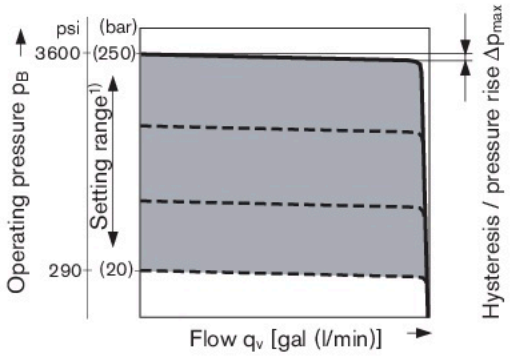
DR – Pressure control

The pressure control limits the maximum pressure at the pump output within the pump control range. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the target pressure set at the pressure valve, the pump will regulate towards a smaller displacement. The pressure can be set steplessly at the control valve.

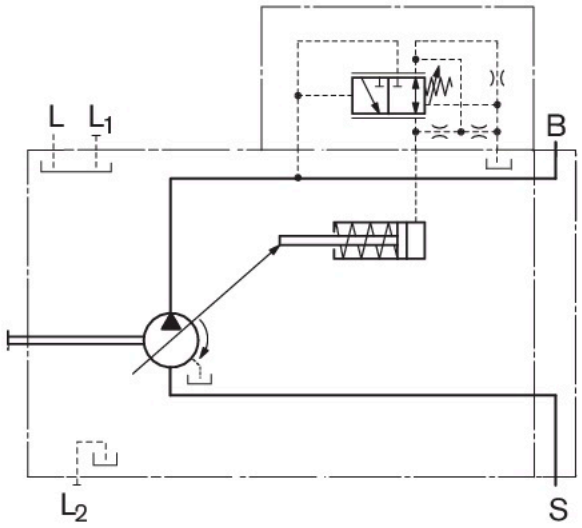
Static characteristic

(at n_1 = 1500 rpm; t_{fluid} = 120 °F (50 °C))



1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and it is not allowed to exceeded.
The range of possible settings at the valve are greater.

Circuit diagram



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)

Controller data

Hysteresis and repeatability Δp _____ maximum 45 psi (3 bar)

Pressure rise, maximum

NG		10	18	28	45	60/63	85	100
Δp	psi	90	90	90	90	115	175	200
	(bar)	(6)	(6)	(6)	(6)	(8)	(12)	(14)

Control fluid consumption_____ max. approx. 0.8 gpm (3 l/min)

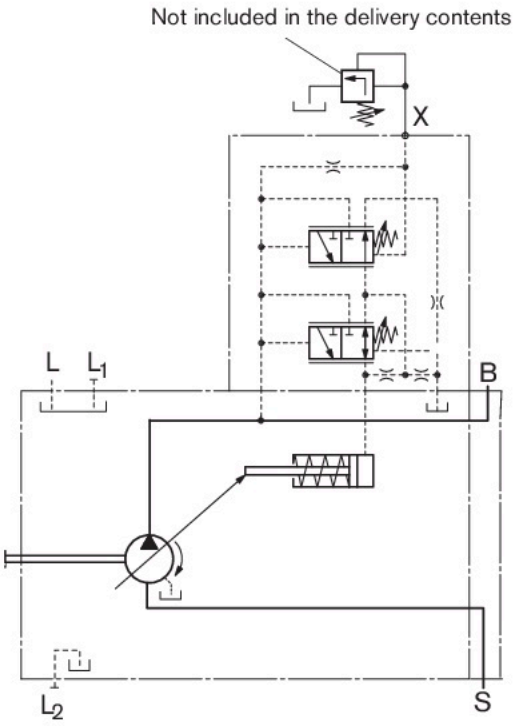
DRG – Pressure control remotely operated

The DRG control valve overrides the function of the DR pressure controller

A pressure relief valve can be externally piped to port X for remote setting of pressure below the setting of the DR control valve spool. This relief valve is not included in the delivery contents of the pump.

The differential pressure at the control valve is set as standard to 290 psi (20 bar). The control fluid volume at port X is approx. 0.4 gpm (1.5 l/min). If another setting is required (range from 145 to 320 psi (10 to 22 bar)) please state this in clear text.

