WSM

WORKSHOP MANUAL
KUBOTA EXCAVATOR

U27-4

Kubota

KiSC issued 05, 2019 A

CONTENTS

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**

- **Corresponding model list**

Machine Model		Engine Model
U27-4	For European Union	D1105-E4-BH-2

■ **IMPORTANT**

- **Refer to the information of the engine below.**
- Engine model : D1005-E4B, D1105-E4B, D1305-E4B, V1505-E4B
- Web PDF-Code : No.9Y111-07840
- Hard Copy-Code : No.9Y121-07840
- CD-ROM-Code : No.9Y131-07840

March, 2014

Record of Revisions

Last digit of the Code No.	Date	Main Revised Point and Corrective Measures	Remarks
1	2016.07	Addition Hi spec version.	H. N
2	2018.07	Control valve disassembly / assembly procedures has been updated.	T. F
3	2019.05	Added dimensions of new rubber track (serial number: from 63660).	T. S
4			

I INFORMATION

INFORMATION

CONTENTS

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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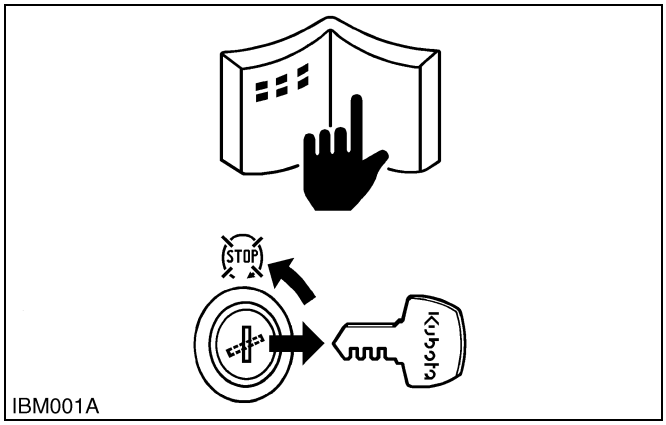
2. IN THE INTEREST OF WORK SAFETY

[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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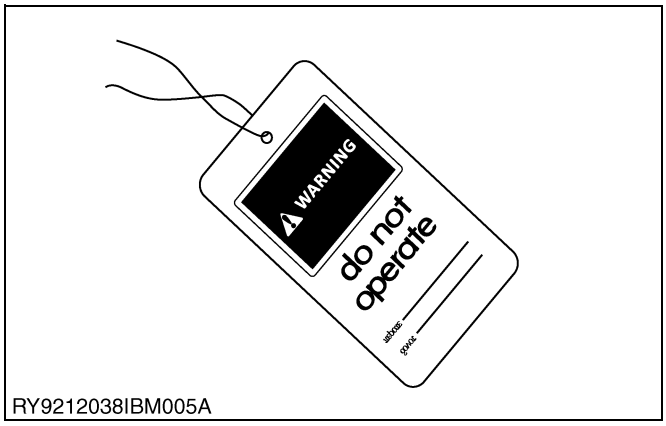

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- When performing maintenance on the equipment, hang the DO NOT OPERATE sign where it will be obvious from and around the driver's seat.
- When performing maintenance or repairs, always lower attachments to the ground, stop the engine and attach the 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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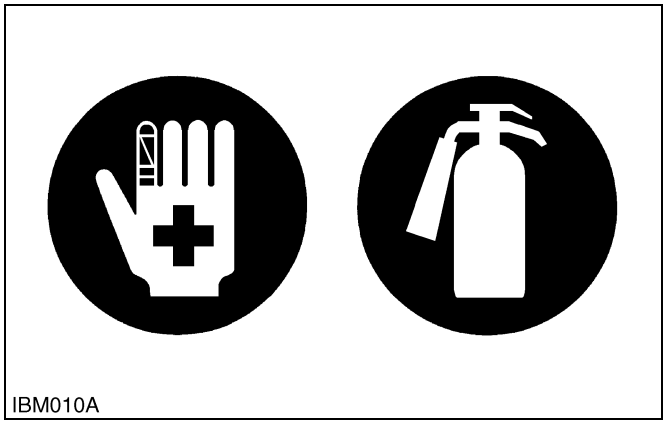
IBM010A

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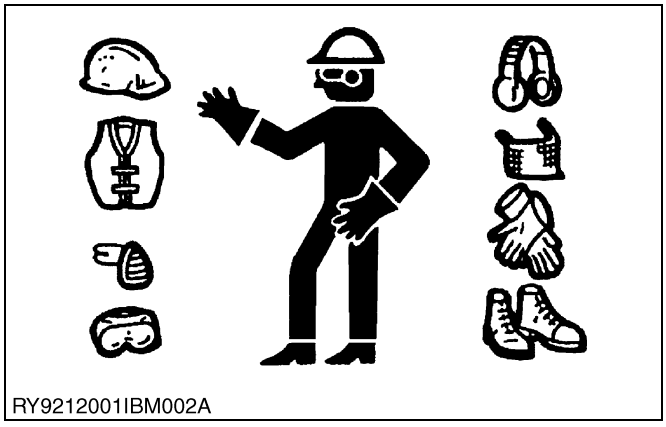
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- Wear clothes appropriate for working on equipment. Do not wear loose-fitting clothes as they may catch on the machine controls.
- When working on the equipment, use all safety gear, such as a helmet, safety glasses and shoes, that are required by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

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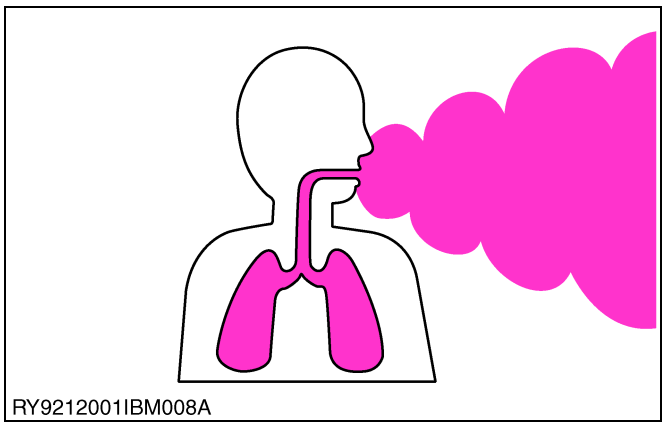
(2) Precautions Before Working on the Equipment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- Stop the machine on a hard and level location and make sure the area around the machine is free of obstacles and hazardous materials. When parking the machine indoors, select a spot that can be properly 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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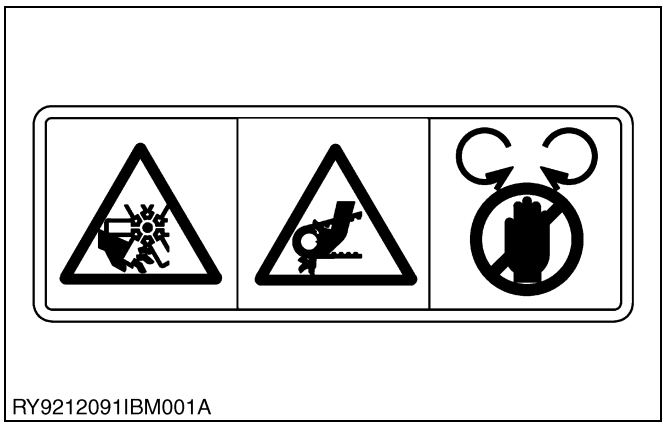
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- Whenever it is necessary to open the engine covers or bonnet in order to service the machine, always prop them open.
- If it is absolutely necessary to run the engine while working on the machine, make sure you are clear of all rotating or moving parts. Also take care not to leave anything, such as tools or rags, near any moving parts.

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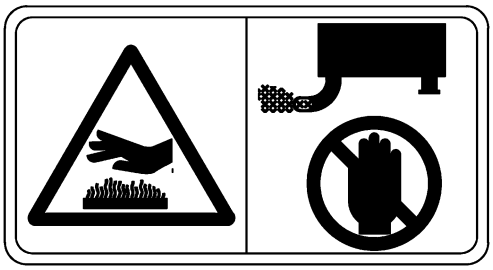

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- The engine, muffler, radiator, hydraulic line, etc., have parts that remain very hot even after the engine has been stopped. Be sure to avoid these parts, as touching them can result in burns. Radiator coolant, hydraulic fluid and oil also remain 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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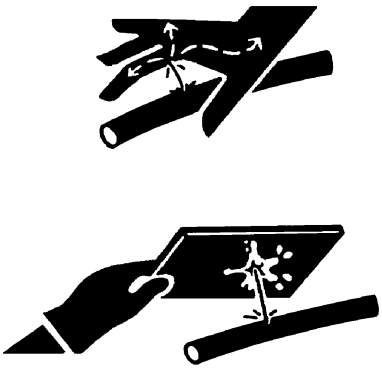

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- The pressure in the hydraulic circuit stays at pressure even after the engine stops.
  Before removing parts, such as hydraulic devices from the machine, first release the pressure. Please note that when releasing residual pressure, the machine itself 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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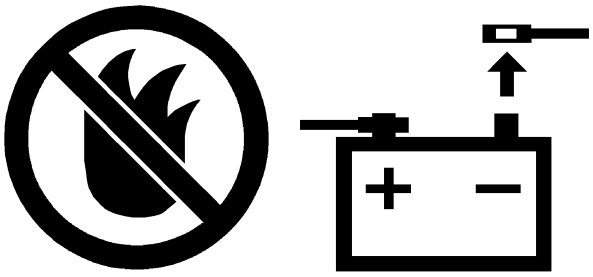

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- Always wear safety glasses and gloves when handling the battery.
- The gas generated by the battery is flammable. Never weld or use tools like a grinder near the battery. And never smoke near it.
- When disconnecting the battery, always disconnect 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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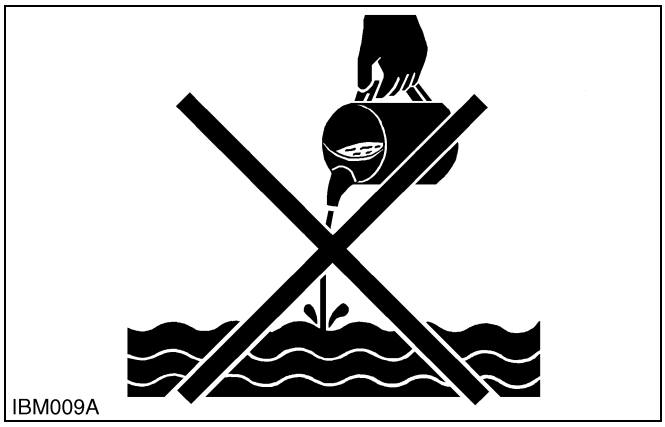
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Dispose of Waste Fluids Properly

- 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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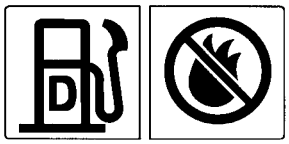

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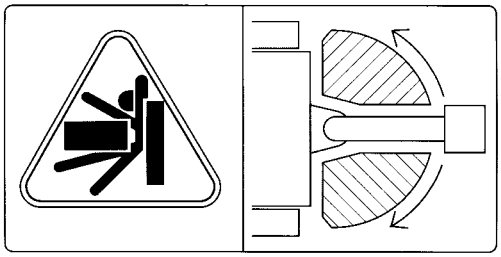

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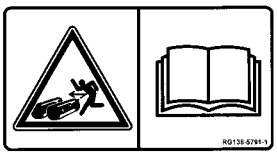

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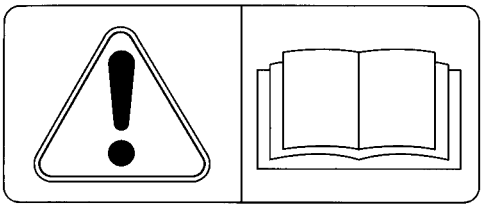

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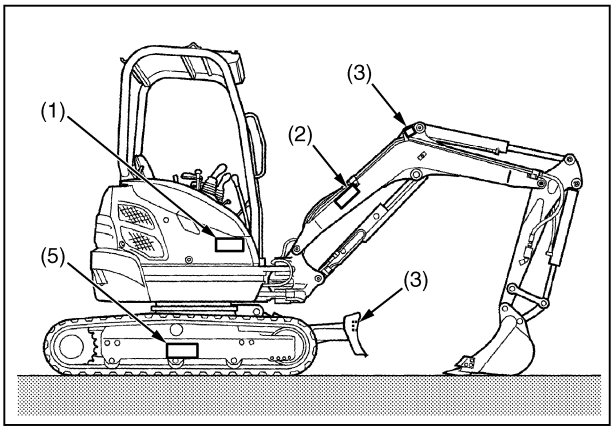

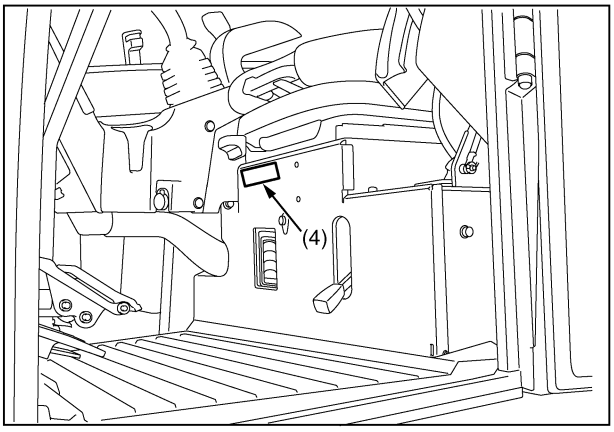

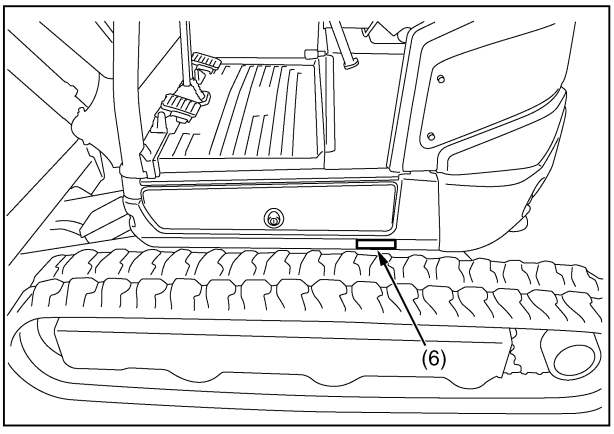

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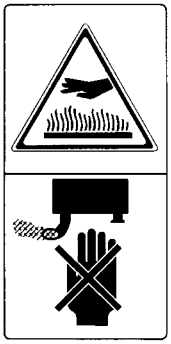

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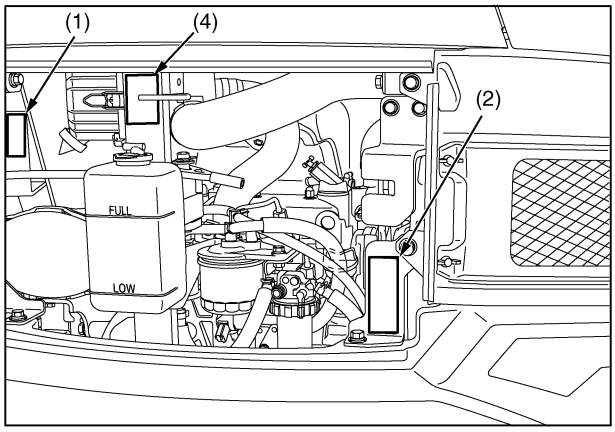

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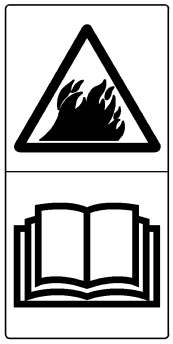

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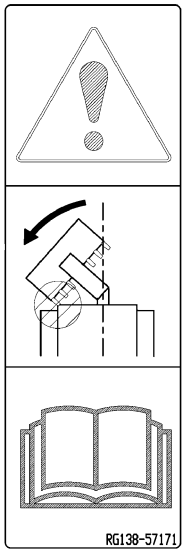

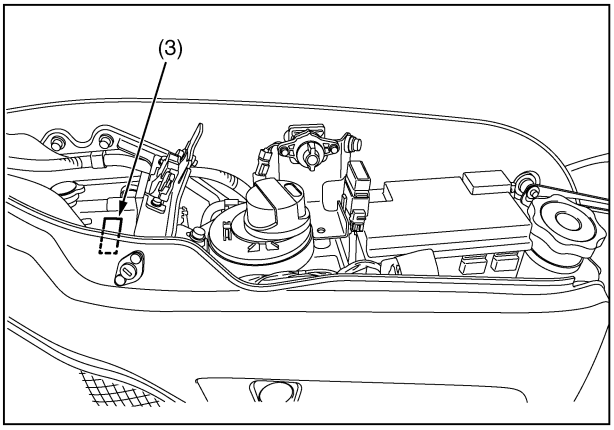

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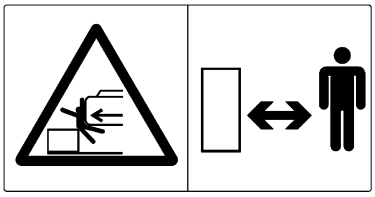

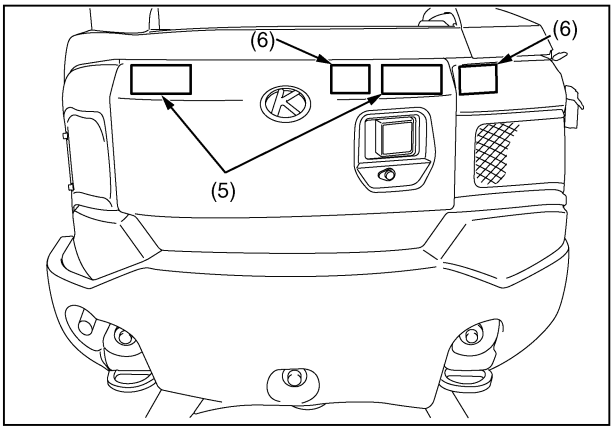

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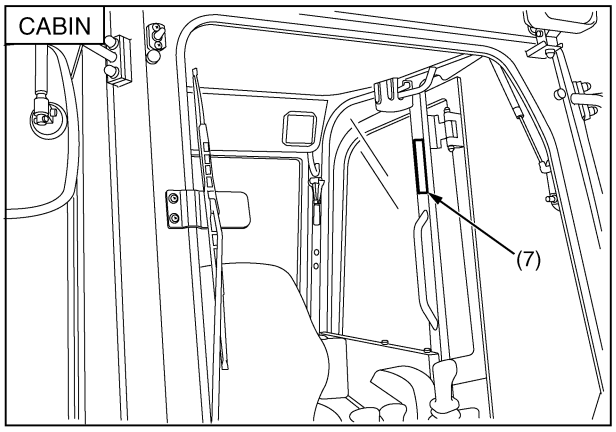

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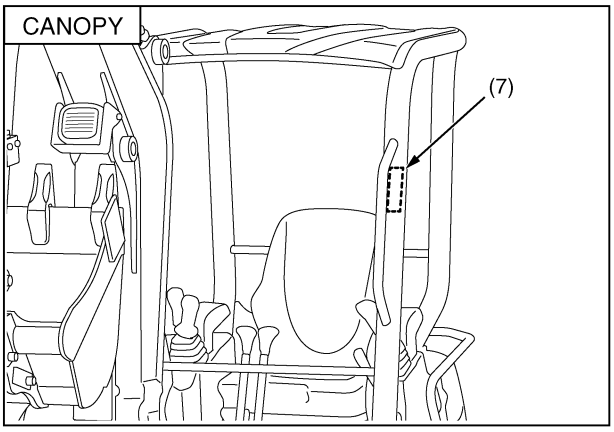

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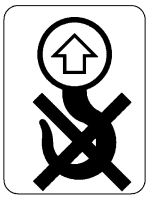

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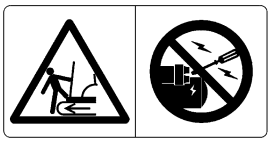

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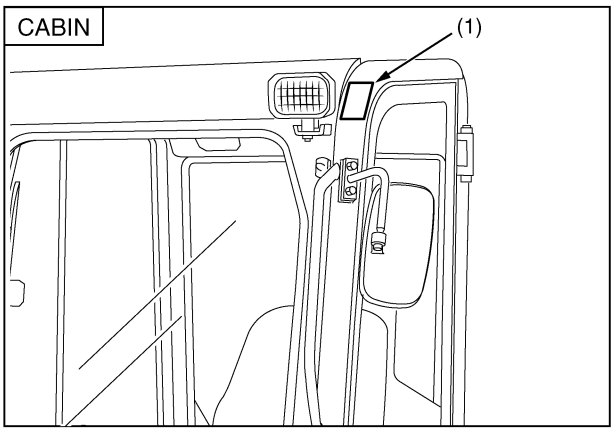

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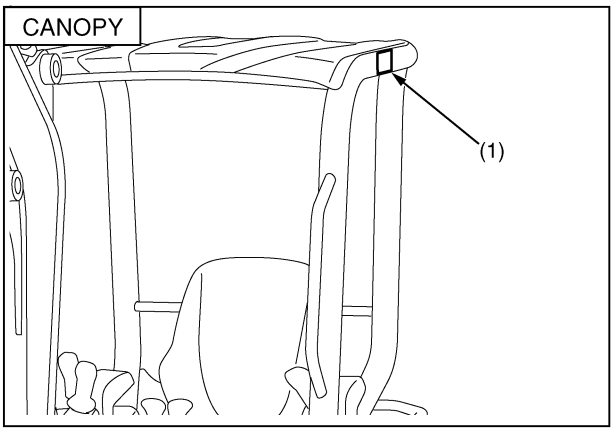

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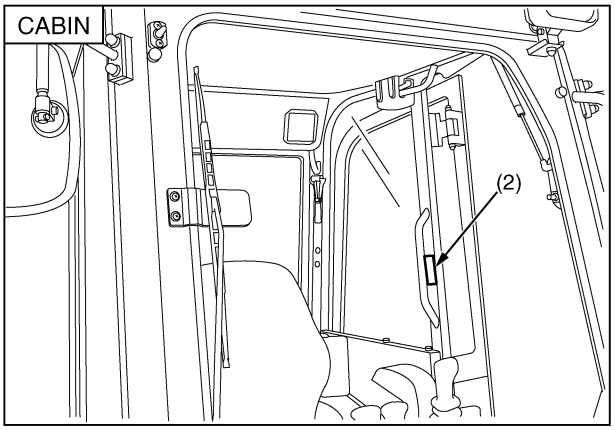

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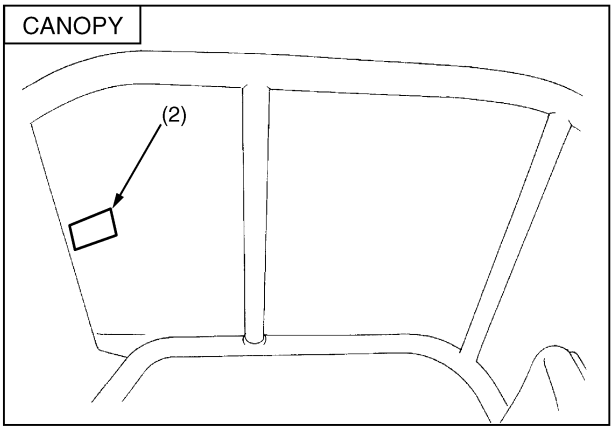

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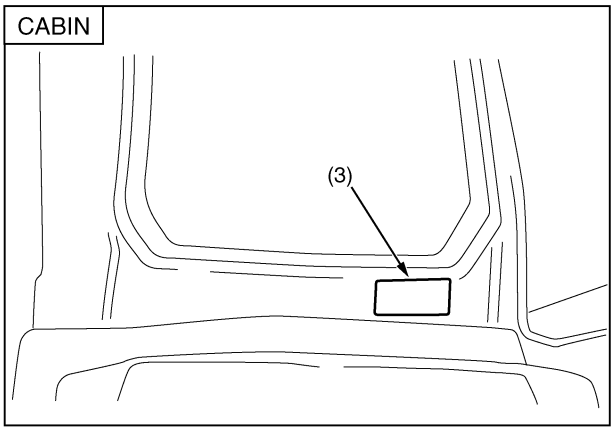

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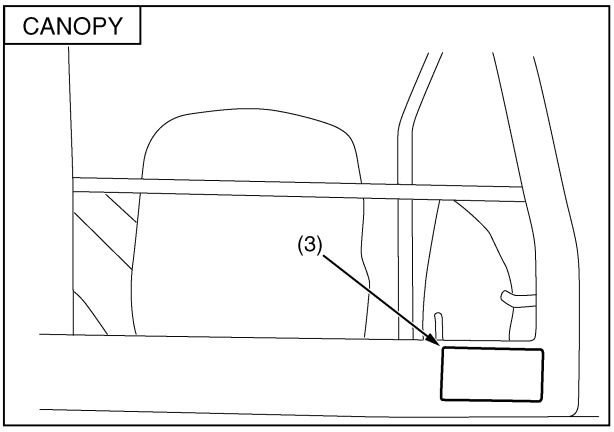

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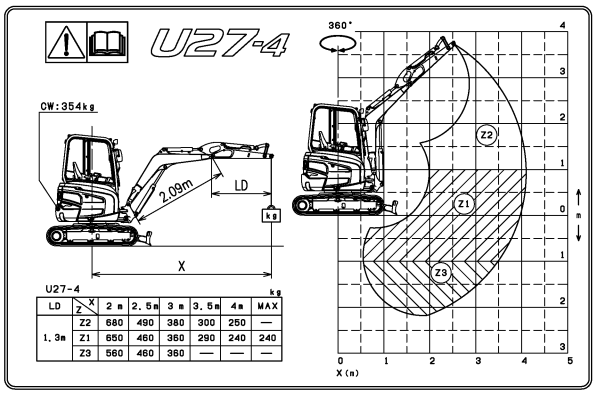

U27-4 kg

LD	X / Z	2 m	2.5m	3 m	3.5m	4m	MAX
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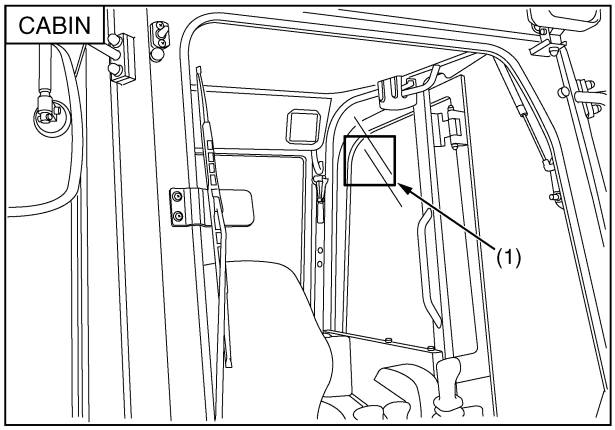
	Z1	650	460	360	290	240	240
	Z3	560	460	360	—	—	—



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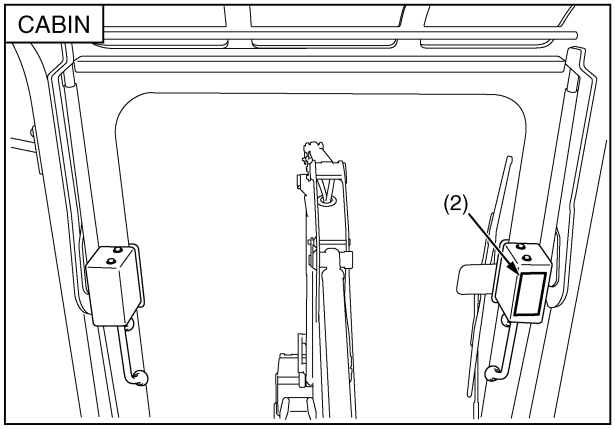

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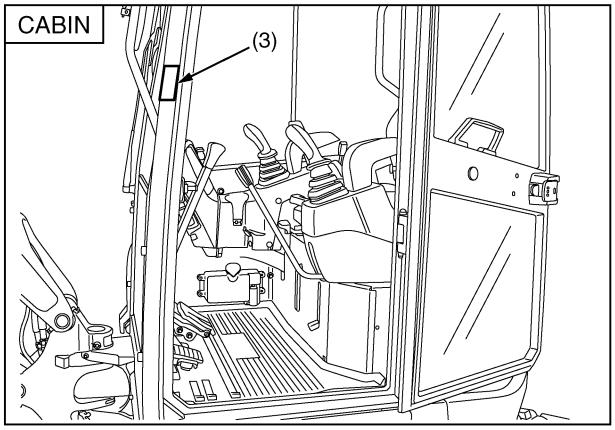

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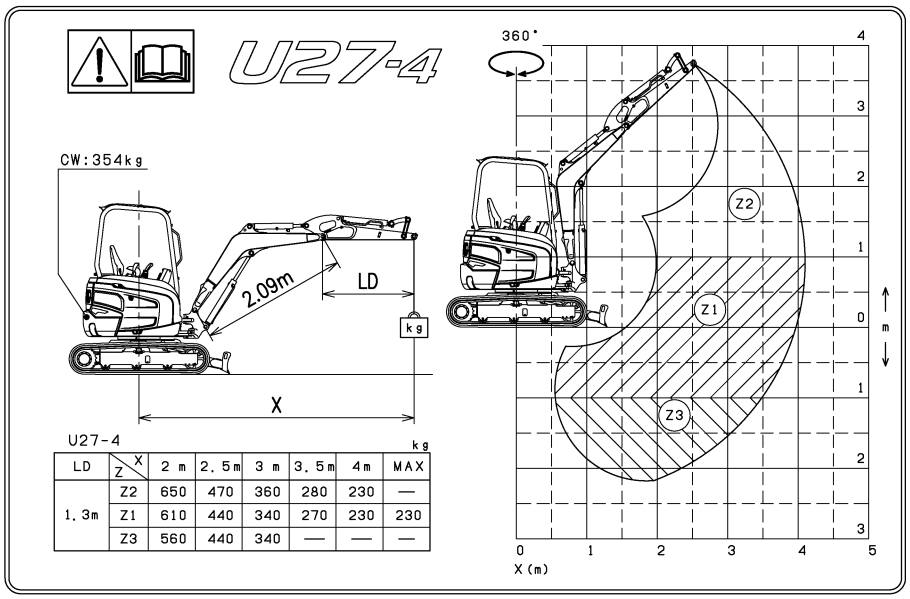
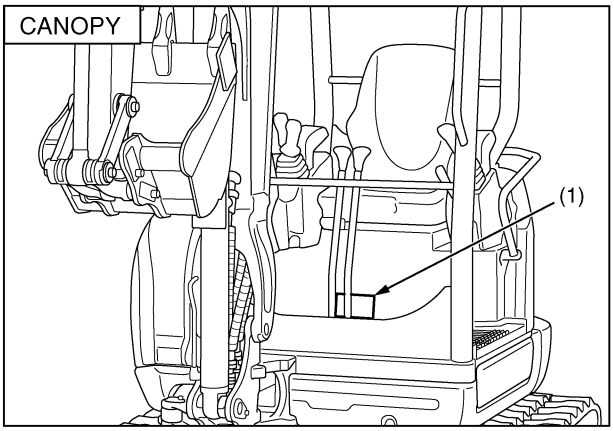


U27-4 kg

LD	Z \ X	2 m	2.5m	3 m	3.5m	4m	MAX
1.3m	Z2	650	470	360	280	230	—
	Z1	610	440	340	270	230	230
	Z3	560	440	340	—	—	—



RY9212180ICI004A

RY9212180INI0006US0

[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. MAIN SPECIFICATIONS

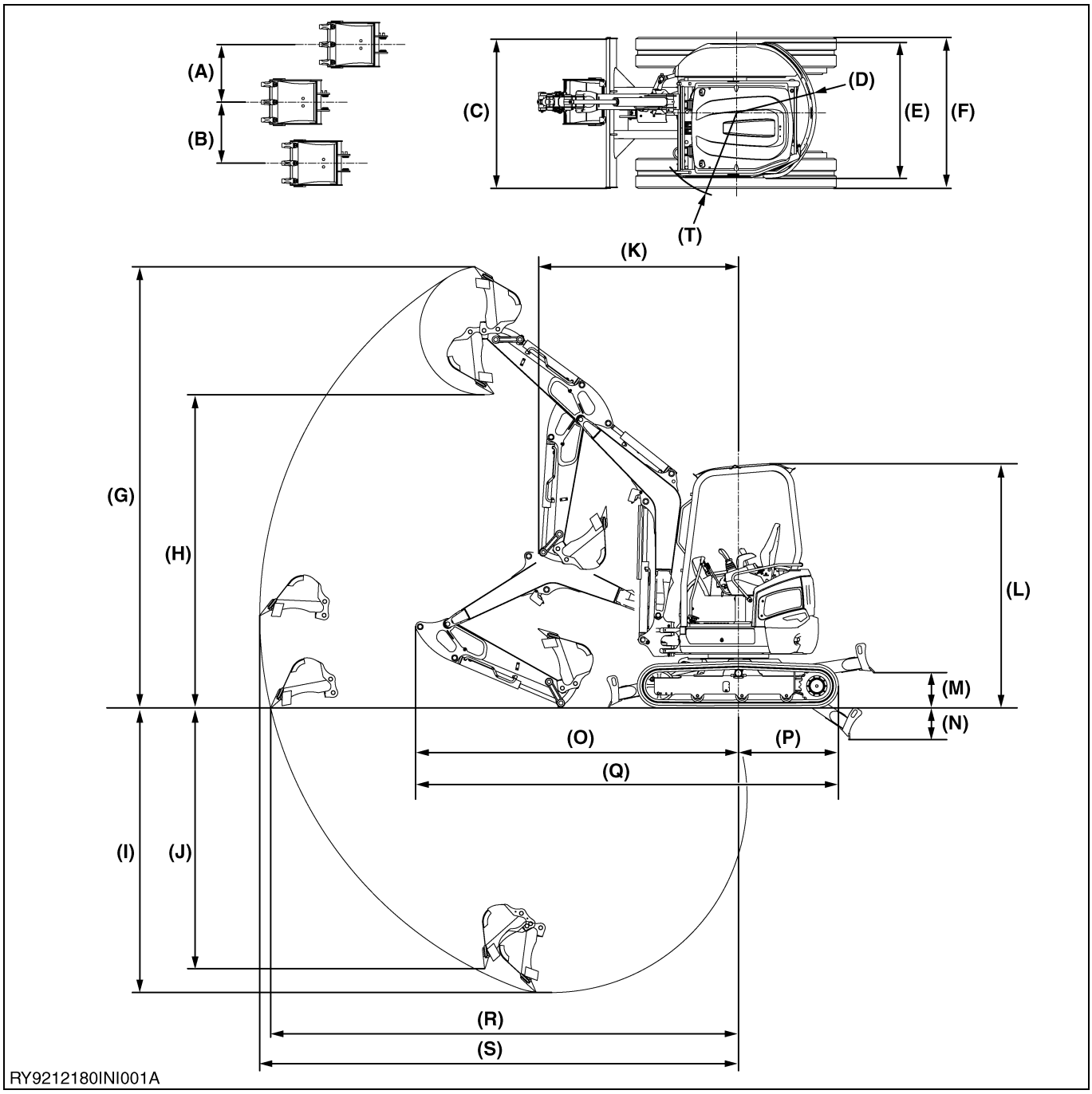
			KUBOTA EXCAVATOR	
Model name			U27-4	
Type			CANOPY	CABIN
Machine weight			2490 kg 5490 lbs	2590 kg 5710 lbs
Operating weight			2565 kg 5655 lbs	2665 kg 5875 lbs
Standard bucket	Volume (CECE)		0.060 m^3	
	Width (with side cutter)		450 mm (500 mm) 17.7 in. (19.7 in.)	
Engine	Type (water cooled 4 cycle Diesel)		3 cylinder	
	Model name		D1105-E4-BH-2	
	Total displacement		1123 cm^3	
	Output (ISO 9249)		15.6 kW	
	Rated speed		2400 rpm	
Performance	Swing speed		9.8 rpm	
	Travel speed	1F	2.6 km / h	
		2F	4.6 km / h	
	Ground pressure		23.7 kPa 0.24 kgf/cm^2	24.7 kPa 0.25 kgf/cm^2
	Climbing angle		20 deg	
Blade (width and height)			1500 x 300 mm 59.06 x 11.8 in.	
Boom swing angle	Left		1.31 rad (75 deg)	
	Right		0.96 rad (55 deg)	
Pressure connection for attachments	Max. displacement (Theoretical)		48.0 L/min	
	Max. pressure		21.6 MPa (220 kgf/cm^2, 3130 psi)	
Fuel tank capacity			33 L	

■ **NOTE**
- **Above dimensions are based on the machine with rubber tracks and JPN bucket.**
  JPN = made in Japan
- **Specifications subject to change without notice.**
- **With unloaded digging bucket.**
- **Firm compacted soil.**
- **Operators must exercise extra caution and follow instructions in the operator's manual.**
- **Worse condition or heavier attachment to the above will decrease climbing angle.**

RY9212180INI0001US0

5. DIMENSIONS

CANOPY TYPE



RY9212180INI001A

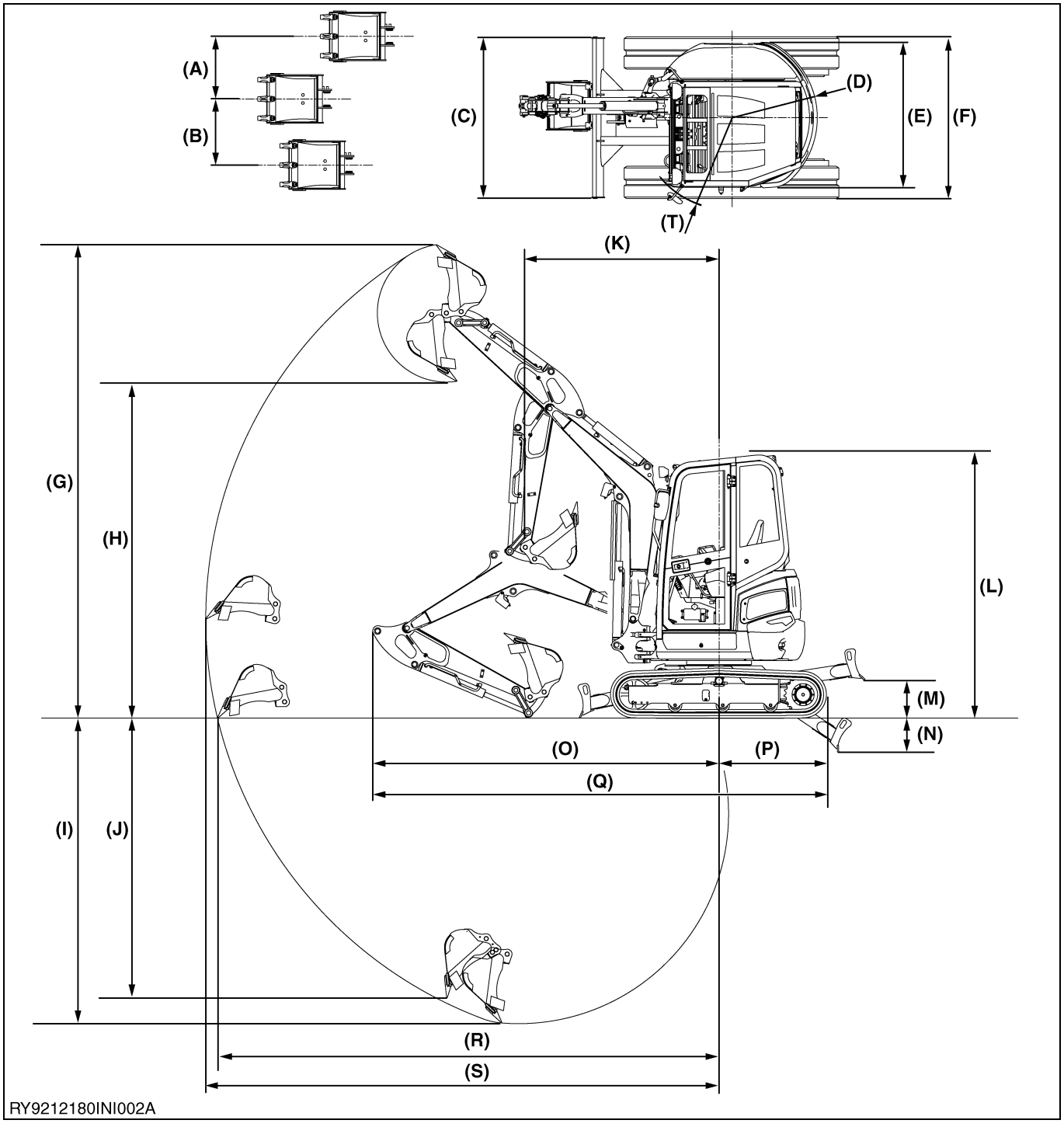
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
U27-4 CANOPY	580 mm 22.8 in.	610 mm 24.0 in.	1500 mm 59.1 in.	790 mm 31.1 in.	1350 mm 53.1 in.	1500 mm 59.1 in.	4370 mm 172.0 in.

	(H)	(I)	(J)	(K)	(L)	(M)	(N)
U27-4 CANOPY	3100 mm 122.0 in.	2820 mm 111.0 in.	2580 mm 101.6 in.	1980 mm 78.0 in.	2420 mm 95.3 in.	350 mm 13.8 in.	320 mm 12.6 in.

	(O)	(P)	(Q)	(R)	(S)	(T)
U27-4 CANOPY	3200 mm 126.0in.	990 mm 39.0 in.	4190 mm 165.0 in.	4630 mm 182.3 in.	4740 mm 186.6 in.	850 mm 33.5 in.

RY9212180INI0002US0

CABIN TYPE



RY9212180INI002A

	(A)	(B)	(C)	(D)	(E)	(F)	(G)
U27-4 CAIBN	580 mm 22.8 in.	610 mm 24.0 in.	1500 mm 59.1 in.	790 mm 31.1 in.	1350 mm 53.1 in.	1500 mm 59.1 in.	4370 mm 172.0 in.

	(H)	(I)	(J)	(K)	(L)	(M)	(N)
U27-4 CAIBN	3100 mm 122.0 in.	2820 mm 111.0 in.	2580 mm 101.6 in.	1980 mm 78.0 in.	2430 mm 95.7 in.	350 mm 13.8 in.	320 mm 12.6 in.

	(O)	(P)	(Q)	(R)	(S)	(T)
U27-4 CAIBN	3200 mm 126.0in.	990 mm 39.0 in.	4190 mm 165.0 in.	4630 mm 182.3 in.	4740 mm 186.6 in.	870 mm 34.3 in.

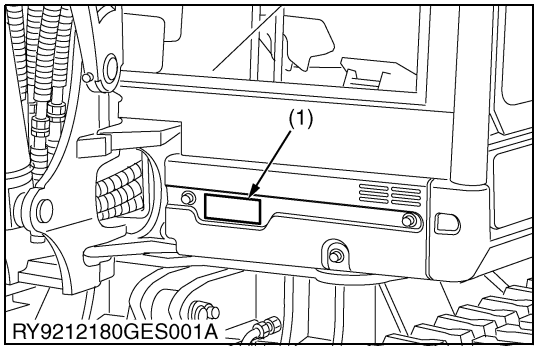
RY9212180INI0008US0

G GENERAL

GENERAL

CONTENTS

1. MACHINE INDENTIFICATION



RY9212180GES001A

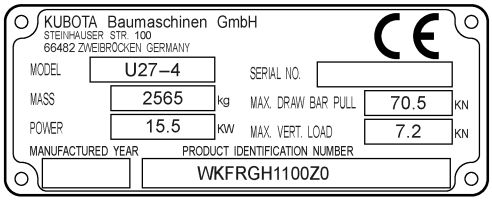
When consulting with your local Kubota dealer about this machine, please provide the model of the machine, its frame and engine numbers and the number of hours on the hour meter.

(1) machine Nameplate (Model, frame number, engine number)
(2) Frame Number
(3) Engine Number

(a) Model Nameplate (CANOPY)
(b) Model Nameplate (CABIN)

RY9212180GEG0001US0

(a)



RY9212180GES004A

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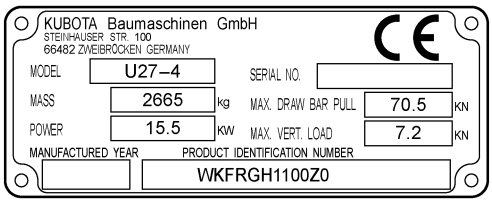

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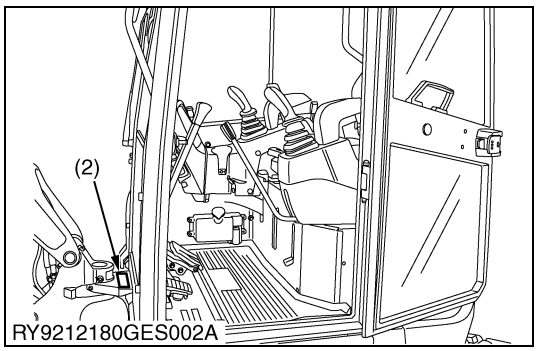

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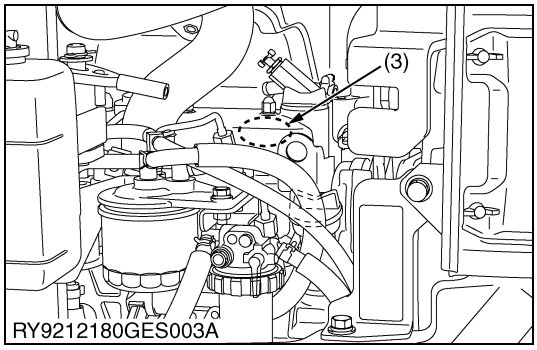
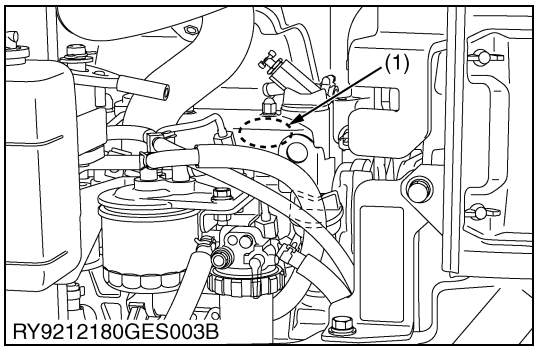


RY9212180GES003A

2. ENGINE INDENTIFICATION

[1] MODEL AND ENGINE 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)	6	GZ, OC, AC, EA, E
2	V3	7	03
3	08	8	07
4	SM (include: WG)	A	EA, RK
5	Air Cooled Gasoline	B	03 (KET Production)

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. D1105 - 1 E G1237

(a) **D1105**: Engine Model Name
(b) **1**: Engine Series (05 series)
(c) **E**: Production Year (2014)
(d) **G**: Production Month (April)
(e) **1237**: Lot Number: (**0001 to 9999** or **A001 to Z999**)

RY9212180GEG0002US0

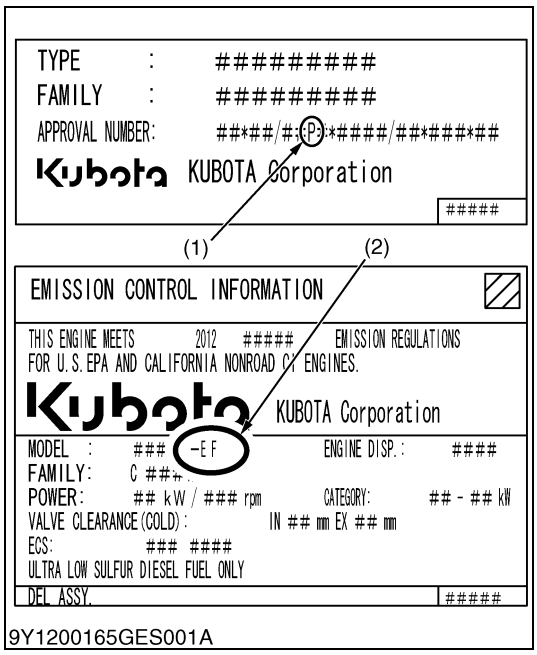
[2] E4B ENGINE

[Example: Engine Model Name D1105-M-DI-E4]

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, E4B will be the designation that identifies engine models affected by the next emission phase (See the table below).

When servicing or repairing ###-E4B series engines, use only replacement parts for that specific E4B engine, designated by the appropriate E4B KUBOTA Parts List and perform all maintenance services listed in the appropriate KUBOTA Operator's Manual or in the appropriate E4B 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 E4B 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. E4B engines are identified with "EF" at the end of the Model designation, on the US EPA label. Please note: E4B is not marked on the engine.



9Y1200165GES001A

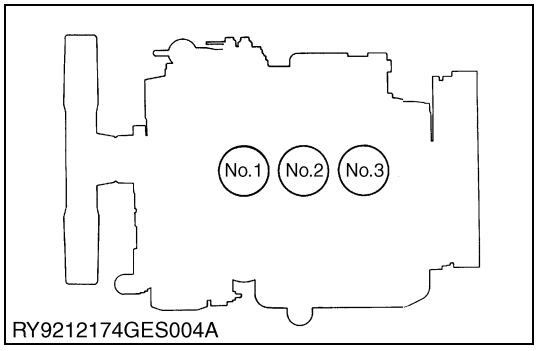
Category (1)	Engine output classification	EU regulation
K	From 19 to 37 kW	STAGE IIIB
P	From 37 to less than 56 kW	STAGE IIIB
N	From 56 to less than 75 kW	STAGE IIIB
M	From 75 to less than 130 kW	STAGE IIIB

Category (2)	Engine output classification	EPA regulation
EF	Less than 19 kW	Tier 4
	From 19 to less than 56 kW	Interim Tier 4
	From 56 to less than 75 kW	Interim Tier 4
	From 75 to less than 130 kW	Interim Tier 4

(1) EU regulation engine output classification category
(2) "E4B" engines are identified with "EF" at the end of the Model designation, on the US EPA label.
"E4B" designates some Interim Tier 4 / Tier 4 models, depending on engine output classification.

RY9212180GEG0003US0

[3] CYLINDER NUMBER



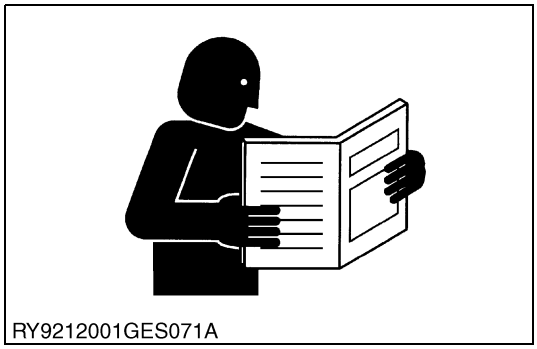
RY9212174GES004A

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

The sequence of cylinder numbers is No.1, No.2 and No.3 and it starts from the gear case side.

RY9212174GEG0003US0

3. 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.

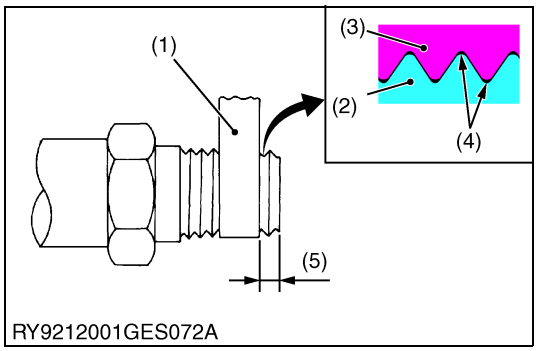
Before performing any maintenance on the machine, make sure it is sufficiently clean and choose a sufficiently clean location to perform any disassembly.

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.

RY9212001GEG0011US0



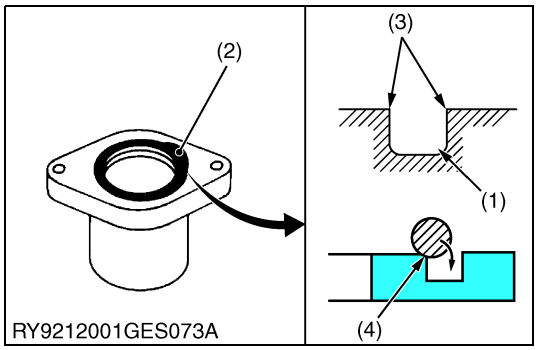
RY9212001GES072A

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

RY9212001GEG0012US0



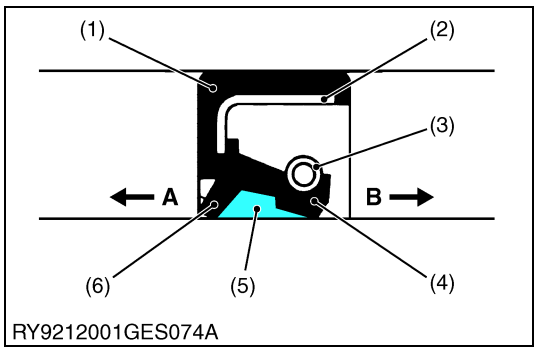
RY9212001GES073A

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

RY9212001GEG0013US0



RY9212001GES074A

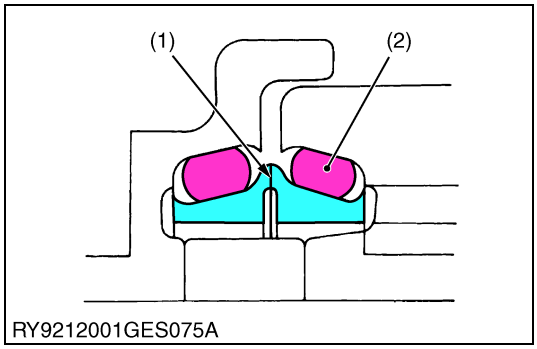
Oil Seal

- 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)

RY9212001GEG0014US0



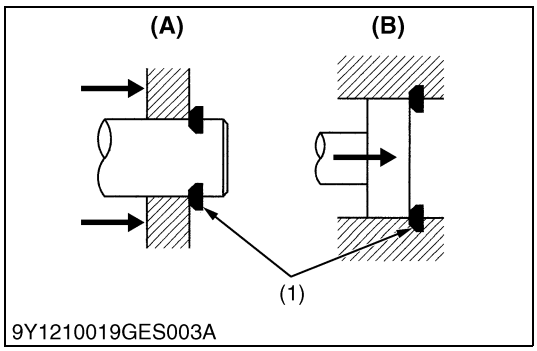
RY9212001GES075A

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

RY9212001GEG0015US0



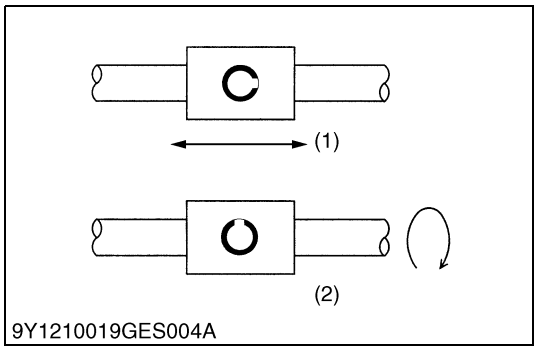
9Y1210019GES003A

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

RY9212001GEG0016US0



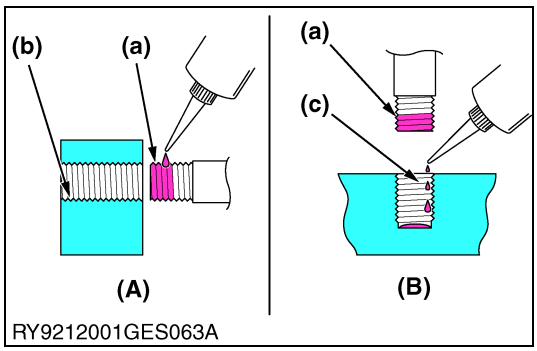
9Y1210019GES004A

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

RY9212001GEG0017US0



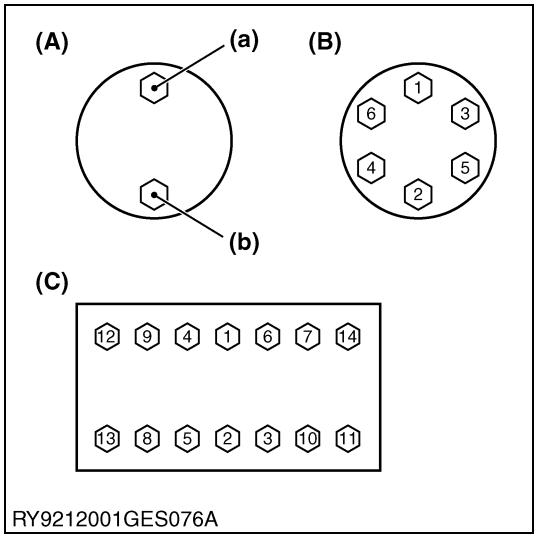
RY9212001GES063A

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

RY9212001GEG0018US0



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.

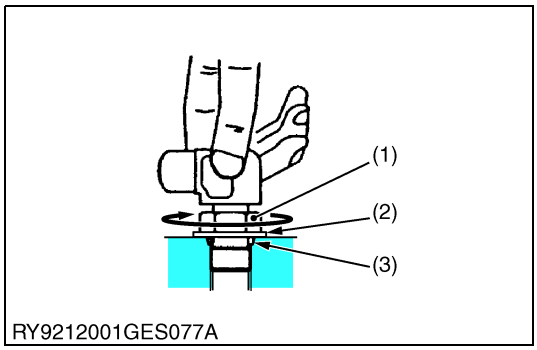
(A) Top/Bottom Alternately
(B) Across Diagonally
(C) Diagonally Across the Center

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.

RY9212001GEG0020US0

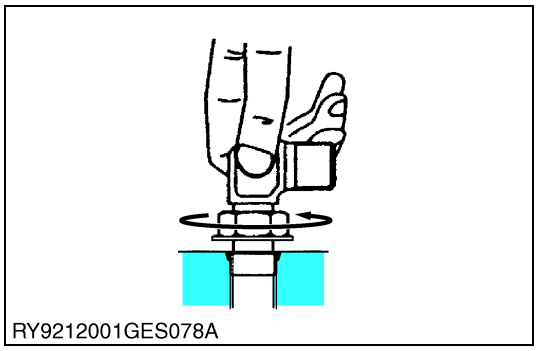


RY9212001GES077A

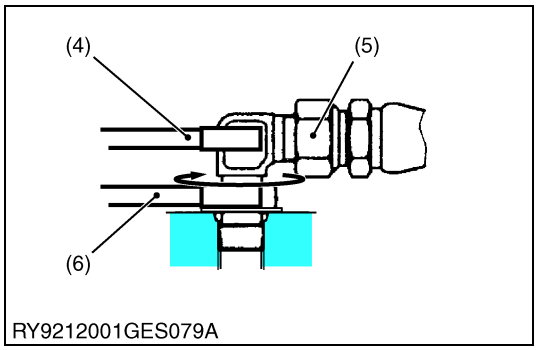
Elbow with Male Seat Assembly Procedure

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).

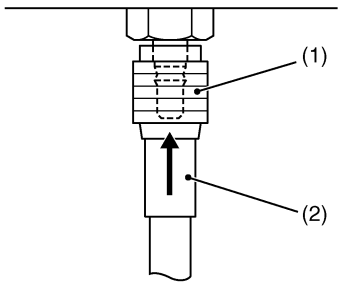


RY9212001GES079A

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

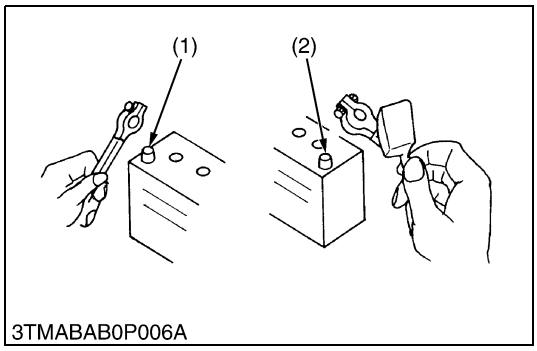
Installing and Removing Quick Couplings

- 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

RY9212001GEG0022US0

4. 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.

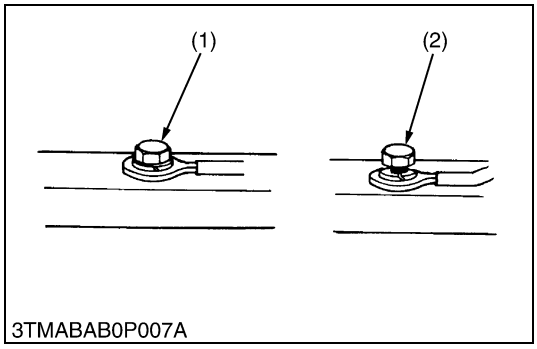
■ **IMPORTANT**

- **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

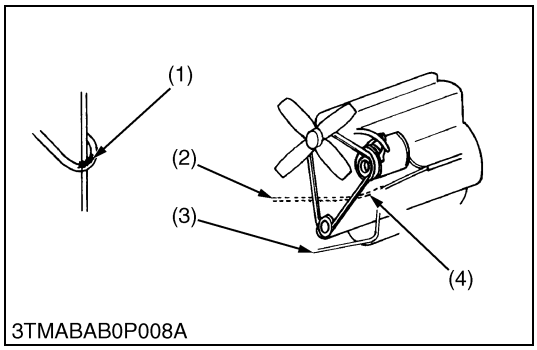


3TMABAB0P007A

- Tighten wiring terminals securely.

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

RY9212001GEG0024US0

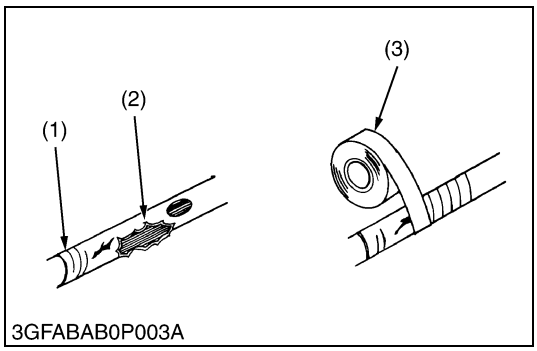


3TMABAB0P008A

- Keep wiring away from hazards.

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

RY9212001GEG0025US0

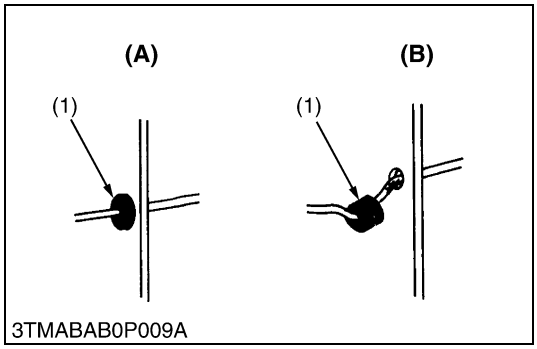


3GFABAB0P003A

- Immediately repair or replace old or damaged wiring.

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

RY9212001GEG0026US0



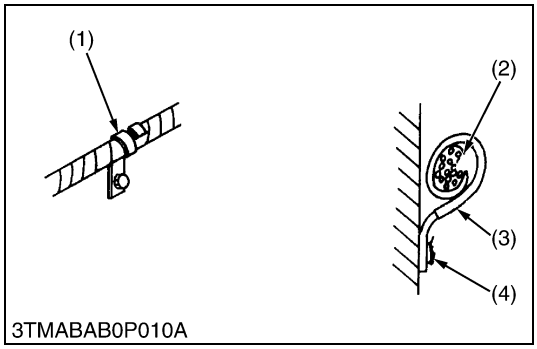
3TMABAB0P009A

- Insert grommet securely.

(1) Grommet

(A) Correct
(B) Incorrect

RY9212001GEG0027US0

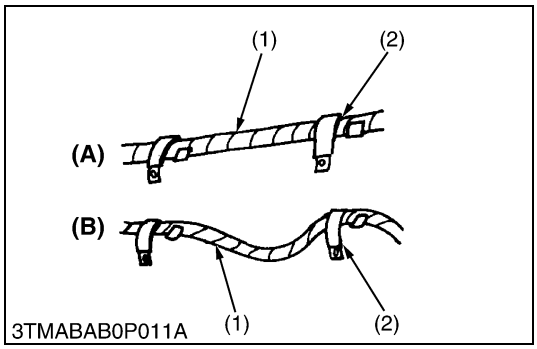


3TMABAB0P010A

- 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



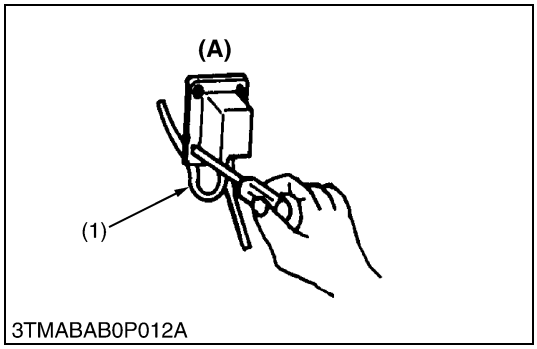
3TMABAB0P011A

- 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



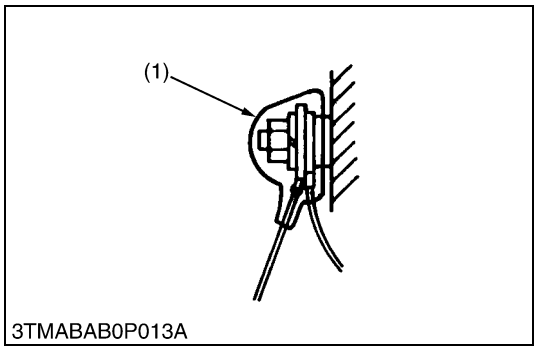
3TMABAB0P012A

- Do not pinch or bind wiring when installing parts.

(1) Wire

(A) Incorrect

RY9212001GEG0030US0



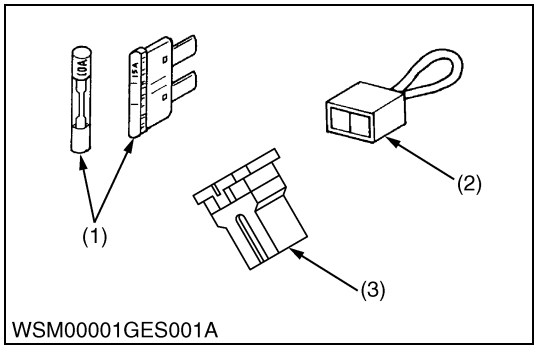
3TMABAB0P013A

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

(1) Cover (Install Covers Securely)

RY9212001GEG0031US0

[2] FUSES



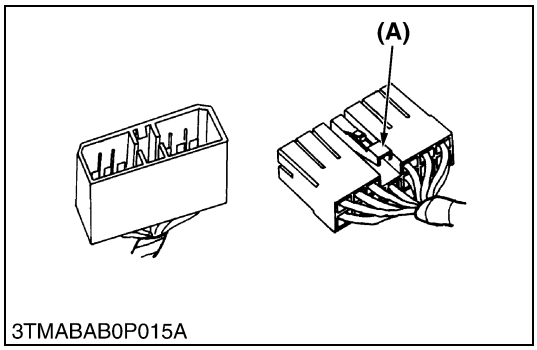
WSM00001GES001A

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

RY9212001GEG0032US0

[3] CONNECTOR

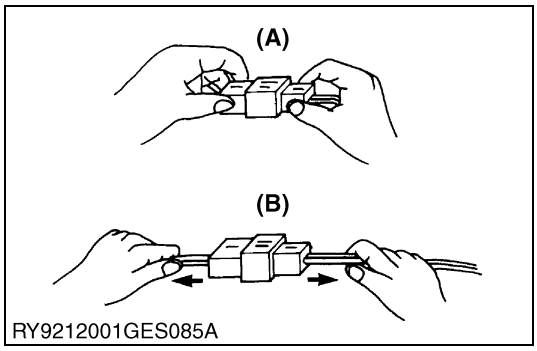


3TMABAB0P015A

- Press the lock to disconnect locking connectors.

