



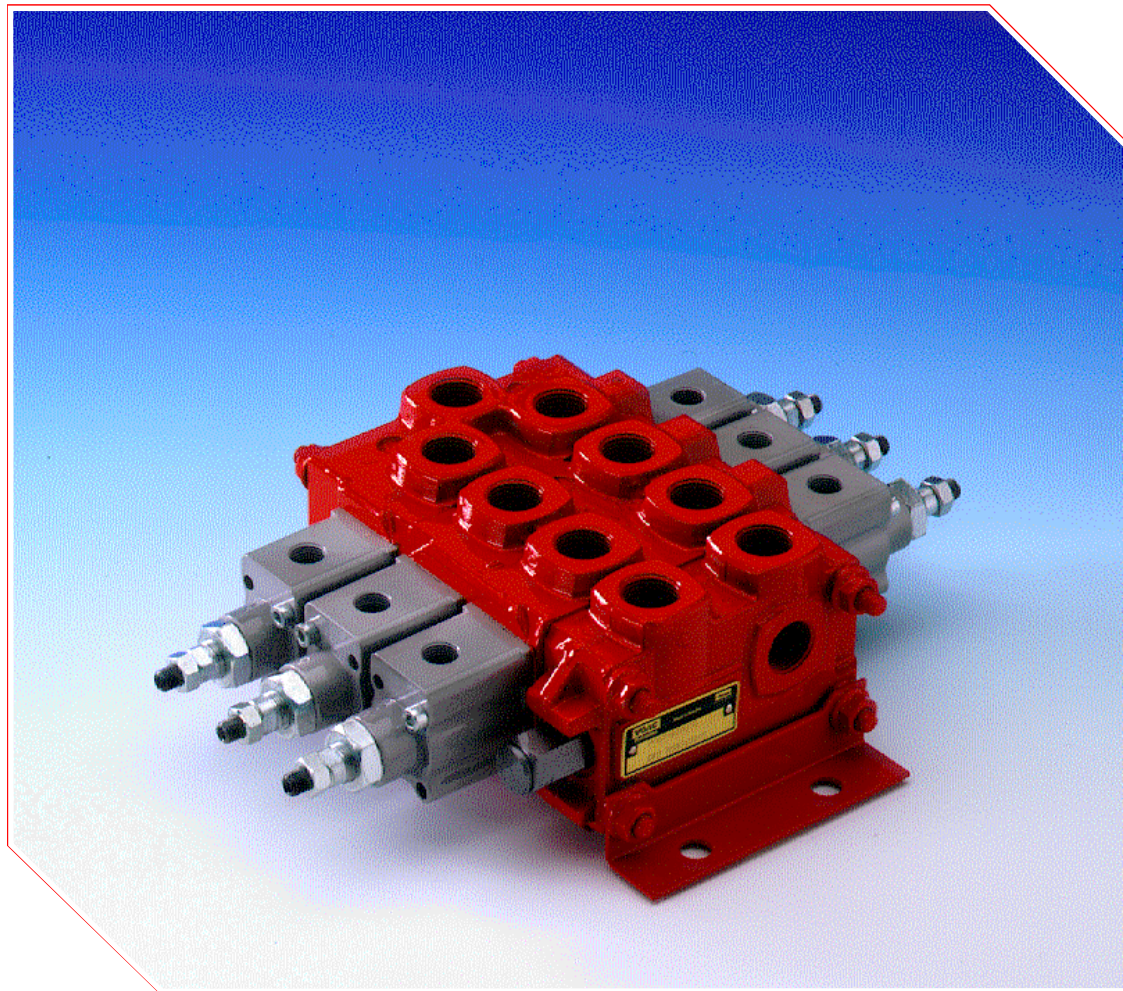
# *Directional control valve HV07*

*Constant flow and  
constant pressure valve*

*Catalogue 9129 8539-02 (GB)*

*9129 8539-06 (US)*

*October 1998*



## Catalogue layout

This catalogue has been designed to give an overview of the HV07 valve and to show how easily it can be customized to meet your needs. Apart from general information and basic technical data, the catalogue contains descriptions for the variety of options available for the different function areas of the valve. After you have studied the options and made your selection, we will tailor your valve to meet your operating and control criteria.

Each function area is given as a subheading, followed by a brief description. When options are available for the function area, the subheading is followed by an "Item number" in square brackets, e.g. Main pressure relief valve [6]. This is followed by a series of coded options, e.g. PS, PB, Y, together

with a brief description of what each code represents. Alternatively, one or more pressure, flow or voltage options are given.

On page 10 is a general circuit diagram showing the basic function areas of the HV07 valve, together with the item numbers or letters used to represent them. Naturally, the same item numbers or letters are used in all sub-circuit diagrams that appear elsewhere in the catalogue in conjunction with descriptions of the respective function areas. All sub-circuit diagrams have been extracted from the general circuit diagram. 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 next step is to fill in a "Customer Specification Form" (CSF) to specify the options and characteristics you wish to be incorporated into your valve. The CSF contains the same item numbers that appear in square brackets in this catalogue. To specify your valve, simply choose the common and spool-section specific options you require and enter the corresponding code or value into the box for the relevant item number in the CSF.

Should you require assistance completing the CSF, please do not hesitate to contact your nearest VOAC representative, who will either help personally or refer you to the appropriate product

specialist. The information in your CSF will be entered into our computerized valve specification program, which initiates the assembly process and generates a unique product ID number that is subsequently stamped into the data plate on your valve. Your valve specifications remain on our database to facilitate rapid identification in the event of subsequent re-ordering or servicing of your valve.

## 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

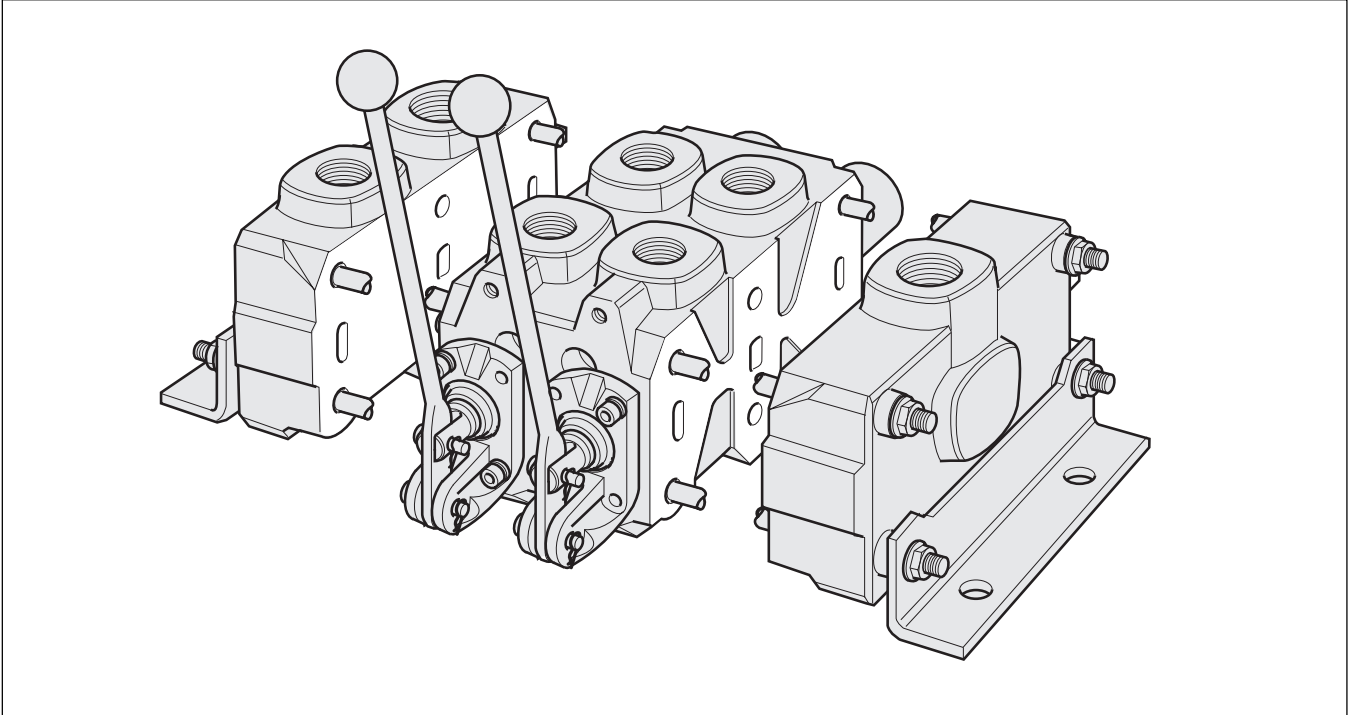
characteristics and economic demands. By consulting VOAC early in the project planning stage, you are assured of a comprehensive hydraulic system that will give your machine the best possible operating and control characteristics.

Subject to alteration without prior notice. The graphs and diagrams in this catalogue are typical examples only. While the contents of the catalogue are updated continually, the validity of the information given should always be confirmed. For more detailed information, please contact VOAC.

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[00] refers to item numbers in Customer Specification Form.

## General



The HV07 is a stackable directional valve with a high flow capacity and small installation dimensions. It has been available in the market for a number of years, during which time it has demonstrated its efficiency and reliability in many different applications. It has become a popular choice for the hydraulic systems of smaller trucks and cranes, loading machines, forestry machines, etc. The valve is designed for use in both constant-flow (CFO) and constant-pressure (CP, CPU) systems. With its great versatility, a wide range of accessories and optional functions, the HV07-series valves enables machine manufacturers to optimize hydraulic systems to give peak performance and outstanding control characteristics.

### Compact system construction

Since the HV07 is of modular construction, it can be equipped and dimensioned precisely to integrate the desired application-adapted functions into a compact and total system solution for the machine.

### Freedom in machine design

The valve can be equipped for direct control or for electric, pneumatic or hydraulic remote control. Even a combination of direct and remote control can be specified. This gives great freedom to the machine designer, since it enables the valve to be located ideally on the machine using the control medium best suited to the application in question.

### Economy

Thanks to its modular construction, the HV07 can be optimized for both simple and complex functions. This, together with its facilities for integrating total func-

tion solutions, gives low overall system costs. What is more, the valve can be re-built or expanded at any time to meet changing demands on customization.

### Safety

Thanks to the simple construction of the HV07, training personnel to understand and service the valve is very straightforward, and this contributes greatly to safety. Moreover, by means of a special inlet section, an emergency STOP function can be incorporated into the valve to enable you to meet the demands of the EC Machinery Directive in a uniquely simple way.

### Design

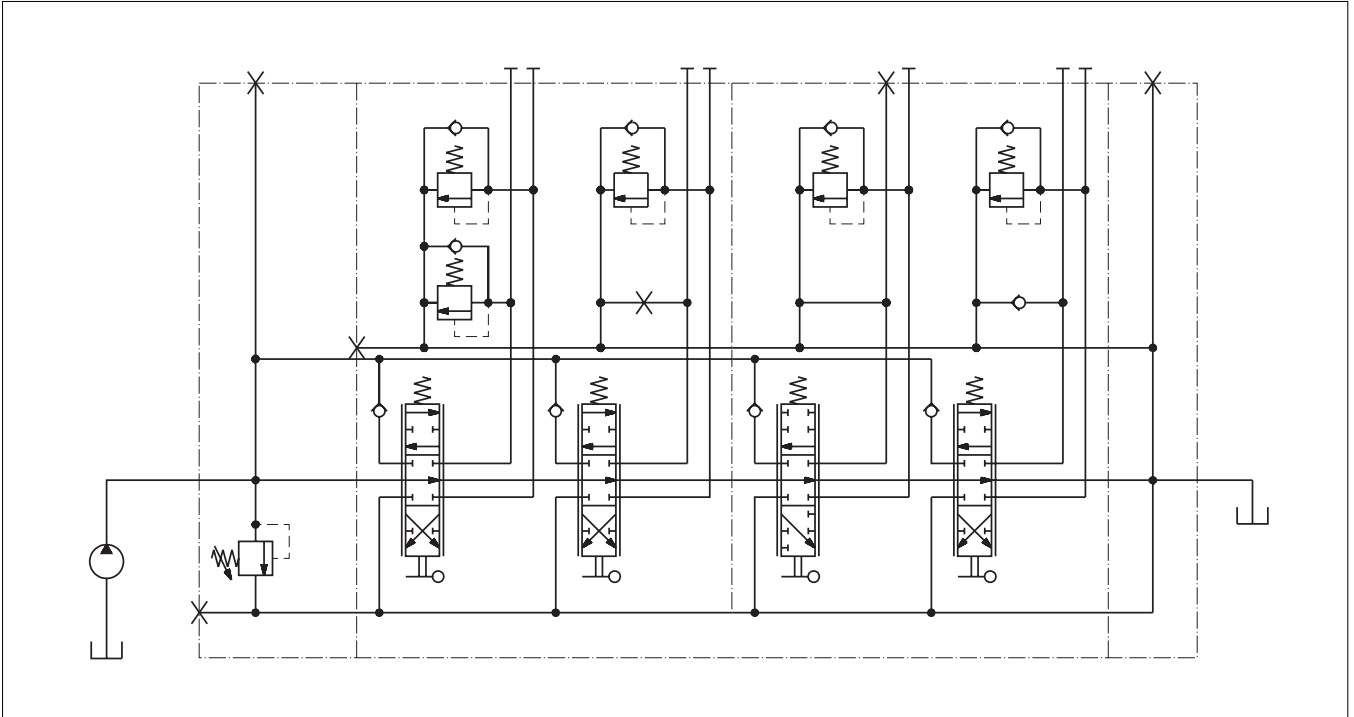
The HV07 is stackable and can be supplied in combinations of 1 to 10 spool sections, and also in combination with function blocks. The valve is designed for system pressures up to 250 bar and can be equipped with port relief valves in the service ports for pressures up to 280 bar. The flow range is up to 90 l/min, depending on how the valve is equipped. The maximum recommended pump flow for the CFO version is 50 l/min (depending on the choice of spool), and for the CP/CPU version, 90 l/min. There is a very wide range of spools for the valve, which enables optimum adaptation of control characteristics.

### Essential characteristics

- Flexible, modular construction makes it easy to re-build or expand the HV07 to meet changing needs.
- The valve can be flanged to specially adapted VOAC function blocks that enable even more functions to be integrated into a compact, single unit with minimal piping.

- The valve can be equipped for both multi-pump and multi-valve systems, thus increasing its range of applications in many different types of hydraulic system.
- Wide range of spool actuators, either hand-operated or remote controlled, the latter in both ON/OFF and proportional versions for pneumatic, hydraulic, electro-pneumatic or electro-hydraulic control. Most of our spool actuators can be operated manually in emergencies.
- Very wide range of application-adapted spools designed to optimize control characteristics.
- Our proportional remote controlled valves have pressure compensated spools, which further improve control and simultaneous-operating characteristics.
- Separate check valves in each spool section prevent undesirable sinking of the load.
- Separate port-relief valves in each service port give port-specific maximum pressure limitation.
- Our port-relief valves have outstanding pressure characteristics, even as secondary pressure limiters, and respond very quickly to sudden changes in load.
- Our quality materials and high manufacturing precision ensure a superior product with low internal leakage and long service life.
- An emphasis on simplicity of design makes the HV07 easy to service.
- A wide range of accessories and optional functions enables the HV07 to be customized to meet your needs precisely.

## System description



Basic circuit diagram, CFO

### Constant-flow systems (CFO)

A constant-flow system is a system in which the flow remains constant at a given engine speed, while the pressure is adapted according to the load.

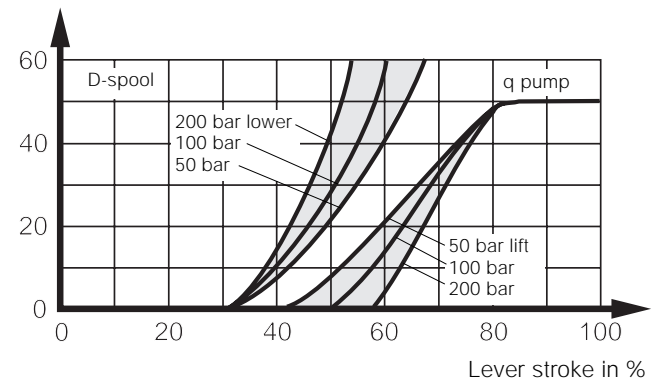
The CFO system is the most well proven of systems for mobile machines. It contains less complicated components compared with other types of system and therefore relatively insensitive to impurities in the hydraulic oil. Any oil that is not directed out to a consumer is pumped back to tank via the free-flow gallery in the valve. When several lifting functions are activated simultaneously, the pressure is determined by the heaviest load. Simultaneously operated functions should therefore have roughly the same pressure needs, or be divided into separate circuits to minimize cross-functional interference and give good operating economy. Provided that the greater part of pump capacity is utilized, the CFO system is very economical to operate. For this reason, it is important for the pump to be dimensioned correctly.