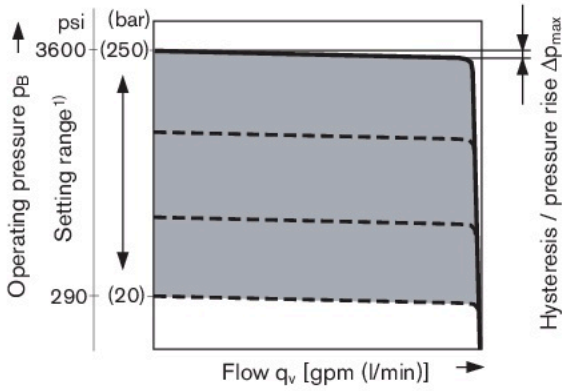
Circuit diagram



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Pilot pressure

Static characteristic

(at n_1 = 1500 rpm; t_{fluid} = 120 °F (50 °C))



1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and it is not allowed to be exceeded.
The range of possible settings at the valve is higher.

Controller data

Hysteresis and repeatability Δp _____ maximum 45 psi (3 bar)

Pressure rise, maximum

NG		10	18	28	45	60/63	85	100
Δp	psi	90	90	90	90	115	175	200
	(bar)	(6)	(6)	(6)	(6)	(8)	(12)	(14)

Control fluid consumption____max. approx. 1.2 gpm (4.5 l/min)

DRF (DFR) DRS (DFR1) – Pressure and flow control

In addition to the pressure control function , a variable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual required flow by the consumer, regardless of changing pressure levels.

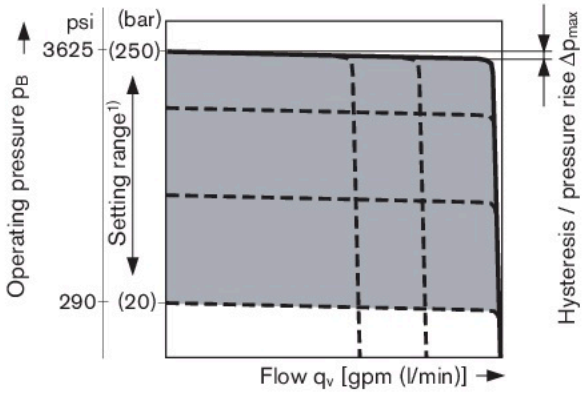
The pressure control overrides the flow control function.

Note

The DRS (DFR1) valve version has no connection between X and the reservoir. Unloading the LS-pilot line must be possible in the valve system.
Because of the flushing function sufficient unloading of the X-line must also be provided.

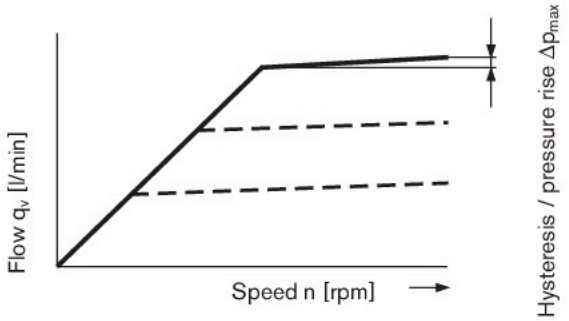
Static characteristic

Flow control at n_1 = 1500 rpm; t_{fluid} = 120 °F (50 °C))



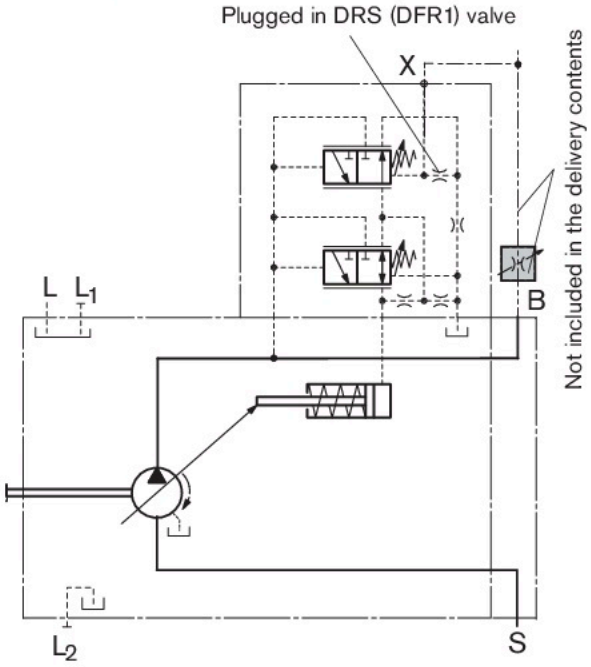
1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and it is not allowed to be exceeded.
The range of possible settings at the valve is higher.

