

DOOSAN

950106-00013E
January 2011

EXCAVATOR
**Shop
Manual**

DX700LC

Serial Number 5001 and Up

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MEMO

Clothing and Personal Protective Items

Contain long hair, and avoid loose clothing and jewelry. They can catch on controls or in protruding parts and cause serious injury or death.

Do not wear oily clothes. They are highly flammable.

Full eye protection, a hard hat, safety shoes and gloves may be required at the work site.

While working on the machine, never use inadequate tools. They could break or slip, causing injury, or they may not adequately perform intended functions.



Figure 1

Breathing Masks, Ear Protection May Be Required

Do not forget that some risks to your health may not be immediately apparent. Exhaust gases and noise pollution may not be visible, but these hazards can cause disabling or permanent injuries.

NOTE: *The equivalent continuous a weighted sound pressure level at the workstation for this machine is 73 dB (A).*

Measurement is obtained on a dynamic machine following the procedures and cabin conditions as described in ISO 6396.

NOTE: *The guaranteed sound power level emitted by the machinery for this machine is 104 dB(A).*

Measurement is obtained on a dynamic machine with the procedures as described in 2000/14/EC.

Vibration Level Information

Hands/Arms: The weighted root mean square acceleration to which the hands/arms are subjected, is less than 2.5 m/s^2 .

Whole body: The weighted root mean square acceleration to which the whole body is subjected, is less than 0.5 m/s^2 .

Measurements are obtained on a representative machine, using measuring procedures as described in the following standard: ISO 2631/1, ISO 5349, and SAE J1166.

Travel Precautions

Never turn the starting switch to the "O" (OFF) position when traveling. It is dangerous if the engine stops when the machine is traveling. It will be impossible to operate the steering.

Attachment control levers should not be operated while traveling.

Do not change selected travel mode (FAST/SLOW) while traveling.

Fold in work equipment so that the outer end of the boom is as close to the machine as possible, and is 40 - 50 cm (16 - 20 in) above ground.

Never travel over obstacles or slopes that will cause the machine to tilt severely. Travel around any slope or obstacle that causes the machine to tilt 10 degrees or more to the right or left, or 30 degrees or more from front to rear.

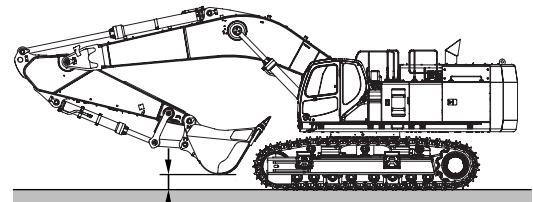
Do not operate the steering suddenly. The work equipment may hit the ground and cause the machine to lose its balance, and this may damage the machine or structures in the area.

When traveling on rough ground, travel at low speed, and avoid sudden changes in direction.

Always keep to the permissible water depth. Permissible water depth is to the center line of the upper track rollers.

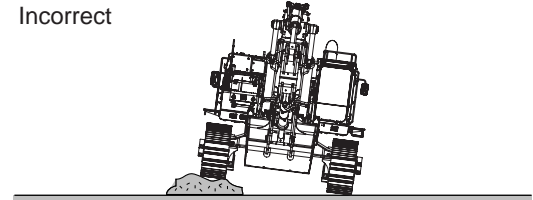
When traveling over bridges or structures on private land, check first that the bridge or structure can withstand the weight of the machine. When traveling on public roads, check with the local authorities and follow their instructions.

Travel Posture



40 ~ 50 cm (16 ~ 20 in.)

Incorrect



FG015845

Figure 17

Precautions for Removal, Installation, and Storage of Attachments

Before starting removal and installation of attachments, decide the team leader.

Do not allow anyone except the authorized workers close to the machine or attachment.

Place attachments that have been removed from the machine in a safe place so that they do not fall. Put up a fence around the attachments and take other measures to prevent unauthorized persons from entering.



Figure 38

HDO1041L

Precautions When Working on Machine

When carrying out maintenance operations on the machine, keep the area around your feet clean and tidy to prevent you from falling. Always do the following;

- Do not spill oil or grease.
- Do not leave tools laying about.
- Watch your step when walking.

Never jump down from the machine. When getting on or off the machine, use the steps and handrails, and maintain a three-point contact (both feet and one hand or both hands and one foot) to support yourself securely.

If the job requires it, wear protective clothing.

To prevent injury from slipping or falling, when working on the hood or covers, never use any part except the inspection passage fitted with nonslip pads.



Figure 39

ARO1380L

Lock Inspection Covers

When carrying out maintenance with the inspection cover open, lock the cover securely in position with the lock bar.

If maintenance work is carried out with the inspection cover open but not locked, there is danger that it may suddenly close and cause injury if there is a gust of wind.

Boom Type (One Piece)		7.7 m (25' 3")			6.65 m (21' 10")	
Arm Type		3.55 m (11' 8")	2.9 m (9' 6")	4.2 m (13' 9")	2.9 m (9' 6")	2.6 m (8' 6")
Bucket Type (SAE)		3.3 m ³	3.3 m ³	3.0 m ³	3.9 m ³	4.5 m ³
Max. Digging Reach	A	13,250 mm (43' 6")	12,720 mm (41' 9")	13,865 mm (45' 6")	11,605 mm (38' 1")	11,345 mm (37' 3")
Max. Digging Reach (Ground)	B	12,990 mm (42' 7")	12,450 mm (40' 10")	13,610 mm (44' 8")	11,305 mm (37' 1")	11,040 mm (36' 3")
Max. Radius Vertical	C	10,230 mm (33' 7")	10,790 mm (35' 5")	10,360 mm (33' 12")	9,860 mm (32' 35")	9,655 mm (31' 8")
Min. Radius 8' Line	D	4,540 mm (14' 11")	4,530 mm (14' 10")	10,360 mm (33' 12")	3,800 mm (12' 6")	3,785 mm (12' 5")
Min. Digging Reach	E	2,350 mm (7' 9")	3,060 mm (10' 0")	170 mm (7")	1,835 mm (6' 0")	2,050 mm (6' 9")
Min. Swing Radius	F	5,780 mm (18' 12")	5,790 mm (18' 12")	5,810 mm (19' 1")	5,230 mm (17' 2")	5,195 mm (17' 1")
Min. Loading Height	G	3,248 mm (10' 8")	3,950 mm (12' 12")	2,630 mm (8' 8")	3,080 mm (10' 1")	3,380 mm (11' 1")
Max. Vertical Wall Depth	H	5,730 mm (18' 10")	4,060 mm (13' 4")	6,515 mm (21' 4")	3,450 mm (11' 4")	3,305 mm (10' 10")
Max. Loading Height	I	8,320 mm (27' 4")	8,220 mm (26' 12")	8,660 mm (28' 5")	7,020 mm (23' 0")	6,940 mm (22' 9")
Max. Depth To 8' Line	J	8,270 mm (27' 2")	7,550 mm (24' 9")	8,910 mm (29' 3")	6,925 mm (22' 9")	6,620 mm (21' 9")
Max. Bucket Pin Height	K	10,470 mm (34' 4")	10,380 mm (34' 1")	10,795 mm (35' 5")	9,210 mm (30' 3")	9,135 mm (29' 12")
Max. Digging Depth	L	8,410 mm (27' 7")	7,730 mm (25' 4")	9,030 mm (29' 8")	7,075 mm (23' 3")	6,780 mm (22' 3")
Max. Digging Height	M	12,165 mm (39' 11")	12,040 mm (39' 6")	12,520 mm (41' 1")	10,740 mm (35' 3")	10,680 mm (35' 0")
Bucket Angle	d	179.4 deg	177.8 deg	179.4 deg	167.4 deg	166.4 deg

Swing Deceleration Force Test

With the boom, arm and bucket in the same position as for the swing speed test, rotate the turntable so that the boom is evenly centered between the side frames, pointing straight ahead. Locate the 90° reference point, perpendicular to the boom. Mark the turntable and undercarriage with paint at the 90° point.

Make several attempts to rotate the turntable exactly 90°, starting from the boom straight ahead position. Engage the swing lever and brake at the 90° point, shown as "swing stop" in Figure 8.

Record how far the turntable drifts past the stop point, measuring the distance between paint marks. Maximum distance should be less than 900 mm (56°), in both Power Mode and Standard Mode.

Reference Number	Description
1	Start Swing
2	90° Swing
3	Swing Force
4	Swing Stop

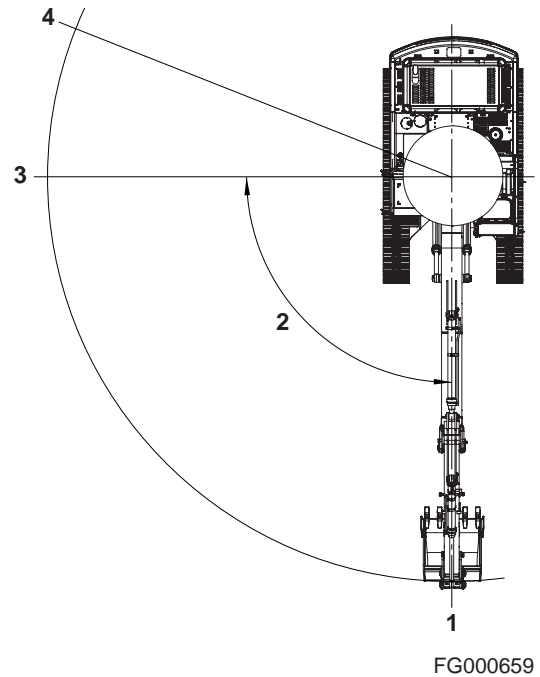


Figure 8

 **CAUTION**

Observe the following safety precautions:

1. Use extra caution and adequate safety shielding when welding near fuel and oil tanks, batteries, hydraulic piping lines or other fire hazards.
 2. Never weld when the engine is running. Battery cables must be disconnected before the welding procedure is started.
 3. Never weld on a wet or damp surface. The presence of moisture causes hydrogen embrittlement and structural weakening of the weld.
 4. If welding procedures are being performed near cylinder rods, operator's cabin window areas or any other assemblies that could be damaged by weld spatters, use adequate shielding protection in front of the assembly.
 5. During equipment setup, always attach ground cables directly to the area or component being welded to prevent arcing through bearings, bushings, or spacers.
 6. Always use correct welding rods for the type of weld being performed and observe recommended precautions and time constraints. AWS Class E7018 welding rods for low alloy to medium carbon steel must be used within two hours after removal from a freshly opened container. Class E11018G welding rods for T-1 and other higher strength steel must be used within 1/2 hour.
-

HYDRAULIC SYSTEM - GENERAL PRECAUTIONS

Always maintain oil level in the system at recommended levels. Assemblies that operate under heavy loads, at high speed, with extremely precise dimensional tolerances between moving parts - pistons and cylinders, or shoes and swash plates, for example - can be severely damaged if oil supply runs dry.

Assemblies can be run dry and damaged severely in a very short time when piping or hoses are disconnected to repair leaks and/or replace damaged components. Hoses that are inadvertently switched during disassembly (inlet for outlet and vice versa), air introduced into the system or assemblies that are low on oil due to neglect or careless maintenance, could all produce sufficient fluid loss to cause damage.

When starting the engine (particularly after long layoff or storage intervals), make sure that all hydraulic controls and operating

Abrasive Roller Wear

Pattern on races and rollers caused by fine abrasives.

Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.



Figure 13

HASA560S

Cracked Inner Race

Race cracked due to improper fit, cocking or poor bearing seat.

Replace all parts and housings, check seals and bearings and replace if leaking.

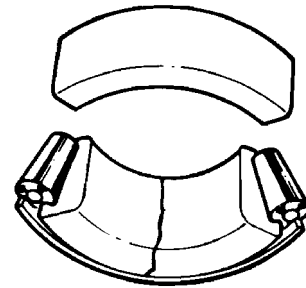


Figure 14

HASA570S

Smears

Smearing of metal due to slippage caused by poor fitting, lubrication, overheating, overloads or handling damage.

Replace bearings, clean related parts and check for proper fit and lubrication.

Replace shaft if damaged.

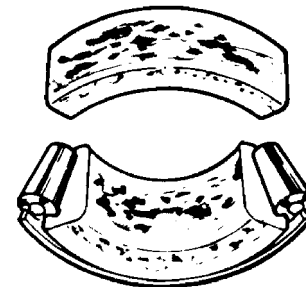


Figure 15

HASA580S

TYPE 8 PHOSPHATE COATED HARDWARE

This chart provides tightening torque for general purpose applications using original equipment standard hardware as listed in the Parts Manual for the machine involved. **DO NOT SUBSTITUTE.** In most cases, original equipment standard hardware is defined as Type 8, coarse thread bolts and nuts and thru hardened flat washers (Rockwell "C" 38 - 45), all phosphate coated and assembled without supplemental lubrication (as received) condition.

The torques shown below also apply to the following:

1. Phosphate coated bolts used in tapped holes in steel or gray iron.
2. Phosphate coated bolts used with phosphate coated prevailing torque nuts (nuts with distorted threads or plastic inserts).
3. Phosphate coated bolts used with copper plated weld nuts.

Markings on bolt heads or nuts indicate material grade ONLY and are NOT to be used to determine required torque.

Nominal Thread Diameter	Standard Torque ±10%	
	Kilogram Meter (kg·m)	Foot Pounds (ft lb)
1/4"	1.1	8
5/16"	2.2	16
3/8"	3.9	28
7/16"	6.2	45
1/2"	9.7	70
9/16"	13.8	100
5/8"	19.4	140
3/4"	33.2	240
7/8"	53.9	390
1"	80.2	580
1 - 1/8"	113.4	820
1 - 1/4"	160.4	1160
1 - 3/8"	210.2	1520
1 - 1/2"	279.4	2020
1 - 3/4"	347.1	2510
2	522.8	3780

MEMO

Counterweight

Edition 1

19. Tag and disconnect wires leading to fuel sender (1, Figure 11) on side of fuel tank (2).

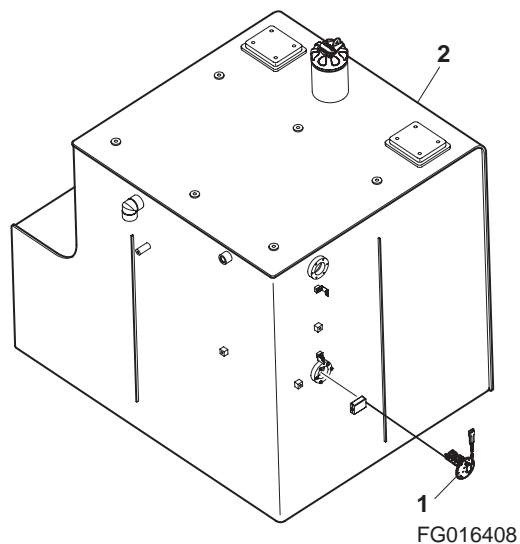


Figure 11

20. Install two 12 mm eyebolts in threaded holes (1 and 2, Figure 12). Using a suitable lifting device, sling eyebolts.
21. Remove six bolts and spacers (4, Figure 12) holding tank (3) to frame. Lift tank 25 mm (1") and make sure it is balanced. Make sure that there are no other electrical wires or hoses connected to tank. Completely remove tank after inspection.

NOTE: *The clear level gauge on the side of the tank is easily damaged. Be careful of obstacles and wind gusts.*

22. Remove shims (5, Figure 12).

NOTE: *If tank is to be reused note position and amount of shims used for each mounting bolt location.*

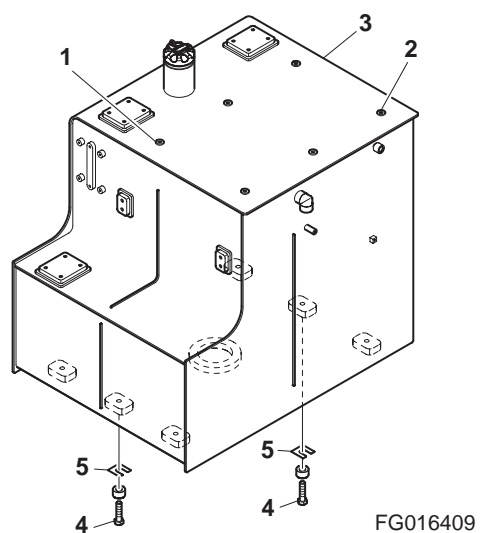
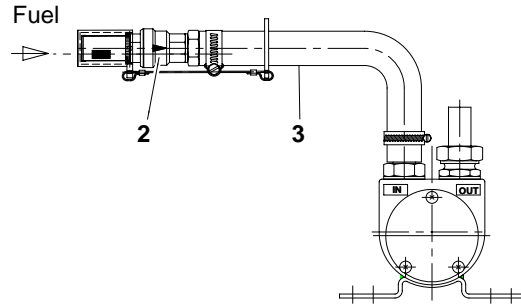
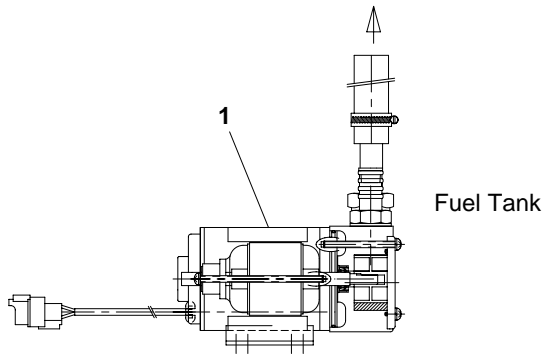


Figure 12

GENERAL DESCRIPTION

Theory of Operation



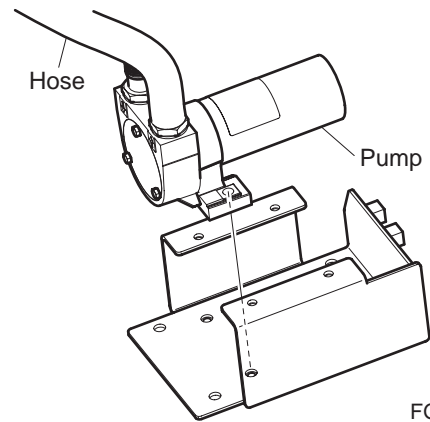
FG016185

Figure 1

Reference Number	Description
1	Body
2	Check Valve

Reference Number	Description
3	Inlet Hose

The fuel pump consists of a motor, pump, switch, and hose assembly.



FG016399

Figure 2

Swing Reduction Gear

Edition 1

REMOVAL

1. Park on firm and level ground.
2. Lower front attachment (bucket) to ground.
3. Shut down engine.
4. Set safety lever on "RELEASED" position.
5. Turn starter switch to "I" (ON) position.



WARNING

If engine must be running while performing maintenance, always use extreme caution. Always have one person in cab at all times. Never leave cab with engine running.

6. Fully stroke work levers (joysticks) in all directions to relieve any pressure from accumulators.
7. Set safety lever on "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Hang a maintenance warning tag on controls.
10. Disconnect negative (-) battery cable leading to frame from battery.
11. Tag and disconnect hoses from swing motor (1, Figure 3). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.
12. Disconnect tube (2) from drain cock (3) and hose fitting (7) from fill hole.
13. Remove twelve bolts and washers (4, Figure 3) holding swing reduction gearbox (5) to frame.
14. Using a suitable lifting device, sling swing motor (1, Figure 3) and remove swing motor and reduction gearbox (5) as an assembly from unit.

NOTE: A drain cock (3, Figure 3) and tube are on side of gearbox. Be careful not to damage valve or tube.

NOTE: There are two alignment pins (6, Figure 3), one on each side of reduction gearbox flange.

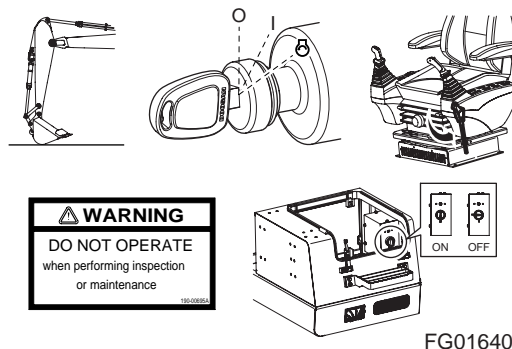


Figure 2

FG016400

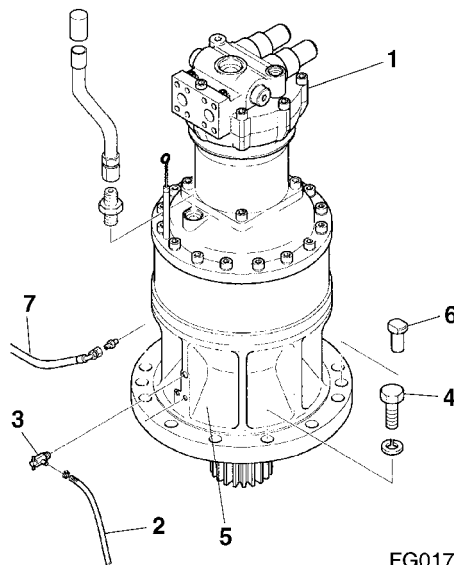


Figure 3

FG017136



Figure 31

Assembly of the Carrier Subassembly 2

1. Put the carrier No.2 on the assembly die as shown in the figure below.



Figure 32

2. Insert the bush No.2 in the planetary gear No.2 and put the thrust washer No.2 on it.



Figure 33



Figure 71



Figure 72

3. Put out the inner part of the prepared bearing (23024CD) and assemble them again that its trade mark is visible, insert it in the shaft as shown in the figure below, put the bearing press fitting jig on it, and use a press to insert it.



