



## Valve technology for additional functions and attachments on mobile equipment

- Installation of additional functions
- Optimizing functions
- Product descriptions



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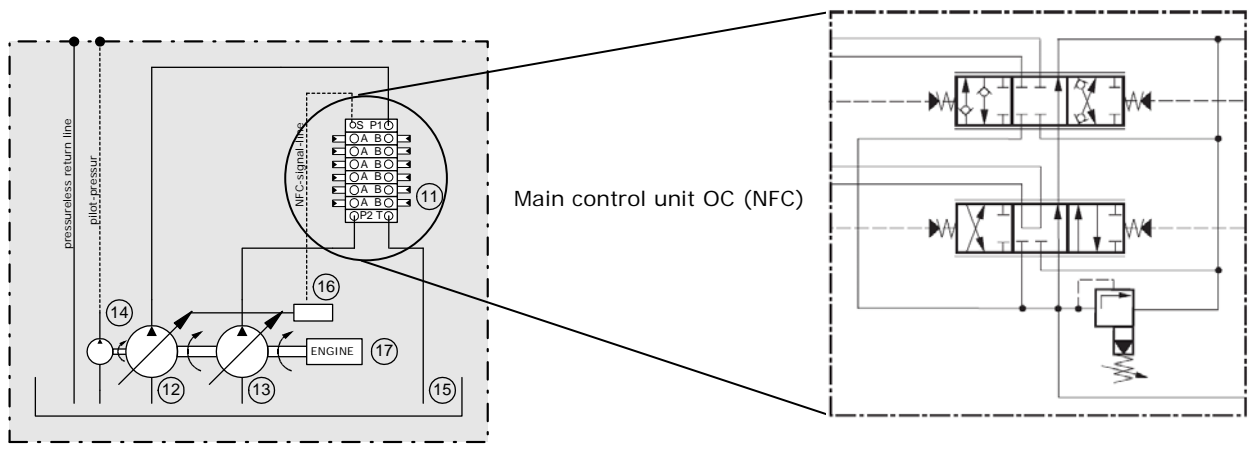
# 1. General Description of Systems and their Components

In mobile equipment, both power and signals are transferred by the hydraulics. The pump, driven by a diesel engine, makes the power available centrally (volume flow and pressure). Valve technology branches the hydraulic power and forwards it on to the individual consumers.

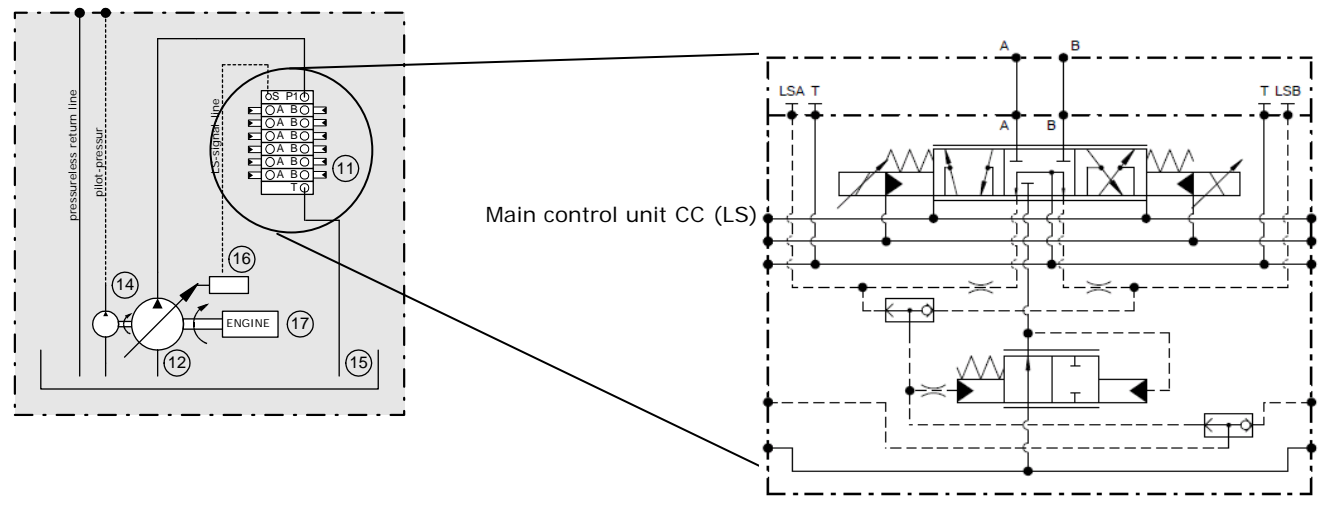
## 1.1 Common hydraulic systems

Systems with one or two pumps, which drive the main and auxiliary functions e.g. of an excavator via the valves of the main control unit, are widely used. There are generally two types of controllers: Open Center (OC) and Closed Center (CC) systems.

The OC systems are normally operated with a Negative Flow Control (NFC) regulation of the pumps, which always makes available to the consumers a certain excess of volume flow with respect to the actual demand.



The CC systems mainly use the Load Sensing (LS) regulation. The exact power needed for the movement is made available to the individual consumer.



Summations are frequently performed in the main control unit in order to be able to supply large consumers simultaneously from 2 pumps or sections. Or certain functions have priority over other functions in a main control unit.

## 1.2 Options for upgrading hydraulic systems

### Additional pumps

A separate pump can be installed on the diesel engine for additional volume flow. This measure is usually difficult to perform, is inflexible and thus reserved for certain applications, e.g. generator drives.

### OC NFC with priority

It has been established in OC systems to divide the flow of the pump directly at its outlet and to provide the remainder to the main control unit. Thus, the priority supply of the additional function, e.g. a hydraulic hammer, is ensured. Hence the additional function has priority.

### CC LS without and with priority

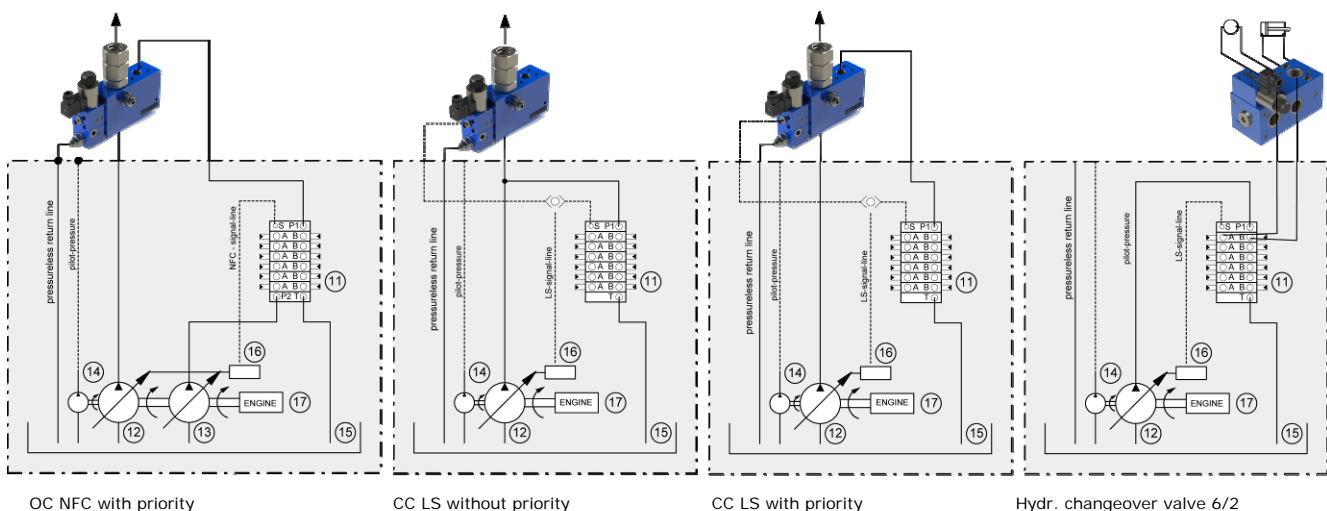
In CC systems, the additional function is connected to the pump outlet in parallel to the main control valve (without priority) or in the same manner as the OC system (with priority). In any case, the load pressure of the additional function should be plugged into the system as an LS signal so that the pump regulation includes the additional function.

### Hydraulic changeover valve

A simple functional enhancement is that with a hydraulic changeover valve, which enables the selective use of the original function or an additional function. More comprehensive valve controllers can naturally also be connected to a main control unit. It should be noted in particular here whether the respective section of the main control unit is suitable for enhancement in the overall functional context.

### Combination of circuits

Not least, volume flows separately divided from two pumps are combined into a particularly powerful workflow. The option is available in particular for crawler excavators, which typically have two identical pumps due to the symmetrical traction drives.



## 1.3 Control equipment

### Actuation types

Valves for the operation of additional functions are normally actuated hydraulically or electrically, switching or proportionally for the control of volume flow and/or pressure.

### Pilot control system

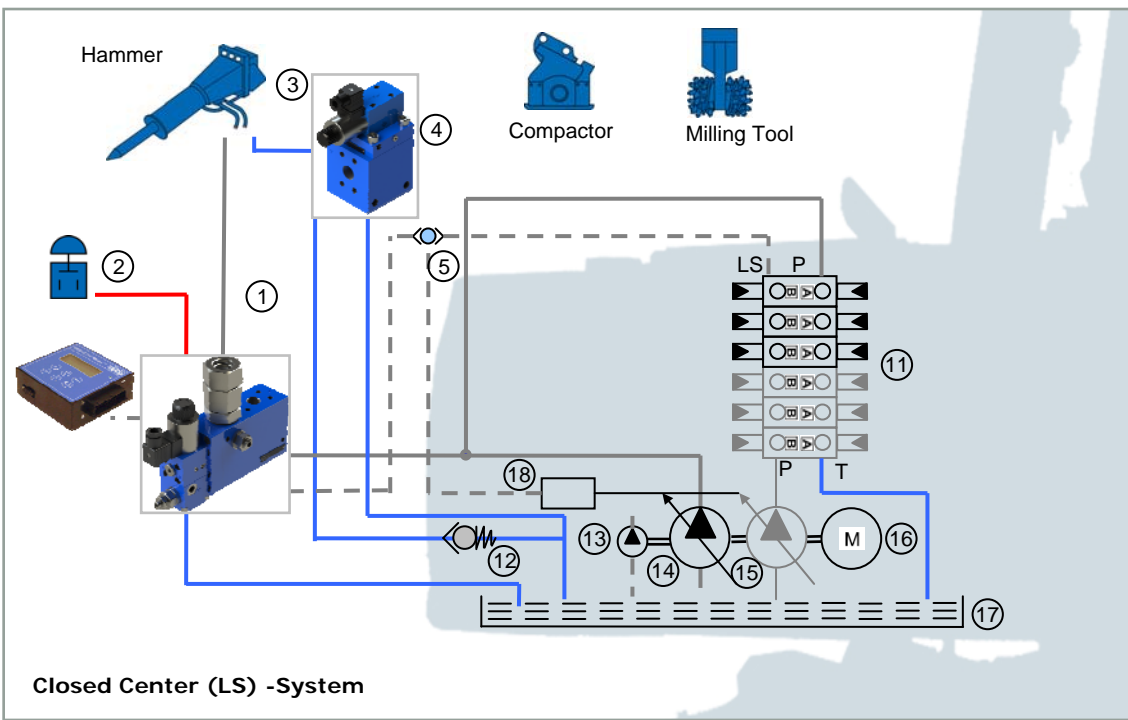
It is often necessary to also enhance the pilot control system of the machine for additional functions. This is done by means of control units, which are connected to the pilot pump and output a corresponding hydraulic control signal according to the electrically proportionally input signal.

### Control elements

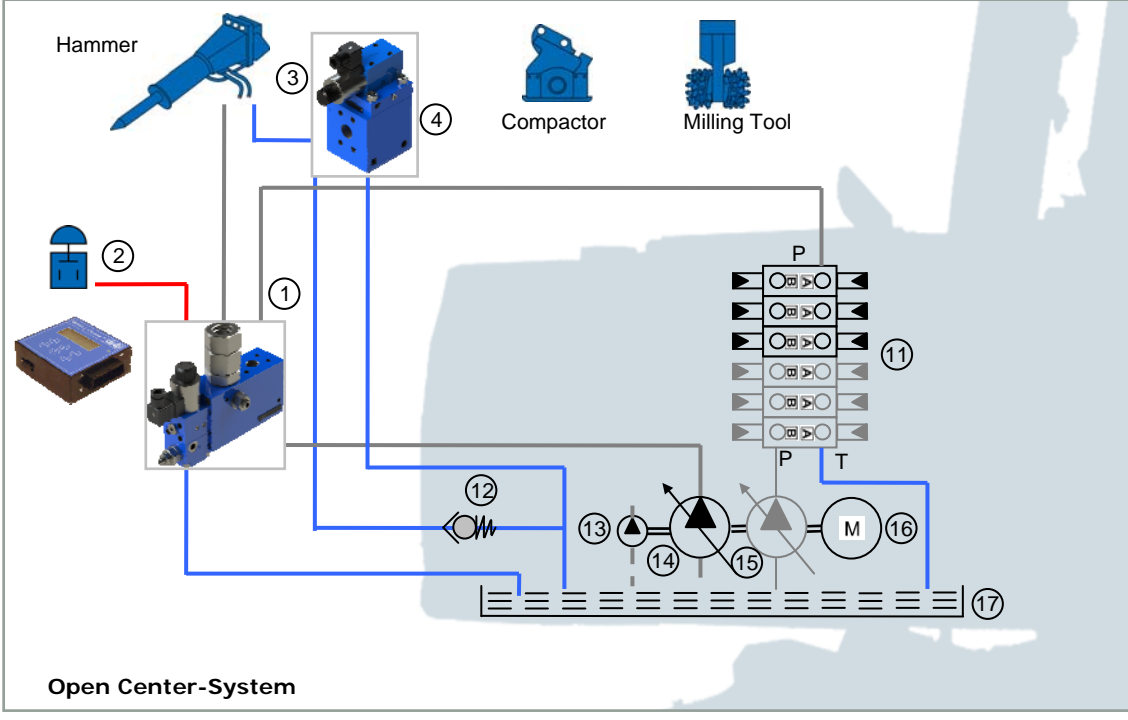
Hydraulic foot pedals, electric switches, buttons or proportional sensors are used as control elements. The electrical control elements can act on the valves directly or via amplifiers and programmable controllers.

## 2. Additional Functions and Attachment

### 2.1 Installation of attachment tools with one-way functions



- |   |                          |
|---|--------------------------|
| 1 Flow control valve FC1 with check valve | 11 Main control valve    |
| 2 Electrical switch/WTC+                  | 12 Preloaded check valve |
| 3 Additional consumer                     | 13 Pilot pump            |
| 4 Relief valve D22-NA, D33-NA             | 14 Main pump 1           |
| 5 Shuttle valve                           | 15 Main pump 2           |
|   | 16 Diesel engine         |
|   | 17 Tank                  |
|   | 18 LS controller         |



### **Volume flow supply**

The flow control valve of type FC1 (1) supplies the attachment tool with the necessary volume flow and restricts the load pressure to a permissible value through the installed pressure valve. The remaining volume flow is available for the other machine functions.

An attachment tool with hydromotor can often be operated with different working speeds. The working speed is then set with a proportionally actuated flow control valve (type FC1-1P).

A preloaded check valve mounted directly on the flow control valve is necessary for consumers with little startup pressure (e.g. hammer), in order to generate the required minimum load pressure of 8 bar. For one, this is necessary in order to switch on the flow control function and secondly prevents the connected consumer from unwanted volume flows eventually being created in the non-actuated state.

If the flow control valves FC1-1N or FC1-2N are used in a LS system or locking of load pressure needs to be avoided, a preloaded throttle check valve is recommended instead of the preloaded check valve.

While the switchable flow control valves FC1-1N and FC1-2N may overshoot, this effect does not occur in proportional flow control valves FC1-1P. If the valve is actuated via a controller, a dampened startup of the tool can be set via a ramp function. This preserves the tool and lengthens the service life.



### **Hydraulic hammer**

The hydraulic hammer normally requires an exactly defined volume flow, fitting for its optimal working range. Thus, a switching flow control valve from product group FC1-1N is used here, preferably with preloaded throttle check valve in order to offload the hammer mechanism during standstill.

A hydraulic hammer must be operated at low pressure in the return line. Thus, the returning oil is not fed through the main control unit but is rather released or switched to separate return lines directly. A return relief valve e.g. of type D22-NA can be used for this.

### **Overrun and cavitation protection**

In the case of an attachment with a large rotating mass and switchoff without load, too long of an overrun should be prevented. This can be achieved with a preloaded valve, which is installed in the return line of the tool to the tank and is normally preloaded with a pressure of 20 to 40 bar. This is particularly recommended for mowers. The rotation after shutdown is thus slowed. The hydromotor then works like a pump and requires a supply of oil on the intake side since damaging cavitation would otherwise occur. In order to prevent cavitation a check valve acting as a suction valve is installed between the return and the intake of the motor.

### **Control devices**

A control device of type CTR like the WESSEL Tool Control plus switches the flow control valve and thus the attachment tool on and off. Additional valves like the relief valve can be actuated simultaneously with it for a certain tool. If the signal is not a switching one, but rather proportionally changing, the speed or working speed can also be controlled via a proportional priority valve of the series FC1-1P. The maximum working pressure can also be set via the WESSEL Tool Control plus so that the tool is optimally protected.

## **2.2 Installation of attachment with high demand for a constant speed (generator, compressor, mower, ...)**

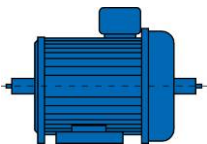
### **Drive by separate pump**

For tools that have a high volume flow accuracy requirement, the installation of a separate pump on the drive train is recommended. The pump must be designed such that it delivers a volume flow in the case of a diesel engine operating speed that is approx. 15% higher than is needed for the operation of the attachment device.

The flow control valve FC1-2G allocates the necessary volume flow to the attachment tool with a high level of accuracy and restricts through the installed pressure valve the load pressure on the permissible value. The low remaining volume flow is returned to the tank.

For a generator installation, a check pre-pressurization valve is needed on the flow control valve in order to create a minimum load pressure of 8 bar, which prevents the unwanted switching on of the priority valve in the case of very small load pressures on the consumer. The check pre-pressurization valve with fixed cover plate is part of variant FC1-2G.

A pre-pressurization valve is also recommended in the return due to the low load torque.



