WSM

WORKSHOP MANUAL
KUBOTA EXCAVATOR

KX080-4α2

Kubota

KiSC issued 07, 2019 A

TO THE READER

This Workshop Manual provides service personnel with information about the mechanisms, service and maintenance of the construction machinery. This Workshop Manual is divided into 3 sections, General, Mechanisms and Service.

■ **General**

This section contains information such as engine and equipment ID numbers, general precautions, maintenance schedules, inspections and maintenance items and special tools.

■ **Mechanisms**

This section describes the structure of mechanisms and explains their functions.Be sure that you fully understand this Mechanisms section prior to performing any service work, such as troubleshooting or when performing any disassembly or assembly work.

■ **Service**

This section contains information and procedures for performing maintenance on the backhoe, such as troubleshooting, service specification tables, torque specifications, items to be inspected and adjusted, disassembly and assembly procedures, as well as precautions, maintenance standard values and usage limits.

All of the illustrations, specifications and other information in this manual were created based on the latest model at the time of publication.

Please be aware that changes to the content may be made without prior notice.

■ **NOTE**

- **For the engine servicing information, please refer to the following engine WSM, DM, or DPF handling manual.**
- **The PDF No. may be changed by revision.**

Manuals related to the engine (V3307-CR-TE5-BH-1)

Manuals	Title	PDF No.
WSM	V2607-CR-E5B, V2607-CR-TE5B, V2607-CR-TIE5B, V3307-CR-TE5B, V3307-CR-TIE5B	9Y311-00070 (English) 9Y311-00080 (French) 9Y311-00090 (German) 9Y311-00100 (Italian) 9Y311-00110 (Spanish)
DM	V2607-CR-E5B, V2607-CR-TE5B, V2607-CR-TIE5B, V3307-CR-TE5B, V3307-CR-TIE5B	9Y310-00070 (English) 9Y310-00080 (French) 9Y310-00090 (German) 9Y310-00100 (Italian) 9Y310-00110 (Spanish)
DPF handling manual	DIESEL ENGINE FOR EXCAVATOR	RY910-22370 (English) RY910-22380 (German) RY910-22390 (French) RY910-22400 (Italian)

May, 2019

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Record of Revisions

Last digit of the Code No.	Date	Main Revised Point and Corrective Measures	Remarks
1	2019.07	Added 2 piece boom specification information.	T. S
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4			

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1. SAFETY FIRST

⚠ SAFETY FIRST

- **This "Safety Alert Symbol" is used in this manual and on labels on equipment to indicate important issues and warn of the danger of personal injury. Read and follow these warnings carefully.**
- **It is important that you thoroughly read these instructions and safety rules prior to working on the equipment and that you always follow them.**

⚠ DANGER
- **Indicates that failure to follow the warning will result in serious injury or death.**

⚠ WARNING
- **Indicates that failure to follow the warning may result in serious injury or death.**

⚠ CAUTION
- **Indicates that failure to follow the warning may result in injury.**

■ IMPORTANT
- **Indicates that failure to follow the warning may result in damage to or a breakdown of the equipment.**

■ NOTE
- **Indicates supplementary explanations that will be helpful when using the equipment.**

[NOTE]
- Indicates other supplementary information to take note of.

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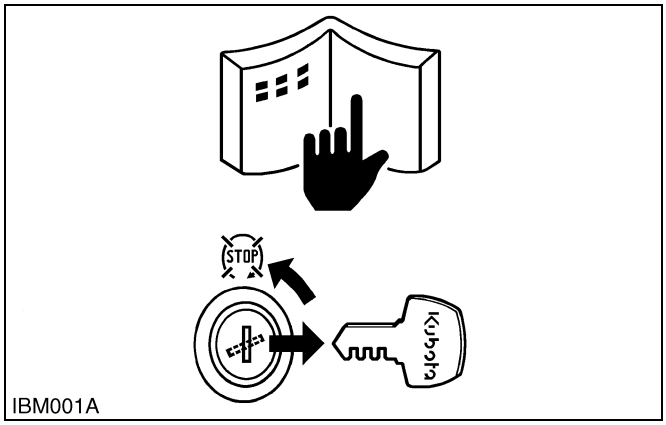
2. IN THE INTEREST OF WORK SAFETY

[1] WORKING SAFELY WITH THE EQUIPMENT MEANS ALWAYS FOLLOWING THESE INSTRUCTIONS:

(1) Precautions Before Working on the Machine



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Before starting any service or maintenance work

- Read all the general and safety instructions in this manual, as well as the decals on your equipment.
- Always stop the engine whenever you leave the driver's seat to inspect or clean the machine or its devices, or to inspect or adjust parts.
- Choose a safe spot for inspecting the equipment-on flat, hard ground.

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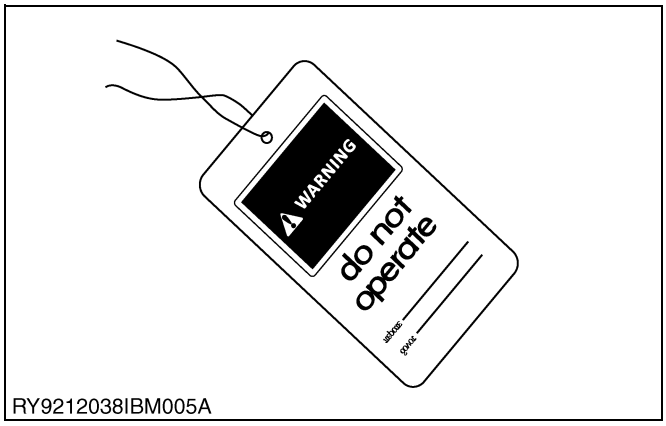

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- When performing maintenance on the equipment, hang the DO NOT OPERATE sign where it will be obvious from and around the driver's seat.
- When performing maintenance or repairs, always lower attachments to the ground, stop the engine and attach the warning sign clearly visible.
- When performing maintenance on the equipment, always disconnect the negative battery cable.
- Before using tools, make sure you understand how to use them correctly and use tools in good condition and of the right size for the job.

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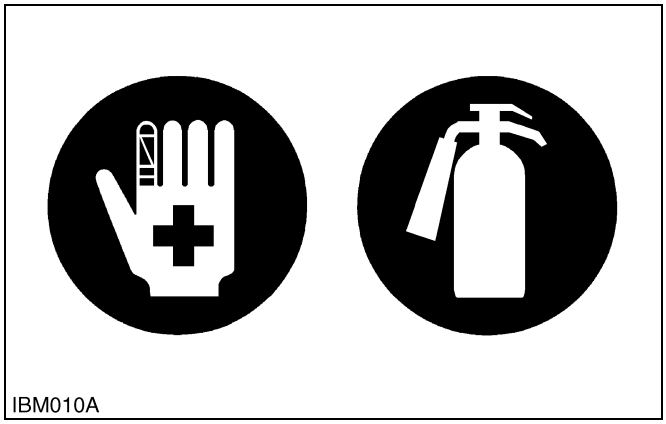

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Be Ready for an Emergency

- Keep a first-aid kit and fire extinguisher close at hand so you can use it when needed.
- Keep emergency contact information for doctors, hospitals and ERs handy.

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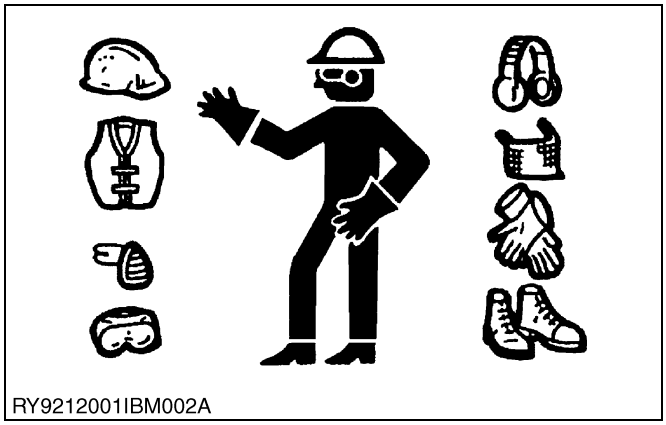

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- Wear clothes appropriate for working on equipment. Do not wear loose-fitting clothes as they may catch on the machine controls.
- When working on the equipment, use all safety gear, such as a helmet, safety glasses and shoes, that are required by law or regulation.
- Never perform maintenance while drowsy or under the influence of alcohol or drugs.

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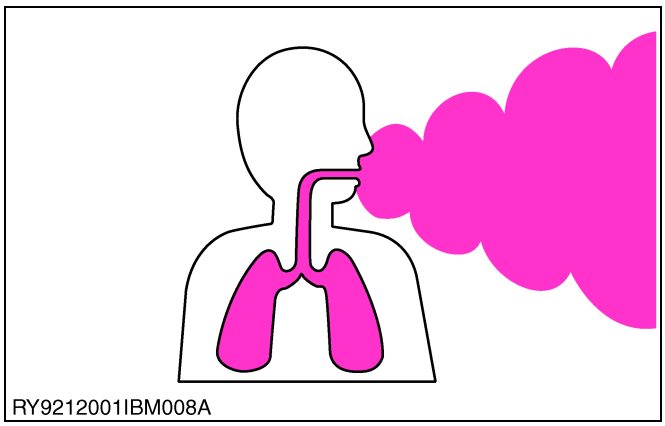
(2) Precautions Before Working on the Equipment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- Stop the machine on a hard and level location and make sure the area around the machine is free of obstacles and hazardous materials. When parking the machine indoors, select a spot that can be properly ventilated.
- When performing work such as with a hammer, fragments may chipping off, so make sure only authorized persons are around the machine.
- Before servicing the machine, clean it off so there is no mud, debris, oil or the like sticking to it.

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- Before getting on/off of the machine, clean off around the steps so there is no mud on them. Always give yourself 3-point support when getting on/off the machine.

CAUTION

- **3-point support means using both legs and one hand or both hands and one leg as you climb up/down.**

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Starting the Machine Safely

- Before starting the engine, always sit in the driver's seat and make sure the area is safe and clear.
- As it is dangerous, never start the engine from anywhere but the driver's seat.
- Always check and make sure control lever(s) are not engaged before starting the engine.
- Never start the engine by hot-wiring the starter circuit. This is not only dangerous, but may damage the machine.

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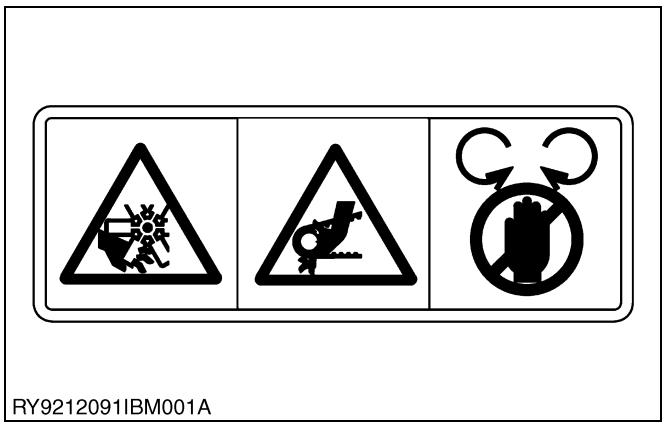
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- Whenever it is necessary to open the engine covers or bonnet in order to service the machine, always prop them open.
- If it is absolutely necessary to run the engine while working on the machine, make sure you are clear of all rotating or moving parts. Also take care not to leave anything, such as tools or rags, near any moving parts.

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- The engine, muffler, radiator, hydraulic line, etc., have parts that remain very hot even after the engine has been stopped. Be sure to avoid these parts, as touching them can result in burns. Radiator coolant, hydraulic fluid and oil also remain hot. Therefore, do not attempt to remove caps and plugs, etc., before these fluids have sufficiently cooled.
- Make sure the coolant temperature has dropped sufficiently before opening the radiator cap.
  Also, since the inside of the radiator is pressurized, when removing the cap, first loosen it to release the pressure before removing the cap completely.

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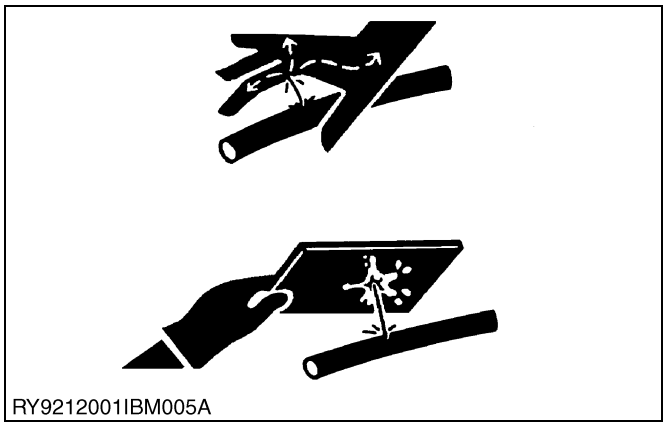
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- The pressure in the hydraulic circuit stays at pressure even after the engine stops.
  Before removing parts, such as hydraulic devices from the machine, first release the pressure. Please note that when releasing residual pressure, the machine itself and/or implements may move without warning, so be very careful when releasing the pressure.
- Oil gushing out under pressure is extremely dangerous as it may pierce your skin or your eyes. Similarly, oil leaking out of pinholes is not visible.
  So when checking for oil leaks, always wear safety glasses and gloves and use a piece of cardboard or a wood block to shield yourself from oil.

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No Smoking or Open Flames while Fueling

- Fuel is extremely flammable and dangerous.
  Never smoke near fuel. If fuel is spilled on the machine, its engine, or electrical parts, it may cause a fire. If fuel is spilled, wipe it all up immediately.
- Never smoke while filling the machine with fuel.
  And always tighten the fuel cap securely and wipe up any spilled fuel.

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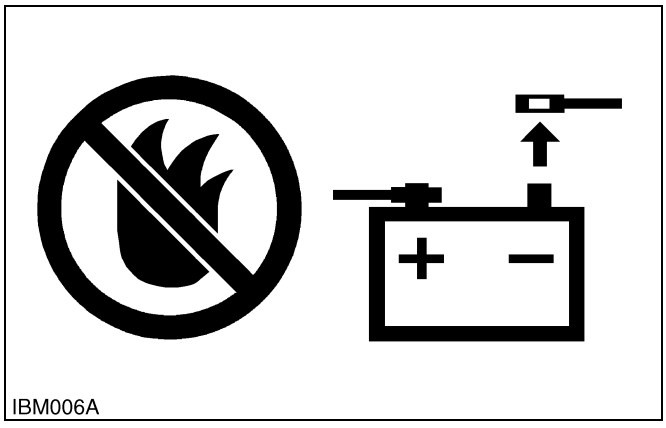
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- Always wear safety glasses and gloves when handling the battery.
- The gas generated by the battery is flammable. Never weld or use tools like a grinder near the battery. And never smoke near it.
- When disconnecting the battery, always disconnect the negative cable first. When connecting the battery, always connect the positive cable first.

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- Grease is under high pressure inside the hydraulic cylinder. It is very dangerous to loosen a grease nipple quickly as it may shoot off. Always loosen grease nipples slowly.
- And never face a grease nipple while loosening it.

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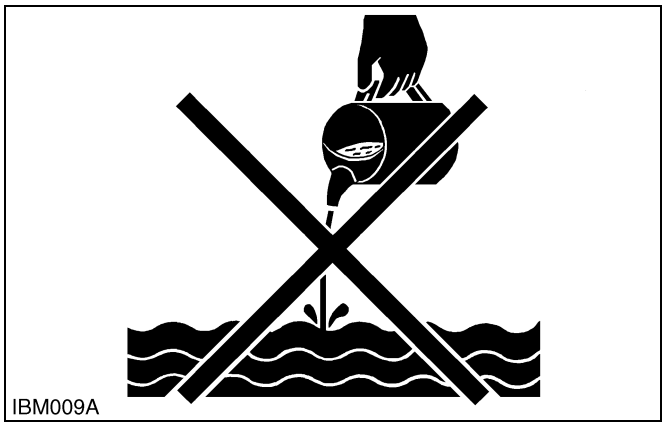
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Dispose of Waste Fluids Properly

- Never dispose of waste fluids on the ground, in the gutter, a river, pond or lake. Always dispose of hazardous substances like waste oil, coolant and electrolytic fluid in accordance with the relevant environmental protection regulations.
- Keep the safety plates clean so they can be read. If a safety plate is damaged and comes off or becomes illegible, put a plate with the same warnings back in its place.

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3. LABELS DISPLAYED TO PROMOTE WORK SAFETY

[1] LOCATIONS

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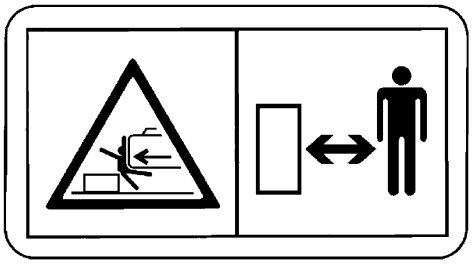

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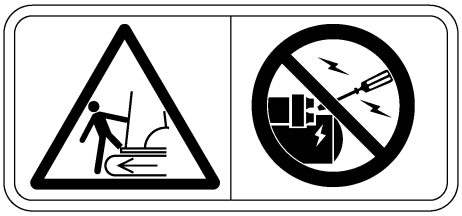

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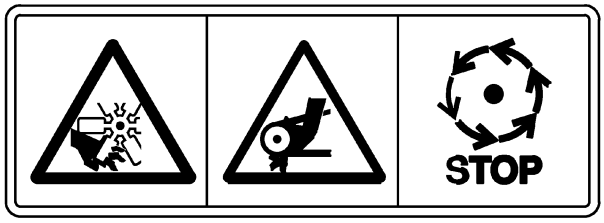

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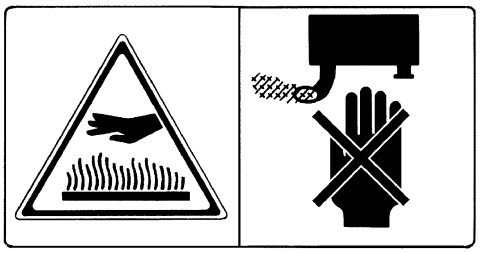

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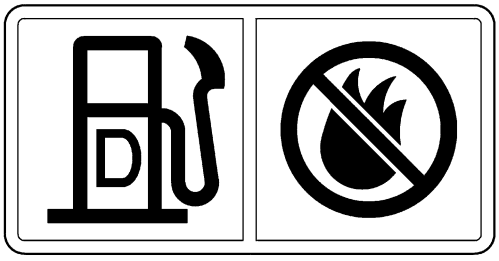

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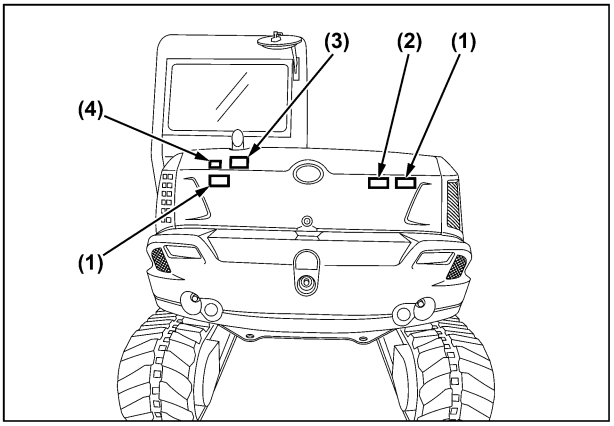

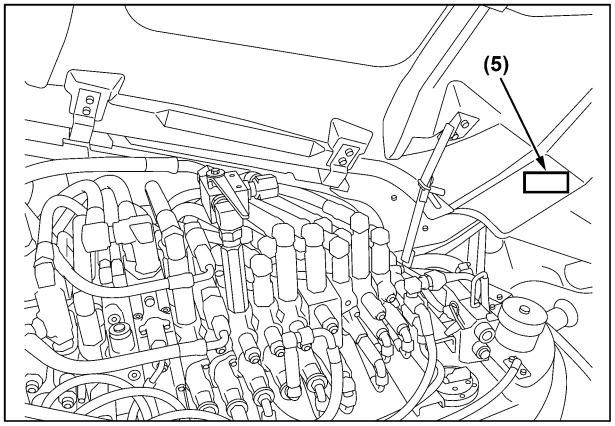

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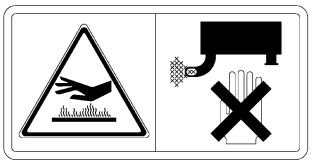

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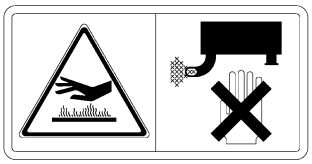

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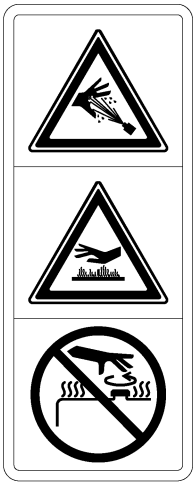

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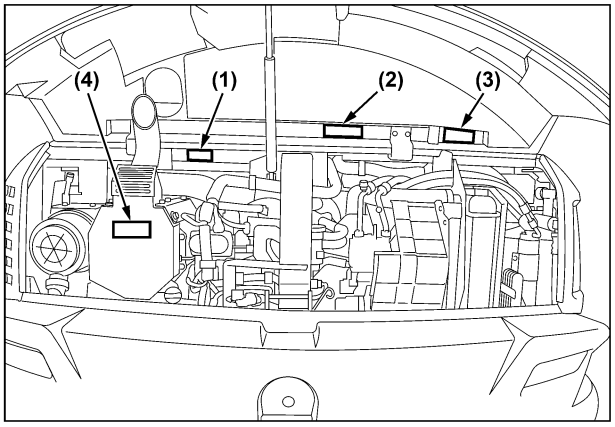

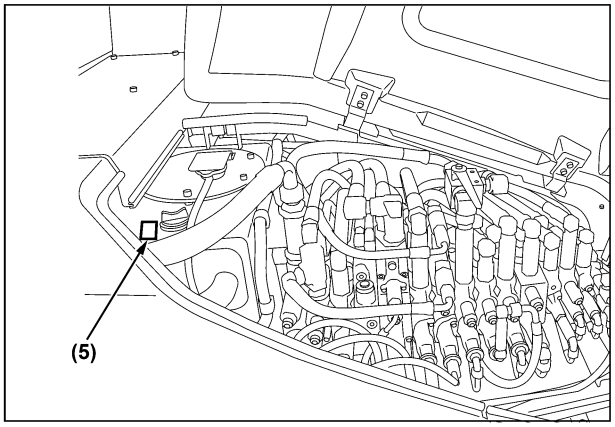

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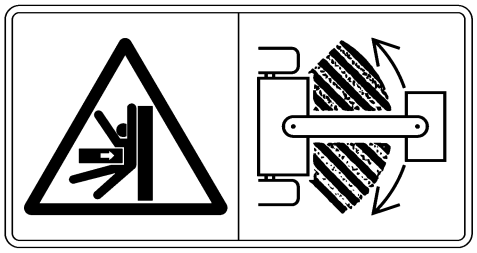

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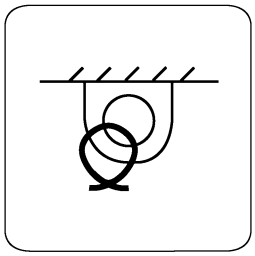

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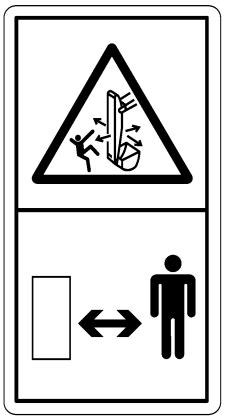

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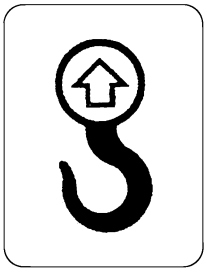

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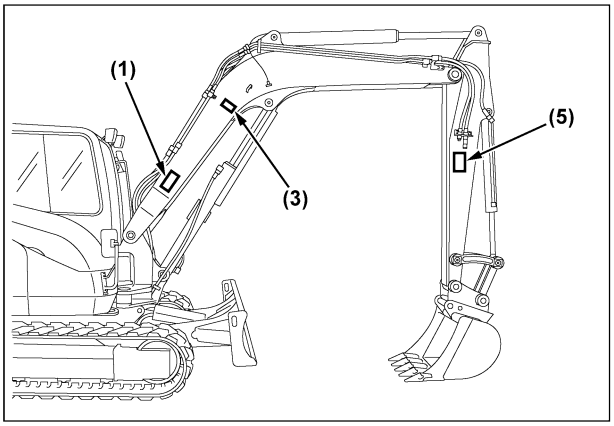

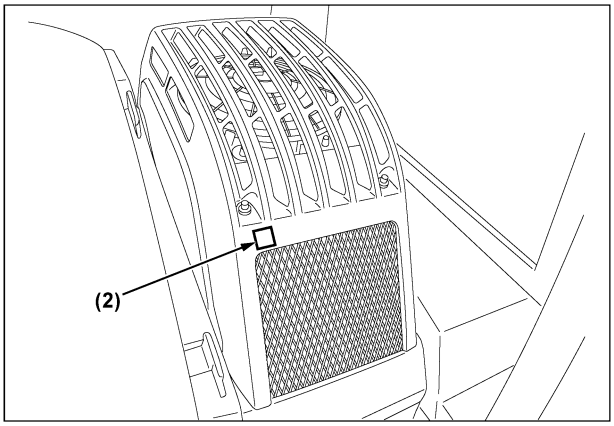

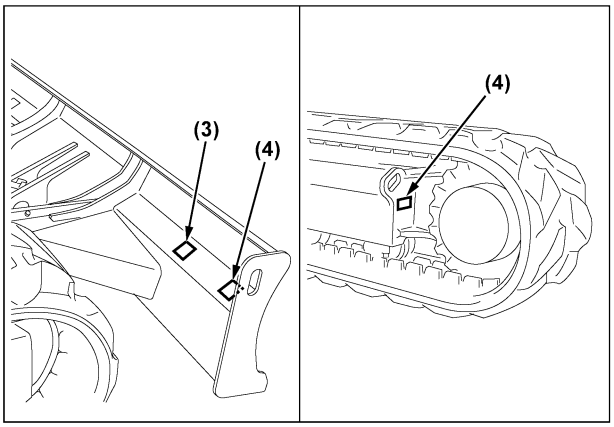

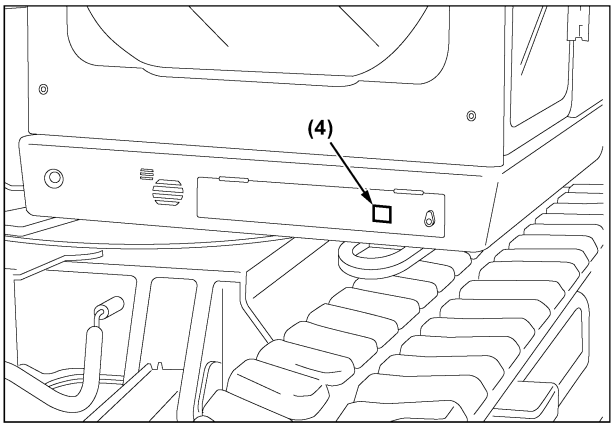

RY9212724ICI003A

RY9212724INI0003US0

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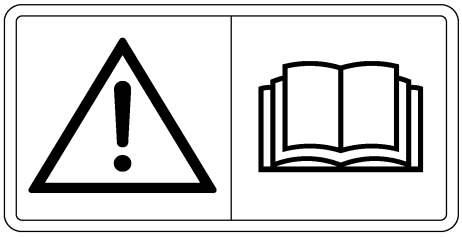

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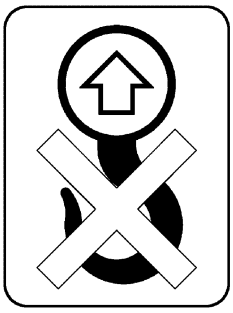

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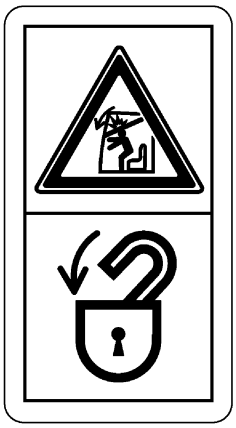

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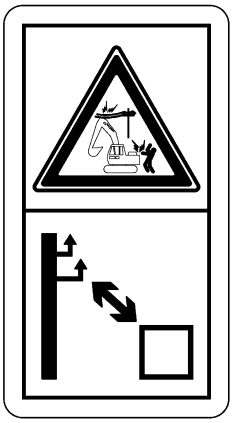

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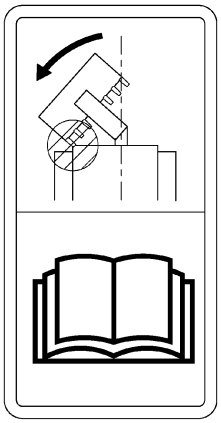

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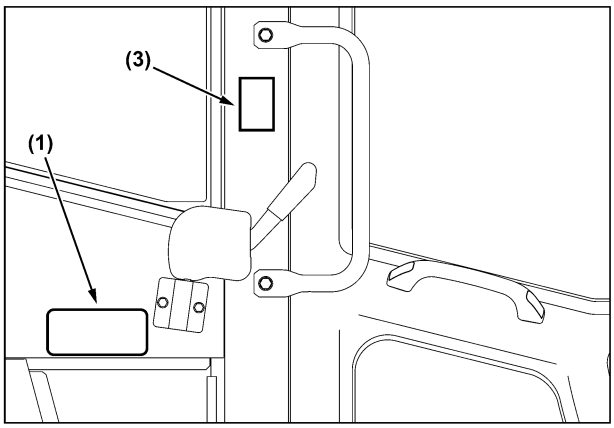

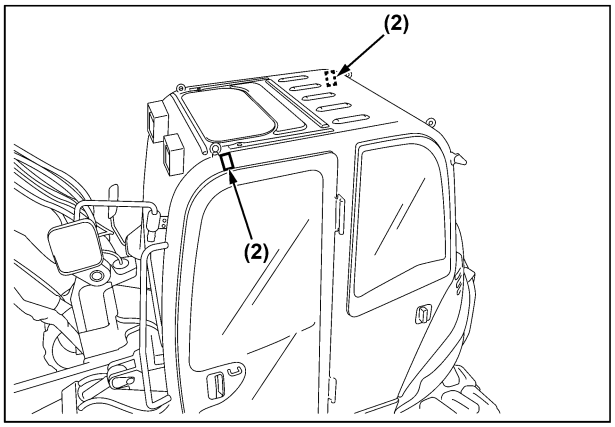

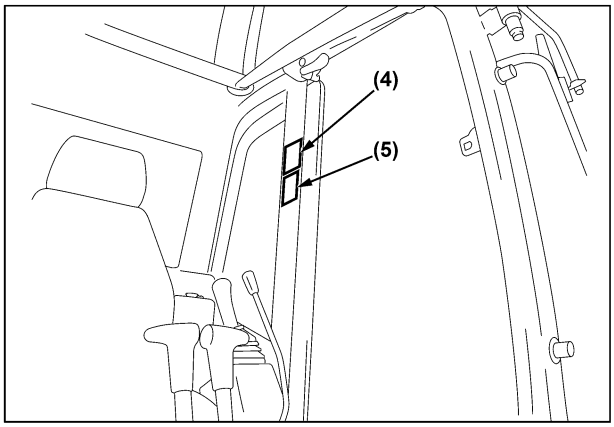

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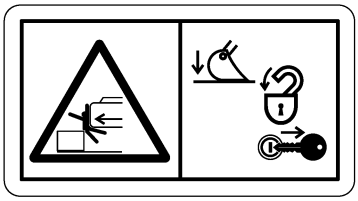

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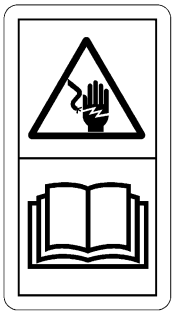

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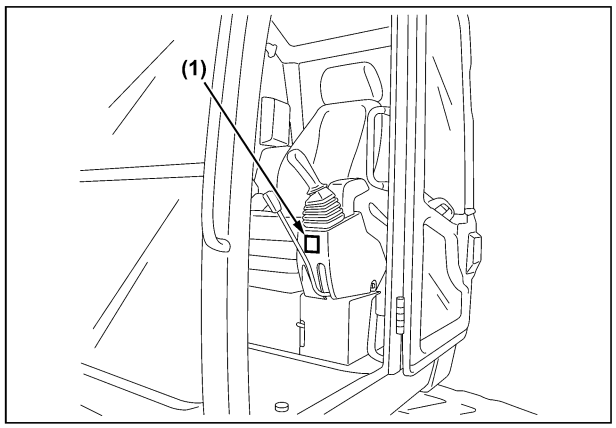

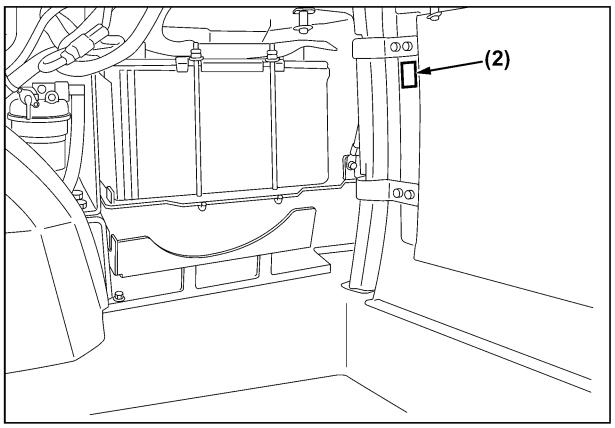

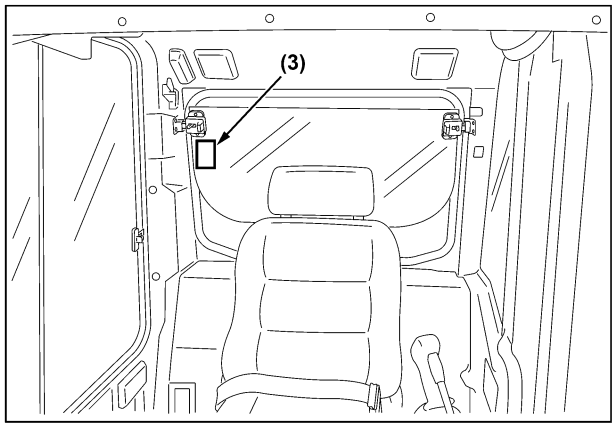

RY9212724ICI005A

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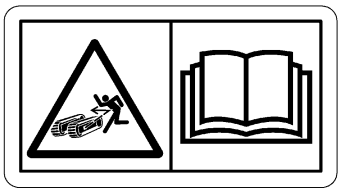

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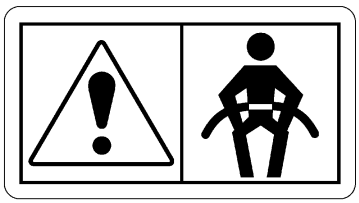

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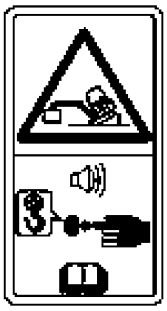
(2)



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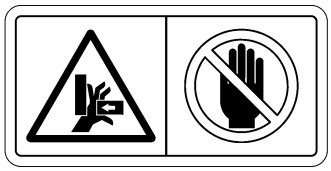

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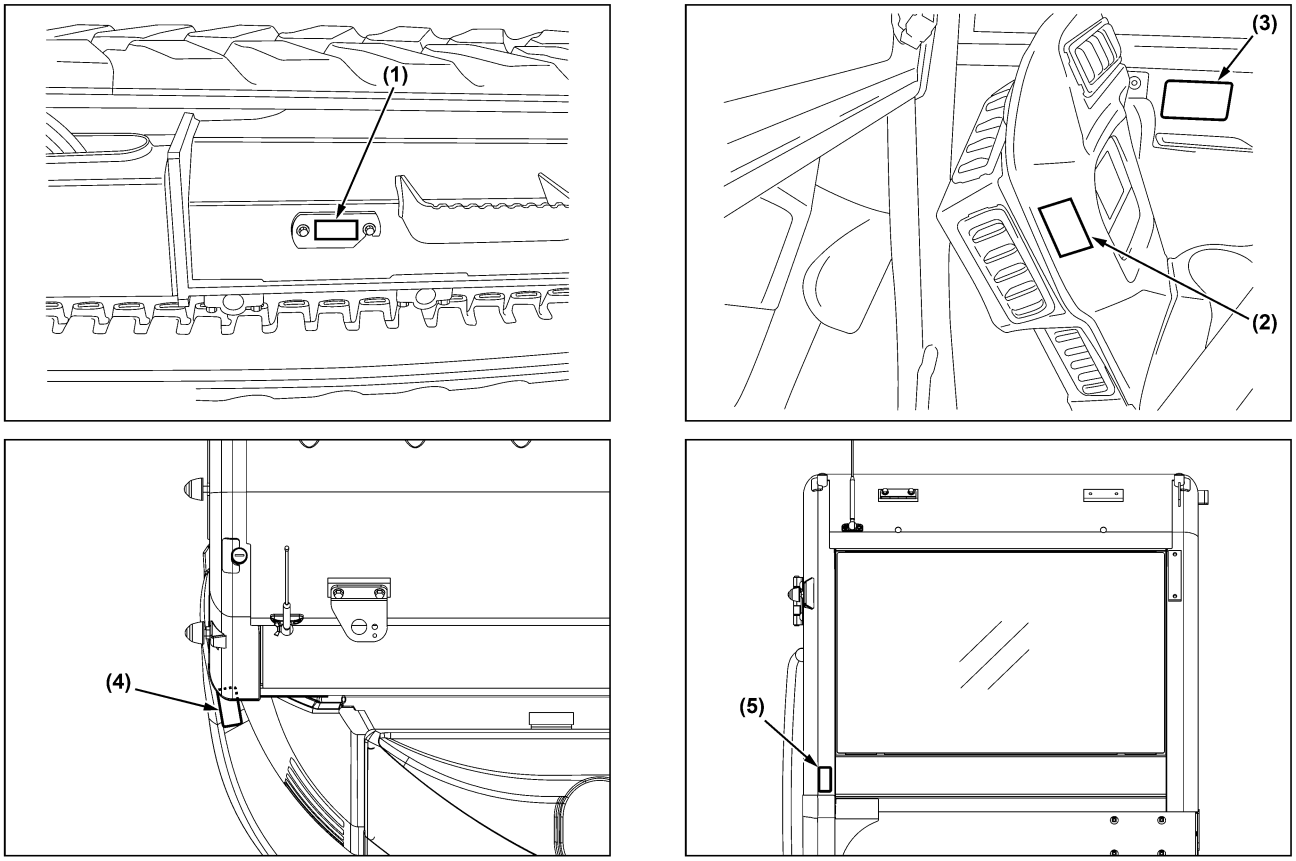
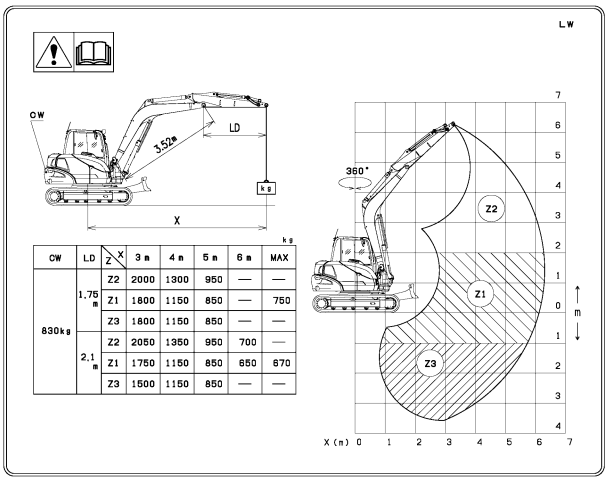


RY9212724ICI006A

RY9212724INI0006US0

(1) Operating weight 8115 kg (17890 lbs)

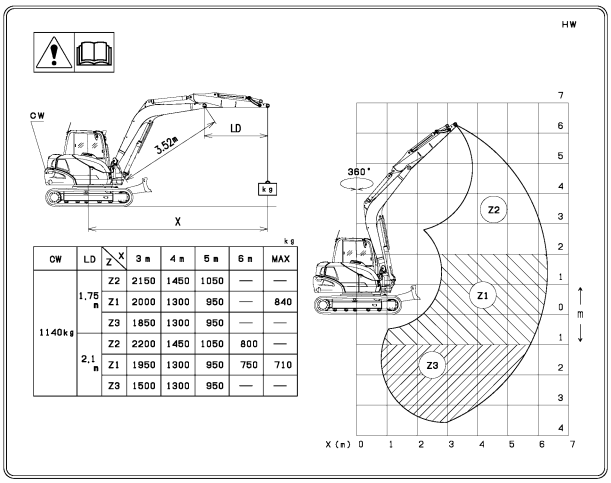


kg

CW	LD	Z \ X	3 m	4 m	5 m	6 m	MAX
830kg	1.75 m	Z2	2000	1300	950	—	—
		Z1	1800	1150	850	—	750
		Z3	1800	1150	850	—	—
	2.1 m	Z2	2050	1350	950	700	—
		Z1	1750	1150	850	650	670
		Z3	1500	1150	850	—	—

1JXJX00074A01

(1) Operating weight 8425 kg (18574 lbs)

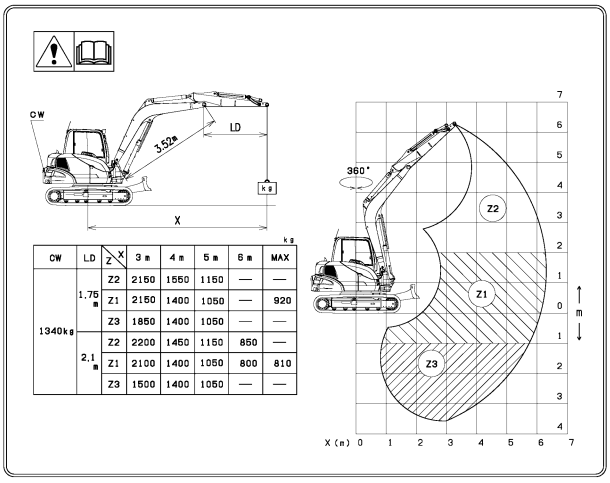


kg

CW	LD	Z \ X	3 m	4 m	5 m	6 m	MAX
1140kg	1.75 m	Z2	2150	1450	1050	—	—
		Z1	2000	1300	950	—	840
		Z3	1850	1300	950	—	—
	2.1 m	Z2	2200	1450	1050	800	—
		Z1	1950	1300	950	750	710
		Z3	1500	1300	950	—	—

1JXJX00075A01

(1) Operating weight 8625 kg (19015 lbs)

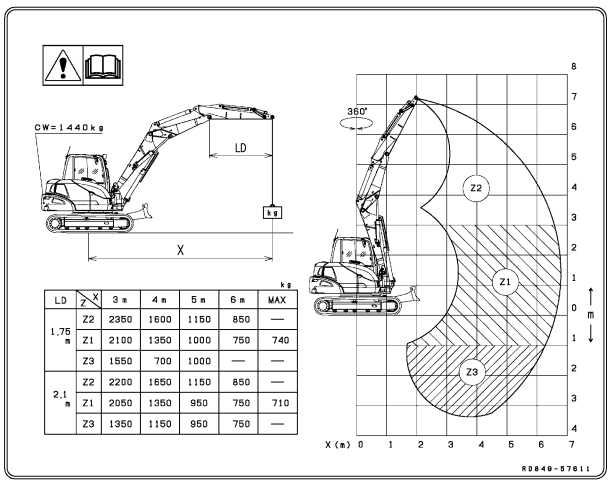


kg

CW	LD	Z \ X	3 m	4 m	5 m	6 m	MAX
1340kg	1.75 m	Z2	2150	1550	1150	—	—
		Z1	2150	1400	1050	—	920
		Z3	1850	1400	1050	—	—
	2.1 m	Z2	2200	1450	1150	850	—
		Z1	2100	1400	1050	800	810
		Z3	1500	1400	1050	—	—

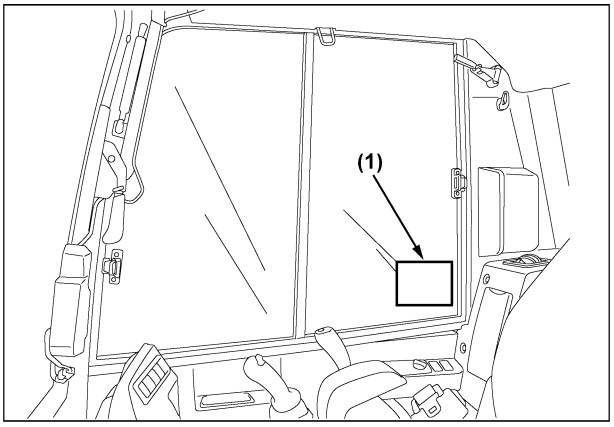
1JXJX00076A01

(1) Operating weight 9065 kg (19985 lbs)



kg

LD	Z \ X	3 m	4 m	5 m	6 m	MAX
1.75 m	Z2	2350	1600	1150	850	—
	Z1	2100	1350	1000	750	740
	Z3	1550	700	1000	—	—
2.1 m	Z2	2200	1650	1150	850	—
	Z1	2050	1350	950	750	710
	Z3	1350	1150	950	750	—



RY9212724ICI008US

RY9212724INI0012US0

[2] LABEL MAINTENANCE

Thoroughly Read, Understand and Follow Safety Precautions on Labels

- Always keep labels in a clean, undamaged state.
- If labels get dirty, wipe them off with soapy water and a soft cloth.
  If solvents such as paint thinner or engine oil are used, the text and or figures may fade away.
- When using a pressure washer to clean the equipment, do not spray any labels directly as doing so may make them peel off.
- If a label is damaged or lost, order a new one from your dealer and affix it as before.
- Before affixing a new label, completely wipe off any dirt or grime on the surface, allow it to dry and then affix in the same place.
- When replacing a part that has a label on it, replace the label at the same time.

RY9212001INI0018US0

4. TABLE OF MAIN SPECIFICATIONS

[1] STANDARD

			KUBOTA Excavator		
Model name			KX080-4α2		
Counter weight type (rubber crawler)			830 kg	1140 kg	1340 kg (1140 + 200 kg)
Machine weight	(without operator)		8040 kg	8350 kg	8550 kg
Bucket (KUBOTA)	Volume (SAE/CECE)		0.21 m^3		
	Width with side cutters attached		800 mm		
Engine	Type		Water-cooled 4-cylinder turbo-diesel engine		
	Model name		V3307-CR-TE5-BH-1		
	Displacement		3331 cm^3		
	Engine performance (ISO 9249)		46.5 kW		
	Rated speed		2000 min^{-1}		
Performance	Swivel speed (swivel frame)		9.8 min^{-1}		
	Travel speed	2nd speed	4.8 km/h		
		1st speed	2.7 km/h		
	Ground pressure		35.2 kPa (0.359 kgf/cm^2)	36.6 kPa (0.373 kgf/cm^2)	37.5 kPa (0.382 kgf/cm^2)
	Climbing performance		36 % (20 degrees)		
	Max. swivel capability at slope angle		27 % (15 degrees)		
Blade (width × height)			2200 × 500 mm		
Swing angle of the boom	Left		67 degrees		
	Right		60 degrees		
Auxiliary port 1	Max. flow rate (theoretical)		100 L/min		
	Max. pressure		20.6 MPa (206 bar)		
Auxiliary port 2	Max. flow rate (theoretical)		55.8 L/min		
	Max. pressure		20.6 MPa (206 bar)		
Fuel tank capacity			115 L		
Pulling capacity at the towing eyes			116900 N		
Vertical load at the towing eyes			12100 N		
Noise level	LpA		75 dB (A)		
	LwA	(2000/14/EC)	96 dB (A)		
Vibration	Hand arm system (ISO 5349-2: 2001)	Digging	< 2.5 m/s^2		
		Leveling	< 2.5 m/s^2		
		Driving	4.40 m/s^2		
		Idling	< 2.5 m/s^2		
	Whole body (ISO 2631-1: 1997)	Digging	< 0.5 m/s^2		
		Leveling	< 0.5 m/s^2		
		Driving	0.879 m/s^2		
		Idling	< 0.5 m/s^2		

* These values are measured under specific conditions at maximum engine speed and can deviate, depending on the operating situation.

RY9212724INI0009US0

[2] TWO PIECE BOOM

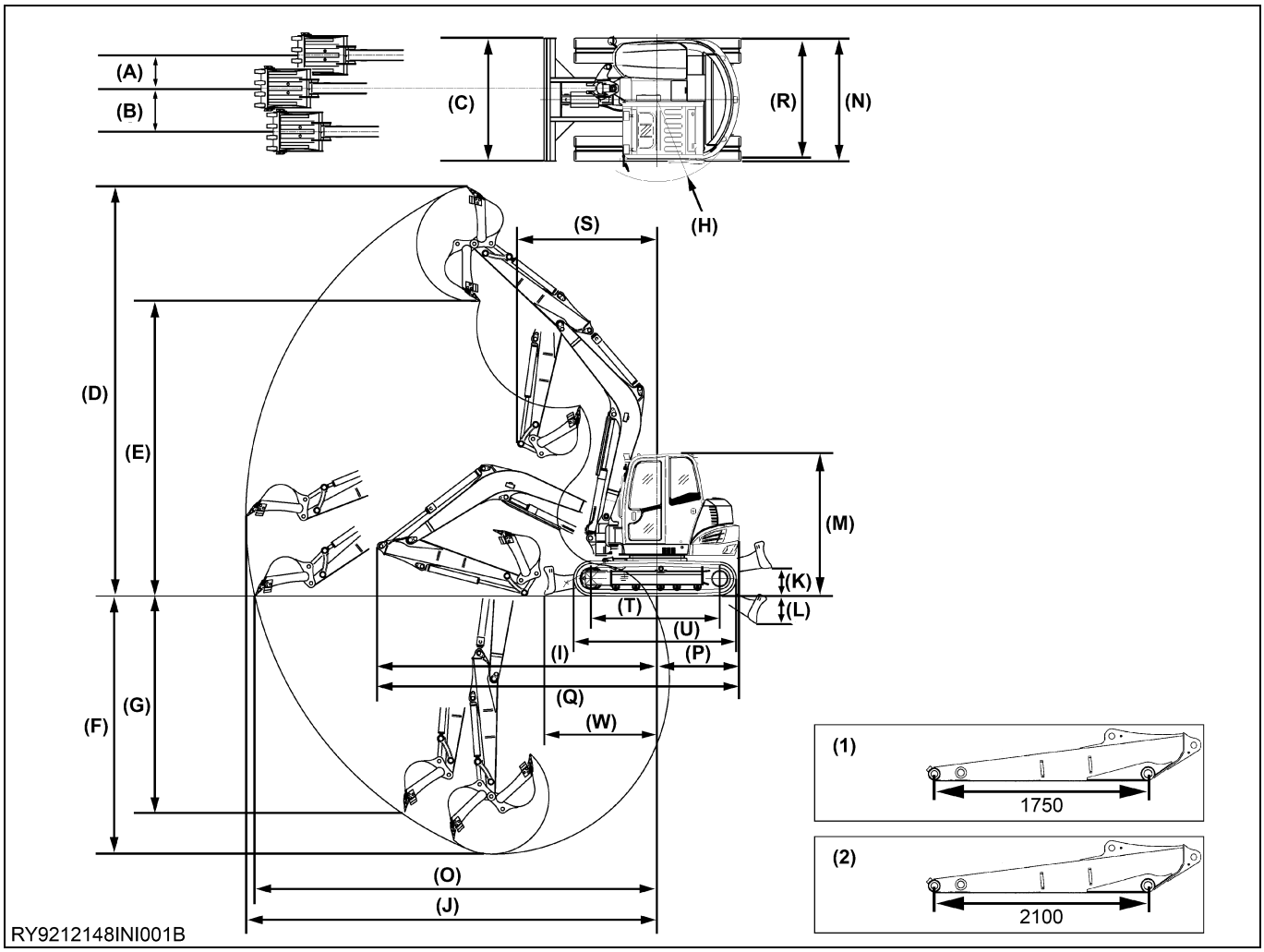
			KUBOTA Excavator
Model name			KX080-4α2
Counter weight type (rubber crawler)			1700 kg (1440 + 260 kg)
Machine weight	(without operator)		9250 kg
Bucket (KUBOTA)	Volume (SAE/CECE)		0.21 m^3
	Width with side cutters attached		800 mm
Engine	Type		Water-cooled 4-cylinder turbo-diesel engine
	Model name		V3307-CR-TE5-BH-1
	Displacement		3331 cm^3
	Engine performance (ISO 9249)		46.5 kW
	Rated speed		2000 min^{-1}
Performance	Swivel speed (swivel frame)		9.8 min^{-1}
	Travel speed	2nd speed	4.8 km/h
		1st speed	2.7 km/h
	Ground pressure		40.5 kPa (0.413 kgf/cm^2)
	Climbing performance		36 % (20 degrees)
	Max. swivel capability at slope angle		27 % (15 degrees)
Blade (width × height)			2200 × 500 mm
Swing angle of the boom	Left		67 degrees
	Right		60 degrees
Auxiliary port 1	Max. flow rate (theoretical)		100 L/min
	Max. pressure		20.6 MPa (206 bar)
Auxiliary port 2	Max. flow rate (theoretical)		55.8 L/min
	Max. pressure		20.6 MPa (206 bar)
Fuel tank capacity			115 L
Pulling capacity at the towing eyes			116900 N
Vertical load at the towing eyes			12100 N
Noise level	LpA		75 dB (A)
	LwA	(2000/14/EC)	96 dB (A)
Vibration	Hand arm system (ISO 5349-2: 2001)	Digging	< 2.5 m/s^2
		Leveling	< 2.5 m/s^2
		Driving	4.40 m/s^2
		Idling	< 2.5 m/s^2
	Whole body (ISO 2631-1: 1997)	Digging	< 0.5 m/s^2
		Leveling	< 0.5 m/s^2
		Driving	0.879 m/s^2
		Idling	< 0.5 m/s^2

* These values are measured under specific conditions at maximum engine speed and can deviate, depending on the operating situation.

RY9212724INI0011US0

5. DIMENSIONS

[1] STANDARD



(1) Arm Length: 1750 mm (68.9 in.)
(2) Arm Length: 2100 mm (82.7 in.)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
(1)	590 mm 23.2 in.	770 mm 30.3 in.	2200 mm 86.6 in.	7060 mm 278.0 in.	5010 mm 197.2 in.	4250 mm 167.3 in.	3510 mm 138.2 in.	1460 mm 57.5 in.
(2)	590 mm 23.2 in.	770 mm 30.3 in.	2200 mm 86.6 in.	7300 mm 287.4 in.	5250 mm 206.7 in.	4600 mm 181.1 in.	3850 mm 151.6 in.	1460 mm 57.5 in.

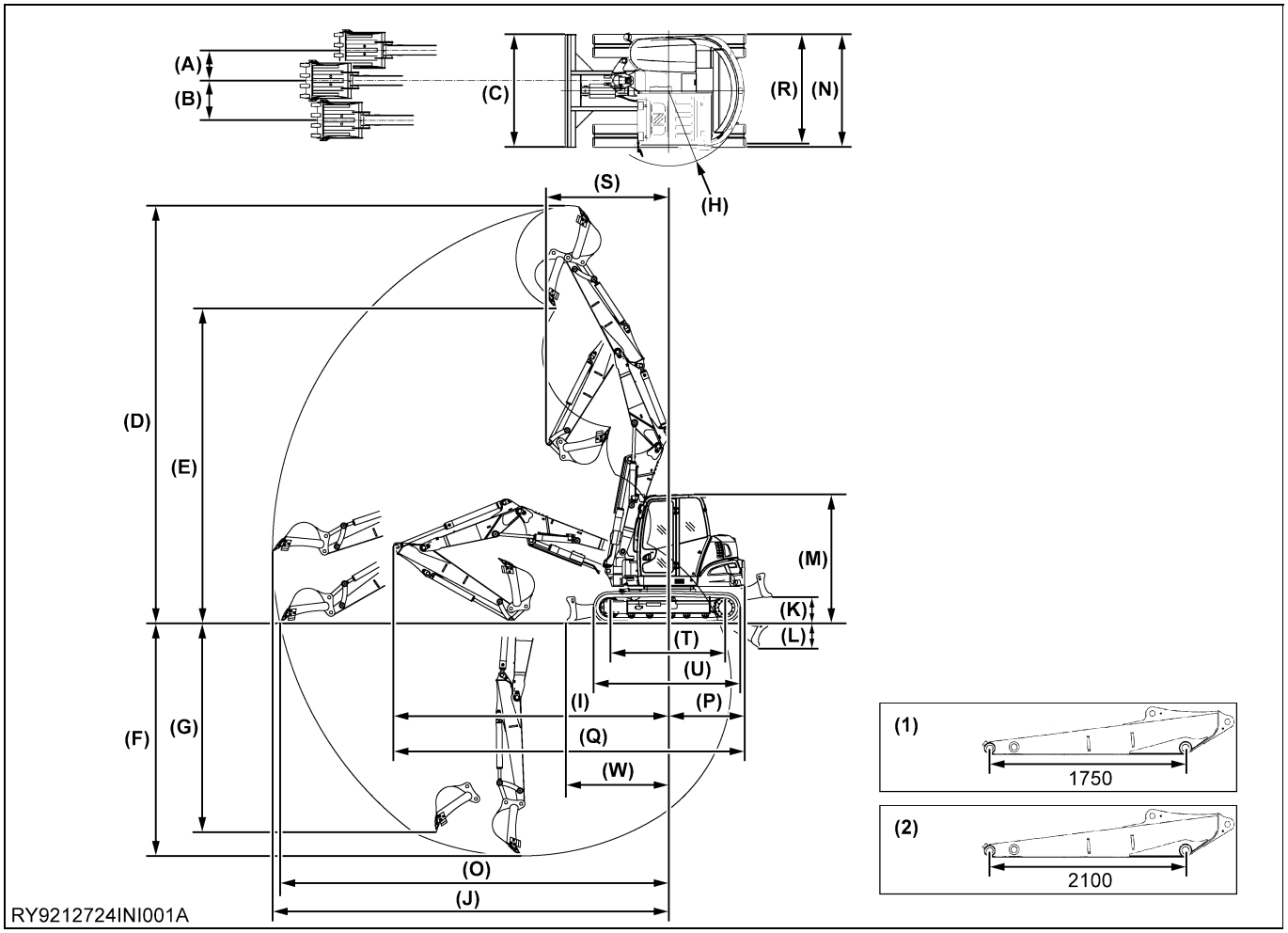
	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)
(1)	4950 mm 194.9 in.	7010 mm 276.0 in.	500 mm 19.7 in.	500 mm 19.7 in.	2540 mm 100.0 in.	2200 mm 86.6 in.	6840 mm 269.3 in.	1460 mm 57.5 in.
(2)	4990 mm 196.5 in.	7330 mm 288.6 in.	500 mm 19.7 in.	500 mm 19.7 in.	2540 mm 100.0 in.	2200 mm 86.6 in.	7170 mm 282.3 in.	1460 mm 57.5 in.

	(Q)	(R)	(S)	(T)	(U)	(W)
(1)	6410 mm 252.4 in.	2150 mm 84.6 in.	2410 mm 94.9 in.	2300 mm 90.5 in.	2900 mm 114.2 in.	2000 mm 78.7 in.
(2)	6450 mm 253.9 in.	2150 mm 84.6 in.	2490 mm 98.0 in.	2300 mm 90.5 in.	2900 mm 114.2 in.	2000 mm 78.7 in.

- Above dimensions are based on the machine with KUBOTA original bucket.
- Above dimensions are based on the machine with rubber track.
- Specifications subject to change without notice.

RY9212724INI0008US0

[2] TWO PIECE BOOM



(1) Arm Length: 1750 mm (68.9 in.)
(2) Arm Length: 2100 mm (82.7 in.)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
(1)	590 mm 23.2 in.	770 mm 30.3 in.	2200 mm 86.6 in.	7930 mm 312.2 in.	5900 mm 232.3 in.	4240 mm 167.0 in.	3780 mm 148.9 in.	1500 mm 59.1 in.
(2)	590 mm 23.2 in.	770 mm 30.3 in.	2200 mm 86.6 in.	8240 mm 324.4 in.	6210 mm 244.5 in.	4590 mm 180.7 in.	4120 mm 162.2 in.	1500 mm 59.1 in.

	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)
(1)	5430 mm 213.8 in.	7490 mm 294.9 in.	500 mm 19.7 in.	500 mm 19.7 in.	2540 mm 100.0 in.	2200 mm 86.6 in.	7330 mm 288.6 in.	1500 mm 59.1 in.
(2)	5440 mm 214.2 in.	7820 mm 307.9 in.	500 mm 19.7 in.	500 mm 19.7 in.	2540 mm 100.0 in.	2200 mm 86.6 in.	7670 mm 302.0 in.	1500 mm 59.1 in.

	(Q)	(R)	(S)	(T)	(U)	(W)
(1)	6930 mm 272.8 in.	2150 mm 84.6 in.	2230 mm 87.8 in.	2300 mm 90.5 in.	2900 mm 114.2 in.	2000 mm 78.7 in.
(2)	6940 mm 273.2 in.	2150 mm 84.6 in.	2420 mm 95.3 in.	2300 mm 90.5 in.	2900 mm 114.2 in.	2000 mm 78.7 in.

- Above dimensions are based on the machine with KUBOTA original bucket.
- Above dimensions are based on the machine with rubber track.
- Specifications subject to change without notice.

RY9212724INI0010US0

G GENERAL

GENERAL

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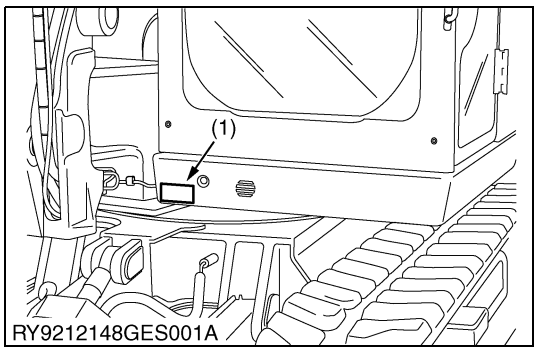
   [2] SERVICING BY SKILLED PERSONNEL OR KUBOTA DEALER G-22

1. CHECKING EXCAVATOR IDENTIFICATION



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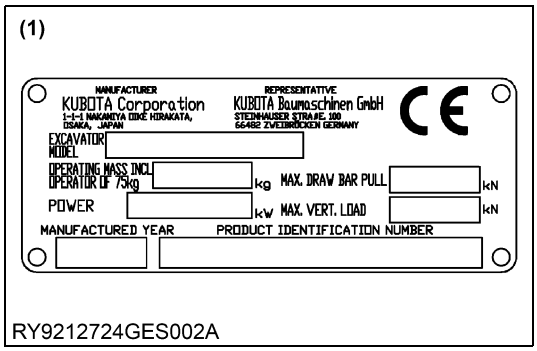

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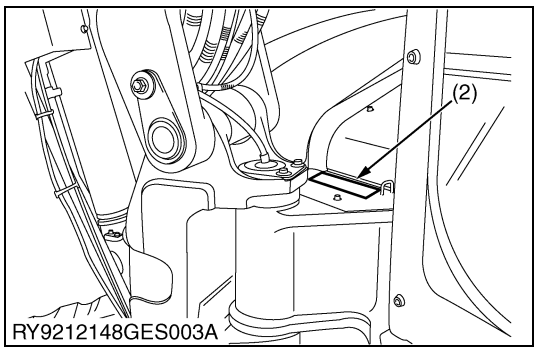

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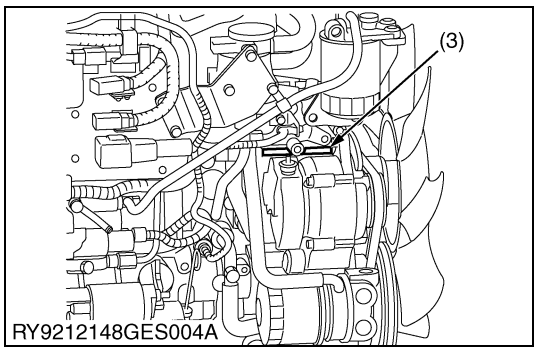


RY9212148GES004A

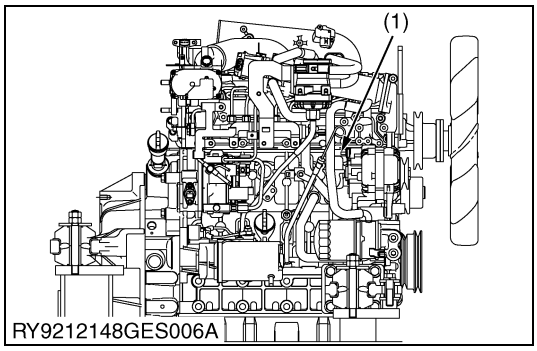
When consulting with your local KUBOTA dealer about this excavator, please provide the model of the excavator, its frame and engine numbers and the number of hours on the hour meter.

(1) Excavator Nameplate
(2) Product Identification Number
(3) Engine Number

RY9212724GEG0008US0

2. ENGINE IDENTIFICATION

[1] MODEL NAME AND SERIAL NUMBER



Be sure to check the engine nameplate and serial number when you wish to consult about the engine.

The model and serial number of the engine need to be checked prior to servicing the engine or replacing any of its parts.

■ **Engine Serial No.**

The engine serial number is the numerical ID of the engine and is printed after the engine's model number.

The year and month of manufacture are indicated as follows.

Engine Series

Number or Alphabet	Series	Number or Alphabet	Series
1	05 (include: WG)	7	03 (include: WG)
2	V3 (include: WG)	8	07
3	08	A	EA, RK
4	SM (include: WG)	B	03 (KET production)
5	Air Cooled Gasoline	C	V3, 07 (KEW production)
6	GZ, OC, AC, EA, E		

Production Year

Alphabet or Number	Year	Alphabet or Number	Year
1	2001	F	2015
2	2002	G	2016
3	2003	H	2017
4	2004	J	2018
5	2005	K	2019
6	2006	L	2020
7	2007	M	2021
8	2008	N	2022
9	2009	P	2023
A	2010	R	2024
B	2011	S	2025
C	2012	T	2026
D	2013	V	2027
E	2014		

(1) Engine Model Name and Serial Number

(To be continued)

(Continued)

Production Month and Lot Number

Month	Engine Lot Number	
January	A0001 to A9999	from B0001
February	C0001 to C9999	from D0001
March	E0001 to E9999	from F0001
April	G0001 to G9999	from H0001
May	J0001 to J9999	from K0001
June	L0001 to L9999	from M0001
July	N0001 to N9999	from P0001
August	Q0001 to Q9999	from R0001
September	S0001 to S9999	from T0001
October	U0001 to U9999	from V0001
November	W0001 to W9999	from X0001
December	Y0001 to Y9999	from Z0001

* Alphabetical letters "I" and "O" are not used.

(a) (b)(c)(d) (e)
e.g. V2607 - 8 C L A001

(a) **V2607**: Engine Model Name
(b) **8**: Engine Series (07 series)
(c) **C**: Production Year (2012)
(d) **L**: Production Month (June)
(e) **A001**: Lot Number: (**0001 to 9999** or **A001 to Z999**)

RY9212724GEG0001US0

[2] E5B ENGINE

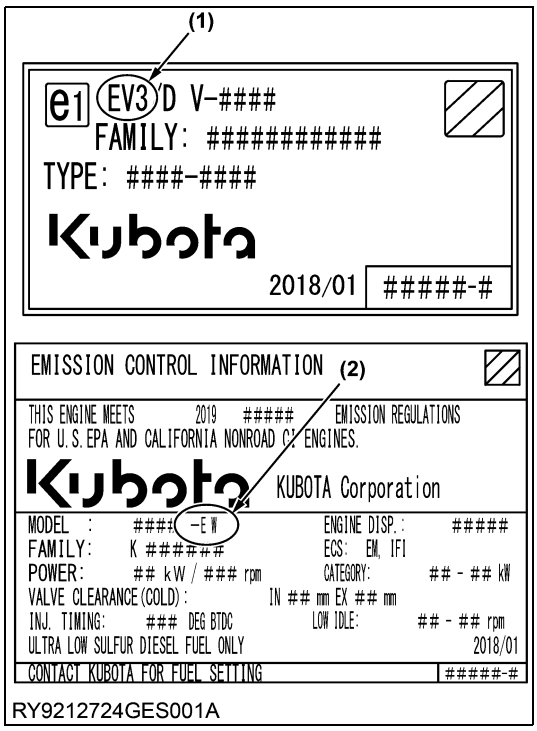
[Example: Engine model name V2607-CR-E5-XXXX or V3307-CR-TE5-XXXX]

The emission controls previously implemented in various countries to prevent air pollution will be stepped up as Nonroad Emission Standards continue to change. The timing or applicable date of the specific Nonroad Emission regulations depends on the engine output classification.

Over the past several years, Kubota has been supplying diesel engines that comply with regulations in the respective countries affected by Nonroad Emission regulations. For Kubota Engines, E5B will be the designation that identifies engine models affected by the next emission phase.

When servicing or repairing ###-E5B series engines, use only replacement parts for that specific E5B engine, designated by the appropriate E5B Kubota Parts List and perform all maintenance services listed in the appropriate Kubota Operator's Manual or in the appropriate E5B Kubota Workshop Manual. Use of incorrect replacement parts or replacement parts from other emission level engines (for example: E3B engines), may result in emission levels out of compliance with the original E5B design and EPA or other applicable regulations. Please refer to the emission label located on the engine head cover to identify Output classification and Emission Control Information. E5B engines are identified with "EW" at the end of the Model designation, on the US EPA label.

Please note: E5B is not marked on the engine.



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Category (1)	Engine output classification	EU regulation
EV3	From 19 to 37 kW	STAGE V
EV4	From 37 to less than 56 kW	STAGE V

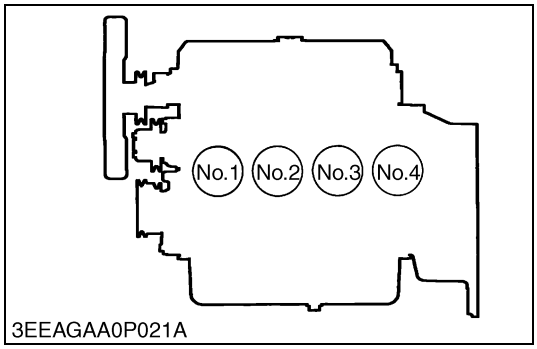
Category (2)	Engine output classification	EPA regulation
EW	From 19 to less than 56 kW	Tier 4

■ **NOTE**

- **EU regulation engine output classification category "E5B" designates some STAGE V models, depending on engine output classification.**
- **"E5B" engines are Identified with "EW" at the end of the model designation, on the US EPA label.**

RY9212724GEG0002US0

[3] CYLINDER NUMBER



3EEAGAA0P021A

You can see the cylinder numbers of KUBOTA diesel engine in the figure.

The sequence of cylinder numbers is No.1, No.2, No.3 and No.4 and it starts from the front cover side.

RY9212148GEG0013US0

3. MUFFLER FULL ASSEMBLY IDENTIFICATION

[1] PART NUMBER AND SERIAL NUMBER

Diesel Particulate Filter (hereinafter referred to as the "DPF") Muffler Full Assembly Serial Number

The DPF muffler full assembly serial number is an identified number for the DPF muffler full assembly.

It shows the month and year of manufacture as below.

Year of manufacture

Alphabet or Number	Year	Alphabet or Number	Year
1	2001	F	2015
2	2002	G	2016
3	2003	H	2017
4	2004	J	2018
5	2005	K	2019
6	2006	L	2020
7	2007	M	2021
8	2008	N	2022
9	2009	P	2023
A	2010	R	2024
B	2011	S	2025
C	2012	T	2026
D	2013	V	2027
E	2014		

Month of manufacture

Month	DPF Muffler Full Assembly Lot Number	
January	A0001 to A9999	B0001 to BZ999
February	C0001 to C9999	D0001 to DZ999
March	E0001 to E9999	F0001 to FZ999
April	G0001 to G9999	H0001 to HZ999
May	J0001 to J9999	K0001 to KZ999
June	L0001 to L9999	M0001 to MZ999
July	N0001 to N9999	P0001 to PZ999
August	Q0001 to Q9999	R0001 to RZ999
September	S0001 to S9999	T0001 to TZ999
October	U0001 to U9999	V0001 to VZ999
November	W0001 to W9999	X0001 to XZ999
December	Y0001 to Y9999	Z0001 to ZZ999

* Alphabetical letters "I" and "O" are not used.

(a)(b) (c)
e.g. C L 0019

(1) DPF Muffler Full Assembly Part Number and Serial Number

(a) Year: C indicates 2012
(b) Month: L or M indicates June
(c) Lot Number: (**0001 to 9999** or **A001 to Z999**)

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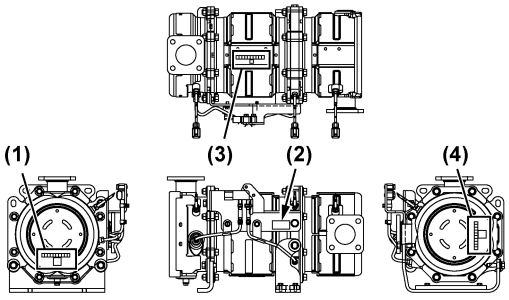


9Y1210674GES031C

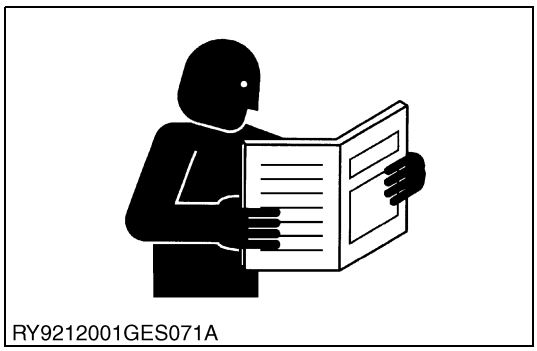
You must keep the records of the filter comp (DPF) part number and serial number and catalyst (DOC) part number and serial number before you remove the DPF for cleaning.

When you install the other catalyst (DOC) or filter comp (DPF), you have to check the part number because E5 model of them are similar to E4 model.

(1) Muffler Assembly Part Number and Serial Number
(2) DPF Muffler Full Assembly Part Number and Serial Number
(3) Filter Comp (DPF) Part Number and Serial Number
(4) Catalyst (DOC) Part Number and Serial Number

RY9212724GEG0003US0

4. GENERAL PRECAUTIONS


RY9212001GES071A

Whenever performing maintenance on the machine, always read the Safety Precautions in this manual and the Operator's Manual carefully, become familiar with them and perform the work safely.

Before performing any maintenance on the machine, make sure it is sufficiently clean and choose a sufficiently clean location to perform any disassembly.

Before performing maintenance on the machine, always disconnect the negative battery cable first.

Whenever a special tool is required, use the special tool that KUBOTA recommends. Make any special tools that are not used very frequently according to the diagrams in this manual.

Always use genuine KUBOTA parts to maintain the performance and safety characteristics of the machine.

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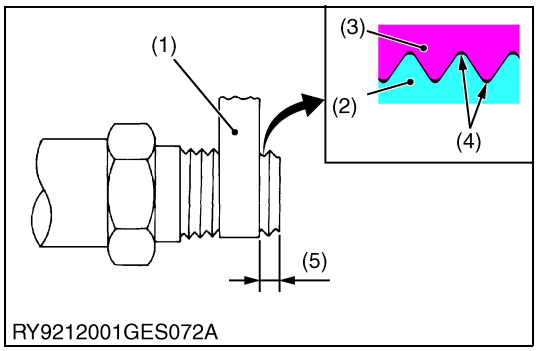

RY9212001GES072A

Plumber's Tape

- Wrap plumber's tape on the threads before tightening taper couplings. After wrapping (2 wraps) the plumber's tape, tighten to the specified torque. Once the coupling is tightened, do not loosen it as this will cause an oil leak.

(1) Plumber's Tape
(2) External Thread
(3) Internal Thread
(4) Gap
(5) Leave 1 to 2 Threads

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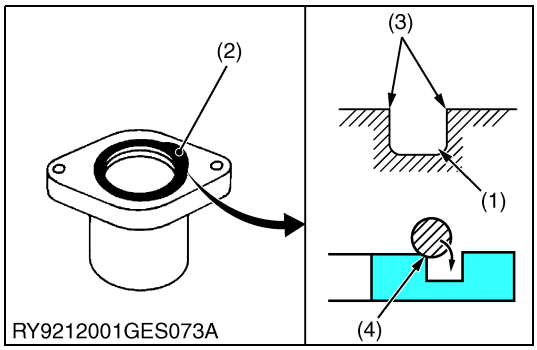

RY9212001GES073A

O-Ring

- Clean the groove the O-ring goes in and remove any burrs. Apply grease on the O-ring when inserting it in the groove (Except floating seals).
- When putting the O-ring in the groove, be careful as it is easy at the very end to twist the O-ring against the inside of the groove. If it gets twisted, roll it gently with your fingertip to untwist it.

(1) O-Ring Groove
(2) O-Ring
(3) Check for Burrs
(4) If the Ring Touches This Corner, It Will Twist

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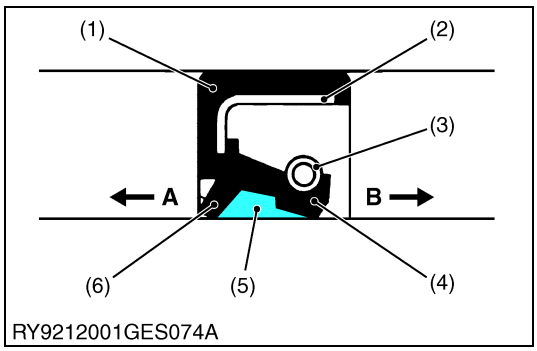

RY9212001GES074A

Oil Seal

- Do not face the lip of the oil seal in the wrong direction. Face the main lip toward the material to be sealed.
- After oil seals are replaced, apply grease to the moving parts around the lip to prevent the dry surfaces from wearing against each other when the engine is started. If the seal has a dust lip, fill the gap between the lips with grease.
- As a general rule, use a press to insert the oil seal in place. If that is not possible, use an appropriate tool to gently and evenly tap it into place, taking care that it does not go in at a slant. Press the seal all the way so it seats in the boss.

(1) Gasket
(2) Metal Ring
(3) Spring
(4) Main Lip
(5) Grease
(6) Dust Lip
A : Air (Outside)
B : Hydraulic Chamber (Inside)

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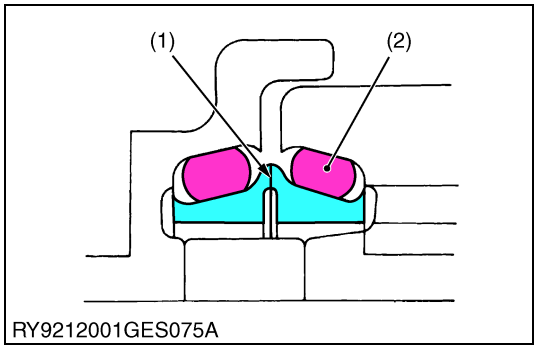

RY9212001GES075A

Floating Seal

- Be sure to wipe off any oil from the O-ring or surfaces that touch the O-ring (For wheel motors, apply a light film).
- When putting an O-ring into a floating seal, make sure the O-ring does not twist.
- Apply a light film of oil to surrounding surfaces when working to get the floating seal with O-ring in place; take care that the surrounding surfaces, O-ring and housing are parallel with each other.
- After getting the seal in place, turn the engine over 2 or 3 revolutions, to both create a film of oil on surrounding surfaces and to properly seat the face of the seal.

(1) Surrounding Surfaces (2) O-Ring

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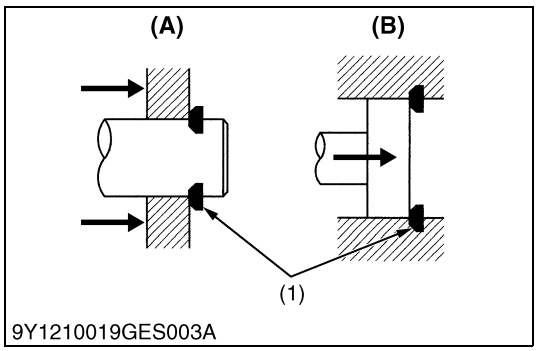

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Snap Ring Related

- When installing external or internal snap rings, orient them as shown in the diagram so the angled side faces the direction of force.

(1) Position so the Angled Part Receives the Force
(A) External
(B) Internal

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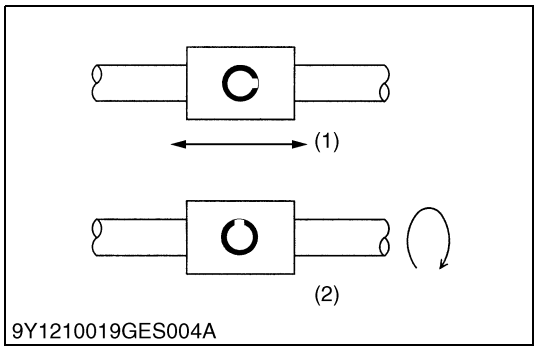

9Y1210019GES004A

Spring Pins

- When driving a spring pin, face the split in the direction that receives the force, as shown in the diagram.

(1) With Lateral Movement (2) With Rotational Movement

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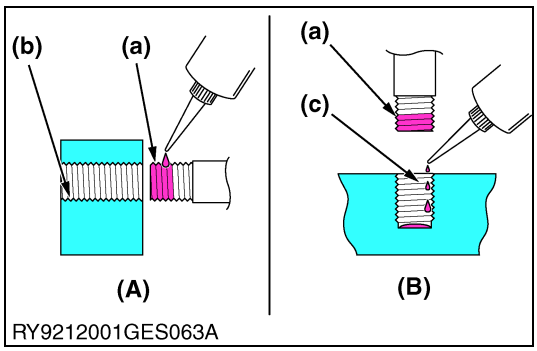

RY9212001GES063A

Adhesive

- Clean and dry the area where adhesive will be applied with a solvent so it is free of moisture, oil and dirt.
- Apply adhesive all around the threads of the bolt except the first set of threads at the tip and fill the grooves between the threads. If the threads or the grooves are large, adjust the amount of adhesive accordingly and apply it all around the bolt hole as well.

(A) Bolt Through-Hole (Nut)
(B) Pocket Bolt Hold (Capsule Shape, etc.)
(a) Apply Here
(b) Do Not Apply
(c) Drip On

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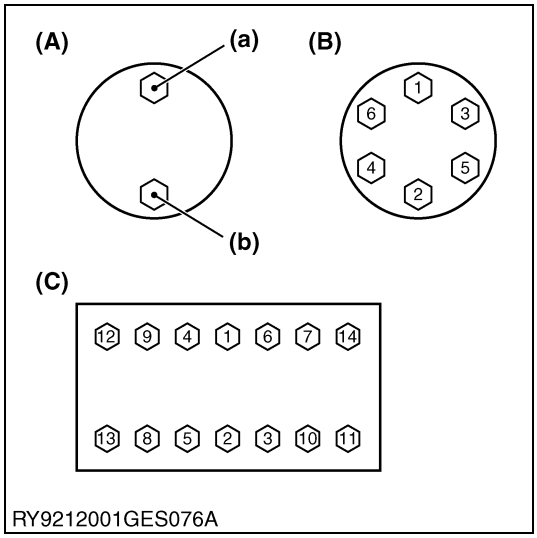

RY9212001GES076A

Tightening Bolts and Nuts

- Tighten bolts and nuts to their specified torque.
- Tighten nuts and bolts alternately top/bottom **(a) (b)**, left/right so the torque is distributed evenly.

(A) Top/Bottom Alternately
(B) Across Diagonally
(C) Diagonally Across the Center

RY9212001GEG0019US0

Assembling Hydraulic Hoses

- Tighten to their specified torque.
- Before assembling, wipe the inside of metal fittings clean of any dirt.
- After assembly, put the fitting under normal pressure and check that it does not leak.

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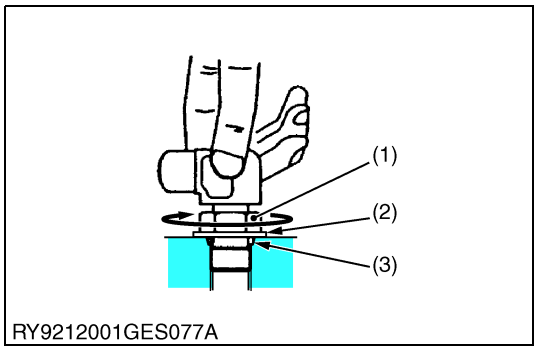
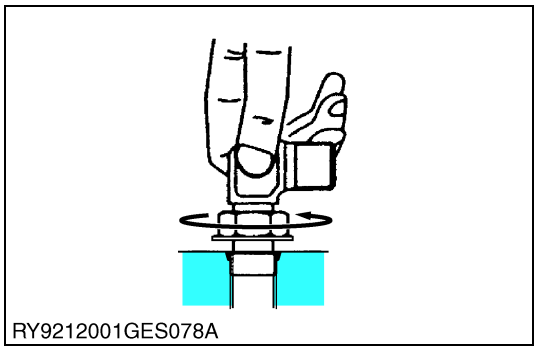


RY9212001GES077A

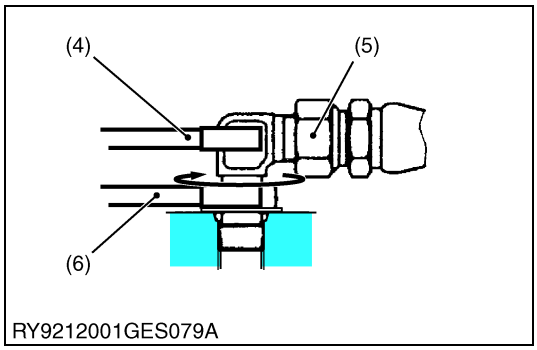
Elbow with Male Seat Assembly Procedure

When assembling an elbow with male seat, adhere to the following procedures to prevent deformation of O-rings and leaks.

1. Connecting to Valves
   - Clean the blow with male seat and the surface of the seal opposite and mount with the lock-nut on top.
   - Finger tighten till it touches the washer.


RY9212001GES078A

2. Positioning
   - Turn the mouth of the elbow back so it faces the right direction (not back over 1 turn).

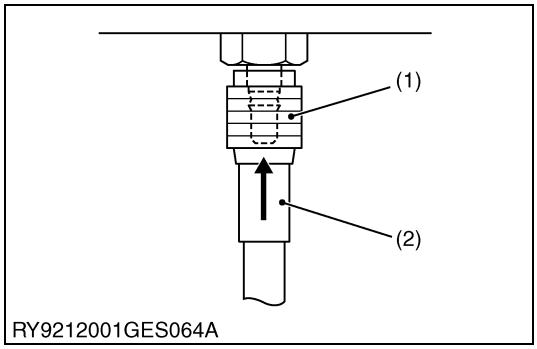


RY9212001GES079A

3. Fasten
   - Tighten the lock-nut to the specified torque with a wrench.

(1) Lock-Nut
(2) Washer
(3) Seal (O-Ring)
(4) Wrench for Holding
(5) Hose
(6) Torque Wrench for Tightening

RY9212001GEG0021US0



RY9212001GES064A

Installing and Removing Quick Couplings

- To remove a quick hose coupling, push the fitting in the direction of the arrow and pull on the plastic part in the opposite direction.
- To attach a quick coupler, push it in firmly in the direction of the arrow. Then check that it will not pull off.

(1) Plastic Part (2) Fitting

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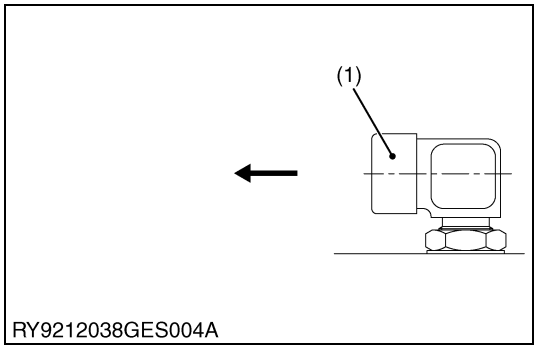
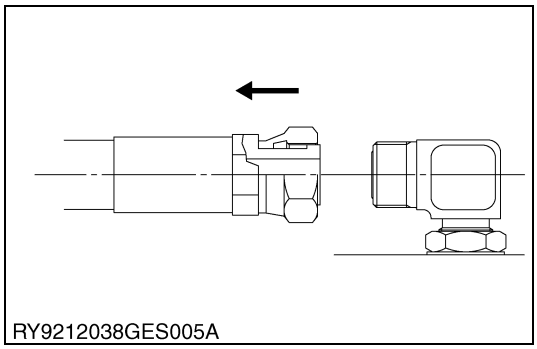


RY9212038GES004A

Connecting the face sealing (ORS) type hose

1. Remove the protective cap from the adapter and make sure the O-ring is installed in its groove (If the O-ring is missing, fit the specified size in position).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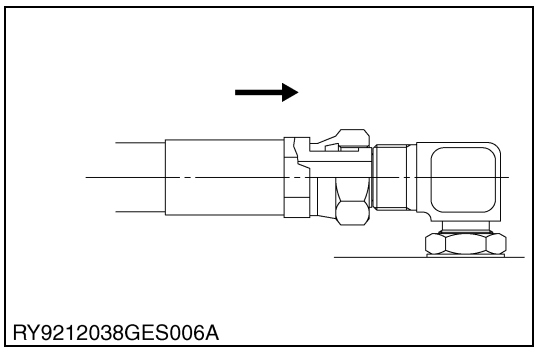
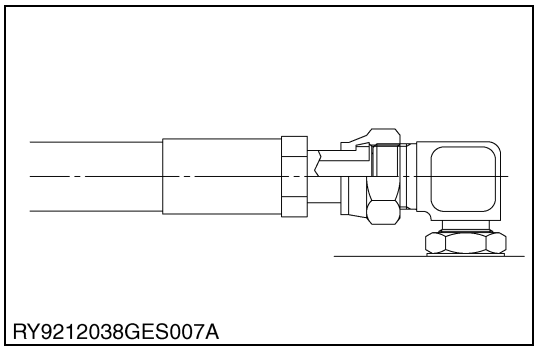
2. Shift the hose's cap nut in the direction of arrow until the O-ring contact face stretched out of the cap nut.


RY9212038GES006A

3. Bring the hose's O-ring contact face in close contact with the joint's O-ring.
   Make sure they do not come off each other.


RY9212038GES007A

4. Tighten up the cap nut to the specified torque.

(1) Protective Cap

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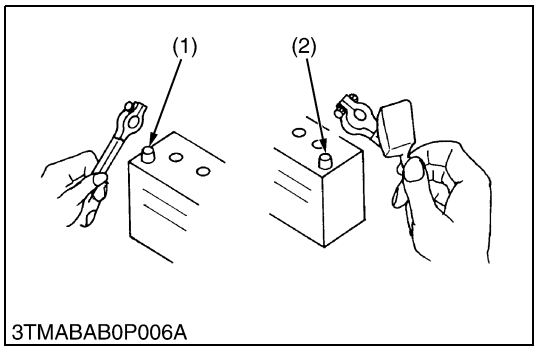
5. HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING



3TMABAB0P006A

Follow the precautions below for handling electrical parts and wiring to ensure safety and prevent damage to the machine and nearby equipment.

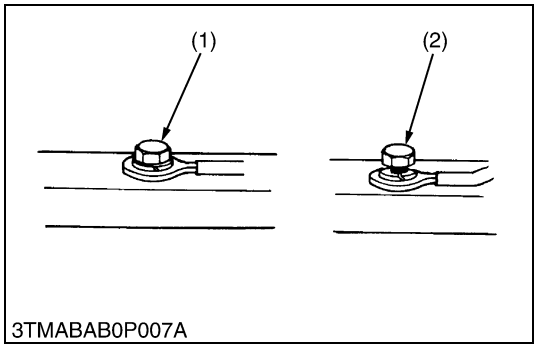
■ **IMPORTANT**

- **Inspect electrical wiring for damage and/or loose connections.**
- **Do not alter or rewire any electrical parts or wiring.**
- **Always remove the negative battery cable first when disconnecting the battery and attach the positive cable first when connecting it.**

(1) Battery Cable (-) Side (2) Battery Cable (+) Side

RY9212001GEG0023US0

[1] WIRING

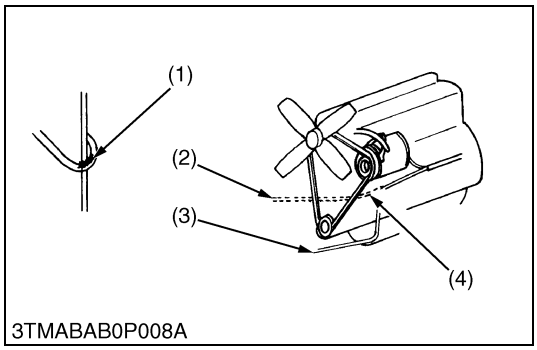


3TMABAB0P007A

- Tighten wiring terminals securely.

(1) Correct (Tightened Securely) (2) Incorrect (Poor Contact if Loose)

RY9212001GEG0024US0

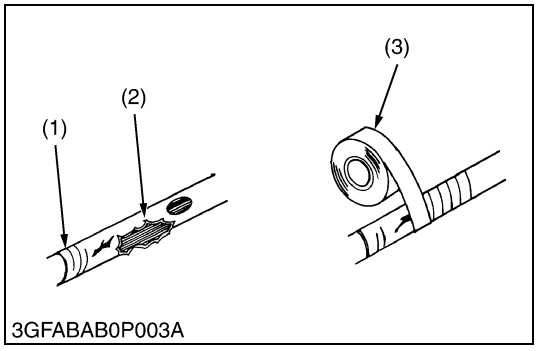


3TMABAB0P008A

- Keep wiring away from hazards.

(1) Hazardous Positioning (3) Wiring Position (Right)
(2) Wiring Position (Wrong) (4) Hazardous Position

RY9212001GEG0025US0

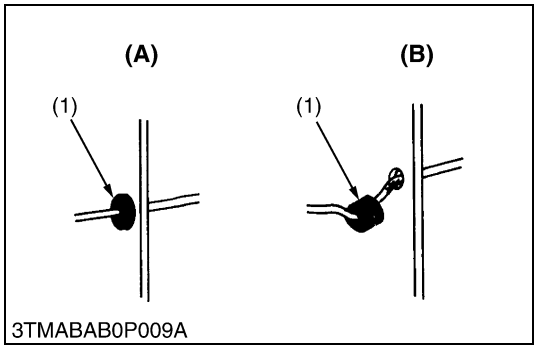


3GFABAB0P003A

- Immediately repair or replace old or damaged wiring.

(1) Damaged (3) Electrical Tape
(2) Torn

RY9212001GEG0026US0

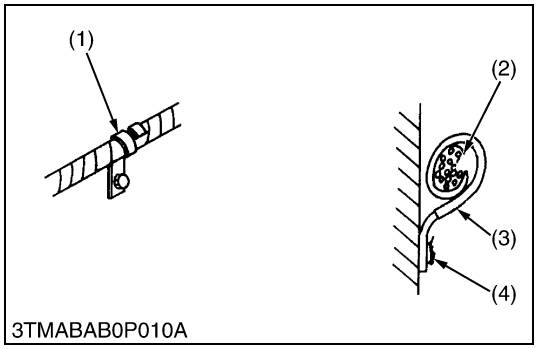


3TMABAB0P009A

- Insert grommet securely.

(1) Grommet
(A) Correct
(B) Incorrect

RY9212001GEG0027US0

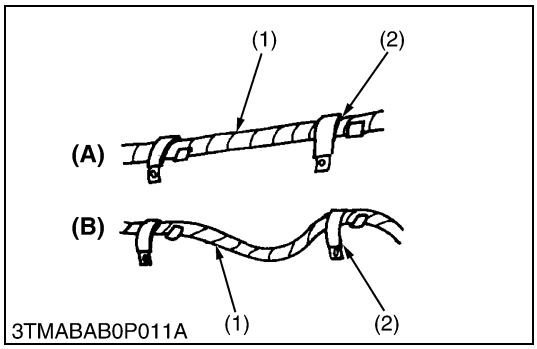


3TMABAB0P010A

- Clamp wiring securely but do not damage wires with the clamp.

(1) Clamp (Spiral Clamp Around Wire)
(2) Wire
(3) Clamp
(4) Welding Mark

RY9212001GEG0028US0

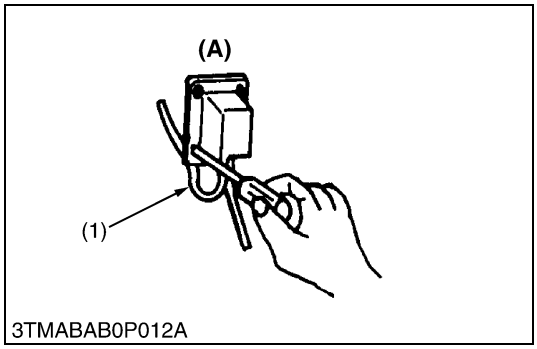


3TMABAB0P011A

- Clamp wiring so it is not twisted, pulled too tight or sag too much. However, moving parts may require play in the wiring.

(1) Wire
(2) Clamp
(A) Correct
(B) Incorrect

RY9212001GEG0029US0

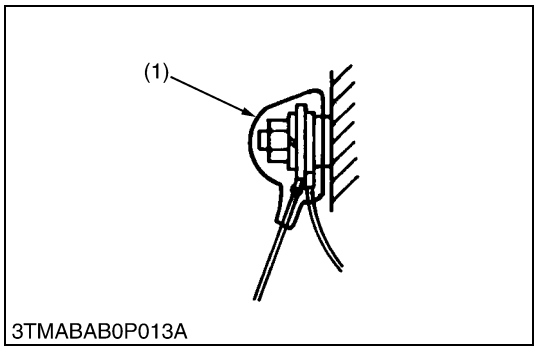


3TMABAB0P012A

- Do not pinch or bind wiring when installing parts.

(1) Wire
(A) Incorrect

RY9212001GEG0030US0

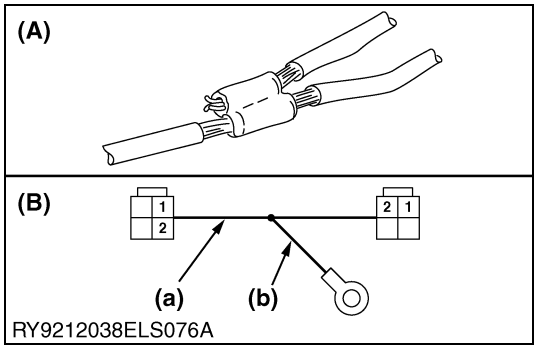


3TMABAB0P013A

- After wiring, double-check terminal protectors and clamps before connecting battery cables.

(1) Cover (Install Covers Securely)

RY9212001GEG0031US0



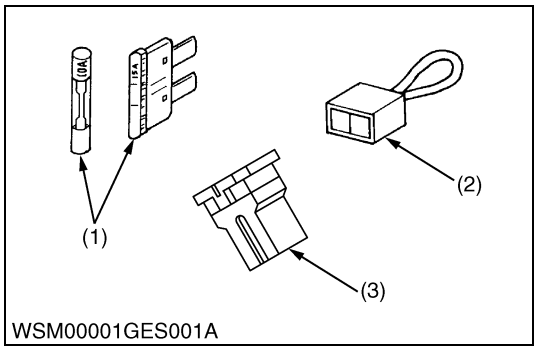
RY9212038ELS076A

- Do not modify harnesses. The diameter of wires in each harness is determined after calculating its capacity.
- Modifying harnesses may cause a malfunction or a fire.

(A) Wiring Diagram **(a) Standard Wiring**
(B) Diagram of Modification **(b) Modified Wiring**

RY9212038ELS0008US0

[2] FUSES



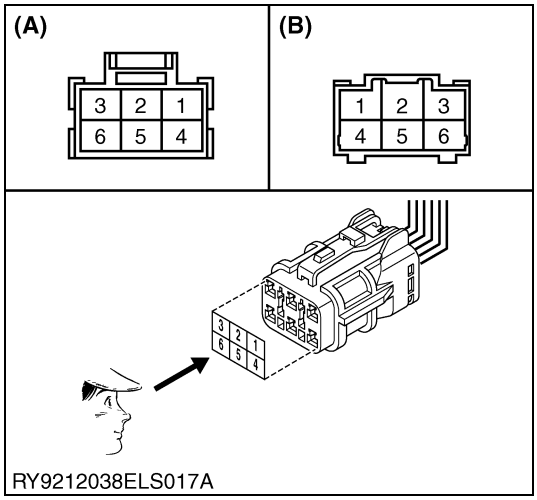
WSM00001GES001A

- Always use fuses of the specified capacity.
  Never use over or undersized fuses.
- Never use copper or steel wire in place of a fuse.
- Do not install accessories such as work lights, radios, etc., if your machine does not have an auxiliary circuit.
- Do not install accessories as they will exceed the capacity of fuses.

(1) Fuse (3) Slow-Blow Fuse
(2) Fusible Link

RY9212001GEG0032US0

[3] CONNECTOR



RY9212038ELS017A

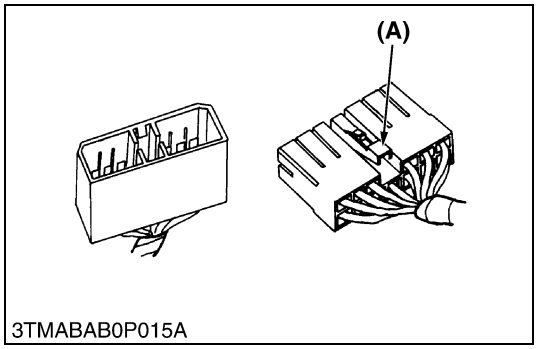
Connectors

The terminals of female connector are numbered from #1 on the top right when facing it.

Male terminals are numbered from #1 on the top left.

(A) Female connector terminals **(B) Male connector terminals**

RY9212038ELS0010US0

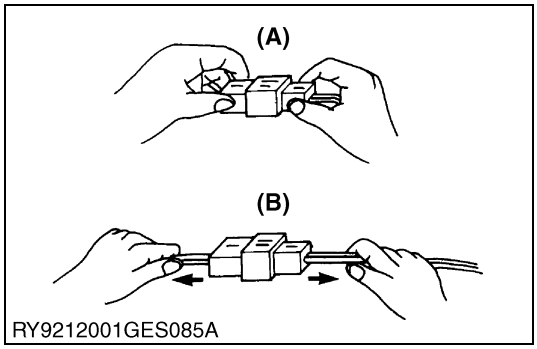


3TMABAB0P015A

- Press the lock to disconnect locking connectors.

(A) Push

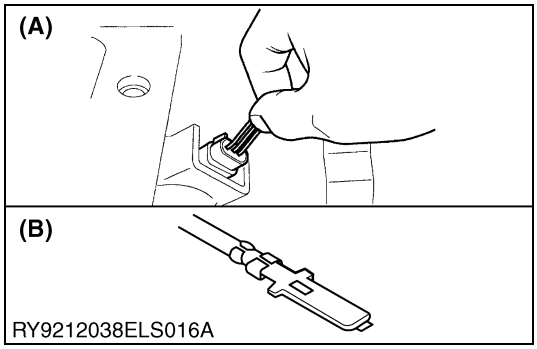
RY9212001GEG0033US0



- Hold the connectors when separating them.
- Do not pull on the wire harness to separate the connectors.

(A) Correct **(B) Incorrect**

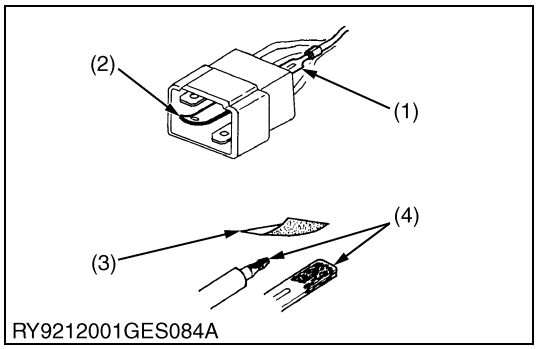
RY9212001GEG0034US0



Pull on the harness from the connector and make sure the harness does not come off. (Pull with 3 kgf (30 N, 7 lbf) or less of force)

(A) Pull **(B) Loosened Crimping**

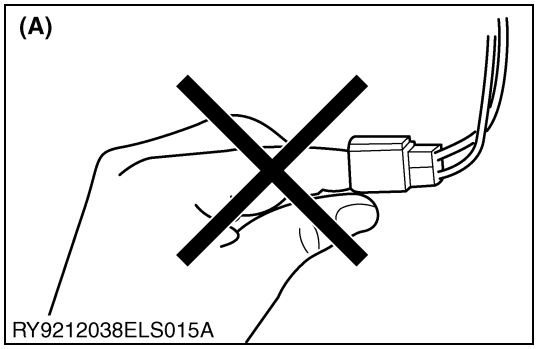
RY9212038ELS0011US0



- Straighten bent prongs and make sure none are sticking out or missing.
- Remove corrosion from terminals with sandpaper.

(1) Missing Terminal (3) Sandpaper
(2) Bent Prong (4) Corrosion

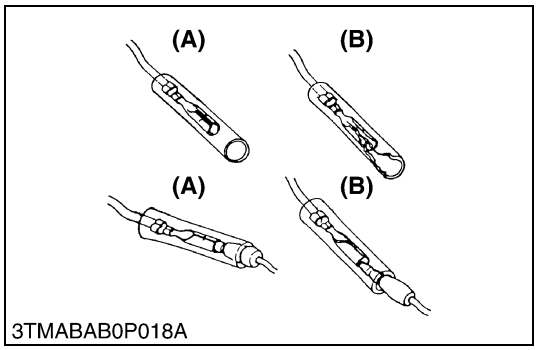
RY9212001GEG0035US0



- Do not touch the terminals of connectors with bare hands.

(A) Do not touch

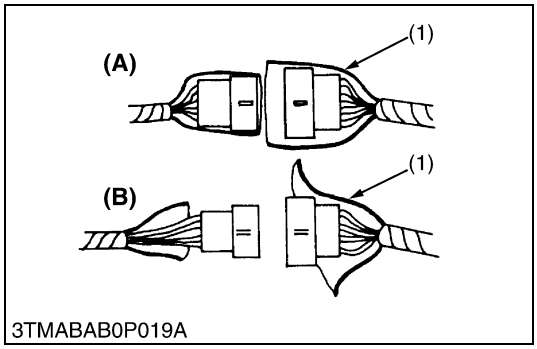
RY9212038ELS0012US0



- Female connectors must not be spread too far open

(A) Correct **(B) Incorrect**

RY9212001GEG0036US0



3TMABAB0P019A

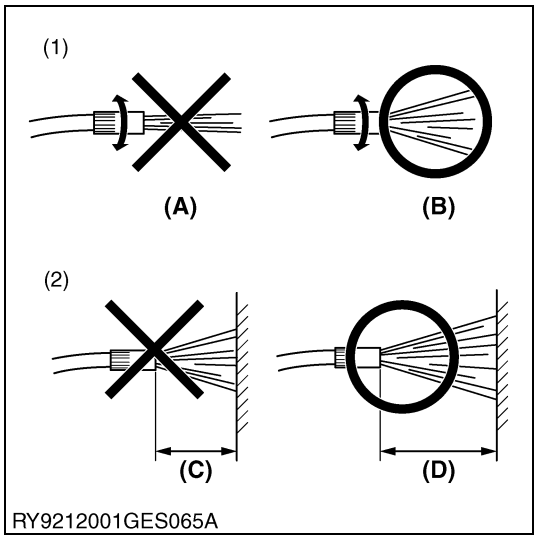
- The plastic covers of connectors must cover them completely.

(1) Cover

(A) Correct
(B) Incorrect

RY9212001GEG0037US0

[4] WASHING THE MACHINE WITH A HIGH-PRESSURE WASHER



RY9212001GES065A

Using a high-pressure washer incorrectly can lead to personal injury and/or damage, break or cause parts of the machine to fail, so use the power washer properly according to its operator's manual and labels.

CAUTION

- **Stand at least 2.0 meters from the machine and adjust the nozzle for a wide spray so it does not cause any damage. If you blast the machine with water or wash it from too close a distance,**

1. It may cause a fire due to damaged or cuts in the insulation of electrical wiring.
2. An injury may result if hydraulic oil gushes out under high pressure, due to damaged hydraulic hoses.
3. It may damage, break or cause parts of the machine to fail. (E.g.)
(1) Stickers or labels may come off
(2) Electrical parts or the engine may fail due to water in them.
(3) Damage glass, resins, etc. or the rubber of oil seals.
(4) Tear off paint or the film from plating

(1) Do Not Blast with Water
(2) Never Wash from Too Close

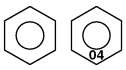
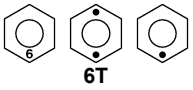
(A) Blasting
(B) Wide Spray
(C) Less Than 2.0 m (80 in.)
(D) Over 2.0 m (80 in.)

RY9212001GEG0038US0

6. TIGHTENING TORQUES

[1] TORQUES FOR GENERAL USE NUTS AND BOLTS

Screws, bolts and nuts whose tightening torques are not specified in this Workshop Manual should be tightened according to the table below.

Indication on top of bolt	No-grade or 4T			7T			9T		
Indication on top of nut	 No-grade or 4T						 6T		
Material of opponent part	Ordinariness			Aluminum			Steel			Aluminum			Steel		
Unit	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M6	7.9 to 9.3	0.8 to 0.95	5.8 to 6.8	7.9 to 8.8	0.8 to 0.9	5.8 to 6.5	9.81 to 11.2	1.0 to 1.15	7.24 to 8.31	7.9 to 8.8	0.8 to 0.9	5.8 to 6.5	12.3 to 14.2	1.25 to 1.45	9.05 to 10.4
M8	18 to 20	1.8 to 2.1	13 to 15	17 to 19	1.7 to 2.0	13 to 14	24 to 27	2.4 to 2.8	18 to 20	18 to 20	1.8 to 2.1	13 to 15	30 to 34	3.0 to 3.5	22 to 25
M10	40 to 45	4.0 to 4.6	29 to 33	32 to 34	3.2 to 3.5	24 to 25	48 to 55	4.9 to 5.7	36 to 41	40 to 44	4.0 to 4.5	29 to 32	61 to 70	6.2 to 7.2	45 to 52
M12	63 to 72	6.4 to 7.4	47 to 53	–	–	–	78 to 90	7.9 to 9.2	58 to 66	63 to 72	6.4 to 7.4	47 to 53	103 to 117	10.5 to 12	76 to 86.7
M14	108 to 125	11 to 12.8	79.6 to 92.5	–	–	–	124 to 147	12.6 to 15	91.2 to 108	–	–	–	167 to 196	17 to 20	123 to 144
M16	167 to 191	17 to 19.5	123 to 141	–	–	–	197 to 225	20 to 23	145 to 166	–	–	–	260 to 304	26.5 to 31	192 to 224
M18	246 to 284	25 to 29	181 to 209	–	–	–	275 to 318	28 to 32.5	203 to 235	–	–	–	344 to 402	35 to 41	254 to 296
M20	334 to 392	34 to 40	246 to 289	–	–	–	368 to 431	37.5 to 44	272 to 318	–	–	–	491 to 568	50 to 58	362 to 419

RY9212032GEG0001US0

[2] STUD BOLTS

Material of opponent part	Steel			Aluminum		
Unit	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M8	12 to 15	1.2 to 1.6	8.7 to 11	8.9 to 11	0.90 to 1.2	6.5 to 8.6
M10	25 to 31	2.5 to 3.2	18 to 23	20 to 25	2.0 to 2.6	15 to 18
M12	30 to 49	3.0 to 5.0	22 to 36	31	3.2	23
M14	62 to 73	6.3 to 7.5	46 to 54	–	–	–
M16	98.1 to 112	10.0 to 11.5	72.4 to 83.1	–	–	–
M18	172 to 201	17.5 to 20.5	127 to 148	–	–	–

RY9212032GEG0002US0

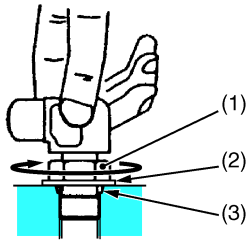
[3] TORQUE FOR HYDRAULIC HOSE FITTINGS

(1) Torque for Hydraulic Hose Fittings

Union nut (metal seal type)		Union nut (ORS type)	
1/8	7.8 to 11.8 N·m 0.8 to 1.2 kgf·m 5.7 to 8.7 lbf·ft	–	–
1/4	24.5 to 29.2 N·m 2.5 to 3.0 kgf·m 18.1 to 21.7 lbf·ft	9/16UNF	35.2 to 43.1 N·m 3.6 to 4.4 kgf·m 26.0 to 31.8 lbf·ft
3/8	37.2 to 42.1 N·m 3.8 to 4.3 kgf·m 27.5 to 31.1 lbf·ft	11/16UNF	60.0 to 73.5 N·m 6.1 to 7.5 kgf·m 44.3 to 54.2 lbf·ft
1/2	58.8 to 63.7 N·m 6.0 to 6.5 kgf·m 43.4 to 47.0 lbf·ft	13/16UNF	70.6 to 86.2 N·m 7.2 to 8.8 kgf·m 52.1 to 63.6 lbf·ft
3/4	117.6 to 127.4 N·m 12.0 to 13.0 kgf·m 86.8 to 94.0 lbf·ft	1-14UNS	105.8 to 129.4 N·m 10.8 to 13.2 kgf·m 78.0 to 98.4 lbf·ft
1	181.3 to 191.1 N·m 18.5 to 19.5 kgf·m 133.7 to 140.9 lbf·ft	–	–
1 - 1/4	220.5 to 230.3 N·m 22.5 to 23.5 kgf·m 162.7 to 169.8 lbf·ft	–	–

RY9212435GEG0002US0

(2) Torques of Lock-Nuts for Elbows with Male Seats and Adaptors with O-rings (Straight Threads)



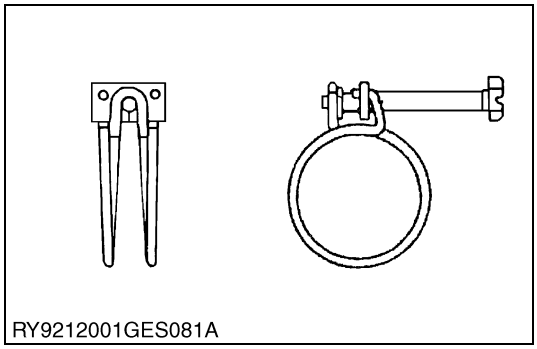
RY9212001GES077A

Tightening torque	1/8	15.0 to 16.5 N·m 1.5 to 1.7 kgf·m 11.1 to 12.2 lbf·ft
	1/4	24.5 to 29.4 N·m 2.5 to 3.0 kgf·m 18.1 to 21.7 lbf·ft
	3/8	49.0 to 53.9 N·m 5.0 to 5.5 kgf·m 36.1 to 39.8 lbf·ft
	1/2	58.8 to 63.7 N·m 6.0 to 6.5 kgf·m 43.4 to 47.0 lbf·ft
	3/4, 1	117.6 to 127.4 N·m 12.0 to 13.0 kgf·m 86.8 to 94.0 lbf·ft
	1-1/4	220.5 to 230.3 N·m 22.5 to 23.5 kgf·m 162.8 to 170.0 lbf·ft
	7/8 - 14UNF	55.9 to 60.8 N·m 5.7 to 6.2 kgf·m 41.2 to 44.8 lbf·ft

(1) Lock-nut
(2) Washer
(3) Seal (O-ring)

RY9212148GEG0007US0

[4] HOSE CLAMP SCREW TORQUE



RY9212001GES081A

Type 1

Tightening torque	ϕ10-ϕ14	6C040-58721	2.5 to 3.4 N·m 25 to 35 kgf·cm 1.8 to 2.5 lbf·ft
	ϕ12-ϕ16	09318-89016	2.5 to 3.4 N·m 25 to 35 kgf·cm 1.8 to 2.5 lbf·ft
	ϕ19-ϕ25	09318-89024	2.5 to 3.4 N·m 25 to 35 kgf·cm 1.8 to 2.5 lbf·ft
	ϕ31-ϕ40	09318-89039	2.5 to 3.4 N·m 25 to 35 kgf·cm 1.8 to 2.5 lbf·ft
	ϕ36-ϕ46	09318-89045	2.5 to 3.4 N·m 25 to 35 kgf·cm 1.8 to 2.5 lbf·ft
	ϕ44-ϕ53	09318-89052	3.9 to 4.9 N·m 40 to 50 kgf·cm 2.9 to 3.6 lbf·ft
	ϕ51-ϕ59	09318-89058	3.9 to 4.9 N·m 40 to 50 kgf·cm 2.9 to 3.6 lbf·ft
	ϕ86-ϕ96	RD809-42241	2.5 to 3.4 N·m 25 to 35 kgf·cm 1.8 to 2.5 lbf·ft

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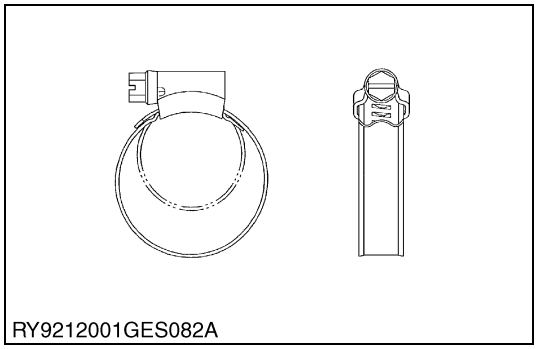
RY9212001GES082A

Type 2

Tightening torque	ϕ13-ϕ20	RB101-63631	2.5 to 3.4 N·m 25 to 35 kgf·cm 1.8 to 2.5 lbf·ft
	ϕ15-ϕ25	RC101-64581	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ19-ϕ28	R1401-63211	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ22-ϕ32	R1401-63151	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ26-ϕ38	68311-72821	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ32-ϕ44	RD411-63821	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ40-ϕ55	RC411-63181	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ50-ϕ65	RC401-63191	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ58-ϕ75	36919-04591	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ60-ϕ80	RD809-63101	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ68-ϕ85	RD809-63061	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft
	ϕ77-ϕ95	69284-63171	4.9 to 5.9 N·m 50 to 60 kgf·cm 3.6 to 4.3 lbf·ft

RY9212148GEG0009US0

7. OIL AND WATER CAPACITY TABLE

Item		KX080-4α2
Engine oil (when filter changed)		9.7 L (2.6 U.S.gal)
Coolant		10.5 L (2.77 U.S.gal)
Reserve tank		1.1 L (0.29 U.S.gal)
Fuel (full)		115 L (30.4 U.S.gal)
Hydraulic oil	Total volume (Std. spec.)	146 L (38.6 U.S.gal)
	Total volume (Two piece boom spec.)	159 L (42.0 U.S.gal)
	Inside tank (gauge middle)	75 L (20.0 U.S.gal)
Travel motor		1.35 L (0.36 U.S.gal)
Idler assy		80 ml (4.88 cu.in.)
Track rollers		80 ml (4.88 cu.in.)
Carrier rollers		80 ml (4.88 cu.in.)
Grease		–

RY9212724GEG0007US0

8. MAINTENANCE INTERVALS

[1] OPERATOR SERVICING

General maintenance			Elapsed hours of operation																			Interval
			50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	
	Check the fuel level																						daily
	Check the coolant level																						daily
	Checking the engine oil level																						daily
	Check the hydraulic oil level																						daily
	Grease the bucket bolt and bucket linkage bolt																						daily
	Check the V-belt																						daily
	Check the fluid level of the washer system reservoir																						daily
	Check the electric cables and connections																						daily
	Clean radiator																						daily
	Lubricate the front-end attachments	Grease the swing bracket		❍		❍		❍		❍		❍		❍		❍		❍		❍		❍	100 h
		Other greasing points					❍					❍					❍					❍	250 h
	Check the water separator		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	50 h
	Drain water from the fuel tank		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	50 h
	Check the battery electrolyte level		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	50 h
	Grease the swivel gear		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	50 h
	Crawlers and chassis: Clean, visually inspect and check tension		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	50 h
	Grease the swivel ball bearing					❍				❍				❍				❍				❍	200 h
*1	Check, clean the interior air filter					❍				❍				❍				❍				❍	200 h
	Clean A/C condenser					❍				❍				❍				❍				❍	200 h
*1	Check, clean the air filter					❍				❍				❍				❍				❍	200 h
	Check the coolant hoses and hose clamps					❍				❍				❍				❍				❍	200 h
	Check the fuel lines and air intake hoses					❍				❍				❍				❍				❍	200 h
	Check the pipes and hoses of the air-conditioner																						annually

*1 : Under very dusty conditions, the air filter and the interior air filter must be cleaned more frequently or replaced.

RY9212148GEG0010US0

[2] SERVICING BY SKILLED PERSONNEL OR KUBOTA DEALER

	Servicing	Elapsed hours of operation																				Interval
		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	
	Check the coolant hoses and hose clamps					❍					❍					❍					❍	250 h
	Check and adjust the V-belt					❍					❍					❍					❍	250 h
	Change the engine oil and oil filter										❍										❍	500 h
*3	Replace the drive unit oil	●									❍										❍	500 h
	Replace the water separator element										❍										❍	500 h
	Replace the fuel filter element										❍										❍	500 h
*2	Replace the return filter					●					❍										❍	500 h
	Replace the pilot circuit filter																				❍	1000 h
*2	Change the hydraulic oil and replace the suction filter																				❍	1000 h
*1	Replace the air filter elements																				❍	1000 h
*1	Replace the interior air filter																				❍	1000 h
	Change the oil of the idler and track roller																					2000 h
	Check alternator and starter motor																					2000 h
*4	Safety inspection																					annually
	Replace the coolant hoses and hose clamps																					every 2 years
	Replace the fuel lines and air intake hoses																					every 2 years
	Replace the pipes and hoses of the air-conditioner																					every 2 years
	Replace the coolant																					every 2 years
	Replace the hydraulic hoses																					every 6 years
	Check the refrigerant content																					Maintenance on demand
	Replace oil separator																					1500 h
	Check EGR cooler																					1500 h
	Check EGR system																					3000 h
	Check turbo charger																					3000 h
*5	Change diesel particle filter																					6000 h

- The maintenance tasks identified with ● must be carried out once the indicated hours of operation after the initial commissioning have been reached.

*1 : Under very dusty conditions, the air filter and the interior air filter must be cleaned more frequently or replaced.
*2 : When using a breaker over 20 % → every 800 h.
When using a breaker over 40 % → every 400 h.
When using a breaker over 60 % → every 300 h.
When using a breaker over 80 % → every 200 h.
*3 : Earlier if necessary.
*4 : At least annually.
*5 : DPF need clean every less than 6000 hours. This machine is equipped with DPF cleaning alarm system, clean the DPF in case of an alarm or every 6000 operating.

Servicing	Elapsed hours of operation																				Interval
	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	
Check load pressure sensor and mass air flow sensor																					annually
Check condition of DPF catalyst																					annually
Check DPF differential pressure sensor and tubings for gas leakage																					annually
Check DPF exhaust gas temperature sensor																					annually
Check EGR and tubings for gas leakage																					annually
Flush the radiator																					every 2 years
Replace crankcase ventilation and hoses																					every 2 years
Replace DPF differential pressure sensor hoses (front and rear)																					every 2 years
Replace the mass air flow sensor downstream suction pipe																					every 2 years
Replace the load pressure sensor hose																					every 2 years
Replace the EGR cooler hose																					every 2 years

RY9212724GEG0005US0

■ **NOTE**

Engine Oil:

- **Oil used in the engine should have an American Petroleum Institute (API) service classification and Proper SAE Engine Oil according to the ambient temperatures.**

Above 25 °C (77 °F)	SAE30 or SAE 10W-30, SAE 15W-40
0 to 25 °C (32 to 77 °F)	SAE20 or SAE 10W-30, SAE 15W-40
Below 0 °C (32 °F)	SAE10W or SAE 10W-30, SAE 15W-40

- Refer to the following table for the suitable API classification engine oil and the fuel.

Fuel used	Engine oil classification (API classification)
	Oil class of engines except external DPF
Ultra Low Sulfur Fuel [< 0.0015 % (15 ppm)]	**CJ-4**

Fuel:

- Use the ultra low sulfur diesel fuel only [below 0.0015 % (15 ppm)] for these engines.
- Cetane number of 45 minimum. Cetane number greater than 50 is preferred, especially for temperatures below -20 °C (-4 °F) or elevations above 1500 m (5000 ft).
- Diesel fuels specified to EN 590 or ASTM D975 are recommended.
- No. 2-D is a distillate fuel of lower volatility for engines in industrial and heavy mobile service. (SAE J313 JUN87)

- Indicated capacities of water and oil are manufacture's estimate.

■ **IMPORTANT**

- **If you use different fuel or engine oil, the cleaning interval of the DPF (6000 hours) can't be secured and the DPF will be clogged for a shorter time than expected.**
- **Filters must trap fuel and lubricant sulfate additives (Zn, Pb, Na, K, Ca, Mg, Cu, Ba, P, etc.) as ash during combustion. Fuel must be controlled carefully to prevent the additives being mixed into fuel such as fuel tank anti-oxidants, water remover, anti-freeze and so on.**

RY9212724GEG0006US0

Recommended lubricants

		Ambient temperature conditions	Recommendation		Filled at the factory		Note
			Viscosity	Quality standard	Brand	Type	
Engine oil	Engine	Above 25 °C (77 °F)	SAE 30 SAE 10W-30 SAE 15W-40	API CJ-4 *1	JXTG	JASO DH-2 SAE 10W-30	
		0 to 25 °C (32 to 77 °F)	SAE 20 SAE 10W-30 SAE 15W-40				
		Below 0 °C (32 °F)	SAE 10W SAE 10W-30 SAE 15W-40				
	Front idlerTruck roller		SAE 30	API CD	–	API CD *2 SAE 30	
Coolant			–	SAE J1034 MB 325.0 ASTM D3306 ASTM D4985	KUBOTA	LLC-N-50F Mixture ratio 50%	Always use distilled water as the admixture for antifreeze. Refer to the respective coolant manufacturer's recommendations for the correct mixing ratio. Do not mix with other coolants.
Grease		Pin, Bushing, Bearing, Gear	NLGI-2	DIN 51825 KP2K-30	COSOMO	Dynamax EP2	
Hydraulic oil		In winter or at low ambient temperatures	VG 32 VG 46	ISO	SHELL	Tellus S2M46ISO VG 46	
		In summer or at high ambient temperatures	VG 46 VG 68				
Gear oil		Travel motor	SAE 90	API GL-4	–	API GL-4 *2 SAE 90	
Fuel			–	EN 590	–	–	The fuel filled at the factory is not winter diesel.When preparing the machine for the winter, fill the fuel tank with winter diesel and let the motor run for a few minutes.
Refrigerant			–	HFC134a (R134a)	–	HFC134a (R134a)	

- *1 If use CJ-4 to the non common rail engine, must use specified EN590 diesel fuel (maximum sulfer 10 ppm).
- *2 This gear oil is filled up at the manufacturer factory.

RY9212509GEG0006US0

1 MACHINE BODY

SERVICING

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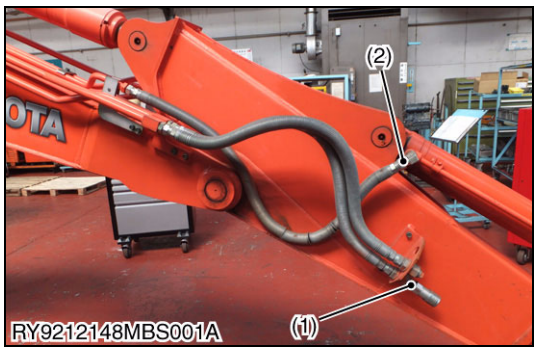
1. FRONT

[1] BOOM ASSEMBLY/DISASSEMBLY

CAUTION

- **Wear protective gear, such as a helmet, eye protection, etc., during assembly/disassembly.**
- **For group work, decide on signals for communication, make sure everyone understands and uses them and be very careful about safety.**
- **Never put your finger in the pin hole when aligning the pin with the hole.**
- **When hoisting anything heavy, always determine its center of gravity before hoisting it.**
- **When working with a sling, use a cloth or the like in places that may be hit hard by the nylon sling.**

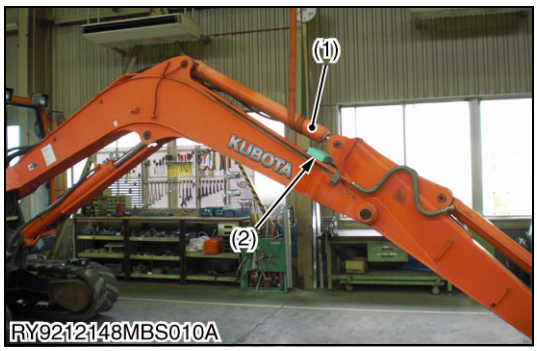
RY9212148MBS0012US0



1. Lower the front to the ground.
   Remove the AUX lines from each bracket and disconnect the bucket cylinder hoses.

(1) AUX Line (2) Bucket Cylinder Hose

RY9212148MBS0017US0



2. Suspend the arm cylinder temporarily and remove the pin on the rod side.
   Operate the crane and lower the arm cylinder onto a block on top of the boom.

(1) Arm Cylinder (2) Block

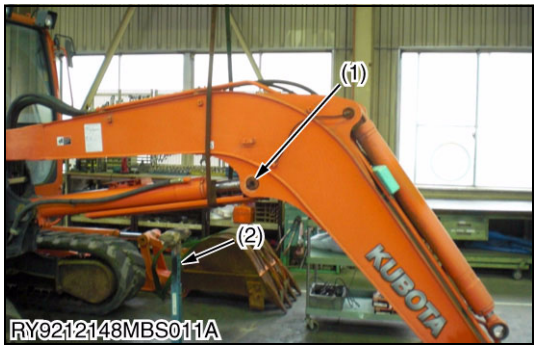
RY9212148MBS0018US0

3. Suspend the arm and bucket temporarily with the crane, then remove the linkage pin between the arm and the boom and then remove the bucket and the arm.

Weight	Approx. 510 kg (1120 lbs)

(1) Pin

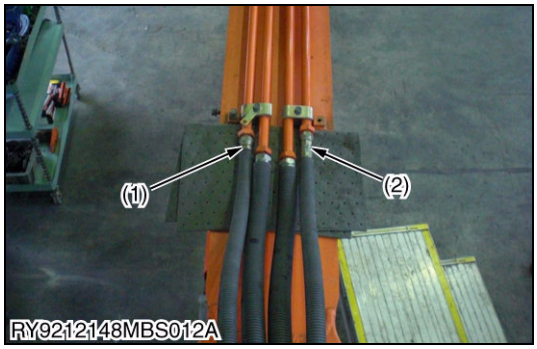
RY9212148MBS0019US0



4. Set the end of the boom on the ground.
   Suspend the boom cylinder temporarily and remove the pin on the rod side.
   Operate the crane and lower the boom cylinder onto a stand.

(1) Pin (2) Cylinder Stand

RY9212148MBS0020US0



5. Remove all the arm cylinder and bucket cylinder hoses.

(1) Arm Cylinder Hose (2) Bucket Cylinder Hose

RY9212148MBS0021US0

6. Suspend the boom temporarily and remove the pin at the base of the boom.

(1) Pin

RY9212148MBS0022US0

7. Operate the crane and remove the boom.

Boom weight	Approx. 500 kg (1102 lbs)

RY9212148MBS0023US0

8. Perform the procedure in reverse for assembly.

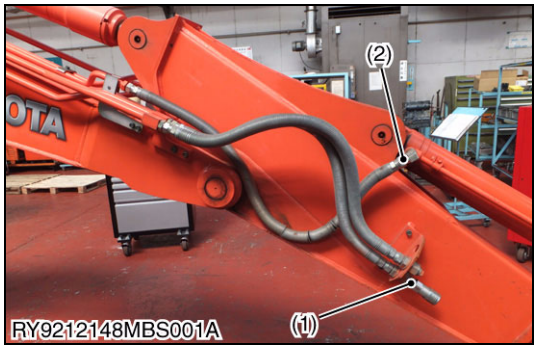
RY9212148HYS0096US0

[2] TWO PIECE BOOM ASSEMBLY/DISASSEMBLY

CAUTION

- **Wear protective gear, such as a helmet, eye protection, etc., during assembly/disassembly.**
- **For group work, decide on signals for communication, make sure everyone understands and uses them and be very careful about safety.**
- **Never put your finger in the pin hole when aligning the pin with the hole.**
- **When hoisting anything heavy, always determine its center of gravity before hoisting it.**
- **When working with a sling, use a cloth or the like in places that may be hit hard by the nylon sling.**

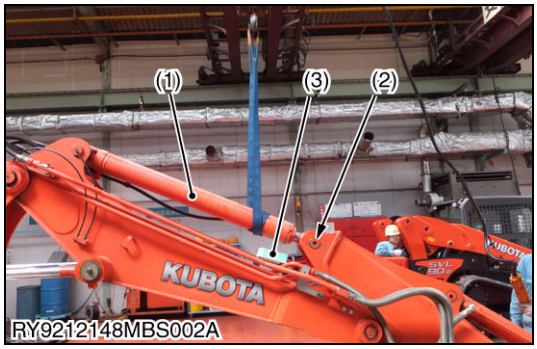
RY9212148MBS0012US0



1. Lower the front equipment to the ground.
   Remove the AUX lines from each bracket and disconnect the bucket cylinder hoses.

(1) AUX Lline (2) Bucket Cylinder Hose

RY9212148MBS0024US0



2. Suspend the arm cylinder temporarily and remove the pin on the rod side.
   Operate the crane and lower the arm cylinder onto a block on top of the 2nd boom.

(1) Arm Cylinder (3) Block
(2) Pin

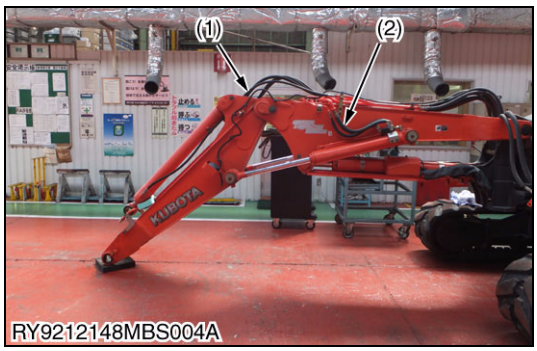
RY9212148MBS0025US0

3. Suspend the arm and bucket temporarily with the crane, then remove the linkage pin between the arm and the 2nd boom and then remove the bucket and the arm.

Weight	Approx. 510 kg (1120 lbs)

(1) Pin

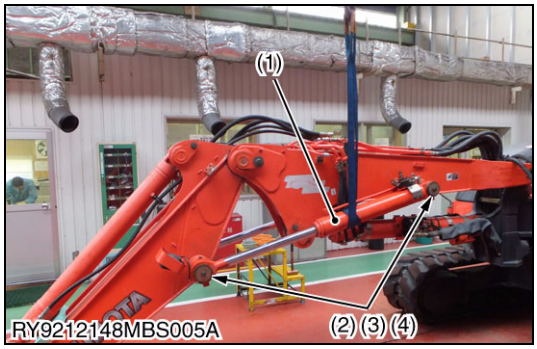
RY9212148MBS0026US0



4. Put the end of the 2nd boom onto the ground and disconnect the wiring harness and the two-piece cylinder hoses.

(1) Wire harness (2) Two-piece Cylinder Hoses

RY9212148MBS0027US0

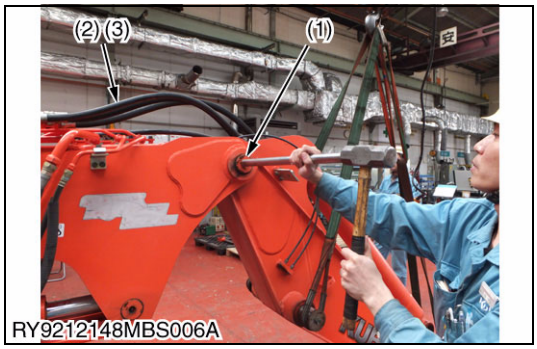


5. Suspend the two-piece cylinder with the crane and remove the stopper bolt, cover plate, spacer and two-piece cylinder in order. Remove the two-piece cylinder on the other side in the same way.

Weight	Approx. 56 kg (120 lbs)

(1) Two-piece cylinder
(2) Stopper bolt
(3) Cover plate
(4) Spacer

RY9212148MBS0028US0

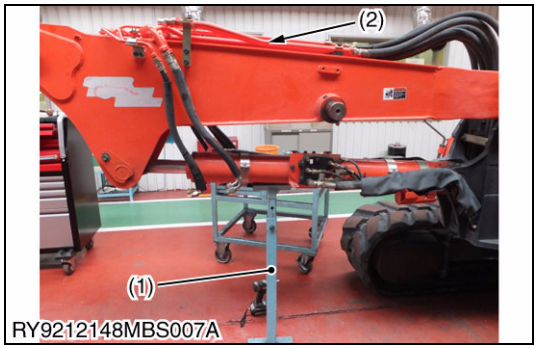


6. Disconnect the arm cylinder and bucket cylinder hoses and suspend the 2nd boom with the crane.
Remove the linkage pin between the 1st and 2nd booms and remove the 2nd boom.

Weight	Approx. 342 kg (754 lbs)

(1) Pin
(2) Arm Cylinder Hose
(3) Bucket Cylinder Hose

RY9212148MBS0029US0



7. Remove the boom cylinder cover and lower the boom cylinder onto a stand.
Remove all of the front hose lines.

(1) Cylinder Stand
(2) Front Hose Lines

RY9212148MBS0030US0

8. Suspend the 1st boom and remove the pin on the boom cylinder rod side and then the pin at the base of the 1st boom.

(1) Pin
(2) Pin

RY9212148MBS0031US0

9. Operate the crane and remove the 1st boom.

Weight	Approx. 318 kg (701 lbs)

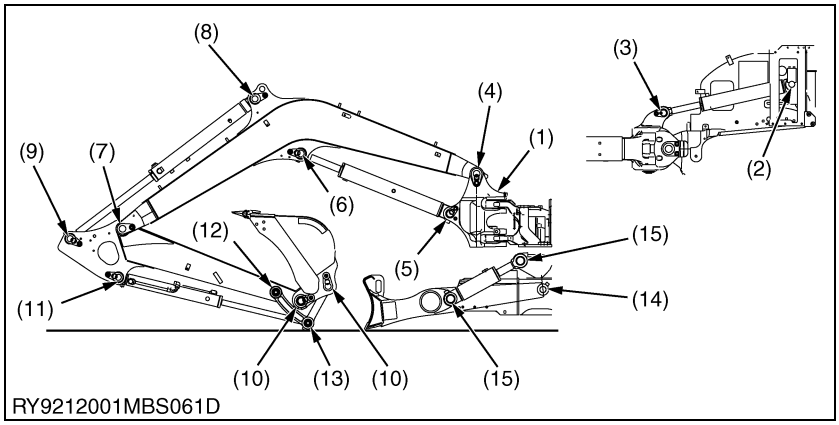
RY9212148MBS0032US0

10. Perform the procedure in reverse for assembly.

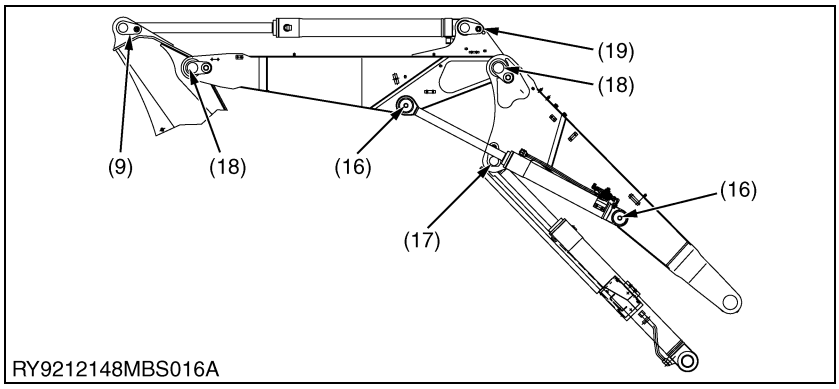
RY9212148HYS0096US0

[3] TABLE OF DIMENSIONS

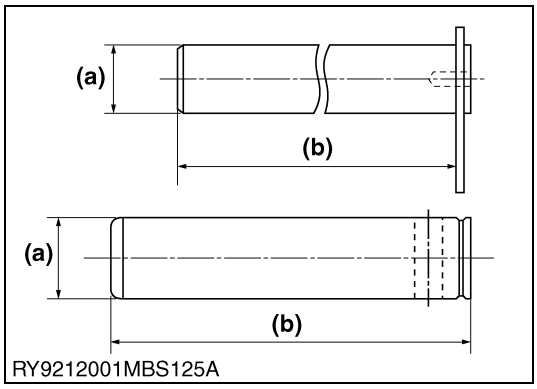
(1) Front Pin



RY9212001MBS061D



RY9212148MBS016A



RY9212001MBS125A

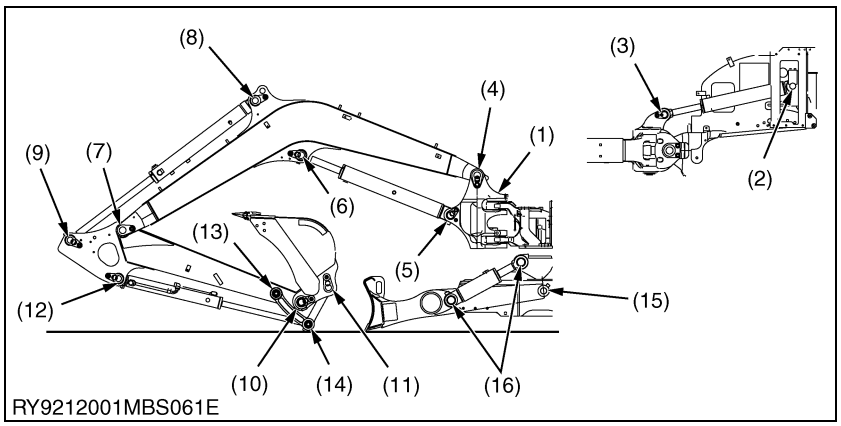
Item	KX080-4α2 (Pin dia. X length)
(1)	ϕ100 × 474 mm ϕ3.94 × 18.66 in.
(2)	ϕ70 × 183 mm ϕ2.76 × 7.20 in.
(3)	ϕ70 × 168 mm ϕ2.76 × 6.61 in.
(4)	ϕ80 × 437 mm ϕ3.15 × 17.20 in.
(5)	ϕ70 × 200 mm ϕ2.76 × 7.87 in.
(6)	ϕ70 × 226 mm ϕ2.76 × 8.90 in.
(7)	ϕ70 × 332 mm ϕ2.76 × 13.07 in.
(8)	ϕ60 × 226 mm ϕ2.36 × 8.90 in.
(9)	ϕ60 × 175 mm ϕ2.36 × 6.89 in.
(10)	ϕ60 × 333 mm ϕ2.36 × 13.11 in.
(11)	ϕ60 × 151 mm ϕ2.36 × 5.94 in.
(12)	ϕ60 × 275 mm ϕ2.36 × 10.83 in.
(13)	ϕ60 × 275 mm ϕ2.36 × 10.83 in.
(14)	ϕ60 × 167 mm ϕ2.36 × 6.57 in.
(15)	ϕ70 × 144 mm ϕ2.76 × 5.67 in.
(16)	ϕ70 × 520 mm ϕ2.76 × 20.47 in.
(17)	ϕ70 × 258 mm ϕ2.76 × 10.16 in.
(18)	ϕ70 × 332 mm ϕ2.76 × 13.07 in.
(19)	ϕ60 × 226 mm ϕ2.36 × 8.90 in.

- The pin usage limit is when the wear exceeds 1.0 mm (0.039 in.) from the factory spec. from new.

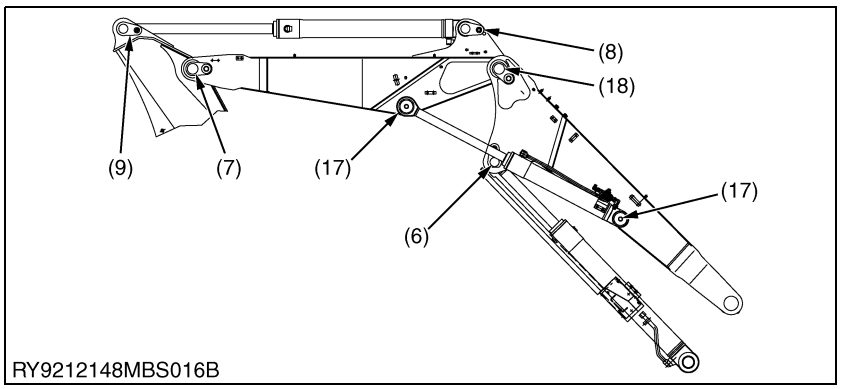
(a) Pin Diameter
(b) Length

RY9212724MBS0019US0

(2) Front Bushings



RY9212001MBS061E



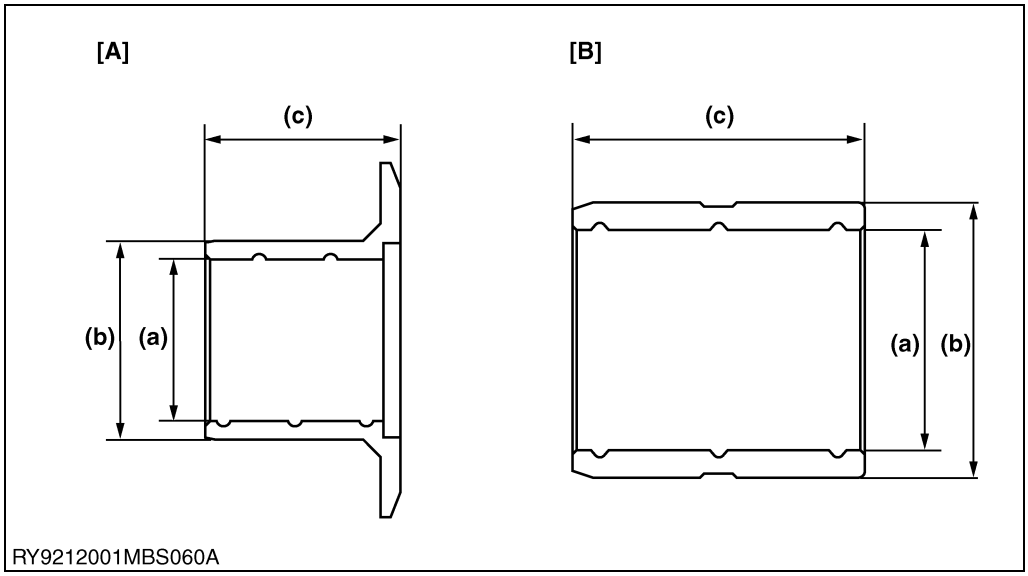
RY9212148MBS016B

Item	Point used	KX080-4α2 (I.D. × O.D. × Length)	Item	Point used	KX080-4α2 (I.D. × O.D. × Length)
(1)	Swing bracket top	ϕ100 × 115 × 64 mm ϕ3.94 × 4.53 × 2.52 in.	(7)	Arm ends	ϕ70 × 82 × 80 mm ϕ2.76 × 3.23 × 3.15 in.
	Swivel frame top/bottom	ϕ100 × 115 × 110 mm ϕ3.94 × 4.53 × 4.33 in.	(8)	Cylinder	ϕ60 × 70 × 75 mm ϕ2.36 × 2.76 × 2.95 in.
	Swing bracket bottom	ϕ100 × 115 × 61 mm ϕ3.94 × 4.53 × 2.40 in.	(9)	Cylinder	ϕ60 × 70 × 75 mm ϕ2.36 × 2.76 × 2.95 in.
(2)	Cylinder	ϕ70 × 82 × 65 mm ϕ2.76 × 3.23 × 2.56 in.	(10)	Arm ends	ϕ60 × 80 × 65 mm ϕ2.36 × 3.15 × 2.56 in.
(3)	Swing bracket top	ϕ70 × 82 × 45 mm ϕ2.76 × 3.23 × 1.77 in.	(11)	Bucket link ends	ϕ60 × 70 × 60 mm ϕ2.36 × 2.76 × 2.36 in.
	Cylinder	ϕ70 × 82 × 65 mm ϕ2.76 × 3.23 × 2.56 in.	(12)	Cylinder	ϕ60 × 70 × 65 mm ϕ2.36 × 2.76 × 2.56 in.
	Swing bracket bottom	ϕ70 × 82 × 36 mm ϕ2.76 × 3.23 × 1.42 in.	(13)	Arm ends	ϕ60 × 70 × 60 mm ϕ2.36 × 2.76 × 2.36 in.
(4)	Swing bracket ends	ϕ80 × 95 × 80 mm ϕ3.15 × 3.74 × 3.15 in.	(14)	Bucket link ends	ϕ60 × 70 × 52 mm ϕ2.36 × 2.76 × 2.05 in.
	Boom ends	ϕ80 × 95 × 80 mm ϕ3.15 × 3.74 × 3.15 in.		Cylinder	ϕ60 × 70 × 65 mm ϕ2.36 × 2.76 × 2.56 in.
(5)	Swing bracket right	ϕ70 × 82 × 49 mm ϕ2.76 × 3.23 × 1.93 in.	(15)	Blade	ϕ60 × 70 × 88 mm ϕ2.36 × 2.76 × 3.46 in.
	Cylinder	ϕ70 × 82 × 75 mm ϕ2.76 × 3.23 × 2.95 in.	(16)	Blade	ϕ70 × 82 × 60 mm ϕ2.76 × 3.23 × 2.36 in.
	Swing bracket left	ϕ70 × 82 × 49 mm ϕ2.76 × 3.23 × 1.93 in.	(17)	Cylinder	ϕ70 × 82 × 52 mm ϕ2.76 × 3.23 × 2.05 in.
(6)	Cylinder	ϕ70 × 82 × 75 mm ϕ2.76 × 3.23 × 2.95 in.	(18)	Boom ends	ϕ70 × 82 × 80 mm ϕ2.76 × 3.23 × 3.15 in.

- The usage limit for bushings is when the wear exceeds 1.0 mm (0.039 in.) from the factory spec. from new.

RY9212724MBS0020US0

Bushing shape



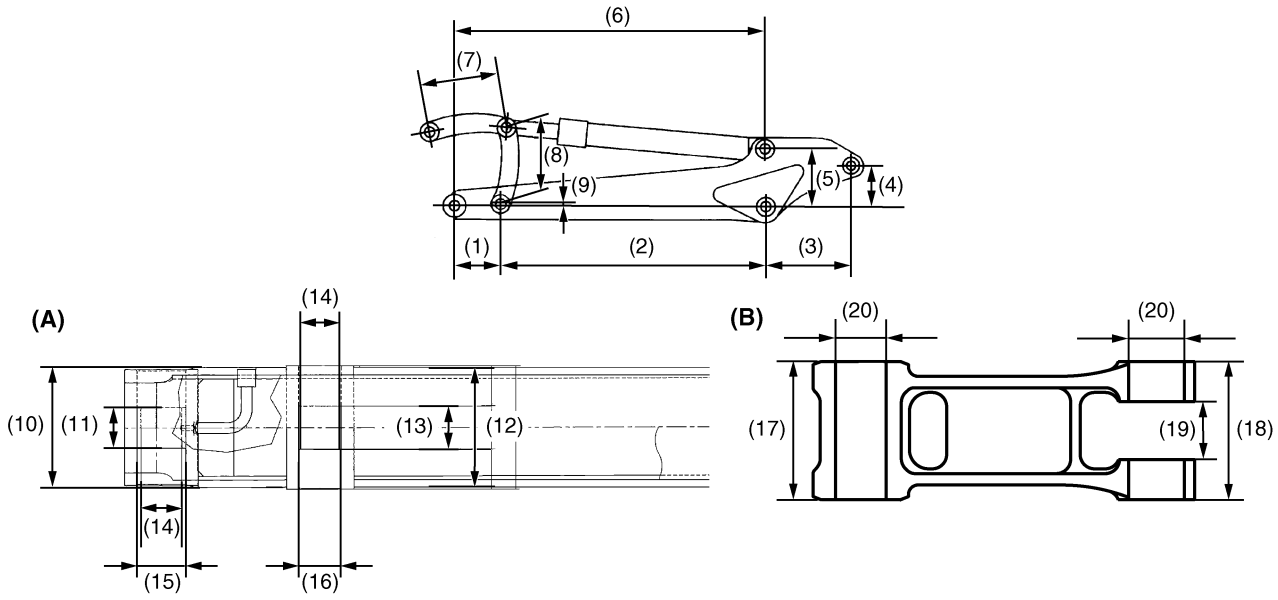
RY9212001MBS060A

(A) Flanged Bushing
(B) Normal Bushing

(a) I.D.
(b) O.D.
(c) Length

RY9212148MBS0036US0

(3) Arm



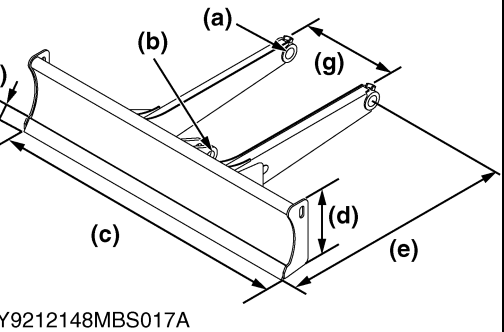
RY9212148MBS088A

(A) Arm Tip **(B) Bucket Link 1**

No.	KX080-4α2	No.	KX080-4α2	No.	KX080-4α2	No.	KX080-4α2
(1)	260 mm 10.24 in.	(6)	1745 mm 68.70 in.	(11)	66 mm 2.60 in.	(16)	ϕ70 mm ϕ2.76 in.
(2)	1840 mm 72.44 in. (long arm) 1490 mm 58.66 in. (short arm)	(7)	403 mm 15.87 in.	(12)	200 mm 7.87 in.	(17)	200 mm 7.87 in.
(3)	451 mm 17.76 in.	(8)	428 mm 16.85 in.	(13)	70 mm 2.76 in.	(18)	
(4)	279 mm 10.98 in.	(9)	13 mm 0.51 in.	(14)	ϕ67 mm ϕ2.64 in.	(19)	76 mm 2.99 in.
(5)	370 mm 14.57 in.	(10)	188 mm 7.40 in.	(15)	ϕ80 mm ϕ3.15 in.	(20)	ϕ70 mm ϕ2.76 in.

RY9212724MBS0003US0

(4) Blade



RY9212148MBS017A

No.	Item	KX080-4α2
(a)	I.D. X Length	ϕ70 × 98 mm ϕ2.76 × 3.86 in.
(b)	I.D. X Length	ϕ70 × 28 mm ϕ2.76 × 1.10 in.
(c)	Width	2200 mm 86.61 in.
(d)	Height	500 mm 19.69 in.
(e)	Length	1448 mm 57.01 in.
(f)	Tip height - plate thickness	90 × t 16 mm 3.54 × t 0.63 in.
(g)	Distance between supports	698 mm 27.48 in.

RY9212724MBS0004US0

2. SWIVEL FRAME

[1] WEIGHT ASSEMBLY/DISASSEMBLY

1. Remove the left and rear bonnets.

CAUTION

- **It takes at least 2 people to remove the rear bonnet.**

Rear hood weight	Approx. 27 kg (60 lbs)

(1) Rear Hood (2) Left Hood

RY9212435MBS0005US0

2. Remove the weight.

CAUTION

- **Find its center of gravity and suspend it securely.**

Tightening torque	Weight	367.7 to 431.5 N·m 37.5 to 44.0 kgf·m 271.2 to 318.3 lbf·ft

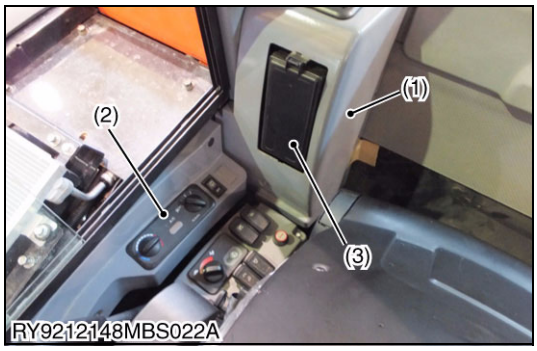
During installation, apply a threadlock. (Loctite 271)

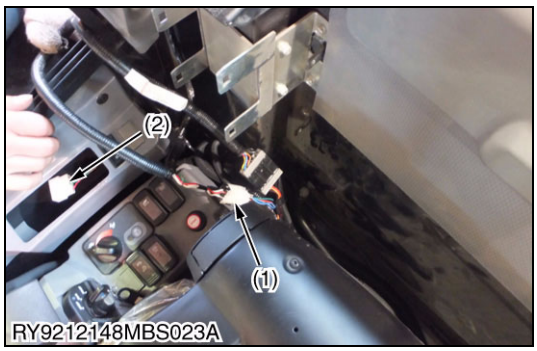
Weight of the weight	Heavy weight spec.	Approx. 1140 kg (2513 lbs)
	Light weight spec.	Approx. 830 kg (1830 lbs)

(1) Weight

RY9212724MBS0005US0

[2] CABIN REMOVAL AND MOUNTING





1. Remove the blower cover and AC panel, then remove the blower hose, fuse box and AC connector.

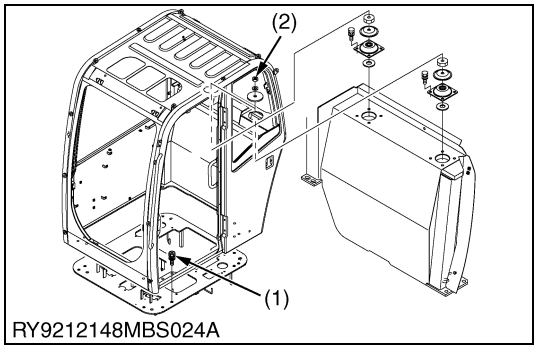
(1) Blower Cover (3) Fuse Box
(2) AC Panel

RY9212148MBS0043US0

2. Disconnect the cabin harness and the washer harness.

(1) Cabin Harness (2) Washer Harness

RY9212148MBS0044US0



RY9212148MBS024A

RY9212148MBS025A

3. Suspend the cabin with the crane and remove the cabin mounting bolts (nine) and nuts (two).

Tightening torque	Bolt	259.9 to 304.0 N·m 26.5 to 31.0 kgf·m 191.7 to 224.2 lbf·ft
	Nut	107.9 to 127.4 N·m 11.0 to 13.0 kgf·m 79.6 to 94.0 lbf·ft

(1) Bolt (2) Nut

RY9212148MBS0045US0

4. Remove the cabin.

■ **IMPORTANT**

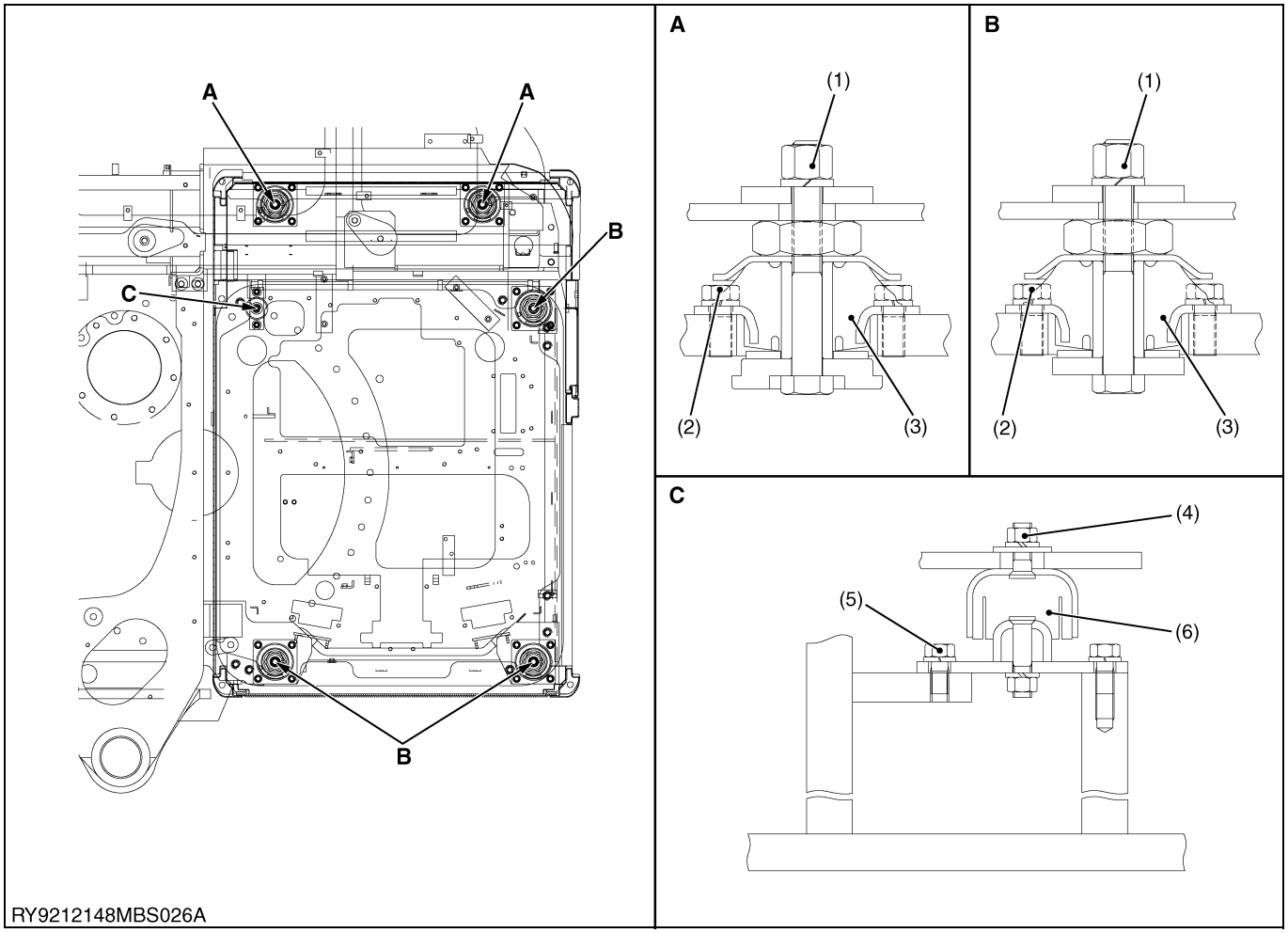
- **Find its center of gravity and suspend it securely.**

Cabin weight	Approx. 260 kg (573 lbs)

(1) Cabin

RY9212435MBS0029US0

Installation of cabin rubber vibration dampers



RY9212148MBS026A

(1) Nut
(2) Bolt
(3) Rubber Vibration Damper
(4) Nut
(5) Bolt
(6) Rubber Vibration Damper

Tightening torque	Nut (1)	107.9 to 127.4 N·m 11.0 to 13.0 kgf·m 79.6 to 94.0 lbf·ft
	Bolt (2)	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft
	Nut (4)	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 lbf·ft
	Bolt (5)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft

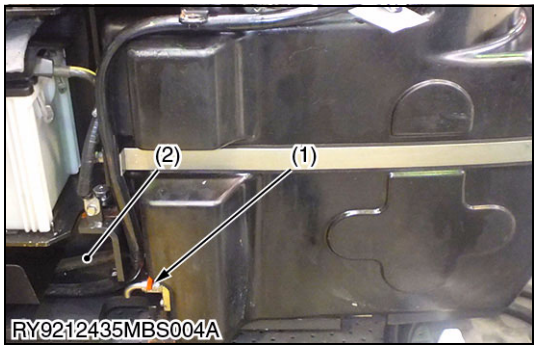
RY9212148MBS0047US0

[3] FUEL TANK ASSEMBLY/DISASSEMBLY

1. Remove the cover.

(1) Cover

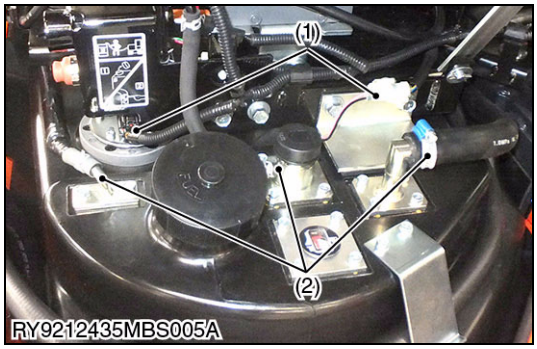
RY9212435MBS0007US0



2. After draining the fuel, remove the fuel hose.

(1) Water Drain Cock (2) Fuel Hose

RY9212435MBS0008US0



3. Remove the electrical wiring and the fuel hose.

(1) Electrical Wiring (2) Fuel Hose

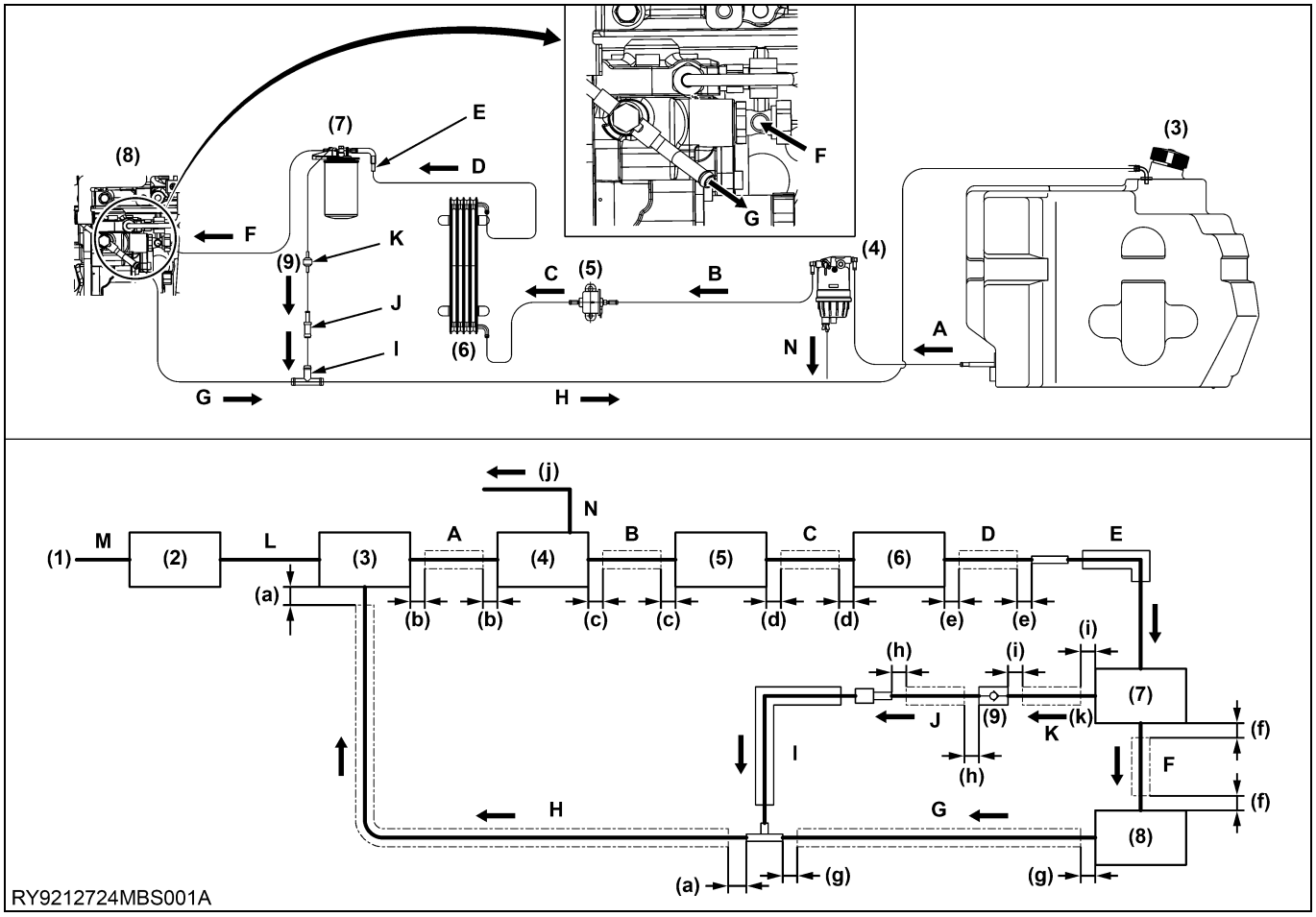
RY9212435MBS0009US0

4. Remove the band for mounting the fuel tank and then remove the fuel tank.

(1) Fuel Tank Mounting Band (2) Fuel Tank

RY9212435MBS0010US0

Fuel hose circuit



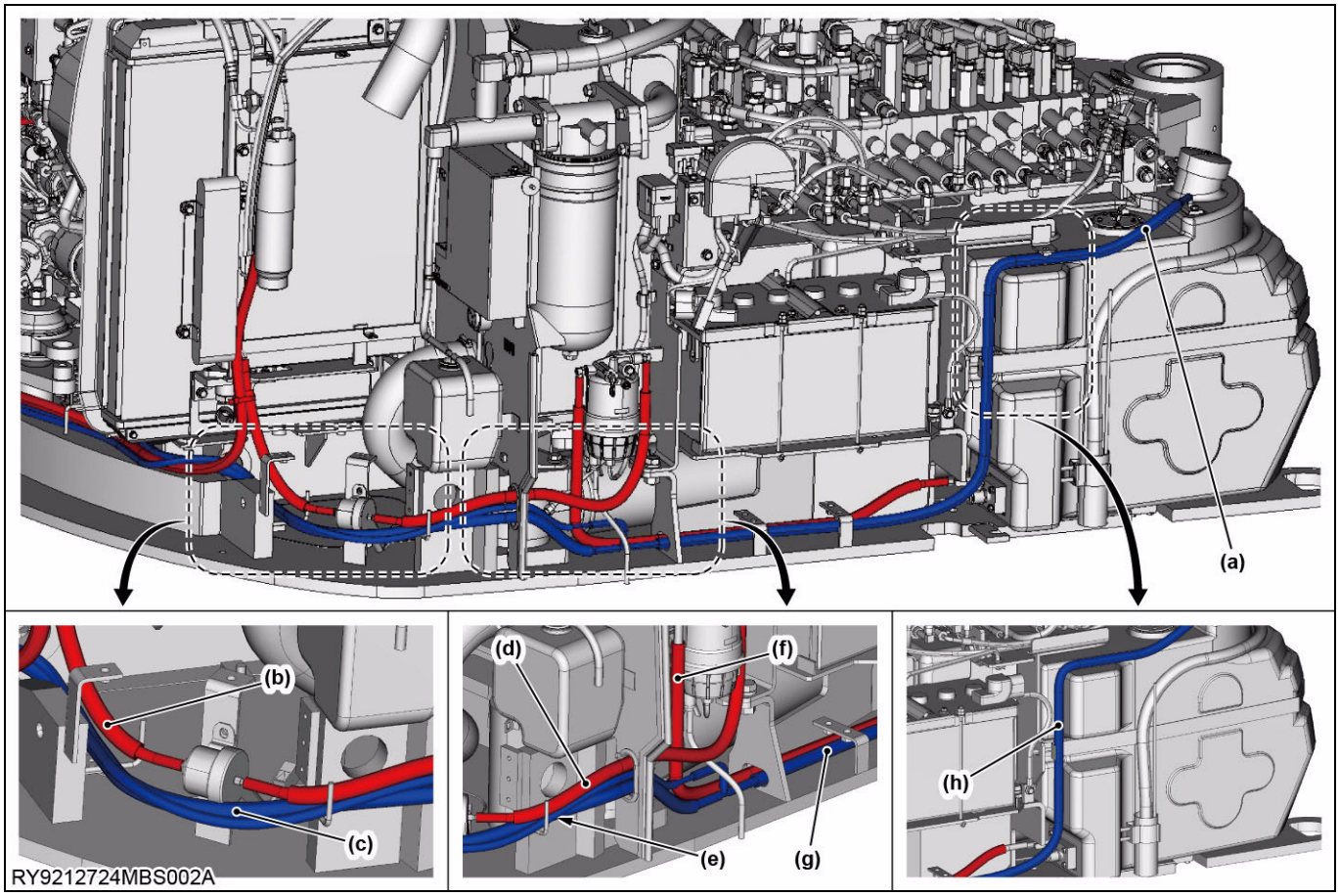
(1) Outside Air
(2) Strainer (Eur. Only)
(3) Fuel Tank
(4) Water Separator
(5) Fuel Pump
(6) Fuel Cooler
(7) Fuel Filter
(8) Engine
(9) Fuel Check Valve

(a) 50 mm (2.0 in.)
(b) 50 mm (2.0 in.)
(c) 50 mm (2.0 in.)
(d) 50 mm (2.0 in.)
(e) 50 mm (2.0 in.)
(f) 40 mm (1.6 in.)
(g) 50 mm (2.0 in.)
(h) 30 mm (1.2 in.)
(i) 40 mm (1.6 in.)
(j) Drain (for Bleeding Water)
(k) Air Bleed

	Tube		Protective tube			Tube		Protective tube	
	Length	**I.D.**	**Length**	**I.D.**		**Length**	**I.D.**	**Length**	**I.D.**
A	950 mm 37.40 in.	8 mm 0.31 in.	800 mm 31.50 in	15 mm 0.59 in.	**H**	1470 mm 57.87 in.	7.3 mm 0.29 in.	1370 mm 53.94 in.	15 mm 0.59 in.
B	700 mm 27.56 in.	8 mm 0.31 in.	600 mm 23.62 in.	15 mm 0.59 in.	**I**	Molded hose	8 mm 0.31 in.	–	–
C	350 mm 13.78 in.	7.3 mm 0.29 in.	240 mm 9.45 in.	15 mm 0.59 in.	**J**	1700 mm 66.93 in.	4 mm 0.16 in.	1650 mm 64.96 in.	10 mm 0.39 in.
D	1600 mm 62.99 in.	8 mm 0.31 in.	1500 mm 59.06 in.	15 mm 0.59 in.	**K**	250 mm 9.84 in.	4 mm 0.16 in.	170 mm 6.69 in.	10 mm 0.39 in.
E	Molded hose	8 mm 0.31 in.	–	–	**L**	180 mm 7.09 in.	8 mm 0.31 in.	–	–
F	320 mm 12.60 in.	8 mm 0.31 in.	240 mm 9.45 in.	15 mm 0.59 in.	**M**	Rubber cap	8 mm 0.31 in.	–	–
G	1900 mm 74.80 in.	8 mm 0.31 in.	1800 mm 70.87 in.	15 mm 0.59 in.	**N**	210 mm 8.27 in.	5 mm 0.20 in.	–	–

RY9212724MBS0006US0

Fuel supply and return hose route

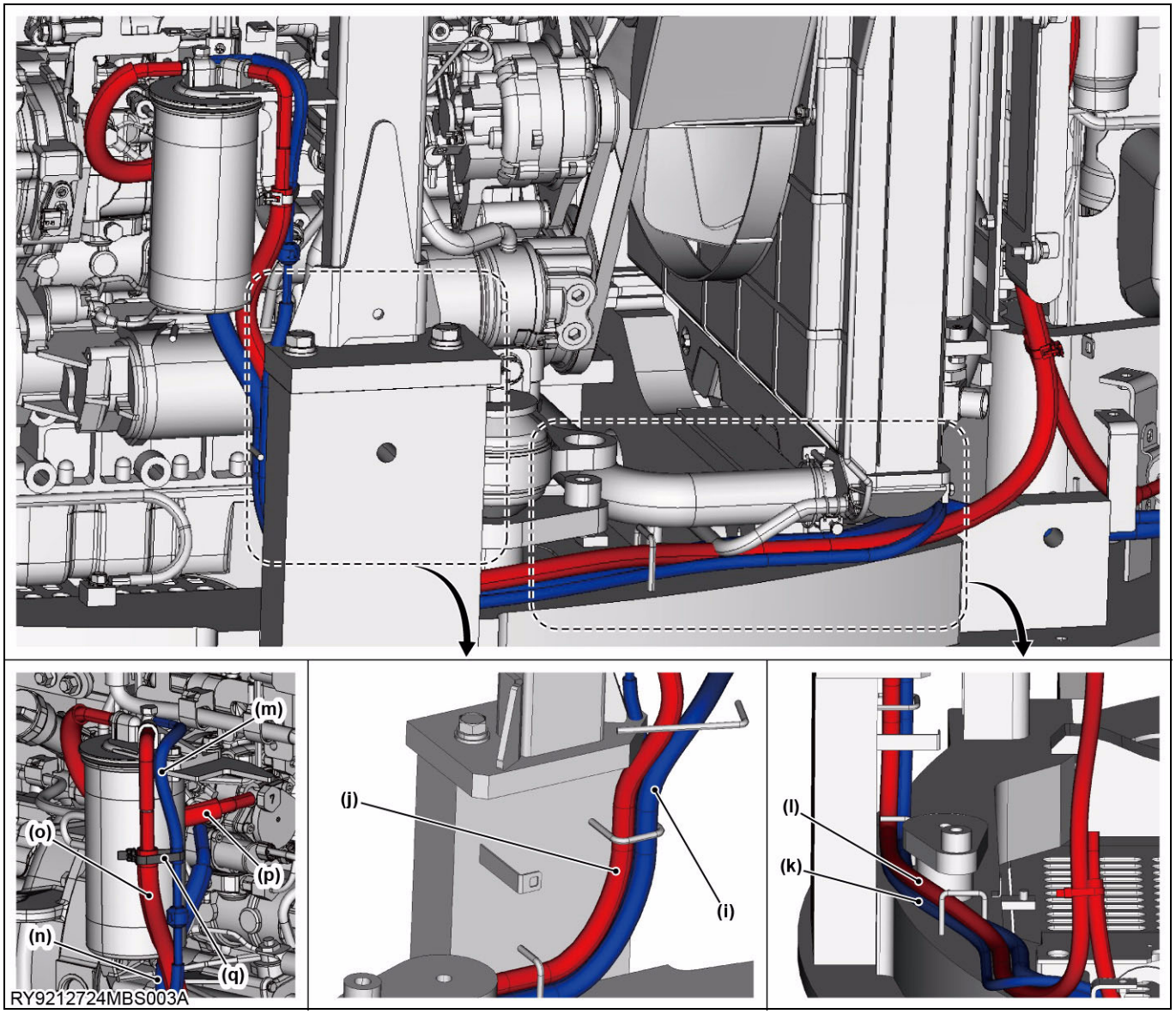


■ **NOTE**

- **(a): Route of return hose it does not touch the fuel sensor connector.**
- **(b): Fuel hose supply side (by adjusting this location so as not to contact the engine around the fuel filter).**
- **(c): Fuel hose return side (pump and return hose should not interfere after assembling).**
- **(d): Fuel hose supply side.**
- **(e): Fuel hose return side.**
- **(f): Fuel hose supply side.**
- **(g): Fuel hose return side.**
- **(h): Through outside of band.**

(To be continued)

(Continued)



■ **NOTE**

- **(i): Fuel hose return side lower.**
- **(j): Fuel hose supply side upper.**
- **(k): Fuel hose return side lower.**
- **(l): Fuel hose supply side upper.**
- **(m): Air venting**
- **(n): Fuel hose return side.**
- **(o): Fuel hose supply side.**
- **(p): Fuel hose supply side.**
- **(q): Clamp (Make sure to install the clamp).**

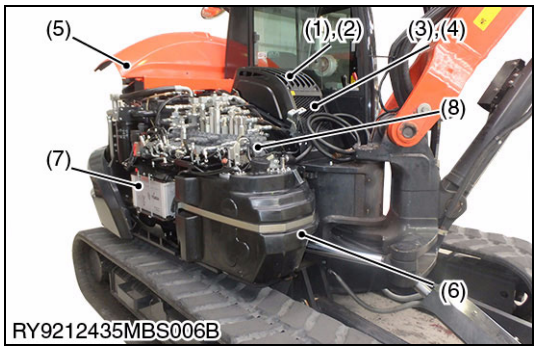
RY9212724MBS0007US0

[4] HYDRAULIC OIL TANK ASSEMBLY/DISASSEMBLY

1. After draining the hydraulic oil, remove the front, right and tank covers.

(1) Front Cover
(2) Right Cover
(3) Tank Cover

RY9212435MBS0013US0



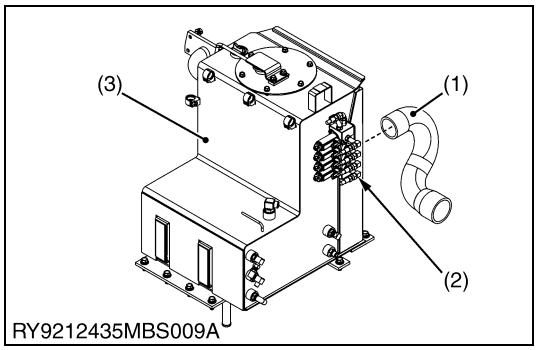
2. Remove the cover, electric fan, center cover and center frame.
3. Remove the top cover, fuel tank, battery and control valve (Refer to sections on removing the fuel tank and control valve).

[Work Tip]

- Move the condenser toward the rear of the machine with the AC hoses still installed.

(1) Cover
(2) Electric Fan
(3) Center Cover
(4) Center Frame
(5) Top Cover
(6) Fuel Tank
(7) Battery
(8) Control Valve

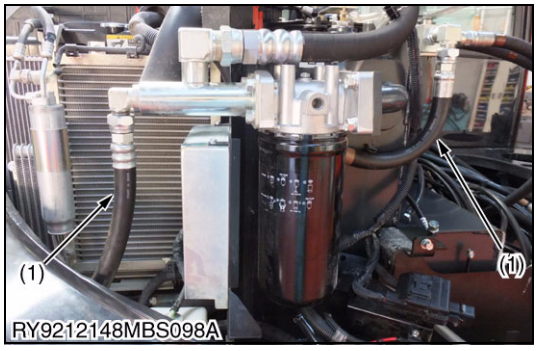
RY9212435MBS0014US0



4. Disconnect all the harnesses and the hydraulic hose connected to the hydraulic oil tank.
5. Remove the AUX solenoid valve from the hydraulic oil tank.

(1) Suction Hose
(2) AUX Solenoid Valve
(3) Hydraulic Oil Tank

RY9212435MBS0015US0



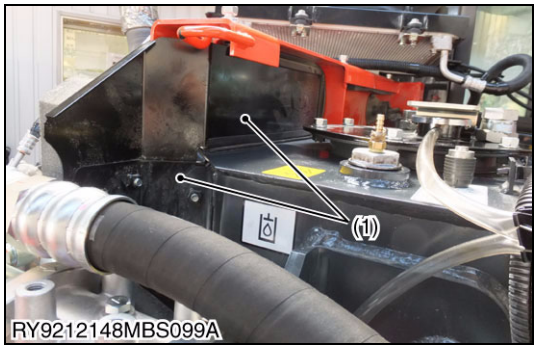
6. Remove the hydraulic hoses.

■ **IMPORTANT**

- **Plug the disconnected hoses and adapters.**

(1) Hydraulic Hose

RY9212148MBS0153US0



7. Remove the divider plates.

(1) Divider Plate

RY9212148MBS0154US0

8. Remove the battery support mounting bolts and slide the battery support to the right side of the machine.

■ **IMPORTANT**
- **Apply a thread lock (Loctite 271).**

Tightening torque	Bolt	196.1 to 225.6 N·m 20.0 to 23.0 kgf·m 144.6 to 166.4 lbf·ft

(1) Battery Support

RY9212148MBS0155US0

9. Suspend the hydraulic oil tank with a crane.
10. Remove the hydraulic tank mounting bolts, then lift with the crane and remove it.

■ **IMPORTANT**
- **Apply a thread lock (Loctite 271).**

Tightening torque	Bolt	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft

Hydraulic tank weight	Approx. 19 kg Approx. 42 lbs

(1) Hydraulic Oil Tank

RY9212148MBS0156US0

[5] ASSEMBLY/DISASSEMBLY OF ENGINE RELATED COMPONENTS

(1) DPF Muffler

1. Remove the rear and left hoods and the air cleaner.

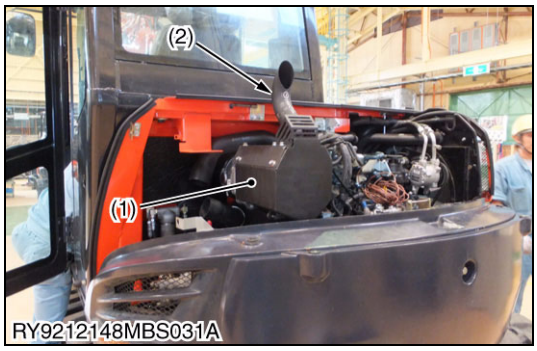
CAUTION

- **For hood removal, a minimum of 2 persons is needed.**

Rear hood weight	Approx. 27 kg (60 lbs)

(1) Air Cleaner

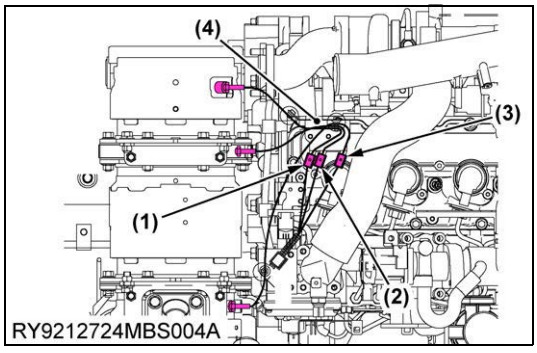
RY9212148MBS0052US0



2. Remove the DPF muffler cover and the DPF exhaust pipe.

(1) DPF Muffler Cover (2) DPF Exhaust Pipe

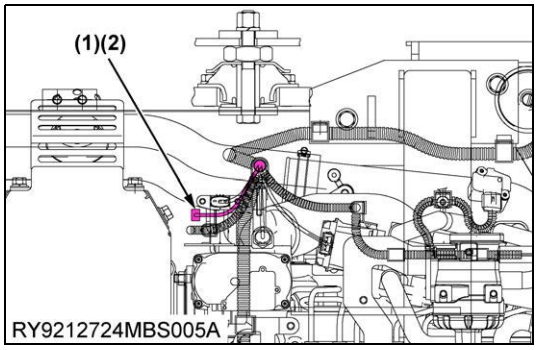
RY9212148MBS0053US0



3. Remove the DOC intake temperature sensor, DOC outlet temperature sensor and DPF outlet temperature sensor connectors and then remove the bracket.

(1) DOC Intake Temperature Sensor Connector
(2) DOC Outlet Temperature Sensor Connector
(3) DPF Outlet Temperature Sensor Connector
(4) Bracket

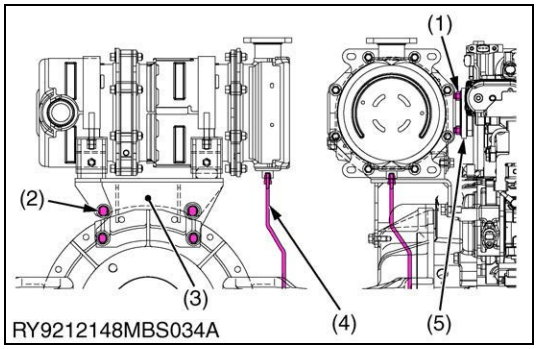
RY9212724MBS0008US0



4. Disconnect the DPF pressure differential sensor connector and remove the bracket.

(1) DPF Pressure Differential Sensor Connector (2) Bracket

RY9212724MBS0009US0



5. Remove the 4 flange nuts, bracket mounting bolts, drain pipe and then the DPF muffler.

CAUTION
- **It takes at least 2 people to remove the DPF muffler.**

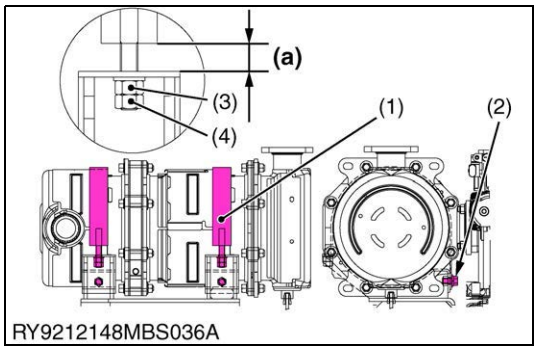
IMPORTANT
- **Record the machine number, engine number and DPF muffler number.**
- **Refer to the DPF handling manual for cleaning DPF.**
- **During installation, first mount all the flange nuts and bracket mounting bolts loosely and then tilt the muffler itself in position, adjusting it so there is no stress on it and tighten the nuts/bolts.**
  Install the gasket so the protruding side faces the exhaust manifold side.
- **Apply the anti-seize lube ("Pure Nickel Special" in Never-Seez Anti-Seize and Lubricating Compounds) on the screw part when attaching the drain pipe.**

DPF muffler weight	Approx. 23 kg (51 lbs)

Tightening torque	Bolt (M10)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft
	Bolt (M12)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft
	Flange nut	49.0 to 59.9 N·m 5.0 to 6.1 kgf·m 36.1 to 44.2 lbf·ft
	Drain pipe	16.0 to 23.0 N·m 1.6 to2.3 kgf·m 11.8 to 17.0 lbf·ft

(1) Flange Nut
(2) Bracket Mounting Bolt
(3) DPF Muffler Bracket
(4) Drain Pipe
(5) Gasket
(6) DPF Muffler

RY9212148MBS0056US0



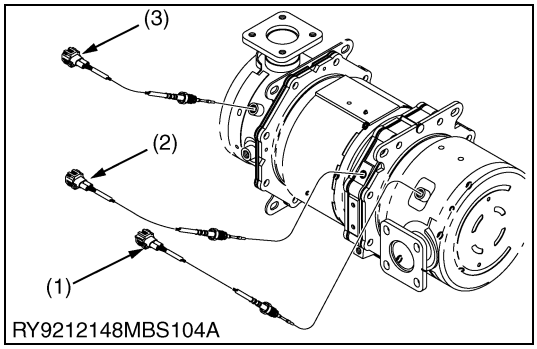
6. Remove the DPF muffler bracket and muffler mounting band from the DPF muffler.

IMPORTANT
- **During installation, tighten the bolts fully and then with the nuts mounted loosely, install onto the machine.**
  When fully tightening the nuts, tilt the muffler itself, adjusting it so it is not under stress.
  Install the DPF mounting band so it fits within the specified dimensions at the location shown at left.

Tightening torque	Bolt (M10)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft
	Nut 1	9.8 to 11.3 N·m 1.0 to 1.2 kgf·m 7.2 to 8.3 lbf·ft
	Nut 2	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 lbf·ft

(1) Muffler Mounting Band
(2) Bolt
(3) Nut 1
(4) Nut 2
(a) 12 to 16 mm (0.5 to 0.6 in.)

RY9212148MBS0057US0



7. Remove the exhaust temperature sensor from the DPF muffler as needed.
   - Tools: Flare nut wrench

■ **IMPORTANT**
- **Never use the spanner to prevent the nut break.**
- **If the exhaust temperature sensor does not be loosened, apply the lubricant (KURE CRC) on the screw part and leave it for a day and restart the work.**
- **When tightening the exhaust temperature sensor, apply the anti-seize lube ("Pure Nickel Special" in Never-Seez Anti-Seize and Lubricating Compounds).**

Tightening torque	Exhaust temperature sensor	25.0 to 35.0 N·m 2.5 to 3.6 kgf·m 18.4 to 25.8 lbf·ft

(1) Exhaust Temperature Sensor (T0) (3) Exhaust Temperature Sensor (T2)
(2) Exhaust Temperature Sensor (T1)

RY9212148MBS0157US0

(2) Engine

CAUTION
- **Wear protective gear, such as a helmet, safety glasses, etc., during assembly/disassembly.**
- **Disconnect the negative terminal of the battery prior to any assembly/disassembly work.**
- **For group work, decide on signals for communication, make sure everyone understands and uses them and be very careful about safety.**

RY9212148MBS0058US0

1. Remove the weight.

   Refer to the section Weight Assembly/Disassembly for the weight removal/mounting procedure.

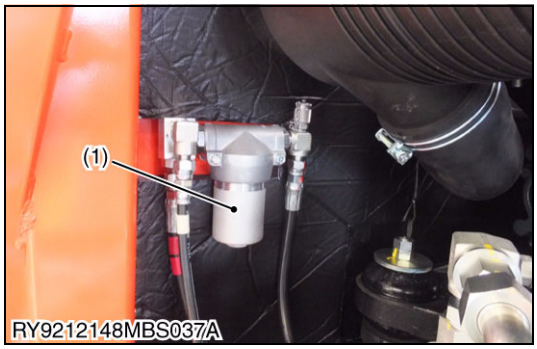
(1) Weight

RY9212435MBS0016US0

2. Remove the cabin.

   Refer to the section Cabin Removal and Mounting for the cabin removal/mounting procedure.

RY9212148MBS0060US0



3. Remove the pilot filter.

(1) Pilot Filter

RY9212148MBS0061US0

4. Remove the electrical wiring and air cleaner pipe mounted on the arch.

(1) Air Cleaner Pipe (2) Electrical Wiring

RY9212148MBS0062US0

5. Suspend the arch and remove the five arch mounting bolts. Remove the arch.

■ **IMPORTANT**
- **Find its center of gravity and suspend it securely.**
- **Be careful of the electrical wiring.**

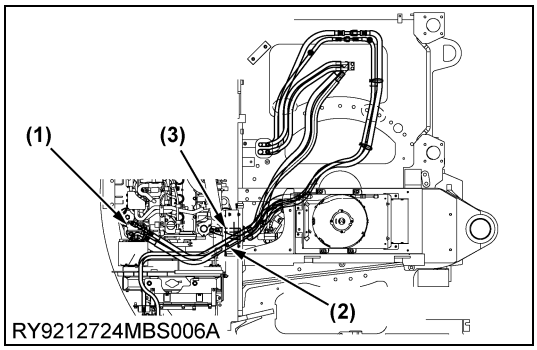
Tightening torque	Bolt	259.9 to 304.0 N·m 26.5 to 31.0 kgf·m 191.7 to 224.2 lbf·ft

Apply thread lock compound (Loctite 271).

Arch weight	Approx. 85 kg (187 lbs)

(1) Arch

RY9212148MBS0063US0

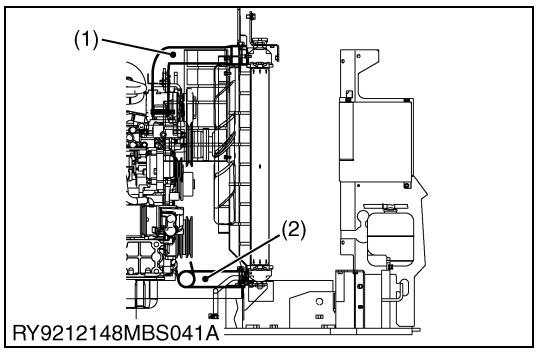


6. Remove the compressor.
7. Drain the coolant inside the radiator and disconnect the heater hose.

■ **IMPORTANT**
- **Move the compressor across to the condenser side.**
- **Plug the disconnected heater hoses.**

(1) Compressor (3) Heater Hose
(2) AC Hose

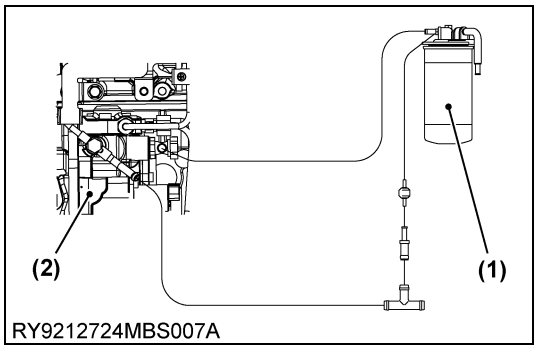
RY9212724MBS0010US0



8. Disconnect the upper and lower hoses.

(1) Upper Hose (2) Lower Hose

RY9212148MBS0065US0

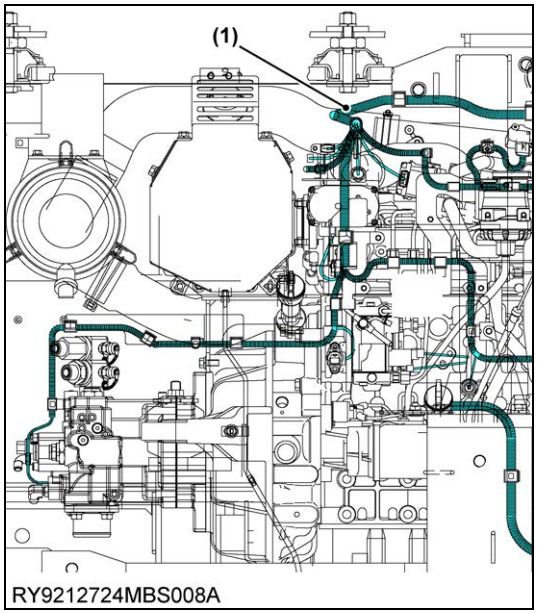


9. Disconnect the fuel hoses on the supply pump side.

■ **IMPORTANT**
- **Between the fuel filter and supply pump**
- **Plug the disconnected hoses.**

(1) Fuel Filter (2) Supply Pump

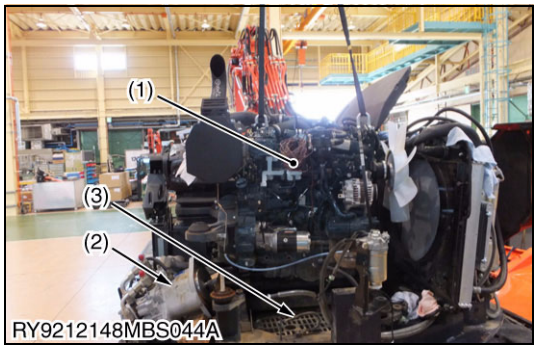
RY9212724MBS0011US0

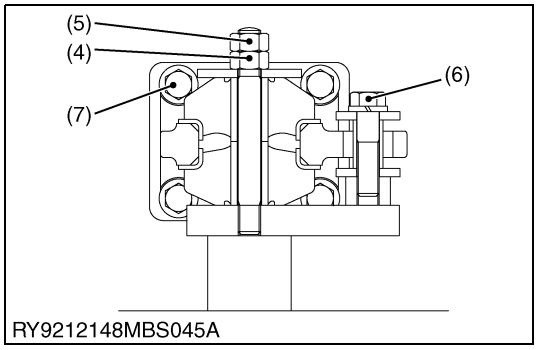


10. Disconnect all the connections and clamps to the engine.

(1) Engine Electrical Wiring

RY9212724MBS0012US0





11. Remove the pump mounting bolts and disconnect from the pump connector.
12. Suspend the engine and remove the bolts and nuts holding the engine to its mounts.
13. Disconnect the ground and remove the engine.

CAUTION

- **Find its center of gravity and suspend it securely.**
- **Make sure you have not forgotten to disconnect any electrical wiring before removing the engine.**

Tightening torque	First nut	88.2 to 107.8 N·m 9.0 to 11.0 kgf·m 65.1 to 79.5 lbf·ft
	Second nut	166.0 to 191.0 N·m 16.9 to 19.5 kgf·m 122.4 to 140.9 lbf·ft
	Bolt (M16)	196.1 to 225.6 N·m 20.0 to 23.0 kgf·m 144.6 to 166.4 lbf·ft
	Bolt (M14)	123.6 to 147.1 N·m 12.6 to 15.0 kgf·m 91.2 to 108.5 lbf·ft

Apply thread lock compound (Loctite 271).

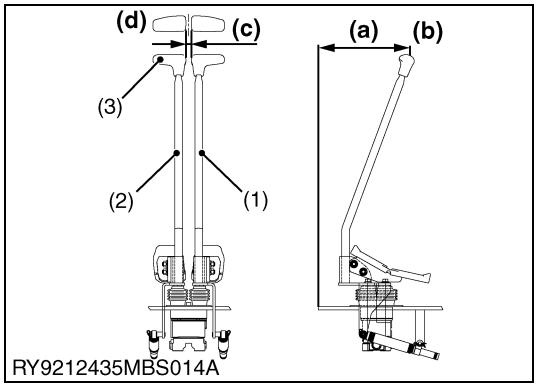
Engine weight	Approx. 350 kg (772 lbs)

(1) Engine
(2) Pump
(3) Ground Wire
(4) First Nut
(5) Second Nut
(6) Bolt (M16)
(7) Bolt (M14)

RY9212148MBS0068US0

[6] ASSEMBLING OPERATING LEVERS

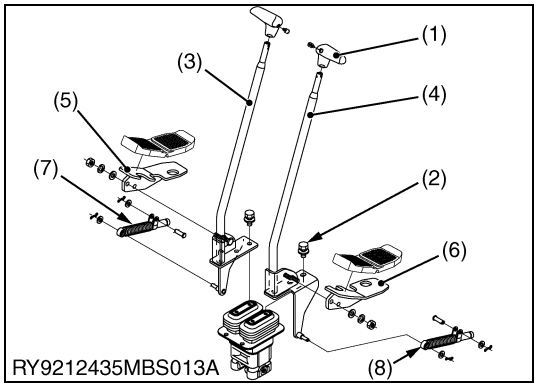
(1) Travel Lever



(1) Left Travel Lever
(2) Right Travel Lever
(3) Grip

(a) 260 mm (10.2 in.)
(b) When in neutral
(c) 12 to 18 mm (0.47 to 0.71 in.)
(d) Fwd/rear deviation of l/r levers to be within 2mm (0.08 in.)

RY9212435MBS0026US0



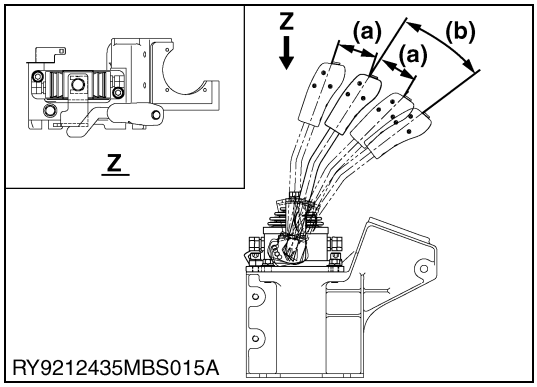
1. Install the left and right travel levers.
   The pilot valve side is die cast aluminum so be careful not to over tighten; tighten to the torques indicated below.

Tightening torque	Left/right travel levers	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft

(1) Grip
(2) Bolt
(3) Right Travel Lever
(4) Left Travel Lever
(5) Right Pedal
(6) Left Pedal
(7) Right Damper
(8) Left Damper

RY9212724MBS0013US0

(2) Blade Lever

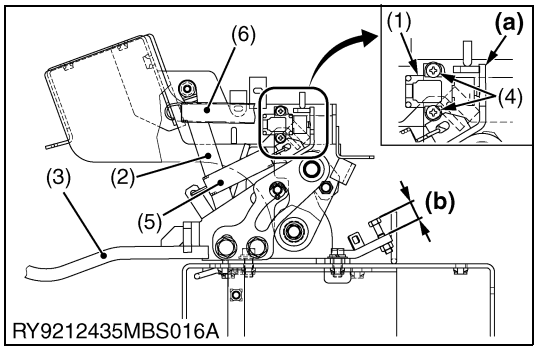


Neutral position

(a) 64.5 mm (2.5 in.)
(b) Detent Angle 20.1° (0.35 rad)

RY9212435MBS0027US0

(3) Limit Switch



1. No clearance **(a)** when limit switch operated.

Tightening torque	Bolt	3.9 to 4.9 N·m 0.4 to 0.5 kgf·m 2.9 to 3.6 lbf·ft

Apply thread lock compound ThreeBond TB1401B.

(1) Limit Switch
(2) Damper
(3) Unload Lever
(4) Bolt
(5) Spring
(6) Spring

(a) No clearance on (a) part when limit operating side.
(b) 21 mm (0.8 in.)

RY9212435MBS0028US0

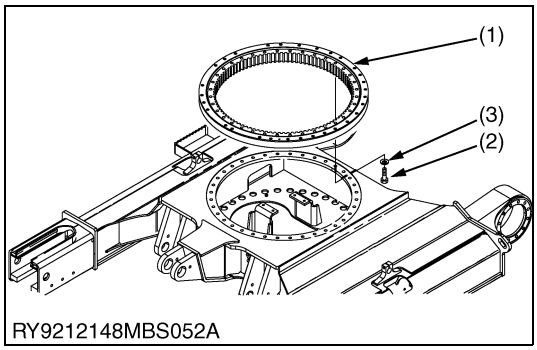
3. TRACK FRAME

[1] SWIVEL BEARING ASSEMBLY/DISASSEMBLY

RY9212148MBS051A

1. Remove the swivel frame.

RY9212148MBS0073US0



RY9212148MBS052A

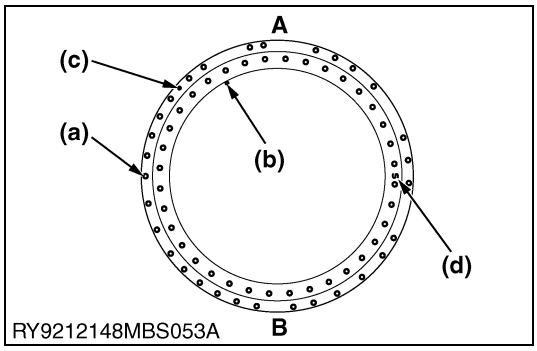
2. Suspend the swivel bearing with a crane, remove the swivel bearing mounting bolts on the bottom side, then remove the swivel bearing.

Swivel bearing weight (reference value)	110 kg (243 lbs)

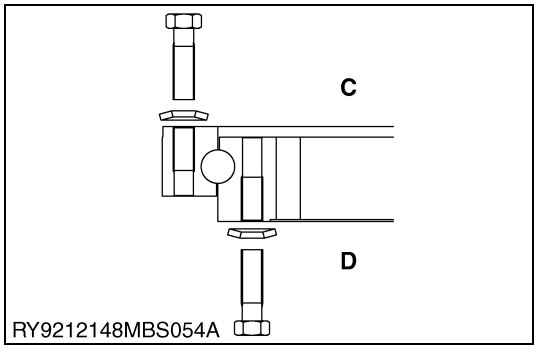
Component names

No.	Name of part	Qty
(1)	Swivel bearing	1
(2)	Bolt	36
(3)	Diaphragm spring	36

RY9212148MBS0074US0



RY9212148MBS053A



RY9212148MBS054A

Mounting Procedure

1. Set the "S" mark on the right side of the machine and mount the swivel bearing mounting bolts finger tight.
   Once they are all finger tight, tighten them in a diagonal pattern to the specified torque.

Tightening torque	Swivel bearing	259.9 to 304.0 N·m 26.5 to 31.0 kgf·m 191.7 to 224.2 lbf·ft

Thread locking compound (Loctite 271)

■ **IMPORTANT**

- **Make sure the diaphragm springs face the right way.**
- **After mounting the bearing, apply grease so that it covers the entire surface of bearing teeth.**

(a) Ball Insertion Holes (Outer Soft Zone)
(b) Tooth surface grease application zone
(c) Port for applying grease to the balls (mates with hole in swivel frame)
(d) 'S' Mark

A : Front of machine
B : Back of machine
C : Swivel frame side
D : Track frame side

RY9212148MBS0075US0

[2] TRACK

WARNING

- **The backhoe is equipped with an overload warning system.**
  When changing the rubber track to an iron track, or vice versa, it is necessary to change the preset code in either case.
  If the preset code is not set correctly, the overload warning will fail to work correctly, which presents the risk of serious injury or death.
  After making the setting, always make sure the overload warning is working correctly as per the overload warning test procedure (Refer to the electrical part of the Overload Warning System section).

CAUTION

- **As the grease cylinder is under high pressure, loosening the grease nipple all at once may cause the nipple to go flying and/or grease to spray out.**
- **Do not get your face or any body part right in front of the nipple while loosening it and loosen the nipple gradually.**

RY9212148MBS0001US0

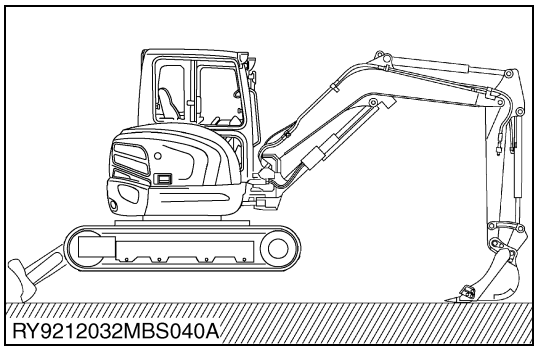
(1) Assembly/Disassembly of the Rubber Track

RY9212148MBS055A

1. Remove the cover on the grease nipple.
2. Press a socket wrench onto the base of the grease nipple and loosen slowly.
   If there are any rocks or the like caught in the sprocket, remove the rocks first.
   - Tool to use: 22 mm socket

(1) Grease Nipple

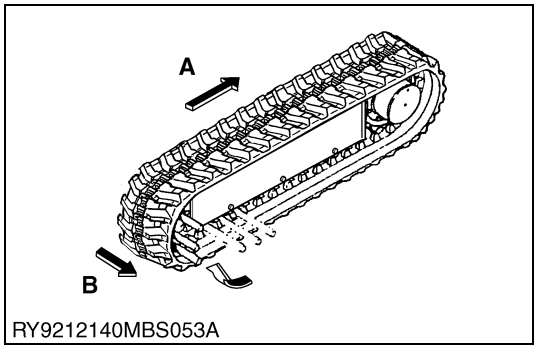
RY9212148MBS0002US0


RY9212032MBS040A

3. Jack up the body using the front end and blade, expel grease from inside the grease cylinder, and fully loosen up the track.
   When the track loosens up, attach the grease nipple.

Tightening torque	Grease nipple	98.0 to 107.8 N·m 10.0 to 11.0 kgf·m 72.0 to 80.0 lbf·ft

RY9212148MBS0003US0

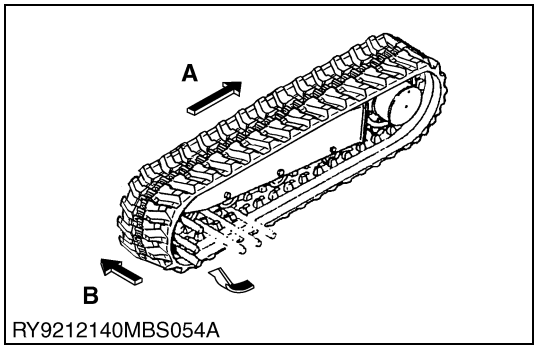


RY9212140MBS053A

4. With the machine lifted slightly, wedge a steel pipe into the track and turn the sprocket backwards in direction **A**.
   When the steel pipe reaches halfway up the idler and the track lifts off the idler, stop turning the sprocket and slide the track sideways in direction **B** to remove it.
   - Weight of rubber track: approximately 405 kg (893 lbs)

A : Backwards **B : Direction to Slide**

RY9212148MBS0004US0



RY9212140MBS054A

Assembling the Rubber Track

1. Jack up the machine with the front and the blade and with it lifted slightly off the ground, wedge the track onto the sprocket and set it on the frame.
2. Wedge steel pipes into the track and rotate the sprocket backwards in direction **A**. When a steel pipe reaches halfway up the idler, stop turning the sprocket. Slide the track sideways in direction **B** and set the track onto the idler. Lower the machine and drive it backwards to make sure the tracks are on securely. Adjust the tension of the track.

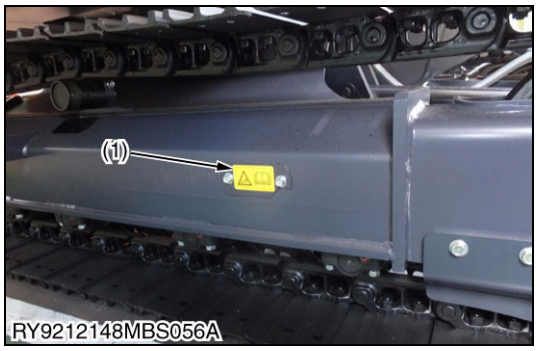
CAUTION

- **Make sure to assemble the rubber track facing the right way.**

A : Backwards **B : Direction to Slide**

RY9212148MBS0013US0

(2) Assembly/Disassembly of Iron Tracks



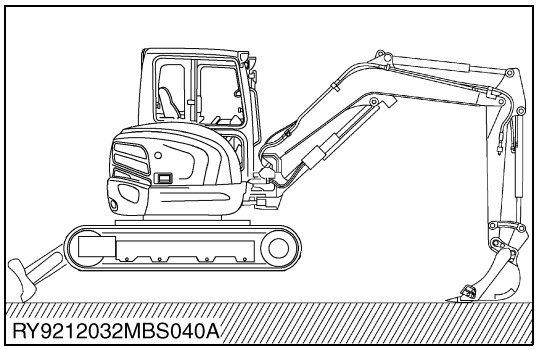
RY9212148MBS056A

Removal

1. Remove the cover on the grease nipple.
2. Press a socket wrench onto the base of the grease nipple and loosen slowly.
   If there are any rocks or the like caught in the sprocket, remove the rocks first.
   - Tool to use: 22 mm socket

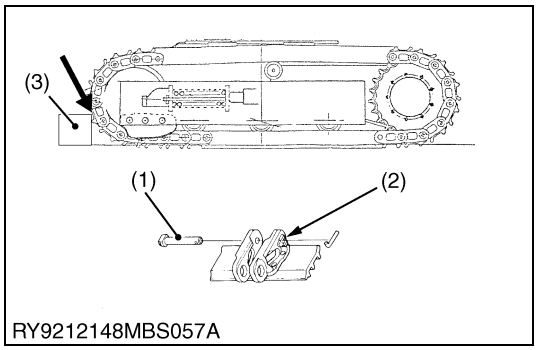
(1) Cover

RY9212148MBS0005US0


RY9212032MBS040A

3. Jack up the body using the front end and blade, expel grease from inside the grease cylinder, and fully loosen up the track. When the track loosens up, attach the grease nipple.

RY9212148MBS0076US0

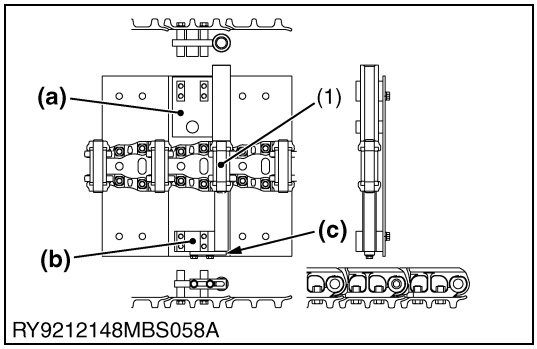


RY9212148MBS057A

4. Rotate the track so the master pin comes to the front idler side and put a block under the track.

(1) Master Pin
(2) Master Link
(3) Block

RY9212148MBS0077US0



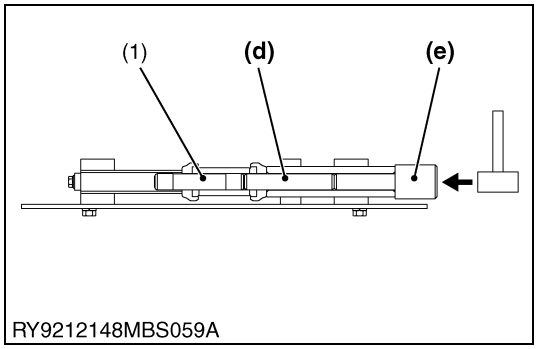
RY9212148MBS058A

5. Lower the machine to the ground and mount tools a, b, and c to the track.

■ **IMPORTANT**
- **With tool b in place, mount tool c.**

(1) Master Pin
(a) Tool a
(b) Tool b
(c) Tool c

RY9212148MBS0078US0

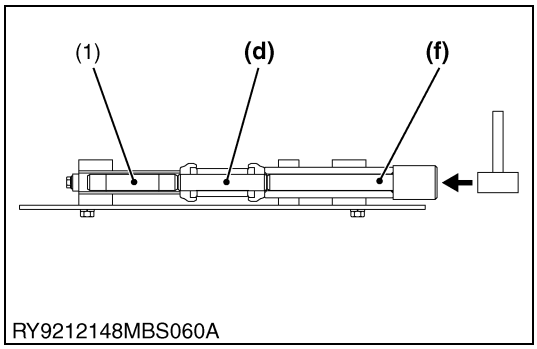


RY9212148MBS059A

6. After inserting tools d and e inside tool c, tap the side of tool e with a hammer.

(1) Master Pin
(d) Tool d
(e) Tool e

RY9212148MBS0079US0



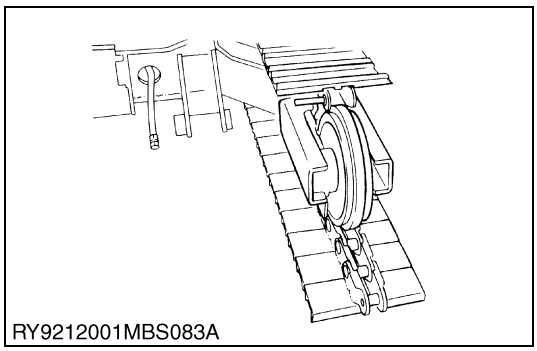
RY9212148MBS060A

7. Switch tools e and f and tap with a hammer until the master pin comes out.
8. Once the master pin comes out, remove all of the mounted tools.

■ **IMPORTANT**
- **Be careful when working because the moment tool d is removed, the master link will come off.**

(1) Master Pin
(d) Tool d
(f) Tool f

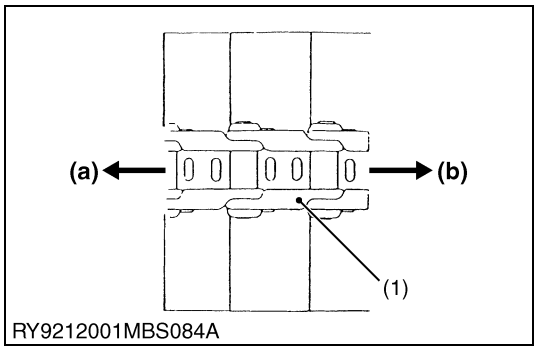
RY9212148MBS0080US0


RY9212001MBS083A

9. Slowly operate the travel lever backwards on the side being removed and remove the track.

DANGER
- **Do not get your feet under the excavator.**

RY9212148MBS0081US0



RY9212001MBS084A

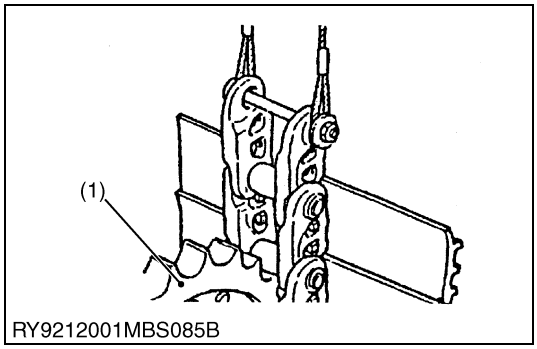
Mounting

1. Jack up the excavator using the front end and blade and place the track so that the end of the track meshes with the sprocket under the excavator.

■ **IMPORTANT**
- **Take care to face the track in the correct direction.**

(1) Master Link
(a) Sprocket Side
(b) Front Idler Side

RY9212148MBS0082US0

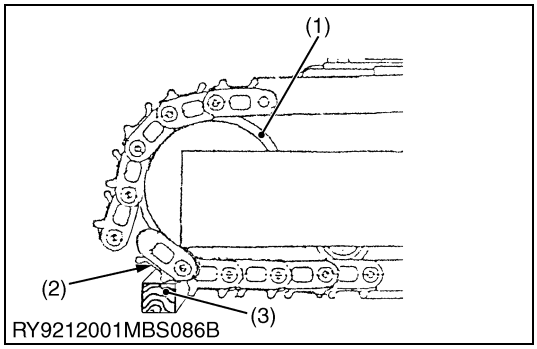


RY9212001MBS085B

2. Raise the track using a crane and mesh it with the sprocket.

(1) Sprocket

RY9212148MBS0083US0

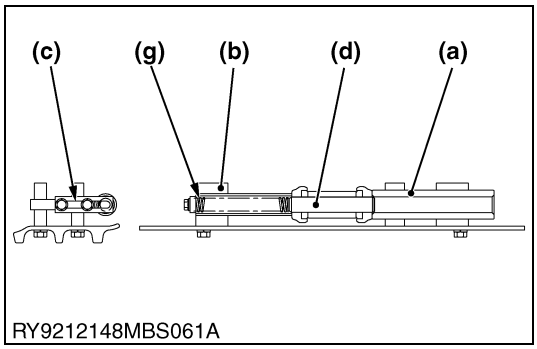


RY9212001MBS086B

3. Operate the travel lever forward slowly and wind the track on. When the track is sufficiently pulled on to where the track link joint is at the front idler, lower the excaavator and place a block under the track to support it.

(1) Front Idler
(2) Track
(3) Block

RY9212148MBS0084US0



RY9212148MBS061A

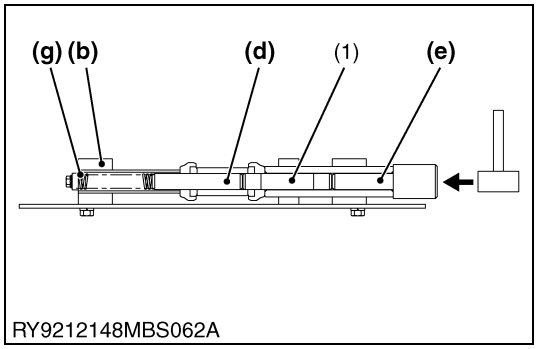
4. Mount tools a and b on the track plate and insert tool d from the tool a side.

■ **IMPORTANT**

- **Set tools c and g on tool b. Align the holes of tools a and b with that of the master link and then install.**

(a) Tool a
(b) Tool b
(c) Tool c
(d) Tool d
(g) Tool g

RY9212148MBS0085US0



RY9212148MBS062A

5. Insert the master pin from the tool a side and use a hammer on tool e to insert the master pin.
6. After tapping tool e in to the end, remove tools b and g.

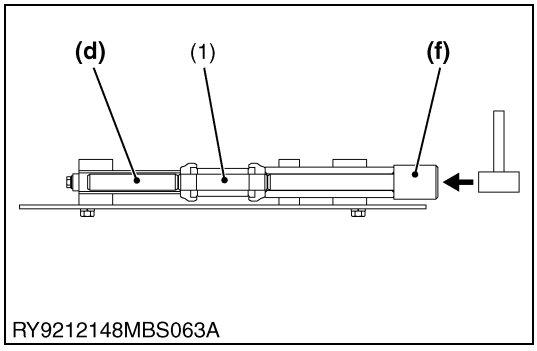
■ **IMPORTANT**

- **When removing tool g, be careful that the spring doesn't make it go flying.**

(1) Master Pin

(b) Tool b
(d) Tool d
(e) Tool e
(g) Tool g

RY9212148MBS0086US0



RY9212148MBS063A

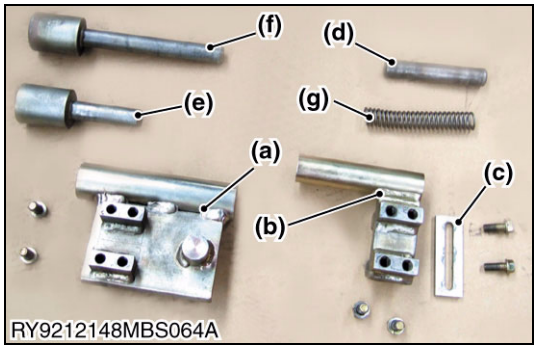
7. After remounting tool b, tap tool f with a hammer until the master pin is all the way in.

(1) Master Pin

(d) Tool d
(f) Tool f

RY9212148MBS0087US0

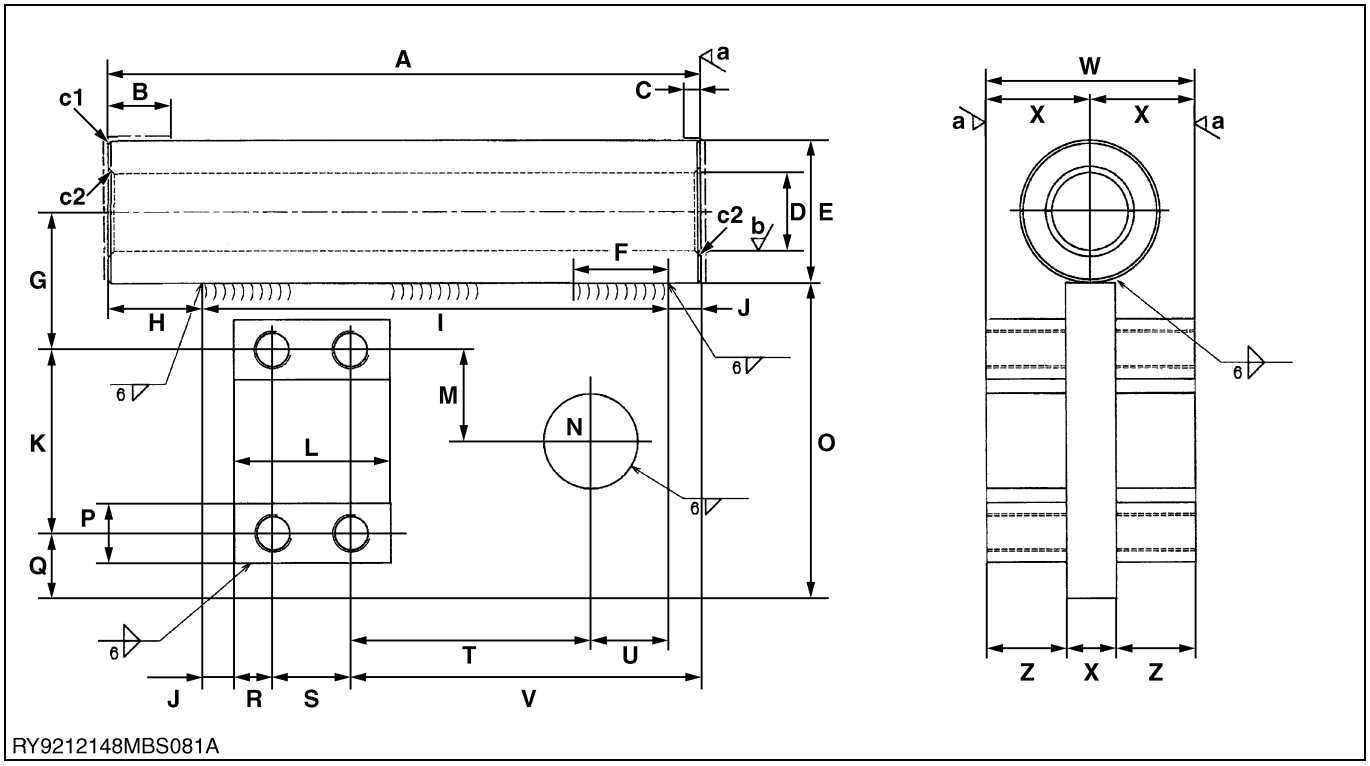
(3) Steel Track Removal/Installation Tools



No. in Figure	Name of part
(a)	Guide (outside)
(b)	Guide (inside)
(c)	Stopper plate
(d)	Pin
(e)	Pusher 1
(f)	Pusher 2
(g)	Spring

RY9212148MBS0088US0

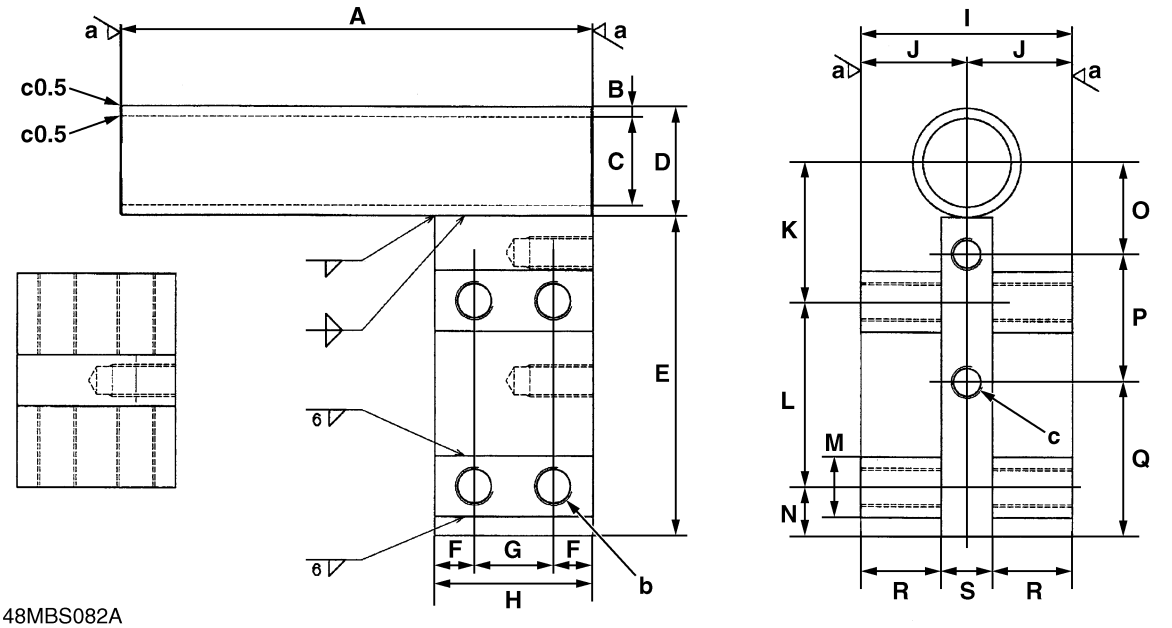
(a) Guide (Outside)



A	189.5 to 190.5 mm (7.46 to 7.50 in.)	**Q**	21.0 mm (0.83 in.)
B	20.0 mm (0.79 in.)	**R**	12.5 mm (0.49 in.)
C	5.0 mm (0.20 in.)	**S**	24.5 to 25.5 mm (0.96 to 1.00 in.)
D	ϕ24.4 to 24.6 mm (0.96 to 0.97 in.)	**T**	77.0 mm (3.03 in.)
E	45.0 mm (1.77 in.)	**U**	25.0 mm (0.98 in.)
F	30.0 mm (1.18 in.)	**V**	112.5 mm (4.43 in.)
G	43.5 mm (1.71 in.)	**W**	67.0 mm (2.64 in.)
H	29.5 mm (1.16 in.)	**X**	33.4 to 33.6 mm (1.31 to 1.32 in.)
I	150.0 mm (5.91 in.)	**Y**	16.0 mm (0.63 in.)
J	10.5 mm (0.41 in.)	**Z**	25.5 mm (1.00 in.)
K	57.5 to 58.5 mm (2.26 to 2.30 in.)	**C1**	1.0 mm (0.04 in.) bevel
L	50.0 mm (1.97 in.)	**C2**	2.0 mm (0.08 in.) bevel
M	29.0 mm (1.14 in.)	**a**	Ra=12.5a
N	ϕ30.0 mm (1.18 in.)	**b**	Ra=6.3a
O	100.0 mm (3.94 in.)	**c**	2 x M12 x 1.25 / ϕ10.8
P	19.0 mm (0.75 in.)		

RY9212148MBS0089US0

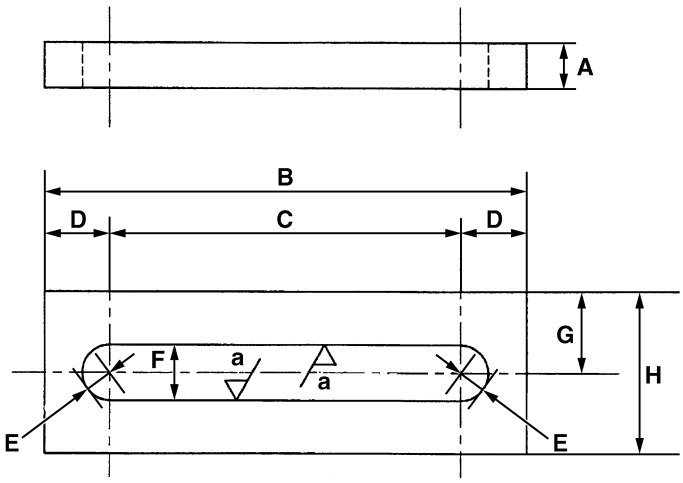
(b) Guide (Inside)



RY9212148MBS082A

A	150.0 mm (5.91 in.)	**M**	19.0 mm (0.75 in.)
B	3.2 mm (0.13 in.)	**N**	15.5 mm (0.61 in.)
C	ϕ27.6 mm (1.09 in.)	**O**	28.5 mm (1.12 in.)
D	ϕ34.0 mm (1.34 in.)	**P**	39.5 to 40.5 mm (1.56 to 1.59 in.)
E	100.0 mm (3.94 in.)	**Q**	48.5 mm (1.91 in.)
F	12.5 mm (0.49 in.)	**R**	25.5 mm (1.00 in.)
G	24.5 to 25.5 mm (0.96 to 1.00 in.)	**S**	16.0 mm (0.63 in.)
H	50.0 mm (1.97 in.)	**C0.5**	0.5 mm (0.02 in.) bevel
I	67.0 mm (2.64 in.)	**a**	Ra=12.5a
J	33.0 to 34.0 mm (1.30 to 1.34 in.)	**b**	2 x M12 x 1.25 / ϕ10.8
K	43.5 mm (1.71 in.)	**c**	2 x M10 x 1.25 x 20 / ϕ8.8 x 25
L	57.5 to 58.5 mm (2.26 to 2.30 in.)		

