



Directional control valve L90LS

*Proportional, load sensing and
pressure compensated valve*

Catalog 9129 8504-02 (GB)

Catalog 9129 8504-06 (US)

January, 1998



Catalog layout

This catalog has been designed to give a brief overview of L90LS valves, and to make it easy for you to study and choose from the different options available, so that we may customize your valve in accordance with your wishes. In addition to general information and basic technical data, the catalog therefore contains descriptions of the options available for various so-called "function areas" of the valve.

Each function area is given as a subheading, followed by a brief description. When options are available for a function area, the subheading is followed by an "Item number" in brackets, e.g. Pressure relief valve [16]. This is followed by a

series of coded options, e.g. PA1, PS, Y, together with a brief description of what each code represents. Alternatively, one or more pressure, flow or voltage options are given.

On page 7 is a general circuit diagram showing the basic function areas in a L90LS valve and the item numbers that represent them. Naturally, the same item numbers are used for the respective function areas in all sub-circuit diagrams that appear elsewhere in the catalog. Please note that, unless stated otherwise, all sections and views of the valves have been drawn as seen from the inlet section.

How to order your valve

The L90LS directional control valve can be easily specified using VOAC Hydraulics computer programme. This means the customer can optimize his valve specification to give the best performance for his application and specific hydraulic system.

Once the demands placed on each individual function have been specified the computer will select the valve design required to give optimum performance. The computer also produces complete documentation for your valve, in the form of a detailed specification and hydraulic circuit diagram.

The computer also generates a unique identification number for each valve type and customer. The number is then stamped into the I.D. plate of each valve. The specification of your valve is then recorded by VOAC Hydraulics, so that exact identification of the product can be made at any time in the future to facilitate repeat ordering or servicing.

Early consultation with VOAC saves time and money

Our experienced engineers have in-depth knowledge of the different types of hydraulic system and the ways in which they work. They are at your disposal to offer qualified advice on the best system for the desired combination of functions, control

characteristics and economic demands. By consulting VOAC early in the project planning stage, you are assured of a comprehensive hydraulic system that gives your machine the best possible operating and control characteristics.

VOAC reserves the right to modify products without prior notice.

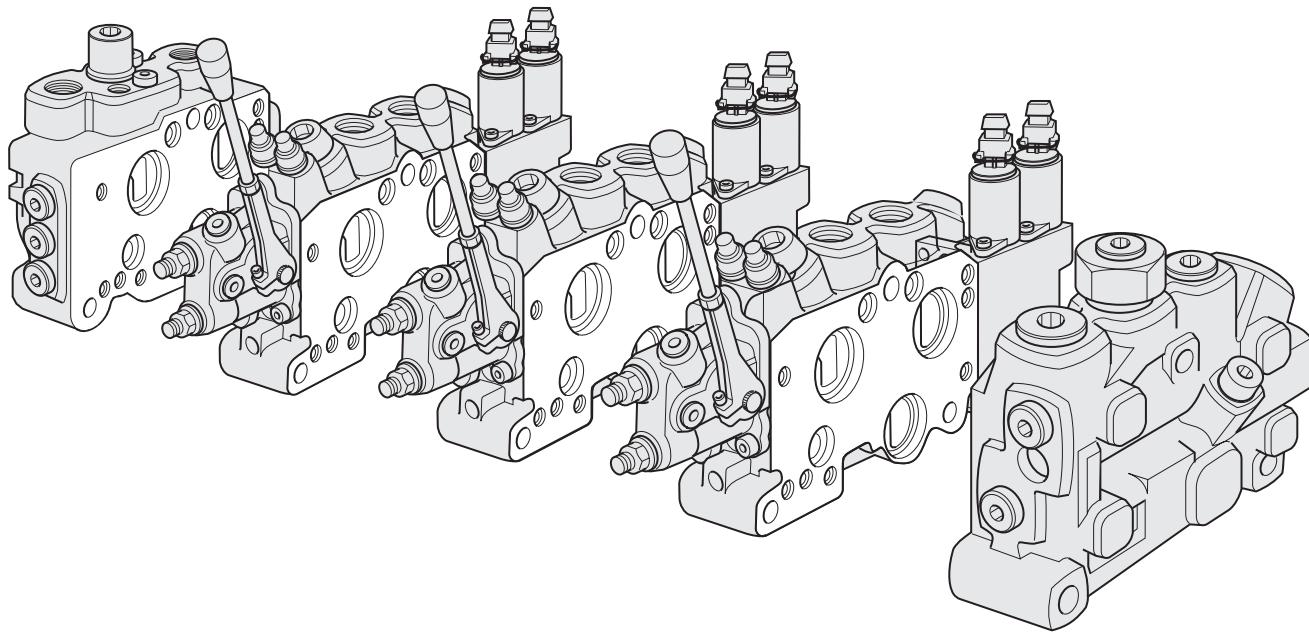
Typical curves and diagrams are used in this catalog. Even though the catalog is revised and updated continuously, there is always the possibility of errors. For more detailed information about the products, please contact VOAC.

Conversion factors

1 kg	= 2.2046 lb
1 N	= 0.22481 lbf
1 bar	= 14.504 psi
1 l	= 0.21997 UK gallon
1 l	= 0.26417 US gallon
1 cm ³	= 0.061024 in ³
1 m	= 3.2808 feet
1 mm	= 0.03937 in
9/5 °C + 32	= °F

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[00] refer to position numbers in the customer specification.



General

The L90LS is a stackable, load-sensing and pressure compensated directional valve. It is designed for many different applications, both mobile and industrial, e.g. it can be used in cranes, general contractors' plant, forestry machines, working platforms etc.

Compact system construction

The L90LS valve is of modular construction, with unique possibilities to integrate application-adapted function solutions, thus facilitating a complete system solution for your machine.

Freedom in machine construction

The L90LS valve can be equipped solely for manual operation, or for manual operation combined with hydraulic or electro-hydraulic remote control. This gives great freedom in terms of component location and pipework arrangements.

Economy

The modular construction of the L90LS can be optimized for both simple and demanding functions. The possibilities for integrating complete function solutions give low system costs. Function-adapted solutions enable energy consumption to be kept at a minimum level.

Safety

The L90LS has been designed to make it easy for machine manufacturers to observe the safety demands in EC Machinery Directives 89/392/EEC and 91/368/ EEC. The valve is of robust construction, with each function built into a unit, which facilitates training and service. Application-adapted, integrated safety functions, e.g. for cranes, enables simple system construction.

Construction

The L90LS is stackable, and can be supplied in combinations of 1 to 12 spool sections, or in combination with function blocks. The valve is designed for system pressures up to 320 bar, and can be equipped with port relief valves in the motor ports for a maximum shock pressure of 350 bar. The flow rate range is up to 150 l/min, depending on how the valve is equipped. The maximum recommended flow per section is 90 l/min with pressure compensator, and 125 l/min without.

Functions

The inlet section of the L90LS can be equipped with a bypass for systems fed by pumps with fixed displacement, as well as a copy function for the load signal and an emergency stop function that blocks the pump inlet.

The end section can be equipped with a built-in pilot pressure supply, as well as a counterpressure function that gives exceptionally good make-up characteristics and the possibility of unloading lowering functions.

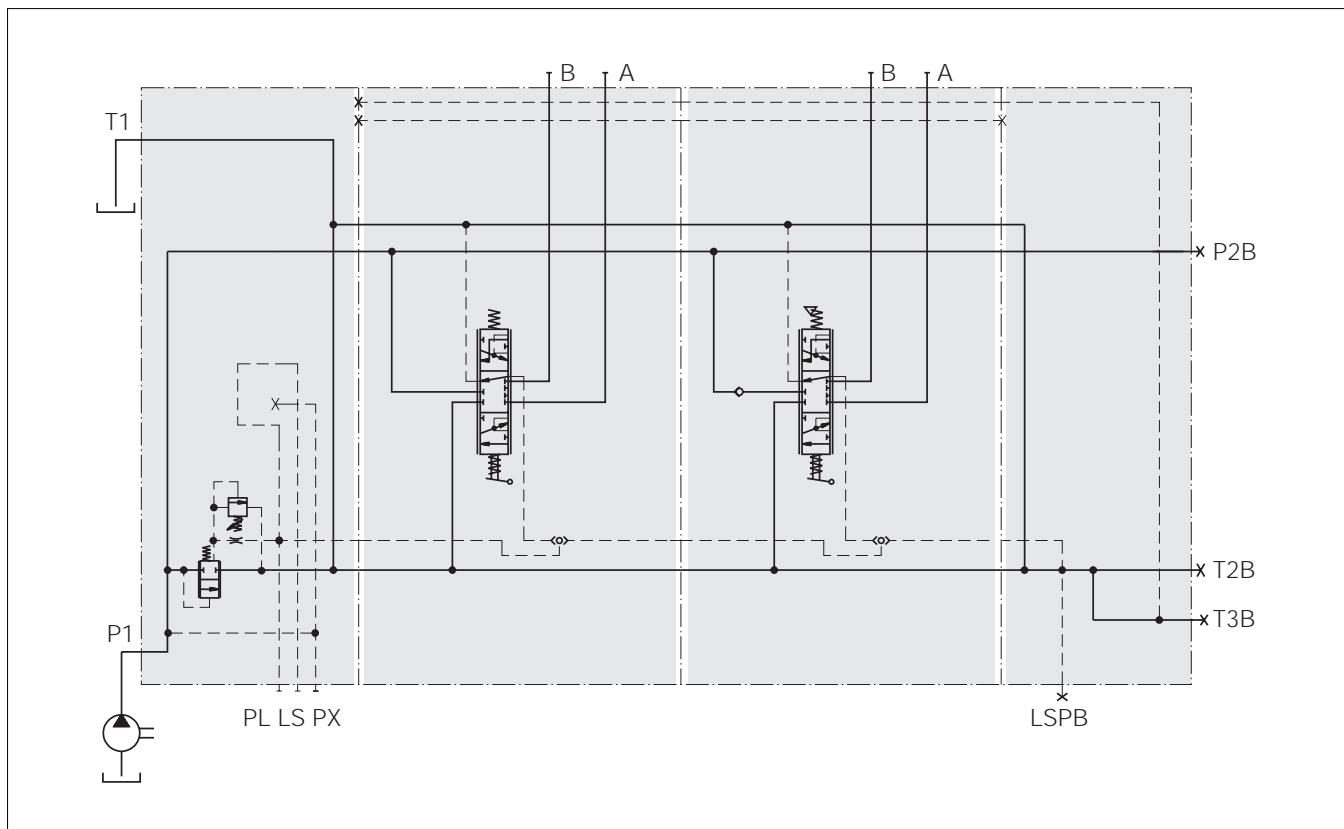
The spool sections can be equipped with pressure compensation and feed reducers, as well as combined port relief and anti-cavitation valves in the motor ports. Optional pressure feedback makes the valve force sensing, and also acts as a hydraulic ramp function.

System functions

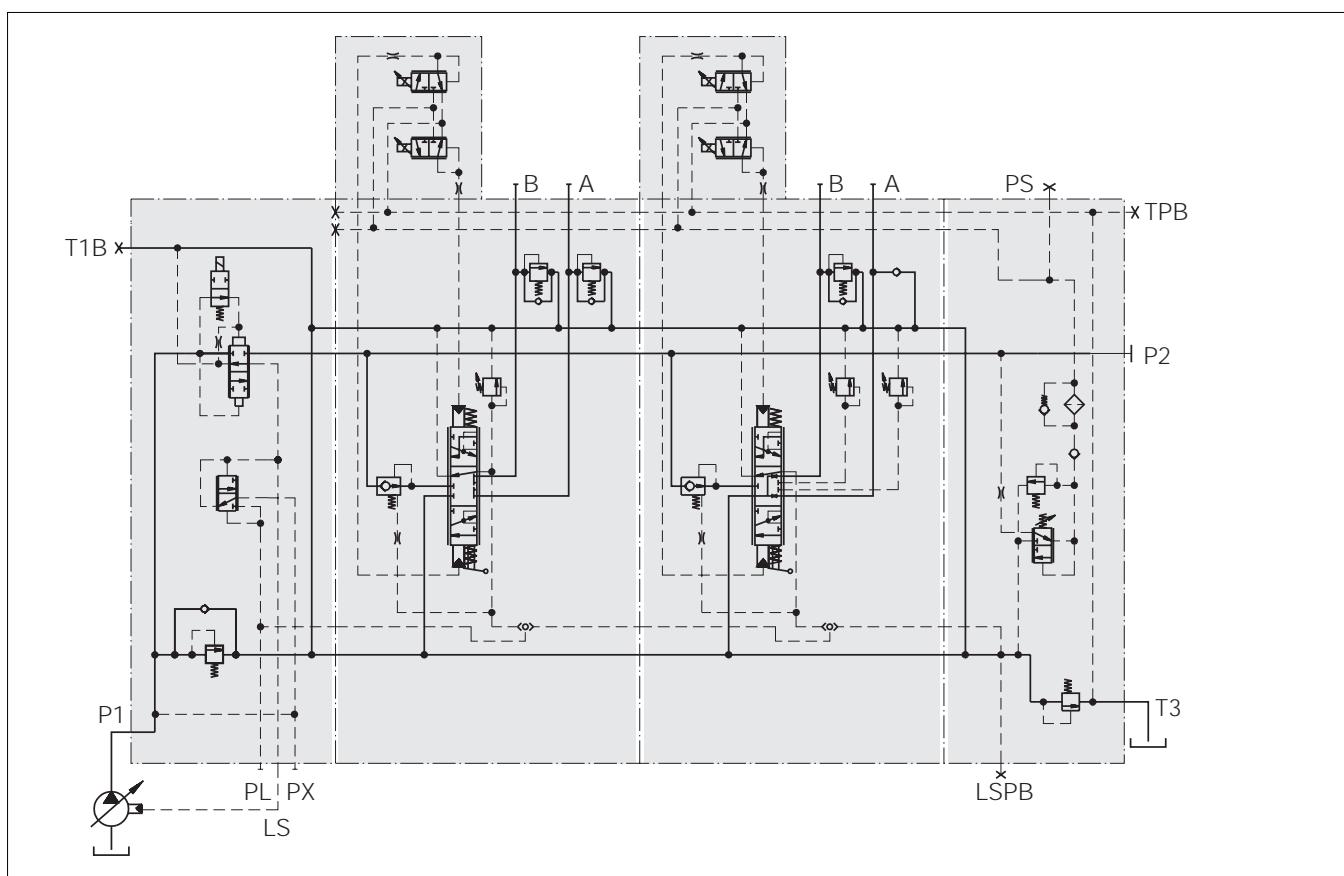
The L90LS can be supplied with individual two-speed functions that permit switching between precision- or performance work, e.g. in cranes and skylifts. Functions for stopping selected movements, e.g. for overload protection, can be integrated. The valve can also be equipped with lever disengagement, which prevents unintentional operation of the hand levers while working through remote control, e.g. radio control. A modular system with function blocks enables the integration of application solutions, such as priority for brakes and steering.

