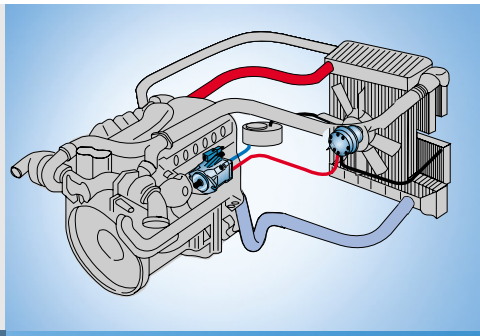
Rexroth
Bosch Group

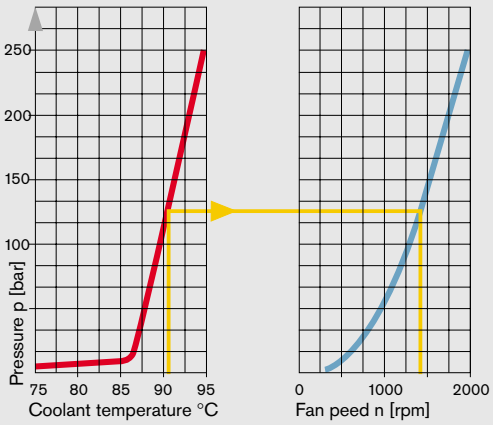
More power less energy. Hydrostatic Fan Drives from Rexroth



The Drive & Control Company

Hydrostatic Fan Drives

Fan drives diagram



Fan drives dissipate the heat, coming with the coolant from the combustion engine.
The cooling performance of a radiator is determined by the fan size, pitch of blades and fan speed.
Controlled hydrostatic fan drives are superior to the conventional units with V-belts:

Stepless control of fan speed between minimum and maximum

The mounting location in the vehicle is completely optional

The components are small and space saving

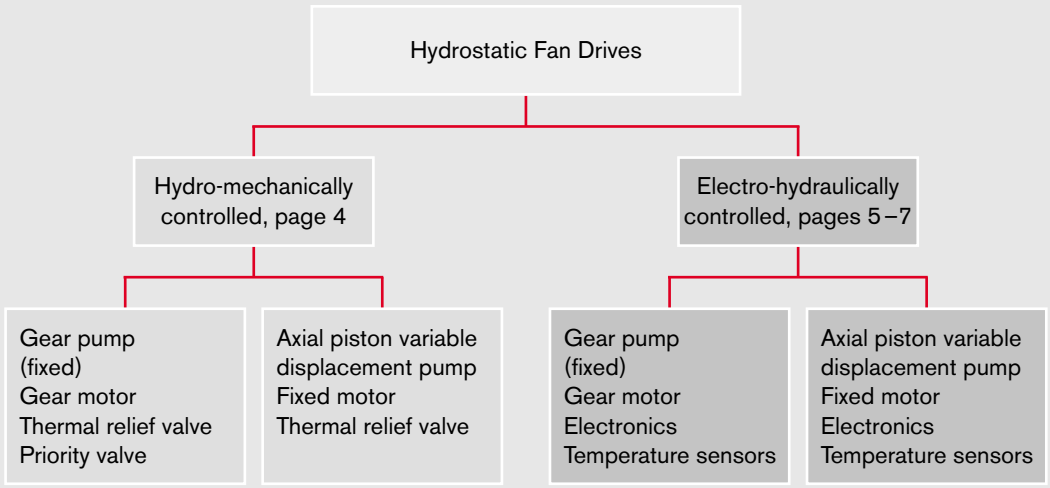
Other advantages of controlled hydrostatic fan drives:

General
- high reliability
- a wide ambient temperature range from –40 °C to +100 °C

Control system based on cooling performance requirements
- Reduced exhaust gas and noise emissions
- Reduced fuel consumption
- Maximum fan speed limitation independent of the combustion engine speed

Other technical options
- Automatic increase of fan speed when actuating functions with high heat load (e. g. retarder)
- Fail safe mode of operation, that means going automatically to maximum fan speed in case of control function failure.
- Starting up at defined fan speeds

For a hydraulic fan drive the following options are possible



Components for controlled hydrostatic fan drives

The classification displayed in the following chart is dependent on the gear ratio (combustion engine to pump) and the general speed and pressure level. Please confer before project planning.