### 2.3 Installation of attachment tools with two-way functions

#### Hydraulic changeover valves, 6/2 or 6/3 directional control valves (type D6X):

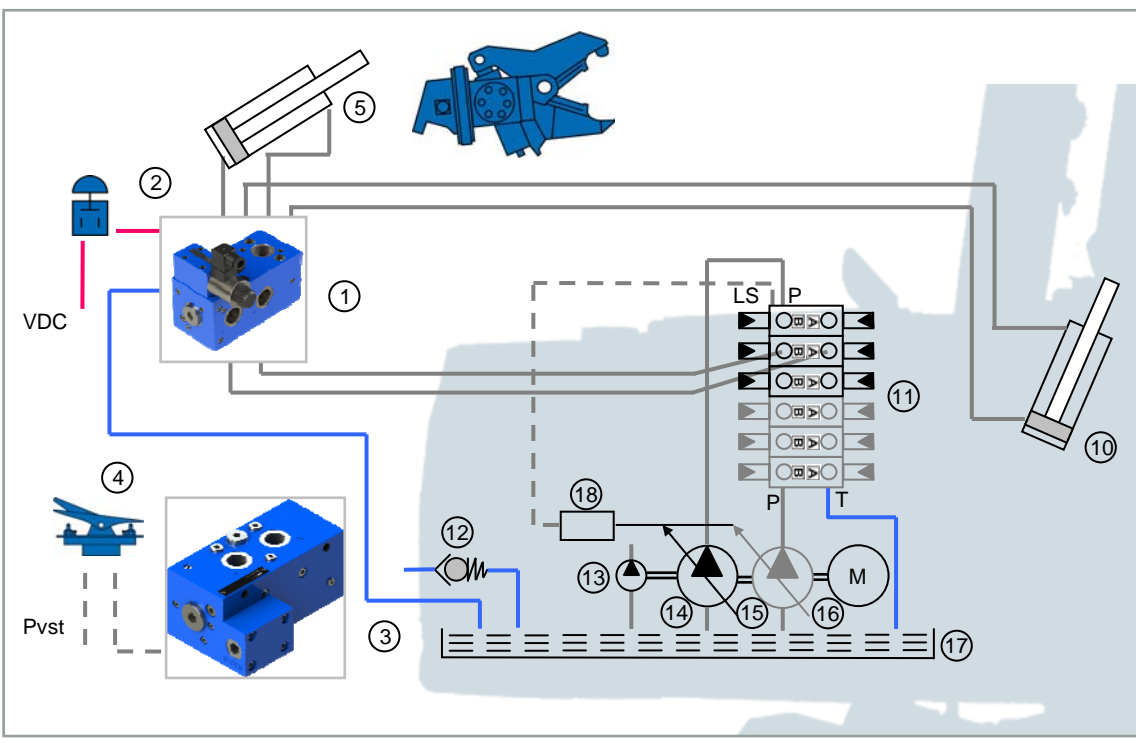
An additional consumer should be operated from an existing hydraulic circuit. For this, a 6/2 or 6/3 directional valve is integrated into the existing circuit. The volume flow can thus be switched selectively to one of the two connected consumers. This can be done electrically or hydraulically.

#### Advantages

- Minimum modification of the hydraulics
- The existing joystick can continue to be used
- Independent of the existing hydraulic system

#### Disadvantage

- No parallel actuation of both functions possible



- |   |                          |
|---|--------------------------|
| 1 Directional control valve 6/2, electrically operated  | 10 Existing consumer     |
| 2 Electrical switch                                     | 11 Main control valve    |
| 3 Directional control valve 6/2, hydraulically operated | 12 Preloaded check valve |
| 4 Pilot control unit                                    | 13 Pilot control pump    |
| 5 Additional consumer                                   | 14 Main pump 1           |
|   | 15 Main pump 2           |
|   | 16 Diesel engine         |
|   | 17 Tank                  |

#### Design

The valve can be designed as a 6/2 or 6/3 directional valve. As a 6/2 directional valve, the priority consumer is always connected with the main control unit and the additional consumer is only operated by switching of the valve. In the 6/3 variant, both consumers are separated from the main control unit in the neutral position of the directional valve.

#### Types of piloting

Depending on size and model the valve is operated:

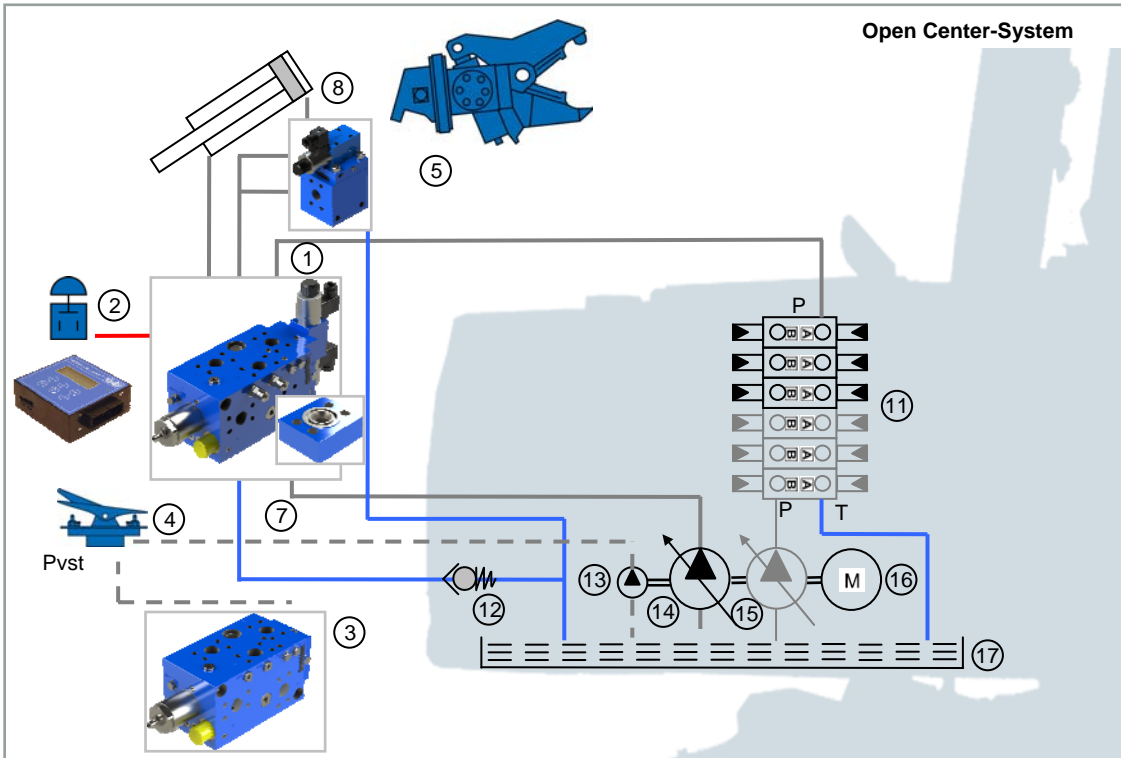
- (a) directly electrical
- (b) electrically via internal pilot pressure (2)
- (c) pilot-controlled hydraulically e.g. via a foot pedal (4), eventually restricted by an electrical control valve PCV-1N



### Shear control valves (type D53)

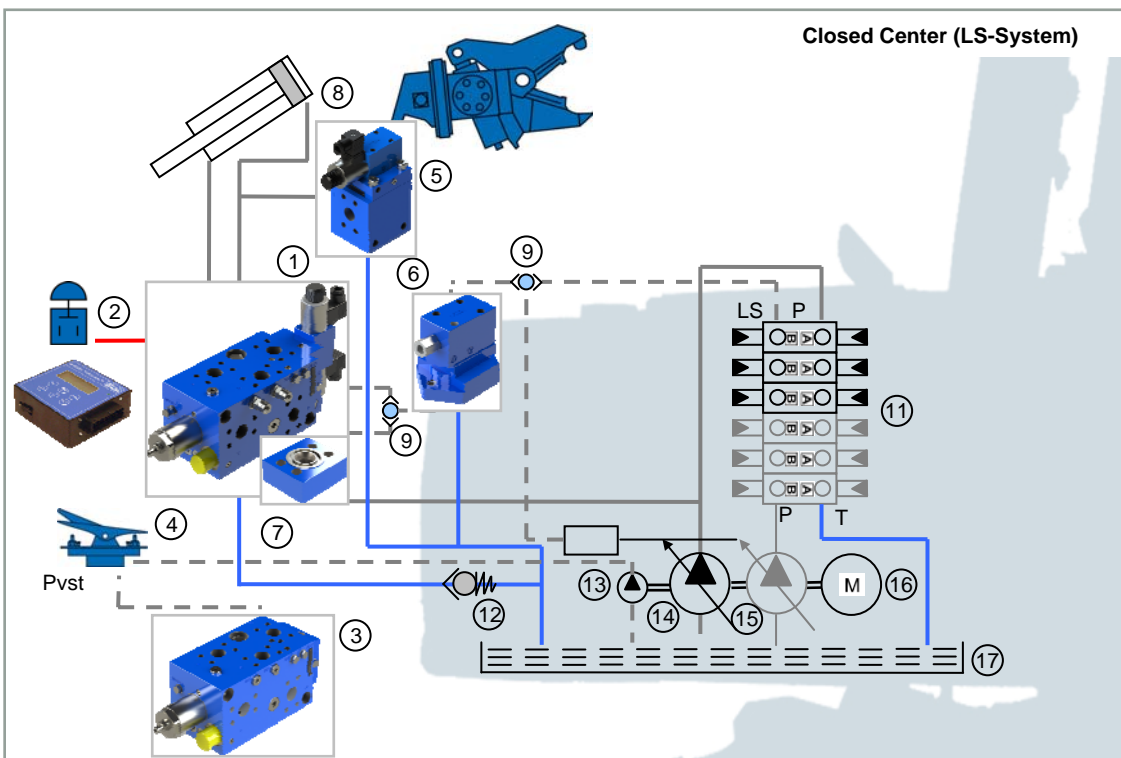
Additional consumers with a high volume flow demand and/or a large volume flow transmission (differential cylinder) must be supplied through a valve with sufficient nominal size, in order to work with only a reasonable loss and to achieve a high power output.

5/3 directional valves are suitable for this as they are specially designed for the operation of demolition and scrap shears.



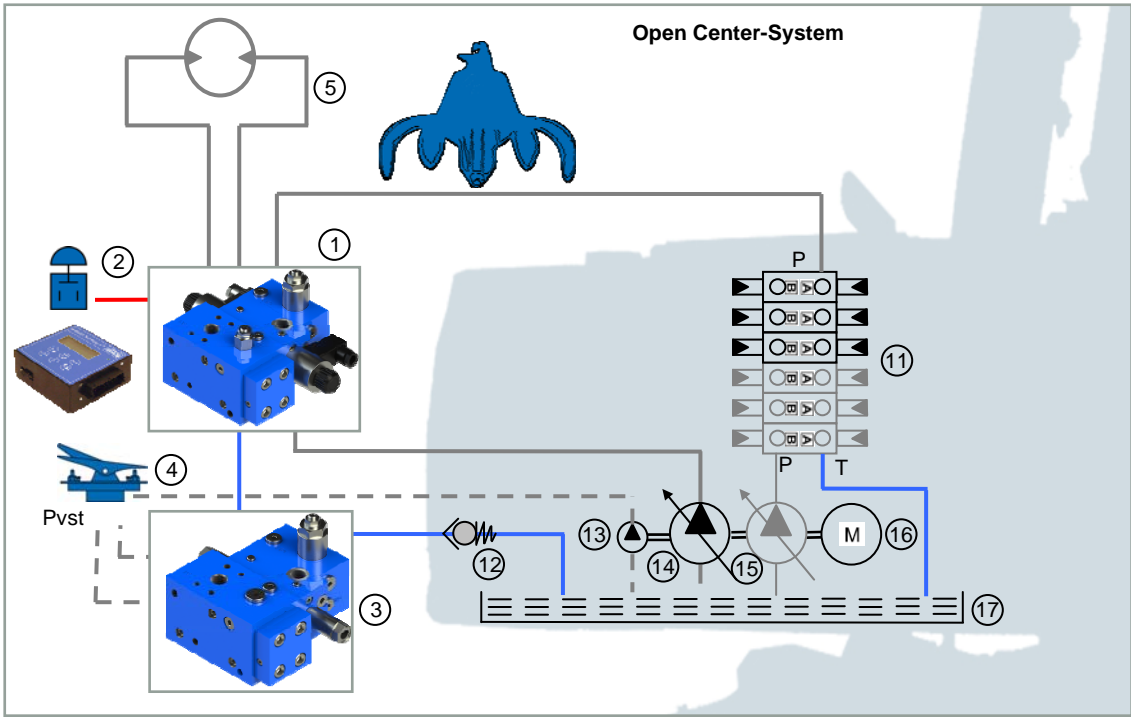
- 1 Shear controller D5/3 electrically operated
- 2 Electrical switch/WTC+
- 3 Shear controller D5/3 hydraulically operated
- 4 Foot pedal
- 5 Relief valve D22-NA, D33-NA

- 6 LS kit (directional valve D42)
- 7 Quantity restriction (accessories)
- 8 Additional consumer, e.g. shears
- 9 Check valve

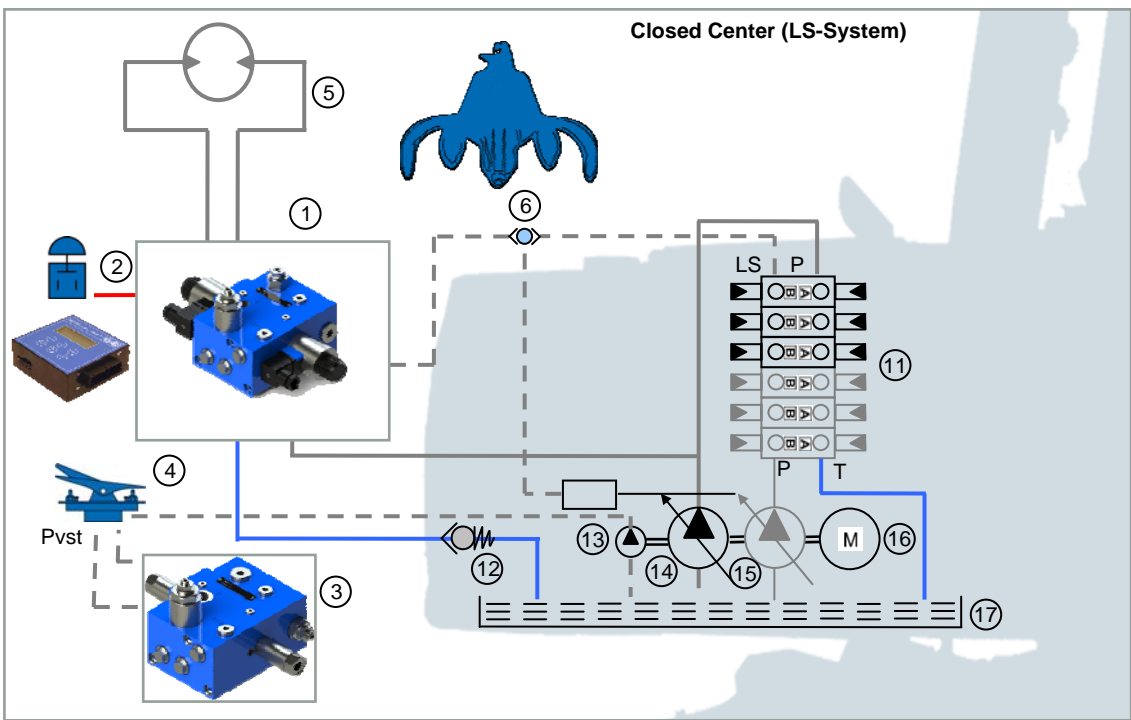


**Dual-acting additional sections for small and medium volume flows (rotate gripper, ...),  
Type FC2**

Additional consumers with small or medium volume flow demand can be operated via flow control valves of type FC2. These valves are designed for Open and Closed Center systems and are available both switching and proportional with electric or hydraulic actuation.



- |   |                          |
|---|--------------------------|
| 1 Flow control valve FC2-2N, electrically pilot-controlled  | 11 Main control valve    |
| 2 Electrical switch or WTC <sup>plus</sup>                  | 12 Preloaded check valve |
| 3 Flow control valve FC2-2N, hydraulically pilot-controlled | 13 Piloting pump         |
| 4 Hydraulic foot pedal                                      | 14 Main pump 1           |
| 5 Additional consumer                                       | 15 Main pump 2           |
|   | 16 Diesel engine         |
|   | 17 Tank                  |
|   | 18 LS controller         |

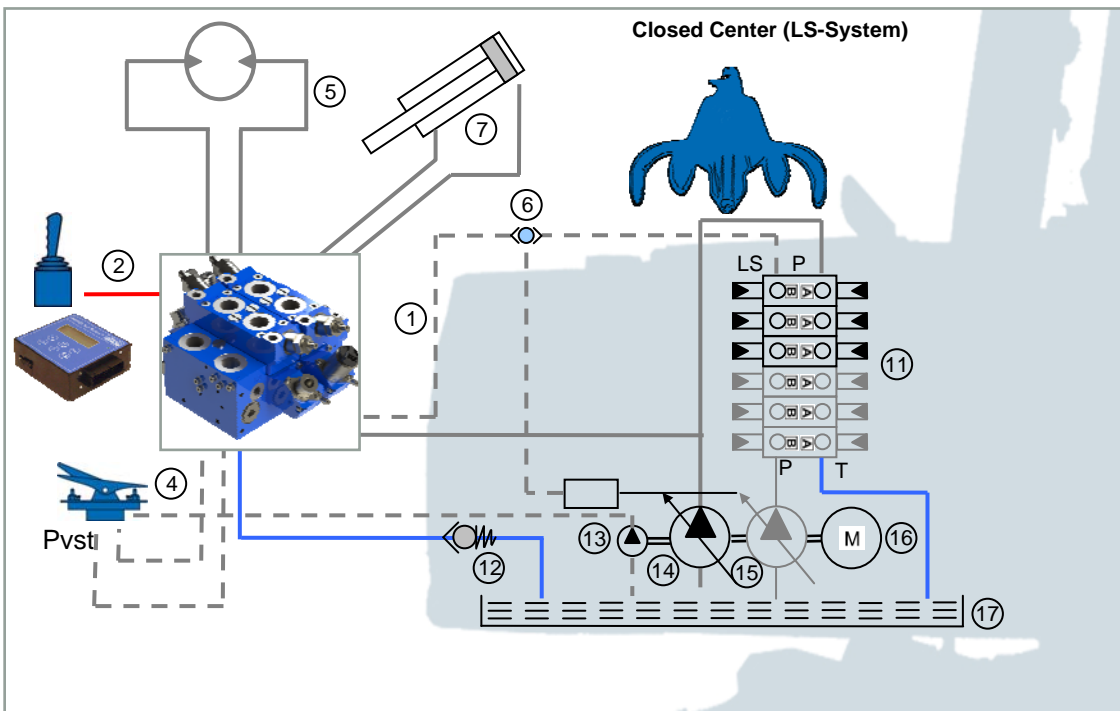


## 2.4 Installation of multiple functions (type MCV)

### Using additional functions simultaneously and load-independent

#### Example: Operate and rotate gripper

A multi control block is used for the retrofit of multiple consumers. This can be actuated hydraulic or electrically proportional. As in the below example, both actuation types are also conceivable in one valve block: The gripper is opened and closed with the foot pedal and rotated with an electric joystick or switch. In connection with other elements, activation with the WESSEL Tool Control<sup>plus</sup> is recommended. The pressure compensator functions contained in the multi control block ensure a volume flow corresponding with the respective proportional control signal regardless of how high or low the load is and whether the function is performed individually or together with other functions. The functions thus do not impact each other.