Figure 73

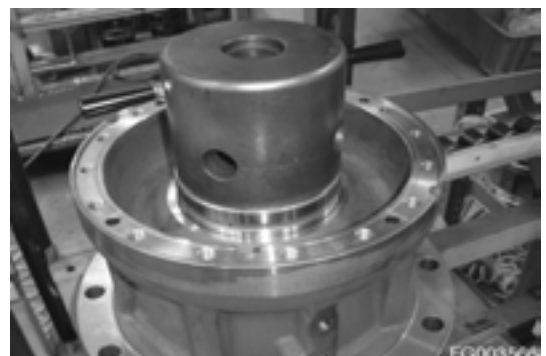


Figure 74



Figure 108

Assembly of the Motor

Supply of Gear Oil

Upon the completion of the noise test, remove the test motor and pour gear oil of 2.5 ℓ more.

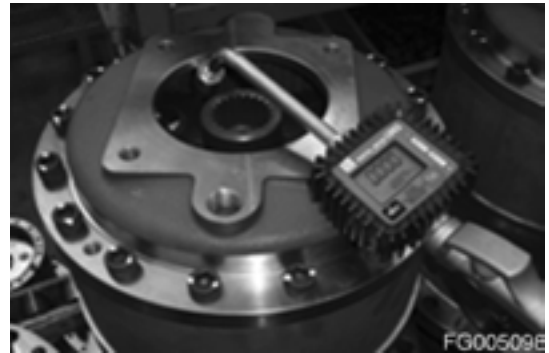


Figure 109

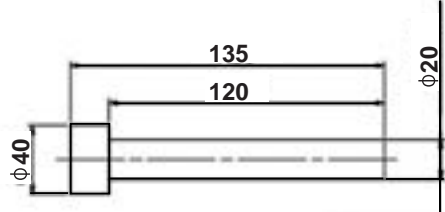
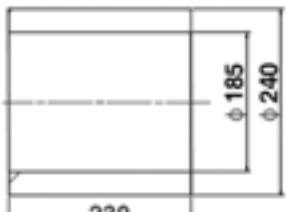
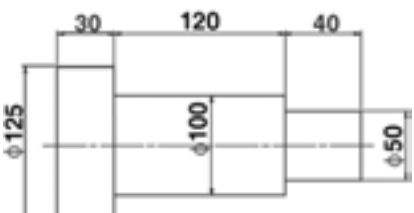
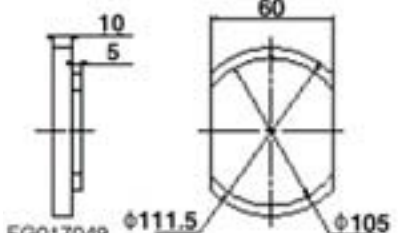
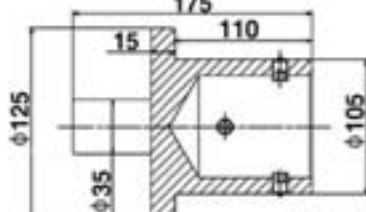


Figure 110

MEMO

Lower Roller Disassembly

Lower Roller Disassembly or Reassembly Tool

	Tool	Remarker
a	Press	50 ton
b	Hammer	-
c	Pin Disassembly Jig	 <p>FG017046</p>
d	Lower Roller Support Jig	 <p>FG017047</p>
e	Shaft Extract Jig	 <p>FG017048</p>
f	Bushing Disassembly Jig	 <p>FG017049</p>
g	Bushing Reassembly Jig	 <p>FG017050</p>

5. Install idler (2, Figure 24) on the axle.
6. Install bearing (3, Figure 24) and pin (6) to the axle.

NOTE: *Fill the idler assembly with new engine oil or SAE 40 oil with approximately 535 cc. (18.1 oz)*

7. Install plug (9, Figure 24) on the idler.

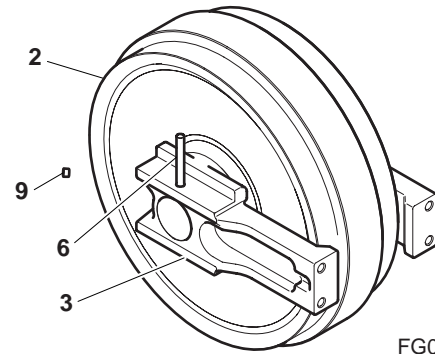
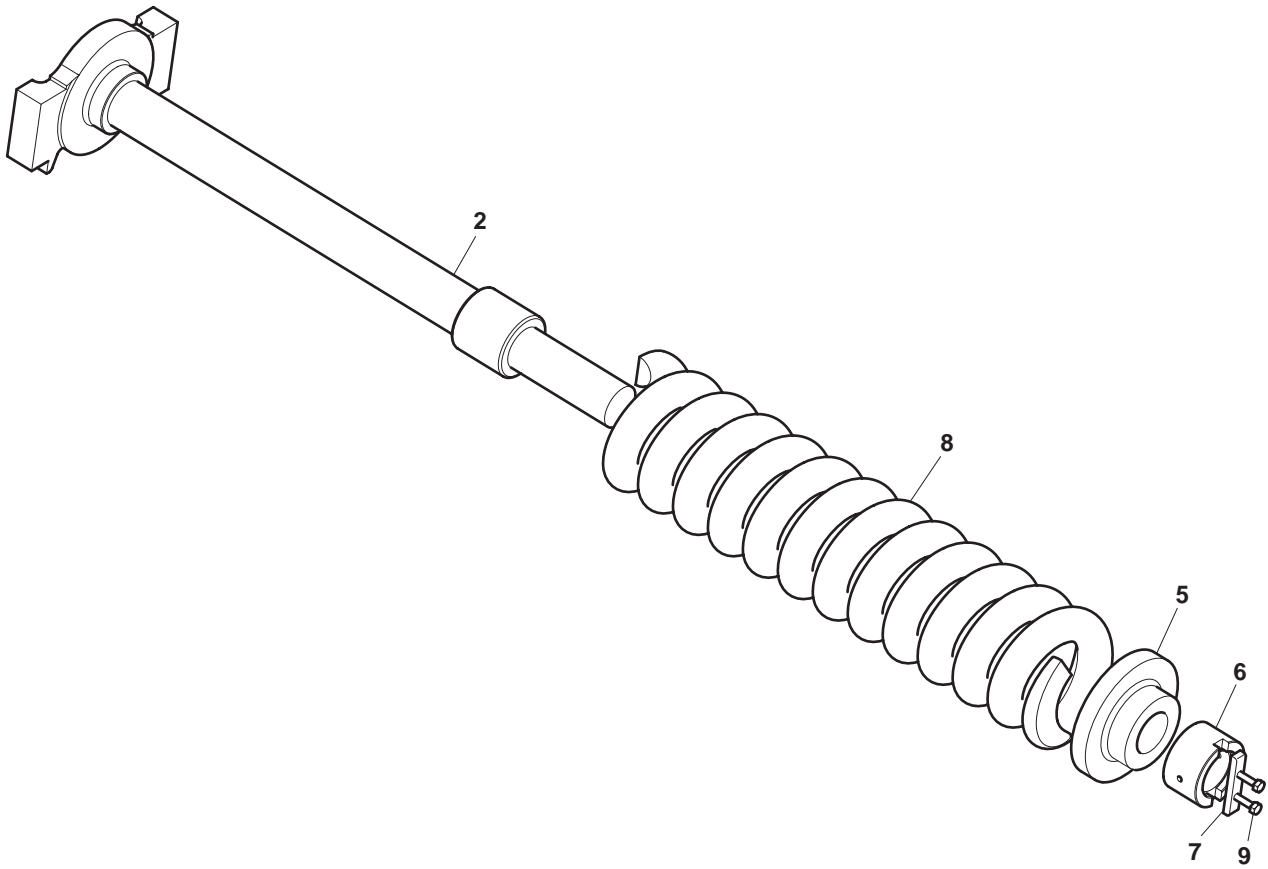


Figure 24

FG016582

Track Spring Disassembly Diagram



FG016728

Figure 48

Reference Number	Description
2	Piston Rod
5	Bracket
6	Ring

Reference Number	Description
7	Plate
8	Spring
9	Bolt

Application procedure

1. Wipe the contact surfaces clean of all water, oil or grease. The contact surfaces should be dry.
2. Apply a regular bead width of liquid gasket to one of the contact surfaces. Make sure that the bead does not break at this point.

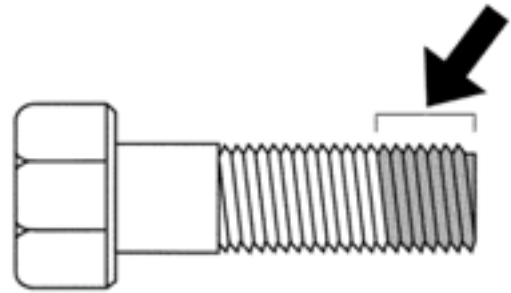
NOTE: *If there are special regulations concerning the application procedure in the repair document, please follow those regulations.*

Work procedure

1. Wipe the joint surfaces of the bolt, bolt hole, and threads clean of water, grease, and oil. The contact surfaces should be dry.
2. Apply Loctite to the top 1/3 of the screw.
3. Tighten the bolt to the specified torque.

IMPORTANT

After tightening the bolt, do not apply excessive torque or try to rotate the bolt until at least one hour has passed, and the Loctite has hardened.



FG017149

Figure 7

Flare nut

	Pipe Diameter	Tightening Torque (For Medium and Large Size Vehicles)	Width Across Flats of Flare Nut (mm)	
			Old	New
Flare nut tightening torque (service standard value) N•m (kg•m)	ø4.76 mm	12.8 - 18.6 (1.3 - 1.9)	14	14
	ø6.35 mm	23.5 - 49 (2.4 - 5.0)	17	17
	ø8.0 mm	23.5 - 49 (2.4 - 5.0)	19	17
	ø10.0 mm	44.1 - 93.2 (4.5 - 9.5)	22	19
	ø12.0 mm	58.8 - 137.3 (6.0 - 14.0)	27	24
	ø15.0 mm	78.5 - 156.9 (8.0 - 16.0)	30	30

Taper screw from connectors (brass)

Screw size	N•m (kg•m)			
	PT (R) 1/8	PT (R) 1/4	PT (R) 3/8	PT (R) 1/2
-	2.0 - 14.7 (0.2 - 1.5)	4.9 - 15.7 (0.5 - 1.6)	9.8 - 16.7 (1.0 - 1.7)	9.8 - 17.7 (1.0 - 1.8)

Special Tool Classification

A: Essential tool

Servicing operation cannot be done with any other tools than the essential tool.

B: Recommend tool

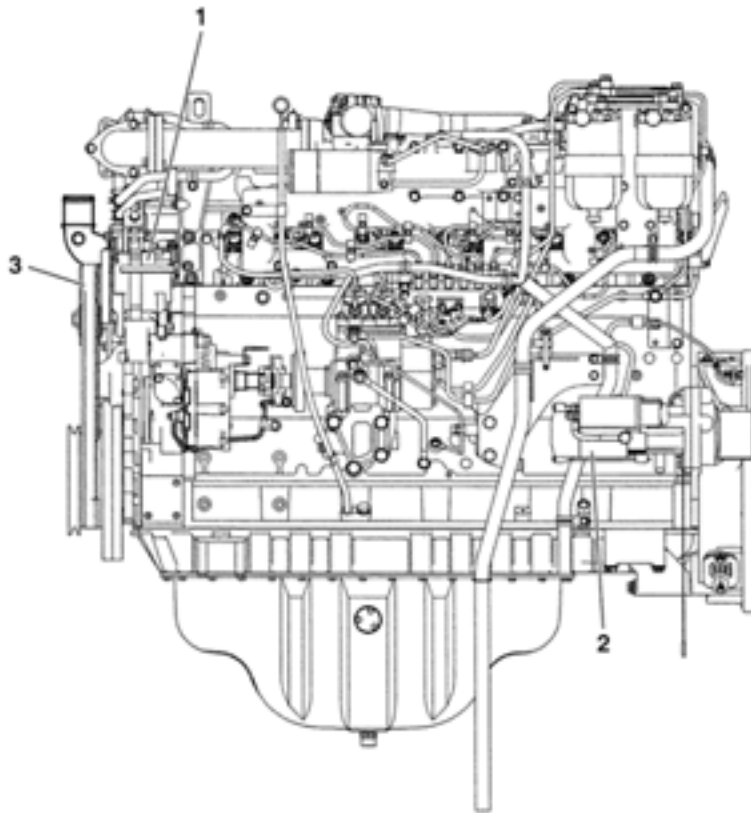
Servicing work can be done with a general-purpose tool commercially available. However, it is advisable to use the recommended tool as much as possible for a reduced work time and an improved safety in work operations.

C: Available tool

Although it takes a more working time, servicing operations can be made with a tool commercially available as substitute for the available tool.

Engine Accessories

Components



FG017170

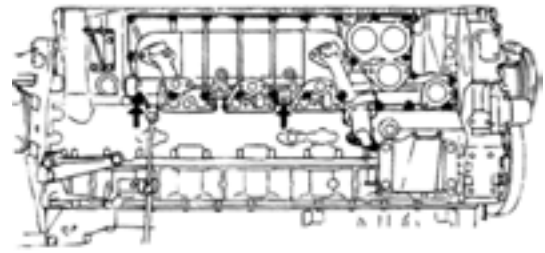
Figure 26

Reference Number	Description
1	Generator
2	Starter Motor

Reference Number	Description
3	Belt (Generator)

15. Remove the oil cooler.

- Remove the oil cooler tightening bolt, insert and tighten the removed bolts into the replacer holes (two places) and remove the oil cooler.



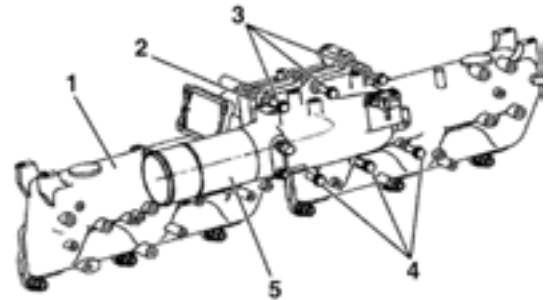
FG017191

Figure 51

16. Remove the level gauge and guide tube.

17. Remove the intake pipe.

Reference Number	Description
1	Inlet Manifold
2	Gasket
3	Bolt
4	Bolt
5	Intake Pipe

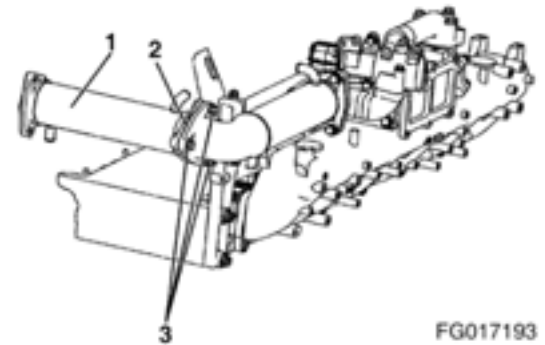


FG017192

Figure 52

18. Remove the primary EGR cooler.

Reference Number	Description
1	Primary EGR Cooler
2	Gasket
3	Bolt



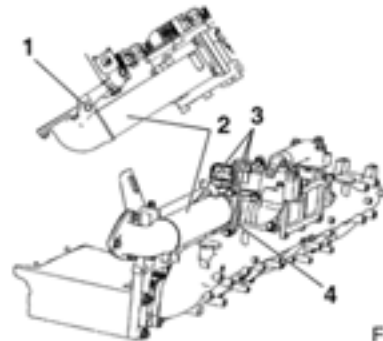
FG017193

Figure 53

19. Remove the secondary EGR cooler.

- Remove the primary side (entrance side) fixing bolts.

Reference Number	Description
1	Bolt
2	Secondary EGR Cooler
3	Bolt
4	Gasket



FG017194

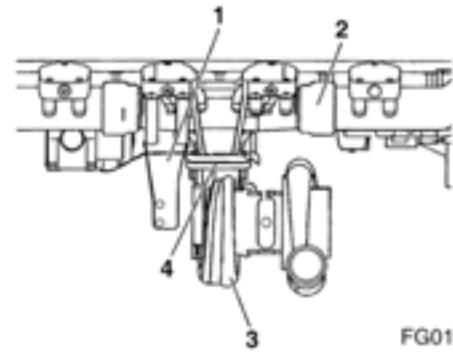
Figure 54

8. Clip the gasket and install the turbocharger to the exhaust manifold. Pour a suitable quantity of engine oil into the opening of the turbocharger and turn the turbine shaft slightly, and then lubricate the shaft bearing.

- Tighten the turbocharger with a double nut.

Tightening torque: 40 N•m (4.1 kg•m/30 lb•ft)

Reference Number	Description
1	Exhaust Bracket
2	Exhaust Manifold
3	Turbocharger
4	Gasket



FG017185

Figure 85

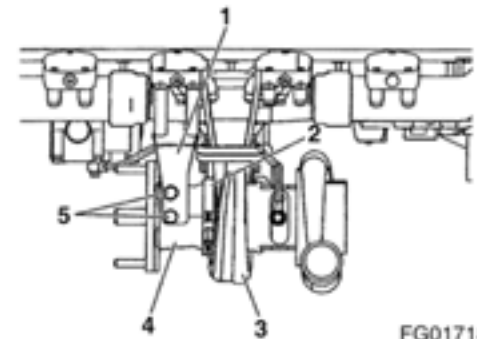
9. Connect the exhaust pipe.

- Tighten the exhaust pipe to the turbocharger with clamps, and fix to the bracket with bolts.

Tightening torque:

Clamp: 14.7 N•m (1.5 kg•m/11 lb•ft)

Reference Number	Description
1	Exhaust Pipe Bracket
2	Clamp
3	Turbocharger
4	Exhaust Pipe
5	Bolt



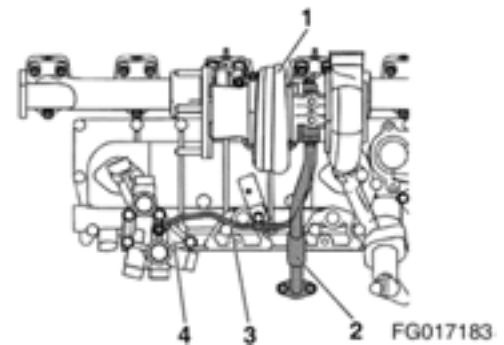
FG017184

Figure 86

10. Connect the oil feed pipe (turbocharger), and fix it with a clip.

Tightening torque: Eyebolt: 34 N•m (3.5 kg•m/25 lb•ft)

Reference Number	Description
1	Turbocharger
2	Oil Return Pipe (Turbocharger)
3	Oil Feed Pipe (Turbocharger)
4	Oil Port



FG017183

Figure 87

40. Install the oil level gauge guide tube.
- Apply a thin coat of oil to O-ring and insert it without damaging the O-ring.

Reference Number	Description
1	Oil Level Gauge
2	Guide Tube
3	Stay
4	Stay

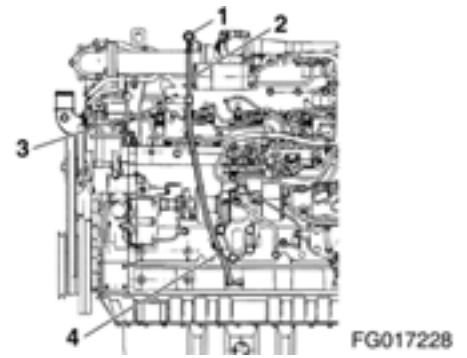


Figure 117

41. Install the engine harness.
- Install the engine harness as shown in diagram (1), then fix it with clips in the position marked when it was disassembled.

