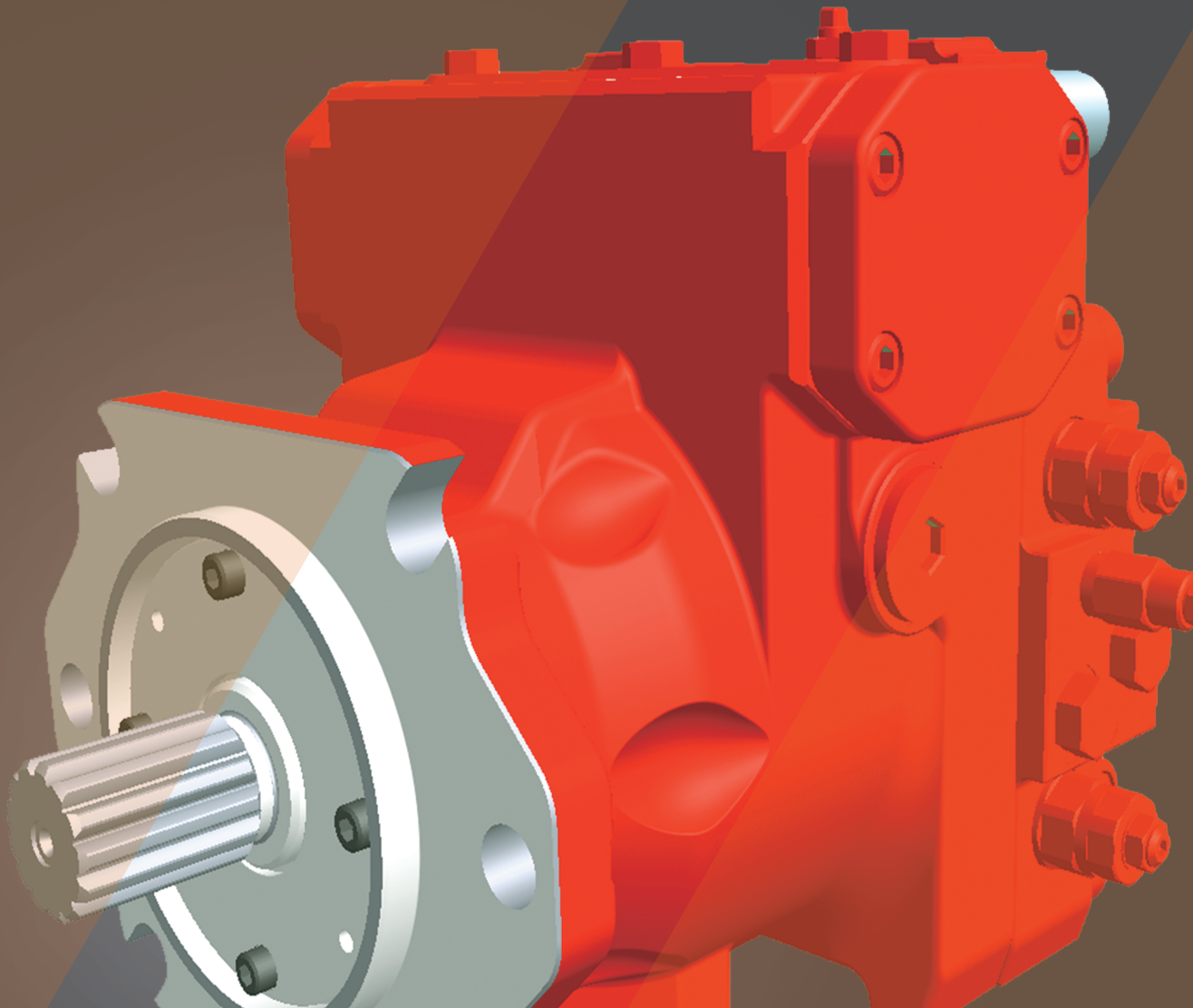


Closed Loop
Swash Plate Type Axial Piston Pump
K8V Series



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I . Applications / Product Usage

The following must be taken into consideration before use.

1. The operating condition of the products shown in this catalog varies depending upon each application. Therefore, the product suitability must be judged by the designer of the hydraulic system and/or the person who finalizes the technical specifications of the machine after analysis and testing. The product specification shall be determined based on the latest catalog and technical documents. The system must be designed taking into account the possibility of machine failure to ensure that all safety, warning, and application requirements are met.
2. For the proper use of the products, descriptions given in the SAFETY PRECAUTIONS must be observed.
3. The technical information in this catalog represents typical characteristics and performance of the products as of the published date.
4. If the products are intended to use in the following, please consult with Kawasaki in advance.
 - (1) Use the product under the operating conditions or environments other than those described in the technical documents.
 - (2) Use the product in the nuclear sector, aviation sector, medical sector, and/or food sector.
 - (3) Use the product in applications which may cause substantial harm to others and their property, and especially in applications where ensuring safety is a requirement.
5. The information described in this catalog is subject to change without notice. For the latest information, please contact Kawasaki.

II. Safety Precautions

Before using the product, you **MUST** read this catalog and **MUST** fully understand how to use the product. To use the product safely, you **MUST** carefully read all Warnings and Cautions in this catalog.

1. Cautions related to operation



- Use the personal protective equipment to prevent injury when the product is in operation.



