Heavy Duty Hydrostatic Transmissions

Series 1 Variable Displacement Piston Pumps (ACA) and Motors (ACE)

Fixed Displacement Motors (HHD)

64 cm³/r - 125 cm³/r
3.9 in³/r - 7.6 in³/r

Powering Business Worldwide

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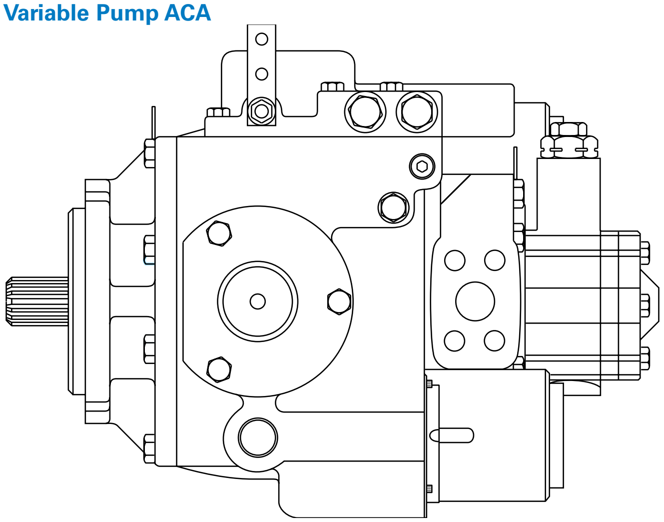
SUMINISTRES INDUSTRIALS

Variable Pump ACA



Drive shafts – a wide variety of options are available to suit every need.

High strength swashplates on variable pumps and motors – resist deflection under high load.

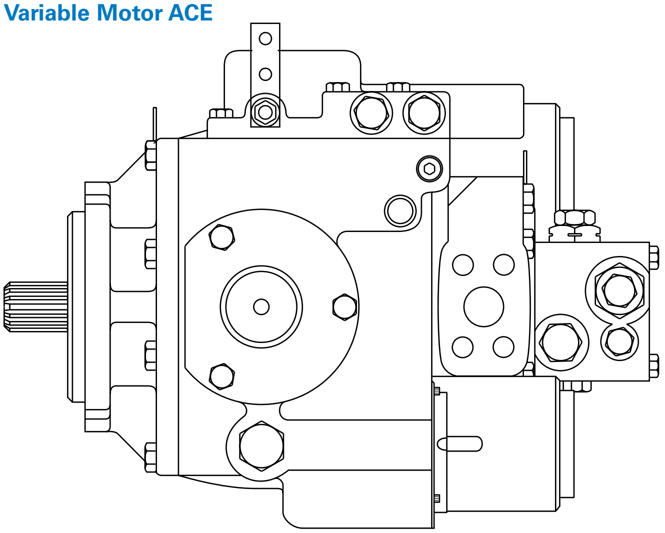
High strength cast iron housings – provide greater noise damping and wall strength.

High flow check valves in pumps – keep the system primed with minimal pressure drop.

Charge pumps on pumps – gerotor type, several displacement options are available to suit the needs of every application. All cast iron construction.

Cartridge shaft seal – lends itself to easy serviceability. Mechanical face seal design tolerates high speed and high case pressures.

Variable Motor ACE



Bi-metal bearing plate – has steel for high speed and pressure. Bronze provides greater bearing properties.

Valve plate – hardened steel for long life.

End cover – large passages minimizes losses. Both side and rear ports are available on Models 39 through 64 fixed motors.

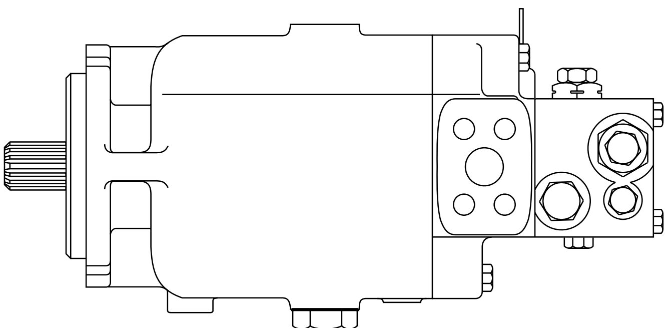
C-Pad rear mount – available on Models 39 through 64 variable pumps for tandem units or for a through shaft.

Relief valves – pilot operated cartridge and fast acting direct types available.

Controls – a wide variety of control options are available for pumps and motors to meet application needs.

Ports – SAE code 61 and code 62 as well as o-ring boss ports are available.

Fixed Motor HDD



Advanced cylinder barrel design – permits high speed and pressure.

Fixed clearance slipper hold down – on Models 39 through 64 allows operation at high speed and reduces friction. Model 76 is a ball guide unit.

Pistons – have long engagement with cylinder bore resulting in low leakage.

Hydraulic servo control – provides low effort operation with low control pressure. Large servo pistons hold swashplate position and provide damping.

Large case drain ports – minimize case back pressure.

Model Code

ACA Series 1 Variable Pump

The following 33 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Variable Displacement Pump. Use this model code to specify a pump with the desired features. All 33 digits of the code must be present to release a new product number for ordering.

ACA	39	2	03	02	L	1	A	C	C	EA	A	A	A	2	C	N	A	A	1	0	D	A	15	0	0	B
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15,16	17	18	19	20	21	22	23	24	25	26	27	28	29,30	31	32	33

1, 2, 3 Pump Series

ACA – Hydrostatic - Heavy Duty Variable Pump

4,5 Displacement

39 – 63.66 cm^3/r (3.885 in^3/r)
46 – 75.28 cm^3/r (4.594 in^3/r)
54 – 89.13 cm^3/r (5.439 in^3/r)
64 – 105.4 cm^3/r (6.431 in^3/r)
76 – 124;8 cm^3/r (7.616 in^3/r)

6 Type

2 – Variable Displacement Pump

7 Design Type

0 – Ball-Guide (Model 76)
3 – Series 1 (Models 39-64)

8, 9 Input Shaft

01 – (1.500) Diameter straight with (.3750) x (2.5) square key (Models 39-64)
02 – (1.750) Diameter straight with (.4375) x (3.0) square key (Model 76)
13 – 13 Tooth 8/16 pitch spline (Model 76)
14 – 14 Tooth 12/24 pitch spline (Models 33-64)
21 – 21 Tooth 16/32 pitch spline (Models 39-64)
22 – 21 Tooth 16/32 pitch spline with (3.22) extension (Models 46-64)
23 – 23 Tooth 16/32 pitch spline (Models 39-64)
24 – 23 Tooth 16/32 pitch Sspline with 3/8-24 UNF hole (Models 39-64)
25 – 21 Tooth 16/32 pitch spline with 3/8-24 UNF hole (Models 39-64)
27 – 27 Tooth 16/32 pitch spline (Model 76)
30 – 13 Tooth 8/16 pitch spline with (2.93) extension and for 76 seal (Models 54-64)
33 – 13 Tooth 8/16 pitch spline with (2.19) extension and for 76 seal (Model 54)
36 – 21 Tooth 16/32 pitch spline with M10 x 1.5 threaded hole (Models 39-46)
37 – 23 Tooth 16/32 pitch spline with M10 x 1.5 threaded hole (Models 39-54)
38 – 27 Tooth 16/32 pitch spline with (2.93) extension and for 76 seal (Models 54-64)
39 – 34.9 (1.375) Diameter tapered with 9.5 (.3750) x 25.4 (1.00) square key (Models 39-64)
40 – 38 (1.50) Diameter tapered with 9.5 (.3750) x 25.4 (1.00) square key (Models 54-64)
41 – 44 (1.75) Diameter tapered with 11 (.4375) x 25.4 (1.00) square key (Model 76)
44 – 14 Tooth 12/24 pitch spline with M10 x 1.5 threaded hole (Models 39-46)

10 Input Rotation

L – Counterclockwise (Lefthand)
R – Clockwise (Righthand)

11 Valve Plate

0 – Standard (V-groove)
1 – Propel

12 Main Ports

A – 25.4 (1.00) - Code 61 per SAE J518
B – 25.4 (1.00) - Code 62 per SAE J518
D – (1.00) - Code 61 per SAE J518 with port A and B gage ports
E – (1.00) - Code 62 per SAE J518 with port A and B gage ports

13,14 Power Limiter Valve Setting Port A (position 13 and Port B (position 14)

0 – None
C – 103 bar (1500 lbf/in^2)
D – 138 bar (2000 lbf/in^2)
E – 172 bar (2500 lbf/in^2)
F – 207 bar (3000 psi)
G – 241 bar (3500 psi)
H – 276 bar (4000 psi)
J – 310 bar (4500 psi)
K – 345 bar (5000 psi)
L – 379 bar (5500 psi)
M – 414 bar (6000 psi)
N – 448 bar (6500 psi)

15,16 Control

0B – Shipping cover, with control feedback link
EJ – Electronic proportional control 12 volt DC without electronic driver
EK – Electronic proportional control 24 volt DC without electronic driver
FR – Forward-neutral-reverse control 12 volt DC with 2-pin weatherpack connector
FS – Forward-neutral-reverse control 24 volt DC with 2-pin weatherpack connector
HA – Hydraulic remote 1.4-14.1 bar (20-205 psi)
HB – Hydraulic remote 1.4-14.1 bar (20-205 psi) with wide band neutral
HC – Hydraulic remote 3.1-14.5 bar (45-210 psi)
HD – Hydraulic remote 4.5-20.0 bar (65-290 psi)
HF – Hydrualic remote 4.5-20.0 bar (65-290 psi) with wide band neutral
HG – Hydraulic remote 4,5-20,0 bar (65-290 lbf/in^2) with 12vdc (NC) destroke valve (non-manifold) with electrical connector (male only) per din 43650
HH – Hydraulic remote 11,0-32,4 bar (160-470 lbf/in^2)
HJ – Hydraulic remote 3.1-14.5 bar (45-210 psi) with wide band neutral
HK – Hydraulic remote 4,5-20,0 bar (65-290 lbf/in^2) with 12vdc (NC) destroke valve (non-manifold) with electrical connectors (male & female) per din 43650 for 6,0-10,0 (.24-.39) diameter cable
MA – Manual

Model Code

ACA Series 1 Variable Pump

The following 33 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Variable Displacement Pump. Use this model code to specify a pump with the desired features. All 33 digits of the code must be present to release a new product number for ordering.

ACA	39	2	03	02	L	1	A	C	C	EA	A	A	A	2	C	N	A	A	1	0	D	A	15	0	0	B
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15,16	17	18	19	20	21	22	23	24	25	26	27	28	29,30	31	32	33

MB – Manual with wide band neutral and 3/4-16UN plug in neutral lockout port

MC – Manual with wide band neutral

MD – Manual With (NC) neutral lockout switch (wide band neutral)

ME – Manual with neutral detent (wide band neutral)

MJ – Manual with destroke valve (manifold) 12vdc (NO) 3 pin weather-pack connector

MK – Manual With Neutral Detent (Wide Band Neutral) And 24Vdc (Nc) Destroke Valve (Non-Manifold) With Electrical Connectors (Male & Female) Per Din 43650 For 4,5-8,0(.18-.31) Diameter Cable

ML – Manual with (NC) neutral lockout switch (wide band neutral) and 12vdc (NC) destroke valve (non-manifold) with electrical connectors (male & female) per DIN 43650 for 4,5-8,0(.18-.31) diameter cable

MM – Manual with (NO) neutral lockout switch (wide band neutral) and destroke valve (manifold) 12vdc with 2 pin weather pack connector

MN – Manual with (NC) neutral lockout switch (wide band neutral) and destroke valve 12vdc (NO), (non-manifold), no manual override, 2 pin weath-erpack connector mounted connector down

MP – Manual with destroke valve (non-manifold) 12vdc (NO), 3 pin packard connector mounted right angle up

MS – Manual with wide band neutral and 24vdc (NC) destroke valve (non-manifold) with electrical connectors (male & female) per din 43650 for 4,5-8,0(.18-.31) diameter cable

MT – With wide band neutral and inching valve with seal

MU – Manual with wide band neutral, inching valve with seal and neutral detent

MV – With wide band neu-tral, inching valve with seal and neutral lock-out switch (NC)

MW – Manual with destroke valve (manifold) 12vdc (NO) with 2 pin weatherpack connector

MZ – Manual with (NC) neutral lockout switch (wide band neutral) with packard 2 pin connector

NA – Manual with destroke valve (manifold) 12vdc (NO) 3 pin weatherpack connector and (NC) neutral lockout switch (wide band neutral) with packard 2 pin connector

NB – Manual with destroke valve (manifold) 24vdc (NO) 2 pin weatherpack connector

NC – Manual with wide band neutral, inching valve with seal and neutral lockout switch (NC) with packard 2 pin connector

ND – Manual with destroke valve (manifold) 12vdc (NO) with 2 pin weath-erpack connector with (NC) neutral lockout switch (wide band neutral) with packard 2 pin connector

NG – Manual with (NC) neutral lockout switch (wide band neutral) and destroke valve (mani-fold) 12vdc (NC) with 2 pin weatherpack con-nector

NH – Manual with neutral detent (wide band neutral) and 12vdc (NO) destroke valve (manifold) with manual override and electrical connectors (male & female) per DIN 43650 for 4.5-8.0(.18-.31) diameter cable

NK – Manual with wide band neutral, inching valve with seal and neutral lockout switch (NO)

NR – Manual with destroke valve (manifold) 12vdc (NO) with 2 pin weath-erpack connector. no manual override. (NC) neutral lockout switch (wide band neutral) with packard 2 pin connector

NS – Manual with (NC) neutral lockout switch (wide band neutral) and destroke valve (manifold) 24vdc (NC) with 2 pin weatherpack connector

NT – Manual with (NC) neutral lockout switch (wide band neutral) and destroke valve (manifold) 12vdc (NO) with 2 pin metri-pack connector

NV – Manual with (NC) neutral lockout switch (wide band neutral) and destroke valve (manifold) 24vdc (NO) with 2 pin weatherpack connector

NW – Manual with (NC) neutral lockout switch (wide band neutral) with weatherpack (2) pin connector and destroke valve (manifold) 12vdc (NO) with 2 pin metri-pack connector

PA – Port plate, no control feedback link

RD – Remote electric with (NC) destroke valve, (3) 12vdc with (1) 2 pin and (1) 4 pin weath-erpak connectors, no displacement control, with 0,33 (.013) control supply orifice

RE – Remote electric with (NC) destroke valve, (3) 12vdc with (3) 2 pin weatherpak connec-tors, no displacement limiter, with 0,33 (.013) control supply orifice

RF – Remote electric with (nc) destroke valve including 3,58 (.141) orifice, (3) 12vdc with (3) 2 pin weatherpak connectors, no displacement limiter, with 0,33 (.013) control supply orifice

RG – Remote electric with (NC) destroke valve, (3) 24vdc with (3) 2 pin weatherpak connectors, no displacement limiter, with 0,33 (.013) control supply orifice

Model Code

ACA Series 1 Variable Pump

The following 33 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Variable Displacement Pump. Use this model code to specify a pump with the desired features. All 33 digits of the code must be present to release a new product number for ordering.

ACA	39	2	03	02	L	1	A	C	C	EA	A	A	A	2	C	N	A	A	1	0	D	A	15	0	0	B
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15,16	17	18	19	20	21	22	23	24	25	26	27	28	29,30	31	32	33

RH – Remote electric with (NC) destroke valve including 3,18 (.125) orifice, (3) 12vdc with (1) 2 pin and (1) 4 pin weatherpak connectors, no displacement limiter, with 0,33 (.013) control supply orifice

RJ – Remote electric with (NO) destroke valve including 3,58(.141) orifice, (3) 12vdc with (3) 2 pin weatherpak connectors, no displacement limiter, with 0,33 (.013) control supply orifice

RK – Remote electric with (NC) destroke valve, (3) 12vdc with wireleads, no displacement limiter, with 0,33 (.013) control supply orifice

17,18,19 Control Supply Orifice

P (pos. 17)
Upper Servo (S1 pos. 18)
Lower Servo (S2 pos. 19)

0 – None
A – 0.71 (.028) Diameter
B – 0.91 (.036) Diameter
C – 1.12 (.044) Diameter
D – 1.32 (.052) Diameter
E – 1.45 (.057) Diameter
F – 1.65 (.065) Diameter
G – 1.85 (.073) Diameter
H – 2.39 (.094) Diameter
J – 2.59 (.102) Diameter

20 Press Override

0 – None

2 – Internal Pressure Override

5 – Internal Pressure Override Externally Adjustable

21 Press Setting for Pressure Override

0 – None
1 – 196 bar (2850 lbf/in²)
D – 138 bar (2000 psi)
E – 172 bar (2500 psi)
F – 207 bar (3000 psi)
G – 241 bar (3500 psi)
H – 276 bar (4000 psi)
J – 310 bar (4500 psi)
K – 345 bar (5000 psi)
L – 379 bar (5500 psi)
M – 414 bar (6000 psi)
P – 362 bar (5250 lbf/in²)

22 Control Special Features

0 – No control special features

3 – Manual control lever with attachment holes located 66;7 (2.625) and 82;6 (3.25) and 98;4 (3.875) from control shaft mounting hole

6 – Control special features severe duty coils with boots for electronic proportional control with weather-pack connector

7 – Severe duty coils with boots for electronic proportional control

8 – Manual control lever with attachment hole located 98;4 (3.875) from control shaft mounting hole

A – No manual control lever

B – Hardened Standard Manual Control lever mounted parallel to the pump drive shaft towards the mounting flange

D – Hardened standard manual control lever

E – Manual control lever with attachment hole 71;9 (2.83) from control shaft mounting hole. lever mounted parallel to pump drive shaft towards the mounting flange

H – Manual control lever with ball stud mounted 50;8 (2.00) from control shaft mounting hole. lever mounted parallel to pump drive shaft towards mounting flange

K – Manual control lever with 10;4 (0.41) diameter attachment hole 50;8 (2.00) from control shaft mounting hole

M – Manual control lever with ball stud mounted 76;2 (3.00) from control shaft mounting hole. Lever mounted parallel to pump drive shaft towards mounting flange.

N – Manual control lever with external torsion spring mechanism for neutral return

S – Manual control lever with two 1/4-28 UNF attachment holes located at 85;7 (3.375) and 98;4 (3.875) from control shaft mounting hole. Lever mounted parallel to pump drive shaft towards mounting flange.

W – Manual control lever mounted 1 to 2 spline teeth from vertical with external torsion spring mechanism for neutral return

Y – Manual control lever with two 1/4-28 UNF attachment holes located at 85;7 (3.375) and 98;4 (3.875) from control shaft mounting hole

23 Charge Pump

0 – Charge pump included

2 – Charge pump with integral pressure filter mounted on the -A- port side

3 – Charge pump with short element integral pressure filter mounted on the -A- port side and external discharge port for 7/8-14 UNF-2B SAE O-ring fitting with steel hex plug

A – Charge pump with remote pressure filter ports on the -A- port side

B – Charge pump with integral pressure filter mounted on the -B- port side

C – Charge pump with J.Deere integral pressure filter mounted on the -B- port side. diagnostic fitting included

D – Charge pump with external discharge port for 7/8-14 UNF SAE O-ring fitting. With steel hex plug

Model Code

ACA Series 1 Variable Pump

The following 33 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Variable Displacement Pump. Use this model code to specify a pump with the desired features. All 33 digits of the code must be present to release a new product number for ordering.

ACA	39	2	03	02	L	1	A	C	C	EA	A	A	A	2	C	N	A	A	1	0	D	A	15	0	0	B
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15,16	17	18	19	20	21	22	23	24	25	26	27	28	29,30	31	32	33

E – No charge pump
F – Charge pump with external discharge port with 90 degree. 7/8-14 UNF. 37 degree flare tube fitting
G – Charge pump with integral pressure filter and diagnostic fitting mounted on the -B- port side plus inlet gage port with hex plug
H – Charge pump with remote pressure filter ports on -A- port side and inlet gage port on -B- port side
J – Charge pump with integral pressure filter and diagnostic fitting; mounted on the -B- port side and external discharge port with 90 degree; 7/8-14 UNF; 37 degree flare; tube fitting
K – Charge pump with remote pressure filter ports on the -B- port side and external discharge port with 90 degree; 7/8-14 UNF; 37 degree flare; tube fitting
L – Charge pump with integral pressure filter and diagnostic fitting; mounted on the -B- port side and external discharge port with straight; 7/8-14 UNF; 37 degree flare; tube fitting
M – Charge pump with remote pressure filter ports on the -B- port side and external discharge port with straight 7/8-14 UNF SAE O-ring to 3/4-16 UNF; 37 degree flare; tube fitting
P – Charge pump with remote pressure filter ports on the -B- port side and external discharge port with straight 7/8-14 UNF; 37 degree flare; tube fitting
R – No charge pump; with remote pressure filter ports on the -B- port side and external discharge port with 90 degree; 7/8-14 UNF; 37 degree flare; tube fitting
S – Charge pump with integral pressure filter and diagnostic fitting; mounted on the -B- port side and external discharge port for 7/8-14 UNF-2B SAE O-ring fitting; with steel hex plug
T – Charge pump with external discharge port with straight 7/8-14 UNF; 37 degree flare; tube fitting
U – Charge pump with integral pressure filter; mounted on the -B- port side and external discharge port for 7/8-14 UNF-2B SAE O-ring fitting; with steel hex plug
W – Charge pump with integral pressure filter mounted on the -A- port side and external discharge port for 7/8-14 UNF-2B SAE O-ring fitting with steel hex plug
Y – Charge pump with remote pressure filter ports on the -B- port side and external discharge port for 7/8-14 UNF-2B SAE O-ring fitting with steel hex plug
Z – Charge pump with remote pressure filter ports on the -B- port side

24 Auxiliary Mounting

0 – No auxiliary mounting
1 – SAE B-pad, no shaft seal and M12x 1.75-6H Thd
A – SAE A-pad. With shaft seal (dry)
B – SAE B-pad. With shaft seal (dry)
C – SAE A-pad. No shaft seal (wet)
E – SAE C-pad. (Typically front pump of tandem) no shaft seal. Includes 14 tooth 12/24 pitch spline coupling. Charge pressure inlet port with 7/8-14 UNF. 37 degree flare. Tube fitting (45 degree for models 33-46 and straight for models 54-64)
F – SAE B-pad; no shaft seal
G – SAE C-pad; (typically front pump of tandem) no shaft seal; Includes 21 tooth 16/32 pitch spline coupling; Charge pressure inlet port with 7/8-14 UNF; 37 degree flare; Tube fitting (45 degree for models 33-46 and straight for models 54-64)
H – SAE C-pad; (typically front pump of tandem) no shaft seal; Includes 23 tooth 16/32 pitch spline coupling; Charge pressure inlet port with 7/8-14 UNF; 37 degree flare; Tube fitting (45 degree for models 33-46 and straight for models 54-64)
L – SAE C-pad; (typically front pump of tandem) no shaft seal; Includes 14 tooth 12/24 pitch spline coupling; With 7/8-14 SAE O-ring port for charge pressure inlet (no fitting provided)(models 54-64)
N – SAE C-pad; (Typically front pump of tandem) no shaft seal; Includes 14 tooth 12/24 pitch spline coupling; Charge pressure inlet port with 45 deg 7/8-14 UNF; 37 Degree flare; Tube fitting (For models 54-64 Only)
P – SAE C-pad; (Front of tandem) No shaft seal; includes 14 tooth 12/24 Pitch spline coupling; Chg press inlet port with 7/8-14 UNF; 37 deg flare; Tube fitting (45 deg for models 33-64);Chg press gage port 7/8-14 UNF-2A capped
R – SAE A-pad With 11 tooth 16/32 pitch internal spline; No shaft seal (wet)
S – SAE C-pad; (Typically front pump of tandem) no shaft seal; Includes 14 tooth 12/24 pitch spline coupling; Charge pressure inlet port with 7/8-14 UNF; 37 Degree flare; Tube fitting (Straight for models 33-46)
U – SAE C-pad; (Typically front pump of tandem) no shaft seal; Includes 14 tooth 12/24 pitch spline coupling; Charge pressure inlet port on pump centerline with 7/8-14 UNF; 37 Deg flare; Tube fitting (45 degree for models 33-46 and straight for models 54-64)

25 Charge Pump Displacement

0 – No Charge Pump
1 – 13.9 cm^3/r (0.85 in^3/r)
2 – 17.4 cm^3/r (1.06 in^3/r)
3 – 21.0 cm^3/r (1.28 in^3/r)
4 – 27.9 cm^3/r (1.70 in^3/r)
5 – 34.7 cm^3/r (2.12 in^3/r)

26 2nd Displacement of Dual Element

0 – No Dual Element

Model Code

ACA Series 1 Variable Pump

The following 33 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Variable Displacement Pump. Use this model code to specify a pump with the desired features. All 33 digits of the code must be present to release a new product number for ordering.

