HYDRAULIC COMPONENTS
HYDROSTATIC TRANSMISSIONS
GEARBOXES - ACCESSORIES

Certified Company ISO 9001 - 14001

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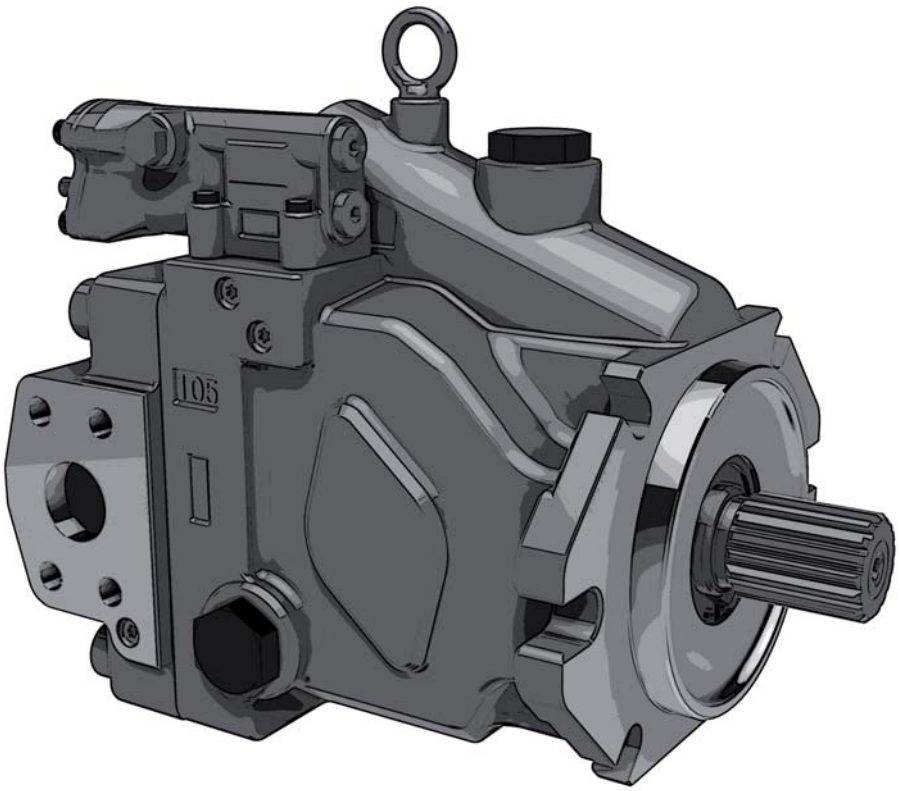
HT 16 / F / 1002 / 0616 / E / M

Swash Plate Type
Axial Piston Pump for Load Sensing

Kawasaki
Hydraulic Products

K3VLS Series



Instruction Manual

Table of contents

Table of contents (continue)

Safety Precaution Symbols

In order to indicate the degree and urgency of injuries and damages that would be caused by wrong operation, in this manual the risks are classified into 3 ranks: **"DANGER"**, **"WARNING"**, and **"CAUTION"**. Besides the safety indication, information required for correct use of the product is indicated with "Important".

DANGER	A very urgent situation where death or serious injury will be caused unless emergency avoidance measures are taken.
WARNING	A situation where death or serious injury may be caused by wrong handling.
CAUTION	A situation where mild or intermediate injury or property damage may be caused by wrong handling.
Important:	Information required for correct use of this product.

Be sure to read **"1. Safety Precautions"** first.

1. Safety Precautions

The following are points which require extra care in order to use this product safely.
These points are very important points related to safety and must be strictly observed in addition to related standards and laws regarding safety to handle this product safely.

■ Related Standards Regarding Safety

- High Pressure Gas Control Law
- Fire Service Act
- JIS B 8265, 8266 Structure of Pressure Vessels
- Industrial Safety and Health Act
- Explosion Class
- JIS B 8361 Hydraulic fluid power-General rules relating to systems

1.1 Cautions related to operation

CAUTION	Use personal protective equipment to prevent injury when the product is in operation.
CAUTION	Some components are heavy. Handle the product carefully to avoid hurting your hands or lower back.
CAUTION	Do not step on, hit, drop, or apply strong force to the product, as these actions may cause operation failure, product damage, or oil leakage.
CAUTION	Wipe off any oil on the product or the floor completely, since oil can create slippery conditions that may cause dropping of the product and personal injury.

1.2 Warnings and Cautions related to installation and removal of the product

DANGER	Make sure that the hydraulic power unit is turned off and that the electric motor or engine has completely stopped before starting installation or removal. Also check that the system pressure has dropped to zero.
DANGER	Make sure that the power source is turned off before installing electric components to reduce the risk of electric shock.
CAUTION	Installation, removal, piping, and wiring must be done by qualified technicians. * Qualified technician: Class II hydraulic system adjustment technician or equivalent, or a person who has received our service training.
CAUTION	Clean the threads and the mounting surface to prevent damage or oil leakage. Inadequate cleaning may cause insufficient torque and broken seals.
CAUTION	Use the designated bolts and fasten them with the prescribed torque when installing the product. Use of undesignated bolts and excessive or insufficient tightening torque may lead to operation failure, damage, or oil leakage.

1.3 Warnings and Cautions for operation

DANGER	Always equip the product with explosion or ignition protection if it will be used in potentially explosive or combustible atmospheres.
DANGER	Shield rotating parts such as the motor and pump shaft to avoid injuries.
DANGER	Stop operation immediately and take proper measures when an abnormality such as abnormal noise, oil leakage, or smoke is found. Continuing operation under such condition may lead to damage, a fire hazard, or injury.
CAUTION	Make sure that all pipes, hoses, and connections with pipes or hoses are correctly connected and tightened before starting operation.
CAUTION	Use the product under the operating conditions and limitations described in the catalog, drawings, and specification sheets.
CAUTION	Do not touch the product during operation to reduce the risk of skin burn.
CAUTION	Use the proper hydraulic oil and maintain the filtration at the recommended level to prevent premature wear and damage.

1.4 Cautions related to maintenance

CAUTION	Never modify the product by yourself.
CAUTION	Never disassemble or reassemble the product without approval from our Tech. Dept. Doing so may prevent the product from providing satisfactory performance and cause malfunctions or accidents. If disassembly or reassembly is necessary, those operations must be done by a qualified technician.
CAUTION	Keep the product clean and dry when storing or transporting.
CAUTION	The seals may need to be replaced if the product has been stored for an extended period of time.

2. Handling Precautions

(1) Wrong handling during use may prevent the product from providing satisfactory performance and may cause accidents.
Be sure to read this instruction manual and understand the details well before use.

(2) The following operations must be performed by a qualified technician having sufficient technical knowledge and skill:
Transportation, installation, piping, operation, maintenance and inspection.

(3) Check the following items before use.
- Compatibility with hydraulic system
- Product specifications
- No damaged section or major flaws

Important: For product specifications, refer to "3. Ordering Code" and "4. Specifications".

(4) When the product is used under the following conditions or environments, consult our Tech. Dept. before use.
- When the product will be used under conditions or environments other than those specified.
- When the product will be used for critical applications such as nuclear power, aviation, space, medical, food, etc.
- When the product will be used for applications which may adversely affect human bodies or property significantly through use of the product and special safety is required.

(5) When the product will be used for transportation or elevator devices for people, be sure to attach safety apparatus to the devices.

3. Ordering Code

Model Code **K3VLS 105 - 1 BB R CC S - L1 A A M1**

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫

■ Pump

① K3VLS Series
K3VLS series, variable displacement swash plate type, open loop pump

② Pump Size	65	85	105
Maximum displacement cm^3	●	●	●

③ O-ring Material (Oil seal in Fluororubber only)	
–	NBR (nitrile rubber) O-ring seals

④ Series Type Code	
1	Standard type

⑤	Through Drive and Porting	65	85	105
O	Without through drive, side ported	●	●	●
A	SAE-A through drive, side ported	●	●	●
B	SAE-B through drive, side ported	●	●	●
BB	SAE-BB through drive, side ported	●	●	●
C	SAE-C, 2/4 bolt, through drive, side ported	●	●	●
CC	SAE-CC, 2/4 bolt, through drive, side ported	–	–	●
N	With through drive shaft, without coupling, closed with steel cover, side ported	●	●	●
R	Without through drive, rear ported	●	●	●

For details of through drive, refer to "9.4 Through Drive".

⑥	Rotation Direction	65	85	105
R	Clockwise	●	●	●
L	Counterclockwise	●	●	●

● = Available
○ = Under development
– : Not available

Ordering Code

⑦	Mounting Flange and Shaft	65	85	105
B	SAE-B mount & SAE-B spline	●	–	–
BB	SAE-B mount & SAE-BB spline	●	–	–
C	SAE-C mount & SAE-C spline	●	●	●
CC	SAE-C mount & SAE-CC spline	–	–	●

For the details of mounting flange and shaft, refer to "9.3 Connection and Shaft end shape".

⑧	Flange Fixing Thread (Suction/Discharge)	65	85	105
S	SAE 4-bolt flange, UNC threaded	●	●	●
H	SAE 4-bolt flange, metric threaded	●	●	●

For the details of flange port, refer to "9.5 Port Specifications".