### Control characteristics

In hand-operated CFO systems, there is no clear-cut connection between the stroke of the lever and the speed of the load. The load speed is affected by the weight of the load and the directions of force and movement, and also by the pump flow and how many other load functions are operated simultaneously. The reason for this is that, when additional functions are activated, the flows redistribute themselves so that the pressure drop in the flow paths becomes equal. The use of application-adapted valve spools gives considerably better simultaneous-operation characteristics. In some cases, this can result in higher energy losses during the fine-metering stage. In certain applications, however, this characteristic is exploited, since it enables the operator to sense the weight of the load he is handling (so-called force control).

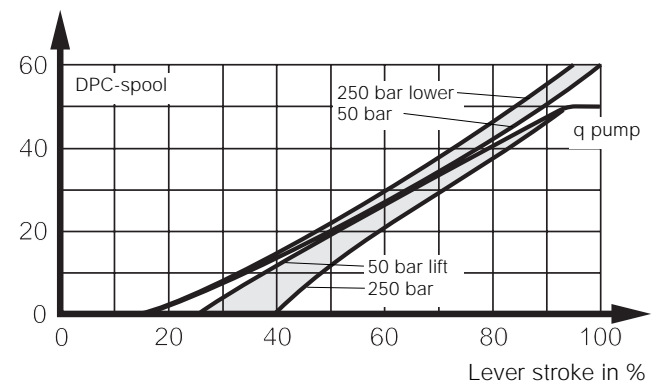
In several of our proportional remote-control systems, the control spool is "pressure compensated", which means that the regulated flow rate remains constant for a given lever stroke, regardless of the pressure variations, i.e. speed control.

q(l/min) Flow rate in service port

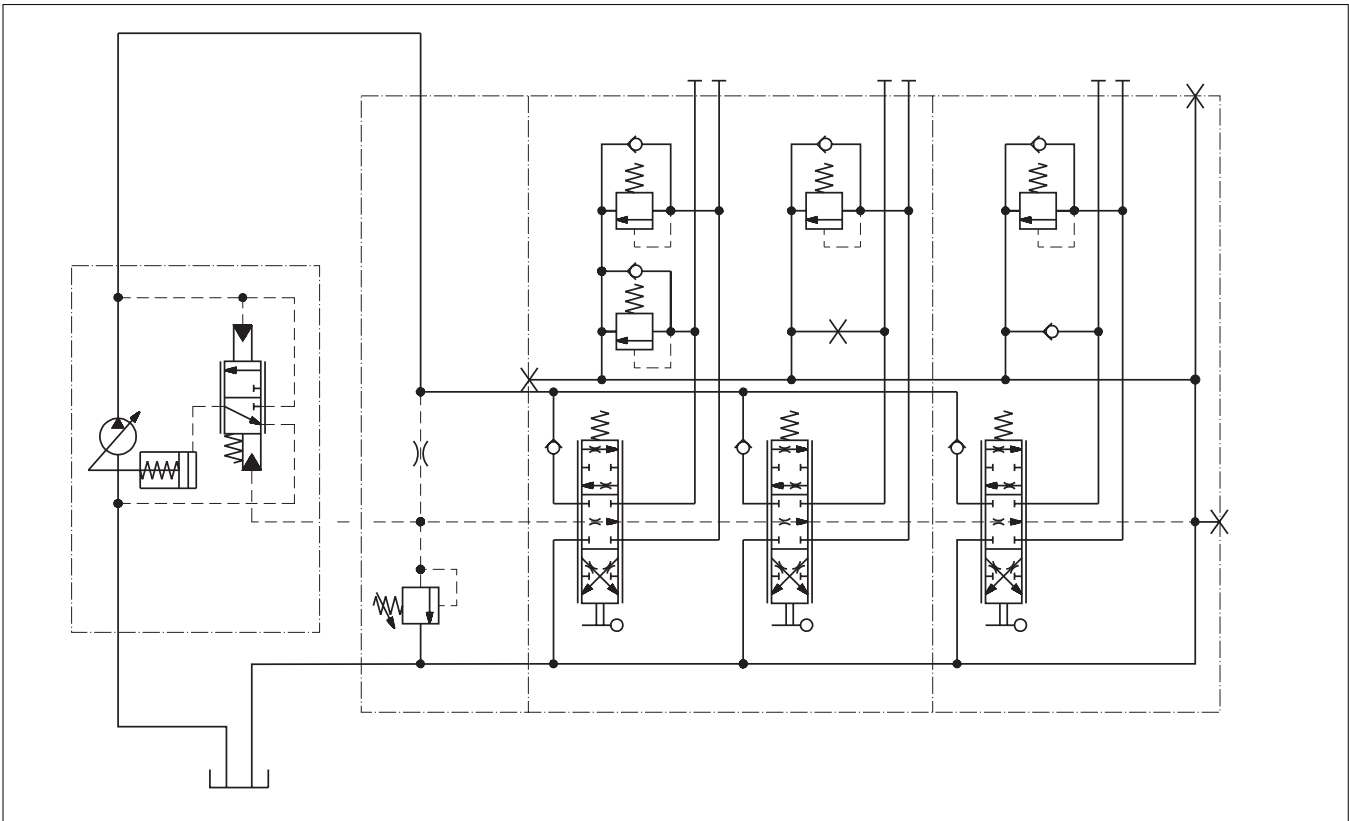


In HV07 valves with hand-operated spools, speed is affected by the weight of the load, i.e. the heavier the load, the longer the lever stroke needed before the load starts to move.

q(l/min) Flow rate in service port



In HV07 valves with closed spool actuators (PC and EHC), the spools are pressure compensated, with the result that the load's effect on speed is minimal.



Basic circuit diagram, CPU

## Constant-pressure systems, CP

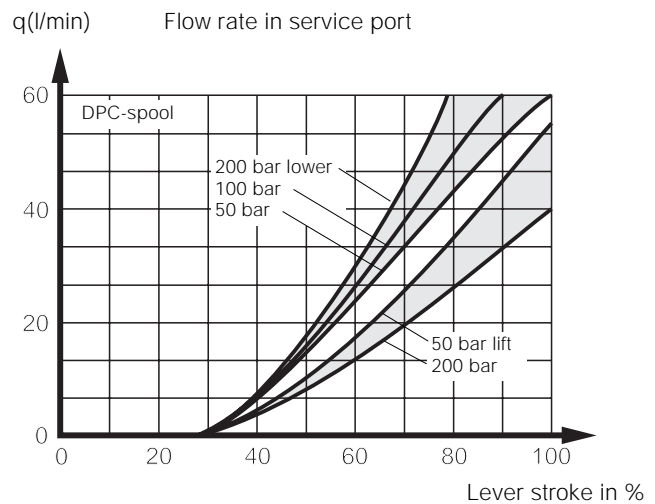
The CP system is a system in which the pressure is constant, while the flow is varied as required. The constant-pressure system is of simple construction with uncomplicated components. The pump usually has variable displacement, which is regulated to keep the pressure constant. The pump should be dimensioned to give the sum of the maximum flows of simultaneously operated functions. The system is less sensitive to pressure drops, since a pressure corresponding to the machine capacity limit is always available.

## Unloaded constant-pressure systems, CPU

To save energy and avoid so-called creeping during transportational driving, there is a variant of the CP system - the CPU system - in which a hydraulic signal from the valve to the pump causes the pump to adopt the rest position. Then, as soon as a control spool is operated, the pump gives maximum pressure. The HV07 can be used equally effectively in CPU systems as in CP systems.

## Control characteristics

With the valve customized correctly, the system is given good control characteristics without cross-functional interference. Since the system has good replenishing characteristics, a lowering movement can be switched to a lifting movement without delay. The maximum speed of each function is determined by the design of the spool and the pressure demand of the load. Even in constant-pressure valves, the remote-controlled spools are pressure compensated. If the flow demand of the system exceeds the maximum capacity of the pump, however, the pressure level cannot be maintained and the very good simultaneous-operation characteristics deteriorate.



In CP and CPU systems with hand-operated spools, all loads start at the same point, regardless of the weight and direction of the load. The weight of the load affects the slope of the graph to some extent.

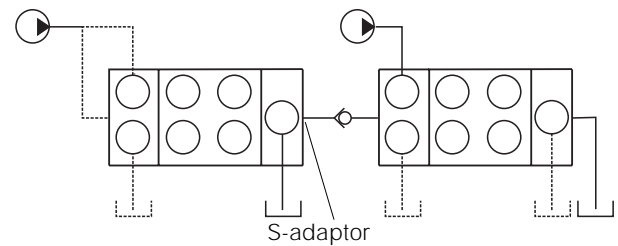
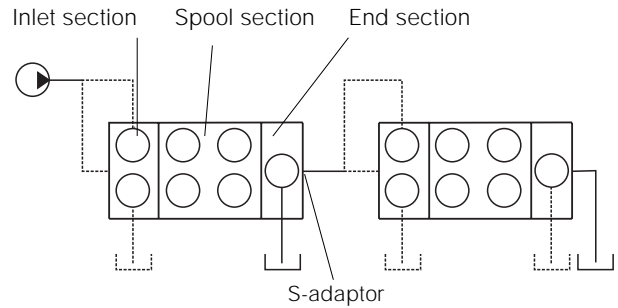
## System connection

When the system contains more than one valve and one pump, it can be connected up in different ways. A number of examples are given below.

### A. Series connection (CFO)

The pump is connected to valve one. The flow that is not directed out to a consumer via valve one continues to valve two. Prioritization is obtained in this way. When a spool in valve one is fully actuated, no flow reaches valve two.

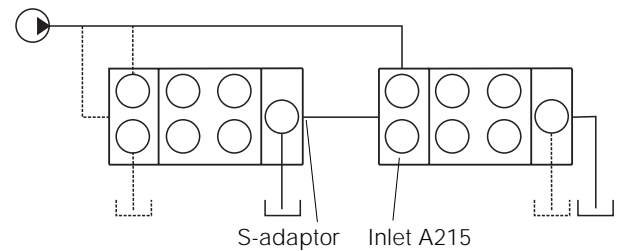
If a second pump is connected to valve two, it will receive the flow from the second pump as well as any surplus flow from valve one.



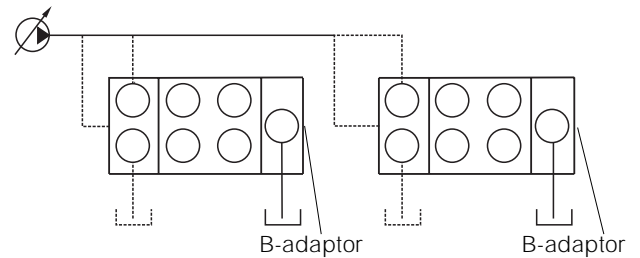
### B. Parallel connection

In parallel connection, the same pump is connected to two or more valves. The function is the same as if the pump were connected to one large valve.

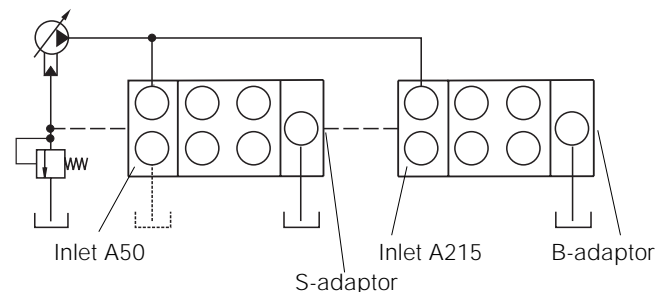
Parallel connection, constant-flow (CFO)



Parallel connection, constant-pressure (CP)



Parallel connection, unloaded constant-pressure (CPU)

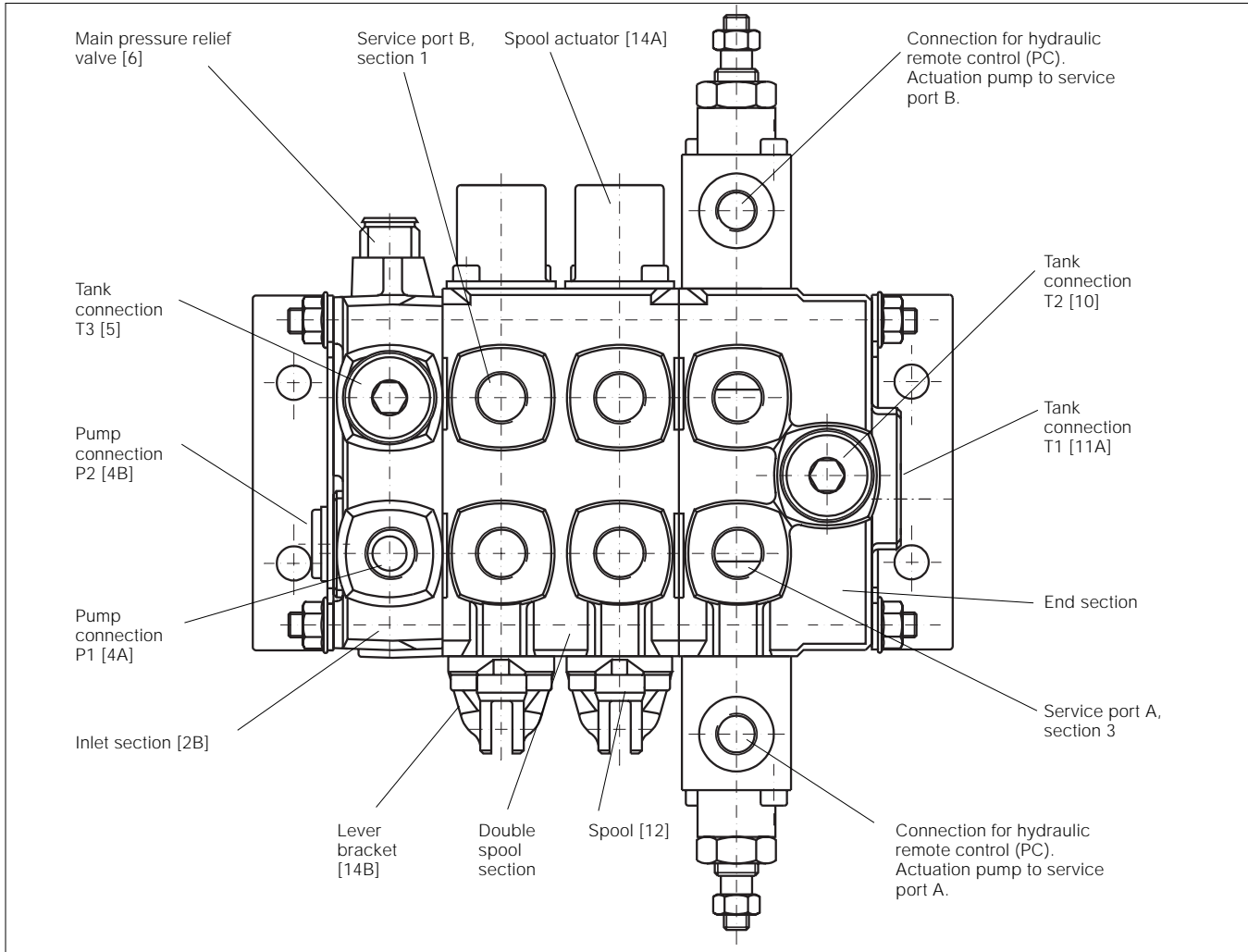


----- = alternative connection

----- = signal line

The different connections and inlets are described in more detail on pages 11 to 15.

## Technical data



### Pressure

Pump connection: max. 250 bar\*  
 Service port: max. 280 bar\*  
 Tank connection, static: max. 10 bar  
 \* Stated pressures are maximum absolute shock pressures at 10 bar tank pressure

### Flow rate (recommended)

Constant-flow version: Pump connection max. 50 l/min\*\*  
 Constant-pressure version: Pump connection max. 90 l/min  
 \*\* Max. recommended flow rate will depend on choice of spool.