Static characteristic at variable speed



Possible connections at port B
(not included in the delivery, order separately)

Circuit diagram



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Pilot pressure

Differential pressure Δp

Standard setting: 200 to 320 psi (14 to 22 bar).
If another setting is required, please state in clear text.
Relieving the load on port X to the reservoir results in a zero stroke ("standby") pressure which lies about 15 to 30 psi (1 to 2 bar) higher than the differential pressure Δp). No account is taken of system influences.

Controller data

Data pressure control DR,
Maximum flow deviation measured with drive speed n = 1500 rpm.

NG		10	18	28	45	60/ 63	85	100
$\Delta q_{v\,max}$	gpm	0.13	0.24	0.26	0.48	0.66	0.83	0.83
	(l/min)	(0.5)	(0.9)	(1.0)	(1.8)	(2.5)	(3.1)	(3.1)

Control fluid consumption
DRF (DFR) __ maximum approx. 0.8 to 1.2 gpm (3 to 4.5 l/min)
DRS (DFR1) _____ maximum approx. 0.8 gpm (3 l/min)

LA... – Pressure, flow and power control

Pressure control equipped as DR(G)
Flow control equipped as DRF, DRS

In order to achieve a constant drive torque with varying operating pressures, the swivel angle and with it the output flow from the axial piston pump is varied so that the product of flow and pressure remains constant.

Flow control is possible below the power control curve.

When ordering please state the power characteristics to be set ex works in clear text, e.g. 27 HP (20 kW) at 1500 rpm.

Controller data

For pressure controller DR data
For flow control FR data.

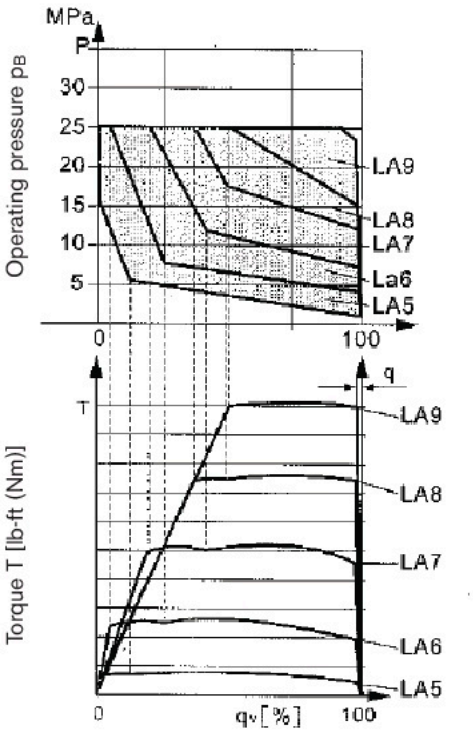
Controller data
Maximum control fluid consumption.

Start of control	Torque T [lb-ft (Nm)] for size						Order code
[psi ((bar)]	18	28	45	63	85	100	
145 to 510 (10 to 35)	2.80 - 8.92 (3.8 - 12.1)	4.4 - 14 (6 - 19)	7.4 - 22.1 (10 - 30)	11 - 32 (15 - 43)	15 - 42 (20 - 57)	18 - 49.5 (24 - 68)	**LA5**
520 to 1015 (36 to 70)	8.92 - 17.2 (12.2 - 23.3)	14 - 26.5 (19.1 - 36)	22.2 - 43.5 (30.1 - 59)	32 - 61 (43.1 - 83)	42 - 83 (57.1 - 112)	49.5 - 97.1 (68.1 - 132)	**LA6**
1030 to 1520 (71 to 105)	17.2 - 24.9 (23.4 - 33.7)	26.6 - 38.4 (36.1 - 52)	43.6 - 62 (59.1 - 84)	61 - 88 (83.1 - 119)	83 - 118) (112.1 - 160)	97.1 - 139.4 (132.1 - 189)	**LA7**
1535 to 2030 (106 to 140)	24.9 - 33.2 (33.8 - 45)	38.4 - 51.6 (52.1 - 70)	62 - 83 (84.1 - 112)	88 - 116 (119.1 - 157)	118 - 156 (160.1 - 212)	139.4 - 183.6 (189.1 - 249)	**LA8**
2045 to 3335 (141 to 230)	33.2 - 55.2 (45.1 - 74.8)	51.7 - 86.3 (70.1 - 117)	83 - 139 (112.1 - 189)	116 - 195 (157.1 - 264)	156 - 263 (212.1 - 357)	183.3 - 309 (249.1 - 419)	**LA9**