Fan power in kW	7 – 10	10 – 15	15 – 20	20 – 25	> 25 250
Axial-piston pump size			18 / 28	45	60 500
Axial-piston motor size			18	23 / 28	32 500
Gear pump size	16	19	32		
Gear motor size	8	16	22,5	32	

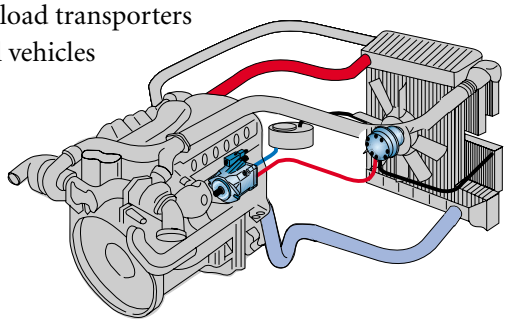
Areas of application for hydrostatic fan drives

Construction Machines
- Crawler excavators
- Mobile excavators
- Bulldozers
- Wheel loaders
- Excavator loaders
- Mobile cranes
- Forklifts
- Telehandlers
- Pavers
- Others

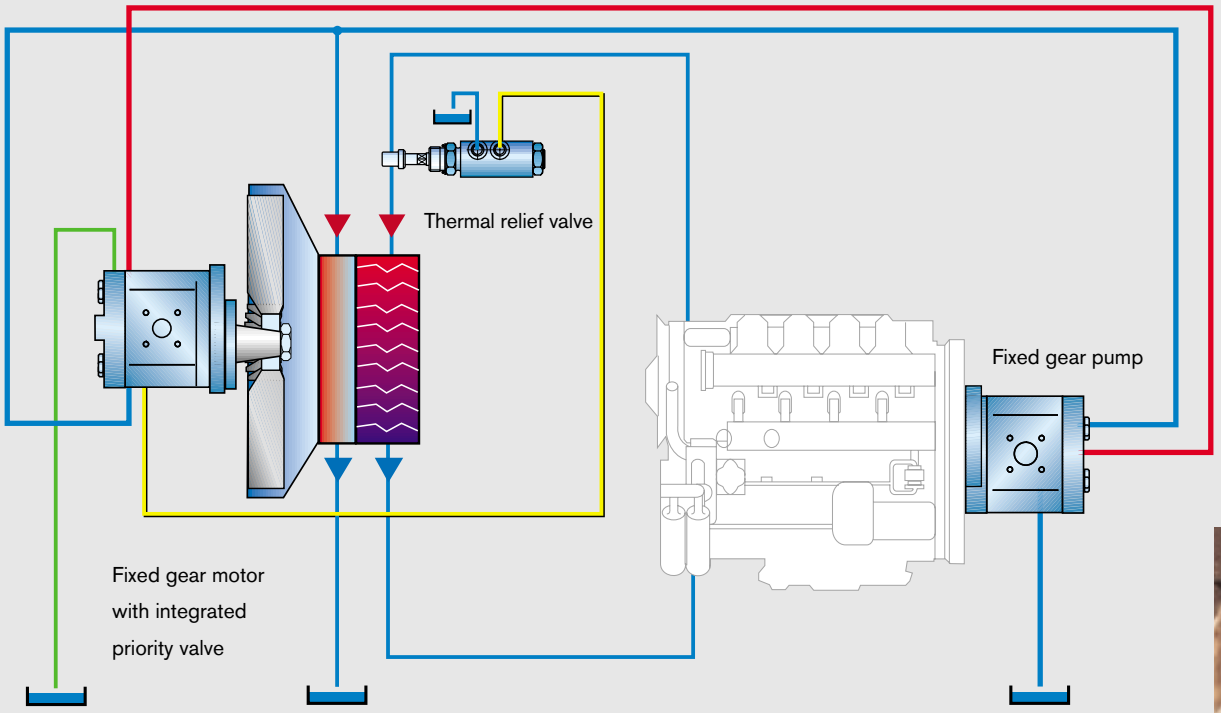
Agriculture and Forestry
- Tractors
- Combine
- Forestry machinery

Road Vehicles
- Buses
- Trucks
- Heavy load transporters
- Special vehicles

Rail Vehicles
- Locomotives
- Diesel railcars



Fan drive, hydro-mechanically controlled with gear pump and gear motor



For higher fan drive power (>15kW), this system is carried out with variable axial piston pump and gear motor without priority valve or with variable axial piston pump and fixed axial piston motor.