(A) Push

RY9212001GEG0033US0

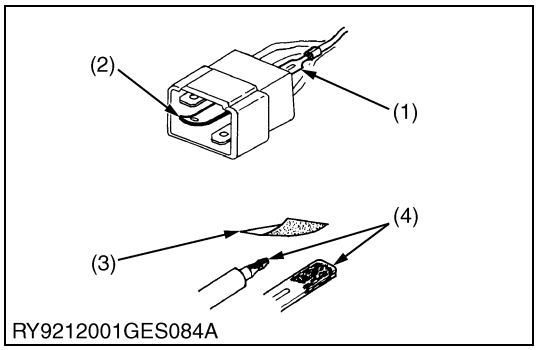


RY9212001GES085A

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

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

RY9212001GEG0034US0

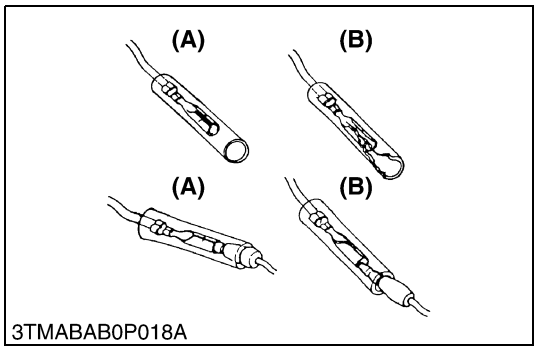


RY9212001GES084A

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

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

RY9212001GEG0035US0

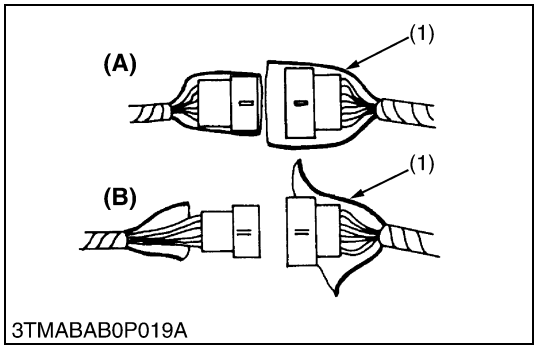


3TMABAB0P018A

- Female connectors must not be spread too far open

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

RY9212001GEG0036US0



3TMABAB0P019A

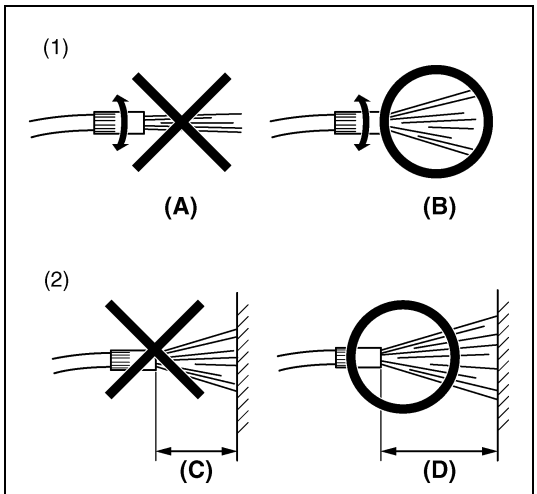
- The plastic covers of connectors must cover them completely.

(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

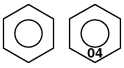
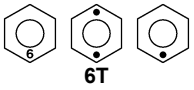
(A) Blasting
(B) Wide Spray
(C) Less Than 2.0 m (80 in.)
(D) Over 2.0 m (80 in.)

RY9212001GEG0038US0

5. TORQUE SPECIFICATION TABLE

[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

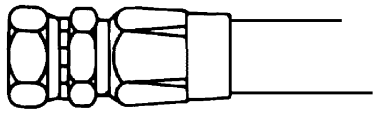
[2] TORQUES OF STUD BOLTS

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

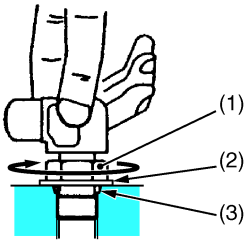


RY9212001GES067B

Hose size	Thread size	Wrench size	Torque
DN 4 - 1 / 8	M12 × 1.5	14 mm	15 to 20 N·m 1.5 to 2.0 kgf·m 11.1 to 14.8 lbf·ft
DN 6 - 1 / 4	M14 × 1.5	17 mm	15 to 20 N·m 1.5 to 2.0 kgf·m 11.1 to 14.8 lbf·ft
DN 8 - 5 / 16	M16 × 1.5	19 mm	30 to 35 N·m 3.1 to 3.6 kgf·m 22.1 to 25.8 lbf·ft
DN 10 - 3 / 8	M18 × 1.5	22 mm	40 to 45 N·m 4.1 to 4.6 kgf·m 29.5 to 33.2 lbf·ft
DN13 - 1 / 2	M22 × 1.5	27mm	50 to 55 N·m 5.1 to 5.6 kgf·m 36.9 to 40.6 lbf·ft

RY9212091GEG0017US0

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



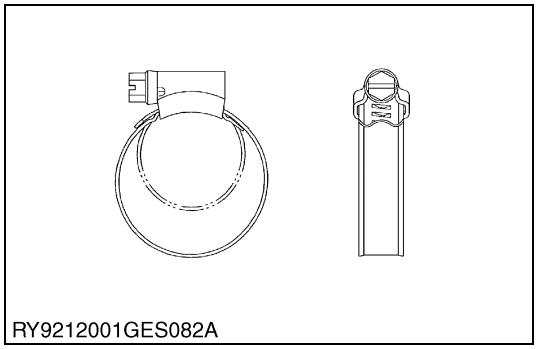
RY9212001GES077A

Hose size	Thread size	Wrench size	Torque
1 / 8	M10 × 1.0	14 mm	15 to 20 N·m 1.5 to 2.0 kgf·m 11.1 to 14.8 lbf·ft
1 / 8	M12 × 1.5	17 mm	25 to 35 N·m 2.6 to 3.6 kgf·m 18.4 to 25.8 lbf·ft
1 / 4	M14 × 1.5	19 mm	34 to 45 N·m 3.5 to 4.6 kgf·m 25.1 to 33.2 lbf·ft
1 / 4	M16 × 1.5	19 - 22 mm	40 to 55 N·m 4.1 to 5.6 kgf·m 29.5 to 40.6 lbf·ft
3 / 8	M18 × 1.5	22 - 24 mm	45 to 65 N·m 4.6 to 6.6 kgf·m 33.2 to 47.9 lbf·ft
1 / 2	M22 × 1.5	27 mm	70 to 80 N·m 7.1 to 8.2 kgf·m 51.6 to 59.0 lbf·ft
1 / 2	M24 × 1.5	27 mm	80 to 90 N·m 8.2 to 9.2 kgf·m 59.0 to 66.4 lbf·ft
3 / 4	M26 × 1.5	32 mm	100 to 120 N·m 10.2 to 12.2 kgf·m 73.8 to 88.5 lbf·ft
1	M30 × 2.0	36 mm	120 to 140 N·m 12.2 to 14.3 kgf·m 88.5 to 103.3 lbf·ft

(1) Lock-Nut
(2) Washer
(3) Seal (O-Ring)

RY9212091GEG0018US0

[4] HOSE CLAMP SCREW TORQUE



RY9212001GES082A

	Hose diameter	Hydraulic oil	Water	Air
Tightening torque	ϕ10-ϕ16	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	3.0 N·m 0.35 kgf·m 2.2 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ12-ϕ20	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	3.0 N·m 0.35 kgf·m 2.2 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ16-ϕ25	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	4.5 N·m 0.46 kgf·m 3.3 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ20-ϕ32	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	4.5 N·m 0.46 kgf·m 3.3 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ25-ϕ40	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	4.5 N·m 0.46 kgf·m 3.3 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ40-ϕ60	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	4.5 N·m 0.46 kgf·m 3.3 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ32-ϕ50	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	4.5 N·m 0.46 kgf·m 3.3 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ50-ϕ70	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	4.5 N·m 0.46 kgf·m 3.3 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft
	ϕ68-ϕ85	5.4 N·m 0.55 kgf·m 4.0 lbf·ft	4.5 N·m 0.46 kgf·m 3.3 lbf·ft	2.0 N·m 0.20 kgf·m 1.5 lbf·ft

Assembling instruction for clamps

1. At normal Temperature
2. Tightening rpm = max. 350 rpm
3. Tightening the clamps by hand only; measure torque value after tightening (within ≤ 20 sec.)
4. If using powertool, insure torque adjustment to result in same as above.

RY9212180GEG0006US0

6. TYPES OF OIL

[1] TABLE OF OIL AND FLUID CAPACITIES

Item		
Engine oil (when replacing filter)		3.6 L (0.95 U.S.gals)
Radiator coolant (not including coolant in reserve tank)	Canopy spec.	2.4 L (0.63 U.S.gals)
	Cabin spec.	2.6 L (0.69 U.S.gals)
Reserve tank coolant		0.6 L (0.2 U.S.gals)
Hydraulic oil	Total amount of oil	37.5 L (9.91 U.S.gals)
	In tank (gauge centre)	22 L (5.8 U.S.gals)
Fuel tank capacity when full		33 L (8.7 U.S.gals)
Wheel motor		0.35 L (0.092 U.S.gals)
Track rollers		80 ml (4.88 cu. in.)
Carrier roller (Top track roller)		60 ml (3.66 cu. in.)
Front idler		75 ml (4.60 cu. in.)

RY9212180GEG0004US0

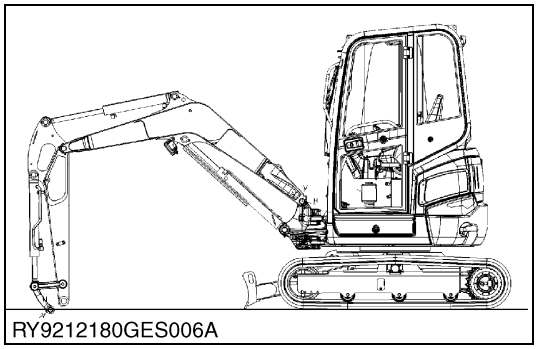
[2] RECOMMENDED LUBRICANTS

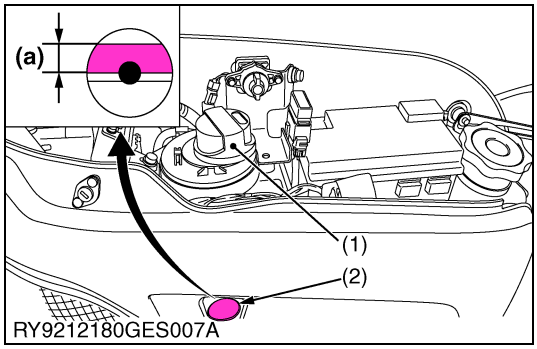
	Recommendation			Ex factory filling		Note
	Ambient Temperature Condition	Viscosity	Quality Standard	Brand	Type	
Engine oil	In winter, at low temperatures	SAE 10W SAE 20W	API CF * API CI-4 * API CJ-4 *			When diesel fuel with a higher sulfur content (between 0.50% and 1.00%) is used, the engine oil and engine oil filter must be replaced at shorter intervals. Never use diesel fuel with a sulfur content exceed 1.00%.
	In summer, at high ambient temperatures	SAE 30 SAE 40 SAE 50				
	All weather	15W40 *		Shell	Rimula R4L *	15W40, API CJ-4
Coolant			G048 * SAE J1034 * MB 325.0 * ASTM D3306 * D4985	ROWE	Hightec Antifreeze AN (–37 °C) *	For mixing with anti-freeze, always use distilled water. Always refer to the recommendations of coolant manufacturer as for the mixing ratios.Don't mix with other coolants.
Grease		NLGI-2 *	DIN 51825 KP2K-30 *	Mobil	Mobilux EP2 *	
		NLGI-1		Weicon	Antiseize Standard	To be used only for the first 50 working hours, on all greasing points around the swing bracket.
Hydraulic oil	In winter, at low temperatures	ISO 32 ISO 46 *		Shell	Tellus S2M46 *	
	In summer, at high ambient temperatures	ISO 46 ISO 68				
Gear oil	In winter, at low temperatures	SAE 75 SAE 80	MIL-L-2105C *			
	In summer, at high ambient temperatures	SAE 90 SAE 140				
	All weather	80W90 *		Shell	Spirax MA80W *	
Diesel			EN 590 ASTM D975			The factory filled-up fuel is no winterized diesel. To winterize the machine, fill up the fueltank with winterized diesel, and let the engine run for a few minutes.
Refrigerant			HFC R134a			

* : This lubricant is filled up at the production line.

RY9212180GEG0008US0

[3] CHECKING AND FILLING HYDRAULIC OIL


RY9212180GES006A



RY9212180GES007A

Stop vehicle body on horizontal ground, extend cylinder rods to near central position, and place bucket and blade on the ground.

Check that the oil level is in the centre of the oil level gauge when the hydraulic oil is at room temperature (10 to 30 °C).

The level is normal, if the oil is in the range **(a)** at or above the centre of the level gauge.

If there is insufficient oil, refill via the filler port.

(1) Filler port
(2) Oil level gauge

(a) Normal range of hydraulic oil

RY9212180GEG0005US0

7. MAINTENANCE INTERVALS

[1] OPERATOR SERVICING

No.	Check points		Intervals	Hour meter indicator																	Consequently	
				50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	1000		
1	Coolant		check	Daily check																		
2	Fuel		check	Daily check																		
3	Engine oil		check	Daily check																		
4	Hydraulic oil		check	Daily check																		
5	Lubrication points		–	Daily check																		
6	Radiator and oil cooler		check	Daily check																		
7	Engine and electrical wiring		check	Daily check																	every year	
8	Washer liquid		–	Daily check																		
9	Fuel tank, Fuel filter		drain	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	every 50 hrs	
10	Battery condition		check	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	every 50 hrs	
11	Greasing swing bearing teeth		–	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	every 50 hrs	
12	Fan belt tension		check	Daily check																		
13	Radiator hoses and clamps		check				❍				❍				❍				❍	❍	every 200 hrs	
			replace																		every 2 years	
14	Air filter element	Outer element	clean				❍				❍				❍				❍	❍	every 200 hrs	*1
			replace																	❍	every 1000 hrs	*1 *2
		Inner element	replace																	❍	every 1000 hrs	*1 *2
15	Greasing swing ball bearings		–				❍				❍				❍				❍	❍	every 200 hrs	
16	Radiator system		rince																		every 2 years	
17	Fuel line and Intake air line		check				❍				❍				❍				❍	❍	every 200 hrs	

■ **IMPORTANT**

- ***1 : Clean and replace the air filter more frequently if used under dusty conditions. When the filter is very dirty from dusty conditions, replace the filter.**
- ***2 : The maintenance identified with "*2" is appeared on the meter panel at each specified maintenance hours.**

RY9212091GEG0014US0

[2] SERVICING BY SKILLED PERSONAL OR KUBOTA DEALER

No.	Check points	Intervals	Hour meter indicator																	Consequently	
			50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	1000		
1	Coolant	change																		every 2 years	
2	Engine oil	change										❍							❍	every 500 hrs	*4
3	Hydraulic oil	change																	❍	every 1000 hrs	*1 *4
4	Fan belt tension	adjust					❍					❍					❍		❍	every 250 hrs	
5	Fuel filter cartridge	replace										❍							❍	every 500 hrs	*4
6	Engine oil filter	replace										❍							❍	every 500 hrs	*4
7	Drive unit oil	change	●									❍							❍	every 500 hrs	*4
8	Breather filter	replace										❍							❍	every 500 hrs	*4
9	Hydraulic return filter element	replace					●					❍							❍	every 500 hrs	*4
10	Hydraulic suction filter element	replace																	❍	every 1000 hrs	*4
11	Pilot filter	replace																	❍	every 1000 hrs	*4
12	Fuel injection nozzle injection pressure	check																		every 1500 hrs	*3
13	Front idler and track roller oil	change																		every 2000 hrs	*4
14	Alternator and starter motor	check																		every 2000 hrs	
15	Injection pump	check																		every 3000 hrs	*3
16	Radiator system	rinse																		every 2 years	
17	Fuel line and Intake air line	replace																		every 2 years	*2

■ **IMPORTANT**

- **● : First operation**
- ***1 : When using a hydraulic breaker over 20 % → every 800 h (Hydraulic oil) / every 200 h (Return filter)**
  When using a hydraulic breaker over 40 % → every 400 h (Hydraulic oil) / every 200 h (Return filter)
  When using a hydraulic breaker over 60 % → every 300 h (Hydraulic oil) / every 100 h (Return filter)
  When using a hydraulic breaker over 80 % → every 200 h (Hydraulic oil) / every 100 h (Return filter)
- ***2 : Replace only if necessary.**
- ***3 : Consult your local KUBOTA Dealer for this service.**
- ***4 : The maintenance identified with "*4" is appeared on the meter panel at each specified maintenance hours.**

RY9212180GEG0007US0

1 MACHINE BODY

SERVICING

CONTENTS

1. FRONT EQUIPMENT

[1] BUCKET

(1) Removal and Installation Procedure

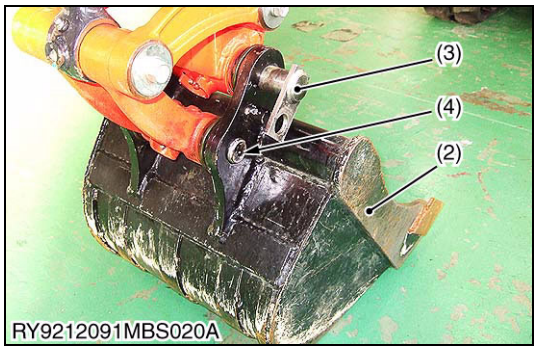
CAUTION

- **Wear safety equipment such as a helmet and safety glasses during mounting and removal.**
- **When working with others, pay full attention to safety and make sure communication signals are completely clear to each other.**
- **Never ever put a finger in a pin hole when aligning a pin to the hole.**

RY9212001MBS0020US0

Removing the Bucket

1. Place the back of the bucket on a flat, hard ground surface. Stop the engine and relieve pressure from the hydraulic system. Remove the mounting pin.



2. Use a hammer and a round punch to remove pin A and pin B.

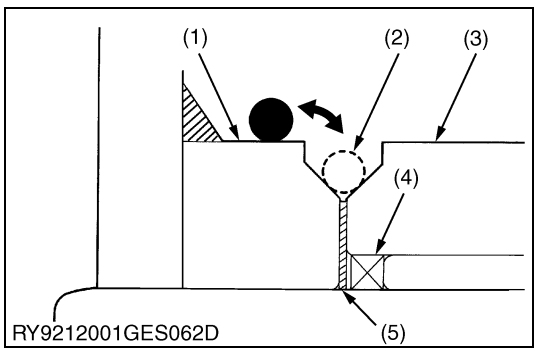
CAUTION

- **After removing pins, make sure no sand or mud gets on them.**
- **When removing/installing the pins take care not to damage the dust seals on both ends of the bushings.**

3. Start the engine, raise the boom and separate the arm and the bucket.

(1) Mounting Pin
(2) Bucket
(3) Pin A
(4) Pin B

RY9212091MBS0001US0



Assembling the Bucket

1. Place O-ring on the boss section of the bucket before assembling the bucket.
2. Assemble the bucket in the reverse order of disassembly.
3. Put the O-ring in the groove.

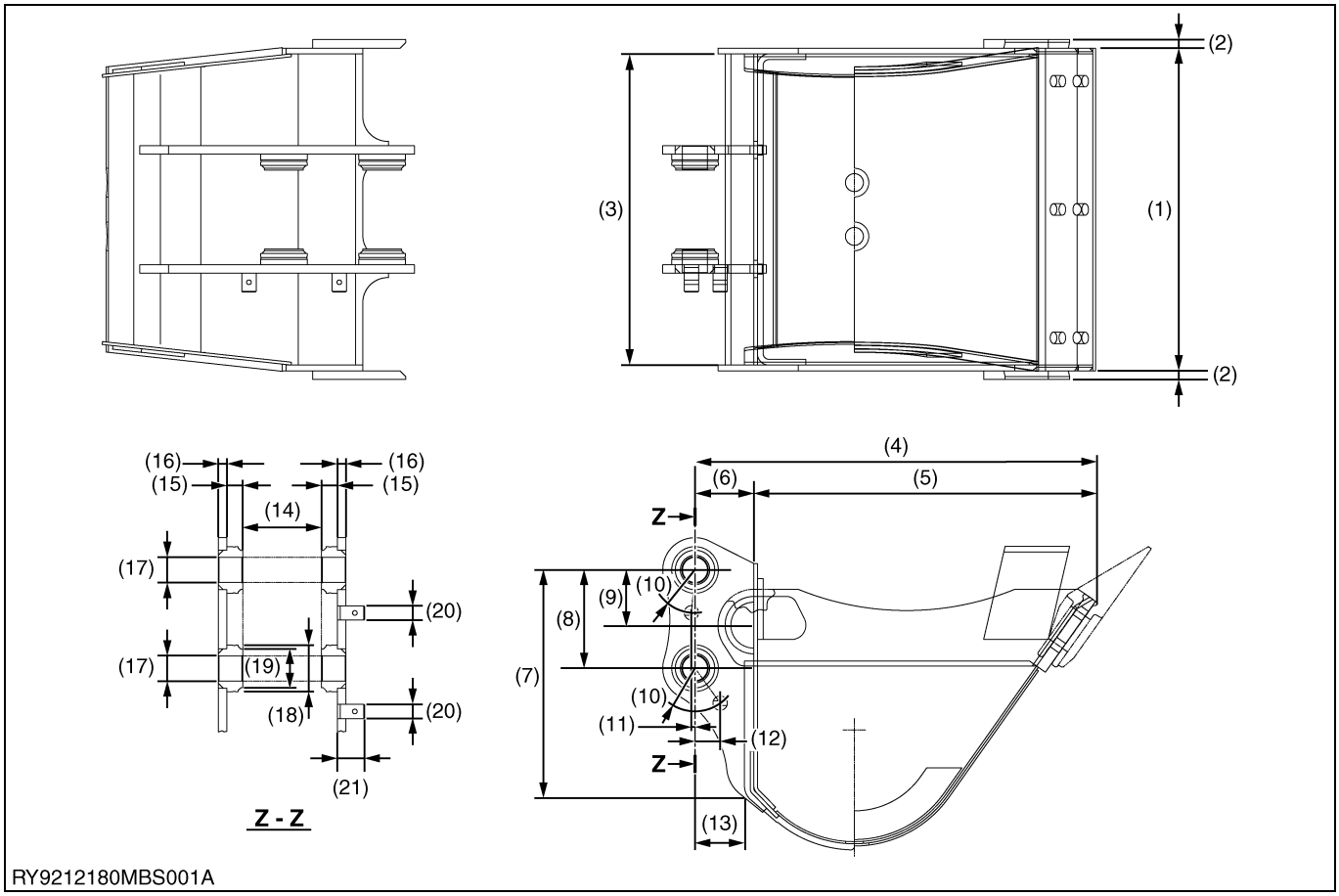
■ **IMPORTANT**

- **The axial free play must be within 0.6 mm. If the free play exceeds, insert suitable spacers.**
- **This O-ring protects against incoming dirt and soil. Therefore it prevents from excessive wear.**

(1) Bucket
(2) O-ring
(3) Arm
(4) Dust seal
(5) Shim

RY9212180MBS0065US0

(2) Bucket Dimensions



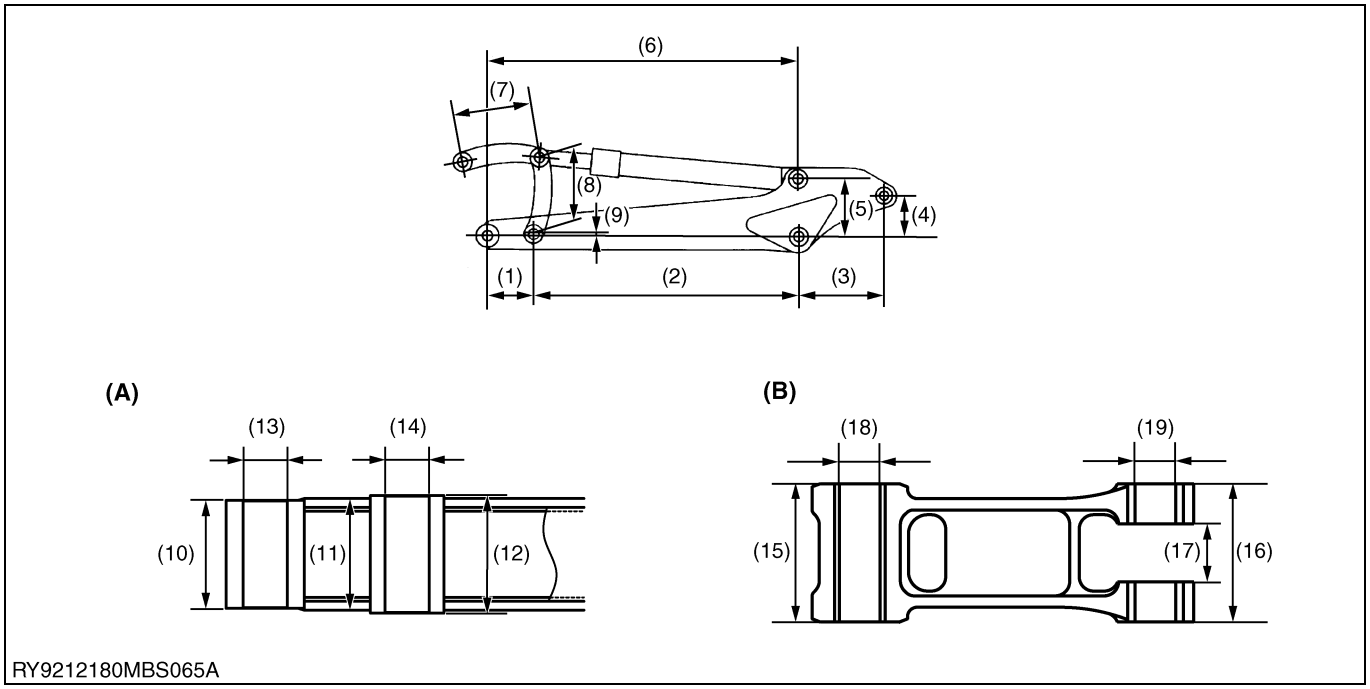
RY9212180MBS001A

No.		No.		No.		No.		No.	
(1)	450 mm 17.7 in.	(6)	82 mm 3.2 in.	(11)	5.0 mm 0.2 in.	(16)	12 mm 0.47 in.	(21)	34 mm 1.3 in.
(2)	12 mm 0.47 in.	(7)	313 mm 12.3 in.	(12)	35 mm 1.4 in.	(17)	35 mm 1.4 in.		
(3)	434 mm 17.1 in.	(8)	137 mm 5.39 in.	(13)	69 mm 2.7 in.	(18)	65 mm 2.6 in.		
(4)	555 mm 21.8 in.	(9)	57 mm 2.2 in.	(14)	110 mm 4.33 in.	(19)	54 mm 2.1 in.		
(5)	473 mm 18.6 in.	(10)	60 mm 2.4 in.	(15)	22 mm 0.87 in.	(20)	20 mm 0.79 in.		

- Bucket weight: Approx. 46 kg (100 lbs)

RY9212180MBS0003US0

(3) Relative dimensions of bucket installation joints



RY9212180MBS065A

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

No.		No.		No.		No.	
(1)	145 mm 5.71 in.	(6)	1076 mm 42.36 in.	(11)	114 mm 4.49 in.	(16)	120 mm 4.72 in.
(2)	1155 mm 45.47 in.	(7)	240 mm 9.45 in.	(12)	120 mm 4.72 in.	(17)	51 mm 2.0 in.
(3)	225.5 mm 8.88 in.	(8)	240 mm 9.45 in.	(13)	ϕ 35 mm ϕ 1.4 in.	(18)	ϕ 35 mm ϕ 1.4 in.
(4)	157 mm 6.18 in.	(9)	10 mm 0.39 in.	(14)	ϕ 35 mm ϕ 1.4 in.	(19)	ϕ 35 mm ϕ 1.4 in.
(5)	259 mm 10.2 in.	(10)	110 mm 4.33 in.	(15)	110 mm 4.33 in.		

RY9212180MBS0004US0

[2] FRONT EQUIPMENT

(1) Removal and Installation Procedure

CAUTION

- **Each of the devices and the hydraulic and lubricating oils are hot and/or under high pressure immediately after operating the machine. If the hydraulic oil reached a high operating temperature, it may cause a burn.**
- **Oil gushing out under pressure has enough force to pierce your skin and may cause you injury. Always allow the temperature of each part to drop and relieve any remaining pressure prior to starting to remove any parts of the hydraulic system.**

RY9212091MBS0013US0


RY9212180MBS004A


RY9212180MBS005A


RY9212180MBS006A


RY9212180MBS007A

Removing Front Machine

1. Operate the front machine as shown on the left, and lower the arm tip to the ground.
2. Remove the bucket cylinder and AUX hydraulic hoses.
3. After suspending the Nylon sling from the bucket and arm, take out the pin from the arm cylinder rod and then the linkage pin between the arm and the boom, and remove the bucket and arm section.
4. Lower the boom end to the ground and remove the worklight harness and the arm cylinder hydraulic hose.
5. Remove the pin on the boom cylinder rod and lower the rod side to the ground.
6. After suspending the Nylon sling from the boom, take out the boom base pin and remove the front machine.

RY9212180MBS0030US0

Attaching the Front Equipment

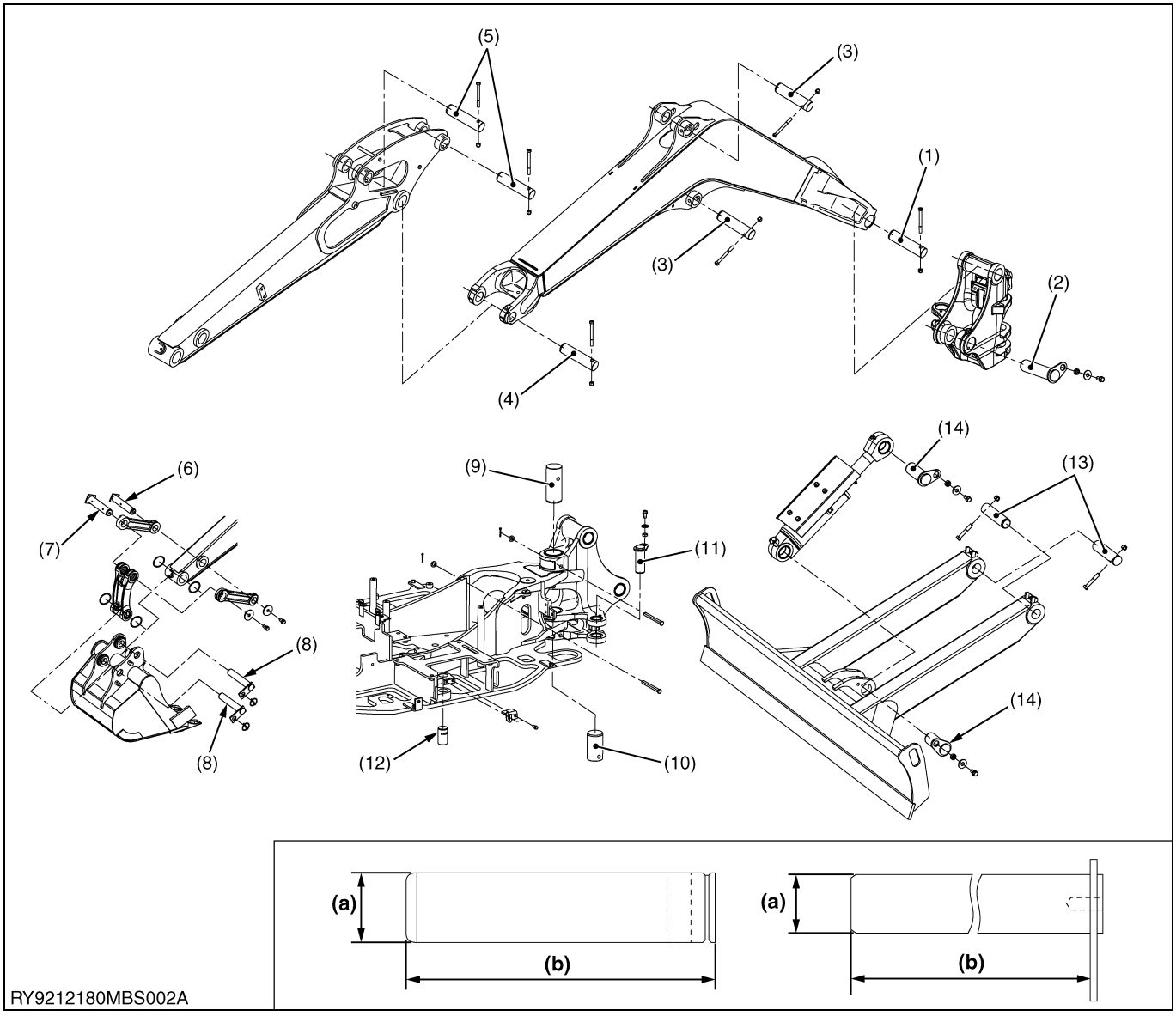
Perform the procedures in reverse to attach the equipment.

■ **NOTE**

- **The thrust play must be within 0.6 mm. If it is bigger, insert suitable / additional shims.**

RY9212180MBS0031US0

(2) Diagram and List of Front Pins



(a) Pin Diameter **(b) Pin Length**

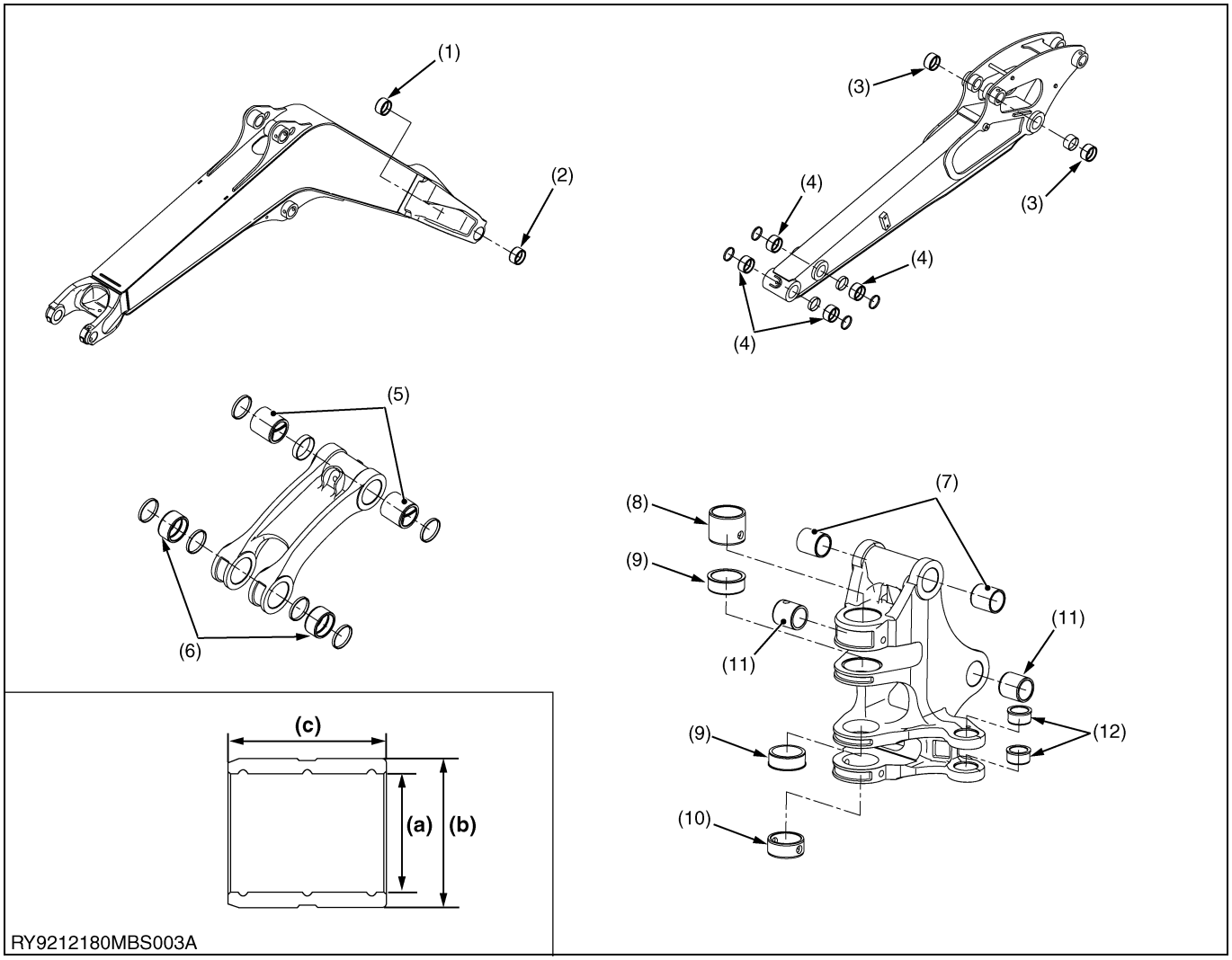
No.	Item	Qty		No.	Item	Qty	
(1)	Pin Diameter and Length	1	ϕ40 × 250 mm ϕ1.6 × 9.8 in.	(8)	Pin Diameter and Length	2	ϕ35 × 200 mm ϕ2.0 × 7.9 in.
(2)	Pin Diameter and Length	1	ϕ40 × 171 mm ϕ1.6 × 6.73 in.	(9)	Pin Diameter and Length	1	ϕ60 × 141 mm ϕ2.4 × 5.6 in.
(3)	Pin Diameter and Length	2	ϕ40 × 177 mm ϕ1.6 × 6.97 in.	(10)	Pin Diameter and Length	1	ϕ60 × 106 mm ϕ2.4 × 4.2 in.
(4)	Pin Diameter and Length	1	ϕ40 × 216 mm ϕ1.6 × 8.50 in.	(11)	Pin Diameter and Length	1	ϕ35 × 103 mm ϕ1.4 × 4.1 in.
(5)	Pin Diameter and Length	2	ϕ40 × 160 mm ϕ1.6 × 6.3 in.	(12)	Pin Diameter and Length	1	ϕ35 × 102.5 mm ϕ1.4 × 4.0 in.
(6)	Pin Diameter and Length	1	ϕ35 × 182 mm ϕ1.4 × 7.2 in.	(13)	Pin Diameter and Length	2	ϕ40 × 151 mm ϕ1.6 × 5.9 in.
(7)	Pin Diameter and Length	1	ϕ40 × 182 mm ϕ1.6 × 7.2 in.	(14)	Pin Diameter and Length	2	ϕ45 × 114 mm ϕ1.8 × 4.5 in.

■ **NOTE**

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

RY9212180MBS0001US0

(3) List of Front Bushing Dimensions



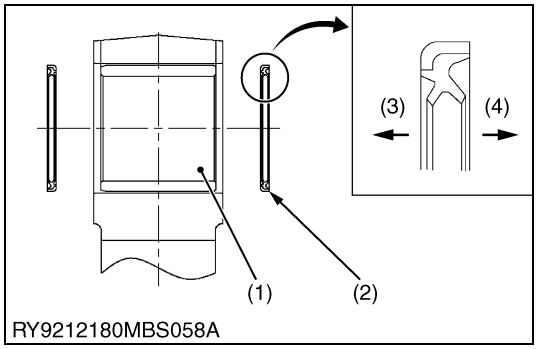
(a) I.D. **(b) O.D.** **(c) Length**

No.	Item	Qty		Material Quality
(1)	I.D. x O.D. x Length	1	40 x 50 x 37 mm (1.6 x 2.0 x 1.5 in.)	CK45, C40E (CK40) or C45E (CK45)
(2)	I.D. x O.D. x Length	1	40 x 50 x 37 mm (1.6 x 2.0 x 1.5 in.)	CK45, C40E (CK40) or C45E (CK45)
(3)	I.D. x O.D. x Length	2	40 × 50 × 50 mm (1.6 × 2.0 × 2.0 in.)	STKM16A, S43C or S45C
(4)	I.D. x O.D. x Length	4	35 × 45 × 45 mm (1.4 × 1.8 × 1.8 in.)	STKM16A, S43C or S45C
(5)	I.D. x O.D. x Length	2	35 × 45 × 45 mm (1.4 × 1.8 × 1.8 in.)	STKM16A, S43C or S45C
(6)	I.D. x O.D. x Length	2	40 × 48 × 24 mm (1.6 × 1.9 × 0.9 in.)	C40E (CK40) or C45E (CK45)
(7)	I.D. x O.D. x Length	2	40 × 48 × 50 mm (1.6 × 1.9 × 2.0 in.)	STKM16A, S43C or S45C
(8)	I.D. x O.D. x Length	1	60 × 72 × 58 mm (2.4 × 2.8 × 2.3 in.)	STKM16A, S43C or S45C
(9)	I.D. x O.D. x Length	2	60 × 72 × 27 mm (2.4 × 2.8 × 1.1 in.)	STKM16A, S43C or S45C
(10)	I.D. x O.D. x Length	1	60 × 72 × 30 mm (2.4 × 2.8 × 1.2 in.)	STKM16A, S43C or S45C
(11)	I.D. x O.D. x Length	2	40 × 50 × 50 mm (1.6 × 2.0 × 2.0 in.)	C40E (CK40) or C45E (CK45)
(12)	I.D. x O.D. x Length	2	35 × 45 × 24 mm (1.4 × 1.8 × 0.9 in.)	STKM16A, S43C or S45C

■ **NOTE**

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

RY9212180MBS0002US0



RY9212180MBS058A

Installation of Dust Seal

Install the dust seals in the direction as shown at left. If in the wrong direction, the sealing effect is adversely affected, which may get the pins worn out earlier.

(1) Bush
(2) Dust Seal
(3) Toward the Bushing
(4) Outside

RY9212180MBS0052US0

[3] BLADE

(1) Removal and Installation Procedure


RY9212180MBS008A


RY9212180MBS009A

Removing the Blade

1. Put the machine on hard, level ground, swivel the frame to 180 ° and set the bucket and blade on the ground.
2. Suspend the boom cylinder from a nylon sling. Set a block under the blade cylinder to support it and remove the bottom pin.
3. Suspend the blade at three points from a nylon sling. Remove the pin and then remove the blade.

- Blade weight: Approx. 89 kg (200 lbs)

(1) Blade
(2) Blade Cylinder
(3) Pin

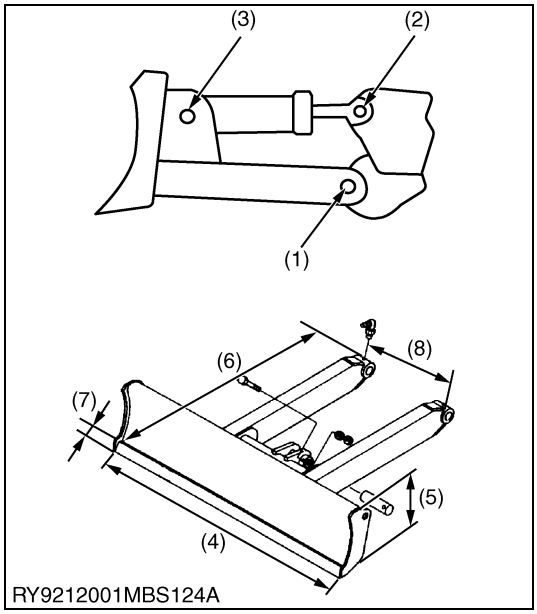
RY9212180MBS0032US0

Mounting the Blade

Perform the procedures in reverse to attach the equipment.

RY9212001MBS0038US0

(2) Blade Dimensions



RY9212001MBS124A

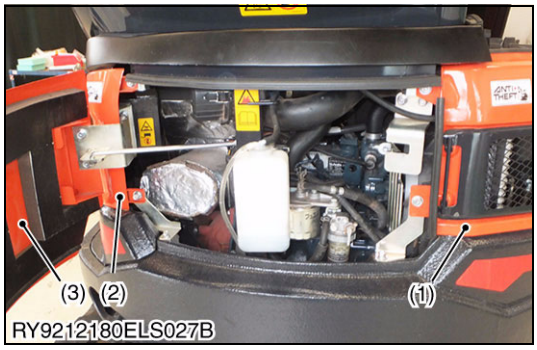
		Remarks
(1) Pin diameter × length	ϕ40 x 151 mm ϕ1.6 x 5.94 in.	
(2) Pin diameter × length	ϕ45 x 114 mm ϕ1.8 x 4.49 in.	
(3) Pin diameter × length	ϕ45 x 114 mm ϕ1.8 x 4.49 in.	
(4) Blade width	1500 mm 59.06 in.	
(5) Blade height	295 mm 11.6 in.	
(6) Blade length	965 mm 38 in.	
(7) Blade tip plate height × thickness	65 × t 12 mm 2.6 × t 0.47 in.	
(8) Length between blade arms	430 mm 16.9 in.	

RY9212180MBS0033US0

2. SWIVEL FRAME

[1] WEIGHT

(1) Removal and Installation Procedure

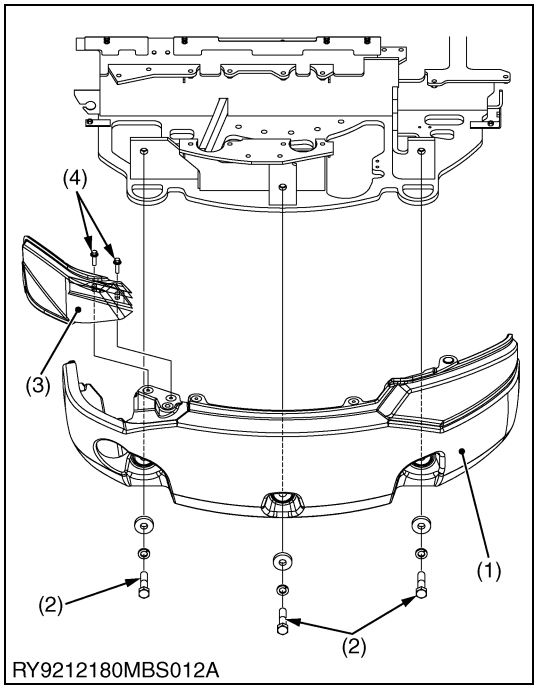


Removing the Bonnet

1. Remove the right bonnet, left bonnet and rear bonnet.

(1) Right Bonnet
(2) Left Bonnet
(3) Rear Bonnet

RY9212180MBS0034US0

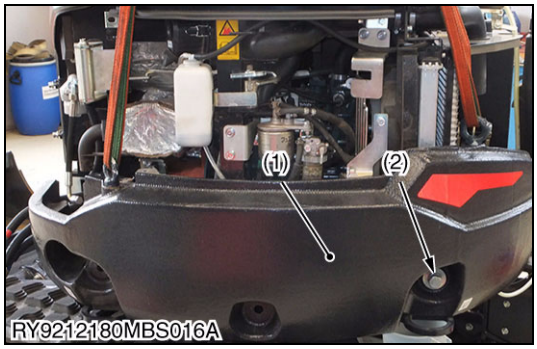


2. Remove the left weight.

- Left weight: Approx. 14 kg (31 lbs)

(1) Weight
(2) Bolt (M20 x 2.5)
(3) Left Weight
(4) Bolt (M10 x 1.25)

RY9212180MBS0035US0



Removing the Weight

1. Attach two eyebolts (M16 x 2.0) to the weight, connect a nylon sling to these and support the weight with a crane.
2. Remove the two weight mounting bolts, lift slightly with the crane, slide the weight to the rear, and with the weight suspended, remove it from the frame.

- Weight: Approx. 341 kg (752 lbs)

Tightening torque	Weight (1)	367.7 to 431.5 N·m 37.5 to 44.0 kgf·m 271.2 to 318.2 lbf·ft

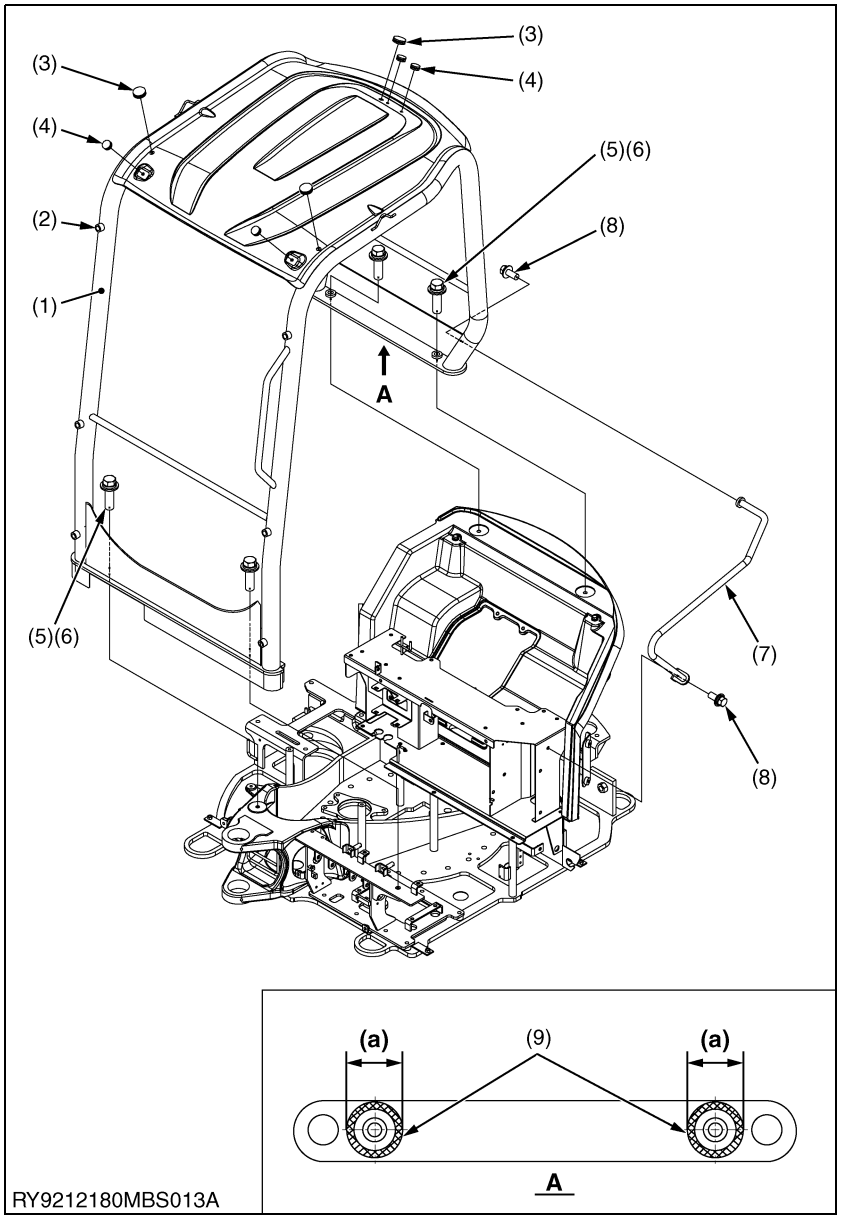
Apply thread lock (Loctite AN302-71).

(1) Weight
(2) Bolt

RY9212180MBS0036US0

[2] CANOPY

(1) Removal and Installation Procedure



(1) ROPS Canopy
(2) Plug
(3) Grommet
(4) Grommet
(5) Bolt (M14 x 1.5, 9T)
(6) Flat Metal Washer
(7) Handrail
(8) Bolt (M10 x 1.25, 7T)
(9) Sealing Rubber (225)

(a) ϕ 82 mm (ϕ 3.2 in.)

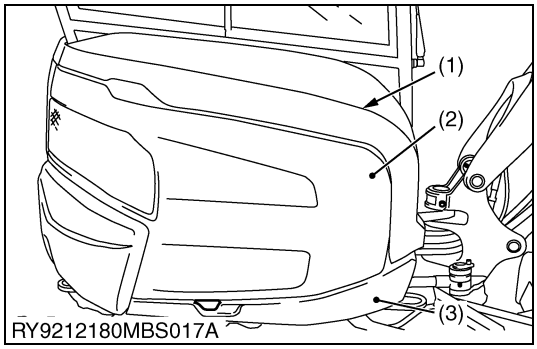
Tightening torque	Bolt (5)	166.7 to 196.1 N·m 17.0 to 20.0 kgf·m 123.0 to 144.6 lbf·ft

Apply thread lock (Loctite AN302-71 equivalent).

RY9212180MBS0037US0

[3] FUEL TANK

(1) Removal and Installation Procedure



Removing the Cover and Right Bonnet

1. Remove the three tank cover mounting bolts and then the cover.
2. Remove the six right bonnet mounting bolts and then the right bonnet.
3. Remove the four cover mounting bolts and then the cover.

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

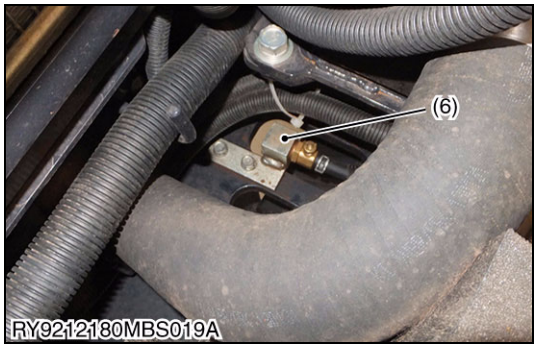
RY9212180MBS0053US0

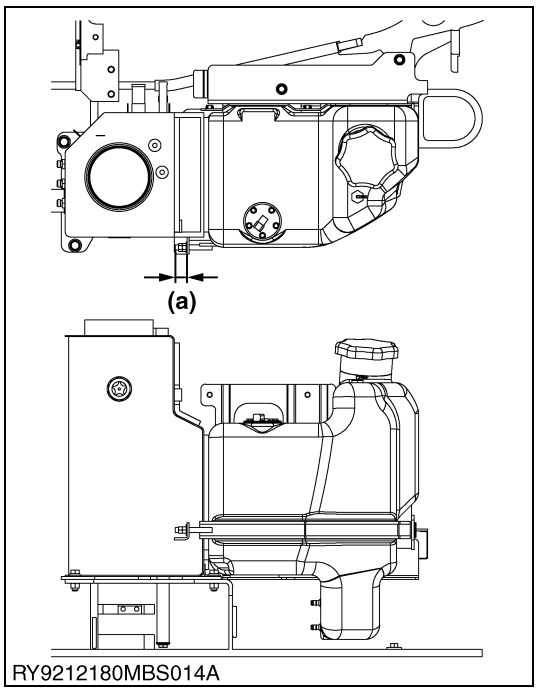
Removing the Fuel Tank

1. Remove the fuel sensor connector from the battery cable's negative side.
2. After draining the fuel from the fuel tank, remove the two bolts and then the water drain cock.
3. Pull out the fuel hose from the fuel tank and plug it.
4. Free the fuel band nut and remove the band.
5. Remove the fuel tank.

(1) Fuel tank
(2) Battery cable (-)
(3) Fuel sensor connector
(4) Fuel band
(5) Nut
(6) Water drain cock

RY9212180MBS0054US0





RY9212180MBS014A

Assemblying the fuel tank

The assembly procedure is the reverse of the disassembly procedure.

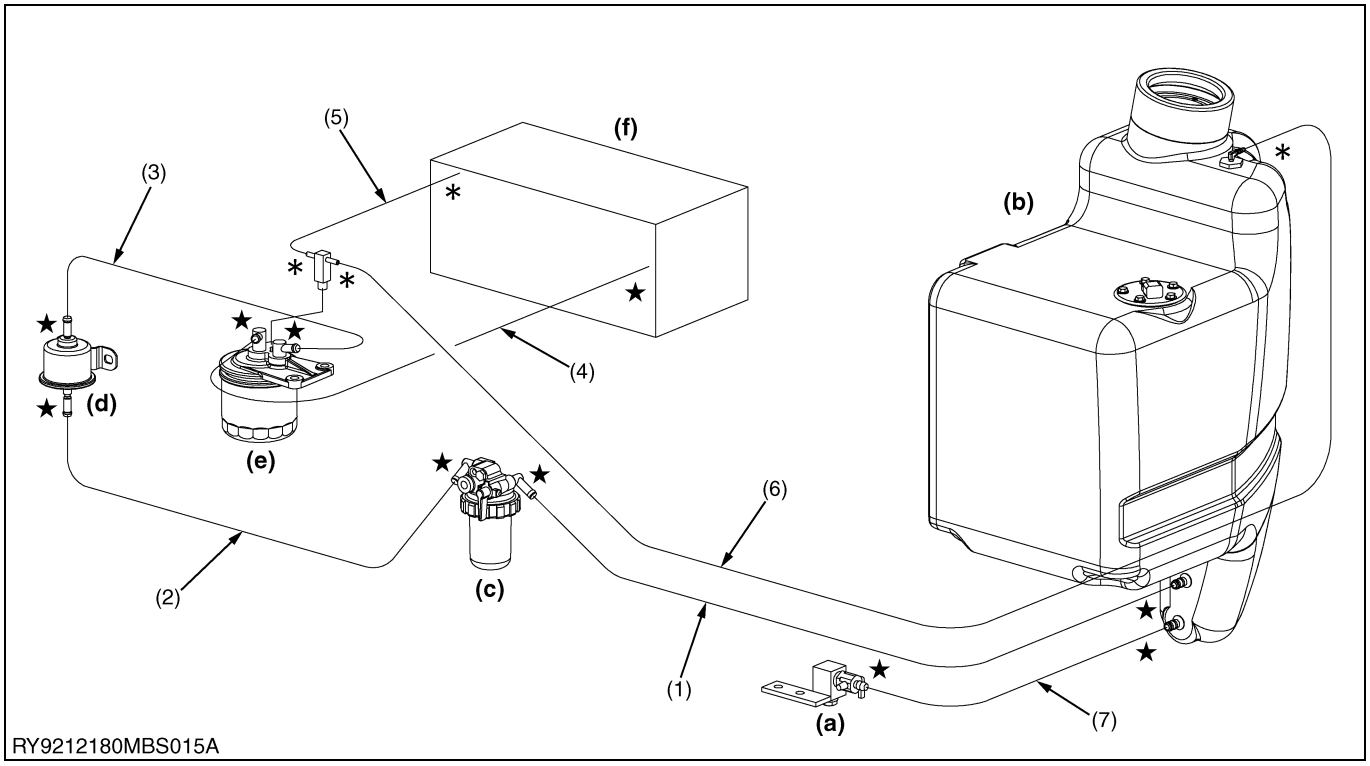
■ **IMPORTANT**

- **After tightening the band, check that the fuel tank is fixated securely.**

Tolerance from fuel band installation component **(a)**	24 to 30 mm (0.94 to 1.18 in.)

RY9212180MBS0055US0

Fuel Hose Routing



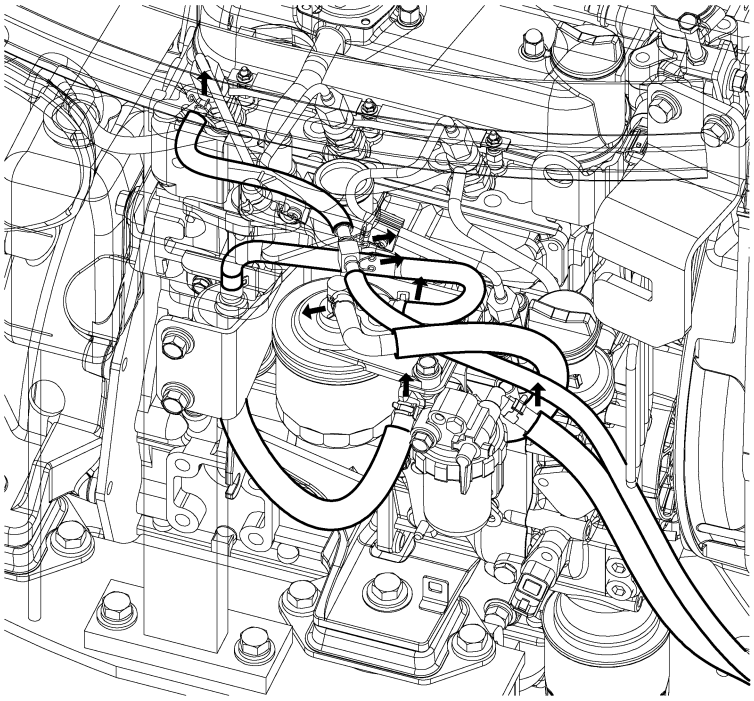
(a) Water Drain Cock **(c) Water Separator** **(e) Fuel Filter** **(f) Engine**
(b) Fuel Tank **(d) Fuel Pump**

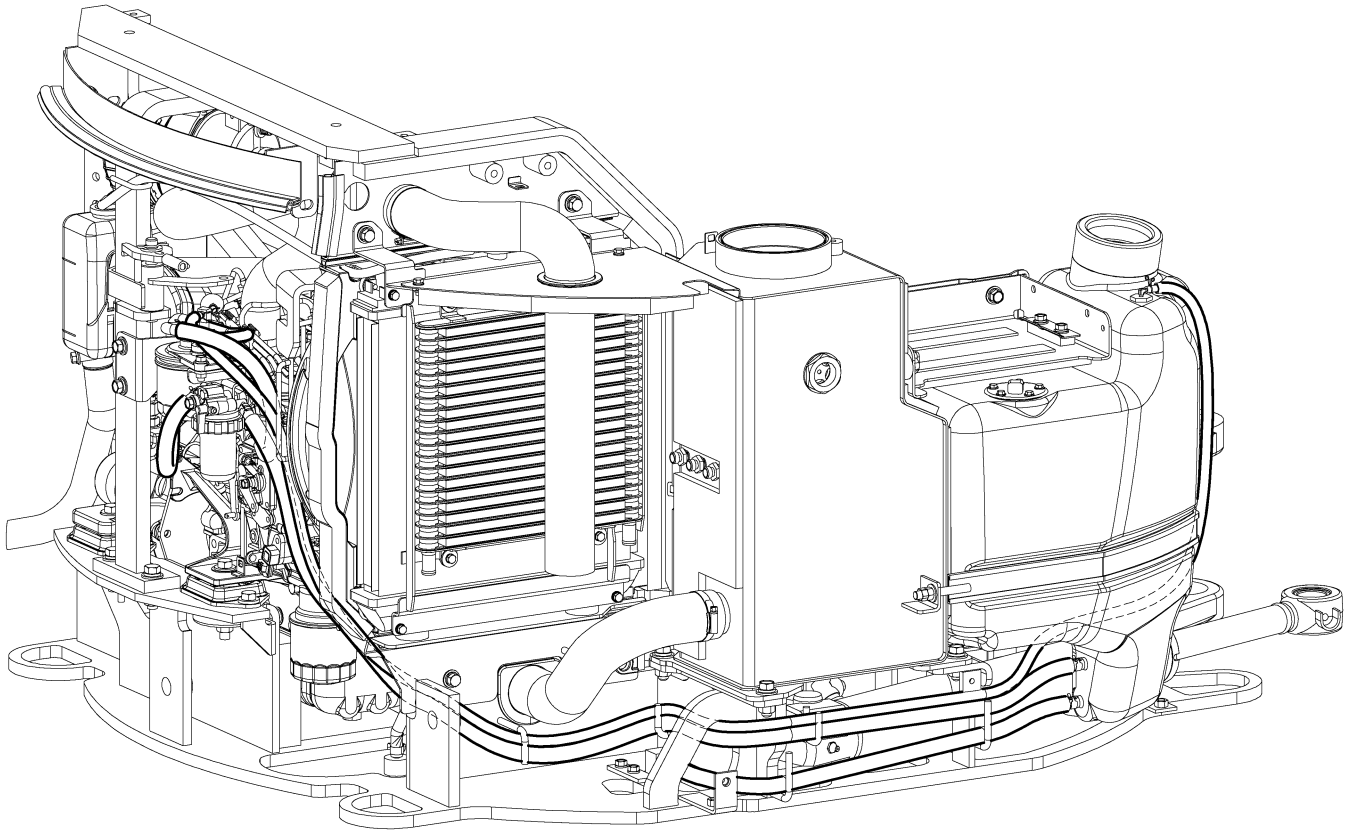
No.	Fuel Tube Length	Protective Tube Length	No.	Fuel Tube Length	Protective Tube Length
(1)	1500 mm 59.1 in.	1450 mm 57.1 in.	(5)	250 mm 9.84 in.	200 mm 7.87 in.
(2)	290 mm 11.4 in.	240 mm 9.45 in.	(6)	2300 mm 90.55 in.	2200 mm 86.61 in.
(3)	306 mm 12 in.	–	(7)	650 mm 25.6 in.	600 mm 23.6 in.
(4)	360 mm 14.2 in.	310 mm 12.2 in.			

