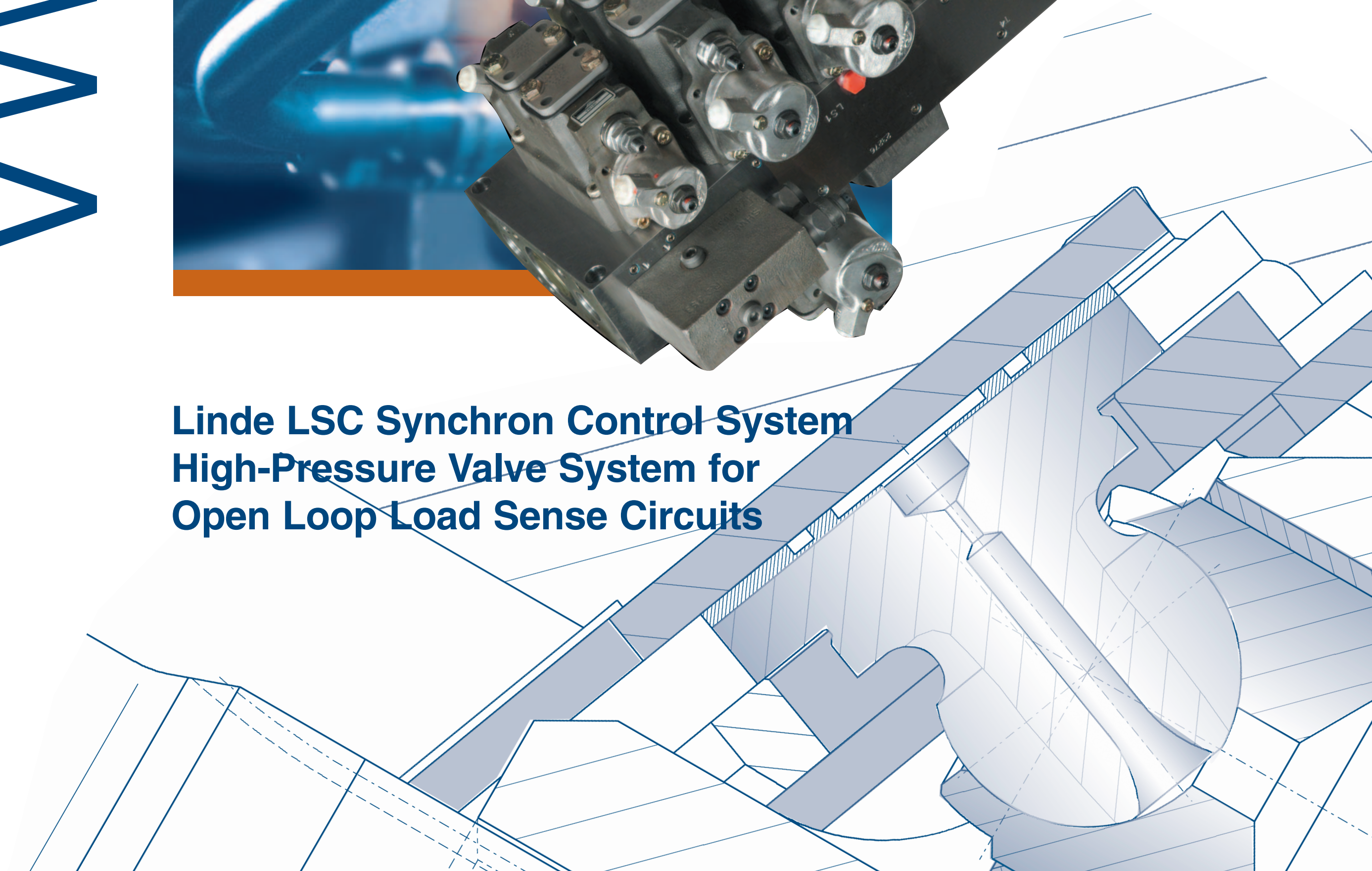
Linde

VW/MW/VT



Linde LSC Synchron Control System
High-Pressure Valve System for
Open Loop Load Sense Circuits

Linde Hydraulics
A Market Leader

Linde – **the pioneer in mobile hydraulics** – discovered and perfected hydrostatics as the ideal drive for mobile working machines. Since 1959, Linde has equipped two million vehicles in the fields of

- Construction machinery
- Agricultural and forestry machinery
- Municipal vehicles
- Fork lift trucks

with hydrostatic transmissions and working drives. The use of hydrostatic transmissions in its own fork lift trucks has made **Linde the world market leader!**

VW/MW/VT

CONTENTS

1. LINDE SYNCHRON CONTROL (LSC) SYSTEM TECHNOLOGY

The first hydraulic systems utilized fixed displacement pumps with valves, (throttles, figure 1) to control or adjust flow rates or speeds. This throttling or restricting pump flow to achieve control forces excess flow over the relief valve, wasting power (figure 2). The power loss is converted into heat.

As time passed, energy conservation became more important. A new generation of variable volume pumps evolved. These pumps were power (hp) regulated (figure 3). Since these pumps reduce output to maintain a constant hp., the amount of flow over the relief valve was lower, reducing power losses (figure 4).

The power wasted in the horsepower controlled system is still considerable. A system, which senses the required flow and adjusts pump displacement to meet it, is required to optimize energy usage: a flow on demand system (figure 5). The flow on demand system provides only the flow and pressure required for the function. Except for losses due to the margin pressure (typically 300 psi), losses and wasted power are at a minimum (figure 6).

All of these systems, however, have a similar problem. Because flow always follows the path of least resistance, continuous adjustment of the valves (throttling device) is required if the operator wants the speeds to remain as selected; a difficult and tiring job. Even the flow on demand system which maintains a given pressure drop (Δp) will require the operator to adjust continually, if the functions demand more flow than the pump can provide. Using a larger pump than necessary or a pump for each function is expensive and wasteful.

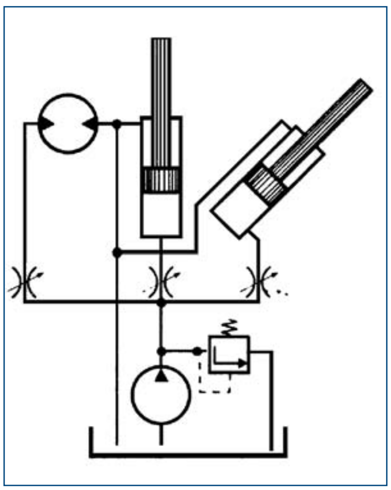


figure 1

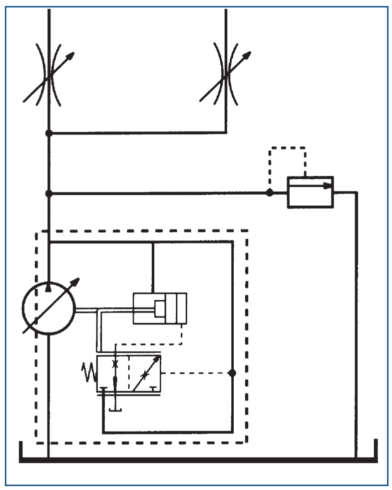


figure 3

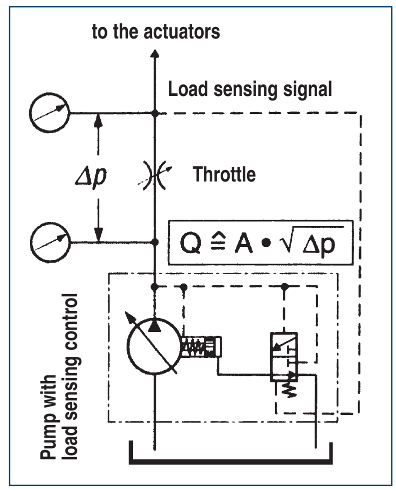


figure 5

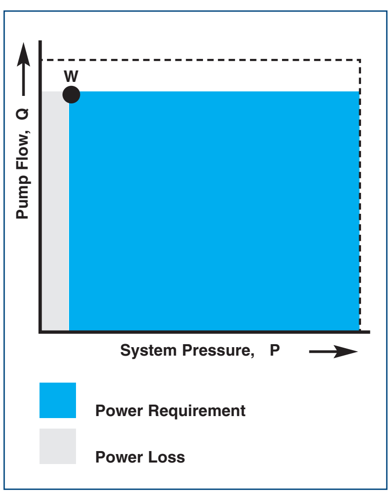


figure 2

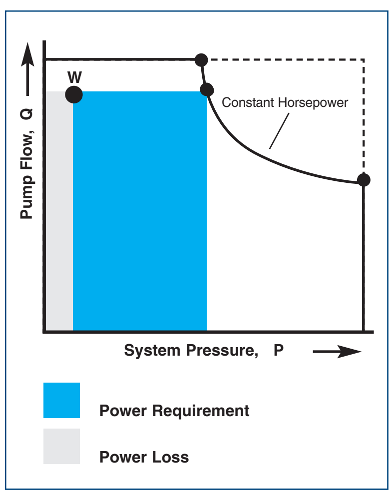


figure 4

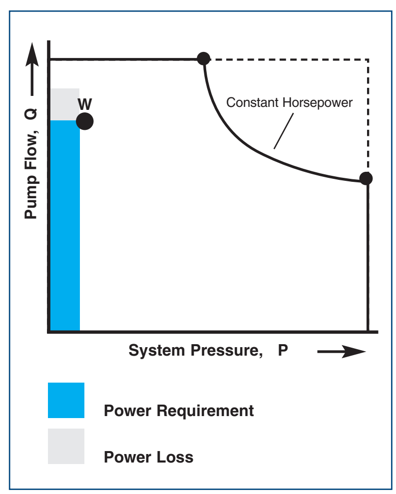


figure 6

The LSC system, or Synchron Control was developed to address those problems. The LSC system from Linde combines the energy saving benefits of flow on demand with load compensation to each work port. The compensator eliminates the need for operator flow adjustments. This makes operating any machine easier, safer, less tiring and more productive. Truly user friendly.