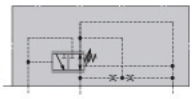
Conversion of the torque values in power [kW]:

$$P = \frac{T}{3.5\ (6.4)}\ \text{[HP (kW)]}\ (\text{at 1500 rpm}) \quad \text{or} \quad P = \frac{2\pi \cdot T \cdot n}{33.000\ (60000)}\ \text{[HP (kW)]}$$

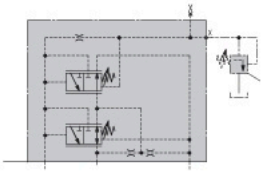
Static curves and torque characteristic



Circuit diagram (LAXD) with pressure cut-off

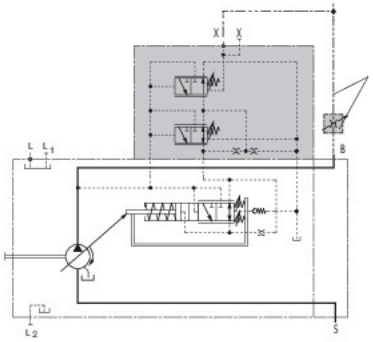


Circuit diagram (LAXDG) with pressure cut-off, remotely operated



Not included in the delivery contents

Circuit diagram (LAXDS) with pressure and flow control



Not included in the delivery contents

EP – Electro-proportional control

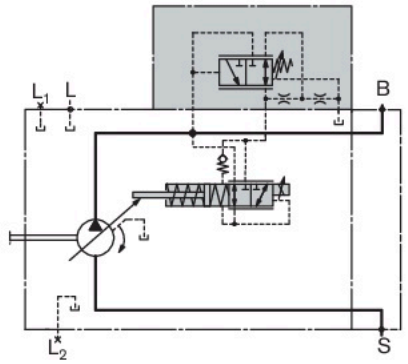
Electro-proportional control makes a stepless and reproducible setting of the pump displacement possible directly via the swashplate. The control force of the control piston is applied by a proportional solenoid. The control is proportional to the current (for start of control, see table right).

In a depressurized state, the pump is swiveled to its initial position ($V_{g\,max}$) by an adjusting spring. If the operating pressure exceeds 200 psi (14 bar), the pump will swivel from $V_{g\,max}$ to $V_{g\,min}$ without control by the solenoid (control current < start of control). A PWM signal is used to control the solenoid.

EP.D: The pressure control regulates the pump displacement back to $V_{g\,min}$ after the set target pressure has been reached.

A minimum operating pressure of 200 psi (14 bar) is needed for control. The necessary control fluid is taken from the high pressure.

Circuit diagram EP.D



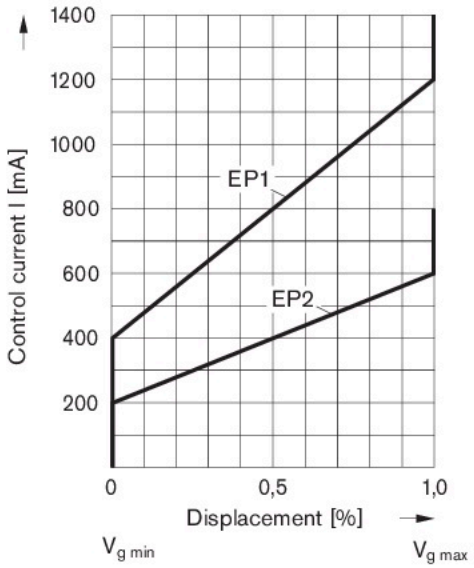
	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

Technical data, solenoid	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %
For protection rating, please refer to "Socket version" on page 55		

Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)

Characteristic EP1/2

Hysteresis < 5 %



Note

The spring return at the controller is not a safety device

Dirt contamination (contaminated hydraulic fluid, wear or residual dirt from system components) could cause the controller to stick in an undefined position. The volume flow of the axial piston unit will then no longer follow the commands of the operator.

Check whether remedial measures for your application are needed on your machine in order to put the driven consumer in a safe state (e.g. immediate stop).

EK – Electro-proportional control with controller cut-off

The variant EK... is based completely on the variant EP...