RY9212148MBS0090US0

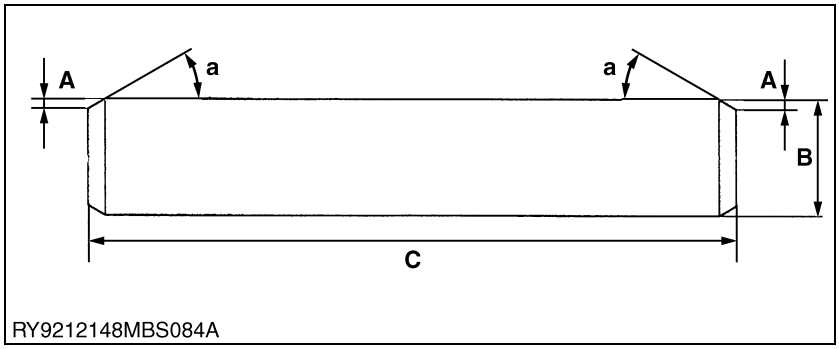


RY9212148MBS083A

(c) Stopper plate

A	9.0 mm (0.35 in.)
B	96.0 mm (3.78 in.)
C	70.0 mm (2.76 in.)
D	13.0 mm (0.51 in.)
E	5.5 mm (0.22 in.)
F	11.0 mm (0.43 in.)
G	16.0 mm (0.63 in.)
H	32.0 mm (1.26 in.)
a	Ra=12.5a

RY9212148MBS0091US0

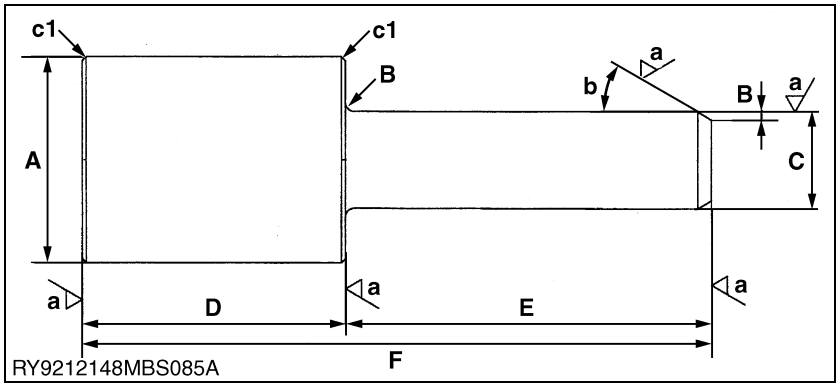


RY9212148MBS084A

(d) Pin

A	2.0 mm (0.08 in.)
B	ϕ23.4 to 23.6 mm (0.92 to 0.93 in.)
C	132.7 to 133.3 mm (5.22 to 5.25 in.)
a	30°(0.52 rad)

RY9212148MBS0092US0

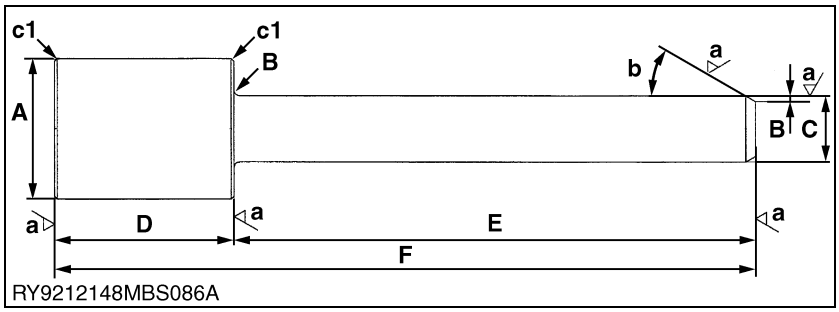


RY9212148MBS085A

(e) Pusher 1

A	ϕ50.0 mm (1.97 in.)
B	2.0 mm (0.08 in.)
C	ϕ23.4 to 23.6 mm (0.92 to 0.93 in.)
D	65.0 mm (2.56 in.)
E	89.7 to 90.3 mm (3.53 to 3.56 in.)
F	155.0 mm (6.10 in.)
C1	1.0 mm (0.04 in.) bevel
a	Ra=12.5a
b	30°(0.52 rad)

RY9212148MBS0093US0

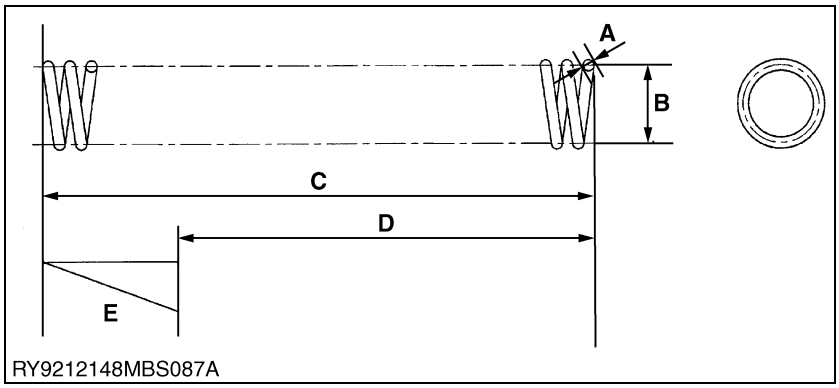


RY9212148MBS086A

(f) Pusher 2

A	ϕ50.0 mm (1.97 in.)
B	2.0 mm (0.08 in.)
C	ϕ23.4 to 23.6 mm (0.92 to 0.93 in.)
D	65.0 mm (2.56 in.)
E	188.7 to 189.3 mm (7.43 to 7.45 in.)
F	254.0 mm (10.00 in.)
C1	1.0 mm (0.04 in.) bevel
a	Ra=12.5a
b	30°(0.52 rad)

RY9212148MBS0094US0



RY9212148MBS087A

(g) Spring

A	ϕ2.9 mm (0.11 in.)
B	ϕ20.0 mm (0.79 in.)
C	144.0 mm (5.67 in.)
D	109.0 mm (4.29 in.)
E	106.0 N (10.8 kgf, 23.8 lbs)

RY9212148MBS0095US0

[3] FRONT IDLER

(1) Assembly/Disassembly of Front Idler

RY9212148MBS065A

RY9212148MBS066A

1. Remove the track (Refer to the chapter Assembly/Disassembly of the Rubber Track).

■ **IMPORTANT**
- **Jack up the machine with the front-end and the blade and place blocks under the frame.**

2. Use a crow bar to separate the front idler and the yoke from the track frame.

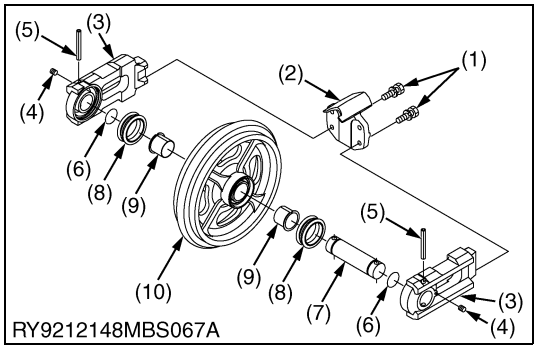
Front idler assembly weight	Approx. 70 kg (150 lbs)

3. Use a crane during assembly.

■ **IMPORTANT**
- **Wipe off any dirt, sand, etc. sticking to the inside of the track frame prior to inserting the component.**
- **Make sure it slides smoothly and insert it.**

RY9212148MBS0096US0

(2) Assembly/Disassembly of the Front Idler

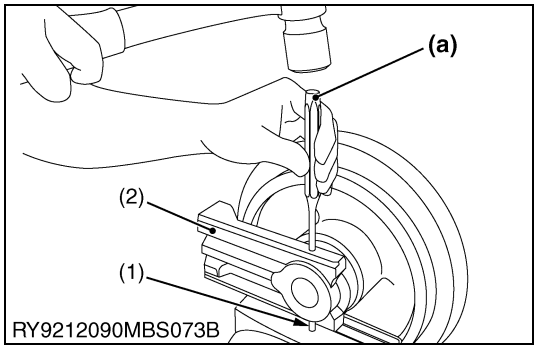


RY9212148MBS067A

■ **IMPORTANT**
- **There are not interchangeability the idler for rubber track and the idler for steel track.**

No.	Name of part	Qty	Notes
(1)	Bolt	4	123.6 to 147.1 N·m 12.6 to 15.0 kgf·m 91.2 to 108.5 lbf·ft
(2)	Yoke	1	
(3)	Bracket	2	
(4)	Plug	2	R1/8
(5)	Spring pin	2	
(6)	O-ring	2	
(7)	Shaft	1	
(8)	Floating seal	2	
(9)	Bushing	2	
(10)	Idler	1	

RY9212435MBS0030US0



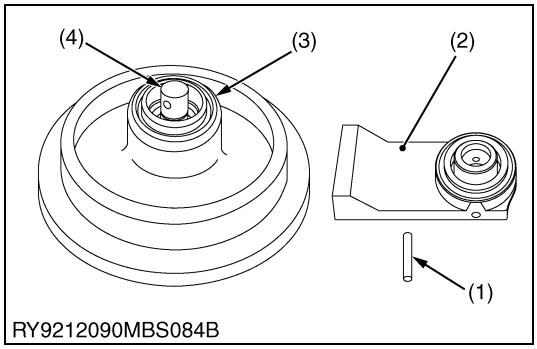
RY9212090MBS073B

Disassembly Procedures

1. Remove the plug from the bracket and drain the oil.
2. Use a pin punch to extract the left and right spring pins and then remove the bracket.

(1) Spring Pin
(2) Bracket
(a) Pin Punch

RY9212148MBS0006US0

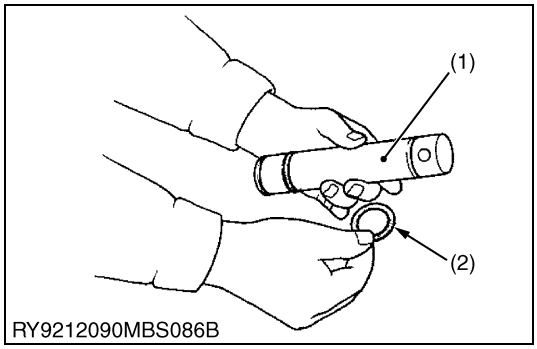


RY9212090MBS084B

3. Remove the floating seal.
4. Remove the shaft.

(1) Spring Pin
(2) Bracket
(3) Floating Seal
(4) Shaft

RY9212148MBS0007US0



RY9212090MBS086B

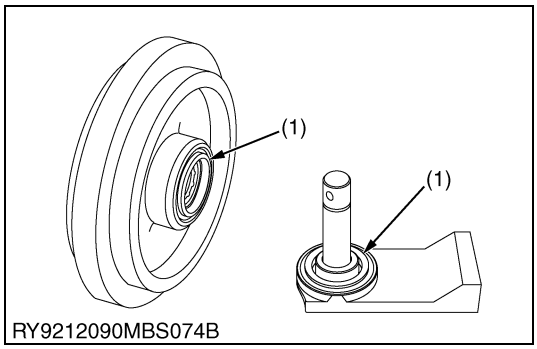
Assembly Procedures

1. Mount the O-rings on the shaft.

■ **IMPORTANT**
- **Apply engine oil to the O-rings.**

(1) Shaft
(2) O-Ring

RY9212148MBS0008US0



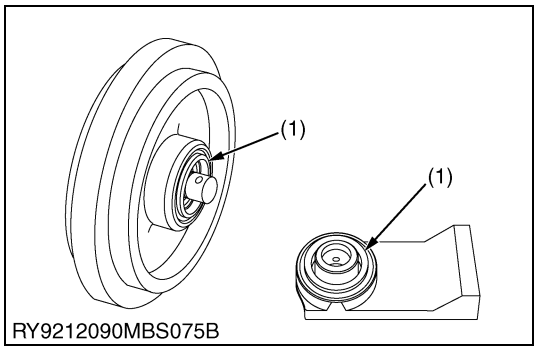
RY9212090MBS074B

2. After installing a floating seal on one side of the bracket, mount the shaft and fix it in place with a spring pin.
3. Install a floating seal on the idler.

■ **IMPORTANT**
- **Face the split in the spring pin so it is perpendicular to the shaft and tap it in.**
- **Make sure there is no oil or debris on the O-ring or the O-ring seat.**
- **Apply a thin film of oil to the sliding surfaces.**
- **Make sure there are no scratches in the sliding surfaces or the O-rings.**

(1) Floating Seal

RY9212148MBS0098US0



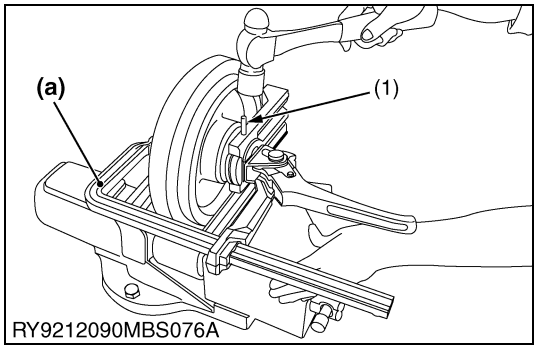
RY9212090MBS075B

4. Install a floating seal to the bracket on the other side of the idler.

■ **IMPORTANT**
- **Make sure there is no oil or debris on the O-ring or the O-ring seat.**
- **Apply a thin film of oil to the sliding surfaces.**
- **Make sure there are no scratches in the sliding surfaces or the O-rings.**

(1) Floating Seal

RY9212148MBS0099US0



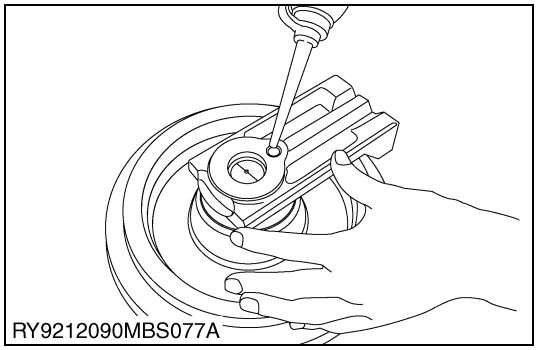
RY9212090MBS076A

5. Align the holes in the shaft and the brackets, hold them in place with a clamp and tap in a spring pin.

■ **IMPORTANT**
- **Face the split in the spring pin so it is perpendicular to the shaft and tap it in.**
- **After completing the assembly, turn the idler a little to form a film of oil on the sliding surface of the floating seals.**

(1) Spring Pin
(a) Clamp

RY9212148MBS0009US0


RY9212090MBS077A

6. Fill with engine oil via the plug hole in the bracket.
7. Install the plug.

Lubricant	Type SAE #30CD engine oil	80 cc 4.88 cu.in

Tightening torque	Plug	10.0 N·m 1.0 kgf·m 7.4 lbf·ft

Apply thread lock compound (Loctite 503 or equivalent)

RY9212148MBS0010US0

[4] GREASE CYLINDER

(1) Assembly/Disassembly of the Grease Cylinder

RY9212148MBS068A

1. Remove the track and the front idler (Refer to the Track and Front Idler chapters for assembly/disassembly of the track and front idler).
2. Remove the grease cylinder from the track frame.

Grease cylinder weight	Approx. 20 kg (44 lbs)

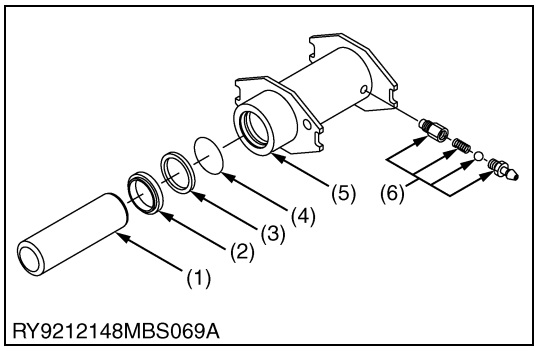
3. Use a crane during assembly.

■ **IMPORTANT**

- **Wipe off any dirt, sand, etc. sticking to the inside of the track frame prior to inserting the component.**
- **Make sure it slides smoothly and insert it.**

RY9212148MBS0100US0

(2) Components



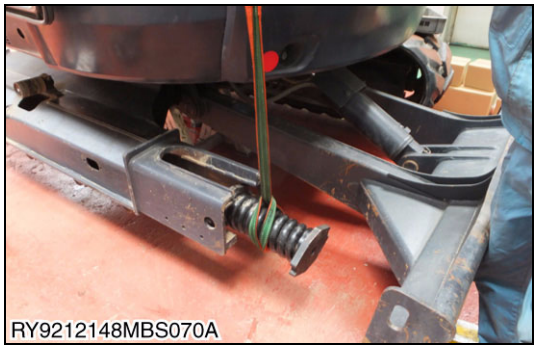
RY9212148MBS069A

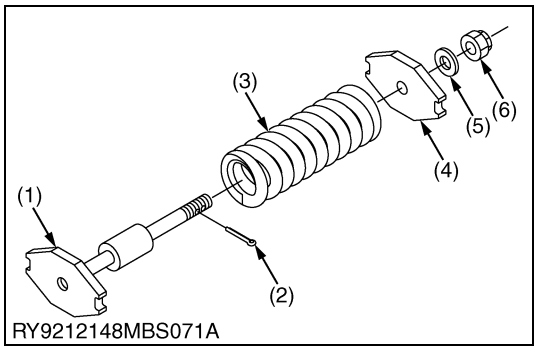
No.	Name of part	Qty	Notes
(1)	Rod	1	
(2)	Seal	1	
(3)	Backup ring	1	
(4)	O-ring	1	
(5)	Cylinder tube	1	
(6)	Grease nipple	1	98.0 to 107.8 N·m 10.0 to 11.0 kgf·m 72.3 to 79.5 lbf·ft

RY9212148MBS0101US0

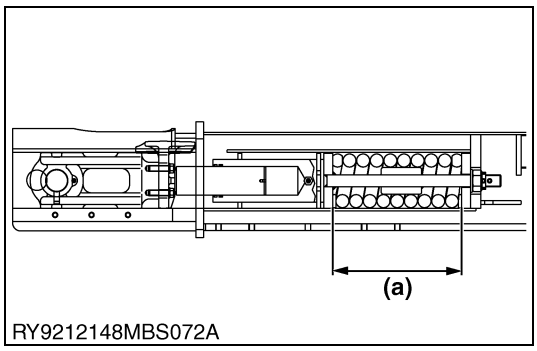
[5] TENSIONER

(1) Tensioner Assembly/Disassembly


RY9212148MBS070A



RY9212148MBS071A



RY9212148MBS072A

1. Remove the track front idler and grease cylinder (Refer to the Track and Front Idler and Grease Cylinder sections for their assembly/disassembly procedures).
2. Remove the tensioner from the track frame.

Tensioner weight	Approx. 30 kg (66 lbs)

3. Use a crane during assembly.

■ **IMPORTANT**
- **Wipe off any dirt, sand, etc. sticking to the inside of the track frame prior to inserting the component.**
- **Make sure it slides smoothly and insert it.**

RY9212148MBS0102US0

No.	Name of part	Qty	Notes
(1)	Bolt	1	
(2)	Split pin	1	
(3)	Spring	1	
(4)	Retainer	1	
(5)	Washer	1	
(6)	Nut	1	

RY9212148MBS0103US0

When switching from a rubber track to a steel one or vice versa, set to the appropriate preset length.

Preset length	Steel	Factory Specification	334 mm 13.1 in.
	Rubber		319 mm 12.6 in.

(a) Preset length

RY9212148MBS0104US0

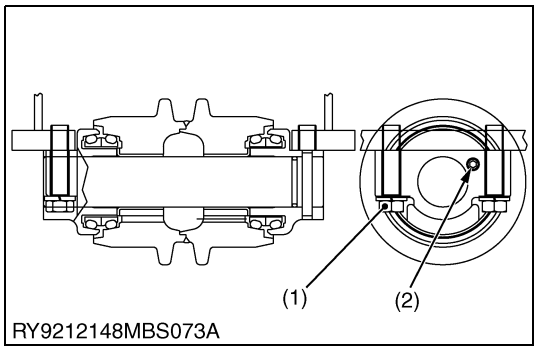
[6] TRACK ROLLERS

(1) Track Roller Assembly/Disassembly

CAUTION

- **As the grease cylinder is under high pressure, loosening the grease nipple all at once may cause the nipple to jump out and/or grease to spray out.**
- **Do not get your face or any body part right in front of the nipple while loosening it and loosen the nipple gradually.**

RY9212148MBS0016US0



RY9212148MBS073A

1. Remove the track roller mounting bolts.

Tightening torque	Bolt	166.7 to 196.1 N·m 17.0 to 20.0 kgf·m 123.0 to 144.6 lbf·ft

Apply a threadlock (ThreeBond 1305P).

(1) Bolt (2) Grease Plug

RY9212148MBS0105US0

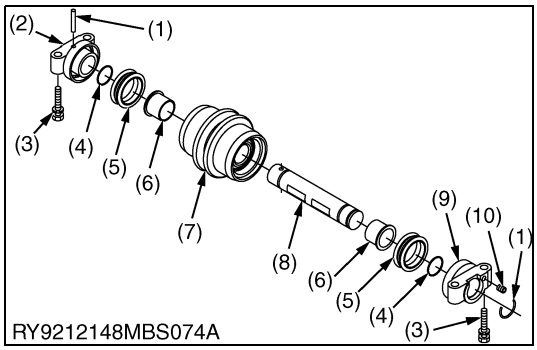
RY9212435HYS081A

2. Jack up the body using the front end and blade, expel grease from inside the grease cylinder, and fully loosen up the track. When the track is loose, attach the grease nipple and place a block under the track frame.
3. Remove the track roller(s).

Track roller weight	Approx. 12.4 kg (27.3 lbs)

RY9212435MBS0022US0

(2) Components



RY9212148MBS074A

(1) Spring pin
(2) Bracket 1
(3) Bolt
(4) O-ring
(5) Floating Seal
(6) Bushing
(7) Roller
(8) Shaft
(9) Bracket 2
(10) Plug

RY9212148MBS0106US0

[7] CARRIER ROLLERS

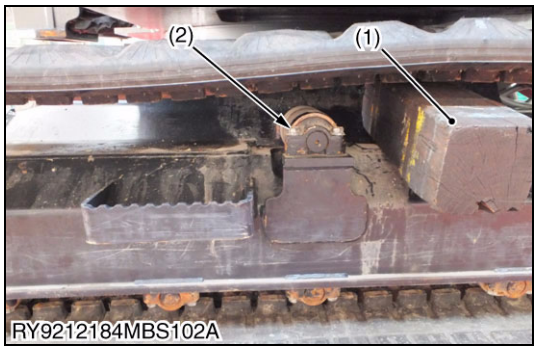
(1) Carrier Roller Assembly/Disassembly

CAUTION

- **As the grease cylinder is under high pressure, loosening the grease nipple all at once may cause the nipple to jump out and/or grease to spray out.**
- **Do not get your face or any body part right in front of the nipple while loosening it and loosen the nipple gradually.**

RY9212148MBS0016US0

RY9212435HYS081A



RY9212184MBS102A

1. Jack up the body using the front end and blade, expel grease from inside the grease cylinder, and fully loosen up the track. When the track is loose, attach the grease nipple and place a block under the track frame.
2. Insert a block between the track frame and the track and remove the carrier roller.

Tightening torque	Bolt	166.7 to 196.1 N·m 17.0 to 20.0 kgf·m 123.0 to 144.6 lbf·ft

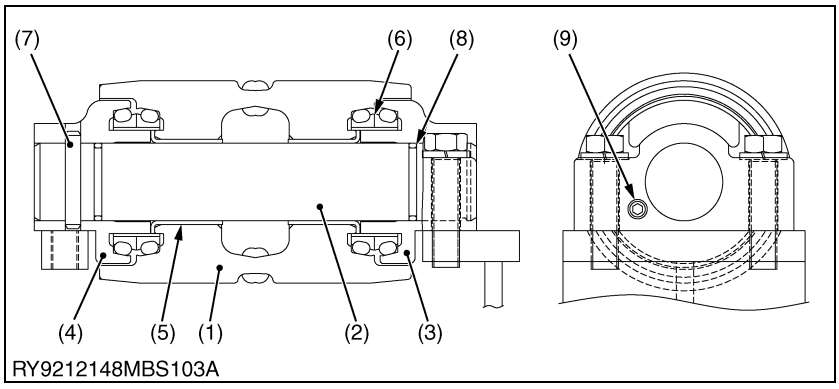
Apply a threadlock (ThreeBond 1305P).

Carrier roller weight	Approx. 10.8 kg Approx. 23.8 lbs

(1) Block (2) Bolt

RY9212435MBS0021US0

(2) Components



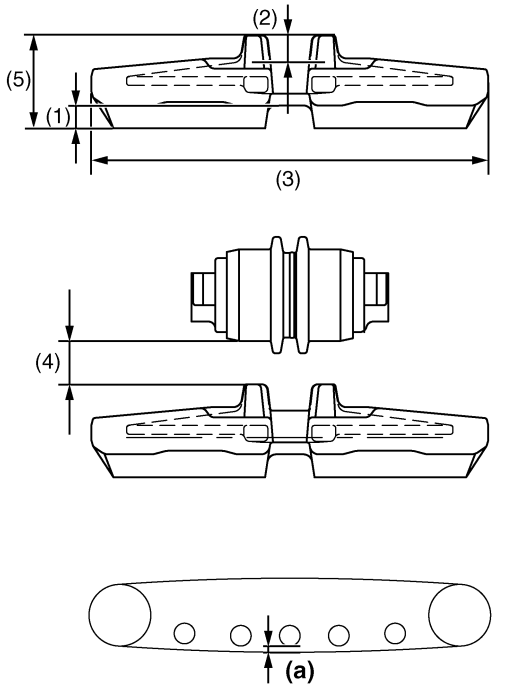
RY9212148MBS103A

(1) Roller
(2) Shaft
(3) Bracket 1
(4) Bracket 2
(5) Bushing
(6) Floating Seal
(7) Spring Pin
(8) O-ring
(9) Grease Plug

RY9212148MBS0147US0

[8] TABLE OF DIMENSIONS

(1) Rubber Track



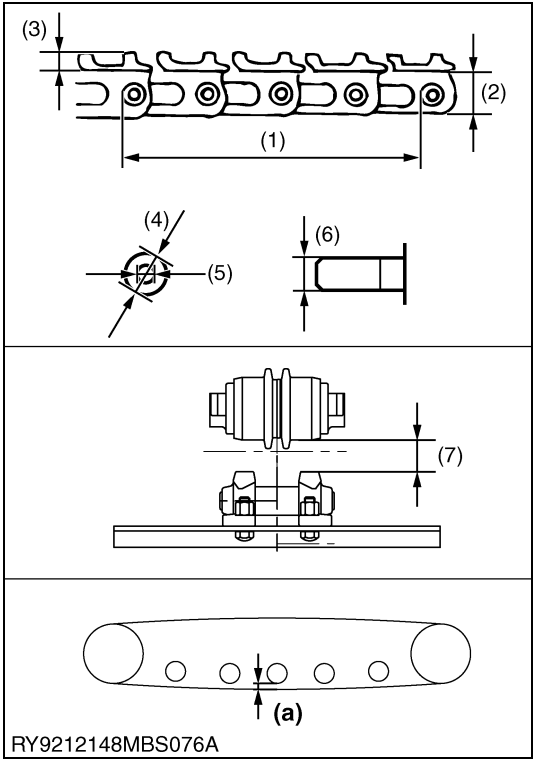
RY9212148MBS075A

No.	Item	KX080-4α2
(1)	Lug height	20 mm 0.79 in.
(2)	Link height	30 mm 1.18 in.
(3)	Track width	450 mm 17.72 in.
(4)	Track tension	25 to 40 mm 0.98 to 1.57 in.
(5)	Track height	102.5 mm 4.04 in.
	No. of cored bars	76
	Circumference in middle	6194 mm 243.86 in.
	Cored bar pitch	81.5 mm 3.21 in.
	Endless ID mark	∞

(a) Track Adjustment Point

RY9212724MBS0014US0

(2) Steel Track



RY9212148MBS076A

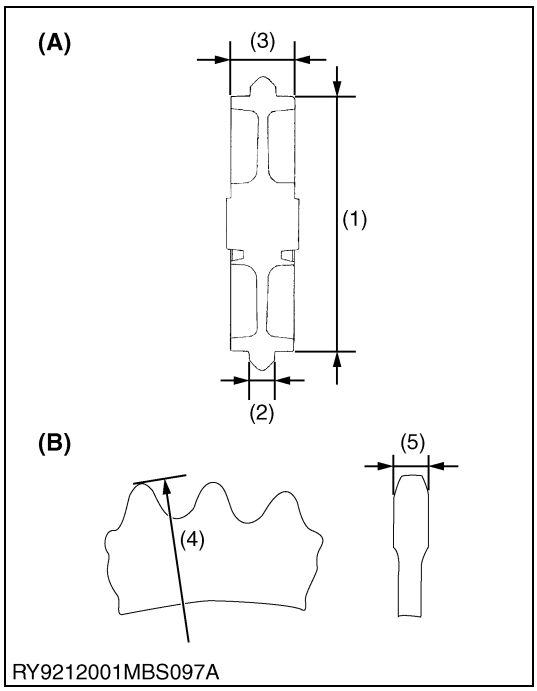
No.	Item	KX080-4α2	
	Track width	450 mm 17.72 in.	600 mm 23.62 in.
	No. of links	39	
(1)	4 Link lengths (A)/(B)	616.0 / 632.0 mm 24.25 / 24.88 in.	
(2)	Height (A)/(B)	74.0 / 70.0 mm 2.91 / 2.76 in.	
(3)	Grouser height (A)/(B)	26.0 / 16.0 mm 1.02 / 0.63 in.	
(4)	Bushing O.D. (A)/(B)	ϕ41.26 / 40.26 mm ϕ1.62 / 1.59 in.	
(5)	Bushing I.D. (A)/(B)	ϕ24.5 / 27.0 mm ϕ0.96 / 1.06 in.	
(6)	Pin O.D. (A)/(B)	ϕ24.0 / 21.0 mm ϕ0.94 / 0.83 in.	
(7)	Track tension	40 to 55 mm 1.57 to 2.17 in.	

(A): Factory spec. when new
(B): Recommended replacement values

(a) Track Adjustment Point

RY9212724MBS0015US0

(3) Idler Sprocket



RY9212001MBS097A

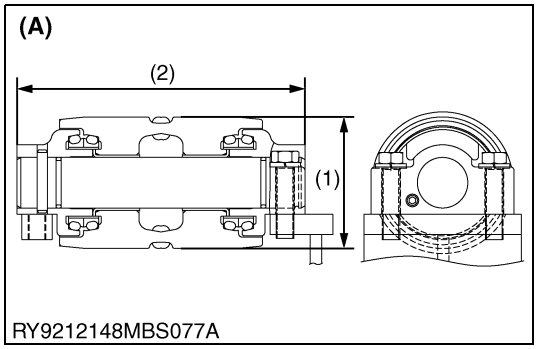
No.	Item	KX080-4α2
Front Idler (for Steel Track)		
(1)	O.D. (A)/(B)	ϕ390 / 384 mm ϕ15.35 / 15.12 in.
(2)	Guide width (A)/(B)	38 / 32 mm 1.50 / 1.26 in.
(3)	Width	98 mm 3.86 in.
Front Idler (for Rubber Track)		
(1)	O.D. (A)/(B)	ϕ400 / 394 mm ϕ15.7 / 15.5 in.
(2)	Guide width (A)/(B)	38 / 32 mm 1.50 / 1.26 in.
(3)	Width	98 mm 3.86 in.
Sprocket		
(4)	O.D. (A)/(B)	ϕ493 / 481 mm ϕ19.41 / 18.94 in.
(5)	Wheel width	39 mm 1.54 in.

(A): Factory spec. when new
(B): Recommended replacement values

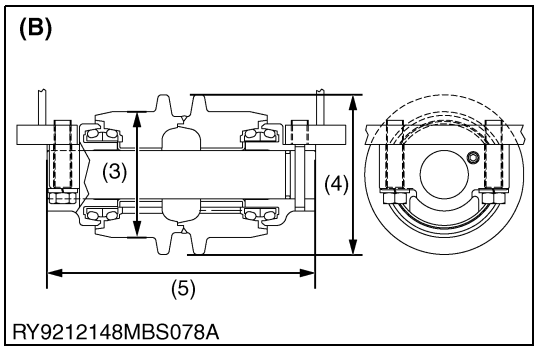
(A) Front Idler **(B) Sprocket**

RY9212724MBS0016US0

(4) Carrier Rollers and Track Rollers



RY9212148MBS077A



RY9212148MBS078A

No.	Item	KX080-4α2
Carrier Rollers		
(1)	O.D. (A)/(B)	ϕ80 / 76 mm ϕ3.15 / 2.99 in.
(2)	Roller width	ϕ228.6 mm ϕ9.00 in.
Track Rollers		
(3)	Guide width (A)/(B)	ϕ104 / 96 mm ϕ4.09 / 3.78 in.
(4)	O.D. (A)/(B)	ϕ132 / 124 mm ϕ5.20 / 4.88 in.
(5)	Roller width	ϕ228.6 mm ϕ9.00 in.

(A): Factory spec. when new
(B): Recommended replacement values

(A) Carrier Rollers **(B) Track Rollers**

RY9212724MBS0017US0

4. MEASURING MACHINE PERFORMANCE

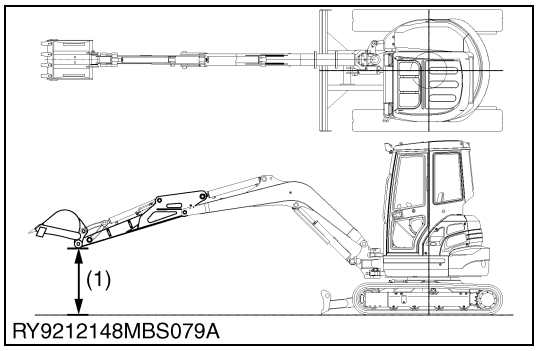
[1] MEASURING FRONT PERFORMANCE

(1) Measuring Swivel Gear Backlash

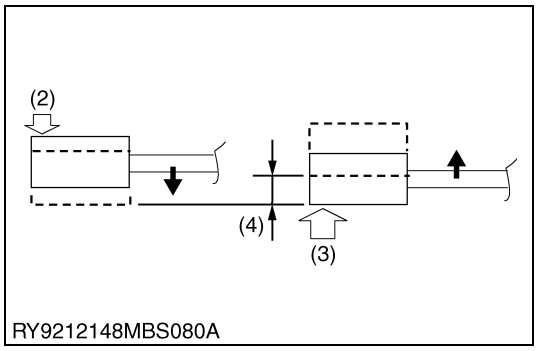
Purpose

- Measure the degree of overall wear in the front and replace pins and/or bushings or add shims as needed.
- When there is a great deal of play, it may cause wear in the swivel bearing teeth, swivel motor pinion gear and front pins and bushings.

RY9212148MBS0112US0



RY9212148MBS079A



RY9212148MBS080A

Measurement preparation

1. To make the measurements, position the machine so the arm cylinder and bucket cylinder are fully compressed with the end of the arm at a height of 1.0 m (40 in.) off the ground.
2. Stop the engine.

[Left play measurement]

1. Push to the right with 50 N (5.0kgf, 11 lbs) of pressure, making that position the zero point; then press to the left with 300 N (30 kgf, 67.4 lbs) of pressure and take a reading at that point.
2. Take three measurements, determine the average and take that as the measured value.

[Right play measurement]

1. Push to the left with 50 N (5.0 kgf, 11 lbs) of pressure, making that position the zero point; then press to the right with 300 N (30 kgf, 67.4 lbs) of pressure and take a reading at that point.
2. Take three measurements, determine the average and take that as the measured value.

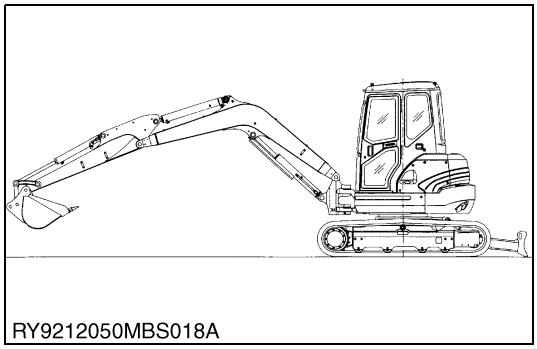
(1) 1.0 m (40 in.)
(2) 50 N (5.0 kgf, 11 lbs)
(3) 300 N (30 kgf, 67.4 lbs)
(4) Amount of Play

RY9212148MBS0113US0

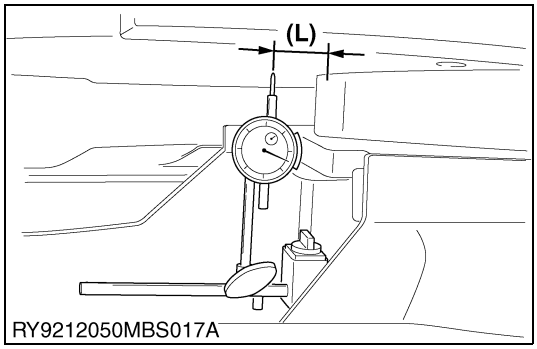
(2) Measuring Swivel Bearing Play

Purpose

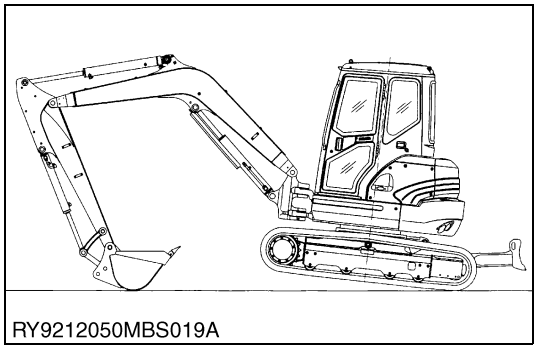
- Assesses the degree of wear in the ball bearings and race surfaces of the swivel bearing according to the amount of wear in the inner and outer races.



RY9212050MBS018A



RY9212050MBS017A



RY9212050MBS019A

[Measurement preparation]

1. Make sure there is no looseness in the swivel bearing mounting bolts.
2. Operate the swivel and make sure there are no abnormal sounds and that it operates smoothly.
3. Fasten the dial gauge and the dial gauge stand to the track frame so the probe of the dial gauge touches the swivel frame.

[Measurement]

1. Arm cylinder fully compressed and bucket cylinder fully extended, keeping the boom base pin and the arm end pin at the same height.
2. Zero the dial gauge.
3. Use the front attachment to tilt the body of the machine upwards and take a reading on the dial gauge.
4. Take three measurements, determine the average and take that as the measured value.

(L) Measurement Position 50 mm (1.97 in.)

RY9212148MBS0132US0

5. SWIVEL GEAR BACKLASH PERFORMANCE

No.	Item		Factory Specification
(1)	Front play measurement		≤70 mm ≤2.76 in.
(2)	Swivel bearing play	Factory spec. when new	≤1.24 mm ≤0.05 in.
		Usage limit	≤2.48 mm ≤0.10 in.

RY9212724MBS0018US0

2 ENGINE

GENERAL

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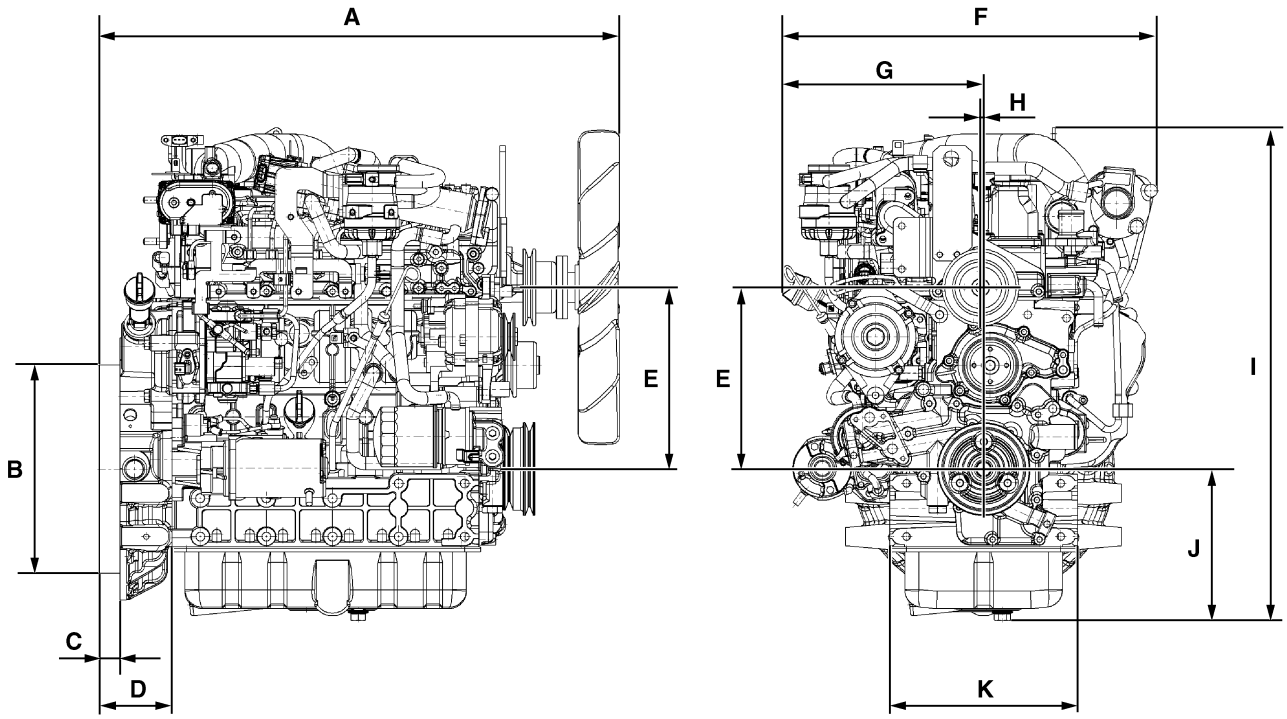
4. FAN DRIVE 2-G4

1. SPECIFICATIONS

		KX080-4α2
Model		V3307-CR-TE5-BH-1
No. of cylinders		4
Cylinder Bore × Stroke		94.0 × 120 mm (3.70 × 4.72 in.)
Total displacement		3331 cm^3 (203.3 cu.in.)
Idling RPM		1100 min^{-1}
Rated RPM		2000 min^{-1}
Maximum RPM		2000 min^{-1}
Rated output/RPM	Net	46.5 kW/2000 min^{-1} (62.4 HP/2000 min^{-1})
	Gross	49.7 kW/2000 min^{-1} (66.6 HP/2000 min^{-1})
Max torque/RPM	Net	256.0 N·m/1400 min^{-1} (26.1 kgf·m/1400 min^{-1}, 188.8 lbf·ft/1400 min^{-1})
	Gross	263.0 N·m/1400 min^{-1} (26.8 kgf·m/1400 min^{-1}, 194.0 lbf·ft/1400 min^{-1})
Machine dimensions (L×W×H)		803 × 578 × 760 mm (31.61 × 22.76 × 29.92 in.)
Dry weight		330 kg (728 lbs)
Combustion type		Reentrant type, Center direct injection system (E-CDIS)
Fuel injection pump type		Denso common rail system
Governor type		
Nozzle type		
Fuel injection timing		
Fuel injection pressure		
Rotation direction		Counterclockwise viewed from flywheel side
Firing sequence		1-3-4-2
Compression ratio		18.0
EGR		External EGR
Compression pressure		2.90 to 3.92 MPa (29.6 to 40.0 kgf/cm^2, 421 to 569 psi)
Fuel consumption (at rated RPM)	Net	245.0 g/kW·h (182.7 g/HP·h, 0.401 lb/HP·h)
	Gross	223.4 g/kW·h (166.6 g/HP·h, 0.367 lb/HP·h)
Engine oil consumption (at rated RPM)		0.54 g/kW·h (0.40 g/PS·h) or less
Alternator		12 V, 960 W
Battery name	ETN	600 035 060
	DIN	60035
	JIS	12V92AH, 130E41R
Starter motor		12 V, 2.7 kW

RY9212724END0003US0

2. DIMENSIONS



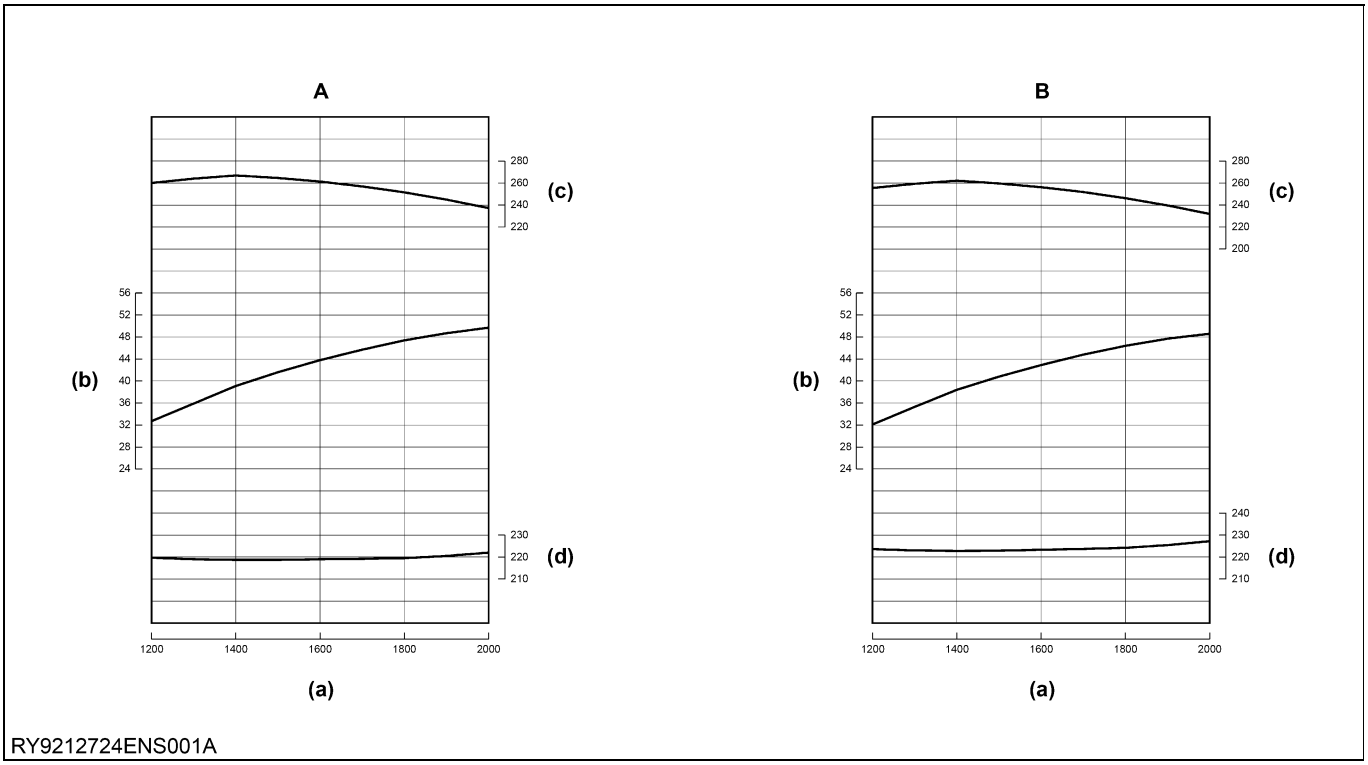
RY9212148ENS001A

A	802.9 mm (31.57 in.)	E	280 mm (11.02 in.)	**I**	759.8 mm (29.91 in.)
B	ϕ321 mm (12.64 in.)	F	578.1 mm (22.76 in.)	J	233.6 mm (9.20 in.)
C	32.6 mm (1.28 in.)	**G**	310.2 mm (12.21 in.)	K	290 mm (11.42 in.)
D	113 mm (4.45 in.)	H	5 mm (0.20 in.)		

RY9212148END0002US0

3. PERFORMANCE CURVES

ISO 3046

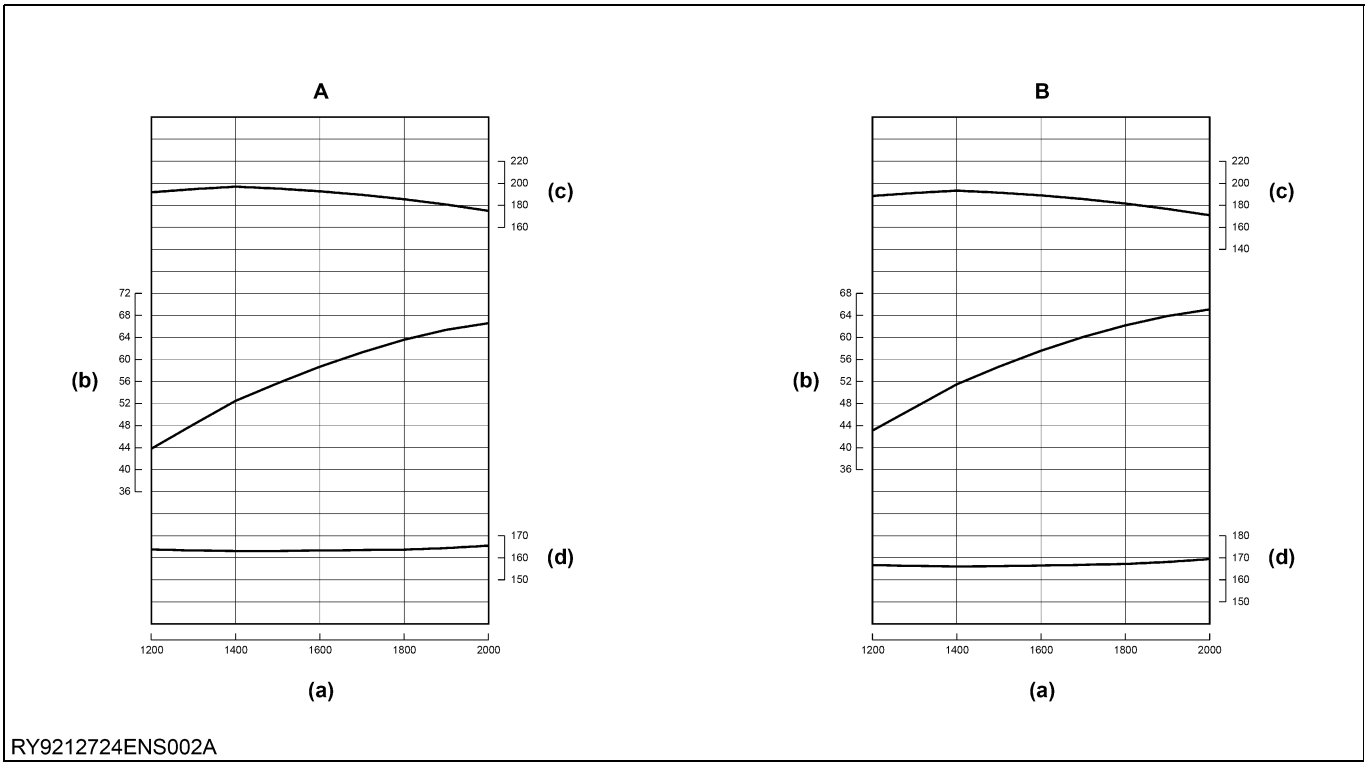


RY9212724ENS001A

(a) Engine RPM **(c) Torque (N·m)** **A : Gross** **B : Net**
(b) Output (kW) **(d) Fuel Consumption (g/kWh)**

RY9212724END0001US0

SAE J1349

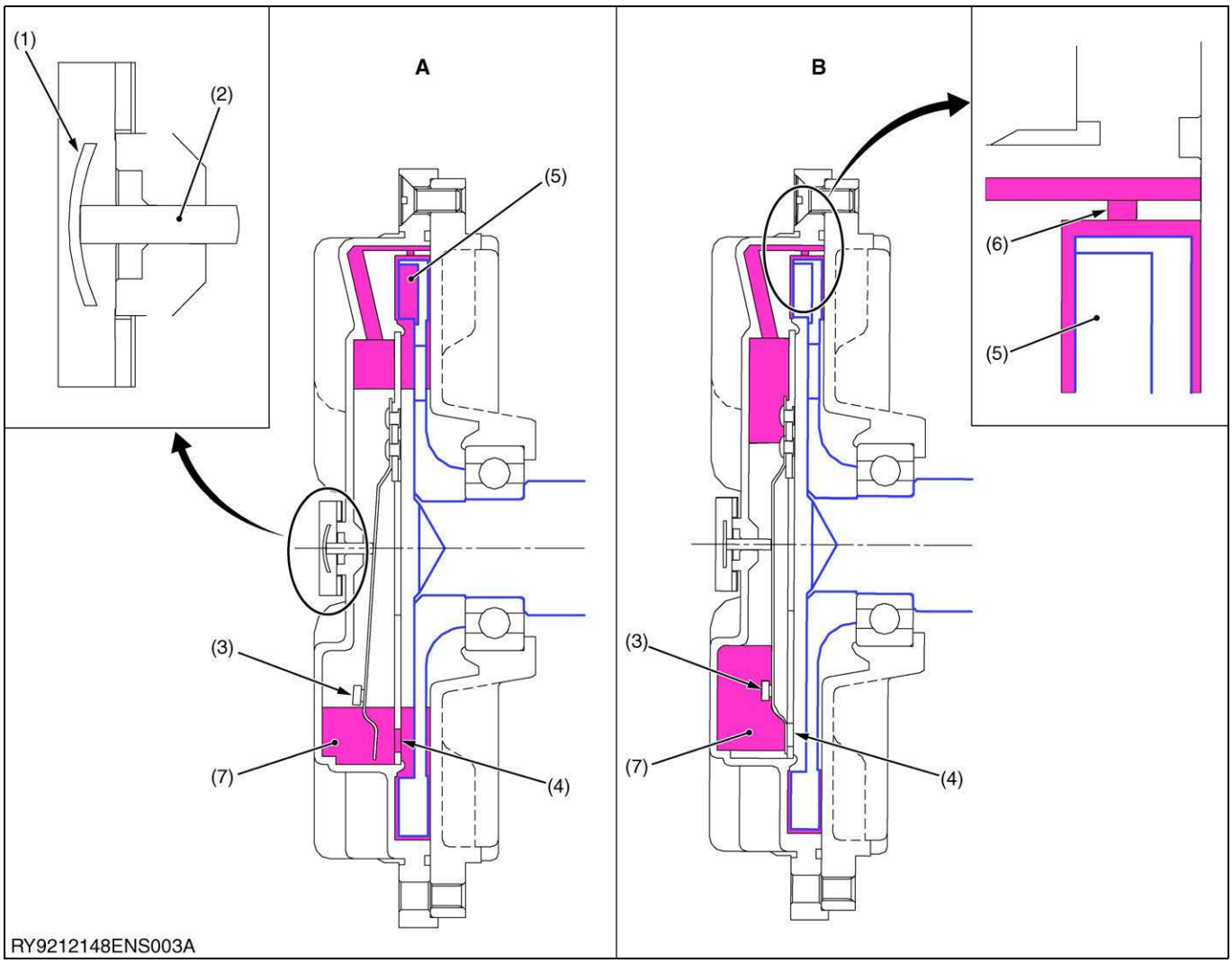


RY9212724ENS002A

(a) Engine RPM **(c) Torque (ft/lb)** **A : Gross** **B : Net**
(b) Output (HP) **(d) Fuel Consumption (g/HPh)**

RY9212724END0002US0

4. FAN DRIVE



(1) Bimetallic Strip
(2) Piston
(3) Flat Spring (Valve)
(4) Feed Orifice
(5) Torque Transmission Chamber
(6) Collection Orifice
(7) Oil Collection Chamber

A : At High Temperature
B : At Low Temperature

[At high temperature]

- When the temperature rises, the bimetallic strip (1) bends slightly, opening the supply orifice (4) via the linkage of the piston (2) and the valve (3).
- Silicon oil flows from the supply orifice (4) into the torque transmission chamber (5), increasing the transmitted torque and increasing fan RPM.

[At low temperature]

- The supply orifice (4) closes and oil is not supplied to the torque transmission chamber (5).
- As the part colored in blue is directly coupled to the engine, it rotates at the same speed as the engine. Conversely, the fan drive body turns at a lower RPM as there is little oil remaining in the torque transmission chamber (5) (The blue part turns at high RPM and the fan body turns at low speed).
- The oil from the torque transmission chamber (5) returns to the oil collection chamber (7) via the collection orifice (6).

RY9212148END0004US0

SERVICING

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1. MEASURING ENGINE PERFORMANCE

[1] MEASURING ENGINE COMPRESSION PRESSURE

Purpose

If the engine compression pressure is lower than the reference value, something may be wrong with the engine.

[Measurement preparations]

1. Warm up the engine.
2. Stop the engine.
3. Disconnect the negative cable from the battery.
4. Disconnect the wire harness, hose and wire harness bracket.
5. Remove the wire harness from the glow lead and apply insulating tape on the terminal of the wire harness.

Tightening torque	Wire harness	1.0 to 2.5 N·m 0.10 to 0.25 kgf·m 0.74 to 1.80 lbf·ft

6. Remove the glow lead.

Tightening torque	Glow lead	1.0 to 1.8 N·m 0.10 to 0.18 kgf·m 0.74 to 1.30 lbf·ft

7. Disconnect the injector connectors.
8. Remove all of the glow plugs, and install a compression tester with an adapter on one of the glow plug holes.

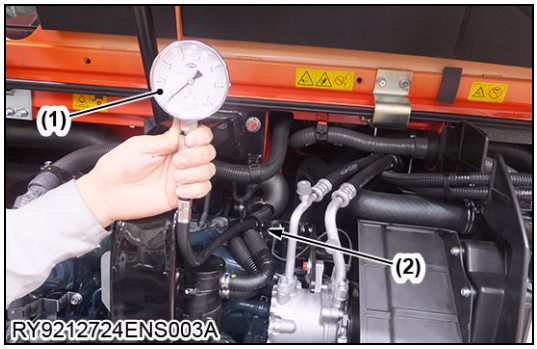
Tightening torque	Glow plug	7.65 to 9.35 N·m 0.78 to 0.95 kgf·m 5.64 to 6.90 lbf·ft

9. Connect the negative cable to the battery.

[Measurement]

1. Crank the engine with the starter motor.
2. Measure the compression pressure with a compression tester.

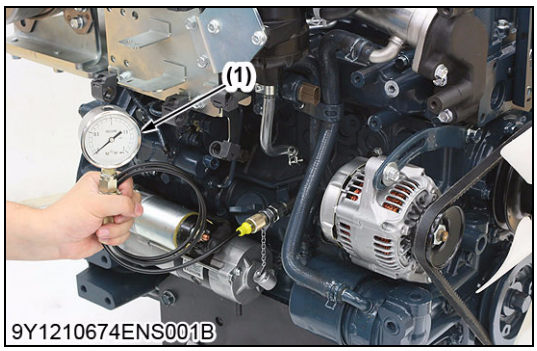
Compression pressure	Service specification	3.92 MPa / 250 min^{-1} (rpm) 40.0 kgf/cm^2 / 250 min^{-1} (rpm) 569 psi / 250 min^{-1} (rpm)
	Service limit	2.90 MPa / 250 min^{-1} (rpm) 29.6 kgf/cm^2 / 250 min^{-1} (rpm) 421 psi / 250 min^{-1} (rpm)



(1) Compression Tester (2) Compression Tester Adapter

RY9212724ENS0001US0

[2] MEASURING ENGINE OIL PRESSURE



Purpose

If the engine oil pressure is lower than the reference value, something may be wrong with the engine.

[Measurement preparations]

1. Disconnect the engine oil pressure switch connector.
2. Remove the engine oil pressure switch.

Tightening torque	Oil pressure switch	15.7 to 19.6 N·m 1.60 to 2.00 kgf·m 11.6 to 14.5 lbf·ft

3. Set the oil pressure tester.
4. Operate the engine for warming-up.

[Measurement]

1. Measure the oil pressure at the idle speed and rated speed.

Engine oil pressure	Maximum speed	Service specification	196 to 392 kPa 2.00 to 4.00 kgf/cm^2 28.4 to 56.9 psi
		Service limit	150 kPa 1.53 kgf/cm^2 21.8 psi

(1) Oil Pressure Tester

RY9212724ENS0002US0

3 HYDRAULIC SYSTEM

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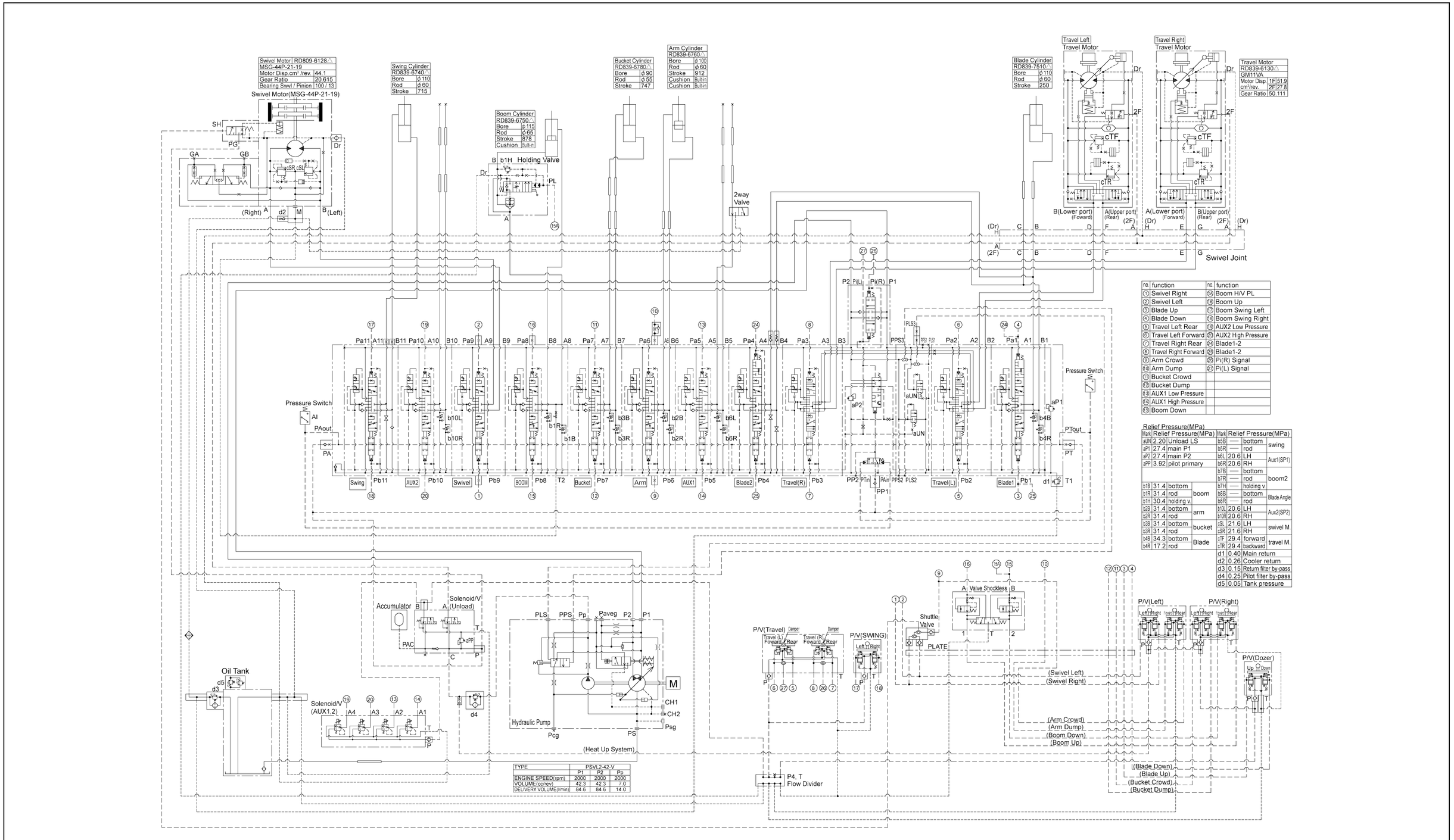
1. HYDRAULIC CIRCUIT DIAGRAM

[1] HYDRAULIC CIRCUIT DIAGRAM (KX080-4α2 STANDARD SPECIFICATION)



no.	function	no.	function
①	Swivel Right	⑯	Boom H/V PL
②	Swivel Left	⑱	Boom Up
③	Blade Up	⑰	Boom Swing Left
④	Blade Down	⑲	Boom Swing Right
⑤	Travel Left Rear	⑲	AUX2 Low Pressure
⑥	Travel Left Forward	㉓	AUX2 High Pressure
⑦	Travel Right Rear	㉔	Blade1-2
⑧	Travel Right Forward	㉓	Blade1-2
⑨	Arm Crowd	㉘	Pi(R) Signal
⑩	Arm Dump	㉗	Pi(L) Signal
⑪	Bucket Crowd		
⑫	Bucket Dump		
⑬	AUX1 Low Pressure		
⑭	AUX1 High Pressure		
⑮	Boom Down		

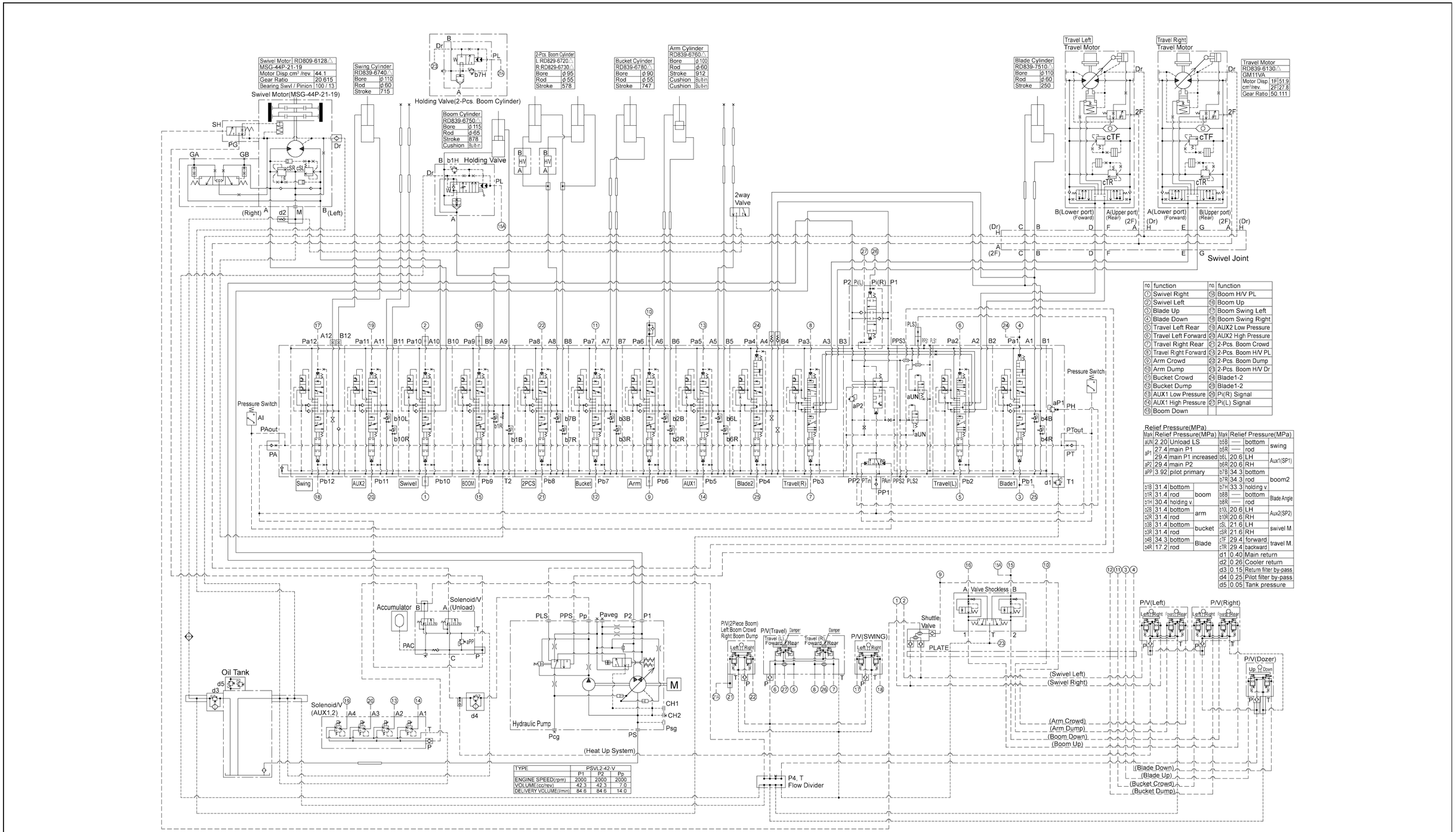
Relief Pressure(MPa)

Mark	Relief Pressure(MPa)		Mark		Relief Pressure(MPa)	
aUN	2.20	Unload LS	b5B	—	bottom	swing
aP1	27.4	main P1	b5R	—	rod	
aP2	27.4	main P2	b6L	20.6	LH	Aux1(SP1)
aPP	3.92	pilot primary	b6R	20.6	RH	
			b7B	—	bottom	boom2
b1B	31.4	bottom	b7H	—	holding v	
b1R	31.4	rod boom	b8B	—	bottom	Blade Angle
b1H	30.4	holding v	b8R	—	rod	
b2B	31.4	bottom arm	b10L	20.6	LH	Aux2(SP2)
b2R	31.4	rod	b10R	20.6	RH	
b3B	31.4	bottom bucket	cSL	21.6	LH	swivel M
b3R	31.4	rod	cSR	21.6	RH	
b4B	34.3	bottom Blade	cTF	29.4	forward	travel M
b4R	17.2	rod	cTR	29.4	backward	

d1	0.40	Main return
d2	0.26	Cooler return
d3	0.15	Return filter by-pass
d4	0.25	Pilot filter by-pass
d5	0.05	Tank pressure

RY9212724HYT002US

[2] HYDRAULIC CIRCUIT DIAGRAM (KX080-4α2 TWO PIECE BOOM SPECIFICATION)



Swivel Motor	RD809-6128△
MSG-44P-21-19	
Motor Disp.cm³ /rev.	44.1
Gear Ratio	20.615
Bearing Swvl / Pinion	100 / 13

Swing Cylinder	RD839-6740△
Bore	ϕ110
Rod	ϕ60
Stroke	715

Boom Cylinder	RD839-6750△
Bore	ϕ115
Rod	ϕ65
Stroke	878
Cushion	Built-in

2-Pcs. Boom Cylinder	
L RD829-6720△	
R RD829-6730△	
Bore	ϕ95
Rod	ϕ55
Stroke	578

Bucket Cylinder	RD839-6780△
Bore	ϕ90
Rod	ϕ55
Stroke	747

Arm Cylinder	RD839-6760△
Bore	ϕ100
Rod	ϕ60
Stroke	912
Cushion	Built-in
Cushion	Built-in

Blade Cylinder	RD839-7510△
Bore	ϕ110
Rod	ϕ60
Stroke	250

Travel Motor	RD839-6130△		
GM11VA			
Motor Disp. cm³/rev.	1F	51.9	
	2F	27.8	
Gear Ratio	50.111		

no	function	no	function
①	Swivel Right	⑮	Boom H/V PL
②	Swivel Left	⑯	Boom Up
③	Blade Up	⑰	Boom Swing Left
④	Blade Down	⑱	Boom Swing Right
⑤	Travel Left Rear	⑲	AUX2 Low Pressure
⑥	Travel Left Forward	⑳	AUX2 High Pressure
⑦	Travel Right Rear	㉑	2-Pcs. Boom Crowd
⑧	Travel Right Forward	㉒	2-Pcs. Boom H/V PL
⑨	Arm Crowd	㉓	2-Pcs. Boom Dump
⑩	Arm Dump	㉔	2-Pcs. Boom H/V Dr
⑪	Bucket Crowd	㉕	Blade1-2
⑫	Bucket Dump	㉖	Blade1-2
⑬	AUX1 Low Pressure	㉗	PI(R) Signal
⑭	AUX1 High Pressure	㉘	PI(L) Signal
⑮	Boom Down		

Relief Pressure(MPa)

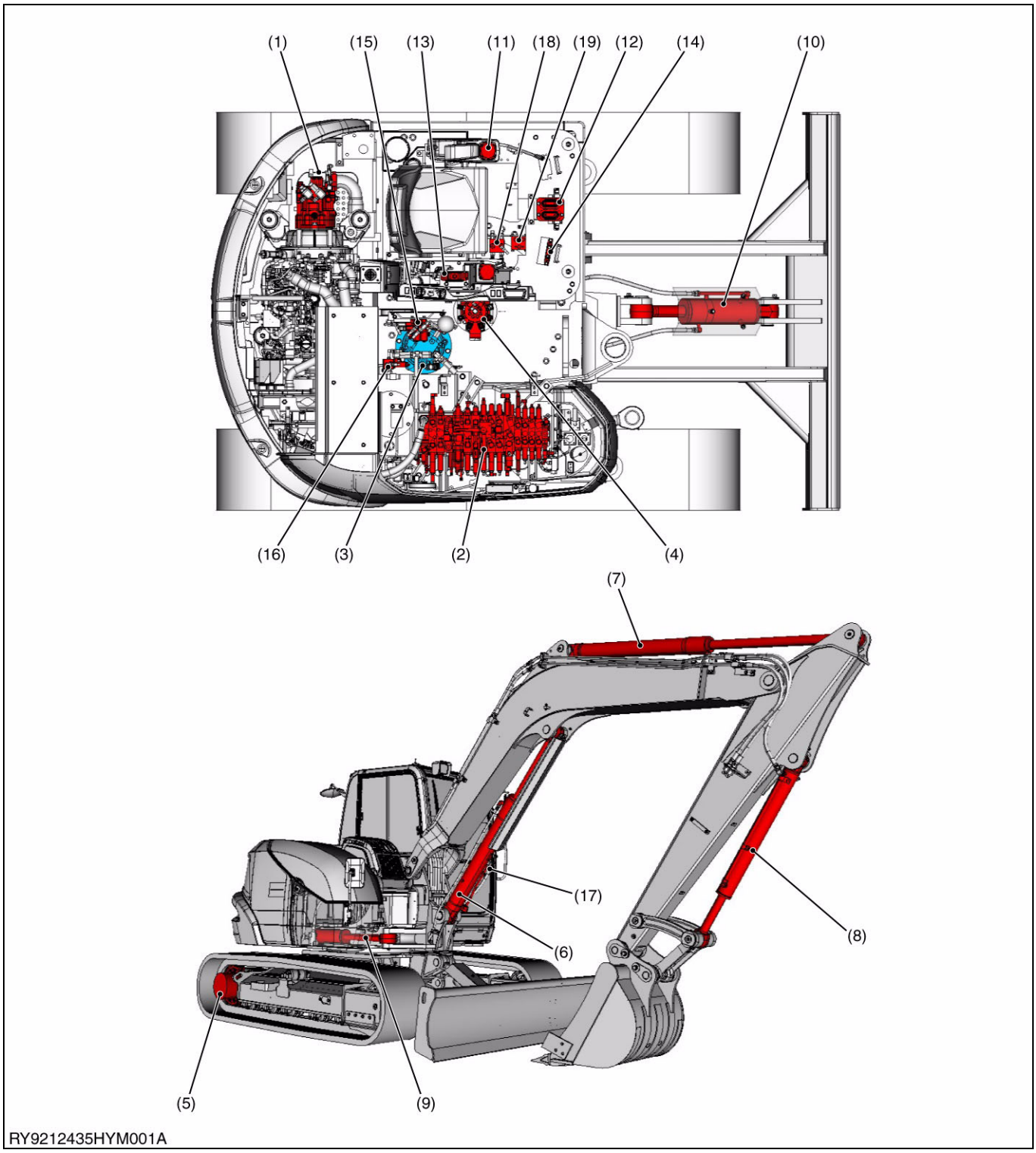
Mark	Relief Pressure(MPa)		Mark	Relief Pressure(MPa)	
aUN	2.20	Unload LS	b5B	— bottom	swing
aP1	27.4	main P1	b5R	— rod	
	29.4	main P1 increased	b6L	20.6 LH	Aux1(SP1)
aP2	29.4	main P2	b6R	20.6 RH	
aPP	3.92	pilot primary	b7B	34.3 bottom	boom2
			b7R	34.3 rod	
b1B	31.4	bottom boom	b7H	33.3 holding v.	
b1R	31.4	rod	b8B	— bottom	Blade Angle
b1H	30.4	holding v.	b8R	— rod	
b2B	31.4	bottom arm	b10L	20.6 LH	Aux2(SP2)
b2R	31.4	rod	b10R	20.6 RH	
b3B	31.4	bottom bucket	cSL	21.6 LH	swivel M.
b3R	31.4	rod	cSR	21.6 RH	
b4B	34.3	bottom Blade	cTF	29.4 forward	travel M.
b4R	17.2	rod	cTR	29.4 backward	
			d1	0.40	Main return
			d2	0.26	Cooler return
			d3	0.15	Return filter by-pass
			d4	0.25	Pilot filter by-pass
			d5	0.05	Tank pressure

TYPE	PSVL2-42-V		
	P1	P2	Pp
ENGINE SPEED(rpm)	2000	2000	2000
VOLUME(cc/rev)	42.3	42.3	7.0
DELIVERY VOLUME(l/min)	84.6	84.6	14.0

RY9212724HYT003US

2. HYDRAULIC DEVICE LAYOUT

[1] KX080-4α2 STANDARD SPECIFICATION

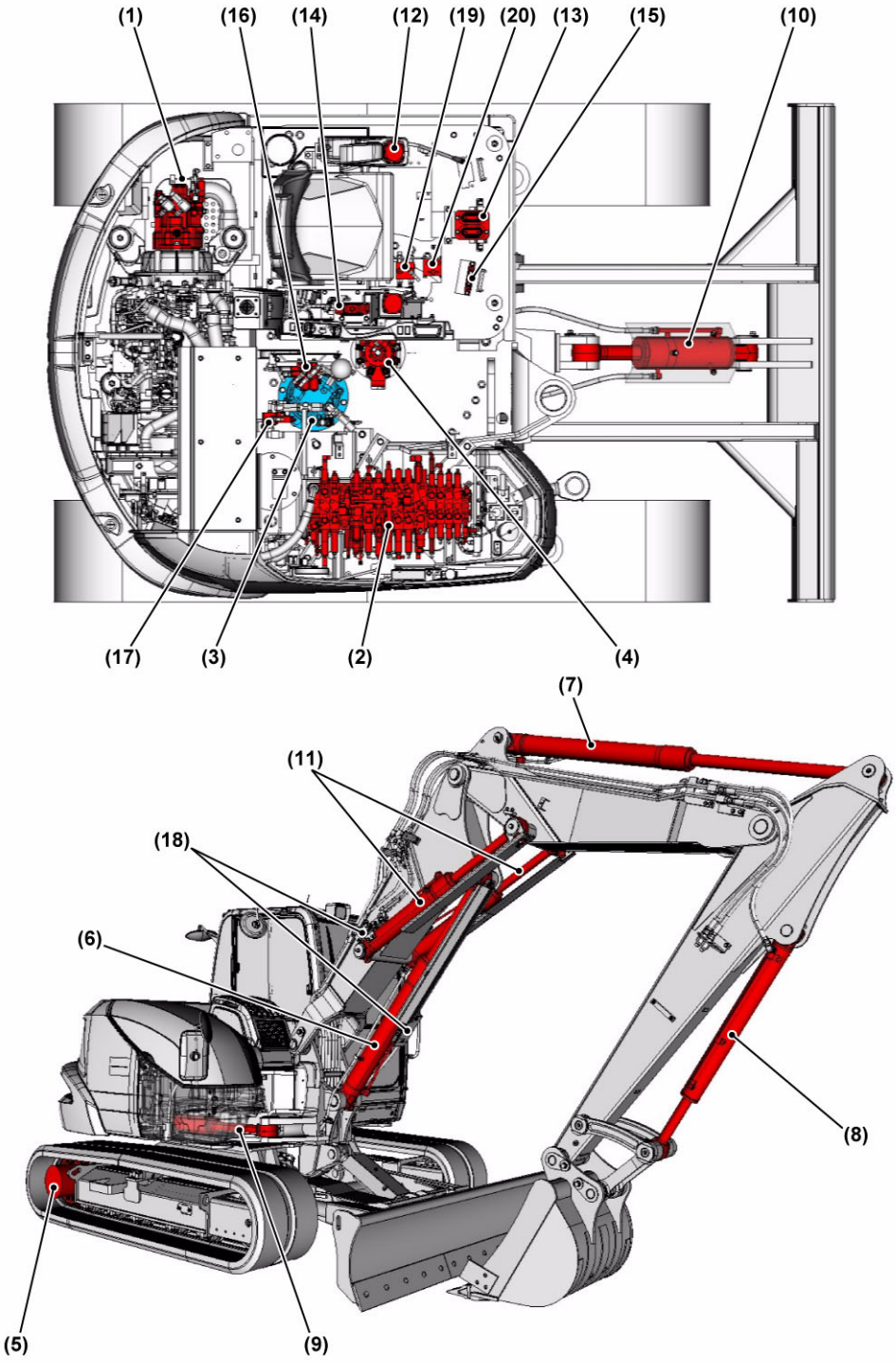


RY9212435HYM001A

(1) Pump
(2) Control Valve
(3) Swivel Motor
(4) Swivel Joint
(5) Travel Motor
(6) Boom Cylinder
(7) Arm Cylinder
(8) Bucket Cylinder
(9) Swing Cylinder
(10) Blade Cylinder
(11) Control Pilot Valve
(12) Travel Pilot Valve
(13) Blade Pilot Valve
(14) Swing Pilot Valve
(15) Unload Valve
(16) AUX Solenoid Valve
(17) Holding Valve
(18) Boom Shockless Valve
(19) Swivel Shuttle Valve

RY9212435HYM0003US0

[2] KX080-4α2 TWO PIECE BOOM SPECIFICATION

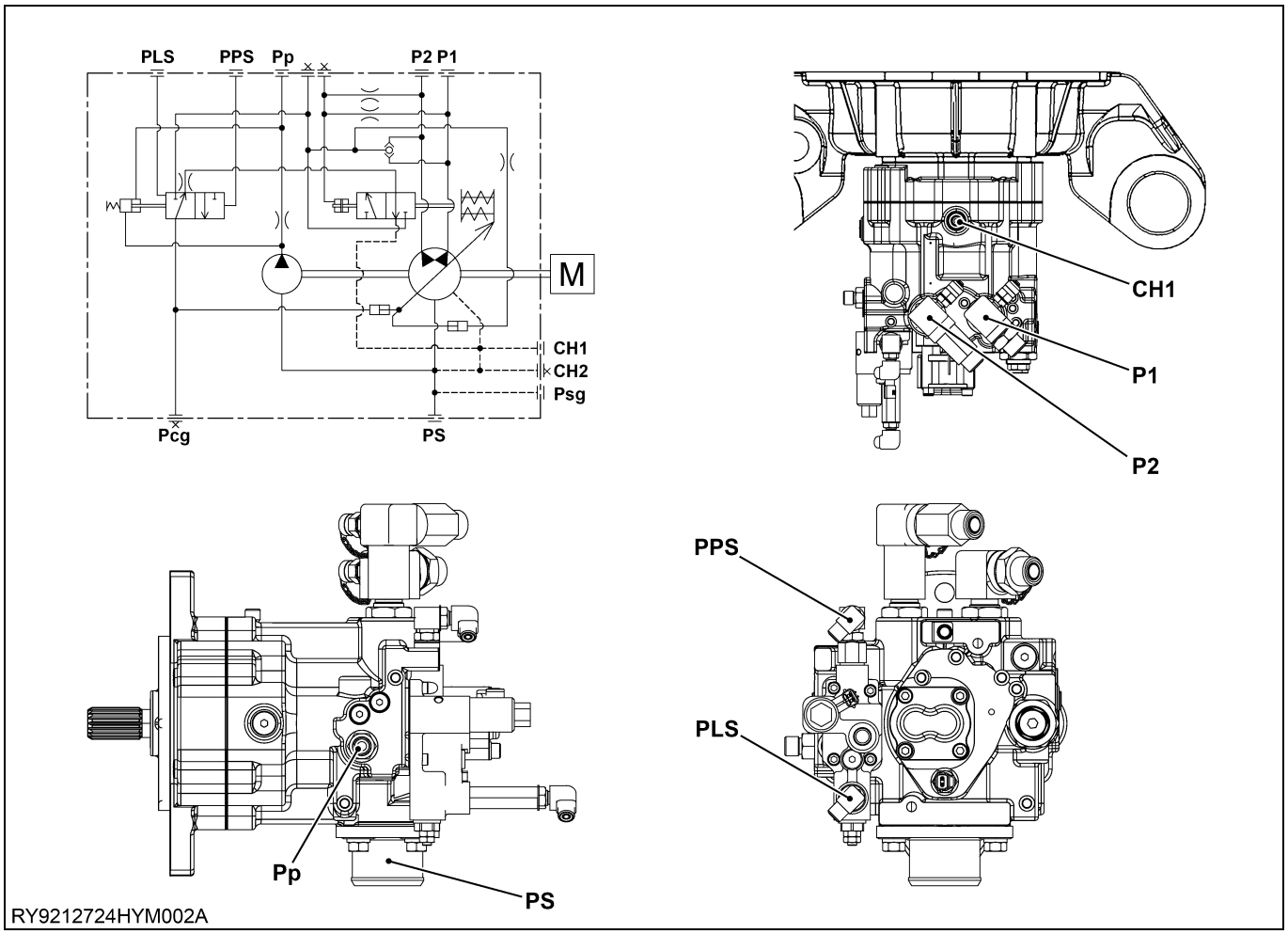


RY9212724HYM023A

(1) Pump
(2) Control Valve
(3) Swivel Motor
(4) Swivel Joint
(5) Travel Motor
(6) Boom Cylinder
(7) Arm Cylinder
(8) Bucket Cylinder
(9) Swing Cylinder
(10) Blade Cylinder
(11) Two Piece Boom Cylinder
(12) Control Pilot Valve
(13) Travel Pilot Valve
(14) Blade Pilot Valve
(15) Swing Pilot Valve
(16) Unload Valve
(17) AUX Solenoid Valve
(18) Holding Valve
(19) Boom Shockless Valve
(20) Swivel Shuttle Valve

RY9212724HYM0029US0

3. PUMP
[1] SPECIFICATIONS

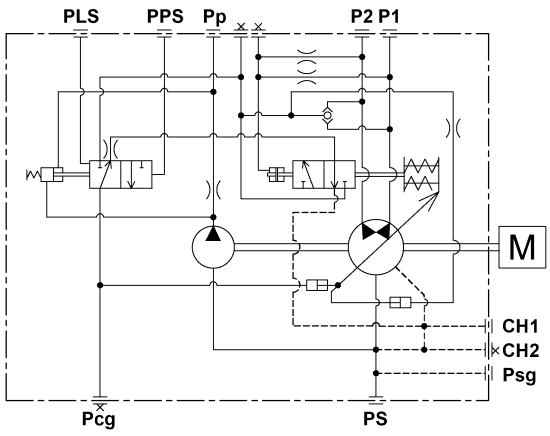


P1, P2 : Piston Pump Discharge Pressure **Pp : Pilot Pump Discharge Pressure** **PLS : Load Pressure** **PPS : Valve Inlet Pressure** **PS : Suction Pressure** **CH1 :Air Bleed**

Maker		KYB
Model		PSVL2-42
Rated RPM		2000 rpm
Rotation direction		Right
Piston pump	Max displacement	42.3 + 42.3 cc/rev (2.58 + 2.58 cu.in./rev)
Pilot pump		7.0 cc/rev (0.43 cu.in./rev)
Standby flow amount		5.1 + 5.1 L/min (1.34 + 1.34 U.S.gals)

RY9212724HYM0006US0

[2] PISTON PUMP HYDRAULIC CIRCUIT DIAGRAM

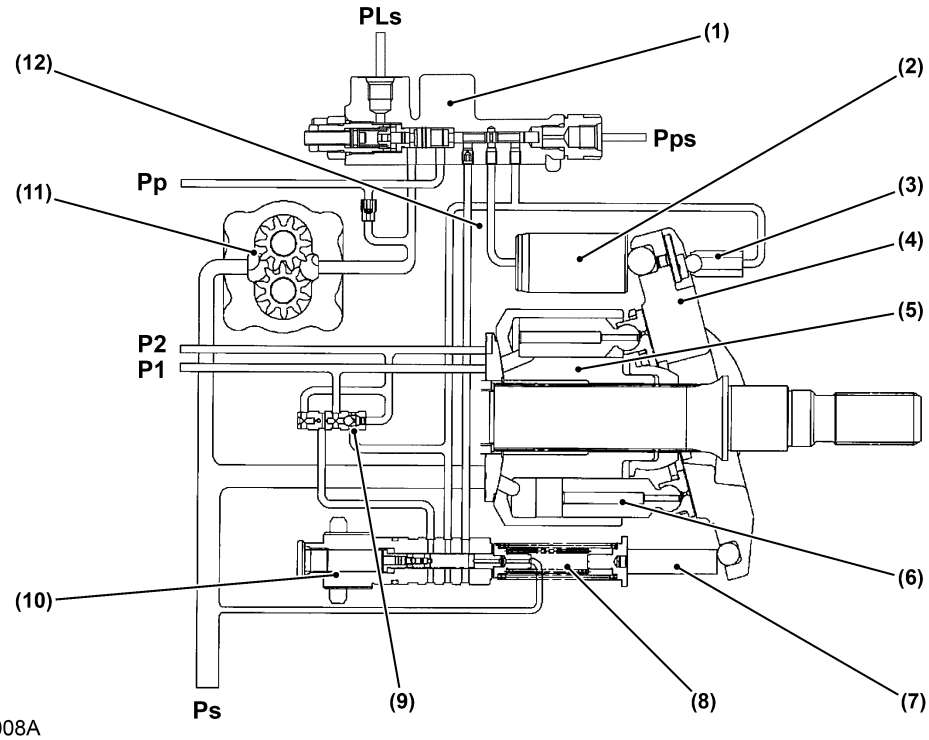


RY9212724HYM003A

P1 : Piston Pump Discharge Pressure 1
P2 : Piston Pump Discharge Pressure 2
PLS :Load Pressure
PPS :Valve Inlet Pressure
Pp : Pilot Pump Discharge Pressure
PS : Suction Pressure
CH1 :Air Bleed 1
CH2 :Air Bleed 2

RY9212724HYM0007US0

[3] PISTON PUMP CONFIGURATION DIAGRAM

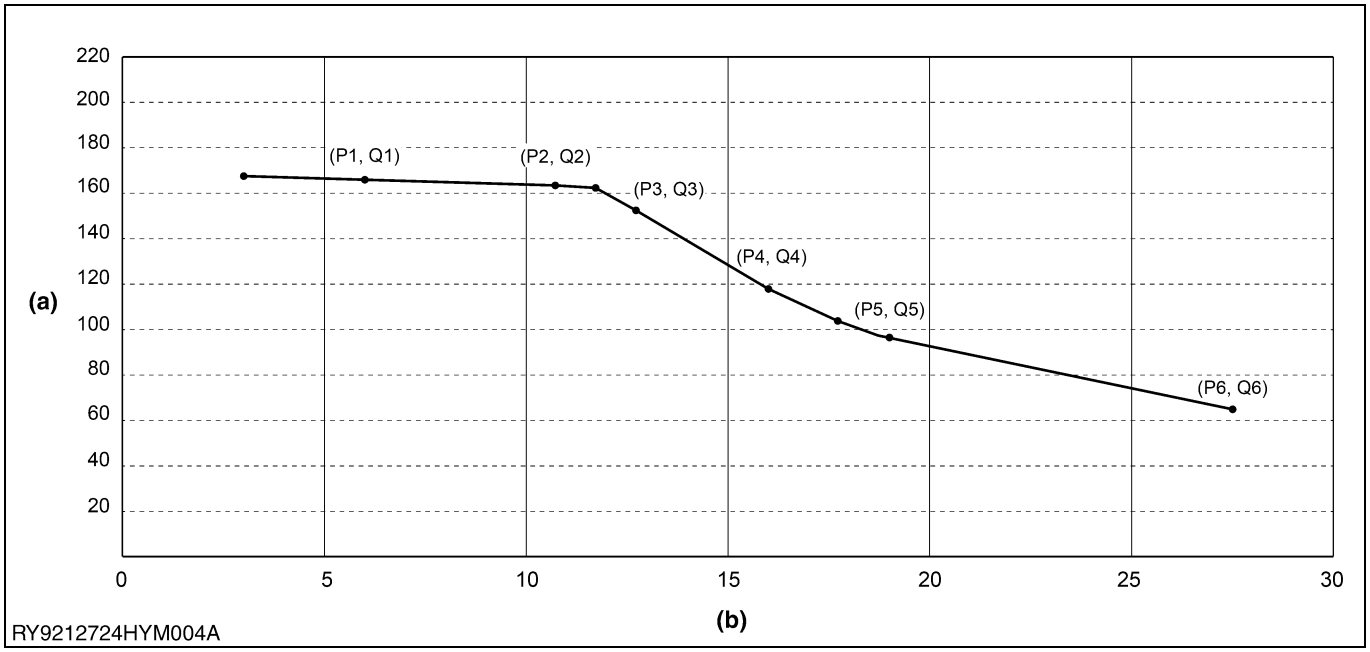


RY9212724HYM008A

(1) LS Regulator
(2) Control Pin
(3) Control Pin
(4) Swash-Plate
(5) Cylinder Block
(6) Piston
(7) Feedback Pin
(8) Horsepower Control Spring
(9) Intermediate Pressure Orifice and Pressure Selector Valve
(10) Horsepower Control Valve
(11) Pilot Pump

RY9212724HYM0015US0

[4] PISTON PUMP HORSEPOWER CONTROL CURVE



(a) Discharge Flow Rate: Q (Q1 + Q2) (L/min)

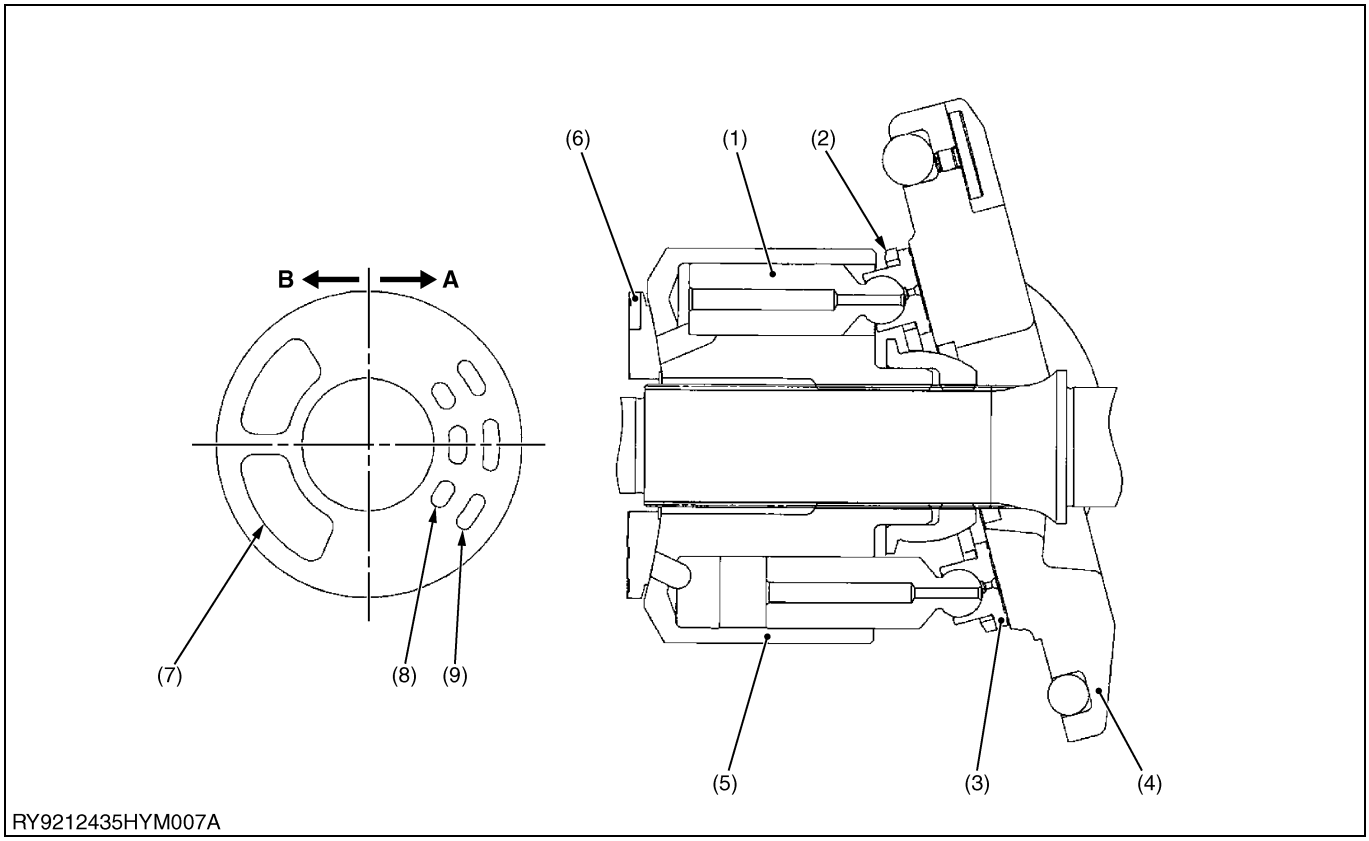
(b) Discharge Pressure: P (P1 = P2) (MPa)

Pump input RPM: 2000			
Discharge pressure	**Discharge flow rate**	**Discharge pressure**	**Discharge flow rate**
P1 = 6.0 MPa	166.0 ± 2.5 L/min	P4 = 16.2 MPa	117.9 ± 6.0 L/min
P2 = 10.7 MPa	163.5 ± 4.0 L/min	P5 = 19.2 MPa	97.4 ± 6.0 L/min
P3 = 12.7 MPa	152.5 ± 6.0 L/min	P6 = 27.4 MPa	64.9 ± 6.0 L/min

RY9212724HYM0008US0

[5] FUNCTION AND STRUCTURE

(1) Operating Principles



RY9212435HYM007A

(1) Piston
(2) Retainer Plate
(3) Shoe
(4) Swash-Plate
(5) Cylinder Block
(6) Valve Plate
(7) Suction Port
(8) P1 Discharge Port
(9) P2 Discharge Port

A : Discharge Side
B : Suction Side

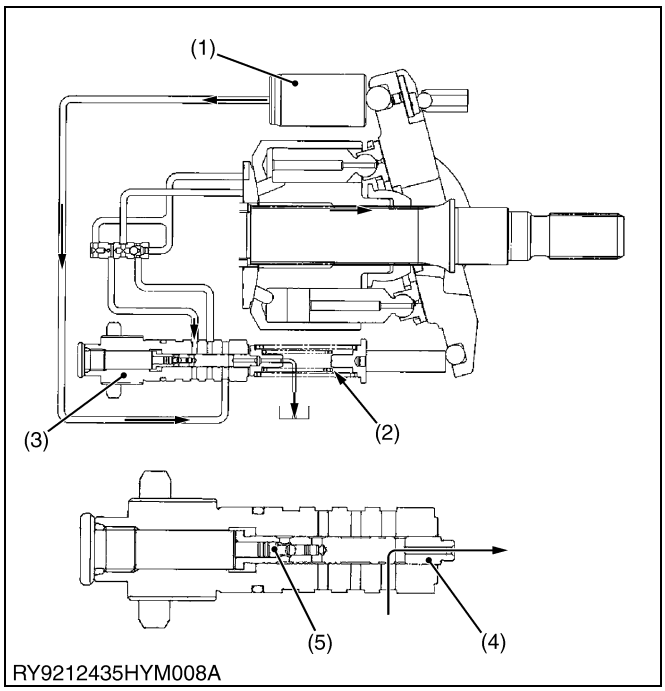
There are 10 pistons (1) built into the cylinder block (5) and it is coupled to the axle via a spline. Also, one end of the cylinder block is in contact with a valve plate (6), which has half-moon shaped ports (kidney ports); these two kidney ports are connected to suction and discharge ports respectively, so when the cylinder block rotates, the pistons are connected to the passage on the suction side for an interval of 180 degrees and to the discharge side for the remaining interval. There are shoes (3) crimped so they can rotate freely against the ball on the end of the piston and the retainer plate (2) presses them against the swash-plate(4). As a result, the shoes are always in contact with the swash-plate as it moves, so as the angle of the swash-plate changes, that translates into changes in the stroke of the piston and ultimately alters the amount of discharge from the pump. As a result of the cylinder block rotation, the side that is pressed into the cylinder block by the piston via the swash-plate is the discharge path. At this time the compressed chambers of the cylinder block are connected to the kidney ports on the discharge side A and the side where the pistons are being withdrawn become the suction path and are connected to the suction side kidney port. As a consequence, during the interval of one revolution of the cylinder block, each piston alternately provides suction at the suction port and then discharge at the discharge port. Thus smooth pump operation is achieved by having 10 pistons constantly alternating between suction and discharge.

RY9212435HYM0012US0

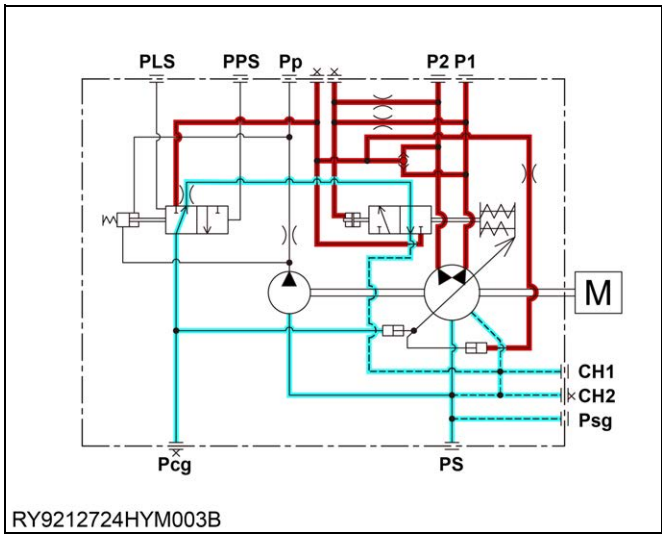
(2) Horsepower Control

Horsepower control is a matter of controlling the discharge flow of the piston pump in such a way that the total consumed horsepower (torque) of the pump does not exceed the specified horsepower (torque) of the engine.

RY9212174HYM0005US0



RY9212435HYM008A



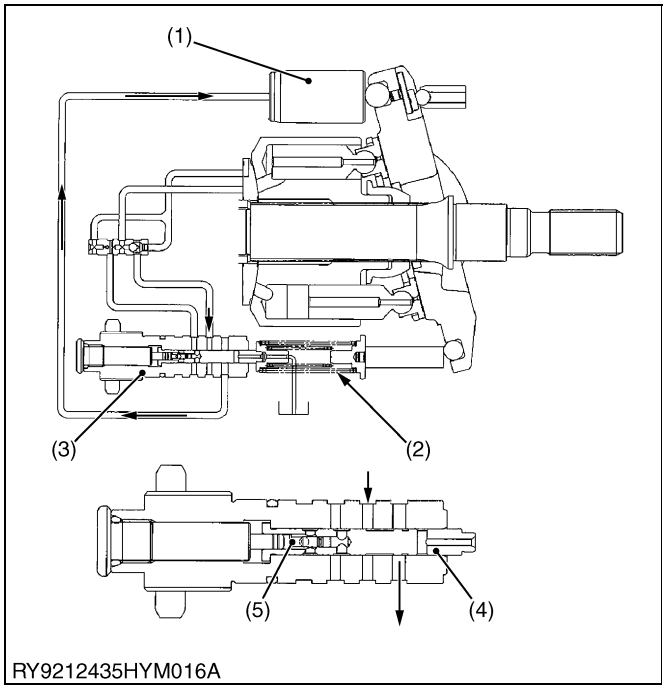
RY9212724HYM003B

1. When pressure P is low (when the load is low)

The horsepower control spool (4) is positioned at the far left, thus connecting the control pin (1) to the tank via the horsepower control spool (4). Consequently, there is no force on the control pin (1), which results in the maximum swash-plate tilt angle and discharge flow.

(1) Control Pin
(2) Horsepower Control Spring
(3) Horsepower Control Valve
(4) Horsepower Control Spool
(5) Reaction Pin

RY9212724HYM0009US0



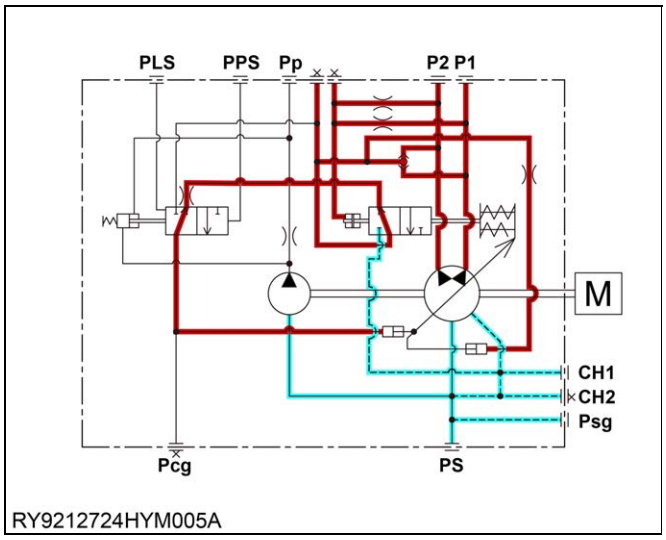
RY9212435HYM016A

2. When pressure P increases (when the load increases)

When the piston pump discharges pressure P rises due to the load, the horsepower control spool (4) in the middle of the diagram moves to the right. This connects discharge pressure P to the control pin (1), creating pressure on the control pin (1) and thus reducing the swash-plate tilt angle and reducing discharge flow. When the swash-plate tilt angle is reduced, the horsepower control spring (2) returns the horsepower control spool (4) to the left, cutting off the connection between discharge pressure P and the control pin and this results in a balance of pressure.

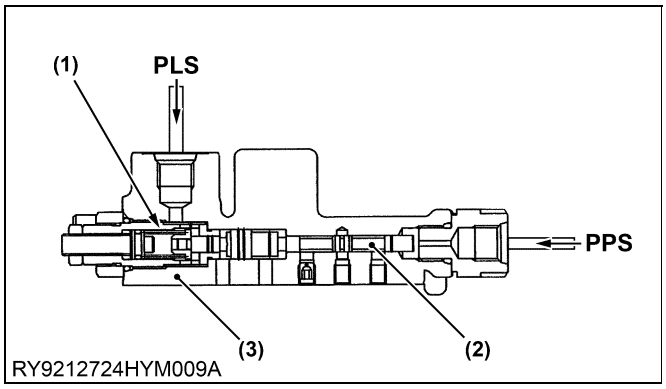
(1) Control Pin
(2) Horsepower Control Spring
(3) Horsepower Control Valve
(4) Horsepower Control Spool
(5) Reaction Pin

RY9212724HYM0010US0



RY9212724HYM005A

(3) Flow Control (LS Control)

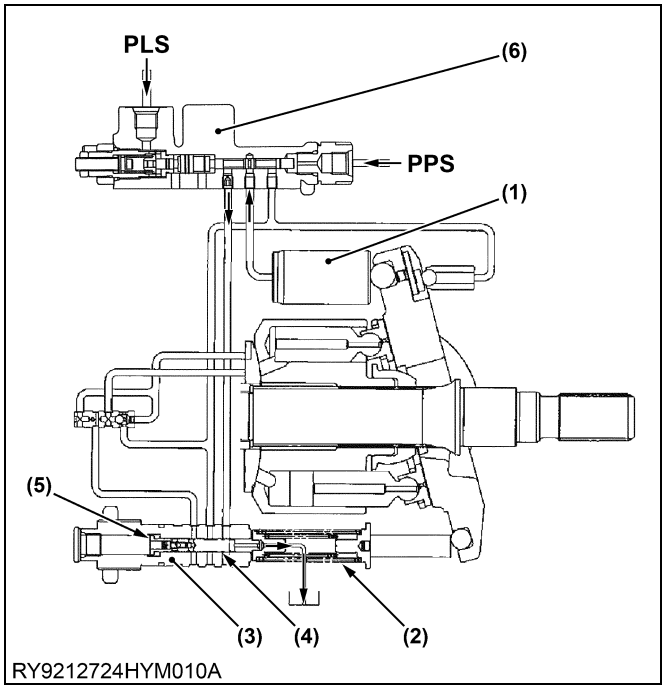


RY9212724HYM009A

LS control supplies the pressure and flow needed for a given load by controlling the pump's discharge pressure and flow so that pump discharge pressure PPS = load pressure PLS + spring pressure.

(10) Spring
(11) Spool
(12) LS Regulator

RY9212724HYM0016US0



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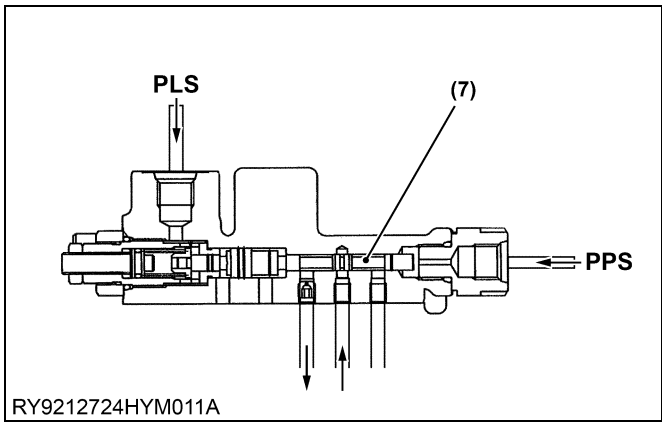

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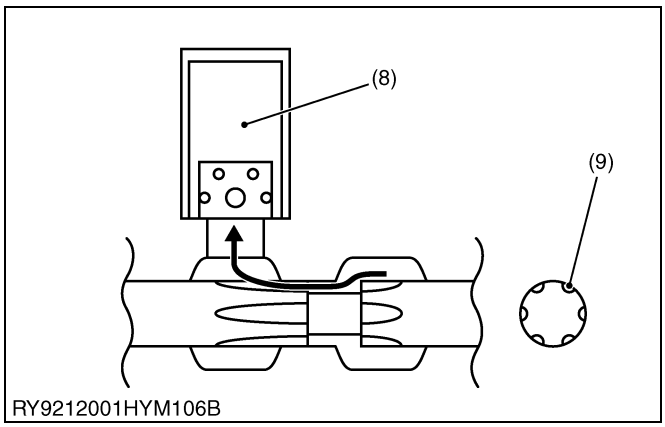
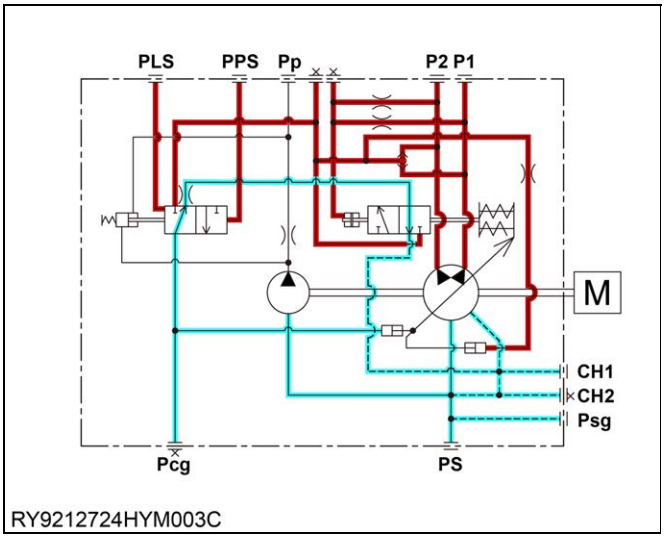


RY9212001HYM106B

1. When the control valve is open wide

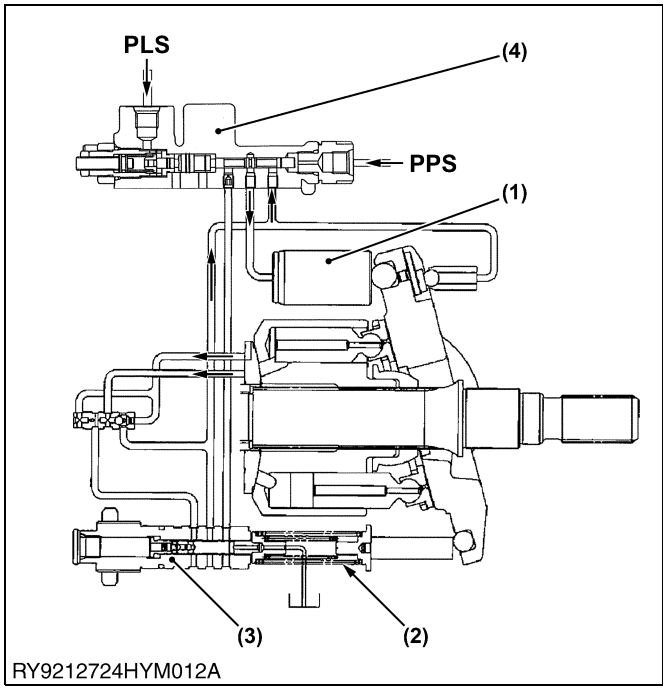
If the control valve is opened wide (9) in order to quickly actuates the actuator, the pressure differential between the pump discharge pressure P and the load pressure drops temporarily, moving the spool (7) of the LS regulator (6) to the right; this connects the control pin (1) to the horsepower control valve (3). When this happens, the horsepower control spool (4) moves to the left, connecting the control pin (1) to the tank, thus increasing the swash-plate tilt angle and increasing discharge flow. This equalizes the differential pressure and moves the LS regulator spool back to the left.



RY9212724HYM003C

(1) Control Pin
(2) Horsepower Control Spring
(3) Horsepower Control Valve
(4) Horsepower Control Spool
(5) Reaction Pin
(6) LS Regulator
(7) Spool
(8) Compensator Spool
(9) Opening Area

RY9212724HYM0011US0



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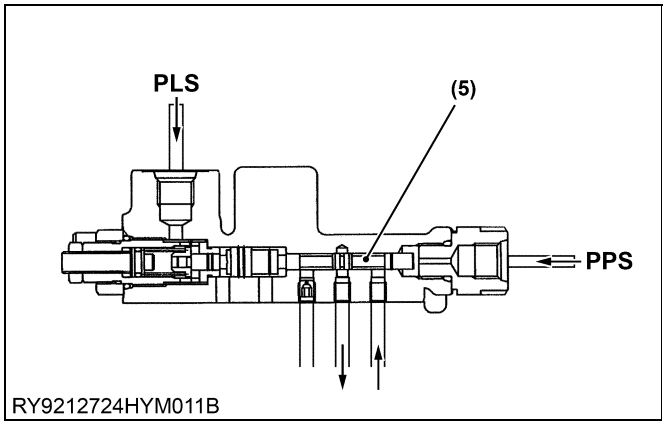

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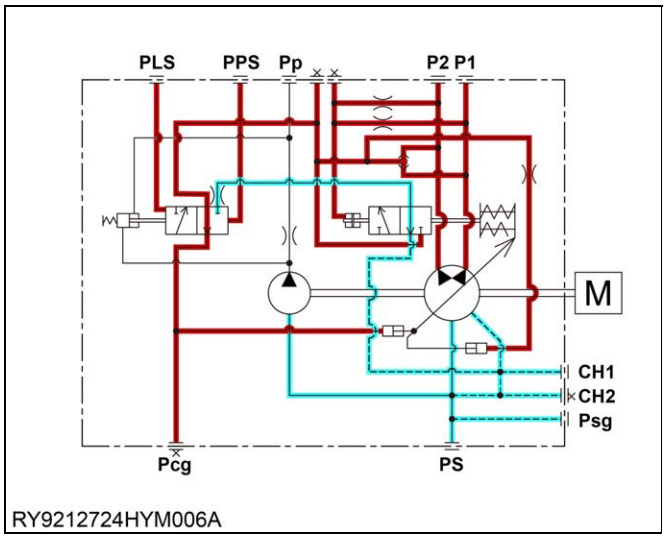


RY9212724HYM006A

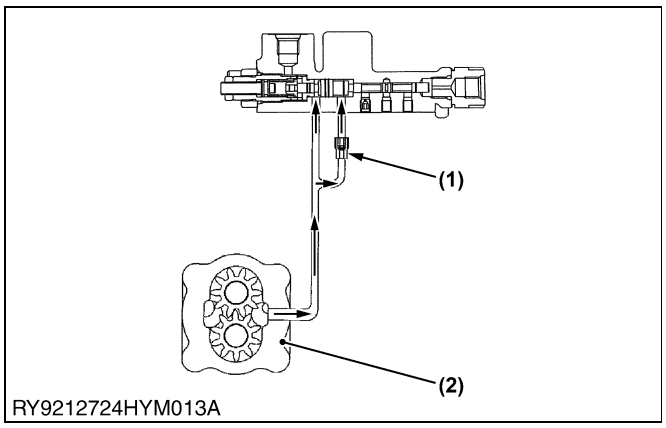
2. When the control valve is slightly open

When the control valve is only slightly open, it produces a large difference in pressure between the pump discharge pressure P and the load pressure, so the spool (5) of the LS regulator (4) moves to the left and the discharge pressure P and the control pin (1) are connected. When this happens, it creates pressure on the control pin, thus reducing the swash-plate tilt angle and reducing the discharge flow.

(1) Control Pin
(2) Horsepower Control Spring
(3) Horsepower Control Valve
(4) LS Regulator
(5) Spool

RY9212724HYM0012US0

(4) Gain Control

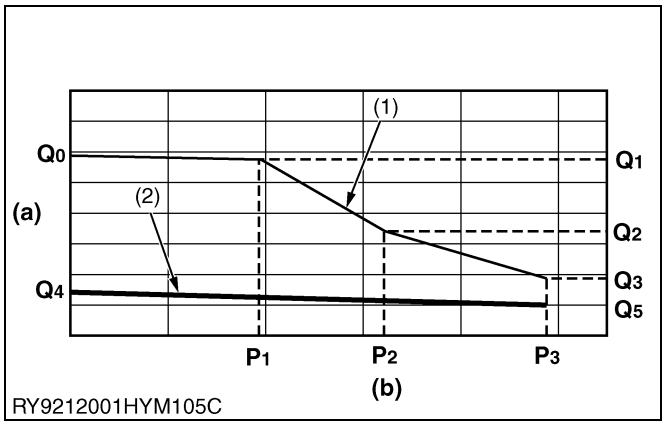


There is an orifice (1) in the discharge circuit of the pilot pump (2) that leads to the spool of the LS regulator for differential pressures that arise from acceleration in engine RPM. This orifice makes it possible to control pump discharge pressure and flows so that pump discharge pressure PPS = load pressure PLS + spring pressure + differential pressure. In other words, it changes the PPS and PLS differential pressure control from a constant control to a variable control and enables the proportional flow control of the engine RPM by how wide the same control valve is open.

(1) Orifice
(2) Gear Pump (Pilot Pump)

RY9212724HYM0017US0

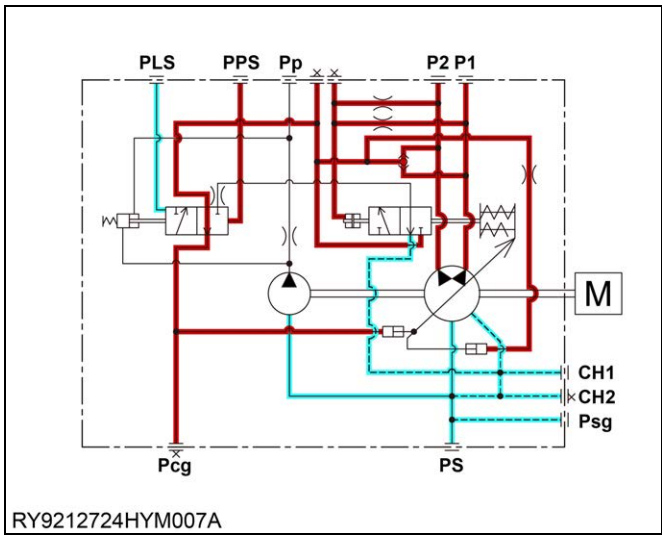
(5) Standby Flow Amount



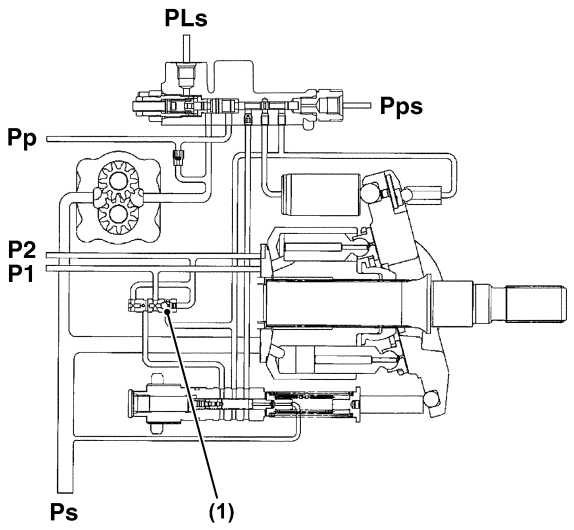
A standby flow volume is established so that oil is always flowing in the hydraulic system, even when idling. Because oil is always flowing to the oil cooler, it is possible to lower the oil temperature. The control valve is in a center closed circuit, so when all the sections are in neutral, the operating oil returns to the tank via an unload valve.

(1) Horsepower Control Curve
(2) Standby Flow Amount
(a) Discharge Flow
(b) Discharge Pressure

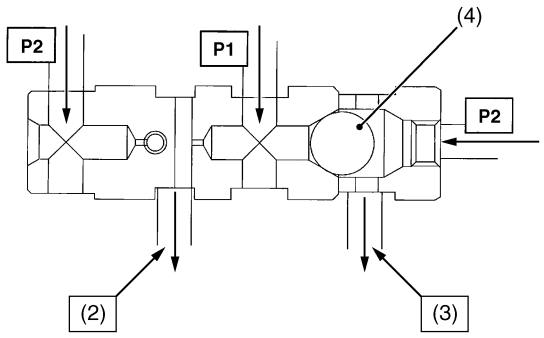
RY9212724HYM0013US0



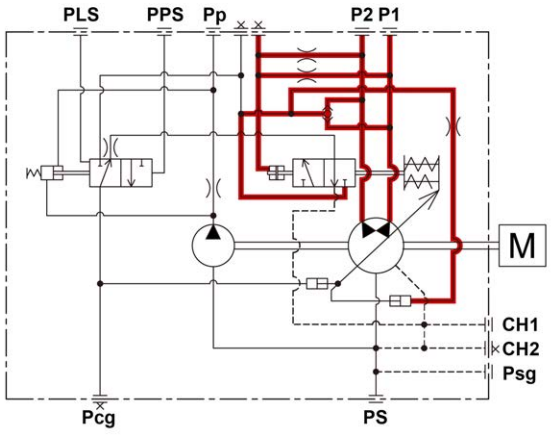
(6) Orifice for P1 + P2 Average Pressure and High Pressure Selector Valve



RY9212724HYM014A



RY9212435HYM027A



RY9212724HYM003D

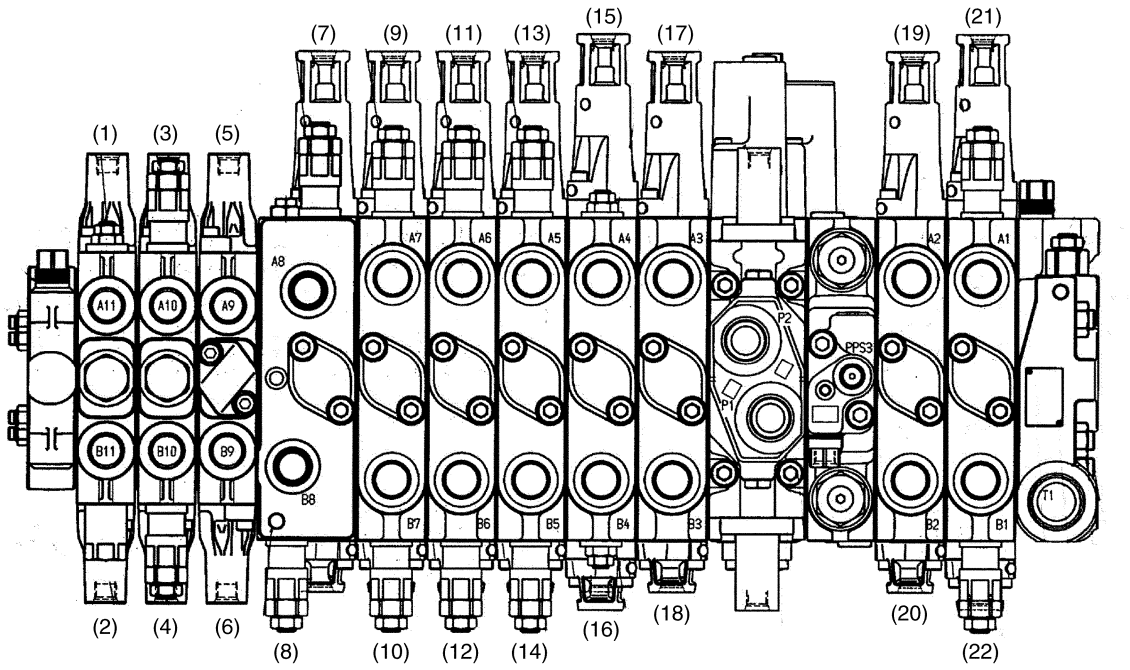
Delivery pressure goes to HP control valve through the orifice make the average pressure between P1 and P2 and the pressures selector valve. The average pressure goes to the reaction force pin into HP control valve. The selected pressure is used as the source of the control pressure.

(1) Orifice for P1 + P2 Average Pressure and High Pressure Selector Valve
(2) Average Pressure→Hosepower Control Valve (Reaction Pin)
(3) Selective Pressure→Hosepower Control Valve
(4) Steel Ball

RY9212724HYM0014US0

4. CONTROL VALVE

[1] SPECIFICATION (STANDARD)



RY9212435HYM021A

(1) Swing Left (Pa11)
(2) Swing Right (Pb11)
(3) AUX2 Low (Pa10)
(4) AUX2 High (Pb10)
(5) Swivel Left (Pa9)
(6) Swivel Right (Pb9)
(7) Boom Up (Pa8)
(8) Boom Down (Pb8)
(9) Bucket Crowd (Pa7)
(10) Bucket Dump (Pb7)
(11) Arm Dump (Pa6)
(12) Arm Crowd (Pb6)
(13) AUX1 Low (Pa5)
(14) AUX1 High (Pb5)
(15) Blade Down (Pa4)
(16) Blade Up (Pb4)
(17) Travel R Forward (Pa3)
(18) Travel R Rear (Pb3)
(19) Travel L Forward (Pa2)
(20) Travel L Rear (Pb2)
(21) Blade Down (Pa1)
(22) Blade Up (Pb1)

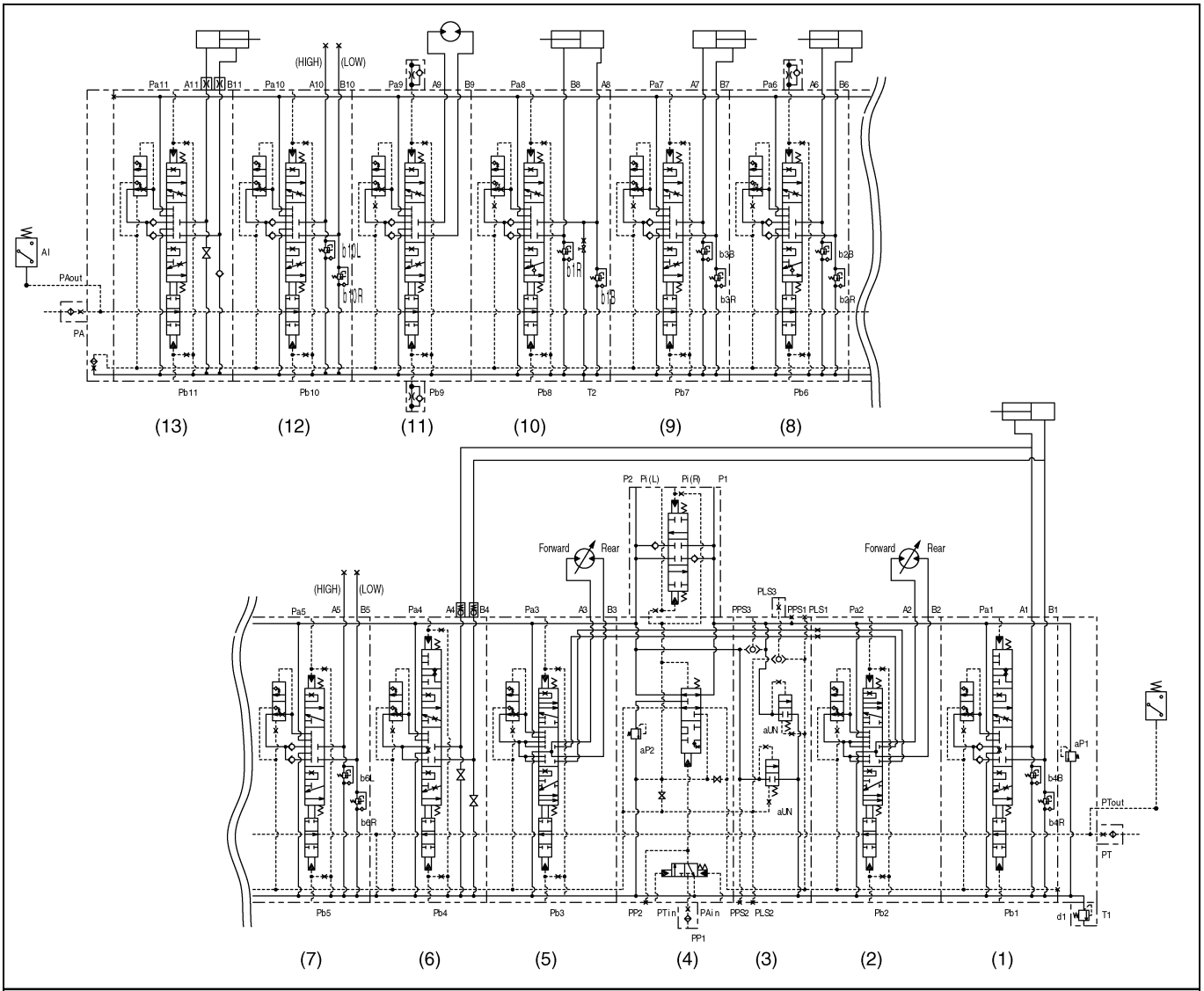
(To be continued)

(Continued)

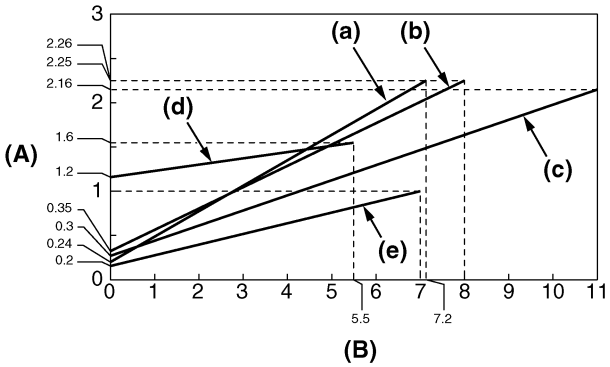
Category				Info.
Manufacturer			KYB corp.	
Model			KVSX-18-14	
Main relief valve setting pressure	P1 (aP1) P2 (aP2)		27.4 MPa 279 kgf/cm^2 3974 psi	72 L/min 4394 cu.in./min 19 U.S.gals/min
	Unload LS (aUN)		2.20 MPa 22.4 kgf/cm^2 319 psi	15 L/min 915 cu.in./min 4.0 U.S.gals/min
Overload relief valve setting pressure	Boom	b1B b1R	31.4 MPa 320 kgf/cm^2 4554 psi	5 L/min 305 cu.in./min 1.3 U.S.gals/min
	Arm	b2B b2R	31.4 MPa 320 kgf/cm^2 4554 psi	
	Bucket	b3B b3R	31.4 MPa 320 kgf/cm^2 4554 psi	
	Blade	b4B	34.3 MPa 350 kgf/cm^2 4974 psi	
		b4R	17.2 MPa 175 kgf/cm^2 2495 psi	
	AUX1	b6L b6R	20.6 MPa 210 kgf/cm^2 2988 psi	
	AUX2	b10L b10R	20.6 MPa 210 kgf/cm^2 2988 psi	

RY9212435HYM0021US0

Hydraulic Circuit



A



RY9212435HYM022A

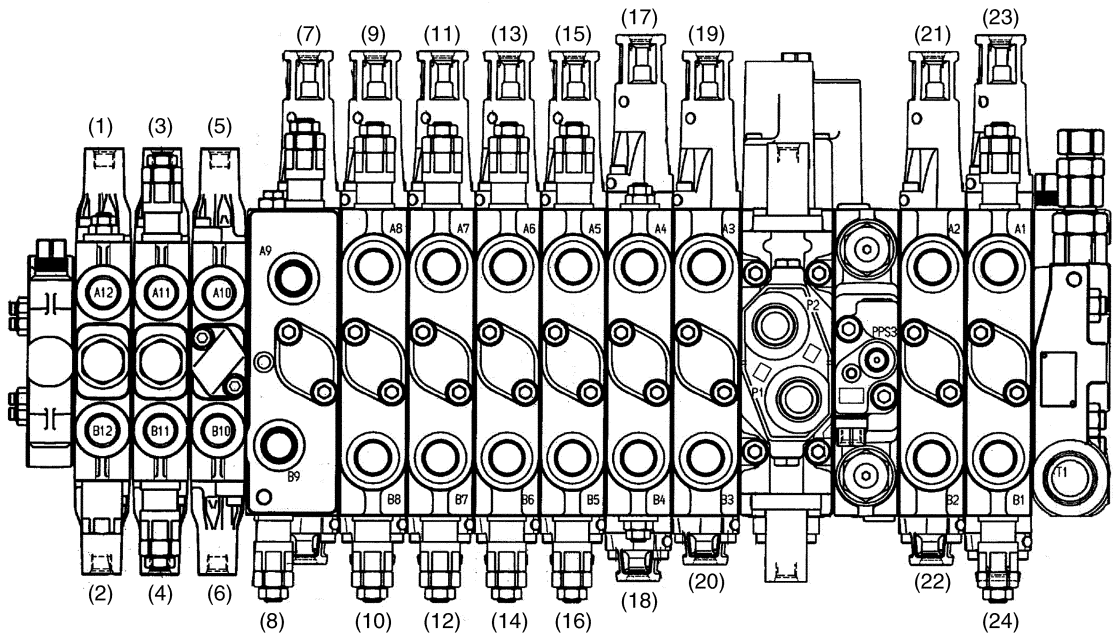
(1) Blade1
(2) Travel Left
(3) High Pressure Select
(4) Travel Independent
(5) Travel Right
(6) Blade2
(7) AUX1
(8) Arm
(9) Bucket
(10) Boom
(11) Swivel
(12) AUX2
(13) Swing

(a) Swivel, Swing, AUX2 (2.26 MPa)
(b) Travel, AUX1, Arm, Bucket, Boom (2.25 MPa)
(c) Blade (2.16 MPa)
(d) Travel Independent
(e) High Pressure Select

A : Pilot Pressure Characteristics
(A) Pilot Pressure (MPa)
(B) Spool Stroke (mm)

RY9212724HYM0001US0

[2] SPECIFICATION (TWO PIECE BOOM)



RY9212435HYM020A

(1) Swing Left (Pa12)
(2) Swing Right (Pb12)
(3) AUX2 Low (Pa11)
(4) AUX2 High (Pb11)
(5) Swivel Left (Pa10)
(6) Swivel Right (Pb10)
(7) Boom Up (Pa9)
(8) Boom Down (Pb9)
(9) Two Piece Boom (Pa8)
(10) Two Piece Boom (Pb8)
(11) Bucket Crowd (Pa7)
(12) Bucket Dump (Pb7)
(13) Arm Dump (Pa6)
(14) Arm Crowd (Pb6)
(15) AUX1 Low (Pa5)
(16) AUX1 High (Pb5)
(17) Blade Down (Pa4)
(18) Blade Up (Pb4)
(19) Travel R Forward (Pa3)
(20) Travel R Rear (Pb3)
(21) Travel L Forward (Pa2)
(22) Travel L Rear (Pb2)
(23) Blade Down (Pa1)
(24) Blade Up (Pb1)

(To be continued)

(Continued)

Category				Info.
Manufacturer			KYB corp.	
Model			KVSX-18-14	
Main relief valve setting pressure	P1 (aP1) (variable relief valve)	Front attachment	27.4 MPa 279 kgf/cm^2 3974 psi	72 L/min 4394 cu.in./min 19 U.S.gals/min
		Travel blade	29.4 MPa 300 kgf/cm^2 4264 psi	
	P2 (aP2)	Travel	29.4 MPa 300 kgf/cm^2 4264 psi	
	Unload LS (aUN)		2.20 MPa 22.4 kgf/cm^2 319 psi	15 L/min 915 cu.in./min 4.0 U.S.gals/min
Overload relief valve setting pressure	Boom	b1B b1R	31.4 MPa 320 kgf/cm^2 4554 psi	5 L/min 305 cu.in./min 1.3 U.S.gals/min
	Arm	b2B b2R	31.4 MPa 320 kgf/cm^2 4554 psi	
	Bucket	b3B b3R	31.4 MPa 320 kgf/cm^2 4554 psi	
	Blade	b4B	34.3 MPa 350 kgf/cm^2 4974 psi	
		b4R	17.2 MPa 175 kgf/cm^2 2495 psi	
	AUX1	b6L b6R	20.6 MPa 210 kgf/cm^2 2988 psi	
	Two piece boom	b7L b7R	34.3 MPa 350 kgf/cm^2 4974 psi	
	AUX2	b10L b10R	20.6 MPa 210 kgf/cm^2 2988 psi	

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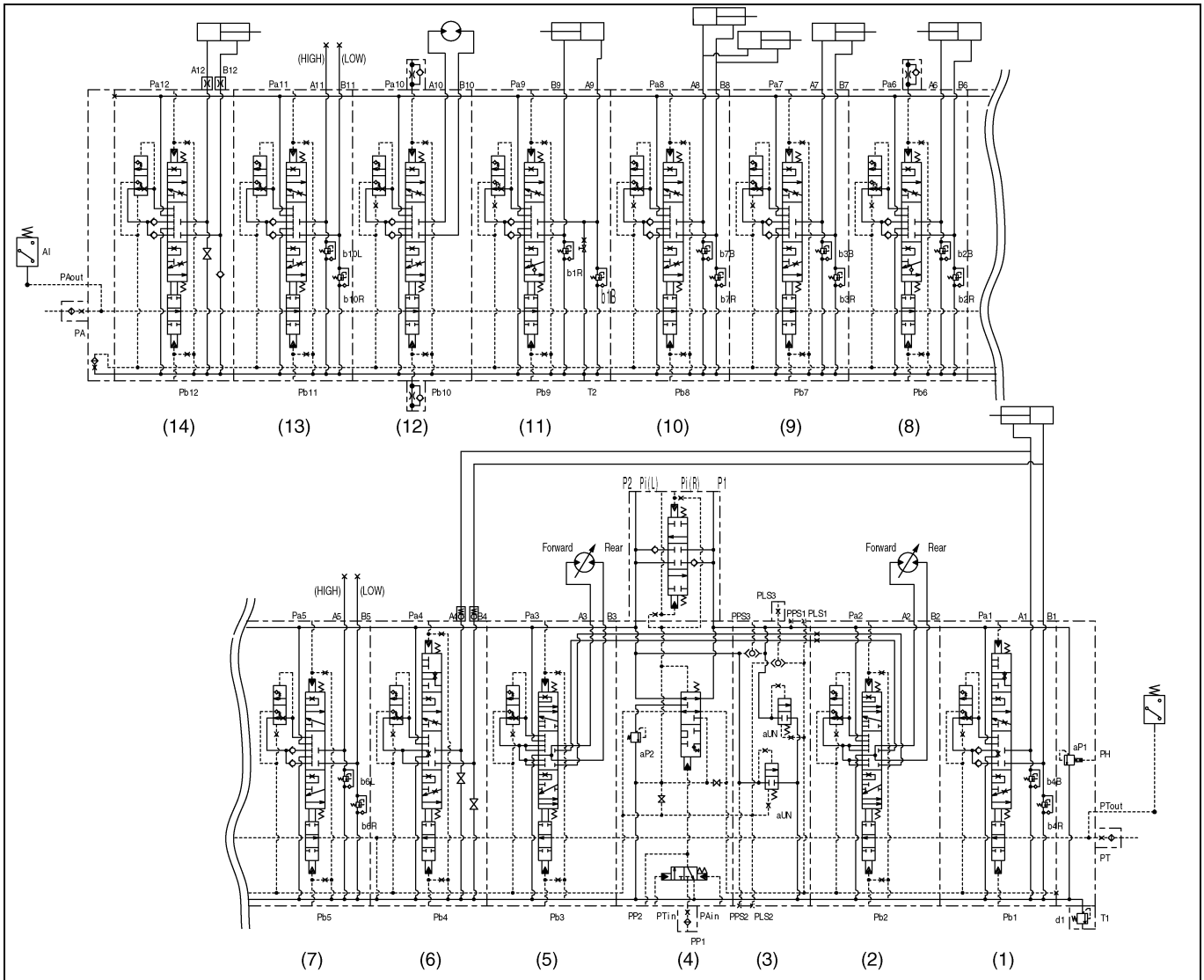
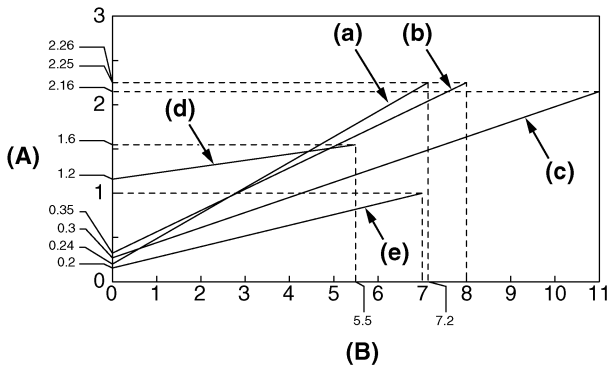
Hydraulic Circuit (Two Piece Boom Spec.)



A



RY9212435HYM019A

(1) Blade1
(2) Travel Left
(3) High Pressure Select
(4) Travel Independent
(5) Travel Right
(6) Blade2
(7) AUX1
(8) Arm
(9) Bucket
(10) Two Piece Boom
(11) Boom
(12) Swivel
(13) AUX2
(14) Swing

(a) Swivel, Swing, AUX2 (2.26 MPa)
(b) Travel, AUX1, Bucket, Two Piece Boom (2.25 MPa)
(c) Blade (2.16 MPa)
(d) Travel Independent
(e) High Pressure Select

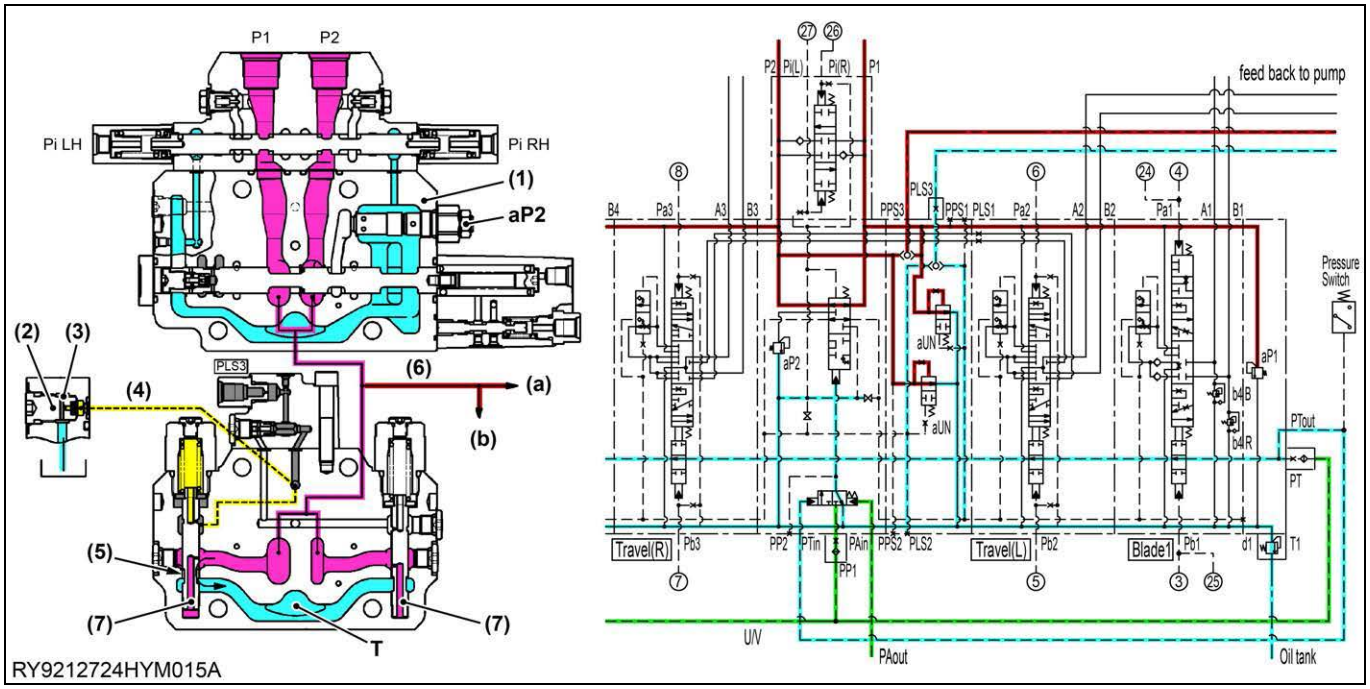
A : Pilot Pressure Characteristics
(A) Pilot Pressure (MPa)
(B) Spool Stroke (mm)

RY9212435HYM0024US0

[3] FUNCTION AND STRUCTURE

(1) Unload Valve Section

When in neutral



(1) Independent Travel Valve Section
(2) LS Drain Plug
(3) Micro-Orifice
(4) PLS Pressure Passage
(5) Notch
(6) PPS Pressure Passage
(7) Unload Spool

(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump

- Pump discharge pressure PPS and maximum load pressure PLS act on either end of the unload spool.
- The PLS pressure passage (4) is connected to the tank circuit via the micro-orifice (3) in the LS drain plug (2).
- When the spool section is in neutral, no PLS pressure is generated, so PLS=tank pressure ≈ 0 and only spring pressure (unload valve setting pressure) acts on the upper side of the unload spool.
- Hydraulic oil that flows in from the pump ports P1 and P2 is combined inside the independent travel valve section (1) and guided to the pump pressure passage, but when a spool section is in neutral, the pump pressure passage is stopped and pump discharge pressure PPS rises.
- When pump discharge pressure PPS rises to the unload valve setting pressure, the unload spool moves to the upper side, and the pump pressure passage is connected to the tank circuit via the notch (5) in the unload spool. This mechanism maintains the pump pressure passage PPS at the unload valve setting pressure.
- The unload valve is set at a pressure somewhat higher than the LS control differential pressure value set for the pump, so the pump maintains it at standby flow rate discharge status (fixed flow rate).

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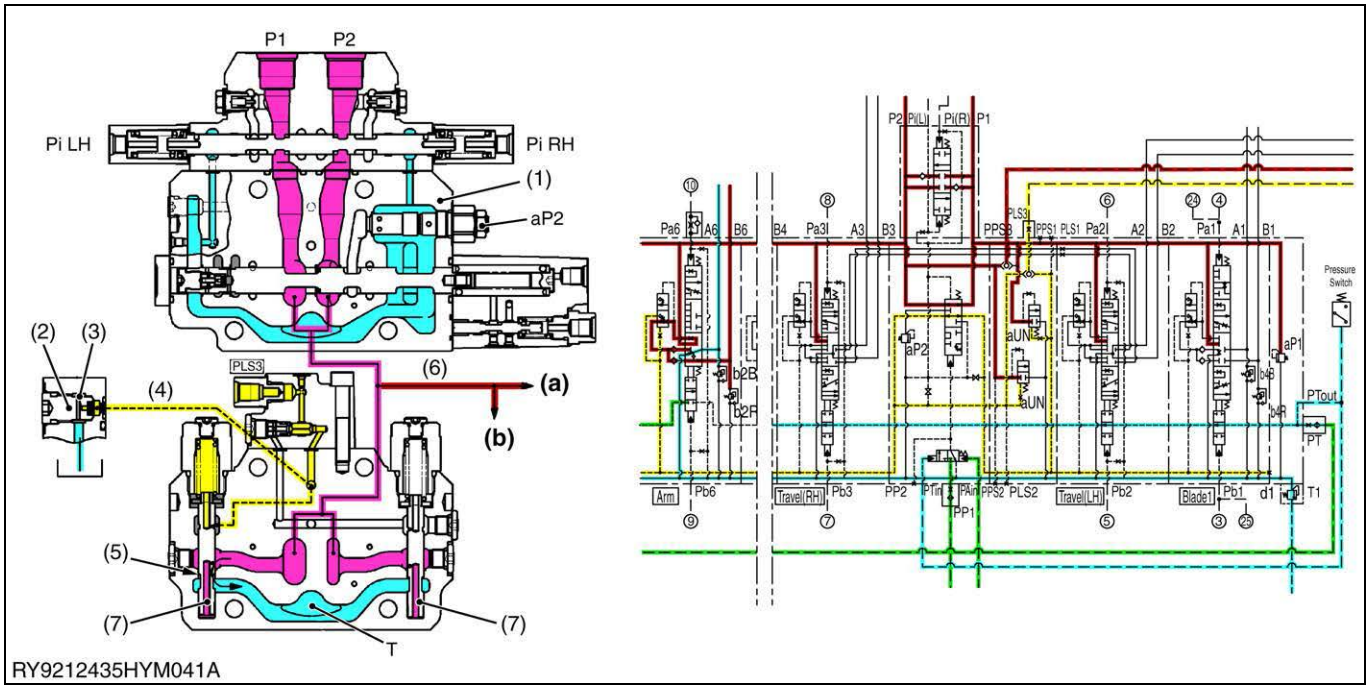
During fine operation of spool section



(1) Independent Travel Valve Section
(2) LS Drain Plug
(3) Micro-Orifice
(4) PLS Pressure Passage
(5) Notch
(6) PPS Pressure Passage
(7) Unload Spool
(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump

- When the spool section is switched, the oil in the pump pressure passage passes through the main spool and is discharged to the cylinder port. The operating load pressure of the cylinder port is guided from inside the spool section to the PLS pressure passage (4) and becomes the PLS pressure (Refer to the explanation of how the spool section operates).
- As long as the amount switched from the spool section is small (fine operation), the open area of the spool section becomes also small, so it increases the pressure differential (PPS-PLS) between the pump pressure PPS and PLS.
- Once the pressure differential (PPS-PLS) between the pump pressure PPS and PLS reaches the unload valve setting pressure, the unload spool moves to the lower side, automatically adjusting the open area in the notch between the pump pressure passage and the tank passage, thus maintaining a steady pressure differential (PPS-PLS) between the pump pressures PPS and PLS.
- The mechanism described above maintains a constant pressure differential (PPS-PLS) between the pump pressures PPS and PLS, even when there is a change in the spool section operating load pressure.
- The unload valve is set at a pressure somewhat higher than the LS control differential pressure value set for the pump, so the pump maintains it at standby flow rate discharge status (fixed flow rate).

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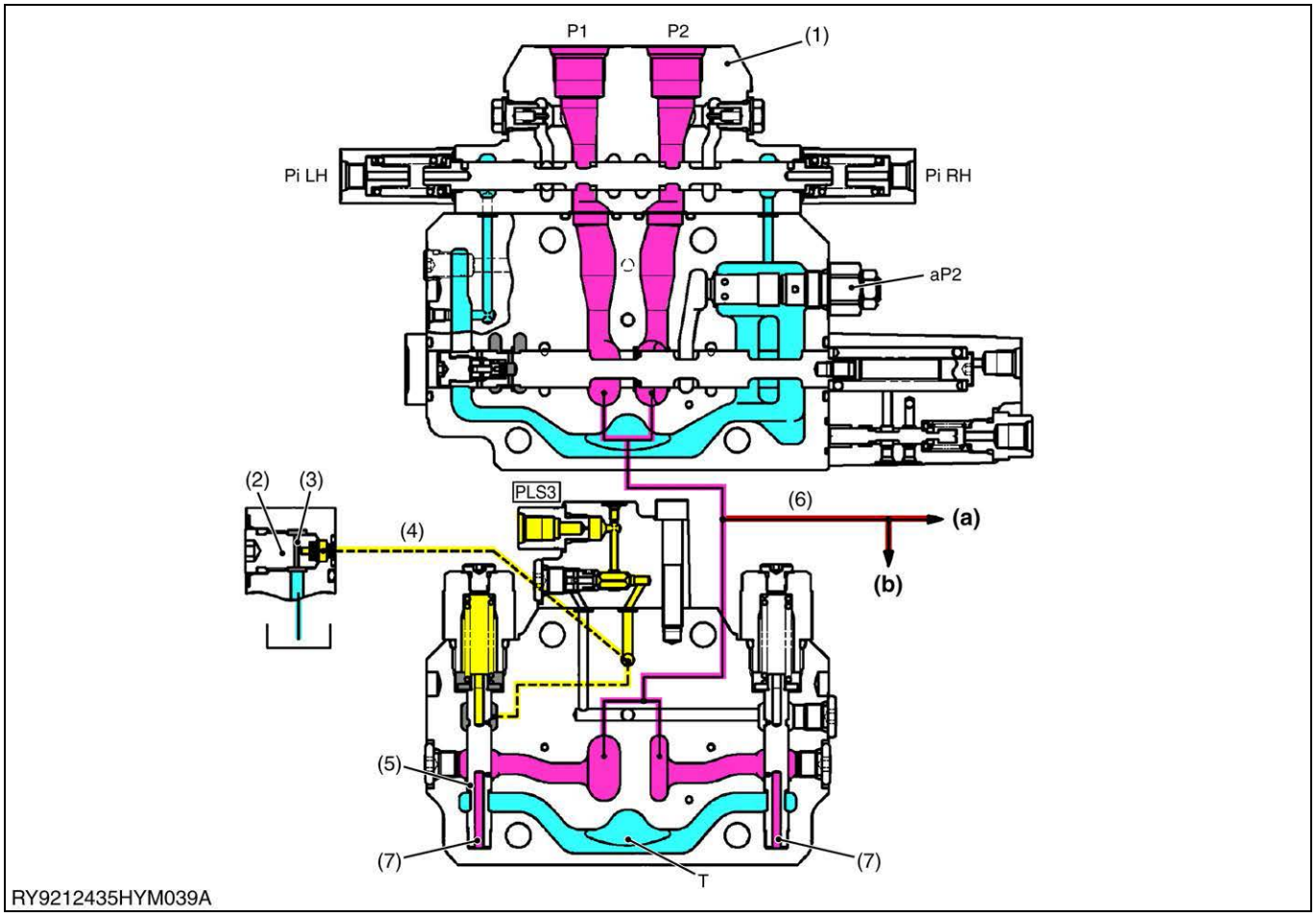
During operation of spool section



(1) Travel Bypass Valve
(2) LS Drain Plug
(3) Micro-Orifice
(4) PLS Pressure Passage
(5) Notch
(6) PPS Pressure Passage
(7) Unload Spool
(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump

- When the spool section is switched, the oil in the pump pressure passage passes through the main spool and is discharged to the cylinder port. The operating load pressure of the cylinder port is guided from inside the spool section to the PLS pressure passage (4) and becomes the PLS pressure (Refer to the explanation of how the spool section operates).
- When the amount switched from the spool section is great, the area of the spool section that opens is large, so it reduces the pressure differential (PPS-PLS) between the pump pressure PPS and PLS.
- When the pressure differential (PPS-PLS) between the pump pressure PPS and PLS drops to the unload valve setting pressure, the unload spool moves to the lower side, closing the opening at the notch between the pump pressure passage and the tank circuit, thus completely closing the unload spool.
- If the pressure differential (PPS-PLS) between the pump pressure PPS and PLS drops further to the LS limit pressure differential setting set for the pump, it increases the pump's swash-plate tilt angle, thus increasing the pump's discharge flow rate.
- The pump automatically changes the discharge flow rate according to the amount the spool section is switched and changes in the operating load pressure, thus limiting it to maintain a constant differential pressure (PPS-PLS) between the pump pressure PPS and PLS.

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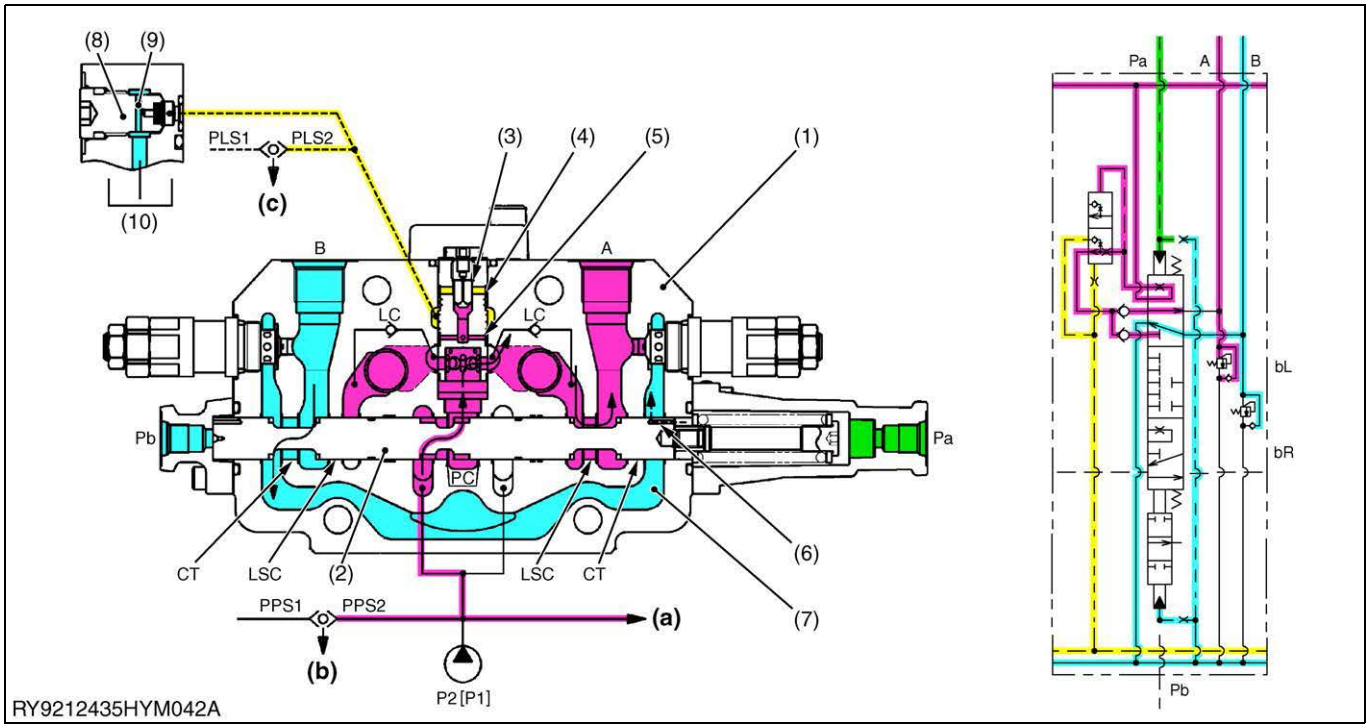
(2) Spool Section Operation (AUX1, Bucket, Two Piece Boom)

When Pa port pressurized



(1) (AUX1, Bucket, Two Piece Boom) Section
(2) Main Spool
(3) Shuttle Poppet
(4) Compensator Spool
(5) LS Pressure Introduction Orifice
(6) Air Bleed Micro-Orifice
(7) Tank Circuit
(8) LS Drain Plug
(9) Micro-Orifice
(10) Tank Circuit
(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump
(c) From PLS3 Port to the Variable Pump

- When the spool is shifted by the Pa port pressure, the pump pressure PPS is guided to cylinder port A via the main spool PC notch, compensator spool notch, the left load check and the main spool LSC notch.
- When the Pa port is pressurized, part of the hydraulic oil flow passes through the air bleed micro-orifice and returns to the tank circuit.
- The pressure (load pressure) in the load check upstream passage is guided to the PLS pressure circuit via the valve housing LS pressure guide and high pressure selector plate, becoming the PLS pressure; it is then guided to the pump as the PLS signal pressure from the PLS port.
- The pressure PPS in the pump pressure passage is guided to the pump from the PPS port as the pump signal pressure.
- Oil flowing back from the actuator is guided from cylinder port A to the tank circuit via the main spool CT notch.
- It flows in the reverse direction when the Pb port is pressurized.

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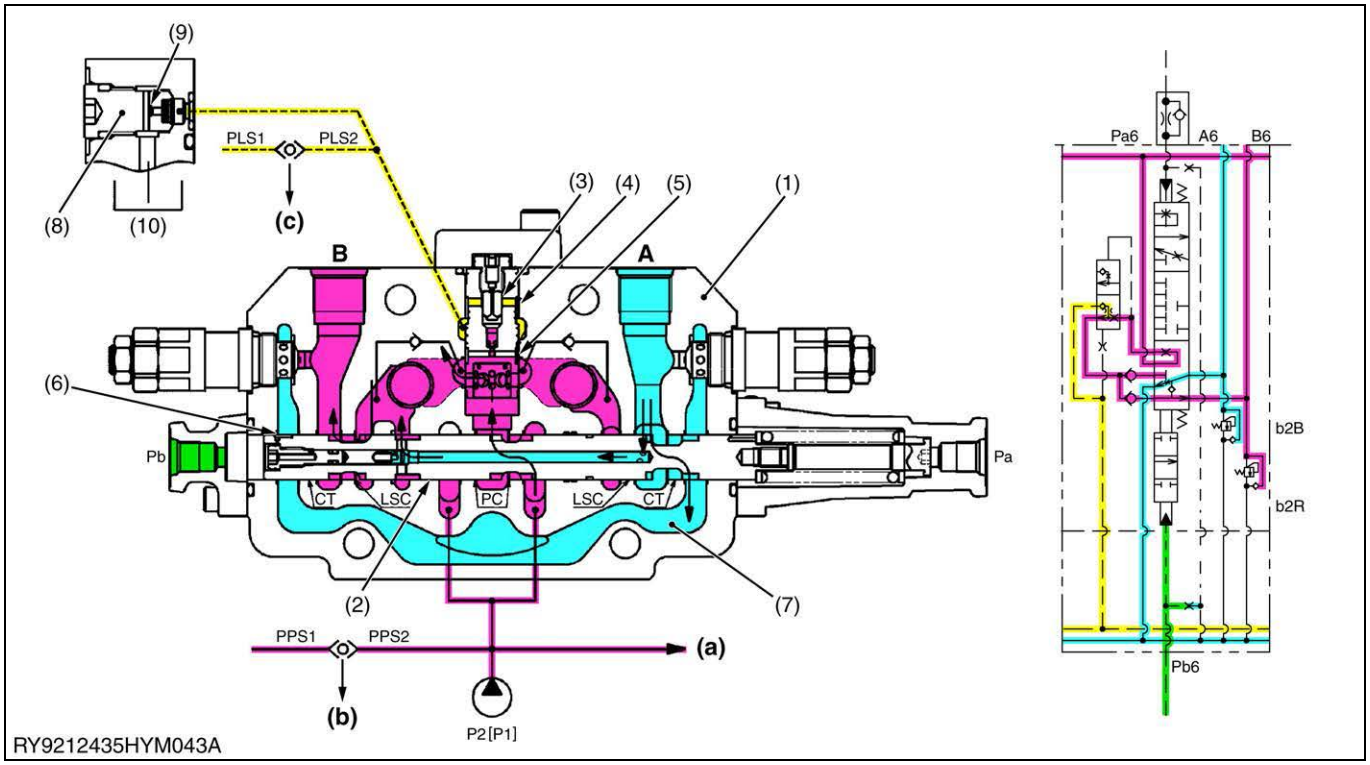
(3) Arm Regeneration Function



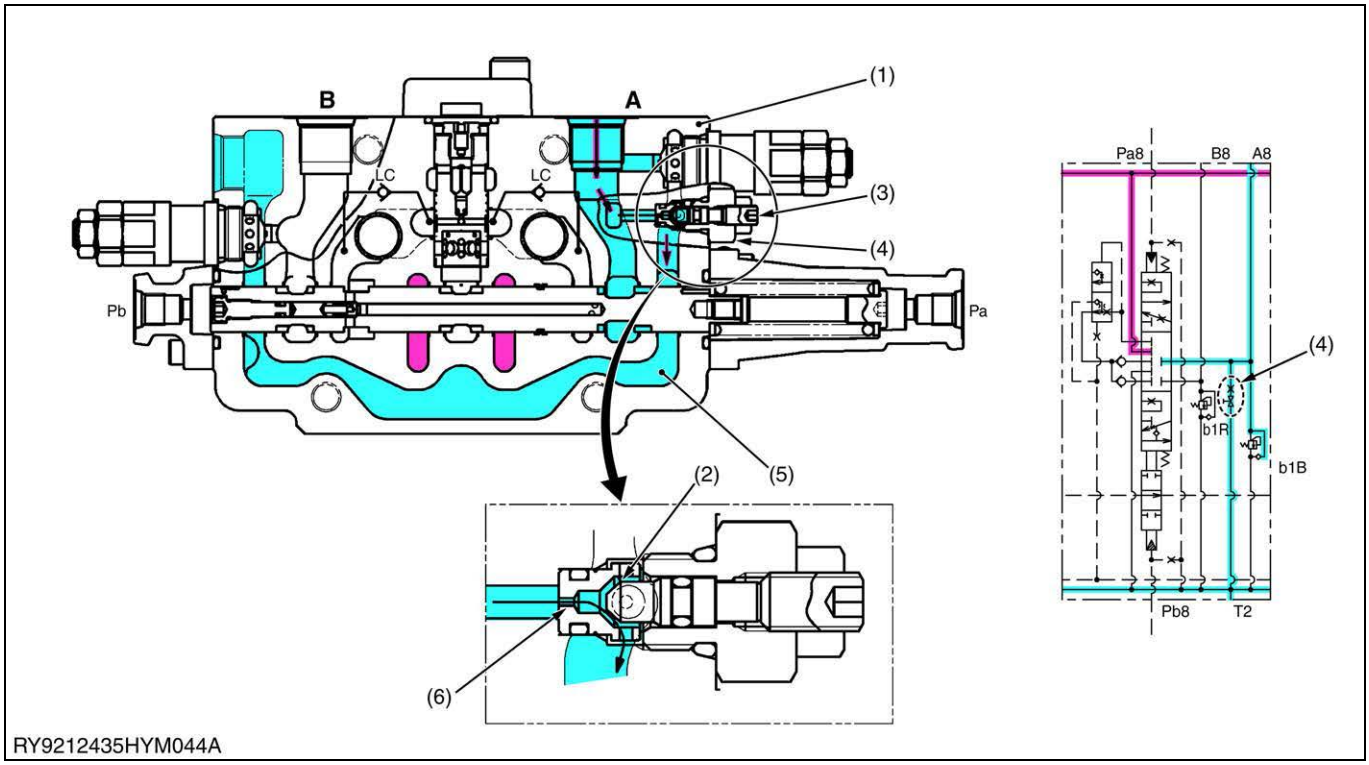
(1) Arm Section
(2) Main Spool
(3) Shuttle Poppet
(4) Compensator Spool
(5) LS Pressure Introduction Orifice
(6) Air Bleed Micro-Orifice
(7) Tank Circuit
(8) LS Drain Plug
(9) Micro-Orifice
(10) Tank Circuit
(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump
(c) From PLS3 Port to the Variable Pump

- When the main spool is shifted by Pb6 port pressurization, the supply oil from the pump pressure flows to the cylinder port B via the main spool PC notch, the compensator spool, and the main spool LSC notch.
- When the port Pa2 (Pa3) is pressurized, part of the flow rate of the pressurized oil in the pilot line passes through the air bleed micro-orifice and return to the tank circuit.
- The pressure (load pressure) in the upstream passage of the load check valve passes through the LS pressure guide orifice of the compensator spool and opens the shuttle poppet, and is guided to the PLS pressure passage, becoming the PLS signal pressure; it is then guided to the variable pump as the PLS signal pressure from the PLS3 port in the high selector valve.
- Part of the flow rate of the pressurized oil in the PLS pressure passage passes through the micro-orifice of the LS drain plug and return to the tank circuit.
- The pressure PPS in the pump passage is guided to the variable pump as the pump signal pressure from the PPS3 port of the high-pressure selector valve.
- Oil flowing back from the actuator flows from the cylinder port A via the oil passage inside the spool to the downstream passage of the load check poppet at B and is combined as a regenerative flow. And part of the returning oil passes through the CT notch in the main spool and is guided to the tank circuit.

RY9212435HYM0038US0

(4) Boom Section Operation

Boom emergency valve



(1) Boom Section
(2) Poppet
(3) Set Screw
(4) Boom Emergency Valve
(5) Tank Circuit
(6) Orifice

- The boom emergency valve is a function to lower the boom when the main spool is locked and the boom is raised. It opens the cut off valve built in the boom section, and communicates the cylinder (at the bottom) and the tank circuit.
- Loosen the set screw of the cut off valve built in the boom section to open the poppet. The pressurized oil passes through the orifice of the boom cylinder (at the bottom) and is guided to the tank circuit to be able to lower the boom gradually.

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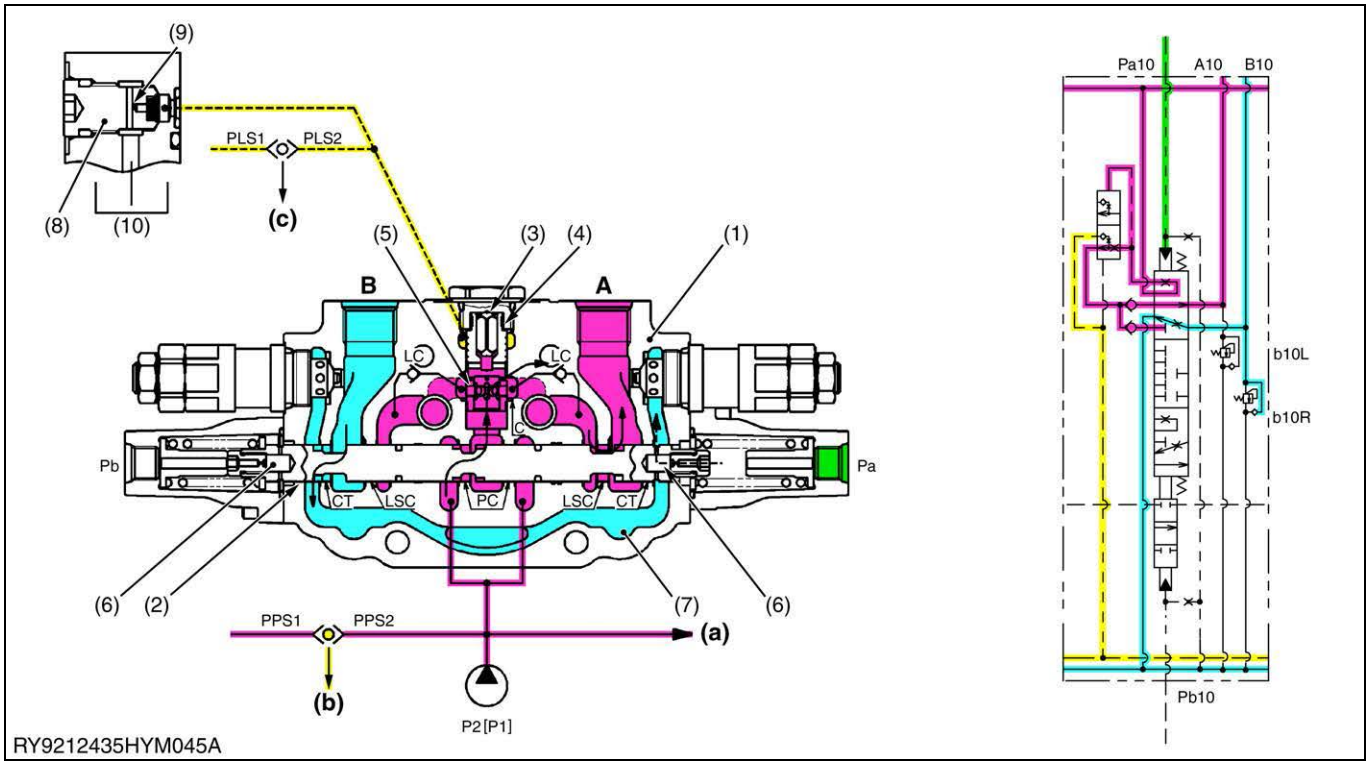
(5) Spool Section Operation (Swivel, AUX2, Swing)

Pressurized Pa port



(1) (Swivel, AUX2, Swing) Section
(2) Main Spool
(3) Shuttle Poppet
(4) Compensator Spool
(5) LS Pressure Introduction Orifice
(6) Air Bleed Micro-Orifice
(7) Tank Circuit
(8) LS Drain Plug
(9) Micro-Orifice
(10) Tank Circuit
(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump
(c) From PLS3 Port to the Variable Pump

- When the spool is shifted by the Pa port pressure, the pump pressure PPS is guided to cylinder port A via the main spool PC notch, compensator spool notch, the left load check and the main spool LSC notch.
- When the Pa port is pressurized, part of the hydraulic oil flow passes through the air bleed micro-orifice and returns to the tank circuit.
- The pressure (load pressure) in the load check upstream passage is guided to the PLS pressure circuit via the valve housing LS pressure guide and high pressure selector plate, becoming the PLS pressure; it is then guided to the pump as the PLS signal pressure from the PLS port.
- Part of the flow rate of the pressurized oil in the PLS pressure passage passes through the micro-orifice of the LS drain plug and return to the tank circuit.
- The pressure PPS in the pump pressure passage is guided to the pump from the PPS port as the pump signal pressure.
- Oil flowing back from the actuator is guided from cylinder port A to the tank circuit via the main spool CT notch.
- It flows in the reverse direction when the Pb port is pressurized.

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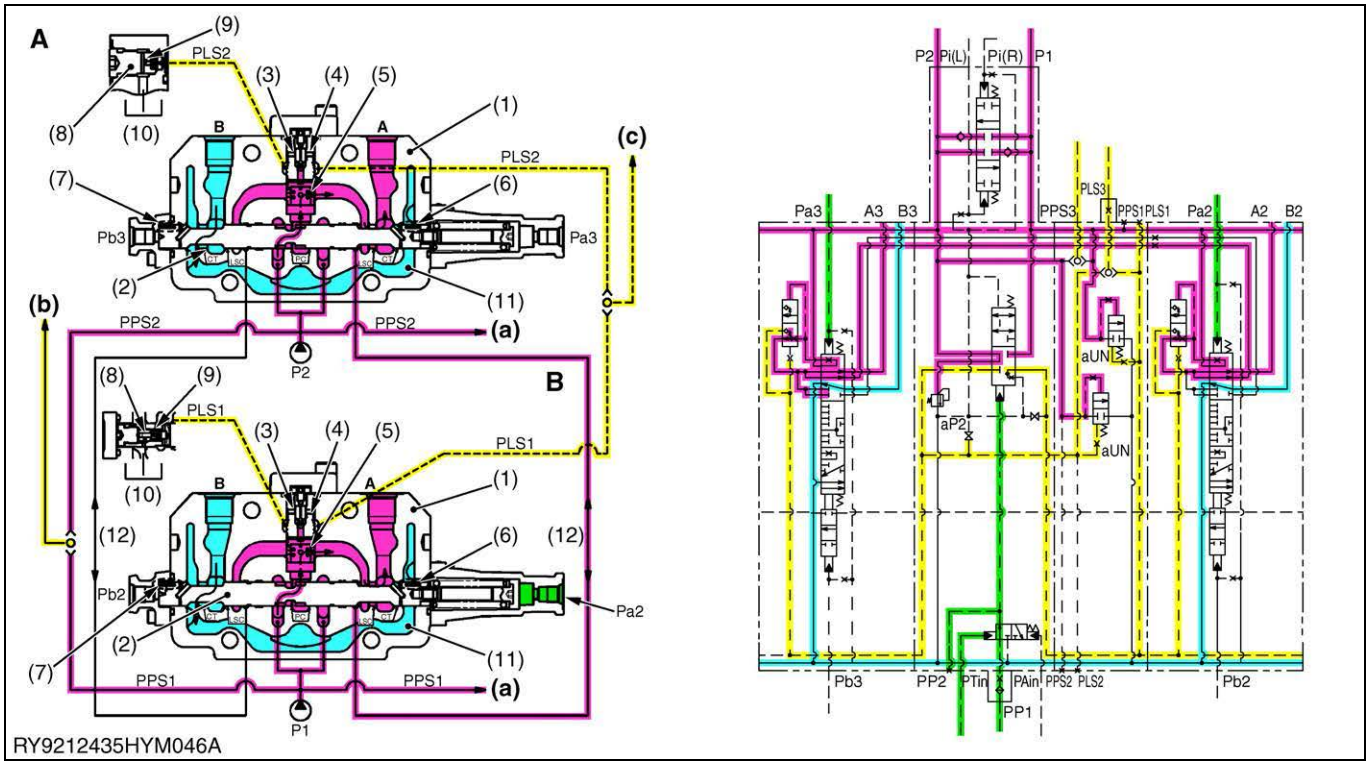
(6) Travel Section Operation

Pressurized Pa2 (Pa3) port



(1) Travel Section
(2) Main Spool
(3) Shuttle Poppet
(4) Compensator Spool
(5) LS Pressure Introduction Orifice
(6) Air Bleed Micro-Orifice
(7) Air Bleed Micro-Orifice
(8) LS Drain Plug
(9) Micro-Orifice
(10) Tank Circuit
(11) Tank Circuit
(12) Travel Communication Circuit

A : Travel (RH)
B : Travel (LH)

(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump
(c) From PLS3 Port to the Variable Pump

- When the main spool is shifted by Pa2 (Pa3) port pressurization, the pump pressure flows to the cylinder port A via the main spool PC notch, the compensator spool, and the main spool LSC notch.
- If the Pa2 and Pa3 port are pressurized simultaneously, and the main spool is set in the full stroke, the travel communication circuit (the ports supply oil to the left/right travel motors communicate) maintains a straight travel path forward.
- When the port pressurizing Pa2 (Pa3), part of the flow rate of the pressurized oil in the pilot line passes through the air bleed micro-orifice and return to the tank circuit.
- The pressure (load pressure) in the downstream passage of the compensator notch passes through the LS pressure guide orifice of the compensator spool and opens the shuttle poppet, and is guided to the variable pump as PLS signal pressure from the high pressure selector valve.
- Part of the flow rate of the pressurized oil in the PLS1 (PLS2) pressure passage passes through the micro-orifice of the LS drain plug and return to the tank circuit.
- The pressure PPS1 (PPS2) in the pump passage is guided to the variable pump as the pump signal pressure from the PPS3 port of the high-pressure selector valve.
- Oil flowing back from the actuator is guided from the cylinder port B to the tank circuit via the main spool CT notch.
- It flows in the reverse direction when the Pb2 (Pb3) is pressurized.

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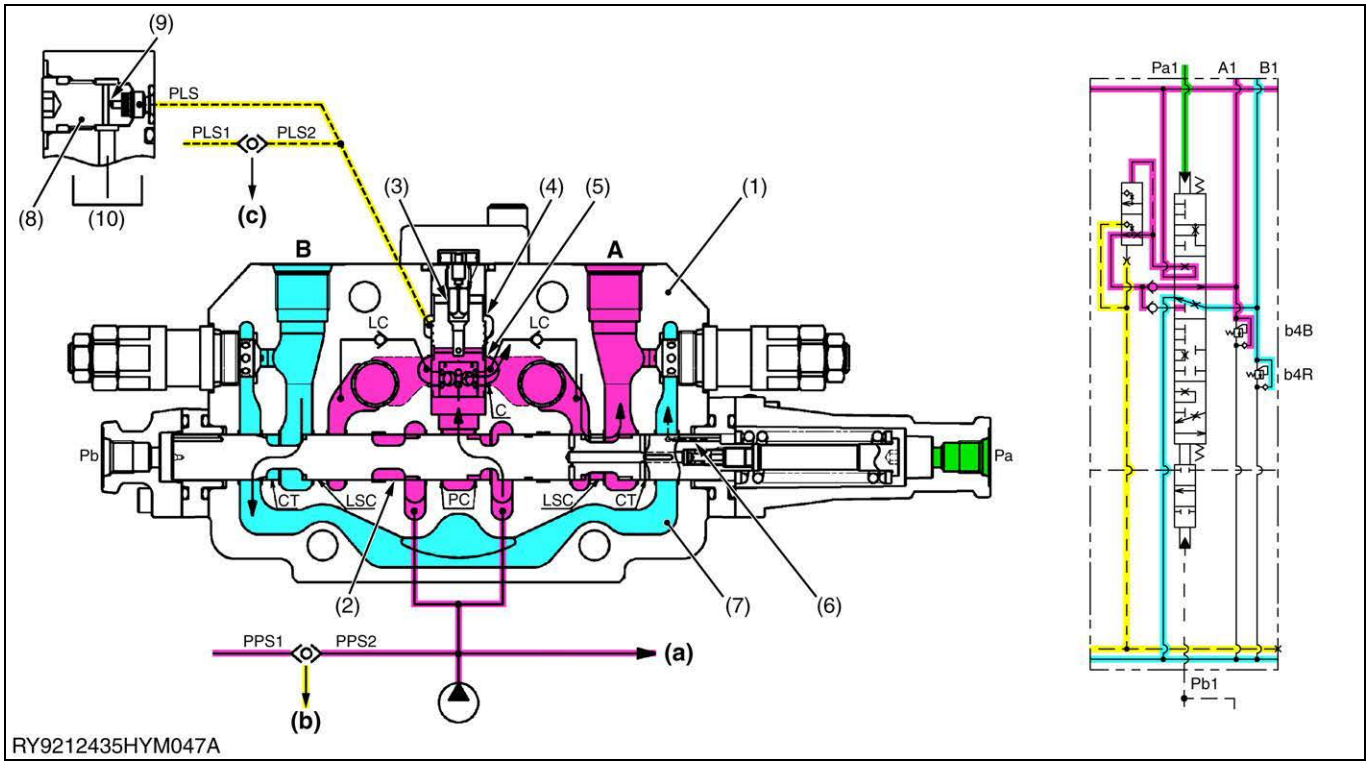
(7) Blade Section Operation

Pressurized Pa port (blade lowering) main spool stroke: 6 mm



(1) Blade Section
(2) Main Spool
(3) Shuttle Poppet
(4) Compensator Spool
(5) LS Pressure Introduction Orifice
(6) Air Bleed Micro-Orifice
(7) Tank Circuit
(8) LS Drain Plug
(9) Micro-Orifice
(10) Tank Circuit
(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump
(c) From PLS3 Port to the Variable Pump

- The main spool stroke rate is limited 6mm by controlling the pilot valve pressure control in the machine during blade lowering.
- When the main spool is shifted by Pa port pressurization, the supply oil flows to the cylinder port A via the main spool PC notch, compensator notch, and the main spool LSC notch.
- When Pa port is pressurized, part of oil flow in the pilot line passes through the air bleed orifice and return to the tank circuit.
- The pressure (load pressure) in the upstream passage of the load check valve passes through the LS pressure guide orifice of the compensator spool and opens the cattle poppet, and is guided to the PLS pressure passage, becoming the PLS signal pressure; it is then guided to the variable pump as the PLS signal pressure from the PLS3 port in the high selector valve.
- Part of the flow rate of the pressurized oil in the PLS pressure passage passes through the micro-orifice of the LS drain plug and return to the tank circuit.
- The pressure PPS in the pump passage is guided to the variable pump as the PPS pump signal pressure from the PPS3 port of the high-pressure selector valve.
- Oil flowing back from the actuator is guided from the cylinder port B to the tank circuit via the main spool CT notch.

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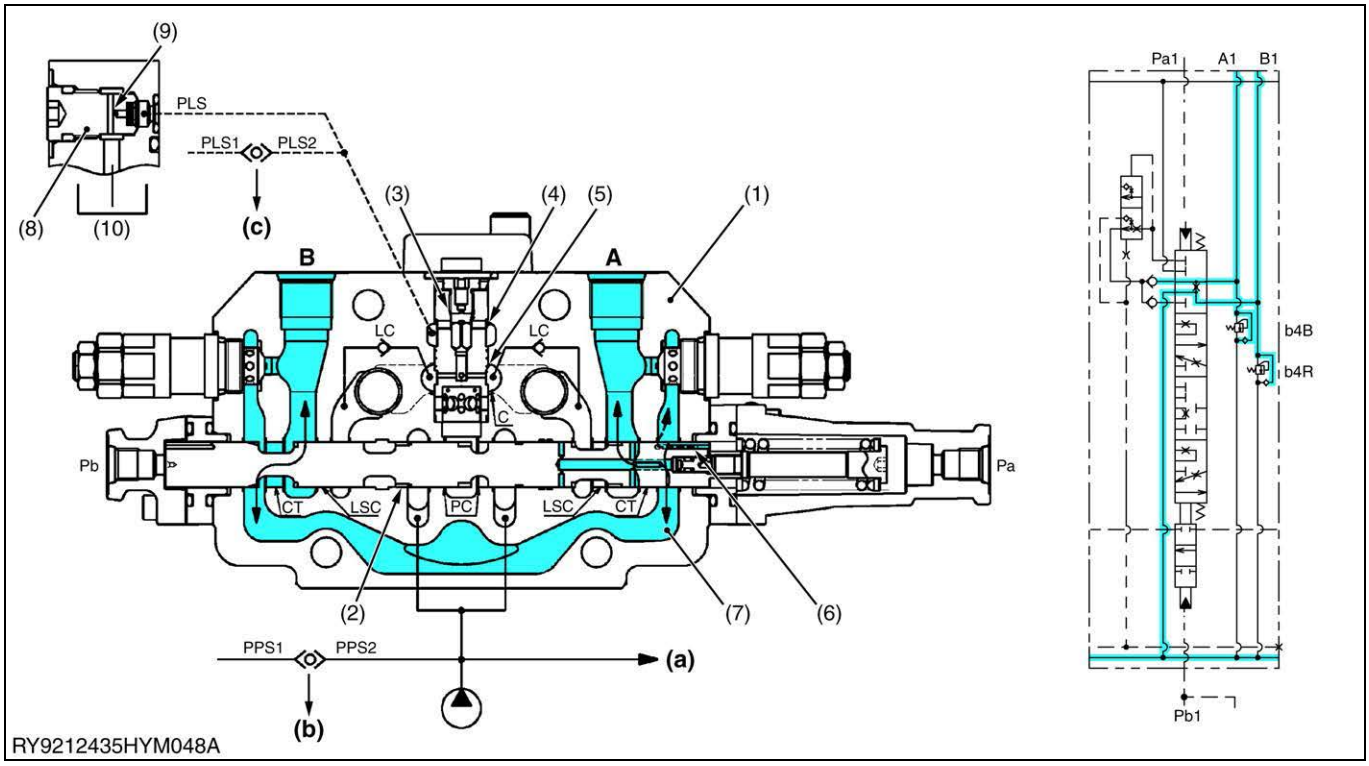
Pressurized Pa port (blade float) main spool stroke: 11 mm



(1) Blade Section
(2) Main Spool
(3) Shuttle Poppet
(4) Compensator Spool
(5) LS Pressure Introduction Orifice
(6) Air Bleed Micro-Orifice
(7) Tank Circuit
(8) LS Drain Plug
(9) Micro-Orifice
(10) Tank Circuit
(a) From Unload Valve to the Tank Circuit
(b) From PPS3 Port to the Variable Pump
(c) From PLS3 Port to the Variable Pump

- The main spool stroke rate is limited 11 mm by controlling the pilot valve pressure control in the machine during blade lowering.
- When the main spool is shifted by Pa port pressurization, the supply oil from the pump stops to the cylinder port A because the main spool PC notch is closed and the pump pressure passage and the compensator upstream passage is cut off.
- When Pa port is pressurized, part of flow rate in the pilot line passes through the air bleed micro-orifice and return to the tank circuit.
- The cylinder A connects the tank circuit via the main spool float grooving, and the cylinder B connects the tank circuit via the main spool CT notch (float position).

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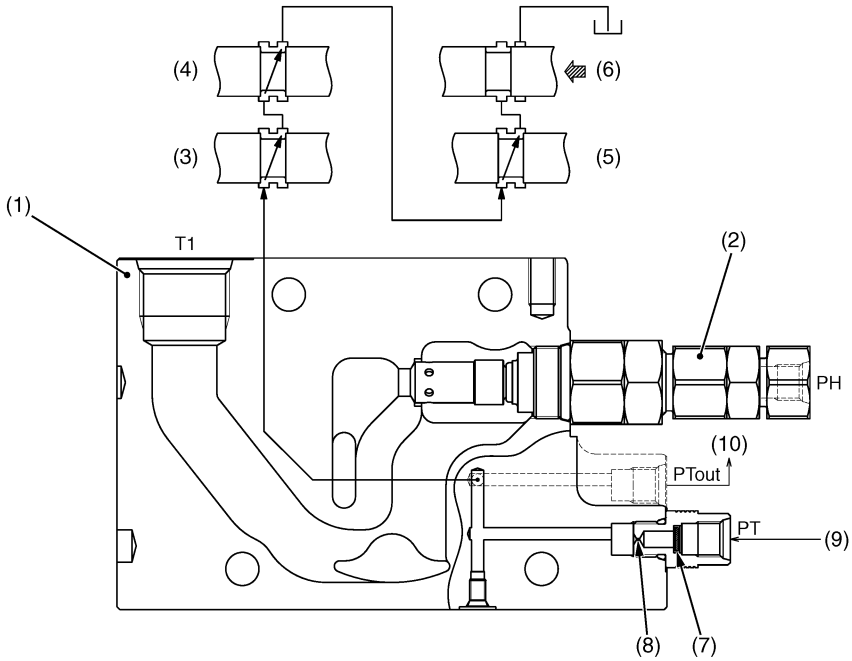
(8) Signal Circuit

PT signal circuit



RY9212435HYM049A

(1) Outlet Section
(2) Main LS Valve
(3) Blade 1
(4) Travel LH
(5) Travel LH
(6) Blade 2
(7) Filter
(8) Micro-Orifice
(9) Pilot Pump Pressure
(10) PTout Port Pressure Rises

[In neutral]

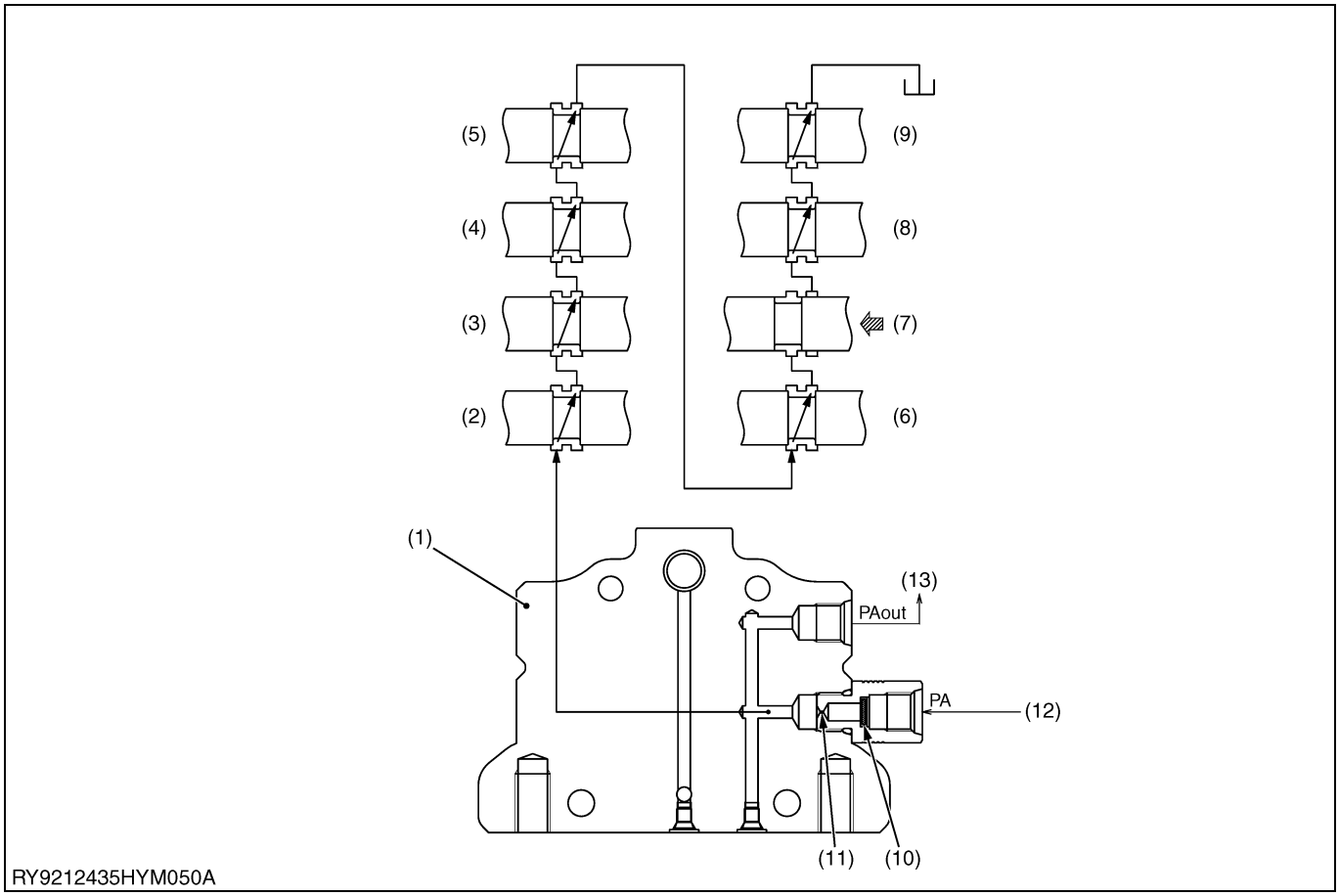
- Pilot pump pressure is guided to the hydraulic supply port PT of the signal circuit.
- The pilot pump pressure supplied to port PT of the outlet section returns to the tank circuit via the filter and micro-orifice and via the main spool signal passage switch of all sections so port PTout=tank pressure.

[PTout signal pressure rises]

- It switches the main spool of each section to either the A or the B port side and cuts off the passage that connects the PT port micro-orifice downstream and the tank circuit.
- This raises the PTout port pressure to the PT port pressure (that is the pilot pump pressure).

RY9212435HYM0044US0

PA signal circuit (outlet section)



RY9212435HYM050A

(1) Outlet Section
(2) Swing
(3) AUX2
(4) Swivel
(5) Boom
(6) Two Piece Boom
(7) Bucket
(8) Arm
(9) AUX1
(10) Filter
(11) Micro-Orifice
(12) Pilot Pump Pressure
(13) PAout Port Pressure Rises

[In neutral]

- Pilot pump pressure is guided to the hydraulic supply port PA of the signal circuit.
- The pilot pump pressure supplied to port PA of the outlet section returns to the tank circuit via the filter and micro-orifice and via the main spool signal passage switch of all sections so port PAout=tank pressure.

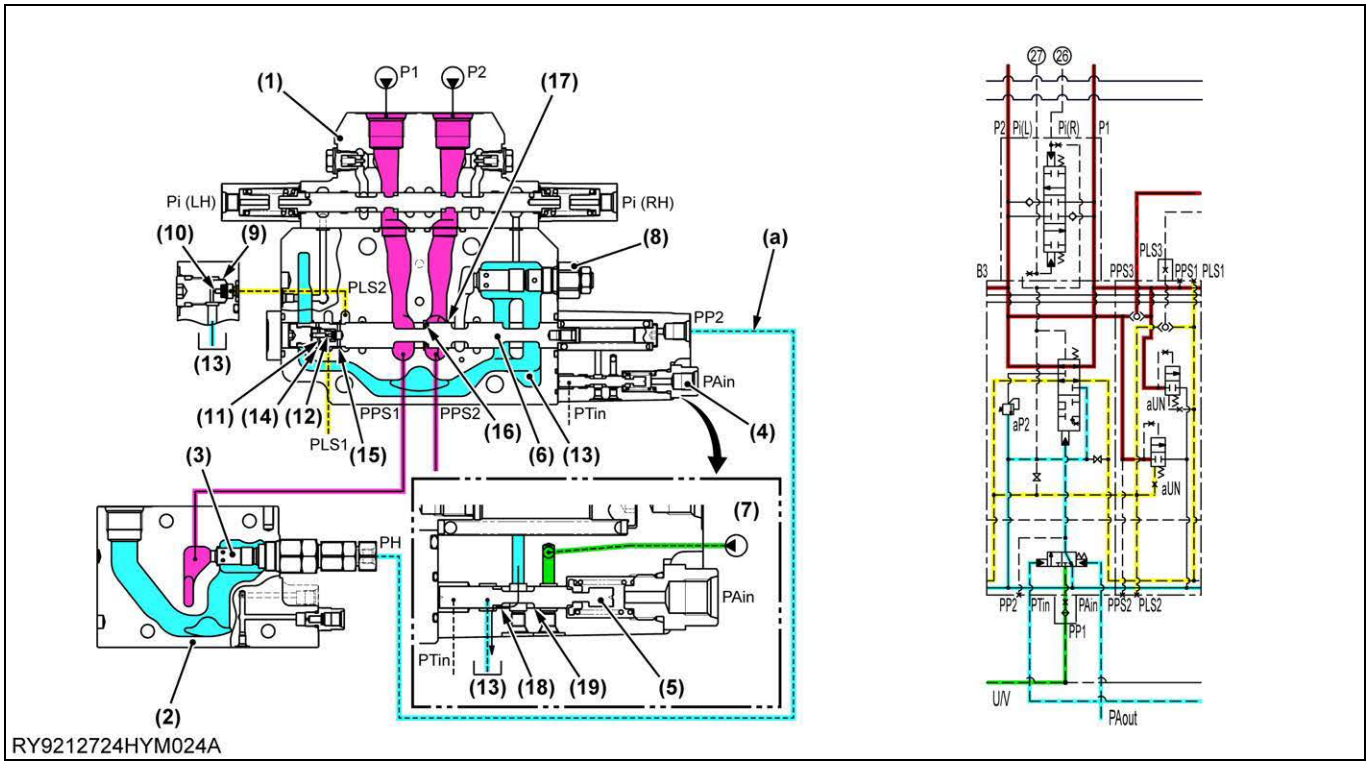
[PAout signal pressure rises]

- It switches the main spool of each section to either the A or the B port side and cuts off the passage that connects the PA port micro-orifice downstream and the tank circuit.
- This raises the PAout port pressure to the PA port pressure (that is the pilot pump pressure).

RY9212724HYM0031US0

(9) Independent Travel Valve Section (Inlet Section)

Independent travel spool in neutral (PPS circuit, PLS circuit: communication)

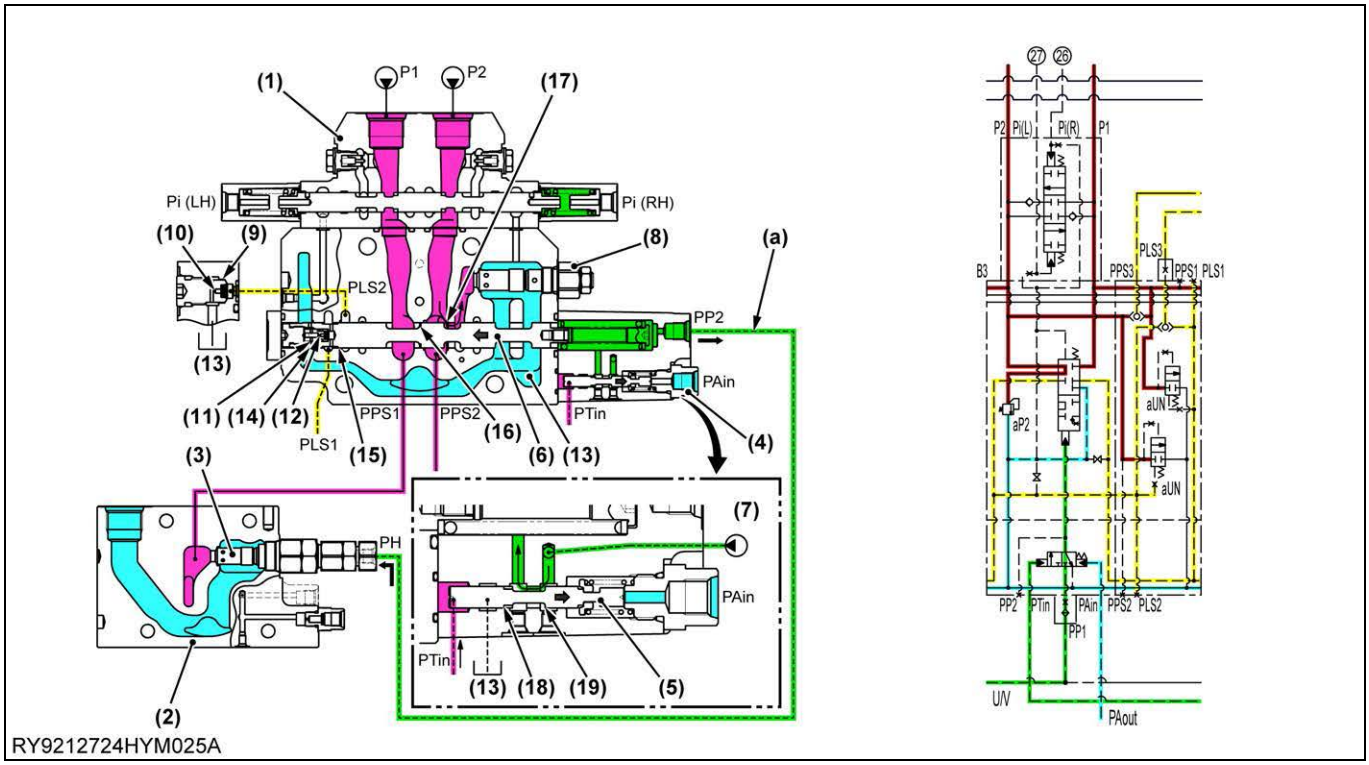


(1) Travel Bypass Valve
(2) Outlet Section
(3) Main Relief Valve (P1)
(4) Sub Valve
(5) Sub Spool
(6) Independent Travel Spool
(7) Pilot Pressure (PP1)
(8) Main Relief Valve (P2)
(9) LS Drain Plug
(10) Micro-Orifice 1
(11) LS Drain
(12) Micro-Orifice 2
(13) Tank Circuit
(14) Tank Connecting Passage Close
(15) PLS Circuit Shift Land Open
(16) PPS Circuit Shift Notch Open
(17) Relief Valve Circuit Shift Land Close
(18) Sub Spool Shift Notch Open
(19) Sub Spool Shift Land Close
(a) To Connect to the Relief Valve RH Port of the Outlet Section (Two Piece Boom Only)

- The oil flows in from the pump port P1 and P2 passes through the travel bypass valve, and is guided to the PPS 1 and PPS2 of the travel independent valve section.
- The PT/PA signal stays the tank pressure while the main spool of each spool section is unoperated and the sub spool inside the sub valve does not shift the travel independent spool becomes neutral condition because the travel independent spool pilot chamber connects the tank circuit.
- PPS1/PPS 2 circuit communicate through the travel independent spool shift notch.
- The PPS circuit is controlled by max. pressure of the main relief valve at P1 side which built in the outlet section.
- PLS1/PL2 circuit communicates through the travel independent spool shift land.
- PLS circuit passes through the micro-orifice 1 of the LS drain plug built in the outlet section and communicate the tank circuit
- The main relief valve at P2 built in the inlet section and the micro orifice 2 of the PLS drain spacer exists in the travel independent spool are cut off from the PPS circuit and PLS circuit, and they don't work.

RY9212724HYM0032US0

Travel independent spool shift (PPS circuit, PLS circuit: communication to independent)

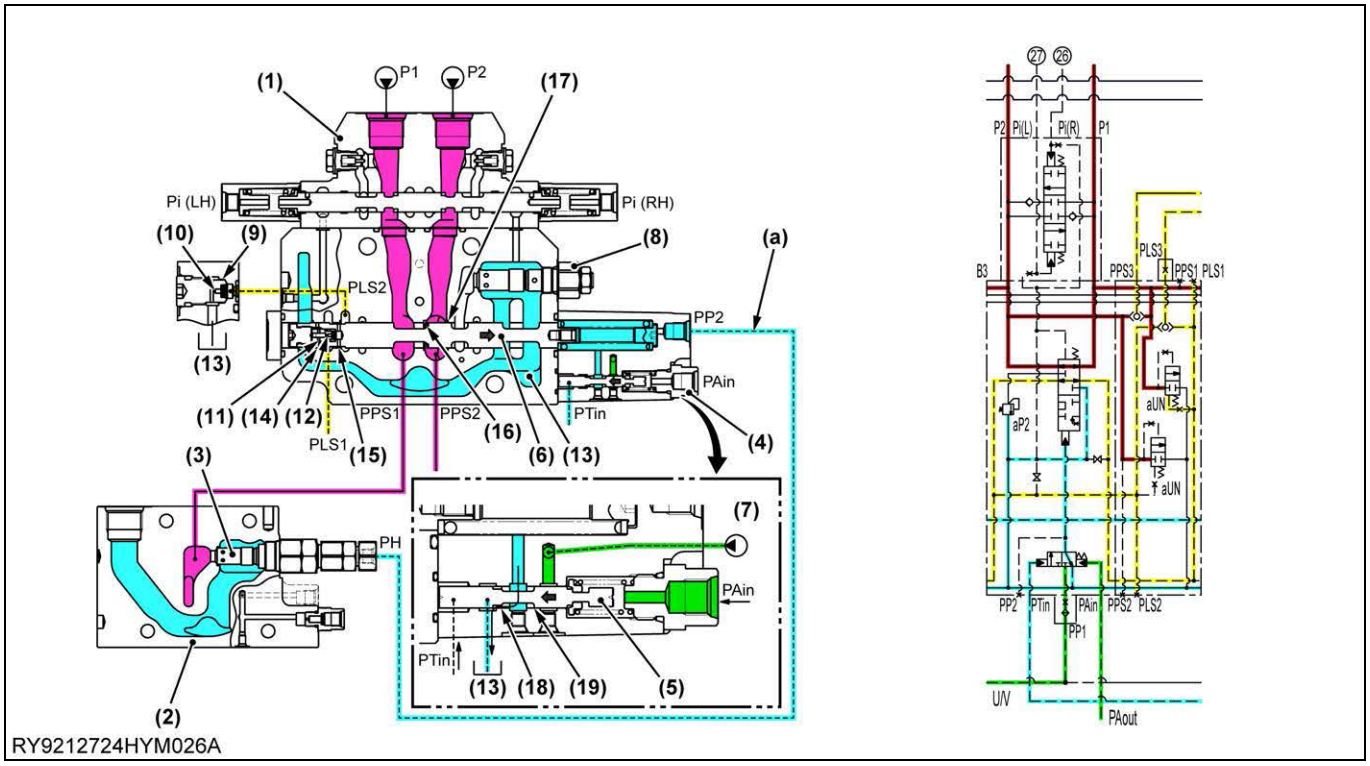


(1) Travel Bypass Valve
(2) Outlet Section
(3) Main Relief Valve (P1)
(4) Sub Valve
(5) Sub Spool
(6) Independent Travel Spool
(7) Pilot Pressure (PP1)
(8) Main Relief Valve (P2)
(9) LS Drain Plug
(10) Micro-Orifice 1
(11) LS Drain
(12) Micro-Orifice 2
(13) Tank Circuit
(14) Tank Connecting Passage Open
(15) PLS Circuit Shift Land Close
(16) PPS Circuit Shift Notch Close
(17) Relief Valve Circuit Shift Land Open
(18) Sub Spool Shift Notch Close
(19) Sub Spool Shift Land Open
(a) To Connect to the Relief Valve RH Port of the Outlet Section (Two Piece Boom Only)

- The PT signal boosts at the outlet section when the main spool of the travel (blade) section shifts during the travel independent spool in neutral (Work principle is described in the outlet section).
- When the PT signal pressure work towards to the sub spool left in the sub valve and operate except the travel/blade section, the PA signal stays the tank pressure and the sub spool shifts.
- Connection of the travel independent spool pilot chamber and the tank circuit is cut off due to the closure of the sub spool shift notch. When the shift land opens, the pressure from the pilot valve is guided and the travel independent spool pilot chamber boosts and the travel independent spool shifts.
- The PPS 1 and PPS2 circuits are cut off due to the closure of the sub spool shift notch and become independent.
- The PPS 1 circuit is controlled in the max. pressure with the main relief valve at P1 built in the outlet section. The PPS 2 circuit is controlled in the max. pressure with the main relief valve at P2 built in the outlet section. When travel independent spool shift land opens, connect the main relief valve at P2 and is controlled by the max. pressure in the PPS 2 circuit.
- The PLS 1 and 2 circuits are cut off due to the closure of the sub spool shift land and, become independent.
- In PLS 1 circuit, the LS drain spacer downstream opens the tank connection passage, passes through the micro-orifice 2 and communicate the tank circuit. In PLS, the LS drain plug micro-orifice 1 built in the outlet section passes through the tank circuit and conduct.
- The PP2 port boosts by the boosting the travel independent spool pilot chamber. The PP2 port connects the relief valve's PH port with boost function built in the outlet section by the outer pipe, and the relief valve set pressure boosts (Two piece boom spec. only).

RY9212724HYM0033US0

Travel independent spool shift return (PPS circuit, PLS circuit: independent to communicate



(1) Travel Bypass Valve
(2) Outlet Section
(3) Main Relief Valve (P1)
(4) Sub Valve
(5) Sub Spool
(6) Independent Travel Spool
(7) Pilot Pressure (PP1)
(8) Main Relief Valve (P2)
(9) LS Drain Plug
(10) Micro-Orifice 1
(11) LS Drain
(12) Micro-Orifice 2
(13) Tank Circuit
(14) Tank Connecting Passage Close
(15) PLS Circuit Shift Land Open
(16) PPS Circuit Shift Notch Open
(17) Relief Valve Circuit Shift Land Close
(18) Sub Spool Shift Notch Open
(19) Sub Spool Shift Land Close
(a) To Connect to the Relief Valve RH Port of the Outlet Section (Two Piece Boom Only)

[Travel/blade section complete]

- When the travel (or blade) section in operation returns to neutral, the PT signal is reduced in the outlet section.
- The PT signal is reduced to the tank pressure and the sub spool inside the sub valve returns to the neutral position due to spring force.
- Connect between the travel independent spool pilot chamber and tank circuit by shift notch of the spool.
- Close between the travel independent spool pilot and pressure from pilot valve by shift land of the spool.
- The travel independent spool pilot is returned in neutral due to reduce pressure in the travel independent spool pilot chamber.

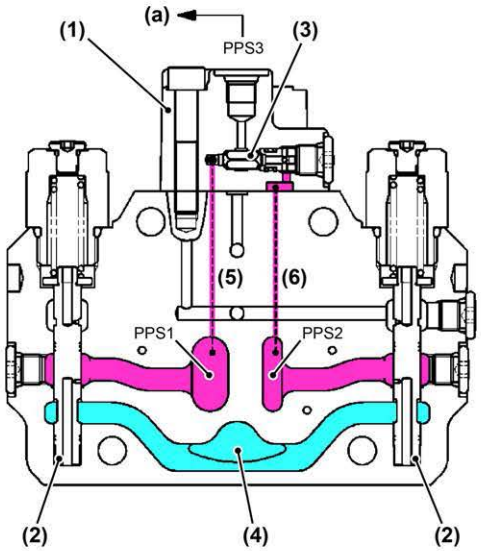
[Operation in the other section]

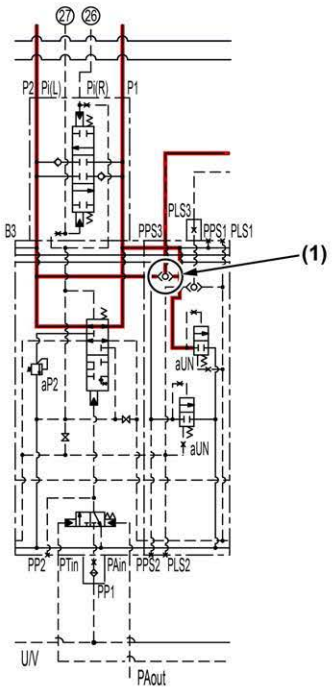
- When the one of the main spools (except travel or blade) are shifted, the PA signal boosts in the outlet section. (Work principle is described in the outlet section)
- The PT signal pressure is same as the PA signal pressure. When the PA signal pressure acts right on the sub spool inside the sub valve, the pressure applies to the both spool ends and takes balance. The spring force at the PA port, then the sub spool returns to the neutral position.
- The sub spool shift notch reopens and the travel independent spool pilot chamber conducts the tank circuit. When the shift land closes, the pressure from the pilot valve is cut off, the travel independent spool pilot is reduced, and the travel independent spool returns to neutral.

RY9212724HYM0034US0

(10) High Pressure Selector Valve

Select the pump pressure (PPS pressure)





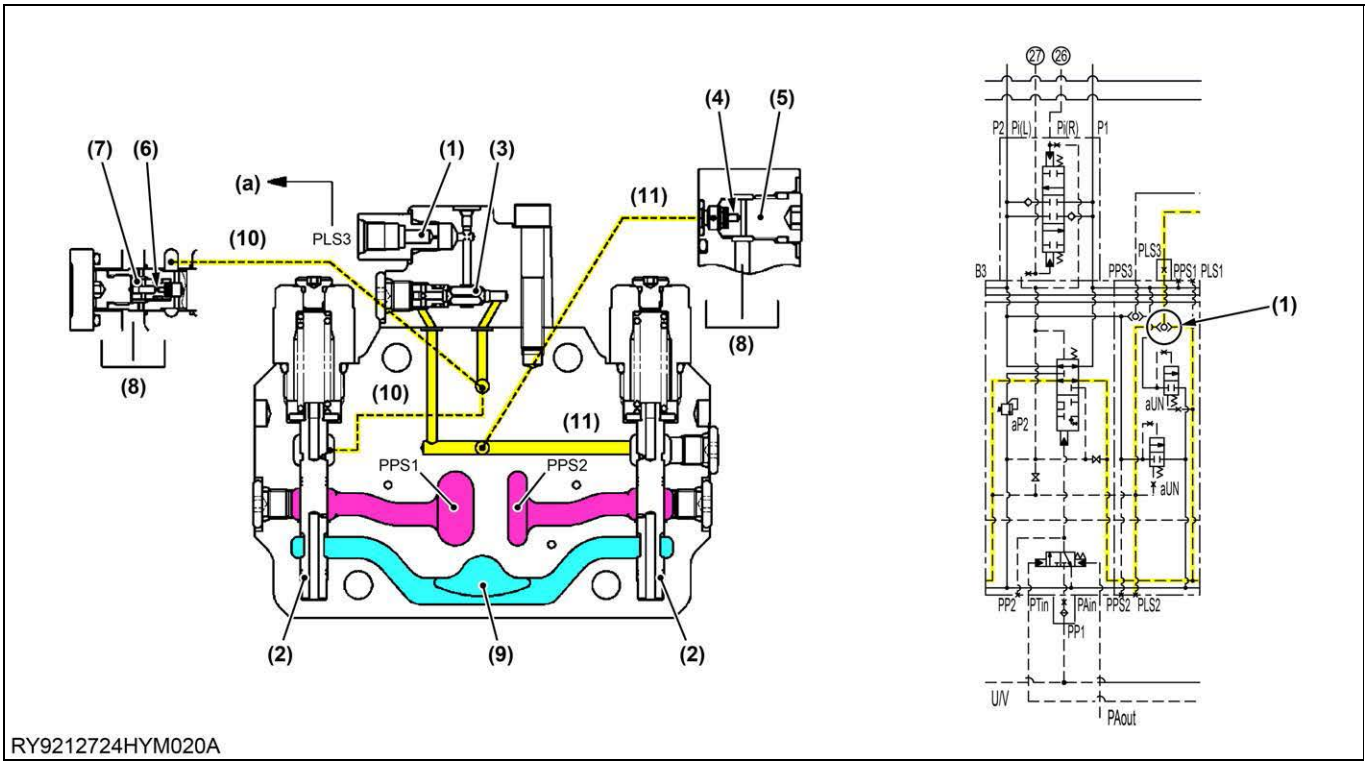
RY9212724HYM019A

(1) High Pressure Selector Valve
(2) Unload Spool
(3) Shuttle Poppet
(4) Tank Passage
(5) PPS1 Pressure Passage
(6) PPS2 Pressure Passage
(a) To Variable Pump

- Select the max. pump discharge pressure in the circuit by the high pressure selector valve implemented in the upper unload section. The selected pressure becomes the PPS signal pressure and is guided to the variable pump from the PPS3 port.
- Pump pressure at P1 (PPS1) and pump pressure at P2 (PPS2) that comes from the unload section to the shuttle poppet end inside the high pressure selector valve acts. PPS1 pressure and the PPS2 pressure at the high pressure seats, and the shuttle poppet and the pressure at low side is cut off, and the pressure at high is guided to the PPS3 port.

RY9212724HYM0022US0

Selection of Unload pressure (PLS pressure)



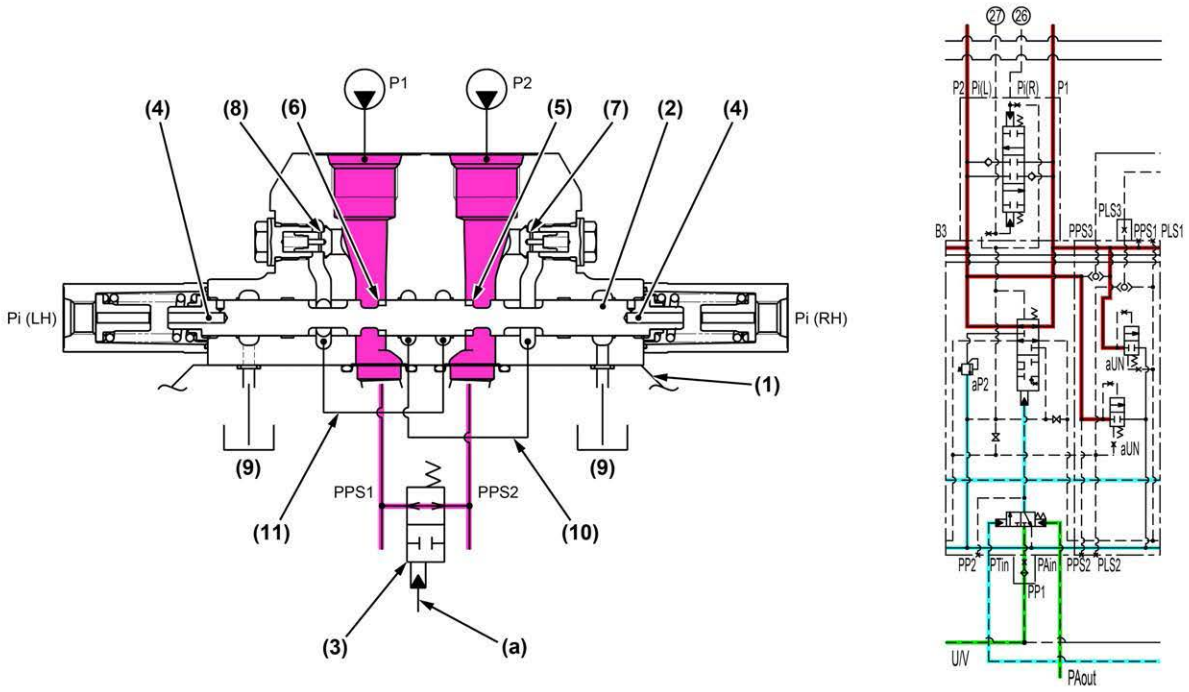
(1) High Pressure Selector Valve
(2) Unload Spool
(3) Shuttle Poppet
(4) Micro-Orifice
(5) LS Drain Plug
(6) Micro-Orifice
(7) LS Drain Plug
(8) Tank Circuit
(9) Tank Passage
(10) PLS1 Pressure Passage
(11) PLS2 Pressure Passage
(a) To Variable Pump

- Select the max. pressure of the pump load pressure in the circuit by the high pressure selector valve built in the upper load section. The selected pressure becomes the PLS signal pressure and is guided to the variable pump from the PLS 3 port.
- Pump pressure at P1 and pump pressure at P2 (PPS2) that are introduced from the unload section to the shuttle poppet end inside the high pressure selector valve acts. PLS 1 pressure and the PLS 2 pressure at the high pressure seats the shuttle poppet and the pressure at low side is cut off, and the pressure at high pressure is guided to the PLS 3 port.

RY9212724HYM0023US0

(11) Travel Bypass Valve

Bypass spool neutral (travel section unoperated)



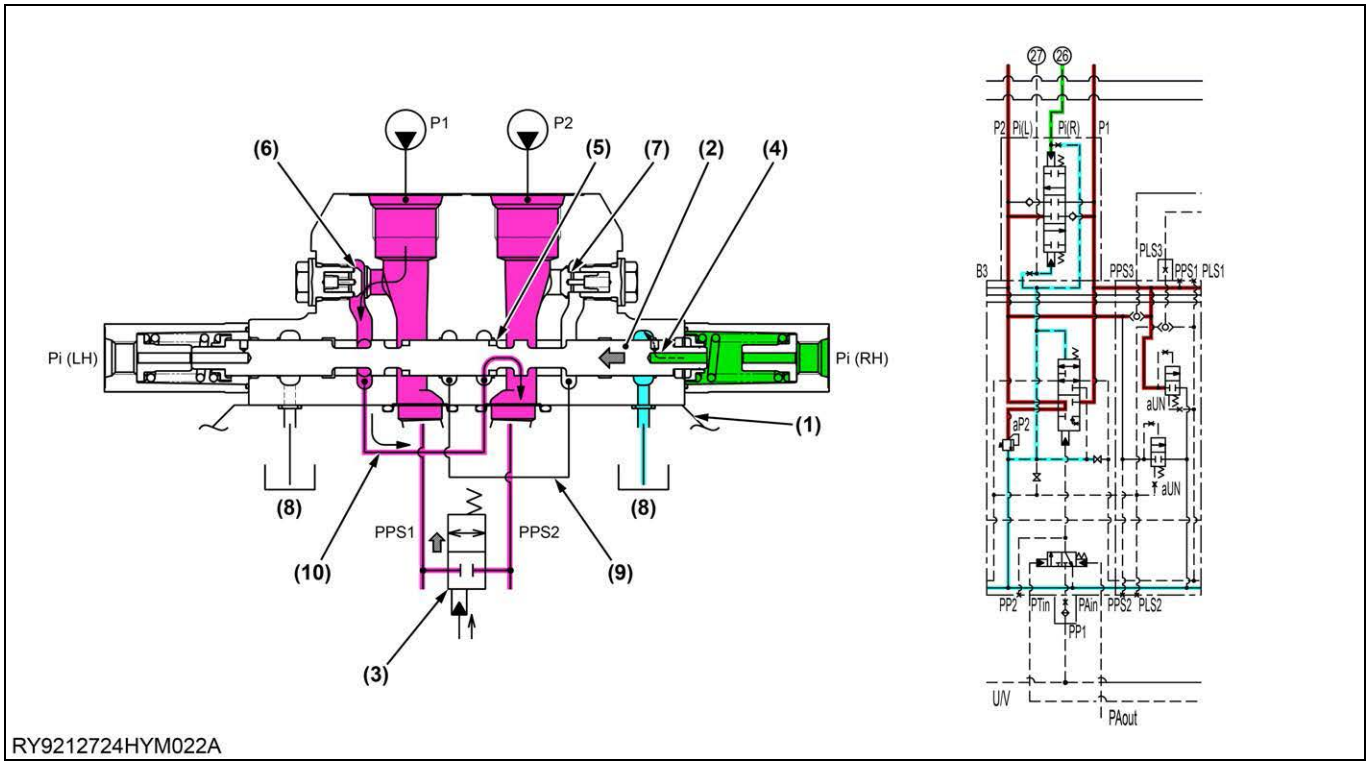
RY9212724HYM021A

(1) Independent Travel Valve Section
(2) Bypass Spool
(3) Independent Travel Spool
(4) Air Bleed Micro-Orifice Close
(5) Notch (P1 to P2)
(6) Notch (P2 to P1)
(7) Bypasas Check Poppet (P2 to P1)
(8) Bypass Check Poppet (P1 to P2)
(9) Tank Circuit
(10) Bypass Circuit (P2 to P1)
(11) Bypass Circuit (P1 to P2)
(a) It be Comes Pressure Rises when Operating the Travel or Blade Section

- Oil came from the pump port P1 and P2 respecively passes through the travel bypass valve, and flow to the upper travel independent section's PPS1 and PPS2 circuit.
- If the travel and blade section is not operated, the travel independent spool does not work. The PPS1 and the PPS2 circuit communicate inside the lower travel independent section.
- The pilot pressure is guided to the Pi R port and the Pi L port that the travel R section pilot pressure is in proportion to the travel Left section pilot pressure.
- The spool notch that controls open/close the bypass circuit and each PPS circuit is closed.
- The bypass check poppet in the each bypass circuit upstream is closed.
- The air bleed micro-orifice of the pilot line pressure oil is closed.

RY9212724HYM0024US0

Pi RH port pressurization during travel section operation

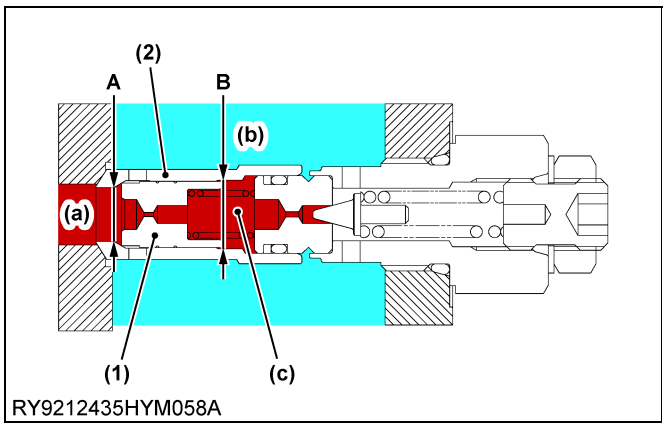


(1) Independent Travel Valve Section
(2) Bypass Spool
(3) Independent Travel Spool
(4) Air Bleed Micro-Orifice Open
(5) Notch (P1 to P2) Open
(6) Bypasas Check Poppet (P1 to P2) Open
(7) Bypasas Check Poppet (P2 to P1) Close
(8) Tank Circuit
(9) Bypass Circuit (P2 to P1)
(10) Bypass Circuit (P1 to P2)

- Oil flow in from the pump ports P1 and P2 passes through the travel bypass valve, and flow to the lower travel independent section's PPS1 and PPS2 circuit.
- The travel independent spool is shifted by the travel section operation, and the PPS1 circuit and the PPS2 circuit is cut off inside the lower travel independent valve.
- The pilot pressure is guided to Ri R port in proportion to the travel R section pilot pressure and shifts the travel bypass spool.
- The spool notch that controls open/close of the bypass circuit (P1 to P2) and the PPS2 circuit, and conduct the bypass circuit from PPS1 circuit to PPS2 circuit.
- When Pi R port is pressurized, part of pilot line pressurized oil passes through the air bleed micro-orifice, and return to the tank circuit inside the travel independent section.
- If the PPS1 pressure is higher than PPS2 pressure, the bypass check poppet stayed in the upstream bypass circuit (P1 – P2) opens, part of the hydraulic oil flowed from the PPS1 circuit to PPS2 circuit is supplied.
- If the PPS1 pressure is lower than PPS2 pressure, the bypass check poppet stayed in the upstream bypass circuit (P1 – P2) closes, part of the hydraulic oil flowed from the PPS1 circuit to PPS2 circuit is not supplied.
- It flows in the reverse direction when the Pi L port is pressurized.

RY9212724HYM0025US0

(12) Relief Valve



RY9212435HYM058A

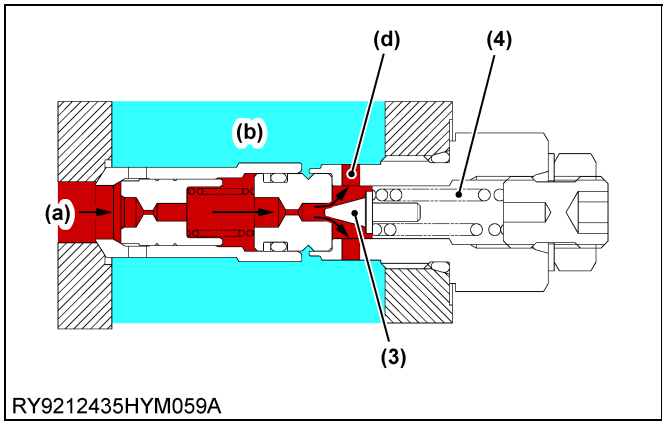
Main relief valve

[Function of relief valve]

- P port pressurized oil flows to the chamber C through the orifice of the main poppet.
- The main poppet is pressed to left due to the area difference between **A** and **B**.
- No pressurized oil flows to the tank port because sleeve and pilot poppet are sheeted.

(1) Main Poppet
(2) Sleeve

(a) P Port
(b) Tank Port
(c) Chamber C

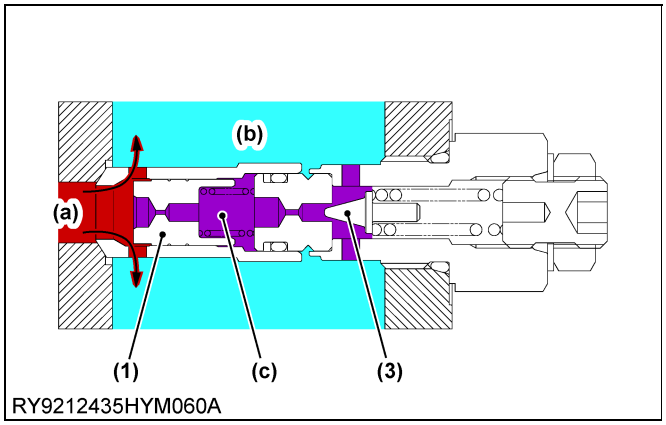


RY9212435HYM059A

- In case of the oil pressure in the P port exceeds the set pressure of the regulating pilot spring the pilot poppet shifts to the left.
- P port pressurized oil flows to the tank port through the drain port.

(3) Pilot Poppet
(4) Pilot Spring

(a) P Port
(b) Tank Port
(d) Drain Port



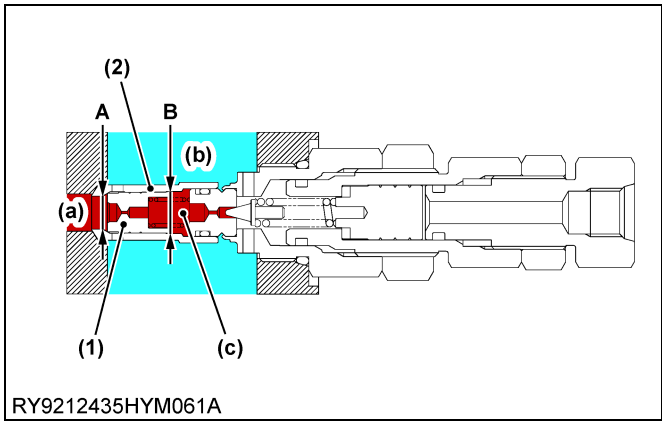
RY9212435HYM060A

- The pressure in the chamber C decrease and the main poppet shift to the right.
- P port pressurized oil flows to the tank port through the passage between the sleeve and the main poppet.

(1) Main Poppet
(3) Pilot Poppet

(a) P Port
(b) Tank Port
(c) Chamber C

RY9212435HYM0055US0



RY9212435HYM061A

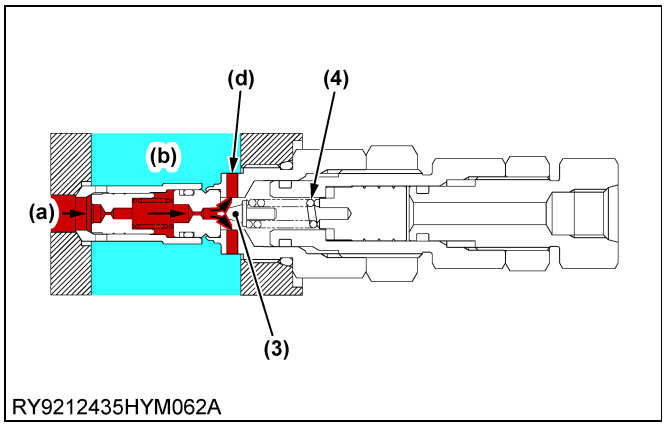
Variable main relief valve

[Function of relief valve]

- P port pressurized oil flows to the chamber C through the orifice of the main poppet.
- The main poppet is pressed to left due to the area difference between **A** and **B**.
- No pressurized oil flows to the tank port because sleeve and pilot poppet are sheeted.

(1) Main Poppet
(2) Sleeve

(a) P Port
(b) Tank Port
(c) Chamber C

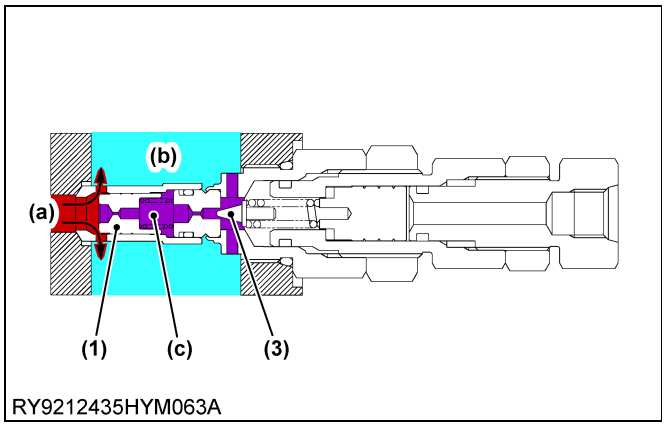


RY9212435HYM062A

- In case of the oil pressure in the P port exceeds the set pressure of the regulating pilot spring the pilot poppet shifts to the left.
- P port pressurized oil flows to the tank port through the drain port.