■ Regulator

⑨	Control Method		65	85	105
L0	Load sense & pressure cut-off	With LS bleed-off orifice	●	●	●
L1		Without LS bleed-off orifice	●	●	●

⑩	Differential Pressure Setting Range	65	85	105
A	Standard setting range (1.0 to 3.0MPa)	●	●	●
C	High setting range (1.5 to 4.0MPa)	●	●	●

⑪	Additional Control Options				65	85	105
Blank	Without any additional control				●	●	●
A	Torque limit control	Without power shift control			○	○	○
B		With power shift control	Pilot operated		○	○	○
C1			With electric proportional reducing valve	Voltage = 24V, AMP connector	○	○	○
C2				Voltage = 24V, Deutsch connector	○	○	○
C3				Voltage = 12V, Deutsch connector	○	○	○

⑫	Torque Limit Setting (Available only with the attachment of torque limiter)
**	For torque limiting, refer to Horsepower setting codes (under preparation)

● = Available
○ = Under development
– : Not available

4. Specifications

4.1 Device Specifications

Size			K3VLS65	K3VLS85	K3VLS105
Displacement		cm^3	65	85	105
Discharge pressure	Rated	MPa	28		
	Peak	MPa	35		
Allowable casing pressure		MPa	0.1 (regular use) / 0.4 (peak value)		
Rotation speed	Self-priming maximum *1	min^{-1}	2,600	2,500	2,300
	Maximum *2	min^{-1}	3,000		2,640
Casing oil volume		L	1.0	1.2	1.7
Oil temperature range		°C	-20 to +95		
Viscosity range		cSt	10 to 1,000		
Allowable contamination level			ISO 4406 –/ 18 / 15		
Allowable through drive range	SAE A	Nm	123		
	SAE B		380		
	SAE BB		435		
	SAE C		–	435	
Mass *3		kg	–		
Moment of inertia (GD^2 value)		Nm^2	1.64×10^{-2}	2.21×10^{-2}	3.33×10^{-2}
Torsional stiffness		Nm/rad	5.26×10^{4}	6.74×10^{4}	1.32×10^{5}

*1: Self-priming maximum is the maximum speed under the self-priming condition at the maximum displacement. Steady state inlet pressure should be greater or equal to 0 MPa gauge.

*2: Maximum speed is the maximum operating speed that the pump can be run at without damage to the pump under specific operating conditions.

*3: Mass varies depending on type. For the details, refer to "9. Outside dimensions".

■ Allowable Maximum Input Torque

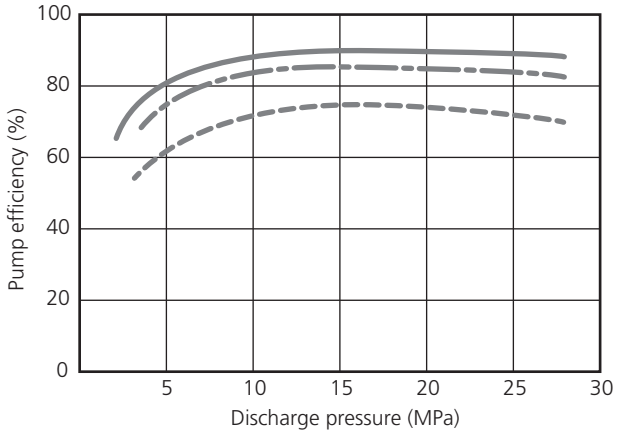
Shaft end shape		SAE B	SAE BB	SAE C	SAE CC
Splined shaft specifications		13T DP=16/32	15T DP=16/32	14T DP=12/24	17T DP=12/24
Allowable maximum input torque	(Nm)	200	315	630	1,060
Pump size		K3VLS65		K3VLS65/85/105	K3VLS105

Input splined shaft specifications are based on SAE J744.
Be sure to lubricate the engagement surface of the splined shaft to prevent the input splined shaft from being worn.

4.2 Pump Efficiency

q: Pump displacement ratio =
Pump displacement/maximum displacement

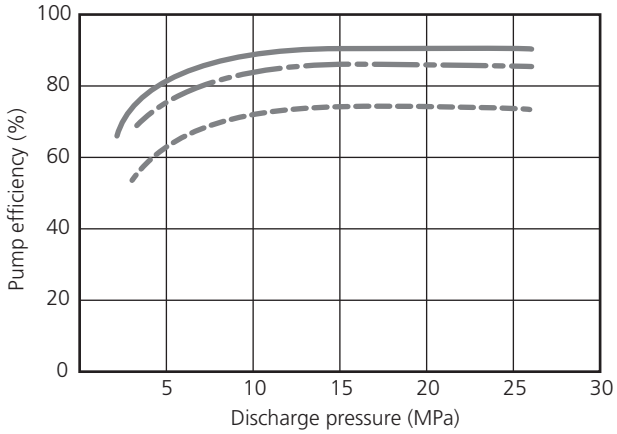
◆ K3VLS65



: q = 100%
: q = 50%
: q = 25%

Rotation speed	(min^{-1})	2300
Oil type		ISO VG46
Temperature	(°C)	50

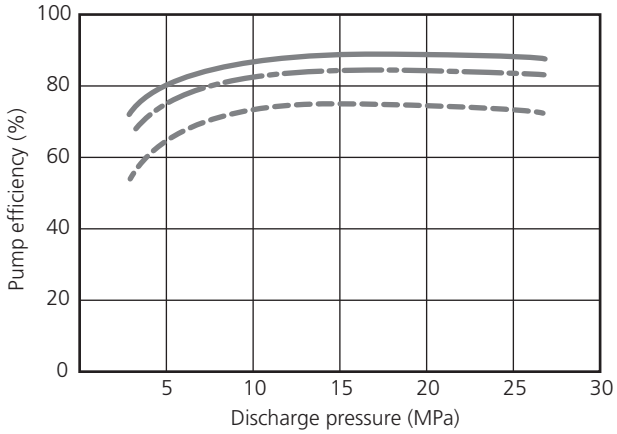
◆ K3VLS85



: q = 100%
: q = 50%
: q = 25%

Rotation speed	(min^{-1})	2200
Oil type		ISO VG46
Temperature	(°C)	50

◆ K3VLS105



: q = 100%
: q = 50%
: q = 25%

Rotation speed	(min^{-1})	2100
Oil type		ISO VG46
Temperature	(°C)	50

* These data are representative values but not guaranteed values.

Specifications (continued)

4.3 Control Responsiveness

4.3.1 Cut-off Responsiveness

Pressure: 2 to 28 MPa (Cut-off pressure setting: 28 MPa)

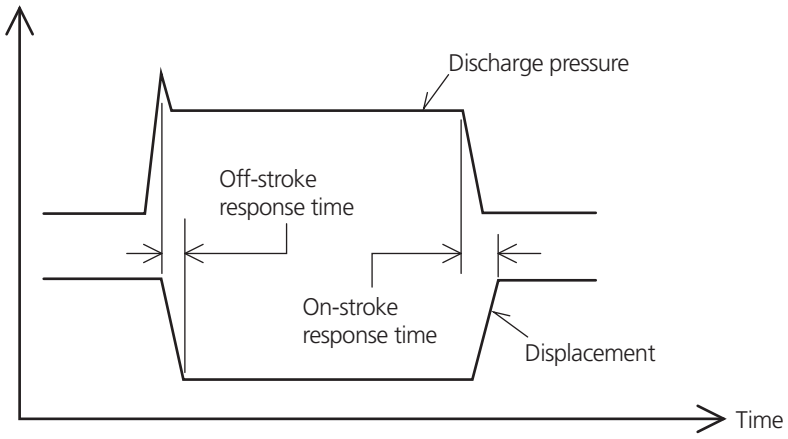
Oil type: ISO VG46

Temperature: 50 °C

Rotation speed: K3VLS65 2600 min^{-1}
K3VLS85 2200 min^{-1}
K3VLS105 2100 min^{-1}

Unit: msec

Pump size	K3VLS65	K3VLS85	K3VLS105
On-stroke response	110	80	135
Off-stroke response	50	50	125



* These data are representative values but not guaranteed values.

4.3.2 Load Sensing Responsiveness

Pressure: 10MPa (under the maximum displacement)

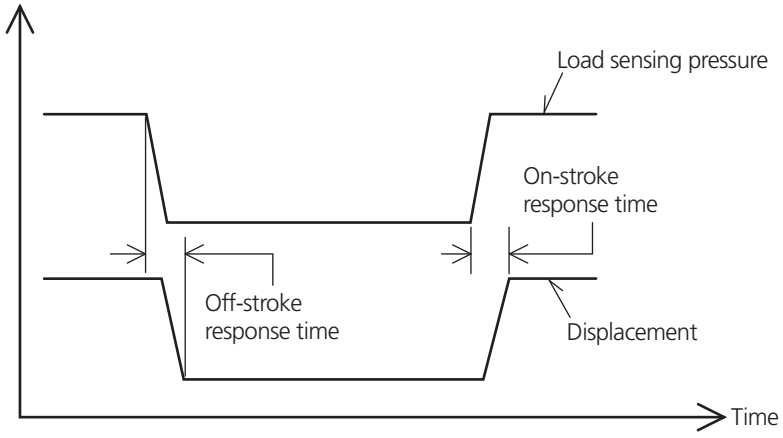
Oil type: ISO VG46

Temperature: 50 °C

Rotation speed: K3VLS65 2600 min^{-1}
K3VLS85 2200 min^{-1}
K3VLS105 2100 min^{-1}

Unit: msec

Pump size	K3VLS65	K3VLS85	K3VLS105
On-stroke response	120	90	145
Off-stroke response	50	60	110



