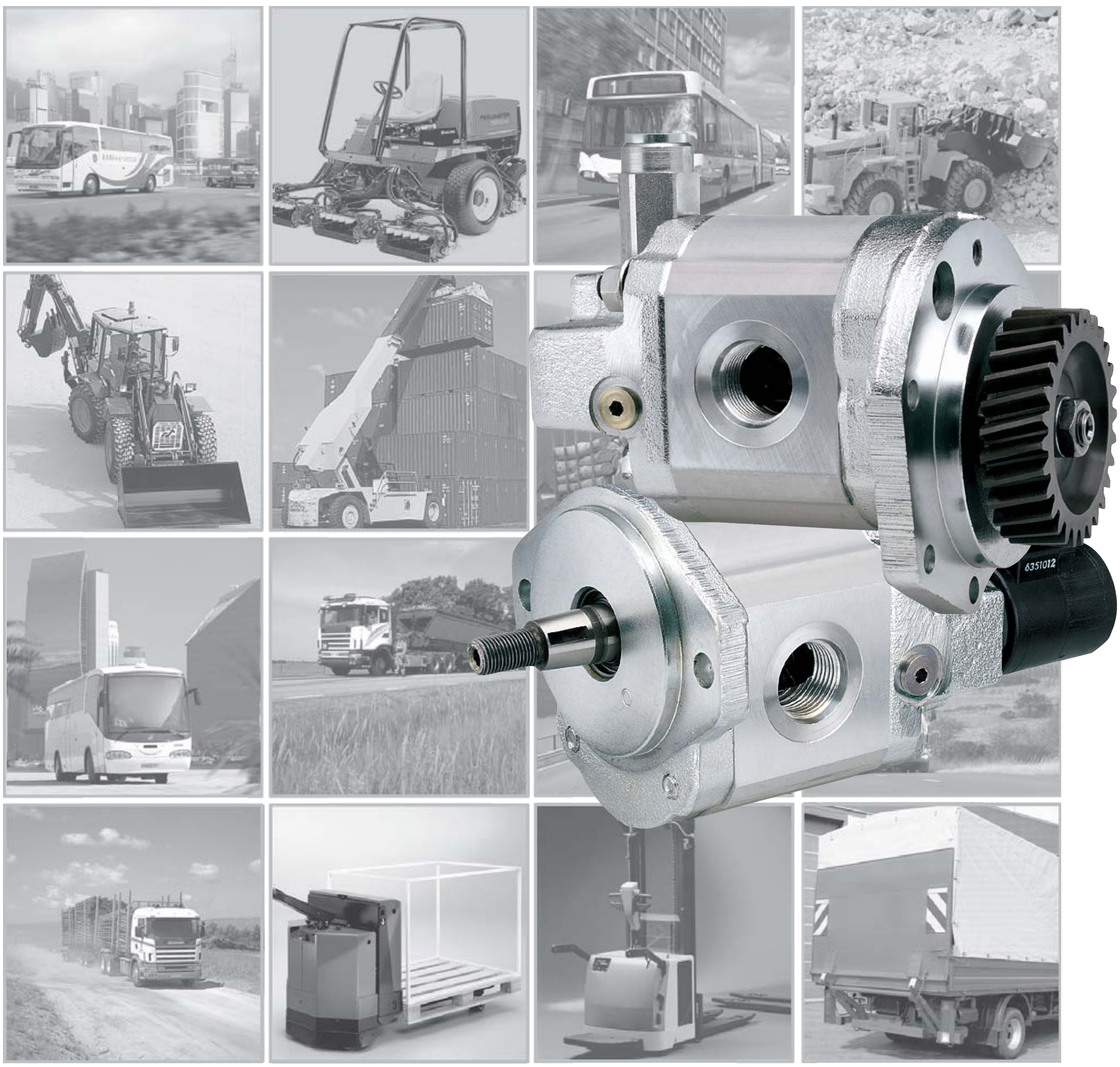
CONCENTRIC

HYDRAULIC FAN DRIVE SYSTEMS



Concentric AB

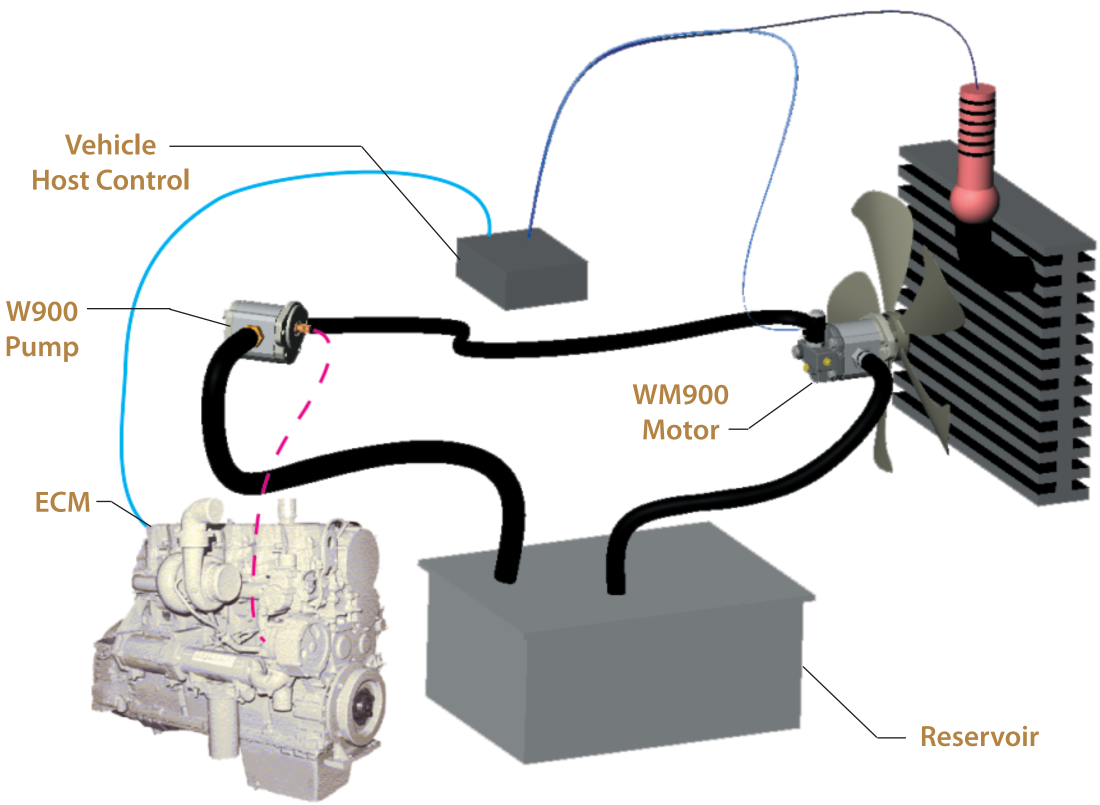
Innovation in Hydraulics

Concentric Hydraulic Fan Drives

The demand for increased energy savings, reduced emissions and reduced noise in vehicles is requiring that vehicle engineers question traditional design approaches and traditional systems. One area of focus on vehicles ranging from buses to excavators is cooling systems.

Concentric fan drive systems offer significant advantages to cooling system designers when compared to traditional belt and electric fan drive systems. These advantages include:

- Fan speed independent of engine speed
- Precise control of coolant temperature
- On-Demand cooling capability which eliminates excess power consumption
- Reduced noise
- Reduced emissions
- Flexibility in cooling system design



The Concentric fan drive offering includes systems that range from simple to complex. System designers can choose the option best suited to the design criteria driving each vehicle and cooling system project. The fan drive systems and components within this catalog are not all inclusive regarding system solutions. For instance, the fan drive system may also be integral to the hydrostatic drive charge pump system, the brake charging system, the pilot control valve system, etc. Concentric has provided fan drive system solutions for all these and many other types of integrations. Solutions from the vehicle perspective are one of our core competencies. We have many other products (pumps, electrohydraulic power systems, valves, etc.) that may be applicable to your application. Therefore, if you do not find the specific solution within this catalog, contact Concentric for assistance. We will engineer a solution specifically for your vehicle.

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About This Catalog

Concentric is a leader in the design and application of Hydraulic Fan Drive systems. This catalog has been designed to be a tool to assist you in selecting the fan drive system that best meets your vehicle needs. A simple guide to mating the system to your objectives is included on Page 4. Pages 5-10 outline each type of fan drive system and the various circuits available for each type of system. The systems are:

- Follows Engine Speed
- On / Off
- Independently Variable
- Two Speed

A typical performance map is included for each circuit along with a circuit diagram. A very detailed guide to applying a fan drive system is featured on Page 11. A quick reference to the full line of Concentric pumps and fluid motors is included on Page 14. The catalog also describes the electronic controls that are available for controlling fan drive systems as well as guidance in specifying the control parameters required for your system.

When used in conjunction with the Concentric Hydraulic Motor catalog, this catalog allows for the fan drive system you have chosen to be specified by model code. In addition, a staff of knowledgeable applications specialists is available to assist you with any of your custom requirements.

Table of Contents

Selecting The Best System For Your Needs

The system drivers shown on the "Y" axis generally provide an initial indication of the basic type of fan drive system to pursue:

Matrix of criteria vs. type of hydraulic fan drive systems. Select two drivers.