### Internal pilot pressure

Fixed setting: 35 bar for ESO and ESP spool actuators  
 25, 35 or 50 bar for EHC spool actuator

### Leakage from service port over spool

From A or B port: max. 9 cm<sup>3</sup> at 100 bar, oil temperature 50 °C and viscosity 30 mm<sup>2</sup>/s (cSt).

### Connections

All standard connections are available in two versions (unless stated otherwise): G version (BSP pipe thread) for flat seal (type Tredo) according to ISO 228/1 and UNF version for O-ring seal according to SAE J1926/1.

Connection	Location	G-version	UNF-version
P1, P2	Inlet section	G 3/8 or G1/2	7/8-14 UNF-2B
T1, T2	End section	G1/2	7/8-14 UNF-2B
T3	Inlet section	G3/8 or G1/2	7/8-14 UNF-2B
Service ports	Spool section	G 3/8 or G 1/2	3/4-16 UNF-2B

### Weight

Weight varies somewhat depending on the configuration of the valve. The details below are therefore approximate.

### Valve housing inclusive of spool, pressure relief valve and hand-operated spool actuator type C without lever.

No. of sections	Weight in kg
1	5,5
2	8,3
3	10,5
4	12,6
5	14,8
6	16,9
7	19,1
8	21,2
9	23,4
10	25,5



## Environmental characteristics

While the HV07 can be mounted in any conceivable direction, care should be taken not to expose the spool-end on open spool actuators to heavy fouling. Moreover, the mounting base should be flat and stable, so that the valve is not subjected to stress. If the valve is mounted with the spool-actuator cap pointing downwards, then cap A92 should be chosen for spool actuators C and B3 [14A]. See page 18.

The O-rings in the valve are usually of nitrile rubber. Several special O-ring variants are available in Viton. For further details, please contact VOAC. In constant-pressure systems, it is recommended that A157 [11B] is selected, since it has Viton O-rings in the parting surfaces between the sections. Viton withstands heat better than Nitrile rubber, and much heat is generated in constant-pressure systems that work hard.

## Temperature

Oil temperature, functional range -20 °C to + 70 °C  
 Oil temperature, working range +20 °C to + 70 °C

## Filtration

For the main circuit, filtration should be arranged so that Target Contamination Class 18/14 according to ISO 4406 is not exceeded. For the pilot circuit, Target Contamination Class 18/13 according to ISO 4406 must not be exceeded.

## Hydraulic fluids

Best performance is obtained using mineral-base oil of high quality and cleanness in the hydraulic system. HLP hydraulic fluids (DIN 51524), automatic-gearbox oil type A and API CD engine oils can be used. Synthetic, fire-resistant and environmentally friendly fluids can also be used. If in doubt, please contact VOAC for further information.

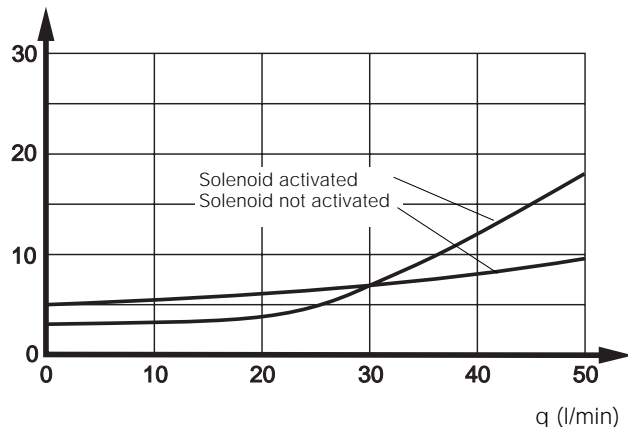
Viscosity, function range 15 - 5000 mm<sup>2</sup>/s (at start-up only)  
 Viscosity, working range 15 - 380 mm<sup>2</sup>/s

**Technical data in this catalogue is applicable at a viscosity of 30 mm<sup>2</sup>/s and temperature of 50 °C.**

## Pressure drop

Pressure drop with the pump-unloading inlet.

$\Delta p$  (bar) Pressure drop P1 to T3, 6-section valve

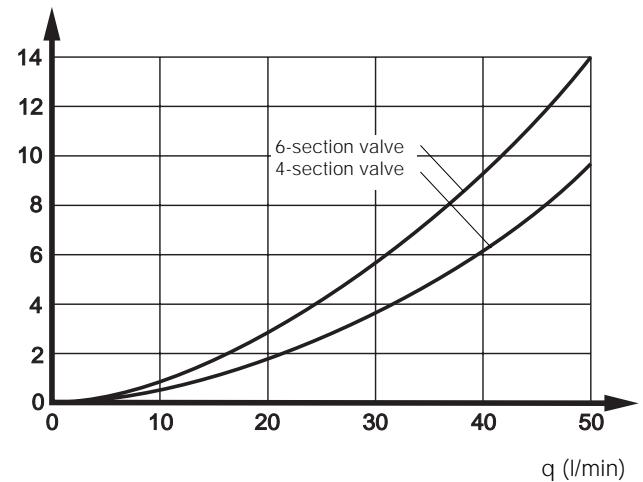


Pump unloading function.

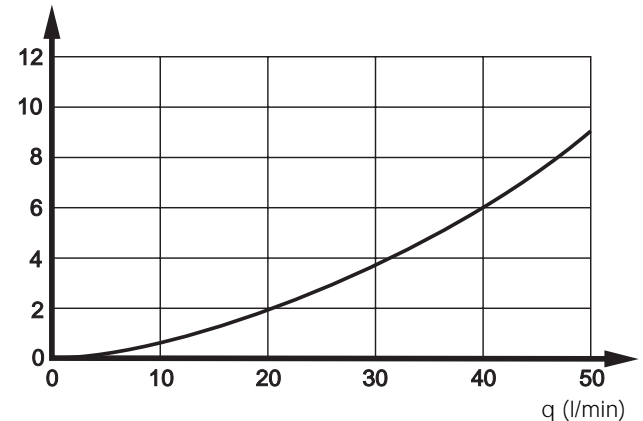
See description and hydraulic circuit diagram on page 12. With pump unloading-inlet and activated solenoid, the pressure drop is not less than 3 bar. With solenoid not activated, pressure drop is not less than 5 bar. This is due to a counterpressure valve, which guarantees the function.

Pressure drop with standard inlet.

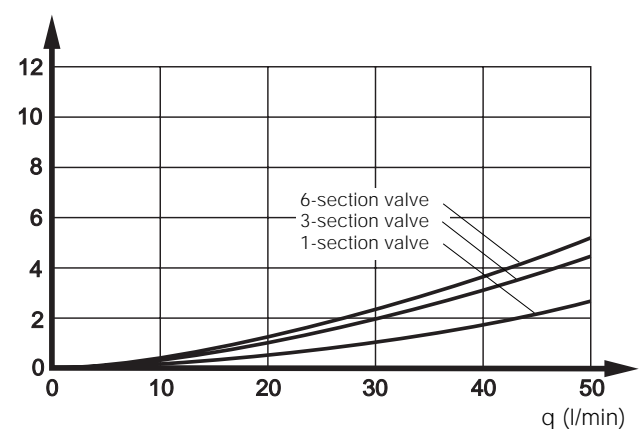
$\Delta p$  (bar) Pressure drop P1/P2 to T1/T2



$\Delta p$  (bar) Pressure drop P1/P2 to service port A/B



$\Delta p$  (bar) Pressure drop service port A/B to T1/T2



## Hydraulic circuit diagram for basic functions

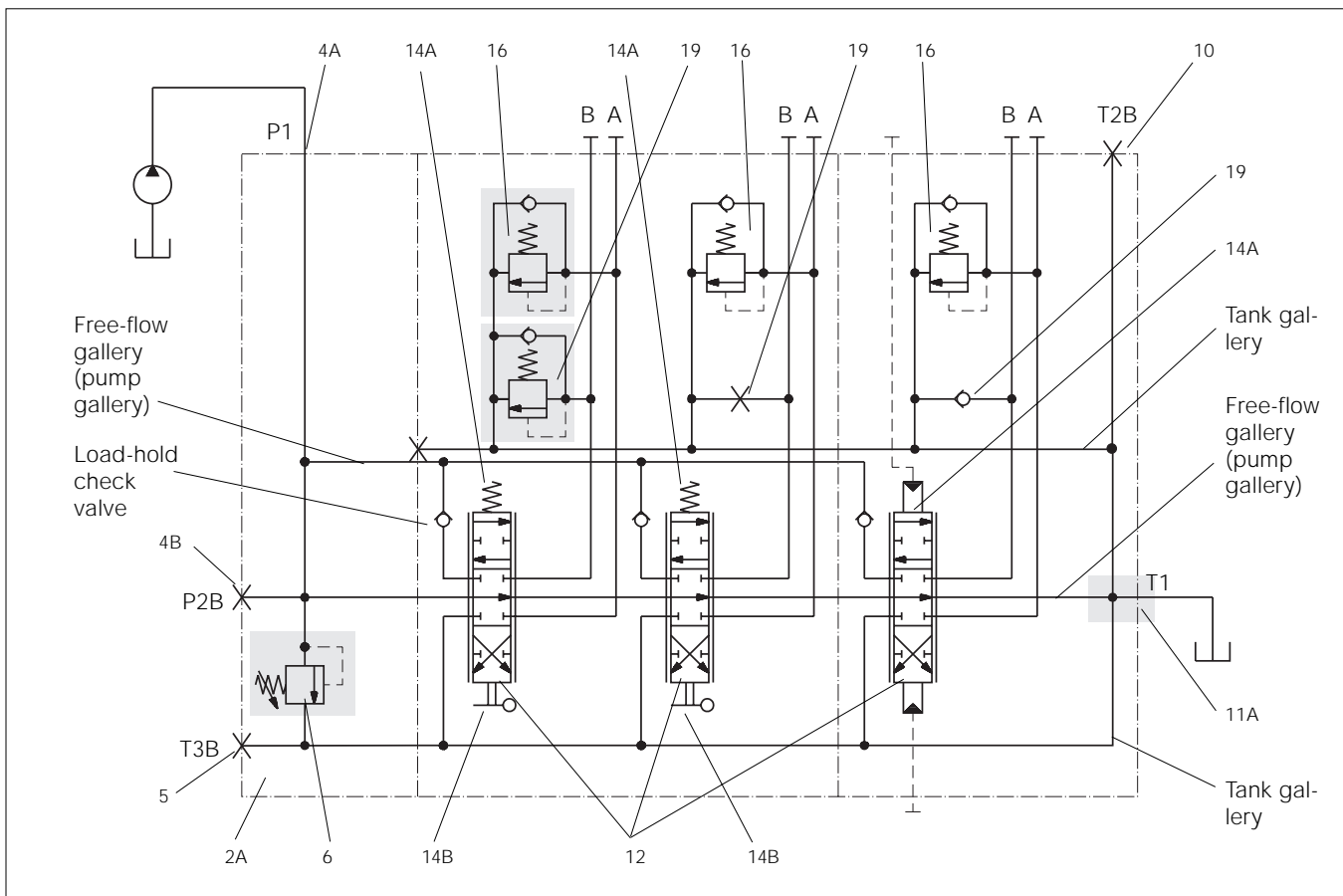


Diagram shows HV07 with three spool sections. For other function options, see under respective function area [item number] elsewhere in catalogue.

The item numbers in the hydraulic circuit diagram above and in the columns below refer to different function areas for

which different options can be selected. The valve above is equipped according to the description below.

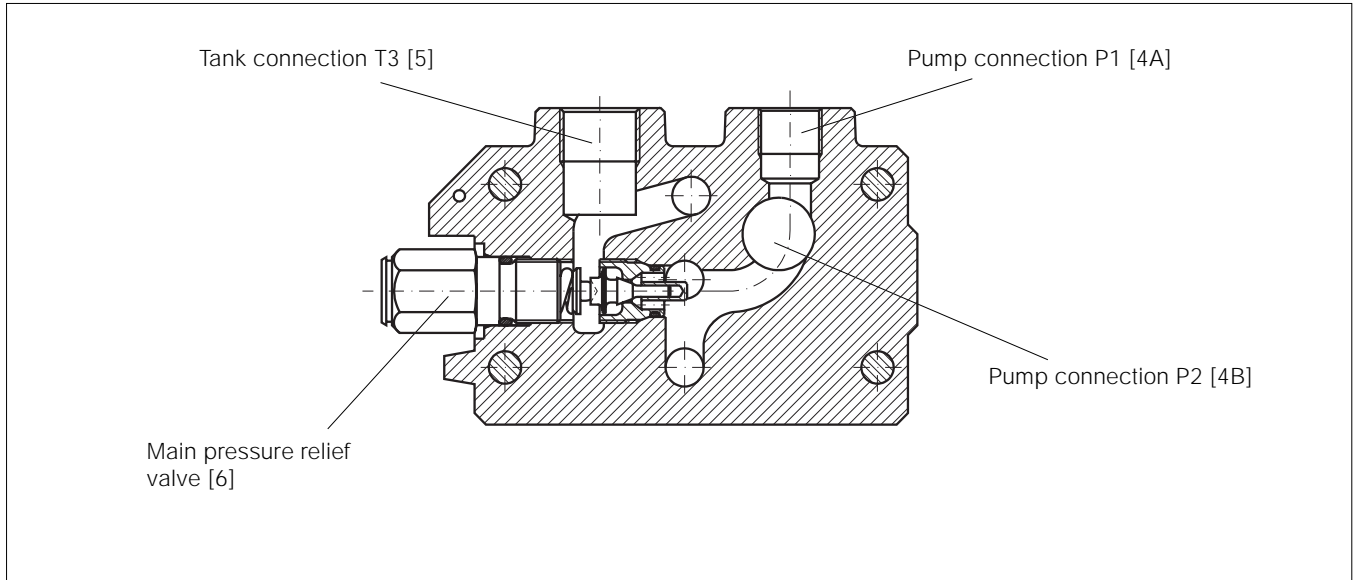
### Item Code Description

2A	/	Standard inlet section.
4B	P2B	Pump connection P2 in inlet is plugged.
4A	P1	Pump connection P1 in inlet is open.
5	T3B	Tank connection in inlet is plugged.
6	PS	Adjustable main pressure relief valve in inlet.
10	T2B	Tank connection T2 in end section is plugged.
11A	T1	Tank connection T1 in end section is open. Free-flow gallery connected with tank.
12	D	Spool for double-acting function in all sections.

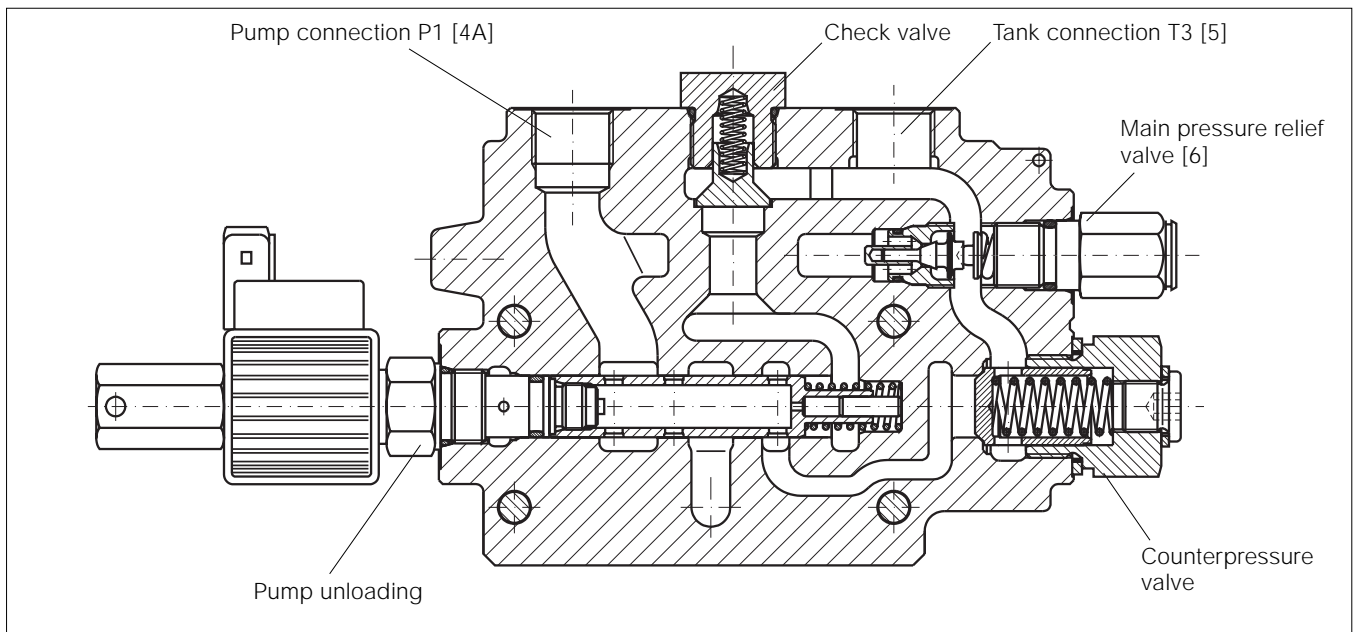
### Item Code Description

14A	C	Stepless, hand-operated, spring-centred spool actuator in sections 1 and 2.
	PC	Stepless, pilot-pressure controlled spool actuator in section 3.
14B	LM	Lever bracket mounted on sections 1 and 2.
16	PA	Combined port-relief and anti-cavitation valve in service port A on all sections.
19	PA	Combined port-relief and anti-cavitation valve in service port B on section 1.
	Y	Connection service port B to tank gallery blocked in section 2.
	N	Anti-cavitation valve fitted in service port B, section 3.