Remarkably enough, the system is quite simple (figure 7). The LSC system consists of a single HPR pump and a group of valves (one for each function usually). The pump is a fast response flow on demand design. The valves (figure 8) contain 2 orifices in series and a logic element. The logic element is a load sense resolver that selects the pressure from the highest pressure function to go to the load sense port on the pump. This same pressure is fed to the spring end of all the compensators.

The first of the 2 orifices is controlled by the operator. Its size is determined by the position of the valve spool (see valve 1 & valve 2 in figure 7). It is this orifice that determines the amount of flow through the valve.

The second orifice is the load compensator. It automatically adjusts to make up the difference between the pressure required by its load and the load sense pressure. The pressure downstream of the first orifice is fed to the metering end of the compensator and directly opposes the load sense pressure being fed to the spring end. This pressure must be slightly higher than the load sense pressure for the compensator to open. Initially the compensator is closed but since the pump outlet pressure is higher than load sense and with no flow past the compensator there is no pressure drop across the first orifice. At this point the compensator will open but only until the pressure drop across the first orifice lowers the pressure to the metering end of the compensator to a point slightly above load sense. This occurs when the pressure drop across the compensator equals the difference between the load pressure and load sense pressure. A result of this condition is that the pressure drop across the first orifice (valve 1 and valve 2 in figure 7) of both (any) functions are equal. This allow the LSC system to maintain proportionality.

If the functions demand more flow than the pump can provide, the Δp across the valves will change,

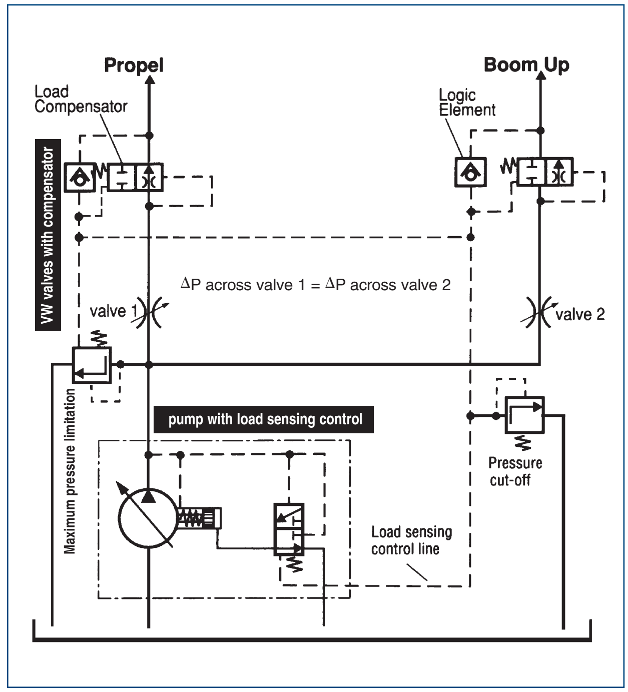


figure 7

but they will all change together, therefore the function speeds will be slower, but in the exact ratio the operator demands. No sudden surprises. No quick operator adjustments. Smooth precise control made easy. No other system can do this!

The LSC system from Linde is an opportunity to take a fresh look at your system. New possibilities for circuit simplification, component reduction.

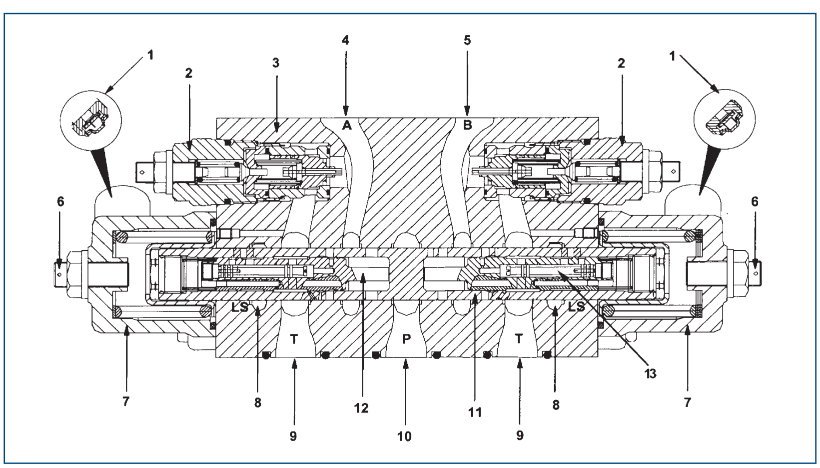


figure 8

1 Throttle check valve
2 Combined relief and make-up valve
3 Housing
4 Port “A”
5 Port “B”
6 Mechanical stroke limiter
7 Pilot cap
8 LS port
9 Return (tank)
10 Pump supply
11 Control spool
12 Compensator
13 Logic element

2. FEATURES AND TECHNICAL DATA

Features

- Pressure compensated load sense valve with these general advantages.
  - Multifunction proportionality maintained when flow demand exceeds – available flow
  - Fine metering down to very low flows
  - High stability
- Pilot operated actuation
- Compact design with high power density
- Superior quality

Design Characteristics

- Hollow spool using holes instead of tapered lands for metering
- Normally closed compensator downstream of metering orifice
- Load sense check/shuttle built into spool
- Easily adjustable maximum spool stops for flow limiting
- Anti-cavitation check valves (AC) or combination fully adjustable relief valve with anti-cavitation checks (RVAC) are integrated into work ports.
- Manifold (VW Series) or monoblock (MW Series) mounting options

Optional

- Pressure cut-off with one or two stages
- Priority function
- Torque control
- Multi-operational modes when combined with Linde electronic components

Only The LSC System Can Provide These Benefits For Your Applications

For the Manufacturer:
Circuit simplicity
Single pump, no pump drives
Reduce assembly cost
Reduce parts inventory
Ease of modification
Smaller, lighter, high power
Density of components

For the User:
Energy savings, smaller engines
Ease of operation
Reduce operator fatigue
Higher productivity
Ease of service
Field proven reliability
Positive control for safety

Technical Data

Nominal Sizes	Description	VW14	VW18	VW25
Flow	Maximum flow [lpm (gpm)]	140 (37)	230 (60)	380 (100)
Pressure	Working work port pressure [bar (psi)]	350 (5075)	350 (5075)	350 (5075)
	Max. work port pressure [bar (psi)]	420 (6090)	420 (6090)	420 (6090)
	Max. pilot port pressure [bar (psi)]	45 (653)	45 (653)	45 (653)
Temperature	Permissible housing temperature [Deg. C (Deg. F)]	90 (194)		
Weights	Valve section* [kg (lbs.)]	6.5 (14.5)	13 (14.5)	16 (14.5)
Dimensions	Installation dimensions	See Section 6		

* Approximate weight of individual sections. Monoblocks weights vary on selected components.

3. LINDE SYNCHRON CONTROL (LSC) VALVES

Linde Synchron Control (LSC) valve sections are available with a variety of spools designed for particular applications.

Auxiliary (Aux) – General purpose closed center valve with symmetrical flow paths and without integrated load checks. This valve is sometimes used for rubber tire propel applications no counterbalance valve used in the propel applications.

Cylinder – Designed for cylinder applications. This valve design includes load check capability and meter out for fine load control.

Hoist – This valve is the similar to the Auxiliary valve, but with the addition of neutral bleeds. This was initially used by Linde Hydraulics Corporation (LHC) for winch applications, but is also suitable for rubber tire propel where a counterbalance valve is used.

Motor – The motor valve has a large path from the A and B work ports to the tank port. It is normally used for applications that require a motor to coast, such as a crane swing.

Propel – Designed for tracked propel applications where the track motors have counterbalance valves. The valve incorporates special features to improve straight tracking when two propel valves are used in parallel as well as a neutral bleed.

Swing – Designed for excavator type swing. It has a little bit of priority at high flows to improve boom interaction. The spool is closed center.

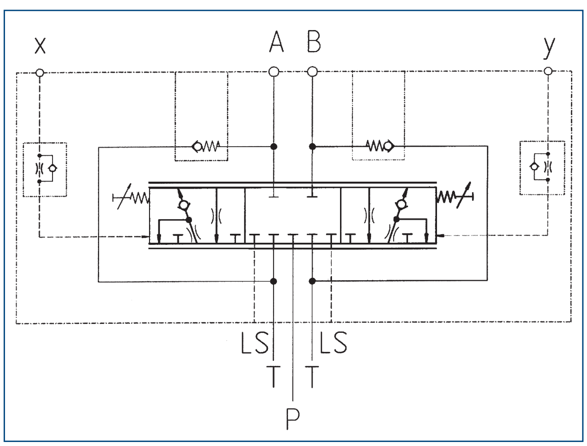
Valve sections use one of these spools in either a subplate or sandwich style housing. They also include anti-cavitation (AC) check valves or combination relief valve with anti-cavitation checks (RVAC) in the work ports of the housing.

