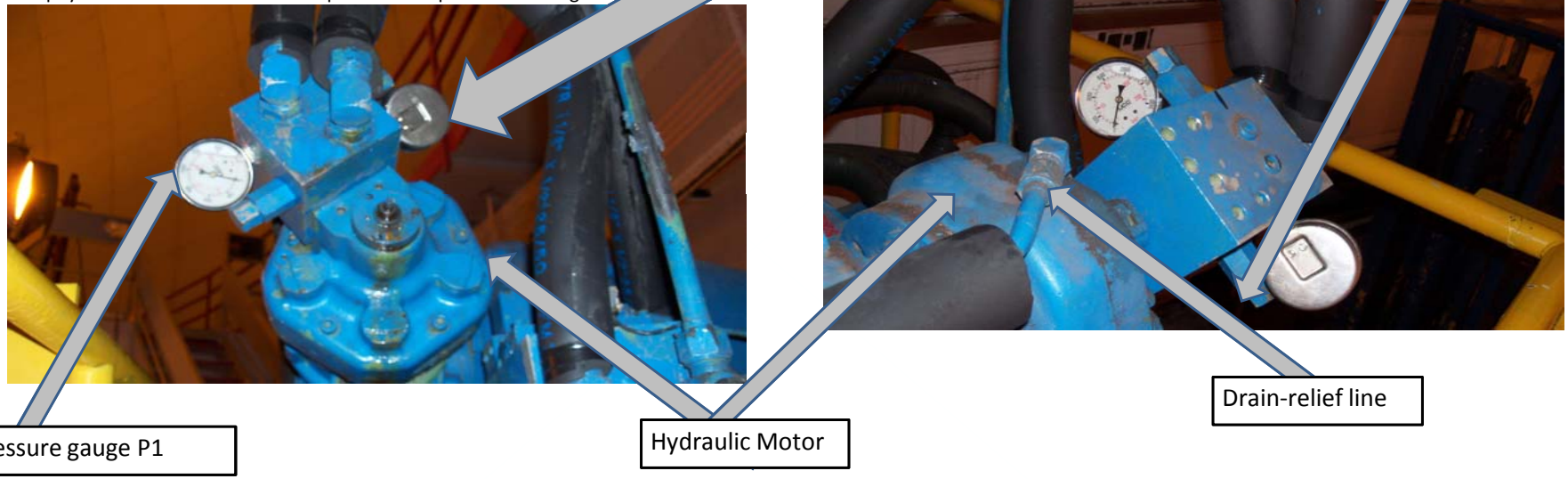
Dome drive system operating time	Dome drive system operating time	Dome drive system operating time
Nightly operation	Daily operation	Total operation time in 24hrs
secondary motor/pump assembly comes on and off line intermittently	motor/pump assembly comes on and off line intermittently	is running but the secondary motor/pump assembly
~ 11 hrs during nighttime observations	~ 1.5 hrs during daytime maintenance.	~ 12.5 hrs during a 24hr period.

The physical location of the manifold ports for the pressure readings:



The technical data sheet for the Moog Servo-vavle
which controls the fluid flow to the hydraulic motor:

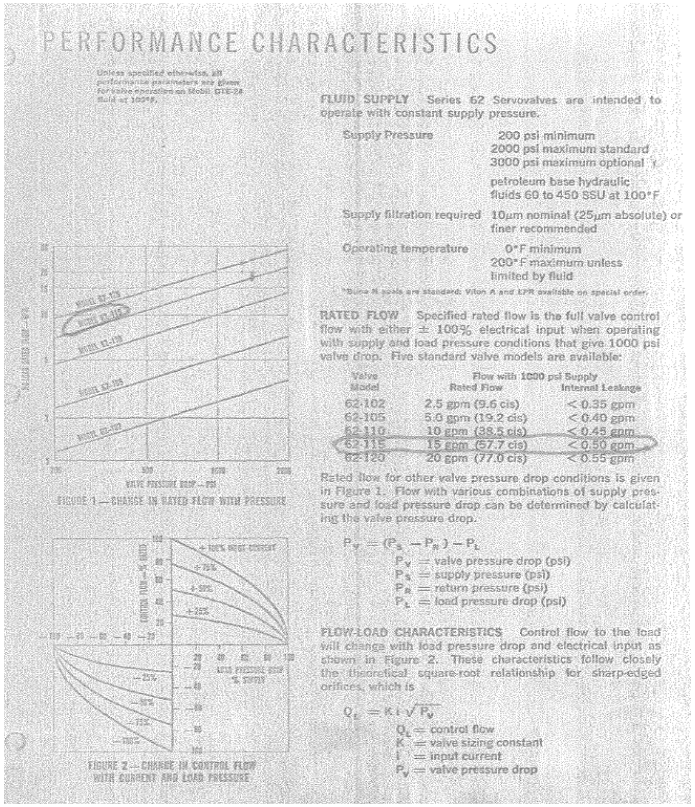
Flow-Load characteristics:
QL= k * I * (Pv)^(1/2)
assume I is constant,
therefore i=1
Rated flow:

Pv = (Ps - Pr) - Pl

assume is neglagable, therefore
Pr=0
Pv = Ps - Pl
Ps = 1,000 PSI supply pressure
Pl = P2-P1 Counter clockwise or
P1-P2 Clockwise
To find k?