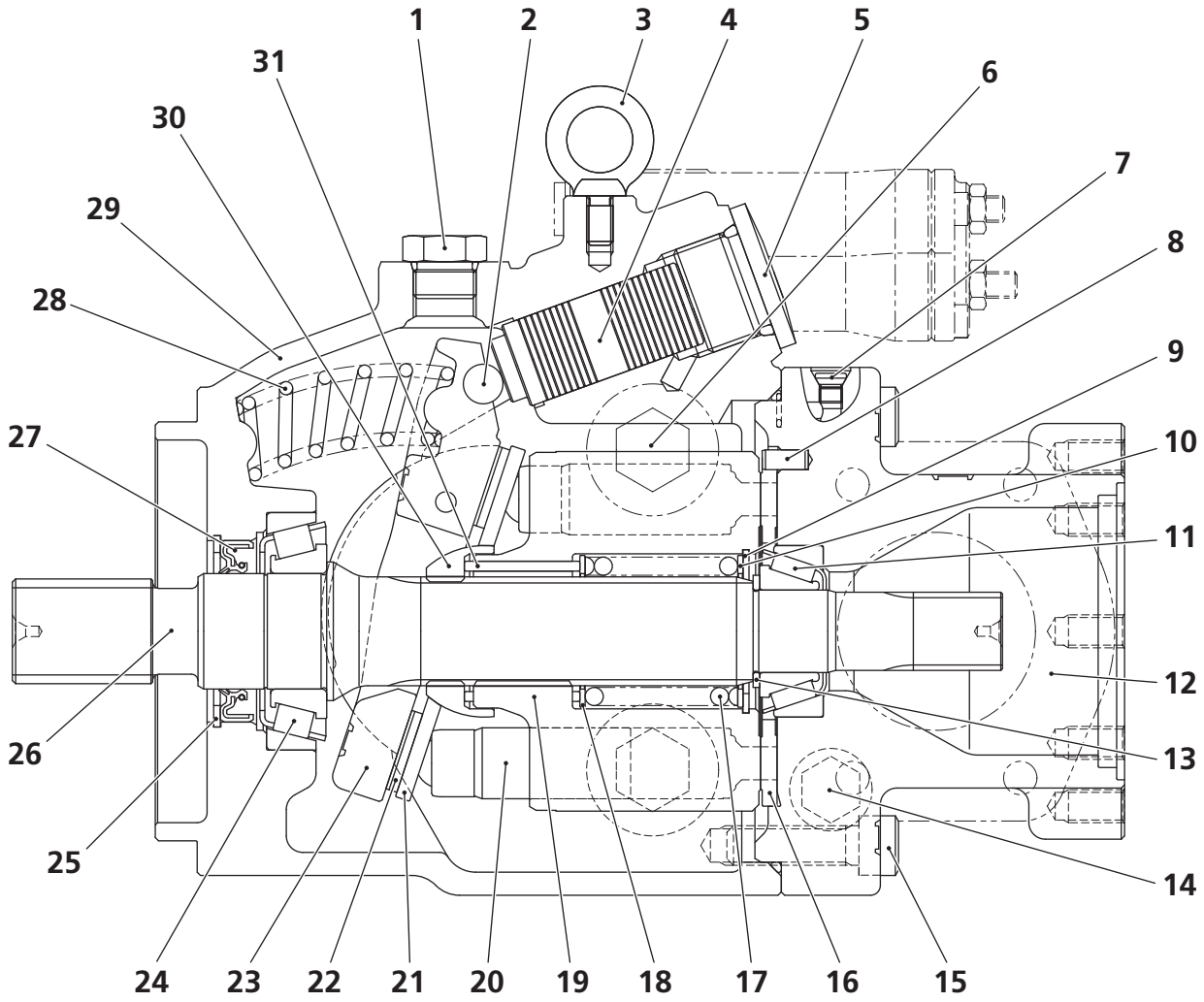
* These data are representative values but not guaranteed values.

5. Structure and Operating Principle

5.1 Structure of Pump

This pump is an open loop variable displacement axial piston pump with a swash plate structure. This pump is composed of 3 groups: **A Rotating Group** as a main rotating operation part, **a Swash Plate Group** to change the discharge flow rate, and **a Valve Cover Group** to change oil suction and discharge.

◆ Part Name



1. Plug
2. Tilting pin
3. Eye bolt
4. Tilting piston
5. Plug
6. Plug
7. MH plug
8. Spring pin
9. Locking ring
10. Spacer
11. Tapered roller bearing R
12. Valve cover
13. Bearing spacer
14. Plug
15. Hexagon socket head cap screw
16. Valve plate
17. Cylinder spring
18. Spacer
19. Cylinder block
20. Piston
21. Set plate
22. Shoe
23. Swash plate
24. Tapered roller bearing F
25. Locking ring
26. Drive shaft
27. Oil seal
28. Return spring
29. Pump casing
30. Spherical bush
31. Push rod

5.2 Pump Operating Principle

■ Rotating Group

This group consists of the drive shaft (26), cylinder block (19), piston (20), set plate (21), shoe (22), spherical bush (30), cylinder spring (17), push rod (31) and spacers (10, 18). The drive shaft is supported by tapered roller bearings (11, 24) at both ends. The piston sub whose piston is caulked with a shoe not only forms a ball joint but also has a pocket capable of achieving pressure balance to relieve the thrust force generated by loading pressure and allow it to slide with light pressure on the swash plate (23). The piston sub is pressed against the swash plate by the cylinder spring via the set plate, spherical bush and push rod to allow smooth sliding on the swash plate. The cylinder block is also pressed against the valve plate (16) by the cylinder spring in the same manner.

■ Swash Plate Group

This group consists of the swash plate (23), tilting pin (2), return spring (28) and tilting piston (4). The swash plate has a cylindrical part formed on the side opposite to the shoe sliding surface which is supported by the pump casing (29), and is capable of changing the tilt angle (α) by movement of the tilting piston. When the pressure controlled by the regulator increases and pushes the tilting piston, the tilt angle of the swash plate decreases and when the pressure decreases, the tilt angle of the swash plate increases by hydraulic reaction applied from the piston sub and the force of the return spring.

■ Valve Cover Group

This group consists of the valve cover (12), valve plate (16), and spring pin (8). The valve plate, which has two oval ports and is attached to the valve cover, supplies hydraulic oil to the cylinder block and collects the oil. The switchover of the valve plate sends the hydraulic oil to the external piping from the valve cover.

■ Operation

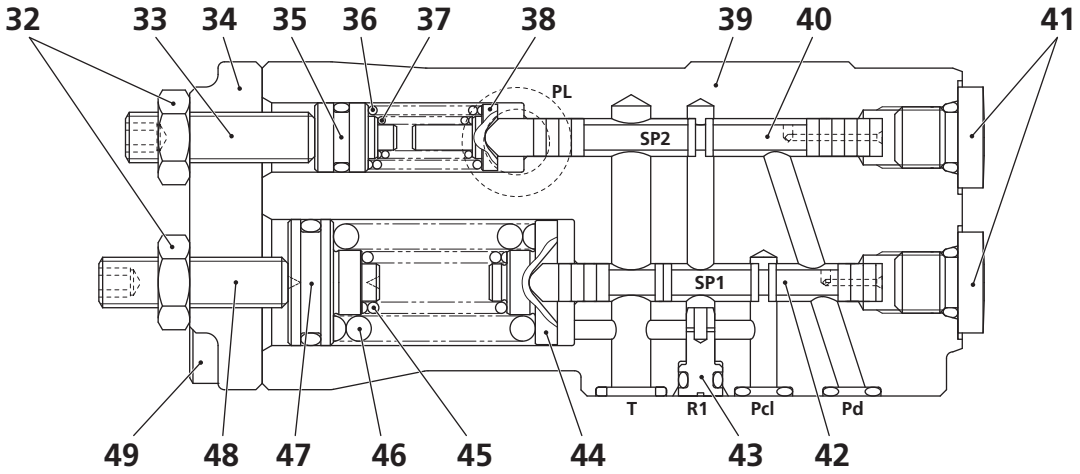
When the drive shaft is driven by motors (electric motor, engine, etc.), the cylinder block rotates via the spline connection at the same time. If the swash plate is tilted, the piston provided in the cylinder block performs reciprocating operation relatively to the cylinder while rotating together with the cylinder block.
Focusing on the operation of a single piston, as the cylinder block moves through a single rotation, the piston is moving away from the valve plate (hydraulic oil suction process) for 180° and then is moving closer to the valve plate (hydraulic oil discharge process) for the remaining 180°.
At this time, the larger the swash plate tilt angle, the larger the piston stroke. As a result, the pump displacement becomes larger. In addition, if the tilt angle of swash plate is "0", the piston does not perform stroke operation and therefore, the hydraulic oil is not discharged.

Structure and Operating Principle (continued)

5.3 Structure of Regulator

The regulator has a load sensing control function and pressure cut-off control function. The load sensing control is flow rate control to discharge oil at the required flow rate regardless of load pressure. The pressure cut-off control is pressure control to limit the pump flow and prevent the discharge pressure from exceeding the set pressure when the discharge pressure becomes closer to the set value. Both perform control by changing the tilt angle of the swash plate. In addition, the pressure cut-off control has priority over the load sensing control.

◆ Part Name (Regulator)



32. Lock nut
33. Differential pressure adjusting screw
34. Cover
35. Stopper A
36. Spring
37. Spring
38. Spring seat
39. Casing
40. Differential pressure spool
41. Plug
42. Cut-off spool
43. Restrictor
44. Spring seat
45. Spring
46. Spring
47. Stopper B
48. Cut-off adjusting screw
49. Hexagon socket head cap screw

5.4 Operating Principle of Regulator

The pump flow is controlled by the load sensing control within the set pressure of the cut-off control. When the discharge pressure becomes closer to the set value, the pump control is changed to the pressure cut-off control to control the pump discharge pressure.

5.4.1 Pressure Cut-off Control

The pressure cut-off control keeps the pump discharge pressure constant by repeating steps (1) through (3) to achieve balance.

(1) Condition where the pump discharge pressure is low

If the discharge pressure is low, the port (Pd) pressure is also low and the spring force is larger than the cut-off spool (SP1) push force; therefore, the cut-off spool stays at the right end. In this condition, the port (Pcl) is connected to the tank port (T) via the cut-off spool, which does not apply pressure to the tilting piston, causing the tilt angle of the swash plate to be positioned at the maximum displacement.

(2) Increase in pump discharge pressure

When the pump discharge pressure increases, the pressure of the port (Pd) pushes the cut-off spool (SP1). If the push force exceeds the spring force, the cut-off spool (SP1) moves to the left. The cut-off spool closes the connection between the port (Pcl) and the tank port (T), which leads the port (Pd) pressure to the port (pcl). At this time, the pump reduces the tilt angle of the swash plate gradually while maintaining the discharge pressure.