- Some components are heavy. Handle the product carefully not to hurt your hands and lower back.



- Do not step on, hit or drop, or apply strong force to the product, as these actions may cause operation failure, product damage, or oil leakage.



- Wipe off any oil on the product or the floor completely, as oil can create slippery conditions that may cause drop of the product and personal injury.

2. Warnings and Cautions related to installation and removal of the product



- Installation, removal, piping, and wiring must be done by a qualified technician.



- 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. You must also check that the system pressure has dropped to zero.



- Make sure that the power source is turned off before installing electric components to reduce the risk of electric shock.



- Clean the threads and the mounting surface to prevent damage or oil leakage. Inadequate cleaning may cause insufficient torque and broken seals.



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

3. Warnings and Cautions for operation



- Always equip the product with explosion or ignition protection if it is used in potentially explosive or combustible atmospheres.



- Shield rotary parts, such as the motor and pump shaft, to avoid injury.



- Stop operation immediately, and take proper measures when the abnormality such as unusual noise, oil leakage, and smoke is found. Continuing operation under such condition may bring about damage, a fire hazard, or injury.



- Make sure that all pipes, hoses, and connecting points with pipes or hoses, are correctly connected and tightened before starting operation.



- Use the product under the operating conditions and limitations described in the catalog, drawings, and specification sheets.



- Do not touch the product in operation, to reduce the risk of skin burn.



- Use the proper hydraulic oil and maintain the filtration at the recommended level to prevent premature wear and damage.

4. Cautions related to maintenance



- Never modify the product without approval from Kawasaki.



- Disassembly of the product may void the warranty.



- Keep the product clean and dry when storing or transporting.



- The seals may need to be replaced if the product has been stored for an extended period of time.



- Making adjustments of this product will result in the warranty being null and void.

III. Handling Precautions

1. Operating Fluid and Temperature Range

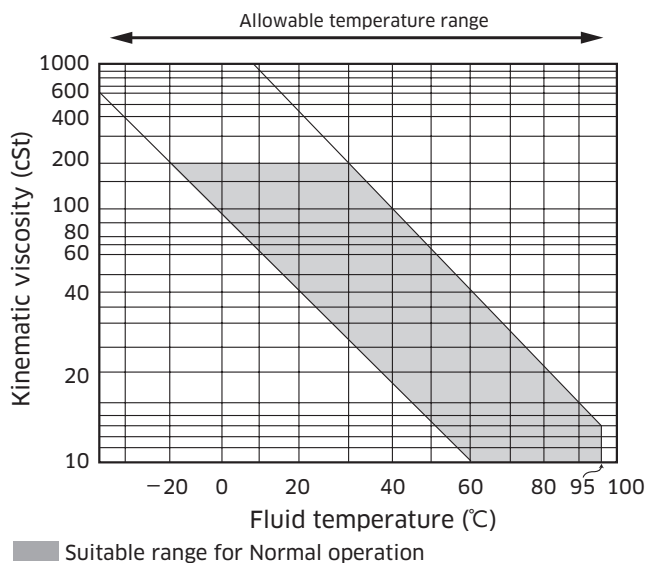
1) Operating fluid

Values shown in this catalog are based upon using mineral oil based anti-wear hydraulic fluid. To ensure optimal performance use of mineral oil based anti-wear hydraulic fluid is recommended.

2) Viscosity and temperature range

To minimize both oil and seal deterioration, a maximum operating temperature of 60°C should be considered. Please note that the regulator may become slow to respond when operating at low temperatures (below 20°C) in extreme cold environments. At such low temperature it is strongly suggested that a warm up cycle is introduced until an operating temperature of 20°C is achieved.

	Suitable range for Normal operation	Allowable range
Viscosity [mm ³ /s(cSt)]	10 to 200	10 to 1,000
Fluid Temperature [°C (°F)]	-20 to +95 (-4 to +203)	



2. Filtration and Contamination Control

1) Filtration of working oil

The most important means to prevent premature damage to the pump and associated equipment and to extend its working life, is to ensure that hydraulic fluid contamination control of the system is working effectively.

This begins by ensuring that at the time of installation that all piping, tanks etc. are rigorously cleaned in a sanitary way. Flushing should be provided using an off line filtration system and after flushing the filter elements should be replaced.

2) Suggested acceptable contamination level

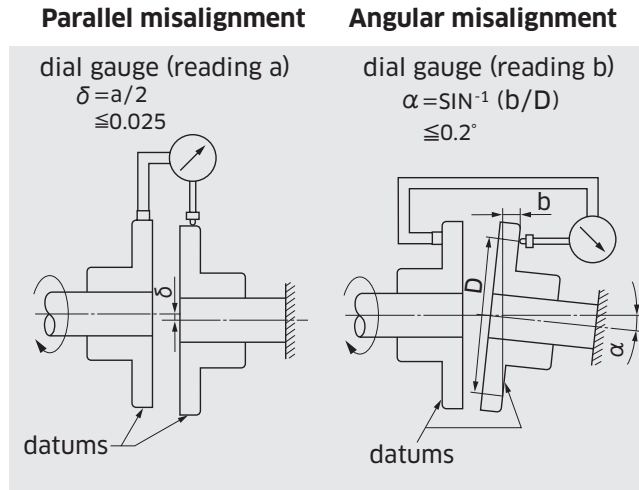
The relationship between contamination level and pump life is very difficult to predict as it depends on the type and nature of the contaminant present in the system. Sand or Silica in particular, due to its abrasive nature, does significantly reduce the expected life of a pump. Based on the precondition that there is no significant presence of Silica type substances then a minimum Cleanliness level of -/18/15 ISO 4406 or SAE AS 4059E Table 1 Class 9 (NAS 1638 Class 9).