We use the values, Pv=1,000 PSI,
Ql=15GPM at maximum flow
k = Ql / (Pv)^(1/2)
k=.474341

See k value above



PERFORMANCE CHARACTERISTICS

Unless specified otherwise, all performance parameters are given for valve operation on Moog D1E-28 fluid at 100°F.

FLUID SUPPLY Series 62 Servovalves are intended to operate with constant supply pressure.

Supply Pressure	200 psi minimum 2000 psi maximum standard 3000 psi maximum optional †
	petroleum base hydraulic fluids 60 to 450 SSU at 100°F
Supply filtration required	10μm nominal (25μm absolute) or finer recommended
Operating temperature	0°F minimum 200°F maximum unless limited by fluid

†Buna N seals are standard; Viton A and EPR available on special order.

RATED FLOW Specified rated flow is the full valve control flow with either ± 100% electrical input when operating with supply and load pressure conditions that give 1000 psi valve drop. Five standard valve models are available:

Valve Model	Flow with 1000 psi Supply Rated Flow	Internal Leakage
62-102	2.5 gpm (9.6 cis)	< 0.35 gpm
62-105	5.0 gpm (19.2 cis)	< 0.40 gpm
62-110	10 gpm (38.5 cis)	< 0.45 gpm
62-115	15 gpm (57.7 cis)	< 0.50 gpm
62-120	20 gpm (77.0 cis)	< 0.55 gpm

Rated flow for other valve pressure drop conditions is given in Figure 1. Flow with various combinations of supply pressure and load pressure drop can be determined by calculating the valve pressure drop.

$$P_v = (P_s - P_R) - P_L$$

P_v = valve pressure drop (psi)
P_s = supply pressure (psi)
P_R = return pressure (psi)
P_L = load pressure drop (psi)

FLOW-LOAD CHARACTERISTICS Control flow to the load will change with load pressure drop and electrical input as shown in Figure 2. These characteristics follow closely the theoretical square-root relationship for sharp-edged orifices, which is

$$Q_L = K\,I\,\sqrt{P_v}$$

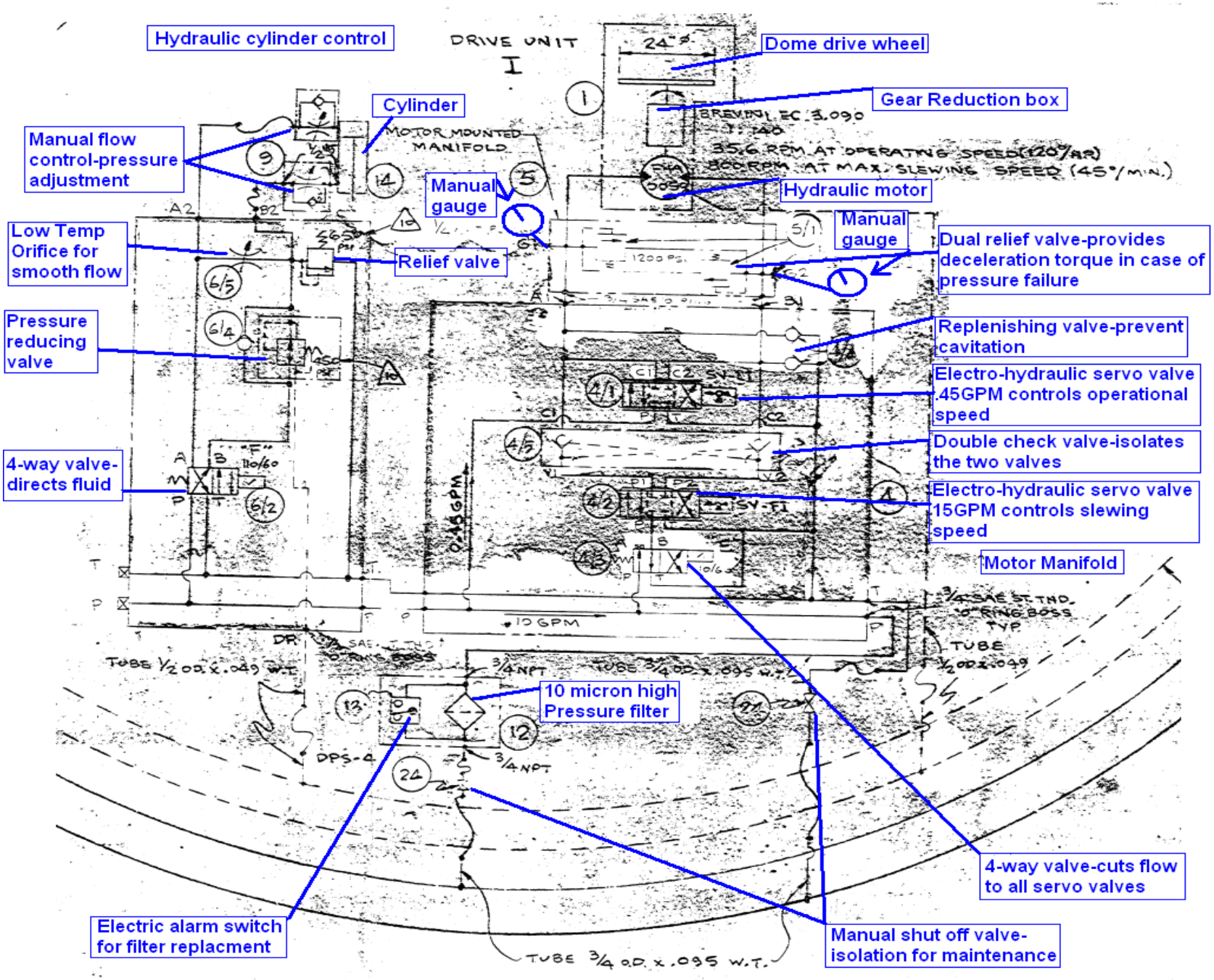
Q_L = control flow
K = valve sizing constant
I = input current
P_v = valve pressure drop

