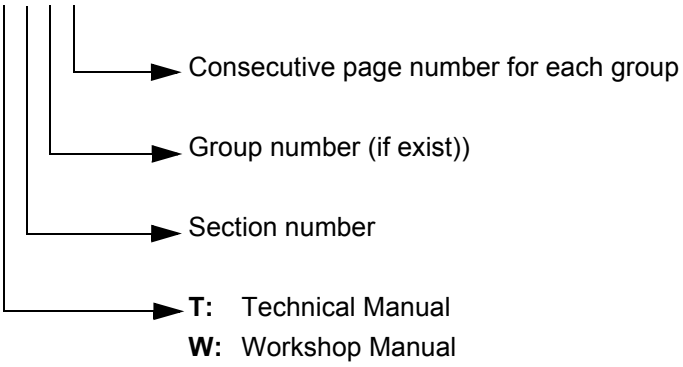
PAGE NUMBER

- Each page has a number, located on the external upper corner of the page. Each page number contains the following information:

Example: **T 1-2-3**



SYMBOLS

In this manual, the following safety alert symbol and signal words are used to alert the reader to the potential for personal injury or machine damage.

This is the safety alert symbol.
When you see this symbol, be alert to the potential for personal injury.
Never fail to follow the safety instructions prescribed along with the safety alert symbol.
The safety alert symbol is also used to draw attentio in to component/part weights.
To avoid injury and damage, be sure to use appropriate lifting techniques and equipment when lifting heavy parts.

UNITS USED

SI Units (International System of Units) are used in this manual.
MKSA system units and English units are also indicated in parentheses just behinds SI units.

Example: 24.5 MPa (250 kgf/cm^2)

A table for conversion from SI units to other system units is shown below for reference purposes.

Quantity	To convert from (SI)	Into (Others)	Multiply by
Lenght	mm	in	0.03937
	mm	ft	0.003281
Volume	L	US gal	0.2642
	L	US qt	1.057
	m^3	yd^3	1.308
Mass	kg	lb	2.205
Force	N	kgf	0.10197
	N	lbf	0.2248
Torque	N.m	kgf.m	0.10197
	N.m	lbf.ft	0.7375

Quantity	To convert from (SI)	Into (Others)	Multiply by
Pressure	MPa	kgf/cm^2	10.197
	MPa	psi	145.0
Power	kW	CV-PS	1.360
	kW	HP	1.341
Temperature	°C	°F	°C x 1.8 + 32
Velocity	km/h	mph	0.6214
	min^{-1}	rpm	1.0
Flow rate	L/min	US gpm	0.2642
	mL/rev	cc/rev	1.0

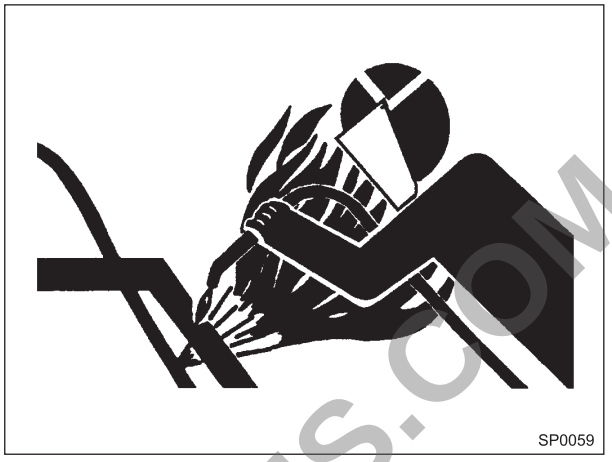
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AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders.

Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials.

Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area. Install temporary fire resistant guards to protect hoses or other materials when welding, soldering, etc.


SP0059

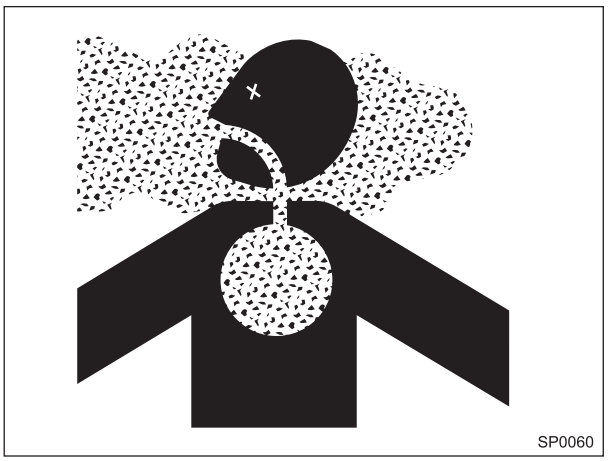
AVOID APPLYING HEAT TO LINES CONTAINING FLAMMABLE FLUIDS

- Do not weld or flame cut pipes or tubes that contain flammable fluids.
- Clean them thoroughly with non-flammable solvent before welding or flame cutting them.

REMOVE PAINT BEFORE WELDING OR HEATING

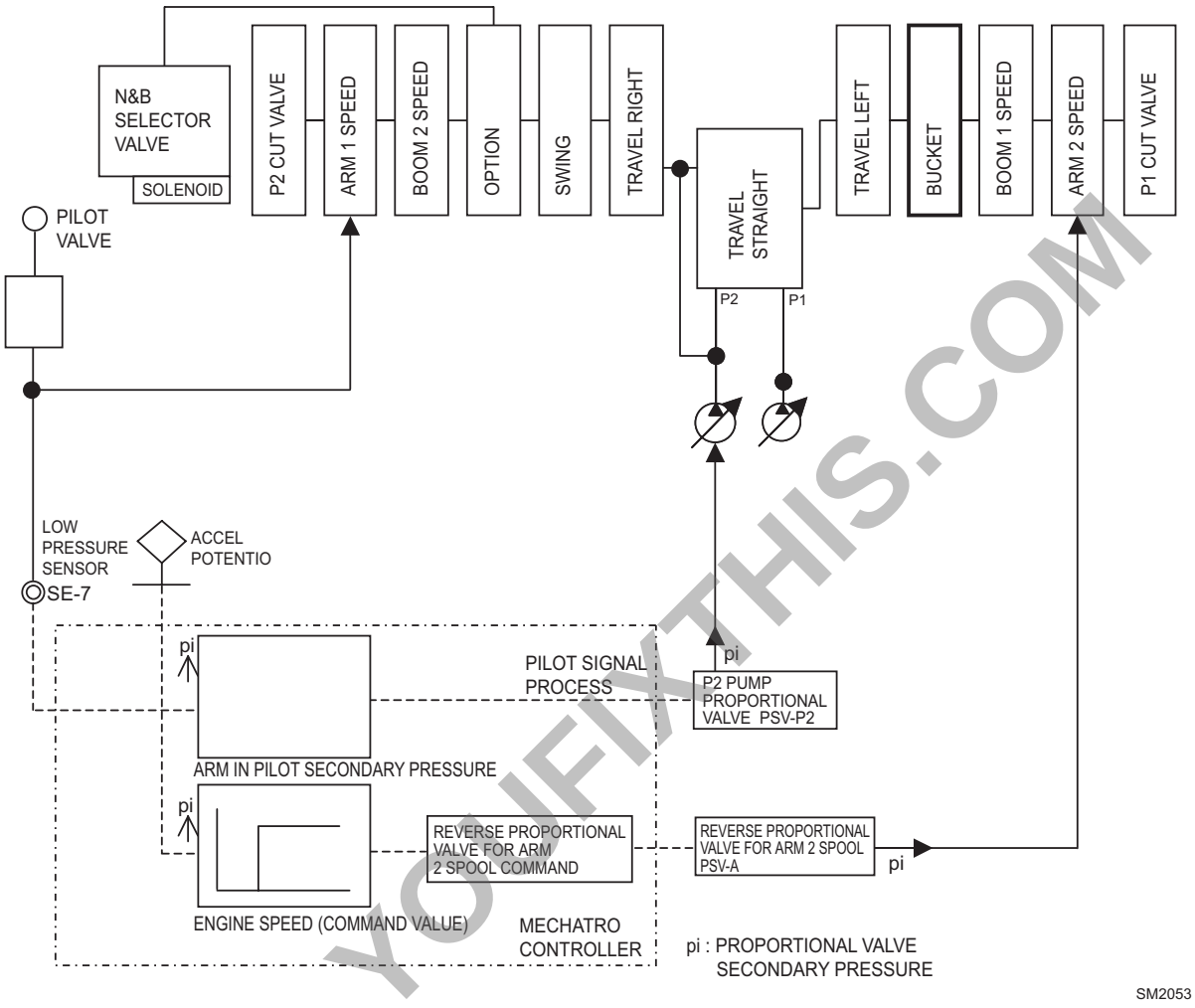
- Hazardous fumes can be generated when paints is heated by weiding, soldering, or using a torch. If inhaled, these fumes may cause sickness.
  - Avoid breathing potentially toxic fumes and dust.
  - Do all such work outside or in a well-ventilated area.
  - Dispose of paint and solvents properly.
  - Remove paint before welding or heating:

1. If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
2. If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.


SP0060

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2.5 ARM-IN ANTI-CAVITATION CONTROL



1. On starting arm-in operation, arm-in operating pilot secondary pressure switches arm 1 spool and is input to low pressure sensor.
2. The engine speed command output by accel potentiometer is input to mechatro controller.
3. Low pressure sensor output voltage is input to mechatro controller, and the mechatro controller processes pilot signal processing and outputs command according to the input voltage to P2 pump proportional valve.
4. And also outputs command according to input pressure output by potentiometer to reverse proportional valve for arm 2 spool.
5. Each proportional valve outputs pilot secondary pressure according to each command output by mechatro controller, and consequently since the reverse proportional valve for arm 2 spool is controlled to spool stroke according to engine speed and changes recirculation rate to prevent the cavitation from occurring even if pump delivery rate is low due to low engine speed.

