3. Install the drive shaft (111) with the bearing (124), the bearing spacer (127) and the stop ring (824) on the swash plate support (251).

   A. Do not tap the drive shaft with the hammer or anything else.

   B. Softly tap the outer race of the bearing with a plastic hammer and completely insert it using a tool or steel bar.

Figure 14

4. Insert the front cover (261) on the pump casing (271) and fasten it with the screw hex S.H.C. (406).

   A. Nominally coat the oil seal of the front cover with grease.

   B. Be careful not to scratch the oil seal when inserting it.

   C. Install the rear cover in the same way.

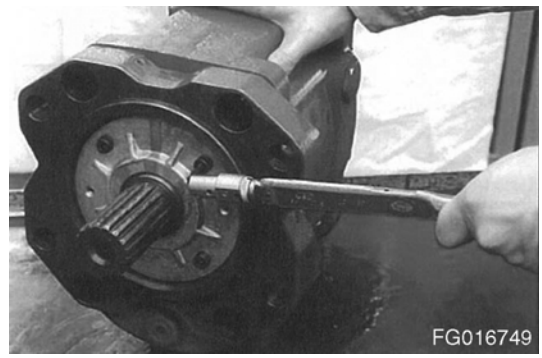


Figure 15

5. Assemble the piston cylinder sub [cylinder sub (014), piston sub (151, 152), the set plate (153), the spherical bush (156) and the cylinder spring (157)]. Align the spherical bush and the cylinder spline when inserting them into the pump casing.

   A. Make sure not to scratch the shaft bearing.

   B. Check if the swash plate is loosened off.

   C. Install the rear pump in the same way.

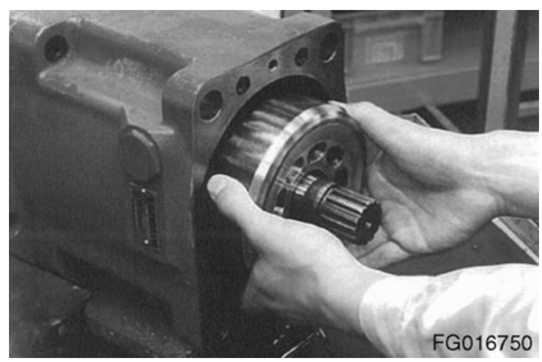


Figure 16

6. Mount the valve plate (R) (313) to the valve cover (F) (313) and the valve plate (L) (314) to the valve cover (R) (312) by aligning the pin (885).

   Make sure that the in and out direction of the valve plate are correct.

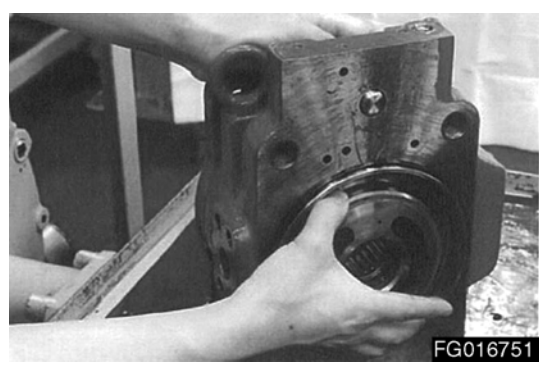


Figure 17

7. Mount the pump casing (271) to the valve cover (R) (312) with the screw hex S.H.C. (415) and insert the spline joint (114) and the booster (130) on the drive shaft (R) (113).

   A. Place a tarsal plate on the work table when placing the regulator on it so that there is no scratch on the regulator.

   B. Make sure not to scratch the needle bearing.

   C. Refer to the pump structural diagram in order to correctly align the booster.

8. Mount the valve cover (F) (311) and fasten the screw hex S.H.C. (402).

9. Mount the pump casing (271) inserted in the drive shaft (F) (111) on the valve cover (F) (311) and tighten the screw hex S.H.C. (401).

   Insert the spline phase of the drive shaft (F) and the spline joint on the drive shaft (F) by twisting it.

10. Insert the feedback pin of the tilt pin in the feedback lever of the regulator, mount the regulator and tighten it with the screw hex S.H.C..