(3) When the discharge pressure of pump exceeds the set value

The cut-off spool (SP1) moves fully to the left, which leads the port (Pd) pressure to the port (Pcl). The tilt angle of the swash plate becomes the minimum, which causes the pump to be in full cut-off condition.

5.4.2 Load Sensing Control

In order to keep the differential pressure constant before and after the variable restrictor, the load sensing controls the tilt angle of pump to make the pump discharge at flow rate according to the opening of variable restrictor.

(1) Condition where the variable restrictor is opened wide

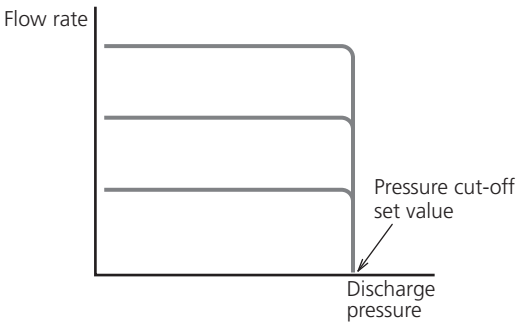
Since the decrease in pressure is low before and after the variable restrictor, there is little difference in pressure between the port (Pd) and the port (PL), the differential pressure spool (SP2) is maintained at the right end by the spring force. In this condition, the port (Pcl) is connected to the tank port (T) via the differential pressure spool, which does not apply pressure to the tilting piston and makes the tilt angle of the swash plate to be positioned at the maximum displacement.

(2) Condition where the variable restrictor is slightly closed

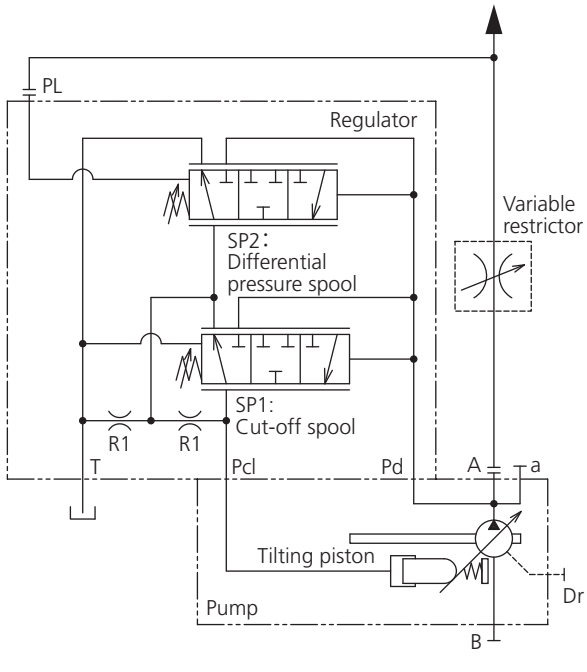
When the variable restrictor is slightly closed, differential pressure is generated between before and after the variable restrictor and the force by differential pressure between the port (Pd) and port (PL) exceeds the spring force, which makes the differential pressure spool (SP2) move to the left. The differential pressure spool closes the connection between the port (Pcl) and the tank port (T), which leads the port (Pd) pressure to the port (Pcl). For this reason, the tilt angle of the swash plate starts to become smaller to reduce the pump flow and achieve balance between the pressure decrease amount and spring force. Changing the opening of the variable restrictor changes the flow rage required for maintaining the differential pressure: however, the pump automatically changes the pump flow and functions to keep the differential pressure constant.

(3) When the variable restrictor is fully closed

The differential pressure spool (SP2) moves leftward fully and leads the port (Pd) pressure to the port (Pcl). The tilt angle of the swash plate becomes the minimum, which causes the pump to be in standby condition. At this time, the pump discharge pressure becomes the pressure equivalent to the differential pressure set value.



Pressure flow rate characteristics diagram



Hydraulic circuit diagram

6. Handling Procedures

6.1 Installation

Important: For drain piping, install pipes according to "6.2.3 Installation of Drain Pipes".

6.1.1 Standard Installation

Install pumps below the tank minimum oil level with the pump drive shaft positioned horizontally.

Important: If installing pumps above the tank, refer to "6.2.4 When installing the Pump above the Tank".

6.1.2 Tightening Torque of Pump Mounting Bolt

Be sure to use a designated bolt and tighten it to the designated torque.
Installing pumps by methods other than those specified may cause operation failure, damage or oil leakage.

When installing pumps, be sure to use hexagon bolts or hexagon socket head cap screws. Use flat washers at the same time.

Important: Be sure to use bolts whose strength class is 10.9 or higher.

■ Tightening Torque

Pump size		K3VLS65		K3VLS85/105	
Mount flange		SAE B (with 2 holes)	SAE C (with 4 holes)	SAE B (with 2 holes)	SAE C (with 4 holes)
Bolt size		M12	M12	M16	M12
Tightening torque	(N·m)	98	98	240	98

Important: The tightening torque on the above table shows data in the case where the parts to be attached to the pump are made of cast-iron or iron-based materials. In the case of other materials, be sure to consult our Tech. Dept.

6.1.3 Shaft Loading and Bearing Life

Although K3VLS series pumps are equipped with bearings that can accept some external thrust and radial forces, application of such loads will affect bearing life. Depending on the load magnitude, load position, and load orientation, bearing life may be significantly reduced.

6.1.4 Removal of Rust-prevention Paint

Since rust-prevention paint is applied to the spline part of the shaft end, be sure to remove it with cleaning solvent before use.

Important: Be careful not to let cleaning solvent splash on the oil seal part.

6.1.5 How to attach the Coupling to the Drive Shaft

When inserting the coupling into the drive shaft, do not insert by tapping the coupling. In addition, when pulling the coupling out, be sure to use a coupling remover to prevent impact from being applied to the inside bearing.

6.1.6 Engagement Length between the Drive Shaft and Coupling

For dimensions on the coupling side, refer to the respective standard dimensions shown in the dimensional outline drawing. For engagement length of the spline, adjust properly so that engagement is fully achieved at the specified length.

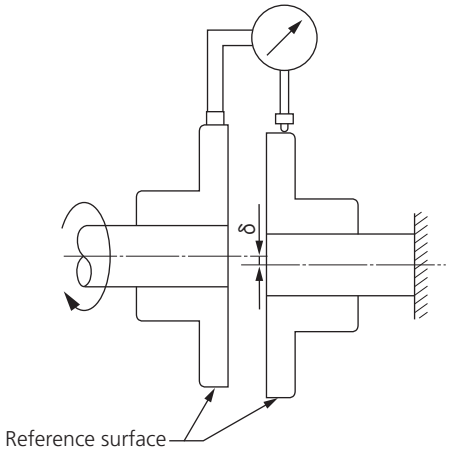
6.1.7 Connection of Drive Shaft

Perform centering by the method shown in the following figure. It is recommended that the axial eccentricity be set to 0.025 mm or less (value indicated by a dial gauge is 0.05 mm or less) and the axial deflection angle be set to 0.2° or less. When the pump drive shaft is directly connected to the engine output shaft, use a flexible coupling.

Important: When 2 shafts are connected by a shaft coupling, even when using a flexible coupling, align the centers of both shafts with each other as much as possible to extend the service life of the shaft coupling and prevent excessive loads from being applied to the shaft, bearing, etc.

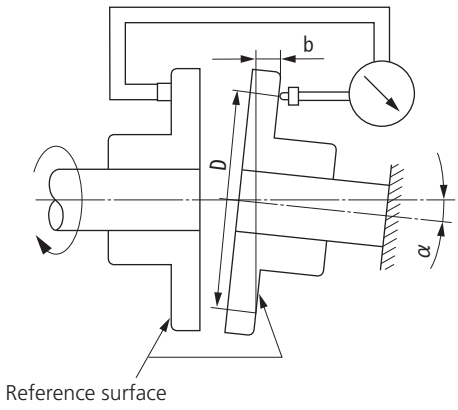
■ Measurement of Axial Eccentricity

Value indicated by dial gauge: a ≦ 0.05 mm
Axial eccentricity: $\delta = a/2$
≦ 0.025 mm



■ Measurement of Axial Deflection

Value indicated by dial gauge: b
Axial deflection: $\alpha = SIN^{-1}(b/D)$
≦ 0.2°



Handling Procedures (continued)

6.2 Piping

Important:
1. For variable pumps, the rotation direction and discharge direction are specified depending on each pump type; therefore, be sure to check the type and dimensional outline drawing.
2. In order to prevent rust and foreign materials from entering the pump, perform acid washing and flushing of pipes and tank. For suction pipes in particular, wash them thoroughly.

6.2.1 Installation of Suction and Discharge Pipes

For suction pipes, use pipes according to the port size and shorten the length as much as possible.
For pump suction pressure, 0MPa or higher pressure is required at the suction flange part.
Perform piping properly to prevent excessive force from being applied to the pump suction inlet and discharge port and avoid sharp-angle bent sections.

6.2.2 Tightening Torque when Mounting Pipes

Use the designated bolts and tighten them to the prescribed torque when installing the product.
Use of undesignated bolts or excessive or insufficient tightening torque may induce operation failure, damage, or oil leakage.