## Inlet section



Standard inlet section



Inlet section with integrated pump unloading to enable emergency STOP of function

The inlet section comes in three basic versions: a standard version for constant-flow systems (CFO) and constant-pressure systems (CP); an integrated pump-unloading version for constant-flow systems (CFO) and a version for unloaded constant-pressure systems (CPU).

The standard inlet section is equipped with two pump connections, P1 and P2, and a tank connection, T3. The main pressure relief valve is located in the inlet section.

The inlet for integrated pump-unloading contains (in addition to the pump unloading functions and main pressure relief valve) one pump connection, P1, and a tank connection, T3.

The inlet for unloaded constant-pressure comes in a number of versions, with or without main pressure relief valve, pilot-pressure relief valve, pump, tank and signal connections.

## Inlet type [2B]

### Inlet with integrated pump unloading

A pump unloading function is incorporated into the inlet section. The inlet, together with some form of overcentre valve, enables the machine to be equipped with an emergency STOP function.

According to the EC Machinery Directive, machines must be equipped with one or more emergency STOP functions to enable actual or impending danger to be averted.

*"The emergency STOP device must have clearly identifiable, clearly visible and quickly accessible controls. It must stop the dangerous process as quickly as possible, without creating additional hazards."*

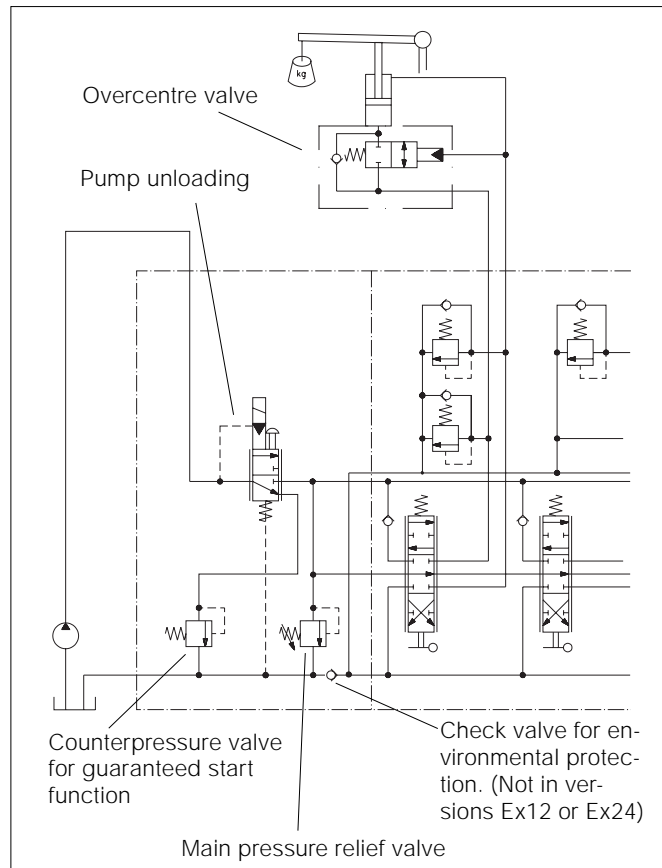
Moreover, the energy supply to the function should be cut off by the emergency STOP device.

The inlet section in the valve opposite has an integrated function that cuts off the energy supply to the valve sections.

On environmental and economic grounds, the tank gallery too should be shut off to prevent oil from running out via the anti-cavitation valve, e.g. in the event of hose rupture.

N.B. Since the pump unloading function forms part of the machine safety system, please refer also to separate printed matter No. 9129 8561-42: Installation instructions for inlet section with integrated pump unloading. The publication is obtainable through your VOAC representative.

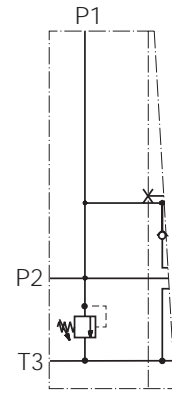
The electromagnet that controls the pump unloading function is available in 12 and 24 VDC versions. The connector is of type AMP Junior-Timer type C, 963040-3 or Bosch 1928 402 404. The electromagnet is equipped with a manual override facility for use in emergencies.



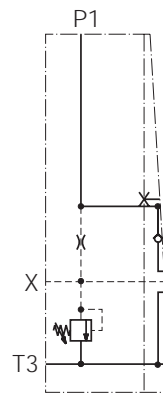
Valve inlet with integrated pump unloading, E12, Ex12, E24, Ex24.

## Optional functions

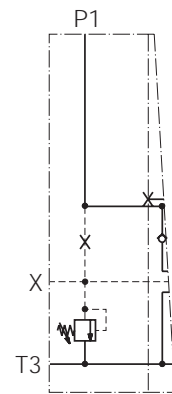
- /** Standard inlet for constant-flow (CFO) and constant-pressure (CP).
- A50** Inlet for unloaded constant-pressure (CPU) with connection between pump port and signal line (via Ø8 mm restrictor) to deliver unloading signal to pump regulator. If the inlet is equipped with a pressure limiter (PA at item 6), it functions as a signal-pressure limiter, i.e. it limits the pressure in signal line X (see diagram).
- A55** Inlet for unloaded constant-pressure (CPU). Same as A50 but without connection between pump port and signal line.
- A200** Inlet for constant-pressure (CP). Contains only one pump port.
- A215** Inlet for constant-flow (CFO) or unloaded constant-pressure (CPU). Used - in case of parallel connection - on valve that is connected to preceding valve by means of S-nipple. [See also page 7.](#)
- A222** Same as A55, but pressure relief valve limits the pump pressure.
- E12** Inlet with integrated pump unloading function, for 12 V system.
- EX12** Inlet with integrated pump unloading function - without check valve in tank gallery - for 12 V system.
- E24** Inlet with integrated pump unloading function, for 24 V system.
- EX24** Inlet with integrated pump unloading function - without check valve in tank gallery - for 24 V system.



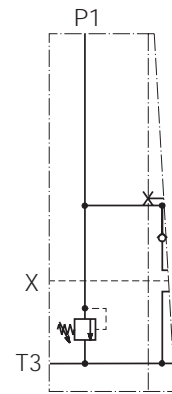
/ Standard inlet



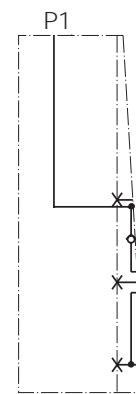
A50



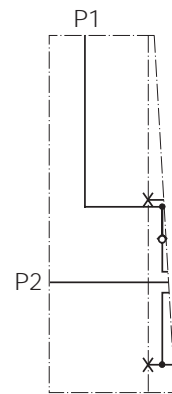
A55



A222



A200



A215

## Pump connection P1 [4A]

**P1** Pump connection P1 open. Normal version.

**P1B** Pump connection P1 plugged.

## Pump connection P2 [4B]

Not applicable to pump-unloading inlet, since it is not equipped with P2 connection.

**P2** Pump connection P2 open.

**P2B** Pump connection P2 plugged. Normal version.

## Tank connection T3 [5]

**T3** Tank connection T3 open.

**T3B** Tank connection T3 plugged. Normal version.

## Main pressure relief valve [6-8]

The pressure relief valve is direct-acting and steplessly adjustable. For best characteristic, the working range is divided into four different ranges: 50-70 bar, 71-150 bar, 151-210 bar and 211-250 bar. The VOAC PLD6, which has a very good characteristic, is used as the main pressure relief valve. As an alternative to the pressure relief valve, a plug can be fitted to block the pump-to-tank connection in cases where the main pressure relief valve is located elsewhere in the system.

## Main pressure relief valve [6]

**PS** Adjustable main pressure relief valve. Delivered factory-set.

**PB** Adjustable main pressure relief valve. Delivered factory-set and sealed.

**Y** Without pressure relief valve.

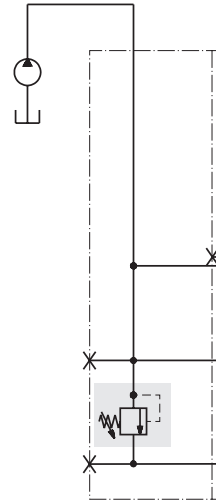
## Pressure setting [7]

Max. 250 bar.

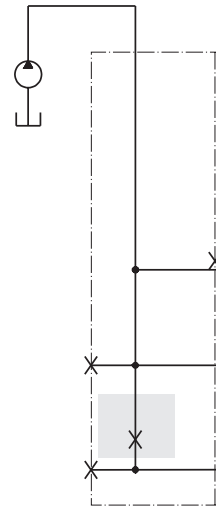
## Pressure-setting flow [8]

**/** Pressure is set while a flow of 20 l/min is passing through the pressure relief valve. Normal version.

Pressure set while other specified flow is passing through pressure relief valve.

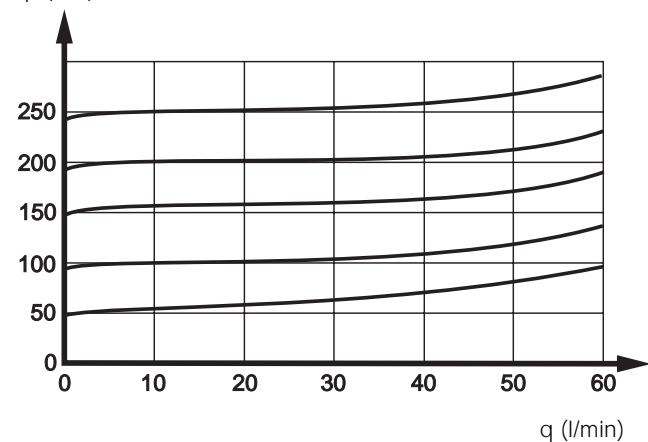


Main pressure relief valve PS or PB

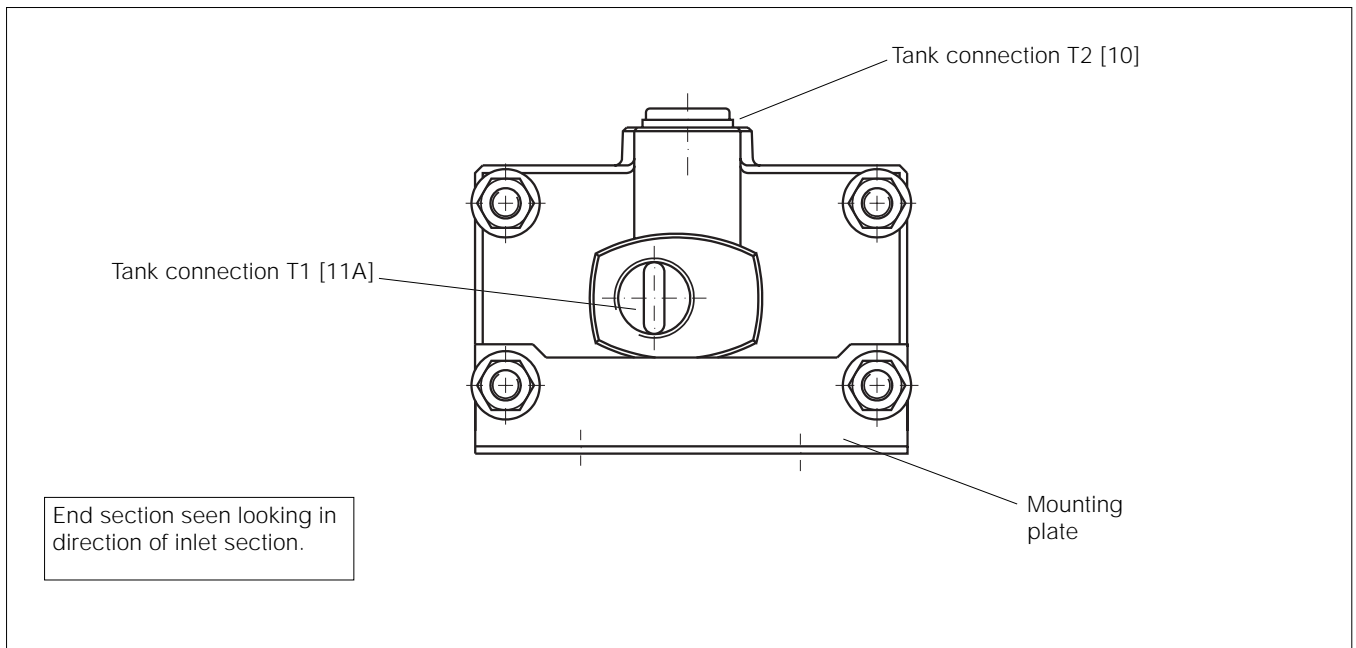


Inlet section without main pressure relief valve

$\Delta p$  (bar) Pressure relief characteristic



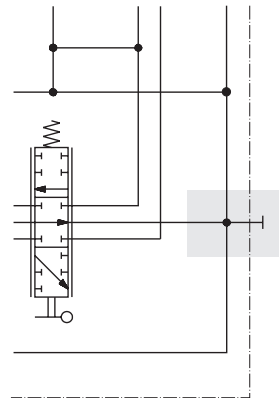
## End section



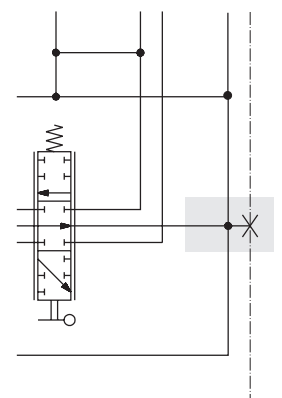
The end section comes in two different versions, the first with only two tank connections (T1 [11A] and T2 [10]) and the second with the end section combined with a spool section to give a "spool section with outlet". The latter is used in valves that have an odd number of spool sections, in order to give a cost-effective and compact valve. In addition to the service ports, the "spool section with outlet" is equipped with the same tank connections as the ordinary end section.

### Tank connection T1 [11A]

- T1** Tank connection T1 open. Normal version.
- T1B** Tank connection T1 plugged.
- B** Blocking adaptor. Blocks the free-flow gallery's tank connection. Used only in constant-pressure systems (CP) and always used when there are no subsequent valves. If there are subsequent valves, an S-nipple is fitted instead.
- S** Series-connection adaptor used to block the connection between the free-flow gallery and tank, while the free-flow gallery flow is directed on to a subsequent valve through the T1 connection.



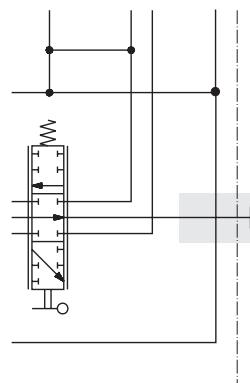
*Tank connection T1 open (T1). Free-flow gallery connected with tank.*



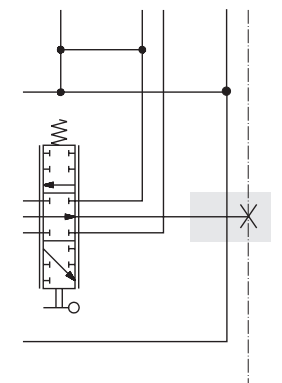
*Tank connection T1 blocked (T1B). Free-flow gallery connected with tank.*

### Tank connection T2 [10]

- T2** Tank connection T2 open.
- T2B** Tank connection T2 plugged. Normal version.