	Follows Engine Speed: No Over Speed Protection		Follows Engine Speed: w/ Over Speed Protection		On / Off		Independently Variable		2 Speed	
Cost	5		4		3		1		2	
Noise	1		2		3		5		4	
Temperature control	1		2		4		5		3	
Efficiency	1		2		4		5		3	
TOTALS										

INSTRUCTIONS:

1. Choose your most important drivers (cost, noise, temperature control or efficiency) for determining the appropriate fan drive system. You may choose any number of these drivers.
2. Assign a number between 1 and 10 for importance to the drivers you have chosen (10 being the highest importance).
3. Place these numbers in the boxes to the left of the drivers.
4. Multiply the importance number by the number in each circuit column. (ex. check valve circuit: 5, 1, 1, 1, etc.) Then put that product into the box to the right.
5. Total the numbers in the boxes for each circuit column. The highest total represents the system that will most likely fit your needs.

EXAMPLE: Assuming ***Cost*** and ***Temperature Control*** are the most important drivers. ***Cost*** is ranked as a ***9*** and ***Temperature Control*** as a ***7***. (See scenario below.)

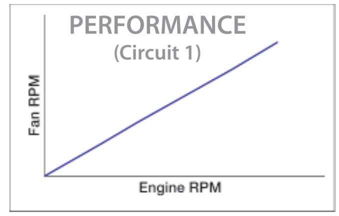
		Follows Engine Speed: No Over Speed Protection		Follows Engine Speed: w/ Over Speed Protection		On / Off		Independently Variable		2 Speed	
9	Cost	5	45	4	36	3	27	1	9	2	18
	Noise	1		2		3		5		4	
7	Temperature control	1	7	2	14	4	28	5	35	3	21
	Efficiency	1		2		4		5		3	
	TOTALS	52		50		55		44		39	

An ***On / Off*** will be most likely to fit your needs for your hydraulic fan drive system. Of course, other system parameters may override this choice.

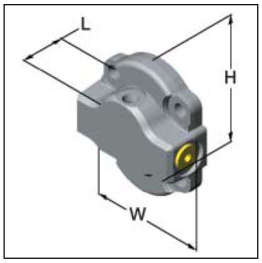
System Descriptions

FAN DRIVE SYSTEMS: Follows Engine Speed

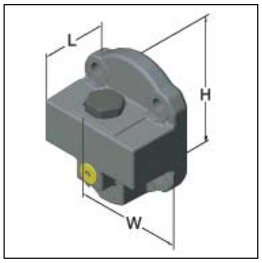
No Over Speed Protection



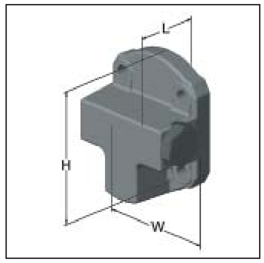
Circuit 1 - Check valve to prevent cavitation during deceleration and spin-down.



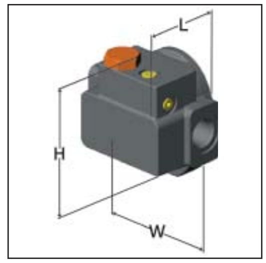
WM600



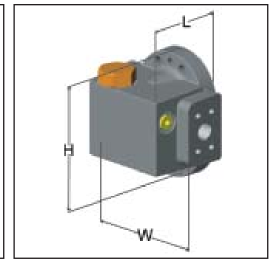
WM900



WM1500

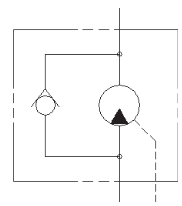


FM20



FM30

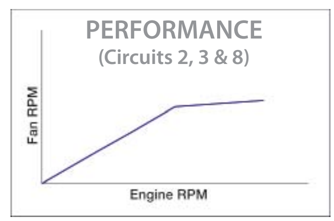
FAMILY	L*	W	H
WM600	13 [.51]	77 [3.03]	86 [3.38]
WM900	32 [1.25]	88 [3.46]	106 [4.17]
WM1500	40 [1.57]	115 [4.52]	135 [5.31]
GM20	32 [1.25]	149 [5.86]	164 [6.45]
GM30	35 [1.37]	171 [6.73]	183 [7.2]



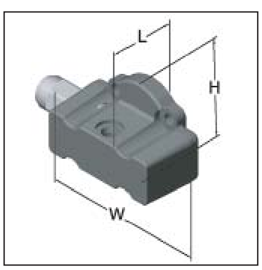
*** Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 32 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 32 mm + 111 mm = 143 mm [5.62 in.] max. length.

FAN DRIVE SYSTEMS: Follows Engine Speed

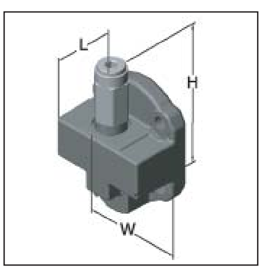
w/ Over Speed Protection



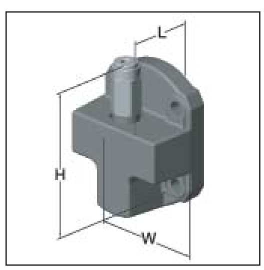
Circuit 2 - Relief valve to limit the maximum motor speed and protect the motor from over-pressurization.



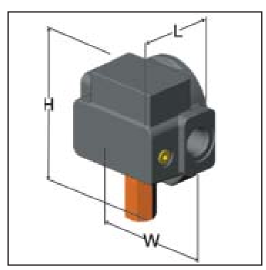
WM600



WM900



WM1500



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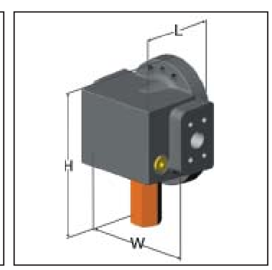
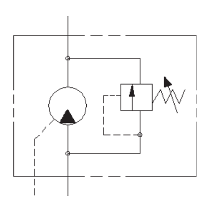


FM30

FAMILY	L*	W	H
WM600	37 [1.45]	140 [5.51]	86 [3.38]
WM900	32 [1.25]	88 [3.46]	130 [5.11]
WM1500	40 [1.57]	113 [4.44]	144 [5.66]
GM20	32 [1.25]	148 [5.82]	170 [6.69]
GM30	35 [1.37]	171 [6.73]	213 [8.38]

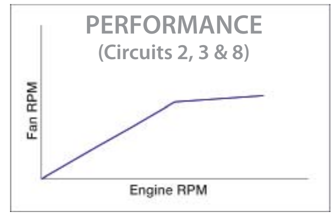


*** Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 32 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 32 mm + 111 mm = 143 mm [5.62 in.] max. length.

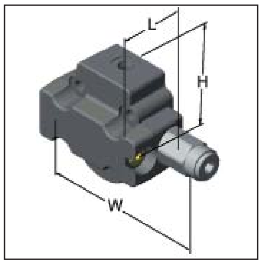
System Descriptions (cont.)

FAN DRIVE SYSTEMS: Follows Engine Speed

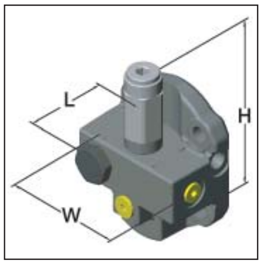
w/ Over Speed Protection



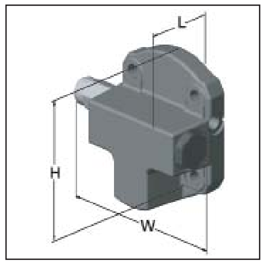
Circuit 3 - Check valve to prevent cavitation during deceleration and spin-down and a relief valve to limit the maximum motor speed and protect the motor from over-pressurization.



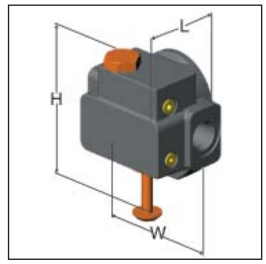
WM600



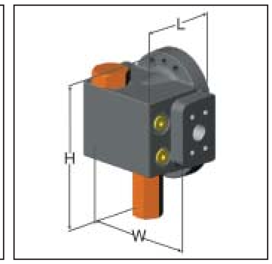
WM900



WM1500

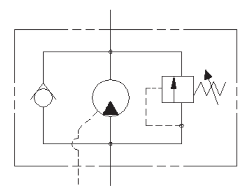


FM20



FM30

FAMILY	L*	W	H
WM600	37 [1.45]	138 [5.43]	89 [3.5]
WM900	40 [1.57]	90 [3.54]	130 [5.11]
WM1500	40 [1.57]	160 [6.29]	135 [5.31]
GM20	32 [1.25]	148 [5.82]	180 [7.08]
GM30	35 [1.37]	171 [6.73]	213 [8.38]

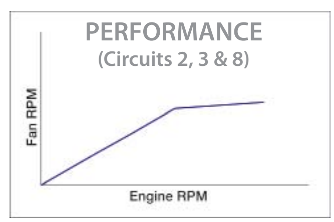


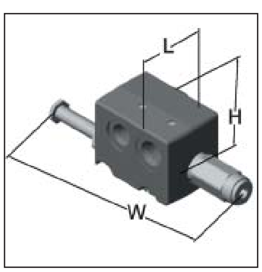
* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 40 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 40 mm + 111 mm = 151 mm [5.94 in.] max. length.

FAN DRIVE SYSTEMS: Follows Engine Speed

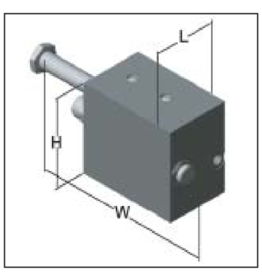
w/ Over Speed Protection

Circuit 8 - Check valve to prevent cavitation during deceleration and spin-down, a solenoid valve to control the direction of flow through the motor and a cross-over relief valve to limit the maximum motor speed and protect the motor from over-pressurization in both directions.