ACA	39	2	03	02	L	1	A	C	C	EA	A	A	A	2	C	N	A	A	1	0	D	A	15	0	0	B
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15,16	17	18	19	20	21	22	23	24	25	26	27	28	29,30	31	32	33

27 Charge Pressure Rel Valve Setting

0 – None
D – 15 bar (220 psi) - Standard
E – 16 bar (240 lbf/in^2)
F **–** 18 bar (260 lbf/in^2)
G – 19 bar (280 psi)
H – 21 bar (300 lbf/in^2)
J – 22 bar (320 lbf/in^2)
K – 23 bar (340 psi)
L – 24 bar (350 lbf/in^2)
M – 26 bar (380 lbf/in^2)
N – 28 bar (410 lbf/in^2)

28 Charge Pump Special Features

0 – No charge pump special features
A – Steel core charge pump gasket
B – Steel core charge pump gasket and 90 degree inlet fitting; 1 5/8-12 UN threaded end for 37 degree flare tubing ((1.25) OD tubing; (1.25) ID hose)
J – Steel core charge pump gasket; needle bearing
M – Charge inlet manifold with charge relief valve
N – Steel core charge pump gasket and charge inlet mainifold with charge relief valve
P – Charge inlet manifold with external discharge port for 7/8-14 unf sae o-ring port and steel hex plug in inlet port

29,30 Special Pump Assembly Features

00 – No special features
05 – Bottom servo piston with 0.0 degree stop
11 – Both servo sleeves have 1/2-20 UNF-2B thread and steel hex bolts
12 – Bottom servo sleeve has 7/8-14 UNF SAE O-ring port with hex steel plug
13 – Model 76 shaft seal and grade 8 bolts in mounting flange to pump housing (models 54-64)
14 – Special thick section end cover gasket
15 – Rear pump unit for tandem pump assembly (no shaft seal)
18 – Hi-Speed rotating group (model 76)
32 – Both servo sleeves have 7/8-14 UNF SAE O-Ring ports and steel hex plugs
39 – Bottom servo piston with externally adjustable stop
40 – Both servo pistons with externally adjustable stops
53 – Model 76 shaft seal
58 – 1350 Series end yoke assembled to drive shaft (Pos 8,9 must be Code 40)
59 – 1310 Series end yoke assembled to drive shaft (Pos 8,9 must be Code 40)
67 – Metal case drain plug in both ports
79 – Rear pump unit for tandem pump assembly (no shaft seal), both servo pistons with externally adjustable stops
82 – Rear pump unit for tandem assembly (no shaft seal), top servo piston with externally adjustable stop
83 – Externally adjustable displacement stops set at 3.32 in^3/rev (54.4cc/rev)

31 Paint and Packaging

0 – Painted primer blue (standard)
A – Painted finish black

32 Identification on Unit

0 – Standard

33 Design Code

A – A
B – B

Model Code

HHD Fixed Motor

The following 23 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Fixed Displacement Motor. Use this model code to specify a motor with the desired features. All 23-digits of the code must be present to release a new product number for ordering.

HHD	39	3	0	01	A	A	0	0	0	0	0	0	0	00	0	0	B
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15	16	17	18	19,20	21	22	23

1, 2, 3 Pump Series

HHD – Heavy Duty Hydrostatic Fixed Displacement Motor

4,5 Displacement

33 – 54 cm^3/r (3.3 in^3/r) at 15.5 deg. swashplate angle
39 – 64 cm^3/r (3.9 in^3/r) at 18 deg. swashplate angle
46 – 75 cm^3/r (4.6 in^3/r) at 18 deg. swashplate angle
54 – 89 cm^3/r (5.4 in^3/r) at 18 deg. swashplate angle
64 – 105 cm^3/r (6.4 in^3/r) at 18 deg. swashplate angle
76 – 125 cm^3/r (7.6 in^3/r) at 18 deg. swashplate angle

6 Type

3 – Fixed displacement motor

7 Design Type

0 – Ball-guide - (model 76)
3 – Bixed clearance - (models 39-64)

8, 9 Input Shaft

01 – (1.50) Diameter straight with (.38) x (2.5) square key (models 39-64)
02 – (1.75) Diameter straight with (.44) x (3.0) square key (model 76)
06 – (1.50) Diameter straight with (.38 x (2.5) square key with 3/8-24 UNF x (.75) DP hole in end of shaft (models 39-64)
07 – (1.75) Diameter straight with (.44) x (3.0) square key with 3/8-24 UNF x (.75) dp hole in end of shaft (model 76)
13 – 13 Tooth 8/16 pitch spline (model 76)
14 – 14 Tooth 12/24 pitch spline (models 39-64)
21 – 21 Tooth 16/32 pitch spline (models 39-64)
23 – 23 Tooth 16/32 pitch spline (models 39-64)
24 – 23 Tooth 16/32 pitch spline with (1.92) extension (models 39-64)
25 – 23 Tooth 16/32 pitch spline with 3/8-24 UNF x (.75) DP hole in end of shaft (models 39-64)
27 – 27 Tooth 16/32 pitch spline (model 76)
29 – 14 Tooth 12/24 pitch spline with 3/8-24 UNF x (.75) DP hole in end of shaft (models 39-64)
30 – 21 Tooth 16/32 pitch spline with 3/8-24 UNF x (.75) DP hole in end of shaft (models 39-64)
31 – 17 Tooth 12/24 pitch spline with (2.54) extension (model 76)
32 – (1.50) Diameter tapered with (.38) x (1.00) square key (models 39-64)
33 – 21 Tooth 16/32 pitch spline with M10 x 1.5 threaded hole (models 39-64)
34 – (1.38) Diameter tapered with (.38) x (1.00) square key (models 39-64)
35 – 14 Tooth 12/24 pitch spline (models 39-64) shot peened shaft
37 – 13 Tooth 8/16 pitch spline with (2.93) extension and for 76 seal (models 54-64)
38 – (1.75) Diameter tapered with (.44) x (1.00) square key (model 76)
39 – (1.75) diameter straight with (.38) x (2.00) square key with (2.22) extension (model 39-64 with 76 seal)
41 – 27 tooth 16/32 pitch spline with 2.19 extension and for 76 seal (models 39-64)

10 Main Ports

A – (1.00) SAE 4-bolt split flange port, standard pressure series (code 61)
B – (1.00) SAE 4-bolt split flange port, high pressure series (code 62)
C – 1 5/16-12 UN-2B SAE O-ring port
F – (1.00) SAE 4-bolt split flange port, standard pressure series (code 61) with (2) gauge/pilot pressure ports for .4375-20 UNF-2B SAE O-ring fittings
G – (1.00) SAE 4-bolt split flange port, high pressure series (code 62) with (2) gauge/pilot pressure ports for .4375-20 UNF-2b SAE O-ring fittings
J – Rear ports - (1.00) SAE 4-bolt split flange port, standard pressure series (code 61)
K – Rear ports - (1.00) SAE 4-bolt split flange port, high pressure series (code 62) with diagnostic fittings per SAE J1502 (U.S. units)

11 End Cover and Composite Valve Block Assy

A – Standard end cover, composite valve block with high-rate shuttle valve springs
B – Standard end cover, composite valve block with low-rate shuttle valve springs
C – No composite valve block - with cover plate
D – No composite valve block
G – Integral shuttle valve with low-rate shuttle valve springs and charge pressure relief valve
H – Integral shuttle valve with high-rate shuttle valve springs and charge pressure relief valve
J – Composite valve block without charge pressure relief valve or shuttle valve, but with high pressure relief valves
K – Integral shuttle valve and low pressure relief valve not included - rear ports
N – Integral shuttle valve with low-rate shuttle valve springs and charge pressure relief valve, valve block with high pressure relief valve on side -A- only
P – Standard end cover, shuttle valve block with high-rate shuttle valve springs
R – Integral shuttle valve and low press relief valve not included, removable orifice (.073), rear ports
S – Integral shuttle valve with high-rate shuttle valve springs and charge pressure relief valve, valve block with high pressure relief valves with threaded retainer
T – Composite valve block without charge pressure relief valve or shuttle valve, but with high pressure relief valve with threaded retainer on side -A- only
U – standard end cover, shuttle valve block with low-rate shuttle valve springs

12 Charge Pressure Relief Valve

0 – No relief valve
1 – Standard
2 – Orificed charge pressure relief valve (for composite valve blocks only)
3 – Plugged, no relief valve function

Model Code

HHD Fixed Motor

The following 23 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Fixed Displacement Motor. Use this model code to specify a motor with the desired features. All 23-digits of the code must be present to release a new product number for ordering.

HHD	39	3	0	01	A	A	0	0	0	0	0	0	0	00	0	0	B
1, 2 ,3	4, 5	6	7	8, 9	10	11	12	13	14	15	16	17	18	19,20	21	22	23

13 Charge Pressure Relief Valve Setting

0 – none
B – 11,0 bar (160 lbf/in^2)
C – 12,4 bar (180 lbf/in^2)
D – 13,8 bar (200 lbf/in^2)
E – 15,2 bar (220 lbf/in^2)
F – 16,6 bar (240 lbf/in^2)
G – 17,9 bar (260 lbf/in^2)
H – 19,3 bar (280 lbf/in^2)
J – 20,7 bar (300 lbf/in^2)
K – 24,0 bar (350 lbf/in^2)
L – 22,5 bar (326.6 lbf/in^2)

14,16 High Pressure Relief Valve –
Port A (Pos. 14)
Port B (Pos. 16)

0 – None
1 – Standard
2 – Remote pilot operated relief valve
3 – Standard with threaded retainer
4 – Remote pilot operated relief valve with threaded retainer
7 – Remote pilot operated relief valve with o-ring face seal fitting
8 – Remote pilot operated relief valve with threaded retainer, special orifice and spring, with o-ring face seal fitting
9 – Anti-cavitation check valve

15,17 High Pressure Relief Valve Setting –
Port A (Pos. 15)
Port B (Pos. 17)

0 – None
1 – 11 bar (160 lbf/in^2)
2 – 12,4 bar (180 lbf/in^2)
3 – 13,8 bar (200 lbf/in^2)
4 – 15,2 bar (220 lbf/in^2)
5 – 16,6 bar (240 lbf/in^2)
6 – 17,9 bar (260 lbf/in^2)
7 – 19,3 bar (280 lbf/in^2)
8 – 28,3 bar (410 lbf/in^2)
C – 103 bar (1500 lbf/in^2)
D – 138 bar (2000 lbf/in^2)
E – 172 bar (2500 lbf/in^2)
F – 207 bar (3000 lbf/in^2)
G – 241 bar (3500 lbf/in^2)
H – 276 bar (4000 lbf/in^2)
J – 310 bar (4500 lbf/in^2)
K – 345 bar (5000 lbf/in^2)
L – 379 bar (5500 lbf/in^2)
M – 414 bar (6000 lbf/in^2)
N – 448 bar (6500 lbf/in^2)
P – 483 bar (7000 lbf/in^2)
Q – 155 bar (2250 lbf/in^2)
R – 362 bar (5250 lbf/in^2)
S – 466 bar (6750 lbf/in^2)
T – 359 bar (5200 lbf/in^2)
U – 366 bar (5300 lbf/in^2)
V – 400 bar (5800 lbf/in^2)
W – 431 bar (6250 lbf/in^2)

18 Speed Sensor

0 – No speed sensor
A – Magnetic sensor with 2 wire weather pack connector
B – Digital sensor with 3 wire weather pack connector
C – Speed sensor hole (5/8-18 UNF thread) plugged (for digital or magnetic sensor)
D – Quadrature speed sensor with 4 wire weather pack connector (one 24 pulse per rev speed signal and one directional signal)
E – Quadrature speed sensor with 4 wire weather pack connector (two 12 pulse per rev speed signal in quadrature)
F – Speed sensor hole (9/16-32 UN thread) plugged (for quadrature sensor)

19,20 Special Features

00 – No special features
03 – Bypass valve-spool stem is on the opposite side from the low pressure relief valve in the composite valve block
04 – Int hex case drain plug in motor housing
05 – Case drain plug located opposite the swashplate dowel plug
22 – Nametag opposite dowel
23 – High speed rotating group
26 – Lightweight pistons and nametag opposite dowel
31 – Lightweight pistons
32 – Metal case drain plug in both ports
33 – Nametag opposite dowel and bar code label
34 – Shot peened barrel splines
35 – Metal case drain plug in both ports, shot peened barrel splines, SAE mounting flange tapped with 5/8-18 UNF-2B threads
36 – Bar code label on unit and one on packaging
37 – Lightweight pistons and nametag opposite dowel and bar code label
39 – Lightweight pistons - nametag and case drain plug located opposite the swashplate dowel plug

21 Paint and Packaging

0 – Painted primer blue (standard)
J – Rust preventative spray

22 Identification on Unit

0 – Standard

23 Design Code

A – A
B – B

Model Code

ACE Variable Motor

The following 23 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Variable Displacement Motor. Use this model code to specify a motor with the desired features. All 29-digits of the code must be present to release a new product number for ordering.

ACE	39	4	0	01	A	A	A	0	0	0	0	0	0	EA	0	0	0	0	00	B	0	A
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15	16	17	18	19, 20	21	22	23	24	25, 26	27	28	29

1, 2, 3 Pump series

ACE – Heavy Duty HydroStatic Variable Displacement Motor

4,5 Displacement

39 – 64 cm^3/r (3.9 in^3/r)
46 – 75 cm^3/r (4.6 in^3/r)
54 – 89 cm^3/r (5.4 in^3/r)
64 – 105 cm^3/r (6.4 in^3/r)
76 – 125 cm^3/r (7.6 in^3/r)

6 Type

4 – Variable displacement motor

7 Design Type

0 – Ball-guide (model 76)
1 – Series 1 (models 39-64)
3 – Series 1 (models 39-64)

8, 9 Output Shaft

01 – (1.500) Diameter straight with (.3750) x (2.5) square key (models 33-64)
02 – (1.750) Diameter straight with (.4375) x (3.0) square key (model 76)
13 – 13 Tooth 8/16 pitch spline (model 76)
14 – 14 Tooth 12/24 pitch spline (models 39-64)
19 – 19 Tooth 16/32 pitch spline (models 39-64)
21 – 21 Tooth 16/32 pitch spline (models 39-64)
23 – 23 Tooth 16/32 pitch spline (models 39-64)
27 – 27 Tooth 16/32 pitch spline (model 76)
28 – 27 Tooth 16/32 pitch spline for 76 seal with (2.19) extension (model 54)
30 – 13 Tooth 8/16 pitch spline for 76 seal with (2.93) extension (model 64)
31 – (1.750) Diameter tapered with (.4375) x (1.00) square key (model 76)

10 Minimum Swashplate Angle

A – 18 degrees
B – 17 degrees
C – 16 degrees
D – 15 degrees
E – 14 degrees
F – 13 degrees
G – 12 degrees
H – 11 degrees
J – 10 degrees
K – 9 degrees
L – 8 degrees
M – 7 degrees
N – 6 degrees
P – 5 degrees
Q – 4 degrees
R – 3 degrees
S – 2 degrees
T – 1 degrees
U – 0 degrees

11 Main Ports

A – (1.00) SAE 4-bolt split flange port, standard pressure series (code 61)
B – (1.00) SAE 4-bolt split flange port, high pressure series (code 62)
D – (1.00) SAE 4-bolt split flange port, standard pressure series (code 61) with A and B gauge ports
E – (1.00) SAE 4-bolt split flange port, high pressure series (code 62) with a and B gauge ports

12 End Cover and Composite Valve Block Assy

A – Standard end cover, composite valve block with high-rate shuttle valve springs
B – Standard end cover, composite valve block with low-rate shuttle valve springs
C – No composite valve block - with cover plate
D – No composite valve block
J – High pressure relief valves only - no shuttle or charge pressure relief valves
L – Standard end cover, composite valve block with high-rate shuttle valve springs, remote pilot operated relief valves with O-ring face seal fittings, and O-ring face seal fittings opposite remote pilot operated relief valves
M – Standard end cover, shuttle valve block with high-rate shuttle valve springs
N – Standard end cover, shuttle valve block with low-rate shuttle valve springs

13 Charge Press Relief Valve – Composite Valve Block

0 – No relief valve
1 – Standard
2 – Orificed charge pressure relief valve

14 Charge Pressure Relief

0 – None
B – 11 bar (160 lbf/in^2) - standard
C – 12,4 bar (180 lbf/in^2)
D – 13,8 bar (200 lbf/in^2)
E – 15,2 bar (220 lbf/in^2)
F – 16,6 bar (240 lbf/in^2)
G – 17,9 bar (260 lbf/in^2)
H – 19,3 bar (280 lbf/in^2)
J – 20,7 bar (300 lbf/in^2)

15,17 Composite Valve Block High Pressure Relief Valve –
Port A (Pos. 15)
Port B (Pos. 17)

0 – None
1 – Standard
2 – Remote pilot operated relief valve
3 – Standard with threaded retainer
4 – Remote pilot operated relief valve with threaded retainer
7 – Remote pilot operated relief valve with O-ring face seal fitting
8 – Remote pilot operated relief valve with threaded retainer, special orifice and spring, with O-ring face seal fitting

Model Code

ACE Variable Motor

The following 23 digit coding system has been developed to identify standard configuration options for the Series 1 Hydrostatic Variable Displacement Motor. Use this model code to specify a motor with the desired features. All 29-digits of the code must be present to release a new product number for ordering.

ACE	39	4	0	01	A	A	A	0	0	0	0	0	0	EA	0	0	0	0	00	B	0	A
1, 2, 3	4, 5	6	7	8, 9	10	11	12	13	14	15	16	17	18	19, 20	21	22	23	24	25, 26	27	28	29

16,18 High Pressure Relief Valve Setting – Port A (Pos. 16) Port B (Pos. 18)

0 – None
1 – 11,0 bar (160 lbf/in^2)
2 – 12,4 bar (180 lbf/in^2)
3 – 13,8 bar (200 lbf/in^2)
4 – 15,2 bar (220 lbf/in^2)
5 – 16,6 bar (240 lbf/in^2)
6 – 17,9 bar (260 lbf/in^2)
7 – 19,3 bar (280 lbf/in^2)
C – 103 bar (1500 lbf/in^2)
D – 138 bar (2000 lbf/in^2)
E – 172 bar (2500 lbf/in^2)
F – 207 bar (3000 lbf/in^2)
G – 241 bar (3500 lbf/in^2)
H – 276 bar (4000 lbf/in^2)
J – 310 bar (4500 lbf/in^2)
K – 345 bar (5000 lbf/in^2)
L – 379 bar (5500 lbf/in^2)
M – 414 bar (6000 lbf/in^2)
N – 448 bar (6500 lbf/in^2)
P – 483 bar (7000 lbf/in^2)
Q – 155 bar (2250 lbf/in^2)
R – 362 bar (5250 lbf/in^2)
S – 465 bar (6750 lbf/in^2)
T – 359 bar (5200 lbf/in^2)
U – 365 bar (5300 lbf/in^2)
V – 400 bar (5800 lbf/in^2)

19,20 Control

0A – Shipping plate without control link
HA – Hydraulic remote with pump linkage 4,5-20,0 bar (65-290 lbf/in^2)
HB – Hydraulic remote 4,5-20,0 bar (65-290 lbf/in^2)
HC – Hydraulic remote 11,0-32,4 bar (160-470 lbf/in^2)
HD – Hydraulic remote 1,4-14,1 bar (20-205 lbf/in^2)
MA – Manual
PA – Port plate
RA – Pressure response with stroking valve 12 vdc (NC) with 2 pin amp connector
RB – Pressure response
RC – Pressure response with stroking valve 24 vdc (NC) with wire leads
RD – Pressure response with stroking valve 12 vdc (NC) with 2 pin amp connector - special 90 deg diagnostic fitting assembly
RE – Pressure response with stroking valve 12 vdc (NC) - solenoid coil with diode, 2 pin metripak connector - special 90 deg diagnostic fitting assembly
RG – Pressure response with stroking valve 24 vdc (NC) with wire leads and 9/16-18 fittings and hoses
SA – Stroking valve 12 vdc (NC) with 2 pin cannon sure-seal connector
SB – Stroking valve 24 vdc (NC) with wire leads
SC – stroking valve 12 vdc (NC) with 2 pin weath-ersd stroking valve 12 vdc (NC) with 2 pin weatherpack connector (shroud)
SE – Stroking valve 12 vdc (no) with 2 pin dt04-2p connector

21 Control Orifice

0 – None
A – 0,71 (.028) diameter
B – 0,91 (.036) diameter
C – 1,12 (.044) diameter
D – 1,32 (.052) diameter
E – 1,45 (.057) diameter
F – 1,65 (.065) diameter
G – 1,85 (.073) diameter
H – 2,39 (.094) diameter
J – 2,59 (.102) diameter

22 Press Setting for Pressure Response

0 – None
B – 69 bar (1000 lbf/in^2)
C – 103 bar (1500 lbf/in^2)
D – 138 bar (2000 lbf/in^2)
E – 172 bar (2500 lbf/in^2)
F – 207 bar (3000 lbf/in^2)
G – 241 bar (3500 lbf/in^2)
H – 276 bar (4000 lbf/in^2)
J – 310 bar (4500 lbf/in^2)
K – 345 bar (5000 lbf/in^2)
M – 414 bar (6000 lbf/in^2)
V – 250 bar (3625 lbf/in^2)
W – 228 bar (3300 lbf/in^2)

23 Control Special Features

0 – No special features

24 Speed Sensor

0 – No speed sensor
A – Magnetic speed sensor with 2-wire weather pack connector
B – Digital speed sensor with 3-wire weather pack connector
C – Quadrature speed sensor with 4 wire weather pack connector (one 24 pulse per rev speed signal and one directional signal)

25,26 Displacement

00 – No special features
03 – Externally adjustable servo piston stop - top servo sleeve
06 – Bypass valve - spool stem is on the opposite side from the low pressure relief valve in the composite valve block
08 – Model 76 seal in model 54 with grade 8 mounting flange assembly bolts
22 – High speed rotating group
23 – High speed rotating group and externally adjustable servo piston stop - top servo sleeve
24 – High speed rotating group and plug in top case drain port
25 – Model 76 seal in model 64
27 – Externally adjustable servo piston stops - top and bottom servo sleeves
30 – Bypass valve - spool stem is on the opposite side from the low pressure relief valve in the composite valve block, and charge pressure gauge port with internal hex plug

27 Paint and Packaging

B – Painted primer blue (standard)
J – Rust preventative spray

28 Identification

0 – Standard

29 Identification

A – A
B – B

Pump Performance

Model		39	46	54	64	76
Displacement	in³/rev	3.89	4.60	5.44	6.44	7.62
	cm³/rev	63,7	75,3	89,1	105,5	124,8
Maximum Shaft	rpm	4160	4160	3720	3720	2775
Speed†	@ 18°					
Nominal Pressure*	psi	6000	6000	6000	6000	6000
	(bar)	(420)	(420)	(420)	(420)	(420)
Peak Pressure**	psi	7000	7000	7000	7000	7000
	(bar)	(480)	(480)	(480)	(480)	(480)
Output Flow	gpm @	67.3	79.2	84.1	99.1	87.9
	3500 psi					
	lpm @	255	300	318	375	333
	241 bar					
Input Torque	lb-in @	2346	2786	3285	3900	4552
	3500 psi					
	Nm @	265	315	371	441	514
	241 bar					

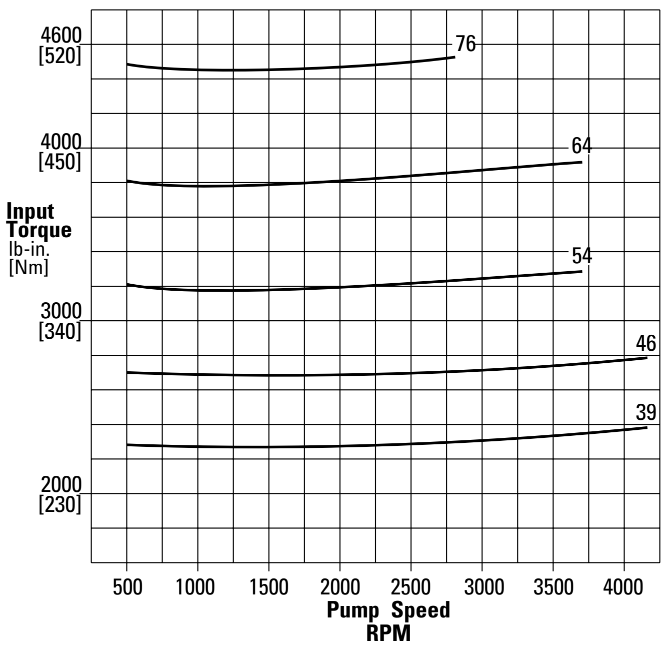
Pump performance calculated at 96% efficiency.

† The maximum pump shaft speed may be limited by the charge pump speed rating.

* Nominal Pressure: Max delta system pressure at which component fatigue does not occur (pump life estimated by bearing life).