■ **Tightening Torque**

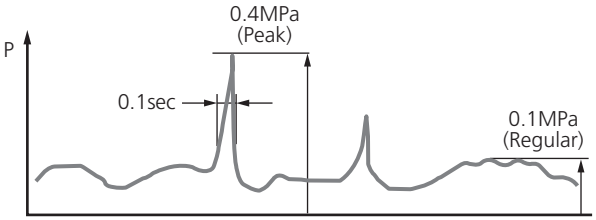
Pump size		K3VLS65	K3VLS85	K3VLS105
Suction port	Bolt size	M12 or 1/2-13UNC		
	Tightening torque (N·m)	98		
Discharge port	Bolt size	M10 or 3/8-16UNC	M12 or 1/2-13UNC	
	Tightening torque (N·m)	57	157	
Drain port	Port size	3/4-16UNF-2B		1 1/16-12UN-2B
	Tightening torque (N·m)	98		167
Load sensing port	Port size	7/16-20UNF-2B		
	Tightening torque (N·m)	12		
Gauge port	Port size	9/16-18UNF-2B		
	Tightening torque (N·m)	59		

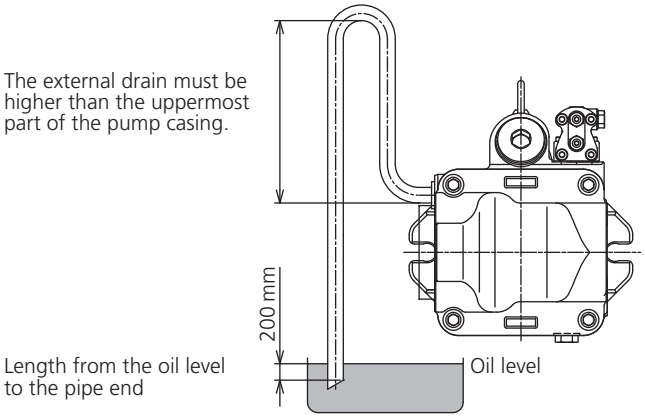
Important: For the details of each port, refer to "9. Outside Dimensions".

6.2.3 Installation of Drain Pipes

Since the K3VLS series pumps are external drain type pumps, be sure to perform drain piping. The allowable value of the casing internal pressure is 0.1MPa or less in regular use and 0.4MPa or less for surge pressure. For drain pipes, use pipes having the specified port size or larger according to the length of pipe so that the casing pressure does not exceed the allowable value. For pump drain piping, run the piping from the drain port on the upper part. If the oil level of the tank is lower than the pump shaft center, run the piping so that it is raised once above the pump and then returned to the tank as shown in the figure below. In order to prevent the inside of tank from foaming, position the return of the drain lower than the oil level of tank.

Important: Perform drain piping so that the end of the pipe is always immersed 200mm or deeper below the oil level. Do not connect the drain line to the inlet line.

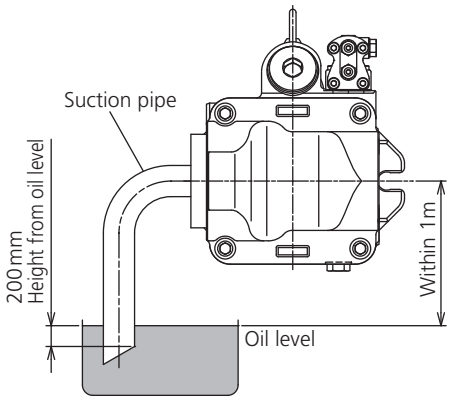


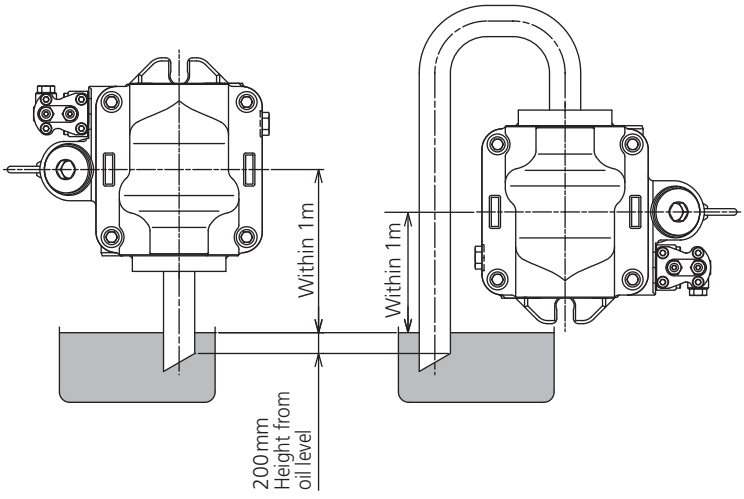


6.2.4 When installing the Pump above the Tank

The height of the pump above the oil level shall be within 1 meter at most and the suction pressure shall be set to -0.01MPa or higher. If the tank top plate rigidity is low, adverse effects such as vibration, noise, etc. may occur. Be careful that the tank top plate has sufficient rigidity.

Important: The maximum rotation speed is limited at suction pressure of 0MPa or less. In this case, consult our Tech. Dept.





Handling Procedures (continued)

6.3 Filter

6.3.1 Filtration of Hydraulic oil

The most important thing to prevent early wear of the pumps and related devices and extend the service life of the product is proper control of the cleanliness of hydraulic oil in the system. To achieve this, it is necessary to wash all the pipes and tanks thoroughly in a sanitary manner during installation. It is also necessary to perform flushing of off-line filter circuits and replace filter elements after flushing.

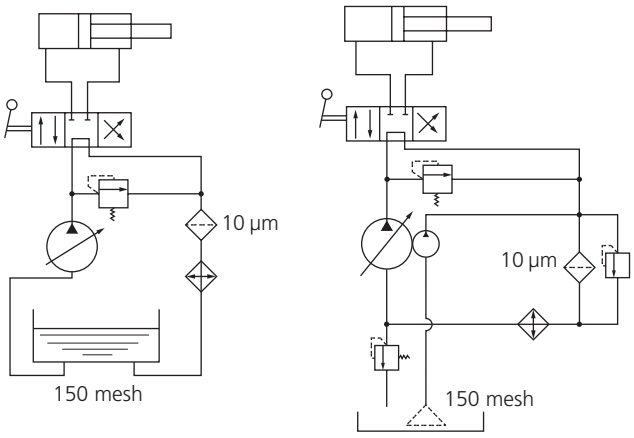
6.3.2 Recommended Cleanliness Control Level of Hydraulic oil

The relationship between the pump service life and cleanliness of hydraulic oil depends on the type and characteristics of foreign materials in the system, and so it is not easy to predict. Sand and silica with high hardness in particular cause metal to be worn, resulting in a remarkable decrease in the service life of pumps.
On the assumption that materials having characteristics similar to silica are not mixed in, the allowable minimum cleanliness of hydraulic oil is as follows:

ISO 4406 grade –/18/15 class or less
(NAS grade class 9 or less)

6.3.3 Filter Installation Example

To prevent foreign materials from entering, provide a return filter of 10µm in the return line. In addition, it is recommended to provide a filter of 5 to 10µm in the air breather of the tank. Cases of providing the drain line with a filter have been increasing recently.



6.4 Hydraulic oil and Temperature Range

CAUTION

Use appropriate hydraulic oil and control the cleanliness to the recommended value.
Failure to do may cause an operation failure or damage.

6.4.1 Oil Type

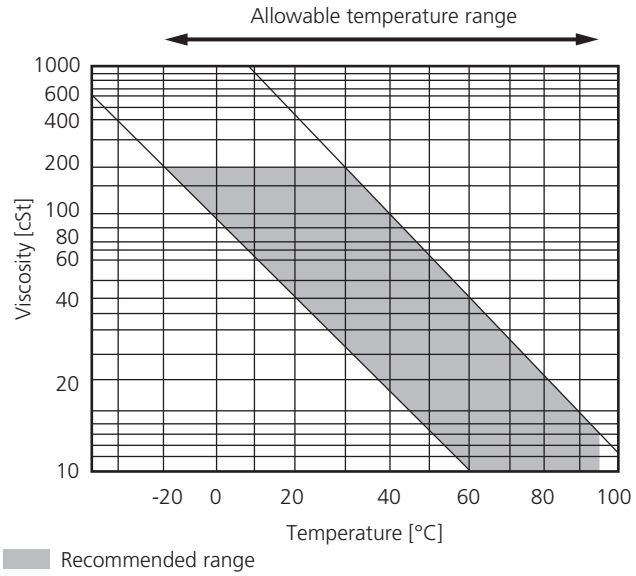
Anti-wear hydraulic oil (mineral-based) shall be used as a rule. To maintain the optimal performance of devices, it is recommended to use anti-wear hydraulic oil (mineral-based).

Important: When using hydraulic oil other than mineral-based, such as phosphate-based, water-glycol-based, or fatty acid ester-based hydraulic oil, be sure to consult our Tech. Dept. It is necessary to take countermeasures for some parts in some cases.

6.4.2 Optimal Viscosity and Temperature of Hydraulic oil

It is recommended to use oil with a 10 to 200cSt viscosity range. If the viscosity is higher than 200cSt, it is necessary to apply boost pressure to the suction side from the standpoint of suction performance. In this case, it is possible to use hydraulic oil with viscosity of 10 to 1000cSt; however, since it may be necessary to employ a complicated circuit, it is recommended to use hydraulic oil with 10 to 200cSt viscosity. In addition, the temperature range is limited to -20°C to +95°C by oil seals, O-rings, etc. In consideration of deterioration of hydraulic oil and seals, hydraulic oil should be used at 60°C or less as much as possible. Furthermore, since the viscosity of normal hydraulic oil exceeds 200cSt at temperatures of 15 to 20°C in winter, a delay in response of devices such as regulator may occur in addition to deterioration of suction performance. At temperatures as low as above, perform a warming-up operation by starting the unit at low pressure by minimizing the pump tilt angle and shifting to full-pressure operation mode after the oil temperature exceeds 20°C.

	Range in normal operation	Allowable range
Viscosity [cSt]	10 to 200	10 to 1000
Temperature [°C]	–20 to +95	



6.5 Startup of Pump

6.5.1 Filling with Hydraulic oil

Be sure to fill the pump casing with oil from the drain port. The pump inside is provided with high-speed sliding parts such as bearings, piston sub, spherical bush, etc. Serious troubles such as seizing, damage, etc. may occur in these parts unless the pump casing is filled with oil; therefore, be sure to fill it with oil. In addition, when using a system with several pumps connected, supply oil to the respective pump casings.