III. Handling Precautions

3. Drive Shaft Coupling

Alignment between the prime mover and the pump shaft should be within a tolerated margin, that is, parallel misalignment within 0.05mm TIR* and angular misalignment within 0.2° TIR*. In case the pump is directly coupled to the engine flywheel, use a flexible coupling.

*TIR = Total Indicator Reading



4. Oil Filling and Air Bleeding

1) Pump case filling

Be sure to fill the pump casing with oil through the drain port, filling only the suction line with oil is totally insufficient. The pump contains bearings and high-speed sliding parts including pistons with shoes and a spherical bush that need to be continuously lubricated. Part seizure or total premature failure will occur very quickly if this procedure is not rigidly followed.

2) Air bleeding

Run the pump unloaded for a period to ensure that all residual air within the system is released.

3) Long term out of usage

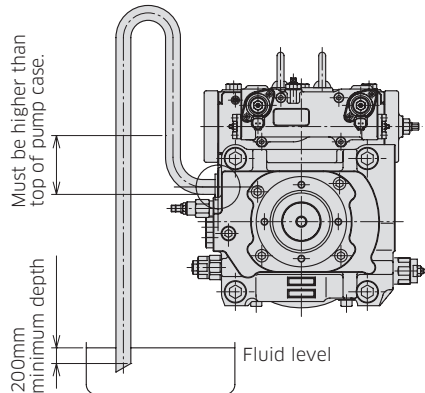
It is undesirable to leave the pump out of use for a long period e.g. a year or more. In such a situation it is recommended that the pump is run for a short period on a more frequent basis even if it is just unloaded. With regard to a pump held in storage then rotating the shaft on a frequent basis is sufficient. If the pump is left out for more than the suggested time it will require a service inspection.

III. Handling Precautions

5. Drain Piping

1) Installation of drain line

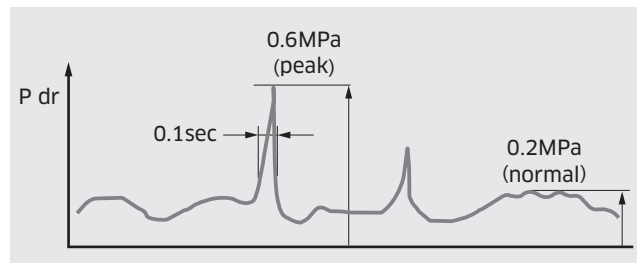
It is the preferred option to mount the pump with the case drain piping initially rising above the pump before continuing to the tank. Do not connect the drain line to the inlet line.



Cautions

- A) Inlet and drain pipes must be immersed by 200 mm minimum from the lowest level under operating conditions.
- B) Height from the oil level to the centre of the shaft must be within 1 meter maximum.
- C) The oil in the pump case must be refilled when the pump has not been operated for one month or longer.

The uppermost drain port should be used and the drain piping must be larger in size than the drain port to minimize pressure in the pump case. The pump case pressure must not exceed 0.2 MPa as shown in the illustration below. (Peak pressure must never exceed 0.6 MPa.)



2) Size of drain hose or drain pipe

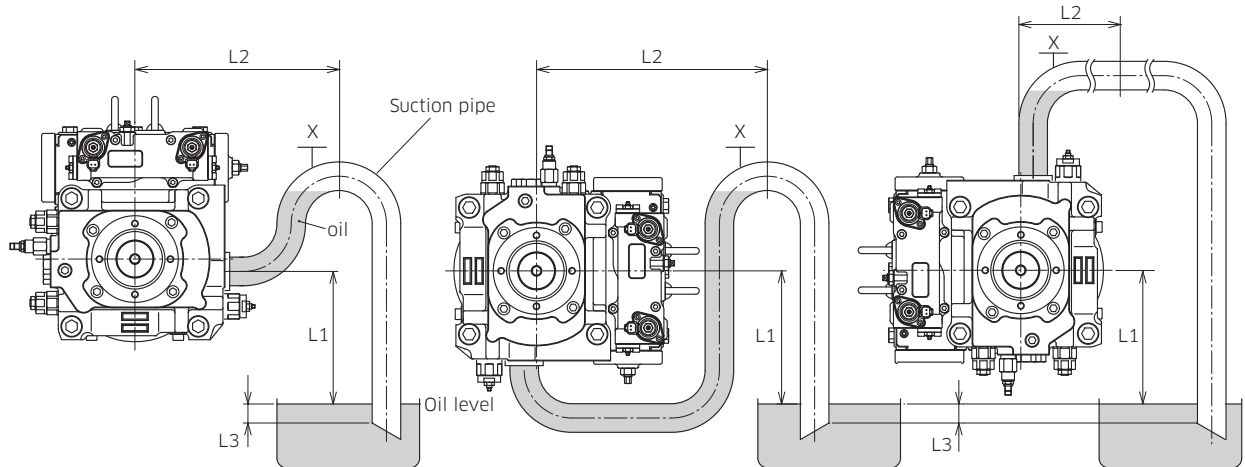
The internal bore size of the drain hose or drain pipe must be larger than that of the drain port. Arrange the drain line as short as possible.