(3) Pilot Poppet
(4) Pilot Spring

(a) P Port
(b) Tank Port
(d) Drain Port

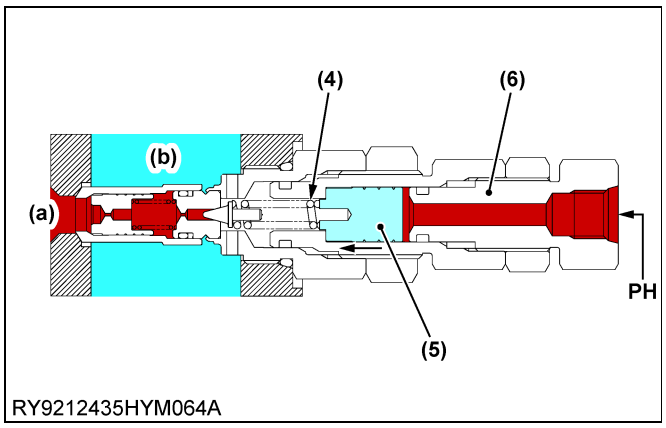


RY9212435HYM063A

- The pressure in the chamber C decrease and the main poppet shift to the right.
- P port pressurized oil flows to the tank port through the passage between the sleeve and the main poppet.

(1) Main Poppet
(3) Pilot Poppet

(a) P Port
(b) Tank Port
(c) Chamber C



RY9212435HYM064A

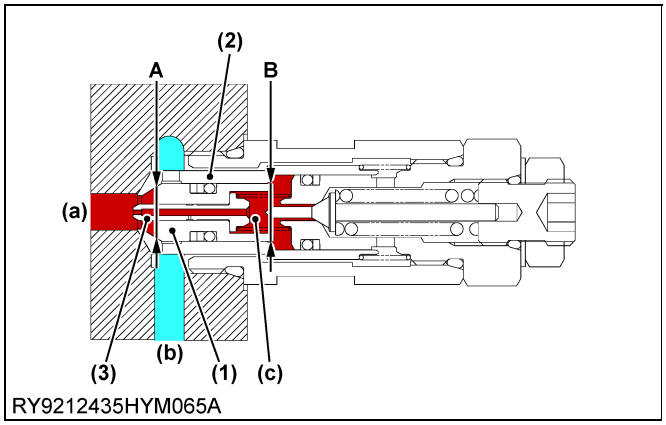
[Function of variable relief valve]

- If pressurized oil flows to the pilot port, the piston shifts to the right.
- The set pressure of the regulating pilot spring increased and p port relief pressure also increases.

(4) Pilot Spring
(5) Piston
(6) Plug

(a) P port
(b) Tank Port

RY9212435HYM0056US0



RY9212435HYM065A

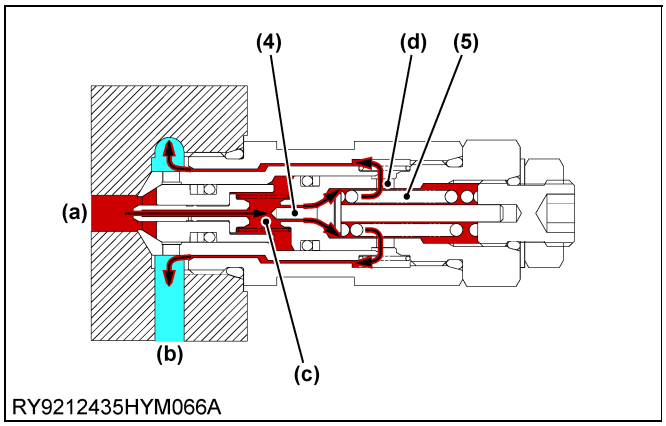
Overload relief valve

[Function of relief valve]

- P port pressurized oil flows to the chamber C through the orifice of the main poppet.
- The main poppet is pressed to left due to the area difference between **A** and **B**.
- No pressurized oil flows to the tank port because sleeve and pilot poppet are sheeted.

(1) Main Poppet
(2) Sleeve
(3) Piston

(a) P Port
(b) Tank Port
(c) Chamber C

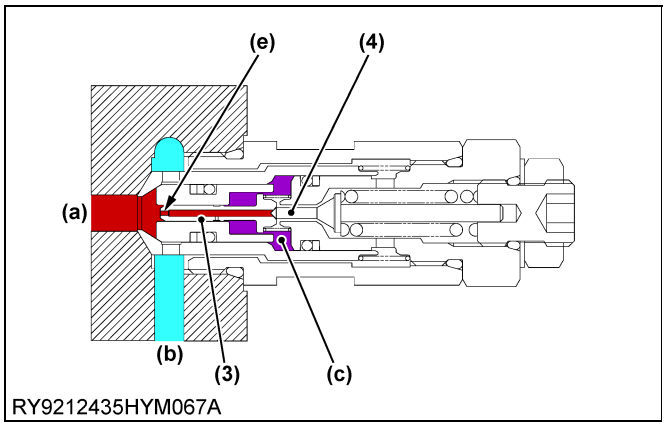


RY9212435HYM066A

- In case of the oil pressure in the P port exceeds the set pressure of the regulating adjuster spring the pilot poppet shifts to the left.
- P port pressurized oil flows to the tank port through the drain port.

(4) Pilot Poppet
(5) Adjuster Spring

(a) P Port
(b) Tank Port
(c) Chamber C
(d) Drain Port

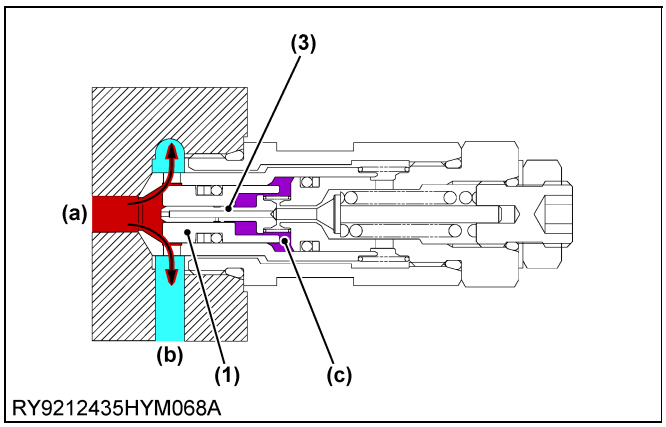


RY9212435HYM067A

- The pressure in the chamber C decrease and the piston shift to the right.
- Piston and pilot poppet are sheeted.

(3) Piston
(4) Pilot Poppet

(a) P Port
(b) Tank Port
(c) Chamber C
(e) Orifice of Piston



RY9212435HYM068A

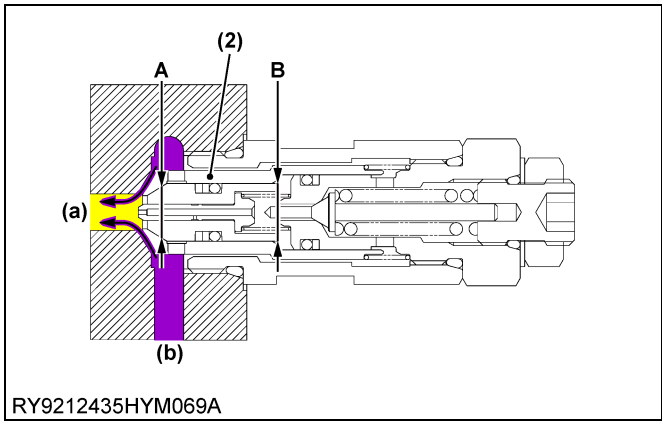
- P port pressure is increased and the main poppet shift to the right.
- P port pressurized oil flows to the tank port through the passage between the sleeve and the main poppet.

(1) Main Poppet
(3) Piston

(a) P Port
(b) Tank Port
(c) Chamber C

(To be continued)

(Continued)



RY9212435HYM069A

[Prevent cavitation]

- In case of P port pressure is lower than tank pressure, the sleeve is pressed to left due to the area difference between **A** and **B**.
- Supplies hydraulic oil from tank port to P port, to prevent cavitation.

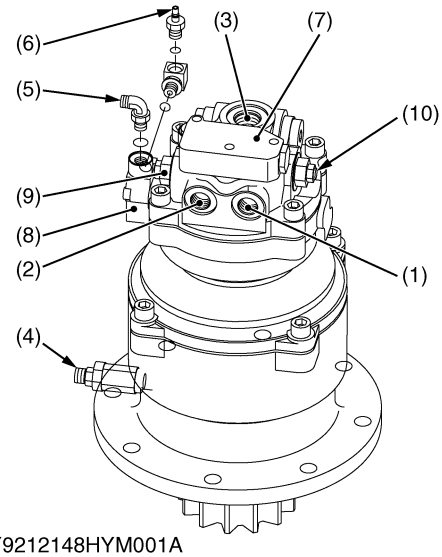
(2) Sleeve

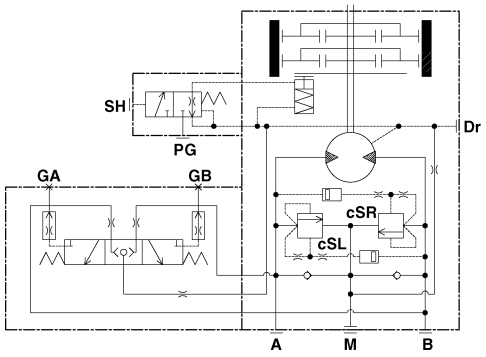
(a) P Port
(b) Tank Port

RY9212435HYM0057US0

5. SWIVEL MOTOR

[1] SPECIFICATIONS





RY9212148HYM001A

(1) Port A
(2) Port B
(3) Port M
(4) Drain port
(5) Port SH
(6) Port PG
(7) Reverse check valve
(8) Hydraulic timer
(9) Swivel left relief valve (cSL)
(10) Swivel right relief valve (cSR)

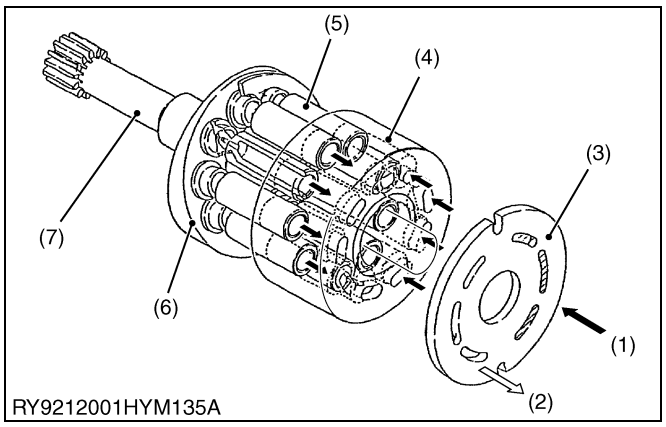
Item			Notes
Maker		KYB	
Model		MSG-44P-21-19	
Total displacement		909 cm^3/rev 55.5 cu.in./rev	
Motor displacement		44.1 cm^3/rev 2.7 cu.in./rev	
Reduction ratio		20.615	
Relief valve	cSR cSL	21.6 MPa 220 kgf/cm^2 3133 psi	At 66 L/min., 17.4 U.S. gals
	Shockless pressure	8.3 ± 0.1 MPa 84.70 ± 1.02 kgf/cm^2 1203.8 ± 14.5 psi	
	Shockless time	0.03 ± 0.05 sec	
Useful flow		66 L/min 17.4 U.S.gals	
Parking brake release pressure	PG	1.5 to 4.9 MPa 15.3 to 50.0 kgf/cm^2 217.6 to 711.0 psi	
	SH	0.4 ± 0.1 MPa 4.10 ± 1.02 kgf/cm^2 58.0 ± 14.5 psi	
	Hydraulic timer	5.0 ± 1.5 sec	

RY9212148HYM0030US0

[2] FUNCTION AND STRUCTURE

(1) Operating Principles

[A] Motor



RY9212001HYM135A

- The pressurized oil from port A (1) goes through valve plate (3), enters piston (5) inside cylinder block (4) and presses against the swash-plate (6). The pistons receive the counterforce from the swash-plate, part of which becomes rotational force, and the block rotates due to the sum total of the rotational forces exerted by the pistons that the hydraulic oil entered.
- The cylinder block and the shaft (7) are linked via a spline, so rotation is transferred to the shaft.
- When in reverse, hydraulic oil flows in via port B (2) and is discharged via port A.

(1) Port A
(2) Port B
(3) Valve Plate
(4) Cylinder Block
(5) Piston
(6) Swash Plate
(7) Shaft

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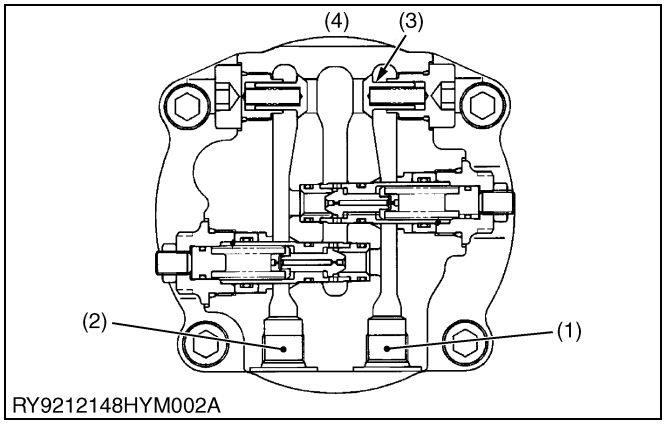
[B] Make Up Circuit



RY9212148HYM002A

- If the swivel is decelerated with pressurized oil supplied via port A (1), the motor rotates due to the inertia of the swiveling equipment, and the motor drives the pump.
- This results in load on the port A side; in order to prevent this, the oil on the return side passes through the poppet (3) in the make up circuit and is supplied to the port A side.

(1) Port A
(2) Port B
(3) Poppet
(4) Port M

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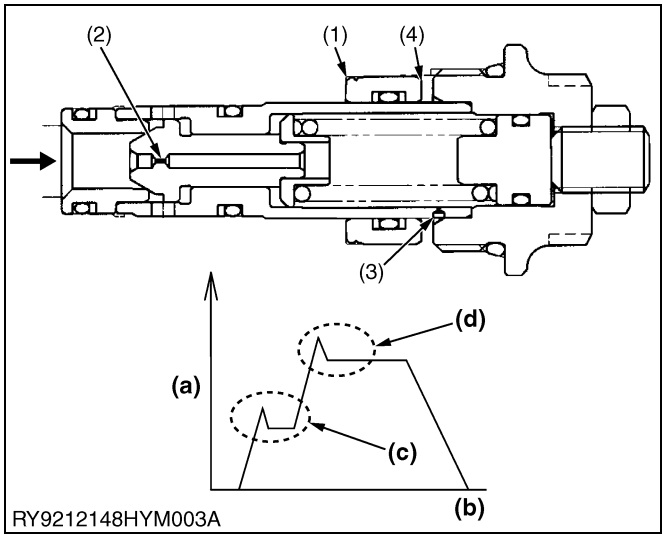
[C] Relief Valve



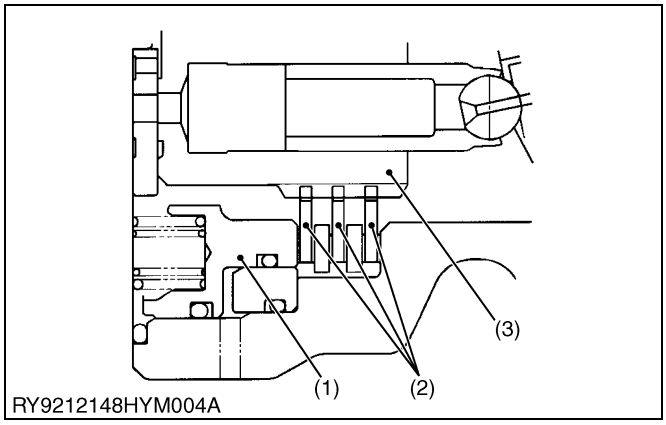
RY9212148HYM003A

- The relief valve is the valve that determines the drive and brake forces during swiveling and it's equipped with main ports A/B lines for each.
- Oil that enters port B is guided to the piston chamber (4) via the relief valve orifice (2) and the body orifice (3). While the piston is moving to the left side, the spring chamber is at low pressure, so it acts on the piston with the low force provided by the spring. (Primary relief pressure)
- When the piston in the diagram reaches the left side, the pressure in the spring chamber rises, and acts on the piston with the total force of the spring and the pressure. (Secondary relief pressure)
- Because of this, the system can suppress dramatic changes in pressure and can mitigate the shock of starting up and stopping the equipment.

(1) Piston
(2) Relief Valve Orifice
(3) Body Orifice
(4) Piston Chamber
(a) Pressure
(b) Time
(c) Primary Relief Pressure
(d) Secondary Relief Pressure

RY9212148HYM0031US0

[D] Parking Brake



RY9212148HYM004A

a) When the parking brake is operated

- When the brake release pressure is interrupted, springs press the brake piston (1) against the disc (2) that meshes with the spline on the circumference of the cylinder block (3).
- Friction holds the cylinder block (3) to the case, preventing it from turning.

(1) Brake Piston
(2) Disc
(3) Cylinder Block

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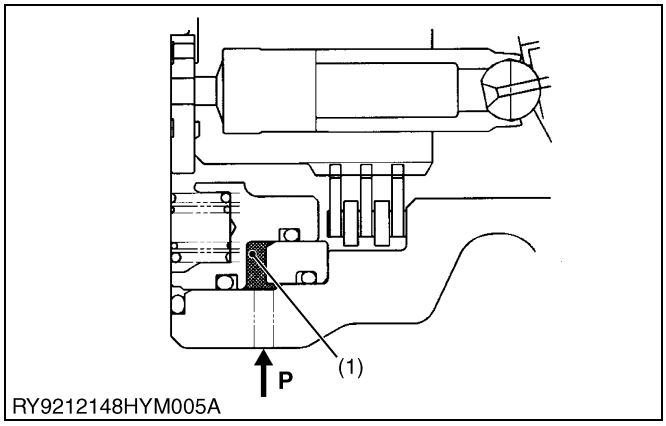


RY9212148HYM005A

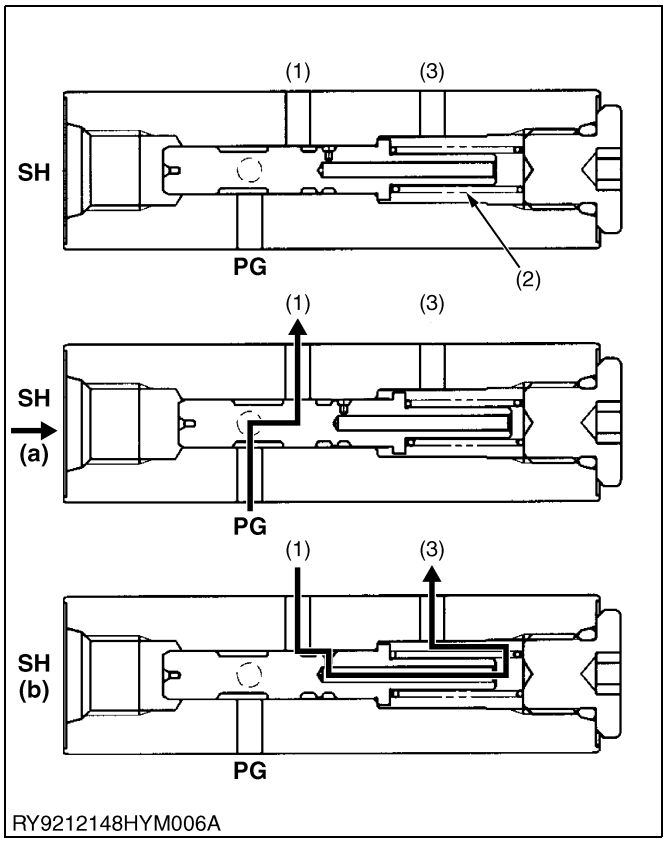
b) When the parking brake is released

- When the brake release pressure is guided to the brake piston chamber (1) via the PG port **(P)**, the release pressure acts against the resistance of the brake piston's spring, eliminating the friction with the disc and allowing the cylinder block to turn freely.

(1) Brake Piston Chamber **P: Port PG**

RY9212148HYM0033US0

[E] Hydraulic Timer



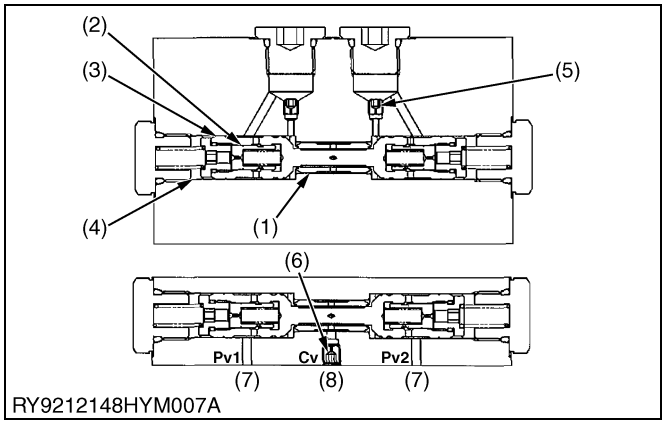
RY9212148HYM006A

- The hydraulic timer is a function for preventing drag on the parking brake when the swivel brake is used and it plays the role of ensuring delayed timing so the parking brake does not operate while hydraulic dynamic braking is absorbing inertial energy from the turning of the swivel; the delayed timing is achieved via flow control through an orifice that slows the discharge of oil from the brake piston chamber (1).
- From the state of the motor turning, when the pilot valve returns to neutral, the pilot valve switch signal and the linked timer valve switch pressure SH go to low pressure, and the brake piston chamber (1) and drain port (3) are linked by the spring (2).
- The pressure on the brake piston chamber (1) moves it in the direction to allow it to press against the disc via the force of the spring acting on the brake piston, but as flow is restricted by the timer valve orifice, until a certain amount of time passes, the brake piston does not touch the disc and the parking brake does not engage.

(1) Brake Piston Chamber **(a) ON**
(2) Spring **(b) OFF**
(3) Drain Port

RY9212148HYM0034US0

[F] Reverse Check Valve

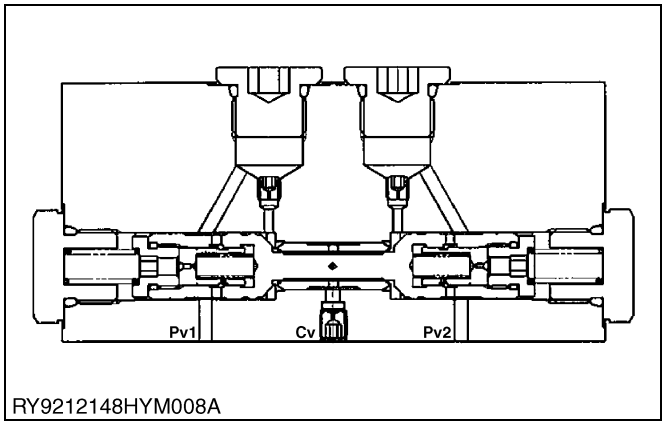


RY9212148HYM007A

- When the motor is stopped, the reverse check valve prevents the swivel body from turning in reverse when it is stopped due to accumulated pressure by linking the motor's main line and makeup line for a certain period of time.

(1) Sleeve
(2) Flow Regulating Valve
(3) Check Valve
(4) Damper Chamber
(5) Orifice A
(6) Orifice B
(7) To High-Pressure Passage
(8) To Makeup

RY9212148HYM0035US0



RY9212148HYM008A

a) In neutral

- The check valve is held in balance in the middle by the spring. (Equal pressure on ports P1 and P2)

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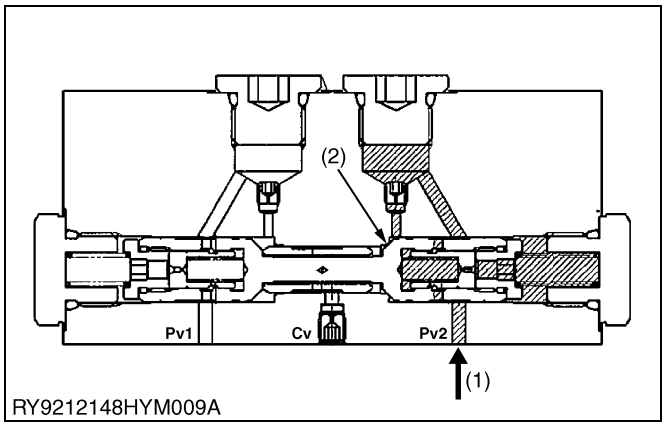


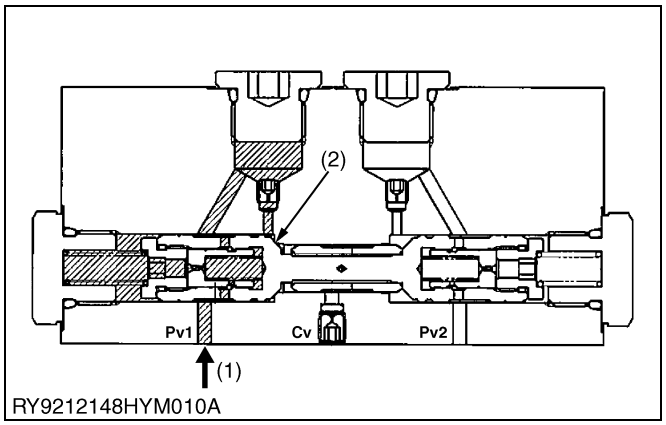
RY9212148HYM009A

b) Acclerating to uniform RPM

- When swiveled, the check valve is pressed on the high-pressure side, seating the check valve.

(1) Supply Pressure
(2) Seat

RY9212148HYM0037US0



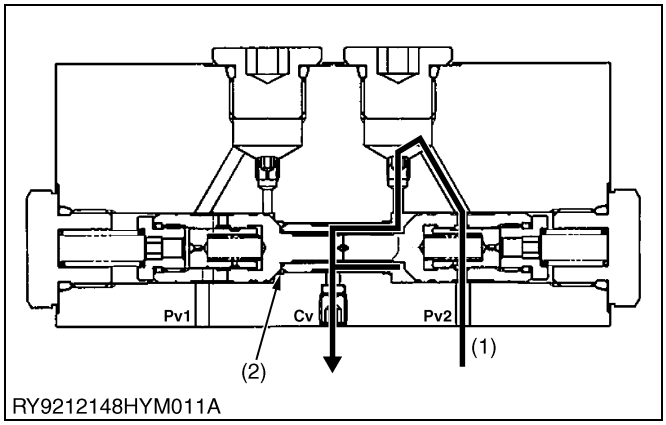
RY9212148HYM010A

c) When braking

- Brake pressure shifts the check valve full stroke, seating it.

(1) Brake Pressure
(2) Seat

RY9212148HYM0038US0



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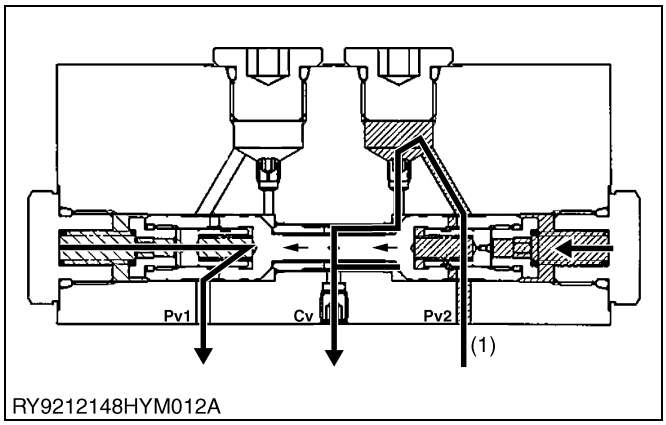
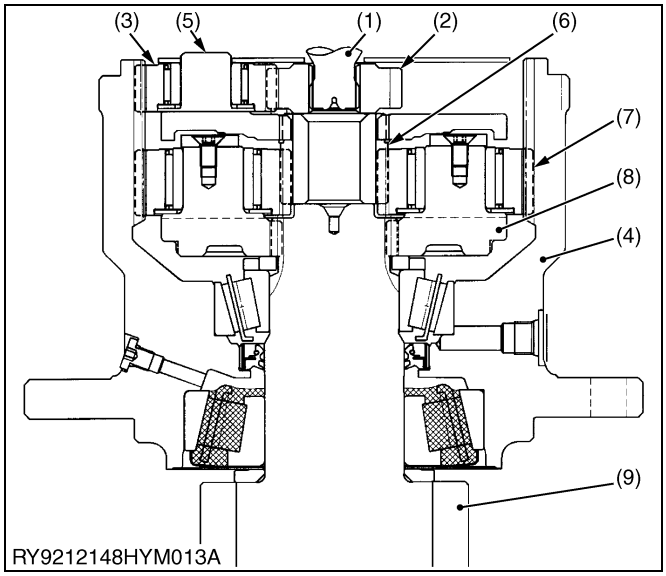


RY9212148HYM012A

[G] Two-Stage Planetary Gear Decelerator



RY9212148HYM013A

d) When reversing 1

- After valve unit braking makes it stop, the motor tries to turn in reverse due to accumulated pressure in its main line.
- This reverse pressure makes the shuttle valve (sleeve) inside the check valve seat on the low-pressure side of the check valve; this forms a passage between the port (Pv2) pressurized by the reverse pressure and the port (Cv) linked by the main line, giving the reverse pressure access to the Cv port.

(1) Reverse Pressure (2) Seat

RY9212148HYM0039US0

e) When reversing 2

- The reverse pressure pushes in the opposite direction during check valve braking at the same time.
- The flow regulating valve inside the check valve, which is now on the low-pressure side, is open at a certain flow rate to oil from inside the damper chamber. As a result, the check valve is shifted at a certain speed.
- The check valve eventually seats, so the passage formed between the Pv2 and Cv ports is blocked.

(1) Reverse Pressure

RY9212148HYM0040US0

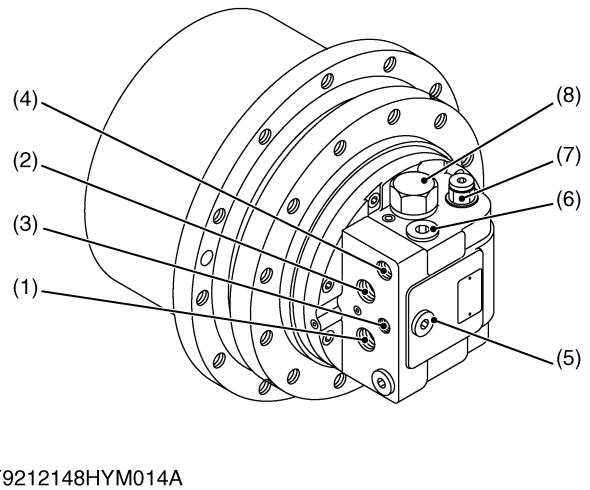
- The motor shaft (1) is coupled to the drive gear (2) and the spline, so the drive force of the motor is transmitted to planetary gear A (3), which meshes with the drive gear (2).
- Planetary gear A (3) meshes with the ring gear of the decelerator housing (4). As a result, when it rotates, it turns around the ring gear.
- Planetary gear A (3) is held to holder (5) by the bearing and the holder (5) transmits the rotary motion of planetary gear A (3) to the sun gear (6), which is coupled to the spline.
- Sun gear (6) meshes with planetary gear B (7) and transmits the rotary motion to planetary gear B (7) in the same way as the first stage.
- As planetary gear B (7) meshes with the ring gear of the housing (4), it rotates around it as it turns.
- Planetary gear B (7) is held to holder (8) by the bearing and the holder (8) transmits the rotary motion of planetary gear B (7) to the pinion shaft, which is coupled to the spline.

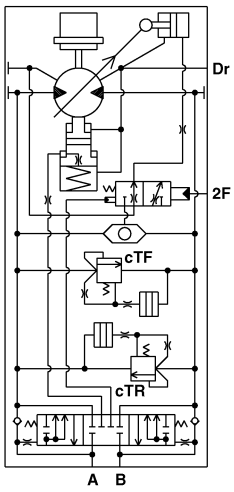
(1) Motor Shaft
(2) Drive Gear
(3) Planetary Gear A
(4) Housing
(5) Holder
(6) Sun Gear
(7) Planetary Gear B
(8) Holder
(9) Pinion Shaft

RY9212148HYM0041US0

6. TRAVEL MOTOR

[1] SPECIFICATIONS





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(1) Port A
(2) Port B
(3) Travel 2-Speed Signal
(4) Drain Port
(5) 2-speed Switch Valve
(6) Anticavitation Valve (Check Valve)
(7) Relief Valve (cTR)
(8) Counterbalance Valve (Spool)

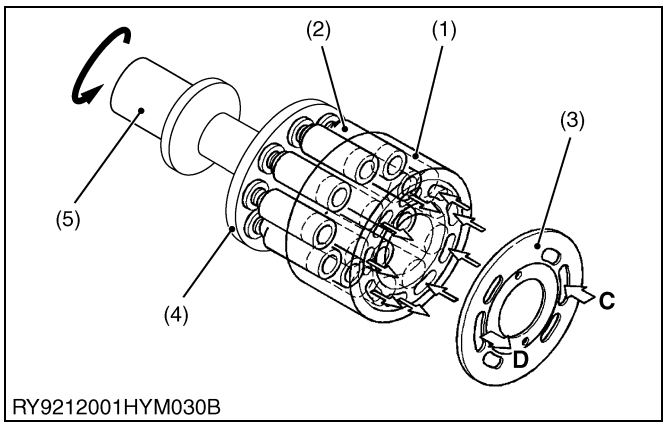
Item			Notes
Maker		Nabtesco	
Model		GM11VA	
Decelerator	Reduction ratio	50.111	
	Output torque (1F/2F)	10720 / 5610 N·m 1093.4 / 572.2 kgf·m 7907.1 / 4137.9 lbf·ft	
	RPM (1F/2F)	27.1 / 49.6 rpm	
Hydraulic motor	Displacement (1F/2F)	51.9 / 27.8 cm^3/rev 3.17 / 1.70 cu.in./rev	
	RPM (1F/2F)	1360 / 2486 rpm	
	Flow Rate	72.0 L/min 19.0 U.S.gals	
	Relief valve (cTF, cTR)	29.4 MPa 300 kgf/cm^2 4264 psi	
	2-speed switch pressure	4.0 MPa 40.8 kgf/cm^2 580 psi	
	Auto 2-speed switch pressure	24.4 MPa 249 kgf/cm^2 3539 psi	
Parking brake	Release pressure	0.63 MPa 6.4 kgf/cm^3 91.4 psi	

RY9212148HYM0042US0

[2] FUNCTION AND STRUCTURE

(1) Operating Principles

[A] Motor



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- Nine pistons (2) are built into the cylinder block (1), and the end section of the block is in contact with a valve plate (3), which has two half-moon shaped ports (port C and port D for switching between high and low pressure).
- If high-pressure oil is guided to port C, the pressurized oil passes through port C and presses on the swash-plate (4). The pistons receive the counterforce from the swash-plate, part of which is converted into rotational force, and the block rotates due to the sum total of the rotational forces exerted by pistons that the hydraulic oil entered.
- The cylinder block and the shaft (5) are linked via a spline, so the rotation is transferred to the shaft.

(1) Cylinder Block
(2) Piston
(3) Valve Plate
(4) Swash Plate
(5) Shaft

C : Port C
D : Port D

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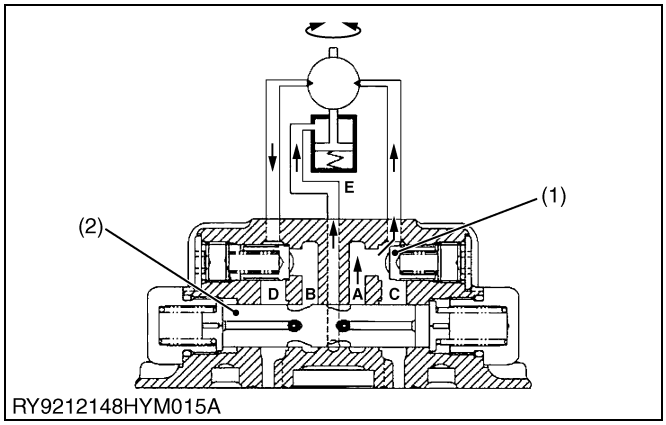
[B] Brake Valve



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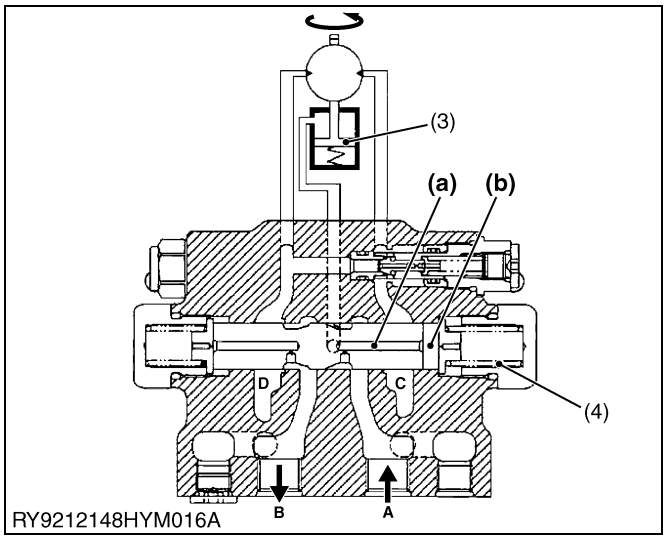


RY9212148HYM016A

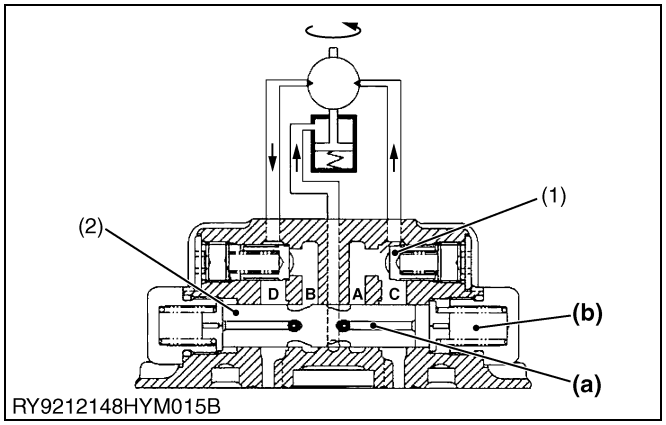
a) During normal operation

- Oil supplied by the pump enters port A and opens the check valve (1). The oil passes through the check valve and goes from port C into the hydraulic motor, providing rotary force to the motor.
- On the other hand, the oil enters port A, passes through line a from the small hole in the spool (2) and enters chamber b. The hydraulic force from chamber b shifts the spool from the center position to the left side.
- The shifting of the spool makes a link between port D and port B, allowing the oil to return from the control valve to the tank and the motor turns.
- In addition, the shifting of the spool allows oil to enter port E. The oil in port E flows to the parking brake (3) and the 2-speed switch valve.

(1) Check Valve
(2) Spool
(3) Parking Brake
(4) Spring

(a) Line a
(b) Chamber b

RY9212148HYM0043US0



RY9212148HYM015B

b) When stopping (brake operation)

- When the oil supplying port A is stopped, the pressure at port A and chamber b drops. As a result of the pressure drop, the spring starts pushing the spool (2) from left to right toward its neutral position. At that time, the oil in chamber b tries to go out toward the port A side via line a inside the spool, but the effect of the orifice in line a creates back pressure, limiting the return speed of the spool.
- Conversely, even though the oil from port A is stopped, the inertial force tries to keep the motor turning, and the oil discharged from the motor tries to return to port B from port D.
  Once the spool returns completely to neutral, the return passage from the spool to the motor is completely cut off and the motor stops.
  The check valve (1) moves under the slightest of loads, opening a passage between the circuit on the port A side and port C of the motor intake, preventing motor cavitation.

(1) Check Valve
(2) Spool
(a) Line a
(b) Chamber b

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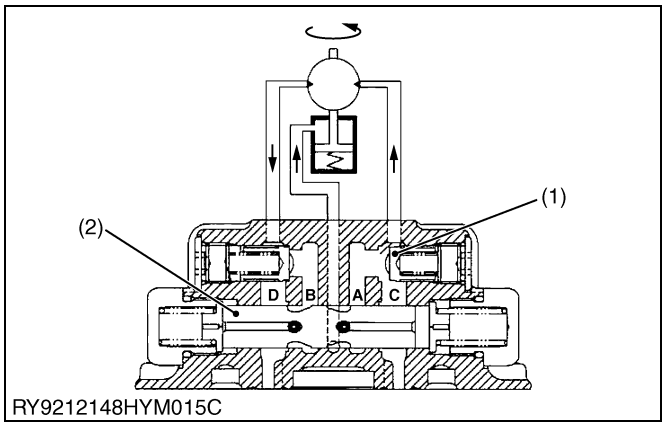

RY9212148HYM015C

c) Runaway check function (for descending steep slopes)

- Under normal operation, the pressure on the supply side drops when the motor is driven by external forces. When the pressure approaches that required to start running away, the spool (2) starts moving toward the neutral position in the middle.
- The surface area in the passage to port B from port D on the motor outlet side drops in relation to the distance the spool moves, limiting the amount of oil discharged. At the same time, the pressure at port D (back pressure) rises as well, preventing the machine from running away down a hill.

(1) Check Valve
(2) Spool

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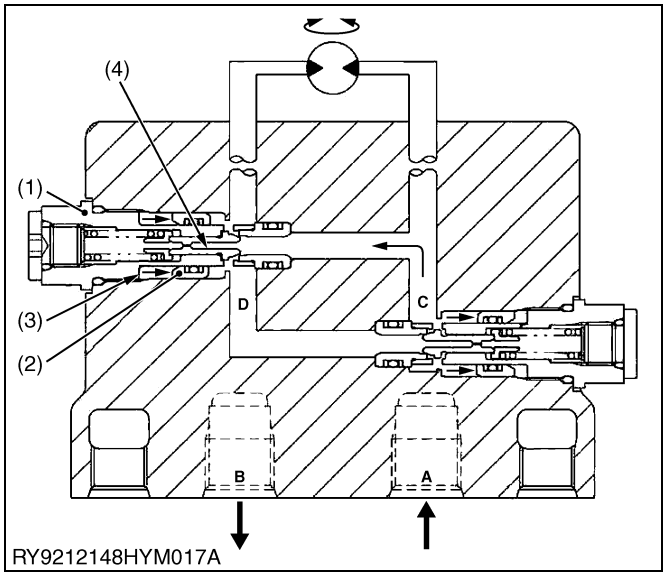
[C] Relief Valve



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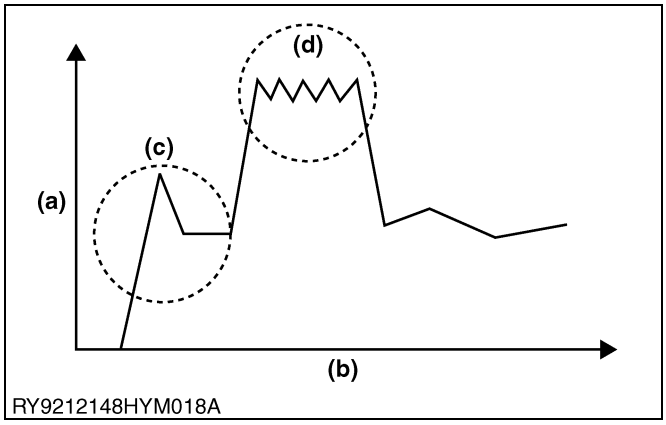


RY9212148HYM018A

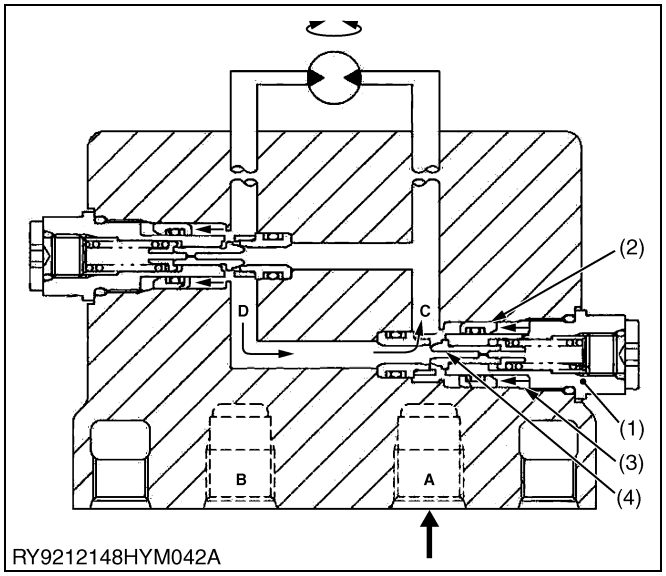
a) At start up

- Until the position of piston h (2) of relief valve B (1) reaches the end of its stroke, the oil from port C is released at the pressure setting (low-pressure relief) of valve e (4) and is guided to port D.
- When piston h (2) reaches the end of its stroke, the pressure in chamber y (3) rises, and valve e (4) closes and the main relief valve of the control valve opens.
- These mechanisms raise the pressure at port C, applying rotary force to the motor.

(1) Relief Valve B
(2) Piston h
(3) Chamber y
(4) Valve e

(a) Pressure
(b) Time
(c) Low-Pressure Relief
(d) Main Relief

RY9212148HYM0046US0



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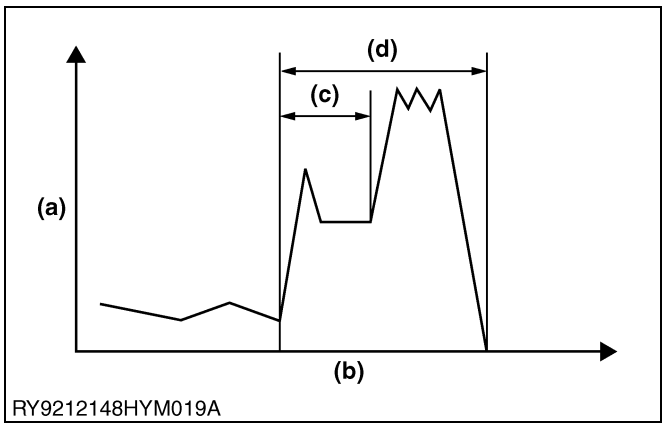

RY9212148HYM019A

b) When stopping

- Once the counterbalance valve returns to neutral, it cuts off port D on the outlet side, and as the motor keeps turning due to inertia, it increases the pressure inside port D.
- The oil inside port D passes through the orifice inside relief valve A (1) and is guided to chamber x (3). Until the oil supplied to chamber x (3) shifts the position of piston d (2) and it reaches the end of its stroke, the oil from port D is released at the pressure setting (low-pressure relief) of valve a (4) and is guided to port C. The supply of oil to port C prevents cavitation.
- Once piston d (2) reaches the end of its stroke, the pressure in chamber x (3) rises, closing valve a (4) and acting with the total force of the spring and the pressure inside chamber x. (Secondary relief pressure)
  The mechanisms above stop the motor.

(1) Relief Valve A
(2) Piston d
(3) Chamber x
(4) Valve a

(a) Pressure
(b) Time
(c) Low-Pressure Relief (Primary Relief Pressure)
(d) Relief Valve A Release Timing

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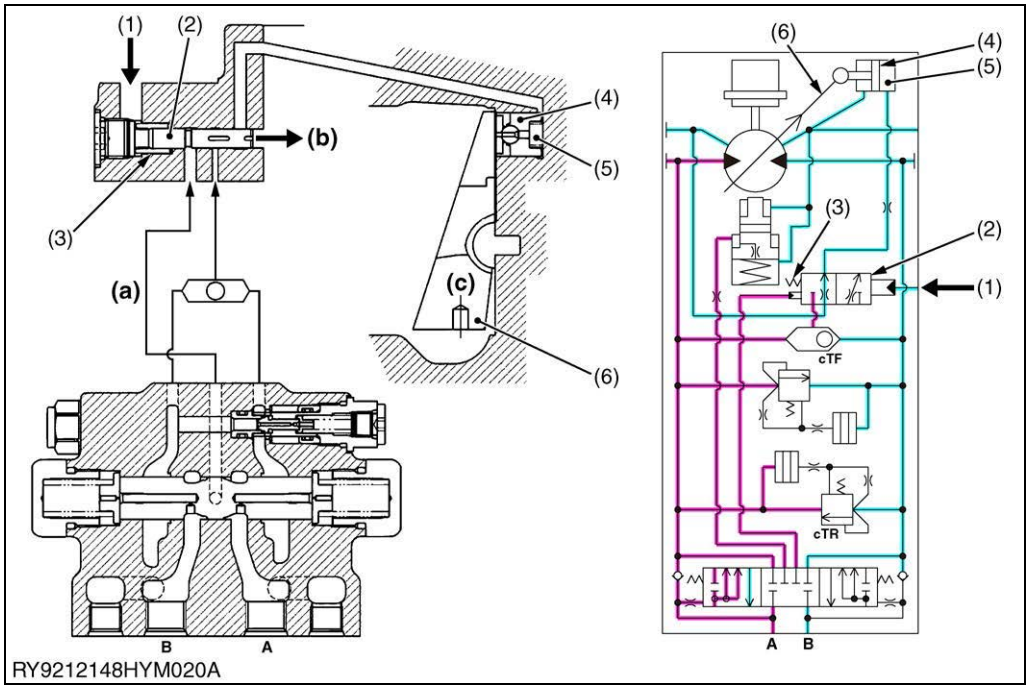
[D] Auto-decelerator Function



RY9212148HYM020A

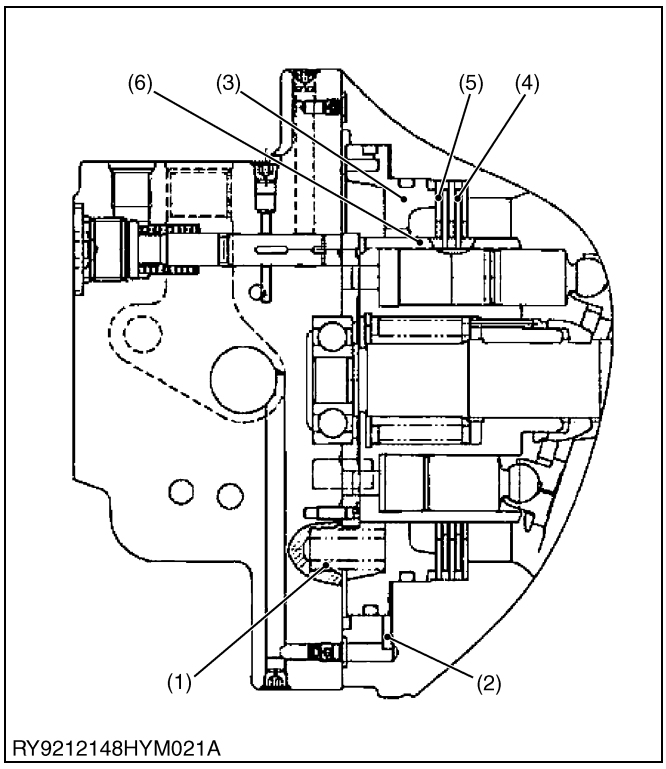
(1) 2-Speed Port
(2) Ridged Spool
(3) Spring
(4) 2-Speed Switch Piston
(5) S Chamber
(6) Swash-Plate

(a) Motor Load Pressure
(b) Drain
(c) Fulcrum

- This function gives priority to power for traveling and when the excavator is traveling in the 2nd speed, if the travel load becomes great, such as when climbing or turning, it automatically decelerates to 1st speed (low-speed). When the load is low, it returns to the 2nd speed (high-speed).
- When the speed button on top of the blade lever is pressed, it actuates the solenoid of the unload valve, thus guiding oil from the pilot pump to the 2-speed port (1). When pressure oil flows to the 2-speed port, it moves the ridged spool (2) to the right.
- Conversely, when the load **(a)** on the motor rises, pressure is guided against the small area of the ridged spool (2), overcoming the pilot pressure and pressing the ridged spool (2) to the left, which releases the oil in chamber S (5) to the drain via the ridged spool.

RY9212148HYM0048US0

[E] Parking Brake



RY9212148HYM021A

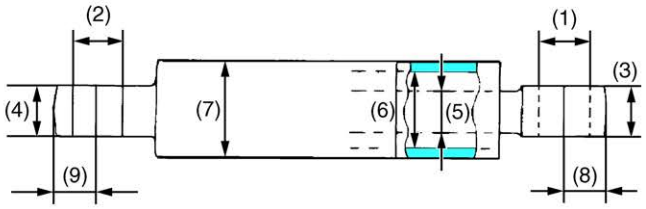
- The parking brake is a negative brake composed of a rotating disc (friction material) (4), an opposing plate (5) a brake piston (3) and a spring (1).
- When the travel motor is stopped (the travel lever in neutral), the parking brake takes effect.
- The cylinder block (6) and the disc are linked via a spline and a friction material is applied to both sides of the disc. The disc is spring-loaded and friction is generated between the flange holder and the brake piston, and this limits the force with which the motor can turn, allowing it to function as a parking brake
- When pressurized oil is guided into the brake piston chamber (2), it generates an amount of thrust that matches the area of the brake piston that receives the pressure and overcomes the spring, thus moving the brake piston. The disk rotates freely between the flange holder and the brake piston, eliminating the parking brake function.

(1) Spring
(2) Brake Piston Chamber
(3) Brake Piston
(4) Disc (Friction Material)
(5) Opposing Plate (Plate)
(6) Cylinder Block

RY9212148HYM0003US0

7. HYDRAULIC CYLINDER

[1] SPECIFICATIONS



RY9212148HYM022A

	Boom	2P boom	Arm	Bucket	Blade	Swing
(1)	82 mm 3.23 in.	82 mm 3.23 in.	70 mm 2.76 in.	70 mm 2.76 in.	82 mm 3.23 in.	82 mm 3.23 in.
(2)	82 mm 3.23 in.	82 mm 3.23 in.	70 mm 2.76 in.	70 mm 2.76 in.	82 mm 3.23 in.	82 mm 3.23 in.
(3)	90 mm 3.54 in.	65 mm 2.56 in.	85 mm 3.35 in.	75 mm 2.95 in.	75 mm 2.95 in.	80 mm 3.15 in.
(4)	90 mm 3.54 in.	65 mm 2.56 in.	85 mm 3.35 in.	75 mm 2.95 in.	75 mm 2.95 in.	80 mm 3.15 in.
(5)	65 mm 2.56 in.	55 mm 2.17 in.	60 mm 2.36 in.	55 mm 2.17 in.	60 mm 2.36 in.	60 mm 2.36 in.
(6)	115 mm 4.53 in.	95 mm 3.74 in.	100 mm 3.94 in.	90 mm 3.54 in.	110 mm 4.33 in.	110 mm 4.33 in.
(7)	134 mm 5.28 in.	112 mm 4.41 in.	118 mm 4.65 in.	106 mm 4.17 in.	130 mm 5.12 in.	130 mm 5.12 in.
(8)	57 mm 2.24 in.	65 mm 2.56 in.	55 mm 2.17 in.	60 mm 2.36 in.	65 mm 2.56 in.	65 mm 2.56 in.
(9)	65 mm 2.56 in.	55 mm 2.17 in.	58 mm 2.28 in.	55 mm 2.17 in.	65 mm 2.56 in.	65 mm 2.56 in.
Max compressed length	1369 mm 53.90 in.	1050 mm 41.34 in.	1378 mm 54.25 in.	1138 mm 44.80 in.	689 mm 27.13 in.	1165 mm 45.87 in.
Stroke	878 mm 34.57 in.	578 mm 22.76 in.	912 mm 35.91 in.	747 mm 29.41 in.	250 mm 9.84 in.	715 mm 28.15 in.

RY9212724HYM0035US0

[2] FUNCTION AND STRUCTURE

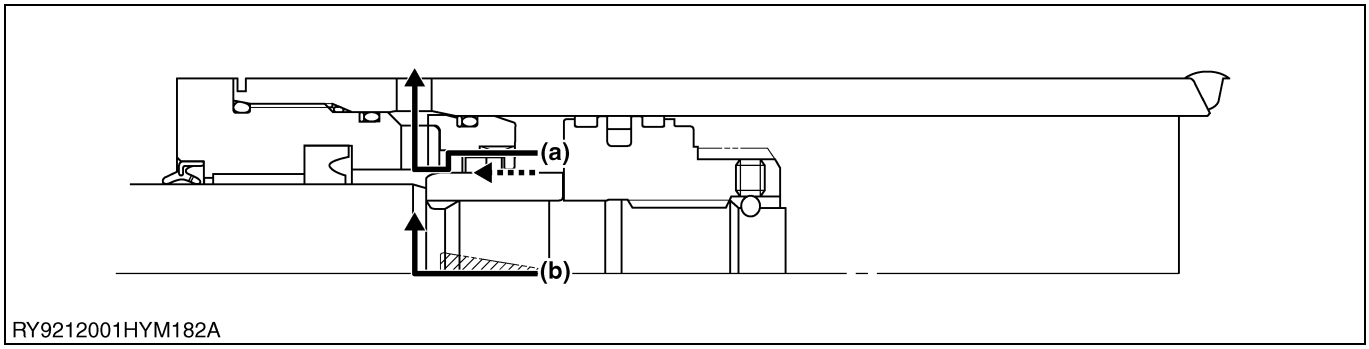
(1) Operating Principles

• Cushion Function

The device is equipped with a cushion to prevent spilling of earth or the like when it reaches the end of the cylinder.

RY9212148HYM0050US0

Cushion function on the lift end of the boom



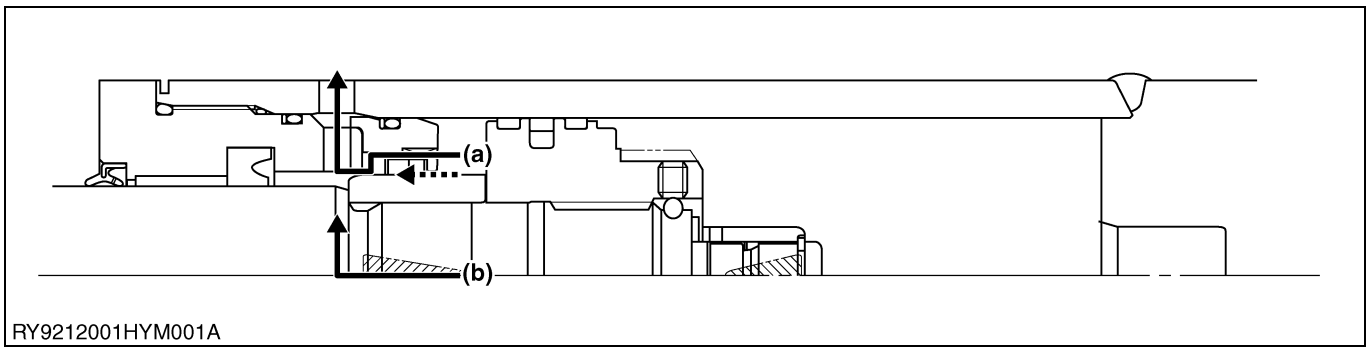
RY9212001HYM182A

(a) Flow Via a Slit **(b) Flow from Indentation**

The discharge pressurized oil is automatically reduced on the lift end of the boom, slowing the operation of the cylinder and cushioning the shock on the lift end of the boom. An indentation and a split in the cushion bearing are provided as a means to reduce the pressure.

RY9212148HYM0027US0

Cushion function on the rake end of the arm



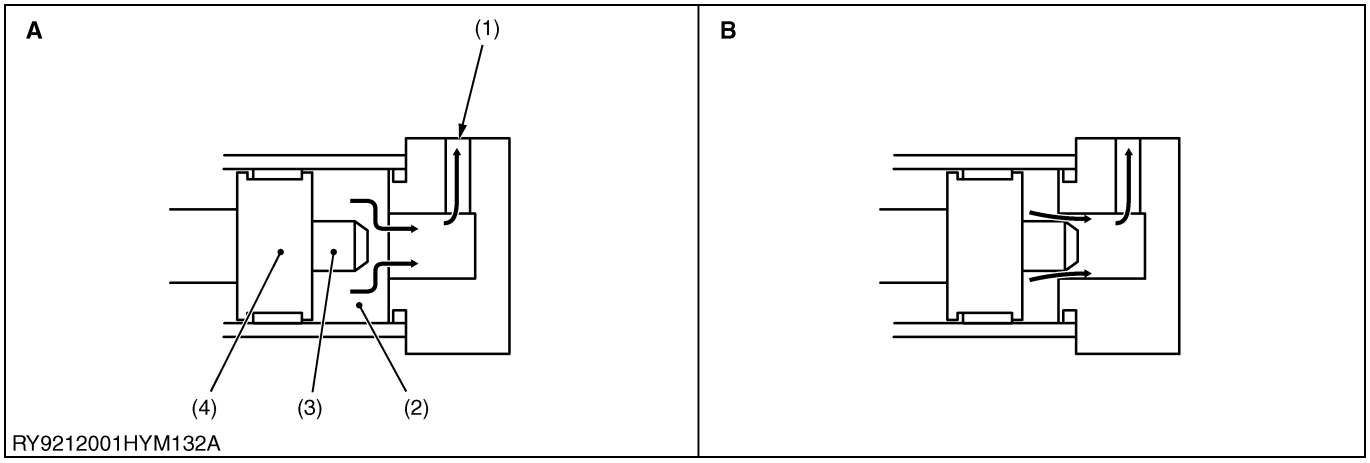
RY9212001HYM001A

(a) Flow Via a Slit **(b) Flow from Indentation**

The discharge pressurized oil is automatically reduced on the rake end of the arm, slowing the operation of the cylinder and cushioning the shock on the rake end of the arm. An indentation and a split in the cushion bearing are provided as a means to reduce the pressure.

RY9212148HYM0028US0

Cushion function on dumping end of arm



(1) Port
(2) Cushion Chamber
(3) Cushion Plunger
(4) Piston

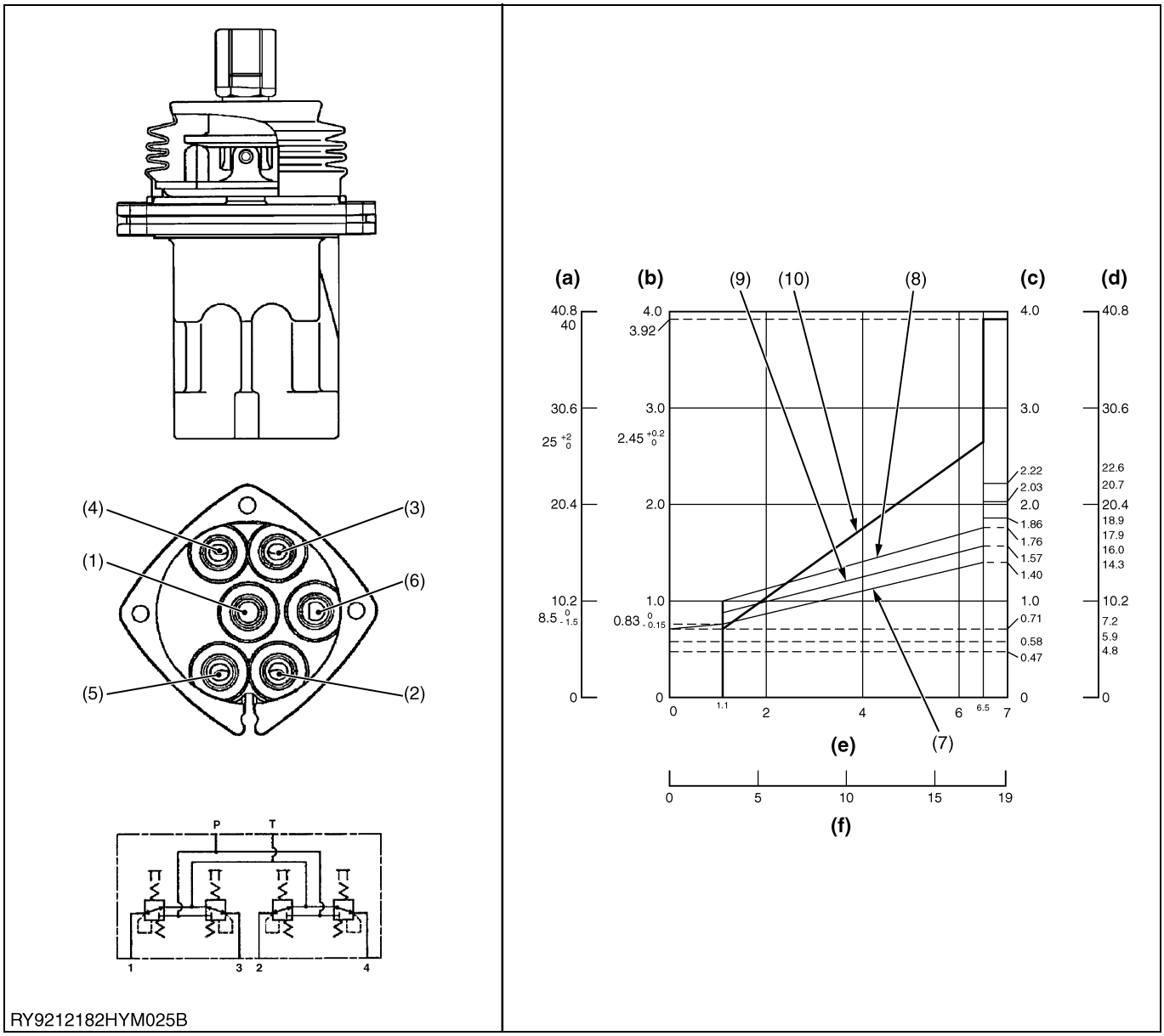
A : Before Cushion Enters
B : After Cushion Enters

RY9212148HYM0029US0

8. PILOT VALVE

[1] CONTROL PILOT VALVES

(1) Specifications



RY9212182HYM025B

(1) Port P
(2) Port 1 (Left)
(3) Port 2 (Front)
(4) Port 3 (Right)
(5) Port 4 (Rear)
(6) Port T
(7) Independent operation torque (ports 1, 3)
(8) Independent operation torque (port 2)
(9) Independent operation torque (port 4)
(10) Secondary pressure

(a) Secondary pressure (kgf/cm^2)
(b) Secondary pressure (MPa)
(c) Operating torque (N·m)
(d) Operating torque (kgf·cm)
(e) Pushrod stroke (mm)
(f) Operating angle (deg)

Maker		Kawasaki Heavy Industries, Ltd.
Model	Left	PV48M2199
	Right	PV48M2198

RY9212148HYM0004US0

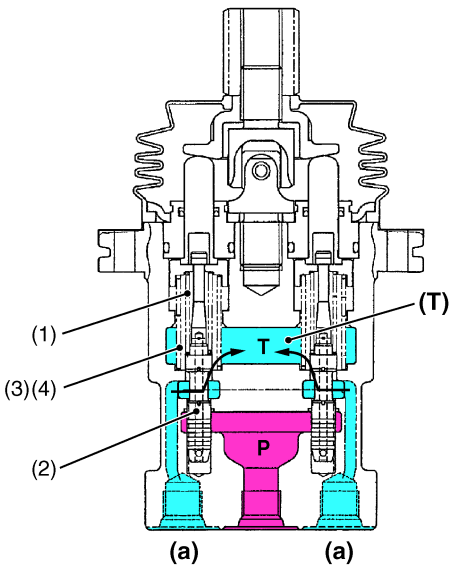
(2) Function and Structure

[A] Function

The pilot valve is the valve that controls the direction and volume of the stroke of the control valve, and lowers the primary pressure from the unload valve to a secondary pressure only as much as is necessary to move the control valve spool.

RY9212001HYM0001US0

[B] Operation



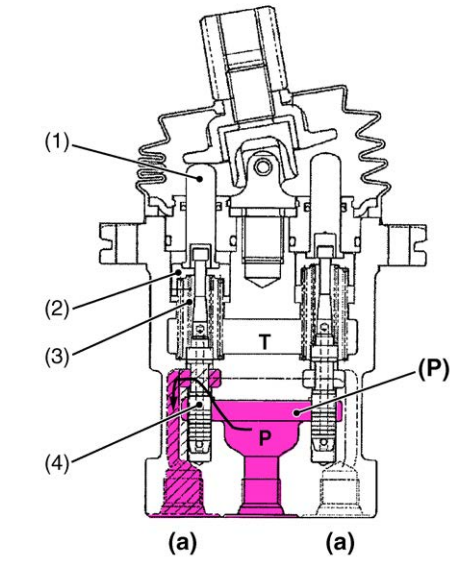
RY9212001HYM017C

1. When the control lever is in neutral

The force of the secondary pressure spring (1) does not press on the spool (2). As a result, the spool is held in a neutral position by the return spring (3) or (4). At such time, the output port (control valve port) **(a)** and port T **(T)** are connected.

(1) Secondary Pressure Spring **(a) Output Port**
(2) Spool **(T) Port T**
(3) Return Spring
(4) Return Spring

RY9212148HYM0005US0



RY9212001HYM018B

2. When the control lever has been actuated

When the control lever is actuated, the pushrod (1) presses down on the spool (4) via the spring seat (2) and the secondary pressure spring (3). In doing so, port P **(P)** and the output port **(a)** are connected, so the oil from the pilot pump flows through the output port to the control valve.

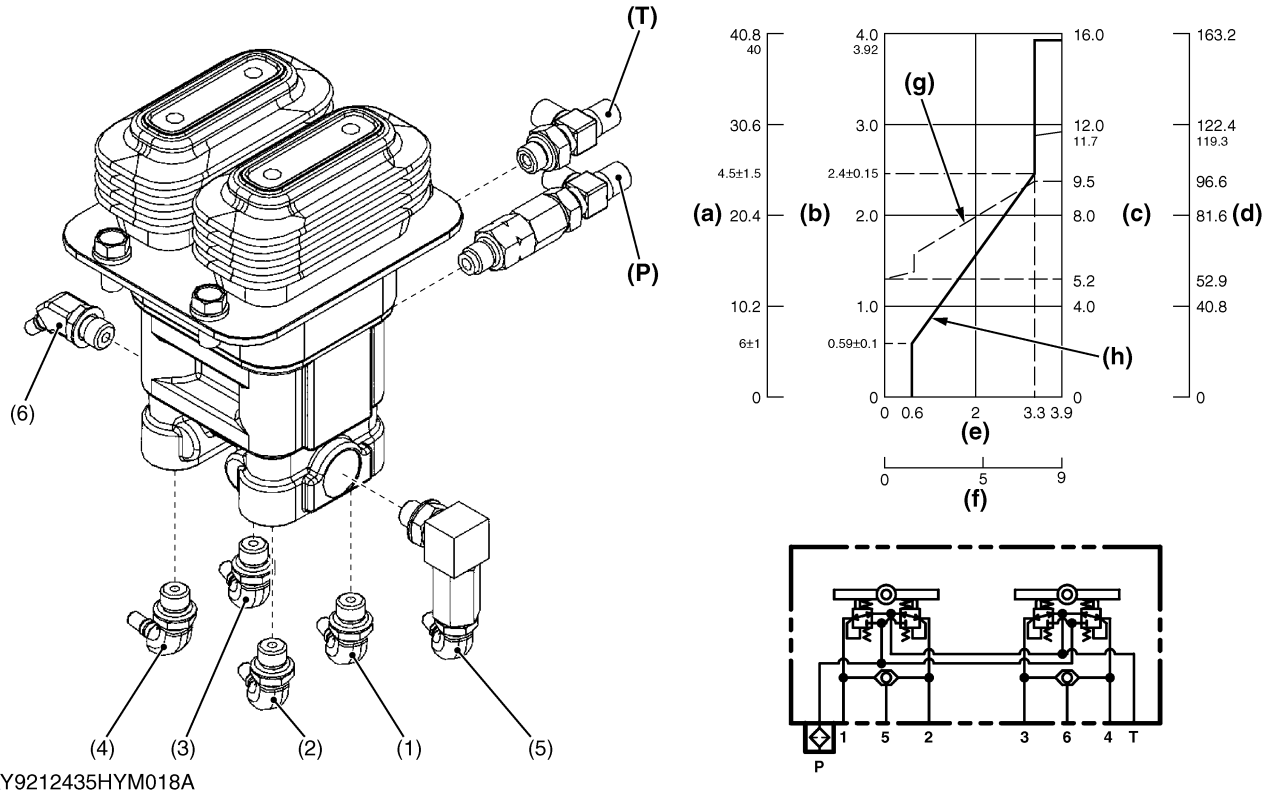
The pressure at the output port rises until it is equivalent to the force of the secondary pressure spring, thus balancing the hydraulic pressure on the spool with the tension of the secondary pressure spring and maintaining a fixed output port pressure.

(1) Pushrod **(a) Output Port**
(2) Spring Seat **(P) Port P**
(3) Secondary Pressure Spring
(4) Spool

RY9212148HYM0006US0

[2] TRAVEL PILOT VALVE

(1) Specifications



RY9212435HYM018A

(1) Port 1 (L Bwd)
(2) Port 2 (L Fwd)
(3) Port 3 (R Bwd)
(4) Port 4 (R Fwd)
(5) Port 5
(6) Port 6

(a) Secondary Pressure (kgf/cm^2)
(b) Secondary Pressure (MPa)
(c) Operating Torque (N·m)
(d) Operating Torque (kgf·cm)
(e) Pushrod Stroke (mm)
(f) Operating Angle (deg)
(g) Operating Torque
(h) Secondary Pressure
(P) Port P
(T) Port T

Maker	Kawasaki Heavy Industries, Ltd.
Model	PVD8PC6004A

RY9212435HYM0020US0

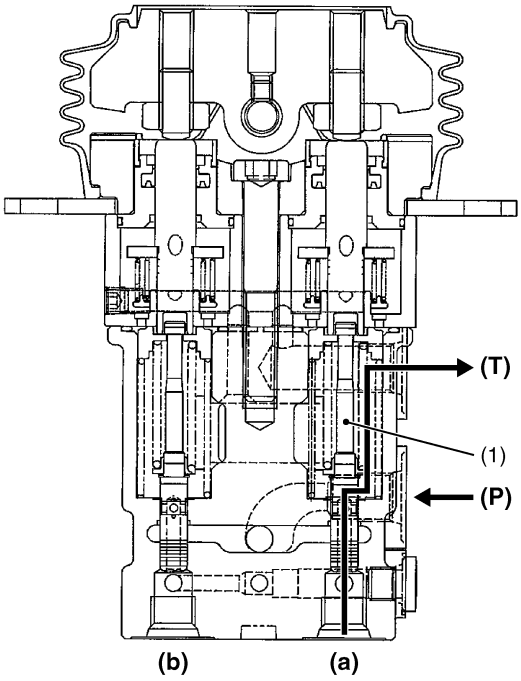
(2) Function and Structure

[A] Function

The pilot valve is the valve that controls the direction and volume of the stroke of the control valve, and lowers the primary pressure from the unload valve to a secondary pressure only as much as is necessary to move the control valve spool.

RY9212001HYM0001US0

[B] Operation



RY9212435HYM002A

1. When the control lever is in neutral

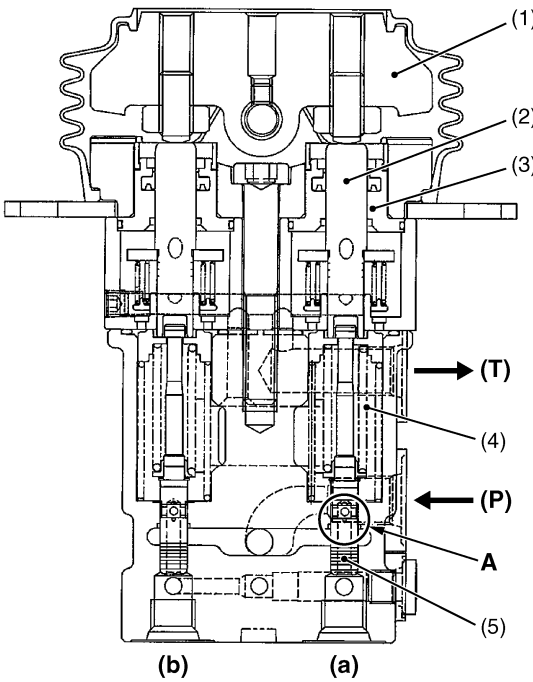
The oil from the pilot pump that flows into Port P **(P)** via the unload valve is cut off from port T **(T)** and port 1 **(a)** by the spool (1).

And port 1 is connected to port T through the inside of the spool, so port 1 is at the tank pressure.

(1) Spool

(a) Port 1
(b) Port 2
(P) Port P
(T) Port T

RY9212435HYM0005US0



RY9212435HYM002B

2. When the control lever has been actuated (when governing pressure)

When the cam (1) operating angle exceeds 1.9°, the pushrod (2) presses down on the spool (5) via the spring seat (3) and the secondary pressure spring (4).

At part A, port P **(P)** and port 1 **(a)** are connected, while port 1 and port T **(T)** at part **A** are cut off, so the oil flows from port P to port 1.

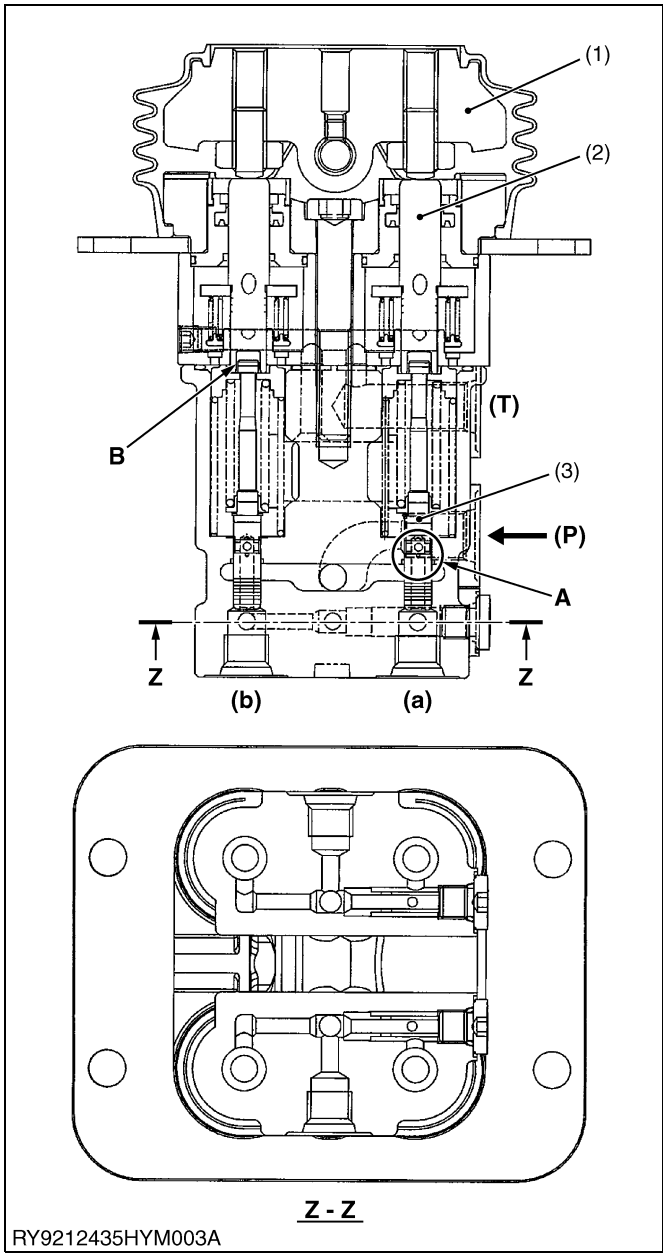
When the pressure at port 1 gets high enough, it counters the secondary pressure spring and presses the spool up, thus cutting off port P and port 1 at part **A** and allowing port 1 and port T to be connected and lowering the pressure at port 1. The repetition of this process maintains a constant pressure equal to the secondary pressure spring load.

If the cam is depressed further, the position of the spool does not change and the pushrod and spring seat move downwards, compressing the secondary pressure spring and putting a large load on the spring; this generates pressure equivalent to this load at port 1.

(1) Cam
(2) Pushrod
(3) Spring seat
(4) Secondary pressure spring
(5) Spool

(a) Port 1
(b) Port 2
(P) Port P
(T) Port T

RY9212435HYM0006US0



RY9212435HYM003A

3. When the control lever has been actuated (when shorted)

Once the pushrod on cam (1) exceeds a stroke of 3.3mm (0.13 in.), the pushrod (2) touches the spool (3) at point **B** and the spool (3) stops providing control by balancing the pressure. As a result, part **A** is left open and the pressures of port P and port 1 equalize.

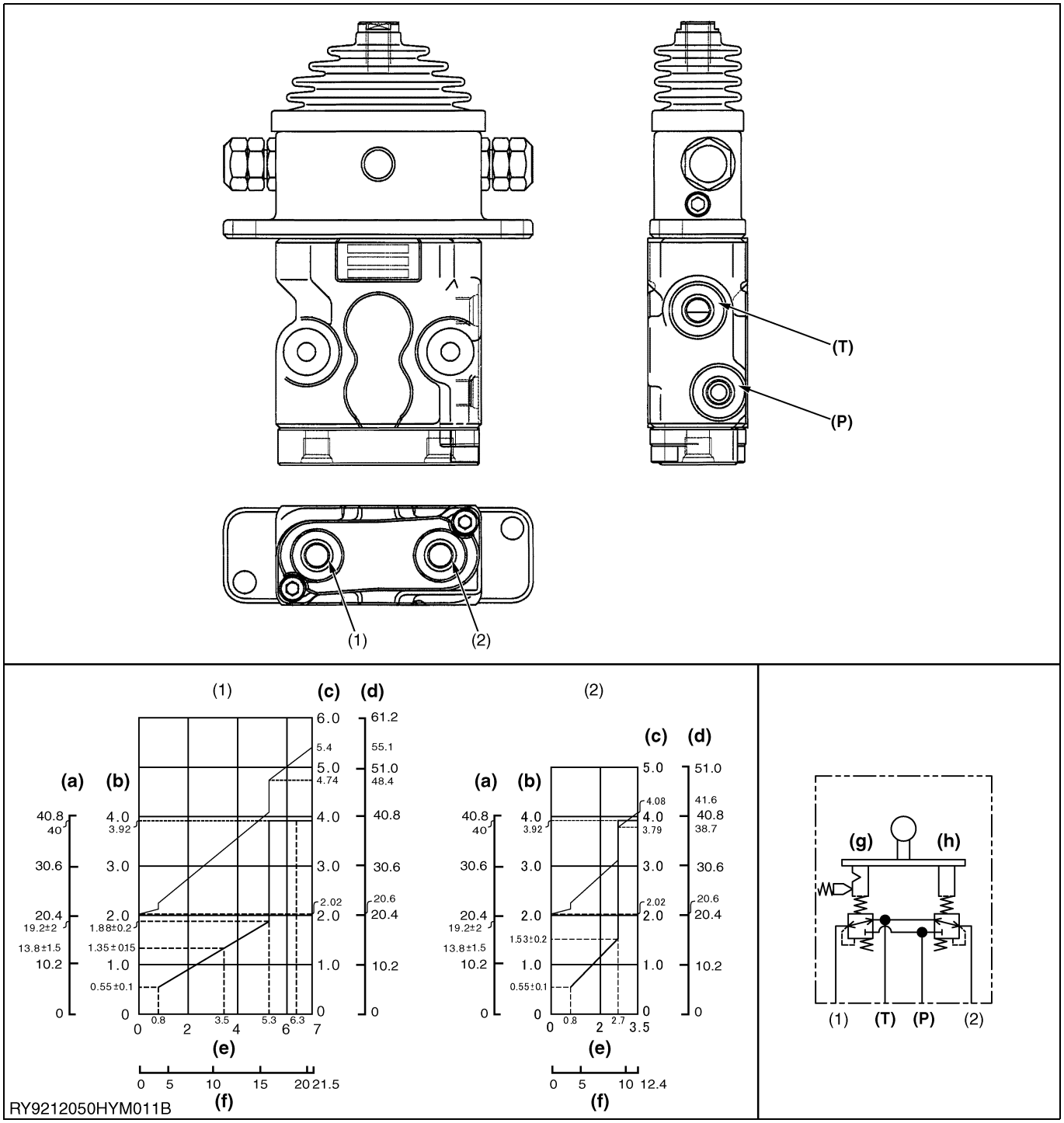
(1) Cam
(2) Pushrod
(3) Spool

(a) Port 1
(b) Port 2
(P) Port P
(T) Port T

RY9212435HYM0007US0

[3] BLADE PILOT VALVES

(1) Specifications



(1) Port 1
(2) Port 2
(P) Port P
(T) Port T

(a) Secondary Pressure (kgf/cm^2)
(b) Secondary Pressure (MPa)
(c) Operating Torque (N·m)
(d) Operating Torque (kgf·m)
(e) Pushrod stroke (mm)
(f) Operating Angle (deg)
(g) Down
(h) Up

Maker	Kawasaki Heavy Industries, Ltd.
Model	TH40P1048B

RY9212158HYM0004US0

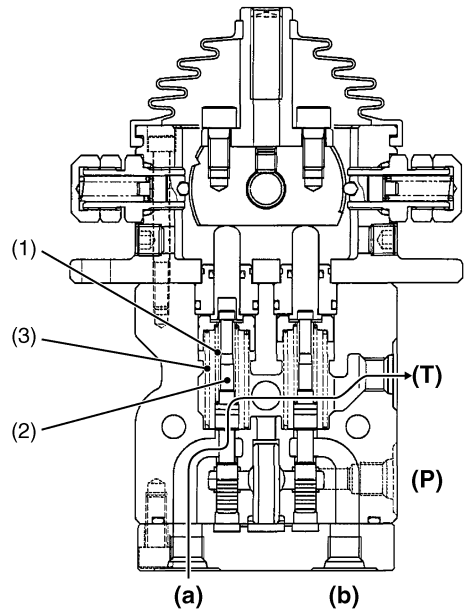
(2) Function and Structure

[A] Function

The pilot valve is the valve that controls the direction and volume of the stroke of the control valve, and lowers the primary pressure from the unload valve to a secondary pressure only as much as is necessary to move the control valve spool.

RY9212001HYM0001US0

[B] Operation



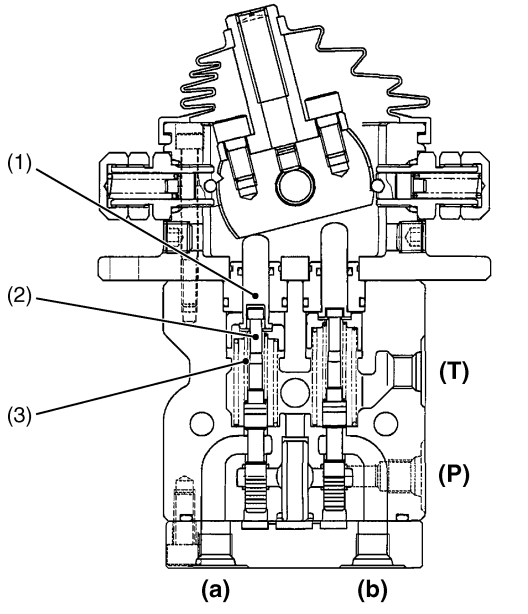
RY9212050HYM013B

1. When the control lever is in neutral

The force of the secondary pressure spring (1) does not press on the spool (2). Consequently, spool (2) is pushed up by the return spring (3), and port 1 **(a)**and port T **(T)** are connected.

(1)	Secondary Pressure Spring	**(a)**	**Port 1**
(2)	Spool	**(b)**	**Port 2**
(3)	Return Spring	**(P)**	**Port P**
		(T)	**Port T**

RY9212158HYM0005US0



RY9212050HYM014C

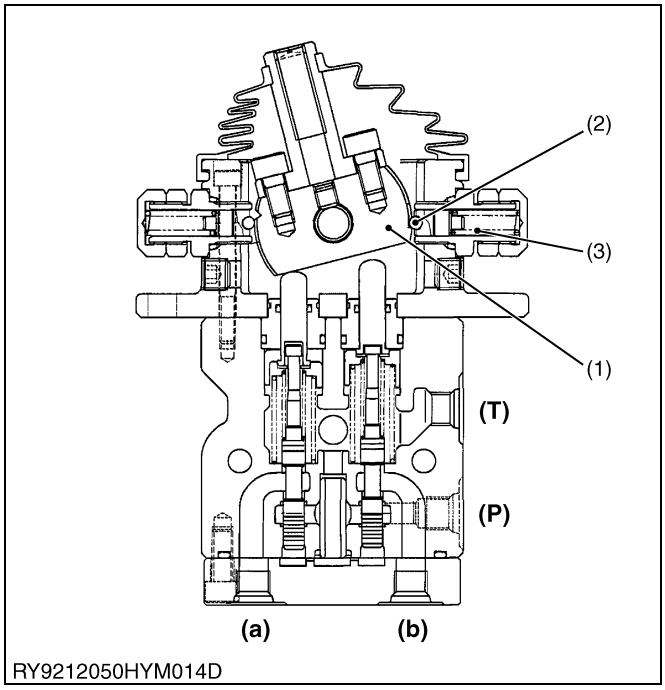
2.When the control lever has been actuated

When the control lever is tilted and pushrod (1) goes through its stroke, spool (2) moves downwards, port P**(P)**and port 1 **(a)** are connected, and oil from the pilot pump flows via port 1 to the control valve.

The pressure at the port rises until it is equivalent to the force of the secondary pressure spring (3), thus balancing the hydraulic pressure on the spool with the tension of the secondary pressure spring and maintaining a fixed port pressure.

(1)	Pushrod	**(a)**	**Port 1**
(2)	Spool	**(b)**	**Port 2**
(3)	Secondary Pressure Spring	**(P)**	**Port P**
		(T)	**Port T**

RY9212158HYM0006US0



RY9212050HYM014D

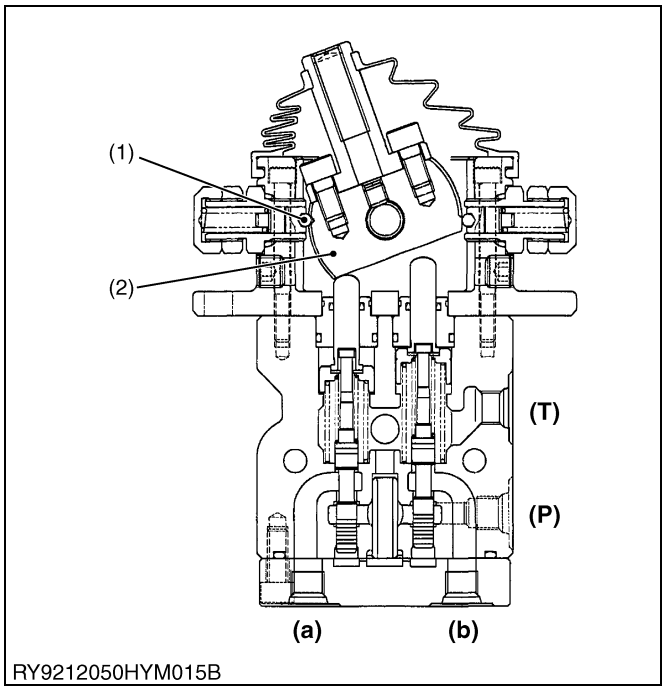
3. Pre-detent operation

Pre-detent is activated at a specified operating angle. When steel ball (2) in the stepped section of the disc (1) passes the step, operating torque increases owing to compression of the spring (3). Due to this change in operating torque, the operator knows he is close to the actuation angle of detent operation at a predetermined actuation angle.

(1) Disc
(2) Steel Ball
(3) Spring

(a) Port 1
(b) Port 2
(P) Port P
(T) Port T

RY9212158HYM0007US0



RY9212050HYM015B

4. When detent is activated

At the detent operation activation angle before the end of stroke, the steel ball (1) slides into the V-shaped groove of the disc (2), which is detent operation status.

If the operator releases the lever during detent operation, the lever control angle is maintained and a fixed secondary pressure continues to be applied.

(1) Steel Ball
(2) Disc

(a) Port 1
(b) Port 2
(P) Port P
(T) Port T

RY9212158HYM0008US0

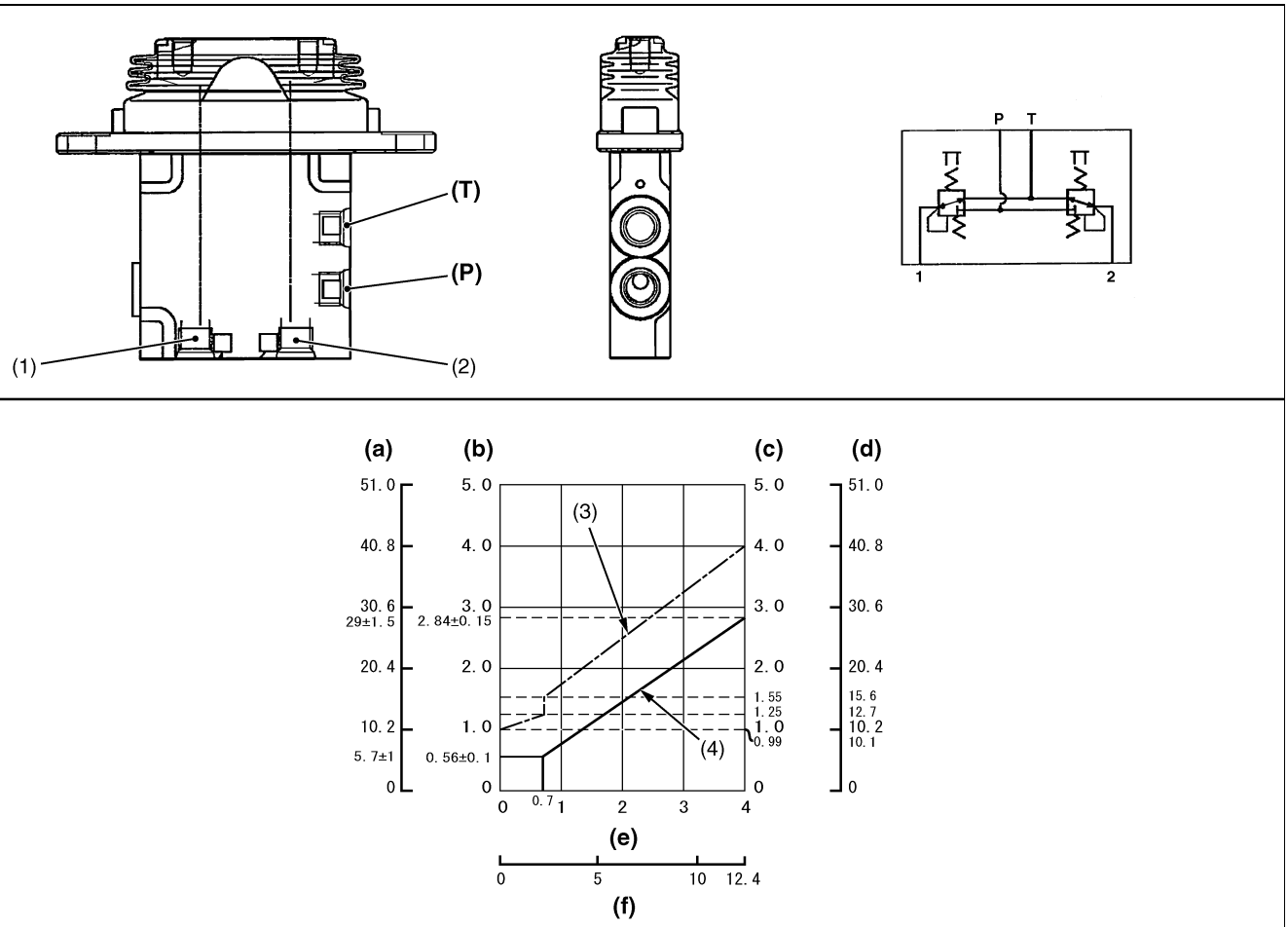
5. When detent is released

Detent can be released manually by applying a force greater than the release torque to the operating lever in the direction of neutral.

RY9212050HYM0022US0

[4] SWING AND TWO PIECE BOOM PILOT VALVES

(1) Specifications



RY9212435HYM004A

(1) Port 1
(2) Port 2
(3) Operating torque
(4) Secondary pressure

(a) Secondary pressure (kgf/cm^2)
(b) Secondary pressure (MPa)
(c) Operating torque (N·m)
(d) Operating torque (kgf·cm)
(e) Pushrod stroke (mm)
(f) Pedal operating angle (deg)
(P) Port P
(T) Port T

- **For swing**

Maker	Kawasaki Heavy Industries, Ltd.
Model	PV6P1005A

RY9212724HYM0004US0

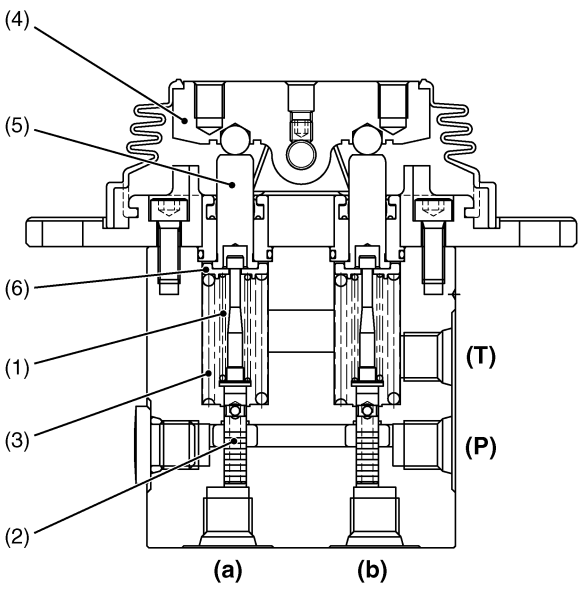
(2) Function and Structure

[A] Function

The pilot valve is the valve that controls the direction and volume of the stroke of the control valve, and lowers the primary pressure from the unload valve to a secondary pressure only as much as is necessary to move the control valve spool.

RY9212001HYM0001US0

[B] Operation



RY9212001HYM019B

1. When the control lever or pedal is in neutral

The force of the secondary pressure spring (1) does not press on the spool (2). As a result, the spool is held in a neutral position by the return spring (3). At such time, the output ports (ports to the control valve port) port 1 **(a)** and port 2 **(b)**) and port T **(T)** are connected.

2. When a control lever or pedal has been actuated

The cam (4) is turned counterclockwise, the port 1 side pushrod (5) presses down on the spool (2) via the spring seat (6) and the secondary pressure spring (1). When doing so, port P **(P)** and port 1 **(a)** are connected, so the oil from the pilot pump flows through port 1 to the control valve.

The pressure at port 1 rises until it is equivalent to the force of the secondary pressure spring, thus balancing the hydraulic pressure on the spool with the tension of the secondary pressure spring and maintaining a fixed port 1 pressure.

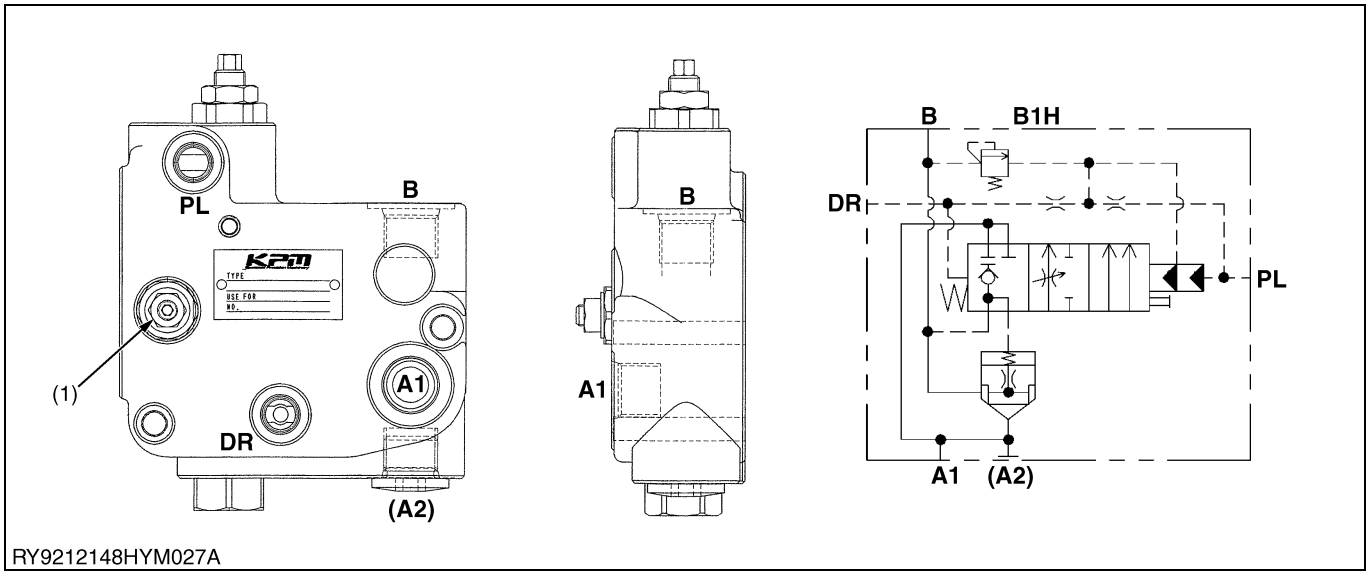
(1)	Secondary pressure spring	**(a)**	**Port 1**
(2)	Spool	**(b)**	**Port 2**
(3)	Return spring	**(P)**	**Port P**
(4)	Cam	**(T)**	**Port T**
(5)	Pushrod		
(6)	Spring seat		

RY9212148HYM0011US0

9. BOOM HOLDING VALVE

[1] BOOM HOLDING VALVE

(1) Specifications



RY9212148HYM027A

(1) Relief valve (B1H)

A1 : Port A1
B : Port B
PL : Pilot pressure port
DR : Drain port

Maker	Kawasaki Heavy Industries, Ltd.	Notes
Model	KHCV15G-A101-3.2	
Relief valve pressure setting	30.4 MPa 310 kgf/cm^2 4410 psi	
Leak volume	0.8 cc/min 0.05 cu.in./min	@Temp. 50 °C (122 °F), B Port : 8.3 MPa (85 kgf/cm^2, 1200 psi) pressure

RY9212435HYM0053US0

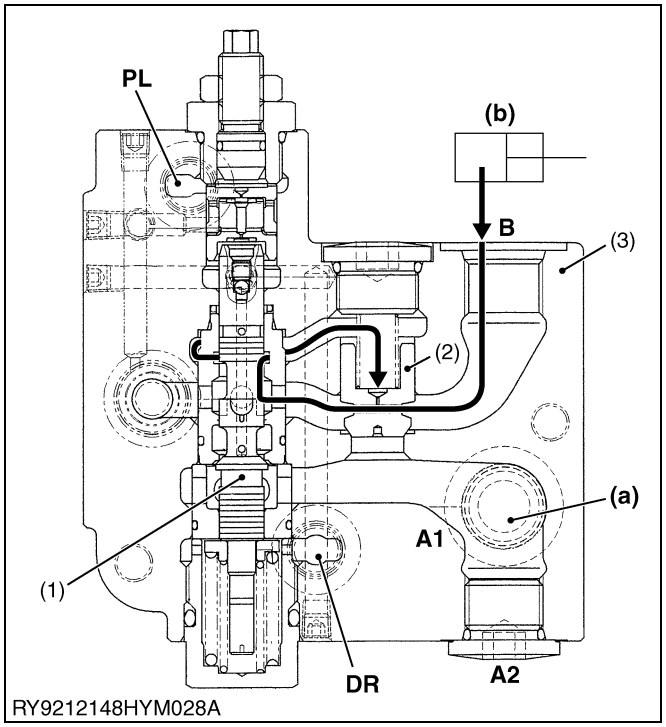
(2) Function and Structure

[A] Function

Located between the control valve and cylinder bottom side, the holding valve prevents drift of the cylinder due to leakage from the control valve as well as sudden descent of the boom in the event of a burst cylinder hose.

RY9212032HYM0024US0

[B] Operation



RY9212148HYM028A

1. During Cylinder Hold

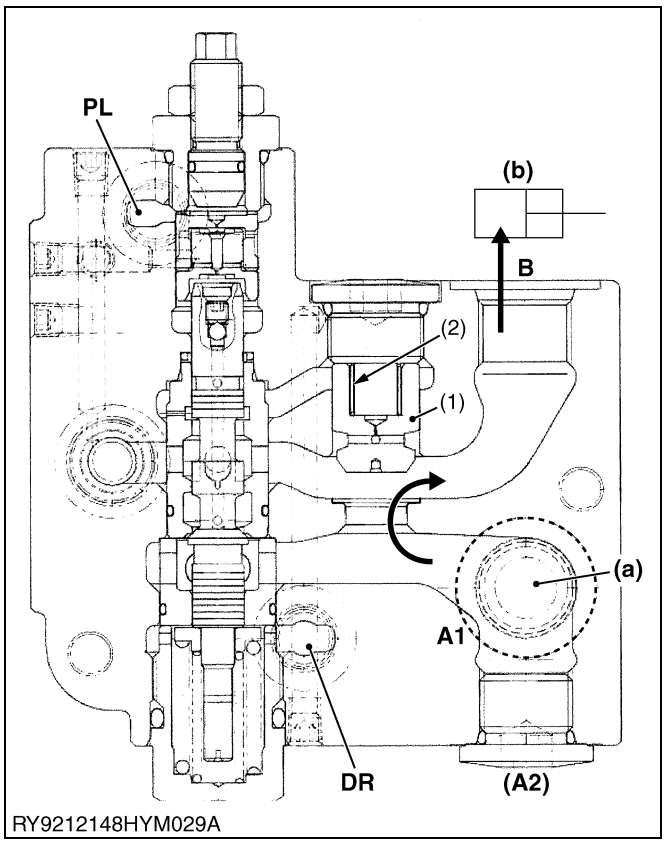
The holding pressure of boom cylinder **(b)** passes through port B, around spool (1) and is guided to the spring chamber of the poppet (2). Therefore, since the poppet is pressed onto the casing (3), it is seated. Due to this, the passage for oil returning to the boom cylinder bottom is shut off, so cylinder drift is prevented.

(1) Spool
(2) Poppet
(3) Casing

(a) Control Valve
(b) Boom Cylinder

A1 : Port A1
A2 : Port A2
B : Port B
PL : Pilot Pressure Port
DR : Drain port

RY9212148HYM0013US0



RY9212148HYM029A

2. Boom-up operation

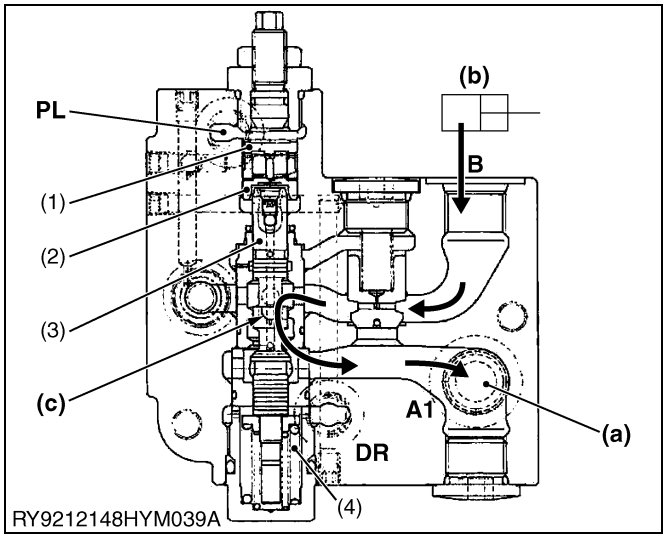
When a boom-up operation is conducted, pressure oil from control valve **(a)** passes through port A1, pushes up the poppet (1), and flows from port B to the boom cylinder **(b)** bottom.

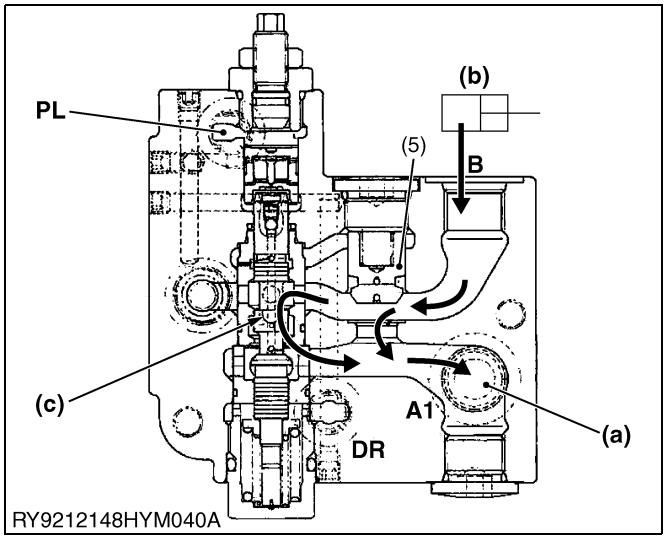
(1) Poppet
(2) Spool

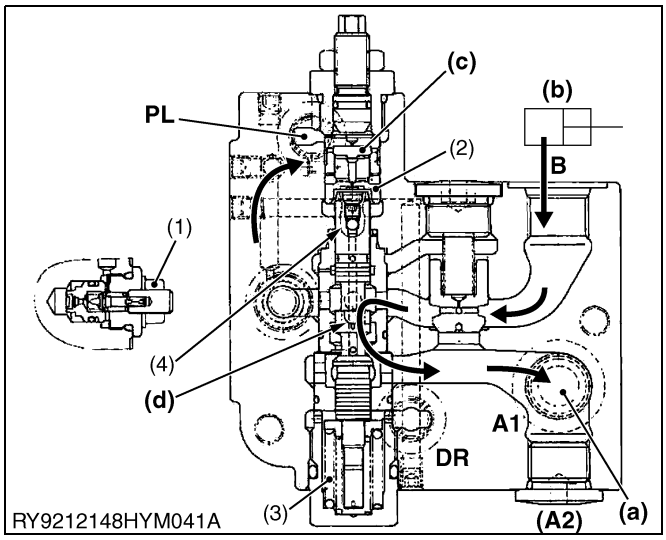
(a) Control valve
(b) Boom cylinder

A1 : Port A1
B : Port B
PL : Pilot pressure port
DR : Drain port

RY9212148HYM0014US0







3. Boom-down operation

When a boom-down operation is conducted, pressure oil flows to pilot pressure port PL; piston B (1), piston A (2) and spool (3) push against spring (4), and move downward.

Oil returning from the boom cylinder**(b)**bottom passes from port B through the spool's controller **(c)**, and is discharged from port A to the control valve.

In addition, when the pilot pressure becomes high, the spring chamber of the poppet (5) connects with port A via an internal passage in the spool.

Due to the poppet's orifice, a pressure difference develops between port B and the poppet's spring chamber, which opens the poppet.

(1) Piston B
(2) Piston A
(3) Spool
(4) Spring
(5) Poppet

(a) Control valve
(b) Boom cylinder
(c) Controller

A1 : Port A1
B : Port B
PL : Pilot pressure port
DR : Drain port

RY9212148HYM0015US0

4. During Overload

While the boom cylinder**(b)**is held, the relief valve (1) operates when the cylinder is overloaded. The hold pressure on the cylinder bottom side passes through the relief valve and is guided to chamber K **(c)**.

Piston A (2) pushes against the spring (3) to press down the spool (4), so that oil from port B passes through the spool's controller **(d)**, though port A and the control valve**(a)**, escaping to the tank.

(1) Relief valve
(2) Piston A
(3) Spring
(4) Spool

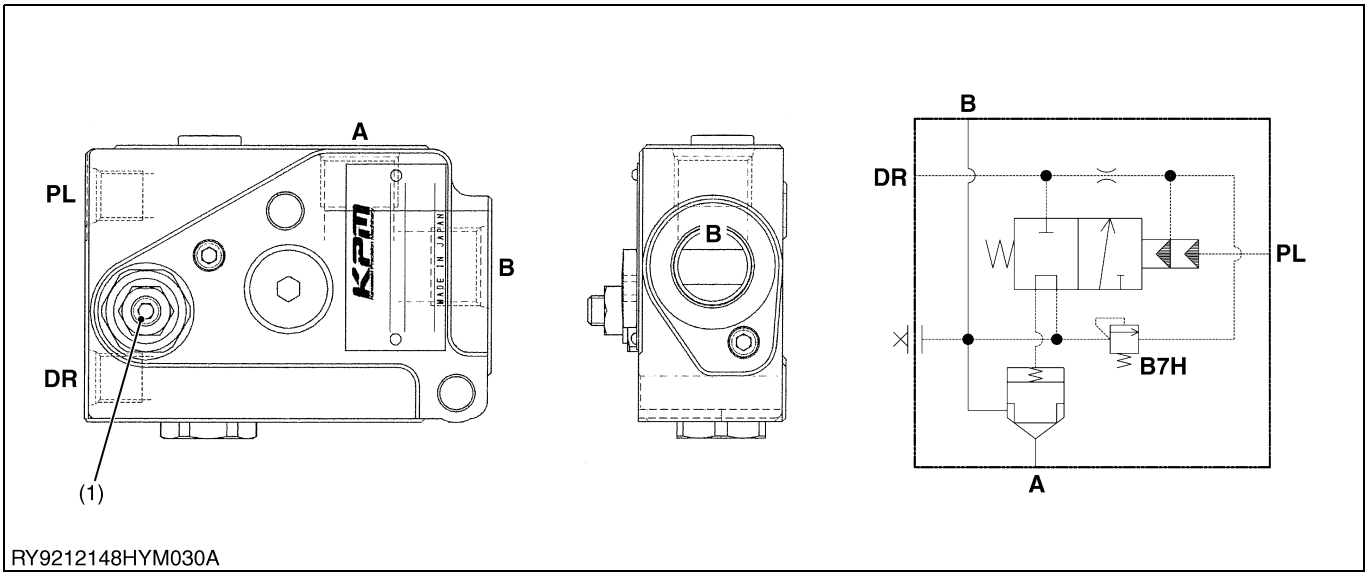
(a) Control valve
(b) Boom cylinder
(c) Chamber K
(d) Controller

A1 : Port A1
B : Port B
PL : Pilot pressure port
DR : Drain port

RY9212148HYM0016US0

[2] TWO PIECE BOOM HOLDING VALVE

(1) Specifications



RY9212148HYM030A

(1) Relief valve (B7H)

A : Port A
B : Port B
PL : Pilot pressure port
DR : Drain port

Maker	Kawasaki Heavy Industries, Ltd.	Notes
Model	KHV10N30/34	
Relief valve pressure setting	34.3 MPa 350 kgf/cm^2 4970 psi	
Leak volume	1.5 cc/min 0.09 cu.in./min	@Temp. 50 °C (122 °F), B Port : 8.3 MPa (85 kgf/cm^2, 1200 psi) pressure

RY9212148HYM0017US0

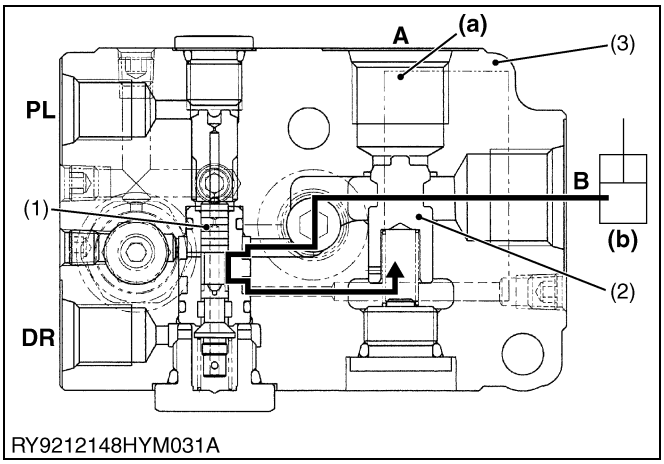
(2) Function and Structure

[A] Function

Located between the control valve and cylinder bottom side, the holding valve prevents drift of the cylinder due to leakage from the control valve as well as sudden descent of the boom in the event of a burst cylinder hose.

RY9212032HYM0024US0

[B] Operation



RY9212148HYM031A

1. During Cylinder Hold

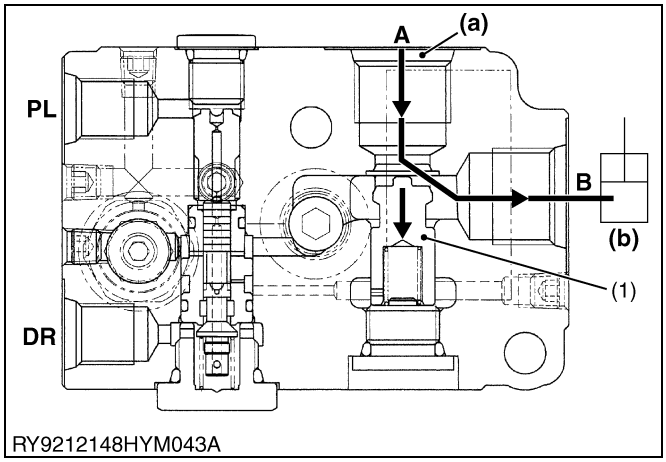
The holding pressure of boom cylinder **(b)** passes through port B, around spool (1) and is guided to the spring chamber of the poppet (2). Therefore, since the poppet is pressed onto the casing (3), it is seated. Due to this, the passage for oil returning to the boom cylinder bottom is shut off, so cylinder drift is prevented.

(1) Spool
(2) Poppet
(3) Casing

A : Port A
B : Port B
PL : Pilot Pressure Port
DR : Drain Port

(a) Control Valve
(b) Boom Cylinder

RY9212148HYM0018US0



RY9212148HYM043A

2. Boom-up operation

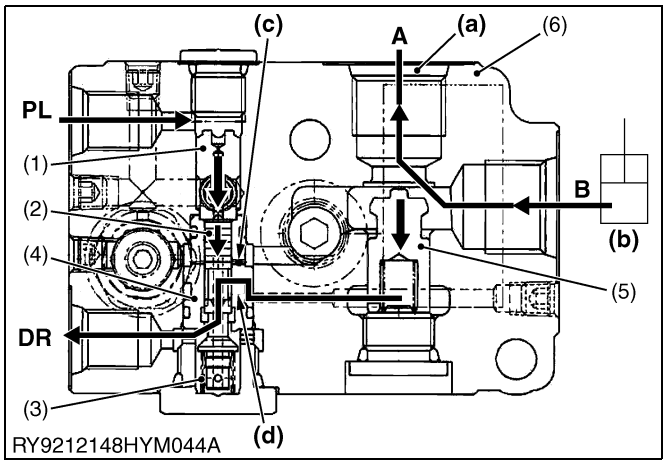
When a boom-up operation is conducted, pressure oil from control valve **(a)** passes through port A, pushes up the poppet (1), and flows from port B to the boom cylinder **(b)** bottom.

(1) Poppet

(a) Control Valve
(b) Boom Cylinder

A : Port A
B : Port B
PL : Pilot Pressure Port
DR : Drain Port

RY9212148HYM0019US0



RY9212148HYM044A

3. Boom-down operation

When a boom down operation is initiated, oil flows to pilot pressure port PL and the spool (2) pushes against the set load of the spring (3) via the piston.

As the spool (2) moves, it closes hole X **(c)** in the sleeve (4), cutting off the cylinder hold pressure and the spring chamber of the poppet (5).

When the spool (2) goes further to full stroke, it opens the notch in the spool (2) and the pressure of the spring chamber of the poppet (5) is guided to the drain DR via hole Y **(d)** in the sleeve (4) and the notch in the spool (2).

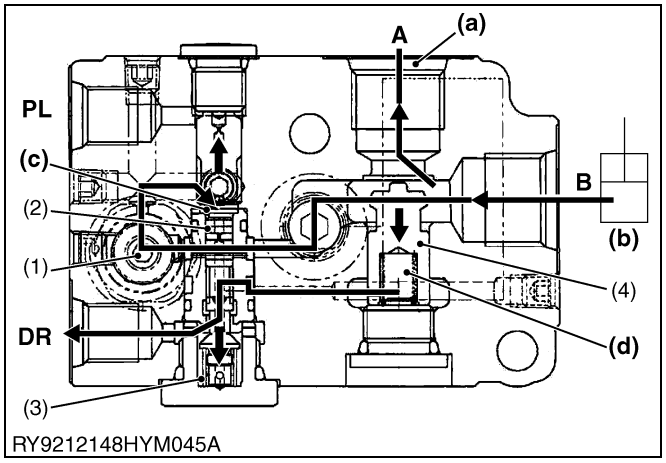
As a result, a pressure difference develops between port B and the poppet's spring chamber, which opens the poppet.

(1) Piston
(2) Spool
(3) Spring
(4) Sleeve
(5) Poppet
(6) Casing

(a) Control valve
(b) Boom cylinder
(c) Hole X
(d) Hole Y

A : Port A
B : Port B
PL : Pilot pressure port
DR : Drain port

RY9212148HYM0020US0



RY9212148HYM045A

4. During Overload

While the boom cylinder**(b)**is held, the relief valve (1) operates when the cylinder is overloaded. The hold pressure on the cylinder bottom side passes through the relief valve and is guided to chamber K **(c)**.

The oil from chamber K is guided to the drain DR via the orifice in the spool (2). Then, when it passes through the orifice in the spool (2), the pressure differential that results raises the pressure in chamber K and the spool (2) moves downwards as it bends the spring (3). As a result of the spool (2) moving, the oil in the spring chamber **(d)** is linked to the drain DR and the pressure in the spring chamber **(d)** drops.

Consequently, the oil from port B presses down on the poppet (4), passes through port A and the control valve **(a)**, escaping to the tank.

(1) Relief valve
(2) Spool
(3) Spring
(4) Poppet

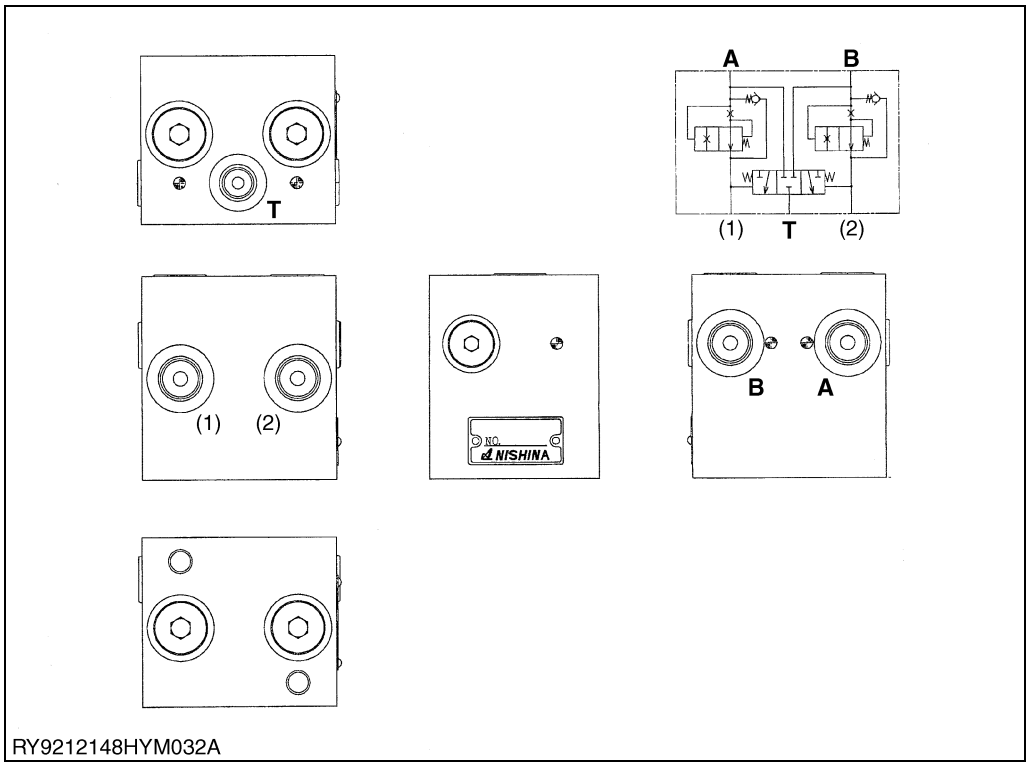
(a) Control valve
(b) Boom cylinder
(c) Chamber K
(d) Spring chamber

A : Port A
B : Port B
PL : Pilot pressure port
DR : Drain port

RY9212148HYM0021US0

10. SHOCKLESS VALVES

[1] SPECIFICATIONS



RY9212148HYM032A

(1) Port 1 (Pilot valve side, boom up)
(2) Port 2 (Pilot valve side, boom down)

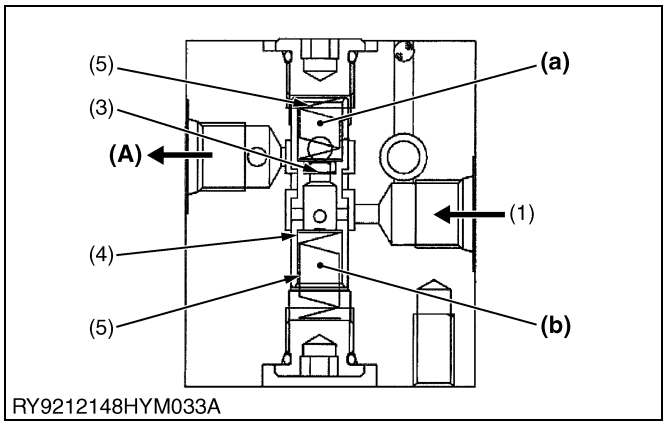
A : Port A (control valve side, boom up)
B : Port B (control valve side, boom down)
T: Port T

RY9212148HYM0052US0

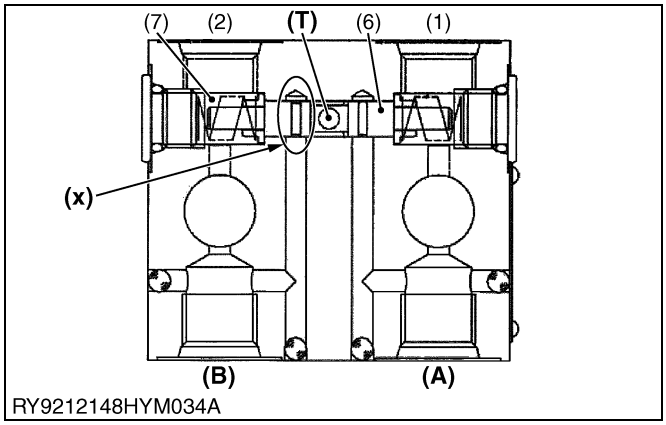
[2] FUNCTION AND STRUCTURE

The boom circuit is equipped with a shockless valve, which operates when stopping boom movement up or down.

RY9212148HYM0053US0



RY9212148HYM033A



RY9212148HYM034A

a) During boom up operation

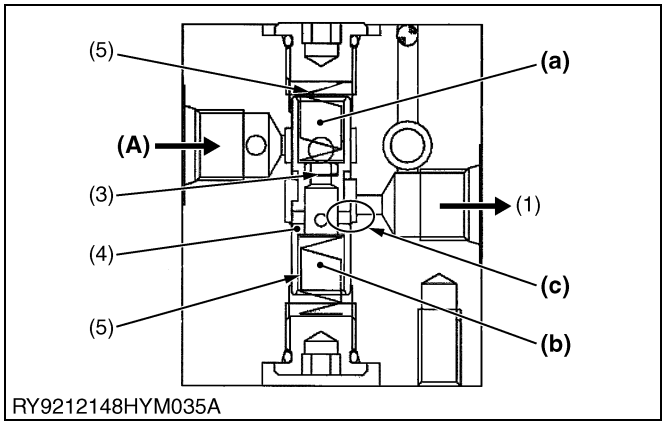
- When pilot pressure enters port 1 (1), the oil passes through the orifice (3) and is discharged to port A **(A)**. At such time the resistance to passing through the orifice (3) results in the pressure of chamber a **(a)** being less than that of chamber b **(b)**, so the plunger (4) moves upwards.
- The movement of the plunger (4) causes the entire flow of the oil that connects port 1 and port A to be discharged to port A.
- Conversely, normally the spool (6) is held in the neutral position by the left/right spring (7), and the oil returning from port B is cut off at point X **(x)** from port T.
- When the pilot oil from port 1 (1) generates enough pressure to overcome the spring (7), it moves the spool, connecting port B and port T and the oil returning from port B returns directly to the tank.

(1) Port 1
(2) Port 2
(3) Orifice
(4) Plunger
(5) Spring
(6) Spool
(7) Spring

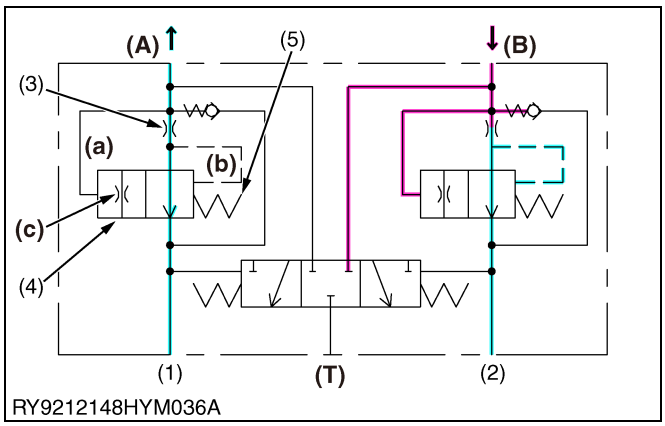
(A) Port A
(B) Port B
(T) Port T

(a) Chamber a
(b) Chamber b
(x) Chamber X

RY9212148HYM0054US0



RY9212148HYM035A



RY9212148HYM036A

b) During boom down operation (return circuit operation)

- The return oil from the control valve enters port A **(A)**, passes through the orifice (3) and is discharged to port 1 (1). When it does, the resistance to passing through the orifice (3) results in the pressure of chamber a **(a)** being greater than that of chamber b **(b)**, so the plunger (4) moves downwards.
- The movement of the plunger (4) closes orifice c **(c)**, raising the pressure in chamber b **(b)**.
- Once the pressures of chamber a **(a)** and chamber b **(b)** equalize, the plunger (4) is returned toward neutral by the spring (5). Repition of this dynamic keeps the plunger (4) at a balanced position. As a result, the pressure differential across the orifice (3) is fixed, allowing the flow of oil through the orifice (3) to be steady without maintaining the pilot pressure.
- When the pilot valve is returned to its neutral position, no oil comes from the pilot valve and the control valve tries to return to the neutral position.
- Return oil from port B flows to port 1 via the orifice (3). The speed of the main spool of the control valve is limited by passing through the orifice (3). (Shockless function)

(1) Port 1
(2) Port 2
(3) Orifice
(4) Plunger
(5) Spring

(A) Port A
(B) Port B
(T) Port T

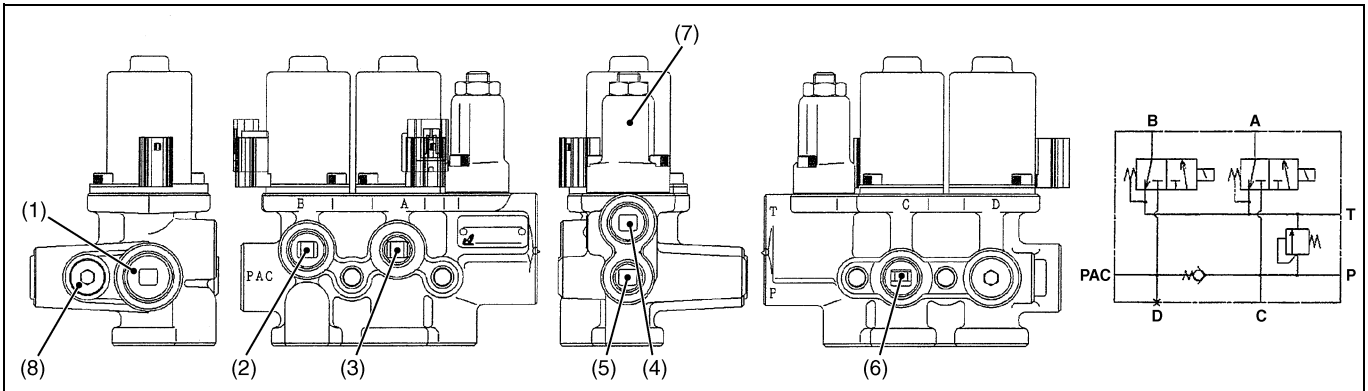
(a) Chamber a
(b) Chamber b
(c) Orifice c

RY9212148HYM0055US0

11. SOLENOID VALVE

[1] UNLOAD VALVE

(1) Specifications



(1) PAC Port (Accumulator)
(2) Port A (2nd Speed Travel Switch)
(3) Port B (Pilot Operation, Swivel Parking Brake)
(4) Drain Port (to Hydraulic Oil Tank)
(5) Port P (to Control Valve)
(6) Port C (from Pilot Pump)
(7) Pilot Primary Relief Valve (aPP)
(8) Check Valve

Maker	Nishina Industrial	Notes
Rated Voltage	12 V	
Relief Valve Pressure Setting (aPP)	3.92 + 0.29 MPa 40.0 + 3.0 kgf/cm^2 570 + 42 psi	at Temp. 50 °C (144 °F), 14.7 L/min (897 cu.in./min, 3.9 USGPM)
Leak volume port P → port T	130 ml/min 7.9 cu.in./min 0.03 USGPM	at 2.5 MPa (25.5 kgf/cm^2, 363 psi)
Leak volume port PAC → other ports	90 ml/min 5 cu.in./min 0.02 USGPM	at 3.9 MPa (40.0 kgf/cm^2, 569 psi)

RY9212148HYM0022US0

(2) Function and Structure

[A] Function

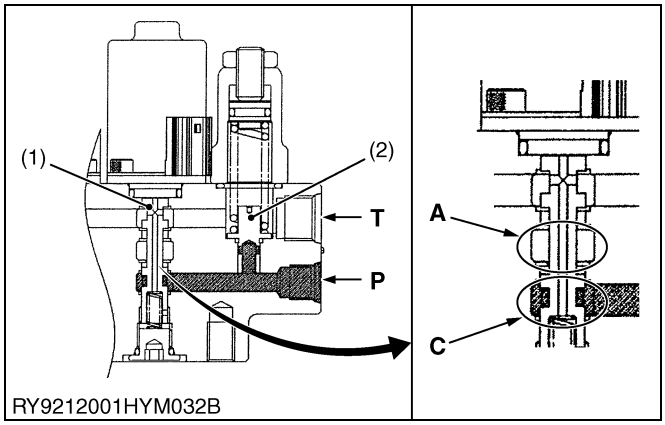
The unload valve consists of two directional change valves operated by solenoid, a check valve and a relief valve; it perform functions such as unloading control pressure from the pilot pump (returning oil to the hydraulic oil tank) and supplying control pressures to pilot valves for operation and travel, as well as to the swivel motor (for the parking brake) and the travel motor (for switching the two speeds).

RY9212001HYM0124US0

[B] Operation

With this device, oil from the pilot pump enters port C and is supplied to the control valve from port P, but that is functionally identical to when oil from the pilot pump enters from port P and supplied to the control valve from port C. Following is a description of when oil enters from port P from the pilot pump.

RY9212001HYM0125US0



RY9212001HYM032B

1. When the solenoid is off

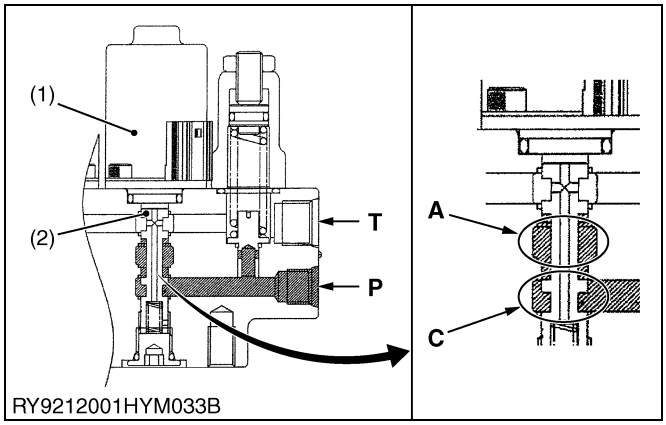
Oil from port P is cut off from passages to port A and port T by a spool (1) and plunger (2). Ports A and T are connected. And Port C and Port P are connected, so the pressures at port C and port P are always the same.

When the pressure from port P reaches the relief valve pressure setting, the oil from port P returns to the tank via the relief valve (pushes the plunger up).

(1) Spool
(2) Plunger

A : Port A
C : Port C
P : Port P
T : Port T

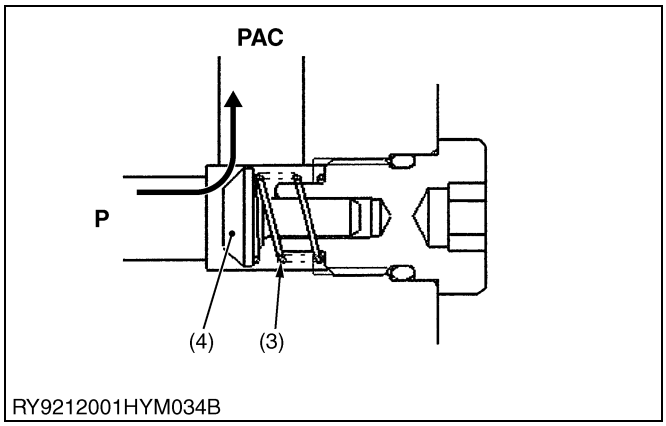
RY9212148HYM0023US0



RY9212001HYM033B

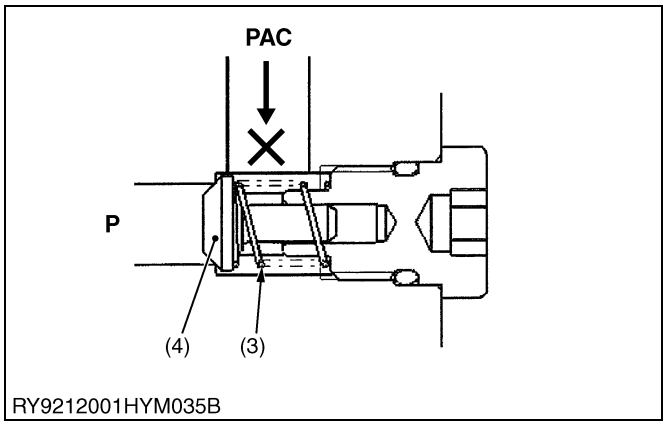
2. When the solenoid is on

When the solenoid (1) is energized, the solenoid's pushrod presses the spool (2) down, connecting port P to port A and cutting off port A and port T, so the oil from port P flows to port A.



RY9212001HYM034B

When port P pressure reaches a pressure at or greater than the spring (3), the plunger (4) moves to the right and pressure oil flows from port P to port PAC.



RY9212001HYM035B

When the pressure at port P is low, the oil from port PAC is cut off, preventing backflow.

(1) Solenoid
(2) Spool
(3) Spring
(4) Plunger

A : Port A
C : Port C
P : Port P
T : Port T

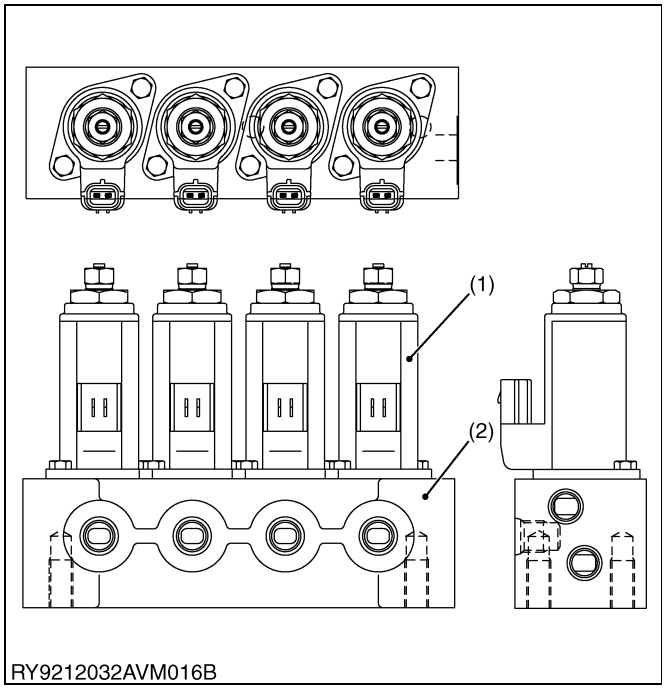
RY9212148HYM0024US0

[2] AUX SOLENOID VALVE

(1) Specifications

Proportional Control Solenoid Valve

This valve is an electromagnetic solenoid valve. Normally, a solenoid valve is turned off and on via 12 V battery voltage, but this valve is controlled via pulsed signals from the computer built into the ECU and the meter panel. (PWM Control)

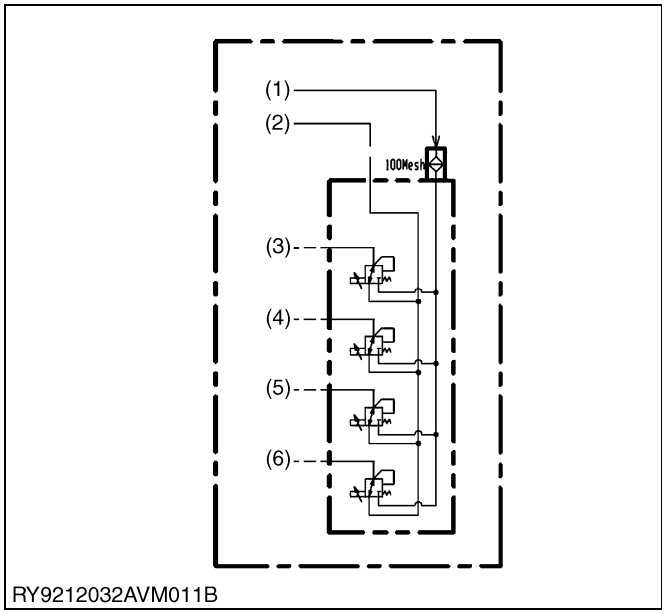


RY9212032AVM016B

Item	Specifications
Max operating pressure (input pressure)	3.9 MPa 40 kgf/cm^2 570 psi
Allowable back pressure (pressure T)	1.0 MPa 10 kgf/cm^2 100 psi
Maximum proportional valve operating flow volume (input flow volume)	14.0 L/min, 4.1 GPM
Drain volume when solenoid off	AUX1, 2: 0.8 L/min ≥ (At 20 cST, port P pressure = 4.9 MPa, 50 kgf/cm^2, 710 psi)
Waterproof Standard	JIS D 0203 S2 equivalent
Vibration Proof Standard	JIS D 1601–1995
Hydraulic Oil Grade	ISO VG32 to 68 equivalent
Hydraulic Oil Contamination Level	NAS Class 10 ≥
Electrical Specifications	Rated Amperage: 1600 mA Coil resistance: 3.2 ± 0.5 Ω (at 20 °C, 68 °F)
Second pressure control range	0 to 2.7 MPa 0 to 27 kgf/cm^2 0 to 390 psi

(1) Solenoid (2) Case

RY9212435HYM0030US0

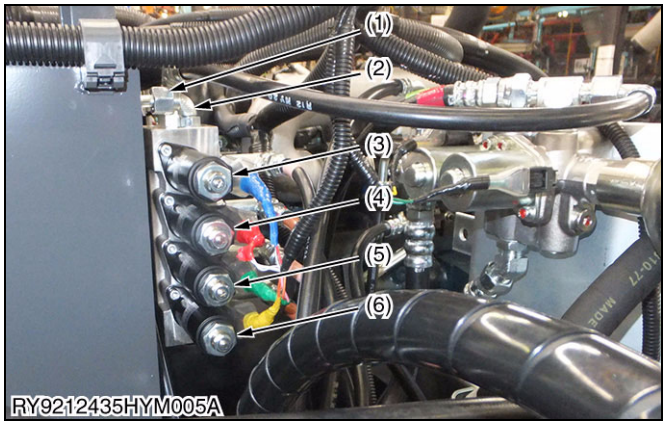


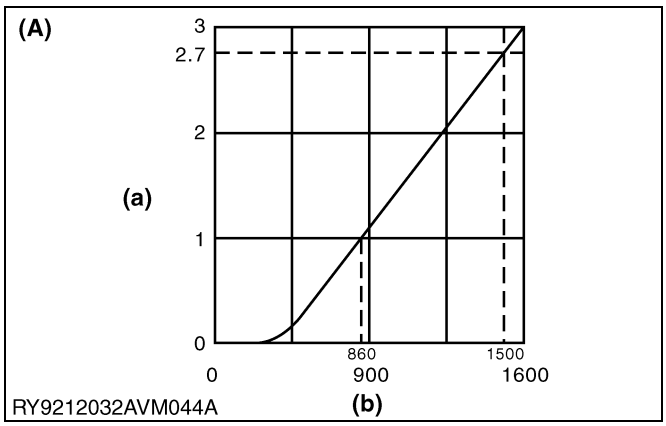
RY9212032AVM011B

Hydraulic Circuit Diagram

(1) Port P
(2) Port T
(3) AUX1 High Pressure Port
(4) AUX1 Low Pressure Port
(5) AUX2 High Pressure Port
(6) AUX2 Low Pressure Port

RY9212435HYM0031US0





(1) Port P
(2) Port T
(3) AUX1 High Pressure Port
(4) AUX1 Low Pressure Port
(5) AUX2 High Pressure Port
(6) AUX2 Low Pressure Port

(A) Control Diagram

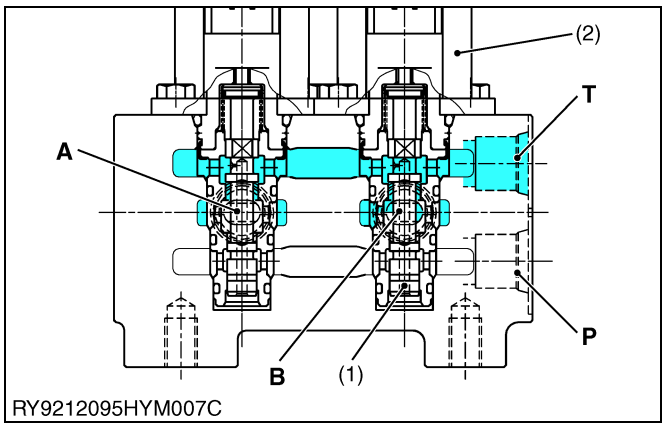
(a) Secondary Pressure (MPa)
(b) Input Current (mA)

RY9212435HYM0009US0

(2) Function and Structure

The pressure from port P is supplied or cut off from port A or port B by the solenoid valve used when operating the AUX.

RY9212095HYM0019US0



RY9212095HYM007C

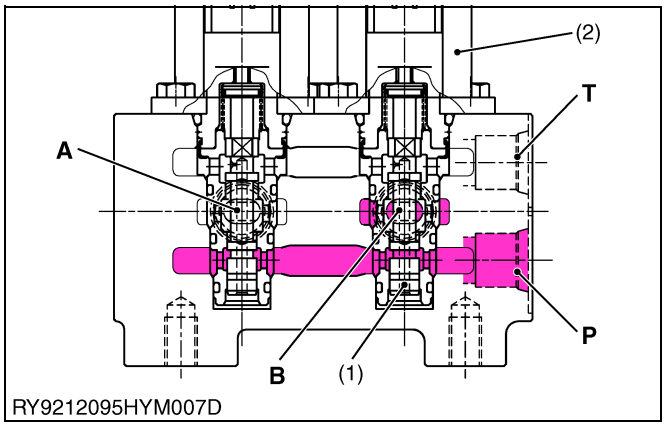
1. When the solenoid is off

When the solenoid is off, port P and port B are cut off by the spool. Port B and port T are connected, so no pressure is produced at port B.

(1) Spool
(2) Solenoid

A : Port A
B : Port B
P : Port P
T : Port T

RY9212095HYM0020US0



RY9212095HYM007D

2. When the solenoid is on

When the solenoid is on, the spool is pressed down, connecting port P and port B. And as port B and port T are cut off, the oil from port P flows to port B.

(1) Spool
(2) Solenoid

A : Port A
B : Port B
P : Port P
T : Port T

RY9212095HYM0021US0

SERVICING

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1. PUMP

[1] REMOVAL AND INSTALLATION OF THE PUMP

CAUTION

- **When removing a hydraulic device after operating the excavator, lower the bucket and blade to the ground and turn off the engine.**
- **Each of the devices and the hydraulic oil are hot right after stopping the excavator. The oil is hot enough to cause a burn, so always let it cool down before starting any work.**
- **Oil gushing out under pressure has enough force to injure you by piercing your skin. Always relieve any pressure remaining in the system prior to working to remove any hydraulic equipment or lines.**

RY9212148HYS0149US0

1. Remove the left and rear hoods.

■ **IMPORTANT**
- **For hood removal, a minimum of 2 persons is needed.**

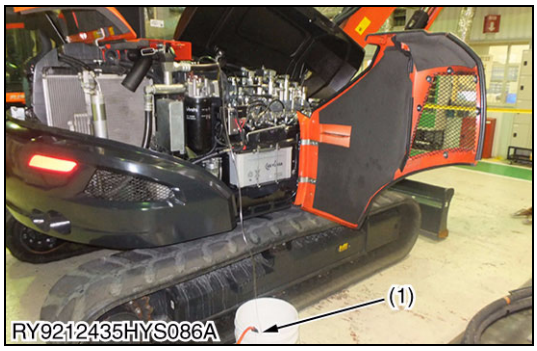
(1) Rear Hood (2) Left Hood

RY9212435HYS0103US0

2. Remove the air cleaner.

(1) Air Cleaner

RY9212435HYS0104US0



3. Attach a vacuum pump and depressurize the inside of the tank.

■ **IMPORTANT**
- **Plug the breather hose.**

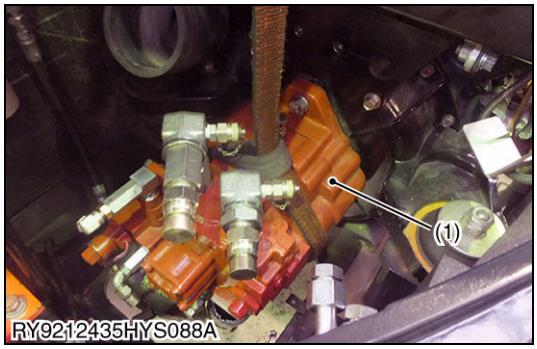
(1) Vacuum Pump

RY9212435HYS0105US0

4. Remove the bottom cover of the pump and disconnect all the hoses connected to the pump.

■ **IMPORTANT**
- **Plug the disconnected hoses and adapters.**

RY9212435HYS0106US0



5. Suspend the pump with a crane and remove the pump mounting bolts (two).
   Use the crane to remove the pump.

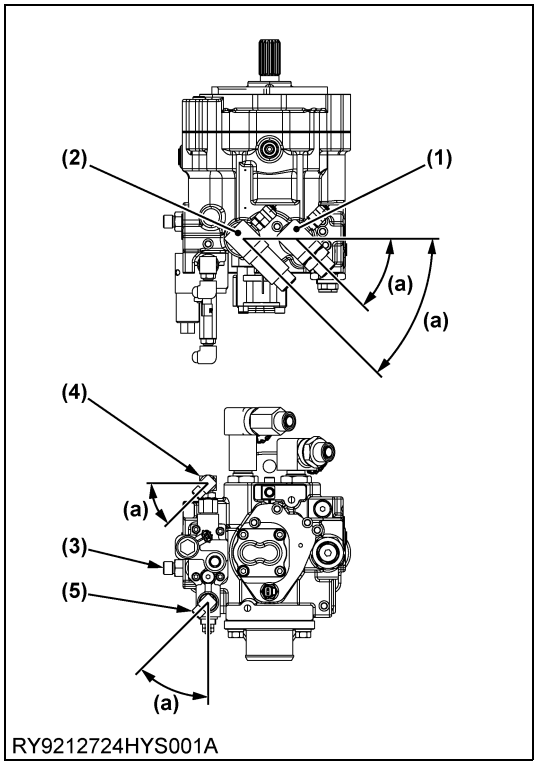
Tightening torque	Bolt	196.1 to 225.6 N·m 20.0 to 23.0 kgf·m 144.6 to 166.4 lbf·ft

Pump weight	Approx. 43.8 kg (96.6 lbs)

(1) Pump

RY9212724HYS0001US0

Adapter angles

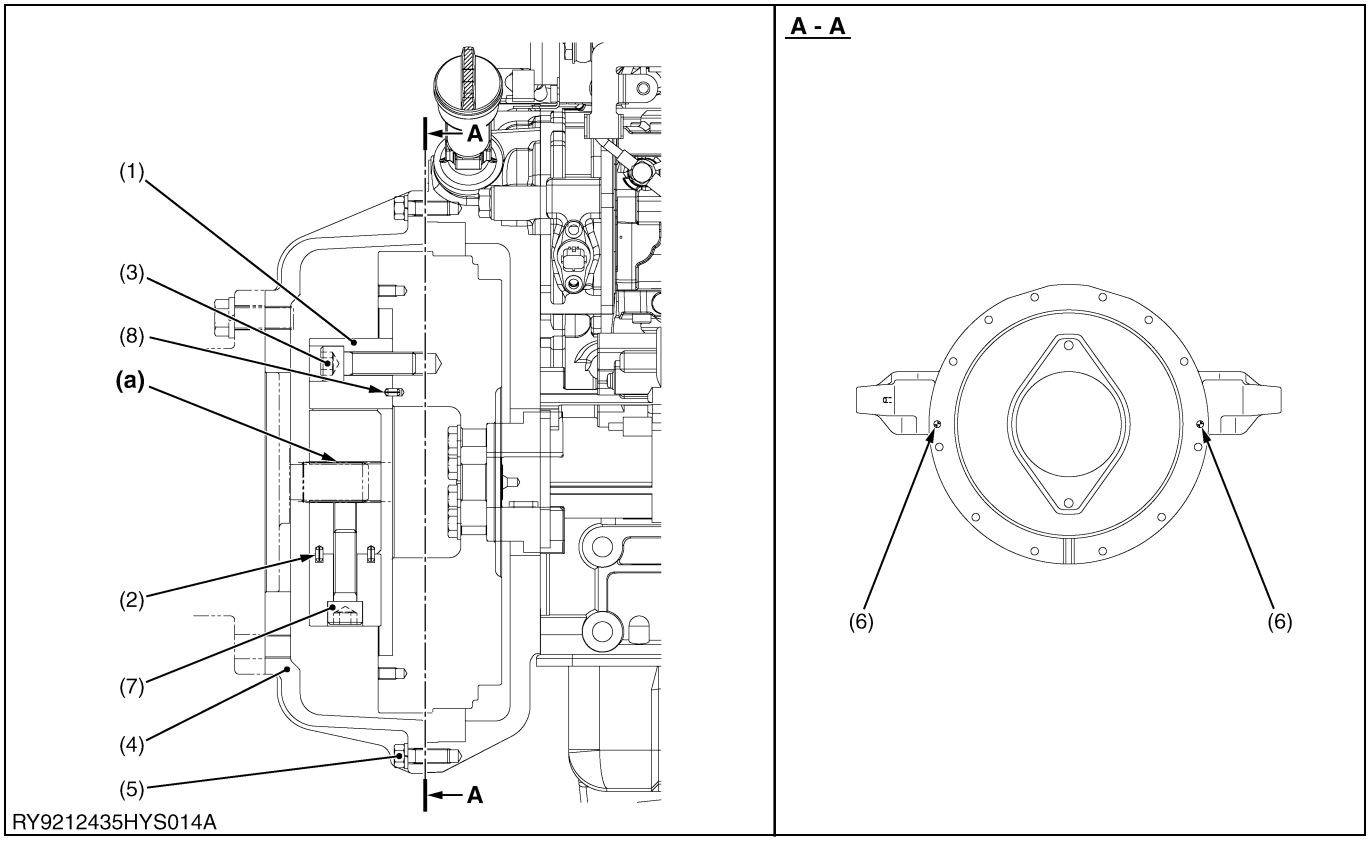


(1) P1
(2) P2
(3) PP
(4) Pps
(5) Pls

(a) 45° (0.79 rad)

RY9212724HYS0002US0

Pump coupling and Housing assembly diagram



(1) Coupling
(2) Coupling Bolt
(3) Coupling Bolt
(4) Pump Housing
(5) Housing Bolt
(6) Parallel Pin
(7) Spring Pin
(8) Spring Pin

- **(a)** Coating the spline portion with grease.

■ **IMPORTANT**

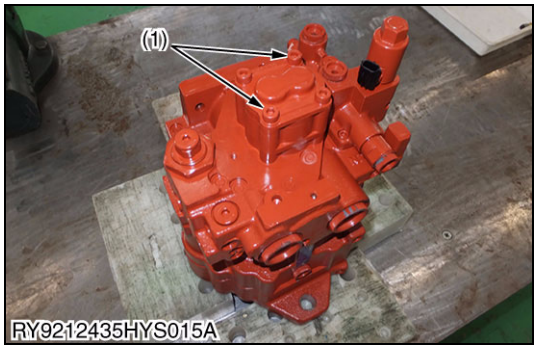
- **Install the coupling after the aligning the spring pin.**
- **Do not use screws fixing agent in coupling bolt.**
- **Do not coating the coupling rubber portion with grease.**
- **Install the coupling after the aligning the parallel pin.**
- **Step of coupling assembly.**
  First, Align the spring pin (7), and tighten the coupling bolt (2).
  Second, Align the spring pin (8), and tighten the coupling bolt (3).

Tightening torque	Coupling Bolt	210.0 to 230.0 N·m 21.4 to 23.5 kgf·m 154.9 to 169.6 lbf·ft
	Housing Bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft

RY9212435HYS0002US0

[2] PUMP ASSEMBLY/DISASSEMBLY

(1) Disassembly

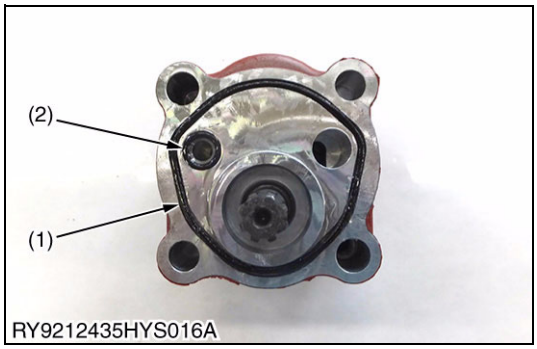


1. Remove the hex socket bolts and then the gear pump.
   - Tool to use: 6 mm hex socket

CAUTION
- **Don't pinch your fingers between the port block and the gear pump.**
- **If it is difficult to remove, tap lightly on it with a plastic hammer and remove.**

(1) Hex Socket Bolt (With / Washer) M6×65×2

RY9212435HYS0038US0

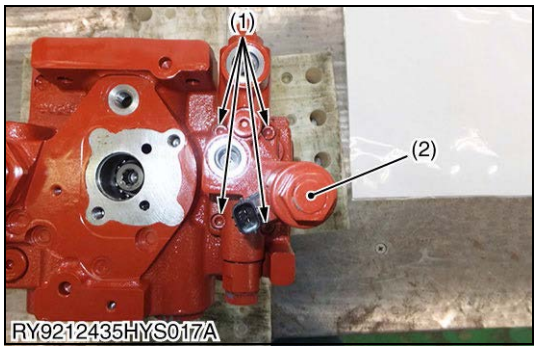


2. Remove the O-rings.

IMPORTANT
- **Take care not to scratch the surface of the port.**

(1) O-Ring (2) O-Ring

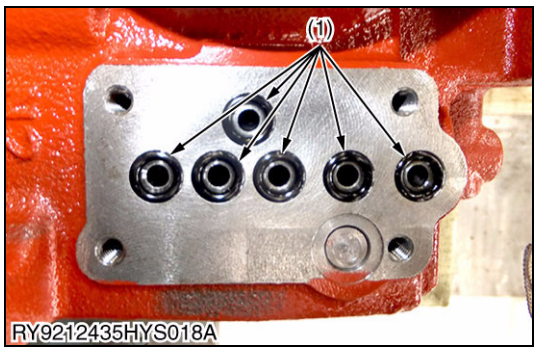
RY9212435HYS0003US0



3. Remove the hex socket bolts and then the LS regulator.
   - Tool to use: 5 mm hex socket

(1) Hex Socket Bolt M6×15×4 (2) LS Regulator

RY9212435HYS0039US0

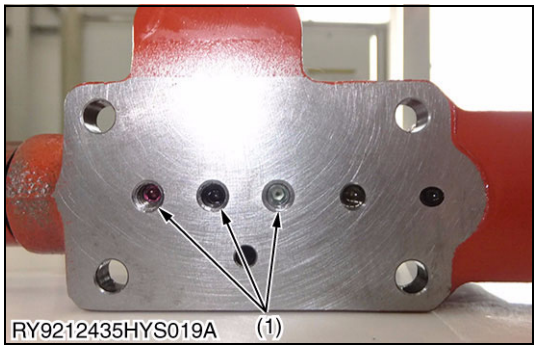


4. Remove the O-rings.

IMPORTANT
- **Take care not to scratch the surface of the port.**

(1) O-Ring

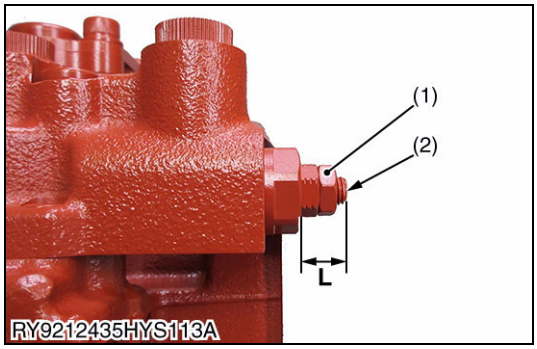
RY9212435HYS0004US0



5. Remove the orifices.
   - Tool to use: 3 mm hex socket

(1) Orifice

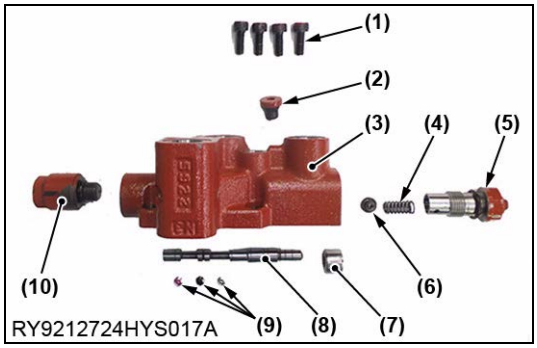
RY9212435HYS0005US0



6. After measuring the distance of **L**, loosen the nut and remove the set screw.
7. Remove the parts inside the LS regulator.
   - Tool to use: 13, 24 mm spanner, 4 mm hex socket

(1) Nut
(2) Set Bolt

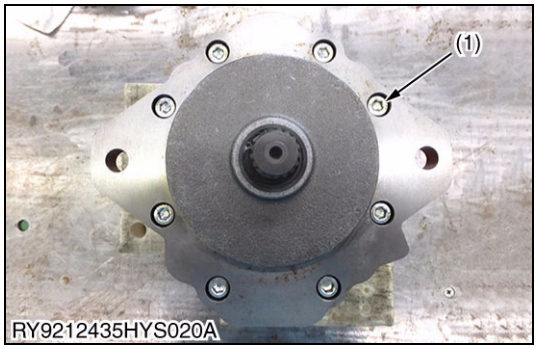
RY9212435HYS0120US0



8. LS Regulator Components

(1) Hex Socket Bolt
(2) Plug
(3) Valve Body
(4) Spring
(5) Holder
(6) Spring Seat
(7) Bush
(8) Spool
(9) Orifice
(10) Plug

RY9212724HYS0043US0



9. Remove the hex socket bolts.
   - Tool to use: 8 mm hex socket

(1) Hex Socket Bolt M10×80×8

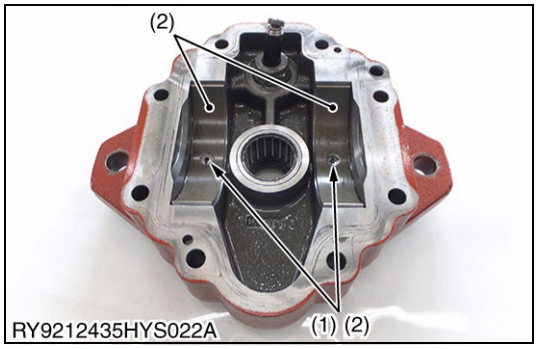
RY9212435HYS0040US0

10. Remove the flange.

CAUTION
- **If the flange is difficult to remove, tap lightly on it with a plastic hammer and take it apart.**
- **Don't pinch your fingers between the flange and the case.**

(1) Flange

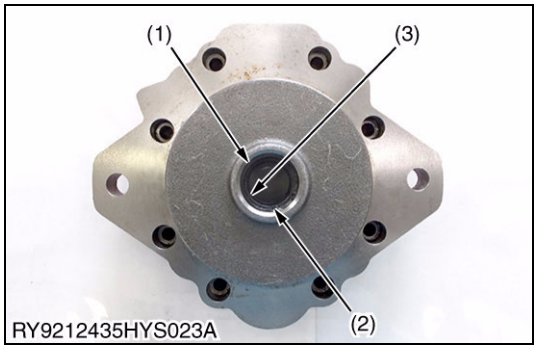
RY9212435HYS0006US0



11. Remove the screw and the bushing.
12. Remove the piston.
   - Tool to use: 3 mm hex socket

(1) Screw
(2) Bushing

RY9212435HYS0041US0

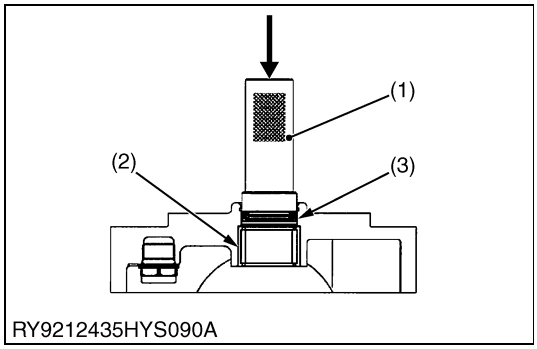


13. Remove The snap ring.
14. Use the jig 1 remove the oil seal and the needle bearing.
- Tool to use: Snap ring pliers

CAUTION
- **Take care so the snap ring does not go flying.**

(1) Snap Ring
(2) Oil Seal
(3) Needle Bearing

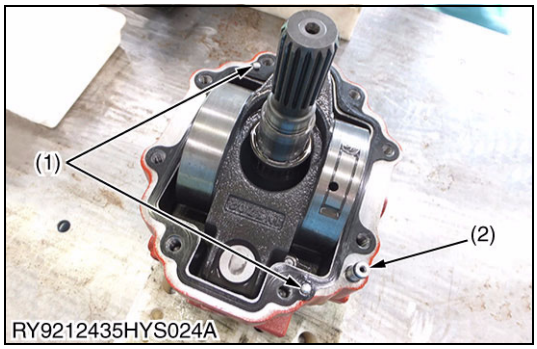
RY9212435HYS0007US0



Tool 1

(1) Tool 1
(2) Needle Bearing
(3) Oil Seal

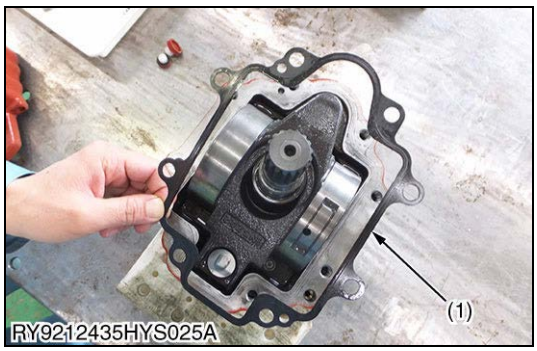
RY9212435HYS0112US0



15. Remove the pins and bush.

(1) Pin
(2) Bush

RY9212435HYS0042US0

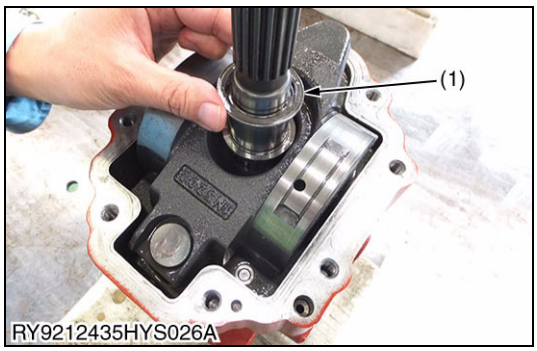


16. Remove the gasket.

CAUTION
- **Be careful not to cut your fingers on the gasket.**

(1) Gasket

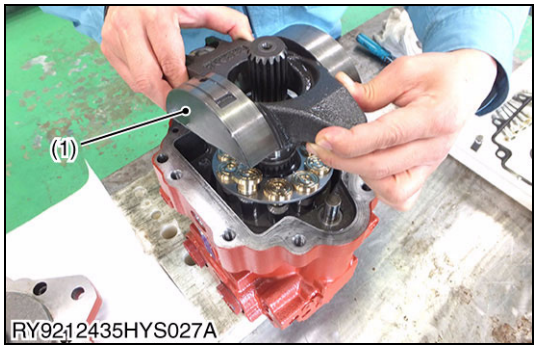
RY9212435HYS0008US0



17. Remove the thrust washer.

(1) Thrust Washer

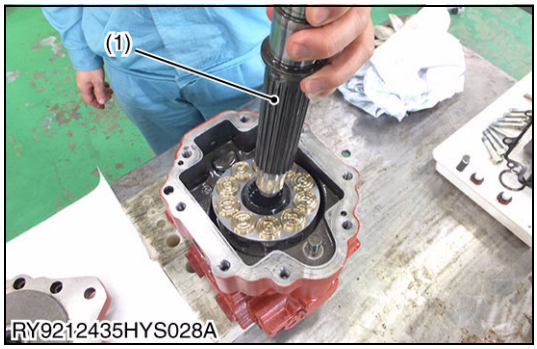
RY9212435HYS0043US0



18. Remove The swash-plate.

(1) Swash-Plate

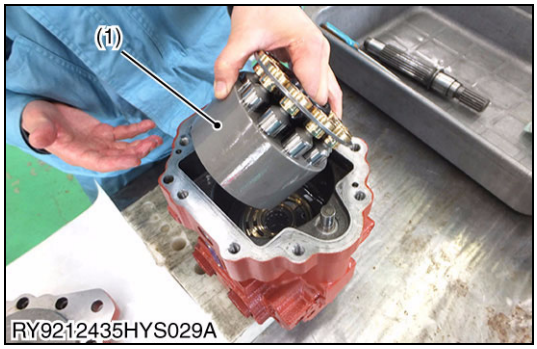
RY9212435HYS0009US0



19. Remove the shaft.

(1) Shaft

RY9212435HYS0010US0



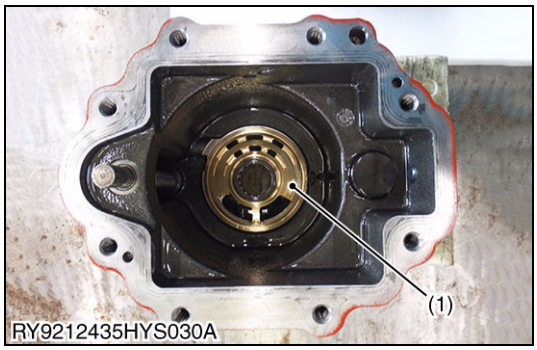
20. Remove the cylinder block assy.

CAUTION

- **Note that valve plate comes with the bottom surface of the cylinder block assy.**

(1) Cylinder Block Assy

RY9212435HYS0044US0



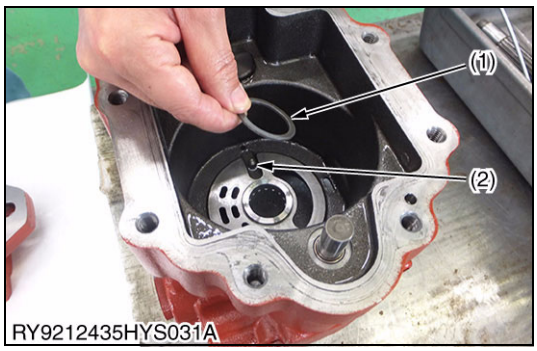
21. Remove the valve plate.

IMPORTANT

- **Do not scratch the valve plate.**

(1) Valve Plate

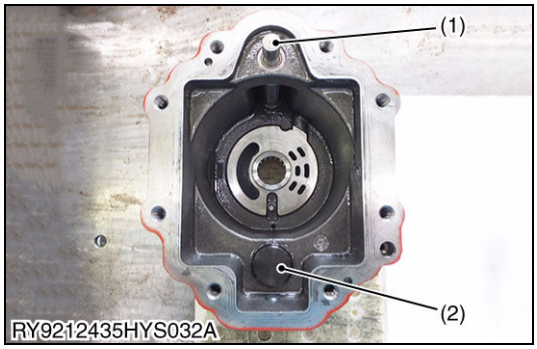
RY9212435HYS0011US0



22. Remove the thrust washer.
23. Remove the pin.

(1) Thrust Washer (2) Pin

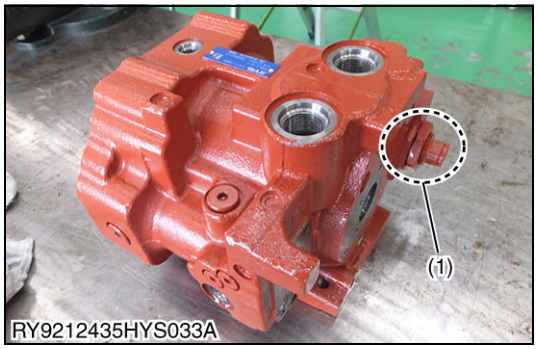
RY9212435HYS0045US0



24. Remove the feedback pin.
25. Remove the control pin.

(1) Feedback Pin (2) Control Pin

RY9212435HYS0046US0

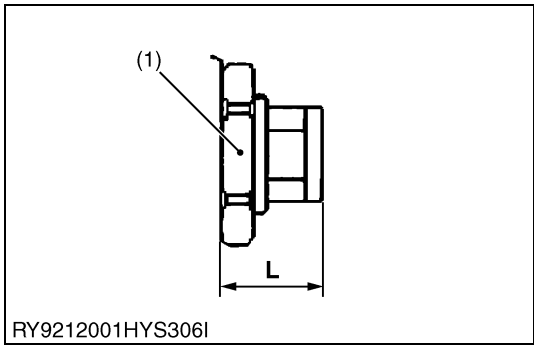


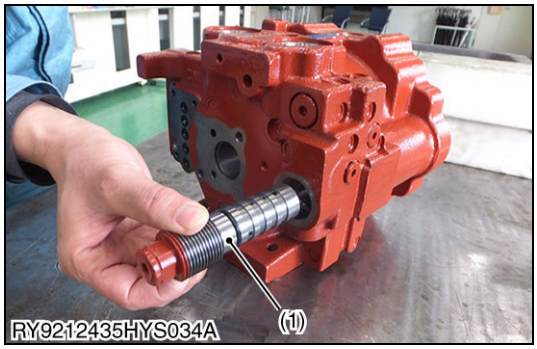
26. Remove the nut.
- Tool to use: 41 mm wrench

■ **IMPORTANT**
- **Measure the width of l before removing the nut.**

(1) Nut

RY9212435HYS0012US0

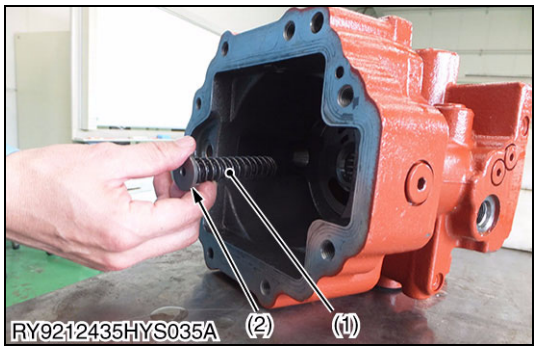




27. Remove the pressure selector valve.
- Tool to use: 20 mm wrench

(1) Pressure Selector Valve.

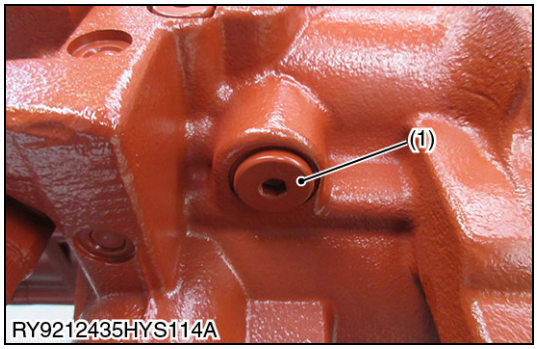
RY9212435HYS0013US0



28. Remove the spring and the spring seat from the case.

(1) Spring (2) Spring Seat

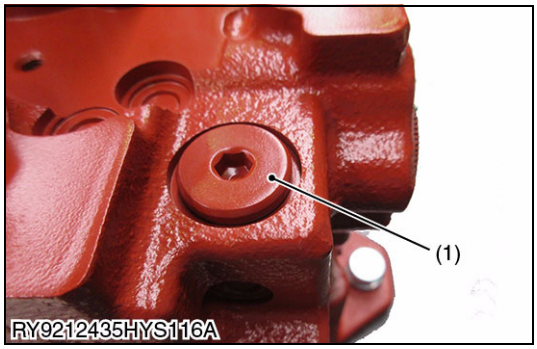
RY9212435HYS0014US0



29. Remove the plug.
    - Tool to use: 6 mm hex socket

(1) Plug

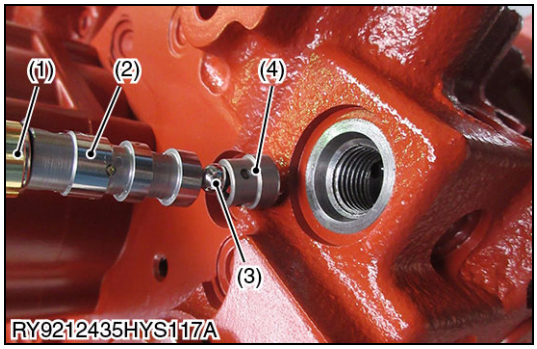
RY9212435HYS0121US0



30. Remove the plug.
    - Tool to use: Hex socket

(1) Plug

RY9212435HYS0123US0

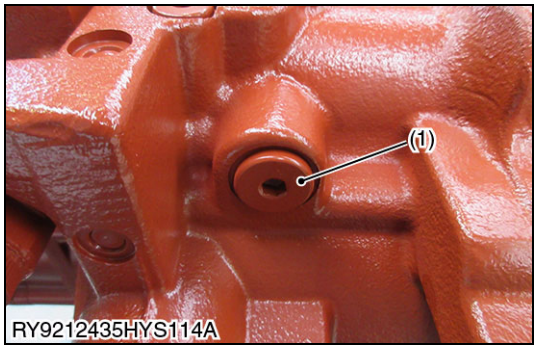


31. Remove the intermediate pressure valve, ball and pressure select valve.
    - Tool to use: Magnet

(1) Magnet
(2) Intermediate Pressure Valve
(3) Ball
(4) Pressure Select Valve

RY9212435HYS0124US0

(2) Assembly

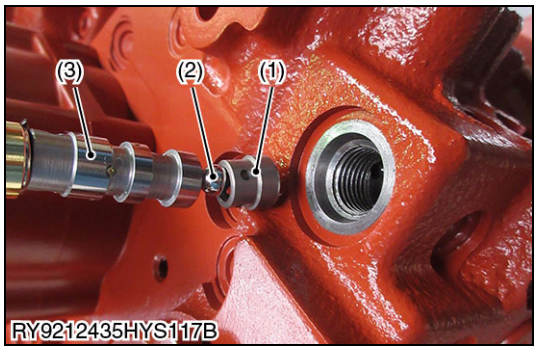


1. Tighten the plug.
   - Tool to use: 6 mm hex socket

Tightening torque	Plug	29.4 N·m 3.0 kgf·m 21.7 lbf·ft

(1) Plug

RY9212724HYS0044US0

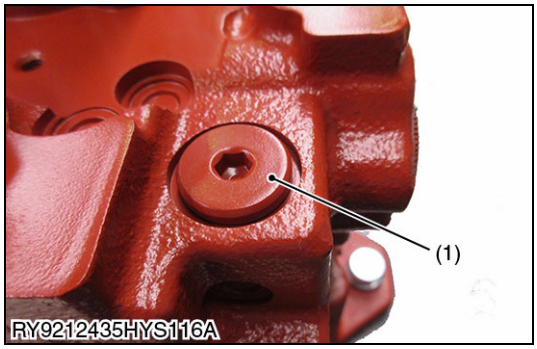


2. Insert the pressure select valve, ball and intermediate pressure valve.

■ **IMPORTANT**
- **Take care of the mounting sequence.**

(1) Pressure Select Valve
(2) Ball
(3) Intermediate Pressure Valve

RY9212435HYS0127US0

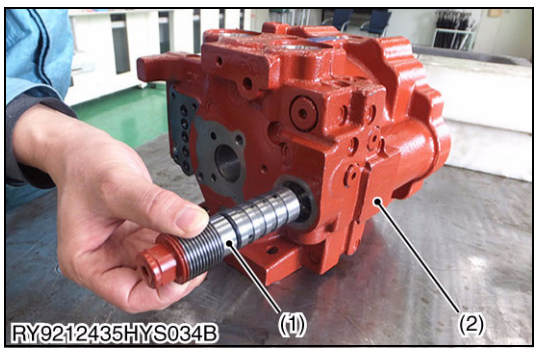


3. Tighten the plug.
   - Tool to use: 6 mm hex socket

Tightening torque	Plug	29.4 N·m 3.0 kgf·m 21.7 lbf·ft

(1) Plug

RY9212435HYS0128US0

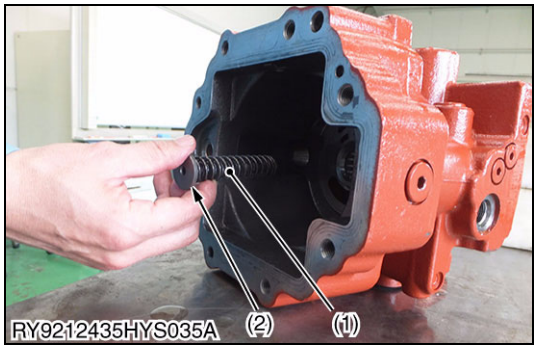


4. Install the horsepower control valve in pump case.

■ **IMPORTANT**
- **Lubricate the sleeve of the valve with hydraulic oil.**

(1) Horsepower Control Valve
(2) Pump Case

RY9212435HYS0047US0

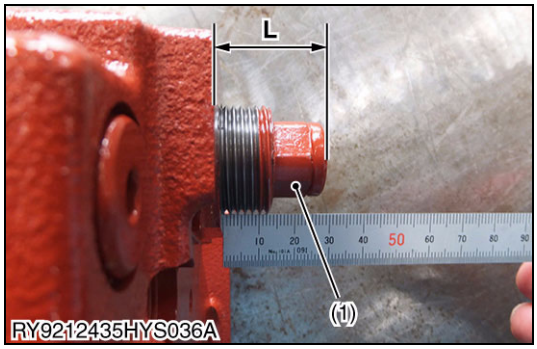


5. Install the spring and spring seat in pump case.

CAUTION
- **Be careful to avoid any dents on the surfaces of the suction and delivery pots.**

(1) Spring
(2) Spring Seat

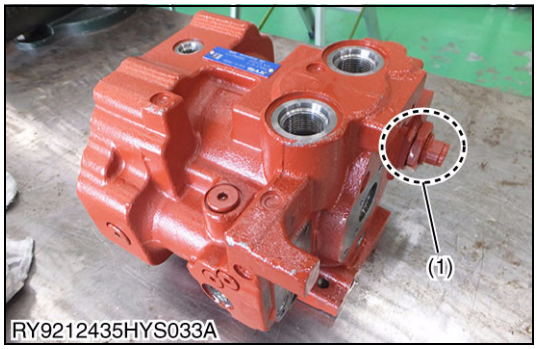
RY9212435HYS0048US0



6. Screw in the horse power control valve until the length "L" of the previous setting is reached.
   - Tool to use: Spanner 20 mm

(1) Horsepower Valve

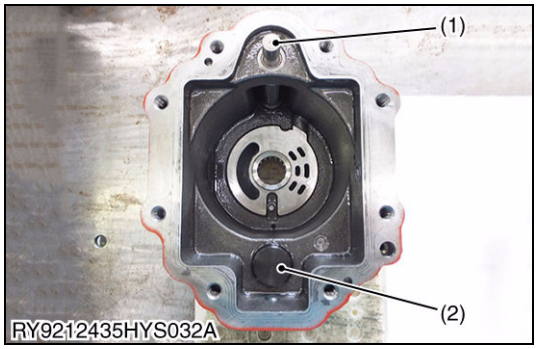
RY9212435HYS0049US0



7. Tightening the lock nut.
   - Tool to use: Spanner 41 mm

(1) Lock Nut

RY9212435HYS0050US0

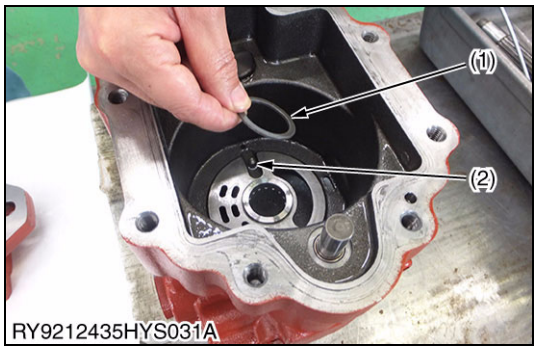


8. Install the feedback pin.
9. Install the control pin.

CAUTION
- **Please note the direction of the assembly.**

(1) Feedback Pin (2) Control Pin

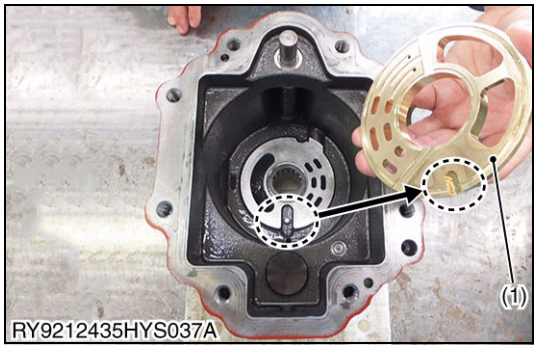
RY9212435HYS0051US0



10. Insert the thrust washer.
11. Insert the control pin.

(1) Thrust Washer (2) Pin

RY9212435HYS0052US0

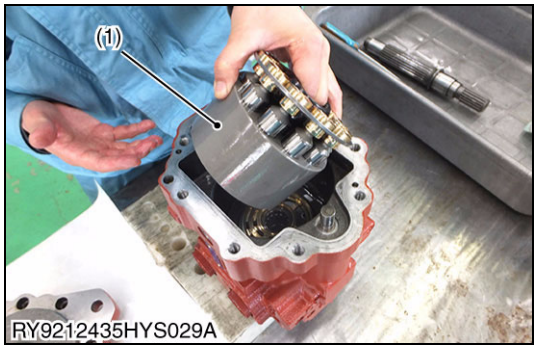


12. Insert the valve plate.

IMPORTANT
- **Lubricate the sleeve of the valve plate with hydraulic oil.**
- **Align the notch groove to the pin position.**

(1) Valve Plate

RY9212435HYS0053US0

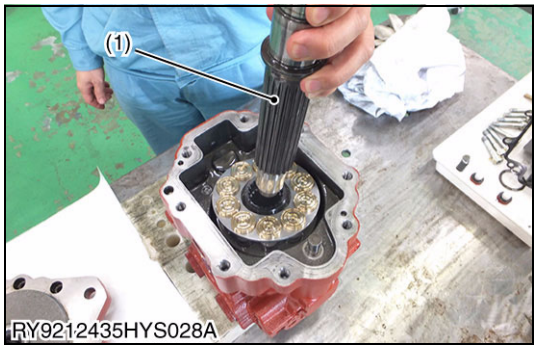


13. Insert the cylinder block assy.

■ **IMPORTANT**
- **Lubricate the sleeve of the cylinder block assy with hydraulic oil.**
- **Please be careful not to damage the cylinder block assy.**

(1) Cylinder Block Assy

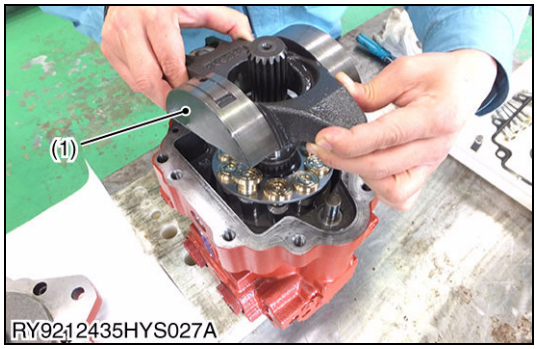
RY9212435HYS0054US0



14. Insert the shaft.

(1) Shaft

RY9212435HYS0015US0

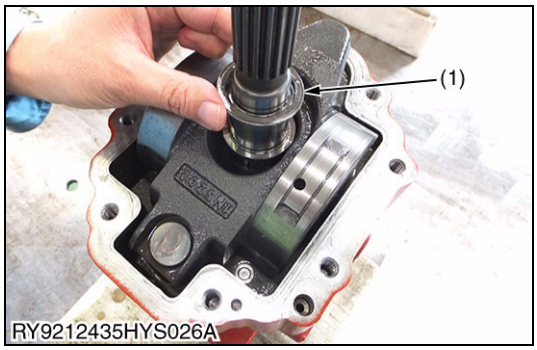


15. Insert the swash plate.

■ **IMPORTANT**
- **Please take care of the swash plate mounting direction.**

(1) Swash Plate

RY9212435HYS0016US0

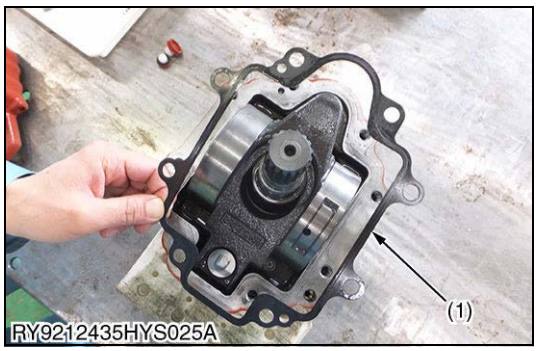


16. Insert thrust washer.

■ **IMPORTANT**
- **Please note in the direction of the thrust washer.**

(1) Thrust Washer

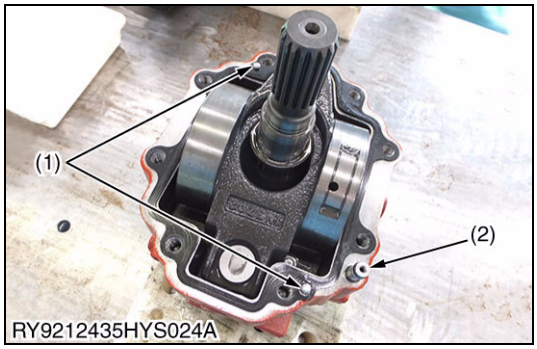
RY9212435HYS0017US0



17. Set the gasket.

(1) Gasket

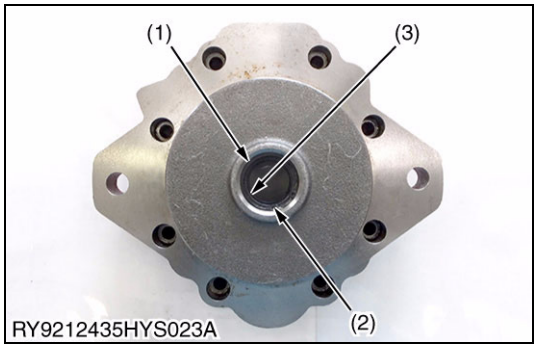
RY9212435HYS0018US0



18. Insert 2 pins and the bush.

(1) Pin (2) Bush

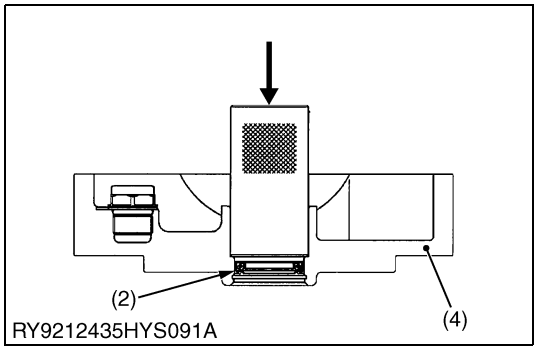
RY9212435HYS0055US0



19. Insert the oil seal using the Jig 2.
20. Insert the needle bearing using the Jig 3.
21. Insert the snap ring.
    - Tool to use: Snap ring pliers

■ **IMPORTANT**
- **Snap ring is assembling a sharp surface of the corner on the outside of the pump housing.**

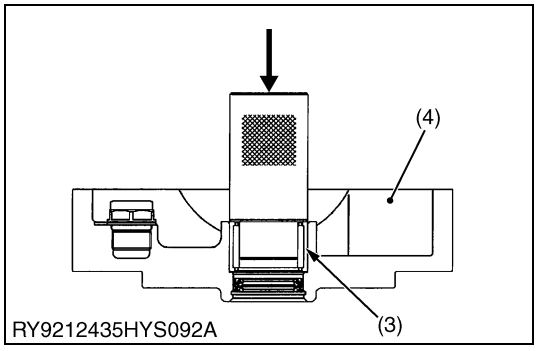
(1) Snap Ring (3) Needle Bearing
(2) Oil Seal



Jig 2

■ **IMPORTANT**
- **Coating the lip of oil seal with grease.**

(2) Oil Seal (4) Case

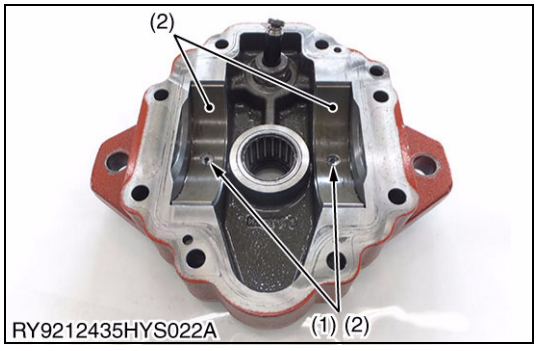


Jig 3

■ **IMPORTANT**
- **The stamped side of the bearing has to be faced upwards.**

(3) Needle Bearing (4) Case

RY9212435HYS0056US0



22. Tighten the bush by the screw.
    - Tool to use: 3 mm hex socket

tightening torque	Screw	5.9 N·m 0.6 kgf·m

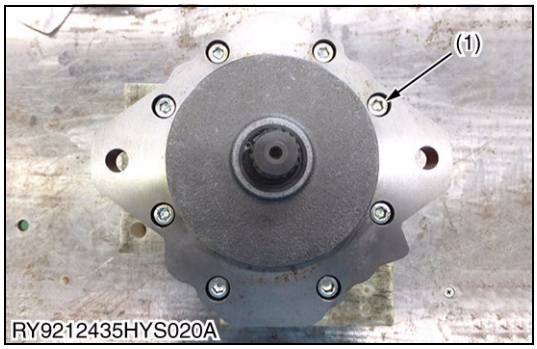
(1) Screw (2) Bush

RY9212435HYS0057US0

23. Set the flange.

(1) Flange

RY9212435HYS0019US0

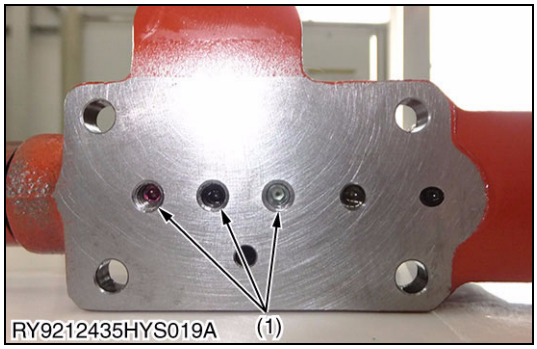


24. Tightening the hex socket head bolt.
- Tool to use: 8 mm hex socket

tightening torque	Hex socket head bolt	44.1 N·m 4.5 kgf·m

(1) Hex Socket Head Bolt (M10×80×8)

RY9212435HYS0058US0

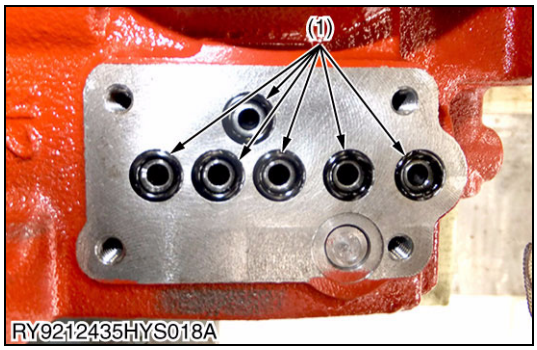


25. Insert the orifice.
- Tool to use: 3 mm hex socket

tightening torque	Orifice	2.45 N·m 0.25 kgf·m

(1) Orifice

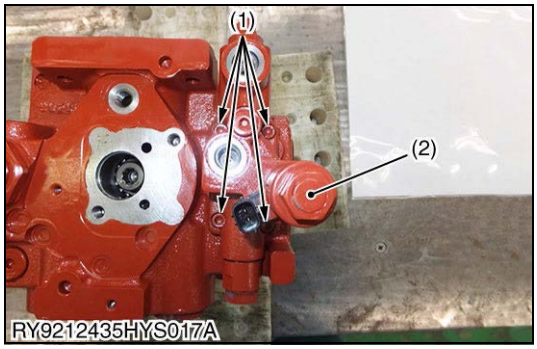
RY9212435HYS0020US0



26. Set the O-ring.

(1) O-Ring

RY9212435HYS0021US0

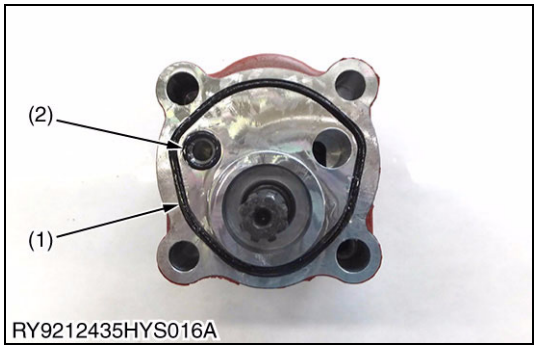


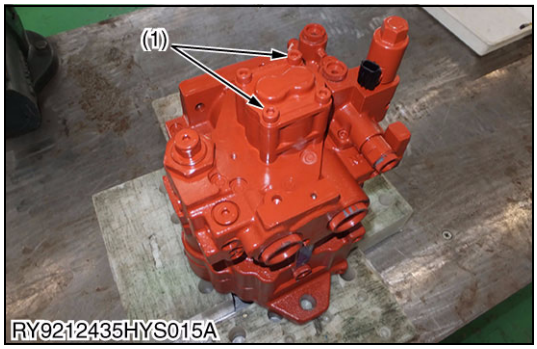
27. Set the LS regulator, and tighten with hex bolt.
- Tool to use: 5 mm hex socket

tightening torque	Hex socket head bolt	12.7 N·m 1.30 kgf·m

(1) Hex Socket Head Bolt (M5×16×4) (2) LS Regulator

RY9212435HYS0059US0





28. Set the O-ring.

■ **IMPORTANT**

- **Don't scratch the lip of the oil seal.**

(1) O-Ring (2) O-Ring

RY9212435HYS0022US0

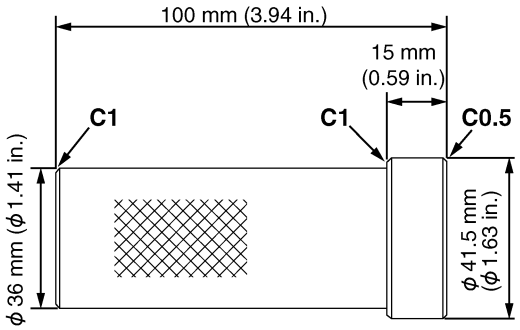
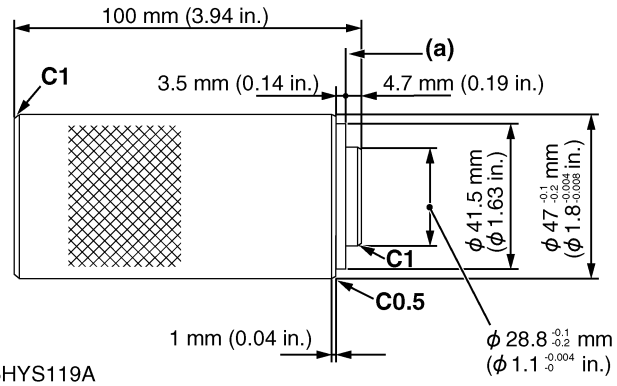
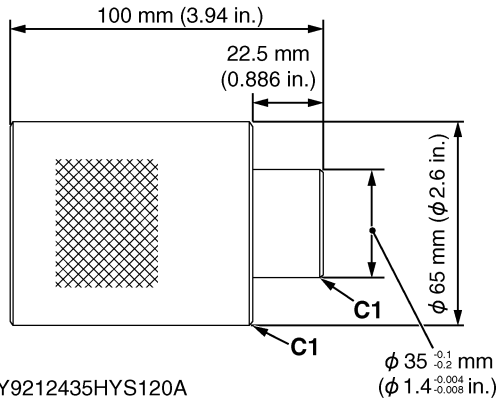
29. Install the gear pump with 2 hex socket head bolts.
- Tool to use: 6 mm hex socket

tightening torque	Hex socket head bolt	11.8 N·m 1.20 kgf·m

(1) Hex Socket Head Bolt (Include washer) (M6×65×2)

RY9212435HYS0060US0

Special Tools

No.	Tool to be used for	Shape of tool
1	To disassembly • Bearing • Oil seal	 RY9212435HYS118A
2	To assembly • Oil seal	 RY9212435HYS119A **(a)** Surface the oil seal is against.
3	To assembly • Bearing	 RY9212435HYS120A

RY9212435HYS0113US0

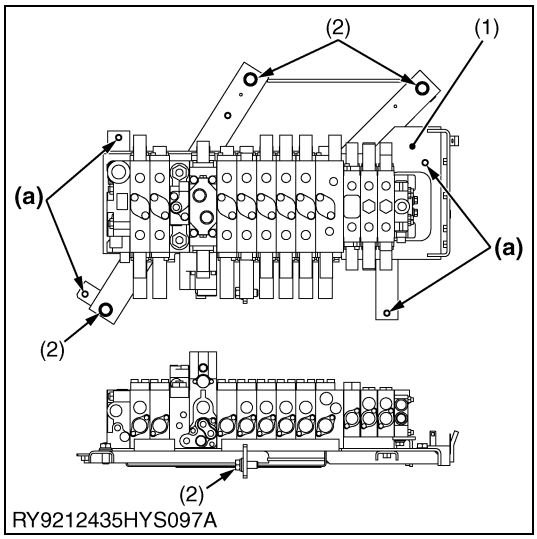
2. CONTROL VALVE

[1] REMOVAL AND INSTALLATION OF THE CONTROL VALVE

1. Remove the cover.
2. Attach a vacuum pump and depressurize the inside of the tank.

(1) Cover

RY9212724HYS0003US0



3. Disconnect all the hoses and wiring connected to the control valve.
4. Attach eye bolts to the base of the control valve and suspend the control valve with a crane.

■ **IMPORTANT**

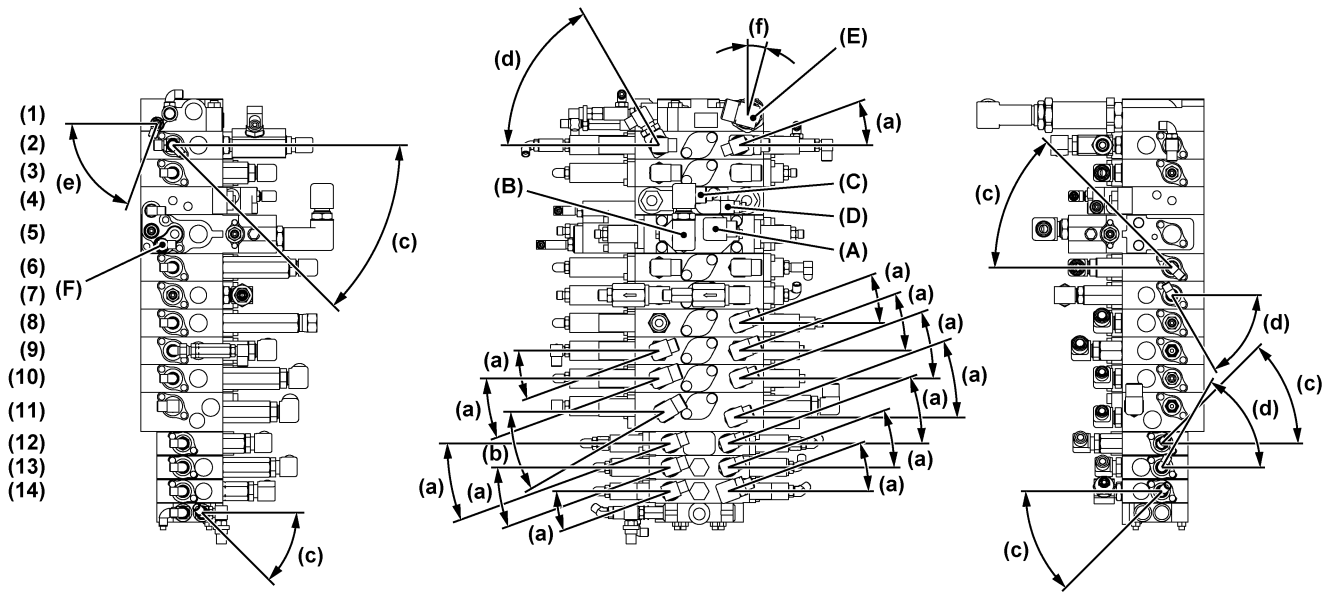
- **Plug the disconnected hoses and adapters.**
- **Label all of the disconnected hoses so you can identify them during assembly.**

5. Remove the 4 base mounting bolts, then lift with the crane and remove it.

(1) Cover
(2) Bolt
(a) Eye Bolt Mounting Hole (M12, Pitch 1.75)

RY9212435HYS0109US0

Control valve adapter angles (Standard boom spec.)



RY9212724HYS003A

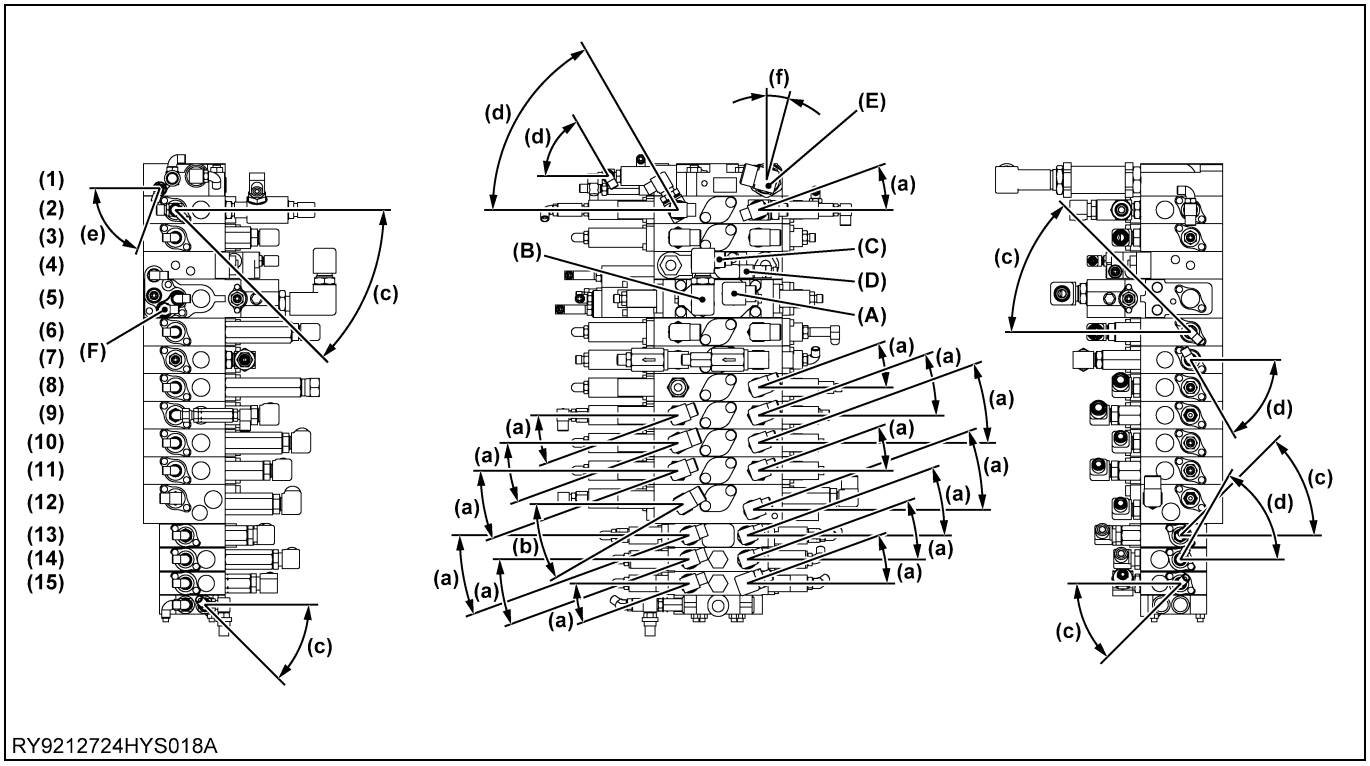
(1) Outlet
(2) Blade1
(3) Travel Left
(4) Unload
(5) Inlet
(6) Travel Right
(7) Blade2
(8) AUX1
(9) Arm
(10) Bucket
(11) Boom
(12) Swivel
(13) AUX2
(14) Swing

(A) P1
(B) P2
(C) Pps
(D) Pls
(E) T1
(F) PP1

(a) 20° (0.35 rad)
(b) 30° (0.52 rad)
(c) 45° (0.79 rad)
(d) 60° (1.05 rad)
(e) 70° (1.2 rad)
(f) 15° (0.26 rad)

RY9212724HYS0045US0

Control valve adapter angles (Two piece boom spec.)



RY9212724HYS018A

(1) Outlet
(2) Blade1
(3) Travel Left
(4) Unload
(5) Inlet
(6) Travel Right
(7) Blade2
(8) AUX1
(9) Arm
(10) Bucket
(11) Two Piece Boom
(12) Boom
(13) Swivel
(14) AUX2
(15) Swing

(A) P1
(B) P2
(C) Pps
(D) Pls
(E) T1
(F) PP1

(a) 20° (0.35 rad)
(b) 30° (0.52 rad)
(c) 45° (0.79 rad)
(d) 60° (1.05 rad)
(e) 70° (1.2 rad)
(f) 15° (0.26 rad)

RY9212724HYS0046US0

[2] CONTROL VALVE ASSEMBLY/DISASSEMBLY

Precautions during Disassembly / Assembly

Precautions during Disassembly

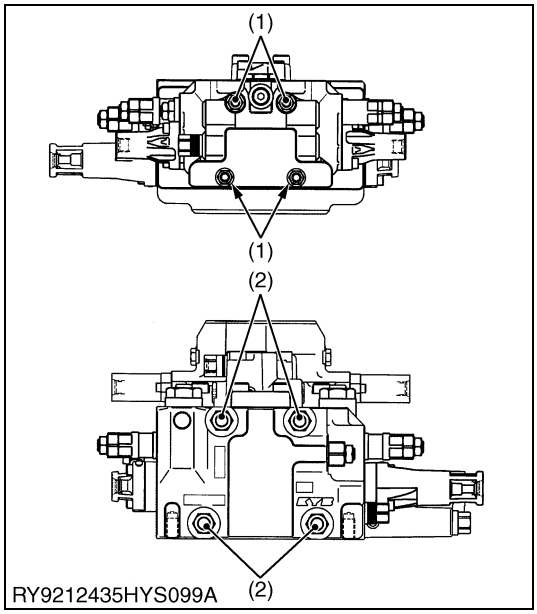
1. Generally, hydraulic devices are precision machined, and disassembly should therefore be conducted in a clean environment to prevent entry of debris into the narrow interstices formed in the device structure.
2. Always use clean tools and cleaning oil.
3. After removing from the machine, first wash the outside of the assembly.
4. Before starting work, prepare the necessary parts for the aims and extent of disassembly. Before reassembling, as a rule you should replace all seals and O-rings, etc. Also, since a subassembly is available with the required parts if parts cannot be supplied as single items, refer to the parts catalog beforehand in preparation.

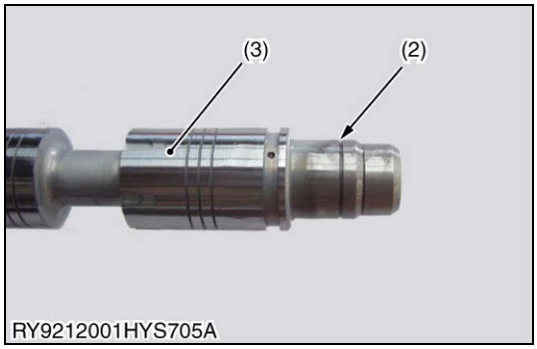
Precautions on Assembly

1. Apply clean grease or hydraulic fluid to O-rings and their countersunk parts for mounting.
2. There should be no flaws in O-rings due to forming, and no marks or heat deformation incurred when handling.
3. If permanently deformed, O-rings will not straighten out (Make sure that no flaws are incurred by an O-ring when passing it through sharp angled sections of a spool).
4. Do not turn over O-rings on installation (Fouled O-rings are difficult to re-install and can easily result in oil leakage).

Before assembling, at the mating surface of each section, make sure no cleaning oil, hydraulic fluid, etc., is adhered to the outer surface of the O-ring groove (If you assemble with oil adhered to a mating surface, this may be mistakenly recognized as oil leakage from that location when the machine is running).

RY9212001HYS0140US0





Control Valve Disassembly / Assembly Procedures

1. Loosen the nuts on one side with a ring spanner.

Tightening torque	Nut (four locations) (1)	26.5 to 29.4 N·m 2.7 to 3.0 kgf·m 19.6 to 21.7 lbf·ft
	Nut (four locations) (2)	89 to 97 N·m 9.1 to 9.9 kgf·m 66 to 72 lbf·ft

2. Pull out each section with a tie rod, and arrange in order on a workbench.

CAUTION

- **When removing each section, take care not to lose the load check valve and spring of the mating surface.**
- **Identify the load check valve and spring of each section so that they are not mismatched.**
- **Apply a location mark for each section.**
- **Excess torque on threads will cause defective spool operation. Therefore, be sure to use the specified torque.**
- **Take care over the direction of installation of each spool, align with the holes and insert slowly.**

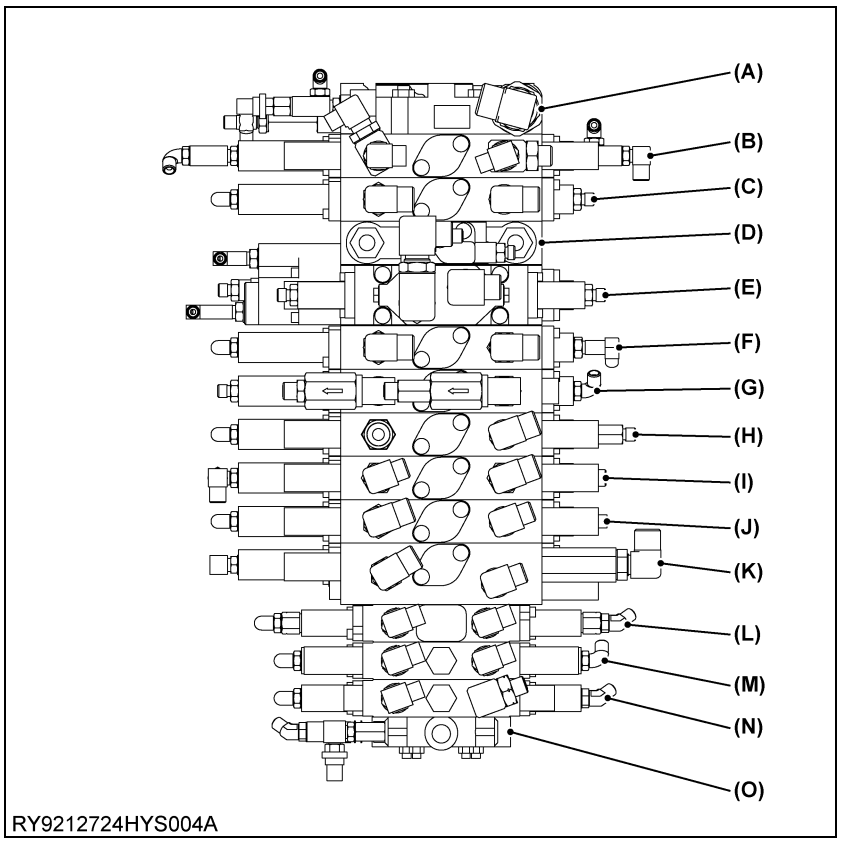
(1) Nut
(2) Identification groove for spool assembly orientation
(3) Spool

RY9212435HYS0025US0

[3] CONTROL VALVE COMPONENTS

(1) Section Components

Standard Boom Spec.

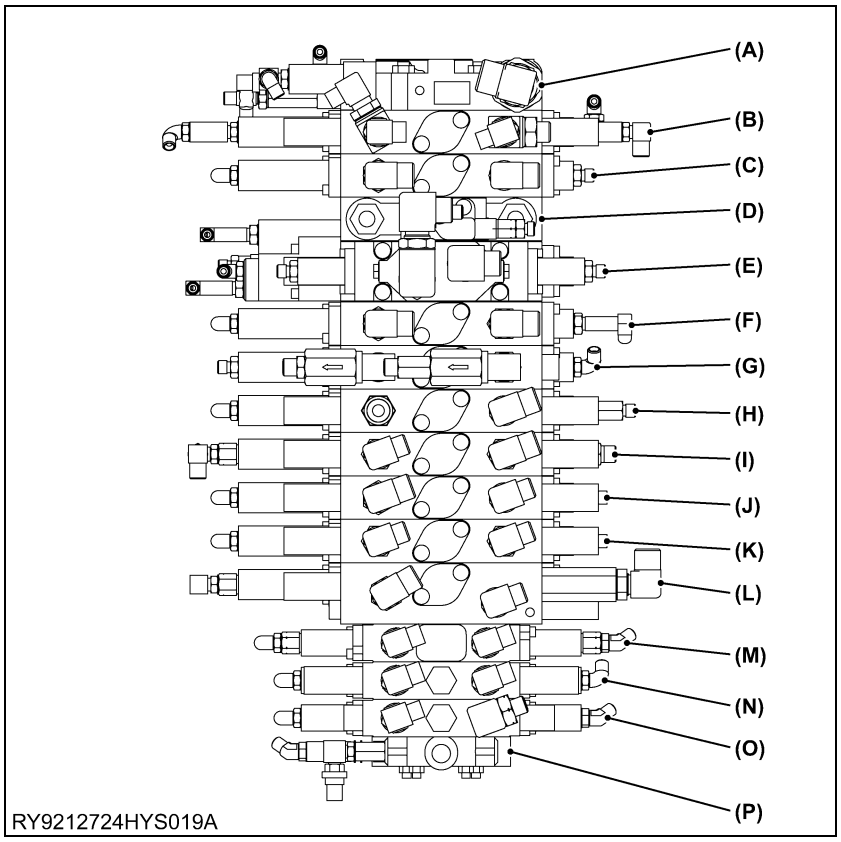


RY9212724HYS004A

(A) Outlet
(B) Blade-1
(C) Travel (LH)
(D) Unload
(E) Inlet
(F) Travel (RH)
(G) Blade-2
(H) AUX1
(I) Arm
(J) Bucket
(K) Boom
(L) Swivel
(M) AUX2
(N) Swing
(O) Housing

RY9212724HYS0047US0

Two Piece Boom Spec.



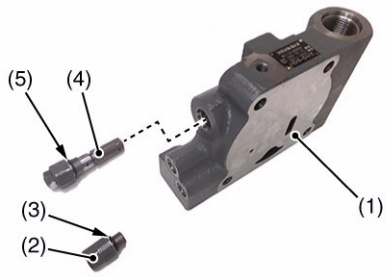
RY9212724HYS019A

(A) Outlet
(B) Blade-1
(C) Travel (LH)
(D) Unload
(E) Inlet
(F) Travel (RH)
(G) Blade-2
(H) AUX1
(I) Arm
(J) Bucket
(K) Two Piece Boom
(L) Boom
(M) Swivel
(N) AUX2
(O) Swing
(P) Housing

RY9212724HYS0048US0

(2) Outlet Section

[A] Standard Boom Spec.

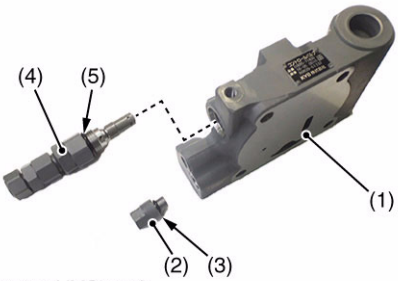


RY9212435HYS100A

No.	Part Name	Tightening torque
(1)	Outlet housing	–
(2)	Plug	29.1 N·m 3.0 kgf·m 21.5 lbf·ft
(3)	O-ring	–
(4)	Main relief valve assy	49 ~ 54 N·m 5.0 to 5.5 kgf·m 36.1 to 39.8 lbf·ft
(5)	O-ring	–

RY9212435HYS0063US0

[B] Two Piece Boom Spec.

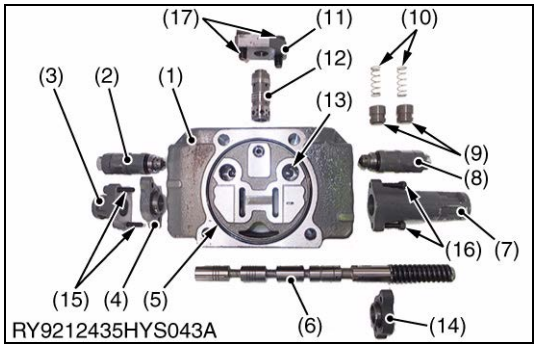


RY9212435HYS111A

No.	Part Name	Tightening torque
(1)	Outlet housing	–
(2)	Plug	29.1 N·m 3.0 kgf·m 21.5 lbf·ft
(3)	O-ring	–
(4)	Main relief valve assy	49 to 54 N·m 5.0 to 5.5 kgf·m 36.1 to 39.8 lbf·ft
(5)	O-ring	–

RY9212435HYS0115US0

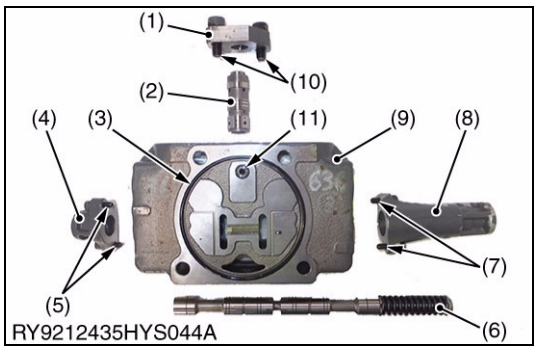
(3) Blade-1 Section



No.	Part Name	Tightening torque
(1)	Body	–
(2)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(3)	Cap	–
(4)	Seal holder (2 O-ring)	–
(5)	O-ring	–
(6)	Spool	–
(7)	Cap	–
(8)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(9)	poppet	–
(10)	Spring	–
(11)	Flange	–
(12)	Spool	–
(13)	O-ring	–
(14)	Seal holder (2 O-ring)	–
(15)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(16)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(17)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft

RY9212435HYS0064US0

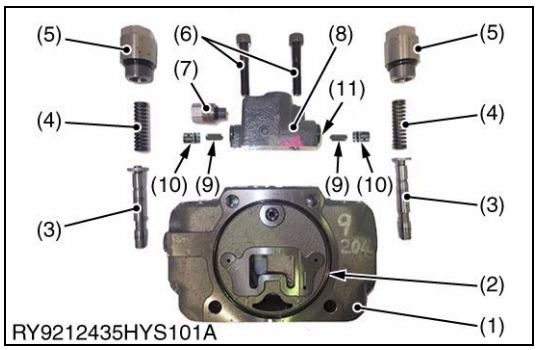
(4) Travel (LH) Section



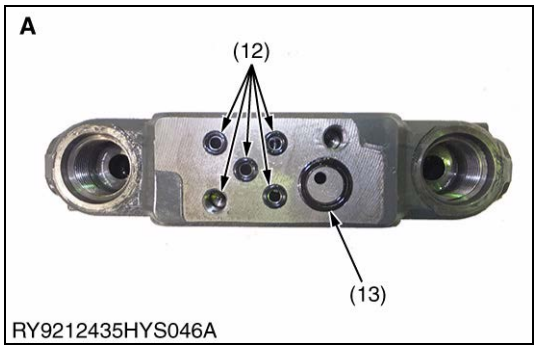
No.	Part Name	Tightening torque
(1)	Flange	–
(2)	Spool	–
(3)	O-ring	–
(4)	Cap	–
(5)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(6)	Spool	–
(7)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(8)	Cap	–
(9)	Body	–
(10)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(11)	O-ring	–

RY9212435HYS0065US0

(5) Unload Section



RY9212435HYS101A



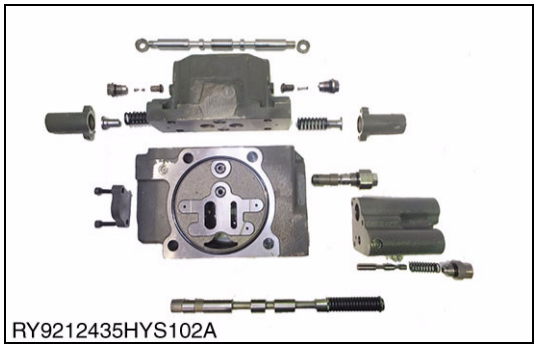
RY9212435HYS046A

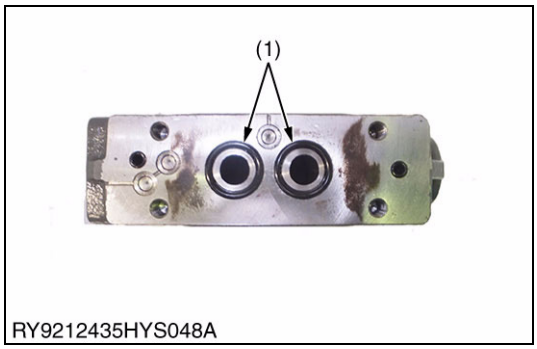
No.	Part Name	Tightening torque
(1)	Body	–
(2)	O-ring	–
(3)	Spool	–
(4)	Spring	–
(5)	Plug assy	167 to 197 N·m 17.0 to 20.1 kgf·m 123 to 145 lbf·ft
(6)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(7)	Plug assy	28.4 to 30.4 N·m 2.9 to 3.1 kgf·m 20.9 to 22.4 lbf·ft
(8)	Body	–
(9)	Poppet	–
(10)	Spacer	–
(11)	Plug	28.4 to 30.4 N·m 2.9 to 3.1 kgf·m 20.9 to 22.4 lbf·ft
(12)	O-ring	–
(13)	O-ring	–

A: Upper Side

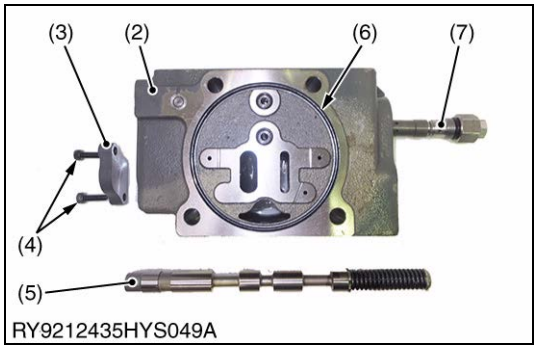
RY9212435HYS0066US0

(6) Inlet Section


RY9212435HYS102A



RY9212435HYS048A



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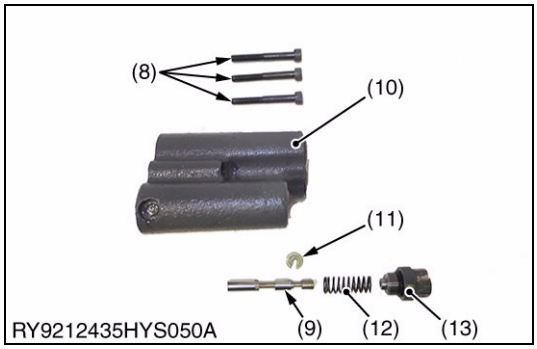
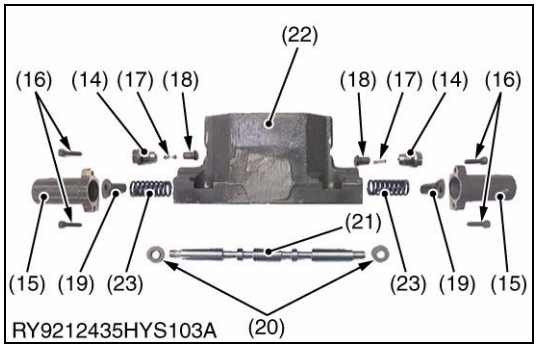


RY9212435HYS050A

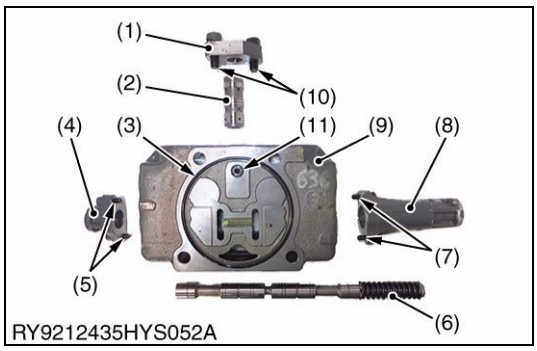


RY9212435HYS103A

No.	Part Name	Tightening torque
(1)	O-ring	–
(2)	Body	–
(3)	Cap	–
(4)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(5)	Spool	–
(6)	O-ring	–
(7)	Main relief valve assy (O-ring)	49 to 54 N·m 5.0 to 5.5 kgf·m 36.1 to 39.8 lbf·ft
(8)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(9)	Spool	–
(10)	Cap	–
(11)	Plate	–
(12)	Spring	–
(13)	Cap	–
(14)	Plug	30.4 to 32.4 N·m 3.1 to 3.3 kgf·m 22.4 to 23.9 lbf·ft
(15)	Cap	–
(16)	Hexagonal bolt	7.5 N·m 0.8 kgf·m 5.5 lbf·ft
(17)	Spring	–
(18)	Poppet	–
(19)	Spring seat	–
(20)	Spring seat	–
(21)	Spool	–
(22)	Body	–
(23)	Spring	–

RY9212435HYS0067US0

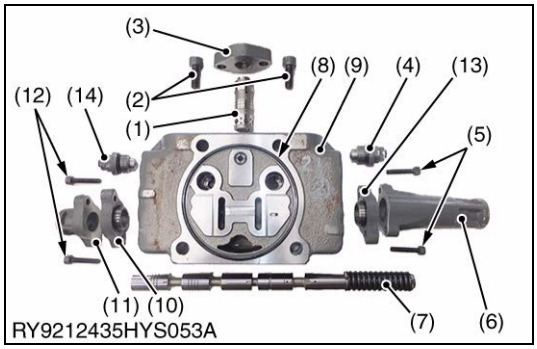
(7) Travel (RH) Section



No.	Part Name	Tightening torque
(1)	Flange	–
(2)	Spool	–
(3)	O-ring	–
(4)	Cap	–
(5)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(6)	Spool	–
(7)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(8)	Cap	–
(9)	Body	–
(10)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(11)	O-ring	–

RY9212435HYS0068US0

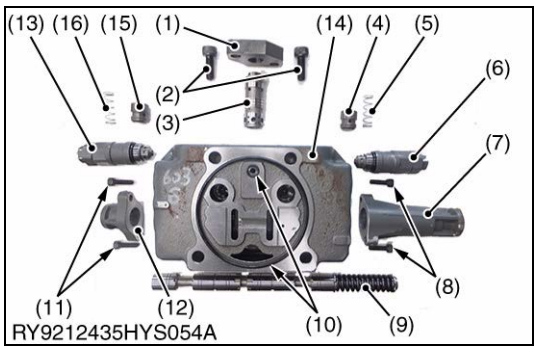
(8) Blade-2 Section



No.	Part Name	Tightening torque
(1)	Spool	–
(2)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(3)	Flange (O-ring)	–
(4)	Shut-off valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(5)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(6)	Cap	–
(7)	Spool	–
(8)	O-ring	–
(9)	Body	–
(10)	Seal holder (2 O-ring)	–
(11)	Cap	–
(12)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(13)	Seal holder (2 O-ring)	–
(14)	Shut-off valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft

RY9212435HYS0069US0

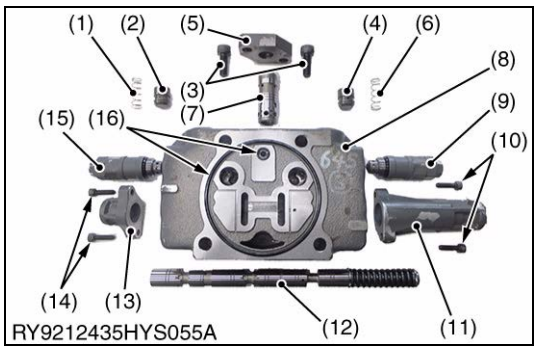
(9) AUX1 Section



No.	Part Name	Tightening torque
(1)	Flange (O-ring)	–
(2)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(3)	Spool	–
(4)	Poppet	–
(5)	Spring	–
(6)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(7)	Cap (O-ring)	–
(8)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(9)	Spool	–
(10)	O-ring	–
(11)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(12)	Cap (O-ring)	–
(13)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(14)	Body	–
(15)	Poppet	–
(16)	Spring	–

RY9212435HYS0070US0

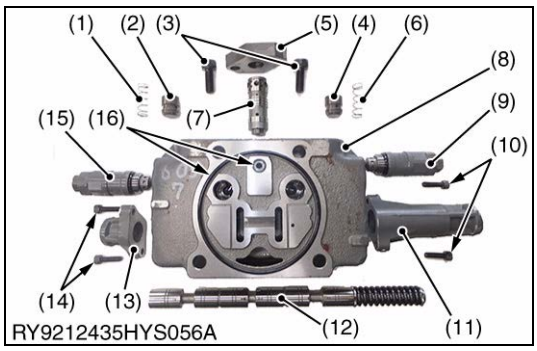
(10) Arm Section



No.	Part Name	Tightening torque
(1)	Spring	–
(2)	Poppet	–
(3)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(4)	Poppet	–
(5)	Flange (O-ring)	–
(6)	Spring	–
(7)	Spool	–
(8)	Body	–
(9)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(10)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(11)	Cap (O-ring)	–
(12)	Spool	–
(13)	Cap (O-ring)	–
(14)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(15)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(16)	O-ring	–

RY9212435HYS0071US0

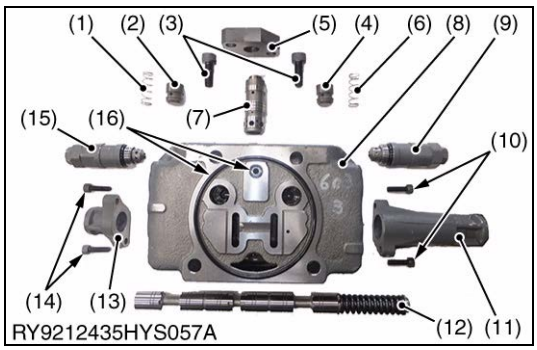
(11) Bucket Section



No.	Part Name	Tightening torque
(1)	Spring	–
(2)	Poppet	–
(3)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(4)	Poppet	–
(5)	Flange (O-ring)	–
(6)	Spring	–
(7)	Spool	–
(8)	Body	–
(9)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(10)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(11)	Cap (O-ring)	–
(12)	Spool	–
(13)	Cap (O-ring)	–
(14)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(15)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(16)	O-ring	–

RY9212435HYS0072US0

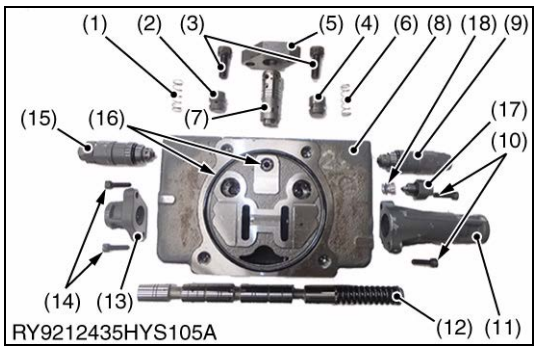
(12) Two Piece Boom Section



No.	Part Name	Tightening torque
(1)	Spring	–
(2)	Poppet	–
(3)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(4)	Poppet	–
(5)	Flange (O-ring)	–
(6)	Spring	–
(7)	Spool	–
(8)	Body	–
(9)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(10)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(11)	Cap (O-ring)	–
(12)	Spool	–
(13)	Cap (O-ring)	–
(14)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(15)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(16)	O-ring	–

RY9212435HYS0073US0

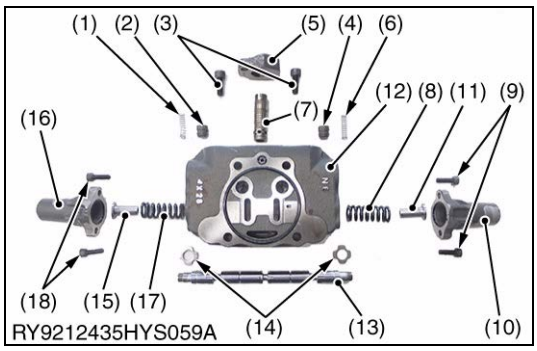
(13) Boom Section



No.	Part Name	Tightening torque
(1)	Spring	–
(2)	Poppet	–
(3)	Hexagonal bolt	58 to 64 N·m 5.9 to 6.5 kgf·m 42.8 to 47.2 lbf·ft
(4)	Poppet	–
(5)	Flange (O-ring)	–
(6)	Spring	–
(7)	Spool	–
(8)	Body	–
(9)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(10)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(11)	Cap (O-ring)	–
(12)	Spool	–
(13)	Cap (O-ring)	–
(14)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(15)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(16)	O-ring	–
(17)	Shot-off valve	28 to 30 N·m 2.9 to 3.1 kgf·m 20.7 to 22.1 lbf·ft
(18)	Sleeve (O-ring)	–

RY9212435HYS0074US0

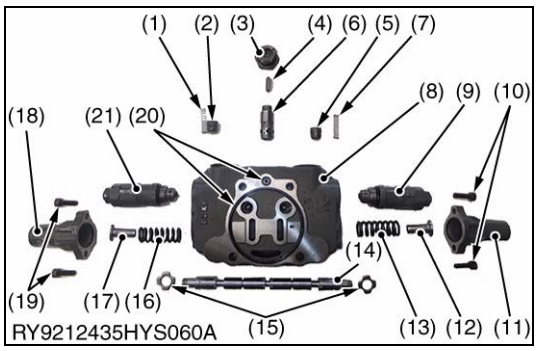
(14) Swivel Section



No.	Part Name	Tightening torque
(1)	Spring	–
(2)	Poppet	–
(3)	Hexagonal bolt	30.4 to 32.4 N·m 3.1 to 3.3 kgf·m 22.4 to 23.9 lbf·ft
(4)	Poppet	–
(5)	Flange (O-ring)	–
(6)	Spring	–
(7)	Spool	–
(8)	Spring	–
(9)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(10)	Cap (O-ring)	–
(11)	Spring seat	–
(12)	Body	–
(13)	Spool	–
(14)	Spring plate	–
(15)	Spring seat	–
(16)	Cap (O-ring)	–
(17)	Spring	–
(18)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft

RY9212435HYS0075US0

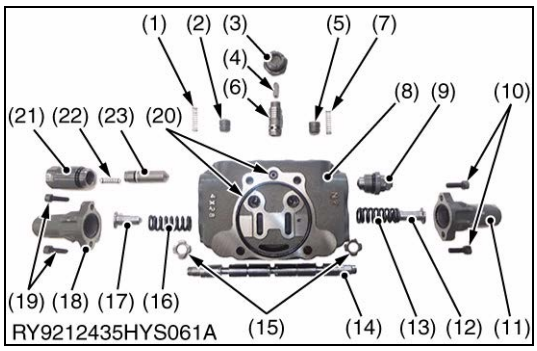
(15) AUX2 Section



No.	Part Name	Tightening torque
(1)	Spring	–
(2)	Poppet	–
(3)	Plug (O-ring)	67.7 to 73.5 N·m 6.9 to 7.5 kgf·m 49.9 to 54.2 lbf·ft
(4)	Poppet	–
(5)	Poppet	–
(6)	Spool	–
(7)	Spring	–
(8)	Body	–
(9)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(10)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(11)	Cap (O-ring)	–
(12)	Spring seat	–
(13)	Spring	–
(14)	Spool	–
(15)	Spring plate	–
(16)	Spring	–
(17)	Spring seat	–
(18)	Cap (O-ring)	–
(19)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(20)	O-ring	–
(21)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft

RY9212435HYS0076US0

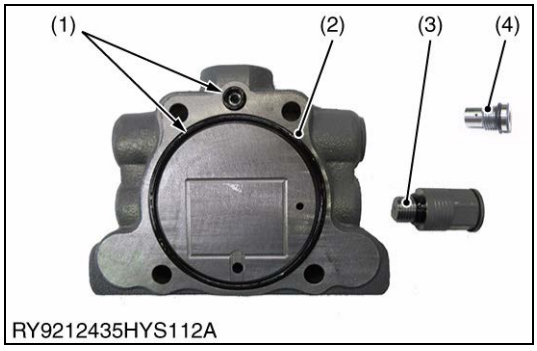
(16) Swing Section



No.	Part Name	Tightening torque
(1)	Spring	–
(2)	Poppet	–
(3)	Plug (O-ring)	67.7 to 73.5 N·m 6.9 to 7.5 kgf·m 49.9 to 54.2 lbf·ft
(4)	Poppet	–
(5)	Poppet	–
(6)	Spool	–
(7)	Spring	–
(8)	Body	–
(9)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(10)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(11)	Cap (O-ring)	–
(12)	Spring seat	–
(13)	Spring	–
(14)	Spool	–
(15)	Spring plate	–
(16)	Spring	–
(17)	Spring seat	–
(18)	Cap (O-ring)	–
(19)	Hexagonal bolt	8.8 to 11.0 N·m 0.9 to 1.1 kgf·m 6.5 to 8.0 lbf·ft
(20)	O-ring	–
(21)	Overload relief valve (O-ring)	59 to 69 N·m 6.0 to 7.0 kgf·m 43.5 to 50.9 lbf·ft
(22)	Spring	–
(23)	Poppet	–

RY9212435HYS0077US0

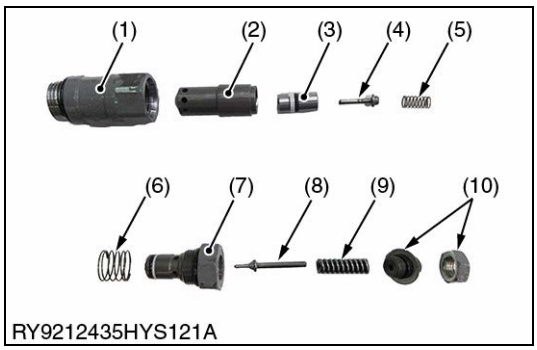
(17) Housing Section



No.	Part Name	Tightening torque
(1)	O-ring	–
(2)	Body	–
(3)	Plug (O-ring)	28 to 30 N·m 2.9 to 3.1 kgf·m 20.7 to 22.1 lbf·ft
(4)	Plug assy (O-ring)	28 to 30 N·m 2.9 to 3.1 kgf·m 20.7 to 22.1 lbf·ft

RY9212435HYS0078US0

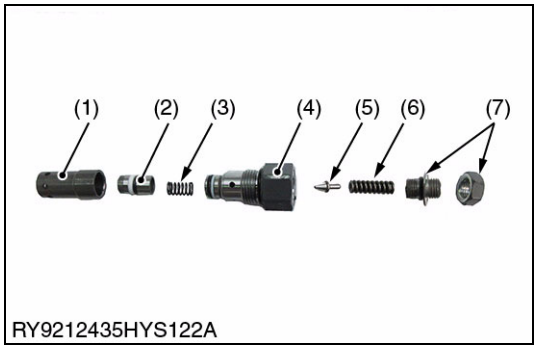
(18) Overload Relief Valve



No.	Part Name	Tightening torque
(1)	Plug	–
(2)	Sleeve	–
(3)	Poppet	–
(4)	Piston	–
(5)	Spring	–
(6)	Spring	–
(7)	Plug	67 to 78 N·m 7.0 to 8.0 kgf·m 50.9 to 57.5 lbf·ft
(8)	Pilot poppet	–
(9)	Spring	–
(10)	Adjuster kit	27 to 31 N·m 2.8 to 3.2 kgf·m 20.3 to 23.1 lbf·ft

RY9212435HYS0129US0

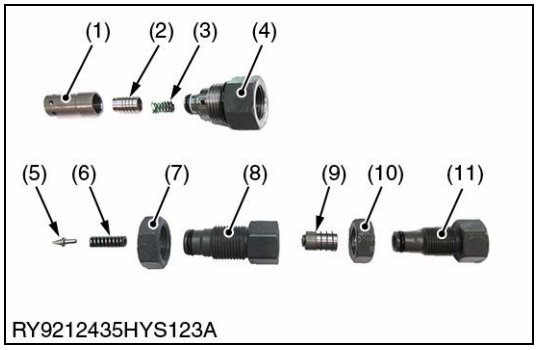
(19) Main Relief Valve (ap1 Standard Boom Spec., ap2 both Spec.)