Directional control valve

L90LS



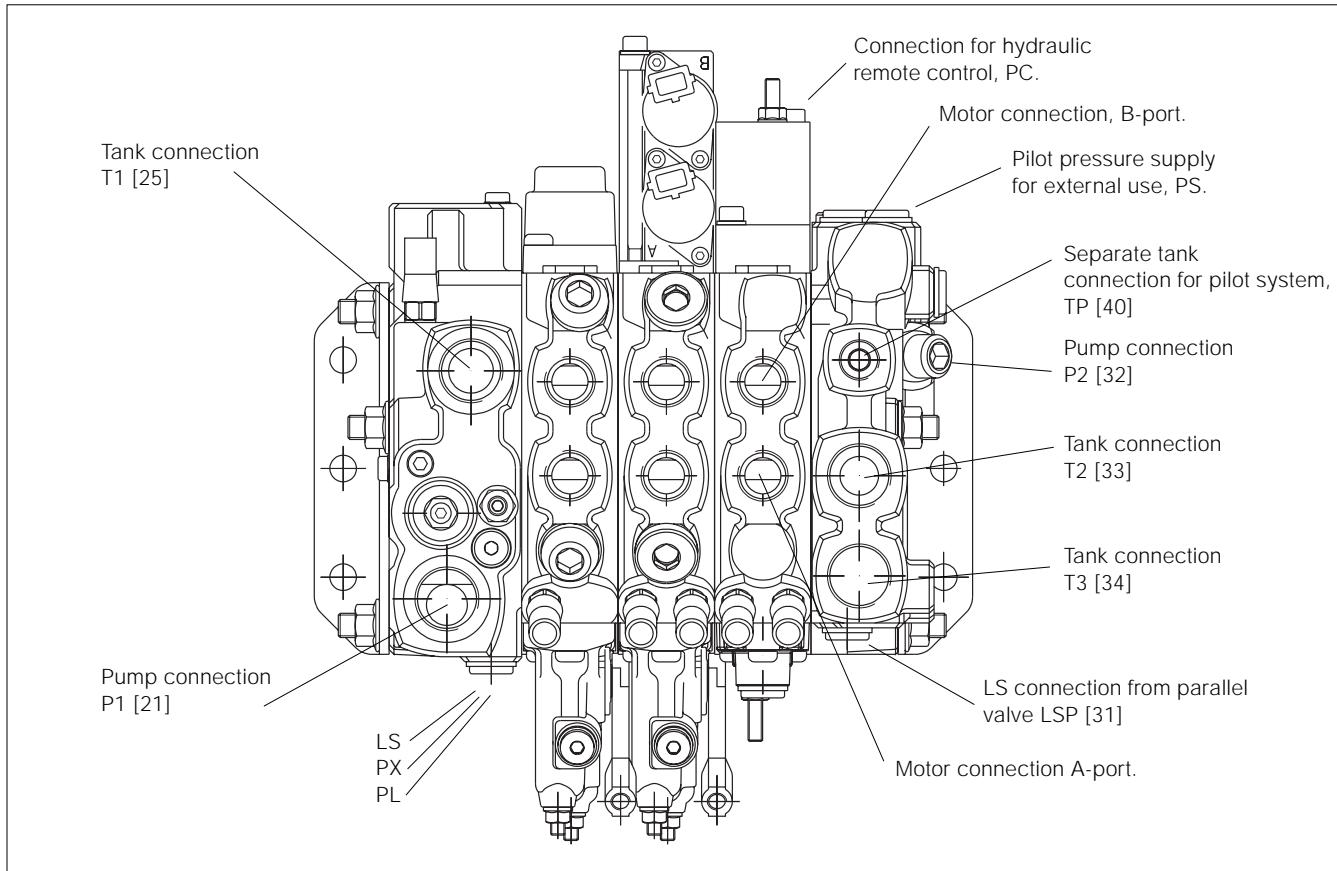
L90LS valve with manual activation, equipped with bypass for systems fed by pumps with fixed displacement.



L90LS valve with electro-hydraulic activation, equipped with directly controlled port relief valve for systems with LS pump, emergency stop, integrated pilot oil supply, counterpressure

function, individual pressure compensator, feed reducer, port relief and anti-cavitation valves etc.

Technical data



Pressures

Pump inlet	max. 320 bar* (4600 psi)
Motor ports	max. 350 bar* (5000 psi)
Tank connection	max. 20 bar (290 psi)

Flow rates, recommended

Pump connection	max. 150 l/min (40 US gpm)
Motor port, with compensator	max. 90** l/min (24 US gpm)
Motor port, without compensator	max. 125** l/min (33 US gpm)
Return from motor port	max. 150 l/min (40 US gpm)

* Stated pressures are absolute shock pressures at 10 bar tank pressure.

** Depending on spool variant.

Feed reducers

Setting range	50 - 330 bar (725-4800 psi)
---------------	-----------------------------

Internal pilot pressure

Fixed setting	22 or 35 bar (320 or 508 psi)
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Temperature

Oil temperature, function range	-20 to 90 °C (-4 to 194 °F)
Oil temperature, working range	+20 to 90 °C (68 to 194 °F)

Filtration

Filtration must be arranged so that Target Contamination Class 18/14 according to ISO 4406 is not exceeded.

For the pilot system, Target Contamination Class 16/13 according to ISO 4406 is recommended.

Hydraulic fluids

The best performance is obtained if mineral-base oil of high quality and cleanliness is used in the hydraulic system.

Hydraulic fluids of type HLP (DIN 51524), oil for automatic gearboxes Type A and engine oil type API CD can be used.

Synthetic, fire-resistant and environmentally friendly oils can also be used. If in doubt about the suitability of an oil, please contact your nearest VOAC representative for information.

Viscosity, function range 15-5000 mm²/s (cSt)
(at start-up)

Viscosity, working range 15-380 mm²/s (cSt)

Technical information in this catalogue applies to a viscosity of 30 mm²/s (cSt) and temperature of 50 °C (122 °F).

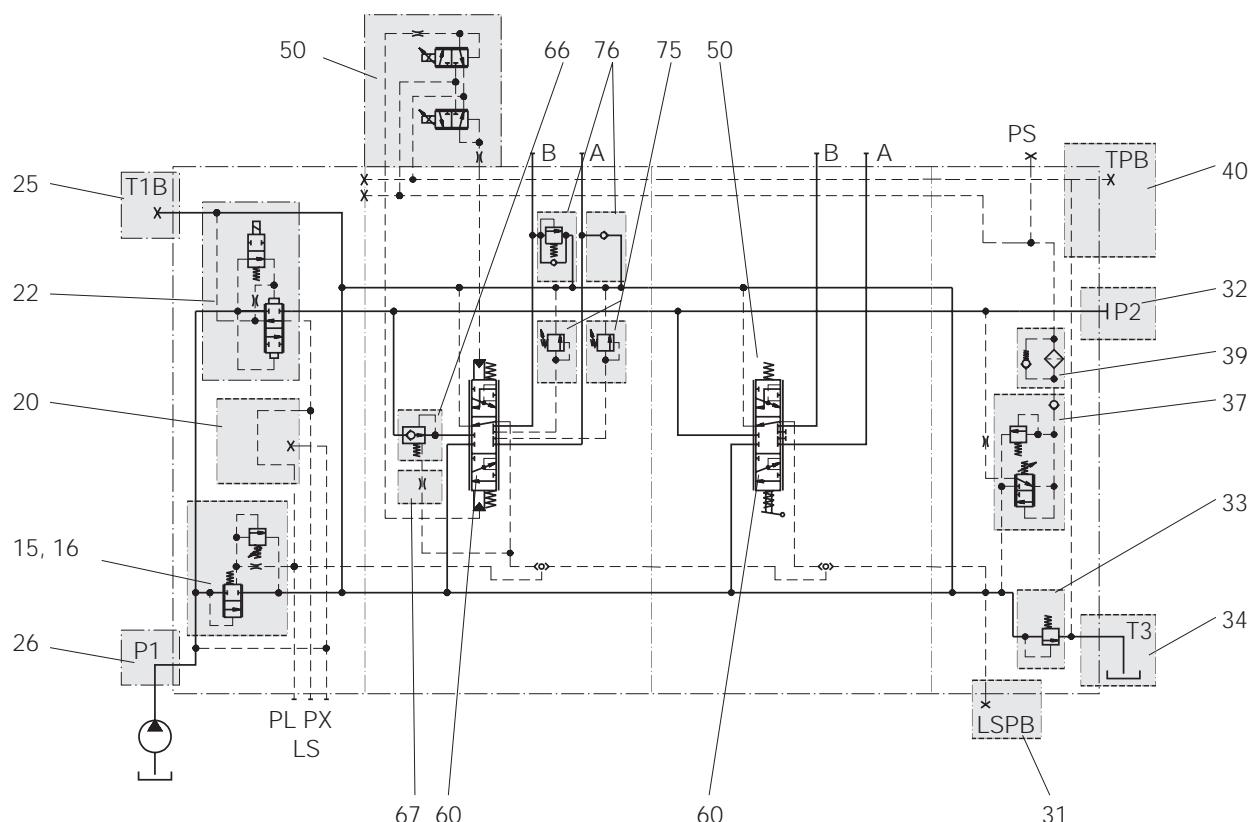
Connections

Connection	Location	G-version	UN-version
P1	inlet section	G 3/4	1 1/16-12 UN-2B
P2	end section	G 1/2	7/8-14 UNF-2B
T1	inlet section	G 3/4	1 1/16-12 UN-2B
T2, T3	end section	G 3/4	1 1/16-12 UN-2B
TP	end section	G 3/8	3/4-16 UNF-2B
A, B	spool section	G 1/2	7/8-14 UNF-2B
LS, PL	inlet section	G 1/4	9/16-18 UNF-2B
PX	inlet section	G 1/4	9/16-18 UNF-2B
PS	end section	G 1/4	9/16-18 UNF-2B
PS2	end section	G 1/8	7/16-20 UNF-2B
PC	spool section	G 1/4	9/16-18 UNF-2B
ACP ,ACE, ACEF	spool section	G 1/8	1/8-27 NPTF
LSA/B	spool section	G 1/8	3/8-24 UNF-2B
LSP	end section	G 1/4	9/16-18 UNF-2B

Weights

Inlet section	5.5 kg	12.1 lb
End section	4.2 kg	9.3 lb
Spool section with spool actuator type:		
C, B3	4.1 kg	9.0 lb
ACE	5.2 kg	11.5 lb
CH, CHB3, CHX, PC	4.5 kg	9.9 lb
PCH	4.7 kg	10.4 lb
EC, EB, ECM	5.2 kg	11.5 lb
ECH, ECHL, ECHLM, ECHM, EBHL	5.4 kg	11.9 lb

Hydraulic circuit diagram showing basic functions for L90LS

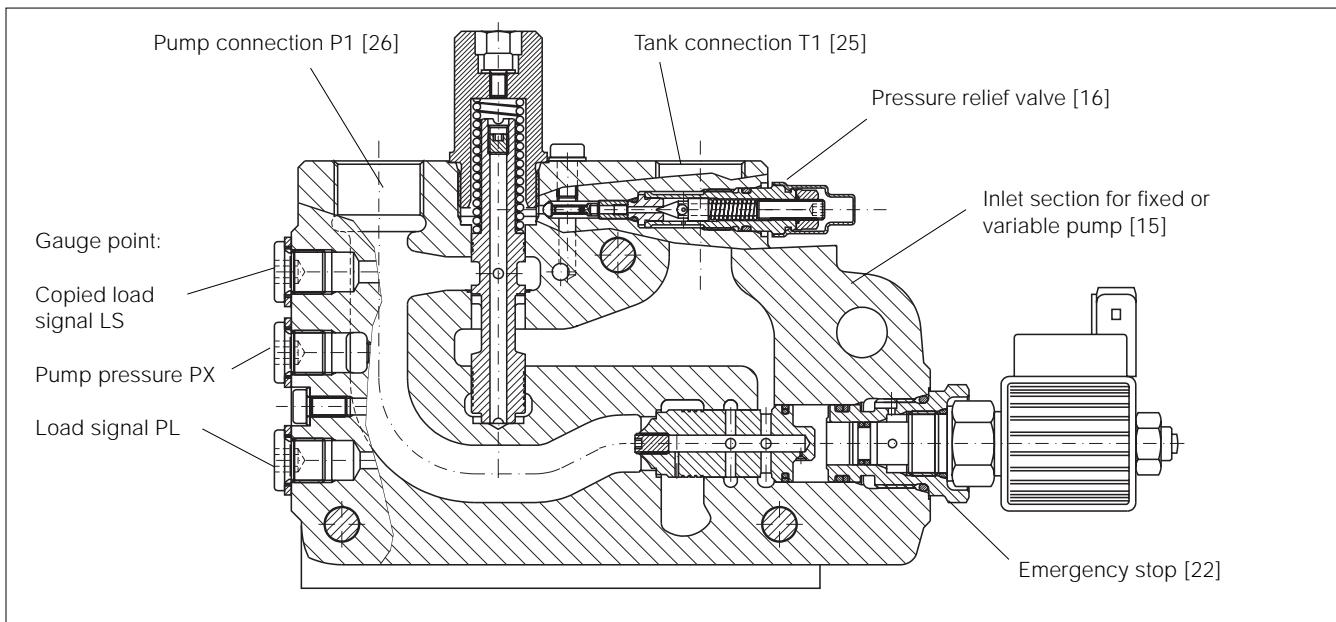


The position numbers in the hydraulic circuit diagram and table below refer to the function areas for which different options are available. The valve in the example above is

equipped according to the description below. For other equipment alternatives, see under respective function area [Position number] in catalogue.

Pos. Code	Description	Pos. Code	Description
15 CFC	Inlet with bypass for systems with fixed pump.	47 TTT	Section 1 equipped with pressure compensator, separate feed reducers for A- and B-ports, and prepared for port relief valves in both motor ports.
16 PS	Pilot operated main pressure relief valve.	000	Section 2 without pressure compensator, feed reducer or port relief valve.
20 KB	Prepared for load-signal copying.	50 EC	Section 1 equipped with proportional electrohydraulic remote control.
22 BEN	Electrically activated emergency stop function that blocks the pump and unloads the load signal.	CH	Section 2 equipped for manual operation with spring centering.
25 T1B	Tank connection in inlet plugged.	60 D	Sections 1 and 2 equipped with spool for doubleacting function, with blocked neutral position.
26 P1	Pump connection in inlet open.	66 K	Pressure compensator with built-in check valve function.
31 LSPB	Load-signal connection for parallel-connected valve plugged.	67 0.8	Restriction of load signal to compensator.
32 P2	Pump connection	75	Setting pressure for feed reducers for A- and B-ports.
33 MF	Fixed operated counterpressure valve.	76A N2	Anti-cavitation valve for A-port.
34 T3	Tank connection open.	76B	Setting pressure for combined port relief and anti-cavitation valve for B-port.
37 R	Regulating valve with separate safety valve for internal pilot pressure supply.		
39 S	Internal coarse filter for pilot circuit.		
40 TPB	Prepared for separate tank connection from pilot system.		

Inlet section



The inlet section is available in three variants, one for fixed pumps and two for systems with variable pumps. The inlet section is equipped with pump- and tank connections, a connection for the load signal to LS pumps, and a gauge point for pump- and load signal pressures. In the basic variant, the pump connection P1 [26] and tank connection T1 [25] are open, while the other connections are plugged.

The variant for fixed pumps can be converted easily in the field to work with variable pumps, and vice versa. (CFC \leftrightarrow LS1).

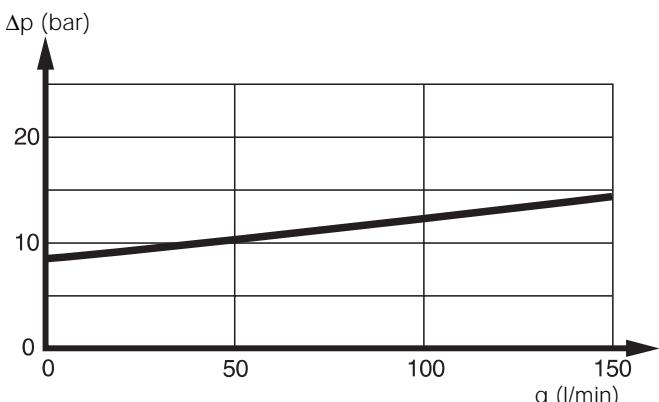
Functions for maximum pressure relief, copying of the load signal, and emergency stop, which blocks the energy supply to the valve, can be integrated into the section.

Inlet sections [15]

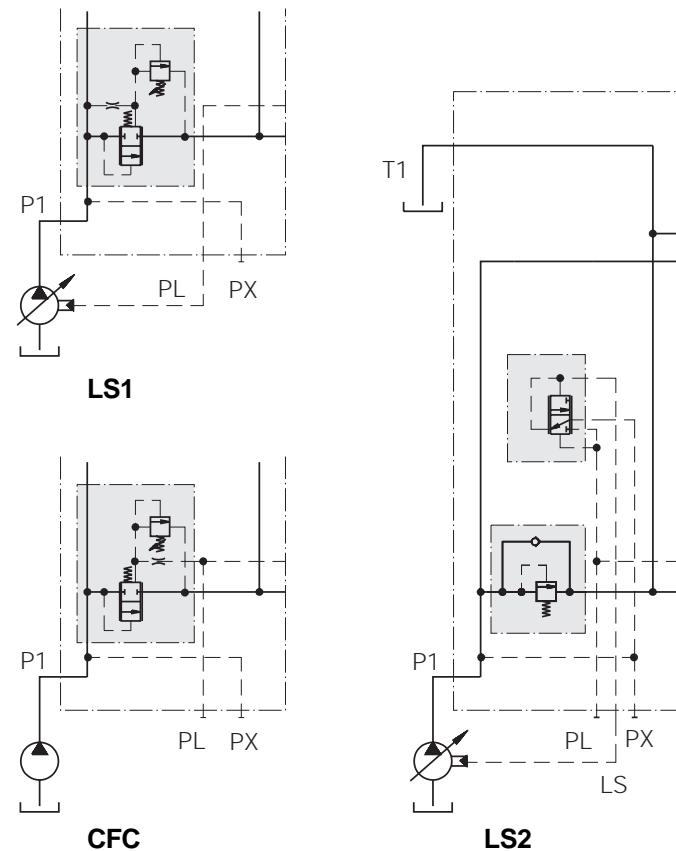
CFC Inlet section for systems with fixed pump. The system is equipped with an adjustable, pilot-operated pressure relief valve [16], which protects the pump and inlet side of the valve. A built-in bypass diverts excess oil directly to tank. The bypass pressure level is controlled by the load signal, and is approx. 10 bar above the actual load signal pressure.