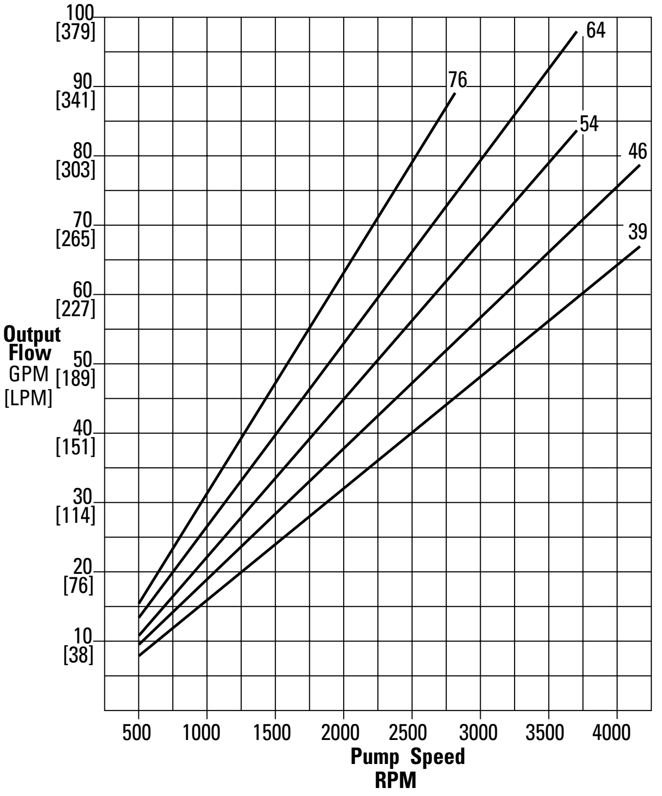
** Peak Pressure: Max operation pressure which is permissible for a short duration of time (t < 1 sec).

Input Torque vs Speed



System Pressure........... 3500 psi (240 bar)
Charge Pressure .... 220 psi (15 bar)
Oil Viscosity .... 60 SUS
Temperature .... 180°F (82°C)

Output Flow vs Speed



Performance – Motor

Motor Performance

Model		39	46	54	64	76
Displacement	in³/rev	3.89	4.60	5.44	6.44	7.62
	cm³/rev	63,7	75,3	89,1	105,5	124,8
Nominal Pressure*	psi	6000	6000	6000	6000	6000
	(bar)	(420)	(420)	(420)	(420)	(420)
Peak Pressure**	psi	7000	7000	7000	7000	7000
	(bar)	(480)	(480)	(480)	(480)	(480)
Maximum	rpm @ 18°	4160	4160	3720	3720	2775
Shaft Speed	rpm @ 10°	5380˜	5380˜	4810˜	4810˜	3425˜
Maximum	lb-in	3511	4149	4916	5807	6911
Output Torque†	Nm	397	469	556	656	781

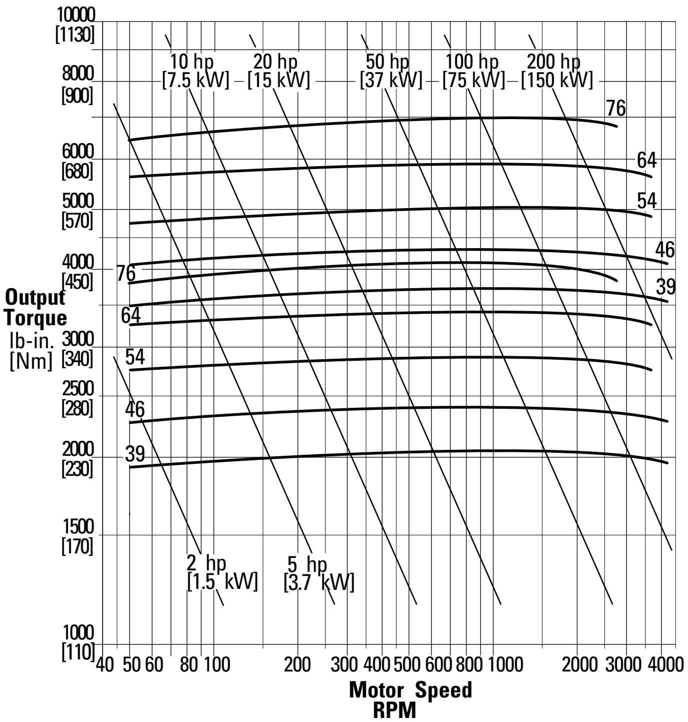
˜ These shaft speeds require maximum charge pressure relief: 340 psi (23 bar) pump and 280 psi (19 bar) motor.

† Maximum output torque is measured at 6000 psi (415 bar).

* Nominal Pressure: Max delta system pressure at which component fatigue does not occur (pump life estimated by bearing life).

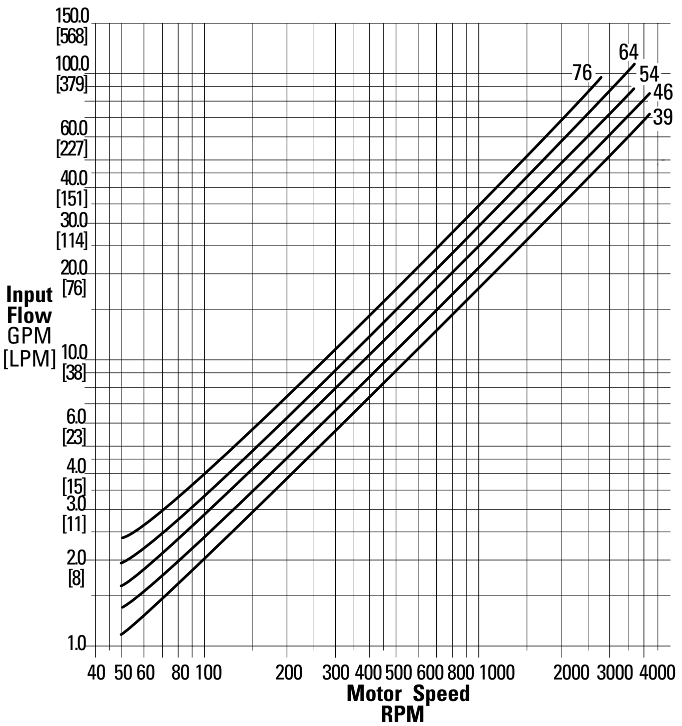
** Peak Pressure: Max operation pressure which is permissible for a short duration of time (t < 1 sec).

Output Torque vs Speed



at 3500 psi [240 bar] —— —— at 6000 psi [415 bar]

Input Flow vs Speed



System Pressure........... 3500 psi (240 bar)
Charge Pressure .... 220 psi (15 bar)
Oil Viscosity .... 60 SUS
Temperature .... 180° F (82° C)

Note: Operating the motor below 50 rpm is not recommended for best performance.

Charge Pump Performance

Eaton offers a choice of four charge pump displacements to go with their heavy duty transmission line: .85, 1.28, 1.70, and 2.12 in³/rev (13,9; 21,0; 27,8; 34,7 cm³/rev).

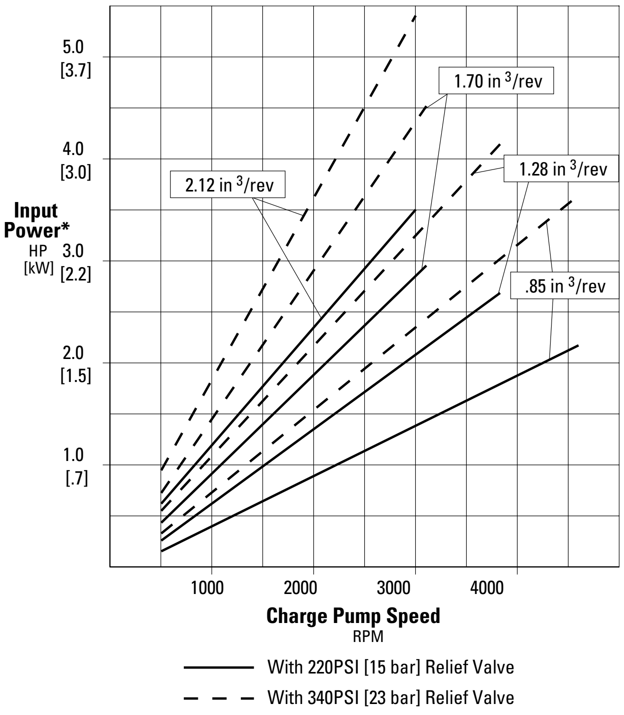
These charge pumps are available with one or more of the following options:

- a pressure sensing port
- remote pressure side filter ports
- a spin-on pressure side filter
- mounting flanges for auxiliary pumps

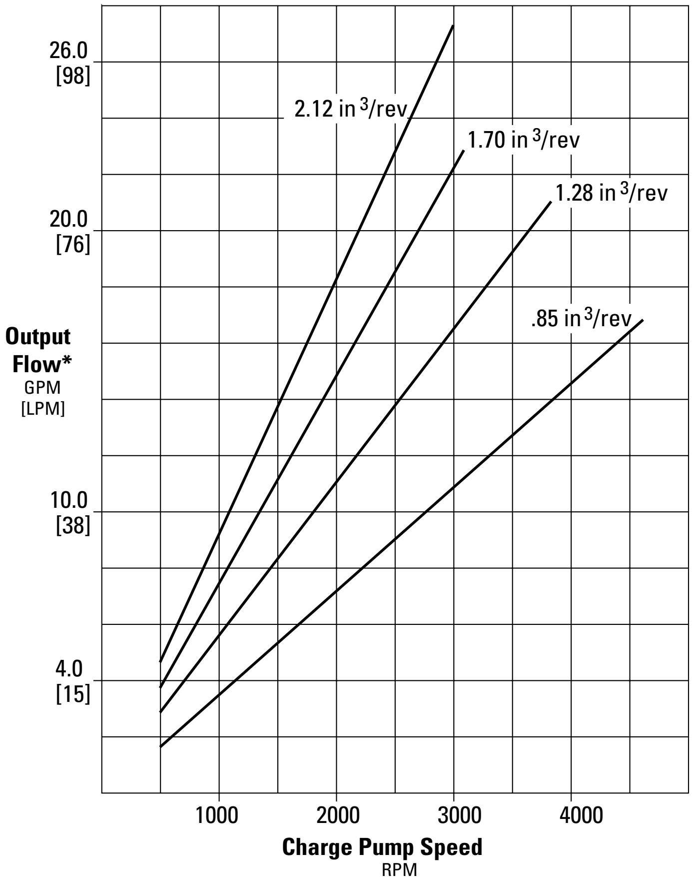
Displacement	in³/rev	.85	1.28	1.70	2.12
	cm³/rev	13,9	21,0	27,9	34,7
Maximum Shaft Speed	rpm	4600	3800	3100	3000
Output Flow @	gpm	16.9	21.0	22.8	27.5
Maximum Speed*	lpm	64,0	79,5	86,3	104,2
Input Power @ 220 psi	hp	2.17	2.70	2.93	3.54
(15 bar) and Maximum Speed*	kW	1,62	2,01	2,18	2,64

*Theoretical Values

Charge Pump Power vs Speed

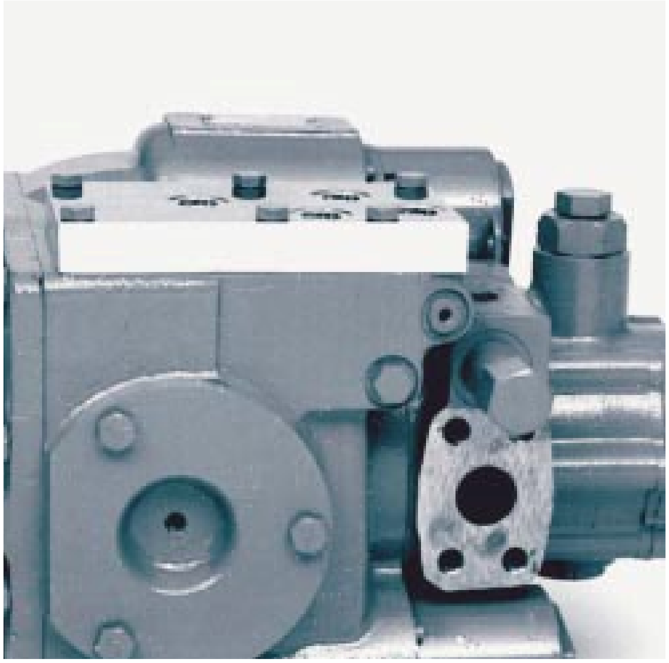


Charge Pump Flow vs Speed



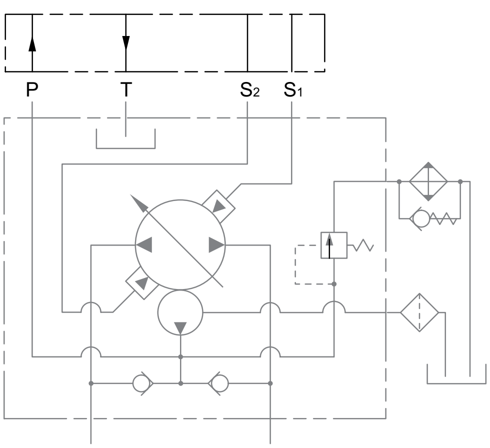
Oil Viscosity . . . . 60 SUS
Temperature . . . . 180°F (82°C)
* Theoretical Values

Port Plate

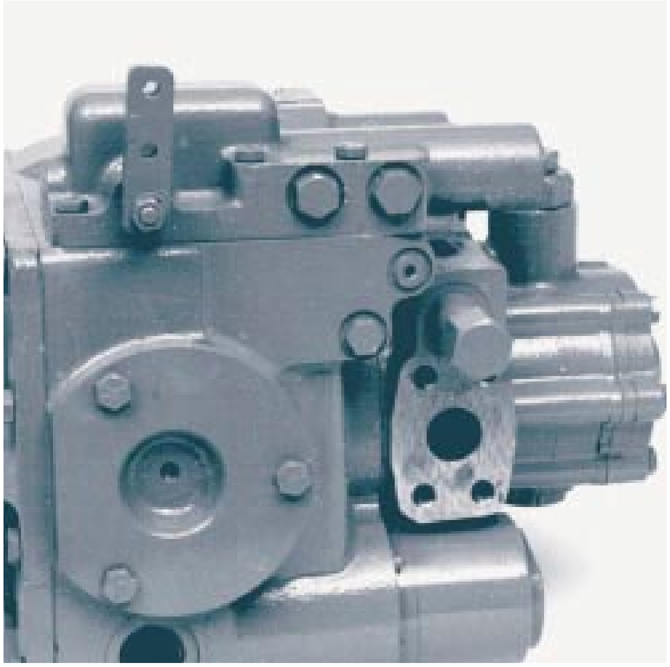


The port plate is the simplest control option available. It fits all Eaton heavy duty pumps and motors.

The port plate is commonly used as a slave control that receives commands from other controls in the same system.

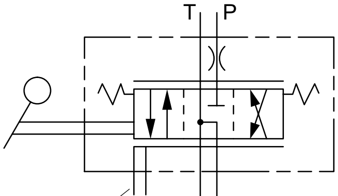


Standard Variable Manual Pump Control



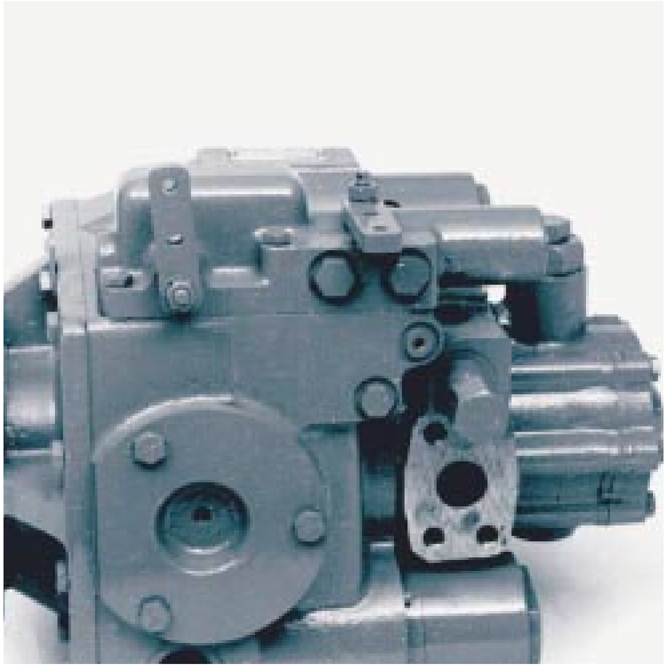
The standard variable pump control is the most common type of control used on heavy duty hydrostatic variable displacement pumps. It is normally actuated by direct mechanical linkages or cables.

A wide band neutral zone controller is available. It expands the center lever position where the pump output is zero flow.

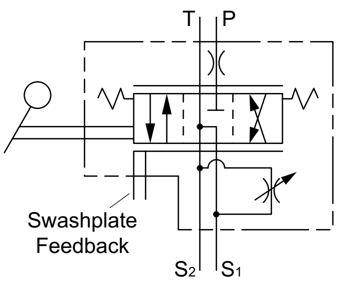


Control Options – Pump

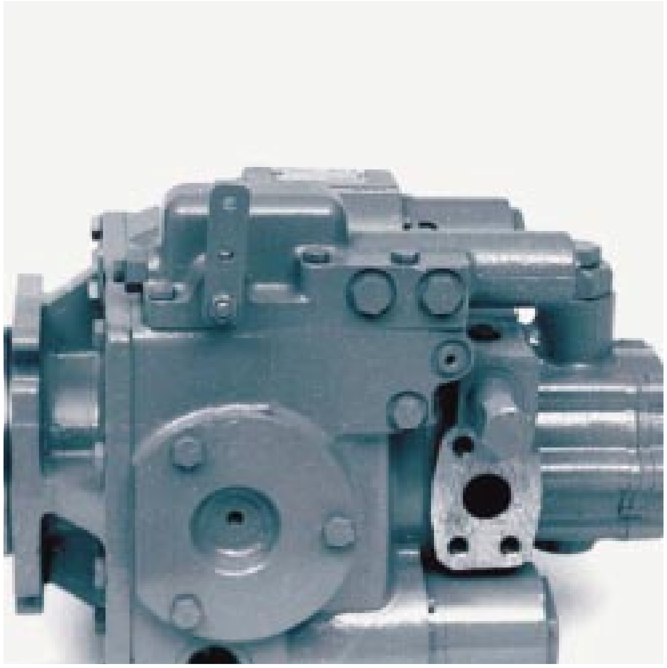
Standard Control with Inching Valve



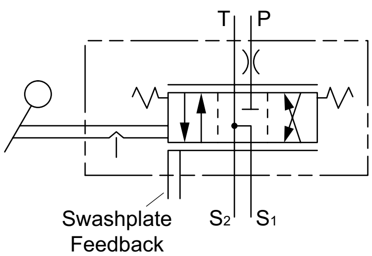
The inching valve is an option that is used in conjunction with the standard variable pump control. This control option would typically be used on a vehicle propel transmission. When the inching valve is operated with a foot pedal it functions like a clutch. A metering orifice in the inching valve's rotary spool cross ports the servo pressure lines providing the operator with smooth acceleration and deceleration.



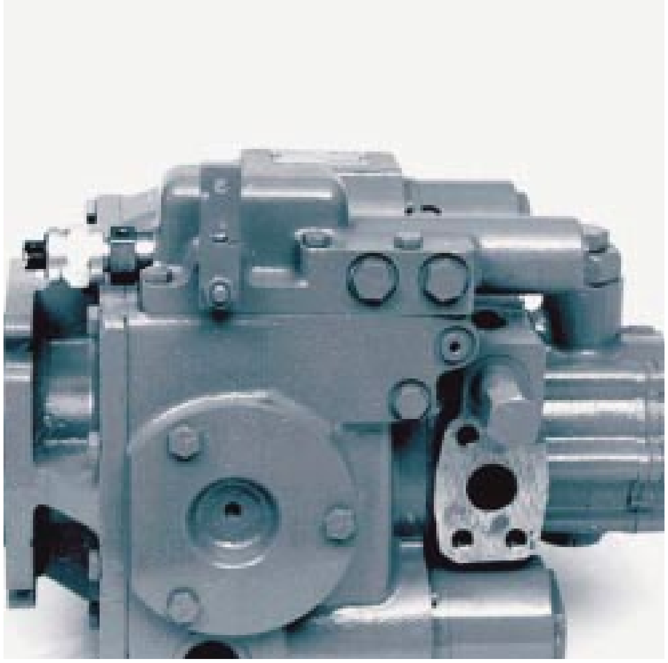
Standard Control with Neutral Detent



The neutral detent feature on the standard control valve provides a more positive feel when finding neutral. This control is a good choice for transmissions that have long control linkages or cables with varying amounts of free play.

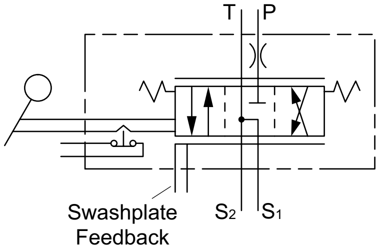


Standard Control with Neutral Lock-out

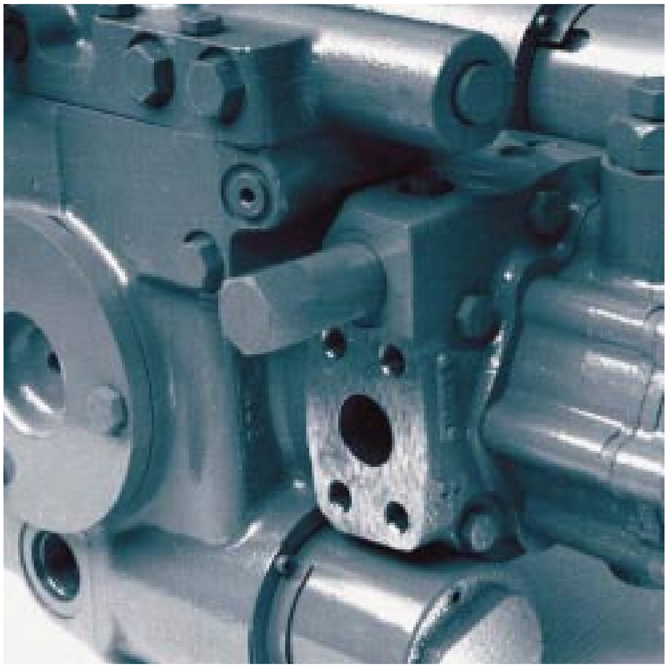


The neutral lock-out feature is an electrical switch that is closed when the transmission is in neutral. This switch can be used to prevent the activation of certain functions that require the pump to be in neutral.

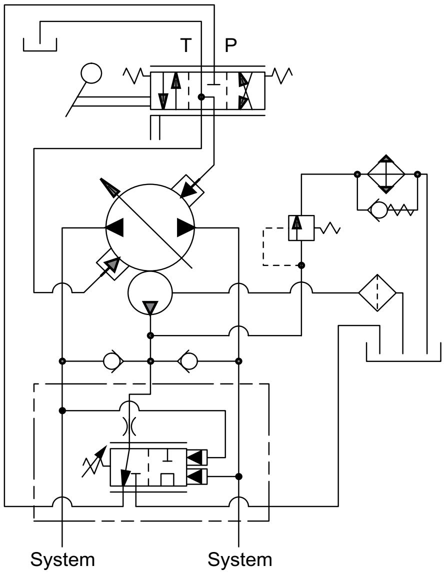
The lock-out feature is commonly used to prevent starting the prime mover or activating auxiliary functions. The electrical switch is available as normally open or normally closed.



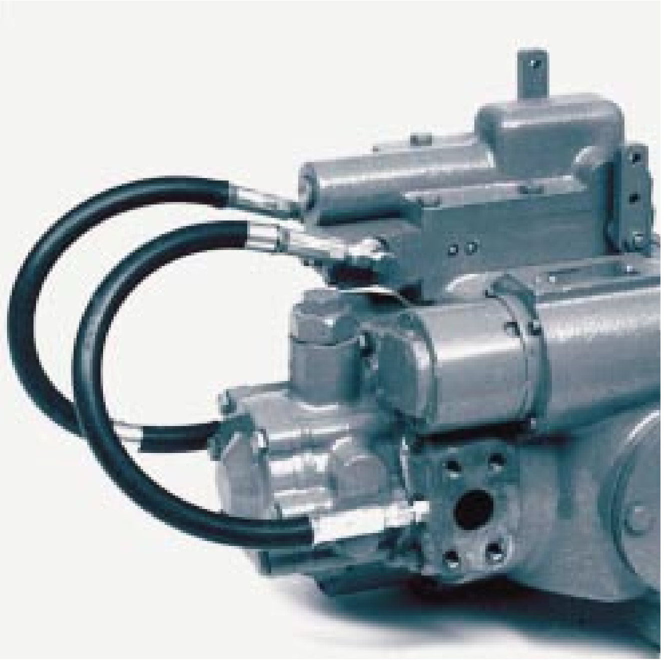
Internal Pressure Override Control (IPOR)



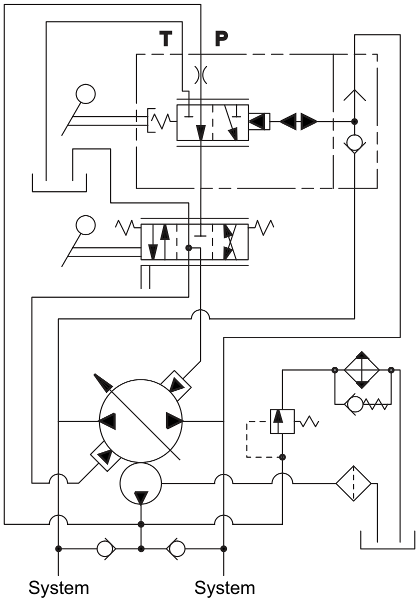
The internal pressure override (IPOR) protects the transmission from running at overload conditions for extended periods. It senses system pressure and allows the pump to destroke if pressures exceed a preset limit. The override pressure setting is shim adjustable. Since the IPOR is built into the pump end cover it is not a field conversion option.