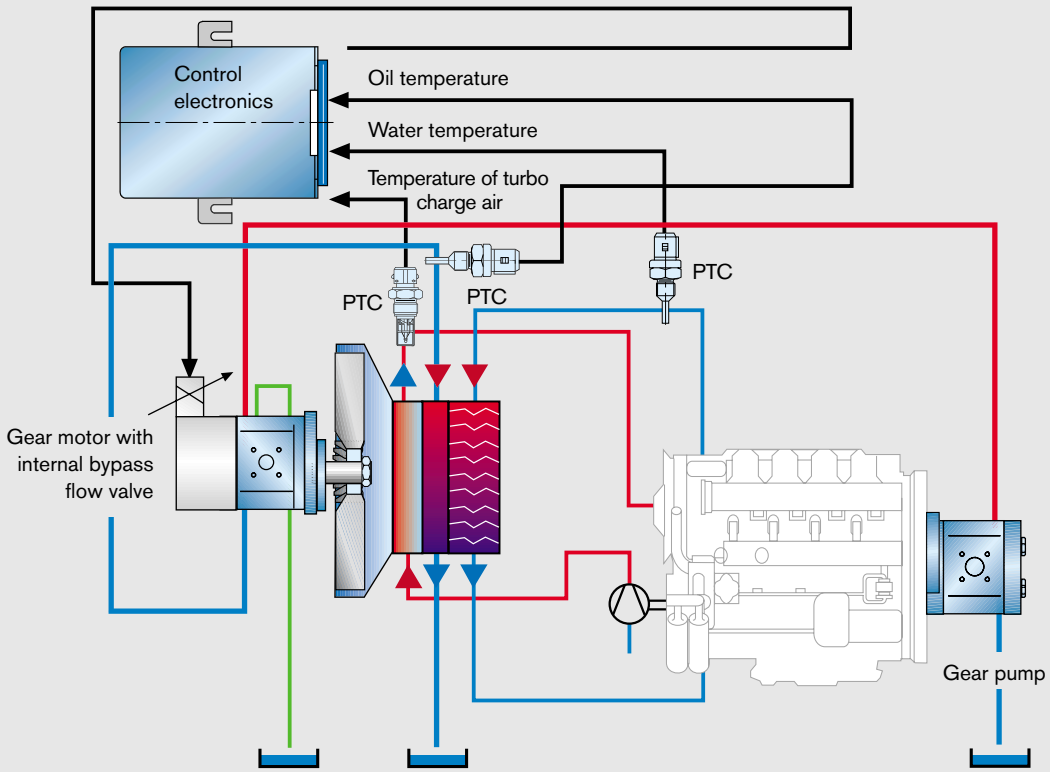
Hydrostatic fan drives with gear pump and gear motor with integrated priority valve use a thermal relief valve to control the hydraulic pressure.
When using a system with variable pump, the thermal relief valve controls the pump's pressure controller, which can be remote-controlled.
This guarantees that there is always pressure and flow at the fan motor, which are required for cooling the combustion engine using the air flow.
The priority valve can direct any available excess flow to other hydraulic functions.