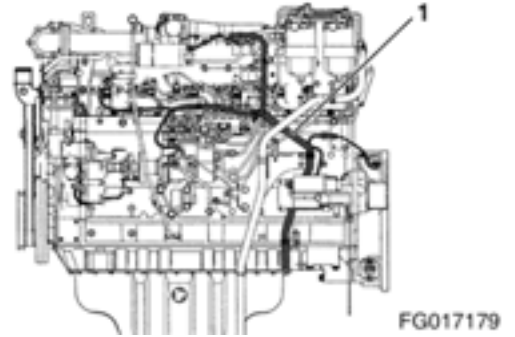


Figure 118

21. Remove the valve seat insert.
- Heat-up the two parts of insides of the insert (up to 600 - 700°C (1,112 - 1,292°F)) with welding gas burner, and leave it to cool down for 3 to 5 minutes then pull out with a screwdriver.

IMPORTANT

Do not cool it forcefully.

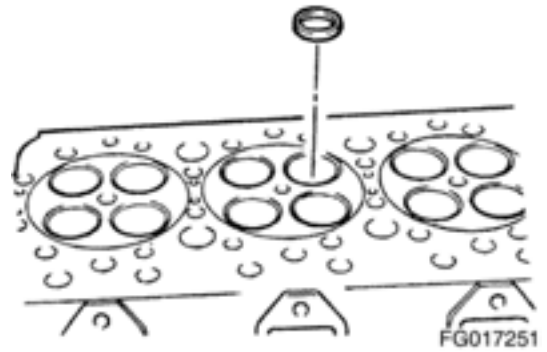


Figure 141

22. Remove the nozzle sleeve.
- Removal of the nozzle sleeve
Strike from the head lower side to extract.
23. Remove the nozzle sleeve O-ring.

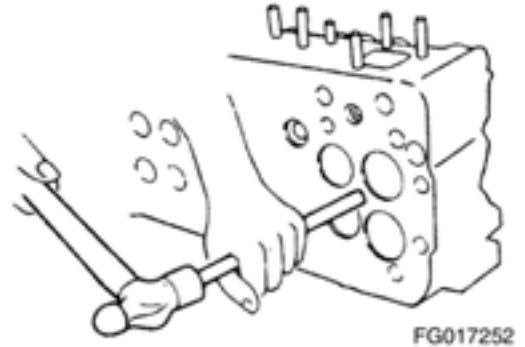


Figure 142

Inspection

Idle gear shaft C

- Measure the outside diameter of the idle gear shaft, and the clearance between the shaft and the bushing.
- Check to see if there is also any damage on the bushing.

	Nominal Dimension mm (in)	Limit of Usage mm (in)
Outside diameter of the shaft	49 (1.9291)	48.85 (1.9232)

	Assembly Standard mm (in)	Limit of Usage mm (in)
Clearance between the shaft and bushing	0.04 - 0.105 (0.0016 - 0.0041)	0.20 (0.0079)

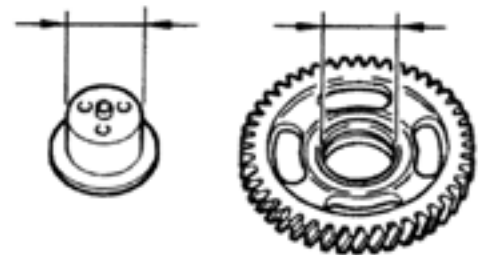


Figure 143

Installation

1. Install the head gasket to the cylinder block.
 - Use new parts when re-assembling.
2. Apply liquid gasket to the cylinder head side.
 - In line with the gear case and cylinder head match surfaces, apply liquid gasket using the edge of the gear case hole as a standard, with a width of approx. 5 mm (0.2 in), height of approx. 3 - 4 mm (0.12 - 0.16 in), and length of approx. 30 mm (1.18 in).

Liquid gasket: TB1207B

- Assemble the parts within 7 minutes of applying the liquid gasket.

Reference Number	Description
1	Liquid Gasket Length
2	Liquid Gasket Width
3	Liquid Gasket Applied Area
4	Oil Hole
5	Liquid Gasket Length
6	Liquid Gasket Width
7	Cylinder Head
8	Gear Case (Head)
9	Head Gasket Rubber Ring Position
10	Edge of the gear case (head) hole as a standard

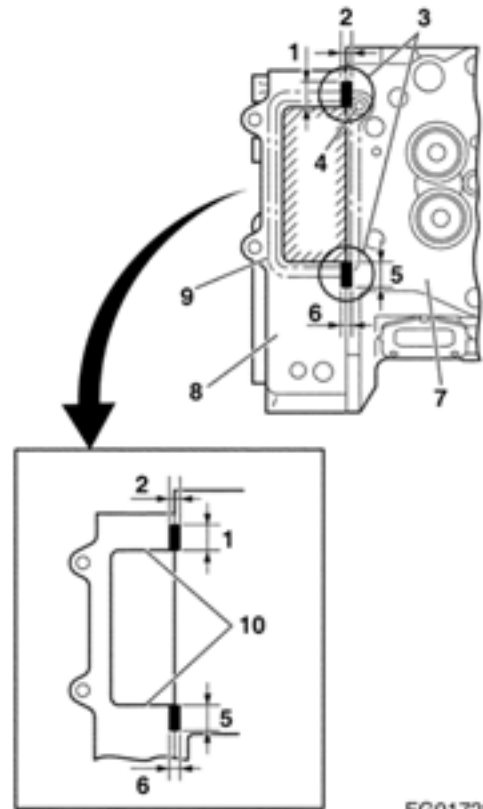


Figure 174

FG017283

Rocker arm shaft

- Check for oil hole of the rocker arm shaft.

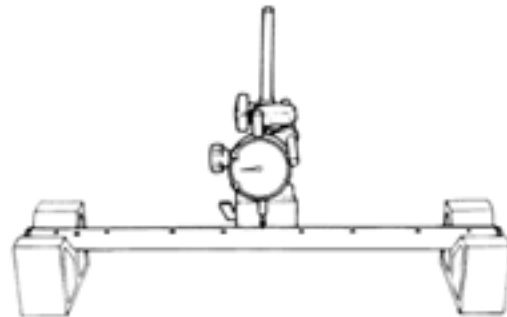


FG017308

Figure 201

- Check for bend of the rocker arm shaft.

	Limit of Usage mm (in)
Shaft bend	0.3 (0.0118)

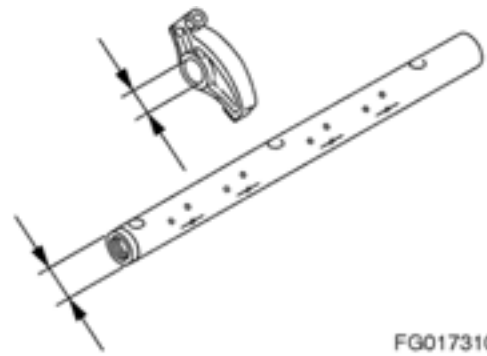


FG017309

Figure 202

- Measure the outside diameter of the rocker arm shaft, and the clearance between the shaft and the rocker arm bushing.

	Nominal Dimension mm (in)	Assembly Standard mm (in)	Limit of Usage mm (in)
Clearance between the shaft and the rocker arm	-	0.02 - 0.074 (0.0008 - 0.0029)	0.20 (0.0078)
Outside diameter of the shaft	ø28 (1.1023)	-	ø27.85 (1.0965)



FG017310

Figure 203

Installation

1. Install the timing gear case.
 - A. Apply approx. 0.3 mm (0.012 in) thickness, approx. 4 mm (0.16 in) width of Loctite No.FMD127 liquid gasket to the installation surface.

Also apply liquid gasket to the cylinder block and crankcase match surfaces.

NOTE: *Make sure that no liquid gasket gets into the bolt holes.*

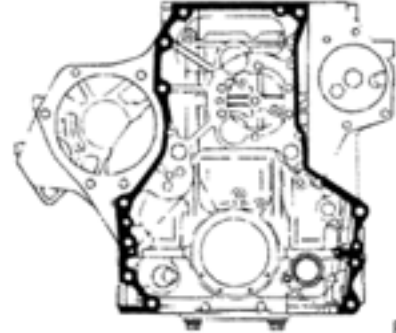
Install soon after applying liquid gasket.

- B. Install the timing gear case.

Tightening torque:

M14: 135 N•m (13.8 kg•m/100 lb•ft)

M10: 43 N•m (4.4 kg•m/32 lb•ft)



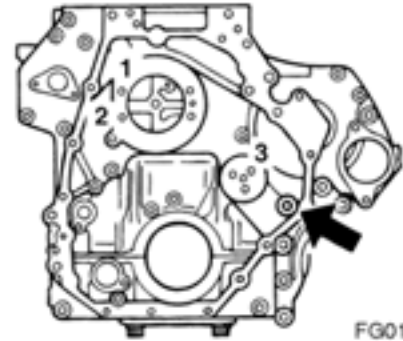
FG017333

Figure 227

IMPORTANT

To reuse the tightening bolts in the arrow section, apply Loctite 271 to the screw section.

After installing the timing gear case, if there will be an interval of more than 30 minutes until the idle gear A and B installation work, temporarily tighten M10 x 1.5 bolts to the specified torque to sections 1 - 3 in the illustration.



FG017334

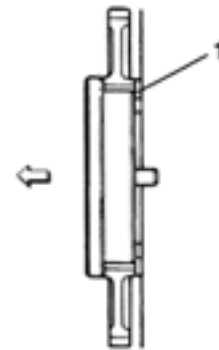
Figure 228

2. Install the cover.
3. Install the idle gear B.

Apply engine oil to idle gear B bore and thrust sections, check the front/back markings that you made when disassembling the idle gear B and thrust plate, and install them.

NOTE: *If you have temporarily installed the bolts, do not forget to remove them.*

Tightening torque: 46 N•m (4.7 kg•m/34 lb•ft)

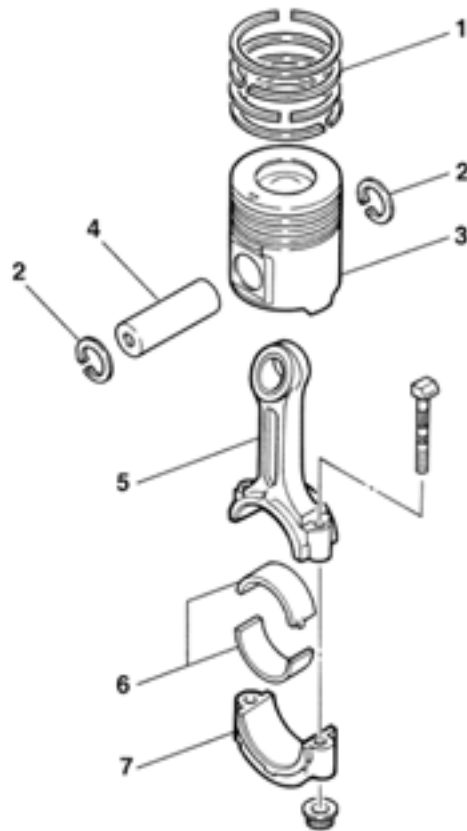


FG017335

Figure 229

Piston, Connecting Rod

Components



FG017356

Figure 254

Reference Number	Description
1	Piston Ring
2	Snap Ring
3	Piston
4	Piston Pin

Reference Number	Description
5	Connecting Rod
6	Bearing
7	Connecting Rod Cap

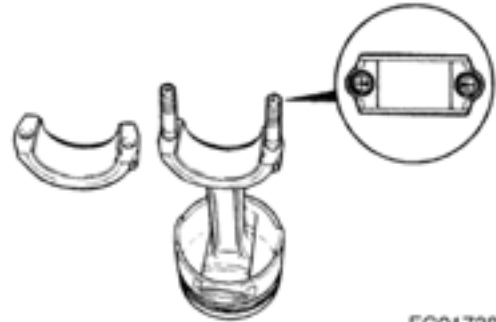
3. Install the connecting rod cap and bearing.
 - Install the bolts so that the arrows on the connecting rod bolt tip are in the direction shown in the illustration.
 - Match the cylinder numbers on the connecting rod and cap. Apply molybdenum disulfide to the thread and seating side of the bolt, and tighten them alternately. At this time, check that the connecting rod cylinder number and cap cylinder number are facing to the right of the cylinder block.

Tightening torque:

98 N•m (10.0 kg•m/72 lb•ft) -> 30° -> 30°

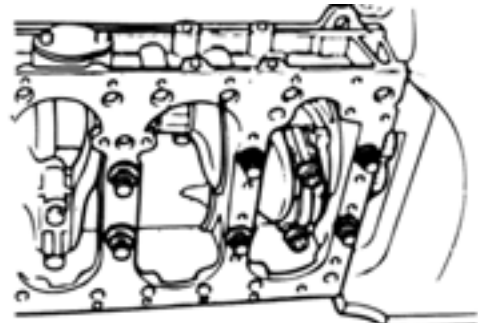
- Rotate the crankshaft and check to see it rotates smoothly without getting stuck. Check it is not interfering with oil jet.

NOTE: *Stopper the liner so that it does not get extracted.*



FG017381

Figure 285

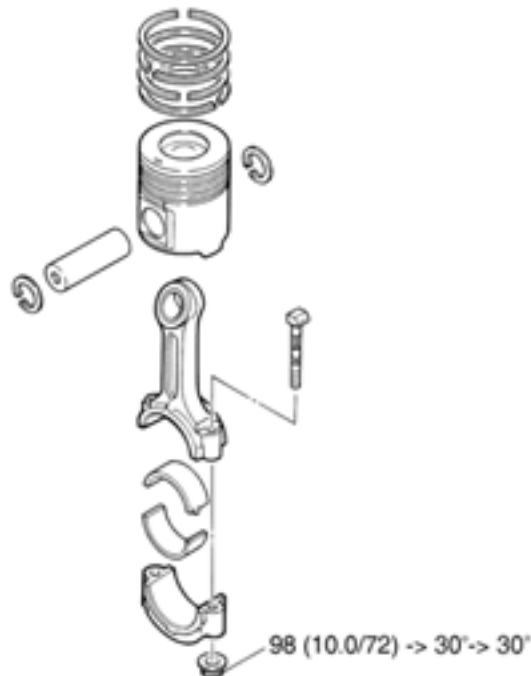


FG017386

Figure 286

Torque Specifications

N•m (kg•m/lb•ft)



FG017387

Figure 287

Cylinder block

- Inspection for corrosion and clogging of coolant and in the oil passage
Check for any clogging carefully on coolant passage between each cylinder.
- Check the cylinder block for cracks or damage.
Perform magnetic flux method or red check inspection as required.
- Inspection for water leakage from the water jacket
Apply water pressure of 490 kPa (71 psi) with a hydraulic test machine for three minutes, and check for any leakage from each cylinder block part.

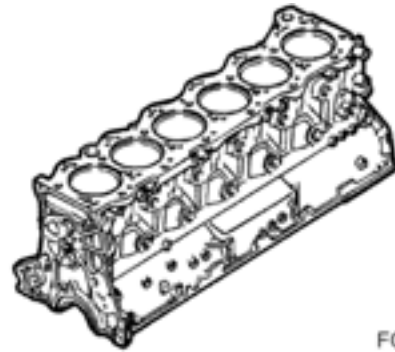


Figure 314

FG017412

Reassembly

1. Assemble the cylinder block.

Grade selection of cylinder liner

- Match the cylinder block bore diameter (1) and liner outside diameter grade.
- Using the number written on the right side surface of the cylinder block, select a 1X for 1 or 2, or a 3X for 3 liner and install it.

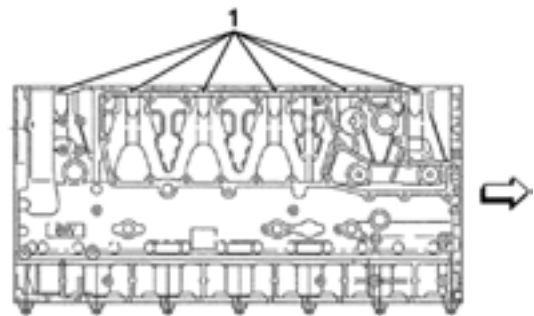


Figure 315

FG017413

IMPORTANT

If the assembly was carried out without grade selection of liner, it can cause insufficient cooling (large clearance), liner insertion difficulties (small clearance) and distortion.

	Block Inscribed Number	Liner Grade
Cylinder block and liner combination	1, 2	1X
	3	3X

	Assembly Specification mm (in)
Clearance between the cylinder block and liner	0.001 - 0.030 (0.0004 - 0.00118)

Installation

1. Install the seal ring.
 - Turn the lip of seal ring as shown in the illustration, and use a installer to install it.
2. Install the thermostat.
 - Install the thermostat as shown in the illustration, taking care not to damage the seal ring.
3. Install the O-ring.
4. Install the gasket.
5. Install the thermostat housing.
 - Tighten the water pump side bolts while holding the thermostat housing against the oil cooler side, then tighten the oil cooler side bolts.

Thermostat seal ring installer: 1-8522-1034-0

Tightening torque: 39 N•m (4.0 kg•m/29 lb•ft)

Reference Number	Description
1	Seal Ring
2	Thermostat
3	Gasket
4	Bolt (Portion C)
5	Thermostat Housing
6	O-ring

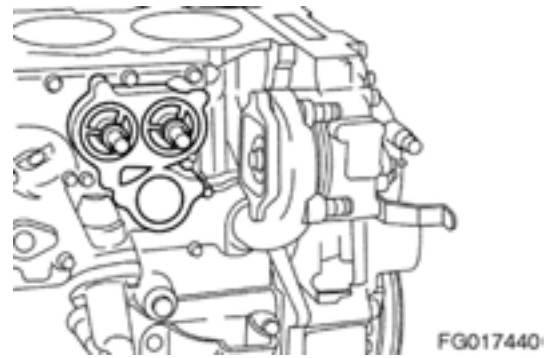


Figure 330

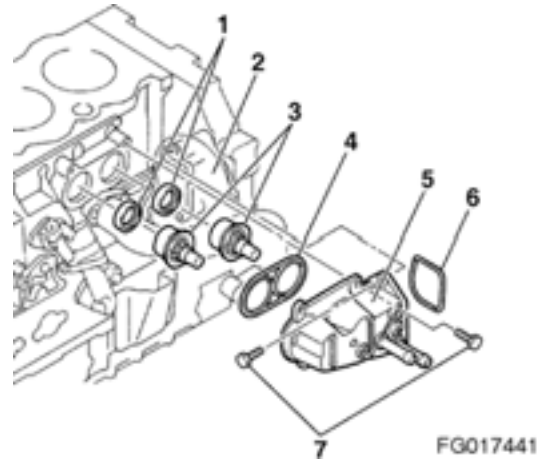
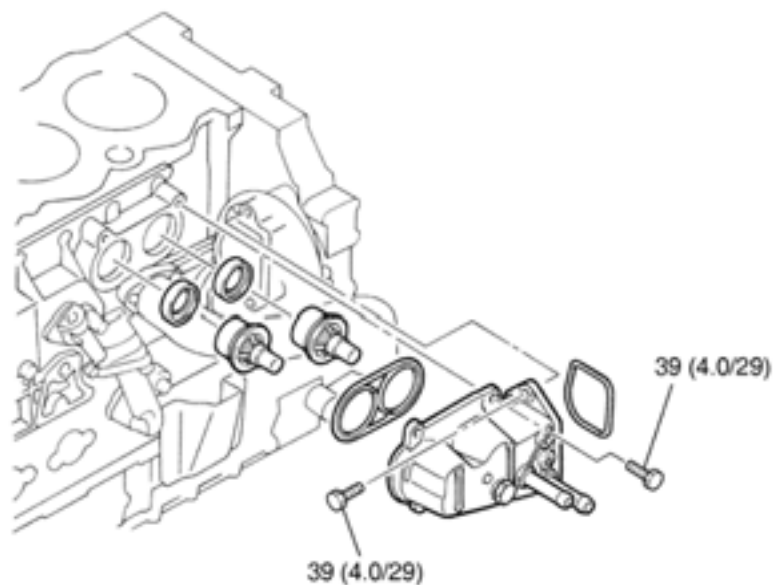


Figure 331

Torque Specifications

N•m (kg•m/lb•ft)



FG017442

Figure 332

Function Check

Fuel filter water drain

1. Loosen the air bleed plug (2) on the fuel filter.
2. Loosen the drain plug (4) on the fuel filter and drain the water.
3. Loosen the drain plug (4).
4. Let the air bleed from the fuel.