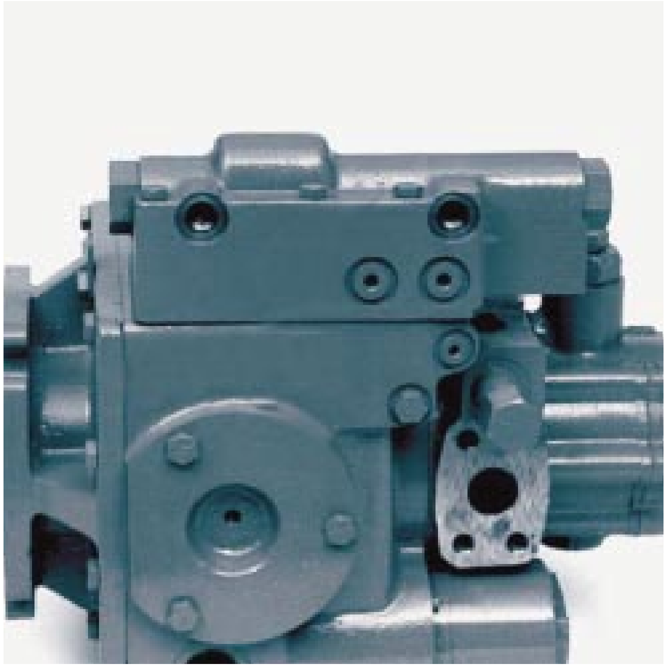
Remote Pressure Override



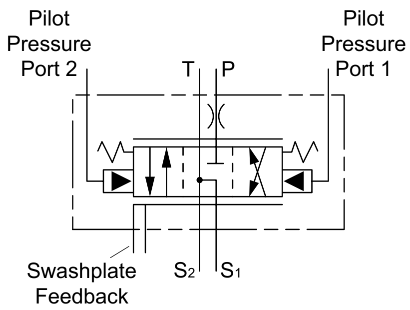
The remote pressure override control provides a means to remotely adjust the pressure setting of the pressure override valve. This control may be used in applications requiring variable system pressure protection to prevent overloads and excessive heat generation. This valve operates similarly to the IPOR control.



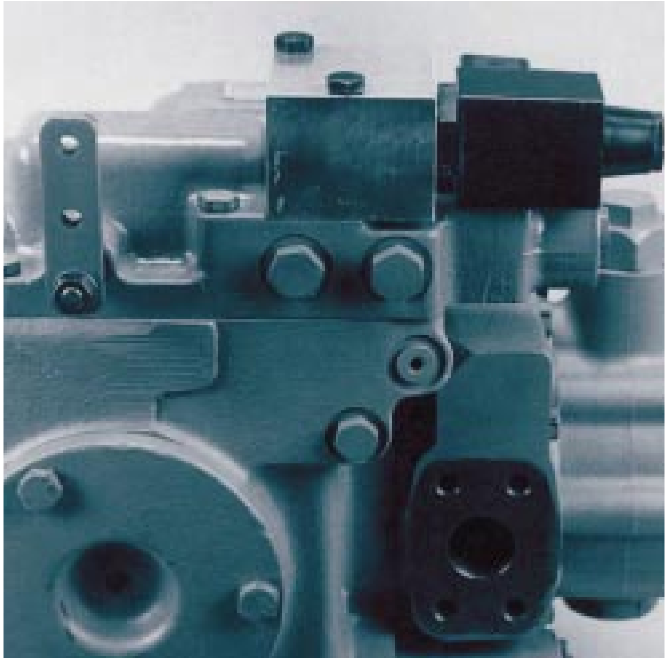
Hydraulic Remote Control Pump Control



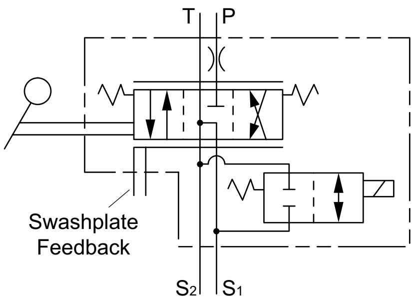
The hydraulic remote control uses a remote pilot pressure signal to move the control spool. This control can be used where cables or mechanical linkages are not feasible.



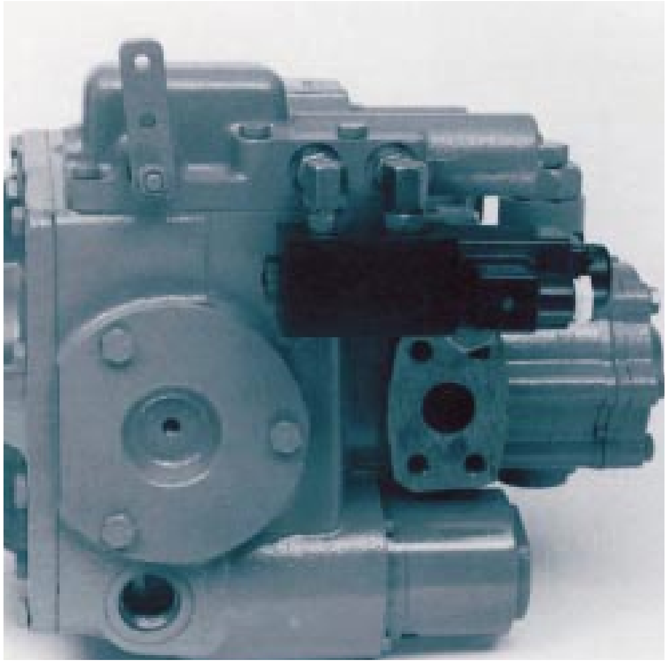
Destroke Control



The heavy duty Destroke Control is a solenoid valve mounted on the standard variable pump control. When energized, the valve cross-ports control pressure allowing centering springs to bring the pump out of stroke. It can be energized with a single switch, push-button, or dead man's switch. The solenoid coil is available in 12 volt or 24 volt DC and normally open and normally closed configurations.



Destroke Solenoid

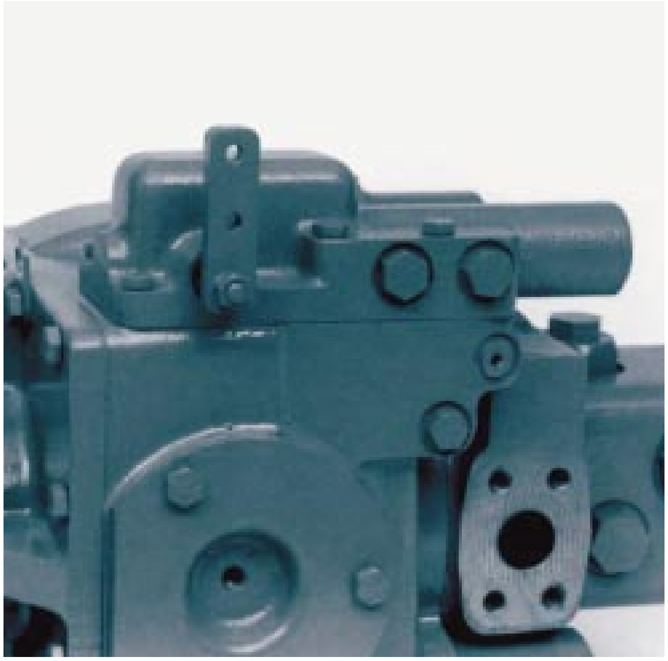


The heavy duty Destroke Solenoid is available to field convert the standard variable pump control into a destroke control.

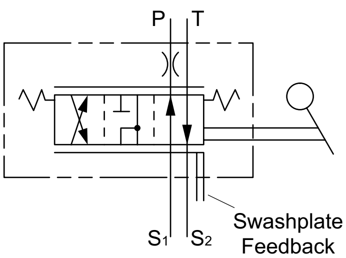
An Anti-Stall Electronics Module is available to drive a normally closed destroke valve. The electronic circuit monitors engine speed. When engine speed drops the anti-stall electronic reduce the pump's displacement.

Anti-Stall Electronics Module

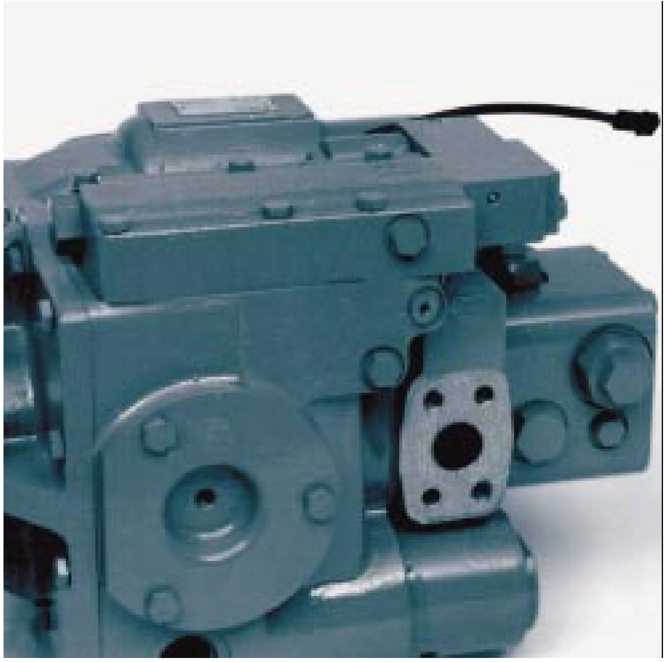
Manual Control



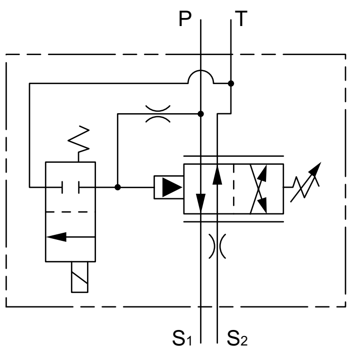
The manual displacement control for variable motors permits remote control of motor displacement using mechanical links or cables. The control operates similarly to the pump manual control, except the motor is biased to maximum displacement when the control handle is in a "neutral" position. Motor displacement may be controlled between maximum and minimum by moving the control lever.



Stroking Valve Control

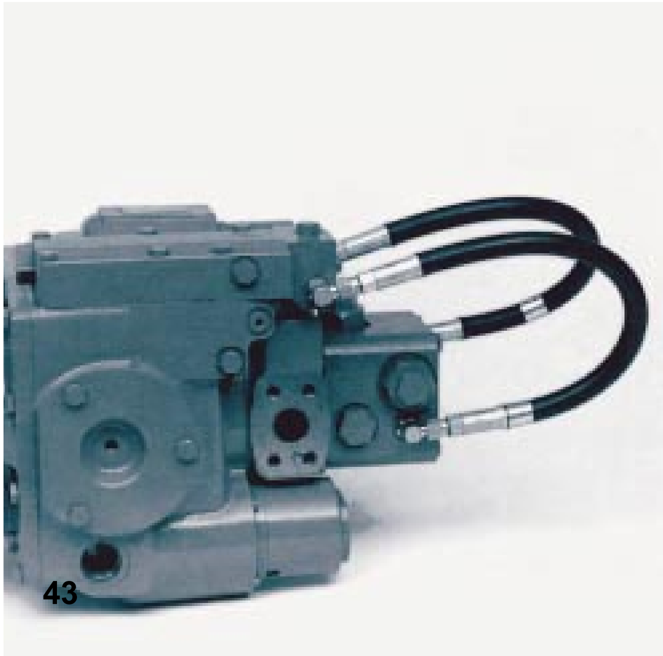


The variable motor stroking control provides a means of controlling motor displacement remotely via an electrical signal. When no electrical signal is supplied to the solenoid valve, the motor will be commanded to maximum displacement to provide maximum torque. Conversely, providing an electrical signal to the solenoid valve will command minimum displacement for maximum output speed. The control is available in 12 volt and 24 volt DC configurations.

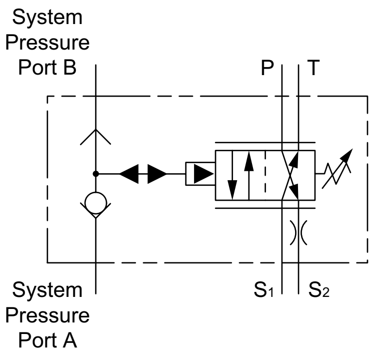


Control Options – Variable Motor

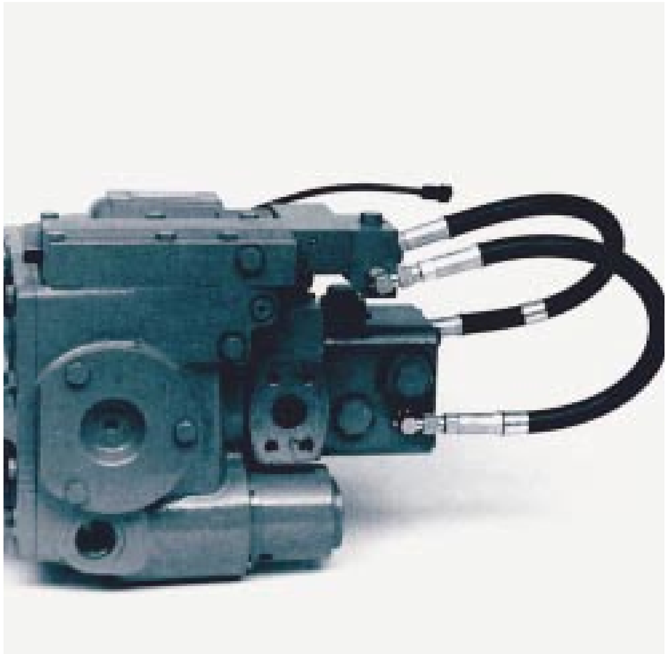
Pressure Response Control



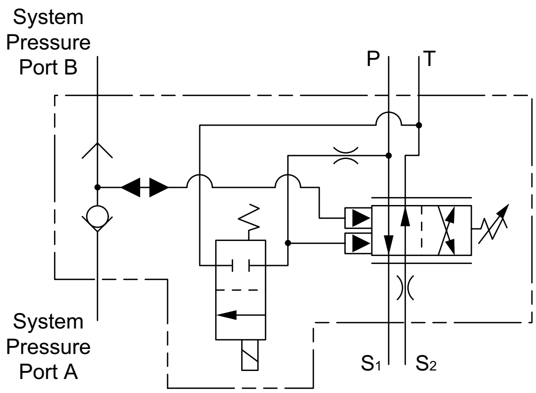
The variable motor pressure response control automatically adjusts motor displacement to meet torque requirements by sensing system pressure. The motor is biased to minimum displacement until system pressure reaches the pressure response setting. The control will then increase motor displacement to maintain the control pressure setting until maximum motor displacement is reached or the load on the system is reduced.



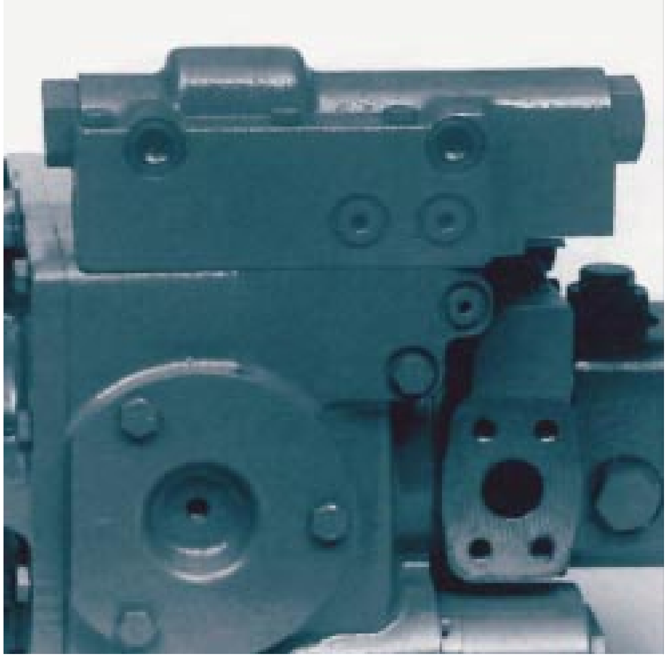
Pressure Response Control with Stroking Valve



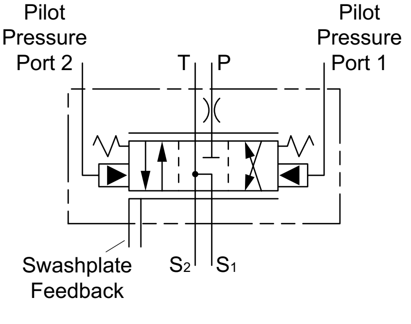
This control valve is a combination of the pressure response control and the stroking valve. With the stroking valve solenoid energized it works like the variable motor pressure response control. De-energize the stroking valve solenoid and the motor goes to full stroke. The control is available in 12 volt and 24 volt configurations.



Hydraulic Remote Control Variable Motor Control

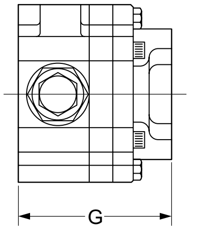


The hydraulic remote control uses a remote pilot pressure to move the control spool. There are two versions of the control available for variable motors. The first version contains a feedback linkage that biases the motor to minimum angle when the pilot pressure is below the control range. The second version contains a feedback linkage that biases the motor to full displacement when the pilot pressure is below the control range. This version permits the use of a single pilot signal to control the displacement of both the pump and motor. The operating pressure ranges of the hydraulic remote controls on pump and motor are selected such that the pump reaches full displacement before the pilot signal begins to reduce the displacement of the variable motor. This system provides infinitely variable speed control range and maximum motor output torque at lower speeds.

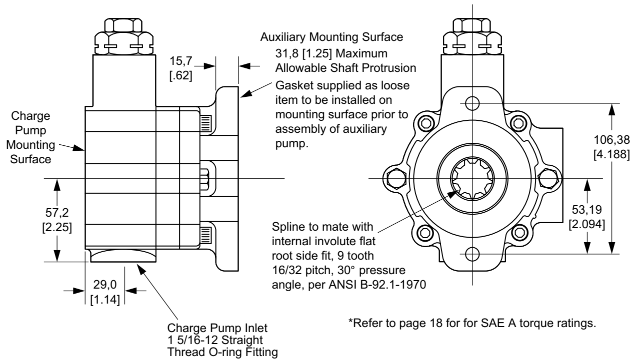


Charge Pump Dimensions

Charge Pump with SAE A Auxiliary Mount

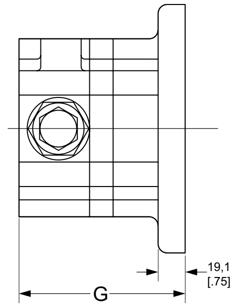


Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	105,2	4.14
1.28	21,0	111,5	4.39
1.70	27,8	117,8	4.64
2.12	34,7	124,5	4.89

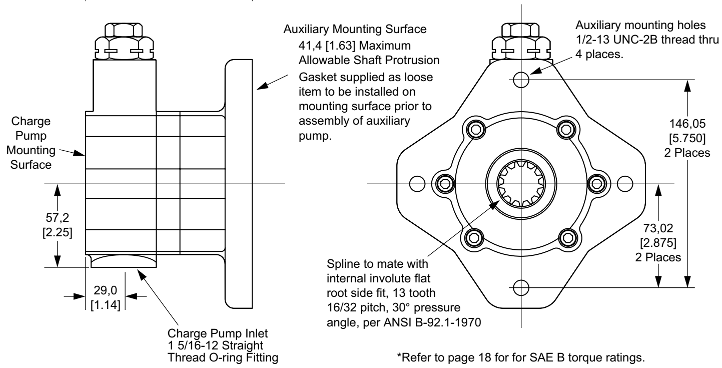


*Refer to page 18 for for SAE A torque ratings.

Charge Pump with SAE B Auxiliary Mount



Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	114,3	4.50
1.28	21,0	120,6	4.75
1.70	27,8	127,0	5.00
2.12	34,7	133,7	5.25

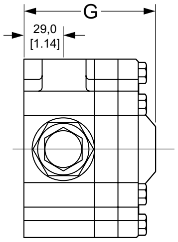


*Refer to page 18 for for SAE B torque ratings.

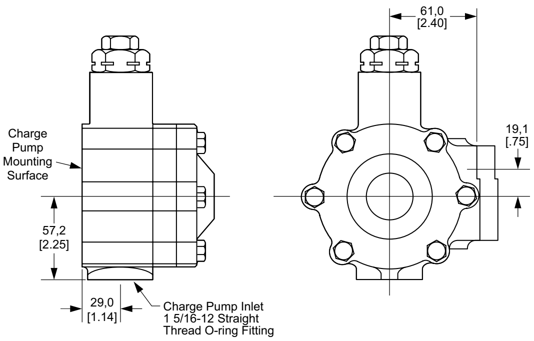
Dimensions in mm (in)

Charge Pump Dimensions

Charge Pump with Auxiliary Pressure Port

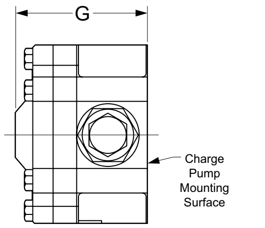


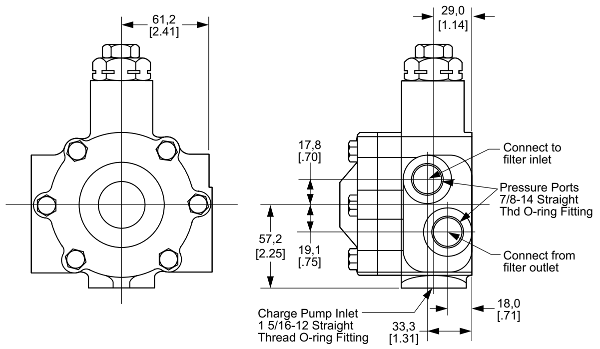
Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	92,2	3.63
1.28	21,0	98,6	3.88
1.70	27,8	104,9	4.13
2.12	34,7	111,6	4.38



Charge Pump with Remote Filter Ports

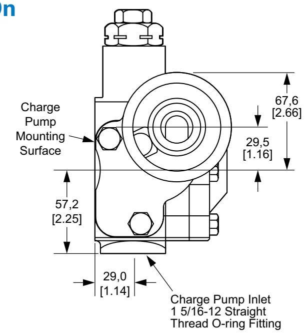
Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	92,2	3.63
1.28	21,0	98,6	3.88
1.70	27,8	104,9	4.13
2.12	34,7	111,6	4.38

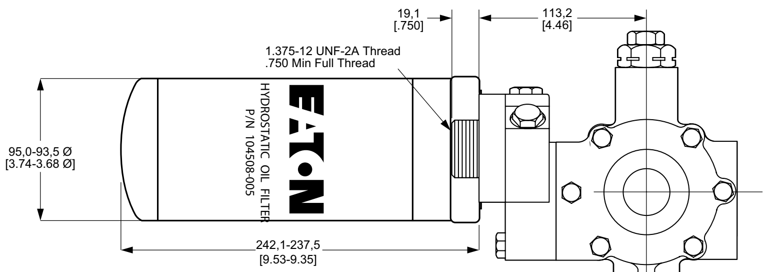




Charge Pump with Spin-On Pressure Side Filter Pad

*Note: This option supplied with filter.





Dimensions in mm (in)

Dimensions

Models 39 and 46

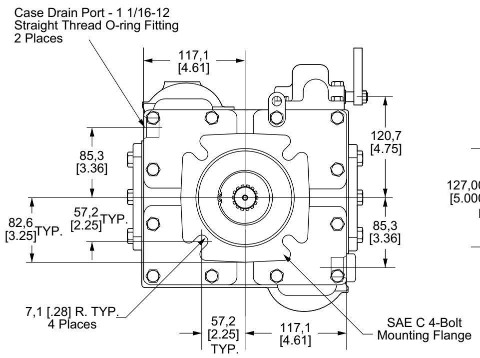
The variable pumps and motors are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

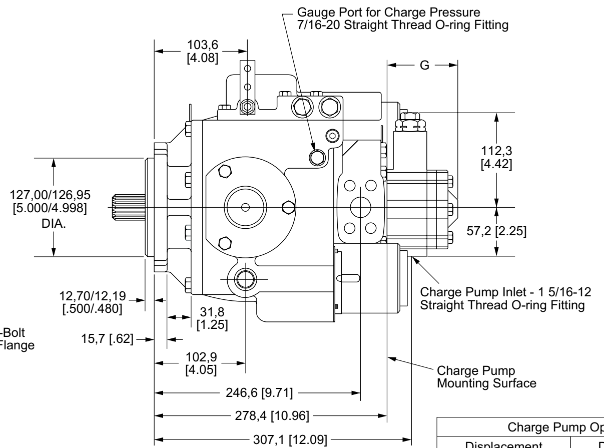
The variable pumps are shown with standard charge pumps. Installation drawings of other charge pumps are available from your Eaton representative.