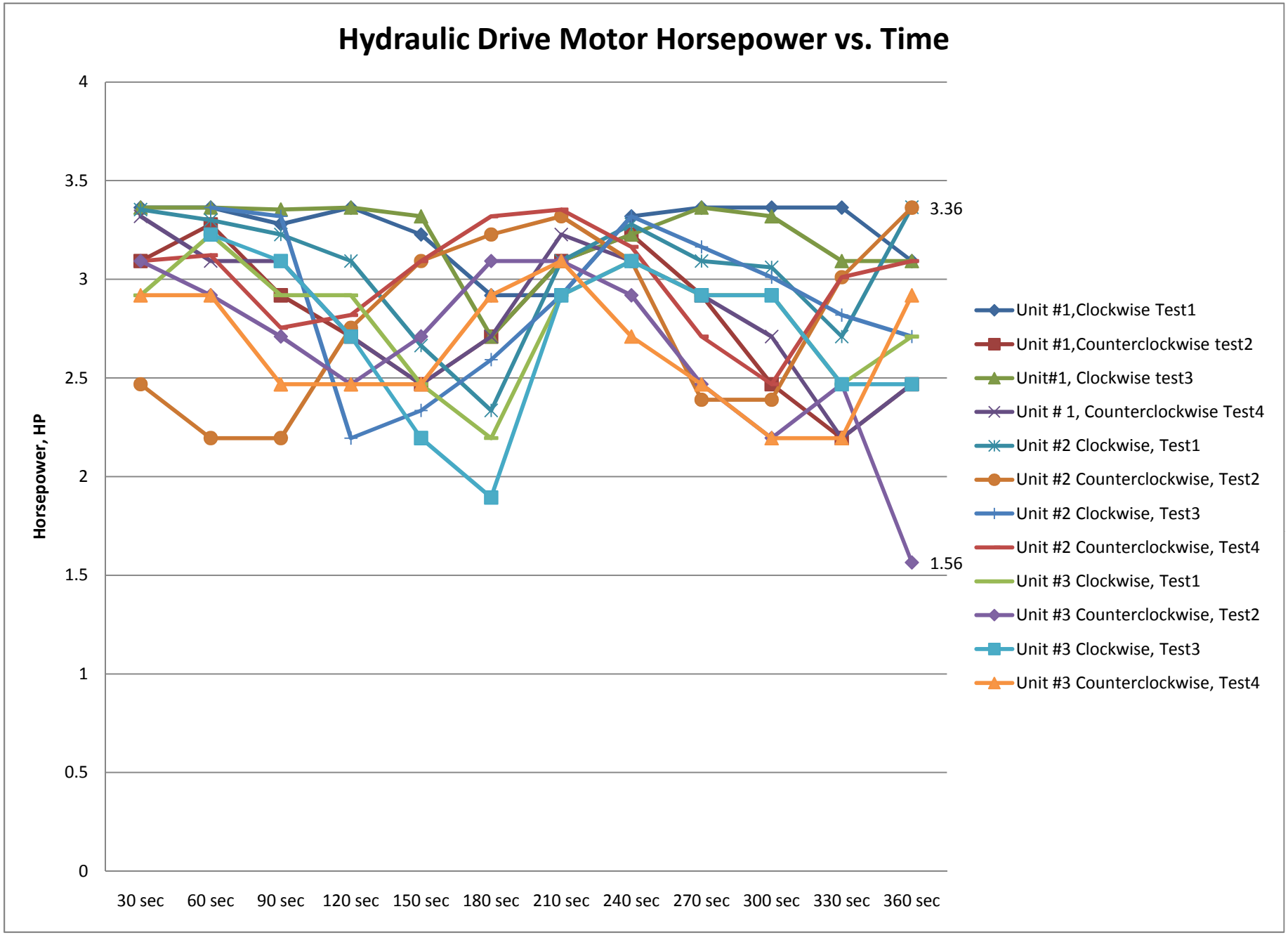
FIGURE 1 — CHANGE IN RATED FLOW WITH PRESSURE