3.1 Subplate Valves
Table of Available Configurations:

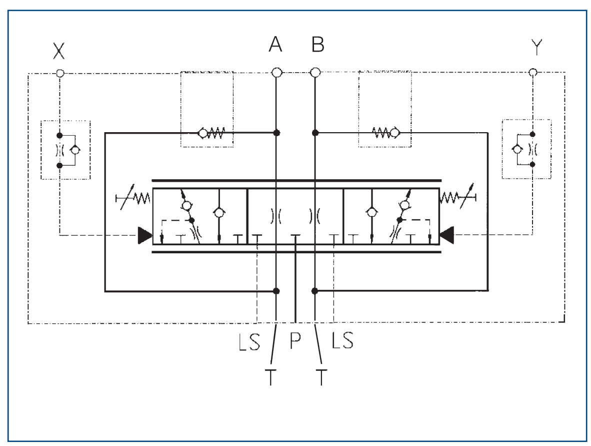
Spool Type	VW18		VW25		RVAC or AC Check
	Part #	Flow A/B [lpm (gpm)]	Part #	Flow A/B [lpm (gpm)]	
Propel	VW18028	190/190 (50/50)	VW25045	340/340 (90/90)	AC
Swing	VW18025	190/190 (50/50)	VW25016	380/380 (100/100)	AC
Cylinder	VW18024	285/265 (75/70)	VW25015	325/370 (112/98)	RVAC
Auxiliary	VW18064	227/227 (60/60)	VW25012	380/380 (100/100)	RVAC
Hoist	VW18065	227/227 (60/60)	VW25047	380/380 (100/100)	RVAC
Motor	VW18048	227/227 (60/60)	VW25017	380/380 (100/100)	RVAC

Valve Reference

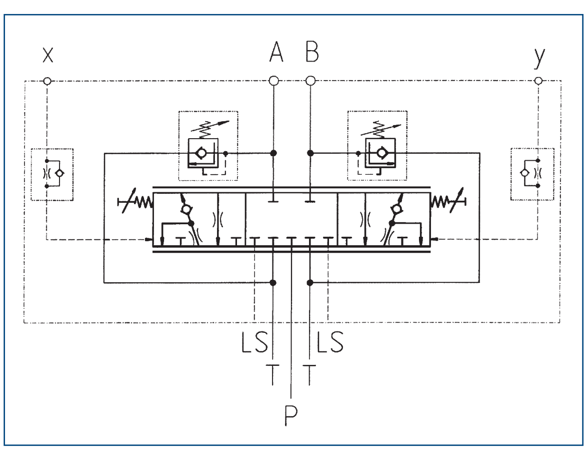
Function	Valve	Flow Curve	Schematic
Auxiliary	VW14018	1	5
Hoist	VW14023	1	6
Propel	VW18028	2	2
Swing	VW18025	3	1
Cylinder	VW18024	4	3
Auxiliary	VW18064	5	3
Hoist	VW18065	6	4
Motor	VW18048	7	4
Cylinder	VW18033	4	5
Auxiliary	VW18069	5	5
Hoist	VW18070	6	6
Motor	VW18062	7	6
Propel	VW25045	8	2
Swing	VW25016	9	1
Cylinder	VW25015	10	3
Auxiliary	VW25012	11	3
Hoist	VW25047	11	4
Motor	VW25017	11	4
Auxiliary	MW14020	1	7
		1	
		1	
	MW18041	5	7
		5	
		5	
	MW18042	2	8
		2	
		5	
	MW18026	4	7
		4	
		4	



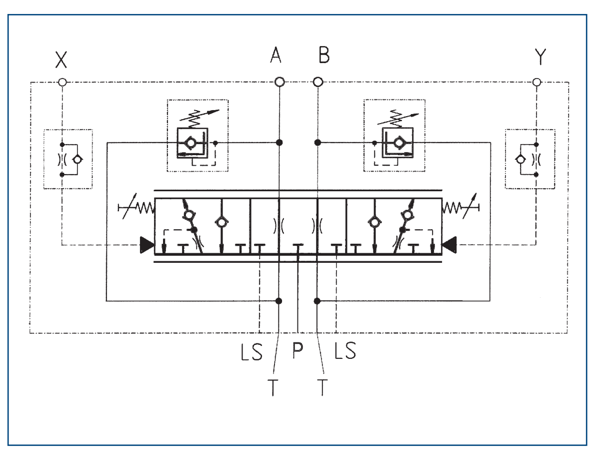
schematic 1



schematic 2



schematic 3



schematic 4

3.2 Sandwich Valves

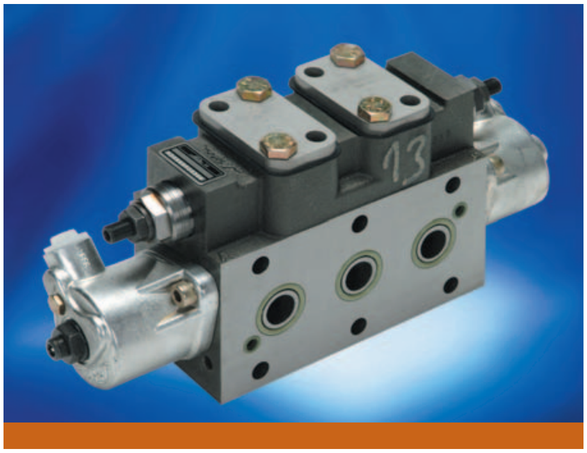
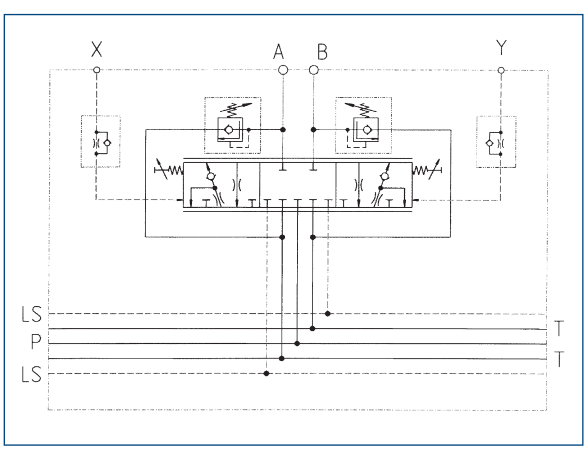


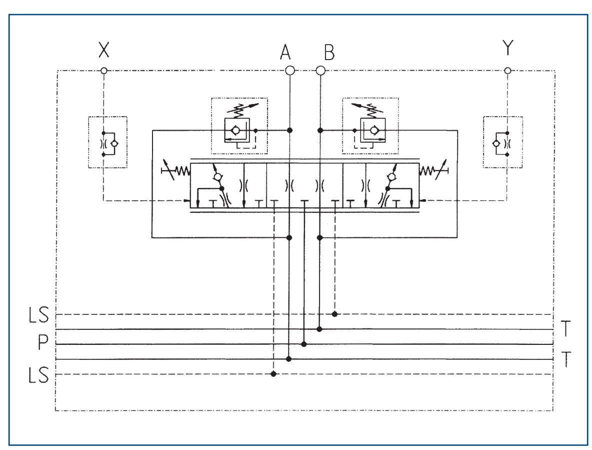
Table of Available Configurations:

Spool Type	VW14		VW18		RVAC or AC Check
	Part #	Flow A/B [lpm (gpm)]	Part #	Flow A/B [lpm (gpm)]	
Cylinder	N/A*	N/A*	VW18033	285/265 (75/70)	RVAC
Auxiliary	VW14018	148/148 (39/39)	VW18069	227/227 (60/60)	RVAC
Hoist	VW14023	148/148 (39/39)	VW18070	227/227 (60/60)	RVAC
Motor	N/A*	N/A*	VW18062	227/227 (60/60)	RVAC

* Consult factory for availability



schematic 5



schematic 6

4. MANIFOLD MOUNTED SYSTEMS

Subplate valves must be mounted on a manifold. Customers can design their own manifold or ask Linde to design it. Linde carries a few different manifold designs in inventory. All of these require a pressure control option and tank check option in addition to the valve selections. It is recommended that these features be incorporated into customer designed manifolds.

4.1 Standard Manifolds

Standard Manifold Kits*						
			Footprints			Cavity
Kit Number	**Sides**	**VW14**	**VW18**	**VW25**	**PCO**	**Tank Check**
MK00009	1		1	3	1 or 2**	2
MK00010	2	1	2	5	1 or 2**	2
MK00011	1		2		1	1
MK00012	1	1	3		1 or 2**	2

*Kits include manifold plate and plugs for construction or auxiliary ports.
**1 or 2 refers to single or dual setting PCO blocks.

(Valve and pressure cut-off (PCO) footprints can be found in section 7)

4.2 Pressure Cut-Off (PCO)

The Linde single stage PCO or "pressure cut off" blocks the control pressure in the LSC system. It contains at least one load sense relief valve and a safety relief valve. The load sense relief valve limits the load sense pressure to a set level and signals the pump to compensate and to maintain the predetermined pressure. The safety relief valve operates at a fixed differential between pump outlet and load sense pressure. By doing this it serves two functions. The primary function of a system relief valve is to eliminate pressure spikes within the work line. If the pump outlet pressure rises above the load sense relief setting by more than 60 bar (870 psi) the safety relief will re-direct the pump outlet flow to tank until the surge has passed. The second function of the safety relief is to reduce the load on the engine starter. During start-up, the VW valves are all in their neutral position, so the pump outlet path is blocked. Since the pump starts at maximum displacement, pressure rises in the pump outlet until the pump can react to its internal control signal and destroke to its standby pressure. This pressure could reach nearly 400 bar (5800 psi) except for the safety relief. In this condition the load sense pressure is 0 bar (0 psi), so the safety relief works like a 60 bar (870 psi) fixed system relief. Even with overshoot, the pump outlet pressure is limited to about 100 bar (1450 psi). The single stage PCO is kit number SMK00054 which includes mounting bolts and o-rings.

The 2-stage or dual setting PCO operates just like the single stage except it has two (2) load sense relief valves. When an external pilot pressure is applied to the Z port of this valve, it causes load sense pressure to be ported to the spring chamber of the low relief valve causing it to remain closed. The load sense pressure can then rise to the setting of the high relief valve. The 2-stage PCO is kit number SMK00055 which includes mounting bolts and o-rings.

In some situations such as a two (2) manifold system, it is necessary to blank off one of the manifold's PCO footprint. For this, one should use kit number SMK00003 which includes mounting bolts and o-rings and will work for either a 1 or 2 stage footprints.