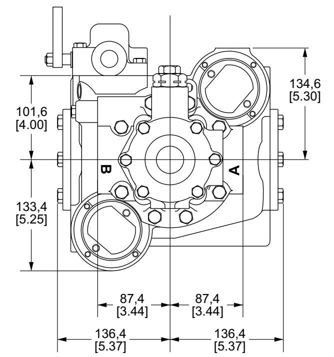
The lever on the standard control has linkage connection holes at 1 and 2 inch radii from the control shaft center.

Detailed drawings of available shafts and ports are shown on page 21.

Variable Pump



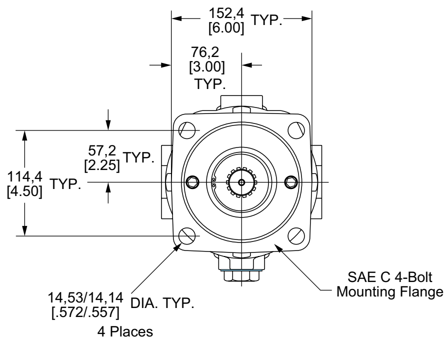


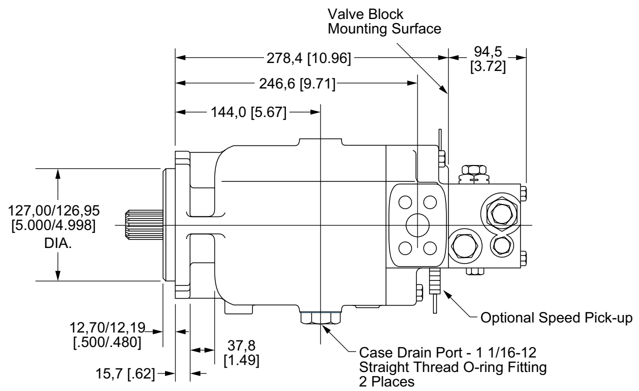


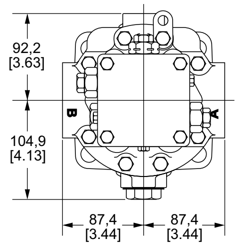
All dimensions are given in millimeters (inches).

Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	92,2	3.63
1.28	21,0	98,6	3.88
1.70	27,8	104,9	4.13
2.12	34,7	111,6	4.38

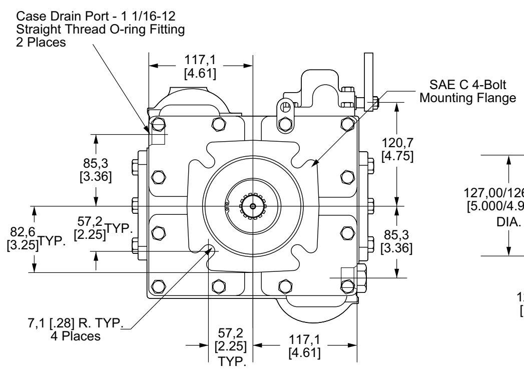
Fixed Motor

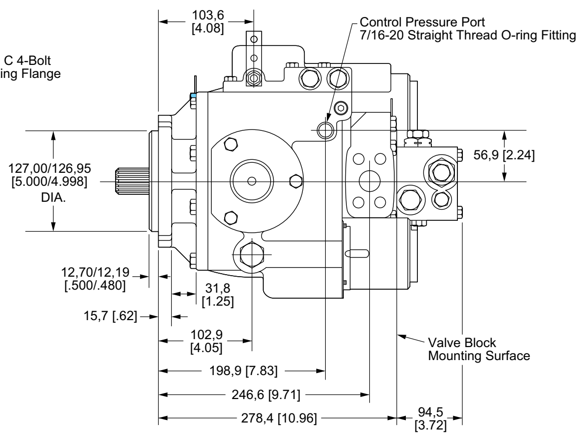


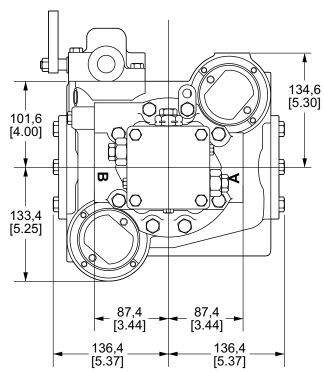




Variable Motor



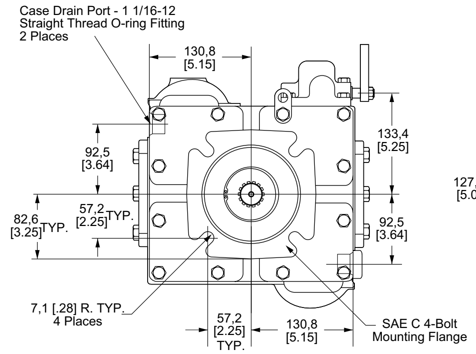


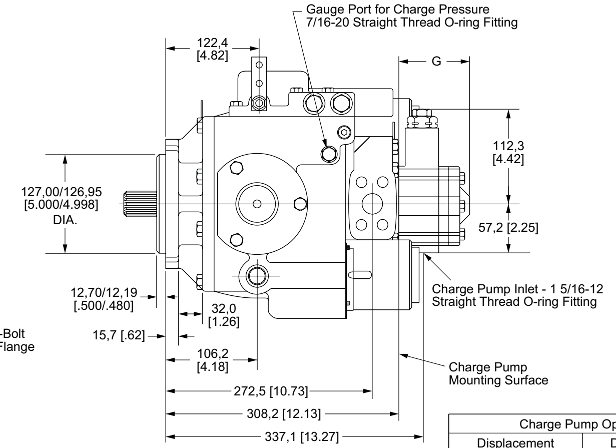


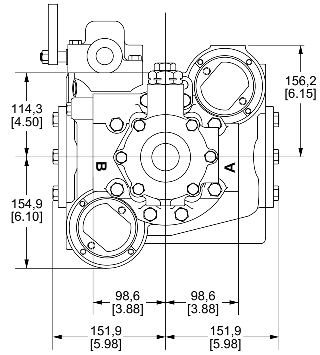
Dimensions

Models 54 and 64

Variable Pump



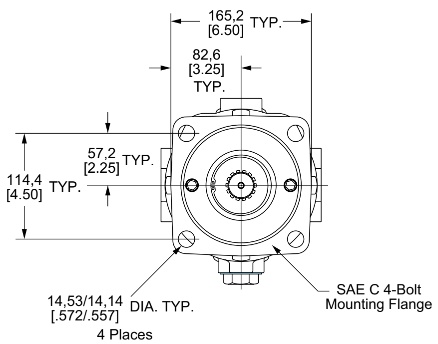


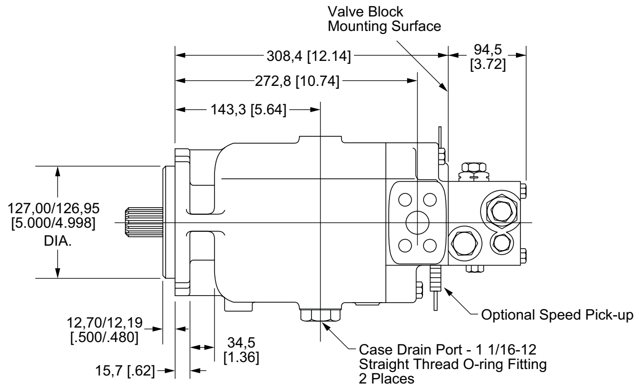


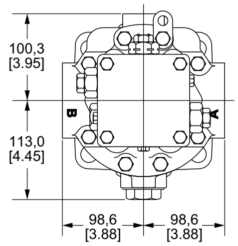
All dimensions are given in millimeters (inches).

Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	92,2	3.63
1.28	21,0	98,6	3.88
1.70	27,8	104,9	4.13
2.12	34,7	111,6	4.38

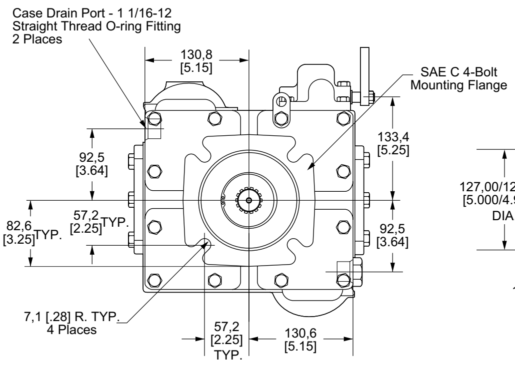
Fixed Motor

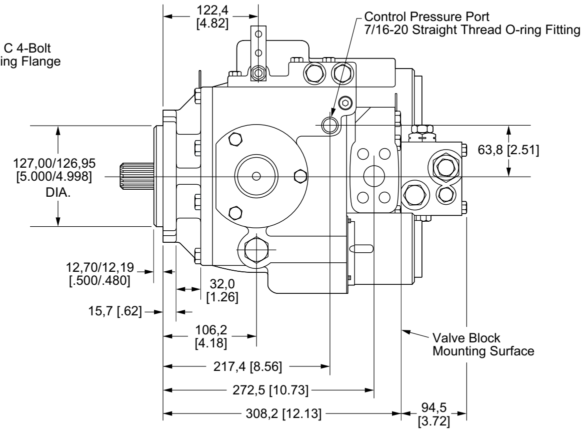


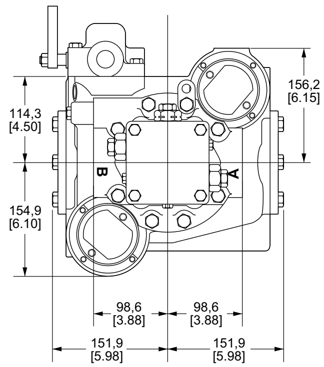




Variable Motor





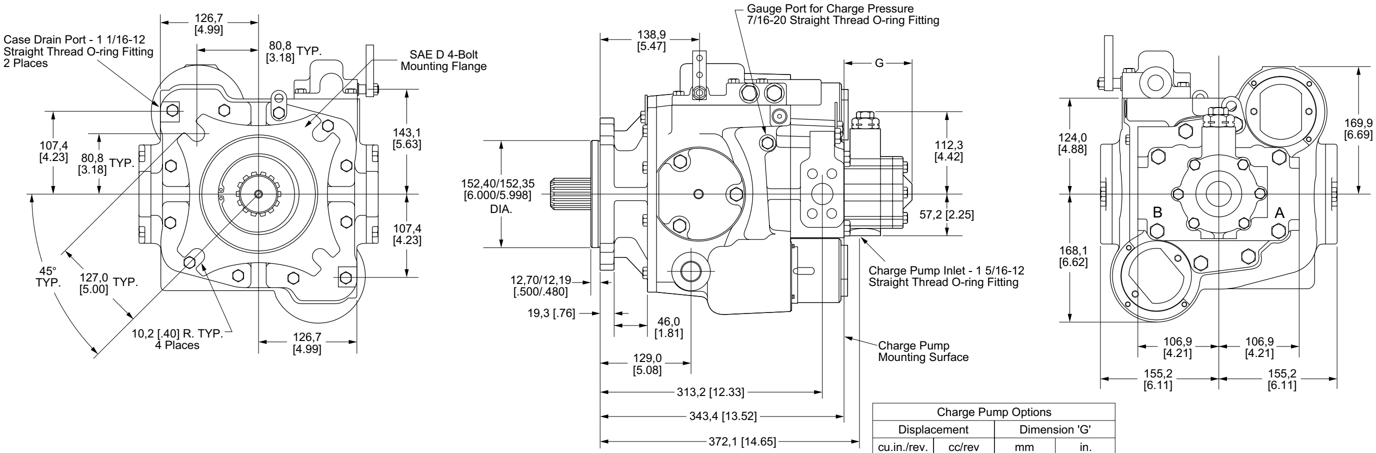


Dimensions

Models 54 and 64

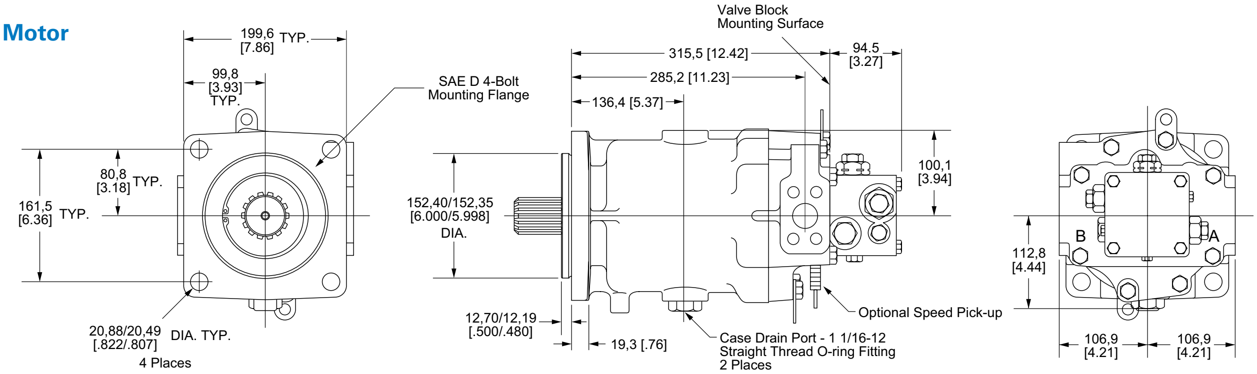
Model	Variable Pump	Fixed Motor	Variable Motor
33	138 (62,6)	83 (37,6)	140 (63,5)
39	138 (62,6)	83 (37,6)	140 (63,5)
46	138 (62,6)	83 (37,6)	140 (63,5)
54	188 (85,3)	106 (48,1)	190 (86,2)
64	188 (85,3)	106 (48,1)	190 (86,2)
76	226 (101,7)	121 (54,5)	228 (102,6)

Variable Pump

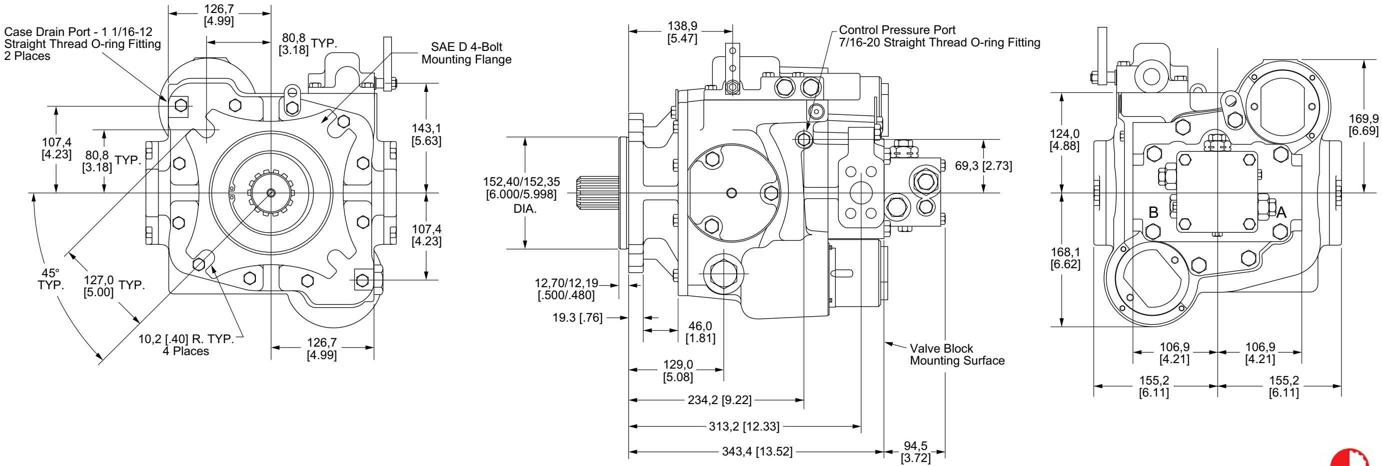


Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
1.28	21,0	98,6	3.88
1.70	27,8	104,9	4.13
2.12	34,7	111,6	4.38

Fixed Motor



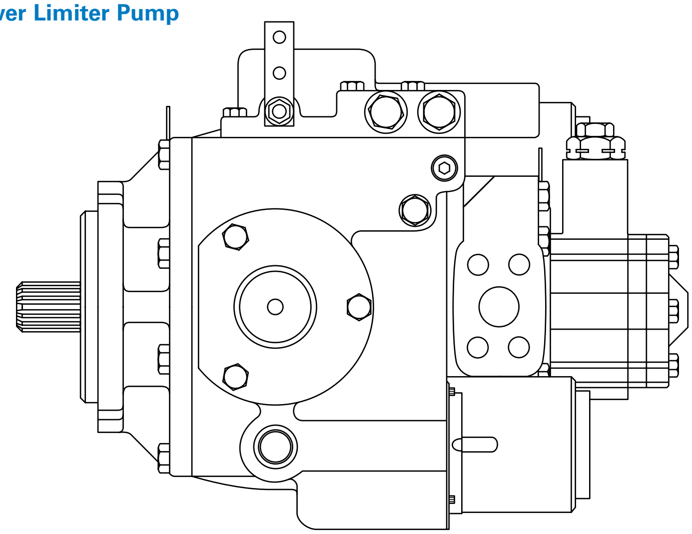
Variable Motor

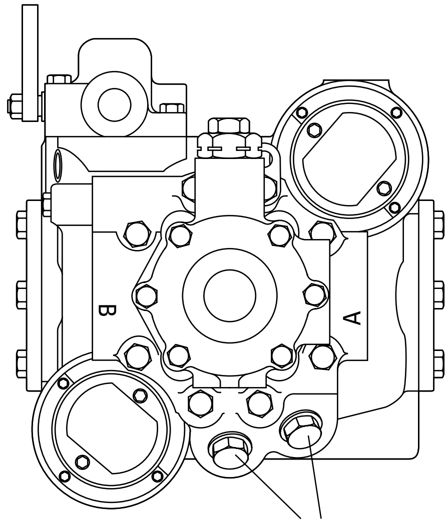


Power Limiter Pumps and Integral Shuttle Valve Motors

Models 39 through 64

Power Limiter Pump





Power Limiter Valve Operation*

Power limiter valves (PLV) are high pressure relief valves built into the pump's end cover. When pressure in the high pressure loop gets too high, the PLV opens to the pump case. Besides an immediate drop in the loop high pressure, the open PLV also causes control pressure to drop. This in turn allows the centering springs on the servo pistons to bring the pump out of stroke until the pressure drops to the relief valve setting and the PLV closes.

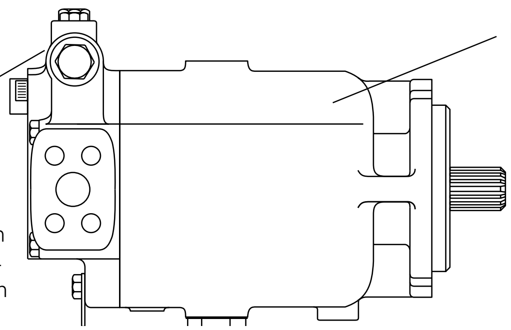
The PLV will also act as a check valve to prevent cavitation in the event of a rapid pressure rise and hose expansion.

A motor with integral shuttle valve is used in conjunction with the power limiter valve pump.

Note: Power limiter valves are not recommended for applications with large overrunning loads.

Feature/Benefits

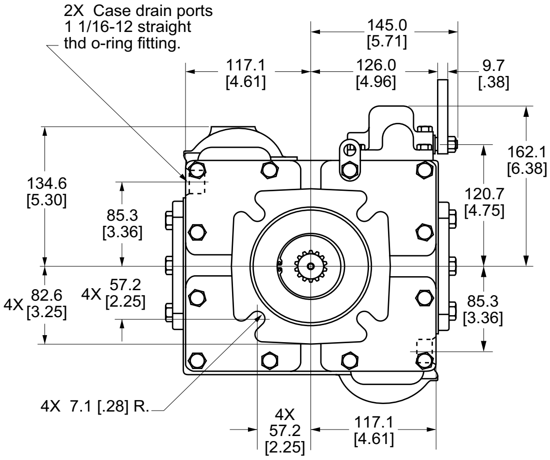
- The motor is shorter and lighter allowing it to fit in tighter spaces.
- The motor's integral shuttle valve and low pressure relief assure good loop flushing.
- The motor is available with side ports, end ports, or both allowing maximum mounting flexibility.
- The power limiter valves (PLV) are quick, direct acting relief valves that prevent high pressure spikes.
- The power limiter pump is ideally suited for use with motors that do not have valve blocks because it eliminates the need for a remote valve block.

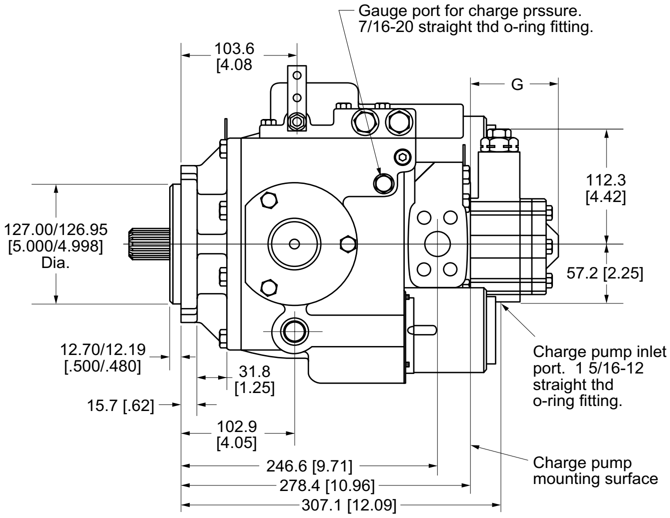


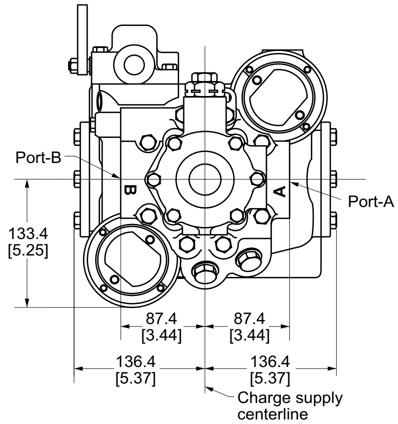
Power limiter valve option not available on Model 54 and Model 64 pumps with SAE C auxiliary option.