Reference Number	Description
1	Priming Pump (Fuel Filter)
2	Air Bleed Plug
3	Fuel Filter
4	Drain Plug
5	Priming Pump (Supply Pump)
6	Supply Pump

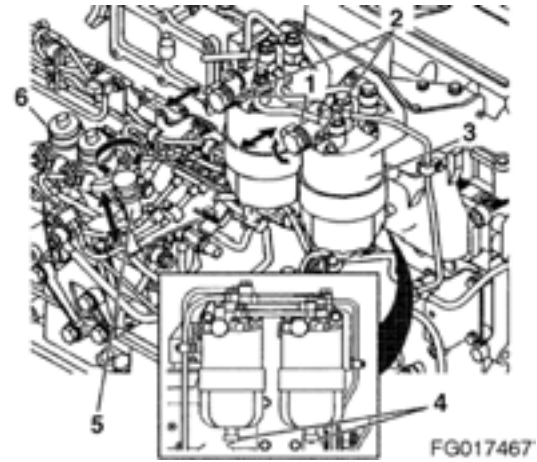


Figure 353

Bleed air from fuel system

1. Turn the key switch to ON, and activate the electromagnetic pump. (on the machine with electromagnetic pump)
2. Loosen the air bleed plug (2) on the fuel filter.
3. Operate the priming pump on the supply pump to bleed air from the fuel filter and fix the priming pump.
 - Move the priming pump of fuel filter to bleed the remaining air.
 - Loosen the air bleed plug (2).

IMPORTANT

Adequate care should be taken as over-tightening the air bleed plug could lead to damage.

NOTE: *Bleed the air from the fuel filter one by one.*

Reference Number	Description
1	Priming Pump (Fuel Filter)
2	Air Bleed Plug
3	Fuel Filter
4	Drain Plug
5	Priming Pump (Supply Pump)
6	Supply Pump

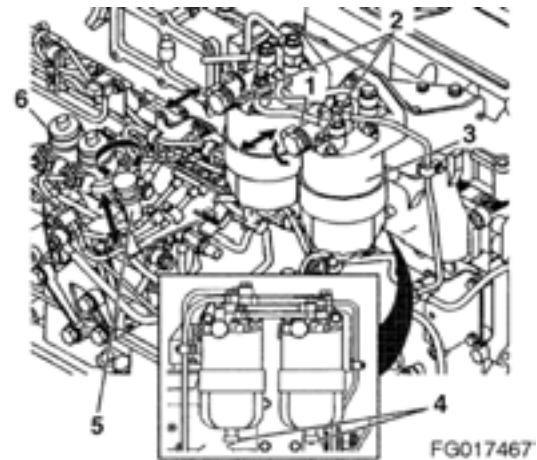


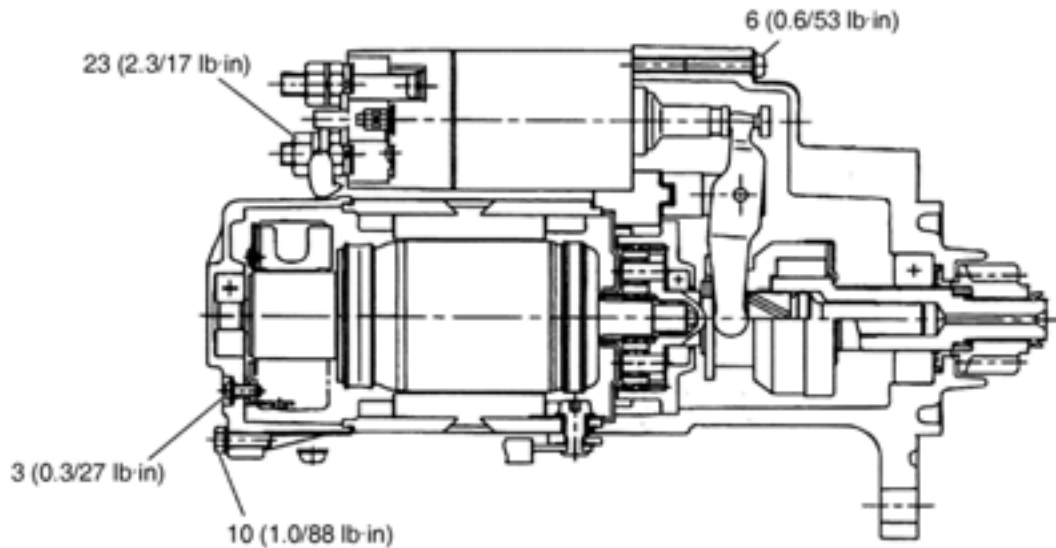
Figure 354

Maintenance Standard

Item			Standard Values and Limitation Values
No load characteristic	Voltage	V	23.5
	Current	A	125 or less
	Speed	r/min	3,000 or more
Commutator	Outside diameter	mm (in)	38.7 (1.52)
	Limit	mm (in)	38.1 (1.50)
Commutator	Undercut	mm (in)	0.8 (0.03)
	Limit	mm (in)	0.2 (0.008)
Brush	Length	mm (in)	23 (0.91)
	Limit	mm (in)	12 (0.47)
Brush spring	Pressure	N (kg/lb)	33 - 45 (3.4 - 4.6/7.4 - 10.1)
	Limit	N (kg/lb)	20 (2.0/4.5)
Protruded position of pinion		mm (in)	0.5 - 2.0 (0.02 - 0.08)

Torque Specifications

N•m (kg•m/lb•ft)



FG017502

Figure 390

6. Regulator
 - The regulator cannot be checked with a circuit tester.
After re-assembling the generator, check it to make sure that regulator controls the voltage for generator.

Reassembly

Assembly can be performed in the reverse order of disassembly.

However, be careful with the following.

1. Bearing is filled with grease and is sealed, so there is no need to apply oil or grease.



Keep a bearing with resin band for rotor shaft away from oil. Wipe off oil on bearing box area of rear bracket. Oil may cause creep.

2. Use a high temperature solder (melting point: 230°C (446°F)).
Using a soldering iron (with 180 - 270 watt), soldering must be performed quickly (within five seconds) not to heat the rectifier.
3. Tightening torque for various sections
Refer to page -201, "Torque Specifications".



Be careful not to overtighten them.

4. Assembly of rear bracket to stator ASM and front bracket to rotor ASM
 - The rotor bearing and rear bracket are engaged tightly. Heat the bearing box area of rear bracket to 50 - 60°C (122 - 140°F) prior to assembly.
 - After re-assembling the generator, rotate the pulley to confirm that the rotor rotates smoothly.

Removal

1. Remove the oil pan.
2. Remove the spacer and bracket (oil pan).
3. Remove the gasket.
4. Remove the oil strainer.
5. Remove the O-ring for the oil strainer.
6. Remove the oil strainer bracket.
7. Remove the joint bolt for the oil jet.
8. Remove the oil jet.

Installation

1. Install the oil jet.
 - Align the convex part of the oil jet with the positioning hole of the cylinder block, and tighten six places with the joint bolt to the specified torque to fix it.
Tightening torque: 70 N•m (7.1 kg•m/52 lb•ft)

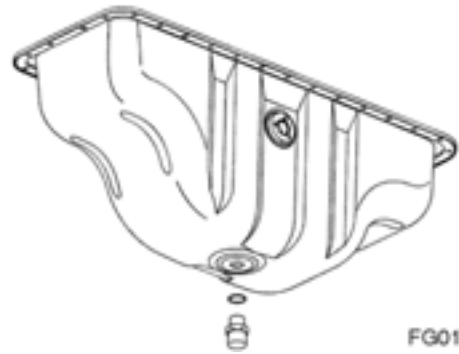


Figure 410

FG017522

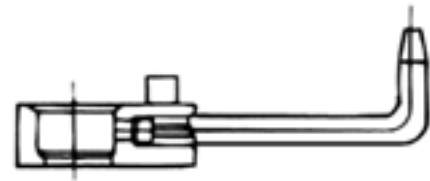


Figure 411

FG017411

IMPORTANT

Be careful when handling the pipe of oil jet as it deforms easily.

2. Install the oil strainer bracket.
3. Install the O-ring to the oil strainer.
4. Install the oil strainer and tighten up according to the order shown in the illustration.
Tightening torque: 49 N•m (5.0 kg•m/36 lb•ft)
5. Install the spacer and gasket to the crankcase.
 - Apply liquid gasket ThreeBond No.TB1207B by approx. 3 - 4 mm (0.12 - 0.16 in) thickness and width to the lower surface of mating portion (1) of the cylinder block, flywheel housing and gear case.

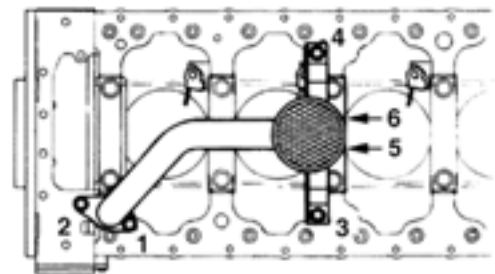


Figure 412

FG017523

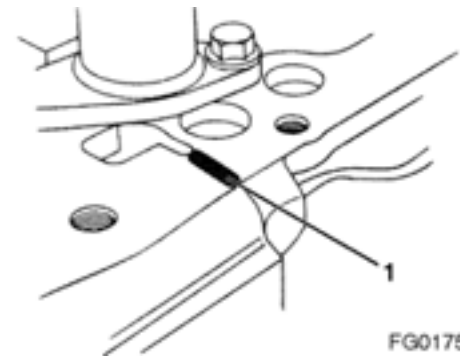


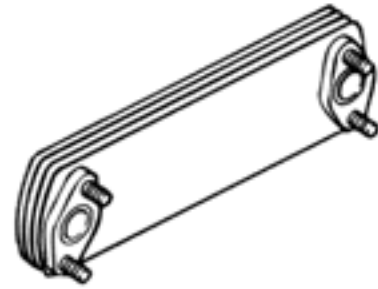
Figure 413

FG017524

Inspection

Oil cooler element

- Check the oil cooler element for cracks.
- Carry out an inspection by red check if required.

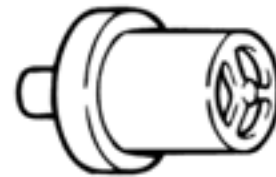


FG017545

Figure 435

Oil thermo valve

- Inspection of the oil thermo valve for clogging/damage
Check the piston and valve seat surface for wear or damage.
Also, check the spring for damage or weakness.
- Operation check of oil thermo valve
Check whether valve is open at 98°C (208°F).
Oil thermostat opening temperature: 98°C (208°F)



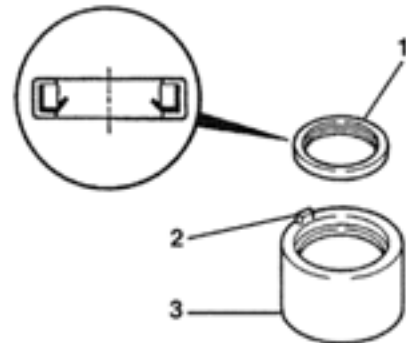
FG017546

Figure 436

Reassembly

1. Set the body case.
2. Be careful with the seal ring direction when installing.

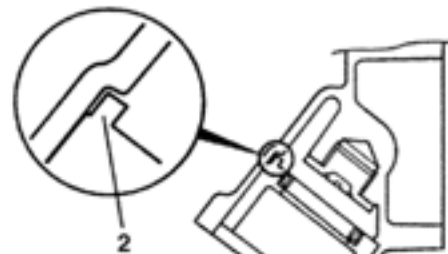
Reference Number	Description
1	Seal Ring
2	Anti-rotation Stopper
3	Oil Thermo Valve Support



FG017547

Figure 437

- Line up the anti-rotation stopper section and install the oil thermo valve.
3. Install the oil thermostat support.
 4. Install the spacer.
 5. Install the oil thermostat.
 6. Install the O-ring to the oil pipe.



FG017548

Figure 438

Bearing

- Measure the outside diameter of the bearing.
If the measurement is the limit or less, replace the bearing.

	Limit of usage mm (in)
Bearing outside diameter	ø20.382 (0.80244)

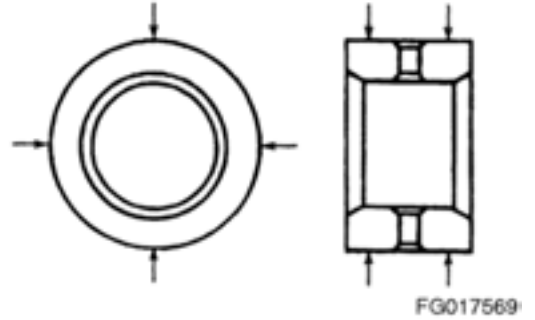


Figure 459

- Measure the inside diameter of the bearing.
If the measurement is the limit or more, replace the bearing.

	Limit of usage mm (in)
Bearing inside diameter	ø12.042 (0.47409)

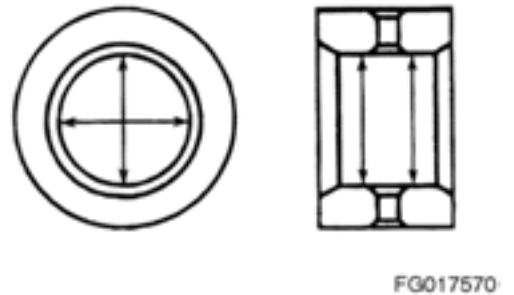


Figure 460

- Measure the length of the bearing.
If the measurement is the limit or less, replace the bearing.

	Limit of usage mm (in)
Bearing length	ø11.94 (0.47008)

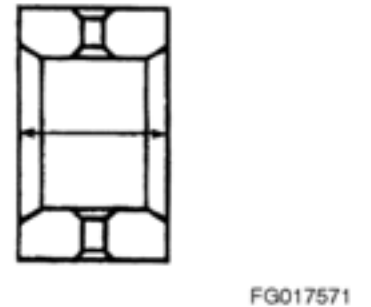


Figure 461

Shaft & turbine wheel

- Measure outside diameter of the shaft & turbine wheel journal section.
If the measurement is the limit or less, replace the shaft & turbine wheel.

	Limit of usage mm (in)
Shaft outside diameter	ø11.996 (0.47228)

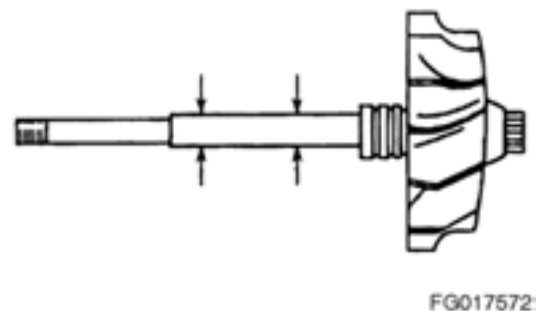


Figure 462

List of Trouble Symptom

Condition	Possible Cause	Correction
The glow indicator lamp does not light up.	Slow-blow fuse blown-out	Replace the slow-blow fuse.
	Blown fuse	Replace the fuse.
	Indicator valve is burnt out	Replace the indicator valve.
Preheating is not performed.	Fuse blown-out	Replace the fuse.
Preheating time is too long or too short.	Thermo-sensor fault or open/short circuit	Replace the thermo-sensor. Repair the circuit.
	Faulty glow plug	Replace or tighten the glow plug.

Specifications

Item	Model
Preheating system	Glow plug/QOS timer
Glow plug rated voltage/current (V - A)	23 - 3.0

Hydraulic System Troubleshooting, Testing and Adjustment

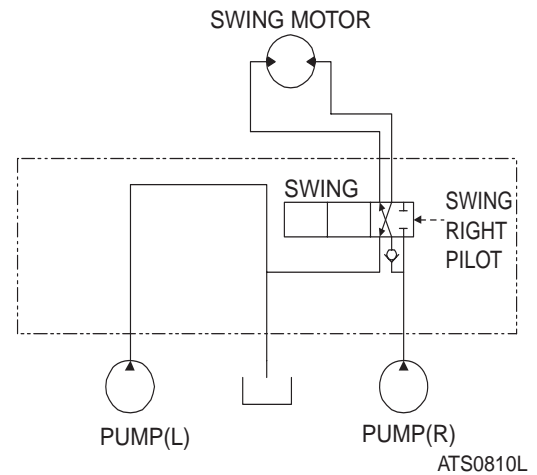
Edition 1

Swing Operating Circuit

The swing operating circuit consists of the right main pump in the pump assembly, the right half of the control valve and the swing motor. To keep the upper works from coasting when the swing control is in neutral, an electrical sensor in the control circuit activates a valve to automatically engage a mechanical brake.

Right Swing Operating Circuit

When the swing control lever is pushed to the right swing position, pilot pressure from the left side pilot valve is directed to the right side pump regulator and right half of the control valve. Output flow from the right pump is then directed through the PR and SWR ports of the control valve to the swing motor.

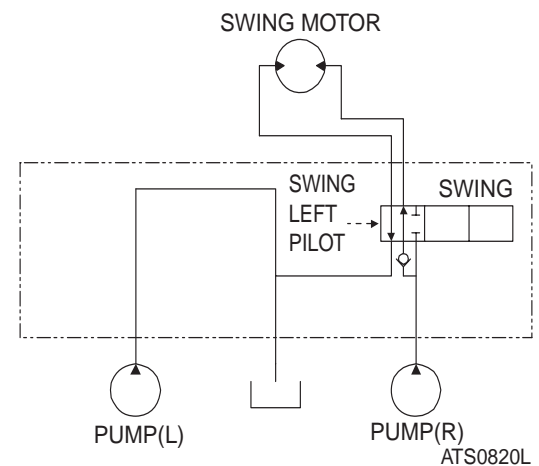


Left Swing Operating Circuit

When the swing control lever is pushed to the left swing position, the control valve spool at the right side of the control valve moves in the opposite direction and output flow from the right pump is directed through the PR and SWL ports of the control valve to the swing motor.

Swing Relief Valve and Makeup Valve

Whenever the spool is shifted to the neutral mode during swing operation, the possibility exists that surge pressure in the circuit - caused by inertial momentum of the upper works and correspondingly reduced pressure at the opposite motor port - could produce cavitation in the circuit. To keep that from happening, a 300 kg/cm² (4,278 psi) relief valve is installed in the swing motor and a large capacity makeup valve is connected to the entrance port of the hydraulic reservoir, helping maintain acceptable pressures on both sides of the circuit.



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the output of the other. It is not necessary to adjust both regulators at the same time, but after checking or adjusting one of them, the remaining unit should also be checked.

Start the engine and turn the engine speed dial to maximum. When normal operating temperature is reached, loosen the largest diameter lock nut around the adjustment screw (2) for the outer regulator spring. Tightening the screw shifts the P/Q (Pressure/Flow) control curve to the right, and increases compensating control pressure.

On the other hand, if the persistent cause of performance problems is engine overloading, decreasing the adjustment by turning the larger diameter adjusting screw (2) out will decrease pump input horsepower. 1/4 turn on the adjusting screw is equal to approximately 17 horsepower.

IMPORTANT

Because changing the position of adjusting screw (2) also affects the setting of the adjustment for the inner spring, the smaller diameter adjusting screw (1), turn in the inner screw 198° (slightly more than 1/2 turn, 180°) before screw (2) is backed out 1/4 turn (90°).

NOTE: For each full turn of adjustment on the larger diameter screw (2), the square-tipped adjusting screw should be turned in the opposite direction 2.2 turns to avoid changing inner spring adjustment.

Pump input power adjustments are normally made in small increments, 1/4 turn (90°) or less, each time.

Turning the square-tipped, smaller diameter screw (1) clockwise moves the flow curve up, increasing flow and then input horsepower.

The adjusting screw (1, Figure 12) affects the delivery rate (Q) of the pump. Tightening the adjusting screw decreases the maximum cut flow (as shown in Figure 15) while backing out the screw increases cut flow delivery rate.

Balance both pumps for equal output.

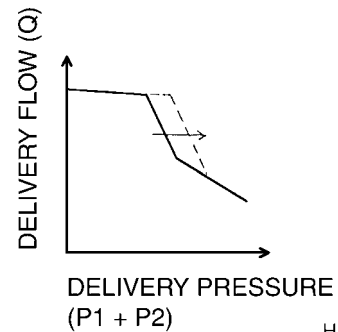


Figure 13

HAAD4090

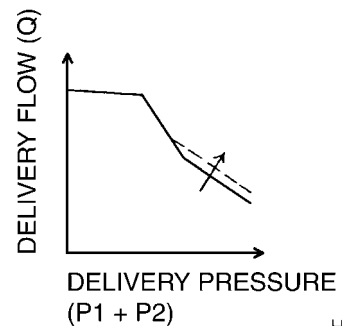


Figure 14

HAAD4100

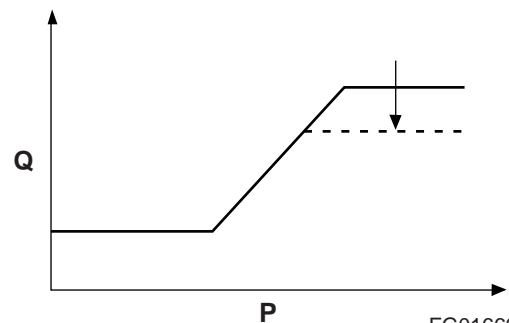


Figure 15

FG016694

TROUBLESHOOTING – TRAVEL CONTROL VALVE

Problem	Possible Cause	Remedy
Secondary pressure does not increase.	Low primary pressure.	Check primary pressure.
	Broken spring.	Replace spring.
	Spool sticking.	Clean, repair or replace.
	Excess spool to casing clearance.	Replace spool casing.
	Worn or loose universal joint (handle) subassembly.	Repair or replace U-joint subassembly.
Secondary pressure too high.	Dirt, other interference between valve parts.	Clean, repair or replace.
	Return line pressure too high.	Redirect return line.
Secondary pressure does not hold steady.	Dirt, other interference between valve parts, or worn spool sticking intermittently.	Clean, repair or replace.
	Interference or binding on spool return spring.	Clean, repair or replace.
	Interference, restriction or unsteady pressure in tank return line.	Repair or reroute tank return line.
	Air bubbles in piping (temporary) or air leak.	Vent air, or repair leak.
NOTE: Look for evidence of leaking oil.		

