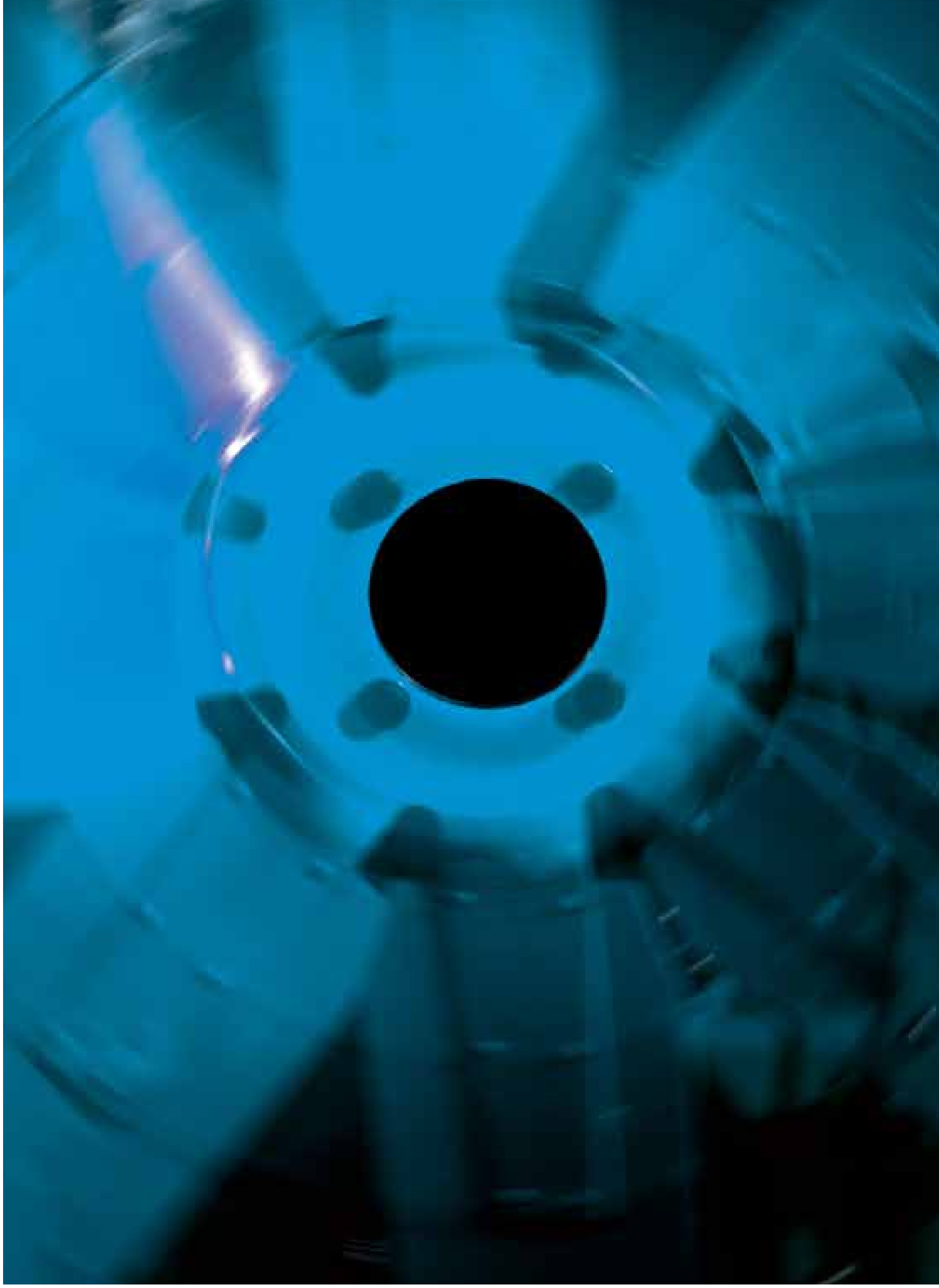
aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



Hydraulic Fan Drive Solutions

For the Bus Market

ENGINEERING YOUR SUCCESS.

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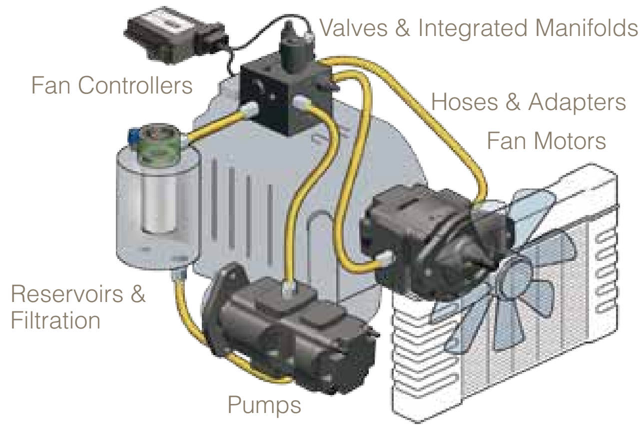

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Performance & Fuel Saving Solutions for Bus Cooling Systems

Increasing government emission regulations on buses and transit vehicles require engine solutions with significantly higher cooling requirements and more precise temperature control. Engine cooling systems need to be highly efficient to conserve power and fuel for the vehicle. In addition, these systems need to be quiet and reliable. An integral part of the engine cooling system is the fan drive system, and hydraulic fan drive systems are an excellent solution to meet these demands.

An optimized cooling system requires skilled integration of multiple technologies

Hydraulic Fan Drive

- Hydraulic System Type
- System Efficiency
- Durability
- Motor Bearing Load
- Valve & Control Options
- Noise
- Space

Cooler

- Space
- Cooler Type
- Cooling Capacity
- Cooling Fluid Flow
- Air Characteristics
- Air Recirculation
- Safety Factors

Vehicle

- Engine Cooling Spec
- Engine Audit Tests
- Drivability
- Vehicle Performance
- Altitude & Environment
- Space
- Control & Sensors

Fan

- Power Curve
- Max Torque
- Airflow vs. Speed
- Noise
- Thrust & Axial Loads
- Efficiency

Engine

- Cooling Load Specs
- Audit Requirements
- Coolant Flow
- Fan Drive Torque Limits

Optimizing the System:

Parker has extensive experience in designing fan drive systems for the bus and transit market, but the fan drive is only one piece of a fully optimized cooling system. Designing an engine cooling system is complex, and can require time consuming coordination with multiple technologies and suppliers. Design decisions for one component such as the cooler impact others such as the fan drive, and each supplier may make assumptions with additional factors for safety. Parker will lead or support a collaborative system design process to speed your development time while maximizing total system performance and value.

Global Support: System Engineering Centers

Parker's global engineering team, systems centers and market specialists ensure your Parker system is supported from initial design all the way through to your end customer.

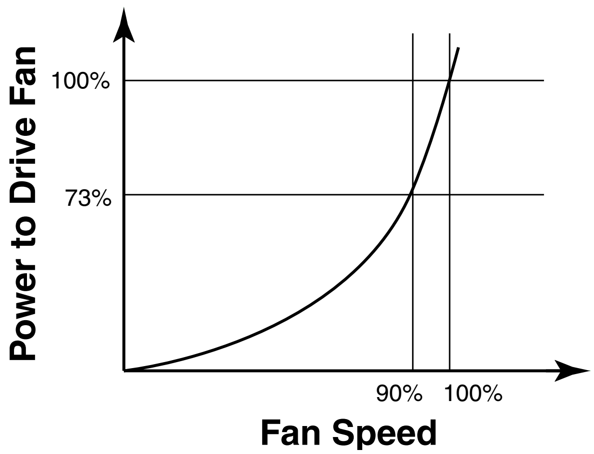
Advantages of Parker's Hydraulic Fan Drive Systems

Parker hydraulic fan drive systems are efficient throughout the engine and vehicle's operating range. Traditional on/off clutch solutions operate only at maximum speed and can suddenly drain power to the vehicle and even require downshifting. The unnecessary stresses of the on/off cycle reduce the life of the cooling system. Viscous or wet clutch solutions offer variable fan speed but have limited efficiency when the fan is being commanded to intermediate speeds which occur during the majority of the operating conditions.