No.	Part Name	Tightening torque
(1)	Sleeve	–
(2)	Poppet	–
(3)	Spring	–
(4)	Plug	49 to 54 N·m 5.0 to 5.5 kgf·m 36.1 to 39.8 lbf·ft
(5)	Pilot poppet	–
(6)	Spring	–
(7)	Adjuster kit	27 to 31 N·m 2.8 to 3.2 kgf·m 20.3 to 23.1 lbf·ft

RY9212435HYS0130US0

(20) Main Relief Valve (ap1 Two Piece Boom Spec.)



No.	Part Name	Tightening torque
(1)	Sleeve	–
(2)	Poppet	–
(3)	Spring	–
(4)	Plug	49 to 54 N·m 5.0 to 5.5 kgf·m 36.1 to 39.8 lbf·ft
(5)	Pilot poppet	–
(6)	Spring	–
(7)	High pressure set lock nut	78 to 88 N·m 8.0 to 9.0 kgf·m 57.5 to 64.9 lbf·ft
(8)	High pressure set plug	–
(9)	Poppet	–
(10)	Low pressure set lock nut	59 to 69 N·m 6.0 to 7.0 kgf·m 93.5 to 50.9 lbf·ft
(11)	Low pressure set plug	–

RY9212435HYS0131US0

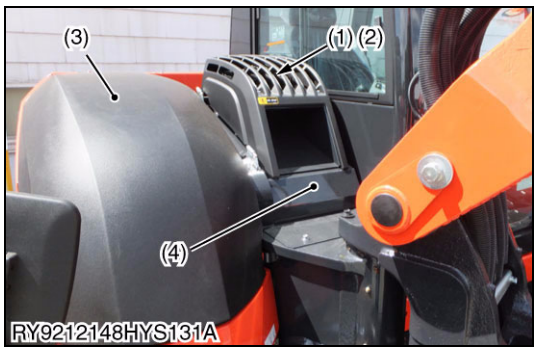
3. SWIVEL MOTOR

[1] REMOVAL AND INSTALLATION OF THE SWIVEL MOTOR

CAUTION

- **When removing a hydraulic device after operating the excavator, lower the bucket and blade to the ground and turn off the engine.**
- **Each of the devices and the hydraulic oil are hot right after stopping the excavator. The oil is hot enough to cause a burn, so always let it cool down before starting any work.**
- **Oil gushing out under pressure has enough force to injure you by piercing your skin. Always relieve any pressure remaining in the system prior to working to remove any hydraulic equipment or lines.**

RY9212148HYS0149US0



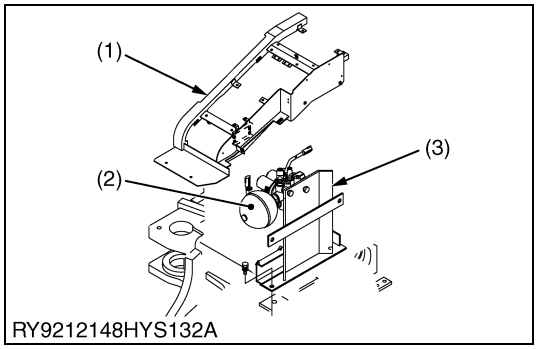
1. Remove the cover, electric fan, tank cover and center cover.

[Work Tip]

- Move the condenser toward the rear of the machine with the AC hoses still installed.

(1) Cover
(2) Electric fan
(3) Tank cover
(4) Center cover

RY9212148HYS0212US0



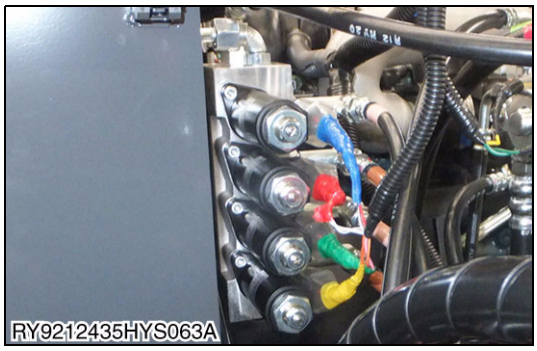
2. Remove the center frame, unload valve and unload valve bracket in order.

■ **IMPORTANT**

- **Disconnect the wire harness prior to removing the center frame.**
- **Plug the disconnected hoses and adapters.**

(1) Center frame
(2) Unload valve
(3) Unload valve bracket

RY9212148HYS0213US0



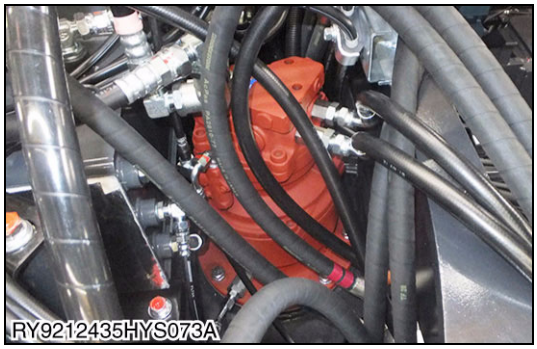
3. Remove the AUX1 and AUX2 solenoid valves.

■ **IMPORTANT**

- **Plug the disconnected hoses and adapters.**

(1) AUX1 Solenoid Valve
(2) AUX2 Solenoid Valve

RY9212435HYS0026US0



4. Disconnect all the hoses connected to the swivel motor.

■ **IMPORTANT**

- **Plug the disconnected hoses and adapters.**

RY9212435HYS0037US0

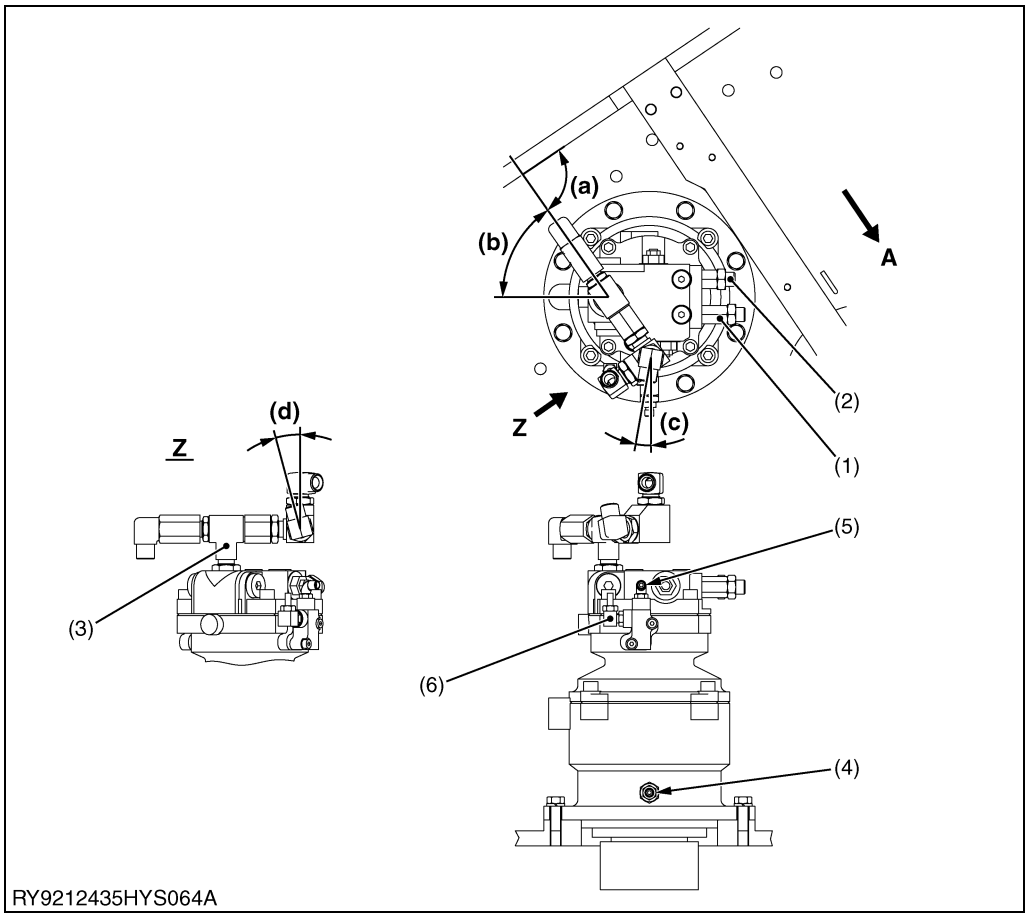
5. Remove the 8 swivel motor mounting bolts and remove the swivel motor.

Tightening torque	Bolt	259.9 to 304.0 N·m 26.5 to 31.0 kgf·m 191.7 to 224.2 lbf·ft

Swivel motor weight	Approx. 80 kg (180 lbs)

RY9212148HYS0216US0

Swivel motor adapter angles



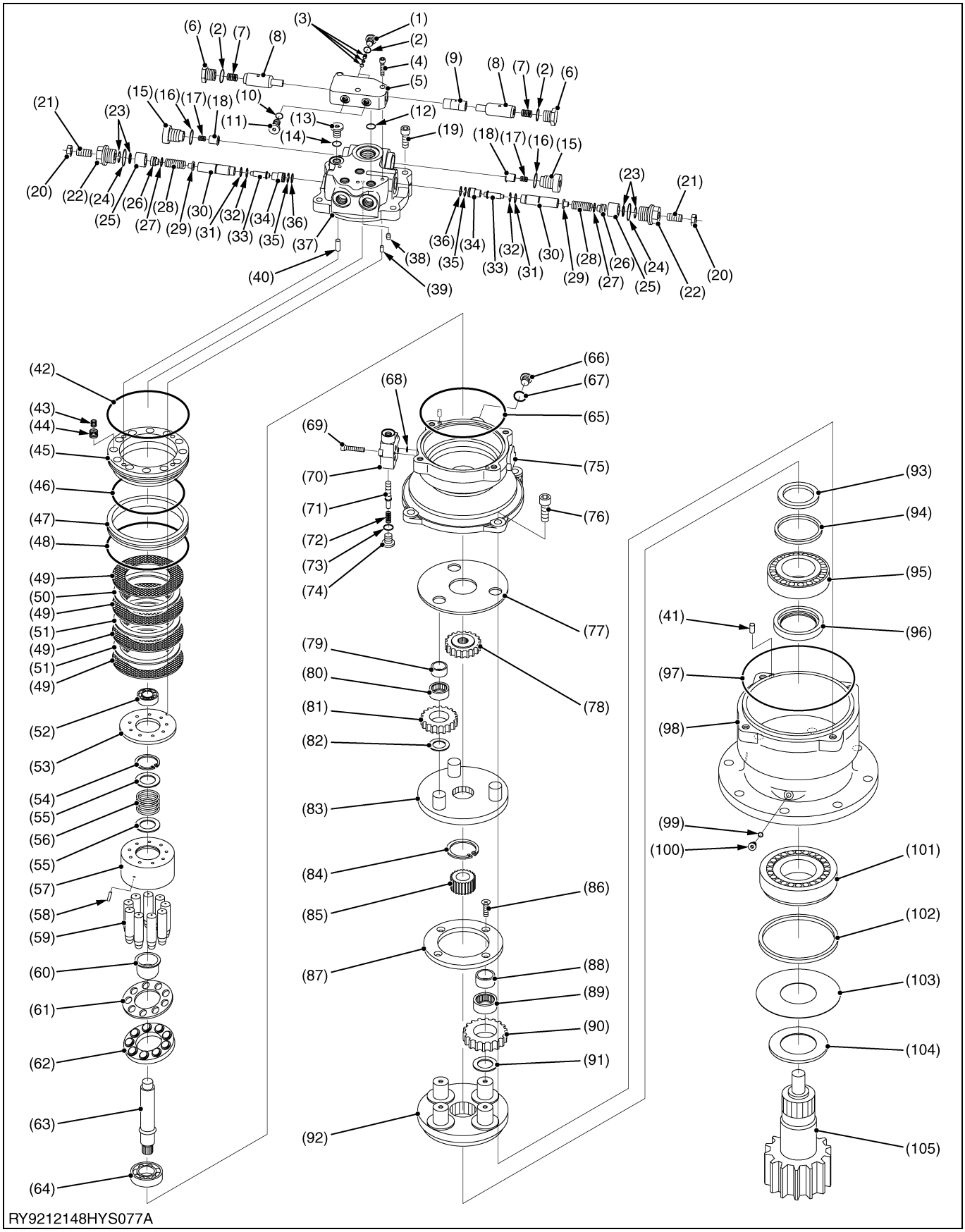
(1) Port A
(2) Port B
(3) Port M
(4) Drain Port
(5) Port SH
(6) Port PG

(a) 90 ° (1.57 rad)
(b) 55 ° (0.96 rad)
(c) 10 ° (0.17 rad)
(d) 15 ° (0.26 rad)

A : Front Side

RY9212435HYS0027US0

[2] SWIVEL MOTOR DISASSEMBLY/ASSEMBLY PROCEDURES



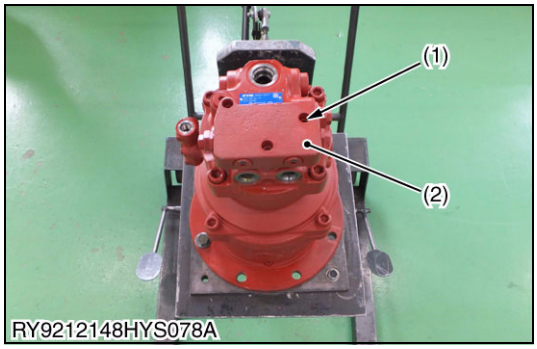
(To be continued)

(Continued)

No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty
(1)	Plug	2	(36)	O-ring	2	(71)	Spool	1
(2)	O-ring	4	(37)	Cover	1	(72)	Spring	1
(3)	Orifice	2	(38)	Orifice	1	(73)	O-ring	1
(4)	Hex socket bolt	3	(39)	Knock pin	1	(74)	Plug	1
(5)	Body	1	(40)	Pin	2	(75)	Housing	1
(6)	Plug	2	(41)	Pin	2	(76)	Hex socket bolt	4
(7)	Spring	2	(42)	O-ring	1	(77)	Plate	1
(8)	Check valve	2	(43)	Spring, small	8	(78)	Drive gear	1
(9)	Sleeve	1	(44)	Spring, large	12	(79)	Inner race	3
(10)	O-ring	2	(45)	Brake piston	1	(80)	Needle bearing	3
(11)	Plug	2	(46)	O-ring	1	(81)	Planetary gear A	3
(12)	O-ring	3	(47)	Collar	1	(82)	Washer	3
(13)	Plug	1	(48)	O-ring	1	(83)	Holder	1
(14)	O-ring	1	(49)	Disc	4	(84)	Circlip	1
(15)	Plug	2	(50)	Plate A	1	(85)	Sun gear	1
(16)	O-ring	2	(51)	Plate B	2	(86)	Hex flange bolt	4
(17)	Spring	2	(52)	Ball bearing	1	(87)	Plate	1
(18)	Poppet	2	(53)	Valve plate	1	(88)	Inner race	4
(19)	Hex socket bolt	4	(54)	Circlip	1	(89)	Needle bearing	4
(20)	Nut	2	(55)	Washer	2	(90)	Planetary gear B	4
(21)	Set screw	2	(56)	Spring	1	(91)	Washer	4
(22)	Plug	2	(57)	Cylinder block	1	(92)	Holder	1
(23)	Backup ring	4	(58)	Pin	3	(93)	Plate	2
(24)	O-ring	2	(59)	Piston ASSY	9	(94)	Collar	1
(25)	Piston	2	(60)	Retainer holder	1	(95)	Tapered roller bearing	1
(26)	Spring guide	2	(61)	Retainer plate	1	(96)	Oil seal	1
(27)	O-ring	2	(62)	Swash-plate	1	(97)	O-ring	1
(28)	Spring	2	(63)	Shaft	1	(98)	Housing	1
(29)	Spring seat	2	(64)	Ball bearing	1	(99)	O-ring	1
(30)	Housing	2	(65)	O-ring	1	(100)	Plug	1
(31)	Backup ring	2	(66)	Plug	1	(101)	Tapered roller bearing	1
(32)	O-ring	2	(67)	O-ring	1	(102)	Collar	1
(33)	Poppet	2	(68)	O-ring	2	(103)	Plate	1
(34)	Poppet seat	2	(69)	Hex socket bolt	2	(104)	Plate	1
(35)	Backup ring	2	(70)	Valve body	1	(105)	Shaft	1

RY9212148HYS0097US0

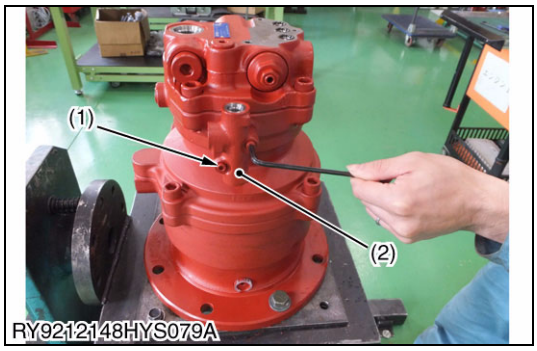
(1) Disassembly Procedures



1. Mount the swivel motor on an assembly platform.
2. Remove the hex socket bolts and then the body.
   - Tool to use: 6 mm hex socket

(1) Hex socket bolt (2) Body

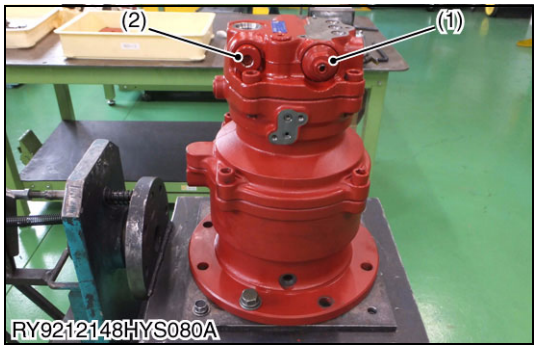
RY9212148HYS0098US0



3. Remove the hex socket bolts and then the valve body.
   - Tool to use: 5 mm hex socket

(1) Hex socket bolt (2) Valve body

RY9212148HYS0099US0



4. Remove the relief valve and loosen the plug (both sides).
   - Tool to use: 27mm box wrench, 12 mm hex socket

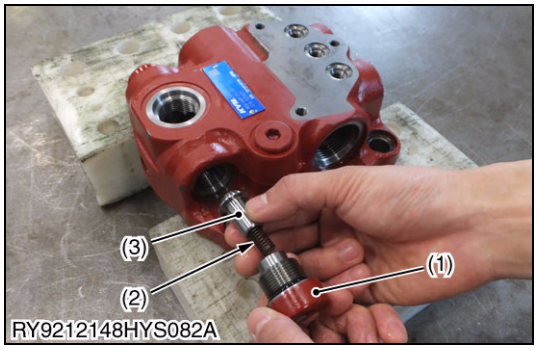
(1) Relief valve (2) Plug

RY9212148HYS0100US0

5. Remove the hex socket bolts and then the cover.
   - Tool to use: 12 mm hex socket

(1) Hex socket bolt (2) Cover

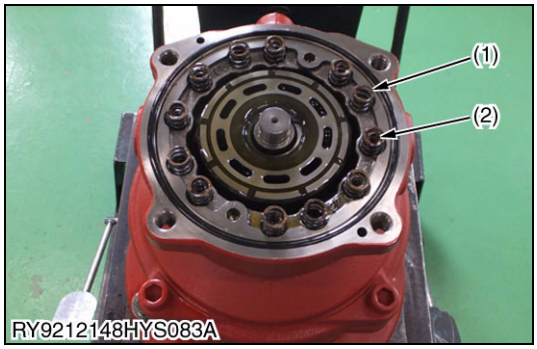
RY9212148HYS0101US0



6. Remove the plug, spring and poppet in order.
   - Tool to use: 12 mm hex socket

(1) Plug (3) Poppet
(2) Spring

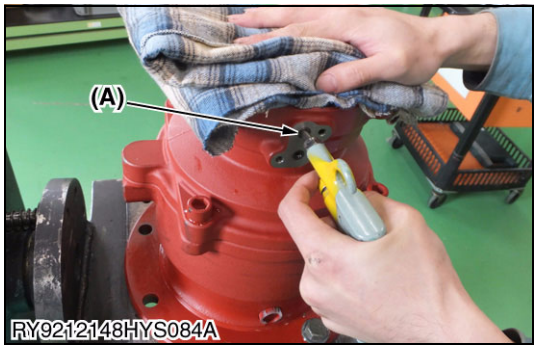
RY9212148HYS0102US0



7. Remove the large and small springs.

(1) Spring, large
(2) Spring, small

RY9212148HYS0103US0

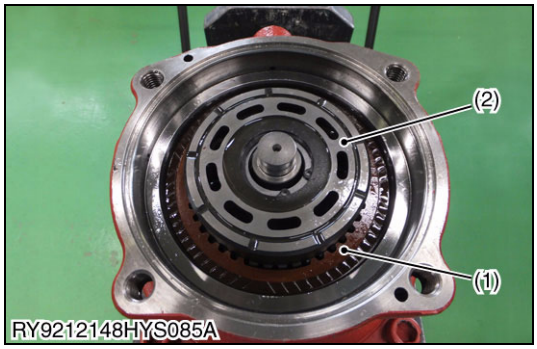


8. While pressing down on the brake piston with a rag, blow air through the brake release oil passage hole and remove the brake piston.
- Tool to use: air gun

CAUTION
- **Be careful because if you blast air into the passage, the brake piston may come flying out.**

(A) Brake release oil passage hole

RY9212148HYS0104US0



9. Remove the 1 disc and then the cylinder block ASSY.

(1) Disc
(2) Cylinder block ASSY

RY9212148HYS0105US0

10. Remove the collar.
- Tool to use: Slotted screwdriver

CAUTION
- **Be careful not to scratch the plate with the screwdriver.**

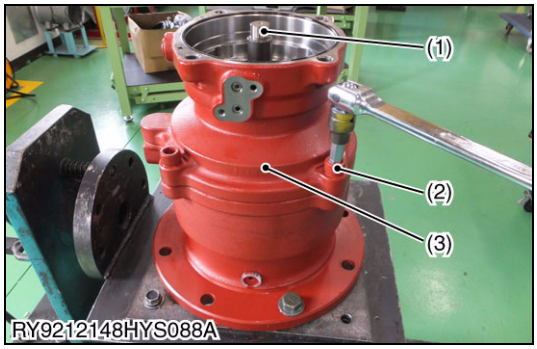
(1) Collar

RY9212148HYS0106US0

11. Remove the plate, disc and swash-plate.

(1) Plate
(2) Disc
(3) Swash-plate

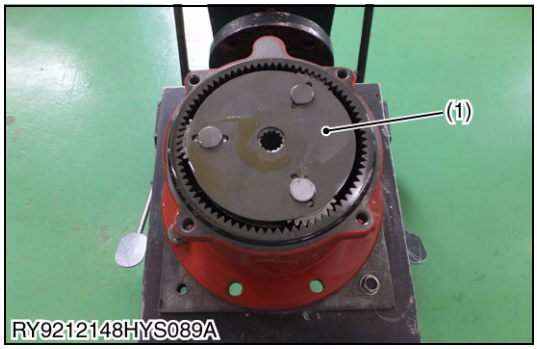
RY9212148HYS0107US0



12. Remove the shaft. Remove the hex socket bolts and then the housing.
- Tool to use: 12 mm hex socket

(1) Shaft
(2) Hex socket bolt
(3) Housing

RY9212148HYS0108US0



13. Remove the plate.

(1) Plate

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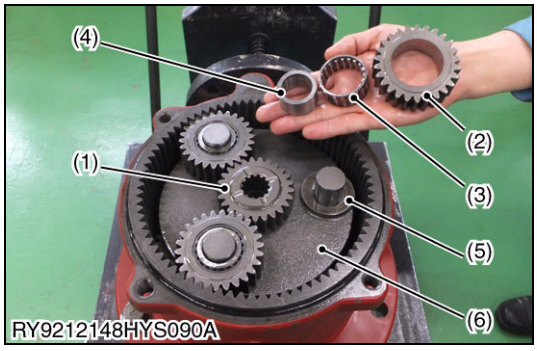

14. Remove the driver gear, planetary gear A, needle bearing, inner race and washer and then remove the flange holder.

(1) Drive gear
(2) Planetary gear A
(3) Needle bearing
(4) Inner race
(5) Washer
(6) Flange holder

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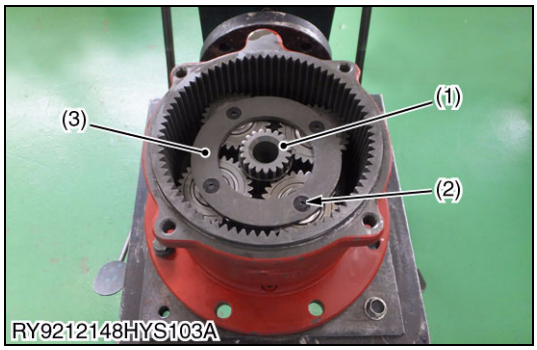
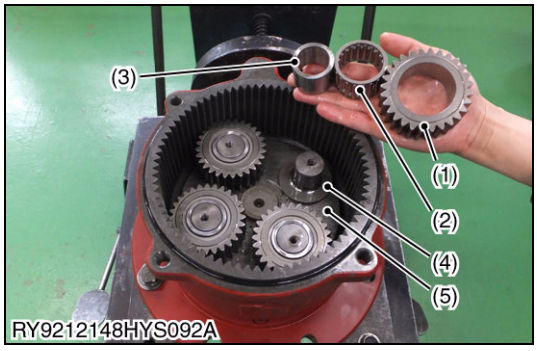


15. Remove the sun gear, hex flange holder and then the plate.
- Tool to use: 5 mm hex socket

CAUTION
- **If the bolts are tight and you can't loosen them, heat them with a heat gun or the like.**
- **Always use a tap to clean the threads of any thread lock on them..**

(1) Sun gear
(2) Hex flange bolt
(3) Plate

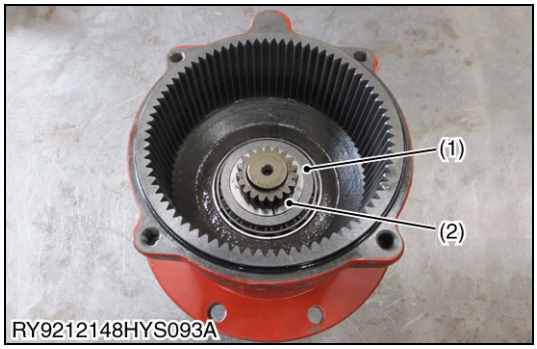
RY9212148HYS0111US0



16. Remove planetary gear B, needle bearing, inner race and washer and then remove the flange holder.

(1) Planetary gear B
(2) Needle bearing
(3) Inner race
(4) Washer
(5) Flange holder

RY9212148HYS0112US0



17. Remove the housing from the assembly platform and then remove the collar.

CAUTION

- **If the plate comes off, the shaft may fall, so take care in handling it.**
- **Always have the bottom of the shaft touching the ground when removing the collar and plate.**

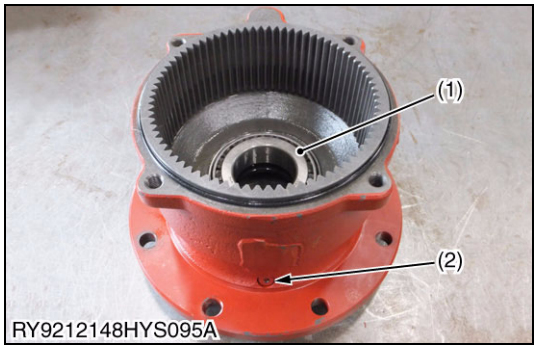
(1) Collar (2) Plate

RY9212148HYS0113US0

18. Remove the plate and then the shaft.
- Tool to use: punch and hammer

(1) Plate (2) Shaft

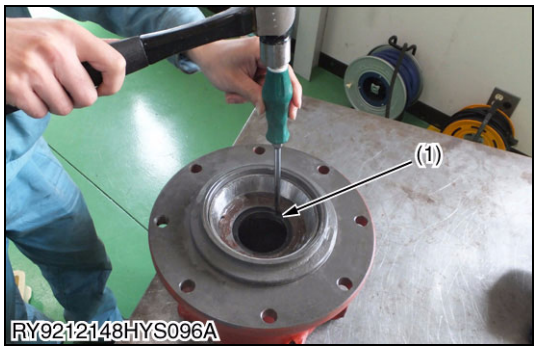
RY9212148HYS0114US0



19. Remove the tapered roller bearing and the plug.
- Tool to use: 5 mm hex socket

(1) Tapered roller bearing (2) Plug

RY9212148HYS0115US0



20. Remove the oil seal.
- Tool to use: slotted screwdriver and hammer

(1) Oil seal

RY9212148HYS0116US0

(2) Assembly Procedures

- Prior to assembly, clean all of the parts and make sure there is no dirt or other debris sticking to them.
- Always replace all of the O-rings, backup rings and oil seals with new ones.

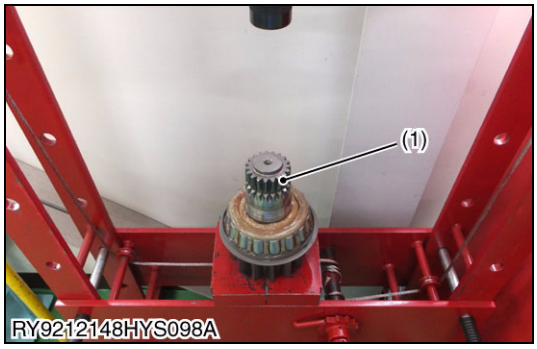
RY9212148HYS0117US0

1. Install the oil seal.
   - Tool to use: hammer
   - Tool to use: Oil seal installation tool

■ IMPORTANT
- **Apply grease to the lip and circumference of the oil seal.**

(a) Oil seal installation tool

RY9212148HYS0118US0

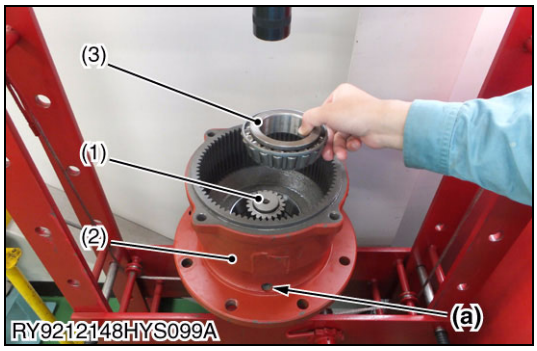


2. Apply grease to the pinion shaft's tapered roller bearing.

■ IMPORTANT
- **Brand of grease: Shell Alvania Grease**
- **Amount of grease: Approx. 66 to 75 g (0.15 to 0.17 lbs)**

(1) Pinion shaft

RY9212148HYS0119US0

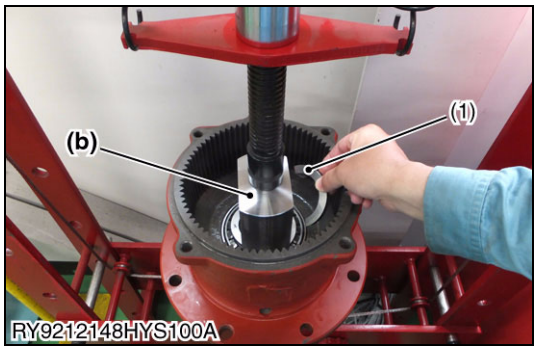


3. Mount the housing on the pinion shaft and install the tapered roller bearing.

■ IMPORTANT
- **Make sure the plug is not installed.**
- **If you mount the pinion shaft with the plug in place, the internal pressure rises and may blow the oil seals.**

(1) Pinion shaft
(2) Housing
(3) Tapered roller bearing
(a) Plug installation position

RY9212148HYS0120US0



4. Use a press on the plate installation tool to install the plate.

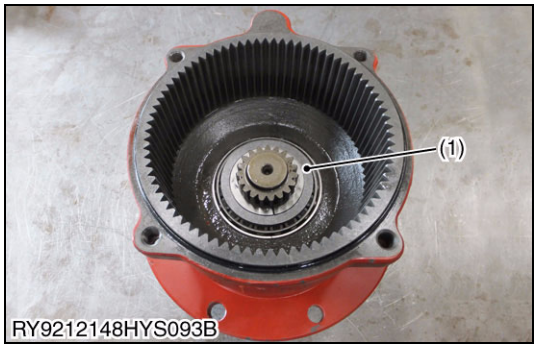
Press pressure	Factory specification	11770 N 1200 kgf 2646 lbs

- Tool to use: Plate installation tool

CAUTION
- **If the plate comes off, the shaft may fall, so take care in handling it.**

(1) Plate
(b) Plate installation tool

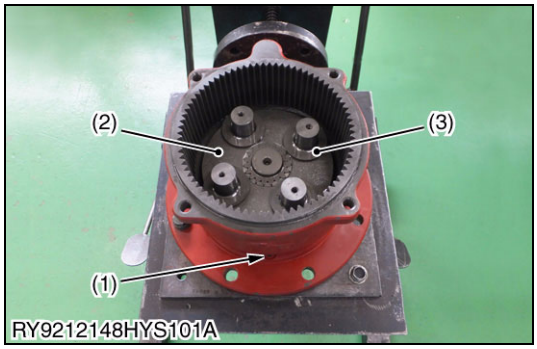
RY9212148HYS0121US0



5. Install the collar.

(1) Collar

RY9212148HYS0122US0



6. Put the housing on the assembly platform and install the plug.
7. Install the holder and the washer.

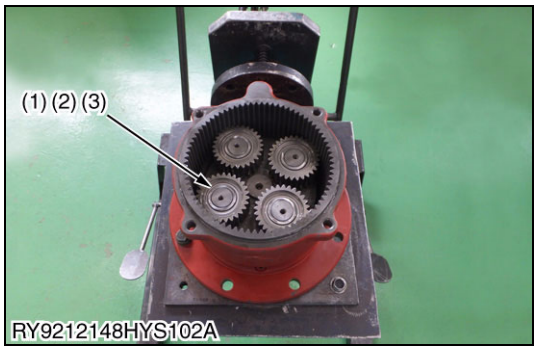
Tightening torque	Plug	15.7 ± 0.8 N·m 1.6 ± 0.1 kgf·m 11.6 ± 0.6 lbf·ft

- Tool to use: 5 mm hex socket

■ **IMPORTANT**
- **Install with the rounded side of the washer down.**

(1) Plug
(2) Holder
(3) Washer

RY9212148HYS0123US0

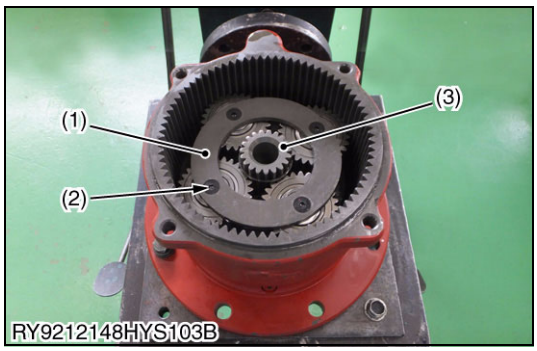


8. Install the inner race, needle bearing and planetary gear B in order.

■ **IMPORTANT**
- **Take care to install the gear facing the right direction.**

(1) Inner race
(2) Needle bearing
(3) Planetary gear B

RY9212148HYS0124US0



9. Install the plate and then the sun gear.

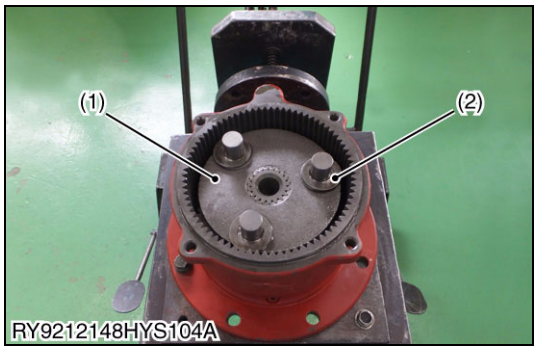
■ **IMPORTANT**
- **Apply a thread lock (Loctite 242) to the hex flange bolts.**

Tightening torque	Hex flange bolt	24.5 ± 4.9 N·m 2.5 ± 0.5 kgf·m 18.1 ± 3.6 lbf·ft

- Tool to use: 5 mm hex socket

(1) Plate
(2) Hex flange bolt
(3) Sun gear

RY9212148HYS0125US0

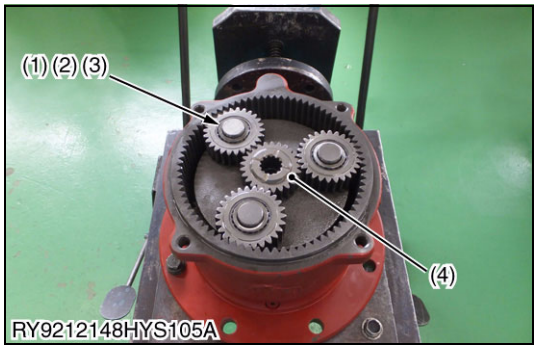


10. Install the holder and the washer.

■ **IMPORTANT**
- **Install with the rounded side of the washer down.**

(1) Holder
(2) Washer

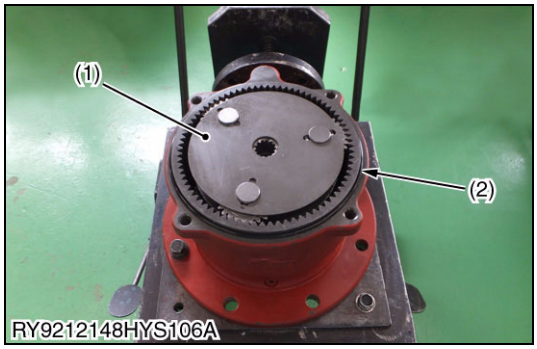
RY9212148HYS0126US0



11. Install the inner race, needle bearing, planetary gear A and drive gear in order.

(1) Inner race
(2) Needle bearing
(3) Planetary gear A
(4) Drive gear

RY9212148HYS0127US0



12. Install the plate and O-ring.

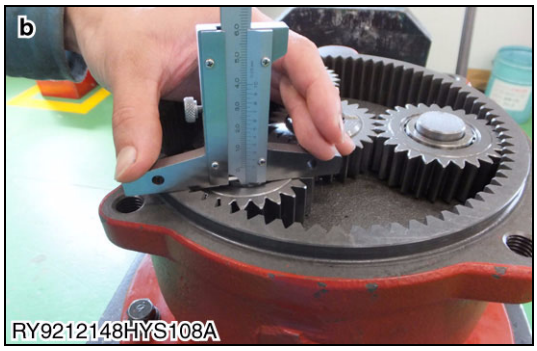
■ **IMPORTANT**
- **Apply grease to the O-ring.**

(1) Plate (2) O-ring

RY9212148HYS0128US0

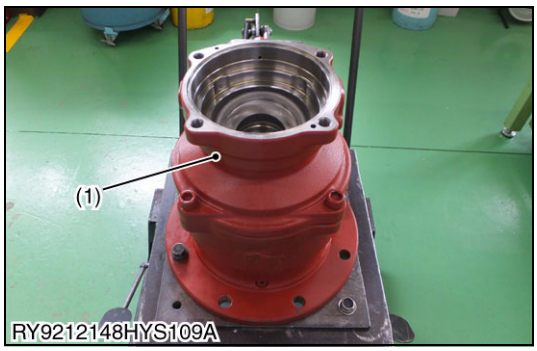
When parts inside the gear case have been replaced, take measurement C between the inner race and the housing and then select the correct plate.
- Tool to use: depth gauge

[Measurement Method]
Measurement A (Photo a) - measurement B (Photo b) = measurement C
- Housing height: measurement A (Photo **a**)
- Height between inner race and highest point of housing: measurement B (Photo **b**)



Measure-ment C	Less than 5.3 to 5.8mm (0.21 to 0.23 in.)	Less than 5.3 to 5.8mm (0.21 to 0.23 in.)	6.5 to 7.0 mm (0.26 to 0.28 in.)
Plate to use	2.8 mm (0.11 in.)	2.3 mm (0.09 in.)	1.8 mm (0.07 in.)

RY9212148HYS0148US0



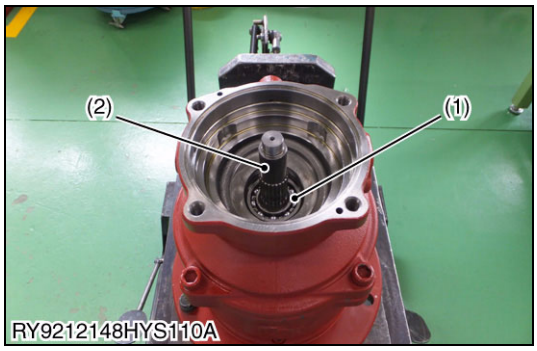
13. Install the housing.

Tightening torque	Hex socket bolt	177.0 ± 10.0 N·m 18.0 ± 1.0 kgf·m 130.5 ± 7.5 lbf·ft

- Tool to use: 12 mm hex socket

(1) Housing

RY9212148HYS0130US0

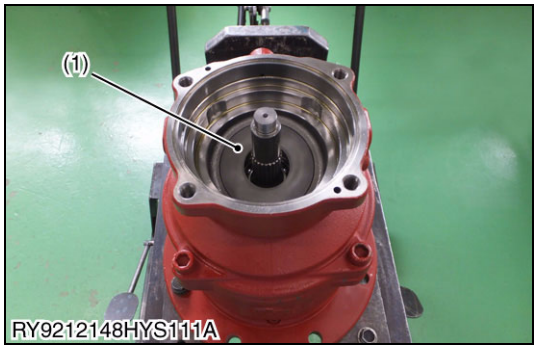


14. Tap the ball bearing in and install the shaft.

■ **IMPORTANT**
- **Face the ball bearing so the inscription is up.**
- **Apply grease to the circumference of the ball bearing.**

(1) Ball bearing (2) Shaft

RY9212148HYS0131US0

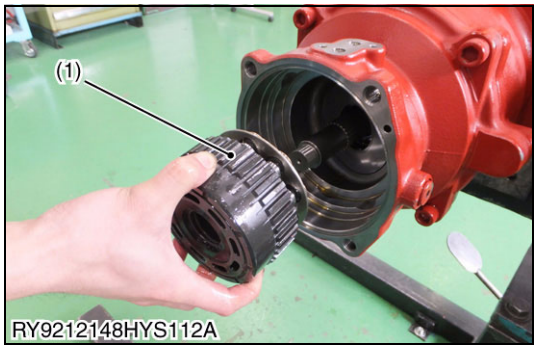


15. Install the swash-plate.

■ **IMPORTANT**
- **Install with the tapered side down.**
- **Apply grease to the back of the swash-plate.**

(1) Swash-plate

RY9212148HYS0132US0

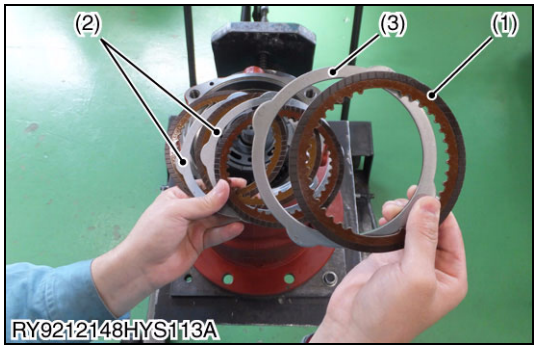


16. Turn the assembly platform 1.6 rad (90°) and install the cylinder block.

■ **IMPORTANT**
- **After installing the part, turn the platform back.**

(1) Cylinder block

RY9212148HYS0133US0

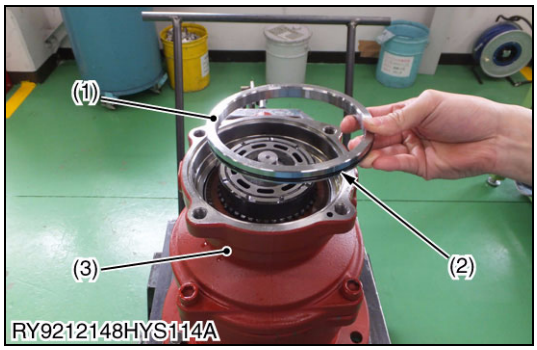


17. Install the disc, plate B and plate A.

■ **IMPORTANT**
- **Install plates A and B with their rounded side up.**
- **Be careful to install the disc and plates in order.**
- **Plate A: thickness 3.0mm (0.063 in.)**
- **Plate B: thickness 1.6 mm (0.118 in.)**

(1) Disc
(2) Plate B
(3) Plate A

RY9212148HYS0134US0

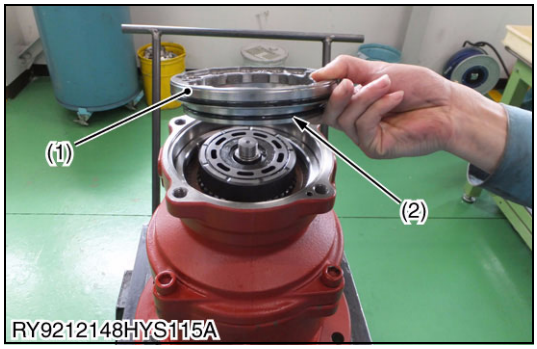


18. Mount the O-ring on the collar and install it in the housing.

■ **IMPORTANT**
- **Apply grease to the collar and the O-ring.**

(1) Collar
(2) O-ring
(3) Housing

RY9212148HYS0135US0

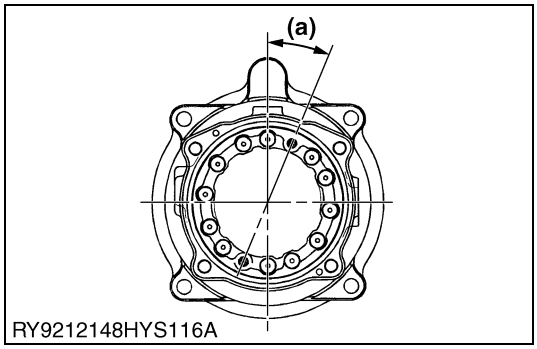


19. Mount the O-ring on the brake piston and install it in the housing.

■ **IMPORTANT**
- **Apply grease to the O-ring.**
- **Take care to position the holes in the brake piston correctly.**

(1) Brake piston
(2) O-ring

RY9212148HYS0136US0

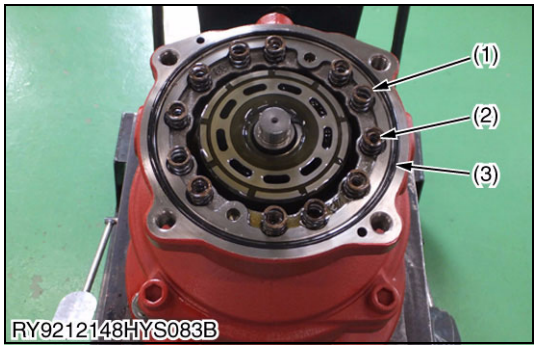


Brake piston hole alignment positions

Install so the pin hole is at position ●.

(a) 0.393 rad (22.5 °)

RY9212148HYS0137US0

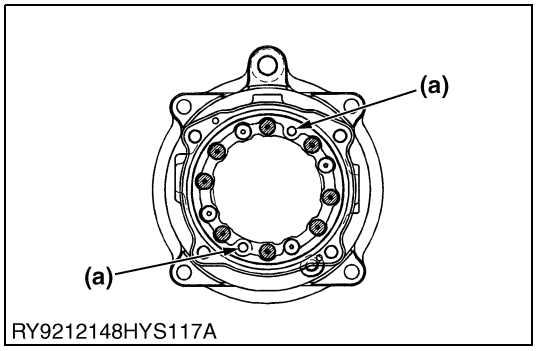


20. Install the large and small springs and the O-ring.

■ **IMPORTANT**
- **Apply grease to the O-ring.**

(1) Spring, large
(2) Spring, small
(3) O-ring

RY9212148HYS0138US0

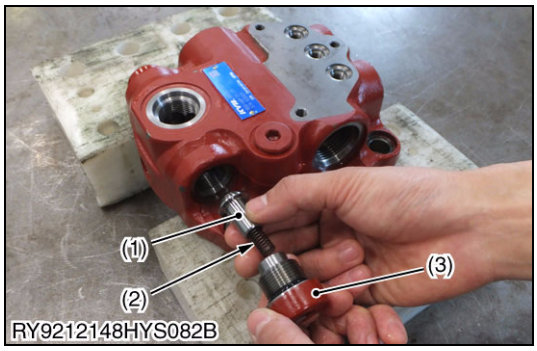


Small spring installation position

Install the small springs at position ●.

(a) Pin hole position

RY9212148HYS0139US0

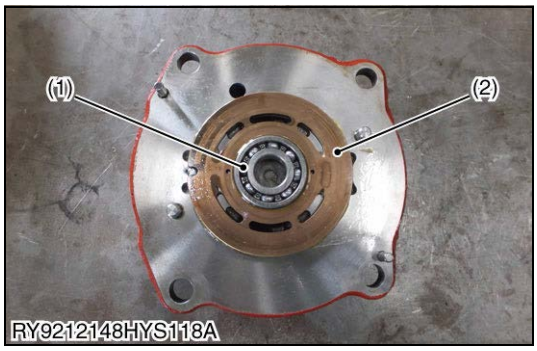


21. Insert the poppet and spring into the cover and mount the plug loosely (both sides).

■ **IMPORTANT**
- **Apply hydraulic fluid to the spool.**

(1) Poppet
(2) Spring
(3) Plug

RY9212148HYS0140US0

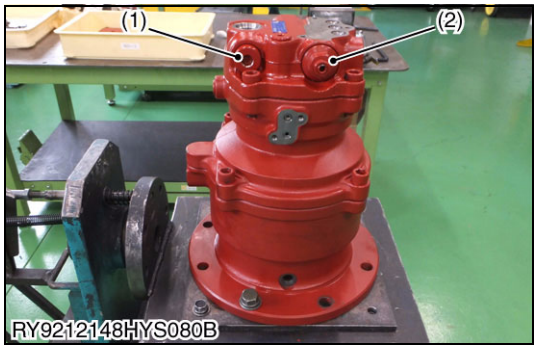


22. Install the ball bearing and valve plate on the cover.

■ **IMPORTANT**
- **Take care to face the valve plate correctly.**
- **Apply grease to the back of the valve plate so it will not fall off.**

(1) Ball bearing
(2) Valve plate

RY9212148HYS0141US0



23. Install the cover.

■ **IMPORTANT**

- **Take care so the valve plate does not fall off.**

Tightening torque	Hex socket bolt	177.0 ± 10.0 N·m 18.0 ± 1.0 kgf·m 130.5 ± 7.5 lbf·ft

- Tool to use: 12 mm hex socket

(1) Cover

RY9212148HYS0142US0

24. Install the plug and relief valve.

■ **IMPORTANT**

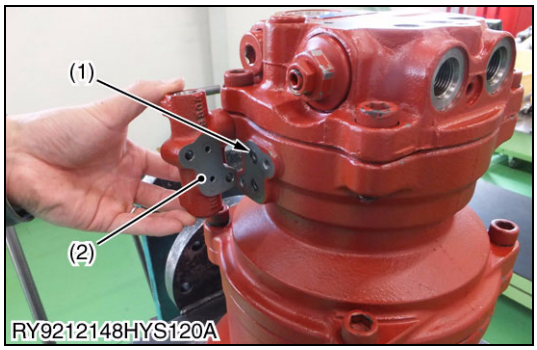
- **Apply hydraulic oil to the relief valve.**

Tightening torque	Plug	157.0 ± 10.0 N·m 16.0 ± 1.0 kgf·m 115.5 ± 7.5 lbf·ft
	Relief valve	373.0 ± 20.0 N·m 38.05 ± 2.05 kgf·m 275.0 ± 15.0 lbf·ft

- Tool to use: 12 mm hex wrench, 27 mm box wrench

(1) Plug (2) Relief valve

RY9212148HYS0143US0



25. Install the O-rings and valve body.

■ **IMPORTANT**

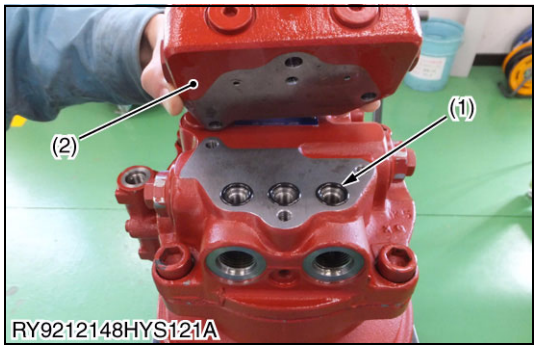
- **Apply grease to the O-ring.**

Tightening torque	Hex socket bolt	9.8 ± 1.0 N·m 1.0 ± 0.1 kgf·m 7.2 ± 0.7 lbf·ft

- Tool to use: 5 mm hex socket

(1) O-ring (2) Valve body

RY9212148HYS0144US0



26. Install the O-rings and body.

■ **IMPORTANT**

- **Apply grease to the O-ring.**

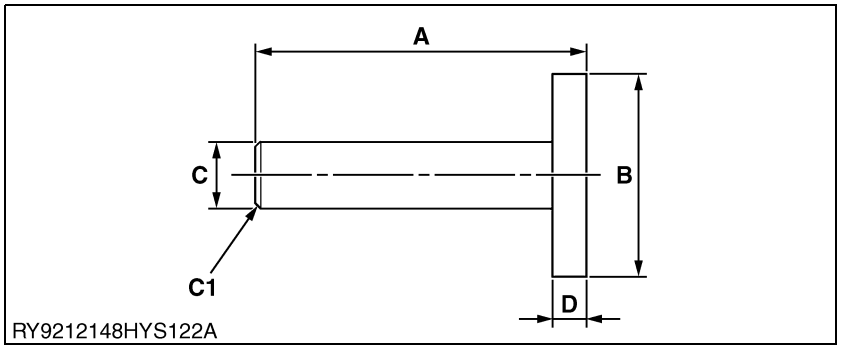
Tightening torque	Hex socket bolt	32.4 ± 2.0 N·m 3.3 ± 0.2 kgf·m 23.9 ± 1.5 lbf·ft

- Tool to use: 6 mm hex socket

(1) O-ring (2) Body

RY9212148HYS0145US0

(3) Special Tools



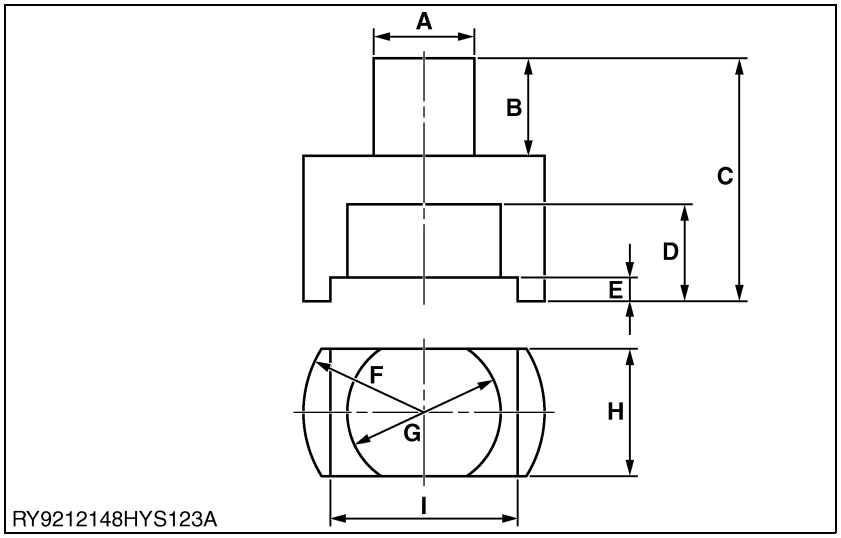
RY9212148HYS122A

(a) Oil seal installation tool

A	150 mm (5.9 in.)
B	ϕ94.8 - 94.9 mm (ϕ3.73 - 3.74 in.)
C	ϕ30 mm (ϕ1.18 in.)
D	15 mm (0.59 in.)
C1	1 mm (0.04 in.) bevel

- If angle is not specified, there must not be any burrs. Corner to be max of R0.4 mm (0.016 in.)

RY9212148HYS0146US0



RY9212148HYS123A

(b) Plate installation tool

A	ϕ40 mm (ϕ1.57 in.)
B	40 mm (1.57 in.)
C	100 mm (3.93 in.)
D	40 mm (1.57 in.)
E	10 mm (0.39 in.)
F	50 mm (1.96 in.)
G	ϕ63.2 - 63.4 mm (ϕ2.48 - 2.49 in.)
H	53 mm (2.08 in.)
I	78.2 to 78.4 mm (3.07 to 3.08 in.)

- If angle is not specified, there must not be any burrs. Corner to be max of R0.4 mm (0.016 in.)

RY9212148HYS0147US0

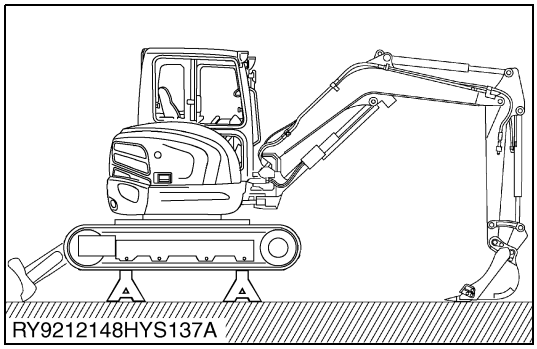
4. SWIVEL JOINT

[1] REMOVAL AND INSTALLATION OF THE SWIVEL JOINT

CAUTION

- **When removing a hydraulic device after operating the excavator, lower the bucket and blade to the ground and turn off the engine.**
- **Each of the devices and the hydraulic oil are hot right after stopping the excavator. The oil is hot enough to cause a burn, so always let it cool down before starting any work.**
- **Oil gushing out under pressure has enough force to injure you by piercing your skin. Always relieve any pressure remaining in the system prior to working to remove any hydraulic equipment or lines.**

RY9212148HYS0149US0

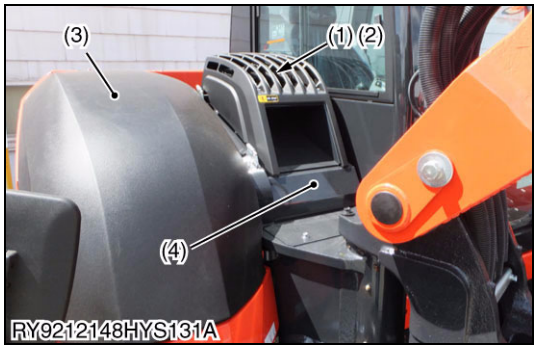

RY9212148HYS137A

1. Use the front and the blade to jack up the excavator.

CAUTION

- **Always put stands under the track while the excavator is jacked up.**

RY9212148HYS0218US0



RY9212148HYS131A

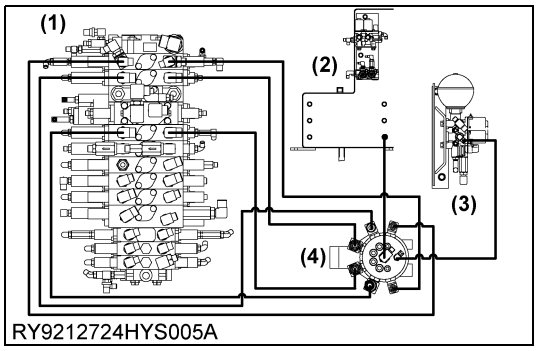
2. Remove the cover, electric fan, tank cover and center cover.

[Work Tip]

- Move the condenser toward the rear of the machine with the AC hoses still installed.

(1) Cover
(2) Electric fan
(3) Tank cover
(4) Center cover

RY9212148HYS0219US0



RY9212724HYS005A

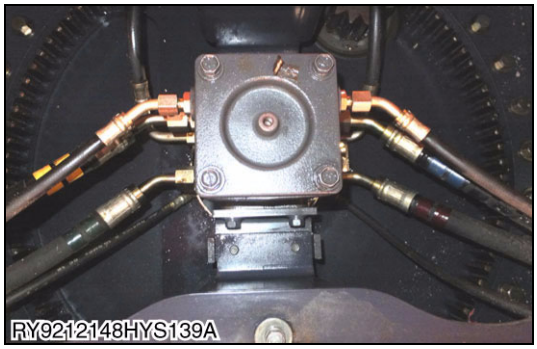
3. Disconnect the 2-speed pilot hose and drain hose from the swivel joint.
4. Disconnect the R/L travel fwd/bwd hoses from the control valve side.

■ IMPORTANT

- **Plug the disconnected hoses and adapters.**

(1) Control valve
(2) Hydraulic oil tank
(3) Unload valve
(4) Swivel joint

RY9212724HYS0006US0

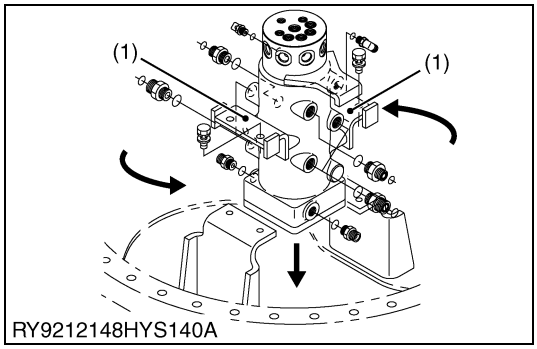

RY9212148HYS139A

5. Remove the bottom cover of the track frame and disconnect all the hoses connected to the swivel joint body.

■ IMPORTANT

- **Plug the disconnected hoses and adapters.**

RY9212148HYS0221US0



RY9212148HYS140A

6. To prevent the swivel joint from falling, support the bottom of the body with a hydraulic jack, then remove the swivel joint mounting bracket and remove the swivel joint.

■ **IMPORTANT**
- **Apply a thread lock (Loctite 271).**

Tightening torque	Swivel joint mounting bracket	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft

Swivel joint weight	Approx. 41.4 kg (91.3 lbs)

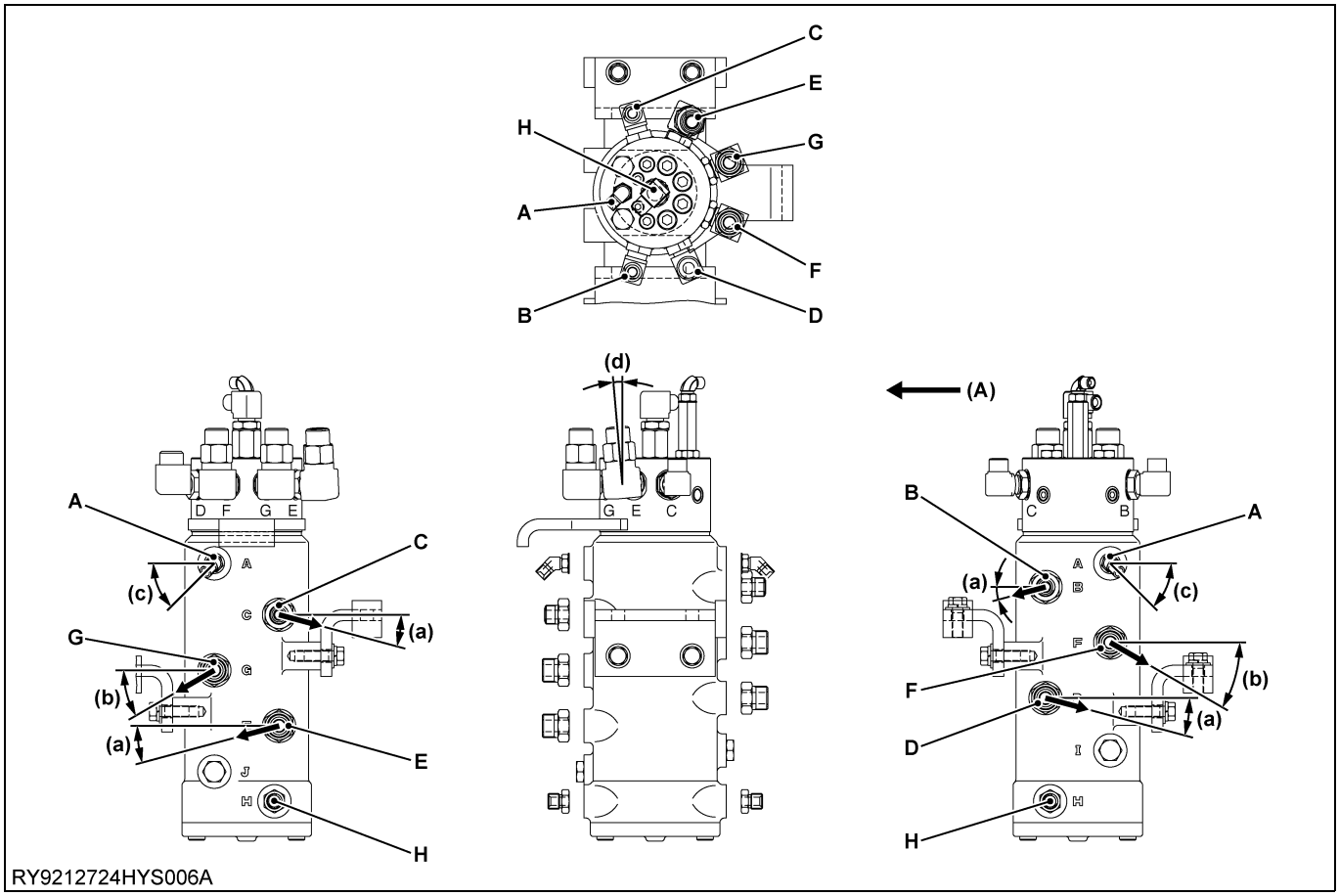
(1) Swivel joint mounting bracket

RY9212724HYS0007US0

7. Perform the procedure in reverse for assembly.

RY9212148HYS0096US0

Adapter angles



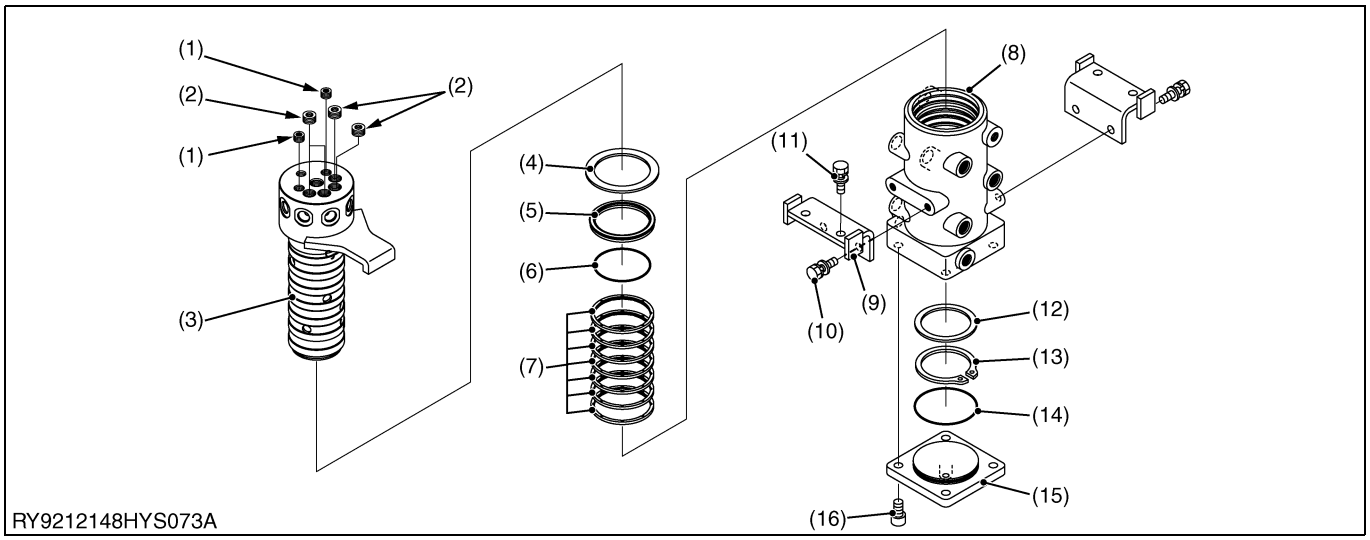
RY9212724HYS006A

A : 2-Speed Pilot
B : Blade Down
C : Blade Up
D : Left Forward
E : Right Forward
F : Left Backward
G : Right Backward
H : Drain
(A) Blade Side
(a) 15 ° (0.26 rad)
(b) 30 ° (0.52 rad)
(c) 45° (0.79 rad)
(d) 5° (0.09 rad)

RY9212724HYS0008US0

[2] SWIVEL JOINT DISASSEMBLY / ASSEMBLY PROCEDURES

Components

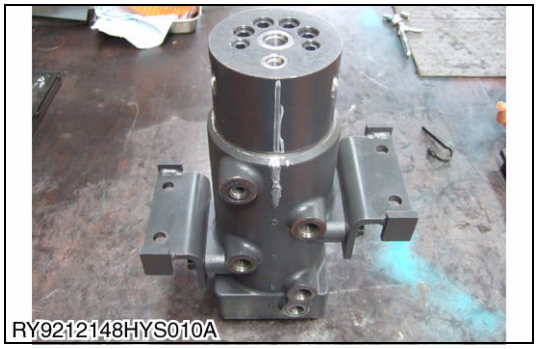


No.	Part Name	Qty	Notes
(1)	Plug (PT3/8)	2	71.1 ± 2.5 N·m 7.2 ± 0.2 kgf·m 52.4 ± 1.8 lbf·ft
(2)	Plug (PT1/2)	4	85.9 ± 2.5 N·m 8.8 ± 0.2 kgf·m 63.3 ± 1.8 lbf·ft
(3)	Shaft	1	
(4)	Collar	1	
(5)	Packing (U)	1	
(6)	O-ring	1	
(7)	Seal	7	
(8)	Body	1	
(9)	Bracket	2	
(10)	Bolt	4	84.0 ± 6.0 N·m 8.6 ± 0.6 kgf·m 62.0 ± 5.0 lbf·ft Thread locking compound (Loctite 1324 or equivalent)
(11)	Bolt	4	84.0 ± 6.0 N·m 8.6 ± 0.6 kgf·m 62.0 ± 5.0 lbf·ft Thread locking compound (Loctite 271)
(12)	Collar	1	
(13)	Circlip	1	
(14)	O-ring	1	
(15)	Bottom cover	1	
(16)	Hex socket bolt	4	84.0 ± 6.0 N·m 8.6 ± 0.6 kgf·m 62.0 ± 5.0 lbf·ft Thread locking compound (Loctite 1324 or equivalent)

- During disassembly, always use a tap to clean the threads of any thread lock on them.

RY9212148HYS0090US0

(1) Disassembly Procedures



1. Prior to disassembly, mark the alignment of the shaft and body.

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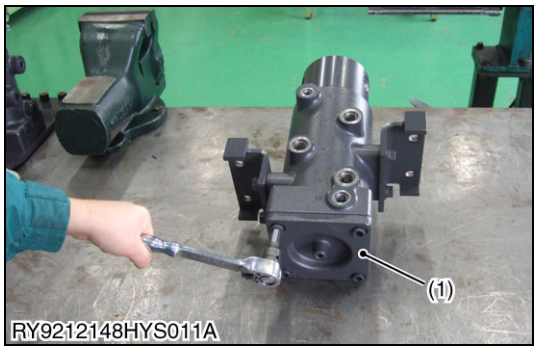

2. Remove the hex socket bolts and then the bottom cover.
   - Tool to use: 10 mm hex socket

(1) Bottom cover

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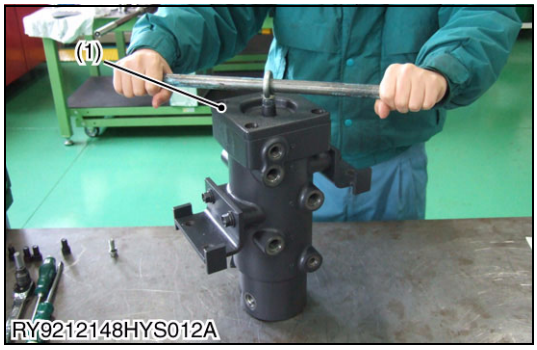

3. Mount an eye bolt on the bottom cover and put a bar through the hole in the eye bolt. Knock upwards on both sides of the bar and remove the bottom cover.

(1) Bottom cover

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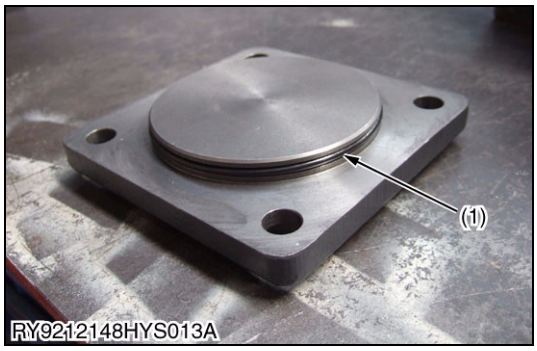

4. Remove the O-ring.

(1) O-ring

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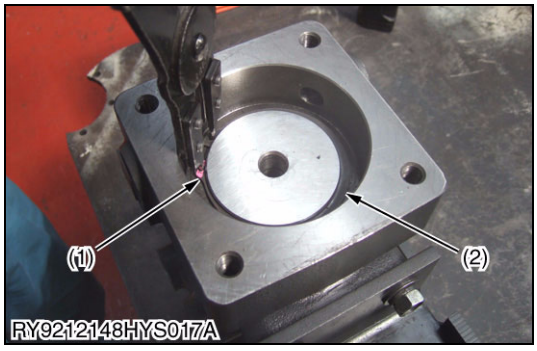

5. Remove the circlip and then the collar.

■ **IMPORTANT**
- **Be careful so the circlip does not go flying.**

- Tool to use: snap ring pliers

(1) Circlip (2) Collar

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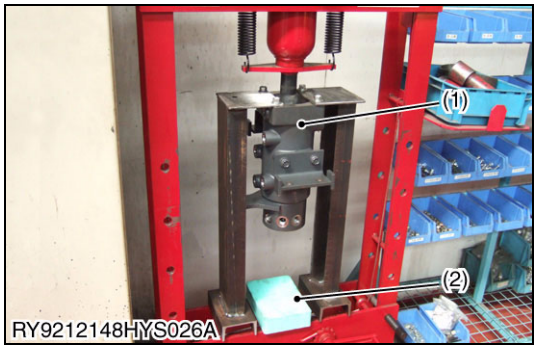

6. Use a press to remove the shaft.

■ **IMPORTANT**
- **Spread a protective mat to prevent the shaft from hitting if it falls.**
- **Be careful so the shaft does not fall all of a sudden.**

(1) Swivel joint (2) Protective mat

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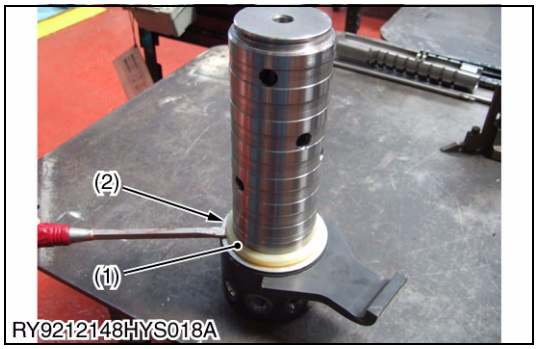

7. Remove the U packing and the collar in order.
- Tool to use: Slotted screwdriver

(1) Packing (U) (2) Collar

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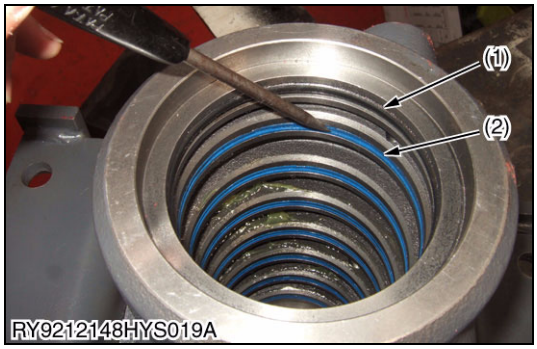

8. Remove the O-ring and seal inside the body.
- Tool to use: awl

■ **Work Tip**
- Depending on the position where the seal is inserted, turn the body counterclockwise to remove it.

(1) O-ring (2) Seal

RY9212148HYS0009US0

(2) Assembly Procedures

- Prior to assembly, clean all of the parts and make sure they are not damaged and there is no dirt or other debris sticking to them.
- After washing parts, blow them dry to remove any detergent (Be particularly careful to remove any detergent around port holes and bolt holes).
- Always replace all of the O-rings, seals and U packings with new ones.

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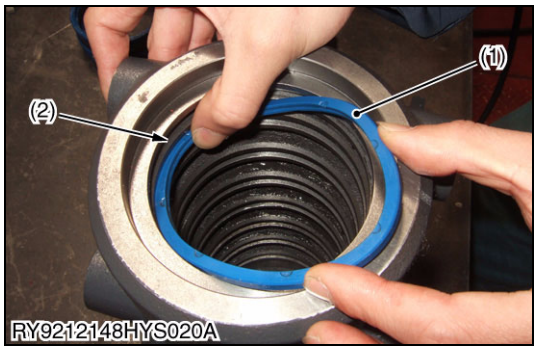

1. Install the seal and O-ring in the body.

■ **IMPORTANT**
- **Apply grease uniformly to the O-ring and the seal.**
- **Manipulate the seal and O-ring until they seat perfectly into the groove.**

■ **Work Tip**
- Depending on where the seal is being inserted, turn the body the opposite direction to mount it.
- If it is difficult to get the seal in, use a spatula with rounded edges to mount it.

(1) Seal (2) O-ring

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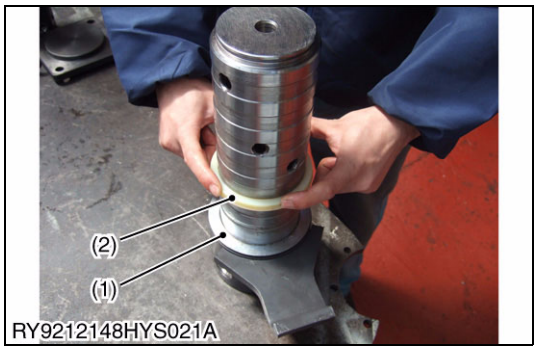

2. Mount the collar and U packing in order on the top of the shaft.

■ **IMPORTANT**
- **Apply grease uniformly on the U packing.**
- **Make sure the collar and U packing stick to the head of the shaft.**

(1) Collar (2) Packing (U)

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3. Apply grease uniformly onto the shaft.

RY9212148HYS0012US0

4. Check the positioning of the alignment mark and insert the shaft.

■ **IMPORTANT**
- **Make sure there are no scratches or debris.**

(1) Shaft (2) Body

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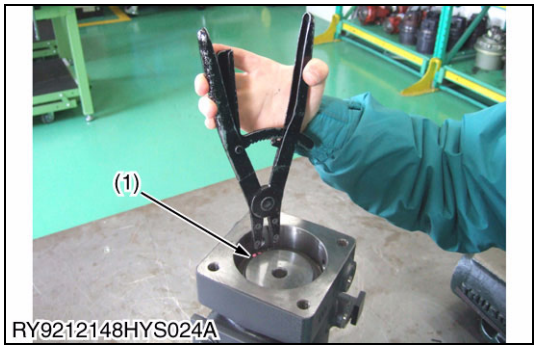

5. After inserting the collar, install the circlip.

■ **IMPORTANT**
- **Install the circlip with the rounded side down.**

- Tool to use: snap ring pliers

(1) Circlip

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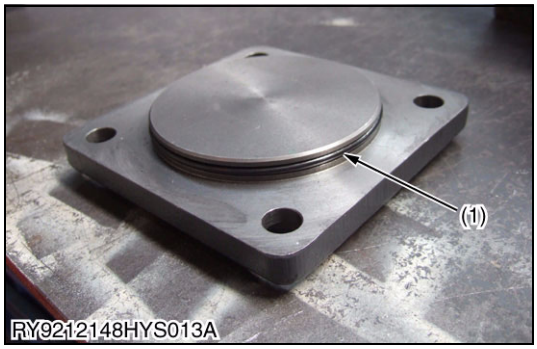

6. Install the O-ring on the bottom cover.

■ **IMPORTANT**
- **Apply grease to the O-ring.**

(1) O-ring

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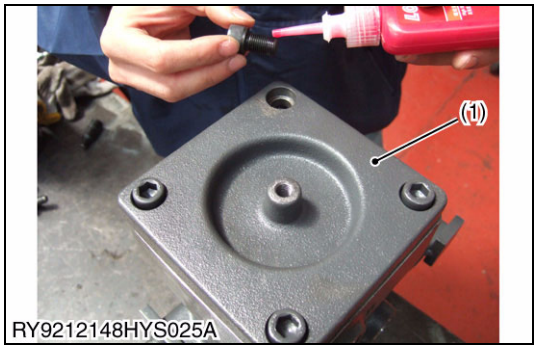


7. Mount the bottom cover.

Tightening torque	Hex socket bolt	84.0 ± 6.0 N·m 8.6 ± 0.6 kgf·m 62.0 ± 5.0 lbf·ft

- Tool to use: 10 mm hex socket

■ **IMPORTANT**
- **Apply thread lock (ThreeBond 1324 or equivalent) to the hex bolts.**

(1) Bottom cover

RY9212148HYS0016US0

5. TRAVEL MOTOR

[1] REMOVAL AND INSTALLATION OF THE TRAVEL MOTOR

CAUTION

- **Before removing hydraulic devices, lower the bucket and blade to the ground and stop the engine.**
- **Each of the devices and the hydraulic oil are hot right after stopping the excavator. The oil is hot enough to cause a burn, so always let it cool down before starting any work.**
- **When hydraulic oil is under pressure, it has enough force to pierce your skin or eyes. When working with hydraulic lines always relieve any residual pressure before starting work.**

RY9212148HYS0091US0

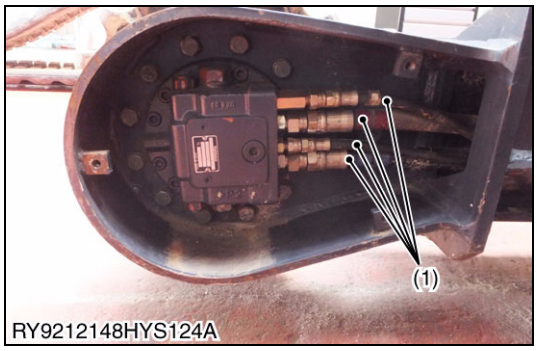
1. Remove the track and cover.
   - Tool to use: 14 mm socket

DANGER

- **Always support the track frame with blocks.**

(1) Cover (2) Bolt

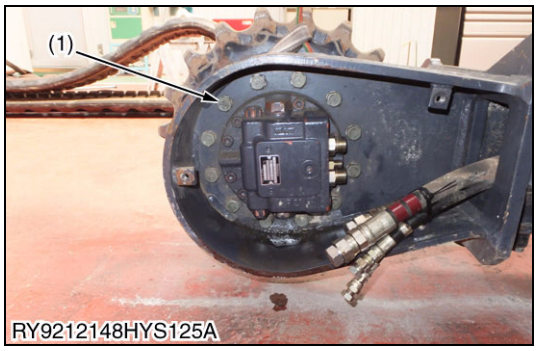
RY9212148HYS0092US0



2. Use a vacuum pump to depressurize the hydraulic oil tank and then disconnect the hoses that are connected to the travel motor.

(1) Hose

RY9212148HYS0093US0



3. Suspend the travel motor with a nylon sling and remove the bolts.

IMPORTANT

- **Apply a thread lock (Loctite 271).**

Tightening torque	Travel motor	282.0 ± 22.0 N·m 28.8 ± 2.3 kgf·m 208.0 ± 16.0 lbf·ft

(1) Bolt

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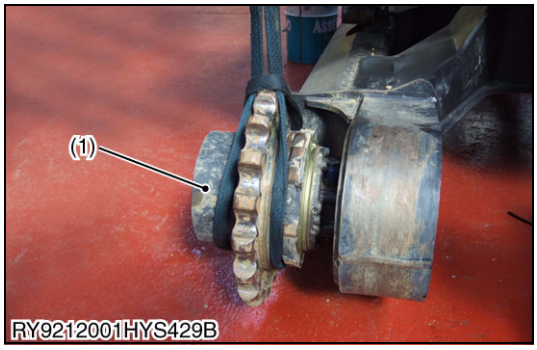


4. Use a crane to hoist and remove the travel motor.

IMPORTANT

- **Apply a thread lock (Loctite 271).**

Tightening torque	Sprocket	181.4 ± 14.7 N·m 18.5 ± 1.5 kgf·m 133.8 ± 10.8 lbf·ft

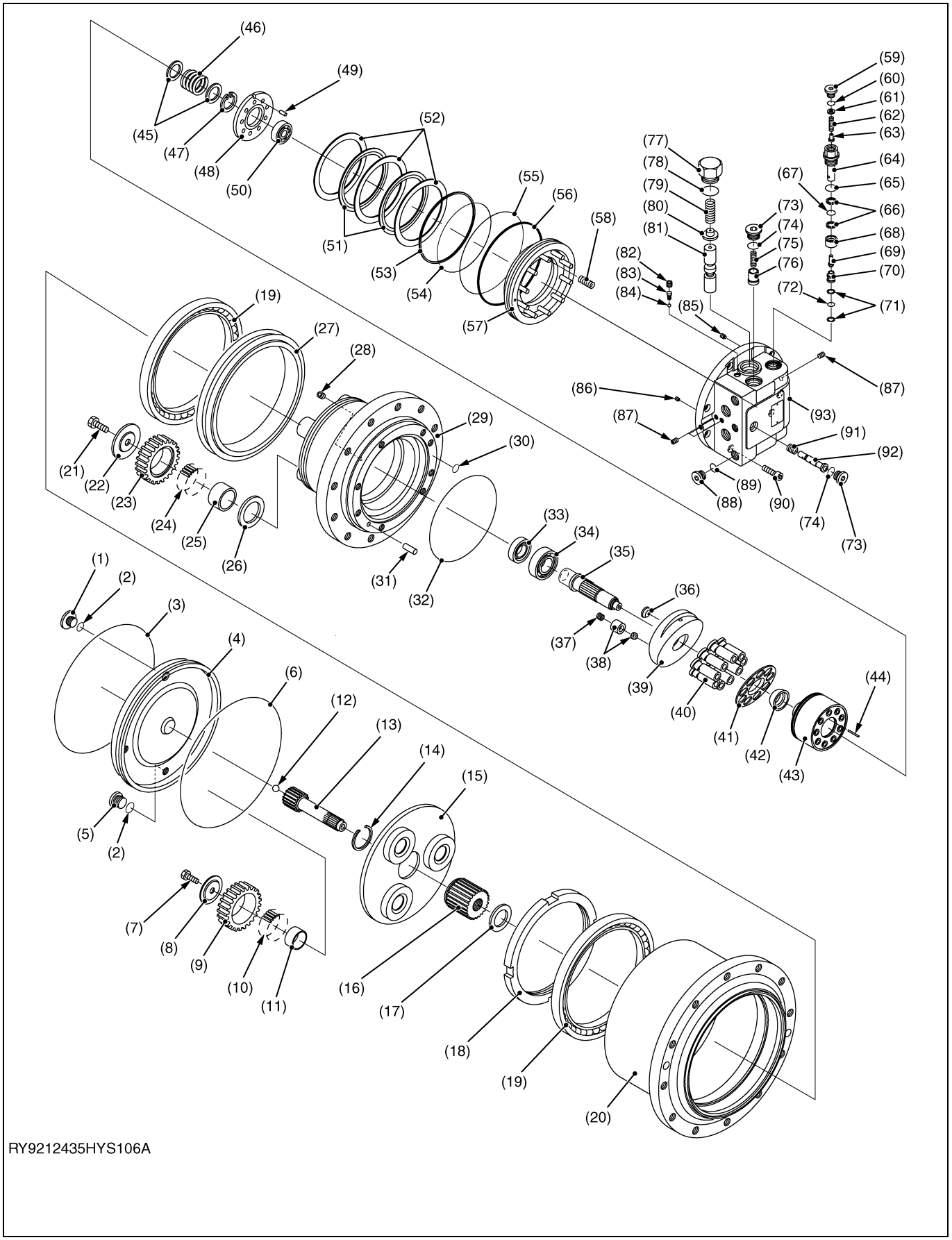
(1) Travel motor

RY9212148HYS0095US0

5. Perform the procedure in reverse for assembly.

RY9212148HYS0096US0

[2] TRAVEL MOTOR DISASSEMBLY / ASSEMBLY PROCEDURES



RY9212435HYS106A

(To be continued)

(Continued)

No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty
(1)	Plug	1	(32)	O-ring	1	(63)	Piston	2
(2)	O-ring	3	(33)	Oil seal	1	(64)	Sleeve	2
(3)	Wire	1	(34)	Ball bearing	1	(65)	O-ring	2
(4)	Cover	1	(35)	Shaft	1	(66)	Backup ring	4
(5)	Plug	2	(36)	Pivot	2	(67)	O-ring	2
(6)	O-ring	1	(37)	Spring	1	(68)	Collar	2
(7)	Bolt	3	(38)	2-speed piston	1	(69)	Valve	2
(8)	Plate	3	(39)	Swash-plate	1	(70)	Valve seat	2
(9)	Planetary gear B	3	(40)	Piston ASSY	1	(71)	Backup ring	4
(10)	Needle bearing	3	(41)	Retainer plate	1	(72)	O-ring	2
(11)	Collar	3	(42)	Collar	1	(73)	Plug	3
(12)	Ball	1	(43)	Cylinder block	1	(74)	O-ring	3
(13)	Drive gear	1	(44)	Pin	3	(75)	Spring	2
(14)	Circlip	1	(45)	Washer	2	(76)	Poppet	2
(15)	Holder	1	(46)	Spring	1	(77)	Plug	2
(16)	Sun gear	1	(47)	Circlip	1	(78)	O-ring	2
(17)	Collar	1	(48)	Valve plate	1	(79)	Spring	2
(18)	Ring nut	1	(49)	Knock pin	1	(80)	Spring seat	2
(19)	Angular bearing	2	(50)	Ball bearing	1	(81)	Spool	1
(20)	Gear case	1	(51)	Disc	2	(82)	Plug	3
(21)	Bolt	4	(52)	Plate	3	(83)	Flanged plug	1
(22)	Plate	4	(53)	O-ring	1	(84)	Ball	1
(23)	Planetary gear A	4	(54)	O-ring	1	(85)	Orifice	1
(24)	Needle bearing	4	(55)	O-ring	1	(86)	Orifice	1
(25)	Collar	4	(56)	O-ring	1	(87)	Plug	4
(26)	Thrust washer	4	(57)	Brake piston	1	(88)	Plug	1
(27)	Floating seal	1	(58)	Spring	10	(89)	O-ring	1
(28)	Set screw	2	(59)	Plug	2	(90)	Hex socket bolt	8
(29)	Flange holder	1	(60)	O-ring	2	(91)	Spring	1
(30)	O-ring	2	(61)	Shim	2	(92)	Spool	1
(31)	Pin	2	(62)	Spring	2	(93)	Base plate	1

RY9212435HYS0114US0

(1) Disassembly Procedures

[A] Gear Case

1. Mount the travel motor to the assembly platform and remove the plug.
   - Tool to use: 8 mm hex socket

(1) Plug

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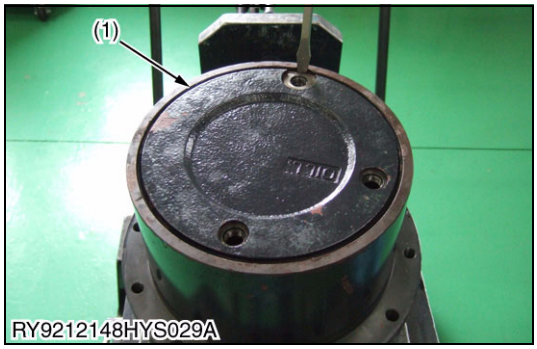

2. Remove the wire.
   - Tool to use: Slotted screwdriver

(1) Wire

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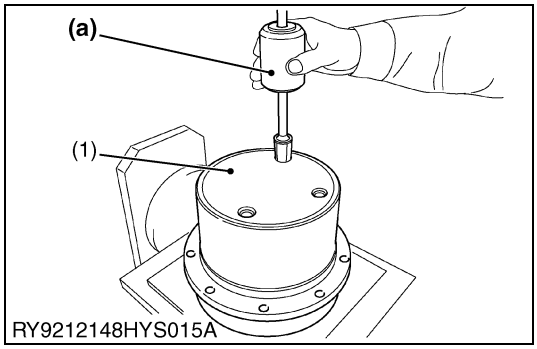
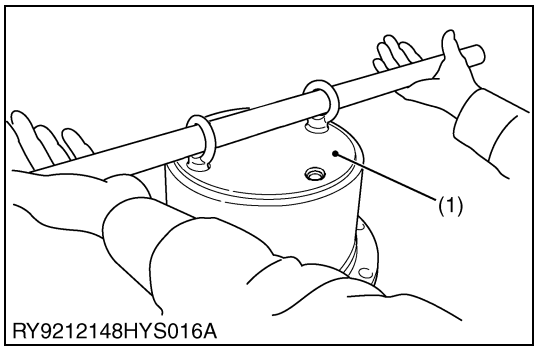


3. Attach the cover removal tool and knock it up to remove the cover.
   - Tool to use: Cover removal tool



■ **If a cover removal tool is not available:**
- Mount an eye bolt on the cover and put a bar through the hole in the eye bolt.
- Knock upwards on both sides of the bar and remove the cover.

(1) Cover **(a) Cover removal tool**

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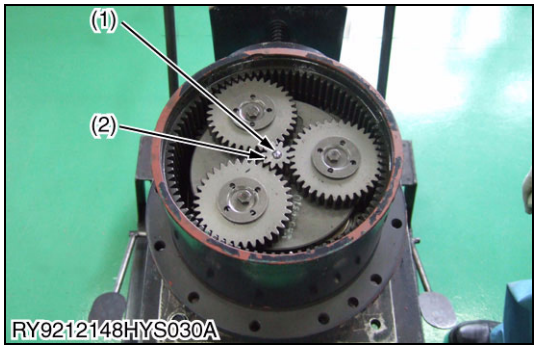

4. Remove the ball and the drive gear.

(1) Ball (2) Drive gear

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5. Remove the holder sub-assembly.

(1) Holder sub-assembly

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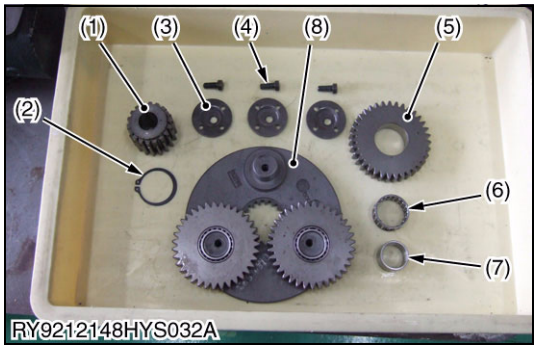

Holder sub-assembly components

(1) Sun gear
(2) Circlip
(3) Plate
(4) Bolt
(5) Planetary gear B
(6) Needle bearing
(7) Collar
(8) Holder

■ **IMPORTANT**
- **Use a M8 X P1.25 tap to clean the threads of any thread lock in the thread holes.**
- **Always replace removed bolts with new ones.**

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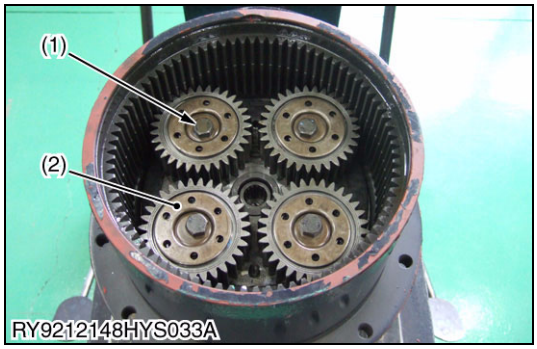

6. Remove the bolts and plate in order.
- Tool to use: 17 mm socket

■ **IMPORTANT**
- **Use a M10 X P1.5 tap to clean the threads of any thread lock in the thread holes.**
- **Always replace removed bolts with new ones.**

(1) Bolt
(2) Plate

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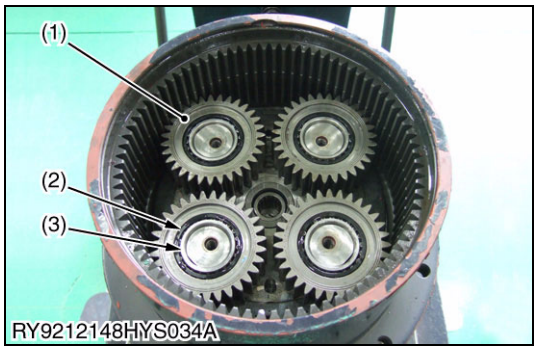

7. Remove planetary gear A, the needle bearing and collar in order.

(1) Planetary gear A
(2) Needle bearing
(3) Collar

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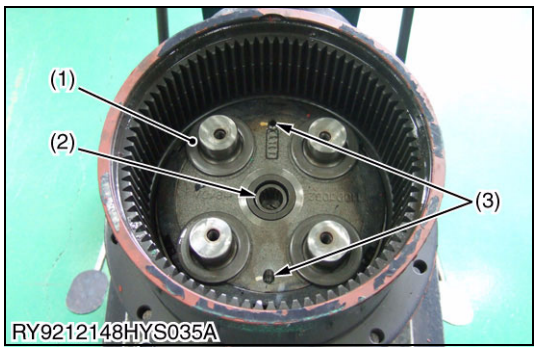

8. Remove the thrust washer, collar and set screw.
- Tool to use: 4 mm hex socket

(1) Thrust washer
(2) Collar
(3) Set screw

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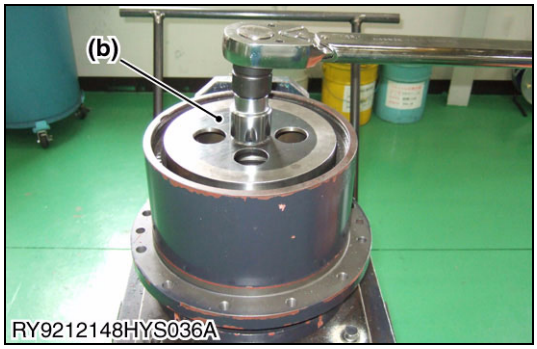

9. Remove the ring nut.
   - Tool to use: Ring nut socket

■ **IMPORTANT**
- **Be careful that the ring nut socket doesn't come off during installation/removal.**
- **Always replace removed ring nut with a new one.**

(b) Ring nut socket

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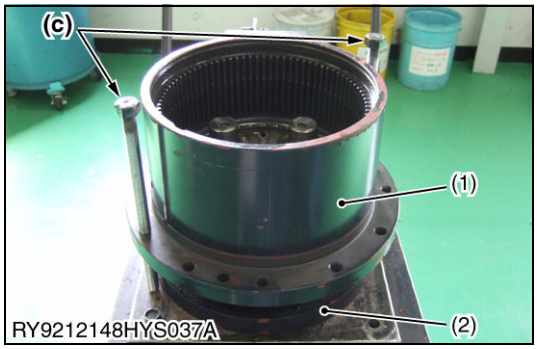

10. Use removal bolts to raise the gear case up higher than the flange holder and remove the gear case.
    - Tool to use: removal bolts

■ **IMPORTANT**
- **Tighten the removal bolts equally.**

(1) Gear case
(2) Flange holder
(c) Removal bolts

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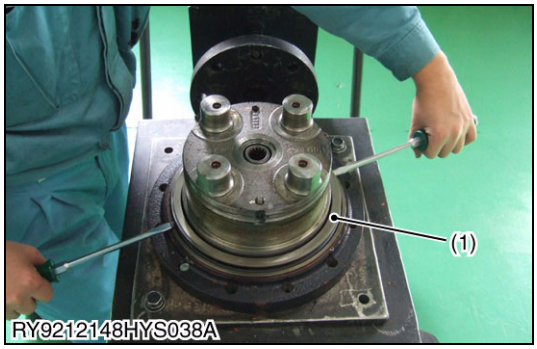

11. Remove the floating seal from the flange holder side.
    - Tool to use: Slotted screwdriver

(1) Floating seal

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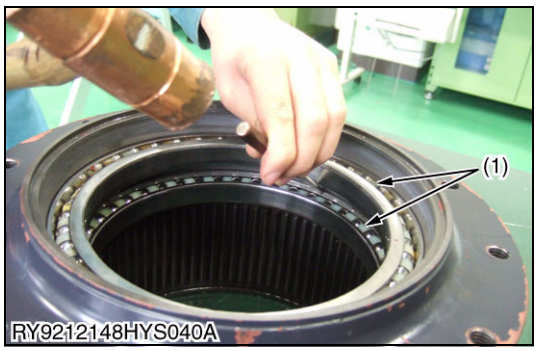
12. Remove the floating seal from the gear case side.
    - Tool to use: Slotted screwdriver

(1) Floating seal

RY9212148HYS0025US0



13. Remove one of the angular bearing.
    - Tool to use: pin punch and a hammer

■ **IMPORTANT**
- **Tap and remove the outer race of the angular bearing.**
- **Tap evenly on the angular bearing with the pin punch.**

(1) Angular bearing

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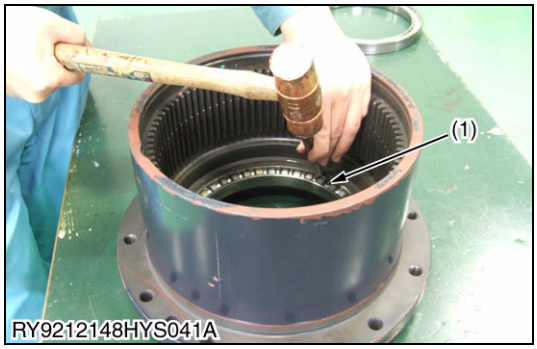

14. Turn the gear case over and remove the other angular bearing.
    - Tool to use: pin punch and a hammer

■ **IMPORTANT**
- **Tap and remove the outer race of the angular bearing.**
- **Tap evenly on the angular bearing with the pin punch.**

(1) Angular bearing

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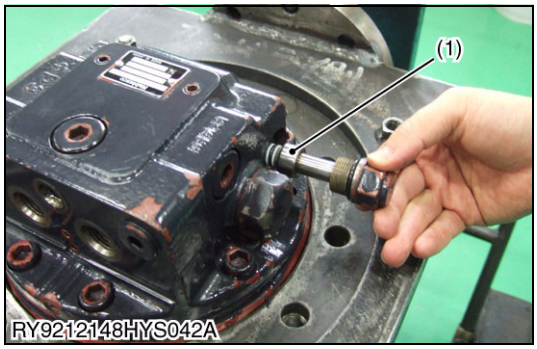
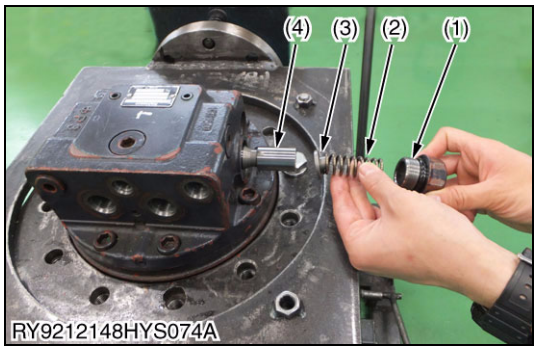
[B] Motor



1. Remove the shockless valve.
    - Tool to use: 24 mm socket

(1) Shockless valve

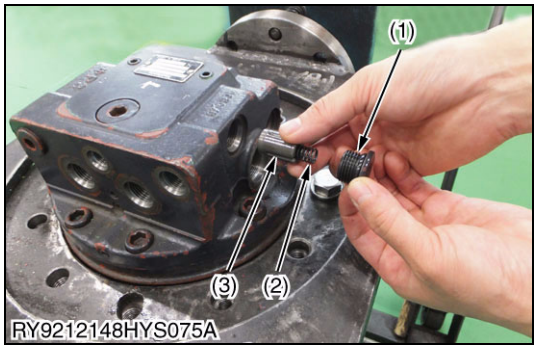
RY9212148HYS0044US0



2. Remove the plug, spring, spring seat and spool in order.
    - Tool to use: 36 mm socket

(1) Plug
(2) Spring
(3) Spring seat
(4) Spool

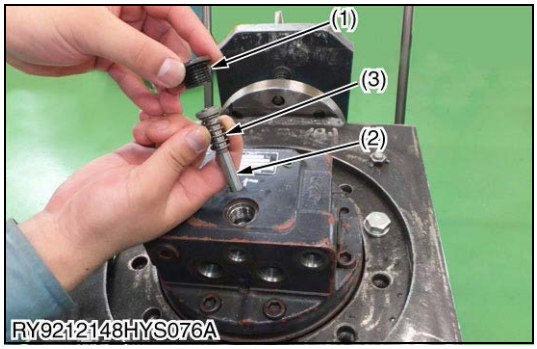
RY9212148HYS0045US0



3. Remove the plug, spring and poppet in order.
    - Tool to use: 10 mm hex socket

(1) Plug
(2) Spring
(3) Poppet

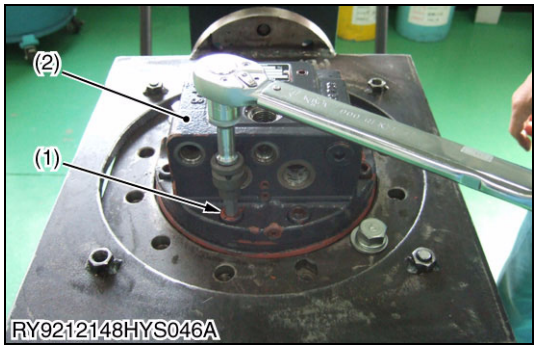
RY9212148HYS0046US0



4. Remove the plug, spool and spring in order.
    - Tool to use: 10 mm hex socket

(1) Plug
(2) Spool
(3) Spring

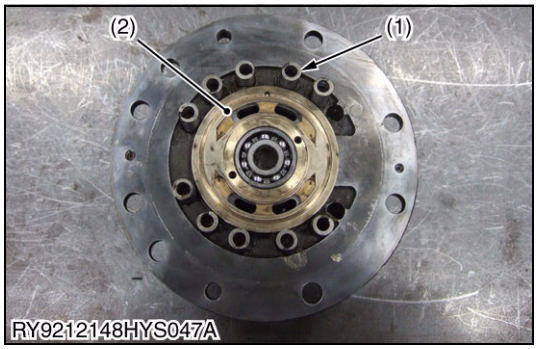
RY9212148HYS0047US0



5. Remove the hex socket bolts and then the base plate.
   - Tool to use: 10 mm hex socket

(1) Hex socket bolt
(2) Base plate

RY9212148HYS0048US0



6. Remove the springs and valve plate from the base plate.

(1) Spring
(2) Valve plate

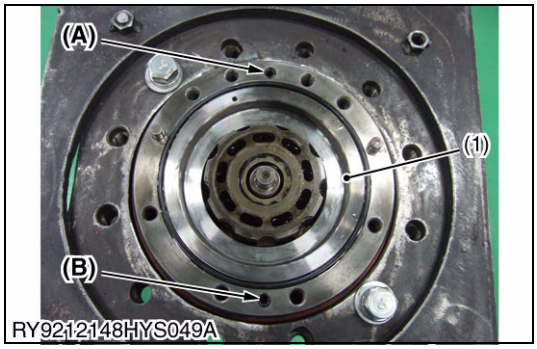
RY9212148HYS0049US0

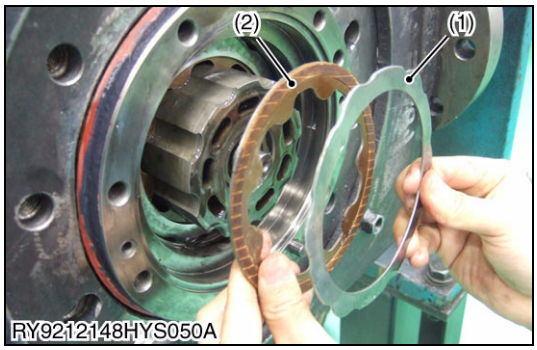
7. While pressing down on the brake piston with a rag, blow air through the brake release oil passage hole and remove the brake piston.

CAUTION
- **Be careful because if you blast air into the passage, the brake piston may come flying off.**

(1) Brake Piston
(A) Brake Release Oil Passage Hole
(B) 2-Speed Switch Oil Passage Hole

RY9212148HYS0017US0

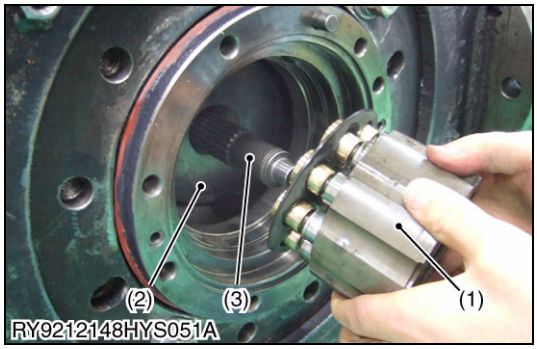




8. Turn the assembly stand 1.6 rad (90°) and remove the plate and disc.

(1) Plate
(2) Disc

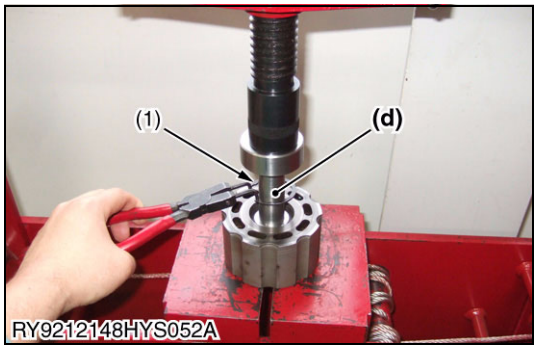
RY9212148HYS0050US0



9. Remove the cylinder block ASSY, swash-plate and shaft in order.

(1) Cylinder block sub-assembly
(2) Swash-plate
(3) Shaft

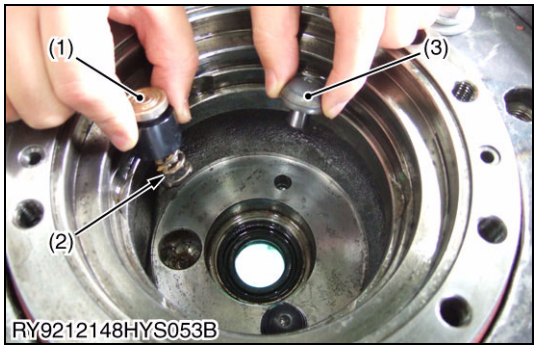
RY9212148HYS0051US0



10. Use a press to press down the washer inside the cylinder block and then remove the circlip. Remove the cylinder block from the press and remove the washer and the spring.
- Tool to use: snap ring pliers
- Tool to use: Tool for pressing cylinder block

(1) Circlip
(d) Tool for pressing cylinder block

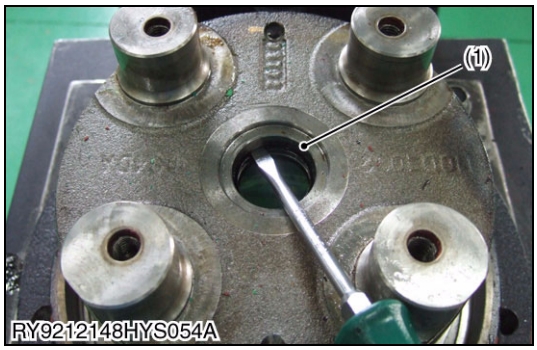
RY9212148HYS0052US0



11. Turn the assembly platform back as it was and remove the 2-speed piston, spring, pivot and parallel pin.

(1) 2-Speed Piston
(2) Spring
(3) Pivot

RY9212435HYS0118US0



12. Remove the oil seal.
- Tool to use: slotted screwdriver and hammer

■ **IMPORTANT**
- **When you removed the shaft, if the ball bearing had not been removed, remove them together now.**

(1) Oil seal

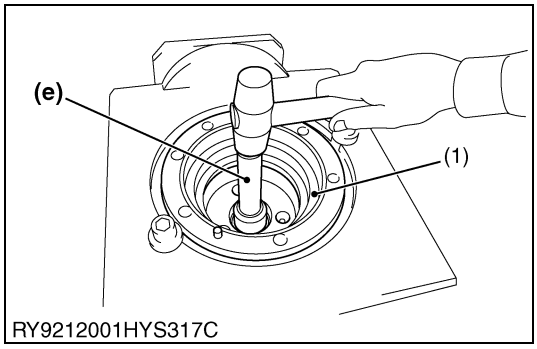
RY9212148HYS0054US0

(2) Assembly Procedures

[A] Motor

- Prior to assembly, clean all of the parts and make sure they are not damaged and there is no dirt or other debris sticking to them.
- Always replace all of the O-rings, backup rings, oil seals and floating seals with new ones.

RY9212148HYS0028US0



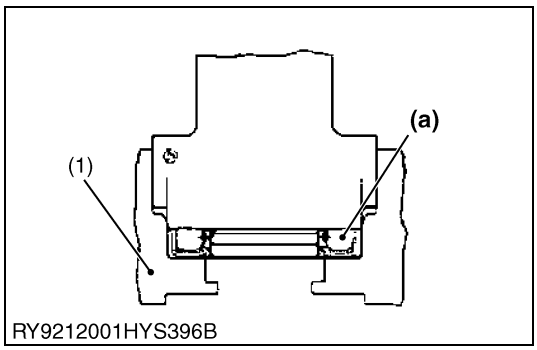
RY9212001HYS317C

1. Put the flange holder on the assembly platform and tap in the oil seal with an oil seal installation tool.
   - Tool to use: Oil seal installation tool

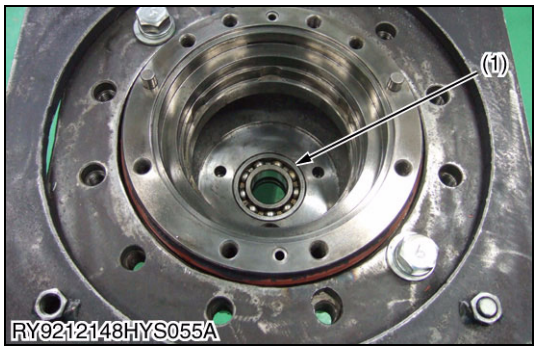
■ **IMPORTANT**
- **Take care to face the oil seal the right direction.**
- **Apply grease to its lip and circumference.**

(1) Flange holder
(a) Oil seal lip
(e) Oil seal installation tool

RY9212148HYS0029US0



RY9212001HYS396B



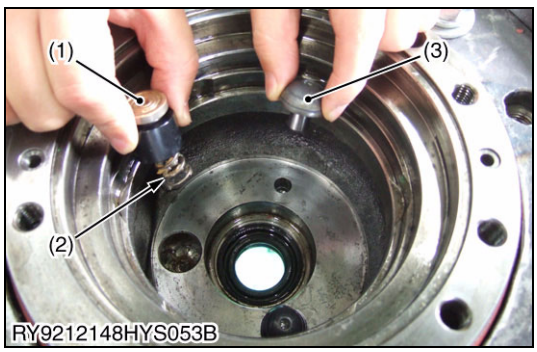
RY9212148HYS055A

2. Tap the ball bearing in.

■ **IMPORTANT**
- **Face the ball bearing so the inscription is up.**
- **Apply grease to the circumference of the ball bearing.**

(1) Ball Bearing

RY9212148HYS0018US0



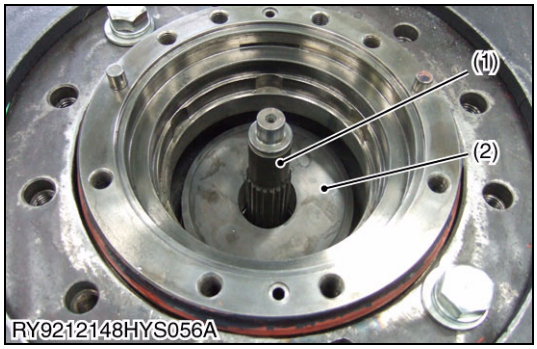
RY9212148HYS053B

3. Install the 2-speed piston, spring, pivot and parallel pin.

■ **IMPORTANT**
- **The spring comes out easily, so apply some grease to it.**
- **Press the piston down and make sure it moves smoothly.**

(1) 2-Speed Piston
(2) Spring
(3) Pivot

RY9212435HYS0119US0

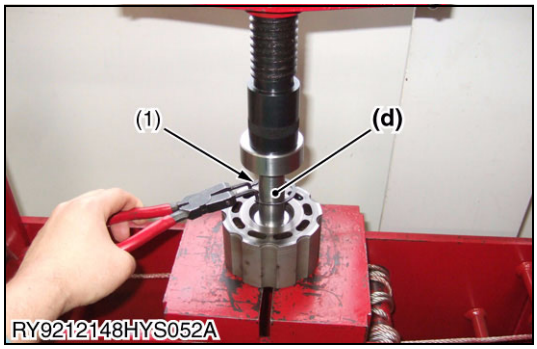


4. Install the shaft and swash-plate in order.

■ **IMPORTANT**
- **Apply grease to the back of the swash-plate.**

(1) Shaft
(2) Swash-plate

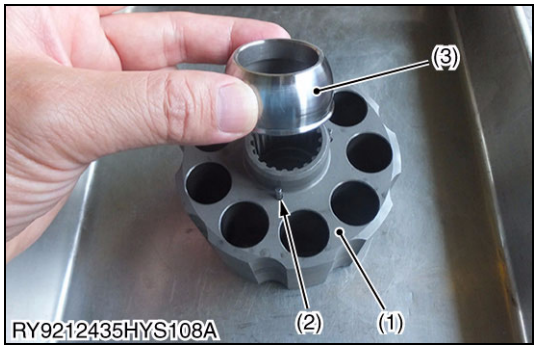
RY9212148HYS0056US0



5. Install the washer, spring, washer and circlip in order inside the cylinder block. Use a press to press on the inside of the cylinder block and install the circlip.
- Tool to use: snap ring pliers
- Tool to use: Tool for pressing cylinder block

(1) Circlip
(d) Tool for pressing cylinder block

RY9212148HYS0057US0



6. Install the 3 pins in the cylinder block and then install the collar and retainer holder in order.

■ **IMPORTANT**
- **Apply grease to the pins.**

(1) Cylinder Block
(2) Pin
(3) Retainer Holder

RY9212435HYS0116US0

7. Install the piston ASSY into the retainer plate and then install it into the cylinder block.

■ **IMPORTANT**
- **Apply hydraulic oil to the pistons.**
- **Make sure the pistons move smoothly.**

(1) Piston ASSY
(2) Retainer Plate

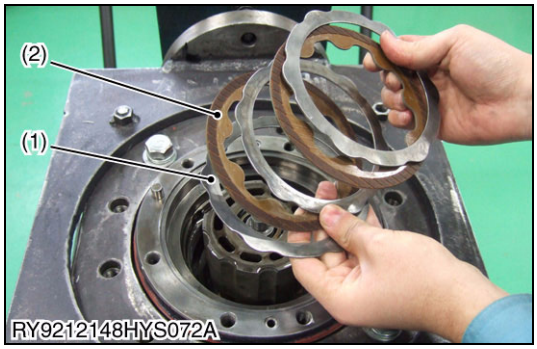
RY9212435HYS0117US0

8. Install the sub-assy of the cylinder block to the flange holder.

■ **IMPORTANT**
- **Turn the assembly platform 1.6 rad (90°) to install it and then turn it back afterwards.**

(1) Cylinder block sub-assembly

RY9212148HYS0060US0



9. Install the plate and disc in order.

■ **IMPORTANT**
- **Install the plates and discs alternately.**
- **Apply hydraulic oil to the plates.**

(1) Plate (2) Disc

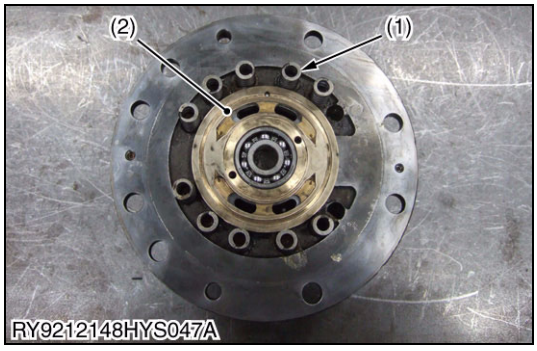
RY9212148HYS0061US0

10. Install the brake piston.

■ **IMPORTANT**
- **Apply grease to the O-ring.**

(1) Brake Piston (2) O-Ring

RY9212148HYS0019US0

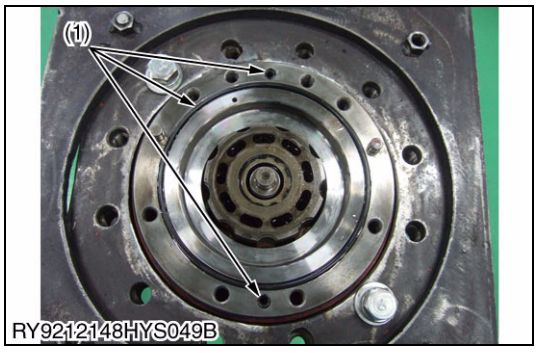


11. Install the valve plate and springs.

■ **IMPORTANT**
- **Take care to face the valve plate correctly.**
- **Apply grease to the back of the valve plate so it will not fall off.**

(1) Spring (2) Valve plate

RY9212148HYS0062US0



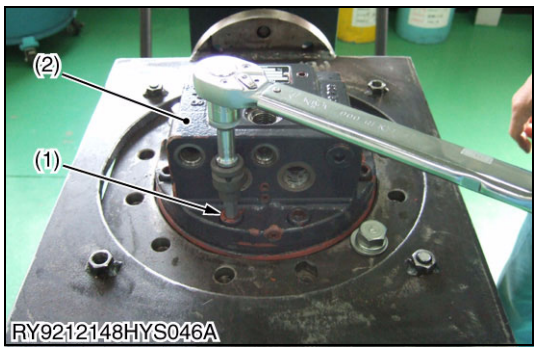
12. Install the O-ring and fill with hydraulic oil on the motor side.

■ **IMPORTANT**
- **Apply grease to the O-ring.**

Hydraulic oil	1.2 L (0.32 U.S. gals)

(1) O-ring

RY9212148HYS0063US0



13. Install the base plate.

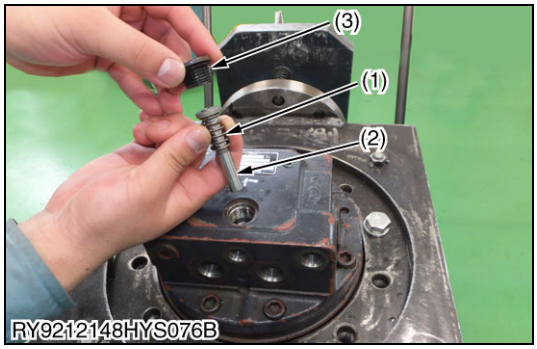
■ **IMPORTANT**
- **Be careful so the base plate does not fall off.**
- **Tighten the hex socket bolts diagonal to each other.**

Torque	Hex socket bolt	102.0 ± 15.7 N·m 10.4 ± 1.6 kgf·m 75.2 ± 11.6 lbf·ft

- Tool to use: 10 mm hex socket

(1) Hex socket bolt (2) Base plate

RY9212148HYS0064US0



14. Install the spring, spool and plug in order.

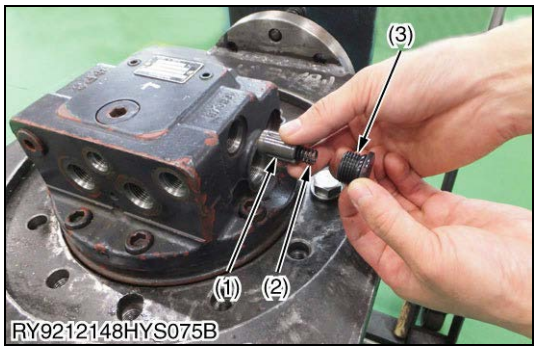
■ **IMPORTANT**
- **Apply hydraulic oil to the spool.**
- **The spool must slide smoothly.**

Torque	Plug	98.1 ± 119.6 N·m 10.0 ± 2.0 kgf·m 72.3 ± 14.5 lbf·ft

- Tool to use: 10 mm hex socket

(1) Spring
(2) Spool
(3) Plug

RY9212148HYS0065US0



15. Install the poppet, spring and plug in order.

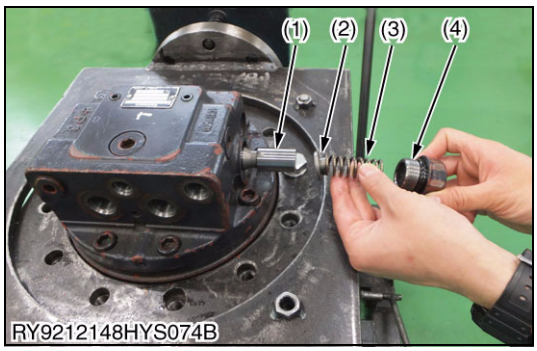
■ **IMPORTANT**
- **Apply hydraulic fluid to the spool.**

Torque	Plug	98.1 ± 119.6 N·m 10.0 ± 2.0 kgf·m 72.3 ± 14.5 lbf·ft

- Tool to use: 10 mm hex socket

(1) Poppet
(2) Spring
(3) Plug

RY9212148HYS0066US0



16. Install the spool spring seat, spring and plug in order.

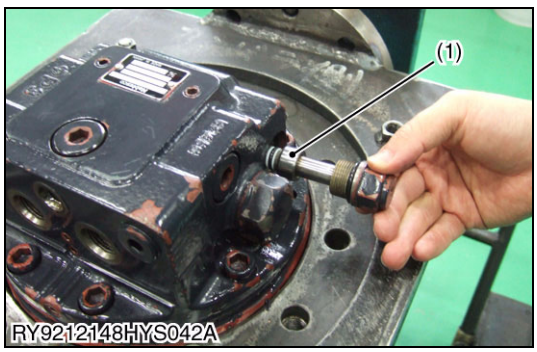
■ **IMPORTANT**
- **Apply hydraulic oil to the spool.**
- **The spool must slide smoothly.**

Torque	Plug	353.0 ± 39.2 N·m 36.0 ± 4.0 kgf·m 260.0 ± 29.0 lbf·ft

- Tool to use: 36 mm socket

(1) Spool
(2) Spring seat
(3) Spring
(4) Plug

RY9212148HYS0067US0



17. Install the shockless valve.

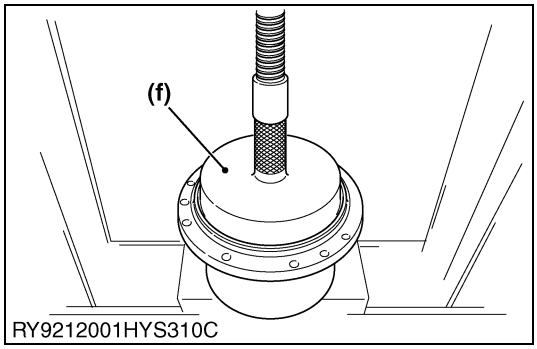
Torque	Shockless valve	137.0 ± 14.7 N·m 14.0 ± 1.5 kgf·m 101.0 ± 11.0 lbf·ft

- Tool to use: 24 mm socket

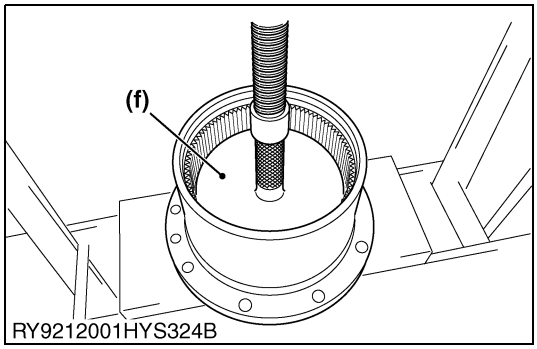
(1) Shockless valve

RY9212148HYS0068US0

[B] Gear Case



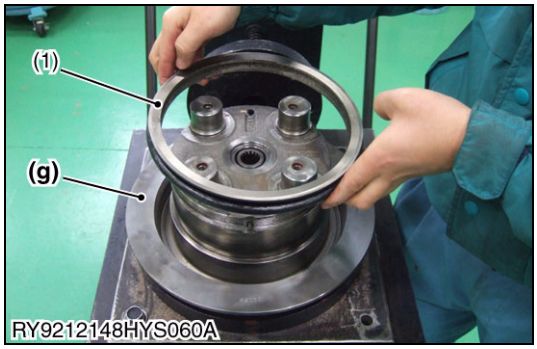
1. Set one of the angular bearings in the gear case and use a press to mount it.
   - Tool to use: Angular bearing press-in tool



Turn the gear case over and install the other angular bearing with the press.
- Tool to use: Angular bearing press-in tool

(f) Angular bearing press-in tool

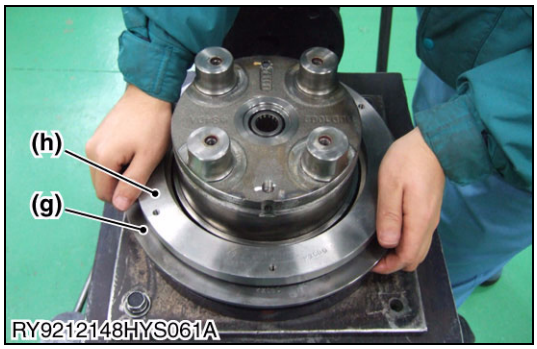
RY9212148HYS0030US0



2. Set the floating seal installation tool on the flange holder. Grease the O-ring of the floating seal and set the floating seal on the flange holder.
   - Tool to use:
     Floating seal installation tool (for flange holder)

(1) Floating seal
(g) Floating seal installation tool (for flange holder)

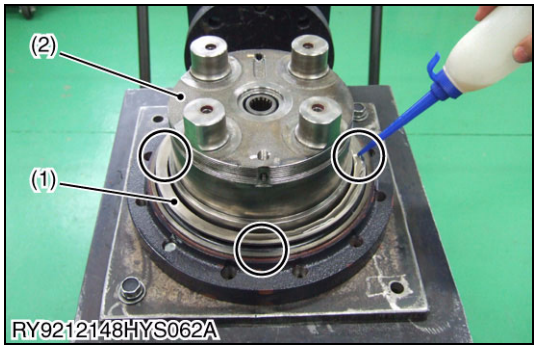
RY9212148HYS0069US0



3. Install the floating seal in the flange holder with the floating seal installation tool.
   - Tool to use:
     Floating seal installation tool (for flange holder)
     Floating seal installation tool (pusher)

(g) Floating seal installation tool (for flange holder)
(h) Floating seal installation tool (pusher)

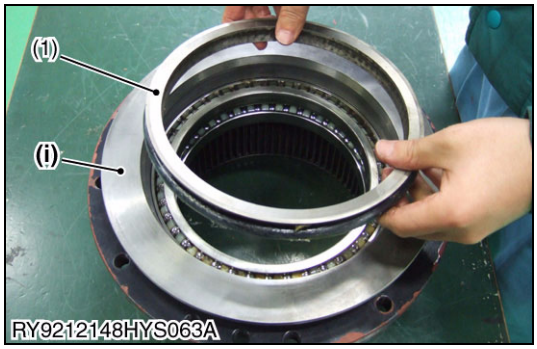
RY9212148HYS0070US0



4. Apply a little gear oil on the sliding surface of the floating seal. [4 places, every 1.6 rad (90°)]

(1) Floating seal
(2) Flange holder

RY9212148HYS0031US0



5. Set the floating seal installation tool on the gear case. Grease the O-ring of the floating seal and set the floating seal on the gear case.
   - Tool to use: Floating seal installation tool (for gear case)

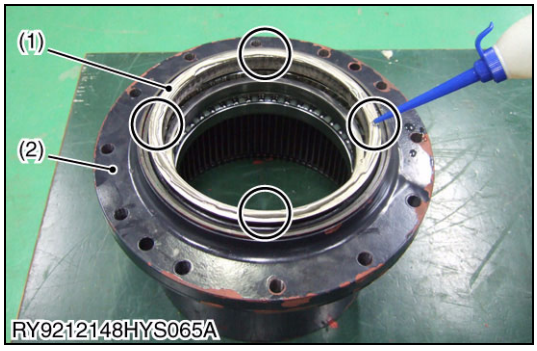
(1) Floating seal
(i) Floating seal installation tool (for gear case)]

RY9212148HYS0071US0

6. Install the floating seal in the gear case with the floating seal installation tool.
   - Tool to use: Floating seal installation tool (pusher), floating seal installation tool (for gear case)

(h) Floating seal installation tool (pusher)
(i) Floating seal installation tool (for gear case)]

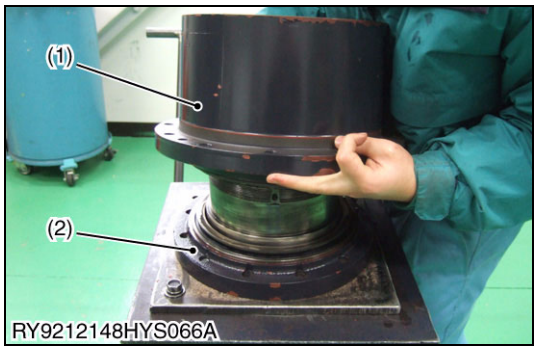
RY9212148HYS0072US0



7. Apply a little gear oil on the sliding surface of the floating seal. [4 places, every 1.6 rad (90°)]

(1) Floating seal
(2) Gear case

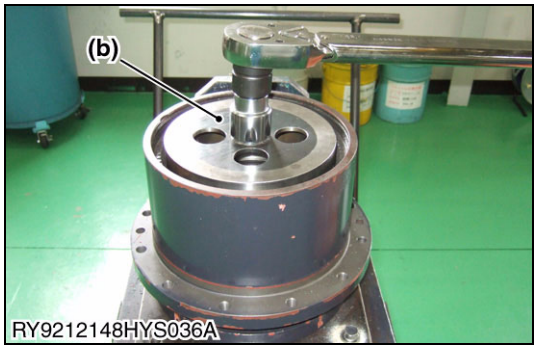
RY9212148HYS0032US0



8. Install the gear case on the flange holder.

(1) Gear case
(2) Flange holder

RY9212148HYS0033US0



9. Install the ring nut.

Torque	Ring nut	588.0 ± 55.8 N·m 63.0 ± 6.0 kgf·m 433.6 ± 41.1 lbf·ft

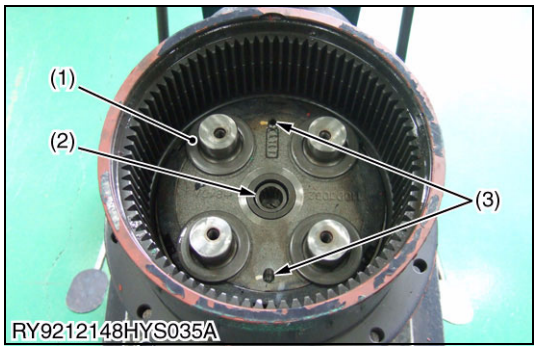
- Tool to use:Ring nut socket

■ **IMPORTANT**

- **Apply a thread lock (Loctite #638) at 4 places, about 30 to 40mm (1.2 to 1.6 in.) wide on the threads (3 threads wide) on the C bevel side around the circumference of the ring nut.**
- **Be careful that the ring nut socket doesn't come off during installation/removal.**
- **Install the side with a greater bevel to the angular bearing side.**

(b) Ring nut socket

RY9212148HYS0073US0



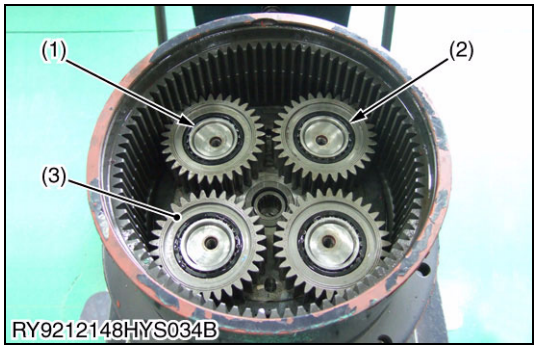
10. Install the thrust washer, collar and set screw.
11. After installing the set screw, swage the hole with a punch.

Torque	Set screw	9.8 ± 1.6 N·m 1.0 ± 0.2 kgf·m 7.2 ± 1.2 lbf·ft

- Tool to use: 4mm hex socket, punch, hammer

(1) Thrust washer
(2) Collar
(3) Set screw

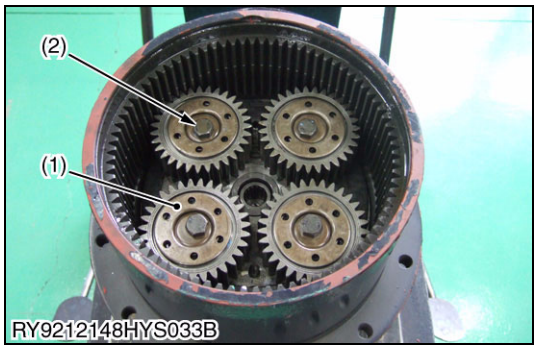
RY9212148HYS0074US0



12. Install the collar, needle bearing and planetary gear A in order.

(1) Collar
(2) Needle bearing
(3) Planetary gear A

RY9212148HYS0075US0



13. Install the plate and bolts in order.

Torque	Bolt	57.9 ± 9.8 N·m 5.9 ± 1.0 kgf·m 42.7 ± 7.2 lbf·ft

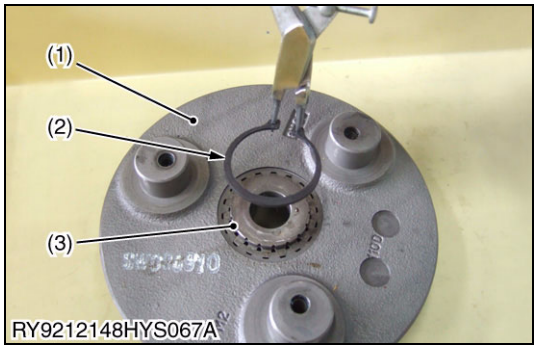
- Tool to use: 17 mm socket

■ **IMPORTANT**

- **Make sure the plate does not ride up on planetary gear A.**
- **Always replace bolts with new ones.**

(1) Plate
(2) Bolt

RY9212148HYS0076US0

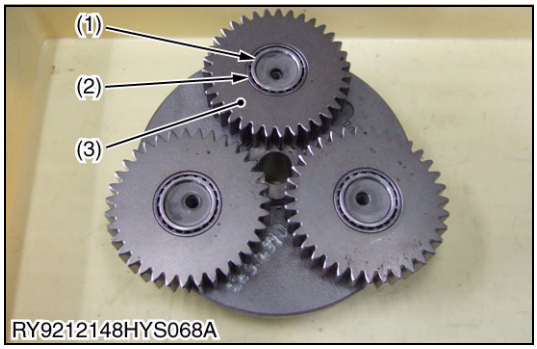


14. Mount the sun gear on the holder.
    - Tool to use: circlip

■ **IMPORTANT**
- **Install the circlip with the rounded side down.**

(1) Holder
(2) Circlip
(3) Sun gear

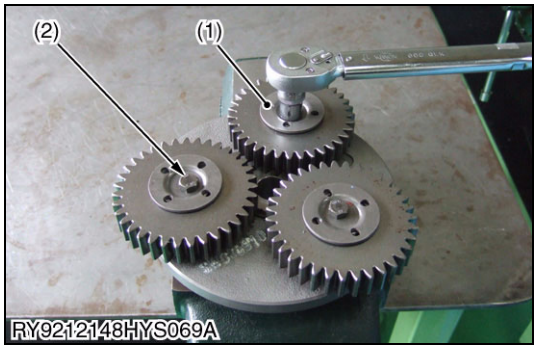
RY9212148HYS0077US0



15. Install the collar, needle bearing and planetary gear B on the holder in order.

(1) Collar
(2) Needle bearing
(3) Planetary gear B

RY9212148HYS0078US0



16. Install the plate and bolts in order.

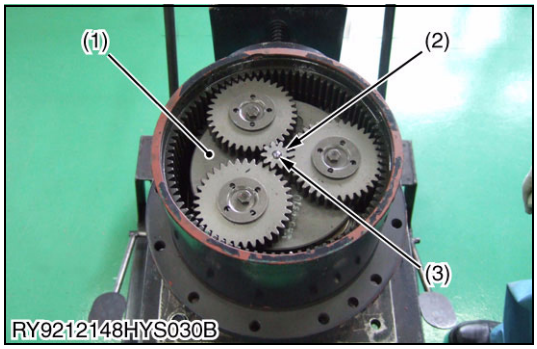
■ **IMPORTANT**
- **Use a cushioning plate when clamping in a vise.**
- **Make sure the plate does not ride up on planetary gear B.**
- **Always replace bolts with new ones.**

Torque	Bolt	33.3 ± 4.9 N·m 3.4 ± 0.5 kgf·m 24.5 ± 3.5 lbf·ft

- Tool to use: 14 mm socket

(1) Plate
(2) Bolt

RY9212148HYS0079US0



17. Install the holder sub-assembly, drive gear and balls in order.

■ **IMPORTANT**
- **When the holder sub-assembly is installed, turn the gear case and make sure it turns smoothly. (Take the drive gear out)**

(1) Holder sub-assembly
(2) Drive gear
(3) Ball

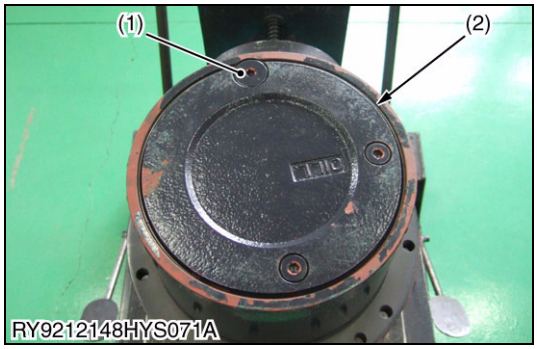
RY9212148HYS0080US0

18. Install the cover.

■ **IMPORTANT**
- **Apply grease to the O-ring.**

(1) Cover
(2) O-ring

RY9212148HYS0081US0



19. Install the wire and plug.

Torque	Plug	58.8 ± 9.8 N·m 6.0 ± 1.0 kgf·m 43.4 ± 7.2 lbf·ft

- Tool to use: 8 mm hex socket

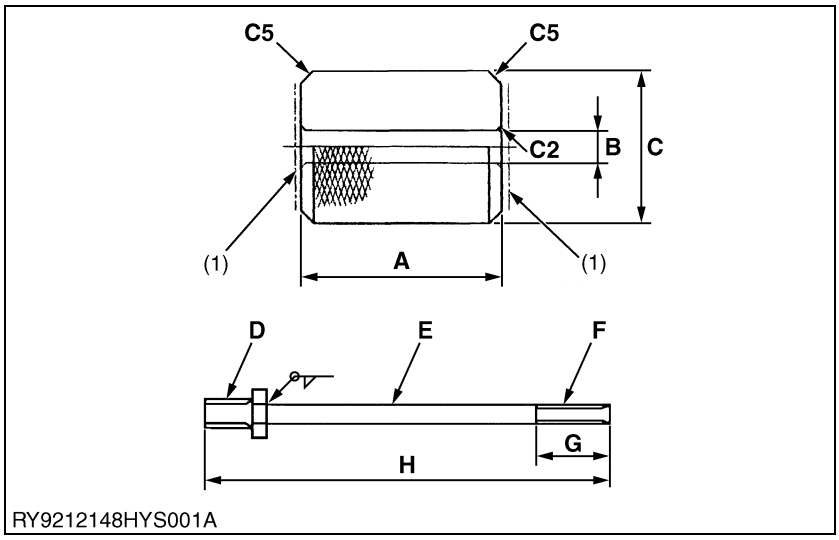
■ **IMPORTANT**

- **Be sure to fill the specified amount of gear oil (1.3 L, 0.34 US gal.) prior to mounting on the machine.**
- **After mounting the travel motor on the machine, double-check the gear oil level.**

(1) Plug (2) Wire

RY9212148HYS0082US0

(3) Special Tools

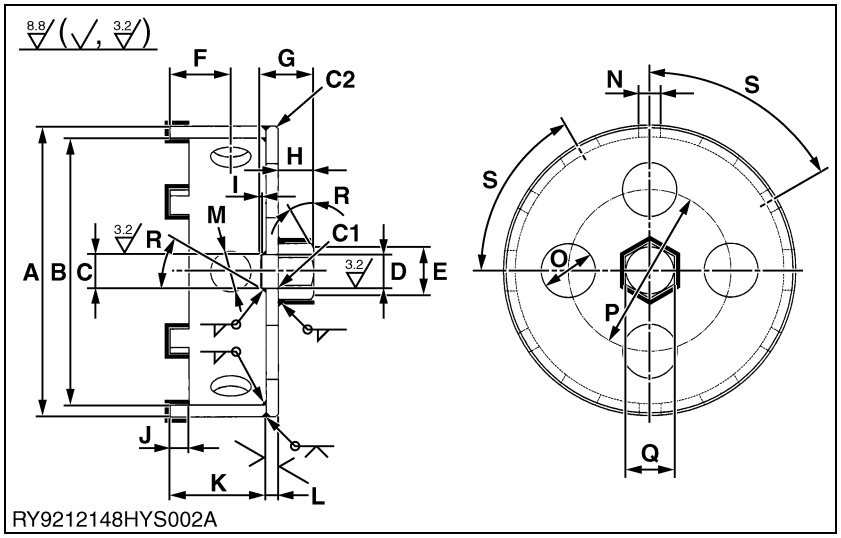


(a) Cover removal tool

A	80 mm (3.1 in.)
B	ϕ13 mm (0.51 in.)
C	ϕ60 mm (2.4 in.)
D	R3/8
E	ϕ12.5 mm (0.492 in.)
F	M12 x P1.25
G	25 mm (0.98 in.)
H	315 mm (12.4 in.)
C2	2 mm (0.08 in. bevel)
C5	5 mm (0.2 in. bevel)

(1) Tempered

RY9212148HYS0021US0



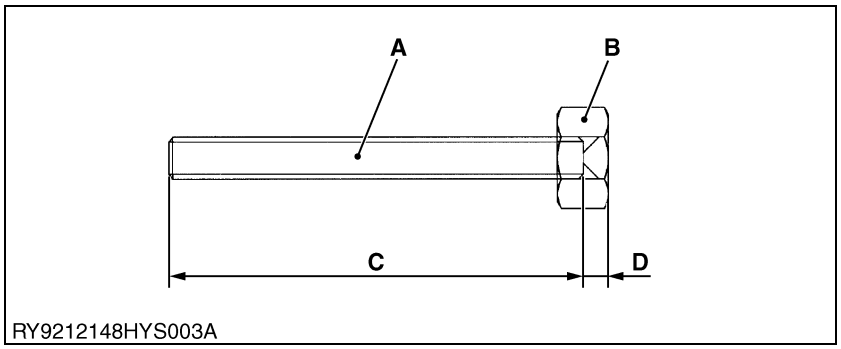
RY9212148HYS002A

(b) Ring nut socket

A	ϕ215.5 mm (8.48 in.)
B	ϕ198 mm (7.80 in.)
C	ϕ24.979 - 25.000 mm (ϕ0.98343 - 0.98425 in.)
D	ϕ25.000 - 25.021 mm (ϕ0.98425 - 0.98508 in.)
E	ϕ34.5 - 35.0 mm (1.36 - 1.38 in.)
F	45 mm (1.77 in.)
G	39 mm (1.54 in.)
H	26 mm (1.02 in.)
I	1 mm (0.04 in.)
J	14 mm (0.55 in.)
K	71 mm (2.80 in.)
L	9 mm (0.35 in.)
M	6 - ϕ30 mm (6 - 1.18 in.)
N	6 - 16 mm (6 - 0.63 in.)
O	4 - ϕ40 mm (4 - 1.57 in.)
P	P.C.D. 120 mm (4.724 in.)
Q	35.7 - 35.9 mm (1.406 - 1.413 in.)
R	0.52 rad (30 °)
S	6 - 6.82 rad (6 - 360 °)
C1	1 mm (0.04 in.) bevel
C2	2 mm (0.08 in.) bevel

- Bold line indicates high-frequency tempering
- If angle is not specified, there must not be any burrs. Corner to be max of R0.4 mm (0.016 in.)

RY9212148HYS0083US0

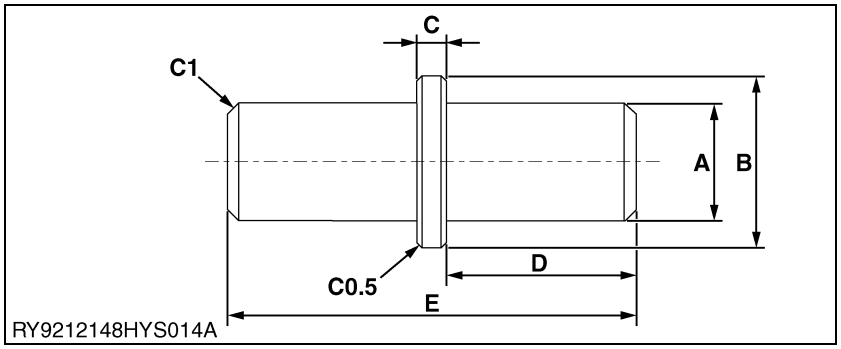


RY9212148HYS003A

(c) Removal bolts (M14 × 2.0)

A	M14 x P2.0
B	M14 nut
C	250 mm (9.84 in.)
D	5 mm (0.5 in.)

RY9212148HYS0020US0

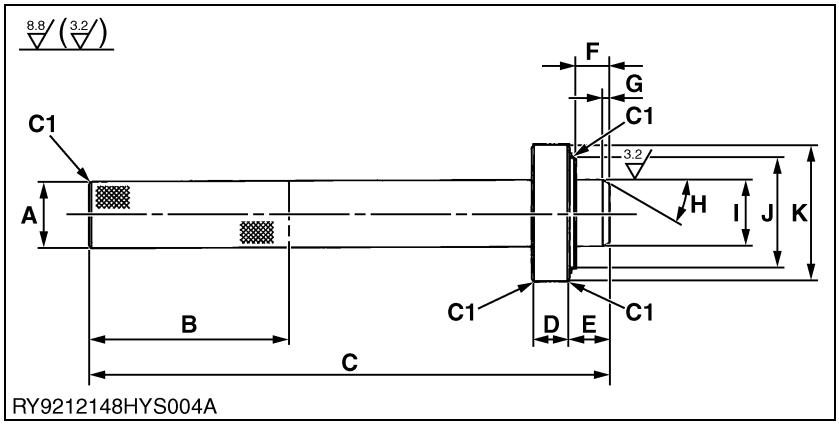


RY9212148HYS014A

(d) Tool for pressing cylinder block

A	ϕ24 mm (0.945 in.)
B	ϕ33.2 - 33.5 mm (1.31 - 1.32 in.)
C	5 mm (0.2 in.)
D	60 mm (2.362 in.)
E	125 mm (4.921 in.)
C1	1 mm (0.04 in.) bevel
C0.5	0.5 mm (0.02 in.) bevel

RY9212148HYS0084US0

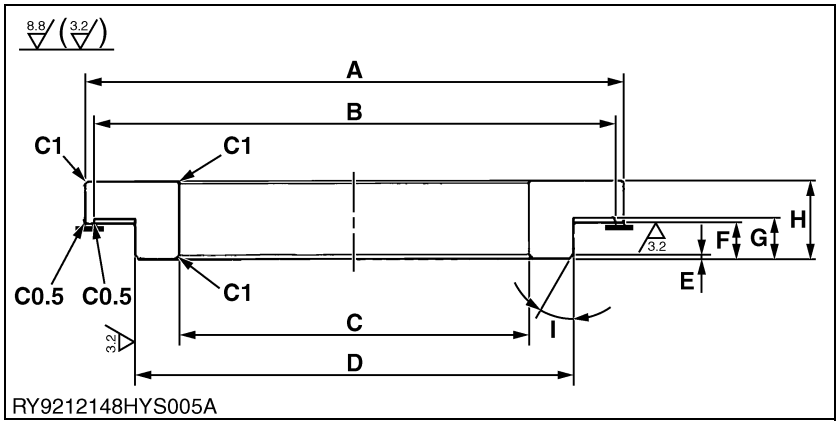


RY9212148HYS004A

(a) Oil seal installation tool

A	ϕ30 mm (1.18 in.)
B	90 mm (3.54 in.)
C	235 mm (9.25 in.)
D	17 mm (0.67 in.)
E	18 mm (0.71 in.)
F	15 mm (0.59 in.)
G	3 mm (0.12 in.)
H	0.52 rad (30 °)
I	ϕ29.8 to 30.0 mm (1.17 to 1.18 in.)
J	ϕ49.1 to 49.0 mm (1.92 to 1.93 in.)
K	ϕ61 mm (2.4 in.)
C1	1 mm (0.04 in.) bevel

RY9212148HYS0085US0



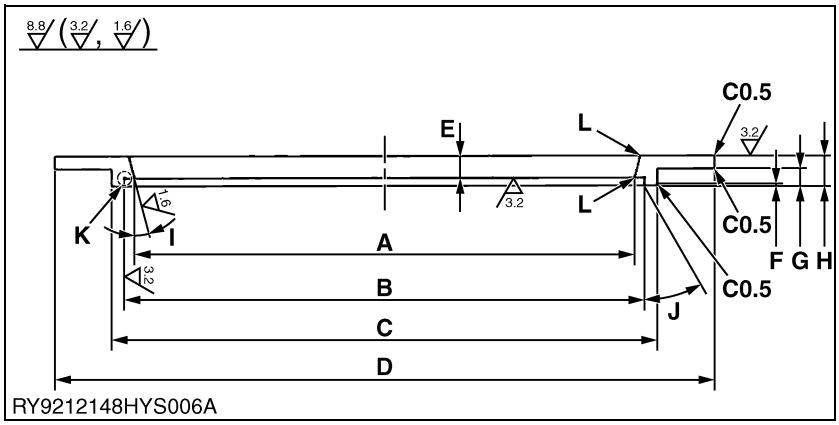
RY9212148HYS005A

(f) Angular bearing insertion tool

A	ϕ214.8 to 215.0 mm (8.457 to 8.464 in.)
B	ϕ208 mm (8.189 in.)
C	ϕ140 mm (5.512 in.)
D	ϕ175.3 to 175.5 mm (6.902 to 6.909 in.)
E	2 mm (0.08 in.)
F	14 mm (0.55 in.)
G	16 mm (0.63 in.)
H	31 mm (1.22 in.)
I	0.52 rad (30 °)
C1	1 mm (0.04 in.) bevel
C0.5	0.5 mm (0.02 in.) bevel

- Bold line indicates high-frequency tempering

RY9212148HYS0086US0



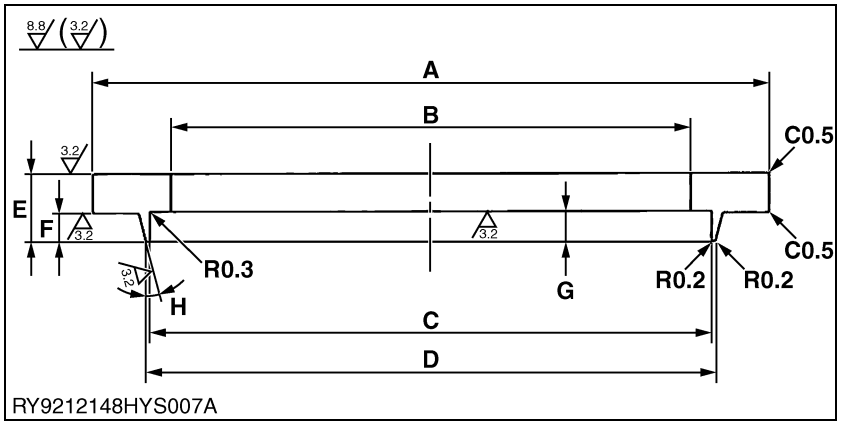
RY9212148HYS006A

(g) Floating seal installation tool (for flange holder)

A	ϕ219.7 - 219.9 mm (8.650 - 8.657 in.)
B	ϕ228.5 - 228.6 mm (8.996 - 9.000 in.)
C	ϕ240 mm (9.45 in.)
D	ϕ290 mm (11.42 in.)
E	9.3 to 9.5 mm (0.366 to 0.374 in.)
F	1 mm (0.04 in.)
G	7.5 mm (0.30 in.)
H	13 mm (0.51 in.)
I	0.24 to 0.28 rad (14 to 16 °)
J	0.52 rad (30 °)
K	Machined recess
L	Light chamfering
C0.5	0.5 mm (0.02 in.) bevel

- Corner to be max of R0.4 mm (0.016 in.)

RY9212148HYS0087US0



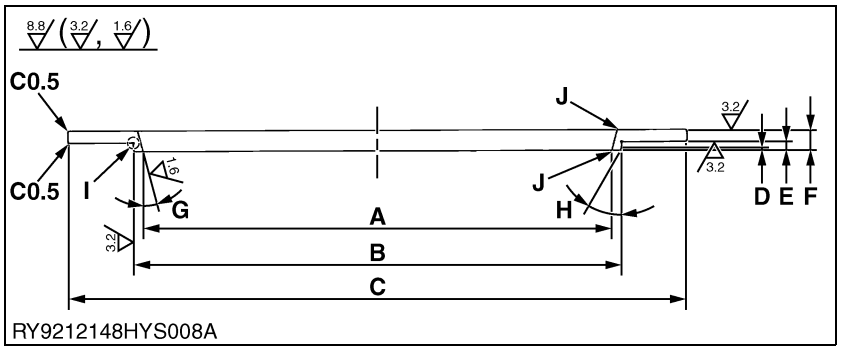
RY9212148HYS007A

(h) Floating seal installation tool (pusher)

A	ϕ260 mm (10.24 in.)
B	ϕ197 to 200 mm (7.756 to 7.874 in.)
C	ϕ215.9 to 216.1 mm (8.500 to 8.508 in.)
D	ϕ218.9 to 219.1 mm (8.618 to 8.626 in.)
E	25.5 mm (1.00 in.)
F	10.5 to 10.7 mm (0.414 to 0.421 in.)
G	11.3 to 11.6 mm (0.445 to 0.457 in.)
H	0.24 to 0.28 rad (14 to 16 °)
R0.3	Radius 0.3 mm (0.012 in.)
R0.2	Radius 0.2 mm (0.008 in.)
C0.5	0.5 mm (0.02 in.) bevel

- Material: nylon
- Corner to be max of R0.4 mm (0.016 in.)

RY9212148HYS0088US0



RY9212148HYS008A

(i) Floating seal installation tool (for gear case)]

A	ϕ219.7 - 219.9 mm (8.650 - 8.657 in.)
B	ϕ218.8 - 218.9 mm (8.618 - 8.626 in.)
C	ϕ290 mm (11.42 in.)
D	1 mm (0.04 in.)
E	3.8 to 4.0 mm (0.150 to 0.157 in.)
F	9.3 to 9.5 mm (0.366 to 0.374 in.)
G	0.24 to 0.28 rad (14 to 16 °)
H	0.52 rad (30 °)
I	Machined recess
J	Light chamfering
C0.5	0.5 mm (0.02 in.) bevel

- Corner to be max of R0.4 mm (0.016 in.)

RY9212148HYS0089US0

6. CYLINDER

[1] TIGHTENING TORQUE

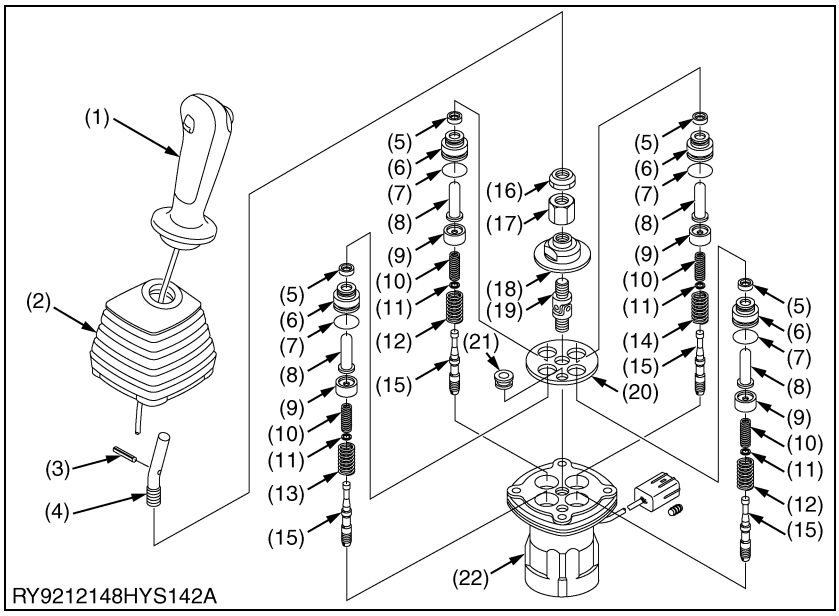
		KX080-4α2	Remarks
Boom	Manufacturer	KYB Corp.	
	Screw torque	56.9 ± 10.7 N·m 5.8 ± 1.1 kgf·m 42.0 ± 7.9 lbf·ft	
	Screw size	M12 × 1.75	Tap with punch on two places
	Piston torque	3070 N·m 313.1 kgf·m 2264 lbf·ft	
	Width across hex-head	80	
	Head torque	950 N·m 96.9 kgf·m 701 lbf·ft	Apply ThreeBond #1901
Two piece boom	Manufacturer	KYB Corp.	
	Screw torque	31.5 N·m 3.2 kgf·m 23.2 lbf·ft	
	Screw size	M10 × 1.5	Tap with punch on two places
	Piston torque	1980 N·m 202.0 kgf·m 1460 lbf·ft	
	Width across hex-head	70	
	Head torque	669 N·m 68.2 kgf·m 493 lbf·ft	Apply ThreeBond #1901
Arm	Manufacturer	KYB Corp.	
	Screw torque	31.5 ± 5.88 N·m 3.2 ± 0.6 kgf·m 23.2 ± 4.3 lbf·ft	
	Screw size	M10 × 1.5	Tap with punch on two places
	Piston torque	3040 N·m 310.1 kgf·m 2242 lbf·ft	
	Width across hex-head	70	
	Head torque	950 N·m 96.9 kgf·m 701 lbf·ft	Apply ThreeBond #1901
Bucket	Manufacturer	Hengli Hydraulic Corp.	
	Screw torque	31.5 ± 5.9 N·m 3.2 ± 0.6 kgf·m 23.2 ± 4.4 lbf·ft	
	Screw size	M10 × 1.5	TTap with punch on two places
	Piston torque	2573 N·m 262.4 kgf·m 1897.7 lbf·ft	
	Width across hex-head	70	
	Head torque	931 ± 50 N·m 94.9 ± 5.1 kgf·m 686.7 ± 37 lbf·ft	Apply ThreeBond #1901

		KX080-4α2	Remarks
Blade	Manufacturer	Hengli Hydraulic Corp.	
	Screw torque	31.5 ± 5.9 N·m 3.2 ± 0.6 kgf·m 23.2 ± 4.4 lbf·ft	
	Screw size	M10 × 1.5	Tap with punch on two places
	Piston torque	3000 N·m 305.9 kgf·m 2213 lbf·ft	
	Width across hex-head	80	
	Head torque	850 ± 90 N·m 86.7 ± 9.2 kgf·m 626.9 ± 66 lbf·ft	Apply ThreeBond #1901
Swing	Manufacturer	Hengli Hydraulic Corp.	
	Screw torque	31.5 ± 5.9 N·m 3.2 ± 0.6 kgf·m 23.2 ± 4.4 lbf·ft	
	Screw size	M10 × 1.5	Tap with punch on two places
	Piston torque	3000 N·m 305.9 kgf·m 2213 lbf·ft	
	Width across hex-head	80	
	Head torque	850 ± 90 N·m 86.7 ± 9.2 kgf·m 626.9 ± 66 lbf·ft	Apply ThreeBond #1901

RY9212724HYS0049US0

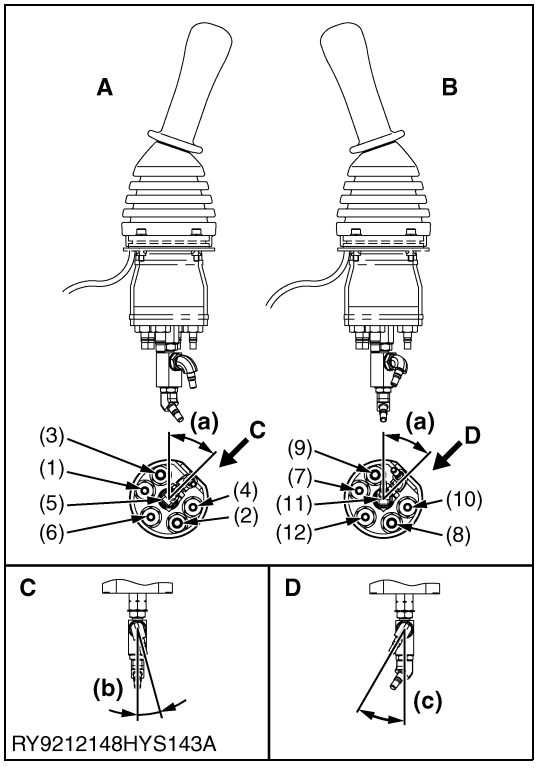
7. PILOT VALVE

[1] CONTROL PILOT VALVES



No.	Part Name	Qty
(1)	Handle	1
(2)	Bellows	1
(3)	Spring pin	1
(4)	Lever	1
(5)	Seal	4
(6)	Plug	4
(7)	O-ring	4
(8)	Pushrod	4
(9)	Spring seat	4
(10)	Secondary pressure spring	4
(11)	Shim	4
(12)	Return spring (Ports 1 and 3)	2
(13)	Return Spring (Port 2)	1
(14)	Return Spring (Port 4)	1
(15)	Spool	4
(16)	Lock nut	1
(17)	Adjusting nut	1
(18)	Round plate nut	1
(19)	U-joint	1
(20)	Plate	1
(21)	Bushing	1
(22)	Casing	1

RY9212148HYS0226US0



Adapter angles

A	Point used	Tape color
(1)	Swivel left	Gray
(2)	Arm dump	Pea green
(3)	Swivel right	Light blue
(4)	Arm crowd	Blue
(5)	P	White
(6)	T	None

B	Point used	Tape color
(7)	Bucket crowd	Orange
(8)	Boom down	Yellow
(9)	Bucket dump	Red
(10)	Boom up	Green
(11)	P	White
(12)	T	None

A : Left pilot valve
B : Right pilot valve

(a) 45 ° (0.79 rad)
(b) 15 ° (0.26 rad)
(c) 30 ° (0.52 rad)

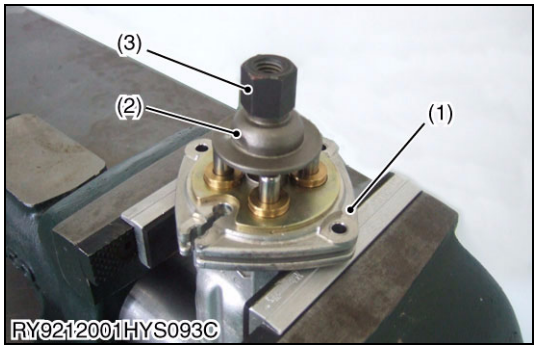
RY9212148HYS0227US0

(1) Disassembly

CAUTION

- **All of the parts are precision parts, so be very careful in handling them and take care not to drop or hit parts against each other.**
- **If you hit a part too hard while working on it, it may result in burrs or other damage, thus preventing installation as well as oil leaks and/or compromised performance, so be careful when handling parts.**
- **If parts are left disassembled or left partway disassembled, humidity or foreign matter may cause rust, so if interrupting the work is unavoidable, take precautions to protect the parts from rust and dust.**

RY9212148HYS0150US0



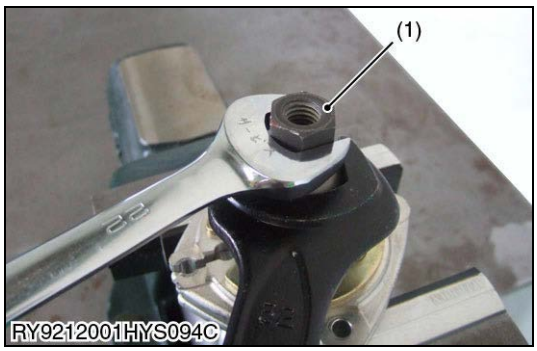
1. Clamp the pilot valve in a vise.

■ **IMPORTANT**

- **When clamping it in a vise, use a sheet of copper to prevent scratching the pilot valve.**

(1) Casing
(2) Round Plate Nut
(3) Adjusting Nut

RY9212148HYS0151US0

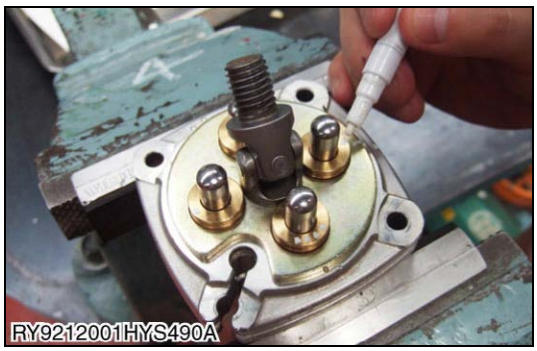


2. Use wrenches to remove the adjusting nut and round plate nut.

- Tools to use: 22 mm and 32 mm wrenches

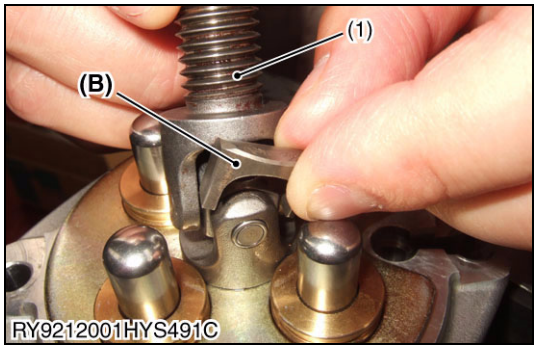
(1) Adjusting Nut

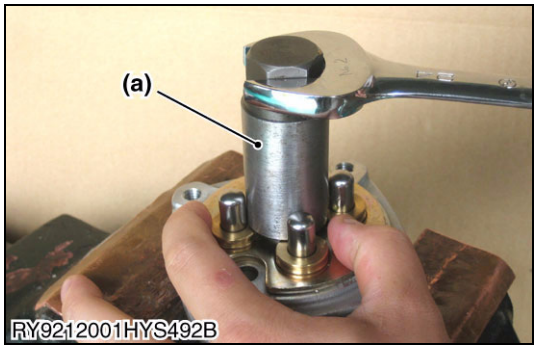
RY9212148HYS0152US0

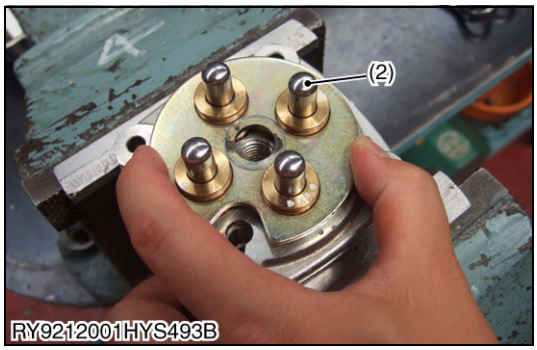


3. Mark the alignment of holes to the casing.

RY9212001HYS0479US0







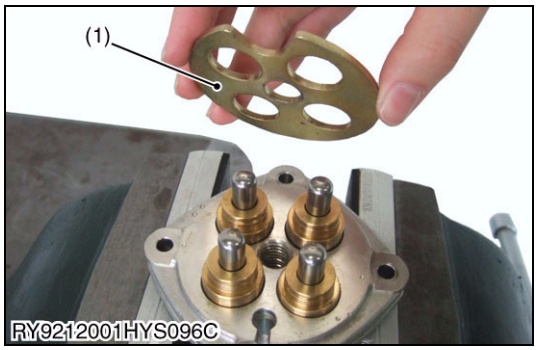
4. After mounting tool **(b)** on the U-joint, use tool **(a)** to turn the U-joint counterclockwise and loosen it.

- Tool **(a)**: U-joint clamping tool
- Tool **(b)**: Bushing (two)

CAUTION
- **When removing the U-joint, take care that it does not pop off.**

(1) U-Joint (2) Plug

RY9212148HYS0153US0



5. Remove the plate.

(1) Plate

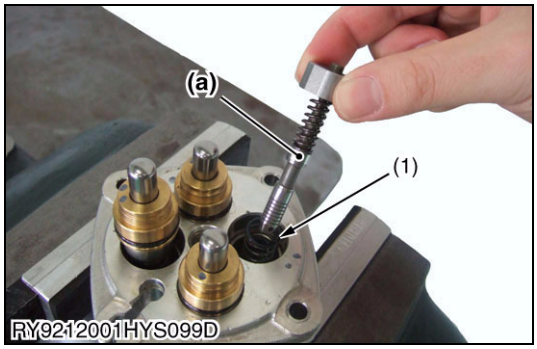
RY9212148HYS0154US0

6. Slip a slotted screwdriver in the groove in the plug to remove the plug.

CAUTION
- **Take care so the plug does not pop out.**
- **Take care not to damage it by exerting force unevenly.**
- **If a burr is formed, use a whetstone to remove it.**

(1) Plug

RY9212148HYS0155US0



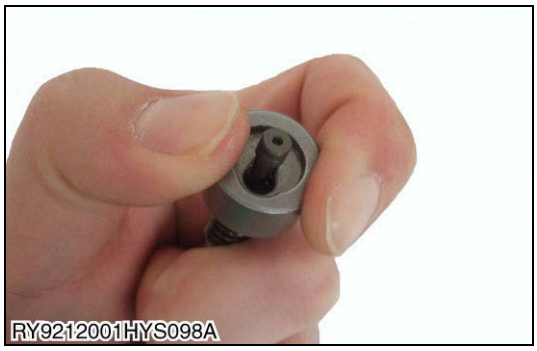
7. Remove the reducing valve ASSY and the return spring.

■ **IMPORTANT**
- **Tag the return springs to positively ID which port they go to.**

(1) Return Spring
(a) Reducing Valve ASSY

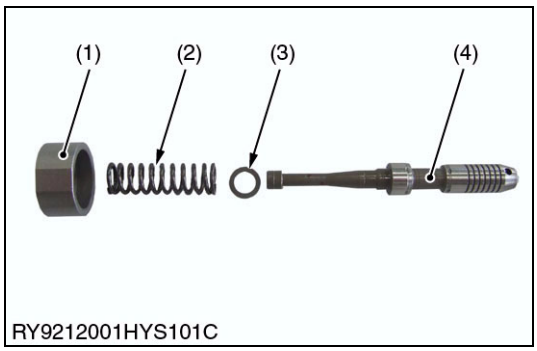
RY9212148HYS0156US0

8. To disassemble a reducing valve, press the spring seat in and while compressing the secondary pressure spring, shift the spring seat to the side and remove it from the spool via the larger hole.



■ **IMPORTANT**
- **Be careful not to scratch the surface of the spool.**
- **Do not depress the spring seat more than 6mm (0.24 in.).**
- **Do not disassemble the reducing valve unless there is a problem with it.**

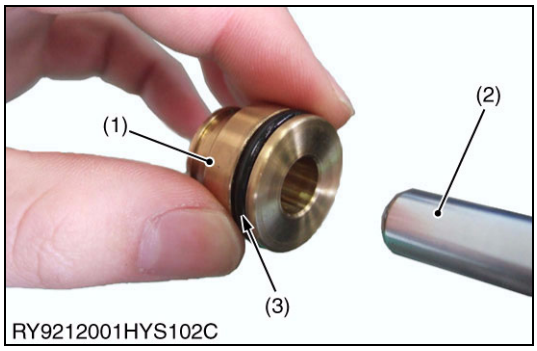
Components of the reducing valve



(1) Spring Seat
(2) Secondary Pressure Spring
(3) Washer
(4) Spool

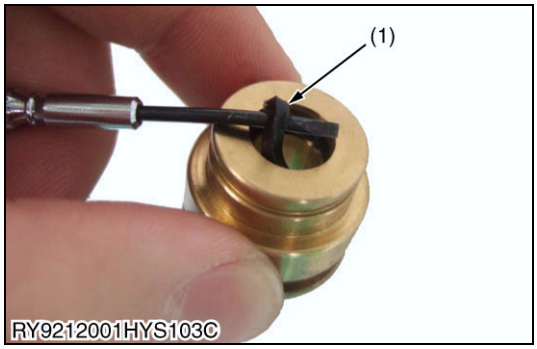
RY9212148HYS0157US0

9. Remove the plug from the pushrod.



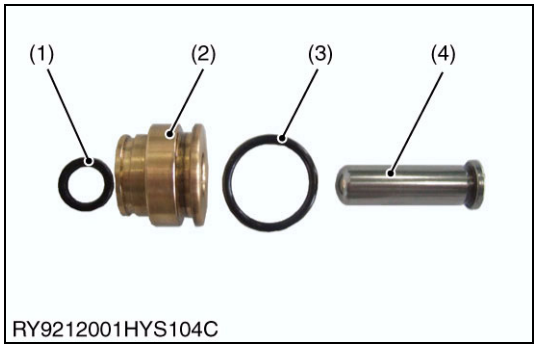
(1) Plug
(2) Pushrod
(3) O-Ring

RY9212148HYS0158US0



10. Remove the O-ring and seal from the plug.

■ **IMPORTANT**
- **Use a mini slotted screwdriver.**
- **Be careful not to scratch the inside surface of the plug.**



Components of the Plug

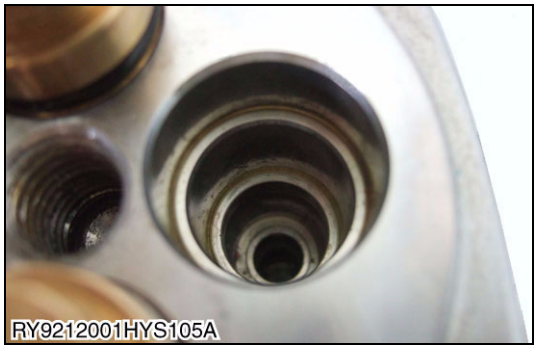
(1) Seal
(2) Plug
(3) O-Ring
(4) Pushrod

RY9212148HYS0159US0

(2) Assembly

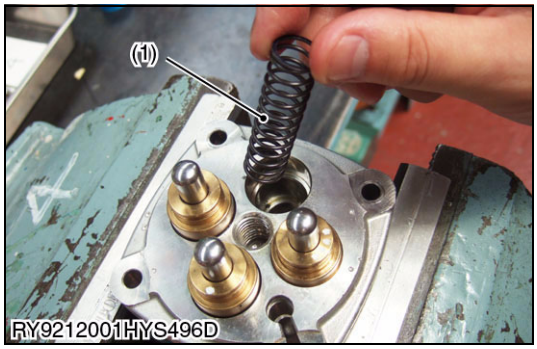
CAUTION
- **Prepare your workbench in the same way as for disassembly.**
- **Follow the same general precautions as in the disassembly.**
- **When assembling the parts, remove all bits of metal or foreign matter from all the parts and make sure there aren't any burrs or dings on the parts.**
- **Replace used O-rings with new ones.**
- **Take care not to damage the O-rings when installing them.**

RY9212148HYS0160US0



1. Make sure there aren't any burrs or scratches inside the casing.

RY9212001HYS0487US0

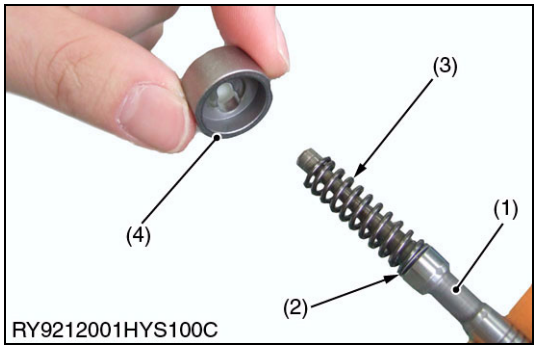


2. Install the return spring in the casing.

■ **IMPORTANT**
- **Install it in the same position as before disassembly.**

(1) Return Spring

RY9212148HYS0161US0

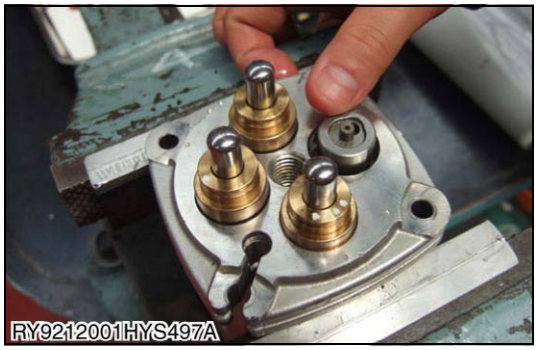


3. Install the washer, secondary pressure spring and spring seat on the spool in order.

■ **IMPORTANT**
- **Do not depress the spring seat more than 6 mm (0.24 in.).**
- **Be careful not to scratch the spool.**

(1) Spool
(2) Washer
(3) Secondary Pressure Spring
(4) Spring Seat

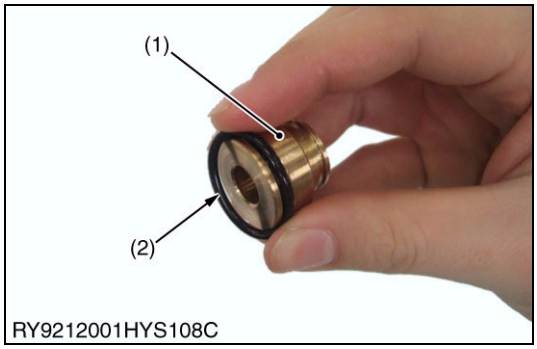
RY9212148HYS0162US0



4. Install the reducing valve ASSY.
After installing it, make sure the spool moves smoothly.

■ **IMPORTANT**
- **Install it in the same position as before disassembly.**

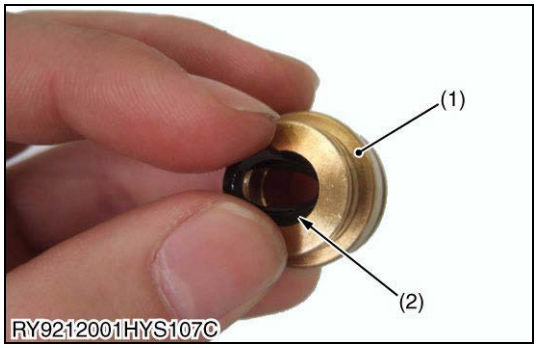
RY9212001HYS0490US0



5. Install the O-ring on the plug.

(1) Plug
(2) O-Ring

RY9212148HYS0163US0

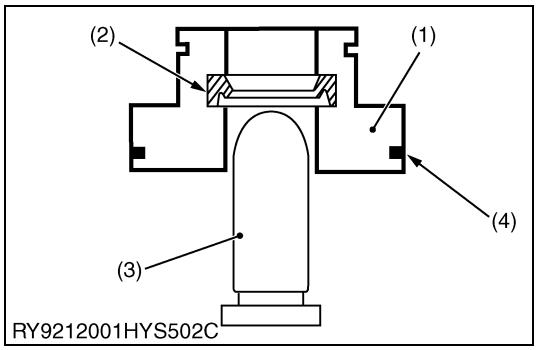


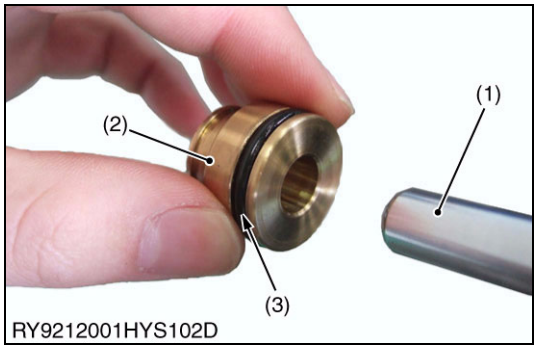
6. Install the seal on the plug.

■ **IMPORTANT**
- **Be careful that the seal faces the right direction.**
- **Apply hydraulic oil on the circumference and lip of the seal.**

(1) Plug
(2) Seal
(3) Pushrod
(4) O-Ring

RY9212148HYS0164US0





7. Install the plug on the pushrod.

■ **IMPORTANT**
- **Apply hydraulic oil to the pushrod.**

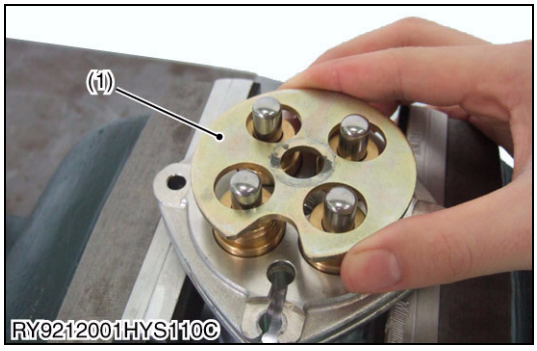
(1) Pushrod
(2) Plug
(3) O-Ring

RY9212148HYS0165US0

8. Install the plug ASSY into the case.
If the return spring is too stiff, use the plate to install the ASSY.

■ **IMPORTANT**
- **Make sure not to scratch the hole of the case.**
- **Take care so the plug ASSY does not pop out.**

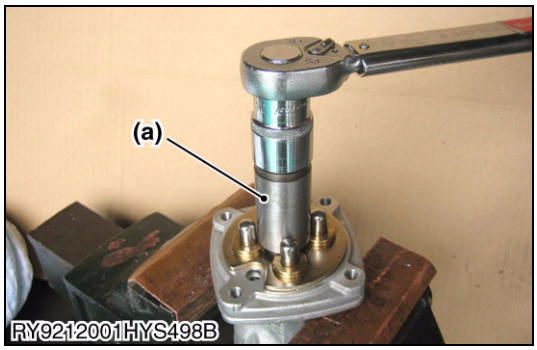
RY9212001HYS0494US0



9. Install the plate.

(1) Plate

RY9212148HYS0166US0

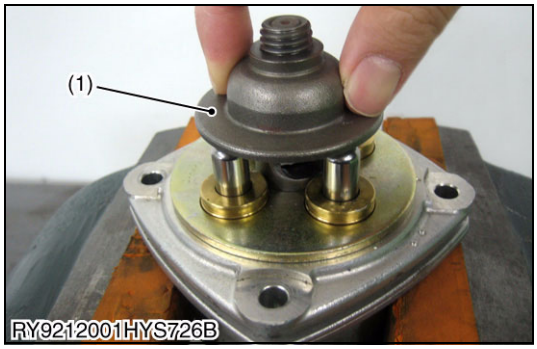


10. Install the U-joint.

Tightening torque	U-joint	47.0 ± 3.0 N·m 4.8 ± 0.3 kgf·m 35.0 ± 2.0 lbf·ft

- Tool **(a)**: U-joint clamping tool

RY9212148HYS0167US0

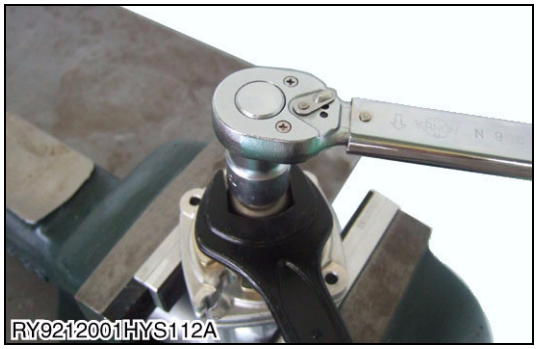


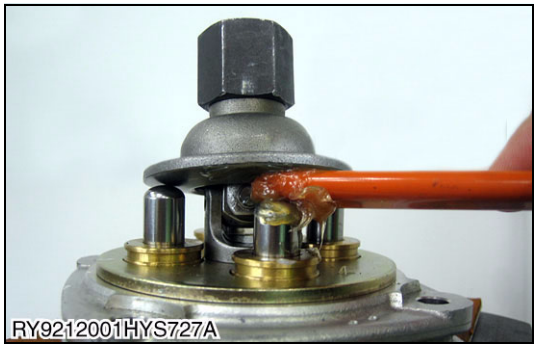
11. Install the round plate nut on the U-joint.
Tighten it until it touches all four pushrods equally.

■ **IMPORTANT**
- **Apply Loctite 262 to the top threads of the U-joint.**
- **Do not overtighten the round plate nut.**

(1) Round Plate Nut

RY9212148HYS0168US0





12. Install the adjusting nut.
    Hold a wrench on the head of the round plate nut while tightening the nut.

    • Tools to use: 22 mm and 32 mm wrenches

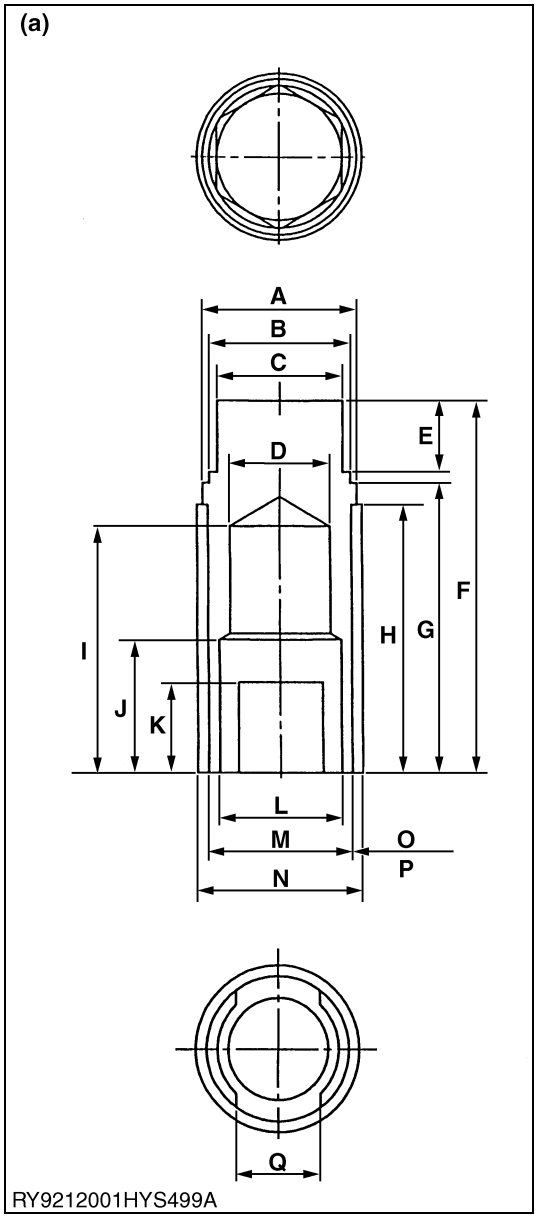
Tightening torque	Adjusting nut	70.0 ± 5.0 N·m 7.0 ± 0.5 kgf·m 51.6 ± 4.0 lbf·ft

RY9212148HYS0169US0

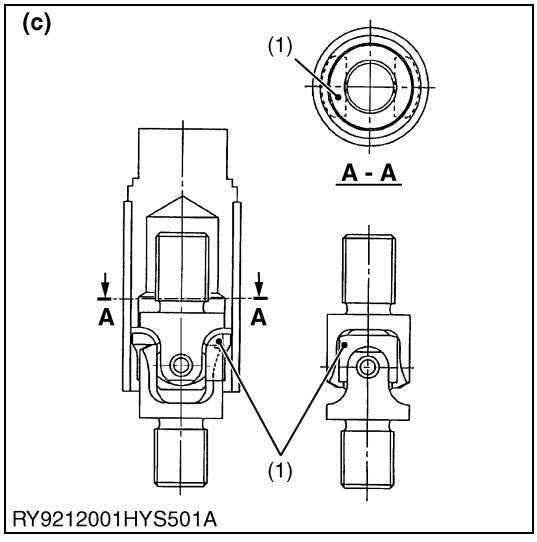
13. Apply grease to the rotating parts of the universal joint and to the ends of the pushrods.

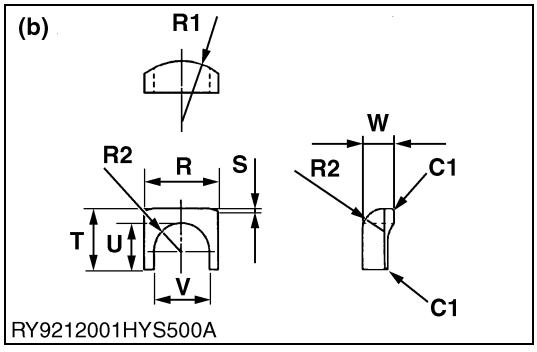
RY9212001HYS0499US0

(3) Special Tools



A	ϕ29 mm (ϕ1.142 in.)
B	ϕ26.5 mm (ϕ1.043 in.)
C	23.5 mm (0.925 in.) (nut width)
D	ϕ19 mm (ϕ0.748 in.)
E	13 mm (0.512 in.)
F	69 mm (2.717 in.)
G	54 mm (2.126 in.)
H	50 mm (1.968 in.)
I	46 mm (1.811 in.)
J	25 mm (0.984 in.)
K	17 mm (0.669 in.)
L	ϕ23 mm (ϕ0.906 in.)
M	ϕ27 mm (ϕ1.063 in.)
N	ϕ31 mm (ϕ1.220 in.)
O	Hole H 6
P	Axle n 6
Q	16 mm (0.6299 in.)
R	15.5 mm (0.6102 in.)
S	0.5 mm × 15 mm (0.0197 in. × 0.591 in.)
T	12.5 mm (0.492 in.)
U	9.5 mm (0.374 in.)
V	11.6 mm (0.457 in.)
W	6.5 mm (0.256 in.)
C1	0.5 mm (0.0197 in.) bevel
R1	R 13 mm (0.512 in.)
R2	R 5.8 mm (0.228 in.)
R3	R 4.5 mm (0.177 in.)



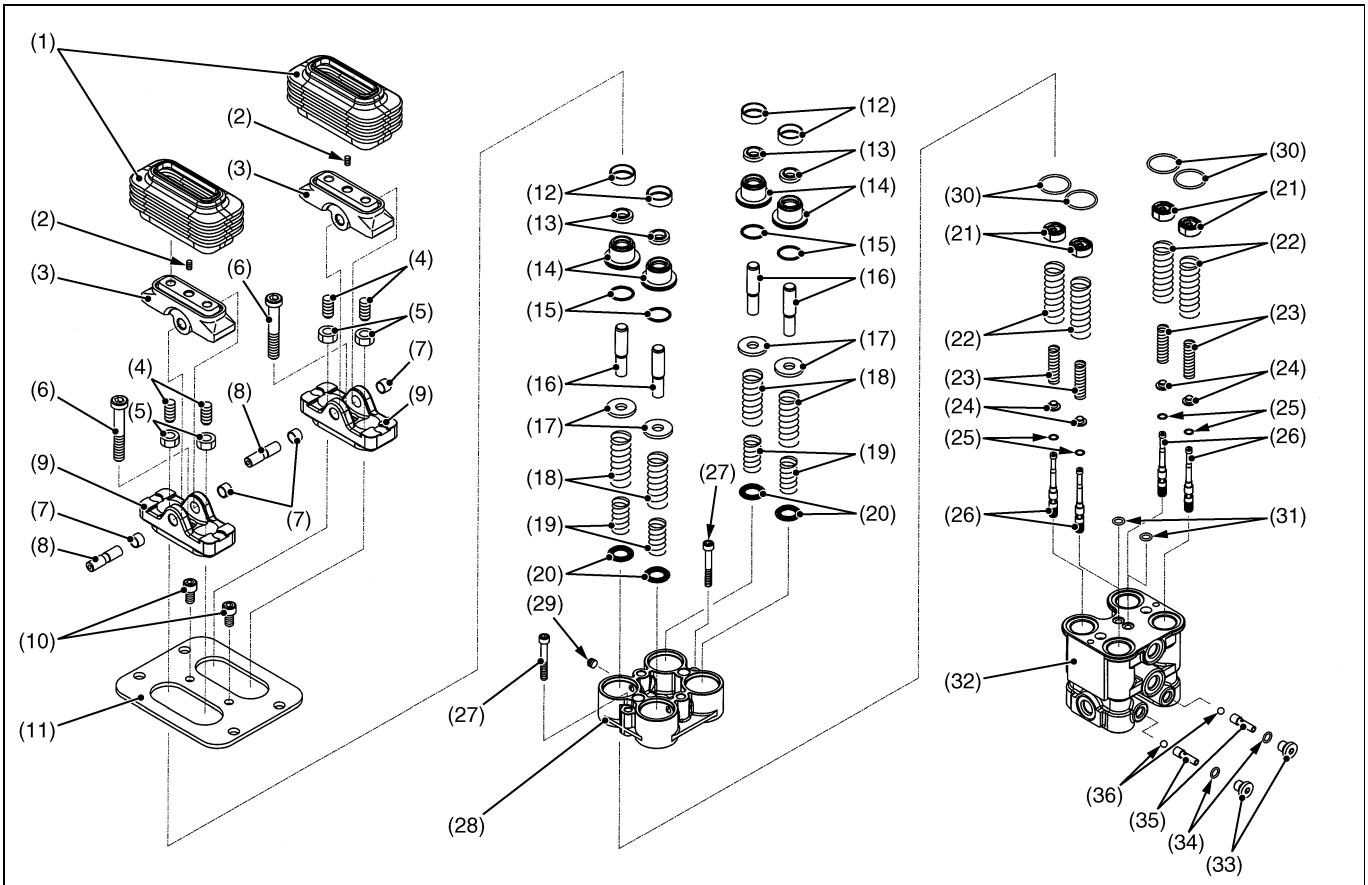


(1) Bushing

(a) U-Joint Tightening Tool, Detailed Schematic
(b) Bushing, Detailed Schematic
(c) Assembled U-Joint

RY9212001HYS0500US0

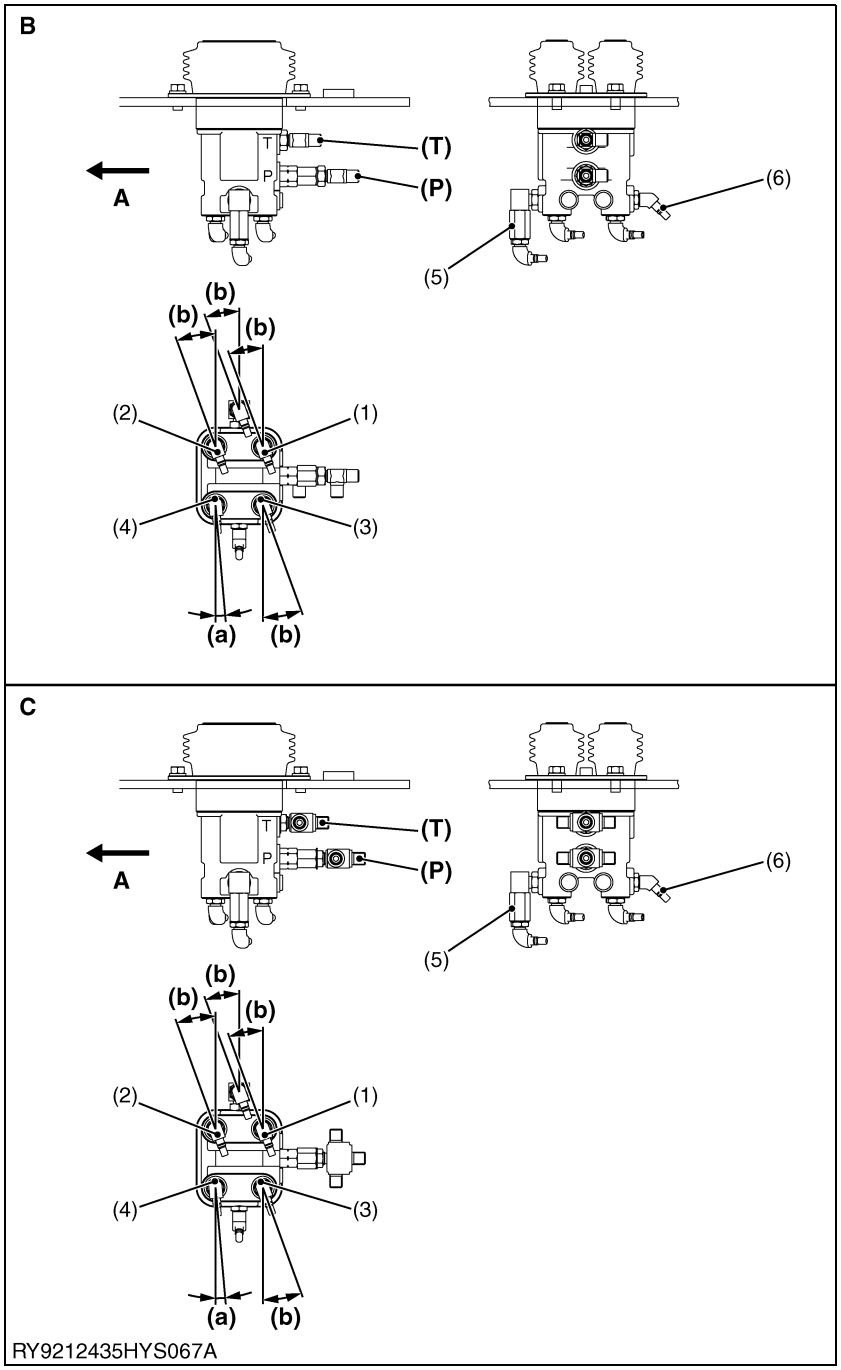
[2] TRAVEL PILOT VALVE



RY9212435HYS066A

No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty
(1)	Bellows	2	(13)	Gasket	4	(25)	Secondary pressure adjustment shim	4
(2)	Set screw	2	(14)	Plug	4	(26)	Spool	4
(3)	Cam	2	(15)	O-ring	4	(27)	Hex socket bolt	2
(4)	Set screw	4	(16)	Pushrod	4	(28)	Damper casing	1
(5)	Lock nut	4	(17)	Seat	4	(29)	Plug	5
(6)	Hex socket bolt	2	(18)	Damping spring, small	4	(30)	O-ring	4
(7)	Bushing	4	(19)	Damping spring, large	4	(31)	O-ring	2
(8)	Camshaft	2	(20)	Spring seat	4	(32)	Casing	1
(9)	Cover	2	(21)	Spring seat	4	(33)	Plug	3
(10)	Hex socket bolt	2	(22)	Return spring	4	(34)	O-ring	3
(11)	Cover	1	(23)	Secondary pressure spring	4	(35)	Seat	3
(12)	Grease cap	4	(24)	Washer	4	(36)	Steel ball	3

RY9212435HYS0030US0



RY9212435HYS067A

Travel pilot valve adapter angle

	Use Position	Tape Color
(1)	Left rearward	Blue
(2)	Left forward	Red
(3)	Right rearward	Green
(4)	Right forward	Yellow
(5)	Left travel signal	Red and blue
(6)	Right travel signal	Green and yellow
(P)	P port	White
(T)	T port	none

(a) 5 ° (0.09 rad)
(b) 20 ° (0.35 rad)

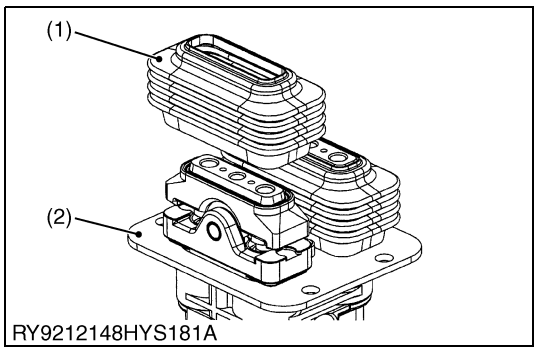
A : Front Side
B : Standard Boom Spec.
C : Two Piece Boom Spec.

RY9212724HYS0050US0

(1) Disassembly

- To ensure parts that are reused are installed in the same place as before disassembly, mark the parts as needed during disassembly.

RY9212148HYS0230US0



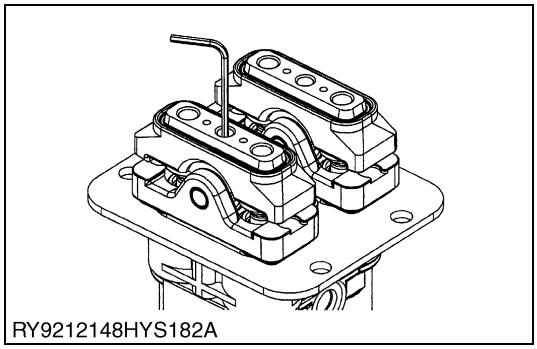
RY9212148HYS181A

1. Clamp the pilot valve in a vise.
2. Remove the bellows from the cover.

■ **IMPORTANT**
- **Use a copper plate when clamping the pilot valve.**

(1) Bellows (2) Cover

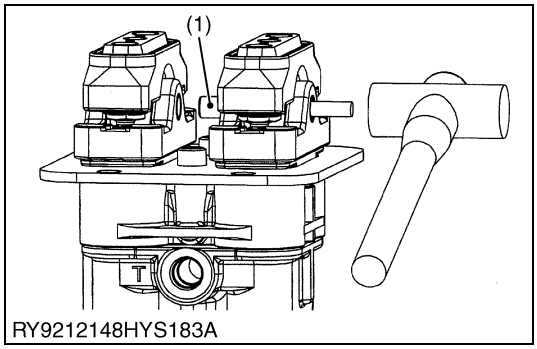
RY9212148HYS0231US0


RY9212148HYS182A

3. Loosen the hex socket set screws.
   - Tool to use: 7 mm hex socket

■ **IMPORTANT**
- **The set screw is held with a thread lock, so be careful when removing it.**

RY9212148HYS0232US0

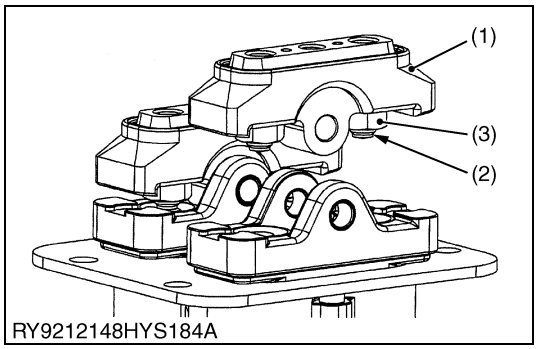


RY9212148HYS183A

4. Put a rod against the camshaft and tap it out gently with a hammer.
   - Tools to use: rod (8mm (ϕ0.31 in.) or less) and hammer

(1) Camshaft

RY9212148HYS0233US0



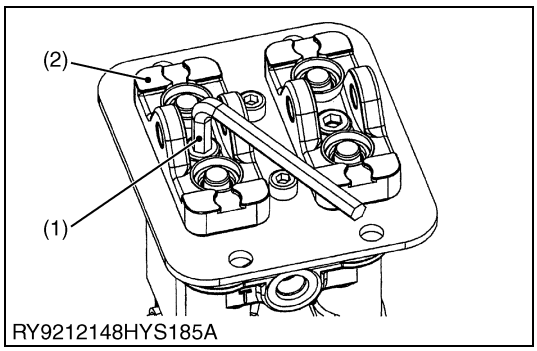
RY9212148HYS184A

5. Remove the cam with the set screw and lock nut in place.

■ **IMPORTANT**
- **Be careful as a pushrod may pop out.**

(1) Cam
(2) Set screw
(3) Lock nut

RY9212148HYS0234US0

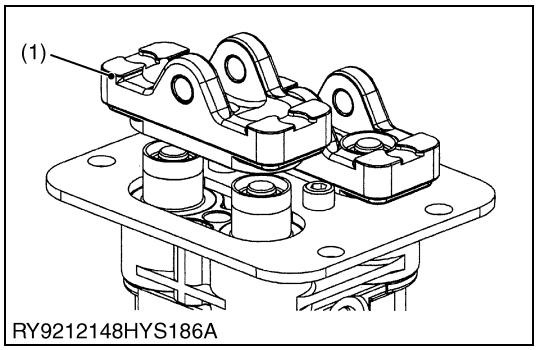


RY9212148HYS185A

6. Remove the hex bolts.
   - Tool to use: 7 mm hex socket

(1) Hex socket bolt
(2) Cover

RY9212148HYS0235US0



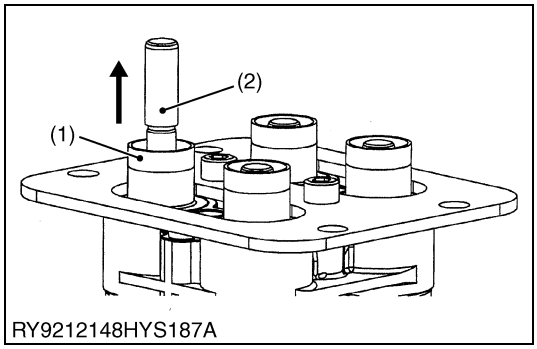
RY9212148HYS186A

7. Remove the cover.

■ **IMPORTANT**
- **Be careful as the pushrod and/or the plug may pop out due to the force of the spring.**

(1) Cover

RY9212148HYS0236US0



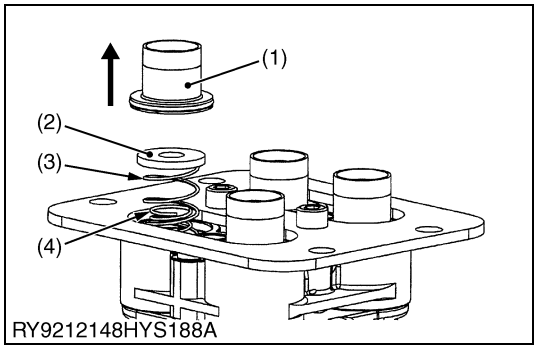
RY9212148HYS187A

8. Take the pushrod off the plug.

■ **IMPORTANT**
- **Be careful not to scratch the pushrod.**
- **Be careful as the plug may pop out due to the force of the spring.**

(1) Plug
(2) Pushrod

RY9212148HYS0237US0



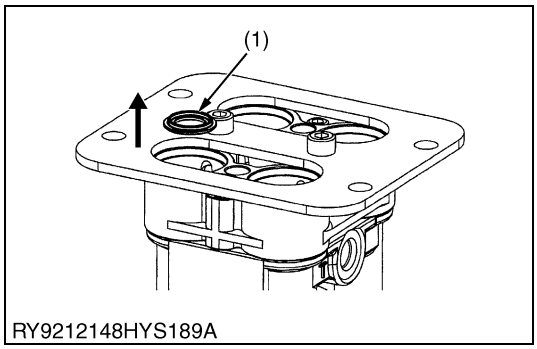
RY9212148HYS188A

9. Remove the plug with its grease cap and gasket intact.
10. Take out the seat and damping spring.

■ **IMPORTANT**
- **Be careful as the piston may pop out due to the force of the spring.**

(1) Plug
(2) Seat
(3) Damping spring, large
(4) Damping spring, small

RY9212148HYS0238US0

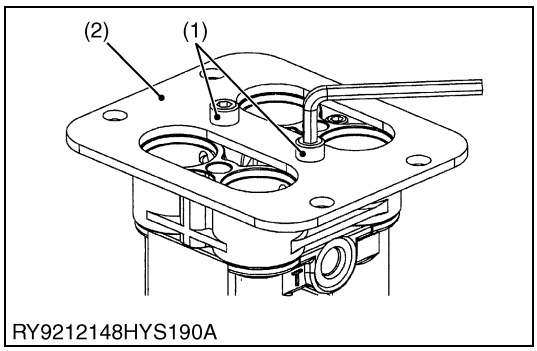


RY9212148HYS189A

11. Remove the spring seat from the casing.

(1) Spring seat

RY9212148HYS0239US0

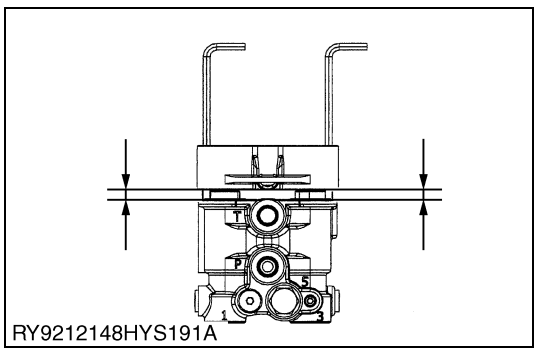


RY9212148HYS190A

12. Remove the hex socket bolts and then the cover.
- Tool to use: 7 mm hex socket

(1) Hex socket bolt
(2) Cover

RY9212148HYS0240US0

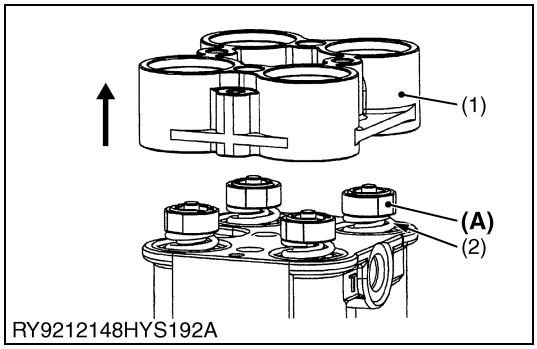


RY9212148HYS191A

13. Remove the hex bolts.
- Tool to use: 7 mm hex socket

■ **IMPORTANT**
- **Loosen the 2 hex socket bolts evenly to keep the damper casing level.**

RY9212148HYS0241US0



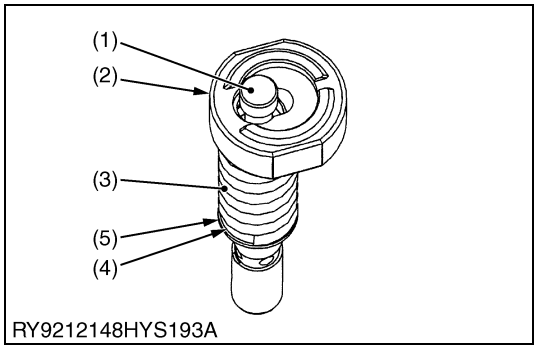
RY9212148HYS192A

14. Remove the damper casing, reducing valve ASSY and the return spring.

■ **IMPORTANT**
- **Be careful as the reducing valve ASSY may pop out due to the force of the spring.**

(1) Damper casing
(2) Return spring
(A) Reducing valve ASSY

RY9212148HYS0242US0



RY9212148HYS193A

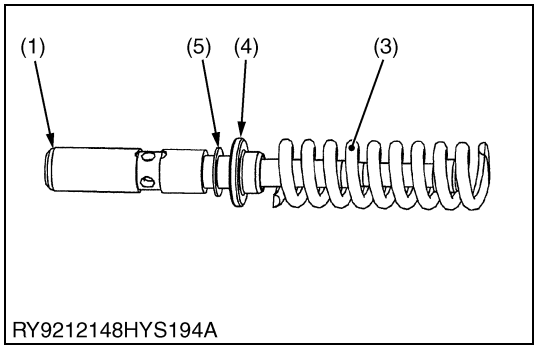
15. To disassemble the reducing valve, rest the bottom of the spool on a flat work surface, press the spring seat in and while compressing the secondary pressure spring, shift the spring seat to the side and remove it via the larger hole.

■ **IMPORTANT**
- **Be careful not to scratch the surface of the spool.**
- **Do not disassemble the reducing valve unless there is a problem with it.**
- **Do not depress the spring seat more than 4 mm (0.16 in.).**

Reducing valve ASSY

(1) Spool
(2) Spring seat
(3) Secondary pressure spring
(4) Washer
(5) Secondary pressure adjustment shim

RY9212148HYS0243US0



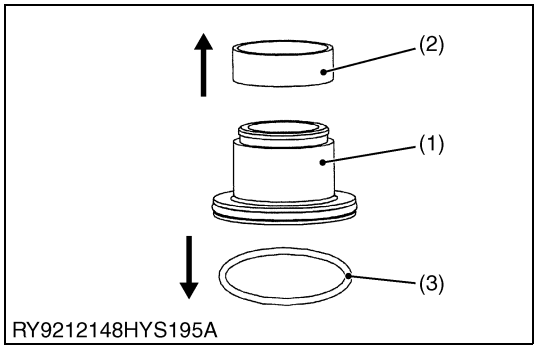
RY9212148HYS194A

16. Disassemble the spool, secondary pressure spring, washer, and secondary pressure adjusting shim.

■ **IMPORTANT**
- **The thickness of the secondary pressure adjusting shim varies for each spool due to the preset adjustment of the secondary pressure spring.**

(1) Spool
(3) Secondary pressure spring
(4) Washer
(5) Secondary pressure adjustment shim

RY9212148HYS0303US0

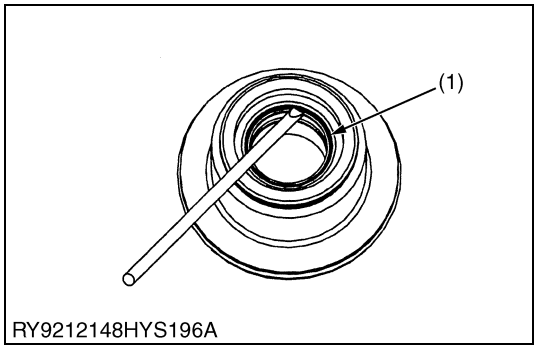


RY9212148HYS195A

17. Remove the grease cap and O-ring from the plug.

(1) Plug
(2) Grease cap
(3) O-ring

RY9212148HYS0244US0



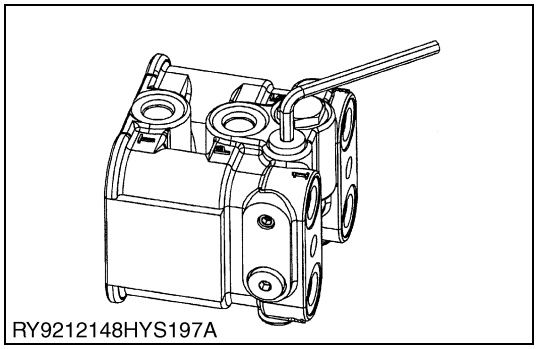
RY9212148HYS196A

18. Remove the gasket from the plug.
- Tool to use: plastic spatula

■ **IMPORTANT**
- **Be careful not to scratch the inside surface of the plug.**

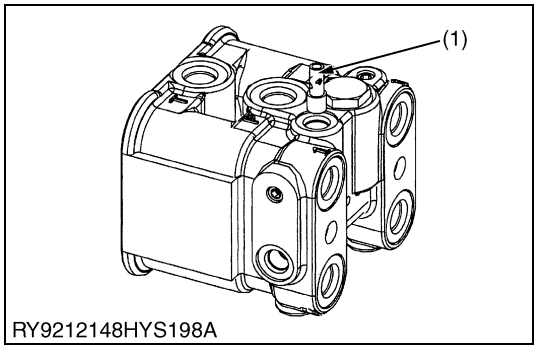
(1) Gasket

RY9212148HYS0245US0


RY9212148HYS197A

19. Put the casing in a vise and remove the plug.
    - Tool to use: 7 mm hex socket

RY9212148HYS0246US0

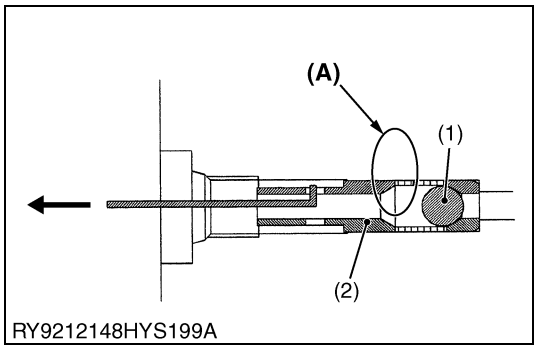


RY9212148HYS198A

20. Remove the seat from the casing.
    - Tool to use: magnet or L-shaped piece of wire

(1) Seat

RY9212148HYS0247US0

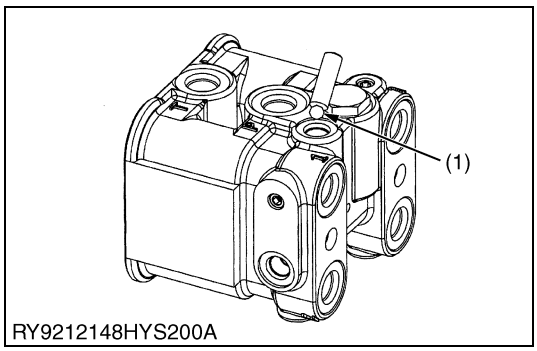


RY9212148HYS199A

■ **IMPORTANT**
- **Take care not to scratch steel balls or the surfaces they touch.**

(1) Steel ball
(2) Seat
(A) Steel ball contact surface

RY9212148HYS0248US0



RY9212148HYS200A

21. Remove the steel ball from the casing.
    - Tool to use: Magnet

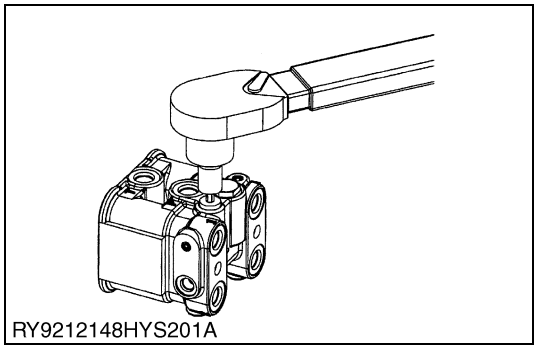
(1) Steel ball

RY9212148HYS0249US0

(2) Assembly

- Assembly is basically the reverse of disassembly.