4.3 Tank Checks

The purpose of the tank check(s) is to provide back pressure in the tank line to allow oil to flow through the anti-cavitation check valves in the VW valves on the manifold. It is generally a good idea to add additional make-up oil through a tank port in the manifold that is upstream of the check valves. The typical setting is 3 bar (43.5 psi) but some applications require 5 bar (72.5 psi). Most Linde manifolds have 2 tank check cavities which allow the customer to use a 3 bar (43.5 psi) in one cavity and a 5 bar (72.5 psi) in the other so that the 5 bar (72.5 psi) provides a cooler bypass. If the circuit already has enough back pressure, a tank check kit without the check is available. The tank check flange has a 1 1/4", code 61, 4-bolt flange pattern with clearance holes for SAE bolts. The bolts will need to be about 10 mm (3/8") longer than standard bolts used with 4-bolt flange with the *Tank Check* option.

Tank Check Options

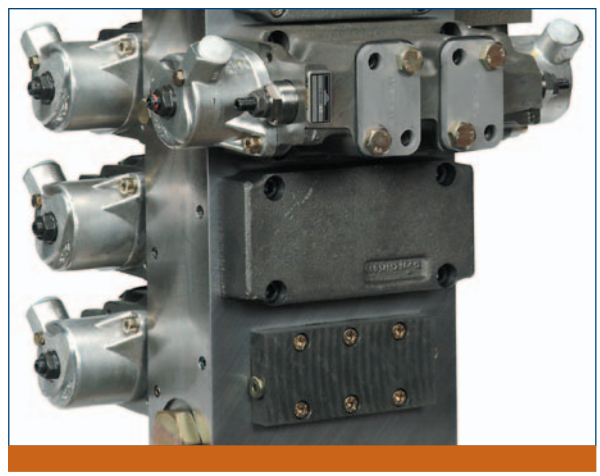
Kit Number	Description
SMK00015	Tank check – 1-1/4" – 3 bar (43.5 psi)
SMK00019	Tank check – 1-1/4" – 5 bar (72.5 psi)
SMK00030	Tank check – 1-1/4" – 0 bar (0 psi)

4.4 Cover Plates

Cover plates are available to allow blanking off unused footprints on a manifold.

Cover Plate Options	
Kit Number	**Description**
SMK00021	VW14 Cover plate
SMK00002	VW18 Cover plate
SMK00004	VW25 Cover plate
SMK00003	Pressure cut-off (PCO) cover plate – 1 & 2-Stage

Cover plate kits includes: cover plate, o-rings, and bolts.



4.5 Conversion Plates

It is possible to adapt a footprint on a manifold to use a smaller valve by means of a conversion plate.

Conversion Plate Options	
Kit Number	**Description**
6613404302	VW18 to VW14 conversion plate*
SMK00010	VW25 to VW14 conversion plate
SMK00053	VW25 to VW18 conversion plate*

*Requires longer mounting bolts than normal (VW14 = + 10 mm, VW18 = + 15mm)

4.6 Sandwich Valves Mounted On Manifolds

It is sometimes advantageous to use sandwich valves on manifolds. The VW14 has its own footprint but the VW18 sandwich valve can use the same footprint as the VW18 subplate valve. With sandwich valves it is possible to stack more than one valve on a single footprint. It is also possible to mount a VW18 sandwich valve under a VW18 subplate valve. There are several things to consider when using sandwich valves that do not apply to subplate valves.

- The top of the stack must be covered by a cover plate, an end plate (see explanation in section 4.2) or a subplate valve.
- The work ports are at right angles to the subplate valve work ports.
- Because of the work port orientation, the valves can only be mounted on a footprint that is on an end position (they cannot be mounted between two other valves).
- A valve mounted directly to the manifold will have its full flow capacity.
- Valves that receive their flow through another valve will have a reduced flow capacity.
- The flow capacity of a valve stack can be increased by using an end plate with P & T ports to provide flow from both ends of the stack.
- It is generally not a good idea to stack more than 3 valves.
- The total flow capacity of a valve stack should be limited to the maximum capacity of the first valve in the stack.

Cover Plate Kits for Mounting VW Sandwich Valves		
No. of Add On Sections	VW14	VW18
	Part Number	Part Number
1	SMK00022	SMK00083
2	SMK00023	SMK00084
3	SMK00024	N/A

Cover Plate Kits for Mounting VW Sandwich Valves to Adapter		
No. of Add On Sections	VW14	VW18
	Part Number	Part Number
1	SMK00032	SMK00094
2	SMK00033	SMK00095
3	SMK00034	N/A

P & T End Plate Kits for Mounting VW Sandwich Valves		
No. of Add On Sections	VW14	VW18
	Part Number	Part Number
1	SMK00062	SMK00085
2	SMK00063	SMK00086
3	SMK00064	SMK00087

P & T End Plate Kits for Mounting VW Sandwich Valves to Adapter		
No. of Add On Sections	VW14	VW18
	Part Number	Part Number
1	SMK00069	SMK00088
2	SMK00070	SMK00089
3	SMK00071	SMK00090

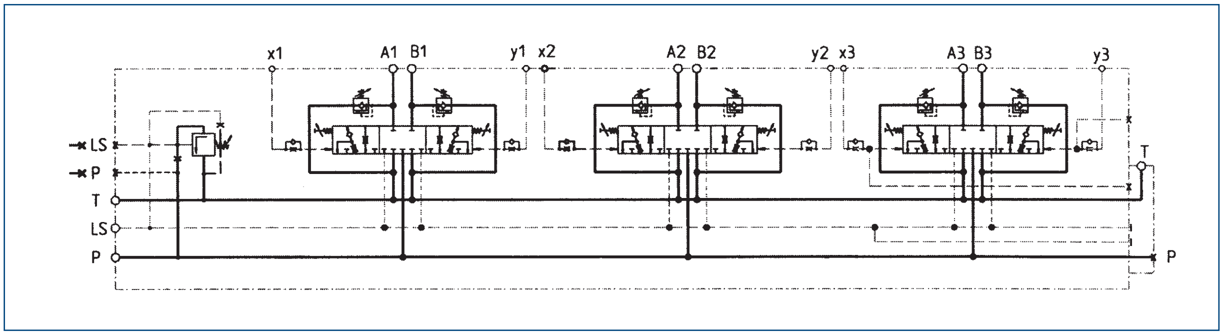
5. MONOBLOCK SYSTEMS

Monoblocks incorporate three (3) valve spools and a pressure control into a single housing. The housing includes pressure port (P), tank port (T) and load sense ports (LS). In addition there is a removable end plate that allows sandwich valves to be added to increase the number of functions. The end plate includes additional P and T ports to allow even flow distribution at higher flows. For OEM applications, monoblocks can be configured with any combination of spools but Linde carries several configurations in inventory.

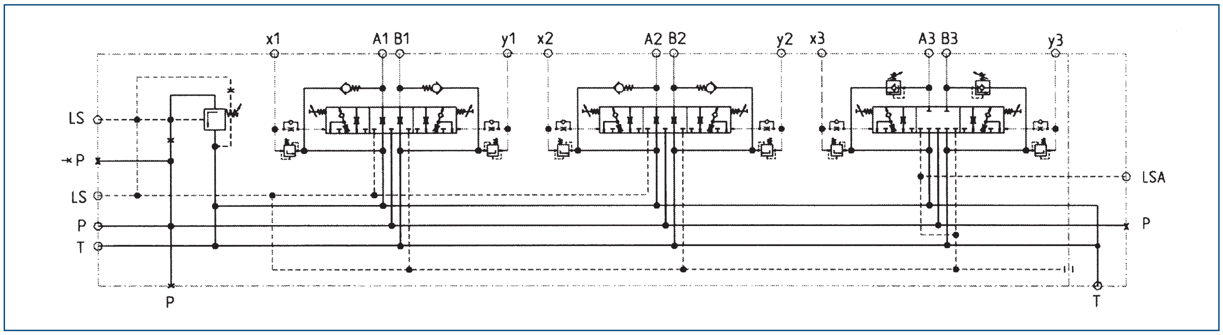
5.1 Standard Monoblocks

Part Number	Size	Spools	Flow A/B* lpm (gpm)	RVAC or AC Check
MW14020	VW14	Aux	148/148 (39/39)	RVAC
		Aux	148/148 (39/39)	RVAC
		Aux	148/148 (39/39)	RVAC
MW18041	VW18	Aux	227/227 (60/60)	RVAC
		Aux	227/227 (60/60)	RVAC
		Aux	227/227 (60/60)	RVAC
MW18042	VW18	Propel	190/190 (50/50)	AC
		Propel	190/190 (50/50)	AC
		Aux	227/227 (60/60)	RVAC
MW18026	VW18	Cylinder	285/265 (75/70)	RVAC
		Cylinder	285/265 (75/70)	RVAC
		Cylinder	285/265 (75/70)	RVAC

*Max flow for spool when operated by itself. Max flow capacity of monoblock when multiple spools are operated is 285 lpm (75 gpm) for VW14 size and 380 lpm (100 gpm) for VW18 size.



schematic 7



schematic 8

5.2 Pressure Cut-Of (PCO) Options

The pressure control feature in the standard monoblocks is configured as a load sense relief valve. If a system requires two monoblocks on the same pump, the pressure control feature in one of the monoblocks can be changed to a safety relief. This gives the system the same protection as a manifold system with a single stage PCO. If a single monoblock is used, the end plate can be changed to one that has a safety relief built-in to provide the same protection.