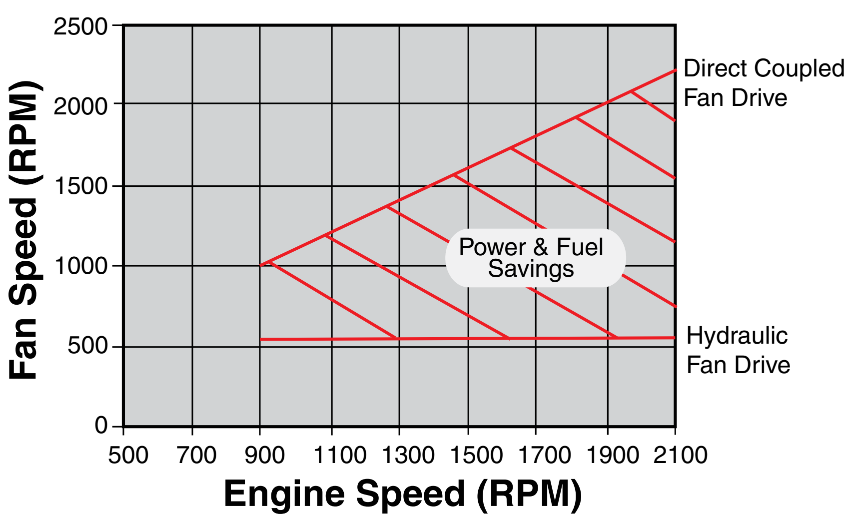
Parker hydraulic fan drives offer maximum power density & efficiency and can be optimized when using Parker's independent fan controller or when the control logic is integrated into their complete vehicle controller.

Reduced Power Consumption, Increased Control:

Traditional direct-drive engine mounted fan systems consume excess power because the fan speed is dependent on the engine speed. As the engine speed changes, the fan is often driven faster than what is required to cool the engine. This inefficiency is very significant especially at high fan speeds because the power required to increase fan speed increases exponentially by the power of 3. In addition, direct-drive systems have difficulty achieving high cooling levels at low engine speeds such as when a bus starts and stops in heavy traffic.

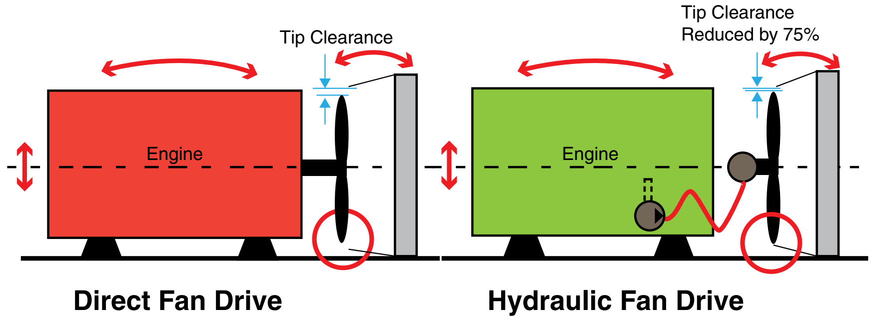


A hydraulic fan drive system allows variable fan speed independent of the engine speed. It provides only the cooling that is required throughout the operating range of the vehicle, including such requirements as the maximum engine rated torque point where high cooling may be required at lower than maximum engine speed. The full cooling control of hydraulic fan drives enables ramping of the fan speed command to avoid shock and to idle the fan during engine startup to preserve power. Hydraulic fan drive systems enable full fan control yielding significant power and fuel savings.



Maximum Efficiency to Conserve Power and Fuel:

Direct-driven fan drives require large tip clearance to allow for independent movement between the engine and radiator assembly. This large tip clearance reduces the efficiency of the cooling air flow across the radiator by as much as 10-15% compared to a hydraulic fan drive system where the fan motor, fan and radiator are attached to each other.



A hydraulic fan drive reduces tip clearance and improves airflow by 10-15%.

Flexible Installation:

For a rear engine bus, front cooling air is not available and the cooling flow must be generated completely by the fan drive. In addition, vehicle designers are challenged to meet styling and serviceability requirements in less space with reduced noise. Parker's hydraulic fan drive systems solve these challenges by allowing the drive motor, shroud and radiator to be strategically located anywhere on a vehicle.

Reliability:

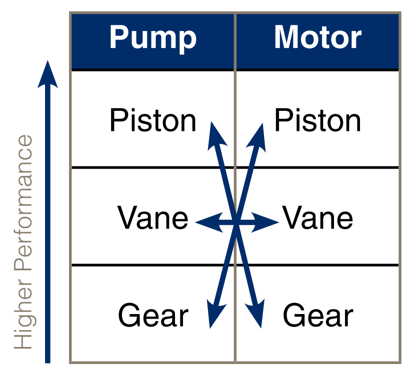
Parker's hydraulic systems have proven reliability in the most rugged applications. They are simple to service and provide exceptional life when properly maintained. Parker's hoses and fittings ensure efficient installation and leak free performance.

Solutions for the Bus Market

Parker is in the unique position of having three fan drive motor and pump technologies which can be supplied for the fan drive function on a bus. Each of these technologies, Gear, Vane and Piston, offer distinct advantages in terms of initial purchase cost, life time cost, efficiency and noise.

In this section, three example systems are summarized and categorized as "Basic Efficient System, Additional Performance and Optimized Performance". The "Basic Efficient" system can be considered lower installed cost while still retaining the main hydraulic fan drive benefits outlined earlier in this guide. The "Optimized Performance" system will have the highest installed cost, but offers very distinct advantages when considering the environment, efficiency and life time cost.

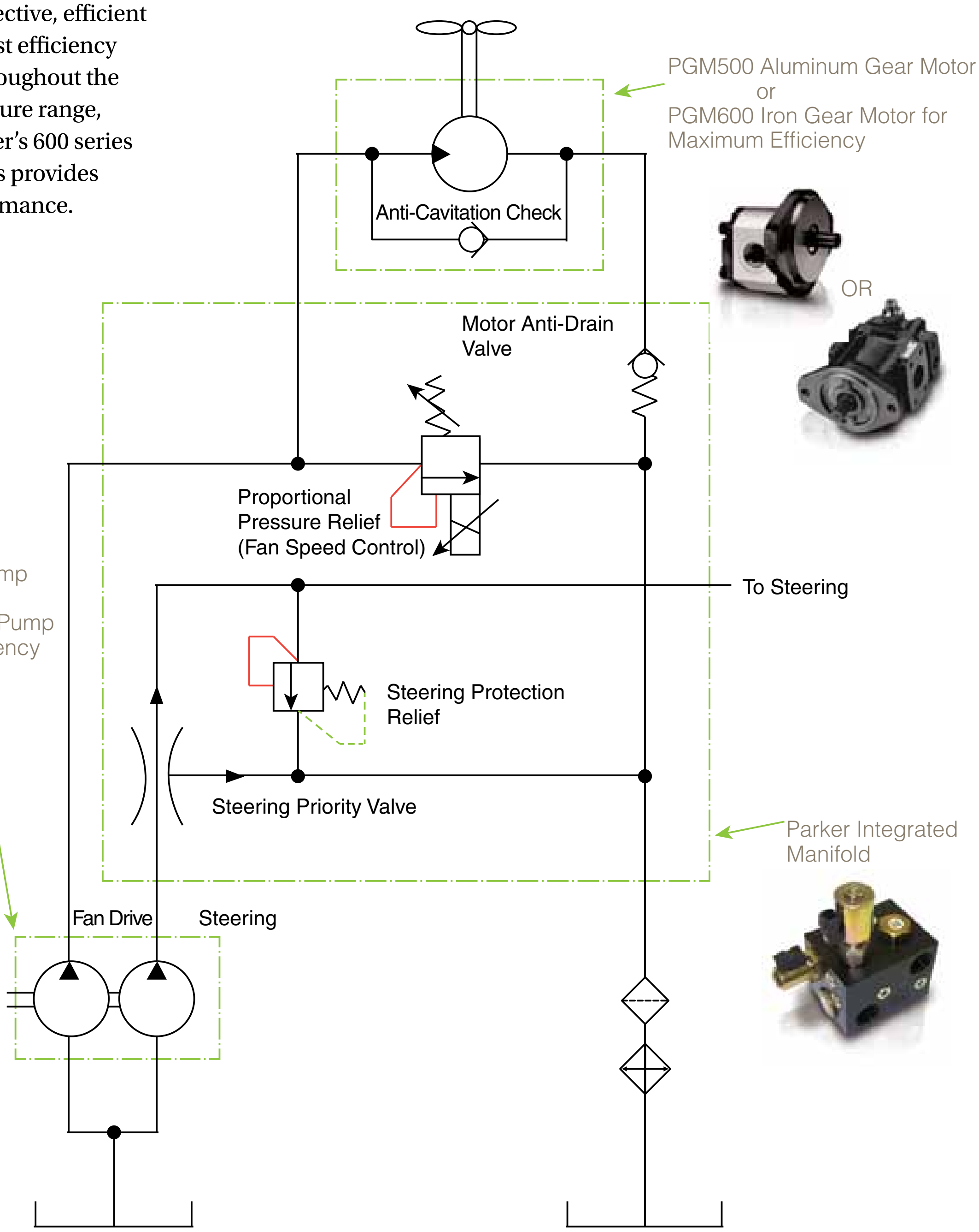
Parker's representatives can help you select the correct system to meet the needs of your vehicle and to maximize their benefits in your cooling system. In addition to the drive motor and pump, they can help you select the right Parker control valves, electronic controller, filters and hose assemblies.