III. Handling Precautions

6. Mounting the Pump Above the Tank

Install the suction pipe for the charge pump as shown in the following figures and fill the pump side of the suction pipe (colored sections in the figures) with oil before starting the pump. Adjust the suction pressure so that -0.02 MPa or higher pressure is obtained at the suction port.

installing conditions: $L1 \leq 1\text{m}$, $L2 \geq L1$, $L3 \geq 200\text{mm}$



X : Air release and oil filling port

7. Shaft Loading and Bearing Life

Although K8V pumps are equipped with bearings that can accept some external radial forces, exertion of external radial loads will affect bearing life. Depending on the load magnitude, the load position, and the load orientation, bearing life may be influenced and reduced.

Consult with Kawasaki for further details.

8. Minimum Boost Pressure

The K8V series pump requires the minimum boost pressure of 2.0 MPa in the low pressure line in order to provide stable control. In addition, setting value of the charge pressure should be lower than that of the low pressure relief valve.

9. Minimum effective pressure

In order to maintain stable control characteristics, ensure the effective pressure of main pump more than 1 MPa during continuous operation.

IV. Conversion Factors, Formula and Definition

◆ Conversion Factors

	Formula	Note
Displacement	$1 \text{ cm}^3 = 0.061 \text{ in}^3$	
Pressure	$1 \text{ MPa} = 145 \text{ psi}$	
Flow	$1 \text{ L/min} = 0.264 \text{ gpm}$	US gallon
Torque	$1 \text{ Nm} = 0.74 \text{ lb ft}$	
Power	$1 \text{ kW} = 1.341 \text{ hp}$	
Weight	$1 \text{ kg} = 2.205 \text{ lb}$	

◆ Formula

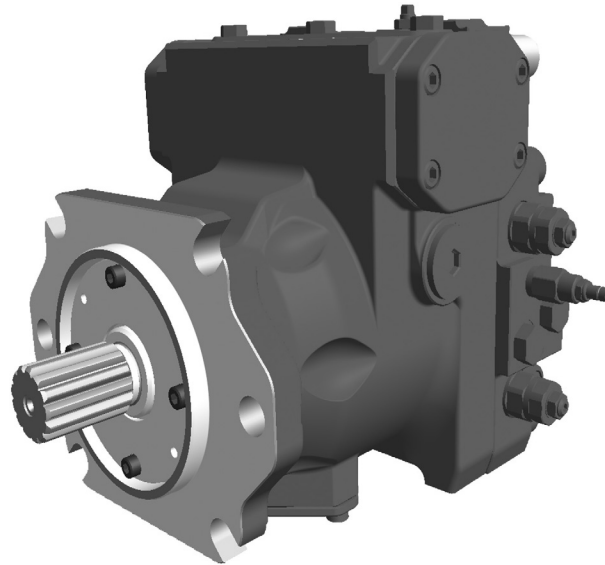
	Metric system		Imperial system	
Output flow	$Q = q \times N \times \eta_v / 1000$	L/min	$Q = q \times N \times \eta_v / 231$	gal/min
Input torque	$T = q \times \Delta P / 2\pi / \eta_m$	Nm	$T = q \times \Delta P / 24\pi / \eta_m$	lbf-ft
Input power	$L = T \times N / 9550 = Q \times \Delta P / 60 / \eta_t$	kW	$L = T \times N / 5252 = Q \times \Delta P / 1714 / \eta_t$	hp

◆ Definition

q	= Pump displacement / rev.	$\text{cm}^3 (\text{in}^3)$
L	= Input power	kW (hp)
N	= Speed	$\text{min}^{-1} (\text{rpm})$
N_{max}	= Maximum speed at maximum displacement	$\text{min}^{-1} (\text{rpm})$
ΔP	= $P_{\text{high}} - P_{\text{low}}$ (Differential pressure)	MPa (psi)
P_{high}	= High pressure	MPa (psi)
P_{low}	= Low pressure	MPa (psi)
P_{rated}	= Rated pressure	MPa (psi)
P_{peak}	= Peak pressure	MPa (psi)
P_c	= charge pressure	MPa (psi)
T	= Input torque	Nm (lbf-ft)
T_{max}	= Maximum input torque	Nm (lbf-ft)
η_v	= Pump volumetric efficiency	
η_m	= Pump mechanical efficiency	
η_t	= Pump total efficiency	

K8V Series

Closed Loop Swash Plate Type Axial Piston Pump



■ Specifications

Size: 71, 90, 125
 Rated Pressure: 42 MPa
 Peak Pressure: 50 MPa

■ General Descriptions

The K8V series are variable displacement axial piston pumps for closed loop systems, with superior overall efficiency, stability, and control characteristics.

The K8V pumps are applicable for a wide range of applications, including industrial vehicles such as construction machinery, agricultural equipment with hydrostatic drive systems, and other closed loop applications. Also, this pump can be used in combination with M7V series motors for high pressure closed loop applications.