- |                                     |                          |
|-------------------------------------|--------------------------|
| 1 Flow control valve MCV 16         | 11 Main control valve    |
| 2 Joystick with WTC <sup>plus</sup> | 12 Preloaded check valve |
| 4 Hydraulic foot pedal              | 13 Piloting pump         |
| 5 Consumer 1: Rotation motor        | 14 Main pump 1           |
| 6 Shuttle valve                     | 15 Main pump 2           |
| 7 Consumer 2: Cylinder              | 16 Diesel engine         |
|                                     | 17 Tank                  |
|                                     | 18 LS controller         |

Control blocks of type MCV are also available for Open Center systems. These systems are using a pressure compensator function that divides the volume flows for the attachment tool from the main pump's volume flow and forwards the remaining volume flow for further use to the main control valve in the inlet control block.

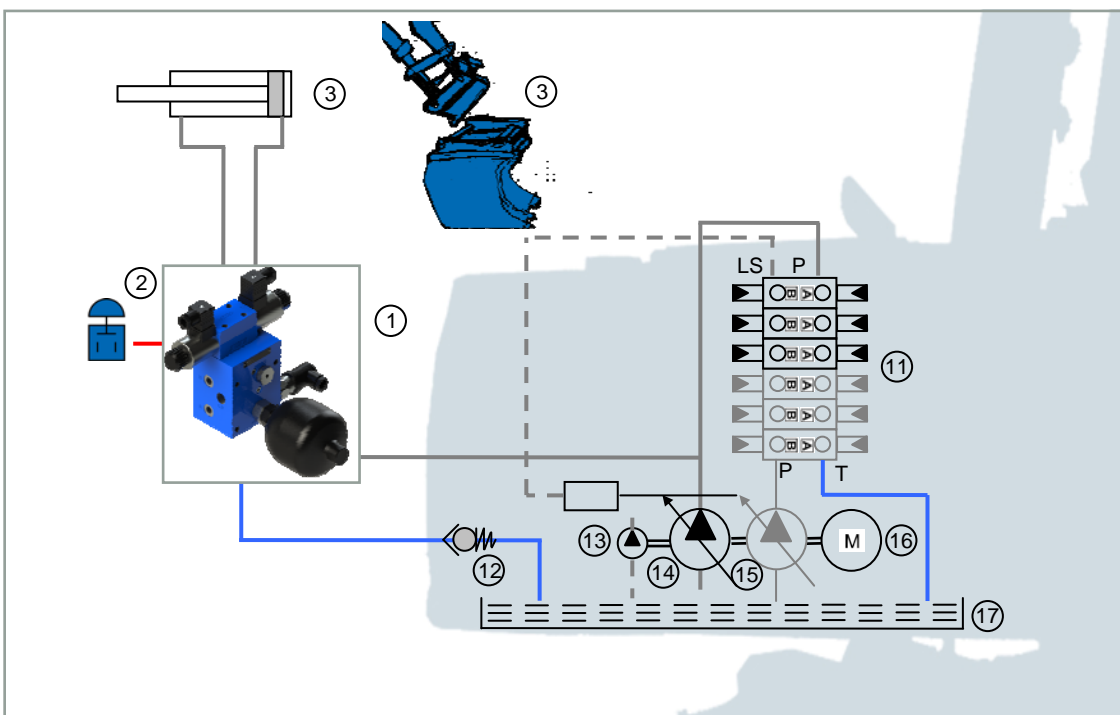
## 2.5 Actuation of quick couplers (Type QCV)

### Use of quick coupler systems

Quick coupler systems serve to easily change tools on construction machines without the driver having to leave the cabin. The main functional part of the quick change system is a hydraulic cylinder that opens and closes the lock of the quick coupler for the change-over procedure and locks the tool securely in place when closed.

The quick coupler controls and actuates the quick coupler cylinder and secures it from being opened unintended. Two methods for controlling quick couplers are generally used:

- The quick coupler valve opens and closes the quick coupler actively. The lock is held via spring force, check valves and pressure accumulators.
- The quick coupler valve opens the quick coupler actively. In neutral state of the valve, the coupler is closed hydraulically and held locked.



- 1 Quick coupler valve QCV
- 2 Switch
- 3 Locking cylinder

- 11 Main control unit
- 12 Preloaded check valve
- 13 Piloting pump
- 14 Main pump 1
- 15 Main pump 2
- 16 Diesel engine
- 17 Tank
- 18 LS controller

### Permanent pressure for holding the lock

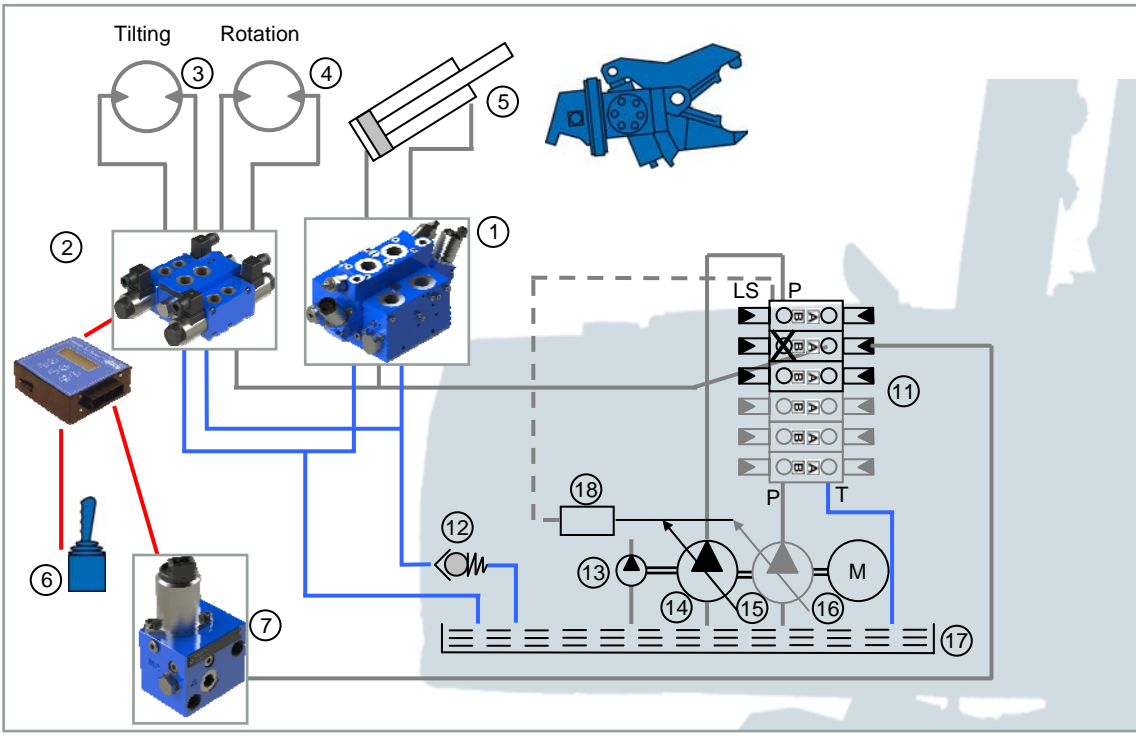
In the case of a hydraulic locking of the quick coupler, the locking cylinder must be supplied with constant pressure during the entire working period of the construction machine.

This can be ensured in two ways:

1. Pressure maintenance by means of accumulators, which are regularly reloaded, e.g. from a main function of the machine, which is frequently used
2. Pressure supply with the control pressure, which is always present during operation

### Retrofitting a tiltrotator and shear function

The below example shows the retrofitting of a shear function in which a tiltrotator is also used. The volume flow is taken from a section of the construction machine hydraulics provided for this. Thus, the suggested installation is applicable for Open and also Closed Center systems. With activation of one of the functions, the main control function switches on and a volume flow is sent to the directional valve with flow control function (1) and to the tiltrotator valve (2). The excess volume flow is fed to the tank via an input pressure compensator in the tiltrotator valve (2). So that the valve (1) can thus also work with higher load pressures, the load pressure must be reported to the input pressure compensator of the valve (2) via a LS line. Opening/closing, tilting and rotating can be performed independently of each other and independently of the load pressure.



- |                                     |                          |
|-------------------------------------|--------------------------|
| 1 Flow control valve FC2-L3         | 11 Main control valve    |
| 2 Tiltrotator control FC1-K1        | 12 Preloaded check valve |
| 3 Consumer 1: Tilting               | 13 Piloting pump         |
| 4 Consumer 2: Rotating              | 14 Main pump 1           |
| 5 Consumer 3: Opening/closing shear | 15 Main pump 2           |
| 6 electr. prop. Joystick            | 16 Diesel engine         |
| 7 Piloting valve PCV                | 17 Tank                  |
|                                     | 18 LS controller         |

### **Monitor the locking**

Mechanical indicators on the quick coupler, which are always in the view of the machine operator and detect proper locking, are common.

Moreover, acoustic signals are used that report the unlocked state and danger during unlocking and in the case of impermissible pressure loss during operation.

### **Actuation**

Since the quick coupler must not be actuated accidentally, electrical safety switches are required in particular for unlocking. For example, two buttons must be held down simultaneously for two seconds in order to trigger the actuation.

### **Control the locking**

According to the actuation, the quick coupler valve (1) is activated via a relay. A 4/2 directional valve is usually switched for this, which causes the unlocking.

If the quick coupler is operated on a supply with a pressure above the permissible pressure for the quick coupler, the quick coupler valve contains a pressure reducer (1.1) in the inlet.

Differential cylinders are frequently used to establish the lock over the bottom side and there is a risk that the lock becomes jammed. The locking pressure is then reduced by a pressure reducer (1.2), so that the unlocking takes place securely with a higher pressure.

### **Control elements for the actuations of a quick coupler system**

The actuation of a quick coupler can take place by means of the internal programming of the WESSEL Tool Control<sup>plus</sup> over 2 buttons of the control panel.

However, an actuation with any other control elements, e.g. with a switch, can also be programmed in the parameter records of the WESSEL Tool Control<sup>plus</sup>.

### 3 Optimizing Functions

#### 3.1 Reducing backpressure

**ENERGY  
SAVING  
SYSTEMS**

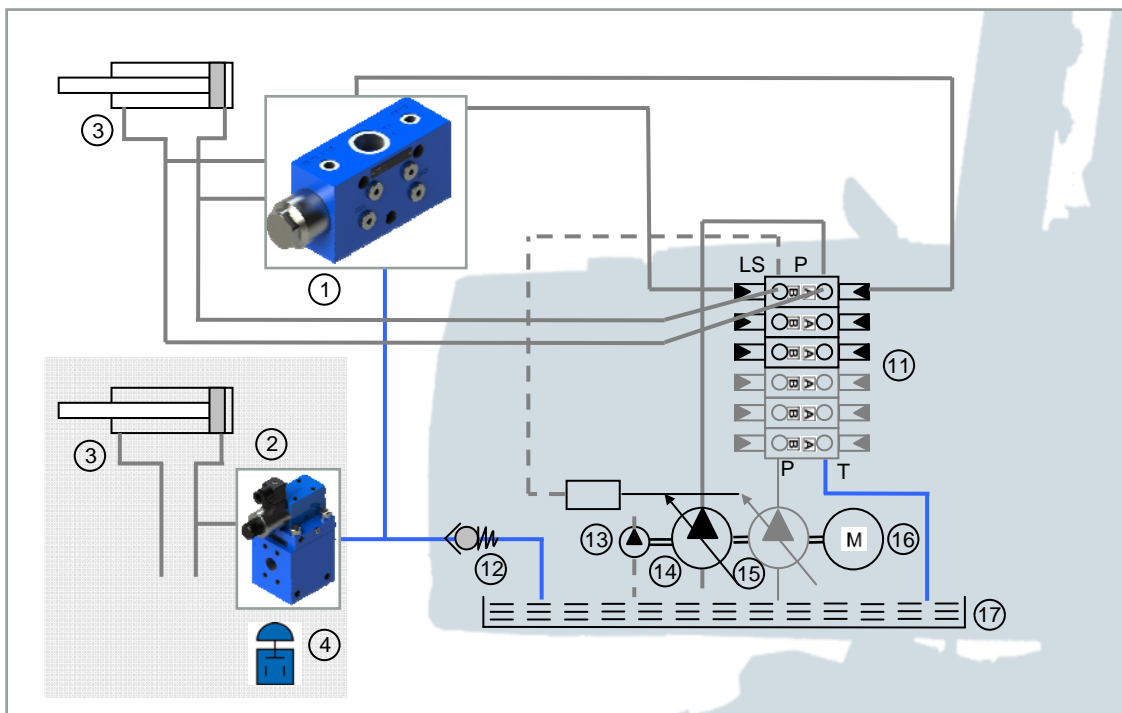
High backpressure cause unnecessary energy losses in hydraulic systems. This has two consequences:

- The fuel consumption is unnecessarily high and causes excessive operating costs
- The speeds of hydraulic consumers can drop since the pump is displaced back by the necessary high inflow pressure (power regulation).

This problem often occurs with cylinder applications: In the case of a 1:2 cylinder ratio, 400 l/min are output in case of a volume flow of 200 l/min into the rod side. If this volume flow causes a back pressure of e.g. 80 bar, 160 bar are needed for this on the inflow side!

This back pressure can be reduced considerably with a simple switch valve: If the rod side is activated, the bottom side is connected with the tank in parallel to the main control valve section. Staying with the above example: If the return pressure can be reduced from 80 to 10 bar, the inflow pressure reduces to 20 bar and power of more than 40 KW is saved.

Through the use of a valve of type D22, this effect can be achieved for one supply line, using type D33 for both lines!



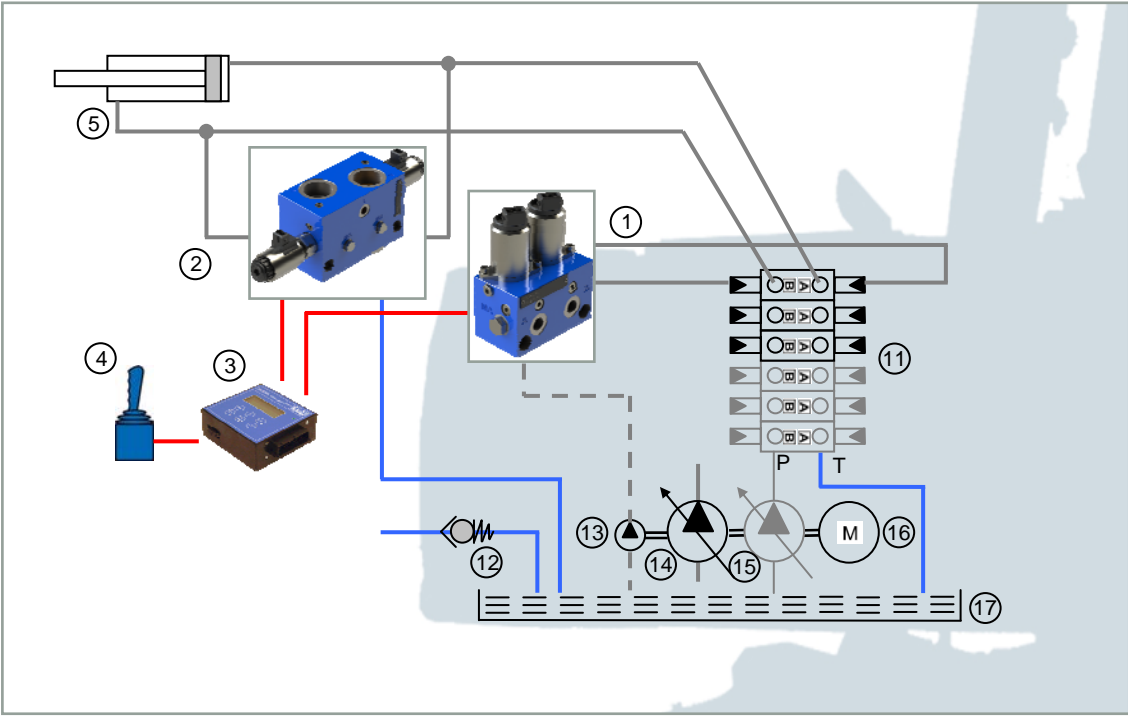
- 1 Relief valve type D33
- 2 Relief valve type D22
- 3 Cylinder
- 4 electrical activation

- 11 Main control unit
- 12 Preloaded check valve
- 13 Piloting pump
- 14 Main pump 1
- 15 Main pump 2
- 16 Diesel engine
- 17 Tank

### 3.2 Controlling and limiting power

Additional consumers must often be limited in speed (volume flow) and maximum pressure. The speed can be achieved by limiting the pilot pressure for the main spool. The maximum pressure can be limited by pressure relief valves.

If one wants to operate different consumers with the installation, we recommend selecting valves that can be set electrically proportionally. For the pilot pressure, control valves of type PCV are available for the pressure restriction valves of type PRV.



- |  |                          |
|--|--------------------------|
| 1 Control valve type PCV                                   | 11 Main control unit     |
| 2 Electrical-proportional pressure limiting valve Type PRV | 12 Preloaded check valve |
| 3 WESSEL Tool Control plus                                 | 13 Piloting pump         |
| 4 Joystick   | 14 Main pump 1           |
| 5 Cylinder   | 15 Main pump 2           |
|  | 16 Diesel engine         |
|  | 17 Tank                  |



### 3.3 Lock cylinders leakage free (type LHB or LHV)

If no lockvalves are installed on the boom or stick cylinder of an excavator the attachment or the boom might lower after a longer standstill of the machine. This unwanted effect is even more significant on older machines with worn out main control valve sections.

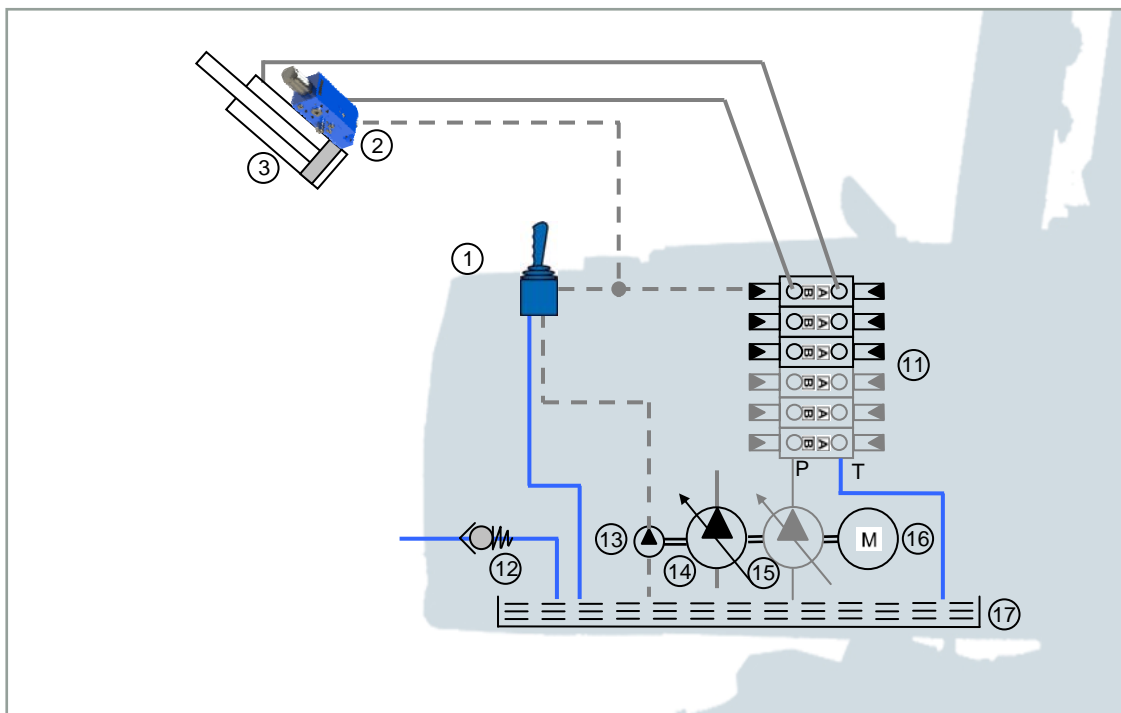
By the use of load control valves or leakage free lockvalves this leakage can be avoided. Load control valves are flanged directly onto the cylinder and operated with the same piloting signal which is used for the cylinder's main control valve section.