Dimensions – Power Limiter Pump

Models 39 and 46



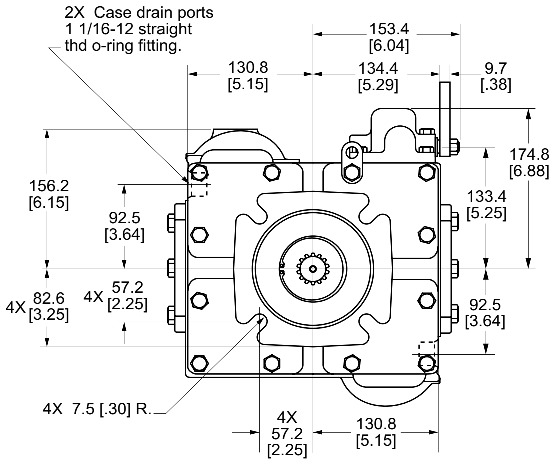


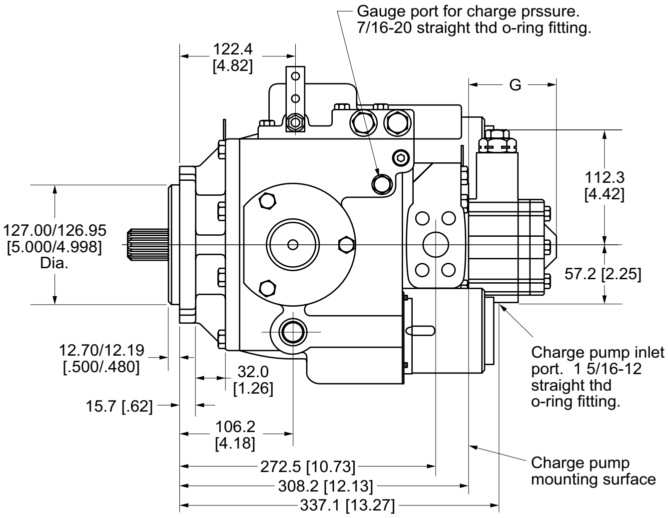


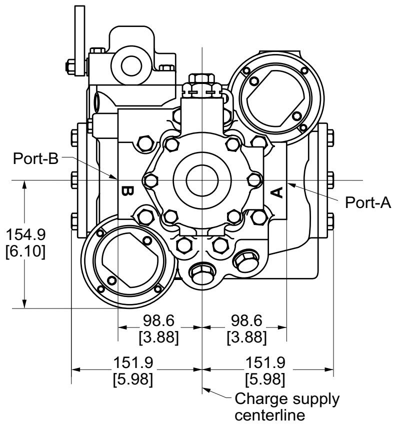
Charge Pump Options			
Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	92.2	3.63
1.28	21,0	98.6	3.88
1.70	27,8	104.9	4.13
2.12	34,7	111.6	4.38

Dimensions – Power Limiter Pump

Models 54 and 64

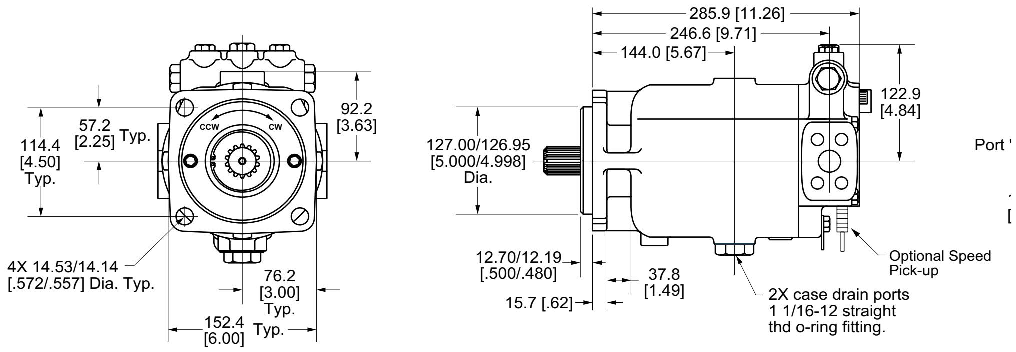




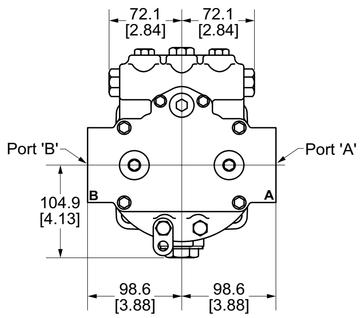


Dimensions – Integral Shuttle Motor

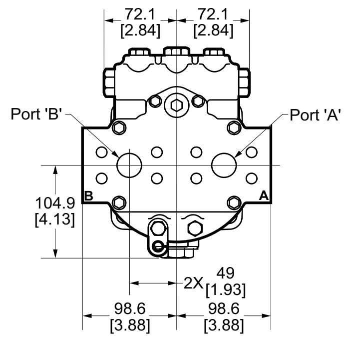
Models 39, and 46



Side Ports



End Ports



PL Pump and IS Motor Approximate Weights lb (Kg)

Model	PL Pump	IS Motor
39	138 (62,6)	70 (31,8)
46	138 (62,6)	70 (31,8)
54	188 (85,3)	93 (42,2)
64	188 (85,3)	93 (42,2)

Notes: All dimensions are given in millimeters (inches).

The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

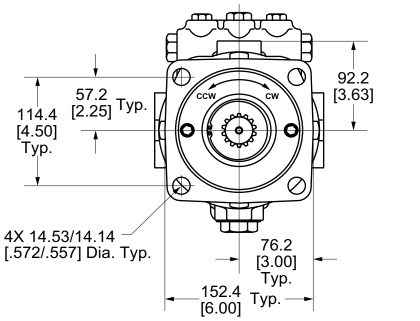
The variable pumps are shown with standard charge pumps. Installation drawings of other charge pumps are available from your Eaton representative.

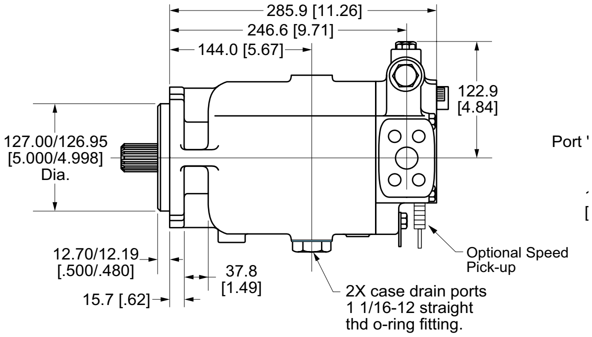
The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center.

Detailed drawings of available shafts and ports are shown on page 21.

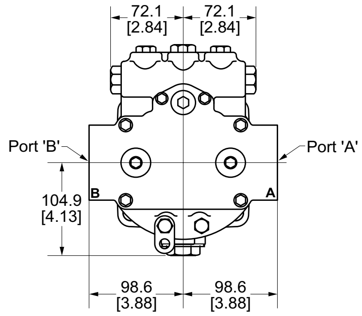
Dimensions – Integral Shuttle Motor

Models 54 and 64

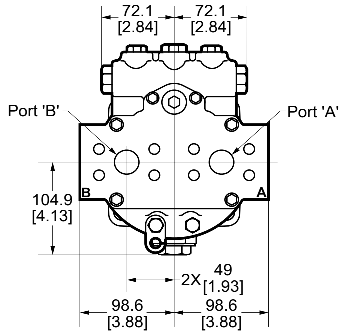




Side Ports



End Ports



PL Pump and IS Motor Approximate Weights lb (Kg)

Model	PL Pump	IS Motor
39	138 (62,6)	70 (31,8)
46	138 (62,6)	70 (31,8)
54	188 (85,3)	93 (42,2)
64	188 (85,3)	93 (42,2)

Notes: All dimensions are given in millimeters (inches).

The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

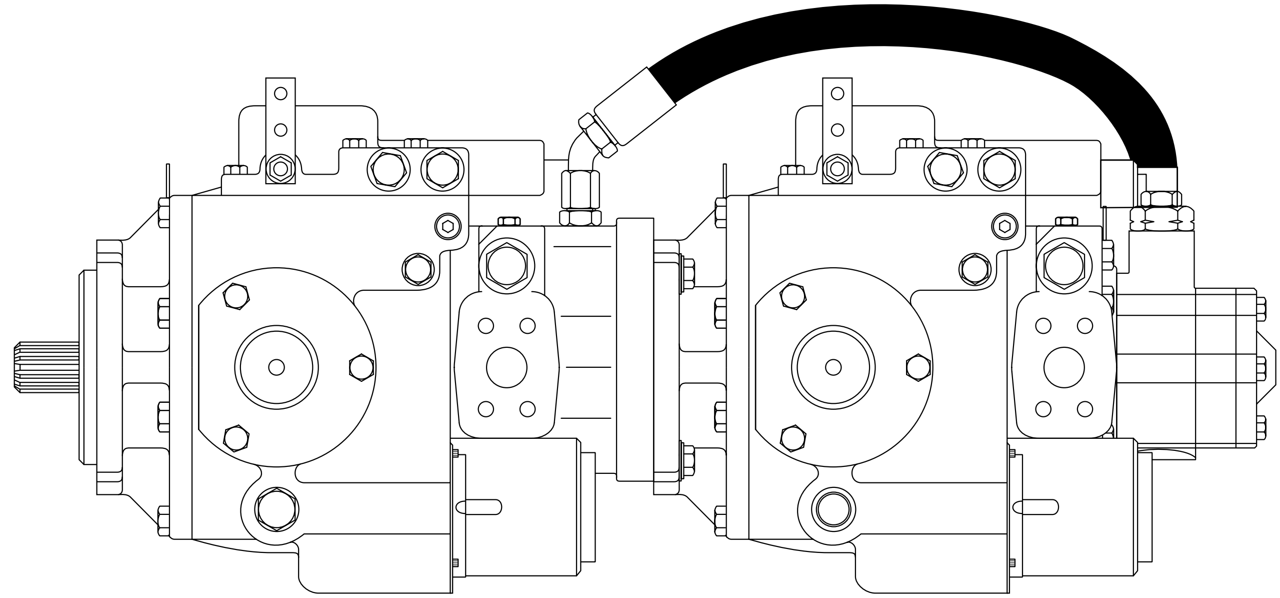
The variable pumps are shown with standard charge pumps. Installation drawings of other charge pumps are available from your Eaton representative.

The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center.

Detailed drawings of available shafts and ports are shown on page 21.

Heavy Duty Tandem Pumps

Models 39 through 64



Tandem Pump Applications

Tandem pumps are most typically used in applications where two independent sources of hydraulic power are required while taking advantage of using only one power source to drive the two pumps. This saves on the expense of driving two pumps by eliminating the split drive gear box or eliminating another power source such as a second engine or motor. Tandem pumps can be used on machines such as track drive equipment where independent power is required at each track. Speed and power can be controlled to each side of the vehicle for steering and vehicle speed control both in forward and reverse directions.

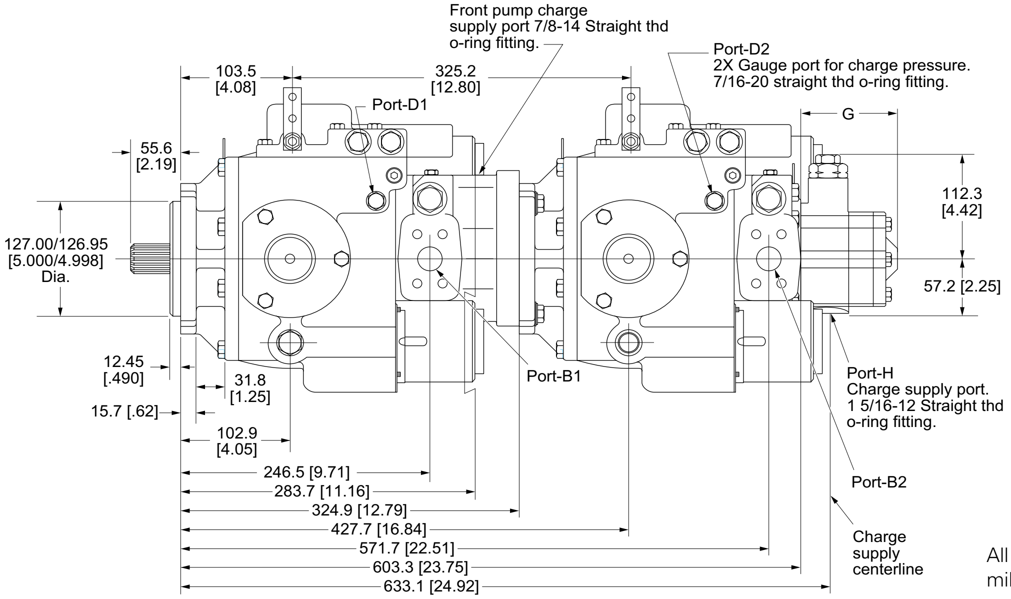
Tandem pumps can also be used to create the equivalent flow of one larger displacement pump by combining the flows of the two pumps. This is an economic advantage over using a single large displacement pump.

Tandem pumps may also be used in industrial, construction or mining applications where several sources of hydraulic power are required while taking advantage of using only one power source to drive the two pumps.

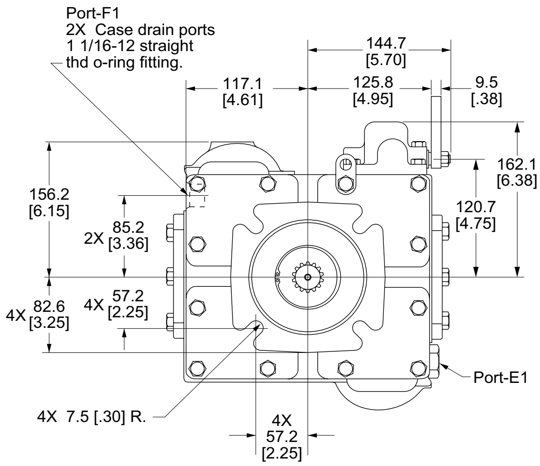
Features/Benefits

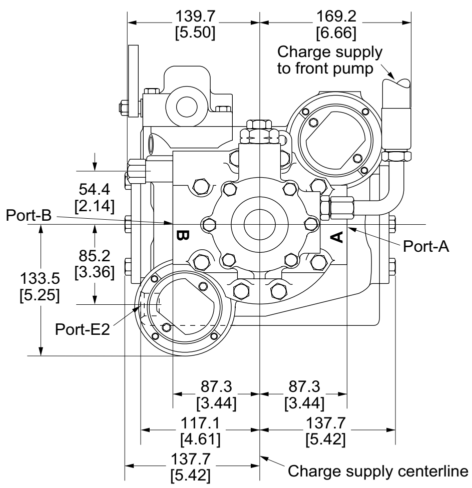
- Pumps mounted in tandem save the expense of a pump drive.
- Tandem pumps, in some applications, are required because of space limitations.
- The rear pump may be the same displacement or smaller than the front pump.
- A tandem pump may be used as an economical alternative for a larger displacement pump by combining the flow of both pumps. For example, combining the flows of two 6.4 in^3/rev pumps connected in tandem provides the flow equivalent to a 12.8 in^3/rev pump.
- Charge pumps with SAE A or SAE B auxiliary mounts are available.
- Pump has standard SAE C flange mount.
- Rear pump can be the same displacement or smaller than front pump.

Models 39 and 46 Tandem Pumps



All dimensions are given in millimeters (inches).





Charge Pump Options

Displacement		Dimension 'G'	
cu.in./rev.	cc/rev	mm	in.
.85	13,9	92.2	3.63
1.28	21,0	98.6	3.88
1.70	27,8	104.9	4.13
2.12	34,7	111.6	4.38

Notes: The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

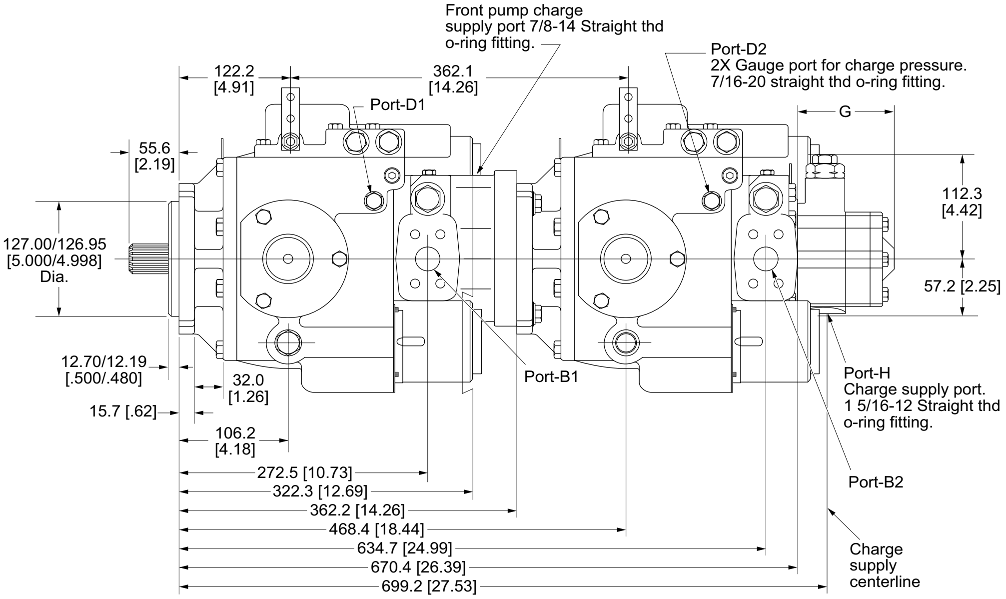
The variable pumps are shown with standard charge pumps. Installation drawings of other charge pumps are available from your Eaton representative.

The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center.

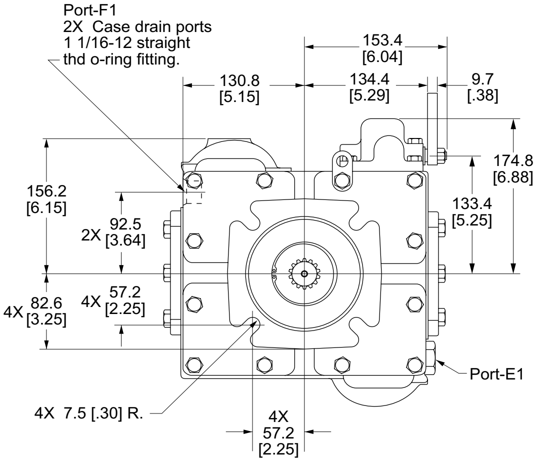
Detailed drawings of available shafts and ports are shown on page 21.

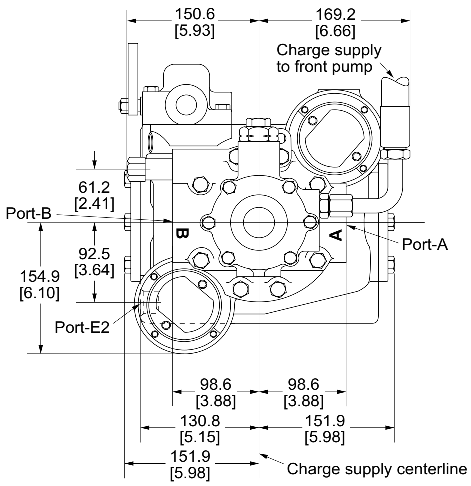
Dimensions – Tandem Pumps

Models 54 and 64 Tandem Pumps



All dimensions are given in millimeters (inches).





Charge Pump Options

Displacement		Dimension 'G'	
cu.in./rev.	**cc/rev**	**mm**	**in.**
.85	13,9	92.2	3.63
1.28	21,0	98.6	3.88
1.70	27,8	104.9	4.13
2.12	34,7	111.6	4.38

Tandem Pump Application Information

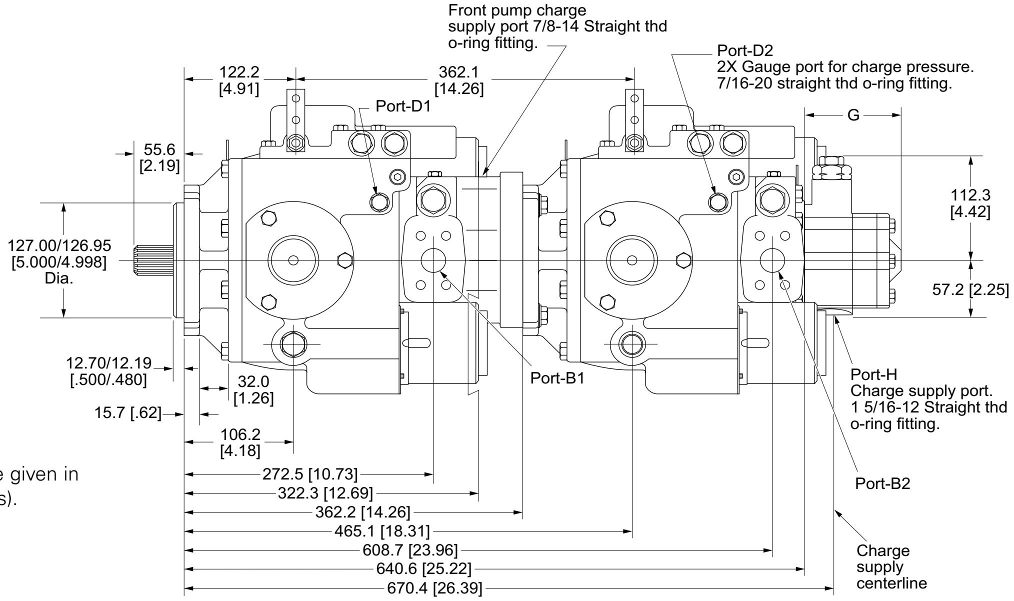
Some tandem applications require larger displacement charge pumps.

Refer to the Heavy Duty Application manual (no. 5-401) for more information on heavy duty pump and motor applications.

Tandem Pump Approximate Weights

Front Pump	Rear Pump	Weight lb (kg)
Model 39 - 46	Model 33 - 46	276 (125.2)
Model 54 - 64	Model 54 - 64	376 (170.6)
Model 54 - 64	Model 33 - 46	326 (147.9)

Tandems, Model 54 or 64 Front Pump with Model 39, or 46 Rear Pump



All dimensions are given in millimeters (inches).

Maximum Shaft Torque Limitations

The total input torque, as well as, the torque at each of the drive shaft coupling points must be considered in a tandem pump system.

Torque calculation formulas and the maximum allowable shaft torque limits, for each shaft coupling point in the tandem pump, are given below.

For longest shaft life, use the largest shaft possible.

Charge Pump Options

Displacement		**Dimension 'G'**	
cu.in./rev.	**cc/rev**	**mm**	**in.**
.85	13,9	92.2	3.63
1.28	21,0	98.6	3.88
1.70	27,8	104.9	4.13
2.12	34,7	111.6	4.38

Shaft Coupling Point	**lb-in.**	**Nm**
Input Shaft Models 54 – 64	11150	1260
Input Shaft Models 33 – 46	8550	966
Front/Rear Pump Coupler	6600	746
Charge Pump	2050	232
B-Pad Auxiliary Pump	1852	209
A-Pad Auxiliary Pump	517	58

Shaft Torque Formulas

$$\text{Max. Aux Pump Torque} = \frac{(\text{Max Displ}_{\text{aux pmp}})(\text{Max Pressure}_{\text{aux pmp}})}{(6.28)(.9)}$$

$$\text{Max. Chg Pump Torque} = \frac{(\text{Max Displ}_{\text{chg pmp}})(\text{Max Pressure}_{\text{chg pmp}})}{(6.28)(.9)} + \text{Max. Aux Pump Torque}$$

$$\text{Max. Front/Rear Pump Coupler Torque} = \frac{(\text{Max Displ}_{\text{pmp 2}})(\text{Max Pressure}_{\text{pmp 2}})}{(6.28)(.9)} + \text{Max. Chg Pump Torque}$$

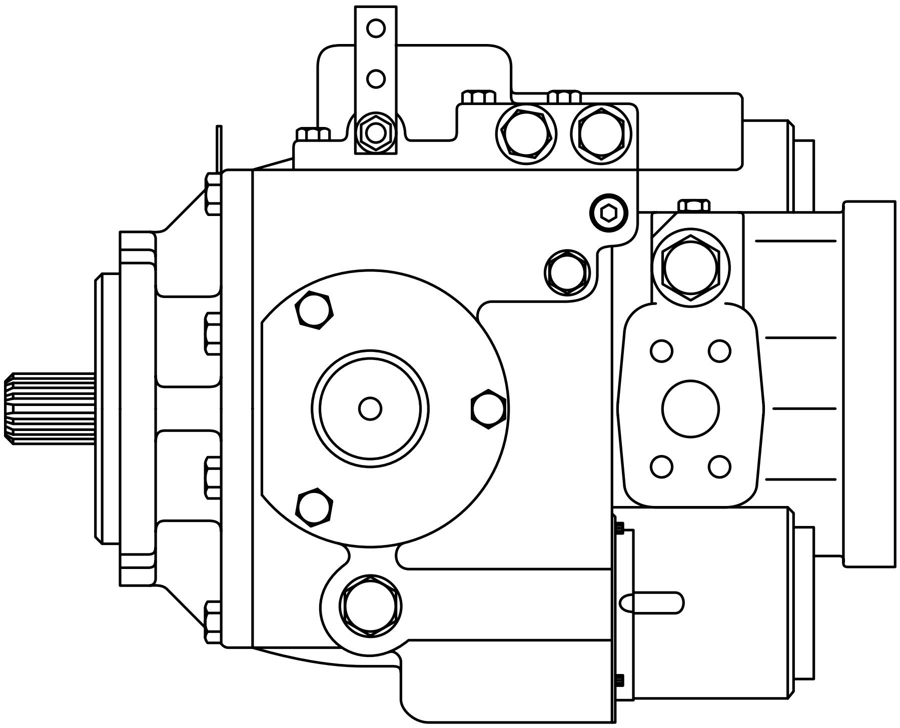
$$\text{Max. Input Shaft Torque} = \frac{(\text{Max Displ}_{\text{pmp 1}})(\text{Max Pressure}_{\text{pmp 1}})}{(6.28)(.9)} + \text{Max. Front/Rear Pump Coupler Torque}$$

Heavy Duty Pumps with C-Pad Rear Mount

Models 39 through 64

Features/Benefits

- The heavy duty pump with a C-Pad rear mount is the front half of the tandem unit.
- Pump has standard SAE C flange mount.
- Rear pump can be the same displacement or smaller than front pump
- The rear mount accepts a standard SAE C flange.
- This pump is ideal for applications that require two different pumps. Road rollers and some construction equipment are applications that employ two different pumps.



Application Information

Maximum Shaft Torque Limitations

The total input torque, as well as, the torque at the drive shaft coupling point must be considered when the pump with the SAE C rear mount is used. Maximum torque values and formulas are given on page 18.

Pumps with SAE C Rear Mount

A 14 tooth, 12/24 pitch, internal spline coupling (Part No. 105853) is required between front and rear pump. A coupling is provided with each SAE C Pump. Optional couplings with 21 tooth, 16/32 pitch; and 23 tooth, 16/32 pitch, are also available.

Pump requires remote charge pump and charge pressure relief. (Charge pressure relief may be built into pump.)

Refer to the Heavy Duty Application manual (no. 5-401) for more information on heavy duty pump and motor applications.

