

GENERAL

The cooling system is to minimize energy consumption and noise by speed control of fan motor. The cooling is accomplished by continuously monitoring the temperature of the cooling water of engine and oil of the transmission and fitting the required fan speed.

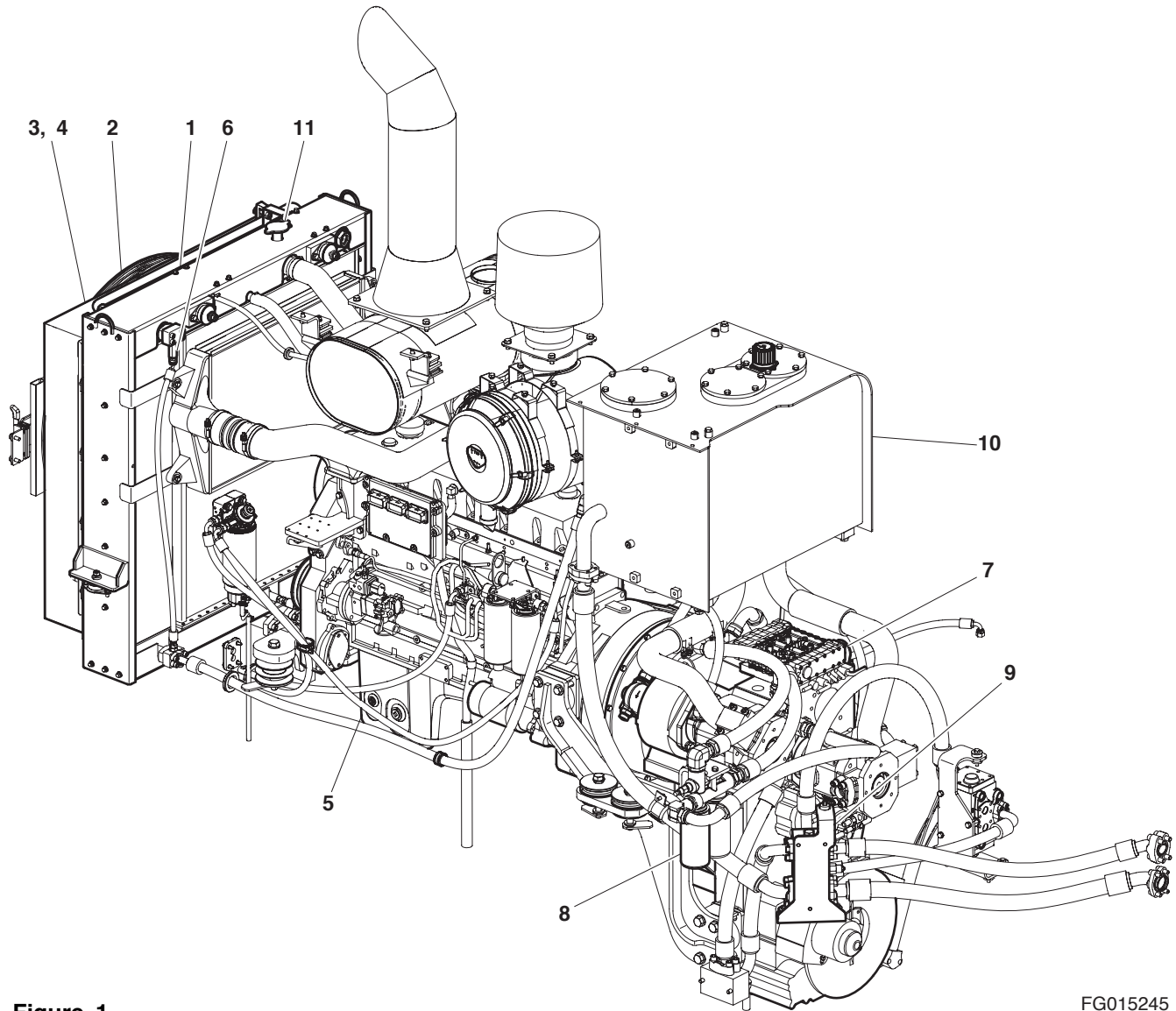


Figure 1

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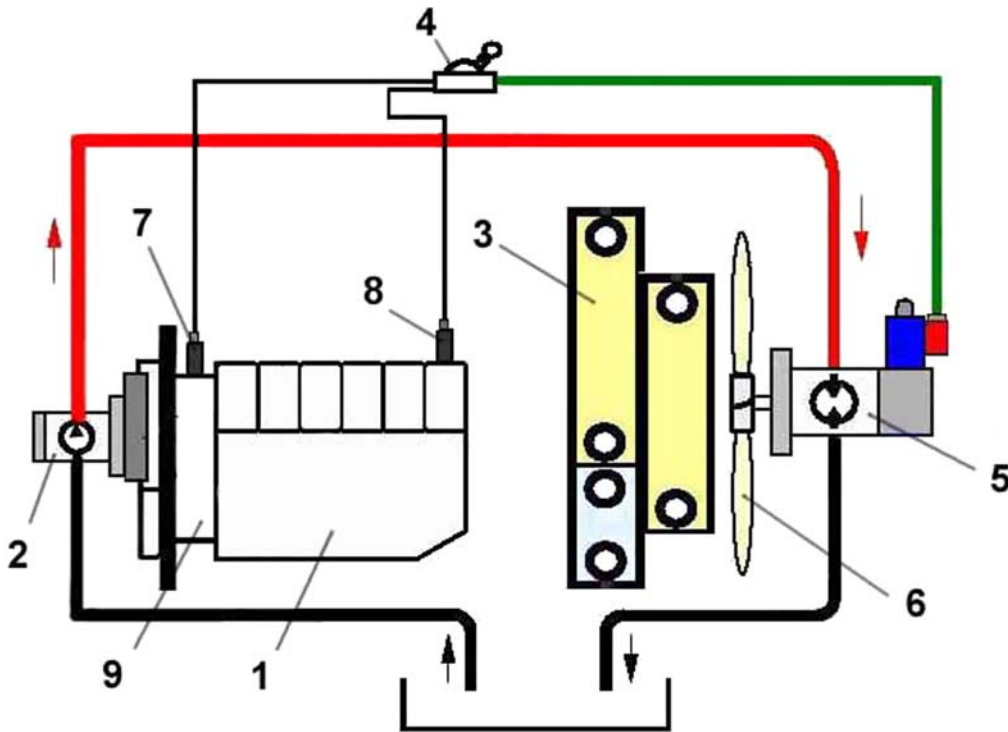
Reference Number	Description
1	Radiator Assembly
2	Fan Guard
3	Fan Motor (Rear Side)
4	Cooling Fan (Rear Side)
5	Engine
6	Bypass Valve

Reference Number	Description
7	Transmission
8	Transmission Oil Filter
9	Block Valve
10	Oil Tank
11	Radiator Cap

COOLING SYSTEM