11. Mount the gear pump and tighten the screw hex S.H.C..

12. Mount the drain port plug (468). The work is completed.

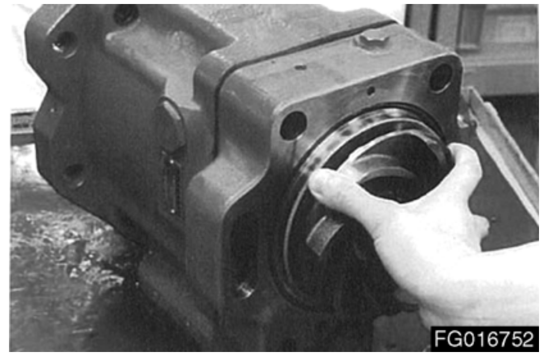


Figure 18

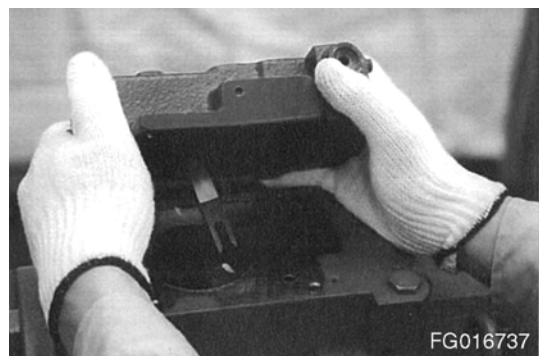


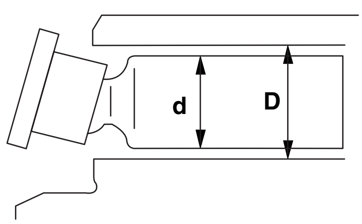
Figure 19

Pump Main Body Maintenance Standard

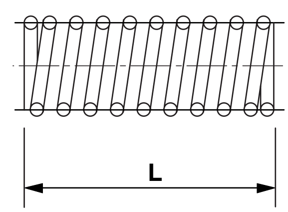
Replacement of Consumable Parts

If wear and tear of a part exceeds the following guideline, replace or readjust it. If there is clear damage, replace it regardless of the guideline.

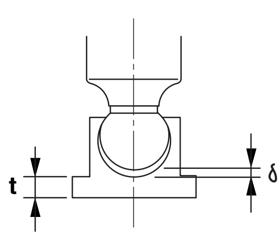
Part and Inspected Item	Standard Size/ Recommended Replacement	Follow-up
	Pump Type	
	K3V280	
Clearance between the piston and cylinder ball (D-d)	0.047 / 0.094	Replacement of the piston or cylinder
Gap among the piston, shoe and coking part (δ)	0 - 0.1 / 0.35	Replace the assembly (piston and shoe)
Shoe thickness (t)	6.5 / 6.3	Replace the assembly (piston and shoe)
Free height of the cylinder spring (L)	49.5 / 48	Replacement of the cylinder spring
Set height of the set plate and spherical bush (H-h)	33.0 / 32.0	Replacement of the set plate or spherical bush



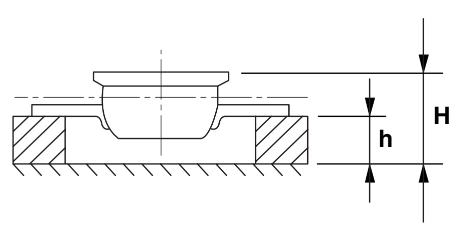
Clearance between the piston and cylinder wall (D-d)



Free height of the cylinder spring (L)



Gap among the piston, shoe and coking part (δ)
Show thickness (t)



Set height of the set plate and spherical bush (H-h)

FG016753

Figure 20

Guideline for Correction of Cylinder, Valve Plate and Swash Plate (Shoe Plate)

Valve Plate (Moving Part) Shoe Plate Cylinder (Moving Part) Surface Roughness	Surface Roughness Requiring Correction	3-Z
	Standard Surface Roughness (Corrected)	0.4Z or less (raping)

Tightening Torque

Part Name	Size	Tightening Torque (N•m)	Tool	
Screw hex S.H.C. (Material SCM-435)	M5	6.9	B = 4	Hexagonal Torque Wrench
	M6	12	5	
	M8	29	6	
	M10	57	8	
	M12	98	10	
	M14	160	12	
	M16	240	14	
	M18	330	14	
	M20	430	17	
Nipple (Material S45C) **NOTE:** *Wind the seal tape 1.5 - 2 revolutions.*	R1/16	6.9	4	Same as above
	R1/8	10	5	
	R1/4	17	6	
	R3/8	34	8	
	R1/2	49	10	
PO Plug (Material S45C)	G1/4	29	6	Same as above
	G1/2	98	10	
	G3/4	150	14	
	G1	190	17	
	G11/4	260	17	
	G11/2	270	17	

Regulator of Main Pump

Edition 1

MEMO

Table of Contents

Regulator Pump

MEMO

SAFETY PRECAUTIONS

CAUTION

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX700LC	5001 and Up

NAMING CONVENTION

KR3 D - Z P 53 V

V: O-Ring Fluorine

53: Regulator Design Series No.