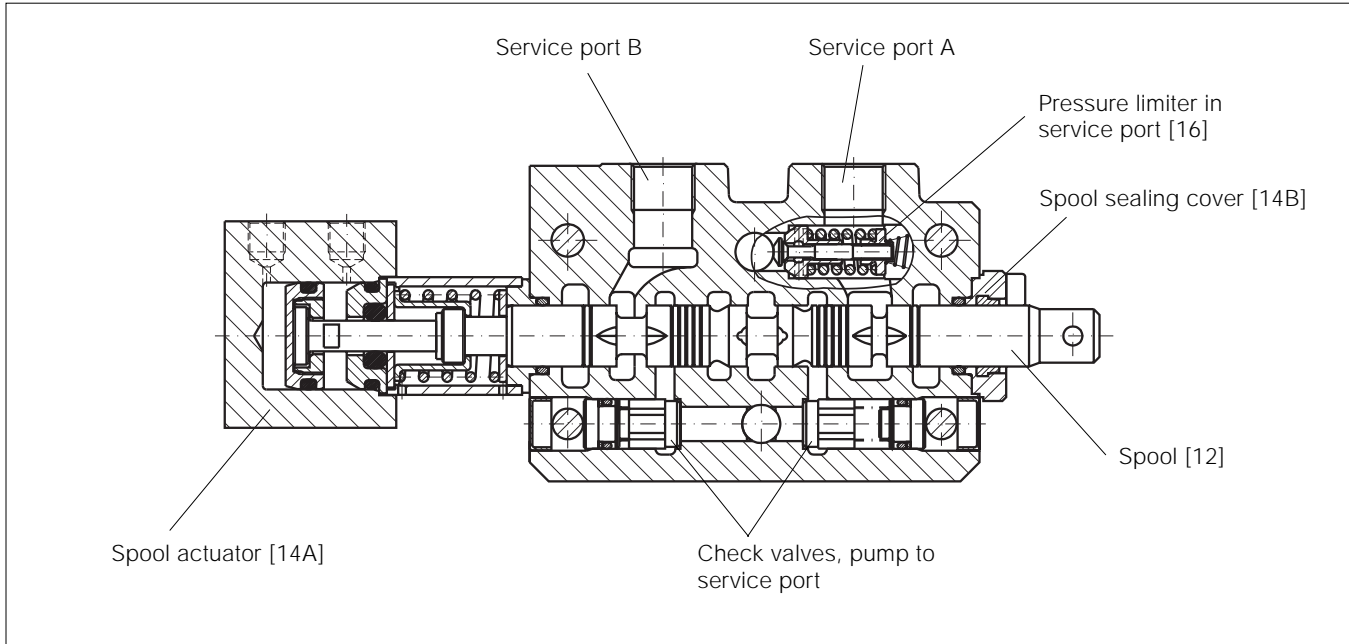


*Tank connection T1 fitted with S-adaptor. Free-flow gallery not connected with tank.*



*Tank connection T1 fitted with B-adaptor. Free-flow gallery not connected with tank.*

## Spool section



The HV07 is stackable and can be supplied in combinations of 1 to 10 spool sections. Each spool section can be equipped individually with a wide range of supplementary functions, spools and spool actuators for optimal customization to suit both the application and the controlled function. For best economy, spool sections come in two basic versions:

- double spool section for two spools
- single spool section in combination with an end section.

### Spool actuators [14A]

There is a wide range of spool actuators for the HV07. They are divided into three groups: hand-operated, ON/OFF remote controlled and proportionally remote controlled.



## Choice of spool [12]

The spool is the most important link between the actions of the operator and the movement of the controlled function. VOAC Hydraulics therefore goes to great lengths to optimize spools for different flows, load conditions, functions and applications. Since this is a continuous development process, new spools are being introduced all the time. For this reason, the many different spools available are not detailed in this catalogue. For assistance with the choice of spool, please contact your nearest VOAC representative.

### Spool function

Spools are divided into different groups, depending on their basic function.

- D** Double-acting spool e.g. for use with a double-acting cylinder. A and B ports blocked in the neutral position.
- E** Single-acting spool for, e.g. single-acting cylinder. B port blocked in the neutral position and service port A blocked.
- M** Double-acting spool for, e.g. hydraulic motor. Service ports connected with tank (float position) in neutral.
- F** Double-acting spool with fourth position in which both service ports are connected to tank in the float position and blocked in neutral position.
- S** Double-acting spool for double-acting function. S spools are specially designed to handle light-load functions such as swing, slew, rotate, etc.
- DQ** DQ, EQ, MQ and FQ spools have the same basic function as D, E, M and F spools. The difference is that a flow limiting valve (lowering brake) is built into the spool. This limits the lowering speed from service port B to tank.
- EQ**
- MQ**
- FQ**

In addition to the grouping of spools according to their function, they are also grouped according to whether the spool end is open or closed. Spools with closed spool end are used for PC or EHC spool actuators and have the letters PC as a suffix to the spool designation. The following "PC functions" are available: DPC, EPC, MPC and SPC. Other spool actuators have spools with open spool end.

Spools with closed spool end are designed in such a way that the flow forces can be exploited to pressure-compensate the spool, i.e. when the load pressure or pump pressure changes, the flow to the service port remains almost unaffected. [See page 5 for more information.](#)

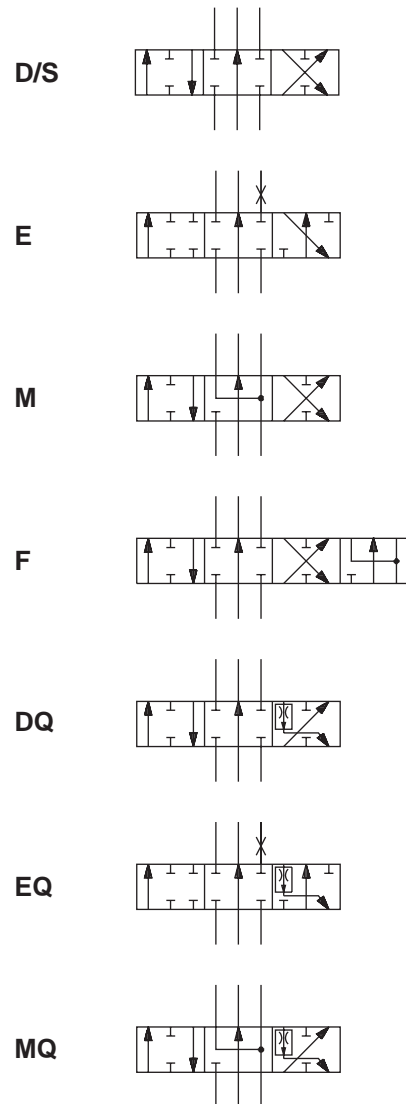
### Spool designation

Each spool has an imprinted letter code to facilitate identification during tuning or servicing in the field.

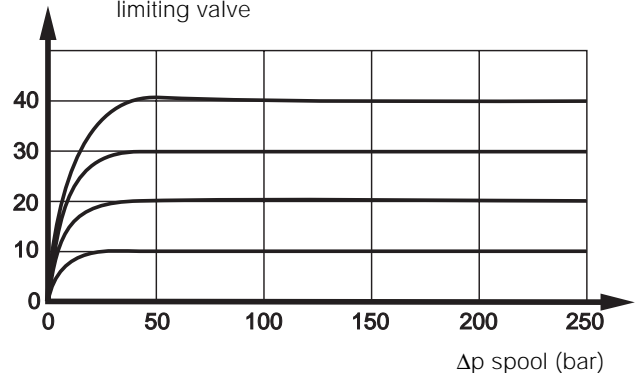
### Flow limitation (lowering brake) [13]

As stated above, DQ, EQ, MQ and FQ spools are equipped with a flow-limiting valve between service port B and the tank gallery. The flow limiting valve limits the maximum flow almost regardless of the load pressure.

The following standard settings are available:  
3.5, 5, 6, 7.5, 10, 12, 15, 20, 22 and 50 l/min.



q (l/min) Flow from service port B to T through flow limiting valve

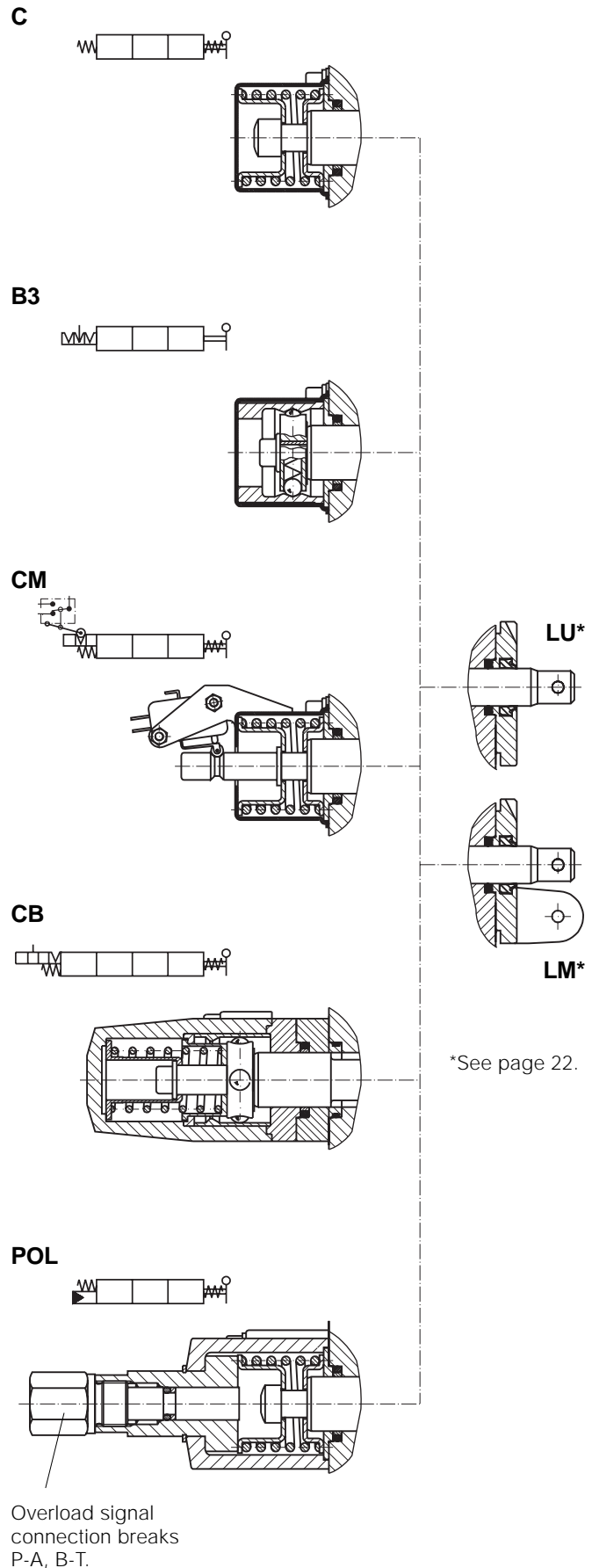


## Spool actuators [14A]

A large number of spool actuators have been developed for the HV07. They are divided into three different groups: hand operated, ON/OFF remote controlled and proportionally remote controlled.

### Hand-operated spool actuators with open spool end

- C** Spring-centred spool actuator.  
Stepless actuator with spring return to neutral position.
- B3** Three-position spool actuator.  
The B3 actuator has 3 mechanically detented positions: neutral and fully actuated at either end position. The spool remains in the selected position and must be moved mechanically from one position to another.
- C+A92** Spool actuator C/B3 with special cap furnished with  
**B3+A92** extra drainage holes.  
C+A92 or B3+A92 are used when the valve is mounted in such a way that the cap of the spool actuator points downwards. In the standard cap, drainage is arranged towards the directional valve. The A92 version also has drainage holes in the bottom.
- CM** Spring-centred spool actuator with cam-operated microswitch.  
Spool actuator for stepless control, with spring centring back to the neutral position. There are a large number of different cam functions for inductive sensors too, as well as different caps with one or two microswitches. For further information, please contact VOAC.
- CB** Float-position spool actuator.  
The CB is a special spool actuator for F-spools (see [page 17](#)). It is of the stepless type with spring return from the two end positions to neutral. It also has a mechanically detented fourth position, in which the spool remains until moved out mechanically.
- POL** Spring-centred spool actuator for overload protection.  
The POL actuator is of the stepless type with spring return to neutral. It is furnished with a connection to which the signal line from a load-limiting device can be connected. The signal forces the spool into neutral. For the spool to be actuated again, the moment of the dangerous load must be reduced.  
On receipt of the overload signal, the POL actuator breaks the connection "pump to service port A".  
Connection thread: G 1/4 or 9/16-18 UNF-2B.



## Remote controlled ON/OFF spool actuators with open spool end and manual override facility

### AC2 Pneumatic ON/OFF spool actuator.

The AC2 is a pneumatically controlled ON/OFF spool actuator with spring centring and the possibility of stepless control by means of a hand lever.

Control pressure: min. 4.5 bar  
max. 10 bar.

Connection thread: G 1/8 or NPTF 1/8-27

### ACE2 Electro-pneumatic ON/OFF spool actuator.

The ACE2 is an electro-pneumatically controlled ON/OFF spool actuator with spring centring and the possibility of stepless control by means of a hand lever.

Primary air: 4-10 bar  
Control current: (12 VDC) min. 0.85 A  
(24 VDC) min. 0.42 A  
Voltage tolerance:  $\pm 20\%$

Connection thread: G 1/8 or NPTF 1/8-27

### ACE2F Electro-pneumatic ON/OFF spool actuator.

The ACE2F is identical to the ACE2 except that it has a common supply gallery for primary air. The primary air can be connected to either the last or the first valve section that is equipped with an ACE2F spool actuator.

Connection thread: G 1/8 or NPTF 1/8-27

### ACE2+ ACE2 or ACE2F spool actuator with special cable

### A184 connector. The ACE2+A184 or ACE2F+A184 are

### ACE2F+A184 supplied with cable connectors equipped with light-emitting diodes.

### ESO Electro-hydraulic ON/OFF spool actuator.

The ESO is an electro-hydraulically controlled ON/OFF spool actuator with spring centring to neutral and the possibility of stepless control by means of a hand lever.

Ideally, remote control of the ESO spool actuator should be effected using a VOAC electric remote-control system. See separate brochure.

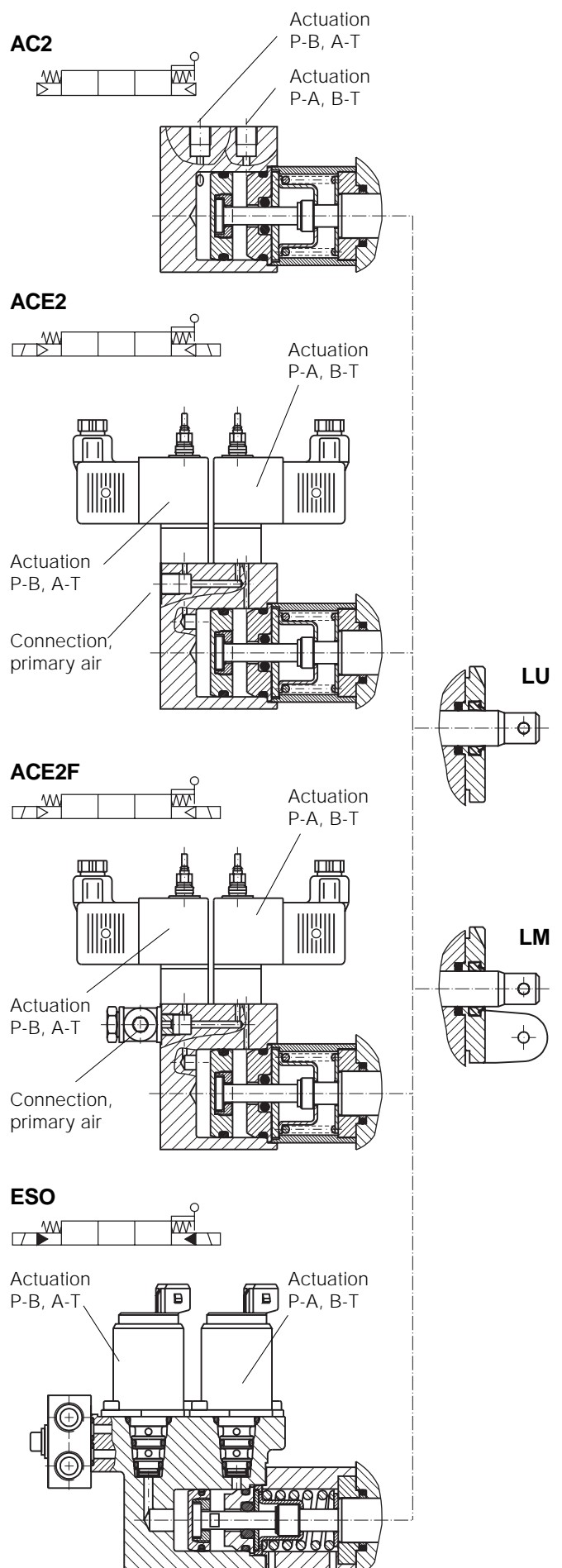
The VOAC QDC25 cartridge valve is used as a remote control valve.