By the motor integrated proportional pressure relief valve, the fan speed (and therewith the cooling performance) can be infinitely controlled in dependence on two different simultaneously input signals from temperature sensors.

The electronic control unit ECU processes the input signals and controls the valve coil current. The proportional relief valve has a fail safe characteristic, this means, max. relief valve setting is adjusted automatically at interrupted voltage supply (e.g. broken wire). This results in a max. fan speed and therefore in a max. cooling performance.



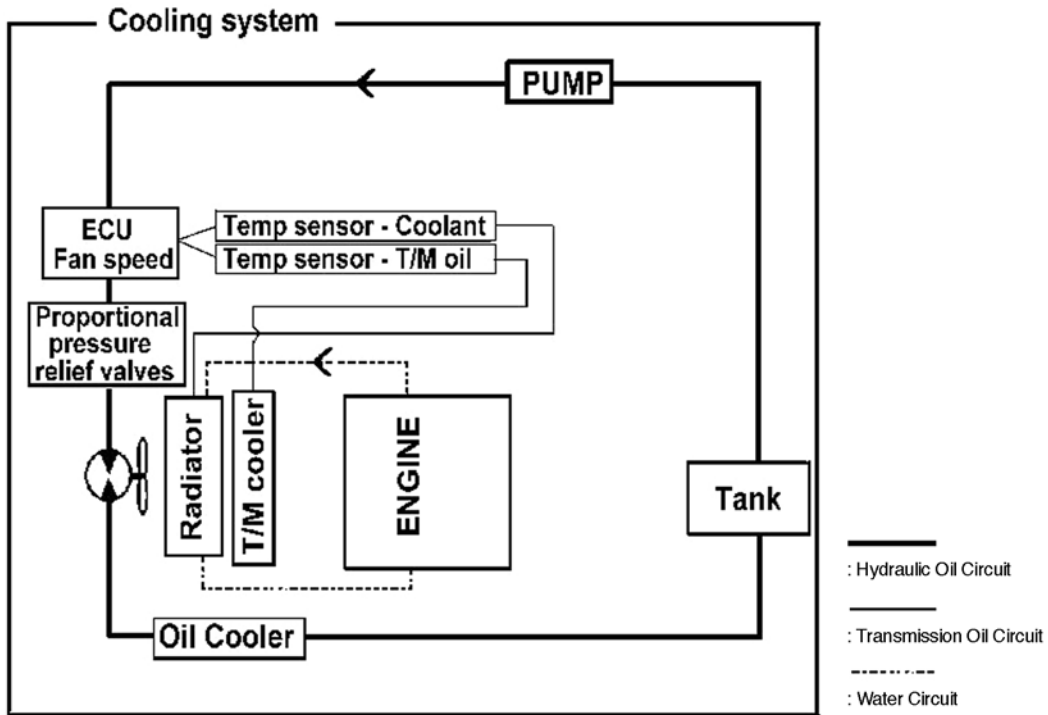
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Figure 2