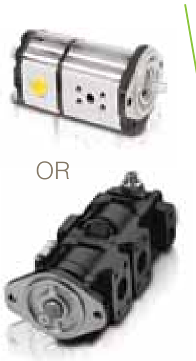


Parker offers the widest selection of hydraulic fan drive solutions. Pump and motor technologies are selected to optimize performance and value.

"Basic" - Efficient System:
Fixed Pump, Variable Speed Fan + Steering Control

This system utilizes gear pump and motor technology and combines a variable speed fan drive together with the power steering control into 3 simple integrated components to create a cost effective, efficient system. For the best efficiency and durability throughout the fan drive temperature range, upgrading to Parker's 600 series pumps and motors provides unmatched performance.





“Basic” - Efficient System Summary:

In this “Basic” system, a double pump feeds both the fan drive and power steering circuits. In the fan drive circuit, fan speed is adjusted by providing a varying Pulse Width Modulated electrical current signal to the proportional relief valve which controls the flow to the fan motor. Excess flow is bypassed to the reservoir.

The proportional relief valve is typically a normally-closed type to assure fail-safe full fan speed in case of a lost signal. The anti-cavitation check valve allows the motor to spin freely when the fan is powered down and the optional anti-drain valve keeps fluid in the motor after long shutdowns. In the steering circuit, the steering protection relief valve protects the steering lines from overpressure.

The steering priority flow valve maintains appropriate flow to the steering unit at engine idle conditions. If a steering circuit is not required, the manifold can be eliminated and replaced with a simple fan drive circuit utilizing a single pump and a fan motor which integrates the proportional pressure relief and check valves into the motor.

Performance and Value:

- Cost effective PGP500 variable fan speed solution
- Efficient and simple system - more power and fuel savings to the vehicle
- Design and Supply Chain savings:
    - The complete fan drive and steering hydraulic system integrated into only 3 components
    - Reduced design, installation labor, hose/fitting and procurement costs
- Upgrading to the 600 series pumps/motors adds market leading durability and efficiency even at high fluid temperatures
- Parker’s strong application expertise and support from design through production stages

Parker’s 600 Series Cast Iron Pumps & Motors:

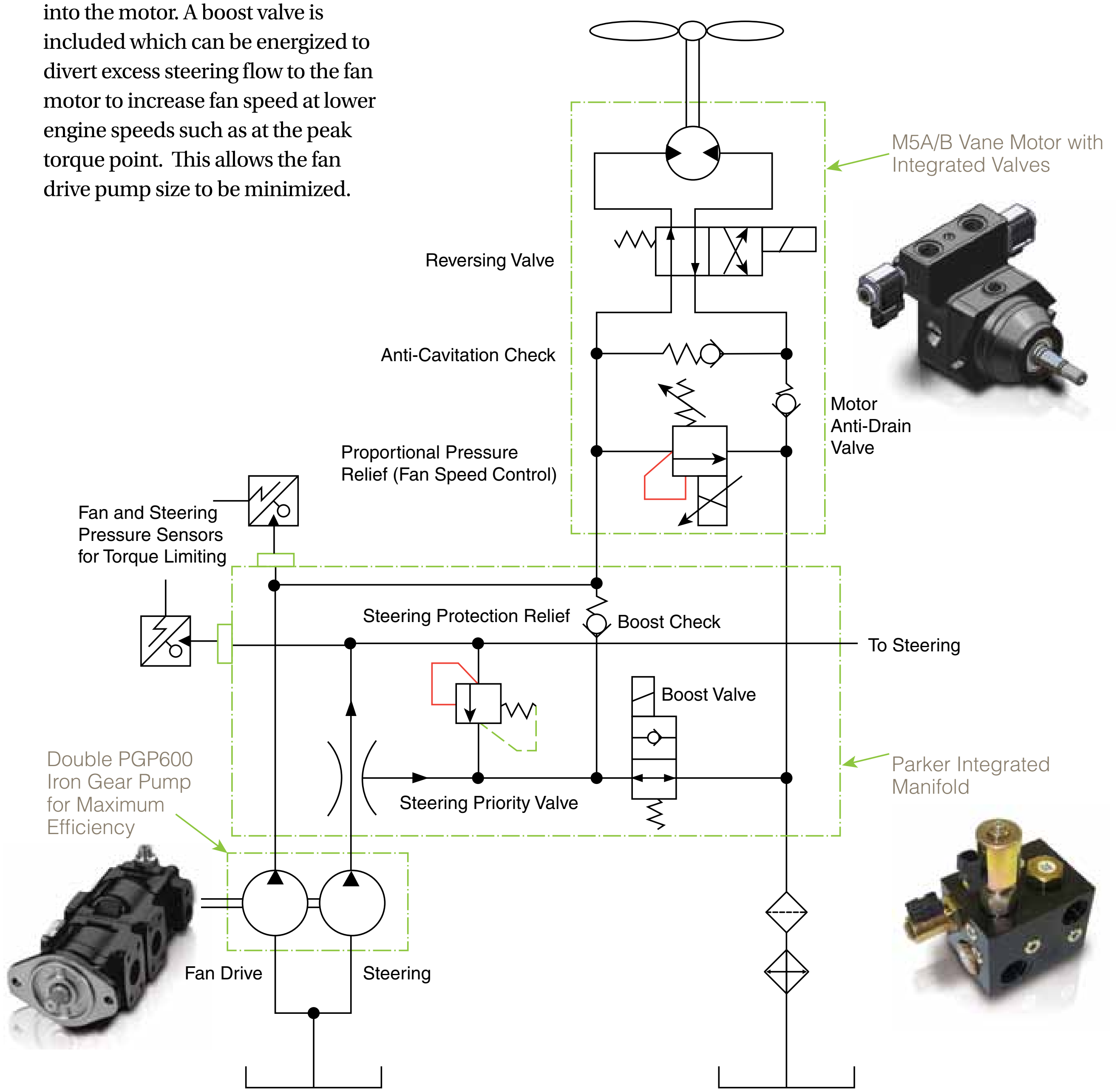
- Patented 2-Piece interlocking body
- Highest efficiency at extreme temperatures
- Compact size and weight
- High pressures

Parker

“Additional Performance”: Basic System + Integrated Vane Motor with Reversing, Boost Valve & Torque Limiting

This system builds on the “Basic Efficient System”. A fan reversing valve is added to periodically clean the radiator and assure optimal radiator efficiency. Robust vane motor technology is utilized with the reversing valve, proportional relief and check valves integrated into the motor. A boost valve is included which can be energized to divert excess steering flow to the fan motor to increase fan speed at lower engine speeds such as at the peak torque point. This allows the fan drive pump size to be minimized.