The connector is not supplied with the valve. Suitable connectors are: AMP Junior-Timer type C, 963040-3 or Bosch 1928 402 404.

Pump pressure: min. 15 bar  
max. 35 bar  
Tank pressure: max. 15 bar  
Control current: (12 VDC) min 900 mA  
(24 VDC) min 430 mA  
Voltage, 12 V systems: max. 14 V, 100% ED  
max. 16 V, 50% ED  
Voltage, 24 V systems: max. 28 V, 100% ED  
max. 32 V, 50% ED  
Coil resistance at +20 °C: (12 V) 5.3 ohms  
(24 V) 21.2 ohms

Connection thread: G 1/4 or 9/16-18 UNF-2B.

See also page 22.



## Remote controlled, proportional spool actuators with open spool end and manual override facility

### ACP2 Pneumatic proportional spool actuator.

The ACP2 is a pneumatically controlled, proportional spool actuator with spring centring and the possibility of stepless control by means of a hand lever. The ACP2 is best controlled by the VOAC VPO4 remote control valve (see separate brochure).

Breakaway pressure\*: 2 bar  
 Final pressure\*: 5.5 bar (max. 10 bar)  
 Connection thread: G 1/8 or NPTF 1/8-27

### ESP Electro-hydraulic proportional spool actuator.

**ESPSB** The ESP and ESPSB are electro-hydraulic, proportionally controlled spool actuators with spring centring and the possibility of stepless control by means of a hand lever. The VOAC PVC25 cartridge valve is used as a pilot valve.

Ideally, remote control of the ESP spool actuator should be achieved using a VOAC electric remote-control system. See separate brochure. The ESPSB is an ESP spool actuator equipped with a "POL" function. The ESPSB breaks the connection "pump to service port A" on receipt of a signal.

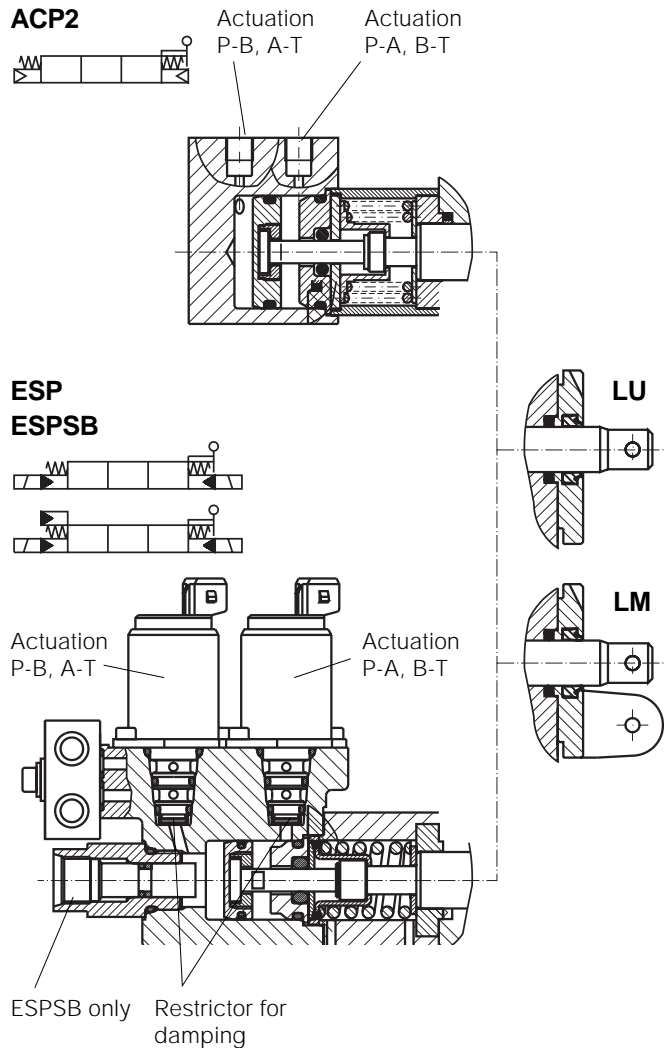
A connector is not supplied with the valve. Suitable connectors are: AMP Junior-Timer type C, 963040-3 or Bosch 1 928 402 404.

Voltage	12 V	24 V
Breakaway current:*	max. 450 mA	max. 225 mA
Final current:*	min. 920 mA	min. 460 mA
Tank pressure:	max. 15 bar	max. 15 bar
Solenoid (PVC25):	max. 1450 mA 100% ED	max. 730 mA 100% ED
Coil resistance at +20 °C:	5.4 Ω	21.7 Ω
Inductance:	27.7 mH	7.0 mH

Connection thread: G 1/4 or 9/16-18 UNF-2B.

See also page 22.

\* See page 21.



## Remote controlled, proportional spool actuators with closed spool end

**PC** Hydraulic proportional spool actuator.  
The PC is a hydraulically, proportionally controlled, spring-centred spool actuator. It is best controlled by the VOAC PCL4 remote control valve (see separate brochure).

Breakaway pressure:\* 5.5 bar  
Final pressure:\* 15 bar  
(max. 35 bar)

**PCH** Hydraulic proportional spool actuator with enclosed lever. The PCH is identical to the PC, except that it is fitted with an enclosed lever and its final pressure is 16 bar.

Connection thread: G 1/4 or 9/16-18 UNF-2B.

**\***

The "breakaway pressure" and "breakaway current" refer to the pressure/current needed for the directional valve to open the connection "pump to service port and back to tank".

The "final pressure" and "final current" are the lowest pressure/current needed to effect full actuation of a spool in the directional valve.

This data must be taken into consideration when choosing pilot valves, since the opening pressure/current of the pilot valve must be lower than the breakaway pressure/current of the spool actuator in order to avoid jerky starting and stopping.

Moreover, the pilot valve's final pressure/current must be higher than the final pressure/current of the directional valve to ensure that the directional valve can be fully actuated. This is important in CFO systems because, if the spool is not fully actuated, the free-flow gallery will not close, with the result that a certain amount of flow will go directly to tank instead of going to the consumer. This must also be taken into consideration in cases of stroke-length limitation of the PC and EHC spool actuators by means of the special stroke-length limitation screw.

**EHC** Electro-hydraulic proportional spool actuator.  
The EHC is an electro-hydraulically, proportionally controlled, spring-centred spool actuator. It is best controlled by means of a VOAC electric remote-control system (see separate brochure). The VOAC PVE102 is used as a pilot valve.

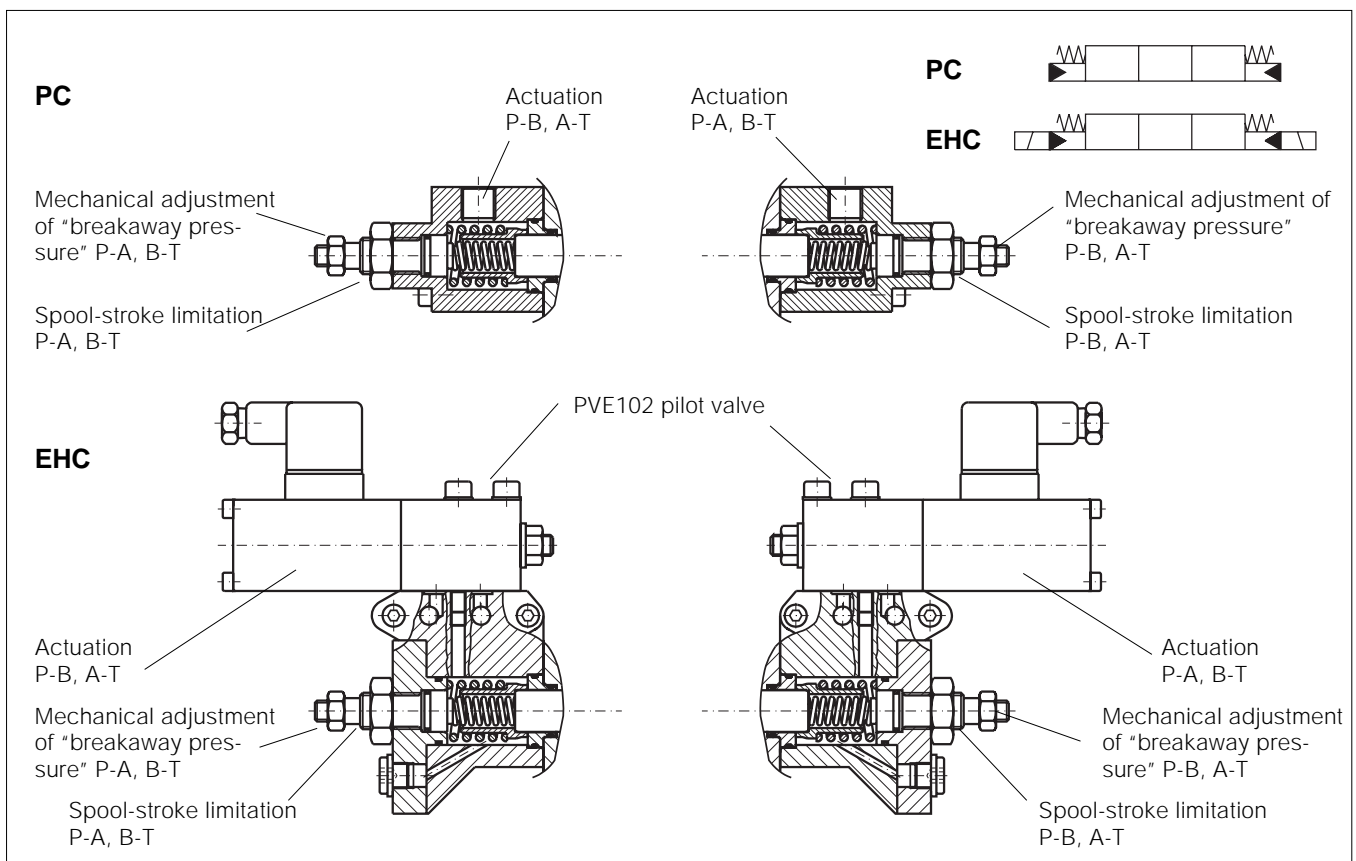
**Voltage: 12 V**  
Breakaway current:\* max. 365 mA  
Final current:\* min. 700 mA  
Pump pressure: max. 35 bar  
Tank pressure: max. 15 bar  
Solenoid (PVE102): max. 1250 mA  
100% ED

Coil resistance at +20 °C: 7.2 ohms  
Inductance: 10 mH

**Voltage: 24 V**  
Breakaway current:\* max. 210 mA  
Final current:\* min. 390 mA  
Pump pressure: max. 35 bar  
Tank pressure: max. 15 bar  
Solenoid (PVE102): max. 680 mA  
100% ED

Coil resistance at +20 °C: 24.6 ohms  
Inductance: 32 mH

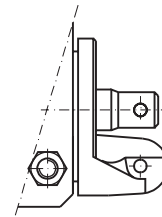
Connection thread: G 1/4 or 9/16-18 UNF-2B.



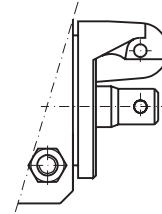
## Lever bracket [14B]

- LM** Bracket for lever. Lever itself not supplied. Please order lever separately. [See page 26.](#)
- LM+A37** Bracket LM turned through 180°. N.B. With this arrangement, the same lever movement activates the opposite service port.
- LU** No bracket for lever. Open spool end.
- X** No bracket for lever. Closed spool end. Always the case with EHC and PC spool actuators only.
- L10** Lever bracket for coordinate lever (joystick) M710.

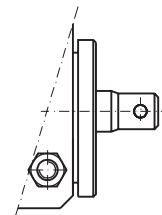
LM



LM + A37



LU



## ESO/ESP/ESPSB spool actuators [18C] [21C] [23] [24] [25] [26]

ESO/ESP and ESPSB spool actuators [14A] are not just actuators for one section, but a package including accessories for several spool sections. Accessories include, e.g. integrated pilot-pressure reducing valve, connection plates and bleed-off restrictor for heating up the oil.

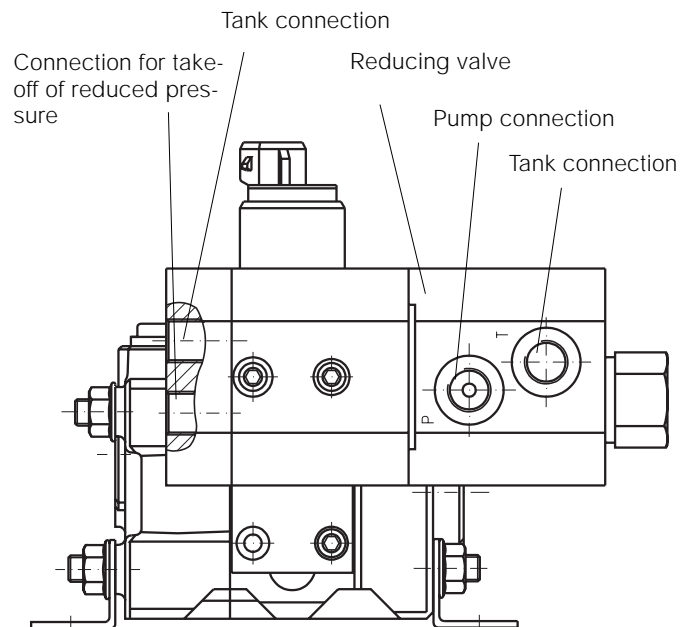
All connections: G 1/4 or 9/16-18 UNF-2B.

## Feed restrictor for ESO/ESP/ESPSB [18C] [21C]

To enable individual adaptation of the speed with which a function responds, a number of restrictors from 0.6 to 1.4 mm in diameter can be chosen. Normal version: 1.0 mm.

## Spool actuator ESO/ESP/ESPSB on one section only [23]

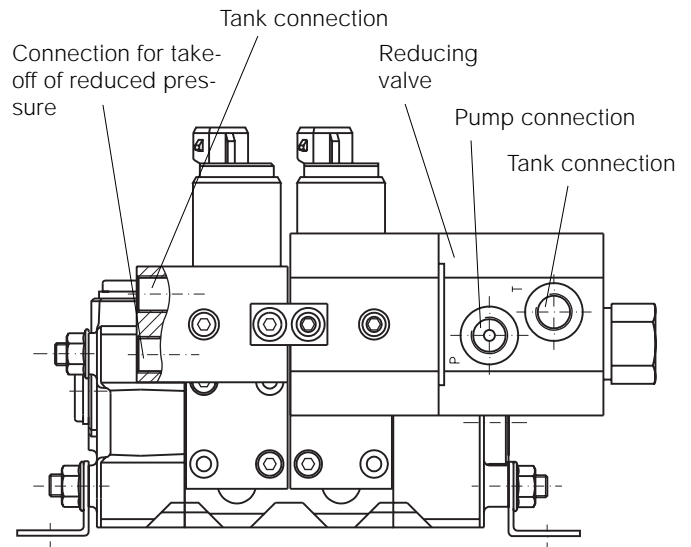
- RB1** Reducing valve - see [26] - mounted on spool section and turned *toward* the inlet section.
- RB2** Reducing valve - see [26] - mounted on spool section and turned *away* from the inlet section.
- RA1** Reducing valve - see [26] - mounted on spool section and turned *toward* the inlet section. The section also has connection threads for tank and external take-off of the reduced pump pressure. The connection threads are turned away from the inlet section.
- RA2** Reducing valve - see [26] - mounted on spool section and turned *away* from the inlet section. The section also has connection threads for tank and external take-off of the reduced pump pressure. The connection threads are turned toward the inlet section.
- G1** Threaded connection port on spool section for connection of pump and tank. Turned *toward* inlet section. Max. pump pressure: 35 bar.
- G2** Threaded connection port on spool section for connection of pump and tank. Turned *away* from inlet section. Max. pump pressure: 35 bar.
- GS1** Threaded connection port on spool section for connection of pump and tank. Turned *toward* inlet section. Max. pump pressure: 35 bar. The threaded connection contains a bleed-off restrictor (Ø1.2 mm) between the pump and tank, so that a flow (for heating up the oil) will always circulate to tank.
- GS2** Threaded connection port on spool section for connection of pump and tank. Turned *away* from inlet section. Max. pump pressure: 35 bar. The threaded connection contains a bleed-off restrictor (Ø1.2 mm) between the pump and tank, so that a flow (for heating up the oil) will always circulate to tank.