Important: 1. For casing oil amount, refer to "4.1 Device Specifications".
2. From the standpoint of pump structure, it is insufficient to only connect the suction pipe.

Handling Procedures (continued)

6.5.2 Check before Startup

CAUTION

Check that all electric wires and hydraulic pipes are correctly connected.

(1) Check of piping and circuit

Inspect to ensure that piping is fully performed. In addition, check that the hydraulic circuit and gate valves operate properly.

(2) Check of rotation direction

Check that the rotation direction and suction and discharge directions are correct.

(3) Circuit unloading check

Check that no load is applied to the pumps before starting the motor.

6.5.3 Startup of Pump

DANGER

Absolutely never start the pump in an atmosphere where an explosion or combustion may occur.

WARNING

Start the pump under a condition where the system can be stopped at once anytime. Maintain a safe distance from the system.

In the case of an engine, operate the engine in an idling state for a while after startup to fully release any air in the circuit. In the case of an electric motor, perform inching operation by turning the motor on and off several times. An abnormal noise may be generated due to air remaining in the circuit for a while after startup. Air remaining in the circuit and pump may cause operation failures and damage; therefore, be sure to perform running-in operation without load until air is fully released.

6.5.4 Checking Each Part for Abnormality

WARNING

Stop operation immediately and take proper measures when any abnormality such as abnormal noise, oil leakage, or smoke is found. Continuing operation under such condition may cause damage, a fire hazard, or injury.

Check for oil leakage, abnormal vibration, etc.

6.6 Long-term Operation Suspension

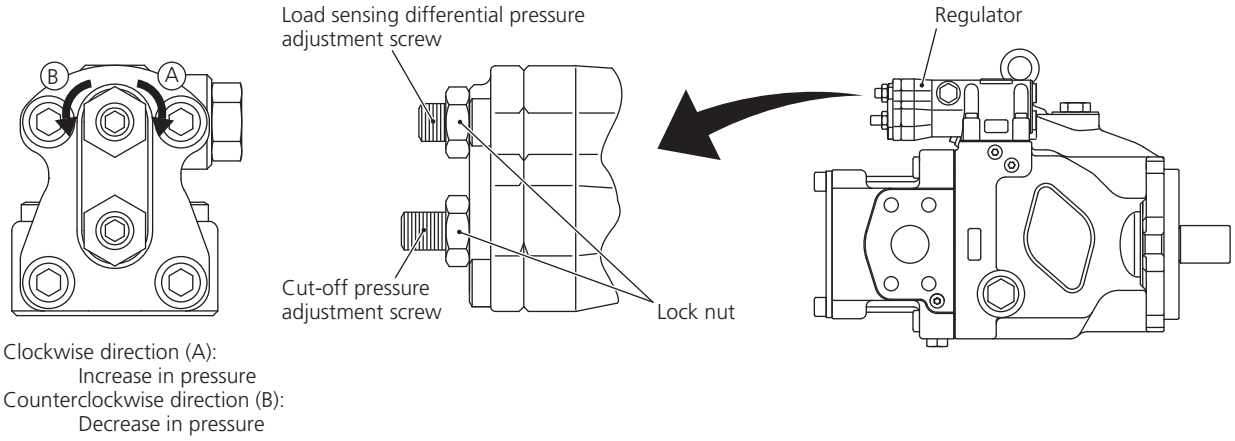
CAUTION

When using the product again after it has not been used for a long time, it is necessary to replace seals in some cases.

It is not recommended to leave the pump without operating it for a long time (approx. 1 year). In this case, operate the pump without load for a short time periodically. If the pump is stored, it is sufficient to only turn the shaft manually. When operating the pump after it has not been used for a longer time, it is necessary to inspect and maintain the pump before using it again.

7. Adjustment

7.1 Adjustment of Regulator



■ Load Sensing Differential Pressure Adjustment

Specifications	Adjustment range	Adjustment sensitivity (per 1 turn)	Setting at time of shipment
Standard setting range	1.0 to 3.0MPa	1.3MPa	1.5MPa
High-zone setting range	1.5 to 4.0MPa	2.5MPa	1.5MPa

Important: For specifications, refer to "3. Ordering Code".

■ Cut-off Pressure Adjustment

Adjustment range	Adjustment sensitivity (per 1 turn)	Setting at time of shipment
2.0 to 28.0MPa	8.0MPa	28.0MPa

■ Adjustment Procedures

(1) Make a marking on the adjustment screw, lock nut and regulator casing before adjustment to allow you to identify their original positions.
(2) Loosen the lock nut while holding the adjustment screw to prevent it from moving.
(3) Adjust the pressure using the adjustment screw while checking the pressure.
(Turn clockwise to increase pressure and turn counterclockwise to decrease pressure)
(4) Tighten the lock nut while holding the adjustment screw to prevent it from moving after adjustment.
(Tightening torque: 16N·m)

8. Inspection/Repair

8.1 Periodic Inspection

It is necessary to maintain the pump in optimal condition and inspect it periodically to prevent troubles from arising.

Inspection point	Inspection details	Interval
Hydraulic unit	Oil level of hydraulic oil tank	Every day
Pump	Oil leakage from each part	
	Abnormal sound and vibration during operation	

8.2 Cause of Malfunctions

8.2.1 If an abnormality is observed during use of pump

Investigate the characteristics of the abnormality first to judge where the cause of the abnormality originates. Check whether or not the problem relates to pump failure and identify the cause from the overall system including regulators, accessory valves, etc.

8.2.2 Method for Identifying Abnormal Point

Although it is very difficult to identify the cause of the malfunction, investigate the following major inspection items to narrow down the location of the abnormal point.

(1) Inspection of filter and drain oil

Inspect the filter element. Check whether or not large amounts of abnormal impurities are generated. Although a small amount of metallic powder may be mixed in because abrasion powder is generated from the shoe and cylinder, it can be assumed that a failure of an internal component caused the problem if large amounts of metallic powder are stuck on the filter. Inspect the drain oil in the pump casing in the same manner.

(2) Abnormal vibration and sound

Check that no abnormal vibration or sound is generated from the pump main body. Check whether or not it is a well-regulated frequency sound like the hunting of the regulator or the hunting of the accessory valve relief. If it is an irregular vibration or sound, it is possible that cavitation or damage inside the pump occurred.

(3) When two pumps are used

In the case of a circuit using two pumps and two motors and double pumps, change the pump pipes respectively. As a result, it can be checked whether the problem is caused by a failure of pump itself or a failure after the pump.

(4) Pressure measurement of each part

If the problem is a control-related problem, do not perform overhaul inspection immediately but measure the pressure of each part to identify the abnormal point.

8.3 Pump Removal

Make sure that the unit is turned off and that the engine or electric motor has completely stopped before starting the work. Check also that the pressure in the hydraulic piping is zero.

Since this unit and hydraulic oil immediately after operation are at high temperatures, burn injury may be caused if they are unexpectedly touched.
Let the unit and hydraulic oil cool down sufficiently after operation and then start to work.

Important: Parts in the pump and the circuit are precision parts. If disassembling even partially, clean a work space and area around the parts to be disassembled so that dust does not intrude into the inside.

■ Removal Procedures

(1) Completely stop the system and fully close the stop valve, etc.
(2) Release pressure from the hydraulic circuit
(3) Wait until the pump and system are sufficiently cooled down by heat release.
(4) Maintain a safe working space.
(5) Prepare an appropriate lifting device.
(6) Be careful that excessive force is not applied to any part.
(7) Remove pipes.
(8) Seal piping connection parts.
(9) Discharge hydraulic oil from the pump.
(10) Remove pumps.
(11) Seal all ports (opening parts).

Inspection/Repair (continued)

8.4 Troubleshooting

8.4.1 Overloading of Motor

Cause	Countermeasures	Caution
The rotation speed and pressure are higher than planned values.	Set the values as planned.	
The pressure set and torque set of the regulator are higher.	Readjust the regulator.	Check the current of the electric motor. Refer to "7.1 Adjustment of Regulator".
The pump internal components are seizing and damaged.	Replace damaged components with new ones.	Check whether or not there is abnormal wear powder by inspecting the filter and drain oil.

8.4.2 Decrease in Discharge Flow Rate/Discharge Pressure

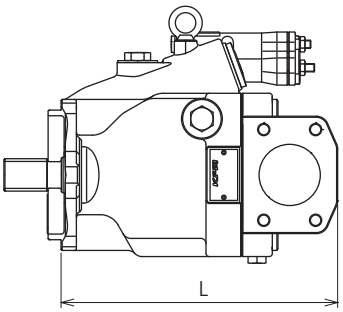
Cause	Countermeasures	Caution
Malfunction of regulator	Replace the regulator with a new one.	Refer to the maintenance procedures.
The pump internal components are seizing and damaged.	Replace damaged components with new ones.	Inspect the filter and drain oil.

8.4.3 Abnormal Sound/Vibration

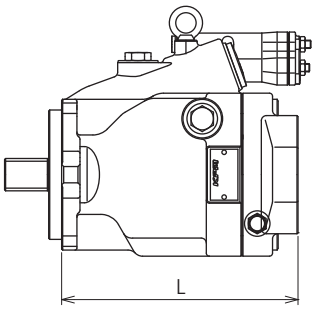
Cause	Countermeasures	Caution
Cavitation	Prevent cavitation from occurring. Inspect whether or not white turbidity occurs in hydraulic oil.	The boost pressure is too low. Air is sucked from the suction pipe. Suction resistance is high.
Damage of shoe caulked part	Replace the piston sub, set plate, etc. with new ones.	Refer to the maintenance procedures.
Cracking of cylinder	Replace the cylinder with a new one.	Refer to the maintenance procedures.
Pump mounting failure	Correct the improper mounting section.	
Hunting of regulator	Adjust the regulator or replace it with a new one.	Refer to "7.1 Adjustment of Regulator".