TROUBLESHOOTING – JOYSTICK CONTROL VALVE

Problem	Possible Cause	Remedy
Secondary pressure does not increase.	Low primary pressure.	Check primary pressure.
	Broken spring.	Replace spring.
	Spool sticking.	Clean, repair or replace.
	Excess spool to casing clearance.	Replace spool casing.
	Worn or loose handle subassembly.	Repair or replace handle subassembly.
Secondary pressure too high.	Dirt, other interference between valve parts.	Clean, repair or replace.
	Return line pressure too high.	Redirect return line.
Secondary pressure does not hold steady.	Dirt, other interference between valve parts, or worn spool sticking intermittently.	Clean, repair or replace.
	Interference or binding on spool return spring.	Clean, repair or replace.
	Unsteady pressure in tank return line.	Redirect return line.
	Air bubbles in piping (temporary) or air leak.	Vent air, or repair leak.
NOTE: Look for evidence of leaking oil to help locate damaged seals or gaskets that could be the cause of air leaks.		

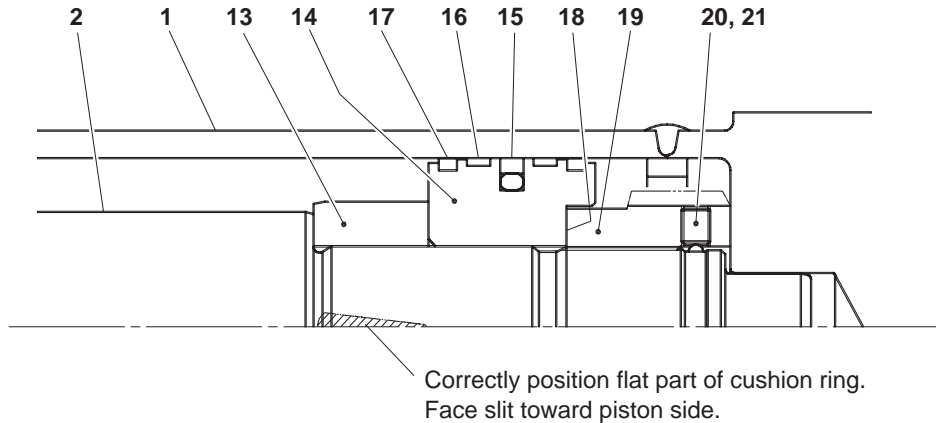
Table of Contents

Center Joint (Swivel)

Safety Precautions	5
Applicable Models	5
General Description	6
Center Joint Disassembly Diagram	7
Disassembly	8
Reassembly	11

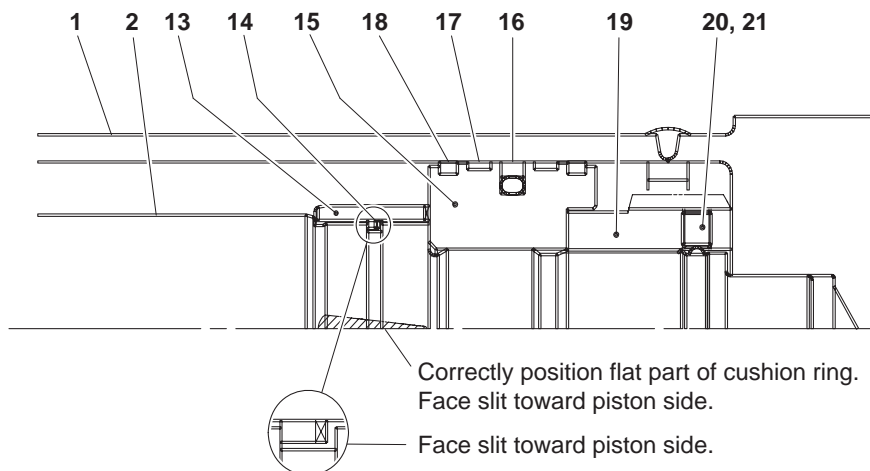
2. Piston assembly

The piston assembly creates cylinder thrust. it prevents flow of pressurized oil from one section of the cylinder tube (1) to the other by installing seal ring (15) in the center of piston (14). Also, the piston assembly has slide-rings (16, 17) on both sides of the seal ring, and it has a slide bearing function for lateral load on the cylinder.



FG016629

Figure 4 Piston Assembly with Tight Type Cushion



FG016630

Figure 5 Piston Assembly with Floating Type Cushion

- Seal ring (15)

Seal ring (15) positions in the center of the piston. It seals a circular gap between piston (14) and cylinder tube (1) with tension of the O-ring. Seal ring (15) separates the inside of cylinder tube (1) into high pressure and low pressure sections with piston (14) as a border.

Problem	Part	Possible Cause	Solution
Oil leakage of the welded part	Pipe cylinder tube	The welded part cracks.	1. replace the pipe or cylinder tube. CAUTION The crack becomes bigger, and the pipe or cylinder tube finally breaks. The crack is considerably dangerous. STOP operating immediately and replace the parts. Even if you weld the cracked part, it never works well.
Oil leakage of cylinder pipe connecting part	Pipe assembly	The bolt for fitting the pipe loosens.	Tighten the bolt to the specified torque.
		The pipe bends.	Replace the pipe assembly.
		The contact surface is scratched.	1. Smooth the surface with an oil stone. 2. If oil does not stop leaking, replace the pipe assembly.
	O-ring	Contamination sticks on the inside and outside diameter. The O-ring is damaged.	1. Remove the contamination. 2. If the O-ring is damaged, replace it. 3. Check the O-ring groove and sealing surface for scratch and rust. If necessary, smooth the surface with an oil stone.
Defective cylinder operation (The cylinder does not move smoothly.)	Piston rod Cylinder tube	The piston rod or cylinder tube bends beyond the standard limit. See "Maintenance Standard" on page -26.	1. Replace the piston rod and cylinder tube. 2. Check the seal and sliding part for damage. if necessary, replace them.
	Cylinder tube	The cylinder tube has a dent.	1. Replace the cylinder tube. 2. Check the seal and sliding part for damage. If necessary, replace them.
	Piston Piston rod	The sliding part is abnormally worn out or damaged.	Check the seals and sliding parts for damage. If necessary, replace them.
	Cylinder tube Cylinder head sliding part	Contamination gets into the sliding parts.	Remove the contamination. check the seals and sliding part for damage. If necessary, replace them
Internal oil leakage (*)	Piston seal	The piston seal is damaged such as scratch and wear.	Replace the piston seal. Check the inside of the cylinder tube.
	Cylinder tube	The cylinder tube has scratch or rust inside it.	1. Remove the scratch and rust, and smooth the surface with a honing or oil stone. When oil does not stop leaking, replace the cylinder tube. 2. Replace the piston seal.

! CAUTION

Pay attention to the following situation when disassembling and assembling the cylinder in a vertical position.

When drawing out the piston rod, the cylinder head may come out of the cylinder tube before the piston rod completely comes out because of packing friction. In this situation, there is a gap between the piston and cylinder head. If this occurs, the cylinder head may slip down and cause injury to persons.

Make sure the cylinder head contacts the piston while working.

! CAUTION

Pay attention to the following situation when disassembling and assembling the cylinder in a horizontal position.

Just after drawing out the piston rod, it may fall and damage the parts.

Always keep the cylinder in a horizontal position with wood spacer blocks under it.

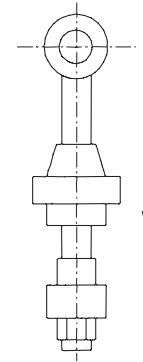


Figure 17

FG016663

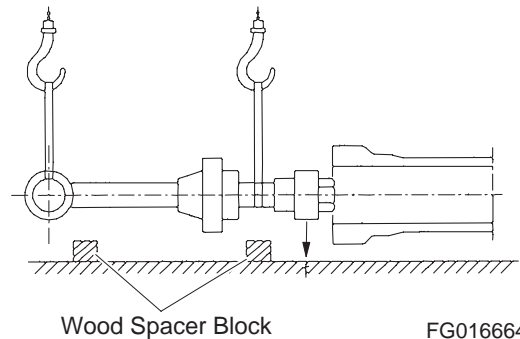


Figure 18

FG016664

5. Clamp the piston rod.

Prevent the piston rod from rotating by squeezing a clevis or putting a pin in a pin hole.

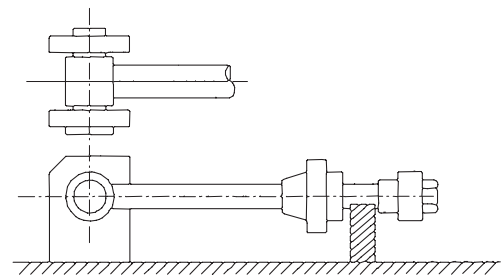


Figure 19 Piston rod support

FG016666

Valve Casing Section

1. Anti-cavitation check valve section some systems using motors of this type have no valves or counter balance functions, and so the motors may be turned beyond their supplied oil flows.

In order to prevent cavitation due to oil shortage, check valves are fitted to suck short oil flows.

2. Relief valve

In acceleration or braking, the relief valve works and the pressure is kept at the set value.

The relief valve provides a small shockless piston, and it works at the start of relief action and keeps the pressure low value for a short time. So smooth acceleration or braking with small shock is possible.

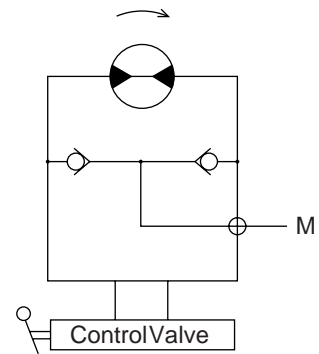


Figure 3

FG016698

MAINTENANCE

Service Limit

1. Hold the piston with shoe by using a vice.
Set a dial gauge to the shoe and move the shoe up and down to measure the clearance of the spherical parts of piston and the shoe.
If the clearance is found to exceed the service limit, replace the piston and the shoe as an assembly.

Nominal Clearance	Service Limit
0 mm	0.3 mm

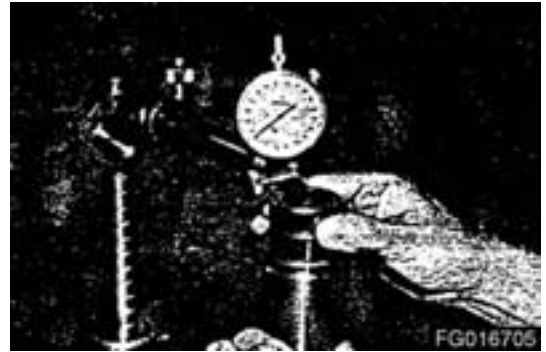


Figure 10

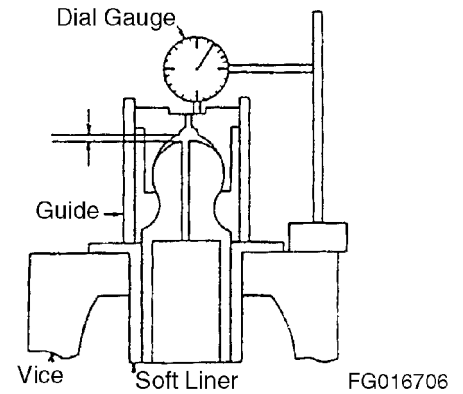


Figure 11

2. Measure the piston diameter with a micrometer in criss-cross directions around top, middle and skirt.



Figure 12

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

Working Principle of Two-Speed Change Mechanism

When running at 1st speed (low speed)

Swash plate has three faces, from "a" to "c", as shown in the Figure 7, and installed in the flange holder with two steel balls in the condition where it can be tilted.

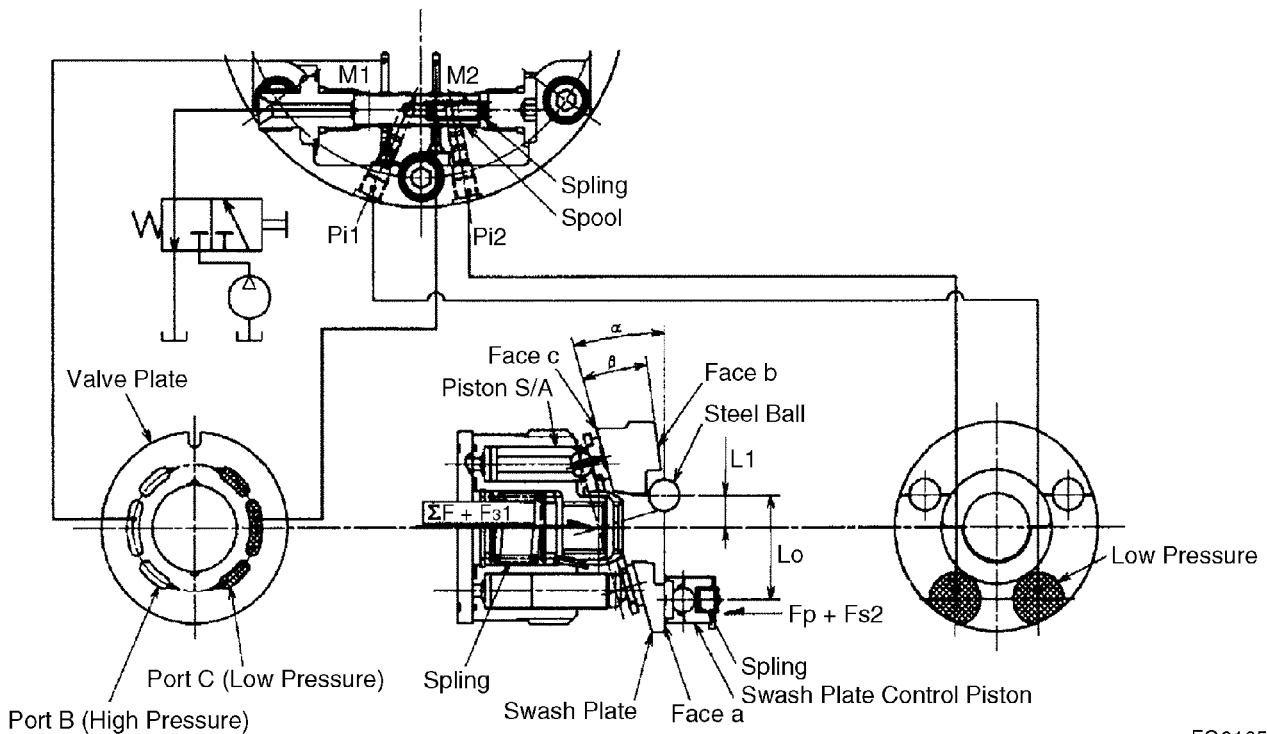
When the control valve is set to the 1st speed position, spool is placed in the position shown in Figure 7 by the force of spring, and the passage of swash plate control piston passes across the Pi1 and Pi2 port positions and led to the tank port. Therefore, the force pushing up the swash plate does not act on swash plate control piston.

$$F_p = (A_p \times P) = 0$$

F_p : Swash plate control piston thrust

A_p : Swash plate control piston pressure receiving area

P : Pressure



FG016510

Figure 7

Counter Balance Valve

Problem	Possible Cause	Remedy
<p>1. Motor does not rotate or motor speed is low.</p>	Pilot port is not pressurized.	Check if piping is not damaged.
	Foreign substances are jammed between plunger and base plate.	Remove foreign articles thoroughly. Repair damaged parts, and reassemble the parts after cleanup. If deep scratches or more than normal wear are found on the parts, the parts should be replaced with new ones.
	Foreign substances are jammed between plunger and base plate.	Remove foreign articles thoroughly. Repair damaged parts, and reassemble the parts after cleanup. If deep scratches or more than normal wear are found on the parts, the parts should be replaced with new ones.
<p>2. Motor does not stop or stops slowly.</p>	Foreign substances are jammed between plunger and base plate.	Remove foreign articles thoroughly. Repair damaged parts, and reassemble the parts after cleanup. If deep scratches or more than normal wear are found on the parts, the parts should be replaced with new ones.
	Spring is not installed in place.	Install spring in proper position.
	Spring is broken.	Replace spring with new one.
	Orifice is clogged.	Remove foreign substances thoroughly, repair damaged parts, then wash the parts before reassembly.

Maintenance Manual

Wash all parts disassembly in treated oil and dry in the compressed air.

Perform maintenance including replacement or corrections in accordance with the following criterion.

Roughly

Parts Name	Appearance	Allowance	Replacement Parts
6. Piston sub assembly	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness: 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Cylinder block kit/perform lapping (#1000). Replace if flaws cannot be completely removed.
	When remarkable flaws or high surface roughness are found on surface of piston.	Roughness: 1.2 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	
	When clearance between piston sub assembly and cylinder block bore is great.	Clearance: 0.060 mm	Cylinder block kit
	When looseness in shoe ball parts is great.	Looseness: 0.4 mm	
4. Cylinder block	When remarkable flaws or high surface roughness are found on the surface with the valve plate.	Roughness: 0.8 a	Cylinder block kit/perform lapping (#1000). Replace if flaws cannot be completely removed.
	When wear inside bore is great.	Roughly: 1.6 a	
	When clearance between piston sub assembly and cylinder block bore is great.	Looseness: 0.4 mm	Cylinder block kit
	When abnormal wear and breakage develop on mating teeth.		
5. Valve plate	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness: 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Cylinder block kit
7. Retainer plate 8. Retainer holder	When remarkable flaws or high surface roughness are found on each sliding surface.	Roughness: 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	7. Retainer plate 8. Retainer holder

19. Place check valve (2-19) and springs (2-20).
Tighten plug (2-21) with O-ring (2-22).

NOTE: Apply slight grease to the O-rings.

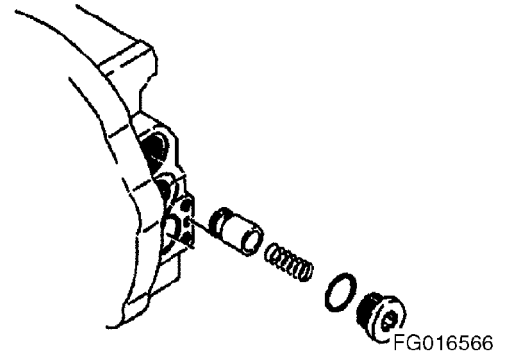


Figure 64

20. Install spool assy (2-2) on base plate (2-1).
Install it while turning to prevent it from sticking.

NOTE: Apply hydraulic oil to spool assy before installation.

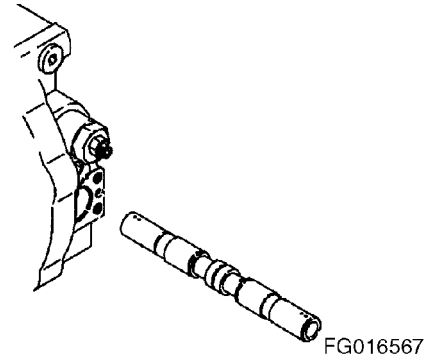


Figure 65

21. Place spring seats (2-3) and springs (2-4).
Install O-rings (2-10) on base plate (2-1).
Install O-rings (2-6-5) on cap assy (2-6).
Place spring seats (2-5) on cap assy (2-6), and then install them on base plate (2-1).
Tighten socket head bolts (2-6-6).
Apply grease to O-rings (2-6-5).

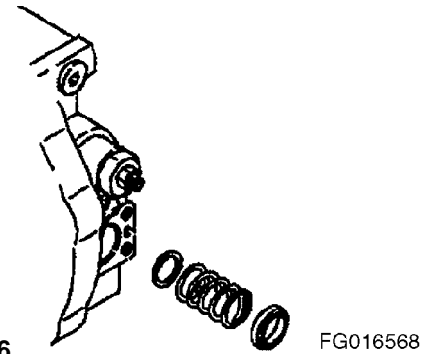


Figure 66

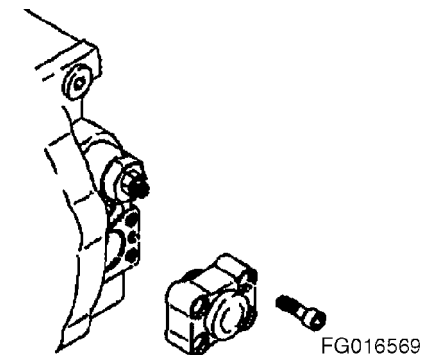


Figure 67

TECHNICAL INFORMATIONS

Product Description

The TRASMITAL BONFIGLIOLI gearboxes of the series described in this manual are designed and built for application as track drive for crawled machines equipped with open loop hydraulic circuit.