LS1 Inlet section for systems with LS pump. The system is equipped with an adjustable, pilot-operated pressure relief valve [16], which protects the pump and inlet side of the valve.

LS2 Inlet section for systems with LS pump. The system is equipped with a non adjustable directly controlled pressure relief valve [16], which protects the pump and inlet side of the valve. The LS2 is normally equipped with a copy function for the load signal, KS [20].



CFC – Idling pressure drop over the bypass. P1 – T1.



CFC – Inlet section for systems with pump.

LS1 – Inlet section for systems with LS pump.

LS2 – Inlet section for systems with LS pump.

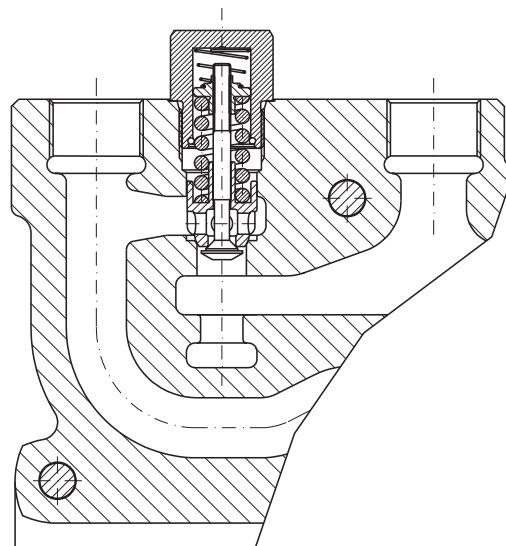
Pressure relief valve [16]

The inlet section is normally equipped with a pressure relief valve to protect the pump and valve from pressure peaks in the system during rapid re-positioning.

PA1 Direct acting port relief valve, PLC183, with very fast opening sequence and good pressure characteristics. The replaceable PLC cartridge is factory set. The cartridge has a make-up function, which means that oil is able to flow from the tank gallery to the pump gallery in the event of underpressure in the pump circuit. The valve is intended for the LS2 inlet section [15]. For setting values, please see Pressure setting [17].

PS Pilot operated pressure relief valve with fast opening sequence and very low pressure intensification, which effectively prevents overloading of the hydraulic pump and the machine. The valve is adjustable, and is delivered factory set according to the value specified. The valve is intended for the CFC and LS1 inlet sections [15].

Y Plug which can replace the pressure relief valve in the LS2 inlet section [15]. The Y-plug blocks the connection between the pump and tank completely.



PA1 - Direct operated pressure relief valve.

Pressure setting [17]

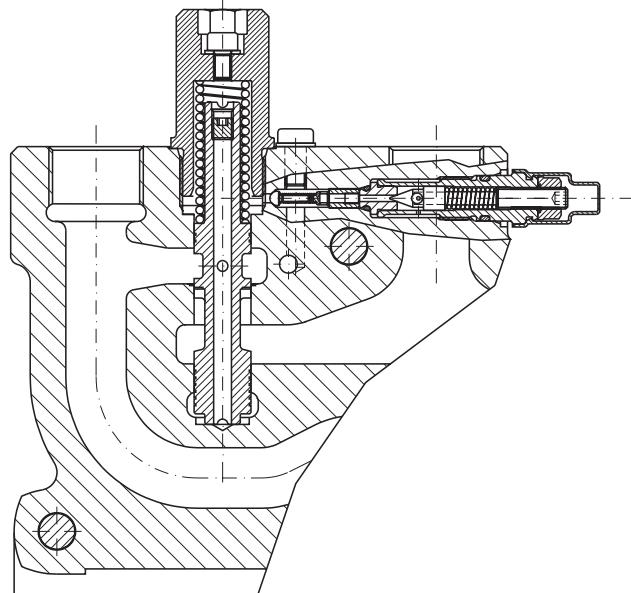
Pressure setting for PA1 [16]

The PA1 direct acting pressure relief valve is delivered with a fixed setting according to the following standard settings.

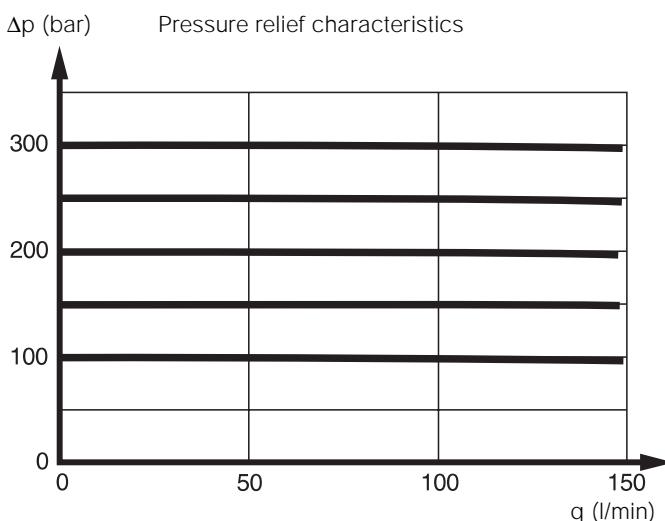
Setting pressure in bar: 63, 80, 100, 125, 140, 160, 175, 190, 210, 230, 240, 250, 260, 280, 300 and 330.

Pressure setting for PS [16]

The PS pilot operated pressure relief valve is adjustable from 50 to 320 bar. The valve can, however, be delivered with a fixed setting according to the value specified.



PS - Pilot operated pressure relief valve.



PS - Pilot operated pressure relief valve.

Load signal system [20]

The load signal system consists of a required number of shuttle valves, which compare the load signals from the spool sections and any incoming signal from a parallel connected valve, which is connected to the LSP port [31]. The dominating signal is transmitted on to the PL connection in the inlet section, or to a copy spool if the section is equipped with one. The copied signal can then be taken out from the LS port.

In the case of the CFC variant, the load signal goes to the bypass that regulates the pressure in the feed gallery to approx. 10 bar above the load signal pressure.

KB Inlet section without copy spool.

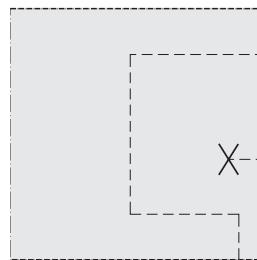
The load signal goes directly to the bypass in CFC systems, or to the PL connection in LS systems.

KS Inlet section with copy spool.

The valve load signal controls a copy spool, which in turn sends a copied load signal to the LS connection.

The system permits a certain consumption in the load signal line to the pump, without the load signal being influenced. This enables simpler system construction, with the possibility of installing logic systems in the LS circuit. Thanks to drainage in the pump LS regulator, the system gives better winter operating characteristics with faster response, since the oil in the LS circuit is always warm. In addition to this, the system prevents the tendency for the load to sink slightly at the beginning of the lifting phase.

Inlet sections of type LS2 [15] are normally equipped with copy spools.

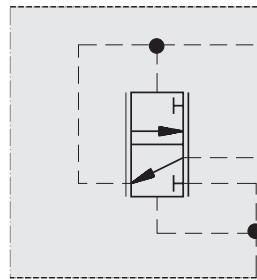


Load signal to bypass or pump regulator

X

Load signal from spool section

KB - Inlet section without copy spool.



Copied load signal to pump regulator

Pump

Load signal from spool section

KS - Inlet section with copy spool.

Emergency stop function [22]

If the requirement is specified, the valve can be equipped with an emergency stop function that is built into the inlet section. The function can be controlled either electrically or hydraulically.

(The inlet section is not normally machined to accommodate an emergency stop function.)

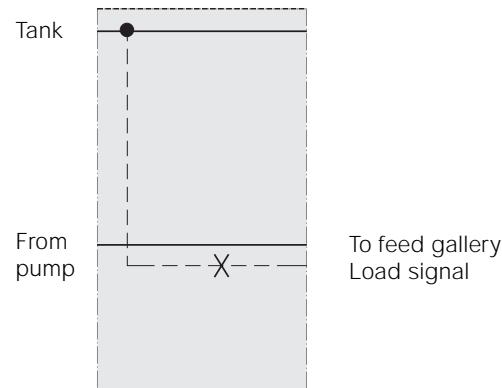
BB The inlet section is machined to accommodate an emergency stop function, and plugged. This permits the building in of an emergency stop function at a later date if required.

BEN Electrically controlled emergency stop function. When the current to the electromagnet is broken, the pump is blocked and the load signal drained to tank. In both LS and CFC systems, this means that the feed gallery is shut off from the pump inlet and the pump is unloaded.

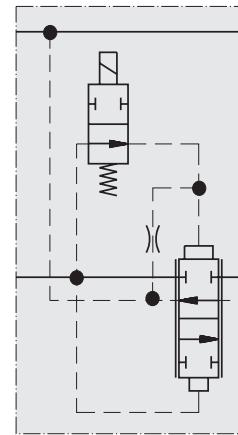
BEA Electrically controlled emergency stop function. When the electromagnet is activated, the pump is blocked and the load signal drained to tank. In other respects, BEA is the same as BEN above.

BX Hydraulically controlled emergency stop function. When an external hydraulic signal with the same pressure as the pump is connected to the BX port, the pump is blocked and the load signal drained to tank. In both LS and CFC systems, this means that the feed gallery is shut off from the pump inlet and the pump is unloaded.

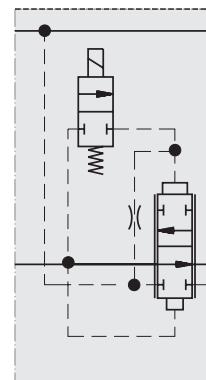
Connection: G1/2 or 9/16-18 UNF-2B.



BB - Machined to accommodate emergency stop function, and plugged.



BEN - Electrically controlled emergency stop function.



BEA - Electrically controlled emergency stop function.

Tank connection T1 [25]

T1 Tank connection T1 is open. Normal variant.

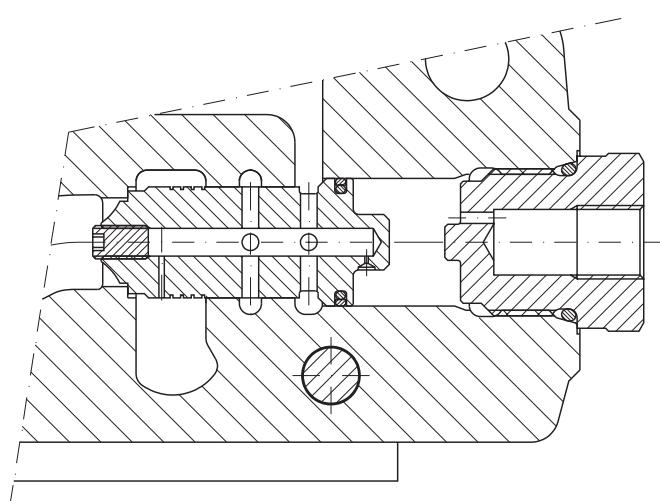
T1B Tank connection T1 is blocked.

T1X Used together with CFC [15] and MF or MP counter-pressure functions [33] only. Tank connection T1 in the inlet section is separated from the tank galleries in the spool sections. Pump oil that is not used flows via the bypass directly to tank via T1, while returning oil from the actuators flows to tank via the counterpressure valve in the end section and tank connection T3.

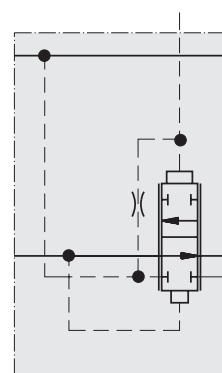
Pump connection P1 [26]

P1 Pump connection P1 is open. Normal variant.

P1B Pump connection P1 is plugged.

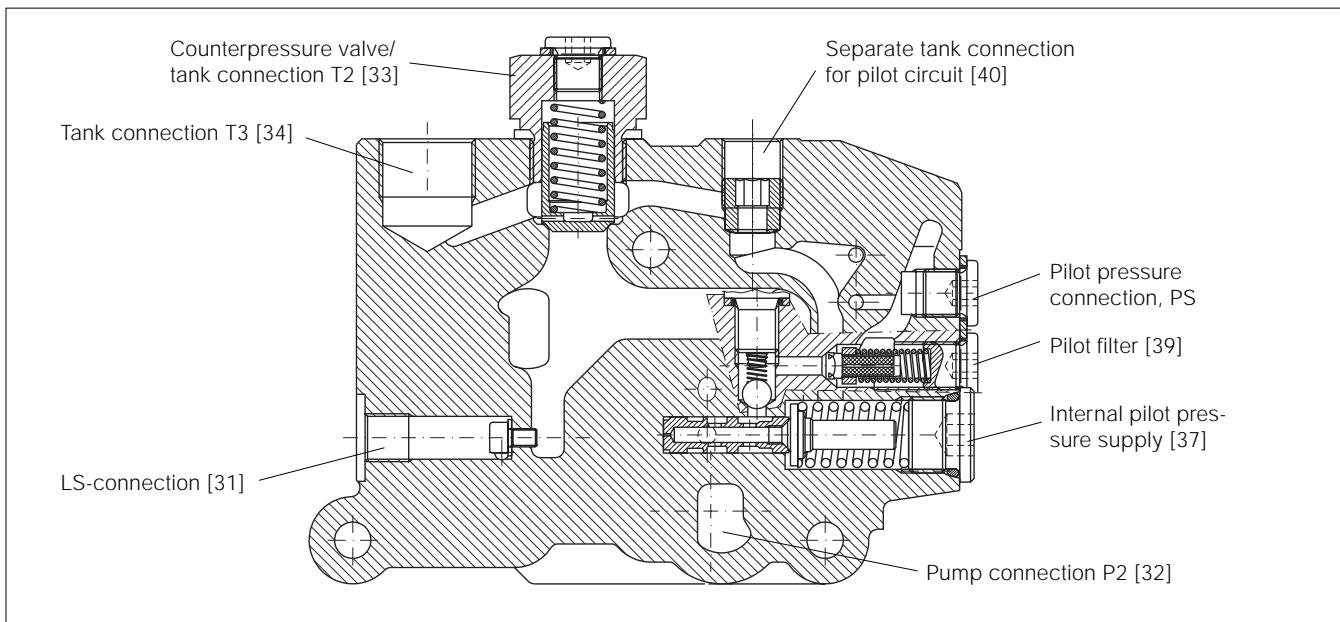


BX - Connection of signal pressure.



BX - Hydraulically controlled emergency stop function.

End section



The end section can be equipped with a large number of additional functions to give optimum application adaptation. The section can, for example, be fitted with a pressure regulator to give an internal pilot pressure supply for hydraulically and/or electro-hydraulically controlled spool actuators.

The section can also be fitted with a factory set counter-pressure valve in the T2 port.

In the basic variant, the pump connection P2 [32] and the tank connections T2 [33] and T3 [34] are plugged.

End section [30]

US Standard end section

LS connection [31]

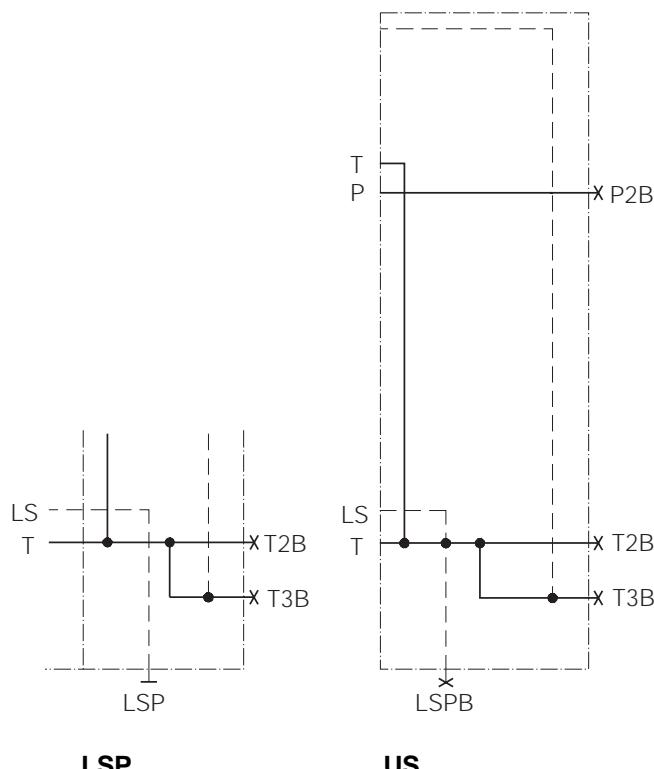
LSP Port for connection of LS signal from other valve open. This connection is used to receive the load signal from a parallel connected valve.