Reference Number	Description
1	Engine
2	Brake and Pilot Pump
3	Cooler
4	Electronic Unit (ECU)
5	Fan Motor

Reference Number	Description
6	Cooling Fan
7	Temperature Sensor
8	Temperature Sensor
9	Transmission

Circuit



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Figure 3

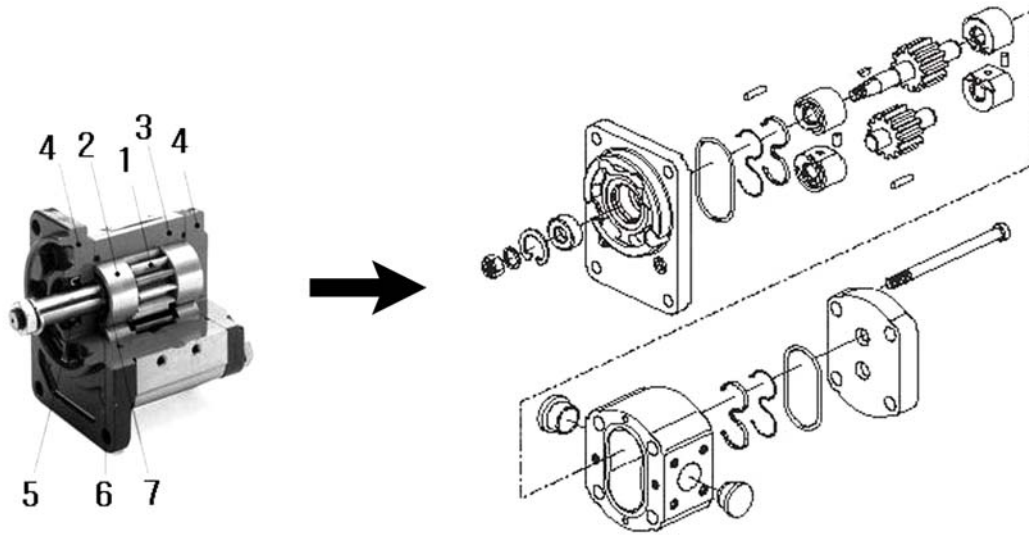
This system have advantages as following:

1. lower fuel consumption
2. lower sound level
3. Faster warming of the transmission
4. Faster warming of the oil in the hydraulic oil tank

Specifications

Cooling Fan Pump / Brake Pump	
Type	Gear Pump
Displacement	28.0 cc/rev (1.71 in ³ /rev)
Flow	56 l/min (15 U.S. gpm)
Thermostat	
No.	1 ea.
Begins Temperature to Open	82 °C
Fully Opened Temperature	92 °C
Cooling Fan	
Size	36"
No. Of Blade	8 ea.
Bypass valve	
Rated Flow	105 l/min (28 U.S. gpm)
Cracking Pressure	3.0 ±0.6 kg/cm ² (42.7 ±8.5 psi)
Pressure Difference	3.0 kg/cm ² at 1 l/min (42.7 psi at 0.26 U.S. gpm.)
	4.5 kg/cm ² at 105 l/min (64.0 psi at 28 U.S. gal.)

Cooling Fan / Brake Pump



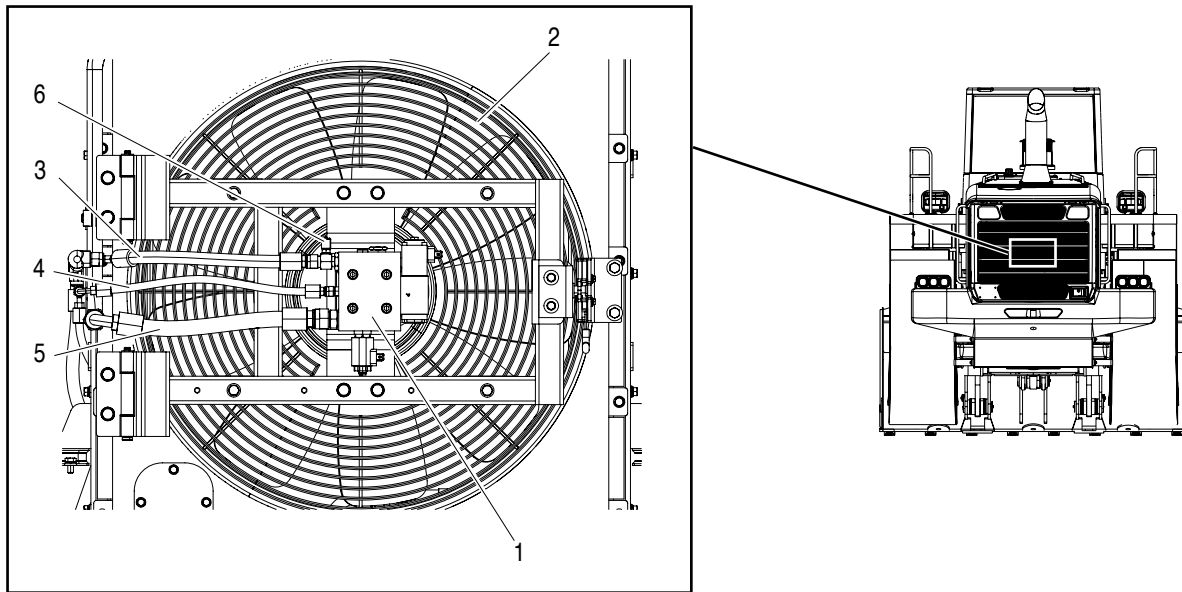
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Figure 4