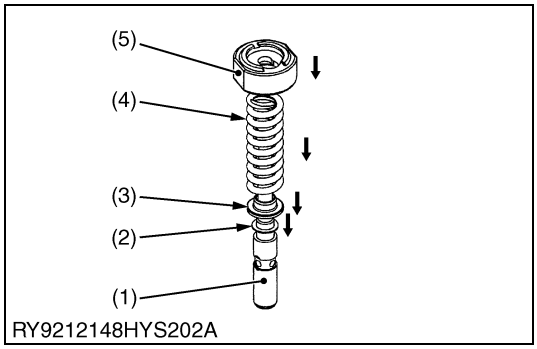
RY9212148HYS0250US0


RY9212148HYS201A

1. Install the steel ball and the seat in that order in the casing and mount and tighten the plug.
    - Tools to use: Magnet, torque wrench

Tightening torque	Hex socket bolt	11.8 ± 1.0 N·m 1.2 ± 0.1 kgf·m 8.7 ± 0.7 lbf·ft

RY9212148HYS0251US0

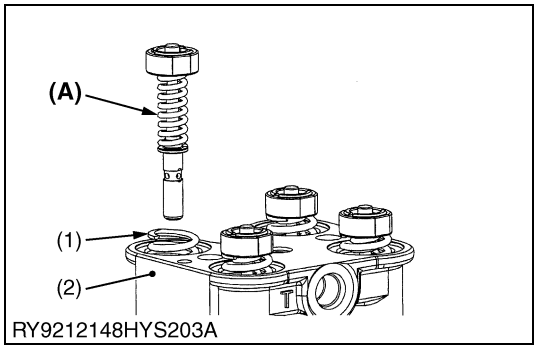


RY9212148HYS202A

2. Install the secondary pressure adjusting shim, washer, secondary pressure spring and spring seat on the spool in order.

(1) Spool
(2) Secondary pressure adjustment shim
(3) Washer
(4) Secondary pressure spring
(5) Spring seat

RY9212148HYS0252US0



RY9212148HYS203A

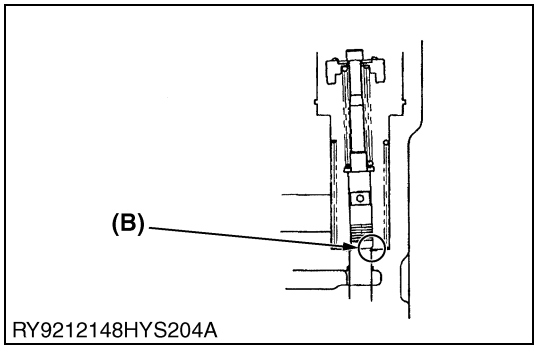
3. Install the return spring and reducing valve ASSY into the casing.

■ **IMPORTANT**
- **Install them in the same position as before disassembly.**

■ **NOTE**
- **When installing the reducing valve ASSY, do not hit the bottom of the spool on the corners of the casing with any force.**

(1) Return spring
(2) Casing
(A) Reducing valve ASSY
(B) Corner of casing

RY9212148HYS0253US0

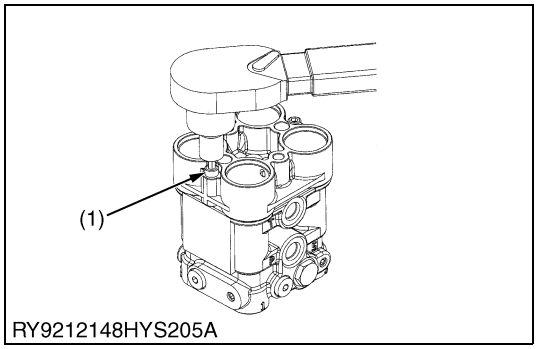


RY9212148HYS204A

4. Install the O-ring in the casing and mount the damper casing to the casing with hex socket bolts.
- Tool to use: torque wrench

■ **IMPORTANT**
- **Apply hydraulic oil to the O-ring.**
- **Tighten the hex socket bolts alternately so the casing stays level during assembly.**

Tightening torque	Hex socket bolt	8.8 ± 1.0 N·m 0.9 ± 0.1 kgf·m 6.5 ± 1.0 lbf·ft



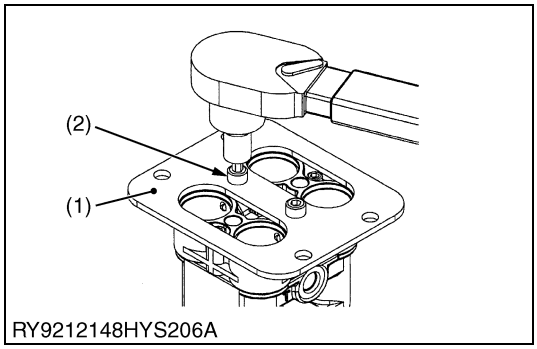
RY9212148HYS205A

(1) Hex socket bolt

RY9212148HYS0254US0

5. Mount the cover to the damper casing with hex socket bolts.
- Tool to use: torque wrench

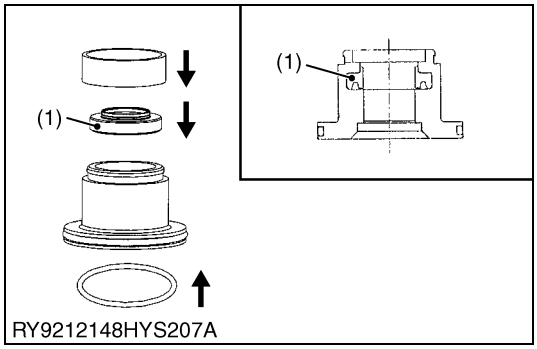
Tightening torque	Hex socket bolt	20.6 ± 1.5 N·m 2.1 ± 0.2 kgf·m 15.2 ± 1.0 lbf·ft



RY9212148HYS206A

(1) Cover
(2) Hex socket bolt

RY9212148HYS0255US0



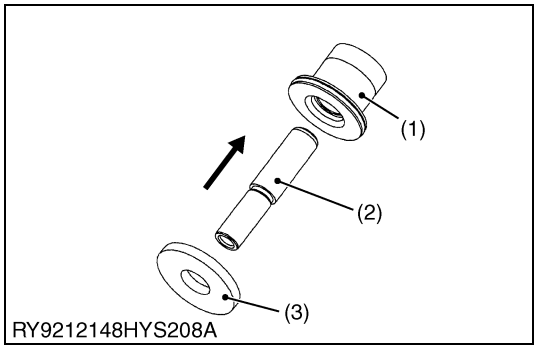
RY9212148HYS207A

6. Install the gasket, grease cap and O-ring on the plug.

■ **IMPORTANT**
- **Make sure to face the gasket the correct way.**
- **Apply grease to the gasket prior to assembly.**

(1) Gasket

RY9212148HYS0256US0



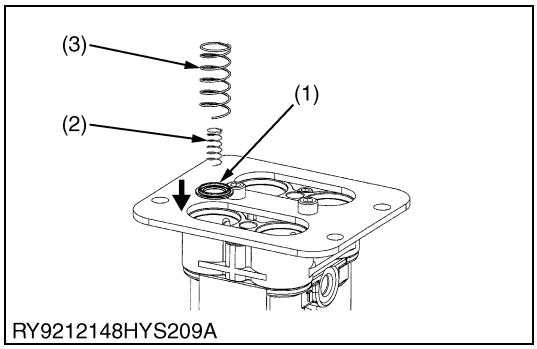
RY9212148HYS208A

7. Install the pushrod into the plug.
8. Install the seat on the pushrod.

■ **IMPORTANT**
- **Apply hydraulic oil to the pushrod prior to assembly.**
- **Install it in the same position as before disassembly.**

(1) Plug
(2) Pushrod
(3) Seat

RY9212148HYS0257US0



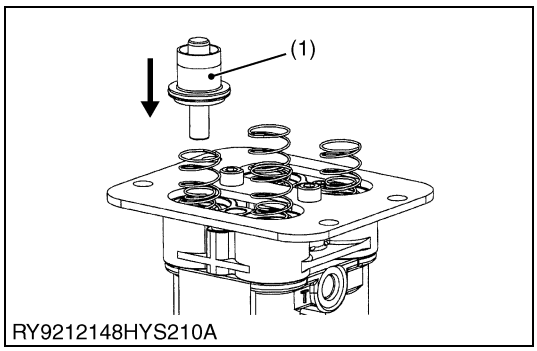
RY9212148HYS209A

9. Install the spring seat and damping springs into the casing.

■ **IMPORTANT**
- **Install them in the same position as before disassembly.**
- **Make sure the springs don't get tangled with each other.**

(1) Spring seat
(2) Damping spring, small
(3) Damping spring, large

RY9212148HYS0258US0

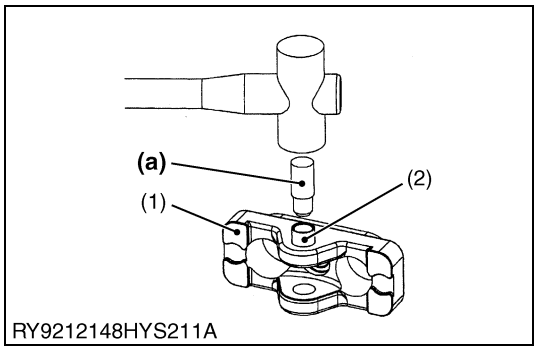


RY9212148HYS210A

10. Install the pushrod ASSY into the casing.

(1) Pushrod ASSY

RY9212148HYS0259US0



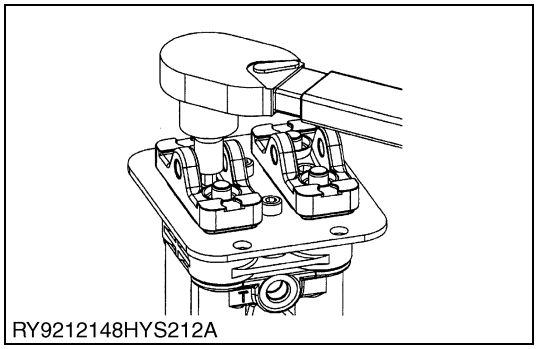
RY9212148HYS211A

11. Use special tool **(a)** to insert the bushing into the cover.
- Tool to use: hammer

■ **IMPORTANT**
- **Take care so the bushing doesn't protrude inside the cover.**

(1) Cover
(2) Bushing
(a) Special tool

RY9212148HYS0260US0

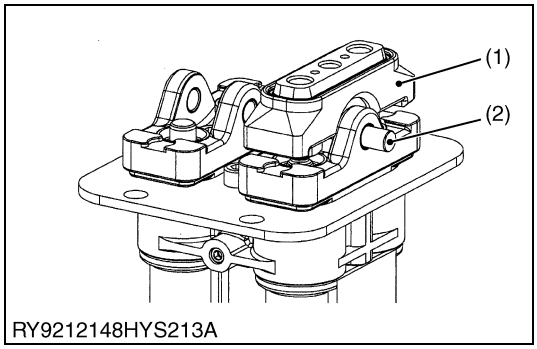

RY9212148HYS212A

12. Mount the cover with hex socket bolts.
    - Tool to use: torque wrench

■ **IMPORTANT**
- **Tighten the hex socket bolts alternately so the cover stays level during assembly.**

Tightening torque	Hex socket bolt	39.8 ± 4.0 N·m 4.1 ± 0.4 kgf·m 29.4 ± 3.0 lbf·ft

RY9212148HYS0261US0

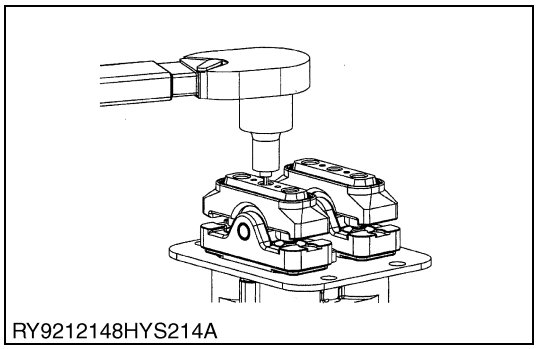


RY9212148HYS213A

13. While holding the cam down, insert the camshaft from the outside.

(1) Cam (2) Camshaft

RY9212148HYS0262US0

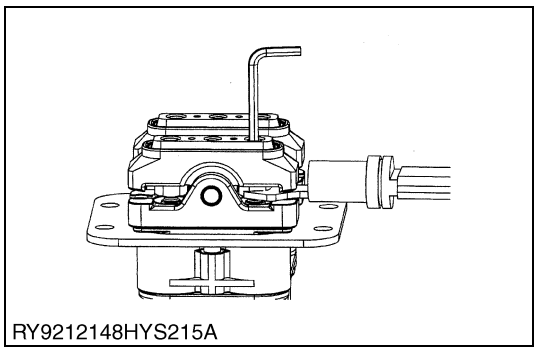

RY9212148HYS214A

14. Install the set screw.
    - Tool to use: torque wrench

■ **NOTE**
- **Wipe clean any excess thread lock compound from the set screws.**
- **Apply a thread lock (Loctite 241) to the set screws.**

Tightening torque	Set screw	6.9 ± 1.0 N·m 0.7 ± 0.1 kgf·m 5.1 ± 0.7 lbf·ft

RY9212148HYS0263US0

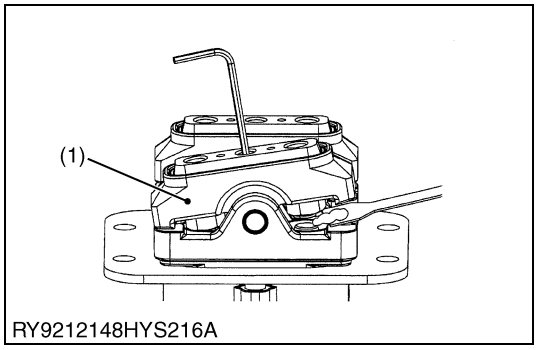

RY9212148HYS215A

15. Adjust the height of the set screws so the top of the cam and the bottom of the cam are level.
    Make sure there isn't any play in the middle and tighten the lock nuts.
    - Tool to use: 7 mm hex socket, torque wrench

■ **IMPORTANT**
- **Be careful because overtightening the set screws can also result in play in the middle and when the engine starts up, it may cause it to move suddenly.**

Tightening torque	Lock nut	33.3 ± 3.4 N·m 3.4 ± 0.3 kgf·m 24.6 ± 2.5 lbf·ft

RY9212148HYS0264US0



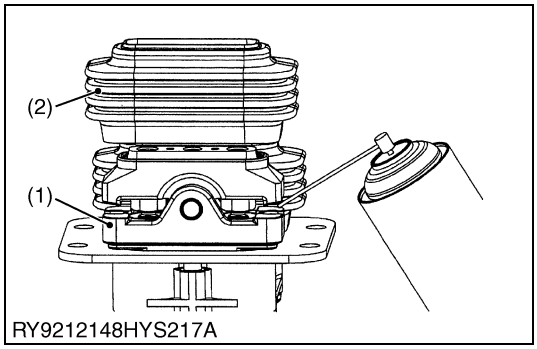
RY9212148HYS216A

16. Tilt the cam and grease the head of the pushrods and inside the grease cap.
    - Tool to use: 7 mm hex socket, spatula

■ **IMPORTANT**
- **Apply grease with a spatula shaped tool made of a soft material so you don't scratch the pushrods or the plug.**

(1) Cam

RY9212148HYS0265US0



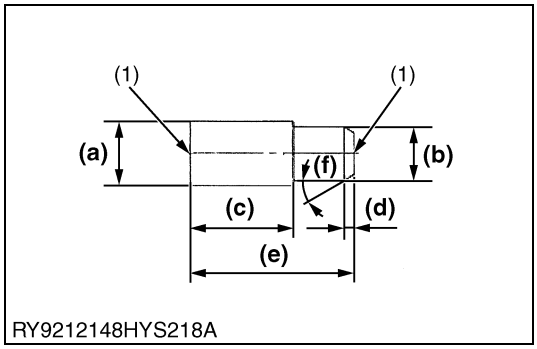
RY9212148HYS217A

17. Apply an anti-rust oil to the parts inside the cover.
    Install the bellows on top of the cover.

(1) Cover
(2) Bellows

RY9212148HYS0266US0

(3) Special Tools



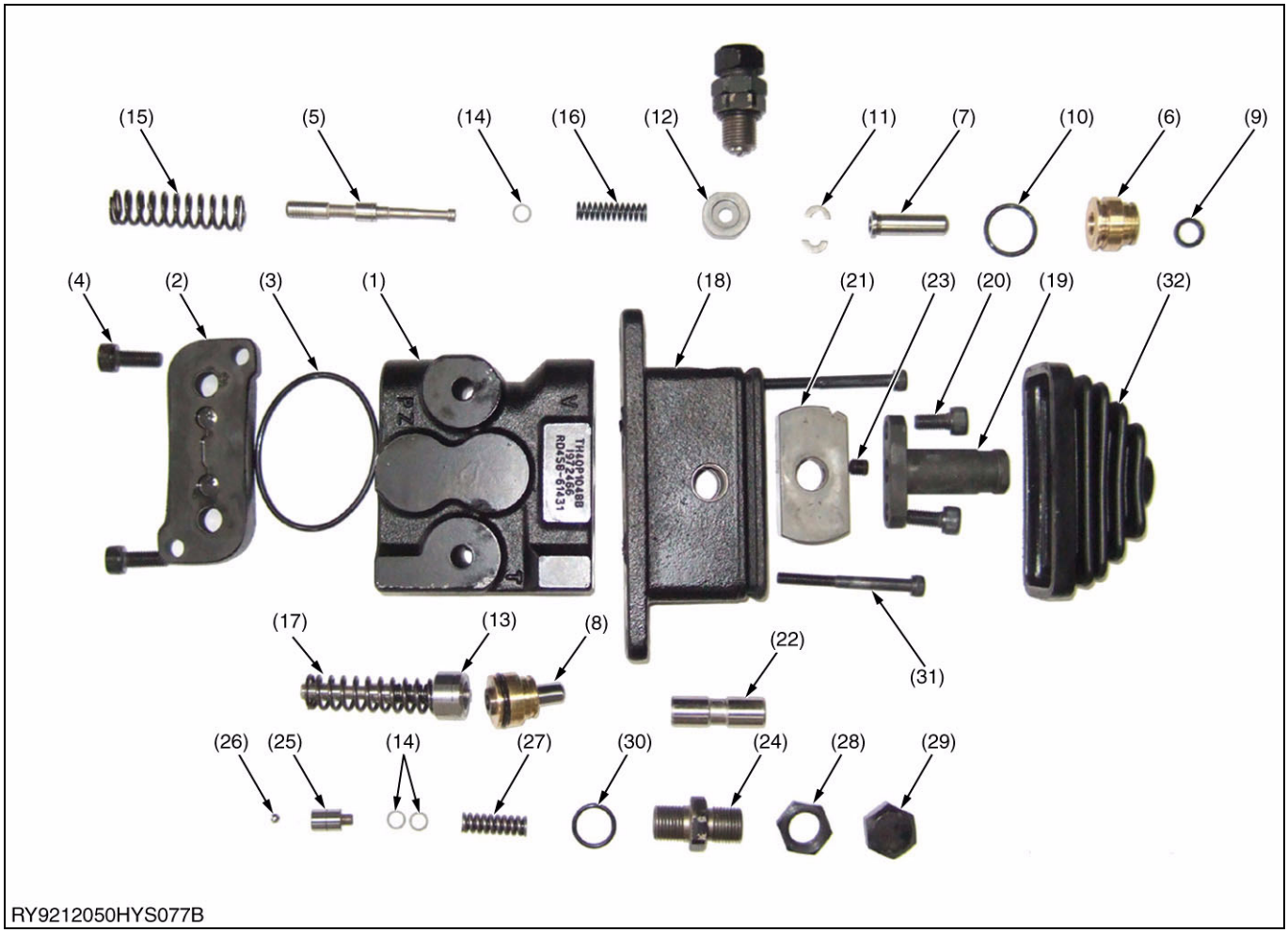
RY9212148HYS218A

(a)Special tool

(1) Center hole OK [ϕ 2mm (0.08 in.) or less]
(a) ϕ12 (-0.25, -0.40) mm (0.42 in.)
(b) ϕ10 (-0.20, -0.25) mm (0.39 in.)
(c) 20 mm (0.79 in.)
(d) 2 mm (0.08 in.)
(e) 32 mm (1.26 in.)
(f) 0.52 rad (30 °)

RY9212148HYS0267US0

[3] BLADE PILOT VALVES



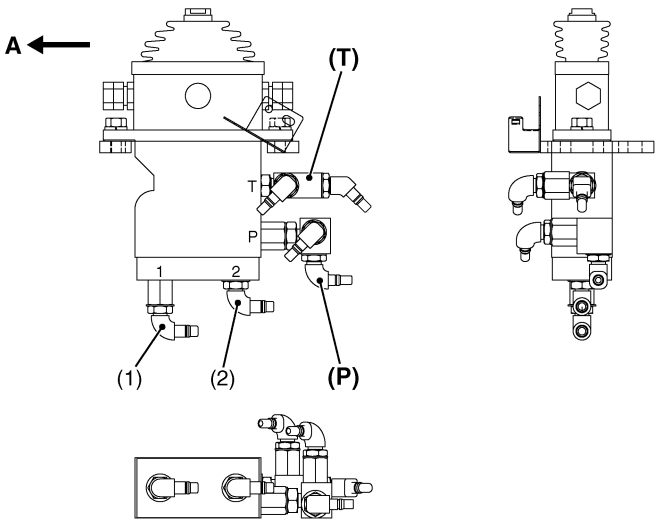
RY9212050HYS077B

No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty
(1)	Casing	1	(12)	Spring seat 1	1	(23)	Set screw	1
(2)	Port plate	1	(13)	Spring seat 2	1	(24)	Detent plug	2
(3)	O-ring	1	(14)	Washer 2	Select thick-ness	(25)	Holder	2
(4)	Hex socket bolt	2	(15)	Return spring	2	(26)	Steel ball	2
(5)	Spool	2	(16)	Secondary pressure spring 1	1	(27)	Spring	2
(6)	Plug	2	(17)	Secondary pressure spring 2	1	(28)	Lock nut	2
(7)	Pushod 1	1	(18)	Cover	1	(29)	Adjusting nut	2
(8)	Pushod 2	1	(19)	Lever	1	(30)	O-ring	2
(9)	Seal	2	(20)	Hex socket bolt	2	(31)	Hex socket bolt	2
(10)	O-ring	2	(21)	Disc	1	(32)	Bellows	1
(11)	Washer 1	4	(22)	Camshaft	1			

- Thickness of washer 2 as per table below

Point used	Thickness
Detent	0 to 2 mm (0 to 0.08 in.) or less
Reducing valve	0.4 mm (0.02 in.) One washer

RY9212158HYS0071US0



RY9212435HYS068A

Adapter angles

	Point used	Tape color
(1)	Down	Brown
(2)	Up	Pink
(P)	Port P	White
(T)	Port T	None

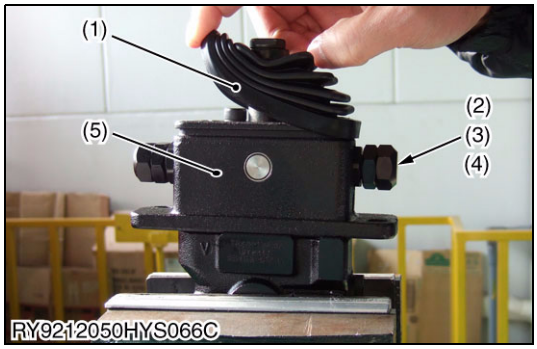
A : Front of the Machine

RY9212435HYS0032US0

(1) Disassembly

- To ensure parts that are reused are installed in the same place as before disassembly, mark the parts as needed during disassembly.

RY9212158HYS0073US0



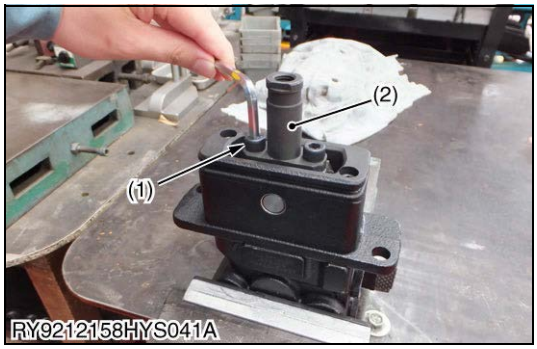
1. Clamp the pilot valve in a vise.
2. Remove the bellows from the cover.
3. Remove the detent parts from the outwards in and remove the ball, holder, washer 2 and the spring that are inside it.
   - Tool to use: 22 mm socket

■ **IMPORTANT**

- **Use a copper plate when clamping the pilot valve.**

(1) Bellows
(2) Detent Plug
(3) Lock Nut
(4) Adjusting Nut
(5) Cover

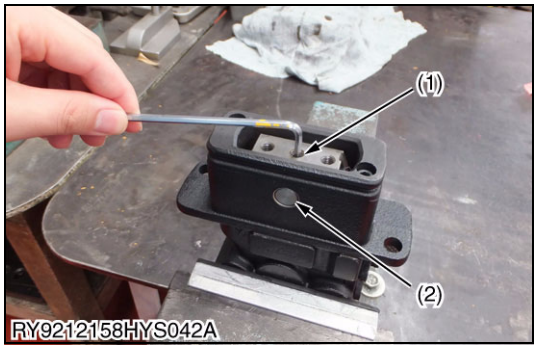
RY9212158HYS0074US0



4. Remove the hex socket bolts and then the lever.
   - Tool to use: 6 mm hex socket

(1) Hex Socket Bolt
(2) Lever

RY9212158HYS0075US0



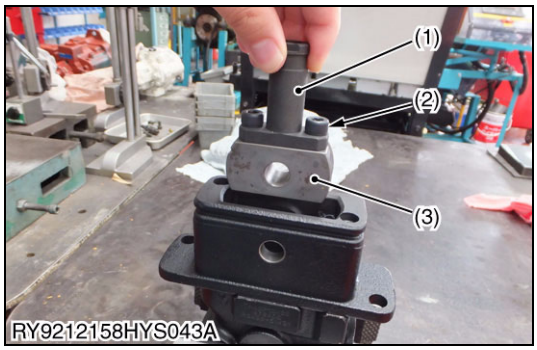
5. Remove the set screw and camshaft.
   - Tool to use: 4 mm hex socket

■ **IMPORTANT**

- **The set screw is held with thread lock, so be careful when removing it.**

(1) Set Screw
(2) CamShaft

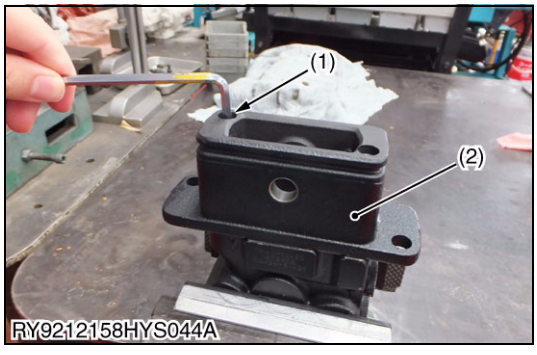
RY9212158HYS0076US0



6. Use the lever and the hex bolts to take the disc out.

(1) Lever
(2) Hex Socket Bolt
(3) Disc

RY9212158HYS0077US0



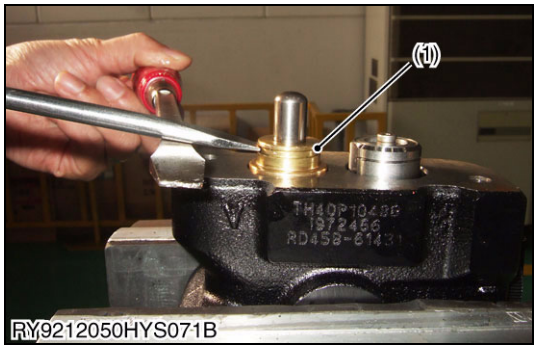
7. Remove the hex socket bolts and then the cover.
   - Tool to use: 5 mm hex socket

■ **IMPORTANT**

- **If the return spring is strong, when you loosen a hex socket bolt, the cover, plug and pushrod will lift up at the same time, so loosen the bolts alternately so the cover stays level.**

(1) Hex Socket Bolt
(2) Cover

RY9212158HYS0078US0

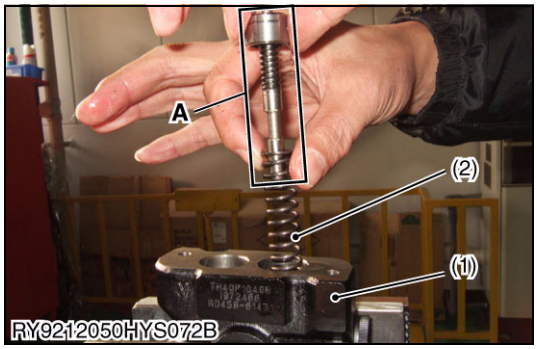


8. If the plug stays in the casing, use a slotted screwdriver to get the plug out.
   - Tool to use: Slotted screwdriver

■ **IMPORTANT**
- **Take care not to use too much force with the screwdriver when removing the plug so you don't damage it.**
- **Also note that the plug may pop out due to the force of the spring.**

(1) Plug

RY9212158HYS0079US0

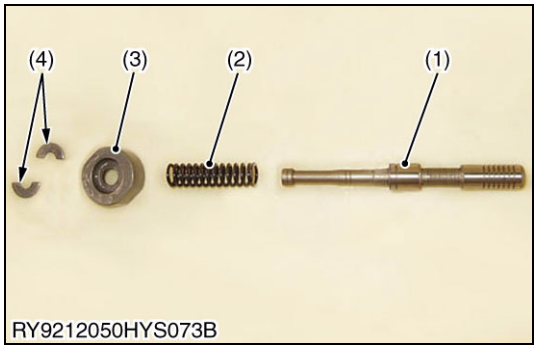


9. Remove the reducing valve and the return spring.

■ **IMPORTANT**
- **Be careful not to scratch the spool.**
- **Do not disassemble the reducing valve unless there is a problem with it.**

(1) Casing
(2) Return Spring
A : Reducing Valve

RY9212158HYS0080US0

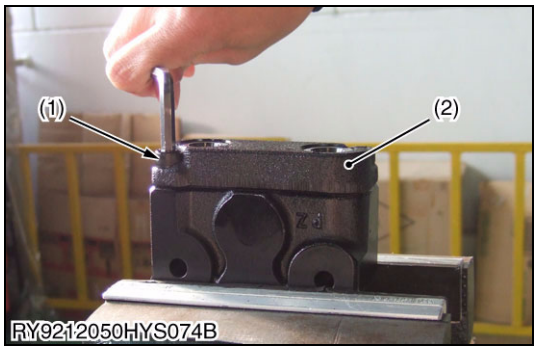


Reducing valve

■ **IMPORTANT**
- **Do not depress the spring seat more than 4 mm (0.16 in.).**
- **The metal washer 2 is not used in the photo at left.**
- **The thickness of washer 2 varies for each spool due to the preset adjustment of the secondary pressure spring.**

(1) Spool
(2) Secondary Pressure Spring
(3) Spring Seat
(4) Washer 1

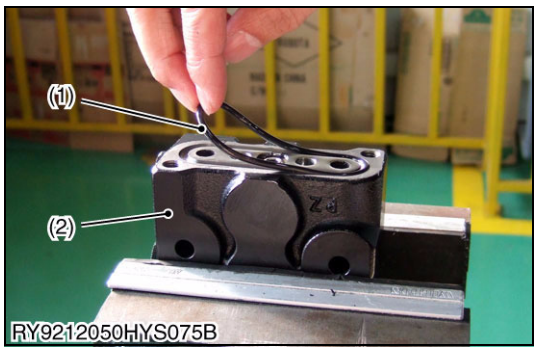
RY9212158HYS0081US0



10. Flip the casing over in the vise and remove the hex socket bolts and the port plate.
    - Tool to use: 6 mm hex socket

(1) Hex Socket Bolt
(2) Port Plate

RY9212158HYS0082US0

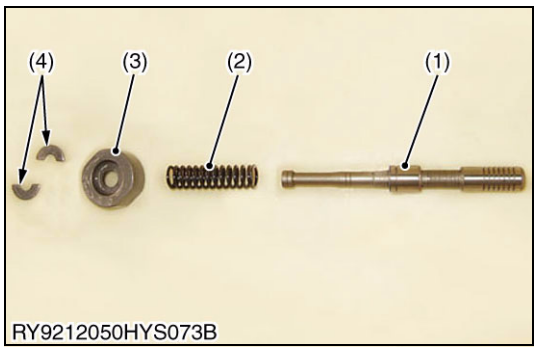


11. Remove the O-ring from the casing.

(1) O-ring
(2) Casing

RY9212158HYS0083US0

(2) Assembly

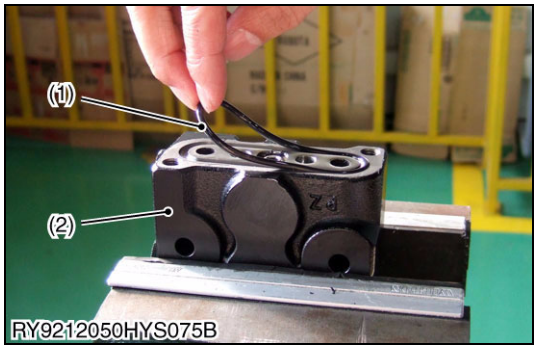


1. Assemble the reducing valve.
   Install the secondary pressure setting spring and the spring seat in that order on the spool, then press the spring seat down and install the two half-circle shaped pieces of washer 1 on the spring seat so they don't overlap.

■ **NOTE**
- **Face washers 1 edge side up so they catch the head of the spool.**
- **Do not depress the spring seat more than 4 mm (0.16 in.).**
- **The metal washer 2 is not used in the photo at left.**
- **The thickness of washer 2 varies for each spool due to the preset adjustment of the secondary pressure spring.**

(1) Spool
(2) Secondary Pressure Spring
(3) Spring Seat
(4) Washer 1

RY9212158HYS0084US0

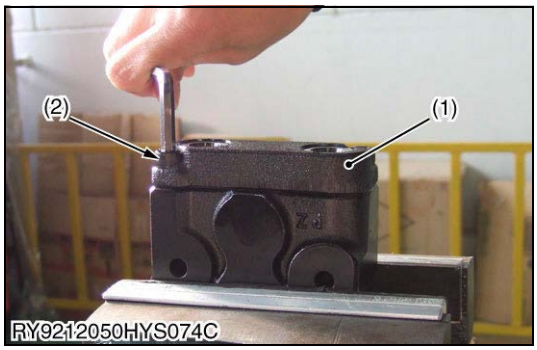


2. Install the O-ring on the casing.

■ **IMPORTANT**
- **Apply hydraulic oil to the O-ring.**

(1) O-ring
(2) Casing

RY9212158HYS0085US0

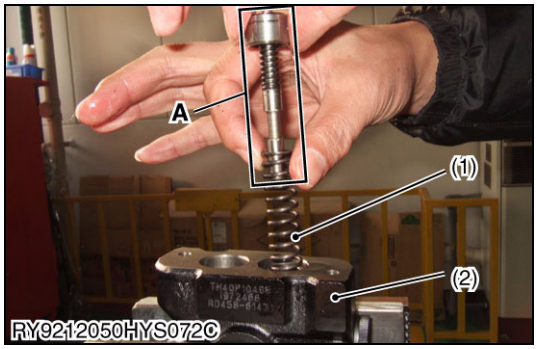


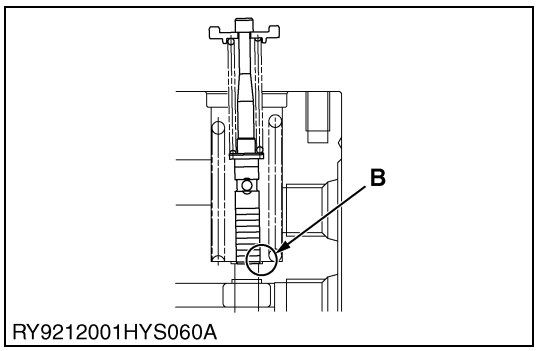
3. Install the port plate on the casing and tighten it with the hex socket bolts.
   - Tool to use: 6 mm hex socket

Tightening torque	Hex socket bolt	29.4 ± 2.0 N·m 3.0 ± 0.2 kgf·m 21.7 ± 1.5 lbf·ft

(1) Port Plate
(2) Hex Socket Bolt

RY9212158HYS0086US0



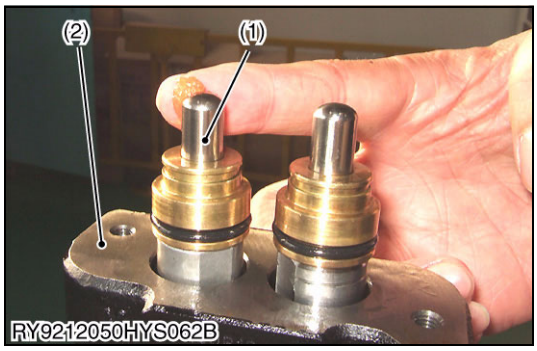


4. Install the return spring and reducing valve into the casing.

■ **NOTE**
- **When installing the reducing valve, do not hit the bottom of the spool on the corners of the casing with any force.**

(1) Return Spring
(2) Casing
A : Reducing Valve
B : Corner of Casing

RY9212158HYS0087US0

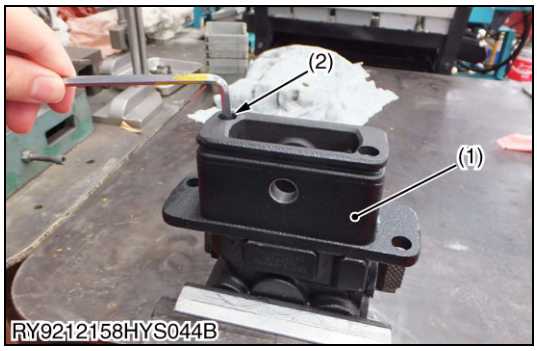


5. Apply grease to the ends of the pushrods and install them in the casing.

■ **NOTE**
- **If the force of the return springs is weak, the plug may be stuck to the casing by the O-ring's resistance to sliding.**
- **If the force of the return springs is strong, put the top cover on and tighten the hex socket bolts alternately so the top cover is installed evenly.**
- **Apply hydraulic oil to the O-ring.**

(1) Pushrod
(2) Casing

RY9212158HYS0088US0

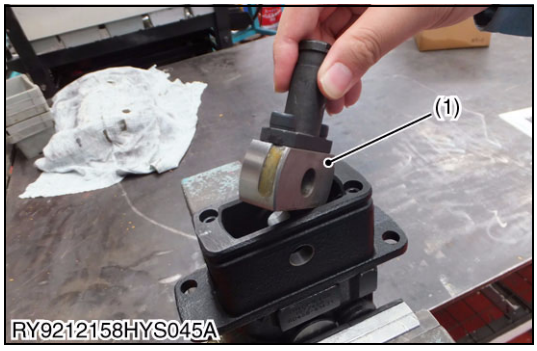


6. Install the cover on the casing and tighten it with the hex socket bolts.
- Tool to use: 5 mm hex socket

Tightening torque	Hex socket bolt	11.8 ± 1.0 N·m 1.2 ± 0.1 kgf·m 8.7 ± 0.7 lbf·ft

(1) Cover
(2) Hex Socket Bolt

RY9212158HYS0089US0

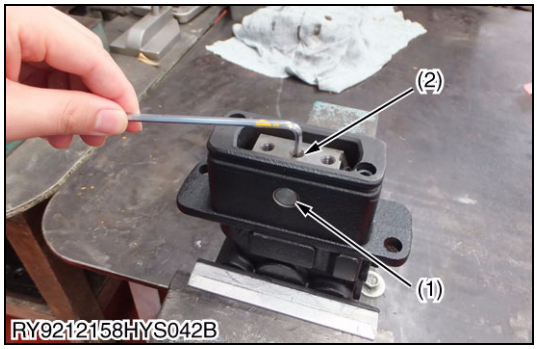


7. Wipe off any thread lock compound remaining on the screw holes on the top of the disc.

■ **IMPORTANT**
- **Apply grease to the surface of the disc where the steel ball rides.**

(1) Disc

RY9212158HYS0090US0



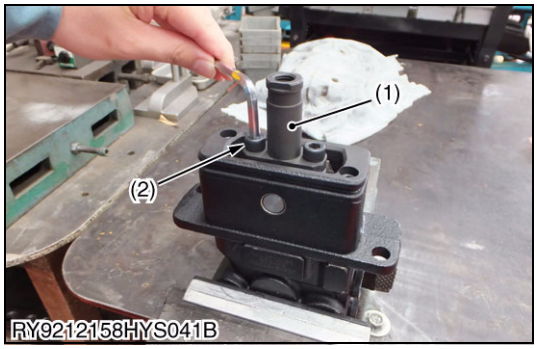
8. After inserting the disc and the camshaft, tighten the set screws.
   - Tool to use: 4 mm hex socket

■ **NOTE**
- **Wipe clean any excess thread lock compound from the set screws.**
- **Apply a thread lock (Loctite 241) to the set screws.**

Tightening torque	Set screw	16.7 ± 1.0 N·m 1.7 ± 0.1 kgf·m 12.3 ± 0.7 lbf·ft

(1) Camshaft (2) Set Screw

RY9212158HYS0091US0



9. Mount the lever on top of the disc and tighten the hex socket bolts.
   - Tool to use: 6 mm hex socket

Tightening torque	Hex socket bolt	29.4 ± 2.0 N·m 3.0 ± 0.2 kgf·m 21.7 ± 1.5 lbf·ft

(1) Lever (2) Hex Socket Bolt

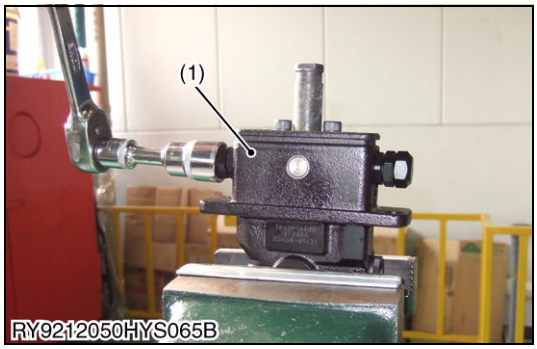
RY9212158HYS0092US0

10. Assemble the steel ball, the holder, washer 2 and the spring inside the detent plug and test fit the lock nut and the adjusting nut.

■ **IMPORTANT**
- **Apply plenty of grease to the area around the steel ball.**

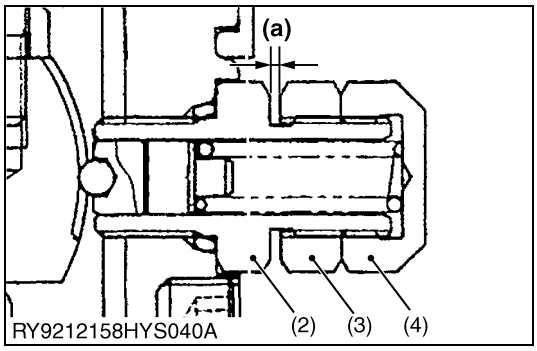
(1) Detent plug

RY9212158HYS0093US0



11. Install the detent plug in the cover and tighten.
12. Turn the adjusting plug to adjust the force required to release the detent and tighten the lock nut.
   - Tool to use: 22 mm socket

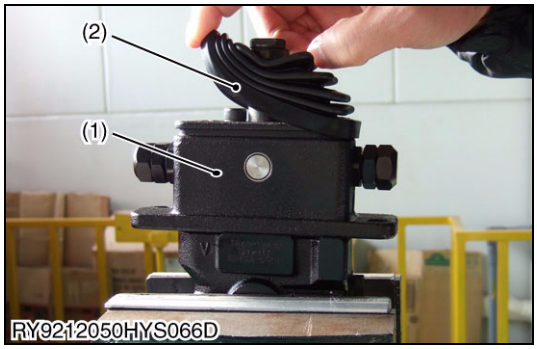
Tightening torque	Detent plug lock nut	41.2 ± 2.9 N·m 4.2 ± 0.3 kgf·m 30.4 ± 2.1 lbf·ft



(1) Cover
(2) Detent plug
(3) Lock Nut
(4) Adjusting Nut

(a) 1.0 to 3.0 mm (0.04 to 0.12 in.)

RY9212158HYS0094US0

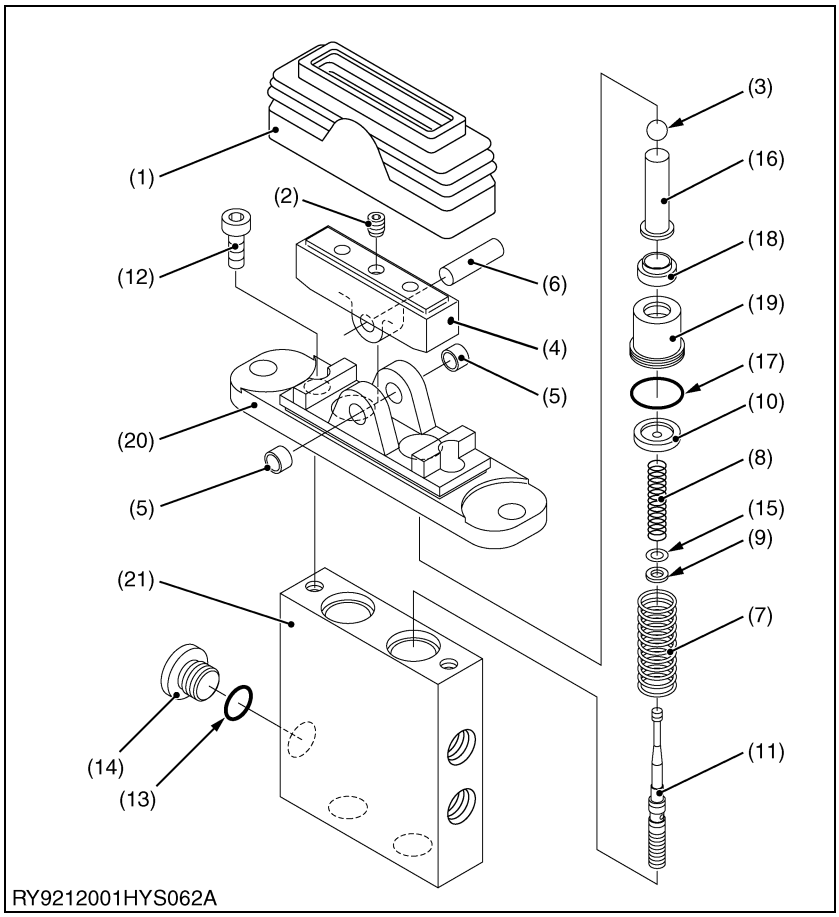


13. Apply an anti-rust oil to the parts inside the cover.
14. Install the bellows on top of the cover.

(1) Cover (2) Bellows

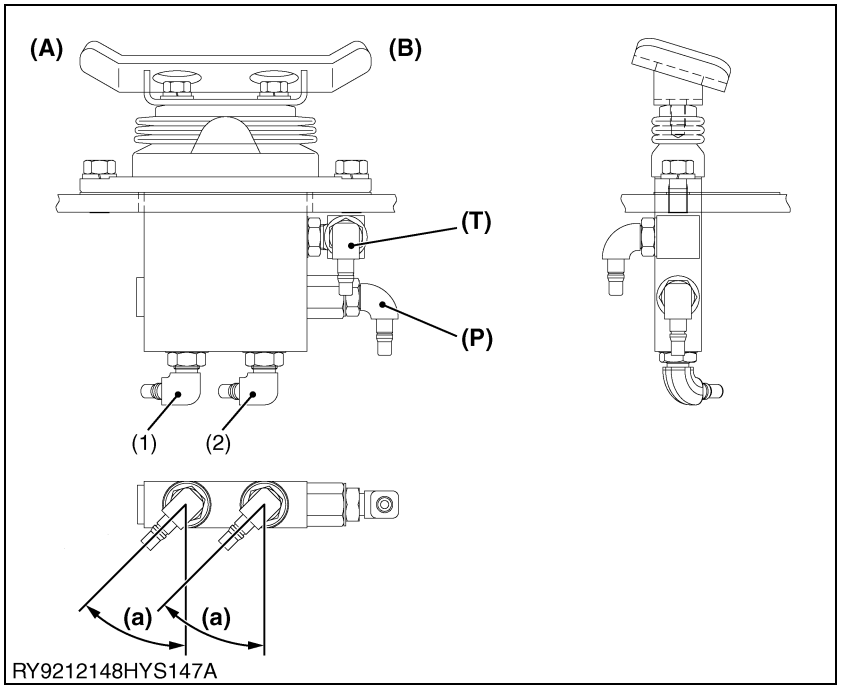
RY9212158HYS0095US0

[4] SWING AND TWO PIECE BOOM PILOT VALVES



No.	Part Name	Qty
(1)	Bellows	1
(2)	Set screw	1
(3)	Ball	2
(4)	Cam	1
(5)	Bushing	2
(6)	Cam shaft	1
(7)	Return spring	2
(8)	Secondary pressure spring	2
(9)	Metal washer	2
(10)	Spring seat	2
(11)	Spool	2
(12)	Hex socket bolt	2
(13)	O-ring	1
(14)	Plug	1
(15)	Shim	2
(16)	Pushrod	2
(17)	O-ring	2
(18)	Gasket	2
(19)	Plug	2
(20)	Cover	1
(21)	Casing	1

RY9212148HYS0170US0



RY9212148HYS147A

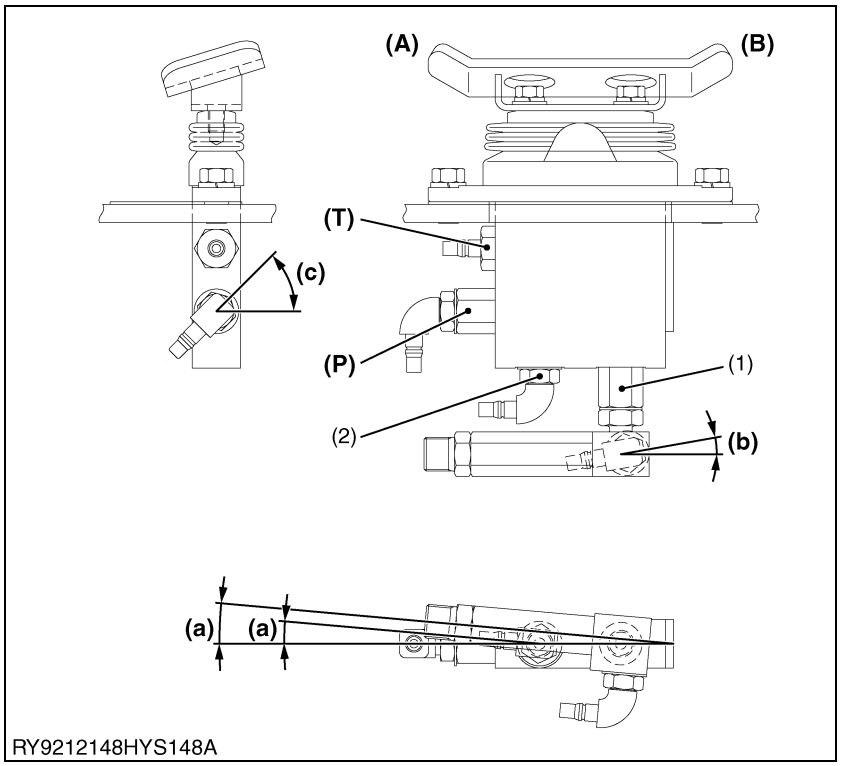
Swing pilot valve adapter angles

	Point used	Tape color
(1)	Left	Pea green
(2)	Right	Orange
(P)	Port P	White
(T)	Port T	None

(A) Right swing
(B) Left swing

(a) 45 ° (0.79 rad)

RY9212148HYS0269US0



RY9212148HYS148A

Two piece boom pilot valve adapter angles

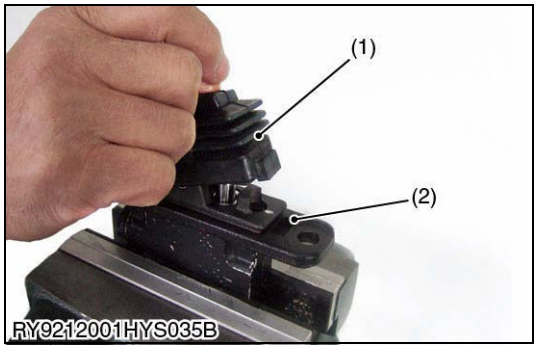
	Point used	Tape color
(1)	Crowd	Yellow Gray
(2)	Dump	Green Gray
(P)	Port P	None
(T)	Port T	None

(A) Dump
(B) Crowd

(a) 5° (0.09 rad)
(b) 10° (0.17 rad)
(c) 45° (0.79 rad)

RY9212724HYS0051US0

(1) Disassembly



1. Clamp the pilot valve in a vise.
2. Remove the bellows from the cover.

■ **IMPORTANT**
- **Use a copper plate when clamping the part.**

(1) Bellows (2) Cover

RY9212148HYS0171US0

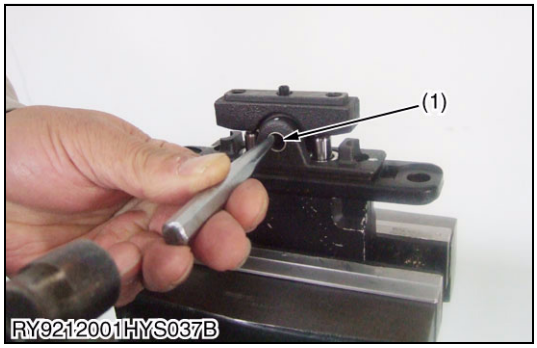
RY9212001HYS036A

3. Remove the set screw.

■ **IMPORTANT**
- **The set screw is held with a thread lock, so be careful when removing it.**

- Tool to use: 3 mm hex socket

RY9212148HYS0172US0



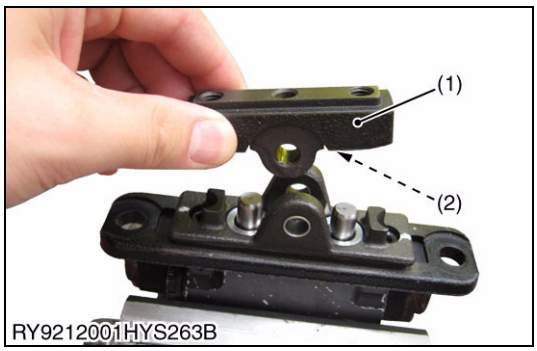
RY9212001HYS037B

4. Put a pin punch against the edge of the cam shaft and tap it lightly with a hammer to remove it.

- Tool to use: Hammer and pin punch (ϕ7 mm, ϕ0.3 in. ≥)

(1) Cam Shaft

RY9212148HYS0173US0



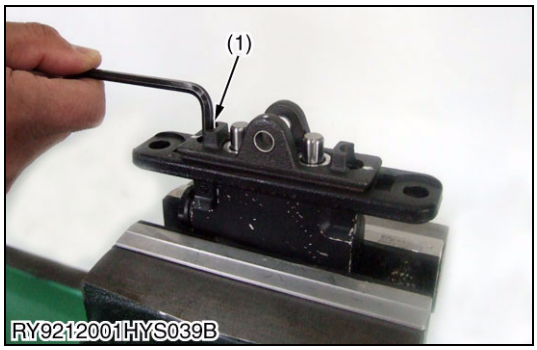
RY9212001HYS263B

5. Remove the cam.

■ **IMPORTANT**
- **Handle the cam and the ball as an assembly. (Cannot be disassembled)**
- **Mark the relationship between the cam and the cover.**

(1) Cam (2) Ball

RY9212148HYS0174US0



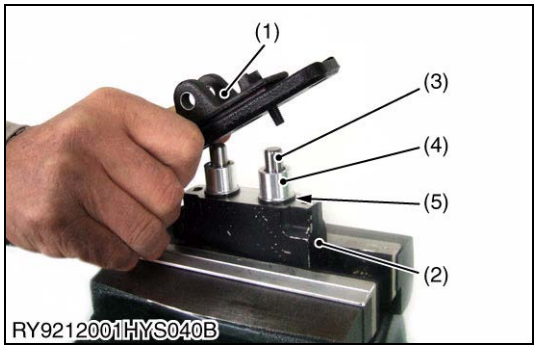
RY9212001HYS039B

6. Remove the hex socket bolt.

- Tool to use: hex socket 5 mm

(1) Hex Socket Bolt

RY9212148HYS0175US0

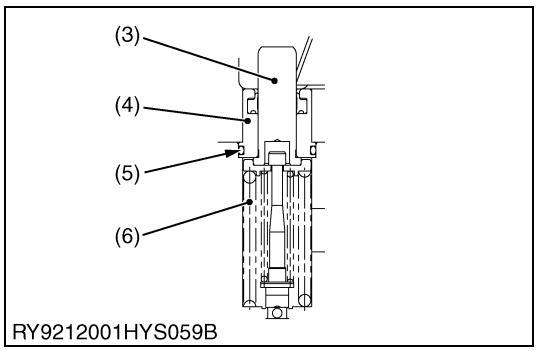


7. Remove the cover.

CAUTION
- **Mark the relationship between the cover and the casing.**
- **Be careful so the pushrod and the plug don't pop out.**

(1) Cover
(2) Casing
(3) Pushrod
(4) Plug
(5) O-ring
(6) Return Spring

RY9212148HYS0176US0

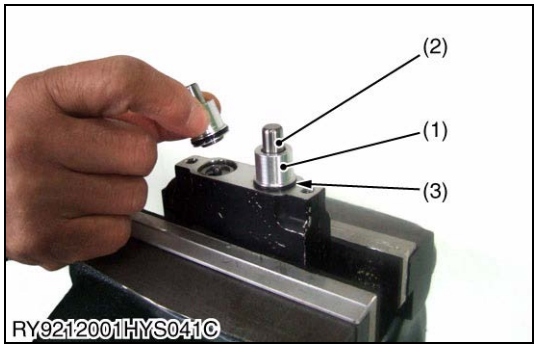


8. Take the plug out with the pushrod still in place.

IMPORTANT
- **Mark the relationship between the plug and the casing.**

(1) Plug
(2) Pushrod
(3) O-ring

RY9212148HYS0177US0

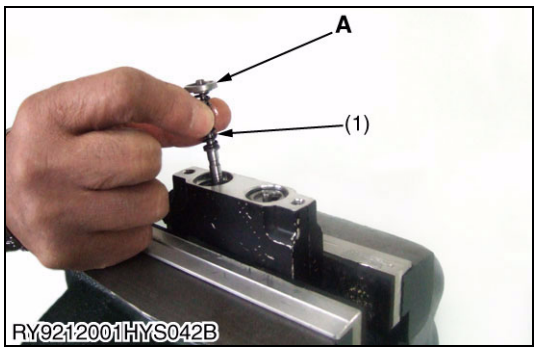


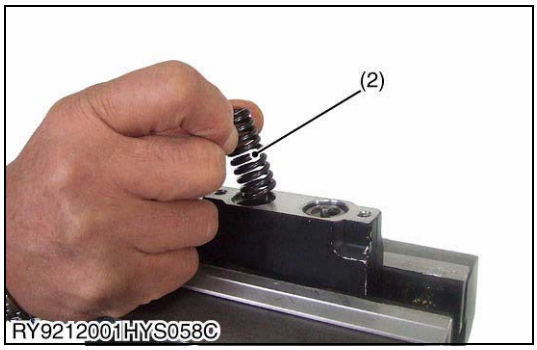
9. Remove the reducing valve ASSY, secondary pressure spring and return spring from the casing.

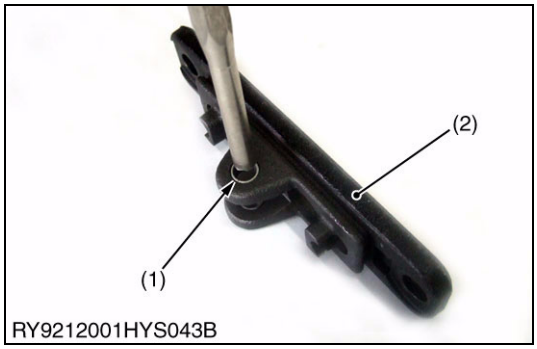
IMPORTANT
- **Mark the relationship of the casing holes.**

(1) Secondary Pressure Spring
(2) Return Spring
A : Reducing Valve ASSY

RY9212148HYS0178US0





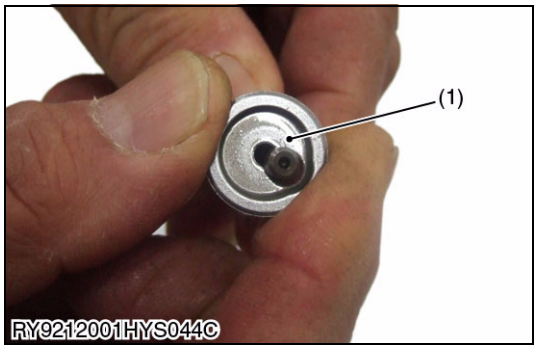


10. Put the cover on its side, put a pin punch against the bushing and lightly tap it with a hammer to remove it.

- Tools to use : Hammer and pin punch (ϕ10 mm, ϕ0.39 in. ≥)

(1) Bushing (2) Cover

RY9212148HYS0179US0

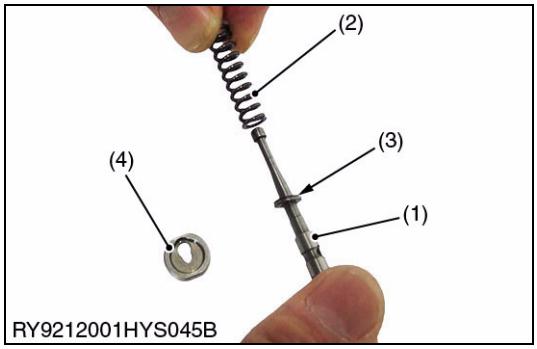


11. To disassemble the reducing valve, compress the secondary pressure spring, shift the spring seat to the side and remove the spool via the large hole.

■ **IMPORTANT**
- **Be careful not to scratch the spool.**
- **Do not depress the spring seat more than 4 mm (0.16 in.).**
- **Do not disassemble the reducing valve unless there is a problem with it.**

(1) Spring Seat

RY9212148HYS0180US0

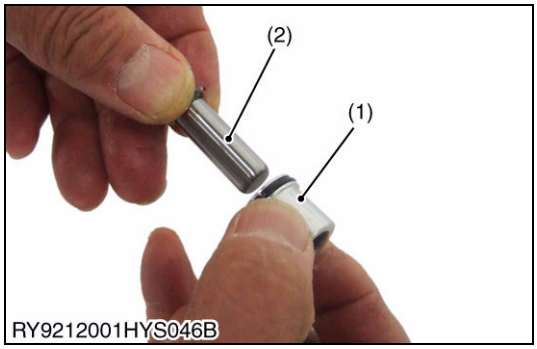


12. Remove the spool, secondary pressure spring shim(s) and washer.

■ **IMPORTANT**
- **Treat as an assembly until reassembly.**
- **The thickness of the metal washers is different for each spool ASSY due to the preset adjustment of the secondary pressure spring.**
- **A metal washer is not used in the figure.**

(1) Spool (3) Shim
(2) Secondary Pressure Spring (4) Spring Seat

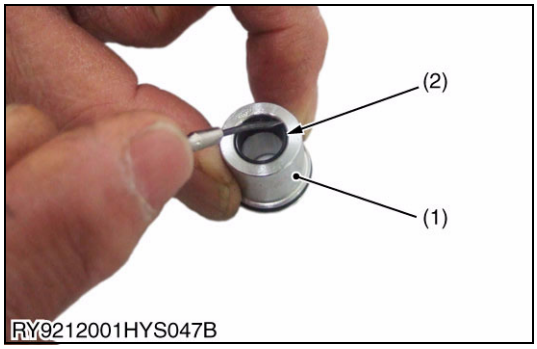
RY9212148HYS0181US0



13. Remove the plug from the pushrod.

(1) Plug (2) Pushrod

RY9212148HYS0182US0



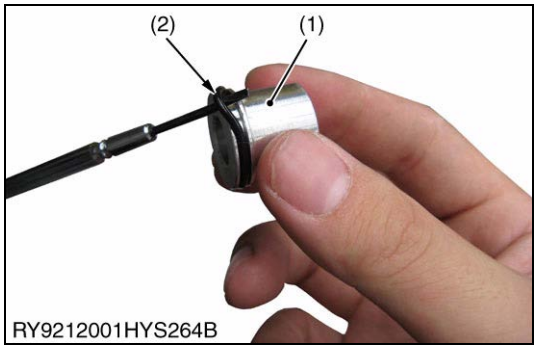
14. Remove the gasket from the plug.

CAUTION
- **Use a mini slotted screwdriver to remove it.**
- **Be careful not to scratch the inside surface of the plug.**

- Tool to use: Slotted screwdriver

(1) Plug (2) Gasket

RY9212148HYS0183US0

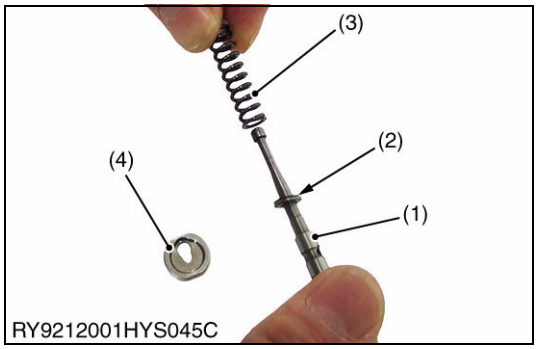


15. Remove the O-ring from the plug.

(1) Plug
(2) O-Ring

RY9212148HYS0184US0

(2) Assembly

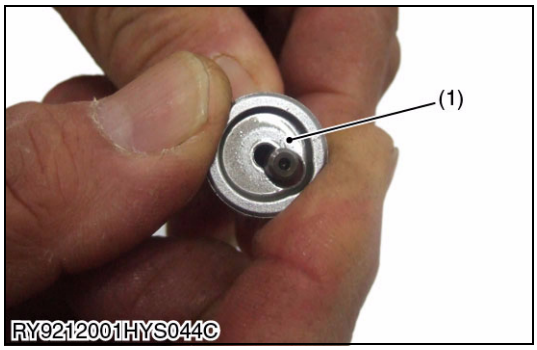


1. Install the metal washer, shim, secondary pressure spring and spring seat in order on the spool.

■ **IMPORTANT**
- **The thickness of the metal washers is different for each spool ASSY due to the preset adjustment of the secondary pressure spring.**

(1) Spool
(2) Shim
(3) Secondary Pressure Spring
(4) Spring Seat

RY9212148HYS0185US0

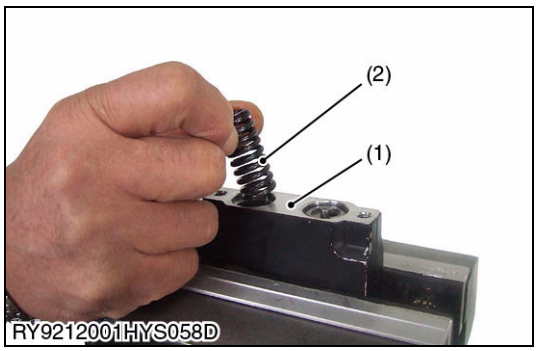


2. Pass the end of the spool through the larger part of the hole in the spring seat (10), compressing the spring and shifting the spring seat to the side to install it.

■ **IMPORTANT**
- **Be careful not to scratch the spool.**
- **Do not depress the spring seat more than 4 mm.**

(1) Spring seat

RY9212148HYS0186US0

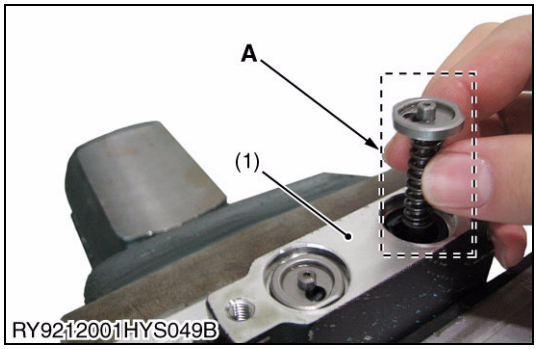


3. Clamp the casing in a vise.
   Install the return spring in the casing.

■ **IMPORTANT**
- **Install it in the same position as before disassembly.**

(1) Casing
(2) Return spring

RY9212148HYS0187US0



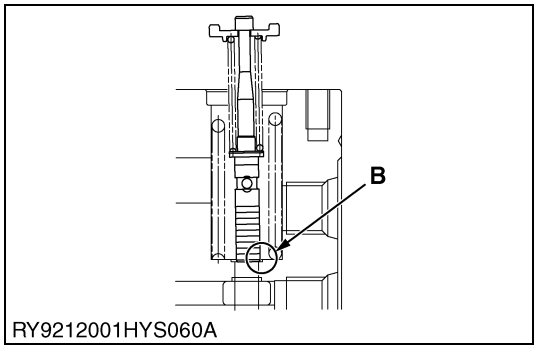
4. Install the reducing valve ASSY **A** to the casing.

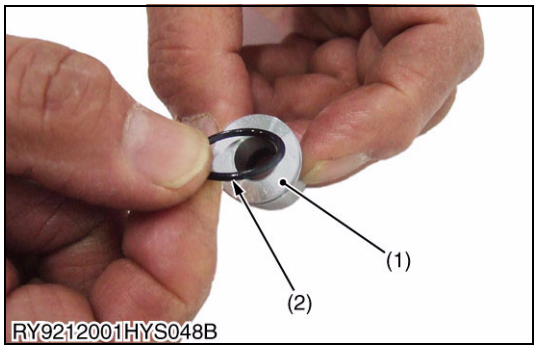
■ **IMPORTANT**
- **Install it in the same position as before disassembly.**
- **When installing the reducing valve ASSY, take care not to hit the bottom edge of the spool hard against the corner B or the casing.**

(1) Casing

A : Reducing Valve ASSY
B : Corner of Casing

RY9212148HYS0188US0



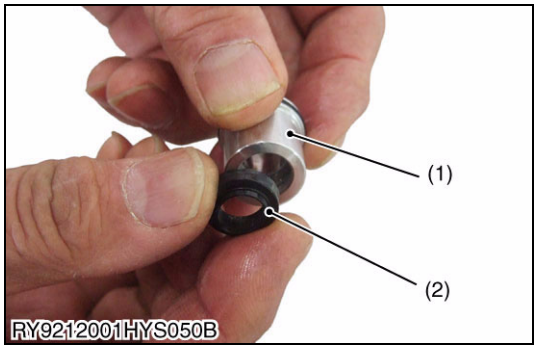


5. Install the O-ring on the plug.

■ **IMPORTANT**
- **Apply hydraulic oil to the O-ring.**

(1) Plug (2) O-Ring

RY9212148HYS0189US0

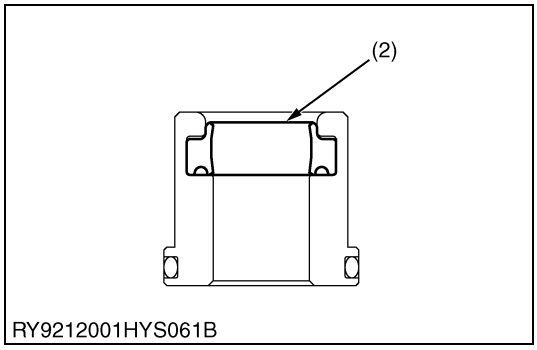


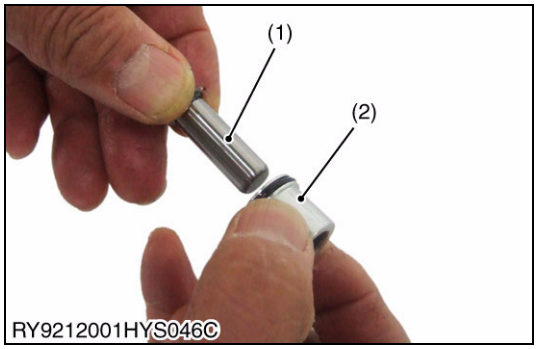
6. Install the gasket on the plug.

■ **IMPORTANT**
- **Be careful that the gasket faces the right direction (The gasket has an uneven shape ; put the end with a larger diameter in first).**
- **Apply hydraulic oil on the circumference and lip of the gasket.**

(2) Gasket (1) Plug

RY9212148HYS0190US0



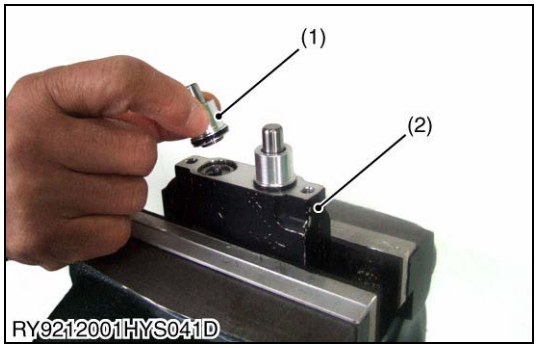


7. Install the pushrod into the plug.

■ **IMPORTANT**
- **Apply hydraulic oil to the pushrod.**
- **Do not force the gasket in as it may damage its lip.**

(1) Pushrod (2) Plug

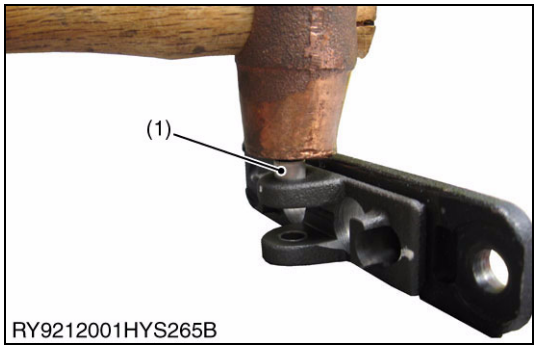
RY9212148HYS0191US0



8. Install the pushrod and plug ASSY in the casing.

(1) Plug (2) Casing

RY9212148HYS0192US0



9. Turn the cover on its side and tap lightly on the bushing with a hammer to install it.

■ **IMPORTANT**
- **Take care not to knock the bushing so it sticks out from the inside of the cover.**

- Tool to use: hammer

(1) Bushing

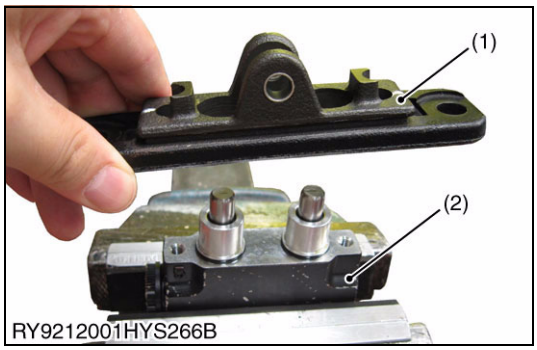
RY9212148HYS0193US0

10. Install the cover on the casing.

■ **IMPORTANT**
- **Install it in the same position as before disassembly.**
- **Note that the cover will ride up due to the springs.**

(1) Cover (2) Casing

RY9212148HYS0194US0



11. Install the hex socket bolts.

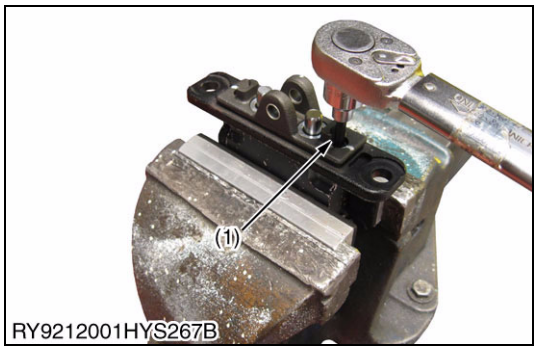
■ **IMPORTANT**
- **Install them so the cover sits flat.**

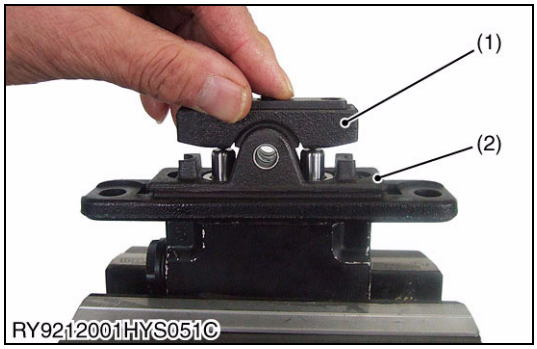
Tightening torque	Cover	8.8 ± 0.8 N·m 0.90 ± 0.08 kgf·m 6.5 ± 0.6 lbf·ft

- Tool to use: hex socket 5 mm

(1) Hex Socket Bolt

RY9212148HYS0195US0



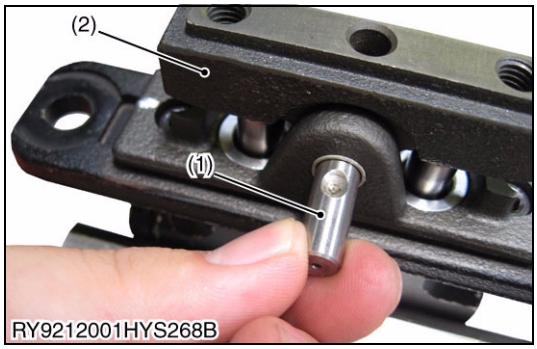


12. Install the cam on the cover.

■ **IMPORTANT**
- **Install it in the same position as before disassembly.**

(1) Cam (2) Cover

RY9212148HYS0196US0



13. Install the camshaft.

■ **IMPORTANT**
- **Grease the sliding part that holds the camshaft.**
- **Install the indentation in the cam faces up.**

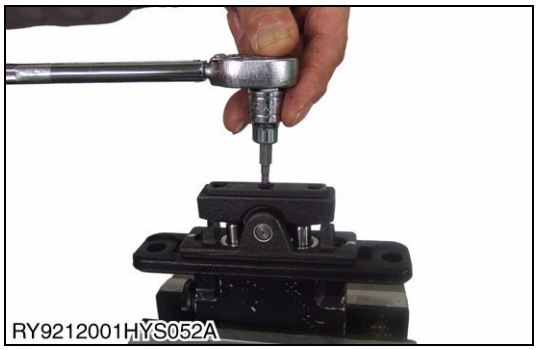
(1) Cam Shaft (2) Cam

RY9212148HYS0197US0

14. Apply Loctite to the threads of the hex socket bolt.

- Loctite #241

RY9212148HYS0302US0

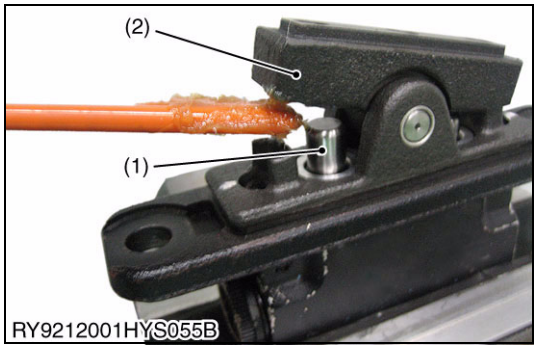


15. Install the hex socket bolt.

Tightening torque	Hex socket bolt	6.9 ± 1.0 N·m 0.7 ± 0.1 kgf·m 5.1 ± 0.7 lbf·ft

- Tool to use: hex socket 3 mm

RY9212148HYS0199US0

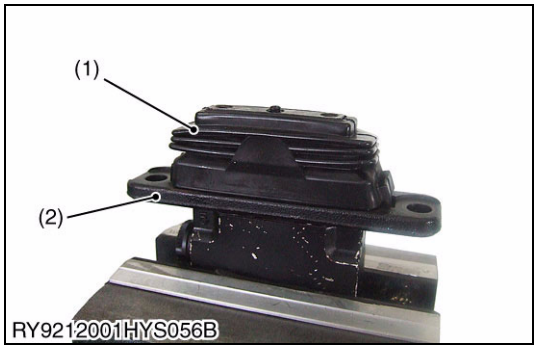


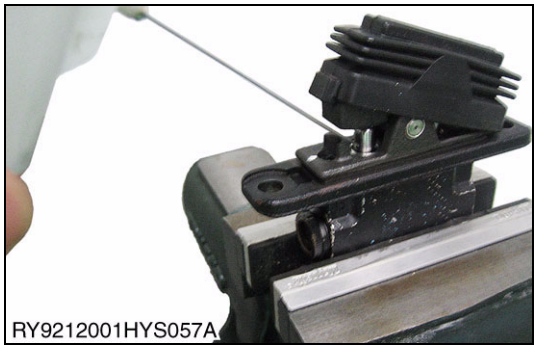
16. Apply grease to the ends of the pushrods.

■ **IMPORTANT**
- **Use a soft spatula to apply the grease so you don't scratch the surfaces of the pushrods or the plugs.**

(1) Pushrod (2) Cam

RY9212148HYS0200US0





17. After fitting the top of the bellows onto the cam, fit the bottom edge into the groove in the cover.

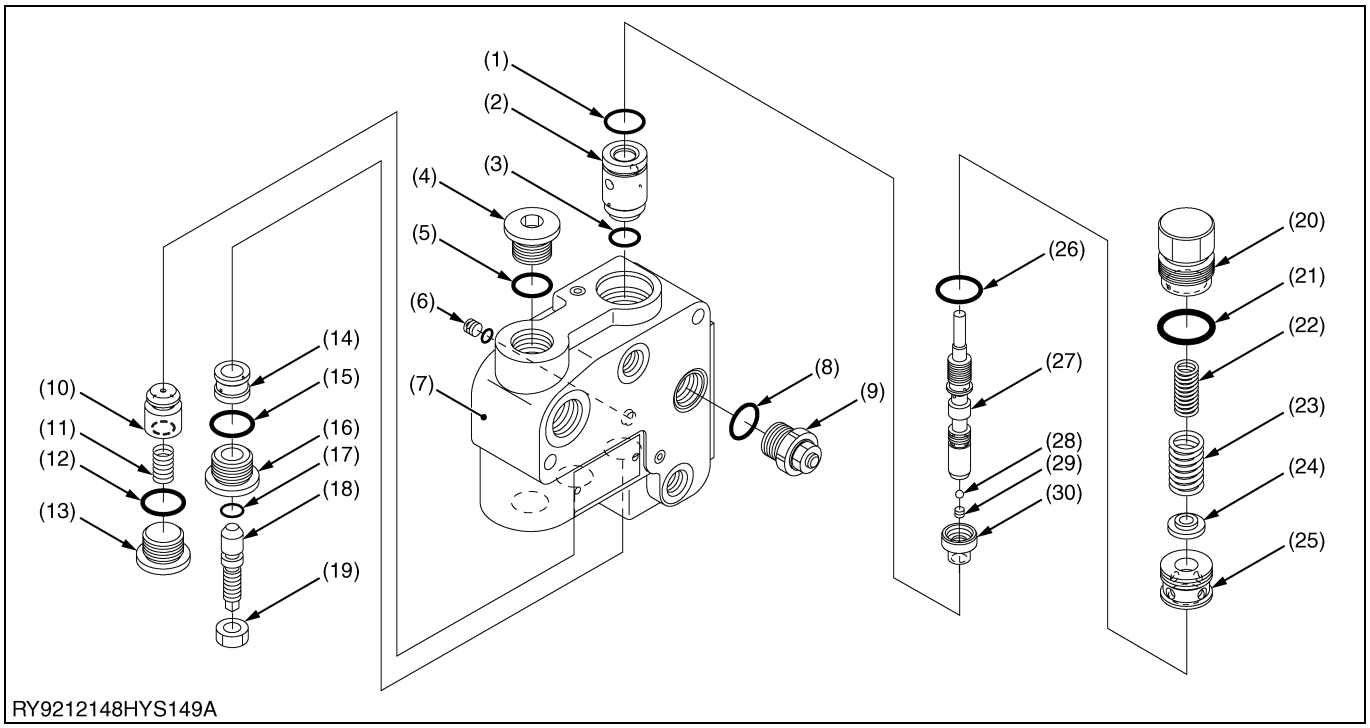
■ **IMPORTANT**
- **Before fitting the bottom edge of the bellows into the groove of the cover, apply an anti-rust oil to the parts inside the bellows.**

(1) Bellows (2) Cover

RY9212148HYS0201US0

8. BOOM HOLDING VALVE

[1] BOOM HOLDING VALVE



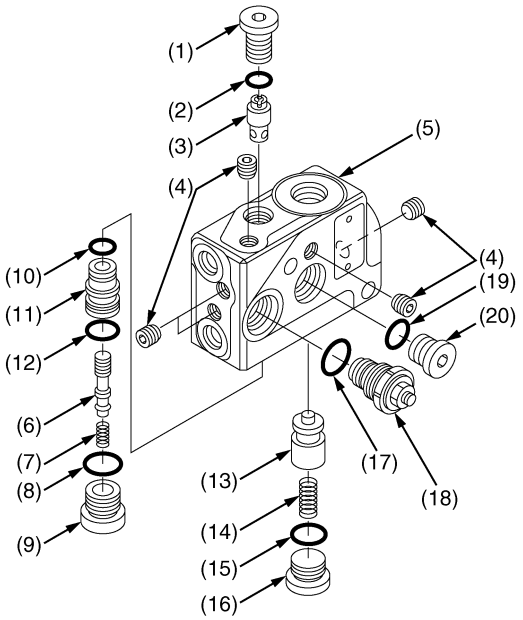
RY9212148HYS149A

No.	Part Name	Qty	Torque	No.	Part Name	Qty	Torque
(1)	O-ring	1		(16)	Plug	1	98.0 to 120.0 N·m 10.0 to 12.2 kgf·m 72.0 to 88.5 lbf·ft
(2)	Bushing	1		(17)	O-ring	1	
(3)	O-ring	1		(18)	Needle bearing	1	
(4)	Plug	1	110.0 to 130.0 N·m 11.2 to 13.3 kgf·m 81.1 to 95.9 lbf·ft	(19)	Lock nut	1	27.0 to 31.0 N·m 2.8 to 3.2 kgf·m 20.0 to 23.0 lbf·ft
(5)	O-ring	1		(20)	Cap	1	110.0 to 130.0 N·m 11.2 to 13.3 kgf·m 81.1 to 95.9 lbf·ft
(6)	Plug	1		(21)	O-ring	1	
(7)	Valve body	1		(22)	Spring	1	
(8)	O-ring	1		(23)	Spring	1	
(9)	Relief valve	1	29.0 to 39.0 N·m 3.0 to 4.0 kgf·m 21.0 to 29.0 lbf·ft	(24)	Spring seat	1	
(10)	Poppet	1		(25)	Bushing	1	
(11)	Spring	1		(26)	O-ring	1	
(12)	O-ring	1		(27)	Spool	1	
(13)	Plug	1	130.0 to 150.0 N·m 13.3 to 15.3 kgf·m 95.9 to 111.0 lbf·ft	(28)	Ball	1	
(14)	Piston	1		(29)	Hex socket set screw	1	
(15)	O-ring	1		(30)	Piston	1	

- Prior to assembly, clean all of the parts and make sure they are not damaged and there is no dirt or other debris on them.
- Always replace all of the O-rings with new ones.
- During assembly, apply hydraulic oil to the spool.

RY9212148HYS0271US0

[2] TWO PIECE BOOM HOLDING VALVE



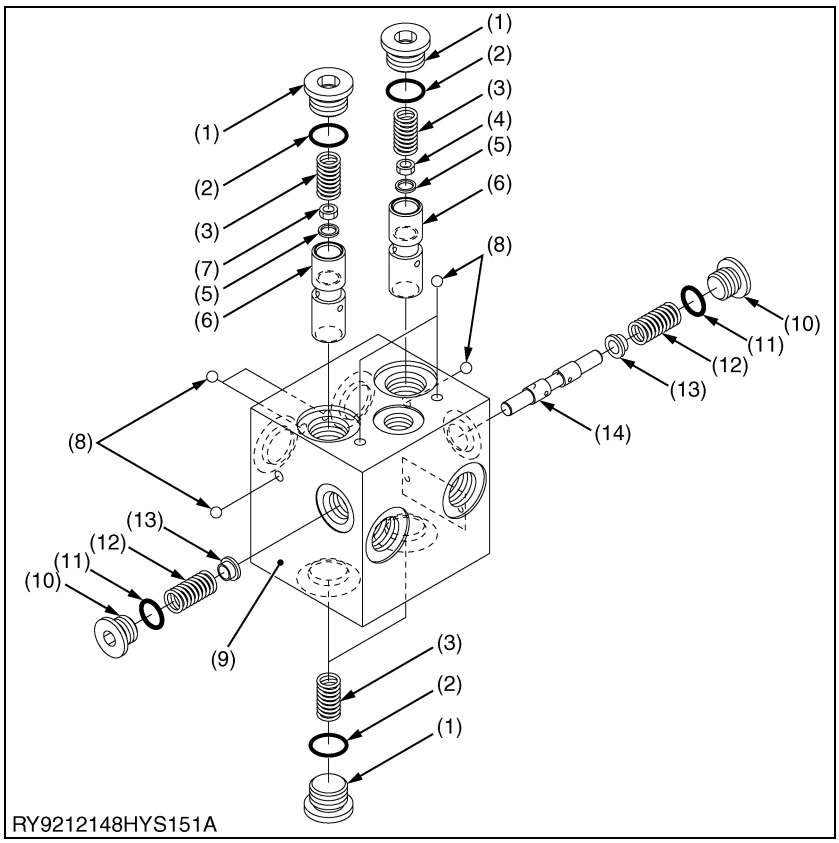
RY9212148HYS150A

No.	Name of part	Qty	Torque
(1)	Plug	1	25.0 to 29.0 N·m 2.5 to 3.0 kgf·m 18.0 to 21.0 lbf·ft
(2)	O-ring	1	
(3)	Poppet	1	
(4)	Plug	5	7.8 to 9.8 N·m 0.8 to 1.0 kgf·m 5.8 to 7.2 lbf·ft
(5)	Valve body	1	
(6)	Spool	1	
(7)	Spring	1	
(8)	O-ring	1	
(9)	Plug	1	49.0 to 59.0 N·m 5.0 to 6.0 kgf·m 36.0 to 44.0 lbf·ft
(10)	O-ring	1	
(11)	Sleeve	1	
(12)	O-ring	1	
(13)	Poppet	1	
(14)	Spring	1	
(15)	O-ring	1	
(16)	Plug	1	39.0 to 49.0 N·m 4.0 to 5.0 kgf·m 29.0 to 36.0 lbf·ft
(17)	O-ring	1	
(18)	Relief valve	1	29.0 to 39.0 N·m 3.0 to 4.0 kgf·m 21.0 to 29.0 lbf·ft
(19)	O-ring	1	
(20)	Plug	1	34.0 to 39.0 N·m 3.5 to 4.0 kgf·m 25.0 to 29.0 lbf·ft

- Prior to assembly, clean all of the parts and make sure they are not damaged and there is no dirt or other debris on them.
- Always replace all of the O-rings with new ones.
- During assembly, apply hydraulic oil to the spool.

RY9212148HYS0272US0

9. SHOCKLESS VALVES



RY9212148HYS151A

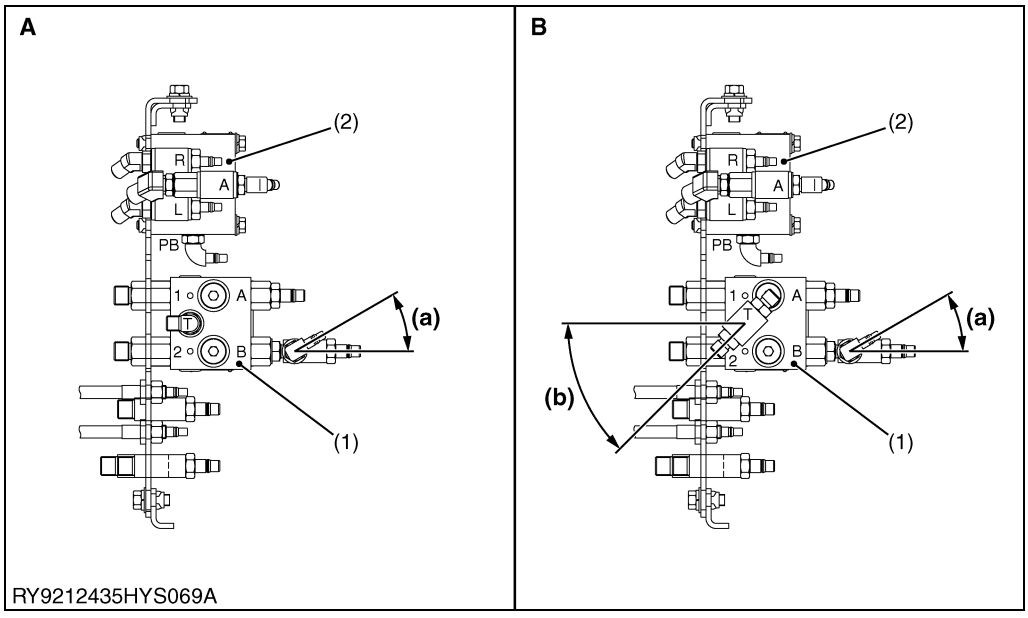
Components

No.	Name of part	Qty	Torque
(1)	Plug	4	44.2 to 54.0 N·m 4.5 to 5.5 kgf·m 32.6 to 39.8 lbf·ft
(2)	O-ring	4	
(3)	Spring	4	
(4)	Orifice	1	
(5)	Ring	2	
(6)	Spool	2	
(7)	Orifice	1	
(8)	Ball	6	
(9)	Body	1	
(10)	Plug	2	23.8 to 29.2 N·m 2.4 to 3.0 kgf·m 17.6 to 21.5 lbf·ft
(11)	O-ring	2	
(12)	Spring	2	
(13)	Spring seat	2	
(14)	Spool	1	

- Prior to assembly, clean all of the parts and make sure they are not damaged and there is no dirt or other debris on them.
- Always replace all of the O-rings with new ones.
- During assembly, apply hydraulic oil to the spool.

RY9212148HYS0273US0

Adapter angles



RY9212435HYS069A

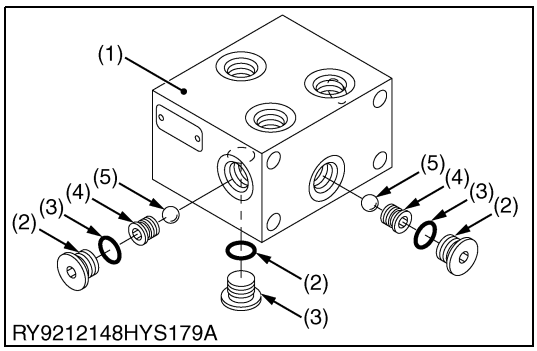
(1) Shockless Valve
(2) Swivel Shuttle Valve

A : Standard Boom Spec.
B : Two Piece Boom Spec.

(a) 30° (0.52 rad)
(b) 45° (0.79 rad)

RY9212724HYS0052US0

10. SWIVEL SHUTTLE VALVE



RY9212148HYS179A

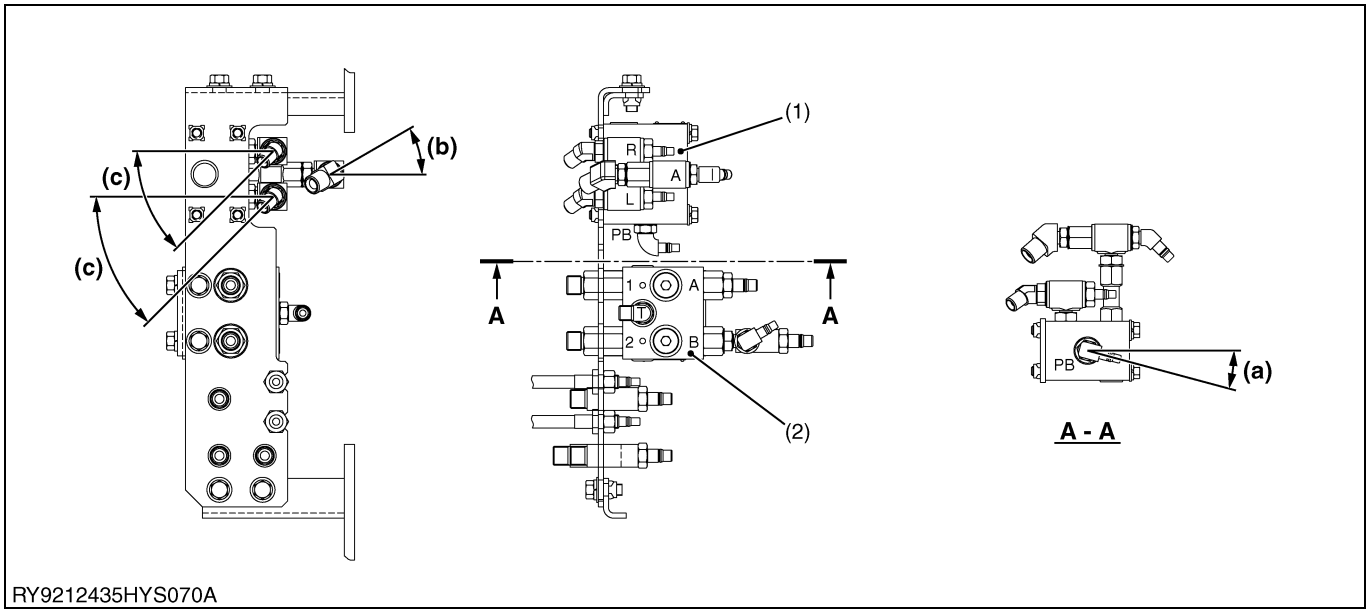
Components

No.	Name of part	Q'ty	Torque
(1)	Body	1	
(2)	Plug	3	23.8 to 29.2 N·m 2.4 to 3.0 kgf·m 17.6 to 21.5 lbf·ft
(3)	O-ring	3	
(4)	Seat	2	13.2 to 16.2 N·m 1.4 to 1.7 kgf·m 9.74 to 11.90 lbf·ft Apply thread lock (Loctite 262 or equivalent)
(5)	Ball	2	

- During disassembly, always use a tap to clean the threads of any thread lock on them.
- Prior to assembly, clean all of the parts and make sure they are not damaged and there is no dirt or other debris on them.
- Always replace all of the O-rings with new ones.

RY9212148HYS0275US0

Adapter angles



RY9212435HYS070A

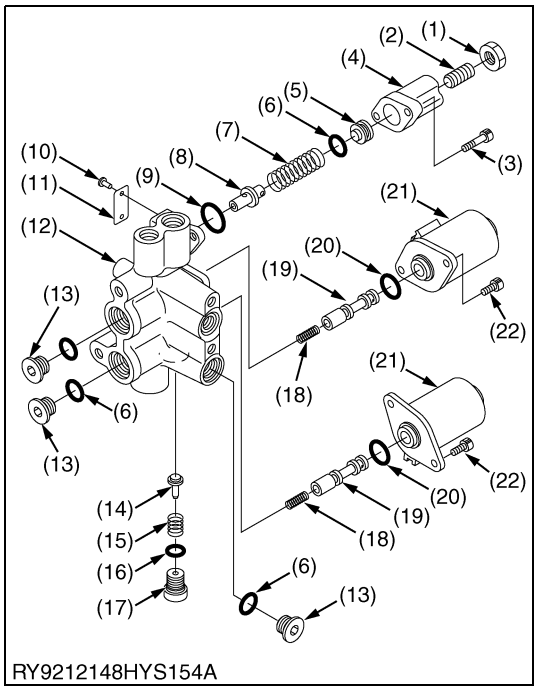
(1) Swivel Shuttle Valve
(2) Shockless Valve

(a) 15 ° (0.26 rad) **(b) 30 ° (0.52 rad)** **(c) 45 ° (0.79 rad)**

RY9212435HYS0034US0

11. SOLENOID VALVE

[1] UNLOAD VALVE

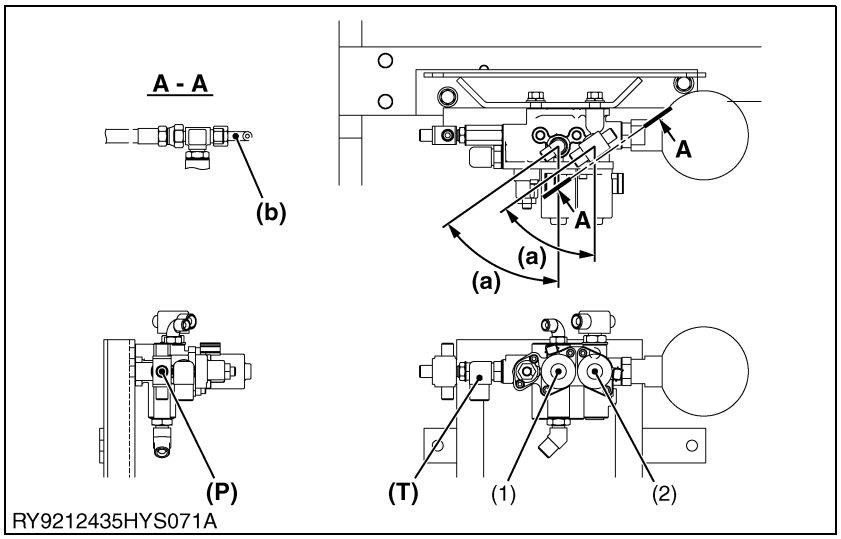


RY9212148HYS154A

Components

No.	Name of part	Qty	Torque
(1)	Hex nut	1	15.7 ± 1.6 N·m 1.6 ± 0.2 kgf·m 11.6 ± 1.2 lbf·ft
(2)	Adjuster screw	1	
(3)	Hex socket bolt	2	3.9 N·m 0.4 kgf·m 2.9 lbf·ft
(4)	Cover	1	
(5)	Plug	1	
(6)	O-ring	4	
(7)	Spring	1	
(8)	Plunger	1	
(9)	O-ring	1	
(10)	Rivet screw	2	
(11)	Nameplate	1	
(12)	Body	1	
(13)	Plug	3	26.5 ± 2.7 N·m 2.7 ± 0.3 kgf·m 19.5 ± 2.0 lbf·ft
(14)	Plunger	1	
(15)	Spring	1	
(16)	O-ring	1	
(17)	Plug	1	21.0 ± 2.1 N·m 2.1 ± 0.2 kgf·m 15.5 ± 1.5 lbf·ft
(18)	Spring	2	
(19)	Spool	2	
(20)	O-ring	2	
(21)	Solenoid	2	
(22)	Hex socket bolt	4	3.9 N·m 0.4 kgf·m 2.9 lbf·ft

RY9212148HYS0277US0



RY9212435HYS071A

Adapter angle

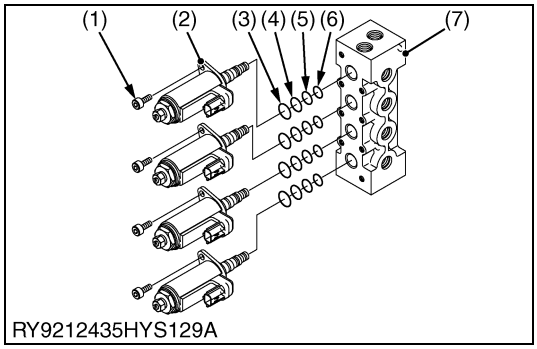
(1) Travel 2-Speed Solenoid
(2) Pilot Solenoid

(P) P Port
(T) T Port

(a) 55 ° (0.96 rad)
(b) Assemble So As To Be Horizontal

RY9212435HYS0035US0

[2] AUX PROPORTIONAL CONTROL SOLENOID VALVE

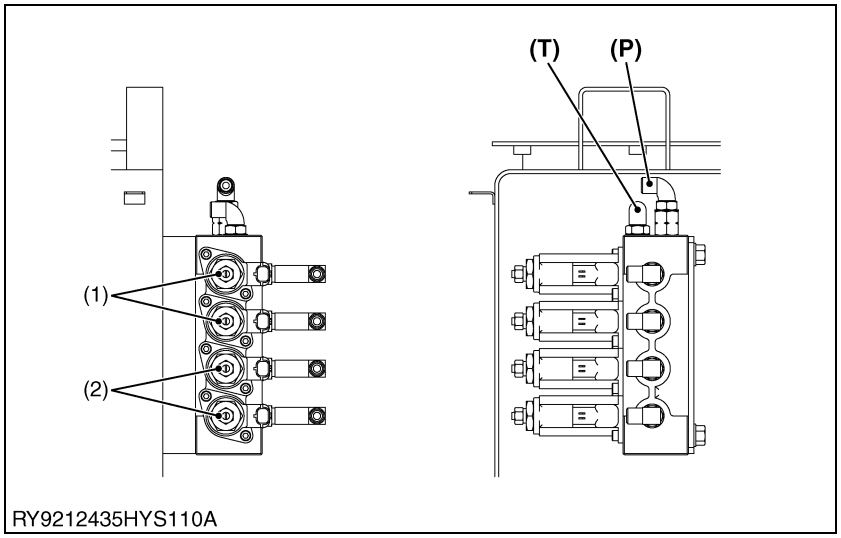


RY9212435HYS129A

Components

No.	Name of part	Qty	Torque
(1)	Bolt	8	7.0 ± 1.0 N·m 0.7 ± 0.1 kgf·m 5.2 ± 0.7 lbf·ft
(2)	Solenoid	4	
(3)	O-ring	4	
(4)	O-ring	4	
(5)	O-ring	4	
(6)	O-ring	4	
(7)	Body	1	

RY9212435HYS0139US0



RY9212435HYS110A

Adapter angles

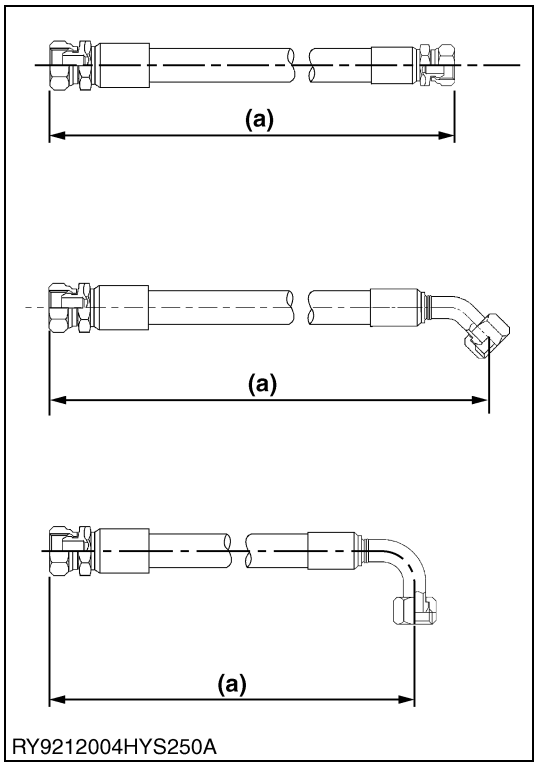
(1) AUX1 Solenoid Valve
(2) AUX2 Solenoid Valve

(P) Port P
(T) Port T

RY9212435HYS0036US0

12. ROUTING OF HYDRAULIC HOSES

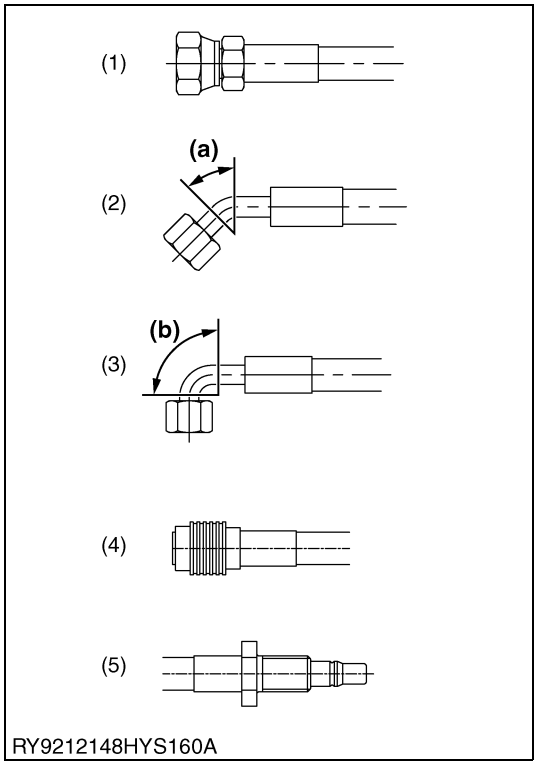
[1] HYDRAULIC HOSE SPECIFICATIONS



RY9212004HYS250A

(a) Total Length

RY9212004HYS0147US0



RY9212148HYS160A

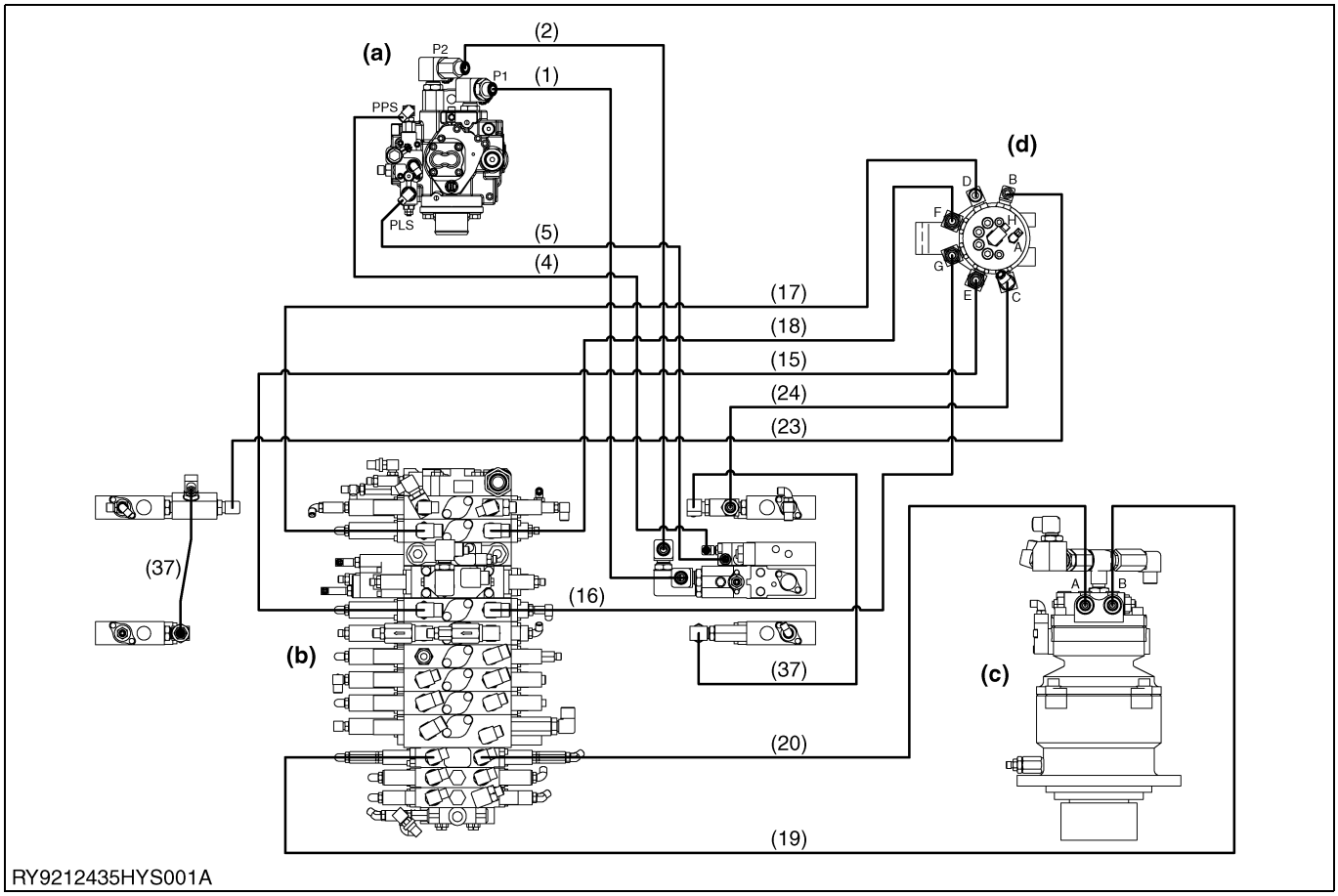
(1) C Type (Straight)
(2) CR4 Type (45°)
(3) CR9 Type (90°)
(4) QM Type (Quick)
(5) Q Type (Quick)

(a) 45 °
(b) 90 °

RY9212148HYS0202US0

[2] HIGH-PRESSURE HOSES

(1) Deliver Hose Routing



(a) Pump **(b) Control Valve** **(c) Swivel Motor** **(d) Swivel Joint**

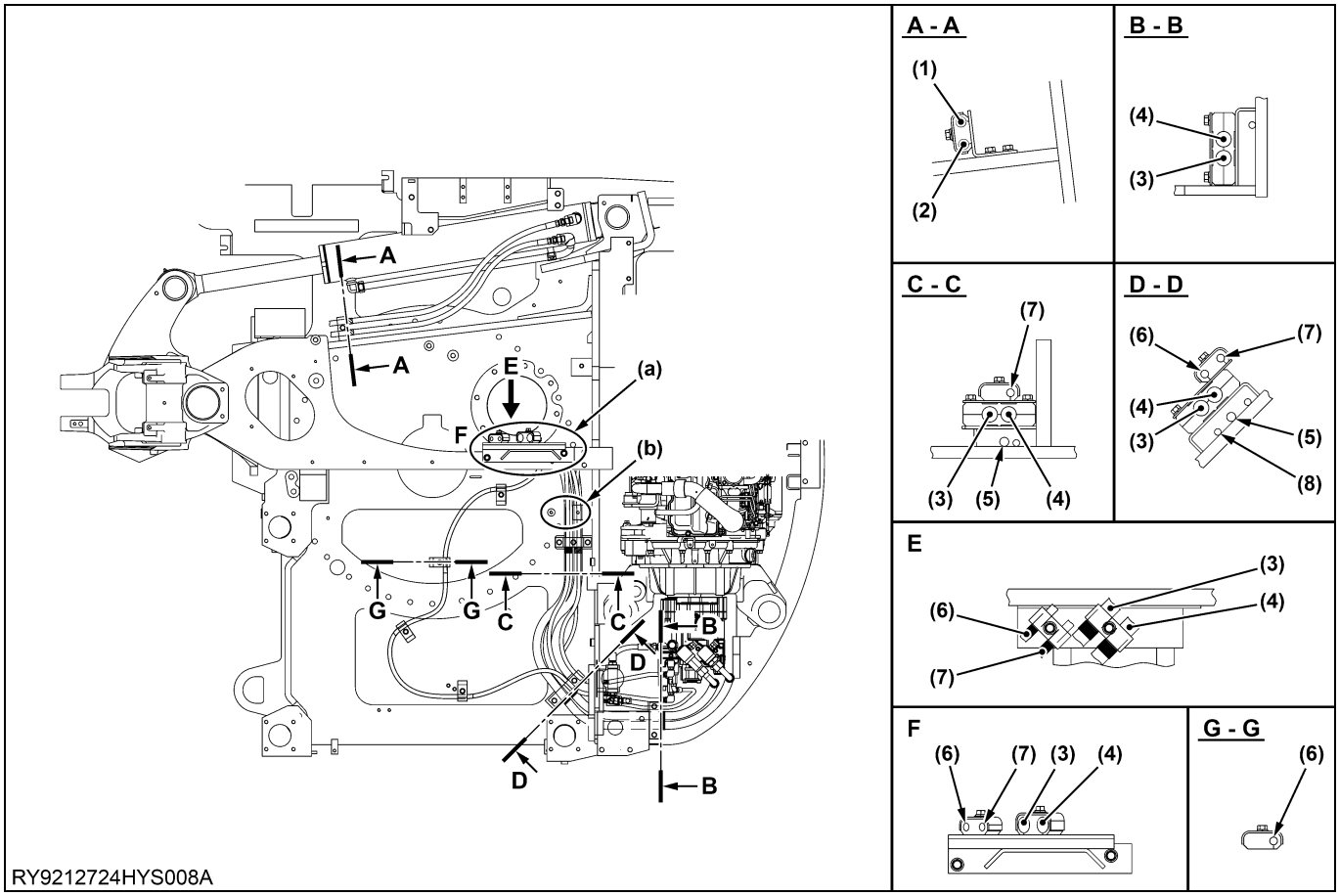
(To be continued)

(Continued)

No.	Function	Hose			Fitting		Point used
		Total length	Size	Tape color	Type	Size	
(1)	P1	2910 mm 114.6 in.	5/8	Red White	CR9·C	1-14UNS	Pump (P1) to C/V (P1)
(2)	P2	2890 mm 113.8 in.	5/8	Red × 2 White × 2	CR9·C	1-14UNS	Pump (P2) to C/V (P2)
(4)	PPS	2370 mm 93.31 in.	1/4	Red White × 2	C·C	9/16-18UNF	Pump (PPS) to C/V (PPS)
(5)	PLS	3160 mm 124.4 in.	1/4	Red	C·C	9/16-18UNF	Pump (PLS) to C/V (PLS)
(15)	Travel right forward	1140 mm 44.88 in.	5/8	Yellow × 2	C·C	1-14UNS	C/V (travel R-FWD) to R/J (E)
(16)	Travel right rear	980 mm 38.6 in.	5/8	Green × 2	C·C	1-14UNS	C/V (travel R-BWD) to R/J (G)
(17)	Travel left forward	1080 mm 42.52 in.	5/8	Red × 2	C·CR4	1-14UNS	C/V (travel L-FWD) to R/J (D)
(18)	Travel left rear	890 mm 35.0 in.	5/8	Blue × 2	C·CR4	1-14UNS	C/V (travel L-BWD) to R/J (F)
(19)	Swivel left	950 mm 37.4 in.	1/2	Gray	C·CR9	13/16-16UN	C/V (swivel left) to swivel motor (left)
(20)	Swivel right	830 mm 32.7 in.	1/2	Light blue	C·CR9	13/16-16UN	C/V (swivel right) to swivel motor (right)
(23)	Blade down	1170 mm 46.06 in.	1/2	Brown	C·CR4	13/16-16UN	C/V (blade down) to R/J (B)
(24)	Blade up	1010 mm 39.8 in.	1/2	Pink	C·CR4	13/16-16UN	C/V (blade up) to R/J (C)
(37)	Blade	320 mm 12.6 in.	3/8	–	C·CR9	11/16UN	C/V (blade I) to C/V (blade II)

RY9212724HYS0041US0

Delivery Hose Clamp Positions

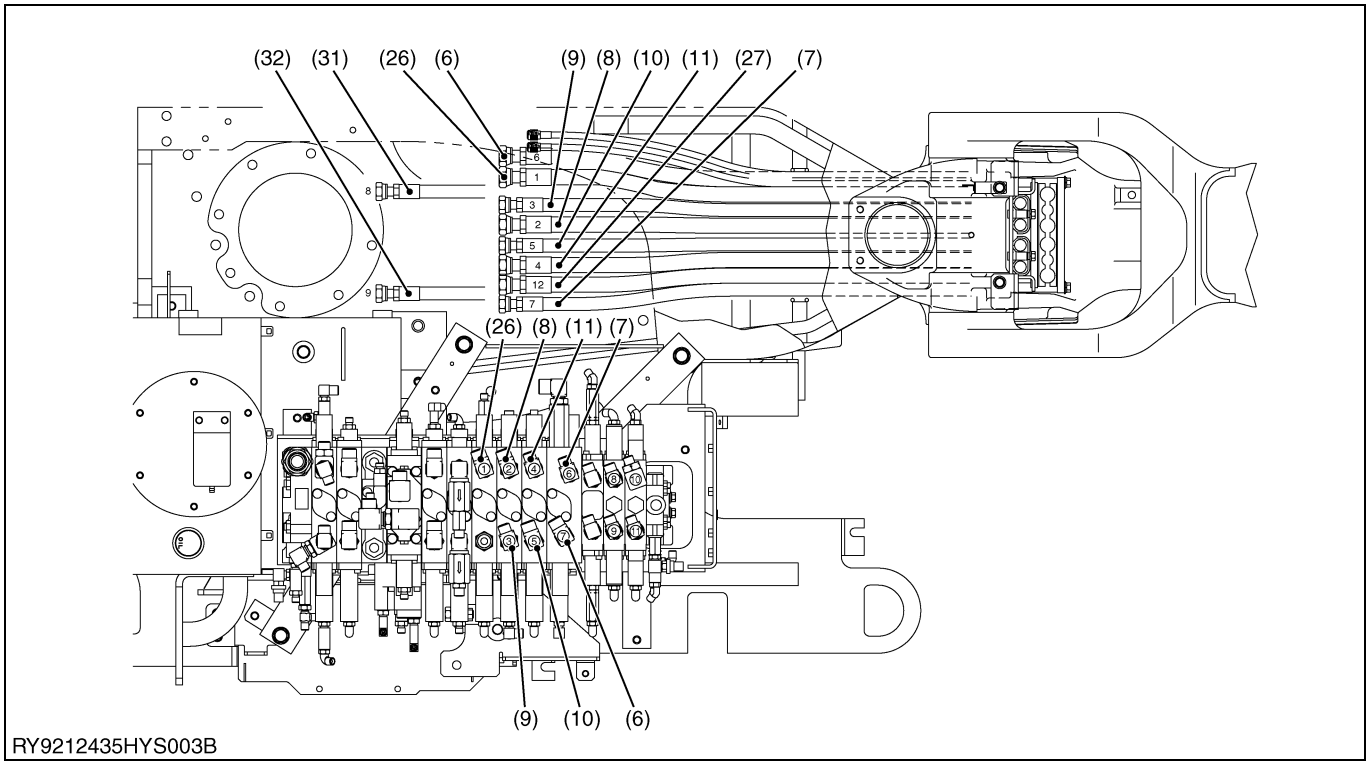


(1) Swing cylinder bottom side
(2) Swing cylinder rod side
(3) P1
(4) P2
(5) PP
(6) PLS
(7) PPS
(8) Heat Up Circuit

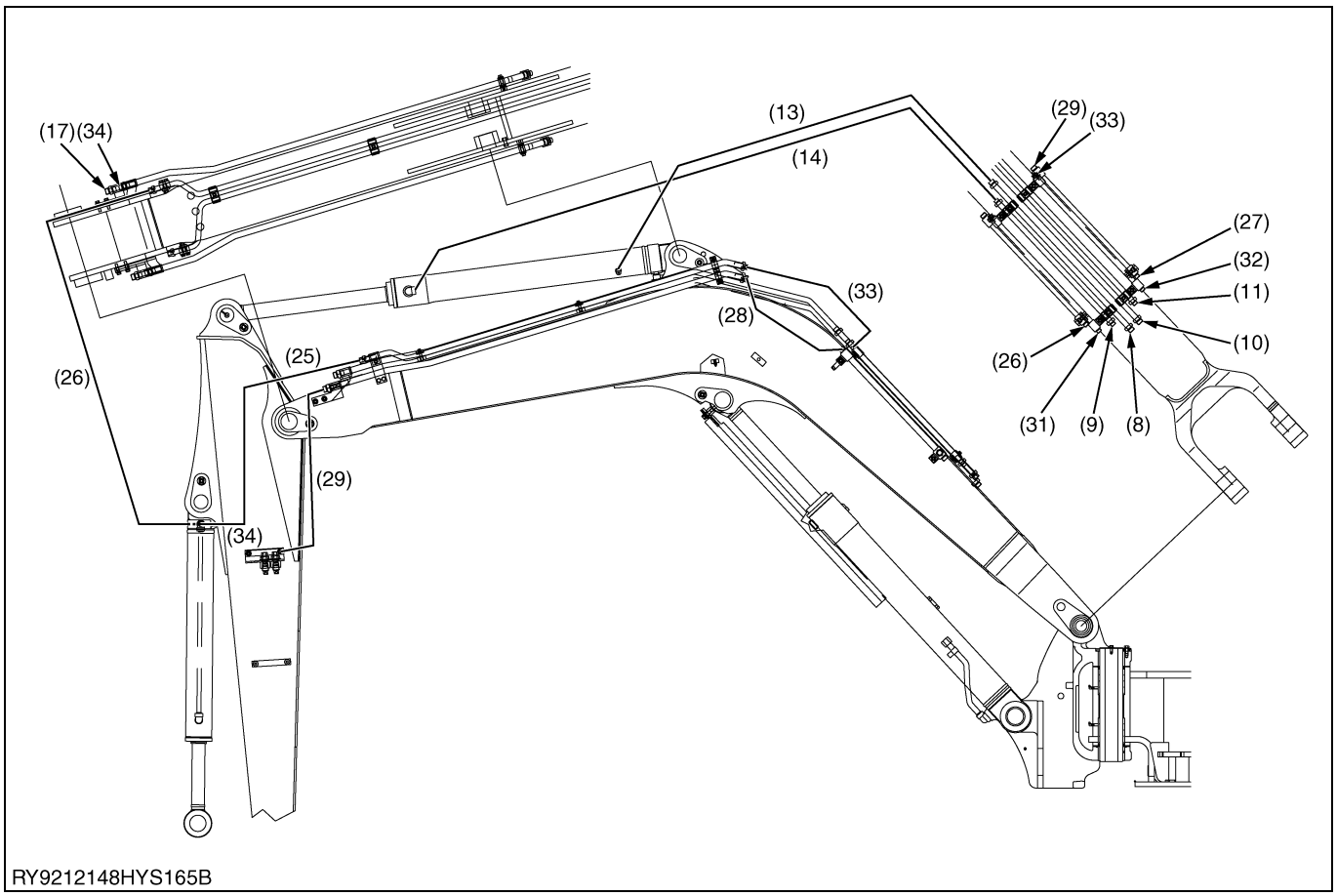
■ **NOTE**
- **(a): So hoses to P1 and P2 don't rub against each other.**
- **(b): Pass all hoses inside the rod.**

RY9212724HYS0011US0

(2) Front Hose Routing



RY9212435HYS003B



RY9212148HYS165B

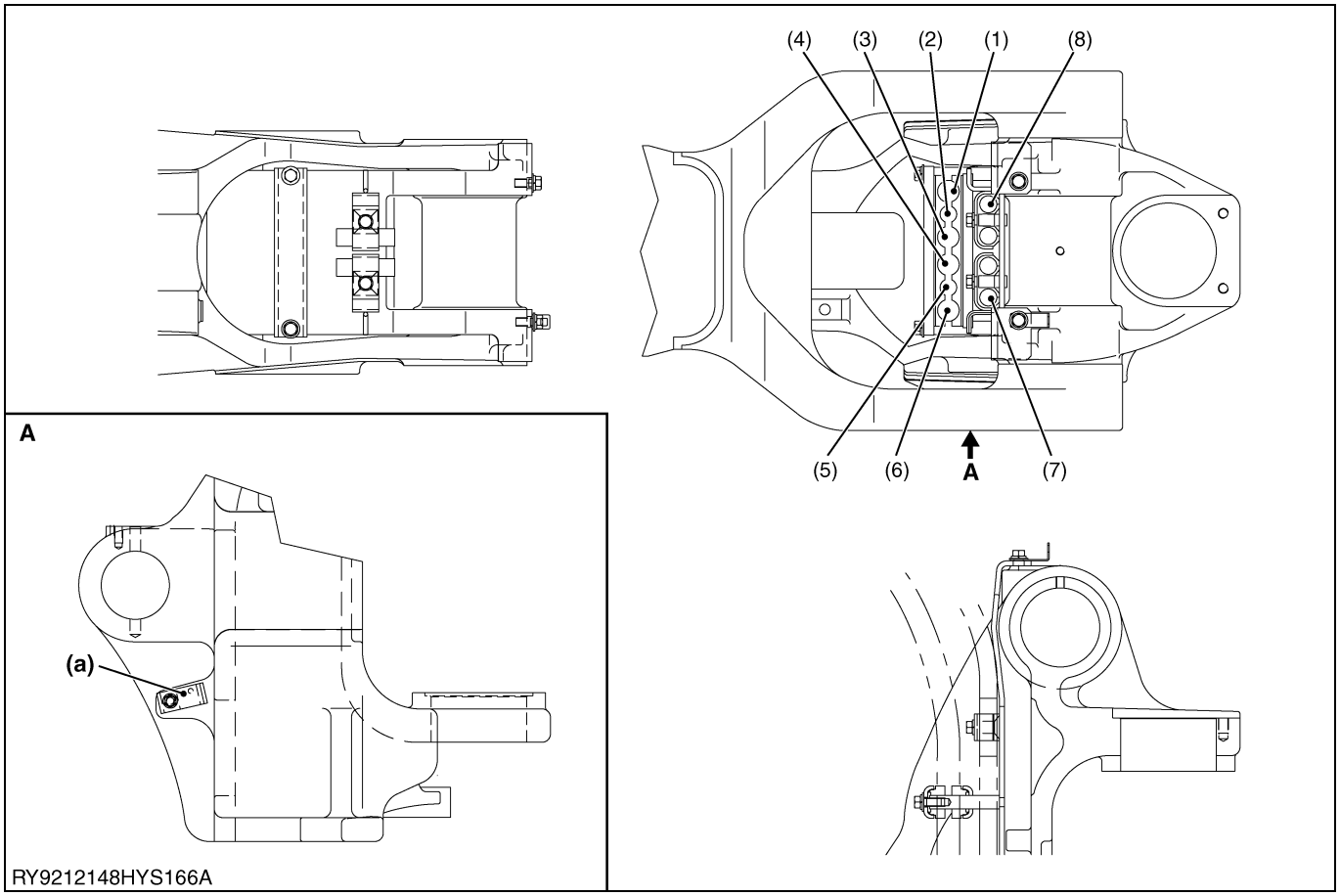
(To be continued)

(Continued)

No.	Function	Hose			Fitting		Guard	Point used
		Total length	Size	Tape color	Type	Size		
(6)	Boom up	2980 mm 117.3 in.	5/8	Green White	C·C	1-14UNS	Colgate tube	C/V (boom up) to boom cylinder (bottom)
(7)	Boom down	3100 mm 122.0 in.	1/2	Yellow	C·C	13/16-16 UN	Colgate tube	C/V (boom down) to boom cylinder (rod)
(8)	Arm crowd	3190 mm 125.6 in.	5/8	Blue	C·C	1-14UNS	Colgate tube	C/V (arm crowd) to boom back (pipe)
(9)	Arm dump	3370 mm 132.7 in.	1/2	Pea green	C·C	13/16-16 UN	Colgate tube	C/V (arm dump) to boom back (pipe)
(10)	Bucket crowd	3310 mm 130.3 in.	5/8	Orange	C·C	1-14UNS	Colgate tube	C/V (bucket crowd) to boom back (pipe)
(11)	Bucket dump	3160 mm 124.4 in.	1/2	Red	C·C	13/16-16 UN	Colgate tube	C/V (bucket dump) to boom back (pipe)
(13)	Arm crowd	720 mm 28.3 in.	5/8	Blue	C·C	1-14UNS		Boom back (pipe) (arm crowd) to arm CYL (bottom)
(14)	Arm dump	1955 mm 76.97 in.	1/2	Pea green	C·C	13/16-16 UN		Boom back (pipe) (arm dump) to arm CYL (rod)
(25)	Bucket crowd long arm	1150 mm 45.28 in.	5/8	–	C·C	1-14UNS	Total spring length	Boom back (pipe) to bucket CYL
	Bucket crowd short arm	1350 mm 53.15 in.	5/8	–	C·C	1-14UNS	Total spring length	Boom back (pipe) to bucket CYL
(26)	AUX1 high pressure	3400 mm 133.9 in.	5/8	Pink	C·C	1-14UNS	Colgate tube	C/V (AUX1 high pressure) to boom back (pipe)
(27)	AUX1 low pressure	3320 mm 130.7 in.	5/8	Brown	C·C	1-14UNS	Colgate tube	3-way valve to boom back (pipe)
(28)	AUX1 high pressure	540 mm 21.3 in.	5/8	–	C·C	1-14UNS		AUX middle (AUX1)
(29)	AUX1 high pressure and low pressure	980 mm 38.6 in.	5/8	–	C·C	1-14UNS	Total spring length	AUX end (AUX1)
(31)	AUX2 high pressure	3155 mm 124.2 in.	1/2	Pink	C·C	13/16-16 UN	Colgate tube	C/V (AUX2 high pressure) to boom back (pipe)
(32)	AUX2 low pressure	3180 mm 125.2 in.	1/2	Brown	C·C	13/16-16 UN	Colgate tube	C/V (AUX2 low pressure) to boom back (pipe)
(33)	AUX2 high pressure and low pressure	605 mm 23.8 in.	1/2	–	C·C	13/16-16 UN		AUX middle (AUX2)
(34)		1110 mm 43.7 in.	5/8	–	C·C	1-14UNS	Total spring length	AUX end (AUX2)

RY9212724HYS0012US0

Front Hose Clamp Positions



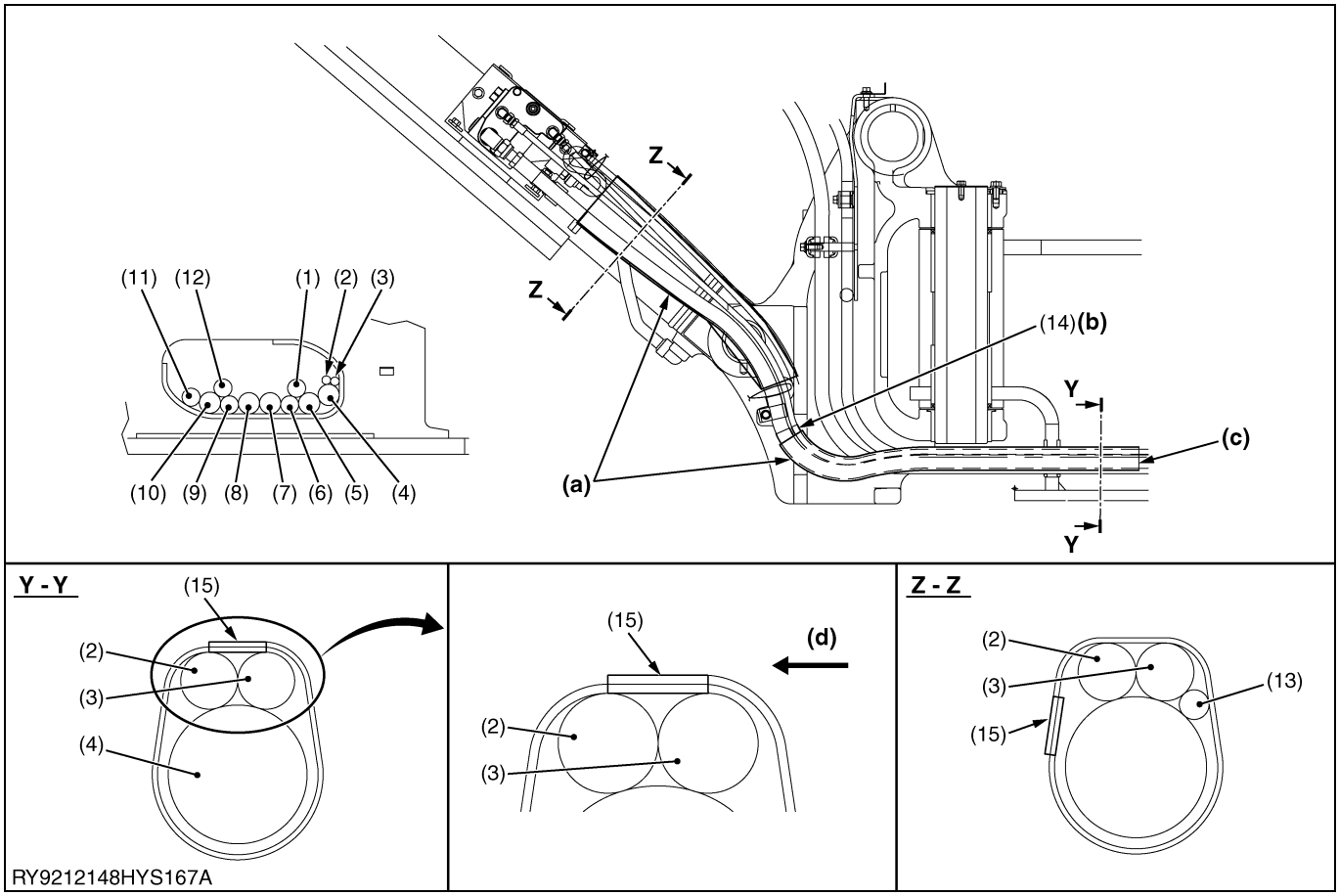
(1) Brown (AUX1 Lo)
(2) Red (Bucket dump)
(3) Orange (Bucket crowd)
(4) Blue (Arm crowd)
(5) Yellow (Arm dump)
(6) Pink (AUX1 Hi)
(7) Pink (AUX2 Hi)
(8) Brown (AUX2 Lo)

■ **NOTE**

- **(a): Use a cushion when clamping on the boom rod side (opposite that in the illustration).**

RY9212724HYS0013US0

(3) Boom Hose Routing



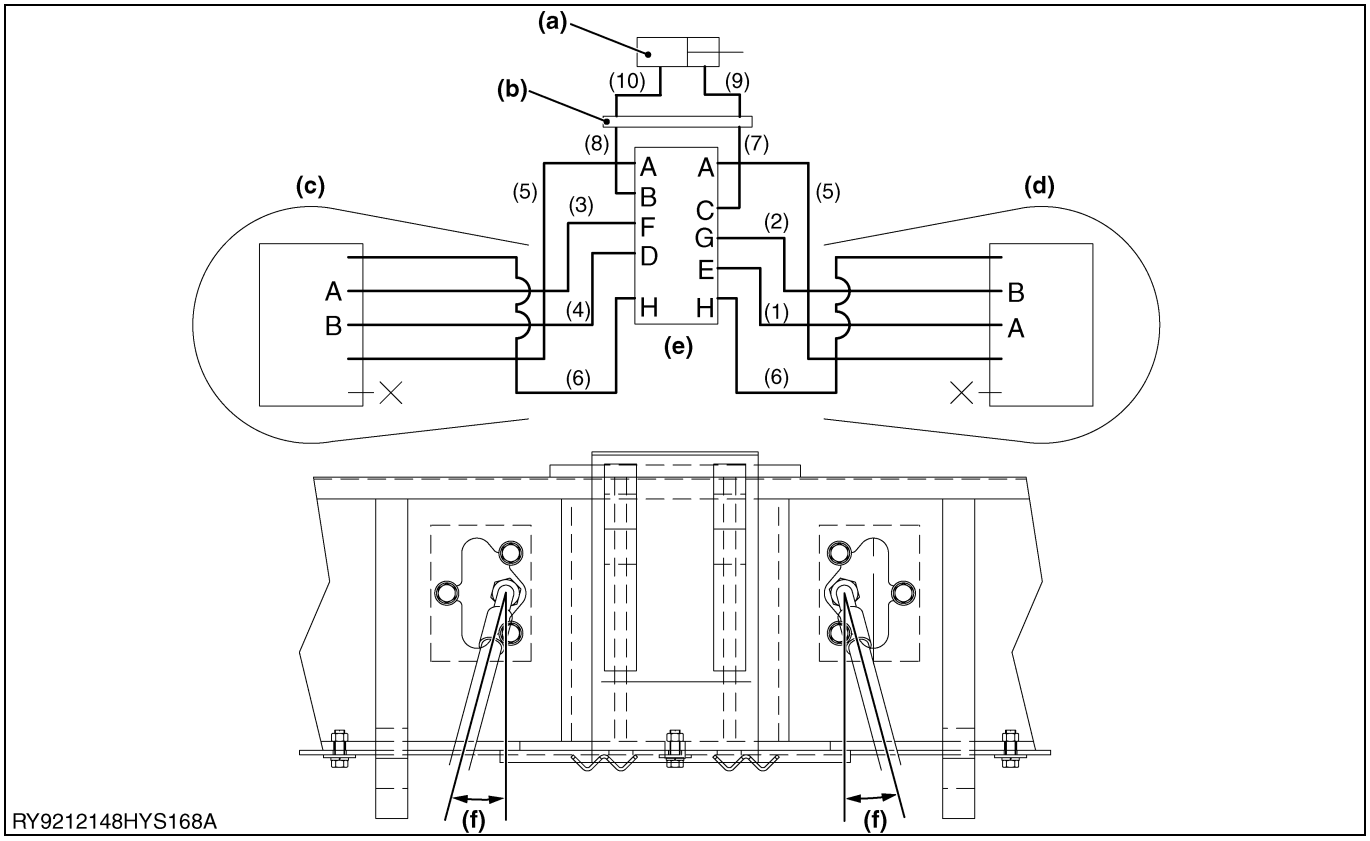
(1) AUX2 (High)
(2) Boom H/V (signal)
(3) Boom H/V (drain)
(4) Boom up
(5) AUX1 (High)
(6) Arm dump
(7) Arm crowd
(8) Bucket dump
(9) Bucket crowd
(10) AUX1 (Low)
(11) Boom down
(12) AUX2 (Low)
(13) Wire harness
(14) White tape
(15) Velcro tape

■ **NOTE**

- **(a): Install the cover with the urethane coated side (slippery side) on the inside (hose side).**
- **(b): Put the white tape in place and install the cover from the end of the tape.**
- **(c): Insert the end of the cover securely inside the swivel frame.**
- **(d): Install so you cannot see the joint in the velcro as viewed from the arrow.**

RY9212148HYS0290US0

(4) Undercarriage Hose Routing

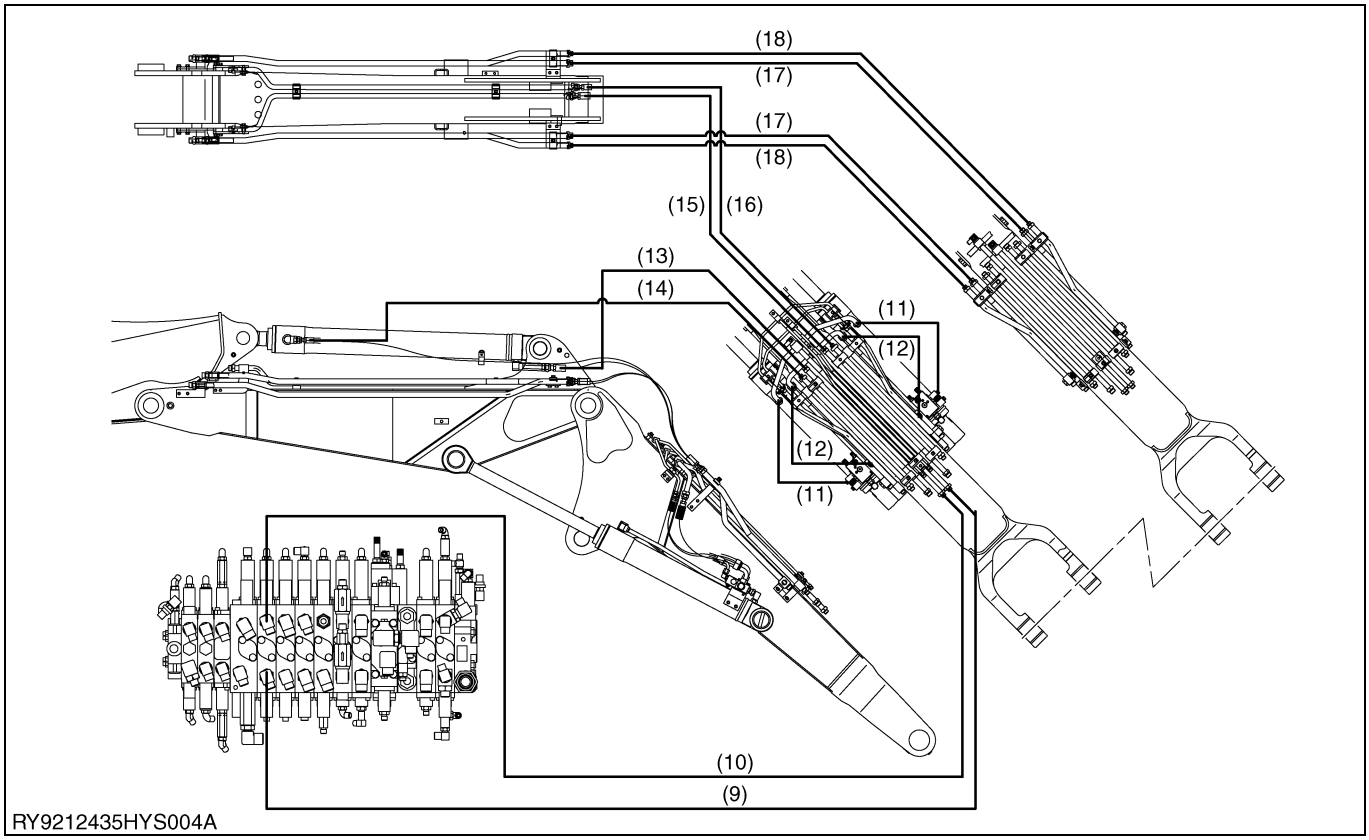


(a) Blade Cylinder
(b) Blade Bulkhead Fitting
(c) Travel Motor L
(d) Travel Motor R
(e) Swivel Joint
(f) 15 ° (0.3 rad)

No.	Function	Hose			Fitting		Guard	Point used
		Total length	Size	Tape color	Type	Size		
(1)	Travel right forward	1415 mm 55.7 in.	5/8	Yellow x 2	CR4·C	1-14UNS	Spiral tube	S/J (E) to motor right down (A)
(2)	Travel right rear	1355 mm 53.3 in.	5/8	Green x 2	CR4·C	1-14UNS	Spiral tube	S/J (G) to motor right up (B)
(3)	Travel left forward	1415 mm 55.7 in.	5/8	Red x 2	CR4·C	1-14UNS	Spiral tube	S/J (G) to motor left down (B)
(4)	Travel left rear	1355 mm 53.3 in.	5/8	Blue x 2	CR4·C	1-14UNS	Spiral tube	S/J (E) to motor left up (A)
(5)	Travel 2nd speed	1385 mm 54.5 in.	1/4	–	C·C	1/4		S/J (A) to motor L/R 2-speed
(6)	Drain	1310 mm 51.6 in.	3/8	–	CR4·C	3/8		S/J (H) to motor L/R drain
(7)	Blade up	430 mm 16.9 in.	1/2	Pink	CR9·C	13/16-16 UN		S/J (C) to blade joint
(8)	Blade down	430 mm 16.9 in.	1/2	Brown	CR9·C	13/16-16 UN		S/J (B) to blade joint
(9)	Blade up	785 mm 30.9 in.	1/2	–	CR4·C	13/16-16 UN	Total spring length	Blade joint to blade cylinder (rod)
(10)	Blade down	785 mm 30.9 in.	1/2	–	CR4·C	13/16-16 UN	Total spring length	Blade joint to blade cylinder (bottom)

RY9212435HYS0110US0

(5) Two Piece Boom Hose Routing



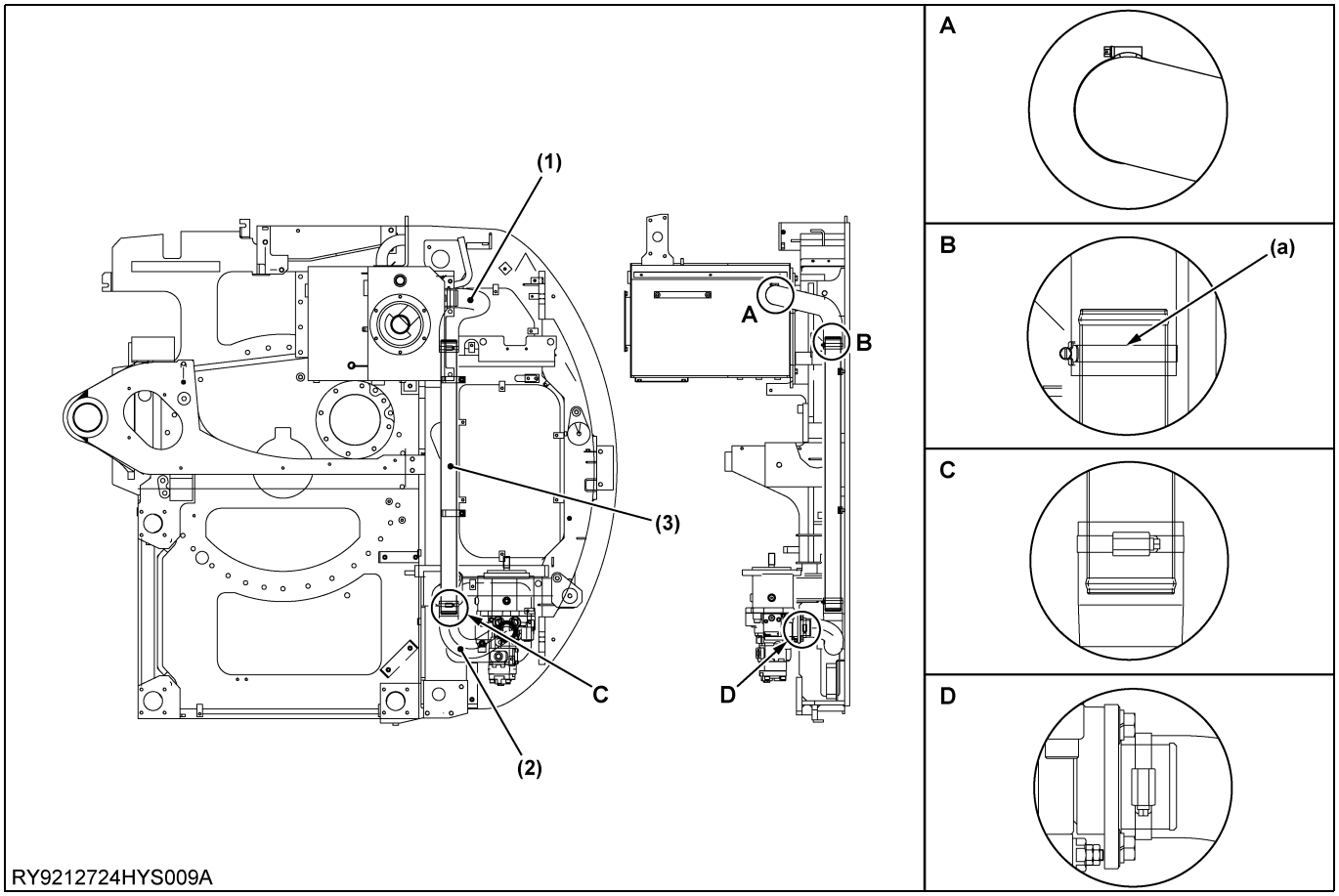
RY9212435HYS004A

No.	Function	Hose			Fitting		Guard	Point used
		Total length	Size	Tape color	Type	Size		
(9)	Two piece boom crowd	3040 mm 119.7 in.	1/2	Yellow Gray	C·C	13/16-16 UN	Colgate tube	C/V (Two piece crowd) to boom back pipe
(10)	Two piece boom dump	3200 mm 126.0 in.	1/2	Green Gray	C·C	13/16-16 UN	Colgate tube	C/V (Two piece dump) to boom back pipe
(11)	Two piece boom crowd	560 mm 22.0 in.	1/2	–	CR9·C	13/16-16 UN	Colgate tube	Boom back pipe to Two piece boom H/V (A) (bottom)
(12)	Two piece boom dump	560 mm 22.0 in.	1/2	–	CR9·C	13/16-16 UN	Colgate tube	Boom back pipe to Two piece boom CYL port (rod)
(13)	Arm crowd	1010 mm 39.76 in.	5/8	Blue	C·C	1-14UNS		Boom back pipe (crowd) to arm CYL (bottom)
(14)	Arm dump	2195 mm 86.42 in.	1/2	–	C·C	13/16-16 UN		Boom back pipe (dump) to arm CYL (rod)
(15)	Bucket crowd	890 mm 35.0 in.	5/8	–	C·C	1-14UNS		Boom back pipe (crowd) to bucket CYL (bottom)
(16)	Bucket dump	890 mm 35.0 in.	1/2	–	C·C	13/16-16 UN		Boom back pipe (dump) to bucket CYL (rod)
(17)	AUX1 high pressure and low pressure	890 mm 35.0 in.	5/8	–	C·C	1-14UNS		AUX middle (AUX1)
(18)	AUX2 high pressure and low pressure	890 mm 35.0 in.	1/2	–	C·C	13/16-16 UN		AUX middle (AUX2)

RY9212724HYS0053US0

[3] LOW-PRESSURE HOSES

(1) Suction Pipe and Hose Routing



RY9212724HYS009A

(1) Suction hose 1 (2) Suction hose 2 (3) Suction pipe

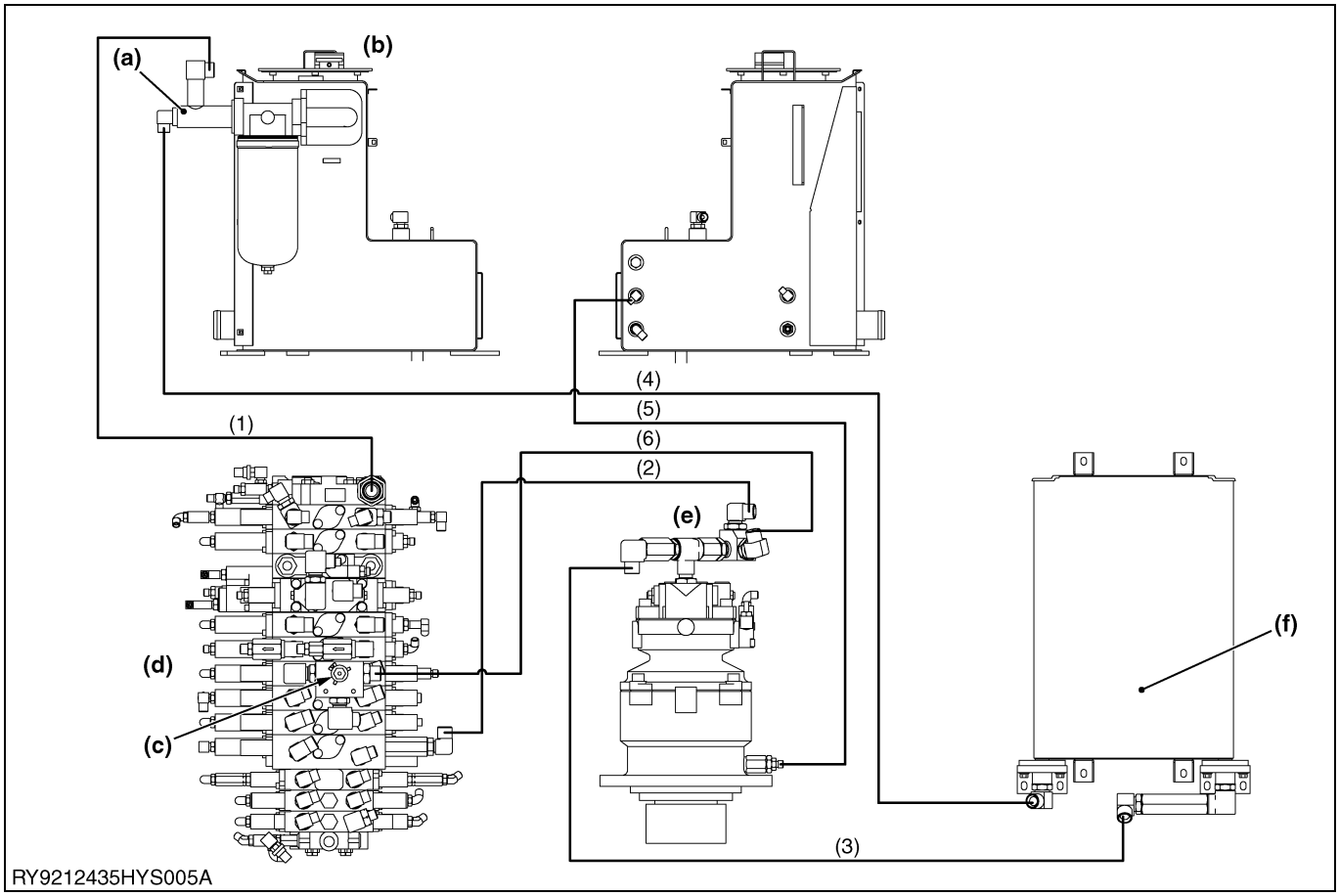
■ **NOTE**

- **(a): Tighten bands from the base plate side (bottom).**

No.	Function	Point used
(1)	Suction	Oil tank to suction pipe
(2)		Pump to suction pipe

RY9212724HYS0014US0

(2) Drain Hose Routing



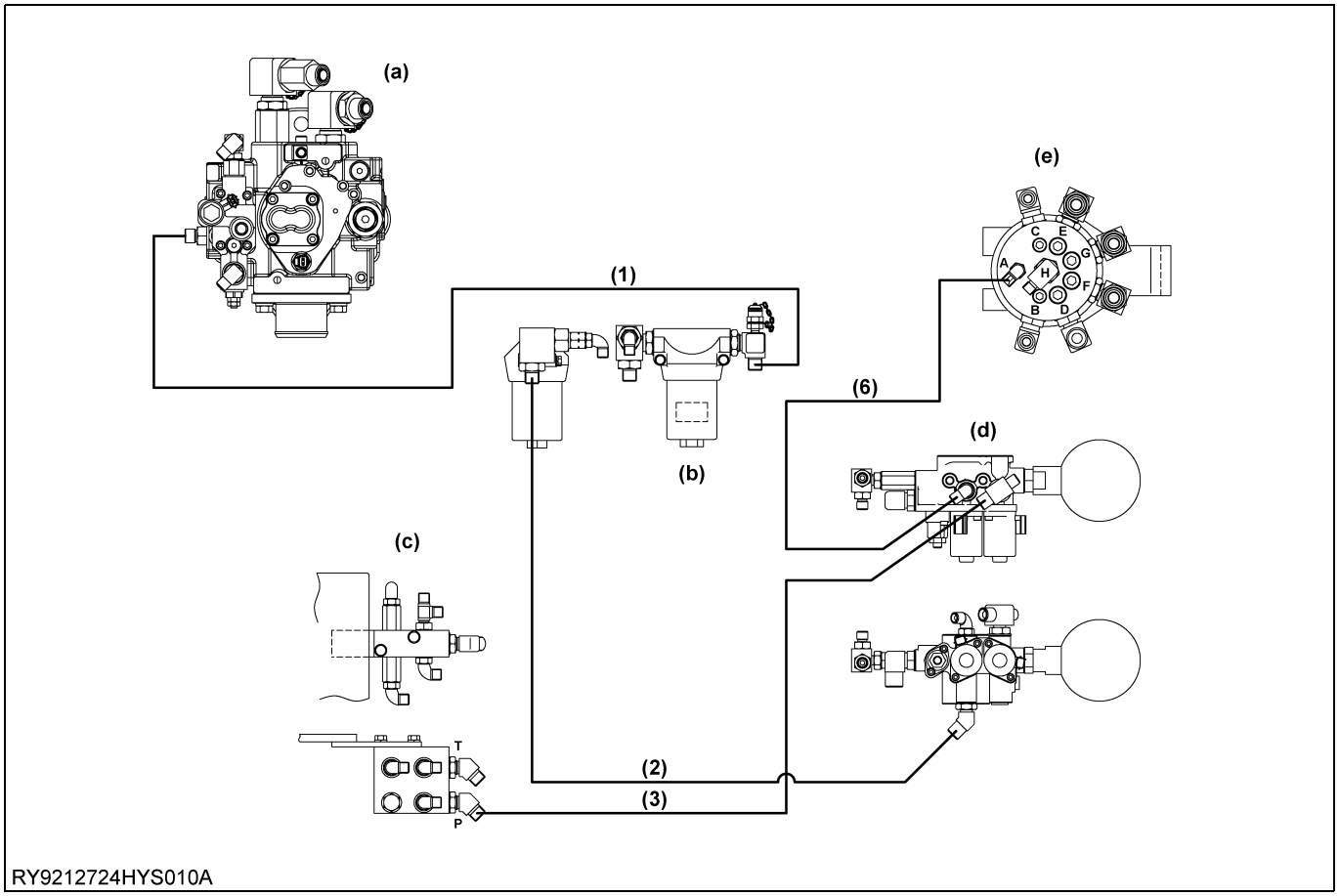
(a) Return Pipe
(b) Hydraulic Oil Tank
(c) 3-Way Valve
(d) Control Valve
(e) Swivel Motor
(f) Oil Cooler

No.	Function	Hose			Fitting		Guard	Point used
		Total length	Size	Tape color	Type	Size		
(1)	Return (T1)	550 mm 21.7 in.	1G	–	C·C	G1		C/V (T1) to return pipe
(2)	Return (T2)	450 mm 17.7 in.	3/4	Black	C·C	G3/4		C/V (T2) to swivel motor (M) (ST)
		500 mm 19.7 in.	3/4	Black × 2	C·C	G3/4		C/V (T2) to swivel motor (M) (2PB)
(3)	Swivel makeup	1180 mm 46.46 in.	5/8	–	C·C	G3/4	PVC tube	Swivel motor (M) to oil cooler
(4)	Return (T2)	800 mm 31.5 in.	3/4	Black	C·C	G3/4		Oil cooler to return pipe
(5)	Swivel drain	360 mm 14.2 in.	1/4	–	CR4·C	G1/4		Swivel motor (Dr) to oil tank
(6)	3-way valve	750 mm 29.5 in.	3/4	–	C·C	G3/4		3-way valve to swivel motor (M)

RY9212724HYS0054US0

[4] PILOT HOSES

(1) Deliver Hose Routing

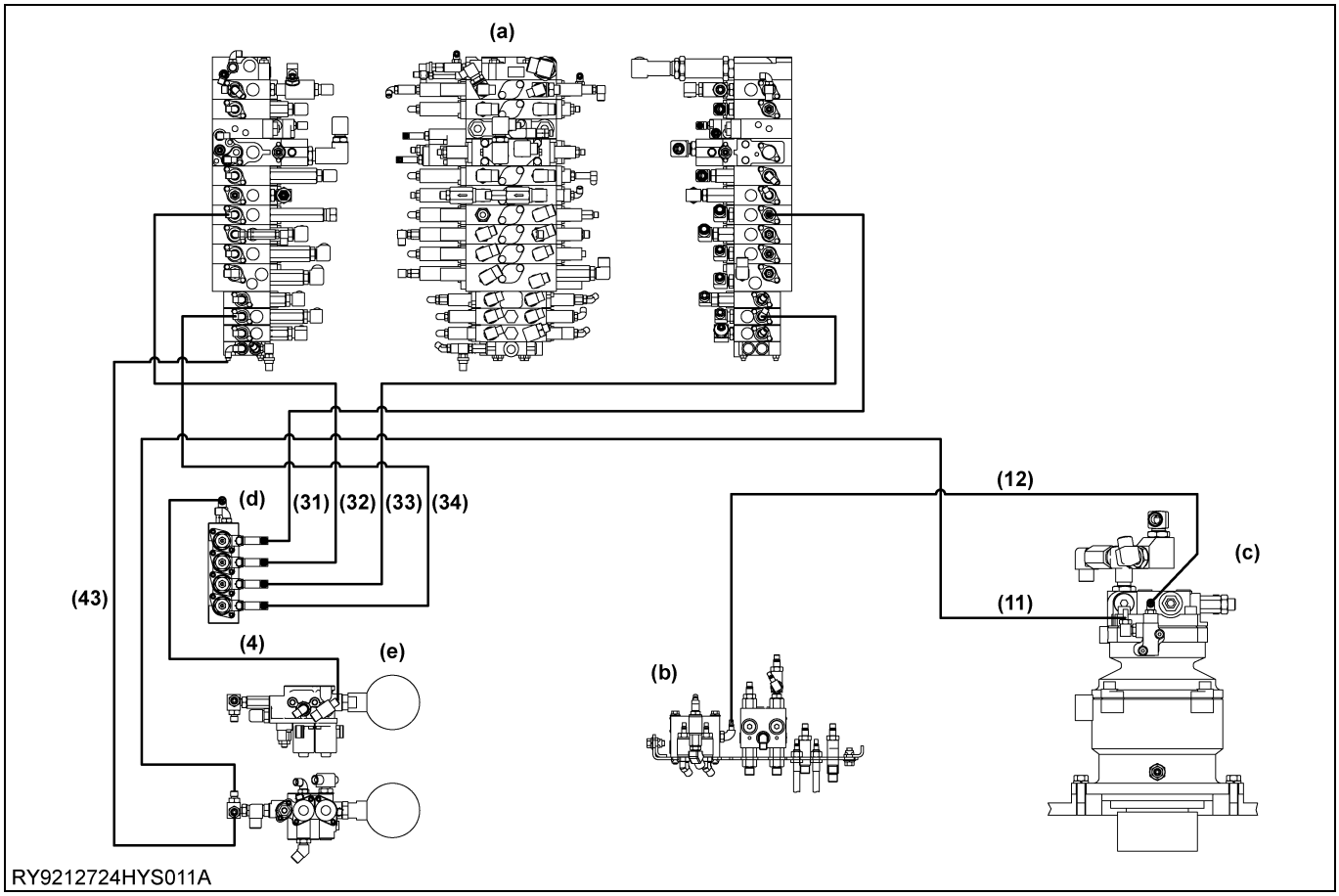


(a) Pump **(c) Collector Block** **(d) Unload Valve** **(e) Swivel Joint**
(b) Line Filter

No.	Function	Hose			Fitting		Point used
		Total length	Size	Tape color	Type	Size	
(1)	Pp	360 mm 14.2 in.	3/8	–	C·C	G3/8	Pump to line filter
(2)		2160 mm 85.04 in.	3/8	Red x 2	C·C	G3/8	Line filter to unload valve (C)
(3)		1860 mm 73.23 in.	3/8	Red	C·C	G3/8	Unload valve (B) to collector block (P)
(6)	Travel 2-speed	1530 mm 60.24 in.	1/4	Pea green	C·C	G1/4	Unload valve (B) to R/J travel 2-speed boost

RY9212724HYS0016US0

(2) Port P Hose Routing

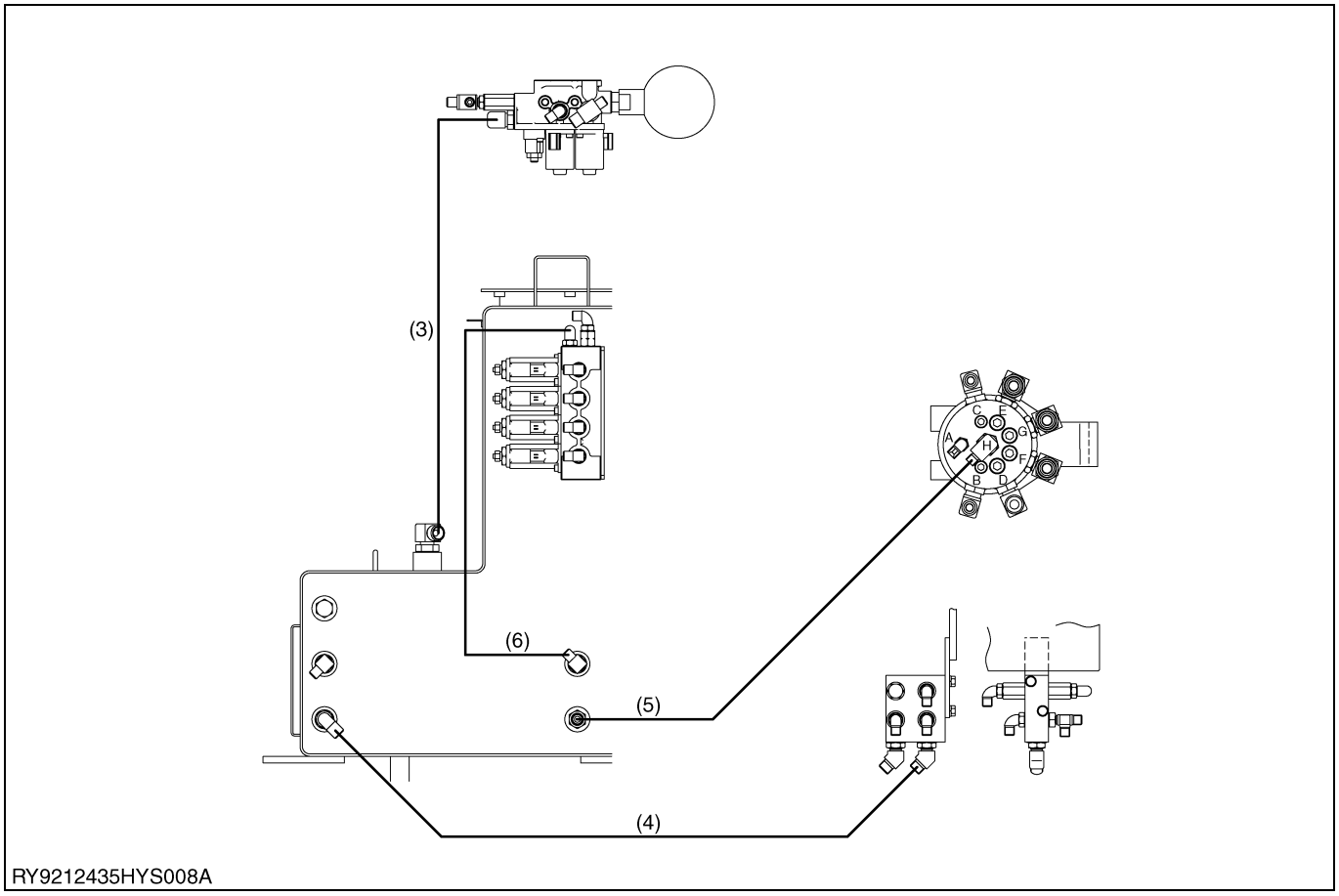


(a) Control Valve **(c) Swivel Motor** **(d) AUX1 Solenoid Valve** **(e) Unload Valve**
(b) Swivel Shuttle Valve

No.	Function	Hose			Fitting		Point used
		Total length	Size	Tape color	Type	Size	
(4)	AUX (P)	500 mm 19.7 in.	1/4	–	CR9·C	G1/4	Unload valve (B) to AUX 4-way valve (P)
(11)	Swivel brake (P)	640 mm 25.2 in.	1/4	Light blue	CR9·Q	G1/4·Q	Unload valve (P) to swivel motor brake (PG)
(12)	Swivel brake signal	1095 mm 43.11 in.	1/4	Light blue Gray	Q·CR9	Q·G1/4	Shuttle valve to swivel motor brake (SH)
(31)	AUX1 (P)	750 mm 29.5 in.	1/4	Pink	C·CR9	G1/4	AUX 4-way valve (A1) to C/V (AUX1 high pressure)
(32)		1140 mm 44.88 in.	1/4	Brown	C·CR9	G1/4	AUX 4-way valve (A2) to C/V (AUX1 low pressure)
(33)	AUX2 P	960 mm 37.8 in.	1/4	Pink × 2	C·C	G1/4	AUX 4-way valve (A3) to C/V (AUX2 high pressure)
(34)		1160 mm 45.67 in.	1/4	Brown × 2	C·CR9	G1/4	AUX 4-way valve (A4) to C/V (AUX2 low pressure)
(43)	Unload valve (P)	1380 mm 54.33 in.	1/4	–	CR9·C	G1/4	Unload valve (P) to C/V (PA)

RY9212724HYS0017US0

(3) Port T Hose Routing

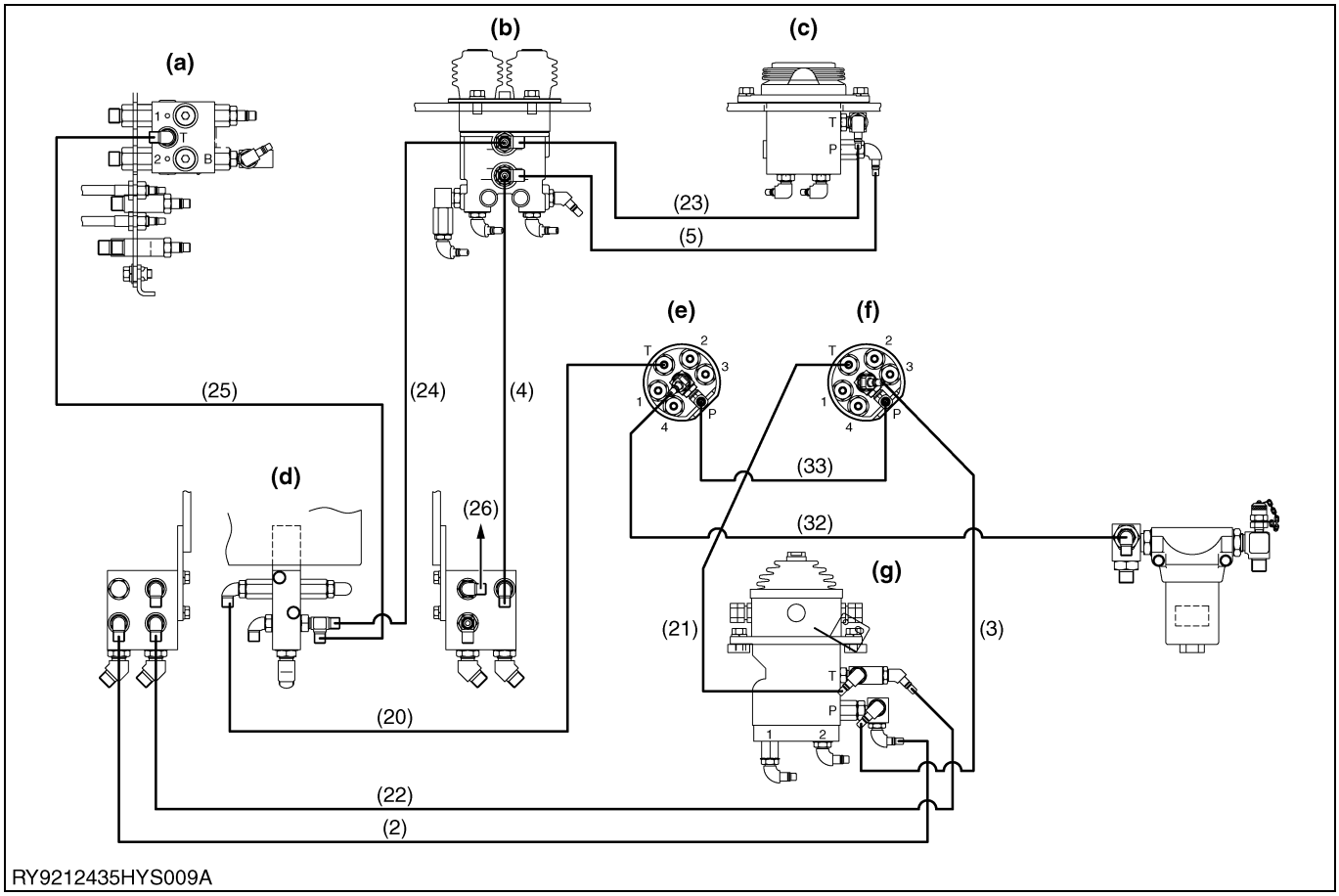


RY9212435HYS008A

No.	Function	Hose			Fitting		Point used
		Total length	Size	Tape color	Type	Size	
(3)	Drain	500 mm 19.7 in.	1/2	Green	C·C	G1/2	Switch valve (T) to tank
(4)		1720 mm 67.7 in.	3/8	Gray	C·C	G3/8	Collector block (T) to tank
(5)		990 mm 39.0 in.	3/8	Orange	C·CR9	G3/8	R/J (T) to tank
(6)		490 mm 19.3 in.	1/4	–	CR9·C	G1/4	SP 4-way valve (T) to tank

RY9212435HYS0086US0

(4) Ports P and T Pilot Valve Hose Routing



(a) Boom Shockless Valve
(b) Travel P/V
(c) Swing P/V
(d) Collector Block
(e) Control Left P/V
(f) Control Right P/V
(g) Blade P/V

(To be continued)

(Continued)

No.	Function	Hose			Fitting		Point used
		Total length	Size	Tape color	Type	Size	
(2)	Blade (P)	1660 mm 65.4 in.	1/4	White	C·Q	G1/4·Q	Collector block (P) to blade P/V (P)
(3)	P/V right (P)	235 mm 9.25 in.	1/4	White	Q·Q	Q	P/V (right) (P) to blade P/V (P)
(4)	Travel P/V (P)	350 mm 13.8 in.	1/4	White	C·C	G1/4	Collector block (P) to travel P/V (P)
(5)	Swing P/V (P)	280 mm 11.0 in.	1/4	White	C·Q	G1/4·Q	Travel P/V (P) to swing P/V (P)
(20)	Drain	1380 mm 54.33 in.	1/4	–	Q·C	Q·G1/4	P/V (left) (T) to collector block (T)
(21)		330 mm 13.0 in.	1/4	–	Q·Q	Q	P/V (right) (T) to blade P/V (T)
(22)		1600 mm 63.0 in.	1/4	Black	Q·C	Q·G1/4	Blade P/V (T) to collector block (T)
(23)		330 mm 13.0 in.	1/4	–	Q·C	Q·G1/4	Swing P/V (T) to travel P/V (T)
(24)		240 mm 9.45 in.	1/4	–	C·C	G1/4	Travel P/V (T) to collector block (T)
(25)		335 mm 13.2 in.	1/4	–	C·C	G1/4	Collector block (T) to shockless valve (T)
(26)		2720 mm 107.1 in.	1/4	Blue Yellow	C·C	G1/4	Boom H/V (Dr) to (P4, T) collector block
(32)	P/V left (P)	1580 mm 62.2 in.	1/4	White	C·Q	G1/4·Q	Line filter (P) to P/V (left) (P)
(33)	P/V right (P)	2135 mm 84.06 in.	1/4	White Yellow	Q·Q	Q	P/V (right) (P) to P/V (left) (P)

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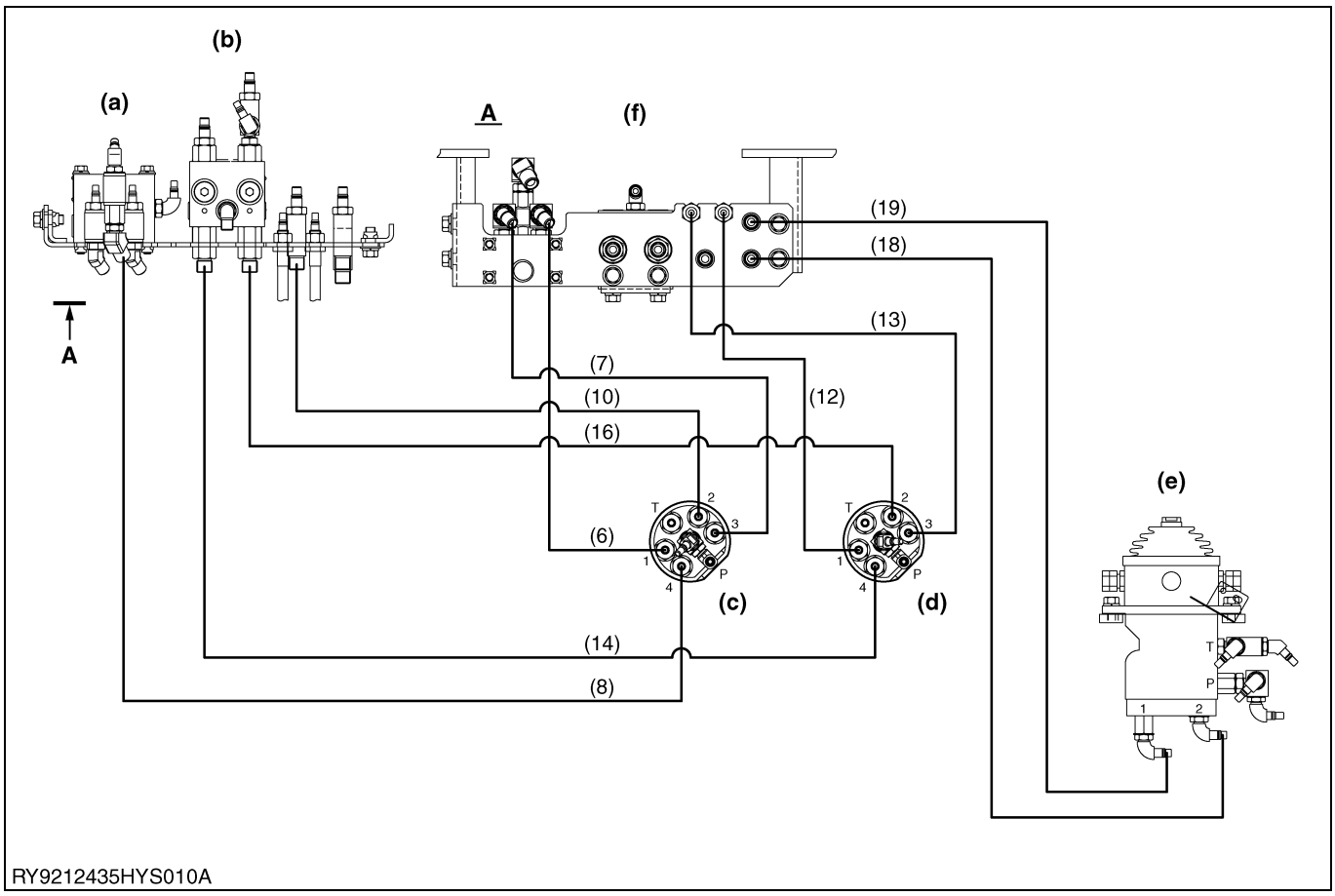
(5) Pilot Valve Hose Routing



RY9212435HYS010A

(a) Swivel Shuttle Valve
(b) Boom Shockless Valve
(c) Control Left P/V
(d) Control Right P/V
(e) Blade P/V
(f) Joint Plate

No.	Function	Hose			Fitting		Point used
		Total length	Size	Tape color	Type	Size	
(6)	Swivel left	1410 mm 55.51 in.	1/4	Gray	Q·C	Q·G1/4	P/V (swivel left) to shuttle valve
(7)	Swivel right	1415 mm 55.71 in.	1/4	Light blue	Q·C	Q·G1/4	P/V (swivel right) to shuttle valve
(8)	Arm crowd	1420 mm 55.91 in.	3/8	Blue	Q·C	Q·G3/8	P/V (arm crowd) to shuttle valve
(10)	Arm dump	1315 mm 51.77 in.	3/8	Pea green	Q·C	Q·G3/8	P/V (arm dump) to joint plate
(12)	Bucket crowd	1655 mm 65.16 in.	1/4	Orange	Q·Q	Q	P/V (bucket crowd) to joint plate
(13)	Bucket dump	1650 mm 64.96 in.	1/4	Red	Q·Q	Q	P/V (bucket dump) to joint plate
(14)	Boom up	1815 mm 71.46 in.	3/8	Green	Q·C	Q·G3/8	P/V (boom up) to shockless valve
(16)	Boom down	1840 mm 72.44 in.	3/8	Yellow	Q·C	Q·G3/8	P/V (boom down) to shockless valve
(18)	Blade up	1520 mm 59.84 in.	3/8	Pink	Q·C	Q·G3/8	Blade P/V (up) to joint plate
(19)	Blade down	1480 mm 58.27 in.	3/8	Brown	Q·C	Q·G3/8	Blade P/V (down) to joint plate

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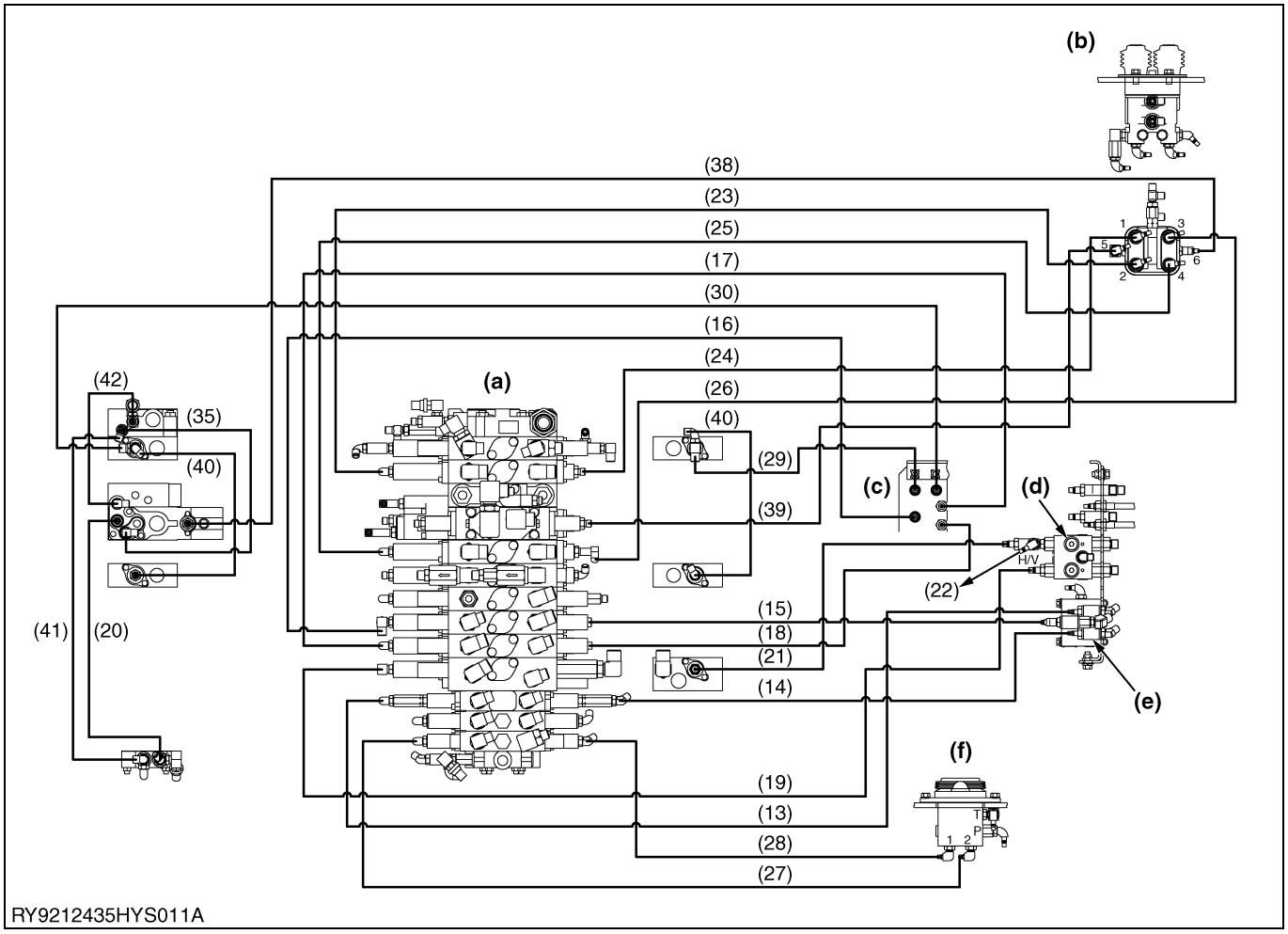

(a) Control Valve
(b) Travel P/V
(c) Joint Plate
(d) Boom Shockless Valve
(e) Swivel Shuttle Valve
(f) Swing P/V

(To be continued)

(Continued)

No.	Function	Hose			Fitting		Point used
		Total length	Size	Tape color	Type	Size	
(13)	Swivel left	1810 mm 71.26 in.	1/4	Gray	Q·CR9	Q·G1/4	Shuttle valve to C/V (swivel left)
(14)	Swivel right	1350 mm 53.15 in.	1/4	Light blue	Q·C	Q·G1/4	Shuttle valve to C/V (swivel right)
(15)	Arm crowd	1405 mm 55.31 in.	3/8	Blue	Q·C	Q·G3/8	Shuttle valve to C/V (arm crowd)
(16)	Arm dump	1980 mm 77.95 in.	3/8	Pea green	Q·CR9	Q·G3/8	Joint plate to C/V (arm dump)
(17)	Bucket crowd	1860 mm 73.23 in.	1/4	Orange	Q·CR9	Q·G1/4	Joint plate to C/V (bucket crowd)
(18)	Bucket dump	1410 mm 55.51 in.	1/4	Red	Q·C	Q·G1/4	Joint plate to C/V (bucket dump)
(19)	Boom up	1740 mm 68.5 in.	3/8	Green	Q·CR9	Q·G3/8	Shockless valve to C/V (boom up)
(20)	PA (standard)	500 mm 19.7 in.	1/4	Green	CR9·C	G1/4	C/V (PA IN) to C/V (PA OUT)
	PA (two piece)	540 mm 21.3 in.	1/4	Green × 2	CR9·C	G1/4	
(21)	Boom down	1270 mm 50.0 in.	3/8	Yellow	Q·C	Q·G3/8	Shockless valve to C/V (boom down)
(22)	Boom down signal	2205 mm 86.81 in.	1/4	Yellow White	Q·C	Q·G1/4	Shockless valve to boom H/V (boom down signal)
(23)	Travel left forward	2100 mm 82.68 in.	1/4	Red × 2	Q·CR9	Q·G1/4	Travel P/V (L-FWD) to C/V (L-FWD)
(24)	Travel left rear	1800 mm 70.87 in.	1/4	Blue × 2	Q·CR9	Q·G1/4	Travel P/V (L-BWD) to C/V (L-BWD)
(25)	Travel right forward	2070 mm 81.5 in.	1/4	Yellow × 2	Q·CR9	Q·G1/4	Travel P/V (R-FWD) to C/V (R-FWD)
(26)	Travel right rear	1660 mm 65.35 in.	1/4	Green × 2	Q·C	Q·G1/4	Travel P/V (R-BWD) to C/V (R-BWD)
(27)	Swing left	1770 mm 69.68 in.	1/4	Orange × 2	Q·CR9	Q·G1/4	Swing P/V (left) to C/V (swing left)
(28)	Swing right	1390 mm 54.72 in.	1/4	Pea green × 2	Q·C	Q·G1/4	Swing P/V (right) to C/V (swing right)
(29)	Blade up	1630 mm 64.17 in.	3/8	Pink	Q·C	Q·G3/8	Joint plate to C/V (blade up)
(30)	Blade down	1900 mm 74.8 in.	3/8	Brown	Q·CR9	Q·G3/8	Joint plate to C/V (blade down)
(35)	PP1	350 mm 13.8 in.	1/4	Blue Red	CR9·C	G1/4	C/V (PT) to C/V (PP1)
(38)	Travel P/V right (P)	2100 mm 82.68 in.	1/4	Yellow Green	CR9·Q	G1/4·Q	C/V (P1 right) to travel P/V (P1 right)
(39)	Travel P/V left (P)	1850 mm 72.83 in.	1/4	Blue Red	CR9·Q	G1/4·Q	C/V (P1 left) to travel P/V (P1 left)
(40)	Blade	275 mm 10.8 in.	1/4	Pink	CR9·C	G1/4	C/V (blade I) to C/V (blade II)
(41)	PA (standard)	660 mm 26.0 in.	1/4	White	CR9·C	G1/4	C/V (PA) to C/V (PT)
	PA (two piece)	700 mm 27.6 in.	1/4	White × 2	CR9·C	G1/4	
(42)	PT	340 mm 13.4 in.	1/4	Green	CR9·C	G1/4	C/V (PT OUT) to C/V (PT IN)

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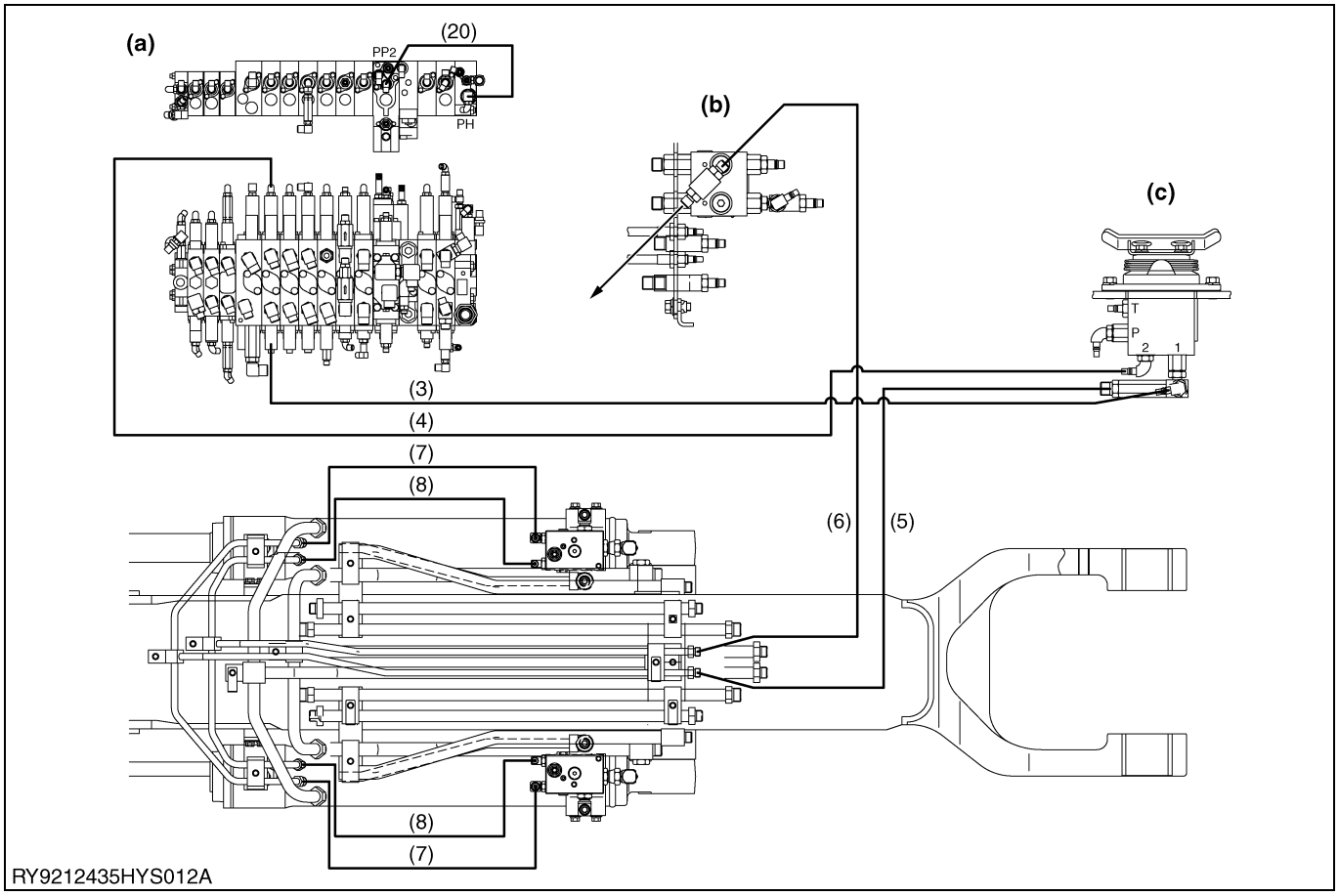
(6) Two Piece Boom Hose Routing



(a) Control Valve **(b) Boom Shockless Valve** **(c) Two Piece Boom P/V**

No.	Hose			Fitting		Guard	Point used
	Total length	Size	Tape color	Type	Size		
(3)	1890 mm 74.41 in.	1/4	Yellow Gray	Q·C	Q·G1/4		Two piece boom P/V (crowd) to C/V (Two piece crowd)
(4)	2260 mm 88.98 in.	1/4	Green Gray	Q·CR9	Q·G1/4		Two piece boom P/V (dump) to C/V (dump)
(5)	3310 mm 130.3 in.	3/8	–	C·C	G3/8	Colgate tube	Two piece boom P/V (crowd) to boom back pipe (lock release)
(6)	2855 mm 112.4 in.	1/4	–	C·C	G1/4	Colgate tube	Boom back pipe (Dr) to shockless valve (T)
(7)	540 mm 21.3 in.	3/8	–	C·CR9	G3/8	Colgate tube	Boom back pipe (lock release) to Two piece boom H/V (PL)
(8)	520 mm 20.5 in.	1/4	–	C·CR9	G1/4	Colgate tube	Two piece boom H/V (Dr) to boom back pipe (Dr)
(20)	250 mm 9.84 in.	1/4	–	CR9·C	G1/4		C/V (PP2) to C/V (PH)

RY9212435HYS0090US0

13. MEASURING HYDRAULIC DEVICE PERFORMANCE

[1] PISTON PUMP AIR BLEEDING PROCEDURE

Purpose

- When disassembling or replacing hydraulic equipment and/or hoses, etc., after changing the hydraulic fluid and using the vacuum pump, and before operating the machine, always air bleed the pump to prevent pump scorching or cavitation.

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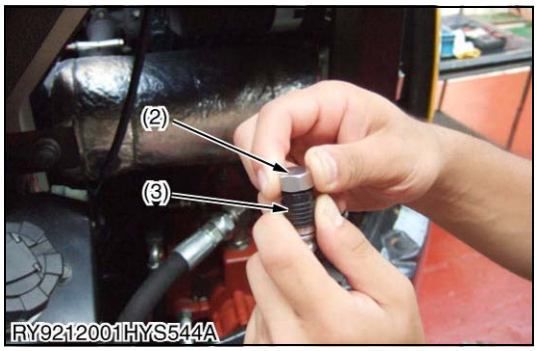

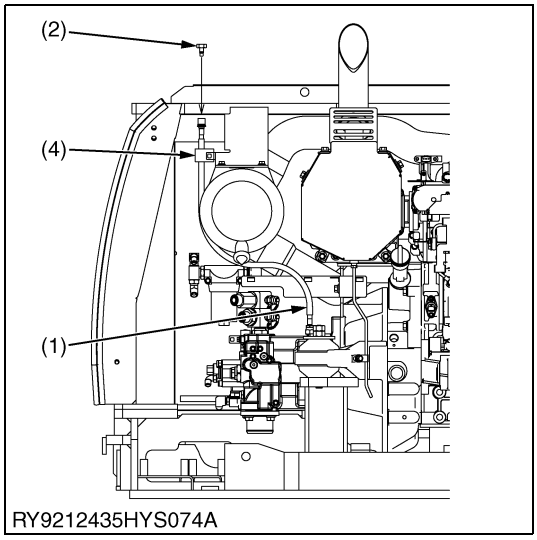

Work Tip

To prevent cavitation, never relieve pressure during air bleeding.

1. With the engine stopped, remove the hose at the top of the pump from its clamp.
2. Gradully loosen oil filling plug on the tank to release pressure in the tank. Press the hexagonal plug of the air bleed hose and the black plastic lock section as well. Then hold the black plastic lock section and pull out the hexagonal plug.
3. Drape the hose on the front of the weight, and leave for 30 seconds.
4. Fit a hexagonal plug to the hose, start and idle the engine, and check whether there is any cavitation noise from the pump.
5. Repeat operations 2, 3 and 4 until pump cavitation noise subsides.
6. When cavitation noise subsides, raise the engine speed to 1500 rpm, slowly operate the arm and check whether any cavitation noise is produced.
7. If there is no cavitation noise, raise the engine speed to 2000 rpm, slowly operate the arm, and check again for cavitation noise. If cavitation noise is produced, stop the engine and carry out steps 2, 3 and 4.
8. Take the engine to max RPM, slowly operate the arm and check for cavitation noise. If cavitation noise is produced, stop the engine and carry out steps 2, 3 and 4.
9. Clamp the air bleed hose in its original position.

(1) Air Bleed Hose
(2) Hexagonal Plug
(3) Lock Section
(4) Clamp

RY9212435HYS0091US0

[2] RELEASE OF RESIDUAL PRESSURE IN THE HYDRAULIC SYSTEM

Purpose

- It is necessary to release the pressure in the hydraulic system when removing/mounting hydraulic devices and as preparation for taking measurements. Always release the pressure in such cases.

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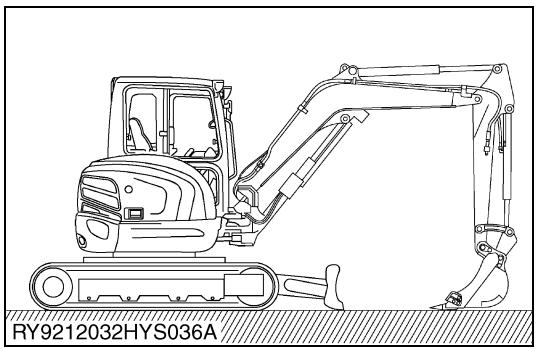
RY9212032HYS036A

Hydraulic System Pressure Release Procedure

1. Place the machine on firm, level ground, lower the bucket and blade to ground level, and stop the engine.

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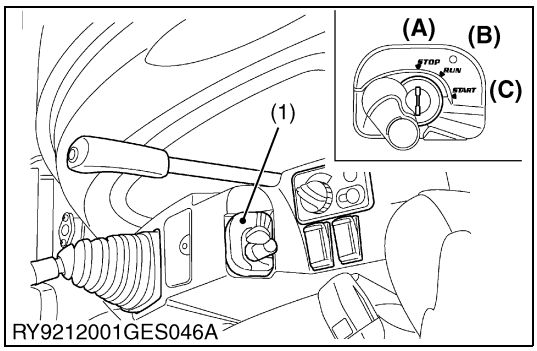

RY9212001GES046A

2. Without starting the engine, place the engine starter switch in the "RUN" **(B)** position.

(1) Starter Switch
(A) STOP
(B) RUN
(C) START

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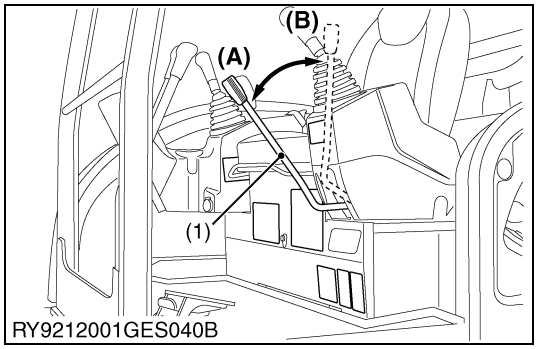

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3. Place the machine lock lever in the release position.

(1) Machine Lock Lever
(A) Release
(B) Lock

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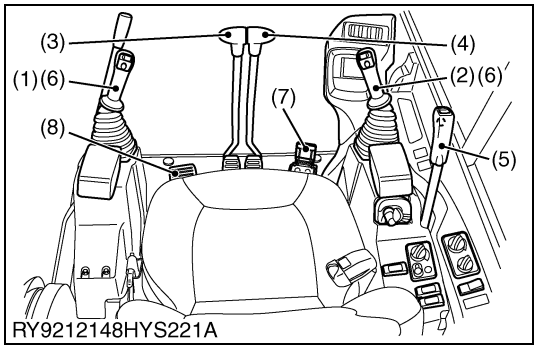

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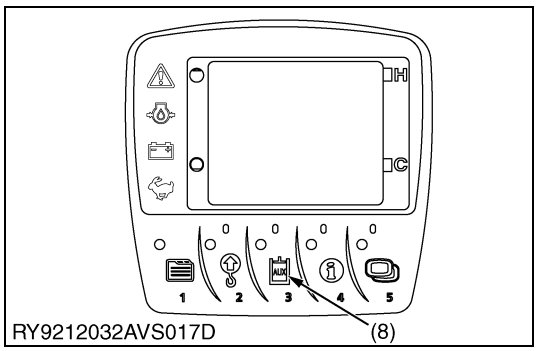

RY9212032AVS017D

4. Operate each control lever for the boom, arm, bucket and swivel to full stroke.
5. Operate each of the travel levers, blade levers, swing pedals and two piece boom pedals to full stroke.
6. Use the AUX enable switch to turn the AUX ports ON and then operate each of the AUX port knob switches full stroke.
7. Place the machine's lock lever in the "Lock" position, and the engine starter switch to the "STOP" position.
8. Loosen the filler port on top of the hydraulic oil tank one half to a full turn to relieve pressure.

(1) Left Machine Control Lever
(2) Right machine Control Lever
(3) Travel Lever Left
(4) Travel Lever Right
(5) Blade Control Lever
(6) AUX Port Knob Switch
(7) Swing Pedal
(8) Two Piece Boom Pedal (Two Piece Boom Spec. only)
(9) AUX Enable Switch

RY9212724HYS0056US0

[3] MANUAL BOOM LOWERING PROCEDURE

Purpose

- This procedure is used in cases where the accumulator stops working and you have an urgent need to lower the boom.

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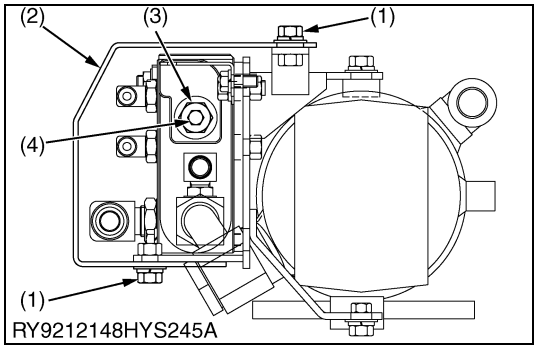


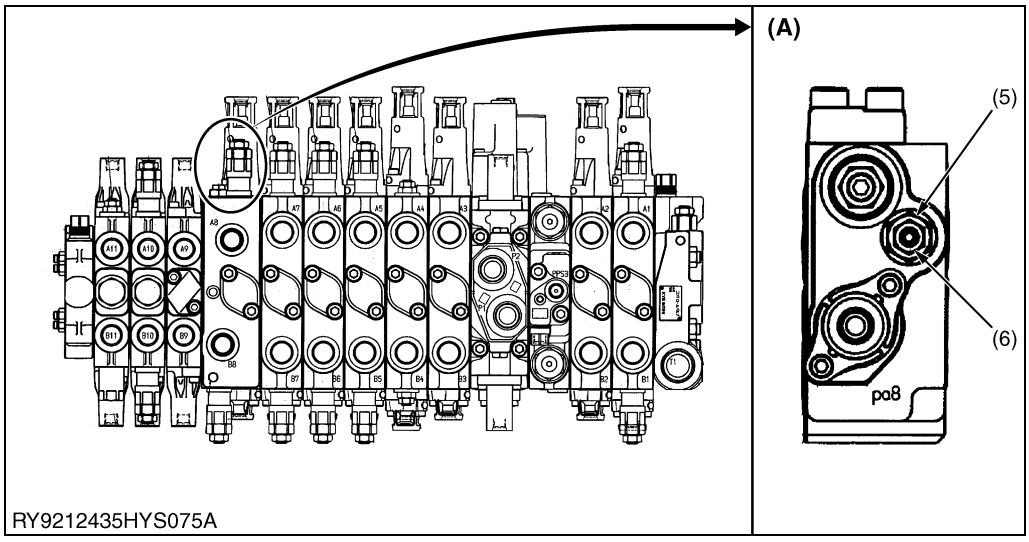
RY9212148HYS245A

Work Procedure

1. With the engine stopped, remove the holding valve cover.
2. Loosen the nut on the holding valve and turn the screw in 45 ° (0.79 rad).
3. Loosen the shutoff valve nut of the boom lock valve.
4. Loosen the boom lock valve screw 45 ° (0.79 rad).

CAUTION

- **Never get under the boom.**
- **After lowering the boom, be sure to retighten the screw and nut to their original positions.**
- **If you overloosen the screw and it comes off, oil will leak out and the boom will drop quickly.**



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(1) Bolt
(2) Cover
(3) Nut
(4) Screw
(5) Nut (Boom Lock Valve)
(6) Screw (Boom Lock Valve)

(A) Boom Lock Valve

RY9212435HYS0092US0

[4] MEASURING THE FLOW RATE

(1) Measuring Main Pump Flow

Purpose

- Measuring the amount of oil discharged from the main pump allows an assessment of its performance.
- If the discharge volume is lower than the factory specification, something may be wrong with the main pump or the engine.

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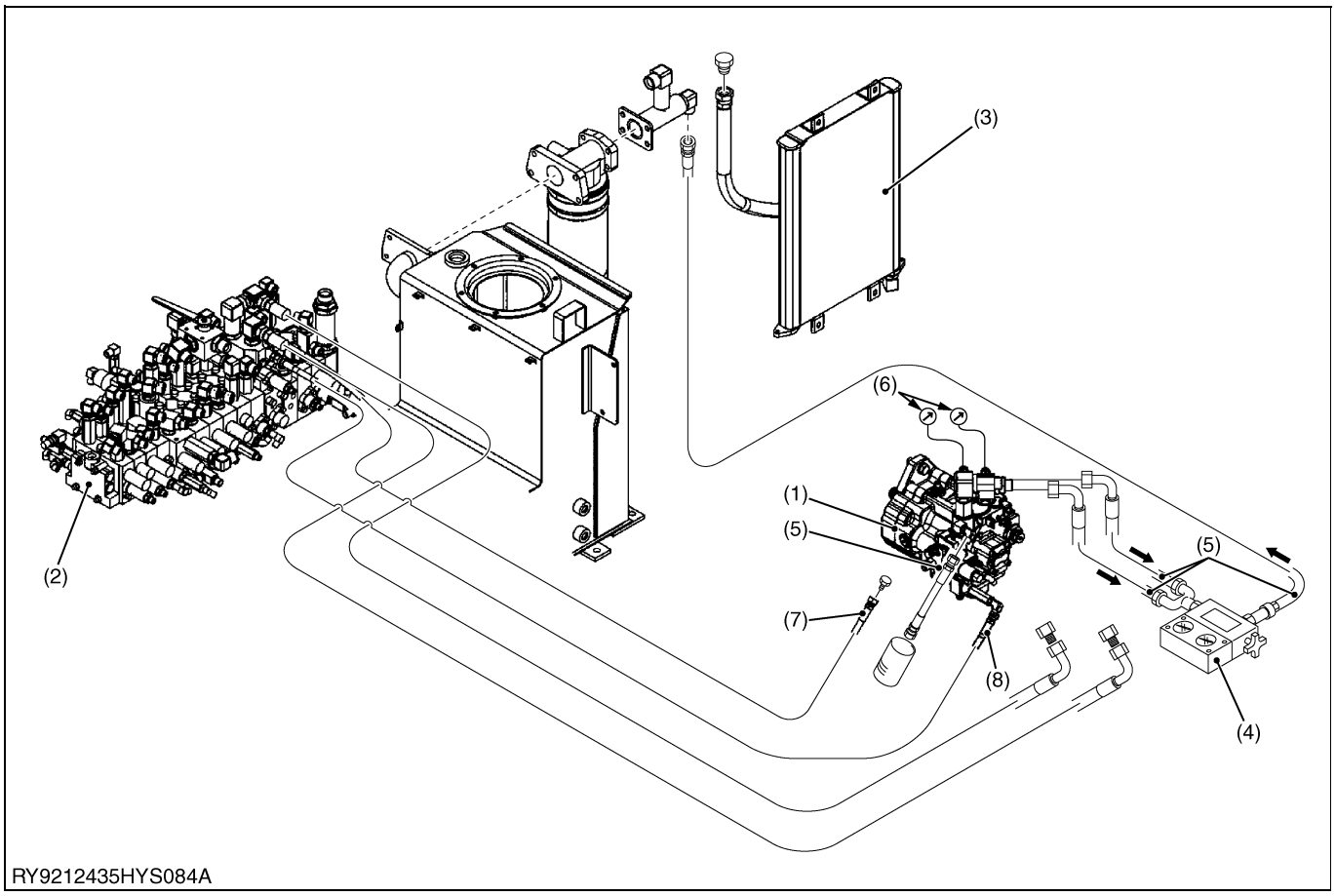

RY9212435HYS084A

(1) Pump
(2) Control Valve
(3) Oil Cooler
(4) Flow Meter
(5) Test Hose
(6) Pressure Gauge
(7) PPS
(8) PLS

RY9212435HYS0093US0

[Measurement preparations]

■ **If measuring the flow rates for P1 and/or P2 (piston pump)**

1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Releasing Pressure in the Hydraulic System and release pressure in the hydraulic lines.
3. Disconnect the P1 and P2 delivery hoses on the pump side and plug the disconnected hoses.
4. Connect a test hose to the P1, P2 discharge ports and connect the flow meter on the IN side (Use an adapter to combine the flows).
5. Disconnect the return hose from the oil cooler OUT side on the return filter side and plug the disconnected hose.
6. Use a test hose to connect the return pipe and the OUT side of the flow meter.
7. Disconnect the PPS hose on the pump side and insert a plug in the disconnected hose.
8. Connect a test hose to the PPS joint on the pump side and place an oil receptacle under the hose end to collect the oil discharge.
9. Remove the vacuum pump and bleed air from the pump and make sure there are not any oil leaks in any of the lines.

RY9212435HYS0094US0

[Measurement]
1. Open the loading valve of the flow meter all the way and start the engine.
2. Bring the hydraulic oil temperature to 50 ± 5 °C (122 ± 9 °F).
3. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max RPM	OFF	OFF

4. Gradually close the flow meter's loading valve until it reaches the main relief pressure, then measure the oil flow and engine RPM at each pressure.
5. Take three measurements of the oil flow, determine the average and take that as the measured value.
6. Convert the measured value to what it would be with the engine at its rated RPM.

RY9212724HYS0020US0

(2) Measuring AUX Discharge Flow

Purpose

- Measuring the flow at the AUX discharge port allows you to confirm AUX port discharge while under load.

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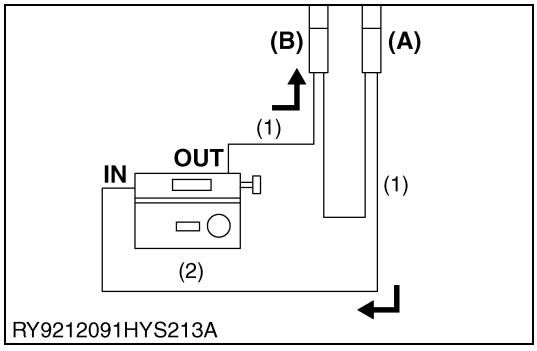

RY9212091HYS213A

[Measurement preparations]
1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Releasing Pressure in the Hydraulic System and release pressure in the hydraulic lines.
3. Connect a vacuum pump.
4. Connect the AUX discharge (high-pressure side) and the IN side of the flow meter with a test hose.
5. Connect the OUT side of the flow meter and the AUX discharge (low-pressure side) with a test hose.
6. Remove the vacuum pump.

[Measurement]
1. Open the loading valve of the flow meter completely and start the engine.
2. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
3. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max RPM	OFF	OFF

4. Gradually close the flow meter's loading valve until it reaches the relief pressure, then measure the oil flow at each pressure.
5. Take three measurements of the oil flow, determine the average and take that as the measured value.

■ **IMPORTANT**
- **First ensure the correct flow direction of the flow meter. Secondly ensure that the AUX slide is activated in the correct direction.**

(1) Test Hose
(2) Flow Meter
(A) AUX LH Pressure Side
(B) AUX RH Pressure Side

RY9212724HYS0021US0

[5] MEASURING PRESSURE

(1) Measuring Main Relief Valve Pressure

Purpose

- Verification of correct pressure setting.
- If the measured value is low, there may be a problem with the relief valve and/or leaks in other hydraulic devices.

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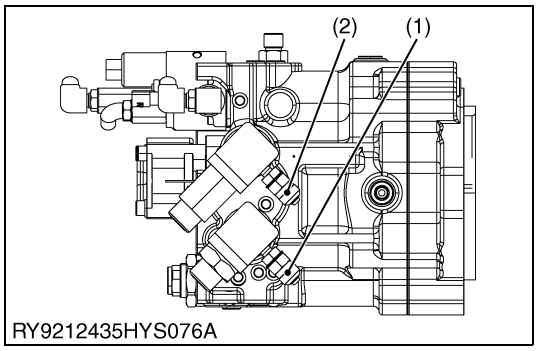

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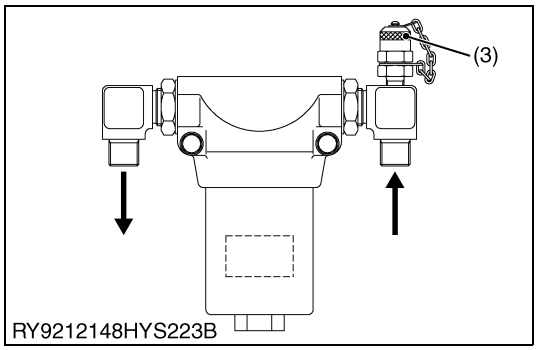

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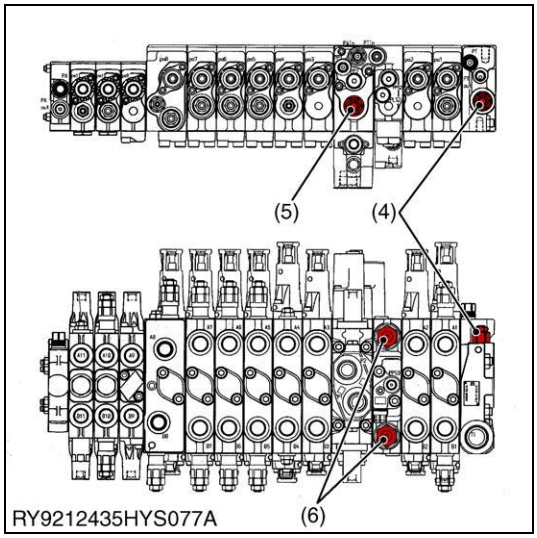

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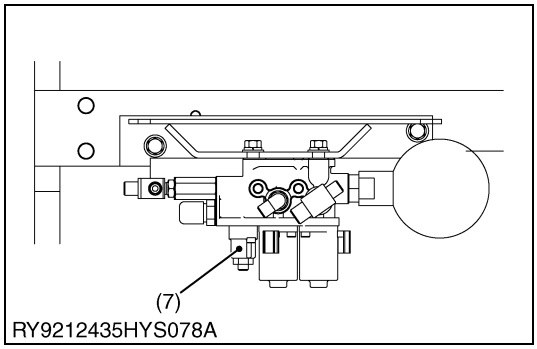

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[Measurement Preparations]

1. Place the machine on firm level ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter releasing pressure in the hydraulic system and release pressure in the hydraulic lines.
3. Start and idle the engine, and check that there is no oil leakage.
4. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).

[Measurement]

1. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max PRM	OFF	OFF

2. Measurement of the P1, P2 and main relief valve is lowering the blade and gradually operating the cylinder reaches the end of stroke until relief.
3. Measurement of unload LS pressure is check the discharge pressure of P1 or P2 when do not operation.
4. Measurement of pilot primary pressure is check the discharge pressure of P4 when do not operation.
5. Measure the pressure three times, determine the average and take that as the measured value.

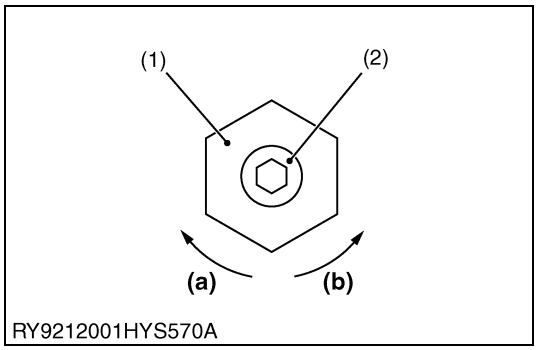
(1) P1 Pressure Detection Port
(2) P2 Pressure Detection Port
(3) Pp Pressure Detection Port
(4) Main P1 Relief Valve (aP1)
(5) Main P2 Relief Valve (aP2)
(6) Unload Ls Valve (aUN)
(7) Pilot Primary Pressure Relief Valve (aPP)

RY9212724HYS0023US0

Adjusting the Main Relief Valve

CAUTION

- **Only adjust the valve if the pressure setting of the main relief valve is lower than specification.**
- **If the pressure is raised above the setting value, it may cause damage to equipment, so never raise the pressure above the setting value.**



RY9212001HYS570A

1. Loosen the relief valve lock nut.
2. Use a hexagonal wrench to turn the adjuster screw, and tighten the lock nut.
3. After setting the pressure, always check the setting according to the section Measuring the Main Relief Valve Pressure.

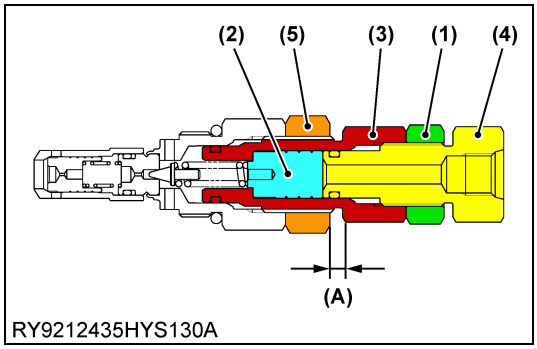
(1) Lock Nut
(2) Adjuster Screw
(a) Pressure Increase
(b) Pressure Decrease

RY9212148HYS0319US0

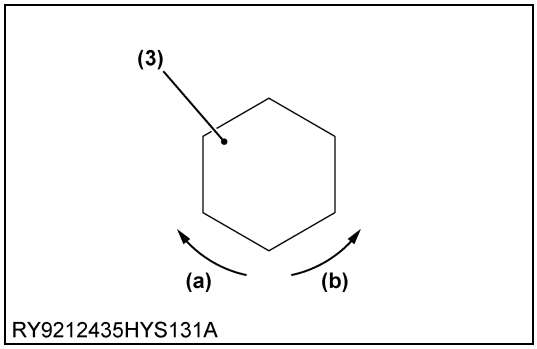
Pressure Change/Turn for Main Relief Valve (Reference Values)

Amount adjuster screw turned	1/4	1/2	3/4	1
• Main relief valve	4.4 MPa 45.1 kgf/cm^2 642 psi	8.9 MPa 90.8 kgf/cm^2 1291 psi	13.3 MPa 135.4 kgf/cm^2 1925 psi	17.7 MPa 180.5 kgf/cm^2 2567 psi
• Pilot primary pressure relief valve	0.2 MPa 2.0 kgf/cm^2 29 psi	0.4 MPa 4.1 kgf/cm^2 58 psi	0.6 MPa 6.1 kgf/cm^2 87 psi	0.8 MPa 8.2 kgf/cm^2 116 psi

RY9212435HYS0140US0



RY9212435HYS130A



RY9212435HYS131A

Adjusting the variable relief valve

Adjusting the high pressure Main Relief Valve

1. Loosen the lock nut (1). Tighten the plug (4) below the specified torque until the piston (2) hits the end face of the plug (3).

■ **IMPORTANT**

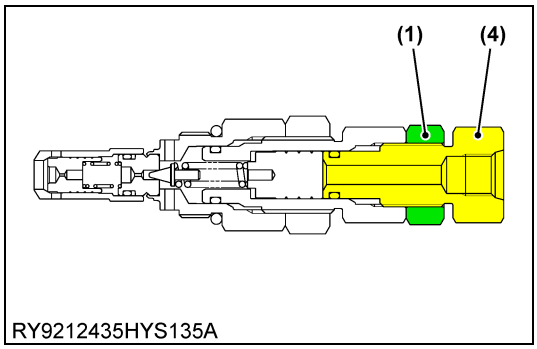
- Tighten the plug (4) to ensure that the plug (3) dose not rotate at the same time and secure a clearance (A) of 4 mm or more.

2. Tighten the lock nut (1) with the specified torque.
3. Loosen the lock nut (5), and turn the plug (3) to set the pressure. Tighten the lock nut (5) with the specified torque.
4. After setting the pressure, always check the setting according to the section Measuring the Main Relief Valve Pressure.

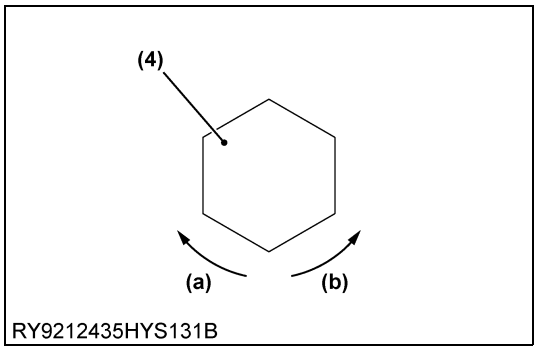
Tightening torque	Plug (4)	19.6 N·m 2.0 kgf·m 14.5 lbf·ft
	Lock nut (1)	59 to 69 N·m 6.0 to 7.0 kgf·m 44 to 51 lbf·ft
	Lock nut (5)	78 to 88 N·m 8.0 to 9.0 kgf·m 58 to 65 lbf·ft

(1) Lock Nut
(2) Piston
(3) High Pressure Side Adjustment Plug
(4) Low Pressure Side Adjustment Plug
(5) Lock Nut

(a) Pressure Increase
(b) Pressure Decrease
(A) 4 mm (0.2 in.) or more



RY9212435HYS135A



RY9212435HYS131B

Adjusting the low pressure Main Relief Valve

1. After setting the pressure of the high pressure relief valve, loosen the lock nut (1). Turn the plug counterclockwise to adjust the pressure at the low pressure side. Tighten the lock nut (1) with the specified torque.
2. After setting the pressure, always check the setting according to the section Measuring the "Main Relief Valve Pressure".

Tightening torque	Lock nut (1)	59 to 69 N·m 6.0 to 7.0 kgf·m 44 to 51 lbf·ft

(1) Lock Nut
(4) Low Pressure Side Adjustment Plug

(a) Pressure Increase
(b) Pressure Decrease

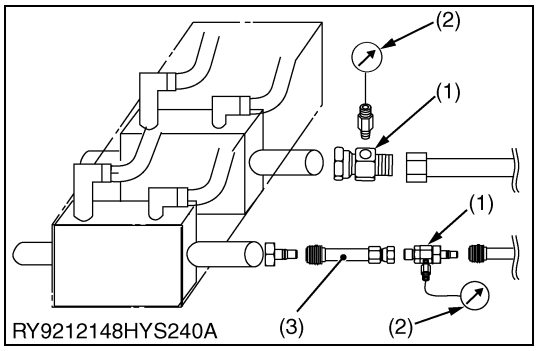
RY9212435HYS0142US0

(2) Measuring Pilot Secondary Pressure

Purpose

- Measure the pressure between the control valves and the oil from each pilot valve and solenoid and make sure they are at specified values.
- If the pressure is lower than the factory specification, in general it indicates something may be wrong with the pilot valve or solenoid valve.

RY9212148HYS0323US0



RY9212148HYS240A

[Measurement preparations]

1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Releasing Pressure in the Hydraulic System and release pressure in the hydraulic lines.
3. Use the vacuum pump and then fit an adapter and test hose to the pilot port on the control valve side to be measured and attach a pressure gauge.
4. Remove the vacuum pump.
5. Start and idle the engine, and check that there is no oil leakage.
6. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).

[Measurement]

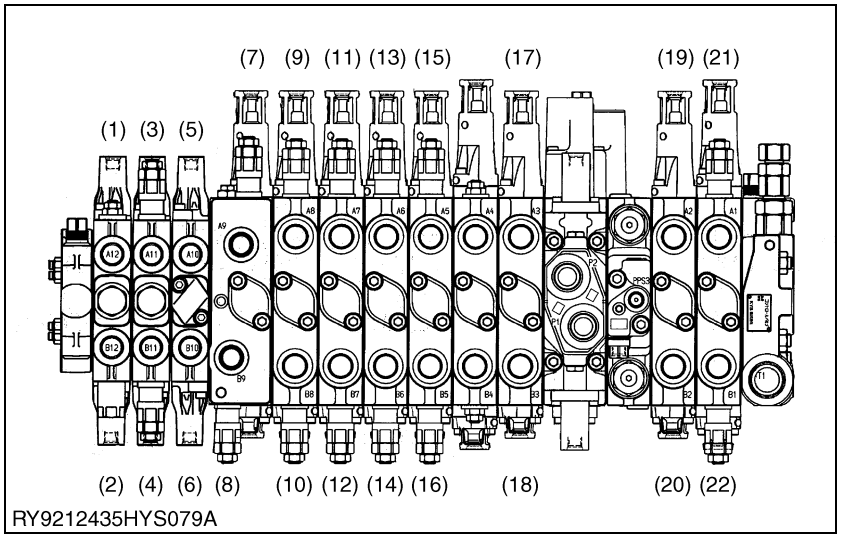
1. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max RPM	OFF	OFF

2. Operate the lever to be tested and measure the secondary pilot pressure at full stroke.
   - When measuring cylinder secondary pressure, take the measurement when at the cylinder end.
   - When measuring motor secondary pressure, take the measurement with it locked.
3. Measure the pressure three times, determine the average and take that as the measured value.

(1) Adapter
(2) Pressure Gauge
(3) Test Hose

RY9212724HYS0024US0



RY9212435HYS079A

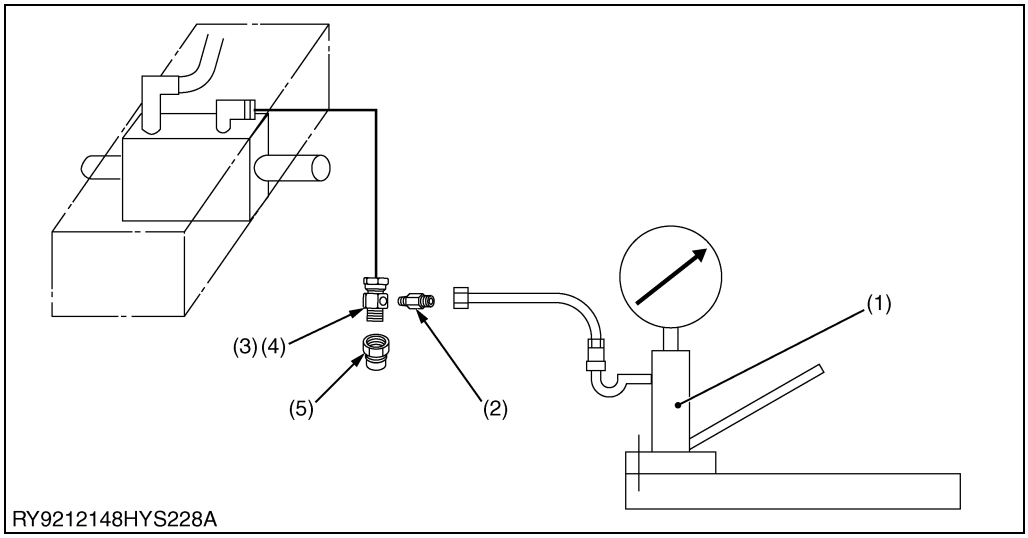
(1) Swing Left
(2) Swing Right
(3) AUX2 Low
(4) AUX2 High
(5) Swivel Right
(6) Swivel Left
(7) Boom Up
(8) Boom Down
(9) Two Piece Dump
(10) Two Piece Crowd
(11) Bucket Crowd
(12) Bucket Dump
(13) Arm Dump
(14) Arm Crowd
(15) AUX1 Low
(16) AUX1 High
(17) Travel Right Forward
(18) Travel Right Rear
(19) Travel Left Forward
(20) Travel Left Rear
(21) Blade Down
(22) Blade Up

RY9212724HYS0057US0

(3) Measuring the Overload Relief Valve Pressure

■ **IMPORTANT**

- **If it is necessary to check the overload relief pressure on this machine, measure the main relief pressure of each circuit (boom, arm, bucket, blade, AUX and two piece boom) and if the main relief pressures are within factory specifications, the overload relief valve is judged to be normal.**
- **If there is a problem, we recommend replacing the overload relief valve as an assembly.**
- **If a measurement has to be made for some reason, the procedures is as follows.**



RY9212148HYS228A

(1) Pressure Measuring Kit
(2) Pipe Joint (R1/8-G1/4)
(3) Straight Pipe Joint (13/16U)
(4) Straight Pipe Joint (1/14U)
(5) Plug

RY9212724HYS0058US0

[Measurement preparations]

1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Release of Residual Pressure in the Hydraulic System and release the residual pressure in the hydraulic lines.
3. Use the vacuum pump and disconnect the high pressure hose from the port where the overload relief valve to be measured is mounted and plug the hose.
4. Attach the pressure measuring kit to the disconnected port.
5. Remove the vacuum pump.
6. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).

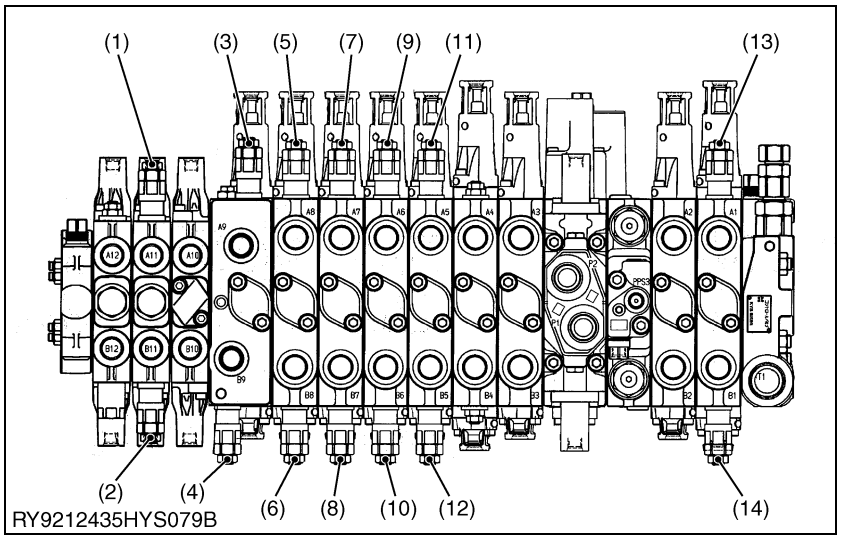
[Measurement]

1. Increase the pressure with the pressure measuring kit until the overload relief valve opens.
2. Measure the pressure three times, determine the average and take that as the measured value.

CAUTION

- **When disconnecting the pressure measuring kit, take appropriate care in removing it as the line is pressurized.**

RY9212148HYS0329US0



RY9212435HYS079B

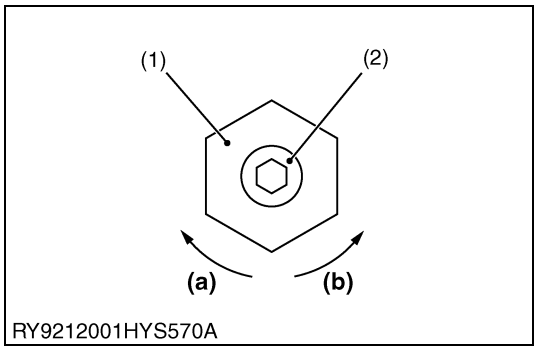
(1) AUX2 Low
(2) AUX2 High
(3) Boom Rod
(4) Boom Bottom
(5) Two Piece Bottom
(6) Two Piece Rod
(7) Bucket Bottom
(8) Bucket Rod
(9) Arm Rod
(10) Arm Bottom
(11) AUX1 Low
(12) AUX1 High
(13) Blade Rod
(14) Blade Bottom

RY9212724HYS0059US0

Adjusting the overload relief valve

CAUTION

- **Only adjust the valve if the pressure setting of the overload relief valve is low.**
- **If the pressure is raised above the setting value, it may cause damage to equipment, so never raise the pressure above the setting value.**



RY9212001HYS570A

1. Loosen the relief valve lock nut.
2. Use a hexagonal wrench to turn the adjuster screw and then tighten the lock nut.
3. After setting the pressure, always check the setting according to the section Measuring the Overload Relief Valve Pressure.