The K8V series with a range in pump size from 71 to 130 cm³/rev are equipped with electric or hydraulic pilot displacement control. The K8V series pumps, having the integrated components required for a closed system, such as a charge pump, high and low pressure relief valves, and a cut-off valve, enable a compact closed loop system.

■ Features

- Swash plate type, variable displacement axial piston pump for closed loop system
- High overall efficiency
- Suitable for wide range of applications
- Precise flow control
- High stability
- Excellent reliability
- Various integrated valves
- Bypass function for emergency towing

1

Ordering Code

1-1 Pump Options

Model Code **K8V 125 B R D1 A1 A B B X X X X - P1 D C B A 01**

1. K8V Series Pump
K8V Series, Variable Displacement,
Axial Piston, Closed Loop Pump

2. Size

Pump Size	71	90	125
	●	●	●

3. Model Code

B Series B	71	90	125
	●	●	●

4. Direction of Rotation

	71	90	125
R Clockwise	●	●	●
L Counterclockwise	●	●	●

5. Mounting Flange and Shaft

	71	90	125
C1 SAE C Mount & SAE C Shaft (14T-12/24DP)	●	—	—
D1 SAE D Mount & SAE D Shaft (13T-8/16 DP)	—	●	●
D2 SAE D Mount & SAE F Shaft (15T-8/16 DP)	—	—	●

6. Through Drive

	71	90	125
A1 SAE A, 2 bolt, Through Drive (9T-16/32 DP)	●	●	●
B1 SAE B, 2 bolt Through Drive (13T-16/32 DP)	●	●	●
B2 SAE BB, 2 bolt, Through Drive (15T-16/32 DP)	●	●	●
C1 SAE C, 2/4 bolt, Through Drive (14T-12/24 DP)	●	●	●
C2 SAE CC, 2/4 bolt, Through Drive (17T-12/24 DP)	—	●	●
D1 SAE D, 2/4 bolt Through Drive (13T-8/16 DP)	—	●	●
AJ SAE A, 2 bolt, Through Drive (9T-16/32 DP) Covered with Steel Plate	●	●	●
BJ SAE B, 2 bolt, Through Drive (13T-16/32 DP) Covered with Steel Plate	●	●	●
BK SAE BB, 2 bolt, Through Drive (15T-16/32 DP) Covered with Steel Plate	●	●	●
CJ SAE C, 2/4 bolt, Through Drive (14T-12/24 DP) Covered with Steel Plate	●	●	●
CK SAE CC, 2/4 bolt, Through Drive (17T-12/24 DP) Covered with Steel Plate	—	●	●
DJ SAE D, 2/4 bolt, Through Drive (13T-8/16 DP) Covered with Steel Plate	—	●	●
X Without Through Drive	●	●	●

7. Thread Type (Suction/Delivery)

Type of Threaded Port	Thread Type for Flange Port	71	90	125
A UNF	Metric	●	●	●
C UNF	UNF	●	●	●

8. Charge Pump

	71	90	125
A 20 cm ³	●	●	—
B 28 cm ³	●	●	●
X Without Integrated Charge Pump	●	●	●

9. Stroking Speed Control Orifice

	71	90	125
A Φ 0.8	●	—	●
B Φ 1.0	●	●	●
C Φ 1.2	●	●	●
D Φ 1.4	—	●	—
X Without Orifice Available Only with Code X of Pressure Cut-off Valve [16]	●	●	●

10. Mechanical Stroke Limiter

	71	90	125
X Without Mechanical Stroke Limiter	●	●	●

11. Filtration System

	71	90	125
B Remote Pressure Filtration With Ports For External Charge Circuit Filter	●	●	●
X Without Pressure Filtration	●	●	●

13. Special Features

	71	90	125
X Without Any Special Feature	●	●	●

12. Swivel Angle Sensor

	71	90	125
X Without Swivel Angle Sensor	●	●	●

● : Available
— : Not available

1. Ordering Code

1-2 Regulator Options

Model Code ¹ **K** ² **8V** ³ **125** ⁴ **B** ⁵ **R** ⁶ **D** ⁷ **1** ⁸ **A** ⁹ **1** ¹⁰ **A** ¹¹ **B** ¹² **B** ¹³ **X** ¹⁴ **X** ¹⁵ **X** ¹⁶ **X** ¹⁷ **X** ¹⁸ **X** - **P1** **D** **C** **B** **A** **01**

14. Control Option

		71	90	125
P1	Electronic Proportional Displacement Control (24V)	●	●	●
P2	Electronic Proportional Displacement Control (12V)	●	●	●
P3	Hydraulic Proportional Displacement Control	●	●	●

15. High Pressure Relief Valve

		71	90	125
K	20 MPa	●	●	●
L	25 MPa	●	●	●
A	30 MPa	●	●	●
B	35 MPa	●	●	●
C	40 MPa	●	●	●
D	45 MPa	●	●	●
E	50 MPa	●	●	●
S	Customized Pressure Setting for Special Case	●	●	●

16. Pressure Cut-Off Valve

		71	90	125
J	15 MPa	●	●	●
K	20 MPa	●	●	●
L	25 MPa	●	●	●
A	30 MPa	●	●	●
B	35 MPa	●	●	●
C	40 MPa	●	●	●
D	42 MPa	●	●	●
S	Customized Pressure Setting for Special Case	●	●	●
X	Without Cut-Off Valve	●	●	●

Note: The pressure setting of cut-off valve must be at least 5MPa lower than the pressure setting of high pressure relief valve.