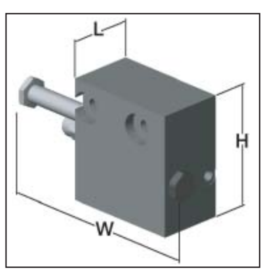




WM600

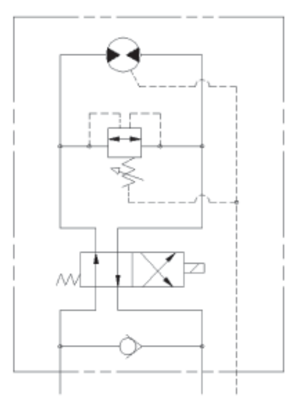


WM900



WM1500

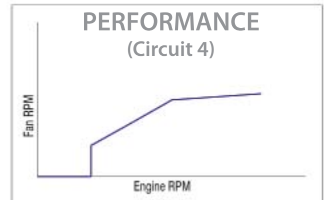
FAMILY	L*	W	H
WM600	47 [1.85]	197 [7.75]	91 [3.58]
WM900	49 [1.92]	238 [9.37]	115 [4.52]
WM1500	51 [2]	243 [9.56]	141 [5.55]



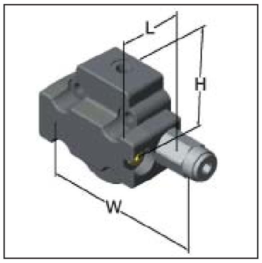
* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 49 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 49 mm + 111 mm = 160 mm [6.29 in.] max. length.

System Descriptions (cont.)

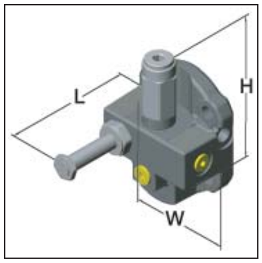
FAN DRIVE SYSTEMS: On / Off



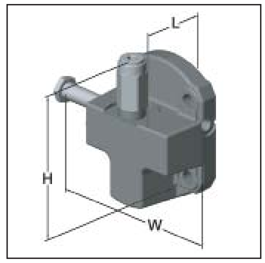
Circuit 4 - Relief valve to limit the maximum motor speed and prevent the motor from over-pressurization and a solenoid valve to bypass flow around the motor.



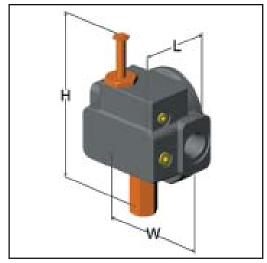
WM600



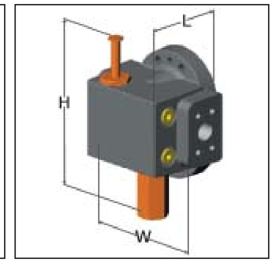
WM900



WM1500



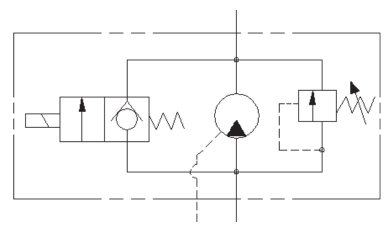
FM20



FM30

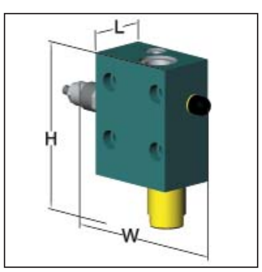
NOTE: Valve coils not shown for clarity.

FAMILY	L*	W	H
WM600	37 [1.45]	138 [5.43]	137 [5.39]
WM900	92 [3.62]	90 [3.54]	130 [5.11]
WM1500	40 [1.57]	177 [6.96]	144 [5.66]
GM20	32 [1.25]	148 [5.82]	230 [9.05]
GM30	35 [1.37]	171 [6.73]	239 [9.4]

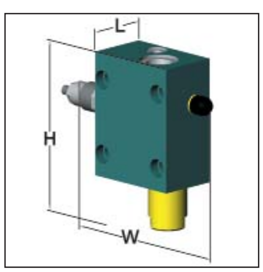


* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 92 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 92 mm + 111 mm = 203 mm [7.99 in.] max. length.

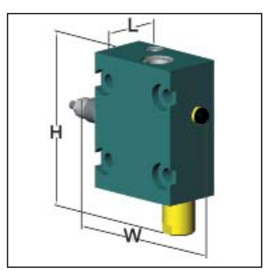
Circuit 10 - Check valve to prevent cavitation during deceleration and spin-down, a thermal pilot-operated wax capsule to activate the relief valve at a specific temperature, a relief valve to limit the maximum fan speed and protect the motor from over-pressurization and a needle valve for field adjusting the relief valve (if required) and the minimum motor speed. Note: This system only monitors the fluid running through it (no external signal available).



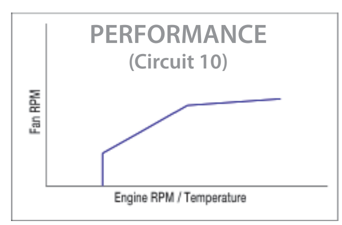
WM600



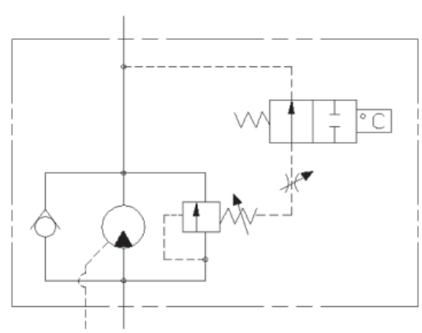
WM900



WM1500

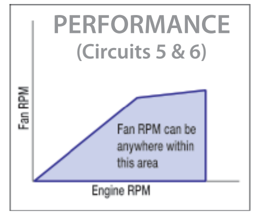


FAMILY	L*	W	H
WM600	29 [1.14]	144 [5.66]	137 [5.39]
WM900	48 [1.88]	146 [5.74]	137 [5.39]
WM1500	33 [1.29]	155 [6.1]	167 [6.57]



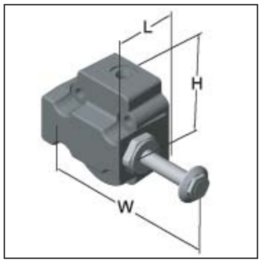
* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 48 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 48 mm + 111 mm = 159 mm [6.25 in.] max. length.

System Descriptions (cont.)

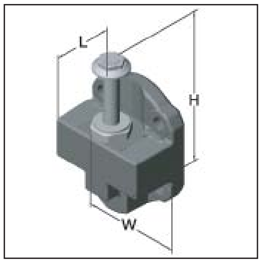


FAN DRIVE SYSTEMS: Independently Variable

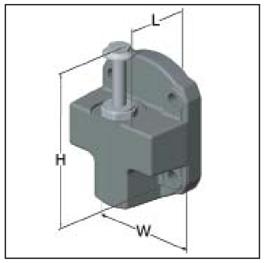
Circuit 5 - Proportional relief valve to control motor speed from idle to max. RPM and to protect the motor from over-pressurization.



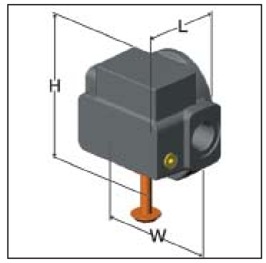
WM600



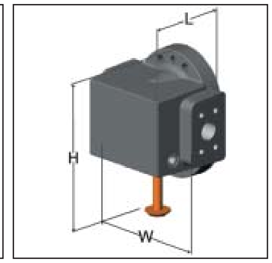
WM900



WM1500



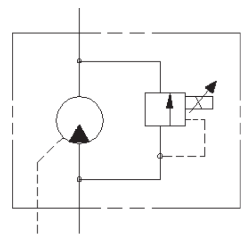
FM20



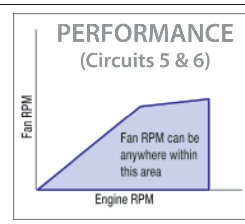
FM30

NOTE: Valve coils not shown for clarity.

FAMILY	L*	W	H
WM600	37 [1.45]	153 [6.02]	89 [3.5]
WM900	32 [1.25]	88 [3.46]	140 [5.51]
WM1500	40 [1.57]	113 [4.44]	159 [6.25]
GM20	32 1.25]	148 [5.82]	180 [7.08]
GM30	35 [1.37]	171 [6.73]	213 [8.38]

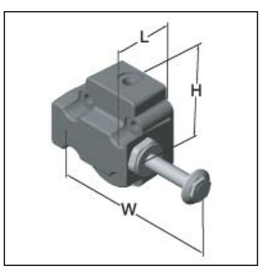


* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 32 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 32 mm + 111 mm = 143 mm [5.62 in.] max. length.

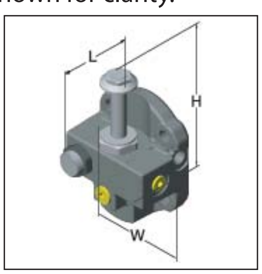


Circuit 6 - Proportional relief valve to control motor speed from idle to max. RPM and protect the motor from over-pressurization and check valve to prevent cavitation during deceleration and spin-down.

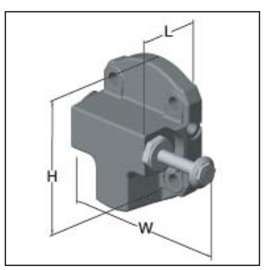
NOTE: Valve coils not shown for clarity.