Pressure sensor ports for the fan and steering circuits enable the system controller to monitor torque on the pump drive (usually the compressor through drive) and adjust the fan speed command to prevent over torque. Parker’s 600 series pump is utilized to provide superior efficiency and performance even at high temperatures.



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"Additional Performance" System Summary:

The system operates the same as the "Basic Efficient System". The fan drive still uses a single pump, but instead of the gear motor, a vane motor is used this has all the necessary valves, including the reversing valve, integrated into one unit.

The reversing valve switches direction of the motor by energizing the solenoid. Appropriate set point logic is incorporated into the fan drive controller to ramp down the fan speed before reversing and then control the maximum time the fan is in reverse. When the solenoid on the boost valve is energized, excess flow from the steering priority valve is combined with the fan pump flow. Control logic to manage these functions is built into a controller such as Parker's PFDC series Controllers.

The PFDC-2 controller can also monitor the pressure sensor inputs shown in the circuit, to ensure maximum input torque on the accessory drive is not exceeded. Although not shown in the circuit, a double vane pump may be used instead of the PGP600 gear pump to achieve lower noise levels and port installation flexibility.

T7BA Double Vane Pump

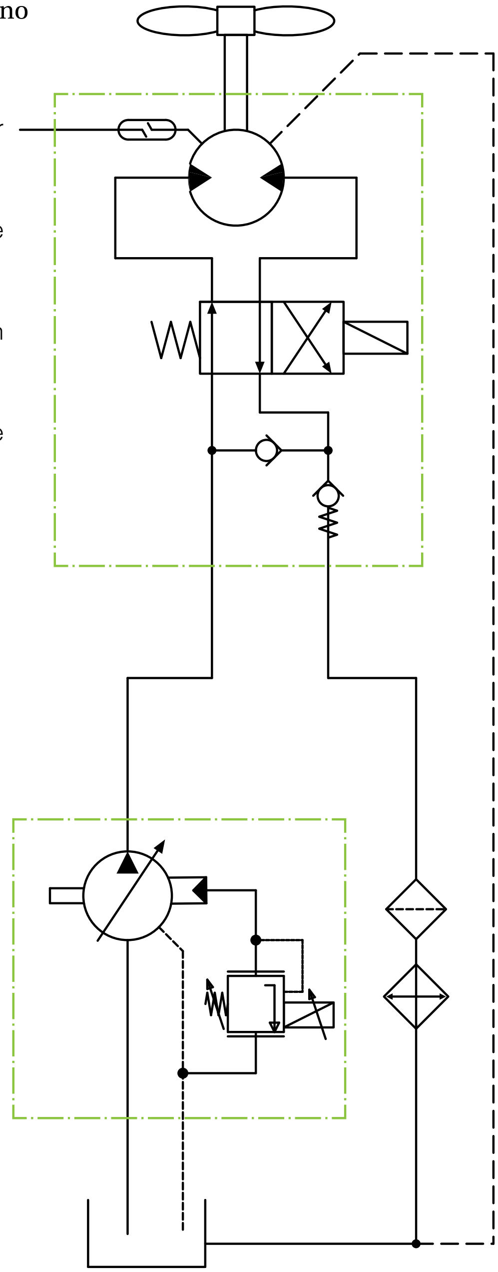
Performance and Value:

- Cost effective variable fan speed solution
- Maximum efficiency and fuel savings for a fixed pump system
- Fan reversing to clear radiator and maximize radiator efficiency
- Patented boost circuit enables additional fan speed at low engine RPM
- Accessory drive input torque protection
- Design and Supply Chain savings:
  - The complete bus fan drive and steering hydraulic supply system integrated into three components
  - Reduced design, installation labor, hose/fitting and procurement costs
- Vane motor optimized for fan drive function:
  - Extremely low noise
  - Integrated valves
  - Heavy duty, long life bearings to support fan loads
  - Excellent mechanical and volumetric efficiency throughout pressure & temperature operating range
  - Unique protected internal shaft seal, barrier to blown in debris
- 600 Series Gear Pump assures market leading pump durability and efficiency even at high fluid temperatures
- Parker's strong application expertise and support from design through production stages

Parker

“Optimized Performance”:
Variable Flow Piston Pump + Integrated Vane Motor

This solution is Parker’s most efficient hydraulic fan drive solution consisting of a variable piston pump system and a vane motor with the exceptional benefits previously summarized in the “Additional Performance Solution”. A variable piston solution produces the exact flow needed to achieve the fan speed with no inefficient bypass flow diverted to tank. A fan reversing valve is added to clean the radiator and assure optimal radiator efficiency. The reversing, anti-cavitation check and anti-drain checks are efficiently integrated into the vane motor casting. A fan speed sensor can also be installed in the vane motor for optimal fan speed monitoring or closed loop control. For example, the speed sensor can be used to assure the fan speed is 0 or low speed before reversing.



M5A/B Vane Motor with Integrated Valves and Speed Sensor

OR

F11/F12 Piston Motor* for the best:

- Efficiency
- Temperature
- Life
- Load
- Power & size density
- Highest pressure & fan speed

* reversing valve requires separate manifold

P1 Piston Pump with ‘Fan Drive Control’ Proportional Pump Pressure Control

"Optimized Performance" System Summary:

The system operates by commanding a Pulse Width Modulated signal to the proportional pressure compensator on the piston pump. When commanded to increase pressure, the piston pump increases it's displacement to increase flow. The fan speed increases as the pressure rises. When the commanded pressure is reached, the pump reduces and modulates its flow to maintain the commanded pressure and fan speed. The default pressure at zero command signal is maximum pressure to assure fail-safe cooling protection.

Total efficiencies of Parker's P1 piston pump range from 85%-91% depending on pump size and operating conditions to assure maximum power stays with the vehicle. A small amount of flow is diverted to control the pump compensator and should be accounted for in sizing calculations. For reversing, appropriate logic is incorporated into the fan drive controller to ramp down the fan speed before reversing. Alternate piston pump controls are available such as Parker's RDEC electronic displacement control which precisely controls pump flow instead of pressure to provide minimal control leakage and excellent system stability.

Performance and Value:

- Maximum fan drive system efficiency and fuel savings
- Fan reversing to clear radiator and maximize radiator efficiency
- Design and Supply Chain savings:
  - The complete hydraulic fan drive integrated together into two components
  - Reduced design, installation labor, hose/fitting and procurement costs
  - Vane motor optimized for fan drive function:
    - Extremely low noise
    - Integrated valves
    - Heavy duty, long life bearings to support fan loads
    - Excellent mechanical and volumetric efficiency throughout pressure & temperature operating range
    - Unique protected internal shaft seal, a barrier to blown in debris
- Parker's P1 piston pump technology:
  - Compact design
  - Lowest noise in the industry due to ripple chamber
  - High overall efficiency throughout temperature range
  - Proven durability in harsh environments
- Optional speed sensor port integral to the motor for monitoring and control
- Parker's strong application expertise and support from design through production stages

Designing the System:

Hydraulic Fan Drive System Information Checklist

The following checklist is helpful to design and optimize a hydraulic fan drive system:

✔ Fan:

- Maximum fan speed required
- Fan power curve or rated power at its rated speed
- Thrust or axial loads
- Weight and center of gravity

✔ Engine:

- Speed at peak torque and peak power
- Lowest engine speed requiring maximum fan speed
- Minimum and maximum engine speed

✔ Power Steering:

- Required flow for the steering gear?
- Maximum steering pressure

✔ Pump Drive:

- Maximum torque available to drive the pump (typically from the compressor thru-drive)
- Speed ratio of Pump Drive to Engine

✔ Maximum Desired Hydraulic Pressure?