17. Low Pressure Relief Valve

		71	90	125
B	2.5 MPa	●	●	●
S	Customized Pressure Setting for Special Case	●	●	●
X	Without Low Pressure Relief Valve	●	●	●

18. Design Code

**	01 ~
----	------

● : Available
 — : Not available

2

Technical Information

2-1 Specifications

Size		71	90	125	
Displacement	Main pump cm ³	71	90	130	
	Charge pump cm ³	20	20	28	
Pressure, main	Rated MPa	42			
	Peak MPa	50			
Pressure, charge	Rated MPa	2.5			
	Peak MPa	4.0			
Allowable case pressure		MPa 0.2 continuous / 0.6 peak			
Speed	Charge pump 20cm ³ , or without Charge pump	Rated* ¹ min ⁻¹	3,300	3,050	2,850
		Maximum* ² (intermittent) min ⁻¹	4,100	3,800	3,450
		Minimum min ⁻¹	500	500	500
	Charge pump 28cm ³	Rated* ¹ min ⁻¹	3,050	3,050	2,850
		Maximum* ² (intermittent) min ⁻¹	3,450	3,450	3,450
		Minimum min ⁻¹	500	500	500
Case volume		L	2.5	3.0	4.0
Temperature range		°C	-20 to +95 (case drain: 115 maximum, intermittent)		
Viscosity range		cSt	10 to 1,000		
Maximum contamination level			ISO 4406 -/18/15		
Allowable through drive torque	Nm	SAE A	123	123	123
		SAE B	395	395	395
		SAE BB	455	575	640
		SAE C	475	575	725
		SAE CC	-	575	830
		SAE D	-	605	870
Mass		kg	60	75	97
Moment of inertia		kg · m ²	8.71 × 10 ⁻³	1.21 × 10 ⁻²	2.35 × 10 ⁻²
Torsional stiffness		Nm/rad	7.97 × 10 ⁴	1.46 × 10 ⁵	2.04 × 10 ⁵
Coating			Red synthetic resin primer		

* 1 : maximum allowable speed for continuous operation.

* 2 : maximum allowable speed for limited operating period and duty. Exceeding this value will result in a reduced service life or the destruction of the pump.

Note: Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or the destruction of the pump.

■ Allowable maximum input torque

	SAE C (Ordering code[5]: C1)	SAE D (Ordering code[5]: D1)	SAE F (Ordering code[5]: D2)
Spline specification	14T DP=12/24	13T DP=8/16	15T DP=8/16
Allowable and maximum input torque (Nm)	600	1,470	2,255
Pump size	K8V71	K8V90/125	K8V125 (Combination pump)

Input shaft splines conform to SAE J744.

Involute splines conform to ANSI B92.1a, 30° pressure angle, side fit.

Two mounting options are available each for the K8V125.

If a combination pump of the K8V125 requires the input torque higher than the allowable maximum input torque of D1 (1470Nm), D2 option must be chosen.

Proper lubrication is required to reduce friction and wear of the shaft.

2. Technical Information

2-1 Specifications

◆ Relief Valve

1. High pressure relief valve

High pressure relief valves (two valves) are equipped to protect the pump from being overloaded.

The high pressure relief valves act to protect the pump from pressure spikes in dynamic control situations and are not equipped for continuous operation.

The settings of the high pressure relief valves are shown in the table below.

Pressure settings

Code[15]	Pressure setting (MPa)
K	20
L	25
A	30
B	35
C	40
D	45
E	50
S	Customized pressure setting for a special case Please contact Kawasaki.

Note:

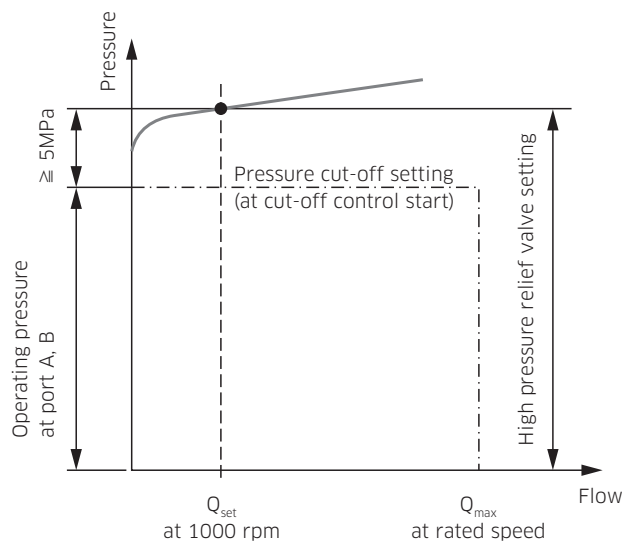
The allowable setting range of the high pressure relief valve is from 20 MPa to 50 MPa, and the customized pressure must be set within this range. For the customized pressure setting contact Kawasaki with the required pressure setting value. The pressure of the high pressure relief valve is factory preset at 40 MPa, if not specified.

2. Low pressure relief valve

Low pressure relief valve is equipped to control the pressure for charge line and servo line.