■ **IMPORTANT**
- **Clamp where the ★ is located (10 positions)**
- **Clamp where the ✻ is located (4 positions)**

RY9212180MBS0038US0

Fuel Hose Routing



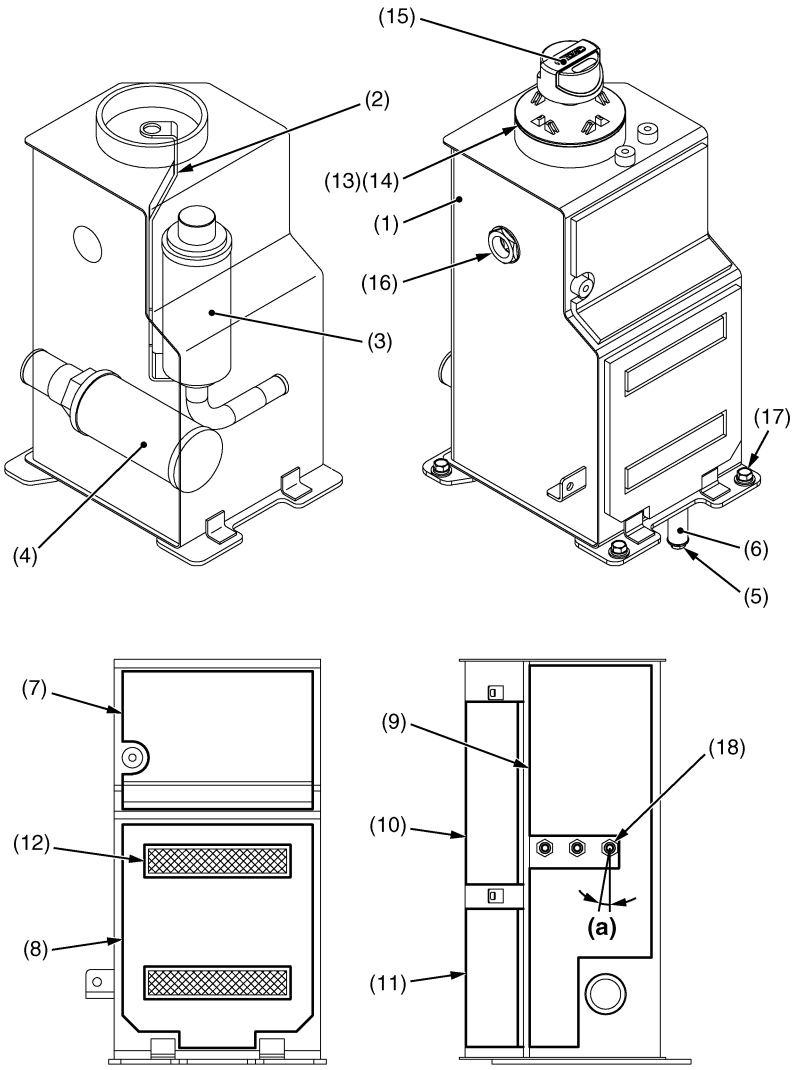


RY9212180MBS060A

RY9212180MBS0056US0

[4] HYDRAULIC OIL TANK

(1) Components



RY9212180MBS011A

No.	Part Name	Q'ty
(1)	Oil tank	1
(2)	Filter Support	1
(3)	Return filter	1
(4)	Suction filter	1
(5)	Plug	1
(6)	Gasket	1
(7)	Sound absorber	1
(8)	Sound absorber	1
(9)	Sound absorber	1
(10)	Sound absorber	1
(11)	Sound absorber	1
(12)	Cushion	2
(13)	Plug	1
(14)	O-ring (2.0 x 129.5)	1
(15)	Breather	1
(16)	Oil gauge	1
(17)	Bolt (M12 x 1.25, 7T)	4
(18)	Elbow pipe	1

(a) 10 °

Fastening torque	Oil gauge (16)	15 N·m 1.5 kgf·m 11 lbf·ft
	Mounting bolt (17)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft
	Suction filter (4)	58.8 to 68.6 N·m 6.0 to 7.0 kgf·m 43.4 to 50.6 lbf·ft
	Plug (13)	20.6 to 31.0 N·m 2.7 to 3.2 kgf·m 19 to 23 lbf·ft

RY9212180MBS0057US0

[5] ENGINE

(1) Removal and Installation Procedure

CAUTION

- **Remove the negative terminal of the battery before starting removal/mounting work.**
- **Wear safety equipment such as a helmet and safety glasses during mounting and removal.**
- **When working with others, pay full attention to safety and make sure communication signals are completely clear to each other.**

RY9212091MBS0034US0

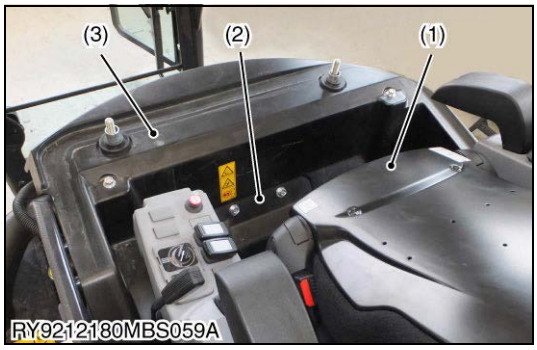
1. Put the bucket on the ground and stop the engine. Remove the cab.
   (Refer to the chapter Cab Removal and Installation.)

RY9212180MBS0039US0

2. Remove the weight.
   (Refer to the chapter Weight Removal and Installation.)

(1) Weight

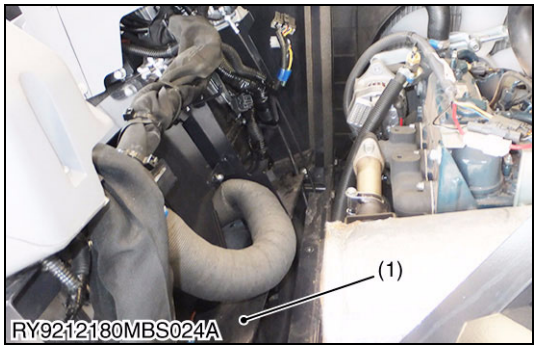
RY9212180MBS0040US0



3. Remove the seat assembly.

(1) Seat Assembly
(2) Front Bonnet Cover
(3) Front Bonnet

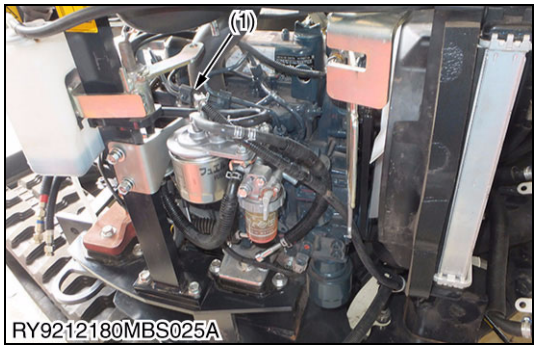
RY9212180MBS0041US0



4. Remove the seat support mounting bolt, move the seat support toward the front of the machine body to remove the front bonnet cover and front bonnet.

(1) Seat support

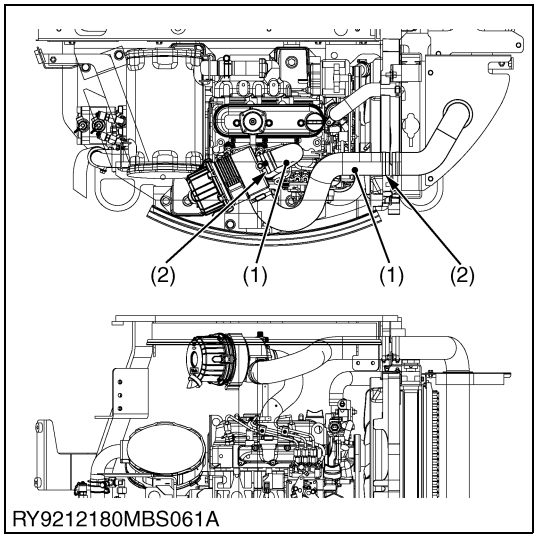
RY9212180MBS0042US0



5. Remove the fuel hoses.

(1) Fuel Hose

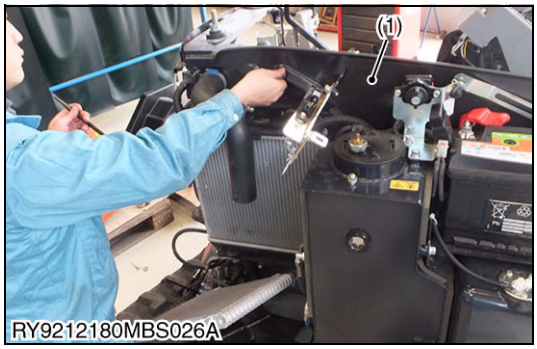
RY9212180MBS0043US0



6. Loosen the hose clamp on the air cleaner and remove the intake hose from the intake manifold.

(1) Intake Hose (2) Hose Clamp

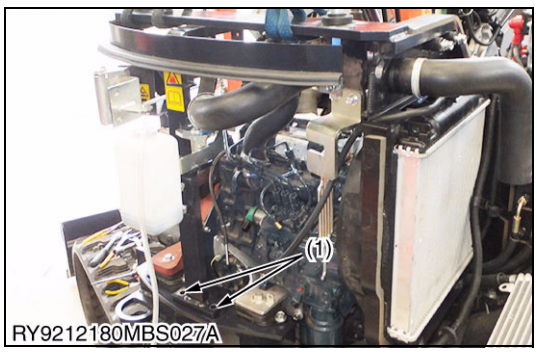
RY9212180MBS0044US0



7. Remove the separator.

(1) Separator

RY9212180MBS0058US0



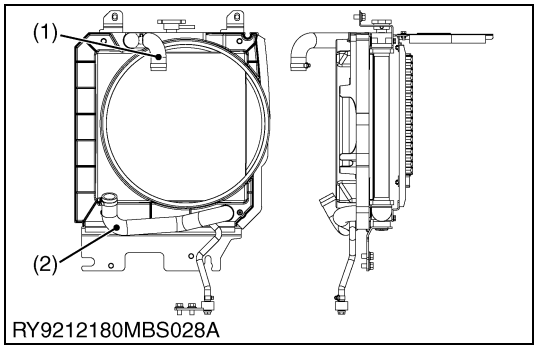
8. Remove the radiator mounting bolts.
9. Remove the wire harness about the engine.
10. Remove the arch mounting bolts.
    Use a crane to suspend the arch with a nylon sling.

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

Apply thread lock (Loctite AN302-71 equivalent).

(1) Bolt

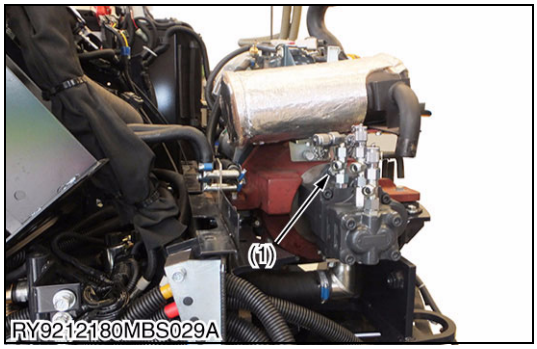
RY9212180MBS0045US0



11. Take the coolant, then loosen and remove the upper and lower radiator hoses.
    Upper hose: engine side
    Lower hose: radiator side

(1) Upper Hose (2) Lower Hose

RY9212180MBS0046US0



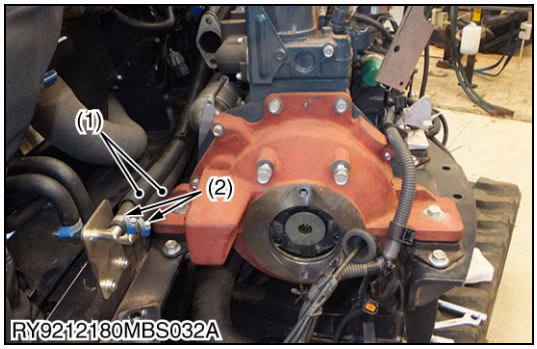
12. Remove the pump mounting bolts and separate it from the pump coupling.
    (Refer to the chapter Pump Removal and Installation.)

Tightening torque	Bolt (1)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft

13. Remove the muffler.

(1) Bolt

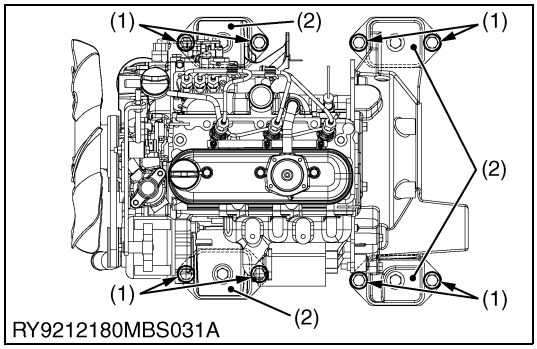
RY9212180MBS0047US0



14. Loosen the hose clamp and remove the heater hose.
15. Remove the accelerator cable.

(1) Heater Hose (2) Hose Clamp

RY9212180MBS0059US0



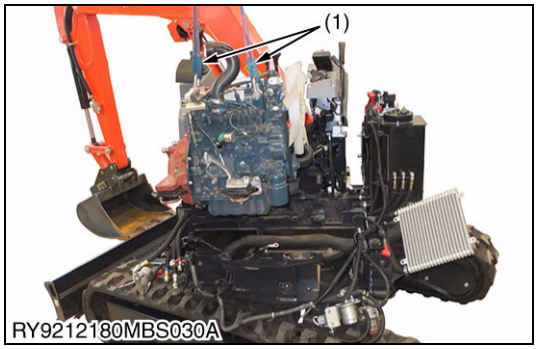
16. Remove the engine and remove the bolt.
17. Remove the harness connected to the starter.

Tightening torque	Bolt	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft

Apply thread lock (Loctite AN302-71 equivalent).

(1) Bolt (2) Anti-Vibration Rubber

RY9212180MBS0048US0

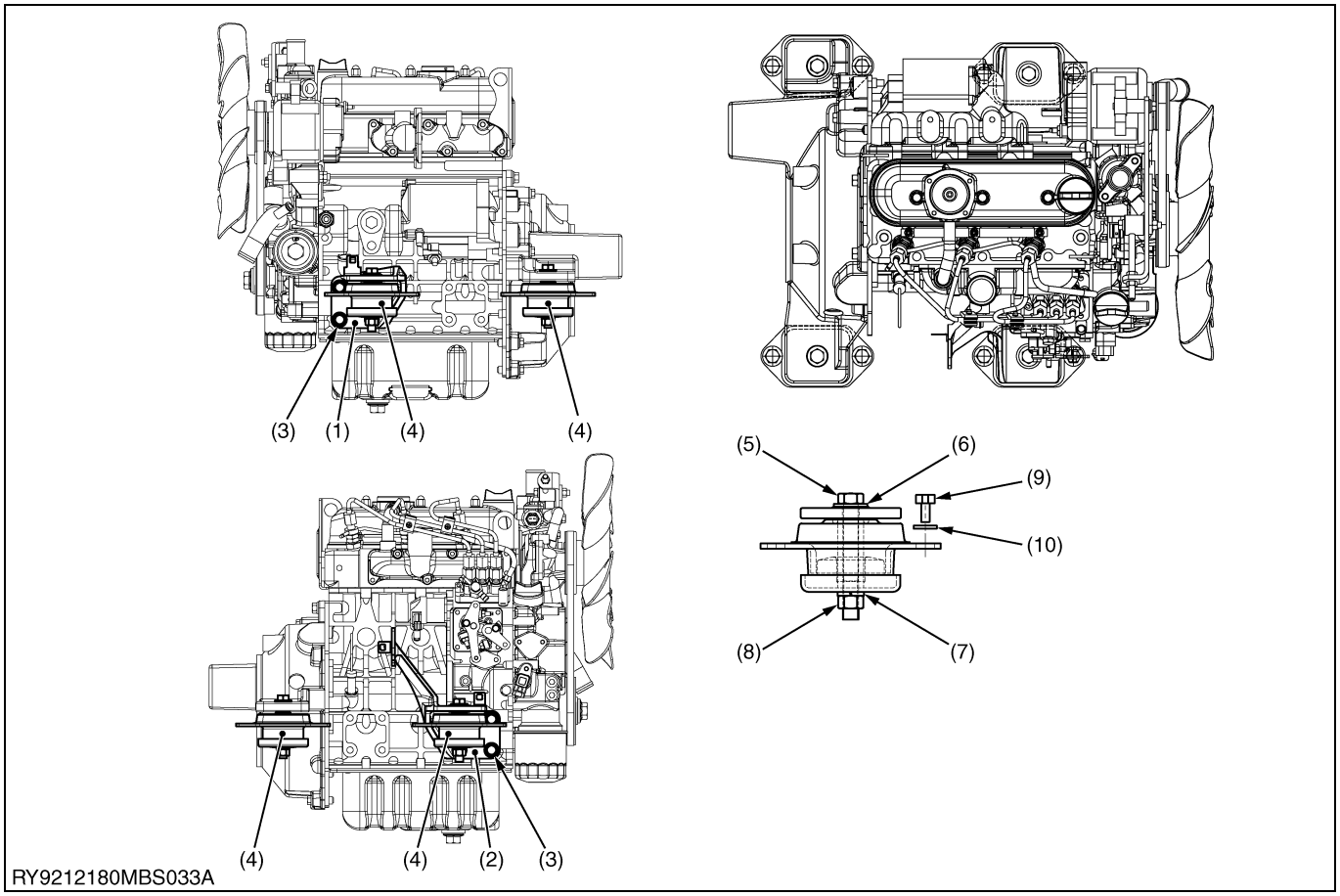


18. Attach two shackles to the engine, connect a nylon sling to these and suspend it with a crane.

(1) Nylon Sling

RY9212180MBS0049US0

(2) Engine Mounts



(1) Engine, Front Bracket
(2) Engine, Rear Bracket
(3) Bolt
(4) Cushion (Rubber)
(5) Bolt
(6) Flat Metal Washer
(7) Spring Washer
(8) Nut
(9) Bolt
(10) Spring Washer

Tightening torque	Mounting bolt (3)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft
	Mounting bolt (5)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft
	Mounting bolt (9)	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft

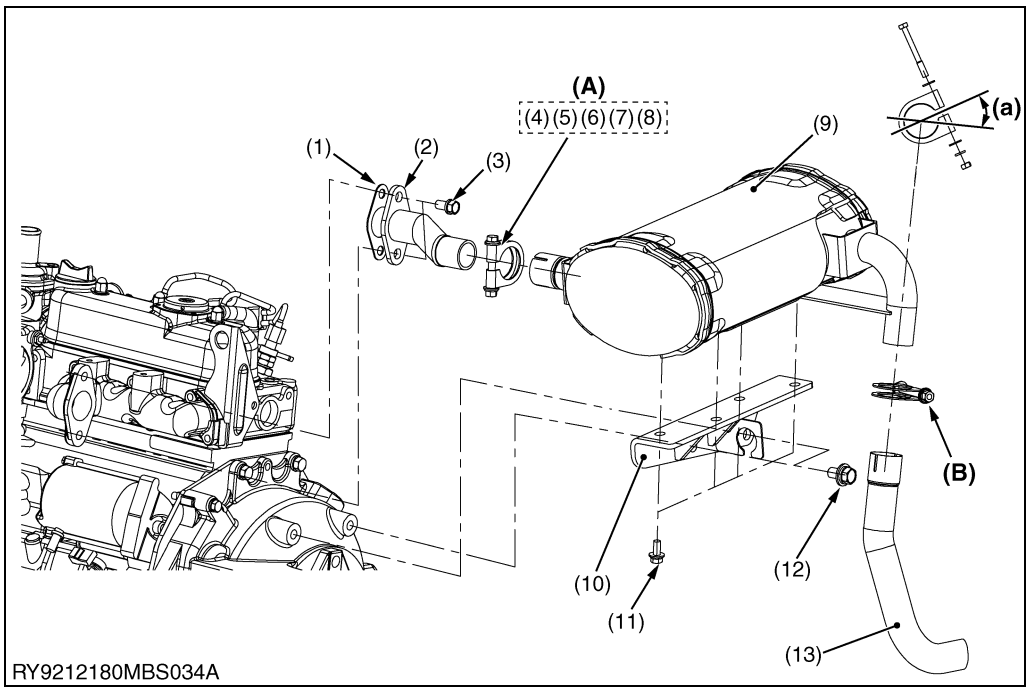
Apply thread lock.

■ **IMPORTANT**

- **When installing the anti-vibration rubber, after the swivel frame side is tightened, tighten the engine side.**

RY9212180MBS0005US0

(3) Muffler



RY9212180MBS034A

(1) Muffler Gasket
(2) Muffler Flange
(3) Bolt
(4) Muffler Pipe Clamp
(5) Bolt
(6) Washer
(7) Spring Washer
(8) Nut
(10) Muffler Assembly
(10) Muffler Bracket
(11) Bolt
(12) Bolt
(13) Muffler Pipe

(A) Band
(B) Band

(a) 30 °

Muffler ASSY Installation Procedures

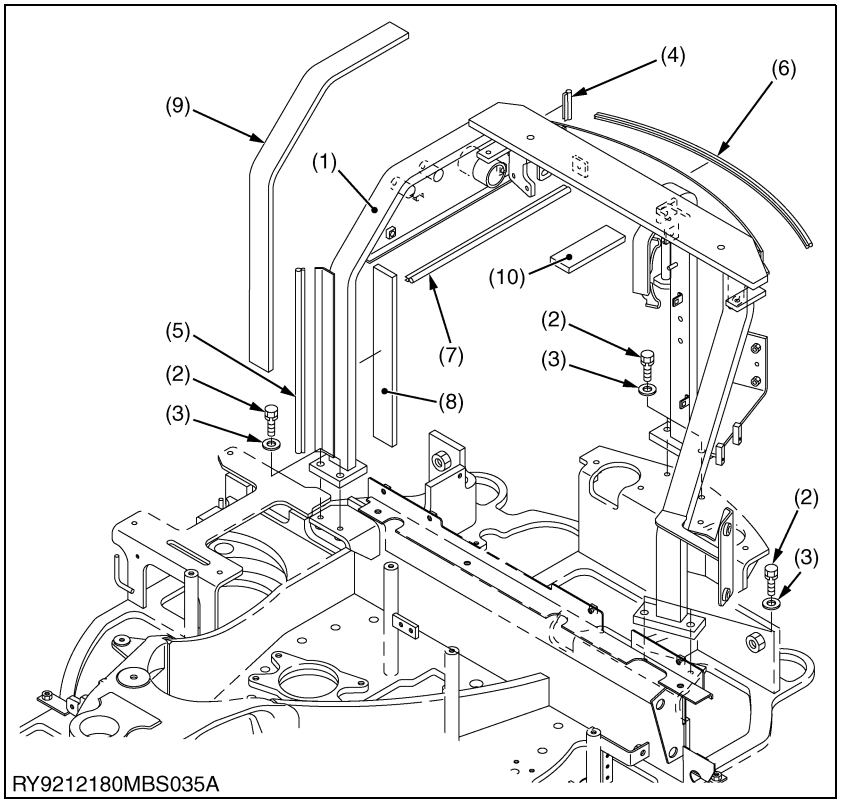
1. Tighten bolt (3).
2. Tighten band **(B)**.
3. Lightly tighten bolts (12), (11), and **(A)**.
4. Tighten bolt (12).
5. Tighten bolt (11).
6. Tighten bolt **(A)**.

Tightening torque	Bolt (3)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft
	Bolt (11)	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 lbf·ft
	Bolt (12)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft
	Band **(A), (B)**	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft

RY9212180MBS0050US0

(4) Arch

Arch Assembly



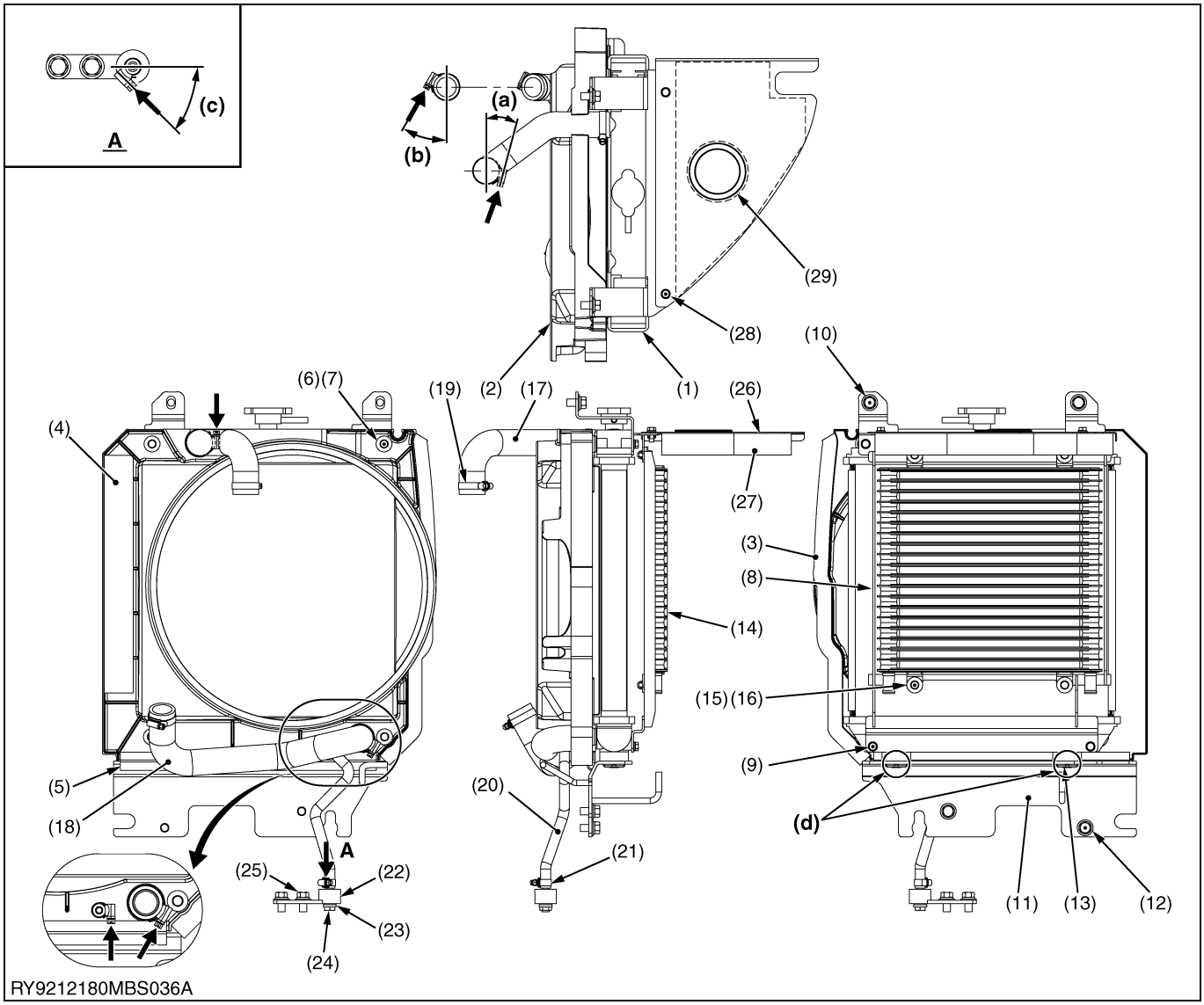
(1) Arch Frame
(2) Bolt
(3) Flat Metal Washer
(4) Rubber Seal
(5) Rubber Seal
(6) Rubber Seal
(7) Rubber Seal
(8) Sponge
(9) Sponge
(10) Sponge

Tightening torque	Bolt (2)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft

Apply thread lock (Loctite AN302-71 equivalent).

RY9212180MBS0007US0

(5) Radiator and Oil Cooler



RY9212180MBS036A

(1) Radiator assembly
(2) Fan shroud
(3) Sound absorber
(4) Sound absorber
(5) Rubber seal (360)
(6) Bolt (M6x1, 7T)
(7) Flat washer
(8) Oil cooler bracket
(9) Bolt (M6x1, 7T)
(10) Bolt (M10x1.25, 7T)
(11) Radiator bracket
(12) Bolt (M10x1.25, 7T)
(13) Cushion
(14) Oil cooler
(15) Bolt (M6x1, 7T)
(16) Flat washer
(17) Hose
(18) Hose
(19) Hose clamp (25 to 40 mm, 0.98 to 1.6 in.)
(20) Hose
(21) Hose clamp (10 to 16 mm, 0.4 to 0.62 in.)
(22) Base
(23) Seal washer
(24) Plug
(25) Bolt (M10x1.25, 7T)
(26) Plate
(27) Sound absorber
(28) Bolt (M6x1, 7T)
(29) Grommet

(a) 15 °
(b) 30 °
(c) 45 °

■ **NOTE**

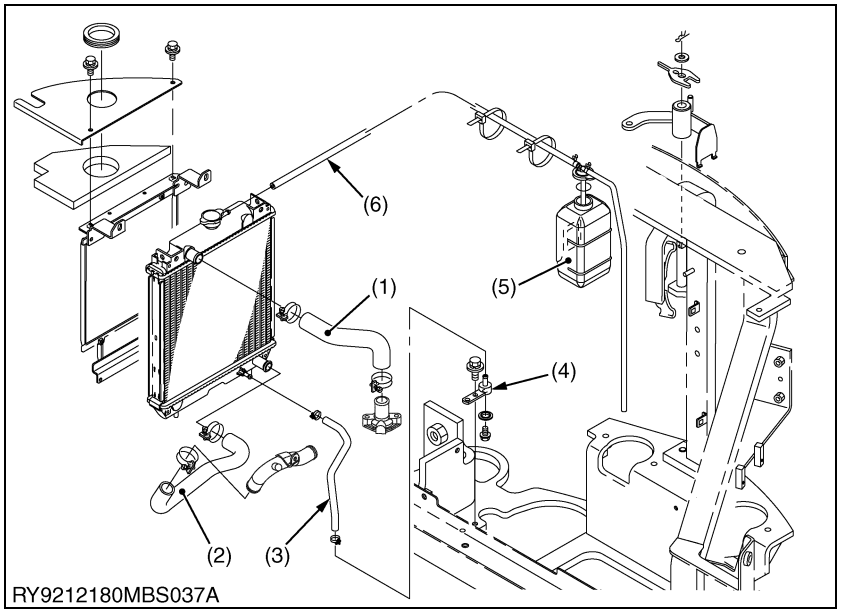
- **(d): Fit the rubber collar section securely.**

RY9212180MBS0008US0

Radiator Removal and Installation Procedure

CAUTION

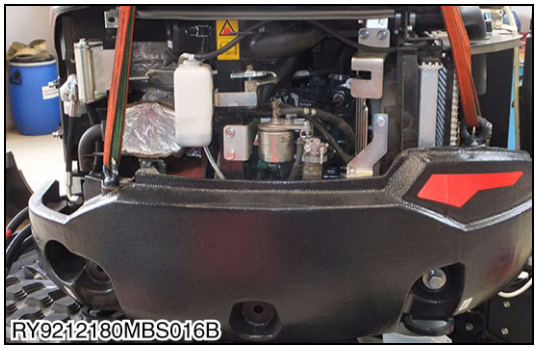
- **Take extra care to prevent burns as coolant is very hot and highly pressurized immediately after the engine has stopped.**



(1) Upper hose
(2) Lower hose
(3) Drain hose
(4) Drain base
(5) Reserve tank
(6) Tube

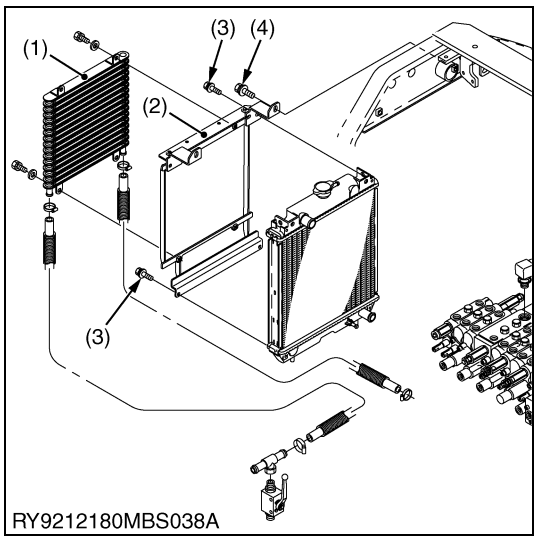
1. Drain off any coolant.
2. Remove the right bonnet.

RY9212180MBS0060US0



1. Remove the weight.
   (Refer to the chapter Weight Removal and Installation.)

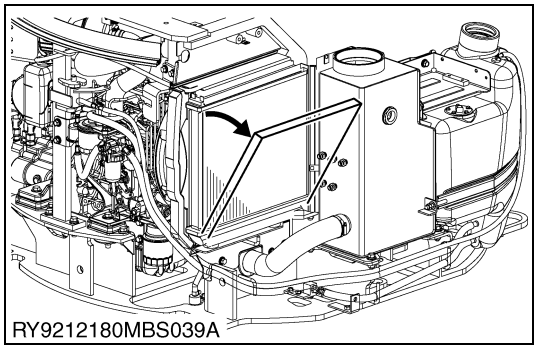
RY9212180MBS0061US0



2. Remove the oil cooler bracket.
3. Remove the upper hose and the tube from the tank from the radiator.

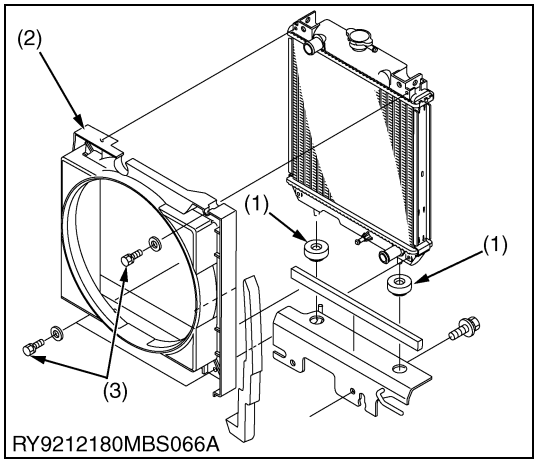
(1) Oil cooler
(2) Oil cooler bracket
(3) Bolt
(4) Bolt

RY9212180MBS0062US0


RY9212180MBS039A

4. Pull out the radiator upper section from the arch together with the fan shroud and tilt it outward.
5. Remove the lower hose at the bottom and the drain hose from the radiator.

RY9212180MBS0063US0



RY9212180MBS066A

6. Remove the cushion from the radiator. Then, remove the fan shroud.

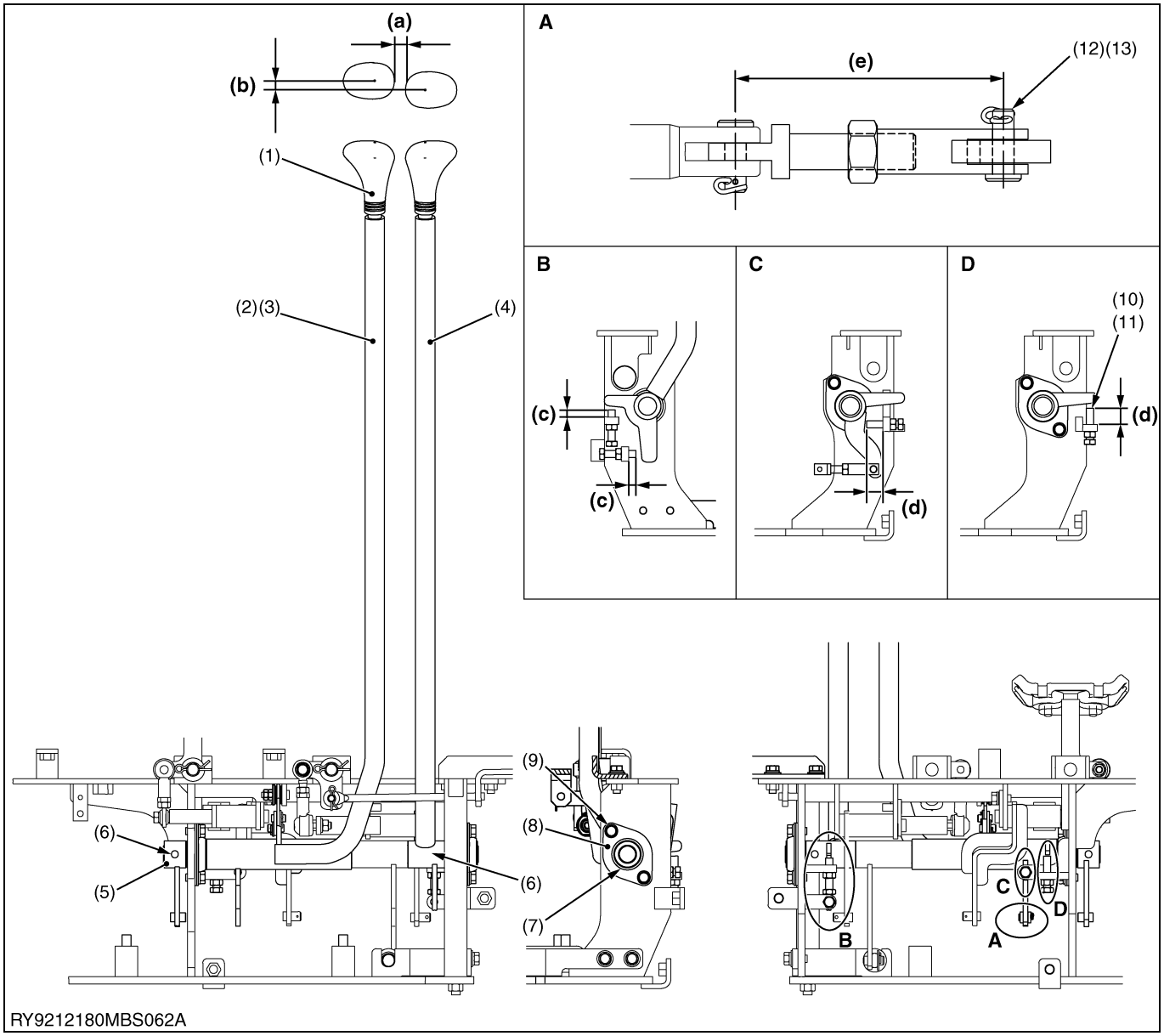
(1) Cushion
(2) Fan shroud
(3) Bolt

RY9212180MBS0064US0

[6] ASSEMBLING OPERATING LEVERS

(1) Travel Lever

Components



RY9212180MBS062A

(1) Grip
(2) Travel lever, Left
(3) Needle Bearing
(4) Travel lever, Right
(5) Travel lever, Right 2
(6) Pin, Spring
(7) Shaft, Travel
(8) Bearing Flange
(9) Bolt
(10) Bolt
(11) Nut
(12) Pin Joint 4.75
(13) Snap Pin

(a) 5 to 15 mm (0.20 to 0.59 in.)
(b) 5.0 mm (0.2 in.)
(c) 8.0 mm (0.3 in.)
(d) 18 mm (0.71 in.)
(e) 59.5 mm (2.34 in.)

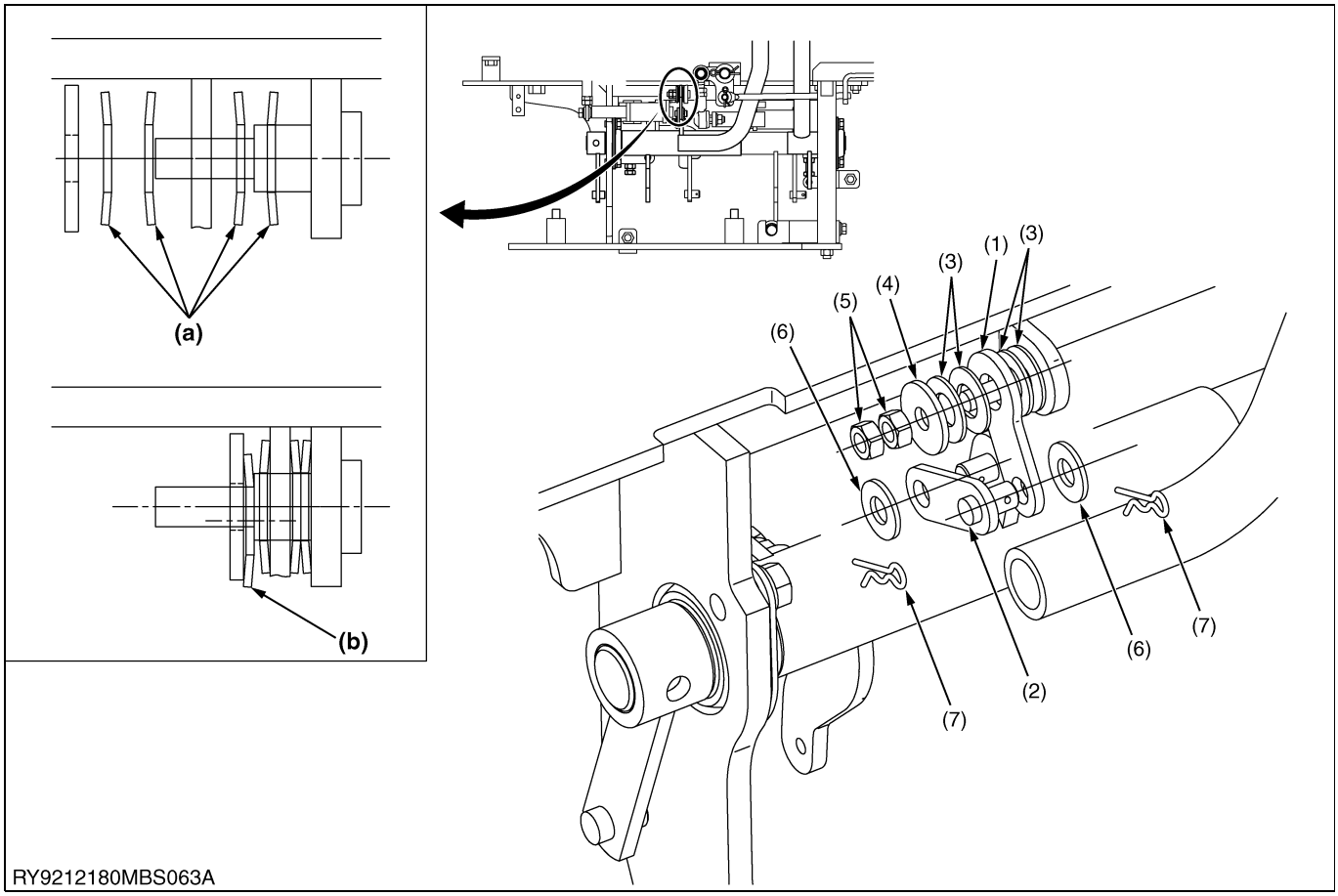
RY9212180MBS0009US0

Spring Pin Installation

Tap it in so the groove of the spring pin is in the direction of rotation.

RY9212091MBS0051US0

Damper Assembly



RY9212180MBS063A

(1) Lever (Travel Damper 1)
(2) Lever (Travel Damper 2)
(3) Plate Spring
(4) Flat metal washer
(5) Nut
(6) Flat metal washer
(7) Snap Pin

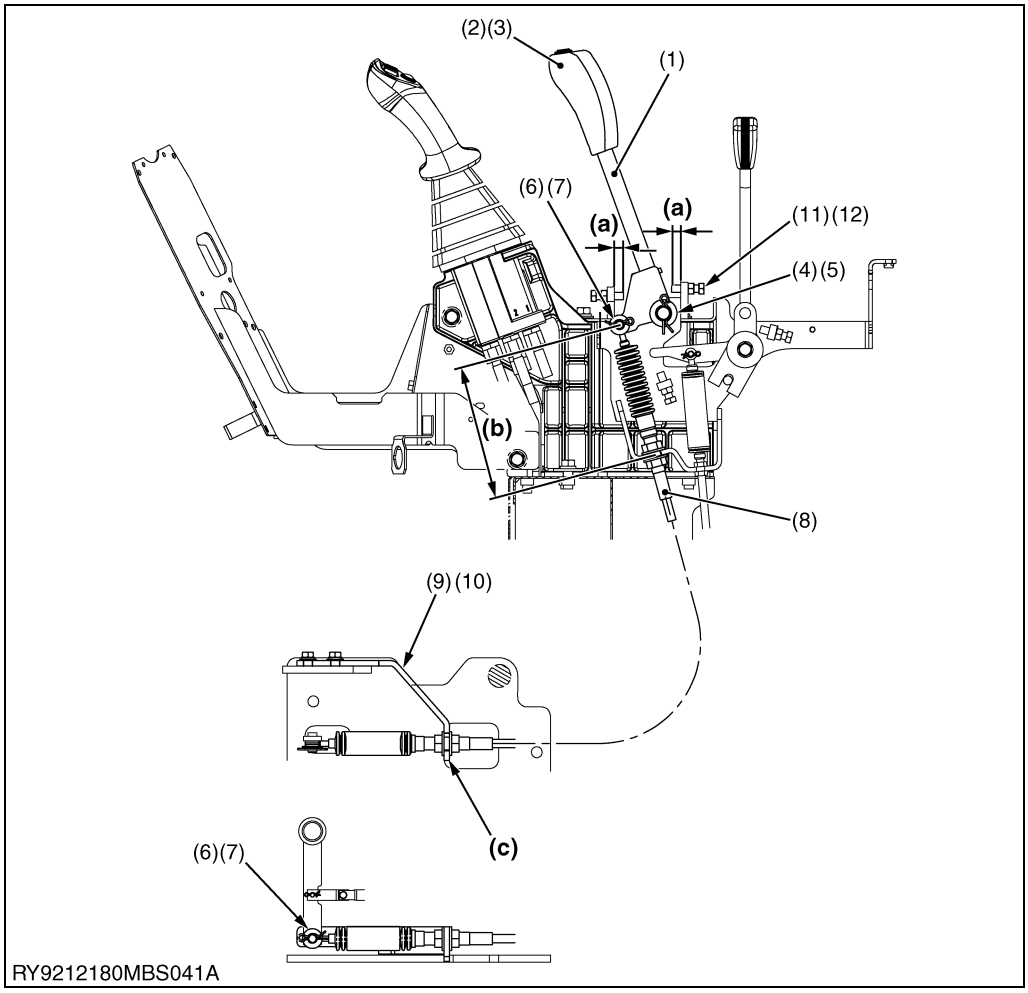
■ **NOTE**

- **(a): Be careful about the assembling direction.**
- **(b): Do not drop.**

RY9212180MBS0067US0

(2) Blade Lever

Components



(1) Blade Lever Assembly
(2) Grip
(3) Pan Head Machine Screw
(4) Flat Metal Washer
(5) Snap Pin
(6) Flat Metal Washer
(7) Snap Pin
(8) Blade Cable
(9) Cable Bracket
(10) Bolt
(11) Bolt
(12) Nut

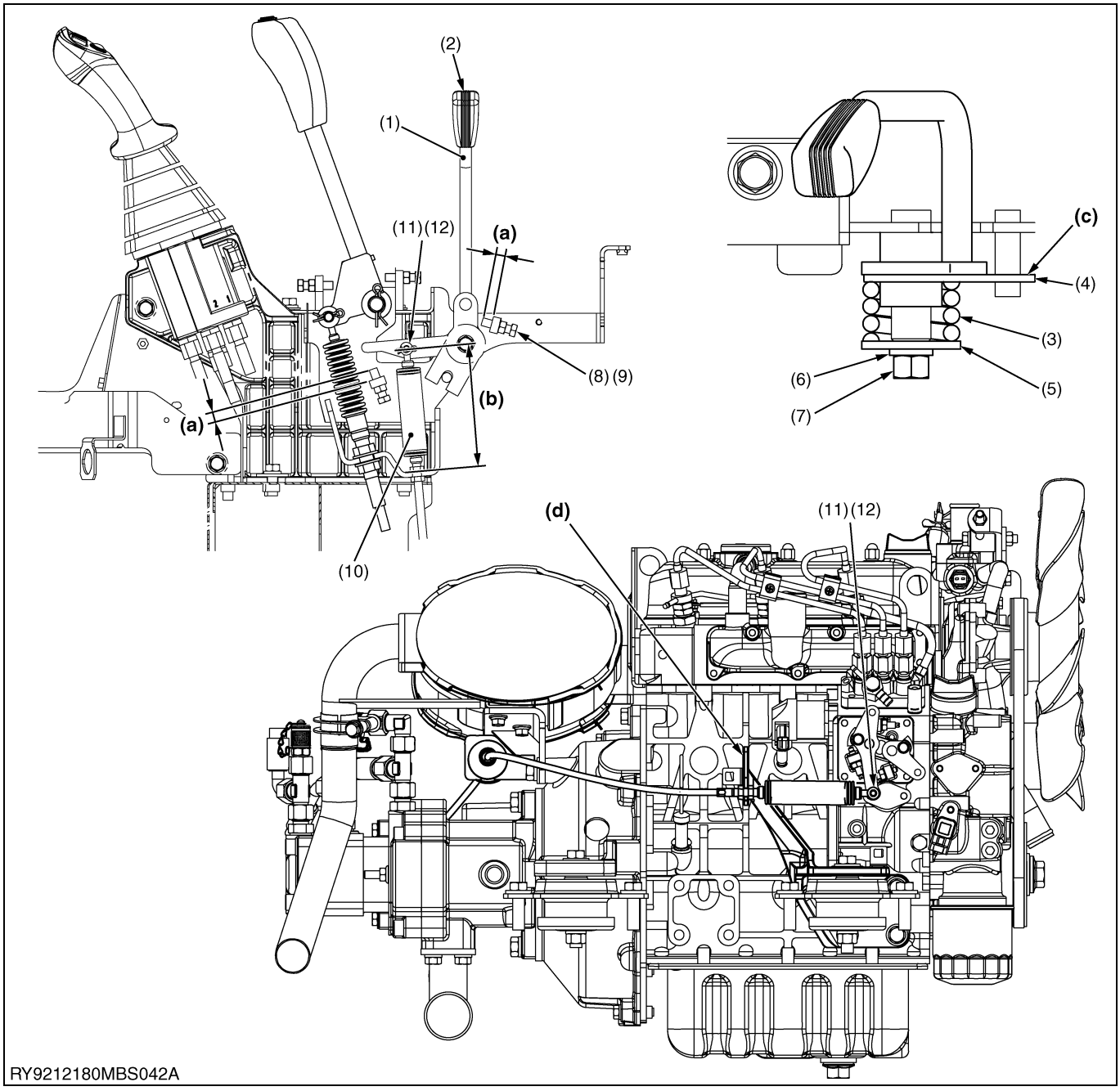
(a) 10 mm (0.39 in.)
(b) 148 mm (5.83 in.)
(c) Assemble at the center of screw.

■ **IMPORTANT**
- **At max curve, the radius should be at least 165 mm (6.5 in.).**
- **Be careful not to twist the cable.**
- **The tip (20 mm, 0.79 in.) of the cable should not be bent.**

RY9212180MBS0010US0

(3) Acceleration Lever

Components



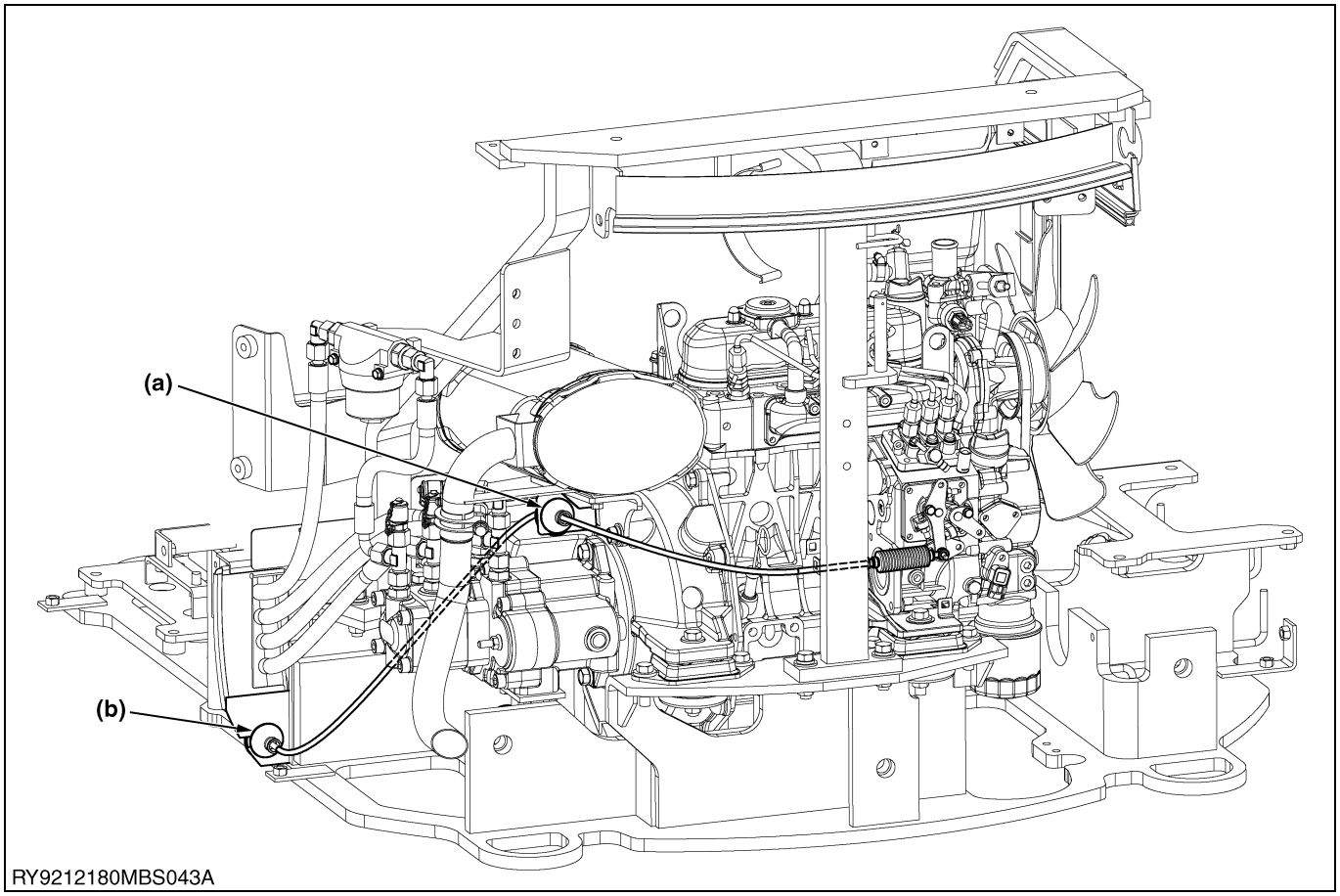
RY9212180MBS042A

(1) Accelerator Lever ASSY
(2) Grip
(3) Spring
(4) Plate
(5) Shim
(6) Spring Washer
(7) Bolt
(8) Bolt
(9) Nut
(10) Accelerator Cable
(11) Flat Metal Washer
(12) Snap Pin
(a) 10 mm (0.39 in.)
(b) 115 mm (4.53 in.)
(c) Greased side
(d) Assemble at the center of screw.

■ **IMPORTANT**
- **Idling RPM: 1350 ± 50 rpm**
- **When in MAX RPM position: ≤ 2600 rpm**
- **Apply grease to the plate (4).**

RY9212180MBS0013US0

(4) Routing of Accelerator Cable



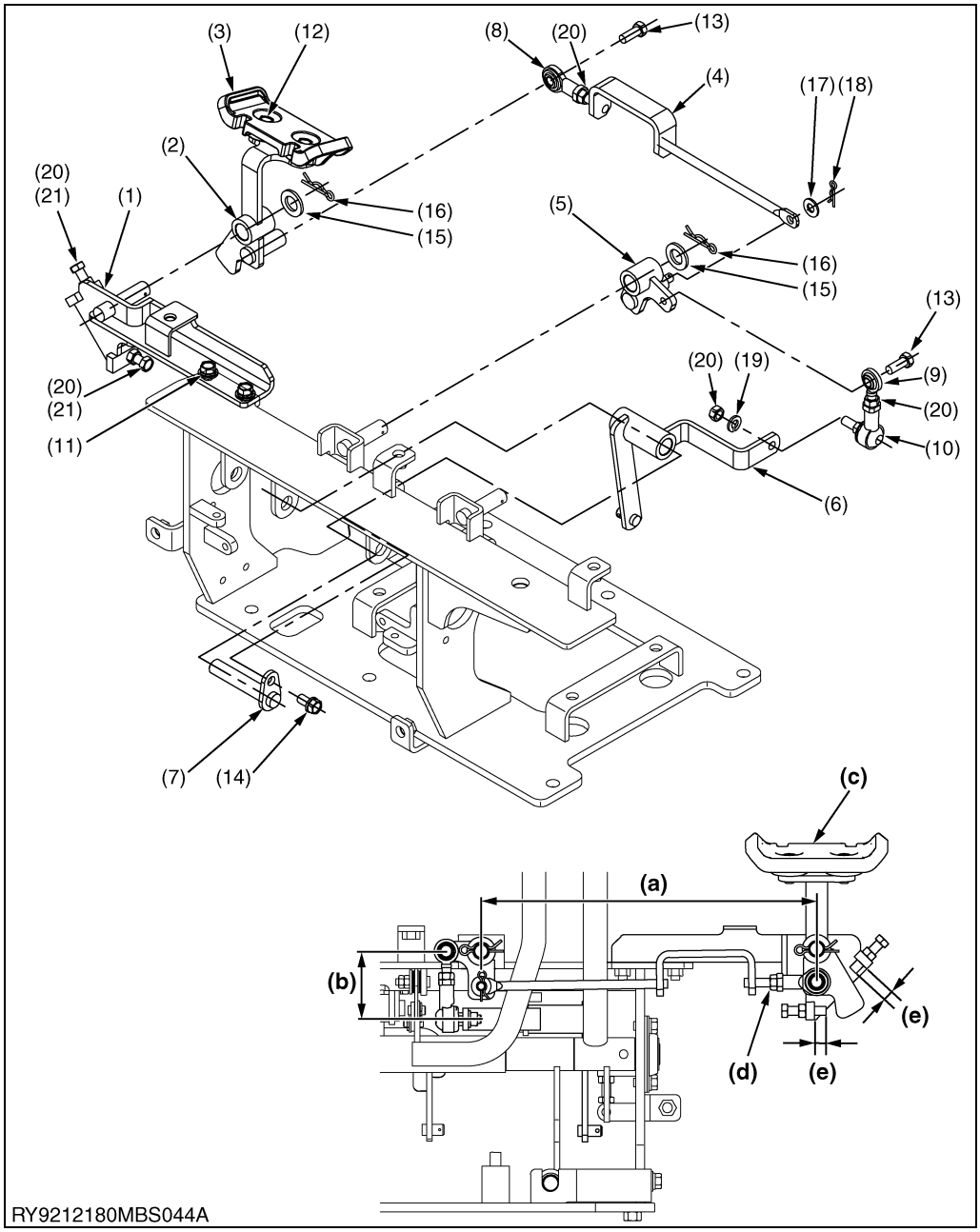
RY9212180MBS043A

■ **NOTE**
- **(a): Fix the grommet to muffler bracket.**
- **(b): Fix the grommet to swing frame.**

RY9212180MBS0014US0

(5) Swing Pedal

Components



(1) Bracket
(2) Lever ASSY
(3) Swing Pedal
(4) Rod
(5) Link ASSY
(6) Link ASSY
(7) Shaft
(8) Rod End, Right
(9) Rod End, Right Screw
(10) Rod End
(11) Bolt
(12) Bolt
(13) Bolt
(14) Bolt
(15) Flat Metal Washer
(16) Snap Pin
(17) Flat Metal Washer
(18) Snap Pin
(19) Spring Washer
(20) Nut
(21) Bolt

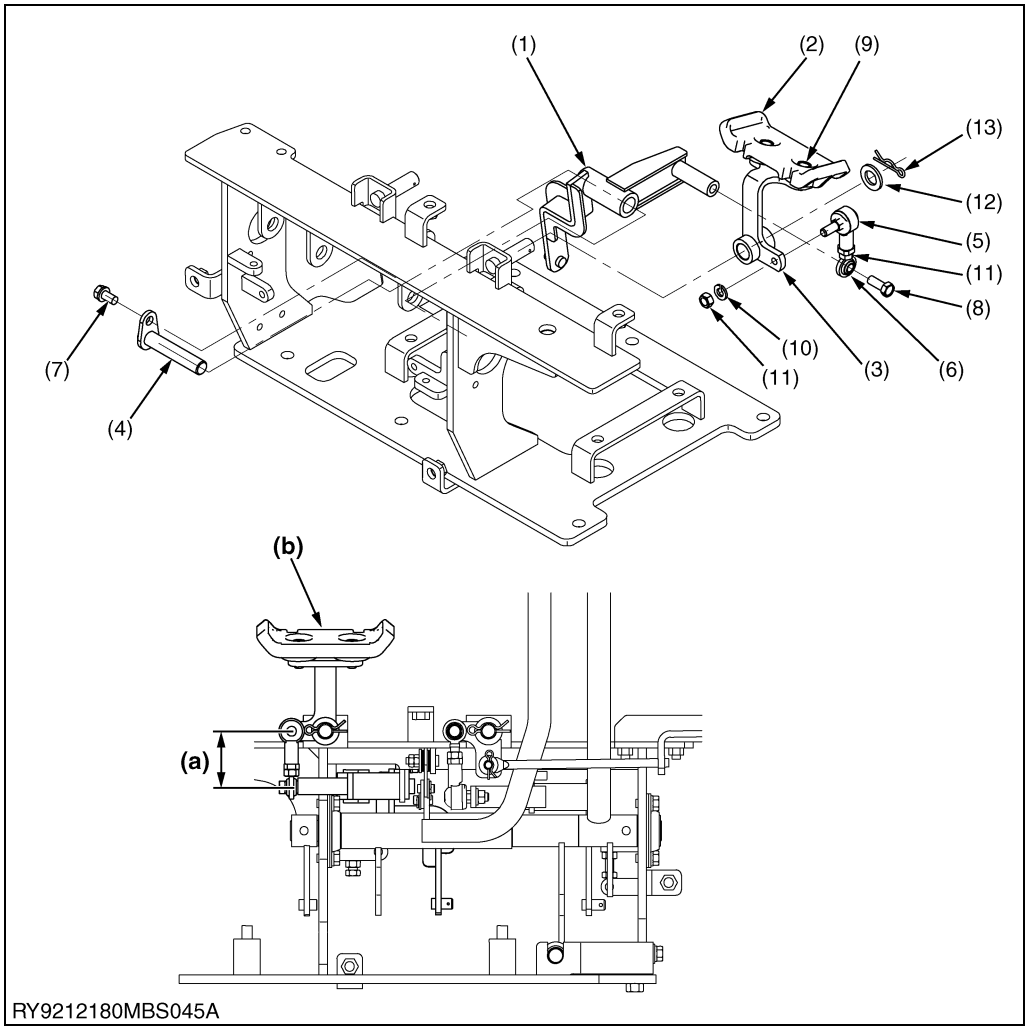
(a) 306 mm (12.0 in.)
(b) 62 mm (2.4 in.)
(c) Pedal should be horizontal.
(d) Adjust rod length.
(e) 10 mm (0.39 in.)

Tightening torque	Nut (20)	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft

RY9212180MBS0015US0

(6) AUX Pedal

Components



RY9212180MBS045A

(1) Link ASSY
(2) AUX Pedal
(3) Lever ASSY
(4) AUX Shaft
(5) Rod End, Screw
(6) Rod End, Right Screw
(7) Bolt
(8) Bolt
(9) Bolt
(10) Spring Washer
(11) Nut
(12) Flat Metal Washer
(13) Snap Pin

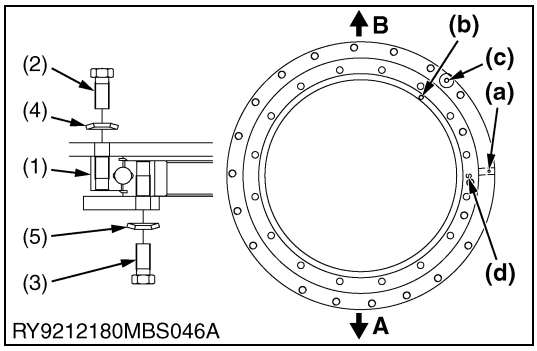
(a) 62 mm (2.4 in.)
(b) Pedal should be horizontal.

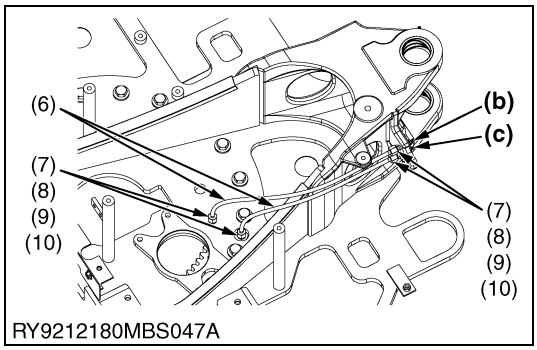
Tightening torque	Nut (11)	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft

RY9212180MBS0016US0

3. TRACK FRAME

[1] SWIVEL BEARING ASSEMBLY





(1) Swivel Bearing Assembly Procedure

1. Component names

No.	Parts Name	Q'ty
(1)	Bearing (swivel)	1
(2)	Bolt (M16 x 1.5, 12.9)	20
(3)	Bolt (M16 x 1.5, 12.9)	16
(4)	Spring washer	20
(5)	Spring washer	16
(6)	Grease tube	2
(7)	Adapter	4
(8)	Nut	4
(9)	Sleeve	4
(10)	Sleeve	4

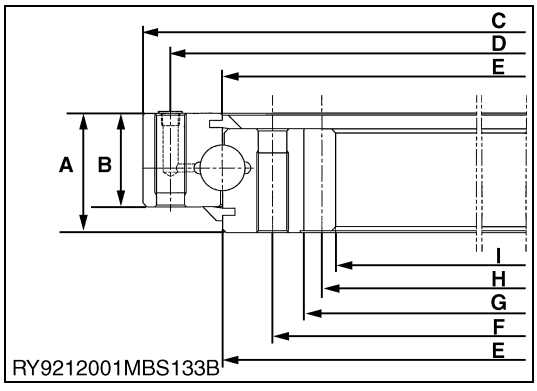
2. Assembly position
   Mount the inner tire soft zone ('S' mark) **(d)** on the right side of the body.
3. Swivel Bearing Torque
   After tightening lightly, tighten the bolts to the torques indicated below diagonally.

Tightening torque	Bolt (2), (3)	259.9 to 304.0 N·m 26.5 to 31.0 kgf·m 191.7 to 224.0 lbf·ft

   Apply thread lock (Loctite AN302-71 equivalent).
4. Grease the tooth surfaces
   Apply grease so that it covers the entire surface of the bearing teeth.

(a) Ball Insert Groove (External Tire Soft Zone)
(b) Area to Grease Tooth Surface
(c) Port for Applying Grease to the Ball (Align with Hole in Swivel Frame)
(d) 'S' Mark
A : Back of Machine
B : Front of Machine

RY9212180MBS0017US0



(2) Exterior Dimensions of Swivel Bearing

No. in Figure	External Dimensions
A	45 mm (1.8 in.)
B	38.5 mm (1.52 in.)
C	ϕ559 mm (ϕ22.0 in.)
D	P.C.D. 574 mm (22.6 in.)
E	ϕ527 mm (ϕ20.7 in.)
F	P.C.D. 482 mm (19.0 in.)
G	ϕ460 mm (ϕ18.1 in.)
H	P.C.D. 440 mm (17.3 in.)
I	ϕ429 mm (ϕ16.9 in.)

RY9212180MBS0018US0

[2] RUBBER TRACK

(1) Removal and Installation Procedure

CAUTION

- **The pressure in the grease cylinder is high so if loosened quickly, the nipple may pop off and the highly pressurized grease in the cylinder may fly out so do not get your face near the nipple nor place your body in front of the nipple and loosen the nipple gradually.**

RY9212001MBS0008US0

RY9212180MBS051A

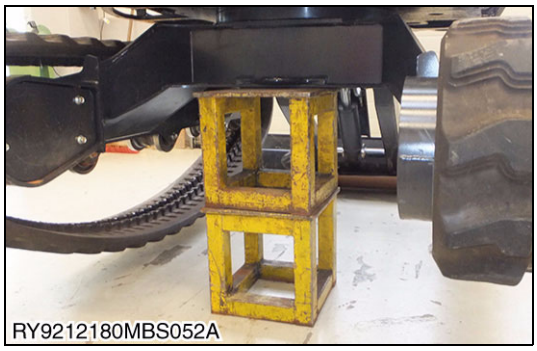
Removing the Grease Nipple

1. Place a socket wrench on the base of the grease nipple and loosen slowly.
   If there is a rock etc. caught in the sprocket, remove the rock first.