Reference Number	Description
1	Gear
2	Bearing
3	Extruded Aluminium Body
4	Cover

Reference Number	Description
5	Shaft Seal
6	Plain Bearing
7	Thrust Pressure Seal
8	Gear Pairs

Checking Hydraulic Function



FG009993

Figure 5

Reference Number	Description
1	Fan Motor
2	Fan Guard
3	Inlet Line

Reference Number	Description
4	Drain Line
5	Outlet Line
6	Pressure Check Port

Maximum Fan Speed, Checking

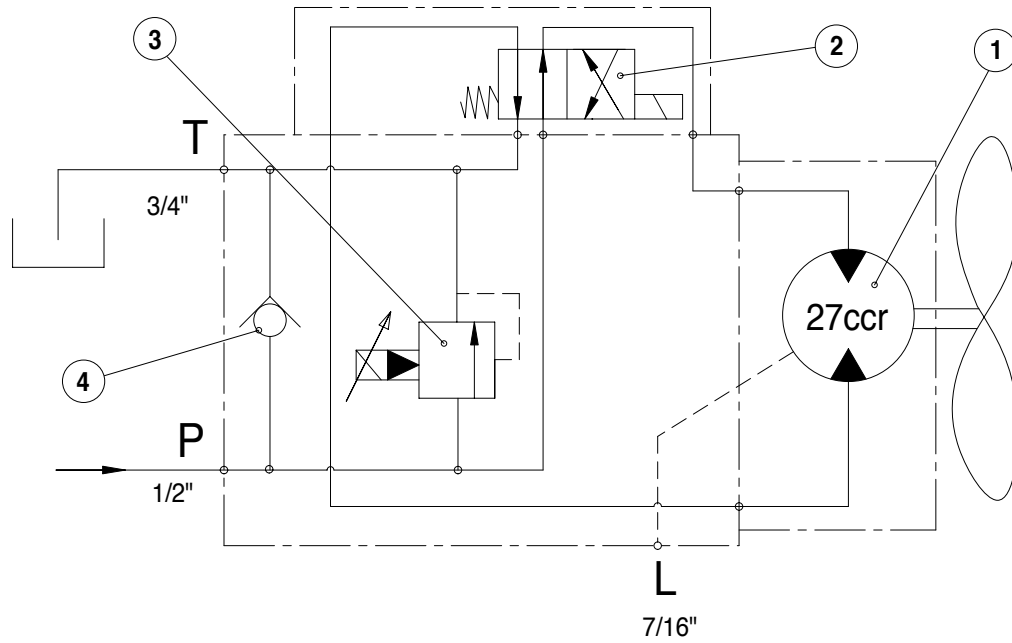
1. Open the radiator grille in order to connect the pressure gauge
2. Connect the pressure gauge to the pressure port (6) on the inlet hose (3)
Check the maximum pressure by pressing in towards the end position of accelerator pedal and reading the pressure in the gauge.
Maximum fan motor pressure: $140 \pm 2 \text{ kg/cm}^2$ ($1,990 \pm 28.4 \text{ psi}$) (The fan speed is approximately 1,200 rpm at this time)
3. If fan speed requires adjusting, shut down engine and adjust a proportional relief valve of the fan motor or the program of control unit.

WARNING

A modifying program of the control unit is permitted by an authorized person.

FAN MOTOR

The cooling fan is driven by a proportional and bidirectional fan motor.