Advantages
- small overall length of pump
- favorable price / performance ratio

Advantages with Variable Pump
- Pump output power is in relation to required fan drive power
- Fan speed independent of engine speed
- Required power is only dependent on coolant temperature
- No hydraulic losses

The thermal pilot relief valve features:
- simple design
- favorable price / performance ratio
- good temperature control with fluids

Fan drive, electro-hydraulically controlled with gear pump and gear motor



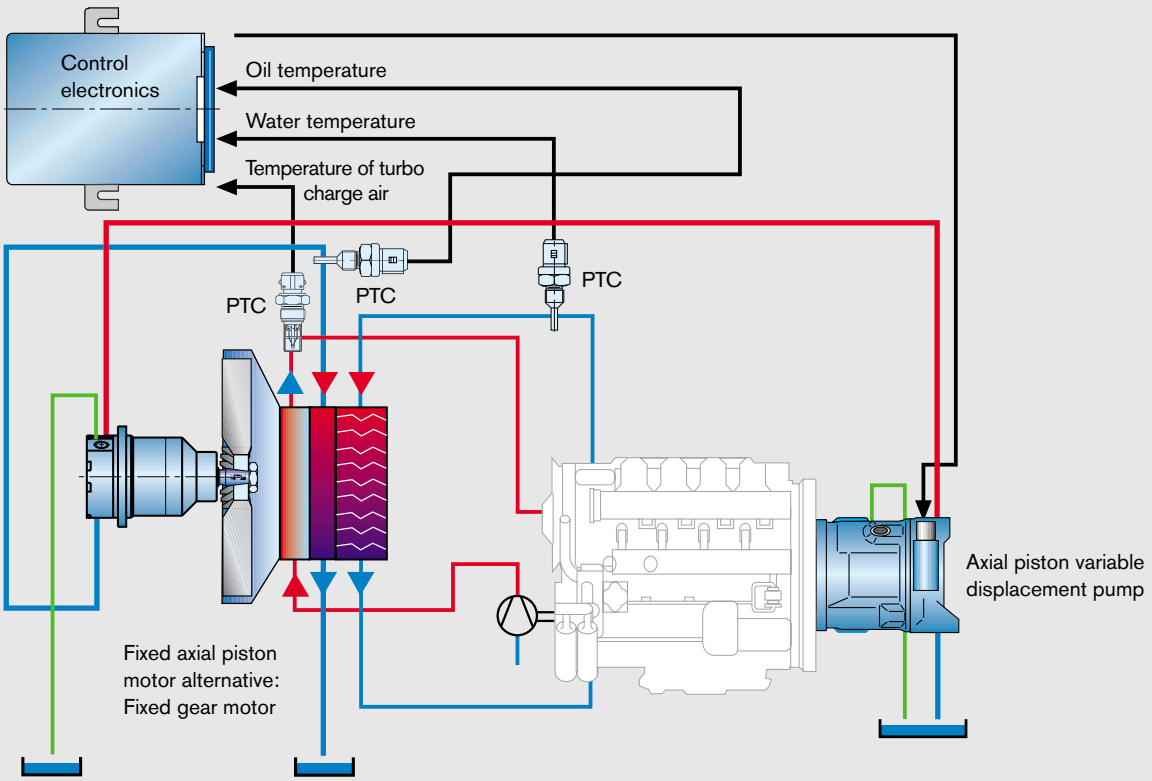
To achieve very high accuracy or to control a number of temperatures, electronic temperature control is the technically sensible solution. Gear pumps and gear motors can be used for small to medium fan power outputs of up to 15 kW.
The electronic cooler controller enables a very accurate control of coolant – and/or turbo-charge air temperature, also during rapid load changes.
Gear pumps and gear motors with electro-proportional bypass flow control are very suitable for these applications.
The internal gear motor features an electro-proportional relief valve. Excess flow, coming from the fixed pump is bypassed via this relief valve to the tank.
This electro-proportional relief valve controls system pressure and fan speed, thus cooling performance. It can be integrated into the motor port plate.
The electro-proportional bypass valve features a “fail safe” control that increases the pressure to full, i. e. maximum fan speed in the event of a power failure.

Advantages

- high control accuracy
- sensing and evaluation of several operating parameters
- fast response times
- interface for diagnostic trouble shooting (optional)

In addition, there is the possibility to increase fan idling speed in anticipation of a heavy heat load, i.e. use of retarder.