LSPB Port for LS signal from other valve plugged.

Pump connection P2 [32]

P2 Alternative pump connection in rear face. The connection can, for example, be used to feed valves located to the rear, or for double feeding of the valve in applications where many functions with very high flow demands are operated simultaneously. Under certain provisions, the connection can also be used in situations when feeding from the rear face is the most suitable option in terms of space available. When feeding via P2, the emergency stop function [22] cannot be used.

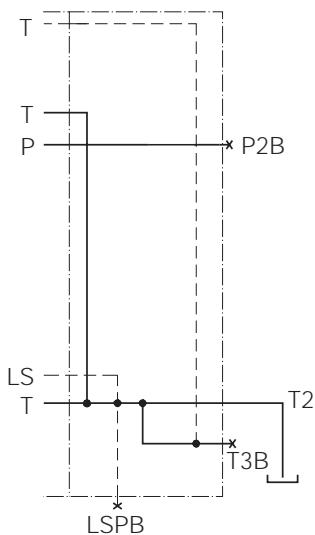
P2B Alternative pump connection plugged.



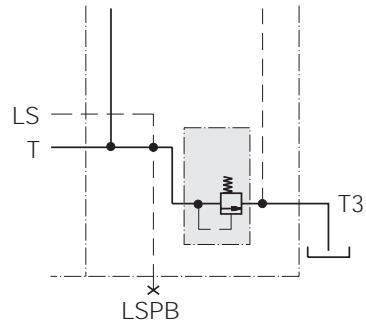
*LSP – Port for connection of LS signal from other valve is open.
US – Standard end section.*

Counterpressure valve / tank connection T2 [33]

- T2** Alternative tank connection T2 open.
- T2B** Alternative tank connection T2 plugged.
- MF** Counterpressure valve factory set to give 5 bar counterpressure. Tank connection T1 must be plugged (T1B) [25] and tank connection T3 [34] must be open.
If the system has a fixed pump, CFC [15], the separate tank line T1X [25] from the bypass can be used to reduce the idling losses in the system.



T2 – Without counterpressure valve.



MF – Factory set counterpressure valve.

Internal pilot pressure supply [37]

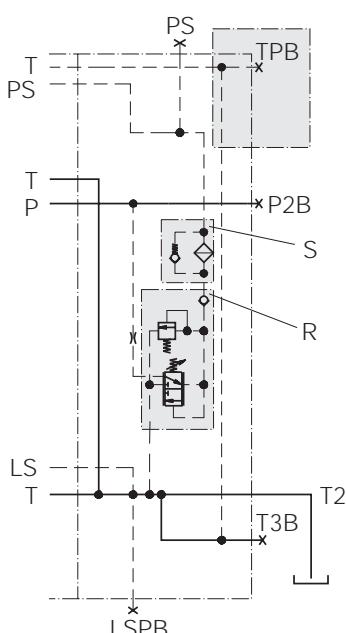
R Internal pilot pressure supply is a valve function, built into the end section, which works as both a pressure regulator and a pressure relief valve in the pilot circuit. For safety reasons, the R-cartridge has also been equipped with a separate safety valve function that prevents the maximum permissible regulated pressure from being exceeded. A check valve prevents pilot oil from leaking back to the pump, and therefore enables the pressure in the pilot supply circuit to be maintained in the event of a temporary fall in pump pressure, e.g. during a rapid lowering movement. Pilot pressure for external use, e.g. for delivery to PCL4 remote control valves in remote control applications, can be tapped from the PS connection on the B-side of the end section. Pressure setting: 35 bar.

R22 Pressure setting: 22 bar.

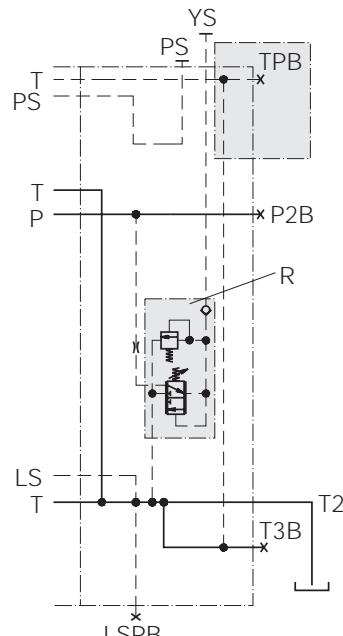
Pilot filter [39]

S Coarse filter with bypass function in the internal pilot pressure supply. The filter protects the pilot circuit from dirt, especially during start-up of the system.

YS Adapter for connection of external filter for pilot pressure oil. Enables the pilot circuit to be supplied with oil of a higher cleanliness class compared with the rest of the system.



*R - internal pilot pressure supply.
S - coarse filter with bypass function.
TPB - end section machined to accommodate separate tank connection for pilot circuit, and plugged.*



*R - internal pilot pressure supply.
YS - adapter for connection of external pilot-pressure filter.
TPB - end section machined to accommodate separate tank connection for pilot circuit, and plugged.*

Separate tank connection for pilot circuit [40]

This connection is machined into the end section in conjunction with internal pilot pressure supply [37] only.

TP Separate tank connection for the pilot circuit is open. The connection to the main tank gallery of the directional valve is blocked. The function is suitable for systems in which there is a risk of dynamic pressure fluctuations in the tank line, which cause fluctuations in the pilot circuit when there is a common tank line.

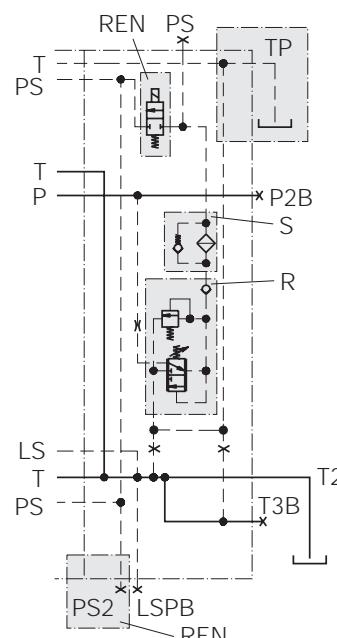
TPB The end section is machined to provide a separate tank connection for the pilot circuit, and plugged. The tank return of the pilot circuit is connected to the tank gallery of the directional valve.

Activation of lever disengagement [42]

RB The end section is machined to accommodate the lever disengagement function, and plugged.

REN Electrically controlled lever disengagement. The pilot pressure is blocked when the solenoid is un-activated. The function is used to disengage the hand levers. When using hydraulic or electro-hydraulic remote control, usage of the hand levers and remote control is eliminated simultaneously. The function is used together with LR Lever disengagement [52].

REA Electrically controlled lever disengagement. The supply of pilot pressure to the valve is shut off when the solenoid is activated. Otherwise, the function is used in the same way as REN above.



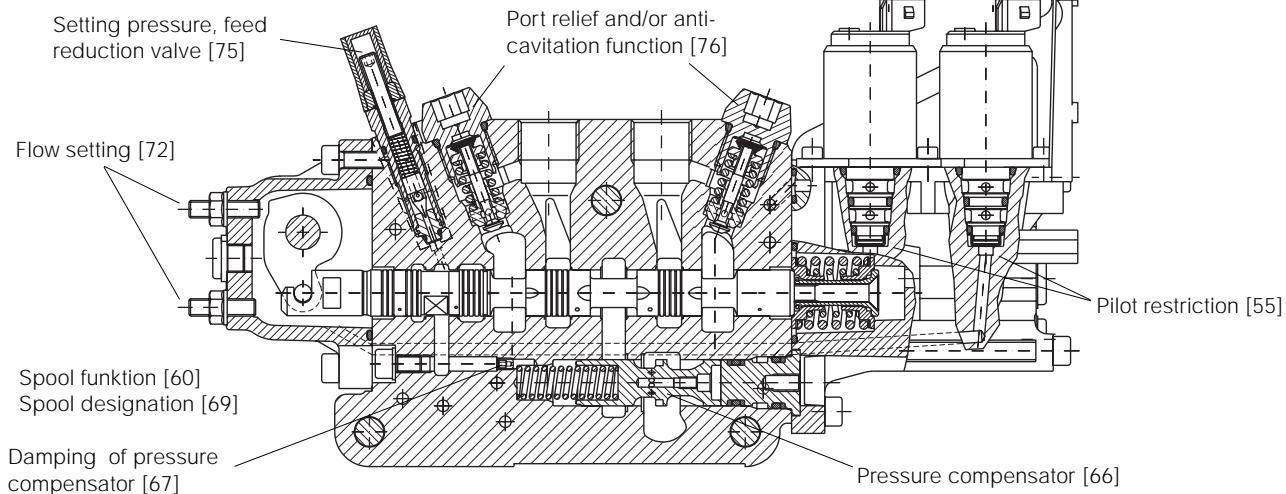
*R - internal pilot pressure supply.
S - coarse filter with bypass function.
TP - end section machined to accommodate separate tank connection for pilot circuit. Open.
REN - lever disengagement function through electrically controlled blocking of pilot pressure.*

Spool section

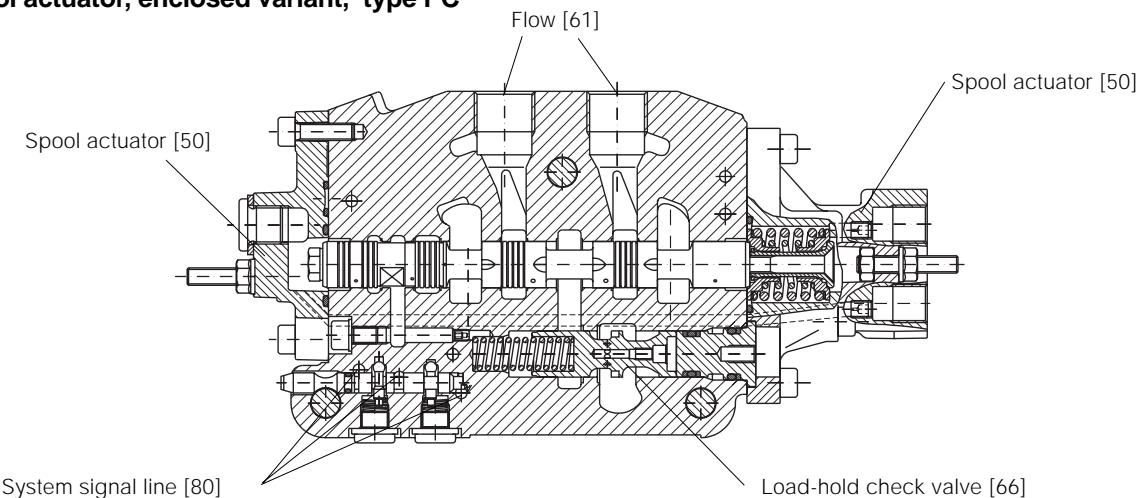
The L90LS directional valve is stackable and can be delivered in combinations of 1 to 12 spool sections. Each section can be equipped individually with a large number of different optional

functions, spools and spool actuators for optimum adaptation to the application and controlled function.

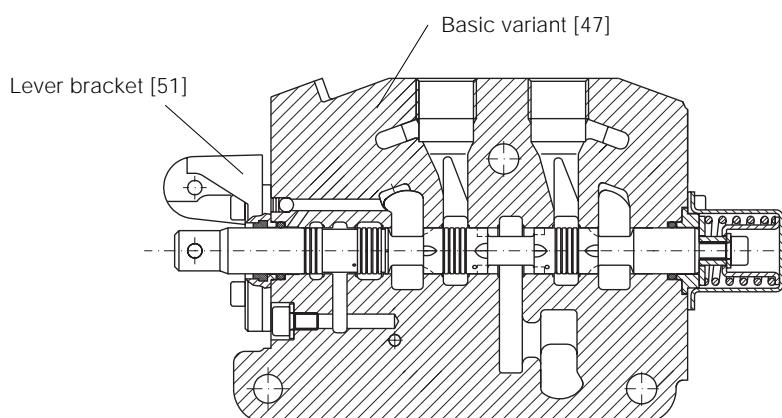
Spool actuator, enclosed variant, type ECH



Spool actuator, enclosed variant, type PC



Spool actuator, open variant, type C



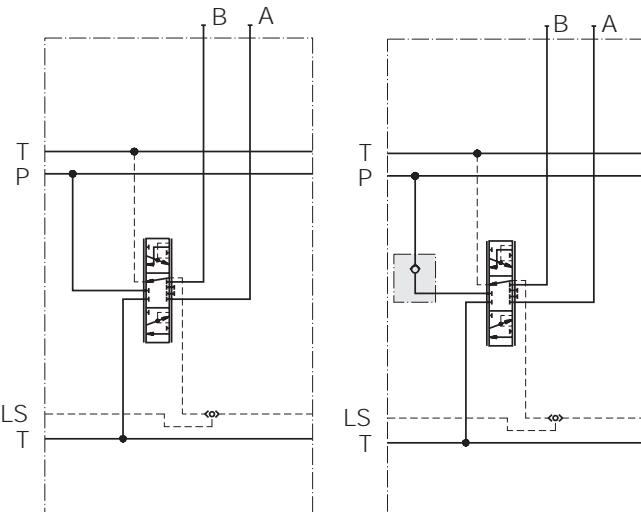
Basic variants of spool section [47]

Spool sections are available in different variants, the choice of which is dependent on the choice of optional functions, according to the following:

- 000** Not machined for pressure compensator, check valve, feed reducer, port relief and/or anti-cavitation valves.
- V00** Section fitted with load-hold check valve, but not machined for port relief valves.
- T00** Section fitted with pressure compensator, but not machined for port relief valves.
- TA0** Section fitted with pressure compensator and feed reduction to A-port, but not machined for port relief valves.
- TC0** Section fitted with pressure compensator and common feed reduction to A- and B-ports, but not machined for port relief valves.
- TT0** Section fitted with pressure compensator and individual feed reduction to A- and B-ports, but not machined for port relief valves.
- **T** All of the section variants above are available in versions that are machined for, and can be fitted with, port relief and/or anti-cavitation valves in motor ports A and B. In such cases, the letter T is given in the third position in the product designation, e.g. 00T, V0T, T0T, TAT, TCT and TTT. For further information, see Port relief and/or anti-cavitation valves [76].

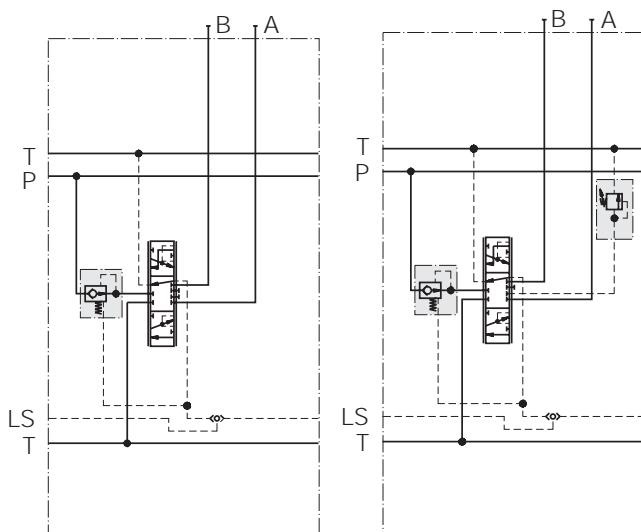
Since V^{**} and T^{**} sections have the same machining, they can easily be converted to 0^{**}, V^{**} or T^{**} sections. However, the machining for *0*, *A*, *C* and *T* sections is different.

For further information, see also "Pressure compensator / load-hold check valve [66]" and Feed reduction valve [75].