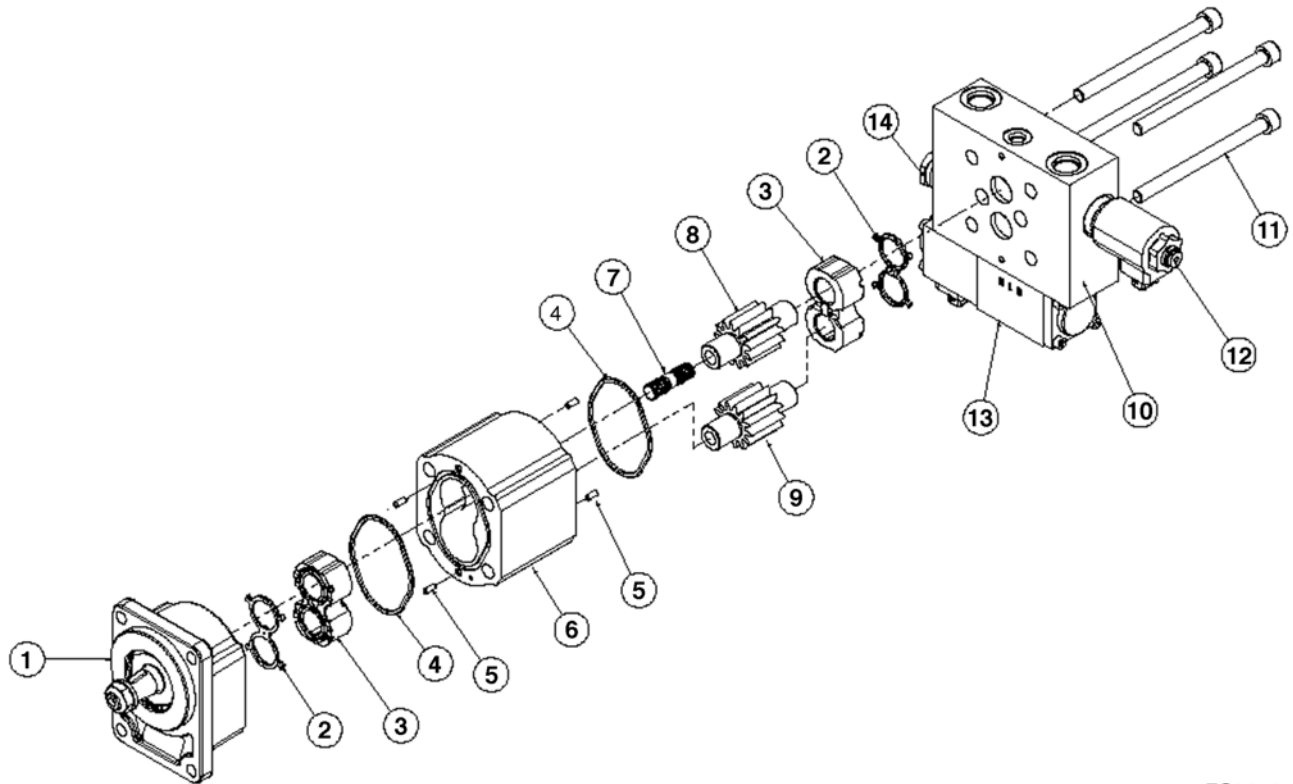
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Figure 6

Reference Number	Description
1	Motor
2	Solenoid Operated Spool Valve

Reference Number	Description
3	Prop. Pressure Relief Cartridge
4	Check Valve

Cooling Fan: Bidirectional motor with speed control



FG004242

Figure 7

Reference Number	Description	Qty.
1	Front Bearing	1
2	Seal	2
3	Bearing Block	2
4	O-ring	2
5	Dowel Pin	4
6	Gear Housing	1
7	Coupling	1
8	Drive Gear	1

Reference Number	Description	Qty.
9	Idler Gear	1
10	Valve Cover	1
11	Bolt	4
12	Prop. Relief Valve Cartridge	1
13	Solenoid Operated Spool Valve	1
14	Check Valve Cartridge	1

Cooling Fan Maximum Speed

Max. speed	1,200 rpm
Noise reduction kit	840 rpm
Max. speed when faulty signals	1,200 rpm or above
Max. reverse speed	1,200 rpm or above

Proportional Pressure Relief Cartridge

Function

The principal function of the pilot operated PRV is controls the motor speed from idle to max. speed by infinitely adjusting the applied solenoid current. Further, the PRV protects the motor from over pressurization. Due to the fail safe function, maximum PRV pressure is automatically set when solenoid de-energized (motor runs at max. speed = max. cooling power). Increasing solenoid current results in decreasing induced spring force, thereby reducing valve opening pressure (motor speed decreases). The nominal pressure is factory set, not adjustable. Because of the pilot operation, the minimal adjustable pressure drop across the valve is slightly higher than for direct operated RV at the same flow.

NOTE: *In the case of bidirectional motor with pressurized outlet port, the back pressure is added to the nominal PRV setting (due to the internal PRV drain).*

Proportional Inverse Pressure Relief Valve

Screw In Cartridge

- Pilot operated
- Nominal pressure adjustable + 20% / - 30%
- Qmax = 100 l/min
- Pmax = 400 bar (5,802 psi)
- PN max = 200 bar (2,901 psi)

General Specifications

Description	Pilot operated proportional inverse pressure relief valve
Construction	Screw in cartridge, cavity to ISO 7789
Operation	Proportional solenoid with slip-on coil
Mounting	Screw in thread M22x1.5
Ambient temperature	-30 - +90°C
Fastening torque	MD = 40 Nm for screw in cartridge
	MD max = 5 Nm for coil retaining nut
Weight	m = 0.45 kg (0.99 lb)