✔ Hydraulic Component Details:

- Pump and motor: flange type, mounting clearance, shaft type, rotation
- Other Information: port type, size & space restrictions, voltage

✔ Fluid Type and Operating Temperature Range

✔ Desired Features - Reversing, Fan Speed Control, etc

✔ Duty Cycle of the Fan and Vehicle

Development Process:

Parker's experienced engine cooling and fan drive application team supports you through every step of the system development process. Often, an important initial step is to benchmark and instrument the current system's performance to define the project scope and goals. Customers often choose to deliver a bus to Parker's Systems Engineering Center for instrumentation and development, or our engineers can assist at your own site.

Whether hydraulic systems are relatively new to your vehicle, or already common, Parker's support team is available to assure success from Baseline Development to Production and Field Support.

Parker's Global Applications Team supports you from system development to the field

Fan Drive Component Specifications

Pump and Motor Summary for Bus Fan Drive Systems:

Parker Fan Drive Pumps

Component Cost

Gear PGP500 Series

- Compact size, low weight (aluminum center housing)
- Displacement: 2 - 52cc
- Pressures to 300 bar
- Speeds: 500 to 4000 rpm
- Many shaft and flange options available
- Various integral valve options available
- Multiple sections possible
- Very good inlet feeding capability

Gear PGP600 Series

- Cast iron construction
- Compact size
- Displacement: 7 - 80cc
- Pressures to 300 bar
- Speeds: 500 to 3300 rpm
- Many shaft and flange options available
- Various integral valve options available
- Very good inlet feeding capability
- Good high temperature efficiency
- Multiple sections possible

Piston P1 - 18 to 140

- Highest efficiency
- Max pressure: 280 bar
- Max self priming speed: 2300 - 2000 rpm
- Control options including prop relief and displacement control
- Compact size
- Quiet pump

Performance & Value

Parker Fan Drive Motors

Component Cost

Gear PGM500 Series

- Compact size, low weight (aluminum center housing)
- Displacement: 2 - 52cc
- Pressures to 300 bar
- Speeds: 500 to 4000 rpm
- Many shaft and flange options available
- Various integral valve options available

Gear PGM600 Series

- Cast iron construction
- Compact size
- Displacement: 7 - 50cc
- Pressures to 300 bar
- Speeds: 500 to 3300 rpm
- Various integral valve options available
- Good high temperature efficiency

Vane M5AF, M5BF

- Lowest noise
- High mechanical & over-all efficiency
- Max pressure: 320 bar
- Max speed: 4000 rpm
- Max. axial load: 1800N
- Good temperature sta-bility
- Good conversion flexibility
- Range of integrated valves

Piston F11/F12

- Highest overall efficiency
- Max pressure: 350 bar
- Max speed: 12,800 rpm
- Max. axial load: 4000N
- Highest power to weight ratio
- Range of integrated valves
- Excellent temperature range
- Heavy duty tapered bearings

Performance & Value

Parker

Gear Pump and Motor Specifications

PGP/PGM 640
PGP/PGM 620
PGP/PGM 610

PGP/PGM 610 Specifications - Standard Displacements - Single Unit

Description	Code	0070	0100	0140	0160	0180	0210	0230	0260	0280	0320
Displacements	cm^3/rev in^3/rev	7 0.43	10 0.61	14 0.85	16 0.98	18 1.10	21 1.28	23 1.40	26 1.59	28 1.71	32 1.95
Continuous Pressure	bar psi	275 3989	275 3989	275 3989	275 3989	265 3843	245 3553	235 3408	215 3118	200 2901	175 2538
Intermittent Pressure	bar psi	300 4351	300 4351	300 4351	300 4351	290 4206	270 3916	260 3771	240 3480	220 3190	175 2538

Max. operating speed 3300 rpm

PGP/PGM 620 Specifications - Standard Displacements - Single Unit

Description	Code	0090	0230	0260	0290	0330	0370	0410	0440	0500
Displacements	cm^3/rev in^3/rev	19 1.16	23 1.40	26 1.59	29 1.77	33 2.01	37 2.26	41 2.50	44 2.68	50 3.05
Continuous Pressure	bar psi	275 3989	275 3989	275 3989	275 3989	275 3989	250 3626	220 3191	210 3046	210 3046
Intermittent Pressure	bar psi	300 4351	300 4351	300 4351	300 4351	300 4351	275 3989	245 3553	230 3336	210 3046

Max. operating speed 3000 rpm

PGP/PGM 640 Specifications - Standard Displacements - Single Unit

Description	Code	0300	0350	0450	0550	0650	0750	0800
Displacements	cm^3/rev in^3/rev	30 1.83	35 2.14	45 2.75	55 3.36	65 3.97	75 4.58	80 4.88
Continuous Pressure	bar psi	275 3989	275 3989	275 3989	275 3989	275 3989	235 3408	215 3118
Intermittent Pressure	bar psi	300 4351	300 4351	300 4351	300 4351	300 4351	260 3771	240 3489

Max. operating speed 3000 rpm

See Parker catalog HY09-0600 for further details on 600 Series products

Gear Pump and Motor Specifications

PGP 500

PGP/PGM 505 Specifications

Description	Code	0020	0030	0040	0050	0060	0070	0080	0090	0100	0110	0120
Displacements	cm^3/rev in^3/rev	2 0.12	3 0.18	4 0.24	5 0.31	6 0.37	7 0.43	8 0.49	9 0.55	10 0.61	11 0.67	12 0.73
Continuous Pressure	bar psi	275 3988	275 3988	275 3988	275 3988	275 3988	275 3988	275 3988	250 3625	250 3625	250 3625	220 3190
Intermittent Pressure	bar psi	300 4350	300 4350	300 4350	300 4350	300 4350	300 4350	300 4350	275 3988	275 3988	275 3988	220 3190
Max. Speed @ 0 Inlet & Max. Outlet Pressure	rpm	4000	4000	4000	4000	3600	3300	3000	2900	2800	2400	2400

PGP/PGM 511 Specifications

Description	Code	0060	0070	0080	0100	0110	0140	0160	0180	0190	0210	0230	0270	0280	0310
Displacements	cm^3/rev in^3/rev	6 0.37	7 0.43	8 0.49	10 0.61	11 0.67	14 0.85	16 0.98	18 1.10	19 1.16	21 1.28	23 1.40	27 1.65	28 1.71	31 1.89
Continuous Pressure	bar psi	250 3625	250 3625	250 3625	250 3625	250 3625	250 3625	250 3625	250 3625	250 3625	235 3410	225 3265	190 2755	185 2685	165 2395
Intermittent Pressure	bar psi	275 3988	275 3988	275 3988	275 3988	275 3988	275 3988	275 3988	260 3770	260 3770	240 3480	235 3408	200 2900	190 2755	170 2465
Max. Speed @ 0 Inlet & Max. Outlet Pressure	rpm	4000	4000	4000	3600	3600	3300	3000	3000	3000	2800	2800	2400	2300	2300

See Parker Catalog HY09-0500 for further detail on 500 Series products

Gear Pump and Motor Options

Shaft Seals for Fan Motors:

It is recommended that an excluder shaft seal be included on fan motors to assure shaft seal protection from contamination. Internal shaft seals are specified according to the pressure on the motor outlet and /or drain line. Contact your Parker representative for further information on specifying the correct shaft seals for the system.