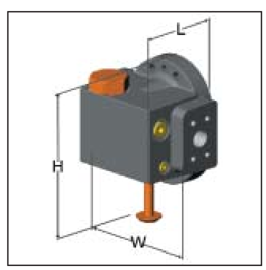
WM600



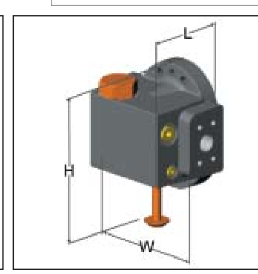
WM900



WM1500

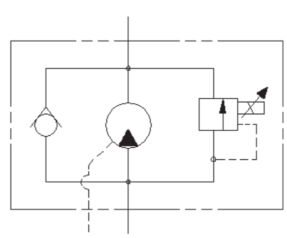


FM20



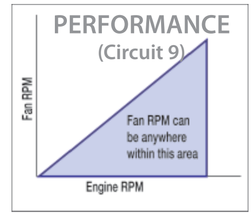
FM30

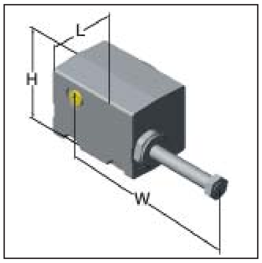
FAMILY	L*	W	H
WM600	37 [1.45]	153 [6.02]	89 [3.5]
WM900	46 [1.81]	90 [3.54]	139 [5.47]
WM1500	40 [1.57]	173 [6.81]	135 [5.31]
GM20	32 [1.25]	148 [5.82]	190 [7.48]
GM30	35 [1.37]	171 [6.73]	213 [8.38]



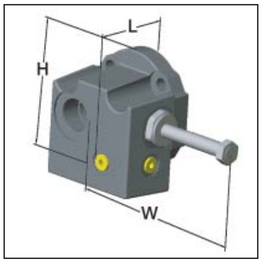
* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 46 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 46 mm + 111 mm = 157 mm [6.18 in.] max. length.

Circuit 9 - Proportional flow control to control the fan speed from idle to max. RPM including a load sense shuttle valve. Primarily used with closed center piston pump systems.

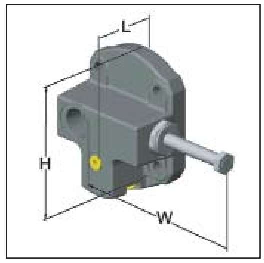




WM600

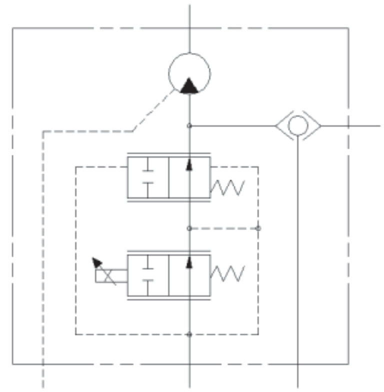


WM900



WM1500

NOTE: Valve coils not shown for clarity.



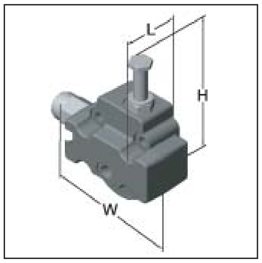
FAMILY	L*	W	H
WM600	48 [1.88]	182 [7.16]	91 [3.58]
WM900	50 [1.96]	184 [7.24]	112 [4.4]
WM1500	41 [1.61]	192 [7.55]	135 [5.31]

* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 50 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 50 mm + 111 mm = 161 mm [6.33 in.] max. length.

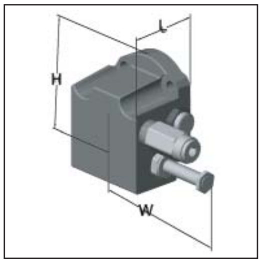
System Descriptions (cont.)

FAN DRIVE SYSTEMS: Two-Speed

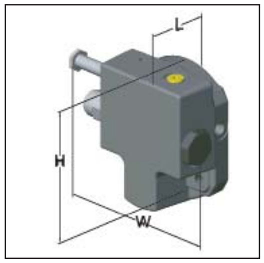
Circuit 7 - Check valve to prevent cavitation during deceleration and spin-down, a relief valve to limit the maximum motor speed and protect the motor from over-pressurization and a solenoid valve to provide two-speed operation.



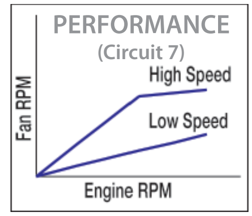
WM600

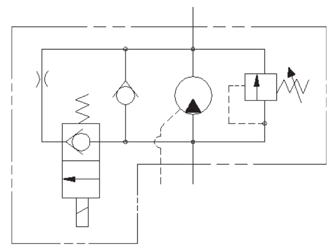


WM900



WM1500





NOTE: Valve coils not shown for clarity.

FAMILY	L*	W	H
WM600	37 [1.45]	138 [5.43]	137 [5.39]
WM900	49 [1.92]	152 [5.98]	112 [4.4]
WM1500	40 [1.57]	166 [6.53]	135 [5.31]

* **Length adder** to Hydraulic Motor Catalog max. length dimension, mm [inch].
E.G. WM900 L above = 49 mm. WM900 max. length in Motor Catalog - pg 16 (X dim.) = 111 mm [4.37 in.] for 19 cc.
Therefore, 49 mm + 111 mm = 160 mm [6.29 in.] max. length.

How To Apply A Fan Drive System

Step by Step instructions on how to apply a Fan Drive System. The balance of the fan drive information is to be filled in on the Fan Drive Application Data sheets (see pages 12 and 13). **NOTE:** Formula numbers in bold and circled correspond to numbers in bold and circled in Application Data Sheets on pages 12 and 13.

1 Determine critical fan speed, N_M at a specified engine speed, N_E (RPM).

2. Determine fan power, HP, or torque, T_M required at the critical speed. (HP or ft-lbs)

3 Convert power to torque, if necessary.

$$T_M\,(ft-lbs) = \frac{HP \times 5252}{N_M}$$

4 Determine fan system operating pressure, P at the critical speed. (PSI)

This pressure is up to the designer's discretion and depends on several factors including pressure ratings for system components, component sizes and system life requirements. Pump and motor sizes will be smaller with higher pressures but system life reduces as pressure increases. Also, any "under hood" regulations should be considered.

5 Calculate motor displacement.

$$D_M\,(cc) = \frac{T_M \times 1374}{P}$$

6 Calculate flow required, Q_M for the motor at critical speed.

$$Q_M\,(GPM) = \frac{D_M \times N_M}{3485}$$

If a clipping relief valve is not being used in the motor, required pump flow, $Q_P = Q_M$ - Skip to step 8.

7 Determine additional flow, Q_A, to allow over the relief valve to compensate for temperature variations and component wear for maintaining a consistent fan speed (at critical fan speed N_M). Add this to the required motor flow, Q_M to get the flow required from the pump. Q_P

$$Q_P\,(GPM) = Q_M + Q_A$$

This flow is up to the designer's discretion. It is safe to assume a 10% reduction in system volumetric efficiency over its life. Also, it is safe to assume a 5-10% reduction in volumetric efficiency at oil temperatures exceeding 180°F. In order to compensate for these factors, the pump can be sized for additional flow.

Note: This additional flow will be discharged over the relief valve at system pressure. This should be calculated into the total heat load requirements of the system.

8 Determine pump speed, N_P at the specified engine speed, N_E (RPM).

This is determined from the engine to pump speed ratio. Example: If the ratio of engine speed to pump speed is 1:1.2, $N_P = N_E \times 1.2$

9 Calculate pump displacement.

$$D_P\,(cc) = \frac{Q_P \times 4030}{N_P}$$

10 Calculate required maximum input torque, T_P for the pump.

$$T_P\,(ft-lbs) = \frac{P \times D_P}{1115}$$

This is required for selecting the type of shaft end (i.e. 9 tooth vs. 11 tooth spline, etc.) and provides for engine HP loss to drive fan at maximum condition.

11. Select the proper pump and motor series based on displacements, pressure, shaft loading, mounting requirements, etc. from the Concentric pump and fluid motor families. See catalog page 14 to begin family selection.

Note: The pump and motor efficiencies assumed in the equations above are conservative to insure that the system is not under cooled.
Variables:

N_M	Motor Speed (RPM)	Q_M	Motor Input Flow (GPM)	D_P	Pump Displacement (cc)
N_P	Pump Speed (RPM)	Q_P	Pump Output Flow (GPM)	D_M	Motor Displacement (cc)
N_E	Engine Speed (RPM)	T_M	Motor Output Torque (ft-lbs)	P	Fan System Pressure (PSI)
HP	Fan Power (HP)	T_P	Pump Input Torque (ft-lbs)	Q_A	Additional Flow over RV (GPM)

See **Application Data Sheets** on pages 12 & 13.

Recommended Application Data Information

Fan Drive System Application Data Sheet

Note: Transfer the items from each step in the fan drive sizing procedure on page 11 to the spaces below (and right) with circled numbers in bold.

Contact: ____________________ Motor Project #: ____________________
Phone: ____________________ Pump Project #: ____________________
Fax: ____________________ Date: ____________________
Customer: ____________________ Originator: ____________________
Address: ____________________ Motor Target Price: __________ Pump Target Price: __________
City, State, Zip: ____________________ E.A.U.: ____________________
E-mail Address: ____________________
Competitive Information (model #, current problems, etc.): ____________________

System Information

Hydraulic Circuit:	Application Description:
	Maximum System Pressure:
	Fluid Type:
	Viscosity Range:
	Temp. Range:
	Filtration Level:
	Ambient Temp. Range:
	Design Life Requirement:
	Noise Limitations:

Motor Information

Customer P/N: ____________________ Current Supplier: ____________________
Displacement: 5 ____________________
Motor Model Code (If Known): ____________________
Valve Model Code (If Known): ____________________
Fan Speed Range: 1 ____________________ Torque Range: 3 ____________________
Critical Fan Speed: ____________________ Torque at Critical Speed: 4 ____________________
Supply Flow Range: ____________________ Pressure at Critical Speed: ____________________

Recommended Application Data Information (cont.)