9. Outside Dimensions

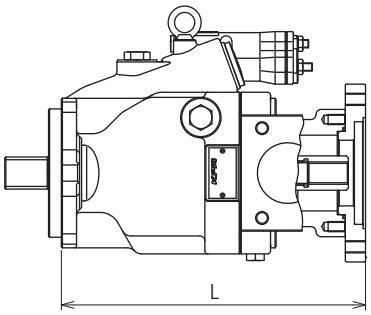
9.1 Overall Length and Weight



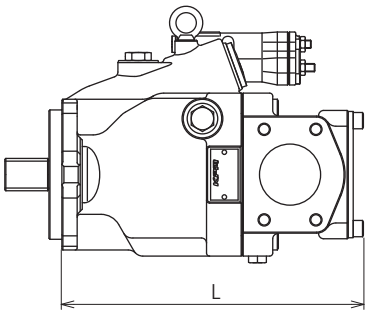
Without through drive, side port



Without through drive, rear port



With through drive



With through drive shaft, closing by iron plate

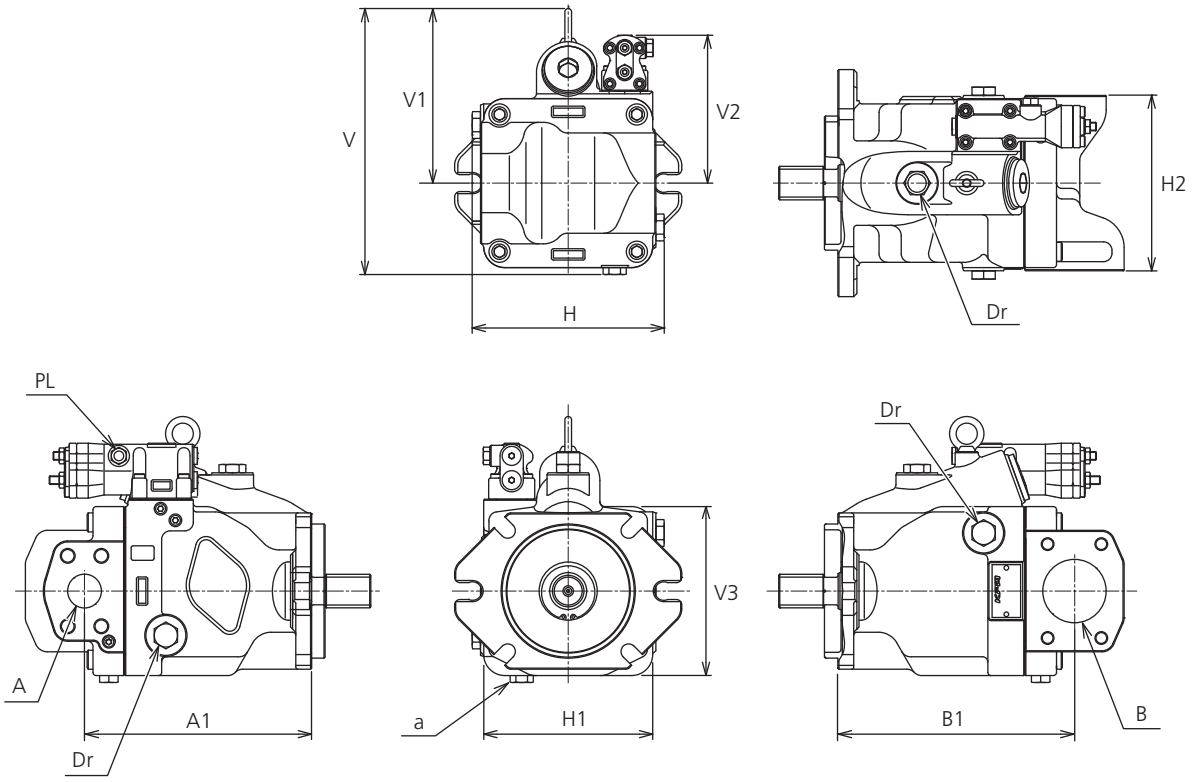
Type	Pump size	K3VLS65 (SAE B mount)	K3VLS65 (SAE C mount)	K3VLS85	K3VLS105
Without through drive, side port	Overall length L (mm)	239	239	271	274
	Weight (kg)	25	26	31	37
Without through drive, rear port	Overall length L (mm)	207	207	232	237
	Weight (kg)	24	24	29	35
Through drive SAE A	Overall length L (mm)	253	253	281	286
	Weight (kg)	28	29	33	39
Through drive SAE B/SAE BB	Overall length L (mm)	273	273	301	306
	Weight (kg)	31	31	37	42
Through drive SAE C	Overall length L (mm)	–	278	306	311
	Weight (kg)	–	32	36	42
Through drive SAE CC	Overall length L (mm)	–	–	–	317
	Weight (kg)	–	–	–	43
With through drive shaft, closing by iron plate	Overall length L (mm)	268	268	396	401
	Weight (kg)	29	30	34	40

Overall length L: Flange mounting surface to pump rearmost end

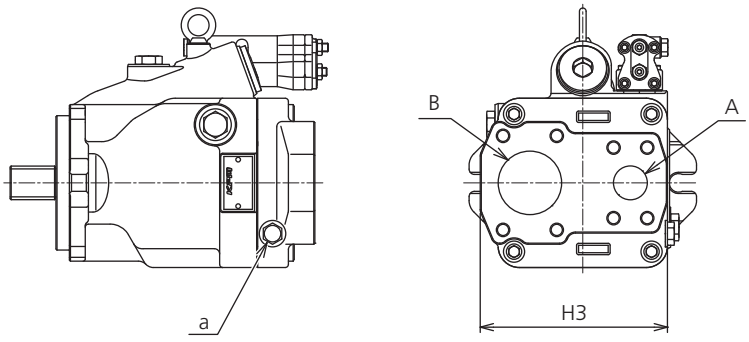
Outside Dimensions (continued)

9.2 Dimensions of Respective Parts

◆ Side Port (clockwise)*



◆ Rear Port (clockwise)*



Important: The product shape varies depending on pump size and type.

* In the case of products (counterclockwise), the positions of ports A, B, and a are rotated by 180°.

■ Dimensions

Unit: mm

Pump size	Type	V	H	V1	V2	V3	H1	H2	H3	A1	B1
K3VLS65	Side port, clockwise	245	168	163	137	150	150	152	–	192	201
	Rear port, clockwise	245	168	163	137	150	150	–	154	–	–
	Side port, counterclockwise	238	168	163	137	150	150	152	–	192	201
	Rear port, counterclockwise	238	168	163	137	150	150	–	154	–	–
K3VLS85	Side port, clockwise	252.1	182	165.5	140	160	160	172	–	215	224
	Rear port, clockwise	252.1	182	165.5	140	160	160	–	177	–	–
	Side port, counterclockwise	245.5	182	165.5	140	160	160	172	–	215	224
	Rear port, counterclockwise	245.5	182	165.5	140	160	160	–	177	–	–
K3VLS105	Side port, clockwise	277.1	196	183.5	149	172	172	181	–	221	228
	Rear port, clockwise	277.1	196	183.5	149	172	172	–	183	–	–
	Side port, counterclockwise	269.5	196	183.5	149	172	172	181	–	221	228
	Rear port, counterclockwise	269.5	196	183.5	149	172	172	–	183	–	–

V : Whole height (excluding the mount flange and through drive)
H : Whole width (excluding the mount flange and through drive)
A1 : Flange mounting surface – A (discharge) port
B1 : Flange mounting surface – B (suction) port

Important: Respective dimensions are given as reference. When designing the system, ask for the outside dimensional drawings for the product to be used.

■ Name of Port

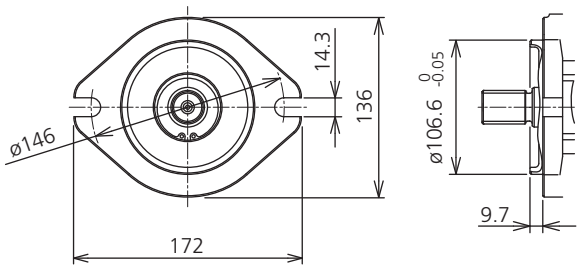
Symbol	Name
A	Discharge port
B	Suction port
Dr	Drain port
PL	Load sending port
a	Gauge port

Important: For the details of each port, refer to "9.5 Port Specifications".