In addition to the electro-proportional control function, a controller cut-off is integrated in the electric characteristic.
The pump then swivels to $V_{g\,max}$ if the control signal is lost (e.g. cable break) and then works with the DRF settings (see page 14). The controller cut-off is only intended for short-term use and not for permanent use if the control signal is lost. If the control signal is lost, the pump swivel times will be reduced by the EK valve.
A PWM signal is used to control the solenoid.

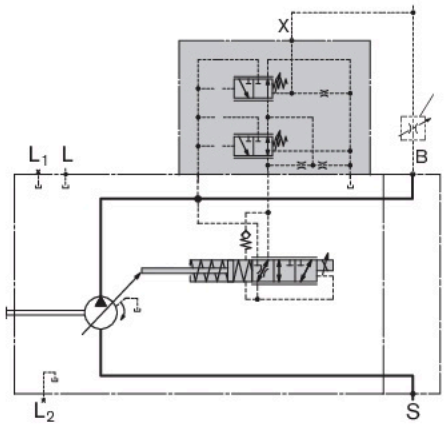
A minimum operating pressure of 200 psi (14 bar) is needed for control. The necessary control fluid is taken from the high pressure.

The $V_{g\,max}$ position is maintained by the force of the adjusting spring. To overcome the force of this spring, the solenoid must be subjected to excessive current (I_{res}).

Technical data, solenoid	EK1	EK2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %
For protection rating, please refer to "Socket version" on page 55		

Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)

Circuit diagram EK.DF



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

Note

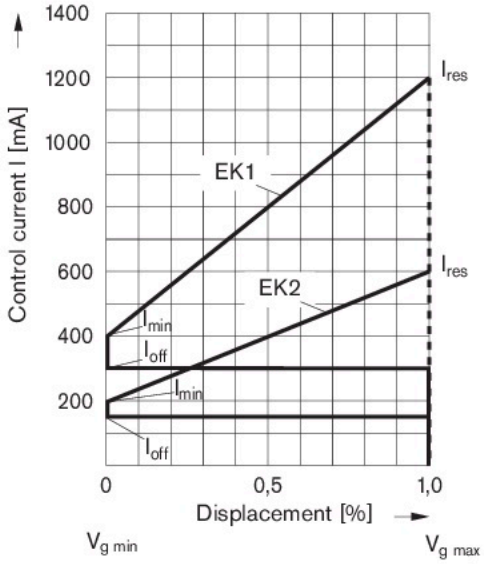
The spring return at the controller is not a safety device

Dirt contamination (contaminated hydraulic fluid, wear or residual dirt from system components) could cause the controller to stick in an undefined position. The volume flow of the axial piston unit will then no longer follow the commands of the operator.

Check whether remedial measures for your application are needed on your machine in order to put the driven consumer in a safe state (e.g. immediate stop).

Characteristic EK

Hysteresis < 5 %



	EK1.	EK2.
I_{min} [mA]	400	200
I_{max} [mA]	1200	600
I_{off} [mA]	< 300	< 150
I_{res} [mA]	> 1200	> 600

For changes in current, ramp times of > 200 ms must be observed.

EP(K).DF / EP(K).DS – EP(K) with pressure and flow control

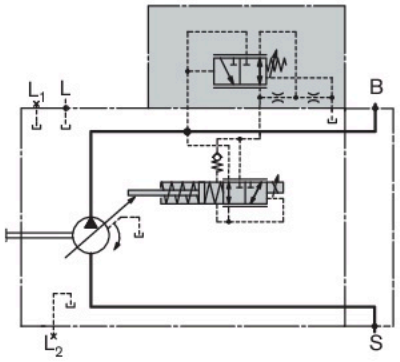
A hydraulic pressure flow control is superimposed on the electro-proportional control.
The pressure control regulates the pump displacement back to $V_{g\,min}$ after the set target pressure has been reached.
This function is super-imposed on the EP or EK control, i.e. the control-current dependent function is executed below the target pressure.
Setting range from 290 to 3600 psi (20 to 250 bar). For the pressure flow control.

Pressure control has priority over electro-proportional control and flow control.

With flow control, the pump flow can be influenced in addition to pressure control. The pump flow is thus equal to the actual amount of hydraulic fluid required by the consumer. This is achieved using the differential pressure at the consumer (e.g. orifice).