If only leakage free locking of cylinders is required the load control valve with the maximum volume flow in respect to its flange size should be chosen (e.g. SAE 1" with  $Q_{max} = 400$  l/min). Through this avoidable losses can be reduced.

If besides the leakfree capability also safety according to ISO 8643 is required it must be guaranteed, that the opening characteristics of the load control valve matches the characteristic of the main control valve section. In any case the nominal volume flow of the load control valve should correspond to the main control valve.

If two cylinders work in parallel (boom cylinder) it must be considered, that the pressure in both cylinders are similar. If this is not guaranteed unequal cylinder forces might cause bending stresses on the boom. This problem can be overcome by using a balance line between both load control valves.

WESSEL load control valves comply with the requirements of ISO 8643 in respect to the maximum allowable balance volume flow.



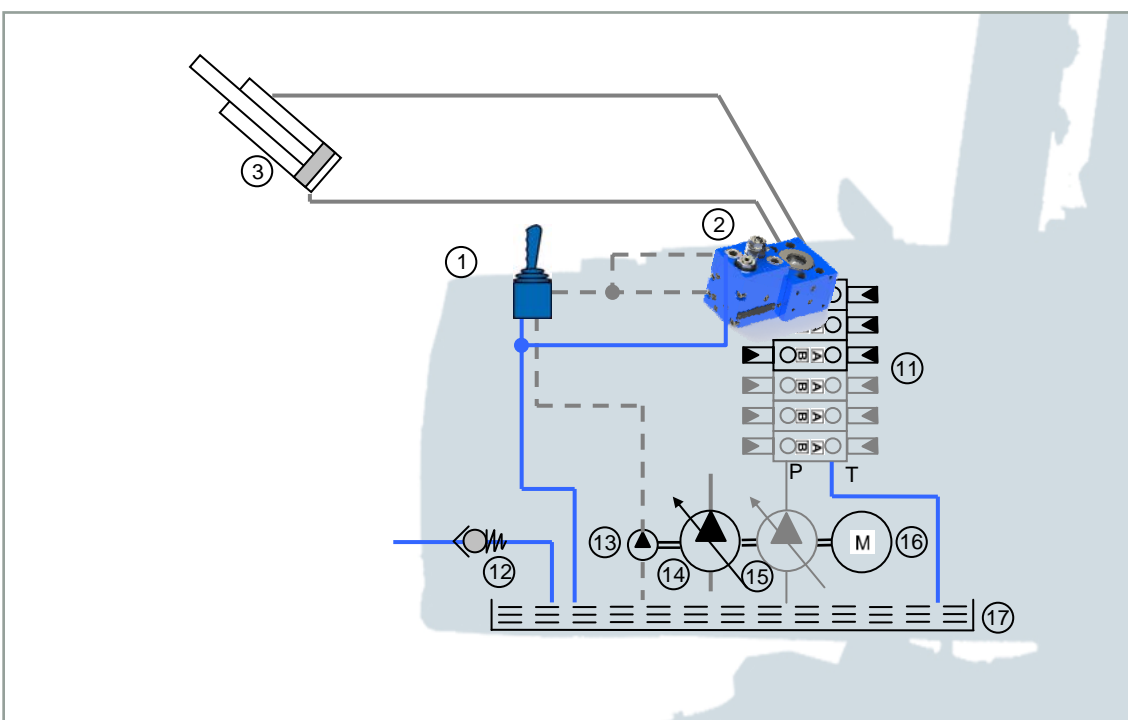
- 1 Hydraulic Joystick
- 2 Load control valve type LHB
- 3 Cylinder

- 11 Main control valve
- 12 Preloaded check valve
- 13 Piloting pump
- 14 Main pump 1
- 15 Main pump 2
- 16 Diesel engine
- 17 Tank

The installation of load control valves might be complex and expensive due to the need of relatively long additional hoses for the piloting signals. It has also be taken into consideration, that for the boom cylinders there are two valves plus balance line necessary.

An appropriate alternative to load control valves might be the use of leakage free lockvalves. These valves are flanged directly onto the main control valve´s section and are also unlocked by the piloting signal for the section. The advantage is, that the supply line to the consumer can be used without any modification. Only the piloting line has to be modified by using a t-piece in order to divert the signal to the main control valve and the lockvalve.

Different to the use of load control valves even for the locking of the boom only one leakage free lockvalve is necessary. In order to protect the consumer against too high loads a pressure relief valve is integrated in the lockvalves.

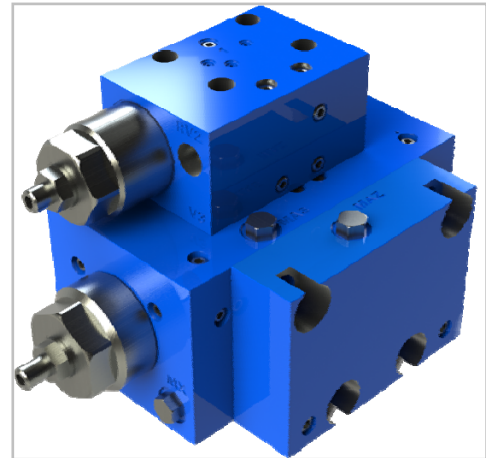


- |                                   |                          |
|-----------------------------------|--------------------------|
| 1 Hydraulic Joystick              | 11 Main control valve    |
| 2 Leakage free lockvalve type LHV | 12 Preloaded check valve |
| 3 Cylinder                        | 13 Piloting pump         |
|                                   | 14 Main pump 1           |
|                                   | 15 Main pump 2           |
|                                   | 16 Diesel engine         |
|                                   | 17 Tank                  |

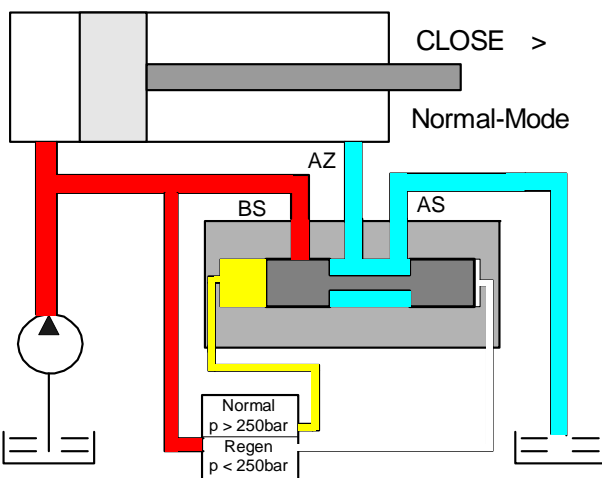
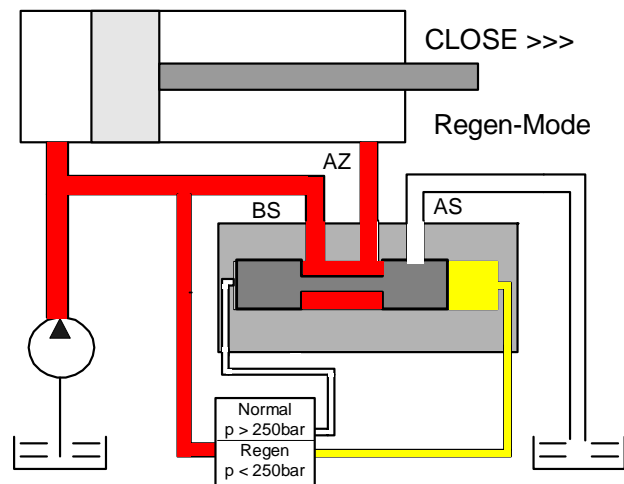
### 3.4 Regeneration mode for cylinders (type REG)

A high breakout force is required by demolition shears. In order to achieve this, the use of cylinders with large diameters is required. However, they also require a large volume flow when closing, which leads to corresponding closing times. The productivity can be considerably increased with WESSEL speed-valves. The closing time can be reduced, without losing power.

The closing of the shears first takes place in regen mode, in which the oil volume from the rod side is fed back additionally into the bottom side of the cylinder. The inflowing volume flow has to replace only the volume of the piston rod. If then cutting power is required, the valve switches to power mode. It switches the rod side to the return line and the pressure acts on the entire cylinder bottom surfaces (normal mode). A patented structure ensures that the regen mode is available up to high working pressures. A lot of work can thus be performed completely in regen mode.



In regen mode, the rod and bottom side of the cylinder are connected via the regen valve. The rod side thus feeds its volume flow additionally to the bottom side. The same pressure acts in the entire cylinder so that only the piston rod surface is in effect for the power.



Once a defined control pressure (e.g. 270 bar) is reached, the valve automatically switches to power mode (normal mode). The rod side is then connected with the return line, the pump pressure acts on the entire piston surface.

## 4 Product Groups

### 4.1 Flow control valves type FC1

The flow control valve (pressure compensator) allows the operation of single-acting attachments (hydraulic hammers, vibration compactors, etc.) on construction machines that are not equipped for them.

The attachment can be used simultaneously in conjunction with normal construction machine functions.

#### Highlights

- Precision flow distribution
- Wide range for adjusting the usable priority flow
- Pressure protection of the consumer independently of flow rate based on the pressure cut-off principle
- Small pressure loss in free-flow

#### 4.1.1 Variants

##### Variant 1N

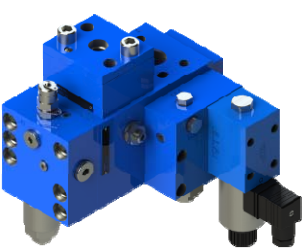


Standard variant  
Sizes for 55, 100 and 200 l/min

The volume flow is set mechanically and fed to connection H upon actuation. The remaining volume flow is available for other applications.  
Pressure range up to 420 bar.

See data sheet FC1-1N

##### Variant 2N

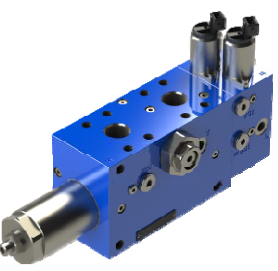


Standard variant  
Sizes for 300 and 550 l/min

The volume flow is set mechanically and fed to connection H upon actuation. The remaining volume flow is available for other applications.  
Pressure range up to 420 bar.

See data sheet FC1-2N

##### Variant 1P

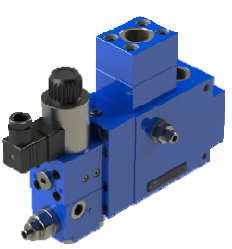


Proportionally adjustable  
Size for up to 300 l/min, SAE 1"

Volume flow and pressure control for the additional consumer can be set proportionally with the valve.  
Pressure range 420 bar.

See data sheet FC1-1P

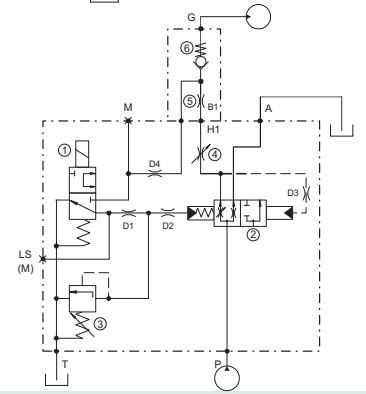
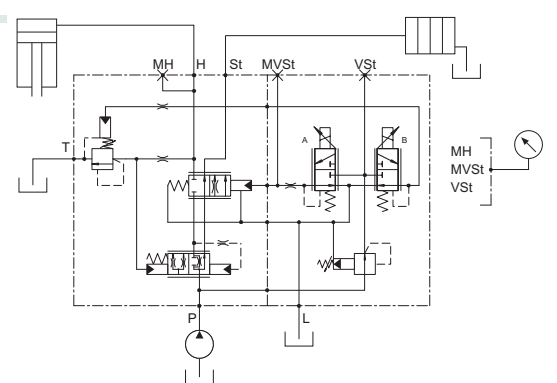
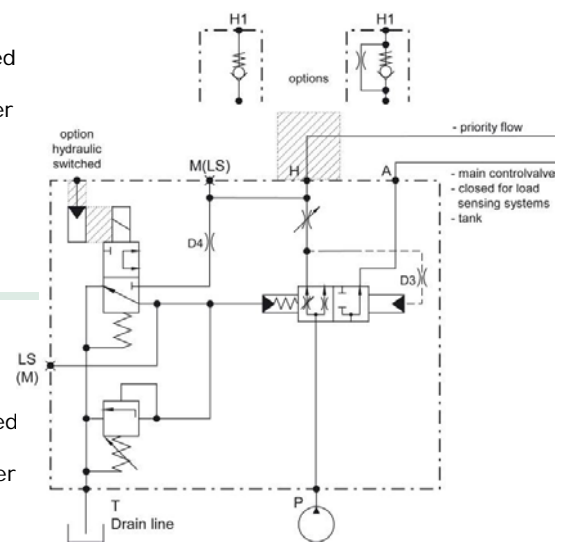
##### Variant 2G



For high accuracy requirements  
e.g. generator operation  
Size for up to 100 l/min.

Valves of this variant are characterized by a high accuracy of the flow control function. They are thus very suitable for the operation of e.g. generators and compressors.

See data sheet FC1-2G



4.1.2 Type code

<b>FC1</b>				<b>420</b>					
00	Product group	Current control valve for simple-actuation applications						<b>FC1</b>	
01	Construction type	<b>1N</b>	<b>2N</b>	<b>1P</b>	<b>2G</b>				
02	Connections	Pump (P), output (A), attachment	55 l/min	G ½" – ISO 1179-1	<b>03D</b>				
			100 l/min	M27x2 – ISO 9974	<b>00H</b>				
			200 l/min	SAE 3/4" - CODE 62	<b>05C</b>				
			300 l/min	SAE 1" - CODE 62	<b>05E</b>				
			550 l/min	SAE 1 ¼" - CODE 62	<b>05G</b>				
03	Input flow rate	l/min	55 l/min	<b>055</b>					
			100 l/min	<b>100</b>					
			200 l/min	<b>200</b>					
			300 l/min	<b>300</b>					
			550 l/min	<b>550</b>					
04	Max. permissible pres-	420 bar					<b>420</b>		
05	Actuation	Hydraulic (p < 50 bar)	<b>HYS03B</b>						
		Electrical switching 12 VDC – connection via ISO 4400 angle plug connection	<b>12S001</b>						
		Electrical switching 12 VDC – connection via Junior Timer plug	<b>12S002</b>						
		Electrical switching 24 VDC – connection via ISO 4400 angle plug connection	<b>24S001</b>						
		Electrical switching 24 VDC – connection via Junior Timer plug	<b>24S002</b>						
		Permanently activated	<b>00000</b>						
		Electrical proportional switching 12 VDC – connection via Junior Timer plug	<b>12P002</b>						
Electrical proportional switching 24 VDC – connection via Junior Timer plug	<b>24P002</b>								
06	Hydraulic system	2-way flow controller – suitable for closed center systems (load-sensing systems)					<b>CC</b>		
		3-way flow controller – suitable for open center systems (throttle, NFC systems, etc.)					<b>OC</b>		
07	Output volume	no presetting	<b>00</b>						
		Adjustable by user	<b>01</b>						
		Electrically proportional, adjustable	<b>02</b>						
		Preset to 45 l/min	<b>045</b>						
		Preset to 50 l/min	<b>050</b>						
		Preset to 57 l/min	<b>057</b>						
		Preset to 69 l/min	<b>069</b>						
		Preset to 80 l/min	<b>080</b>						
		Preset to 90 l/min	<b>090</b>						
Preset to 100 l/min	<b>100</b>								
08	Check valve		Check valve part number	55 l/min	100 l/min	200 l/min	300 l/min	550 l/min	
		No CV		■	■	■	■	■	<b>00</b>
		CV 15L	424.071.333.9	■					<b>01</b>
		CV 25S	427.071.319.9			■			<b>02</b>
		TCV 15L	424.071.306.9		■				<b>11</b>
		TCV 18L	426.072.303.9	■					<b>12</b>
		TCV 20S	426.072.301.9		■				<b>13</b>
		TCV 25S	427.071.301.9			■			<b>14</b>
		CV SAE 1"	427.063.208.9				■		<b>06</b>
		TCV SAE 1"	427.063.206.9				■		<b>21</b>
		CV 38S	448.003.002.8					■	<b>03</b>
TCV 38S	448.003.001.8					■	<b>15</b>		

XXX – Predetermined characteristics XXX- Characteristics selectable by customer ■ available ○ not available

## 4.2 Directional valves 6/2 and 6/3, changeover valves type D6X

Another consumer can be included in an existing installation with a 6/2 or 6/3 directional valve.

The volume flow can thus be switched selectively to one of the two connected consumers. This can take place electrically or hydraulically.