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Connector No.	Pin No.	Port name	Function	Input/putput	Signal level
CN106	1	+24V	Battery relay secondary side	0	20~32V
	2	SHGF	Spare		Shield GND
	3	F1+	Spare	Output	+24V 1.5A
	4	F1-		Output	+24V 1.5A
	5	F2+		Output	+24V 1.5A
	6	F2-		Output	+24V 1.5A
	7	OIL	Spare	0	
	8	OILG			
	9	D11+	OPT changeable relief 2	Output	+0~800mA
	10	D11-			-0~800mA
	11	D12+	Spare	Output	+0~800mA
	12	D12-			-0~800mA
	13	D13+	Spare	Output	+0~800mA
	14	D13-			-0~800mA
	15	D14+	Spare	Output	+0~800mA
	16	D14-			-0~800mA
	17	GND	Battery (-)		0V
	18	D12+	Spare	Output	+0~800mA
	19	D12-			-0~800mA
	20	E1+	E/G speed sensor	Input	XX~XXVp-p
	21	E1-			0V
	22	SHG3			Shiled GND
	23	CANH2	Spare		CAN communication
	24	CANL2			CAN communication

Connector No.	Pin No.	Port name	Function	Input/putput	Signal level
CN107	1	DI 3	Preheating	Input	+24V/OPEN
	2	DI 8	Spare	Input	EARTH / OPEN
	3	DI 9	E/G oil pressure	Input	EARTH / OPEN
	4	DI 10	Air filter	Input	EARTH / OPEN
	5	DI 11	Stroke-end check	Input	EARTH / OPEN
	6	DI 12	Spare	Input	EARTH / OPEN
	7	DI 13	E/G coolant level	Input	EARTH / OPEN
	8	DI 14	Spare	Input	EARTH / OPEN
	9	DI 15	Spare	Input	EARTH / OPEN
	10	DI 20	ECU main relay	Input	EARTH / OPEN
	11	DI 28	Oil filter	Input	EARTH / OPEN
	12	DI 32	Spare	Input	EARTH / OPEN
	13	DI 38	Quick coupler	Input	EARTH / OPEN
	14	DI 39	Spare	Input	EARTH / OPEN
	15	DI 40	Spare	Input	EARTH / OPEN
	16	DI 41	Spare	Input	EARTH / OPEN
	17		Reserved		

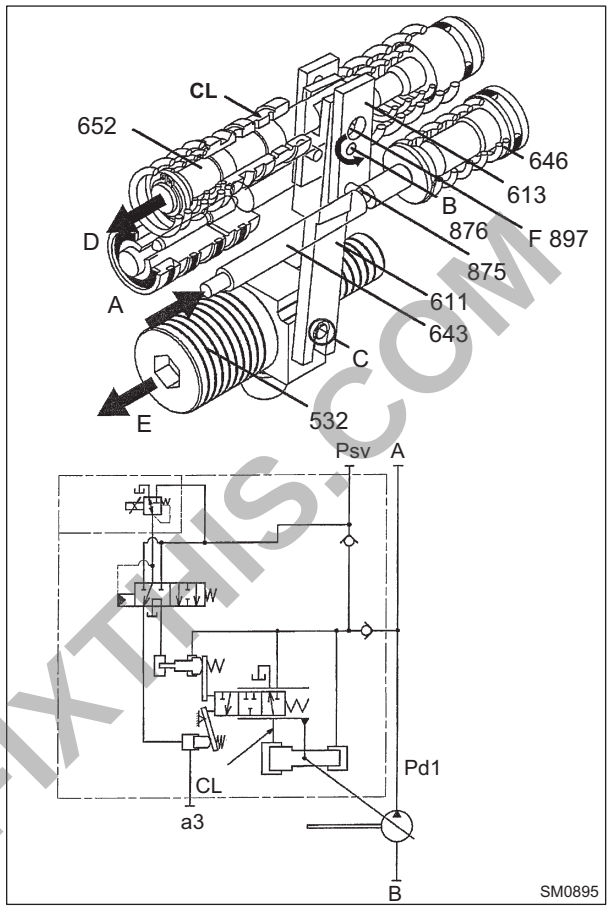
SM2089

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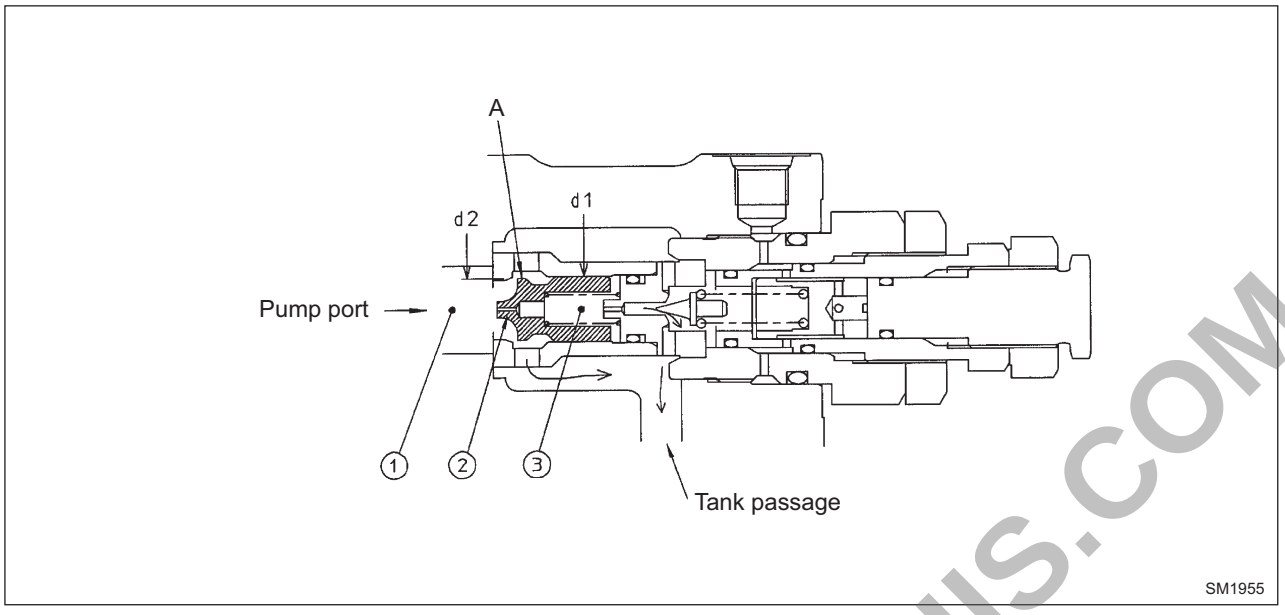
Flow rate increase

As the command current value I rises, the secondary pressure P2 of electromagnetic proportional pressure-reducing valve rises, and by pressing pilot piston (**643**) in (**A**) direction it stops at the position the secondary pressure P2 balances the pilot spring force (**646**). The movement of pilot piston is transferred to lever 2 (**613**) through pin (**875**), and rotates at (**B**) fulcrum in arrow direction. Furthermore the lever 2 movement is transferred to feedback lever (**611**) through pin (**897**) and rotates at (**C**) fulcrum in the same arrow direction as (**B**). Consequently the spool (**652**) connected to feedback lever moves towards (**D**). When the spool moves towards (**D**), the port CL connected to tank port is open and the pressure in servo piston large bore diameter chamber is released, consequently the servo piston (**532**) moves towards (**E**) according to delivery pressure Pd1 in small bore diameter piston chamber, resulting in the rise of flow rate.
Since the feed back lever is connected to the servo piston and spool, the feed back lever rotates at (**F**) fulcrums with the movement of the servo piston towards (**E**), consequently the spool is returned to the original position.
With this movement, the opening of spool sleeve gradually closes, and the servo piston stops at the position the opening closes completely.