Tightening torque	Grease nipple	98.0 to 108.0 N·m 10.0 to 11.0 kgf·m 72.0 to 79.7 lbf·ft

(1) Grease Nipple

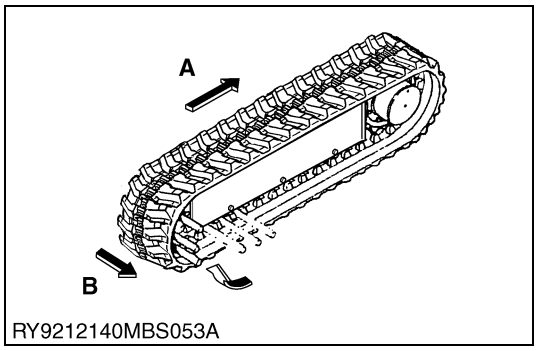
RY9212180MBS0020US0


RY9212180MBS052A

Loosening the Track

1. Jack up the body using the front attachments and blade, expel grease from inside the grease cylinder, and fully loosen up the track.
   Once the track is loosened up, attach the grease nipple.

RY9212180MBS0021US0



RY9212140MBS053A

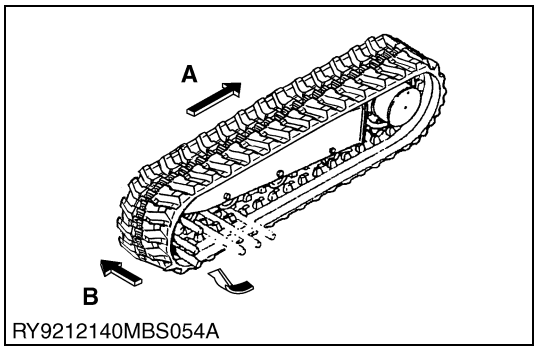
Removing the rubber tracks

1. 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 126 kg (278 lbs)

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

RY9212180MBS0022US0



RY9212140MBS054A

Assembling the rubber tracks

1. Jack up the machine with the front attachments and the blade 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.

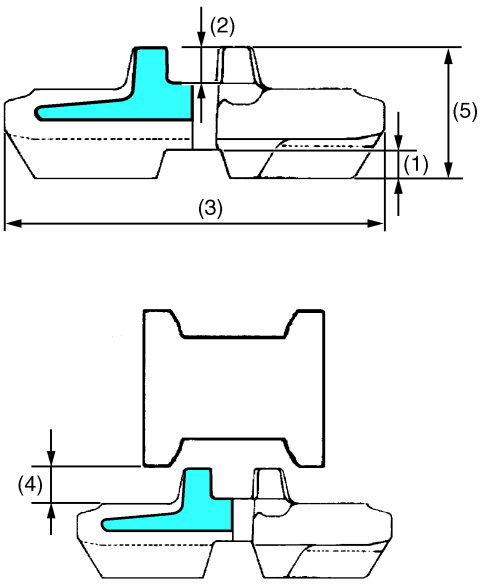
CAUTION

- **Be sure to assemble the rubber track the right way round.**

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

RY9212182MBS0102US0

(2) Rubber Track Dimensions



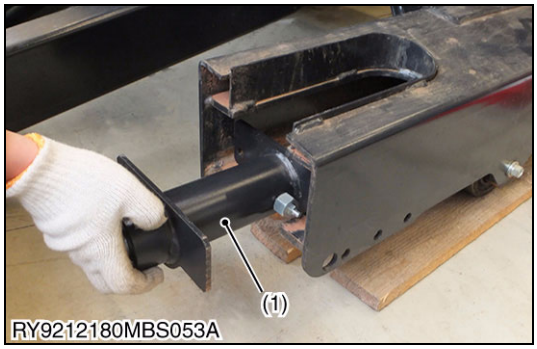
RY9212001MBS094A

	Serial number: to 63659	Serial number: from 63660
Identification mark (Steel cord lapping position)	∞	
(1) Lug height	18 mm 0.71 in.	19.5 mm 0.77 in.
(2) Link height	23.5 mm 0.925 in.	24 mm 0.94 in.
(3) Crawler width	300 mm 11.8 in.	
(4) Crawler sag distance	10 to 15 mm 0.39 to 0.59 in.	
(5) Crawler height	79 mm 3.1 in.	75.5 mm 3.0 in.
Number of core metal	80	
Circumference	4240 mm 166.9 in.	
Core metal pitch	53 mm 2.1 in.	

RY9212180MBS0071US0

[3] CYLINDER ASSEMBLY

(1) Removal and Installation Procedure



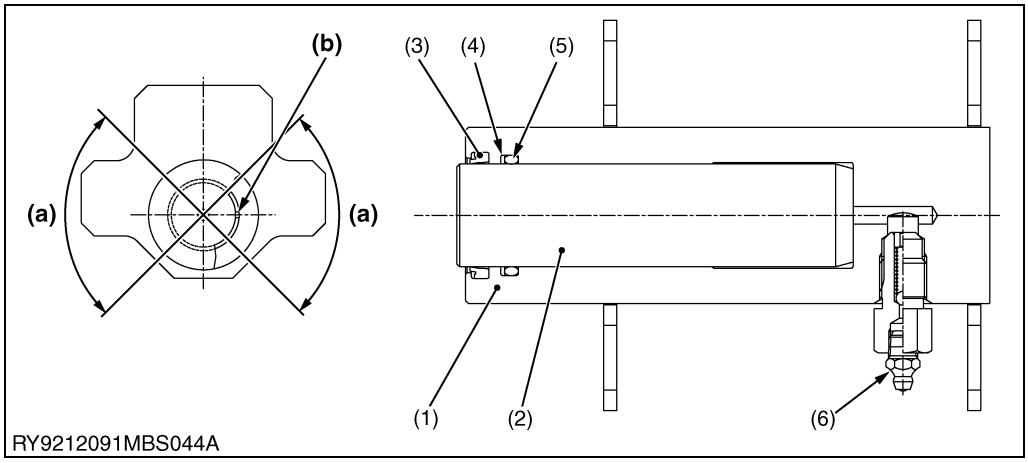
Removing the Cylinder ASSY

1. Remove the track and the front idler.
   (Refer to the "Front Idler" chapter for assembly/disassembly of the front idler.)
   After removing the spring ASSY, pull out the cylinder ASSY from the track frame.

(1) Cylinder ASSY

RY9212180MBS0051US0

(2) Cylinder ASSY Components



(1) Cylinder Tube
(2) Rod
(3) Dust Seal
(4) Backup Ring
(5) O-Ring
(6) Nipple ASSY

(a) 90 °
(b) Backup Ring Mating Surface

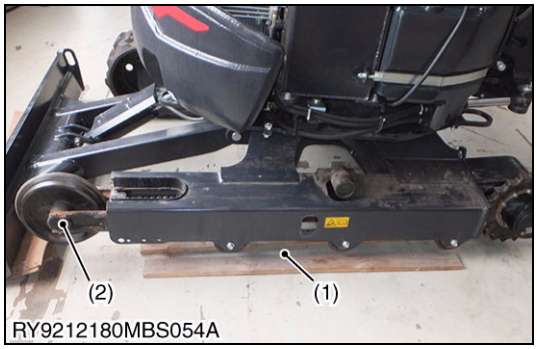
Tightening torque	Nipple ASSY (6)	98.0 to 108.0 N·m 10.0 to 11.0 kgf·m 72.0 to 79.7 lbf·ft

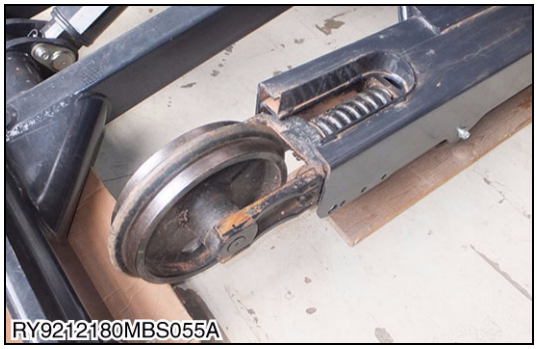
- Position the mating surface of the backup ring within a range of 90 ° laterally.

RY9212091MBS0064US0

[4] FRONT IDLER

(1) Removal and Installation Procedure





Removing the Idler

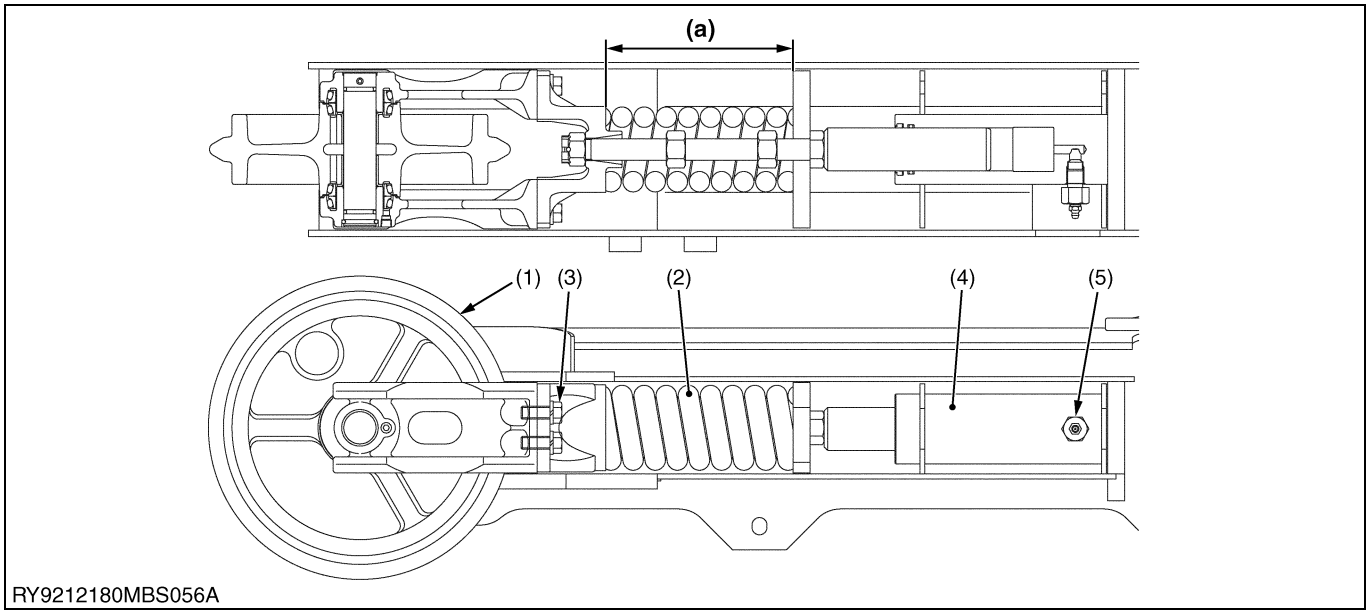
1. Remove the track.
   (Refer to the chapter "Track Removal and Installation.")
   Jack up the machine with the front and the blade and place timbers or the like under the frame.

2. Separate the front idler from the frame.

(1) Block (2) Front Idler

RY9212180MBS0027US0

(2) Front Idler Components



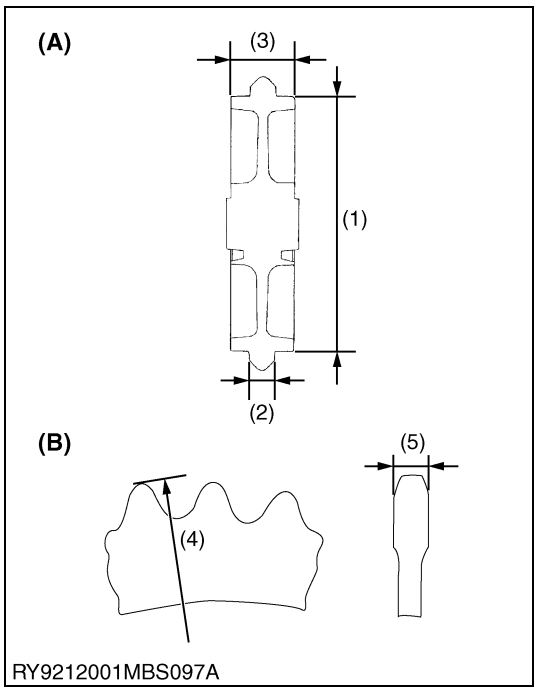
(1) Front Idler, ASSY
(2) Spring, ASSY
(3) Bolt
(4) Cylinder, ASSY
(5) Grease Nipple
(a) Preset Length: 174.3 ± 0.5 mm (6.86 ± 0.02 in.)

Tightening torque	Bolt (3)	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 lbf·ft

Apply thread lock (Loctite AN302-71 equivalent).

RY9212180MBS0028US0

(3) Dimensions of Idler and Sprocket



RY9212001MBS097A

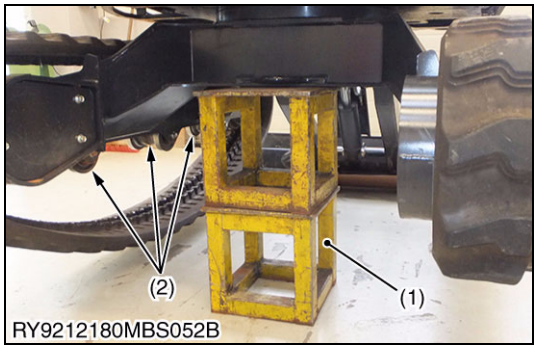
	Std. when new	Allowable limit
(1) Idler O.D.	272 mm 10.7 in.	266 mm 10.5 in.
(2) Guide width	28 mm 1.1 in.	22 mm 0.87 in.
(3) Idler width	72 mm 2.8 in.	–
(4) Sprocket wheel O.D.	356 mm 14.0 in.	350 mm 13.8 in.
(5) Sprocket wheel width	30 mm 1.2 in.	24 mm 0.94 in.

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

RY9212180MBS0029US0

[5] TRACK ROLLER AND CARRIER ROLLER

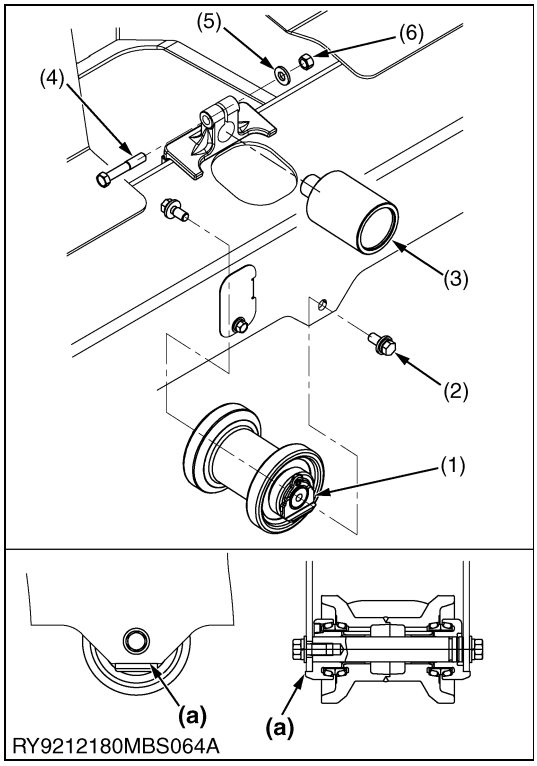
(1) Removal and Installation Procedure



1. Loosen the track.
   (Refer to the chapter "Track Removal and Installation".)
   Jack up the machine with the front and the blade and place timbers or the like under the frame.
2. Loosen the track roller mounting bolt, and remove the track roller.
3. Loosen the carrier roller mounting bolts and nuts, and then remove the carrier roller.

(1) Stand
(2) Track Roller

RY9212180MBS0024US0



Tightening torque	Track roller, ASSY mounting bolt (2)	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft
	Carrier roller, ASSY mounting nut (6)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft

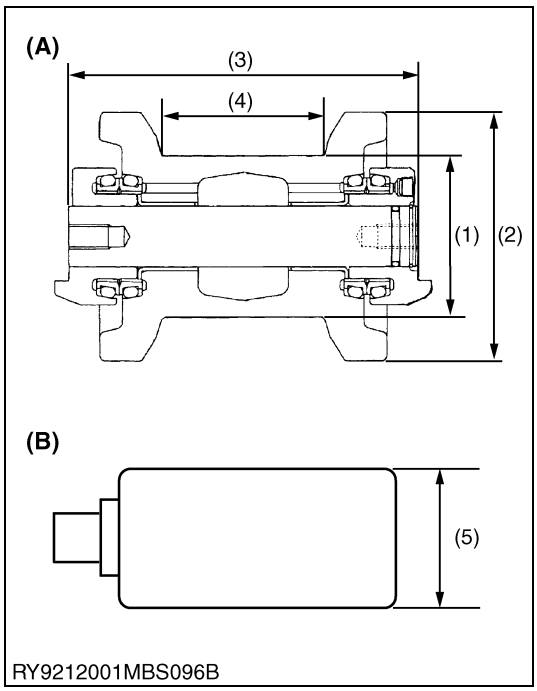
Apply thread lock (Loctite AN302-71 equivalent).

(1) Track Roller, ASSY
(2) Bolt
(3) Carrier roller, ASSY
(4) Bolt
(5) Spring Washer
(6) Nut

(a) Less than 2.0 mm (0.08 in.) (Gap between Working Surfaces)

RY9212180MBS0025US0

(2) Track Roller / Carrier Roller Dimensions



RY9212001MBS096B

Item	Std. when new	Usage limit
Track roller		
(1) Guide width	80 mm (3.1 in.)	75 mm (3.0 in.)
(2) O.D.	124 mm (4.88 in.)	121 mm (4.76 in.)
(3) Roller width	175 mm (6.89 in.)	–
(4) Guide width	81 mm (3.2 in.)	76 mm (3.0 in.)
Carrier roller		
(5) O.D.	76.3 mm (3.0 in.)	72.3 mm (2.85 in.)

(A) Track roller **(B) Carrier roller**

RY9212180MBS0066US0

4. MEASURING MACHINE PERFORMANCE

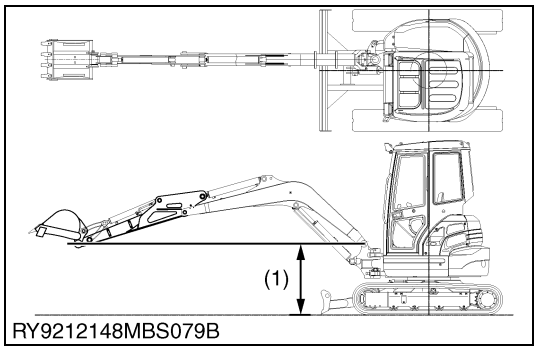
[1] MEASURING FRONT PERFORMANCE

(1) Measuring Swivel Gear Backlash

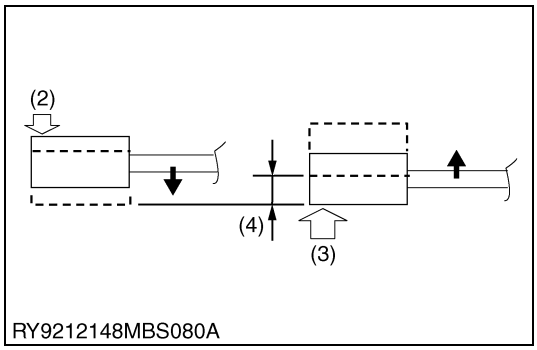
Purpose

- 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



RY9212148MBS079B



RY9212148MBS080A

Measurement preparation

1. To make the measurements, position the machine so the arm cylinder and bucket cylinder are fully compressed, keeping the boom fulcrum pin and the arm fulcrum pin at the same height.
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.

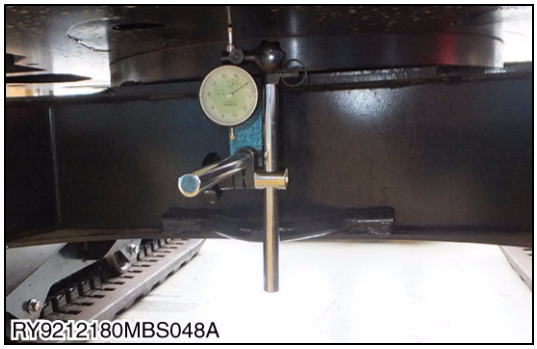
(1) Boom Fulcrum Pin Height
(2) 50 N (5.0 kgf, 11 lbs)
(3) 300 N (30 kgf, 67.4 lbs)
(4) Amount of Play

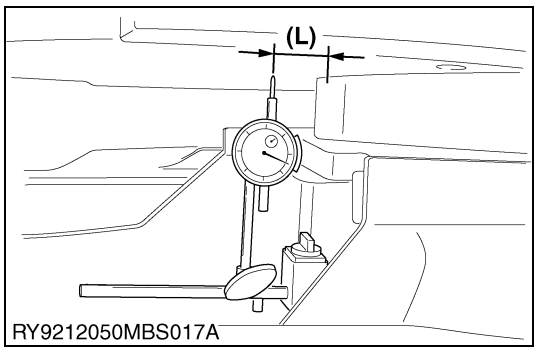
RY9212180MBS0068US0

(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.


RY9212180MBS048A



RY9212050MBS017A


RY9212180MBS049A


RY9212180MBS050A

[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 100 mm (4.0 in.)

RY9212180MBS0069US0

5. SWIVEL GEAR BACKLASH PERFORMANCE

No.	Item		Factory Specification	Notes
(1)	Front play measurement		≤ 73 mm ≤ 2.9 in.	
(2)	Swivel bearing play	Factory spec. when new	2.2 mm 0.09 in.	
		Usage limit	4.4 mm 0.17 in.	

RY9212180MBS0070US0

2 ENGINE

GENERAL

CONTENTS

1. ENGINE

[1] ENGINE SPECIFICATIONS

		U27-4
Model		D1105-E4-BH-2
Number of cylinder		3
Bore × Stroke		78 × 78.4 mm 3.07 × 3.09 in.
Displacement		1123 cc (68.53 in^3)
Minimum bare idling speed		1370 rpm
Maximum bare speed		< 2620 rpm
Compression ratio		24
Max. output / rpm	Net	14.9 / 2400 kW/rpm 20.0 / 2400 HP/rpm
	Gross	15.6 / 2400 kW/rpm 20.9 / 2400 HP/rpm
Max. torque / rpm	Net	71.4 / 1600 N·m/rpm 7.28 / 1600 kgf·m/rpm
	Gross	69.4 / 1600 N·m/rpm 7.04 / 1600 kgf·m/rpm
Dimensions; L × W × H		515 × 406 × 606 mm 20.3 × 16.0 × 23.9 in.
Dry weight		98 kg 220 lbs
Valve clearance		0.165 mm 0.0065 in.
Firing sequence		1-2-3
Combustion chamber		Spherical type (E-VTCS)
Compression pressure		3.72 to 4.12 MPa 38.0 to 42.0 kgf/cm^2 540 to 597 psi
Compression pressure (allowable limit)		2.25 MPa 22.9 kgf/cm^2 326 psi
Fuel consumption ratio (rated engine rpm)	Net	267.1 g/kW·h 199.2 g/HP·h 0.439 lb/HP·h
	Gross	255.1 g/kW·h 190.3 g/HP·h 0.420 lb/HP·h
Fuel injection pressure		13.73 MPa 140 kgf/cm^2 1991 psi
Engine oil pressure (rated engine rpm)		197 to 441 kPa 2.0 to 4.5 kgf/cm^2 28.5 to 64.0 psi
Engine oil consumption ratio (rated engine rpm)		0.5 g/kW·h ≥ 0.37 g/PS·h ≥
Fan belt		RPF 2375

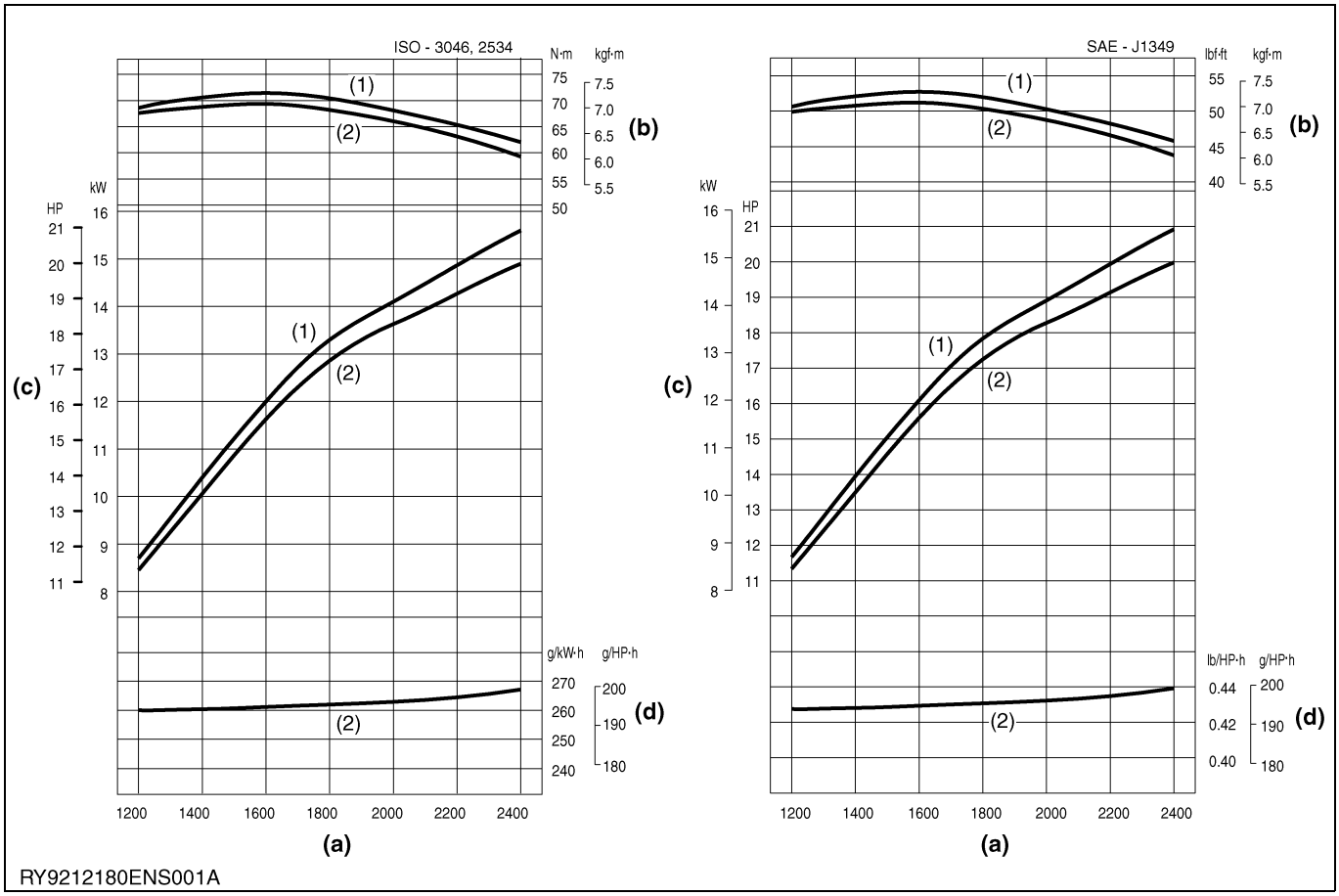
		U27-4
Alternator		12 V (480 W)
Charging current		40 A
Regulation voltage		14.2 to 14.8 V
Battery	Standards	DIN EN 50342, DIN IEC 60095-2
	Rated voltage and capacity	12V 62Ah (K20)
Electrolyte gravity		1.28 ± 0.01
Starter		12 V (1.4 kW)
Glow plug		1.45 Ω

CAUTION
- **Actual measured values may vary with the machine.**

RY9212180END0001US0

[2] PERFORMANCE CURVE

D1105-E4-BH-2

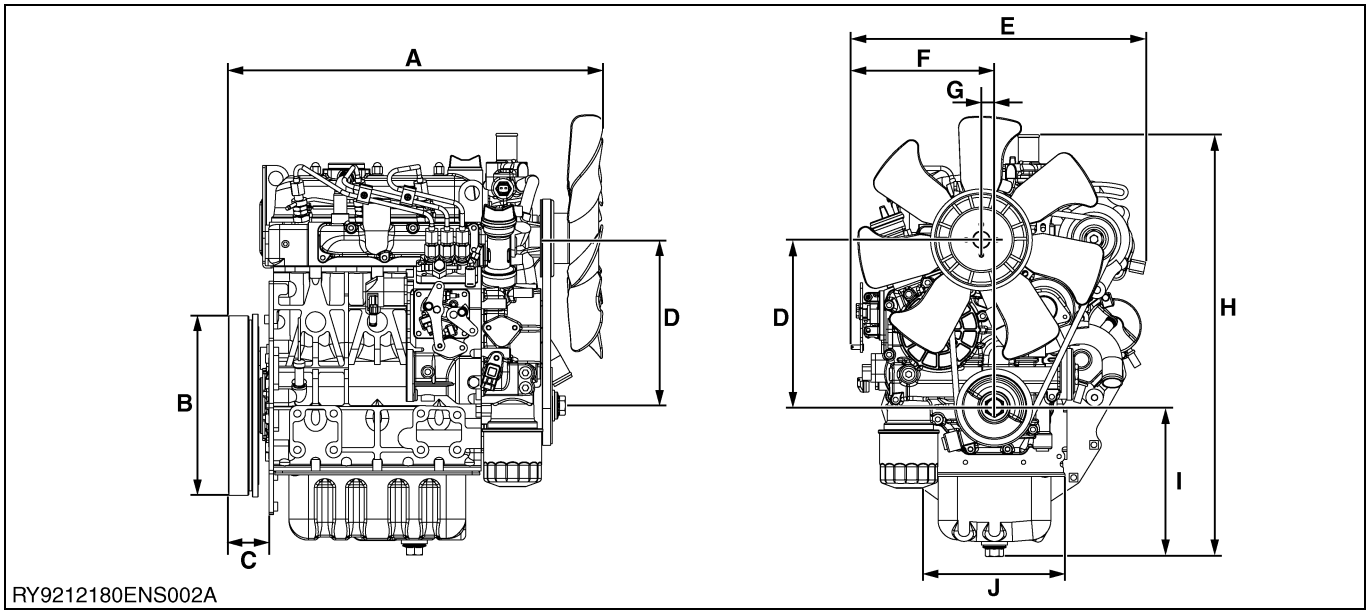


RY9212180ENS001A

(1) Gross int.
(2) Net int.
(a) Engine Speed (rpm)
(b) Torque
(c) Brake Horsepower
(d) Specific Fuel Consumption

RY9212180END0002US0

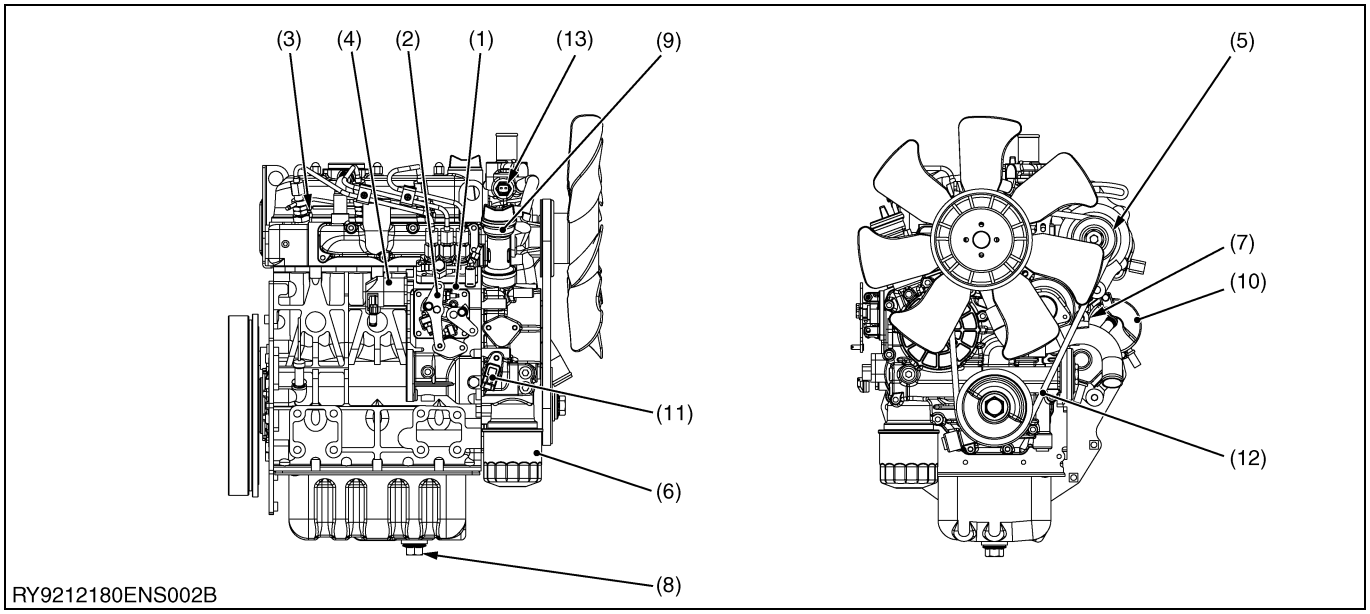
[3] DIMENSIONS



RY9212180ENS002A

A	515.3 mm (20.3 in.)	**F**	197.6 mm (7.78 in.)
B	ϕ251.1 mm (ϕ9.88 in.)	**G**	18 mm (0.71 in.)
C	62 mm (2.44 in.)	**H**	580.1 mm (22.8 in.)
D	230 mm (9.06 in.)	**I**	205.6 mm (8.09 in.)
E	405.8 mm (16.0 in.)	**J**	200 mm (7.87 in.)

Component layout



RY9212180ENS002B

No.	Part Name	No.	Part Name	No.	Part Name
(1)	Injection Pump	(6)	Oil Filter	(11)	Revolution Sensor
(2)	Speed Control Lever	(7)	Oil Switch	(12)	V-Belt
(3)	Glow Plug	(8)	Drain Plug (Oil)	(13)	Coolant Temperature Sensor
(4)	Engine Stop Solenoid	(9)	Oil Inlet Plug		
(5)	Alternator	(10)	Starter		

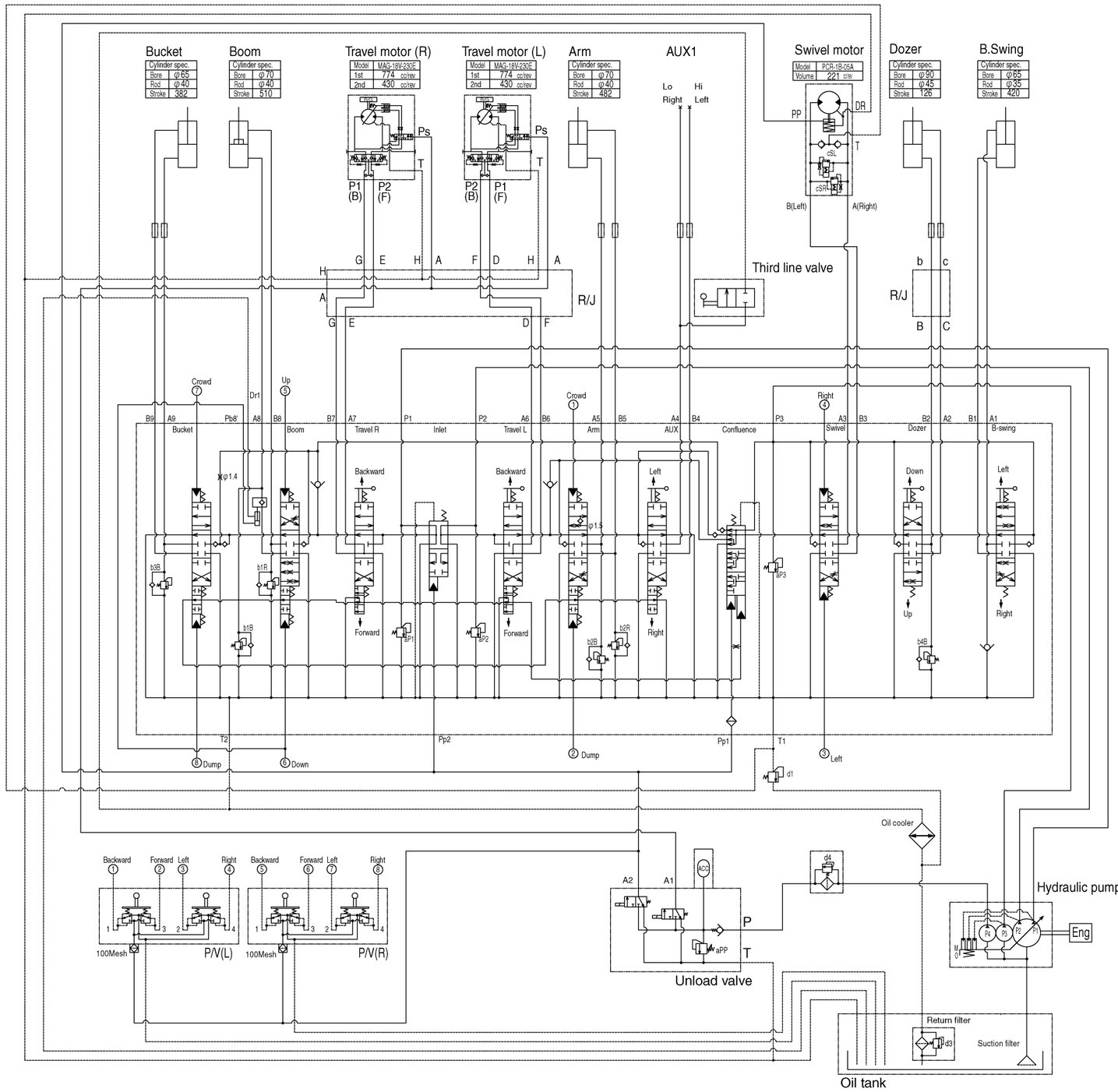
RY9212180END0003US0

3 HYDRAULIC SYSTEM

MECHANISM

CONTENTS

1. HYDRAULIC CIRCUIT DIAGRAM (U27-4 STD)



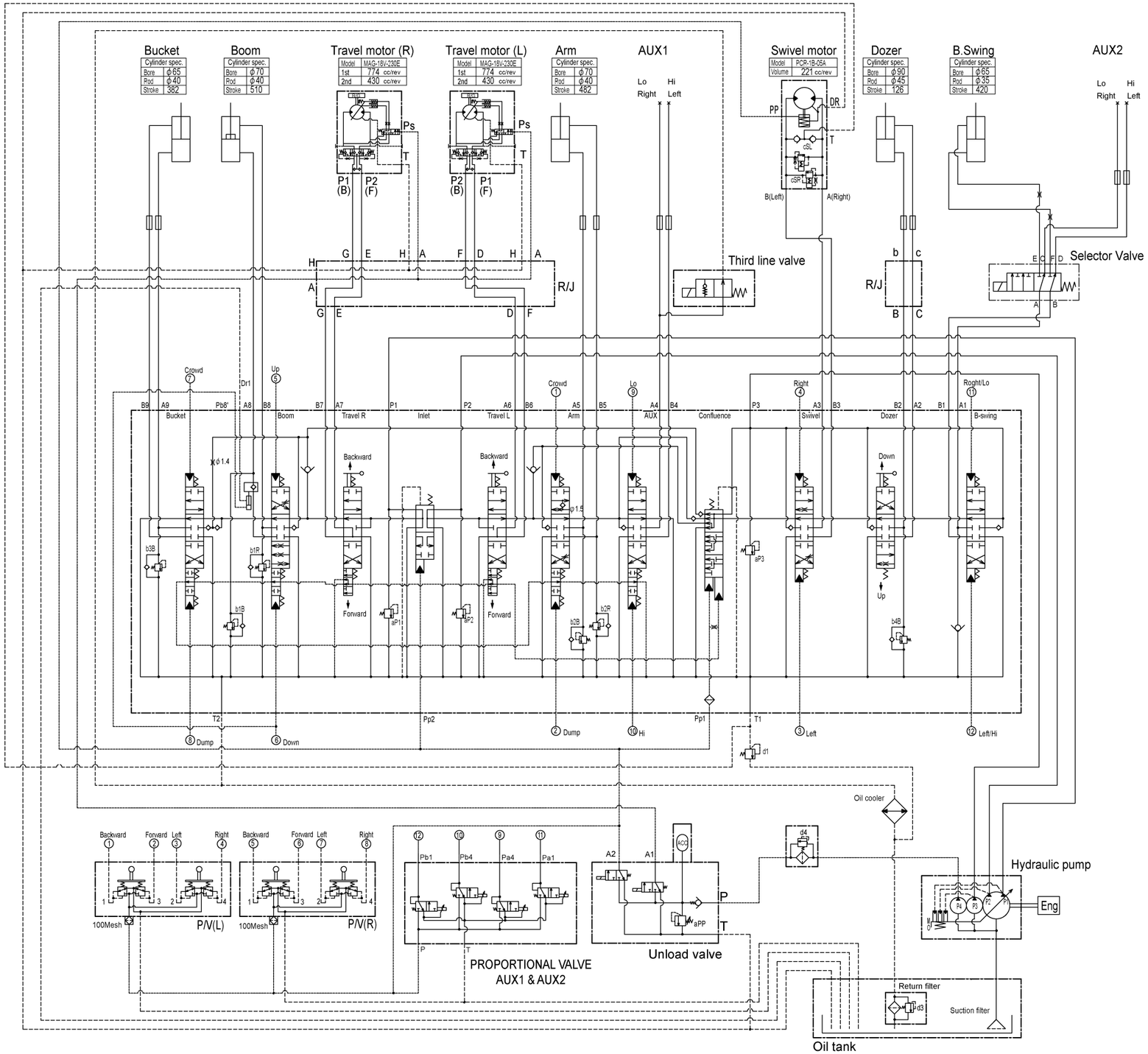
RRY9212180HYT001US

Mark	Relief Pressure(MPa)		
aP1	Main P1		21.6
aP2	Main P2		21.6
aP3	Main P3		17.2
aPP	Pilot Primary		4.0
b1B	Boom	Bottom	24.0
b1R		Rod	24.0
b1H		Holding V	—
b2B	Arm	Bottom	24.0
b2R		Rod	24.0
b3B	Bucket	Bottom	24.0
b3R		Rod	—
b4B	Dozer	Bottom	24.0
b4R		Rod	—
b5B	Swing	Bottom	—
b5R		Rod	—
b6L	Aux1	LH	—
b6R		RH	—
cSL	Swivel Motor	LH	17.7
cSR		RH	17.7
cTF	Travel Motor	Forward	—
cTR		Backward	—
d1	Main Return		0.25
d2	Cooler Return		—
d3	Return Filter By-Pass		0.18
d4	Pilot Line Filter By-Pass		0.15

No.	Function
①	Arm Crowd
②	Arm Dump
③	Swivel Left
④	Swivel Right
⑤	Boom Up
⑥	Boom Down
⑦	Bucket Crowd
⑧	Bucket Dump

	P1	P2	P3	Pp
Drive speed (rpm)	2400	2400	2400	2400
Volume (cc/rev)	12.0	12.0	8.0	2.7
Pump flow (L/min)	28.8	28.8	19.2	6.5

2. HYDRAULIC CIRCUIT DIAGRAM (U27-4 HI SPEC)



Mark	Relief Pressure (MPa)		
aP1	Main P1		21.6
aP2	Main P2		21.6
aP3	Main P3		17.2
aPP	Pilot Primary		4.0
b1B	Boom	Bottom	24.0
b1R		Rod	24.0
b1H		Holding V	—
b2B	Arm	Bottom	24.0
b2R		Rod	24.0
b3B	Bucket	Bottom	24.0
b3R		Rod	—
b4B	Dozer	Bottom	24.0
b4R		Rod	—
b5B	Swing	Bottom	—
b5R		Rod	—
b6L	Aux1	LH	—
b6R		RH	—
cSL	Swivel Motor	LH	17.7
cSR		RH	17.7
cTF	Travel Motor	Forward	—
cTR		Backward	—
d1	Main Return		0.25
d2	Cooler Return		—
d3	Return Filter By-Pass		0.18
d4	Pilot Line Filter By-Pass		0.15

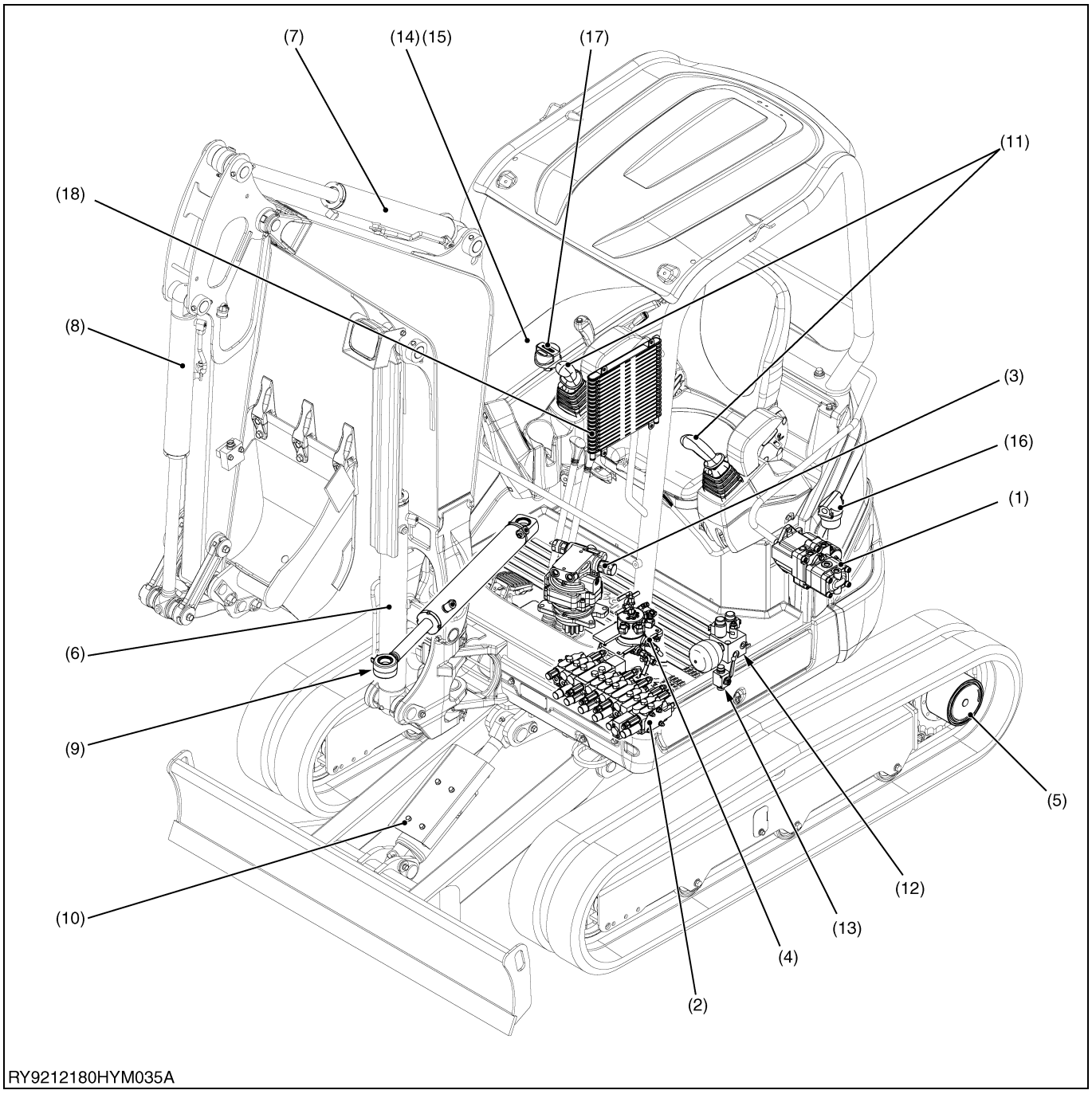
No.	Function
①	Arm Crowd
②	Arm Dump
③	Swivel Left
④	Swivel Right
⑤	Boom Up
⑥	Boom Down
⑦	Bucket Crowd
⑧	Bucket Dump
⑨	AUX1 Right
⑩	AUX1 Left
⑪	Boom Swing Right / AUX2 Right
⑫	Boom Swing Left / AUX2 Left

	P1	P2	P3	Pp
Drive speed (rpm)	2400	2400	2400	2400
Volume (cc/rev)	12.0	12.0	8.0	2.7
Pump flow (L/min)	28.8	28.8	19.2	6.5

RY9212422HYT001US

3. HYDRAULIC DEVICE LAYOUT

[1] STD AND HI SPEC

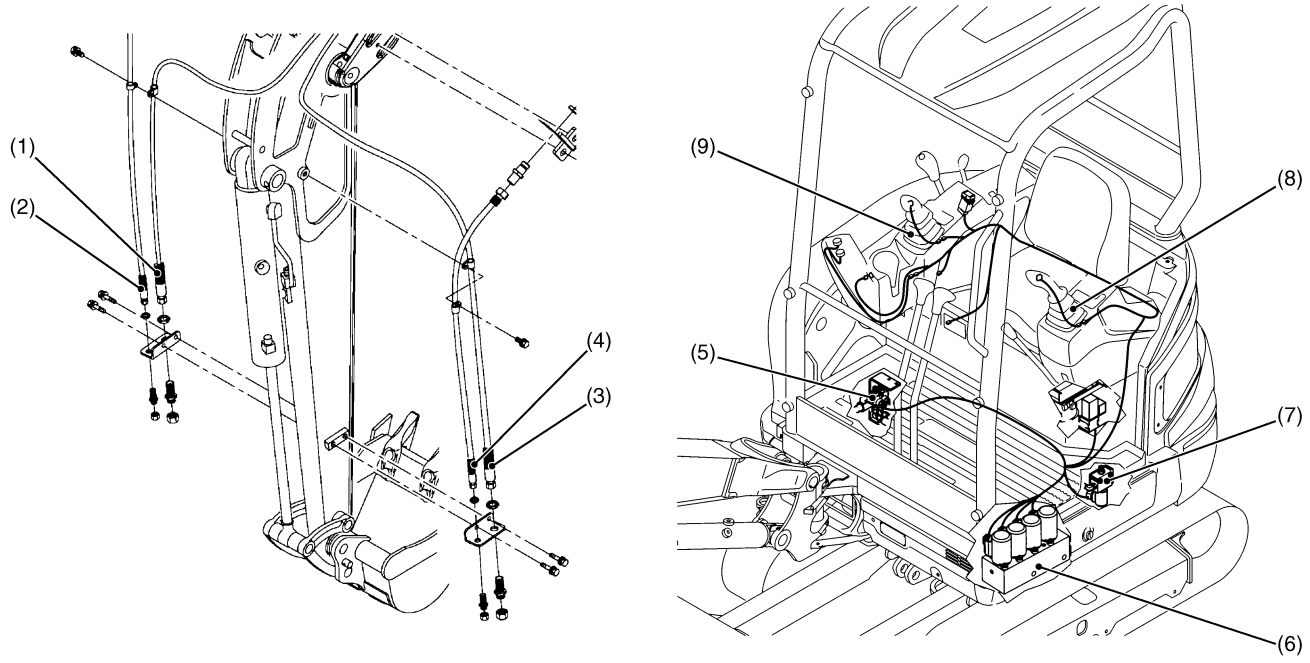


RY9212180HYM035A

(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) Pilot Valve (Control)
(12) Unload Valve
(13) Third Line Valve
(14) Suction Filter
(15) Return Filter
(16) Pilot Filter
(17) Breather Filter
(18) Oil Cooler

RY9212180HYM0001US0

[2] HI SPEC



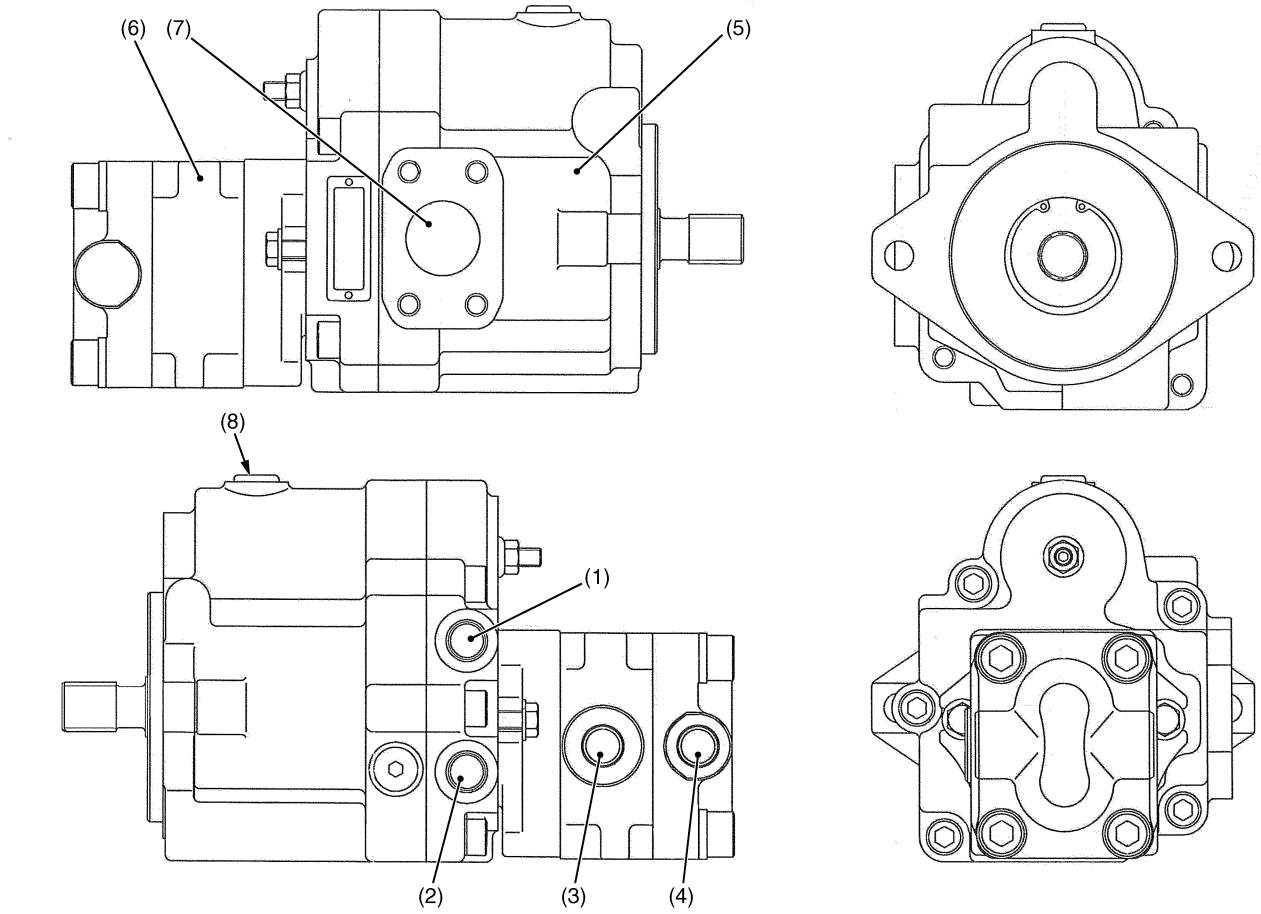
RY9212422HYM001A

(1) AUX1 RH
(2) AUX2 RH
(3) AUX1 LH
(4) AUX2 LH
(5) Selector Valve
(6) Proportional Valve (AUX1, AUX2 / Boom Swing)
(7) Third Line Valve
(8) Control Lever LH (Pilot Valve)
(9) Control Lever RH (Pilot Valve)

RY9212422HYM0002US0

4. PUMP

[1] SPECIFICATIONS



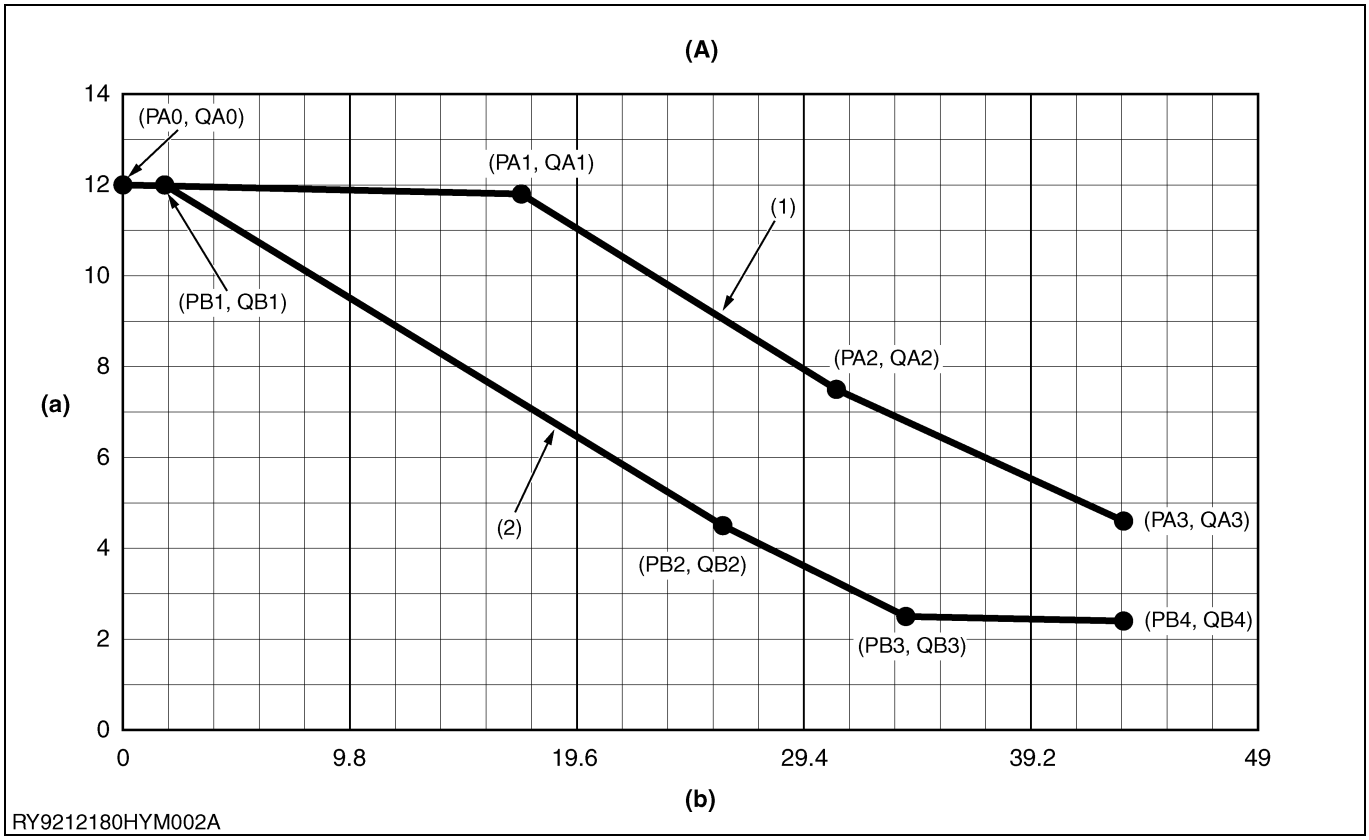
RY9212180HYM001A

(1) P1 Discharge port
(2) P2 Discharge port
(3) P3 Discharge port
(4) P4 Discharge port
(5) Piston pump
(6) Gear pump
(7) Suction port
(8) Lubrication port

Item			Notes
Maker		Fujikoshi (Ltd.)	
Model		PVD-0B-24P-8G3-5456A	
Rated RPM		2400 rpm	
Direction of Rotation		Right	
Max. Displacement	Piston Pumps P1+ P2	12 + 12 cc/rev 0.73 + 0.73 cu.in./rev	
	Gear Pump P3	8.0 cc/rev 0.5 cu.in./rev	
	Pilot Pump P4	2.7 cc/rev 0.16 cu.in./rev	
Max. Pressure	Piston Pumps P1, P2	21.6 MPa 220 kgf/cm^2 3130 psi	
	Gear Pump P3	17.2 MPa 175 kgf/cm^2 2490 psi	
	Pilot Pump P4	3.9 MPa 40 kgf/cm^2 570 psi	

RY9212180HYM0002US0

P - Q Curve



(1) P3 = 0.49 MPa (5.0 kgf/cm^2, 71 psi)
(2) P3 = 17.2 MPa (175 kgf/cm^2, 2490 psi)
(A) Horsepower Control Curve (Reference: Bench Test)
(a) Discharge Flow: q1 = q2 (cm^3/rev)
(b) Discharge Pressure: P1 + P2 (MPa)

Shaft speed: 2300 rpm			
At gear pump pressure: P_3 = 0.49 MPa		At gear pump pressure: P_3 = 17.2 MPa	
Pressure (MPa)	Delivery flow (cm^3/rev)	Pressure (MPa)	Delivery flow (cm^3/rev)
PA0 = 0.0	QA0 = 12.0 (Target value)		
PA1 = 17.2	QA1 = 11.8 (Target value)	PB1 = 1.8	QB1 = 12.0 (Target value)
PA2 = 30.8	QA2 = 7.5 (Target value)	PB2 = 25.9	QB2 = 4.5 (Target value)
PA3 = 43.2	QA3 = 4.6 (Target value)	PB3 = 33.8	QB3 = 2.5 (Target value)
		PB4 = 43.2	QB4 = 2.4 (Target value)

RY9212180HYM0003US0

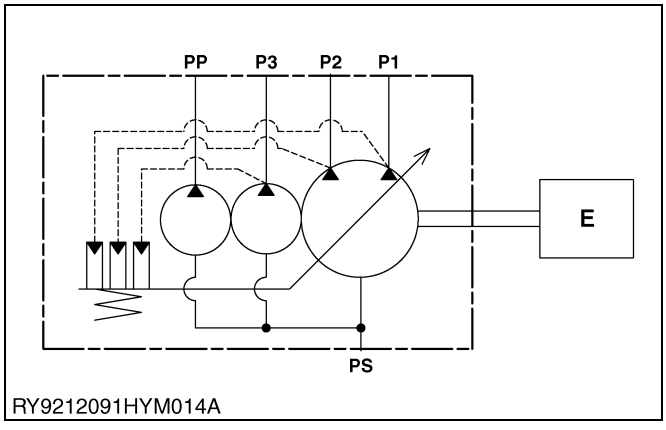
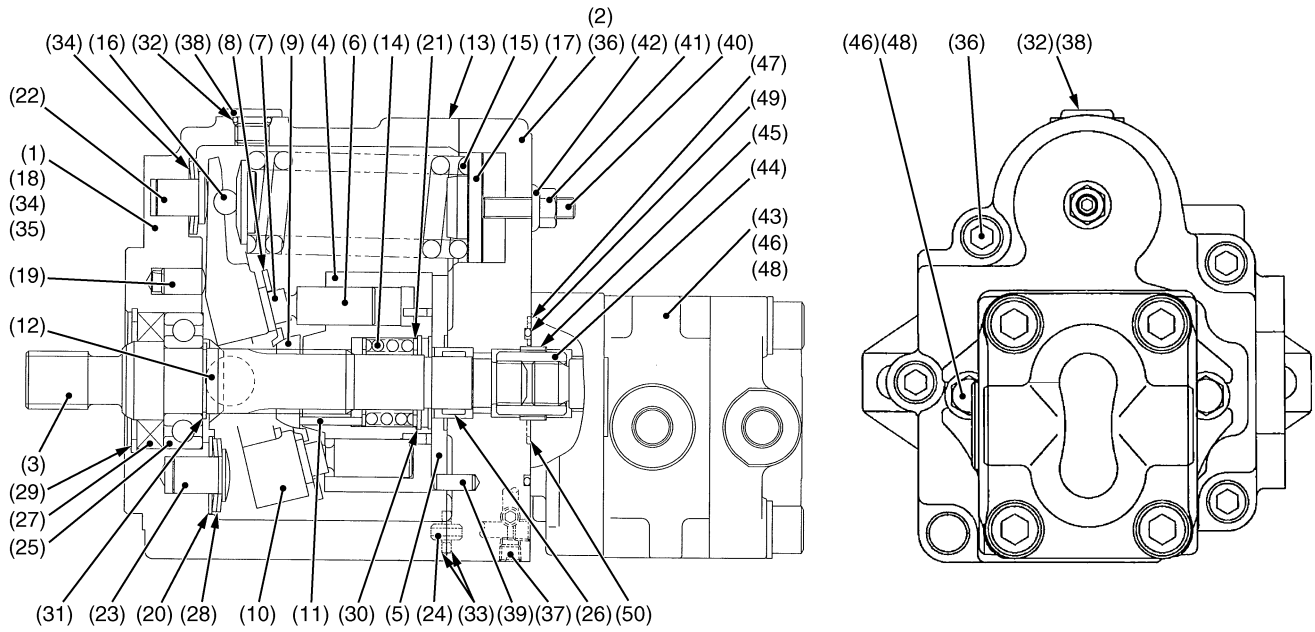


Diagram of Hydraulic Circuit

P1/P2 :Piston Pump Discharge Port
E : Engine
P3 : Gear Pump Discharge Port
PP: Pilot Pump Discharge Port
PS: Suction Port

RY9212095HYM0003US0

[2] COMPONENTS



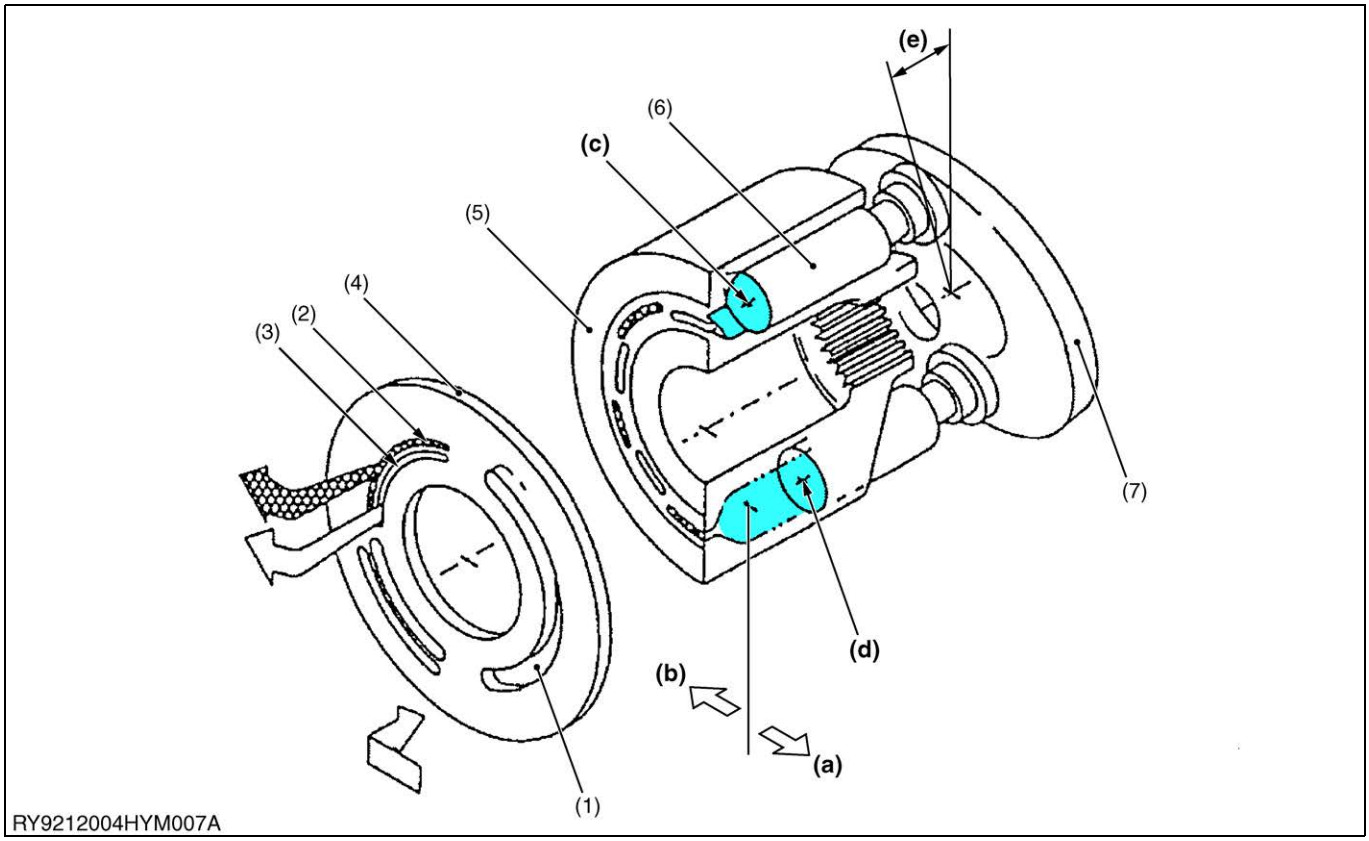
RY9212180HYM003A

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(1)	Body-S	1		(26)	Needle Bearing	1	
(2)	Body-H	1		(27)	Oil Seal	1	
(3)	Shaft	1		(28)	Coned Disk Springs	4	
(4)	Cylinder Barrel	1		(29)	Snap Ring	1	JIS B 2804 52 Hole
(5)	Valve Plate	1		(30)	Snap Ring	1	JIS B 2804 34 Hole
(6)	Piston	10		(31)	Snap Ring	1	JIS B 2804 25 External
(7)	Shoe	10		(32)	O-ring	1	JIS B 2401, 1B, P11
(8)	Shoe Holder	1		(33)	O-ring	2	JIS B 2401, 1B, P12
(9)	Barrel Holder	1		(34)	Plug	1	
(10)	Swash Plate	1		(35)	O-ring	1	JIS B 2401, 1B, P11
(11)	Needle	3		(36)	Bolt	5	M10 x 35 - 12.9
(12)	Pin	2		(37)	Plug	5	
(13)	Gasket	1		(38)	Plug	1	GPF 1/4
(14)	Spring C	1		(39)	Spring pin	1	JIS B 2808 6 × 16 AW
(15)	Spring T1	1		(40)	Screw	1	JIS B 1177 M8 x 30 Flat point
(16)	Spring Holder	1		(41)	Hex nut	1	JIS B 1181 M8
(17)	Spring Guide	1		(42)	Seal Washer	1	
(18)	Pin	1		(43)	Gear Pump Kit	1	
(19)	Rod G	1		(44)	Coupling	1	JIS B 1180 M8 × 25 11T
(20)	Washer	1		(45)	Collar	1	JIS B 2401, 1B, P7
(21)	Retainer	1		(46)	Hex bolt	2	M8 x 25 - 10.9
(22)	Stopper Pin A	1		(47)	O-ring	1	JIS B 2401, 1B, P7
(23)	Stopper Pin B	1		(48)	Washer	2	
(24)	Pin	1		(49)	O-ring	1	JIS B 2401, 1B, G55
(25)	Ball bearing	1		(50)	O-ring	1	JIS B 2401, 1B, P8

RY9212180HYM0004US0

[3] FUNCTION AND STRUCTURE

(1) Pump Operating Principles

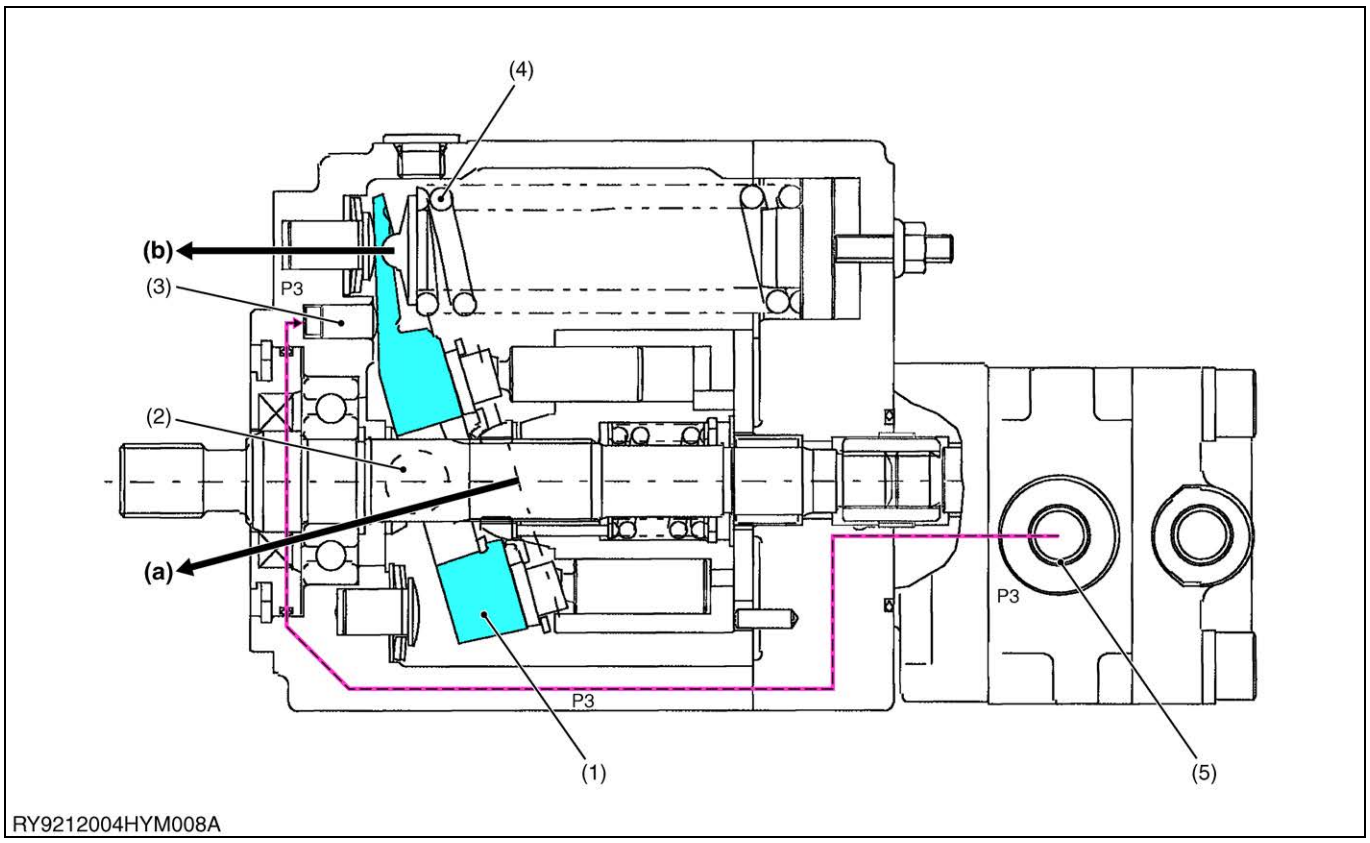


(1) Suction Port
(2) Discharge Port (P1)
(3) Discharge Port (P2)
(4) Valve Plate
(5) Cylinder Barrel
(6) Piston
(7) Swash-plate
(a) Intake Cycle
(b) Discharge Cycle
(c) Top Dead Center
(d) Bottom Dead Center
(e) Tilt Angle

- The cylinder barrel of the piston pump is coupled to the shaft via a spline, so it rotates with the shaft. The pistons in the cylinder barrel move in reciprocating motion within the cylinder barrel in line with the swash-plate as they slide on the top of the swash-plate; the pistons drive the intake and discharge pump operations according to changes in the volume of the cylinder.
- During the interval from TDC to BDC, the piston moves in the direction that increases the volume of the cylinder barrel, so oil flows from the intake port via the valve plate and into the bore of the cylinder barrel. (Intake Cycle)
- As the drive shaft turns further and the piston goes from BDC to TDC, it moves in the direction that decreases the volume of the cylinder barrel, so the oil inside the cylinder barrel is expelled to the discharge port. (Discharge Cycle)
- Because the piston moves in constant contact with the swash-plate, as the swash-plate's tilt angle changes, the stroke of the piston changes and so does the pump discharge quantity.
- As an even number of pistons are used, the number of pistons that open on the outside and the inside of the valve plate is the same; what's more, all the pistons are of the same diameter and are on the same pitch arc and are moving on the same swash-plate, so the discharge quantity from the outside (P1) and the inside (P2) of the valve plate is identical. Furthermore, as the swash-plate is in one place, even when the swash-plate angle changes under variable control, the discharge quantity from ports P1 and P2, both change in the same way, so it does not produce a difference in discharge quantity.