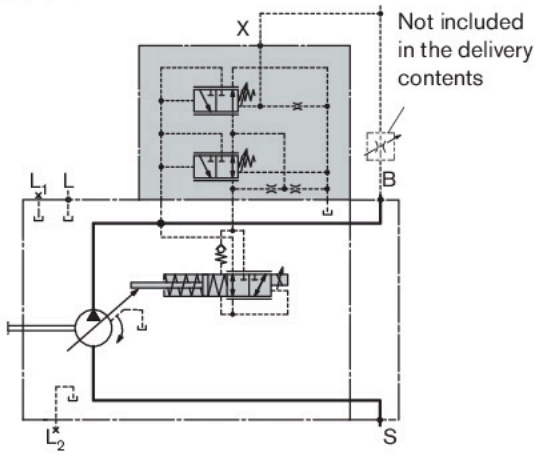
The EP.DS or EK.DS version has no connection between X and the reservoir (load sensing).

Circuit diagram EP.D



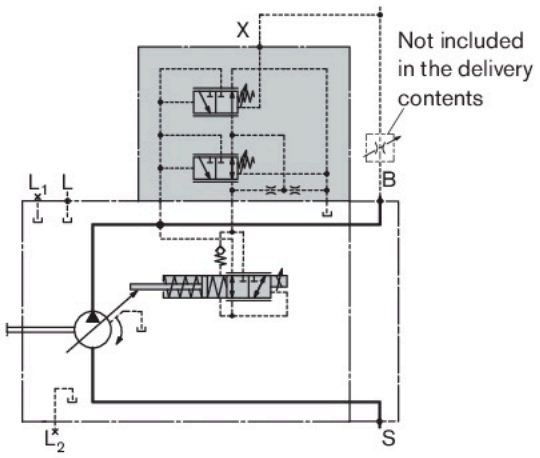
	Port for
B	Service line
S	Suction line
L, L1,2	Case drain fluid ($L_{1,2}$ plugged)

Circuit diagram EP.DF



	Port for
B	Service line
S	Suction line
L, L1,2	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

Circuit diagram EP.DS



	Port for
B	Service line
S	Suction line
L, L1,2	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

EP(K).ED – EP(K) with electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.

When a change is made at the consumer (load pressure), the position of the control piston will shift.

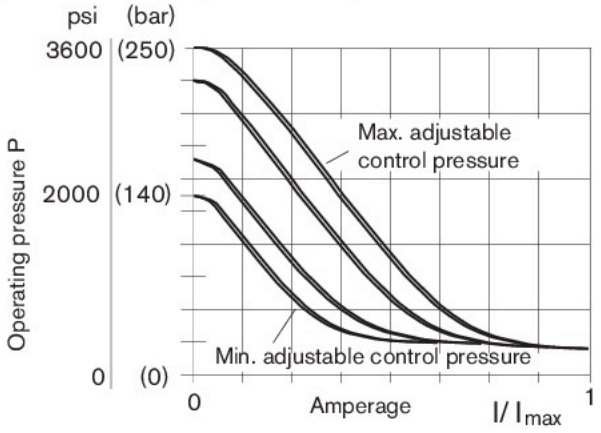
This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

The pump thus only delivers as much hydraulic fluid as the consumers can take. The pressure can be set steplessly by the solenoid current.

As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (negative characteristic, e.g. for fan drives). A PWM signal is used to control the solenoid.

Static current-pressure characteristic ED
(negative characteristic)

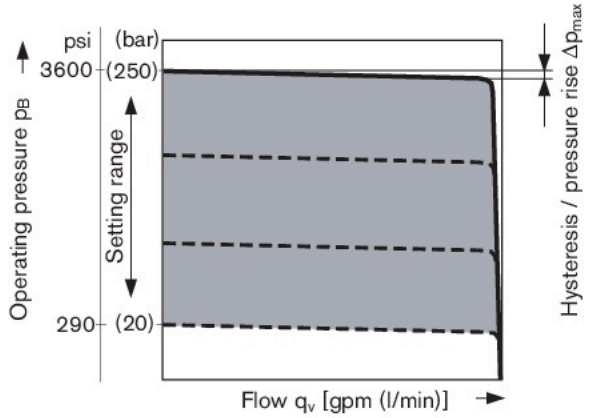
(measured with pump in zero stroke)



Hysteresis static current-pressure characteristic
< 45 psi (3 bar).