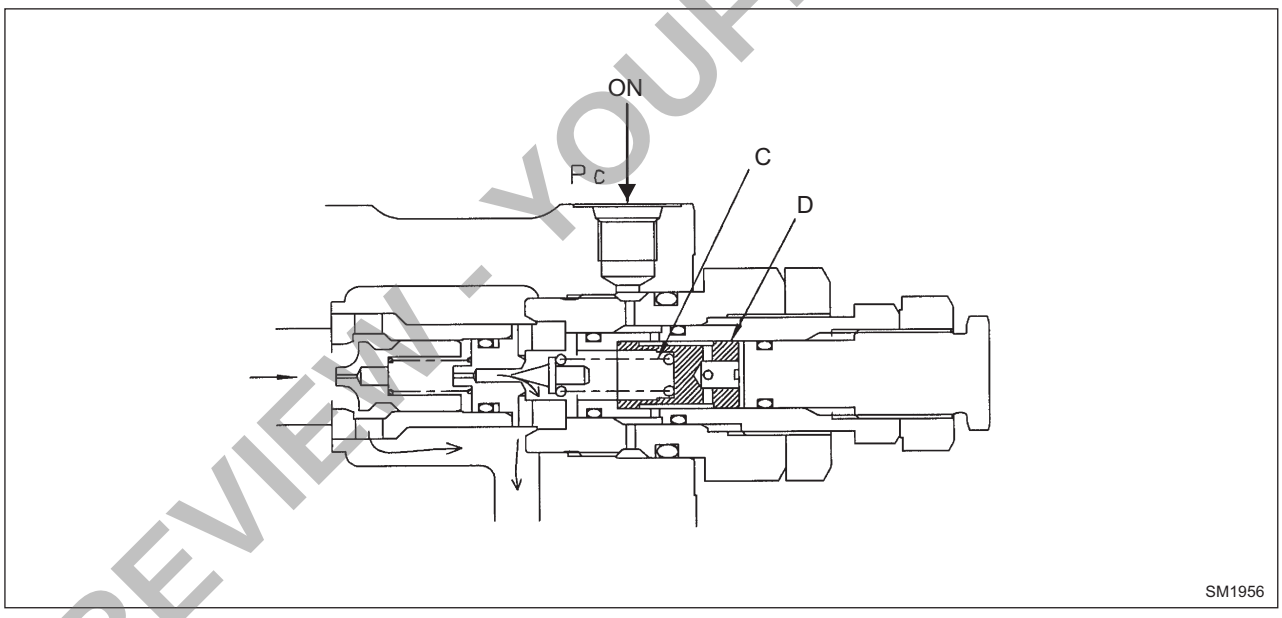


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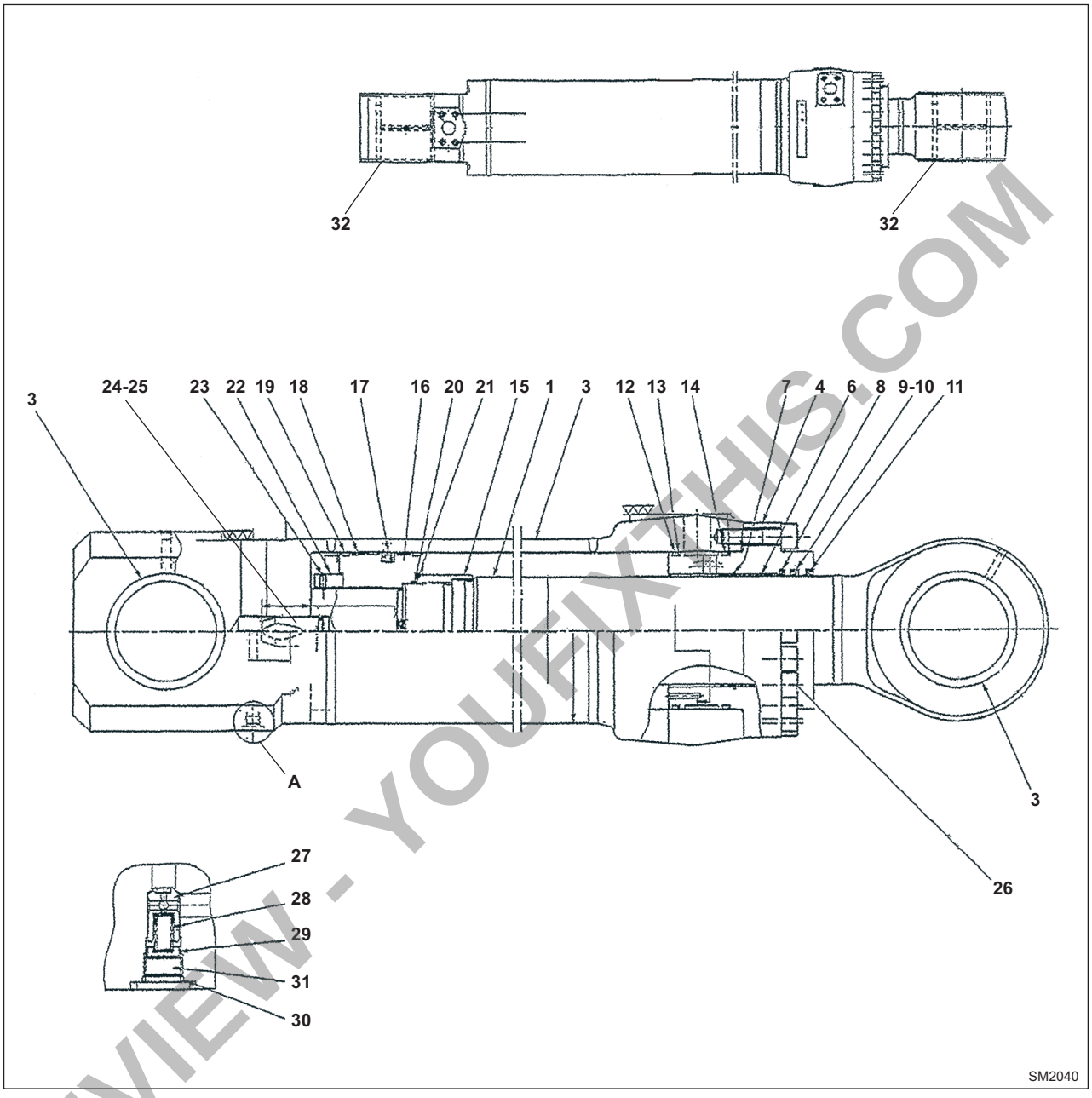
1.3. As oil flows from the pump port to the tank passage through the orifice "**2**" of the main poppet "**A**", the pressure of the chamber "**3**" comes to lower than that of the pump port. Then the main poppet "**A**" is lifted and pressured oil flows into the tank passage.



2. High Pressure Setting (**Pc** Pilot port: ON, proportional valve SV-2 ATT boost operated).
Piston "**D**" is positioned in left side by the pilot pressure "**Pc**".
The setting force of the spring "**C**" increases and the relief setting pressure changes to the high pressure.

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Arm cylinder



1 - **Rod assy**
2 - **Tube assy**
3 - **Bushing** (Q.ty 2)
4 - **Cover**
6 - **Bushing**
7 - **Retaining ring**
8 - **Seal**
9 - **Seal**
10 - **Backup ring**
11 - **Dust seal**
12 - **O-Ring** (Q.ty 2)
13 - **Backup ring** (Q.ty 2)
14 - **O-Ring**
15 - **Ring**
16 - **Piston** 981 ± 98 Nm (724±72 lbf·ft)
17 - **Piston seal**
18 - **Wear ring** (Q.ty 3)
19 - **Ring** (Q.ty 2)
20 - **O-Ring**
21 - **Backup ring** (Q.ty 2)
22 - **Nut** 1860 ± 186 Nm (1372 ± 137 lbf·ft)
23 - **Setscrew** 14.7 Nm (10.8 lbf·ft)
24 - **Cushion**
25 - **Ring**
26 - **Capscrew** (Q.ty 20) 353~382 Nm (260~282 lbf·ft)
27 - **Orifice**
28 - **Spring**
29 - **Spacer**
30 - **O-Ring**
31 - **Plug** 49 Nm (36 lbf·ft)
32 - **Seal** (Q.ty 4)

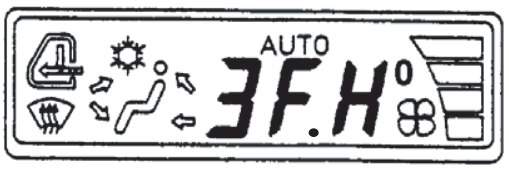
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3. Contents of monitor mode display

Refer to the list of segment display exclusively used for monitor and the list of segments in three digits.

1. Example 1



SM0065

When the segment exclusively used for monitor indicates 0 (displays the inner air sensor condition), since the segment indicates 3F, the sensor is in normal operating condition according to the list of 3 segments.
--> The inner air sensor is in normal operating condition.

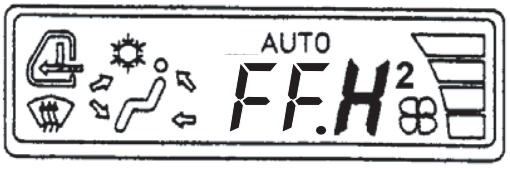
2. Example 2



SM0066

When the segment exclusively used for monitor indicates 1 (displays the evaporator sensor condition), since the segment indicates 00, the sensor is in disconnection condition according to the list of 3 segments.
--> The evaporator sensor is in disconnection condition.

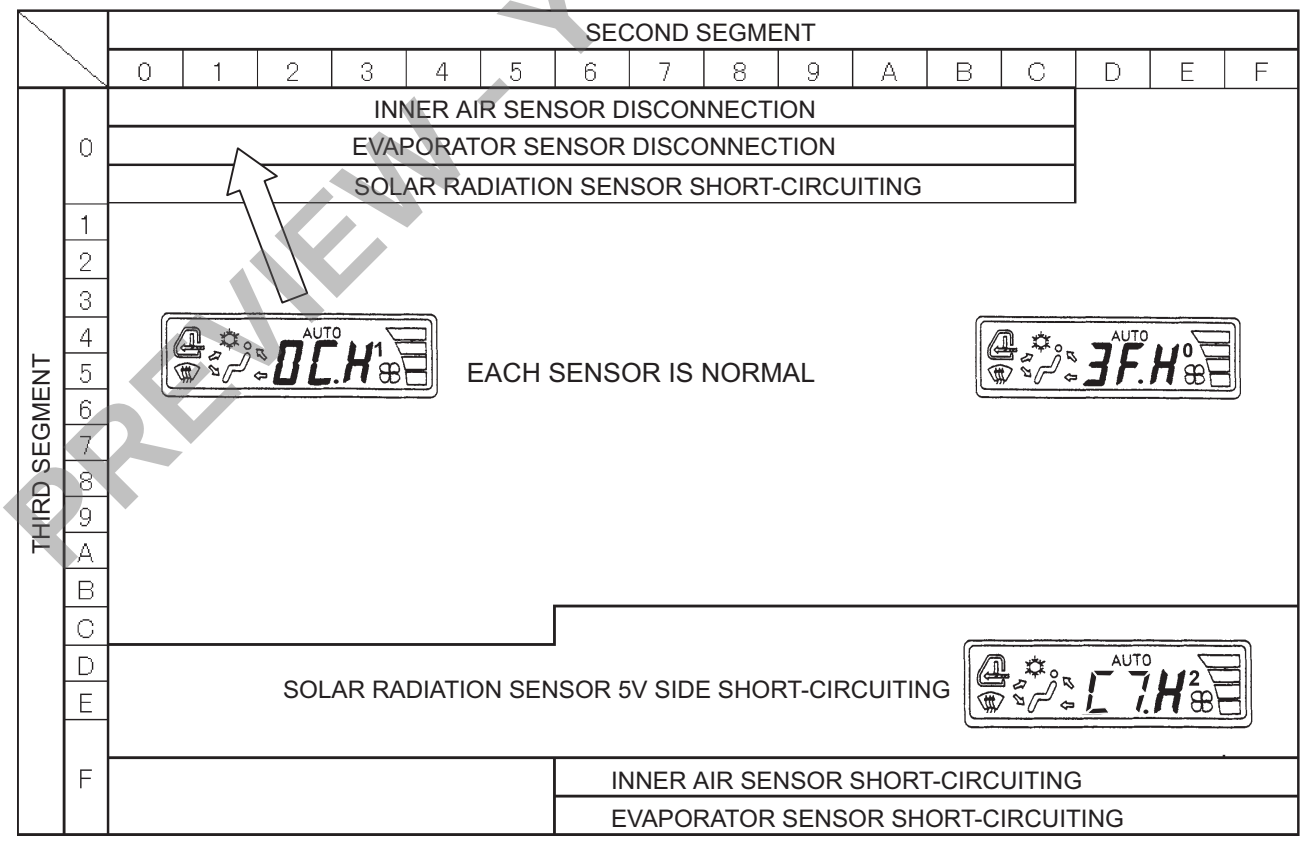
3. Example 3



SM0067

When the segment exclusively used for monitor indicates 2 (displays the solar radiation sensor condition), since the segment indicates FF,the sensor is in short-circuiting condition according to the list of 3 segments.
-->The solar radiation sensor is in short-circuiting condition.