Safety Relief End Plate Kits		
No. of Add On Sections	**VW14**	**VW18**
	Part Number	**Part Number**
0	SMK00057	6683404800
1	SMK00096	SMK00091
2	SMK00097	SMK00092
3	SMK00098	SMK00093

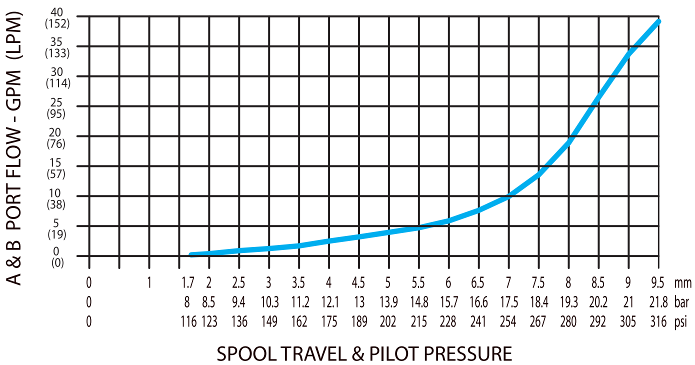
5.3 Sandwich Valves Mounted On Monoblocks

Sandwich valves can be added to a monoblock assembly by removing the bolts from the end plate, placing the section on the end of the monoblock and re-installing the end plate using longer bolts. There are several points to consider when adding sandwich valves.

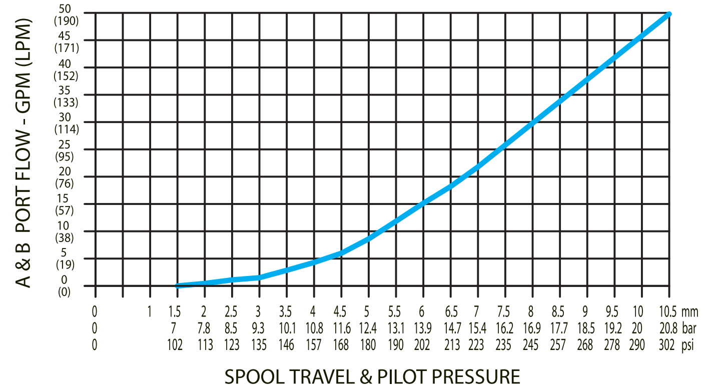
- It is not advisable to use more than 3 sandwich valves.
- It is better to use 2 monoblocks than to use 3 sandwich valves on a single monoblock.
- The flow capacity of a sandwich valve will be less than the same spool used in the monoblock unless pump flow is provided to the monoblock at both the main pressure port and the pressure port in the end plate.
- The flow capacity of a sandwich valve may be reduced even when the end plate pressure port is used if 2 or more sandwich sections are used.

6. FLOW CURVES

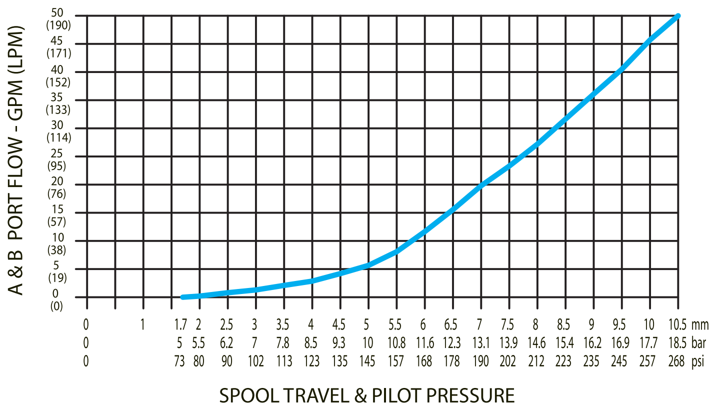
CURVE 1



CURVE 2



CURVE 3



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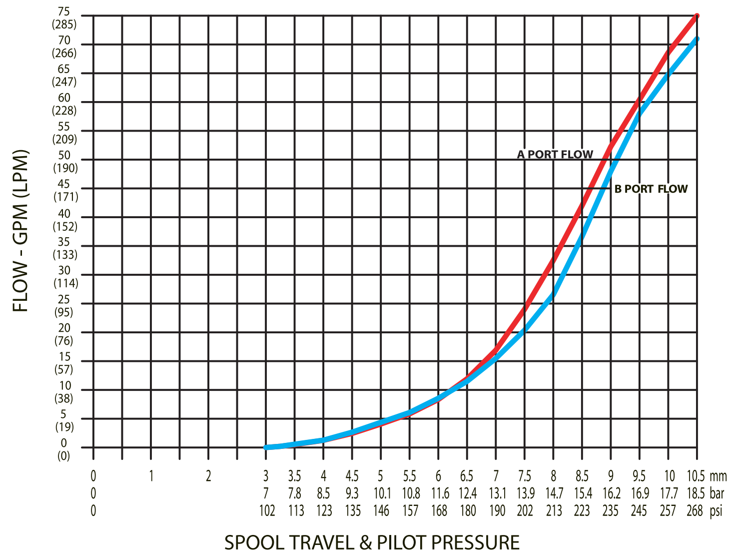

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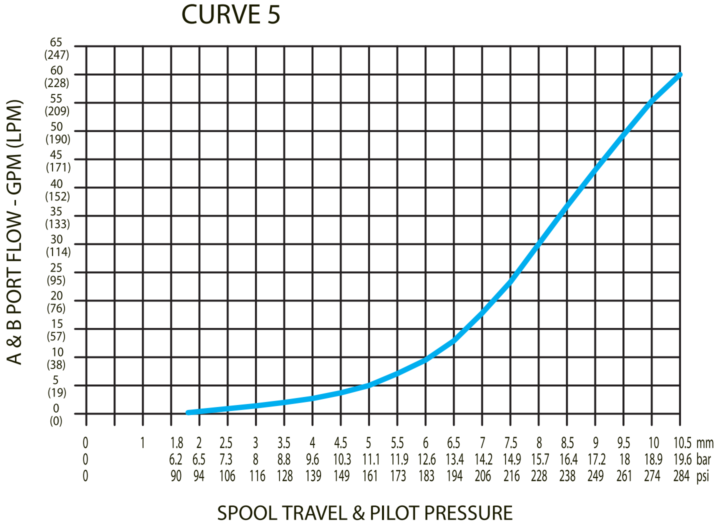

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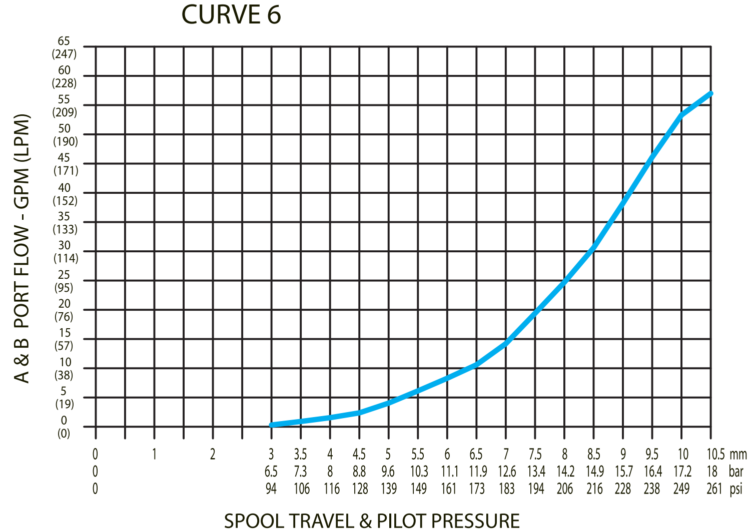

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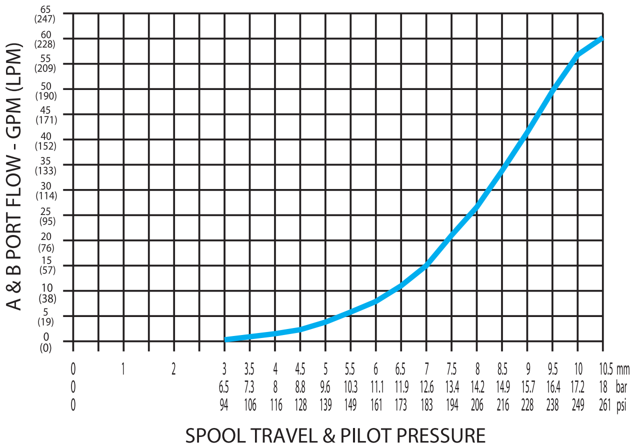

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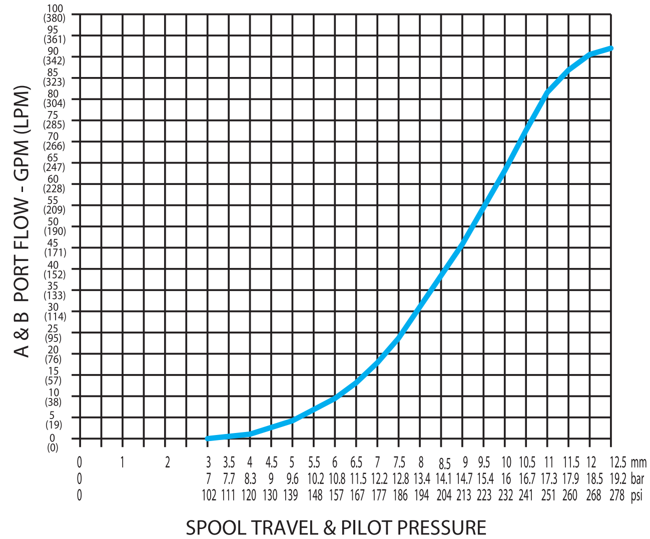