Rear Pump Mounting Information

When an Eaton heavy duty pump is used as the rear

pump, remove its shaft seal so part of the case flow will flow past the bearing into the front pump. It is also necessary to connect the rear pump's upper case drain port to the front pump's lower case drain port, otherwise high case pressures may result.

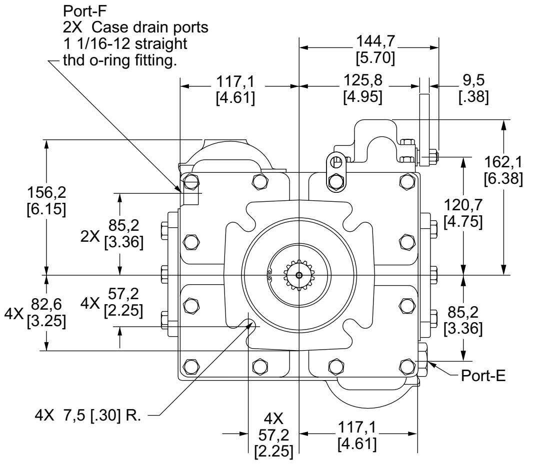
In all cases, check case pressures and ensure that they do not exceed 40 PSI (3 bar).

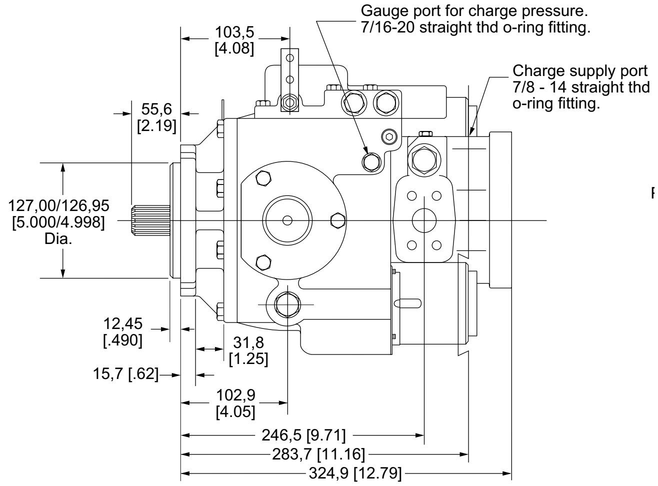
Heavy Duty Application manual (no. 5-401) gives more information on proper case flow routing.

See previous page for shaft torque ratings.

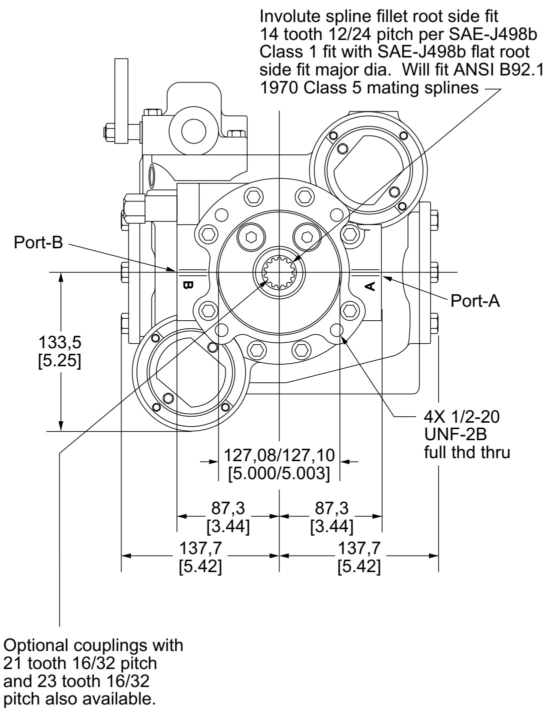
Dimensions – Pumps with C-Pad Rear Mount

Models 39 and 46





All dimensions are given in millimeters (inches).



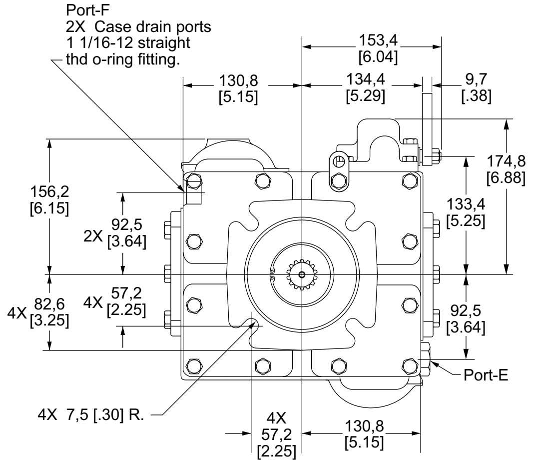
Notes: The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

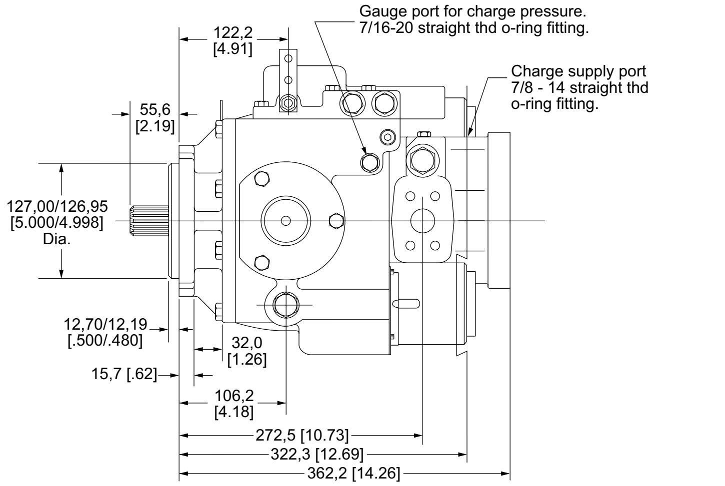
The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center.

Detailed drawings of available shafts and ports are shown on page 21.

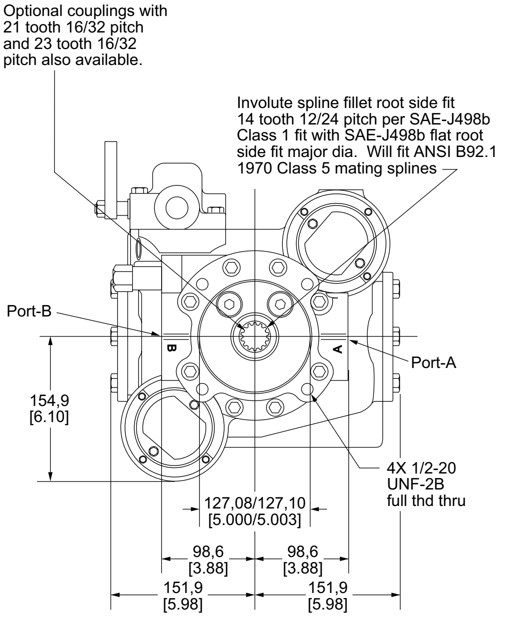
Dimensions – Pumps with C-Pad Rear Mount

Models 54 and 64 Pumps





All dimensions are given in millimeters (inches).



Notes: The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center.

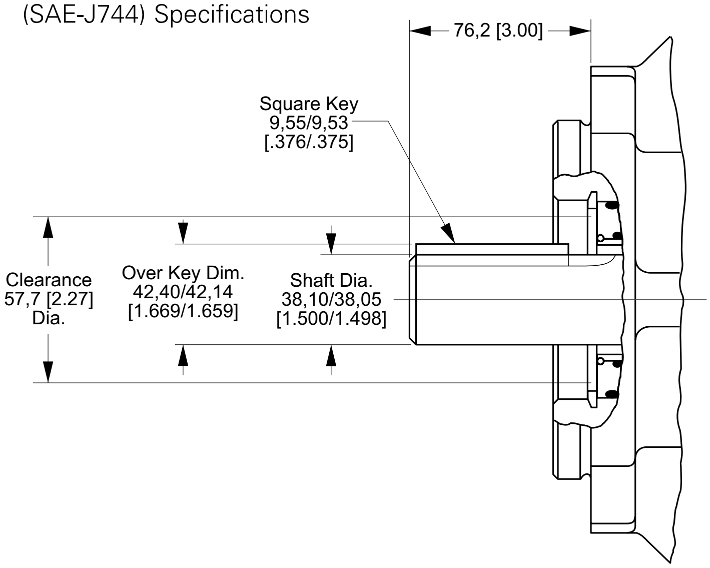
Detailed drawings of available shafts and ports are shown on page 21.

Dimensions – Shaft and Port

Models 39 through 64

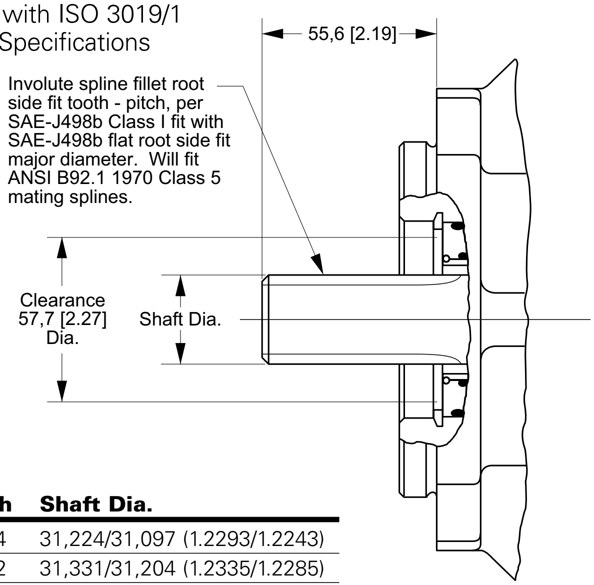
Keyed Shaft Option

Compatible with ISO 3019/1 (SAE-J744) Specifications



Splined Shaft Options

Compatible with ISO 3019/1 (SAE-J744) Specifications

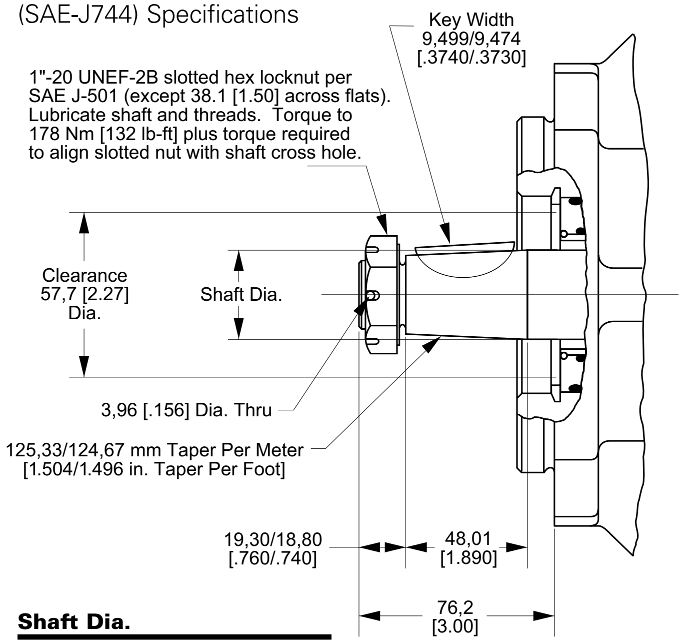


Tooth	Pitch	Shaft Dia.
14*	12/24	31,224/31,097 (1.2293/1.2243)
19	16/32	31,331/31,204 (1.2335/1.2285)
20	16/32	32,918/32,791 (1.2960/1.2910)
21	16/32	34,506/34,379 (1.3585/1.3535)
23	16/32	37,681/37,554 (1.4835/1.4785)

* Not recommended for Model 64 or tandem pumps.

Tapered Shaft Options

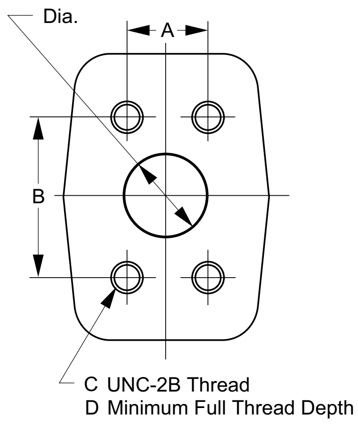
Compatible with ISO 3019/1 (SAE-J744) Specifications



Shaft Dia.
35,05/34,90 (1.380/1.374)
38,23/38,08 (1.505/1.499)

Split Flange Port Options

Per SAE-J518 Specifications

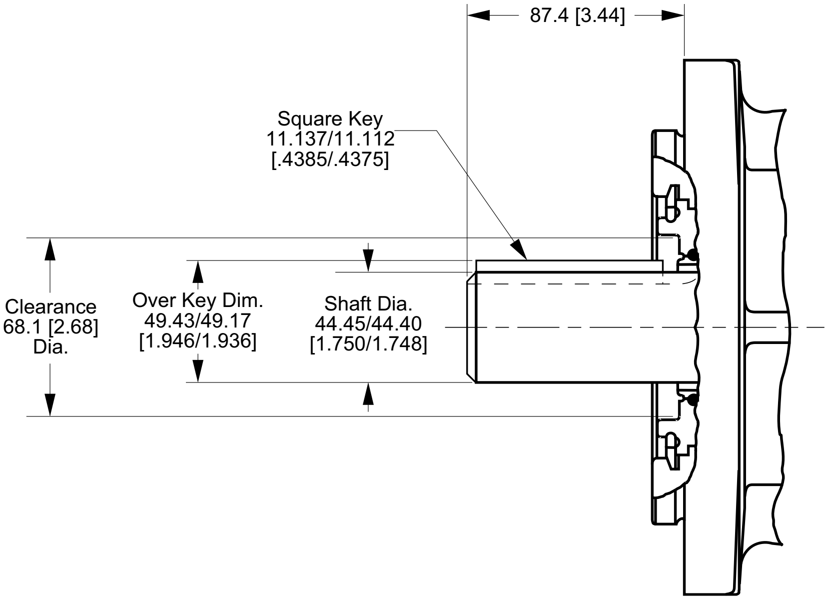


Code	Dia.	A	B	C	D
61	25,4 (1.00)	26,19 (1.031)	52,37 (2.062)	3/8-16	22,4 (.88)
62	25,4 (1.00)	27,76 (1.093)	57,15 (2.250)	7/16-14	27,0 (1.06)

Dimensions in mm (in)

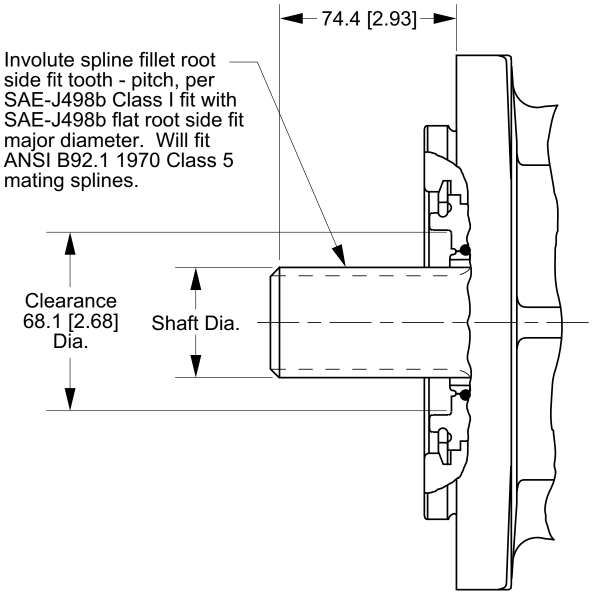
Keyed Shaft Option

Compatible with ISO 3019/1 (SAE-J744) Specifications



Splined Shaft Options

Compatible with ISO 3019/1 (SAE-J744) Specifications



Tooth	Pitch	Shaft Dia.
13	8/16	43.713/43.586 (1.7210/1.7160)
27	16/32	44.031/43.904 (1.7335/1.7285)

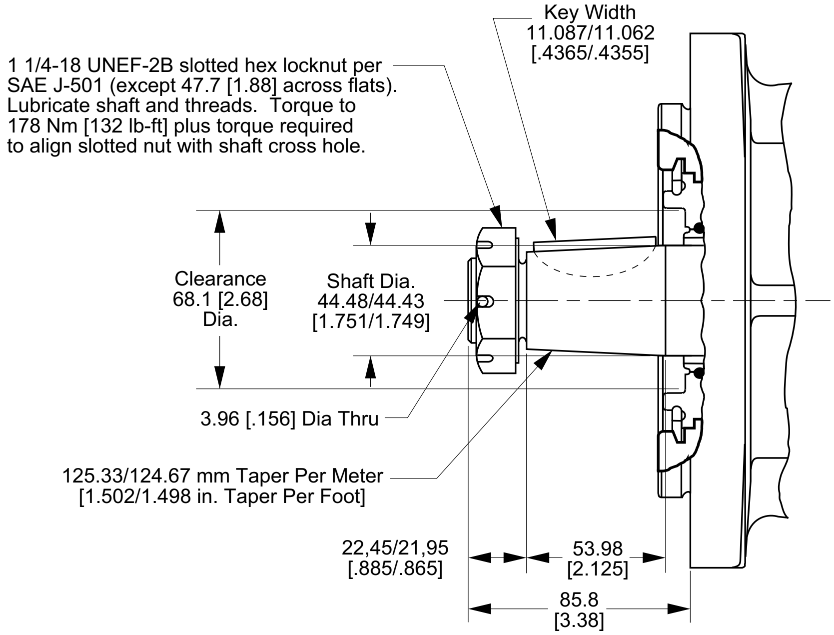
Dimensions in mm (in)

Dimensions – Shaft and Port

Model 76

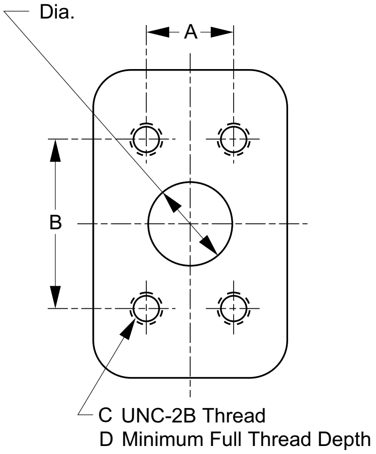
Tapered Shaft Option

Compatible with ISO 3019/1 (SAE-J744) Specifications



Split Flange Port Options

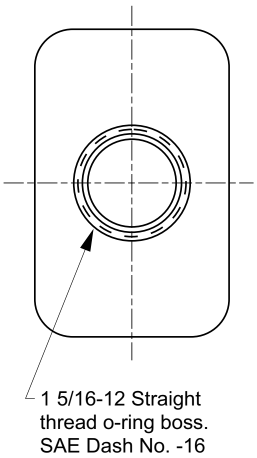
Per SAE-J518 Specifications



Code	Dia.	A	B	C	D
61	25,4 (1.00)	26,19 (1.031)	52,37 (2.062)	3/8-16	22,4 (.88)
62	25,4 (1.00)	27,76 (1.093)	57,15 (2.250)	7/16-14	27,0 (1.06)

O-ring Port Option

Per SAE-J514 Specifications



Dimensions in mm (in)

Component Descriptions

The Operational Diagram on page 46 shows a typical heavy duty hydrostatic transmission. The axial piston pump and axial piston motor are the main components. The filter, reservoir, heat exchanger, and oil lines make up the rest of the system. The function of each of these components is described below:

A separate energy source, such as an electric motor or internal combustion engine, turns the input shaft of the pump.

Variable Displacement Axial Piston Pump

The variable displacement pump provides a flow of high pressure oil. Pump output flow can be varied to obtain the desired motor output speed. For example, when the pump's displacement is zero, no oil is pumped and the transmission's motor output shaft is stopped. Conversely, maximum pump displacement produces maximum motor shaft speed. The direction of high pressure flow can also be reversed; doing so reverses the direction the motor output shaft rotates.

A charge pump is integrated into the piston pump and driven by the shaft of the piston pump. The drawing illustrates a suction filtration circuit. Eaton recommends a suction filter without a bypass valve. The charge pump has a Low Pressure Relief Valve that regulates the output pressure.

Power limiter valves and high pressure relief valves are available as options.

Fixed Displacement Axial Piston Motor

The motor uses the high pressure oil flow from the pump to produce transmission output. The high pressure oil comes to the motor through one of the high pressure lines. It enters the motor, turns the output shaft, then returns to the pump. Eaton piston motors integrate a hot oil shuttle and low pressure relief valve into the end cover. The shuttle valve and low pressure relief valve direct excess charge pump flow into the motor case. The shuttle valve is activated by high pressure and directs excess charge pump flow over the low pressure relief valve. This flushing action allows the charge pump to provide clean, cool oil to the closed loop circuit.

Reservoir

The reservoir is an important part of the hydrostatic transmission system. It should provide adequate oil storage and allow easy oil maintenance.

The reservoir must hold enough oil to provide a continuous oil supply to the charge pump inlet. It must also have enough room for the hydraulic oil to expand as the system warms up. Consider charge pump flow when sizing the reservoir: One half (.5) minute times (X) the maximum charge pump flow should be the minimum oil volume in the reservoir. Maintaining this oil volume will give the oil a minimum of thirty (30) seconds in the reservoir. This will allow any entrained air to escape and contamination to settle out of the oil.

To allow for oil expansion, the reservoir's total volume should be at least six tenths (.6) minute times (X) the maximum charge pump flow.

The reservoir's internal structure should cut down turbulence and prevent oil aeration.

The line returning flow to the reservoir should be fitted with a diffuser to slow the incoming oil to 1 to 1.2 meters (3-4 feet) per second to help reduce turbulence. The return flow line should also be positioned so that returning oil enters the reservoir below the liquid surface. This will help reduce aeration and foaming of the oil.

The reservoir should have baffles between the return line and suction line. Baffles prevent return flow from immediately reentering the pump.

A sixty mesh screen placed across the suction chamber of the reservoir will act as a bubble separator. The screen should be placed at a thirty degree angle to the horizon.

The entrance to the suction line should be located well below the fluid surface so there is no chance of air being sucked into the charge pump inlet. However, the suction line entrance should not be located on the bottom of the reservoir where there may be a buildup of sediment. The suction line entrance should be flared and covered with a screen.

The reservoir should be easily accessible. The fill port should be designed to minimize the possibility of contamination during filling and to help prevent over filling. There should be a drain plug at the lowest point of the reservoir and it should also have a clean-out and inspection cover so the reservoir can be thoroughly cleaned after prolonged use. A vented reservoir should have a breather cap with a micronic filter.

Sealed reservoirs must be used at altitudes above 2500 feet. These reservoirs should be fitted with a two way micronic filter pressure cap to allow for fluid expansion and contraction.

In both cases the caps must be designed to prevent water from entering the reservoir during bad weather or machine washing.

A hydrostatic transmission with a well designed reservoir will run quieter, stay cleaner and last longer.

Filter

A filter must be used to keep the hydraulic fluid clean. Either a suction filter or a pressure side filter may be used. The filter must be a no-bypass type. A suction filter is shown in the operational diagram on page 46 System oil particulate levels should not exceed ISO 18/13. Refer to Eaton Hydraulic Fluid Recommendations on page 54.

Recommended beta ratios for each filter type are listed below:

Suction Filter $ß_{10}$ = 1.5 to 2.0

Pressure Side Filter $ß_{10}$ = 10 to 20

When a suction filter is used, its flow capacity must be large enough to prevent an excessive pressure drop between the reservoir and charge pump inlet. The pressure at the charge pump inlet port must not be less than 0.8 bar (11.6 psi) absolute at normal continuous operating temperatures.

Charge Pump Inlet Line

The inlet line to the charge pump should be large enough to keep the pressure drop between the reservoir and charge pump inlet within the limits described in the filter section. Fittings will increase the pressure drop, so their number should be kept to a minimum. It is best to keep fluid velocities below 1,25 meters (4 feet) per second.

Fluid and temperature compatibility must be considered when selecting the inlet line.

Pump and Motor Case Drain Lines

The case drain lines should be large enough to limit the pump and motor case pressures to 2,8 bar (40 psi) at normal operating temperatures. Fluid and temperature compatibility must also be considered when selecting the case drain lines.

High Pressure Lines

The high pressure lines that connect the pump and motor must be able to withstand the pressures generated in the high pressure loop.

Heat Exchanger

Use of a heat exchanger is dependent on the transmission's duty cycle and on machine layout. The normal continuous operating fluid temperature measured in the pump and motor cases should not exceed 80°C (180°F) for most hydraulic fluids. The maximum fluid temperature should not exceed 105°C (220°F).

The heat exchanger should be sized to dissipate 25% of the maximum input power available to the transmission. It must also be sized to prevent the case pressures in the pump and motor from getting too high. Case pressure up to 2.8 bar (40 psi), at normal operating temperatures, are acceptable.

Heat Exchanger Bypass Valve

The heat exchanger bypass valve is a pressure and/ or temperature valve in parallel with the heat exchanger. Its purpose is to prevent case pressures from getting too high. The heat exchanger bypass valve opens when the oil is thick, especially during cold starts.

Reservoir Return Line

The same general requirements that apply to case drain lines apply to the reservoir return line.