The pressure setting of an integrated low pressure relief valve is preset at 2.5 MPa at the factory.

Do not adjust the pressure of the low pressure relief valve, as it may reduce the controllability of the pump.



High pressure relief valve setting diagram

◆ Pressure Cut-off

Pressure cut-off is the function which adjusts the pump displacement to the neutral position when the pressure reaches its pressure setting.

The pressure cut-off is set lower than high pressure relief valve setting, so that the maximum pump pressure is controlled by the pressure cut-off valve, whereas the high pressure relief valve acts to the pressure spike.

The cut-off pressure must be set at least 5 MPa lower than the setting of the high pressure relief valves.

The allowable setting range of the cut-off pressure is from 15 MPa to 42 MPa.

2. Technical Information

2-1 Specifications

◆ Charge Pump

Charge flow is required on all K8V pumps applied in closed circuit systems. The charge pump supplies flow to replenish, cool and filter oil, provide charge pressure and servo pressure, and flow for system control and auxiliary functions.

The standard size of integrated charge pumps as follows;

K8V71/90: 20 cm³/rev

K8V125: 28 cm³/rev

If the pump is required a lot of flushing flow or continuously operating at low speed or at high temperature, the pump control characteristics might be unstable due to lack of supply from the integrated charge pump. Although the typical integrated charge pump sizes of K8V71/90 are 20 cm³/rev, 28 cm³/rev can be selected if necessary.

Pressure and flow for charge circuit can be supplied by an external auxiliary pump.

An auxiliary pump for charge circuit can also be mounted on the back of main pump using through drive mounting.

In case the auxiliary pump is used for charge circuit, connect the charge pump delivery line to port C so that the flow is provided to the low pressure line and servo line. The integrated low pressure relief valve can be used in this case. If the integrated low pressure relief valve is not used, provide an appropriate relief valve in the system.

2. Technical Information

2-1 Specifications

Filtration of Charge Pump

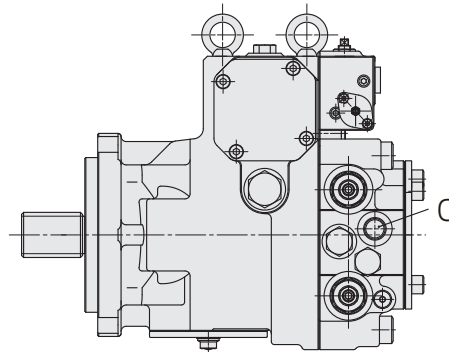
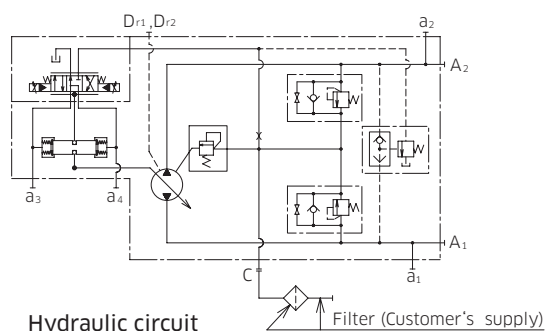
Filtration of the hydraulic fluid reduces premature wear, and enhances the reliability and productivity of the products. To ensure the cleanliness of the working fluid is essential to optimize function of the machine, and extend the service life.

Filtration system

1) External filtration system / External supply (Ordering code [11] : X)

This option is for a pump without an integrated charge pump. External charge pump supply comes from port C.

Filter arrangement should be made separately.



2) Remote filtration system (Ordering code [11] : B)

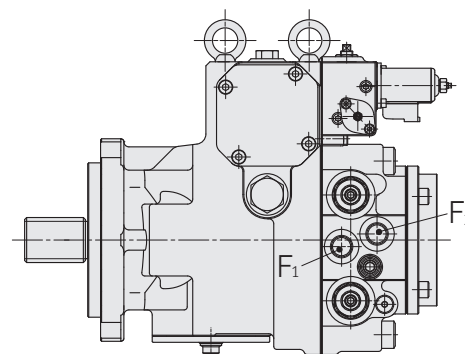
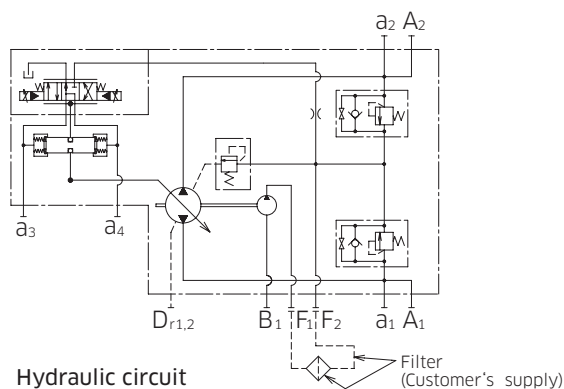
This is for a pump equipped with an integrated charge pump and ports for external charge circuit filter. The filter will be located in the discharge (pressure) line of the charge pump, as shown in the hydraulic circuit below.

Filters with bypass are not recommended.

Filter arrangement should be made separately, as the filter is not included in the delivery contents.