4. List of 3 segments



SM0068

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TROUBLESHOOTING



CONTENTS

Group 1 - Troubleshooting (by Error Codes)

1. Judgment of actual thing at site T5-1-1
2. Classification on failure and troubleshooting T5-1-2
3. The blown fuse of Mechatro Controller T5-1-2
4. Troubleshooting by Error Codes T5-1-2

Group 2 - Troubleshooting (by trouble)

1. Hydraulic system T5-2-1
2. Electric systems T5-2-27
   - 2.1 Wiring checking procedure T5-2-27
   - 2.2 Trouble T5-2-30
3. Engine T5-2-34

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Table 60

Error code	**D063**		
Trouble	Arm-in spool 2 proportional valve's wiring is disconnected.		
Judging condition	The feed-back value from proportional valve is 100 mA or less. (If output is 100 mA or less, judging is not done.)		
Symptom	Operability of combined operation with arm-in becomes poor.		
Control in the event of failure	Set Arm-in spool 2 proportional valve output to 0 mA.		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.	8	D-4 ARM IN-2-SPEED
	Screen No.		
	Screen No.		
Checking object			Checking contents and remedy
1	• Arm-in spool 2 proportional valve PSV-A		When D063 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between Arm-in spool 2 proportional valve and controller CN-121F CN-105F		When D063 is displayed after turning the starter switch on after the connector is exchanged with other sensor. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.
3	• Mechatro controller		Check that the error is corrected after replacement of controller.

Table 61

Error code	**E012**		
Trouble	P1 pump proportional valve and output transistor ON are failure.		
Judging condition	The feed-back value from proportional valve is 1000 mA or more.		
Symptom	The delicate operability of P2 pump related attachment becomes poor.		
Control in the event of failure	Set proportional valve output rate of P1 and P2 pumps to 0 mA. (Hydraulic pump emergency mode)		
Returned in normal condition	Not returned automatically under normal condition. Switch the power OFF once and turns on it again.		
Service diagnosis checking screen	Screen No.	9	E-1 PUMP P1
	Screen No.		
	Screen No.		
Checking object			Checking contents and remedy
1	• P1 pump proportional valve PSV-P1		When E012 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it. When replacing of connector is executed, turn off power source once.
2	• Wiring between P1 pump proportional valve and controller CN-141F CN-105F		When E012 is displayed after turning the starter switch on after the connector is exchanged with other sensor. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. When replacing of connector is executed, turn off power source once.
3	• Mechatro controller		Check that the error is corrected after replacement of controller.

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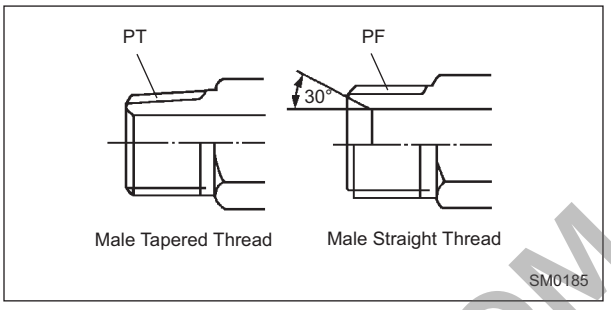
No.	Sections	Contents/normal value		Corrective action, others
7	Secondary pressure of P1, P2 pump proportional valve	Measure the pump proportional valve secondary pressure directly (Ports a6, a7)	Check that secondary pressure of P1/P2 pump proportional valve are within the range of following. P1/P2 pump proportional valve: 2.8 MPa or more.	Replace proportional valve
8	Attachment boost solenoid command	Carry out service diagnosis	No.3 POWER BOOST Bucket digging COMP OFF, MEAS OFF	Check harness Replace solenoid valve
9	Attachment boost solenoid secondary pressure	Measure switching valve secondary pressure	Check that pressure is 0 MPa in bucket digging full lever and high idling operation	Replace solenoid valve
10	Actual measuring current value of P2 bypass cut proportional valve	Carry out service diagnosis	• See Service Diagnosis Data List Operation No.12 Bucket digging full lever & relief	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
11	Secondary pressure of P2 bypass cut proportional valve	Measure directly the proportional valve secondary pressure at the port A5 (Bypass cut) of 8 sections solenoid block	Check that travel straight secondary pressure is 2.7 MPa or more in bucket digging full lever and high idling operation	Replace proportional valve
12	P2 by-pass cut valve <Trouble> Only P2 pressure is low.	Visual check	No problem for sliding ability of main poppet and no contamination on orifice No problem for sliding ability of internal piston.	Clean or replace
13	Check stroke limiter <Trouble> Both P1, P2 pressures are high.	Visual check	When piston is removed from cover, it is free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface	Replace (Check on the casing side for damage.)
14	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage	Replace
15	Main relief valve	Check set pressure	• See Service Diagnosis Data List Operation No.3 Boom up full lever and relief	Reset or replace
16	Travel straight spool <Trouble> P2 pressure is high.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage.	Replace (Check on the casing side for damage)
17	Bucket spool <Trouble> Both P1, P2 pressures are high.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage.	Replace (Check on the casing side for damage)
18	Over load relief valve	Check targeted spool visually	Free from dust entered in over load relief valve. Seat is free from abnormality.	Replace

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Screwed-In Connection

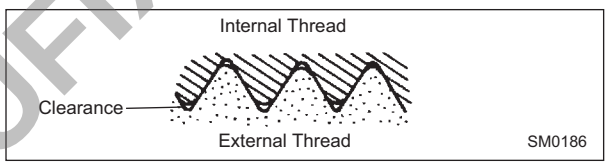
IMPORTANT: *many types of screwed-in connections are used for hose connections.*
Be sure to confirm that the thread pitch and thread type (tapered or straight) are the correct type before using any screw-in connection.



Male Tapered Thread	
Wrench Joint Body	**Tightening Torque (Nm)**
17, 19	34
22	49
27	93
36, 32	157
41	205
50	320
60	410

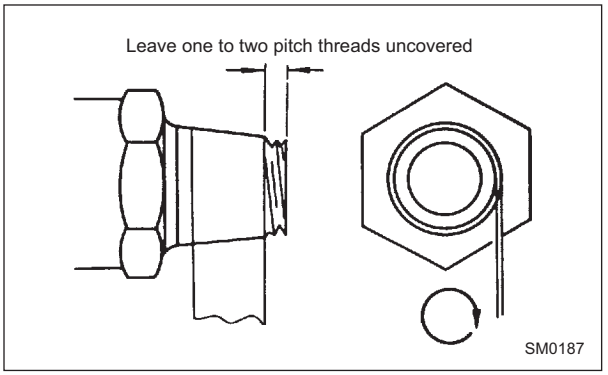
Seal Tape Application

Seal tape is used to seal clearances between male and female threads, so as to prevent any leakage between threads.
Be sure to apply just enough seal tape to fill up thread clearances. Do not overwrap.



- Application Procedure

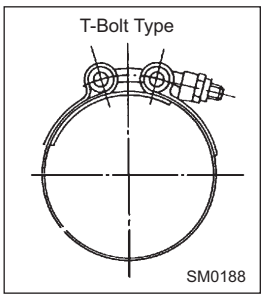
  Confirm that the thread surface is clean, free of dirt or damage.
  Apply seal tape around threads as shown. Wrap seal tape in the same direction as the threads.

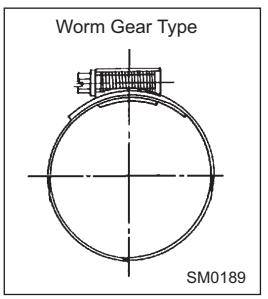


Low-Pressure-Hose Clamp Tightening Torque

Low-pressure-hose clamp tightening torque differs depending on the type of clamp.
See below for correct tightening torque of each type of low-pressure-hose clamp.