Valve Options for Motors:

The following integral valve options are available installed with the motor:

- Proportional Pressure Relief Valve – specify coil voltage, Normally Closed (typical) or Open
- Mechanical Pressure Relief Valve – specify relief valve setting
- Anti-Cavitation Check Valve

Outboard Bearing for Fan Motors:

For large fans producing high axial and/or radial loads on the motor shaft, an outboard bearing may need to be specified.

If envelope or installation constraints exist, the 300 Series Cast Iron pumps and motors are available. See Parker Catalog HY-09-300.

Contact your Parker representative for further information on specifying these options for your system.

Vane Motor Specifications

M5A* Specifications

Description	Code	006	010	012	016	019	025
Displacements	cm^3/rev	6.3	10.0	12.5	16.0	18.0	25.0
Max. Continuous Pressure	bar	300	300	300	300	300	280
Max. Operating Speed	rpm	4000	4000	4000	4000	4000	2500
Max. Intermittent Pressure	bar	300	300	300	300	300	280

M5BF

M5B* Specifications

Description	Code	012	018	028	036	045
Displacements	cm^3/rev	12.0	18.0	28.0	36.0	45.0
Max. Continuous Pressure	bar	290	290	290	290	200
Max. Operating Speed	rpm	4000	4000	2500	2500	2500
Max. Intermittent Pressure	bar	320	320	320	320	280

See Parker catalog HY29-0018 for further details on the M5A* and M5B* products

M5AS* Specifications

Description	Code	006	010	012	016	019	025
Displacements	cm^3/rev	6.3	10.0	12.5	16.0	18.0	25.0
Max. Continuous Pressure	bar	280	280	280	280	280	280
Max. Operating Speed	rpm	5000	5000	3800	3800	3300	2800
Max. Intermittent Pressure	bar	300	300	300	300	300	280

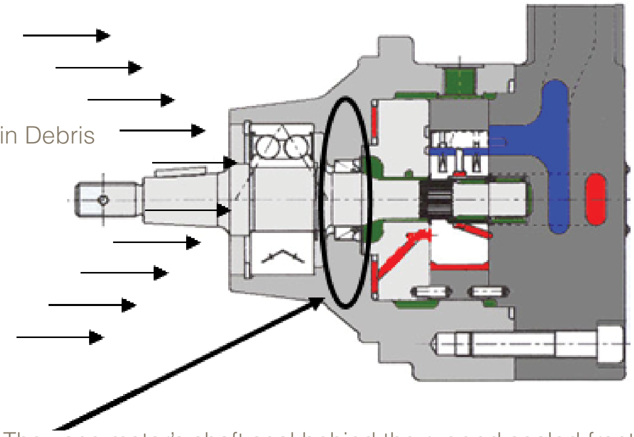
M5AS

See Catalog HY29-0024 for further detail on the M5AS* Product.
Contact your Parker representative for further information on specifying these options for your system.

Vane Motor Optimized for Fan Drive Function:

- Integrated valves
  - Anti-Cavitation Check Valve
  - Anti-Starve Valve
  - Reversing Valve
- Extremely low noise
- Heavy duty, long life bearings to support fan loads
- Excellent mechanical and volumetric efficiency throughout pressure & temperature operating range
- Unique protected internal shaft seal, barrier to blown in debris

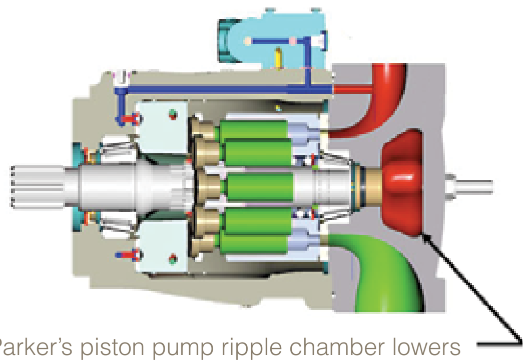
Blown in Debris



The vane motor's shaft seal behind the rugged sealed front bearing protects against shaft seal leaks from debris

Piston Pump and Motor Specifications

P1 Piston Pump



Parker's piston pump ripple chamber lowers pressure pulsations and noise

P1 Piston Pump Specifications

Description	Code	P1 018	P1 028	P1 045	P1 060
Max. Displacements	cm^3/rev cu.in/rev	18 1.10	28 1.71	45 2.75	60 3.66
Outlet Pressure - Continuous	bar psi	280 4000	280 4000	280 4000	280 4000
Intermittent Pressure	bar psi	320 4500	320 4500	320 4500	320 4500
P1 (1.3 bar abs inlet)	rpm	3600	3400	3100	2800
P1 (1.0 bar abs inlet)	rpm	3300	3200	2800	2500
P1 (0.8 bar abs inlet)	rpm	2900	2900	2400	2200

Other displacements available: 75cc, 100cc and 140cc. See Catalog HY28-2665-01 for further detail on the P1 products.

Piston Pump Options

Proportional Pressure Control (Fan Drive) Compensator:

Controls fan speed by electrically commanding the pump pressure setting with PWM signal.

- Specify AJ (12VDC) or AK (24VDC compensator control)
- Specify mechanical maximum pressure setting if needed:
  - 3 = 140 bar; 4 = 210 bar; 5 = 250 bar; 6 = 280 bar; 7 = 350 bar
  - Example: AK6 = 24VDC with 280 bar mechanical max pressure relief

Load Sense Control:

Pump pressure setting can also be varied by supplying an external pressure signal to the pump load sense port. Specifying this 'LO' control allows:

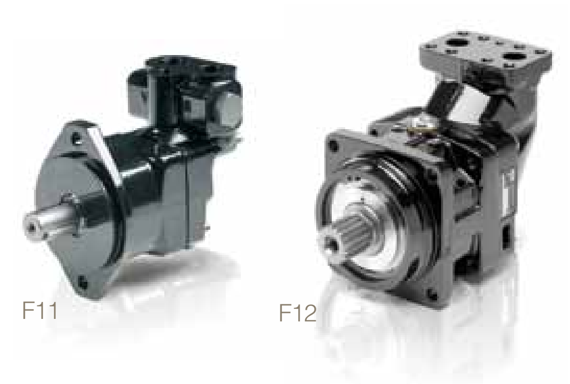
- Load sense differential (standby) pressure adjustment 10-30 bar
- Maximum pressure adjustment 80-280 bar

Electronic Displacement Control:

Parker's RDEC electronic displacement control precisely controls pump flow instead of pressure to control the fan speed, providing maximum efficiency through minimal control leakage and excellent system stability.

Contact your Parker representative for further information on specifying these options for your system.

Bent Axis Piston Motors - F11/F12 Specifications



Bent Axis Specifications

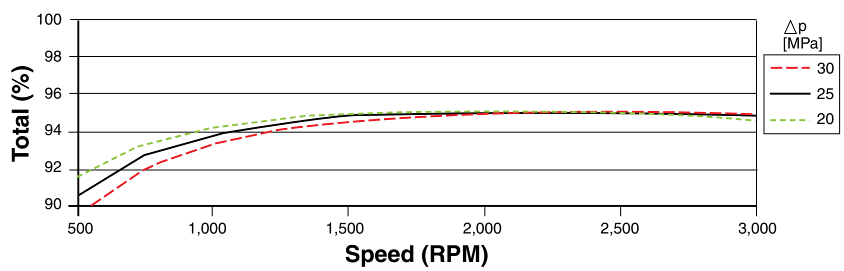
		F11						F12	
Description	**Code**	**-5**	**-6**	**-10**	**-12**	**-14**	**-19**	**-30**	**-40**
Max. Displacements	cm^3/rev	4.9	6.0	9.8	12.5	14.3	19.0	30.0	40.0
Operating Pressure									
Max. Intermittent	bar	420	420	420	420	420	420	480	480
Max. Continuous	bar	350	350	350	350	350	350	420	420
Motor Operating Speed									
Max. Intermittent	rpm	14,000	11,200	11,200	10,300	9,900	8,900	7,300	6,700
Max. Continuous	rpm	12,800	10,200	10,200	9,400	9,000	8,100	6,700	6,100
Min. Continous	rpm	50	50	50	50	50	50	50	50
Motor Input Flow									
Max. Intermittent	l/min	69	67	110	129	142	169	219	268
Max. Continuous	l/min	63	61	100	118	129	154	201	244
Main Circuit Temp.									
Max.	°C	115	115	115	115	115	115	115	115
Min.	°C	-40	-40	-40	-40	-40	-40	-40	-40
Theoretical Torque at 100 bar	Nm	7.8	9.5	15.6	19.8	22.7	30.2	47.6	63.5
Mass Moment of Inertia	$(x10^{-3})$ [kg m^2}	0.16	0.39	0.39	0.40	0.42	1.1	1.7	2.9
Weight	kg	4.7	7.5	7.5	8.2	8.3	11	12	15.5