### Highlights

- Minimum modification of the hydraulic system
- The existing joystick can also be used for the additional consumer
- Independent of the hydraulic system
- Control pressure is generated internally
- High pressure capability

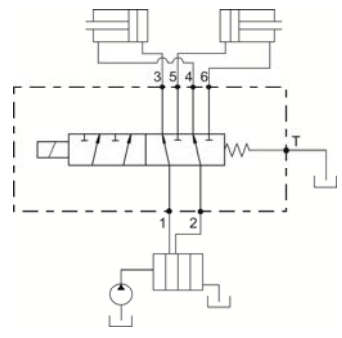
### 4.2.1 Variants

#### Variant D62-2D

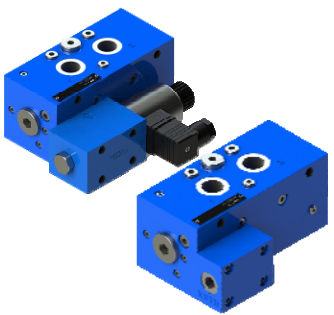


Directly actuated  
Size for 50 l/min, 350 bar

Directional valves of variant D62-2D are directly actuated 6/2 directional valves that can be used up to a maximum input pressure of 350 bar and a volume flow of 50 l/min. They can also be used in the pilot control circuit, e.g. to switch the joystick function to another consumer. See data sheet D62-2D

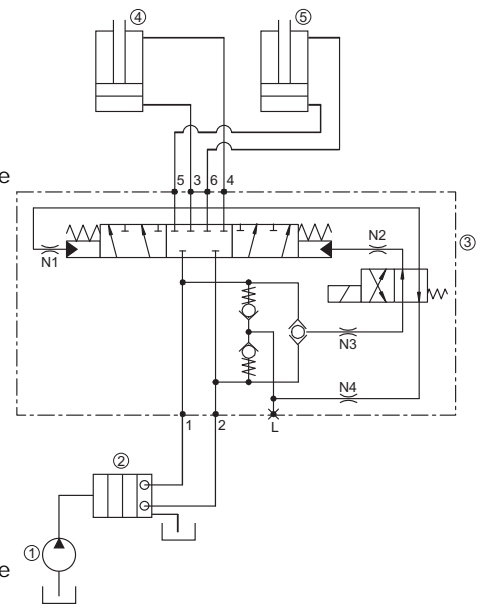


#### Variant D6X-2S

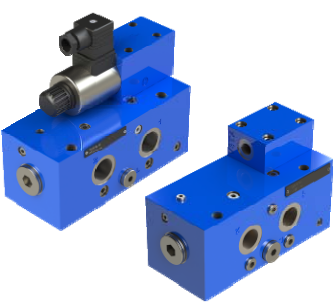


Standard variant  
Size for 100 l/min, 350 bar/420 bar

Directional valves of variant D6X-2S are pre-pressurized valves that can be used up to 420 bar and 100 l/min. They are also available as 6/2 (preferred position) and as 6/3 directional valves (blocked middle position). These valves can be actuated hydraulically or electrically whereby the necessary control pressure in the electrical variant is made available internally. See data sheet D62-2S



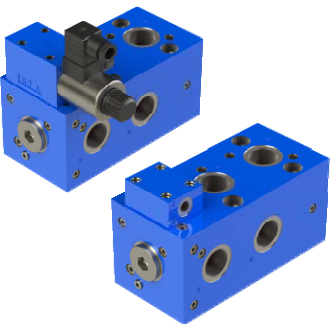
#### Variant 6X-2M.



Standard variant  
Size for 250 l/min, 350 bar/420 bar

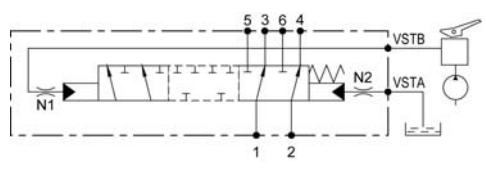
Directional valves of variant D6X-2M are pre-pressurized valves that can be used up to 420 bar and 250 l/min. They are also available as 6/2 (preferred position) and as 6/3 directional valves (blocked middle position). These valves can be actuated hydraulically or electrically whereby the necessary control pressure in the electrical variant is made available internally. See data sheet D62-2M

#### Variant D6X-2L



Standard variant  
Size for 400 l/min, 350 bar/420 bar

Directional valves of variant D6X-2M are pre-pressurized valves that can be used up to 420 bar and 250 l/min. They are also available as 6/2 (preferred position) and as 6/3 directional valves (blocked middle position). These valves can be actuated hydraulically or electrically whereby the necessary control pressure in the electrical variant is made available internally. See data sheet D62-2L



4.2.2 Type code

D6X								
00	01	02	03	04	05	06	07	08
00	Product Group	Directional control valves 6/2 or directional control valves 6/3						D6X
01	Design	Standard Version, directly operated						2D
		Standard Version, small size						2S
		Standard Version, medium size						2M
		Standard Version, large size						2L
02	Connections	Version 2D			1,2,3,4,5,6 in G3/8" ISO 1179-1			03C
		Version 2S			1,2,3,4,5,6 in G1/2" ISO 1179-1			03D
		Version 2M			1,2,3,4,5,6 in G3/4" ISO 1179-1			03E
		Version 2L			1,2,3,4,5,6 in G1" ISO 1179-1			03F
03	Input flow rate	50 l/min						50
		100 l/min						100
		250 l/min						250
		400 l/min						400
04	Max. permissible pressure	350 bar						350
		420 bar						420
05	Actuation	Electrical switching 12 VDC – connection via ISO 4400 angle plug connection						12S001
		Electrical switching 12 VDC – connection via Junior Timer plug						12S002
		Electrical switching 24 VDC – connection via ISO 4400 angle plug connection						24S001
		Electrical switching 24 VDC – connection via Junior Timer plug						24S002
06	Soft switching	Yes						1
		No						0
07	Preferred position	Directional control valves 6/3						630
		Preferred position, Directional valve 6/2, idle position 1-3 and 2-4						620
		Preferred position, Directional valve 6/2, idle position 1-5 and 2-6						621
08	Tank relief	With tank relief						1
		Without tank relief						0

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

### 4.3 Shear controllers type D53

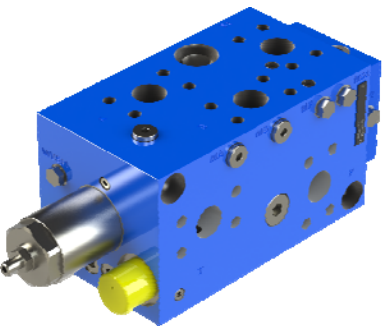
The directional valve of type D53 is a retrofittable pusher valve for throttle, NFC and LS controllers for activation of dual-acting consumers in construction machines. The directional valve serves to take in an oil volume flow from the main volume flow of the construction machine in order to operate additional consumers like shears, pulverizers or other tools.

#### Highlights

- Simple expansion of a hydraulic system by another dual-acting main function
- Low pressure losses
- Electrically or hydraulically switching actuation
- High switching forces on the main spool

#### 4.3.1 Variants

##### Variant 1N

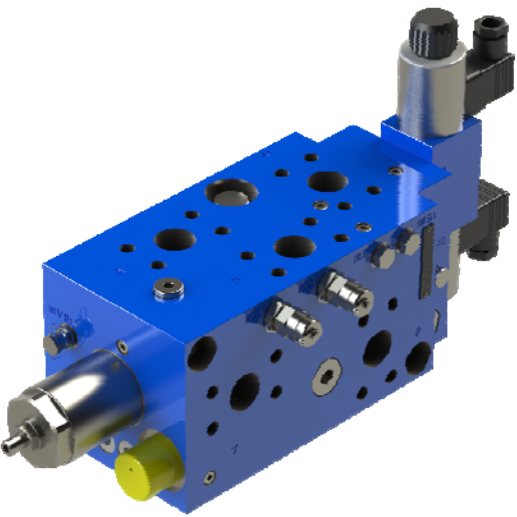


Hydraulically pilot controlled 250 l/min

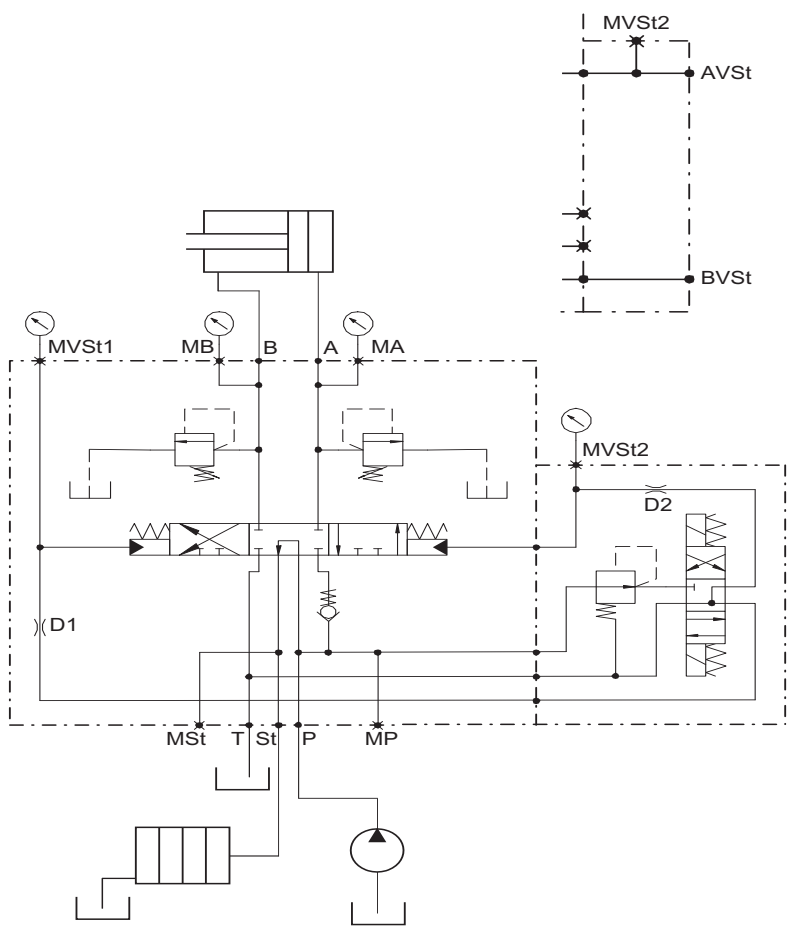
Standard variant  
250/450 l/min, 420 bar, switching

The variant 1N can be used for Open Center and Closed Center hydraulic systems. The valve is actuated electrically or hydraulically depending on the variant. The consumer is protected with two pressure limiting valves against high pressure.

See data sheet D53-1N for detailed information



Electrically pilot controlled 450 l/min





### 4.3.2 Type code

		<b>D53</b>	<b>1N</b>			<b>420</b>		<b>00</b>	
		00	01	02	03	04	05	06	07
00	Product group	Directional valves for dual-acting consumers							<b>D53</b>
01	Variant	Electric or hydraulic actuation							<b>1N</b>
02	Connections	Pump, tank, consumer, connection to main controller block SAE 1" CODE 62							<b>05E</b>
		Pump, tank, consumer, connection to main controller block SAE 1 ¼" CODE 62							<b>05G</b>
03	Input flow rate	250 l/min							<b>250</b>
		450 l/min							<b>450</b>
04	Max. permissible pressure	420 bar							<b>420</b>
05	Actuation	Electrical switching 12 VDC – connection via ISO 4400 angle plug connection							<b>12S001</b>
		Electrical switching 24 VDC – connection via ISO 4400 angle plug connection							<b>24S002</b>
		Hydraulically switching							<b>HYS03B</b>
06	Hydraulic system	System-independent							<b>00</b>
07	Pressure setting	No preset default							<b>00</b>
		Presetting consumer connection A and B = 320 bar							<b>320</b>

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

#### 4.4 Dual-acting flow control valves type FC2

The flow control valve allows the operation of dual-acting consumers (rotary motors for shears and grippers, tilting buckets, sweeper brushes) on constructions machines that are not equipped for them.

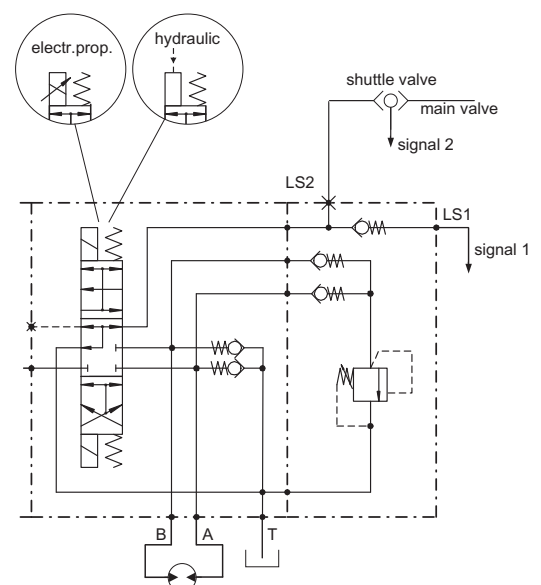
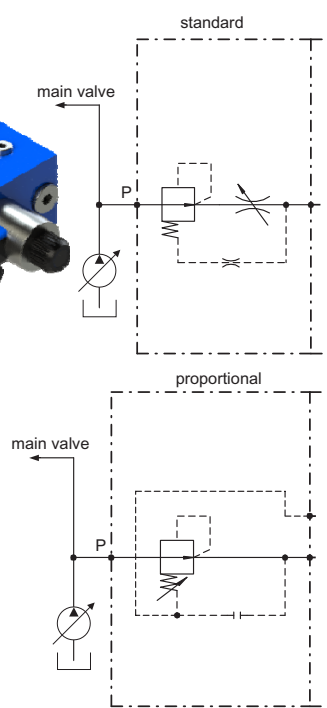
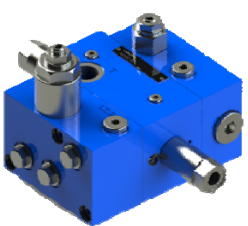
The attachment can be used simultaneously in conjunction with normal construction machine functions.

#### Highlights

- Pressure protection of consumer ports
- Simple expansion of a hydraulic system for attachments with low flow requirements
- Electrically or hydraulically proportional actuation of the attachment is possible
- Integrated suction valves for both attachment connections

#### 4.4.1 Variants

##### Variant 1L

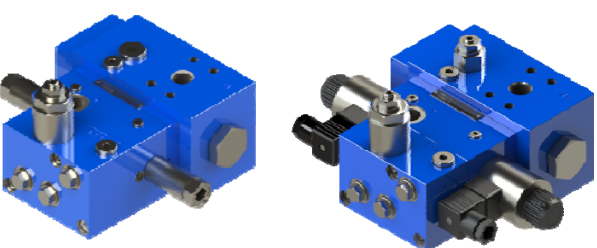


Standard variant for LS systems  
40 l/min proportional  
60 l/min switching

The variant 1L represents the standard variant for LS systems. The valve can be activated hydraulically or electrically, switching or proportional.

See data sheet FC2-1L

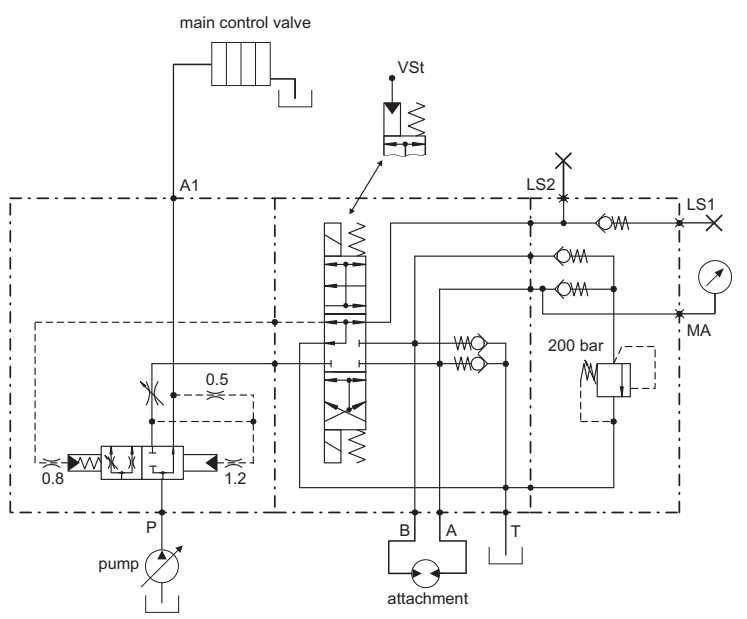
##### Variant 1N



Standard variant for Open Center systems  
SAE 3/4", SAE 1" – 300, 400 l/min input flow rate  
Output volume flow 40 l/min proportional,  
60 l/min switching

The variant 1N represents the standard variant for Open Center systems. The valve is installed between the pump and main control block and divides off a volume flow for the additional consumer.

See data sheet FC2-1N



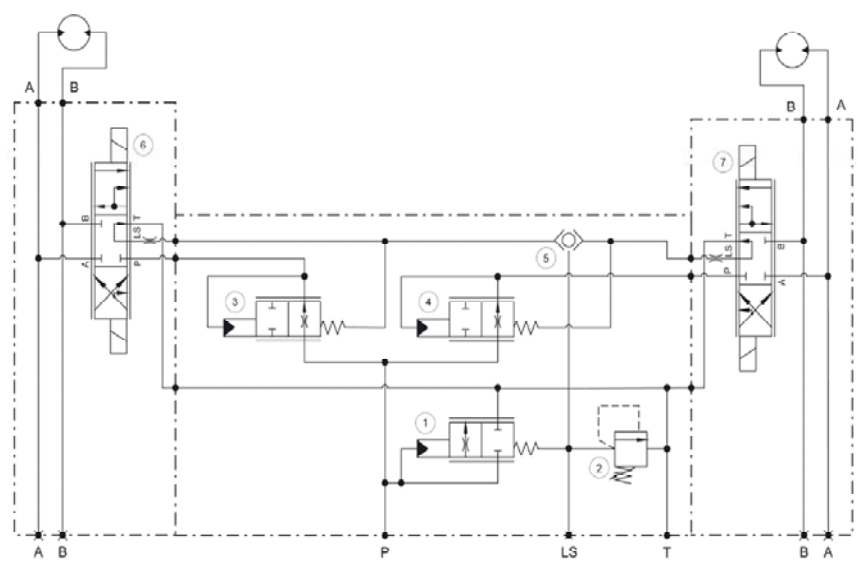
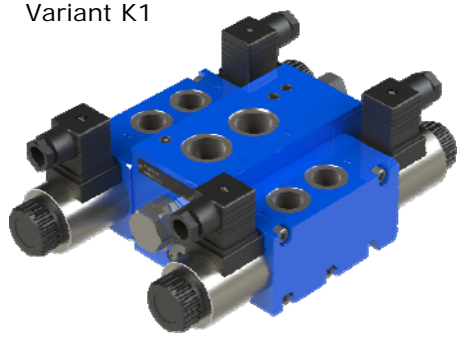
#### 4.4.2 Type code

FC2		03D		400				
00	01	02	03	04	05	06	07	
00	Product group	Flow control valve for dual-acting consumers					<b>FC2</b>	
01	Construction type	Valve for Closed Center Applications (LS)					<b>1L</b>	
		Valve for Open Center Applications (NFC)					<b>1N</b>	
02	Connections	Attachment connections G ½" – ISO 1179-1					<b>03D</b>	
03	Input flow rate	60 l/min (switchable operation); 40 l/min (proportional operation)					<b>60</b>	
		SAE ¾" 300 l/min CODE 62					<b>300</b>	
		SAE 1" 400 l/min CODE 62					<b>400</b>	
04	Max. permissible pressure	400 bar					<b>400</b>	
05	Actuation	Electrical switching 12 VDC – ISO 4400 angle plug connection					<b>12S001</b>	
		Electrical switching 24 VDC – ISO 4400 angle plug connection					<b>24S001</b>	
		Electrical proportional 12 VDC – ISO 4400 angle plug connection					<b>12P001</b>	
		Electrical proportional 24 VDC – ISO 4400 angle plug connection					<b>24P001</b>	
		Electrical switching 12 VDC – connection via Junior Timer plug					<b>12S002</b>	
		Electrical switching 24 VDC – connection via Junior Timer plug					<b>24S002</b>	
		Electrical proportional 12 VDC – connection via Junior Timer plug					<b>12P002</b>	
		Electrical proportional 24 VDC – connection via Junior Timer plug					<b>24P002</b>	
		Hydraulic switching – VST connection G ¼" ISO 1179-1					<b>HYS03B</b>	
Hydraulic proportional – VST connection G ¼" ISO 1179-1					<b>HYP03B</b>			
06	Output flow rate	Proportional (no preset default)					<b>00</b>	
		Switching: default setting 35 l/min					<b>35</b>	
07	Secondary pressure relief	No preset default					<b>000</b>	
		Preset default 200 bar					<b>200</b>	

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

### 4.4.3 Control valves type K1

Variant K1



Control valve for Tiltrotator applications  
output volume flow 2 x 50 l/min

This proportional flow control valve has been designed especially for the operation of two consumers which have to be operated simultaneously and independently. Tiltrotator applications do have these requirements (tilting / rotating). Besides the demand to use this valve in any hydraulic system a compact design has been taken care of especially.