RY9212004HYM0006US0

(2) Pump Horsepower Control Mechanism



RY9212004HYM008A

(1) Swash-plate
(2) Ball
(3) Rod G
(4) Spring
(5) P3
(a) Load F1
(b) Spring Force F2

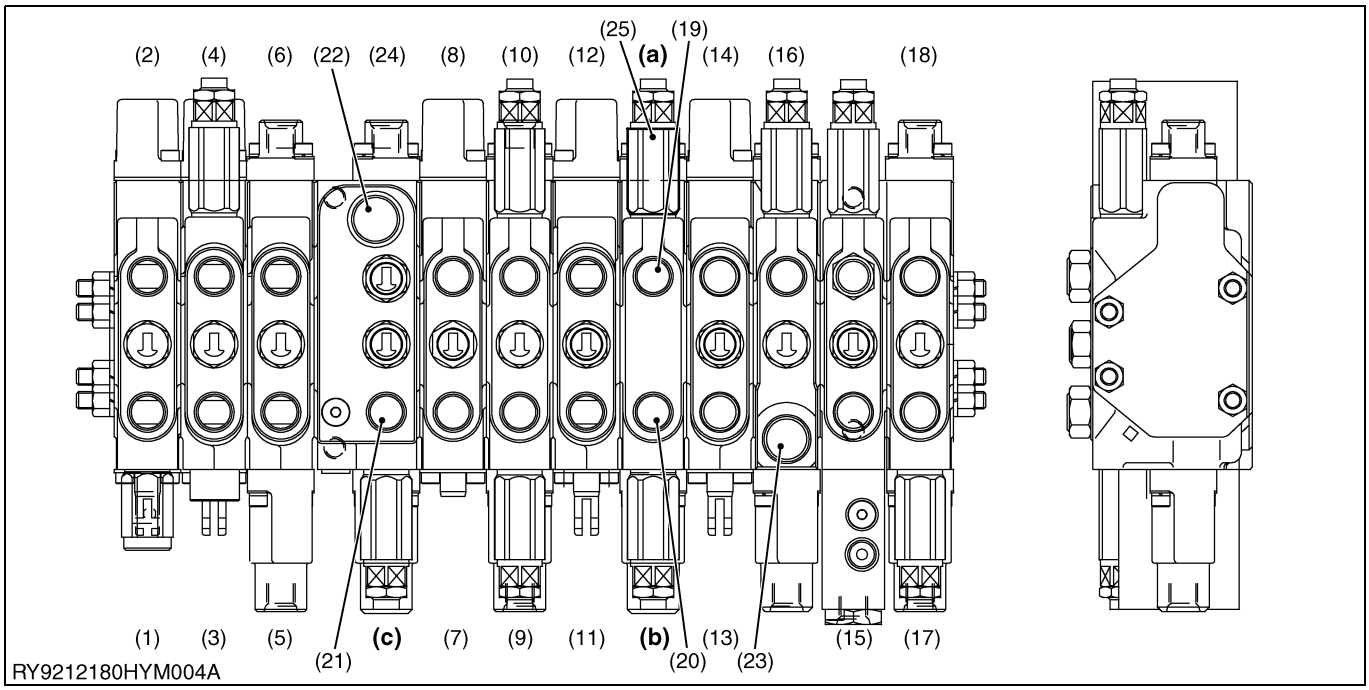
Set Horsepower Control Mechanism

- Although the pump discharge quantity alters the swash-plate angle, the swash-plate angle regulates the fixed horsepower with a direct-acting variable mechanism that utilizes a simple spring.
- There is a ball on the back side of the swash-plate's axis of rotation and the load F1 from the piston side acts in the direction indicated in the figure, generating a clockwise moment against the swash-plate. The spring that sets the fixed horsepower (spring force F2) is set up in opposition to this force at a certain load.
- The more the pressure increases, the more the clockwise moment mentioned above increases, and when it overcomes the counter-clockwise moment of the spring's force, the spring is compressed, making the swash-plate angle smaller and reducing the discharge quantity, thus maintaining the horsepower at the fixed level.
- And when the pressure P3 acts on the rod, the clockwise moment is in proportion to the pressure and acts on the swash-plate, so the characteristic P-Q shifts, which maintains the horsepower at a fixed level, including the gear pump. (Total Horsepower Regulator)

RY9212091HYM0011US0

5. CONTROL VALVE

[1] SPECIFICATIONS (STD)



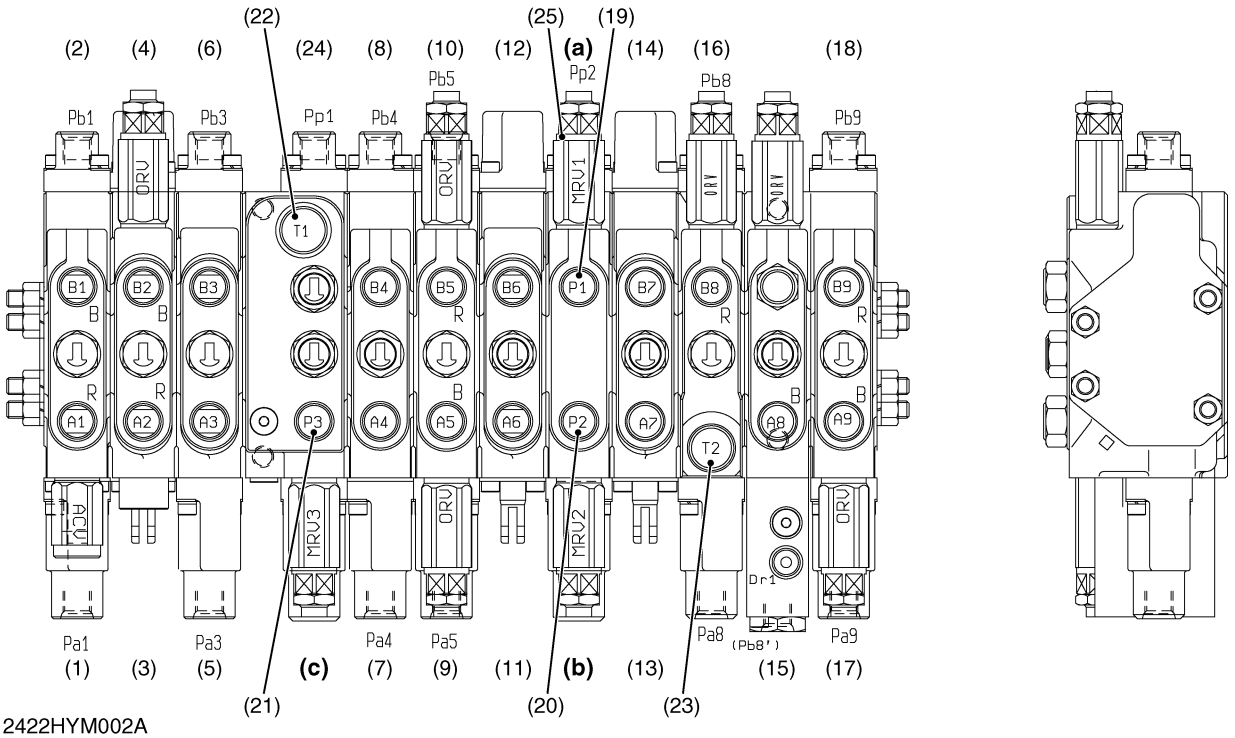
(1) Swing Rod
(2) Swing Bottom
(3) Blade Rod
(4) Blade Bottom
(5) Swivel Right (Pa7)
(6) Swivel Left (Pb7)
(7) AUX (Pa6)
(8) AUX (Pb6)
(9) Arm Bottom (Pa5)
(10) Arm Rod (Pb5)
(11) Travel Left Reverse
(12) Travel Left Forward
(13) Travel Right Reverse
(14) Travel Right Forward
(15) Boom Rod (Pa2)
(16) Boom Bottom (Pb2)
(17) Bucket Bottom (Pa1)
(18) Bucket Rod (Pb1)
(19) P1 Port
(20) P2 Port
(21) P3 Port
(22) T1 port
(23) T2 Port
(24) Pp1 Port
(25) Pp2 Port

(a) Main P1 Relief Valve
(b) Main P2 Relief Valve
(c) Main P3 Relief Valve

Item			Remarks
Maker		Hydrocontrol	
Model		EV310104	
Main relief valve pressure setting	P1, P2	21.6 MPa 220 kgf/cm^2 3130 psi	at 29 L/min 1800 cu.in./min 7.7USGPM
	P3	17.2 MPa 175 kgf/cm^2 2490 psi	at 19L/min 1200 cu.in./min 5.0 USGPM
Overload relief valve pressure setting	Bucket (17)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Boom (16)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Boom (15)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Arm (9), (10)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Blade (3), (4)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM

RY9212180HYM0005US0

[2] SPECIFICATIONS (HI SPEC)



RY9212422HYM002A

(1) Swing Rod/AUX2 RH (Pa1)
(2) Swing Bottom/AUX2 LH (Pb1)
(3) Blade Rod
(4) Blade Bottom
(5) Swivel Right (Pa3)
(6) Swivel Left (Pb3)
(7) AUX1 RH (Pa4)
(8) AUX1 LH (Pb4)
(9) Arm Bottom (Pa5)
(10) Arm Bottom (Pb5)
(11) Travel Left Reverse
(12) Travel Left Forward
(13) Travel Right Reverse
(14) Travel Right Forward
(15) Boom Rod (Pa8)
(16) Boom Bottom (Pb8)
(17) Bucket Bottom (Pa9)
(18) Bucket Rod (Pb9)
(19) P1 Port
(20) P2 Port
(21) P3 Port
(22) T1 Port
(23) T2 Port
(24) Pp1 Port
(25) Pp2 Port

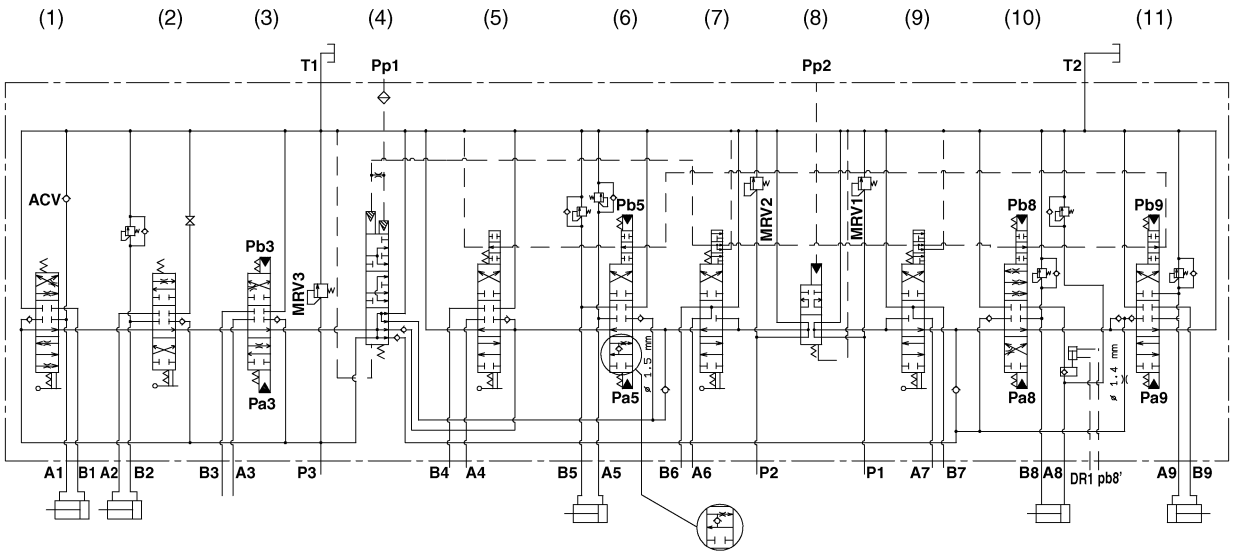
(a) P1 Main Relief Valve
(b) P2 Main Relief Valve
(c) P3 Main Relief Valve

Item			Remarks
Maker		Hydro control	
Model		EV310104	
Main relief valve pressure setting	P1, P2	21.6 MPa 220 kgf/cm^2 3130 psi	at 29 L/min 1800 cu.in./min 7.7USGPM
	P3	17.2 MPa 175 kgf/cm^2 2490 psi	at 19L/min 1200 cu.in./min 5.0 USGPM
Overload relief valve pressure setting	Bucket (17)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Boom (16)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Boom (15)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Arm (9), (10)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM
	Blade (4)	24.0 MPa 245 kgf/cm^2 3500 psi	at 5 L/min 300 cu.in./min 1.3 USGPM

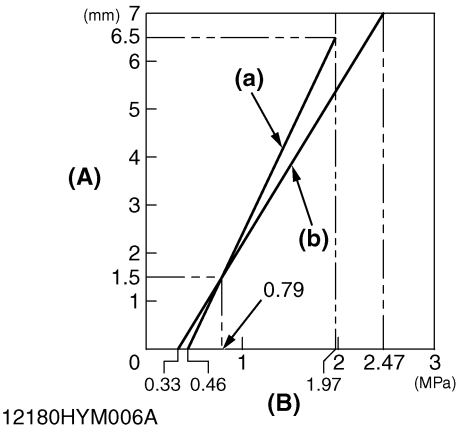
RY9212422HYM0003US0

[3] HYDRAULIC CIRCUIT DIAGRAM

(1) STD



RY9212180HYM005A



RY9212180HYM006A

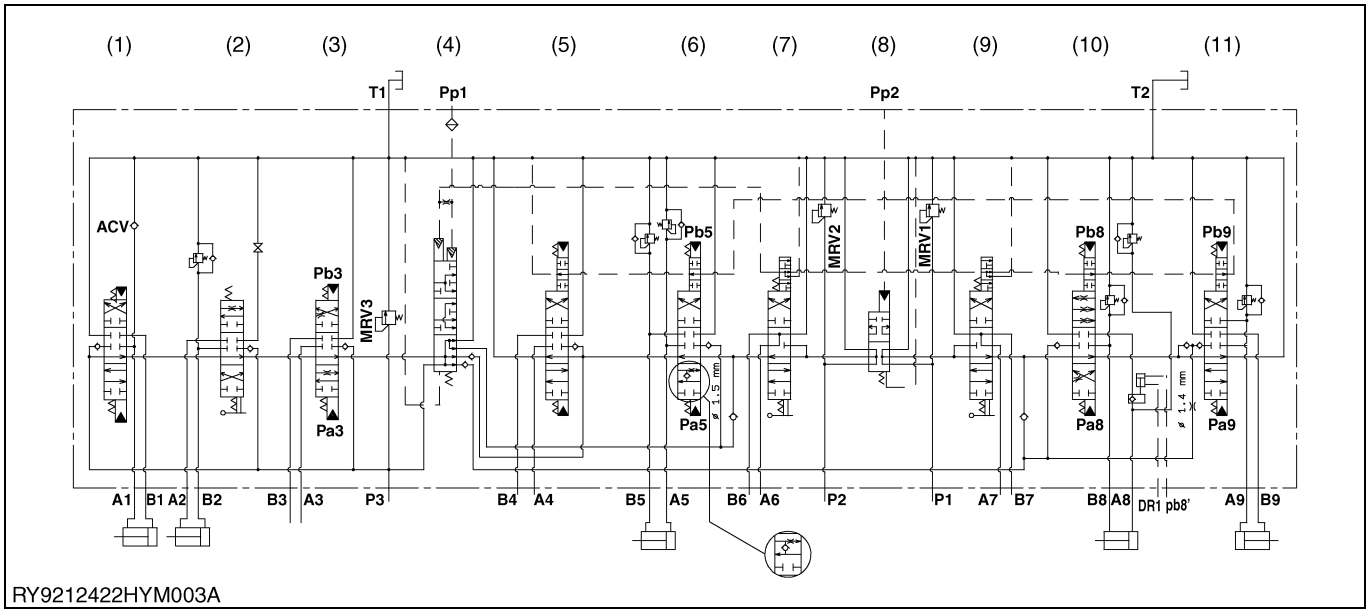
(1) Boom Swing
(2) Blade
(3) Swing
(4) Confluence Valve
(5) AUX
(6) Arm
(7) Travel L
(8) Inlet
(9) Travel R
(10) Boom
(11) Bucket

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

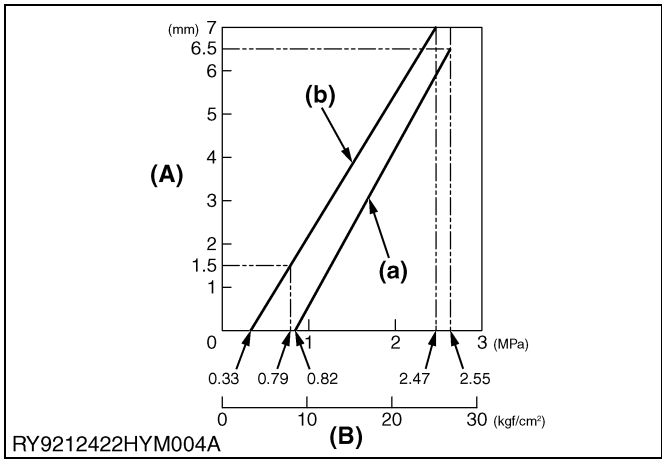
(a) Confluence Valve
(b) Other than Confluence Valve

RY9212180HYM0006US0

(2) HI SPEC



RY9212422HYM003A



RY9212422HYM004A

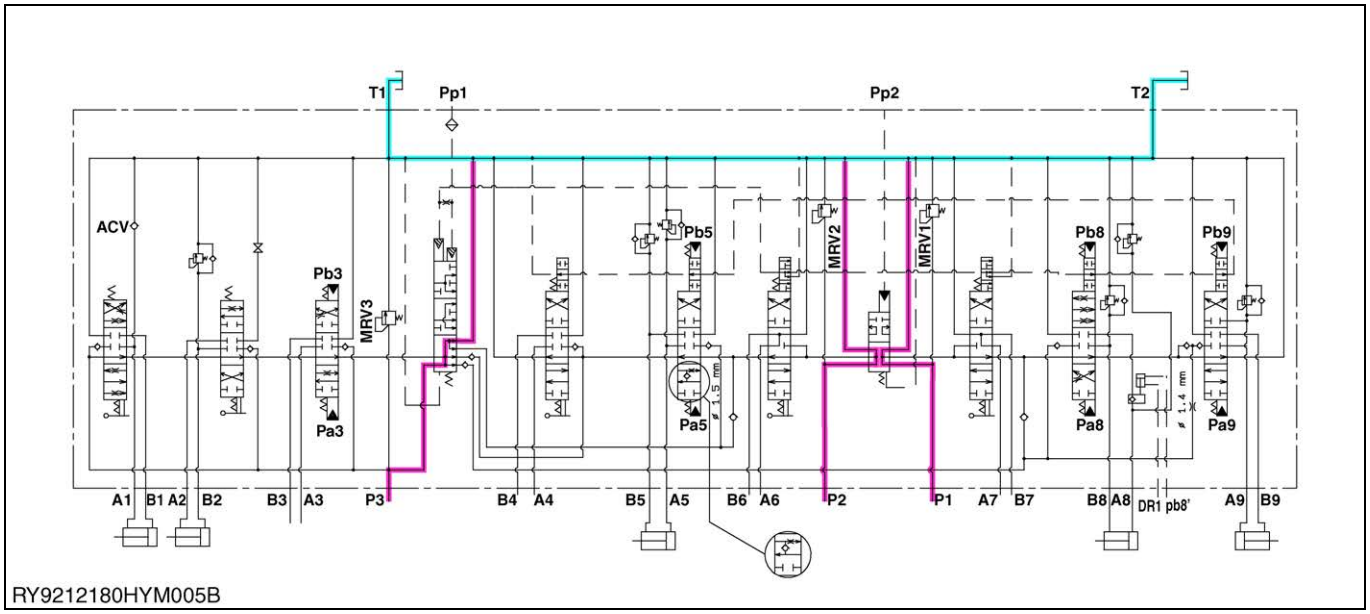
(1) Swing/AUX2
(2) Blade
(3) Swing
(4) Confluence Valve
(5) AUX1
(6) Arm
(7) Travel LH
(8) Inlet
(9) Travel RH
(10) Boom
(11) Bucket

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

(a) Confluence Valve
(b) Other than Confluence Valve

RY9212422HYM0004US0

(3) Hydraulic Lock Lines for All Operations

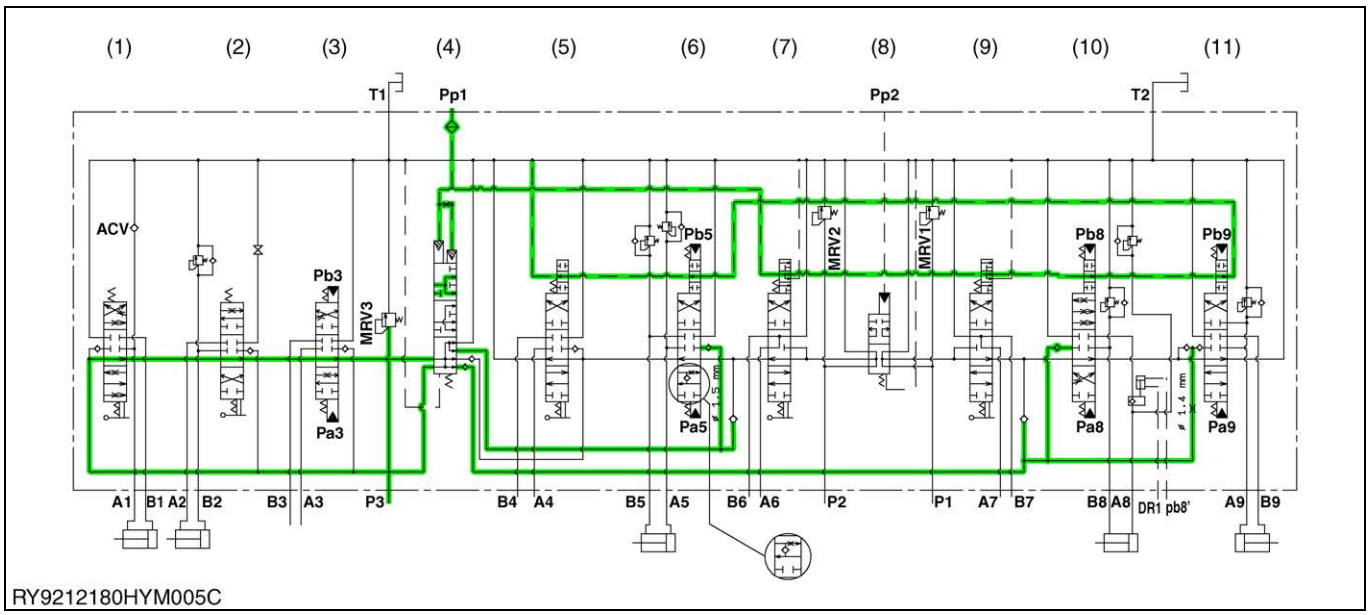


RY9212180HYM005B

When lever is locked, machine will not operate even if the control lever is operated. P1 and P2 pump lines are connected to the tank line at the inlet section. P3 pump line is connected to the tank line at the Confluence valve section.

RY9212180HYM0040US0

(4) Straight Travel Circuit



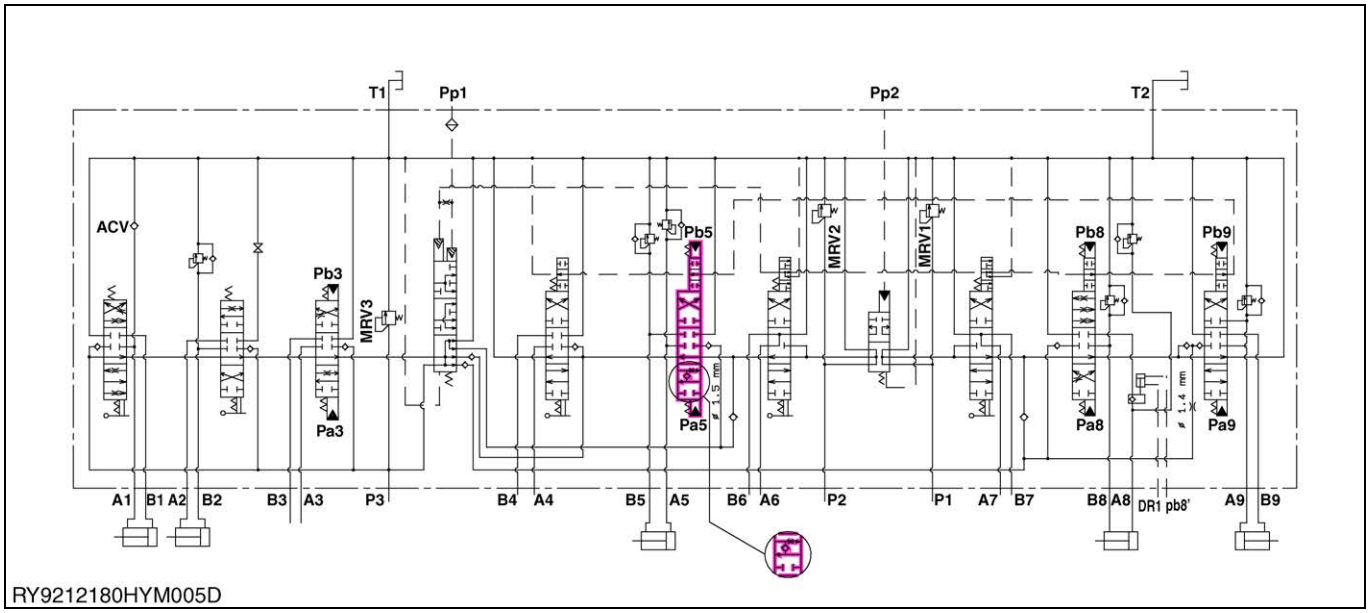
(1) Swing
(2) Blade
(3) Swivel
(4) Confluence Valve
(5) AUX
(6) Arm
(7) Travel L
(8) Inlet
(9) Travel R
(10) Boom
(11) Bucket

RY9212180HYM0019US0

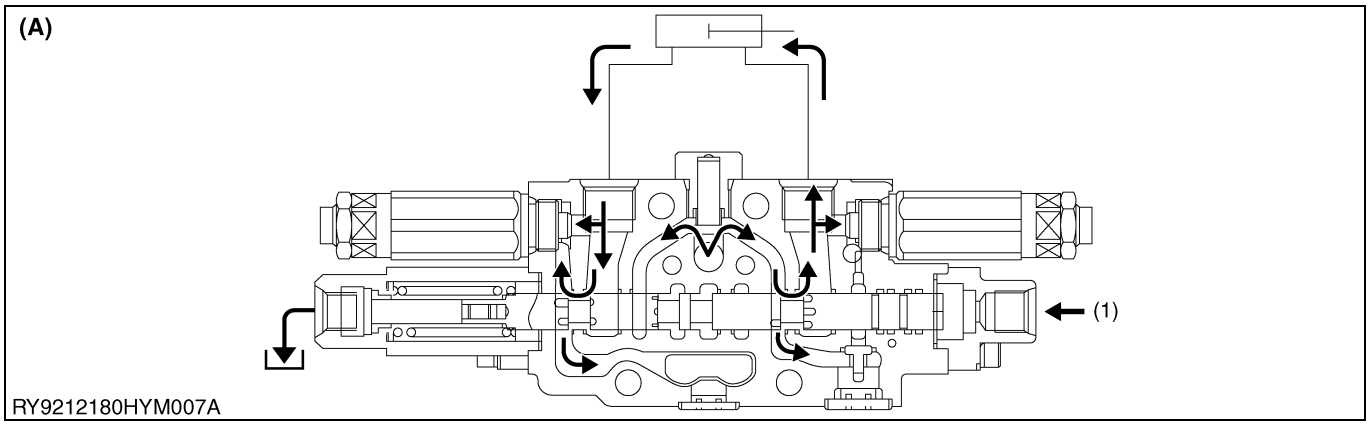
- The travel straight forward signal line is connected with the tank circuit by the left/right travel switch when it is in neutral, and the main spool of the Confluence valve remains in the neutral position.
- By switching to travel left or right, the pilot lines becomes one and if an attachment on any other pump lines, P1 or P2, is switched, the pilot line is cut off from the tank circuit, raising the pressure in the circuit and switching the main spool of the Confluence valve.
- When the main spool of the Confluence valve is completely switched, the oil supplied from P3 passes through the check valve inside the Confluence valve and flows into the P1, P2 parallel circuit. By doing so, oil is supplied from P1 and P2 to travel right/left and from P3 to the switched section.

RY9212180HYM0020US0

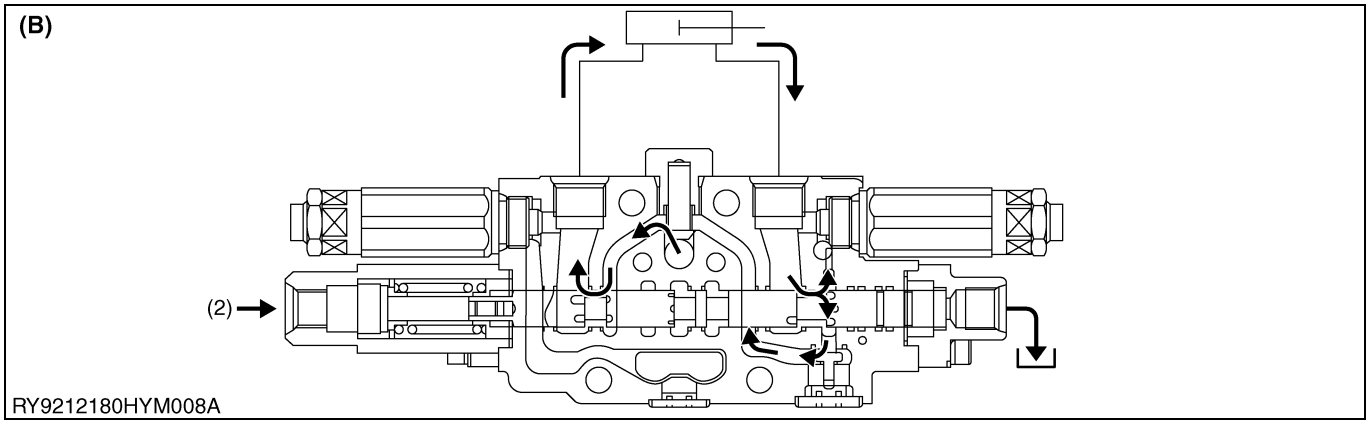
(5) Arm Regeneration Circuit



RY9212180HYM005D



RY9212180HYM007A



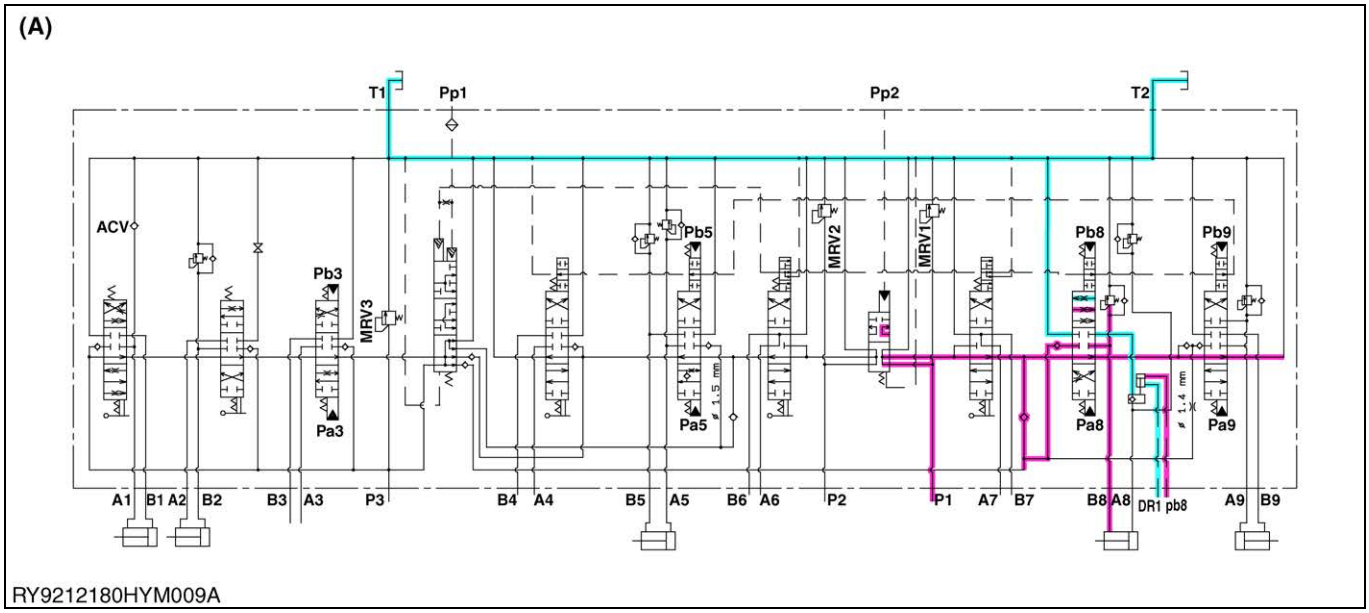
RY9212180HYM008A

(1) Arm extension (pilot secondary pressure)
(2) Arm rake (pilot secondary pressure)
(A) Arm extension operation
(B) Arm rake operation

- When oil flows through the hydraulic pilot passage shown at left above, the spool shifts rightward and the neutral passage gets closed. The pressure oil goes through the parallel feeder, pushes up the load check valve and flow on to the cylinder bottom.
- Part of return oil from the cylinder bottom flows through the spool throttle first and then through the low-pressure passage, returning to the tank. The remaining oil pushes the check valve open and reached the cylinder bottom.

RY9212180HYM0041US0

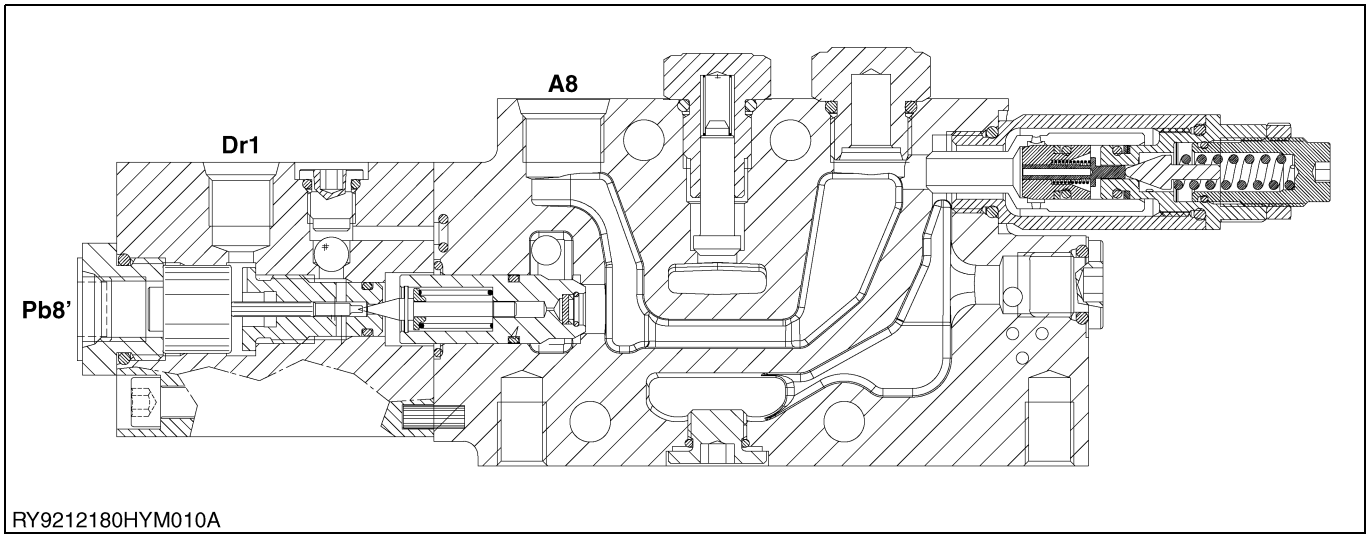
(6) Boom anti-drop check (boom load holding valve)



RY9212180HYM009A

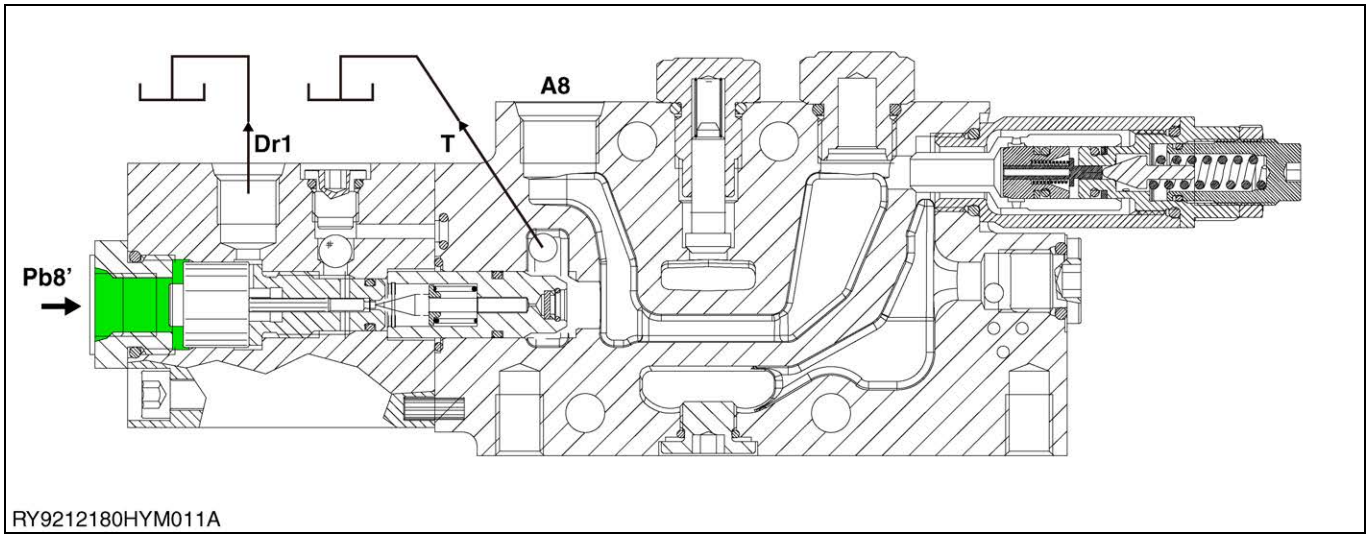
(A) Lower boom operation

Step 1 (Control lever in neutral)



RY9212180HYM010A

Step 2 (Control lever lower boom)



RY9212180HYM011A

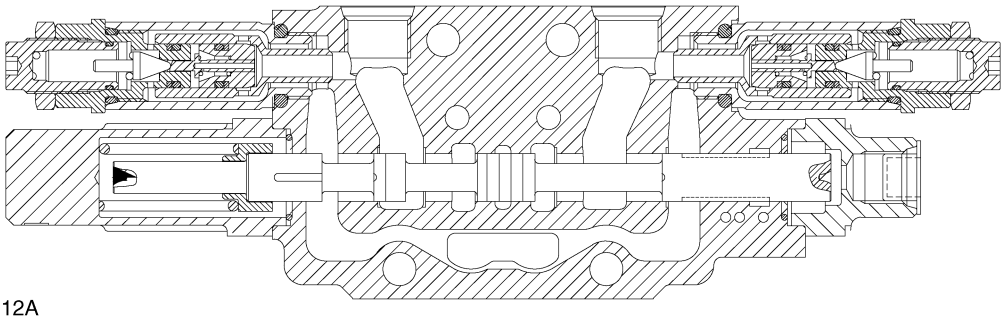
RY9212180HYM0042US0

[4] FUNCTION AND STRUCTURE

(1) Cross-section of Each Section

[A] P1 Line

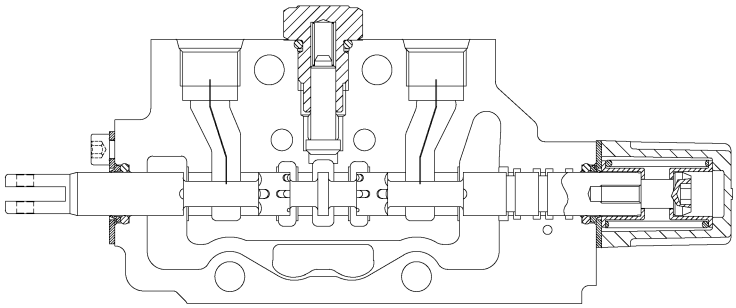
Inlet Section



RY9212180HYM012A

RY9212180HYM0007US0

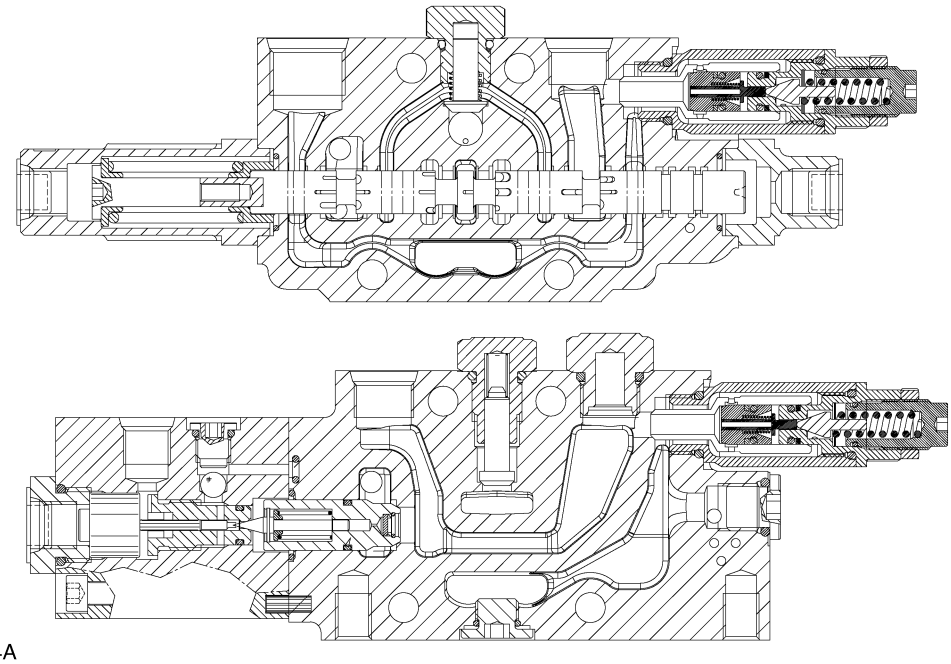
Travel Right Section



RY9212180HYM013A

RY9212180HYM0008US0

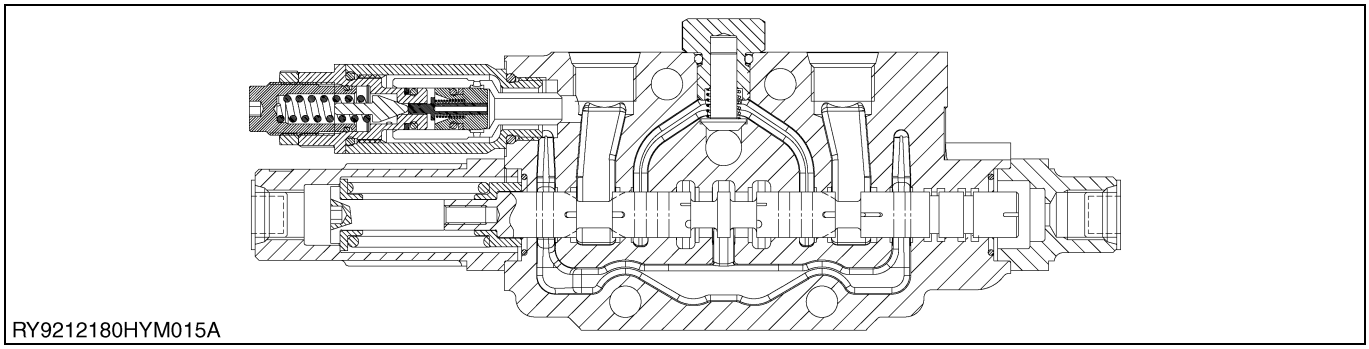
Boom Section



RY9212180HYM014A

RY9212180HYM0009US0

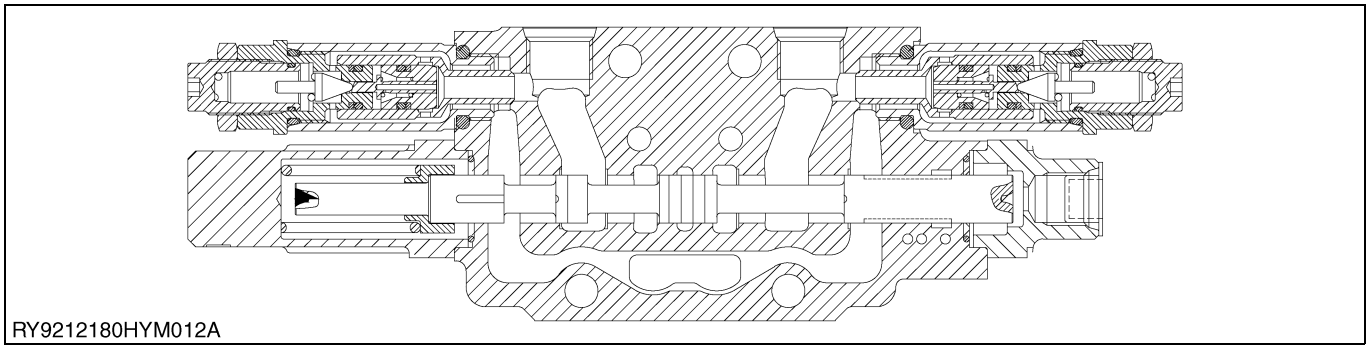
Bucket Section



RY9212180HYM0010US0

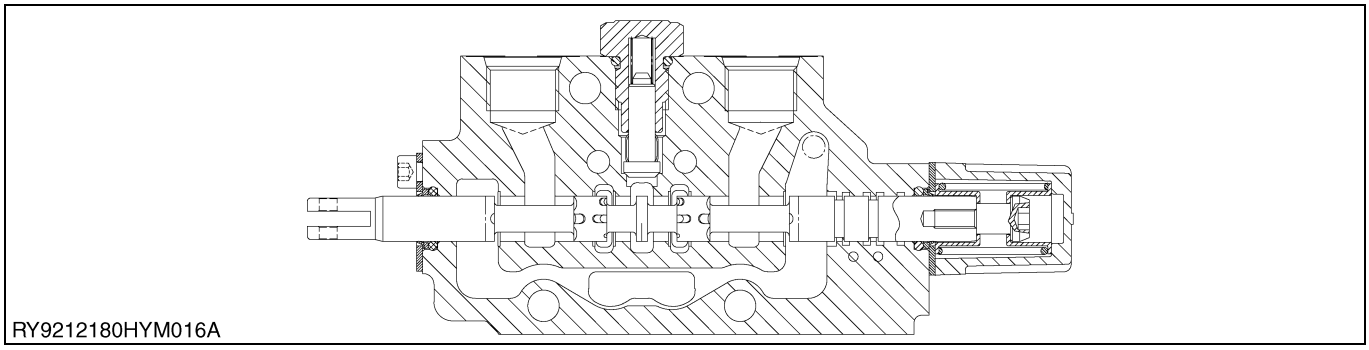
[B] P2 Line

Inlet Section



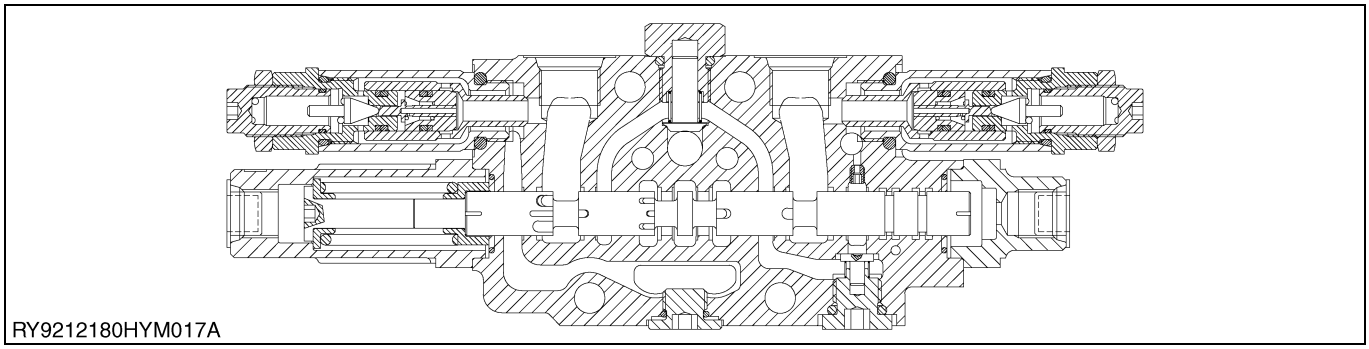
RY9212180HYM0007US0

Travel Left Section



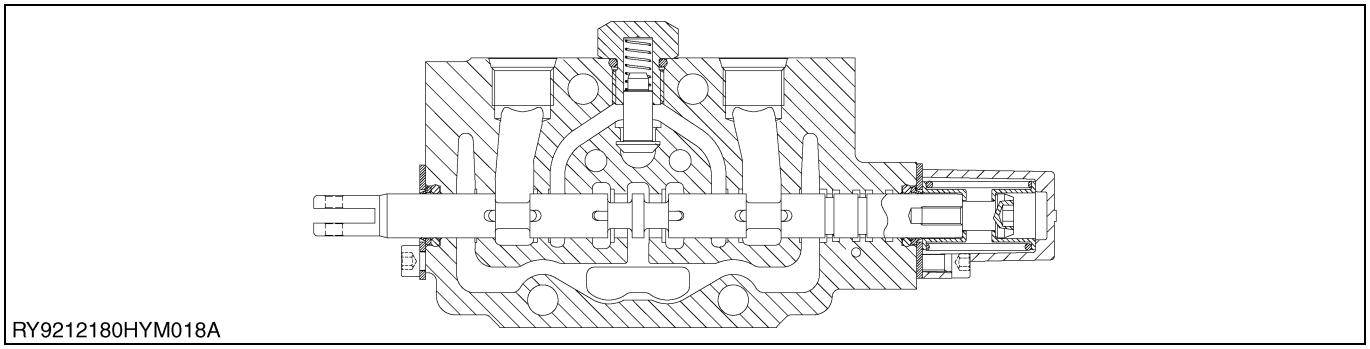
RY9212180HYM0012US0

Arm Section



RY9212180HYM0013US0

AUX Section

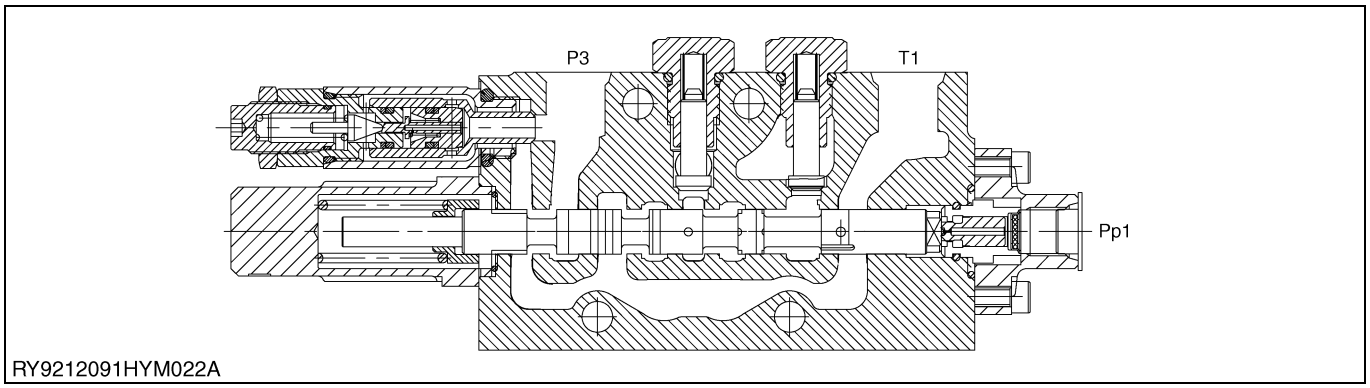

RY9212180HYM018A

RY9212180HYM0014US0

[C] P3 Line

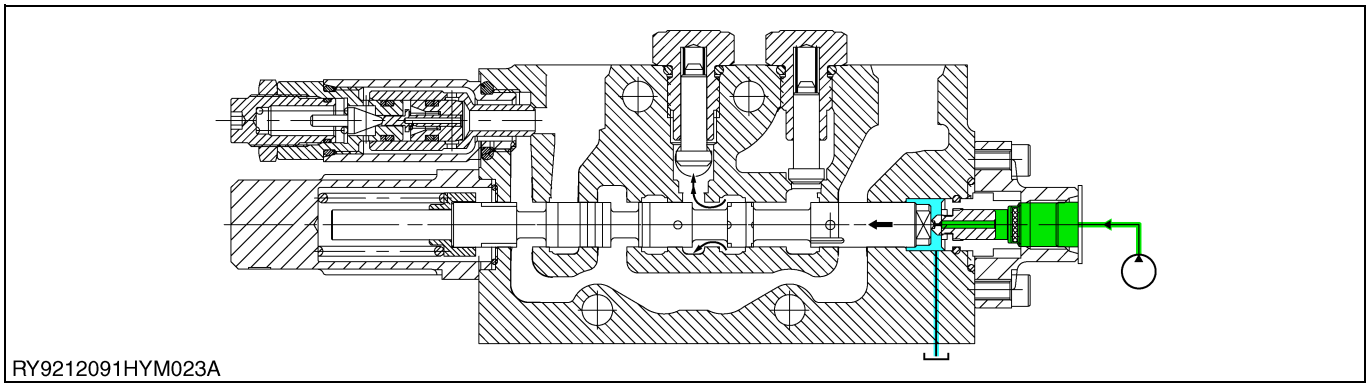
Confluence Valve Section

Step 1 (Raises Unload Lever)

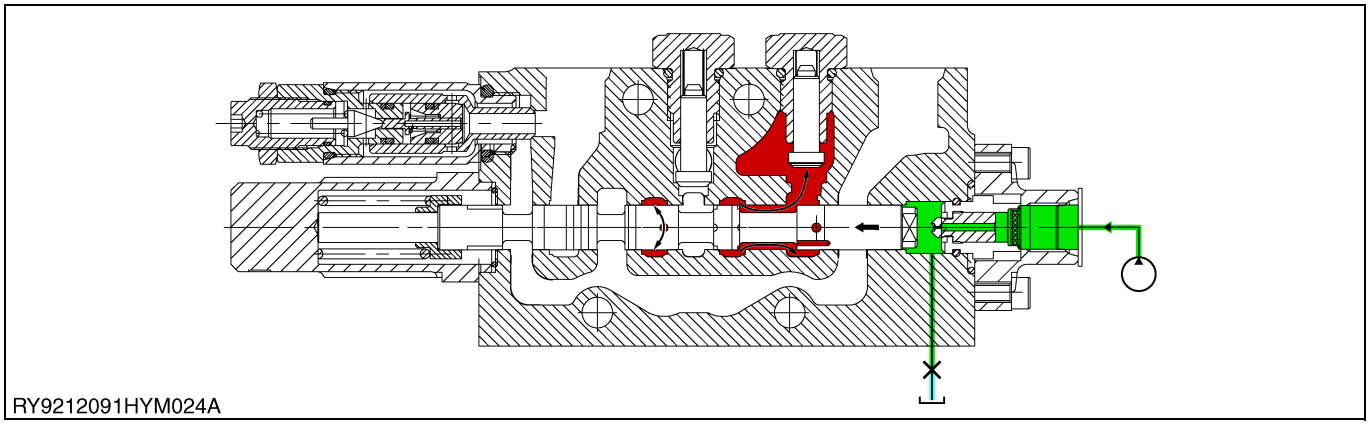


RY9212091HYM022A

Step 2 (Lowers Unload Lever)

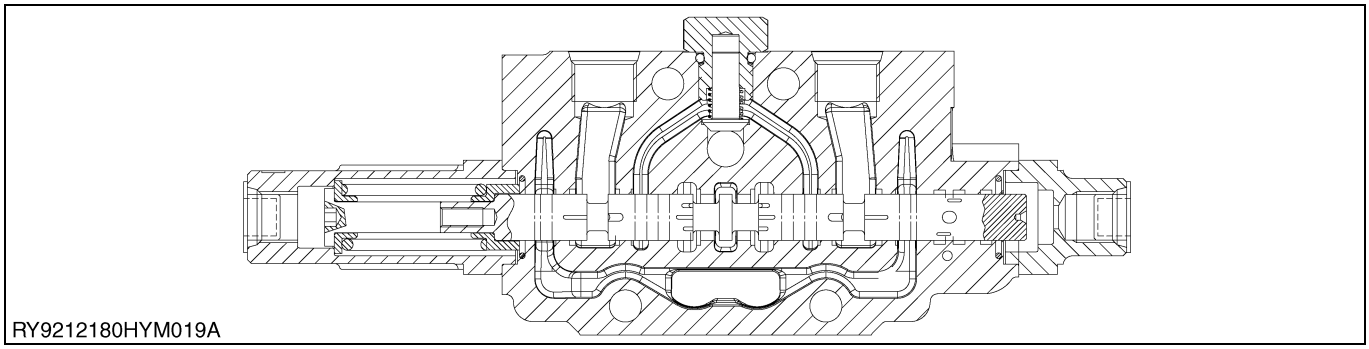

RY9212091HYM023A

Step 3 (Travel + Front Operation)