Hydraulic Specifications

Fluid	Mineral oil, Other fluid on request
Contamination	ISO 4406: 1999, class 18/16/13
Viscosity range	10 mm ² /s - 320 mm ² /s
Fluid temperature	-25 - +90°C
Peak pressure	P _{max} = 400 bar (5,802 psi)
Tank pressure in port T	P _{max} = 50 bar (725 psi)
Nominal pressure ranges	PN = 160 bar (2,321 psi)
Recommended volume flow	Q = 5 -100 l/min with PN = 100 / 160 bar (1,450 / 2,321 psi)
	Q =10 -100 l/min with PN = 200 bar (2,901 psi)

Electrical Control

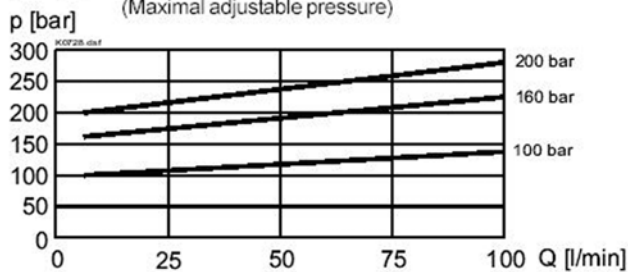
Construction	Solenoid, Wet pin, Push type, Pressure tight with exchangeable slip-on coil
Standard nominal voltage	U = 24 VDC
Limiting current	IG = 680 mA
Protection class	IP 65 to EN 60 529

(only with tested connector)

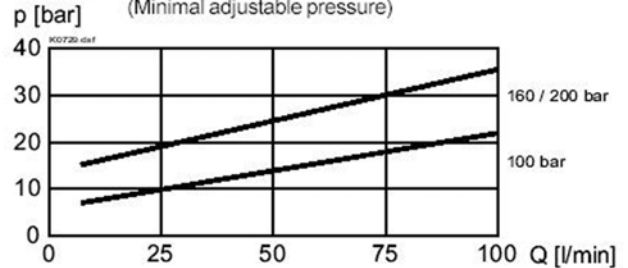
Efficiency

CHARACTERISTICS oil viscosity $\nu = 30 \text{ mm}^2/\text{s}$

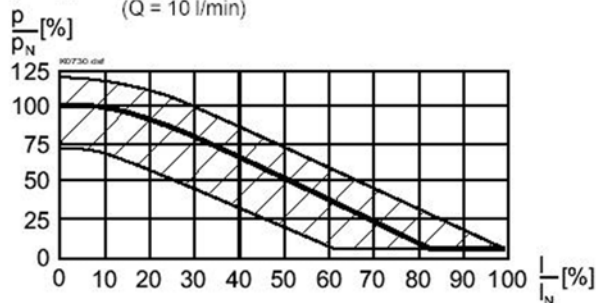
$p = f(Q)$ Pressure volume flow characteristics
(Maximal adjustable pressure)



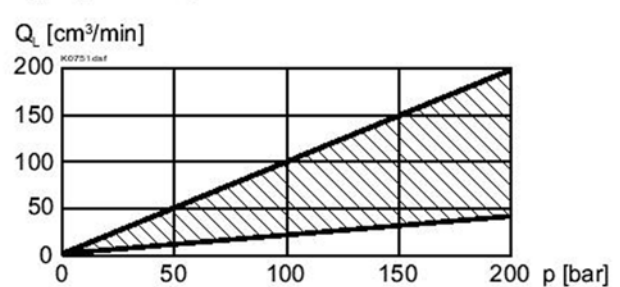
$p = f(Q)$ Pressure volume flow characteristics
(Minimal adjustable pressure)



$p = f(I)$ Pressure adjustment characteristics
(Q = 10 l/min)



$Q_L = f(p)$ Leakage volume flow characteristics

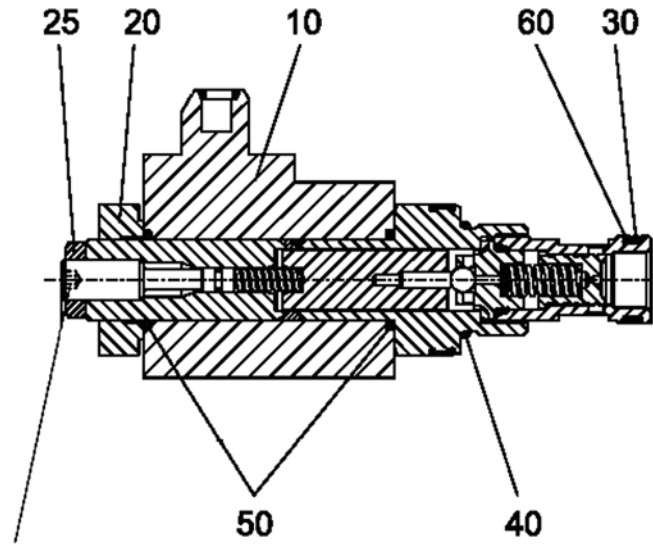


Adjustable range of nominal pressure, adjusted with adjustment screw.

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Figure 8

Parts List



Adjustment screw to set the nominal pressure (+20% / 30%)
Screw out to vent the valve.