(1) Lock Nut
(2) Adjuster Screw
(a) Pressure Increase
(b) Pressure Decrease

RY9212148HYS0331US0

Pressure Change/Turn for Overload Relief Valves (Reference Values)

Amount adjuster screw turned	1/4	1/2	3/4	1
• Blade rod (b4R)	4.5 MPa 45.4 kgf/cm^2 645 psi	8.9 MPa 90.8 kgf/cm^2 1291 psi	13.4 MPa 136.2 kgf/cm^2 1936 psi	17.8 MPa 181.6 kgf/cm^2 2582 psi
• Other	7.1 MPa 72.4 kgf/cm^2 1030 psi	14.2 MPa 144.8 kgf/cm^2 2060 psi	21.3 MPa 217.3 kgf/cm^2 3089 psi	28.4 MPa 289.7 kgf/cm^2 4119 psi

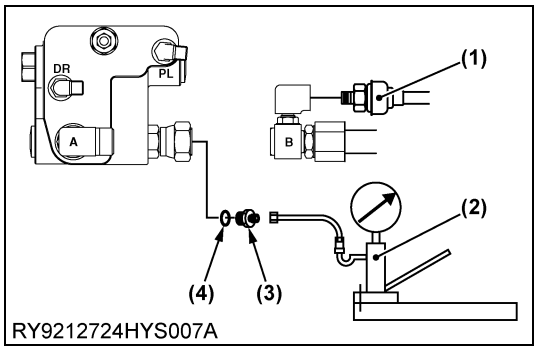
RY9212148HYS0332US0

(4) Measuring Holding Valve Relief Pressure

■ **IMPORTANT**

- **If it is necessary to check the overload relief pressure on this machine, measure the main relief pressure of each circuit (boom, two piece boom) and if the main relief pressures are within factory specifications, the overload relief valve is judged to be normal.**
- **If there is a problem, we recommend replacing the overload relief valve as an assembly.**
- **If a measurement has to be made for some reason, the procedures is as follows.**

RY9212724HYS0060US0



RY9212724HYS007A

Holding Valve

[Measurement preparations]

1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Releasing Pressure in the Hydraulic System and release pressure in the hydraulic lines.
3. Use the vacuum pump and disconnect the PL, A and Dr ports.
4. Attach the plug to PL port, A port.
5. Disconnect the boom pressure sensor wiring and remove the boom pressure sensor.
6. Remove the bolts and holding valve.
7. Disconnect the B port.
8. Attach the pressure measuring kit to the disconnected port.

[Measurement]

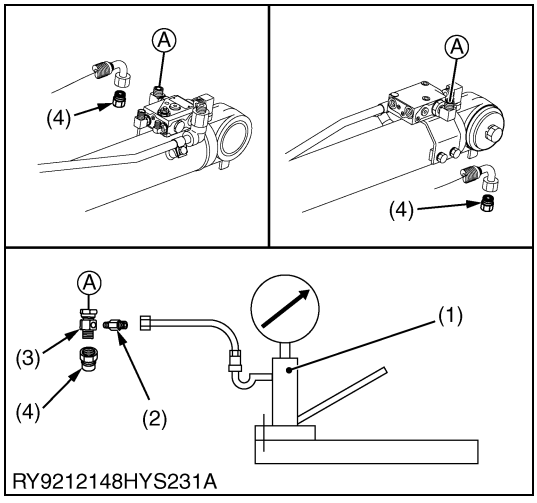
1. Increase pressure until the overload relief valve opens.
2. Measure the pressure three times, determine the average and take that as the measured value.

CAUTION

- **After measuring, the boom will be lifted, so lower it according to the section Manual Boom Lowering Procedure.**

(1) Pressure Sensor
(2) Pressure Measuring Kit
(3) Straight Pipe Joint (G3/8-1-14UNS)
(4) O-Ring

RY9212724HYS0026US0



RY9212148HYS231A

Two Piece Boom Holding Valve

[Measurement preparations]

1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
   - Position for measurement: two piece boom cylinder max extended
2. Follow the chapter Releasing Pressure in the Hydraulic System and release pressure in the hydraulic lines.
3. Disconnect the two piece cylinder hoses on the port A side and plug the disconnected hoses.
4. Attach the pressure measuring kit to the disconnected port.

[Measurement]

1. Increase pressure until the overload relief valve opens.
2. Measure the pressure three times, determine the average and take that as the measured value.

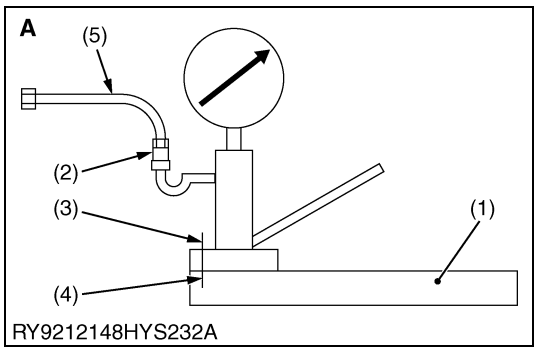
CAUTION

- **When disconnecting the pressure measuring kit, take appropriate care in removing it as the line is pressurized.**

(1) Pressure Measuring Kit
(2) Straight (R1/8-G1/4)
(3) Straight Pipe Joint (G3/8-G1/4)
(4) Plug

RY9212148HYS0335US0

(5) Pressure Measuring Kit



RY9212148HYS232A

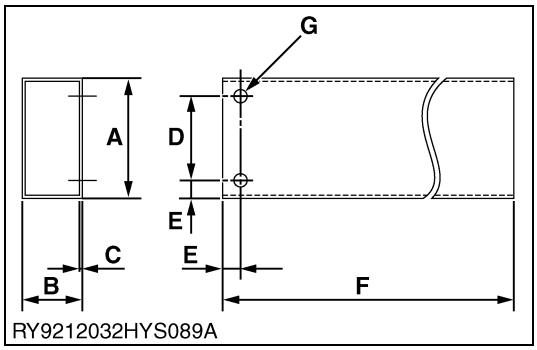
No.	Name of part	Q'ty
(1)	Support	1
(2)	Pipe joint (M12-G1/4)	1
(3)	Bolt (M10 x 35)	2
(4)	Nut (M10)	2
(5)	Test hose	1

CAUTION

- **Use a test hose that can withstand pressure up to the measurement pressure.**

A : Nozzle Tester

RY9212148HYS0336US0



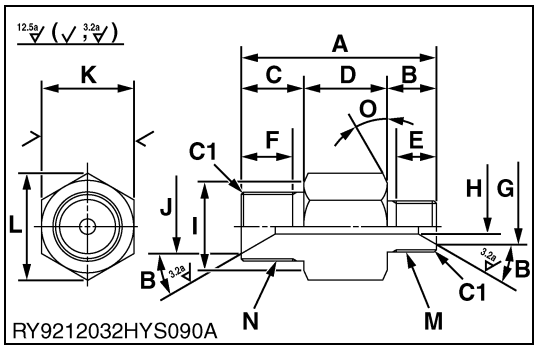
RY9212032HYS089A

(1) Support

A	100 mm (3.94 in.)
B	50 mm (2.0 in.)
C	t = 2.3 mm (0.09 in.)
D	70 mm (2.8 in.)
E	15 mm (0.59 in.)
F	600 mm (23.6 in.)
G	2–11 mm (2–0.43 in.)

Material std.: STKR400

RY9212148HYS0337US0



RY9212032HYS090A

(2) Pipe joint (M12-G1/4)

A	47 mm (1.8 in.)
B	12 mm (0.47 in.)
C	15 mm (0.59 in.)
D	20 mm (0.79 in.)
E	10 mm (0.39 in.) ≤
F	12 mm (0.47 in.) ≤
G	ϕ8 mm (0.3 in.)
H	ϕ3 mm (0.1 in.)
I	ϕ18 mm (0.71 in.)
J	ϕ9.5 ± 0.2 mm (0.37 ± 0.01 in.)
K	19 +0, –0.35 mm (0.75 +0, –0.01 in.)
L	21.9 mm (0.86 in.)
M	M12 × 1.5
N	G1/4
O	0.52 rad (30 °)

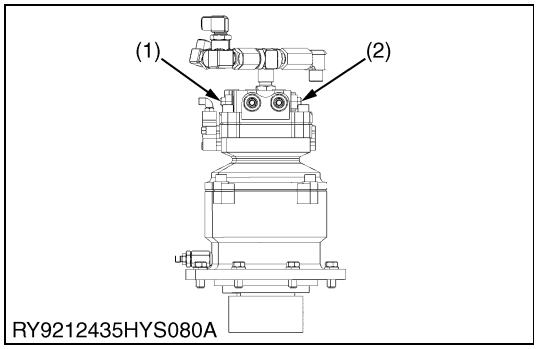
RY9212148HYS0309US0

(6) Adjusting Swivel Relief Valve Pressure

■ **IMPORTANT**

- **When checking the relief pressure of the swivel motor on the machine, measure the main relief pressure and if the main relief pressure is within factory specifications, the swivel relief valve is considered to be normal.**
- **If there is a problem, we recommend replacing the swivel relief valve as an assembly.**

RY9212148HYS0338US0



RY9212435HYS080A

Change/turn for the swivel relief valve (reference values)

	1/4	1/2	3/4	1
Amount adjuster screw turned	2.3 MPa 23.0 kgf/cm^2 326 psi	4.5 MPa 45.9 kgf/cm^2 653 psi	6.8 MPa 68.9 kgf/cm^2 979 psi	9.0 MPa 91.8 kgf/cm^2 1305 psi

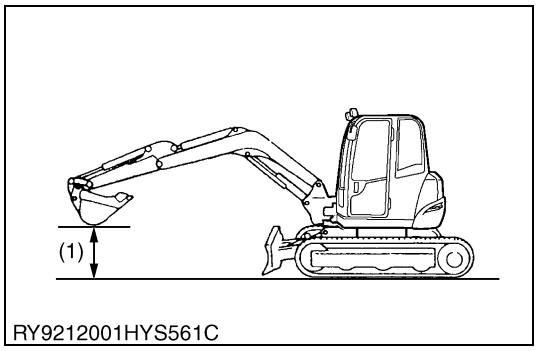
(1) Swivel Right Relief Valve (cSR) (2) Swivel Left Relief Valve (cSL)

RY9212435HYS0099US0

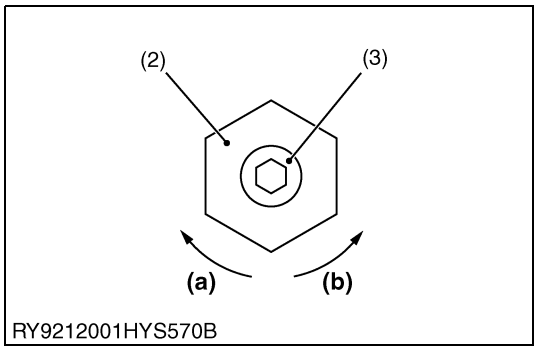
(7) Adjusting the LS Control Differential Pressure Adjusting Spring

CAUTION

- **Perform this adjustment procedure only when the LS regulator has been disassembled or when readjustment is necessary.**
- **Increasing the speed above the factory specification may damage the machine so never raise the speed above the factory specification.**
- **If it is out of adjustment, matching for the entire machine will be off and the operating speed of each device, including the boom, arm, etc. will be altered.**



RY9212001HYS561C



RY9212001HYS570B

[Measurement]

1. Measure the speed of the swing according the section Measuring Hydraulic Cylinder Operating Time.
2. If a value within factory specifications is not obtained, loosen the LS regulator lock nut.
3. Turn the adjuster screw with a hex wrench to adjust the spring tension.
   After setting the pressure, always check the swing speed according to the section Measuring Hydraulic Cylinder Operating Time.
4. Tighten the lock nut.
5. Measure each operating time and make sure they are within specifications.

(1) 1.0 m (40 in.)
(2) Lock Nut
(3) Adjuster Screw
(a) Increase Speed
(b) Reduce Speed

RY9212148HYS0340US0

[6] MEASURING SWIVEL PERFORMANCE

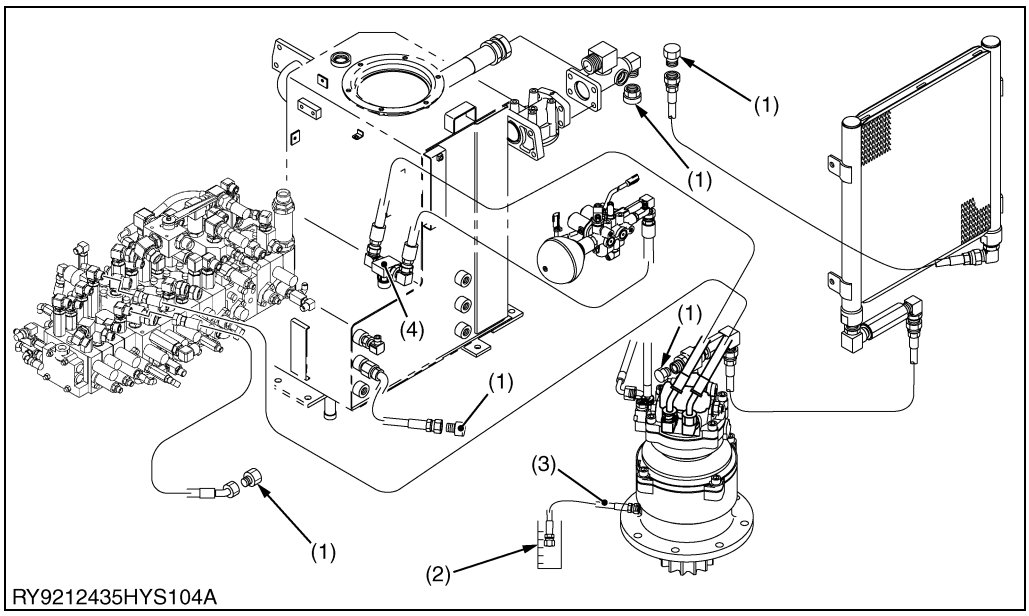
(1) Measuring Swivel Motor Drain Volume

Purpose

- Measuring the drain volume when operating allows an assessment of swivel motor performance.

■ **IMPORTANT**

- **Swivel motor performance is used along with swivel block performance and measurement of swivel speed to make a comprehensive assessment.**
- **When using this procedure to make measurements, the movement is in one direction.**



RY9212435HYS104A

(1) Plug
(2) Graduated Cylinder
(3) Test Hose
(4) Adapter

RY9212435HYS0100US0

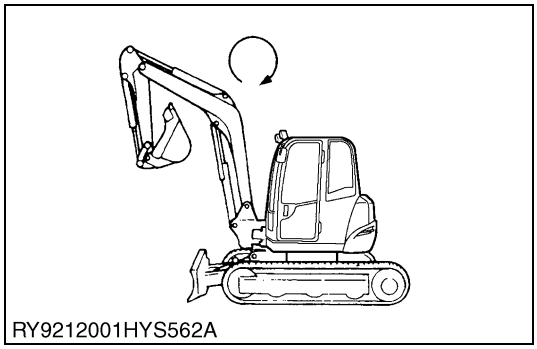
[Measurement preparations]

1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Releasing Pressure in the Hydraulic System and release pressure in the hydraulic lines.
3. Attach a vacuum pump.
4. Disconnect the hose that connects the oil cooler and the return filter on the return filter side and plug the disconnected hose and adapter.
5. Disconnect the return hose that connects the control valve and the swivel motor on the swivel motor side and plug the disconnected hose and adapter.
6. Disconnect one of the high-pressure hoses that connects the control valve and the swivel motor on the control valve side and split the unload valve and port T so it returns directly to the tank. Plug the hose with the disconnected adapter.
7. Disconnect the swivel motor's drain hose from the swivel motor side, and plug the disconnected hose.
8. Swap out the swivel motor drain hose with a test hose.
9. Remove the vacuum pump.
10. Operate the swivel and allow the swivel motor to warm up fully. However, operate the swivel slowly as cavitation may occur.
    - Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).

⚠ CAUTION

- **Before commencing measurement, make sure there are no persons or obstacles within the swivel range.**
- **To measure the opposite direction, swap the swivel motor's high pressure hose.**

RY9212148HYS0342US0


RY9212001HYS562A

[Measurement when turning]

1. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max RPM	OFF	OFF

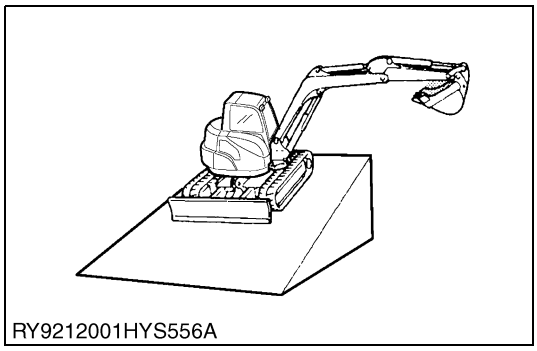
2. The position for measurement should be with maximum extension of the boom cylinder, arm cylinder and bucket cylinder.
3. Operate the swivel lever with full stroke and while maintaining a uniform swivel speed, measure the drain volume coming from the test hose in 1 minute.
4. Measure the drain volume 3 times each left and right, determine the average and take that as the measured value.

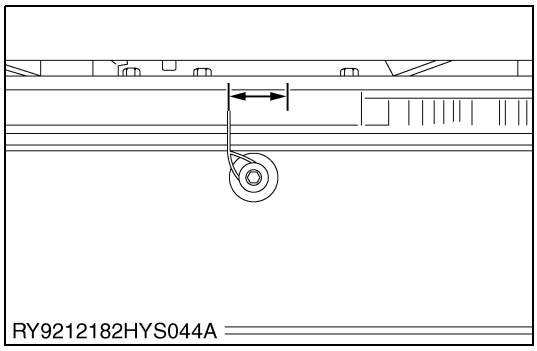
RY9212724HYS0027US0

(2) Measuring Swivel Block Performance

Purpose

- Measure how much the machine slips on sloping ground to asses the performance of the swivel parking brake.


RY9212001HYS556A


RY9212182HYS044A

[Measurement preparation]

1. Repeat swivel left and right operations to sufficiently warm up the swivel motor.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Place dirt or a weight of the specified weight (JIS heap x specific gravity 1.8) in the bucket.

Specified weight	414 kg (913 lbs)

3. Climb onto a slope of 0.35 rad (20 °) but whose surface is even and swivel the machine so the top is at 1.6 rad (90 °) to the slope.
4. The front position should be with the arm cylinder fully compressed and bucket cylinder fully extended, keeping the boom base pin and the arm end pin at the same height.
5. Place marks on the circumference of the swivel bearing and the track frame.

CAUTION

- **Before commencing measurement, make sure there are no persons or obstacles within the swivel range.**

[Measurement]

1. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Idling	OFF	OFF

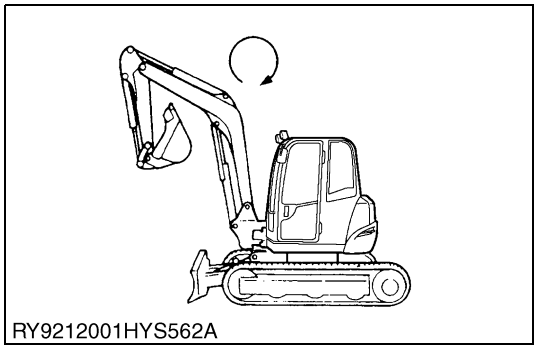
2. Start the engine, release the safety lock lever (lower) and after 1 minute, measure any deviation between the marks on the swivel bearing and the track frame.
3. Measure the swing 3 times each right/left with the engine stopped and at idle and take the average as the measured value.

RY9212724HYS0028US0

(3) Measuring Swivel Speed

Purpose

- Measure how long it takes to swivel 3 times to assess the overall performance of the swivel drive system (main and pilot lines).


RY9212001HYS562A

[Measurement preparation]

1. Repeat swivel left and right operations to sufficiently warm up the swivel motor.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. The position for measurement should be with maximum extension of the boom cylinder, arm cylinder and bucket cylinder.

CAUTION

- **Before commencing measurement, make sure there are no persons or obstacles within the swivel range.**

[Measurement]

1. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max RPM	OFF	OFF

2. Operate the swivel control lever at full stroke, and once it reaches a uniform speed, measure the time taken for three turns of the swivel unit.
3. Take three measurements each swiveling left and right, determine the average and take that as the measured value.

RY9212724HYS0029US0

[7] MEASURING TRAVEL PERFORMANCE

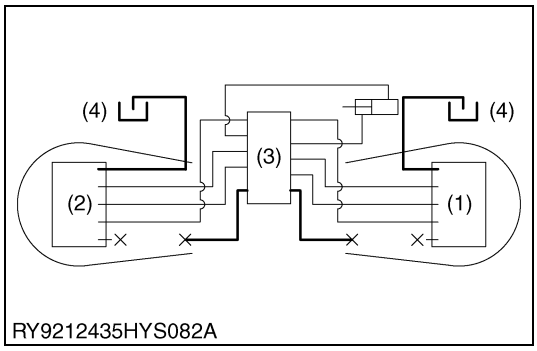
(1) Measuring Travel Motor Drain Volume

Purpose

- Measuring the drain volume when operating and when locked allows an assessment of the travel motor performance.
- Travel motor performance is used along with travel block performance, travel speed and travel drift to make a comprehensive assessment.

RY9212148HYS0344US0

RY9212435HYS081A



RY9212435HYS082A

RY9212435HYS083A

[Measurement preparations]

1. Repeat left and right travel operations to sufficiently warm up the travel motor.
   - Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
3. Follow the chapter Releasing Pressure in the Hydraulic System and release pressure in the hydraulic lines.
4. Use a vacuum pump and disconnect the travel motor's drain hose from the travel motor side, and insert a plug in the disconnected hose.
5. Connect a test hose to the travel motor drain port and remove the vacuum pump.
6. Start the engine and jack up the machine.

CAUTION

- **Place safety blocks and supports under the jacked up machine to prevent it from dropping.**
- **When working near rotating parts, take care not to get your gloves/clothes caught in them.**

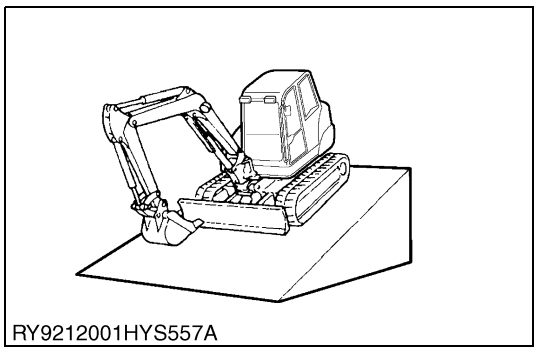
(1) Right Travel Motor
(2) Left Travel Motor
(3) Swivel Joint
(4) Graduated Cylinder

RY9212435HYS0101US0

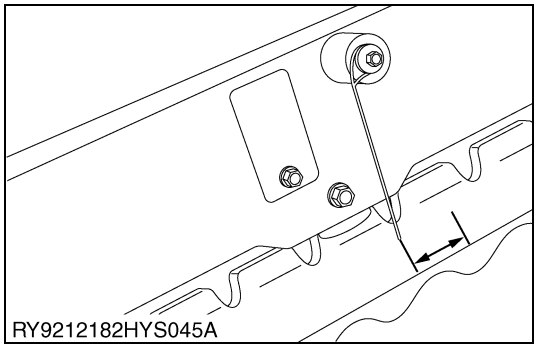
(2) Measuring Travel Block Performance

Purpose

- Measure how much the machine slips on sloping ground to asses the performance of the parking brake.



RY9212001HYS557A



RY9212182HYS045A

[Measurement preparation]

1. Repeat left and right travel operations to sufficiently warm up the travel motor.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Climb onto a slope of 0.35 rad (20°) but whose surface is even.
3. Stop the machine on the slope, and set the front to travel position.

[Measurement]

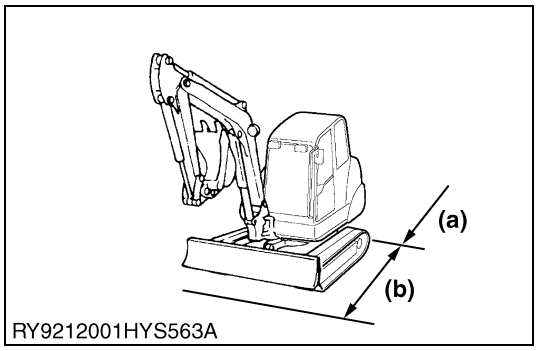
1. Place the travel lever in neutral and stop the engine.
2. Make marks in the track frame and crawler, and measure the slippage after ten minutes.

RY9212148MBS0134US0

(3) Measuring Travel Speed

Purpose

- Measure how long it takes to travel a distance to assess the overall performance of the travel drive system (main and pilot lines).



RY9212001HYS563A

[Measurement preparation]

1. Adjust the left and right crawlers to their specified dimensions and operate the travel motor to thoroughly warm it up.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Set a level course on flat, hard ground of 10 m (390 in.) for the measurement with a run up course of 5.0 m (200 in.).
3. Measure travel performance in the travel position.

[Measurement]

1. Position each of the switches as follows.

No.	Travel 2nd speed switch	Accelerator dial	Auto-idling switch	AC switch
1	1st	Max RPM	OFF	OFF
2	2nd	Max RPM	OFF	OFF

2. Measure travel speed forwards/backwards three times each in 1st and 2nd and take the average as the measured value.

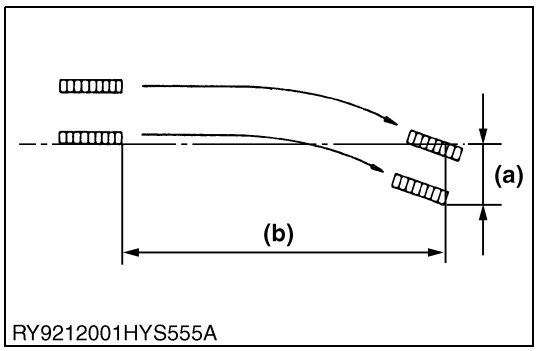
(a) Run-up 5.0 m (200 in.) **(b) Measurement distance 10 m (390 in.)**

RY9212724HYS0030US0

(4) Measuring Travel Drift

Purpose

- Measure travel drift to assess left/right balance in the travel drive system (main and pilot lines).



RY9212001HYS555A

[Measurement preparation]

1. Adjust the left and right crawlers to their specified dimensions and operate the travel motor to thoroughly warm it up.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Determine a 10 m (390 in.) travel course on hard, flat ground, and put the machine in travel position for the measurement.

[Measurement]

1. Position each of the switches as follows.

No.	Travel 2nd speed switch	Accelerator dial	Auto-idling switch	AC switch
1	1st	Max RPM	OFF	OFF
2	2nd	Max RPM	OFF	OFF

2. Measure travel drift forwards/backwards three times each in 1st and 2nd and take the average as the measured value.

(a) Drift **(b) 10 m (390 in.)**

RY9212724HYS0031US0

[8] MEASURING CYLINDER SPEED

(1) Measuring Hydraulic Cylinder Operating Time

Purpose

- Measure the amount of time it takes to operate each of the hydraulic cylinders to assess the overall performance of the front drive system (main and pilot lines).

RY9212148MBS0114US0

Measurement preparation

1. Stop the machine on hard, level ground.
2. Repeat front operations and fully warm up each cylinder.
   - Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).

RY9212148MBS0115US0

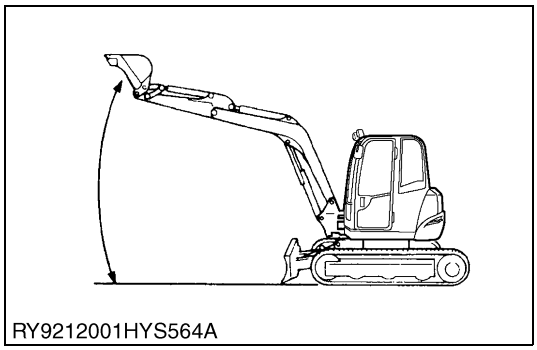
Measurement

1. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max RPM	OFF	OFF

2. Measure the speed of each cylinder three times and take the average as the measured value.
3. Make the measurements for each cylinder in the position given below.

RY9212724HYS0032US0

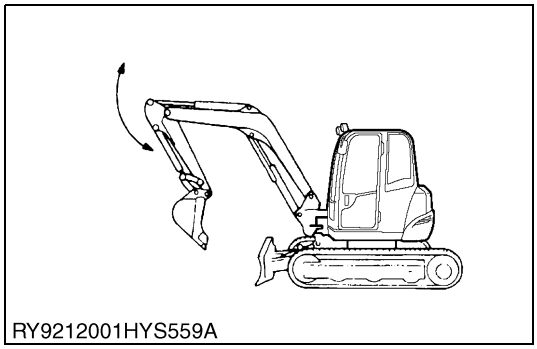


RY9212001HYS564A

Boom Cylinder

1. Arm and bucket cylinder fully compressed.
2. Operate the boom control lever at full stroke and measure the time it takes the boom to go from having the bucket on the ground to the maximum lift position.
   - **Do not include cushion operating time.**

RY9212148MBS0117US0

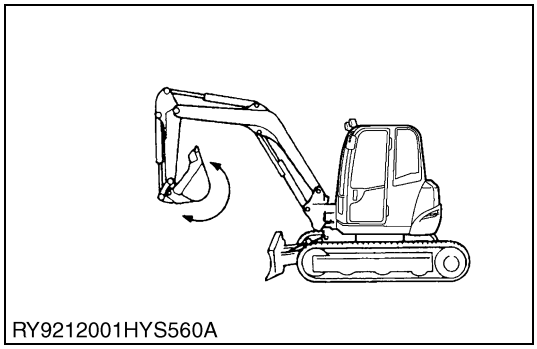


RY9212001HYS559A

Arm Cylinder

1. Boom cylinder fully extended and bucket cylinder fully compressed.
2. Operate the arm control lever at full stroke and measure the time it takes the arm to go full stroke from dump to crowd.
   - **Do not include cushion operating time.**

RY9212148MBS0118US0

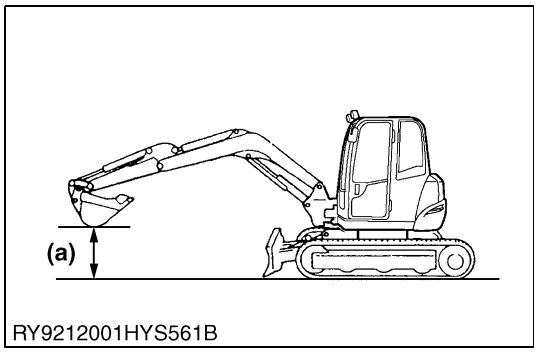


RY9212001HYS560A

Bucket Cylinder

1. Adjust the arm and the boom to positions in which the bucket will not hit the machine when the bucket is operated through its full stroke.
2. Operate the bucket control lever at full stroke and measure the time it takes the bucket to go full stroke from dump to crowd.

RY9212148MBS0119US0



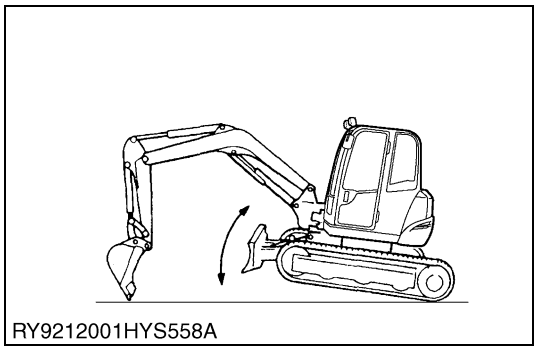
RY9212001HYS561B

Swing cylinder

1. Arm cylinder fully compressed, bucket cylinder fully extended, and bucket bottom approximately 1.0 m (40 in.) above ground level.
2. Operate the swing pedal full stroke and measure how long it takes to swing full stroke to the right and to the left.

(a) 1.0 m (40 in.)

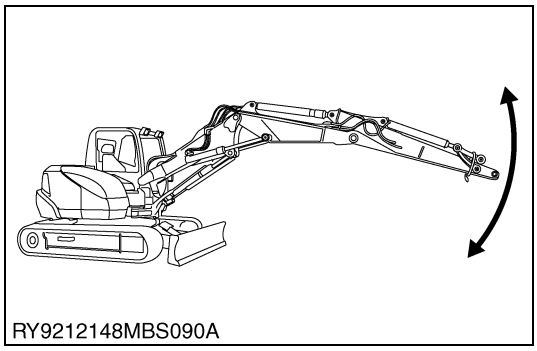
RY9212148MBS0120US0


RY9212001HYS558A

Blade cylinder

1. Jack up the machine with the front to ensure the blade can move through its entire stroke top to bottom.
2. Operate the blade control lever full stroke and measure the time it takes the blade to go full stroke up and down.

RY9212148MBS0121US0

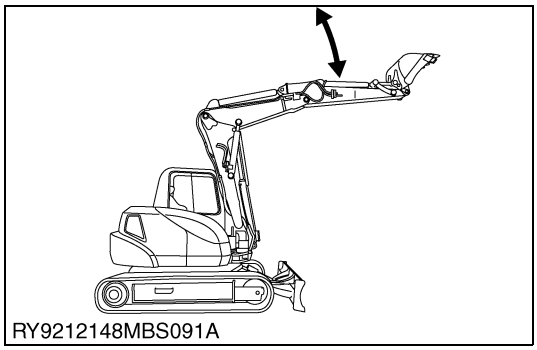

RY9212148MBS090A

Boom cylinder (Two piece boom spec.)

1. The position for measurement should be with the two piece boom cylinder at maximum extension and at maximum compressed length of the arm cylinder and bucket cylinder.
2. Operate the boom control lever at full stroke and measure the time it takes the boom to go from having the tip of the arm on the ground to the maximum lift position.

- **Make this measurement without a bucket mounted.**
- **Do not include cushion operating time.**

RY9212724HYS0061US0


RY9212148MBS091A

Two piece boom cylinder (Two piece boom spec.)

1. Measure with the boom cylinder fully extended and the arm cylinder and bucket cylinder fully compressed.
2. Operate the two piece boom pedal full stroke and measure the time it takes the two piece boom to go full stroke up and down.

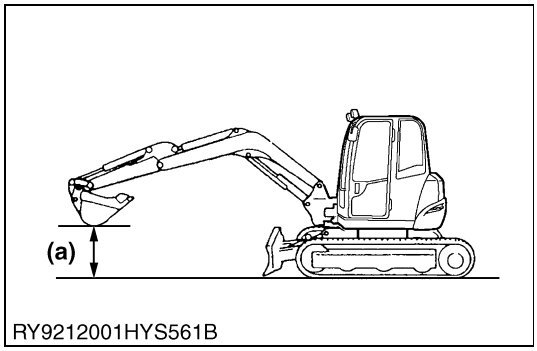
RY9212724HYS0064US0

(2) Measuring Hydraulic Cylinder Drift

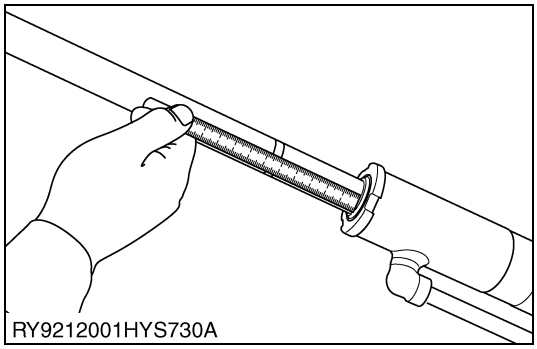
Purpose

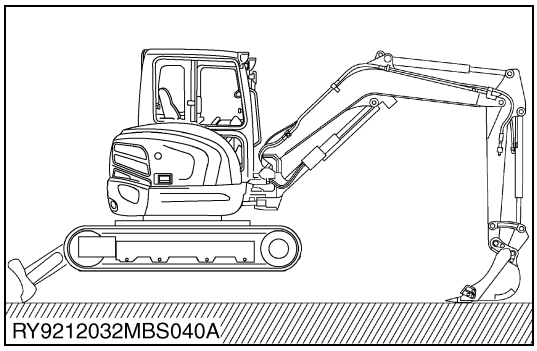
- Measure how far a cylinder drops to asses leakage inside the cylinder, control valve and/or holding valve.
- When measuring a cylinder that has just been replaced, insure to purge any air prior to taking the measurements. Slowly operate the cylinder repeatedly to end stroke and full retraction.

RY9212148MBS0124US0



RY9212001HYS561B


RY9212001HYS730A


RY9212032MBS040A

Measuring drift of the boom, arm and bucket cylinders

[Measurement preparation]

1. Repeat front operations and fully warm up each cylinder.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Place dirt or a weight of the specified weight (JIS heap x specific gravity 1.8) in the bucket and position the machine on flat, hard ground.

Specified weight	414 kg (913 lbs)

3. Arm cylinder fully compressed, bucket cylinder fully extended, and bucket bottom approximately 1.0 m (40 in.) above ground level. Note that the arm cylinder should return about 50 mm (2.0 in.) from the stroke end, and be outside the cushion range.

[Measurement]

1. Stop the engine, and place marks on the boom, arm and bucket cylinder rods.
2. After ten minutes has elapsed, measure the boom cylinder compression, arm cylinder extension and bucket cylinder compression.

(a) 1.0 m (40 in.)

RY9212148MBS0125US0

Measuring blade cylinder drift

[Measurement preparation]

1. Repeat blade operations and fully warm up the cylinders.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Use the blade and front to jack up the machine so blade cylinder is fully extended, the arm is perpendicular to the ground and the excavator is level.

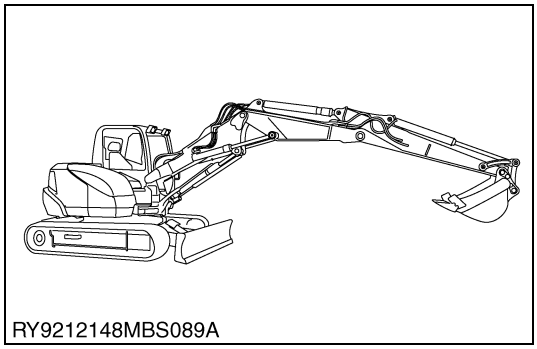
[Measurement]

1. Stop the engine and mark the rod of the blade cylinder.
2. After 10 minutes, measure how much the blade cylinder is compressed.

CAUTION

- **Never allow your feet or any body part to be under the machine when it is jacked up.**

RY9212148MBS0126US0


RY9212148MBS089A

Measuring boom cylinder and Two piece boom cylinder drift (Two piece boom spec.)

[Measurement preparation]

1. Repeat boom operations and fully warm up the cylinders.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Place dirt or a weight of the specified weight (JIS heap x specific gravity 1.8) in the bucket and position the machine on flat, hard ground.

Specified weight	414 kg (913 lbs)

3. Front position: arm cylinder fully compressed, two piece boom cylinder and bucket cylinder fully extended, and bucket bottom approximately 1 m (40 in.) above ground level.

[Measurement]

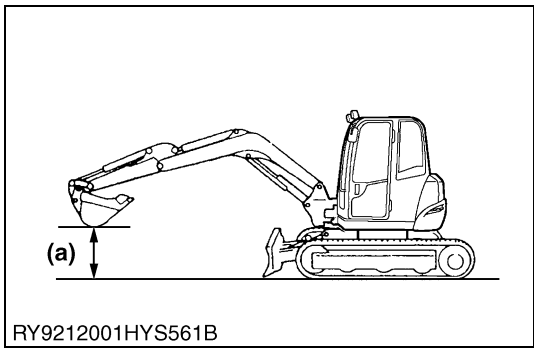
1. Stop the engine and mark the rods of the boom and two piece boom cylinders.
2. After 10 minutes, measure how much the boom and two piece boom cylinders are compressed.

RY9212724HYS0062US0

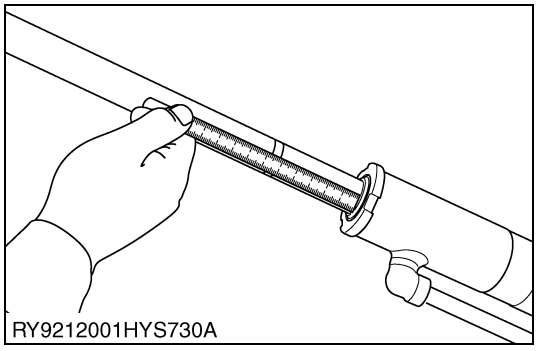
(3) Measuring Swing Cylinder Deviation

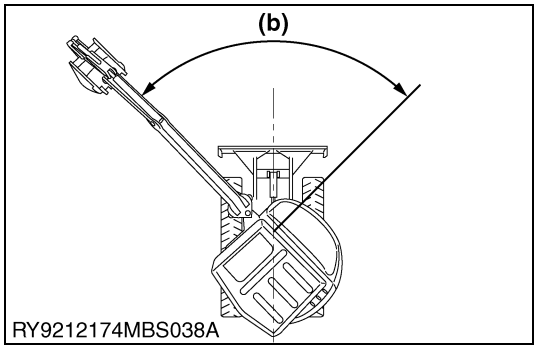
Purpose

- Measure how far the cylinder deviates to assess leakage inside the cylinder and/or control valve.
- When measuring a cylinder that has just been replaced, insure to purge any air prior to taking the measurements. Slowly operate the cylinder repeatedly to end stroke and full retraction.



RY9212001HYS561B


RY9212001HYS730A



RY9212174MBS038A

[Measurement preparation]

1. Repeat swing operations through their full stroke and fully warm up the cylinders.

Hydraulic oil temperature	50 ± 5 °C (122 ± 9 °F)

2. Place dirt or a weight of the specified weight (JIS heap x specific gravity 1.8) in the bucket and position the machine on flat, hard ground.

Specified weight	414 kg (913 lbs)

3. Arm cylinder fully compressed, bucket cylinder fully extended, and bucket bottom approximately 1.0 m (40 in.) above ground level.
4. Put the arm in its central swing position and then swing it back and forth 5 times and stop.

[Measurement]

1. Stop the engine and mark the rod of the swing cylinder.
2. Position each of the switches as follows.

Accelerator dial	Auto-idle switch	AC switch
Max RPM	OFF	OFF

3. Swing the front through 1.6 rad (90 °) and stop 100 times and then measure the deviation.

■ **IMPORTANT**

- **When you stop after swinging the front, let the wobbling of the front stabilize and then perform the following operation.**

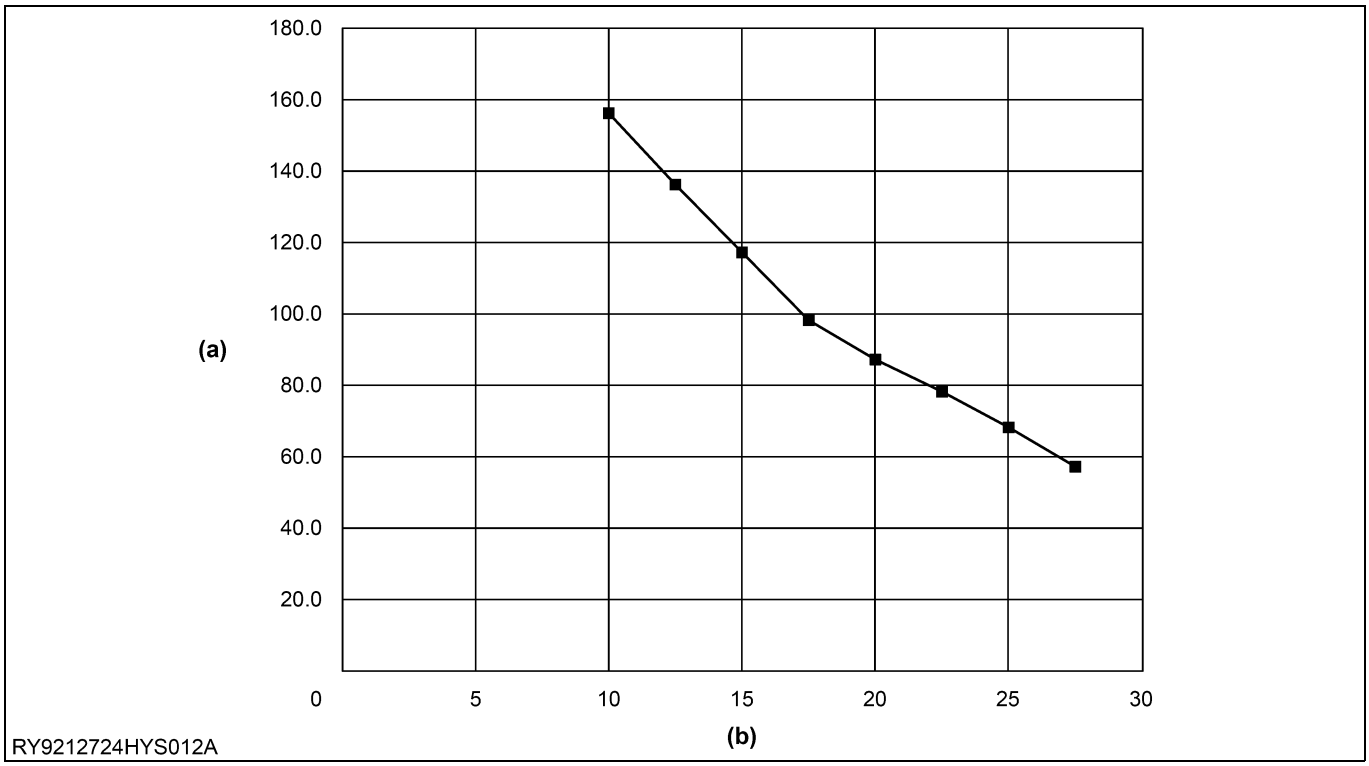
(a) 1.0 m (40 in.) **(b) 1.6 rad (90 °)**

RY9212724HYS0033US0

14. HYDRAULIC DEVICE PERFORMANCE STANDARDS

[1] FLOW RATE

(1) Main Pump Discharge Flow Rate Data (Measured Values)



(a) Flow Rate (L/min) **(b) Pressure (MPa)**

CAUTION

- **Measured values may vary depending on the machine.**
- **This data is of values converted to the rated RPM.**
- **The usage limit is 80% of the discharge volume.**

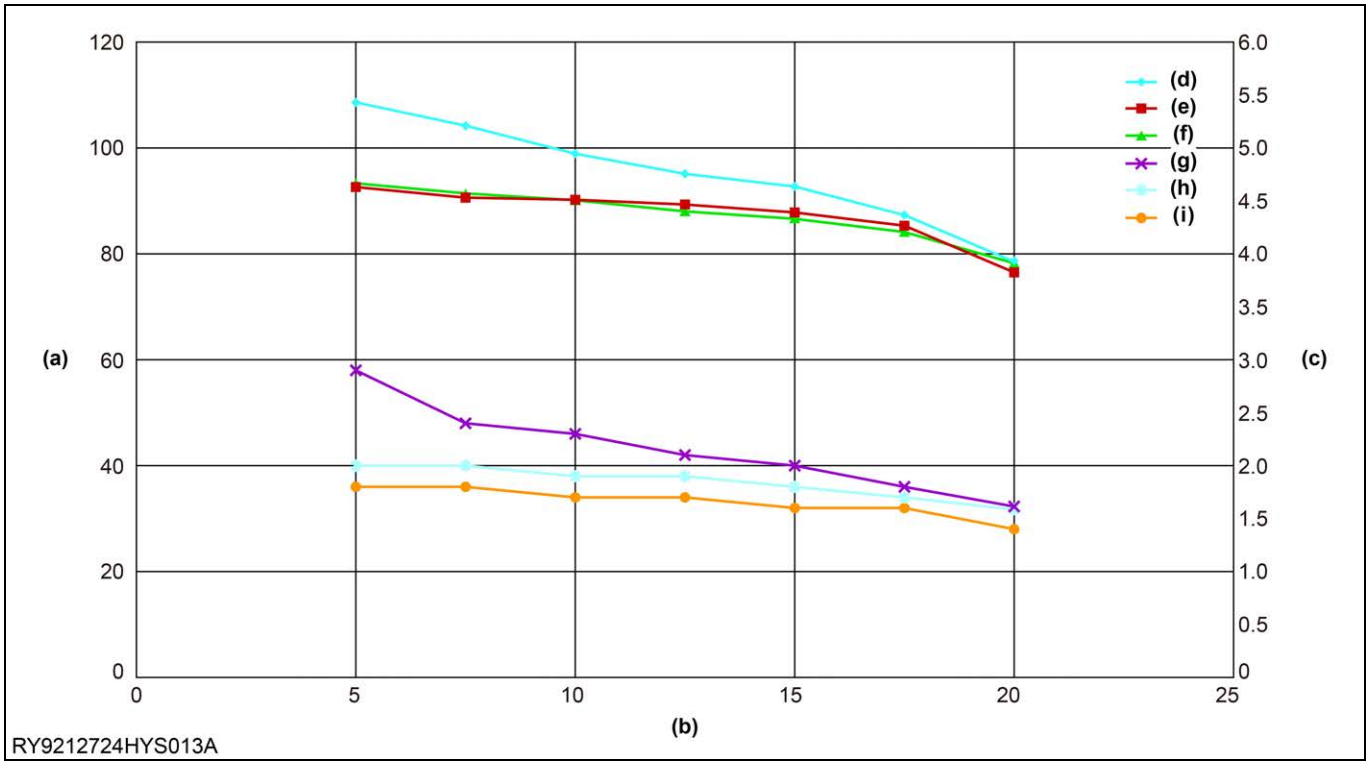
Pressure	10.0 MPa 102.0 kgf/cm^2 1450.4 psi	12.5 MPa 127.5 kgf/cm^2 1813.0 psi	15.0 MPa 153.0 kgf/cm^2 2175.6 psi	17.5 MPa 178.5 kgf/cm^2 2538.2 psi
Flow Rate	153.0 L/min 40.4 U.S.gals	133.4 L/min 35.2 U.S.gals	114.8 L/min 30.3 U.S.gals	95.7 L/min 25.2 U.S.gals

Pressure	20.0 MPa 203.9 kgf/cm^2 2900.8 psi	22.5 MPa 229.4 kgf/cm^2 3263.3 psi	25.0 MPa 255.0 kgf/cm^2 3630.0 psi	27.5 MPa 280.0 kgf/cm^2 3990.0 psi
Flow Rate	85.3 L/min 22.5 U.S.gals	76.5 L/min 20.2 U.S.gals	66.7 L/min 17.6 U.S.gals	55.9 L/min 14.7 U.S.gals

RY9212724HYS0035US0

(2) AUX Discharge Flow Rate Data (Measured Values)

Service specification



(a) Flow Rate (L/min)
(b) Pressure (MPa)
(c) Back Pressure (MPa)
(d) AUX1 LH (Third Line Open)
(e) AUX1 LH (Third Line Close)
(f) AUX1 RH (Third Line Close)
(g) Back Pressure (AUX1 LH (Third Line Open))
(h) Back Pressure (AUX1 LH (Third Line Close))
(i) Back Pressure (AUX1 RH (Third Line Close))

(To be continued)

(Continued)

AUX1 LH (third line open)

Pressure			Discharging flow rate (converted to 2000 rpm)		Back pressure		
5.0 MPa	51.0 kgf/cm^2	725.2 psi	108.6 L/min	28.6 U.S.gals/min	2.9 MPa	30 kgf/cm^2	420 psi
7.5 MPa	76.5 kgf/cm^2	1087.8 psi	104.2 L/min	27.5 U.S.gals/min	2.4 MPa	24 kgf/cm^2	350 psi
10.0 MPa	102.0 kgf/cm^2	1450.4 psi	98.9 L/min	26.1 U.S.gals/min	2.3 MPa	23 kgf/cm^2	330 psi
12.5 MPa	127.5 kgf/cm^2	1813.0 psi	95.1 L/min	25.1 U.S.gals/min	2.1 MPa	21 kgf/cm^2	300 psi
15.0 MPa	153.0 kgf/cm^2	2175.6 psi	92.7 L/min	24.5 U.S.gals/min	2.0 MPa	20 kgf/cm^2	290 psi
17.5 MPa	178.4 kgf/cm^2	2538.2 psi	87.3 L/min	23.0 U.S.gals/min	1.8 MPa	18 kgf/cm^2	260 psi
20.0 MPa	203.9 kgf/cm^2	2900.8 psi	78.5 L/min	20.7 U.S.gals/min	1.6 MPa	16 kgf/cm^2	230 psi

AUX1 LH (third line close)

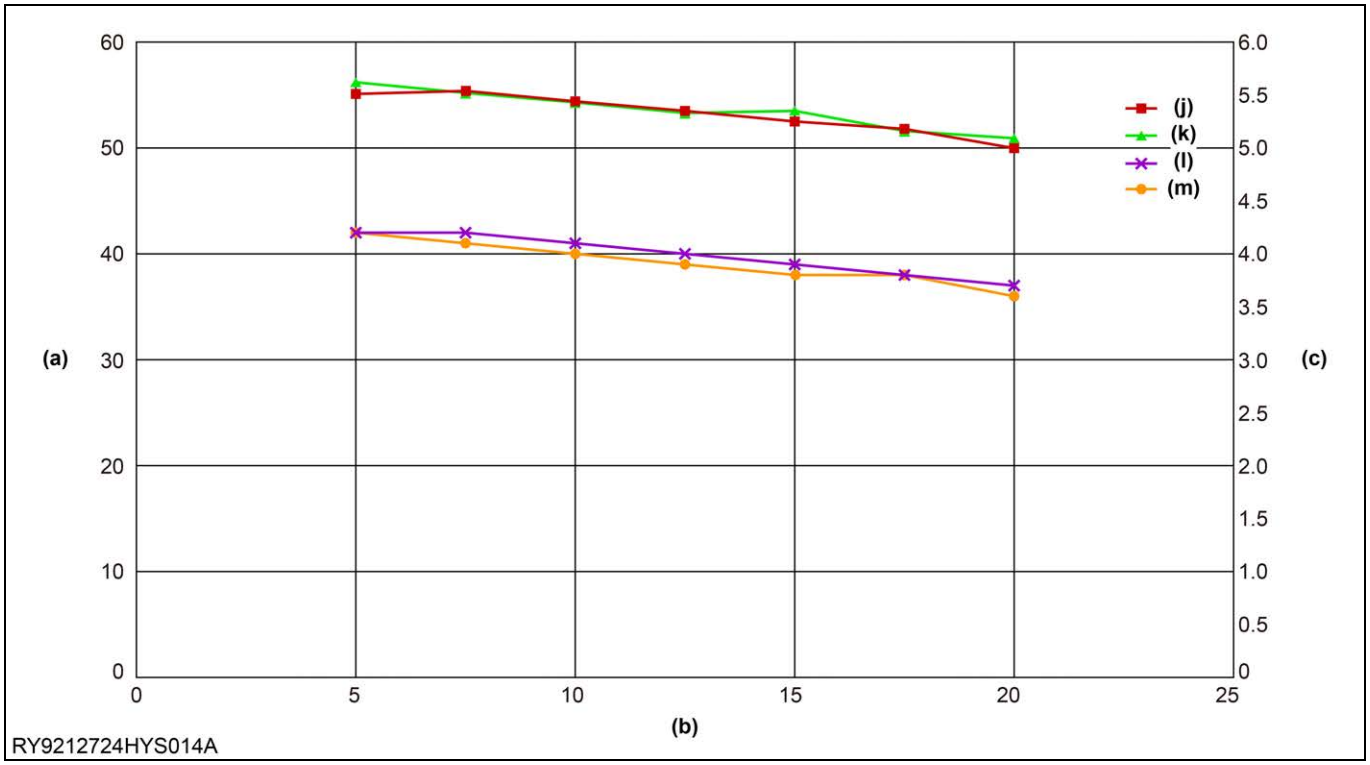
Pressure			Discharging flow rate (converted to 2000 rpm)		Back pressure		
5.0 MPa	51.0 kgf/cm^2	725.2 psi	92.6 L/min	24.4 U.S.gals/min	2.0 MPa	20 kgf/cm^2	290 psi
7.5 MPa	76.5 kgf/cm^2	1087.8 psi	90.6 L/min	23.9 U.S.gals/min	2.0 MPa	20 kgf/cm^2	290 psi
10.0 MPa	102.0 kgf/cm^2	1450.4 psi	90.2 L/min	23.8 U.S.gals/min	1.9 MPa	19 kgf/cm^2	280 psi
12.5 MPa	127.5 kgf/cm^2	1813.0 psi	89.3 L/min	23.6 U.S.gals/min	1.9 MPa	19 kgf/cm^2	280 psi
15.0 MPa	153.0 kgf/cm^2	2175.6 psi	87.8 L/min	23.2 U.S.gals/min	1.8 MPa	18 kgf/cm^2	260 psi
17.5 MPa	178.4 kgf/cm^2	2538.2 psi	85.3 L/min	22.5 U.S.gals/min	1.7 MPa	17 kgf/cm^2	250 psi
20.0 MPa	203.9 kgf/cm^2	2900.8 psi	76.4 L/min	20.1 U.S.gals/min	1.6 MPa	16 kgf/cm^2	230 psi

AUX1 RH (third line close)

Pressure			Discharging flow rate (converted to 2000 rpm)		Back pressure		
5.0 MPa	51.0 kgf/cm^2	725.2 psi	93.3 L/min	24.6 U.S.gals/min	1.8 MPa	18 kgf/cm^2	260 psi
7.5 MPa	76.5 kgf/cm^2	1087.8 psi	91.4 L/min	24.1 U.S.gals/min	1.8 MPa	18 kgf/cm^2	260 psi
10.0 MPa	102.0 kgf/cm^2	1450.4 psi	90.1 L/min	23.8 U.S.gals/min	1.7 MPa	17 kgf/cm^2	250 psi
12.5 MPa	127.5 kgf/cm^2	1813.0 psi	88.0 L/min	23.2 U.S.gals/min	1.7 MPa	17 kgf/cm^2	250 psi
15.0 MPa	153.0 kgf/cm^2	2175.6 psi	86.6 L/min	22.8 U.S.gals/min	1.6 MPa	16 kgf/cm^2	230 psi
17.5 MPa	178.4 kgf/cm^2	2538.2 psi	84.1 L/min	22.2 U.S.gals/min	1.6 MPa	16 kgf/cm^2	230 psi
20.0 MPa	203.9 kgf/cm^2	2900.8 psi	78.2 L/min	20.6 U.S.gals/min	1.4 MPa	14 kgf/cm^2	200 psi

(To be continued)

(Continued)
Service specification



(a) Flow Rate (L/min)
(b) Pressure (MPa)
(c) Back Pressure (MPa)
(j) AUX2 LH
(k) AUX2 RH
(l) Back Pressure (AUX2 LH)
(m) Back pressure (AUX2 RH)

AUX2 LH

Pressure			Discharging flow rate (converted to 2000 rpm)		Back pressure		
5.0 MPa	51.0 kgf/cm^2	725.2 psi	55.1 L/min	14.5 U.S.gals/min	4.2 MPa	43 kgf/cm^2	610 psi
7.5 MPa	76.5 kgf/cm^2	1087.8 psi	55.4 L/min	14.6 U.S.gals/min	4.2 MPa	43 kgf/cm^2	610 psi
10.0 MPa	102.0 kgf/cm^2	1450.4 psi	54.4 L/min	14.4 U.S.gals/min	4.1 MPa	42 kgf/cm^2	590 psi
12.5 MPa	127.5 kgf/cm^2	1813.0 psi	53.5 L/min	14.1 U.S.gals/min	4.0 MPa	41 kgf/cm^2	580 psi
15.0 MPa	153.0 kgf/cm^2	2175.6 psi	52.5 L/min	13.9 U.S.gals/min	3.9 MPa	40 kgf/cm^2	570 psi
17.5 MPa	178.4 kgf/cm^2	2538.2 psi	51.8 L/min	13.7 U.S.gals/min	3.8 MPa	39 kgf/cm^2	550 psi
20.0 MPa	203.9 kgf/cm^2	2900.8 psi	49.9 L/min	13.1 U.S.gals/min	3.7 MPa	38 kgf/cm^2	540 psi

AUX2 RH

Pressure			Discharging flow rate (converted to 2000 rpm)		Back pressure		
5.0 MPa	51.0 kgf/cm^2	725.2 psi	56.2 L/min	14.8 U.S.gals/min	4.2 MPa	43 kgf/cm^2	610 psi
7.5 MPa	76.5 kgf/cm^2	1087.8 psi	55.2 L/min	14.6 U.S.gals/min	4.1 MPa	42 kgf/cm^2	590 psi
10.0 MPa	102.0 kgf/cm^2	1450.4 psi	54.3 L/min	14.3 U.S.gals/min	4.0 MPa	41 kgf/cm^2	580 psi
12.5 MPa	127.5 kgf/cm^2	1813.0 psi	53.3 L/min	14.1 U.S.gals/min	3.9 MPa	40 kgf/cm^2	570 psi
15.0 MPa	153.0 kgf/cm^2	2175.6 psi	53.5 L/min	14.1 U.S.gals/min	3.8 MPa	39 kgf/cm^2	550 psi
17.5 MPa	178.4 kgf/cm^2	2538.2 psi	51.6 L/min	13.6 U.S.gals/min	3.8 MPa	39 kgf/cm^2	550 psi
20.0 MPa	203.9 kgf/cm^2	2900.8 psi	50.9 L/min	13.4 U.S.gals/min	3.6 MPa	37 kgf/cm^2	520 psi

CAUTION
- **Measured values may vary depending on the machine.**
- **This measurement data is of the values set for the max discharge flow rate. (limit=max)**

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[2] RELIEF PRESSURE

Item				Notes
Main P1 (aP1)	Standard boom		28.0 MPa (+1.0 MPa, –0.5 MPa) 285 kgf/cm^2 (+10 kgf/cm^2, –5 kgf/cm^2) 4060 psi (+145 psi, –73 psi)	
	Two piece boom	Front attachment	28.0 MPa (+1.0 MPa, –0.5 MPa) 285 kgf/cm^2 (+10 kgf/cm^2, –5 kgf/cm^2) 4060 psi (+145 psi, –73 psi)	
		Travel blade	30.0 MPa (+1.0 MPa, –0.5 MPa) 306 kgf/cm^2 (+10 kgf/cm^2, –5 kgf/cm^2) 4350 psi (+145 psi, –73 psi)	
Main P2 (aP2)	Standard boom		28.0 MPa (+1.0 MPa, –0.5 MPa) 285 kgf/cm^2 (+10 kgf/cm^2, –5 kgf/cm^2) 4060 psi (+145 psi, –73 psi)	
	Two piece boom		30.0 MPa (+1.0 MPa, –0.5 MPa) 306 kgf/cm^2 (+10 kgf/cm^2, –5 kgf/cm^2) 4350 psi (+145 psi, –73 psi)	
Unload LS (aUN)			2.2 ± 0.25 MPa 22 ± 2.5 kgf/cm^2 320 ± 36 psi	
Pilot primary (aPP)			4.0 ± 0.25 MPa 40.7 ± 2.5 kgf/cm^2 580 ± 36 psi	
Boom	Bottom (b1B)		31.4 ± 1.0 MPa 320 ± 10 kgf/cm^2 4550 ± 145 psi	
	Rod (b1R)		31.4 ± 1.0 MPa 320 ± 10 kgf/cm^2 4550 ± 145 psi	
	Holding valve (b1H)		30.4 ± 1.0 MPa 310 ± 10 kgf/cm^2 4410 ± 145 psi	
Two piece boom	Bottom (b7B)		34.3 ± 1.0 MPa 350 ± 10 kgf/cm^2 4970 ± 145 psi	
	Rod (b7R)		34.3 ± 1.0 MPa 350 ± 10 kgf/cm^2 4970 ± 145 psi	
	Holding valve (b7H)		33.3 ± 1.0 MPa 340 ± 10 kgf/cm^2 4830 ± 145 psi	
Arm	Bottom (b2B)		31.4 ± 1.0 MPa 320 ± 10 kgf/cm^2 4550 ± 145 psi	
	Rod (b2R)		31.4 ± 1.0 MPa 320 ± 10 kgf/cm^2 4550 ± 145 psi	
Bucket	Bottom (b3B)		31.4 ± 1.0 MPa 320 ± 10 kgf/cm^2 4550 ± 145 psi	
	Rod (b3R)		31.4 ± 1.0 MPa 320 ± 10 kgf/cm^2 4550 ± 145 psi	
Blade	Bottom (b4B)		34.3 ± 1.0 MPa 350 ± 10 kgf/cm^2 4970 ± 145 psi	
	Rod (b4R)		17.2 ± 1.0 MPa 175 ± 10 kgf/cm^2 2490 ± 145 psi	

Item			Notes
AUX1	Left (b6L)	20.6 ± 1.0 MPa 210 ± 10 kgf/cm^2 2990 ± 145 psi	
	Right (b6R)	20.6 ± 1.0 MPa 210 ± 10 kgf/cm^2 2990 ± 145 psi	
AUX2	Left (b10L)	20.6 ± 1.0 MPa 210 ± 10 kgf/cm^2 2990 ± 145 psi	
	Right (b10R)	20.6 ± 1.0 MPa 210 ± 10 kgf/cm^2 2990 ± 145 psi	

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[3] SWIVEL PERFORMANCE

Item			Notes
Swivel motor drain volume	When turning	≤0.5 L/min ≤30.5 cu.in./min	
Swivel block performance	When stopped	≤43.2 mm ≤1.70 in.	
	At idle	≤43.2 mm ≤1.70 in.	
Swivel speed	3 revs	16.1 to 19.5 sec	

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[4] TRAVEL PERFORMANCE

Item				Notes
Travel motor drain volume	When turning (1st spd.)		≤0.5 L/min ≤30.5 cu.in./min	
	When locked (1st spd.)		≤4.0 Lmin ≤244 cu.in./min	
	When turning (2nd spd.)		≤1.0 L/min ≤61.0 cu.in./min	
	When locked (2nd spd.)		≤4.0 L/min ≤244 cu.in./min	
Travel block performance			0 mm 0 in.	
Travel speed	Rubber	1st	12.0 to 15.0 sec	10 m traveling time
		2nd	6.8 to 8.4 sec	
	Steel	1st	12.9 to 15.7 sec	
		2nd	7.2 to 8.8 sec	
Amount of travel drift			≤600 mm ≤23.6 in.	

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[5] CYLINDER SPEED

Item			Factory Specification	Notes
Hydraulic cylinder operating time	Boom (mono-boom)	Ground to max lift	3.2 ± 0.3 sec	
		Max lift to ground	3.5 ± 0.3 sec	
	1st boom (Two piece boom spec.)	Ground to max lift	3.8 ± 0.3 sec	
		Max lift to ground	4.1 ± 0.3 sec	
	2nd boom (Two piece boom spec.)	Crowd	5.1 ± 0.3 sec	
		Dump	5.2 ± 0.3 sec	
	Arm	Crowd	3.5 ± 0.3 sec	
		Dump	3.4 ± 0.3 sec	
	Bucket	Crowd	3.3 ± 0.3 sec	
		Dump	2.3 ± 0.3 sec	
	Swing	Left	7.3 ± 0.7 sec	
		Right	7.2 ± 0.7 sec	
	Blade	Max down to Max up	2.4 ± 0.3 sec	
		Max up to Max down	3.1 ± 0.3 sec	
Hydraulic cylinder drift	Boom	Factory spec. when new	≤20.0 mm ≤0.79 in.	
		Usage limit	≤100.0 mm ≤3.94 in.	
	2nd boom (Two piece boom spec.)	Factory spec. when new	≤10.0 mm ≤0.39 in.	
		Usage limit	≤50.0 mm ≤1.97 in.	
	Arm	Factory spec. when new	≤11.0 mm ≤0.43 in.	
		Usage limit	≤55.0 mm ≤2.20 in.	
	Bucket	Factory spec. when new	≤10.0 mm ≤0.39 in.	
		Usage limit	≤50.0 mm ≤1.97 in.	
	Blade	Factory spec. when new	≤20.0 mm ≤0.79 in.	
		Usage limit	≤100 mm ≤3.94 in.	
Swing cylinder deviation		Factory spec. when new	≤10.0 mm ≤0.39 in.	
		Usage limit	≤50.0 mm ≤1.97 in.	

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15. TROUBLESHOOTING

[1] TROUBLESHOOTING ALL ACTUATORS

When all actuators are slow or fail to work

- Likely to be a problem in the pilot system and/or with the engine.
- Check for problems in hydraulic oil level and/or quality.

No.	Cause	Remedy	Notes
1	Low engine RPM	• Check the engine RPM. • Inspect fuel lines and air intake lines. • Test the accelerator dial. • Meter panel settings.	
2	Faulty limit switch	• Check the operation of the limit switch. Move the unload lever up/down and check for continuity in the tester mode. (when locked: OFF, when released: ON)	
3	Faulty unload valve	• Check unload valve operation. 1. Disconnect the unload valve connector and test for continuity. 2. Check for damage to the spool.	
4	Pilot primary pressure relief valve (aPP) faulty	• Measure pilot primary pressure. 1. Disassemble, clean and adjust or replace the relief valve.	
5	Pump fitting Connector faulty	• Replace pump connector.	
6	Pump drive shaft damaged	• Replace shaft.	

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[2] TROUBLESHOOTING FRONT SYSTEMS

When just certain cylinder(s) fail to work, are slow or jerky

- Identify whether the fault is in the main system or the pilot system.
- If a circuit lacks power, test the pressure of the corresponding main relief valve or the overload relief valve.

No.	Cause	Remedy	Notes
1	Defective pilot valve	• Measure the pilot secondary pressure.	
2	• Leak inside a cylinder • Leak inside a control valve section	• Measure the hydraulic drift. If hydraulic drift is outside of factory specs, take the following steps. 1. Exchange hoses with a normally operating section (on control valve side). 2. Test the hydraulic drift again. **[Assessment]** Within factory specs: control valve and/or overload relief valve faulty. Outside specs: replace cylinder seals.	
3	Overload relief valve faulty	• Diagnose the overload relief valve. Temporarily replace with a known good overload relief valve and determine whether faulty or not.	
4	Main spool inside control valve sticking or damaged	• Inspect the main spool or replace the valve. 1. Take the main spool out of the control valve and clean it. 2. After applying hydraulic oil, check whether it slides properly and return to the control valve.	
5	Pressure compensation valve sticking	• Inspect the pressure compensation valve. 1. Take the pressure compensation valve out of the control valve and clean it. 2. After applying hydraulic oil, check whether it slides properly and return to the control valve.	

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Boom operation slow or jerky

No.	Cause	Remedy	Notes
1	Boom holding valve faulty	• Inspect the boom holding valve. 1. Measure the overload relief pressure. 2. Inspect for abnormalities inside.	
2	Shockless valve faulty	• Clean or replace the shockless valve.	

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Arm operation slow or jerky

No.	Cause	Remedy	Notes
1	Arm regenerative valve faulty	• Inspect the arm regenerative valve. 1. Take the spool out of the control valve and clean it. 2. Check the inside and inspect for abnormalities.	

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Swing slow or fails to move

No.	Cause	Remedy	Notes
1	Swing external orifice faulty	• Clean swing external orifice. If same thing happens: problem with anti-void and/or shut-off valves.	

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Swing extends or contracts

No.	Cause	Remedy	Notes
1	Anti-void faulty 1. Seat NG: extends 2. Suction NG: makes it sway	• Disassemble and clean or replace the anti-void valve.	

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When lever operated, it goes down and then back up

No.	Cause	Remedy	Notes
1	Load check valve inside the control valve faulty	• Inspect the load check valve. Remove and clean the load check valve.	

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A great deal of hydraulic drift

No.	Cause	Remedy	Notes
1	1. Leak inside a cylinder 2. Leak inside a control valve	• Measure the hydraulic drift. If hydraulic drift is outside of factory specs, take the following steps. 1. Exchange hoses with a normally operating section (on control valve side). 2. Test the hydraulic drift again. **[Assessment]** Within factory specs: control valve and/or overload relief valve faulty. Outside specs: cylinder seals faulty.	
2	Overload relief valve faulty	• Diagnose the overload relief valve. Temporarily replace with a known good overload relief valve and determine whether faulty or not.	

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Slow during multiple operations

No.	Cause	Remedy	Notes
1	Seat of unload LS valve (aUN) faulty	• Measure unload LS valve pressure. 1. Disassemble and clean or replace the relief valve.	
2	Seat of LS main relief valve (aLS) faulty	• Measure LS main relief valve pressure. 1. Disassemble, clean and adjust or replace the relief valve.	
3	Horsepower control valve faulty or loose	Check and adjust for loose nuts.	

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[3] TRAVEL SYSTEM TROUBLESHOOTING

Fails to travel right and left or is slow

- It is unlikely that the right and left pilot valve, travel motor, control valves (travel section), etc. would become faulty at the same time.
- If neither right nor left will travel, it is likely a common pilot system is faulty.
- Adjust the left/right track tension and get rid of any clumps of mud.

No.	Cause	Remedy	Notes
1	Travel pilot valve filter blockage	• Clean the pilot valve filter.	
2	Pp2, Pp4 filters and/or orifices blocked	• Clean the filters and orifices.	
3	Independent travel valve's sub-spool and/or main spool sticking	• Inspect and replace the sub-spool and/or main spool. 1. Take the sub-spool and/or main spool out of the control valve and clean it. 2. After applying hydraulic oil, check whether it slides properly and return to the control valve.	

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One side fails to travel, is slow or meanders

No.	Cause	Remedy	Notes
1	Defective travel pilot valve	• Measure the pilot secondary pressure.	
2	Travel main relief valve faulty	• Temporarily swap main relief valves forwards/backwards or left right. **[Assessment]** If problem swaps forwards/backwards or left-right: travel main relief valve is faulty. If problem is the same: the main spool is sticking or damaged or the swivel joint and/or travel motor are faulty.	
3	Main spool inside control valve or travel section is sticking or damaged	• Swap the left-right travel hoses on the control valve side and see if the problem changes sides too. **[Assessment]** If problem switches sides: main spool is sticking or damaged. If problem doesn't change: swivel joint and/or travel motor are faulty.	
4	Defective travel motor	• Measure the drain volume. **[Assessment]** If within factory specs: swivel joint is faulty. If outside specs: travel motor is faulty.	
5	Swivel joint faulty	• Swap the left/right travel hoses (swivel joint to travel motor) on the swivel joint side and see if the problem changes sides too.	

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Won't switch to high-speed travel

- Check whether the travel speed switch is switching in the tester mode.

No.	Cause	Remedy	Notes
1	Faulty 2nd speed solenoid valve at unload unit	• Check 2nd speed solenoid valve operation. 1. Check whether there is electricity to the unload valve. 2. Check whether the spool is switching inside.	
2	• Defective travel motor • Swivel joint faulty	• Measure the pressure at the travel motor 2nd speed switch port. **[Assessment]** Rated pressure: travel motor faulty. Below rated pressure: swivel joint faulty.	

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[4] SWIVEL SYSTEM TROUBLESHOOTING

When the swivel is slow, fails to work or is jerky.

- Identify whether the fault is in the main system or the pilot system.

No.	Cause	Remedy	Notes
1	Defective pilot valve	• Measure the pilot secondary pressure.	
2	Slow return valve faulty	Clean or replace the slow return valve.	
3	Timer valve sticking or damaged	Clean or replace the timer valve.	
4	Swivel shuttle valve faulty	• Measure the timer valve release pressure. (When swivel left/right, or at arm crowd). • Clean or replace the swivel shuttle valve.	
5	Swivel relief valve faulty	• Temporarily swap the left/right swivel relief valves. **[Assessment]** If the problem changes sides: swivel relief valve faulty. If problem is the same: the main spool is sticking or damaged or the anticavitation valve and/or swivel motor are faulty.	
6	Anticaviation valve faulty	• Swap anticavitation valves. **[Assessment]** If the problem changes sides: anticavitation valve faulty. If problem is the same: the main spool is sticking or damaged or the swivel motor is faulty.	
7	Swivel motor faulty	• Measure the drain volume.	
8	Main spool inside control valve sticking or damaged	• Inspect the main spool or replace the valve. 1. Take the main spool out of the control valve and clean it. 2. After applying hydraulic oil, check whether it slides properly and return to the control valve.	

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Swivel drifts

- Identify whether the fault is in the main system or the pilot system.

No.	Cause	Remedy	Notes
1	Slow return valve faulty	Clean or replace the slow return valve.	
2	Anti-void valve faulty	Clean or replace the anti-void valve.	
3	Timer valve sticking or damaged	Clean or replace the timer valve.	
4	Pilot valve spool damaged	Check that the pilot valve spool returns to neutral.	
5	Swivel relief valve faulty	• Temporarily swap the left/right swivel relief valves. **[Assessment]** If the problem changes sides: swivel relief valve faulty. If problem is the same: the main spool is sticking or damaged or the anticavitation valve and/or swivel motor are faulty.	
6	Anticaviation valve faulty	• Clean or replace the anticavitation valve. **[Assessment]** If problem is not resolved: the main spool is sticking or damaged or the swivel motor is faulty.	
7	Swivel motor faulty	• Measure the drain volume.	
8	Main spool inside control valve sticking or damaged	• Inspect the main spool or replace the valve. 1. Take the main spool out of the control valve and clean it. 2. After applying hydraulic oil, check whether it slides properly and return to the control valve.	

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[5] TROUBLESHOOTING MULTIPLE OPERATIONS

Front fails to operate during multiple operations or while traveling

No.	Cause	Remedy	Notes
1	• Communication valve sub-spool sticking • Communication valve main spool sticking	• Inspect the sub and main spools or replace the valve. 1. Take the spool out of the control valve and clean it. 2. After applying hydraulic oil, check whether it slides properly and return to the control valve.	

RY9212148HYS0369US0

4 ELECTRICAL SYSTEM

SERVICING

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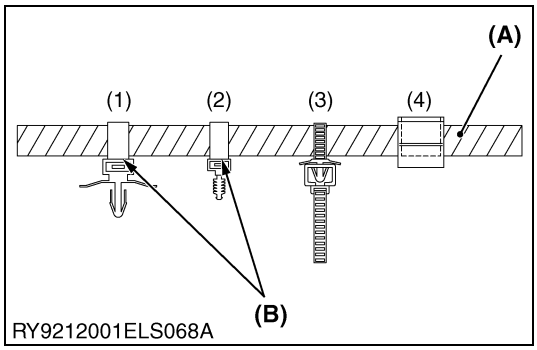
1. LAYOUT OF ELECTRICAL DEVICES AND WIRING ROUTING

[1] PRECAUTIONS ON HOW TO CLAMP THE ELECTRICAL WIRING

1. Do not touch the wiring or the area around it.
   Do not touch where uncovered.
2. Do not clamp to fuel hoses.
3. Connect connectors and terminals securely so they do not come unplugged when pulled on gently.
4. Be sure to clamp the harness at the clamp position.
5. Clamps for securing harnesses



(1) Anchor Type
(Insert Firmly Until it Catches).
(2) Screw Type
(Insert to the End of the Screw).
(3) and (4) Insert Type: Insert Until it Locks.

(A) Harness
(B) Clamp the Harness so It Stays in Position and Does Not Move. Insert the End of the Cable Tie Into the Hole on the Other Side to Clamp the Harness.

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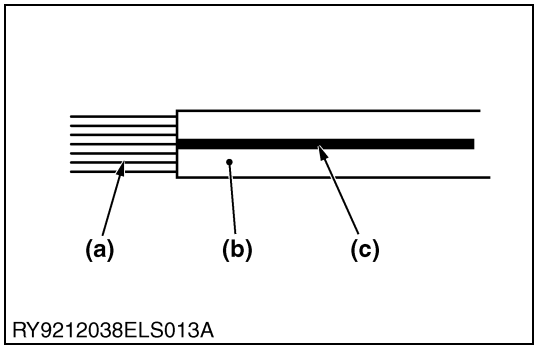
[2] PRECAUTIONS ON HANDLING ELECTRICAL CONNECTORS

1. When disconnecting connectors, grasp the body of the connector and pull it out; do not pull on the wiring harness. If the connector is the locking type, release the lock and then pull to disconnect.
2. When removing a connector's plastic cover (for water protection) to inspect it, be careful not to let any water get in the connector. If water does get in, dry it thoroughly before reassembling the connector and putting its plastic cover securely in place.
3. Straighten any bent connector terminals and make sure none are sticking out or missing. Also make sure there is no corrosion on the connector's terminals before connecting it.
4. When connecting a locking connector, be sure to press it in until you hear it click and then pull gently on the harness close to the connector and make sure the harness does not come out.

RY9212001ELS0224US0

Colors of Wiring

Color of wiring	Color code	Color of wiring	Color code
Black	B	Blue / Green	L/G
Green	G	Blue / Orange	L/Or
Blue	L	Blue / Red	L/R
Pink	P	Blue / White	L/W
Red	R	Blue / Yellow	L/Y
White	W	Light Green / Blue	Lg/B
Yellow	Y	Light Green / Red	Lg/R
Brown	Br	Light Green / White	Lg/W
Gray	GY	Light Green / Yellow	Lg/Y
Light Green	Lg	Orange / White	Or/W
Orange	Or	Pink / White	P/W
Sky Blue	Sb	Pink / Blue	P/L
Black / Green	B/G	Red / Black	R/B
Black / Blue	B/L	Red / Green	R/G
Black / Pink	B/P	Red / Blue	R/L
Black / Violet	B/V	Red / White	R/W
Black / Red	B/R	Red / Yellow	R/Y
Black / White	B/W	Violet / White	V/W
Black / Yellow	B/Y	White / Black	B/W
Brown / Black	Br/B	White / Green	W/G
Brown / Yellow	Br/Y	White / Blue	W/L
Brown / Red	Br/R	White / Red	W/R
Green / Black	G/B	White / Yellow	W/Y
Green / Blue	G/L	Yellow / Black	Y/B
Green / Red	G/R	Yellow / Green	Y/G
Green / White	G/W	Yellow / Blue	Y/L
Green / Yellow	G/Y	Yellow / Red	Y/R
Blue / Black	L/B		



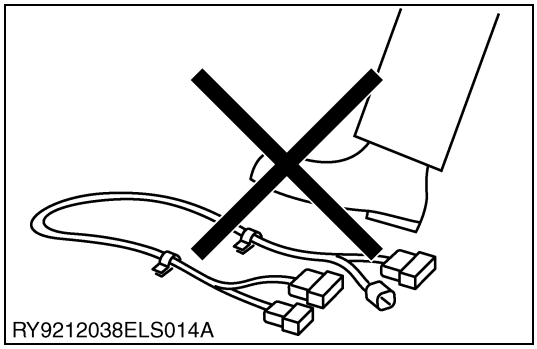
RY9212038ELS013A

(E.g.)
1.25-Y/R means:
1.25 : Wire size (mm^2)
Y : Base color (yellow)
R : Stripe color (red)

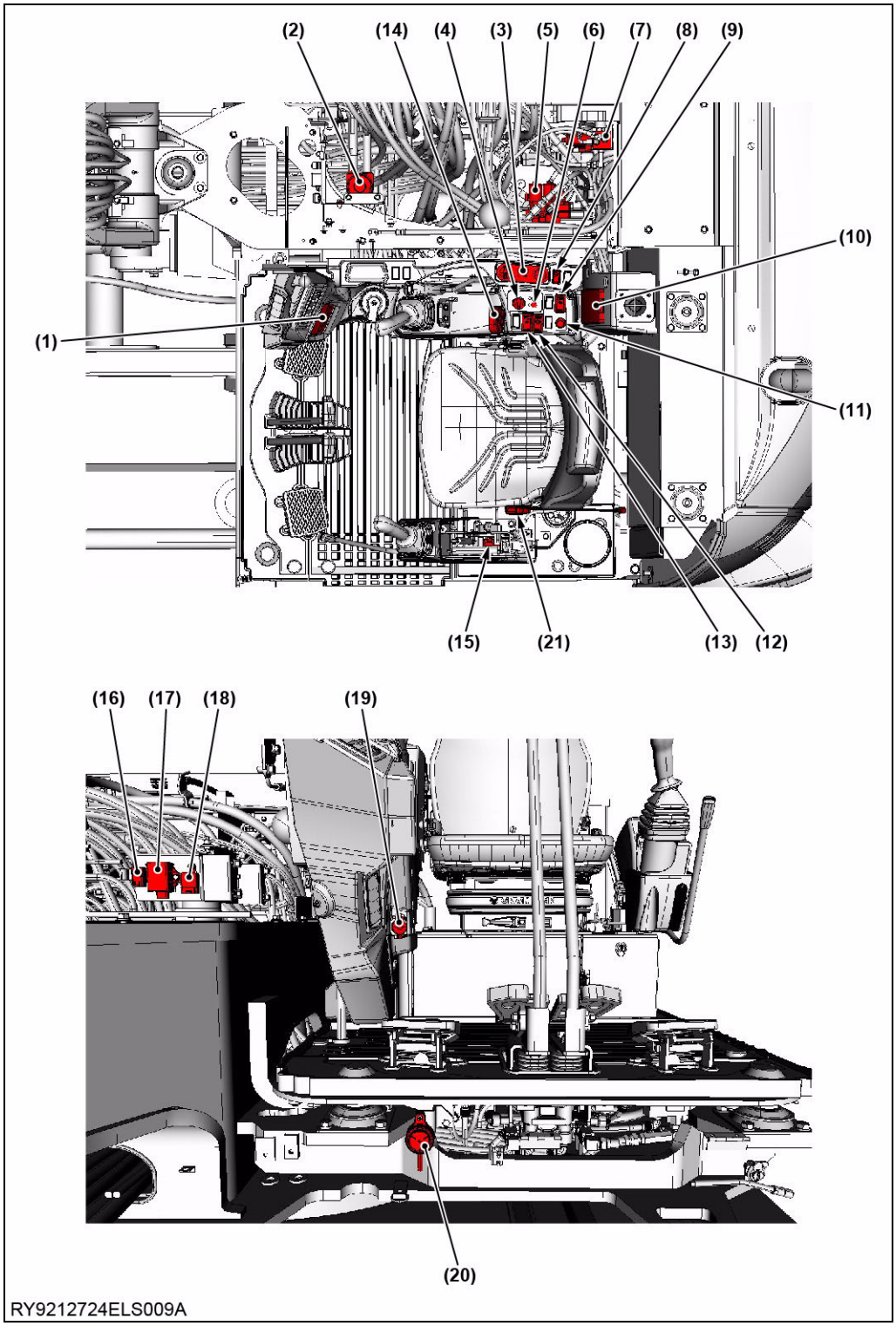
- Do not pull on or step on wires. Also, do not cut wires on burred edges or the like.
- Do not twist or pinch wiring when installing it.

(a) Wire Size (mm^2)
(b) Insulation Base Color
(c) Stripe Color

RY9212038ELS0009US0


RY9212038ELS014A

[3] LAYOUT OF ELECTRICAL DEVICES

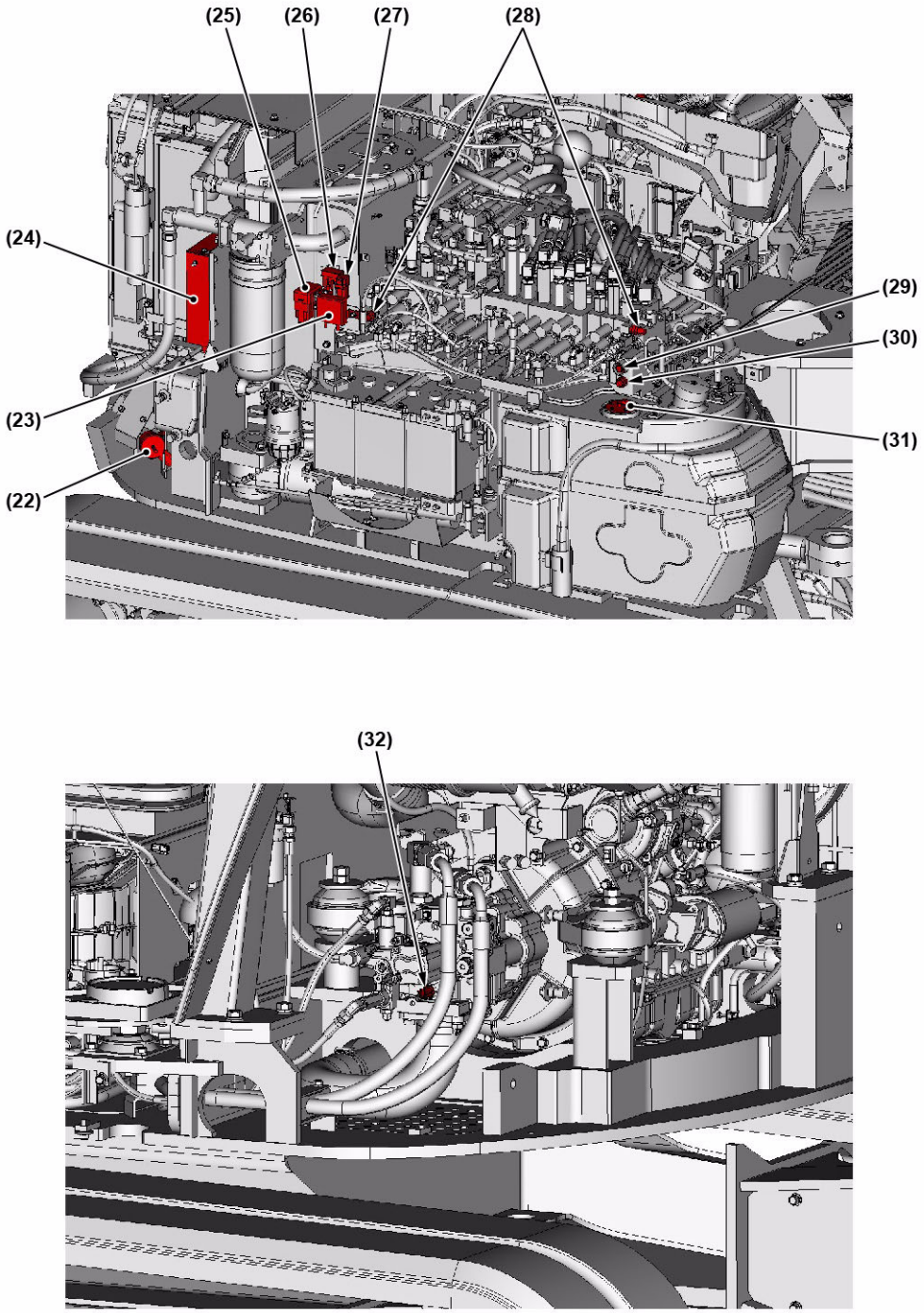


RY9212724ELS009A

(1) Meter Panel
(2) Fuel Supply Pump
(3) A/C Control Panel
(4) Accelerator Dial
(5) Unload Valve
(6) Auto-Idle Switch
(7) Proportional Solenoid Valve
(8) Wiper Switch
(9) DPF Regeneration Inhibitor Switch
(10) Fuse Box
(11) Stop Engine Switch
(12) Beacon Switch
(13) Worklight Switch
(14) Anti-Theft Antenna
(15) Limit Switch (Lever Lock Switch)
(16) Fuel Supply Pump Start Relay
(17) ECU (Timer)
(18) Fuel Supply Pump Stop Relay
(19) Electrical Outlet Socket
(20) Horn
(21) Seat Belt (Seat Belt Switch)

(To be continued)

(Continued)

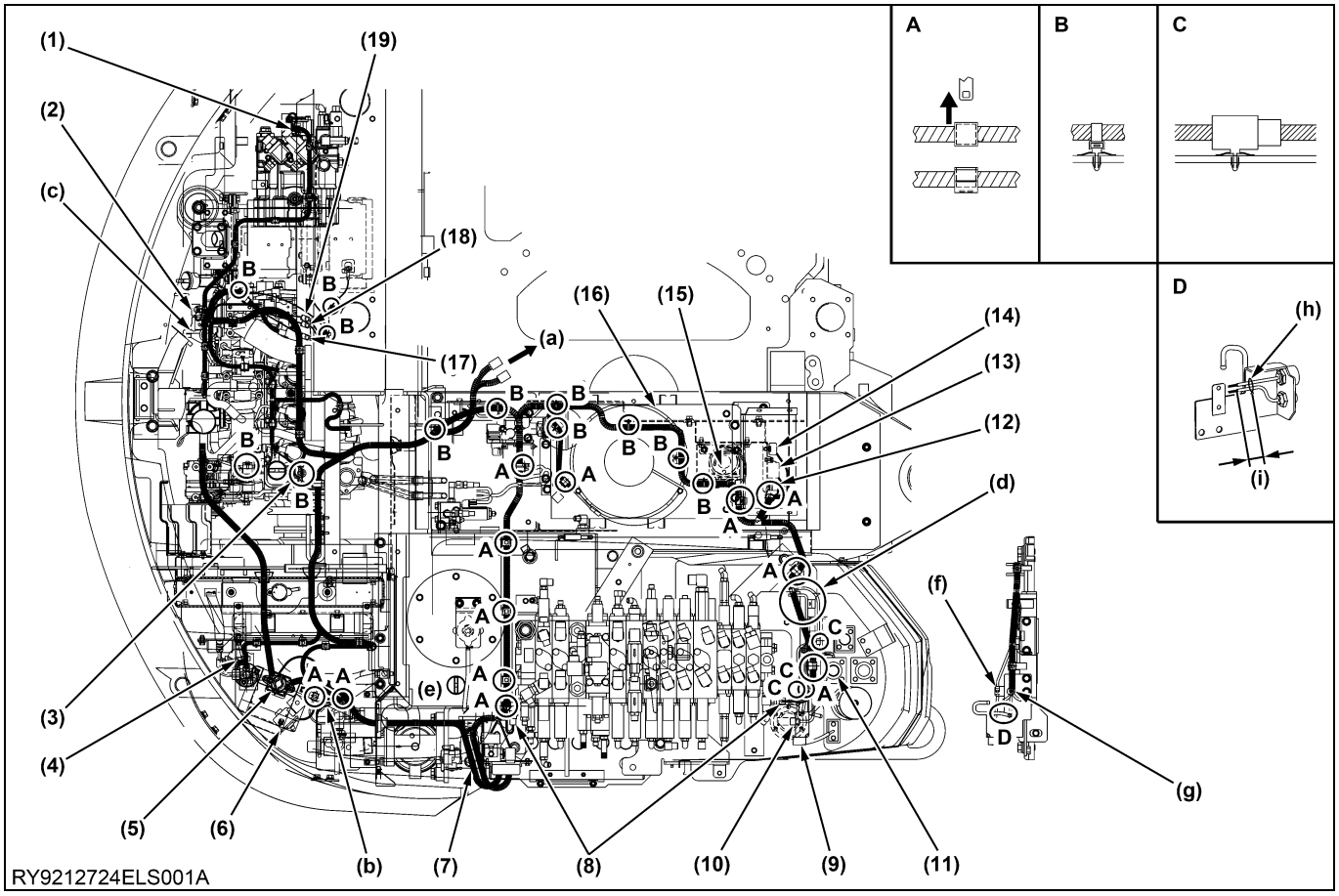


RY9212724ELS010A

(22) Fuel Pump
(23) Slow Blow Fuse
(24) ECU (Engine)
(25) Relay Box
(26) Fuse Box
(27) Fuse Box (Fan)
(28) AI Pressure Switch
(29) Fuel Supply Start Switch
(30) Fuel Supply Stop Switch
(31) Fuel Level Gauge
(32) Oil Temperature Sensor

RY9212724ELS0014US0

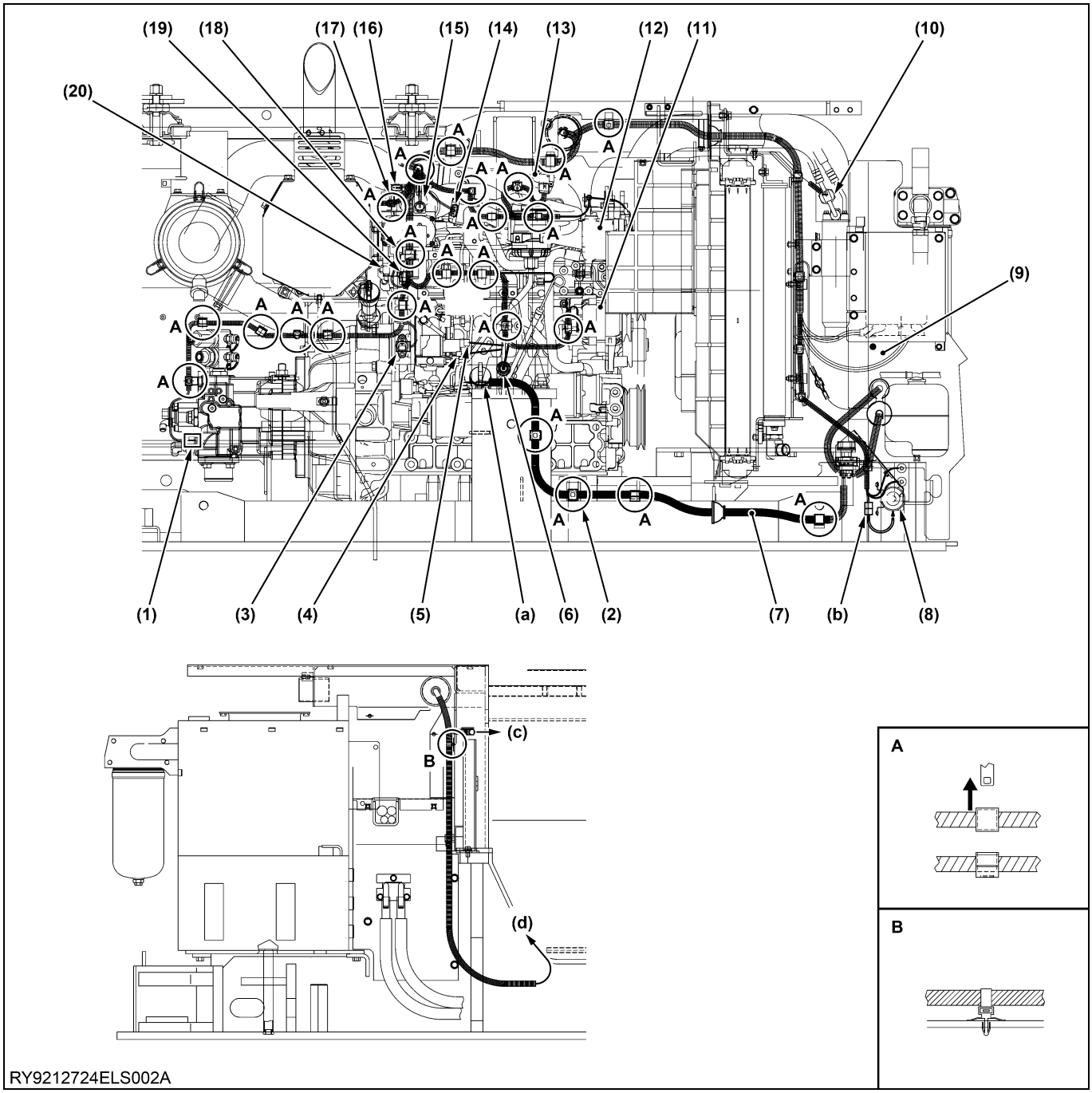
[4] WIRING ROUTING



(1) Oil Temperature Sensor
(2) NE Sensor
(3) Engine Glow
(4) A/C Switch
(5) Battery Isolator
(6) Fuel Pump
(7) Water Level Sensor
(8) AI Pressure Switch
(9) Fuel Feed Switch
(10) Fuel Level Sensor
(11) Fuel Feed Sensor
(12) Fuel Feed Pump Start Relay
(13) Fuel Feed Stop Timer
(14) Fuel Feed Pump Stop Relay
(15) Fuel Feed Pump
(16) Condenser Fan
(17) DPF Outlet Temperature Sensor
(18) DOC Outlet Temperature Sensor
(19) DOC Inlet Temperature Sensor

(a) To Main Harness
(b) Fuel pump harness to pass to the inside of the battery cable.
(c) To Starter Relay
(d) The harness to the fuel feed sensor should pass under the main harness.
(e) To Battery (+) Terminal
(f) Insert the connector from the inside of the bracket.
(g) Insert the connector from the outside of the bracket.
(h) Clamping in place of black tubes.
(i) 30 mm

RY9212724ELS0003US0

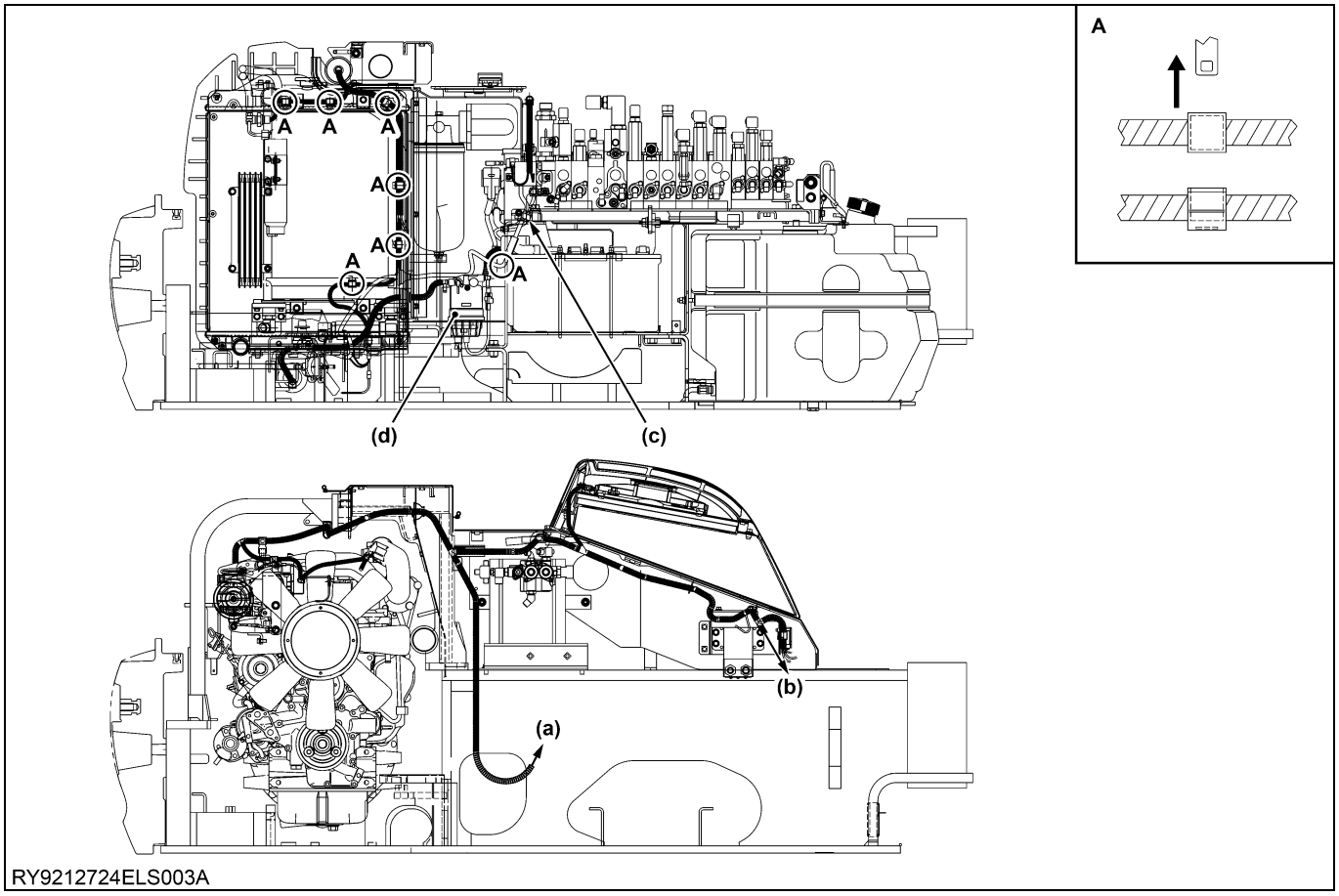


RY9212724ELS002A

(1) Oil Temperature Sensor
(2) G-Sensor Harness
(3) NE Sensor
(4) Fuel Temperature Sensor
(5) SCV
(6) Oil Pressure Switch
(7) Battery (+) Cable
(8) Fuel Pump
(9) Travel Alarm Buzzer (Option)
(10) A/C Switch
(11) Alternator
(12) Compressor
(13) Air Flow Sensor
(14) EGR Valve
(15) Intake Temperature Sensor
(16) Boost Sensor
(17) DPF Differential Pressure Sensor
(18) Intake Throttle Valve
(19) Water Temperature Sensor
(20) G Sensor Harness

(a) To Starter Relay
(b) Fuel pump connector install vertically.
(c) To Fuel Feed Pump
(d) To Main Harness

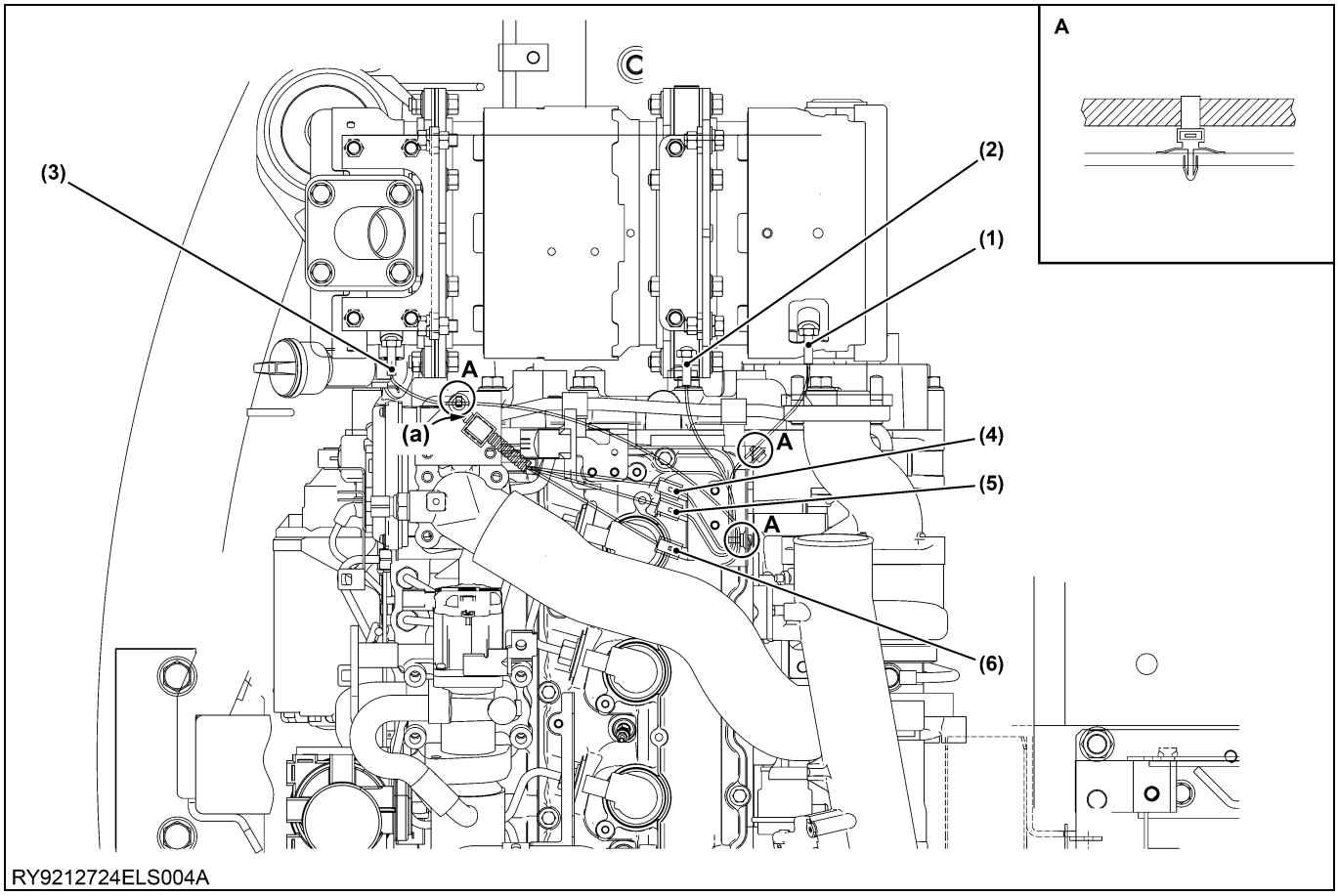
RY9212724ELS0004US0



RY9212724ELS003A

(a) To Main Harness **(b) To Fuel Sensor** **(c) Connect the wiring harness and the battery cable.** **(d) Water Level Sensor**

RY9212724ELS0005US0



RY9212724ELS004A

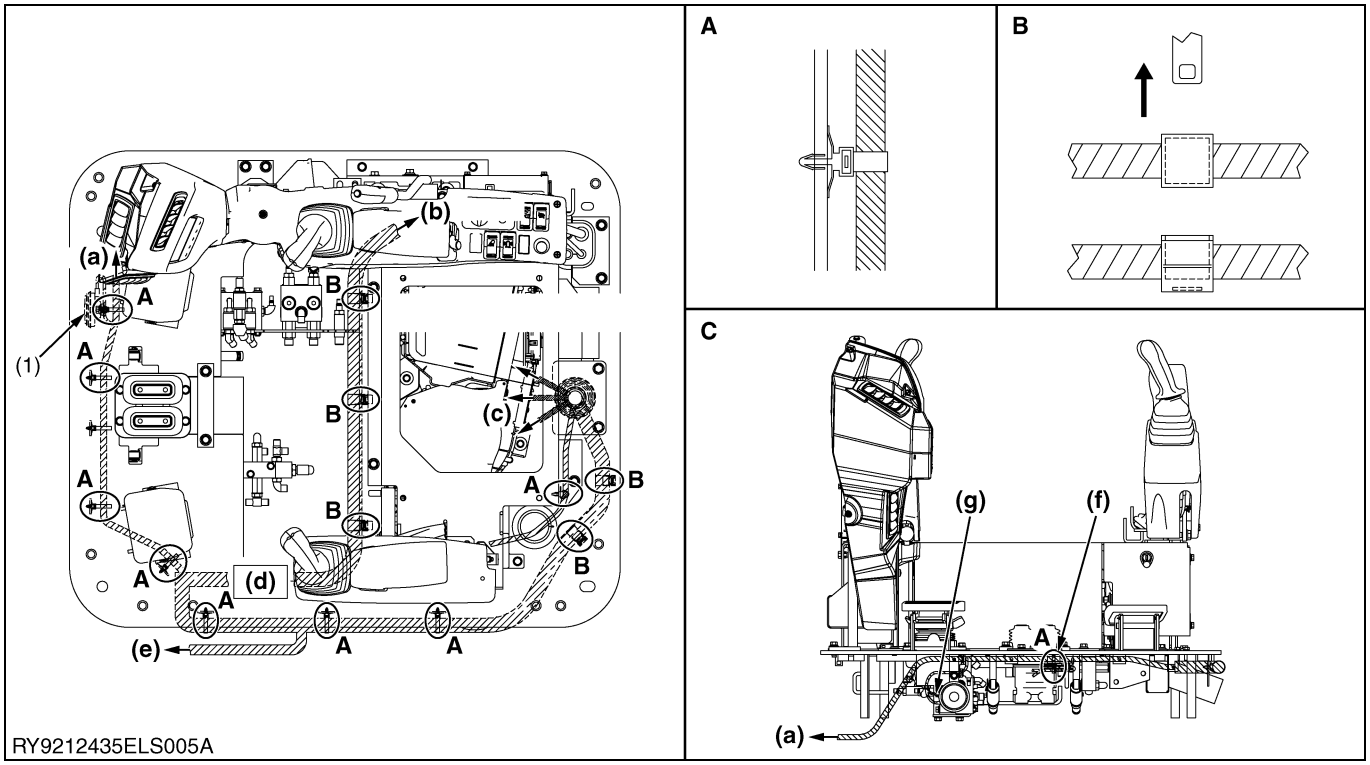
(1) DPF Outlet Temperature Sensor 0 (Black)
(2) DPF Outlet Temperature Sensor 1 (Dark Gray)
(3) DPF Outlet Temperature Sensor 2 (White)
(4) DPF Outlet Temperature Sensor Connector 0 (Black)
(5) DPF Outlet Temperature Sensor Connector 1 (Dark Gray)
(6) DPF Outlet Temperature Sensor Connector 2 (White)

(a) From Engine Harness

■ IMPORTANT

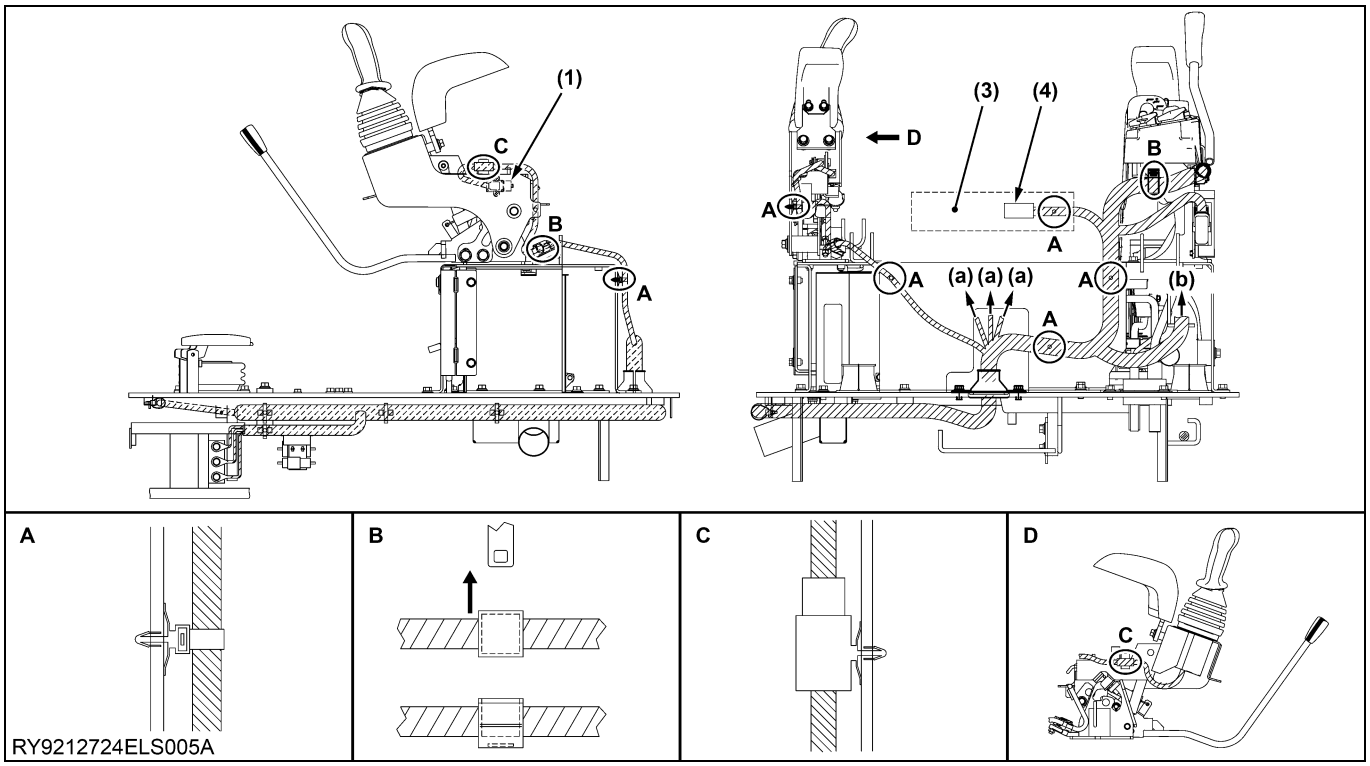
- **When attaching sensors, match the color of the connectors to those of the harness.**

RY9212724ELS0006US0



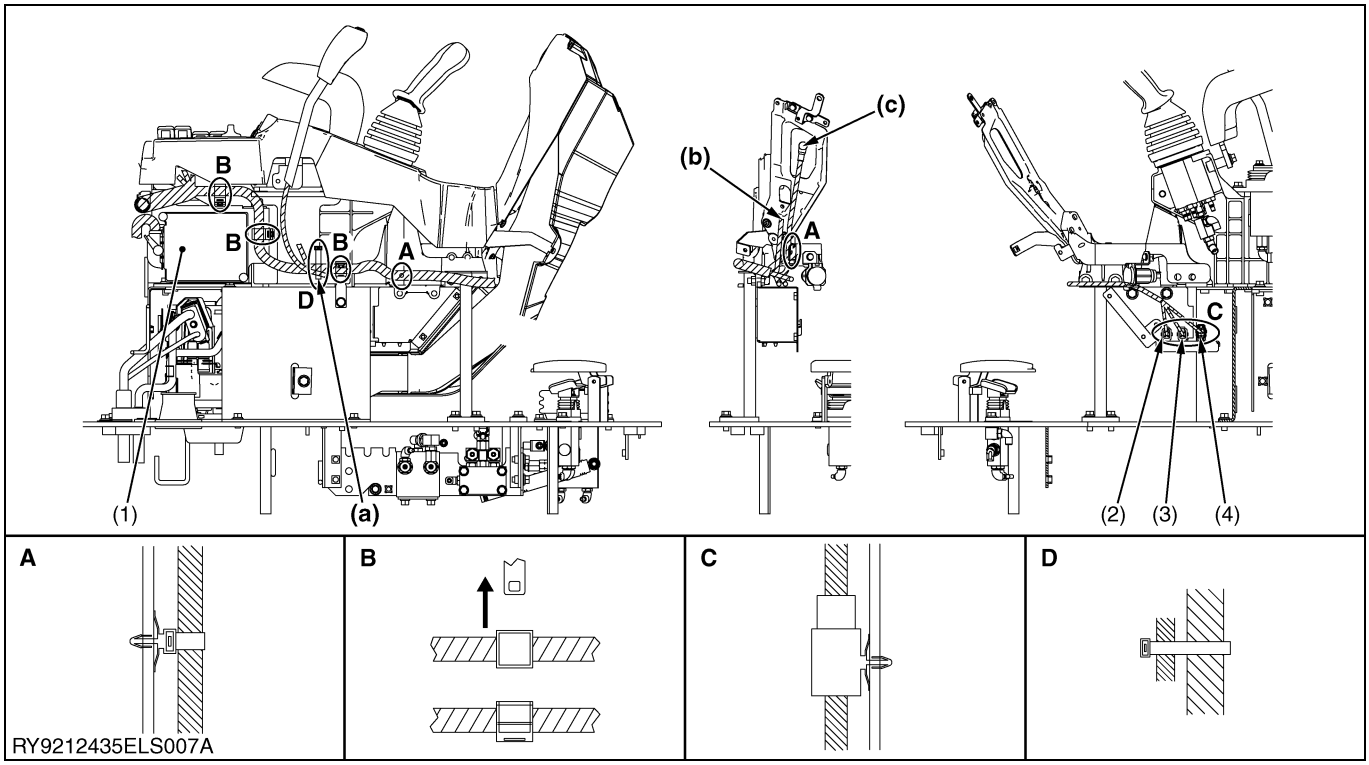
(1) Horn
(a) To Front
(b) To Engine Harness
(c) To A/C Unit
(d) Harness Connecting Part
(e) GND
(f) Clamp by bundling a traveling alarm.
(g) Horn connection (+) or (-) either will do.

RY9212435ELS0005US0



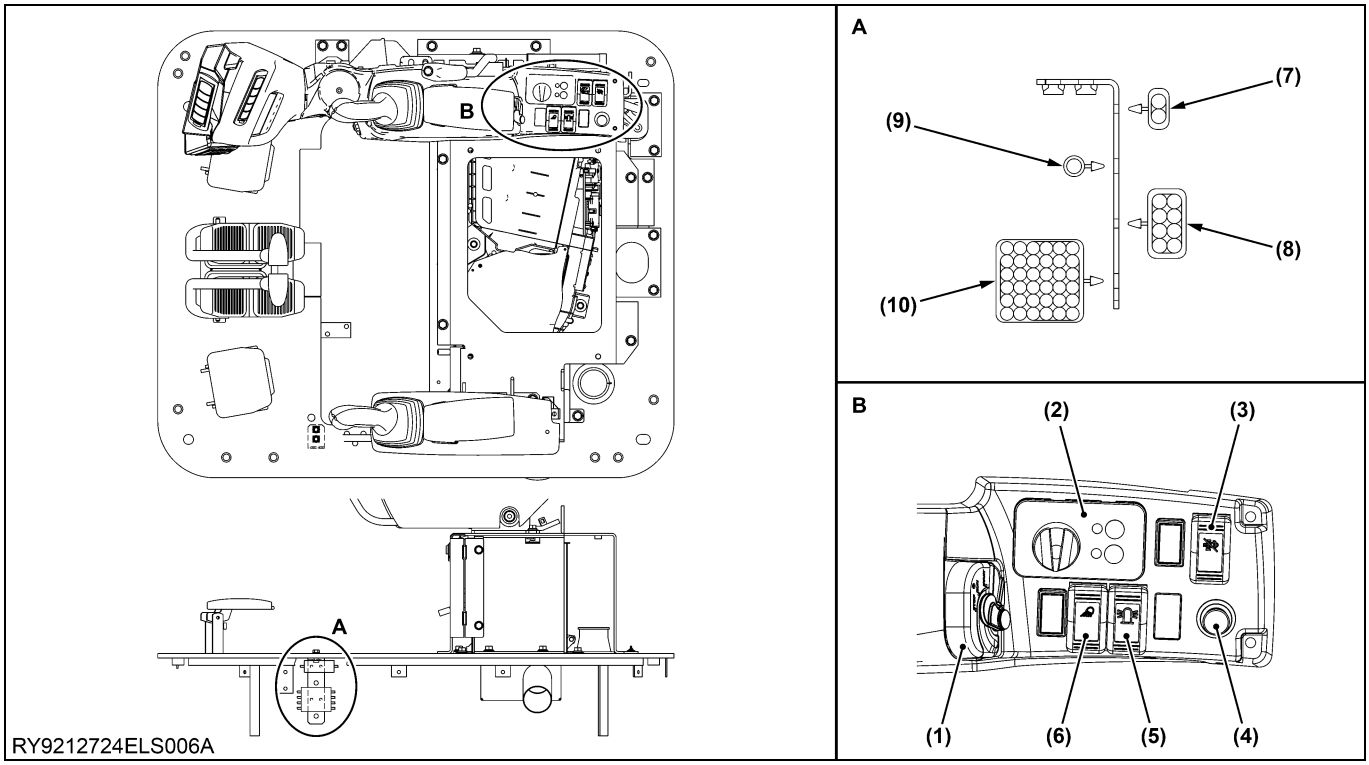
(1) Limit Switch
(2) Main ECU
(3) Seat
(4) Seat Belt Switch
(a) To A/C Unit
(b) To Fuse Box

RY9212724ELS0007US0



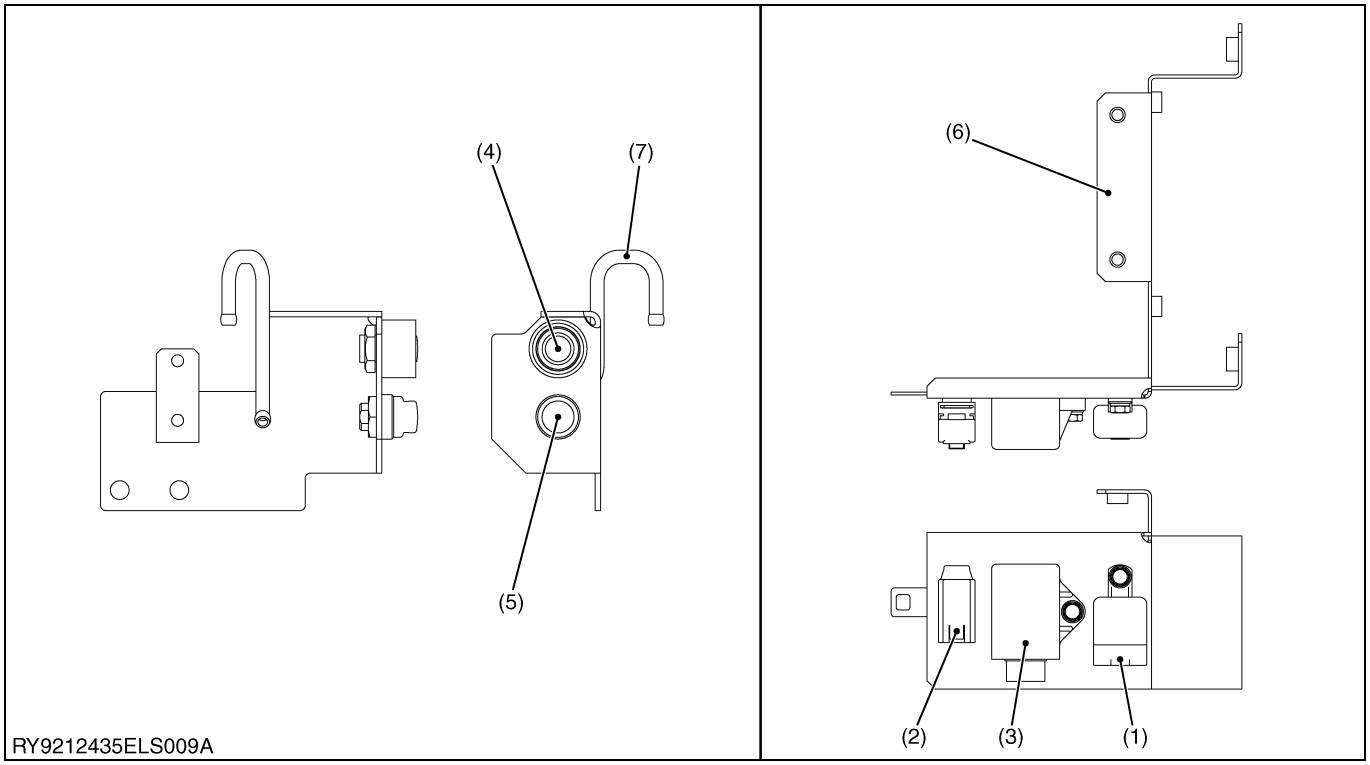
(1) Main ECU
(2) CAN Communication Connector (4-Pin)
(3) CAN Communication Connected (2-Pin)
(4) Engine Diagnostic Tool Connected (4-Pin)
(a) Fastened at the point of white tape.
(b) Connected to the buzzer.
(c) Connected to the Meter.

RY9212435ELS0007US0



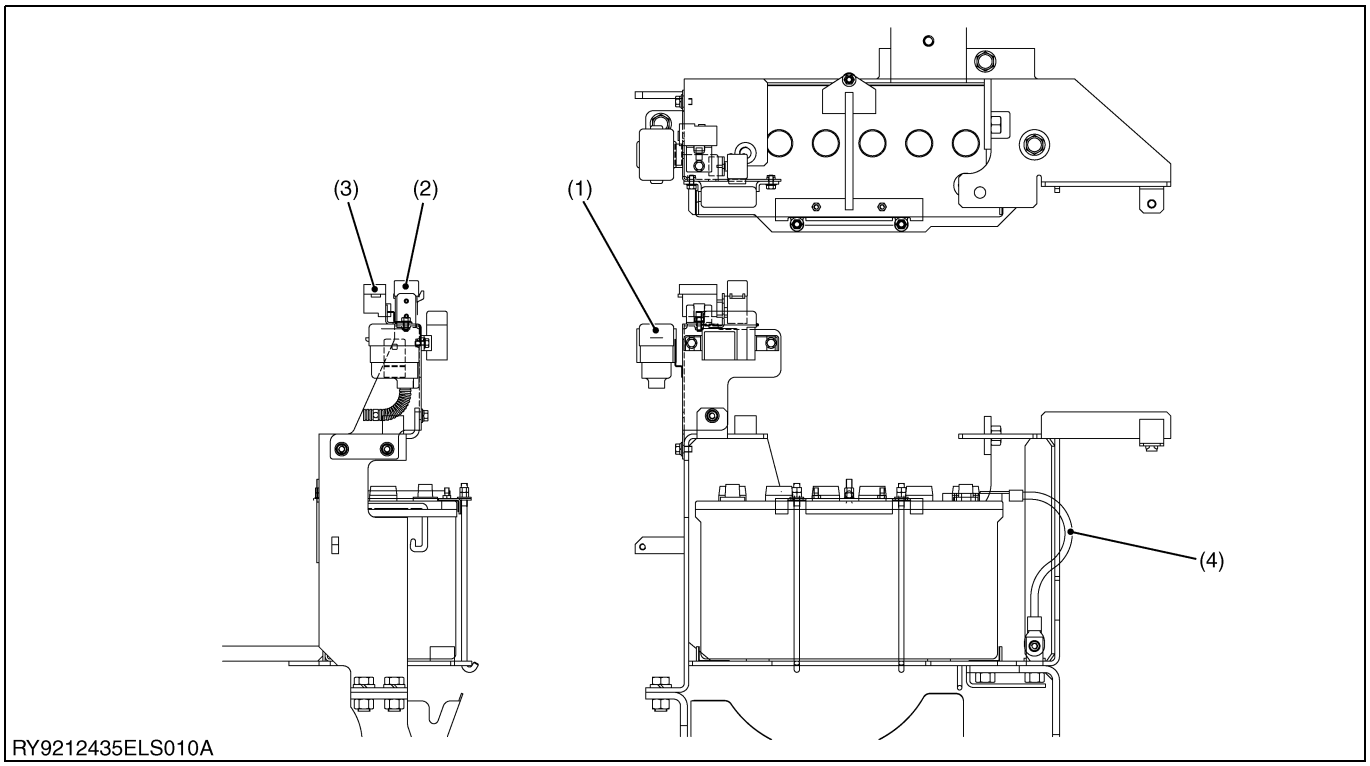
(1) Anti-Theft Antenna
(2) AI Console
(3) DPF Inhibit Switch
(4) Engine Stop Knob
(5) Beacon Switch
(6) Worklight Switch
(7) Engine (2-Pin)
(8) Engine (8-Pin)
(9) Engine (12-Pin)
(10) Engine (16-Pin)

RY9212724ELS0008US0



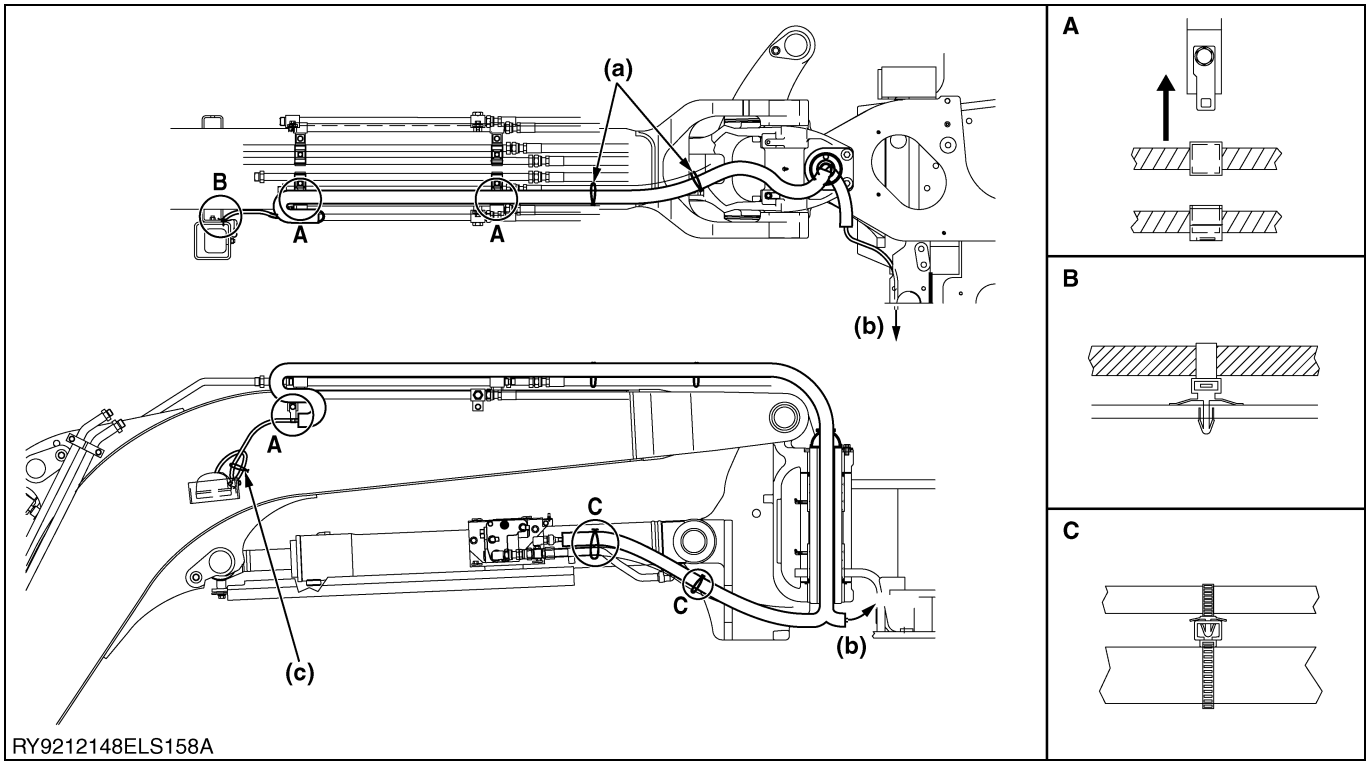
(1) Supply Pump Stop Relay
(2) Supply Pump Start Relay
(3) Supply Pump ECU (4-Min. Timer)
(4) Supply Pump Start Switch
(5) Supply Pump Stop Switch
(6) Supply Pump Bracket
(7) Supply Switch Bracket

RY9212435ELS0009US0



(1) Relay Box
(2) Fuse Box (Condenser Fan)
(3) Slow-Blow Fuse Box
(4) Battery Code

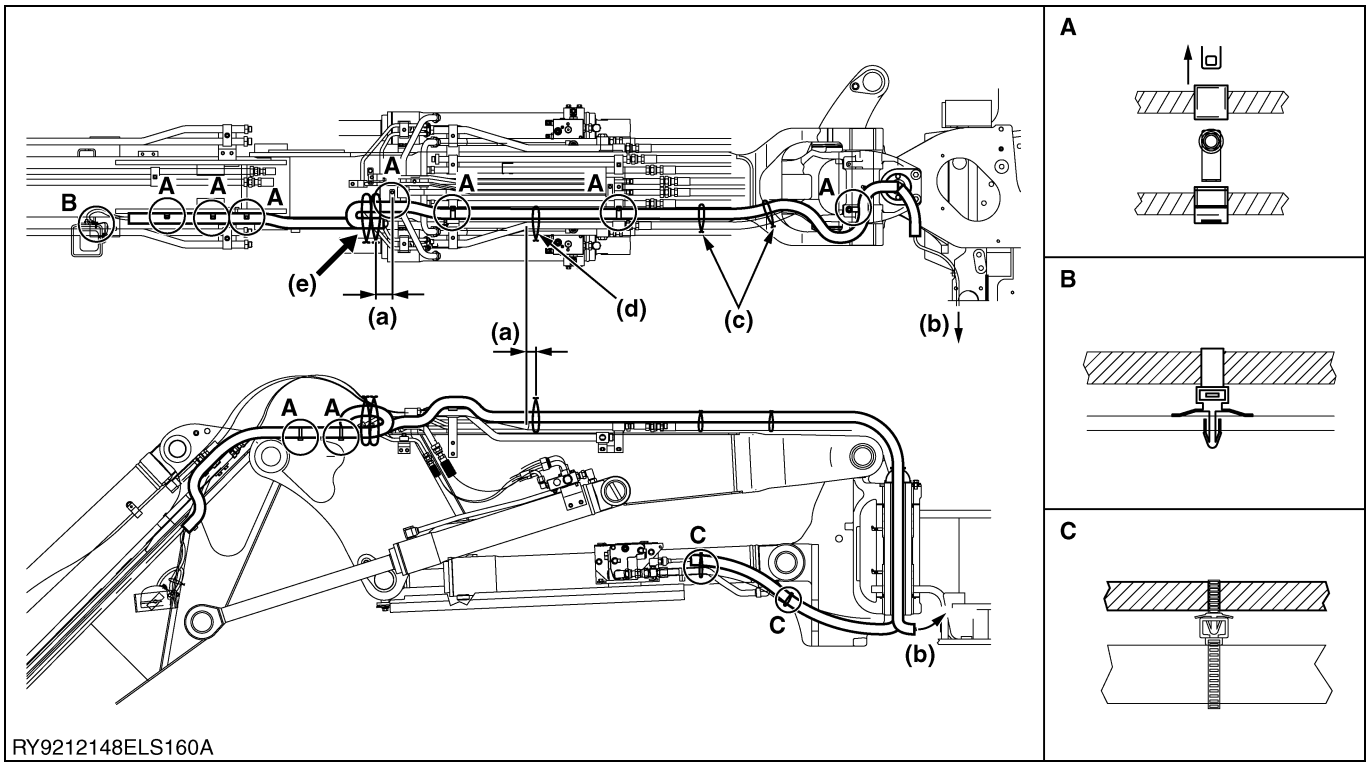
RY9212435ELS0010US0



RY9212148ELS158A

(a) Arm Bottom Hoses and Clamps
(b) To Main Harness
(c) Clamp Wiring

RY9212148ELS0217US0



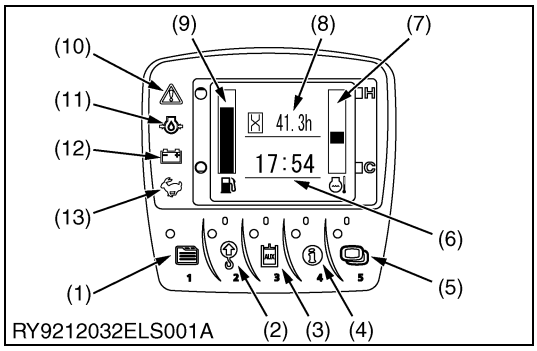
RY9212148ELS160A

(a) 30 mm (1.18 in.)
(b) To the Main Harness
(c) Clamp the AUX2 (HIGH) Hose and the Harness
(d) Clamp the AUX2 (HIGH) Pipe and the Harness
(e) Bind Up the Harnesses with the Clamp at the 30 mm (1.18 in) from the Center of the Harness Clamp.

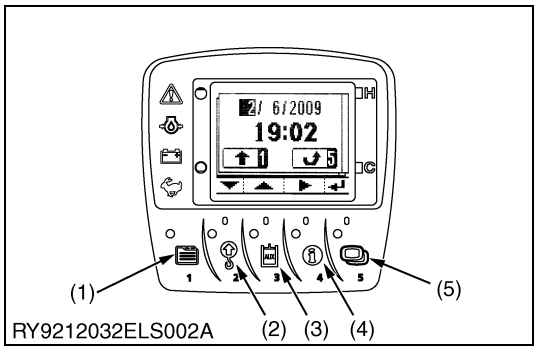
RY9212148ELS0218US0

2. METER PANEL OPERATION

[1] NAMES AND FUNCTIONS OF METERS



RY9212032ELS001A



RY9212032ELS002A

Normal display

(1) User Setting Switch (Switch 1)
(2) Overload Warning Switch (Switch 2)
(3) AUX Port Enable Switch (Switch 3)
(4) Information Switch (Switch 4)
(5) Display Selector Switch (Switch 5)
(6) Clock Display
(7) Water Temperature Gauge
(8) Hour Meter - Engine Tachometer
(9) Fuel Gauge
(10) Warning Lamp (Red, Yellow)
(11) Oil Lamp
(12) Charge Lamp
(13) 2nd Speed Indicator Lamp

RY9212148ELS0001US0

Display at menu-selection

(1) Direction cursor switch (Switch 1)
Stop each setting and return to the original screen.
(2) Cursor move switches (Switch 2)
Move Down the Selection Item.
Move Down the Menu-Selection Position.
(3) Cursor Move Switches (Switch 3)
Move Up the Selection Item.
Move Up the Menu-Selection Position.
(4) Cursor Move Switch (Switch 4)
(5) Save switch (Switch 5)
Decision of the Selection Item.
Selecting the Item at the Menu-Selection Position.

RY9212007ELS0002US0

[2] USER SETTINGS MODE

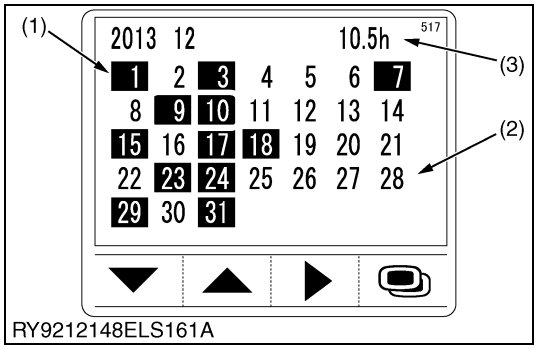
- Turn the key from OFF to ON and press switch 1 to enter the user settings mode.

	Item	Description
(1)	Log Record	Allows you to check the hours in use for each day for up to 3 months prior.
(2)	Periodic Check	Allows you to check the periodic check items and operate the meter panel after conducting periodic inspections.
(3)	Set Clock	Sets the clock.
(4)	AUX Flow Ctrl Set	Sets the AUX flow control.
(5)	Various Settings	Allows you to change the order of the date display and the clock display method.
(6)	Language Setting	Changes the language of the meter panel display.

RY9212724ELS0010US0

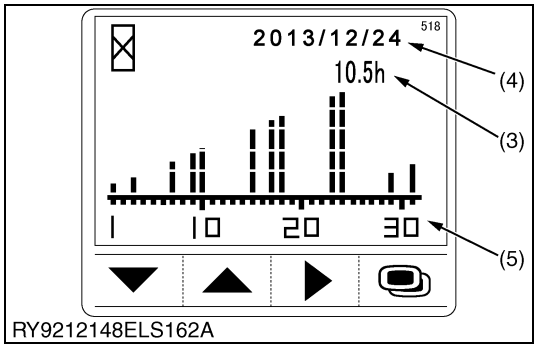
(1) Log Record

- Allows you to check the hours in use for each day for up to 3 months prior.



RY9212148ELS161A

1. Select Log Record.
2. Select the month and day of the hours in operation you wish to check to display the hours in use in the upper right of the screen.
3. If you press switch 5, you can check the hours in operation for one month.



RY9212148ELS162A

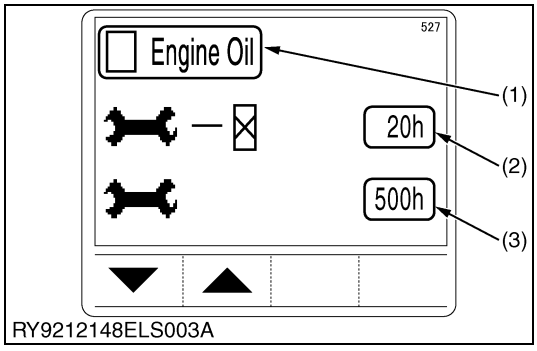
[Sample screenshot using switch 5]

(1) Days in Use (B/W reversed)
(2) Days not in Use
(3) Hours Used for Selected Date
(4) Selected Date
(5) Horizontal Axis (Day)

RY9212148ELS0016US0

(2) Periodic Check

- Allows you to check the periodic check items and operate the meter panel after conducting periodic inspections.



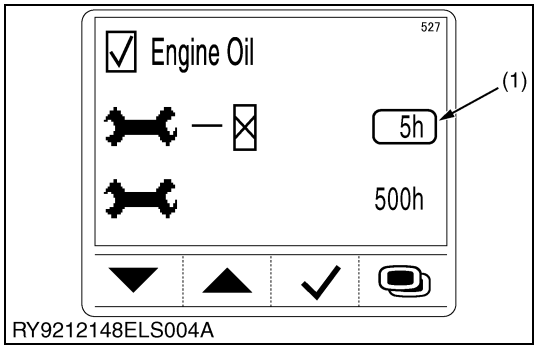
RY9212148ELS003A

1. Select Periodic Check and check the periodic check items.

■ **IMPORTANT**
- **Once an item is within 10 hours of its periodic check time, switches 4 and 5 can be selected.**

(1) Check Item
(2) Hours Until Service (Next check time - service hour meter)
Service Hour Meter: hour meter + offset time
(3) Next Check Time

RY9212148ELS0017US0

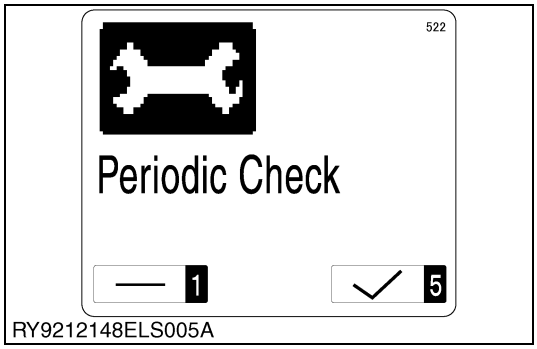


RY9212148ELS004A

Operation after making a periodic check

1. Select Periodic Check and select the periodic check item that was performed.
2. Press switch 4 and make sure the check mark is displayed in the upper left of the meter panel.
3. Press switch 5.

■ **IMPORTANT**
- **When "Periodic Check Selection" is set to Manual, switch 4 cannot be selected unless the worklight is pressed "ON". (Std. for European spec)**
- **When the "Periodic Check Selection" is set to Auto, turning the key ON/OFF 10 times means the periodic check has been done. (Std. for other than European specs)**



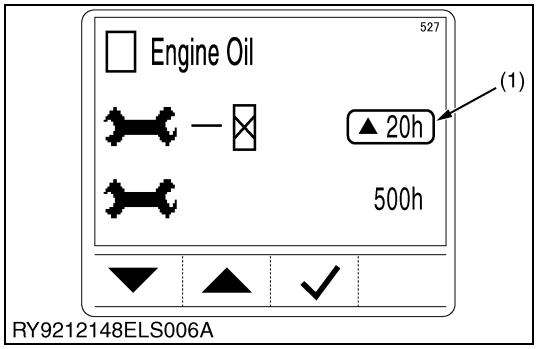
RY9212148ELS005A

4. To perform the check, press switch 5. To return, press switch 1.

■ **IMPORTANT**
- **Once you initiate a check (switch 5), you cannot go back.**

(1) Hours Until Service (5 hours until periodic check time)

RY9212148ELS0018US0



RY9212148ELS006A

[Display when periodic check time exceeded]

E.g.) 20 hours past time to change the engine oil
Service hour meter: 520 hours

(1) Hours Until Service (past 20 hours)

RY9212148ELS0019US0

Periodic Check Items List (The following check items are displayed on the LCD screen at the corresponding hour meter time).

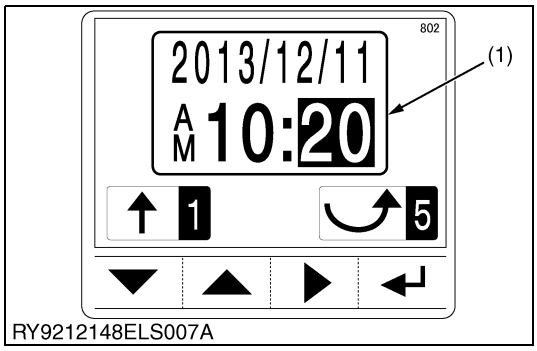
No.	Check Item		Interval	Hour meter indication							Subsequently
				50	100	250	500	600	750	1000	
1	Engine oil (CJ-4)		Change				❍			❍	Every 500 hrs
2	Hydraulic oil									❍	Every 1000 hrs
3	Air cleaner element	Outer element	Replace							❍	Every 1000 hrs
		Inner element								❍	Every 1000 hrs
4	Fuel filter						❍			❍	Every 500 hrs
5	Engine oil filter						❍			❍	Every 500 hrs
6	Travel motor gear oil		Change	●			❍			❍	Every 500 hrs
7	Hydraulic return filter		Replace			●	❍			❍	Every 500 hrs
8	Hydraulic suction filter									❍	Every 1000 hrs
9	Pilot filter									❍	Every 1000 hrs
10	Front idler & track roller oil		–								Every 2000 hrs
11	Oil separator element		Replace								Every 1500 hrs

● First operation

RY9212724ELS0011US0

(3) Set Clock

- Sets the clock.



RY9212148ELS007A

1. Select "Set Clock" and set the clock.

[NOTE]

- Clock precision: 2 seconds/day

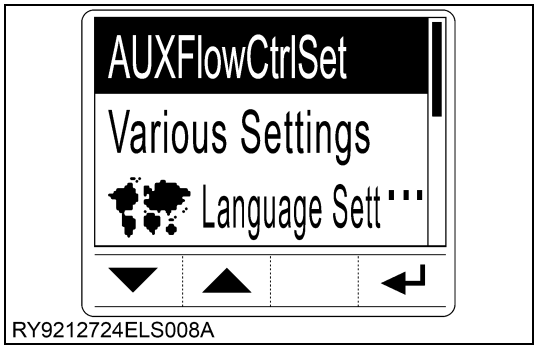
■ **NOTE**

- **Clock settings can be made with the display methods in the "Various Settings" mode.**

(1) Clock Setting Screen

RY9212148ELS0021US0

(4) AUX Flow Ctrl Set



RY9212724ELS008A

1. Select "AUX Flow Ctrl Set" and set the auxiliary flow control.

■ **NOTE**

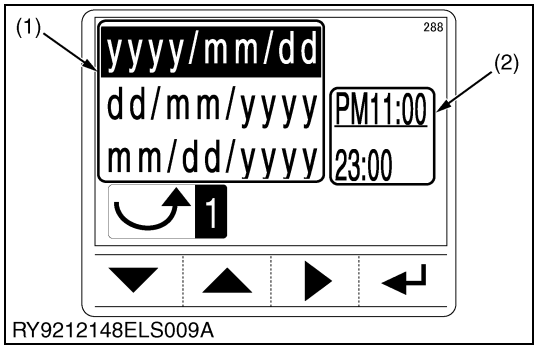
- **When shipped only icons 1 and 2 are recorded. (N.A. spec.)**
- **When shipped only icons 1, 2 and 3 are recorded. (Eur. spec.)**

(1) Icons (1 to 5) (2) Cursor

RY9212724ELS0012US0

(5) Various Settings

- Allows you to change the order of the date display and the clock display method.



RY9212148ELS009A

1. Select Various Settings and then Calendar.
2. Select the date and clock display methods as desired.

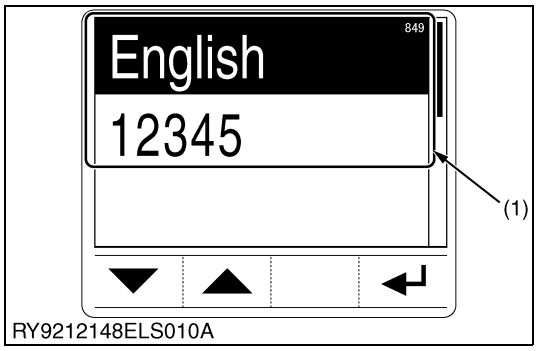
When shipped	N.A. and Australia Specs	MDY/AM-PM
	Eur. spec.	DMY/24 Hour
	Japan spec	YMD/AM-PM

(1) Select the Y/M/D Display Order (2) Select Either AM-PM or 24 Hour Display

RY9212148ELS0023US0

(6) Language Setting

- Changes the language of the meter panel display.



RY9212148ELS010A

1. Select "Language Setting" and select a language.

■ **IMPORTANT**
- **In Eur. ver., 14 languages are available.**
- **In US ver., English only.**
- **In Canada ver., English and French only.**

(1) Language Selection Screen

RY9212435ELS0013US0

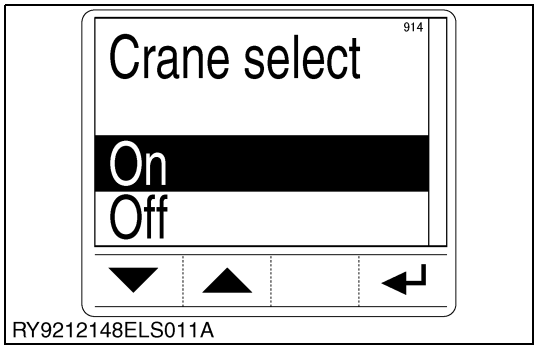
[3] SERVICE DEALER SETTING

- Turning the key ON while holding SW1 down, allows you to enter the hide user mode.
- There are two items in the hide user mode, the crane mode and the arm control mode.

RY9212148ELS0025US0

(1) Crane Mode

- Disables the overload alarm on excavators that have the overload alarm. (Eur. spec.)
- Disables the crane function on excavators with the crane specification. (Japan spec.)



RY9212148ELS011A

1. Select the crane mode.
2. Select the desired setting.
3. Press SW5 to make the setting.

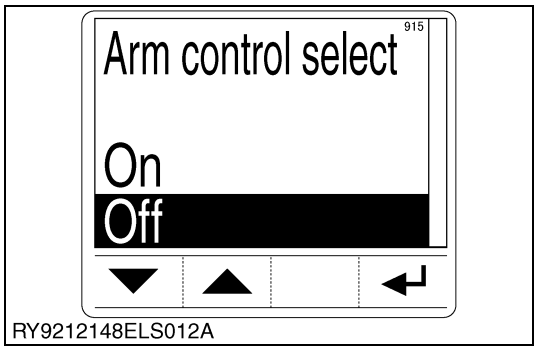
- When shipped: enabled

■ **IMPORTANT**
- **The setting is displayed and can be made on the N.A. specification as well (Does not affect this machine).**

RY9212148ELS0026US0

(2) Arm Control Mode (Only on Japan Spec.)

- Disables the ability to switch the arm control on machines with the arm control specification.



RY9212148ELS012A

1. Select the arm control mode.
2. Select the desired setting.
3. Press SW5 to make the setting.

- When shipped: enabled

■ **IMPORTANT**
- **The setting is displayed and can be made on the Japan specification as well (Does not affect this machine).**

RY9212148ELS0027US0

[4] SERVICE/DEALER MODE

- Turning the key ON while holding down SW5 puts the machine in the service/dealer mode.
- Select a language. (Eur. spec.: 5 languages, US spec.:1 language, Canada spec.: 2 languages)
- There are 2 items in the service/dealer mode, namely "Diagnosis" and "Setting," which allow you to check/set the content in the tables below.

Mode	Item		Description	Notes
(1) Diagnosis	[A] Tester		Checks the data from each sensor and switch.	
	[B] Retrieve Fail Record		Checks the record of past failures.	
	[C] Delete Fail Record		Deletes the record of past failures.	
(2) Setting	[A] AI Set		Make the setting when the AI motor, accelerator dial or governor sensor is touched. Also make the setting when part(s) are replaced.	
	[B] AUX1 Set	(A) Knob Set	Set when the AUX1 knob is replaced.	
		(B) (w/attach) Start Point Set	Set when the AUX1 proportional valve and/or spool are replaced. (w/ attachment mounted)	
		(C) (w/o attach) Start Point Set	Set when the AUX1 proportional valve and/or spool are replaced. (w/ pressure gauge mounted)	
		(D) Feeling Adj.	Make setting when the AUX1 start point is inaccurate.	
	[C] AUX2/Thumb Set	(A) Knob Set	Make setting when the AUX2 knob is replaced.	
		(B) (w/attach) Start Point Set	Set when the AUX2 proportional valve, spool and/or ECU are replaced. (w/ attachment mounted)	
		(C) (w/o attach) Start Point Set	Set when the AUX2 proportional valve, spool and/or ECU are replaced. (w/ pressure gauge mounted)	
		(D) Feeling Adj.	Make setting when the AUX2 start point is inaccurate.	
	[D] AS Set	(A) Front Angle Set	Set when the AS position meter is replaced.	Only on RX series (Japan)
		(B) Start Point Set	Set when the AS 4-way proportional valve and/or control valve are replaced.	
		(C) Feeling Adj.	Set when you wish to change the sensitivity of the AS cylinder end cushion feel.	
		(D) Bucket Width Set	Set when using a bucket that is wider than the standard bucket.	
	[E] Crane Set	(A) Front Angle Set	Set when the crane's position meter is replaced.	Crane spec. only (Japan)
		(B) Maximum Set	Make the setting when the AI motor, accelerator dial or governor sensor is touched. Also make the setting when part(s) are replaced.	
	[F] Over Load Warning		Sets/changes the overload warning pressure.	Eur. spec. only
	[G] Model Set		Set when the ECU and/or meters are replaced.	

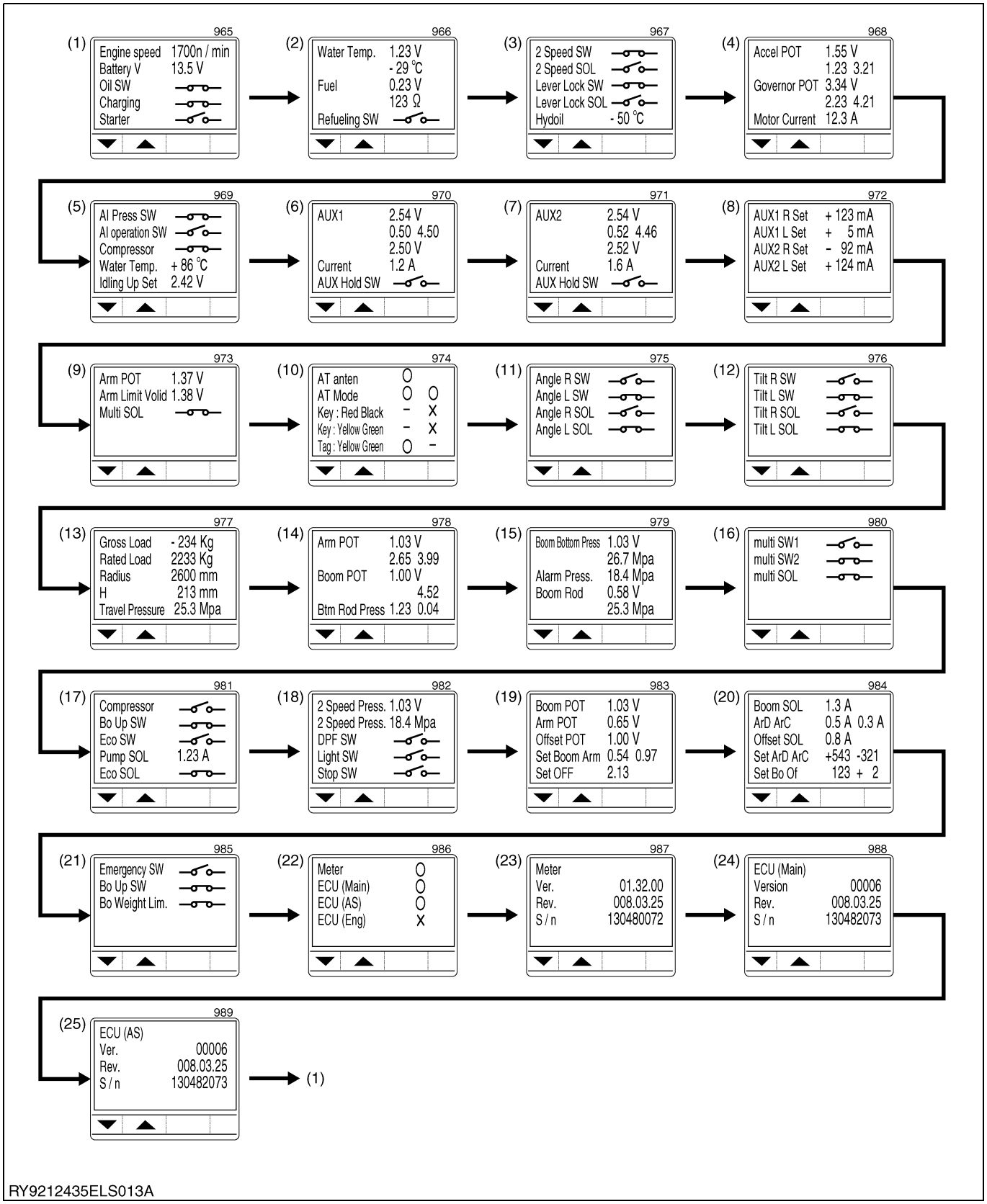
Mode	Item		Description	Notes
(2) Setting	[H] Others	(A) AI Motor Drive	Moves the AI motor position when the accelerator dial is replaced.	
		(B) Exchange (AUX1) (2/Thumb)	Operates AUX2 via the AUX1 knob. Or operates AUX1 via the AUX2 knob.	
		(C) Periodic Check Selection	Changes the method of canceling the periodic check guidance to automatic or to manual.	
		(D) Periodic Check Display	Turns off the display of periodic check guidance. Or turns it on.	
		(E) Annual Guidance	Turns on the display of annual check guidance. Or turns it off.	
		(F) Periodic Check Set	When the meter is replaced, sets the periodic check time prior to replacement to prevent a discrepancy in the periodic check time.	
		(G) Clock Set Warning (Y/N)	Turns the message, "Set clock" to be displayed/not when the clock has the wrong time.	
		(H) Arm Control Adj	Set when making fine adjustments to the stop position of the arm crowd limit.	Japan spec. only
		(I) Multipurpose Mode	Changes the operating conditions of the multi-purpose switch.	
		(J) All Fail Record	Checks all the fail records since the machine was shipped.	
		(K) Opening Select	Changes the opening display screen.	

RY9212724ELS0002US0

(1) Diagnosis

[A] Tester

- Makes it possible to check the data from each sensor and switch.
- Determines when a setting is outside parameters and when a switch or solenoid is irregular in terms of continuity.
- Selecting Diagnosis → Tester puts it into this diagnosis mode.



RY9212435ELS013A

(To be continued)

(Continued)

Screen No.	Content displayed	Description/std. value			Notes
1	Engine RPM	• Current value (n/min)			
	Battery voltage	• Battery voltage ± 0.5 V			
	Oil switch	• Prior to engine start: ON • After engine start: OFF			
	Charge				
	Starter	• Key in the Start position: ON • Key in any other position: OFF			
2	Water temperature	• Current value (V) • Current value (°C)			Common rail spec. voltage (V) is dummy data
	Fuel	• Current value (V) • Current value (Ω)			
			When cut off	When shorted	
		Voltage	5.0 V	0 V	
		Resistance	260Ω	0Ω	
		[NOTE]			
			KX080-4α2		
		Full	5Ω or less		
		Showing 1/2	42.19 Ω		
		3 dots remaining	101.0 Ω		
		Empty	101.0Ω or higher		
		• Fuel low warning displayed when 3 dots remaining.			
	Fuel supply switch	• Press switch: ON • Release switch: OFF			
3	2-speed switch	• Press switch: ON • Release switch: OFF			
	2-speed solenoid	• With output signal from ECU: ON • No output signal from ECU: OFF			
	Lever lock switch	• Lever down: ON • Lever up: OFF			
	Lever lock solenoid	• With output signal from ECU: ON • No output signal from ECU: OFF			
	Oil temperature sensor	• Dummy data			
4	Accelerator POT	• Current value: 1.50 to 3.30 V • Current value: idle, MAX			
	Governor POT	• Current value: 0.25 to 4.75 V • Current value: idle, MAX			Common rail spec. is dummy data
	Motor amperage	• AI motor operating: 0.0 to 15.0A • AI motor stopped: 0.0 to 2.0 A			
5	AI pressure switch	• Not operating: ON • Operating: OFF			
	AI control switch	• Press switch: ON • Release switch: OFF			
	Compressor	• Operating: ON			
	Water temperature	• Current value (°C)			
	Idle up	• Idle up setting value (V)			Common rail spec. is dummy data
6	AUX1	• Current value: 0.25 to 4.75 V • Setting value: left or right • Setting value: neutral			Only for models equipped with AUX1 proportional control (EU, N.A.)
	Amperage	• Operating: 0.5 to 2.0 A • Stopped: 0 to 0.2A			
	AUX hold switch	• Press switch: ON • Release switch: OFF			

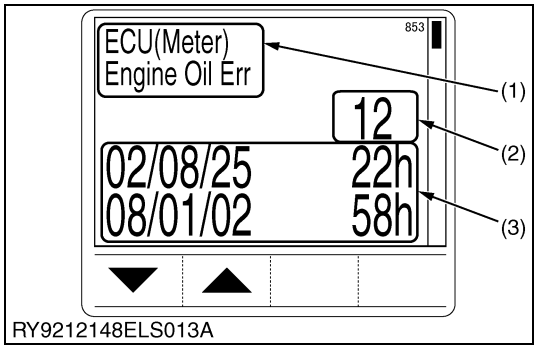
Screen No.	Content displayed	Description/std. value			Notes
7	AUX2	• Current value: 0.25 to 4.75 V • Setting value: left or right • Setting value: neutral			Only for models equipped with AUX2 proportional control (EU, N.A.)
	Amperage	• Operating: 0.5 to 2.0 A • Stopped: 0 to 0.2A			
	AUX hold switch	• Press switch: ON • Release switch: OFF			
8	AUX1 right setting	• AUX start point setting value			Only for models equipped with AUX proportional control (EU, N.A.)
	AUX1 left setting				
	AUX2 right setting				
	AUX2 left setting				
9	Arm POT	• Current value: 0.25 to 4.75 V			Arm limit spec only Japanese models
	Arm limit setting value	• Arm stop setting value			
	Arm limit solenoid	• With output signal from ECU: ON • No output signal from ECU: OFF			
10	Anti-theft antenna	• Antenna working normally: O • Antenna malfunction: X			If unknown or Anti-Theft deactivated: –
	On/off enabled/cancelled	Have key: O No key: X	Anti-theft mode: O Anti-theft off: X		
	Red key, Black key	Same red key: O Different red key: X	Same black key: O Wrong red or black key: X		
	Yellow or green key	Same yellow key: O Different yellow key: X	Same green key: O Different green key: X		
	(Tag) yellow or green	Same yellow key: O Different yellow key: X	Same green key: O Different green key: X		
11	Angle right switch	• Press switch: ON • Release switch: OFF			Angle spec. only N.A. models
	Angle left switch				
	Angle right solenoid	• With output signal from ECU: ON • No output signal from ECU: OFF			
	Angle left solenoid				
12	Tilt right switch	• Press switch: ON • Release switch: OFF			Tilt spec. only N.A. models
	Tilt left switch				
	Tilt right solenoid	• With output signal from ECU: ON • No output signal from ECU: OFF			
	Tilt left solenoid				
13	Actual load	• Current value (kg)			Crane spec. only Japanese models
	Rated load	• Current value (kg)			
	Radius	• Current value (mm)			
	Height	• Current value (mm)			
	Travel pressure	• Current value (MPa)			
14	Arm POT	• Current value: 0.25 to 4.75 V • Setting value: arm crowded, arm dump end			
	Boom POT	• Current value: 0.25 to 4.75 V • Setting value: boom up end			
	Bottom pressure, rod pressure	• Current value: 0.50 to 4.50 V			
15	Boom bottom pressure	• Current value (V) • Current value (MPa)			Only EU models
	Warning pressure	• Current value (MPa)			
	Boom rod pressure	• Current value (V) • Current value (MPa)			Dummy data

Screen No.	Content displayed	Description/std. value	Notes
16	Multi-purpose1 switch 1 (AI control dial)	• Press switch: ON • Release switch: OFF	
	Multi-purpose2 switch 2 (AUX left knob)		
	Multi-purpose switch solenoid	• With output signal from ECU: ON • No output signal from ECU: OFF	
17	Compressor	• Operating: ON	
	Boom up pressure switch	• Blank	
	Eco switch	• Press switch: ON • Release switch: OFF	
	Pump solenoid	• Blank	
	Gain control solenoid	• P mode: ON • E mode: OFF	
18	Travel pressure sensor	• Current value (V) • Current value (MPa)	
	DPF switch	• Press switch: ON • Release switch: OFF	
	Worklight switch		
	Stop engine switch		
19	Boom POT	• Current value: 0.25 to 4.75 V	Only on RX series (Japan)
	Arm POT		
	Offset POT		
	Setting Bo Ar	• Setting value: boom up, arm crowded	
	Setting Of	• Setting value: offset right	
20	Boom solenoid	• Operating: 0.4 to 1.2 A • Stopped: 0.0 to 0.6A	
	Arm dump/crowd		
	Offset solenoid		
	Setting ArD ArC	• Start point setting: arm dump, arm crowd	
	Setting Bo Of	• Starting point setting: boom up, offset right	
21	Emergency switch	• Press switch: ON • Release switch: OFF	
	Boom up pressure switch	• During boom up operation: ON • Not operating: OFF	
	Boom height limit	• Normally: ON • At height limit: OFF	
22	Meter	• Normally: O [If the meter exists, then O]	
	ECU (main)	• Normally: O [If the ECU (main) exists, then O]	
	ECU (AS)	• Normally: O [If the ECU (AS) exists, then O]	Only on RX series (Japan)
	ECU (CRS)	• Normally: O [If the ECU (CRS) exists, then O]	
23	Meter		
	Ver	• Program version	
	Rev	• Program creation date (Y/M/D)	
	Serial No.	• Serial no. (different number each machine)	
24	ECU (main)		
	Ver	• Program version	
	Rev	• Program creation date (Y/M/D)	
	Serial No.	• Serial no. (different number each machine)	
25	ECU (AS)		Only on RX series (Japan)
	Ver	• Program version	
	Rev	• Program creation date (Y/M/D)	
	Serial No.	• Serial no. (different number each machine)	

RY9212724ELS0001US0

[B] Retrieve Fail Record

- Checks the record of past failures.



RY9212148ELS013A

1. Select Diagnosis → Retrieve Fail Record.
2. If there are more than one failure records, you can toggle the display each time you press switch 2 or 3.

[Display when fail record exists]

(1) Content of Failure detected by the ECU (main or meter or AS) that detected it
(2) Number of occurrences (1 to 255)
(3) Date and hour meter of initial occurrence and date and hour meter of last occurrence

RY9212148ELS0030US0

RY9212148ELS014A

[Display when no fail record exists]

RY9212148ELS0031US0

[C] Delete Fail Record

- Deletes the record of past failures.

RY9212148ELS015A

1. Select Diagnosis → Delete Fail Record.

[Display when fail record deleted]

■ **IMPORTANT**

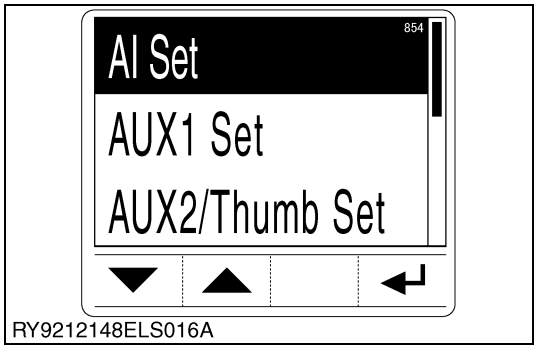
- **Even when fail records are deleted, they are still recorded in the all fail record.**

RY9212148ELS0032US0

(2) Setting

[A] AI Set

- Make the setting when the AI motor, accelerator dial or governor sensor is touched. Also make the setting when part(s) are replaced.



RY9212148ELS016A

1. Select Setting → AI set.
2. Follow the instructions on the meter panel.
3. Press SW5 to make the setting.
4. Follow the instructions on the meter panel and repeat steps 2 and 3.

[Work flow]

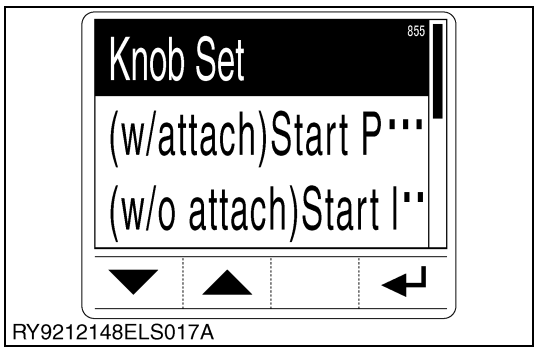
Accel to MAX → Accel to Idling

RY9212148ELS0033US0

[B] AUX1 Set

(A) Knob Set

- Set when the knob is replaced.



RY9212148ELS017A

1. Select Setting → AUX1 Set → Knob set.
2. Follow the instructions on the meter panel.
3. Press SW5 to make the setting.
4. Follow the instructions on the meter panel and repeat steps 2 and 3.

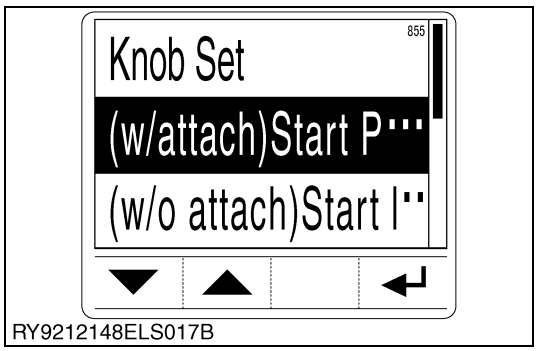
[Work flow]

AUX Knob R END → AUX Knob L END → Knob to neutral.

RY9212148ELS0034US0

(B) (w/attach) Start Point Set

- Make setting when the AUX1 proportional valve, spool and/or AUX1 knob is replaced.
- Mount an attachment on the AUX1 port and make the setting.



RY9212148ELS017B

1. Select Setting → AUX1 Set → (w/attach) Start Point Set.
2. Follow the instructions on the meter panel.
3. Press SW5 to make the setting.
4. Follow the instructions on the meter panel and repeat steps 2 and 3.

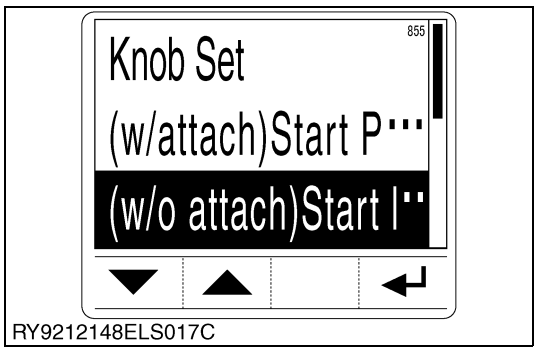
[Work flow]

Accel to MAX → Measure L when attachment moves → Measure R when attachment moves.

RY9212148ELS0035US0

(C) (w/o attach) Start Point Set

- Make setting when the AUX1 proportional valve, spool and/or AUX1 knob is replaced.
- Use this setting method when an attachment is not available.



RY9212148ELS017C

1. Place the excavator on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Release of Residual Pressure in the Hydraulic System and release the residual pressure in the hydraulic line.
3. Attach a pressure gauge at the end of the AUX1 ports (LH and RH).
4. Select Setting → AUX1 Set → (w/o attach) Start Point Set.
5. Follow the instructions on the meter panel.
6. Press SW5 to make the setting.
7. Follow the instructions on the meter panel and repeat steps 5 and 6.

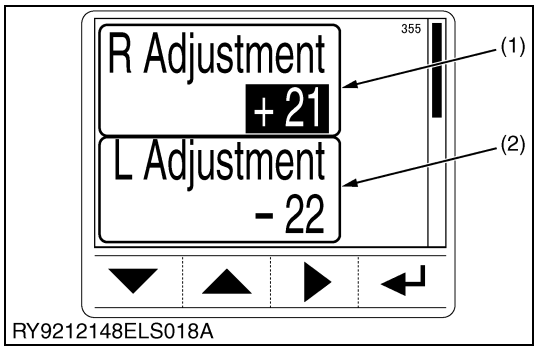
[Work flow]

Accel to MAX → Measure L when pressure rises → Measure R when pressure rises.

RY9212148ELS0036US0

(D) Feeling Adj.

- Adjust the AUX1 start point to customer's specification.



RY9212148ELS018A

1. Select Setting → AUX1 Set → Feeling Adj.
2. Follow the instructions on the meter panel and change the number while monitoring the feel.
3. Press SW5 to make the setting.

CAUTION

- **Only use if it does not work properly even after making the start point setting.**

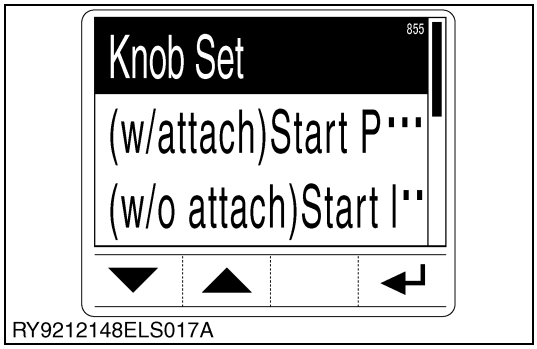
(1) Right Fine Adjustment Value (2) Left Fine Adjustment Value

RY9212148ELS0037US0

[C] AUX2/Thumb Set

(A) Knob Set

- Set when the AUX2 knob is replaced.



RY9212148ELS017A

1. Select Setting → AUX2/Thumb Set → Knob set.
2. Follow the instructions on the meter panel.
3. Press SW5 to make the setting.
4. Follow the instructions on the meter panel and repeat steps 2 and 3.

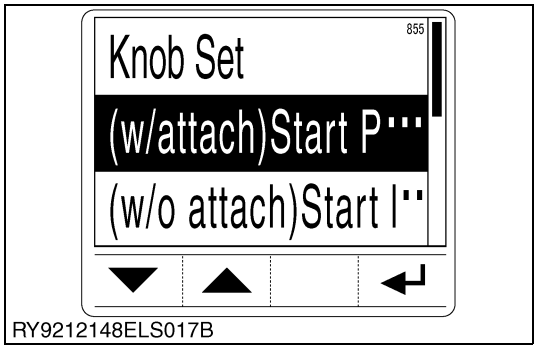
[Work flow]

AUX Knob R END → AUX Knob L END → Knob to neutral

RY9212148ELS0038US0

(B) (w/attach) Start Point Set

- Make setting when the AUX2 proportional valve, spool and/or AUX2 knob is replaced.
- Mount an attachment on the AUX2 port and make the setting.



RY9212148ELS017B

1. Select Setting → AUX2/Thumb Set → (w/attach) Start Point Set.
2. Follow the instructions on the meter panel.
3. Press SW5 to make the setting.
4. Follow the instructions on the meter panel and repeat steps 2 and 3.

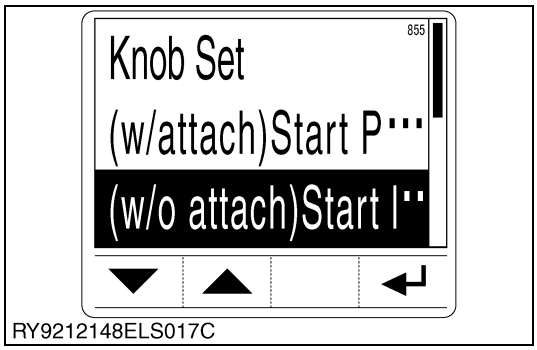
[Work flow]

Accel to MAX → Measure L when attachment moves → Measure R when attachment moves.

RY9212148ELS0039US0

(C) (w/o attach) Start Point Set

- Make setting when the AUX2 proportional valve, spool and/or AUX2 knob is replaced.
- Use this setting method when an attachment is not available.



RY9212148ELS017C

1. Place the machine on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Release of Residual Pressure in the Hydraulic System and Release Pressure in the Hydraulic Line.
3. Attach a pressure gauge at the end of the AUX2 ports (LH and RH).
4. Select Setting → AUX2/Thumb Set → (w/o attach) Start Point Set.
5. Follow the instructions on the meter panel.
6. Press SW5 to make the setting.
7. Follow the instructions on the meter panel and repeat steps 5 and 6.

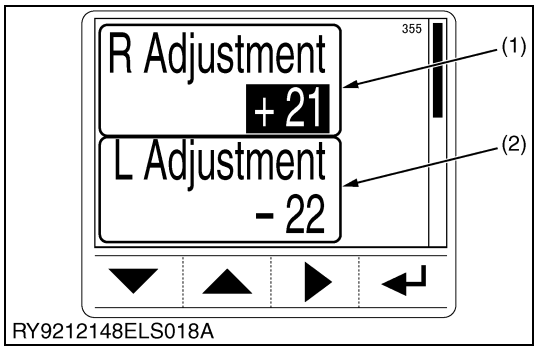
[Work flow]

Accel to MAX → Measure L when pressure rises → Measure R when pressure rises

RY9212148ELS0040US0

(D) Feeling Adj.

- Adjust the AUX2 start point to customer's specification.



RY9212148ELS018A

1. Select Setting → AUX2/Thumb Set → Feeling Adj.
2. Follow the instructions on the meter panel and change the number while monitoring the feel.
3. Press SW5 to make the setting.

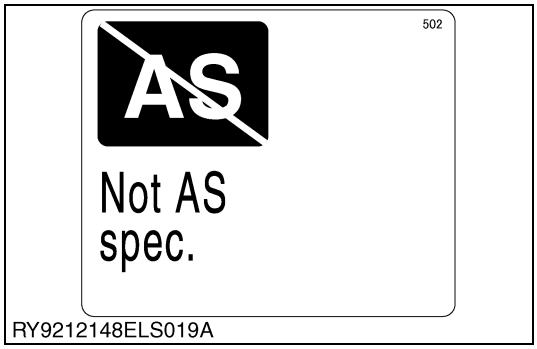
CAUTION

- **Only use when it does not work properly even after making the start point setting.**

(1) Right fine adjustment value (2) Left fine adjustment value

RY9212148ELS0041US0

[D] AS Set (Japan Spec. Only)

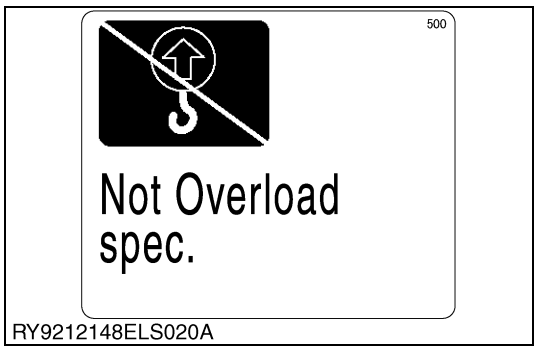


RY9212148ELS019A

[Display when not the Japan spec.]

RY9212148ELS0042US0

[E] Crane Set (Japan Spec. Only)



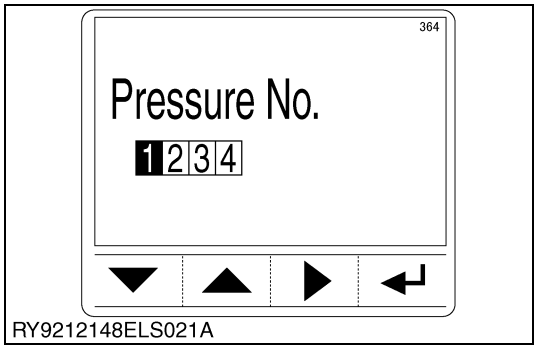
RY9212148ELS020A

[Display when not the Japan spec.]

RY9212148ELS0043US0

[F] Overload Warning (Eur. Spec. Only)

- Sets/changes the overload warning pressure.

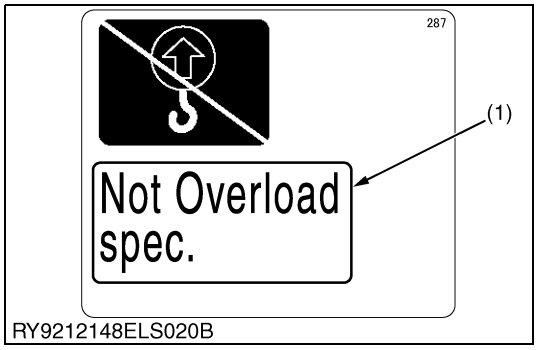


RY9212148ELS021A

1. Select Setting → Overload warning.
2. Enter a pressure warning value appropriate for the specification.

Boom type	Arm	Weight	Warning pressure number	Warning pressure
Mono-boom	Short arm	Light weight (830 kg)	6471	12.3 MPa
		Heavy weight (1140 kg)	6471	12.3 MPa
	Long arm	Light weight (830 kg)	6499	12.0 MPa
		Heavy weight (1140 kg)	2375	12.7 MPa
Two piece boom	Short arm	2 piece boom weight (1440 kg)	5067	13.7 MPa
	Long arm		0973	13.5 MPa

RY9212724ELS0029US0



RY9212148ELS020B

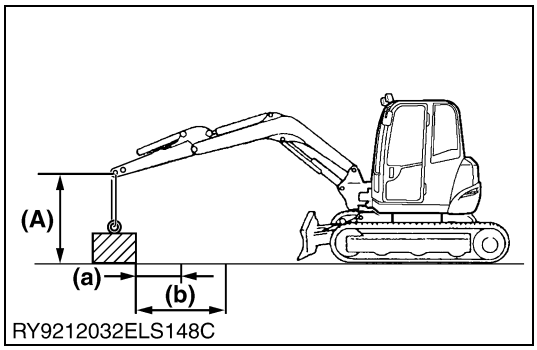
[Display when not overload warning spec.]

(1) Not the crane spec. or the overload warning spec.

RY9212148ELS0045US0

Checking operation of the overload alarm

- Check when the overload alarm pressure number has been changed or when the pressure switch is replaced.



RY9212032ELS148C

1. Remove the bucket.
2. Position the machine facing forward with the arm cylinder fully compressed and the blade touching the ground (Max excavation radius attitude).
3. Suspend a weight from the tip of the arm.

Front type	Suspended weight (including hoist fixture)
Normal boom	735 kg (1620 lbs)
Two piece boom	735 kg (1620 lbs)

4. Operate the boom and lift the suspended weight off the ground slightly. (Approx. 2110 mm, 83.07 in.)
5. Check that overload alarm sounds.
6. Move the weight to the front while maintaining the height of the arm tip.

■ **IMPORTANT**

- **Operate the machine slowly with the engine at idle.**

[Criteria]

- When moving the weight from the initial position to the front, make sure that the warning alarm stops within the range shown in the table below.

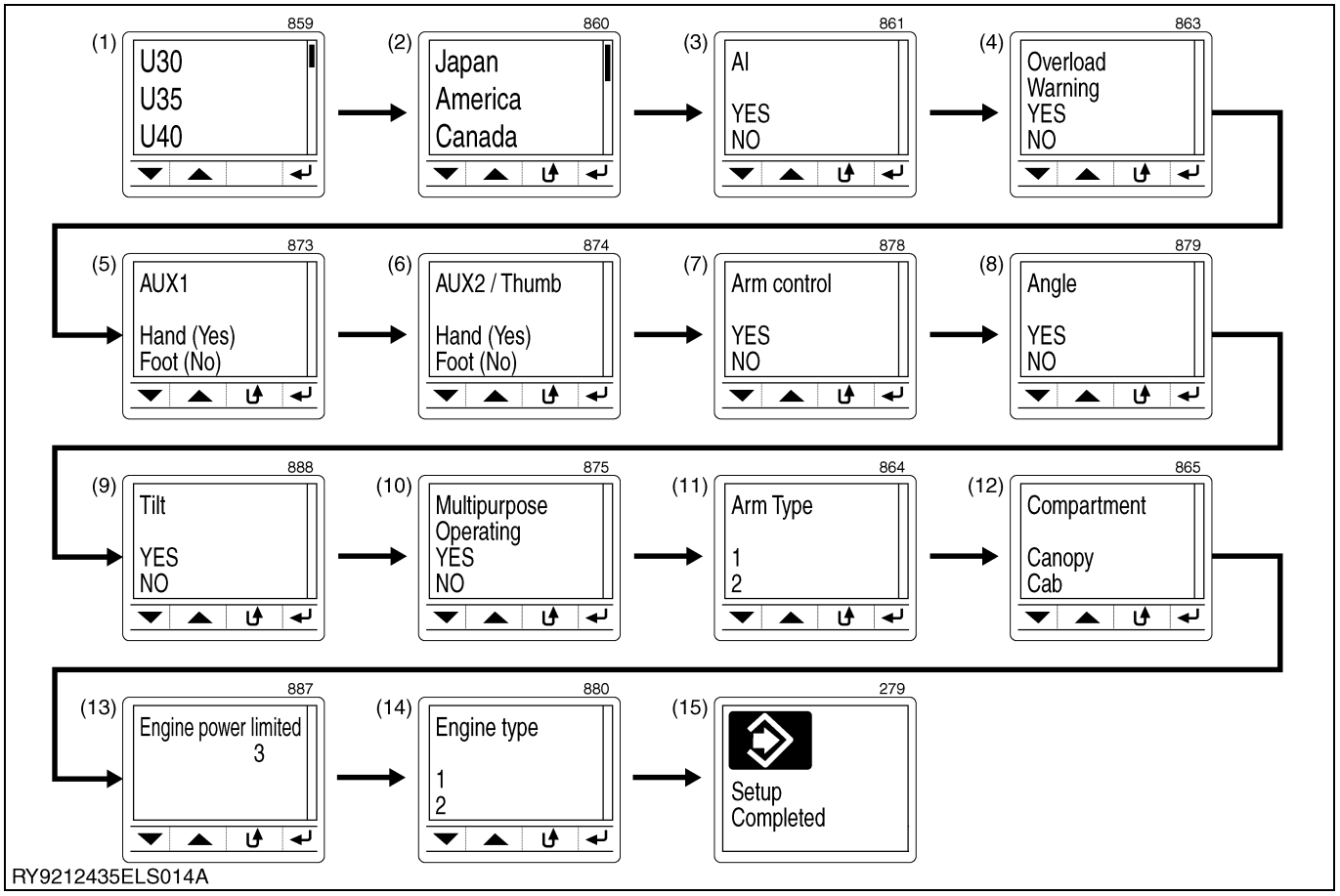
Front type	Warning alarm stop position
Short arm	**(a)** 1100 mm (43.31 in.) **(b)** 1700 mm (66.93 in.)
Long arm	**(a)** 2000 mm (78.74 in.) **(b)** 2600 mm (102.36 in.)

(A) 2100 mm (83.07 in.)

RY9212724ELS0031US0

[G] Model Set

- Set when the ECU and/or meters are replaced.
- Select Diagnosis → Model Set to make this setting.
- After setting the model, it is necessary to make the AI, AUX1 knob, AUX2 knob and Over load warning settings.



RY9212435ELS014A

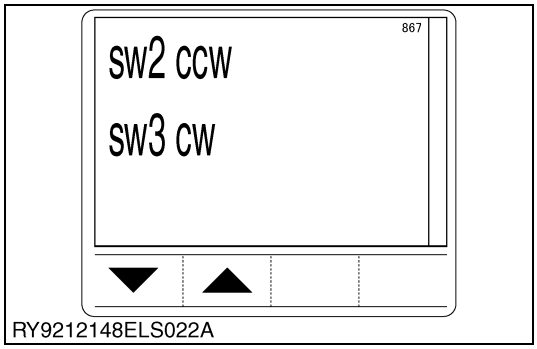
Screen No.	Content displayed	Notes	Initial setting values
(1)	Model name		KX080
(2)	Destination		EU
(3)	AI		YES
(4)	Overload Warning	Eur. spec.: YES N.A. spec.: NO	YES
(5)	AUX1		Hand (Yes)
(6)	AUX2 / Thumb		Hand (Yes)
(7)	Arm Control	Japan spec.: YES (Arm limit spec. only)	NO
(8)	Angle	N.A. spec.: YES (Angle spec. only)	NO
(9)	Tilt	N.A. spec.: YES (Tilt spec. only)	NO
(10)	Multipurpose Operating	Has multi-purpose switch connector spec.: YES	YES
(11)	Arm Type	Two piece boom spec.: 2 Standard boom spec.: 1	1 or 2
(12)	Compartment		Cab
(13)	Engine power limited	No A/C: 0 Old eco mode: 1 W / A/C: 2 New eco mode: 3	0
(14)	Engine type	Common rail engine: 1 Mechanical engine: 2	1
(15)	Setup Completed		

RY9212724ELS0030US0

[H] Others

(A) AI Motor Drive

- Moves the AI motor position when the accelerator dial is replaced.



RY9212148ELS022A

1. Select Setting → Others → AI Motor Drive.
2. Press switch 2 or 3 to move the lever position.

- Switch 2: Counterclockwise
- Switch 3: Clockwise

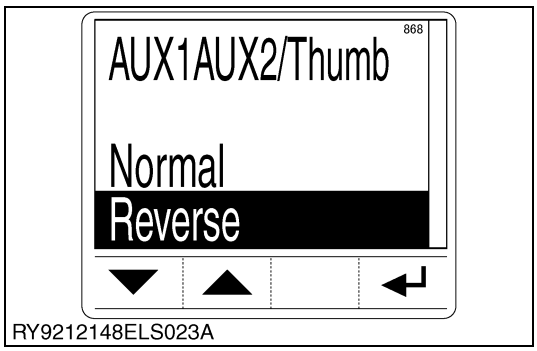
■ **IMPORTANT**

- **The common rail spec. does not have an AI motor, so this does not function.**

RY9212148ELS0003US0

(B) Exchange (AUX1) (2/Thumb)

- Operates AUX2 via the AUX1 knob. Or operates AUX1 via the AUX2 knob.



RY9212148ELS023A

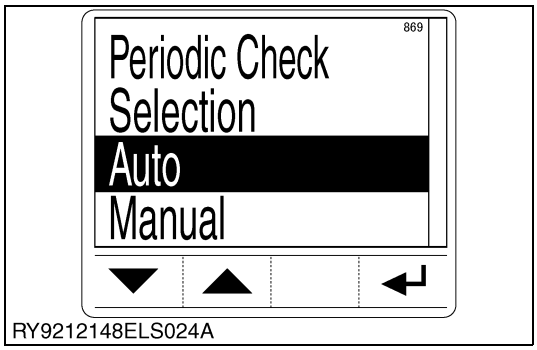
1. Select Setting → Others → Exchange (AUX1) (2/Thumb).
2. Select the desired operating method.
3. Press SW5 to make the setting.

	AUX1	AUX2
Normal	Right control lever	Left control lever
Reverse	Left control lever	Right control lever

RY9212148ELS0004US0

(C) Periodic Check Selection

- Changes the method of canceling the periodic check guidance to automatic or to manual.



RY9212148ELS024A

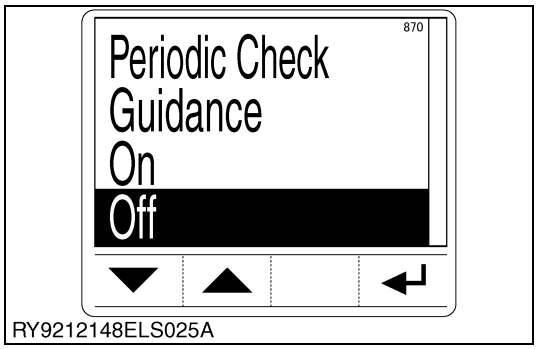
1. Select Setting → Others → Periodic Check Selection.
2. Select the desired operating method.
3. Press SW5 to make the setting.

Selection mode	Method for canceling periodic check guidance
Auto (N.A. spec.)	Turn the key ON/OFF 10 times or operate the meter panel after making periodic checks.
Manual (Eur. spec.)	Operate meter panel after making periodic check.

RY9212148ELS0005US0

(D) Periodic Check Display

- Turns off the display of periodic check guidance. Or turns it on.



RY9212148ELS025A

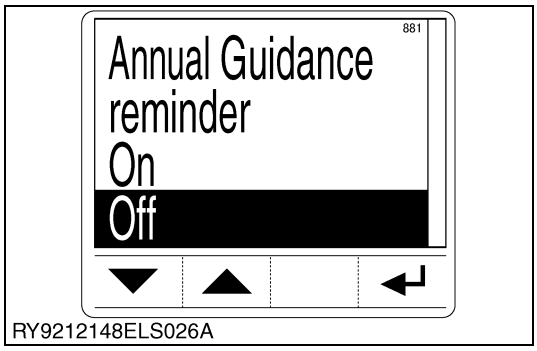
1. Select Setting → Others → Periodic Check Display.
2. Select the desired operating method.
3. Press SW5 to make the setting.

- When shipped: displays

RY9212148ELS0006US0

(E) Annual Guidance

- Turns on the display of annual check guidance. Or turns it off.

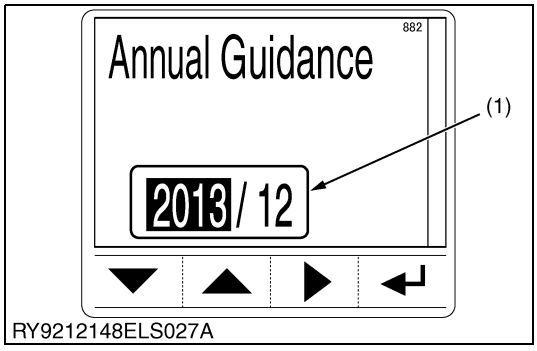


RY9212148ELS026A

1. Select Setting → Others → Annual Guidance.
2. Select the desired operating method.
3. Press SW5 to make the setting.

- When shipped: does not display

RY9212148ELS0007US0



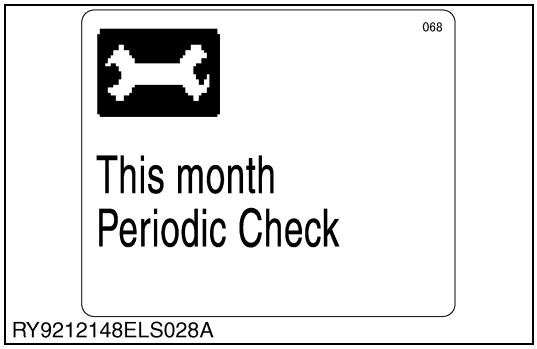
RY9212148ELS027A

[When display is selected]

1. Set the year and month to be displayed.
2. Press SW5 to make the setting.

(1) Annual check guidance display period (Y/M)

RY9212148ELS0008US0



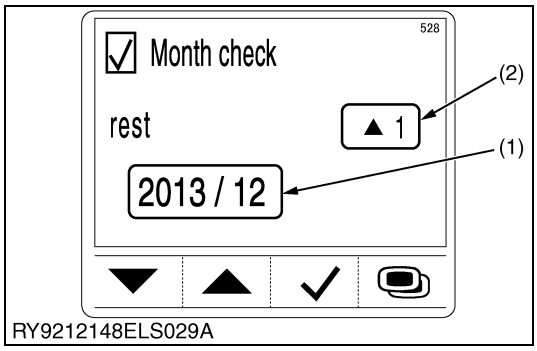
RY9212148ELS028A

[Display when the set month is reached]

■ **IMPORTANT**

- **Each time the key is turned ON, the message is displayed for 10 seconds on the normal screen.**
- **Use Periodic Check in the user setting mode to turn it off.**

RY9212148ELS0009US0



RY9212148ELS029A

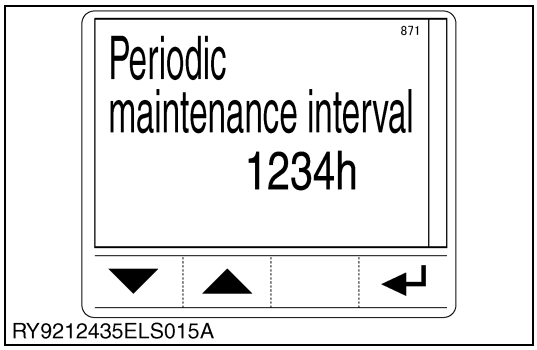
[Display from Periodic Check in the user setting mode]

(1) Selected year and month.
(2) Minus 1 month (E.g.: one month past the period set for the check.)

RY9212148ELS0010US0

(F) Periodic Check Set

- When the meter is replaced, sets the periodic check time prior to replacement to prevent a discrepancy in the periodic check time.



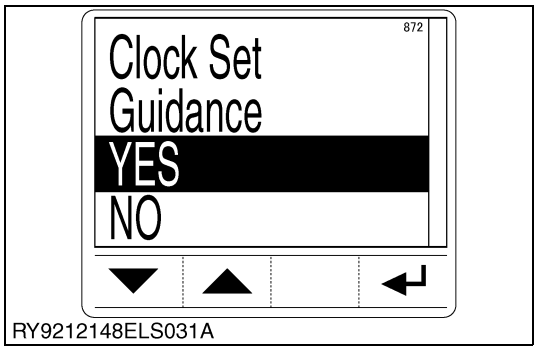
RY9212435ELS015A

1. Select Setting → Others → Periodic Check Set.
2. Enter the service hour meter prior to replacing the meter.
3. Press SW5 to make the setting.

RY9212435ELS0016US0

(G) Clock Set Warning (Y/N)

- Sets whether to display the message, "Set clock" or not.



RY9212148ELS031A

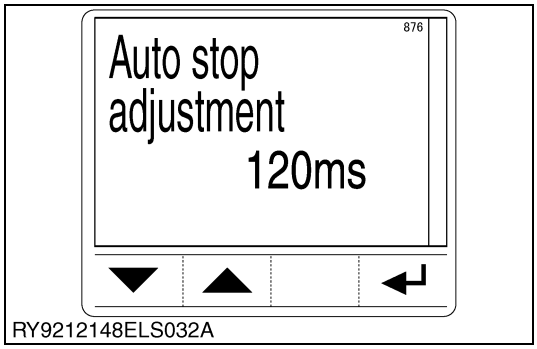
1. Select Setting → Others → Clock Set Warning (Y/N).
2. Select the desired operating method.
3. Press SW5 to make the setting.

- When shipped: prompts to set the clock

RY9212148ELS0012US0

(H) Arm Control Adj (Japan spec. only)

- Set when making fine adjustments to the stop position of the arm crowd limit.



RY9212148ELS032A

1. Select Setting → Others → Arm control Adj.
2. Change to the desired value (0 to 250ms).
3. Press SW5 to make the setting.

- When shipped: 150ms
  Increasing the value: stops closer to the dump side than the original stop position
  Reducing the value: stops closer to the near side than the original stop position

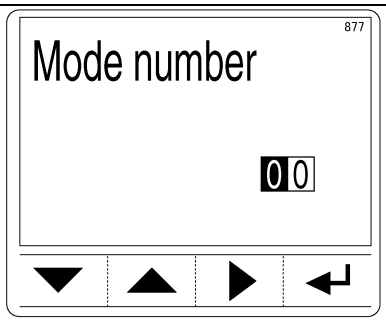
■ **IMPORTANT**

- **The setting is displayed and can be made on the Japan specification as well (Does not affect this machine).**

RY9212148ELS0013US0

(l) Multipurpose Mode

- Enabling the multi-purpose switch function on machines equipped with AUX1 and AUX2 makes 10 modes available for use.
- Depending on the selected mode, it becomes necessary to add equipment to the machine, such as ON/OFF switches, solenoid valves, wire harness, hydraulic hoses, etc.
- The multi-purpose switch allows you to control added solenoid valves and to operate hydraulic devices.



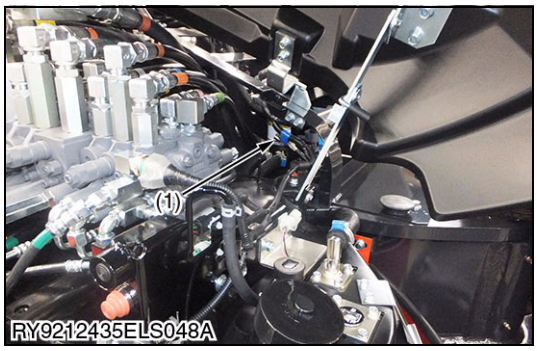
RY9212148ELS034A

1. Select Setting → Others → Multi-purpose mode.
2. Enter the number of the mode you wish to use.
3. Press SW5 to make the setting.

- Available mode numbers: 00 to 10
  Mode number when shipped: 00
  (Multi-purpose switch function disabled and AUX2 hold function disabled)

RY9212724ELS0013US0

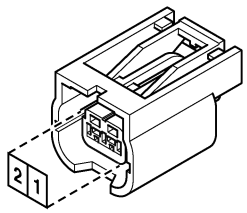
(a) Position of Connector for Operating Added Solenoid Valve



RY9212435ELS048A

(1) Multi-purpose connector

RY9212435ELS0056US0

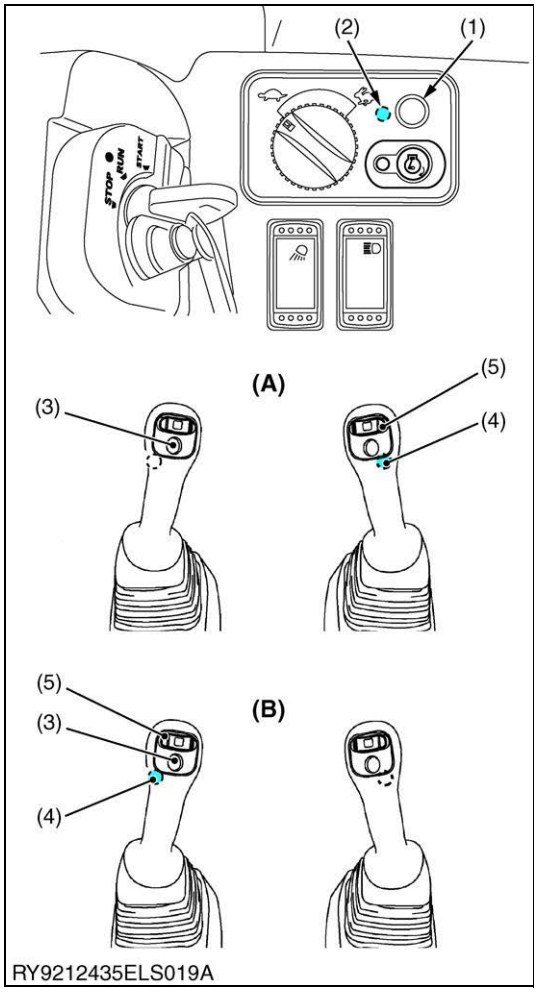


RY9212001ELS326L

Pin No.	Terminal	Max rated amperage
<1>	+ Terminal	1 A
<2>	- Terminal	–

RY9212148ELS0049US0

(b) Names of Parts



(1) Multi-Purpose Switch 1
(2) Indicator
(3) Multi-Purpose Switch 2
(4) AUX2/Thumb Hold Switch
(5) AUX2/Thumb Knob

(A) N.A. Spec.
(B) Australia/Eur. Spec.

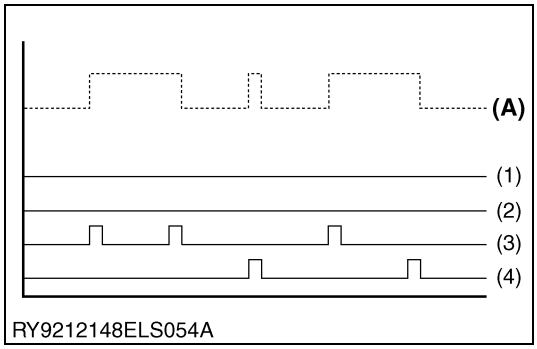
RY9212435ELS0017US0

(c) Description of Each Mode

Mode No. 01: Enables the AUX2 hold switch.

- Pressing the AUX2/Thumb hold switch turns the AUX2 signal ON. Pressing the switch again turns the AUX2 signal OFF.
- The AUX2/Thumb knob signal takes priority over the AUX2/thumb hold switch signal.

Example of Usage: Attachment that is not influenced by the operation of the front, such as a mower (rotary type).



RY9212148ELS054A

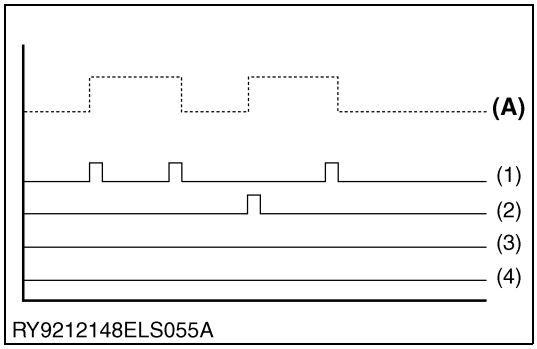
(1) Multi-Purpose Switch 1
(2) Multi-Purpose Switch 2
(3) AUX2/Thumb Hold Switch
(4) AUX2/Thumb Knob

(A) AUX2 signal

RY9212148ELS0051US0

Mode No. 02: (E.g.) Switches swivel/swing operation ON/OFF.

- Pressing multi-purpose switch A or multi-purpose switch B turns and keeps the multi-purpose signal ON. Pressing the switch again turns the multi-purpose signal OFF.



RY9212148ELS055A

(1) Multi-Purpose Switch 1
(2) Multi-Purpose Switch 2
(3) AUX2/Thumb Hold Switch
(4) AUX2/Thumb Knob

(A) Multipurpose signal

RY9212148ELS0052US0

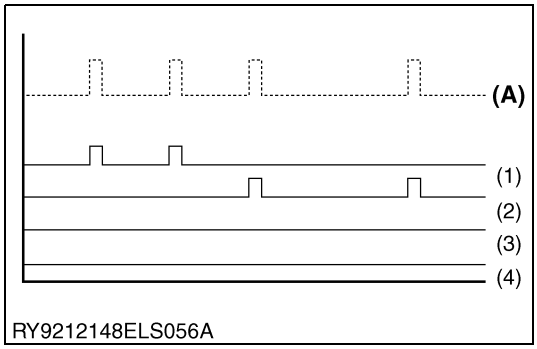
Mode No. 03: Mode No. 01 + Mode No. 02

- Enables the AUX2 hold switch.
- Pressing multipurpose switch A or multipurpose switch B switches the operation of swivel/swing ON/OFF.

RY9212148ELS0053US0

Mode No. 04: Turns the water sprinkler for asphalt planer, etc. ON/OFF.

- The multi-purpose signal is ON only while multipurpose switch A or B is pressed.



RY9212148ELS056A

(1) Multi-Purpose Switch 1
(2) Multi-Purpose Switch 2
(3) AUX2/Thumb Hold Switch
(4) AUX2/Thumb Knob

(A) Multipurpose signal

RY9212148ELS0054US0

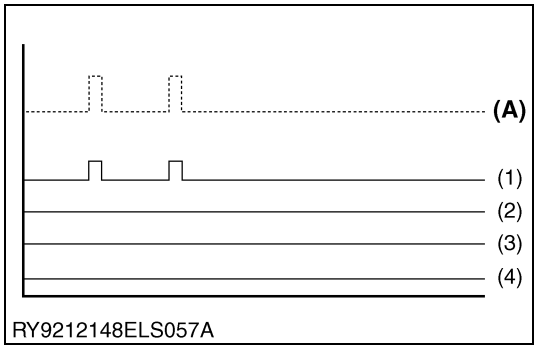
Mode No. 05: Mode No. 01 + Mode No. 04

- Enables the AUX2 hold switch.
- The multi-purpose signal is ON only while multipurpose switch A or B is pressed.

RY9212148ELS0055US0

Mode No. 06: Operates the hydraulic quick hitch (operation of blade, swing, etc.).

- Turns the multipurpose switch signal ON while multipurpose switch A is pressed.
- Operating the actuator while multipurpose switch A is pressed operates the quick hitch.
- Enables the hydraulic quick hitch for single or multi-operation.



RY9212148ELS057A

(1) Multi-Purpose Switch 1
(2) Multi-Purpose Switch 2
(3) AUX2/Thumb Hold Switch
(4) AUX2/Thumb Knob

(A) Multipurpose signal

RY9212148ELS0056US0

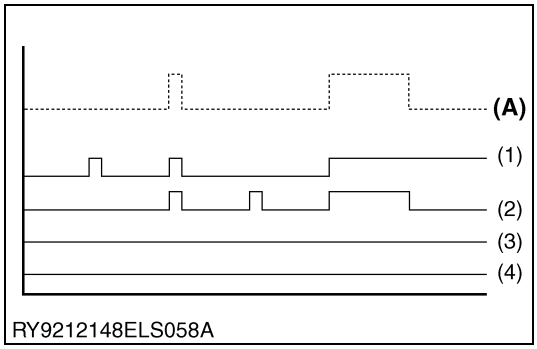
Mode No. 07: Mode No. 01 + Mode No. 06

- Enables the AUX2 hold switch.
- Operating the swing while multipurpose switch A is pressed operates the quick hitch.

RY9212148ELS0057US0

Mode No. 08: Operates the hydraulic quick hitch or for using Tiltrotator.

- The multi-purpose signal is ON only while multipurpose switches A and B are pressed simultaneously.
- Enables a spring-locked hydraulic quick hitch.



RY9212148ELS058A

(1) Multi-Purpose Switch 1
(2) Multi-Purpose Switch 2
(3) AUX2/Thumb Hold Switch
(4) AUX2/Thumb Knob

(A) Multipurpose signal

RY9212148ELS0058US0

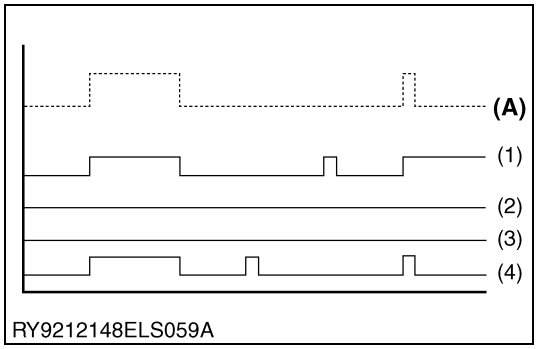
Mode No. 09: Mode No. 01 + Mode No. 08

- Enables the AUX2 hold switch.
- Operates a hydraulic quick hitch or for using Tiltrotator.

RY9212148ELS0059US0

Mode No. 10: Operates a hydraulic quick hitch (Assigns AUX2 to the dedicated quick hitch port).

- While pressing multipurpose switch A, operating the AUX2/thumb knob turns the multipurpose switch signal ON.
- Enables the hydraulic quick hitch for single or multi-operation.



RY9212148ELS059A

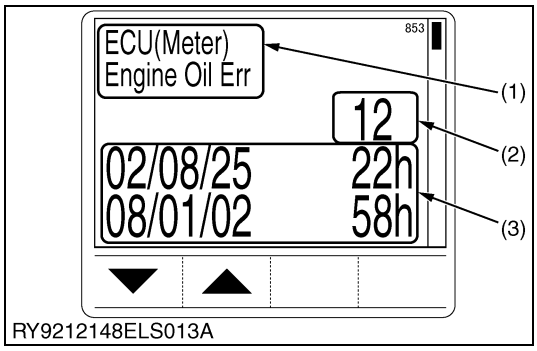
(1) Multi-Purpose Switch 1
(2) Multi-Purpose Switch 2
(3) AUX2/Thumb Hold Switch
(4) AUX2/Thumb Knob

(A) Multipurpose signal

RY9212148ELS0060US0

(J) All Fail Record

- Checks all the fail records since the machine was shipped.



RY9212148ELS013A

1. Select Setting → Others → All Fail Record.
2. If more than one failure record exists, each press of switch 2 or 3 toggles the display.

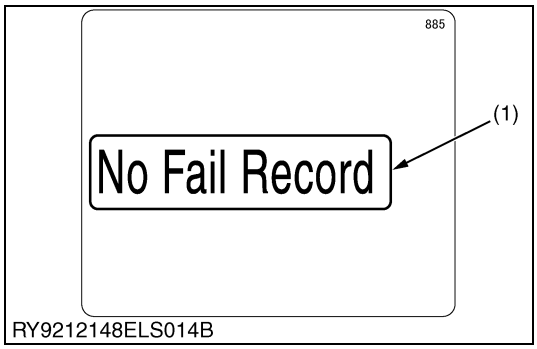
[Display when fail record exists]

■ **IMPORTANT**

- **The content displayed when retrieving all fail records is not deleted even if you delete individual fail records.**

(1) Content of failure detected by the ECU (main or meter or AS) that detected it
(2) Number of occurrences (1 to 255)
(3) Date and hour meter of initial occurrence and date and hour meter of last occurrence

RY9212148ELS0061US0



RY9212148ELS014B

[Display when no fail record exists]

■ **IMPORTANT**

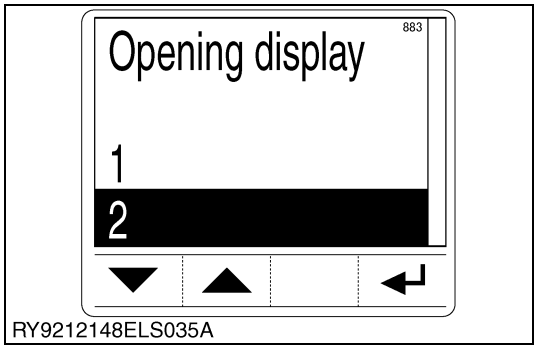
- **As the failures governed by the engine ECU are not left on this machine (all fail record), use the engine diagnosis tool.**

(1) No fail records

RY9212148ELS0062US0

(K) Opening Select

- Changes the opening display screen.



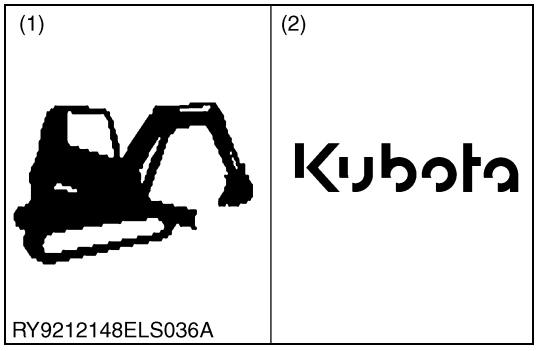
RY9212148ELS035A

1. Select Setting → Others → Opening select.
2. Select the number of the desired display method.
3. Press SW5 to make the setting.

Number	Screen display
(1)	Silhouette of the excavator
(2)	Kubota logo

- When shipped: 2

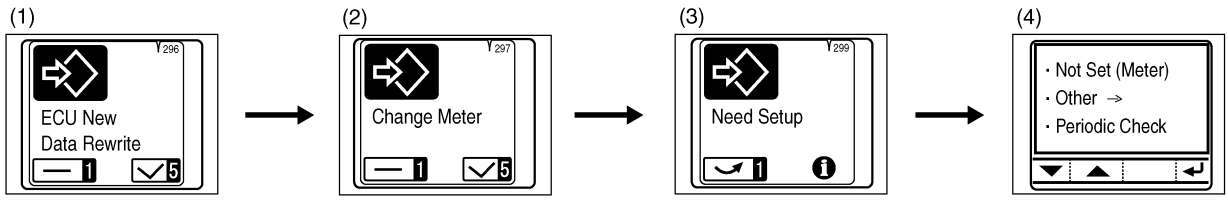
RY9212148ELS0063US0



RY9212148ELS036A

[5] SETTINGS WHEN REPLACING ELECTRONIC DEVICES

(1) When Replacing the Meter or Main ECU



RY9212148ELS038A

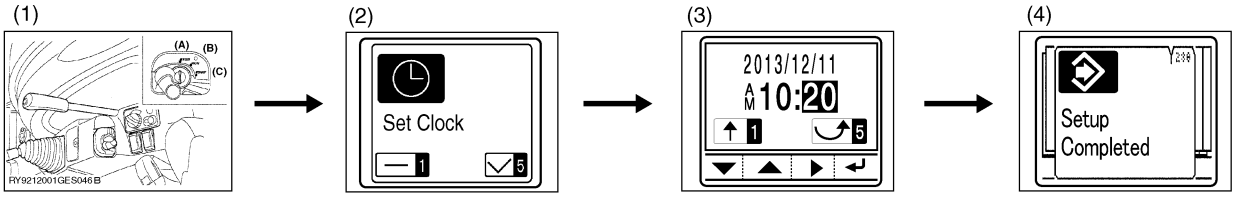
	Content displayed	Explanation
(1)	Overwrite ECU with new data	Press switch 5 "Yes" to overwrite data. Press switch 1 "No" when checking whether another machine's meter or ECU that is temporarily installed is working or not. If "No" is selected, the normal screen appears.
(2)	Meter changed	**[Initializes saved settings.]** Press switch 5 "Yes" if the meter has been changed. Press switch 1 "No" if the ECU has been changed.
(3)	Need setup	Pressing switch 4 allows you to check the items that need to be set up.
(4)	List of items that need to be set up	After checking the items that need to be set up, turn the key to OFF to make the settings.

■ **IMPORTANT**

- **Never install an ECU from a previous model (spec. other than common rail) as doing so will damage the ECU.**

RY9212148ELS0064US0

(2) When the Battery is Removed



RY9212148ELS039A

No.	Content displayed	Explanation
(1)	(A) STOP (B) RUN (C) START	Install the battery and turn the key to **[RUN]**.
(2)	Set Clock	Press switch 5 "Yes" to set. Press switch 1 "No" to skip setting it. If "No" is selected, the normal screen appears.
(3)	Setting screen	**[Clock setting guide]** • Pressing switch 4 (▶) changes the setting item from Yr→ Mo→ Day→ Hr→ Min→ Yr. • Pressing switch 2 (▼) reduces the number. • Pressing switch 2 (▲) increases the number. • Pressing switch 1 while on the clock setting screen takes the screen back without changing the time.
(4)	Setup complete	

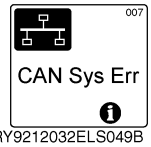
- When in the dealer mode, it is also possible to disable the warning via "Clock Set Warning (Y/N)." (Set to display when shipped)
- After removing the battery, the condenser inside the meter holds its charge for about 2 days.

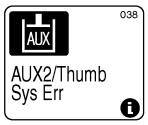
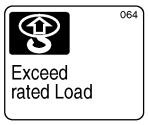
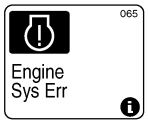
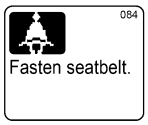
RY9212148ELS0015US0

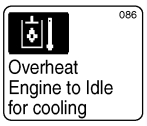
[6] TABLE OF METER PANEL MESSAGES AND ERROR HISTORY LIST

(1) Red Warning Lamp Lit

When needed, pressing switch 4 ⓕ displays a detailed description.

No.	Screen display	Pressing SW4 ⓕ	Message in fail record	Reason detected/steps to take
1	RY9212032ELS044B	–	[Meter] Engine oil pressure error	a) Engine oil pressure low b) Oil switch always ON c) Short in harness
2	RY9212032ELS045B	–	[Meter] Overheated	Engine overheated [118°C (244°F)--automatically goes to idle]
3	RY9212032ELS046B	–	[Meter] Charging System Error	Low alternator voltage detected a) Alternator faulty b) Fan belt loose/off c) Break in harness d) Fuse blown (10A)
4	RY9212032ELS047B	–	[Meter] Fuel Sensor Error	a) Connector disconnected b) Break in harness
5	RY9212435ELS016A	–	[Meter] Water temp sensor Error	The coolant temperature sensor has developed a fault; the coolant temperature gauge does not appear in the display.
6	 RY9212032ELS049B	CANSys (main)	[Meter] CAN Sys (Main)	a) Connector disconnected b) ECU (+B) fuse blown (10A) c) Break or short in harness
		CANSys (CRS)	[Meter] CAN Sys (CRS)	a) Connector disconnected b) Slow blow fuse (CRS) blown (30A) c) Engine ECU relay faulty d) Break or short in harness
7	RY9212148ELS043A	–	[Meter] Setup Data Error	Go through the model setup again. If this doesn't fix it, it's a faulty meter.
8	RY9212032ELS051B	2nd speed solenoid	[Main ECU] 2nd speed SOL	a) 2nd speed solenoid line short
9	RY9212148ELS040A	AUX1 knob	[Main ECU] AUX1 knob	a) AUX1 knob connector disconnected b) Break or short in harness
		AUX1 RH SOL	[Main ECU] AUX1 right SOL	a) AUX1 right solenoid connector disconnected b) Break or short in harness
		AUX1 LH SOL	[Main ECU] AUX1 left solenoid	a) AUX1 left solenoid connector disconnected b) Break or short in harness

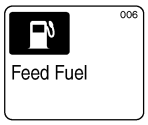
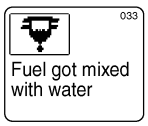
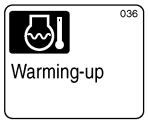
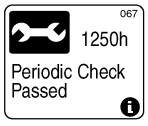
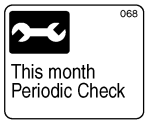
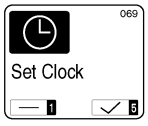
No.	Screen display	Pressing SW4 ⓘ	Message in fail record	Reason detected/steps to take
10	 RY9212148ELS041A	AUX2/thumb knob	[Main ECU] AUX2/thumb knob	a) AUX2 knob connector disconnected b) Break or short in harness
		AUX2/thumb RH SOL	[Main ECU] AUX2/thumb right solenoid	a) AUX2 right solenoid connector disconnected b) Break or short in harness
		AUX2/thumb LH SOL	[Main ECU] AUX2/thumb left solenoid	a) AUX2 left solenoid connector disconnected b) Break or short in harness
11	RY9212032ELS052B	Over voltage	[Main ECU] Over voltage	a) Activated by 18V+ b) Alternator faulty
12	RY9212148ELS062A	Boom bottom	[Main ECU] Boom bottom	a) Connector disconnected b) Break or short in harness
13	RY9212032ELS053B	Accelerator sensor	[Main ECU] Accelerator sensor	a) AI console connector disconnected b) Break or short in harness
14	RY9212032ELS050B	Lever lock solenoid	[Main ECU] Lever lock solenoid	a) Lever lock solenoid line short
15	RY9212148ELS042A	Multipurpose SOL	[Main ECU] Multipurpose solenoid	a) Multipurpose solenoid line short
16	RY9212032ELS055B	External 5 V	[Main ECU] External 5 V	Short in 5 V line
17	 RY9212148ELS069A	–	–	Suspended weight is over the rated load (Eur. overload warning spec. only)
18	 RY9212148ELS063A	1 to 64	–	Engine system error
19	 RY9212724ELS007A	–	[Meter] Fasten seatbelt	Seat belt switch is OFF

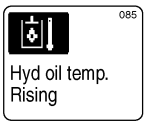
No.	Screen display	Pressing SW4 ⓘ	Message in fail record	Reason detected/steps to take
20	 RY9212435ELS045A	–	[Main ECU] Hydraulic temp sensor	Hydraulic oil temperature rising. Engine speed is reduced down to idle rpm automatically.

RY9212724ELS0009US0

(2) Yellow Warning Lamp Lit

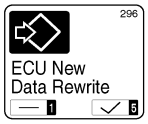
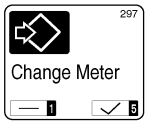
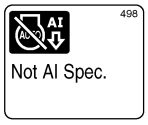
When needed, pressing switch 4 ⓗ displays a detailed description.

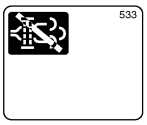
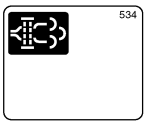
No.	Screen display	Pressing SW4 ⓘ	Message in fail record	Reason detected/steps to take
1	 RY9212148ELS065A	–	–	Fuel low Displayed at 6 minute intervals.
2	RY9212148ELS066A	–	–	Water temperature rising. Displayed at 6 minute intervals. (110 to 117°C, 230 to 242°F)
3	 RY9212435ELS020A	–	[Main ECU] Water mixed with fuel	a) Water mixed with fuel in the fuel filter [Reference value:50 to 70 ml] b) Short in the water separator line
4	 RY9212435ELS047A	–	–	When hydraulic sensor temperature is only low the warming-up mode automatically starts.
5	RY9212148ELS067A	–	–	Tried to start engine with an unregistered key (Anti-theft spec. only)
6	RY9212148ELS068A	–	–	Tried to start engine with a red key (Anti-theft spec. only)
7	RY9212148ELS070A	Check location displayed	–	Displayed 10 hours before periodic check due
8	 RY9212148ELS071A	Check location displayed	–	Past time for periodic check
9	 RY9212148ELS072A	–	–	Annual check
10	 RY9212148ELS048A	–	–	The clock may have the wrong time.

No.	Screen display	Pressing SW4 ⓘ	Message in fail record	Reason detected/steps to take
11	 RY9212435ELS046A	–	–	Hydraulic oil temperature rising. [99 to 103 °C (210 to 217 °F)]

RY9212724ELS0028US0

(3) Other Screens

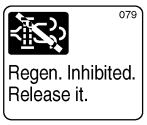
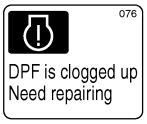
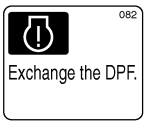
No.	Screen display	Pressing SW4 Ⓡ	Message in fail record	Reason detected/steps to take
1	RY9212148ELS050A	–	–	Switch 2 (crane) pressed on machine w/o overload warning
2	 RY9212148ELS046A	–	–	When meter or ECU replaced without doing setup
3	 RY9212148ELS045A	–	–	During setup after changing the meter or the ECU, this screen comes up to confirm the meter has been changed.
4	RY9212148ELS044A	The setup item is displayed.	–	When neither the meter nor the ECU have been replaced, but some setting needs to be made.
5	RY9212032ELS067B	–	–	If you attempt to start the engine with the lever lock still down.
6	RY9212032ELS074B	–	–	If you press switch 3 (AUX) with the lever lock still up.
7	RY9212148ELS073A	–	–	If you turned the key OFF but fail to take it out (Anti-theft spec. only)
8	RY9212166ELS083A	–	–	• If you press switch 3 (AUX) on a machine w/o AUX1/AUX2/thumb spec. • If you setup the model as AUX1 (w/o) and press switch 3 (AUX).
9	 RY9212148ELS074A	–	–	• If you press the AI switch on a machine w/o the AI spec. • If you set up the model as AI (w/o) spec. and press the AI switch.
10	RY9212148ELS049A	–	–	If you press the multipurpose switch before registering it.

No.	Screen display	Pressing SW4 ⓘ	Message in fail record	Reason detected/steps to take
11	RY9212148ELS075A	–	–	During communication with the key (Anti-theft spec. only)
12	 RY9212148ELS077A	–	–	Displayed for 5 seconds when auto-regeneration of the DPF is inhibited.
13	 RY9212148ELS078A	–	–	Displayed for 5 seconds when the inhibition on DPF auto-regeneration is cancelled.

RY9212724ELS0027US0

(4) PM Clog Level and the State of the Machine

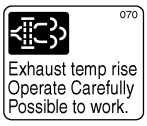
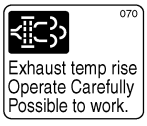
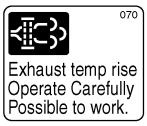
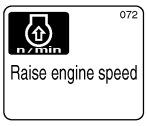
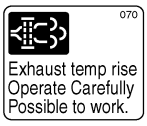
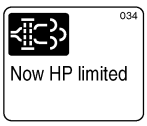
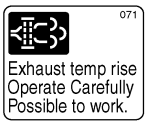
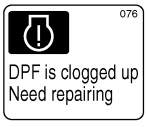
Inhibit switch ON

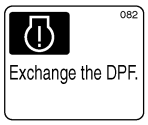
Clog Level	Warning lamp	Buzzer	Engine output	Screen	Content displayed	Status and correction
Level 0	OFF	–	–	–	–	–
Level 1	OFF	–	–	–	–	–
Level 2	Blinking (Yellow)	··PiPiPi·· (Continue)	–	 RY9212148ELS088A	Regeneration of DPF is inhibited. Allow regeneration.	–
Level 3	Blinking (Red)	··PiPiPi·· (0 to 50 sec.) Pi-···Pi- (50 to 60 sec.)	50 %	RY9212148ELS089A	Regeneration of DPF is inhibited. Allow regeneration. HP limited to low power.	*2
		Pi-···Pi- (from 60 sec.)	–	RY9212148ELS092A	Engine forced to stop Increase RPM and restart	Turn and maximize the accelerator dial and restart *1
Level 4	Blinking (Red)	PiPiPiPi (0 to 50 sec.) Pi-···Pi- (from 50 sec.)	50 %	 RY9212148ELS085A	DPF clogged up Needs maintenance	Use the engine diagnosis tool and regenerate it manually *1 *2
Level 5	Blinking (Red)	PiPiPiPi (Continue)	50 %	 RY9212148ELS091A	Replace the DPF	DPF is clogged. Needs replacement.

The engine rpm drops up to only 1650 rpm while pressing the AI switch.
PM clog level does not change when the key is turned OFF. The level stays the same when the engine restarts.
*1 : If the lever lock is up, the engine stops forcibly in 60 seconds.
*2 : If the lever lock is down, the engine does not stop. The same buzzer from 0 to 50 sec. keeps sounding.

RY9212148ELS0221US0

Inhibit switch OFF

Clog Level	Warning lamp	Buzzer	Engine output	Engine RPM	Screen	Contents displayed	Status and correction
Level 0	OFF	–	–	–	–	–	–
Level 1	Blinking (Yellow)	··PiPiPi·· (Every 60 sec.)	–	–	 RY9212148ELS080A	Exhaust temperature rising Operate carefully Can continue working	More than 1650 engine RPM needed: DPF regenerates Less than 1650 engine RPM: DPF may not auto-regenerate due to open air and water temp.
Level 2	Blinking (Yellow)	··PiPiPi·· (Every 60 sec.)	–	More than 1650 rpm	 RY9212148ELS080A	Exhaust temperature rising Operate carefully Can continue working	Being auto-regenerated
				Less than 1650 rpm	 RY9212148ELS080A	Exhaust temperature rising Operate carefully Can continue working	• When the engine RPM is low, DPF may not auto-regenerate due to open air and water temp. • The screen changes every 3 sec.
					 RY9212148ELS082A	Increase engine RPM	
Level 3	Blinking (Yellow)	PiPiPi (Every 60 sec.)	50 %	More than 1650 rpm	 RY9212148ELS080A	Exhaust temperature rising Operate carefully Can continue working	• Being auto-regenerated • The screen is changed every 3 sec.
					 RY9212148ELS079A	HP limited to low power	
	Blinking (Red)	··PiPiPi·· (0-50 sec.) Pi-···Pi- (50-60 sec.)	50 %	Less than 1650 rpm	 RY9212148ELS081A	Exhaust temperature rising Operate carefully Can continue working	• When the engine RPM is low, DPF may not auto-regenerate due to open air and water temp. • The screen changes every 3 sec. *2
					RY9212148ELS084A	Increase engine RPM HP limited low power	
		Pi-···Pi- (from 60 sec.)	–		RY9212148ELS092A	Engine forced to stop Increase RPM and restart	Turn and maximize the accelerator dial and restart. *1
Level 4	Blinking (Red)	PiPiPiPi (0-50 sec.) Pi-···Pi- (from 50 sec.)	50 %	–	 RY9212148ELS085A	DPF clogged up Needs maintenance	Use the engine diagnosis tool and regenerate it manually *1 *2

Clog Level	Warning lamp	Buzzer	Engine output	Engine RPM	Screen	Contents displayed	Status and correction
Level 5	Blinking (Red)	PiPiPiPi (Continue)	50 %	–	 RY9212148ELS091A	Replace the DPF	DPF is clogged. Needs replacement.