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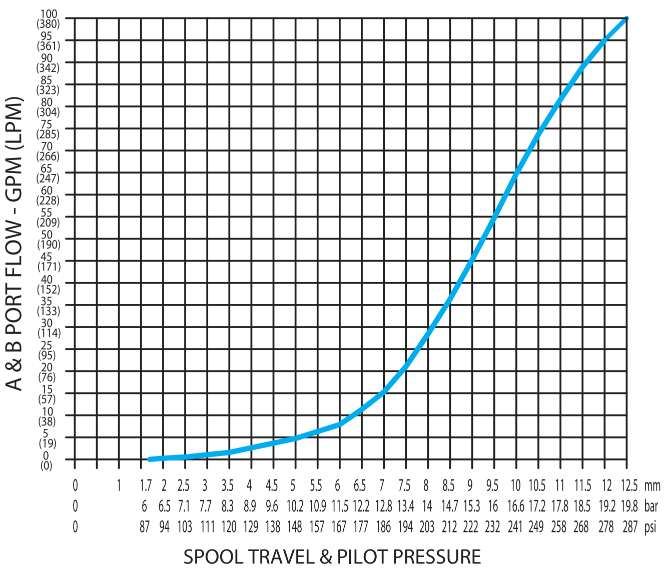

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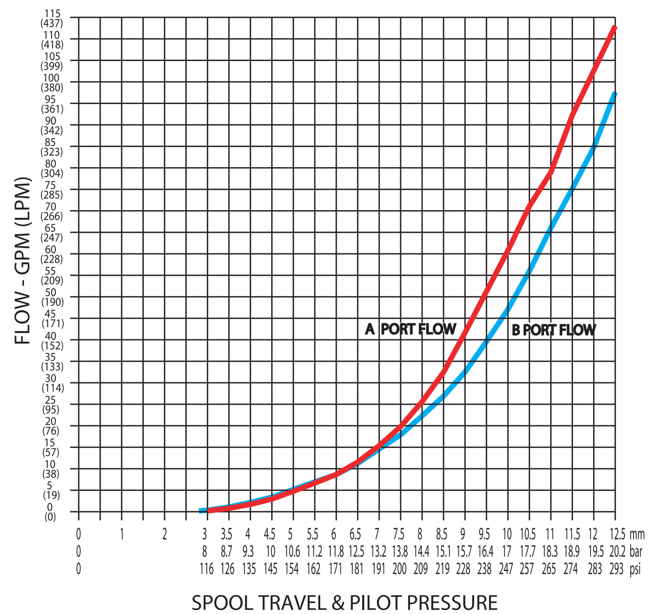

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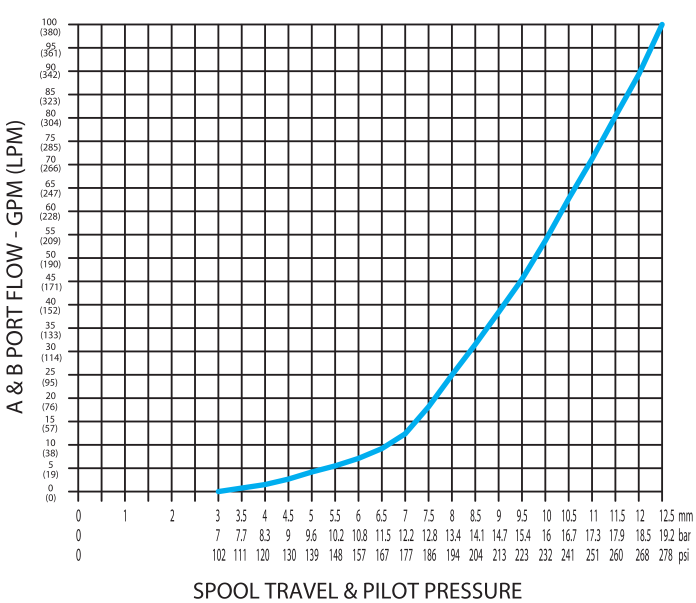
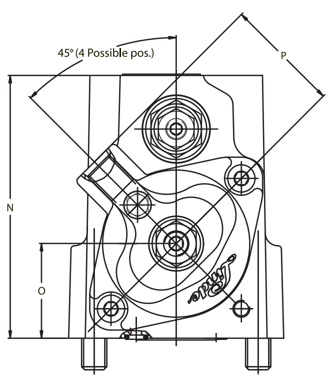


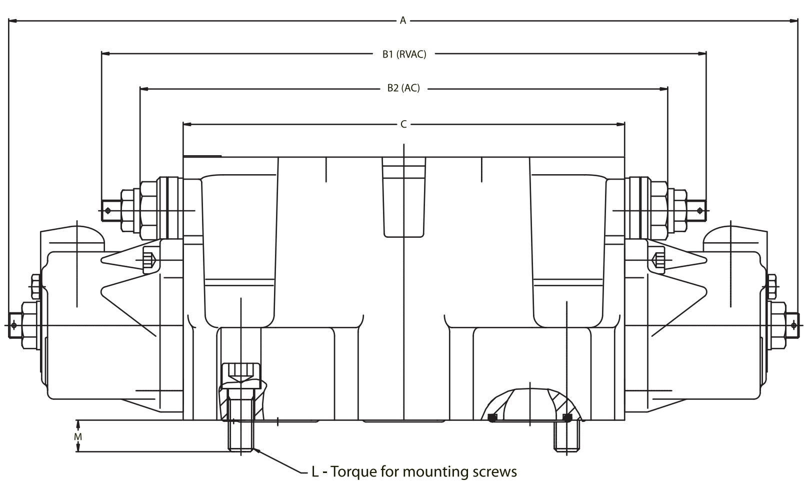
7. INSTALLATION DRAWINGS AND VALVE FOOTPRINTS

Installation Dimensions

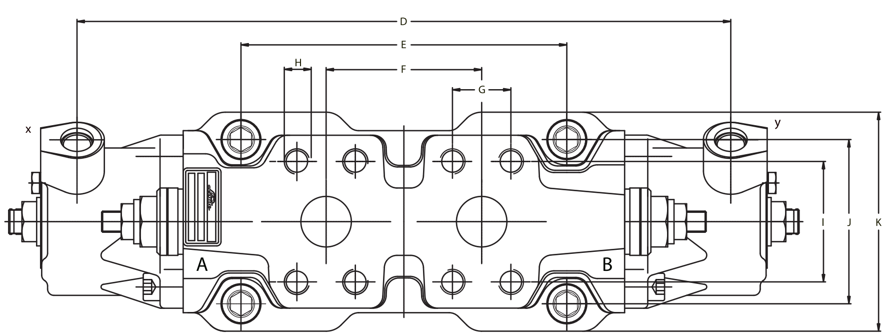
	Units	VW18	VW25
A	[mm (in.)]	~332 (~13.07")	~376 (~14.81")
B1 (RCAV)*	[mm (in.)]	~358 (~10.07")	~286 (~11.26")
B2 (AV)**	[mm (in.)]	210 (8.27")	240 (9.45")
C	[mm (in.)]	180 (7.09")	210 (8.27")
D	[mm (in.)]	268 (10.55")	311 (12.25")
E	[mm (in.)]	130 (5.19")	155 (6.11")
F	[mm (in.)]	64 (2.52")	74 (2.92")
G	[mm (in.)]	23.8 (0.937")	27.78 (1.093")
H		M10 x 17 dp	M12 x 16 dp
I	[mm (in.)]	50.80 (2.000")	57.15 (2.250")
J	[mm (in.)]	70 (2.76")	78 (3.07")
K	[mm (in.)]	94 (3.70")	104 (4.10")
L	[Nm ft. lb.)]	49 (36)	86 (64)
M	[mm (in.)]	45 (1.77")	30 (2.17")
N	[mm (in.)]	115 (4.53")	125 (4.93")
O	[mm (in.)]	40 (1.58")	45 (1.78")
P	[mm (in.)]	46.5 (1.83")	55 (2.17")
Control Ports X, Y		SAE -6 ORB, 9/16 – 18	SAE -6 ORB, 9/16 – 18
Work Ports A, B		0.75" Code 62, 4-bolt flange w/metric threads (ISO 6162)	1" Code 62, 4-bolt flange w/metric threads (ISO 6162)

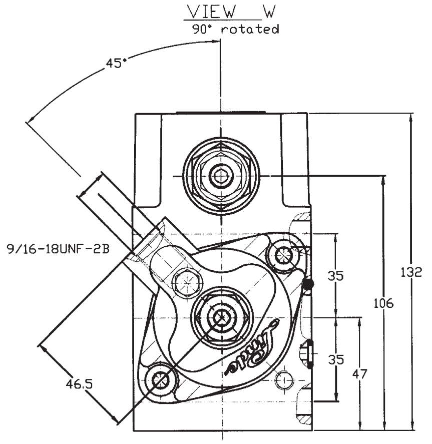
*Dimension for combination relief valve w/anti-cavitation checks.
**Dimension for anti-cavitation checks.