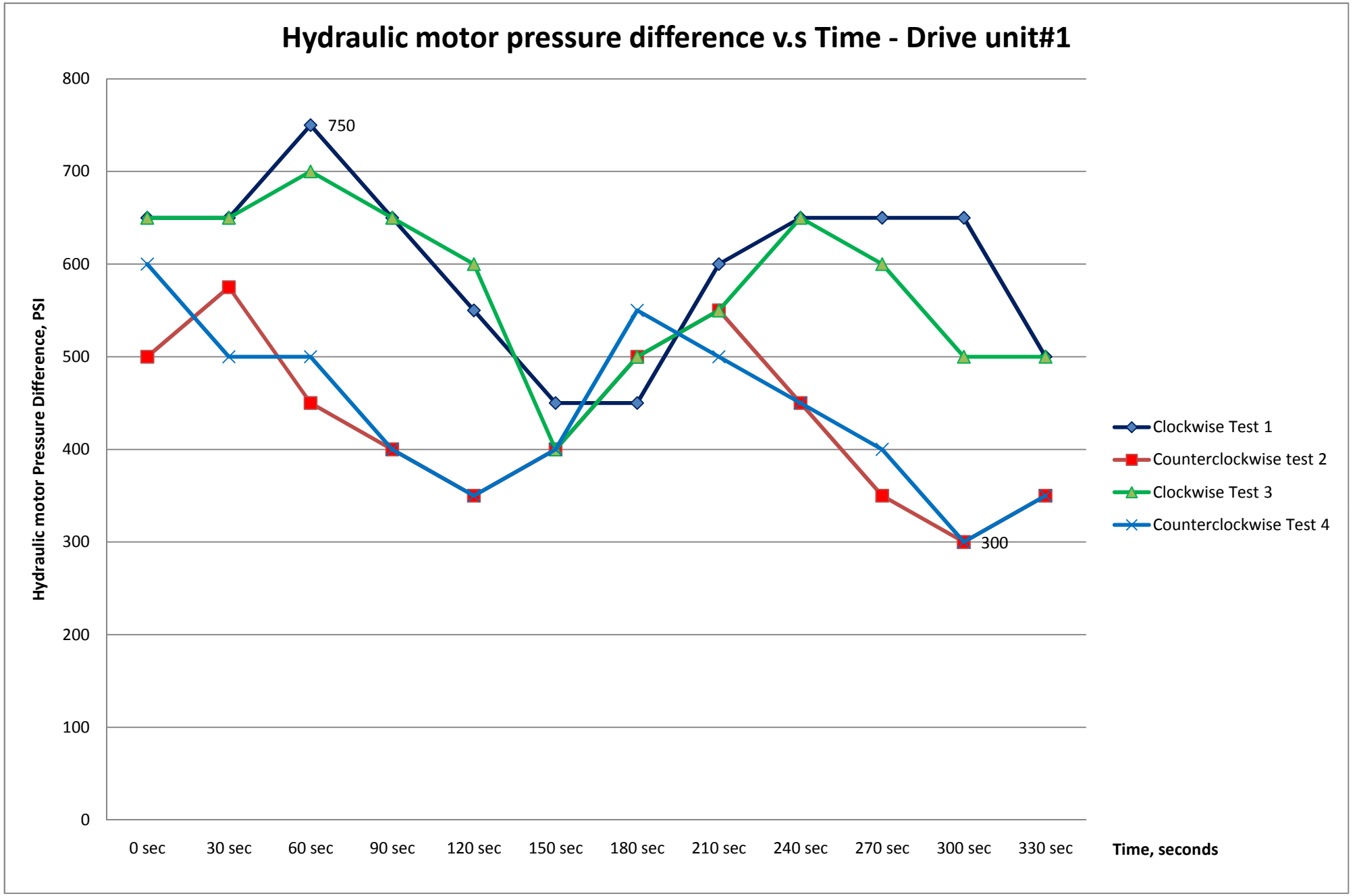
FIGURE 2 — CHANGE IN CONTROL FLOW WITH CURRENT AND LOAD PRESSURE

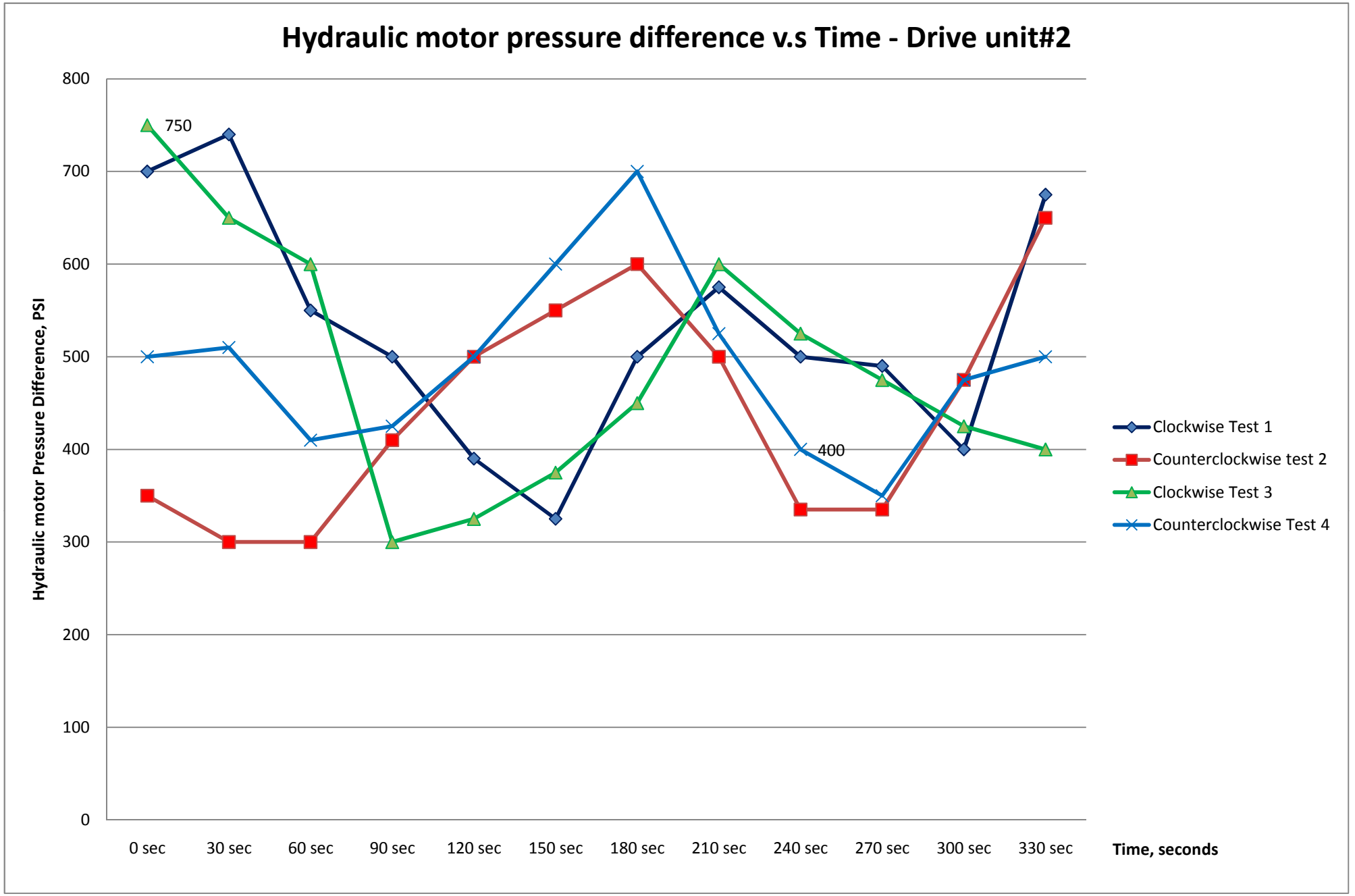
Appendix B 15-03-002 Dome Drive Data 8-4-2010