The engine rpm drops up to only 1650 rpm while pressing the AI switch.
PM clog level does not change when the key is turned OFF. The level stays the same when the engine restarts.
*1 : If the lever lock is up, the engine stops forcibly in 60 seconds.
*2 : If the lever lock is down, the engine does not stop. The same buzzer from 0 to 50 sec. keeps sounding.

RY9212148ELS0222US0

(5) Table of Engine System Error Numbers

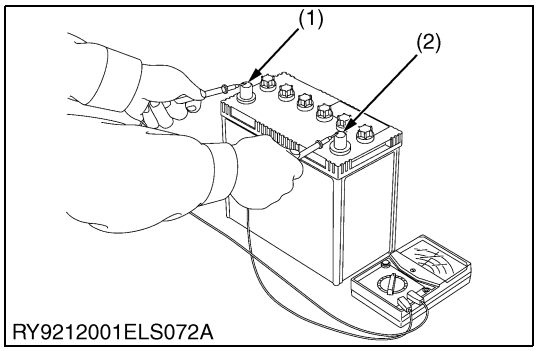
Symptom when error occurs	●	Always happens
	❍	May happen

No. Displayed	Error location	Engine performance			Notes
		Limited RPM	Limited HP	Won't start	
1	RPM sensor system	❍	❍	❍	
2	Fuel/rail pressure system	●	●	●	Fuel may run out.
3	SCV system error	●	●		
4	Intake temperature sensor system				
5	Water temperature sensor system	●	●		
6	Fuel temperature sensor system				
7	Injector system	●	●	❍	
8	Intake pressure sensor system		❍		
9	Battery voltage related	●	●	❍	
10	Sensor voltage related	●	●	❍	
11	Main relay related				
12	Atmospheric pressure sensor related		❍		
13	EGR valve related		●		
14	EGR starting to close warning				
15	Emissions warning		●		
16	Air heater related				
17	Engine ECU	❍	❍	❍	
18	Communication error	❍	❍		
19	Mass airflow sensor related		❍		
20	Intake throttle				
21	Pressure differential sensor related				
22	Exhaust temperature sensor (DOC intake)				
23	Exhaust temperature sensor (DOC outlet)				
24	Exhaust temperature sensor (DPF outlet)				
25	Simultaneous break in all exhaust temperature sensors				
26	DOC reaction	●	●		
27	DPF regeneration time up				
28	Insufficient DPF regeneration water temperature rise				
29	Regeneration too frequent		●		
30	Engine fuel system (P/L)	●	●		
31	Engine fuel system (rail pressure)	●	●		
32	Engine fuel system (fuel leak)	●	●	●	
33	Engine fuel system (SCV)	●	●	●	
34	Engine fuel system (Supply pump)	●	●		
35	Engine air intake system (Insufficient intake)	●	●		
36	Engine air intake system (Insufficient boost pressure)	●	●		
37	Engine exhaust temperature (DOC inlet temperature error)			●	
38	Engine exhaust temperature (DPF inlet temperature error)			●	
39	Engine exhaust temperature (DPF outlet temperature error)			●	
40	Starter relay start warning				
54	PCD (Particulate Control Diagnosis)				
55	NCD (NOx Control Diagnosis)	●	●		
64	Other errors	❍	❍	❍	

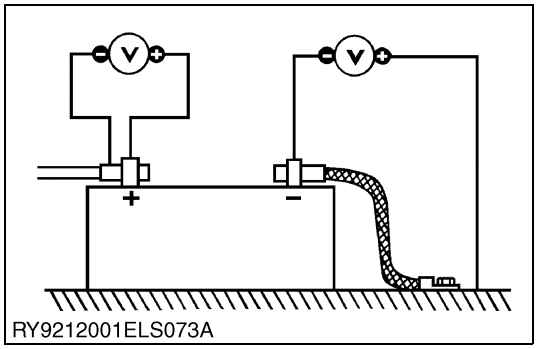
RY9212724ELS0026US0

3. INSPECTIONS

[1] POWER AND GROUND



RY9212001ELS072A



RY9212001ELS073A

Battery

Check the voltage between the terminals

1. Connect a circuit tester between the (+) and (-) terminals of the battery and measure the voltage across the terminals.
2. If the measurement is below factory specs, check the specific gravity of the electrolyte.

Voltage between terminals	Factory specification	At least DC 12 V

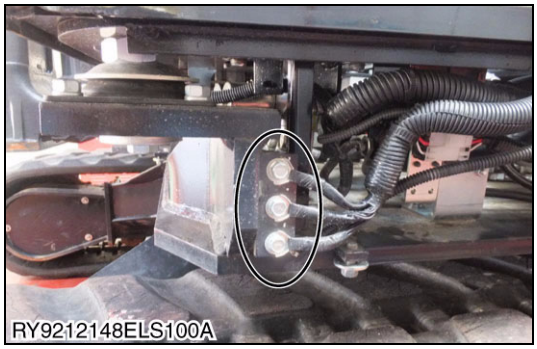
Check the condition of terminal connections

1. Put an electrical load on the battery. (E.g.: Turn the key switch to RUN and turn a worklight on.
2. Connect the (+) side if the circuit tester to the (+) terminal of the battery and the (-) side of the circuit tester to the (+) battery cable. Measure the voltage.
3. Connect the (-) side if the circuit tester to the (-) terminal of the battery and the (+) side of the circuit tester to the (-) battery cable. Measure that voltage.
4. If the measurements are greater than factory specs, check the condition of the contacts at the terminals.

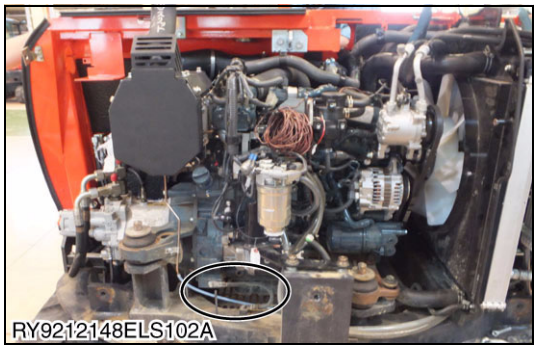
Voltage between terminals	Factory specification	Less than DC 0.1 V

(1) (-) Terminal (2) (+) Terminal

RY9212001ELS0034US0


RY9212148ELS100A

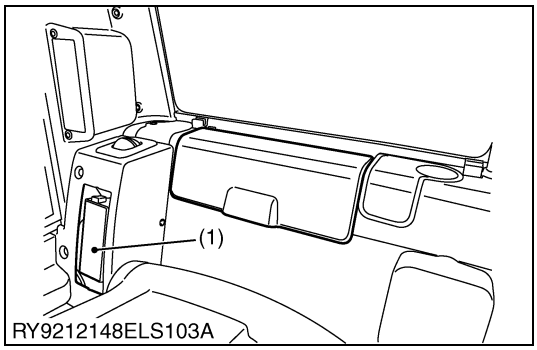
RY9212148ELS101A


RY9212148ELS102A

Ground

Check whether GND wire(s) are securely connected to the body.

RY9212148ELS0136US0



RY9212148ELS103A

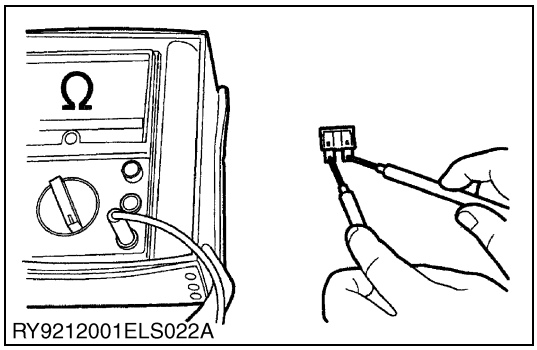
Fuses

■ **IMPORTANT**

- **When replacing a fuse, always use the same capacity fuse and replace it after determining why it blew.**

(1) Fuse box

RY9212148ELS0138US0

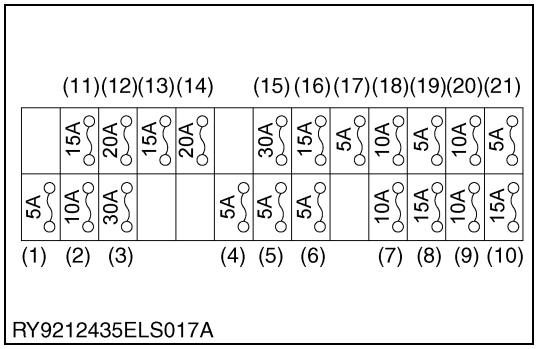


RY9212001ELS022A

Inspecting fuses

- Measurement parameter: check continuity across its terminals

RY9212001ELS0031US0

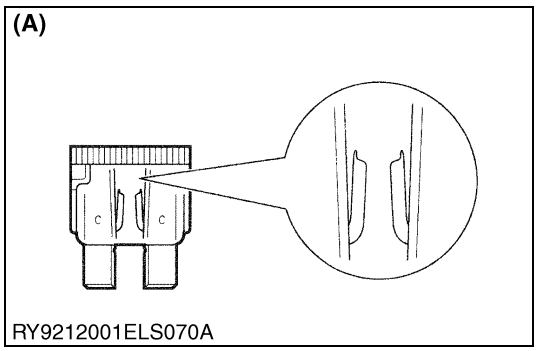


RY9212435ELS017A

Fuse Box Layout and Capacities

(1)	A/C Controller (+B)	(12)	Cabin Work Light
(2)	Meter (+B)	(13)	Radio (A/C)
(3)	Blower Motor	(14)	Fuel Filter Heater
(4)	Relay	(15)	ECU (POWER)
(5)	ECU (A/C)	(16)	Beacon
(6)	Room Light	(17)	Horn Switch
(7)	Starter	(18)	Horn
(8)	Wiper/Washer	(19)	Lever Lock
(9)	Compressor	(20)	Alternator
(10)	Electrical Outlet	(21)	Fuel Pump
(11)	Front Work Light		

RY9212435ELS0020US0

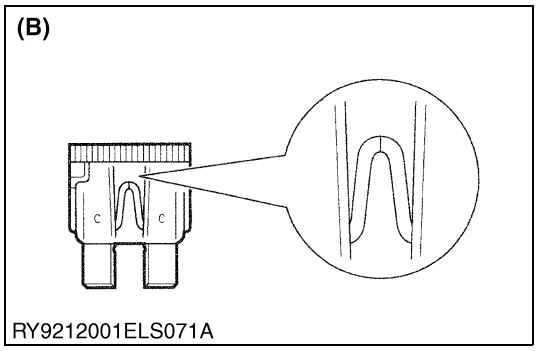


RY9212001ELS070A

Precautions when a Fuse Blows

When a fuse blows, there are 2 potential causes. The first is when an overload of current exceeds the rated amperage of the fuse, blowing it; the other is when it blows due to a repetitive, intermittent current.
These two cases can be readily recognized visually, so when a fuses blows, take note of the following points.

1. When a fuse blows due to an overload of current exceeding its rated capacity.
   An overload current produces a blown fuse such as shown at left **(A)**.
   You should not immediately replace a fuse that blows in this way with a new one.
   The fuse will just blow again when subjected to the overload current, so first inspect the circuit for a short or a problem with a device, then after fixing the problem, install a fuse of the same capacity.
   The purpose of the original fuse is to provide a margin of safety, so never replace a fuse with one of a higher capacity.
   If you replace a fuse with one of a higher capacity, it presents the danger of a current overload damaging the electrical device(s) and/or the wiring in the circuit before blowing the fuse.

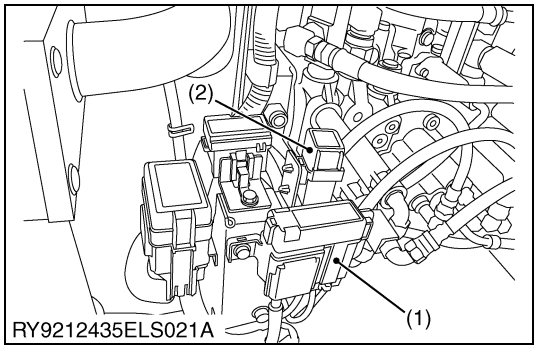


RY9212001ELS071A

2. When a fuse blows due to a repetitive, intermittent current.
   A repetitive, intermittent current produces a blown fuse such as shown at left **(B)**. In general, this kind of blown fuse occurs after a relatively long period of time, so it does not happen very often.
   With this kind of blown fuse, it is OK to replace it with a fuse of the same capacity.

(A) Fuse Blown by Current Overload (B) Fuse Blown by Thermal Fatigue

RY9212001ELS0032US0



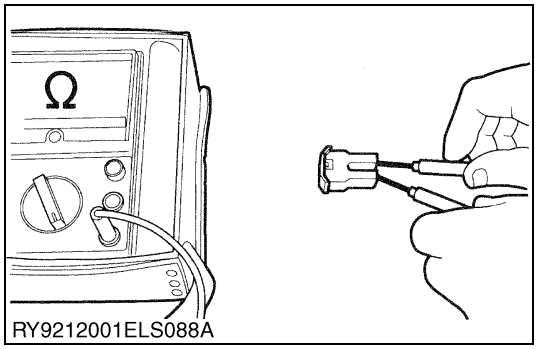
Slow-blow fuses

■ **IMPORTANT**

- **When replacing a slow-blow fuse, always use the same capacity fuse and replace it after determining why it blew.**

(1) Slow-Blow Fuse Box (2) Electric Fan Fuse (20 A)

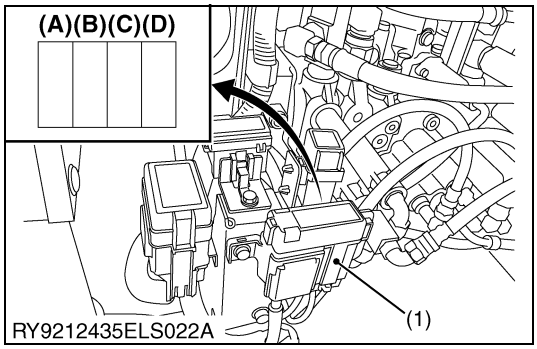
RY9212435ELS0021US0



Inspecting slow-blow fuses

- Measurement parameter: check continuity across its terminals

RY9212001ELS0028US0



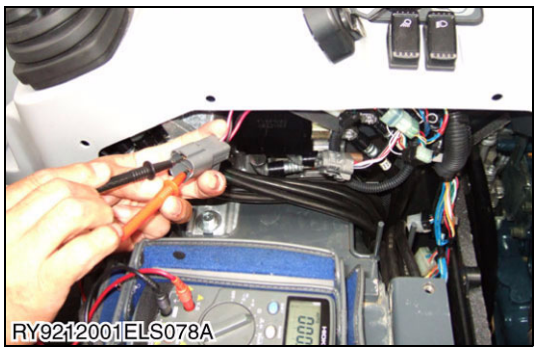
Slow Blow Fuse Layout and Capacities

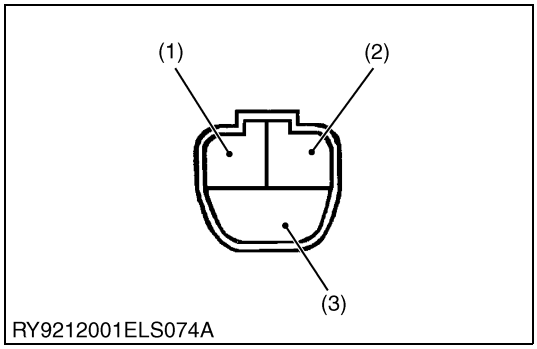
(A)	Alternator (100 A)
(B)	Engine ECU (30 A)
(C)	Main Power (60 A)
(D)	Engine Power (50 A)

(1) Slow-Blow Fuse Box

RY9212435ELS0022US0

[2] STARTING AND STOPPING DEVICE





Key switch

Checks

1. Remove the key switch's 3P connector.
2. Turn the key switch to the RUN position and then check the continuity between the red / white wire terminal of the connector on the key switch side and the red wire terminal on the connector.
3. Turn the key switch to the START position and then check the continuity between the black/white wire terminal of the connector on the key switch side and the red wire terminal on the connector.

Key switch circuit table

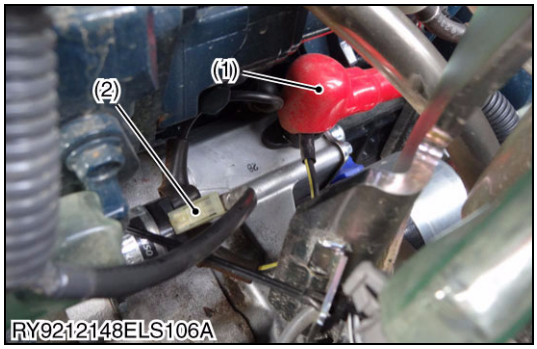
(●—● : Continuity)

Position	(3)	(1)	(2)
STOP			
RUN	●	●	
START	●	●	●

RY9212050ELS011A

(1) Red / White (3) Red
(2) Black / White

RY9212050ELS0027US0



Starter

1. Power supply to terminal B

■ **IMPORTANT**

- **The battery voltage always exists at terminal B of the starter, so do not short it during inspection.**

1. Connect the (+) side of the circuit tester to terminal B of the starter and the (–) side to the body and measure the voltage.
2. If the measurement meets the factory spec, the harness between the battery and terminal B is OK.
3. If the measurement is outside of factory specs, check the condition of the battery cable (+) contact and that of the GND (–) cable and the body.

Measured voltage	Factory specification	11 to 14 V (battery voltage)

2. Power supply to starter's pull-in and holding coils

1. Remove the connector from the starter's S terminal.
2. Connect the (+) of the circuit tester to the connector on the harness side and the (–) to the body.
3. Put the machinery operation lock lever in the lock position and measure the voltage with the key switch held in the START position.

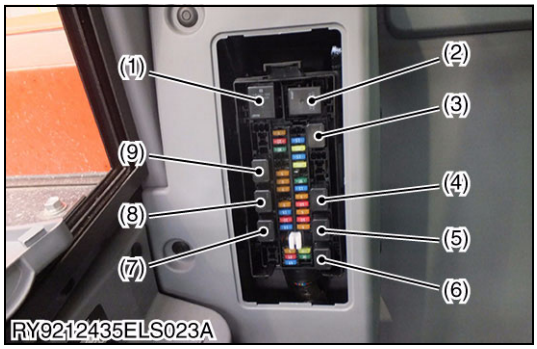
If the measurement meets factory specs, the circuit from the battery to the S terminal is OK (harness, key switch, auto-release relay).

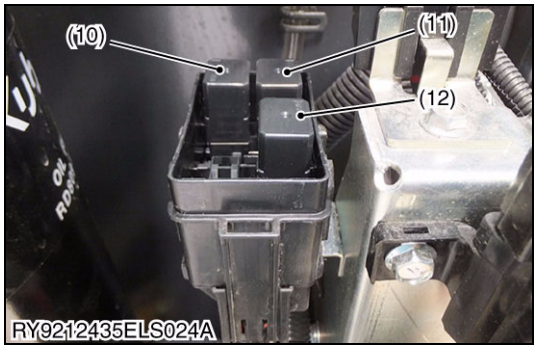
Measured voltage	Factory specification	11 to 14 V (battery voltage)

(1) Terminal B (2) Terminal S

RY9212148ELS0137US0

[3] RELAY LAYOUT

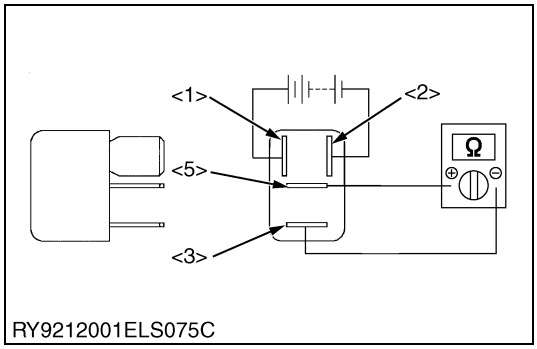




Relay Layout and Capacities

(1)	Power relay (40 A)
(2)	Glow relay (40 A)
(3)	Horn relay (20 A)
(4)	Beacon relay (20 A)
(5)	Worklight relay (20 A)
(6)	Hydraulic pump relay (20 A)
(7)	ECU (Power) relay (20 A)
(8)	Blower relay (20 A)
(9)	Compressor relay (20 A)
(10)	Condenser relay (20 A)
(11)	Engine ECU relay (20 A)
(12)	Starter relay (20 A)

RY9212435ELS0023US0



Testing the Starter Relay

1. Voltage check

[Measurement Conditions]

1. Remove the starter relay.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (+ terminal side)	Pin No.
1	Starter relay	<3>	Body GND	–

Normal: 12 V (battery voltage)
Irregular: Large discrepancy from 12 V

2. Continuity check

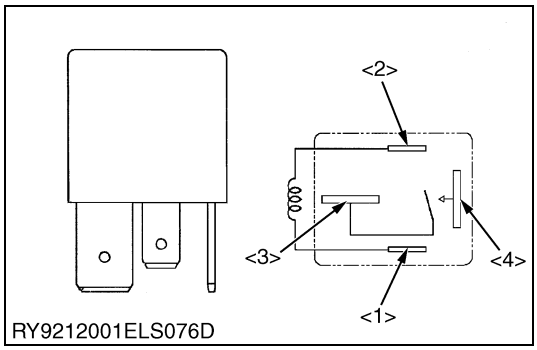
[Measurement Conditions]

1. Key switch: OFF
2. Remove the starter relay.
3. Apply battery voltage across relay terminals 1 and 2.
4. Check for continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (+ terminal side)	Pin No.
1	Starter relay	<5>	Starter relay	<3>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0024US0



Glow relay inspection

1. Voltage check

[Measurement Conditions]

1. Remove the glow relay.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (+ terminal side)	Pin No.
1	Glow relay	<3>	Body GND	–

Normal: 12 V (battery voltage)
Irregular: Large discrepancy from 12 V

2. Continuity check

[Measurement Conditions]

1. Key switch: OFF
2. Remove the glow relay.
3. Apply battery voltage across relay terminals 1 and 2.
4. Check for continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (+ terminal side)	Pin No.
1	Glow relay	<3>	Glow relay	<4>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0025US0

4. TROUBLESHOOTING (START-UP EQUIPMENT VERSION)

Engine does not start

Checkpoint	Cause	Solution
Check whether "Wrong Key" is displayed when it is in the start position. Determine whether it is the registered key or not in the tester mode.	The engine was not started with the registered key.	Start the engine with the registered key.
Check slow-blow and other fuses.	Slow-blow and/or other fuses are blown.	After determining the cause of slow-blow and/or other fuses blowing, replace them.
Check whether GND wire(s) are securely connected to the body.	Ground defective	Tighten GND wire bolt(s).
Check battery voltage and specific gravity.	Battery fault	Recharge or replace the battery.
Check continuity between key switch terminals.	Key switch faulty	Replace the key switch.
Measure the voltage at terminal B of the starter.	Break in continuity of the harness or starter relay.	Repair the harness. Replace the harness, starter relay and/or fuses.
Measure the voltage at terminal S of the starter.	Break in continuity in the harness, starter relay and/or fuses.	Repair the harness. Replace the harness, starter relay and/or fuses.

The engine fails to start sometimes.

Checkpoint	Cause	Solution
Is the key on a metal keyring or have a metal fob?	The key fob and/or keyring are interfering with communication between the key and the antenna.	Get rid of the key fob and/or ring.

Engine starts even with unregistered keys

Checkpoint	Cause	Solution
Check whether the anti-theft system is "OFF" or not initialized.	As the anti-theft function is not working, even unregistered keys can start the engine.	Please contact Kubota service.

RY9212148ELS0135US0

5. METHODS FOR DIAGNOSING ERRORS

The most important thing in diagnosing a malfunction is inferring the cause of the problem. It is important because inferring the cause allows for a narrowing of the places that need to be inspected, and thus reducing wasted inspection work. And the inference has to be supported by theory and practice--relying on intuition does not work.

RY9212038ELS0013US0

[1] GUIDE TO DIAGNOSING ERRORS

When diagnosing errors if you fail to go through the proper procedures, it clouds the view of the actual problem and conversely, in the end you are liable to make an incorrect guess about the cause and repair. For that reason, it is necessary to think through the following 4 steps when diagnosing errors.

1	**Error Diagnosis Procedure**	• Accurately observe what the problem is. Check whether that problem is the only one or whether there are other problems.
2	**Infer the Cause of the Error**	• When inferring the cause of an error, it is important to grasp the circuits in the wiring diagram as a system. Of course you have to know how switches, relays, etc. function, but having a broader view of the causes of errors, such as from experience of what caused past errors that you repaired, is necessary to making inferences.
3	**Test Specified Locations and Find the Cause**	• Error diagnosis is a matter of building up facts from tests and step by step getting closer to the real cause. While making checks, you always have to be thinking, which test can I make where to be more effective.
4	**Check your Repairs**	• After repairing a fault, always check and make sure the system is functioning normally. And make sure no new problem has arisen.

These materials provide information necessary for diagnosing errors and the overall wiring diagram and circuit diagrams for each system were compiled with a view to simplifying error diagnosis.

1. The circuit diagrams show the layout of connectors and wiring routing on the machine.
2. The circuit diagrams show the structure of circuits in the system and indicate the normal (not operating) state of all of the kinds of switches.
3. The flow of electricity when switches are operated is explained based on the circuit diagrams and how each device operates is indicated.
4. Troubleshooting tips are provided to help identify the causes of errors from multiple pieces of information and using common sense.
   If you cannot pinpoint the cause based on these tips, follow the circuit for each system to diagnose the error.

RY9212148ELS0071US0

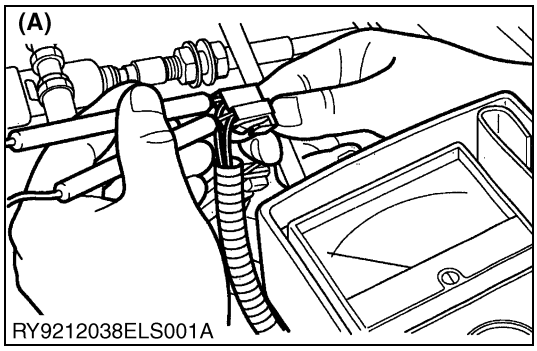
[2] ERROR DIAGNOSIS PROCEDURE

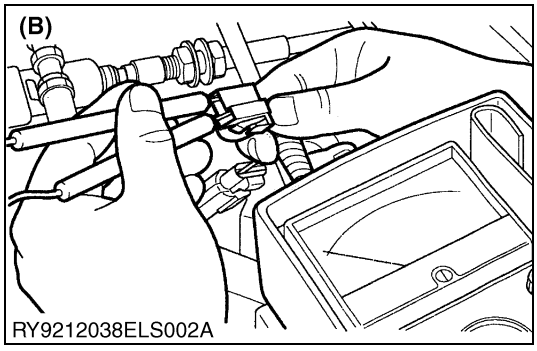
All diagnoses of malfunctions should narrow down the cause via the following procedures and specify the faulty location (Not following the procedures results in not knowing the cause of the fault).

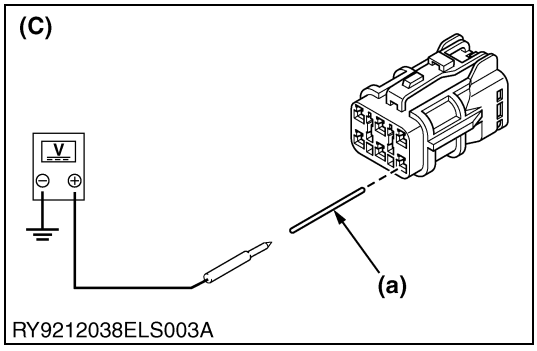
1	**Observing the Malfunction**	• Normal meter display • Abnormal meter display
2	**Checking the Faulty Line**	• Check in the meter's service mode. Checking for breaks in wiring.
3	**Specify the Faulty Circuit with a Circuit Tester**	• Test related circuits with a circuit tester. Specify any faulty circuits in a harness.
4	**Diagnose Sensors and Actuators with the Tester**	• Judge sensors and actuators as normal or abnormal.
5	**Final Operation Check**	• Clear the history display after completing repairs. After clearing the history and thoroughly checking operations, check for a history display again.

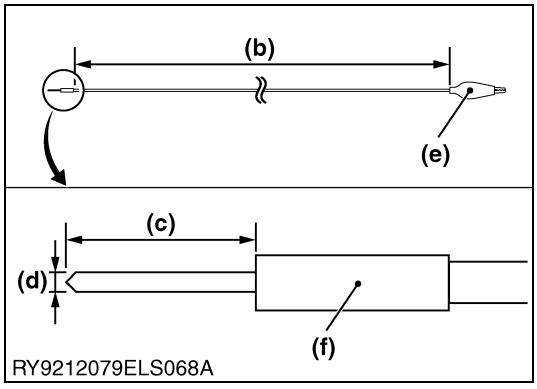
RY9212038ELS0015US0

[3] TESTING WITH A CIRCUIT TESTER









Testing Voltage and Continuity at a Connector

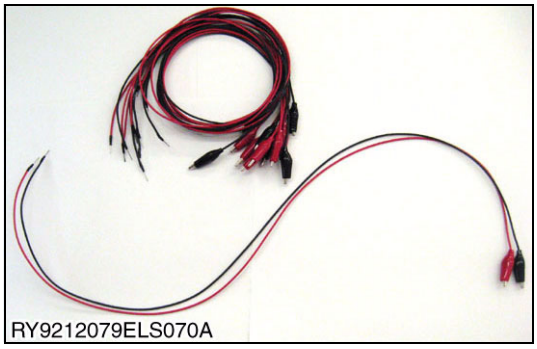
To prevent damage to the connector terminal contacts and/or reducing the water-proofing of the connector when testing a connector for voltage and/or continuity, follow the guidelines below.

RY9212038ELS0016US0

1. General (not waterproof) connectors
   - Insert the test lead from the harness side. Female terminals are particularly prone to damage so always insert the test leads from the harness side.
   - ECU connector terminal pins are extremely small, so do not try and force a test lead in; use the special tool.

2. Waterproof connectors
   - If you try to test the circuit when it is in a closed state and force the test leads in from the harness side, it will reduce the effectiveness of its waterproofing, leading to corrosion, so never do this.
   - When testing a male pin, touch the test lead directly to the pin. In this situation, be very careful not to short circuit across connector terminals.

3. Special tools
   - When the connector pin holes are smaller than the test leads, use thin wires.



(A) Correct Example
(B) Incorrect Example
(C) Using a Special Tool

(a) Measuring Harness
(b) 600 to 700 mm (23.7 to 27.5 in.)
(c) 10 mm (0.39 in.)
(d) 0.6 mm (0.02 in.)
(e) Clip
(f) Tape

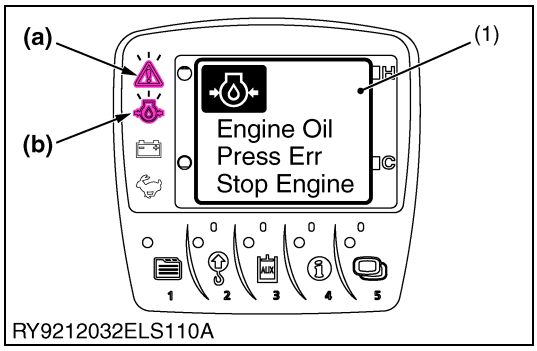
RY9212038ELS0017US0

6. TROUBLESHOOTING (METER PANEL VERSION)

[1] MACHINE RELATED SYSTEM

(1) Engine Oil Pressure Errors

[A] Checking the Meter Panel



RY9212032ELS110A

1. Information displayed on the meter panel

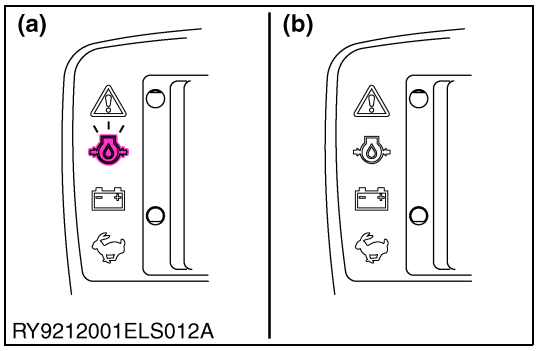
1. When an error appears on the meter panel, stop the engine right away.
2. Check the level of the engine oil.
3. Check whether or not the warning lamp **(a)** on the panel is blinking red.
4. Check whether the oil lamp **(b)** is lit in red or off.

[Reason error screen displayed]

- Engine oil pressure low
- Oil switch always ON
- Short in harness

(1) Engine Oil Press Err Stop Engine
(a) Warning Lamp
(b) Oil Lamp

RY9212148ELS0072US0



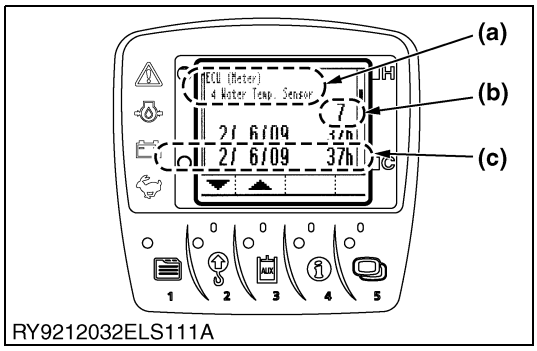
RY9212001ELS012A

[Test Conditions]

1. Key switch: ON

(a) If the oil lamp is lit: caused by a short
(b) If the oil lamp is off: caused by break in wiring

RY9212148ELS0073US0



RY9212032ELS111A

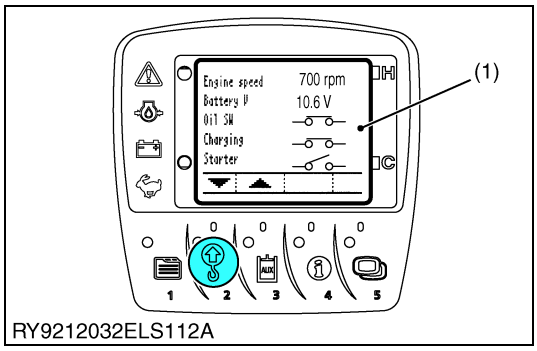
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0



RY9212032ELS112A

3. Tester mode

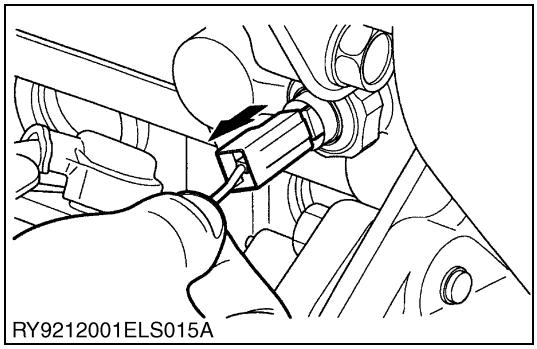
1. Select the tester mode.
2. Check the operation of the oil switch according to the table below.

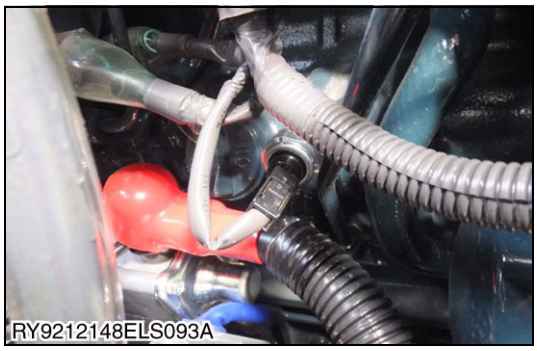
	Regu-lar	Oil Lamp	When cut off	Oil Lamp	When shorted	Oil Lamp
Key Off		Off		Off		Off
Key On		Lit		Off		Lit
Key Start		Off		Off		Lit

(1) Engine Speed
Battery V
Oil SW
Charging
Starter

RY9212148ELS0074US0

[B] Inspecting each device visually and physically


RY9212001ELS015A


RY9212148ELS093A

1. Causes when a break in wiring

[Test Conditions]

1. Key switch: OFF
2. The oil switch connector is disconnected.
3. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely and check the operation of the oil switch again in the tester mode.

RY9212148ELS0075US0

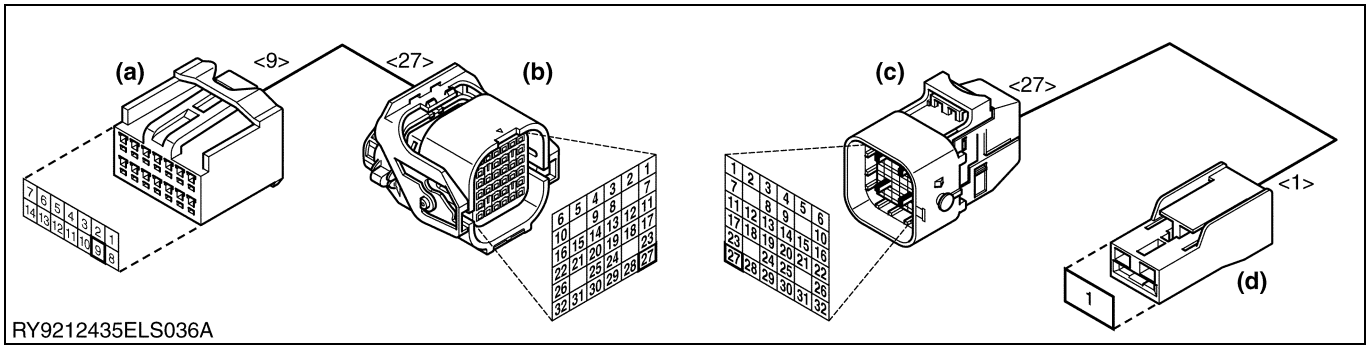
2. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The oil switch wire is pinched against or touching the body.
   If the insulation is damaged, repair it properly and check the operation of the oil switch again in the tester mode.

RY9212148ELS0076US0

[C] Testing with a Circuit Tester



(a) Meter Panel Connector **(b) Engine (Signal) Connector** **(c) Main (Signal) Connector** **(d) Engine Oil Pressure Switch Connector**

RY9212435ELS0039US0

1. Voltage check

[Measurement Conditions]

1. Disconnect the engine oil pressure switch connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Engine oil pressure switch	<1>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

RY9212148ELS0146US0

2. Continuity check

[Measurement Conditions]

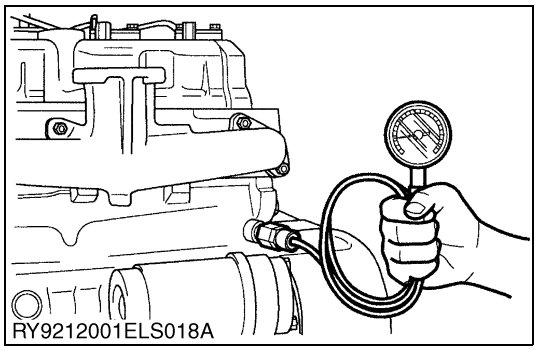
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Engine oil pressure switch	<1>	Main (signal)	<27>
(2)	Engine (signal)	<27>	Meter panel	<9>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0047US0

[D] Testing the Equipment Itself


RY9212001ELS018A

1. Measuring engine pressure

[Measurement Conditions]

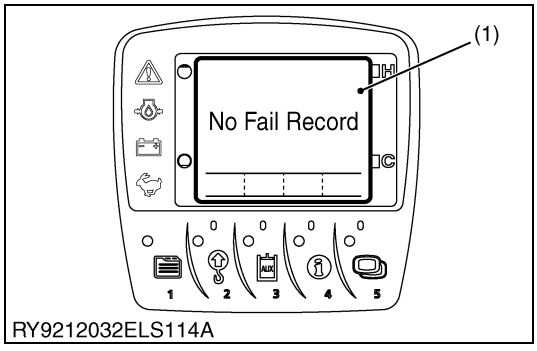
1. Remove the engine oil switch, attach a pressure gauge and measure the pressure.

Engine Oil Pressure	At idle	Usage limit	50 kPa 0.51 kgf/cm^2 7.25 psi
	At Rated RPM	Factory specification	200 to 390 kPa 2.04 to 3.98 kgf/cm^2 29.01 to 56.56 psi
		Usage limit	150 kPa 1.53 kgf/cm^2 21.76 psi

Tightening torque	Oil switch tapering screw R1/8	15 to 19 N·m 1.5 to 1.9 kgf·m 11.1 to 14.0 lbf·ft

RY9212148ELS0077US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

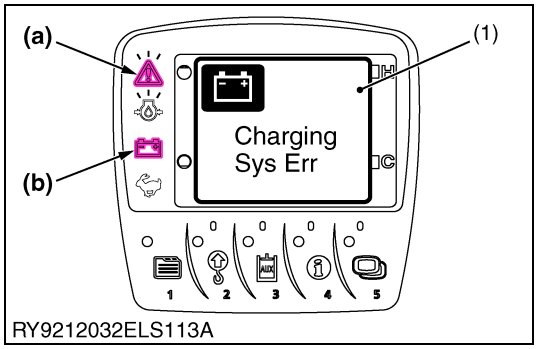
1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

(1) No Fail Record

RY9212148ELS0148US0

(2) Charging System Errors

[A] Checking the Meter Panel



RY9212032ELS113A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Check whether the charging lamp **(b)** is lit in red or off.

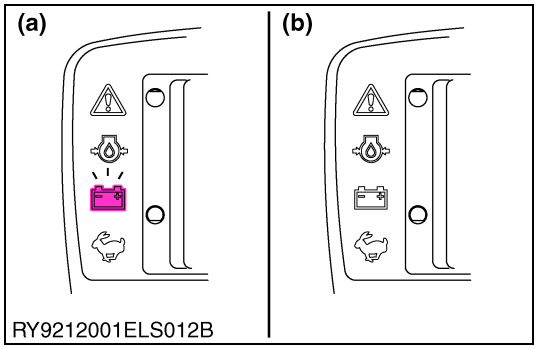
[Reason error screen displayed]

- Alternator faulty
- Fan belt loose/off
- Break in the harness
- Fuse blown (10A)

(1) Charging Sys Err

(a) Warning Lamp
(b) Charging Lamp

RY9212148ELS0078US0



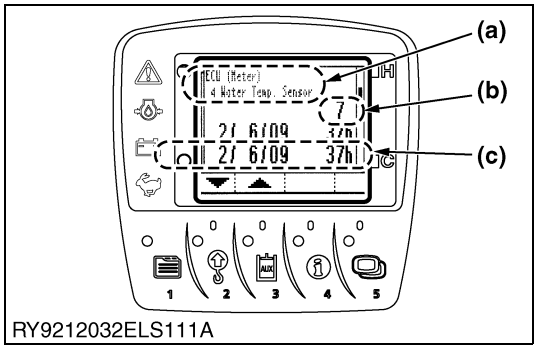
RY9212001ELS012B

[Test Conditions]

1. Key switch: ON

(a) If the charging lamp is lit: caused by a short
(b) If the charging lamp is off: caused by break in wiring

RY9212148ELS0079US0



RY9212032ELS111A

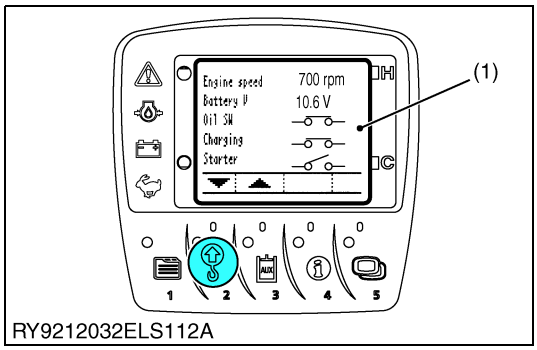
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

   E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0



RY9212032ELS112A

3. Tester mode

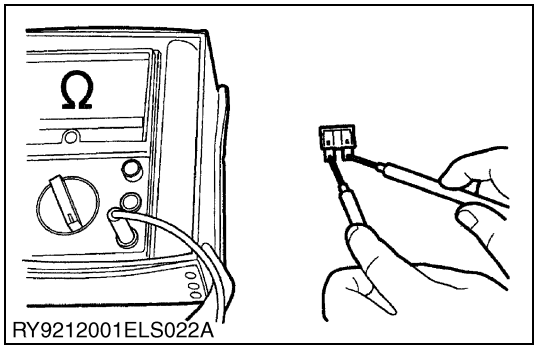
1. Select the tester mode.
2. Check the operation of the charge according to the table below.

	Regu-lar	Charge	When cut off	Charge	When shorted	Charge
Key Off	—o o—	Off	—o o—	Off	—o o—	Off
Key On	—o—o—	Lit	—o o—	Off	—o—o—	Lit
Key Start	—o o—	Off	—o o—	Off	—o—o—	Lit

(1) Engine Speed
Battery V
Oil SW
Charging
Starter

RY9212148ELS0080US0

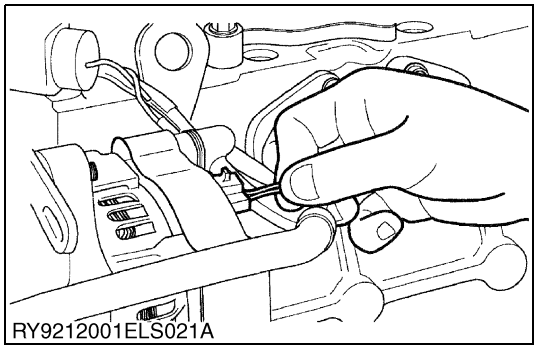
[B] Inspecting each device visually and physically



1. Checking fuses

Check whether the alternator fuse (10A) is blown.

RY9212001ELS0064US0



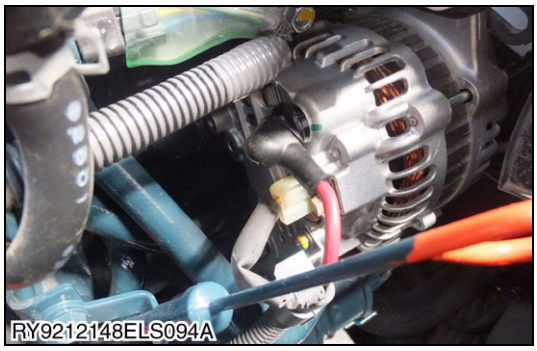
2. Causes when a break in wiring

[Test Conditions]

1. Key switch: OFF
2. The alternator connector is disconnected.
3. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely and check the operation of the charging switch again in the tester mode.

RY9212148ELS0081US0



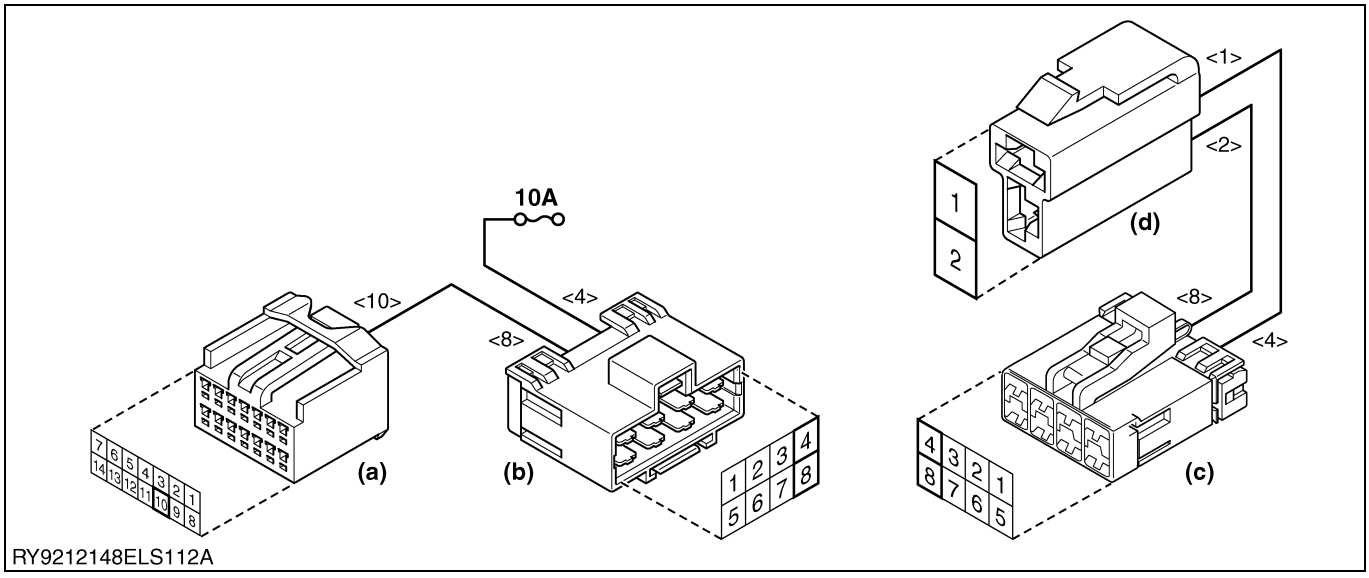
3. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The alternator connector wire is pinched against or touching the body.
   If the insulation is damaged, repair it properly and check the operation of the charging switch again in the tester mode.

RY9212148ELS0082US0

[C] Testing with a Circuit Tester



(a) Meter Panel Connector (b) Engine (Open) Connector (c) Main (Open) Connector (d) Alternator Connector

RY9212435ELS0053US0

1. Voltage check

[Measurement Conditions]
1. Disconnect the alternator connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Alternator	<2>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

RY9212435ELS0067US0

2. Continuity check

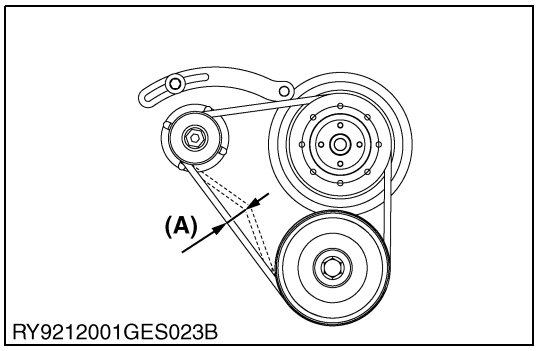
[Measurement Conditions]
1. Key switch: OFF
2. Disconnect the connector and fuse to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Alternator	<1>	Main (open)	<4>
(2)	Alternator	<2>	Main (open)	<8>
(3)	Engine (open)	<4>	10 A fuse	–
(4)	Engine (open)	<8>	Meter panel	<10>

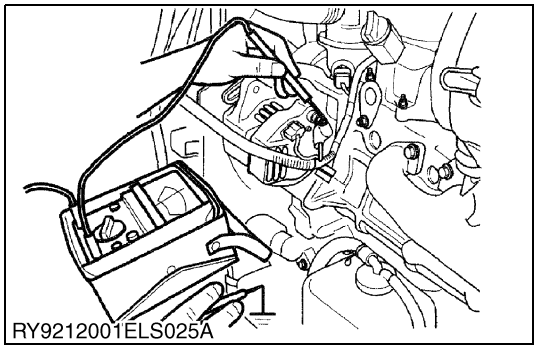
Regular: Continuity
Irregular: No continuity

RY9212148ELS0151US0

[D] Testing the Equipment Itself



RY9212001GES023B


RY9212001ELS025A

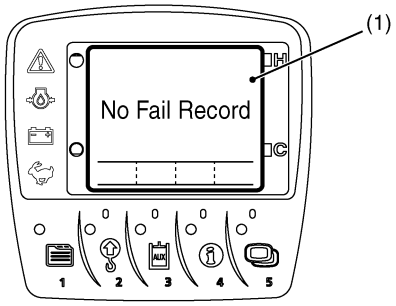
1. Inspecting the alternator

1. Check for a cut, loose or slipping fan belt.
2. Measure the voltage between terminal B of the alternator and body GND. If the measured voltage is about 12 V, it is normal. If the measured voltage is low, it may indicate insufficient battery capacity or looseness in connections somewhere before the alternator.
3. Next, start the engine and measure the voltage generated when the alternator is operating. Take the measurement between terminal B on the alternator side and the body GND. If the measured voltage is about 14V, it is normal. If the measured voltage does not vary from the battery voltage (about 12 V), then the alternator itself or the regulator is faulty.

(A) Displacement 12 to 15 mm (0.47 to 0.59 in.)

RY9212148ELS0083US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

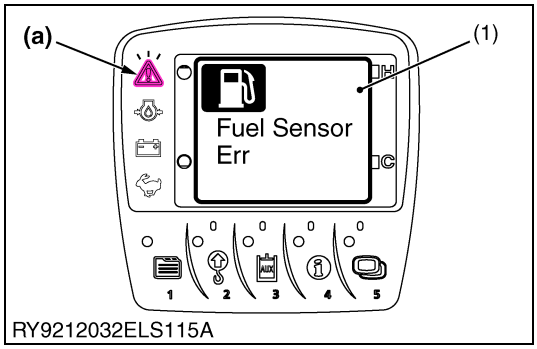
1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

(1) No Fail Record

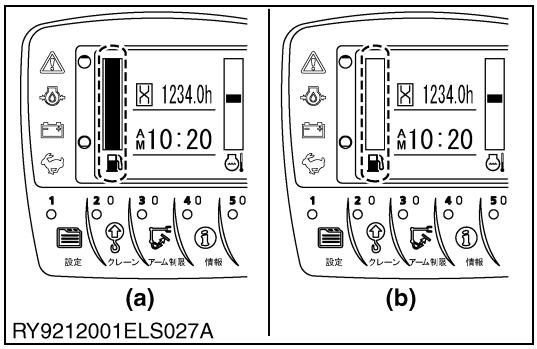
RY9212148ELS0148US0

(3) Fuel Sensor Errors

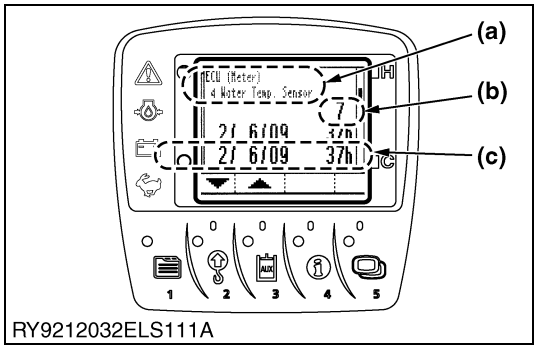
[A] Checking the Meter Panel



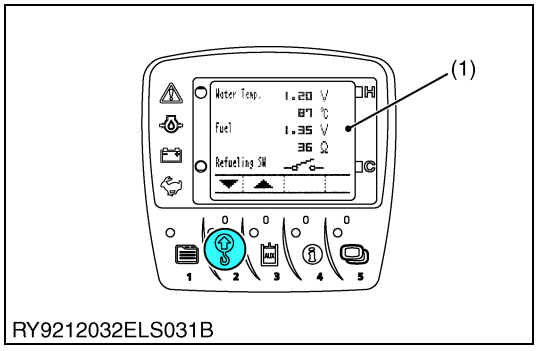
RY9212032ELS115A



RY9212001ELS027A



RY9212032ELS111A



RY9212032ELS031B

1. Information displayed on the meter panel

Check whether or not the warning lamp **(a)** on the panel is blinking red.

[Reason error screen displayed]

- Connector disconnected
- Break in the harness

(1) Fuel Sensor Err
(a) Warning Lamp

RY9212148ELS0084US0

[Test Conditions]

1. Key switch: ON

(a) If the fuel level is at the top: caused by a short
(b) If the fuel level is blank: caused by a break

RY9212148ELS0085US0

2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0

3. Tester mode

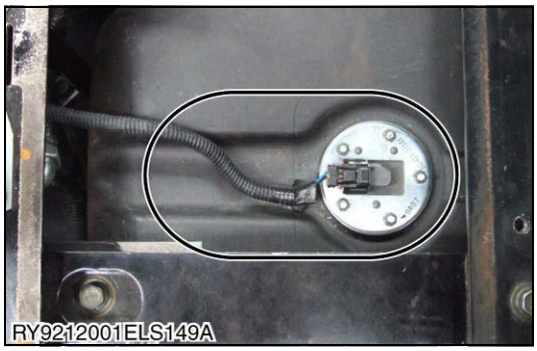
1. Select the tester mode.
2. Start the engine.
3. Check the display for the voltage and resistance of the fuel based on the following table.

	Fuel voltage	Resistance
When cut off	5.00 V	218 Ω
When shorted	0.00 V	0 Ω

(1) Water Temp.
Fuel
Refueling SW

RY9212148ELS0086US0

[B] Inspecting each device visually and physically



1. Causes when a break in wiring

[Test Conditions]
1. Key switch: OFF
2. Fuel sensor connector disconnected.
3. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely and check the voltage and resistance for the fuel again in the tester mode.

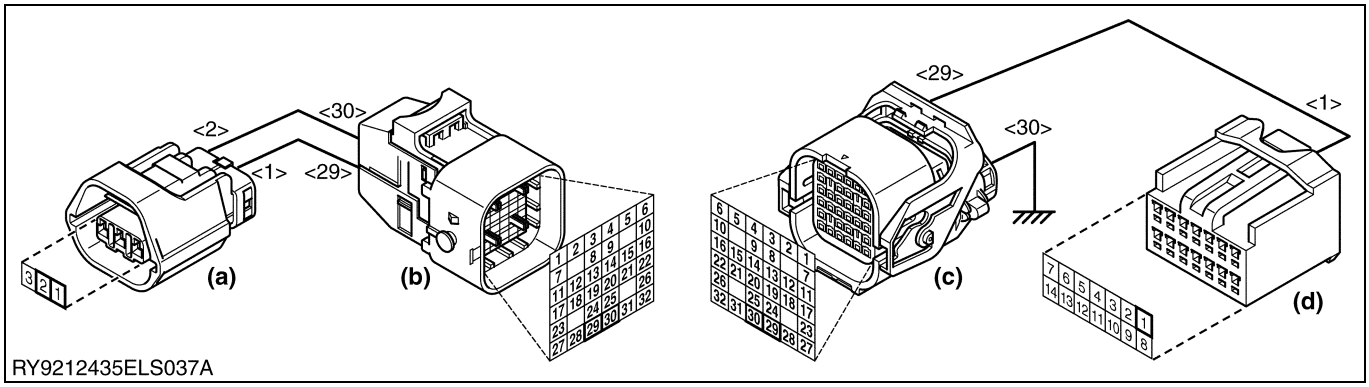
RY9212148ELS0087US0

2. Causes when a short

[Test Conditions]
1. Key switch: OFF
2. The fuel sensor wire is pinched against or touching the body. If the insulation is damaged, repair it properly and check the voltage and resistance for the fuel again in the tester mode.

RY9212148ELS0088US0

[C] Testing with a Circuit Tester



(a) Sensor, Fuel Connector (b) Main (Signal) Connector (c) Engine (Signal) Connector (d) Meter Panel Connector

RY9212435ELS0040US0

1. Voltage check

[Measurement Conditions]
1. Disconnect the fuel sensor connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Mea-sure-ment	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Sensor, Fuel	<1>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

RY9212435ELS0057US0

2. Continuity check

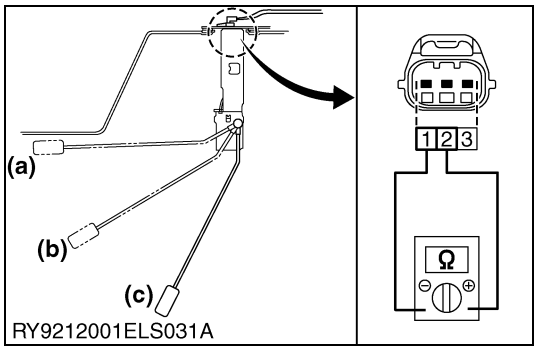
[Measurement Conditions]
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Mea-sure-ment	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Sensor, Fuel	<1>	Main (signal)	<29>
(2)	Sensor, Fuel	<2>	Main (signal)	<30>
(3)	Engine (signal)	<29>	Meter panel	<1>
(4)	Engine (signal)	<30>	Body GND	–

Regular: Continuity
Irregular: No continuity

RY9212435ELS0048US0

[D] Testing the Equipment Itself



RY9212001ELS031A

1. Inspecting the fuel sensor

[Measurement Conditions]
1. Key switch: OFF
2. Disconnect the connector from the fuel sensor and take measurements.
3. Refer to the following table for the resistance at different float positions.

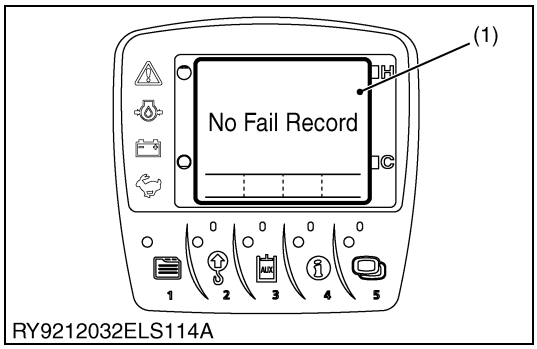
Factory Spec

Float position	F (a)	1/2 (b)	E (c)
Resistance value (Ω)	5 ≥	42.19	101.0 ≤

(a) Full
(b) Half
(c) Empty

RY9212148ELS0089US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

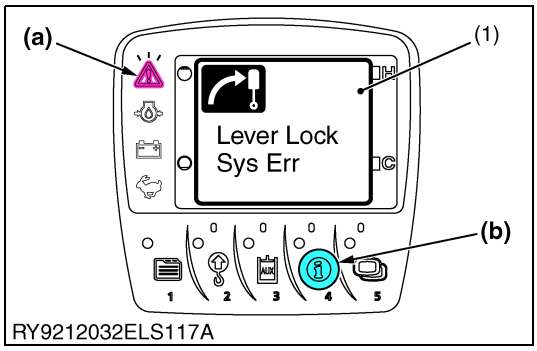
(1) No Fail Record

RY9212148ELS0148US0

[2] FRONT-END SYSTEMS

(1) Lever Lock System Errors

[A] Checking the Meter Panel



RY9212032ELS117A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

   E.g.) Lever lock solenoid

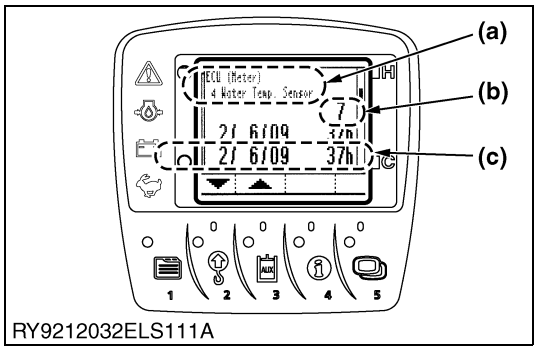
[Reason error screen displayed]

- Lever lock solenoid line short.

(1) Lever Lock Sys Err

(a) Warning Lamp
(b) Info Button

RY9212148ELS0090US0



RY9212032ELS111A

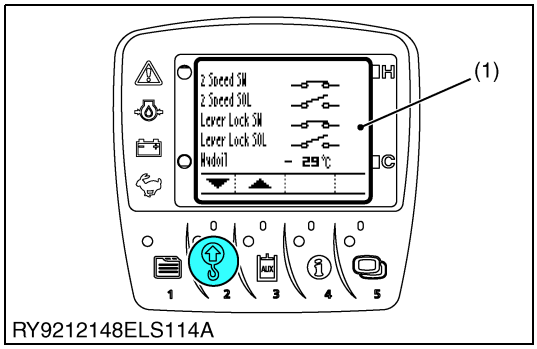
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

   E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0

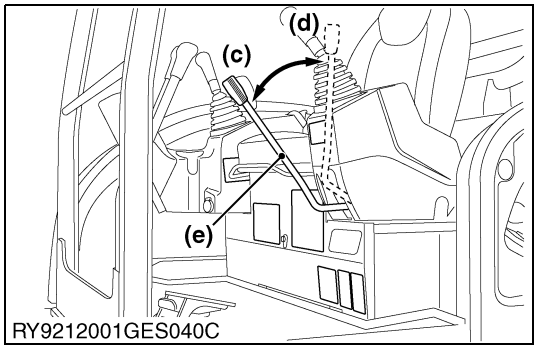


RY9212148ELS114A

3. Tester mode

1. Select the tester mode.
2. Start the engine.
3. Put the lever lock in the [Unlock] position.
4. Operate the lever lock switch and lever lock solenoid and check the switch according to the following table.

	Regular	Warning lamp	When cut off	Warning lamp	When short	Warning lamp
Lever lock switch ON		Off		Off		Off
Lever lock switch OFF		Off		Off		Off
Lever lock solenoid ON		Off		Off		Off
Lever lock solenoid OFF		Off		Off		Off



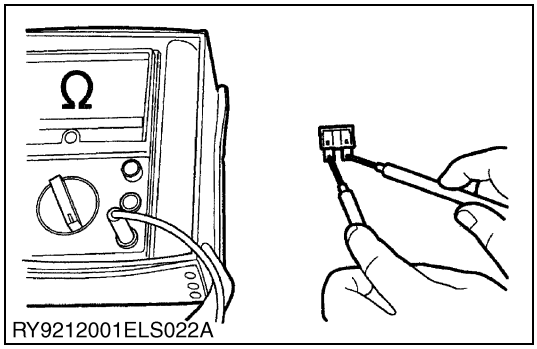
RY9212001GES040C

(1) 2nd Speed SW
2nd Speed SOL
Lever Lock SW
Lever Lock SOL
Hydraulic Oil Temperature

(c) Unlock
(d) Lock
(e) Lever Lock

RY9212148ELS0091US0

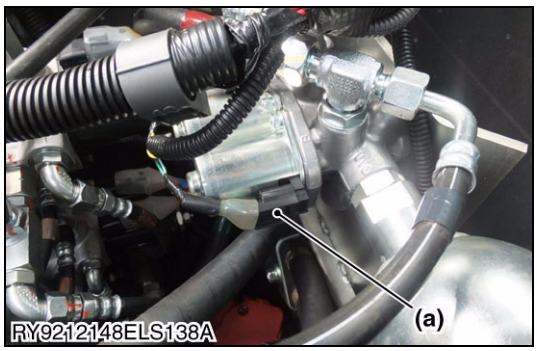
[B] Inspecting each device visually and physically

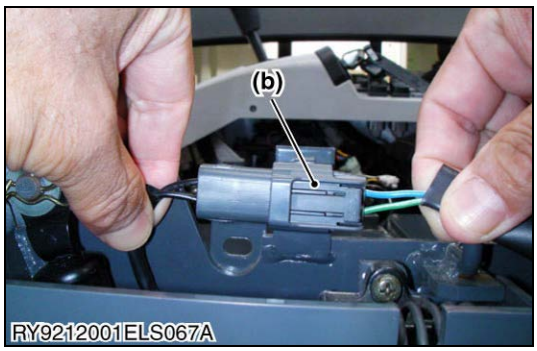


1. Checking fuses

1. Check whether the 5A lever lock fuse is blown.

RY9212001ELS0088US0





2. Causes when a break in wiring

[Test Conditions]

1. Key switch: OFF
2. The lever lock switch connector is disconnected.
3. The lever lock solenoid connector is disconnected.
4. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely and check the lever lock switch and lever lock solenoid in the tester mode.

(a) Lever Lock Solenoid Connector (b) Lever Lock Switch Connector

RY9212148ELS0092US0

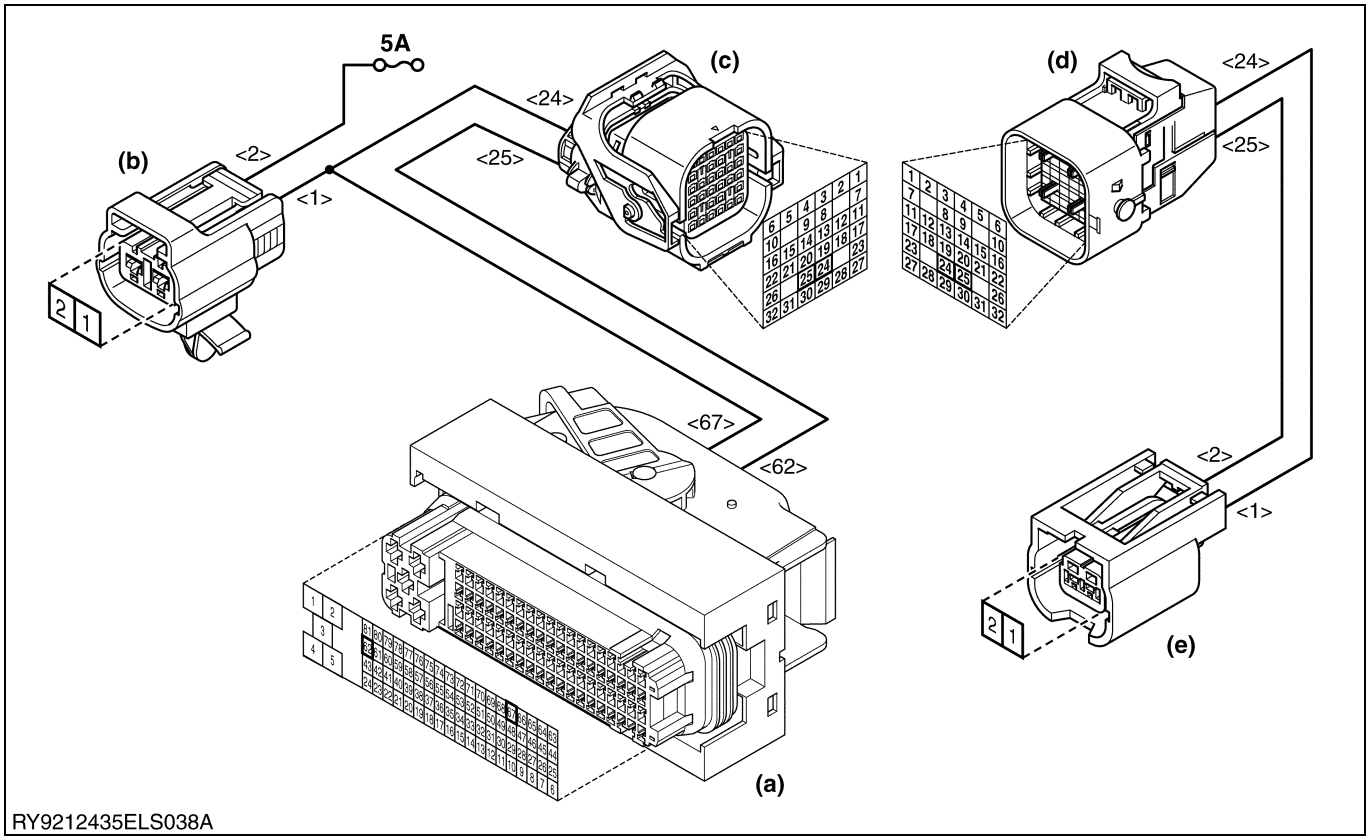
3. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The lever lock switch connector wire and/or lever lock solenoid connector are pinched against or touching the body.
   If the insulation is damaged, repair it properly and check the lever lock switch and the lever lock solenoid again in the tester mode.

RY9212148ELS0093US0

[C] Testing with a Circuit Tester



RY9212435ELS038A

(a) Main ECU Connector
(b) Lever Lock Switch Connector
(c) Engine (Signal) Connector
(d) Main (Signal) Connector
(e) Lever Lock Solenoid Connector

RY9212435ELS0041US0

1. Voltage check

[Measurement Conditions]

1. Disconnect the connector to be tested.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Lever lock switch	<2>	Body GND	–
(2)	Lever lock solenoid	<1>	Body GND	–

- To check the solenoid line, put the control lever lock in the [Unlock] position.
  Regular: 12 V
  Irregular: Large discrepancy from 12 V

RY9212435ELS0058US0

2. Continuity check

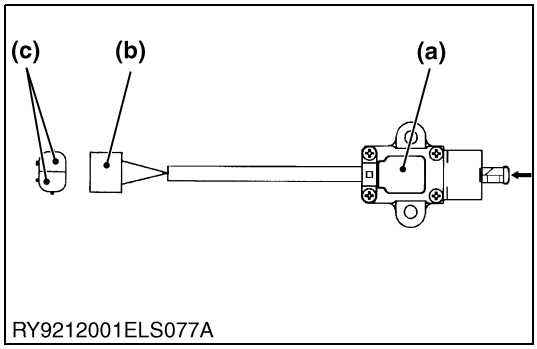
[Measurement Conditions]
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Mea-sure-ment	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	5A fuse	–	Lever lock switch	<2>
(2)	Lever lock switch	<1>	Engine (signal)	<24>
(3)	Lever lock switch	<1>	Main ECU	<67>
(4)	Main ECU	<62>	Engine (signal)	<25>
(5)	Main (signal)	<24>	Lever lock solenoid	<1>
(6)	Main (signal)	<25>	Lever lock solenoid	<2>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0049US0

[D] Testing the Equipment Itself



RY9212001ELS077A

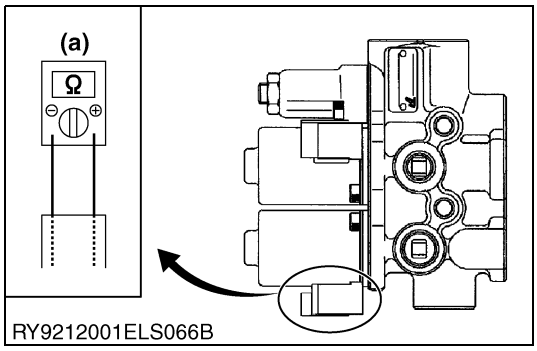
1. Inspecting the lever lock switch

[Test Conditions]
1. Key switch: OFF
2. Disconnect the lever lock switch connector from the machine and press the switch and check for continuity.

   Regular: Continuity
   Irregular: No continuity

(a) Lever Lock Switch
(b) Lever Lock Switch Connector
(c) Lever Lock Switch Connector Terminals

RY9212148ELS0094US0



RY9212001ELS066B

2. Testing the lever lock solenoid

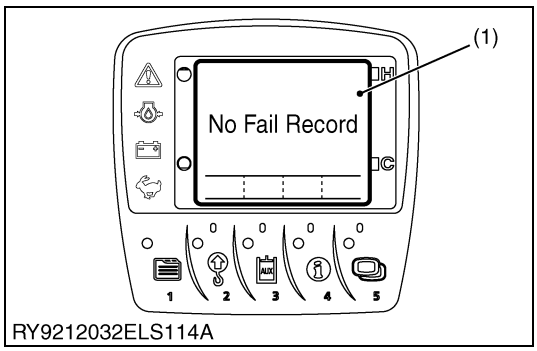
[Test Conditions]
1. Key switch: OFF
2. Disconnect lever lock solenoid connector from the machine and test the solenoid separately.

Lever lock solenoid	Factory specification	12 Ω ±10 %

(a) Lever Lock Solenoid Terminals

RY9212148ELS0095US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

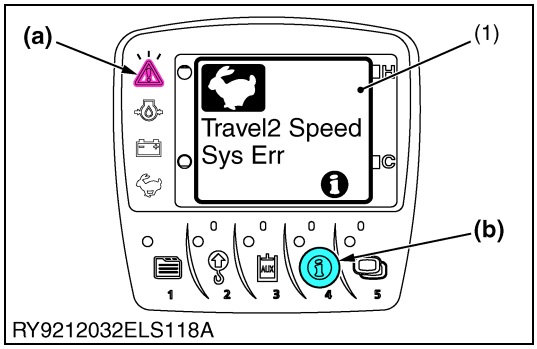
1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

(1) No Fail Record

RY9212148ELS0148US0

(2) Travel 2nd Speed System Error

[A] Error from the Meter Panel



RY9212032ELS118A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

   E.g.) 2nd speed solenoid

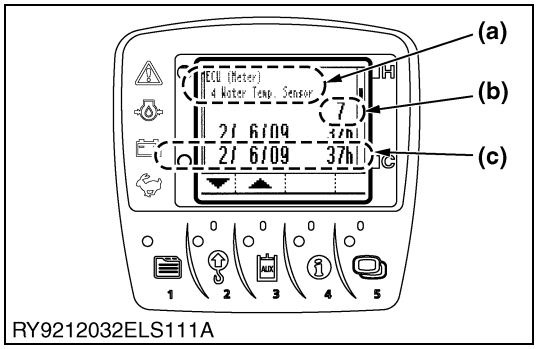
[Reason error screen displayed]

- 2nd speed solenoid line short

(1) Travel2 Speed Sys Err

(a) Warning Lamp
(b) Info Button

RY9212148ELS0096US0



RY9212032ELS111A

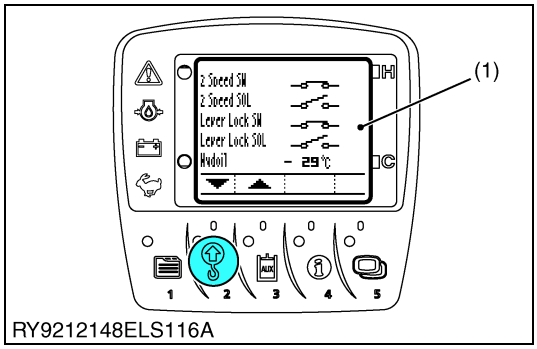
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

   E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0



RY9212148ELS116A

3. Tester mode

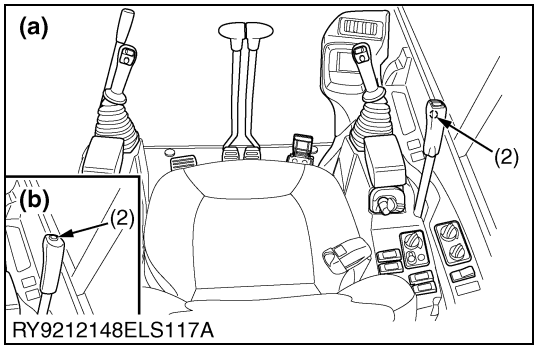
1. Select the tester mode.
2. Start the engine.
3. Put the machinery operation lever lock in the [Unlock] position and press the 2nd speed switch.
4. Operate the 2nd speed switch and check the 2nd speed switch and 2nd speed solenoid based on the following table.

	Regu-lar	2nd speed lamp	When cut off	2nd speed lamp	When shorted	2nd speed lamp
2nd speed switch ON	—o o—	Lit	—o o—	Lit	—o o—	Off
2nd speed switch OFF	—o o—	Off	—o o—	Off	—o o—	Off
2nd speed solenoid ON	—o o—	Lit	—o o—	Lit	—o o—	Off
2nd speed solenoid OFF	—o o—	Off	—o o—	Off	—o o—	Off

(1) 2nd Speed SW
2nd Speed SOL
Lever Lock SW
Lever Lock SOL
Hydoil
(2) 2nd Speed Switch

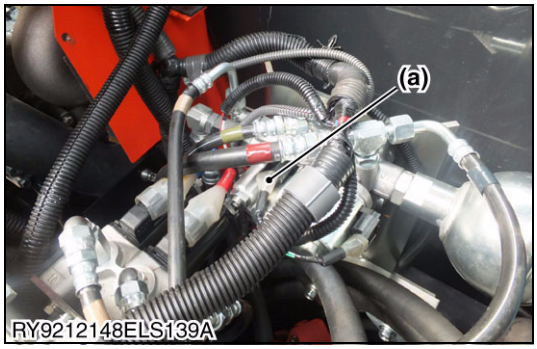
(a) Angle Blade Version
(b) Standard Version

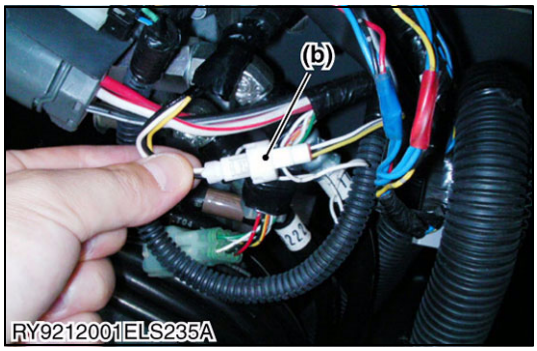
RY9212148ELS0097US0



RY9212148ELS117A

[B] Inspecting each Device Visually and Physically





1. Causes when a break in wiring

[Test Conditions]

1. Key switch: OFF
2. The 2nd speed solenoid connector disconnected.
3. The 2nd speed switch connector disconnected.
4. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely and check the 2nd speed solenoid and the 2nd speed switch in the tester mode.

(a) 2nd Speed Solenoid Connector (b) 2nd Speed Switch Connector

RY9212148ELS0098US0

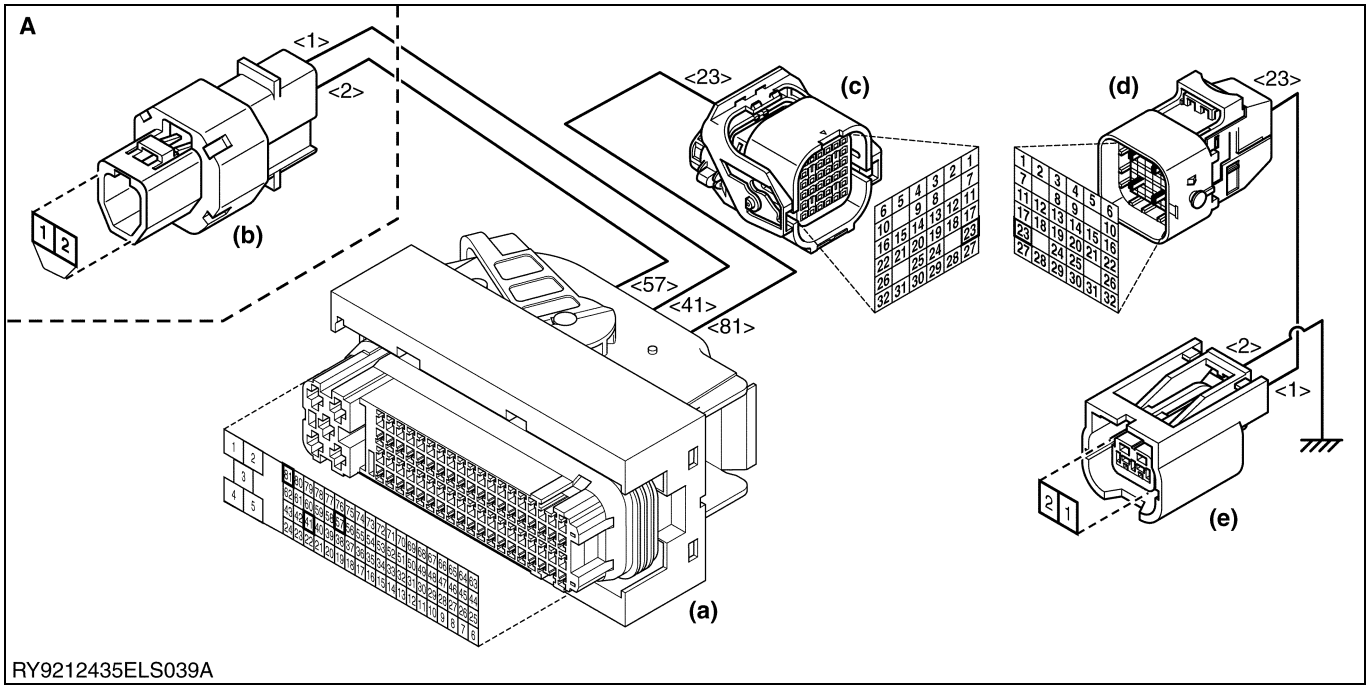
2. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The wiring of the 2nd speed solenoid connector and/or the 2nd speed switch connector are pinched against or touching the body
   If the insulation is damaged, repair it properly and check the 2nd speed solenoid and the 2nd speed switch again in the tester mode.

RY9212148ELS0099US0

[C] Testing with a Circuit Tester



RY9212435ELS039A

(a) Main ECU Connector
(b) 2nd Speed Switch Connector
(c) Engine (Solenoid) Connector
(d) Main (Solenoid) Connector
(e) 2nd Speed Solenoid Connector
A : Standard Spec

RY9212435ELS0042US0

1. Voltage check

[Measurement Conditions]

1. Disconnect the connector to be tested.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	2nd speed switch	<1>	2nd speed switch	<2>
(2)	2nd speed switch	<1>	Body GND	–
(3)	2nd speed solenoid	<1>	2nd speed solenoid	<2>
(4)	2nd speed solenoid	<1>	Body GND	–

- To check the solenoid line, put the machinery operation lever lock in the [Unlock] position and press the 2nd speed switch.
  Regular: 12 V
  Irregular: Large discrepancy from 12 V

RY9212148ELS0159US0

2. Continuity check

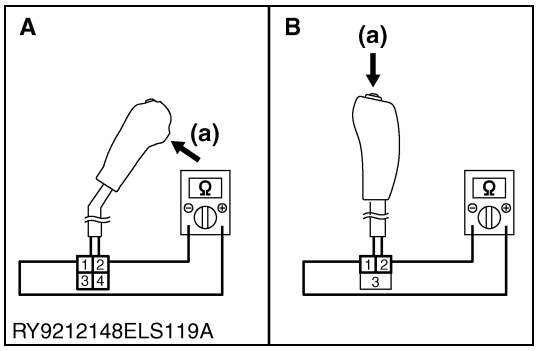
[Measurement Conditions]
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	2nd speed switch	<2>	Main ECU	<57>
(2)	2nd speed switch	<1>	Main ECU	<41>
(3)	Main ECU	<81>	Engine (solenoid)	<23>
(4)	Main (solenoid)	<23>	2nd speed solenoid	<1>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0050US0

[D] Testing the Equipment Itself



1. Testing the 2nd speed switch

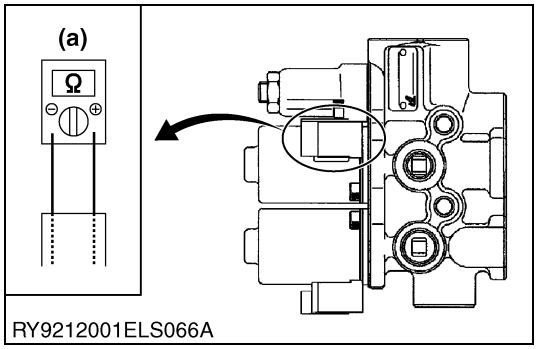
[Test Conditions]
1. Key switch: OFF
2. Disconnect the 2nd speed switch connector from the machine and press the switch and check for continuity.

   Regular: Continuity
   Irregular: No continuity

(a) 2nd Speed Switch

A : Angle Specification
B : Standard Specification

RY9212148ELS0100US0



2. Testing the 2nd speed solenoid

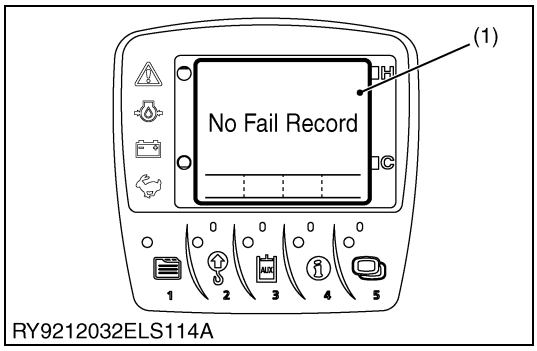
[Test Conditions]
1. Key switch: OFF
2. Disconnect 2nd speed solenoid connector from the machine and test the solenoid separately.

2nd speed solenoid	Factory specification	12 Ω ±10%

(a) 2nd Speed Solenoid Terminals

RY9212148ELS0101US0

[E] Steps to Take after Completing Repairs



1. Delete failure record

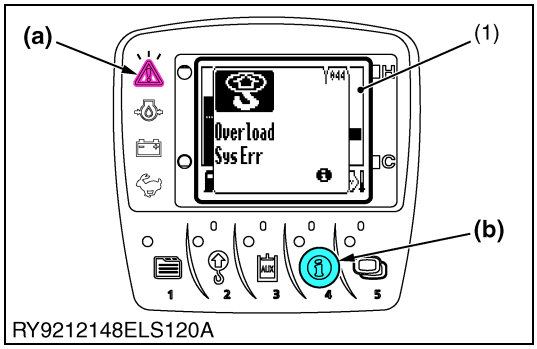
1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

(1) No Fail Record

RY9212148ELS0148US0

(3) Overload warning error

[A] Checking the Meter Panel



RY9212148ELS120A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

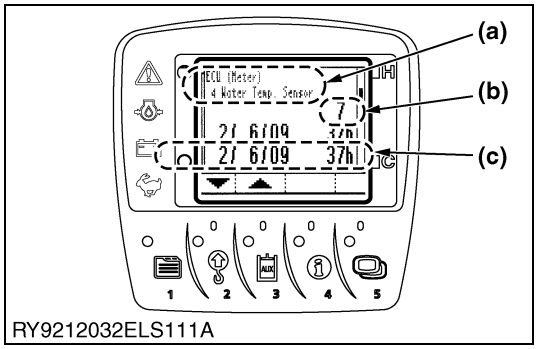
E.g.) Boom bottom

[Reason error screen displayed]
- Connector disconnected
- Break or short in harness

(1) Over Load Sys Err

(a) Warning Lamp
(b) Info Button

RY9212148ELS0161US0



RY9212032ELS111A

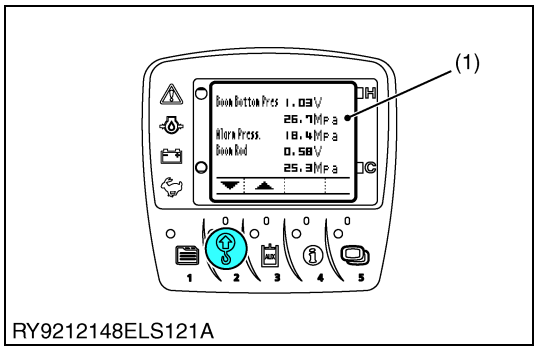
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0



RY9212148ELS121A

3. Tester mode

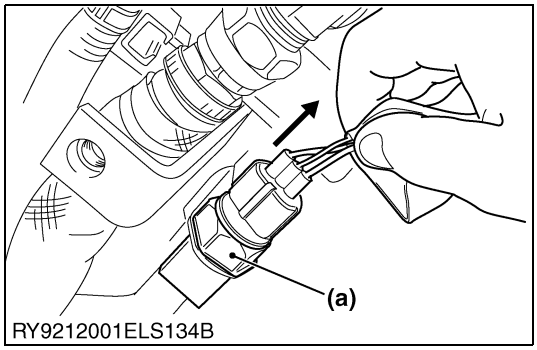
1. Select the tester mode.
2. Start the engine.
3. Put the machine's lever lock in the unlock position and operate the boom.
4. Check that the boom bottom pressure value changes.

Design Value	Regular	When cut off	When shorted
Boom bottom pressure	Current value	0 V	Not stable

(1) Boom Bottom Pres Alarm Press Boom Rod

RY9212148ELS0162US0

[B] Inspecting each device visually and physically



RY9212001ELS134B

1. Causes when a break in wiring

[Test Conditions]
1. Key switch: OFF
2. The boom pressure sensor connector CN765 is disconnected.
3. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force)
If it comes off, plug the connector back in securely and check the boom pressure again in the tester mode.

(a) Boom Pressure Sensor

RY9212148ELS0102US0

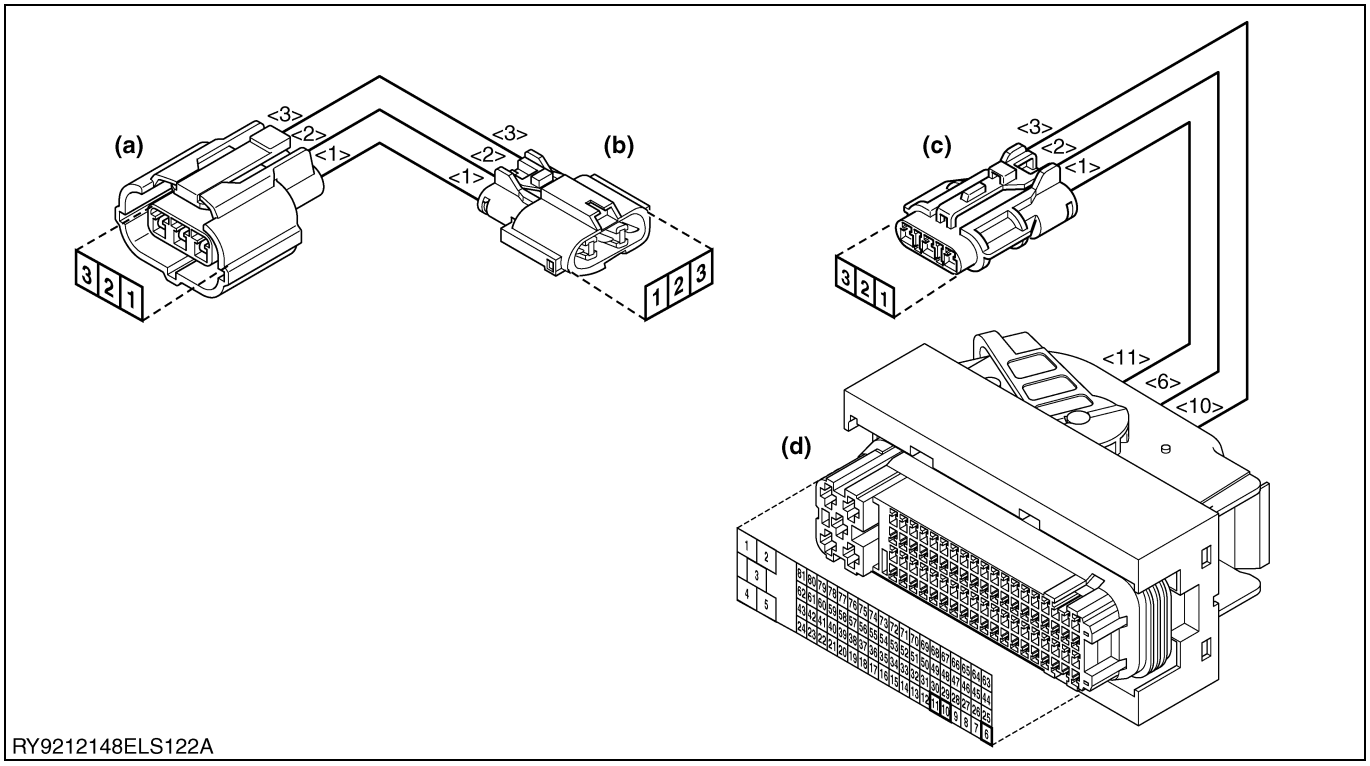
2. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The oil switch wire is pinched against or touching the body. If the insulation is damaged, repair it properly and check the voltage of boom raise end point again in the tester mode.

RY9212148ELS0103US0

[C] Testing with a Circuit Tester



RY9212148ELS122A

(a) Boom Pressure Sensor Connector (b) Relay Connector (Front) (c) Relay Connector (Machine) (d) Main ECU Connector

RY9212148ELS0163US0

1. Voltage check

[Measurement Conditions]

1. Disconnect the boom pressure sensor connector.
2. Key switch: ON
3. Check the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Boom pressure sensor	<1>	Boom pressure sensor	<3>
(2)	Boom pressure sensor	<1>	Body GND	–

Regular: 5 V
Irregular: Large discrepancy from 5 V

RY9212148ELS0164US0

2. Continuity check

[Measurement Conditions]

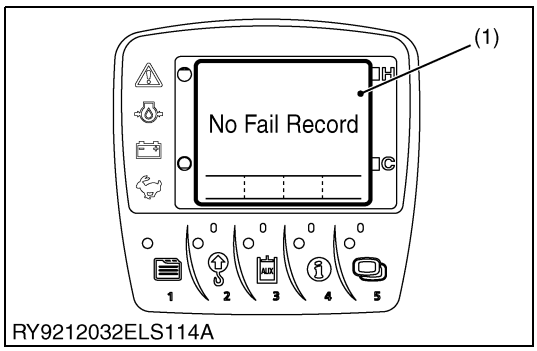
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Boom pressure sensor	<1>	Relay connector (front)	<1>
(2)	Boom pressure sensor	<2>	Relay connector (front)	<2>
(3)	Boom pressure sensor	<3>	Relay connector (front)	<3>
(4)	Relay connector (machine)	<1>	Main ECU	<11>
(5)	Relay connector (machine)	<2>	Main ECU	<6>
(6)	Relay connector (machine)	<3>	Main ECU	<10>

Regular: Continuity
Irregular: No continuity

RY9212148ELS0165US0

[D] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

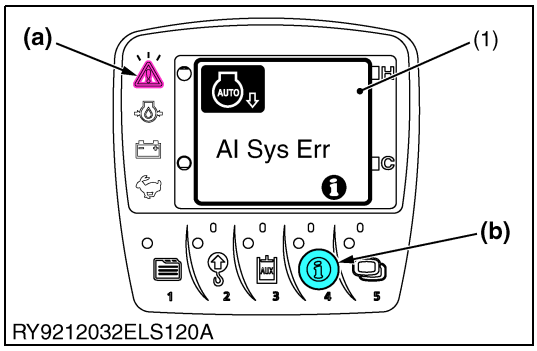
(1) No Fail Record

RY9212148ELS0148US0

[3] AUTO IDLING (AI) SYSTEM

(1) AI System Errors

[A] Checking the Meter Panel



RY9212032ELS120A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

   E.g.) Accelerator sensor

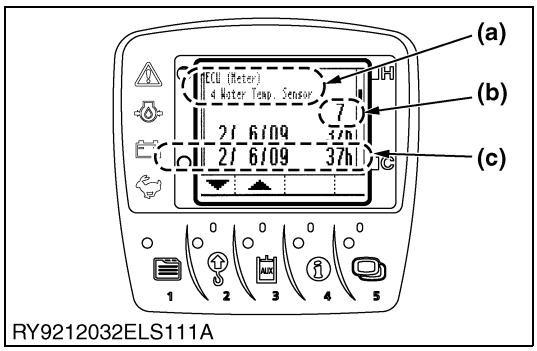
[Reason error screen displayed]

- AI console connector disconnected
- Break or short in harness

(1) AI Sys Err

(a) Warning Lamp
(b) Info Button

RY9212148ELS0104US0



RY9212032ELS111A

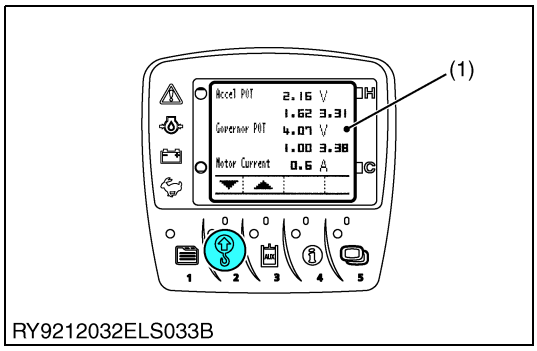
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

   E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0

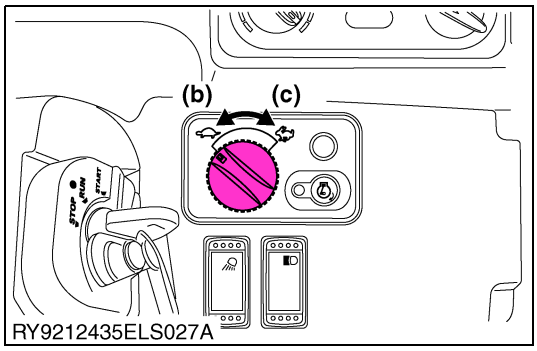


RY9212032ELS033B

3. Tester mode

1. Select the tester mode.
2. Start the engine.
3. Turn the accelerator dial to the right (hi-speed) and to the left (lo-speed) and check the accelerator POT voltage based on the following table.

Design Value	Accelerator POT	Regular	When cut off	When shorted
	Idling	Approx. 1.50 V	0.01 V	Voltage fails to stabilize
	MAX	Approx. 3.30 V	0.01 V	



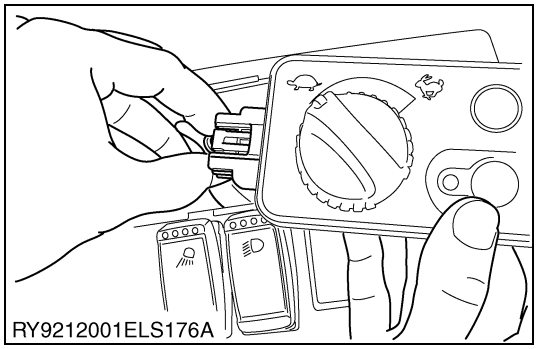
RY9212435ELS027A

(1) Accel POT
Governor POT
Motor Current

(b) Slow
(c) Fast

RY9212435ELS0026US0

[B] Inspecting each device visually and physically



1. Causes when a break in wiring

[Test Conditions]
1. Key switch: OFF
2. AI console connector disconnected.
3. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely, turn the accelerator dial to the right (hi-speed) and the left (lo-speed) and check the voltage of the accelerator sensor again in the tester mode.

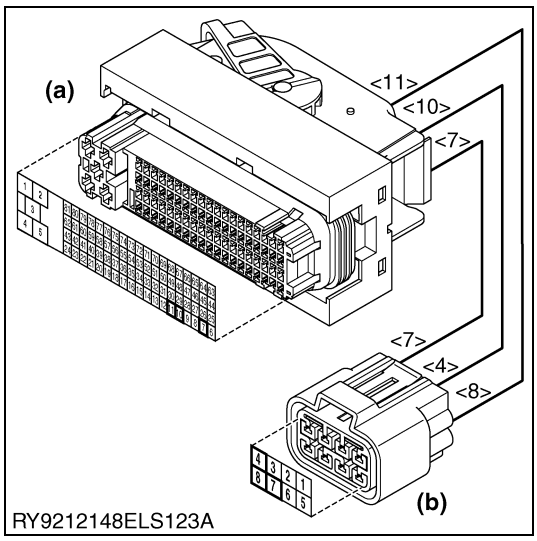
RY9212148ELS0106US0

2. Causes when a short

[Test Conditions]
1. Key switch: OFF
2. The wiring of the AI console connector is pinched against or touching the body.
   If the insulation is damaged, repair it properly, turn the accelerator dial to the right (hi-speed) and the left (lo-speed) and check the voltage of the accelerator sensor again in the tester mode.

RY9212148ELS0107US0

[C] Testing with a Circuit Tester



1. Voltage check

[Measurement Conditions]
1. Disconnect the AI console connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AI console	<8>	Body GND	–

Regular: 5 V
Irregular: Large discrepancy from 5 V

(a) Main ECU Connector **(b) AI console Connector**

RY9212435ELS0059US0

2. Continuity check

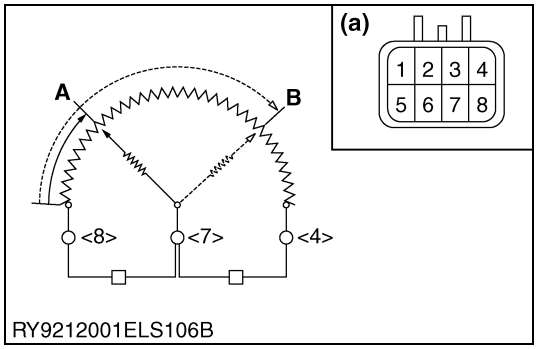
[Measurement Conditions]
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AI console	<7>	Main ECU	<7>
(2)	AI console	<8>	Main ECU	<11>
(3)	AI console	<4>	Main ECU	<10>

Regular: Continuity
Irregular: No continuity

RY9212148ELS0169US0

[D] Testing the Equipment Itself



RY9212001ELS106B

1. Testing the accelerator sensor

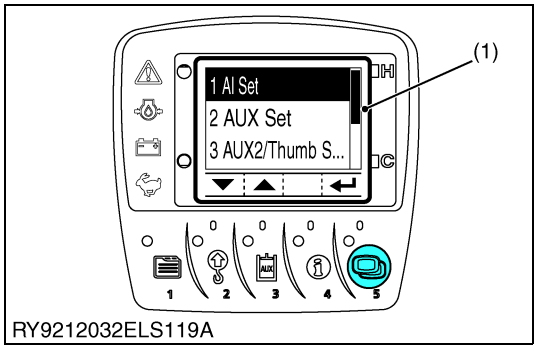
[Measurement Conditions]

1. Key switch: OFF
2. Disconnect the accelerator sensor from the machine and test it separately.

Factory specification	Min.	Max.
Accelerator sensor 4 to 8	1 kΩ ± 10 %	1 kΩ ± 10 %
Accelerator sensor 7 to 8	720 Ω	380 Ω
Accelerator sensor 4 to 7	380 Ω	720 Ω

(a) Accelerator Dial Terminal Numbers

RY9212148ELS0108US0



RY9212032ELS119A

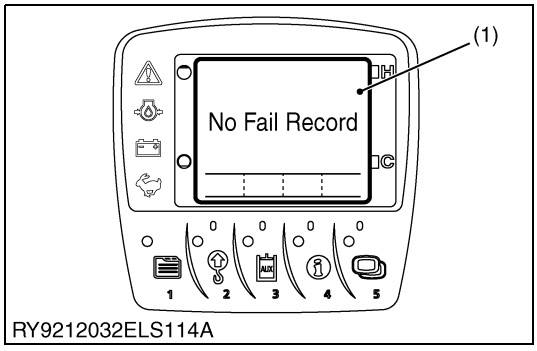
2. Settings after replacing device

1. Make AI settings.

(1) AI Set
AUX Set
AUX2/Thumb Set

RY9212148ELS0109US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

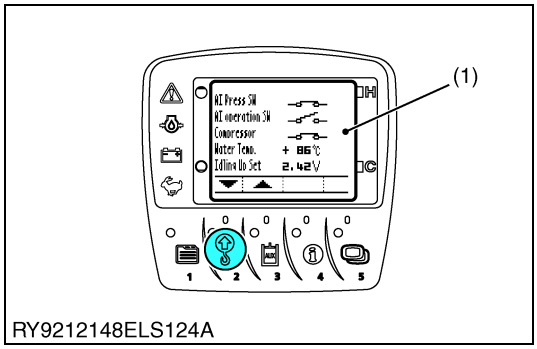
1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

(1) No Fail Record

RY9212148ELS0148US0

(2) Testing the AI Pressure Switch

[A] Checking the Meter Panel



RY9212148ELS124A

1. Tester mode

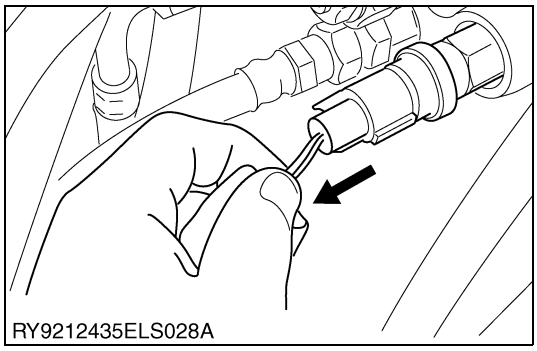
1. Select the tester mode.
2. Start the engine.
3. Check the operation of the AI pressure switch according to the table below.

	Regular	When cut off	When shorted
Operating			
Not operating			

(1) AI Press SW
AI operation SW
Compressor
Water Temp.
Idling Up Set

RY9212148ELS0110US0

[B] Inspecting each device visually and physically


RY9212435ELS028A

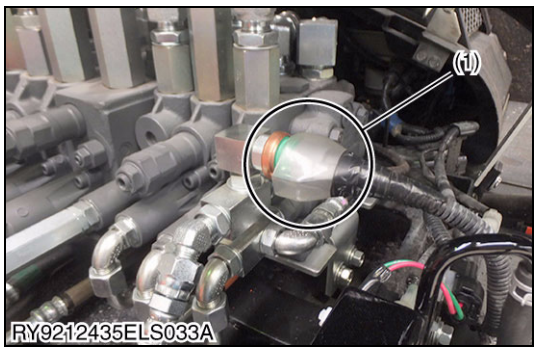
1. Causes when a break in wiring

[Test Conditions]

1. Key switch: OFF
2. The AI pressure switch connector is disconnected.
3. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely and check the operation of the auto-idle switch again in the tester mode.

RY9212435ELS0027US0



RY9212435ELS033A

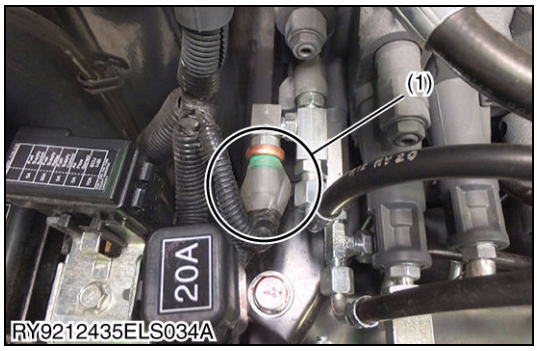
2. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The wire of the auto-idle pressure switch connector is pinched against or touching the body.
   If the insulation is damaged, repair it properly and check the operation of the auto-idle switch again in the tester mode.

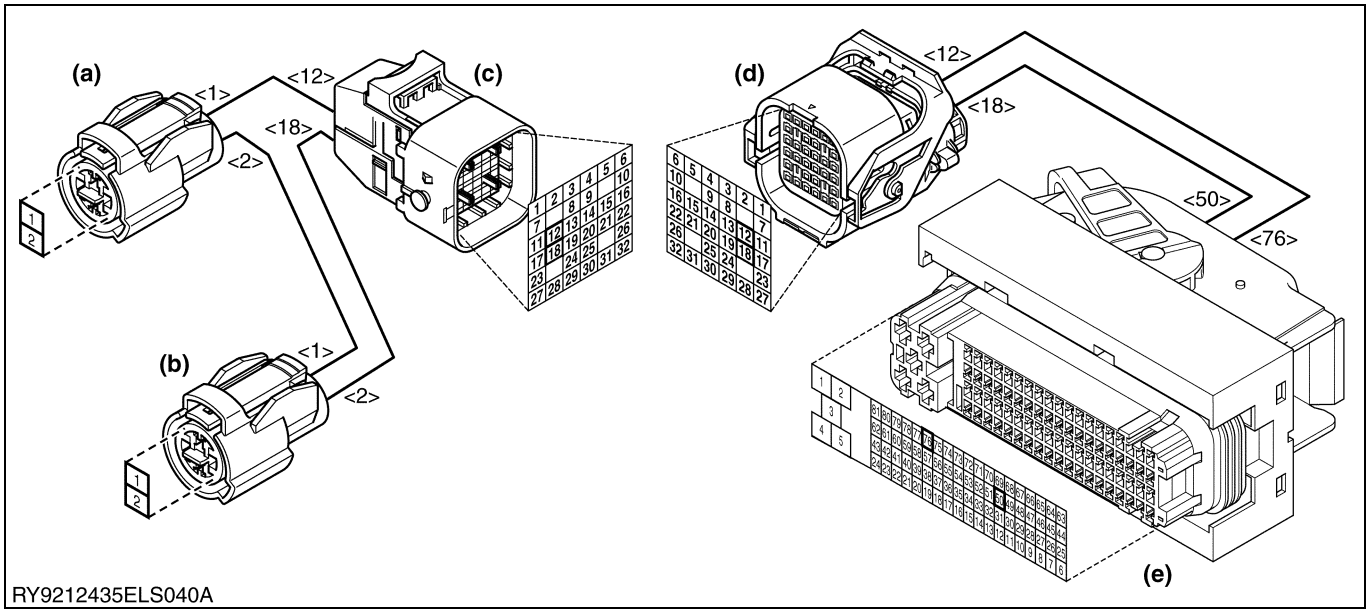
(1) AI Pressure Switch

RY9212435ELS0028US0



RY9212435ELS034A

[C] Testing with a Circuit Tester



(a) AI Pressure Switch Connector 1 **(b) AI Pressure Switch Connector 2** **(c) Main (Signal) Connector** **(d) Engine (Signal) Connector** **(e) Main ECU Connector**

RY9212435ELS0043US0

1. Voltage check

[Measurement Conditions]

1. Disconnect the AI pressure switch connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AI pressure switch	<1>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

RY9212435ELS0060US0

2. Continuity check

[Measurement Conditions]

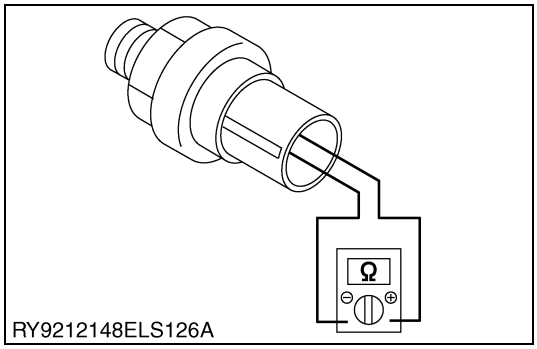
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AI pressure switch 1	<1>	Main (signal)	<12>
(2)	AI pressure switch 1	<2>	AI pressure switch 2	<1>
(3)	AI pressure switch 2	<2>	Main (signal)	<18>
(4)	Engine (signal)	<12>	Main ECU	<76>
(5)	Engine (signal)	<18>	Main ECU	<50>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0051US0

[D] Testing the Equipment Itself



RY9212148ELS126A

1. Testing the AI pressure switch

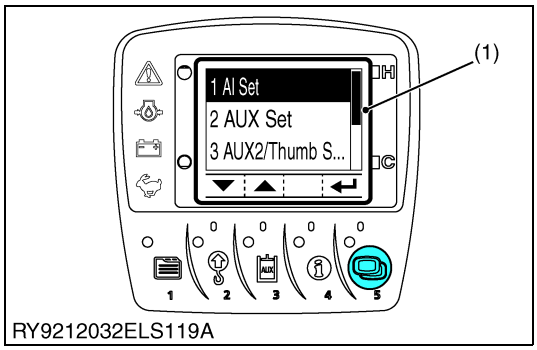
[Test Conditions]

1. Key switch: OFF
2. Disconnect the AI pressure switch connector from the control valve and attach the tester.
3. Start the engine and check continuity when it is operating and when not operating.

   When operating: No continuity
   When not operating: Continuity

   The AI switch is normally closed (normally ON)

RY9212148ELS0173US0



RY9212032ELS119A

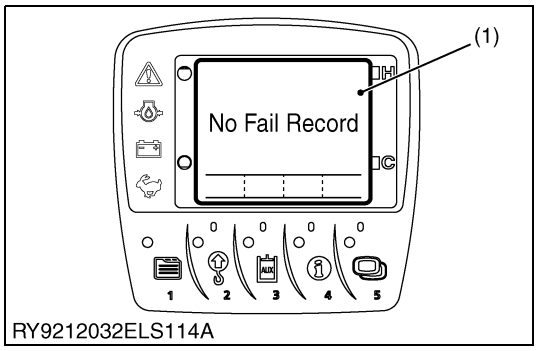
2. Settings after replacing device

1. Make AI settings.

(1) AI Set
AUX Set
AUX2/Thumb Set

RY9212148ELS0205US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

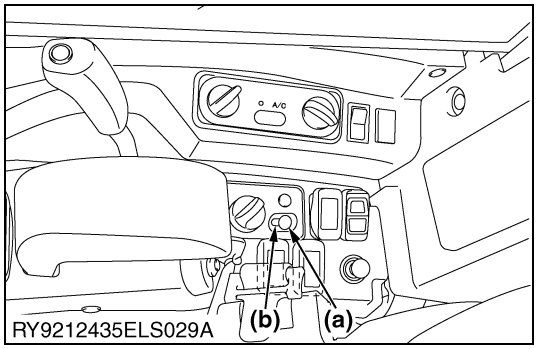
1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

(1) No Fail Record

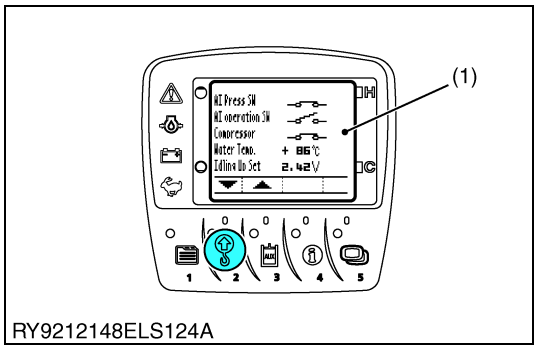
RY9212148ELS0148US0

(3) Testing the AI Switch

[A] Checking the Meter Panel



RY9212435ELS029A



RY9212148ELS124A

1. Information displayed on the meter panel

1. When the AI switch **(a)** on the panel is pressed, check whether the AI lamp **(b)** lights or is off.

   Regular: lamp lights
   Irregular: lamp off

(a) AI Switch **(b) AI Lamp**

RY9212435ELS0029US0

2. Tester mode

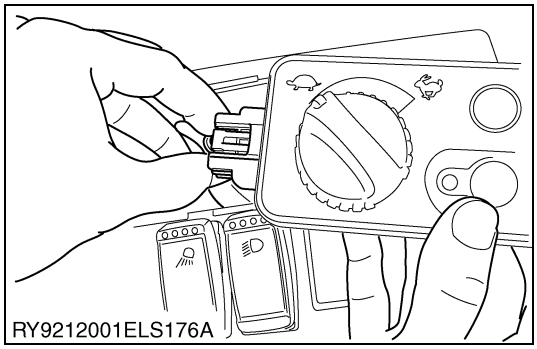
1. Select the tester mode.
2. Check the operation of the AI switch according to the table below.

	Regular	When cut off	When shorted
With AI SW pressed			
With AI SW released			

(1) AI Press SW
AI operation SW
Compressor
Water Temp.
Idling Up Set

RY9212148ELS0114US0

[B] Inspecting each device visually and physically


RY9212001ELS176A

1. Causes when a break in wiring

[Test Conditions]

1. Key switch: OFF
2. AI console connector disconnected.
3. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (pull with a max of 3 kgf (30 N, 7 lbf) of force) If it comes off, plug the connector back in securely and check the operation of the AI switch again in the tester mode.

RY9212148ELS0115US0

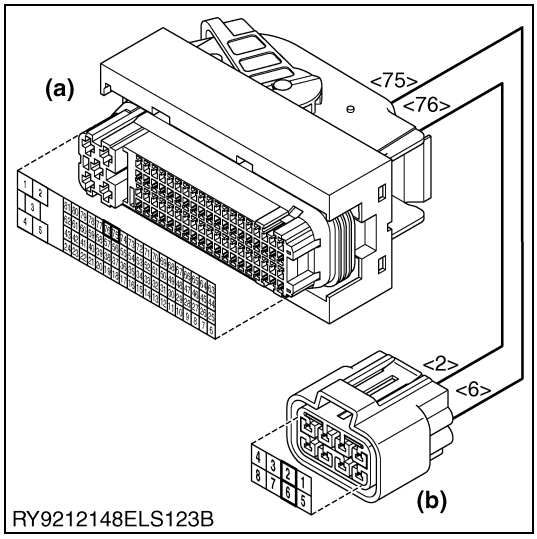
2. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The wiring of the AI console connector is pinched against or touching the body.
   If the insulation is damaged, repair it properly and check the operation of the AI switch again in the tester mode.

RY9212148ELS0116US0

[C] Testing with a Circuit Tester



RY9212148ELS123B

1. Voltage check

[Measurement Conditions]

1. Disconnect the AI console connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AI console	<2>	AI console	<6>
(2)	AI console	<2>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

(a) Main ECU Connector **(b) AI Console Connector**

RY9212148ELS0174US0

2. Continuity check

[Measurement Conditions]

1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AI console	<6>	Main ECU	<75>
(2)	AI console	<2>	Main ECU	<76>

Regular: Continuity
Irregular: No continuity

RY9212148ELS0175US0

[D] Testing the Equipment Itself

RY9212001ELS154A

1. Testing the AI switch

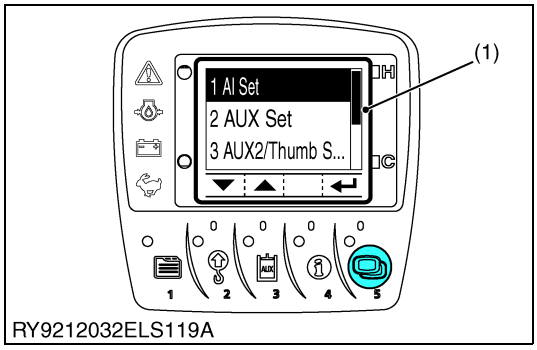
[Measurement Conditions]

1. Key switch: OFF
2. Remove the AI console from the machine and replace with a new AI console.
3. Select the tester mode and check the operation of the AI switch.

Criteria

Regular	AI switch released: no continuity AI switch pressed: continuity
Irregular	Other than above

RY9212148ELS0117US0



RY9212032ELS119A

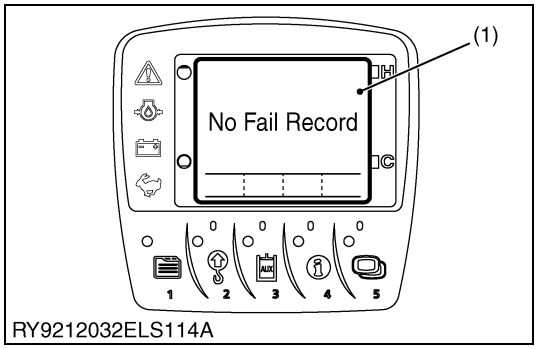
2. Settings after replacing device

1. Make AI settings.

(1) AI Set
AUX Set
AUX2/Thumb Set

RY9212148ELS0118US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

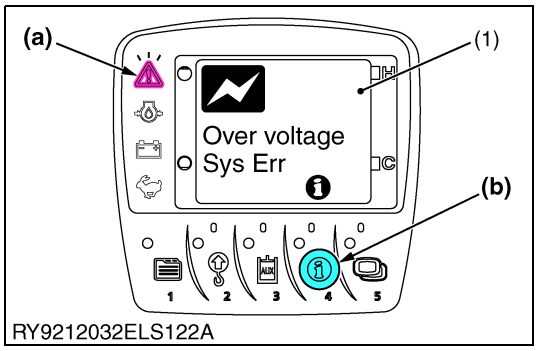
(1) No Fail Record

RY9212148ELS0148US0

[4] POWER SUPPLY SYSTEM

(1) Over Voltage

[A] Checking the Meter Panel



RY9212032ELS122A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

E.g.) Over voltage

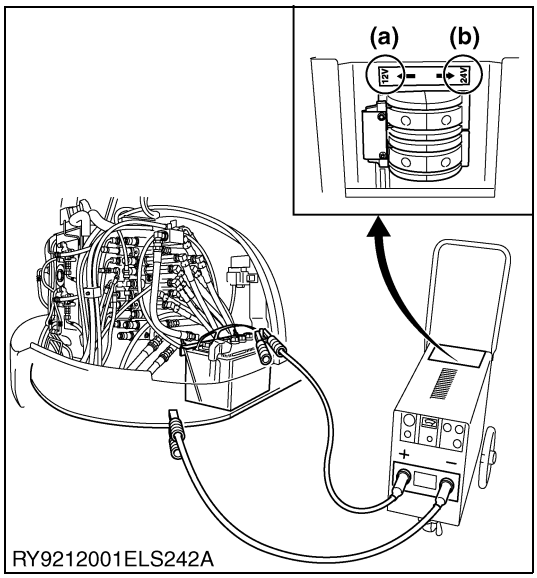
[Reason error screen displayed]

- Activated by 18V+
- Alternator faulty

(1) Over voltage Sys Err

(a) Warning Lamp
(b) Info Button

RY9212148ELS0124US0



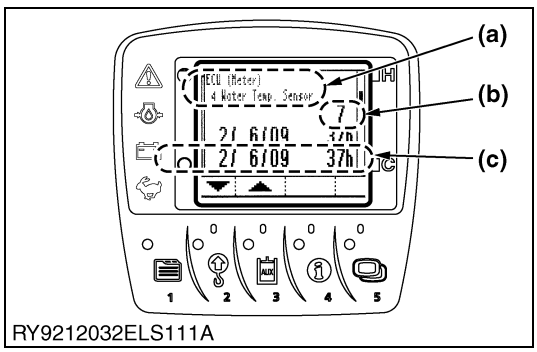
RY9212001ELS242A

Check whether the machine has been jump started with a 24 V battery.

E.g.) Whether switched to 24V

(a) 12 V **(b) 24 V**

RY9212001ELS0207US0



RY9212032ELS111A

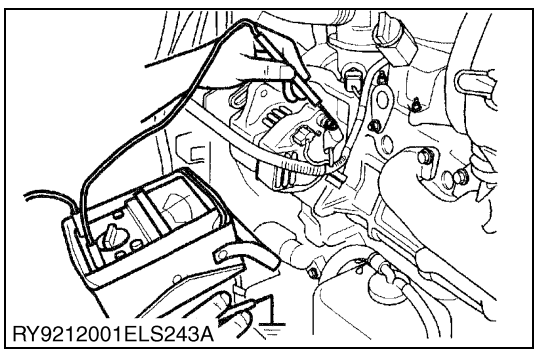
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0

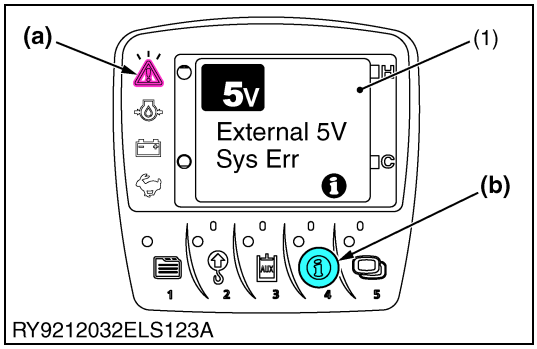

RY9212001ELS243A

An alternator recharging error is also possible.
Refer to the pages on the recharging system errors.

RY9212001ELS0209US0

(2) 5 V Short System Error

[A] Checking the Meter Panel



RY9212032ELS123A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

   E.g.) External 5 V

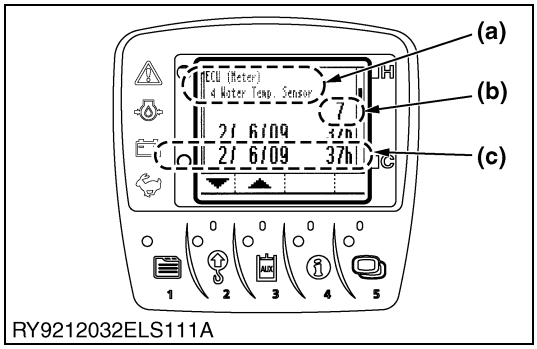
[Reason error screen displayed]

- Short in 5 V line

(1) External 5 V Sys Err

(a) Warning Lamp
(b) Info Button

RY9212148ELS0125US0



RY9212032ELS111A

2. Reading the failure history

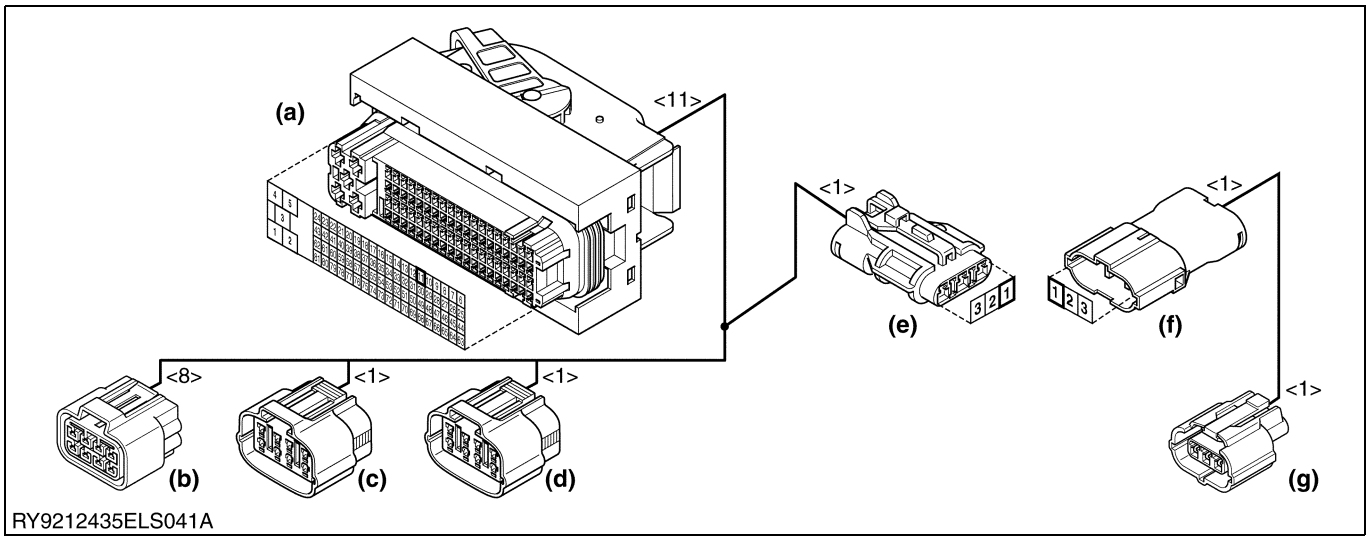
1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

   E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0

Testing the 3.5 V line



RY9212435ELS041A

(a) Main ECU Connector
(b) AI Console Connector
(c) AUX1 Switch Connector
(d) AUX2/Thumb Switch Connector
(e) Front Connector
(f) Main Connector
(g) Boom Pressure Sensor Connector

[Test Conditions]

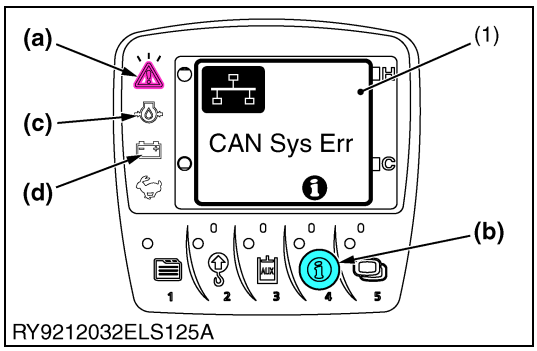
1. Check whether each line is pinched against or touching the body. If the insulation is damaged, repair it properly and check the meter display again.

RY9212435ELS0044US0

[5] COMMUNICATION SYSTEM

(1) CAN Communication Errors

[A] Checking the Meter Panel



RY9212032ELS125A

1. Information displayed on the meter panel

1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

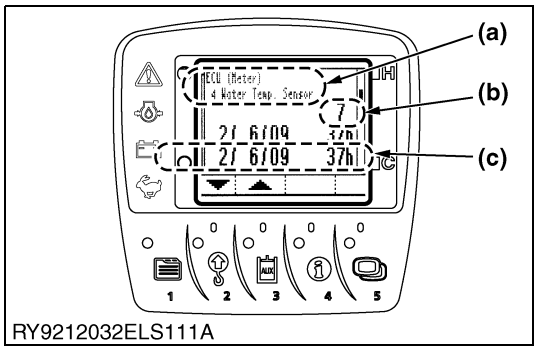
E.g.)
- CAN system (main)
- CAN Sys (Eng)

[Reason error screen displayed]
- ECU connector disconnected
- Fuse blown
- Break or short in harness
- Engine ECU relay faulty

(1) CAN Sys Err

(a) Warning Lamp
(b) Info Button
(c) Oil Lamp
(d) Charging Lamp

RY9212435ELS0030US0



RY9212032ELS111A

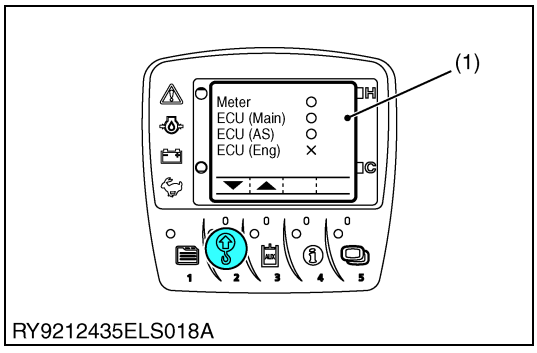
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0



RY9212435ELS018A

3. Tester mode

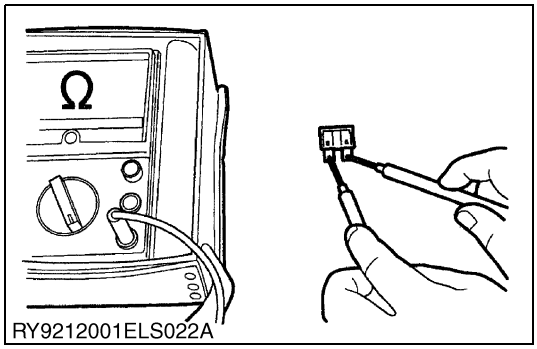
1. Select the tester mode.
2. Confirm the ECU is O.

	Regular	Irregular
ECU (main)	❍	×
ECU (AS)	×	×
ECU (Eng)	❍	×

(1) Meter
ECU (Main)
ECU (AS)
ECU (Eng)

RY9212435ELS0031US0

[B] Inspecting each device visually and physically

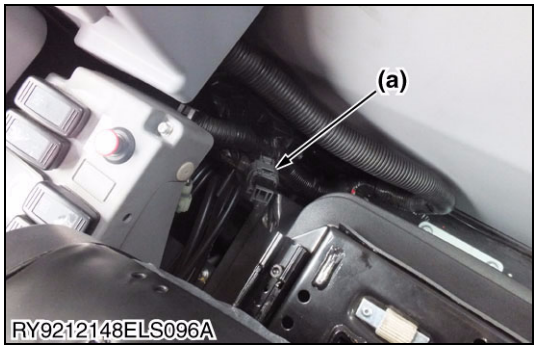


a) If a CAN system (main) error

1. Checking fuses

1. Check if the 10A ECU (+B) fuse is blown.

RY9212148ELS0176US0



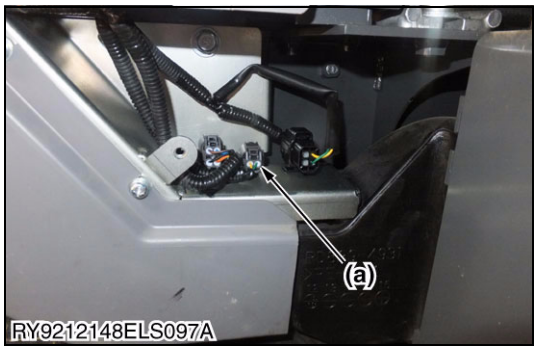
2. Causes when a break in wiring

[Test Conditions]

1. Key switch: OFF
2. Check whether the joint connector is disconnected.
3. Check whether the machine's ECU connector is disconnected.

(a) Joint Connector

RY9212148ELS0177US0



3. Causes when a short

[Test Conditions]

1. Key switch: OFF
2. The CAN connector wire is pinched against or touching the body.
   If the insulation is damaged, repair it properly and check the ECU (main) again in the tester mode.

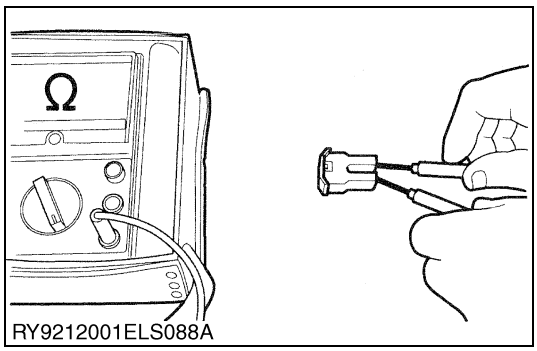
(a) CAN Communication (2 Wires)

RY9212148ELS0129US0

1. Checking fuses

1. Check if the 30A ECU (Eng) slow blow fuse is blown.

RY9212435ELS0032US0

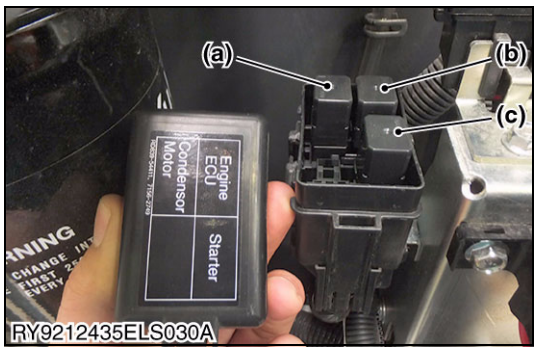


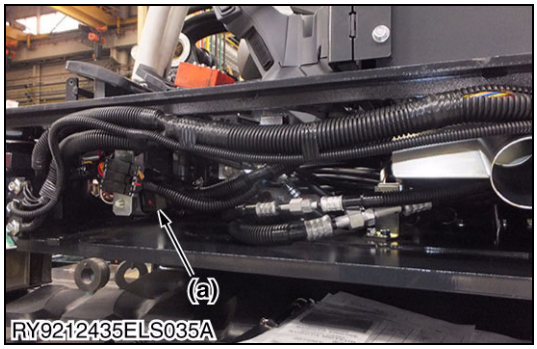
2. Checking relays

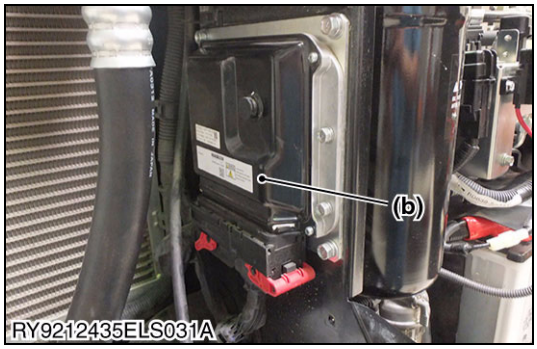
1. Replace the engine ECU and condenser motor relays.
   After replacing them, check for normal operation.

(a) Condenser Motor Relay
(b) Engine ECU Relay
(c) Starter Relay

RY9212435ELS0033US0







3. Causes when a break in wiring

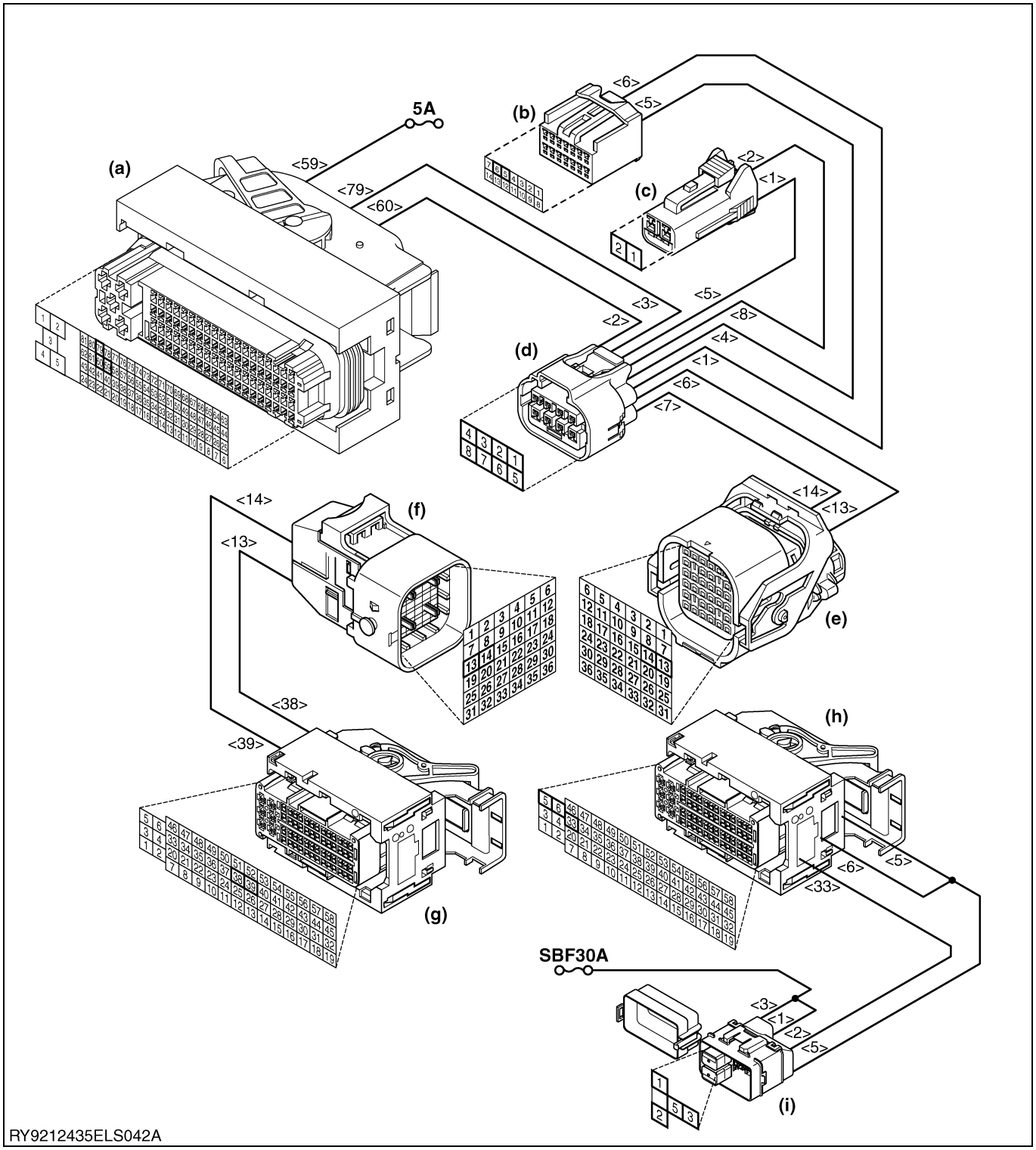
[Test Conditions]

1. Key switch: OFF
2. Check if the relay connector (32 pin) is disconnected.
3. Check whether the engine ECU connector is disconnected.

(a) Relay Connector (32 Pin) **(b) Engine ECU**

RY9212435ELS0034US0

[C] Testing with a Circuit Tester



(a) Main ECU Connector
(b) Meter Panel Connector
(c) CAN Comm Connector
(d) Joint Connector
(e) Engine (Signal) Connector
(f) Main (Signal) Connector
(g) Engine ECU (58 pin) Connector
(h) Engine ECU (58 pin) Connector
(i) Engine Relay

RY9212435ELS0045US0

CAN communication error (main)

1. Voltage check

[Measurement Conditions]

1. Disconnect the ECU connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Main ECU	<59>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

RY9212148ELS0182US0

2. Continuity check

[Measurement Conditions]

1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Main ECU	<60>	Joint connector	<2>
(2)	Main ECU	<79>	Joint connector	<3>
(3)	5 A fuse	–	Main ECU	<59>
(4)	Joint connector	<5>	CAN connector	<1>
(5)	Joint connector	<8>	CAN connector	<2>
(6)	Joint connector	<1>	Meter panel	<6>
(7)	Joint connector	<4>	Meter panel	<5>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0052US0

CAN communication error (CRS)

1. Voltage check

[Measurement Conditions]

1. Disconnect the ECU connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Engine ECU	<5>	Body GND	–
(2)	Engine ECU	<6>	Body GND	–
(3)	Engine ECU	<33>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

RY9212435ELS0061US0

2. Continuity check

[Measurement Conditions]

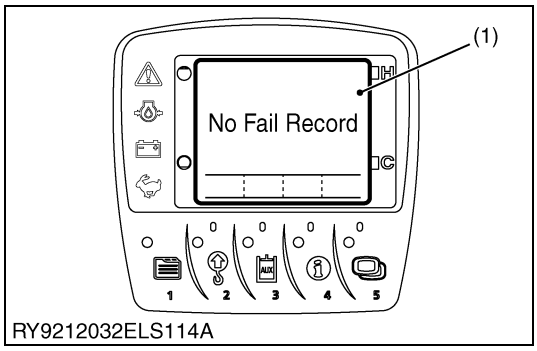
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	SBF (CRS) 30A	–	Engine ECU relay	<1>
(2)	SBF (CRS) 30A	–	Engine ECU relay	<3>
(3)	Engine ECU relay	<5>	Engine ECU	<5>
(4)	Engine ECU relay	<5>	Engine ECU	<6>
(5)	Engine ECU relay	<2>	Engine ECU	<33>
(6)	Joint connector	<6>	Engine (signal)	<13>
(7)	Joint connector	<7>	Engine (signal)	<14>
(8)	Main (signal)	<13>	Engine ECU	<38>
(9)	Main (signal)	<14>	Engine ECU	<39>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0062US0

[D] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

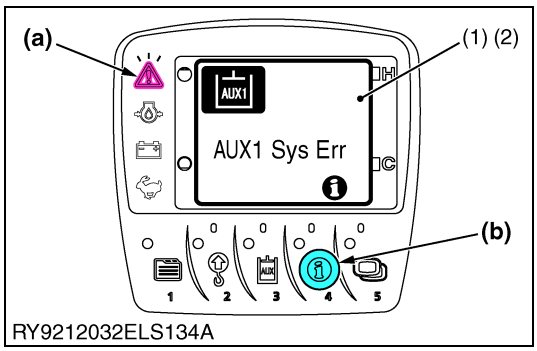
(1) No Fail Record

RY9212148ELS0148US0

[6] AUX SYSTEM

(1) AUX1 / AUX2 (Thumb) System Errors

[A] Checking the Meter Panel



RY9212032ELS134A

1. Information displayed on the meter panel

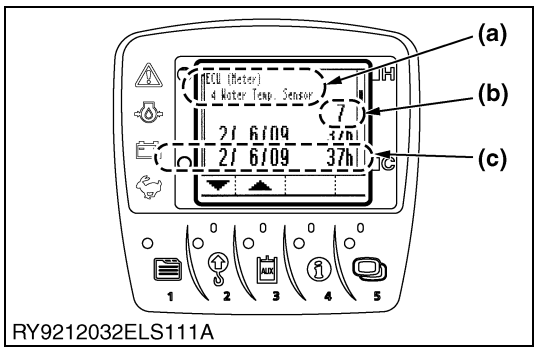
1. Check whether or not the warning lamp **(a)** on the panel is blinking red.
2. Press the info button **(b)** and check the additional content.

E.g.)
- AUX1/AUX2 (thumb) knob
- AUX1/AUX2 (thumb) RH SOL
- AUX1/AUX2 (thumb) LH SOL

[Reason error screen displayed]
- AUX1/AUX2 (thumb) control lever connector disconnected
- AUX1/AUX2 (thumb) solenoid connector disconnected
- Break or short in harness

(1) AUX1 Sys Err
(2) AUX2 Sys Err
(a) Warning Lamp
(b) Info Lamp

RY9212148ELS0130US0



RY9212032ELS111A

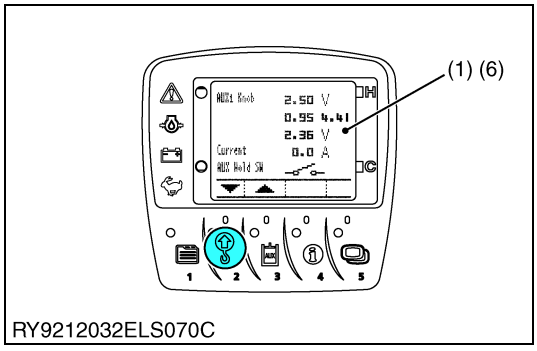
2. Reading the failure history

1. Select the failure history read mode.
2. Read the failure history and check the date (y/m/d) and hour meter of the last occurrence.

E.g.) The last failure record was February 6, 2009 at 37 hours.

(a) Failure
(b) Number of Failure
(c) The Last Breakdown Date (y/m/d) and Hour Meter.

RY9212032ELS0001US0



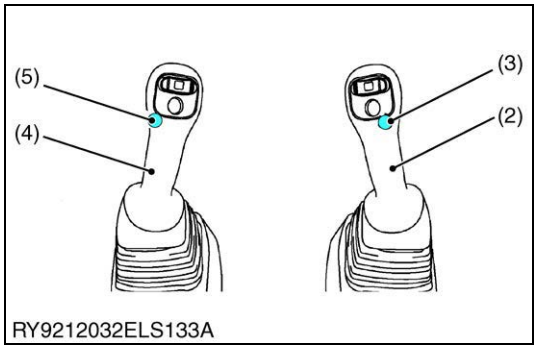
RY9212032ELS070C

3. Tester mode

1. Select the tester mode.
2. Start the engine.
3. Measure the voltage of AUX switch based on the table below.

	Indicated value	Set value (e.g.)			At stop
		LH (small)	RH (large)	Center (medium)	
AUX1 knob switch	0.25 to 4.75 V	0.95 V	4.41 V	2.36 V	0 V
AUX2 / Thumb knob switch	0.25 to 4.75 V	0.77 V	4.21 V	2.59 V	0 V
Output current	0.5 to 2.0 A				0 to 0.2 A

	Regular	When cut off	When shorted
Press the AUX one way hold SW			
Release the AUX one way hold SW			

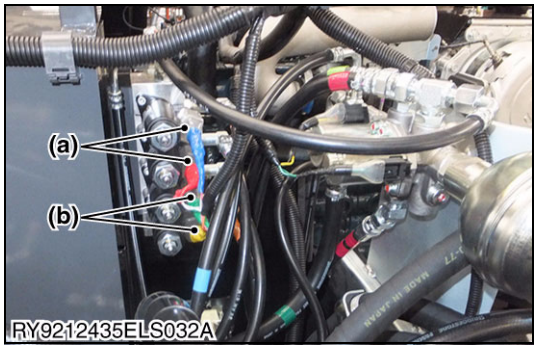


RY9212032ELS133A

(1) AUX1 Knob
Current
AUX Hold SW
(2) Control Lever (RH)
(3) AUX One Way Hold SW
(4) Control Lever (LH)
(5) AUX One Way Hold SW
(6) AUX2 / Thumb knob
Current
AUX Hold SW

RY9212148ELS0131US0

[B] Inspecting each device visually and physically



1. Causes when a break in wiring

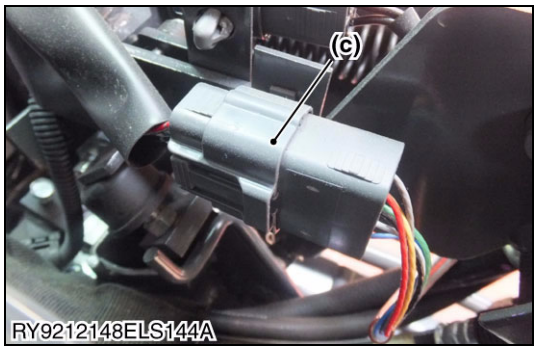
[Test Conditions]

1. Key switch: OFF
2. AUX1/AUX2 solenoid connector disconnected.
3. AUX control lever connector disconnected.
4. There is a break somewhere in the wiring.

Pull on the harness and make sure the connector/harness does not come off. (Pull with a max of 3 kgf of force) If it comes off, plug the connector back in securely and check the AUX1 and 2 solenoids in the tester mode.

(a) AUX1 SOL **(b) AUX2 SOL**

RY9212435ELS0035US0



2. Causes when a short

[Test Conditions]

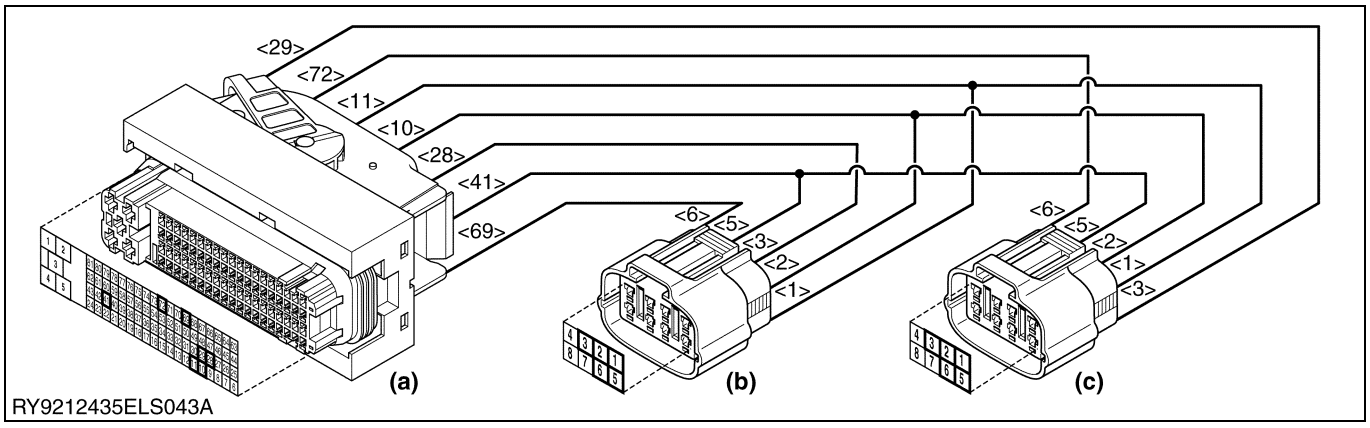
1. Key switch: OFF
2. The AUX1, AUX2 solenoid connector and/or AUX control lever connector wiring is pinched and touching the body, or if the insulation is damaged, repair it properly and check the AUX solenoids again in the tester mode.

(c) AUX control lever connector

RY9212148ELS0133US0

[C] Testing with a Circuit Tester

Switch side



(a) Main ECU Connector **(b) Right Control Lever Connector** **(c) Left Control Lever Connector**

RY9212435ELS0046US0

1. Voltage check (AUX hold switch)

[Measurement Conditions]

1. Disconnect the AUX1/AUX2 control lever connector.
2. Key switch: ON
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Right control lever	<5>	Body GND	–
(2)	Left control lever	<5>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

RY9212435ELS0063US0

2. Voltage check (AUX1/AUX2 switch)

[Measurement Conditions]

1. Disconnect the AUX1/AUX2 control lever connector.
2. Key switch: ON
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Right control lever	<1>	Body GND	–
(2)	Left control lever	<1>	Body GND	–

Regular: 5 V
Irregular: Large discrepancy from 5 V

RY9212435ELS0064US0

3. Continuity check (AUX hold switch)

[Measurement Conditions]

1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Main ECU	<41>	Right control lever	<5>
(2)	Right control lever	<6>	Main ECU	<69>
(3)	Main ECU	<41>	Left control lever	<5>
(4)	Left control lever	<6>	Main ECU	<72>

Regular: Continuity
Irregular: No continuity

RY9212148ELS0189US0

4. Continuity check (AUX1/AUX2 switch)

[Measurement Conditions]

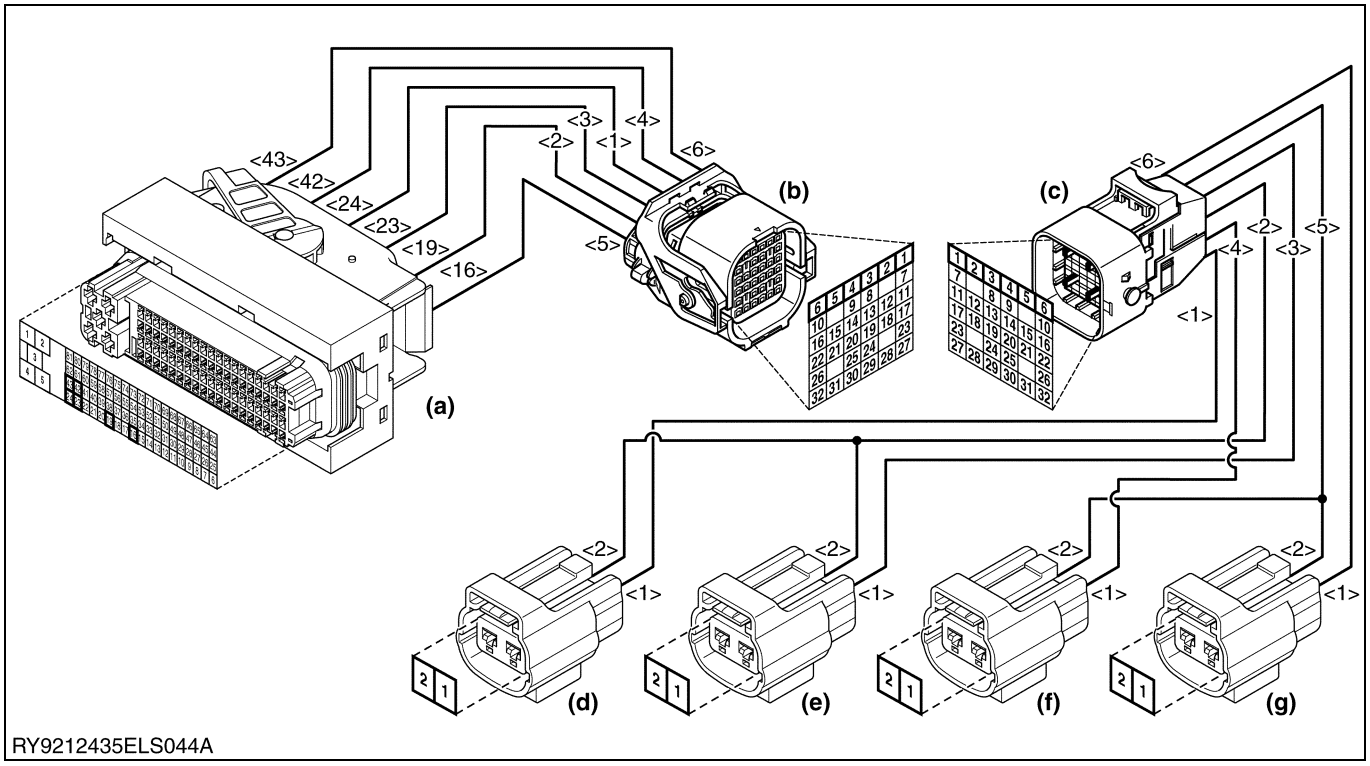
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	Right control lever	<3>	Main ECU	<28>
(2)	Right control lever	<1>	Main ECU	<11>
(3)	Right control lever	<2>	Main ECU	<10>
(4)	Left control lever	<3>	Main ECU	<29>
(5)	Left control lever	<1>	Main ECU	<11>
(6)	Left control lever	<2>	Main ECU	<10>

Regular: Continuity
Irregular: No continuity

RY9212148ELS0190US0

Solenoid side



(a) Main ECU Connector
(b) Engine (Signal) Connector
(c) Main (Signal) Connector
(d) AUX1 (R) Solenoid Connector
(e) AUX1 (L) Solenoid Connector
(f) AUX2 (R) Solenoid Connector
(g) AUX2 (L) Solenoid Connector

RY9212435ELS0054US0

1. Continuity check (AUX1 solenoid)

[Measurement Conditions]

1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AUX1 (right) solenoid	<1>	Main (signal)	<1>
(2)	AUX1 (right) solenoid	<2>	Main (signal)	<2>
(3)	AUX1 (left) solenoid	<1>	Main (signal)	<3>
(4)	AUX1 (left) solenoid	<2>	Main (signal)	<2>
(5)	Main ECU	<24>	Engine (signal)	<1>
(6)	Main ECU	<23>	Engine (signal)	<3>
(7)	Main ECU	<19>	Engine (signal)	<2>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0065US0

2. Continuity check (AUX2 solenoid)

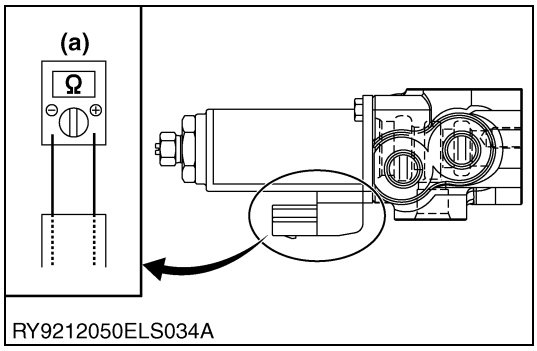
[Measurement Conditions]
1. Key switch: OFF
2. Disconnect the connector to be tested.
3. Test the continuity based on the table below.

Mea-sure-ment	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(1)	AUX2 (right) solenoid	<1>	Main (signal)	<4>
(2)	AUX2 (right) solenoid	<2>	Main (signal)	<5>
(3)	AUX2 (left) solenoid	<1>	Main (signal)	<6>
(4)	AUX2 (left) solenoid	<2>	Main (signal)	<5>
(5)	Main ECU	<42>	Engine (signal)	<4>
(6)	Main ECU	<43>	Engine (signal)	<6>
(7)	Main ECU	<16>	Engine (signal)	<5>

Regular: Continuity
Irregular: No continuity

RY9212435ELS0066US0

[D] Testing the Equipment Itself



RY9212050ELS034A

1. Testing the AUX1 / AUX2 solenoid

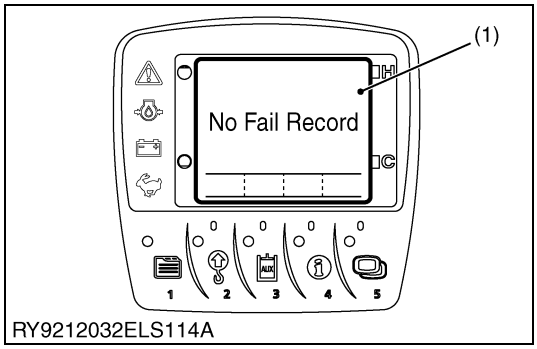
[Test Conditions]
1. Key switch: OFF
2. Disconnect AUX1 / AUX2 solenoid connector from the machine and test the solenoid separately.

AUX1 / AUX2 solenoid	Factory specification	3.2 ± 0.5 Ω (at 20 °C, 68 °F)

(a) AUX1 / AUX2 Solenoid Terminals

RY9212148ELS0134US0

[E] Steps to Take after Completing Repairs



RY9212032ELS114A

1. Delete failure record

1. While in the service/dealer mode, select Delete Fail Record and delete the record.
2. After deleting the record, start the engine again and check to make sure the warning is not shown on the meter panel.

(1) No Fail Record

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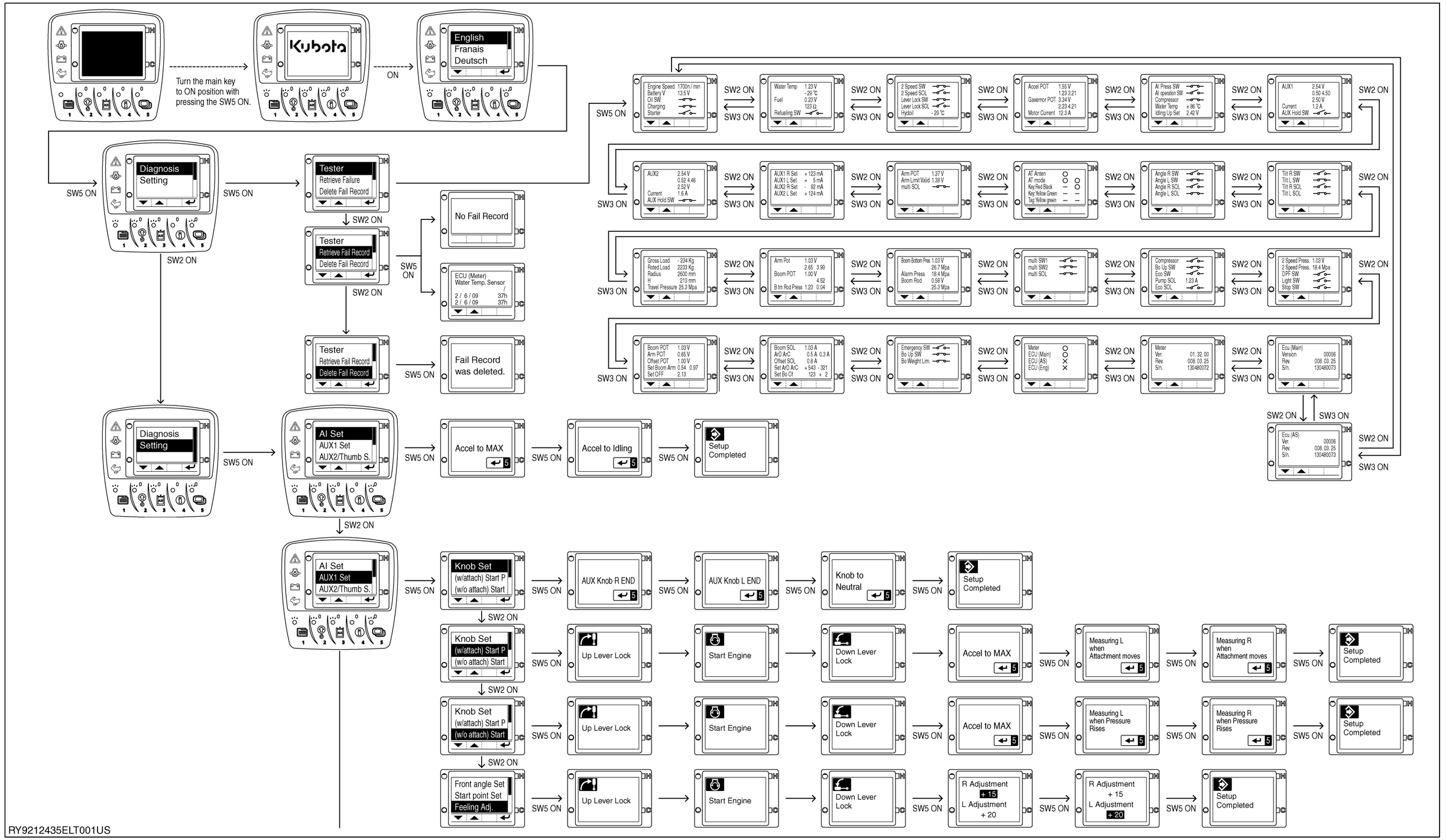
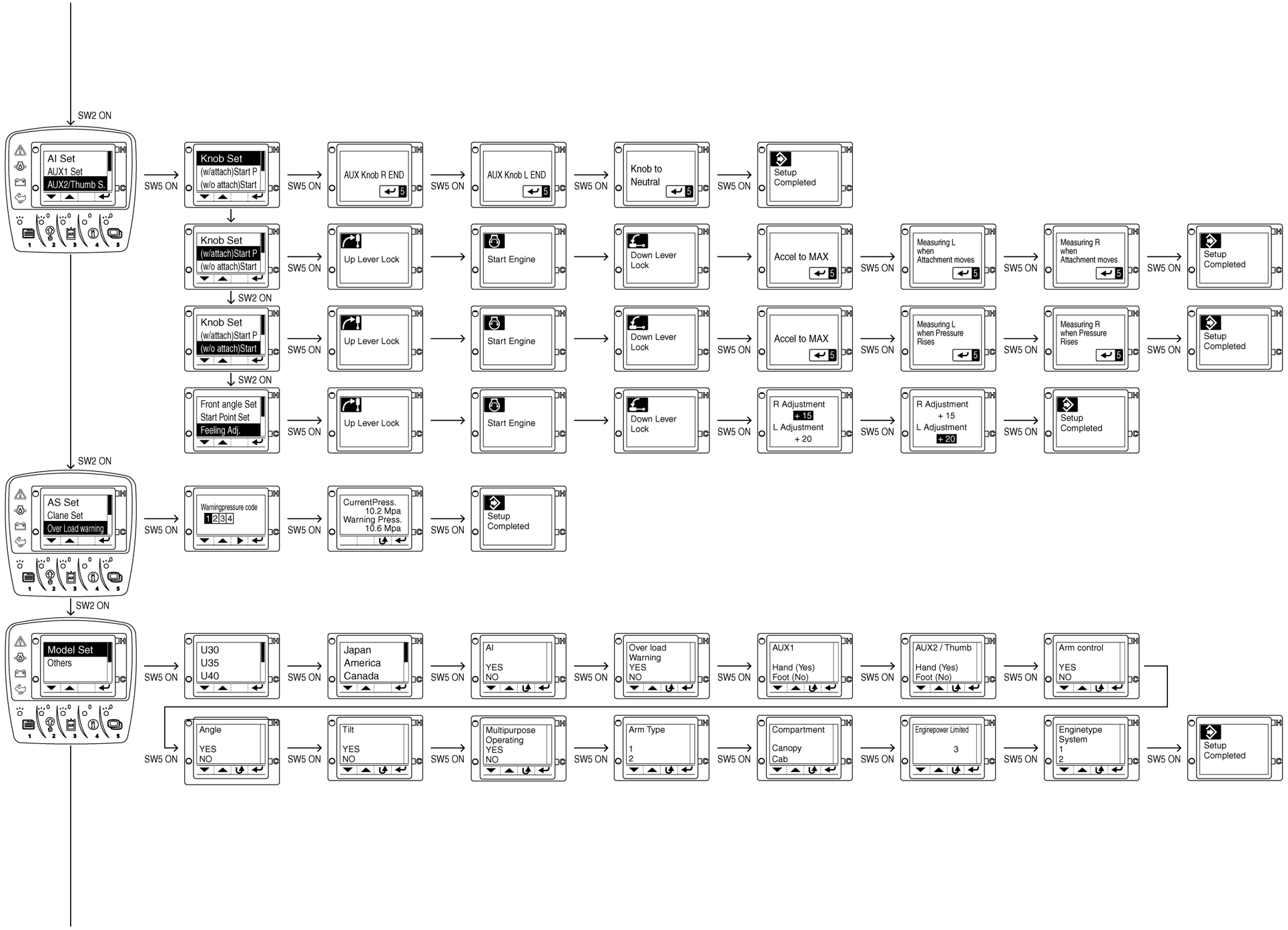
7. DEALER SETTING MODE FLOWCHART





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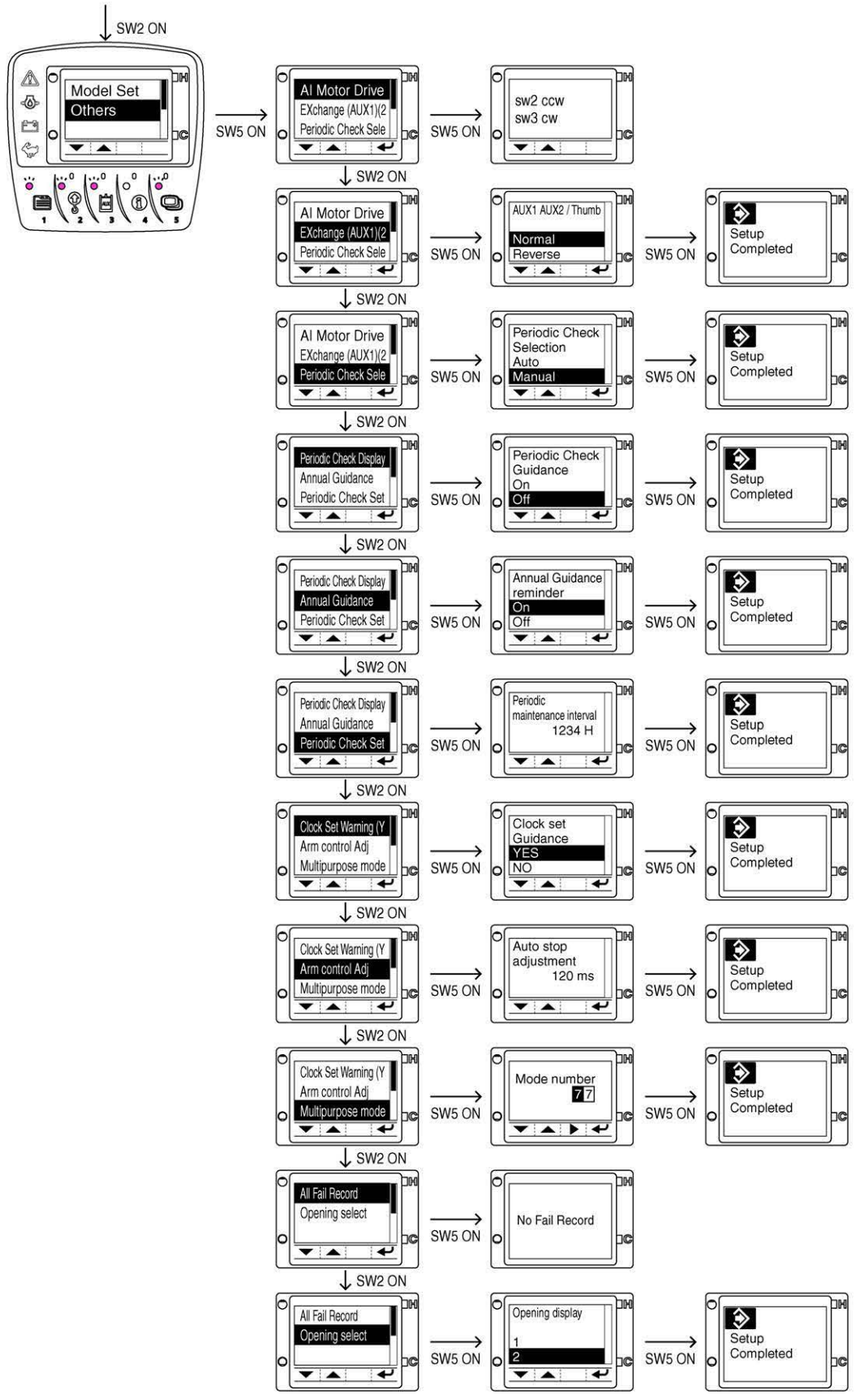

RY9212435ELT003US

5 CABIN

MECHANISM

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   [1] WIPER SWITCH 5-M17
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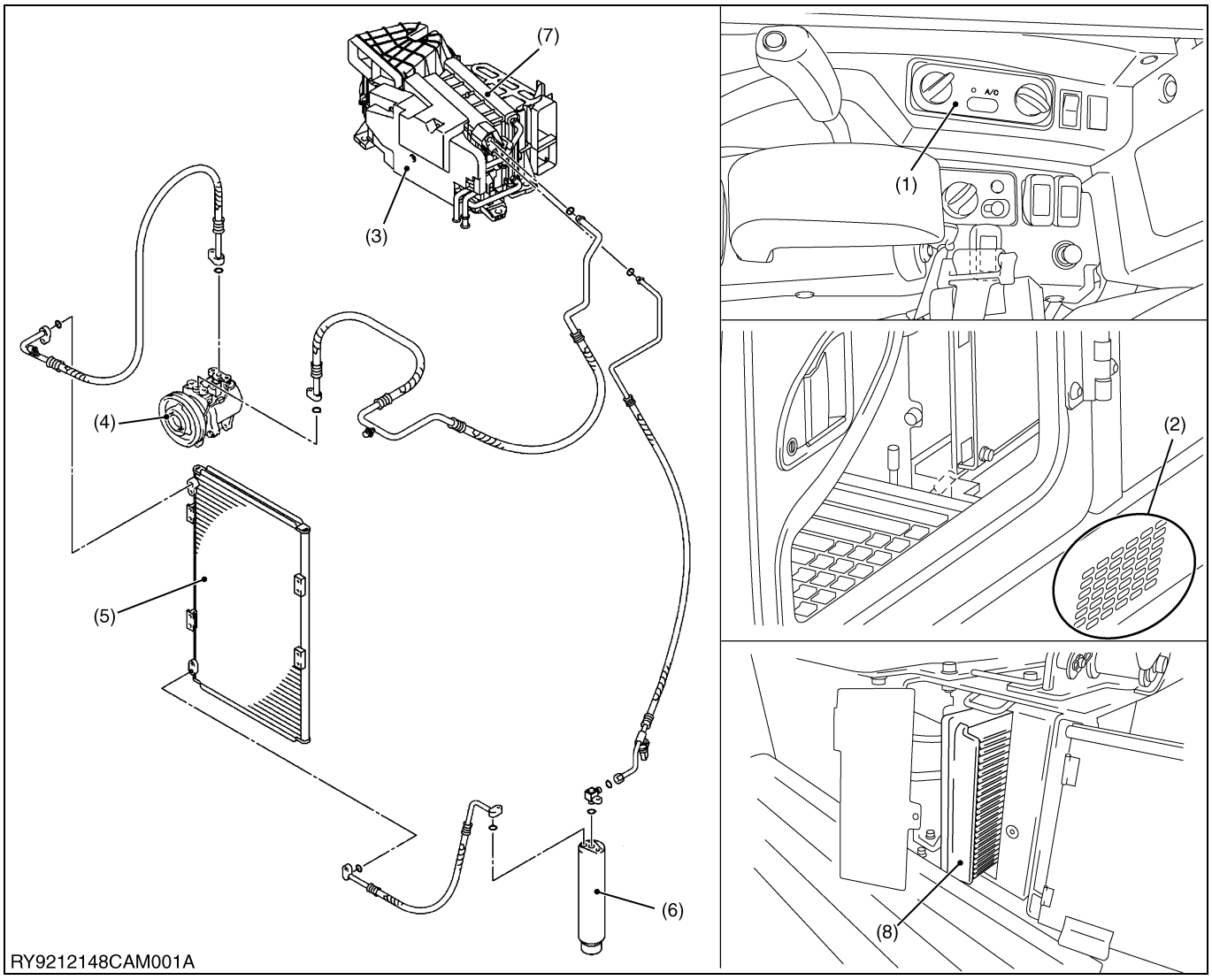
1. AIR CONDITIONING SYSTEM

[1] STRUCTURE



(1) Control panel
(2) External air intake
(3) A/C Unit
(4) Compressor
(5) Condenser
(6) Receiver
(7) Heater core
(8) A/C filter

The cabin is equipped with a high-capacity, low-profile air conditioner that can circulate cabin air or bring in fresh air from outside. Cabin air and outside air are directed through the A/C filter to the A/C unit. The cabin or outside air that is sucked into the A/C unit is cooled and dehumidified by the cooler of the A/C unit. When the system is used for heating, the air is heated by the heater core and then expelled from the air vents. The air vents can be opened and closed and the direction of the airflow can be adjusted.

Cooling capacity	Factory specification	3.3 kW ± 10 %
Heating capacity		4.1 kW ± 10 %
Type of refrigerant (charge capacity)		R134a 980 g 2.16 lbs
Pressure sensor (low)		0.196 MPa 2.0 kgf/cm^2 28.4 psi
Pressure sensor (high)		3.14 MPa 32.0 kgf/cm^2 455 psi

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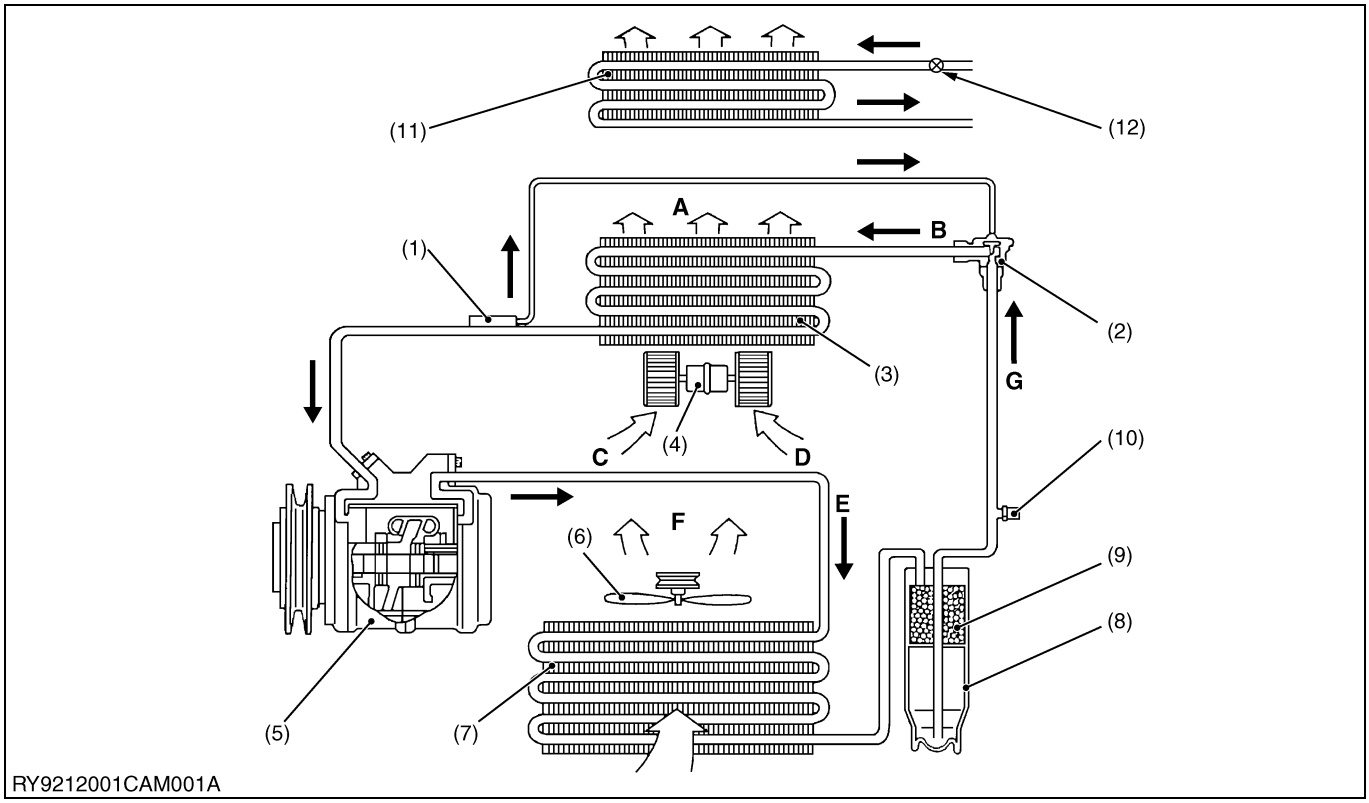
[2] HOW THE MECHANISMS OF THE SYSTEM WORK



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(1) Capillary Tube (Heat Sensitive Capillary Tube)
(2) Expansion Valve
(3) Evaporator
(4) Blower Motor
(5) Compressor
(6) Engine Cooling Fan
(7) Condenser
(8) Receiver
(9) Dryer
(10) Pressure Switch
(11) Heater Core
(12) Hot Water Valve

A : Cooled Air
B : Low Pressure and Temperature Vapor
C, D : Air Passes Through In / Outside Air Filter
E : High Pressure/Temperature Gas
F : Hot Air
G : Liquid

This air conditioning system works as follows.

1. Refrigerant passes through the evaporator (3), is vaporized and then is compressed by the compressor (5) to approximately 1.47 MPa (15 kgf/cm^2, 210 psi) and raised to a temperature of approximately 70 °C (158 °F) the refrigerant is then sent in this state to the condenser (7).
2. The vaporized refrigerant passes through the condenser (7), where it is cooled down to approximately 50 °C (122 °F) and the refrigerant changes back from a vapor to a liquid; it is then sent on to the receiver (8).
   Then the heat from inside the cabin that is captured by the condenser (7) is released outside the cabin.
3. The liquid refrigerant collects in the receiver (8) and any moisture is removed from the refrigerant by the dryer (9).
4. The liquid refrigerant then passes on to the expansion valve (2), where it is sprayed through the small holes in the valve into the evaporator (3), which produces a mist of the refrigerant; its pressure and temperature drop and the refrigerant evaporates.
5. The refrigerant simultaneously captures heat from the surface of the evaporator's (3) pipes and evaporates vigorously at 0 °C (32 °F).
6. As this happens, warm air from inside the cabin is drawn into the evaporator (3) by the blower motor (4) and the refrigerant captures the heat and evaporates. In this way the air in the cabin is cooled.
   [NOTE]
   - Because the warm air inside the cabin is cooled quickly, the moisture in the air condenses. In other words, the air in the cabin can be dehumidified.
7. The refrigerant vaporized in the evaporator (3) is returned to the compressor (5) and compressed, changing it back into a liquid. In doing so, the refrigerant is put under high pressure and temperature.
8. The air that passed through the evaporator (3) can be adjusted to the desired temperature by then passing it through the heater core (11). Engine coolant is heated by the engine and the amount of the coolant that flows into the heater core (11) is controlled by the hot water valve (12), and this adjusts the temperature of the air that flows through the heater core (11).

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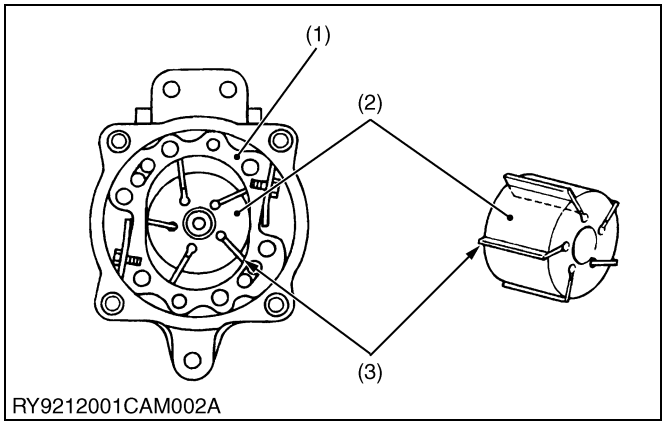
[3] COMPRESSOR



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The vane type of compressor installed in this system is composed of a cylinder (1) that is elliptical in cross-section, along with five vanes (3) attached to the rotor (2). This vane compressor has two each of intake and discharge ports.

The five vanes (3) are attached to the rotor (2) and as it rotates, the tips of the vanes come in contact with the walls of the cylinder (1) and an airtight compression space is maintained both by the centrifugal force exerted by the rotor (2) along with the back pressure on the vanes (3), which is in proportion to the rpms of the rotor (2).

As a result, the volume changes in each of the five segments of the cylinder, which are divided by the five vanes (3) in the cylinder (1).

Each time that the rotor (2) rotates, each of the five segments of the cylinder goes through two cycles of intake, compression and discharge.

(1) Cylinder
(2) Rotor
(3) Vane

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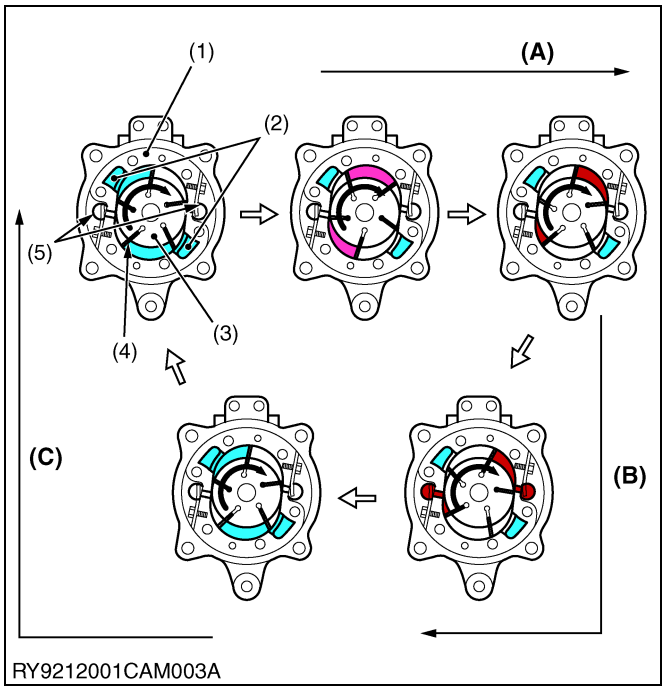

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How it Works

As the rotor (3) turns, the volume of space in a segment, as divided by the cylinder (1) and vanes (4), increases, sucking refrigerant gas from the intake port (2) into the cylinder space.

As the rotor (3) turns further, the volume of the space created between the cylinder (1) and vanes (4) decreases, compressing the refrigerant gas. As the rotor (3) continues to turn, the refrigerant gas is compressed further, putting it under a great deal of pressure, pressing on the discharge valve and opening it. The refrigerant gas is then expelled via the discharge port (5).

(1) Cylinder
(2) Intake Port
(3) Rotor
(4) Vane
(5) Discharge Port
(A) Compression Cycle
(B) Discharge Cycle
(C) Intake Cycle

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Compressor Oil

The compressor oil is dissolved in the refrigerant and circulates throughout the entire cooling system acting as the lubricating oil for the compressor. However, because the previously used R12 compressor oil does not dissolve in R134a, it does not circulate through the cooling cycle. So it drastically reduces the working life of the compressor.

As a result, it is imperative that the right compressor oil is always used. The mineral oil that is used in an R12 cooling system cannot be used in an R134a cooling system. A synthetic PAG oil has to be used in an R134a cooling system. This oil mixes extremely well with refrigerant gas and provides the entire system with the optimum lubrication.

Volume of Oil	Product Name
110 to 120 cc 0.116 to 0.127 U.S.qts 0.098 to 0.106 Imp.qts	ND–OIL8 <PAG* oil>

*PAG : Polyalkylene glycol (synthetic oil)

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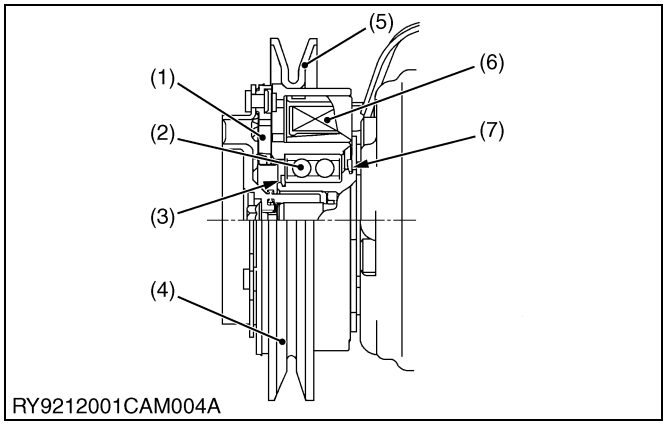

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Magnetic Clutch

A magnetic clutch is a device that governs the mechanical linkage between the engine and the compressor. When the engine is rotating and the A/C switch is on, air at cabin temperature comes out and when the temperature reaches the temperature set with the temperature control switch, or when the cabin gets hot, the clutch works to stop or to drive the compressor, respectively.

The hub of the magnetic clutch is attached to the compressor shaft and when it is not driving the compressor, it is separate from the rotor and just the pulley turns. When the A/C switch is turned on, current flows into the stator coil, making the stator into a magnet, which then holds onto the hub and the pulley turns along with the compressor.

(1) Pressure Plate
(2) Ball Bearing
(3) Snap Ring
(4) Pulley
(5) Rotor w/ Pulley
(6) Stator
(7) Snap Ring

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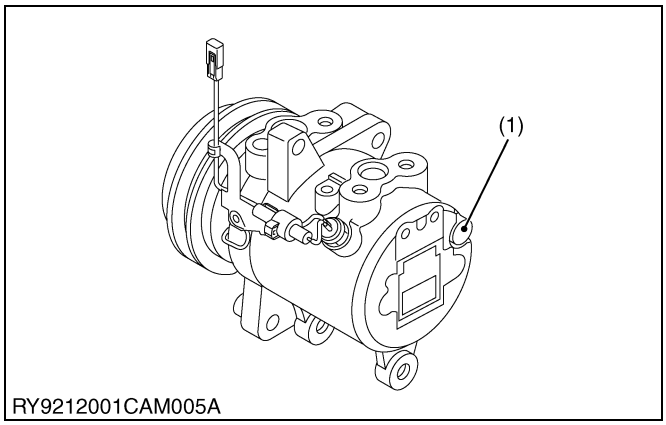

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B. Safety Valve

The valve opens when the refrigerant pressure reaches the specified pressure, thus relieving the pressure. When the pressure becomes abnormally high, it overcomes the force of the spring, allowing refrigerant to leak out of the relief port; when the pressure drops the reverse happens--the spring overcomes the pressure and the safety valve closes. When an error occurs, this also keeps the discharge of refrigerant to a minimum.

(1) Safety Valve

(A) Refrigerant Leak Route
(B) Functional Characteristics
(C) Amount of Refrigerant Leaked
(D) Pressure

a : 113 L/min. (27.2 U.S.gals./min., 24.86 Imp.gals./min.)
b : 2.75 MPa (28.1 kgf/cm^2, 399.7 psi)
c : 3.43 MPa (35.0 kgf/cm^2, 497.8 psi)
d : 4.12 MPa (42.0 kgf/cm^2, 598.0 psi)

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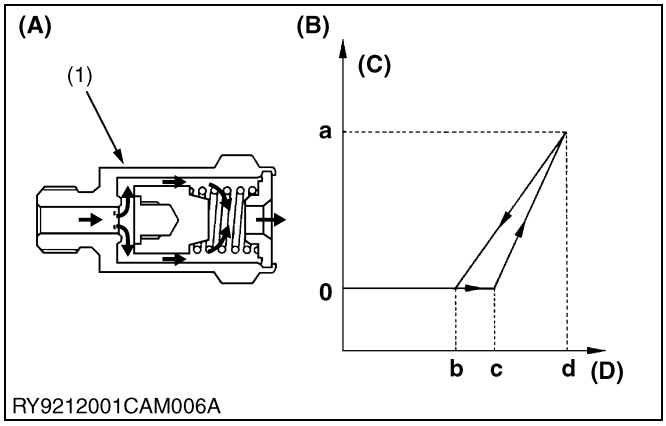

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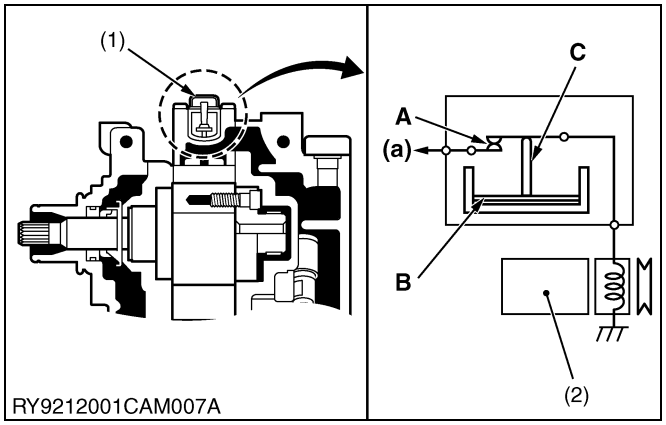

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Temperature Sensor

A temperature sensor is installed on the head of the vane type of compressor. This sensor detects the temperature of the refrigerant and when the refrigerant becomes unusually hot, it cuts off the magnetic clutch, stopping the compressor. The temperature sensor is composed of a bimetallic strip and contacts. A bimetallic strip is a sandwich of two metals with different rates of expansion and it bends when heated due to these different rates of expansion. This characteristic is exploited when there is an excessive temperature via the rod, which breaks the contact and switches the magnetic clutch off.

Operating Ranges	OFF	153 to 163 °C 307 to 325 °F
	ON	120 ± 5 °C 248 ± 41 °F

Tightening torque	Temperature Sensor	11.8 ± 1.47 N·m 1.2 ± 0.15 kg·fm 8.7 ± 1.08 lbf·ft

(1) Temperature Sensor
(2) Compressor

A : Contact
B : Bimetallic Strip
C : Rod

(a) To battery + Terminal

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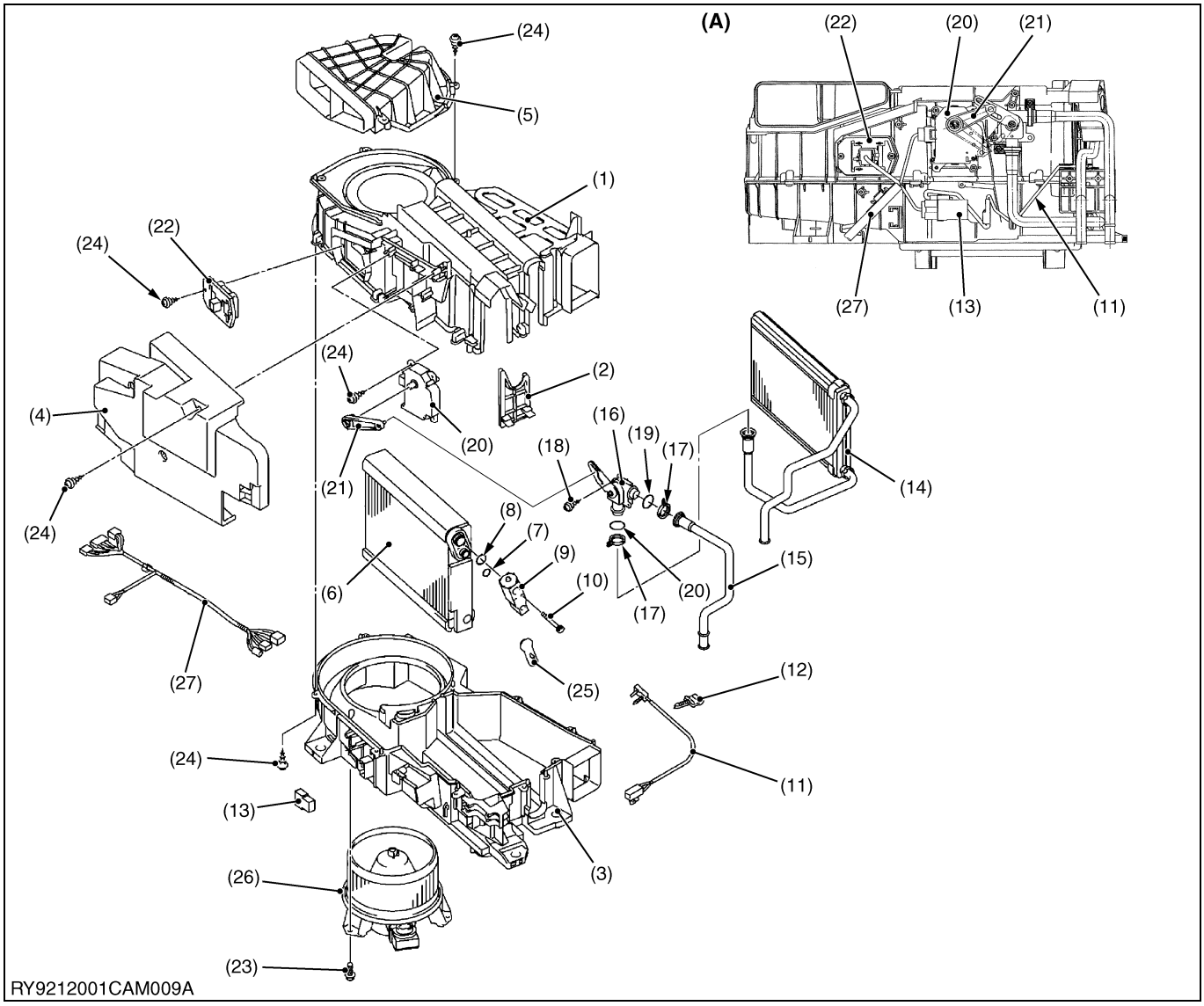
[4] AIR CONDITIONING UNIT



(A) Diagram of Linkages and Electrical Parts

The diagram above was created for general explanations of the air conditioning unit, so it may differ from the air conditioning unit installed in the machine covered by this workshop manual. Similarly, this does not guarantee the parts used inside the air conditioning unit are the same.

The air conditioning unit is composed of an evaporator, an expansion valve, a heater core, a blower, etc.

No.	Name of part	No.	Name of part	No.	Name of part
(1)	Upper case	(10)	Bolt	(19)	O-Ring
(2)	Side cover	(11)	Fin thermistor	(20)	Servo motor
(3)	Lower case	(12)	Clamp	(21)	Linkage lever
(4)	Linkage cover	(13)	A/C Amp	(22)	Blower resistor
(5)	Intake cover	(14)	Heater core	(23)	Self-tapping screw
(6)	Evaporator	(15)	Pipe	(24)	Self-tapping screw
(7)	O-Ring	(16)	Hot water valve	(25)	Cap
(8)	O-Ring	(17)	Pipe clip	(26)	Blower motor
(9)	Expansion valve	(18)	Screw	(27)	Wire harness

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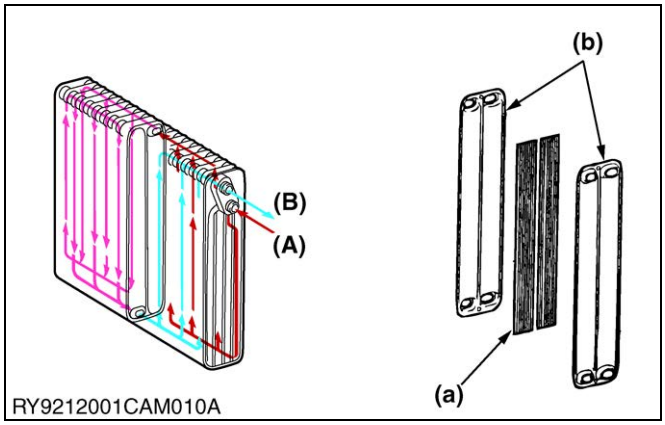

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Evaporator

The evaporator takes the refrigerant, which has been made liquid by the condenser and cooled and put under low-pressure by the expansion valve, and by evaporating it, the heat and humidity of the air passing through the evaporator is removed, thus producing cool, dehumidified air.

(a) Fins
(b) Tubes
(A) Inlet
(B) Outlet

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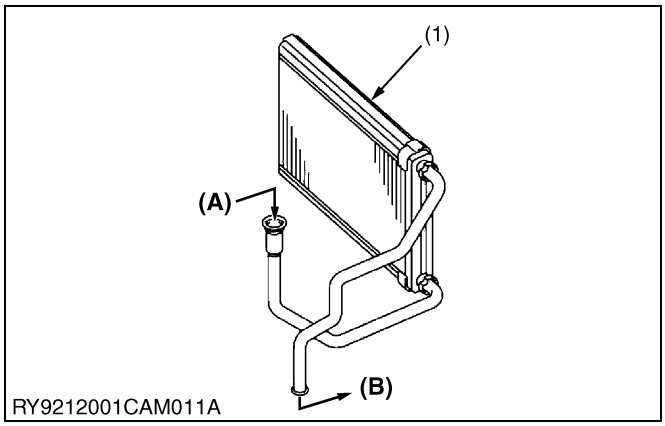

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Heater Core

The heater core dissipates the heat of the heated engine coolant. So, the air that is blown through it by the blower motor passes through the fins of the heater core and the air takes on the heat of the coolant.

(1) Heater Core

(A) Inlet
(B) Outlet

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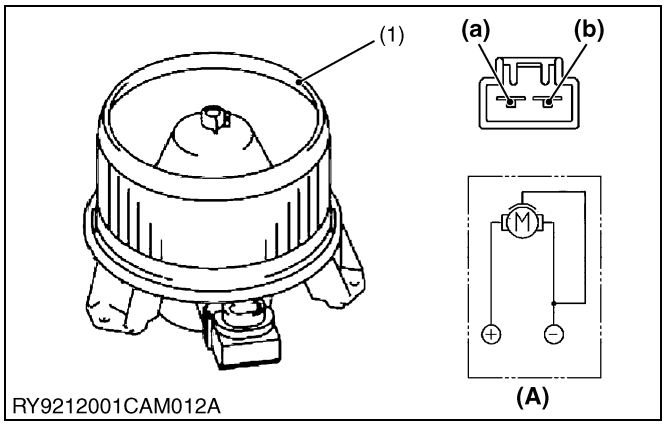

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Blower

The blower is built into the right side of the A/C unit. The blower forces cool, warm or fresh outside air through the vents into the cabin.

The rpm of the blower motor can be adjusted to three levels with the blower resistor. The blower fan is the type that uses centrifugal force and it sucks in air parallel to its axis of rotation and blows it out perpendicular to the centrifugal force, or in other words, perpendicular to the axis of rotation.

Specifications (at 20 °C)	
Model	DC Ferrite
Rated Voltage	12 V
No load RPM	4300 ± 400 rpm
No load amperage	1 to 3 A
Direction of rotation (viewed from drive side)	Left
Rated load torque	461 N·m, 47.0 kgf·m, 340 lbf·ft
RPM	2800 ± 280 rpm
Amperage	18.3 ± 1.8A

(1) Blower

(A) Circuit Diagram
(a) (+) Terminal
(b) (-) Terminal

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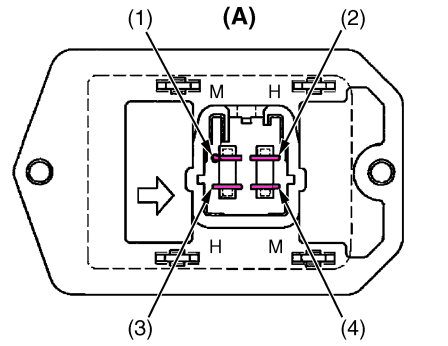

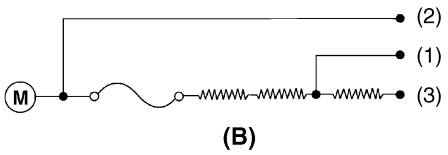

(B)

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Blower resistor

Acts as the blower switch and controls the rpm of the blower motor by switching the degree of resistance. The fan speed can be switched to three levels, 1, 2 and 3, with 3 being the fastest.

(1) MI
(2) HI
(3) LO
(4) Blank

(A) Blower Resistor
(B) Wiring Diagram

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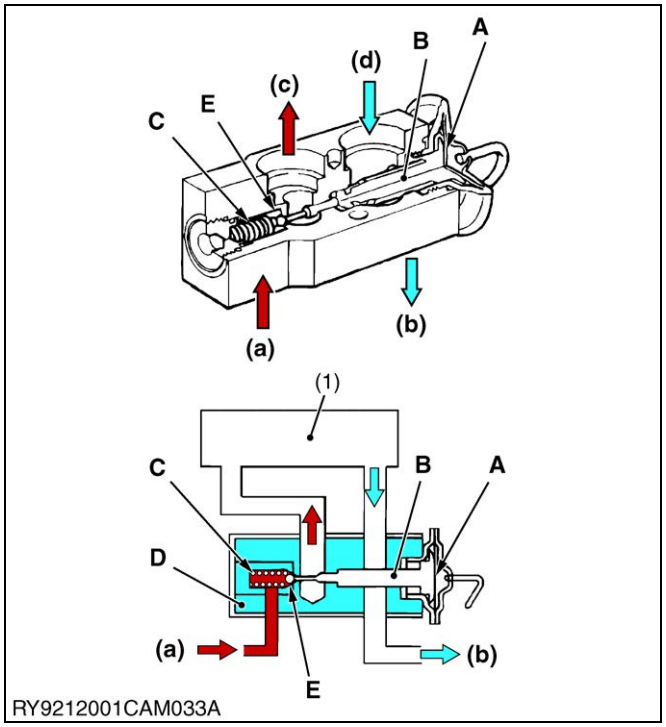

Expansion Valve

[Functions]

The expansion valve works in the following two ways.

1. By spraying the liquid refrigerant, which is hot and under high pressure, it makes it expand rapidly, producing a low-temp, low-pressure refrigerant vapor.
2. It adjusts the amount of refrigerant according to the vaporized state of the refrigerant in the evaporator. In order to take full advantage of the capabilities of the evaporator, a state must always be maintained in which the liquid refrigerant takes on the ambient heat, then it is completely vaporized at the outlet of the evaporator. In order to do so, the expansion valve automatically adjusts the volume of refrigerant in response to changes in the cabin temperature (cooling load) and changes in the compressor RPM.

[Structure (box type)]

- The expansion valve is composed of a diaphragm, heat-sensing rod, and a needle valve (ball) and the refrigerant gas is enclosed upstream of the diaphragm. The downstream side of the diaphragm is pressurized by the evaporator outlet pressure.

[How it Works]

- The heat-sensitive rod senses the temperature of the refrigerant passing to the evaporator and the temperature at that point is communicated to the refrigerant gas on the upstream side of the diaphragm via the heat-sensitive rod. As such, the pressure of the gas varies with the temperature, thus moving the heat-sensitive rod directly connected to the diaphragm and adjusting the opening of the needle valve.

Evaporator outlet temperature	Operation
When low (when cooling load is low)	The pressure of the gas in the diaphragm chamber drops, reducing the volume and moving the heat-sensitive rod to the right, which constricts the needle valve and reduces the flow of refrigerant to the evaporator.
When high (when cooling load is high)	The pressure of the gas in the diaphragm chamber rises, increasing the volume and moving the heat-sensitive rod to the left, which opens the needle valve and supplies more refrigerant to the evaporator.

(1) Evaporator

A : Diaphragm
B : Heat-Sensitive Rod
C : Spring
D : Body
E : Needle Valve
(a) From Receiver (Hi-Pressure)
(b) To Compressor (Lo-Pressure)
(c) To Evaporator
(d) From Evaporator

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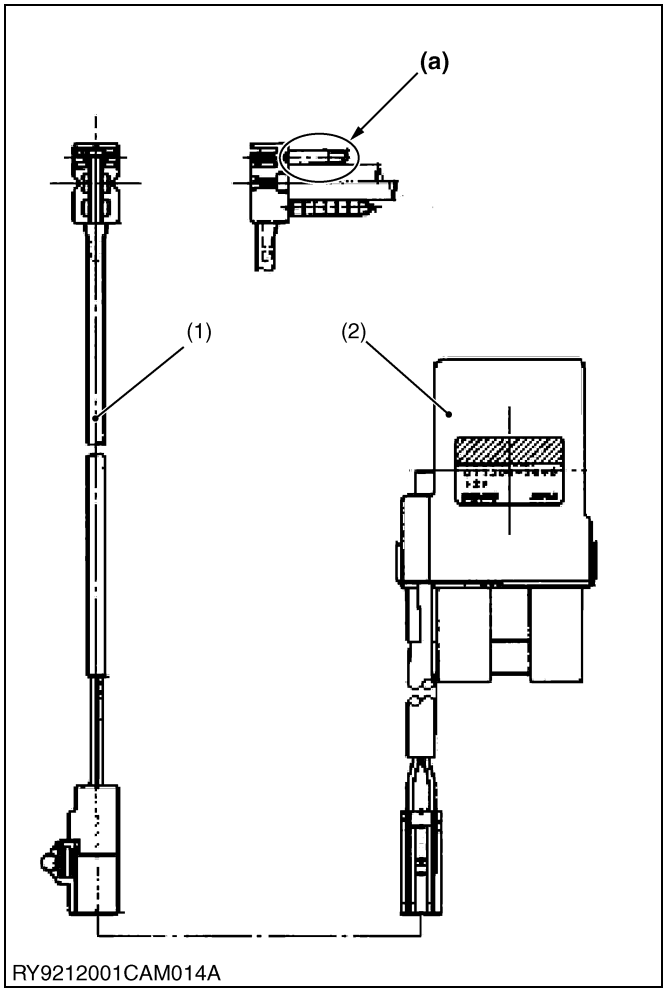

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Fin Thermistor (for frost control)

[Function]

Senses the temperature of the fins of the evaporator and when they are too cold, it stops the compressor and prevents frost from forming before it happens.

[How it Works]

The sensor of the fin thermistor senses the evaporator's fin temperature and if the resistance inside the sensor exceeds the thermo-amp resistance setting, its internal circuit shuts off the power to the compressor clutch.

Specifications		
Rated Voltage	DC12 V	
Measurement Conditions	DC13 ±0.2 V at 25 ± 5 °C (77 ± 9 °F)	
Temperature Detection	OFF R1	4383 ±131 Ω (2 °C, 36 °F)
	ON R2	(4095 Ω) (3.35 °C, 38 °F)
	Hysteresis	215 ±5.0 Ω (1 °C, 34 °F)

Usage Conditions	
Temperature Range	–30 to 80 °C (–22 to 176 °F)
Voltage Range	DC10 to 16 V
Operating Voltage Range	DC8 to 16 V (at 25 °C, 77 °F)

Temperature Detection	10 °C / 50 °F	15 °C / 59 °F	20 °C / 68 °F	25 °C / 77 °F	30 °C / 86 °F
Resistance Value	2.96 kΩ	2.34 kΩ	1.87 kΩ	1.50 kΩ	1.22 kΩ

(1) Fin Thermistor
(2) Thermo-Amp
(a) Evaporator Fin Temperature Detector

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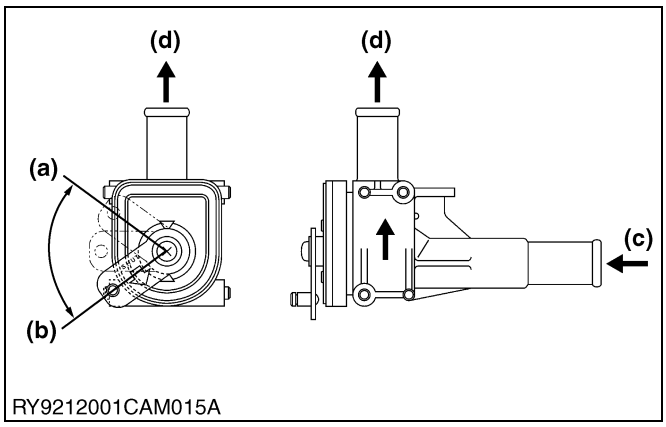

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Hot Water Valve

The hot water valve is the valve that adjusts the volume of engine coolant that flows into the heater core, and this adjustment changes the temperature of the heater core and thus controls the temperature of air flowing through it.

(a) Open (MAX Hot)
(b) Closed (MAX Cool)
(c) Inlet
(d) Outlet

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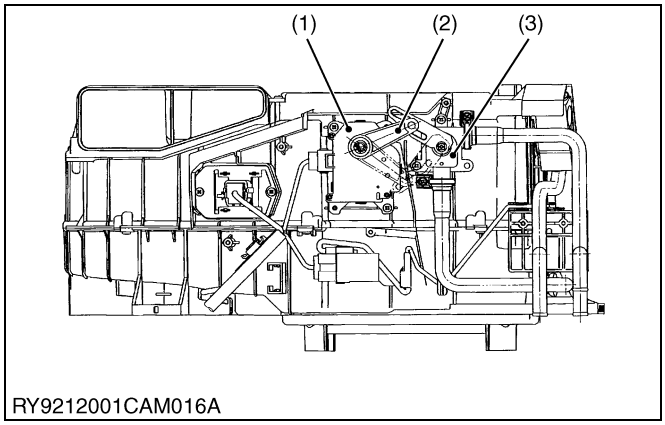

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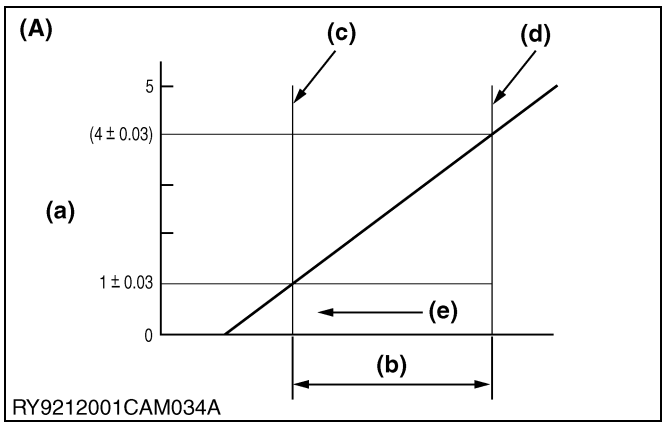

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Servo Motor (for adjusting temperature)

The servo motor is composed of a motor, a potentiometer, movable contacts, etc., and operates according to signals from the A/C's CPU.

The servo motor uses a DC ferrite motor and rotates forward and reverse. Its potentiometer also uses variable resistance and changes the resistance value according to the operating angle.

The servo motor and the hot water valve are linked via a linkage lever and turning the temperature control dial on the control panel opens/closes the hot water valve and adjusts the temperature of air vented inside the cabin.

Specifications (at 20 °C, 68 °F)	
Model	DC Ferrite
Rated Voltage	12 V
Rated load torque	0.3 N·m, 0.03 kgf·m, 0.2 lbf·ft
RPM	3.5 to 5.5 rpm
Amperage	0.02 to 0.10 A
Potentiometer Linearity	± 3 %
Impressed Voltage Terminals	6 (POS.2) 7 (POS.1)

(1) Servo Motor
(2) Linkage Lever
(3) Hot Water Valve

(A) Potentiometer Output Schematic
(a) Voltage (V)
(b) Operating Angle 60 °
(c) MAXCOOL
(d) MAXHOT
(e) CW

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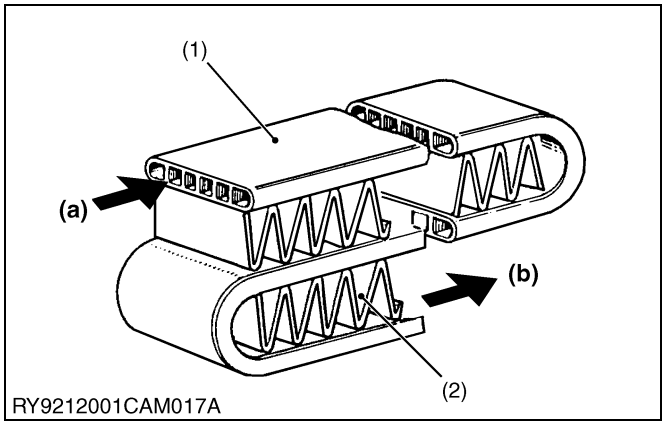
[5] CONDENSER



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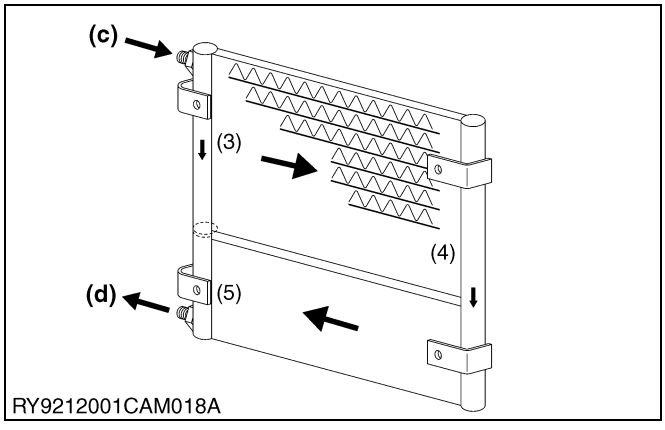

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The hot, compressed refrigerant is under high pressure and in a gaseous state; the condenser cools it and returns it to a liquid state. In the interval between entering and passing through the condenser, the refrigerant is cooled and becomes liquid refrigerant again. At this point, it is necessary to be sure the refrigerant is liquid at the outlet of the condenser. If the refrigerant is not condensed enough in the condenser some refrigerant would be in a gaseous state and that would reduce the A/C's cooling efficiency.

(1) Tubes
(2) Fins
(3) Vapor
(4) Vapor/Liquid Mix
(5) Liquid

(a) Gaseous Refrigerant
(b) Liquid Refrigerant
(c) Inlet (70 °C, 158 °F)
(d) Outlet (50 °C, 122 °F)

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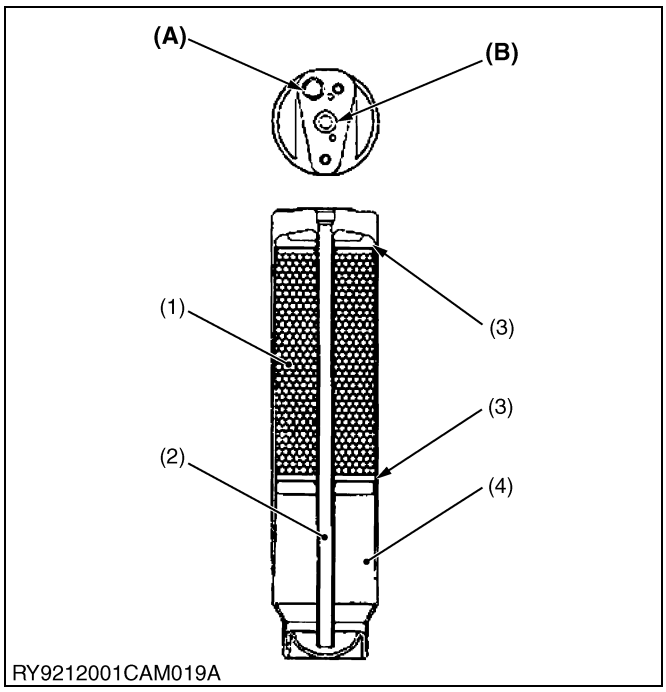
[6] RECEIVER



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The receiver is composed of a receiver tank, dryer, strainer and a receiver tube.

[Receiver Tank]

In the A/C system, the rpm of the compressor changes in response to changes in the engine rpm, so the appropriate amount of refrigerant in the cooling circuit also changes. The receiver tank is the part that reacts to those changes; when a lot of refrigerant is not required in the cooling circuit, excess refrigerant is stored temporarily in the tank and when more coolant is needed, it is supplied to the circuit via the receiver tube.

It also acts to store the balance of refrigerant charges and for extra refrigerant to counteract the leak of small amounts of refrigerant, such as via permeation of rubber hoses.

[Dryer]

If any moisture exists in the cooling circuit, it damages the system by deteriorating the valves of the compressor, its oil, by corroding metal parts in the circuit, and/or freezes in the expansion valve and blocks the circuit. The A/C system uses synthetic zeolite as a dryer that is compatible with the circuit, and it absorbs any moisture that gets mixed into the circuit during installation or charging of refrigerant.

If the expansion valve freezes up frequently due to moisture (icing), it means the dryer has lost its ability to absorb it, so the receiver has to be replaced.

[Strainer]

If dirt gets into the cooling circuit, it blocks the expansion valve, damages the compressor and otherwise hampers its cooling function. The strainer works to prevent any dirt flowing in the refrigerant from going any further. The strainer cannot be cleaned, so when it becomes severely clogged up, (in which case the high pressure gets high, low pressure gets low), the receiver has to be changed.

[Sight Glass]

The sight glass is mounted at the receiver joint on top of the receiver and it is the only place in the circuit where the amount of refrigerant can be visually inspected.

(1) Dryer
(2) Receiver Tube
(3) Strainer
(4) Receiver Tank

(A) Refrigerant Inlet
(B) Refrigerant Outlet

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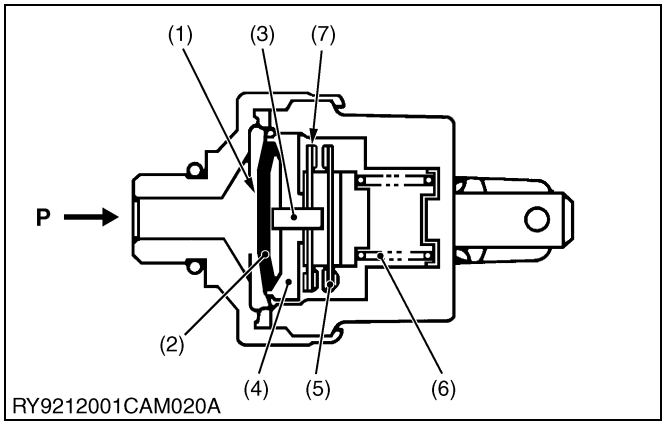
[7] PRESSURE SWITCH



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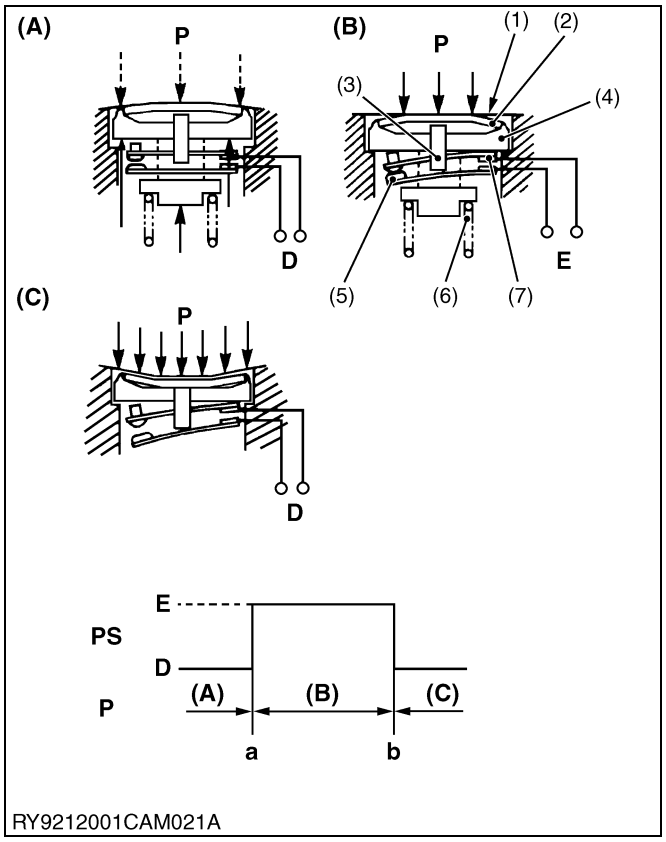

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This dual type of switch detects unusually high and low pressures in the cooling cycle. If the pressure gets abnormally high or, due to a leak, abnormally low, it may damage the equipment or deteriorate the lubricating ability of the compressor oil, leading to scorching and breakdown. To prevent these kind of problems from occurring, the switch cuts the power to the compressor clutch and stops the compressor.

	Refrigerant pressure	Operation
(A)	No increase in pressure state (when abnormally low)	The refrigerant pressure becomes less than the force of the spring, so the spring presses the plate up and the upper contact opens (OFF).
(B)	Contact ON (normal operation)	The refrigerant pressure is greater than the force of the spring, so the pressure plate is pressed down, which presses the upper contact down, closing the contact (ON).
(C)	Contact OFF (abnormally high pressure)	The refrigerant pressure becomes greater than the force of the plate spring and the plate spring pushes down on the pin, which press on the lower contact, opening it (OFF).

(1) Diaphragm
(2) Plate Spring
(3) Pin
(4) Plate
(5) Contact
(6) Spring
(7) Terminal

a : 0.19 MPa (2.0 kgf/cm^2, 28.4 psi)
b : 3.14 MPa (32 kgf/cm^2, 455 psi)
D : OFF
E : ON
P : Pressure
PS : Pressure Switch

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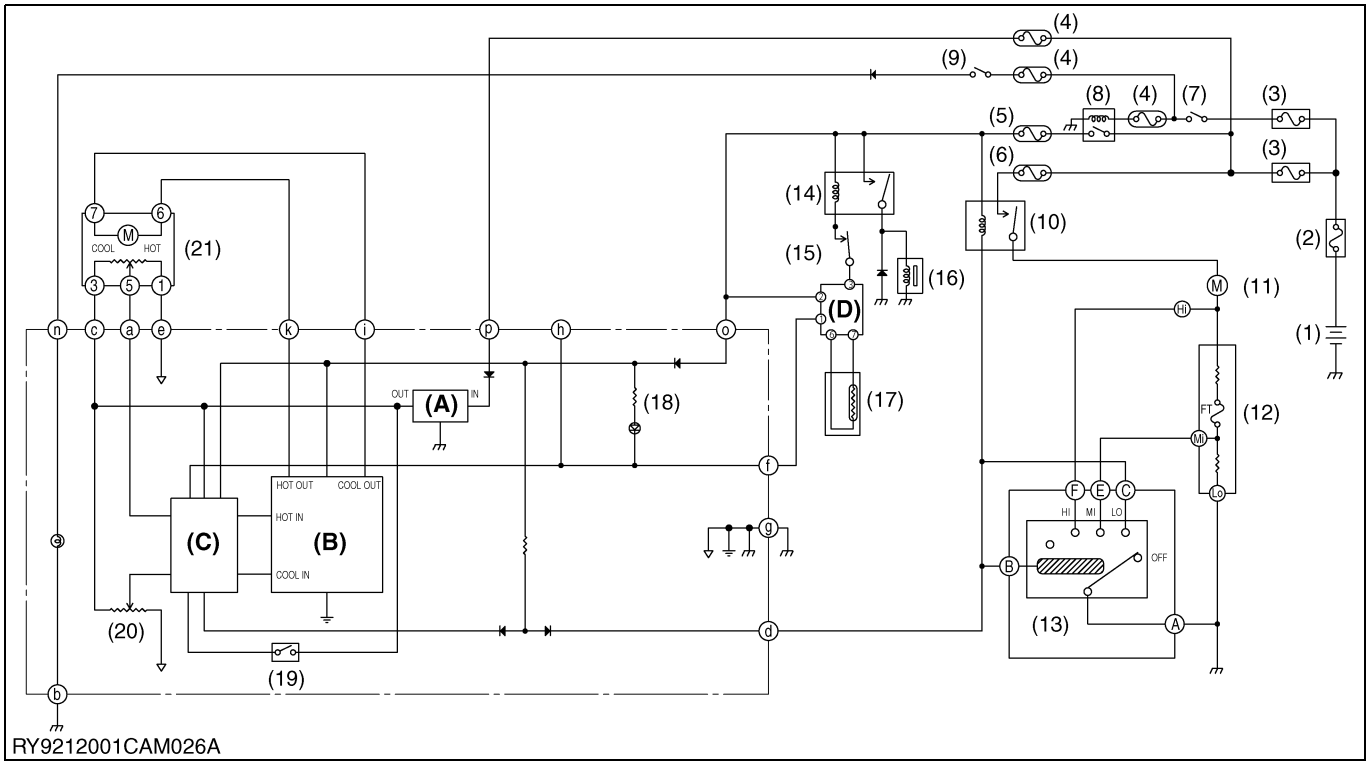
[8] ELECTRICAL SYSTEM

(1) Electrical Circuits



(1) Battery
(2) Slow-Blow Fuse (80A)
(3) Slow-Blow Fuse (50A)
(4) Fuse (5A)
(5) Fuse (10A)
(6) Fuse (30A)
(7) Start Switch
(8) Cab Relay
(9) Headlight Switch
(10) Blower Motor Relay
(11) Blower Motor
(12) Blower Resistor
(13) Blower Switch (Shorting Type)
(14) Compressor Clutch Relay
(15) Pressure Switch
(16) Compressor Magnetic Clutch
(17) Fin Thermistor (Frost Sensor)
(18) Indicator Lamp
(19) A/C switch
(20) Volume (Temperature Setting)
(21) Servo Motor

(A) Fixed Voltage Circuit
(B) Servo Motor Drive Circuit
(C) CPU
(D) Electronic Thermo Amp

(a) Potentiometer Signal
(b) ILL–
(c) Potentiometer Power
(d) Blower Motor
(e) Potentiometer GND
(f) Electronic thermo
(g) GND
(h) (Free)
(i) Servo Motor Output1 (COOL Output)
(j) (Free)
(k) Servo Motor Output2 (HOT Output)
(l) (Free)
(m) (Free)
(n) Headlight Switch
(o) IG
(p) +B Power

The processes up to the compressor's magnetic clutch engaging are indicated below.

1. Start switch → cab relay ON → blower motor relay ON → blower switch ON (LO, MI or HI) →blower motor ON
2. A/C switch ON (indicator lamp lights up) → pressure switch ON → fin thermistor ON → compressor clutch relay ON → compressor magnetic clutch ON (compressor operates)

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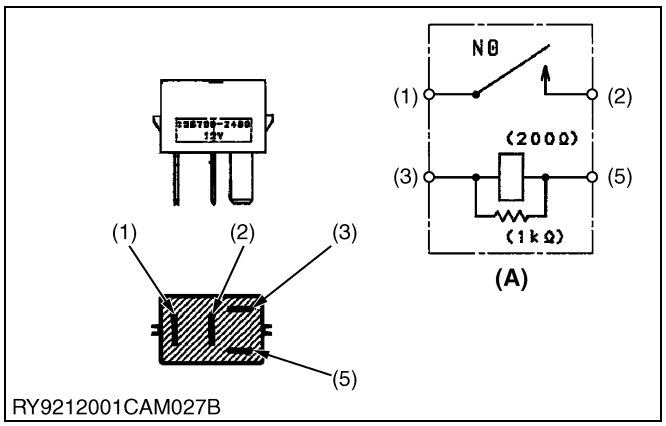
(2) Relays



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Current flows in the components of the A/C system to the blower motor and compressor's magnetic clutch. If all of the current were supplied via the main switch, the current would be too much for the switch, so the contacts of the main switch would be in danger of burning out. Similarly, if this current flowed directly from the battery and the operator forget to turn the blower motor off, the battery would discharge.

The system is equipped with relays in order to prevent these kind of problems. When the current flows through the coils of these relays, their contacts close, allowing electricity to be supplied from the battery. By adopting these relays, only a tiny amount of current is needed to operate the relays, so very little current flows through the main switch. As a result, the concern over its contacts burning out is eliminated and when the main switch is open, the relays' contacts open at the same time. When this occurs, the flow of electricity in the A/C circuit ceases and the possibility of the battery discharging is also eliminated.

(1) Relay Terminal 1
(2) Relay Terminal 2
(3) Relay Terminal 3
(5) Relay Terminal 5

(A) Connection Diagram

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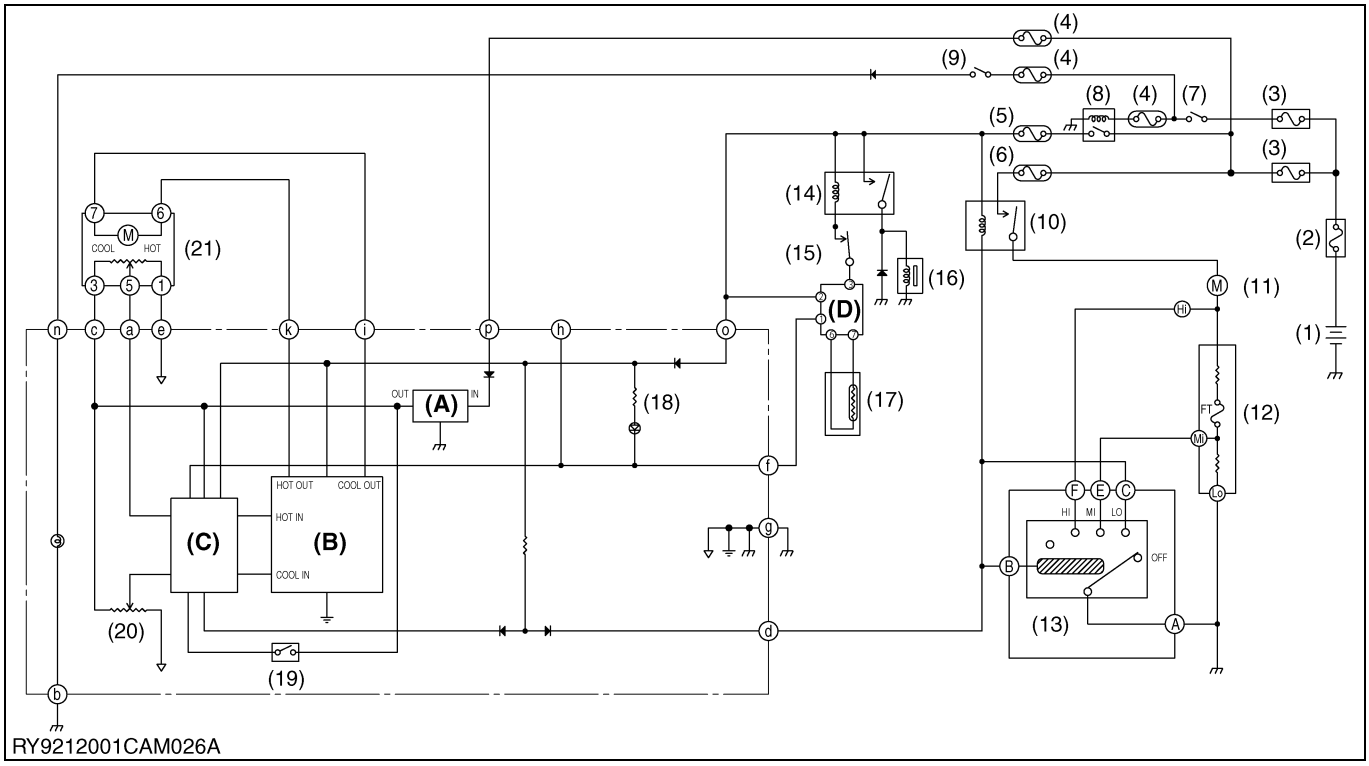
(3) Blower Switch

When the blower switch is in the LO, MI, or HI position



(1) Battery
(2) Slow-Blow Fuse (80A)
(3) Slow-Blow Fuse (50A)
(4) Fuse (5A)
(5) Fuse (10A)
(6) Fuse (30A)
(7) Start Switch
(8) Cab Relay
(9) Headlight Switch
(10) Blower Motor Relay
(11) Blower Motor
(12) Blower Resistor
(13) Blower Switch (Shorting Type)
(14) Compressor Clutch Relay
(15) Pressure Switch
(16) Compressor Magnetic Clutch
(17) Fin thermistor (Frost Sensor)
(18) Indicator Lamp
(19) A/C Switch
(20) Volume (Temperature Setting)
(21) Servo Motor

(A) Fixed Voltage Circuit
(B) Servo Motor Drive Circuit
(C) CPU
(D) Electronic Thermo Amp

When the starter switch and the blower switch are turned on, electricity flows from the battery to the coil of the blower motor relay, turning the blower motor relay on. With the blower motor relay on, the electricity flows to the blower motor as indicated below.