Fan drive, electro-hydraulically controlled with axial piston pump and motor



Variation: combining an axial piston pump and a gear motor is also possible

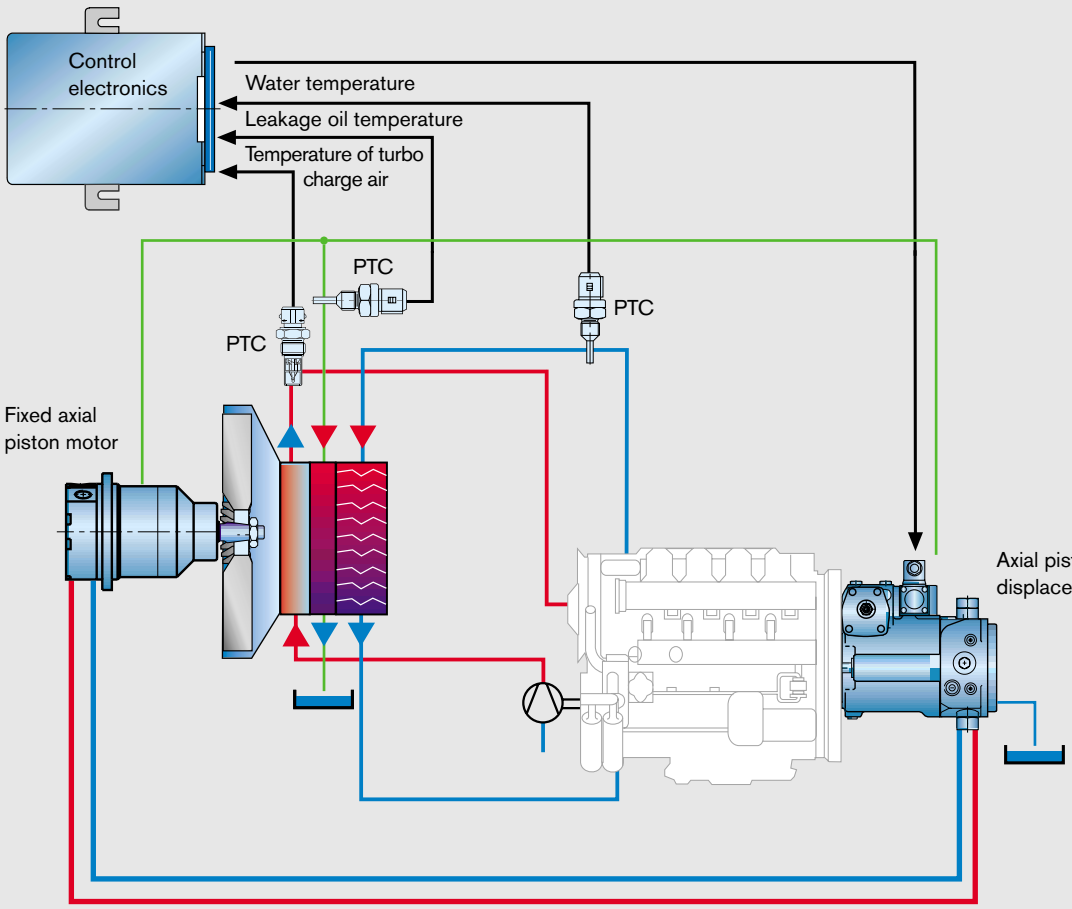
The electronic control senses the temperatures which must be controlled and other parameters, evaluates the values according to a given program and generates a control signal to the pump's electro-hydraulic pressure control.
This regulates pump output pressure and consequently fan power. This results in fan power outputs, which are exactly in accordance with the required cooling performance.
The use of this type of electronically controlled variable pumps features many advantages.

Advantages

- reduction of energy requirements
- high control accuracy
- sensing and evaluation of several operating parameters
- fast response times
- fail safe behavior
- long service life
- interface for diagnostic trouble shooting (optional)

In addition, there is the possibility to increase fan idling speed in anticipation of a heavy heat load – i. e. use of retarder.
For a detailed description of the ED-control see page 10.

Reversible fan drive, electronic controlled with axial piston pump and motor in a closed hydraulic loop



For systems that require the fan wheel to reverse (e.g. for cooler self-cleaning process), drive systems in a closed loop are used.
By simply reversing the hydraulic pump's discharge direction, the direction of rotation of the hydraulic motor and thereby the fan wheel can be changed without complex valve mechanics.
The advantages of the closed loop are particularly apparent where the fan drive system needs to be cleaned frequently due to adverse environmental conditions and increased accumulation of dirt.