Flow Required at Critical Speed: 6

Maximum Outlet Pressure: Is Case Drain Acceptable? : Yes / No

Rotation (looking at fan motor shaft): CW / CCW / Bi-rotational

Flange Style: Shaft Style:

Seal and Outboard Ball Bearing Requirements:

Dust Seal : Yes / No

Radial Shaft Load: _________ @ _________ RPM Axial Shaft Load: _________ @ _________ RPM

Inlet Port Size: Outlet Port Size:

Valving Requirements:

Relief Valve Setting: _________ @ _________ Fan RPM Does RV Limit Fan Speed? Yes / No

Flow Allowed Over RV for Wear / Temperature Variations: 7

Solenoid Coil Voltage: Solenoid Coil Connector Style:

Proportional Controller Required? Yes / No If Yes, see Controller Requirements on pages 16 - 20.

Envelope Restrictions (L x W x H):

Motor Shaft Orientation (horizontal, vertical, other: describe):

Pump Information

Customer P/N: Current Supplier: Displacement: 9

Pump Model Code (if known):

Valve Model Code (if known):

Engine RPM Range: Engine to Pump RPM Ratio: 8

Critical Engine Speed: 1 Pump Flow at Critical Speed: 7

Pump Input Torque: 10

Rotation: CW / CCW

Flange Style: Shaft Style:

Wet Mount: Yes / No

Seal and Outboard Ball Bearing Requirements:

Are Dual Seals and a Weep Hole Required? Yes / No

Radial Shaft Load: _________ @ _________ RPM Axial Shaft Load: _________ @ _________ RPM

Inlet Port Size: Outlet Port Size:

Valving Requirements:

Envelope Restrictions (L x W x H):

Fan Information

Manufacturer: Contact:

Diameter: Material:

Weight: Max. Rated Speed:

Balance Specification:

Torque vs. Speed Equation (supply curve if available):

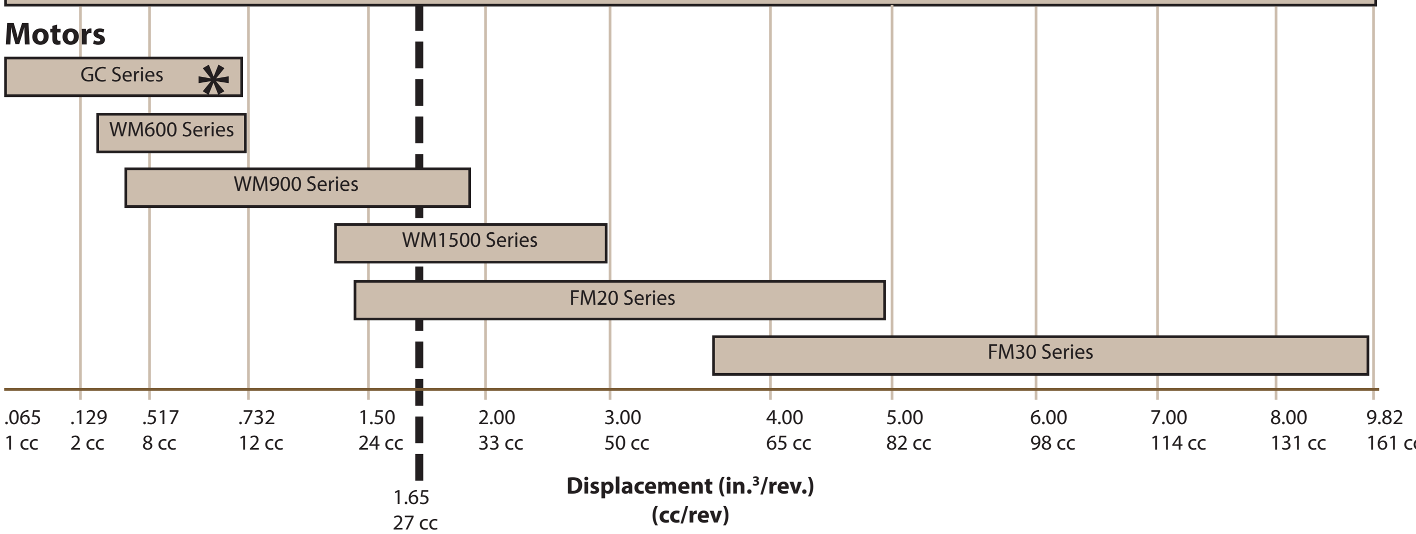
Thrust vs. Speed Equation (supply curve if available):

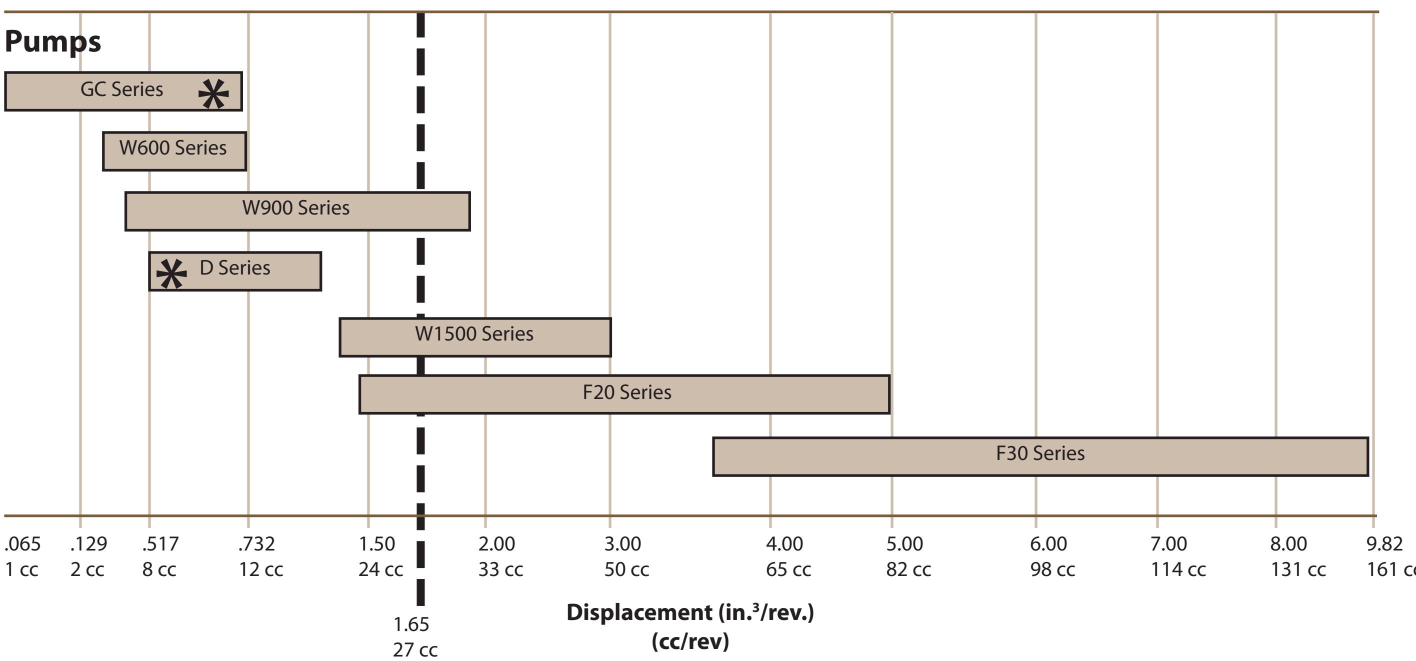
Push / Pull Relative to Motor Shaft:

Concentric Pump & Fluid Motors for Fan Drive Systems

Concentric offers one of the widest selections of gear pumps and hydraulic motors in the industry. All Concentric products are designed to provide solutions to our customers' application challenges. Concentric pumps and motors are used for fan drive systems on skid steer loaders, wheel loaders, excavators, paving equipment, buses and forklifts. Leading equipment manufacturers throughout the mobile equipment market specify these components. The Concentric line of hydraulic pumps and motors covers a displacement range from .065 in.^{3} to 9.82 in.^{3}. The various series include cast iron fixed clearance, aluminum body pressure balanced and cast iron pressure balanced designs. Both unidirectional and birotational configurations are available. Each series offers a large selection of shaft, flange and valve options to meet your application requirements.

Quick Reference Chart





* Special fixed displacement product. Sizing characteristics differ from those shown in this catalog. Contact factory for assistance.

NOTE: As can be seen from the above quick reference chart, a displacement selection may cross several different pump or motor families (frame sizes). Frame sizes overlap intentionally. This provides capability in one frame size that is not achievable in another. For instance, the example illustrates that the displacement selected (27cc) is available in the WM900 and WM1500 motor. The WM1500 has higher bearing side load capability and pressure capability, but is not as economical as the WM900 model. If the application does not need these additional capacities in pressure and load, the WM900 would be the motor of choice; i.e. best value. For a full illustration of the family capability, please refer to the specific product catalog (Concentric Hydraulic Motor Catalog, W900 Pump Catalog, etc.).

Fan Drive System Ordering Information

Each Fan Drive option has been assigned an order code which is listed in the tables below. Configure the desired options as shown in the example model code to the right.