P: Flow Control Type
- O: No Flow Control
- N: Negative Flow Control
- P: Positive Flow Control
- M: Manual Flow Control
- E: Electric Flow Control
- C: Negative Flow Control (with Maximum Flow Cut Function)
- D: Positive Flow Control (with Maximum Flow Cut Function)

Z: Horse Power (HP) Control Type
- 1: Constant HP Control
- 2: Cumulative Total HP Control
- 4: Pressure Cut Off Control
- 5: Constant HP Control + Pressure Cut Off Control
- 6: Cumulative Total HP Control + Pressure Cut Off Control
- 9: Cumulative Total HP Control + Power Shift Control
- H: Cumulative Total HP Control + Power Shift Control (Reducing HP+ Increasing HP)
- Z: Cumulative Total HP Control + Power Shift Control (with Plug Cover at the Bearing Point)

D: Size
- 6: K3V63
- 8: K5V80
- G: K3V112
- S: K5V140
- H: K3V140, K3V180
- K: K5V200DT/DTP/DTH/S
- D: K3V280, K5V200DP (H)

KR3: Regulator for the K3V•K5V Series Pumps

SPECIFICATIONS

Operating Oil	Durable hydraulic oil ISO VG 32, 46, 68
Temperature Range	-20 - 95°C
Viscosity Range	10 - 1000 cSt (10 - 200 cSt at full operation) (1 cst = 1 mm^2/s)

OVERVIEW

A regulator for swash plate type axial pump piston pump K3V series. The regulators KR3D-ZP53-V and KR3D-ZP54-V provide the following control mechanisms.

1. Horsepower Control

   As the pump 1 output pressure P1 and pump 2 pressure p2 increase, the controller automatically reduces the pump output flow and limits the input torque to a certain level or below. (The input horsepower remains constant when the number of rotations is constant.)

   In case of tandem double pumps, it is a simultaneous total horsepower type which is operated by the sum of the load pressures of two pumps. Under the horsepower control, the regulator of each pump is controlled by the same output flow rate. Therefore, overloading of the motor is prevented under the horsepower control regardless of the both pumps load.

2. Power Shift Control

   It manipulates the power shift set pressure, Pf, or electronic proportional reducing value current to shift the horsepower set value. Power shift pressure Pf (electronic proportional reducing valve secondary differential pressure) is induced in the horsepower controller of each pump regulator through the internal path and shifted to the same horsepower set value. With this mechanism, the output power of the pump can be changed as needed and thus the optimum power for the work condition can be obtained.

3. Flow Control

   It controls the pump output flow by manipulating the pilot pressure, Pi. The available control methods include a positive control in which the output flow, Q, increases as the pilot pressure, Pi, increases; and a negative control in which the output flow, Q, decreases as the pilot pressure, Pi increases. This regulator uses the positive control method.

With this mechanism, the pump does not consume any unneeded energy as only the needed flow is output when the pilot pressure is set according to the need.

Although this regulator applies 3 control mechanisms, when multiple controllers are in effect, the low flow control is assigned a higher priority by the mechanical calculation.

OPERATION DESCRIPTION

Flow Control

As shown in the figure at the right, it controls the pump output flow using the pilot pressure, Pi.

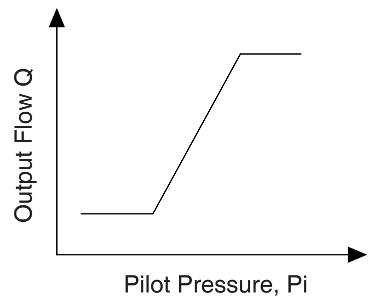


Figure 1

Flow Increase Operation (Ref. Figure 1)

When the pilot pressure, Pi, increases, it stops at the point where the Pi pressing the pilot piston (643) to (A) direction is in equilibrium with the spring force of the pilot spring (643). The movement of the pilot piston (643) is transmitted to the lever (2) (613) by the pin (875) and rotates in the direction of the arrow. The movement of lever (2) (613) is transmitted to the feedback lever (611) by the pin (897) and rotates in the direction of the arrow as (B) with (C) as the bearing point. As a result, the spool (652) connected with the feedback lever (611) moves in the direction of (D). When the spool (652) moves in the direction of (D), the CI port is opened to the tank port and the pressure in the large diameter section of the servo piston (532) is lowered so that the servo piston (532) moves in the direction of (E) to increase the flow of the output pressure, P1, of the Small diameter section. Since the feedback lever (611) is connected to the servo piston (532) and spool (652), when the servo piston (532) moves in the direction of (E), the feedback lever (611) rotates with (F) as the bearing point to return the spool (652) to its initial position. With this movement, the opening of the spool (652) and sleeve (651) are slowly closed. The servo piston (532) stops when the opening is completely closed.