T-Bolt Type Band Clamp:
4.4 Nm (0.45 kgf m)
Worm Gear Type Band Clamp:
5.9 a 6.9 Nm (0.6 a 0.7 kgf m)

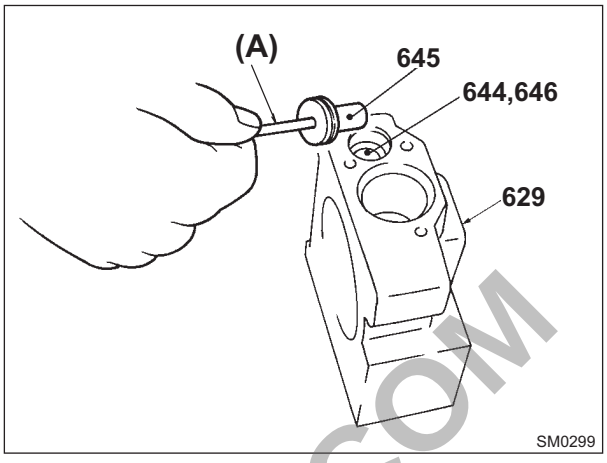




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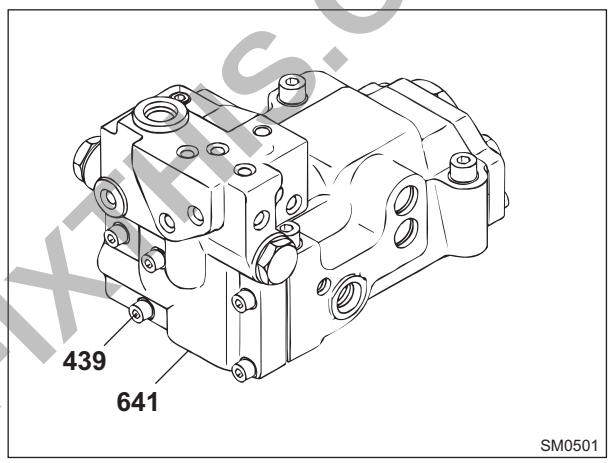
6. After removing the cover (**629**) sub assy, take out outer spring (**625**), inner spring (**626**) and spring seat (**624**) from the compensating part. Then take out adjust stem (**645**), pilot spring (**646**) and spring seat (**644**) from the pilot part.



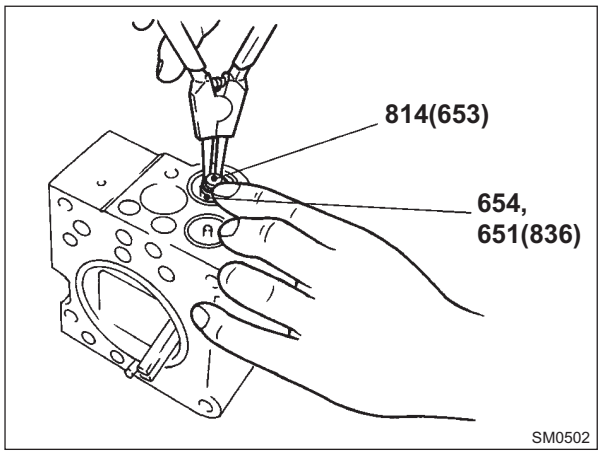
NOTE: *adjust stem (**645**) comes out easily if an M4 bolt is used (**A**).*

7. Remove socket bolt (439) and pilot cover (**641**). Once the pilot cover comes off, separate set spring (**655**) from the pilot section.

: 5 mm

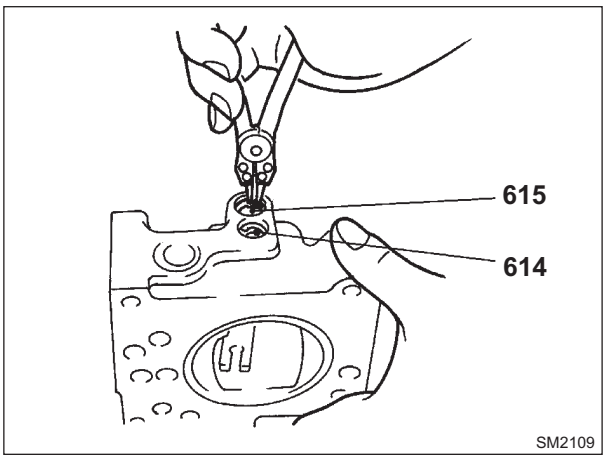


8. Remove snap ring (**814**), spring seat (**653**), return spring (**654**) and sleeve (**651**).



NOTE: *sleeve (**651**) is equipped with snap ring (**836**).*
*When removing snap ring (**814**), return spring (**654**) comes out, use care so as not to lose it.*

9. Loosen socket bolt (**418**), remove cover (**698**) and take out fulcrum plug (**614**) and adjust plug (**615**).



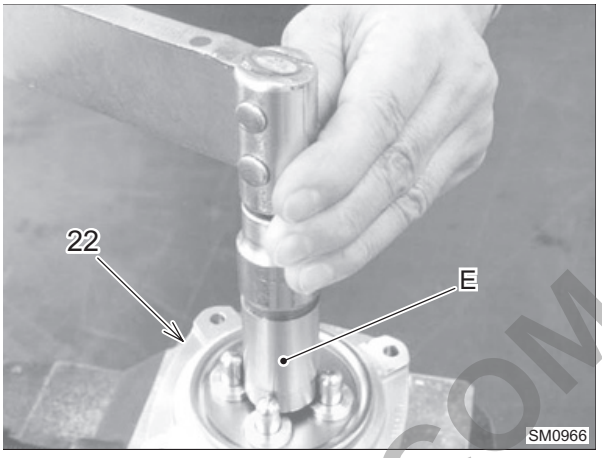
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1 - **Inner ring**
2 - **Oil seal**
3 - **Tapered roller bearing**
4 - **Retaining spring**
5 - **Cam plate**
6 - **Return plate**
7 - **Piston assy** (Q.ty 9)
8 - **Lining plate** (Q.ty 3)
9 - **Friction plate** (Q.ty 3)
10 - **O-Ring**
11 - **Brake piston**
12 - **O-Ring**
13 - **Spring** (Q.ty 19)
14 - **Piston** (Q.ty 2)
15 - **Cap** (Q.ty 3), 29 Nm (22 lbf·ft)
16 - **O-Ring** (Q.ty 3)
17 - **Pin** (Q.ty 2)
18 - **Disc spring** (Q.ty 4)
19 - **Teflon ring** (Q.ty 4)
20 - **Bushing** (Q.ty 4)
21 - **Balance plate**
22 - **Needle bearing**
23 - **Retaining ring**
24 - **Cylinder**
25 - **Housing**
26 - **Collar**
27 - **Retaining ring**
28 - **By-pass hyd. valve** (Q.ty 2), 78 Nm (58 lbf·ft)
29 - **Back-up ring** (Q.ty 2)
30 - **O-Ring** (Q.ty 2)
31 - **O-Ring** (Q.ty 2)
32 - **Cover**
33 - **Relief valve** (Q.ty 2), 78 Nm (58 lbf·ft)
34 - **O-Ring** (Q.ty 4)
35 - **Capscrew M16x60** (Q.ty 4), 284 Nm (209 lbf·ft)
36 - **Check valve** (Q.ty 2)
37 - **Spring** (Q.ty 2)
38 - **Plug** (Q.ty 2), 137 Nm (101 lbf·ft)
39 - **Back-up ring** (Q.ty 2)
40 - **Plug**
41 - **Piston** (Q.ty 2)
42 - **Teflon ring** (Q.ty 2)
43 - **O-Ring**

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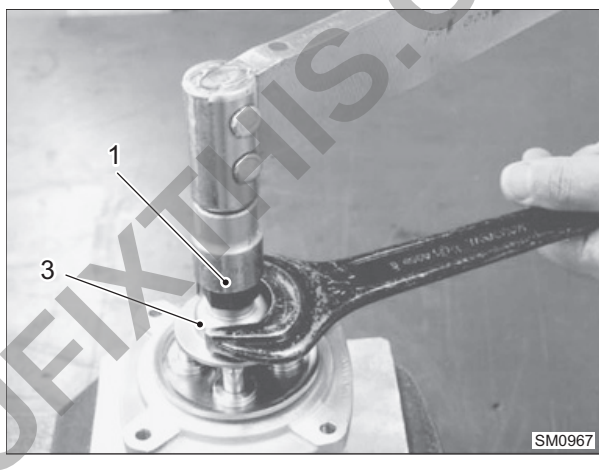
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7. nstall joint (**4**) on casing (**22**) with special tool (**E**) (**380001055**) securely.
   - : 22 mm
   - : 47.1±2.9 Nm (34.8±2.1 lbf·ft)



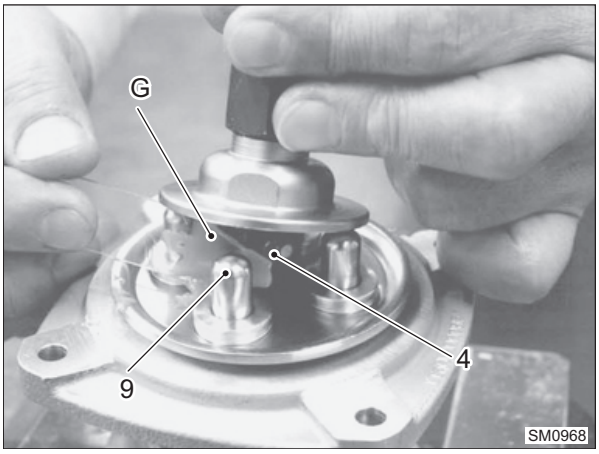
8. Install circular plate (**3**) to joint (**4**).

IMPORTANT: *screw it in until it comes in contact with 4 push rods (**9**) equally.*
The exceeding of screw in may cause malfunction of machine.