The unit includes planetary gearbox, 3 stages, rotating housing type.

An important piece of advice given is "to perfectly" design the main hydraulic system.

The illustrations show the parts and the main functions of the gearbox.

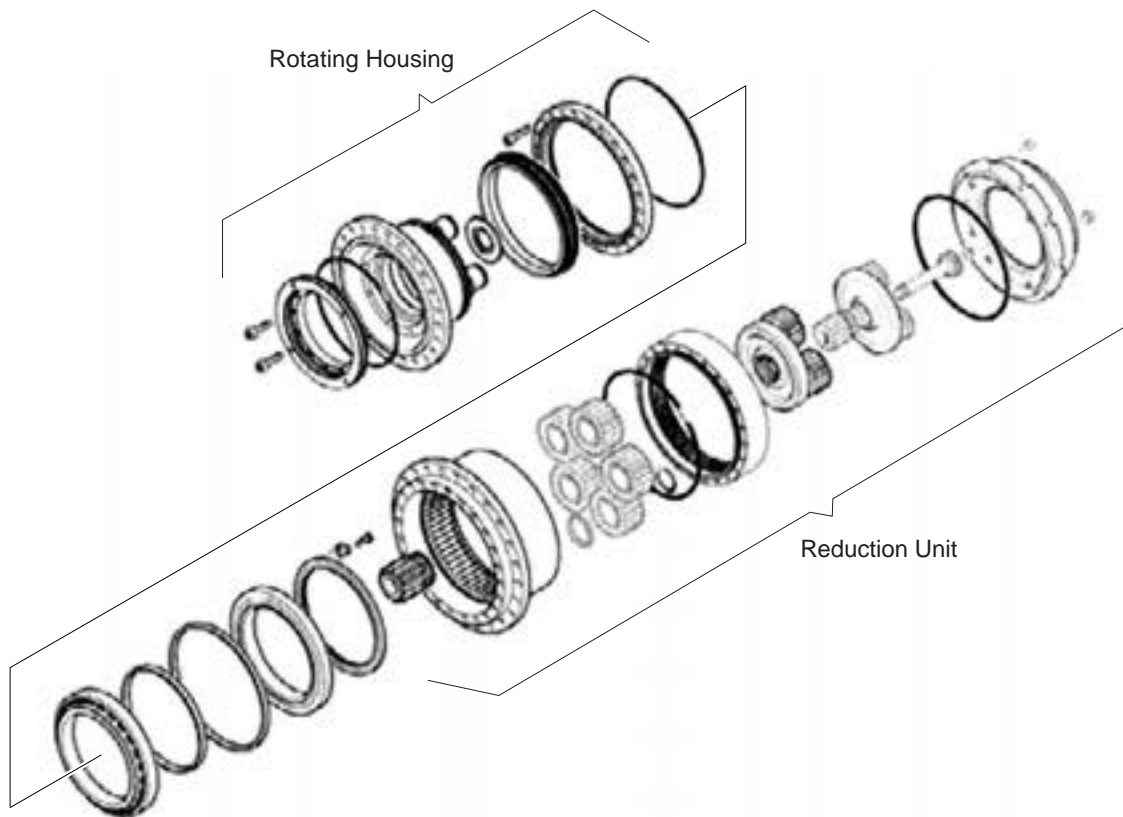


Figure 3

FG016414

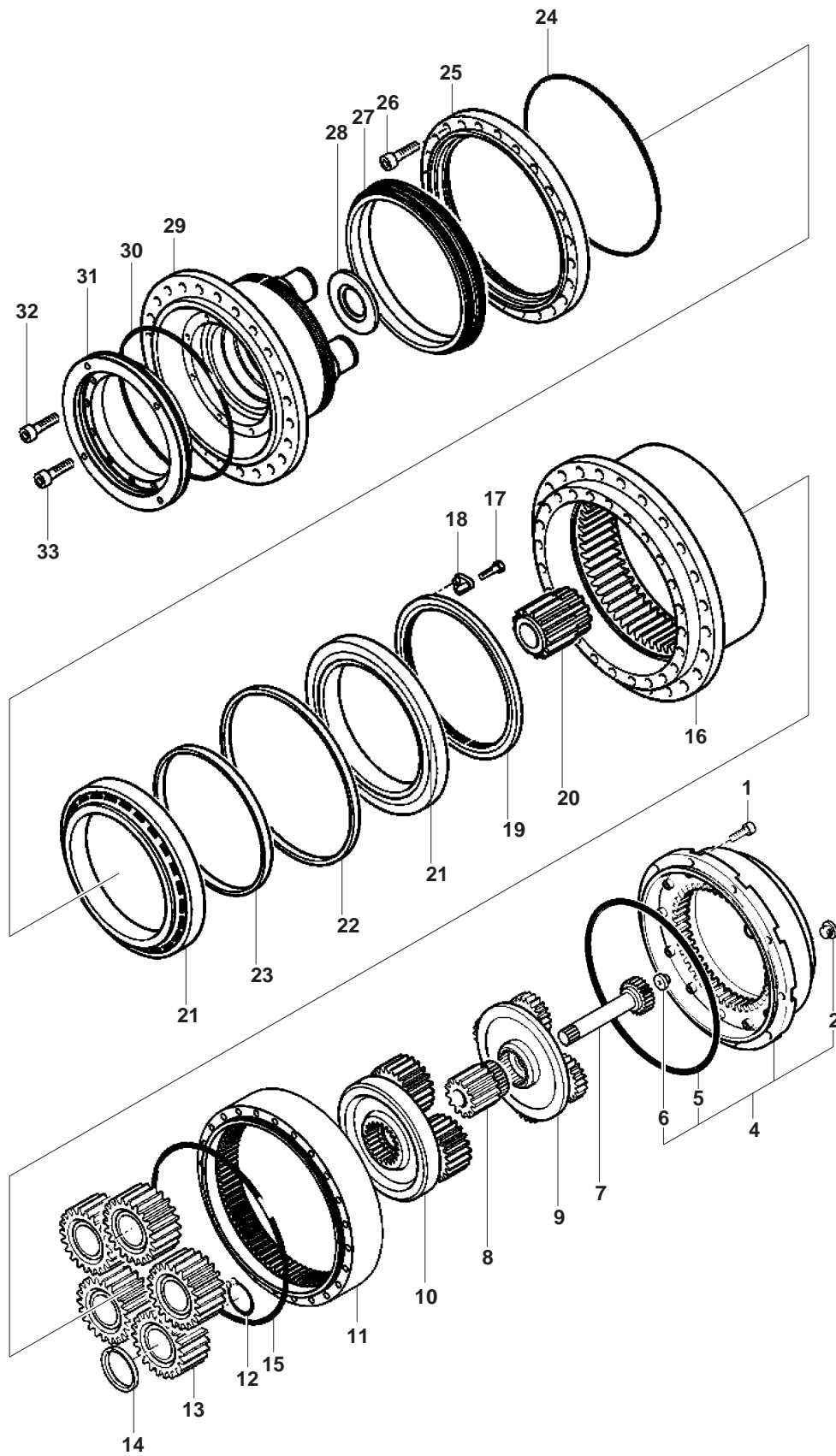


Figure 8

FG016419

Evaluating that Pieces to Replace

The pieces that are subject to general wear and tear are the following:

- Gears.
- Bearings.
- All the seals

Replace the used or irregular parts respecting the following steps:

1. Accurately remove dirt, and in particular properly clean the seals, bearings and locking rings seating.
2. Lubricate the parts before connecting them.
3. In the case of damaged gears, for example a planetary, do not proceed to replace the individual gear but the entire reduction assembly.
4. When reconnecting a part always replace all the seals involved. Add some grease on the seats and on the new seals to make easier the reassembly.
5. Replace all the damaged parts with original spare parts and doing so follow all the steps given by the manufacturer in "Gearbox Reassembly" on page -32.

Gearbox Reassembly

In case of replacement of the gearbox housing (16), of the bearings (21) or of the spacers (22, 23), proceed with the following operations:

1. Assemble the bearings (21) and the spacer (22) into the gearbox housing (16).
2. Determine "H" value of the spacer (22) to get measure $C = 0,05 \div 0,15$.
3. Apply on the inner ring of the bearing (21) a load of 20,000 - 21,000 N.
4. Measure the control size "D".

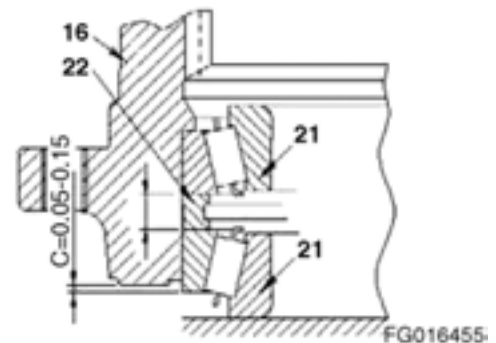


Figure 44

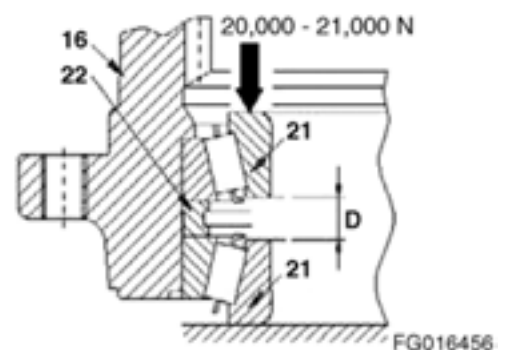


Figure 45

43. By using a tackle assemble the toothed ring (11).

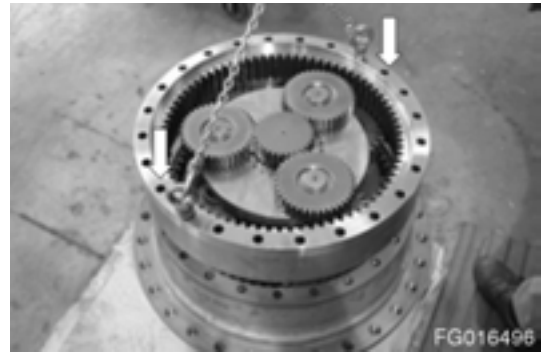


Figure 86

44. Assemble the O-ring (5) into its seat in the end cover (4).



Figure 87

45. By using a tackle and the raising hook (6689960510) place the end cover (4) on the toothed ring (11).



Figure 88

46. Tighten the nos. 21 socket head bolts M16 x 160 (1), grade 8.8, by a torque wrench at 215 N•m torque.



Figure 89

Theory of Operation

Construction

This pump assembly consists of two pumps connected by a spline inside spline coupling (114). The two pumps can be driven simultaneously as the rotation of the prime mover (engine) is transferred by the drive shaft (F) (111) on the front side. The suction and discharge ports are integrated at the connecting part of the two pumps; i.e. in valve block (311, 312): The suction port serves both the front pump and the rear pump.

Function

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

1. Rotary Group

The rotary group consists of a drive shaft (F) (111), cylinder block (12), piston (151), shoes (152), set plate (153), spherical bushing (156) and cylinder spring (157). The drive shaft is supported by bearings (123 and 124) at both ends. The shoe is caulked to the piston to form a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and to take hydraulic balance so that it slides lightly over the shoe plate (211). The subgroup is composed of a piston and shoe pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush.

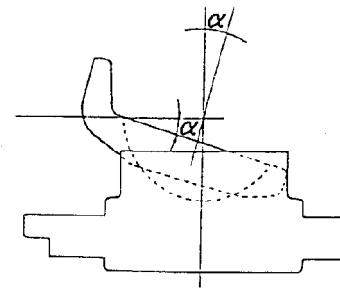
Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.

2. Swash Plate Group

The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bushing (214), tilting pin (531) and servo piston (532).

The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

The servo piston moves to the right and left as hydraulic oil, controlled by the regulator is transmitted to each hydraulic chamber on both ends of the servo piston. The swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle (α).



ARS0130L

Figure 1 Swash Plate Group

14. Pull out the shoe plate (211) and the swash plate (212) from the pump casing (271).



Figure 9

15. Softly tap the edge of the drive shaft (111, 113) with a plastic hammer to pull out the drive shaft (111, 113) from the swash support (251).

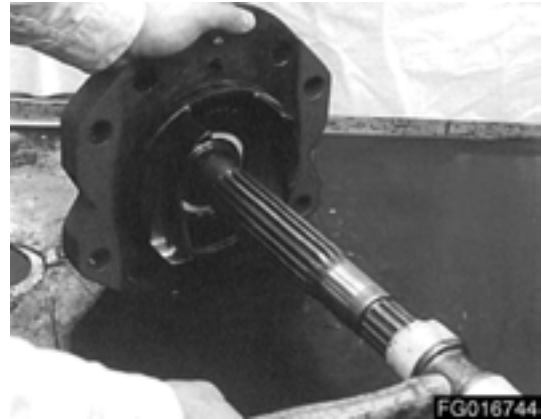


Figure 10

16. Separate the valve plates (313, 314) from the valve covers (311, 312).

They may be separated in Step 8 or 10.

17. If needed, separate the stopper (L) (534), the stopper (S) (535) and the servo piston (532) from the pump casing (271); and the needle bearing (124) from the valve cover (311, 312).

- A. Use a tool when pulling out the tilt pin to make sure there is no scratch to the tilt pin head.
- B. Since Lock Tight is coated on the fitting part of the tilt pin and servo piston, make sure that there is no scratch on the servo piston.
- C. Do not pull out the needle bearing unless it needs to be replaced.
- D. Do not unfasten the screw hex S.H.C. of the valve cover (F and R) and the swash support. The flow rate setting would be changed.

18. This completes the procedure for disassembly.



Figure 11

NAMING CONVENTION

KR3

D

-

Z

P

53

V

O-Ring Fluorine

Regulator Design Series No.

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)

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)

Size

6: K3V63

8: K5V80

G: K3V112

S: K5V140

H: K3V140, K3V180

K: K5V200DT/DTP/DTH/S

D: K3V280, K5V200DP (H)

Regulator for the K3V•K5V Series Pumps

Overload Prevention

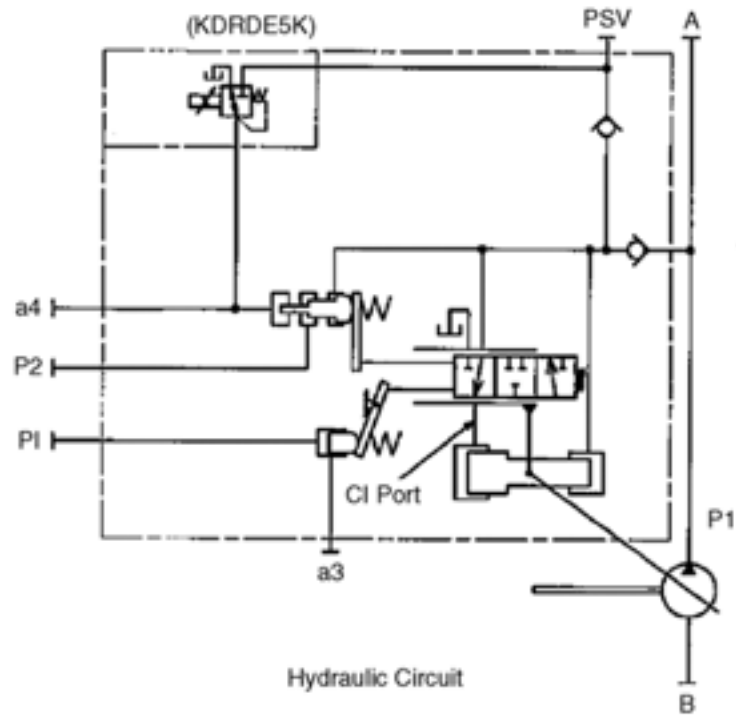
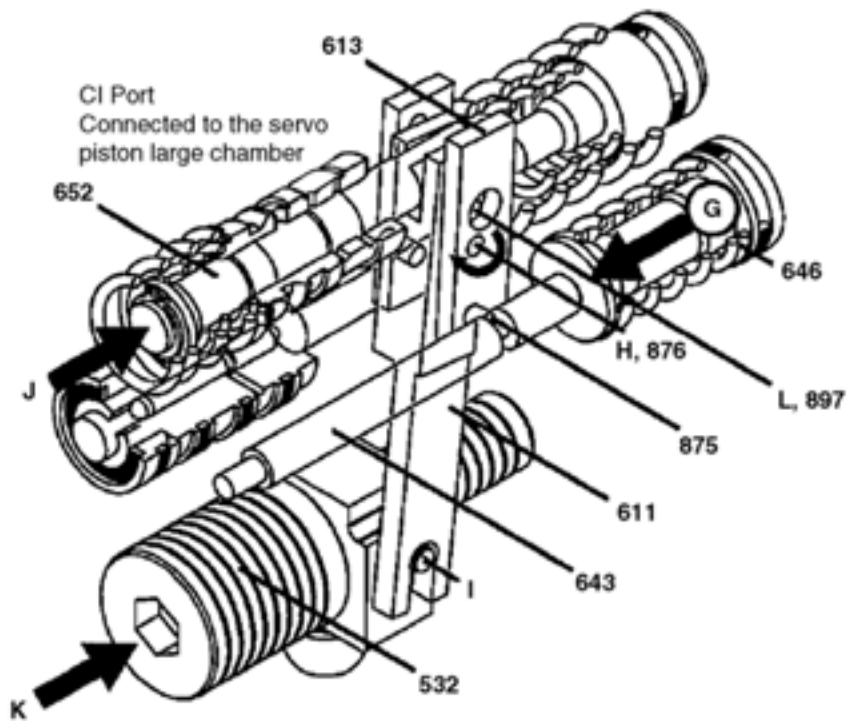


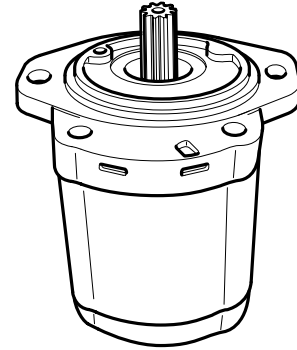
Figure 12

FG016892

SINGLE GEAR PUMP

Disassembly

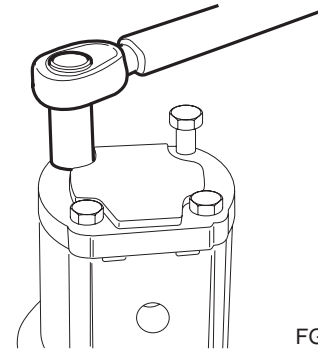
1. Clean exterior of pump.



FG001072

Figure 1

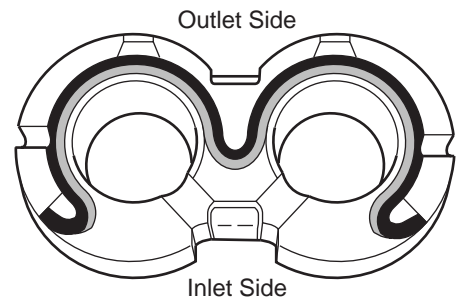
2. Remove clamp bolts.



FG001074

Figure 2

3. Cover sharp edges of drive shaft with adhesive tape and coat shaft end extension with clean grease, to avoid any damage to lip of shaft seal when removing mounting flange.