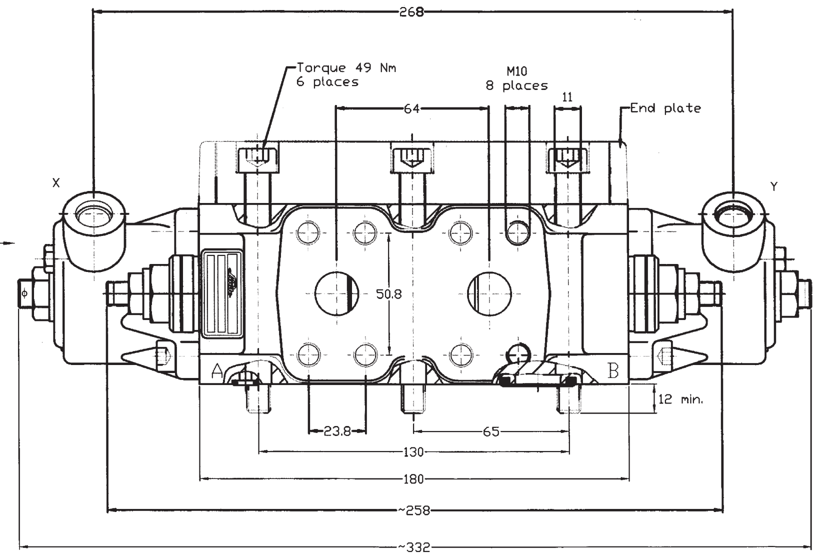




VW18 and VW25
Subplate Valve





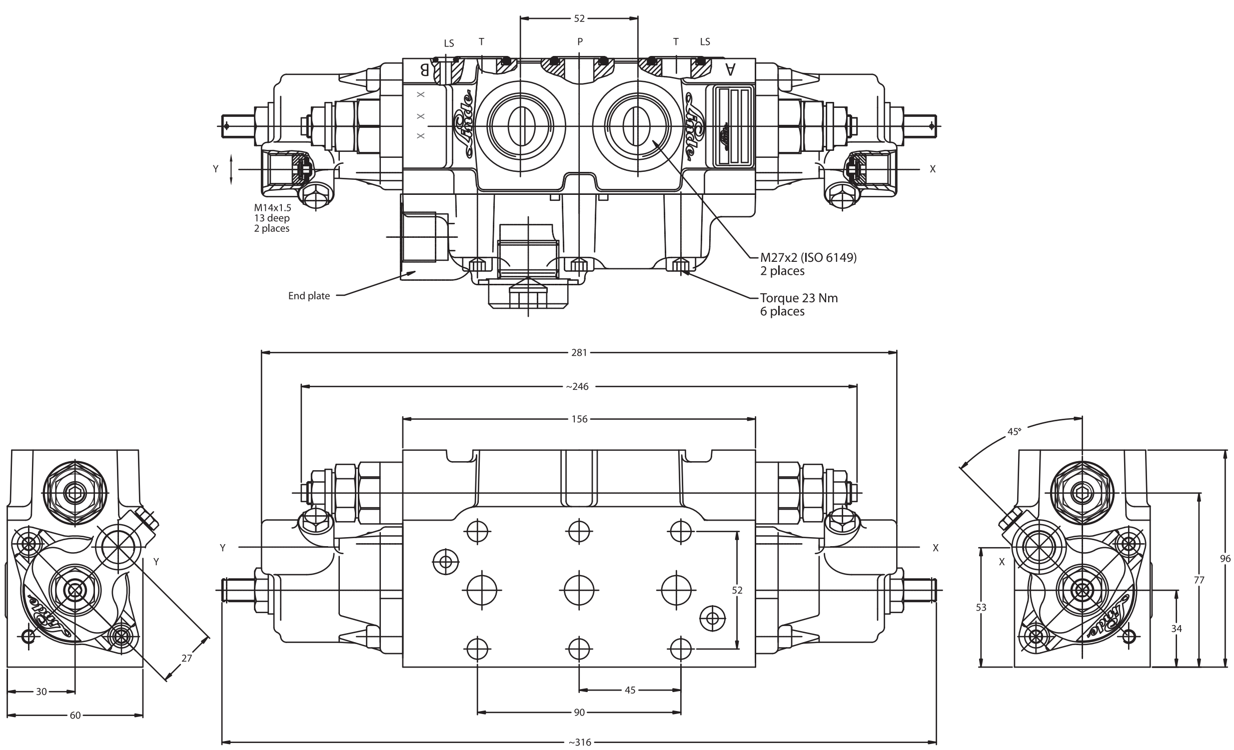


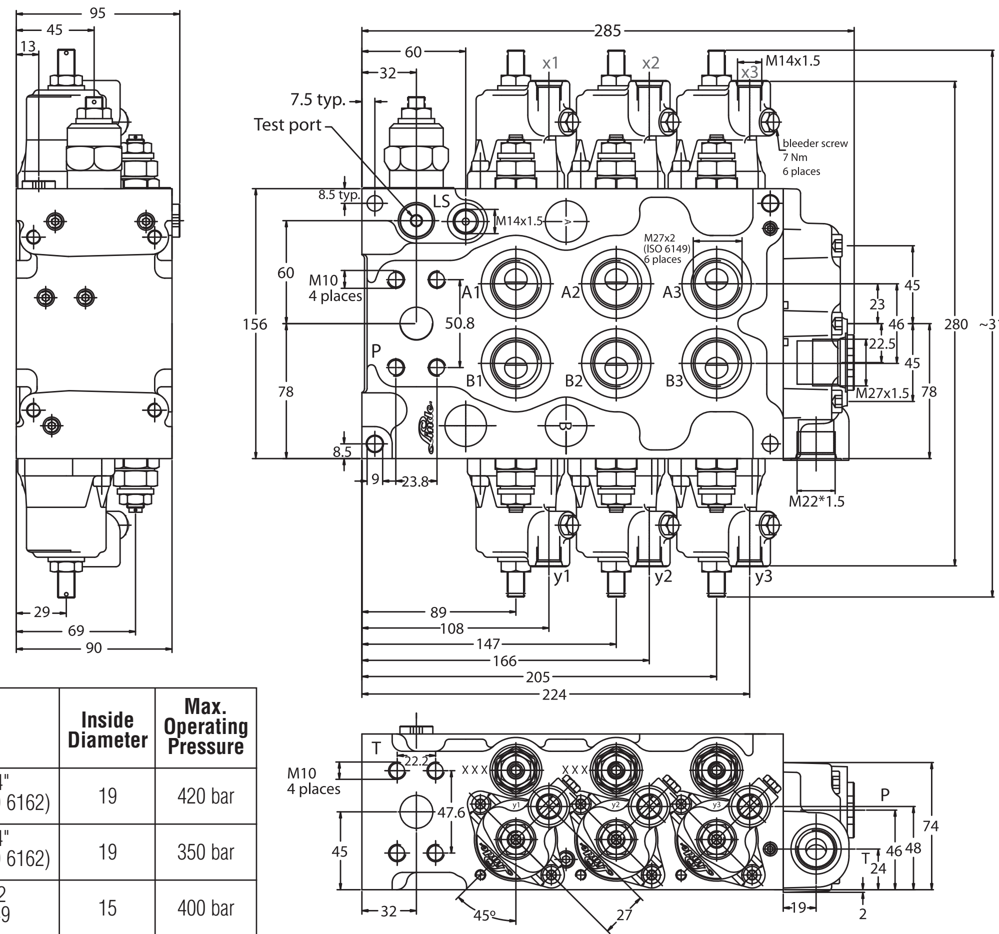
VW18 Sandwich Valve

Port	Size	Inside Diameter	Max. Operating Pressure
A, B = Work Part	M27 x 2 ISO 6149	15	400 bar
X, Y = Control Pressure	M14 x 1.5 ISO 6149	7.5	45 bar

VW14 Sandwich Valve

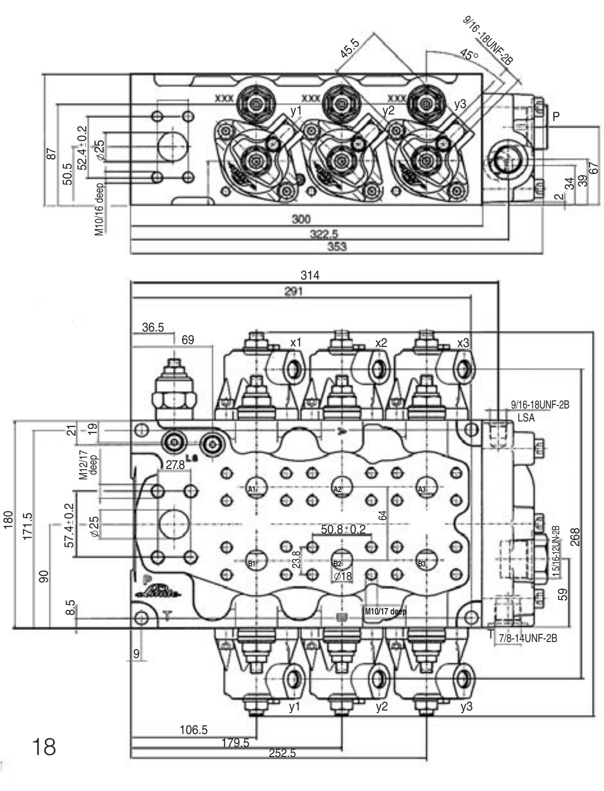
Port	Size	Inside Diameter	Max. Operating Pressure
A, B = Work Part	SAE 3/4" Code 62 (ISO 6162)	18	400 bar
X, Y = Control Pressure	9/16 – 18UNF – 2B		45 bar



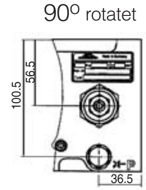


VW14 Monoblock Valve

Port	Size	Inside Diameter	Max. Operating Pressure
P = Pump	SAE 3/4" Code 62 (ISO 6162)	19	420 bar
T = Tank	SAE 3/4" Code 61 (ISO 6162)	19	350 bar
A1 – A3, B1 – B3 = Work Parts	M27 x 2 ISO 6149	15	400 bar
x1 – x3, y1 – y3 = Control Pressure	M14 x 1.5 ISO 6149	7.5	45 bar
LS = LS – Pressure	M14 x 1.5 ISO 6149	6	630 bar
P = Pump	M27 x 2 ISO 6149	15	400 bar
T = Tank	M22 x 1.5 ISO 6149	14	315 bar
xP, xLS	M14 x 1.5 ISO 6149	6	630 bar