See data sheet FC2-K1

## 4.5 Main control valves type MCV

The mobile control block MCV is a modularly structured single or multi proportional directional valve system in sectional construction for mobile applications, which can be retrofitted in Open or Closed Center systems.

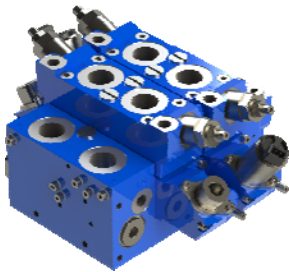
The control block consists of three versatile configurable main components

- Input plates
- Directional valve sections
- End plate

### Highlights

- Modular system
- Simple expansion of a hydraulic system for one or more additional consumers - Input plates available for Open and Closed Center systems
- Maximum pressure 420 bar
- 100 or 240 l/min per additional consumer
- Electrical or hydraulic activation possible
- Pressure relief and suction function integrated to protect the consumer

### 4.5.1 Variants



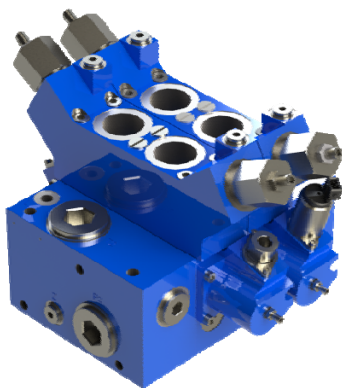
Variant 1NB16

Size NG16 - 100 l/min per section  
Size NG22 - 240 l/min per section

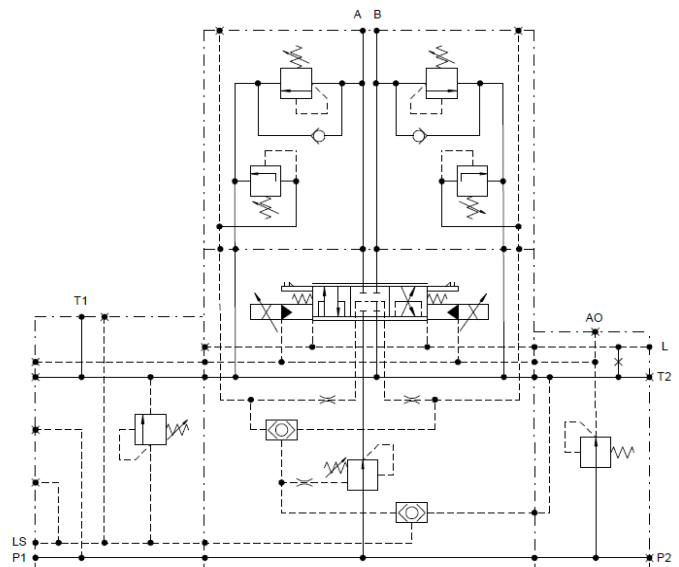
Hydraulically or electrically pilot controlled

Depending on the input plate, the valve is suitable for Open or Closed Center systems. The section plates are designed with or without pressure compensator and can be pilot controlled electrically or hydraulically. - The necessary pilot pressure is generated internally.

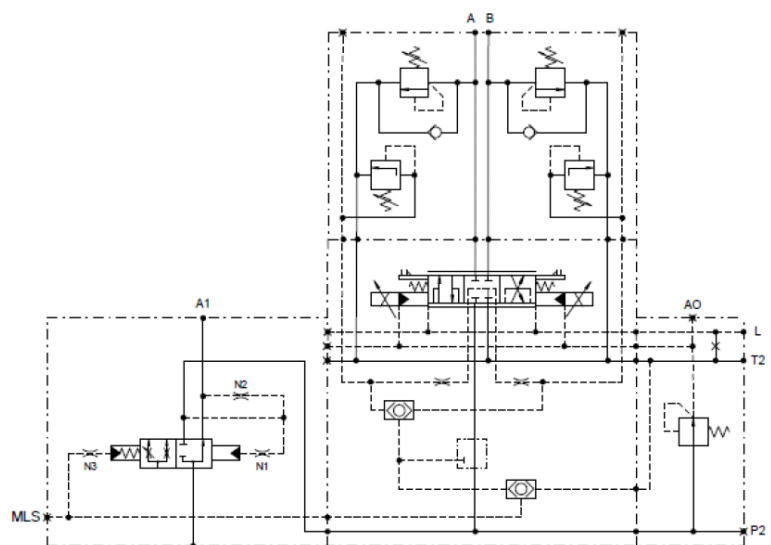
See data sheet MCV-1NB16 or MCV-1NB22



Variant 1NB22



Variants for a LS system, electrically proportionally pilot controlled, one section



Variants for an NFC system, electrically proportionally pilot controlled, one section

#### 4.5.2 Type code

00	01	02	03	04	05	06	07	
00	Product group	Modular control valve for mobile application					<b>MCV</b>	
01	Variant	Sectionalvalve Size 16 (100 l/min per consumer)					<b>1NB16</b>	
		Sectionalvalve Size 22 (300 l/min per consumer)					<b>1NB22</b>	
02	Connections	Port P, T, A and B G ¾					<b>03E</b>	
		Port P, A and B G 1¼					<b>03G</b>	
03	Max. permissible pressure	420 bar					<b>420</b>	
04	Inlet section	LS-System: LS-pressure relief G ¾					<b>CC1</b>	
		LS-System: LS-pressure relief with LS signal amplifier G ¾					<b>CC2</b>	
		Open-Center-System: 300 l/min SAE ¾"					<b>OC1</b>	
		Open-Center-System: 400 l/min SAE 1"					<b>OC2</b>	
05	Electrohydraulic operated directional valve	no elektrohydraulic operated directional valve					<b>0</b>	<b>E</b>
		Elektrohydraulic operated, without pressure compensator, 24 VDC						<b>E124</b>
		Elektrohydraulic operated, with pressure compensator, 24 VDC						<b>E224</b>
06	Hydraulically operated directional valve	no hydraulically operated directional valve					<b>0</b>	<b>H</b>
		hydraulic operated, without pressure compensator, 24 VDC						<b>HY01</b>
		Elektrohydraulic operated, with pressure compensator, 24 VDC						<b>HY02</b>
07	End section	Without pressure reducing valve (if only hydraulically operated sections are used)					<b>E0</b>	
		With pressure reducing valve (if at least one electrically operated section is used)					<b>E1</b>	

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

### 4.6 Directional control valves type D22

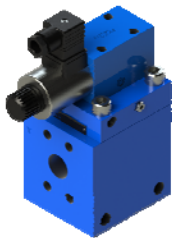
The 2/2 directional valve serves to connect or separate 2 hydraulic lines. It is a pilot controlled valve, which is designed for high pressure and volume flow and is thus suitable above all for mobile applications.

#### Highlights

- Electrically or hydraulically switchable
- Unswitched open or closed
- Soft-switching possible
- Low leakage

#### 4.6.1 Variants

##### Variant NA



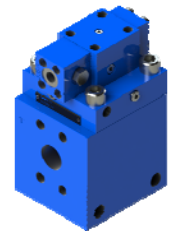
Electrically activated

Standard variant  
SAE 1", 400 l/min

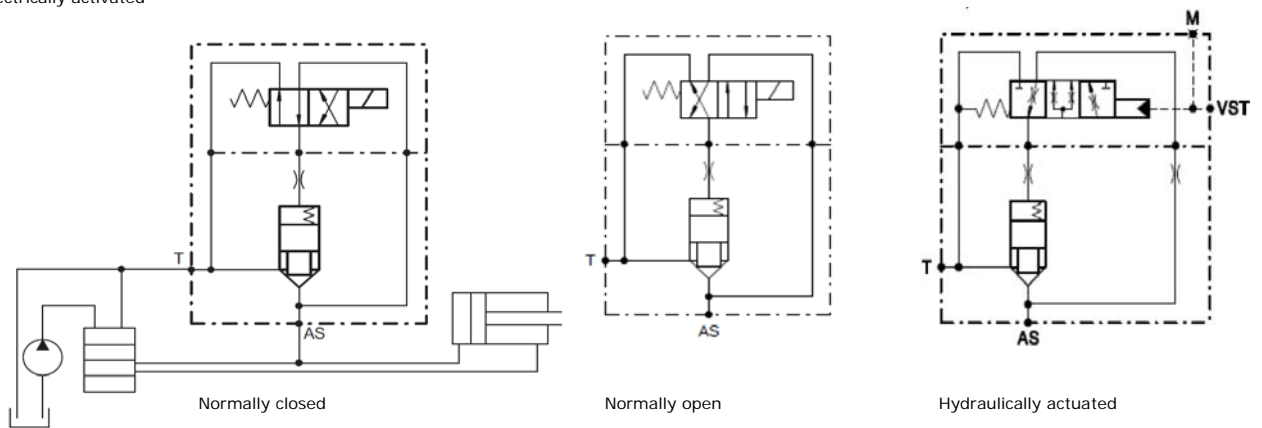
The valve offers the following variants:

- Hydraulically or electrically pilot controlled
- Normally open or closed
- Stepped piston or return-pressure-compensated piston

See data sheet D22-NA



Hydraulically actuated



#### 4.6.2 Type Code

D22	NA	05E	400					
00	01	02	03	04	05	06	07	08
00	Product group	2/2 directional control valve						D22
01	Variant	Standard, pilot-controlled, for high volume flows						NA
02	Connections	Inflow AS, outflow T, SAE 1" ISO 6162-2 (SAE J518Code62)						05E
03	Input flow rate	400 l/min						400
04	Max. permissible pressure	350 bar						350
		420 bar						420
05	Actuation	Electrical switching 12 VDC – connection via ISO 4400 angle plug connection						12S001
		Electrical switching 12 VDC – connection via Junior Timer plug						12S002
		Electrical switching 24 VDC – connection via ISO 4400 angle plug connection						24S001
		Electrical switching 24 VDC – connection via Junior Timer plug						24S002
		Hydraulically switching						HYP03
06	Neutral position	Closed						N0
		Open						N1
07	Switching behavior		Electrically switching		Hydraulically switching			
		Standard	■		○		S0	
	smooth operating		○		■		S1	
08	Main unit	Main unit not pressure-compensated, outflow pressure might open the cone Maximum pressure at port T: < 3 bar						K0
		Main unit pressure-compensated: Can be pressure-loaded on the outflow side Maximum pressure at port T: < 200 bar						K1

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

#### 4.7 Directional control valves type D32, D33

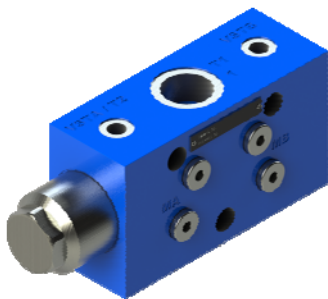
While the relief valves of type D2/2 are using switching cartridge elements, type D3X is designed as a spool valve. This makes a softer switching possible, which can be particularly advantageous in the case of caged pressure. The valve can e.g. be used to release one or two supply lines. But other functions like switching to another consumer are also possible.

#### Highlights

- Simple design
- Hydraulically pilot controlled
- Low pressure loss
- Suitable for large volume flows

#### 4.7.1 Variants

Variant 1N3

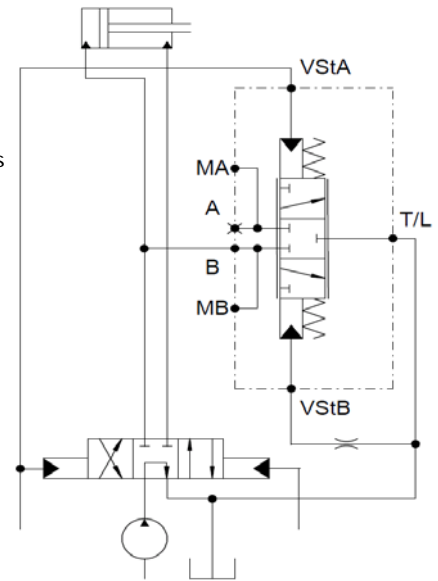


Variant D3/3

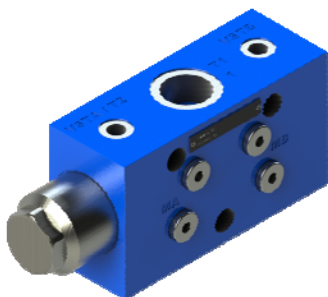
G1, 250 l/min – Order No. 137.901.001.9  
 G1 ¼ 400 l/min – Order No. 138.901.001.9

The valve can e.g. be used to release supply lines to the tank in order to reduce backpressure. One or two supply lines can thereby be connected as necessary. One installation example is located to the right.

See data sheet D3X-1N3 for detailed information



Variant 1N2

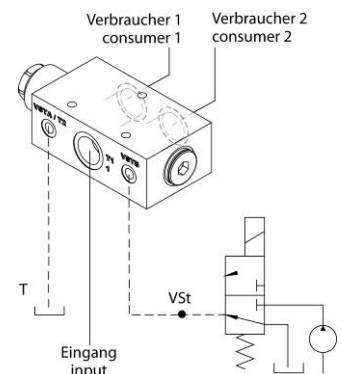
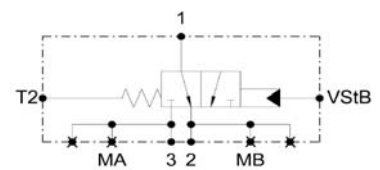


Variant D3/2

G1, 300 l/min - BestellNr. 137.901.002.9

The valve has only two switch positions, i.e. port 1 and 2 are connected in the neutral position. It can be used to switch from one to a second one way consumer or e.g. to also connect two pumps with each other.

See data sheet D3X-1N for detailed information





## 4.8 Pressure relief valves type PRV

With the pressure relief valves, pressure is continuously adjustable according to the electrical current to the solenoid or the mechanical setting and can thus be limited to a certain value. This is a modular set. Certain functions can be achieved with different pressure limiting cartridges and different manifolds, into which the cartridges are screwed.

### Highlights

- Pilot-controlled compact design
- Hardened valve seatings and pistons
- Wide setting range
- Extensive volume flow range up to 400 l/min with mainly constant limitation pressure

### 4.8.1 Variants

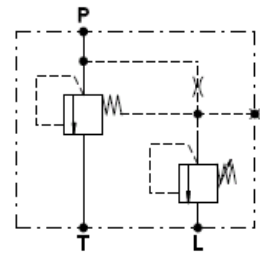
#### Variant CM



Screw-in cartridge Mechanically adjustable, 400 l/min

Pilot controlled pressure limitation valve that can be set mechanically between 150 and 400 bar.

See data sheet PRV for detailed information.



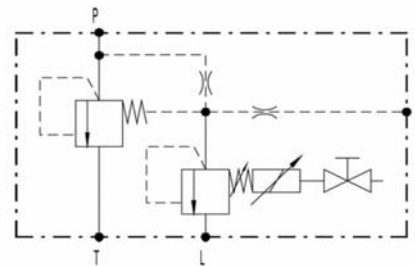
#### Variant CP



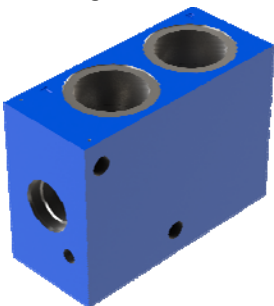
Screw-in cartridge Electrically adjustable, 400 l/min

Pilot controlled pressure limitation valve that can be set electrically between 100 and 350 bar.

See data sheet PRV for detailed information.



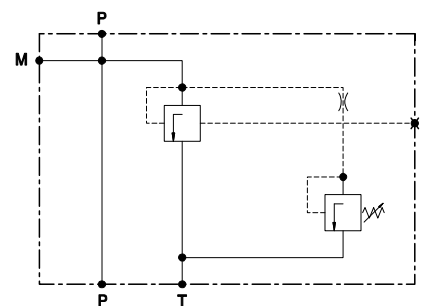
#### Housing-BG A



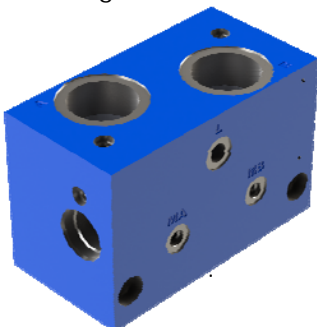
Housing for a screw-in cartridge

Housing for cartridge PRV-CM or PRV-CP for protecting of a consumer, volume flow is output to the tank.

See data sheet PRV for detailed information.



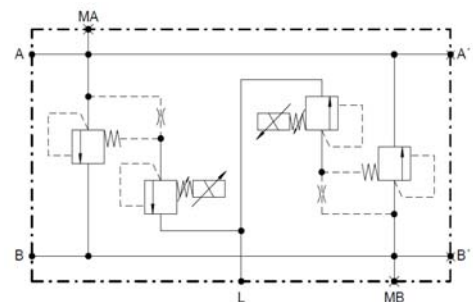
#### Housing-BG B



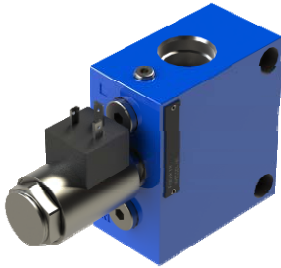
Housing for two screw-in cartridges

Housing for cartridge PRV-CM or PRV-CP for protecting both consumer connections, volume flow is output respectively to the opposite line.

See data sheet PRV for detailed information.



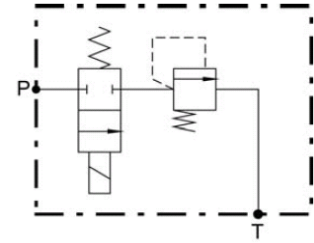
Housing-BG C



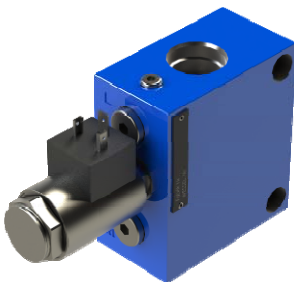
Housing with upstream 2/2 directional valve

The maximum pressure can be lowered in a hydraulic system by actuating this electrically switchable pressure valve. It is thus suitable for protecting attachment on mobile machines from excessive pressures.

See data sheet PRV for detailed information



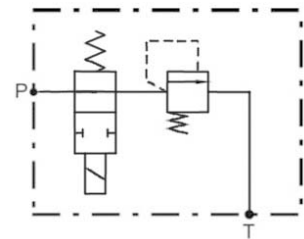
Housing-BG D



Housing with upstream 2/2 directional valve

The pressure valve is active in non-powered state. In case of a wire break, the valve will limit the pressure to the adjusted value, which might be important to protect the tool.