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Figure 9

Reference Number	Description
10	Coil KJ35/16 - G24
20	Retaining Nut M16x1x9.2
25	Hex Nut M8x1
30	O-ring Viton ID 14.00x1.78

Reference Number	Description
40	O-ring Viton ID 18.77x1.78
50	O-ring Viton ID 15.60x1.78
60	Backup Ring RD 14.6x17.5x1.4

Solenoid Operated Spool Valve

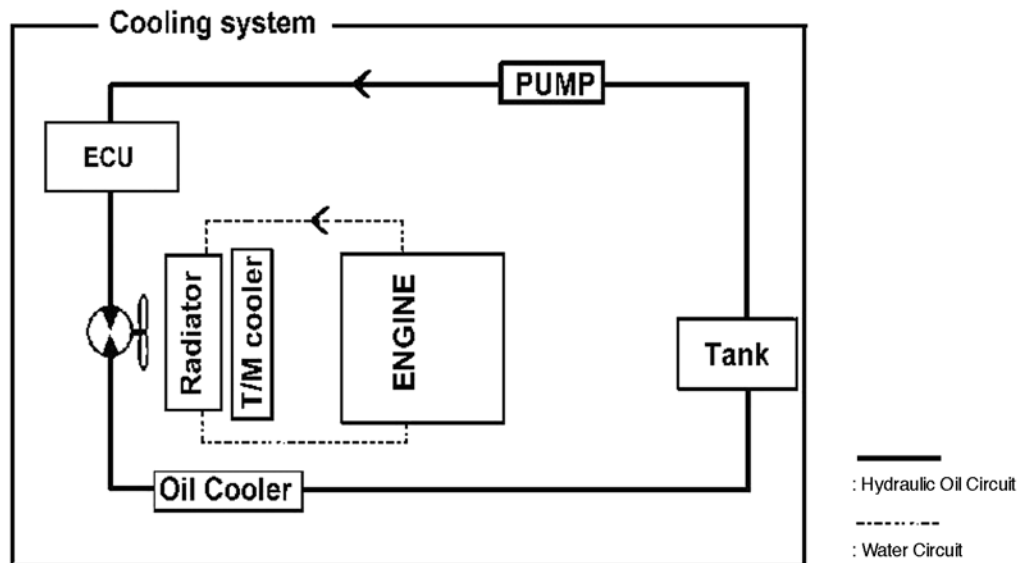
This can be used for cleaning the guard grille at the fan inlet side. The 2-way SV controls the direction of the flow through the motor and thereby the motor rotation. The maximum motor speed and protection against over pressurization in both directions is provided by a double acting RV. The AC check valve prevents cavitation and erosion during motor speed deceleration and spin down.

Check Valve

The AC check valve prevents cavitation and erosion during motor speed deceleration and spin down.

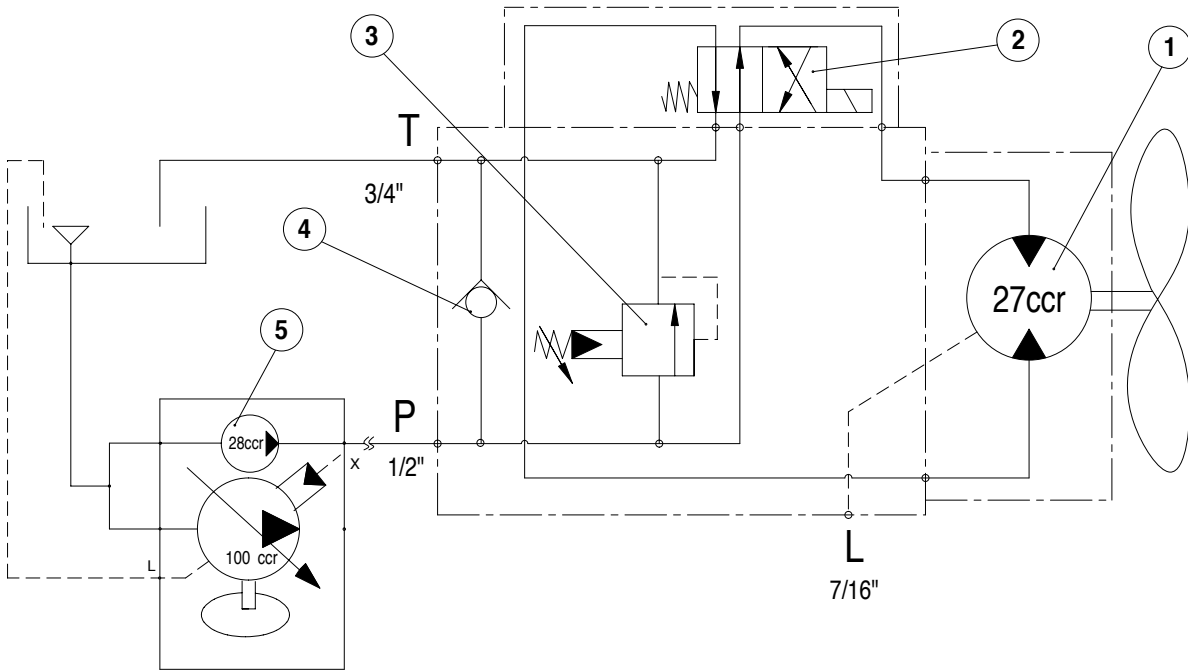
Cooling Fan: Bidirectional Motor

In case of this fan, the cooling system have only a birotation without speed control. The pump of pilot and fan motor provides the required oil flow for the hydrostatic fan drive system as shown on the following schematic. The oil flow drives the hydraulic motor and the fan impeller mounted on the motor shaft.