Note: The fan drive order code is a suffix to the WM600, WM900 & WM1500 motor order code as shown in the example below. The fan drive order code for the FM20 & FM30 appears in the middle of the model code as shown in the example below.

ORDER CODE

	1	2	3	4	5	6	7
	VALVE TYPE	VALVE OPTION	RELIEF VALVE SETTING	FLOW FOR RV SETTING	SOLENOID TYPE	COIL VOLTAGE	TERMINATION TYPE
EXAMPLE	MB	NN	R1200	F45	SF	024	DS
Your Options							

Sample WM900 Motor Model Code from Hydraulic Motor Catalog, page 21, followed by Fan Drive Model Code shown above:

WM900 Motor	Fan Drive
WM09A1 / B / 190 / R / 03 / FA / 103	MB / NN / R1200 / F45 / SF / 024 / DS

(WM600 & WM1500 are similar to the WM900 example shown here.)

Sample FM20 Motor Model Code from Hydraulic Motor Catalog, page 41, with Fan Drive Model Code shown above in between:

FM20 Motor	Fan Drive	FM20 Motor
P1 - FM20D - 2W15V11H	MBNNR1200SF024DS	A1261L

(FM30 is similar to the FM20 example shown here.)

The descriptions and circuit numbers below correspond to the circuits on pages 5 through 10.

1.

VALVE TYPE						
MODEL CODE	DESCRIPTIONS	Circuit #	Page #	Family W600	W900 / W1500	F20 /F30
GE	Overrunning Check Valve, Integral	1	5	•		
GF	Overrunning Check Valve, Cartridge	1	5		•	•
FA	Relief Valve	2	5	•	•	•
HP	Overrunning Check Valve and Relief Valve (Integral CV & Cartridge RV)	3	6	•		
HR	Overrunning Check Valve and Relief Valve (Cartridge CV & RV)	3	6		•	•
MB	Normally Closed Two-Way Solenoid Valve with Relief Valve (Cartridge RV)	4	7	•	•	•
PA	Proportional Relief Valve Only	5	8	•	•	•
PB	Proportional Relief Valve with Check Valve (Integral CV)	6	8	•		
PC	Proportional Relief Valve with Check Valve (Cartridge CV)	6	8		•	•
MD	Normally Closed Two-Way Solenoid Valve with Check Valve and Relief Valve (Integral CV & Cartridge RV)	7	10	•		
ME	Normally Closed Two-Way Solenoid Valve with Check Valve and Relief Valve (Cartridge CV & RV)	7	10		•	
RA	2-Position, 4-Way Solenoid Valve, Cross-Over Relief Valve and Check Valve (Integral CV)	8	6	•		
RB	2-Position, 4-Way Solenoid Valve, Cross-Over Relief Valve and Check Valve (Cartridge CV)	8	6		•	
PD	Proportional Flow Control with Shuttle Valve	9	9	•	•	
TA	Thermo Valve	10	7	•	•	

2.

VALVE OPTION	
For Normally Closed Two-Way Solenoid Valve Options MD & ME, an orifice has to be specified. Orifice size is application dependent. Please contact factory to determine size.	
For Thermo Valve Option TA ONLY (Specify temperature setting):	
Model	**Description**
40	40ºC (104ºF)
50	50ºC (122ºF)
55	55ºC (131ºF)
60	60ºC (140ºF)
For Proportional Valve Options PA, PB, PC & PD ONLY (Specify proportional valve controller):	
Model	**Description**
01	Proportional Valve Controller - Coil Mounted
02	Proportional Valve Controller - Remote
NN	Not Applicable

3.

RELIEF VALVE SETTING	
R**** ********	Available in 100 PSI increments to 3000 PSI. Consult factory for higher pressures. Proportional Relief Valve has a max. setting. Choose 1000, 2000 or 3000 PSI **only.**
NN	Not Applicable

NOTE: WM600 Relief Valve has a max. setting of 2600 PSI. Consult factory for higher settings.

4.

FLOW FOR RV SETTING	
Specify the flow at which the relief valve is to be set. (RV will be set at 0.25 GPM, if not specified.)	
F **	Relief flow multiplied by 10. Available in 0.5 GPM increments from 2 to 8 GPM.
NN	Not Applicable

Example: F45
The relief valve will be set at the specified pressure with a full-bypass flow of 4.5 GPM.

All values assume 32cSt (151 SSU) viscosity.

5.

SOLENOID PRESSURE RATING	
SF	$\leq$ 3000 PSI
NN	Not Applicable

6.

COIL VOLTAGE	
010	10 VDC
012	12 VDC
024	24 VDC
036	36 VDC
048	48 VDC
NN	NOT APPLICABLE

7.

TERMINATION TYPE	
DS	Dual Spades
DL	Leadwires (2)
DM	Leads with Metripak-150 Connectors
DD	DIN 43650 Connector
NN	NOT APPLICABLE

Controls Capability

Concentric offers a complete line of Fan Drive electronic controls that interface directly with the electrohydraulic Fan Drive packages. These range in complexity from simple proportional plug and play controls that plug directly into the electrohydraulic valve coil, to stand alone electronic control packages that operate the entire fan drive control system. The controls illustrated demonstrate the spectrum of features available to the OEM. Concentric will assist the OEM in the control specification to achieve the optimum system for the specific vehicle.

GENERAL OPERATION OF THE Concentric FAN DRIVE CONTROLLERS

Fan drive controllers are designed to control the pressure relieving electro-proportional cartridge valves as part of a proportional fan-drive system. Since fan torque is a cubic function relative to speed, it is more economical to control fan speed using pressure control than flow control. These controllers range in sophistication from simple on-off inputs to multiple sensor proportional inputs and are designed to fit the needs of rugged off-highway vehicles.

The controllers illustrated operate on the principle that temperature is to be proportionally controlled between design set points. They provide the necessary output to the electrohydraulic proportional valve in the fan drive system allowing precise fan motor speed correlated to temperature. The inputs can range from a temperature switch providing a voltage input to the controller, to an analog sensor input correlated to temperature.

The controllers illustrated in this catalog are typical of the two types developed specifically for fan drive systems. However, special controllers can be developed for higher volume OEM applications.

INTEGRAL PLUG-IN CONTROLLERS

DESCRIPTION

These controllers are designed for single input temperature control. They consist of a series of convenient, plug-mounted control amplifiers for controlling the fan drive proportional valves. These valve solenoids and controllers have DIN 43650/ISO 4400 electrical connectors. These controllers come in a variety of input and output configurations and adjustments.

OPERATION

This control module utilizes high frequency switching (PWM) to supply a proportional valve solenoid with an input signal that is proportional to an external signal. The external signal can be from a 10K potentiometer, 0–5 VDC, 0-10 VDC, 0–20 mA, or from other pre-set levels. **NOTE: Simplified controllers are also available (re: ramping only) NOTE: These controllers fail to full fan speed mode.**

TYPICAL FEATURES

- Mounts directly to solenoid coils with DIN 43650A connectors.
- IP65 internal protection (IEC529).
- Adjustments accessible with a removable cover.
- No internal fuses; circuit limits current electronically.
- Short circuit proof and reverse polarity protected.
- Connector can be disconnected from coil when powered.
- Maximum current adjustment does not affect minimum current setting.
- Independent ramp adjustments and internal supply for potentiometer.
- **Fails to full fan speed.**

Controls Capability (cont.)

TYPICAL RATINGS

Supply Voltage: 9–32 VDC
Control Input Signal Options: 10 K external potentiometer (accepts 5K to 50K pots), or 0–5 VDC signal, 0-10 VDC signal, or 0–20 mA current signal.
Input Resistance: Voltage Control: 125K Ohms; Current Control: 50K Ohms
Ramp Up and/or Down: 0.01–5.0 seconds (independently adjustable)
Operating Conditions: –20° to 85°C (-4° to 185°F); 0 to 85% relative humidity

REMOTE MOUNTED CONTROLLER

(See Page 20 for illustration)

Description:

These controllers are designed for multiple input temperature control. Power supply input is 12 or 24 VDC (nominal). The controller accepts up to three analog temperature sensor inputs and up to two digital inputs. The OEM can select the number of temperature inputs by setting a DIP switch on the controller. **NOTE:** Once specified, these can be factory preset by Concentric. The temperature range accepted by the controller is set by the sensor specifications. See Page 19 for sensor input requirements. The controller compares the actual value of the temperature inputs with programmed setpoints (specified by the OEM) to generate a proportional current output to the valve. The valve proportionally controls the pressure at the fan motor and therefore motor speed. Proportional control occurs when the temperature sensor inputs fall within the minimum and maximum temperature setpoints of the controller. Turning on the digital input causes the controller to ramp for a 2.5 second period from maximum current output (idle fan speed) to the necessary current output required to achieve set point fan speed. The fan cools by operating between a starting fan speed and a maximum fan speed, which are determined by the cooling system layout. These requirements should be specified on Page 19 (sensor inputs). Calibrating the controller potentiometer and tuning the pressure setting of the valve sets both speeds. Digital inputs can also be set to actuate full fan speed mode when required for engine retarding or other applications where high heat loads are generated. Idling speed is the mode of operation of the fan when it is not required to cool. The controller and proportional valve are designed to provide a maximum fan speed in the cooling circuit in case of a power loss.

Overcurrent protection is provided. Once an overcurrent situation is detected, the controller output turns off for several cycles of 10 msec. until the situation corrects itself. If the overcurrent situation continues, the controller will eventually shut off completely to allow the fan to run at maximum speed and cool the system.