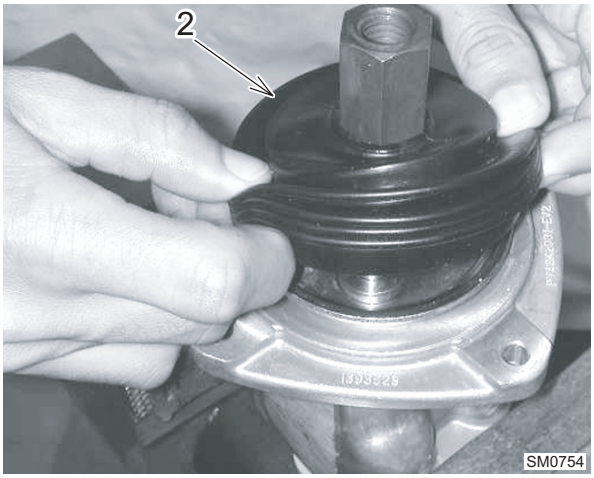
9. Screw adjusting nut (**1**), applying Loctite #277 to the thread of joint, until it touches circular plate (**3**), and tighten it applying spanner to stop circular plate returning.
   - : 22 mm
   - : 68.6±4.9 Nm (50±3.6 lbf·ft)
   - : 32 mm

10. Apply heat-resisting grease (**G**) to joint (**4**) rotating section and the top of push rod (**9**).



11. Cover it with boots (**2**).

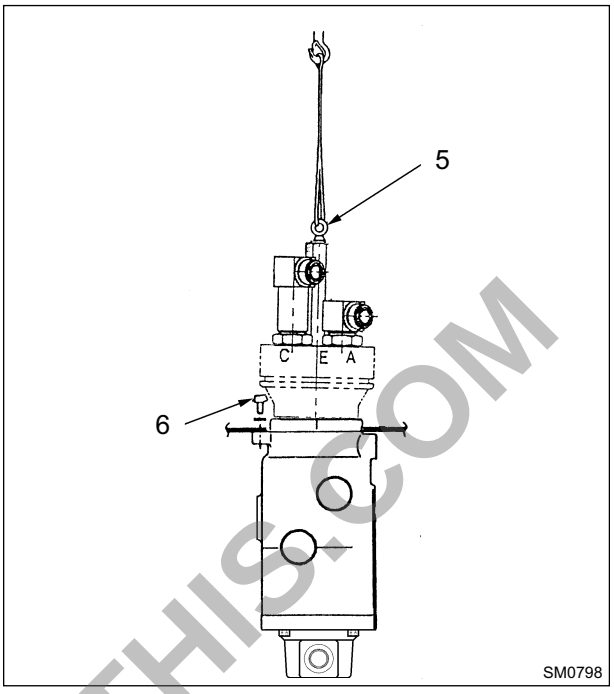
12. Spray rust preventives through each port and attach plug respectively.



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13. Attach eye bolt (**5**), lift it up temporarily, and remove four screws (**6**) M16x40.

    : 24 mm
    : 279 ± 29 Nm (205.8 ± 21.3 lbf·ft)



NOTE: *swivel joint mass: 52.8 kg (116.4 lbs).*

Installation

NOTE: *refer to "Removal" section above for wrench sizes and tightening torque.*

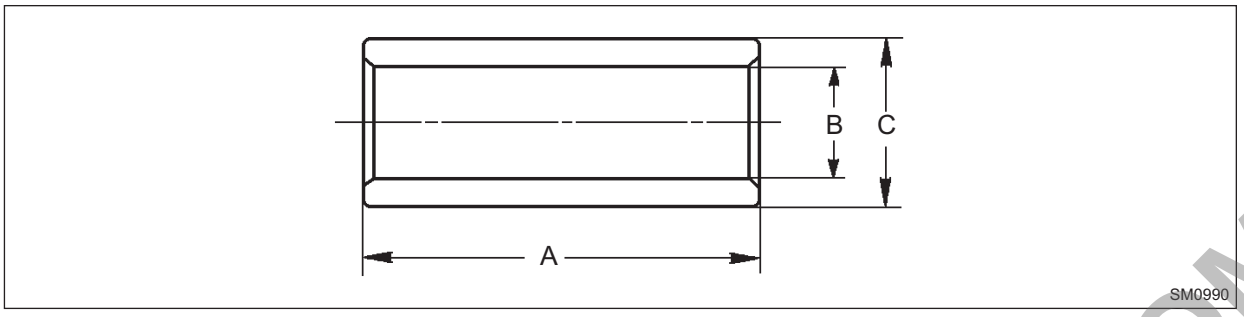
1. Proceed with the re-installation of the centre joint following the operation in reversed order with respect to the removal.

NOTE: *swivel joint mass: 52.8 kg (116.4 lbs).*

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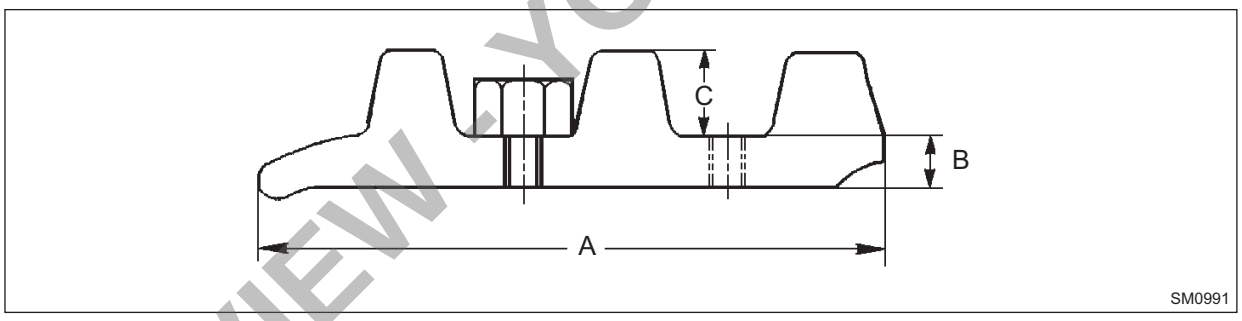
Master Bushing



Unit: mm (in)

	Standard	Allowable Limit	Remedy
A	160 (6.299)	-	Replace
B	Ø 49.5 (Ø 1.949)	Ø 53 (Ø 2.087)	
C	Ø 73.33 (Ø 2.887)	Ø 70 (Ø 2.756)	

Suola



Unit: mm (in)

	Standard	Allowable Limit	Remedy
A	254 ± 3.5 (10.000 ± 0.137)	-	Replace
B	18 ± 0.8 (0.709 ± 0.031)	-	
C	37 ± 1 (1.457 ± 0.039)	20 (0.787)	

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6. How to read explanation details

(1) Part layout

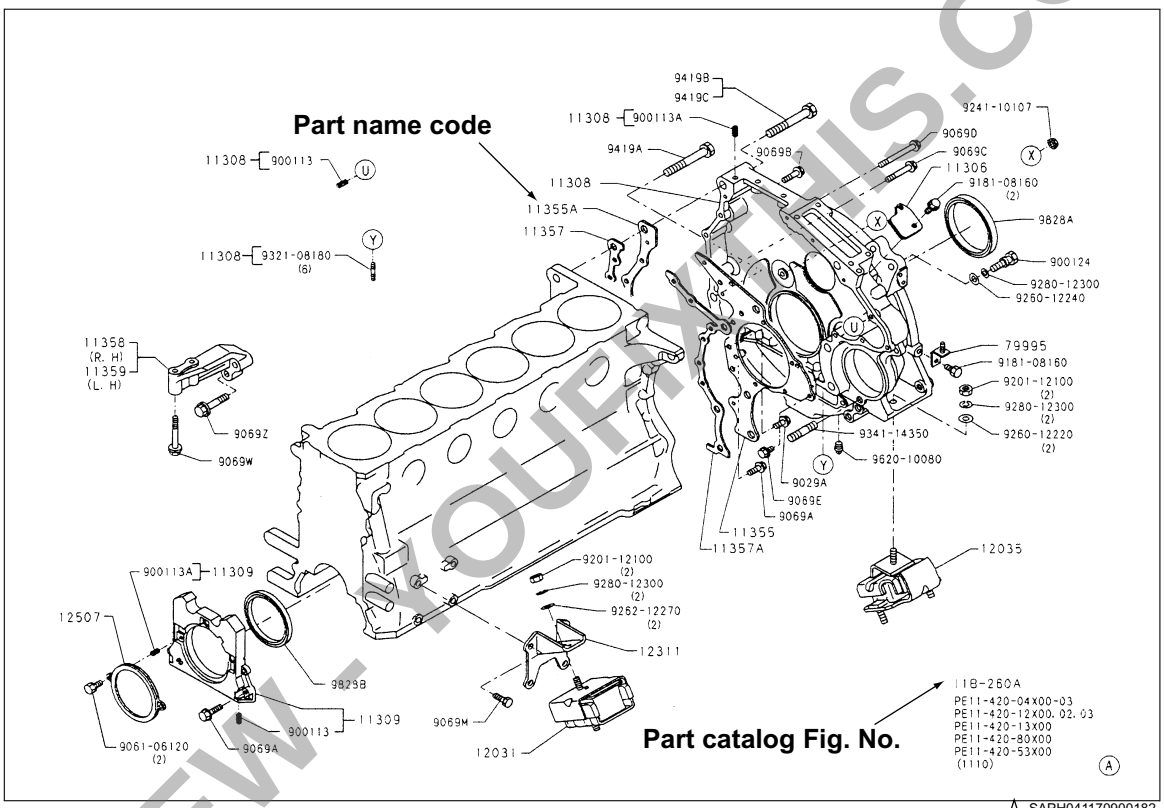
Example

ENGINE MECHANICAL [J08E] 9–17

Timing Gear Cover and Flywheel Housing

Part layout

JP04117090402003



SAPH041170900182

11308	Flywheel housing	11390	End plate
11309	Oil seal retainer	9828A	Front oil seal*
11357	Gasket*	9828B	Rear oil seal*
11357A	Gasket*		

Description of part name code

*Parts not to be reused.

Left: Part name code (nut)

Tightening torque

9069H	M14 : 171.5N m{1, 750kgf cm}	9419A	M16 : 196N m{2, 000kgf cm}
9069J	M12 : 97N m{990kgf cm}	9419B	M16 : 196N m{2, 000kgf cm}

SAPH300020100001

I It is the ID number for parts to prepare electronic data. It is not required for repair work.