Static flow-pressure characteristic

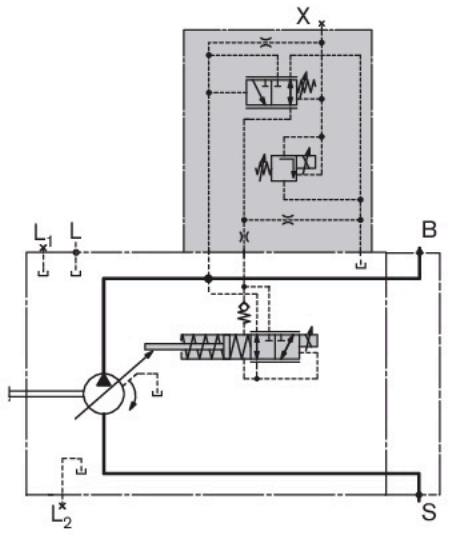
(at n= 1500 rpm; t_{fluid} = 120 °F (50 °C))



Controller data

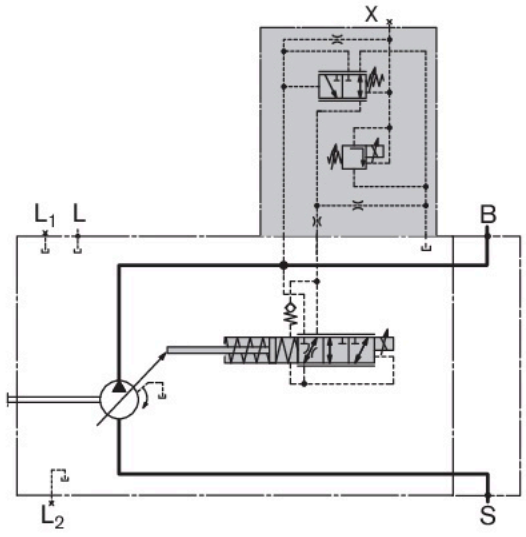
Standby standard setting: 290 psi (20 bar). Other values on request. Hysteresis / pressure rise Δp 60 psi (4 bar)

Circuit diagram EP.ED



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

Circuit diagram EK.ED



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

ED – Electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.

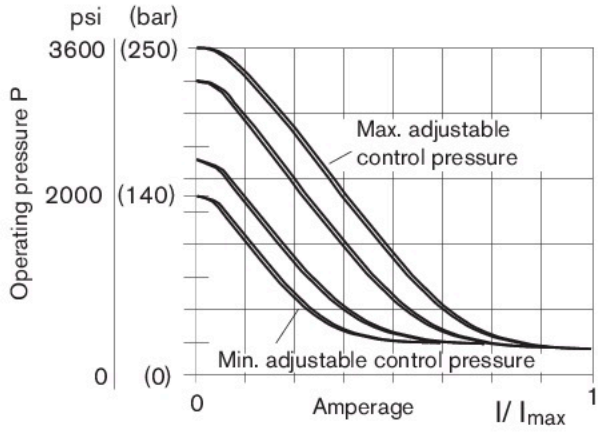
When a change is made at the consumer (load pressure), the position of the control piston will shift.

This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

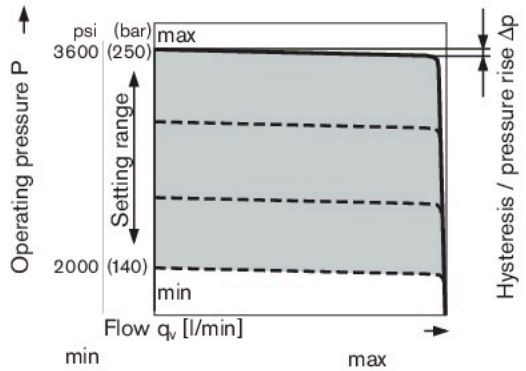
As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of a loss of power, e.g. for fan drives).
The response time characteristic of the ED-control was optimized for the use as a fan drive system.
When ordering, state the type of application in clear text.