See data sheet PRV for detailed information



#### 4.8.2 Type code

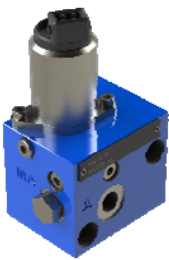
Designation	Part No.
Pressure Valve, 400 l/min, M4x2	418.012.404.9
Pressure Valve, 400 l/min, G1, 24V	418.311.401.9
Pressure Valve, 400 l/min, electrical-proportional	416.381.402.9
Pressure Valve Cartridge, pressure adjustable	416.082.402.9
Pressure Valve Cartridge, electrical-proportional	416.381.401.9
Pressure Valve 2-fold, pressure adjustable	416.011.408.9
Pressure Valve 2-fold, electrical-proportional	416.011.409.9

## 4.9 Pressure control valves type PCV

The pilot control unit is used for the electrical-proportional control of main control valves. These valves can replace a purely hydraulic pilot control valve and it can be used for expanding a hydraulic system for operating additional attachments. Actuating proportional shear controllers or priority valves are possible applications.

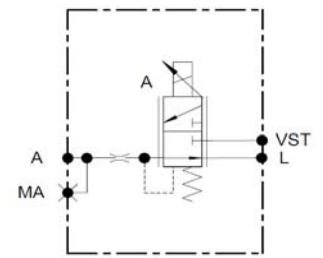
### 4.9.1 Variants

#### Variant 1N



Pressure control valve, single  
0-20 bar or 0-32 bar

Proportional pressure control valve, with which the pressure can be set at output A depending on the electric current.  
The max. input pressure is 50 bar, the max. volume flow 4 l/min.  
Generally serves for the pilot control of a proportional directional valve.



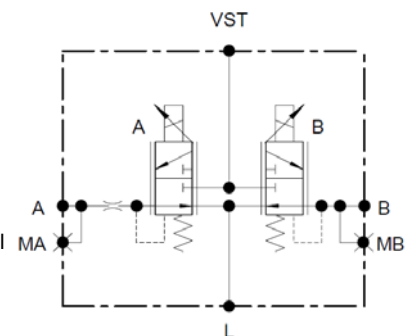
See data sheet PCV-1N for detailed information

#### Variant 2N



Pressure control valve double  
0-20 bar or 0-32 bar

Proportional pressure control valve, with which the pressure can be set at output A and B depending on the electric currents.  
The max. input pressure is 50 bar, the max. volume flow 4 l/min.  
Generally serves for the pilot control of a proportional directional valve.



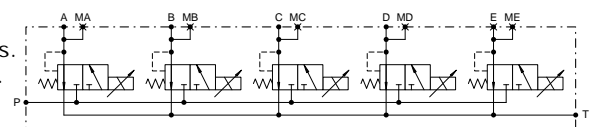
See data sheet PCV-2N for detailed information

#### Variant 5N



Pressure control valve 5-fold  
0-20 bar or 0-32 bar

Proportional pressure control valve, with which the pressure can be set at output A through E depending on the electric currents.  
The max. input pressure is 50 bar, the max. volume flow 4 l/min.  
Generally serves for the pilot control of a proportional directional valve.



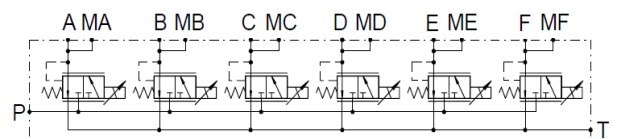
See data sheet PCV-5N for detailed information

#### Variant 6N



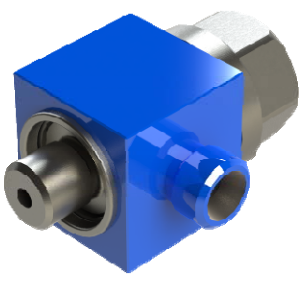
Pressure control valve 6-fold  
0-20 bar or 0-32 bar

Proportional pressure control valve, with which the pressure can be set at output A through F depending on the electric currents.  
The max. input pressure is 50 bar, the max. volume flow 4 l/min.  
Generally serves for the pilot control of a proportional directional valve.



See data sheet PCV-6N for detailed information

### 4.9.2 Accessories for pressure control valves type PCV

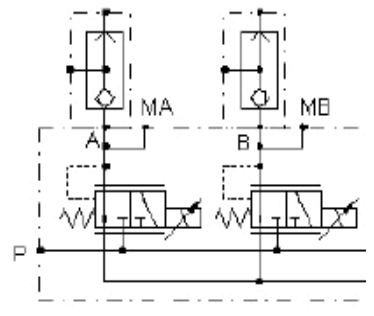


Screw-in shuttle valve

#### Screw-in shuttle valve

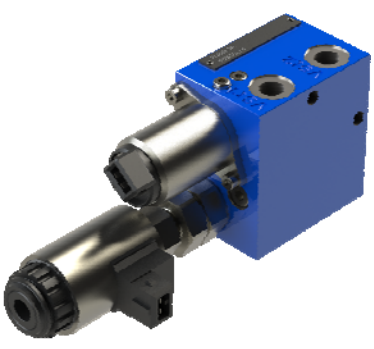
If one wants to expand an existing purely hydraulic pilot control with an electric proportional pilot control in order to use both alternately, this can be performed easily with this shuttle valve. It is screwed into the port(s) of the pilot control valve PCV-1N and connected with the pilot control line.

See data sheet PCV-1N for detailed information



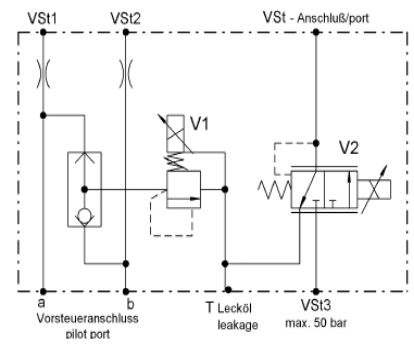
#### Set volume flow and secondary pressure

The maximum value of the pilot control pressure acting on the connection VSt1 or VSt2 on the main spool can be limited with the valve V1 (e.g. open/close shears). Thus, a volume flow limitation can be performed for the main control valve. In the application, e.g. the maximum amount could be limited to a shear control valve per foot pedal. A pilot control pressure is electrically proportionally set to a certain value via the valve V2. This pilot pressure can be used to activate hydraulically pilot controlled pressure valves. The volume flow and the maximum working pressure for different consumers is thus set via V1 + V2.



Special design: Port B equipped with mit proportional pressure relief valve

See data sheet PCV-1N for detailed information.



### 4.9.3 Type code

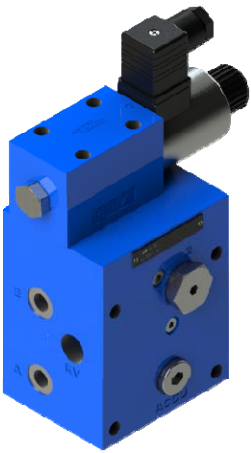
Designation	Working range [bar]	PartNo.
Pressure control valve, single	0-20	221.311.215.9
Pressure control valve, single	0-32	221.311.206.9
Pressure control valve, double	0-20	221.311.214.9
Pressure control valve, double	0-32	221.311.205.9
Pressure control valve, 5-fold	0-32	221.311.216.9
Pressure control valve, 6-fold	0-32	221.311.212.9
Pressure control valve with pressure valve, single	0-32	412.311.402.9

## 4.10 Quick coupler valves type QCV

Quick coupler systems serve to easily change tools on construction machines without the driver having to leave the cabin to do so. The main functional part of the quick change system is a hydraulic cylinder that opens and closes the lock of the quick coupler for the change-over procedure and locks the tool securely in place when closed. The quick coupler controls and actuates the quick coupler cylinder and secures it from being opened accidentally.

### 4.10.1 Variants

#### Variant 1N42



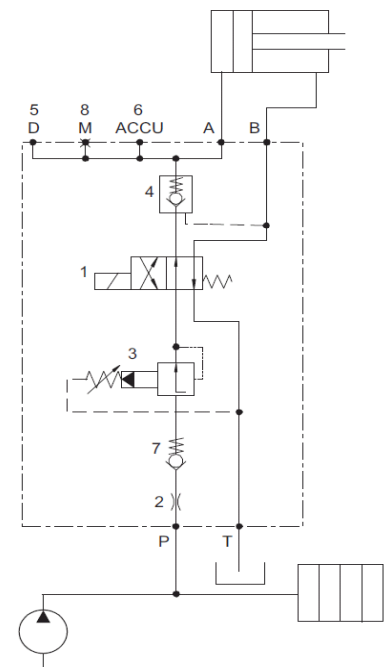
Standard, 4/2 directional valve  
 $p_{max} = 400 \text{ bar}$

The pump pressure holds the locking cylinder in the closed position. Without actuating valve (1), the cylinder is always retracted. The quick coupler is closed.

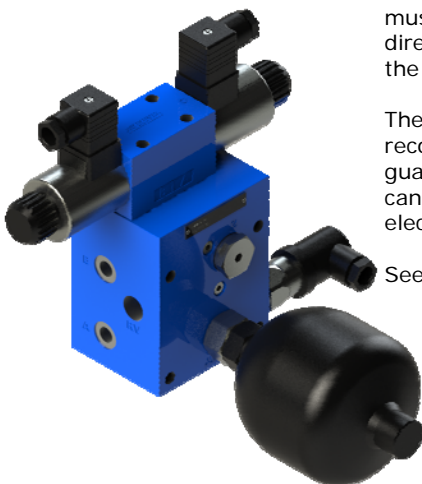
The pressure for protecting the cylinder is thereby reduced by a pilot controlled pressure relief valve. The movement speed is restricted by an inflow nozzle. The 4/2 directional valve is only switched for unlocking the cylinder. Locking and unlocking takes place with the same pressure.

Optionally, a pressure switch can be connected in order to monitor closing pressure that is low as well as an accumulator in order to maintain a steady pressure even in the case of long machine standstill times.

See data sheet QCV-1N for detailed information



#### Variant 1N43

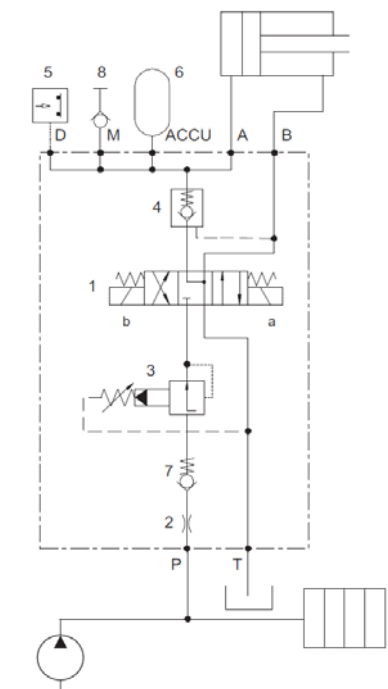


Standard, 4/3 directional valve  
 $p_{max} = 400 \text{ bar}$

In this variant, both the locking and the unlocking must take place actively via the switching of the directional valve. The quick coupler can be held in the open position!

The use of pressure switches and accumulators is recommended in this case in order to be able to guarantee a secured lock. Accumulator charging can be realized with a corresponding control electronics.

See data sheet QCV-1N for detailed information

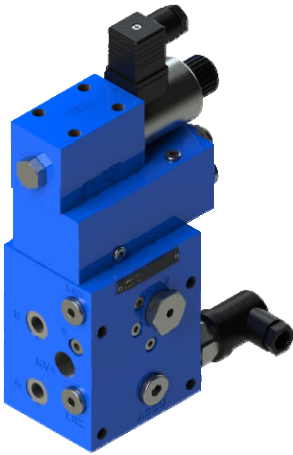


#### 4.10.2 Type code

00	01	02	03	04	05	06	07	08
00	Product group	Quick coupler valve						<b>QCV</b>
01	Variant	Standard variant . Compact housing with add-on, built-in components, 4/2-way valve						<b>1N42</b>
		Standard variant. Compact housing with add-on, built-in components, 4/3-way valve						<b>1N43</b>
02	Connections	Pump (P), outputs (A, B), returnline (T) G ¼ (ISO 1179-1)						<b>03B</b>
03	Input flow rate	Set via orifice, pressure-dependent, approx. 30 l/min						<b>030</b>
04	Max. permissible pressure	400 bar						<b>400</b>
05	Actuation	Electrical switching 12 VDC – connection via ISO 4400 angle plug connection						<b>12S001</b>
		Electrical switching 24 VDC – connection via ISO 4400 angle plug connection						<b>24S001</b>
06	Pressure reducing valve 1	Factory setting in bar						<b>070</b>
		Factory setting in bar						<b>120</b>
		Factory setting in bar						<b>200</b>
07	Pressure reducing valve 2	Pressure reducing valve 2 only available as special option						<b>000</b>
08	Options	No optional components						<b>000</b>
		Digit 1 (ACCU) = 1: Accumulator						<b>1xx</b>
		Digit 2 (DS) = 1 – Pressure switch: normally open    Digit 2 = 2 – Pressure switch: normally closed						<b>x1x</b>
		Digit 3 (M) = 1 – Measurement connection						<b>xx1</b>
		Example: 111 – with accumulator, pressure switch normally open and measurement connection						<b>111</b>

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

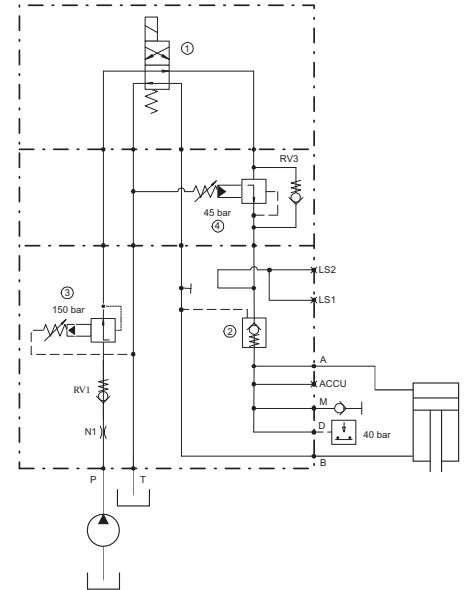
Variant 2N42



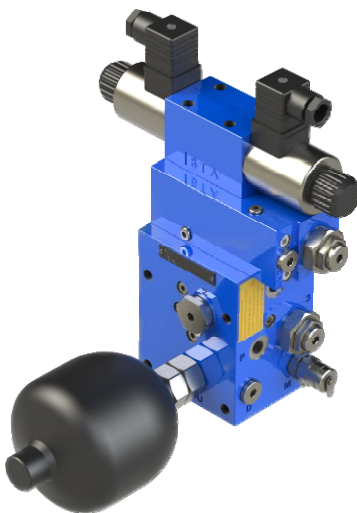
Reduced lock pressure  
4/2 directional valve,  
 $p_{max} = 400$  bar

Two pressure relief valves are integrated in this variant. The first valve restricts the inflow pressure to 160 bar (adjustable) so that the valve can also be used in high pressure circuits up to 400 bar. The second pressure relief valve restricts the locking pressure to a reduced pressure of e.g. 45 bar in order not to jam the locking cylinder. There are then e.g. 150 bar available for opening. Optionally, a pressure switch can be connected in order to report closing pressure that is too low as well an accumulator in order to maintain a steady pressure even in the case of long machine standstill times.

See data sheet QCV-2N for detailed information



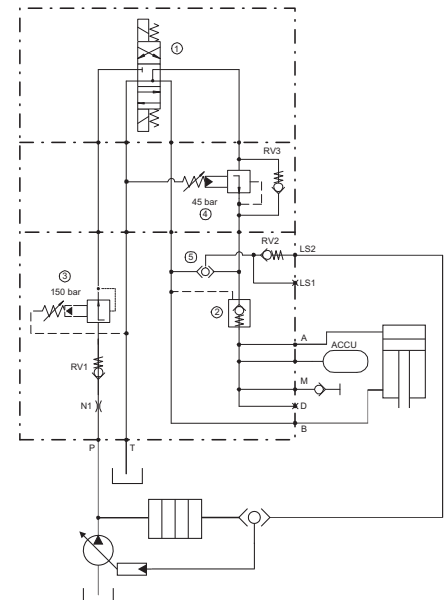
Variant 2N43



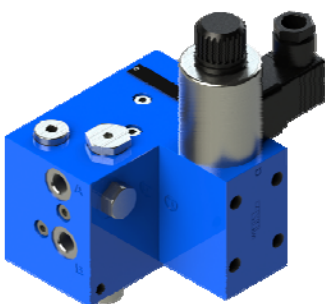
Reduced lock pressure, LS  
4/3 directional valve  
 $p_{max} = 400$  bar

In this variant, both the locking and the unlocking must take place actively via the switching of the directional valve, i.e. the quick coupler can be held in the open position! When switching the valve, the load pressure is available at the LS connection so that the pump can be actively be displaced to the necessary pressure.

See data sheet QCV-2N for detailed information



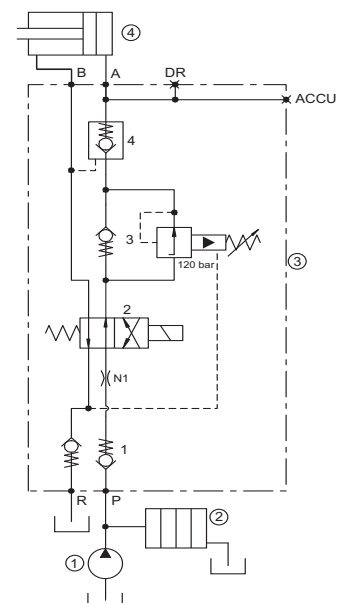
Variant 3N



Reduced lock pressure,  
4/2 directional valve  
 $p_{max} = 350$  bar

Compared to variant 1N, only a reduced pressure is applied for locking, the maximum pump pressure is available for unlocking, but may not exceed 350 bar. The system can be expanded with a pressure switch and accumulator.