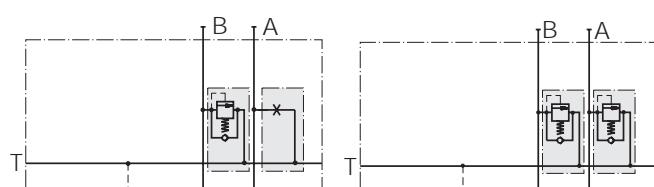
Variant 000 (OOT)

Variant V00 (VOT)



Variant T00 (TOT)

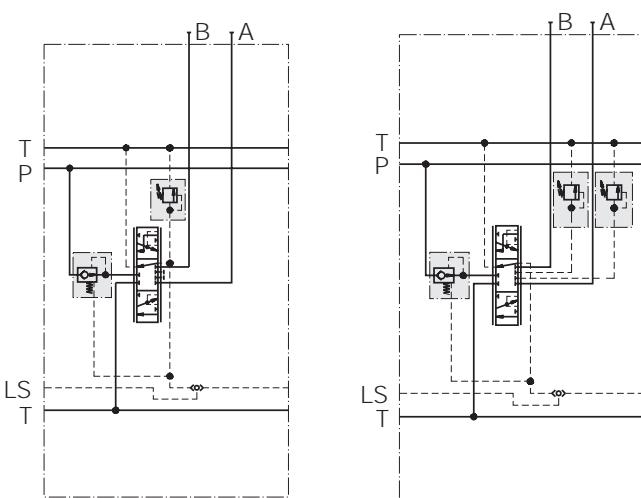
Variant TA0 (TAT)



Variant **T prepared for port relief and/or anti-cavitation valve for motor ports A and B.

The diagram above left shows a section with a Y-plug in the A-port and a port relief and anti-cavitation valve in the B-port.

The diagram above right shows a section with port relief and anti-cavitation valves in the A- and B-ports.



Variant TC0 (TCT)

Variant TT0 (TTT)

Spool actuators

The L90LS directional valve is made for two different types of spool actuator, i.e. open or enclosed variants. The actuators with open spool end are a simpler variant intended for installations in which low price and simpler connection to remote control by means of wires or mechanical coordinate levers (joysticks) is prioritized. The spool actuators available for this purpose are: C, B3 and ACE. In spool actuators of the enclosed type, the spools are totally enclosed in oil filled caps. Enclosed actuators can be obtained in a large number of different variants, details of which are given on [pages 18-19](#).

Spool actuators [50]

Manually operated with open spool end

C Spring centered spool actuator

Spool actuator intended for stepless operation with spring-return to the neutral position.
Spring force in neutral position
Spring force with spool fully actuated

60 N
130 N

B3 Three-position spool actuator

Spool actuator with mechanical 3-position detent for manually operated spools. The spool actuator has three fixed positions: neutral position, and maximum actuation at both end positions. The spool remains in the respective positions and must be moved manually from one position to another.

Force needed on spool to overcome detent position
approx. 160 N

Remote controlled ON/OFF with open spool end

ACE Electro-pneumatic spool actuator, ON/OFF

An electro-pneumatic ON/OFF controlled, spring-centered spool actuator.

ACE also gives the possibility of stepless operation by hand lever.
Control pressure

min. 4 bar
max. 10 bar
95 N

Spring force in neutral position

Spring force with fully

actuated spool

Electromagnet

160 N

12 V DC 0.85 A

24 V DC 0.42 A

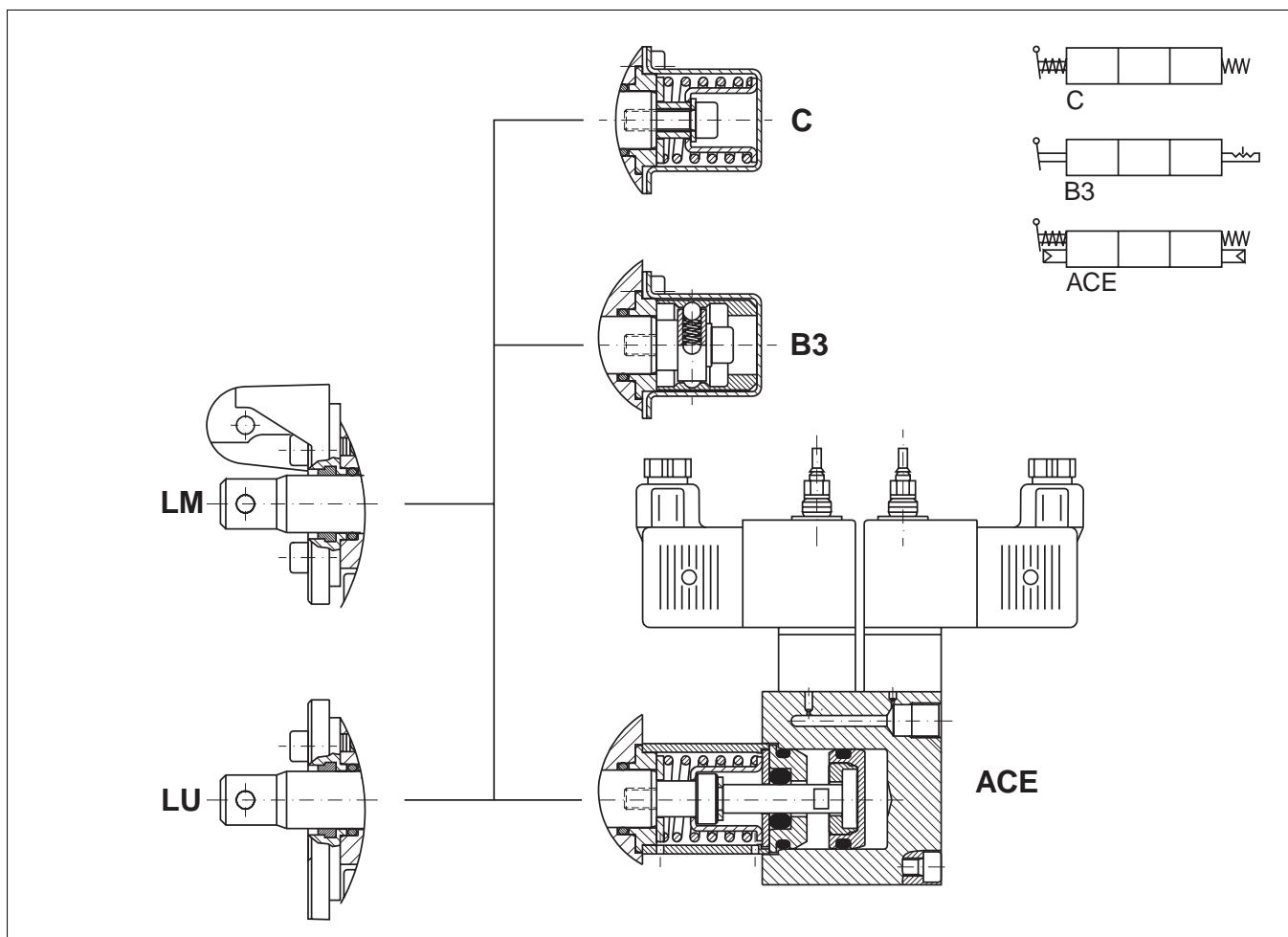
±20%

Voltage tolerance
Connections G1/8 or NPTF 1/8-27

Lever bracket [51]

LM Lever bracket for spool actuators: C, B3 and ACE.

LU Lever cover without lever bracket: C, B3 and ACE.



Spool actuators [50]

Manually operated with enclosed spool end

CH Spring centered spool actuator

A spring centered spool actuator with enclosed spool ends for use in demanding environments. The CH spool actuator is intended for stepless operation with spring-return to the neutral position.

Spring force in neutral position	70 N
Spring force with fully actuated spool	140 N

CHX	Same as CH but with stronger centering springs to compensate for friction in external linkage arms etc.
	Spring force in neutral position 85 N Spring force with fully actuated spool 250 N

Proportionally remote-controlled

PC Hydraulic spool actuation

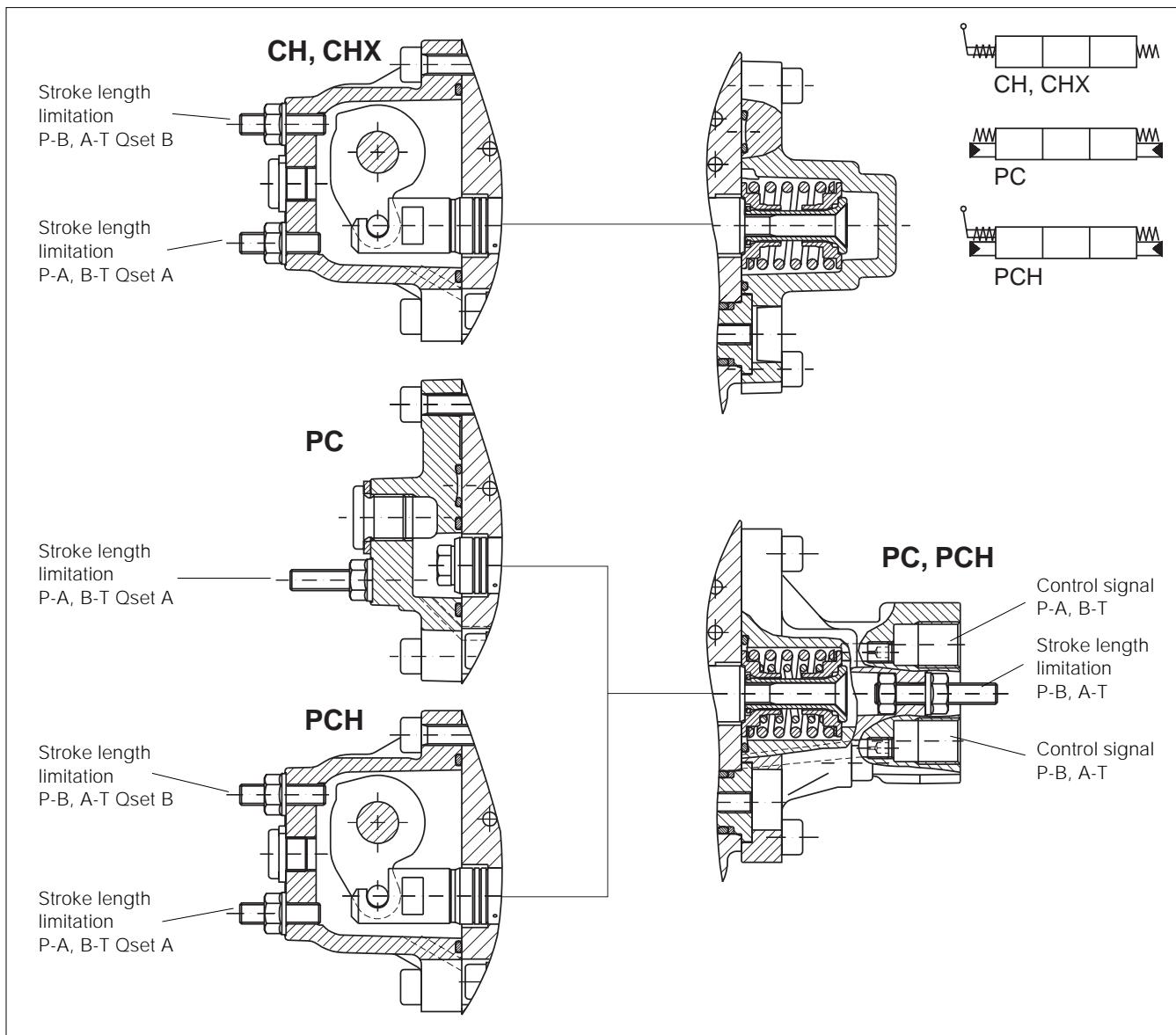
PCH Hydraulic spool actuation with manual operation

The PC and PCH are proportional, hydraulically controlled spool actuators with spring centering to the neutral position. They are intended to be remote controlled by remote control valves type PCL4.

When choosing a control pressure for the PCL4, its starting pressure should be approx. 1 bar lower than that of the directional valve, in order to ensure gentle starting and stopping. The pilot pressure for the control pressure valve can be tapped from the internal pilot pressure supply in the end section of the directional valve, via connection PS.

Control pressure, start	5.5 bar
Control pressure, final	15 bar
Permissible pressure in pilot cap	max. 35 bar
Connections: G1/4 or 9/16-18 UNF	

See also separate catalogue for PCL4.



Spool actuators [50]

Proportionally remote-controlled

EC Electro-hydraulic spool actuator

ECH Electro-hydraulic spool actuator with manual operation

The EC and ECH are proportional, electro-hydraulically controlled spool actuators with spring centering to the neutral position. They are intended to be controlled remotely by the EHC4000, EHC35 or EHC45 control systems. Pilot pressure oil for the converter valves is led to the spool actuators through internal ducts in the valve. This means that only the electric cables from the control system to the solenoid valve need to be connected externally.

The ECH can be operated steplessly by hand lever.

Spring force in neutral position 60 N

Spring force with fully actuated spool 350 N

Control current for PVC25, 12 V

Starting min. 550 mA

Fully actuated max. 980 mA

Control current for PVC25, 24V

Starting min. 260 mA

Fully actuated max. 510 mA

Measuring connections: G1/4 or 9/16-18 UNF

ECHL Same as the ECH but with a weaker centering spring. The ECHL can be used, for example, if the spool actuator is generally intended to be operated by hand.

Spring force in neutral position 85 N

Spring force with fully actuated spool 250 N

Control current for PVC25, 12 V

Starting min. 550 mA

Fully actuated max. 820 mA

Control current for PVC25, 24V

Starting min. 260 mA

Fully actuated max. 440 mA

Other data as for ECH above.

Remote controlled on-off

EB Electro-hydraulic spool actuator

EBHL Electro-hydraulic spool actuator with manual operation

The EB and EBHL are electro-hydraulically controlled on-off spool actuators with spring centering to the neutral position. They are intended to be controlled remotely by means of on-off signals. Pilot pressure oil for the converter valves is led to the spool actuators through internal ducts in the valve. This means that only the electric cables from the control system to the solenoid valve need to be connected externally.

The EBHL can be operated steplessly by hand lever.