Advantages

- simple reversal of the fan wheel's direction of rotation by reversing the hydraulic pump
- switching off the fan wheel by zero positioning the hydraulic pump
- displacement volume of the hydraulic pump is independent of operating pressure and thereby independent of the cooler resistance
- no need for make-up at the hydraulic motor
- Safeguards the maximum fan speed using hydraulic pressure cut-off at the hydraulic pump

Hydraulic components

External gear pump
ZF 004 ... 22.5
ZN 020 ... 36
ZG 022.5 ... 56
Data sheet
1 987 760 100 AKY 001/1

External gear motor
MZFS 8 ... 22.5
Data sheet
1 987 761 700 AKY 017/5

Internal gear pump
PGF2 011 ... 019
PGF 022 ... 040
Data sheet RD 10 213

Internal gear motor
MGF2 006 ... 022
MGF2 025 ... 040
Data sheet RD 14 046

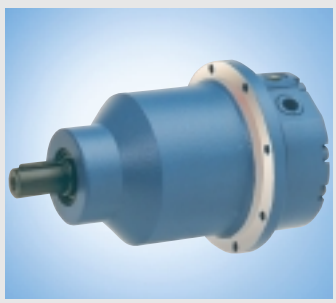
Priority valve LPS
Data sheet RD 27 548

Thermal pilot relief valve MHDBDT
Data sheet RD 64 309

Axial-piston pump
A10VO 28 ... 85 ED/52
A10VO 28 ... 85 DRG/52
Data sheet RD 92703
A10VSO 10 ED/52
A10VSO 10 DRG/52
Data sheet RD 92713

Axial piston pump
A10VO 28 ... 100 ED/31
A10VO 28 ... 140 DRG/31
Data sheet RD 92 701
A10VSO 18 ED/31
A10VSO 18 DRG/31
Data sheet RD 92 712

Axial piston pump
A11V(L)O 190 … 260/11
Data sheet RD 92 500



Axial piston motor
A10FSM 10 ... 18/31
Data sheet RD 91 180
A10FM/E 23 ... 63/52
Data sheet RD 91 172

Axial piston motor
A2FM 5 ... 1000/6
Data sheet RD 91 001

Electrical/Electronic Components

Analogue fan control (Data sheet: 1 987 761 700 AKY 017/5)

One-channel electronics

- 1 analogue input for temperature sensor
- 1 magnetic output

Multi-channel electronics

- 3 analogue inputs for temperature sensors
- 1 digital input
- 1 magnetic output

PTC temperature sensors for air or for fluids

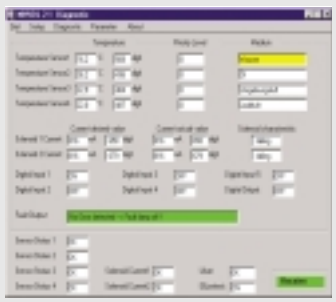
Electro-proportional bypass valve

Digital fan control (Data sheet: RD 29 885)

Multi-channel electronics

- 4 analogue inputs for temperature sensors
- 4 digital inputs
- 2 magnetic outputs
- 1 switch output
- 1 error output
- Interface for diagnostic trouble shooting

PTC temperature sensors for air or for fluids



Diagnostic software

- Parametering
- System optimization
- Troubleshooting

Hydrostatic Fan Drive with Variable or Fixed Pumps

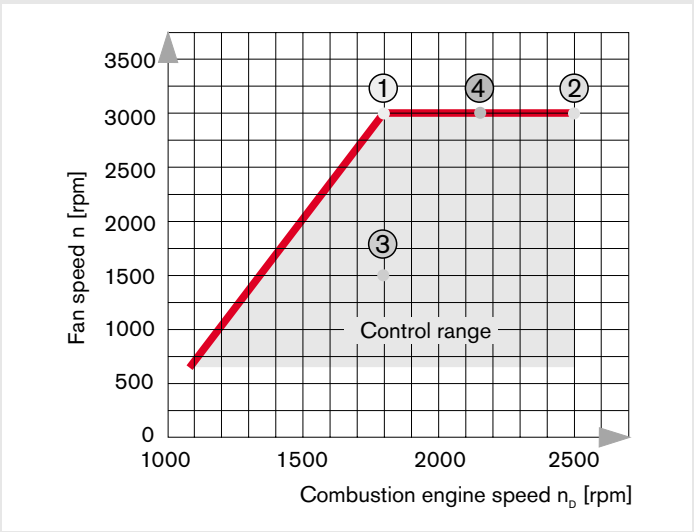
Advantages of fixed pumps
- Minimum system price
- Compact dimensions