See data sheet QCV-3N for detailed information



### 4.10.3 Type code

00	01	02	03	04	05	06	07	08
00	Product group	Quick coupler valve						<b>QCV</b>
01	Variant	Standard const. type, 1 compact housing with add-on, built-in components, 4/2-way valve						<b>2N42</b>
		Standard const. type, 1 compact housing with add-on, built-in components, 4/3-way valve						<b>2N43</b>
02	Connections	Pump (P), outputs (A, B), return (T) G ¼ (ISO 1179-1)						<b>03B</b>
03	Input flow rate	Set via orifice, pressure-dependent, approx. 30 l/min						<b>030</b>
04	Max. permissible pressure	400 bar						<b>400</b>
05	Actuation	Electrical switching 12 VDC – connection via ISO 4400 angle plug connection						<b>12S001</b>
		Electrical switching 24 VDC – connection via ISO 4400 angle plug connection						<b>24S001</b>
06	Pressure reducing valve 1	Factory setting in bar						<b>150</b>
07	Pressure reducing valve 2	Factory setting in bar						<b>045</b>
08	Options	No optional components						<b>000</b>
		Digit 1 (ACCU) = 1: Accumulator						<b>1xx</b>
		Digit 2 (DS) = 1 – Press. switch, opening sensor    Digit 2 = 2 – Press. switch, closing sensor						<b>x1x</b>
		Digit 3 (M) = 1 - Measurement connection						<b>xx1</b>
Example: 111 – with accumulator, pressure switch open and measurement connection						<b>111</b>		

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

00	01	02	03	04	05	06	07	08
00	Product group	Quick coupler valve						<b>QCV</b>
01	Variant	Standard construction form, 1 compact housing						<b>3N</b>
02	Connections	Pump (P), outputs (A, B), return (T) G ¼ (ISO 1179-1)						<b>03B</b>
03	Input flow rate	Set via orifice, pressure-dependent, approx. 30 l/min						<b>030</b>
04	Max. permissible pressure	350 bar						<b>350</b>
		420 bar						<b>420</b>
05	Actuation	Electrical switching 12 VDC – connection via ISO 4400 angle plug connection						<b>12S001</b>
		Electrical switching 24 VDC – connection via ISO 4400 angle plug connection						<b>24S001</b>
06	DMV1 setting	Factory setting in bar. Setting area: 20 ... 350 bar						<b>120</b>
07	DMV2 setting	No second pressure relief valve available						<b>000</b>
08	Options	No optional components available. See Accessories						<b>000</b>

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available



### 4.11 Load control valves type LHB



In case of a pipe or tube rupture the load control valve avoids uncontrolled movement of the cylinder. In various countries these valves are required by law when the construction machine is used for load lifting purposes.

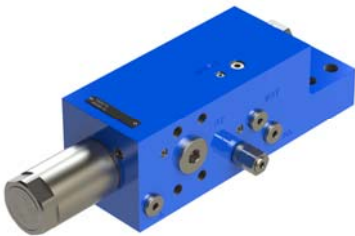
WESSEL load control valves stand for an excellent sensitivity and a very direct response to the joystick stroke.

#### Highlights

- symmetrical structure of the ports
- pilot pressure valve operates the main piston
- filter screen in front of the pressure valve
- connection port for balance line
- maximum lowering speed adjustable (optional)
- leakage free
- complies with the requirements of standard DIN 24093, ISO 8643, EN 474
- Opening level independent from load pressure
- small hysteresis

#### 4.11.1 Variants

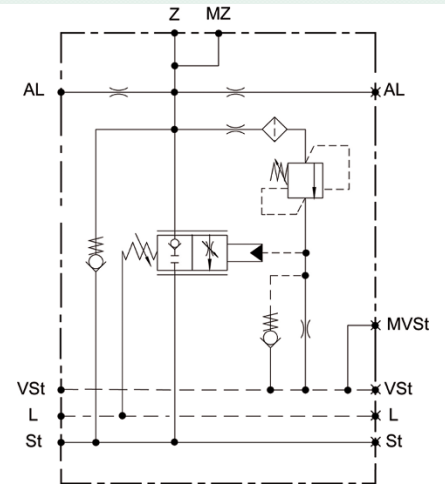
##### Variant 3N



SAE 1" Variant

Flat design, stepped  
SAE 1/2", 3/4", 1"  
flange design according to ISO 6162

This load control valve is available for port sizes of SAE 1/2" to SAE 1" for maximum volume flow (QZ max) up to 400 l/min (100 usgal/min).  
See datasheet LHB-3N.



#### 4.11.2 Type code

<b>LHB</b>	<b>3N</b>				<b>HYP03B</b>	<b>008</b>	<b>00</b>	
00	01	02	03	04	05	06	07	08
00	Product group							<b>LHB</b>
01	Variant	Flat design, stepped						<b>3N</b>
02	Cylinder port		SAE 1/2"	SAE 3/4"	SAE 1"			
		ISO 6162-1 (SAE J518 CODE61) metric	-	<b>04C</b>	<b>04E</b>			
		ISO 6162-1 (SAE J518 CODE62) metric	<b>05A</b>	<b>05C</b>	<b>05E</b>			
03	Control piston l/min		<b>150</b>	<b>200</b>	<b>250</b>	<b>300</b>	<b>350</b>	<b>400</b>
		SAE 1/2"	■	○	○	○	○	○
		SAE 3/4"	○	■	■	■	○	○
		SAE 1"	○	○	■	■	■	■
04	Pressure setting							
05	Activation	Hydraulic proportional activated						<b>HYP03B</b>
06	Opening level	Opening level set to 8 bar						<b>008</b>
07	Compensation setting	No compensation available						<b>00</b>
08	Lowering speed adjustable	Lowering speed adjustable						<b>1</b>
		Lowering speed not adjustable						<b>0</b>

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

#### 4.12 Leakage free lockvalves type LHV

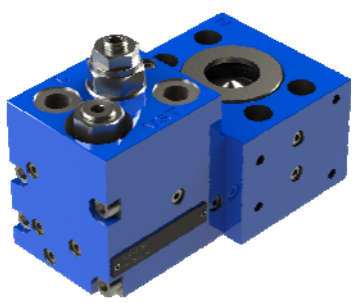
Leakage free lockvalves are used in order to keep a hydraulic consumer locked in its position even when the control valve due to its spool type design causes leakage in neutral position which leads to a lowering of the load. The valves are designed as seat-valves with hardened components. In the locked position an integrated pressure relief valve protects the consumer against to high pressure. The valve is unlocked with hydraulic piloting pressure. The valve is designed to be flanged directly onto a main control valve´s section and is available in differen variants.

#### Highlights

- Modular design
- Flangeable onto the main control valve´s section
- Leakage free
- SAE flange 90° rotatably
- Pressure relief function adjustable
- Low losses
- operable with piloting pressure

#### 4.12.1 Variants

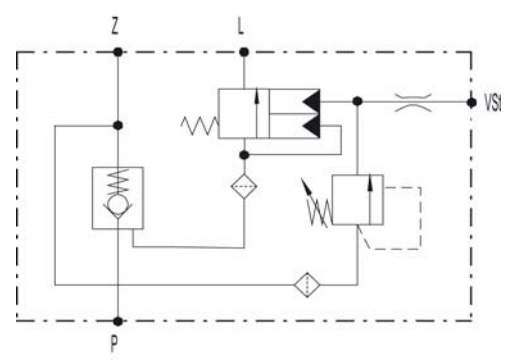
##### Variant 3N



Standard  
SAE 3/4", 1", 1 1/4"  
flange design according to ISO 6162

The volume flow is routed from connection P to connection Z via a checkvalve. If no piloting pressure is applied at port VST port Z is locked leakage free. In order to open the valve in direction from Z to P a piloting pressure has to be applied at port VST. In order to protect the consumer against external loads a pressure relief is integrated.

See datasheet LHV-3N for detailed information



#### 4.12.2 Order code

Part No.	Designation
426.063.282.9	Lockvalve, leakage free, SAE 3/4, 6000psi ISO6162
426.063.283.9	Lockvalve, leakage free, SAE 3/4, 6000psi ISO6162
427.063.282.9	Lockvalve, leakage free, SAE 1, 6000psi ISO6162
427.063.283.9	Lockvalve, leakage free, SAE 1, 6000psi ISO6162
428.063.282.9	Lockvalve, leakage free, SAE 1 1/4, 6000psi ISO6162
428.063.283.9	Lockvalve, leakage free, SAE 1 1/4, 6000psi ISO6162

### 4.13 Regenerative valves type REG

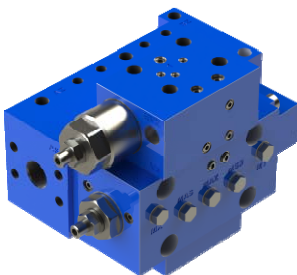
Regenerative valves permit quick differential cylinder extension. A connection to the rod side of the cylinder to the bottom side is made for this. This decreases the effective surface of the cylinder and its strength accordingly. When a defined working pressure is achieved, the regenerative valve separates the connection between the rod side and the bottom side of the cylinder and the entire effective area generates the full cutting force again.

#### Highlights

- Usable in any scrap- or demolition shear
- Flangeable or with SAE-connections
- Automatic switching between speed- and power-mode
- High switching level and hysteresis allow cutting in speed-mode
- Low pressure losses

#### 4.13.1 Variants

##### Variant 2D



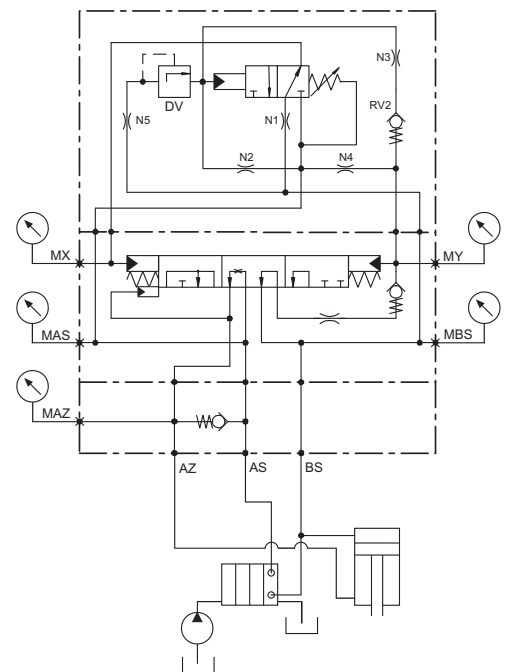
Variant 250 l/min

##### Standard

$p_{max} = 400$  bar  
 Sizes for 250, 400, 800, 1000 l/min

The valve consists of a main valve, which connects either piston rod side and bottom side (regen mode) or piston rod side and return (power mode). The valve is operated by a flanged pilot control valve, which switches from regen mode to power mode when a settable pressure is reached. If power mode is set, it remains on due to a wanted switching hysteresis until the inflow pressure falls to approx. 1/10 of the changeover pressure. A check valve ensures that only small pressure losses occur whenever the shear is opened.

See data sheet REG-2D



#### 4.13.2 Type code

REG	D2		XXXX	420	00000			
00	01	02	03	04	05	06	07	
00	Product group	Regenerative valves					<b>REG</b>	
01	Variant	Standard design used for differential cylinder applications					<b>D2</b>	
02	Construction size	Construction size 0250 (AS, AZ, BS: bore hole diameter 21.0 mm)					<b>996</b>	
		Construction size 0400 (AS, AZ, BS: bore hole diameter 27.0mm)					<b>997</b>	
		Construction size 0800 (AS, AZ, BS: bore hole diameter 35.0mm)					<b>998</b>	
		Construction size 1000 (AS, AZ, BS: bore hole diameter 40.0mm)					<b>999</b>	
03	Input flow rate	Construction size 0250: 250 l/min					<b>0250</b>	
		Construction size 0400: 400 l/min					<b>0400</b>	
		Construction size 0800: 800 l/min					<b>0800</b>	
		Construction size 1000: 1,000 l/min					<b>1000</b>	
04	Max. permissible pressure	420 bar					<b>420</b>	
05	Actuation	Automatic changeover for adjustable changeover pressure					<b>000000</b>	
06	Changeover pressure	Changeover from regen mode to power mode at 270 bar					<b>270</b>	
07	Connection plate / flangeable		250	400	800	1000		
		Line connection via connection plate	■	■	○	○	<b>AP</b>	
	Flangeable directly on the cylinder	■	■	■	■	<b>FL</b>		

XXX – Predetermined characteristics    XXX- Characteristics selectable by customer    ■ available    ○ not available

#### 4.14 Controller, type CTR

The control electronics of type CTR process input signals from proportional sensor and switches into output signals (drift-free power-regulated) for controlling valves.

They adjust automatically to the respective on-board voltage 12 or 24 VDC.

These robust devices are particularly suited for simple use in construction machines.

##### 4.14.1 Variants

###### CTR-1P **Proportional valve controller**

The proportional valve controller is used for the proportional control of a dual-acting function. The function can be operated smoothly in both directions. From standstill to the highest power and back to standstill, even large masses can be moved dynamically and gently at the same time.

A potentiometer or hall effect sensor with latched central position is used as the input signal. The sensor converts the reference signal +5 VDC delivered by the valve controller depending on position (left stop / middle / right stop) into a voltage +0.5 ... 2.5 ... 4.5 VDC. Input voltages smaller than 0.5 VDC are detected by the amplifier as a cablebreak, those higher than 4.5 VDC as a short circuit.

The desired characteristic of the output signal is assigned to the input signal through a simple teach-in under the actual operation conditions for the respective function. This means that the function is still in the middle position of the sensor. The respectively responsible proportional solenoid is activated proportionally in the case of moving the handle in one or the other direction. The highest electrical current and thus also volume flow of the operated valve are achieved in the end positions of the sensor. The movement speeds can thus be comfortably restricted electronically and adjusted at any time.

The size of a pack of cigarettes, the proportional valve controller can be comfortably housed even in the smallest mini excavators.

See data sheet CTR-1P for detailed information.



CTR-2T

**WESSEL Tool Control<sup>plus</sup>**

The WESSEL Tool Control<sup>plus</sup> is a freely programmable electronic controller. It has four configurable single and six configurable multi-configurable outputs. 16 Parameter records with any allocation to the inputs and outputs can be programmed and used immediately at the touch of a button. The WESSEL Tool Control<sup>plus</sup> is thus a universal and flexible option for controlling even complex functions in construction machines.

The input signals from proportional sensors, buttons, pressure switches, etc are programmable  
For the following output signals:

- proportional to the input signal (proportional)
- set to a fixed value (permanent)
- fully switched to on-board voltage (relay)
- triggered by input signal to a fixed value (trigger)
- triggered by input signal fully switched to on-board voltage (trigger relay)



**Typical use: Up to 16 different attachment tools operated alternatively**

In many construction machines, the volume flow and pressure for certain attachment tools cannot easily be restricted in the auxiliary circuits (hammer/shears). The suitable setting of these values is absolutely required for the effective and long-lasting operation of a tool.

Single- and dual-acting functions can be programmed in the 16 parameter records, for example as follows:

Toolname	One-way / two-way	Max. pressure [bar]	Max volume flow [l/min]	Dump valve
Tool 1	One	150	120	Yes
Tool 2	One	120	100	Yes
...	...	...	...	...
Tool 15	Two	190	40	No
Tool 16	Two	320	90	No

**Optional application: Control additional functions proportionally**

In the typical application described above, only four of the six existing power outputs and none of the four existing digital inputs are used. It is thus possible to control a further dual-acting function with the WESSEL Tool Control<sup>plus</sup> with one proportional sensor at an inlet and with two outputs to the valve solenoids.

This functions exactly as described for valve booster CTR-1P.

The sensors and valves in the construction machine can be connected directly to the WESSEL Tool Control<sup>plus</sup> multiple times and can continue to be used. Thus, often only a few additional components need to be installed, which minimizes retrofitting effort.

It is also easy to achieve ergonomic operation, in that e.g. a function can be controlled alternatively by foot pedal or sensor in the joystick handle without conversion.

**Power increase for special functions**

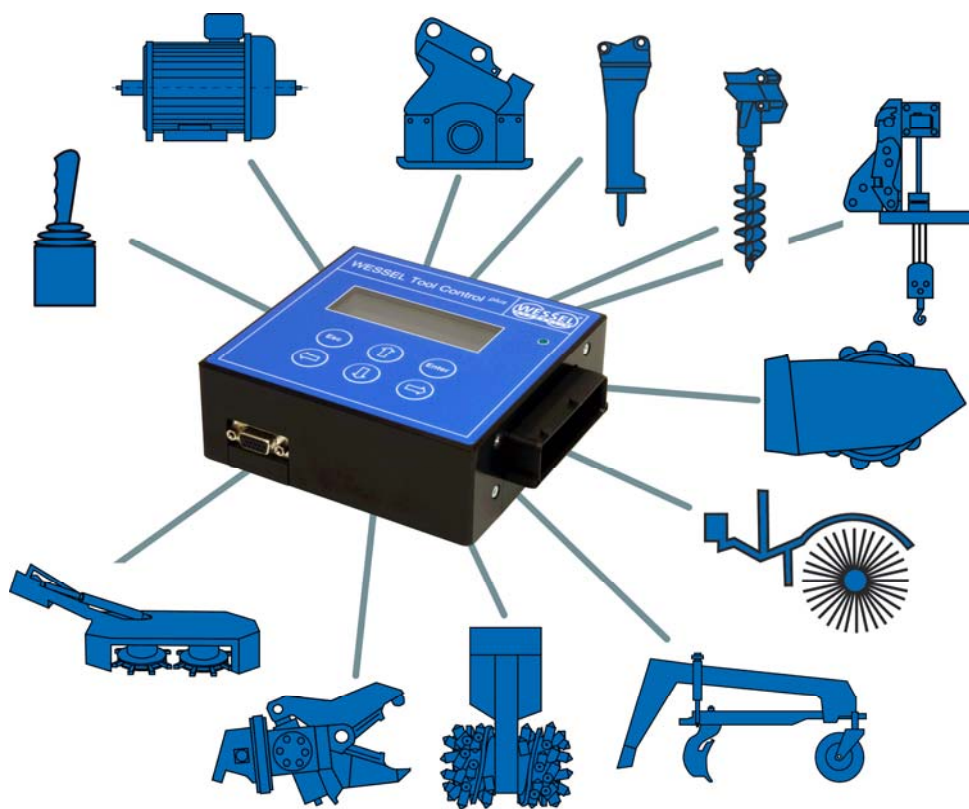
In particular in applications with double pumps, volume flows can be branched off by means of flow control valves in a targeted manner from one of the two pumps or from both at the same time and then merged. Up to 16 different parameter records are also programmable here. And this with variable pressure restriction, merging of the volume flow from the pumps and if necessary further auxiliary functions such as return clearing or a power mode.

**Use and programming**

It is very simple for the machine driver: He selects the programmed parameter record or the desired tool with the push of a button.

The program in turn can only be created, changed, exported or imported with access authorization on the ToolControl itself or - especially clear and comfortable - by means of the attached PC.

See data sheet CTR-2T for detailed information



Designation	Symbol	Value	
Supply voltage	Vin+	12VDC or 24VDC +/- 15%	
Estimated life time of the device		25.000 h	
Operating temperature		-10°C...+65°C	
Applicable standards		EN 61000-6-2 EN 61000-6-3	
Protection class		IP 30	
Operating environmental Temperature		-20°C...60°C	
Reference voltage supplied by the device	+ 10V ext.	10VDC ( $\pm 0,4$ VDC) reference voltage used for analogue signal transmitters (max. 50mA)	
	+ 5V ext.	5VDC ( $\pm 0,4$ VDC) reference voltage used for analogue signal transmitters (max. 50mA)	
Inputs	ANIN 1...4	4 analogue inputs	0-5VDC
			0-10VDC
	DIGIN 1...4	4 digital inputs	0-20mA
4-20mA			
Ext.Freigabe	Enable input	Logic 0 = 0VDC	
		Logic 1 = 12/24VDC	
Outputs	OUT 1...6	6 power outputs (PWM)	12VDC: 200mA ... 2000mA ( $\pm 2$ mA)
			24VDC: 100mA ... 1000mA ( $\pm 2$ mA)



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