See Catalog HY30-8249 for further detail on F11/F12 motors

Piston Motor Features:

- Compact motor range, extremely high power to weight ratio
- Heavy duty bearing
- High speed capability
- Low noise
- Integrated anti-cavitation check valve and pressure relief valve options
- High overall efficiency
- Integrated speed sensor

Total Efficiencies F11 Motor (19cc Example)



The unique spherical piston design of Parker's F11 bent axis motors enable extremely high overall efficiency (mechanical + volumetric) through a wide operating range

Parker

Valve Manifold Specifications

Parker's Hydraulic Cartridge Systems Division has developed an extensive range of manifolds with integrated valves for common fan drive and steering functions on bus and transit vehicles. In addition, modified or custom circuits can be easily designed and delivered for prototyping quickly. Parker's integrated valve manifolds provide the following benefits:

- Flexible envelope and mounting
- Integrated valves reduce:
    - Hoses & fittings
    - Installation time
    - Supply chain logistics & costs
    - Leak points
- Field replaceable valves instead of the entire manifold
- Solid models quickly available
- Rapid prototyping capability

See Catalog HY15-3502 for further detail on valve manifolds

Hose and Fitting Specifications

With a long history of providing the most comprehensive selection of hoses, fittings, equipment and accessories, Parker's Hose Products Division can help you select the best product for your application. The tough conditions in bus and transit operations demand the right product, including hoses that feature a variety of abrasion-resistant cover choices, flexibility, a wide range of fluid compatibility and more – characteristics that make Parker the hose supplier of choice for customers that demand the most from their equipment.

Parker's adapters and hose fittings provide the industry's best corrosion protection, including improved plating to better resist the harsh chemicals used on today's roads. Parker's proprietary XTR coating provides more than seven times SAE standard protection, giving you an outstanding advantage for protecting equipment in severe environments.

See Catalog 4400 for additional information on hose assemblies
See Catalog 4300 for further details on adapters

Fan Drive Controller Specifications

The rugged enclosure houses a state-of-the-art microprocessor with SAE J1939 CAN networking. Superior control is the result of a setup package utilizing an easily understood software interface featuring real time data logging and diagnostic capability.

The controller is versatile. Cooling requirements can be derived from the J1939 CAN data and/or combination of thermistors and pressure transducers. The self-diagnostics protects the controller in the event of overheating.

- Three thermistor inputs, coil current feedback, manual/automatic reversing, air conditioning support, boost solenoid support, diagnostics
- Fault logging
- Data logging
- Adjustable PWM driver for proportional valve
- Torque limiting

PFDC Hydraulic Fan Driver Controller

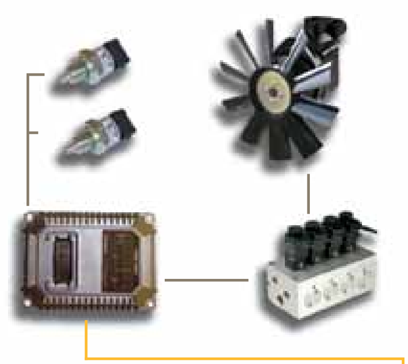
Power			
Nominal	12/24VDC		
Range	9-32VDC		
Protection for	reverse polarity, transient immunity and “load dump”		
Inputs			
PFDC-All	digital	four (4) sourced	9-32VDC (7mA @ 32VDC)
PFDC-1	thermistor	three (3)	-40 to 150C (100K - 50 Ohm, NTC)
PFDC-2	thermistor	one (1)	3V internal bias
PFDC-3	transducer	two (2)	0.5 to 4.5 VDC (pressure transducer)
Outputs			
Digital	9-32VDC 3A max.	four (4)	sourcing/high side switch
PWM	3 Amp max.	frequency adjustable from 10 Hz to 1000 Hz	
Note	output voltage is approximately equal to power input voltage		
Indicator Leds			
Power	green	indicates system power	
J1939	green	indicates J1939 communication connect	
Error	red	flashes on error	
Communication Ports			
Network	J1939 CAN		
Configuration	RS232	Note: used for configuration only	
Environmental			
Temperature operating: Storage:	-40°C - +85°C -40°C - 85°C		

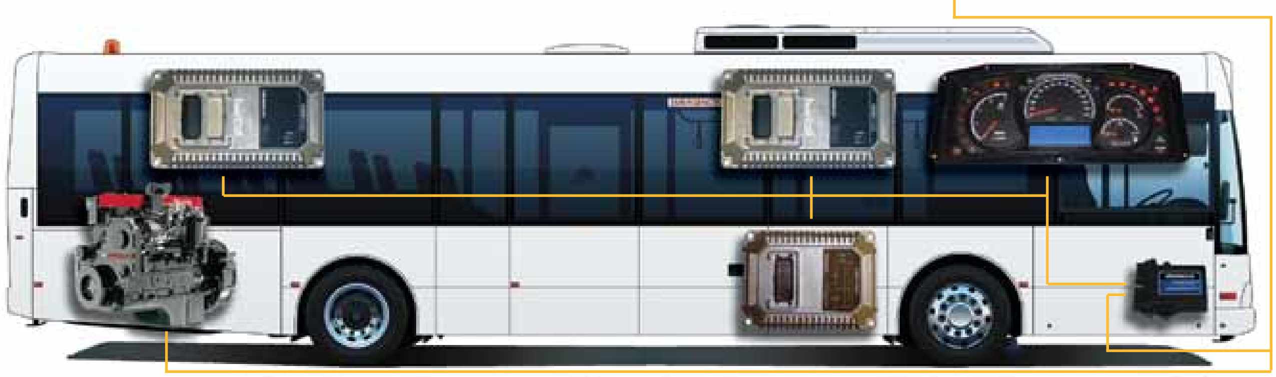
See Catalog HY09-PFDC for further detail on the PFDC Controller

Electronic Controllers - Fan Drive & Full System

With overall vehicle electronic control systems becoming more common in the bus market, the ability to integrate the fan drive control logic into the rest of the vehicle control system is important. Parker Hannifin offers a wide variety of CAN bus based control platforms that can be integrated with the fan drive hydraulics. Integrating the fan drive into the overall vehicle control system can reduce the installation time and cost, reduce diagnostic time and increase fan drive efficiency by allowing all the vehicle functions that could affect fan drive performance to be monitored. Integrating the fan drive into the vehicle control system still allows for full fan drive functionality, including:

- SAE J1939 CAN and analog inputs for fan speed control
- Fan reversing with ramps
- Automated and manual fan reversing
- Multiple fan locations with independent control
- Improved fault detection and diagnostics
- Software configuration of parameters





Full Bus System Controllers – Multiplexing Modules

Filter and Reservoir Specifications

Parker offers a wide array of hydraulic filtration and reservoir capabilities. For bus and transit applications, the PT series filter is an ideal solution combined with either a standard or custom reservoir.