FG0014

Figure 3

11. Install remaining section using preceding procedure.

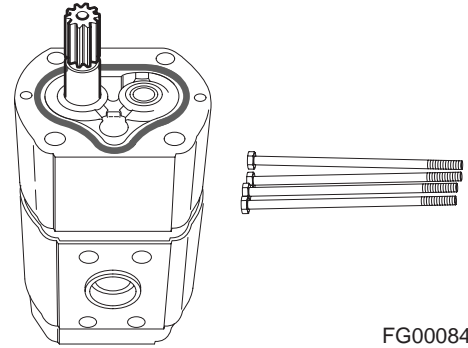


Figure 41

FG000848

12. Locate mounting flange in right position.

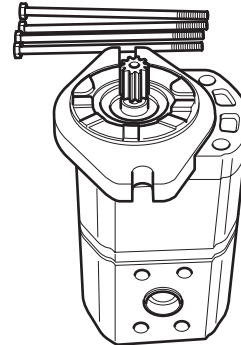


Figure 42

FG000849

13. Tighten bolts with washer in a crisscross pattern to a torque value of 45 Nm.

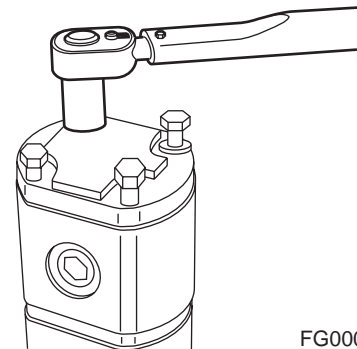


Figure 43

FG000850

14. Check that pump rotates freely when drive shaft is turned by hand. If not a pressure plate seal may be pinched.

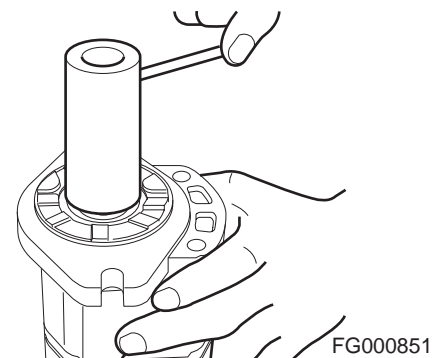


Figure 44

FG000851

Single Operation

Travel Spool Shifting (Figure 3 and Figure 4)

1. When shifting travel spool by increasing pressure of travel (section 1) pilot port (Pb1 (Pa1)), oil supplied to port (P1) flows through neutral passage (L1), to spool, and flows to port (B1 (A1)). Return oil flows through port (A1 (B1)) to spool and returns to tank passage (Ta).
2. When shifting travel spool by increasing pressure of travel (section 6) pilot port (Pb6 (Pa6)), oil supplied to port (P2) flows through neutral passage (R1), and spool, to passage (S6-1) and flows to port (B6 (A6)). At this time poppet (S6-2) is not opened because parallel passage (R3) pressure equals passage pressure (S6-1). Return oil flows through port (A6 (b6)) to spool and returns to tank passage (Ta).
3. When shifting either spool (section 1 or 6), land (Lc4) or (Rc3) is closed. Oil supplied from port (PP) does not flow into tank passage, so that pressure at port (PT) rises.

Relief Valve

1. Main relief valve (Figure 12)

Oil supplied to port (P1) flows through poppet (LP), oil supplied from port (P2), flows through poppet (RP), and passage (3) also, it then joins with the main relief valve. The highest pressure of pump (P1) and (P2) is controlled by actuating of main relief valve.

2. Over load relief valve

The over load relief valve, that is installed in each cylinder port of boom 1, arm 1 and bucket, prevent the actuator pressure from increasing to extremely high pressures by external forces.

This relief valve, when pressure of cylinder port is a negative pressure, also has the function to prevent cavitation by drawing oil from the tank.

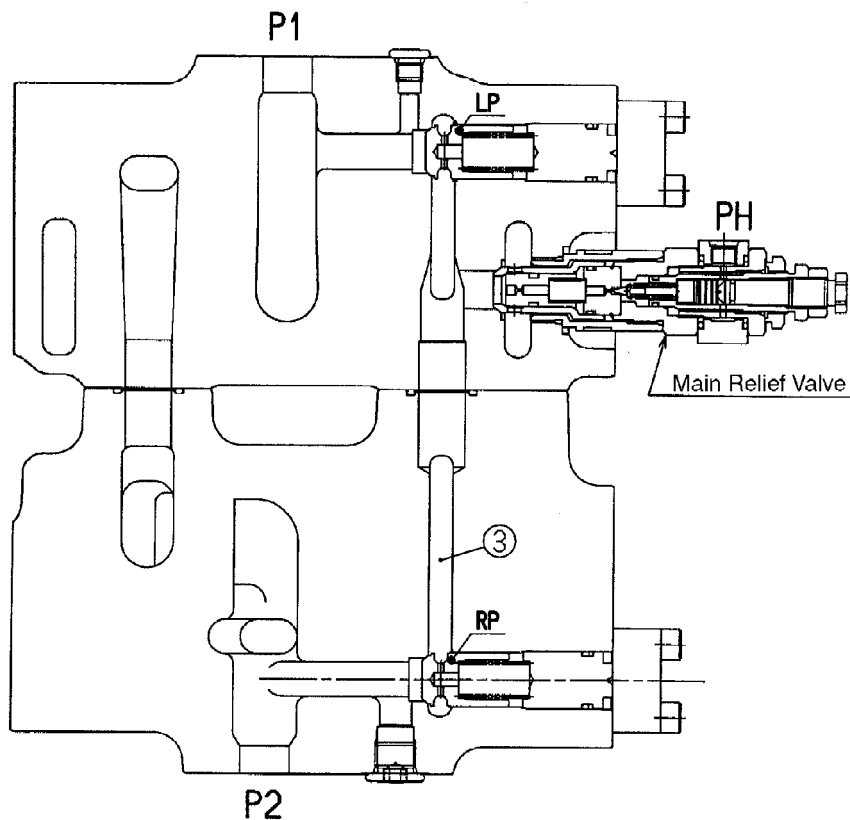
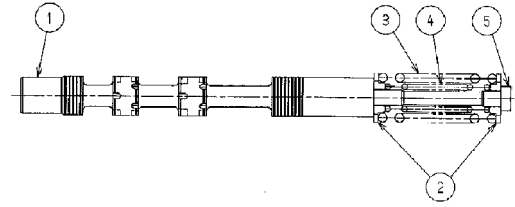


Figure 12

ASS1370S

Spool Assembly (7, Straight Travel)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spring
5	Spool End

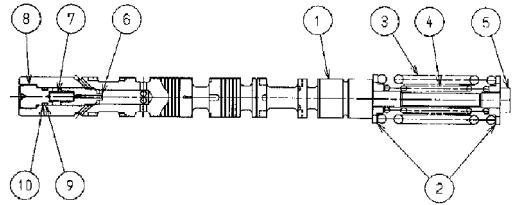


ASS1640S

Figure 32

Spool Assembly (8, Arm1)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spring
5	Spool End
6	Poppet
7	Spring
8	Plug
9	O-ring
10	Backup Ring

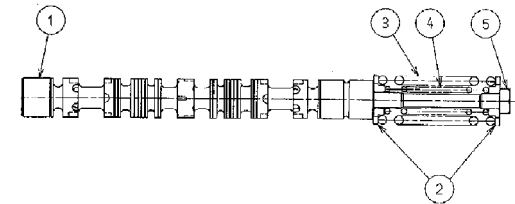


ASS1650S

Figure 33

Spool Assembly (9, Service)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spring
5	Spool End



ASS1660S

Figure 34

Disassembly of Relief Valve

1. Remove eight overload relief valves (49, (8 places, width across flats: 32 mm)).
2. Remove main relief valve (48, width across flats: 41 mm).
3. Remove two negacon relief valves (50, width across flats: 46 mm).

Disassembly of Other Flange

1. Remove plug assemblies (60, 61, 62, 58, 52, 59) and O-rings.

Reference Number	Size	Quantity
60	6 mm	5
61	10 mm	17
62	12 mm	6
58	24 mm	1
52	27 mm	
59	8 mm	

NOTE: *Valve housings (1 and 2) should not be disassembled because O-rings and housings can be deformed and mating surfaces can be crisscrossed when reassembling them.*

Steel ball (75) should not be disassembled since it is a press fit.

INSTALLATION

1. Be careful not to work other foreign strength to control valve by pipe laying.
2. Tighten the assembling bolts alternately and evenly to the specified torque.
3. If welding procedures are being performed near the control valve, the valve could be damaged by weld spatter and heat. Use adequate shielding to protect valve.
4. Clean the installation portion of relief valve and install it. Tighten plug (1). Torque: 10.50 - 11.52 kg•m (76 - 83 ft lb).
5. Valve ports should be covered with caps, plugs or tape to protect them from dust and other foreign materials, until pipe laying work is started.

START-UP PROCEDURES

1. Before operating machine, make sure that oil passages and hydraulic oil are clean.
2. Hydraulic oil of which annealing point is 82-113°C should be used in the hydraulic system.
3. Relief valve pressure should not be raised above specified pressure setting.
4. The difference between main relief valve setting pressure and over load relief valve setting pressure should not be over 2.0 MPa.
5. Before operating machine, the hydraulic system should be fully warmed up. If machine is operated with cold hydraulic oil and valve, be careful of the following, to prevent spool sticking due to heat shock.

NOTE: *Do not operate main relief valve or over load relief valve suddenly and continuously. Cycle oil through all actuators and warmed up cold hydraulic oil in the lines and components uniformly.*

NOTE: *Slight or compound work should not be suddenly operated at cold weather because heat is developed partly at all the orifices.*

Immunity from Responsibility

Kawasaki does not assume the responsibility for the following cases.

1. External factors such as Force Majeure like natural disaster and accident.
2. Intended or unintended misuse.
 - Use for any purpose other than its intended usage.
 - Use in violation of specified conditions.
 - Performing prohibited actions.
 - Performing work other than what is specified in the Operation Manuals (operation, maintenance and inspection procedure).
 - Failure to perform the work specified in the Operation Manuals (operation, maintenance and inspection procedure).
3. Unsafe activity.
4. Performance and functionality after the disassembly and reassembly by the customer or a 3rd party.

OVERVIEW

The pilot valve PV48K2 is the pressure reducing valve type for remote control. It has 4 built-in reducing valves, which control the secondary pressure, inside the valve casing. The output pressure manipulates the inclination of the operating part.

12. Separate the O-ring (214) and seal (213) from the plug (211). For the seal (213), use the small minus driver.

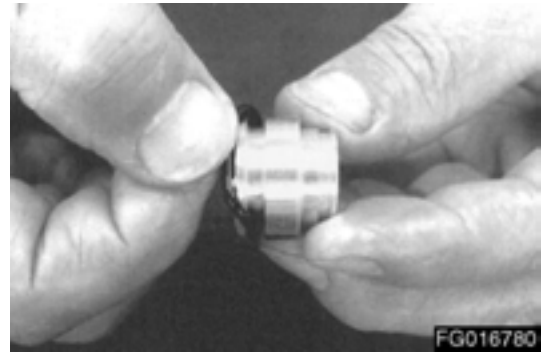


Figure 18



Figure 19

13. Cleaning of Parts

- A. Clean the parts in the preliminary cleaning vessel with kerosene inside (preliminary cleaning).

 **CAUTION**

Scratches can be easily created if the dirty parts are cleaned with the oil from the beginning. Immerse them in the oil for some time until the dust and oil are sufficiently swollen.

If the kerosene is polluted, the parts can be damaged and show the poor performance after reassembly. Keep the kerosene clean.

- B. Immerse the parts in the final cleaning vessel with kerosene and slowly rotate them to clean the inside and outside. (final cleaning)

Wipe out the kerosene from each part with a clean cloth.

 **CAUTION**

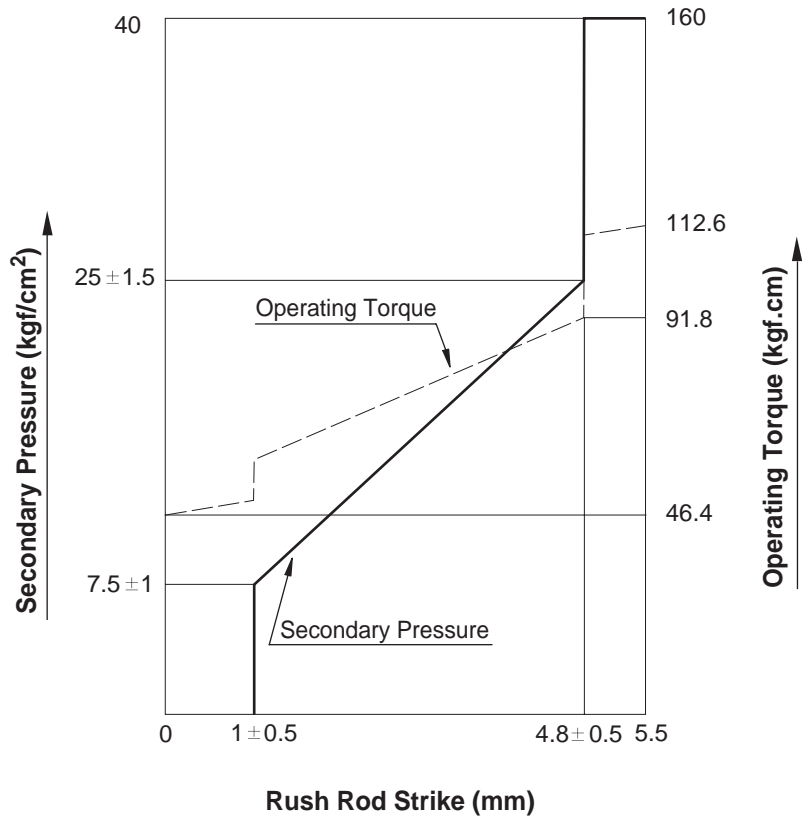
Do not dry the parts with the compressed air as it can create the scratch or rust.

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Travel Control Valve (with Damper)

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Specification



FG013534

Figure 4

Travel Control Valve	Specification
Type	Pilot Control (With Damper)
Pressure / Stroke	25 kg/cm ² @ 4.8 mm Stroke (356 psi @ 0.1890 in Stroke)
Weight	7.8 kg (17 lb)

Torques

No	Bolt Size	Tool	Tightening Torque
26	M6	PT1/8	88 kg•cm (6 ft lb)
30	M8	27 mm	100 kg•cm (7 ft lb)
32	M10	22 mm	440 kg•cm (32 ft lb)
37	M10	22 mm	440 kg•cm (32 ft lb)

START-UP PROCEDURES

1. Start engine and set throttle at "LOW IDLE".
2. Set safety lever on "UNLOCK" position.

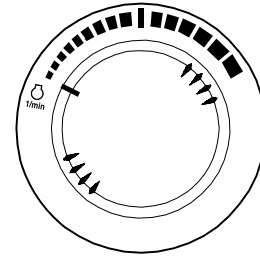


Figure 39

HAOB290L

3. Slowly push and pull both travel lever about five times without a load to vent air from pilot lines.

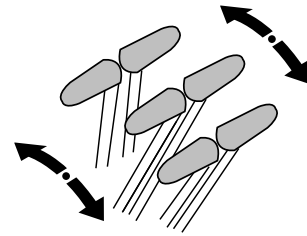


Figure 40

HAOB903L

11. Remove swash plate with special tool.

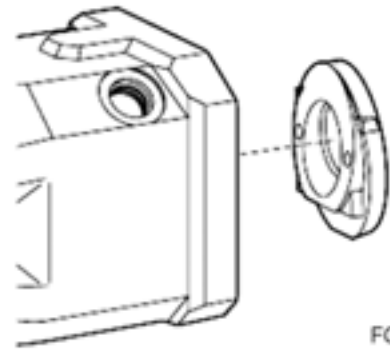


Figure 12

FG016814

12. Loosen the swash plate with a slide hammer (a small hook - diameter 6 mm - catches the end of the swash plate at the bottom).

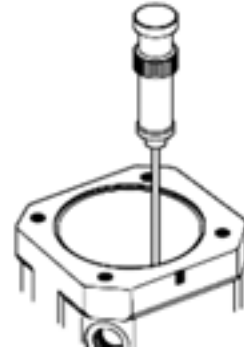


Figure 13

FG016815

13. Press down bearing.

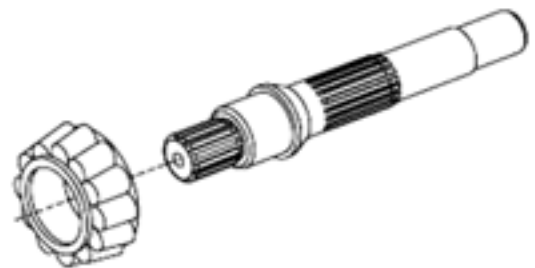


Figure 14

FG016816

14. The external front bearing ring is pulled out of the pump housing.

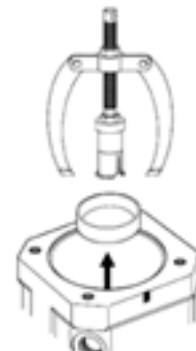


Figure 15

FG016817

Table of Contents

Fan Pump (Fan Cooling Drive)

Safety Precautions	5
Applicable Models	5
Disassembling Fan Pump.....	7
Reassembling Fan Pump	13

4. Assembly instruction shaft seal.

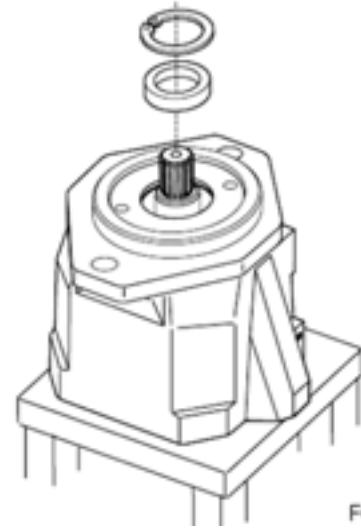


Figure 21

FG016858

5. Fit in bearing shell and spring.
Fix with grease.

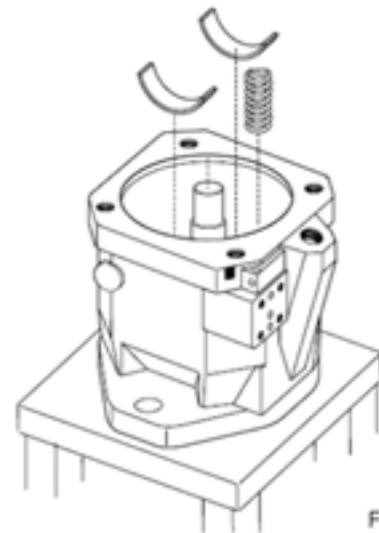


Figure 22

FG016859

Functions of 5-Solenoid Valve Assembly

The solenoid valve assembly controls the following functions.

1. Pilot Cut-off
2. Breaker Pressure Supply
3. High/Low Travel Speed
4. Main Pressure (Power Boost) Increase
5. Breaker/Shear Mode Selection

Functions and Operations of Solenoid Valves

Reference Number	Function	Operations	Remarks
C1	Pilot Cut-off	Provides pressurized oil coming from the pilot pump for the pilot pressure supply solenoid valve to operate each work system.	
C2	Breaker Pressure Supply	Supplies pilot pressure for the pedal valve assembly and shuttle valve.	
C3	High/Low Travel Speed	Sets low and high travel speed. Shifts speed between both depending on the state of the solenoid valve or a signal detected in the e-EPOS controller.	
C4	Main Pressure (Power Boost) Increase	Temporarily increases the pressure setting of the main relief valve, to increase the excavation power.	
C5	Breaker/Shear Mode Selection	Supplies pilot pressure to shear valve that controls the front option attachment so it is ready to work in the breaker mode.	

Detailed Functions and Operations of Solenoid Valves

1. Pilot Cut-off Solenoid Valve (C1)

It provides pressurized oil coming from the pilot pump to the;

- Breaker solenoid valve (C2)
- High/low travel speed solenoid valve (C3)
- Main pressure (power boost) increase solenoid valve (C4)
- Breaker/shear mode selection solenoid valve (C5)

NOTE: Port "P3" from 5-solenoid valve assembly, is connected to a 2-solenoid valve assembly that is used to control a shear.

Pulling up the safety lever, located on the left side of the operator's seat, allows the electrical power from the pilot cutoff switch to activate the pilot cutoff solenoid valve. The pilot cutoff solenoid valve then supplies pressurized oil to each of the other solenoid valves.

2. Assemble the spool, the spring, and the pin.

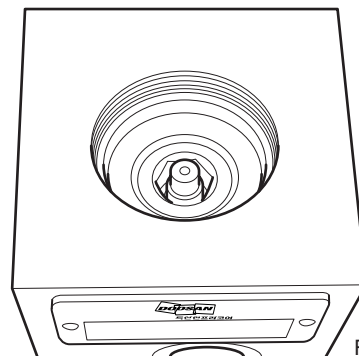


Figure 13

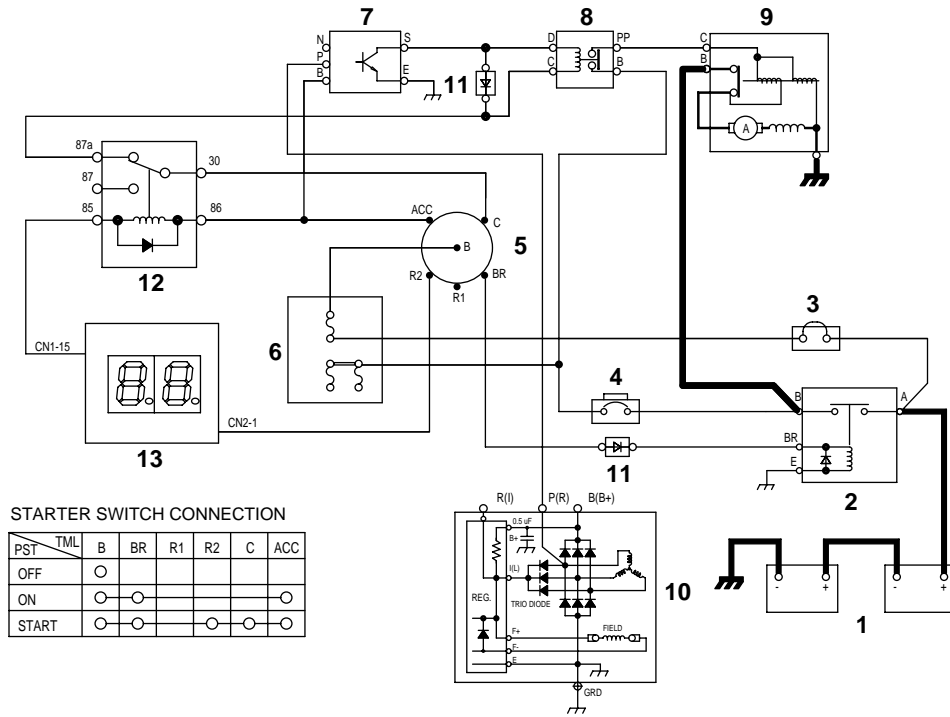
FG003695

- The spring and the pin should not be fell off.