Static current-pressure characteristic ED
(measured at pump in zero stroke – negative characteristic)



Hysteresis static current-press. characteristic < 45 psi (3 bar)

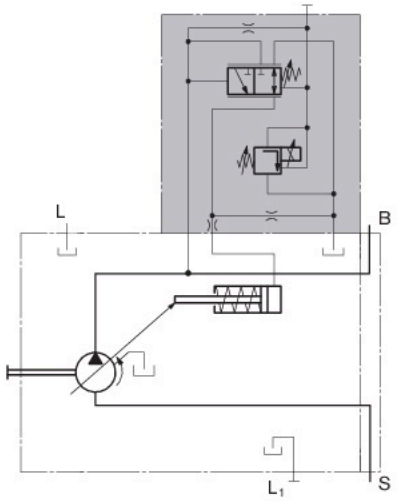
Static flow-pressure characteristic
(at n= 1500 rpm; t_{fluid} = 120 °F (50 °C))



Controller data
Standby standard setting 290 psi (20 bar), other values on request.

Hysteresis and pressure rise _____ Δp < 60 psi (4 bar).
Control flow consumption_____ 0.8 to 1.2 gpm (3 to 4.5 l/min).

Circuit diagram ED..



	Port for
B	Service line
S	Suction line
L, L1	Case drain (L_1 plugged)

Technical data, solenoid	ED71	ED72
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Control begin at $q_{v\ min}$	100 mA	50 mA
End of control at $q_{v\ max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %

Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)

ER – Electro-hydraulic pressure control

The ER valve is set to a certain pressure by a specified variable solenoid current.

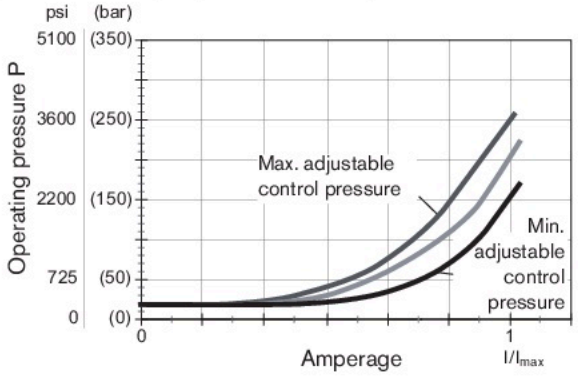
When a change is made at the consumer (load pressure), the position of the control piston will shift.

This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

As the solenoid current signal drops towards zero, the pressure will be limited to p_{min} (stand by).

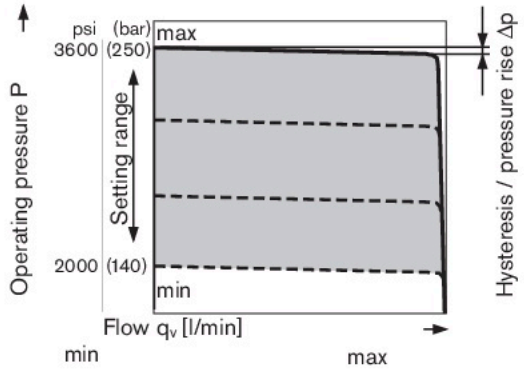
Static current-pressure characteristic ER
(measured with pump in zero stroke – positive characteristic)



Hysteresis static current-pressure characteristic < 45 psi (3 bar)

Influence of pressure setting on stand by ± 30 psi (2 bar)

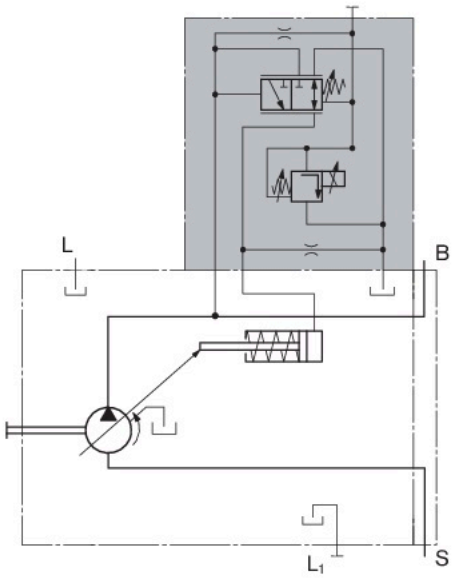
Static flow-pressure characteristic
(at n= 1500 rpm; t_{fluid} = 120 °F (50°C))



Controller data
Standby standard setting 200 psi (14 bar), other values on request.

Hysteresis and pressure rise _____ Δp < 60 psi (4 bar).
Control flow consumption_____ 0.8 to 1.2 gpm (3 to 4.5 l/min).

Circuit diagram ER..



	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)

Technical data, solenoid	ED71	ED72
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Control begin at $q_{v\,min}$	100 mA	50 mA
End of control at $q_{v\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %

Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)