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Figure 10

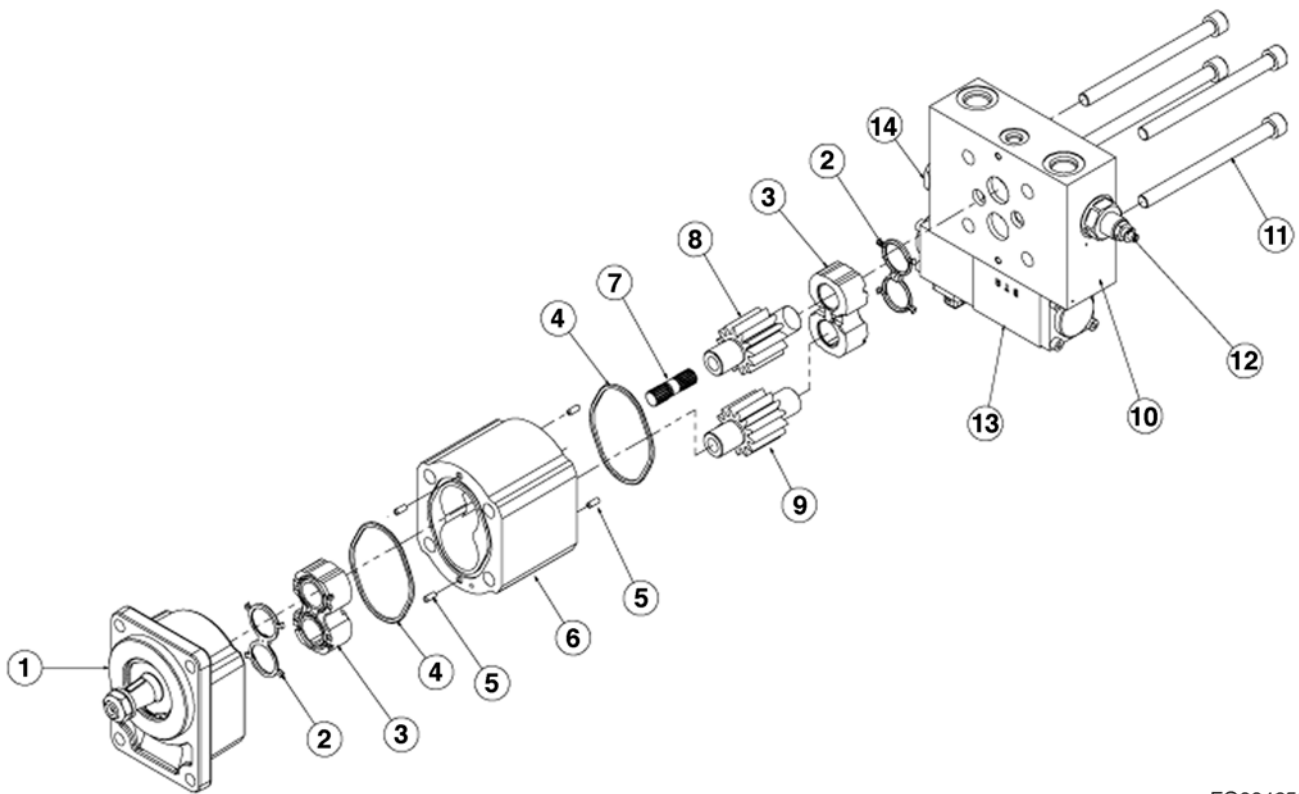


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Figure 11

Reference Number	Description
1	Motor
2	Solenoid Operated Spool Valve
3	Pressure Relief Cartridge

Reference Number	Description
4	Check Valve
5	Pilot and Brake Pump



FG004253

Figure 12

Reference Number	Description	Qty.
1	Front Bearing	1
2	Seal	2
3	Bearing Block	2
4	O-ring	2
5	Dowel Pin	4
6	Gear Housing	1
7	Coupling	1
8	Drive Gear	1

Reference Number	Description	Qty.
9	Idler Gear	1
10	Valve Cover	1
11	Bolt	4
12	Relief Valve Cartridge	1
13	Solenoid Operated Spool Valve	1
14	Check Valve Cartridge	1

Pilot System

Edition 1

MEMO

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MEMO