ESO/ESP on one spool section. Reducing valve R [24] fitted. Threaded connection port RA1 [23] for external take-off of reduced pressure.

## ESO/ESP/ESPSB spool actuator on more than one spool section. Section nearest inlet [24]

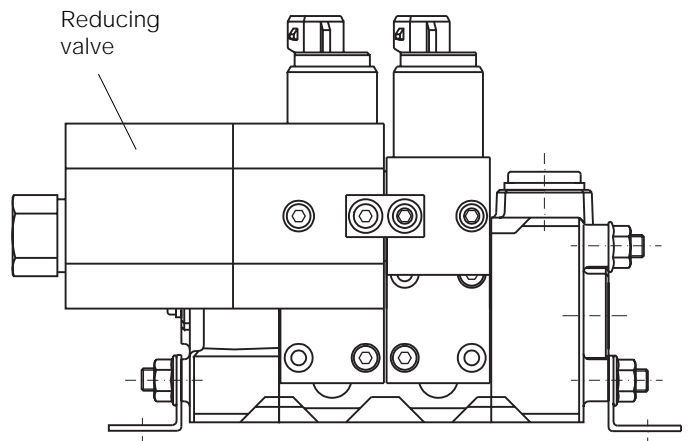
- R** Reducing valve fitted. See [26].
- G** Threaded connection port. Max. 35 bar pump pressure.
- S** No connection or reducing valve.
- SS** Bleed-off restrictor ( $\varnothing 1.2$  mm) between pump and tank for continuous circulation of warm-up flow to tank.



ESO/ESP/ESPSB on more than one spool section. Reducing valve R [24] fitted. Threaded connection port G [25] for external take-off of reduced pressure.

## ESO/ESP/ESPSB spool actuator on more than one spool section. Section furthest from inlet [25]

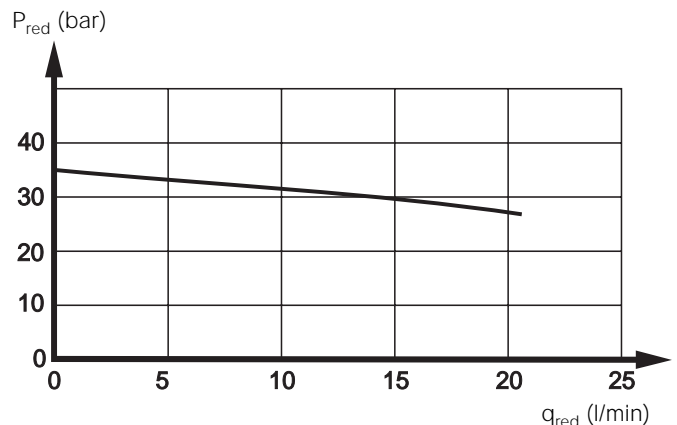
- R** Reducing valve fitted. See [26].
- G** Threaded connection port. Max. 35 bar pump pressure.
- S** No connection or reducing valve.
- SS** Bleed-off restrictor ( $\varnothing 1.2$  mm) between pump and tank for continuous circulation of warm-up flow to tank.



ESO/ESP/ESPSB on more than one spool section. No connection S [24]. Reducing valve R for item [25]. With R as item [25], reducing valve's pump and tank connection are turned in toward the directional valve.

## Reducing valve for ESO/ESP/ESPSB spool actuator [26]

- 35** Reducing valve fitted (for R, RB1, RB2, RA1 or RA2 above). Setting: 35 bar at flow of 0 l/min. Max. pressure in pump connection: 250 bar.



$P_{red}$  = reduced pressure  
 $q_{red}$  = take-off flow from reducing valve

## Pressure limiters in the service ports (port relief valves) [16]-[21]

The service ports can be equipped with individual port-relief and/or anti-cavitation valves.

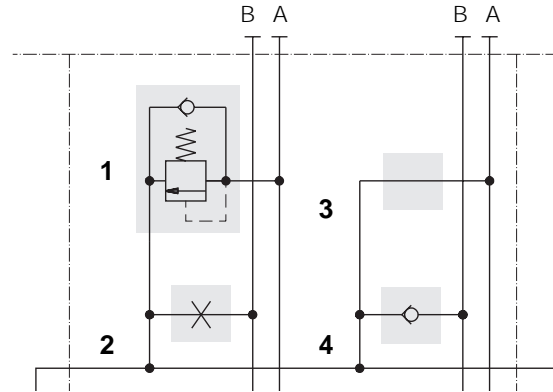
VOAC PLC051 cartridge valves are used as port relief valves. They are renowned for their long service life, tight sealing, fast opening sequence and good characteristics over the entire flow range.

### Port relief valve [16] and [19]

- X** No port relief valve fitted. Service port connected to valve's tank gallery.
- O** Section not machined for pressure limiter. Applies to all four service ports in a double section and both service ports in a "spool section with outlet".
- Y** No port-relief or anti-cavitation valve fitted. Connection between service port and tank gallery blocked.
- PA** Combined port-relief and anti-cavitation valve PLC051 fitted. Valve is factory-set.
- N** Only anti-cavitation valve fitted.

### Pressure setting [17]+[20]

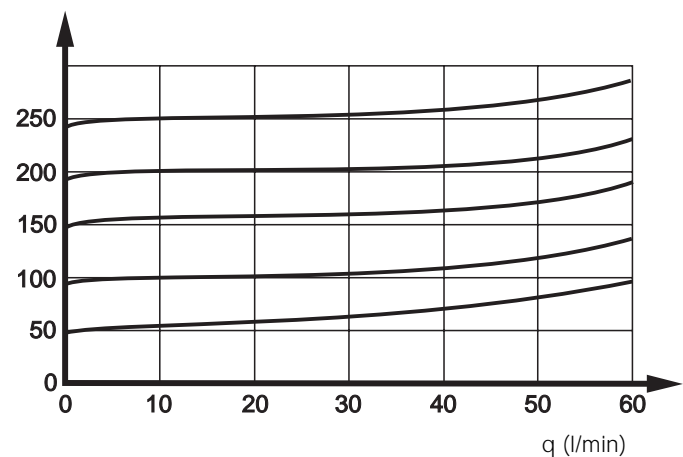
Optional standard settings:  
32, 50, 63, 80, 100, 115, 125, 140, 150, 160, 175, 190, 210, 230, 250, 260 and 280 bar.



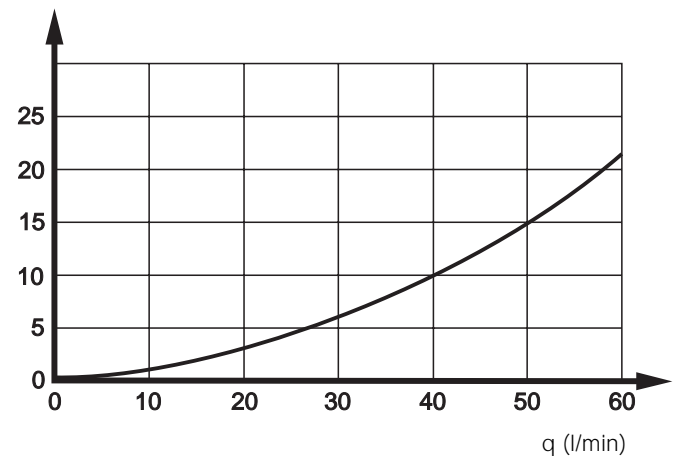
In the circuit diagram above, section 1, service port A, is equipped with a combined port-relief and anti-cavitation valve, PA (1), to limit the pressure and prevent cavitation. Section 1, service port B, is fitted with a Y-plug, Y (2), to block the connection to tank.

Section 2, service port A, is connected to tank, X (3), in the case of E spools. Section 2, service port B, is fitted with an anti-cavitation valve, N (4).

$\Delta p$  (bar) Port-relief characteristic



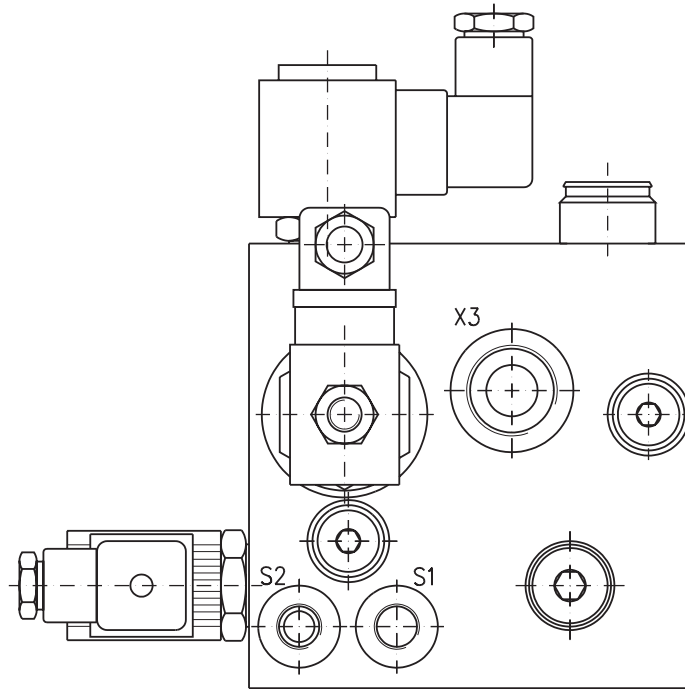
$\Delta p$  (bar) Anti-cavitation characteristic





## Function blocks

The HV07 can be equipped with manifold-type function blocks that enable total system solutions to be integrated into the valve. In addition to the standard function blocks available, our experienced product and system designers can tailor function blocks to meet your needs exactly. For more information about total system solutions, please contact your VOAC representative.



*Above is an example of a specially customized function block. Like most function blocks, it was constructed using cartridge valves. Only the housing is unique.*

## Levers

Levers are not supplied with HV07 valves and must be ordered separately.

The standard levers for HV07 valves are of steel, which is surface treated to give resistance to corrosion. Lever knobs are of black plastic and available in either plain-ball or "window" versions. The window version lets you insert a function symbol beneath the transparent cap.

Levers are supplied complete with pin kits for mounting to the directional valve.

Lever:

- M7** (Ball)
- M71** (Window knob)
- M72** (Window knob)
- M73** (Window knob and bellows)
- M79** (Ball)

Ordering No.

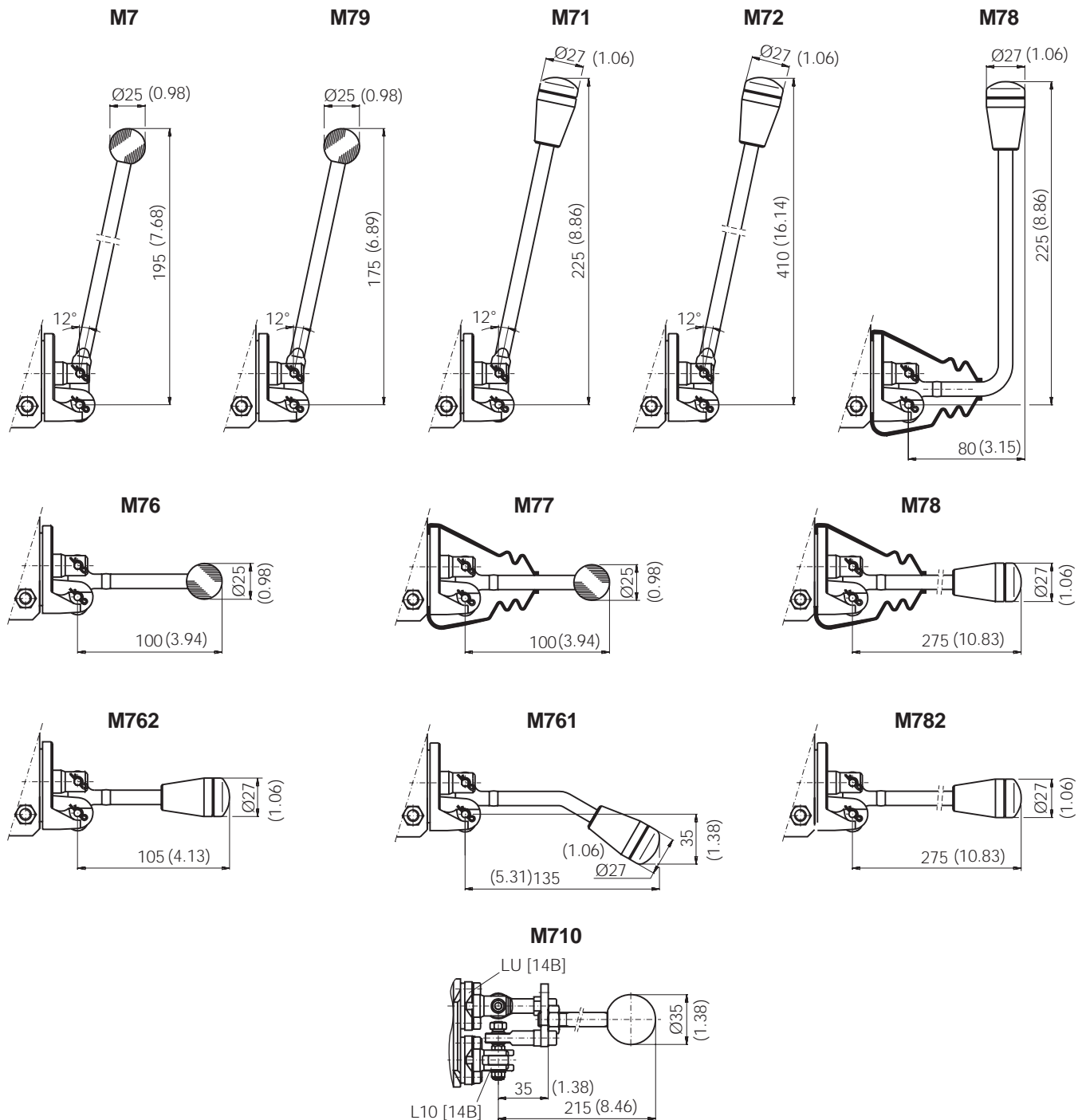
- 9122 1780 08
- 9122 1780 11
- 9122 1780 12
- 9122 1780 13
- 9127 3159 01

- M76** (Ball)
- M761** (Window knob)
- M762** (Window knob)
- M77** (Ball and bellows)
- M78** (Window knob and bellows)
- M782** (Window knob)

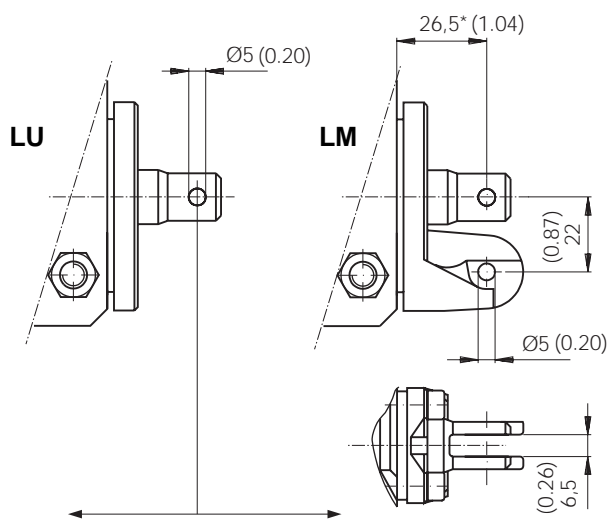
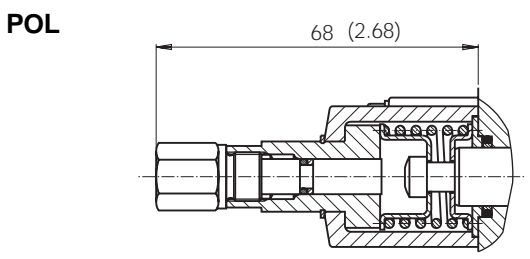
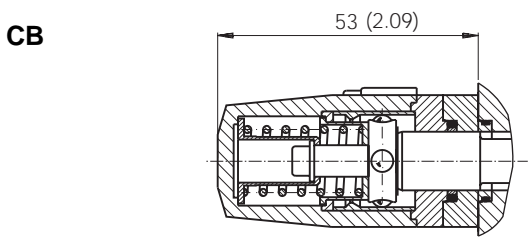
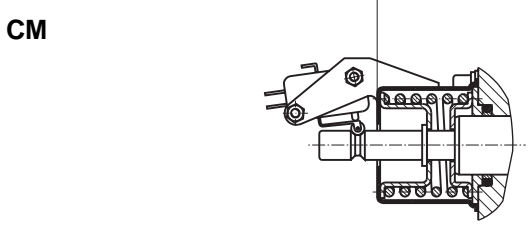
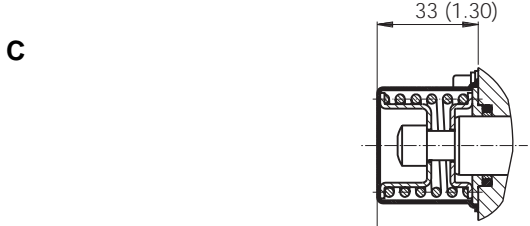
- 9127 2689 01
- 9122 1780 15
- 3763058
- 9127 2815 01
- 9127 2920 01
- 3763416

- M710** Coordinate lever (joystick)

- 9122 1780 14



## Dimensional drawings (spool actuators)

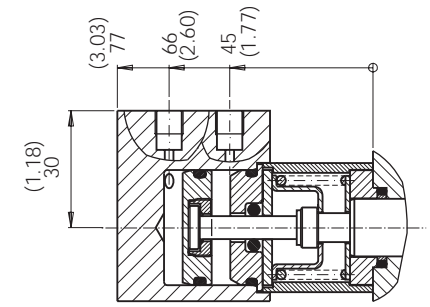


Opens pump to service port A.  
Spool stroke 6 mm (0.24).  
Spool actuator CB 11.5 mm (0.45).