Flow Decrease Operation (Figure 1)

When the pilot pressure, Pi, decreases, it stops at the point where the Pi is in equilibrium with the spring force of the pilot spring (646) which presses the pilot spring (646) in the direction of (G). The movement of the pilot piston (643) is transmitted to the lever (2) (613) by the pin (875) and rotates in the direction of the arrow with (H) as the bearing point. The movement of lever (2) (613) is transmitted to the feedback lever (611) by the pin (897) and rotates in the direction of the arrow as (H) with (I) as the bearing point. As a result, the spool (652) connected with the feedback lever (611) moves in the direction of (J). When the spool (652) moves in the direction of (J), the output pressure, P1, is induced in the servo piston (532) large diameter section through the spool (652) and the CI port. The output pressure, P1, is always induced in the servo piston (532) Small diameter section, and the servo piston (532) moves in the direction of (K) due to the difference in area to reduce the swivel angel and thus the output flow. Since the feedback lever (611) is connected to the servo piston (532) and spool (652), when the servo piston (532) moves in the direction of (K), the feedback lever (611) rotates with (L) as the bearing point to return the spool (652) to its initial position. With this movement, the opening of the spool (652) and sleeve (651) are slowly closed. The servo piston (532) stops when the opening is completely closed.

Horsepower Control

As shown in the figure at right, increasing the load pressure decreases the pump swivel angle to prevent overloading of the motor. Since this regulator uses the simultaneous total horsepower control, the swivel angle (displacement volume) of both pumps is controlled in the same value as shown in the following equation.

$$Tin = P1 \times q / 2\pi + P2 \times q / 2\pi = (P1 + P2) \times q/2\pi$$

Tin: Input torque

q: Displacement volume

P1: Pump 1 pressure

P2: pump 2 pressure

Since the horsepower control operates in the same way as the flow control, it is brieflydescribed below.

(For detailed movement of each part, please refer to the section on flow control.)

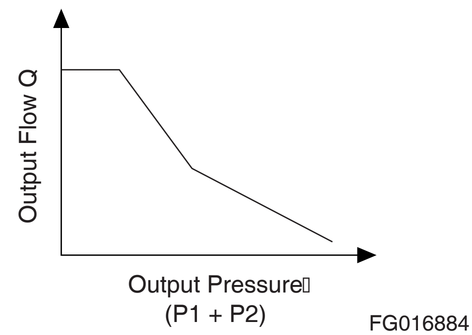


Figure 2

Prevention of Overloading (Figure 2)

When pump 1 output pressure, P1, or pump 2 output pressure, P2, increases, it is applied to the stepped part of the compensator piston (621) so that the compensator rod (623) is pressed in the direction of (M) and moved to the point at which P1 is in equilibrium with the spring force of the outer spring (625) and inner spring (626). The movement of the compensator rod (623) is transmitted to the lever (1) (612) through the pin (875) and rotation in the direction of the arrow with (N) as the bearing point. The movement of the lever (1) (612) is transmitted to the feedback lever (611) through the pin and rotates in the same direction as the arrow like (N) with (O) as the bearing point. When the spool (652) moves in the direction of (P), the output pressure, P1, is induced in the servo piston (532) large diameter section through the spool (652) and the CI port. The output pressure, P1, is always induced in the servo piston (532) Small diameter section, and the servo piston (532) moves in the direction of (Q) due to the difference in area to reduce the swivel angle and thus the output flow. Since the feedback lever (611) is connected to the servo piston (532) and spool (652), when the servo piston (532) moves in the direction of (Q), the feedback lever (611) rotates with (R) as the bearing point to return the spool (652) to its initial position. With this movement, the opening of the spool (652) and sleeve (651) are slowly closed.

The servo piston (532) stops when the opening is completely closed.