Figure 14

FG003696



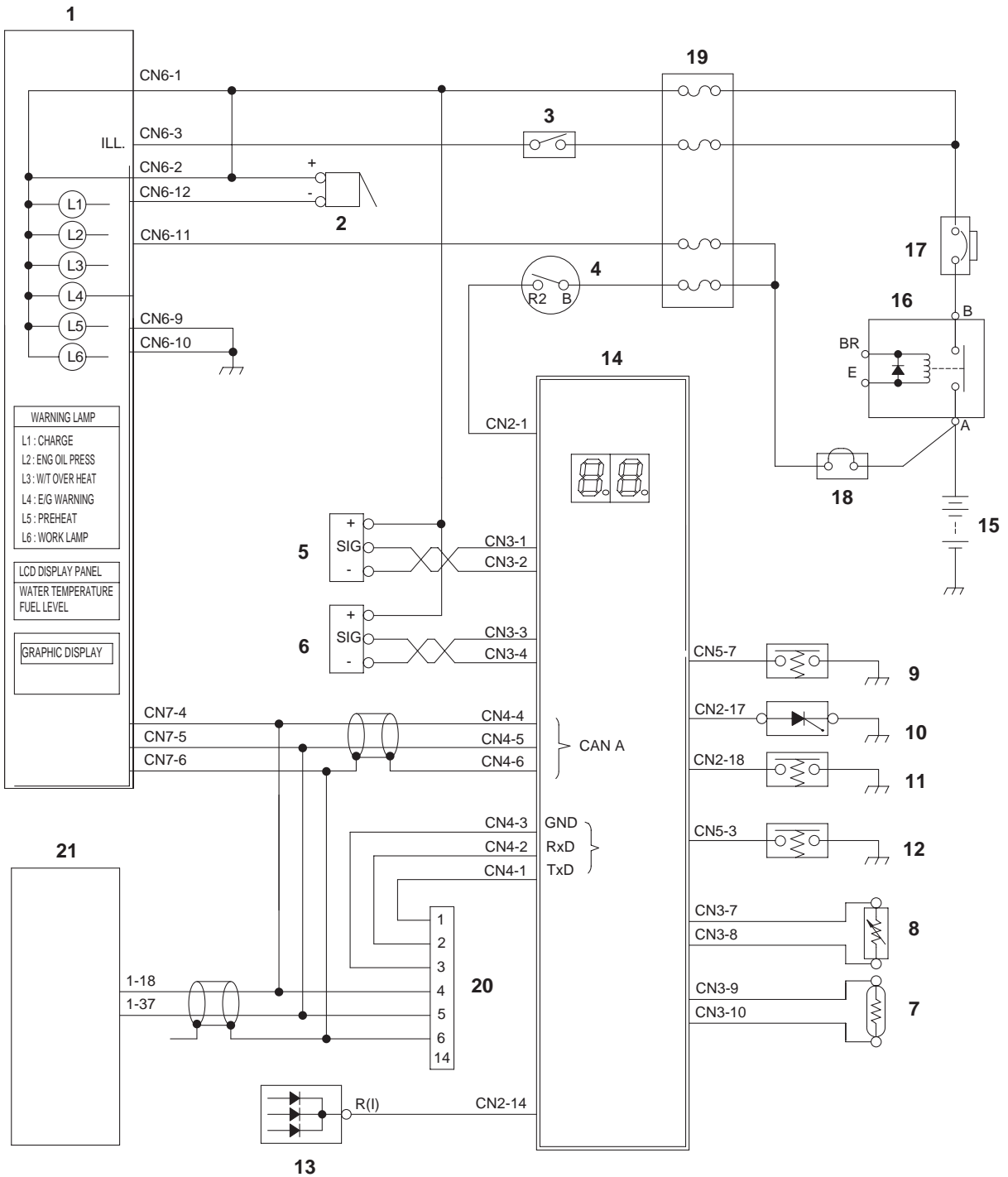
FG007234

Figure 3 Starter Circuit (1) - While Starting

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box
7	Starter Controller

Reference Number	Description
8	Starter Relay
9	Starter
10	Alternator
11	Diode
12	Starter Relay 2
13	e-EPOS Controller

Monitoring System Schematic



FG016386

Figure 11

Main Menus for the Graphic Display Area

1. Main menu: Language setting, Time setting, Filter/Oil information, Brightness adjustment, Password
2. Special menu: Information of machine status, failure information, Information of machine operation.

Menu Selector Buttons

1. Up Arrow Button (▲, 1 on Figure 12): Move the cursor to up, left and previous screen.
2. Down Arrow Button (▼, 2 on Figure 12): Move the cursor to down, right and next screen.
3. Enter Button (↵, 3 on Figure 12): Move the menu to selected mode. When setting the menu, this button is used to function as the selector button.
4. Escape Button (ESC, 4 on Figure 12): Move a screen to previous menu or main menu.
5. Home Button (HOME, 5 on Figure 12): Move a screen to default menu.

A. Current failure information

Current status of failure is displayed (Failure code, failure contents).

When a number of failures are produced, failure information can be checked using "UP" (▲, 1 on Figure 25) or "DOWN" (▼, 2 on Figure 25) button.

* 1/2: A serial number of current failure/ total quantity of failure.

* Vxxx-xx: Vxxx is a unique code and xx is a FMI (Failure Mode Identifier) number.

- V: Machine related failure code

- E: Engine related failure code

Refer to the failure information code for unique codes and FMI numbers.

This example shows one of two failures.

B. Past failure information

Memorized record of past failure is displayed (Failure code, failure contents).

When a number of failures are produced, failure information can be checked using "UP" (▲, 1 on Figure 25) or "DOWN" (▼, 2 on Figure 25) button.

NOTE: " Number: xxx ": "xxx" means that the totally counted number of the same failure.

" Period:xxxxxHrxxm ": It indicates the period for which machine has operated until a failure takes place. (For more than two occurrences of the same failure, until the first occurrence time.)

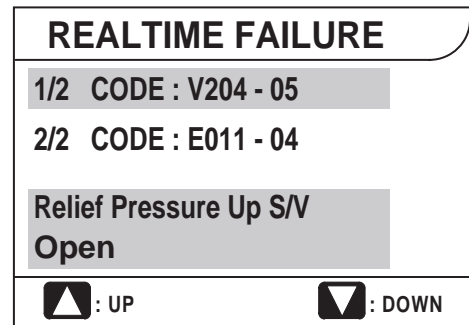
C. Failure record deletion

This mode is used to delete the memorized record of past failure. If this mode is selected, all records will be deleted.

When "YES" (←, 3 on Figure 25) button is pressed, the memorized record will be deleted.

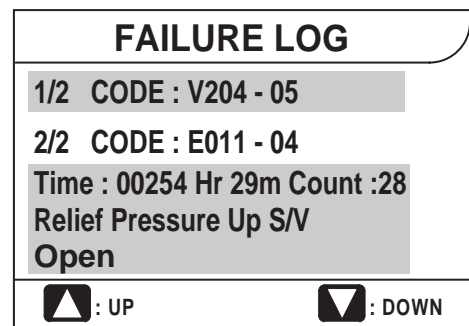
At this time, deletion signal will be displayed and the screen will move to previous menu after deletion.

This screen will be displayed during 3 seconds.



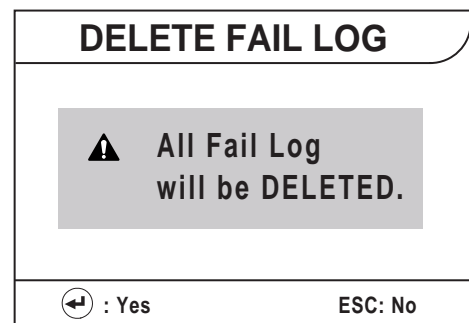
FG013615

Figure 35



FG013616

Figure 36



FG013617

Figure 37

Reference Number	Description
1	Instrument Panel
2	e-EPOS Controller
3	Engine Controller (ECU)
4	Main Pump
5	Aux Pump
6	Control Valve
7	Pressure Switch
8	Pump Pressure Sensor
9	Electromagnetic Proportional Pressure Reducing Valve (Attachment)
10	Electromagnetic Proportional Pressure Reducing Valve (Mode Control)
11	Solenoid Valve (Boost)

Reference Number	Description
12	Solenoid Valve (High Speed)
13	Solenoid Valve (Breaker)
14	Travel Motor
15	Main Relief Valve
16	Engine Control Dial
17	Breaker/Boost/Shear Selector Switch
18	Auto Travel Selector Switch
19	Boost Switch (Right Work Lever)
20	Sensor
21	Aux Mode Switch
22	Aux Mode Resistor
24	Lifting Mode Switch

ENGINE CONTROL CIRCUIT DIAGRAM

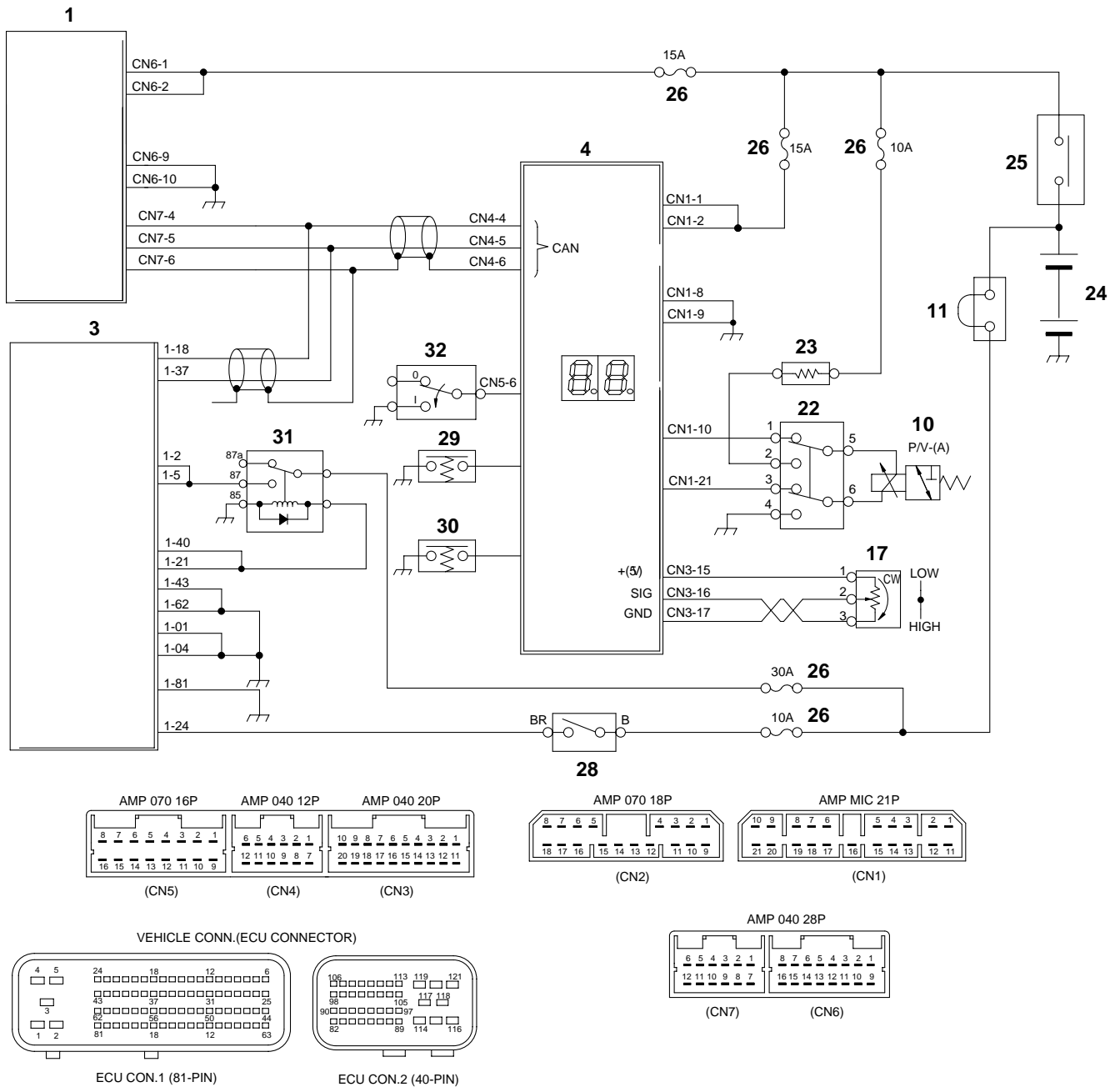
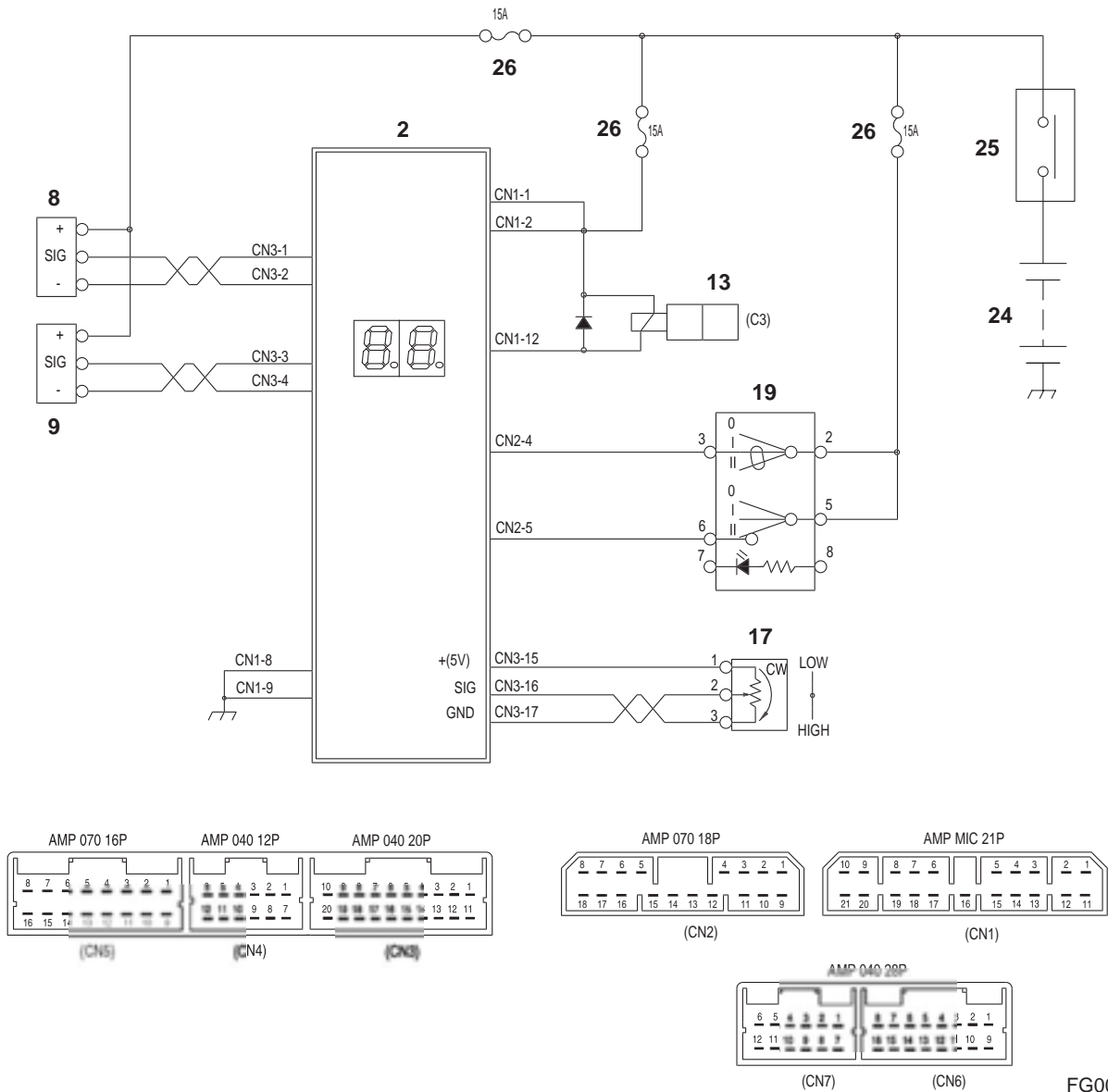


Figure 62

FG016392

Automatic Travel Speed Control - Circuit Diagram



FG000587

Figure 68

Reference Number	Description
2	e-EPOS Controller
8	Pressure Sensor (Front Pump)
9	Pressure Sensor (Rear Pump)
13	Solenoid Valve (High speed)
17	Engine Control Dial

Reference Number	Description
19	Selector Switch For Automatic Travel
24	Battery
25	Battery Relay
26	Fuse

Actuator - Internal/external Air Exchange

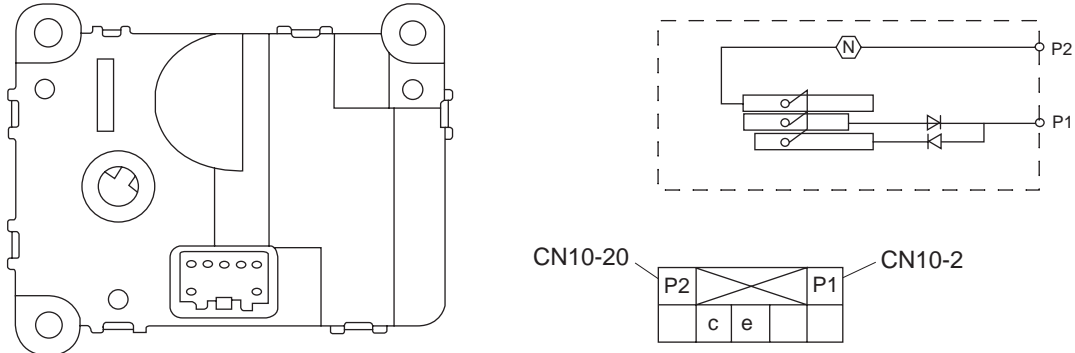


Figure 80

FG001055

Mode	Output Terminal	Output
Intake	P1(+), P2(-)	Moving of exchange door by selecting intake.
Recirculate	P1(-), P2(+)	Moving of exchange door by selecting recirculate.

Air Flow Control Module

Air flow is controlled through the control of voltage between GATE and SOURCE.

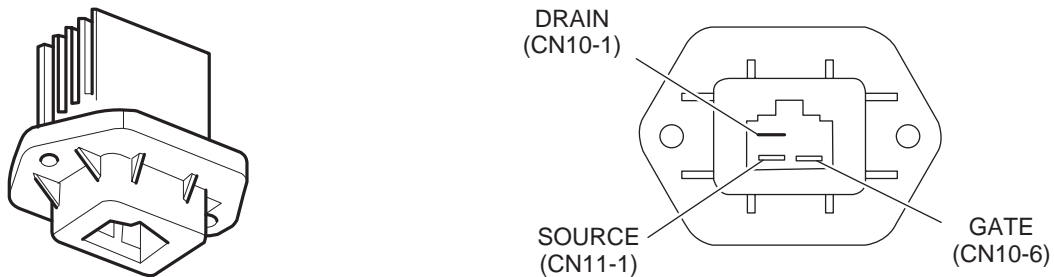


Figure 81

FG001056

Air flow	Output Terminal		Output
1st	CN11-2	CN10-1	$10 \pm 0.5V$
2nd			$12.5 \pm 0.5V$
3rd			$15 \pm 0.5V$
4th			$17.5 \pm 0.5V$
5th			$20.0 \pm 0.5V$
6th			$22.0 \pm 0.5V$
7th			More than 25V

Input voltage is 27.5V.

The air flow is based on manual set.

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