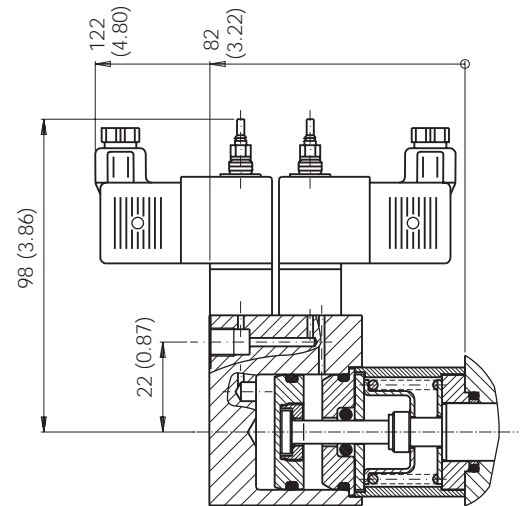
Opens pump to service port B.  
Spool stroke 6 mm (0.24).

\* 40 (1.57) for spool actuator CB

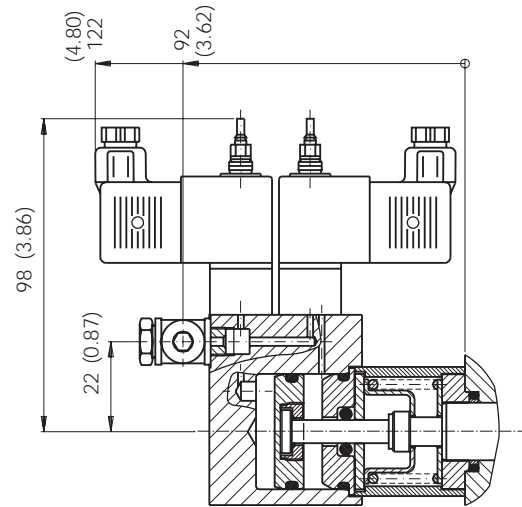
**AC2  
ACP2**



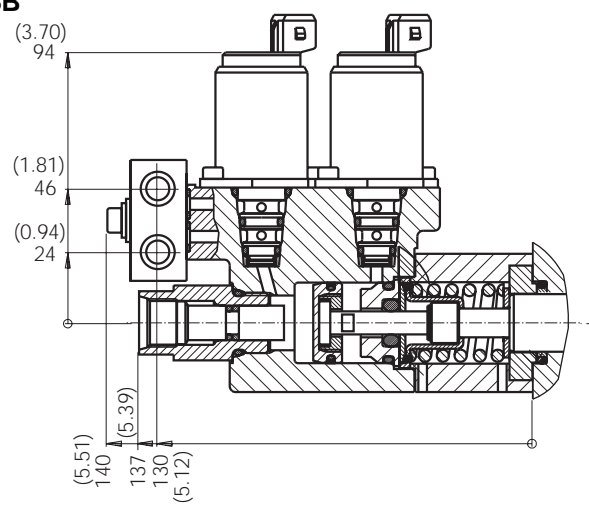
**ACE2**



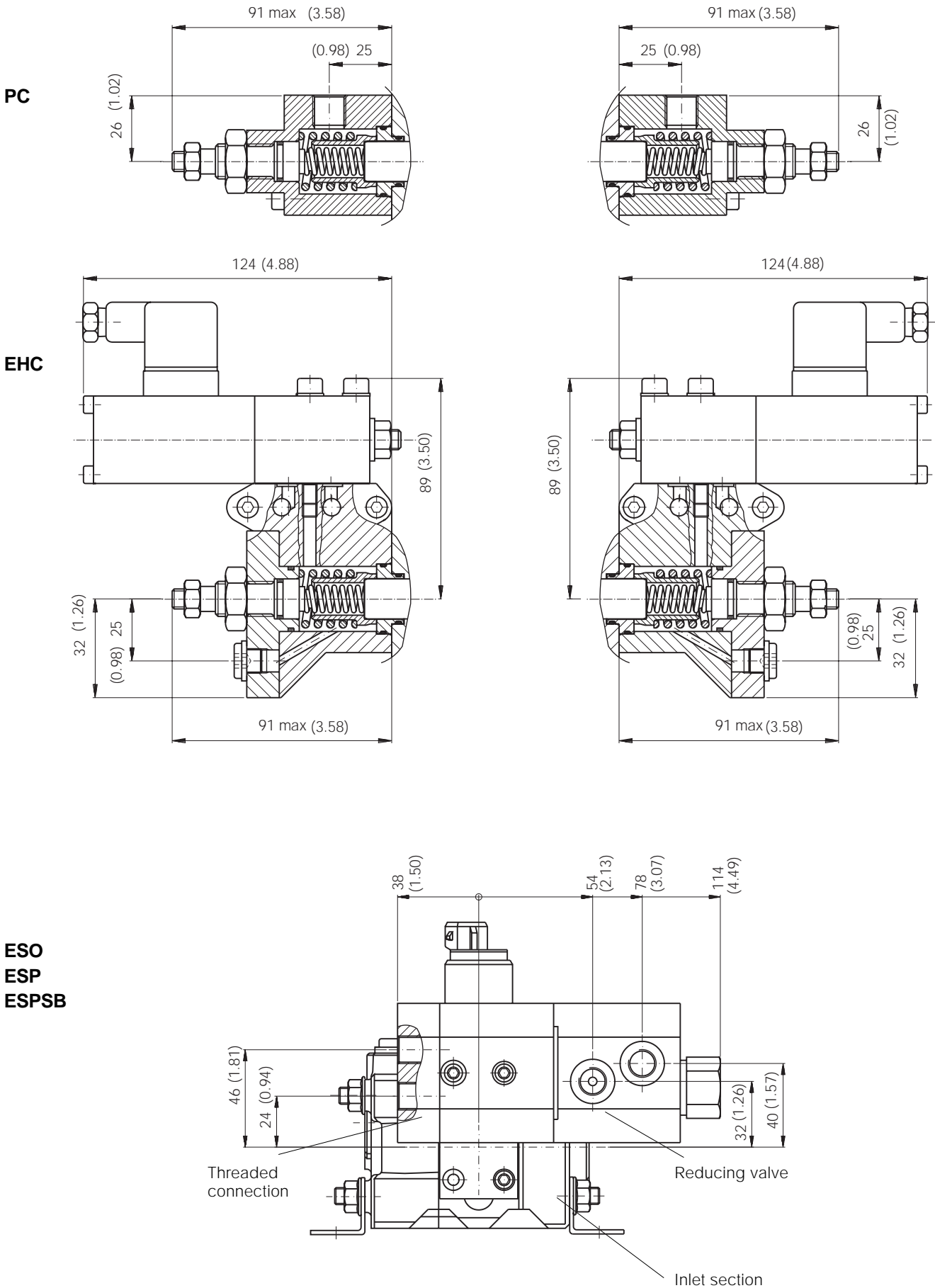
**ACE2F**



**ESO  
ESP  
ESPSB**

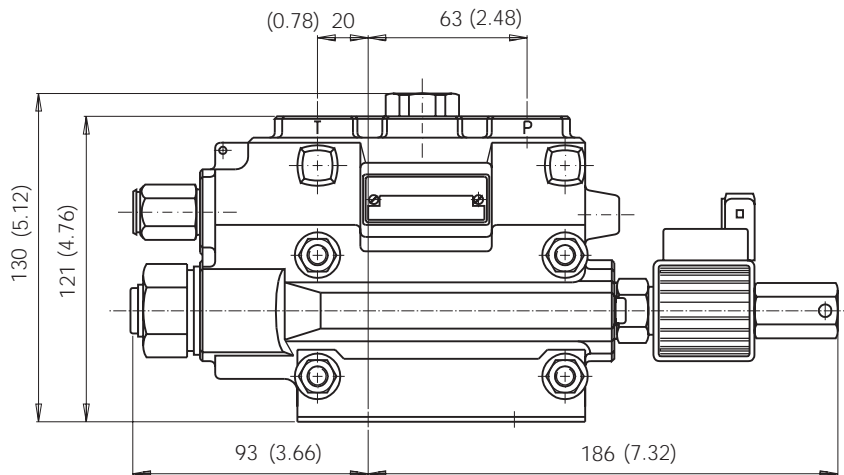


## Dimensional drawings (spool actuators)

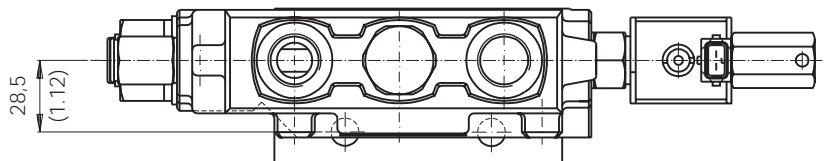


## Dimensional drawings

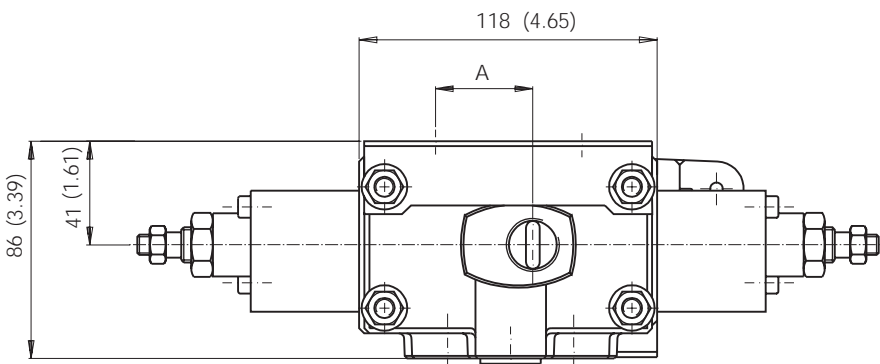
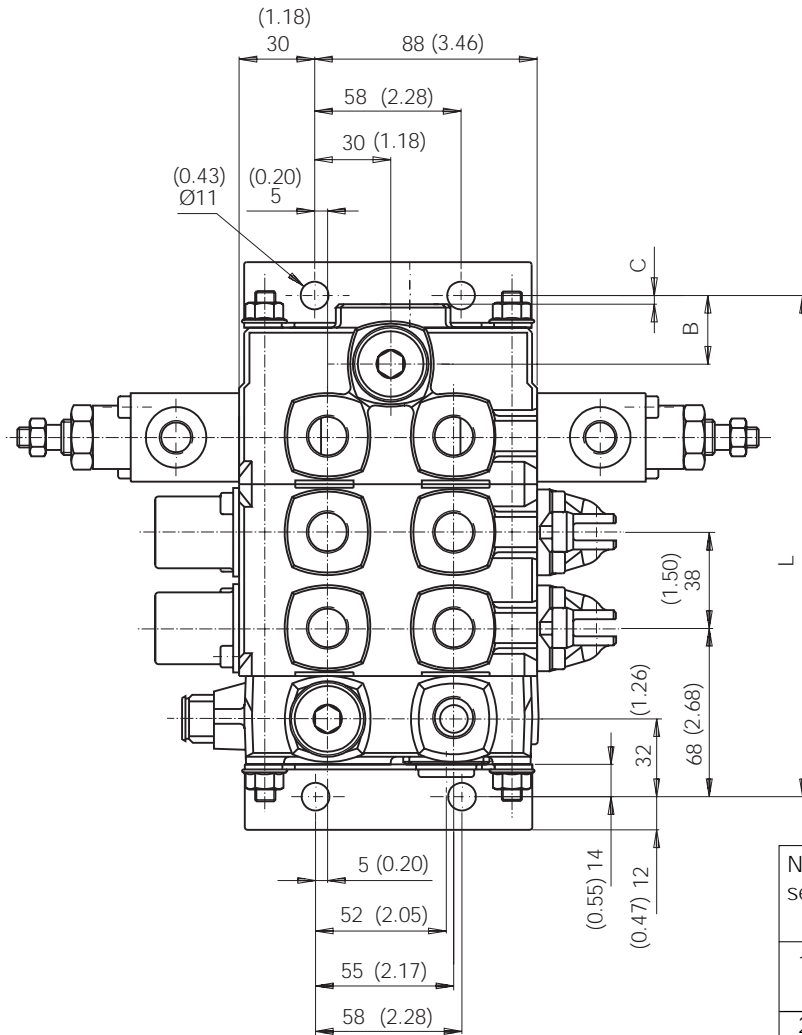
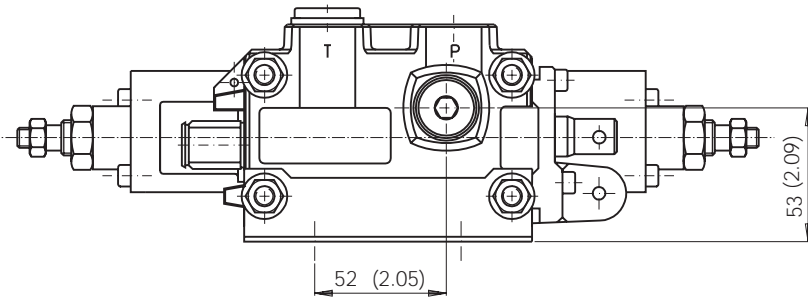
### Inlet with integrated pump unloading [2B]



For the pump-unloading inlet section above, only the dimensions that differ from those of the standard inlet section are given.



## Dimensional drawings



No. of sections	L mm (in)	A mm (in)	B mm (in)	C mm (in)
1	125 (4.92)	38,5 (1.52)	23 (0.91)	5,5 (0.22)
2	181 (7.13)	27 (1.06)	37 (1.46)	14 (0.55)
3	201 (7.91)	38,5 (1.52)	23 (0.91)	5,5 (0.22)
4	257 (10.12)	27 (1.06)	37 (1.46)	14 (0.55)
5	277 (10.91)	38,5 (1.52)	23 (0.91)	5,5 (0.22)
6	333 (13.11)	27 (1.06)	37 (1.46)	14 (0.55)
7	353 (13.90)	38,5 (1.52)	23 (0.91)	5,5 (0.22)
8	409 (16.10)	27 (1.06)	37 (1.46)	14 (0.55)
9	429 (16.89)	38,5 (1.52)	23 (0.91)	5,5 (0.22)
10	485 (19.09)	27 (1.06)	37 (1.46)	14 (0.55)





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