Spring force in neutral position 85 N

Spring force with fully actuated spool 250 N

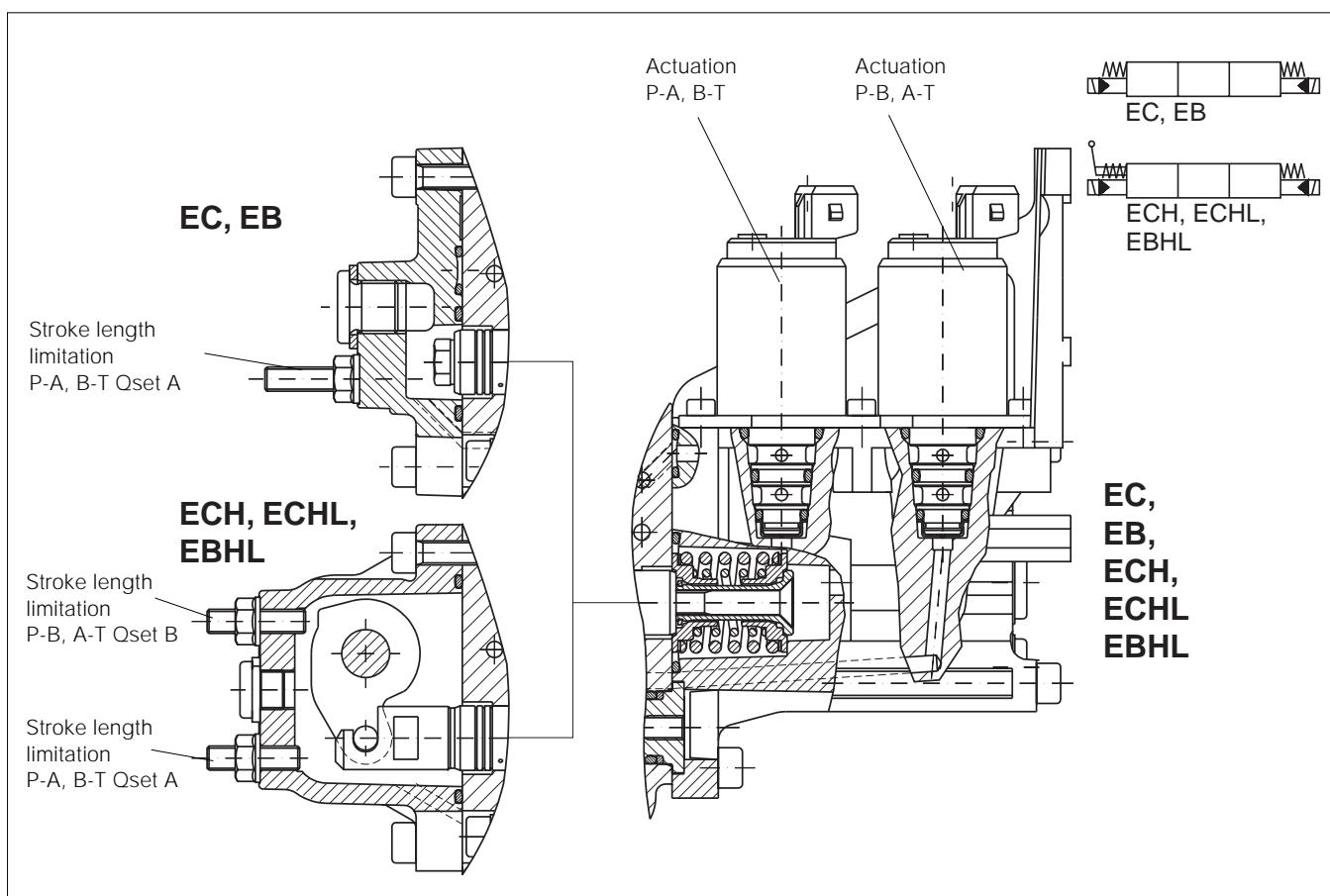
Control current for QDC25, 12 V 1300 mA

Control current for QDC25, 24V 650 mA

Connector

AMP Junior-Timer type C, 963040-3

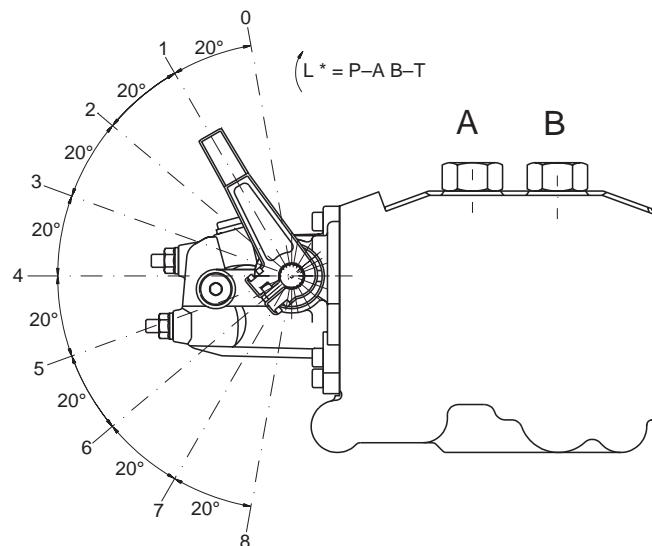
Bosch 1 928 402 404



Lever bracket [51]

- L1** Standard lever bracket for spool actuators: CH, CHB3, CHX, ECH, ECHL, ECHLM, ECHM, EBHL, PCH and PCPH.

Apart from the standard bracket L1, the lever bracket can be obtained in 8 different attachment angles, as shown in the figure opposite. The levers are then designated L0-L8 accordingly. For example, in the L4 lever bracket, the lever is parallel to the spool.

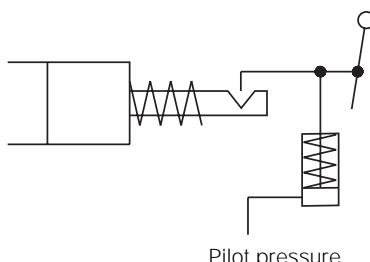


Lever brackets L can be given different attachment angles.

Lever disengagement [52]

CH, CHB3, CHX, ECH, ECHL, ECHLM, ECHM, EBHL, PCH and PCPH spool actuators are available with a function that disengages the lever when the pilot pressure is connected. The function requires the end section to be fitted with REN or REA [42] electrically controlled pilot-pressure blocking. In the case of the PCH, the pilot pressure to the PCL4 control pressure valve must be tapped from the PS2 connection on the A-side of the end section, which gives pilot oil when the hand-lever control is disengaged only.

- LR** Spool-actuator hand lever disengaged upon receipt of pilot pressure signal from REN or REA.

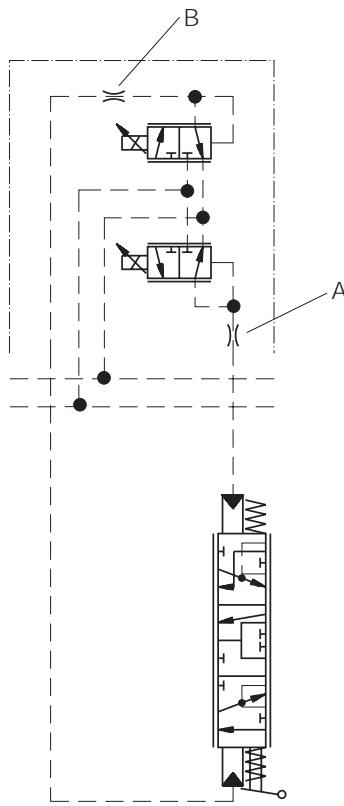


Schematic illustration of lever disengagement.

Pilot restrictor [55 A, B]

To give gentle remote control, the EC, ECH, ECHL, EB, EBHL, PC and PCH spool actuators are fitted with pilot restrictors, which can be chosen individually for each motor port. The restrictor gives a kind of ramp function.

- | | |
|------------|--------------------------|
| 1 | Without pilot restrictor |
| 0.8 | 0.8 mm pilot restrictor |
| 1.0 | 1.0 mm pilot restrictor |
| 1.1 | 1.1 mm pilot restrictor |
| 1.2 | 1.2 mm pilot restrictor |
| 1.3 | 1.3 mm pilot restrictor |
| 1.4 | 1.4 mm pilot restrictor |
| 1.5 | 1.5 mm pilot restrictor |



Pilot restrictor

Spool options

The spool is the most important link between the operator's action via a lever unit and the movement of the controlled function. The spool designs are therefore matched to meet the specific demands of each function with the aid of a computerized specification system, which uses a series of different parameters to make a selection.

Spool function [60]

There are many spool variants: D, EA, EB, M, CA, Dm, Da and Db, which are adapted for different flows, load conditions and actuator area ratios. The spools are also available with different degrees of pressure feedback from the A- and/or B-side.

- D** Double-acting spool for, e.g. double-acting cylinder. Blocked in the neutral position.
- EA** Single-acting spool for, e.g. single-acting cylinder. Blocked in the neutral position. Motor port B blocked.
- EB** Single-acting spool for, e.g. single-acting cylinder. Blocked in the neutral position. Motor port A blocked.
- M** Double-acting spool for, e.g. hydraulic motor. Float position function in neutral position.
- CA** Regenerative spool for rapid feeding of cylinder via the A-port. The large side of the cylinder is connected to the A-port.
- Dm** Double-acting spool with drainage A to T and B to T, which prevents pressure build-up in the neutral position. The spool is used as a double spool in combination with, e.g. an over-centre valve.
- Da** Double-acting spool with drainage A to T, which prevents pressure build-up in the A-port in the neutral position. The spool is used as a double spool in combination with, e.g. an over-centre valve.
- Db** Double-acting spool with drainage B to T, which prevents pressure build-up in the B-port in the neutral position. The spool is used as a double spool in combination with, e.g. an over-centre valve.

Flow requirement [61 A,B]

The L90LS directional valve has a range of optimized spool designs for nominal flows up to 90 l/min when the section is equipped with an individual pressure compensator.

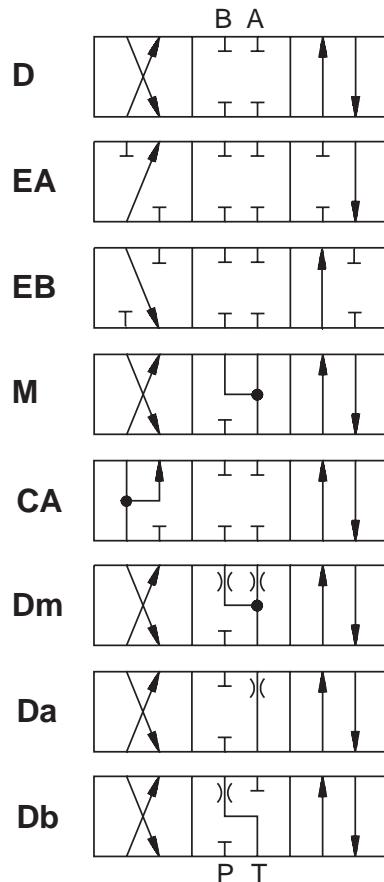
Without an individual pressure compensator, flows up to 125 l/min are obtainable, depending on the pre-set regulating difference in the LS pump.

The desired flow to the A- and B-port is entered in the ordering documentation. VOAC's computerized specification system then selects spools to give at least the flow required whilst taking other parameters into account.

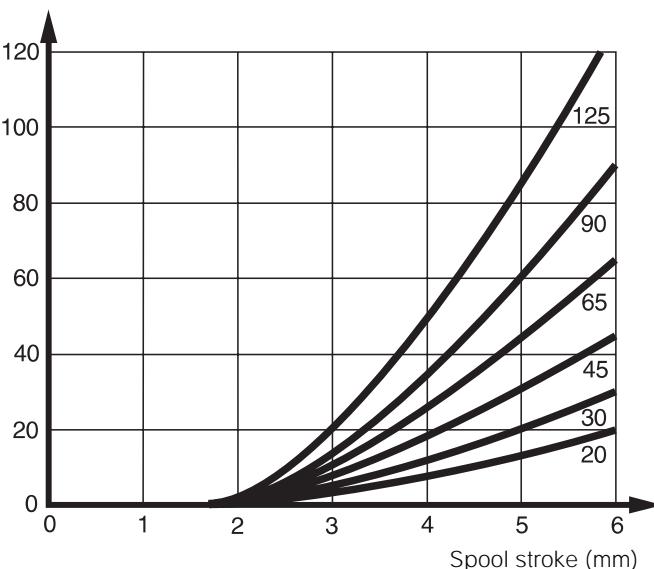
The setting of maximum flow is then effected by limiting the spool stroke by means of adjustment screws on the spool actuator or, in the case of electro-hydraulic remote control, by trimming the electronics.

See Flow settings [72] for details on factory setting of maximum flow.

Spool symbols



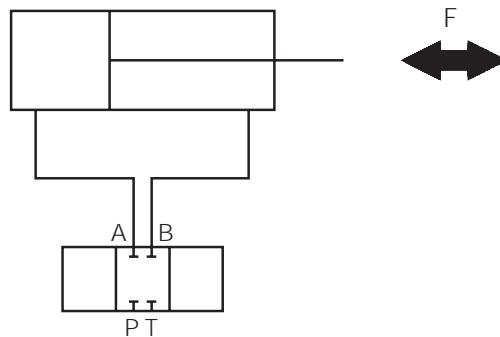
q (l/min) Flow rate in motor connection



Typical curves showing flow as a function of spool stroke.

Area relationships [62]

The area relationship for a section is calculated by dividing the cylinder area that is connected to the B-port by the area that is connected to the A-port. When the large side of the cylinder is connected to the A-port, the area relationship is less than 1. The area relationship for a motor is 1.



LAB - Lift load can change between the A- and B-port.

Load characteristics [63]

The character of the lift load can be selected according to five typical cases. This information is entered so that the spool can be given the best possible adaptation to the intended application.

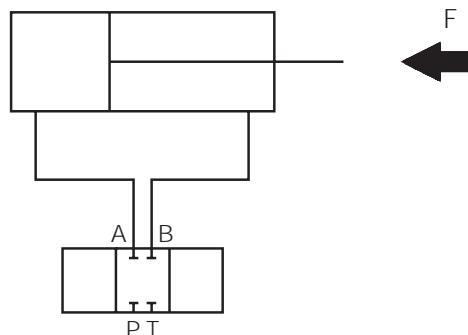
LAB Lift load can change between A-port and B-port.

LA Lift load normally on A-port only.

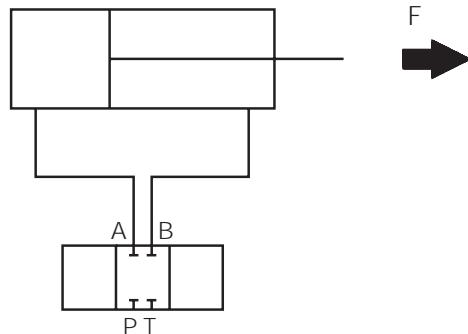
LB Lift load normally on B-port only.

LN No or low lift load on A- and B-ports.

S Slewing function.



LA - Lift load normally on A-port only.



LB - Lift load normally on B-port only.

Pressure feedback [64 A, B]

The L90LS is available with pressure feedback. This means that the positive sensation of force control from the CFO system can be transmitted to the LS system. The operator is then better able to sense when machine load increases or when an obstacle is met, which makes it easier for him to avoid damaging the machine, e.g. during digging.

Pressure feedback also gives a kind of ramp function, which results in more gentle transitions during speed changes. This in turn has a stabilizing effect on the hydraulic system, and the machine operating characteristics become smoother. Both these characteristics are important, especially for slewing functions and similar movements. With pressure feedback, machine wear is reduced and efficiency increases.

The section can be equipped with pressure feedback for the A- and B-ports individually. The degree of pressure feedback can be chosen from three levels. The higher the chosen level of pressure feedback, the greater the reduction of the function's speed upon increasing resistance for the same lever stroke. It follows from this that the lever must be moved further in order for the speed to remain the same when the load is increasing.

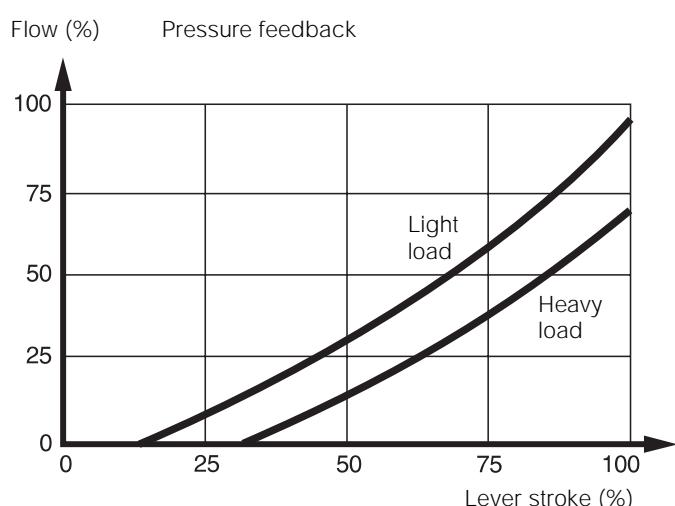
/ No pressure feedback

FN Normal level of pressure feedback

FH High level of pressure feedback

FL Low level of pressure feedback

The pressure feedback function is not available for valves with manual control.



Pressure compensator / load-hold check valve [66]

When there are demands for very good simultaneous operation characteristics, or great rapidity, the L90LS can be equipped with pressure compensators built into each section individually. Sections with built-in pressure compensators are not influenced in any way by other simultaneously operated functions, regardless of variations in load or pump delivery pressure, provided that sufficient pump capacity is available.

The compensator influences the delivery pressure from the pump to the motor. It maintains a constant pressure differential over the regulating restrictor of the main spool, which means that the section is not disturbed in any way by other simultaneously operated functions, regardless of variations in load- or pump delivery pressure.

The pressure compensator is available in a standard variant with the designation K, as well as a variant KL, which has a lower setting. The KL compensator gives a flow corresponding to 85% of the standard flow, and is primarily intended for adapting the flow requirements of the section.

The pressure compensator has a fast control sequence, and is equipped with a built-in load-hold check valve function. Sections with pressure compensators can also, if required, be combined with feed reduction valves that reduce the delivery pressure to the desired level.

Sections for V** and T** [47] have the same machining, and can easily be converted to O**, V** or T** sections with the corresponding machining for feed reduction and port relief valves.

- I** Section is not machined for pressure compensator or load-hold check valve.
- K** Standard pressure compensator.
- KL** Compensator that gives 85% of chosen spool's nominal flow.
- KH** Compensator that gives 120% of chosen spool's nominal flow.
- KX** Compensator that gives 150% of chosen spool's nominal flow.
- N** Section is equipped with load-hold check valve.
- X** Section is machined for pressure compensator or load-hold check valve, and plugged.