The fan controller has two modes of operation; calibration and run. A DIP switch sets the mode of operation. In calibration mode, the OEM powers the controller and adjusts the calibration potentiometer until the fan is running at the desired rpm corresponding to the minimum temperature setpoint programmed in the controller (the starting speed). This is the speed to which the fan should ramp when any of the input temperatures go above the minimum temperature setpoint or the digital input turns on. Once the unit is calibrated, the OEM selects run mode. In run mode, changing the setting of the potentiometer will have no effect on the output. **NOTE:** Once specified, these can be factory preset by Concentric.

The controller is packaged for the rugged mobile environment. OEM specific packaging and connection styles are available. For higher volume applications, contact Concentric.

Controls Capability (cont.)

Inputs to Controller	Controller Output (Run Mode)	Valve Output	Fan Speed
Temperature Sensor (< min. temp. setpoint)	Maximum current output	Fully open	Idling speed
Temperature Sensor (> min. temp. setpoint)	Current ramps over 1 second to the calibration current output (setting. Proportional control occurs when the temp. sensor inputs fall within the min. and max. temp. setpoints of the controller. The controller prioritizes temperature sensor inputs over the digital inputs (priorities are factory set to suit application).	Pressure setting established during calibration	Starting fan speed (the starting point for proportional control of fan speed) The speed of the fan will vary linearly between the starting fan speed (set during calibration of the controller) and maximum fan s peed.
Temperature Sensor (> max. temp. setpoint)	0 Amps	Pressure setting when controller has 0 current output (Closed)	Maximum fan speed
Digital Input 1 ON	Ramps [2] from maximum current output to calibration current output	Pressure setting established during calibration	Fan runs from idling speed to starting fan speed
Digital Input 1 OFF	Ramps to maximum current output (as long as min. temp. setpoint is not exceeded)	Valve returns to fully open position	Fan returns to idling speed from starting fan speed
Power Loss or No Inputs to the Controller	0 Amps	Pressure setting when controller has 0 current output (Closed)	Maximum fan speed

(1) Calibration current output is set by the OEM when calibrating the controller. **NOTE:** Once specified, these can be factory preset by Concentric.

(2) The factory setting for the ramp time for the digital inputs is 2.5 seconds. The factory setting for the ramp time for the temperature sensor inputs is 1 second. If other ramp times are required, specify the ramp times when ordering the controller on Page 19.

Controls Capability (cont.)

Technical Specifications		
Temperature Sensor Inputs *Contact Concentric with OEM specific sensor input requirements. The controller ramps output over a factory set value. Specify ramp rates, if other than factory settings. See specification requirements in table below.*	**Minimum Temperature Setpoint**	**Maximum Temperature Setpoint**
Temperature Sensor Input 1 (1), Sensor Input 2 (1), and Sensor Input 3 (1)	Available (2)	Available (2)
Digital Input 1 (3) and Digital Input 2 (3)	Ramps output over a 2.5 second period. *Specify, if other ramp time required.*	

(1) The controller is programmed with minimum and maximum temperature setpoints. The current output (and resulting fan speed) will be proportional to the highest input temperature over this temperature range. The full temperature range of each sensor and the desired minimum and maximum setpoints must be specified.
(2) Factory set per OEM specifications.
(3) The controller will give priority to the input that requires the fan to operate at the higher speed. This priority is factory set and must be specified by the OEM.

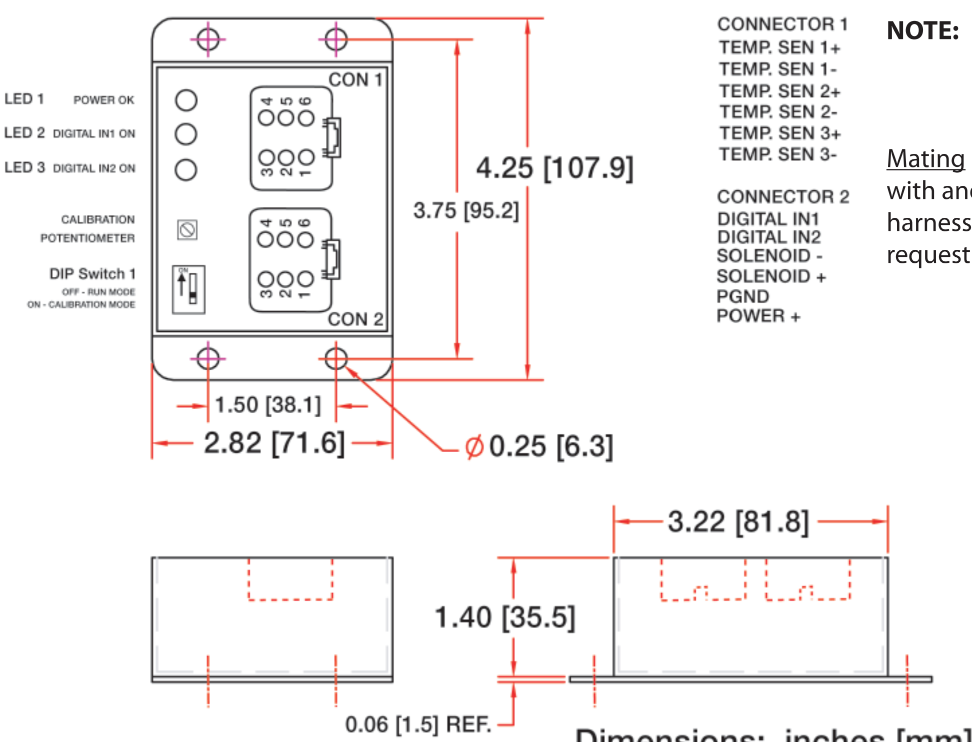
Specification Information Required
Power supply voltage (12 or 24 VDC):
Digital (on/off) inputs (Active high is standard. Active low available for volume OEM applications): Digital 1 input required for ______________________________ Ramp time required: ________________ Priority 1 Digital 2 input required for ______________________________ Ramp time required: ________________ Priority 2
Analog inputs: Sensor 1 manufacturer & p/n (1): ____________________ Sensor 1 function (2): ____________________ Sensor 1: Increasing or decreasing voltage as temperature increases: ____________________ Sensor 1: Linear response: Y / N If no, provide a temperature vs. voltage characteristic table. Sensor 1: Variable resistance type: Y / N If no, please contact Concentric for further details. Sensor 1: Min. setpoint: _____ Max. setpoint: _____ OR Temp. range to be controlled: ____________________ Sensor 2 manufacturer & p/n (1): ____________________ Sensor 2 function (2): ____________________ Sensor 2: Increasing or decreasing voltage as temperature increases: ____________________ Sensor 2: Linear response: Y / N If no, provide a temperature vs. voltage characteristic table. Sensor 2: Variable resistance type: Y / N If no, please contact Concentric for further details. Sensor 2: Min. setpoint: _____ Max. setpoint: _____ OR Temp. range to be controlled: ____________________ Sensor 3 manufacturer & p/n (1): ____________________ Sensor 3 function (2): ____________________ Sensor 3: Increasing or decreasing voltage as temperature increases: ____________________ Sensor 3: Linear response: Y / N If no, provide a temperature vs. voltage characteristic table. Sensor 3: Variable resistance type: Y / N If no, please contact Concentric for further details. Sensor 3: Min. setpoint: _____ Max. setpoint: _____ OR Temp. range to be controlled: ____________________

(1) Provide sensor data sheet with complete specifications.
(2) Liquid temp. sensor for engine coolant, liquid temp. sensor for hyd. oil, air temp. sensor for charge air, etc.

Controls Capability (cont.)

General Specifications	
Operating Conditions	-40 up to 120ºC (-40 up to 250ºF)
Calibration Potentiometer[5]	Turn clockwise to decrease the current output (increases fan speed). Factory setting is 50%.
LED Indicators	LED1 - Power OK LED2 - Digital Input 1 ON LED3 - Digital Input 2 ON
DIP Switch Settings	Sets System Calibration or Run Mode ON (Calibration Mode) OFF (Run Mode)
Electrical Connections	Two Deutsch 6-pin connectors (P/N: DT15-6P) *Mating connectors with wire harnesses are available upon request.*
Enclosure Protection	IP67 (encapsulated model) per IEC 529
Enclosure	See detail below.

[5] Used to adjust the fan speed in calibration mode. A change in the potentiometer causes a corresponding change in the fan speed. Set the potentiometer at the speed to which the fan should ramp when the input temperature(s) goes above the minimum setpoint or the digital input is ON.



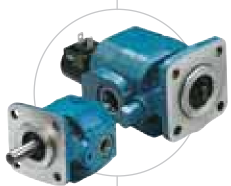
NOTE: Connectors 1 & 2 are Deutsch p/n DT15-6P (male).

Mating (female) connectors with and without wiring harnesses available upon request.