- **Lo Position**
  - Battery → slow-blow fuse (80A) → slow-blow fuse (50A) → fuse (30A) → blower motor relay → blower motor → blower resistor → ground
- **Mi Position**
  - Battery → slow-blow fuse (80A) → slow-blow fuse (50A) → fuse (30A) → blower motor relay → blower motor → blower resistor → blower switch (E→A) → ground
- **Hi Position**
  - Battery → slow-blow fuse (80A) → slow-blow fuse (50A) → fuse (30A) → blower motor relay → blower motor → blower resistor → blower switch (F→A) → ground

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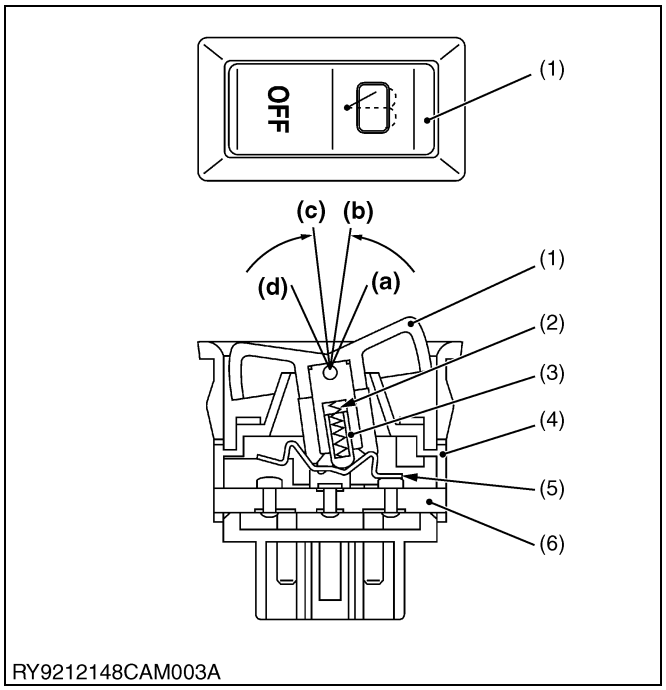
2. WIPER

[1] WIPER SWITCH



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This switch has four positions, namely **(a)**, **(b)**, **(c)** and **(d)** as indicated in the figure. When the starter key is in its [RUN] position and the switch is pressed to its **(b)** position, the wiper motor operates; pressing it in further to its **(a)** position operates the window washer. When the operator releases the switch, it automatically returns from position **(a)** to position **(b)**.

The window washer also operates if it is pressed in to position **(d)** on the [OFF] side. When it is released, it automatically returns in the same way to position **(c)**.

(1) Switch
(2) Spring
(3) Contact
(4) Switch Body
(5) Movable Contact
(6) Insulator

(a) Wash 1 Position (Both Wiper Motor and Window Washer Operate)
(b) On position (Only the Wiper Motor Operates)
(c) Off Position
(d) Wash 2 Position (Only the Window Washer Operates)

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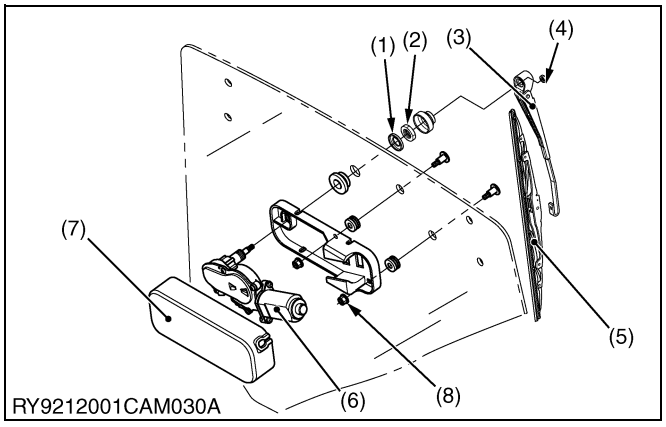
[2] WIPER



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The wiper is composed of a motor, wiper arm, wiper blade, etc.

The motor is fixed speed and automatically returns to a set position.

(1) Washer
(2) Nut
(3) Wiper Arm
(4) Nut
(5) Wiper Blade
(6) Wiper Motor
(7) Wiper Motor Cover
(8) Flange Nut

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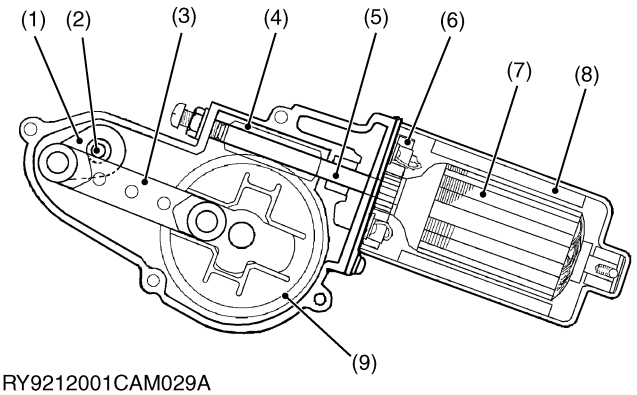
[3] WIPER MOTOR



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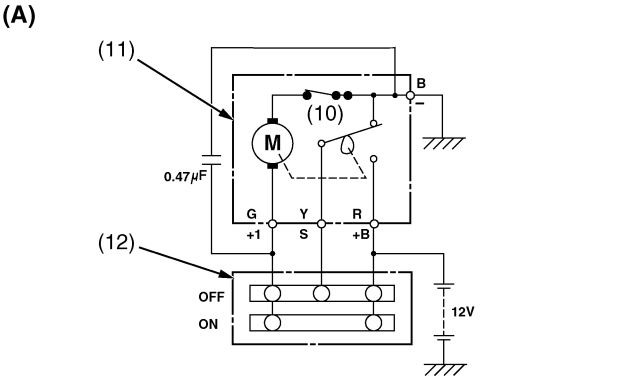

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A cylindrical ferrite magnet and an armature are assembled inside the housing of the wiper motor.
A worm gear and a helical gear are attached to the end of the armature and act as reduction gears and the rod and a segmented arm provide reciprocating motion, which is communicated to the wiper arm via the arms axis.

The motor is a 2-brush specification model and its rpm cannot be altered.

(1) Segmented Arm
(2) Arm's Axis
(3) Rod
(4) Worm Gear
(5) Armature Axle
(6) Brush
(7) Armature
(8) Ferrite Magnet
(9) Helical Gear
(10) Breaker
(11) Motor
(12) Switch

(A) Wiring Diagram (Motor Stop Position)

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SERVICING

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1. TROUBLESHOOTING

Compressor

Problem and/or Situation	Possible Cause	Solution
Noise (compressor on)	Wearing of or damage to the compressor's bearings	Replace
	Compressor valve damaged	Replace
	Belt slipping	Adjust or replace
	Compressor bracket mounting bolt(s) loose	Tighten
	Lines vibrating	Tighten and/or add clamp(s)
Noise (compressor off)	Blower damaged	Repair or replace
	Magnetic clutch, idler pulley and/or crank pulley bearings damaged or wearing	Replace

Air Conditioning System

Problem and/or Situation	Possible Cause	Solution
Cooling not working (air not blowing)	Blown fuse	Replace
	Main A/C relay defective	Replace
	A/C's blower motor damaged	Replace
	A/C's blower switch broken	Replace
	Wiring harness unplugged or poor contact	Fix
Cooling not working (compressor not turning)	Blown fuse	Replace
	Magnetic clutch broken	Repair or replace
	A/C switch broken	Replace
	Pressure switch broken	Replace
	Belt slipping	Adjust or replace
Cooling not working (other)	Not enough refrigerant	Check with a manifold gauge
	Expansion valve broken	Replace
	Compressor broken	Replace
Cooling not working effectively (not enough air blowing)	Filter clogged	Clean or replace
	Frost on the evaporator	Clean or replace the temperature switch
	A/C's blower motor damaged	Replace
	A/C blower resistor broken	Replace
Not cooling effectively (lots of foam visible in sight glass)	Not enough refrigerant	Check with a manifold gauge
	Refrigerant gas leaking from the cooling circuit	Repair and/or recharge refrigerant
	Air got in	Check with a manifold gauge
Too much refrigerant (no foam in sight glass)	Refrigerant overcharged	Check with a manifold gauge
Not cooling effectively (compressor not rotating properly)	Belt slipping	Adjust or replace
	Magnetic clutch broken	Repair or replace
	Compressor broken	Replace

Problem and/or Situation	Possible Cause	Solution
Not cooling effectively (other)	Thermistor broken	Replace
	Hot water valve damaged	Replace
	Condenser clogged with dirt or debris	Clean
	Expansion valve broken	Replace
Not heating effectively	Hot water valve damaged	Replace
	Servo motor broken	Check and repair
Not enough air flow (blower motor not turning)	Blower fan switch broken	Check and repair
	A/C main relay broken	Replace
	Brushes have poor contact	Replace
	Blown fuse	Replace
	Miswiring or poor connections	Check and repair
Not enough air flow (air flow does not change to speed 3)	Blower resistor damaged	Replace
	Relay damaged	Replace
	Blower fan switch broken	Replace
Not enough air flow (other)	Blower not tight enough	Check and repair
	Blower deformed	Replace
	Blower hitting its casing	Check and repair
	Something blocking the inlet	Check and repair
	Frost on the evaporator	Clean or replace
	Filter clogged	Clean or replace
	Vent ducts clogged or detached	Check and repair
Not cooling effectively (compressor clutch not working)	Battery voltage too low	Charge the battery
	Rotor is hitting the stator	Replace
	Miswiring or loose connectors	Check and repair
	Relay damaged	Replace
	Coil shorted	Replace
	Ground defective	Check and repair
	Coil burned out	Replace
Not cooling effectively (high-pressure level too high)	Refrigerant overcharged	Check with a manifold gauge
	Condenser clogged with dirt or debris	Clean
	Air got in	Check with a manifold gauge
Not cooling effectively (high-pressure level too low)	Not enough refrigerant	Check with a manifold gauge
	Compressor discharge valve damaged	Replace
	Compressor gasket damaged	Replace
	Error in the low-pressure line (cracked or clogged)	Replace
Not cooling effectively (low-pressure level too high)	Refrigerant overcharged	Check with a manifold gauge
	Expansion valve too far open	Replace

Problem and/or Situation	Possible Cause	Solution
Not cooling effectively (low-pressure level too low)	Not enough refrigerant	Check with a manifold gauge
	Frost on the evaporator	Clean or replace
	Error in the low-pressure line (cracked or clogged)	Replace
	Expansion valve clogged	Replace
Not cooling effectively (both low and high pressure levels too high)	Refrigerant overcharged	Check with a manifold gauge
Not cooling effectively (both low and high pressure levels too low)	Not enough refrigerant	Check with a manifold gauge
Cannot control temperature (servo motor and/or temperature control dial defective)	Servo motor broken	Replace
	Temperature control dial broken	Replace
	Controller of the wire harness is off	Repair or replace
Cannot control the temperature (hot water valve does not open normally)	Servo motor broken	Replace
	Hot water valve damaged	Replace
Cannot control the temperature (poor heater hose layout)	Heater hose is pinched	Fix
	Heater hose is bent or broken	Repair or replace
Water leak (water leak inside the cab)	Drain hose bent or broken	Check and repair
	Drain hose clogged	Clean

Wiper

Problem and/or Situation	Possible Cause	Solution
Wiper doesn't work	Fuse blown (a part inside the wiper motor or some other moving part is shorted or burned out)	Pinpoint the cause of the damage and replace
	Wiper motor faulty (damaged armature, worn motor brushes, motor shaft locked)	Replace
	Wiper switch faulty	Replace
	Faulty operation of linkage mechanism due to foreign matter	Fix
	Wiper arm locked or rusted together	Grease up or replace
Wiper moves too slowly	Wiper motor faulty (damaged armature, poor contact due to worn motor brushes, faulty operation of motor shaft)	Replace
	Battery voltage low	Recharge or replace
	Wiper arm shaft rusty, foreign matter stuck in it	Grease up or replace
	Poor contact in wiper switch	Replace
Wiper fails to stop in the correct position	Wiper motor faulty (Dirty or poor contact of the contacts at the auto-stop position due to foreign matter)	Replace

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2. SERVICE SPECIFICATIONS

Item		Factory specification	Allowable Limit Value
A/C Compressor Magnetic Clutch	Air Gap	0.30 to 0.65 mm 0.0118 to 0.0255 in.	–
Magnetic Clutch Stator Coil	Electrical Resistance	3.0 to 4.0 Ω	–
Cooling Cycle (cooling cycle when operating normally)	Pressure (low-pressure side)	0.15 to 0.20 MPa 1.5 to 2.0 kgf/cm^2 21 to 28 psi	–
	Pressure (high-pressure side)	1.27 to 1.66 MPa 13 to 17 kgf/cm^2 185 to 242 psi	–
Pressure switch (dual type) (when pressure switch is off)	Pressure setting (low-pressure side)	Lower than the values below About 0.196 MPa 2.0 kgf/cm^2 28.4 psi	–
	Pressure setting (high-pressure side)	Higher than the values below About 3.14 MPa 32 kgf/cm^2 455 psi	–
A/C drive belt	Tension	Deflects 20 to 25 mm (0.79 to 0.98 in.) when 98.0 N (10.0 kgf, 22.0 lbs) of forced is applied	–
Refrigerant	Type (recharge volume)	R134a 980 g 2.16lbs	–
Compressor Oil	Type (usage volume)	ND-OIL8 <PAG*oil> 110 to 120 cc 0.116 to 0.127 U.S.qts 0.097 to 0.106 Imp.qts	–

*PAG : Polyalkylene glycol (synthetic oil)

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3. TORQUE

The following table indicates the specified tightening torque for nuts.

Items		N·m	kgf·m	lbf·ft
Condenser mounting	M8 nut	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2
Compressor mounting	M8 bolt	16.7 to 19.6	1.7 to 2.0	12.3 to 14.5
Compressor bracket mounting	M12 bolt	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
	M8 bolt	16.7 to 19.6	1.7 to 2.0	12.3 to 14.5
Receiver mounting	M8 bolt	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2
High pressure line 1 mounting (on condenser side)	M6 bolt	7.8 to 11.8	0.8 to 1.2	5.8 to 8.7
	M22 × 1.5 lock nut	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Between condenser and receiver	M6 bolt	3.9 to 6.9	0.4 to 0.7	2.9 to 5.1
	M16 × 1.5 lock nut	11.8 to 14.7	1.2 to 1.5	8.7 to 10.8
High pressure line 2 mounting (on receiver side)	M16 × 1.5 lock nut	11.8 to 14.7	1.2 to 1.5	8.7 to 10.8
Low-pressure line between A/C and compressor	M6 bolt	7.8 to 11.8	0.8 to 1.2	5.8 to 8.7
	M24 × 1.5 lock nut	29.4 to 34.3	3.0 to 3.5	21.7 to 25.3
A/C mounting	M6 bolt	3.9 to 6.9	0.4 to 0.7	2.9 to 5.1
	M8 bolt	9.8 to 15.7	1.0 to 1.6	7.2 to 11.6
Magnetic clutch mounting	M6 bolt	10.8 to 16.2	1.10 to 1.65	8.0 to 11.9

RY9212148CAS0002US0

4. PRECAUTIONS WHEN REPAIRING THE REFRIGERANT SYSTEM

[1] USE OF SERVICE TOOLS

(1) Manifold Gauge Set

Always follow the warnings and regulations below when inspecting or repairing the air conditioning system. It is also extremely important that no one other than specially trained service personnel handles refrigerants.

⚠ CAUTION

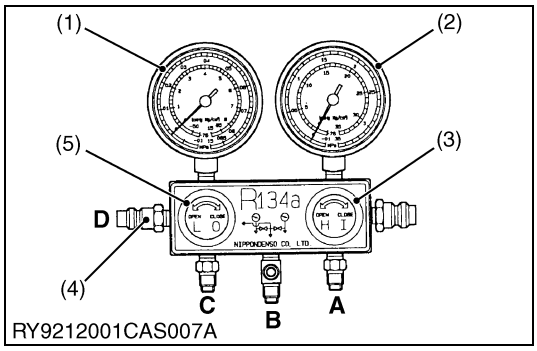
- **If the liquid refrigerant comes in contact with skin, it results in frostbite, so always be careful when handling refrigerants. Always wear goggles when working on this system in order to protect your eyes.**
- **Refrigerant service containers are made very sturdy for safety. However, they can explode if handled improperly. Always follow the instructions printed on their labels. In particular, never heat a refrigerant container above 40 °C (104 °F). Also, never drop one from any height.**
- **Do not steam clean this system. In particular, this system is under extremely high pressure, so do not steam clean the condenser as it may cause the system to explode.**
- **If an error is made in handling the service valve or in connecting a hose between the compressor's service valve and a manifold gauge, it may cause the refrigerant service container or the charging hose to explode. When connecting hoses or handling service valves, always check the pressure on the high-pressure side or on the low-pressure side.**
- **When recharging refrigerant with the compressor operating, do not open the high-pressure valve of the manifold gauge.**
- **Be careful of gas toxicity. The refrigerant gas in its natural state is harmless and is not toxic. However, when it comes in contact with very hot parts, it can break down chemically, producing hazardous materials.**
- **Do not heat service canisters unless absolutely necessary. When necessary to heat a canister, use water at or below 40 °C (104 °F). Never use boiling water to heat a canister.**
- **Take care with the following points on storing and handling service canisters.**
  - **Store in a cool, dry place.**
  - **Never drop or strike a canister.**
  - **Do not use service canisters that are deformed, have unusable screws or are otherwise damaged.**
  - **Never heat a service canister unless necessary. If one must be heated for some reason, use water at or below 40 °C (In such cases, never warm the canister while heating up the water). Do not immerse the valve of the service canister in water. Do not turn the service canister upside down. Turning it upside down allows liquid refrigerant into the compressor, which damages the valve.**
  - **Do not shake hard (If the mounting of the valve is not secure, it may come off).**
  - **Use ND-OIL8 (made by DENSO (Co. Ltd.)) compressor oil (ND-OIL6 is designated for use with R12, so do not mistakenly use ND-OIL6).**
- **Precautions on Inspecting and Charging A/C Gas**
  - **Perform all work in a well-ventilated location.**
  - **Be careful when handling high-pressure valves. When recharging refrigerant with the engine running, do not open the high-pressure valve (HI) of the manifold gauge. Overcharging refrigerant may cause problems such as poor cooling and overheating.**

■ **IMPORTANT**

- **Using R12 refrigerant in an R134a A/C system may cause problems to result, such as leaks of refrigerant at O-rings and fogging of the sight glass. Consequently, the shapes of line joints, service valves and service tools are different in order to prevent mistakes in connecting or recharging the wrong system.**
- **Always keep the work area clean, dry and free of any dirt or dust. Always wipe off any water from line fittings with a clean cloth before opening the fitting.**
- **Only use R134a refrigerant service tools.**
- **When discharging refrigerant, use an R134a refrigerant collection/recycling machine.**
- **Prior to connecting a charging hose to the tap valve of a refrigerant canister, check each seal and make sure it is not clogged up.**
- **When disconnecting charging hoses from compressor and receiver valves, do so as quickly as possible to minimize the leakage of gas.**
- **Be careful to only charge with the specified amount of refrigerant; never overcharge the system. This is important because overcharging the refrigerant can cause poor cooling performance among other things.**

- **Hand tighten when connecting the charging hose to the canister's tap valve. Do not use pliers to tighten the charging hose.**
- **Store refrigerant containers in a cool, dark place and never leave them in direct sunlight or in a hot place.**
- **R134a compressor oil readily absorbs moisture, so always seal any parts after disconnecting them.**
- **Do not use any of the old style R12 refrigerant or previous kinds of refrigerant compressor oil.**

RY9212079CAS0001US0

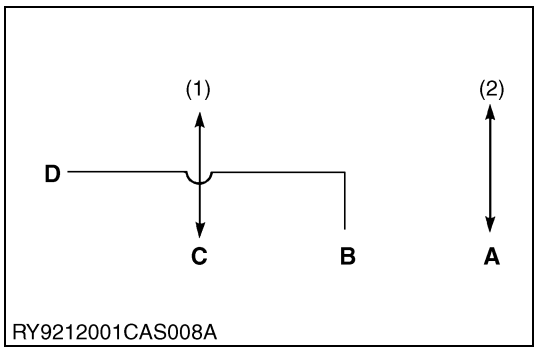


RY9212001CAS007A

The manifold gauge set has a valve handle for opening and closing valves. The valve handle marked LO is for use on the low-pressure valve (5) and the valve handle marked HI is for use on the high-pressure valve (3). The following circuits can be achieved by variously opening and closing the high and low pressure valves.

(1) Low-Pressure Gauge
(2) High-Pressure Gauge
(3) High-Pressure Valve
(4) Valve Core
(5) Low-Pressure Valve

RY9212001CAS0005US0



RY9212001CAS008A

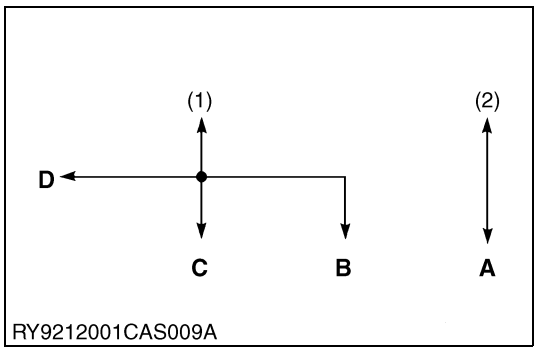
When low and high pressure valves are closed

The following 2 circuits are formed.
Port (C) → Low-pressure gauge (1)
Port (A) → High-pressure gauge (2)

CAUTION
- **Be sure to open the valve core (d).**

(1) Low-Pressure Gauge (2) High-Pressure Gauge

RY9212001CAS0006US0



RY9212001CAS009A

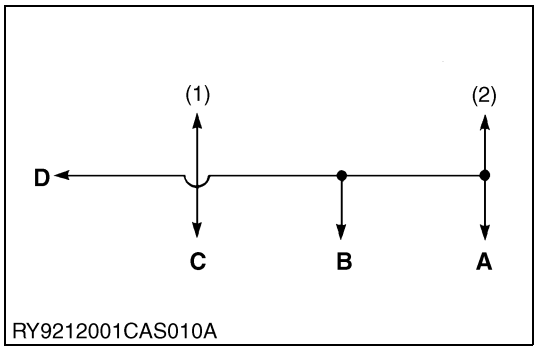
With the low-pressure valve open and the high-pressure valve closed

The following circuits are formed.
Port (C) → Low-pressure gauge (1)
Port (C) → Port (B)
Port (C) → Port (D)
Port (A) → High-pressure gauge (2)

CAUTION
- **Be sure to open the valve core (D).**

(1) Low-Pressure Gauge (2) High-Pressure Gauge

RY9212001CAS0007US0



RY9212001CAS010A

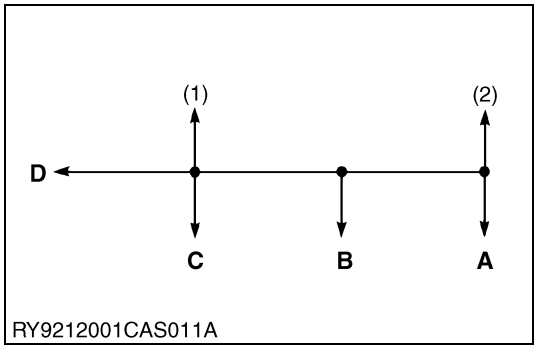
With the low-pressure valve closed and the high-pressure valve open

The following circuits are formed.
Port (C) → Low-pressure gauge (1)
Port (A) → Port (B)
Port (A) → Port (D) (Be sure to open the valve core).
Port (A) → High-pressure gauge (2)

CAUTION
- **Be sure to open the valve core (D).**

(1) Low-Pressure Gauge (2) High-Pressure Gauge

RY9212001CAS0008US0



RY9212001CAS011A

With low and high pressure valves open

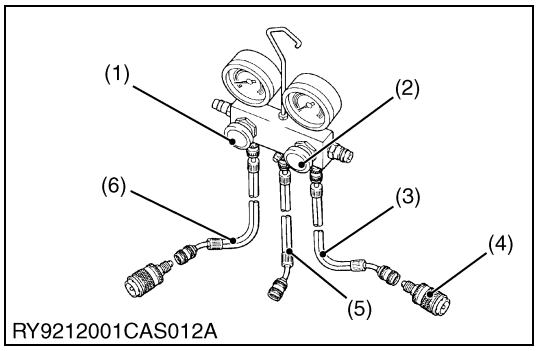
The following circuits are formed.
Port (A) → High-pressure gauge (2)
Port (A) → Low-pressure gauge (1)
Port (A) → Port (B)
Port (A) → Port (C)
Port (A) → Port (D) (Be sure to open the valve core).

CAUTION
- **Be sure to open the valve core (D).**

(1) Low-Pressure Gauge (2) High-Pressure Gauge

RY9212001CAS0009US0

(2) Refrigerant Charging Hoses



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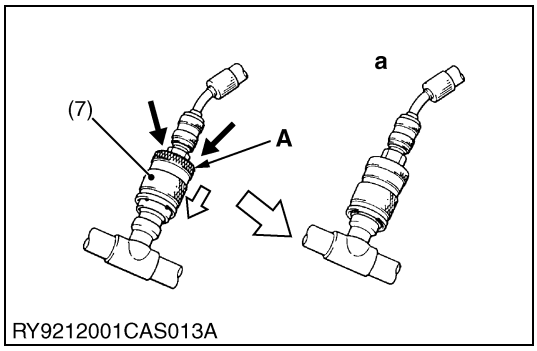

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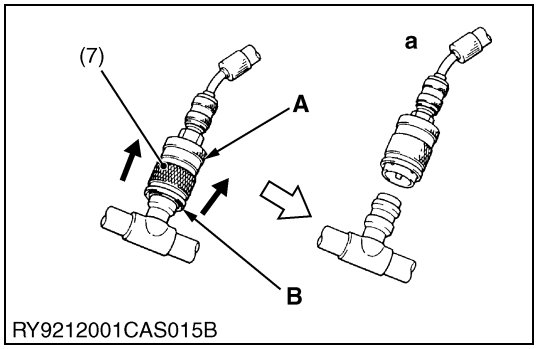
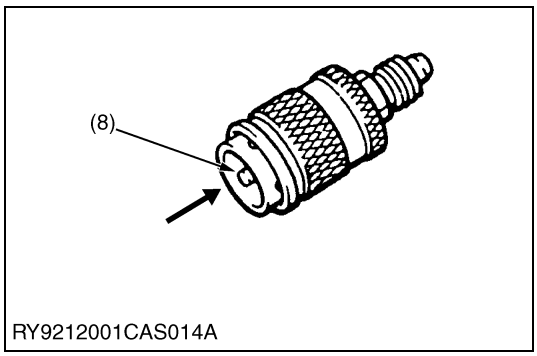


RY9212001CAS015B



RY9212001CAS014A

The three kinds of refrigerant charging hoses can be identified by color. Each of the refrigerant charging hoses is to be used as follows.
- In line with the A/C manufacturer's recommendation, the blue hose (6) is to be used on the low-pressure side (intake side), the green hose (5) on the cooling side (center connection port) and the red hose (3) on the high-pressure side (discharge side).

(When connecting)
- Press the quick disconnect adapter (4) into the recharge valve and push in on part **A** until you hear it catch.

CAUTION
- **While pressing in to make a connection, be careful not to bend any lines.**
- **If the sleeve (7) moves prior to connecting the quick disconnect adapter to the recharge valve, move the sleeve back to its original position and try again to make the connection.**
- **If there is any refrigerant remaining in the refrigerant recharge hose, it makes it difficult to connect the quick disconnect adapter. In this case, relieve the pressure in the refrigerant recharge hose and then connect the adapter (Pressing on the plunger (8) eliminates any residual pressure).**

(When disconnecting)
- With part **A** of the quick-disconnect adaptor held in place, slide part **B** up.

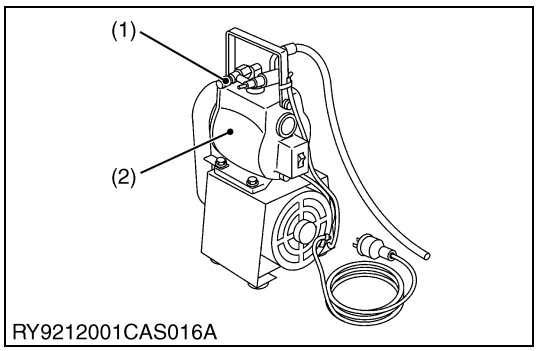
CAUTION
- **After removing the quick-disconnect adapter, be sure to put a cap on the service valve of the adapter.**

(1) Low Pressure Valve
(2) High Pressure Valve
(3) Red Hose
(4) Quick Disconnect Adapter
(5) Green Hose
(6) Blue Hose
(7) Sleeve
(8) Pusher

a : Makes a catching sound

RY9212148CAS0003US0

(3) Vacuum Pump Adapter



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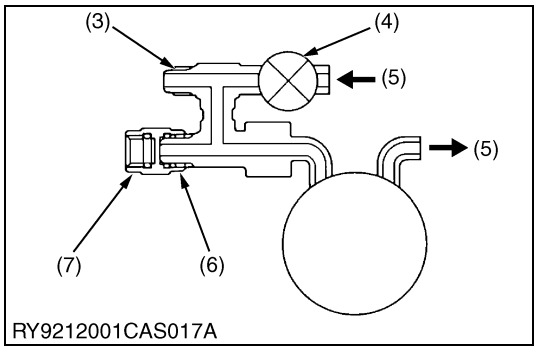


RY9212001CAS017A

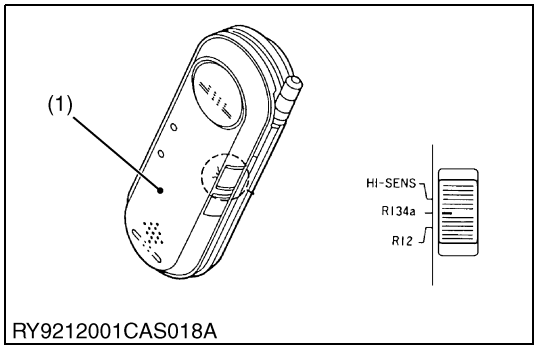
Purpose of the Vacuum Pump Adapter

1. After the A/C cooling system is vacuumed, when the vacuum pump is stopped, there is a vacuum inside the hoses of the manifold gauge, so the oil of the vacuum pump flows back into the refrigerant charging hose. If the refrigerant system is charged in this state, the vacuum pump oil remaining in the refrigerant charging hose will go into the A/C refrigerant system along with the refrigerant. A vacuum pump adaptor equipped with a solenoid valve is used to prevent this backflow of oil from the vacuum pump. The role of the solenoid valve is to close when electricity is flowing to the solenoid valve, cutting it off from outside air and maintaining the vacuum; when the electricity is cut off, the valve opens, bringing in outside air and relieving the vacuum.
2. If this adapter is connected to the currently used R12 vacuum pump, it enables the vacuum pump to be used for both R134a and R12.

(1) Vacuum Pump Adapter
(2) Vacuum Pump
(3) For R134a
(4) Solenoid Valve
(5) Air
(6) For R12
(7) Plug Cap

RY9212001CAS0011US0

(4) Electric Gas Leak Tester



RY9212001CAS018A

The old style R12 gas leak tester are not sensitive enough for R134a and cannot be used. Consequently a new and very sensitive electrical gas leak tester has been designed that can be used with both R134a and R12.

[NOTE]

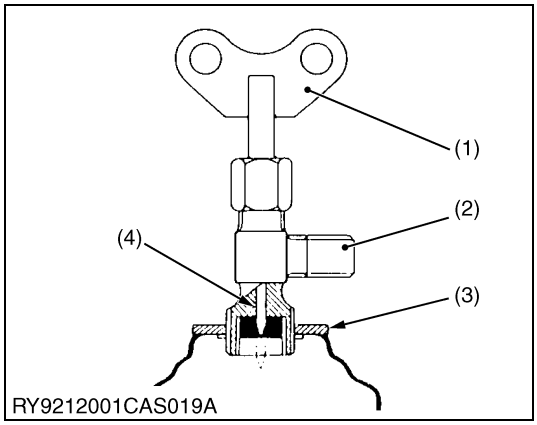
Halogenated Torch Gas Leak Testers

- Because this tester detects gas leaks based on the reaction of chlorine in the refrigerant, it cannot detect R134a because it does not contain chlorine.

(1) Electrical Gas Leak Tester

RY9212001CAS0012US0

(5) Canister Tap Valve



RY9212001CAS019A

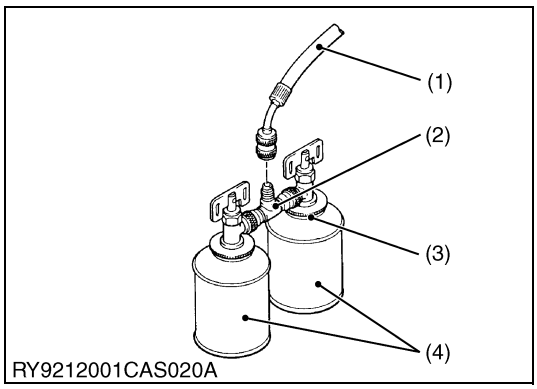
The canister tap valve used in recharging the refrigerant of the A/C system has to be used as follows.

1. Before attaching the canister tap valve to the refrigerant container, rotate the handle (1) counterclockwise until the needle of the valve is completely retracted.
2. Rotate the plate nut (disk) (3) counterclockwise to its highest position and then screw the canister tap valve into the sealed tap.
3. Rotate the plate nut clockwise as far as you can and fasten the center charging hose to the canister tap valve.
4. Tighten the plate nut securely by hand.
5. Rotate the handle (1) clockwise to open a hole in the sealed tap.
6. To charge the system with refrigerant, turn the handle (1) counterclockwise. To stop charging, turn the handle clockwise.

(1) Butterfly Handle
(2) Connector
(3) Disc
(4) Needle

RY9212148CAS0004US0

(6) T-Joint



RY9212001CAS020A

A T-joint (2) is used when using two refrigerant canisters (4) at the same time to make gas recharging more efficient.

1. Attach a refrigerant canister service valve on each side of the T-joint (2) and connect a refrigerant charging hose (1) to the T-joint.

(1) Refrigerant Charging Hose (Green)
(2) T-Joint
(3) Canister Tap Valve
(4) Refrigerant Canister

RY9212001CAS0014US0

(7) R134a Refrigerant Collection/Recycling Device

When it is necessary to discharge the refrigerant in order to work on the machine, a collection / recycling device must be used (Never release refrigerant into the atmosphere).

■ **IMPORTANT**

- **Use a dedicated R134a refrigerant collection/recycling device.**
- **To prevent any damage to the compressor, use neither R12 system refrigerant nor cooling system oil in R134a equipment.**

RY9212001CAS0015US0

5. INSPECTING AND CHARGING THE REFRIGERANT SYSTEM

[1] CHECKING THE SYSTEM WITH A MANIFOLD GAUGE

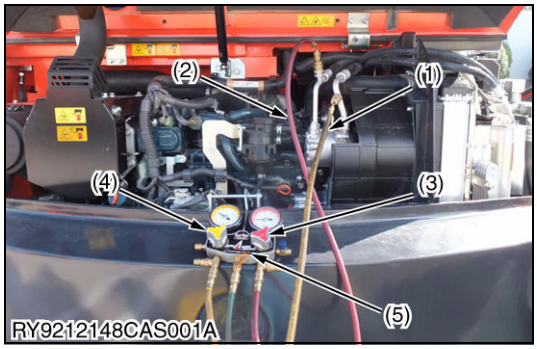
■ **IMPORTANT**

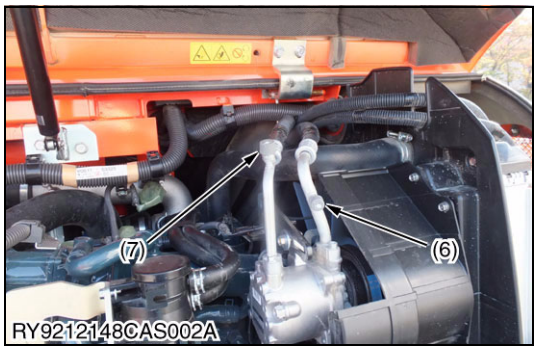
- **Be aware that the gauge pressure values noted in the following test are measured under identical conditions and they may vary somewhat from your gauge pressure values, depending on the prevailing conditions.**

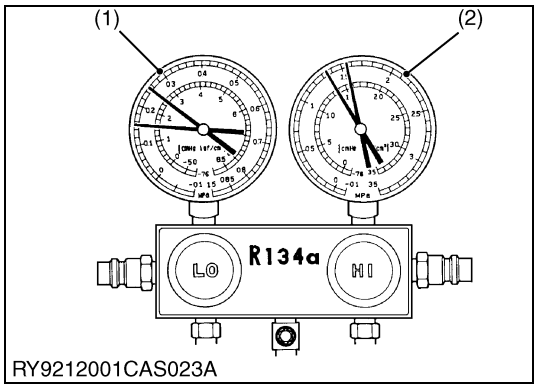
Conditions

- **Ambient temperature : 30 to 35 °C (86 to 95 °F)**
- **Engine RPM : Approx. 1500**
- **Temperature control lever : Max cooling position**
- **Blower switch : HI Position**

RY9212001CAS0016US0







Manifold connections and test preparations

1. Close the manifold gauge's high (3) and low (4) pressure valves tightly.
2. Connect the red (2) refrigerant charging hose to the high-pressure charge valve (7) and the blue or yellow (1) refrigerant charging hose to the low-pressure charge valve (6).

CAUTION

- **Use the refrigerant pressure in the refrigerant cycle to completely flush out the air in the refrigerant charging hose from the end of the manifold gauge's connection.**

3. Start up the engine and set it at approximately 1500 rpms.
4. Turn the A/C switch on and set the temperature control dial to the max cooling position.
5. Set the blower switch to its HI position.

(1) Refrigerant Charging Hose (blue or yellow)
(2) Refrigerant Charging Hose (red)
(3) High-Pressure Valve
(4) Low-Pressure Valve
(5) Manifold gauge
(6) Low-Pressure Side Charge Valve
(7) High-Pressure Side Charge Valve

RY9212148CAS0005US0

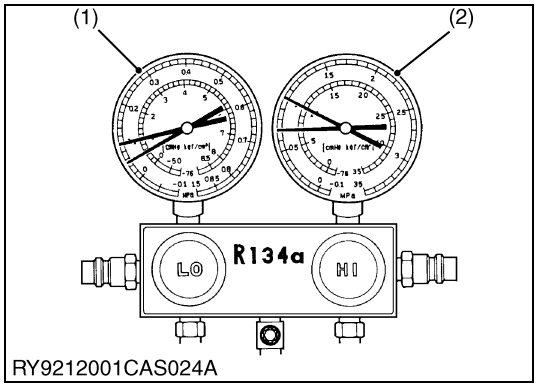
When operating normally

If the refrigerant cycle is operating normally, readings will be around the factory specifications in the table below.

Gas Pressure	Factory specification	Low pressure side	0.15 to 0.20 MPa 1.5 to 2.0 kgf/cm^2 21 to 28 psi
		High pressure side	1.27 to 1.66 MPa 13 to 17 kgf/cm^2 185 to 242 psi

(1) Low Pressure Side
(2) High Pressure Side

RY9212001CAS0018US0



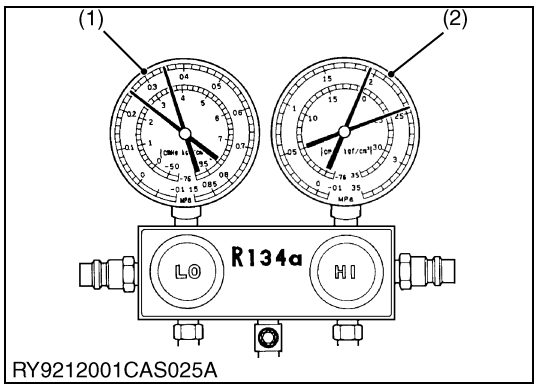
RY9212001CAS024A

Without enough refrigerant

1. Symptoms that appear in the refrigerant cycle
   - Both high (2) and low (1) side pressures are too low. Low-pressure side (1) : 0.05 to 0.10 MPa (0.5 to 1.0 kgf/cm^2, 7.1 to 14.2 psi)
     High-pressure side (2) : 0.69 to 0.98 MPa (7 to 10 kgf/cm^2, 99.6 to 142.2 psi)
   - Foam visible in the sight glass.
   - Air output by the A/C appears to be cooled.
2. Possible Cause
   - Gas leaking from the circuit of the refrigerant cycle.
3. Solution Methods
   - Use an electric gas leak tester to check for leaks and repair any found.
   - Recharge the system with an appropriate amount of refrigerant.

(1) Low Pressure Side (2) High Pressure Side

RY9212001CAS0019US0



RY9212001CAS025A

Excess refrigerant or insufficient condenser cooling

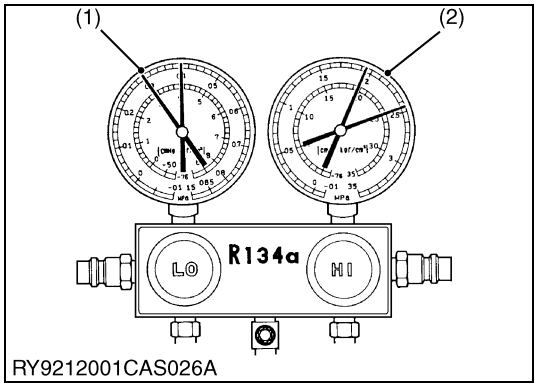
1. Symptoms that appear in the refrigerant cycle
   - Both high (2) and low (1) side pressures are too high. Low-pressure side (1) : 0.20 to 0.35 MPa (2.0 to 3.5 kgf/cm^2, 28.4 to 49.8 psi)
     High-pressure side (2) : 1.96 to 2.45 MPa (20 to 25 kgf/cm^2, 284.5 to 355.6 psi)
2. Possible Causes
   - Cycle charged with too much refrigerant.
   - Poor condenser cooling.
3. Solution Methods
   - Clean the condenser.
   - Adjust the tension of the A/C drive belt to the appropriate tension.
   - If the 2nd item above is normal, check the amount of refrigerant.

CAUTION

- **To discharge excess refrigerant, loosen the manifold's gauge's low-pressure valve and slow discharge it.**

(1) Low Pressure Side (2) High Pressure Side

RY9212001CAS0020US0



RY9212001CAS026A

Air mixed into the cycle

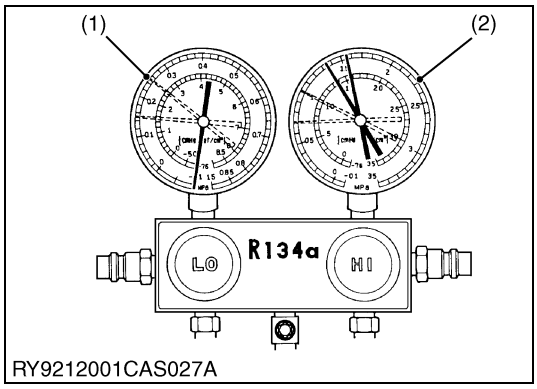
1. Symptoms that appear in the refrigerant cycle
   - Both high (2) and low (1) side pressures are too high. Low-pressure side (1) : 0.20 to 0.35 MPa (2.0 to 3.5 kgf/cm^2, 28.4 to 49.8 psi)
     High-pressure side (2) : 1.96 to 2.45 MPa (20 to 25 kgf/cm^2, 284.5 to 355.6 psi)
   - The line on the low-pressure side (1) feels cold to the touch.
2. Possible Causes
   - Air is mixed in the refrigerant cycle
3. Solution Methods
   - Replace the receiver.
   - Check the amount of compressor oil and whether it is contaminated.
   - Vacuum it out and charge the cycle again with fresh refrigerant.

CAUTION

- **If you fail to vacuum out a refrigerant cycle like that mentioned above and simply charge the cycle with refrigerant, the problem may recur.**

(1) Low Pressure Side (2) High Pressure Side

RY9212001CAS0021US0



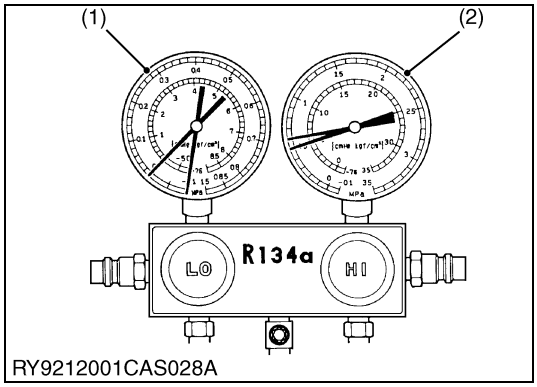
RY9212001CAS027A

Moisture mixed into the cycle

1. Symptoms that appear in the refrigerant cycle
   - At first the A/C works normally, but after some time, the pressure on the low-pressure side (1) becomes a vacuum and the high-pressure side (2) is at a low pressure. Low-pressure side (1) : Vacuum;
     High-pressure side (2) : 0.69 to 0.98 MPa (7 to 10 kgf/cm^2, 99.6 to 142.2 psi)
2. Possible Causes
   - Moisture in the refrigerant cycle freezes up in the expansion valve orifice, creating a temporary blockage. As time elapses, the ice thaws and it returns to normal.
3. Solution Methods
   - Replace the receiver.
   - Eliminate the moisture in the refrigerant cycle by repeatedly vacuuming it out.
   - Recharge the system with an appropriate amount of refrigerant.

(1) Low Pressure Side (2) High Pressure Side

RY9212001CAS0022US0



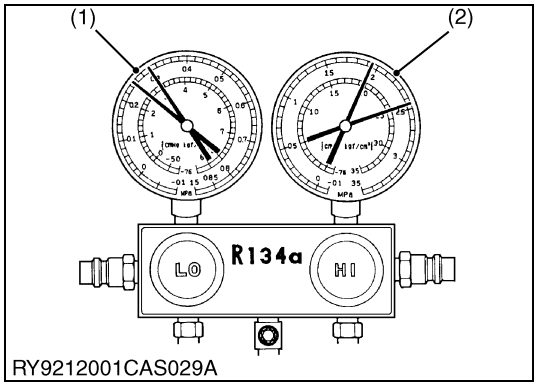
RY9212001CAS028A

Refrigerant fails to circulate

1. Symptoms that appear in the refrigerant cycle
   - Low-pressure side (1) becomes a vacuum and the high-pressure side (2) is at low pressure.
     Low-pressure side (1) : Vacuum;
     High-pressure side (2) : 0.49 to 0.59 MPa (5 to 6 kgf/cm^2, 71.2 to 85.3 psi)
2. Possible Causes
   - The line above the expansion valve orifice is frozen up and the refrigerant cannot flow due to moisture and/or dirt stuck in the refrigerant cycle.
3. Solution Methods
   Wait for some time to elapse and determine whether it is dirt or moisture blocking the line by whether A/C operation recovers or not.
   - If the problem is moisture, the problem resolves itself, as indicated in the previous section.
   - If the cause is dirt, remove the expansion valve and blow out any dirt with compressed air.
   - If the dirt cannot be eliminated, replace the expansion valve and the receiver. Vacuum out the line and charge the cycle with an appropriate amount of fresh refrigerant.
   - If the problem is caused by a gas leak in the heat-sensitive tube, replace the expansion valve.

(1) Low Pressure Side (2) High Pressure Side

RY9212001CAS0023US0



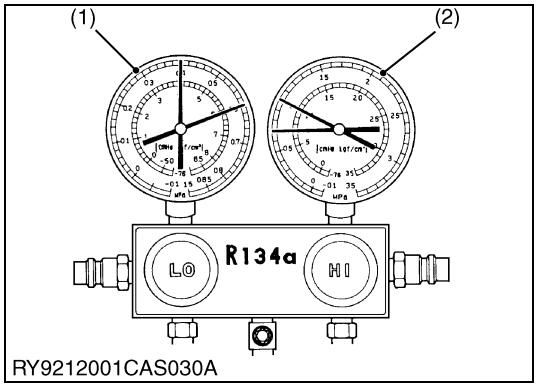
RY9212001CAS029A

Expansion valve too far open

1. Symptoms that appear in the refrigerant cycle
   - Both high (2) and low (1) side pressures are too high. Low-pressure side (1) : 0.29 to 0.39 MPa (3 to 4 kgf/cm^2, 42.7 to 56.9 psi)
     High-pressure side (2) : 1.96 to 2.45 MPa (20 to 25 kgf/cm^2, 284.5 to 355.6 psi)
   - Either frost or heavy condensation on the low-pressure side line
2. Possible Causes
   - Problem with the expansion valve.
   - The flow volume adjustment is set improperly.
3. Solution Methods
   - Replace the expansion valve.

(1) Low Pressure Side (2) High Pressure Side

RY9212001CAS0024US0



RY9212001CAS030A

Faulty compression from compressor

1. Symptoms that appear in the refrigerant cycle
   - Low-pressure side (1) : 0.39 to 0.59 MPa (4 to 6 kgf/cm^2, 56.9 to 85.3 psi)
     High-pressure side (2) : 0.69 to 0.98 MPa (7 to 10 kgf/cm^2, 99.6 to 142.2 psi)
2. Possible Causes
   - Compressor is leaking.
3. Solution Methods
   - Replace the compressor.

CAUTION

- **When the compressor is producing a faulty compression, it can be detected with a manifold gauge (figure at left).**

(1) Low Pressure Side (2) High Pressure Side

RY9212001CAS0025US0

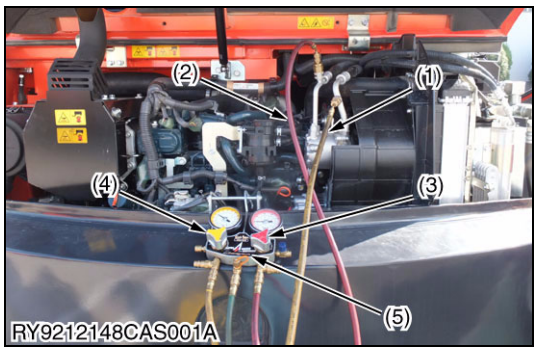
[2] COLLECTION, VACUUMING AND CHARGING

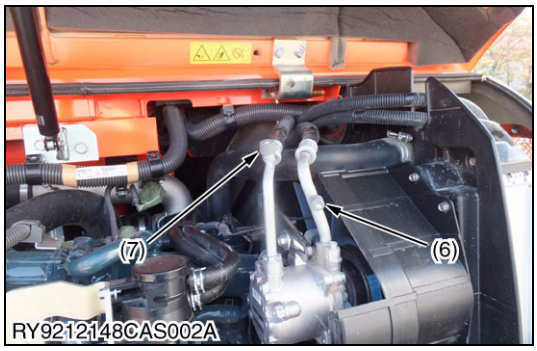
■ **IMPORTANT**

- **Follow 4. Precautions when Repairing the Refrigerant Cycle when discharging, vacuuming and charging the refrigerant system.**

RY9212001CAS0026US0

(1) Collecting Refrigerant





Get a R134a refrigerant collection/recycling device ready to use.

1. Connect the low-pressure hose (blue) (4) from the refrigerant collection/recycling machine to the low-pressure side charge valve (1). Connect the high-pressure hose (red) (5) to the high-pressure charge valve (2).
2. Follow the instructions of the manufacturer and discharge the refrigerant from the cooling system.

■ **IMPORTANT**

- **Do not use device except an R134a refrigerant collection and recycling machine. In order to prevent damage to the compressor, do not mix R134a equipment, refrigerant or compressor oil into an R12 system.**

CAUTION

- **When removing the charge valve hose, cover it with a rag to protect your fingers and eyes from frost bite from the refrigerant.**

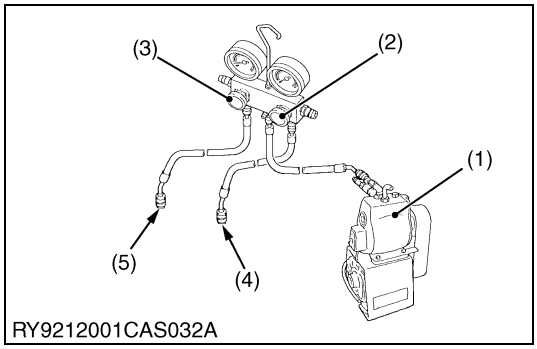
(1) Refrigerant Charging Hose (Blue or Yellow)
(2) Refrigerant Charging Hose (Red)
(3) High-Pressure Valve
(4) Low-Pressure Valve
(5) Manifold Gauge
(6) Low-Pressure Side Charge Valve
(7) High-Pressure Side Charge Valve

RY9212148CAS0006US0

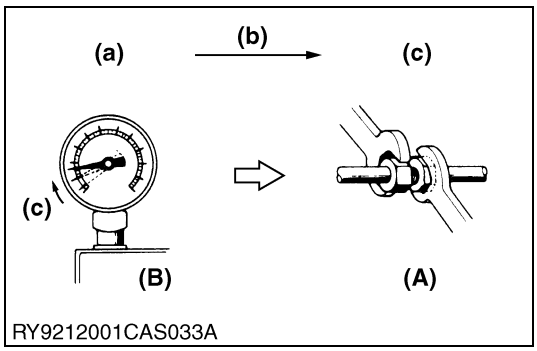
(2) Vacuuming Out the System

No.	Description of Work	Remarks
(1)	Check the connected parts and correct any problems	
(2)	Start vacuuming	Approx 15 minutes, 750 mmHg (229 in.Hg) or greater
(3)	Stop vacuuming	Leave for five minutes
(4)	Check the concentration	If the gauge indicates abnormally, return to (1)
(5)	Charge with refrigerant	98 kPa (1.0 kgf/cm^2, 14 psi)
(6)	Check for gas leaks	
(7)	Charge with refrigerant	

RY9212001CAS0028US0



RY9212001CAS032A



RY9212001CAS033A

Manifold gauge connections and vacuuming

1. Close the high-pressure (HI) and low-pressure (LO) valves of the manifold gauge.
2. Connect the L-shaped side of 2 charging hoses to quick joints and connect them to the compressor and receiver service valves.

Blue hose	Low-pressure side (L mark)
Red hose	High-pressure side (H mark)

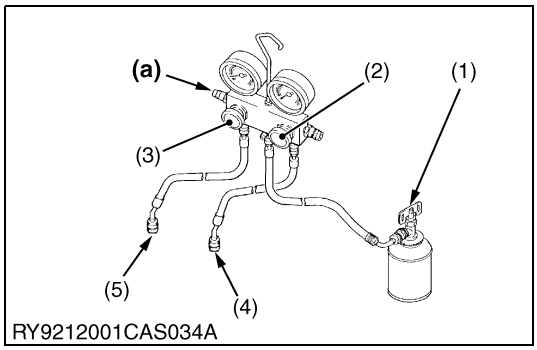
3. Connect the charging hose (green) in the middle of the manifold gauge to the vacuum pump.
4. Open the high and low pressure valves of the manifold gauge.
5. Turn the vacuum pump switch on and vacuum the line until the low-pressure gauge reaches a reading of approximately –0.1 MPa (–750 mmHg). (about 15 minutes)
6. Once about –0.1 MPa (–750 mmHg) is reached, close the high and low pressure valves of the manifold gauge and stop the vacuum pump.
7. Let it set for at least five minutes and check to make sure the indicator needle of the low-pressure gauge does not approach 0.
8. If the needle of the gauge approaches 0, the system's airtightness is compromised somewhere, so after inspecting and repairing the line connections, run the vacuum again and check to make sure there are not any places that are not airtight.

(1) Vacuum Pump
(2) High-Pressure Valve
(3) Low-Pressure Valve
(4) High-Pressure Side (H Mark)
(5) Low-Pressure Side (L Mark)

(A) Inspection Line Connections
(B) Low-Pressure Gauge

(a) Valve Settings (L: Closed, H: Closed)
(b) Leave for at Least Five Minutes
(c) If the Needle Approaches 0, Inspecting and Repairing the Line Connections.

RY9212001CAS0029US0



RY9212001CAS034A

Connections with a refrigerant collector or service canister

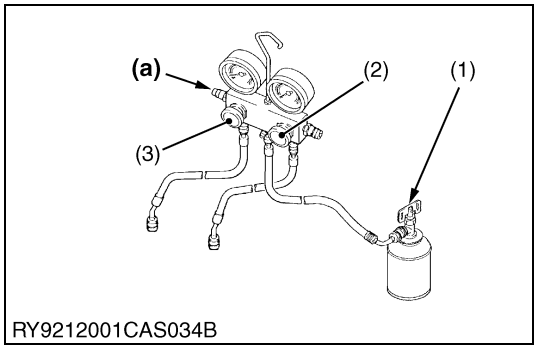
1. Close the high-pressure (HI) and low-pressure (LO) valves of the manifold gauge.
2. Connect the charging hose (green) connected to the vacuum pump to the collector or service canister (Air is in the charging hose, so do not open the high or low pressure valves).
3. Discharge from the collector or open the service canister's valve.
4. Press on the valve core of the manifold gauge for three to five seconds to discharge any air from the hose.

(1) Service Canister Valve
(2) High-Pressure Valve
(3) Low-Pressure Valve
(4) High-Pressure Side (H Mark)
(5) Low-Pressure Side (L Mark)

(a) Press Valve Core to Expel Air

RY9212001CAS0030US0

(3) Charging from the High-Pressure Side



RY9212001CAS034B

Charging from the High-pressure Side

CAUTION
- **Important : do not start the engine. If the engine is running, the gas will flow back and burst either the service canister or a hose.**

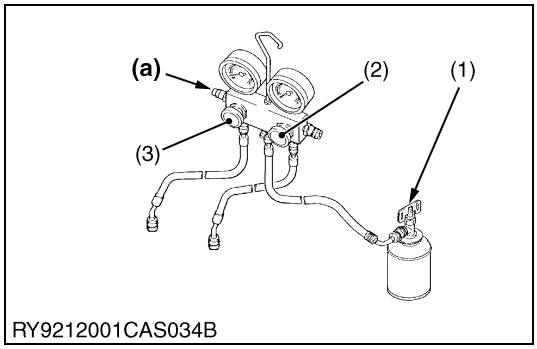
■ **IMPORTANT**
- **Do not open the low-pressure valve of the manifold gauge.**
- **If the service canister has been changed, be sure to expel any air out of the charging hose (green).**

1. Without starting the engine, open the high-pressure valve and charge with approx 500 g of gas.
2. While charging, once the low-pressure gauge indicates approx 0.10 MPa (approx 1.0 kgf/cm^2), close the high-pressure valve and the service canister valve for the time being.
3. Use a gas detector to check the hoses and pipe connections for gas leaks; if any exist, repair them. If there are no leaks, continue charging the refrigerant.
4. When charging on the high-pressure side stops, close the high-pressure valve on the manifold gauge and the service canister valve, and then charge from the low-pressure side.

(1) Service Canister Valve
(2) High-Pressure Valve
(3) Low-Pressure Valve
(a) Press Valve Core to Expel Air

RY9212001CAS0031US0

(4) Charging from the Low-Pressure Side



RY9212001CAS034B

Charging from the Low-Pressure Side

CAUTION
- **Never open the manifold gauge's high-pressure valve when charging refrigerant while the engine is running (If the high-pressure valve is opened, high-pressure gas will flow back up the line and rupture the service canister or a charging hose).**
- **Always keep the service canister upright when charging.**

■ **IMPORTANT**
- **If the service canister has been changed, be sure to expel any air out of the charging hose (green).**

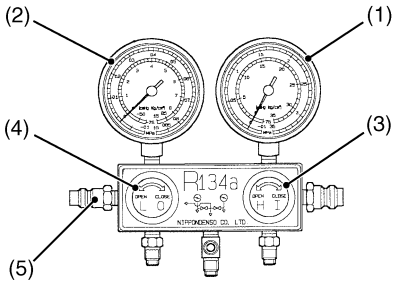
1. Check and make sure the manifold gauge's high-pressure valve is closed.
2. After starting the engine, set it to approx 1500 rpms and open all of the doors.
3. Turn the A/C switch on and set the temperature control to maximum cooling.
4. Open the manifold gauge's low-pressure valve and the service canister valve and charge with the specified amount of gas.
5. After completing refrigerant charging, close the manifold gauge's low-pressure valve and the service canister valve and stop the engine.
6. Check for any gas leaks with the gas leak tester.

(1) Service Canister Valve
(2) High-Pressure Valve
(3) Low-Pressure Valve
(a) Press Valve Core to Expel Air

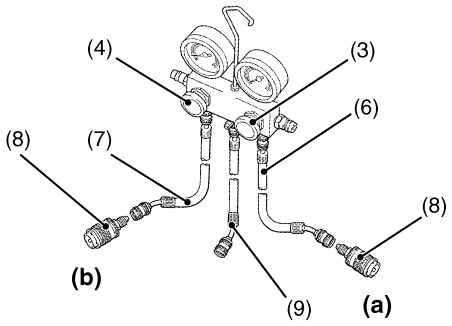
RY9212148CAS0022US0

(5) Inspections and Troubleshooting

[A] Checking the Quantity of A/C Gas



RY9212001CAS035A



RY9212001CAS036A

Checking with a manifold gauge

All the manifold gauge values indicated below are measurements taken under the specified conditions. Please note that the measurements you take will vary depending on the prevailing conditions.

Conditions

Doors	All open
Inside/outside air switch	Inside
Ambient air temperature	30 to 35 °C (86 to 95 °F)
Engine RPM	About 1,500
Temperature control	Max cooling position
Blower switch	HI

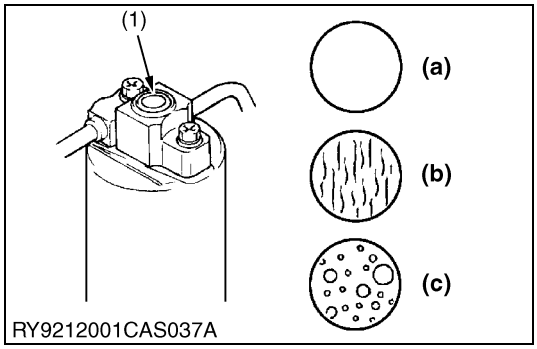
1. After closing both the high and low-pressure valves of the manifold gauge, connect charging hoses (red/blue) to the compressor and the service canister valve of the receiver tank.
2. Loosen the low-pressure valve slightly to expel any air from the charging hose. After expelling the air, close the low-pressure valve again.
3. Expel air from the charging hose on the high-pressure side in the same way.
4. Start the engine and set it at approximately 1500 rpms.
5. Turn the A/C switch ON and set the temperature control to maximum cooling and the blower switch to HI.
6. Read the values on the low-pressure and high-pressure gauges.

When Normal	Factory specification	Low pressure side	0.15 to 0.20 MPa 1.5 to 2.0 kgf/cm^2 21 to 28 psi
	Factory specification	High pressure side	1.27 to 1.66 MPa 13 to 17 kgf/cm^2 185 to 242 psi

(1) High-Pressure Gauge
(2) Low-Pressure Gauge
(3) High-Pressure Valve
(4) Low-Pressure Valve
(5) Valve Core
(6) Red
(7) Blue
(8) Quick Joint
(9) Green

(a) High-Pressure Side (Compressor's H-Mark Side)
(b) Low-Pressure Side (Compressor's L-Mark Side)

RY9212001CAS0033US0



Checking with the sight glass

Conditions

Doors	All open
Inside/outside air switch	Inside
Ambient air temperature	30 to 35 °C (86 to 95 °F)
Engine RPM	About 1500 rpm
Temperature control	Max cooling position
Blower switch	HI

Criteria

(a)	Overcharged	No air bubbles at all in the flow. In this case, both high and low-pressure sides are at high pressure and the cooling is ineffective.
(b)	Normal amount	Almost no air bubbles in the flow. If the engine rpm is raised gradually from idle to 1500 rpm, the air bubbles disappear and the flow becomes transparent.
(c)	Undercharged	Air bubbles flow past constantly.

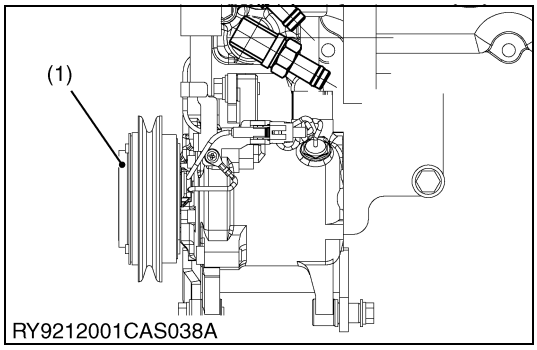
(1) Sight Glass

RY9212001CAS0034US0

6. INSPECTION AND DISASSEMBLY

[1] CHECKS AND ADJUSTMENTS

(1) Compressor



Magnetic clutch

1. Start the engine.
2. With the A/C switch on the A/C control panel off, check and make sure that no scraping sounds or other noise comes from the pulley as it turns.
3. Turn the A/C switch and the fan switch on to make the A/C system operate. With the A/C working, check and make sure the magnetic clutch is not slipping.
4. If there is any noise, repair or replace it.

(1) Magnetic Clutch

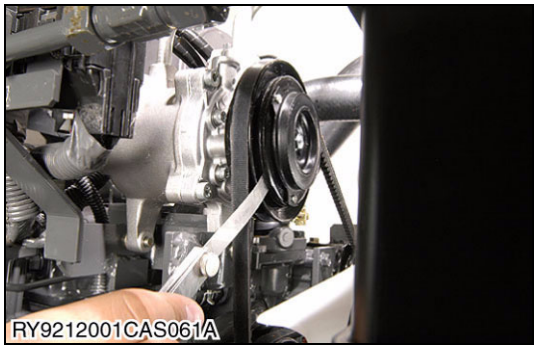
RY9212148CAS0008US0

Stator coil

1. Remove the magnetic clutch's 1P connector.
2. Measure the resistance between the 1P connector on the magnetic clutch side and the body of the stator.
3. If the measurement falls outside of the factory specification, replace the stator coil.

Between stator body and harness side of stator coil	Factory specification	3 to 5 Ω

RY9212148CAS0009US0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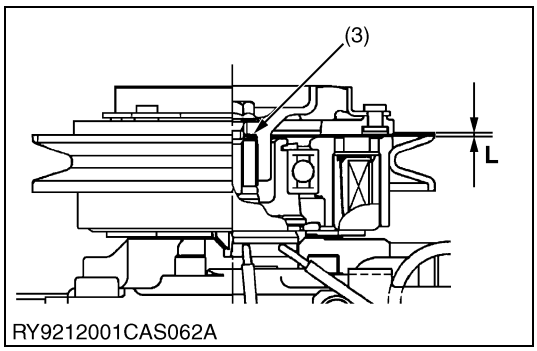

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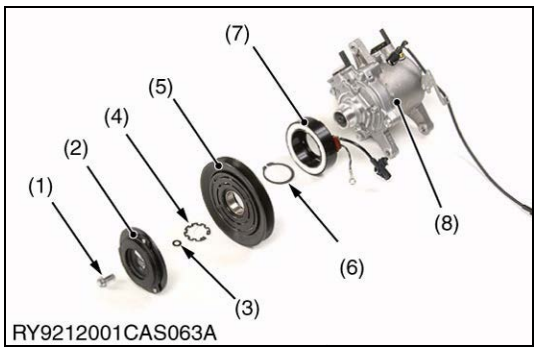


RY9212001CAS063A

Adjusting clearance

1. Use a feeler gauge to check the clearance.
2. If the measurement is outside the factory specification, adjust the clearance.

Clearance	Factory specification	0.30 to 0.65 mm 0.0118 to 0.0255 in.

[NOTE]

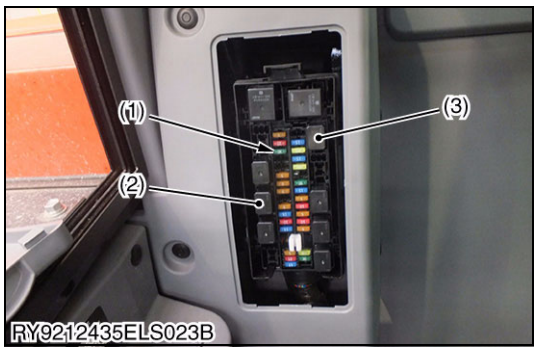
Shim Thickness	Part No.
0.10 mm (0.0039 in.)	T1065-87340
0.15 mm (0.0059 in.)	T1065-87350
0.40 mm (0.016 in.)	T1065-87360
0.60 mm (0.024 in.)	T1065-87370
1.0 mm (0.0394 in.)	T1065-87380

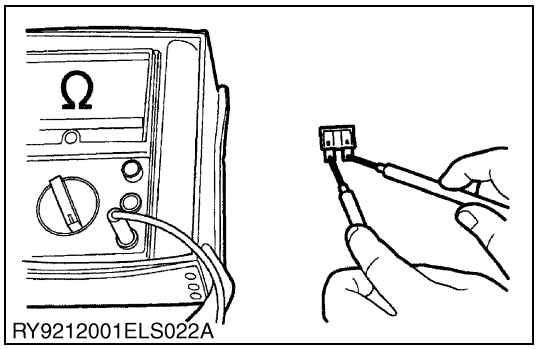
(1) Magnetic Clutch Mounting Screw
(2) Hub Plate
(3) Shim
(4) Snap Ring
(5) Rotor
(6) Snap Ring
(7) Stator
(8) Compressor Body

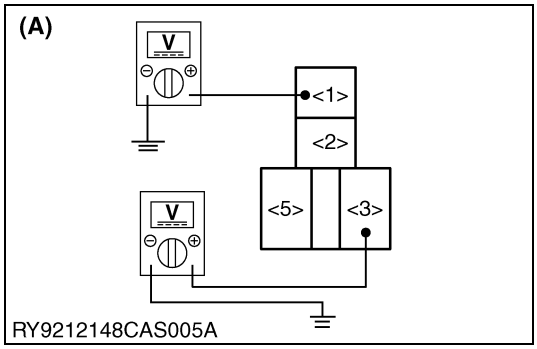
L : Clearance

RY9212148CAS0010US0

(2) Relays







Blower motor inspection

1. Key switch: STOP
2. Check whether the blower motor fuse (30 A) is blown.

Criteria
Regular: no break
Irregular: has a break

3. Switch the blower motor and horn relays.
4. Start the engine, then turn the fan switch to [3] and check if it works.

Criteria
Regular: it works
Irregular: it does not work

(1) Blower Motor Fuse (30 A)
(2) Blower Motor Relay
(3) Horn Relay
(4) Fan Switch

RY9212435CAS0001US0

Blower motor relay voltage check

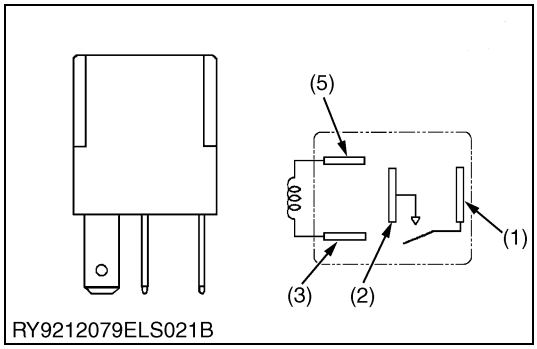
1. Take out the blower motor relay.
2. Key switch: RUN
3. Measure the voltage based on the table below.

Mea-sure-ment	Connector name (+ terminal side)	Pin No.	Connector name (- terminal side)	Pin No.
(a)	Blower motor relay	<1>	Body GND	–
(b)	Blower motor relay	<3>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

(1) Blower Motor Relay
(A) Fuse Box Terminals

RY9212435CAS0002US0



RY9212079ELS021B

Blower motor inspection

1. Key switch: STOP
2. Take out the blower motor relay.
3. Measure the resistance based on the table below.

Measurement	Relay terminal (+ terminal side)	Relay terminal (- terminal side)
(a)	(3)	(5)

Factory spec: 92 to 112 Ω
Outside factory spec: NG

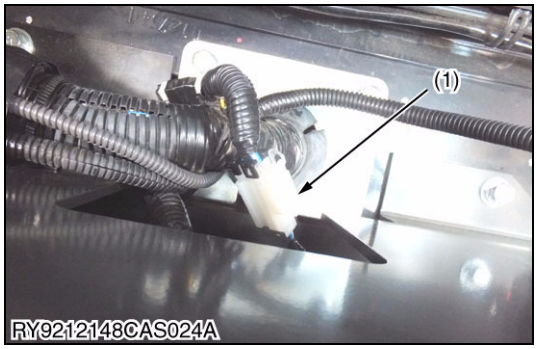
4. Test the continuity based on the table below.

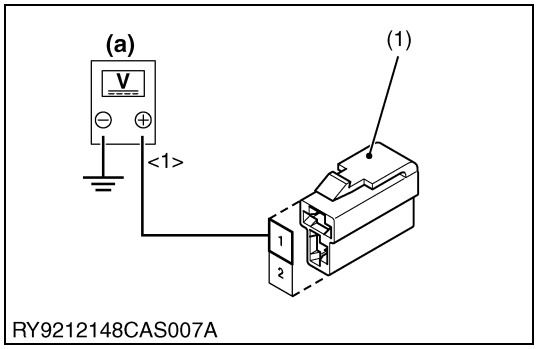
Measurement	Relay terminal (+ terminal side)	Relay terminal (- terminal side)
(a)	(1)	(2)

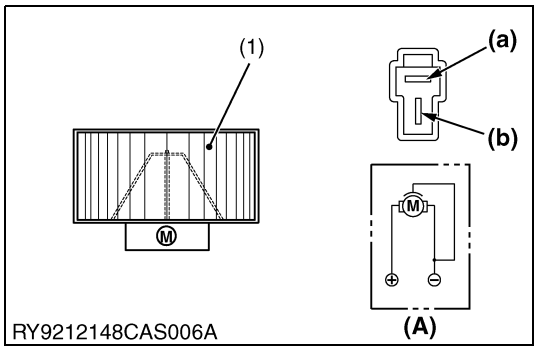
Regular: No continuity
Irregular: Continuity

RY9212148CAS0013US0

(3) Blower Motor







Checking the Voltage

1. Remove the blower motor connector.
2. After starting the engine, set the fan switch on [3].

   Measure the voltage based on the table below.

Mea-sure-ment Point s	Connector Name (+terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(a)	Blower motor connector	<1>	Body GND	–

Normal: 12 V
Irregular: Large discrepancy from 12 V

(1) Blower Motor Connector (2) Fan Switch

RY9212148CAS0014US0

Blower motor test

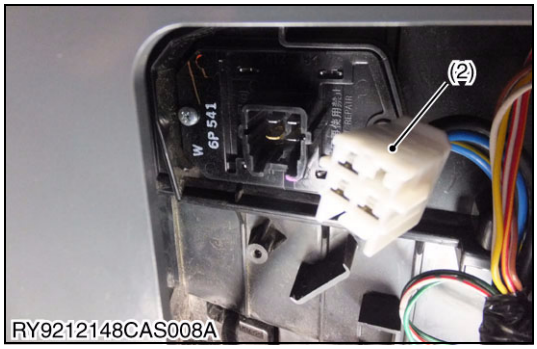
1. Remove the blower resistor.
2. Turn the blower motor by hand and check whether it turns smoothly.
3. If the blower motor fails to turn, check the motor.

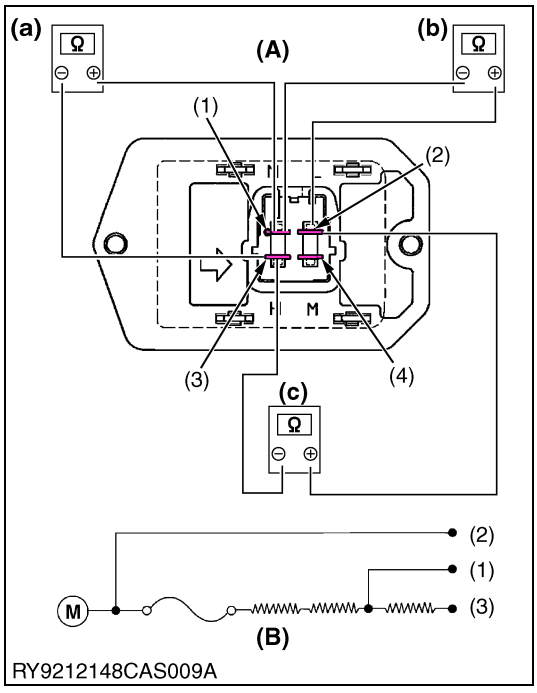
(1) Blower Motor

(A) Circuit Diagram
(a) (+) Terminal
(b) (–) Terminal

RY9212148CAS0015US0

(4) Blower Resistor





Checking the Voltage

1. Remove the blower motor connector.
2. After starting the engine, set the fan switch off.
3. Measure the voltage based on the table below.

Measurement	Connector Name (+terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(a)	Blower resistor motor connector	<2>	Body GND	–

Normal: 12 V
Irregular: Large discrepancy from 12 V

(1) Blower Resistor
(2) Blower Resistor Motor Connector
(3) Fan Switch

RY9212148CAS0016US0

Inspecting the Blower Resistor

1. Put the key switch in its STOP position.
2. Disconnect the blower resistor connector from the machine and test the resistor on its own.
3. Measure the resistance based on the table below.

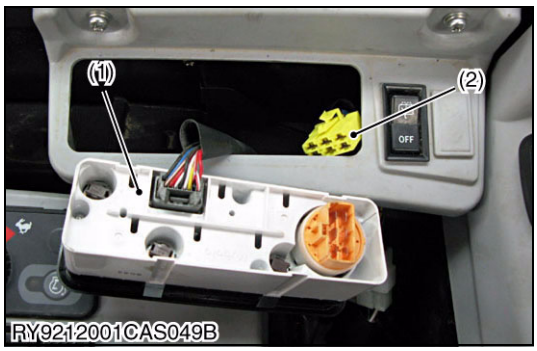
Measurement	Between terminals	Factory specification	Assessment Results
(a)	1 – 3	Approx. 1.0 Ω	
(b)	1 – 2	Approx. 0.7 Ω	
(c)	2 – 3	Approx. 1.7 Ω	

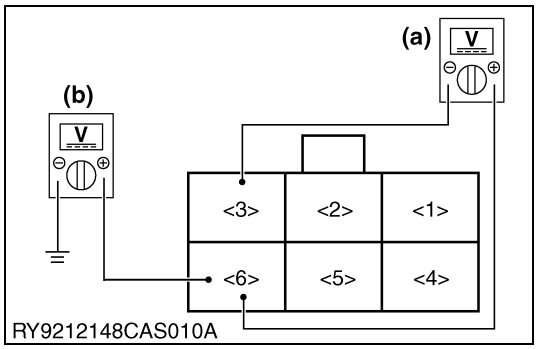
Regular: Within factory specification
Irregular: Outside factory specification

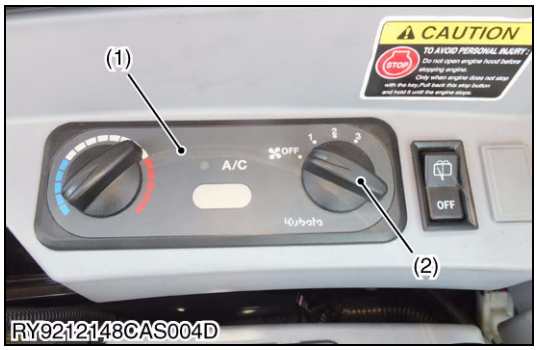
(1) MI
(2) HI
(3) LO
(4) Blank
(A) Blower Resistor
(B) Wiring Diagram

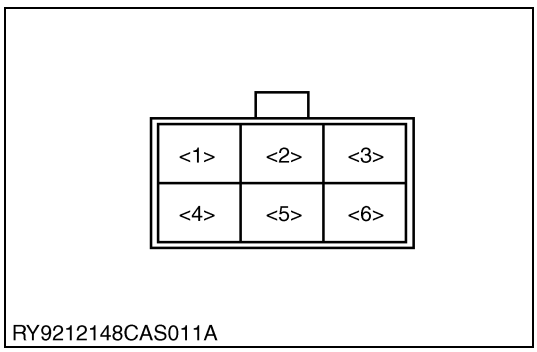
RY9212148CAS0017US0

(5) Blower Switch









Voltage check

1. Disconnect the blower switch connector.
2. Turn the key switch to the RUN position.
3. Measure the voltage based on the table below.

Measurement	Connector terminal name (+ terminal side)	Pin No.	Connector terminal name (- terminal side)	Pin No.
(a)	Blower switch connector	<6>	Blower switch connector	<3>
(b)	Blower switch connector	<6>	Body GND	–

Regular: 12 V
Irregular: Large discrepancy from 12 V

(1) Control Panel (2) Blower Switch Connector

RY9212148CAS0024US0

1. Turn the key switch to the STOP position.
2. Remove the control panel from the machine and test the blower switch independently.

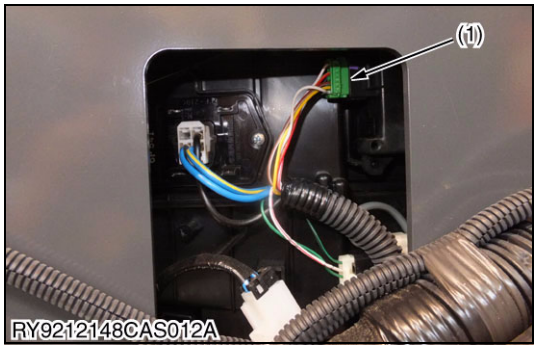
Position		<3>	<6>	<2>	<5>	<1>	<4>
Blower switch	OFF						
	● 1	●	●	●			
	● 2	●	●			●	
	● 3	●	●				●

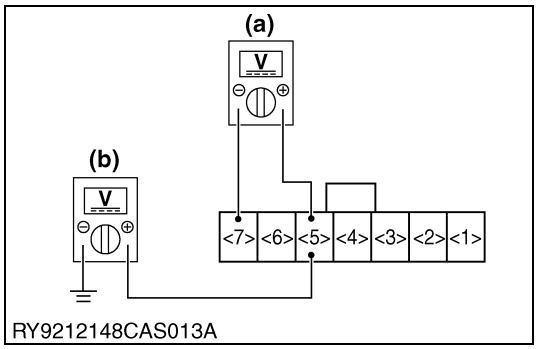
RY9212032CAS011A

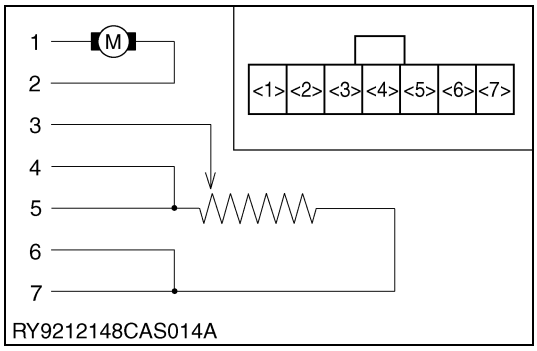
(1) Control Panel (2) Blower Switch

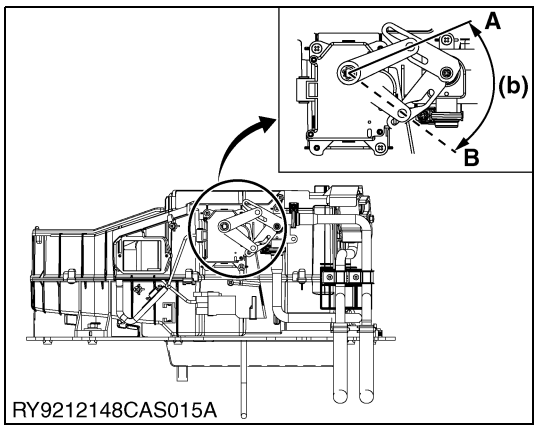
RY9212148CAS0025US0

(6) Servo Motor (for Temp Control)









Voltage check

1. Disconnect the servo motor connector.
2. Turn the key switch to the RUN position.
3. Measure the voltage based on the table below.

Measurement	Connector terminal name (+ terminal side)	Pin No.	Connector terminal name (- terminal side)	Pin No.
(a)	Servo motor connector	<5>	Servo motor connector	<7>
(b)	Servo motor connector	<5>	Body GND	–

Regular: 5V
Irregular: Large discrepancy from 5V

(1) Servo Motor Connector

RY9212148CAS0026US0

Servo motor inspection

1. Turn the key switch to the STOP position.
2. Disconnect the servo motor connector from the machine and test the servo motor independently.
3. Measure the resistance based on the table below.

Measurement	Connector terminal name (+ terminal side)	Pin No.	Connector terminal name (- terminal side)	Pin No.
(a)	Servo motor	<1>	Servo motor	<2>

Regular: Approx. 33 Ω (actual reference value)
Irregular: Large discrepancy from 33 Ω

4. Apply the battery voltage to terminals 1 and 2 of the servo motor and check whether it drives the servo motor.
5. Measure the resistance between A and B in the diagram at left according to the table below.

Measurement	Connector terminal name (+ terminal side)	Pin No.	Connector terminal name (- terminal side)	Pin No.
(b)	Servo motor	<3>	Servo motor	<5>

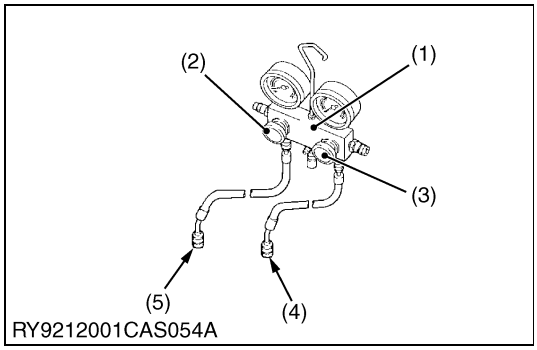
Regular: Gradual change in resistance (0 to within 6 kΩ)
Irregular: No change in resistance

RY9212148CAS0027US0

(7) Pressure Switch

When a pressure switch (inside the high-pressure/low-pressure switch) is operating normally, electricity is conducted (ON) and when an abnormal pressure occurs, it trips the switch, blocking the electricity (OFF).

RY9212001CAS0046US0



RY9212001CAS054A

Manifold gauge connections

1. Close the HI (high-pressure side) valve (3) and the LO (low-pressure side) valve (2) of the manifold gauge (1) securely.
2. Connect the red charging hose (4) to the HI (high-pressure side) charge valve (1) and the blue charging hose (5) to the LO (low-pressure side) charge valve (2).
3. Open the manifold gauge's HI (high-pressure side) valve (3) a little and press on the valve core to expel any air inside its charging hose (4). Then close the HI (high-pressure side) valve (3) tightly.
4. Open the manifold gauge's LO (low-pressure side) valve (2) a little and press on the valve core to expel any air inside its charging hose (5). Then close the LO (low-pressure side) valve (2) tightly.

(1) Manifold Gauge
(2) Low-Pressure Valve
(3) High-Pressure Valve
(4) Red Charging Hose
(5) Blue Charging Hose

RY9212001CAS0047US0

RY9212148CAS016A

When refrigerant pressure is rising (OFF)

1. Start the engine and set it at 1,500 rpms. Turn the A/C switch on the control panel on, set the fan switch to HI and set the temperature control lever to the max cool position.
2. Cover the front of the condenser with cardboard or the like and raise the pressure on the high-pressure side of the A/C cycle.
3. Once the pressure on the high-pressure side rises, the high-pressure switch operates, turning the magnetic clutch of the compressor off. When it does so, read the HI (high-pressure) gauge of the manifold gauge and if it reads higher than the pressure setting, replace the pressure switch (8).

- Pressure setting on the high-pressure side of the switch:
  Switches off at approximately 3.14 MPa (32 kgf/cm^2, 460 psi) or higher

RY9212148CAS0018US0

When refrigerant pressure is dropping (OFF)

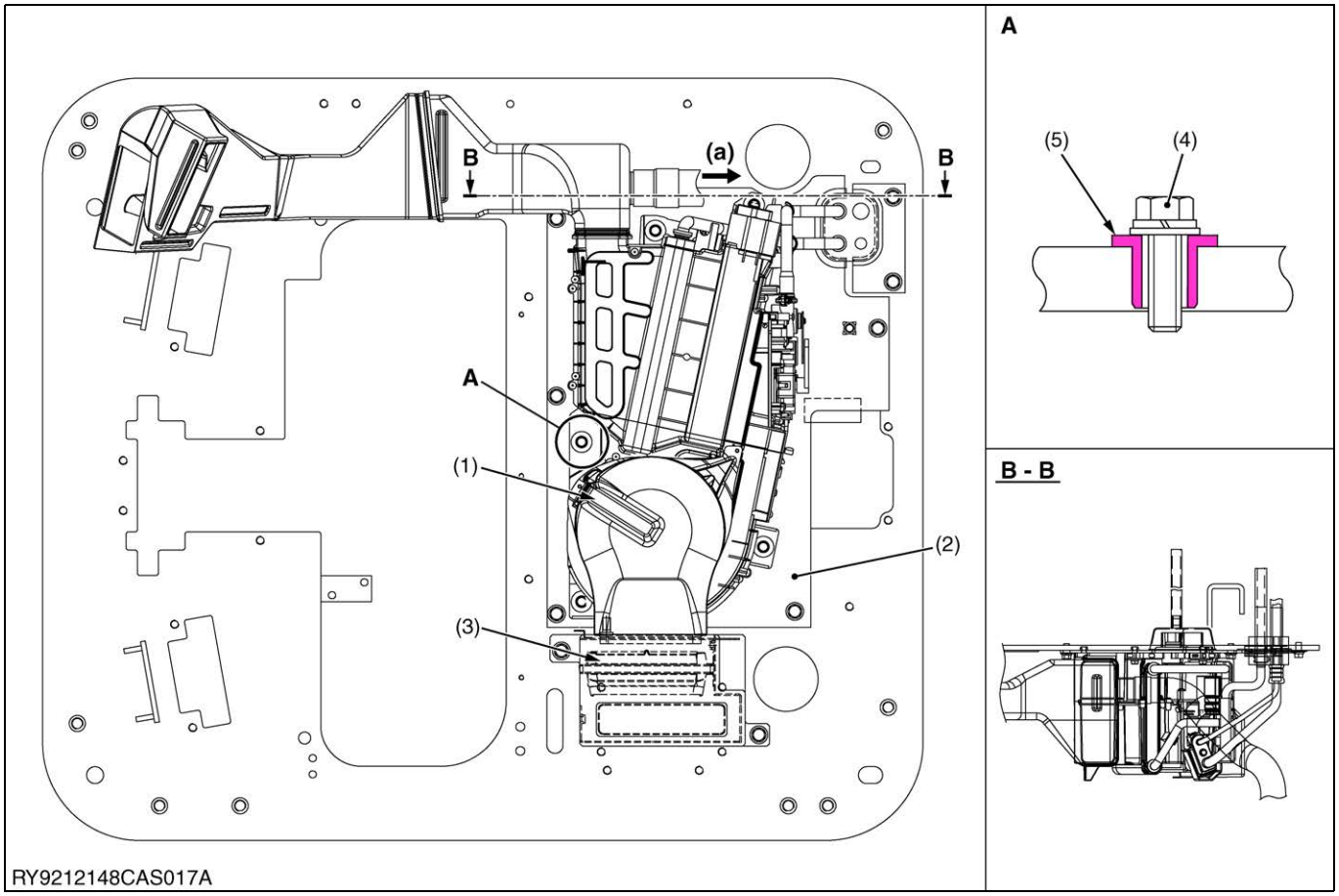
1. Remove the connector of the pressure switch.
2. Measure the resistance between the terminals of the pressure switch with a circuit tester. It should register 0 Ω unless there is insufficient gas due to a leak or unless the pressure switch is faulty.

- Pressure setting on the low-pressure side of the switch:
  Switches off at approximately 0.196 MPa (2.0 kgf/cm^2, 28 psi)

RY9212001CAS0049US0

[2] DISASSEMBLY AND ASSEMBLY

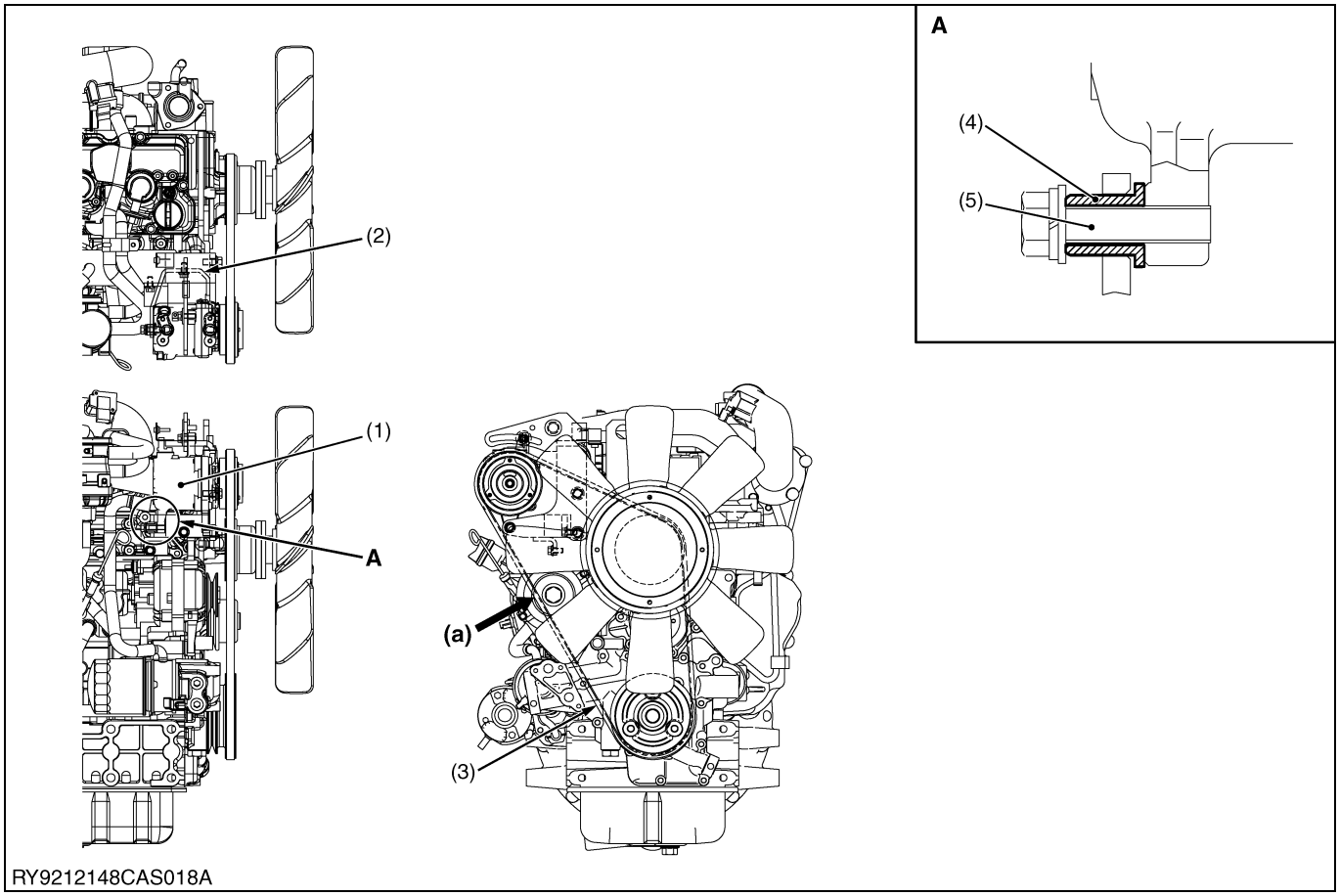
(1) A/C Unit Assembly/Disassembly



(1) A/C Unit
(2) A/C step
(3) Filter
(4) Bolt
(5) Collar
(a) To rear duct

RY9212148CAS0028US0

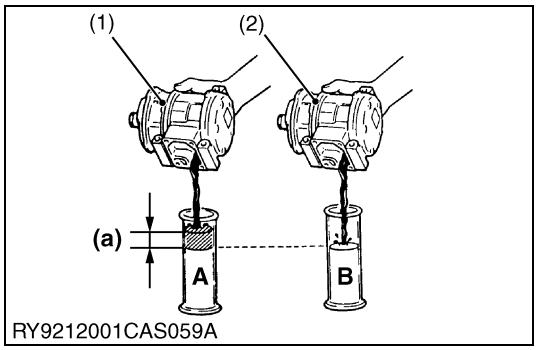
(2) Mounting and Removing the Compressor



RY9212148CAS018A

(1) Compressor ASSY
(2) Compressor bracket
(3) V belt
(4) Bolt
(5) Compressor Bushing
(a) Point to measure compressor belt tension

RY9212148CAS0029US0



RY9212001CAS059A

Filling the Compressor with Oil

When replacing the compressor

- The amount of oil required by the new compressor is enclosed within the A/C cycle. A certain amount of compressor oil circulates along with the gas in the A/C system.
- When replacing the compressor, remove the excess oil from the new compressor.
- Compressor oil (ND-OIL8) readily absorbs moisture, so seal it immediately.

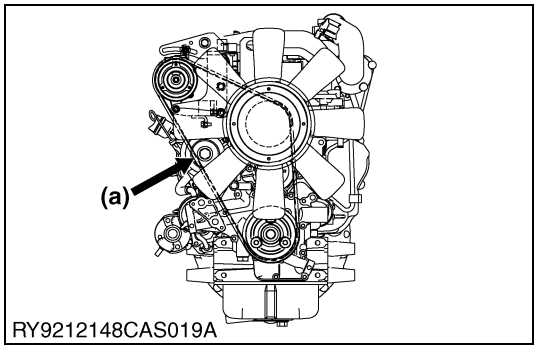
Compressor Oil	Type: ND-OIL8	Capacity (reference value): 60 cc

(1) New Compressor
(2) Compressor Being Replaced

A : Amount of Oil for New Compressor
B : Amount of Oil from Old Compressor

(a) Remove Excess Oil (A-B)

RY9212079CAS0037US0



RY9212148CAS019A

When replacing the compressor, press at point **(a)** on the drive belt and adjust the tension.

■ **IMPORTANT**

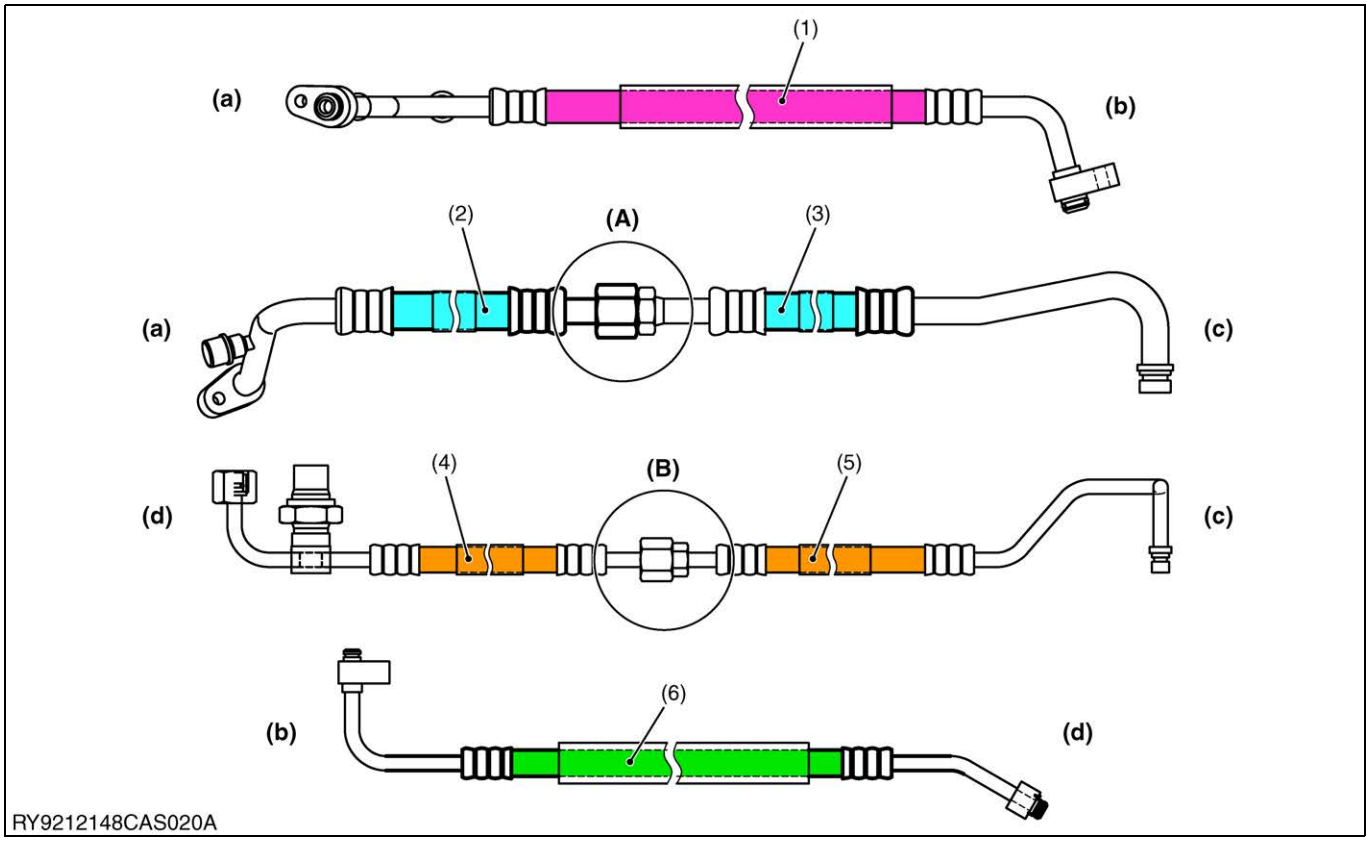
- **Be careful that the compressor bushing faces the right direction.**

Belt tension adjustment	98 N 10.0 kgf 22 lbf	20 to 25 mm 0.79 to 0.98 in.

RY9212148CAS0030US0

(3) A/C and Heater Hose Routing

[A] A/C Hose



(1) Discharge Hose
(2) Suction Hose 2
(3) Suction Hose 1
(4) Liquid Hose P2
(5) Liquid Hose P1
(6) Liquid Hose

(a) Compressor Side
(b) Condenser Side
(c) A/C Unit Side
(d) Receiver Side

(A) M24X1.5 Connection
(B) M16X1.5 Connection

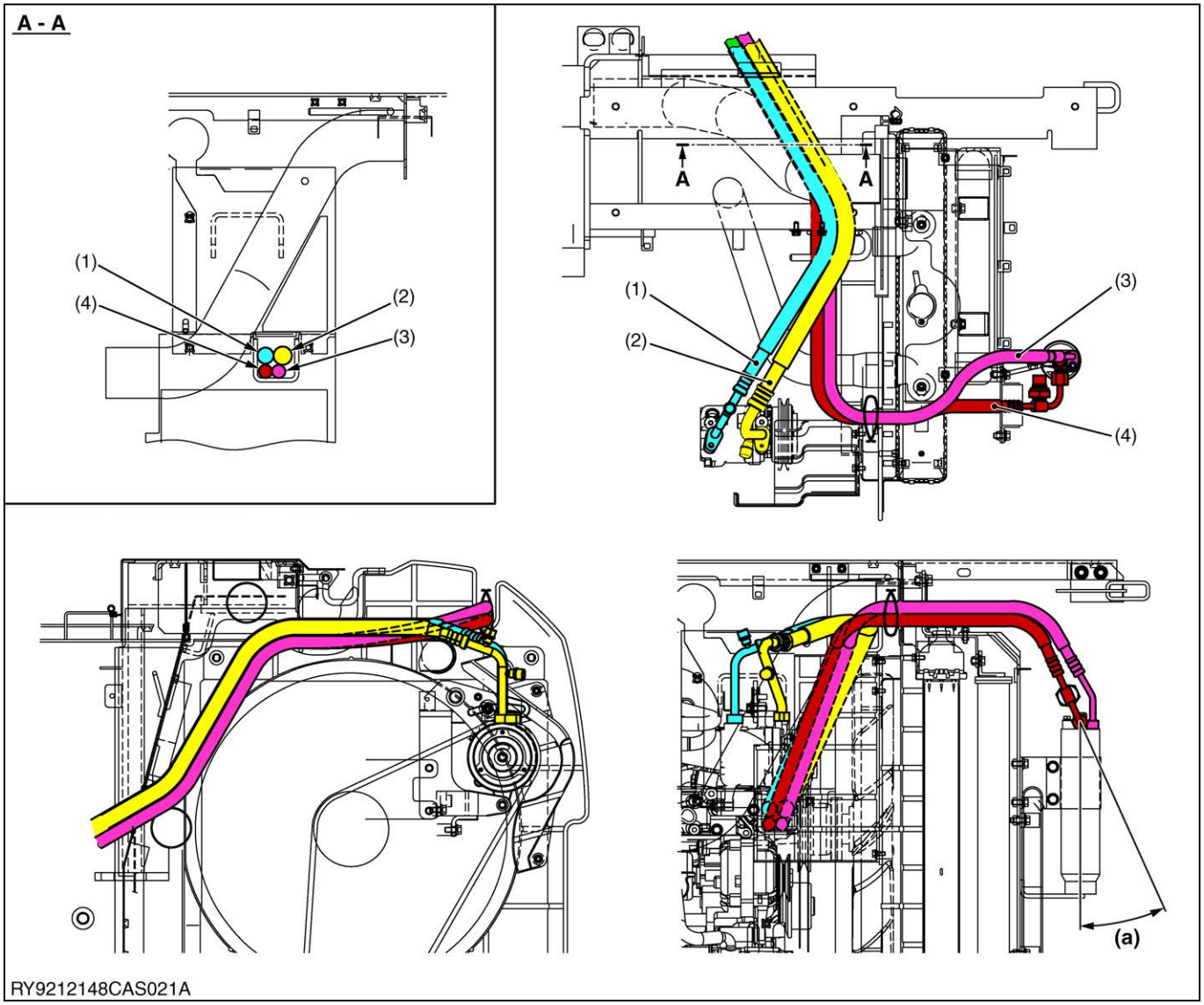
Torque	Discharge hose (1) (M6 bolt)	7.9 to 11.8 N·m 0.8 to 1.2 kgf·m 5.8 to 8.7 lbf·ft
	Suction hose (2), (3) (M24X1.5)	29.4 to 34.3 N·m 3.0 to 3.5 kgf·m 21.7 to 25.3 lbf·ft
	Liquid hose (4), (5) (M16X1.5)	11.8 to 14.7 N·m 1.2 to 1.5 kgf·m 8.7 to 10.8 lbf·ft
	Liquid hose (6) (Condenser side M6 bolt)	7.9 to 11.8 N·m 0.8 to 1.2 kgf·m 5.8 to 8.7 lbf·ft
	Liquid hose (6) (Receiver side M6 bolt)	3.9 to 6.9 N·m 0.4 to 0.7 kgf·m 2.9 to 5.1 lbf·ft

CAUTION

- **Always collect the refrigerant before disconnecting any hoses and promptly seal the A/C system so no moisture or water gets into it.**
- **Disconnect the negative battery terminal before disconnecting any connectors.**
- **Be careful not to mix up the high and low-pressure hoses or the charge/discharge hoses.**
- **Apply compressor oil (ND-OIL8) to pipes with O-rings and push the tip in to the ridged surface.**
- **Install so pipes and hoses are not twisted.**
- **Use two wrenches on aluminum pipe nuts and fasten to keep the companion nut from turning (The material of the companion nut is softer, so be careful when tightening it).**

RY9212148CAS0031US0

[B] Hose Routing

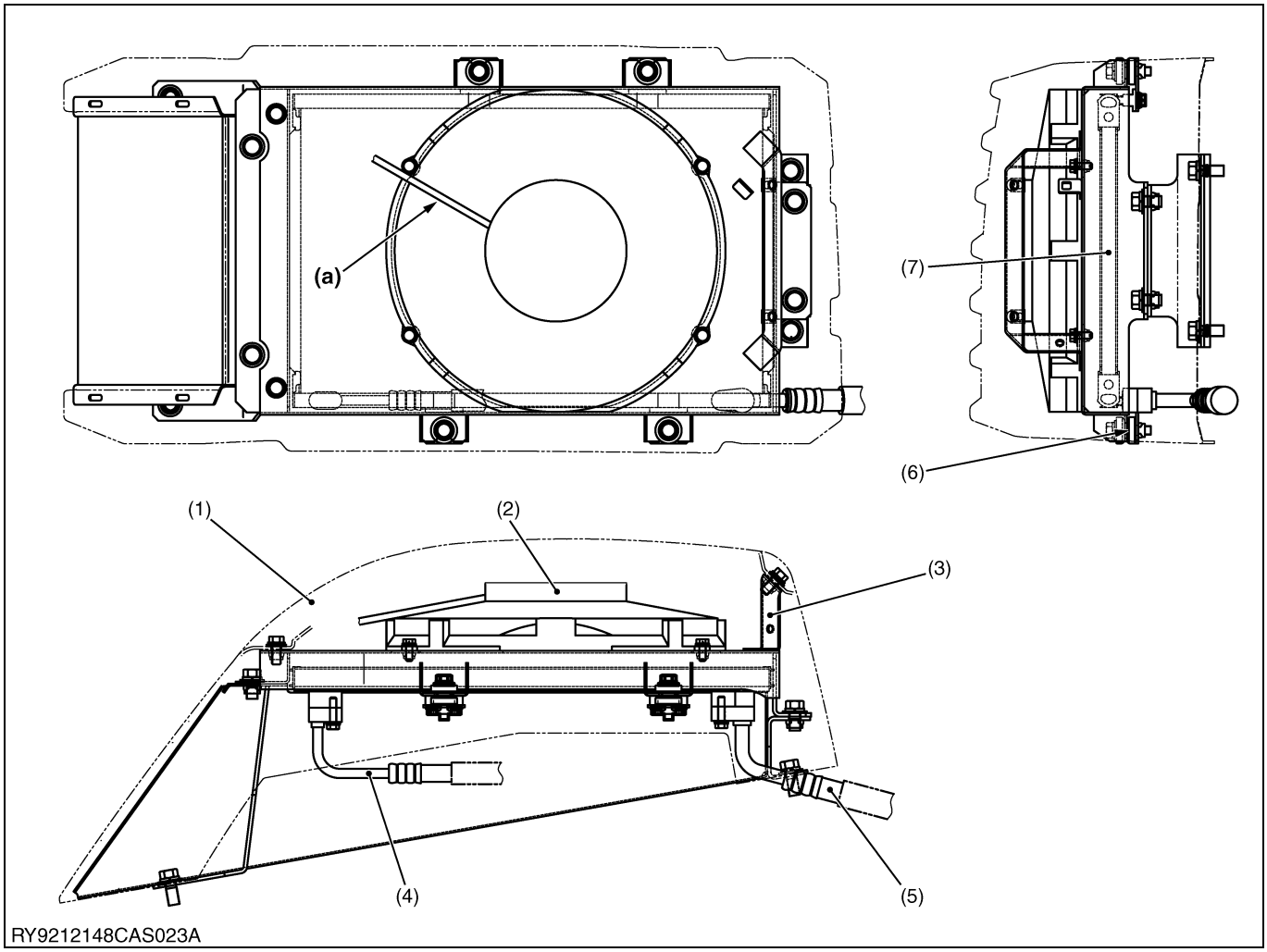


(1) Discharge Hose
(2) Suction Hose 2
(3) Liquid Hose
(4) Liquid Hose P2

(a) 25°(0.44 rad)

RY9212148CAS0032US0

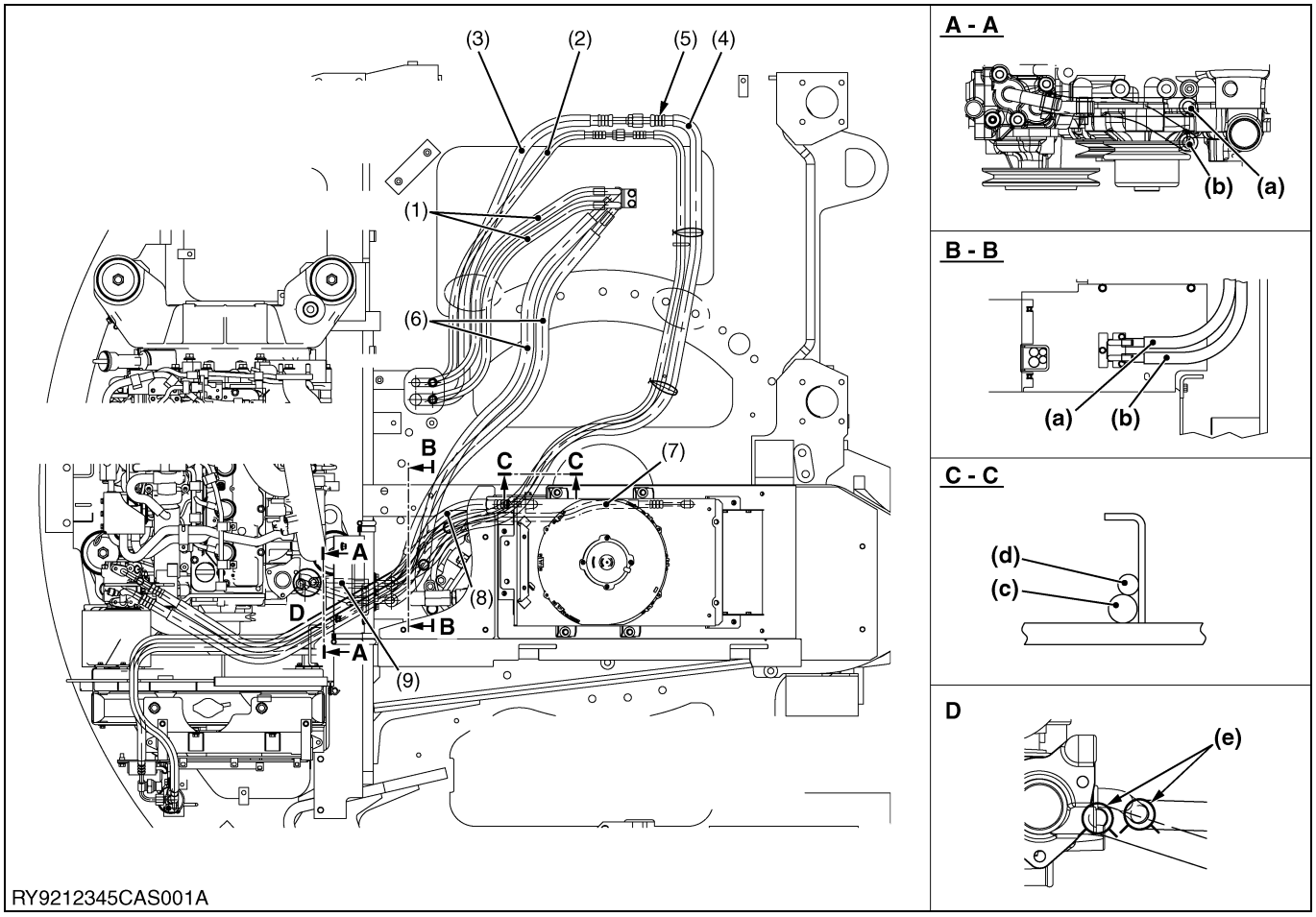
(4) Electric Condenser/Fan Mounting and Removal



RY9212148CAS023A

(1) Condenser Cover
(2) Electric Fan
(3) Condenser Base
(4) Liquid Hose
(5) Discharge Hose
(6) Cushion
(7) Condenser
(a) Electrical Wiring

RY9212148CAS0033US0



RY9212345CAS001A

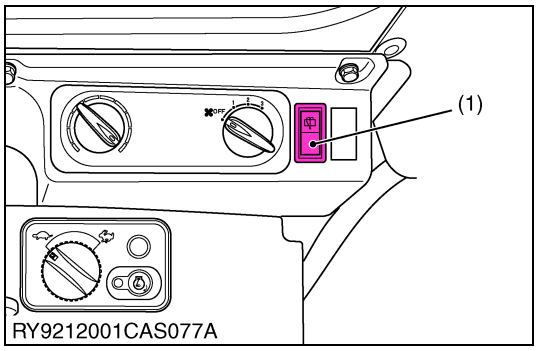
(1) Heater Hose 2
(2) Liquid Hose P1
(3) Suction Hose 1
(4) Liquid Hose P2
(5) Suction Hose 2
(6) Heater Hose 2
(7) Liquid Hose
(8) Discharge Hose
(9) Heater Hose 1

(a) Engine Side Discharge
(b) Engine Side Return
(c) A/C Unit Return
(d) A/C Unit Supply
(e) Take care to face clamps correctly.

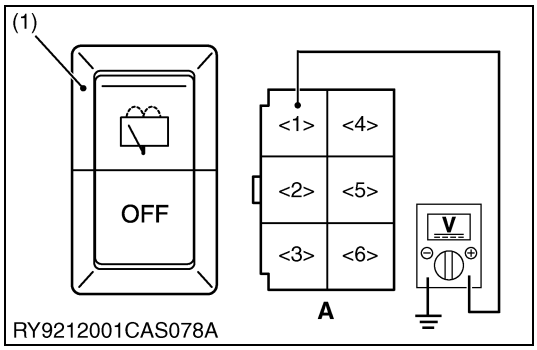
RY9212435CAS0003US0

7. WINDOW WASHER

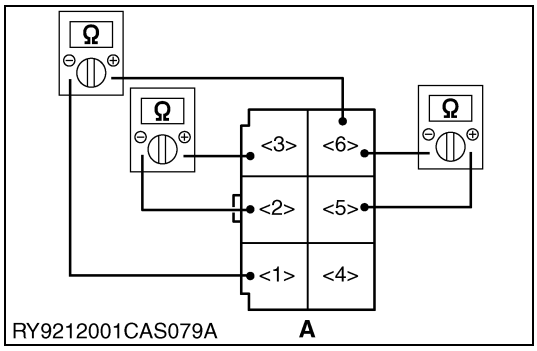
[1] WIPER SWITCH



RY9212001CAS077A



RY9212001CAS078A



RY9212001CAS079A

Connector voltage

1. Remove the 6P connector from the wiper switch.
2. Switch the starter switch to [RUN] and the wiper switch to ON.
3. Measure the voltage between terminal 1of the connector on the harness side and ground on the body.
4. If is the same as the battery voltage (DC 11 to 14 V), it is normal.

(1) Wiper Switch **A : 6P Connector (Harness Side)**

RY9212001CAS0071US0

Checking the wiper switch

1. Check the continuity between each of the terminals according to the table below.
2. If continuity exists, it is normal.

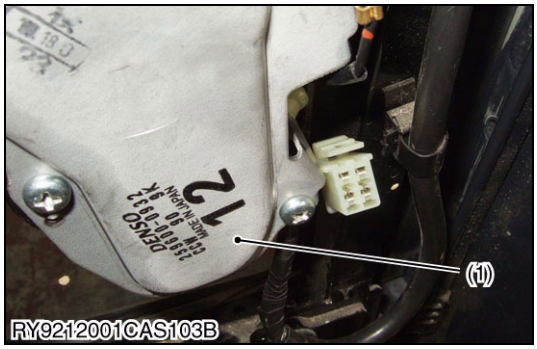
Position	<3>	<2>	<1>	<6>	<5>
WASH1	●	●		●	●
ON			●	●	
OFF				●	●
WASH2	●	●	●	●	

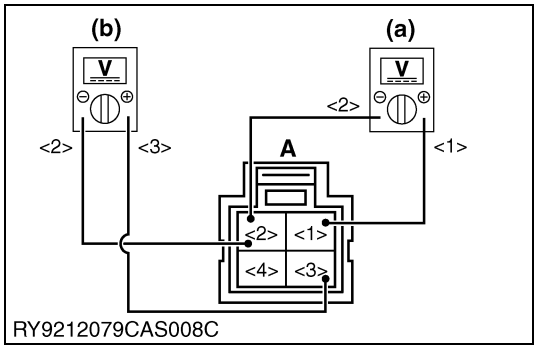
RY9212032CAS012A

A : 6P Connector (Switch Side)

RY9212001CAS0072US0

[2] WIPER MOTOR





Checking the Voltage

1. Remove the wiper motor connector.
2. Start the engine and turn the wiper switch ON.

Measure the voltage based on the table below.

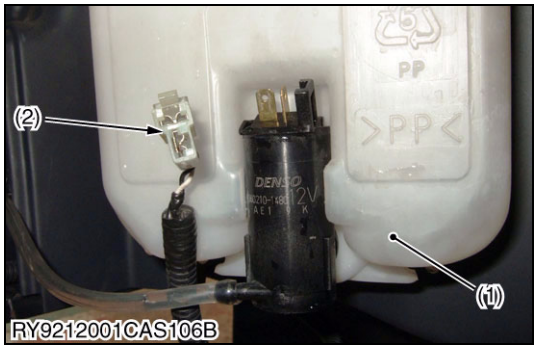
Measurement Points	Connector Name (+terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(a)	Wiper motor connector	<1>	Wiper motor connector	<2>
(b)	Wiper motor connector	<3>	Wiper motor connector	<2>

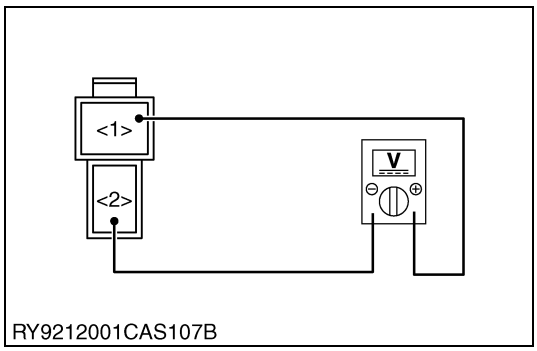
Regular: 12 V
Irregular: Large discrepancy from 12 V

(1) Wiper Motor **A : Wiper Motor Connector**

RY9212148CAS0019US0

[3] WASHER MOTOR





Checking the Voltage

1. Remove the washer motor connector.
2. Start the engine and turn the wiper switch ON.

Measure the voltage based on the table below.

Measurement Points	Connector Name (+terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(a)	Washer motor connector	<2>	Washer motor connector	<1>

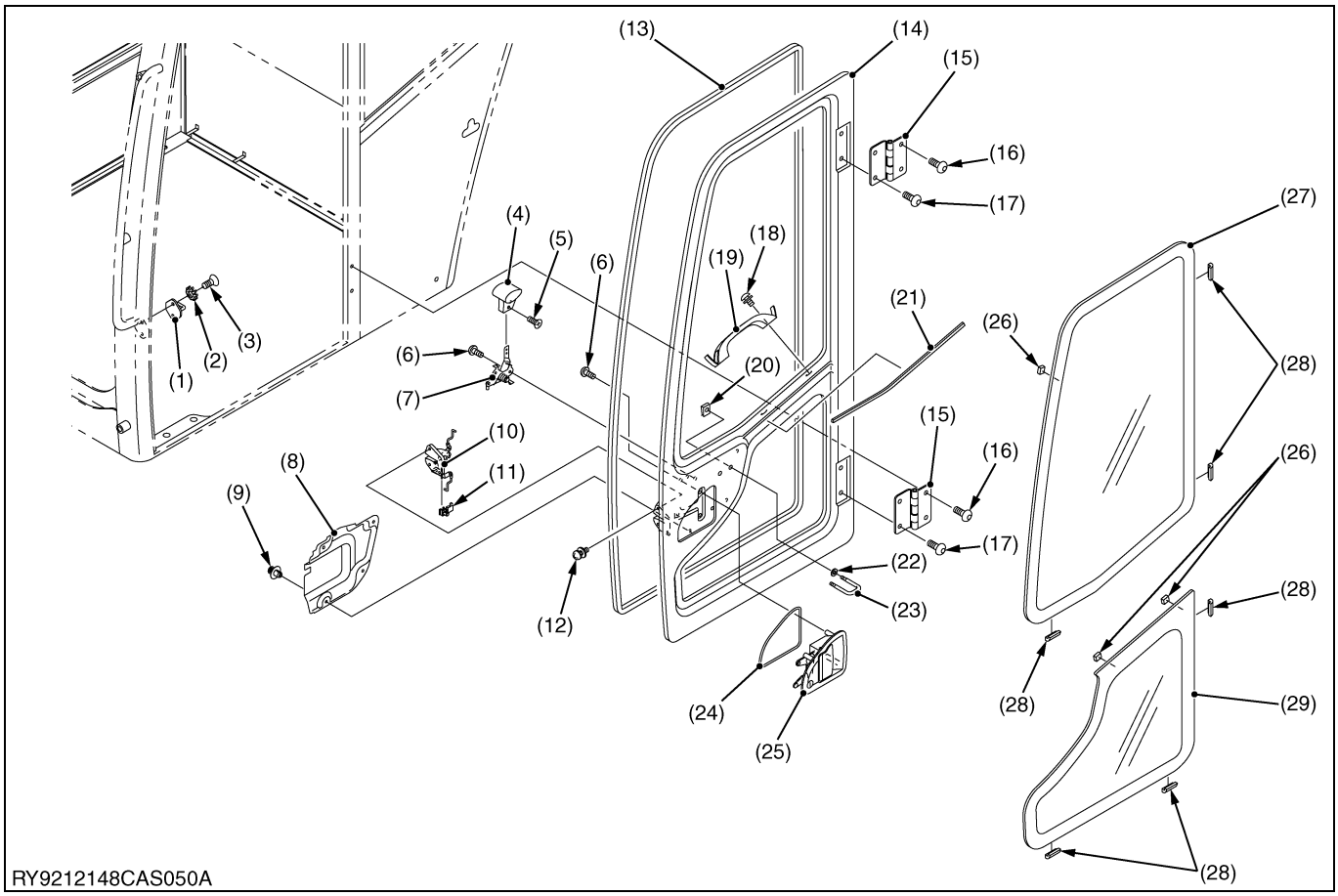
Regular: 12 V
Irregular: Large discrepancy from 12 V

(1) Washer Tank (2) Washer Motor Connector

RY9212148CAS0020US0

8. CABIN GLASS REMOVAL AND MOUNTING

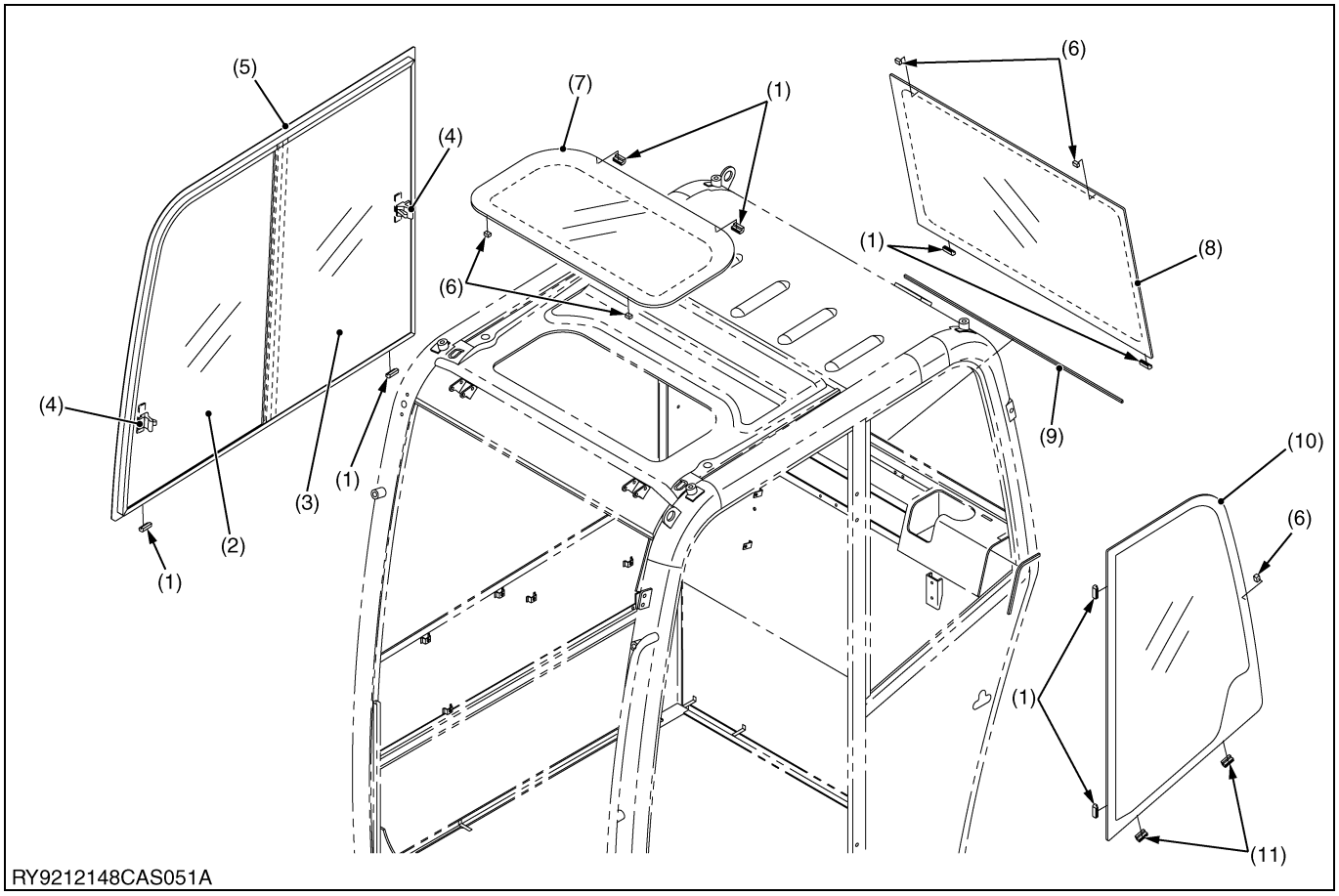
[1] COMPONENT SCHEMATIC



RY9212148CAS050A

No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Striker (door)	1	(16)	Bolt	4
(2)	Toothed washer	2	(17)	Bolt	4
(3)	Screw	2	(18)	Screw	2
(4)	Knob	1	(19)	Handle	1
(5)	Screw	2	(20)	Spring nut	2
(6)	Bolt	5	(21)	Seal	1
(7)	Handle ASSY (inner)	1	(22)	Washer	2
(8)	Cover	1	(23)	U bolt	1
(9)	Fastener	4	(24)	Seal	1
(10)	Door lock ASSY	1	(25)	Handle ASSY (Outer)	1
(11)	Joint	1	(26)	Spacer	3
(12)	Screw	3	(27)	Upper glass	1
(13)	Trim	1	(28)	Spacer	6
(14)	Doors	1	(29)	Lower glass	1
(15)	Hinge	2			

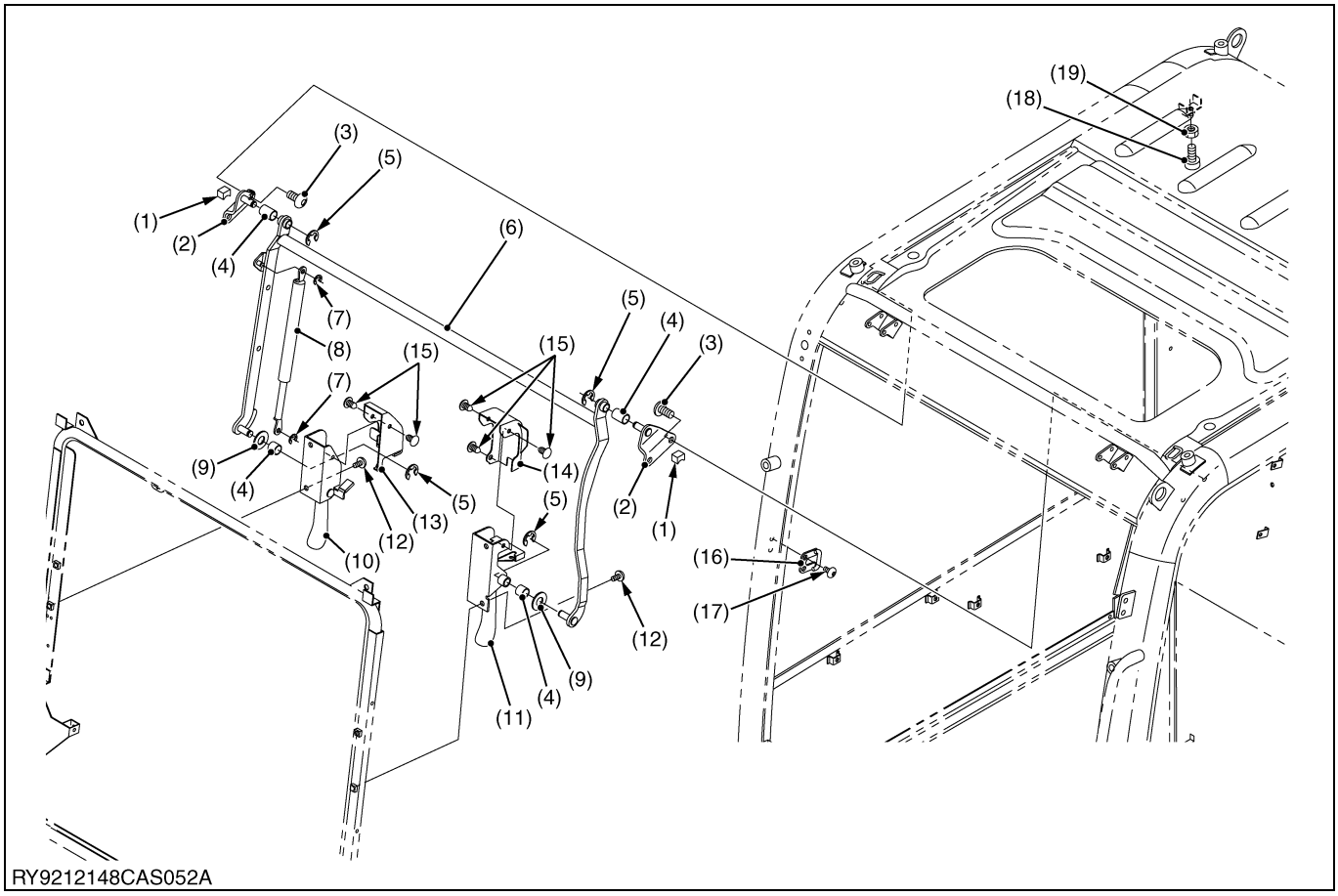
RY9212148CAS0076US0



RY9212148CAS051A

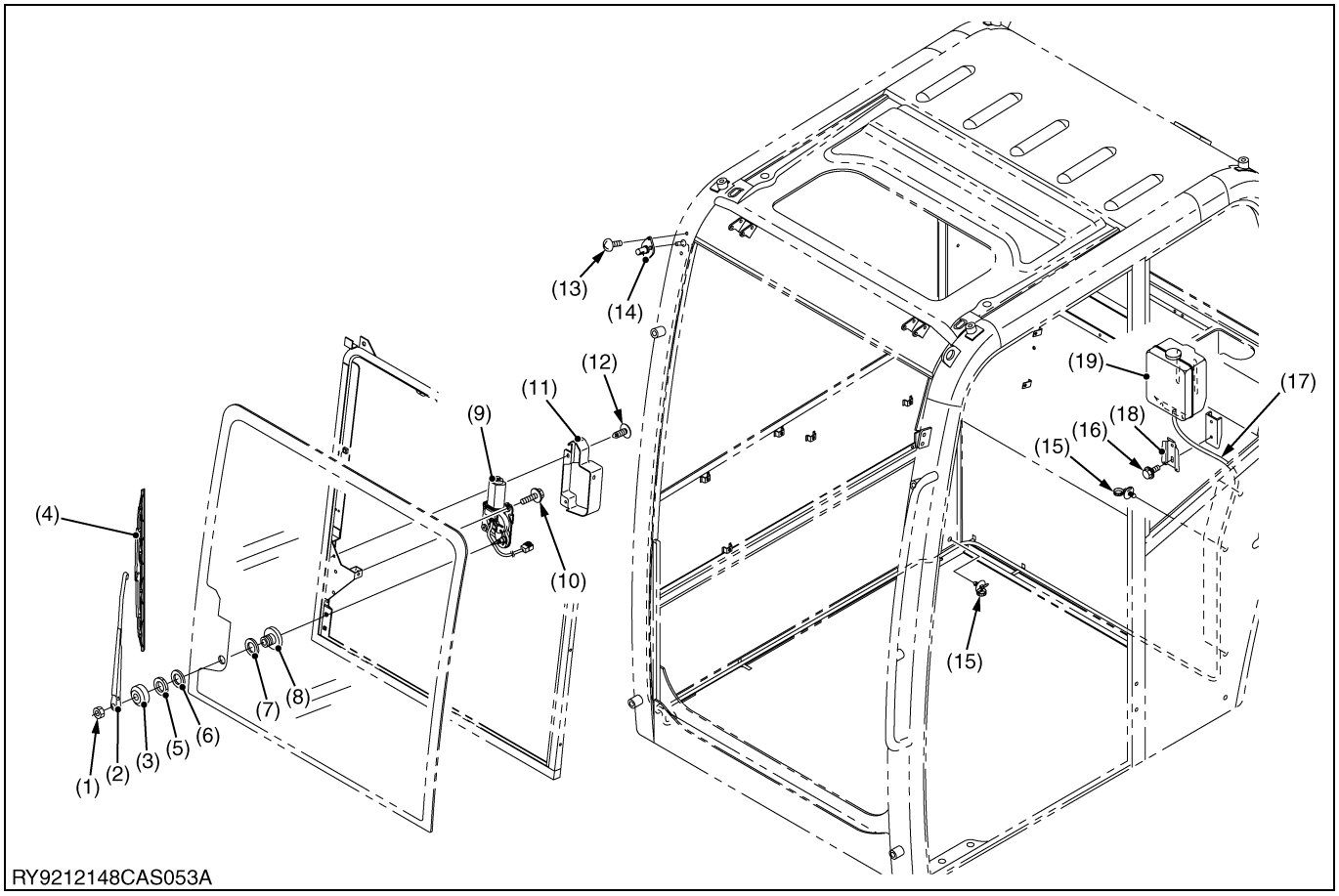
No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Spacer	8	(7)	Roof	1
(2)	Front glass	1	(8)	Glass	1
(3)	Rear glass	1	(9)	Cushion	1
(4)	Hook	2	(10)	Glass	1
(5)	Sash	1	(11)	Spacer	2
(6)	Spacer	5			

RY9212148CAS0077US0



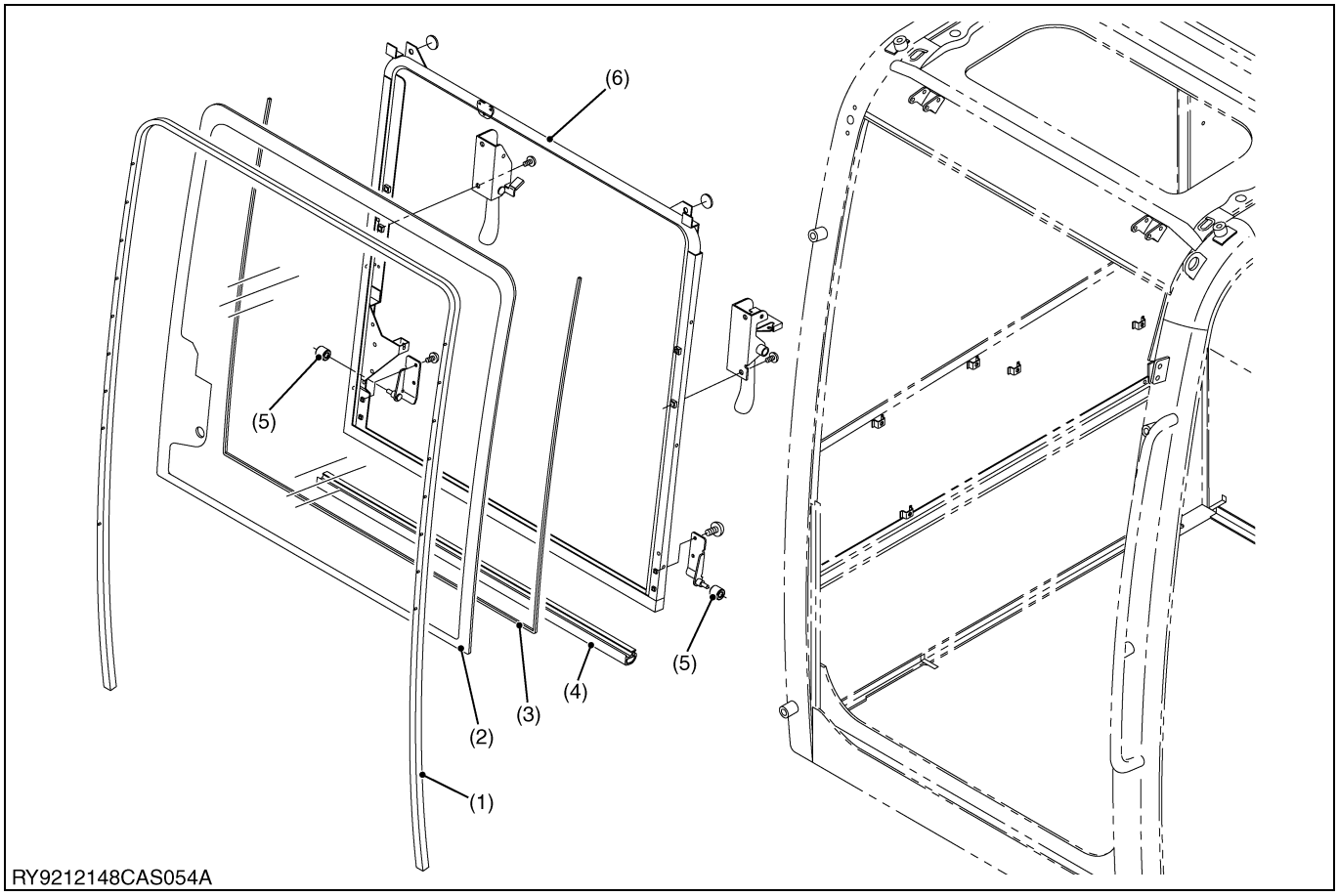
No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Stopper	2	(11)	Lever	1
(2)	Linkage	2	(12)	Bolt	4
(3)	Bolt	4	(13)	Cover	1
(4)	Bushing	4	(14)	Cover	2
(5)	Snap ring	4	(15)	Clip	5
(6)	Linkage	1	(16)	Striker	1
(7)	Snap ring	2	(17)	Bolt	4
(8)	Damper	1	(18)	Stopper (rubber)	2
(9)	Washer	2	(19)	Nut	2
(10)	Lever	1			

RY9212148CAS0078US0



No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Nut	1	(11)	Cover	1
(2)	Arm (wiper)	1	(12)	Clip	3
(3)	Cap	1	(13)	Screw	2
(4)	Blade (wiper)	1	(14)	Nozzle	1
(5)	Nut	1	(15)	Clamp	4
(6)	Washer	1	(16)	Bolt	2
(7)	Gasket	1	(17)	Hose	1
(8)	Holder	1	(18)	Flange	1
(9)	Wiper Motor	1	(19)	Washer tank	1
(10)	Bolt	3			

RY9212148CAS0079US0



No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Seal	1	(4)	Trim	1
(2)	Glass, Front upper	1	(5)	Roller	2
(3)	Trim	1	(6)	Frame	1

RY9212148CAS0080US0

[2] NECESSARY TOOLS

(1) Piano Wire
(2) Scraper
(3) Slotted Screwdriver
(4) Needle-Nose Pliers
(5) Utility Knife
(6) Slotted Screwdriver
(7) Torx (T50)
(8) Wrench (10 mm)
(9) Wrench (27 mm)
(10) Socket (M12), Ratchet
(11) Suction Pads

RY9212148CAS0036US0

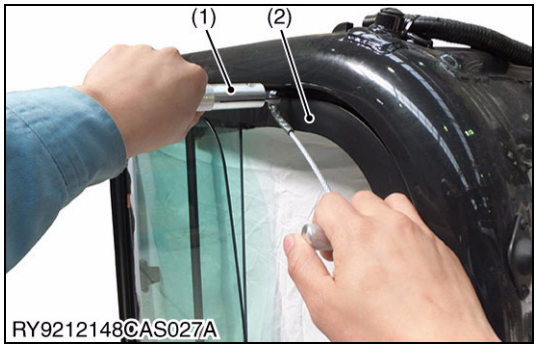
[3] REMOVING THE GLASS ON THE RIGHT

1. Protect inside cabin from possible glass debris.

CAUTION
- **Take care not to get hurt from shards of glass.**

(1) Cover

RY9212148CAS0037US0

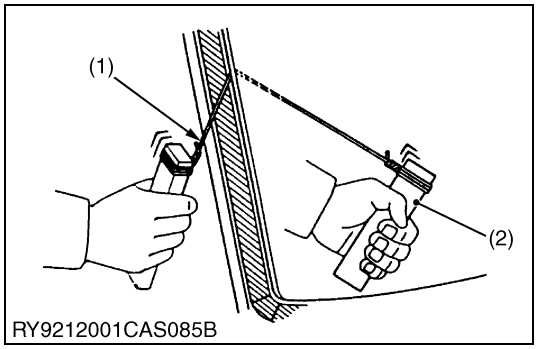


2. Insert the utility knife between the frame of the cabin and the right sash to make an opening to pass the piano wire through.

CAUTION
- **Take care not to cut your hands or fingers on the blade of the utility knife.**

(1) Utility Knife (2) Sash

RY9212148CAS0038US0

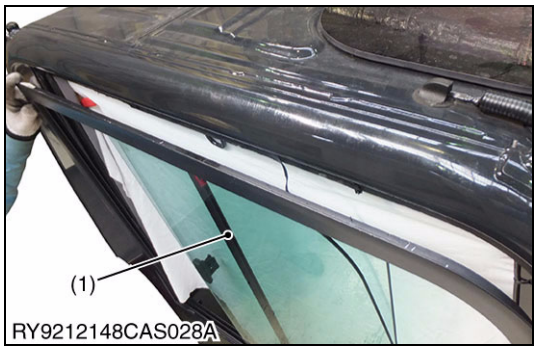


3. Pass the piano wire between the frame of the cabin and the right sash.
4. Wind the ends of piano wire on with wood-block or something like handle, and cut the seal between the frame and glass with moving the piano wire alternately.

CAUTION
- **The piano wire may break due to the heat from the friction, so take care not to cut your hand/fingers.**

(1) Piano Wire (2) Wood Block

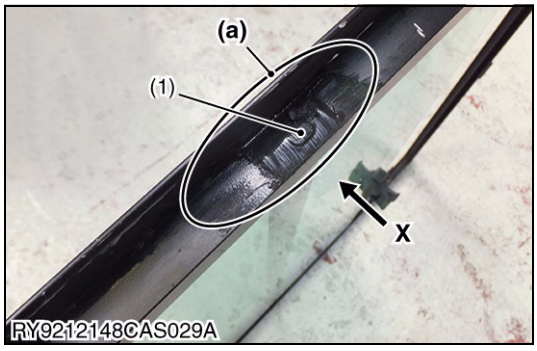
RY9212148CAS0039US0



5. Remove the right sash from the cabin.

(1) Seal

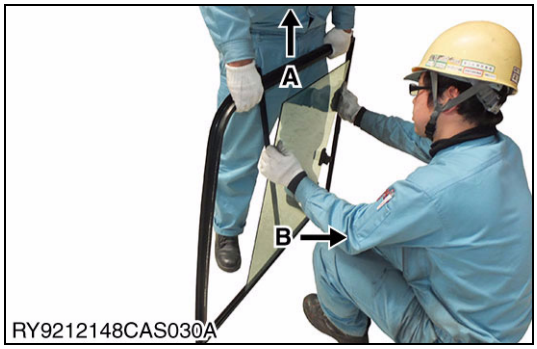
RY9212148CAS0040US0



6. A coating was applied to the right sash, so use the scraper to scrape it off. (2 places)
7. Lift up the end of the seal with a slotted screwdriver from the direction of **X**. (2 places)

(1) Seal **(a) Coating**

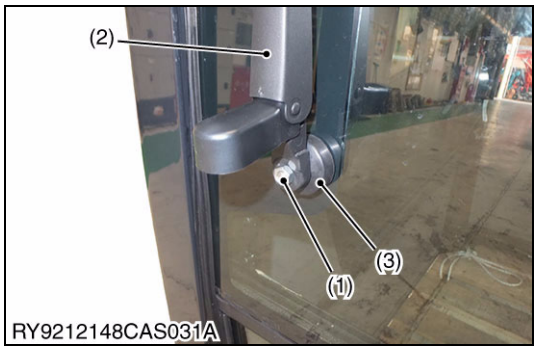
RY9212148CAS0041US0



8. Expand the frame of the right sash in direction **A** and remove the glass in direction **B**.

RY9212148CAS0042US0

[4] REMOVING THE FRONT GLASS



1. Remove the bolts and then the wiper.
2. Remove the cap.

(1) Nut
(2) Wiper
(3) Cap

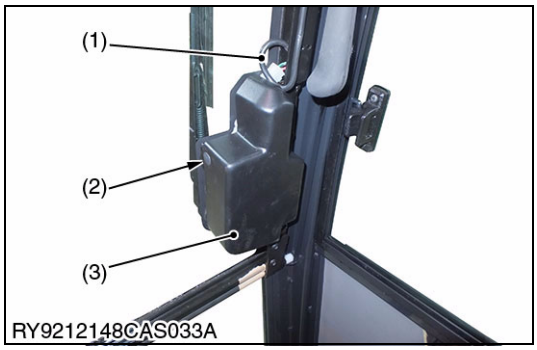
RY9212148CAS0043US0

3. Remove the nut.

■ **IMPORTANT**
- **Take care not to crack the glass.**

(1) Nut

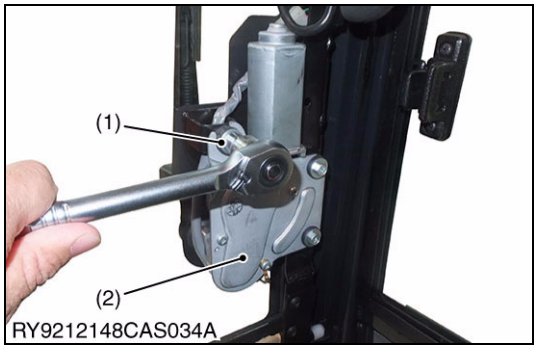
RY9212148CAS0044US0



4. Remove the wiper motor harness, the cap and then the cover.

(1) Harness
(2) Cap
(3) Cover

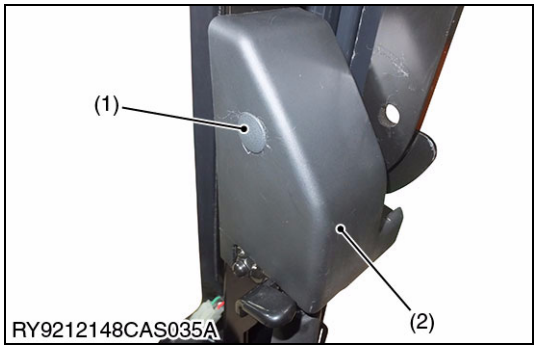
RY9212148CAS0045US0



5. Remove the three bolts and the wiper motor.

(1) 3 × Bolt (M6 × 25)
(2) Wiper Motor

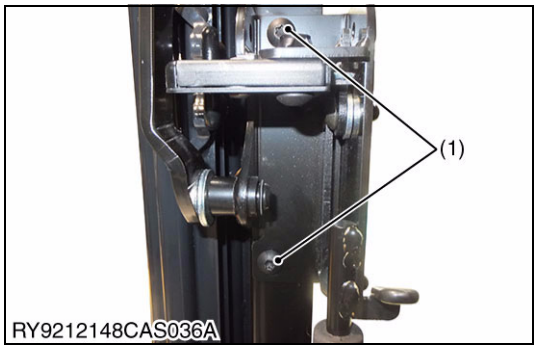
RY9212148CAS0046US0



6. Remove the cap and the cover. (LH/RH 2 places each)

(1) Cap (2) Cover

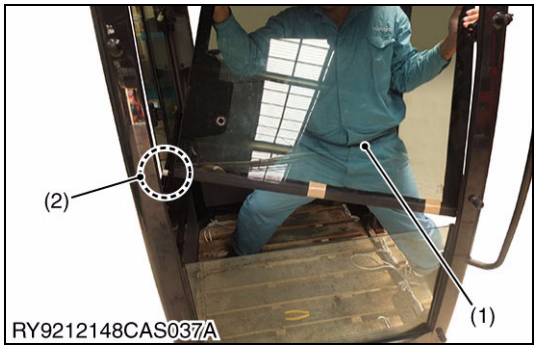
RY9212148CAS0047US0



7. With the front glass closed, remove the 4 bolts. (LH/RH 2 places each)

(1) 4 × Bolt (M6 × 10)

RY9212148CAS0048US0

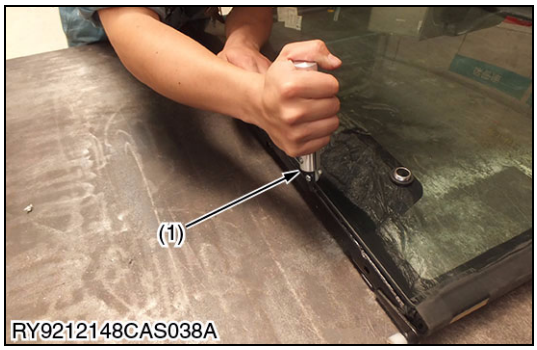


8. Remove the front frame.

■ **IMPORTANT**
- **Take care not to crack the glass.**
- **Take care not to lose the roller.**

(1) Front Frame (2) Roller

RY9212148CAS0049US0

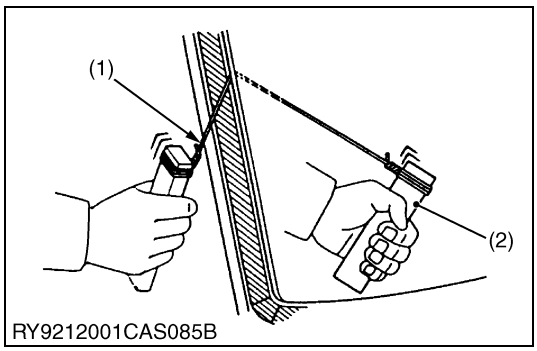


9. Insert the utility knife between the front frame and the glass to make an opening to pass the piano wire through.

CAUTION
- **Take care not to cut your hands or fingers on the blade of the utility knife.**
- **Take care not to get hurt from shards of glass.**

(1) Utility Knife

RY9212148CAS0050US0



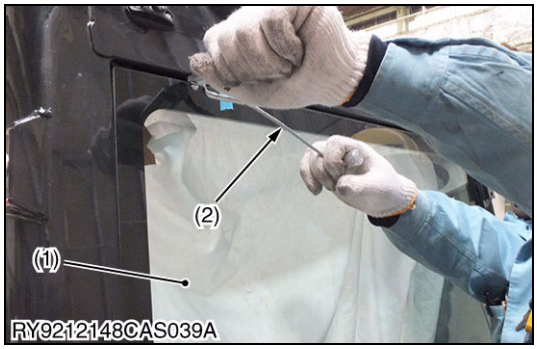
10. Pass the piano wire between the front frame and the glass.
11. Wrap both ends of the piano wire around blocks of wood or the like and move them back and forth.

CAUTION
- **The piano wire may break due to the heat from the friction, so take care not to cut your hand/fingers.**

(1) Piano Wire (2) Wood Block

RY9212148CAS0051US0

[5] REMOVING OTHER PANES OF GLASS

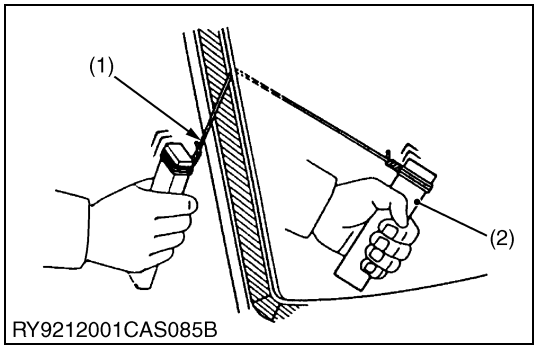


1. Protect inside cabin from possible glass debris.
2. Insert the utility knife between the cabin frame and the glass to make an opening to pass the piano wire through.

CAUTION
- **Take care not to cut your hands or fingers on the blade of the utility knife.**
- **Take care not to get hurt from shards of glass.**

(1) Cover (2) Utility Knife

RY9212148CAS0052US0



3. Pass the piano wire between the cabin frame and the glass.
4. Wind the ends of piano wire on with wood-block or something like handle, and cut the seal between the frame and glass with moving the piano wire alternately.

CAUTION
- **The piano wire may break due to the heat from the friction, so take care not to cut your hand/fingers.**

(1) Piano Wire (2) Wood Block

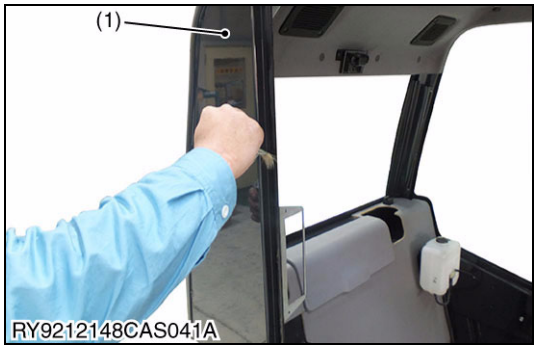
RY9212148CAS0053US0

[6] INSTALLING THE GLASS ON THE RIGHT

1. Remove any adhesive remaining on the cabin frame.

CAUTION
- **Take care not to cut your hands or fingers on the blade of the scraper.**

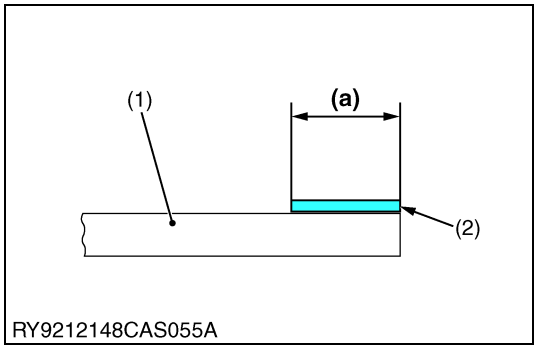
RY9212148CAS0054US0



2. Use the cleaning agent to remove any grime or oil remaining on the cabin frame.
3. Apply primer and allow to dry for the indicated time.
- Cleaning agent (Sika Aktivator-205)
- Primer (Sika Primer-206 G + P)

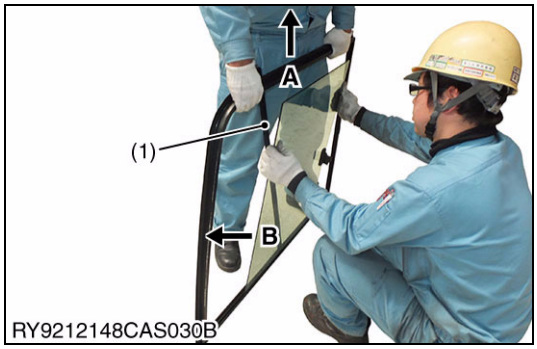
CAUTION
- **Take care not to get the cleaner or the primer in your eyes.**

Ambient temperature	15°C or higher	10 minutes
	Below 15°C	30 minutes



(1) Cabin Frame
(2) Primer
(a) No less than 20 mm (0.79 in.)

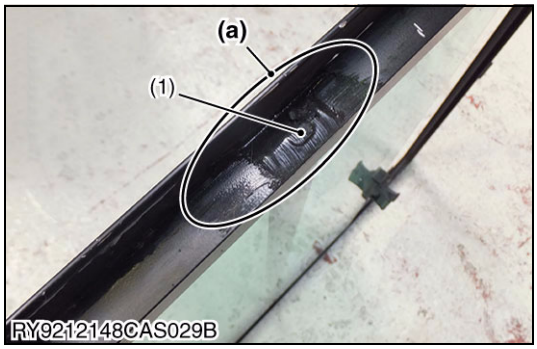
RY9212148CAS0055US0



4. Expand the sash in direction **A** and install the 1st pane of glass in direction **B**, then the seal and then the 2nd pane of glass.

(1) Seal

RY9212148CAS0056US0



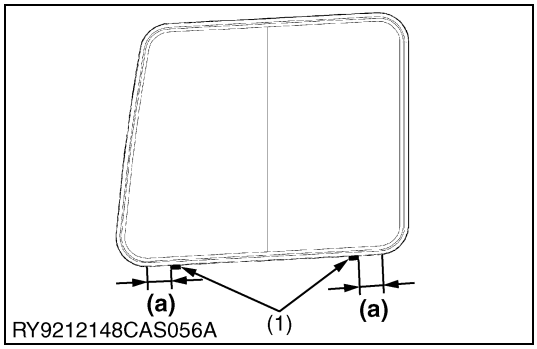
5. Put the end of the seal back in place with a slotted screwdriver. (2 places)
6. Apply the coating.

■ **IMPORTANT**

- **Apply the coating so there are no gaps and water cannot leak.**

(1) Seal
(a) Coating (Sikaflex - 265)

RY9212148CAS0057US0



7. Stick the new spacers at the set locations.

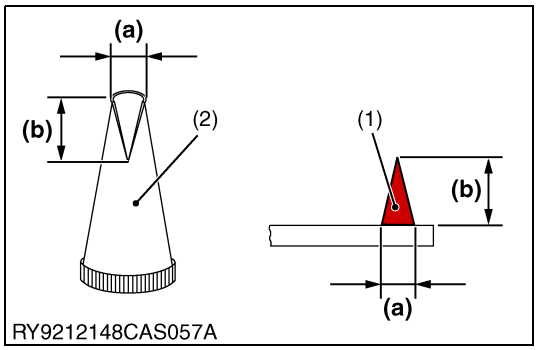
(1) Spacer
(a) 100 mm (3.9 in.)

RY9212148CAS0058US0

8. Apply the adhesive around the entire cabin frame.

(1) Adhesive (Sikaflex - 265)
(2) Nozzle
(a) No less than 10 mm (0.39 in.)
(b) No less than 12 mm (0.47 in.)

RY9212148CAS0059US0



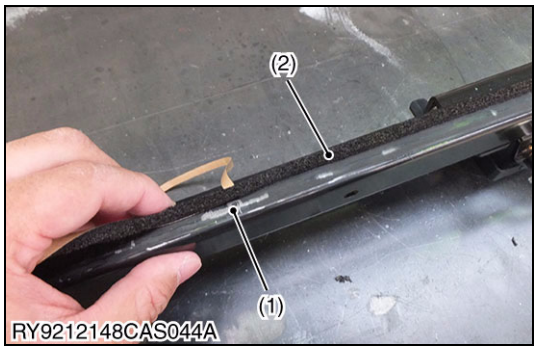
RY9212148CAS043A

9. Use suction pads to install the sash.
10. Use tape or the like to hold it in place until the adhesive hardens.

■ **IMPORTANT**
- **Take care not to drop the glass.**
- **After installation, leave to cure for at least 24 hours.**

RY9212148CAS0060US0

[7] INSTALLING THE FRONT GLASS



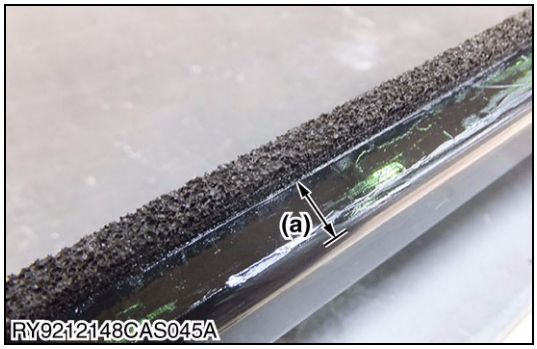
RY9212148CAS044A

1. Use the scraper and the cleaning agent to remove any remaining adhesive, grime or oil on the front frame and then apply the trim to the frame.

CAUTION
- **Take care not to cut your hands or fingers on the blade of the scraper.**
- **Take care not to get the cleaner or the primer in your eyes.**

(1) Front Frame (2) Trim

RY9212148CAS0061US0



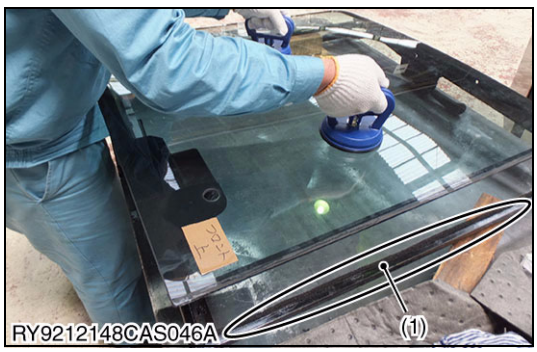
RY9212148CAS045A

2. Apply primer and allow to dry for the indicated time.

Ambient temperature	15°C or higher	10 minutes
	Below 15°C	30 minutes

(a) No less than 12 mm (0.47 in.)

RY9212148CAS0062US0



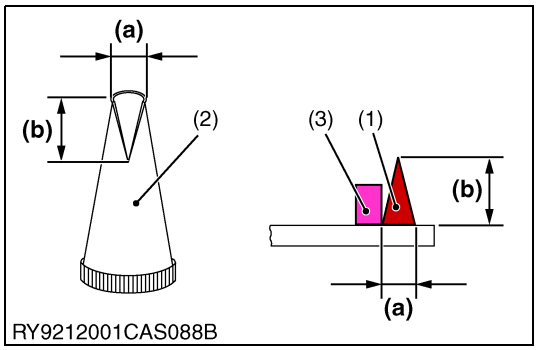
RY9212148CAS046A

3. Apply the adhesive only to the bottom of the front frame (round frame).
4. Use suction pads to mount the front glass to the frame.

■ **IMPORTANT**
- **Take care not to drop the glass.**

(1) Adhesive (Sikaflex - 265)
(2) Nozzle
(3) Trim
(a) No less than 8 mm (0.31 in.)
(b) No less than 12 mm (0.47 in.)

RY9212148CAS0063US0



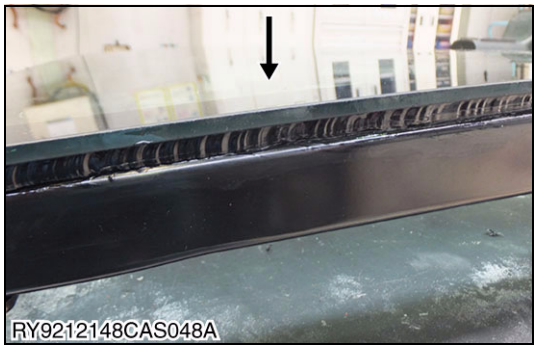
RY9212001CAS088B

RY9212148CAS047A

5. Inject adhesive into the gap between the front glass and the frame.

■ **IMPORTANT**
- **Take care so the adhesive does not stick out.**

RY9212148CAS0064US0


RY9212148CAS048A

6. Put a weight on the glass to the adhesive hardens.

■ **IMPORTANT**
- **Take care not to crack the glass.**

RY9212148CAS0065US0

RY9212148CAS037B

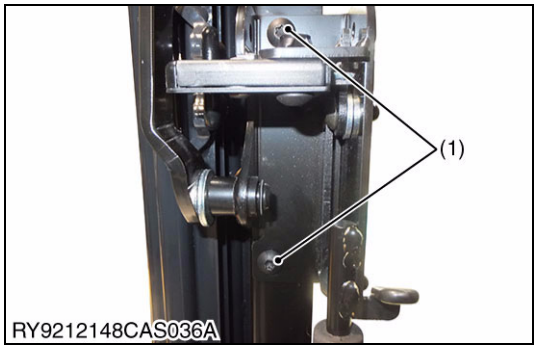
7. Install the front frame.

■ **IMPORTANT**
- **Take care not to crack the glass.**
- **Apply grease to the roller to prevent them to come lose. (LH/RH 2 places each)**

CAUTION
- **Take care not to get your fingers caught between the glass and the frame.**

(1) Roller (2) Front Frame

RY9212148CAS0066US0



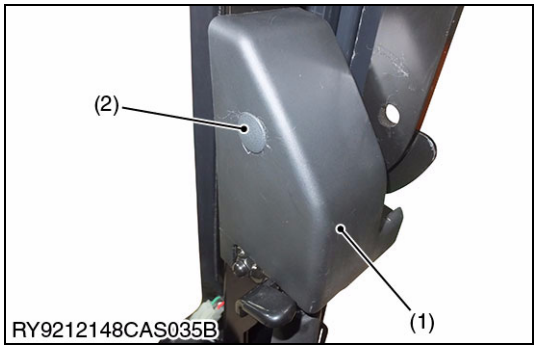
RY9212148CAS036A

8. With the front glass closed, install the 4 bolts. (LH/RH 2 places each)

Tightening torque	Bolt (1)	9.0 to 15.0 N·m 0.92 to 1.53 kgf·m 6.64 to 11.10 lbf·ft

(1) 4 × Bolt (M6 × 12)

RY9212148CAS0067US0

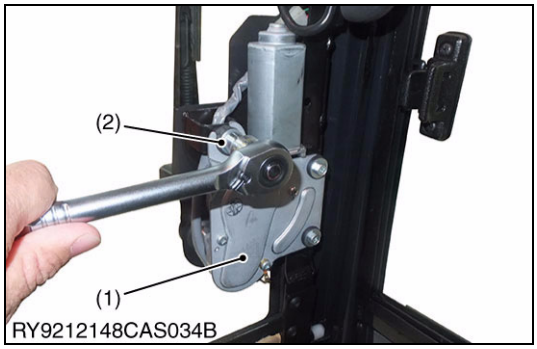


RY9212148CAS035B

9. Install the cover and the cap. (LH/RH 2 places each)

(1) Cover (2) Cap

RY9212148CAS0068US0

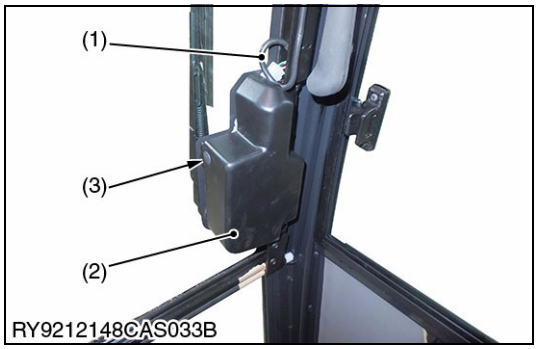


10. Install the wiper motor.

Tightening torque	Bolt (2)	3.5 to 6.5 N·m 0.36 to 0.66 kgf·m 2.58 to 4.79 lbf·ft

(1) Wiper Motor (2) 3 × Bolt (M6 × 25)

RY9212148CAS0069US0



11. Install the wiper motor harness, cover and cap.

(1) Harness (3) Cap
(2) Cover

RY9212148CAS0070US0

12. Install the nut.

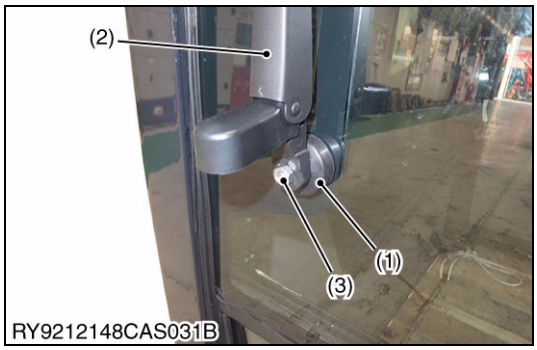
■ **IMPORTANT**

- **Take care not to crack the glass.**

Tightening torque	Nut (1)	2.5 to 3.5 N·m 0.26 to 0.36 kgf·m 1.84 to 2.58 lbf·ft

(1) Nut

RY9212148CAS0071US0



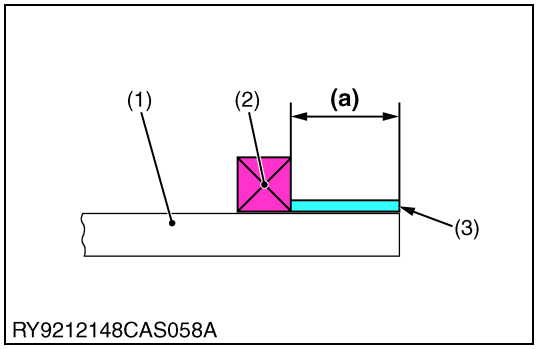
13. Install the cap, wiper and nuts.

Tightening torque	Nut (3)	6.5 to 9.5 N·m 0.66 to 0.97 kgf·m 4.79 to 7.01 lbf·ft

(1) Cap (3) Nut
(2) Wiper

RY9212148CAS0072US0

[8] INSTALLING OTHER PANES OF GLASS



RY9212148CAS058A

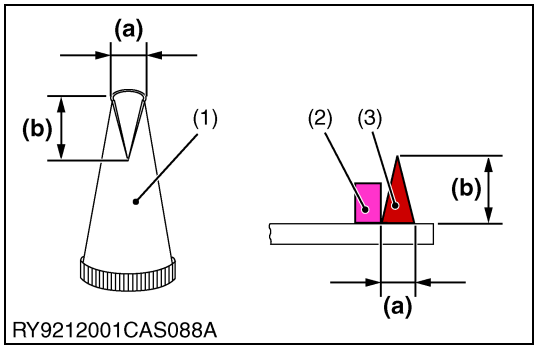
1. Use the scraper and the cleaning agent to remove any remaining adhesive, grime or oil on the frame and then apply the trim to the frame.
2. Apply primer and allow to dry for the indicated time.

Ambient temperature	15°C or higher	10 minutes
	Below 15°C	30 minutes

(1) Cabin Frame
(2) Trim
(3) Primer

(a) No less than 18 mm (0.71 in.)

RY9212148CAS0073US0



RY9212001CAS088A

3. Apply the adhesive.

(1) Nozzle
(2) Trim
(3) Adhesive (Sikaflex - 265)

(a) No less than 7 mm (0.31 in.)
(b) No less than 12 mm (0.47 in.)

RY9212148CAS0074US0

RY9212148CAS049A

Check for Water Leaks

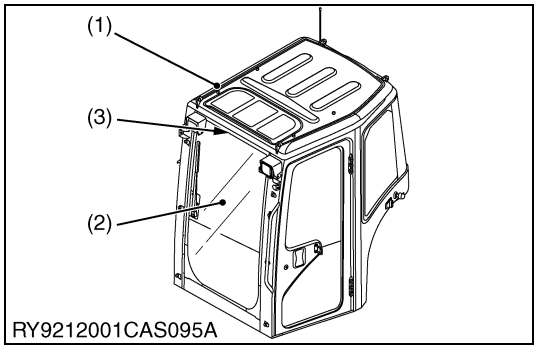
1. After mounting the glass, sprinkle water to test the seal.

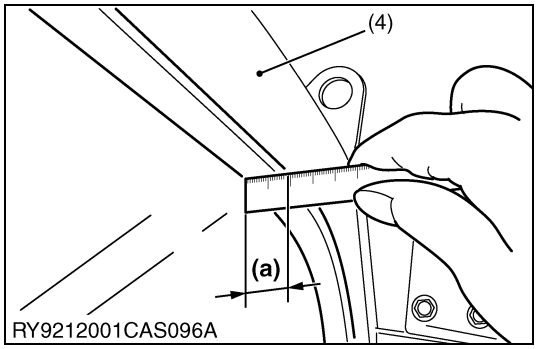
■ **IMPORTANT**
- **Make sure there are no water leaks.**

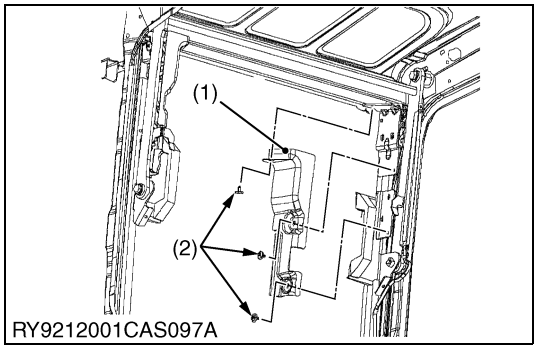
RY9212148CAS0075US0

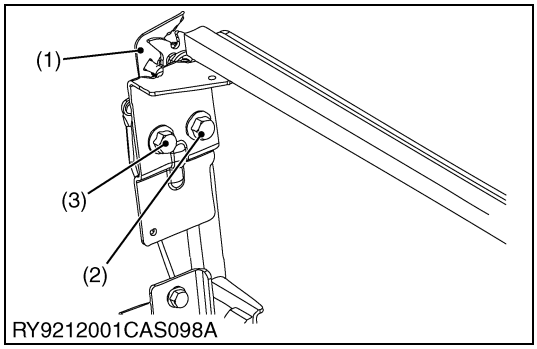
9. FRONT WINDOW

[1] ADJUSTING THE CLOSING LOCK OF THE FRONT WINDOW (TOP)









When water leaks in the cabin or it rattles

1. Close the front window (top) and lock it securely.
2. Remove the trim on the top edge of the front window (top) about half way along the frame and measure the clearance between the glass and the cab frame.

■ **NOTE**

- **If you remove the trim too far, the glass may shift out of position, preventing a reliable measurement of the clearance.**

(1) Cab ASSY
(2) Front Window (Top)
(3) Trim
(4) Cab Frame
(a) Clearance

RY9212001CAS0091US0

3. Remove the clip and then the lock cover.

(1) Lock Cover
(2) Clip

RY9212001CAS0092US0

4. Remove the lock of the front window (top) and loosen the lock's mounting bolts.
5. Leave the rear bolt as is and lift up the front bolt 1.0 to 1.5 mm (0.04 to 0.06 in.).

■ **NOTE**

- **Lifting the bolt more than 1.5 mm (0.06 in.) may prevent the lock from working.**

6. Re-tighten the bolts to the specified torque.
7. Close the front window (top) and lock it securely.
8. Recheck the clearance between the glass and the cab frame and make sure the clearance is smaller.
9. Operate the machine and make sure the rattling has stopped while driving.
10. Spray some water on the window and make sure it does not leak.

(1) Lock
(2) Bolt (Front)
(3) Bolt (Rear)

RY9212001CAS0093US0

[2] ADJUSTING THE OPEN LOCK OF THE FRONT WINDOW (TOP)

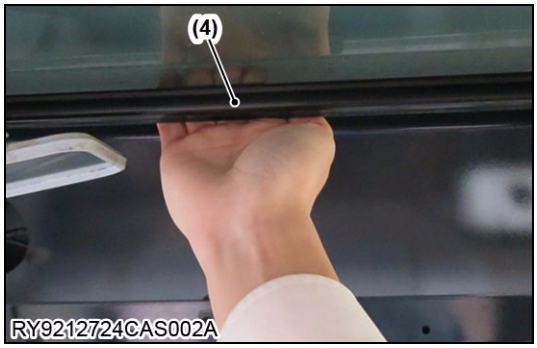
When it rattles on the cabin

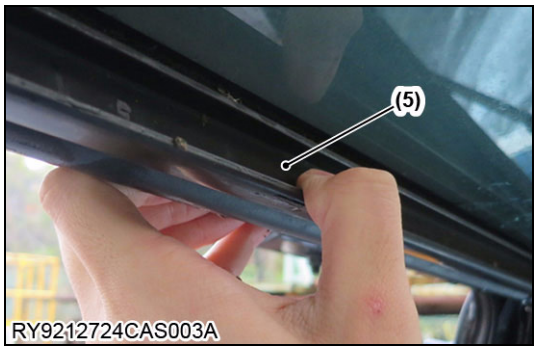
1. Lift the front window (top) and lock it securely onto the ceiling.
2. While pulling down the handle, check whether there is a gap between the frame and the cushion.

■ **IMPORTANT**

- **Rattling occurs if there is a gap between the frame and the cushion. Loosen the nut and adjust the cushion until it contacts the surface of the glass.**

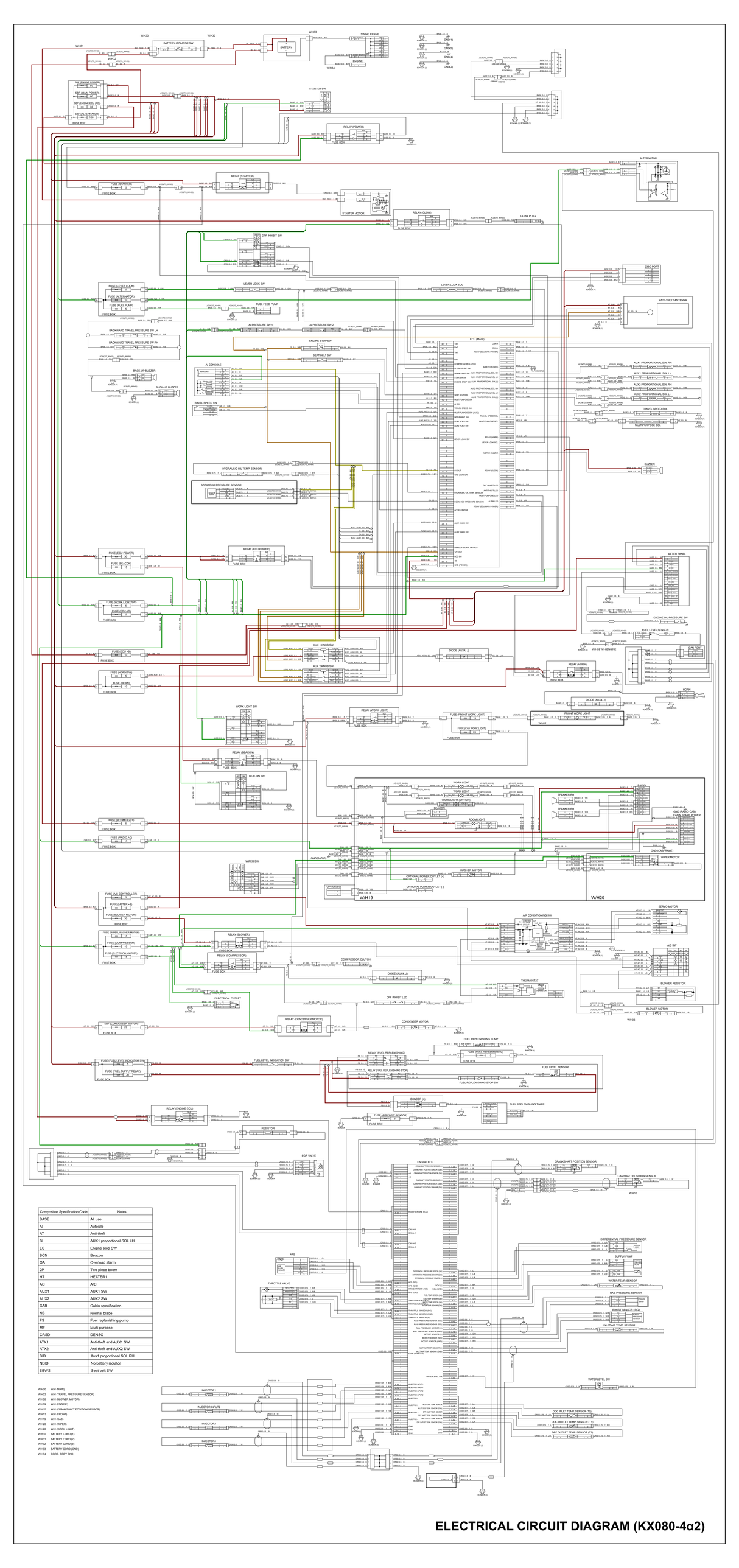
3. Loosen the nut and half-turn the cushion counterclockwise to decrease the gap.
4. After adjusting the cushion, re-tighten the nut.
5. Lift the front window (top) and lock it securely onto the ceiling.
6. Double-check the gap of the front and rear sides of the window. Pull down the center of the rear/front edge of the frame, and if the gap is still remaining, adjust the cushion following the steps 3 and 4.
7. Operate the machine and check if the rattling during operation has stopped.





(1) Frame
(2) Nut
(3) Cushion
(4) Rear Edge of the Frame
(5) Front Edge of the Frame

RY9212724CAS0001US0



Composition Specification Code	Notes
BASE	All use
AI	Autoidle
AT	Anti-theft
BI	AUX1 proportional SOL LH
ES	Engine stop SW
BCN	Beacon
OA	Overload alarm
2P	Two piece boom
HT	HEATER1
AC	A/C
AUX1	AUX1 SW
AUX2	AUX2 SW
CAB	Cabin specification
NB	Normal blade
FS	Fuel replenishing pump
MF	Multi purpose
CRSD	DENSO
ATX1	Anti-theft and AUX1 SW
ATX2	Anti-theft and AUX2 SW
BID	Aux1 proportional SOL RH
NBID	No battery isolator
SBWS	Seat belt SW

WHI00	WH (MAIN)
WHI02	WH (TRAVEL PRESSURE SENSOR)
WHI08	WH (BLOWER MOTOR)
WHI09	WH (ENGINE)
WHI10	WH (CRANKSHAFT POSITION SENSOR)
WHI12	WH (FRONT)
WHI19	WH (CAB)
WHI25	WH (WIPER)
WHI26	WH (WORK LIGHT)
WHI30	BATTERY CORD (1)
WHI31	BATTERY CORD (2)
WHI32	BATTERY CORD (3)
WHI33	BATTERY CORD (GND)
WHI34	CORD, BODY GND

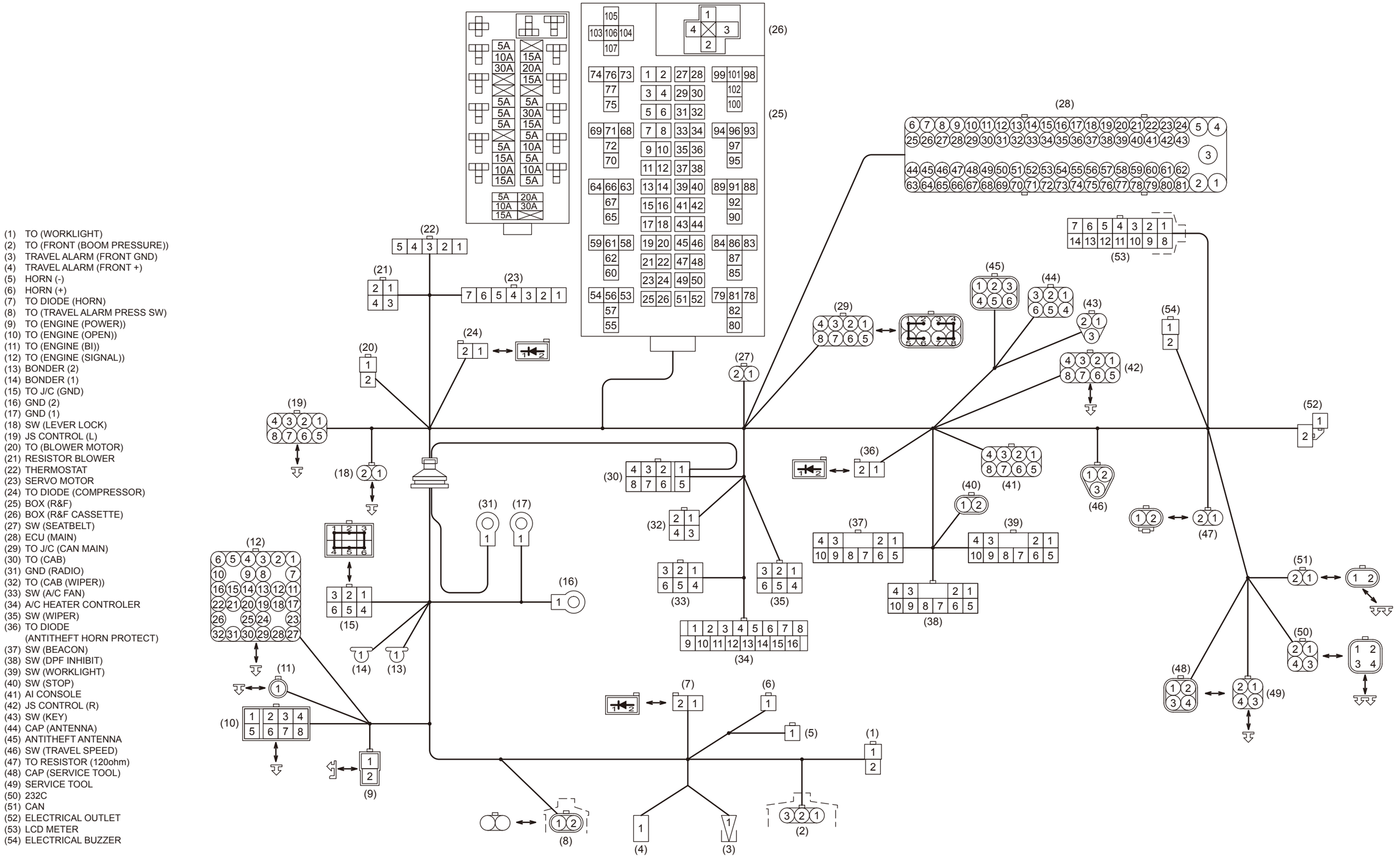
ELECTRICAL CIRCUIT DIAGRAM (KX080-4α2)

CONNECTOR CHART

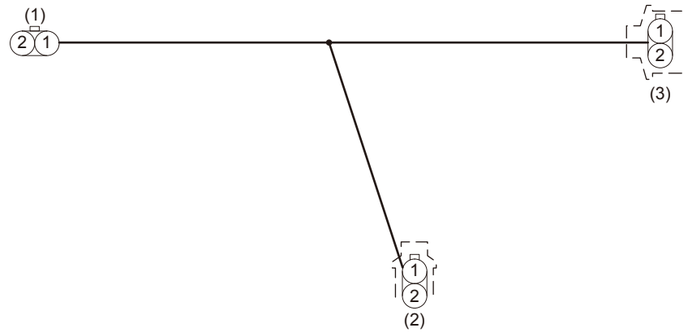
ACC_POWER(+) BULLET_TERMINAL_RECEPTACLE CB	AI_PRESSURE_SWITCH(2) SUMITOMO 6189-0156	BATTERY_ISOLATOR(B-BID) RING_TERMINAL LA_M8	CAB_WORKLIGHT,B(-) YAZAKI CA	CAP(SERVICE_TOOL) AMP_EJ-II 174259-2	TO_DIODE(ANTITHEFT_ HORN_PROTECT) SUMITOMO_090 6098-0017	DPF_OUTLET_TEMP _SENSOR YAZAKI_090-II 7283-7023	FUEL_SENSOR YAZAKI_SSD 7283-8730-30	GND(CABFRAME) --- LA_M8	INTAKE_THROTTLE_ MOTOR YAZAKI_090-II 7283-1968-30	RADIO(GND) BULLET_TERMINAL_PLUG CA	SENSOR,HYDRAULIC _OIL_TEMP AMP_EJ-II 178449-6
ACC_POWER(-) BULLET_TERMINAL_PLUG CA	ALTERNATOR(+B) YAZAKI 7009-1342-02	BATTERY_TERMINAL,BI RING_TERMINAL LA_M8	CAB_WORKLIGHT,FL(+) BULLET_TERMINAL_RECEPTACLE CB	SERVICE_TOOL AMP_EJ-II 174257-2	DIODE(COMPRESSOR) YAZAKI 7321-9822	DUAL_PRESSURE_SWITCH SUMITOMO_090 6189-0094	FUEL_SUPPLY_PUMP DEUTSCH_DT DT06-2S-EP06	GND(RADIO) RING_TERMINAL LA_M8	J/C-SLD-GND YAZAKI_090-II 7282-7020-10	RAIL_PRESSURE_SENSOR AMP_EJ-II 174357-2	SENSOR_BOOST SUMITOMO 6189-0099
(CAP)ANTENNA SUMITOMO_MT/HM090 6180-6181	ALTERNATOR(IG,L) YAZAKI_CN(A) 7123-2820	BEACON(+) BULLET_TERMINAL_RECEPTACLE CB	CAB_WORKLIGHT,FL(-) BULLET_TERMINAL_PLUG CA	CAP(SOL(MULTI)) YAZAKI_HS 7282-2090-30	TO_DIODE(COMPRESSOR) SUMITOMO_090 6098-0017	EGR_VALVE SUMITOMO_DL090 6195-0030	FUEL_TEMP_SENSOR AMP_EJ-II 178449-6	GND(RADIO_CAB) RING_TERMINAL LA_M8	TO_J/C-SLD-GND YAZAKI_090-II 7283-7020-10	REGISTER(120ohm) YAZAKI 7382-5053-3R	SERVO_MOTOR JAE_IL-AG5 IL-AG5-7S-S3C1
ANTITHEFT_ANTENNA SUMITOMO_MT 6189-6171	BATTERY(+),BI EARTH_TERMINAL BA_M10	BEACON(-) BULLET_TERMINAL_PLUG CA	CAB_WORKLIGHT,FR(+) BULLET_TERMINAL_RECEPTACLE CB	SOLENOID(MULTI) YAZAKI_HS 7283-2090-30	DIODE(FUEL_SUPPLY) SUMITOMO_090 6098-0126	ELECTRICAL_BUZZER YAZAKI_CN(A) 7123-2820	FUSE(CONDENSOR_FAN) YAZAKI 361897-0713	HORN(+) YAZAKI_250 7123-2010	JS_CONTROL(L) SUMITOMO_DL090 6195-0051	TO_REGISTER(120ohm) YAZAKI_58X 7123-6423-30	SOLENOID(AUX1-L) AMP_EJ-II 174352-2
4MIN._TIMER FURUKAWA_RFW P010478	BATTERY(ECU,+B),BI YAZAKI_CN(A) 7122-2810	BLOWER_MOTOR YAZAKI 7283-5379	CAB_WORKLIGHT,FR(-) BULLET_TERMINAL_PLUG CA	COMPRESSOR_CLUTCH(A/C) FURUKAWA_RFW P010463	TO_DIODE(FUEL_SUPPLY) SUMITOMO_090 6098-0022	ELECTRICAL_OUTLET YAZAKI_POSITEIVE_LOCK 7123-8322	SBF(CONDENSOR_FAN) --- Plug-in_type	HORN(-) YAZAKI_250 7123-2010	JS_CONTROL(R) SUMITOMO_DL090 6195-0051	RELAY(FUEL_SUPPLY_ START) SUMITOMO 6020-6161	SOLENOID(AUX1-R) AMP_EJ-II 174352-2
232C YAZAKI_62Z 7123-7740-40	MAIN(ECU,+B),BI YAZAKI 7123-2810	BODYEARTH(ENGINE) YAZAKI 7003-1210-02	CAMSHAFT_SENSOR(G) SUMITOMO_TS025 6189-1130	CONDENSOR_FAN DEUTSCH_DT DT06-2S-EP06	DIODE(HORN) YAZAKI 7321-9822	FRONT_WORKLIGHT(+) BULLET_TERMINAL_RECEPTACLE CB	GLOW,D FORK_TERMINAL LE_M4	INJECTOR_1 SUMITOMO_TS090 6189-0611	LCD_METER YAZAKI_040-III 7283-5832	RELAY(FUEL_SUPPLY_ STOP) YAZAKI_CN(A) 7123-2840-90	SOLENOID(AUX2-L) AMP_EJ-II 174352-2
CAP(232C) YAZAKI 7234-2604-40	BATTERY(POWER),BI YAZAKI_58L 7122-4113-30	BODYEARTH(MAIN_FRAME) YAZAKI 7003-1210-02	CAN YAZAKI_62Z 7123-8520-40	CORD,BATTERY(-)(BATTERY) YAZAKI 7003-1210-02	TO_DIODE(HORN) SUMITOMO_090 6098-0017	FRONT_WORKLIGHT(-) YAZAKI CA	GND(1) YAZAKI 7009-1334-02	INJECTOR_2 SUMITOMO_TS090 6189-0611	OIL-SW,D AMP_250 172320-2	RESISTOR_BLOWER SUMITOMO_TS187 6098-0514	SOLENOID(AUX2-R) AMP_EJ-II 174352-2
AIR_FLOW_SENSOR SUMITOMO_TS025 6189-1046	MAIN(POWER),BI YAZAKI_58L 7123-4113-30	BOOM_BOTTOM_PRESSURE _SENSOR AMP_070 2822366-1	CAP(CAN) YAZAKI 7234-2601-40	CORD,BATTERY(-)(MAIN _FRAME) YAZAKI 7003-1210-02	DOC_INLET_TEMP_SENSOR YAZAKI_090-II 7283-7026-30	FUEL_FILTER(WATER _LEVEL_SW) AMP_EJ- II 174352-2	GND(2) YAZAKI 7009-1334-02	INJECTOR_3 SUMITOMO_TS090 6189-0611	R&F_CASSETTE YAZAKI 7154-5597-30	ROOM_LIGHT YAZAKI_090 7123-1347	SOLENOID(LEVER_LOCK) YAZAKI_HS 7283-2090-30
AI_CONSOLE FURUKAWA_RFW P010531	BATTERY_ISOLATOR(A-BI) RING_TERMINAL LA_M8	CAB_POWER_SOURCE YAZAKI_58M 7123-6083-30	CAP(OPT_SW) YAZAKI_CN(A) 7122-2820	CRANKSHAFT_ SENSOR(NE),D YAZAKI_RH 7283-8852-30	DOC_OUTLET_TEMP_ SENSOR YAZAKI_090-II 7283-7028-10	FUEL_LEVEL_SENSOR SUMITOMO_HM090 6180-2451	GND(4) YAZAKI 7009-1836	INJECTOR_4 SUMITOMO_TS090 6189-0611	RADIO(+B) BULLET_TERMINAL_RECEPTACLE CB	SBF,MAIN1-2 YAZAKI_305 7323-3220	SOLENOID(TRAVEL_ SPEED) YAZAKI_HS 7283-2090-30
AI_PRESSURE_SWITCH(1) SUMITOMO 6189-0156	BATTERY_ISOLATOR(B-BI) RING_TERMINAL LA_M8	CAB_WORKLIGHT,B(+) BULLET_TERMINAL_RECEPTACLE CB	OPT_SW YAZAKI_CN(A) 7123-2820	DIODE(ANTITHEFT_HORN _PROTECT) YAZAKI 7321-9822	DPF_DIFF_PRESSURE_ SENSOR AMP 1813271-1	FUEL_PUMP YAZAKI_CN(A) 7123-2820	GND(5) YAZAKI 7009-1836	INLET_AIR_TEMP_ SENSOR YAZAKI_090-II 7283-7027	RADIO(AC) BULLET_TERMINAL_RECEPTACLE CB	SBF-BOX YAZAKI 7257-5155-30	SPEAKER(L) YAZAKI_CN(B) 7123-2825

SPEAKER(L+) BULLET_TERMINAL_PLUG CA	SWITCH(BEACON) YAZAKI_SDL 7123-8307	SWITCH(WORKLIGHT) YAZAKI_SDL 7123-8307	TO_CAB(WORKLIGHT,FL(+)) BULLET_TERMINAL_PLUG CA	TO_ENGINE(BI) YAZAKI_SWP 7222-7414-40	TO_J/C(CAN,MAIN) YAZAKI_090-II 7283-1081-10	TRAVEL_ALARM(FRONT, GND) BULLET_TERMINAL_PLUG CA	RELAY_CASSETTE(A) SUMITOMO 6400-0829	RELAY_CASSETTE(B) SUMITOMO 6400-0829	TO_MAIN(SIGNAL) YAZAKI_090-II 7182-8745-10	A/C_HEATER_CONTROLER JAE_MX34 MX34016SF1
SPEAKER(L-) BULLET_TERMINAL_PLUG CA	SWITCH(DPF,INHIBIT) YAZAKI_SDL 7123-8307	THERMOSTAT YAZAKI_090-II 7283-1050	TO_WORKLIGHT,FL(+) BULLET_TERMINAL_RECEPTACLE CB	TO_MAIN(BI) YAZAKI_SWP 7123-7414-40	J/C(CAN,MAIN) YAZAKI_090-II 7382-1481-10	TRAVEL_ALARM(REAR,+) BULLET_TERMINAL_RECEPTACLE CB				R&FBOX
SPEAKER(R) YAZAKI_CN(B) 7123-2825	SWITCH(FUEL_SUPPLY_ START) SUMITOMO 6187-2802	TO_BLOWER_MOTOR YAZAKI_58M 7123-6020	TO_CAB(WORKLIGHT,FL(-)) BULLET_TERMINAL_RECEPTACLE CB	TO_ENGINE(OPEN) YAZAKI_58M 7122-6083-30	TO_J/C(GND) YAZAKI_58M 7123-6261-40	TRAVEL_ALARM(REAR,GND) BULLET_TERMINAL_PLUG CA	TO_ENGINE(SIGNAL) YAZAKI_090-II 7183-8745-10	FUSE_BOX SUMITOMO 6353-0125		
SPEAKER(R+) BULLET_TERMINAL_PLUG CA	SWITCH(FUEL_SUPPLY_ STOP) SUMITOMO_HM090 6187-2801	TO_MAIN(BLOWER_MOTOR) YAZAKI_58M 7122-6020	TO_WORKLIGHT,FL(-) BULLET_TERMINAL_PLUG CA	TO_MAIN(OPEN) YAZAKI_58M 7123-6083-30	TO_J/C-INJ/SLD-GND YAZAKI_090-II 7283-7080-40	TRAVEL_ALARM_PRESS _SWITCH(1) SUMITOMO 6189-0156				
SPEAKER(R-) BULLET_TERMINAL_PLUG CA	SWITCH(KEY) YAZAKI_58X 7123-6234-40	TO_CAB YAZAKI_58M 7123-6083-30	TO_CAB(WORKLIGHT,FR(+)) BULLET_TERMINAL_PLUG CA	TO_ENGINE(POWER) YAZAKI_58L 7122-4123-30	J/C-INJ/SLD-GND YAZAKI_090-II 7382-1480-40	TRAVEL_ALARM_PRESS _SWITCH(2) SUMITOMO 6189-0158	CRS-ECU(58pin) AMP 9-1452415-9			
STARTER(+B),D,BI EARTH_TERMINAL BA_M10	SWITCH(LEVER_LOCK) SUMITOMO_DL090 6195-0003	TO_MAIN(CAB) YAZAKI_58M 7122-6083-30	TO_WORKLIGHT,FR(+) BULLET_TERMINAL_RECEPTACLE CB	TO_MAIN(POWER) YAZAKI_58L 7123-4123-30	TO_MAIN(TRAVEL_ALARM _PRESS_SW) YAZAKI_SWP 7123-1424-40	WASHER_MOTOR YAZAKI_CN(A) 7123-2820				
STARTER(+B)_D_N_BI EARTH_TERMINAL BA_M10	SWITCH(STOP) SUMITOMO_HM090 6187-2801	TO_CAB(WIPER) YAZAKI_58M 7123-6040	TO_CAB(WORKLIGHT,FR(-)) BULLET_TERMINAL_RECEPTACLE CB	TO_FRONT(BOOM_ PRESSURE) YAZAKI_SWP 7123-7434-40	TO_TRAVEL_ALARM_ PRESS_SW YAZAKI_SWP 7222-1424-40	WATER_TEMP_SENSOR AMP_EJ-II 178449-6	ECU(MAIN) AMP 1473244-1			
STARTER(S),D AMP 172320-1	SW(SEATBELT) DEUTSCH_DT DT06-2S-CE06	TO_MAIN(WIPER) YAZAKI_58M 7122-6040	TO_WORKLIGHT,FR(-) BULLET_TERMINAL_PLUG CA	TO_MAIN(BOOM_PRESSURE) YAZAKI_SWP 7222-7434-40	TO_MAIN(WORKLIGHT) YAZAKI_CN(A) 7122-2820	WIPER,F SUMITOMO_HM090 6090-1011				
SUCTION_CONTROL_VALVE SUMITOMO_MT090 6189-0039	SWITCH(TRAVEL_SPEED) SUMITOMO_TNS040 6092-0013	TO_CAB(WIPER) YAZAKI_090 7122-1347	TO_CAMSHAFT_SENSOR MOLEX_MX150 33472-0406	TO_J/C(CAN,EGR,SERVICE) YAZAKI_RH 7283-8850-30	TO_WORKLIGHT YAZAKI_CN(A) 7123-2820	CRS-ECU(96pin) AMP 9-1452423-9				
SWITCH(A/C_FAN) YAZAKI_CN(B) 7123-2865-70	SWITCH(WIPER) YAZAKI_CN(A) 7123-2860	TO_WIPER YAZAKI_090 7123-1347	TO_MAIN(CAMSHAFT_ SENSOR) MOLEX_MX150 33482-0401	J/C(CAN,EGR,SERVICE) YAZAKI_RH 7182-9630-30	TRAVEL_ALARM(FRONT,+) BULLET_TERMINAL_RECEPTACLE CB					

W/H00 (Main harness)

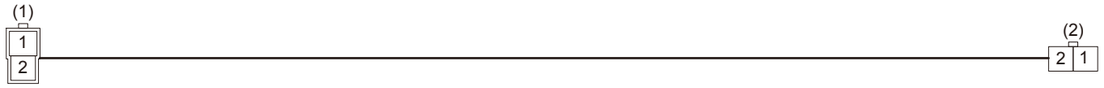


W/H02 (Travel pressure SW harness)



(1) TO (MAIN (TRAVEL ALARM PRESS SW))
(2) TRAVEL ALARM PRESS SW (2)
(3) TRAVEL ALARM PRESS SW (1)

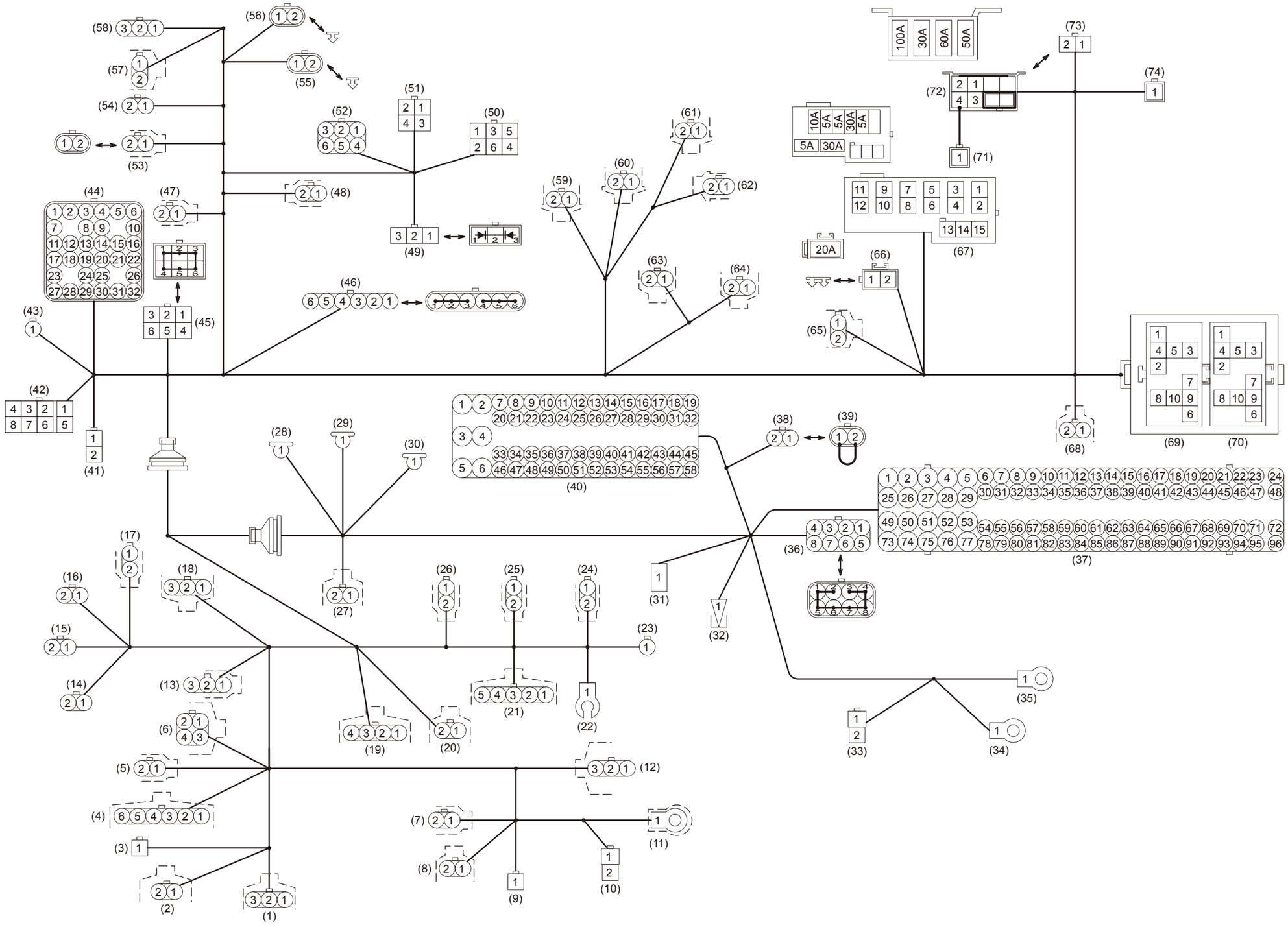
W/H06 (Blower harness)



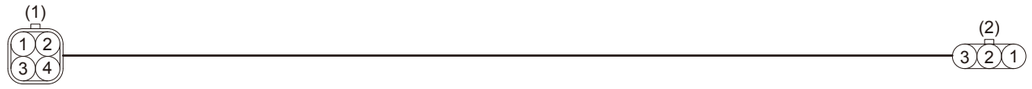
(1) TO (MAIN (BLOWER MOTOR))
(2) BLOWER MOTOR

W/H09 (Engine harness)

(1) CRANKSHAFT SENSOR (NE) D
(2) SENSOR HYDRAULIC OIL TEMP
(3) STARTER (S) D
(4) INTAKE THROTTLE MOTOR
(5) WATER TEMP SENSOR
(6) TO (CAMSHAFT SENSOR)
(7) FUEL TEMP SENSOR
(8) SUCTION CONTROL VALVE
(9) OIL SW (D)
(10) ALTERNATOR (IG L)
(11) ALTERNATOR (+B)
(12) RAIL PRESSURE SENSOR
(13) DPF DIFF PRESSURE SENSOR
(14) DOC INLET TEMP SENSOR
(15) DOC OUTLET TEMP SENSOR
(16) DPF OUTLET TEMP SENSOR
(17) INJECTOR 4
(18) SENSOR BOOST
(19) EGR VALVE
(20) INLET AIR TEMP SENSOR
(21) AIR FLOW SENSOR
(22) GLOW D
(23) COMPRESSOR CLUTCH (A/C)
(24) INJECTOR 1
(25) INJECTOR 2
(26) INJECTOR 3
(27) SW (DUAL PRESSURE)
(28) BONDER
(29) BONDER (4)
(30) BONDER (5)
(31) TRAVEL ALARM (REAR +)
(32) TRAVEL ALARM (REAR GND)
(33) FUEL PUMP
(34) GND (5)
(35) GND (4)
(36) TO J/C (INJ/SLD-GND)
(37) CRS-ECU (96pin)
(38) TO J/C (SLD-GND)
(39) J/C (SLD-GND)
(40) CRS-ECU (58pin)
(41) TO (MAIN (POWER)
(42) TO (MAIN (OPEN))
(43) TO (MAIN (BI))
(44) TO (MAIN (SIGNAL))
(45) TO J/C (GND)
(46) TO J/C (CAN EGR SERVICE)
(47) CONDENSOR FAN
(48) FUEL SUPPLY PUMP
(49) TO DIODE (FUEL SUPPLY)
(50) RELAY (FUEL SUPPLY START)
(51) RELAY (FUEL SUPPLY STOP)
(52) 4MIN. TIMER
(53) SOLENOID (MULTI)
(54) FUEL LEVEL SENSOR
(55) SW (FUEL SUPPLY STOP)
(56) SW (FUEL SUPPLY START)
(57) SW (AI PRESSURE (1))
(58) FUEL SENSOR
(59) SOLENOID (AUX1-R)
(60) SOLENOID (AUX1-L)
(61) SOLENOID (AUX2-L)
(62) SOLENOID (AUX2-R)
(63) SOLENOID (LEVER LOCK)
(64) SOLENOID (TRAVEL SPEED)
(65) SW (AI PRESSURE (2))
(66) FUSE (CONDENSOR FAN)
(67) BOX (FUSE)
(68) FUEL FILTER (WATER LEVEL SW)
(69) RELAY CASSETTE (B)
(70) RELAY CASSETTE (A)
(71) TO (BATTERY (POWER) BI)
(72) SBF-BOX
(73) SBF MAIN1-2
(74) TO (BATTERY (ECU +B) BI)

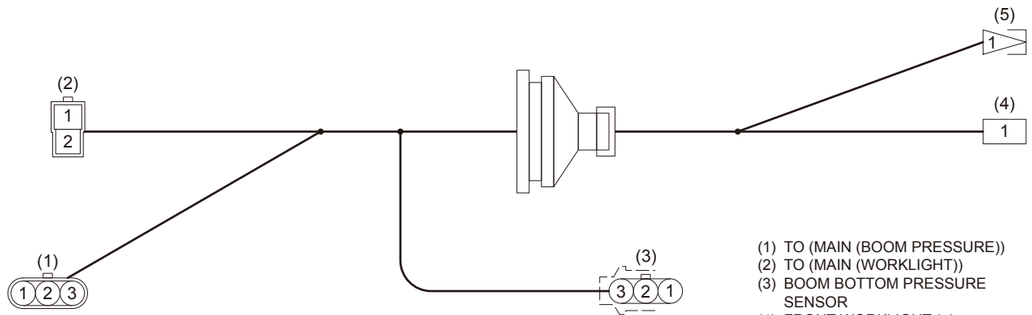


W/H10 (Camshaft position sensor harness)



(1) TO (MAIN (CAMSHAFT SENSOR))
(2) CAMSHAFT SENSOR (G)

W/H12 (Front harness)

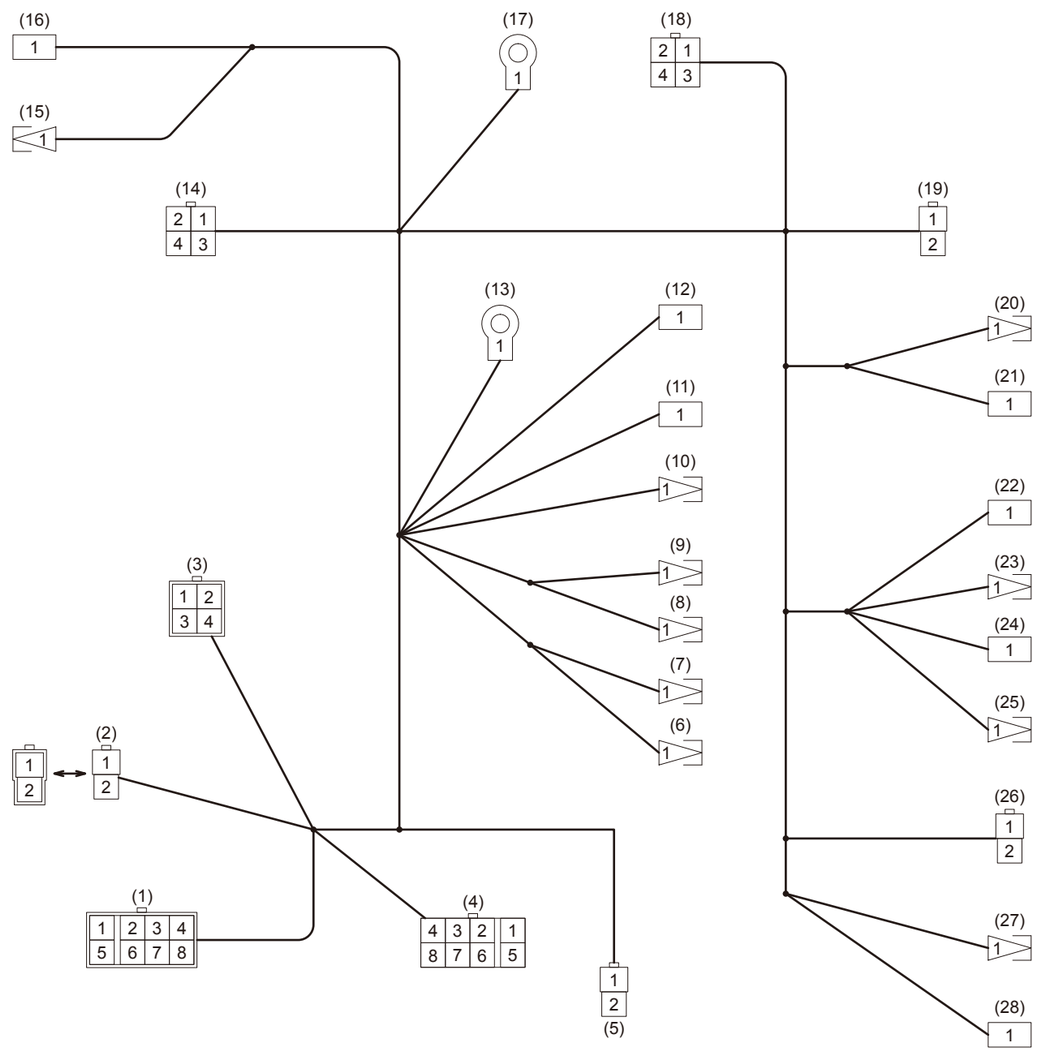


(1) TO (MAIN (BOOM PRESSURE))
(2) TO (MAIN (WORKLIGHT))
(3) BOOM BOTTOM PRESSURE SENSOR
(4) FRONT WORKLIGHT (+)
(5) FRONT WORKLIGHT (-)

W/H14 (Front extension harness)

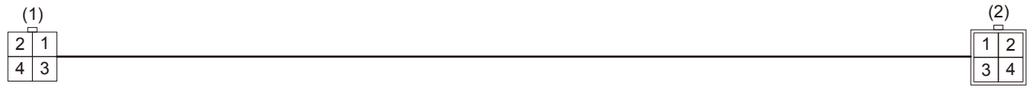
(1) TO (LIGHT WORK (+))
(2) TO (FRONT WORKLIGHT (-))
(3) TO (LIGHT WORK (-))
(4) TO (FRONT WORKLIGHT (+))

W/H19 (Cabin harness)



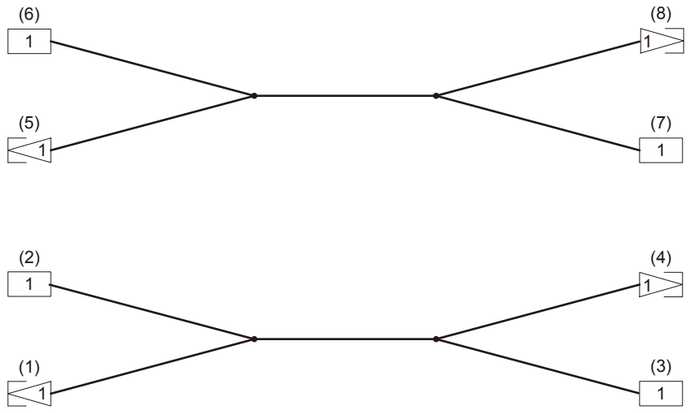
(1) TO (MAIN (CAB))
(2) OPT SW
(3) TO (MAIN(WIPER))
(4) CAB POWER SOURCE
(5) WASHER MOTOR
(6) SPEAKER (L-)
(7) SPEAKER (L+)
(8) SPEAKER (R-)
(9) SPEAKER (R+)
(10) RADIO (GND)
(11) RADIO (AC)
(12) RADIO (+B)
(13) GND (RADIO CAB)
(14) TO (WIPER)
(15) TO (WORKLIGHT FR (-))
(16) TO (WORKLIGHT FR (+))
(17) GND (CABFRAME)
(18) ROOM LIGHT
(19) SPEAKER (R)
(20) ACC POWER (-)
(21) ACC POWER (+)
(22) BEACON (+)
(23) BEACON (-)
(24) CAB WORKLIGHT B (+)
(25) CAB WORKLIGHT B (-)
(26) SPEAKER (L)
(27) TO (WORKLIGHT FL (-))
(28) TO (WORKLIGHT FL (+))

W/H20 (Wiper harness)



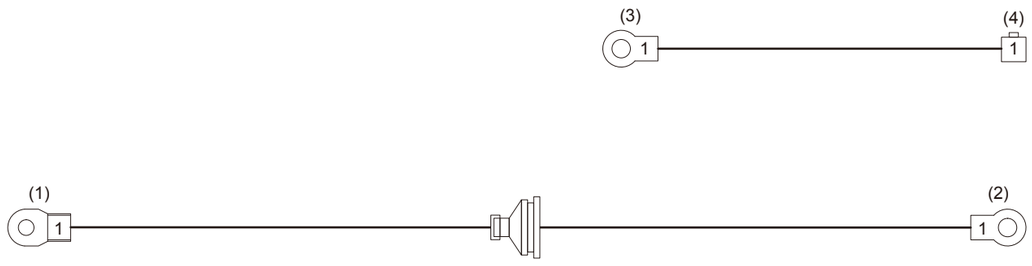
(1) WIPER F
(2) TO (CAB (WIPER))

W/H28 (Cabin work light harness)



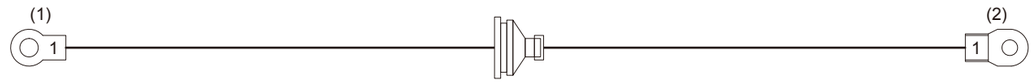
(1) TO (CAB (WORKLIGHT FL (+)))
(2) TO (CAB (WORKLIGHT FL (-)))
(3) CAB WORKLIGHT FL (+)
(4) CAB WORKLIGHT FL (-)
(5) TO (CAB (WORKLIGHT FR (+)))
(6) TO (CAB (WORKLIGHT FR (-)))
(7) CAB WORKLIGHT FR (+)
(8) CAB WORKLIGHT FR (-)

W/H30 (Battery harness (+), 1)



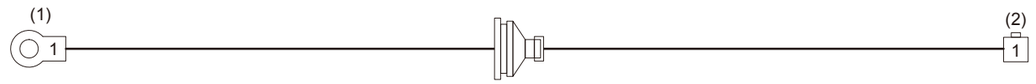
(1) BATTERY (+) BI
(2) BATTERY ISOLATOR (A-BI)
(3) BATTERY TERMINAL BI
(4) TO (MAIN (ECU +B) BI)

W/H31 (Battery harness (+), 2)



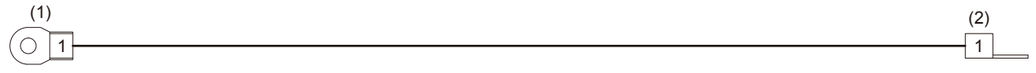
(1) BATTERY ISOLATOR (B-BID)
(2) STARTER (+B) D BI

W/H32 (Battery harness (+), 3)



(1) BATTERY ISOLATOR (B-BI)
(2) TO (MAIN (POWER) BI)

W/H33 (Battery harness (-))

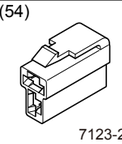
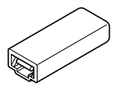
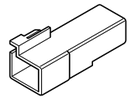
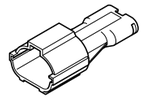
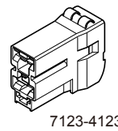
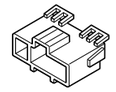
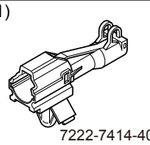
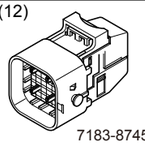
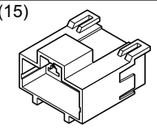


(1) CORD BATTERY (-) (BATTERY)
(2) CORD BATTERY (-) (MAIN FRAME)

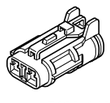
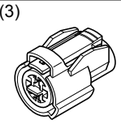
W/H34 (Bodyground harness)

(1) BODYEARTH (MAIN FRAME)
(2) BODYEARTH (ENGINE)

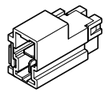
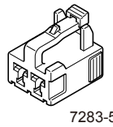
W/H00 (Main harness)

(1)(54)  7123-2820	(2) 7123-7434-40	(3) 7113-1020	(4) 7115-1050	(5)(6)  7123-2010	(7)(24)(36)  6098-0017	(8)  7222-1424-40	(9)  7123-4123-30	(10)  7122-6083-30	(11)  7222-7414-40	(12)  7183-8745-10	(15)  7123-6261-40
(16)(17) 7009-1334-02	(18) 6195-0003	(19)(42) 6195-0051	(20) 7123-6020	(21) 6098-0514	(22) 7283-1050	(23) IL-AG5-7S-S3C1	(27) DT06-2S-CE06	(29) 7283-1081-10	(30) 7123-6083-30	(31) LA-M8	(32) 7123-6040
(33) 7123-2865-70	(34) MX34016SF1	(35) 7123-2860	(37)(38)(39) 7123-8307	(40) 6187-2801	(41) P010531	(43) 7123-6234-40	(44) 6180-6181	(45) 6189-6171	(46) 6192-0013	(28) 1473244-1	
(47) 7123-6423-30	(48) 174259-2	(49) 174257-2	(50) 7123-7740-40	(51) 7123-8520-40	(52) 7123-8322	(53) 7283-5832					

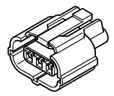
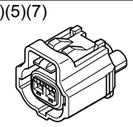
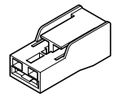
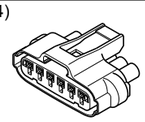
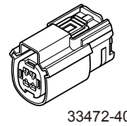
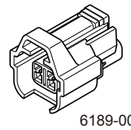
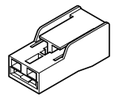
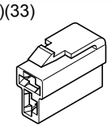
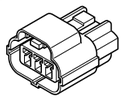
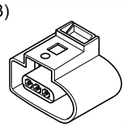
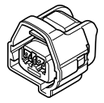
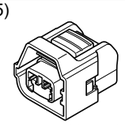
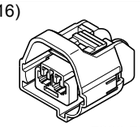
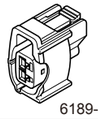
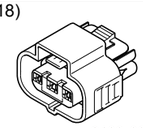
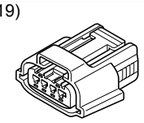
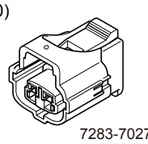
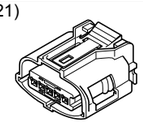
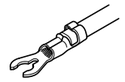
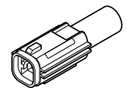
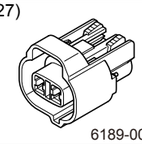
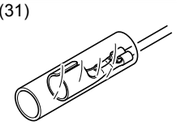
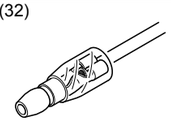
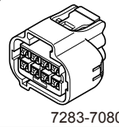
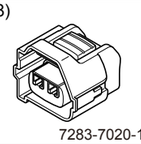
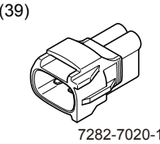
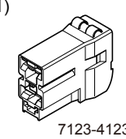
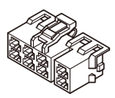
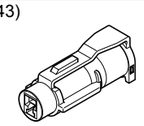
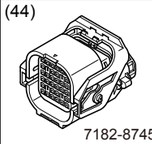
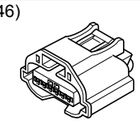
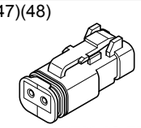
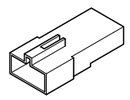
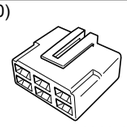
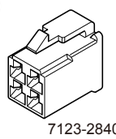
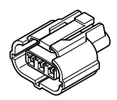
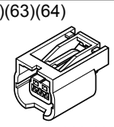
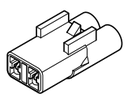
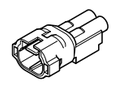
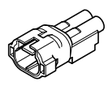
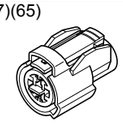
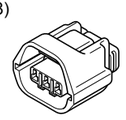
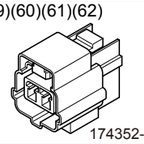
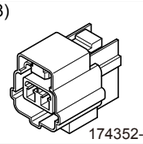
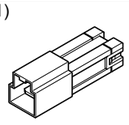
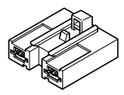
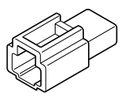
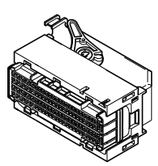
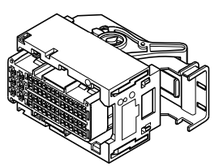
W/H02 (Travel pressure SW harness)

(1)  7123-1424-40	(2)(3)  6189-0158	

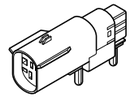
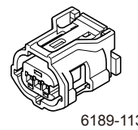
W/H06 (Blower harness)

(1)  7122-6020	(2)  7283-5379	

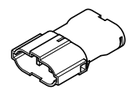
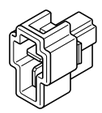
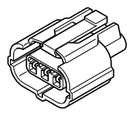
W/H09 (Engine harness)

(1)  7283-8852-30	(2)(5)(7)  178449-6	(3)  172320-1	(4)  7283-1968-30	(6)  33472-4006	(8)  6189-0039	(9)  172320-2
(10)(33)  7123-2820	(11) 7009-1342-02	(12)  174357-2	(13)  1813271-1	(14)  7283-7026-30	(15)  7283-7028-10	(16)  7283-7023
(17)(24)(25)(26)  6189-0611	(18)  6189-0099	(19)  6195-0030	(20)  7283-7027	(21)  6189-1046	(22)  LE-M4	(23)  P010463
(27)  6189-0094	(31)  7115-1050	(32)  7113-1020	(34)(35) 7009-1836	(36)  7283-7080-40	(38)  7283-7020-10	(39)  7282-7020-10
(41)  7123-4123-30	(42)  7123-6083-30	(43)  7123-7414-40	(44)  7182-8745-10	(46)  7283-8850-30	(47)(48)  DT06-2S-EP06	(49)  6098-0022
(50)  6020-6161	(51)  7123-2840-90	(52)  P010478	(53)(63)(64)  7283-2090-30	(54)  6180-2451	(55)  6187-2801	(56)  6187-2802
(57)(65)  6189-0156	(58)  7283-8730-30	(59)(60)(61)(62)  174352-2	(68)  174352-2	(71)  7122-4113-30	(73)  7123-3220	(74)  7122-2810
(37)  9-1452423-9	(40)  9-1452415-9					

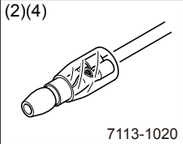
W/H10 (Camshaft position sensor harness)

(1)  33482-0401	(2)  6189-1130		

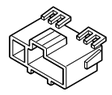
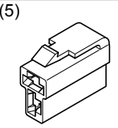
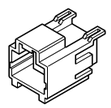
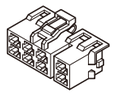
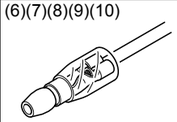
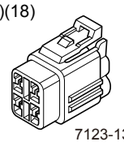
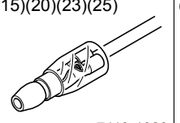
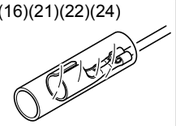
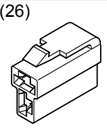
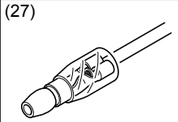
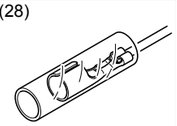
W/H12 (Front harness)

(1)  7222-7434-40	(2)  7122-2820	(3)  2822366-1	(4) 7115-1050	(5) 7113-1020

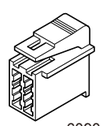
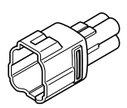
W/H14 (Front extension harness)

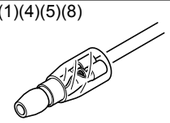
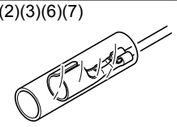
(1)(3) 7115-1050	(2)(4)  7113-1020	

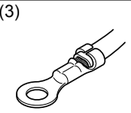
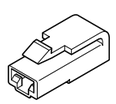
W/H19 (Cabin harness)

(1)  7122-6083-30	(2)(5)  7123-2820	(3)  7122-6040	(4)  7123-6083-30	(6)(7)(8)(9)(10)  7113-1020
(11)(12) 7115-1050	(13)(17) LA-M8	(14)(18)  7123-1347	(15)(20)(23)(25)  7113-1020	(16)(21)(22)(24)  7115-1050
(19)(26)  7123-2825	(27)  7113-1020	(28)  7115-1050		

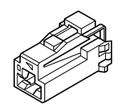
W/H20 (Wiper harness)

(1)  6090-1011	(2)  7122-1347

W/H28 (Cabin work light harness)		
(1)(4)(5)(8)  7113-1020	(2)(3)(6)(7)  7115-1050	

W/H30 (Battery harness (+), 1)		
(2)(3)  LA-M8	(4)  7123-2810	

W/H31 (Battery harness (+), 2)		
(1) LA-M8		

W/H32 (Battery harness (+), 3)		
(1) LA-M8	(2)  7123-4113-30	

W/H33 (Battery harness (-))		
(1)(2) 7003-1210-02		

W/H34 (Bodyground harness)		
(1)(2) 7003-1210-02		

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