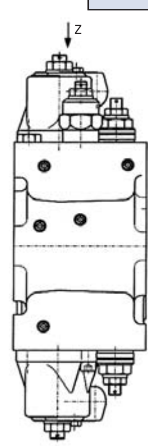


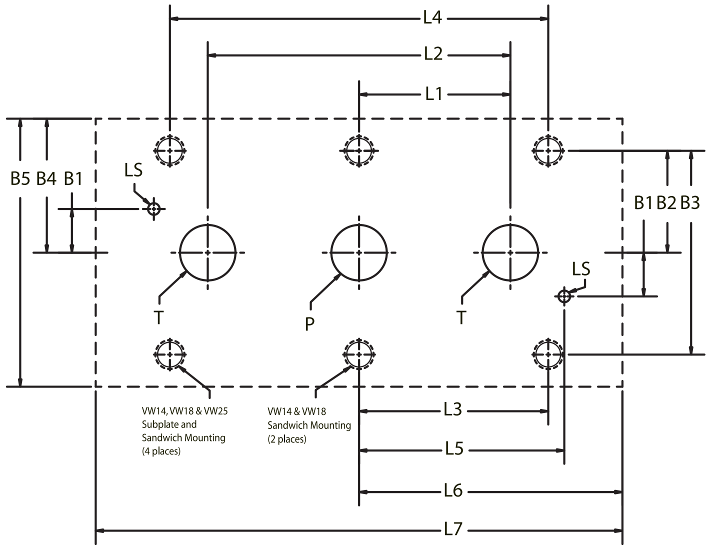
View Z
90° rotatet



VW18 Monoblock Valve

Port	Size	Inside Diameter	Max. Operating Pressure
P = Pump	SAE 1"	25	420 bar
A1 – A3, B1 – B3 = Work Parts	SAE 3/4"	19	420 bar
T = Tank	SAE 1"	25	350 bar
LS, LSA = LS – Pressure	9/16 – 18UNF – 2B		
x1 – x3, y1 – y3 = Control Pressure	9/16 – 18UNF – 2B		
xP = Test Port	9/16 – 18UNF – 2B		
T = Tank	7/8 – 14UNF – 2B		
P = Pump	1-5/16 – 12UNF – 2B		





VW Mounting Pad Table

Related Sizes	**VW14**	**VW18**	**VW25**
B1 [mm (in.)]	12.5 (0.492)	15.0 (0.591)	19.0 (0.748)
B2 [mm (in.)]	26.0 (1.024)	35.0 (1.378)	39.0 (1.535)
B3 [mm (in.)]	52.0 (2.048)	70.0 (2.75)	78.0 (3.070)
B4 [mm (in.)]	35.0 (1.375)	46.0 (1.812)	52.5 (2.062)
B5 [mm (in.)]	70.0 (2.750)	92.0 (3.625)	105.0 (4.125)
L1 [mm (in.)]	43.0 (1.693)	52.0 (2.047)	60.0 (2.362)
L2 [mm (in.)]	86.0 (3.386)	104.0 (4.094)	120.0 (4.724)
L3 [mm (in.)]	45.0 (1.772)	65.0 (2.559)	77.5 (3.051)
L4 [mm (in.)]	90.0 (3.544)	130.0 (5.118)	155.0 (6.102)
L5 [mm (in.)]	59.0 (2.323)	70.5 (2.776)	81.0 (3.189)
L6 [mm (in.)]	86.0 (3.385)	90.5 (3.562)	105.0 (4.133)
L7 [mm (in.)]	172.0 (6.770)	180.0 (7.087)	210.0 (8.226)
P Dia. [mm (in.)]	13.0 (0.51)	19.0 (0.75)	25.0 (1.00)
T Dia. [mm (in.)]	13.0 (0.51)	19.0 (0.75)	25.0 (1.00)
LS Dia. [mm (in.)]	5.0 (0.20)	5.0 (0.20)	5.0 (0.20)
Mounting Holes 1	M8 x 1.25 (4 places)	M10 x 1.5 (4 places)	M12 x 1.75 (4 places)
Mounting Holes 2	M8 x 1.25 (2 places)	M10 x 1.5 (N/A or 2 places)	N/A

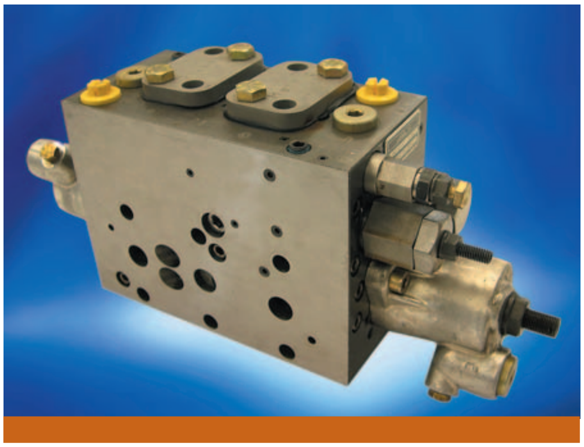
8. SPECIAL VALVES

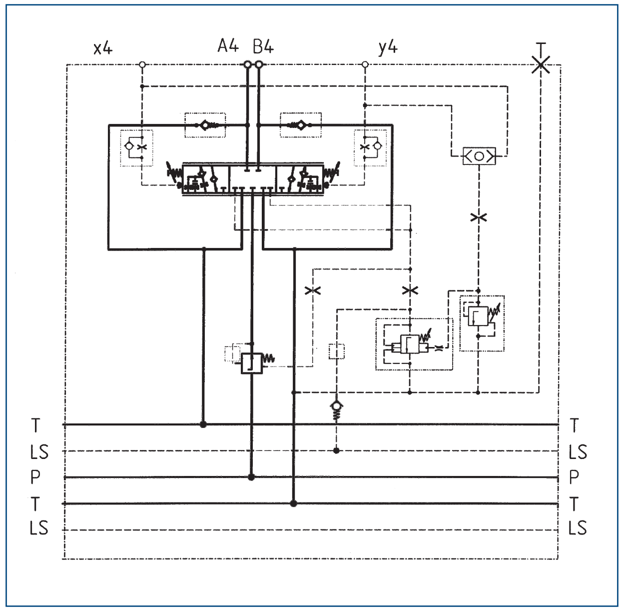
Along with the valve versions shown in Sections 2 through 4, Linde Hydraulics Corporation, also offers custom solutions for special requirements. If you don't see a solution that fits your requirements, please check with our application specialists.

8.1 Priority Swing Valve

This valve offers an integrated

- Directional control valve
- Torque control
- Priority function
- Torque limiting function
- Anti-cavitation function

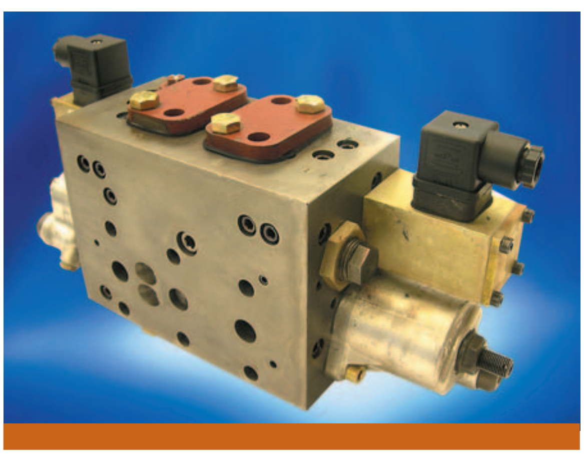


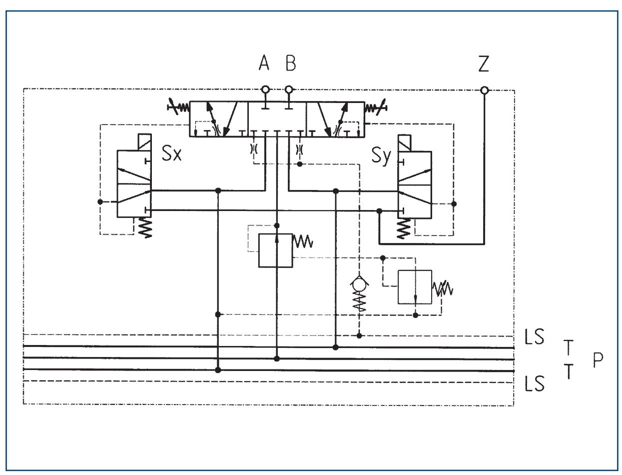


8.2 Grab-rotate Valve

This valve offers an integrated

- Directional control valve
- Solenoid operated pilot valves for on/off operation
- Priority function
- Torque limiting function





9. PRESSURE FLUIDS AND FILTRATION

Permissible Pressure Fluids

- HLP mineral oil per DIN 51524
- Biodegradable oils on request
- Other pressure media on request

Technical Data

Pressure fluid temperature range	[°C]	-20 to +90
Operating viscosity range	[mm²/s] = [cSt]	10 to 80
Optimum operating viscosity range	[mm²/s] = [cSt]	15 to 30
Maximum viscosity (temporary, during startup)	[mm²/s] = [cSt]	1000

Viscosity Recommendations

Operating temperature [°C]	**Viscosity class [mm2/s] = [cSt] at 40°**
Approx. 30 to 40	22
Approx. 60 to 80	46 or 68

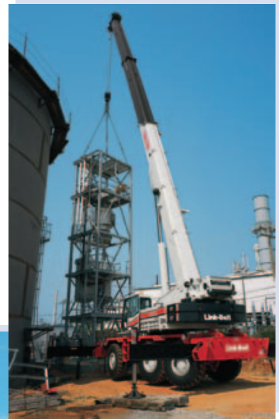
Linde recommends using only pressure fluids which are confirmed by the producer as suitable for use in high pressure hydraulic installations. For the correct choice of suitable pressure fluid it is necessary to know the working temperature in the hydraulic circuit (closed loop). The pressure fluid chosen must allow the working viscosity to be within the optimum viscosity range (refer to above table).

Attention:
Due to pressure and speed influences, the leakage fluid temperature is always higher than the circuit temperature. The temperature must not exceed 90°C in any part of the system. Under special circumstances, if the stated conditions cannot be observed, then please consult Linde.

Filtration

In order to guarantee functions and efficiency of the hydraulic motors the purity of the pressure fluid over the entire operating period, must comply to at least class 18/13 according to ISO 4406.

With modern filtration technology, however, much better values can be achieved which contributes significantly to extending the life and durability of the hydraulic motors and complete system.



10. AREAS OF APPLICATIONS

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