Dimensions: inches [mm]

PUMPS & MOTORS

Cast Iron Pumps Heavy Duty

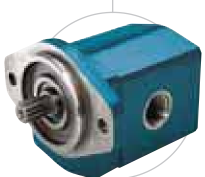


GC Series Pumps

Displacements
0.065 to 0.711 cu. In. (1.06 to 11.65 cc)

GC Series High/Low Pumps

High Pressure Displacements
0.065 to 0.258 cu. In. (1.06 to 4.22 cc)
Low Pressure Displacements
0.258 to 0.776 cu. In. (4.22 to 12.71 cc)
Maximum Pressure
4,000 psi (276 bar)
Maximum Speed
4,000 rpm



F12 & F15 Ferra Series Pumps

F12 Displacements
0.976 to 2.502 cu. In. (16 – 41 cc)
F15 Displacements
1.159 to 3.051 cu. In. (19 to 50 cc)
Maximum Pressure
4,000 psi (276 bar)
Maximum Speed
3,600 rpm

F20/F30 Pumps & F20-LS/F30-LS Load Sense Ferra Series Pumps

Displacements
1.41 to 9.82 cu. In. (23 to 161 cc)
Maximum Pressure
4,000 psi (276 bar)
Maximum Speed
3,600 rpm

D Series Pumps

Displacements
0.232 to 1.395 cu. In. (3.80 to 22.85 cc)

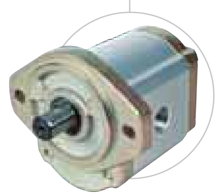
D Series High/Low Pumps

High Pressure Displacements
0.465 cu. In. (7.62 cc)
Low Pressure Displacements
0.930 to 1.395 cu. In. (15.24 to 22.86 cc)
Maximum Pressure
3,000 – 4,000 psi (207 – 276 bar)
Maximum Speed
3,600 – 4,000 rpm

Aluminum Pumps Medium/Light Duty

W-Series Pumps

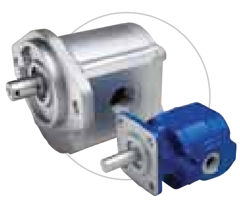
W100 Displacements
0.031 to 0.122 cu. In. (0.50 to 2.00 cc)
W300 Displacements
0.049 to 0.347 cu. In. (0.80 to 5.70 cc)
W600 Displacements
0.244 to 0.732 cu. In. (4 to 12 cc)
W900 Displacements
0.305 to 1.891 cu. In. (5 to 31 cc)
W1200 Displacements
1.526 to 2.014 cu. In. (25 to 33 cc)
W1500 Displacements
1.159 to 3.051 cu. In. (19 to 50 cc)
Maximum Pressure
4,000 psi (276 bar)
Maximum Speed
500 to 4,000 rpm



WQ900 Pumps

Displacements
0.305 to 1.648 cu. In. (5 to 27 cc)
Maximum Pressure
3,336 psi (230 bar)
Maximum Speed
4,000 rpm

Fluid Motors



Cast Iron

Displacements
0.065 to 9.82 cu. In. (1.06 to 161 cc)
Speed
Up to 10,000 rpm

Aluminum

Displacements
0.244 to 3.050 cu. In. (4 to 50 cc)
Speed
Up to 4,000 rpm

Flow Dividers

GC & D Series

GC Displacements
0.097 to 0.517 cu. In. (1.58 to 8.47 cc)
D Displacements
0.232 to 0.813 cu. in. (3.8 to 13.32 cc)
Maximum Pressure
4,500 psi (310 bar)
Maximum Input Flow Per Section
14 gpm (53 lpm)

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Call us for more information
For application assistance or detailed literature on any Concentric product line, call us toll-free: **1-800-572-7867.**
Visit our web site: http://www.concentricAB.com
E-mail us: info.hydraulics.us@concentricab.com

Only Concentric offers this extensive range of products worldwide.

POWER PACKS

PUMP/MOTORS (DC/AC)

DC Voltage Range
12 to 72 VDC

AC Horsepower Range
1/2 to 3 HP

Pump Displacements
0.04 – 1.71 cu. In. (0.65 to 28 cc)

Maximum Pressure
4,000 psi (276 bar)

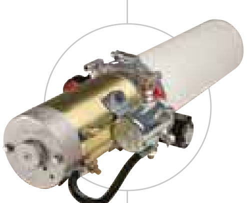
HB800 POWER PACKS

Voltage Range
12 to 24 VDC

Pump Displacements
0.037 to 0.092 cu. In. (0.60 to 1.5 cc)

Reservoirs
0.13 to 1 gal. (.5 to 3.8 ltr.) plastic

Maximum Pressure
2,610 psi (180 bar)



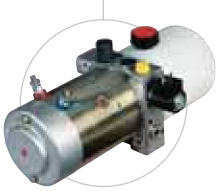
HE1000 SERIES POWER PACKS

Voltage Range
12 to 24 VDC

Pump Displacements
0.015 to 0.122 cu. In. (0.24 to 2 cc)

Maximum Pressure
3,336 psi (230 bar)

Reservoirs
0.13 to 1.0 gal. (0.5 to 3.8 ltr.) plastic



HE2000 SERIES POWER PACKS

Voltage Range
12 to 24 VDC, 115 to 230 VAC

Pump Displacements
0.049 to 0.388 cu. In. (0.80 to 6.36 cc)

Maximum Pressure
3,336 psi (230 bar)

Reservoirs
0.95 qt. to 3.96 gal. (0.9 to 15 ltr.) steel,
0.8 to 1.7 qt. (0.76 to 1.6 ltr.) plastic

HE "BOX" POWER PACKS

Voltage Range
12 to 24 VDC

Pump Displacements
0.049 to 0.388 cu. In. (0.80 to 6.36 cc)

Maximum Pressure
3,336 psi (230 bar)

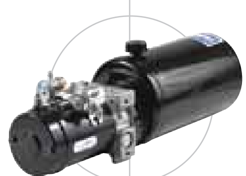
Reservoirs
3 qt. to 5.0 gal. (2.84 to 19 ltr.) steel

HE-Q (QUIET) POWER PACKS

Voltage Range
24 VDC

WQ300 Pump Displacements
0.073 to 0.347 cu. In. (1.2 to 5.7 cc)

Noise
42dB(A)



BIROTATIONAL POWER PACKS

Voltage Range
12 to 24 VDC, 115 to 230 VAC

Pump Displacements
0.049 to 0.129 cu. In. (0.80 to 2.11 cc)

Reservoirs
2 to 2.96 qt. (1.9 to 2.8 ltr.) plastic,
1 to 2 gal. (3.8 to 7.6 ltr.) steel

AC POWER PACKS GC-9500 SERIES

Displacements
0.065 to 1.394 cu. In. (1.06 to 22.85 cc)

Maximum Pressure
3,000 psi (207 bar)

Maximum Speed
3,600 rpm

Reservoirs
5 to 20 gal. (19 to 76 ltr.) steel

CONCENTRIC

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Visit our web site: http://www.concentricAB.com
E-mail us: info.hydraulics.us@concentricab.com

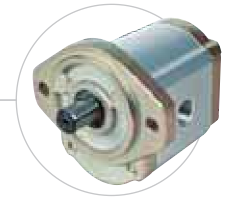
SPECIAL PRODUCTS

HYDRAULICS

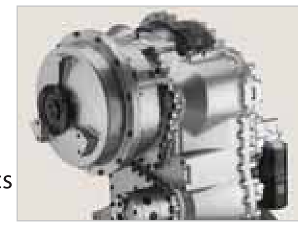
Concentric provides innovative custom solutions to the vehicle industry on a global basis

We focus on the areas where we can create customer value. Our applications expertise enables us to take on customers most unique application challenges. The foundation for this expertise is an expert knowledge of hydraulic systems. The value we bring to our customers is our unique capability to integrate a variety of system components and controls, to provide multiple functions in one custom package.

Our applications specialists seek to understand the overall goals for the vehicle, the vehicle subsystems and then the hydraulics system. This understanding enables them to respond with customized value engineered solutions. Concentric was the first to offer many of the solutions shown here.

High-Speed Rotary Drive Systems



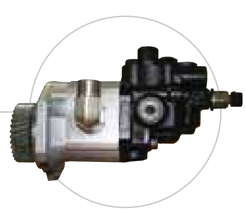

Powershift Transmission Lube and Charge


Electrohydraulic Lifting Systems


Auxiliary Hydraulic Power


Supplemental Power Steering Systems


Axle Cooling and Lube Systems

Fan Drive With Integrated Brake Charge Function

CONCENTRIC

PRODUCT RANGE

HE Powerpacks
12/24/48 VDC 0.3 – 4.5 kW and
0.75 – 3 kW AC modular power packs

HE Box Powerpacks
12/24/48 VDC modular powerpacks
in weatherproof boxes

Pressure Switches
5 - 350 bar, connecting/disconnecting

W100 Hydraulic pumps
0,5 - 2,0 cc 227 bar

W300 Hydraulic pumps
0,8 – 5,7 cc 230 bar

W600 Hydraulic pumps / motors
3 – 12 cc 276 bar

W900 Hydraulic pumps / motors
5 – 31 cc/section 276 bar

Calma The new quiet pumps
6,2 - 23,7 cc/section 250 bar

WQ900 The quiet pumps
5 - 23 cc/section 230 bar

WP900X Hydraulic pumps
16 - 31 cc/section 276 bar

W1500 Hydraulic pumps / motors
19 - 50 cc/section 276 bar

F12 FERRA Heavy duty pumps
16 - 41 cc/section 276 bar

F15 FERRA Heavy duty pumps
19 - 50 cc/section 276 bar

F20/F30 (LS) Hydraulic pumps / motors
23 – 161 cc/section 276 bar

GPA Internal Gear pumps
1,7 – 63 cc/section 100 bar

GC Hydraulic pumps / motors
1,06 – 11,65 cc/section 276 bar

D Hydraulic pumps
3,8 – 22,9 cc/section 207 bar

H Hydraulic pumps
9,8 – 39,4 cc/section 207 bar

II-Stage Hydraulic pumps
4,2 – 22,8 cc/section 276 bar

Rotary Flow Dividers
3,8 – 13,3 cc/section 300 bar

Transmission pumps

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CONCENTRIC

Concentric is an innovator in flow control and fluid power, supplying proprietary systems and components for trucks, buses and industrial vehicles, worldwide. With 1,156 employees and yearly sales exceeding 1,977 million Swedish Kronor, Concentric AB is listed on the Stockholm Stock Exchange (www.concentricAB.com).