# FLUID POWER
Design Data Sheet-

Revised Sheet 2 — Womack Design Data File

MATCHING THE SIZE OF A BROKEN PUMP OR MOTOR

To select a replacement for a broken or worn-out hydraulic pump or motor which has no nameplate or has no rating marked on its case, the formulae on this sheet may be used to calculate its displacement after making physical measurements of the internal elements.
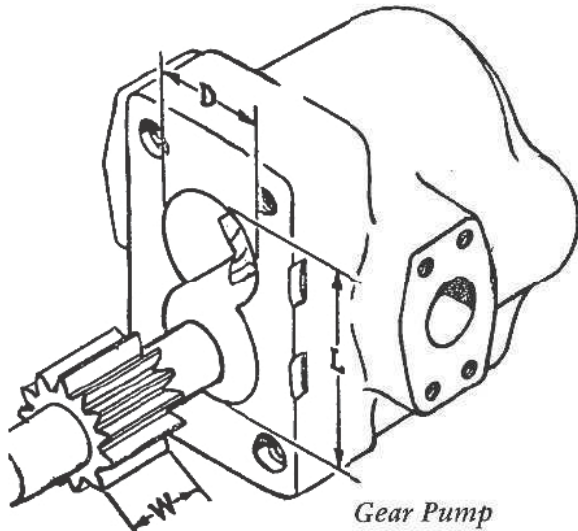
Gear Pump

Vane Pump

When replacing a pump, catalog ratings will usually be shown in GPM at a specified shaft speed. On motors, catalog ratings will usually be shown as C.I.R. (cubic inches displacement per shaft revolution). Formulae are shown for calculating either GPM at 1800 RPM or calculating C.I.R. Use the formula which is appropriate.

Make all measurements in inches, and as accurately as possible. Convert fractional dimensions into decimal equivalents for use in formulae. See conversions on back side of this sheet.

When selecting a new pump or motor, be sure the catalog pressure rating is adequate for your application, and in the case of a pump, be sure the direction of shaft rotation is the same as for the old pump.

GEAR PUMPS AND MOTORS

1. Measure gear width. This is W in the formulae.
2. Measure bore diameter of one of the gear chambers. This is D in the formulae.
3. Measure distance across both gear chambers. This is L in the formulae.

$$GPM @ 1800\ RPM = 47 \times W \times (2D - L) \times \frac{(L - D)}{2}$$

A speed of 1800 RPM is used in the formula. At other speeds, GPM will be directly proportional to RPM.

$$C.I.R.\ Displ. = 6 \times W \times (2D - L) \times \frac{(L - D)}{2}$$

VANE PUMPS AND MOTORS

(Balanced type, not variable displacement)

1. Measure width of rotor. This is W in the formulae.
2. Measure shortest distance across bore. This is D.
3. Measure longest distance across bore. This is L.

$$GPM @ RPM = 94 \times W \times \frac{(L + D)}{4} \times \frac{(L - D)}{2}$$

A speed of 1800 RPM is used in the formula. At other speeds GPM will be proportional to speed.

$$C.I.R.\ Displ. = 12 \times W \times \frac{(L + D)}{4} \times \frac{(L - D)}{2}$$

PISTON PUMPS AND MOTORS

(See formulae on back side of this sheet)

1. Find piston area from piston diameter. This is A in the formulae.
2. Measure length of piston stroke. This is L in formulae.
3. Count the number of pistons. This is N in formulae.

