1.4.3 Charge Pump Sizing Worksheet

Customer: _____ Date: _____

Application: _____

Leakage

"Pump" refers to hydrostatic pump, not charge charge. Actually, a portion of all inefficiencies can be attributed to crossport leakage between high and low system loops. Since the charge pump needs to replace only fluid leaking past the rotating kits (case flow), the calculations below are somewhat conservative. If case flow values are available, they should be used instead of the equations below.

System Pressure _____ psi

Pump
- Series _____
- Frame Size _____
- Speed _____ RPM
- Volumetric Efficiency _____ %
- Leakage _____ gpm

$$\text{Pump Flow} = \frac{\text{Pump Disp x Pump RPM}}{231} \times \frac{\text{Pump Efficiency}}{100}$$

$$\text{Pump Leakage} = \frac{\text{Pump Disp x Pump RPM}}{231} \times \left(1 - \frac{\text{Pump Efficiency}}{100}\right)$$

Motor #1
- Series _____
- Frame Size _____
- Speed _____ RPM
- Volumetric Efficiency _____ %
- Leakage _____ gpm

$$\text{Motor Speed} = \frac{\text{Pump Flow x Motor Efficiency}}{\text{Motor Disp x \# Motors}}$$

$$\text{Motor Leakage} = \frac{\text{Pump Flow}}{\text{\# Motors}} \times \left(1 - \frac{\text{Motor Efficiency}}{100}\right)$$

Motor #2
- Series _____
- Frame Size _____
- Speed _____ RPM
- Volumetric Efficiency _____ %
- Leakage _____ gpm

Consult product technical information bulletins for values of volumetric efficiency.

Total Leakage _____ gpm

Control Requirements

Control Type
- ____ DDC
- ____ MDC _____ gpm
- ____ HDC _____ gpm
- ____ EDC _____ gpm
- ____ Other _____ gpm

$$\text{Flow} = \frac{\text{Servo Volume x 0.26}}{\text{Stroke Time}}$$

For most applications with 1-3 second stroke times, assume a value of 0.5 gpm.

For atypical stroke times, use the chart and equation shown at right.

For pumps with EDC controls, add 0.75 gpm to the servo flow to allow for losses in the PCP.

Series	Servo Volume (in^3)
Series 40	
M46	1.5
Series 42	
28cc	1.0
41cc	1.5
Series 90	
42cc	1.0
55cc	1.3
75cc	1.7
100cc	2.5
130cc	3.5
180cc	5.0
250cc	5.0

Charge Pump Sizing Worksheet (cont.)

Loop Flushing

Loop Flushing flow _____ gpm

The amount of loop flushing will normally vary between 2-4 gpm depending on the charge pump displacement, input speed, and relative settings between the pump and motor charge relief valves.

Fluid Compressibility

Magnitude of pressure spike _____ psi
Time duration _____ sec.
Bulk modulus _____ psi
Hose length _____ feet
Hose I.D. _____ inches
Hose Volume _____ in^3

Charge flow required _____ gpm

Hose Volume = $V = (9.42) \times (I.D.)^2 \times (Length)$

$$Q = \frac{\Delta P \cdot (V)}{(BM) \cdot \Delta t} \cdot 0.26$$

where
Q = additional charge flow required (gpm)
ΔP = change in pressure (gpm)
BM = bulk modulus (psi)
Δt = time duration for pressure change (sec)

Auxiliary Functions

Hydraulically released brakes _____ gpm
Two-speed motor shifting _____ gpm
Cylinders _____ gpm
Other components _____ gpm

Total auxiliary flow _____ gpm

Total Charge Flow Required

Leakage + Control + Loop Flushing + Compressibility + Auxiliary = _____ gpm

Select a preliminary charge pump displacement:

Charge pump displacement _____ in^3
Volumetric efficiency _____ %
Charge flow provided _____ gpm

$$\text{Charge flow} = \frac{(\text{Ch Disp}) \times (\text{Input Speed}) \times (\text{Ch Efficiency})}{231}$$

Is the charge pump capable of providing adequate charge flow?

If not, a larger displacement size must be selected, or an external charge supply must be provided.