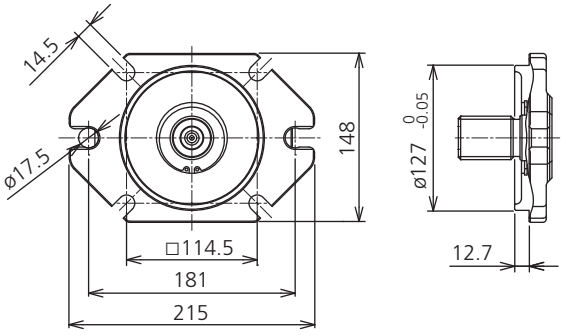
Outside Dimensions (continued)

9.3 Connection and Shaft end shape

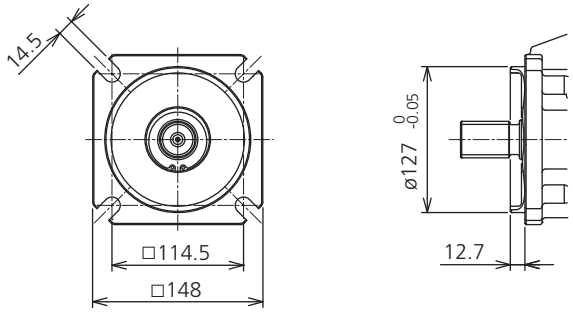
◆ Mounting Flange



SAE-B



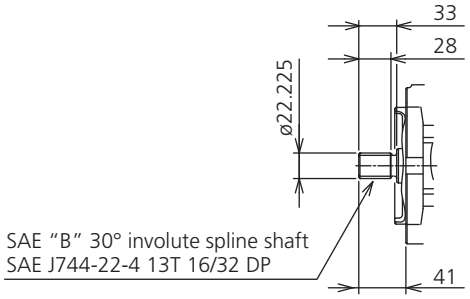
SAE-C (K3VLS85/105)



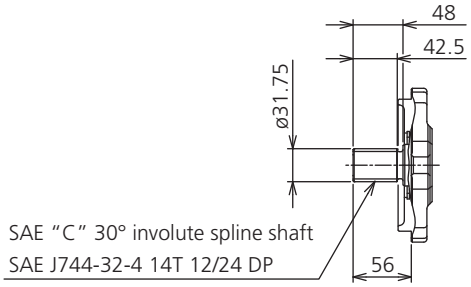
SAE-C (K3VLS65)

Unit: mm

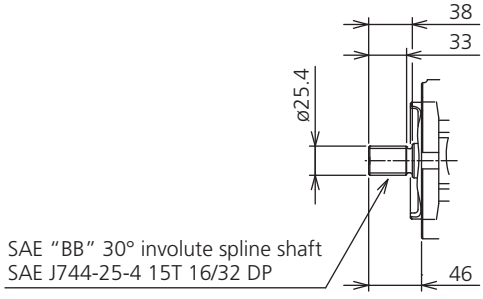
◆ Spline Shaft



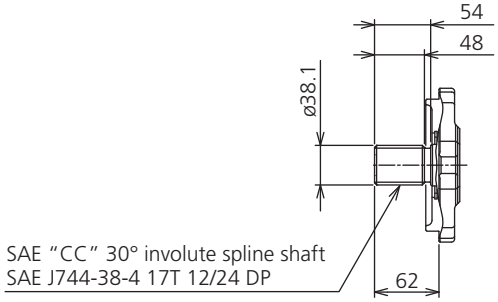
SAE-B



SAE-C



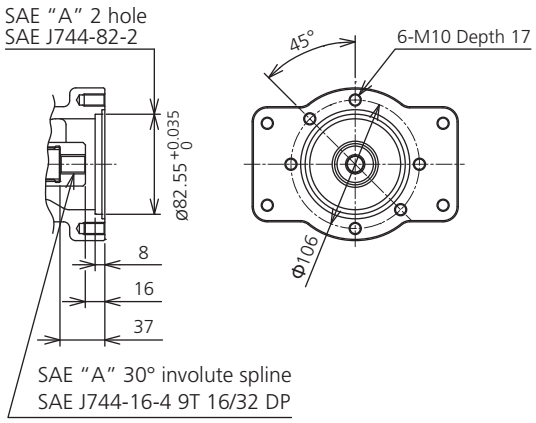
SAE-BB



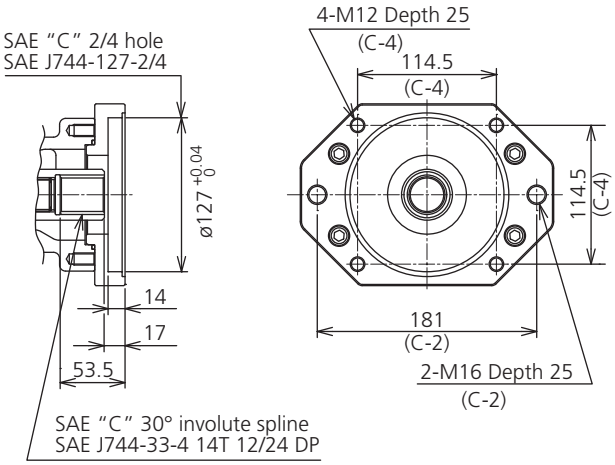
SAE-CC

Unit: mm

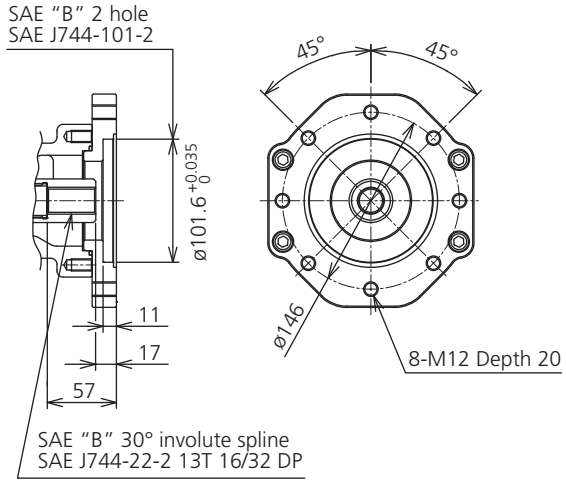
9.4 Through Drive



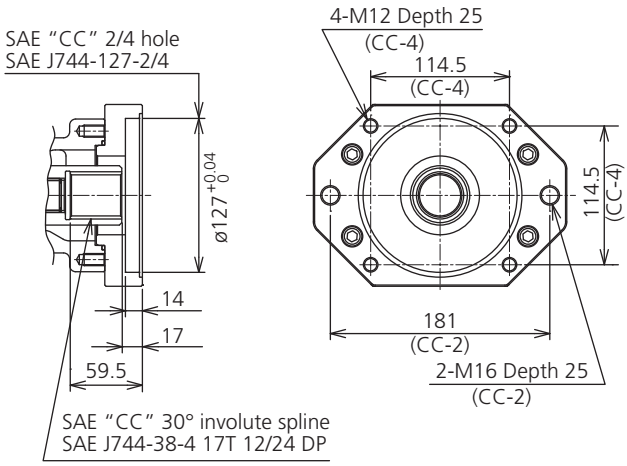
SAE-A



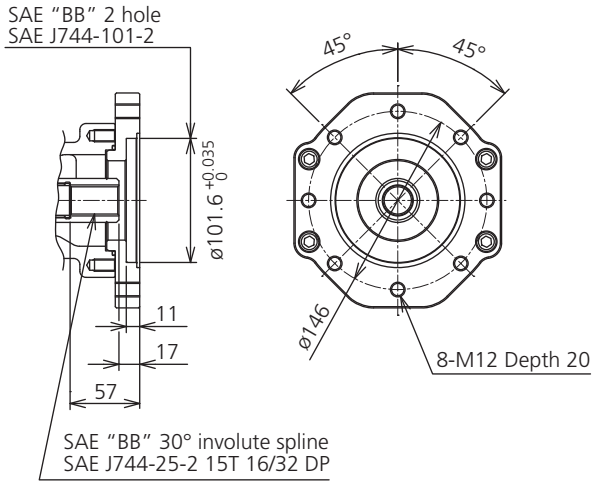
SAE-C



SAE-B



SAE-CC



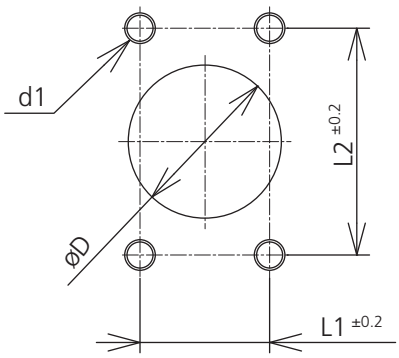
SAE-BB

Unit: mm

Outside Dimensions (continued)

9.5 Port Specifications

◆ Flange Port



Discharge Port (A)

Unit: mm

Pump size	L1	L2	D	d1 (Unified screw thread or M screw)
K3VLS65	26.2	52.4	25	4-3/8-16UNC-2B-18 or 4-M10-17
K3VLS85	31.8	66.7	32	4-1/2-13UNC-2B-22 or 4-M12-23
K3VLS105	31.8	66.7	32	4-1/2-13UNC-2B-22 or 4-M12-23

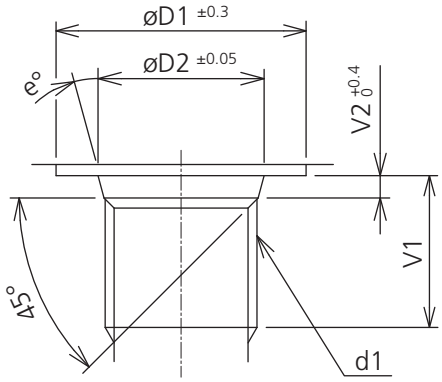
Suction Port (B)

Unit: mm

Pump size	L1	L2	D	d1 (Unified screw thread or M screw)
K3VLS65	42.9	77.8	50	4-1/2-13UNC-2B-20 or 4-M12-20
K3VLS85	50.8	88.9	60	4-1/2-13UNC-2B-22 or 4-M12-22
K3VLS105	50.8	88.9	64	4-1/2-13UNC-2B-22 or 4-M12-22

Outside Dimensions

◆ Screw Port



Drain Port (Dr)

Unit: mm

Pump size	D1	D2	V1	V2	e	d1
K3VLS65	30	20.65	14.3	2.5	15	3/4-16 UNF-2B
K3VLS85	30	20.65	17.5	2.5	15	3/4-16 UNF-2B
K3VLS105	41	29.2	19	3.3	15	1 1/16-12 UN-2B

Load Sensing Port (PL)

Unit: mm

Pump size	D1	D2	V1	V2	e	d1
K3VLS65/85/105	–	12.45	11.5	2.4	12	7/16-20 UNF-2B

Gauge Port (a)

Unit: mm

Pump size	D1	D2	V1	V2	e	d1
K3VLS65/85/105	25	15.7	12.7	2.5	12	9/16-18 UNF-2B

As HANSA-TMP has a very extensive range of products and some products have a variety of applications, the information supplied may often only apply to specific situations.

If the catalogue does not supply all the information required, please contact HANSA-TMP.
In order to provide a comprehensive reply to queries we may require specific data regarding the proposed application.

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