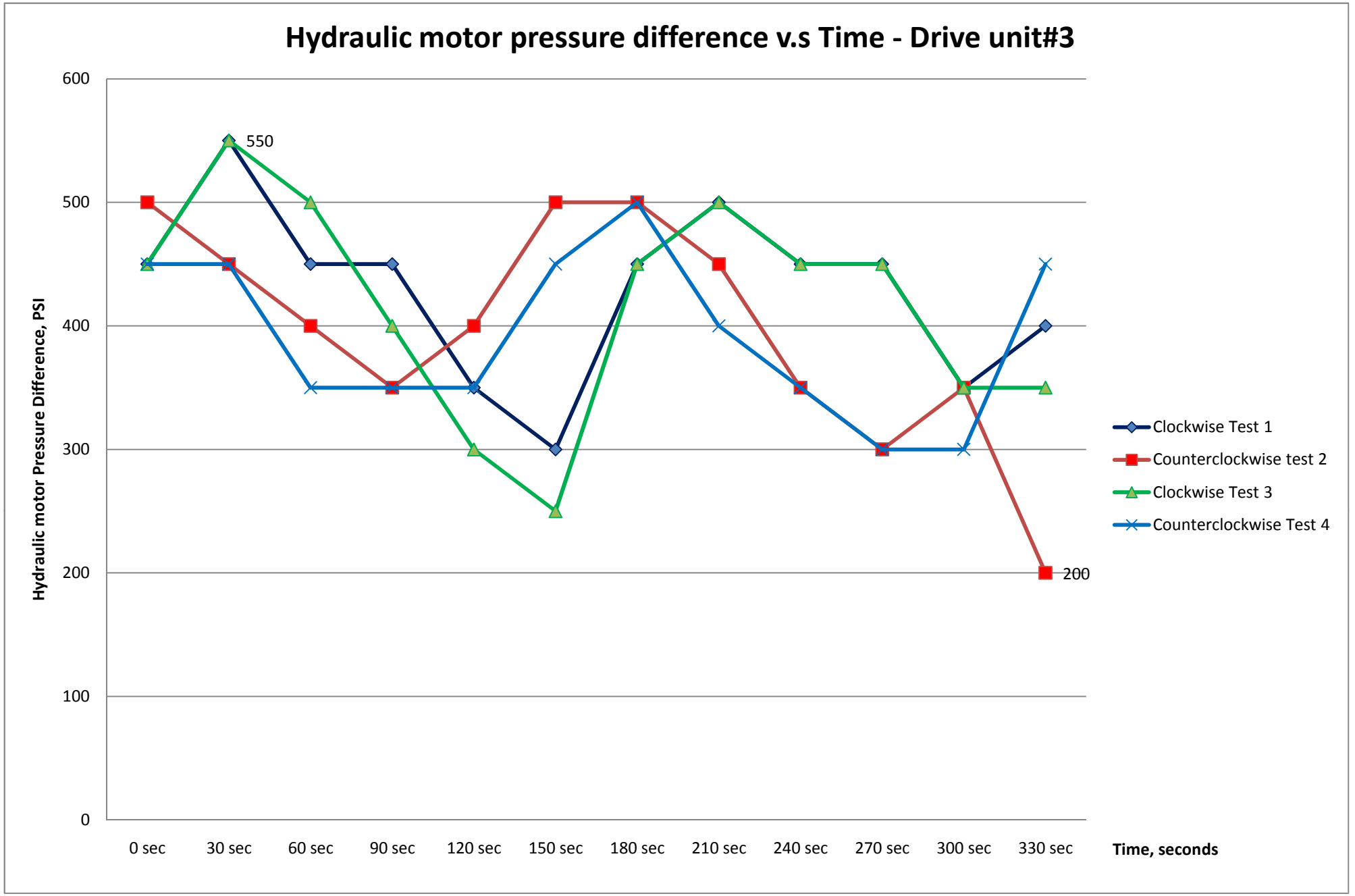
The schematic location of the manifold ports for the pressure readings:

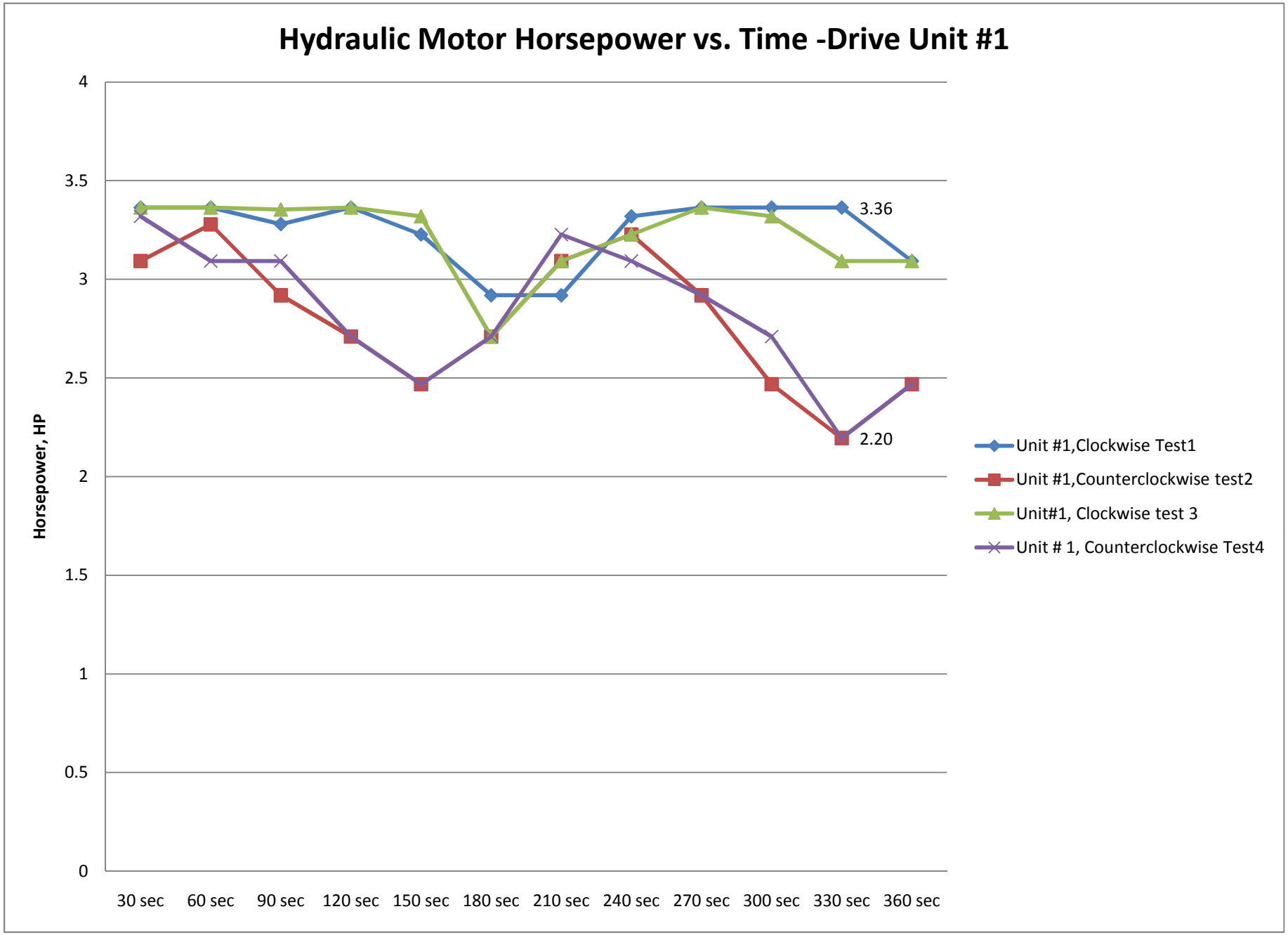


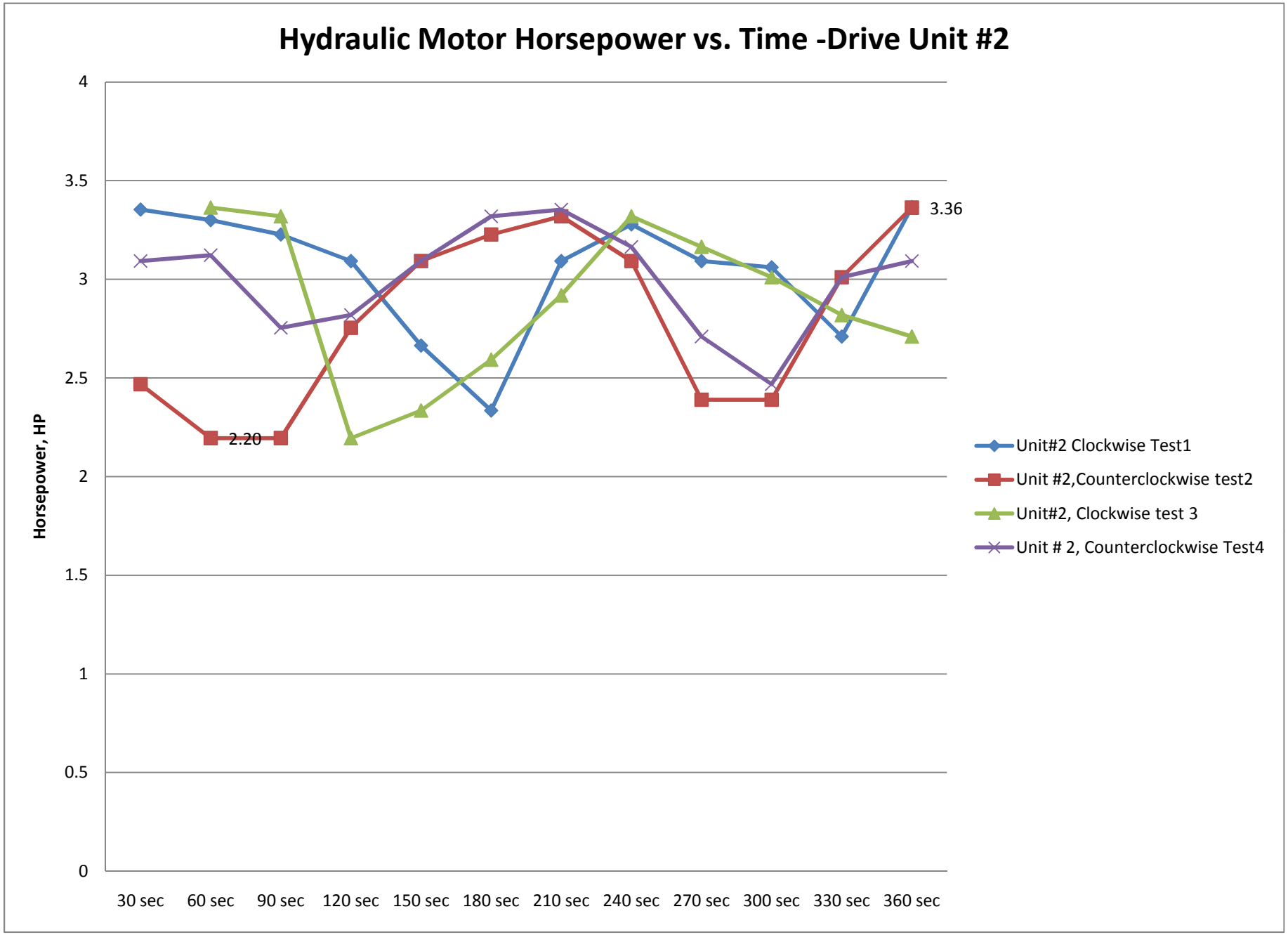

Hydraulic Drive Motor Horsepower vs. Time
Horsepower, HP
4
3.5
3
2.5
2
1.5
1
0.5
0
30 sec
60 sec
90 sec
120 sec
150 sec
180 sec
210 sec
240 sec
270 sec
300 sec
330 sec
360 sec
3.36
1.56
Unit #1,Clockwise Test1
Unit #1,Counterclockwise test2
Unit#1, Clockwise test3
Unit # 1, Counterclockwise Test4
Unit #2 Clockwise, Test1
Unit #2 Counterclockwise, Test2
Unit #2 Clockwise, Test3
Unit #2 Counterclockwise, Test4
Unit #3 Clockwise, Test1
Unit #3 Counterclockwise, Test2
Unit #3 Clockwise, Test3
Unit #3 Counterclockwise, Test4