RY9212091HYM024A

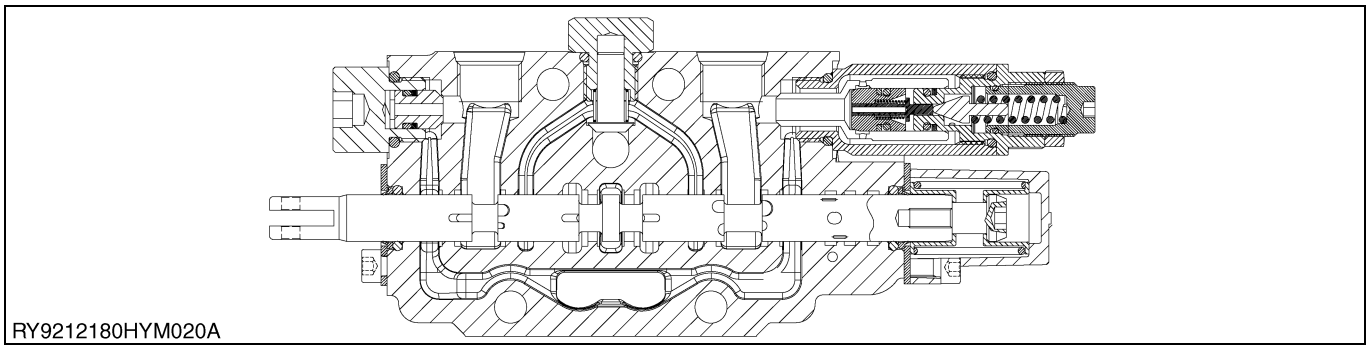
RY9212091HYM0030US0

Swivel Section



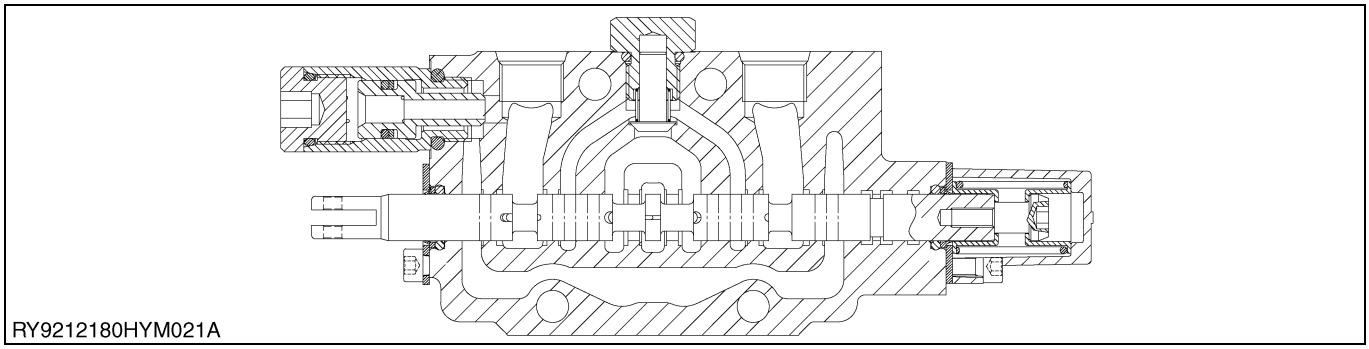
RY9212180HYM0016US0

Blade Section



RY9212180HYM0017US0

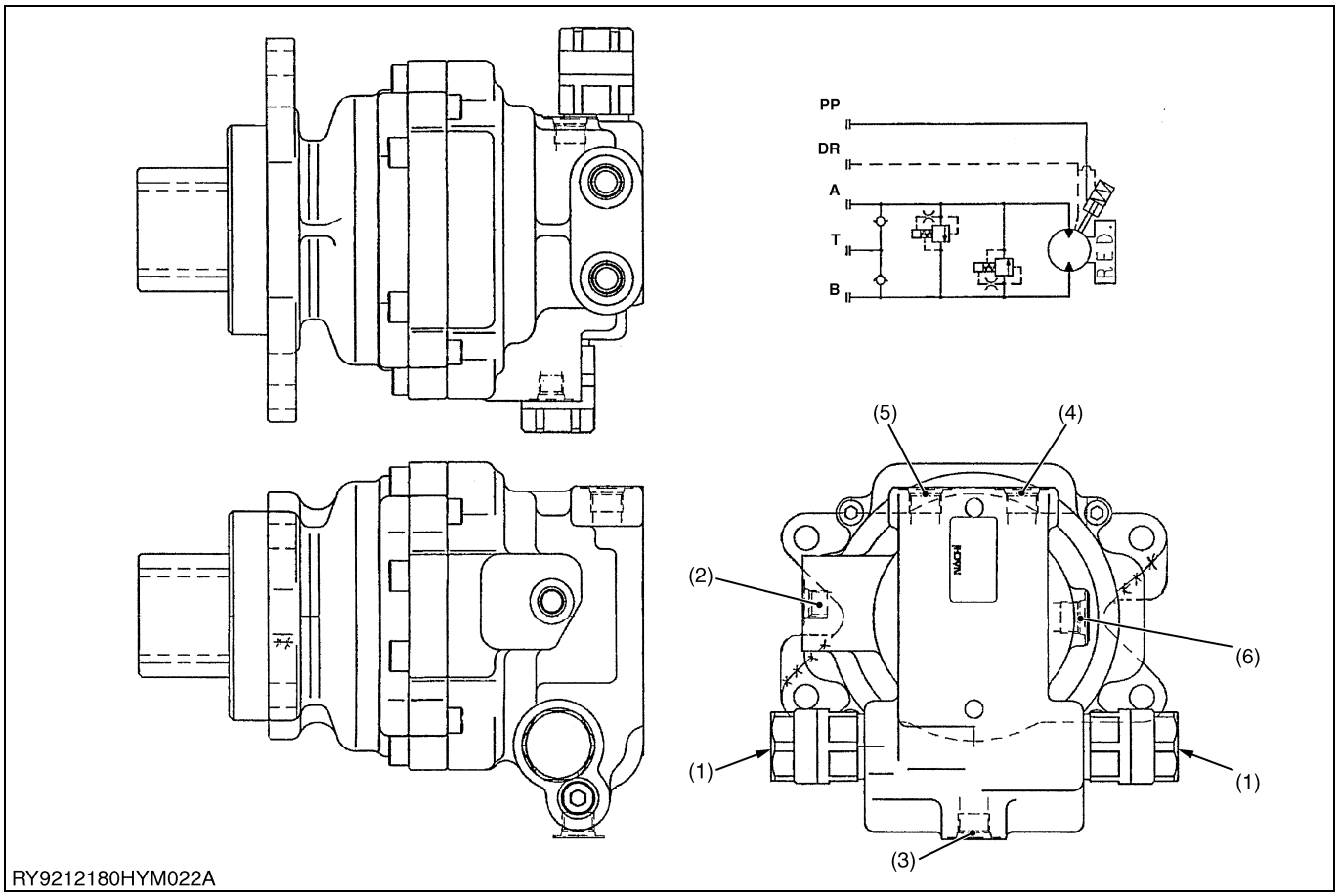
Swing Section



RY9212180HYM0018US0

6. SWIVEL MOTOR

[1] SPECIFICATIONS

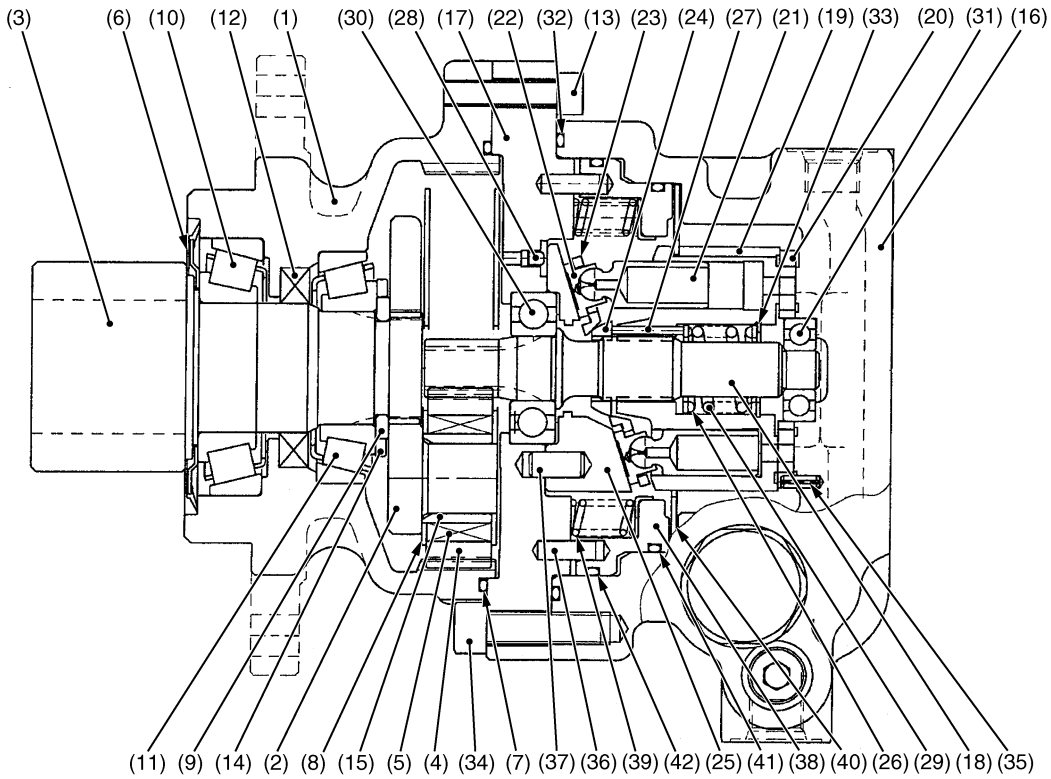


(1) Relief valve
(2) Pilot port (parking brake)
(3) Make-up port
(4) Port B
(5) Port A
(6) Drain port

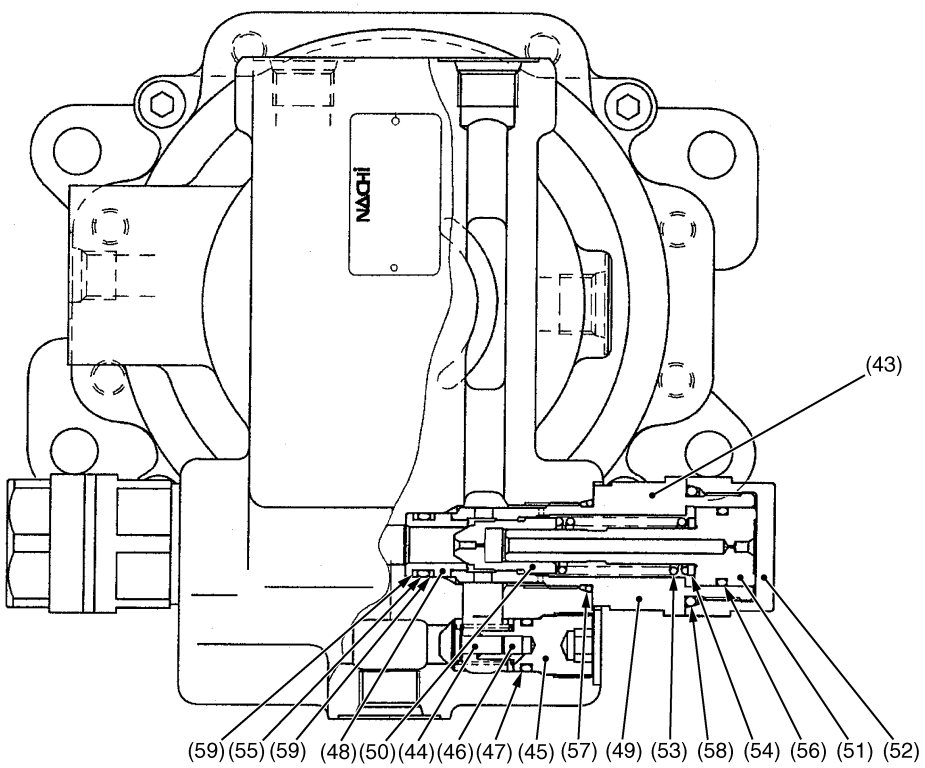
Item	
Maker	Fujikoshi (Ltd.)
Model	PCR-1B-05A-P-8290A
Motor capacity	22.1 cc/rev (1.35 cu.in./rev)
Reduction ratio	10
Total displacement	22.1 cc/rev (1.35 cu.in./rev)
Max Flow	18.4 L/min. (1120 cu.in./min, 4.86 U.S.GPM)
Theoretical RPM	81 rpm
Theoretical ouptut torque	530 N·m (54.0 kgf·m, 391 lbf·ft)
Relief valve brake pressure	17.7 MPa (180 kgf/cm^2, 2570 psi)
Mechanical brake torque	68.4 N·m (7.0 kgf·m, 50.4 lbf·ft) or above
Parking brake release pressure	4.9 MPa (50 kgf/cm^2, 710 psi) or lower

RY9212180HYM0022US0

[2] COMPONENTS



RY9212180HYM023A



RY9212180HYM024A

(To be continued)

(Continued)

(a) Reduction gear

No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(1)	Body	1		(9)	Pre-load collar	2	
(2)	Carrier 1	1		(10)	Bearing	1	
(3)	Piston shaft	1		(11)	Bearing	1	
(4)	B1 gear	3		(12)	Oil seal	1	
(5)	Needle	54		(13)	Screw	4	JIS B1176 M8 x 35
(6)	Ring seal	1		(14)	Ring	1	
(7)	O-ring	1	JIS B2401 Class 1B	(15)	Ring	3	
(8)	Thrust plate	2					

(b) Hydraulic motor

No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(16)	Body H	1		(32)	O-ring	1	JIS B2401 Class 1B G140
(17)	Plate S	1		(33)	Snap ring	1	JIS B2804 ??28
(18)	Shaft	1		(34)	Screw	8	JIS B1176 M10 x 35
(19)	Cylinder barrel	1		(35)	Snap pin	1	JIS B2808 5 x 12 AW
(20)	Valve plate	1		(36)	Pin	3	
(21)	Piston	9		(37)	Pin	1	JIS B1354 B 8 x 15
(22)	Shoe	9		(38)	Break piston	1	
(23)	Shoe holder	1		(39)	Spring assy	1	
(24)	Barrel holder	1		(40)	Disk plate	1	
(25)	Swash plate	1		(41)	O-ring	1	JIS B2401 Class 1B G110
(26)	Retainer	2		(42)	O-ring	1	JIS B2401 Class 1B G125
(27)	Pin	3		(43)	Relief valve	2	
(28)	Filter	2		(44)	Check valve	2	
(29)	Spring C	1		(45)	Plug	2	
(30)	Bearing	1	JIS B1521 6204Z	(46)	Spring	2	
(31)	Bearing	1	JIS B1521 6201	(47)	O-ring	2	JIS B2401 Class 1B P11

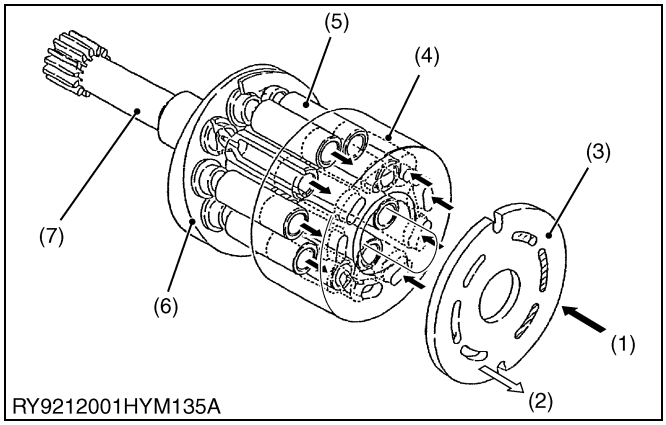
(c) Relief valve assy

No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(48)	Seat	1		(54)	Spacer	1	
(49)	Retainer	1		(55)	O-ring	1	JIS B2401 Class 1B P14
(50)	Popet	1		(56)	O-ring	1	JIS B2401 Class 1B P18
(51)	Piston	1		(57)	O-ring	1	JIS B2401 Class 1B P22
(52)	Cap	1		(58)	O-ring	1	JIS B2401 Class 1B P28
(53)	Spring	1		(59)	Back up ring	2	JIS B2407 T P14

RY9212180HYM0021US0

[3] FUNCTION AND STRUCTURE

(1) Operating Principles



RY9212001HYM135A

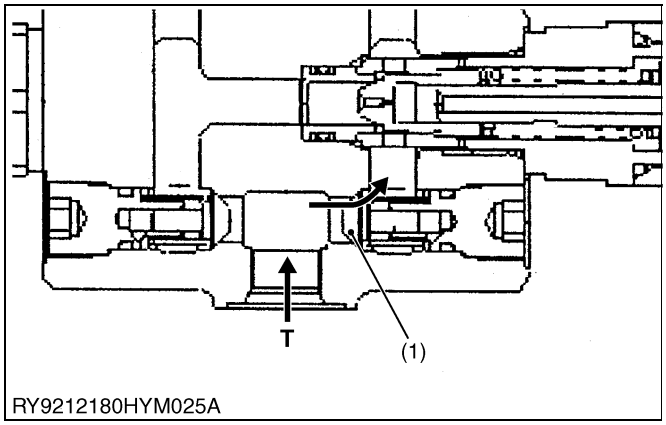
The pressurized oil from port A goes through valve plate, enters the piston inside the cylinder block and presses against the swash-plate. The pistons receive the counterforce from the swash-plate, part of which becomes rotational force and the block rotates due to the sum total of the rotational forces exerted by the pistons which the hydraulic oil entered. The cylinder block and the shaft are linked via a spline, so the rotation is transmitted to the shaft.

When operating in reverse, hydraulic oil flows in via port B and is discharged via port A.

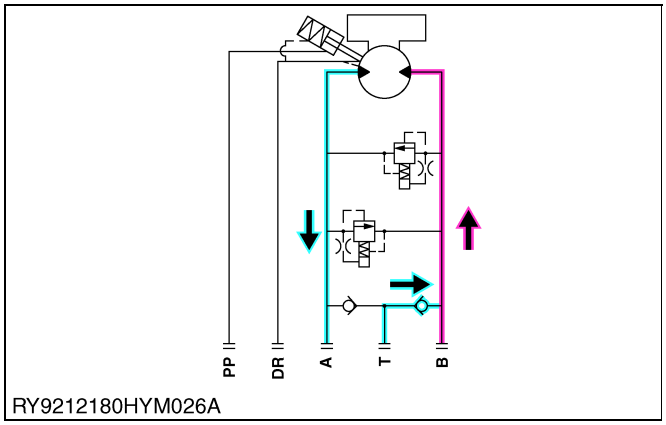
(1) Port A
(2) Port B
(3) Valve plate
(4) Cylinder block
(5) Piston
(6) Swash-plate
(7) Shaft

RY9212004HYM0009US0

(2) Make Up Circuit



RY9212180HYM025A



RY9212180HYM026A

If the swivel is decelerated with the pressurized oil supplied via port B, the motor rotates due to the inertia of the swiveling equipment, and the motor drives the pump. As a result, the load shifts to the port B side.

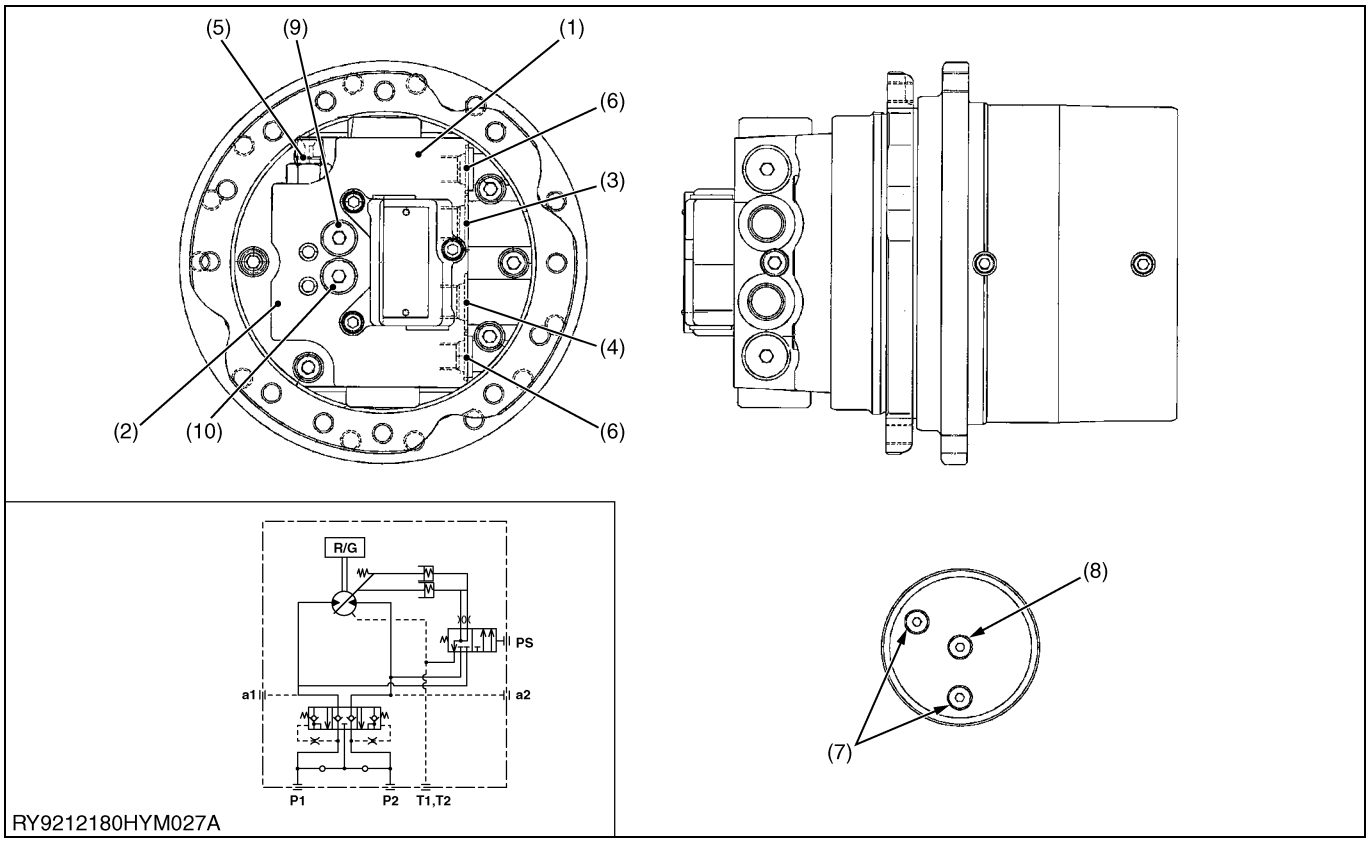
In order to prevent this, the oil on the cylinder side passes through the poppet in the make up circuit and is supplied to the port B side.

(1) Poppet

RY9212180HYM0023US0

7. TRAVEL MOTOR

[1] SPECIFICATIONS (STD)

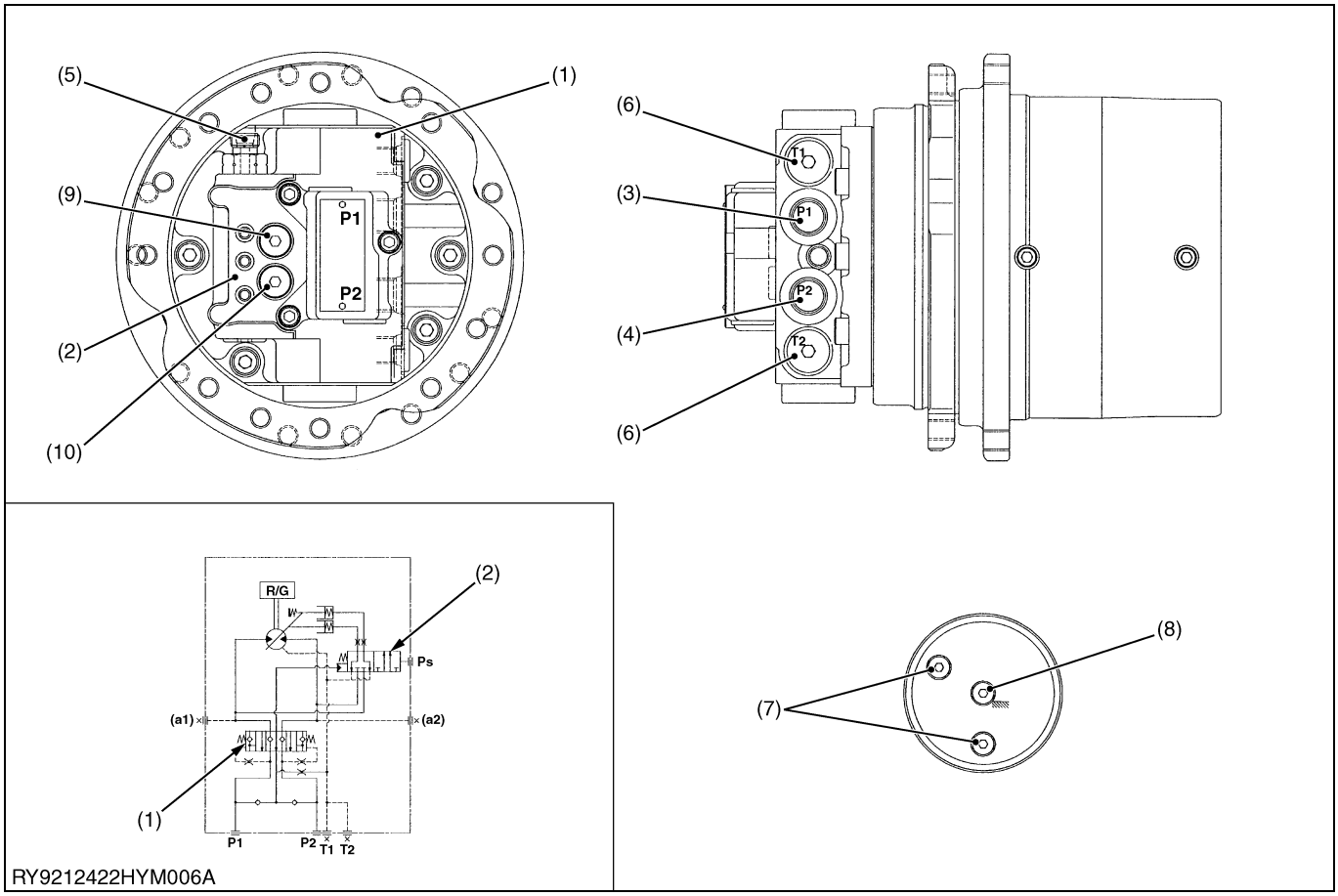


(1) Counterbalance Valve
(2) Travel 2-Speed
(3) A Port (G3/8)
(4) B Port (G3/8)
(5) PP Port (G1/8) (2-speed travel switch)
(6) Drain Port (G1/4)
(7) Lubricating Oil Fill/Drain Ports (PF1/4)
(8) Lubricating Oil Inspection Port (PF1/4)
(9) Pressure Test Port a1 (PF1/8)
(10) Pressure Test Port a2 (PF1/8)

Item		Notes
Maker	KYB	
Model	MAG-18V-230E1	
Motor displacement 1-speed/2-speed	18.0 / 10.0 cc/rev 1.1 / 0.6 cu.in./rev	
Reduction Ratio	1 : 42.958	
Max Pressure	21.6 MPa 220 kgf/cm^2 3130 psi	
Max Flow	27.6 L/min 1680 cu.in./min 7.29 USGPM	
Max Output Torque (Decelerator)	2656 N·m 270.8 kgf·m 1959 lbf·ft	
Max Output RPM 1-speed/2-speed (Decelerator)	35.6 / 64.2 rpm	
2-speed control pilot pressure (PP)	0.59 MPa 6 kgf/cm^2 86 psi	

RY9212180HYM0024US0

[2] SPECIFICATIONS (HI SPEC)



RY9212422HYM006A

(1) Counterbalance Valve
(2) Travel 2-Speed
(3) P1 Port (G3/8)
(4) P2 Port (G3/8)
(5) Ps Port (G1/8) (2-Speed Travel Switch)
(6) Drain Port (G1/4)
(7) Lubricating Oil Fill/Drain Ports (PF1/4)
(8) Lubricating Oil Inspection Port (PF1/4)
(9) Pressure Test Port a1 (PF1/8)
(10) Pressure Test Port a2 (PF1/8)

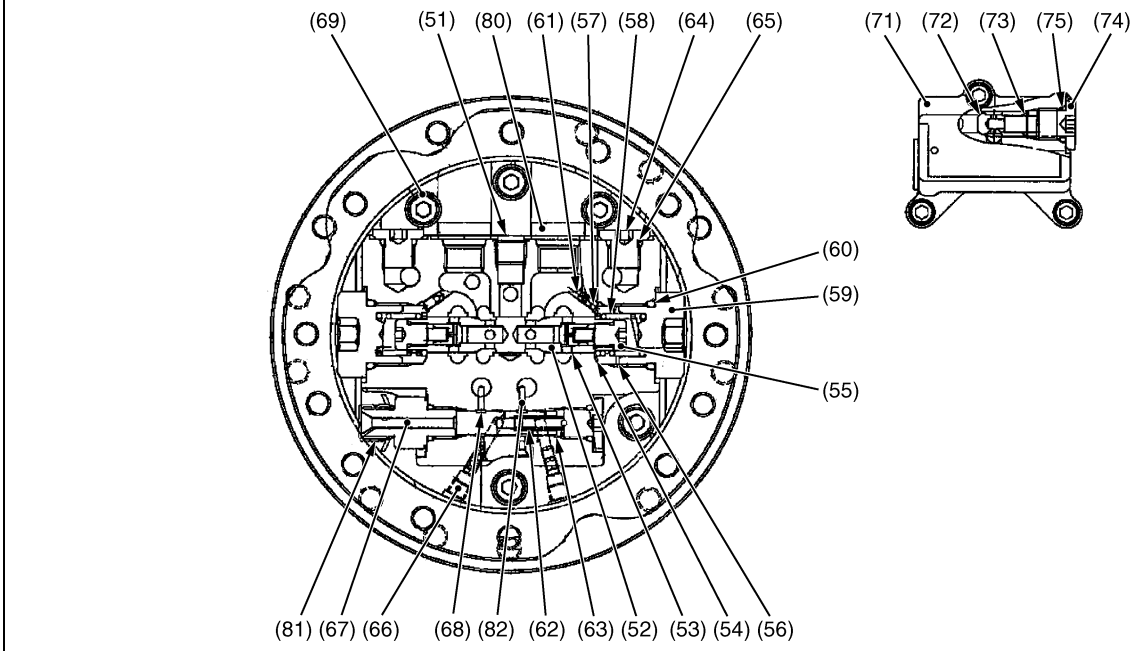
Item		Notes
Maker	KYB	
Model	MAG-18V-230F-4	
Motor displacement 1-speed/2-speed	18.0 / 10.0 cc/rev 1.1 / 0.6 cu.in./rev	
Reduction Ratio	1 : 42.958	
Max Pressure	22.5 MPa 229 kgf/cm^2 3260 psi	
Max Flow	31.5 L/min 1922.2 cu.in./min 8.3 gal (US)/min	
Max Output Torque (Decelerator)	2769 N·m 282.4 kgf·m 2042 lbf·ft	At 22.5 MPa
Max Output RPM 1-speed/2-speed (Decelerator)	40.7 / 73.2 rpm	At 31.5 L/min
2-speed control pilot pressure (PP)	3.9 MPa 40 kgf/cm^2 570 psi	

RY9212422HYM0009US0

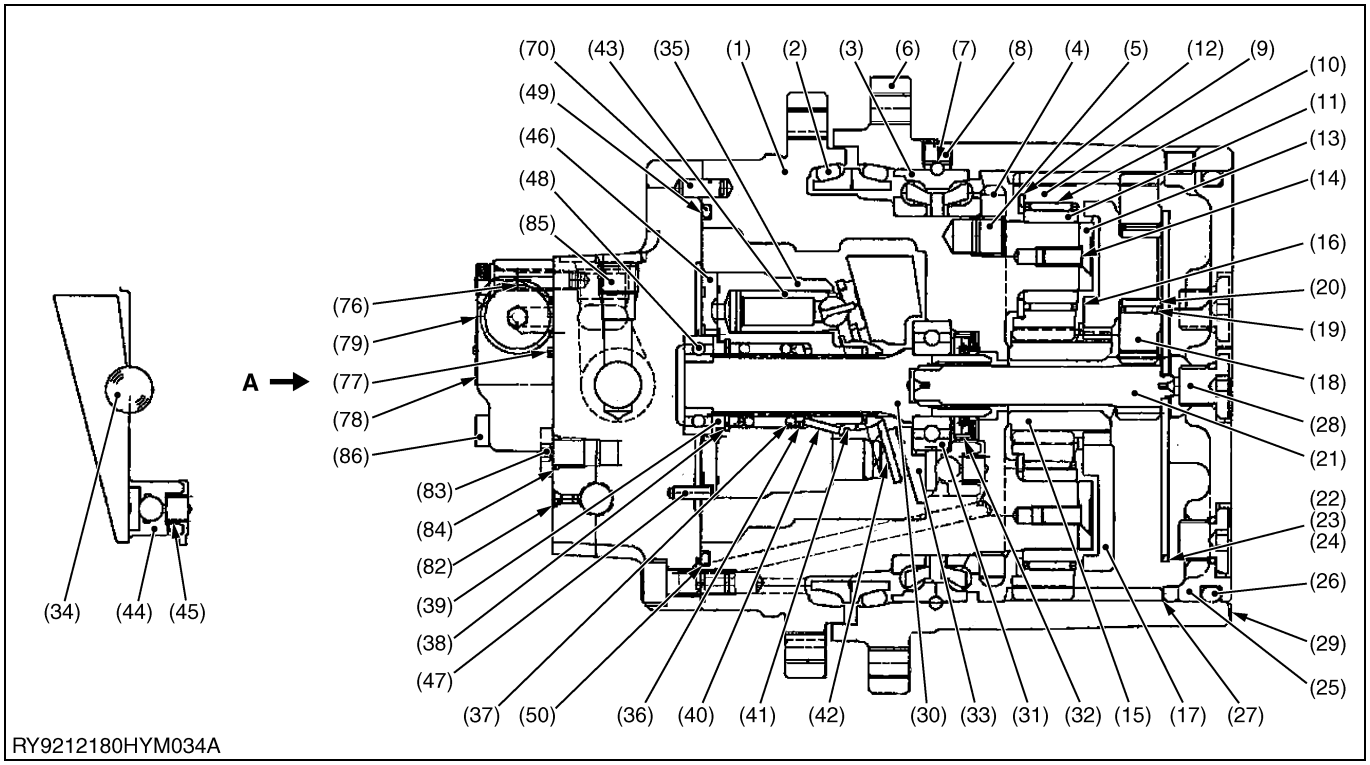
[3] COMPONENTS

STD

A



RY9212180HYM028A



RY9212180HYM034A

(To be continued)

(Continued)

	No.	Part Name	Q'ty	No.	Part Name	Q'ty
Reduction gear	(1)	Flange holder	1	(27)	Wire	1
	(2)	Floating Seal	2	(28)	Plug	2
	(3)	Angular bearing	1	(29)	O-ring	2
	(4)	Ring nut	1	(30)	Shaft	1
	(5)	Plug	2	(31)	Ball bearing	1
	(6)	Housing	1	(32)	Oil seal	1
	(7)	Steel ball	109	(33)	Swash plate	1
	(8)	Hex socket bolt	2	(34)	Steel ball	2
	(9)	Planetary gear B	4	(35)	Cylinder block	1
	(10)	Needle bearing	4	(36)	Spring seat	1
	(11)	Inner race	4	(37)	Spring	1
	(12)	Thrust washer	4	(38)	Washer	1
	(13)	Thrust plate	1	(39)	Snap ring	1
	(14)	Screw	4	(40)	pin	3
	(15)	Sun gear	1	(41)	Retainer holder	1
	(16)	Snap ring	1	(42)	Retainer plate	1
	(17)	Holder	1	(43)	Piston ASSY	9
	(18)	Planetary gear A	3	(44)	Piston ASSY	2
	(19)	Needle bearing	3	(45)	Spring	2
	(20)	Inner race	3	(46)	Valve plate	1
	(21)	Drive gear	1	(47)	Pin	1
	(22)	Thrust plate 1.8 t	1	(48)	Ball bearing	1
	(23)	Thrust plate 2.3 t	1	(49)	O-ring	1
	(24)	Thrust plate 2.8 t	1	(50)	O-ring	3
	(25)	Cover	1	(51)	Base plate	1
	(26)	O-ring	1			

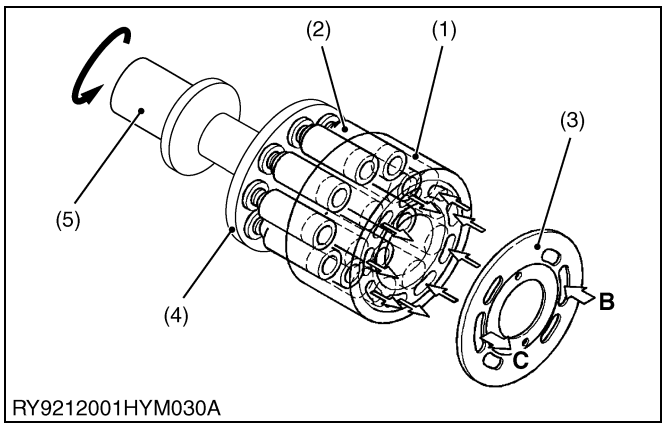
	No.	Part Name	Q'ty	No.	Part Name	Q'ty
Spool ASSY	(52)	Spool	1	(62)	Spool	1
	(53)	Check valve	2	(63)	Spring	1
	(54)	Spring	2	(64)	Plug	3
	(55)	Plug	2	(65)	O-ring	4
	(56)	O-ring	2	(66)	Plug	2
	(57)	Spring seat	2	(67)	Plug	1
	(58)	Spring	2	(68)	Orifice	4
	(59)	Cap	2	(69)	Socket head bolt	6
	(60)	O-ring	2	(70)	Pin	2
	(61)	Orifice	2			

	No.	Part Name	Q'ty	No.	Part Name	Q'ty
Valve ASSY	(71)	Valve body	1	(79)	Drive screw	2
	(72)	Check valve	2	(80)	Shipping plug	2
	(73)	Spring	2	(81)	Shipping plug	1
	(74)	Plug	2	(82)	Plug	2
	(75)	O-ring	2	(83)	Plug	2
	(76)	O-ring	2	(84)	O-ring	2
	(77)	O-ring	1	(85)	Plug	1
	(78)	Name plate	1	(86)	Socket head bolt	3

RY9212180HYM0045US0

[4] FUNCTION AND STRUCTURE

(1) Operating Principles



RY9212001HYM030A

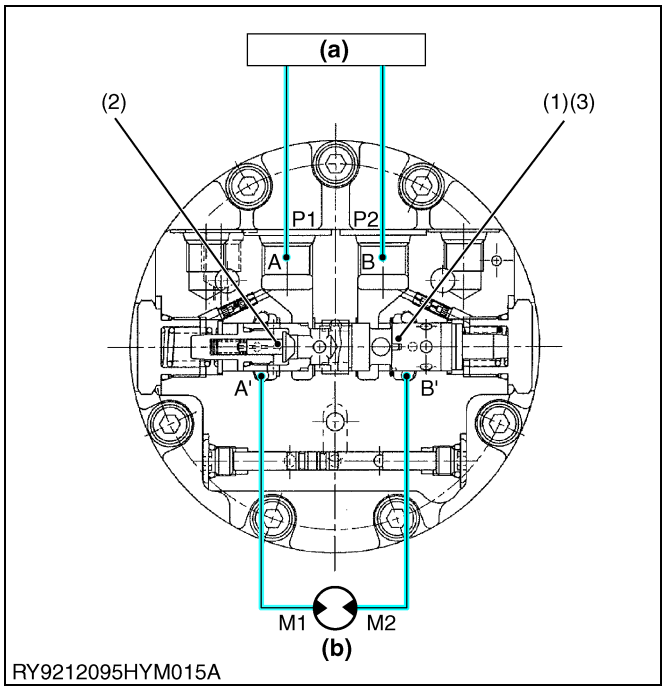
- Nine pistons are built into the cylinder block, and the end section of the block is in contact with a valve plate, which has two half-moon shaped ports (port **B** and port **C** for switching between high and low pressure).
- If high-pressure oil is guided to port **B**, the pressurized oil passes through port **B** and presses on the swash-plate.
- 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 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

B : Port B
C : Port C

RY9212001HYM0002US0

(2) Counterbalance



RY9212095HYM015A

When in neutral

Role of the counter-balance valve

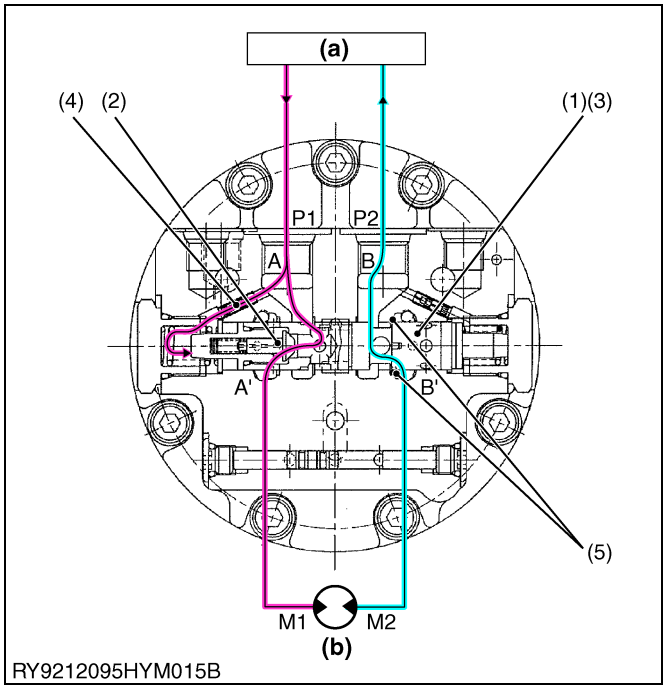
1. Stops the motor **(b)**
2. Prevents overrun

When control valve **(a)** is in neutral, no pressure is generated at either port P1 or P2, so ports M1 and M2 are blocked by plunger (1), check valve L (2) and check valve R (3), so the motor does not rotate.

(1) Plunger
(2) Check Valve L
(3) Check Valve R

(a) Control Valve
(b) Motor

RY9212095HYM0022US0



RY9212095HYM015B

If pressurized oil flows to P1

The pressurized oil that passed through P1 flows through check valve L (2) to the motor **(b)** via the M1 port, thus turning the motor.

The oil returning from the motor flows to the counter-balance valve from port M2, but it is blocked by the check valve R (3), so the pump discharge pressure rises. Pressurized oil passes through orifice L (4) and acts on the left side of plunger (1), moving the plunger to the right.

Oil returning from port M2 passes through the plunger notch (5) and while generating back pressure on port M2, returns to the tank via port P2 and the control valve **(a)**.

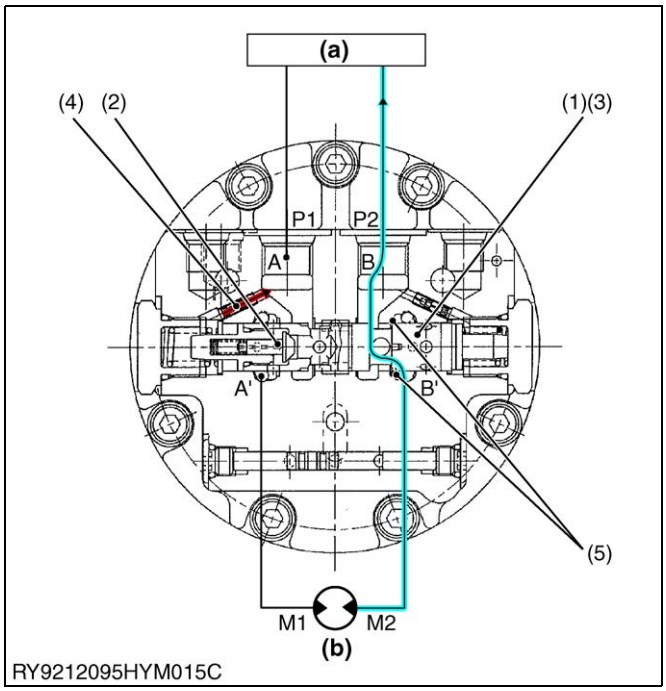
As the pump's discharge pressure rises further, the plunger moves further to the right, enlarging the opening of the orifice at the plunger notch, thus reducing the back pressure

In this way the degree of opening of the plunger notch orifice automatically adjusts the return passage area so that the motor rotates at a speed that matches the pressure on the port P1 side.

(1) Plunger
(2) Check Valve L
(3) Check Valve R
(4) Orifice L
(5) Plunger Notch Section

(a) Control Valve
(b) Motor

RY9212095HYM0023US0



RY9212095HYM015C

Brake operation

When the control valve **(a)** returns to neutral, it cuts off the supply of pressurized oil from the pump, and the pressures at ports P1 and P2 equalize, so spring R (3) works to return the plunger (1) to its neutral position. (moves to the left)

When the plunger moves to the left, the size of the orifice in the plunger notch (5) becomes smaller. Also, the motor **(b)** tries to turn due to inertia, which causes the pressure on the port M2 side to rise. When the plunger moves to the left, the oil in the left pressure chamber (2) escapes to the port P1side, but due to the constricting effect of orifice L (4), the speed with which the plunger moves to the left is limited.

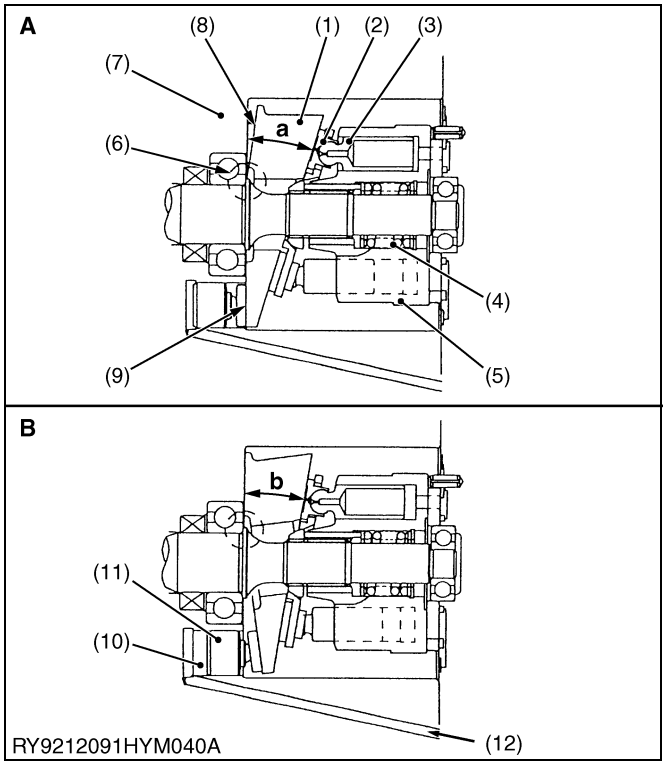
By controlling the speed of the plunger, the motor is stopped without generating cavitation while also absorbing the shock pressure from the inertia of the motor.

(1) Plunger
(2) Left Pressure Chamber
(3) Spring R
(4) Orifice L
(5) Plunger Notch Section

(a) Control Valve
(b) Motor

RY9212095HYM0024US0

(3) 2-Speed Function

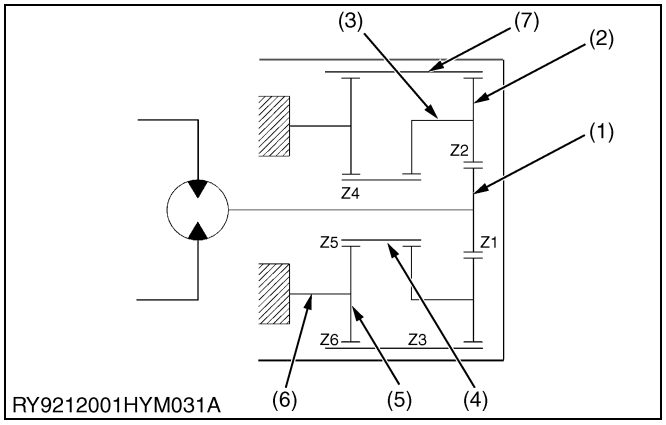


- The swash-plate has two surfaces, I and II, opposite the sliding surfaces of the shoes, and these are supported by the two balls mounted in the body 2.
- The balls are in an an eccentric position above the center of rotation, so when in 1st speed, surface I is pressed against body 2 by the force of the oil pressure that drives the piston and by the force of the spring inside the cylinder barrel; consequently the swash-plate angle is at **a** and is at high capacity.
- When it is switched to 2-speed, the operating pressure is guided into the control chamber via the 2-speed spool, and the control piston moves surface II of the swash-plate until it touches body 2 and holds the swash-plate at angle **b**. At such time the motor is at low capacity.
- When the engine stops, the control chamber is connected to the drain port via the 2-speed spool, so the force of the spring returns the swash-plate to its 1st speed state. Consequently, it is always in 1st at engine start.

(1) swash-plate
(2) Shoe
(3) Piston
(4) Spring
(5) Cylinder Barrel
(6) Ball
(7) Body 2
(8) Surface II
(9) Surface I
(10) Control Chamber
(11) Control Piston
(12) Operating Pressure
A : In 1st
B : In 2nd

RY9212091HYM0018US0

(4) Decelerator



- The drive gear meshes with the 1st stage planetary gear while the 2nd stage sun gear meshes with the 2nd stage planetary gear.
- The 2nd stage planetary carrier is fixed to the body of the decelerator.
- Planetary gears and mesh with ring gear (the housing).
- The drive force from the piston motor is transmitted to the drive gear, which is decelerated by each of the gears.
- The decelerated drive force is transmitted to the ring gears via the 2nd stage planetary gear of the 2nd stage planetary carrier, which is fixed to the final stage of the decelerator. (The drive force from the 1st stage planetary gear is also transmitted.)
- However, the input rotation is opposite the output rotation.

(1) Drive Gear
(2) 1st Stage Planetary Gear
(3) 1st Stage Planetary Carrier
(4) 2nd Stage Sun Gear
(5) 2nd Stage Planetary Gear
(6) 2nd Stage Planetary Carrier
(7) Ring Gear (Housing)

RY9212001HYM0003US0

(5) Auto Deceleration (Hi Spec)

When the travelling load of the travel motor increases excessively in 2nd speed, then the travel motor automatically decelerates the travel speed.

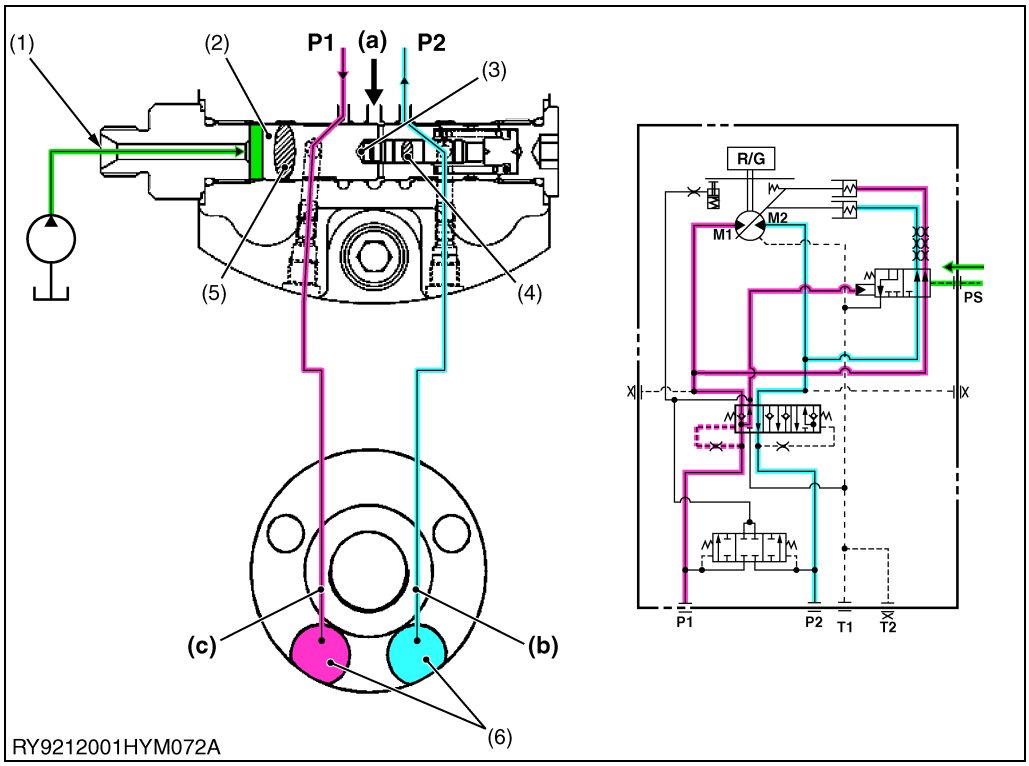
RY9212422HYM0010US0

Rapid speed

- Activate the 2nd speed by pushing the travel speed switch. The PS port in the travel motor is now pressurized from Pump P4.
- The PS port is pressurized and high pressure flows to the speed shift piston.
- The speed-shift piston pushes the swash plate, and the travel motor switches into 2nd speed.

RY9212422HYM0011US0

Low traveling-load



RY9212001HYM072A

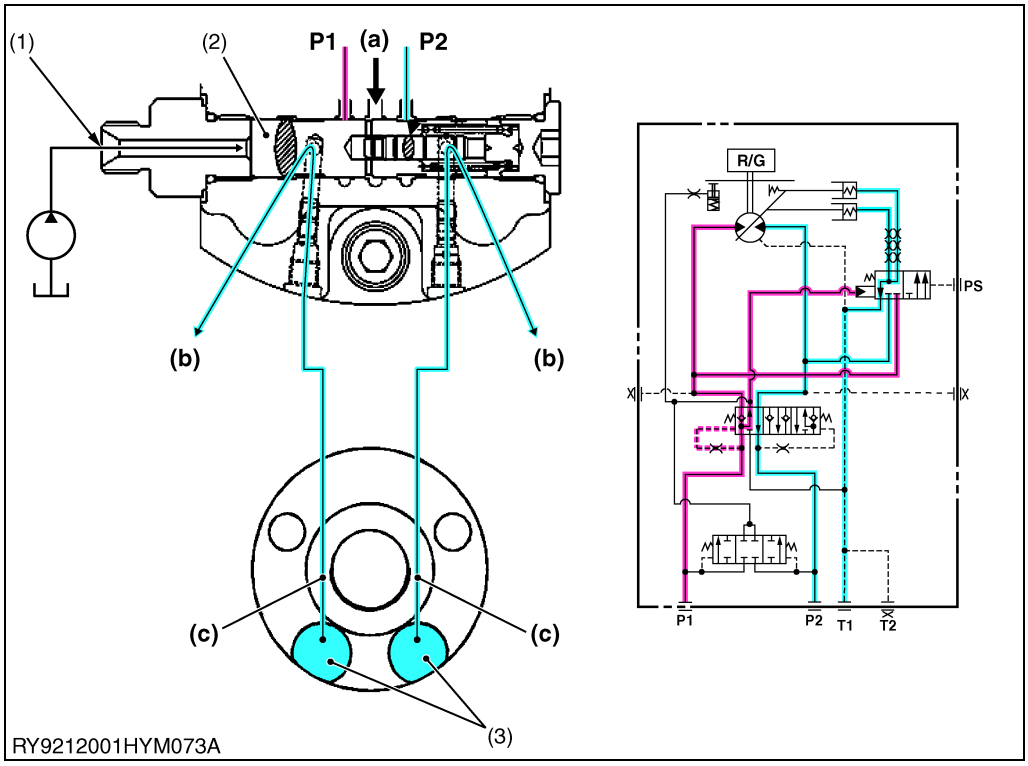
(1) PS Port
(2) Spool
(3) Motor-Load Pressure
(4) Motor-Load Pressure Chamber
(5) Motor-Load Pressure Area
(6) Speed Shift Piston

(a) Motor-Load Pressure
(b) Low Pressure (Secondary Pressure)
(c) High Pressure (Primary Pressure)

- 2nd speed valve is kept in 2nd speed position, because the pressure on PS port side is higher than on high pressure side due to different areas where the pressures are effective.

RY9212422HYM0012US0

High traveling-load



(1) PS Port
(2) Spool
(3) Speed Shift Piston

(a) Motor-Load Pressure
(b) Drain
(c) Low Pressure

- If the pressure in the high pressure line raises, the pressure on the 2nd speed valve, which is pressurized with high pressure, raises too.
- As soon as the high pressure side exceeds a certain value, the pressure in this control area is higher than in the PS port pressure area and the 2nd speed spool shifts into slow speed position.
- Oil in the speed-shift piston returns to oil tank.
- The swash plate in the travel motor tilts back into slow speed position and travel speed is reduced.

RY9212422HYM0013US0

8. HYDRAULIC CYLINDER

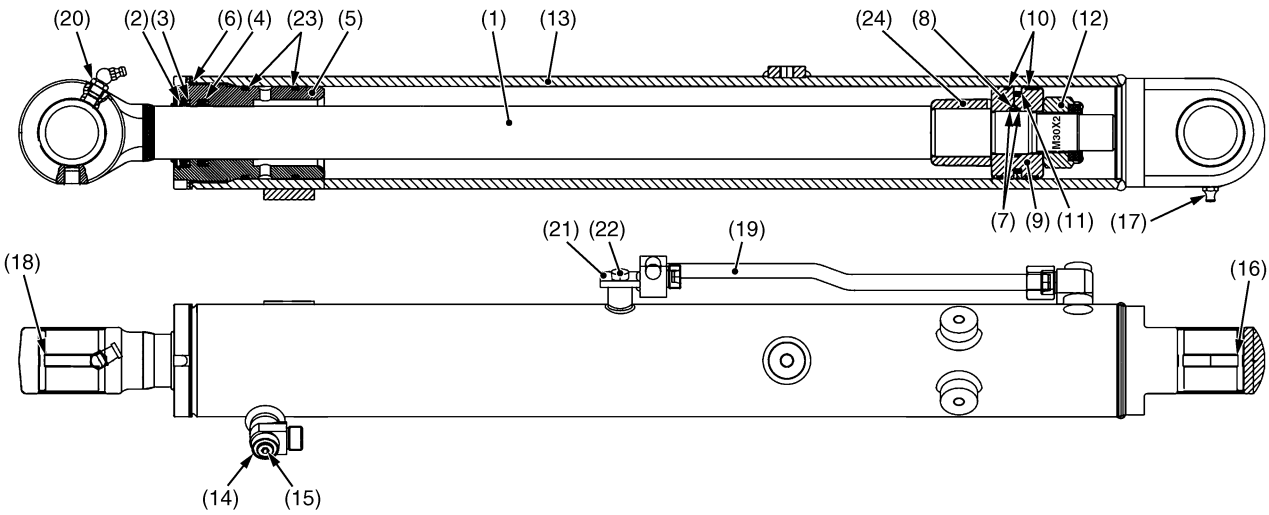
[1] BOOM CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ85 mm (3.5 in.)
Tube inner diameter	ϕ70 mm (2.8 in.)
Rod diameter	ϕ40 mm (1.6 in.)
Stroke	510 mm (20.1 in)
Max compressed length	860 mm (33.9 in)

RY9212180HYM0026US0

(2) Components



RY9212180HYM029A

No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(1)	Rod	1		(13)	Cylinder tube	1	
(2)	Elastic ring	1		(14)	O-ring	2	
(3)	Scraper	1		(15)	Metal plug	2	
(4)	Rod seal	1		(16)	Bearing bush	1	
(5)	End cap	1		(17)	Grease nipple	1	
(6)	O-ring	1		(18)	Bearing bush	1	
(7)	Back-up ring	1		(19)	Pipe	1	
(8)	O-ring	1		(20)	Grease nipple	1	
(9)	Piston	1		(21)	Washer	1	
(10)	Wear ring	2		(22)	Screw	1	
(11)	Piston seal	1		(23)	Dualseal	2	
(12)	Nut	1		(24)	Damping cone	1	

RY9212180HYM0027US0

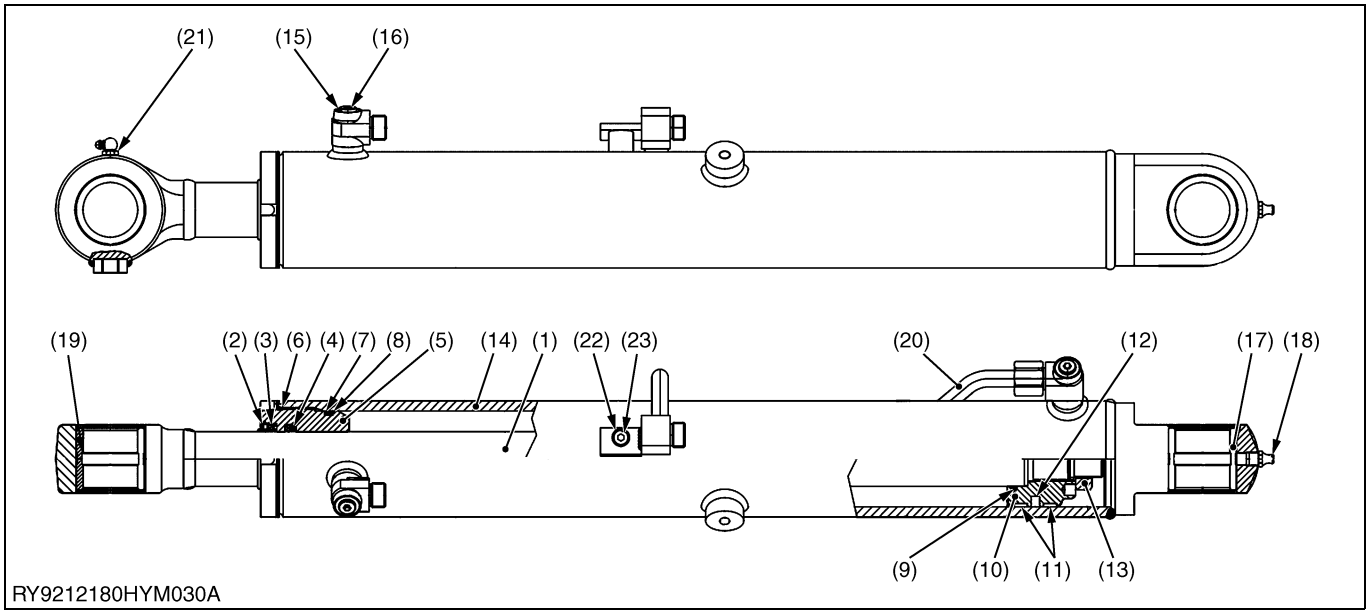
[2] ARM CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ85 mm (3.5 in.)
Tube inner diameter	ϕ70 mm (2.8 in.)
Rod diameter	ϕ40 mm (1.6 in.)
Stroke	482 mm (19.0 in)
Max compressed length	800 mm (31.5 in)

RY9212180HYM0031US0

(2) Components



RY9212180HYM030A

No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(1)	Rod	1		(13)	Nut	1	
(2)	Elastic ring	1		(14)	Cylinder tube	1	
(3)	Scraper	1		(15)	O-ring	2	
(4)	Rod seal	1		(16)	Metal plug	2	
(5)	End cap	1		(17)	Bearing bush	1	
(6)	O-ring	1		(18)	Grease nipple	1	
(7)	Back-up ring	1		(19)	Bearing bush	1	
(8)	O-ring	1		(20)	Pipe	1	
(9)	O-ring	1		(21)	Grease nipple	1	
(10)	Piston	1		(22)	Washer	1	
(11)	Wear ring	2		(23)	Screw	1	
(12)	Piston seal	1					

RY9212180HYM0032US0

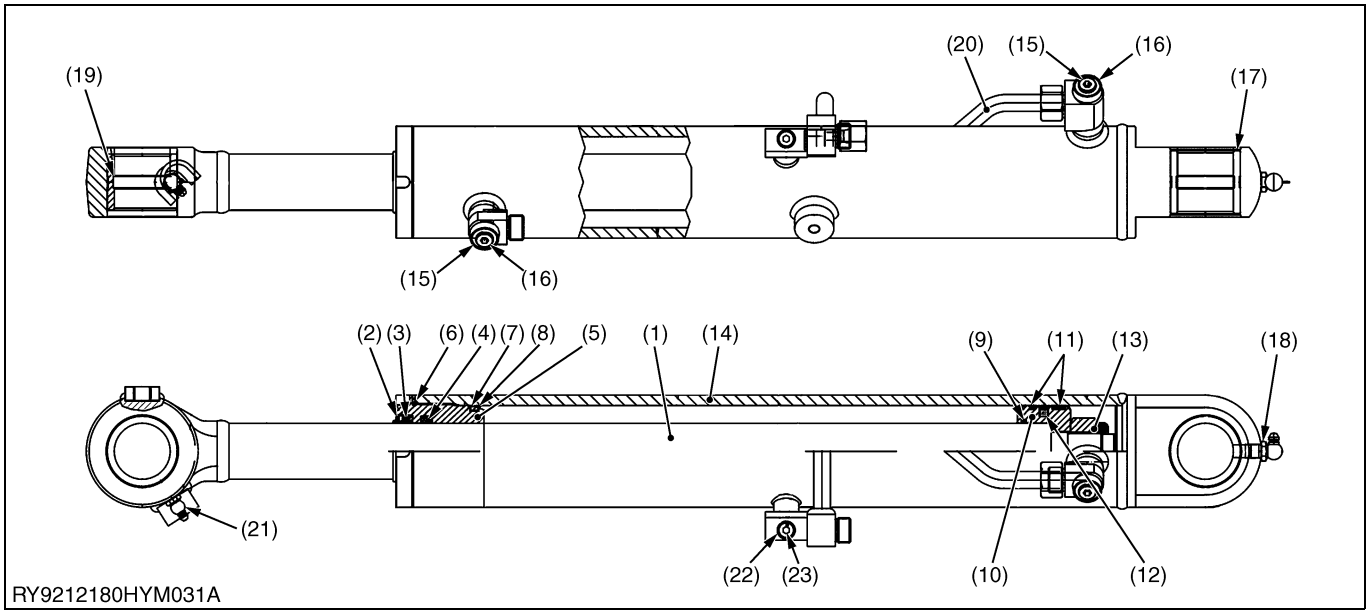
[3] BUCKET CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ80 mm (3.1 in.)
Tube inner diameter	ϕ65 mm (2.6 in.)
Rod diameter	ϕ40 mm (1.6 in.)
Stroke	382 mm (15.0 in)
Max compressed length	761 mm (30.0 in)

RY9212180HYM0033US0

(2) Components



RY9212180HYM031A

No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(1)	Rod	1		(13)	Self-locking nut	1	
(2)	Elastic ring	1		(14)	Cylinder tube	1	
(3)	Scraper	1		(15)	O-ring	2	
(4)	Rod seal	1		(16)	Metal plug	2	
(5)	End cap	1		(17)	Bearing bush	1	
(6)	O-ring	1		(18)	Grease nipple	1	
(7)	Back-up ring	1		(19)	Bearing bush	1	
(8)	O-ring	1		(20)	Pipe	1	
(9)	O-ring	1		(21)	Grease nipple	1	
(10)	Piston	1		(22)	Washer	1	
(11)	Wear ring	1		(23)	Screw	1	
(12)	Piston seal	1					