The example filter + reservoir assembly pictured utilizes the PT Filters integrated into a space efficient cylindrical reservoir for a bus application:

- Complete assembly: filter, reservoir, filter, breather, filter indicator, level gauge
- Rugged, space efficient cold rolled steel reservoir
- Unique PT filter design for tank top or inside tank mounting
- Multiple port options for steering, suction and case drain
- Microglass filter media for cleaner fluid and long filter life
- Aftermarket protected filter element (patented element)
- Top mount access for quick replacement; element service requires no fluid contact or fluid loss

PT Series Filter

Description	Code	PT2-1	PT2-2	PT4-1
Max. Pressure	bar psi	10.3 150	10.3 150	10.3 150
Flow Reference*	LPM GPM	30 8	70 19	150 50
Length (Tank top to Element Bottom)	inch mm	4.52 115	7.23 183.6	3.79 96.2
Element Width	inch mm	1.8 45.7	1.8 45.7	3.09 78.5

*0.5 bar pressure drop with 10μ element

All PT Filters

Select from 2μ, 5μ, 10μ and 20μ elements with 99.5% efficiency		
Max. Operating Pressure	bar psi	10.3 150
Integral Bypass Valve	bar psi	1.7 25

PT4-2 and -3 also available for higher flows

See Catalog 2300-455-1 for further detail on reservoirs
See Catalog 2300-430 for further detail on PT filters

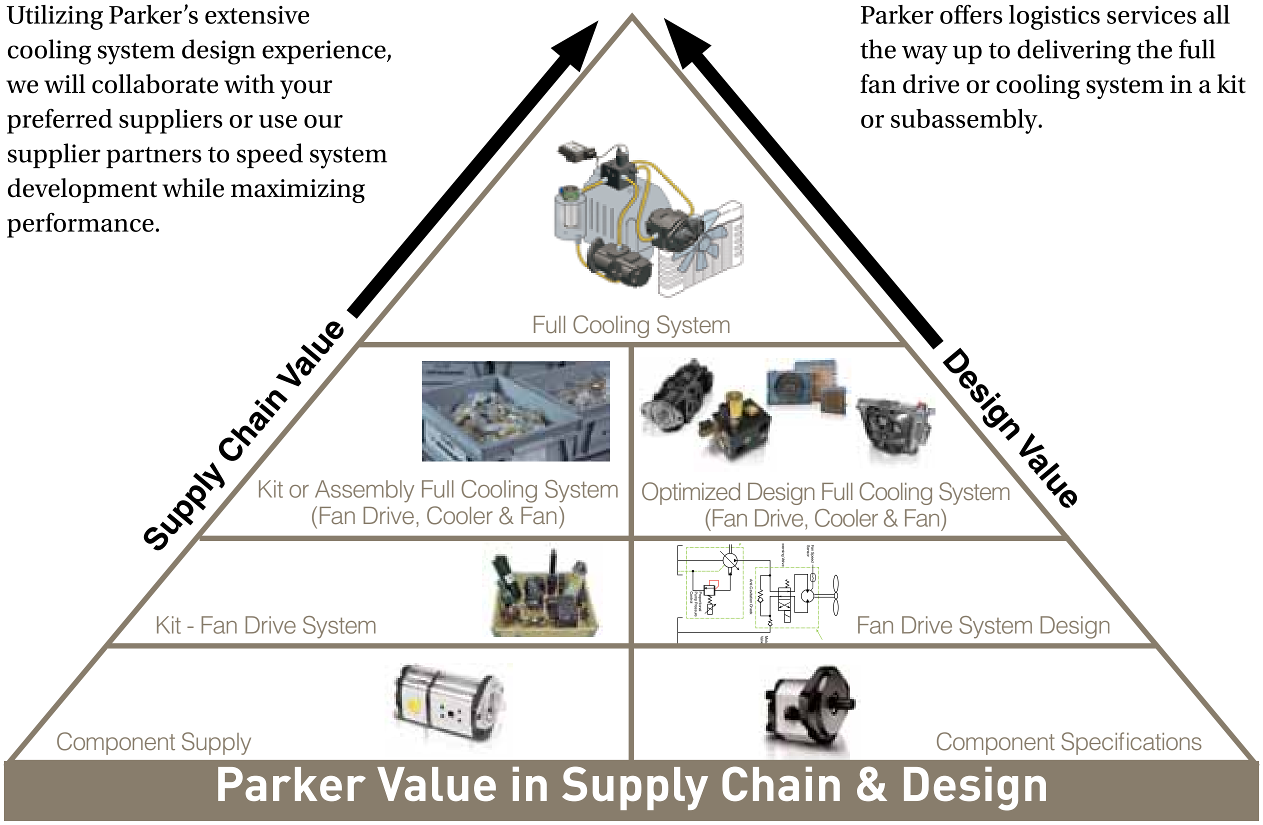
Maximizing Value with Parker

Design:

Utilizing Parker's extensive cooling system design experience, we will collaborate with your preferred suppliers or use our supplier partners to speed system development while maximizing performance.

Supply Chain:

Parker offers logistics services all the way up to delivering the full fan drive or cooling system in a kit or subassembly.



System Expertise:

- World Leader in the design, manufacture, and integration of hydraulic systems
- System Engineering Centers throughout the world to develop and validate an optimized cooling system

Widest Range of Solution Options:

- Full range of hydraulic components and controllers available for Bus Fan Drive Systems
- Enables selection of the best components to optimize the cooling system for your vehicle

Global Support:

- Global Manufacturing Operations, Sales Companies and Distributor Network
- Local Supply, Logistics and Assembly Capability
- Aftermarket , Field Support, Service and Repair

Sales Offices

Argentina, Buenos Aires
Tel: (54) 33 2744 4129

Australia, Castle Hill
Tel: (61) 2 9634 7777

Austria, Wiener Neustadt
Tel: (43) 2622 23501 0

Belgium, Nivelles
Tel: (32) 67 280 900

Brazil, Cachoeirinha RS
Tel: (55) 51 3470 9144

Canada, Milton, Ontario
Tel: (905) 693 3000

China, Beijing
Tel: (86) 10 6561 0520

China, Shanghai
Tel: (86) 21 5031 2525

Czech Republic and Slovakia, Klecany
Tel: (420) 284 083 111

Denmark, Ballerup
Tel: (45) 4356 0400

Finland, Vantaa
Tel: (358) 20 753 2500

France, Contamine-sur-Arve
Tel: (33) 4 50 25 80 25

Germany, Kaarst
Tel: (49) 2131 4016 0

Greece, Athens
Tel: (30) 210 933 6450

Hong Kong
Tel: (852) 2428 8008

Hungary, Budapest
Tel: (36) 1 220 4155

India, Mahape, Navi Mumbai
Tel: (91) 22 6513 7081

Ireland, County Dublin, Baldonnell
Tel: (353) 1 466 6370

Italy, Corsico, Milano
Tel: (39) 02 45 19 21

Japan, Tokyo
Tel: (81) 3 6408 3900

Korea, Seoul
Tel: (82) 2 559 0400

Malaysia, Subang Jaya
Tel: (60) 3 5638 1476

Mexico, Toluca, Edo. de Mexico
Tel: (52) 72 2275 4200

The Netherlands, Oldenzaal
Tel: (31) 541 585000

New Zealand, Mt. Wellington
Tel: (64) 9 574 1744

Norway, Ski
Tel: (47) 64 91 10 00

Poland, Warsaw
Tel: (48) 22 57 32400

Portugal, Leca da Palmeira
Tel: (351) 22 999 7360

Romania, Bucharest
Tel: (40) 21 252 1382

Russia, Moscow
Tel: (7) 495 645 2156

Singapore, Jurong Town
Tel: (65) 6 887 6300

Slovenia, Novo Mesto
Tel: (386) 7 337 6650

South Africa, Kempton Park
Tel: (27) 11 961 0700

Spain, Madrid
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Sweden, Spånga
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Thailand, Bangkok
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