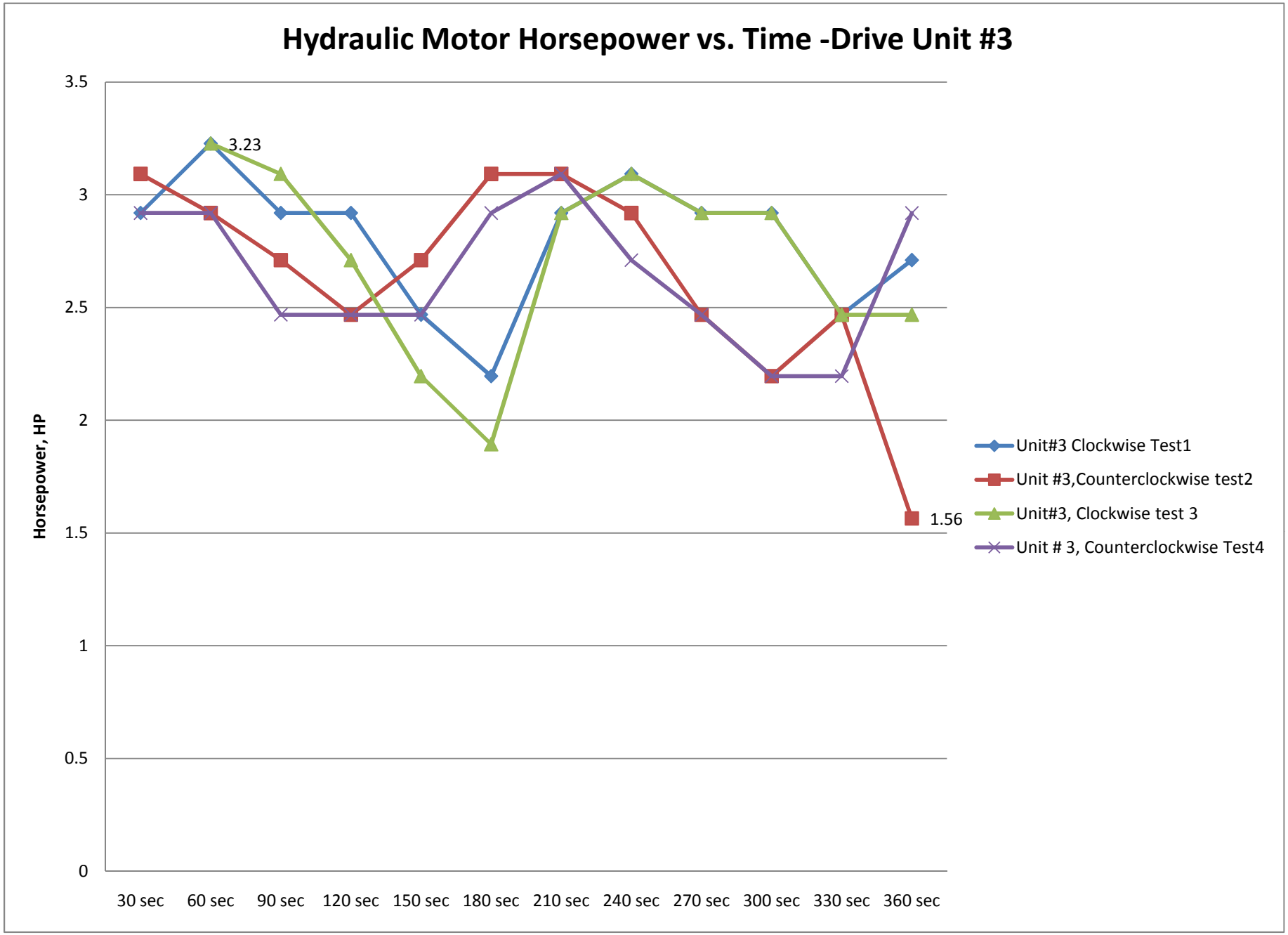

Hydraulic motor pressure difference v.s Time - Drive unit#1
Hydraulic motor Pressure Difference, PSI
800
700
600
500
400
300
200
100
0
750
300
0 sec
30 sec
60 sec
90 sec
120 sec
150 sec
180 sec
210 sec
240 sec
270 sec
300 sec
330 sec
Time, seconds
Clockwise Test 1
Counterclockwise test 2
Clockwise Test 3
Counterclockwise Test 4


Hydraulic motor pressure difference v.s Time - Drive unit#2
Hydraulic motor Pressure Difference, PSI
800
700
600
500
400
300
200
100
0
750
400
0 sec
30 sec
60 sec
90 sec
120 sec
150 sec
180 sec
210 sec
240 sec
270 sec
300 sec
330 sec
Time, seconds
Clockwise Test 1
Counterclockwise test 2
Clockwise Test 3
Counterclockwise Test 4


Hydraulic motor pressure difference v.s Time - Drive unit#3
Hydraulic motor Pressure Difference, PSI
600
500
400
300
200
100
0
550
200
0 sec
30 sec
60 sec
90 sec
120 sec
150 sec
180 sec
210 sec
240 sec
270 sec
300 sec
330 sec
Time, seconds
Clockwise Test 1
Counterclockwise test 2
Clockwise Test 3
Counterclockwise Test 4


Hydraulic Motor Horsepower vs. Time -Drive Unit #1
Horsepower, HP
4
3.5
3
2.5
2
1.5
1
0.5
0
30 sec
60 sec
90 sec
120 sec
150 sec
180 sec
210 sec
240 sec
270 sec
300 sec
330 sec
360 sec
3.36
2.20
Unit #1,Clockwise Test1
Unit #1,Counterclockwise test2
Unit#1, Clockwise test 3
Unit # 1, Counterclockwise Test4


Hydraulic Motor Horsepower vs. Time -Drive Unit #2
Horsepower, HP
4
3.5
3
2.5
2
1.5
1
0.5
0
30 sec
60 sec
90 sec
120 sec
150 sec
180 sec
210 sec
240 sec
270 sec
300 sec
330 sec
360 sec
2.20
3.36
Unit#2 Clockwise Test1
Unit #2,Counterclockwise test2
Unit#2, Clockwise test 3
Unit # 2, Counterclockwise Test4


Hydraulic Motor Horsepower vs. Time -Drive Unit #3
Horsepower, HP
3.5
3
2.5
2
1.5
1
0.5
0
3.23
1.56
30 sec
60 sec
90 sec
120 sec
150 sec
180 sec
210 sec
240 sec
270 sec
300 sec
330 sec
360 sec
Unit#3 Clockwise Test1
Unit #3,Counterclockwise test2
Unit#3, Clockwise test 3
Unit # 3, Counterclockwise Test4

Dome drive hydraulic cylinder (actuator) pressure readings (Cylinder that pivots the frame for dome drive wheel replacment)

Clockwise-Force Tilts the frame for Dome wheel replacment

Gauge 1	0
Gauge 2	600

Counterclockwise-Force Tilts the frame for Dome wheel replacment

Gauge 1	0
Gauge 2	700

Diameter of the cylinder	2.5	in
Radius of the cylinder	1.25	in
Area of the cylinder	4.908734375	in^2
F=P*A		
Force the cylinder exerts	3436.114063	PSI

Clockwise-Force Tilts the frame for additonal wheel traction

Gauge 1	700
Gauge 2	0

Counterclockwise-Force Tilts the frame for additonal wheel traction

Gauge 1	700
Gauge 2	0

Diameter of the cylinder	2.5	in
Radius of the cylinder	1.25	in
Area of the cylinder	4.908734375	in^2
F=P*A		
Force the cylinder exerts	3436.114063	PSI