64ths	32nds	16ths	8ths	4ths	Decimal Inches	Milli-metres
1/64					.01562	0.397
- - - -	1/32				.03125	0.794
3/64					.04688	1.191
- - - -		1/16			.06250	1.588
5/64					.07812	1.984
- - - -	3/32				.09375	2.381
7/64					.10938	2.788
- - - -			1/8		.12500	3.175
9/64					.14062	3.572
- - - -	5/32				.15625	3.969
11/64					.17188	4.366
- - - -		3/16			.18750	4.763
13/64					.20312	5.159
- - - -	7/32				.21875	5.556
15/64					.23438	5.953
- - - -				1/4	.25000	6.350
17/64					.26562	6.747
- - - -	9/32				.28125	7.144
19/64					.29688	7.541
- - - -		5/16			.31250	7.938
21/64					.32812	8.334
- - - -	11/32				.34375	8.731
23/64					.35938	9.128
- - - -		3/8			.37500	9.525
25/64					.39062	9.922
- - - -	13/32				.40625	10.319
27/64					.42188	10.716
- - - -		7/16			.43750	11.113
29/64					.45312	11.509
- - - -	15/32				.46875	11.906
31/64					.48438	12.303
- - - -			1/2		.50000	12.700
33/64					.51562	13.097
- - - -	17/32				.53125	13.494
35/64					.54688	13.891
- - - -		9/16			.56250	14.288
37/64					.57812	14.684
- - - -	19/32				.59375	15.081
39/64					.60938	15.478
- - - -		5/8			.62500	15.875
41/64					.64062	16.272
- - - -	21/32				.65625	16.669
43/64					.67188	17.066
- - - -		11/16			.68750	17.463
45/64					.70312	17.859
- - - -	23/32				.71875	18.256
47/64					.73438	18.653
- - - -				3/4	.75000	19.050
49/64					.76562	19.447
- - - -	25/32				.78125	19.844
51/64					.79688	20.241
- - - -		13/16			.8125	20.638
53/64					.82812	21.034
- - - -	27/32				.84375	21.431
55/64					.85938	21.828
- - - -		7/8			.87500	22.225
57/64					.89062	22.622
- - - -	29/32				.90625	23.019
59/64					.92188	23.416
- - - -		15/16			.93750	23.813
61/64					.95312	24.209
- - - -	31/32				.96875	24.606
63/64					.98438	25.003

$$GPM @ 1800\ RPM = A \times L \times N \times 1800 \div 231$$

A speed of 1800 RPM is used in the formula. At other speeds, GPM will be proportional to RPM.

$$C.I.R.\ Displ. = A \times L \times N$$

Notes: After finding GPM or C.I.R. rating of the old pump or motor, choose a replacement with as near as possible the same rating at zero pressure.

If necessary to choose a pump with higher GPM rating, it will require more input HP to produce the same pressure, and cylinders or motors in the system will move faster. If necessary to choose a pump with lower GPM rating, it will require less HP input to produce the same pressure but cylinders and motors will move more slowly.

If necessary to choose a motor with greater displacement, it will produce higher torque at the same pressure than the original motor but will rotate more slowly. The system will require the same HP as before but will deliver a different ratio of torque and speed. If the new motor has less displacement, it will have less torque at the same pressure but will run faster. The system will run at the same HP but with a different ratio of torque and speed.

EQUIVALENTS — Fractions to Decimals and Millimetres

The table on the left converts inch fractions to inch decimals or millimetres. Since 1 inch = 25.4 mm, millimetre equivalents = inch decimal equivalents multiplied by 25.4.

EQUIVALENTS
Millimetres to Decimal Inches

Figures in the table below convert millimetres into decimal inches and are calculated from: 1 inch = 25.4 mm, or 1 mm = .03937 inches.

mm	Inches	mm	Inches	mm	Inches	mm	Inches
1/4	.00984	18	.70866	38	1.4961	58	2.2835
1/2	.01970	19	.74803	39	1.5354	59	2.3228
3/4	.02953	20	.78740	40	1.5748	60	2.3620
1	.03937	21	.82677	41	1.6142	61	2.4016
2	.07874	22	.86614	42	1.6534	62	2.4409
3	.11811	23	.90551	43	1.6929	63	2.4803
4	.15748	24	.94488	44	1.7323	64	2.5197
5	.19685	25	.98425	45	1.7727	65	2.5591
6	.23622	26	1.0236	46	1.8110	66	2.5984
7	.27559	27	1.0270	47	1.8504	67	2.6378
8	.31496	28	1.1024	48	1.8898	68	2.6772
9	.35433	29	1.1417	49	1.9291	69	2.7165
10	.39370	30	1.1811	50	1.9685	70	2.7559
11	.43307	31	1.2205	51	2.0079	71	2.7953
12	.47244	32	1.2598	52	2.0472	72	2.8346
13	.51181	33	1.2992	53	2.0866	73	2.8740
14	.55118	34	1.3386	54	2.1260	74	2.9134
15	.59055	35	1.3780	55	2.1654	75	2.9528
16	.62992	36	1.4173	56	2.2047	76	2.9921
17	.66929	37	1.4567	57	2.2441	77	3.0315