Advantages of variable pumps
- Optimum adaptation of the pump output to the required fan power
- High system efficiency
- Low fuel consumption

Comparison of efficiency (example application)
Maximum fan drive power: 17 kW
Combustion engine speed: min 650 rpm, max 2500 rpm
Combustion engine speed at which the maximum fan speed must be available: 1800 rpm

Operating cycle

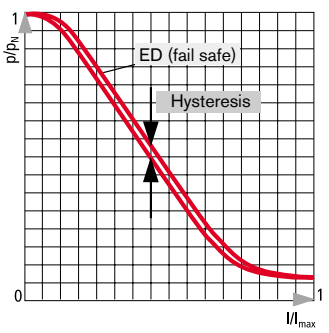
	engine speed/fan speed/operating time [%]		
Operating point ①	1800	3000	40
Operating point ②	2500	3000	25
Operating point ③	1800	1500	25
Operating point ④	2150	3000	10
Total power requirement with fixed pump			approx. 22 kW
Total power requirement with variable pump			approx. 18,5 kW
Power saved with variable pump			**approx. 3,5 kW**



The variable pump saves power at a rate of approx. 18 %!
This example clearly shows that higher system costs quickly pay for themselves with the energy they save.
The power saving example presented here is dependent on the system design and can, in practice, provide lower and also higher results.

A 10 variable pumps with electro-hydraulic pressure control (ED)
The electro-hydraulic pressure control ED has been developed especially for controlled fan drives with A10 variable pumps from series 31 and 52. This enables low-cost, compact and flexible layout of the complete system.
This pressure control regulates maximum system pressure by means of a variable current to the pump solenoid inverse proportional to the current.
In fan drive systems, the control electronics convert the various inputs from the temperature sensor into a solenoid current.
When changing drive speed (engine speed) the control maintains an unchanged pressure level and the pump swivel angle changes keeping the flow equivalent to the actual required fan motor flow, making the fan speed without any hydraulic losses independent of engine speed.
A failure in the control system (i.e. broken cable somewhere) causes the system to go to maximum pressure and maximum fan speed (fail safe).

Static Current



Advantages
- Optimum system efficiency
- Compact design
- Proven A10-technology
- Fast response times and high degree of accuracy
- Easy to drive, standard solenoids (12V resp. 24V)
- Valve variations with high insulations class available (IP69K, salt water proof and explosion proof)
- same valve for all pumps sizes

See data sheet RE 92707 for more information about ED control

Application Center for Fan Drives at Bosch Rexroth Mobile Hydraulics Systems Advice, Planning, Optimization





System solutions – today and in future
The purpose of the Application Centers at Bosch Rexroth Mobile Hydraulics is to analyze customers' present and future requirements in the field of drive and control systems and to develop appropriate solutions – from the individual components to the complete system.

Stronger – faster – better
The future belongs to those vehicles and machines which are more powerful, more rapidly available and more cost-efficient. Among other things, this also requires drive systems which have been optimized for the specific application in question. Our Application Centers provide the required practical know-how, state-of-the-art simulation programs and efficient test systems. Complete operational system solutions are developed in close cooperation with our customers and partners and with a minimum of interfaces, using perfectly matched and coordinated components.
In addition, our Application Centers also make use of the synergistic effects generated by the various divisions of Bosch Rexroth AG and their different technologies.

Bosch Rexroth worldwide
The Bosch Rexroth sales organization spans more than 80 countries. Our global presence is additionally ensured by 45 sales and service offices in 36 countries, as well as 85 production facilities. That means you and your customers dispose of competent Drive and Control partners almost anywhere in the world.

Rexroth
Bosch Group

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