Charge pressure outlet: Port F_1

Charge pressure inlet: Port F_2



2. Technical Information

2-2 Functional Description of Regulator

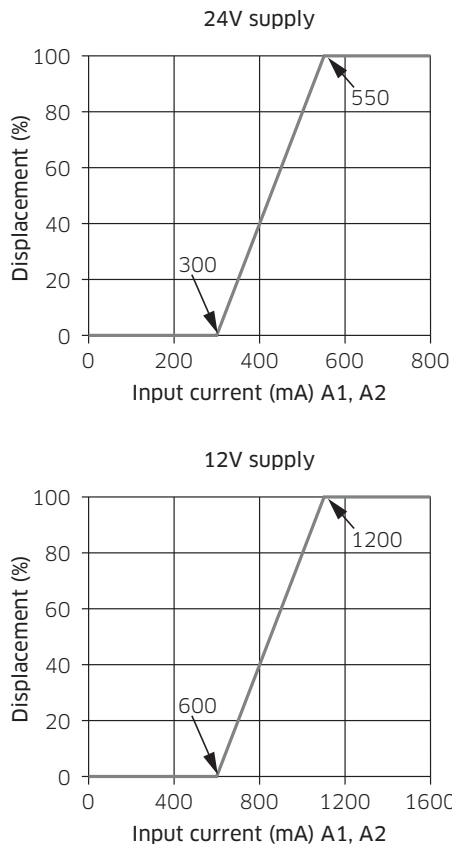
◆ Electric Proportional Control (Ordering code [14] : P1, P2)

Pump delivery flow can be proportionally controlled by the input current to the electric proportional reducing valve equipped on the regulator.

The input current of the electric proportional reducing valve signals the control spool in a regulator to stroke, and to supply pressure to the servo piston. The pump displacement varies with the stroke of the servo piston.

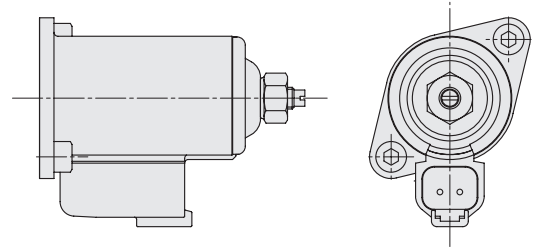
The feedback lever, connected with the servo piston at the one end, moves with the stroke of the servo piston. This movement causes the sleeve of the control spool which is connected to the other end of the feedback lever to stroke, and closes the flow passage to the servo piston. Consequently, the stroke of the servo piston stops, and the pump displacement becomes proportional to the input current.

Control characteristics



The above figures is the control characteristics of electric proportional control. The control characteristics of electric proportional control is not adjustable.

● Electrical specifications

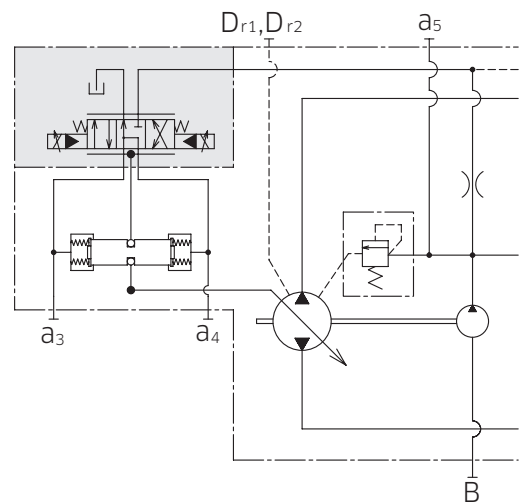


Connector type

TYCO ELECTRONICS JAPAN DT04-2P
Rated Current and Coil Resistance
For 24 V supply: 0.7 A, 15 Ω (at 20°C)
For 12 V supply: 1.6 A, 3.3 Ω (at 20°C)

Recommended dither condition
85 Hz, 200 mAp-p for 24 V
85 Hz, 600 mAp-p for 12 V

(Note)
Electric displacement control regulator requires the minimum servo pressure is 2.0 MPa.



Hydraulic circuit

2. Technical Information

2-2 Functional Description of Regulator

◆ Mechanical Stroke Limiter

Mechanical stroke limiter is available for option. By an adjusting screw the maximum displacement can be adjusted infinitely to the required displacement setting.

This option is under development. For details contact Kawasaki.

◆ Stroking Speed Control Orifice

Pump stroking speed (response) can be adjusted by changing the control orifice which is integrated in the servo line. The available control orifices and those response (for reference) are shown in the table below.

The typical orifice size used is as below;

K8V71: Φ 1.0

K8V90: Φ 1.2

K8V125: Φ 1.0

	Code [9]	Orifice size	Stroking time	
			Neutral to Max.	Max. to Neutral
K8V71	A	Φ 0.8	2.0 to 3.0 sec	0.3 to 1.0 sec
	B	Φ 1.0	1.5 to 2.0 sec	
	C	Φ 1.2	1.0 to 1.5 sec	
K8V90	B	Φ 1.0	2.0 to 2.5 sec	0.5 to 1.5 sec
	C	Φ 1.2	1.5 to 2.0 sec	
	D	Φ 1.4	1.0 to 1.5 sec	
K8V125	A	Φ 0.8	4.0 to 5.0 sec	0.5 to 1.5 sec
	B	Φ 1.0	3.0 to 4.0 sec	
	C	Φ 1.2	2.0 to 3.0 sec	