RY9212180HYM0034US0

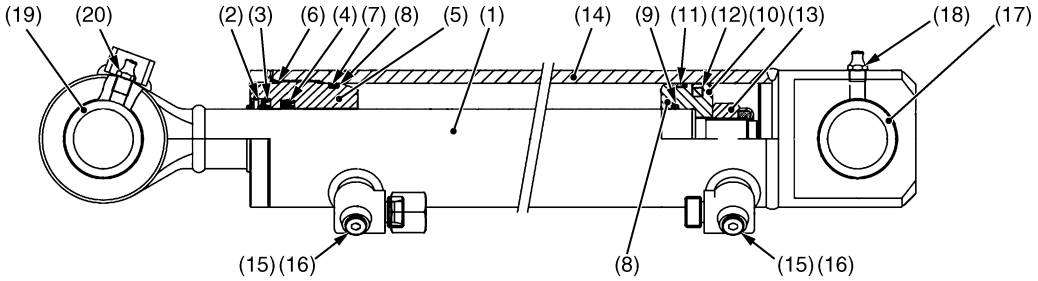
[4] SWING CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ80 mm (3.1 in.)
Tube inner diameter	ϕ65 mm (2.6 in.)
Rod diameter	ϕ35 mm (1.4 in.)
Stroke	420 mm (16.5 in)
Max compressed length	684 mm (26.9 in)

RY9212180HYM0035US0

(2) Components



RY9212180HYM032A

No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(1)	Rod	1		(11)	Wear ring	1	
(2)	Elastic ring	1		(12)	Piston seal	1	
(3)	Scraper	1		(13)	Self-locking nut	1	
(4)	Rod seal	1		(14)	Cylinder tube	1	
(5)	End cap	1		(15)	O-ring	2	
(6)	O-ring	1		(16)	Metal plug	2	
(7)	Back-up ring	1		(17)	Bearing bush	1	
(8)	O-ring	1		(18)	Grease nipple	1	
(9)	O-ring	1		(19)	Bearing bush	1	
(10)	Piston	1		(20)	Grease nipple	1	

RY9212180HYM0036US0

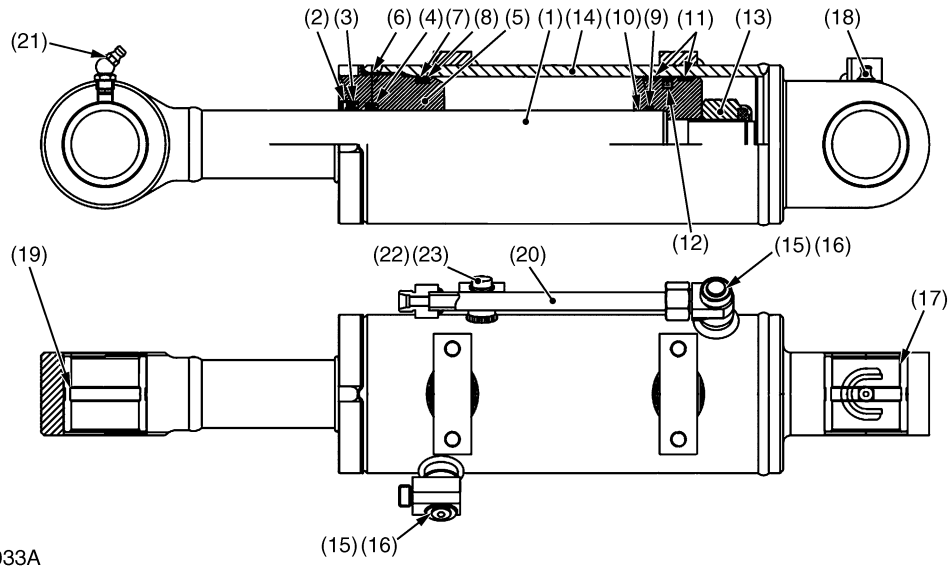
[5] BLADE CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ105 mm (4.1 in.)
Tube inner diameter	ϕ90 mm (3.5 in.)
Rod diameter	ϕ45 mm (1.8 in.)
Stroke	126 mm (5.0 in)
Max compressed length	505 mm (19.9 in)

RY9212180HYM0037US0

(2) Components



RY9212180HYM033A

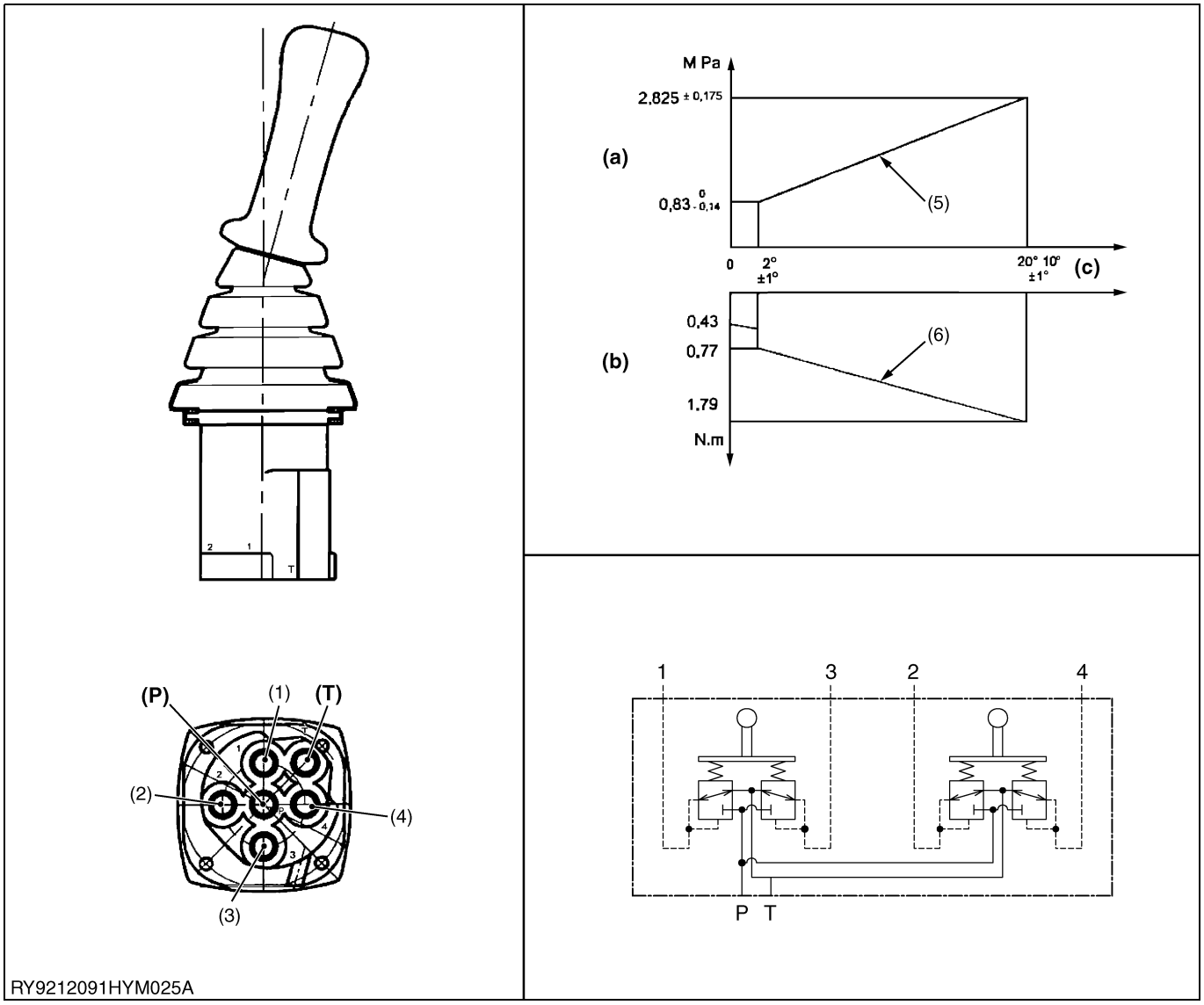
No.	Part Name	Q'ty	Remarks	No.	Part Name	Q'ty	Remarks
(1)	Rod	1		(13)	Self-locking nut	1	
(2)	Elastic ring	1		(14)	Cylinder tube	1	
(3)	Scraper	1		(15)	O-ring	2	
(4)	Rod seal	1		(16)	Metal plug	2	
(5)	End cap	1		(17)	Bearing bush	1	
(6)	O-ring	1		(18)	Grease nipple	1	
(7)	Back-up ring	1		(19)	Bearing bush	1	
(8)	O-ring	1		(20)	Pipe	1	
(9)	O-ring	1		(21)	Grease nipple	1	
(10)	Piston	1		(22)	Washer	1	
(11)	Wear ring	1		(23)	Screw	1	
(12)	Piston seal	1					

RY9212180HYM0038US0

9. PILOT VALVE (BOOM, ARM, BUCKET, SWIVEL)

[1] SPECIFICATIONS (STD)

Left Hand Side



(1) Port 1 (Arm Crowd)
(2) Port 2 (Swivel Left)
(3) Port 3 (Arm Dump)
(4) Port 4 (Swivel Right)
(5) Secondary Pressure
(6) Operating Torque

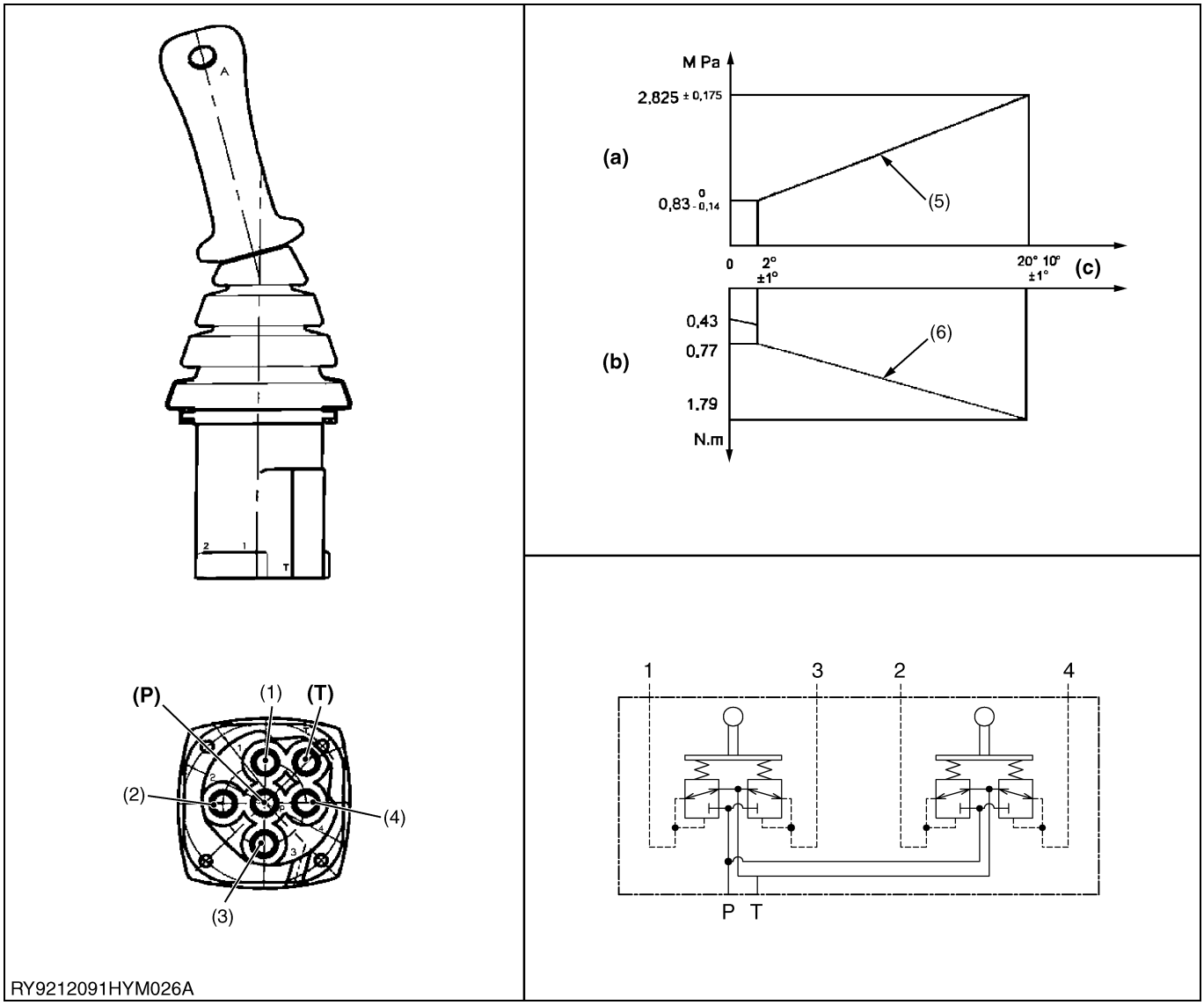
(P) P Port
(T) T Port

(a) Secondary Pressure (MPa)
(b) Operating Torque (N·m)
(c) Operating Angle (deg)

Maker	Rexroth
Model	4TH5E187-11 / TT43M04S057
Secondary pressure	Noted separately

RY9212180HYM0043US0

Right Hand Side



RY9212091HYM026A

(1) Port 1 (Lift Boom)
(2) Port 2 (Dump Crowd)
(3) Port 3 (Lower Boom)
(4) Port 4 (Bucket Dump)
(5) Secondary Pressure
(6) Operating Torque

(P) P Port
(T) T Port

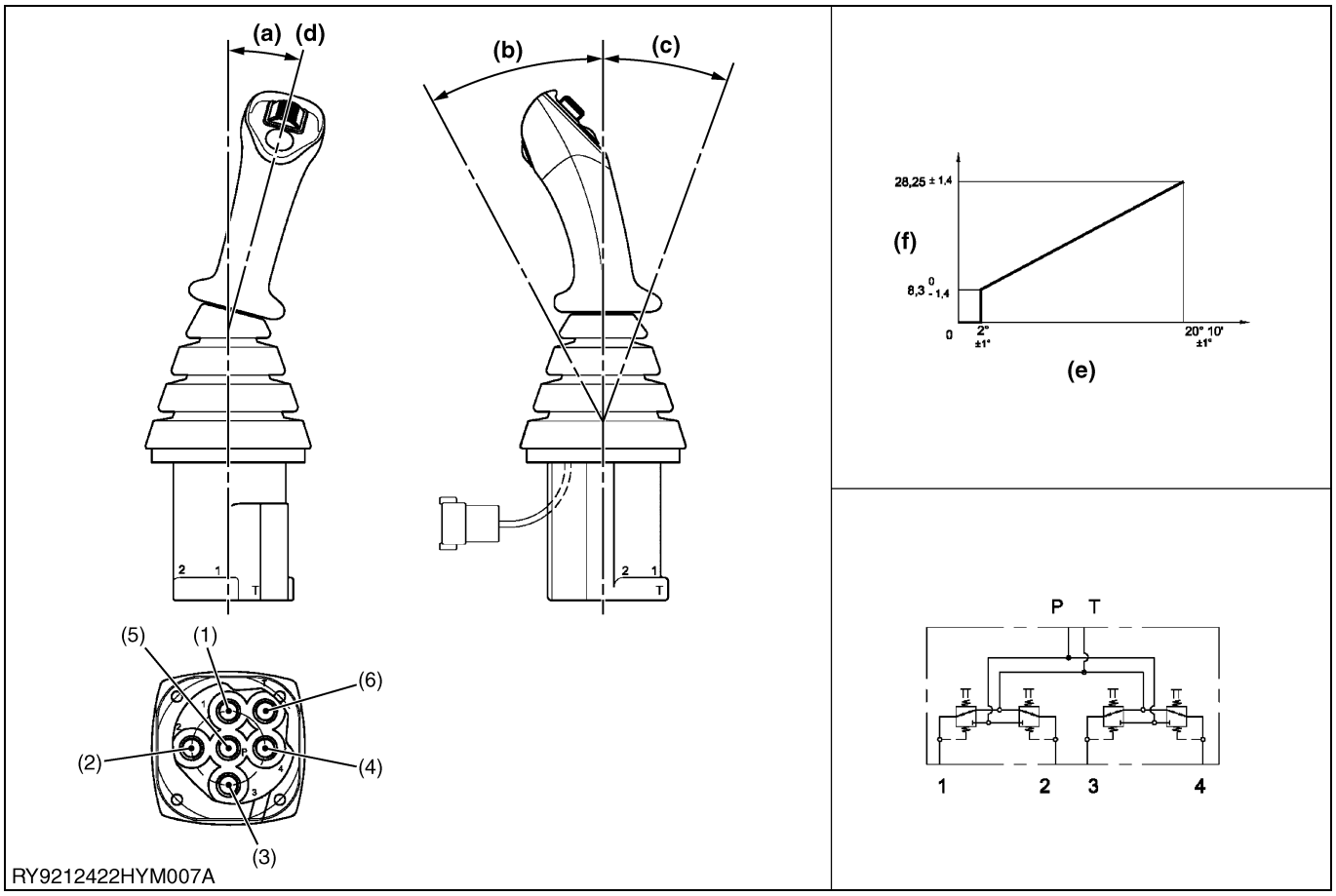
(a) Secondary Pressure (MPa)
(b) Operating Torque (N·m)
(c) Operating Angle (deg)

Maker	Rexroth
Model	4TH5E187-11 / ST235M04S058
Secondary pressure	Noted separately

RY9212180HYM0044US0

[2] SPECIFICATIONS (HI SPEC)

Left Hand Side



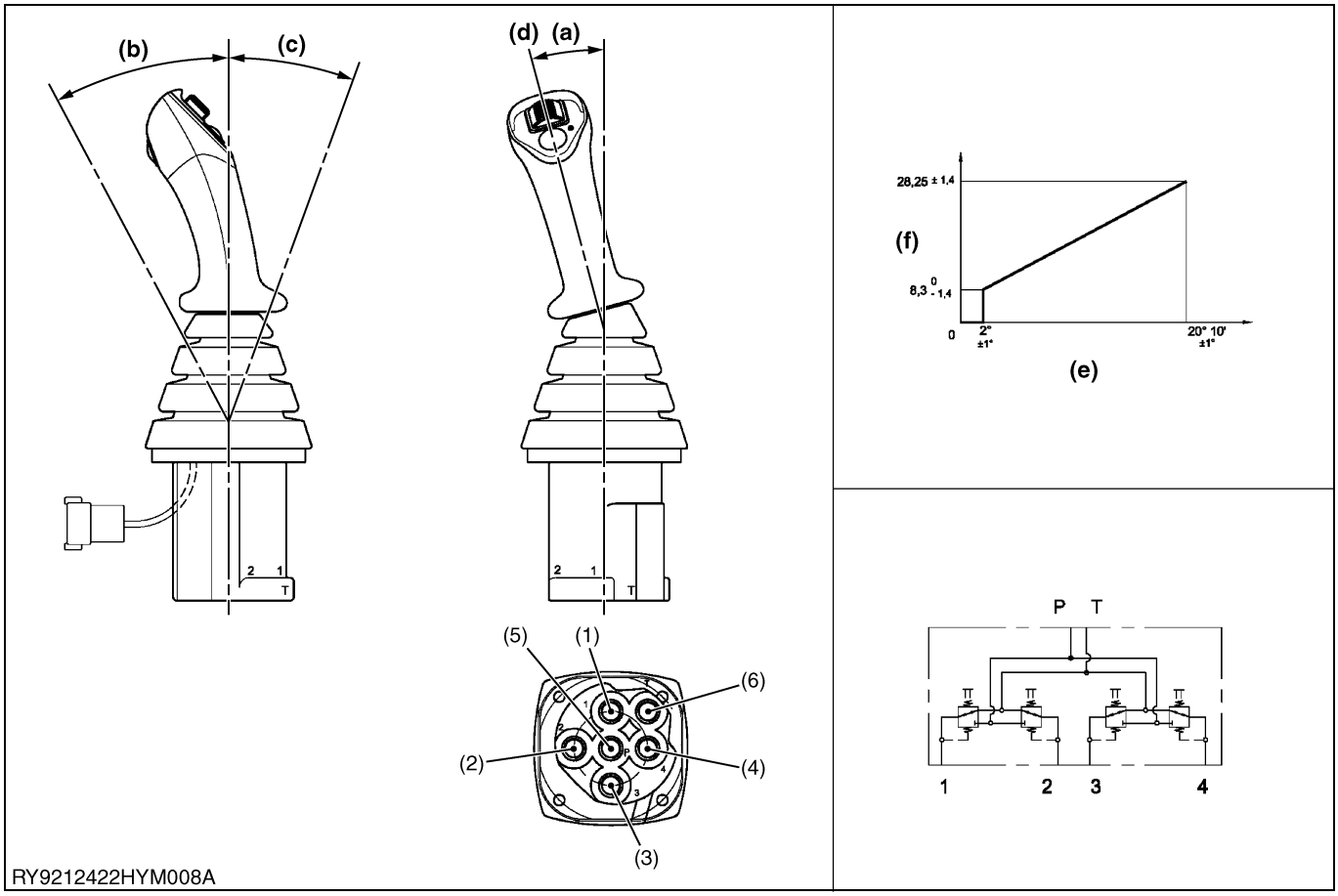
(1) Port1 (Arm Crowd)
(2) Port2 (Swivel Left)
(3) Port3 (Arm Dump)
(4) Port4 (Swivel Right)
(5) P-Port
(6) T-Port

(a) 15 °
(b) 28 °
(c) 20 °
(d) Neutral
(e) Lever Angle (deg)
(f) Secondary Pressure (bar)

Manufacturer	Rexroth
Model	45 TH5I87-11/SH18PHBH435M04S158

RY9212422HYM0014US0

Right Hand Side



RY9212422HYM008A

(1) Port1 (Boom Lift)
(2) Port2 (Bucket Crowd)
(3) Port3 (Boom Lower)
(4) Port4 (Bucket Dump)
(5) P-Port
(6) T-Port

(a) 15 °
(b) 28 °
(c) 20 °

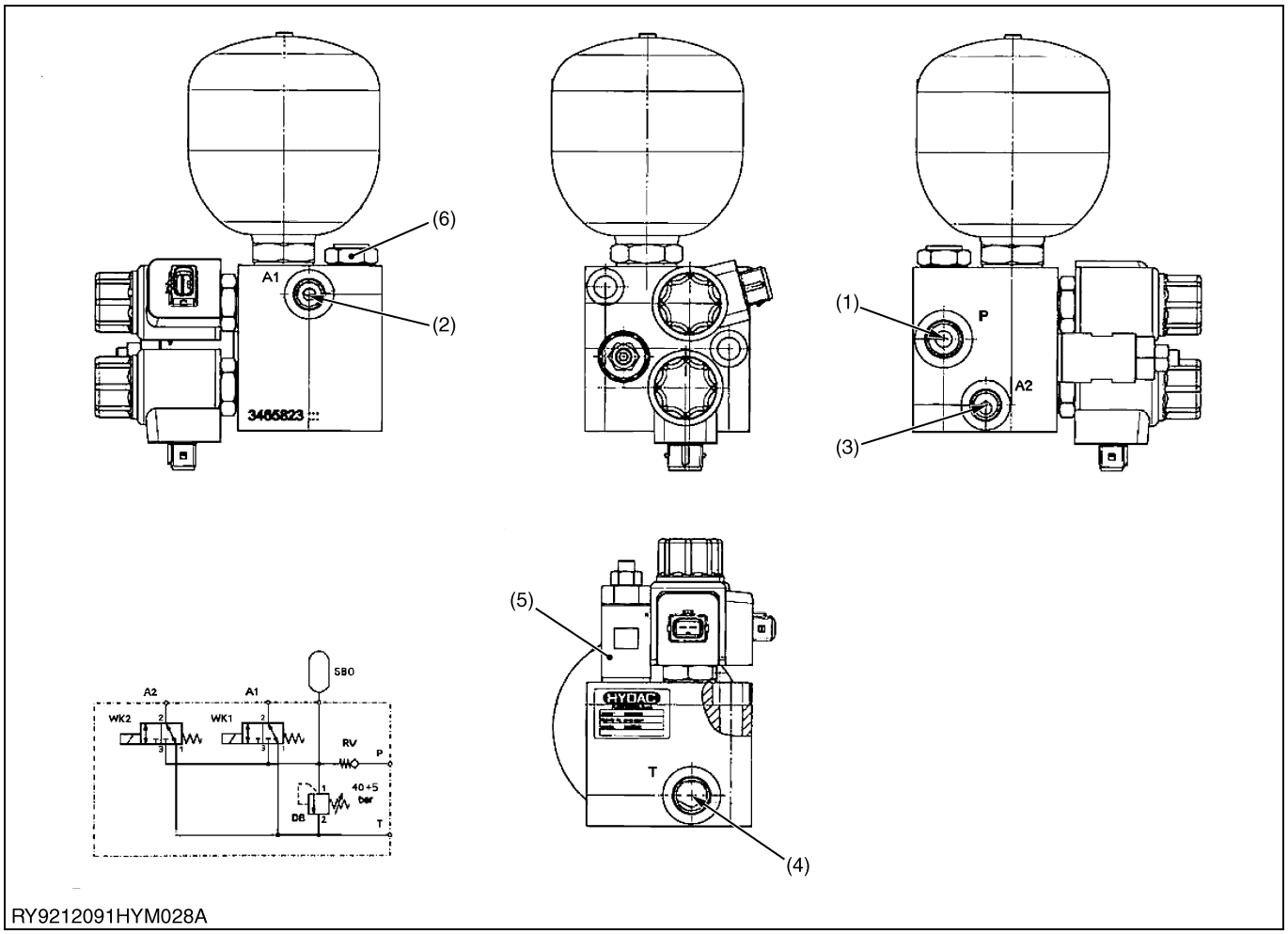
(d) Neutral
(e) Lever Angle (deg)
(f) Secondary Pressure (bar)

Manufacturer	Rexroth
Model	45 TH5I87-11/SH18PGBH235M04S158

RY9212422HYM0015US0

10. UNLOAD VALVE

[1] SPECIFICATIONS



RY9212091HYM028A

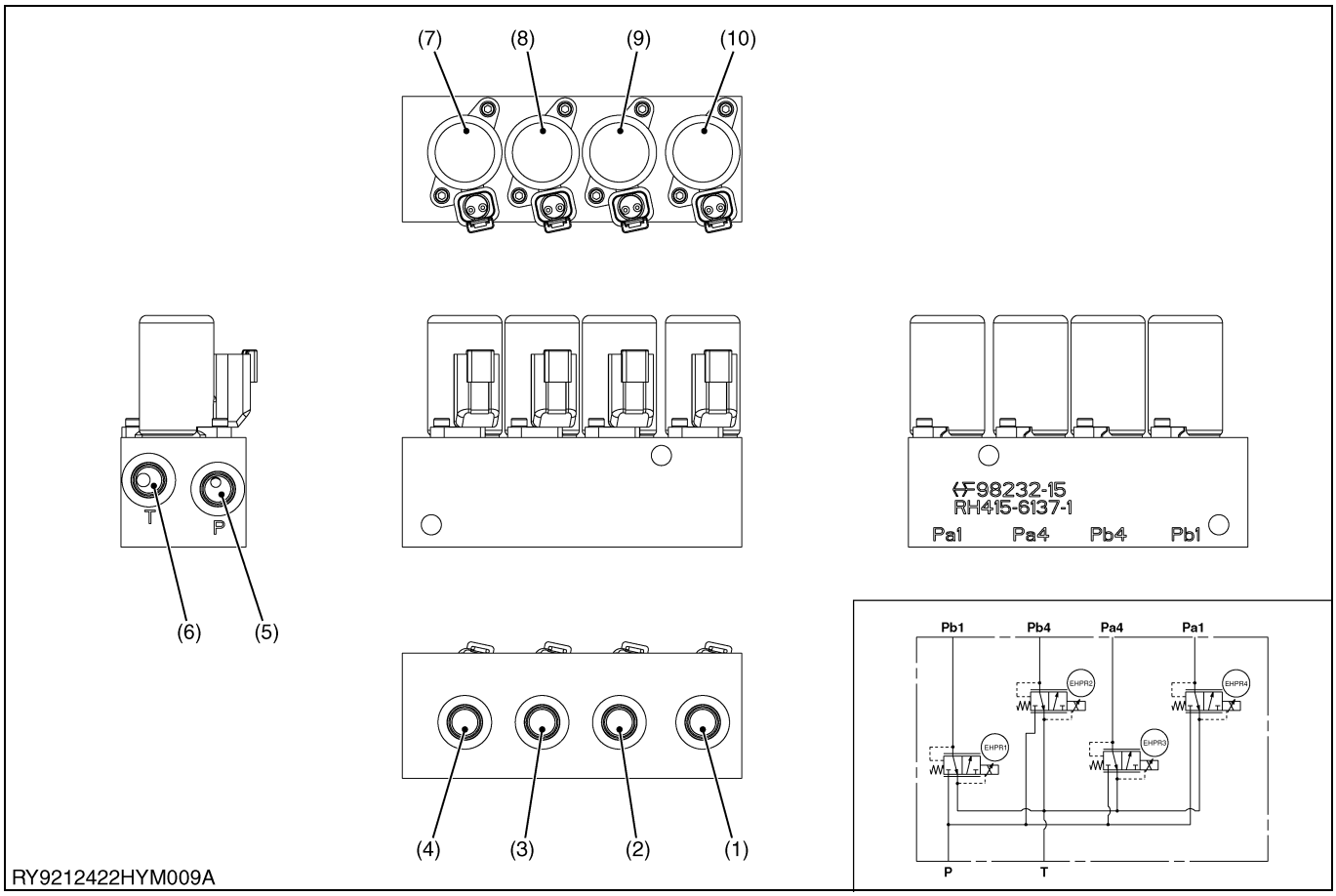
(1) P Port
(2) A1 Port (Pilot Operation)
(3) A2 Port (2-Speed Travel Switch)
(4) T Port (to Hydraulic Oil Tank)
(5) Relief Valve
(6) Check Valve

Maker	Hydac fluid techik
Rated Voltage	12 V
Relief Valve Pressure Setting	4.0 MPa 40 kgf/cm^2 600 psi

RY9212095HYM0029US0

11. PROPORTIONAL VALVE (HI SPEC)

[1] SPECIFICATIONS



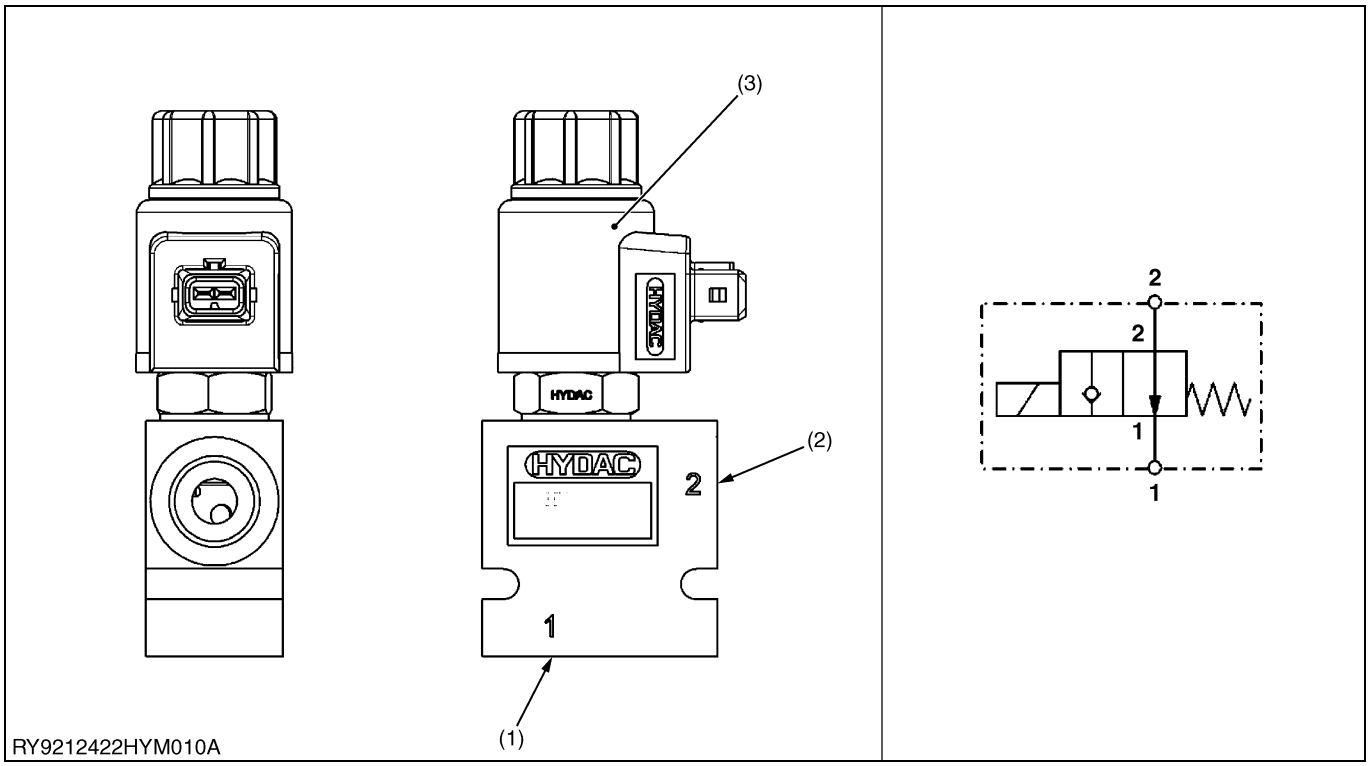
(1) Pa1 (AUX2 RH/Swing Rod)
(2) Pa4 (AUX1 RH)
(3) Pb4 (AUX2 LH/Swing Bottom)
(4) Pb1 (AUX1 LH)
(5) P-Port
(6) T-Port
(7) EHPR1 (AUX1 LH)
(8) EHPR2 (AUX2 LH/Swing Bottom)
(9) EHPR3 (AUX1 RH)
(10) EHPR4 (AUX2 RH/Swing Rod)

Manufacturer	HYDRAFORCE
Model	5976454
Operation temperature range	–40 to 100 °C
Voltage	DC12V
Working normal pressure	30.0 MPa
Volume normal flow rate	2.0 L/min

RY9212422HYM0016US0

12. THIRD LINE VALVE (HI SPEC)

[1] SPECIFICATIONS



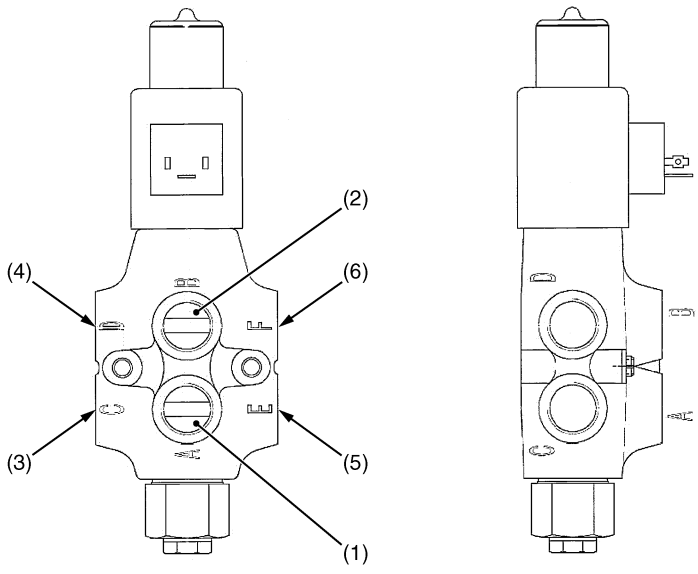
(1) Port1 (to Tank) (2) Port2 (from AUX1 RH) (3) Solenoid Valve

Manufacturer	HYDAC
Model	WS10Y-C-N-12T
Operation temperature range	–20 to 100 °C
Voltage	DC12V
Working normal pressure	21.0 MPa
Volume normal flow rate	75.0 L/min

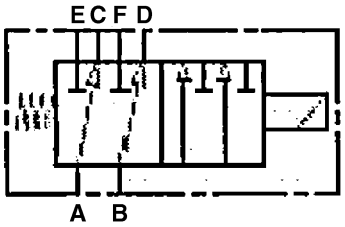
RY9212422HYM0017US0

13. SELECTOR VALVE (HI SPEC)

[1] SPECIFICATIONS



RY9212422HYM011A



(1) Port A (to Control Valve)
(2) Port B (to Control Valve)
(3) Port C (to AUX2 RH)
(4) Port D (to AUX2 LH)
(5) Port E (to Swing Rod)
(6) Port F (to Swing Bottom)

Manufacturer	HYDRO CONTROL
Model	HC-SVE056
Max temperature range	+80 °C
Voltage	DC12V

RY9212422HYM0018US0

SERVICING

CONTENTS

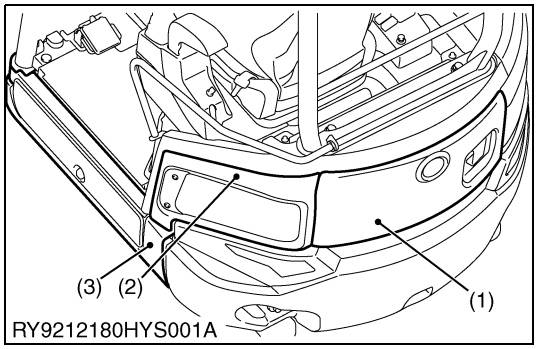
1. PUMP

[1] PUMP REMOVAL AND INSTALLATION

CAUTION

- **When removing a hydraulic device after operating the machine, lower the bucket and blade to the ground and turn off the engine.**
- **Each of the devices and the hydraulic oil are hot and under high pressure immediately after operating the machine. If the hydraulic oil reached a high operating temperature, it may cause a burn.**
- **Oil gushing out under pressure has enough force to pierce your skin and may cause you injury. Always allow the temperature to drop and relieve any remaining pressure prior to working to remove any hydraulic equipment.**

RY9212001MBS0004US0



Removing the Rear Bonnet, Left Bonnet and Cover

1. Remove the four left bonnet mounting bolts, and then remove the left bonnet.
2. Remove the three cover mounting bolts and remove the cover.
3. Remove the two rear bonnet mounting bolts and remove the rear bonnet.

(1) Cap ASSY
(2) Bolt
(3) Cover

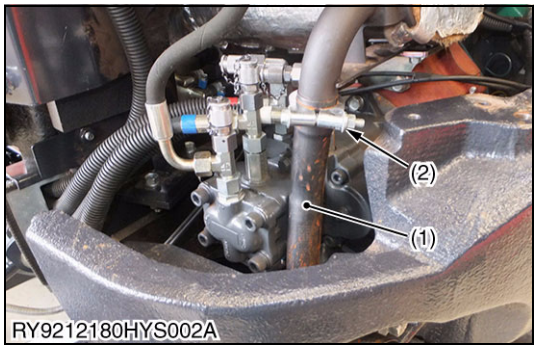
RY9212180HYS0034US0

Removing the Left Weight

1. Remove the two left weight mounting bolts and remove the left weight.
   - Left weight: Approx. 14 kg

(1) Left Weight
(2) Bolt

RY9212180HYS0087US0

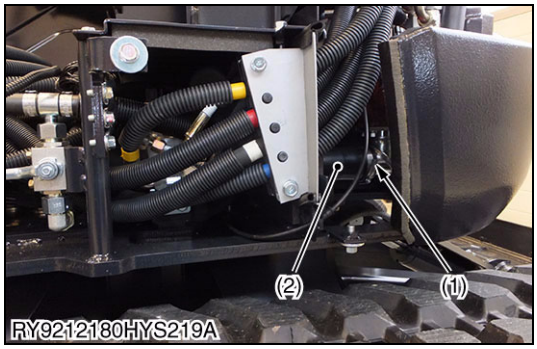


Removing the Muffler Pipe

1. Loosen the muffler clamp, and then remove the muffler pipe.

(1) Muffler Pipe
(2) Muffler Clamp

RY9212180HYS0035US0



Removing the Main Pump

1. Remove all hoses from the pump and fit plugs to the adapter and disconnected hoses.
2. Loosen the suction hose tightening clamp and remove the suction hose from the pump.

(1) Hose Clamp
(2) Suction Hose

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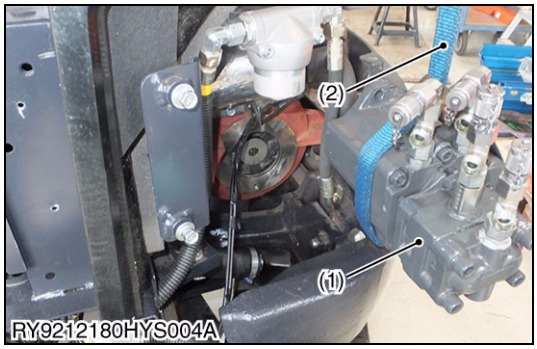
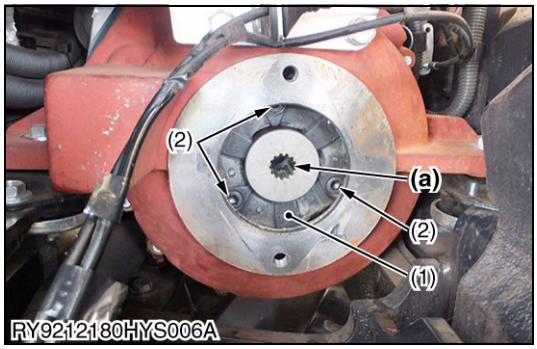
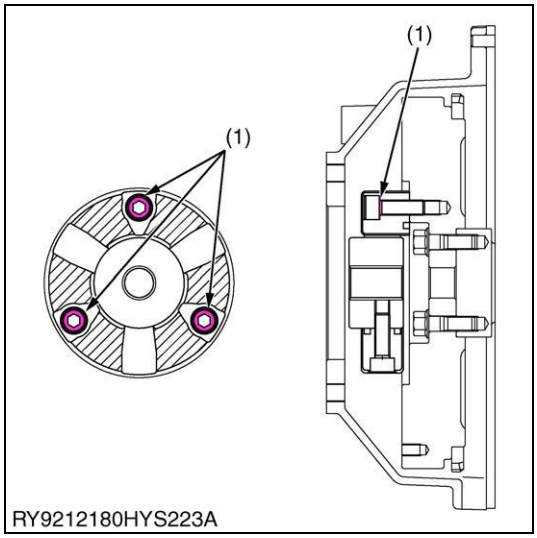






3. Suspend the pump by a nylon sling and support it with a crane. Remove the bolts in two locations, and pull the shaft of the pump from the coupling.

Tightening torque	Pump	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 5.72 to 66.5 lbf·ft

(1) Piston Pump ASSY
(2) Nylon Sling

RY9212180HYS0037US0

Pump coupling assembly procedure

Apply the correct amount of grease to the spline section.

■ **IMPORTANT**

- **Do not apply grease to the rubber section of the coupling.**

(1) Coupling
(2) Bolt (Coupling)
(a) Spline Section

RY9212180HYS0038US0

Tightening the coupling assembly bolts

Apply an extremely thin layer of lubricating oil to the coupling back facing hole, then tighten to the torque indicated in the following table.

Tightening torque	Bolt (coupling) (2)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft

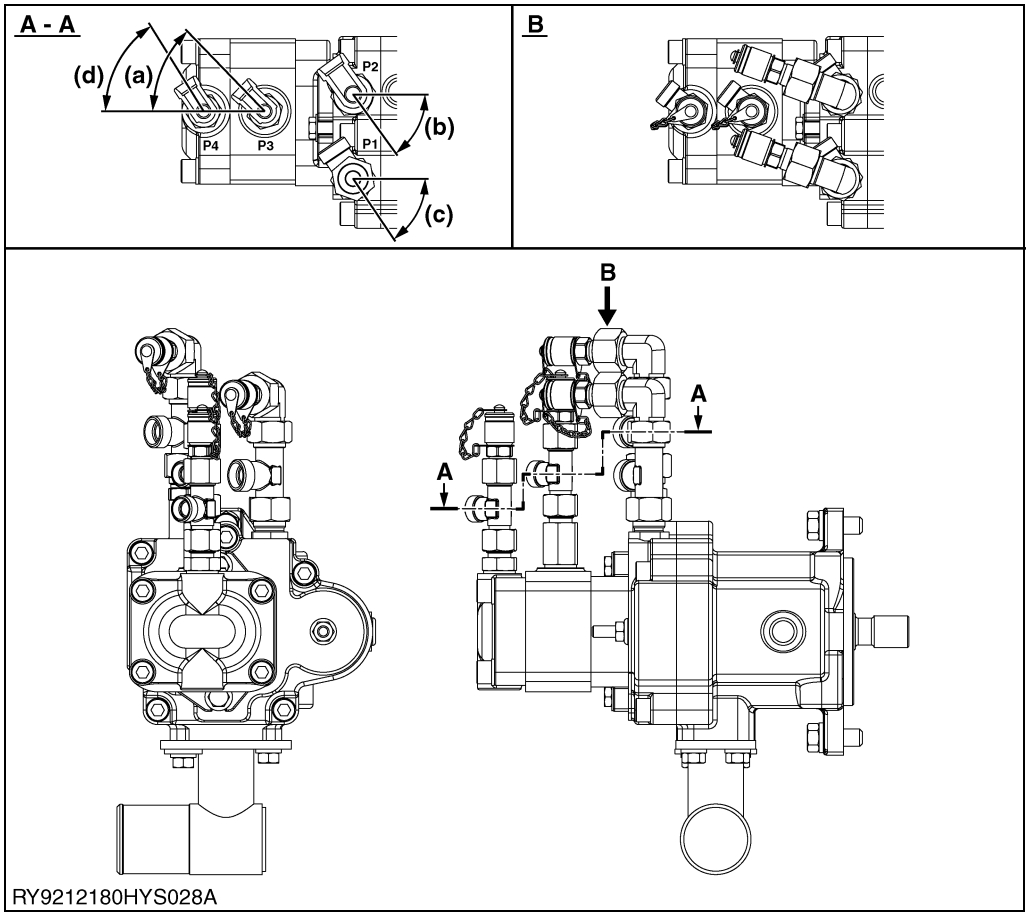
■ **IMPORTANT**

- **Do not apply a thread lock.**

(1) Back Facing Hole

RY9212091HYS0032US0

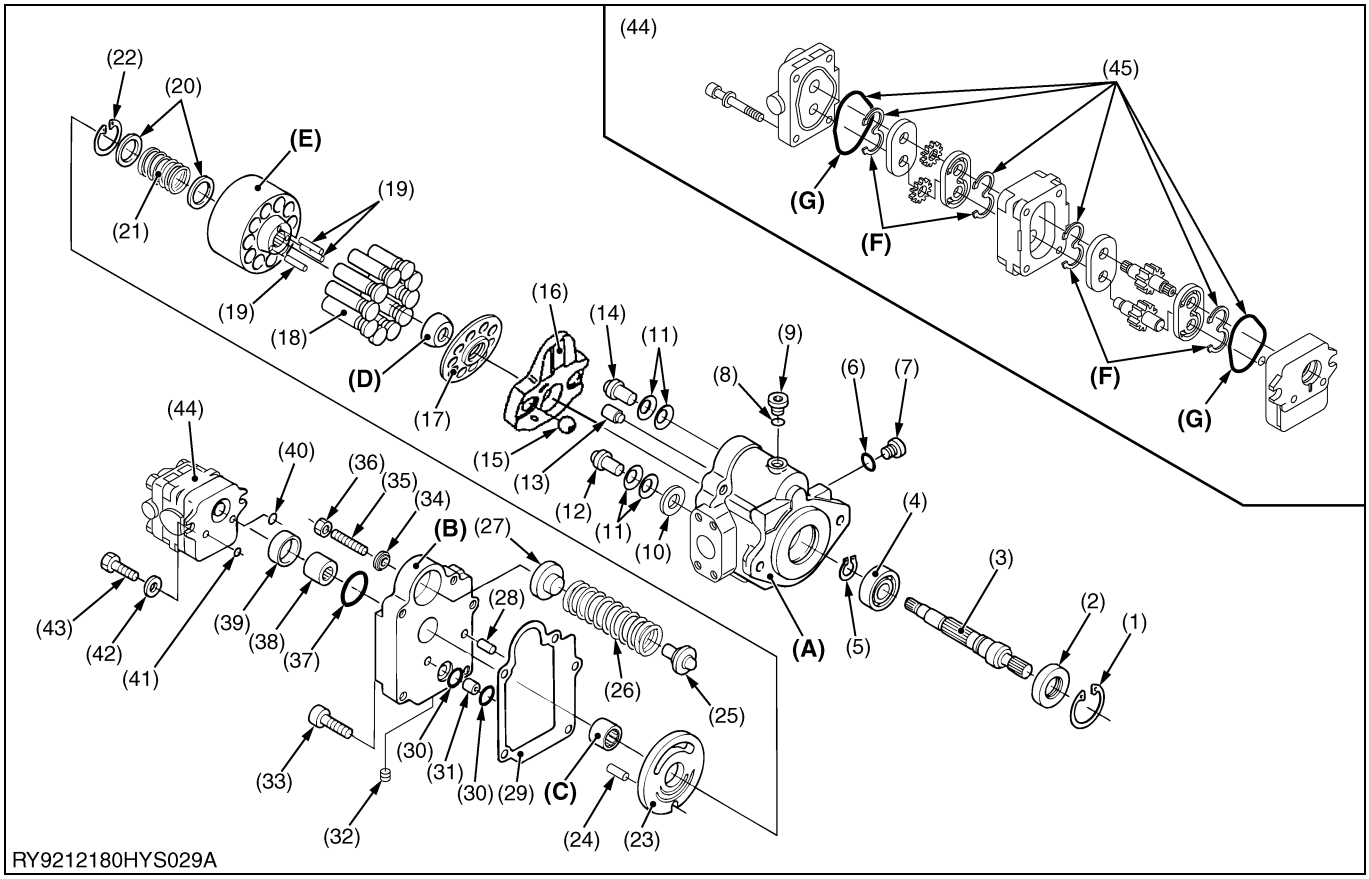
Pump Adapter Angles



(a) 46 °
(b) 54 °
(c) 56 °
(d) 58 °

RY9212180HYS0039US0

[2] PUMP DISASSEMBLY/ASSEMBLY PROCEDURES



(A) Body S **(C) Coupling** **(E) Cylinder barrel** **(G) Gasket**
(B) Body H **(D) Barrel Holder** **(F) Gasket**

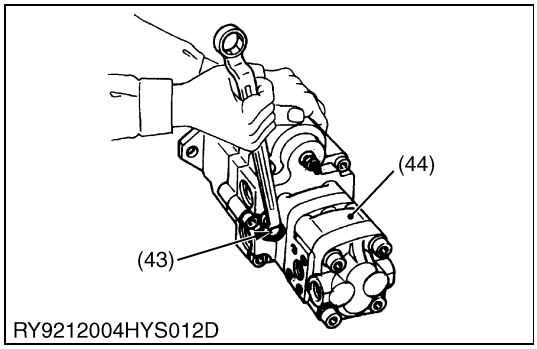
No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty
(1)	Snap ring	1	(16)	Swashplate	1	(31)	Pin	1
(2)	Oil seal	1	(17)	Shoe holder	1	(32)	Plug	1
(3)	Shaft	1	(18)	Piston ASSY	10	(33)	Hex socket bolt	5
(4)	Ball bearing	1	(19)	Pin	3	(34)	Washer seal	1
(5)	Internal circlip	1	(20)	Retainer	2	(35)	Set screw	1
(6)	O-ring	1	(21)	Spring	1	(36)	Lock Nut	1
(7)	Plug	1	(22)	Snap ring	1	(37)	O-ring	1
(8)	O-ring	1	(23)	Valve plate	1	(38)	Coupling	1
(9)	Plug	1	(24)	Spring pin	1	(39)	Collar	1
(10)	Washer	1	(25)	Spring holder	1	(40)	O-ring	1
(11)	Disc spring	4	(26)	Spring	1	(41)	Coupling	1
(12)	Stopper pin B	1	(27)	Stopper guide	1	(42)	Flat metal washer	1
(13)	Rod	1	(28)	Pin	1	(43)	Bolt	1
(14)	Stopper pin A	1	(29)	Gasket	1	(44)	Gear pump ASSY	1
(15)	Ball	2	(30)	O-ring	2	(45)	Seal kit	1

RY9212180HYS0040US0

(1) Disassembly Procedures

After draining the pump of oil, wash off the pump and put a protector, such as clean paper, cloth, rubber mat, etc., on the work surface and proceed with disassembly and reassembly. Use any tools necessary and exercise caution so no parts are damaged and employ sufficient precautions to prevent any foreign matter from getting inside.

RY9212004HYS0163US0



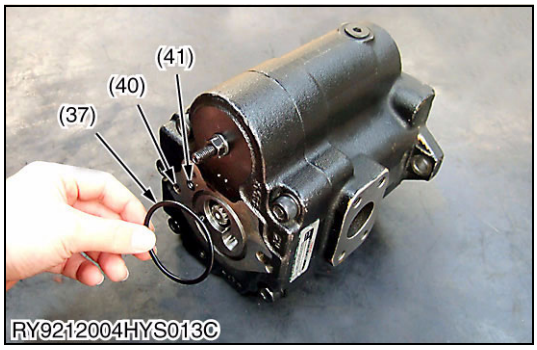
RY9212004HYS012D

1. Remove the two bolts and remove the gear pump, collar and coupling.

- Tool to use: M13 wrench

(43) Bolt (M8 x 25) (44) Gear Pump

RY9212180HYS0041US0

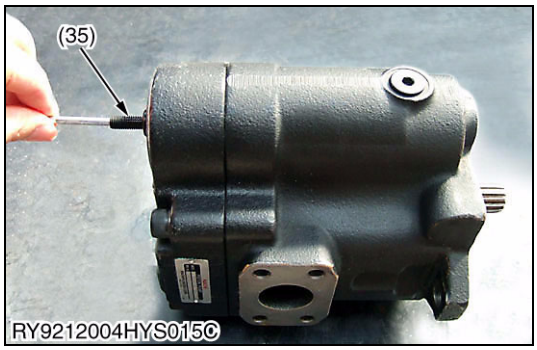


RY9212004HYS013C

2. Remove the O-rings.

(37) O-Ring (41) O-Ring
(40) O-Ring

RY9212180HYS0042US0



RY9212004HYS015C

3. Loosen the nut enough and remove the set screw

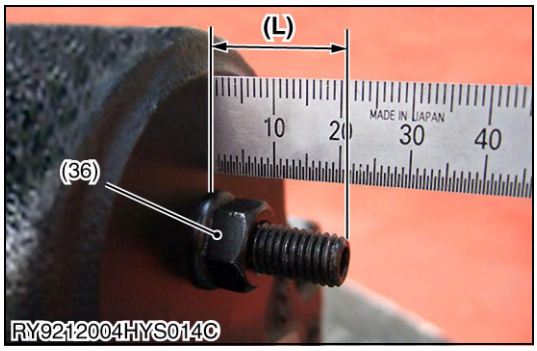
■ **IMPORTANT**

- **Before doing so, record the length (L) it sticks out with the set screw fastened in place.**

- Tool to use: M13 socket wrench, M4 hex socket

(35) Set Screw (36) Nut

RY9212180HYS0043US0



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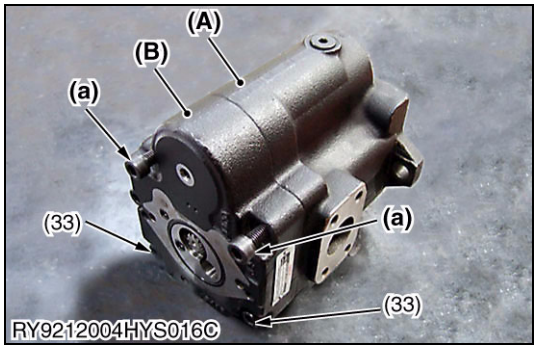


4. Remove the upper two of the four bolts. Install two (M10 x 65) bolts in these positions temporarily and gently loosen the remaining two bolts. Next loosen the two temporary bolts and detach body S.

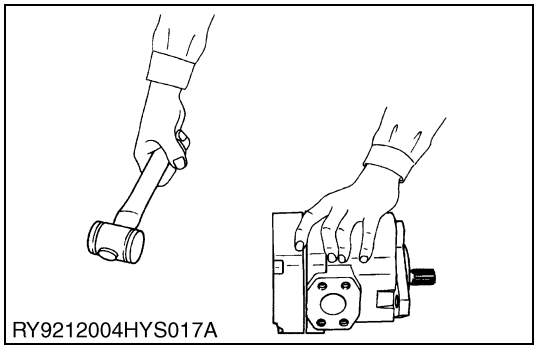
- Tool to use: M8 hex socket

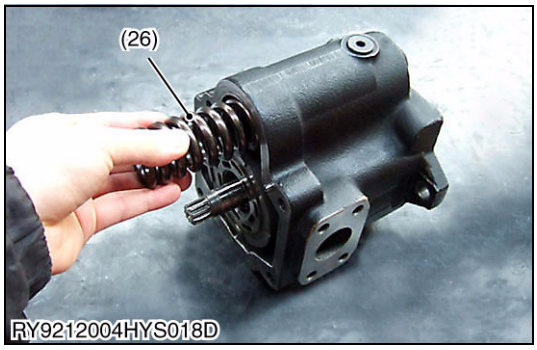
■ **NOTE**
- **If body H is hard to separate, tapping lightly on the spring insertion part with a plastic hammer will make it easier to detach.**

(33) Bolt

(A) Body S
(B) Body H
(a) Temporary Bolt

RY9212091HYS0005US0



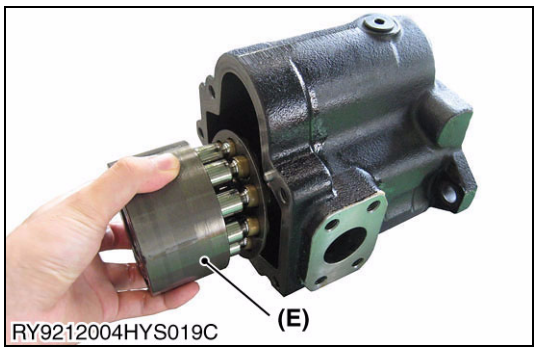


5. Remove the valve plate, gasket, spring and O-ring from body S.

CAUTION
- **Handle the gasket carefully to avoid cutting yourself.**

(26) Spring

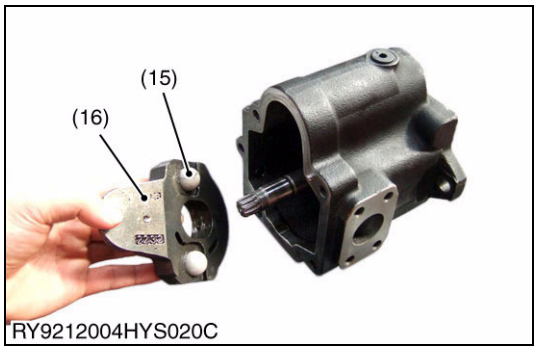
RY9212180HYS0044US0



6. Remove the cylinder barrel from body S.

(E) Cylinder Barrel

RY9212180HYS0045US0

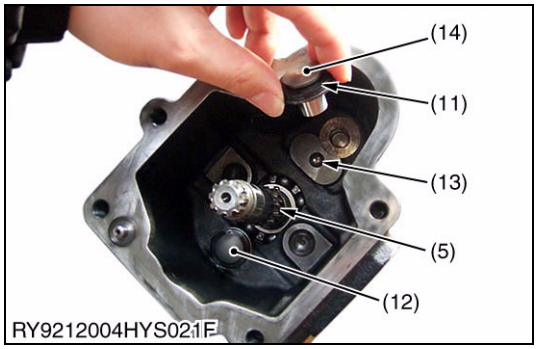


7. Remove the spring holder, swashplate and ball from body S.

(15) Ball

(16) Swashplate

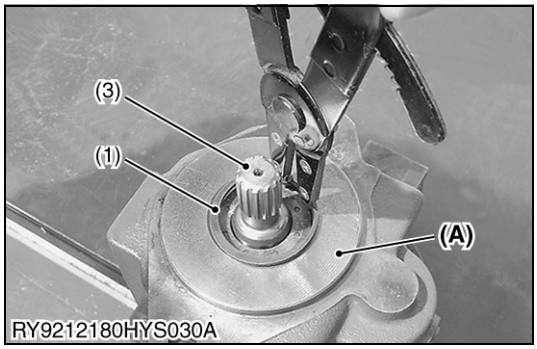
RY9212180HYS0046US0



8. Remove stopper pin A, stopper pin B, disc spring, rod and snap ring.

(5) Internal Circlip
(11) Disc Spring
(12) Stopper Pin B
(13) Rod
(14) Stopper Pin A

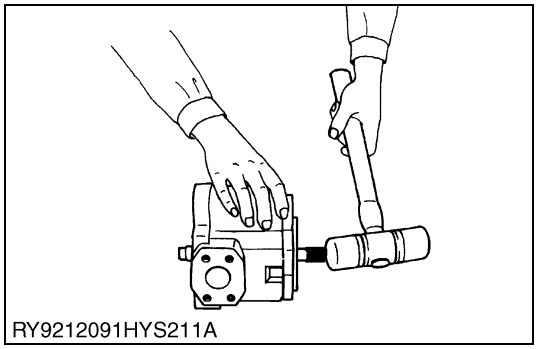
RY9212180HYS0047US0



9. Oil seal disassembly
Remove the snap ring on the shaft drive axle from body S.

(1) Snap ring
(3) Shaft
(A) Body S

RY9212180HYS0236US0



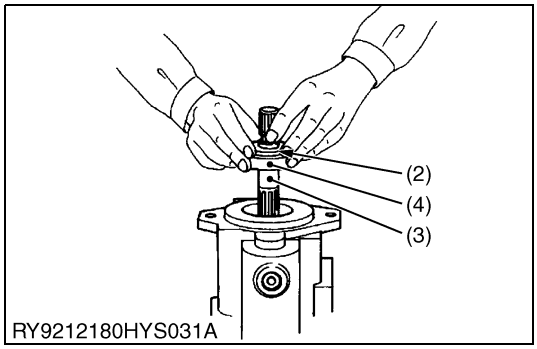
10. Tap the shaft lightly with a plastic hammer and remove the seal holder (with oil seal and O-ring) and the shaft (w/ ball bearing) from body S.

- Tool to use: Plastic hammer

■ **IMPORTANT**
- **Do not use anything but a plastic hammer.**
- **Tap lightly with a plastic hammer.**

RY9212091HYS0281US0

(2) Assembly Procedures



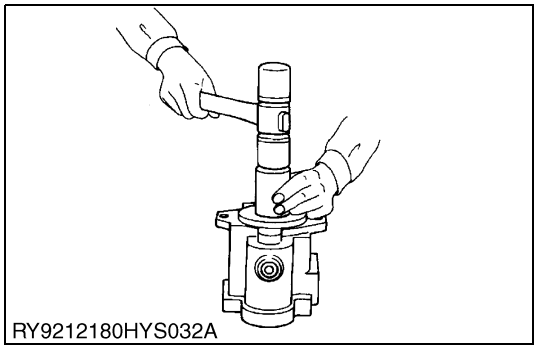
1. Assemble the shaft kit, oil seal and Snap ring on the body S, in this order. Use jig **(a)** to install the oil seal in body S.

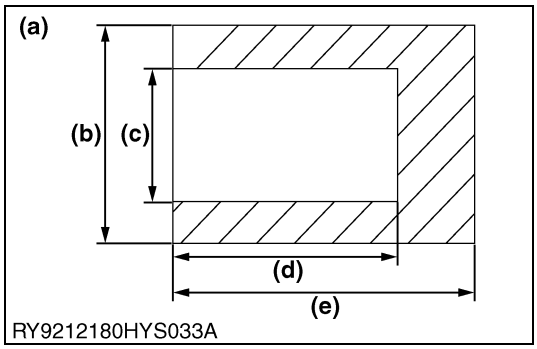
■ **IMPORTANT**
- **Apply grease to the lip of the oil seal.**

(2) Oil Seal
(3) Shaft
(4) Ball Bearing

(a) Jig
(b) ϕ51 mm (2.01 in.)
(c) ϕ31 mm 1.22 in.)
(d) 52 mm (2.05 in.)
(e) 70 mm (2.76 in.)

RY9212180HYS0048US0





2. Install the ball bearing, shaft, circlip, four disc springs, stopper pin A and stopper pin B in body S.

■ **IMPORTANT**
- **Be careful that the springs face the right direction.**

(3) Shaft
(4) Ball Bearing
(5) Internal Circlip
(10) Disc Spring
(12) Stopper Pin A
(14) Stopper Pin B

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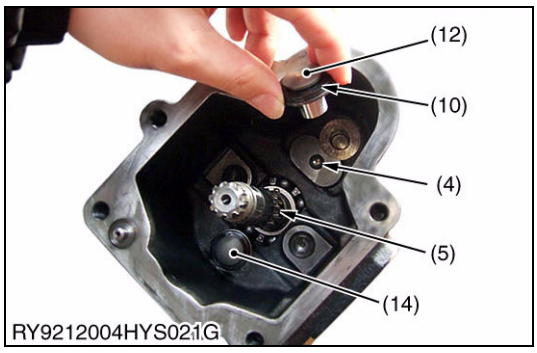

Disc spring installation orientation

(10) Washer
(11) Disc Spring
(12) Stopper Pin A
(14) Stopper Pin B

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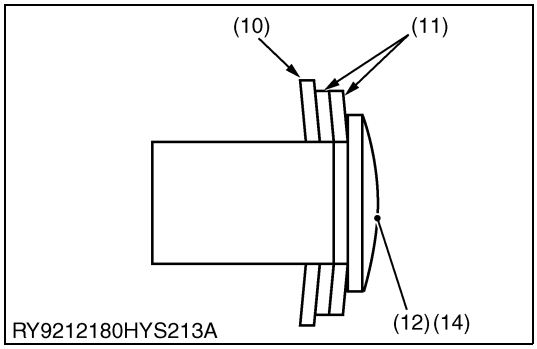

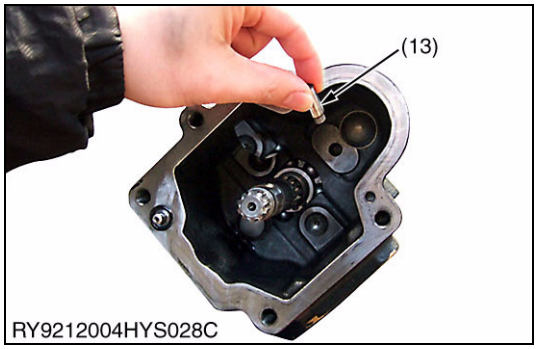

3. Install the rod into body S.

■ **IMPORTANT**
- **Replace used O-rings with new ones.**

(13) Rod

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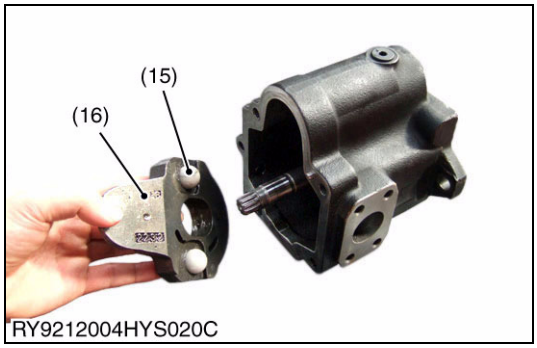

4. Mount the balls on the swashplate and install it in body S.

■ **NOTE**
- **If the balls fall out, apply grease when mounting them.**

(15) Ball (16) Swashplate

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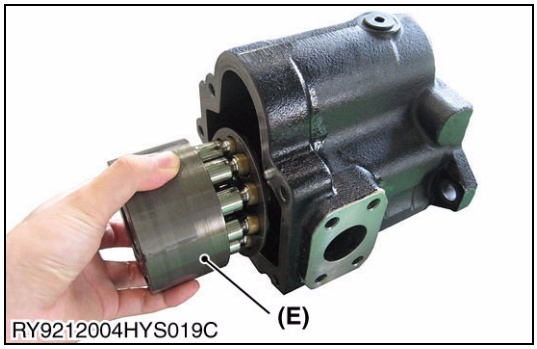

5. After mounting the springs in the cylinder barrel, install the three pins and the barrel holder, then carefully install the shoe holder with the pistons installed in it into body S.