Flow Recovery Operation

When the pump 1 output pressure, P1, or pump 2 output pressure, p2, decreases, the compensator rod (623) is pressed in the direction of (S) by the outer spring (625) and inner spring (626) and moves to the point at which P1 is in equilibrium with the spring force of the outer spring (625) and inner spring (626). The movement of the compensator rod (623) is transmitted to the lever (1) (612) through the pin (875) and rotation in the direction of the arrow with (T) as the bearing point.

The movement of the lever (1) (612) is transmitted to the feedback lever (611) through the pin and rotates in the same direction as the arrow like (T) with (U) as the bearing point. As a result, the spool (652) connected to the feedback lever (611) moves in the direction of (V). When the spool (652) moves in the direction of (V), the CI port is opened to the tank port and the pressure of the servo piston (532) large diameter section is lowered so that the servo piston (532) moves in the direction of (W) by the Small diameter section output pressure, P1, and increases the flow. Since the feedback lever (611) is connected to the servo piston (532) and spool (652), when the servo piston (532) moves in the direction of (W), the feedback lever (611) rotates with (X) as the bearing point to return the spool (652) to its initial position. With this movement, the opening of the spool (652) and sleeve (651) are slowly closed.

The servo piston (532) stops when the opening is completely closed.

Mechanism for Prioritized Low Swivel Angle (Low Flow) Control

As described above, the swivel of the flow control is transmitted to the feedback lever (611) and spool (652) through the lever (2) (613) and that of the horsepower control is transmitted through the large hole unit of the lever (1) (612). However, since the pin (ø5) is protruding in the large hole (ø9), the lever on the side of lowering the swivel contacts the pin (897) while the ø9 hole of the lever on the side of the large swivel is free as it does not contact the pin (897). Such mechanical selection ensures the lower swivel command of the flow control and horsepower control has a higher priority.

Power Shift Control (Reducing Horsepower Control)

As shown in the figure at right, the horsepower is controlled by the power shift pressure, Pf.

When the power shift pressure, Pf, increases, the compensator rod (623) moves to the right through the pin (898) and compensation piston (621). Thus the pump swivel angle decreases and the horsepower set decreases as described in the overload prevention operation. In the same way, the horsepower set increases when the power shift pressure, Pf, decreases.

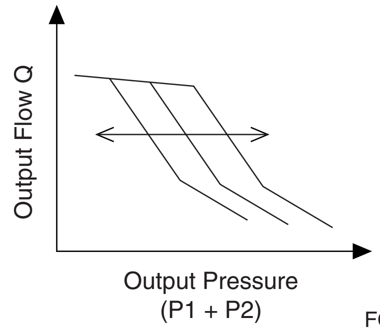


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Figure 3

REGULATOR ADJUSTMENT

This regulator can adjust the maximum flow, minimum flow, horsepower control attribute and flow control attribute by manipulating the adjustment screw. (Regulator adjustment and corresponding change are listed in "Regulator Adjustment Table" on page 1-13.)

Adjustment of Maximum Flow (Pump Main Body)

Unfasten the hexagonal nut (806). Then tighten or loosen the stopping screw (954) to adjust. Other control attributes remain unchanged while only the maximum flow is changed.

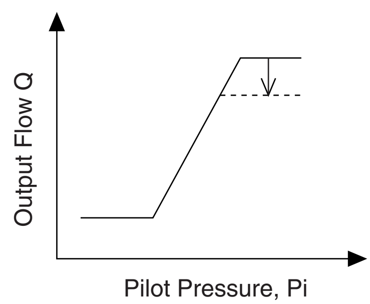

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Figure 4

Adjustment of Minimum Flow (Pump Main Body)

Unfasten the hexagonal nut (806). Then tighten or loosen the hex SHC stopping screw (954) to adjust. Like the adjustment of maximum flow, other control attribute remain unchanged. But if the screw is tightened too much, the energy consumption at maximum output pressure (at relief) can increase.

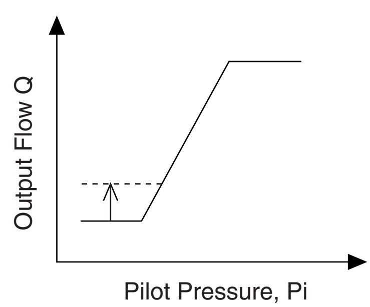

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Figure 5

Adjustment of Input Horsepower

Since this regulator uses a simultaneous total horsepower method, adjust the screw (C) (628) and adjustment screw C (627) of both the front pump and the rear pump for the same amount when changing the horsepower setting. The pressure change by adjustment is the value at the point of simultaneous pressure increase of both pumps.