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Inspection item		Standard value	Repair limit	Operation limit	Action
Start magnet switch assembly	Between C terminal and M terminal (P coil)	0.12 - 0.14 Ω	—	—	Replace start magnet switch assembly.
	Between C terminal and body (H coil)	1.13 - 1.25 Ω	—	—	

Tightening torque (starter)

JP30109020205014

Unit:N·m{kgf·cm,lbf·ft}

Tightening area	Tightening torque	Remark
Starter mounting nut	127{1,300, 114}	
M lead wire mounting nut	12.3 - 15.2{126 - 154, 9.1 - 11.0}	
Rear bracket mounting through bolt	15.7 - 17.6{160 - 179, 11.6 - 12.9}	
Brush holder fixing bolt of rear bracket	3.6 - 4.9{37 - 49, 2.6 - 3.6}	
Start magnet switch assembly mounting bolt at pinion case	3.6 - 4.9{37 - 49, 2.6 - 3.6}	
Battery cable mounting nut	16 - 22{165 - 225, 12 - 16}	

Turbocharger

Standard value

JP30109020205015

Unit:mm{in.}

Inspection item	Standard value	Operation limit	Action
Shaft axial play	0.06 - 0.09 {0.0023 - 0.0035}	0.110{0.0043}	Replacement
Shaft radial play	0.10 - 0.17 {0.0039 - 0.0067}	0.205{0.0081}	Replacement

Tightening torque

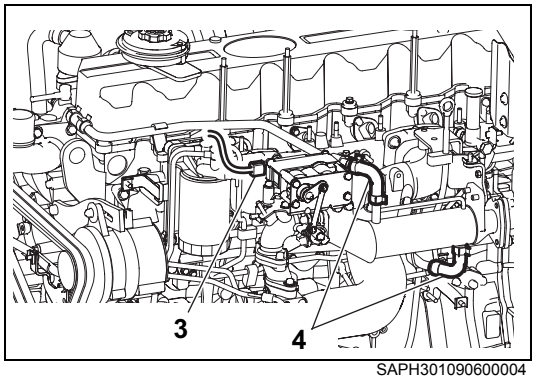
JP30109020205016

Unit:N·m{kgf·cm,lbf·ft}

Tightening area	Tightening torque	Remark
Turbocharger mounting nut	59{600, 44}	

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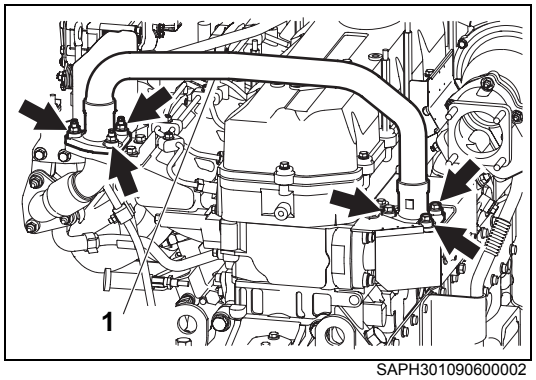
SAPH301090600004

(5) Connect the coolant hose (4) to be connected to the EGR cooler.

(6) Connect the wiring (3) to be connected to EGR valve and EGR cooler.

(7) Return the shifted engine harness to its original position.

(8) Fill up coolant.



SAPH301090600002

6. EGR pipe installation

(1) Replace the gaskets by new ones and install EGR pipe (1).
Tightening torque:72N·m{734kgf·cm,53 lbf·ft}(Nut)

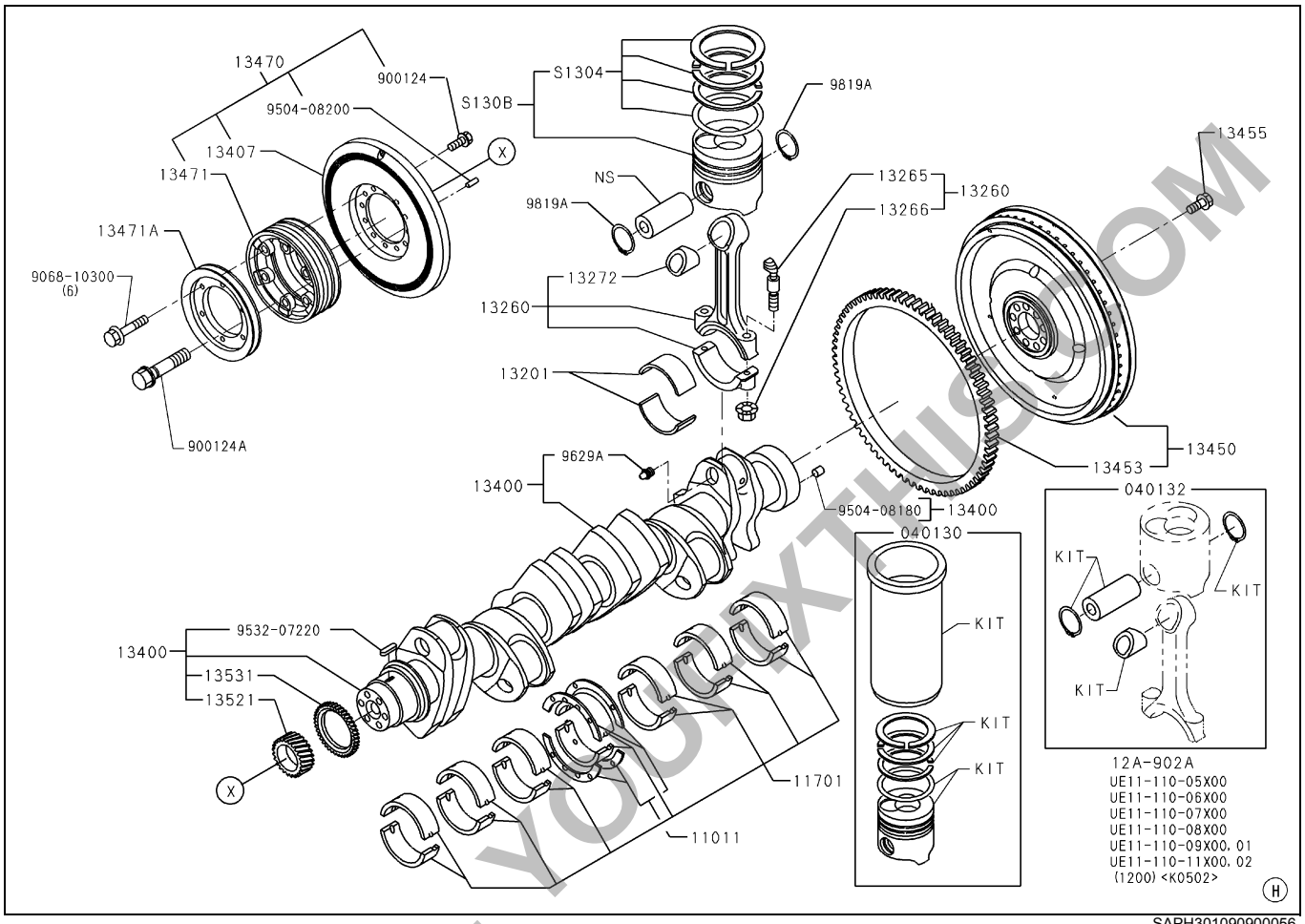
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Main Moving Parts

Part layout

JP30109090402004



SAPH301090900056

04132	Piston pin	13453	Ring gear
11011	Thrust bearing	13470	Crankshaft pulley assembly
11701	Crankshaft bearing	13471	Crankshaft pulley
13201	Connecting rod bearing	13521	Crankshaft gear
13260	Connecting rod assembly	13531	Oil pump drive gear
13265	Connecting rod bolt	9532-07220	Key
13272	Connecting rod bushing	9819A	Retainer ring*
13400	Crankshaft assembly	S1304	Piston ring
13407	Crankshaft damper	S130B	Piston assembly

*Parts not to be reused.

Tightening torque

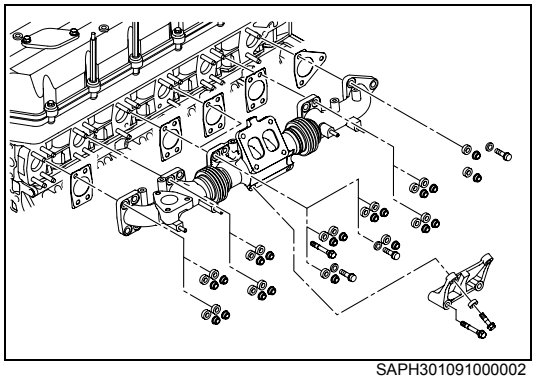
13266	69N·m{700kgf·cm,51 lbf·ft}+90°+90°	900124	108N·m{1,100kgf·cm,80 lbf·ft}
13455	270N·m{2,750kgf·cm,200 lbf·ft}(Standard)	900124A	245N·m{2,500kgf·cm,180 lbf·ft}
13455	225N·m{2,290kgf·cm,166 lbf·ft}(Vehicle with PTO)	9068-10300	55N·m{560kgf·cm,41 lbf·ft}

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Replacement

JP30109100704001



SAPH301091000002

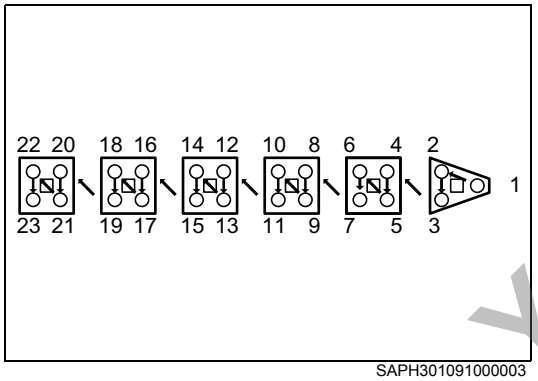
1. Removal of exhaust manifold

(1) Remove the turbocharger.
(2) Remove the insulator.
(3) Remove the exhaust manifold bracket.
(4) Remove the exhaust manifold.