Damping of pressure compensator [67]

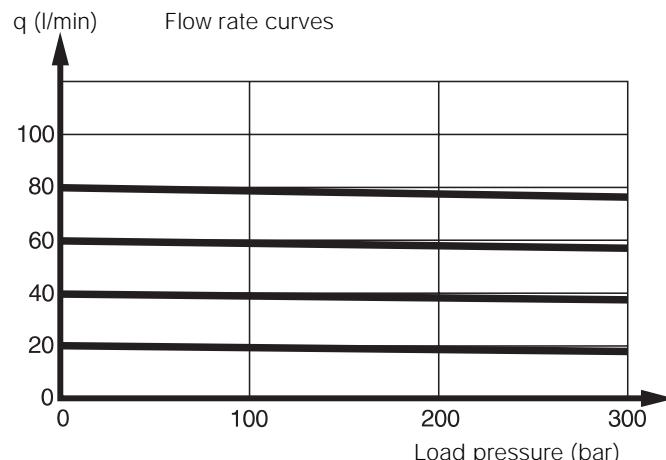
The LS restrictor affects the response of the pressure compensator, and is normally chosen at 0.8 mm.

- I** No LS restrictor for compensator.
- 0.6** Alternative LS restrictor for compensator.
- 0.8** Recommended LS restrictor for compensator.
- 1.0** Alternative LS restrictor for compensator.

Spool designation [69]

The selection of spools are made by VOAC's computerized specification program, which adapts the spool to match the specific demands of each function, thus giving maximum spool optimization.

The information given at positions 61, 62 and 63 therefore makes up part of the basis for the choice of spool.



Load independent flow with pressure compensator.

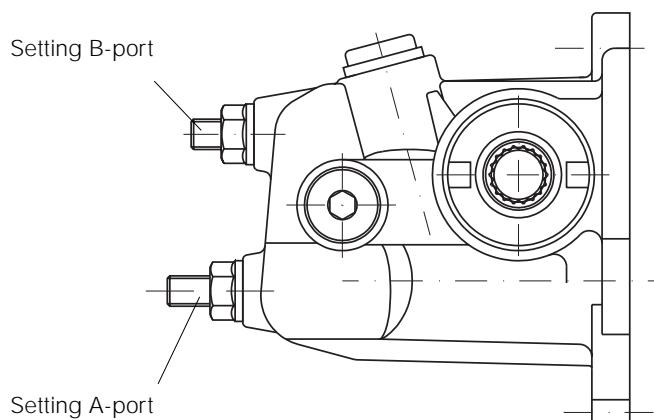
Flow settings [72]

Flow limitation over the spool to motor ports A and B for CH, CHB3, CHX, ECH, ECHL, ECHLM, ECHM, EBHL, PC, PCH and PCPH spool actuators can be effected by means of mechanical stroke-length limitation of the spool stroke.

- Qset** The valve is delivered with a factory-set maximum flow. Setting is carried out according to the stated flow requirements to the A-and B-ports [61 A, B].
- Qset A** The valve is delivered with a factory-set maximum flow. Setting is carried out according to the stated flow requirements to the A-port [61 A].
- Qset B** The valve is delivered with a factory-set maximum flow. Setting is carried out according to the stated flow requirements to the B-port [61 B].

When setting the flow rates for sections without pressure compensators in systems with LS pumps, the flow setting is made with a Δp of 15 bar between the pump pressure in PX and the load signal in PL, at full flow take-up.

For details on setting the flow for PC spool actuators, see [page 18](#).



Limiting the maximum flow over the spool by means of mechanical stroke-length limitation of the spool stroke.

Feed reduction valve [75]

The L90LS with sections designated *A*, *C* or *T* under point [47] is equipped with feed reduction valves.

Sections designated *A* have feed reduction in the A-port; those designated *C* have common feed reduction for the A- and B-ports; those designated *T* have individually adjustable feed reduction for the A-port and B-port.

Feed reduction is used for system functions that require a lower maximum pressure compared with the normal working pressure of the system. The feed reduction valve, which is steplessly adjustable from 50 to 320 bar, reduces the pump pressure so that the delivery pressure in the section does not exceed the pre-set level.

Through the use of feed reduction valves, the delivery pressure can be limited without consuming any more than a pilot flow (<2 l/min).

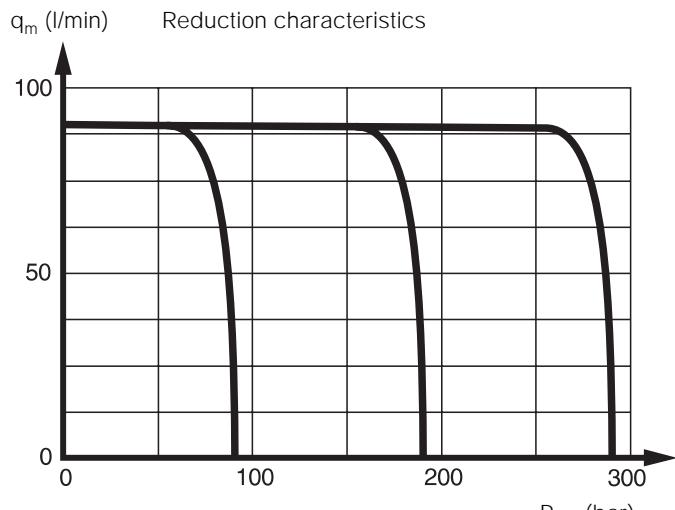
For feed reduction, the section must be equipped with a pressure compensator. Since the feed reduction valve is a 2-way valve, pressure shocks that arise after the feed reduction valve must be limited with the aid of a port relief valve. The pressure setting on the port relief valve should be as close as possible to the setting on the feed reduction valve, although it must be at least 10 bar higher.

Setting of feed reduction in the A-port [75A]

Setting values for the A-port are from 50 to 300 bar.

Setting of feed reduction in the B-port [75B]

Setting values for the B-port are from 50 to 300 bar.



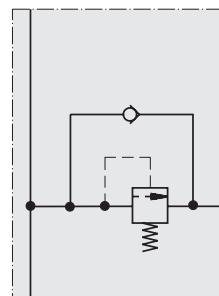
P_{red} = reduced pressure
q_m = flow rate in motor port

Port relief and/or anti-cavitation valves [76 A, B]

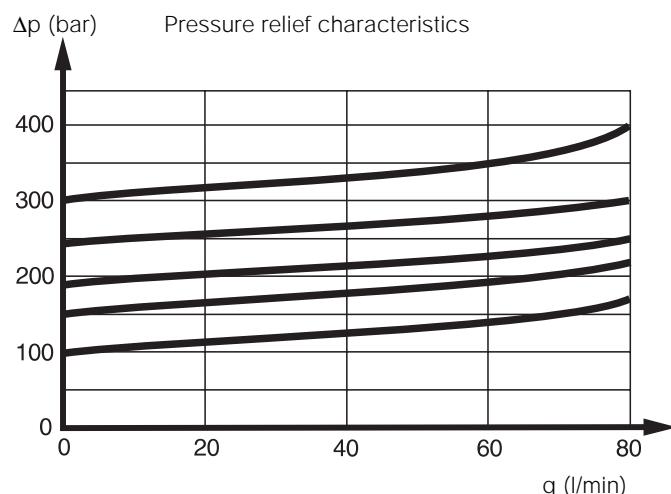
In sections with the designation **T [47], the PLC053 can be used as a port relief and anti-cavitation valve in the motor ports, in order to protect the valve and consumers from pressure peaks and high pressure in the system.

The PLC053 is a direct-acting pressure relief valve with a very fast opening sequence and good pressure characteristics. The replaceable PLC cartridge is factory-set. The make-up function means that oil is able to flow from the tank gallery to the motor port side in the event of underpressure in the motor ports.

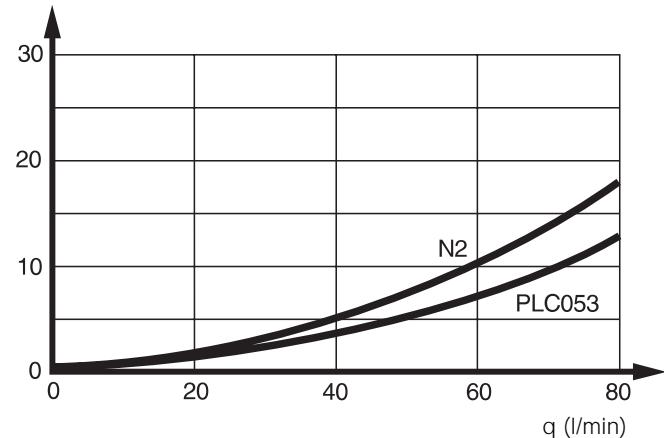
- I** Section not machined for port relief valves.
- X2** Section machined for port relief valve. Motor port open to tank.
- Y2** Section machined for port relief valve. Connection A/B to tank blocked with plug.
- N2** A/B side of section equipped with anti-cavitation valve.
- 50-350** Setting pressures for port relief valve in A- and B-ports.
Standard settings in bar:
50, 63, 80, 100, 125, 140, 160, 175, 190, 210, 230, 250, 260, 280, 300, 320 and 350.



Circuit diagram for PLC053 pressure relief valve.



Make-up characteristics



System functions

The L90LS can be equipped with integrated functions that give complete system solutions. The load signal from any motor port or section can be connected with signal lines for the purpose of, e.g. manipulating the load signal to stop or limit the pressure to individual functions.

The concept above is used together with the M10 function block for load moment limitations on cranes. Feed pressure control based on the rotational torque in a drill is yet another example of the functions that can be integrated into the valve by using the load signal ducts.

System signal lines [80]

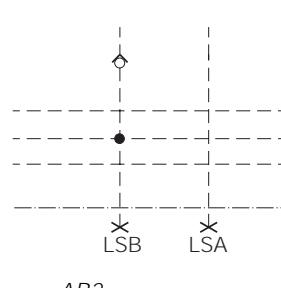
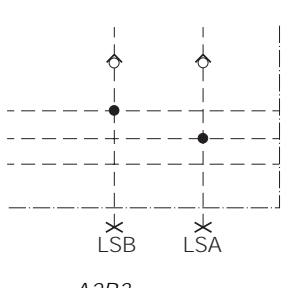
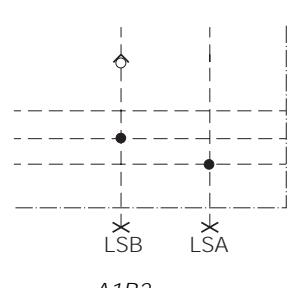
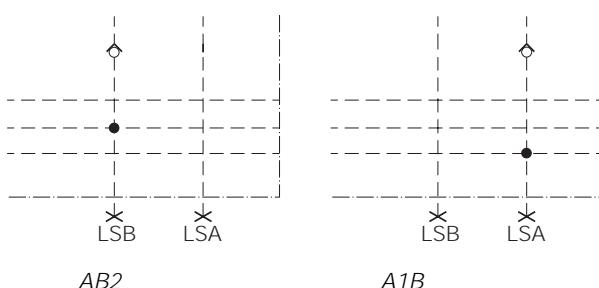
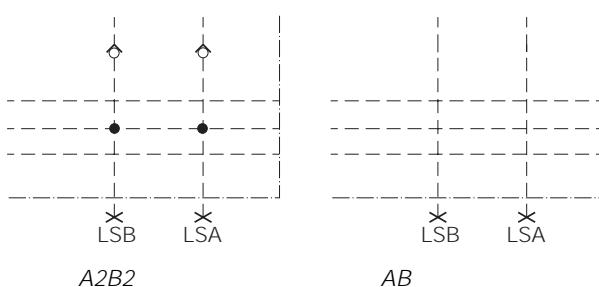
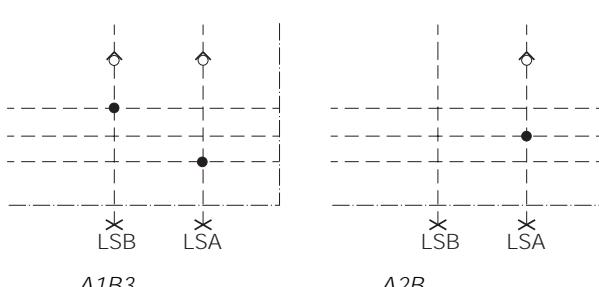
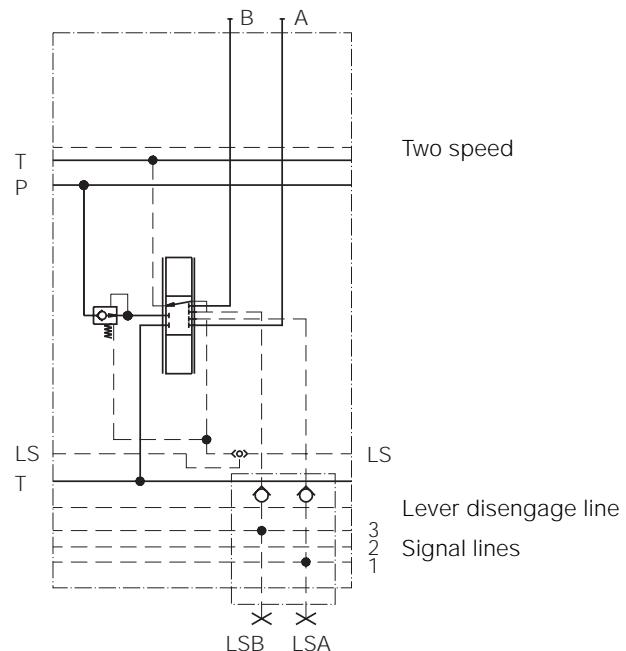
SF Valve section equipped with 3 signal lines that can be connected internally to individual load signals [81], signal line for activation of two-speed function [82] and signal line for disengagement of hand levers [52]. (Lever disengagement not applicable to C, B3 or ACE spool actuators [50]).

Individual LS connection [81]

- I** No LS connection to signal lines. No possibility of external connection either.
- A1B** Load signal from port A connected to duct 1.
- A1B2** Load signal from port A connected to duct 1. Load signal from port B connected to duct 2.
- A1B3** Load signal from port A connected to duct 1. Load signal from port B connected to duct 3.
- A2B** Load signal from port A connected to duct 2.
- A2B2** Load signal from both ports A and B connected to duct 2.
- A2B3** Load signal from port A connected to duct 2. Load signal from port B connected to duct 3.
- AB** No connection between load signal and signal ducts.
- AB2** Load signal from port B connected to duct 2.
- AB3** Load signal from port B connected to duct 3.

The load signal from more than one section can be connected to the same duct. A check valve in each section prevents transmission of the load signal in the ducts to individual sections.

In addition to connection with the signal ducts, the load signal is also available for external connection at the base of the valve.



Two-speed function [82]

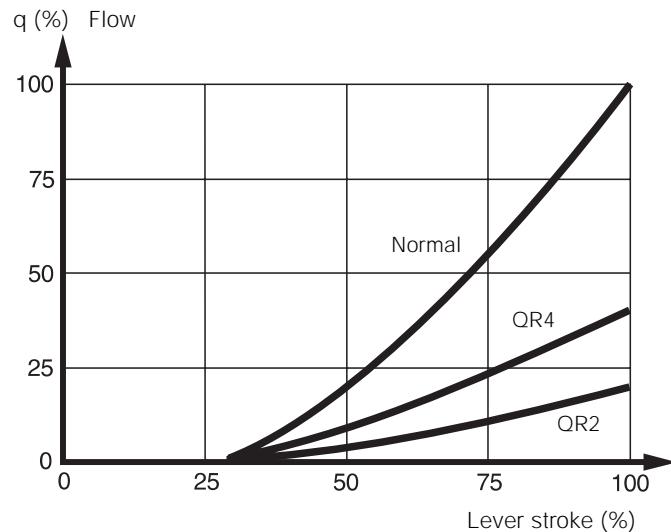
QR2 Activated with the aid of the M11 function block [90]. Activation of QR2 causes the flow rate to the consumer to be reduced to only 20% of normal flow.

QR4 Same as QR2, but on activation gives 40% of normal flow.

Any number of sections in the same valve can be equipped with a two-speed function. The two-speed function enables switching between performance- and precision work in cranes, skylifts etc.

N.B.

When a section is equipped with a two-speed function, the compensator in the section does not have a check valve function. For this reason, overcentre valves are required in the controlled function.