Adjustment of Outer Spring

Unfasten the hexagonal nut (630). Then tighten or loosen the adjustment screw (C) (628) to adjust. When the adjustment screw (C) (628) is tightened, the control curve moves to the right as shown in the figure at right and increases the input horsepower. When the adjustment screw (C) (628) is rotated by N revolutions, the set of inner spring (626) also changes by the equivalent amount. Therefore, rotate the adjustment screw C (627) by N x A revolutions in the reverse direction. (Refer to Table 1 for the value of A).

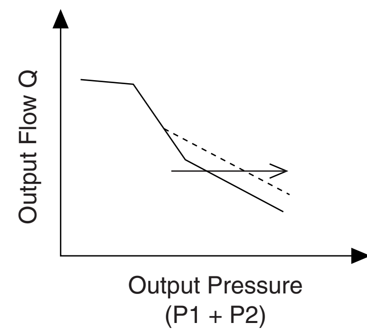

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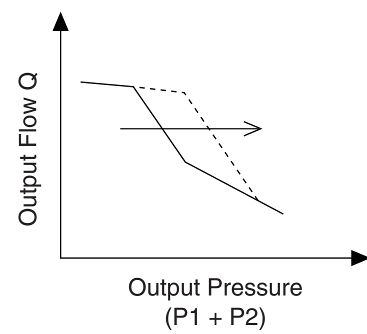
Figure 6

Adjust of Inner Spring

Unfasten the hexagonal nut (802). Then tighten or loosen the adjustment screw (C) (627) to adjust. When the screw C (628) is tightened, the flow increases as shown in the figure at right and thus the input horsepower increases.



FG016889

Figure 7

Adjustment of Flow Control Attribute

Unfasten the hexagonal nut (801). Then tighten or loosen the hex SHC stopping screw (924) to adjust.

When the hex SHC stopping screw (924) is tightened, the control curve moves to the right as shown in the figure at right.

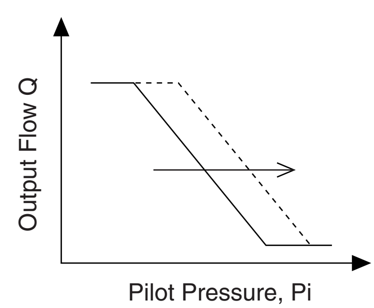


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Figure 8

Regulator Troubleshooting

If there is a malfunction due to the regulator, disassemble and inspect it using the Maintenance Guide as a reference.

Motor Overload

Apply the load to each pump and check which of the front pump and rear pump is experiencing the overload. If there is a problem in both pumps, check steps (1) and (2) below. If there is a problem with one pump, begin with step (3).

1	Check if the power shift ordered current I is normal.	
2	Power shift pressure (Pf) is low.	Check the dither of the amplifier.
		Replace the electronic proportional reducing valve.
3	Compensator piston (621) and compensator rod (623) stick.	Disassemble and clean them.
4	Pin (898) stick	Disassemble and clean it.

Maximum Flow Not Obtained

1	Check if the pilot pressure, Pi, is normal.	
2	Pilot Piston (643) stick	Disassemble and clean it.
3	Spool (652) stick	Disassemble and clean it.

CAUTION

Replace the part if it shows deep scratches.

Regulator Adjustment Table

		Adjustment of Maximum Flow		Adjustment of Minimum Flow		Adjustment of Input Horsepower							Adjustment of Flow Control Attributes		
						Adjustment of Outer Spring				Adjustment of Inner Spring					
Pump, Reg. Type	Revolution (min^{-1})	Adjustment Screw (954) Tightening (Revolution)	Flow Change (L/min)	Adjustment Screw (953) Tightening (Revolution)	Flow Change (L/min)	Adjustment Screw (628) Tightening (Revolution)	Compensator Control Initial Pressure Change MPa	Input Torque Change N•m	A	Adjustment Race (627) Tightening (Revolution)	Flow Change (L/min)	Input Torque Change N•m	Adjustment Screw (924) Tightening (Revolution)	Flow Control Initial Pressure Change MPa	Flow Change (L/min)
K3V280DTH1AJR-ZP53-V K3V280DTH1AJR-ZP54-V KR3D-ZP53-V KR3D-ZP54-V	1800	+1/4	-9.2	+1/4	+9.2	+1/4	+1.88	+146.5	1.87	+1/4	+22.0	+116.7	+1/4	+0.22	+51.6

(+:Clockwise -: Counterclockwise)

FG016882