2. Replacement of stud bolt

(1) Remove dirt (e.g. sealant) at the female thread of the cylinder head and clean the thread again with tap (M10 x 1.5).
(2) Tighten the new stud bolt.
Tightening torque : 30 N·m {300 kgf·cm, 22 lbf·ft}

⚠ **CAUTION** • **Excessive tightening with overtorque may cause crack in the cylinder head.**

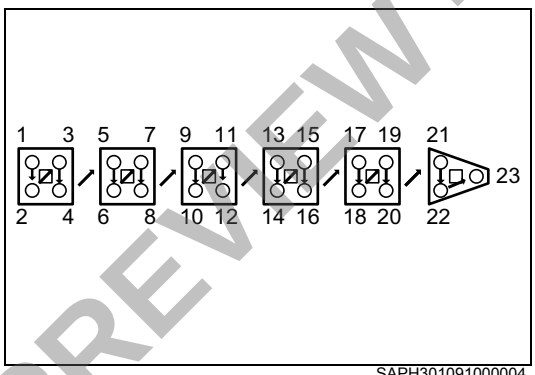


SAPH301091000003

3. Installation of exhaust manifold

(1) Install a new gasket and align the exhaust manifold with the cylinder head.

(2) Tighten the nuts from the top to the bottom and from the right to the left.
Tightening torque : 44 N·m {450 kgf·cm, 32 lbf·ft}



SAPH301091000004

(3) Tighten the nuts again from the top to the bottom and from the right to the left.

Tightening torque : 59 N·m {600 kgf·cm, 44 lbf·ft}

⚠ **CAUTION** • **Be sure to retighten it.**

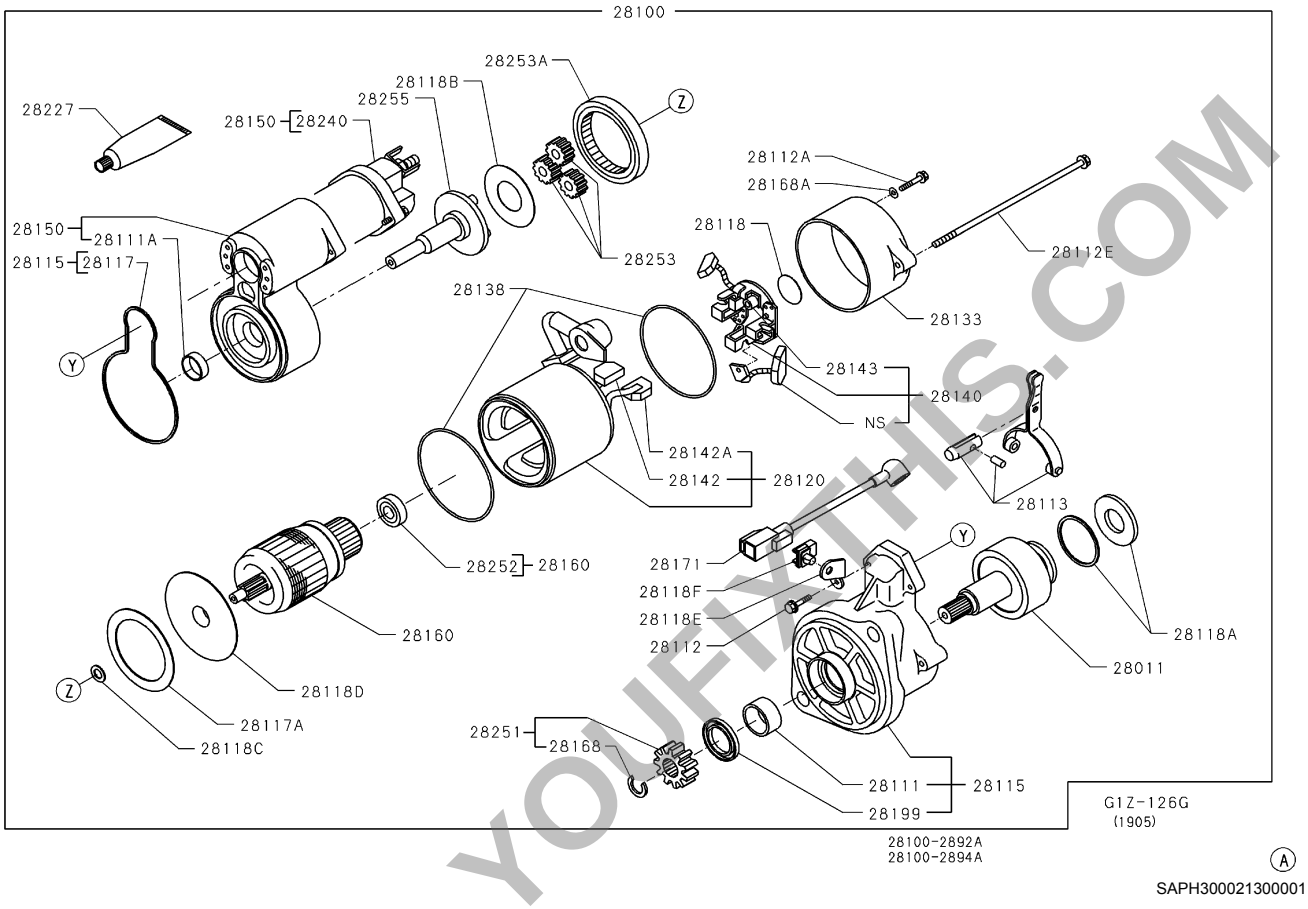
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Starter

Part layout (typical example)

JP30002130402001



28011	Clutch subassembly	28138	Packing*
28100	Starter	28140	Brush holder assembly
28111	Bushing	28142	Brush
28111A	Bushing	28143	Spring
28113	Lever	28150	Center bracket
28115	Start drive housing	28160	Armature assembly
28117	Packing*	28168	Pinion stopper
28117A	Packing*	28199	Dust protector
28118	Plate	28240	Start magnet switch
28118A	Plate	28251	Pinion
28118B	Plate	28252	Bearing
28118C	Plate	28255	Shaft assembly
28118D	Cover	28253	Planetary gear
28120	Yoke assembly	28253A	Internal gear
28133	Commutator end frame		

*Parts not to be reused.

Tightening torque

28112	14-16 N·m{140-160kgf·cm, 10-12lbf·ft}	28112E	15.7-17.6 N·m{160-179kgf·cm, 12-13lbf·ft}
28112A	3.6-4.9 N·m{37-49kgf·cm, 3-4lbf·ft}		

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Turbocharger

JP03Z01020601005

Status	Cause	Action
Exhaust smoke is black (insufficient intake air).	Clogging of air cleaner element	Clean or replace air cleaner element.
	Air intake inlet is closed.	Recover normal status.
	Leak from connection of air intake system	Check and repair.
	Revolution of blower impeller and turbine shaft is heavy	Replacement
	Defective waste gate operation	Check and replace.
Exhaust smoke is black (Turbocharger is not operating).	Oil impurities are deposited at the sealing part of the turbine and revolution of the turbine shaft is heavy.	Replace engine oil and disassemble the turbocharger for cleaning.
	Seizure of bearing	Replace turbocharger.
	Seizure of bearing (insufficient lubrication or clogging of oil pipe)	Check the oil system of the engine and repair faulty areas. Also, replace engine oil.
	Seizure of bearing (Oil temperature is too high.)	Check the oil system of the engine and repair faulty areas. Also, replace engine oil.
	Seizure of bearing (Balance of revolving body is poor.)	Replace turbocharger.
	Seizure of bearing (insufficient warm-up or sudden stop from loaded operation: Unloaded operation)	Observe the precautions strictly in the operation manual.
	Contact of or damage to turbine shaft and blower impeller (excessive operation)	Check and repair engine parts.
	Contact of or damage to turbine shaft and blower impeller (excessive increase of exhaust gas temperature)	Check and repair engine parts.
	Contact of or damage to turbine shaft and blower impeller (entry of foreign matter)	Inspect the air cleaner and the engine parts and repair or replace the turbocharger.
	Contact of or damage to turbine shaft and blower impeller (wear of bearing)	Replace turbocharger.
	Contact of or damage to turbine shaft and blower impeller (faulty assembly)	Replacement

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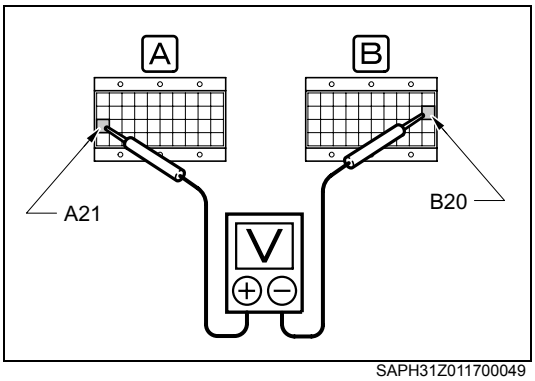
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Accelerator sensor 1 malfunction (DTC code P2122, P2123)

JP31Z01170601020

DTC	P2122	Accelerator sensor circuit 1 low voltage
DTC	P2123	Accelerator sensor circuit 1 high voltage

1	Measurement of voltage between terminals



SAPH31Z011700049

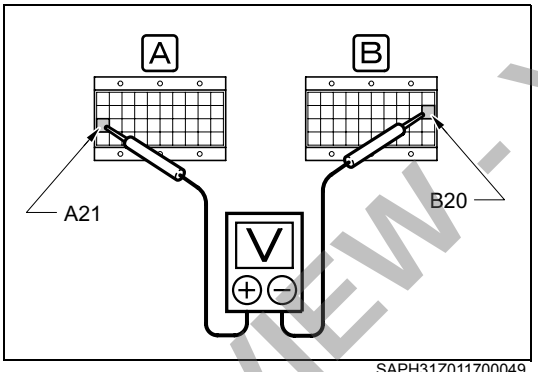
1. Set the starter key to "OFF" and connect the signal check harness.
2. Set the starter key to "ON" and measure the voltage between terminal A21 and terminal B20 of the signal check harness.

Standard value : 1.0 - 1.5V (idle status)

NG → [3] Voltage measuring at the output port of the mechatronic controller

OK

2	Measurement of voltage between terminals



SAPH31Z011700049

1. While increasing the throttle, measure the voltage between terminal A21 and terminal B20 of the signal check harness.

Standard value

Measuring item	Engine revolution(r/min)	Voltage(V)
Low idle	800	Approx. 1.0
High idle	1,850	Approx. 2.9

NG → Defective mechatronic controller

OK

Harness failure

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