Internal connection of motor port [85]

M Gives internal motor-port connection downstream of the section. System solutions with function blocks where the motor port is used by the block can therefore be integrated without the need for external pipework.

Function block [90-99]

The L90LS can be equipped with function blocks that enable the building of complete system solutions that are integrated into the valve.

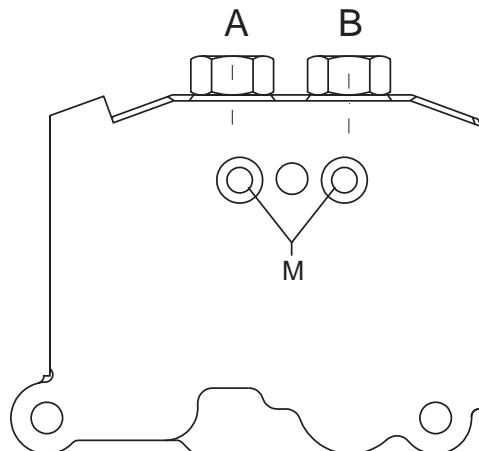
Standardized function blocks are available for overload protection and two-speed functions, float position, priority for steering and braking etc.

Please contact VOAC Hydraulics for more details on integrated system solutions. In addition to standard blocks, VOAC Hydraulics custom-builds function blocks to meet special system demands.

Diagram shows curves for:
Normal flow.

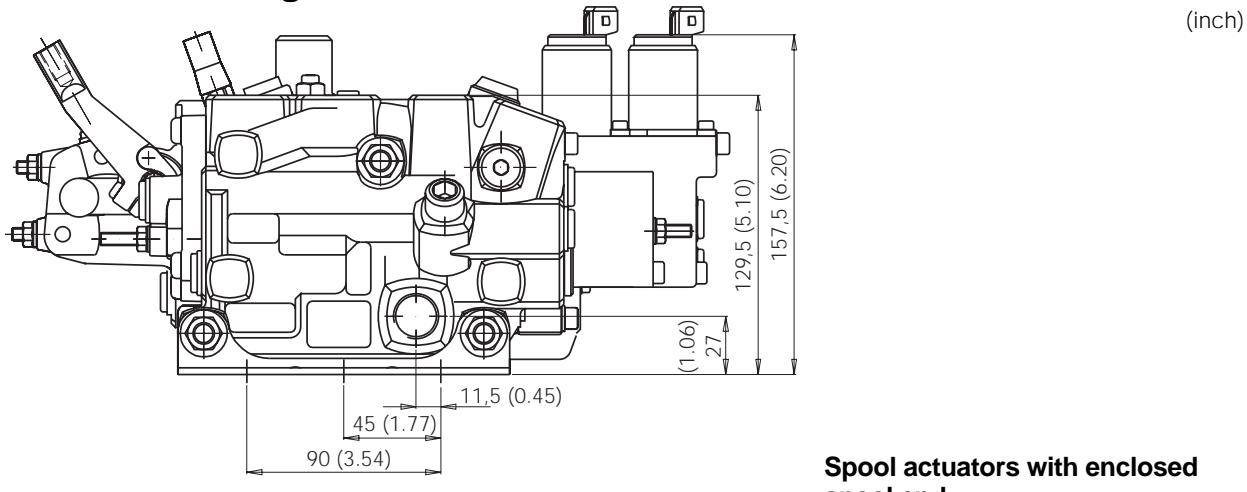
Flow with QR4 activated.

Flow with QR2 activated.

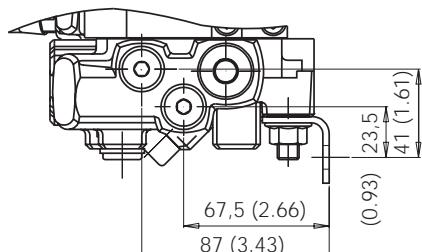
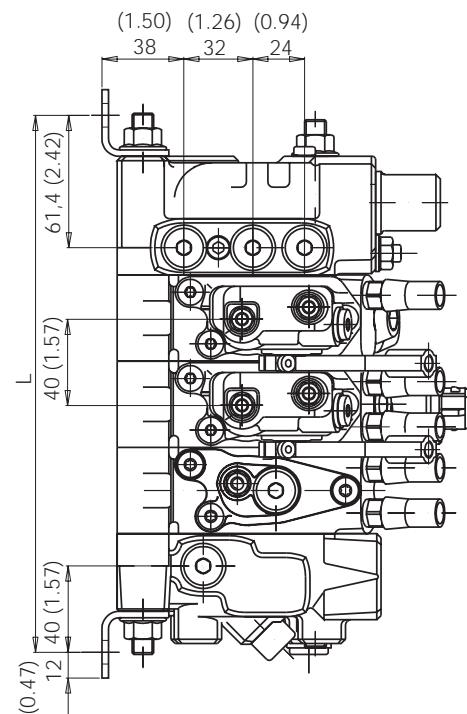
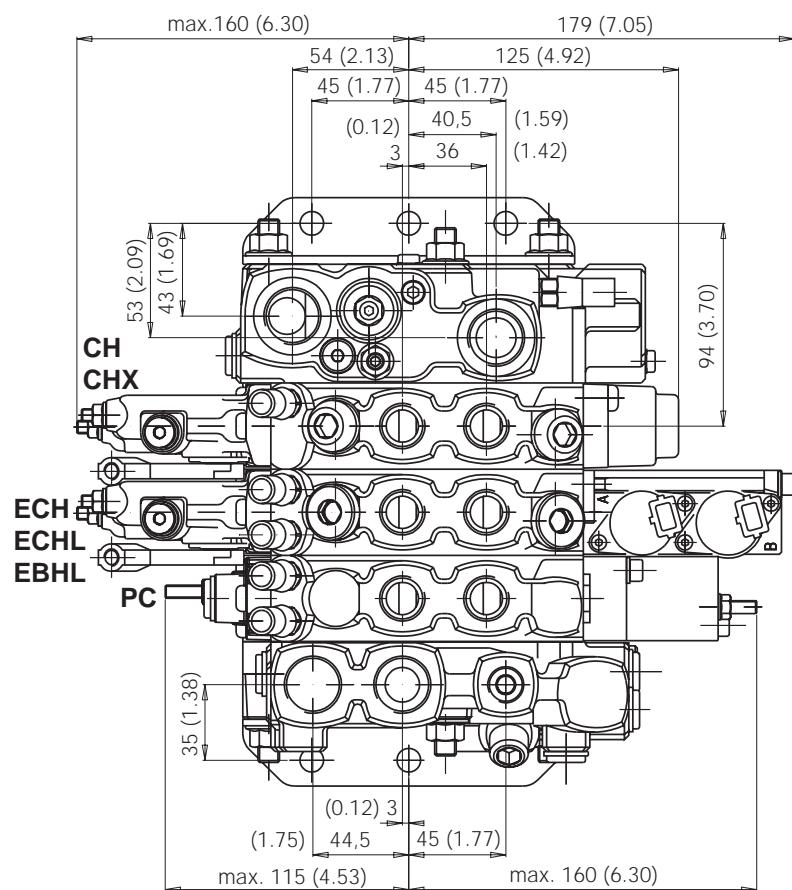


Section block with internal connection of motor ports to downstream-mounted function block.

Dimensional drawing



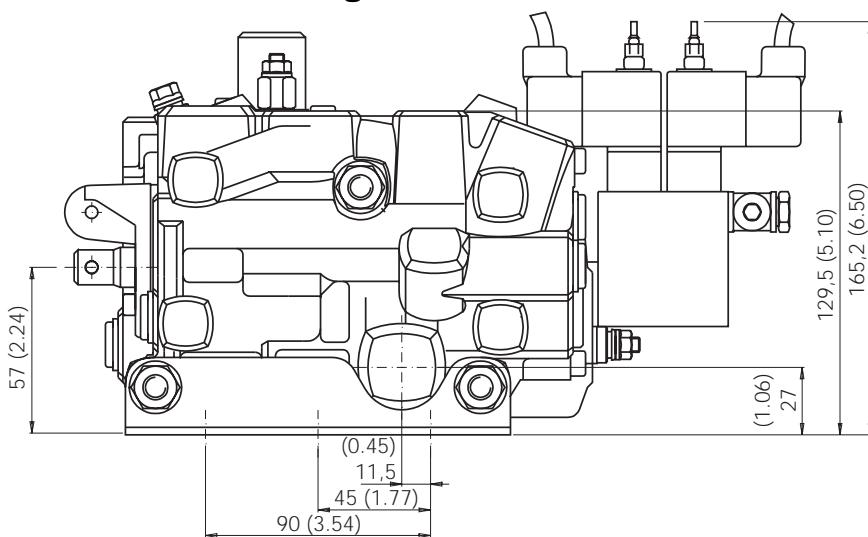
**Spool actuators with enclosed
spool end**



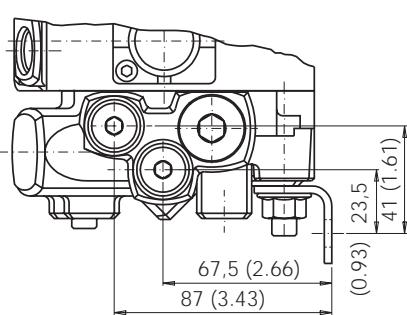
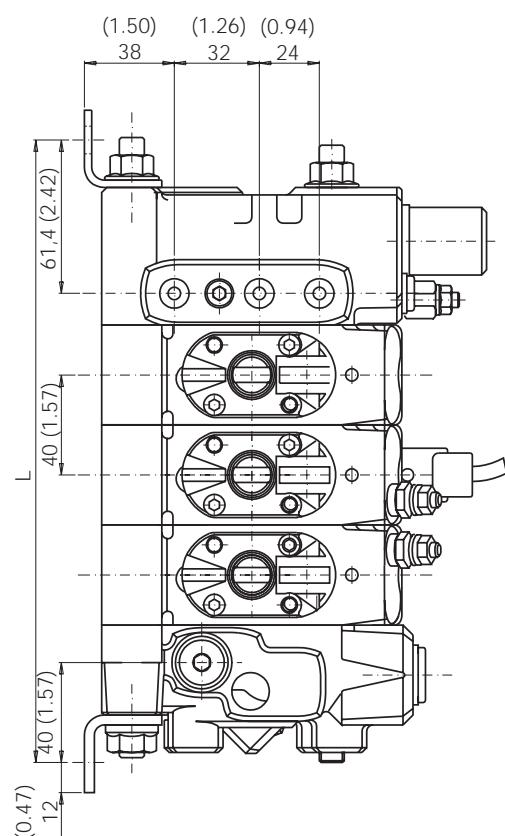
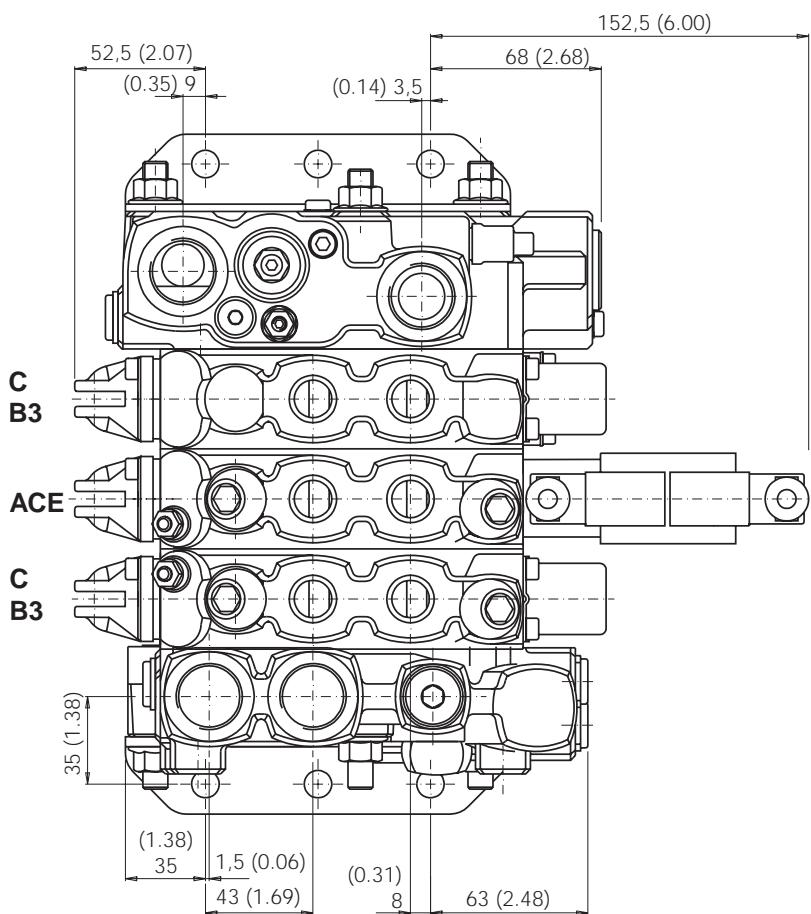
No. of sections	L mm	L inch
1	169	6.65
2	209	8.23
3	249	9.80
4	289	11.38
5	329	12.95
6	369	14.53
7	409	16.10
8	449	17.68
9	489	19.25
10	529	20.83

Connection threads, see page 6.

Dimensional drawing



Spool actuators with open spool end



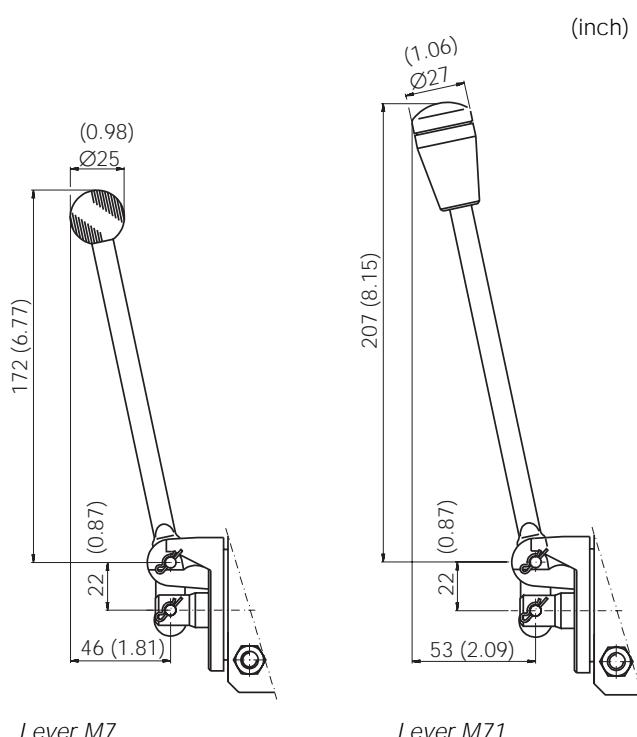
No. of sections	L mm	L inch
1	169	6.65
2	209	8.23
3	249	9.80
4	289	11.38
5	329	12.95
6	369	14.53
7	409	16.10
8	449	17.68
9	489	19.25
10	529	20.83

Connection threads, see page 6.

Hand levers

Levers for open spool actuators

Levers M7 and M71 are made of steel with an anti-rust surface treatment, and fitted with a knob of black plastic. The knob on the M71 lever has a top window for the insertion of a symbol. The lever kits are delivered complete with pin sets for mounting to the valve.



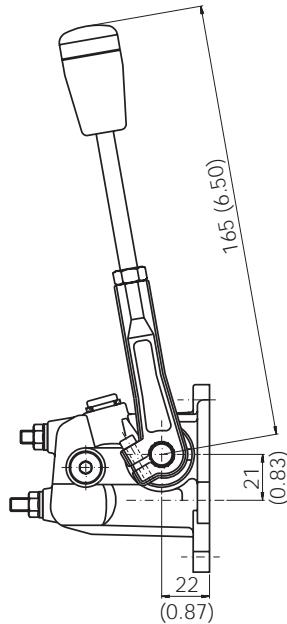
Lever M7

Lever M71

Lever for enclosed spool actuators

Lever for manually operated solenoid actuators with enclosed spool end and remote controlled spool actuators with manual operation.

The ML1 lever is made of steel with an anti-rust surface treatment. The lever knob is of black plastic and has a top window for the insertion of a symbol. The lever kit consists of knob, lever shaft and lock nut.



Lever ML1

Ordering number Designation

9122 1780-08	M7
9122 1780-11	M71
8234 9390-01	ML1

For further information, please contact:



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Ed. 02 (GB)
Catalog 9129 8504-06
Ed. 02 (US)