Shaft Couplings and Mounting Brackets

Shaft couplings must be able to with stand the torque that will be transmitted to the pump or motor. If the pump or motor is to be directly coupled to the drive, the misalignment should not exceed .050 mm (.002 in.) total indicator run-out for the combination of perpendicularity and concentricity measurements.

The hardness of the couplings connected to Eaton pump or motor shafts should be 35 Rc for tapered or straight keyed shafts and 50-55 Rc for splined shafts.

Open Loop Circuits

Eaton heavy duty pumps and heavy duty motors may be used in open loop circuits under certain operating conditions. Consult your Eaton representative for details.

Orientation

The mounting orientation of Eaton heavy duty pumps and motors is unrestricted. The case drain line that carries the flow leaving the pump or motor should be connected to the highest drain port on each of the units. This assures that the pump and motor cases remain full.

Multiple Pump or Motor Circuits

Multiple pumps or motors can be combined in the same circuit. When two pumps are used in a parallel circuit, their swashplate controls can be operated in phase or in sequence. The following precautions should be observed whenever multiple pumps and/or motors are connected in the same circuit:

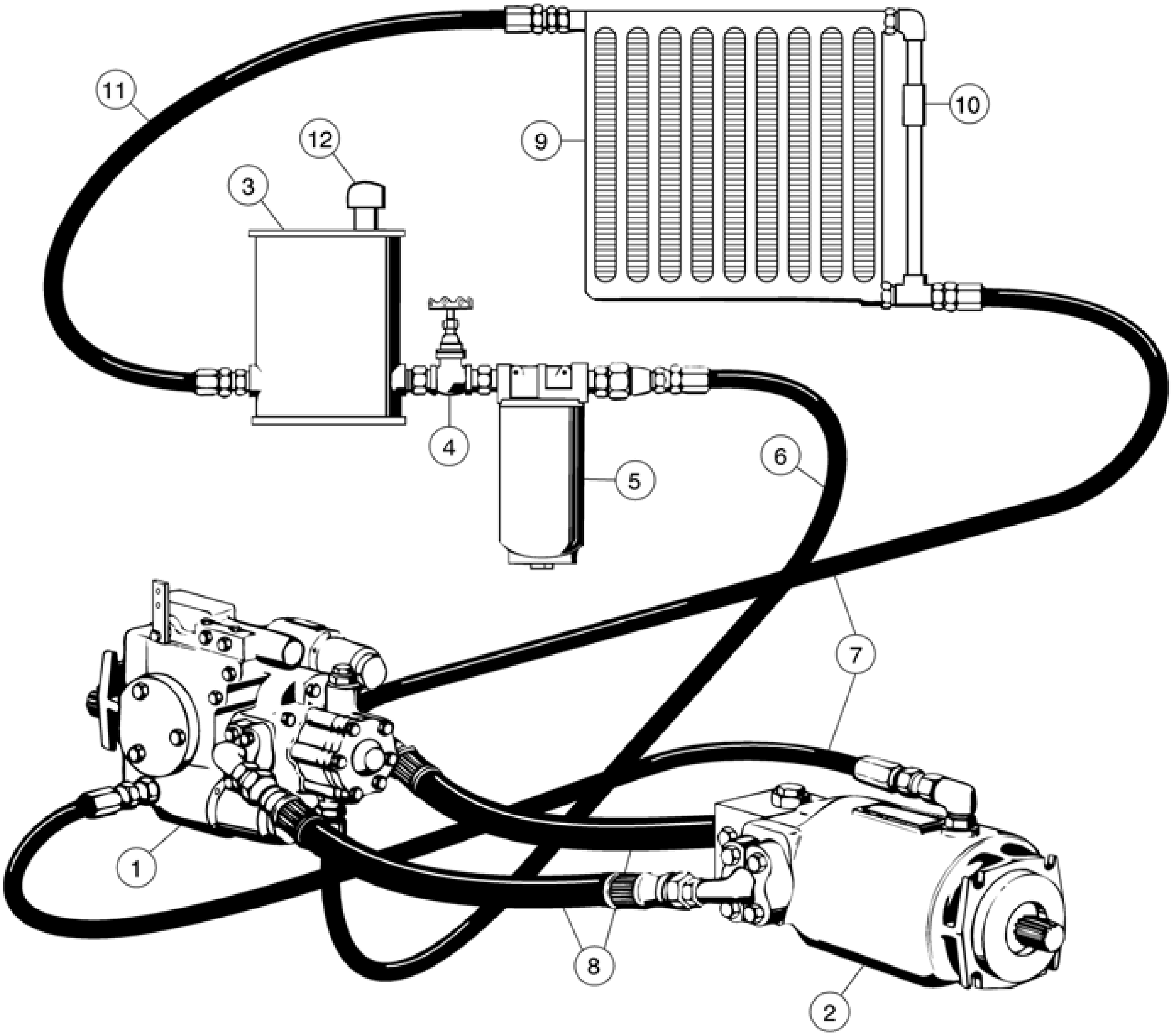
1. Charge pump flow must be greater than the sum of the charge pump flow requirements of the individual units.

2. The possibility of motor overspeeding increases in multiple motor circuits. The parallel motor circuit will act as a frictionless differential. Should one of the motors stall the other could overspeed. The motors used in parallel circuits should, therefore, be sized to prevent overspeeding. Valves that will limit the flow to each of the motors may be used to prevent overspeeding. This will allow the use of smaller motors, however the flow limiting valves will create heat.

3. When using one pump with multiple motors, the case drain lines should be connected in series. The case flow should be routed from the most distant motor, through the remaining motors, to the pump, and finally back to the reservoir. The most distant motor should have the valve block or integral shuttle valve while the additional motors do not need a valve block or integral shuttle valve. A remote valve block is also available for multiple motor circuits. A series-parallel drain line circuit may be needed for the high case flow created in multiple pump circuits. In either case, each pump and motor should be checked for proper cooling when testing the prototype circuit.

4. Series circuits present a unique problem for axial piston motors. Pressure applied to the input port and discharge port are additive as regards to the load and life of the drive shaft and the drive shaft bearings. Please consult with your Eaton representative regarding series circuits.

Description of Operation



← Direction of case flow and charge pump inlet flow.

1 – Variable Displacement Pump
2 – Fixed or Variable Displacement Motor
3 – Reservoir
4 – Shut-off Valve (Optional)
5 – Filter
6 – Charge Pump Inlet Line
7 – Pump and Motor Case Drain LInes
8 – High Pressure Lines
9 – Heat Exchanger
10 – Heat Exchanger By-pass Valve
11 – Reservoir Return Line
12 – Reservoir Fill Cap and Breather

A hydrostatic transmission is a dynamic system that operates through a wide range of conditions. Nevertheless, this wide operating range can conveniently be divided into three basic modes: neutral, forward and reverse.

The following color schematics and their accompanying explanations will help you visualize what's going on inside the transmission during each of the operating modes.

Important: As you study the following flow descriptions remember that in all modes of operation the input shaft of the pump is being turned by an external power source.

Neutral

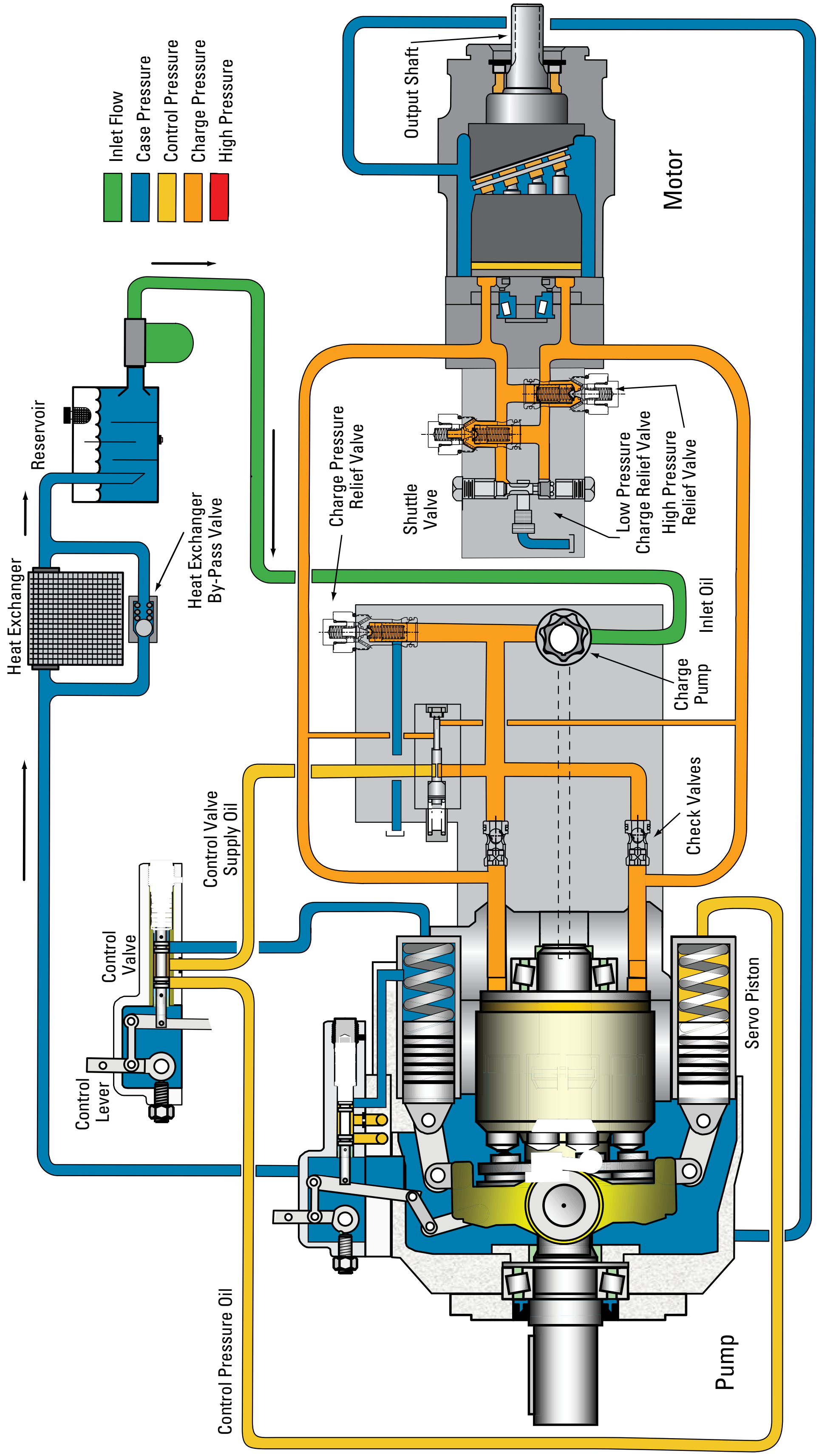
The hydrostatic transmission is in neutral when the variable pump's displacement is zero. With zero displacement no high pressure oil is pumped to the motor and its output shaft is stopped. Refer to the "Neutral" color schematic as you read this explanation.

Putting the control lever in the neutral position centers the control spool. Centering the control spool connects both lines to the serve pistons to case and blocks the control pressure line. Connecting the servo piston lines to case allows the oil to drain from the servo pistons and the servo springs center the variable swashplate. With the swashplate centered the pistons don't reciprocate as the cylinder barrel is rotated, and no high pressure oil is pumped.

The charge pump, which is connected to the input shaft, pumps oil in all modes of transmission operation. In neutral it takes cooled, filtered oil from the reservoir and fills the system. Charge pump flow passes through the check valves in the pump's end cover and fills the pump's pistons, the high pressure lines, and the motor's pistons. This oil flow is intended to make up for internal leakage and keep the circuit primed.

After the high pressure circuit has been primed the charge pump pressure opens the charge pressure relief valve located in the charge pump. This directs the charge pump flow through the pump case and back to the reservoir. This oil flow flushes and cools the pump.

Axial Piston Variable Displacement Pump & Fixed Displacement Motor Schematic



The forward mode and the reverse mode are similar, so hence forth they will be grouped and called the forward/reverse mode.

Forward/Reverse

The hydrostatic transmission is in forward/reverse mode when flow in the high pressure circuit causes the motor shaft to rotate. Refer to the forward/reverse color schematic as you can read this explanation.

Flow in the high pressure circuit is created by tilting the pump's variable swashplate from its center, or neutral, position. With the swashplate tilted the pistons reciprocate as the cylinder barrel rotates and flow is generated.

The swashplate may be tilted to either side of center. Tilting it one way generates flow that makes the transmission go forward. And tilting it the other way reverses flow and the motor shaft rotates in the opposite direction.

Besides controlling direction, the swashplate angle also controls output speed. Swashplate angle affects speed by changing the pump's displacement. The largest swashplate angle produces the largest displacement and the fastest motor speed.

The standard control circuit has a single lever that sets both speed and direction. Center the lever for neutral. Move it to one side of center for forward, the other side for reverse. Motor speed is controlled by how far the lever is moved.

The control circuit varies the swashplate angle by directing control pressure to either of the servo pistons. Control pressure, at the charge pressure relief valve setting, is supplied to the control valve by the charge pump. In the forward/reverse schematic control pressure is directed to the lower servo piston which causes the swashplate to tilt. Oil in the upper servo sleeve drains to case, through the control valve, as the swashplate tilts.

The follow-up link, between the swashplate and control valve, holds the swashplate at the angle set by the control lever. As the swashplate moves to the desired angle the follow-up link moves the control spool so that it opens/closes the lines to the servo pistons. The swashplate will hold that position until the control lever is moved.

Charge pump flow that is not used by the control circuit passes through the end cover check valve into the low pressure side of the loop. There it provides back pressure to the motor pistons.

The spring centered shuttle valve, located in the motor's valve block, moves to connect the low pressure side of the loop to the charge pressure relief valve. When back pressure gets high enough the charge pressure relief valve, in the valve block, opens and charge pump flow enters the motor case.

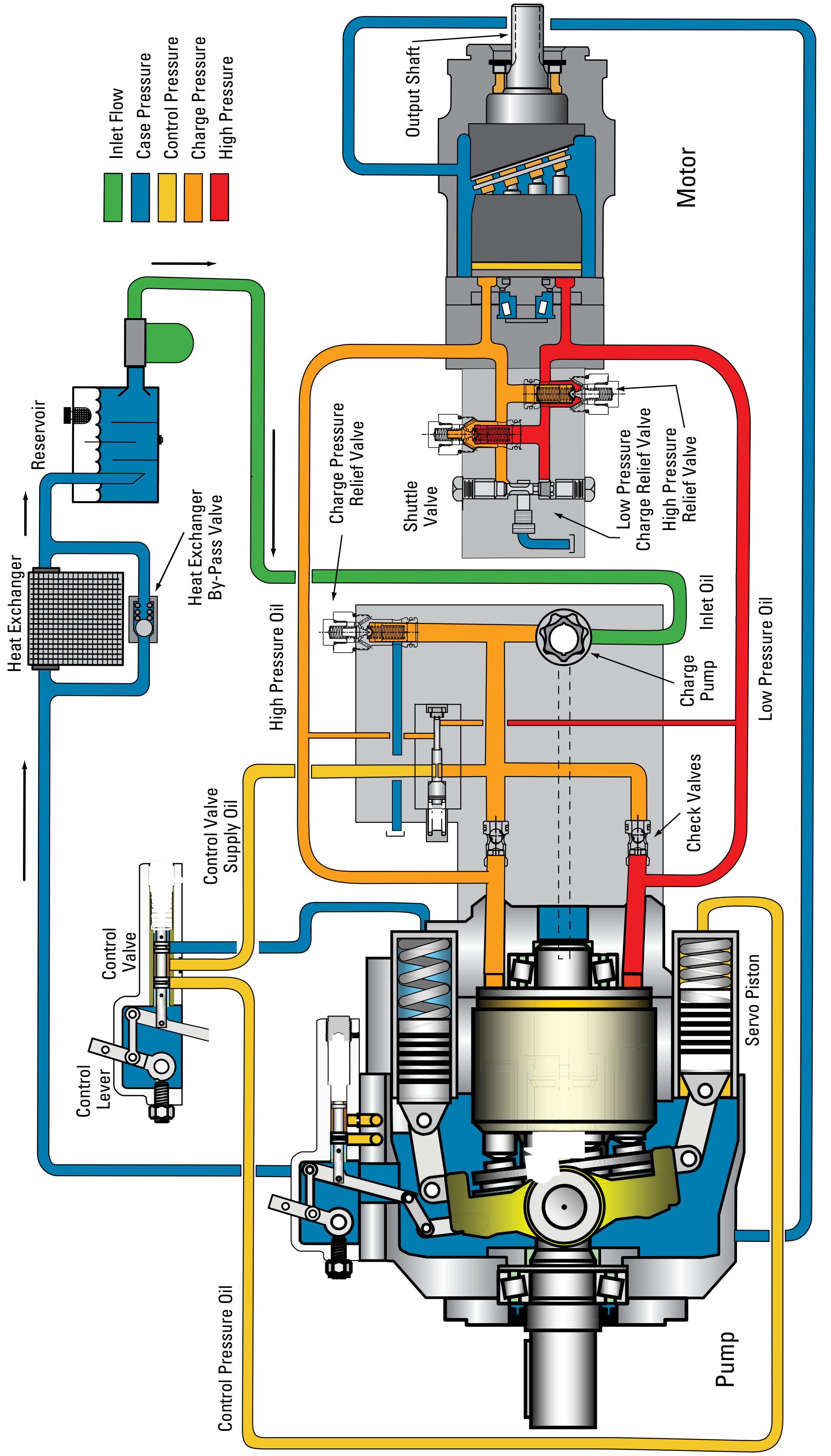
Case flow flushes the pump and motor cases and helps keep the transmission cool. The charge pressure relief valve in the motor's valve block typically has a lower setting than the charge pressure relief valve in the charge pump. This is so case flow will begin at the motor, go to the pump, and return to the reservoir. The arrows on the drawing a A Typical Heavy Duty Hydrostatic Transmission, page 4, show case flow's path.

The charge pressure relief valve in the charge pump opens when the transmission is in neutral and the shuttle valve is centered. Compare the shuttle valve in each of the color schematics to better understand its operation.

The high pressure relief valves in the motor's valve block open to connect the high pressure side of the loop to the low pressure side if the motor stalls and the pressure gets too high. There are two high pressure relief valves; one works in forward the other in reverse.

Flow Description – Forward/Reverse

Axial Piston Variable Displacement Pump & Fixed Displacement Motor Schematic



Objective

The ability of Eaton hydrostatic components to provide the desired performance and life expectancy depends largely on the fluid used. The purpose of this document is to provide readers with the knowledge required to select the appropriate fluids for use in systems that employ Eaton hydrostatic components.

Selecting a Hydraulic Fluid

The hydraulic fluids in hydraulic systems are bound to perform in different dimensions. They serve as the power transmission medium, lubricate the moving components and carry away the heat produced within the system. Therefore the fluids must have adequate properties to give the assurance of adequate wear protection, effective power transmission and excellent chemical stability under the most adverse operating conditions. The multi dimensional performance establishes that the hydraulic fluid is a vital factor in a hydraulic system; proper selection of oil assures satisfactory life and operation of the system components / lubricants.

Viscosity

The most important characteristics to consider when choosing a fluid to be used in a hydraulic system are viscosity. The fluid must be thin enough to flow easily but thick enough to seal and maintain a lubricating film between bearing and sealing surfaces. Viscosity requirements for Eaton's Heavy Duty Hydrostatic product line are specified later in this document

Viscosity and Temperature

Temperature and viscosity are related inversely. As the fluid warms it gets thinner and its viscosity decreases. When fluid cools the fluid viscosity increases. It is important to consider the entire operating temperature window for selecting the right viscosity for a hydraulic system. Calculate the viscosity of the fluid temperatures at start up, normal operating conditions and maximum possible point, and compare the same with the recommendation of the hydraulic system.

Generally, the fluid is thick when the hydraulic system is started. With movement, the fluid warms to a point where the cooling system begins to operate. From then on, the fluid is maintained at the temperature for which the hydrostatic system was designed. In actual applications this sequence varies; hydrostatic systems are used in many environments from very cold to very hot. Cooling systems also vary from very elaborate to very simple, so ambient temperature may affect operating temperature. Equipment manufacturers who use Eaton hydrostatic components in their products should anticipate temperature in their designs and make the appropriate fluid recommendations to their customers.

In general, a lower ISO viscosity grade fluid is recommended for operation in cold to moderate climates. Higher ISO viscosity grade fluid is recommended for operation in moderate to hot climates.

Cleanliness

Cleanliness of the fluid in a hydrostatic system is extremely important. Eaton recommends that the fluid used in its hydrostatic components be maintained at ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5 µm and a maximum of 80 particles per milliliter greater than 15 µm. When components with different cleanliness requirements are used in the same system, the cleanest standard should be applied. OEM's and distributors who use Eaton hydrostatic components in their products should provide for these requirements in their designs. A reputable filter supplier can supply filter information.

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Viscosity and Cleanliness Guidelines

Product Line	Minimum	Optimum Range	Maximum	ISO Cleanliness Requirements
Heavy Duty Piston	10cSt	16 - 39 cSt	2158 cSt	18/13
Pumps and Motors	(60 SUS)	(80 - 180 SUS)	(10,000 SUS)	

Notes:

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. Motor cavitation is not a problem during cold start-ups. Thick oil can cause high case pressures which in turn cause shaft seal problems.
- If the natural color of the fluid has become black it is possible that an over-heating problem exists.
- If the fluid becomes milky, water contamination may be a problem.
- Take fluid level reading when the system is cold.
- Viscosity modified fluid may lose viscosity due to shearing of viscosity improvers.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydrostatic components.

Fluid Maintenance

Maintaining correct fluid viscosity and cleanliness level is essential for all hydrostatic systems. Since Eaton hydrostatic components are used in a wide variety of applications it is impossible for Eaton to publish a fluid maintenance schedule that would cover every situation. Field testing and monitoring are the only ways to get accurate measurements of system cleanliness. OEM's and distributors who use Eaton hydrostatic components should test and establish fluid maintenance schedules for their products. These maintenance schedules should be designed to meet the viscosity and cleanliness requirements laid out in this document.

Fluid Selection

AW Hydraulic Oil

Premium grade petroleum based AW hydraulic fluids will provide the best performance in Eaton hydrostatic components. These fluids typically contain additives that are beneficial to hydrostatic systems. Eaton recommends fluids that contain anti-wear agents, rust inhibitors, anti-foaming agents, and oxidation inhibitors. Premium grade petroleum based hydraulic fluids carry an ISO VG rating.

Pump performance and reliability are directly affected by the anti-wear additive formulation contained in the oil. Oils providing a high level of anti-wear protection are recommended for optimum performance and long life.

Eaton has its own method to estimate Mineral / Petroleum based AW hydraulic oils for their anti-wear property. The fluid must pass Eaton Vickers® 35VQ25 pump test or meet the performance specification Eaton Vickers M 2950 S.

Engine Oils / Motor Oils

Engine oils using for hydraulic applications, must meet API SF / SG / SH or higher performance specifications. Appropriate SAE Grade to be selected based on the operating temperatures.

Additional Notes:

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. Motor cavitation is not a problem during cold start-ups. Thick oil can cause high case pressures which in turn cause shaft seal problems.
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky, water contamination may be a problem.
- Take fluid level reading when the system is cold.
- Viscosity Modified fluid may loose viscosity due to shearing of viscosity improvers.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydrostatic components.

Biodegradable Oil (Vegetable) Guidelines

Product Line	Rating With Biodegradable Oil	Comments
Heavy Duty Piston Pumps and Motors	80% of normal pressure rating listed for mineral oils	82° C (180° F) max fluid temp (unit) 71° C (160° F) max fluid temp (reservoir)

Additional Notes:

- Viscosity and ISO cleanliness requirements must be maintained as outlined on previous page.
- For any system where the fluid is non-petroleum oil, set the target one Range Code cleaner for each particle size, than that of petroleum fluids.

  If the cleanest code required was 19/17/15 and HETG is the system fluid, the target becomes 18/16/14.
- Based on limited product testing to date, no reduction in unit life is expected when operating at the pressure ratings indicated above.
- Vegetable oil is miscible with mineral oil. However, only the vegetable oil content is biodegradable. Systems being converted from mineral oil to vegetable oil should be repeatedly flushed with vegetable oil to ensure 100% biodegradability.
- Specific vegetable oil products may provide normal unit life when operating at pressure ratings higher than those indicated above.
- Vegetable oils oxidize more quickly than petroleum based hydraulic fluid. Care must be taken to maintain fluid temperature within specified limits and to establish more frequent fluid change intervals
- All seals must be Fluorocarbon (FKM) / Viton / HNBR.
- Specific gravity of the fluid is 0.92. Design circuit with reservoir oil level sufficiently above the pump inlet to assure a minimum of 1.0 bar absolute pressure at pump.
- Water contamination may degrade the fluid - 0.07% wt Maximum. Precaution to be taken to avoid water contamination.
- Foaming and aeration can be greater with this fluid than petroleum base oils. Reservoir may be designed to give maximum retention time for effective air release.
- TAN - 2.0 mg KOH/gm Max increase in total acid number from the start up value.

Notes

Notes

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