■ **IMPORTANT**
- **Apply a little hydraulic oil on the pistons.**

(E) Cylinder Barrel

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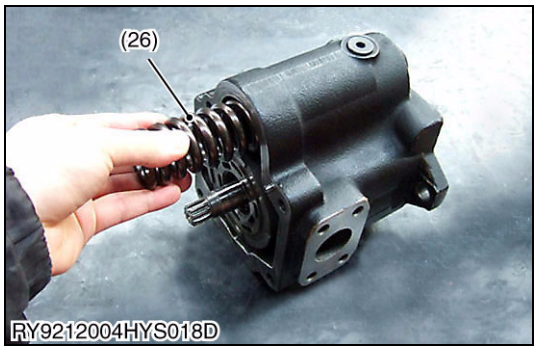
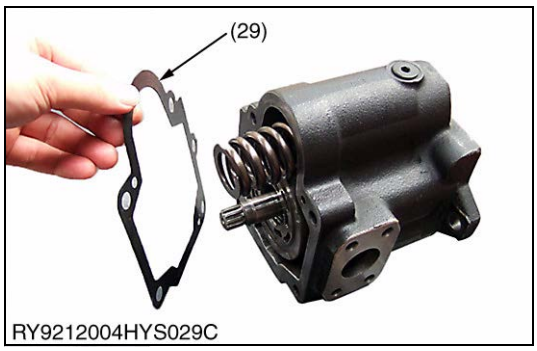


6. After installing the spherical part of the spring holder in the hole of the swashplate, install the spring.

(26) Spring

RY9212180HYS0054US0



7. Insert the locating pin in the mating face of body S and mount the gasket.

⚠ **CAUTION**
- **Handle the gasket carefully to avoid cutting yourself.**

(29) Gasket

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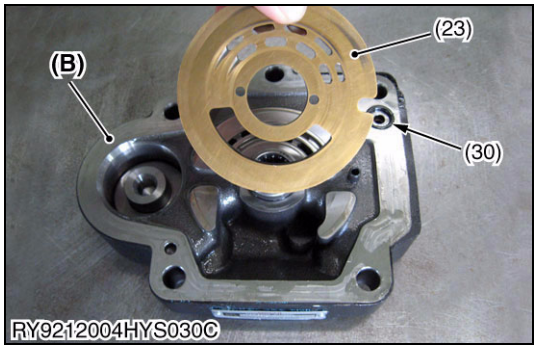

8. Align the valve plate to the spring pins of body H and gently put it on.

■ **IMPORTANT**
- **Replace used O-rings with new ones.**
- **The face of the valve plate that has whisker grooves is the surface that slides on the cylinder barrel, so take care that it does not face the wrong way.**

(23) Valve Plate
(30) O-Ring
(B) Body H

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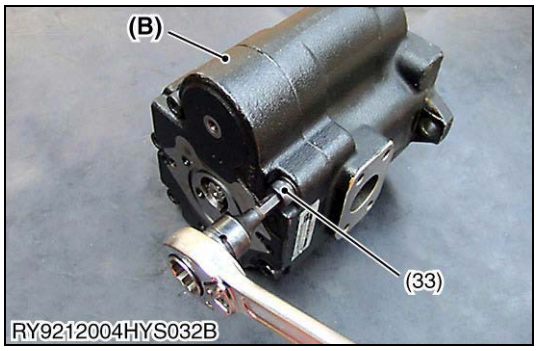


9. Mount body S to body H with the bolts.

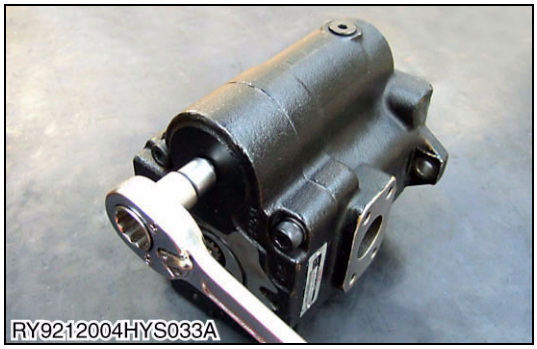
■ **IMPORTANT**
- **When installing the bolts, tighten them diagonally from each other.**

Tightening torque	Bolt (33)	53.9 to 63.7 N·m 5.5 to 6.5 kgf·m 39.8 to 46.9 lbf·ft

- Tool to use: M8 hex socket

(33) Bolt
(B) Body H

RY9212091HYS0017US0



10. Fasten the hex set screw with a hex nut at the same length as was sticking out prior to disassembly.

Tightening torque	Hex nut	14.7 to 19.6 N·m 1.5 to 2 kgf·m 10.8 to 14.5 lbf·ft

- Tool to use: M13 socket wrench, M4 hex socket

■ **IMPORTANT**
- **Replace used seal washers with new ones. Failing to do so may cause oil leaks.**

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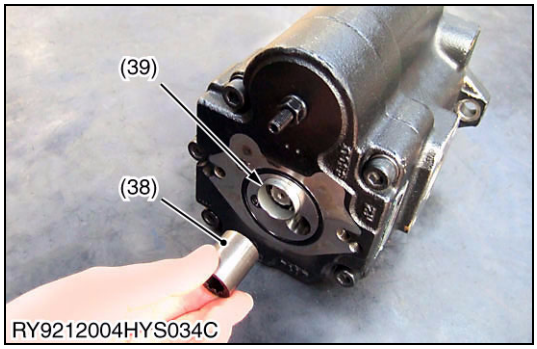
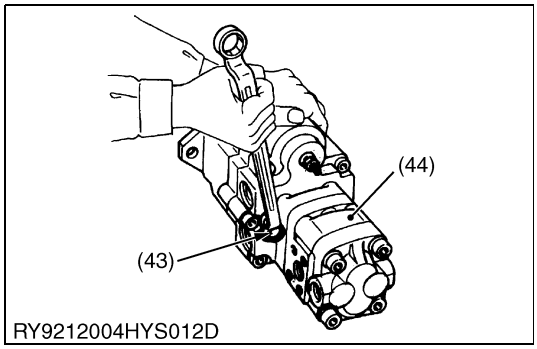


11. Install three O-rings to the mating surfaces of the gear pump and the piston pump kit.
Install a collar and a coupling to the connecting part of the gear pump.

■ **IMPORTANT**
- **Apply grease to the O-rings.**

(38) Coupling
(39) Collar

RY9212180HYS0057US0



RY9212004HYS012D

12. Attach the gear pump with two hex bolts and washers.

Tightening torque	Bolt (42)	19.6 to 23.5 N·m 2.0 to 2.4 kgf·m 14.5 to 17.3 lbf·ft

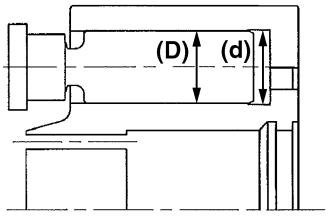
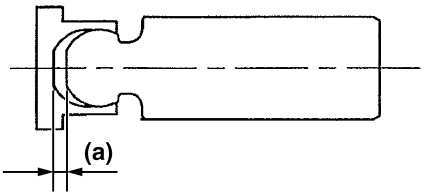
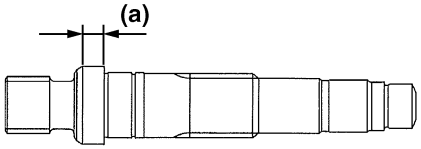
- Tool to use: M13 wrench

■ **IMPORTANT**
- **After assembly is complete, rotate the shaft and make sure it rotates smoothly.**

(43) Bolt (44) Gear Pump

RY9212180HYS0058US0

[3] SERVICE STANDARDS FOR PUMP PARTS

Part	Service Standard
Piston Assembly Cylinder Barrel Valve Plate	1. No scratching, scoring or abnormal wear. (Especially sliding parts)
	2. Check the clearance between the piston O.D. **(D)** and cylinder barrel I.D. **(b)**. • **(d)** – **(D)** ≤ 0.05 mm (0.002 in.).  RY9212004HYS035A
	3. Check the amount of play between the piston and shoe. • **(a)** ≤ 0.2 mm (0.008 in.).  RY9212004HYS036A
Shaft	Check the wear where the oil seal is installed **(a)**. • Amount of wear ≤ 0.25 mm (0.01 in.)  RY9212004HYS037A
Seals (O-ring, oil seal, gasket)	Inspect for cuts, tears and elasticity of rubber. Always replace during reassembly.

RY9212091HYS0021US0

2. CONTROL VALVE

[1] CONTROL VALVE REMOVAL AND INSTALLATION

CAUTION

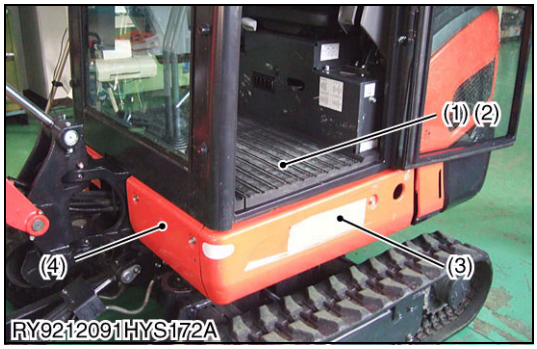
- **When removing a hydraulic device after operating the machine, lower the bucket and blade to the ground and turn off the engine.**
- **Each of the devices and the hydraulic oil are hot and under high pressure immediately after operating the machine. If the hydraulic oil reached a high operating temperature, it may cause a burn.**
- **Oil gushing out under pressure has enough force to pierce your skin and may cause you injury. Always allow the temperature to drop and relieve any remaining pressure prior to working to remove any hydraulic equipment.**

RY9212001MBS0004US0


RY9212180HYS047A

1. Remove the cabin.
   (Refer to the chapter "Cabin Removal and Installation Procedure".)

RY9212180HYS0233US0

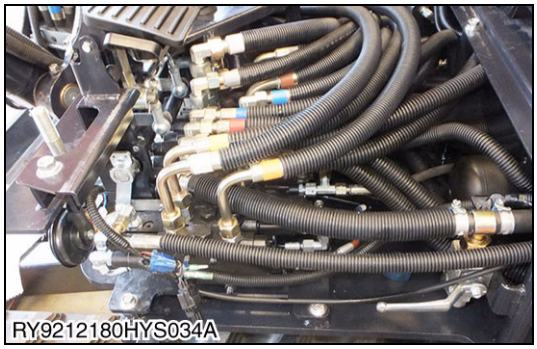


RY9212091HYS172A

2. Remove the step cover and the step.
3. Remove the swivel cover (left) and swivel cover (front) mounting bolts and remove the covers.

(1) Step Cover
(2) Step
(3) Swivel Cover (Left)
(4) Swivel Cover (Front)

RY9212180HYS0059US0

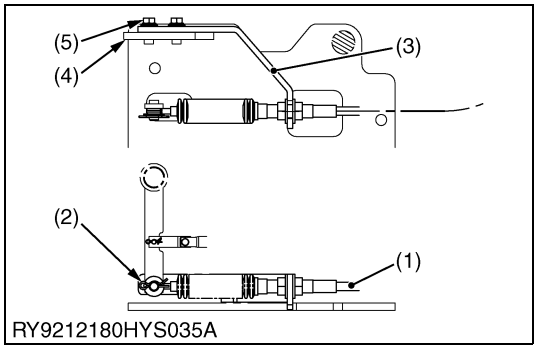

RY9212180HYS034A

4. Attach the breather hose of the hydraulic tank to the vacuum pump, and apply vacuum pressure to the hydraulic tank.
5. Disconnect all hydraulic hoses and electrical wiring from the control valve.

CAUTION

- **Plug all disconnected hydraulic hoses, and affix identification labels on each for reassembly.**

RY9212180HYS0060US0



RY9212180HYS035A

6. Remove the joint pin of the blade cable, and remove the mounting bolt of the blade cable bracket from the control valve bracket.

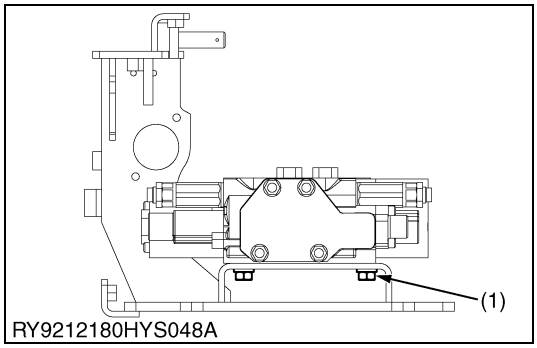
(1) Blade cable
(2) Joint pin
(3) Blade cable bracket
(4) Control valve bracket
(5) Bolt

RY9212180HYS0061US0


RY9212180HYS036A

7. Suspend the control valve bracket and remove the bracket mounting bolts. Operate the crane and remove the control valve bracket.

RY9212180HYS0062US0



RY9212180HYS048A

8. Remove the four bolts and then the control valve.

■ **IMPORTANT**

- **Apply thread lock.**

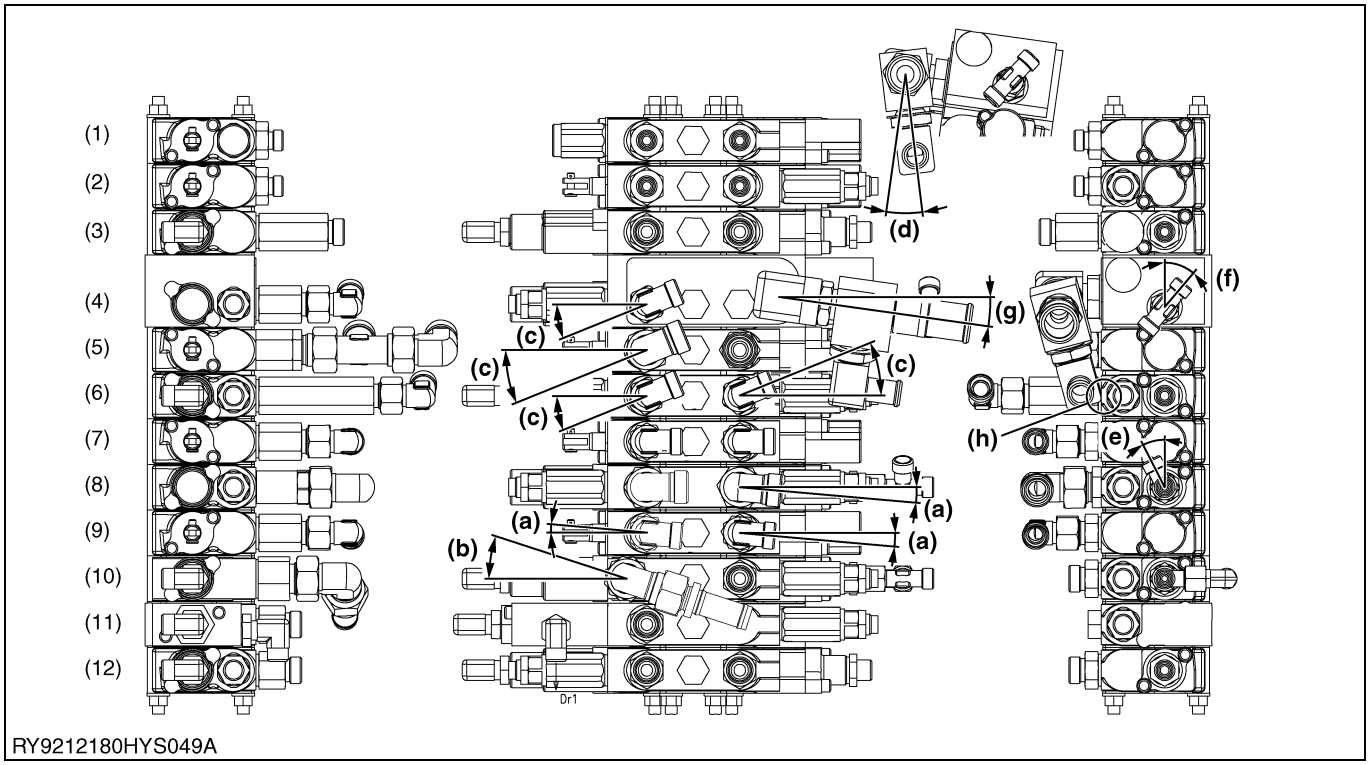
Tightening torque	Bolt (3)	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 lbf·ft

(1) Bolt

RY9212180HYS0063US0

[2] ADAPTER INSTALLATION ANGLE

STD



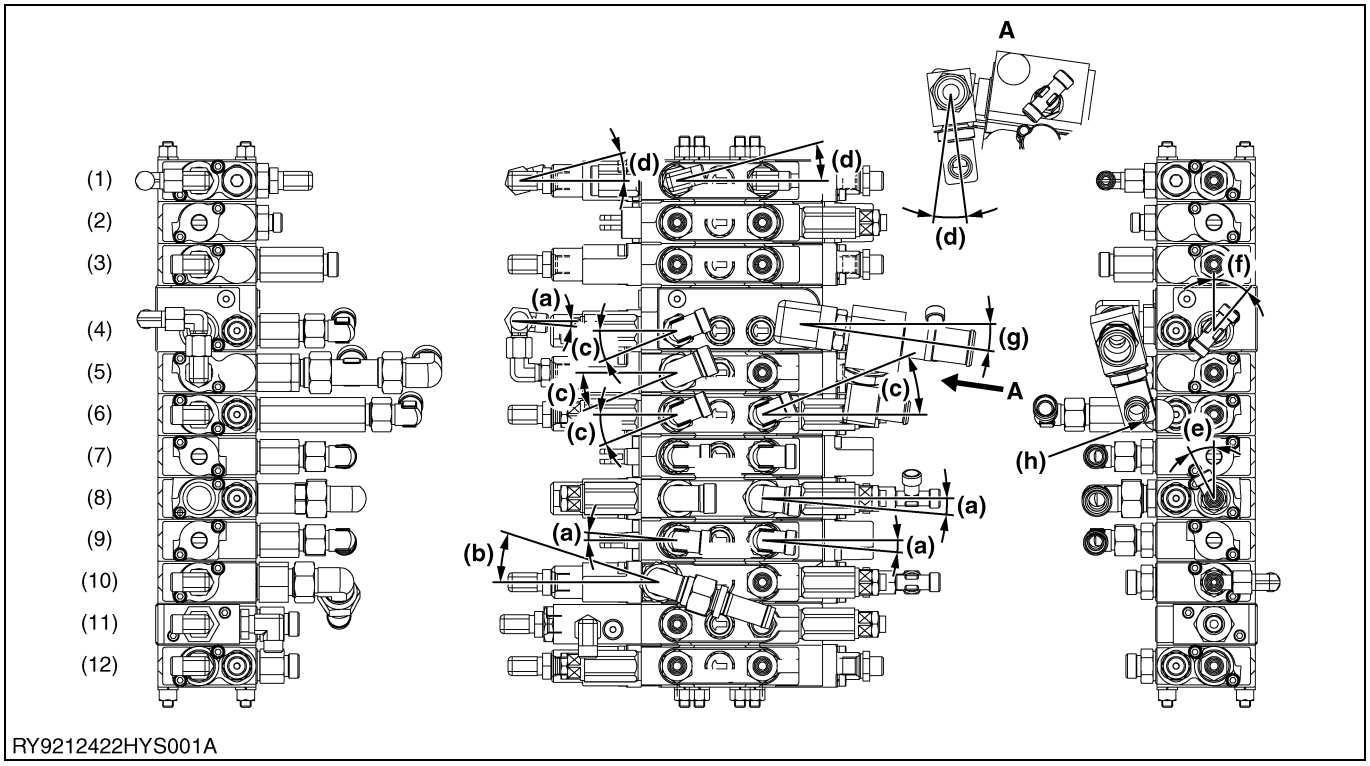
RY9212180HYS049A

(1) Swing
(2) Blade
(3) Swivel
(4) P3, T1
(5) AUX1
(6) Arm
(7) Travel Left
(8) P1, P2
(9) Travel Right
(10) Boom
(11) Boom Lock
(12) Bucket

(a) 5 °
(b) 18 °
(c) 22 °
(d) 15 °
(e) 27 °
(f) 40 °
(g) 8 °
(h) No contact.

RY9212180HYS0246US0

Hi Spec



(1)	AUX2/Swing	(7)	Travel LH	**(a)**	**5 °**	**(g)**	**8 °**
(2)	Blade	(8)	Inlet (P1, P2)	**(b)**	**18 °**	**(h)**	**No Contact**
(3)	Swivel	(9)	Travel RH	**(c)**	**22 °**		
(4)	Confluence (P3, T1)	(10)	Boom	**(d)**	**15 °**		
(5)	AUX1	(11)	Boom Lock	**(e)**	**27 °**		
(6)	Arm	(12)	Bucket	**(f)**	**40 °**		

RY9212422HYS0010US0

[3] CONTROL VALVE DISASSEMBLY/ASSEMBLY PROCEDURES

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).

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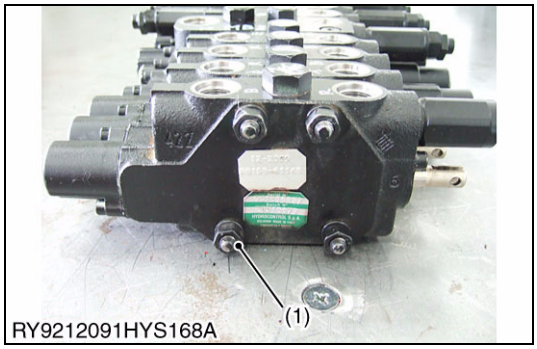


Control Valve Disassembly / Assembly Procedures

1. Loosen the nuts on one side with a ring spanner.

Tightening torque	Nut (four locations)	16.6 to 17.6 N·m 1.7 to 1.8 kgf·m 12.2 to 13.0 lbf·ft

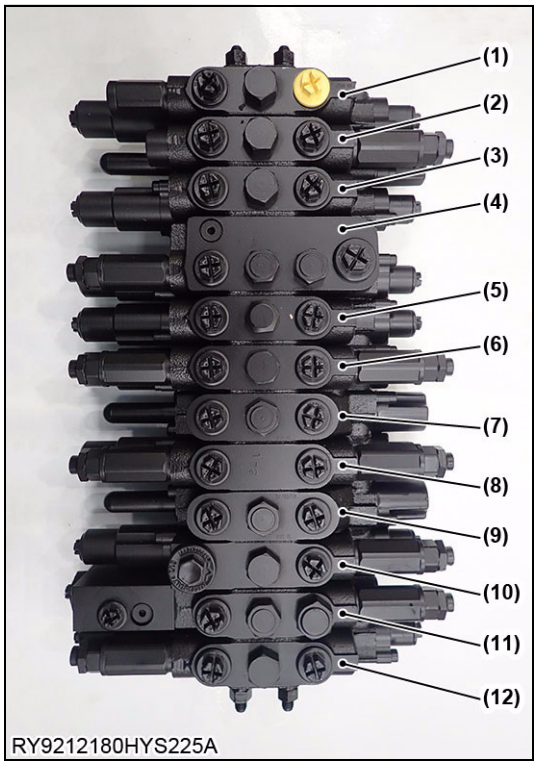
2. Pull out each section with a tie rod, and arrange in order on a workbench.

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.**
- **Align with the holes and insert slowly.**

(1) Nut

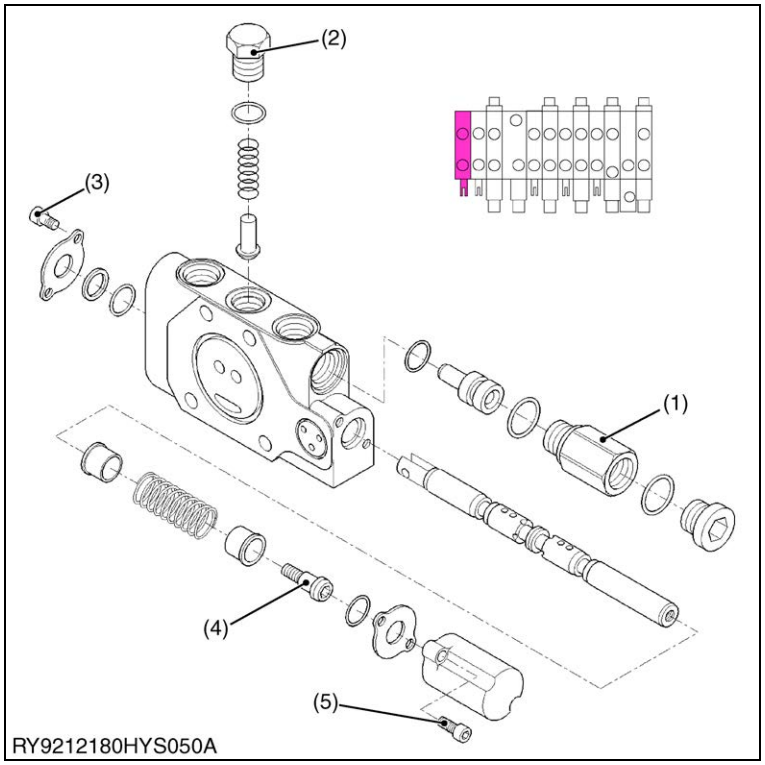
RY9212091HYS0108US0



Control Valve Components (Hi Spec)

(1) Swing / AUX2 Section (Hi Spec)
(2) Blade Section
(3) Swivel Section
(4) Confluence Section
(5) AUX1 Section
(6) Arm Section
(7) Travel Left Section
(8) Inlet Section
(9) Travel Right Section
(10) Boom Section
(11) Boom Anti-Drop Section
(12) Bucket Section

RY9212180HYS0258US0

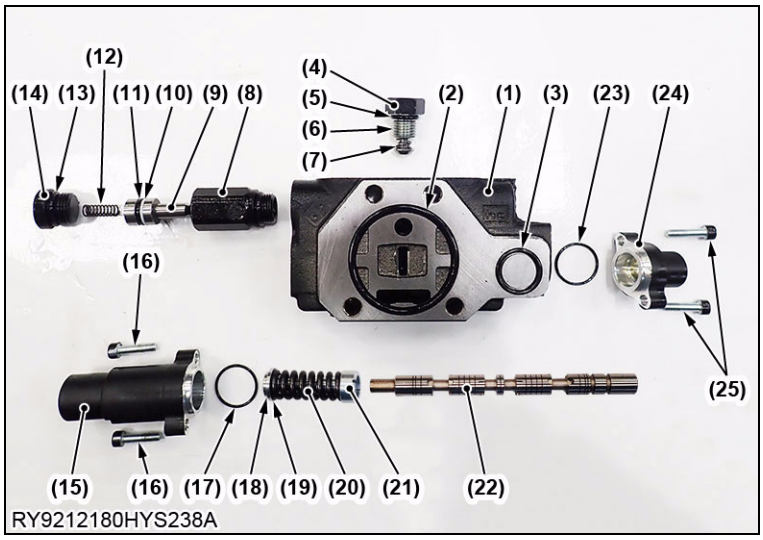


Swing Section (STD)

No.	Part Name	Q'ty	Tightening torque	
(1)	Anti cavitation valve	1	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
(2)	Plug	1	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
(3)	Bolt	2	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	*1
(4)	Bolt	1	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	
(5)	Bolt	2	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

RY9212180HYS0250US0



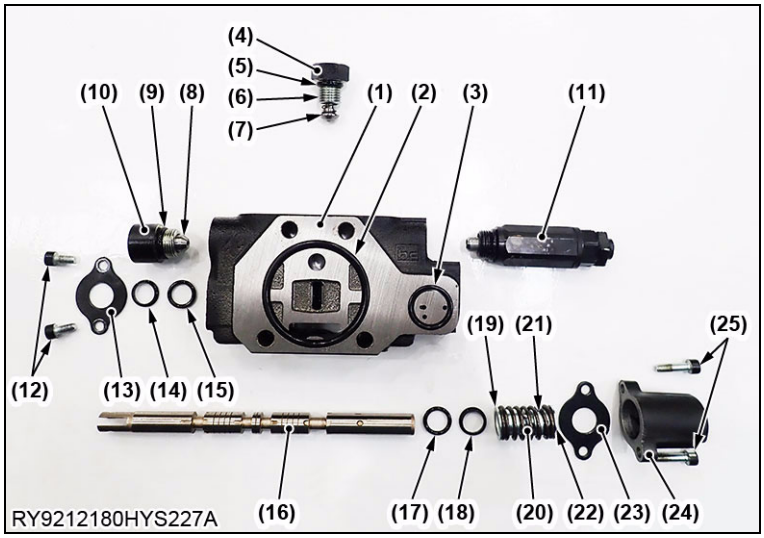
Swing / AUX2 Section (Hi Spec)

Tightening torque	Plug (4)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Anti cavitation valve (8)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cap bolt (16)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (18)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (25)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) Plug
(5) O-Ring
(6) Spring
(7) Poppet
(8) Anti Cavitation Valve
(9) Poppet
(10) Back-Up Ring
(11) O-Ring
(12) Spring
(13) O-Ring
(14) Plug
(15) Cap
(16) Cap Bolt × 2
(17) O-Ring
(18) Screw
(19) Spring Seat
(20) Spring
(21) Spring Seat
(22) Spool
(23) O-Ring
(24) Cap
(25) Cap Bolt × 2

RY9212180HYS0260US0



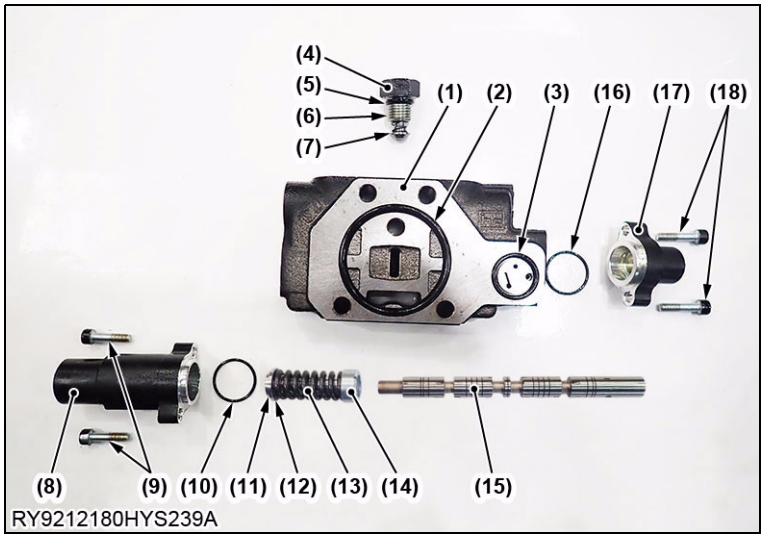
Blade Section

Tightening torque	Plug (4)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Plug (10)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Overload relief valve (11)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cover bolt (12)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (22)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (25)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) Plug
(5) O-Ring
(6) Spring
(7) Poppet
(8) Poppet
(9) O-Ring
(10) Plug
(11) Overload Relief Valve
(12) Cover Bolt × 2
(13) Cover
(14) Wiper Ring
(15) O-Ring
(16) Spool
(17) O-Ring
(18) Wiper Ring
(19) Spring Seat
(20) Spring
(21) Spring Seat
(22) Screw
(23) Cover
(24) Cap
(25) Cap Bolt × 2

RY9212180HYS0261US0



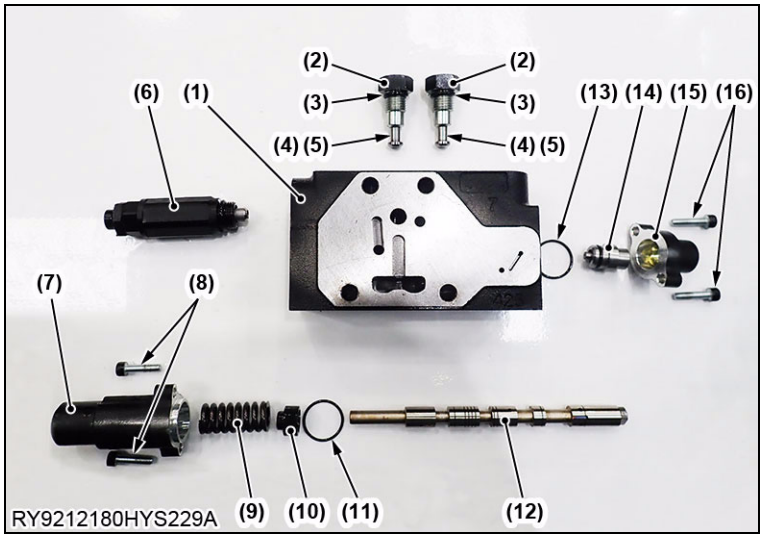
Swivel Section

Tightening torque	Plug (4)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cap bolt (9)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (11)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (18)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) Plug
(5) O-Ring
(6) Spring
(7) Poppet
(8) Cap
(9) Cap Bolt × 2
(10) O-Ring
(11) Screw
(12) Spring Seat
(13) Spring
(14) Spring Seat
(15) Spool
(16) O-Ring
(17) Cap
(18) Cap Bolt × 2

RY9212180HYS0262US0



Confluence Valve Section

Tightening torque	Plug (2)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft
	Main relief valve (6)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft
	Cap bolt (8)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft
	Cap bolt (16)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft

(1) Valve Body
(2) Plug × 2
(3) O-Ring × 2
(4) Spring × 2
(5) Poppet × 2
(6) Main Relief Valve
(7) Cap
(8) Cap Bolt × 2
(9) Spring
(10) Spring Seat
(11) O-Ring
(12) Spool
(13) O-Ring
(14) Piston
(15) Cap
(16) Cap Bolt × 2

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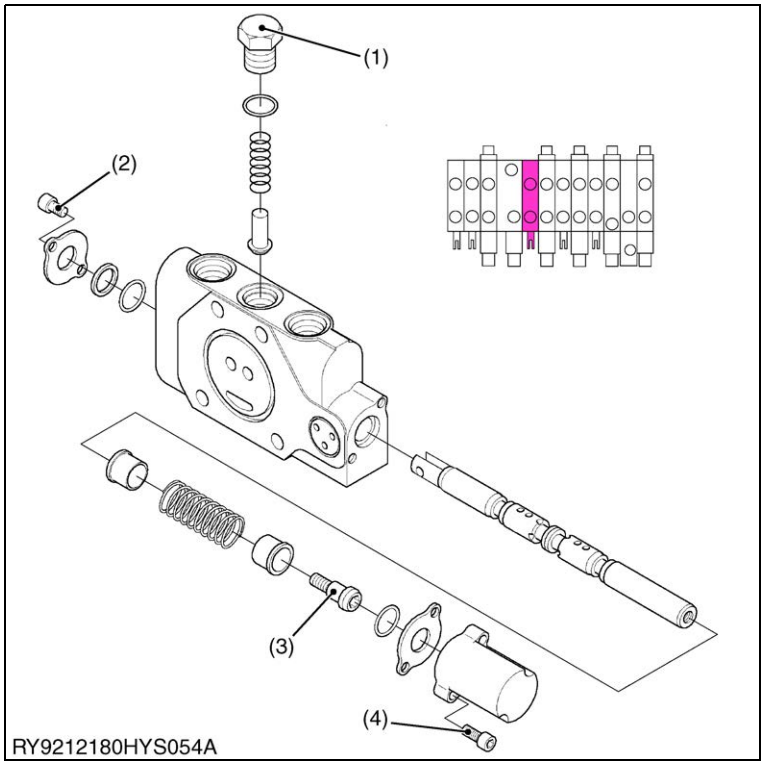

AUX1 Section (STD)

No.	Part Name	Q'ty	Tightening torque	
(1)	Plug	1	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
(2)	Bolt	2	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
(3)	Bolt	1	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
(4)	Bolt	2	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

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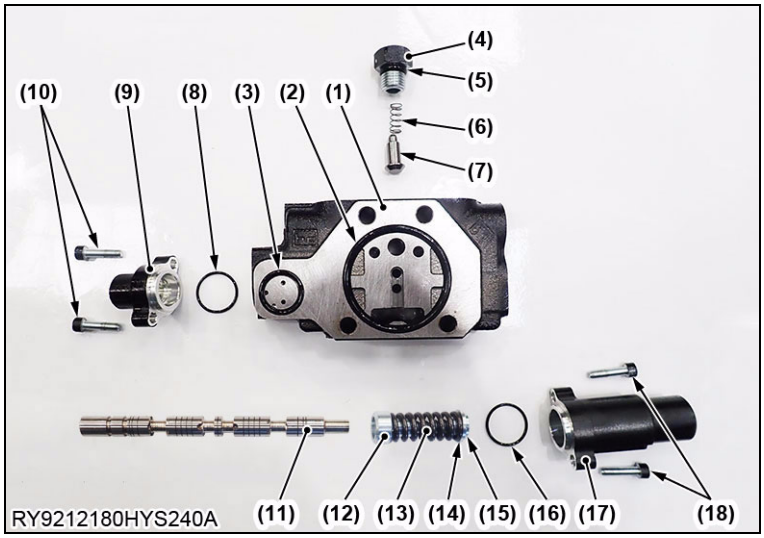


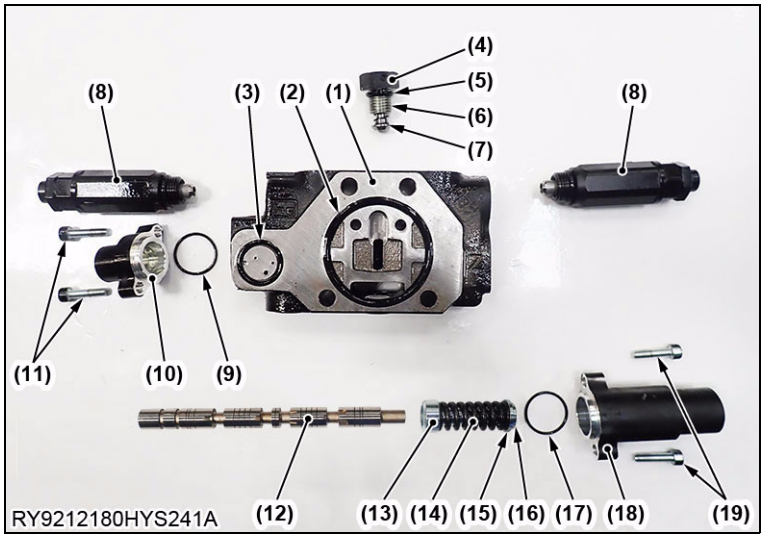
AUX1 Section (Hi Spec)

Tightening torque	Plug (4)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cap bolt (10)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (15)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (18)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) Plug
(5) O-Ring
(6) Spring
(7) Poppet
(8) O-Ring
(9) Cap
(10) Cap Bolt × 2
(11) Spool
(12) Spring Seat
(13) Spring
(14) Spring Seat
(15) Screw
(16) O-Ring
(17) Cap
(18) Cap Bolt × 2

RY9212180HYS0264US0



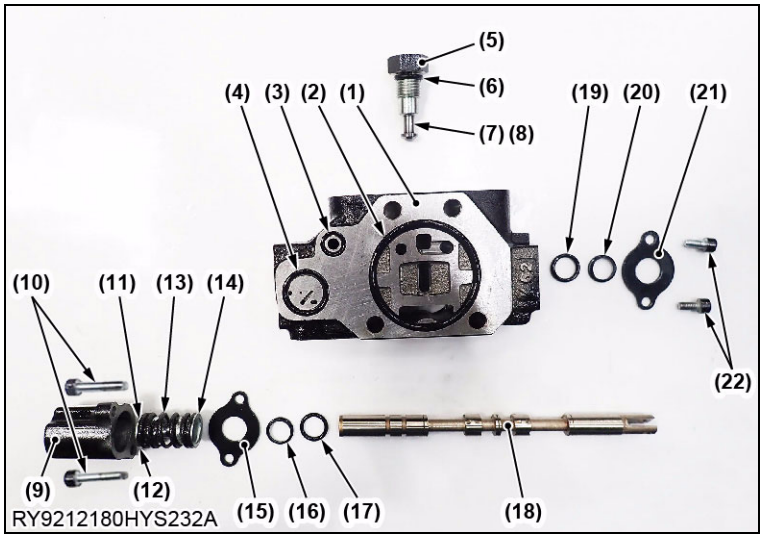
Arm Section

Tightening torque	Plug (4)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Overload relief valve (8)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cap bolt (11)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (16)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (19)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) Plug
(5) O-Ring
(6) Spring
(7) Poppet
(8) Overload Relief Valve × 2
(9) O-Ring
(10) Cap
(11) Cap Bolt × 2
(12) Spool
(13) Spring Seat
(14) Spring
(15) Spring Seat
(16) Screw
(17) O-Ring
(18) Cap
(19) Cap Bolt × 2

RY9212180HYS0265US0



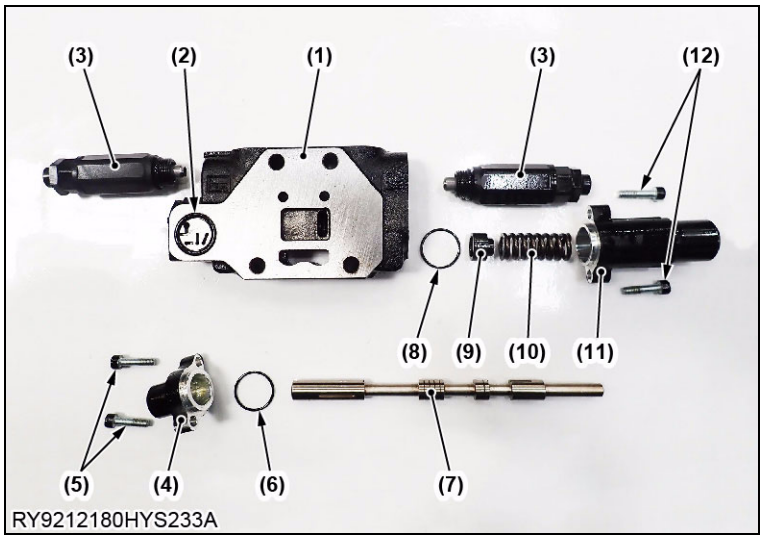
Travel Left Section

Tightening torque	Plug (5)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cap bolt (10)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (11)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cover bolt (22)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) O-Ring
(5) Plug
(6) O-Ring
(7) Spring
(8) Poppet
(9) Cap
(10) Cap Bolt × 2
(11) Screw
(12) Spring Seat
(13) Spring
(14) Spring Seat
(15) Cover
(16) Wiper Ring
(17) O-Ring
(18) Spool
(19) O-Ring
(20) Wiper Ring
(21) Cover
(22) Cover Bolt × 2

RY9212180HYS0266US0

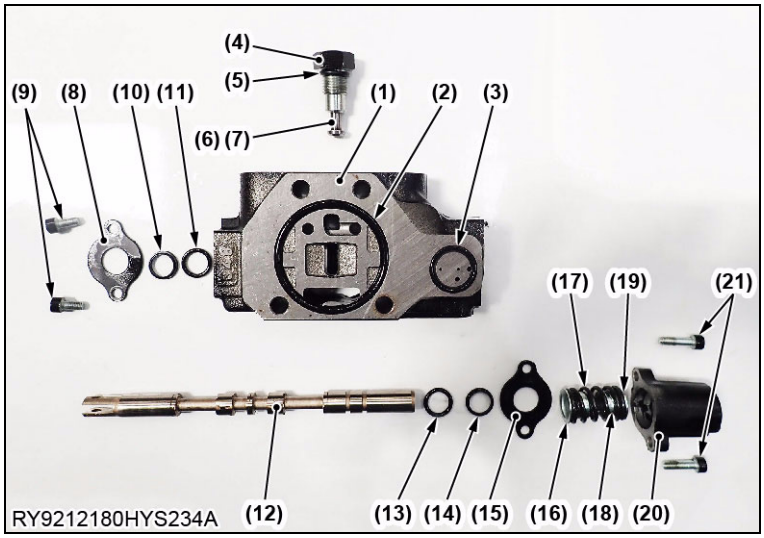


Inlet Section

Tightening torque	Main relief valve (3)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft
	Cap bolt (5)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft
	Cap bolt (12)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft

(1) Valve Body
(2) O-Ring
(3) Main Relief Valve × 2
(4) Cap
(5) Cap Bolt × 2
(6) O-Ring
(7) Spool
(8) O-Ring
(9) Spring Seat
(10) Spring
(11) Cap
(12) Cap Bolt × 2

RY9212180HYS0267US0



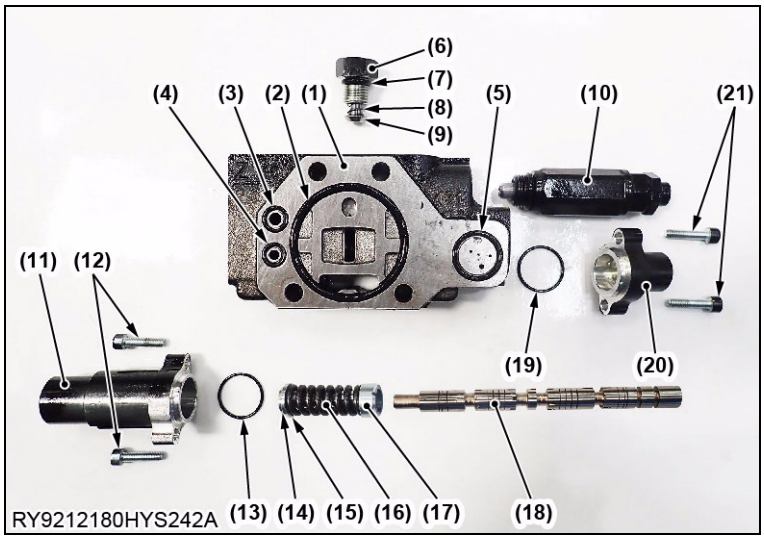
Travel Right Section

Tightening torque	Plug (4)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cover bolt (9)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (19)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (21)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) Plug
(5) O-Ring
(6) Spring
(7) Poppet
(8) Cover
(9) Cover Bolt × 2
(10) Wiper Ring
(11) O-Ring
(12) Spool
(13) O-Ring
(14) Wiper Ring
(15) Cover
(16) Spring Seat
(17) Spring
(18) Spring Seat
(19) Screw
(20) Cap
(21) Cap Bolt × 2

RY9212180HYS0268US0



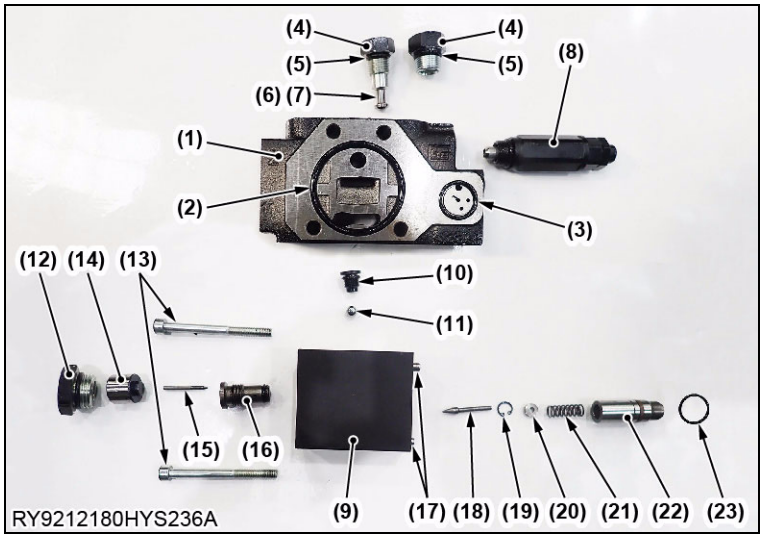
Boom Section

Tightening torque	Plug (6)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Overload relief valve (10)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cap bolt (12)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (14)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (21)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) O-Ring
(5) O-Ring
(6) Plug
(7) O-Ring
(8) Spring
(9) Poppet
(10) Overload Relief Valve
(11) Cap
(12) Cap Bolt × 2
(13) O-Ring
(14) Screw
(15) Spring Seat
(16) Spring
(17) Spring Seat
(18) Spool
(19) O-Ring
(20) Cap
(21) Cap Bolt × 2

RY9212180HYS0269US0

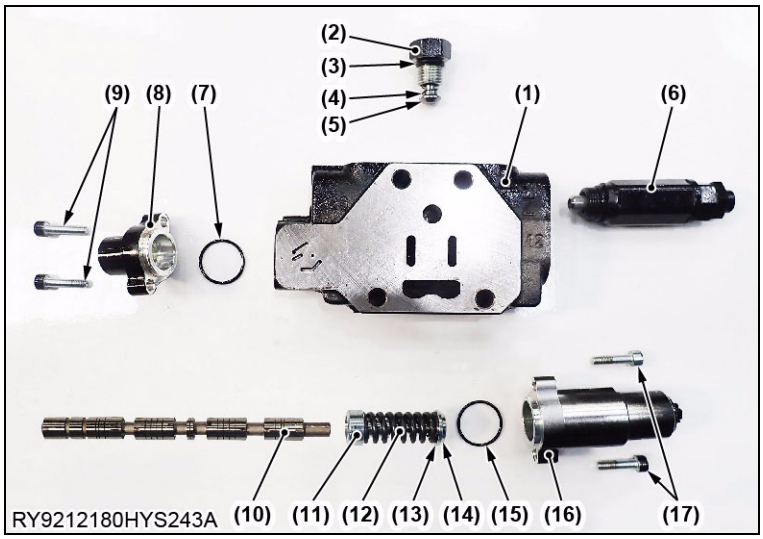


Boom Anti-drop Section

Tightening torque	Plug (4)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft
	Overload relief valve (8)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft
	Plug (10)	18.1 ± 0.49 N·m 1.85 ± 0.05 kgf·m 13.3 ± 0.36 lbf·ft
	Plug (12)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft
	Cap bolt (13)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft
	Plug (16)	18.1 ± 0.49 N·m 1.85 ± 0.05 kgf·m 13.3 ± 0.36 lbf·ft

(1) Valve Body
(2) O-Ring
(3) O-Ring
(4) Plug × 2
(5) O-Ring × 2
(6) Spring
(7) Poppet
(8) Overload Relief Valve
(9) Boom Anti-Drop Valve Body
(10) Plug
(11) Steel Ball
(12) Plug
(13) Cap Bolt × 2
(14) Piston
(15) Boom Anti-Drop Valve Spool
(16) Plug
(17) Pin × 2
(18) Poppet
(19) Circlip
(20) Spring Seat
(21) Spring
(22) Sleeve
(23) O-Ring

RY9212180HYS0270US0



Bucket Section

Tightening torque	Plug (2)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Overload relief valve (6)	39.2 ± 1.96 N·m 4.0 ± 0.2 kgf·m 28.9 ± 1.45 lbf·ft	
	Cap bolt (9)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	
	Screw (14)	4.41 ± 0.49 N·m 0.45 ± 0.05 kgf·m 3.25 ± 0.36 lbf·ft	*1
	Cap bolt (17)	6.37 ± 0.49 N·m 0.65 ± 0.05 kgf·m 4.70 ± 0.36 lbf·ft	

*1: Apply thread lock.

(1) Valve Body
(2) Plug
(3) O-Ring
(4) Spring
(5) Poppet
(6) Overload Relief Valve
(7) O-Ring
(8) Cap
(9) Cap Bolt × 2
(10) Spool
(11) Spring Seat
(12) Spring
(13) Spring Seat
(14) Screw
(15) O-Ring
(16) Cap
(17) Cap Bolt × 2

RY9212180HYS0271US0

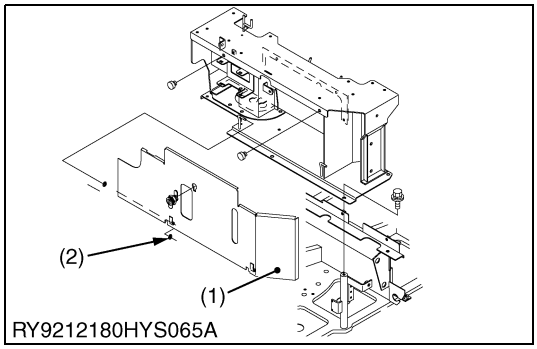
3. SWIVEL MOTOR

[1] SWIVEL MOTOR REMOVAL AND INSTALLATION

CAUTION

- **When removing a hydraulic device after operating the machine, lower the bucket and blade to the ground and turn off the engine.**
- **Each of the devices and the hydraulic oil are hot and under high pressure immediately after operating the machine. If the hydraulic oil reached a high operating temperature, it may cause a burn.**
- **Oil gushing out under pressure has enough force to pierce your skin and may cause you injury. Always allow the temperature to drop and relieve any remaining pressure prior to working to remove any hydraulic equipment.**

RY9212001MBS0004US0



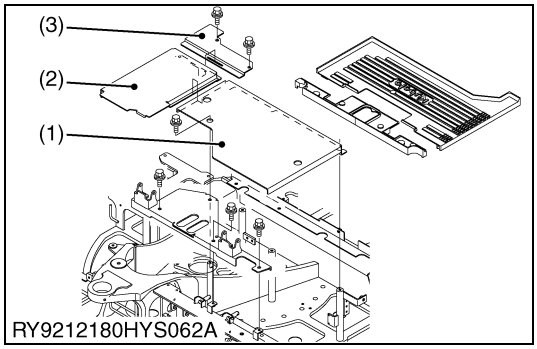
RY9212180HYS065A

Removing Seat Support Cover

1. Remove the circlip and then the seat support cover.

(1) Seat support cover (2) Circlip

RY9212180HYS0237US0



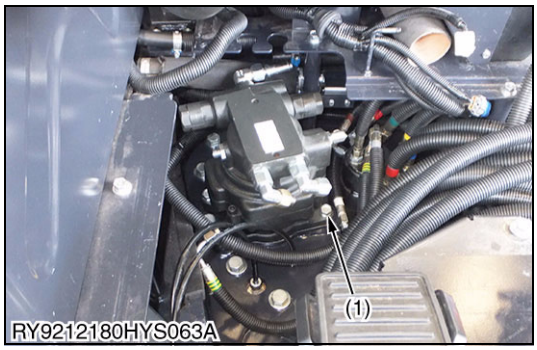
RY9212180HYS062A

Removing the step

1. Remove the step.

(1) Step (LH) (3) Step (RH Support)
(2) Step (RH)

RY9212180HYS0075US0



RY9212180HYS063A

Removing the Swivel Motor

1. Remove the hydraulic hoses around the swivel motor from the motor side.
2. Remove the four swivel motor ASSY mounting bolts.

■ **IMPORTANT**

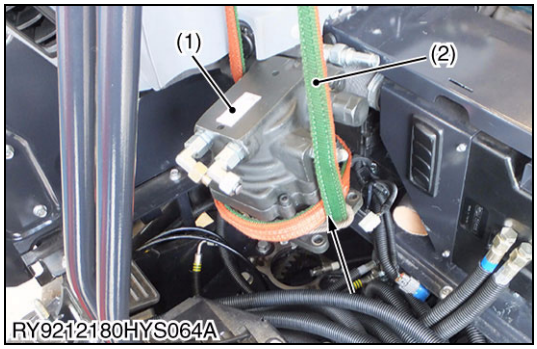
- **Apply thread lock (Loctite AN302-71 equivalent).**

Tightening torque	Swivel motor ASSY	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.7 lbf·ft

(1) Bolt

RY9212180HYS0076US0

3. Suspend the motor ASSY (swivel) from a nylon sling and hoist it up with a crane.



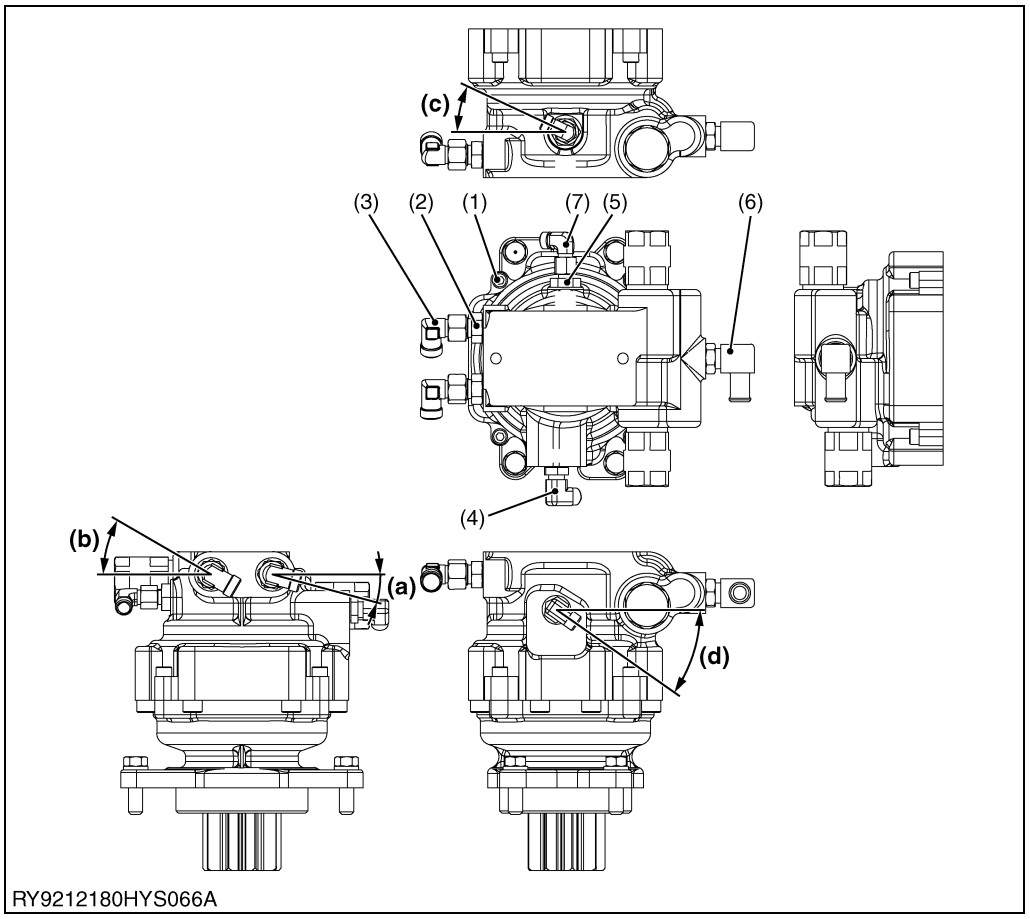
RY9212180HYS064A

(1) Motor ASSY (Swivel) (2) Nylon Sling

RY9212180HYS0077US0

[2] ADAPTER INSTALLATION ANGLES

STD



RY9212180HYS066A

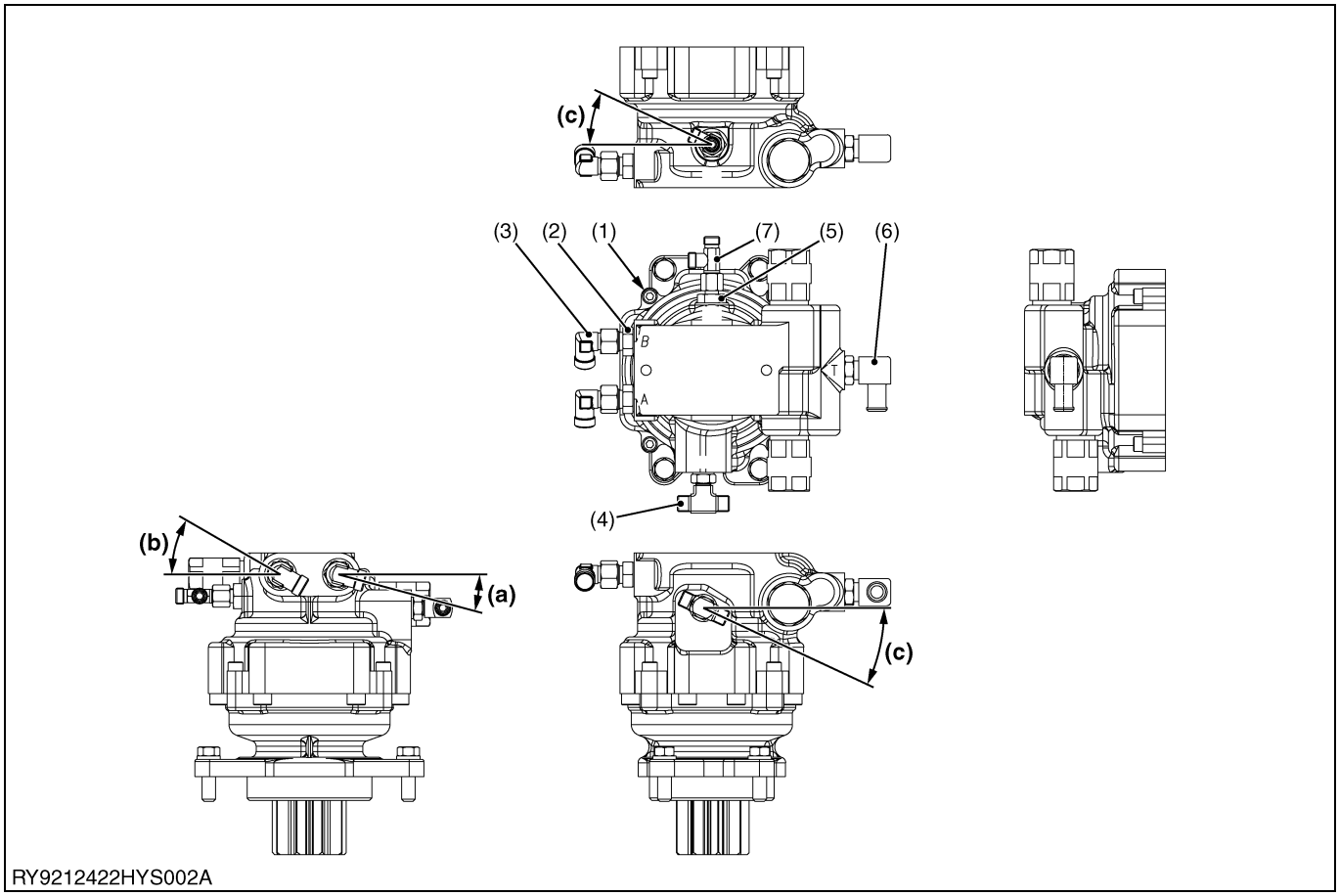
(1) Swivel motor assembly
(2) O-ring type adapter (G3/8-M18 x 1.5)
(3) Adapter (M18 x 1.5)
(4) Joint pipe
(5) O-ring type adapter (G3/8-M14 x 1.5)
(6) Joint pipe
(7) Elbow pipe

(a) 13 °
(b) 27 °
(c) 24 °
(d) 35 °

Tightening Torque	Adapter (3), (5)	45 to 65 N·m 4.6 to 6.6 kgf·m 33 to 48 lbf·ft

RY9212180HYS0247US0

Hi Spec



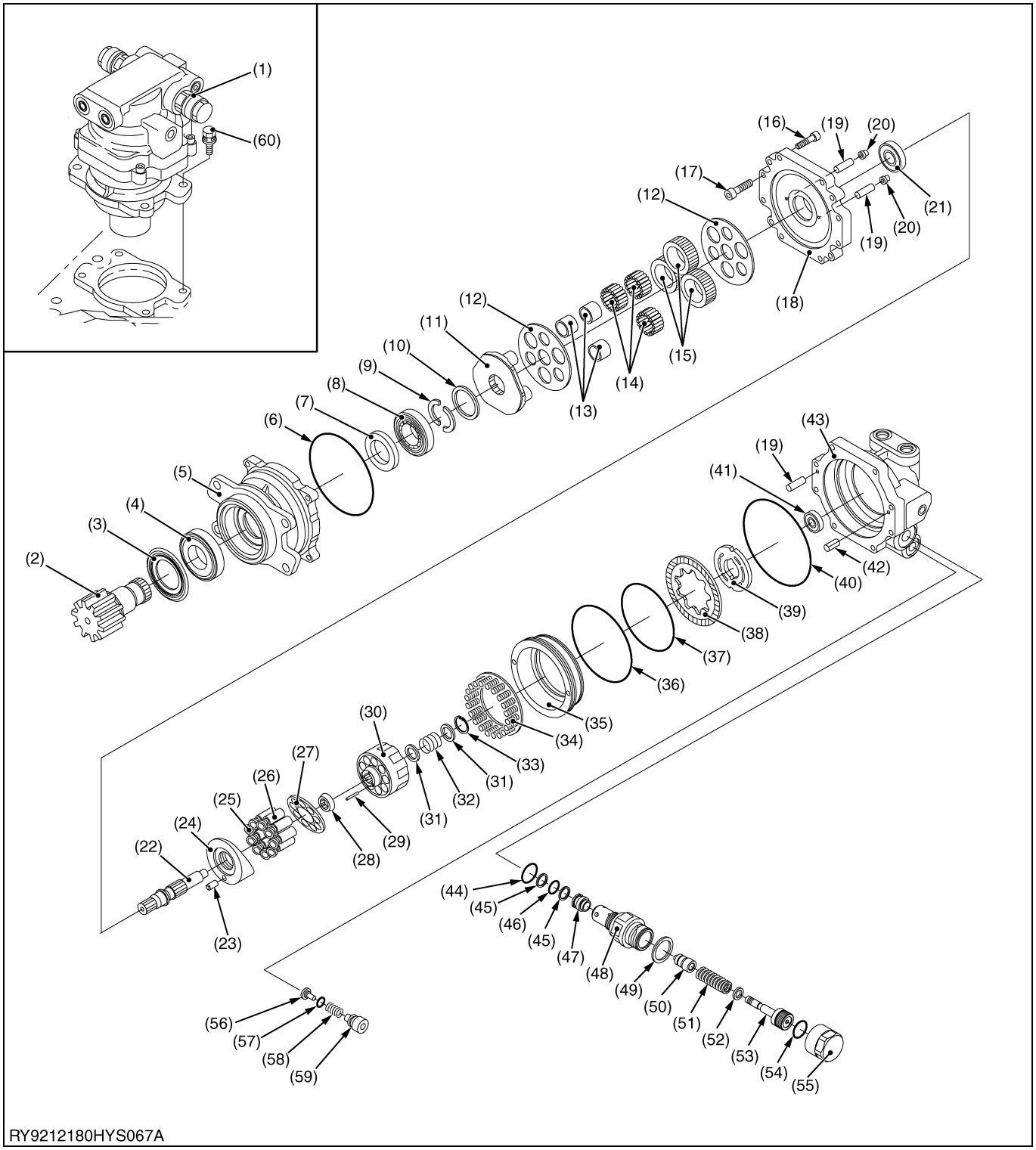
RY9212422HYS002A

(1) Swivel Motor Assembly
(2) O-Ring Type Adapter (G3/8-M14 × 1.5)
(3) Adapter (M18 × 1.5)
(4) Joint
(5) O-Ring Type Adapter (G3/8-M14 × 1.5)
(6) Joint Pipe
(7) Elbow Pipe

(a) 15 °
(b) 27 °
(c) 25 °

RY9212422HYS0011US0

[3] SWIVEL MOTOR DISASSEMBLY/ASSEMBLY PROCEDURES



RY9212180HYS067A

(To be continued)

(Continued)

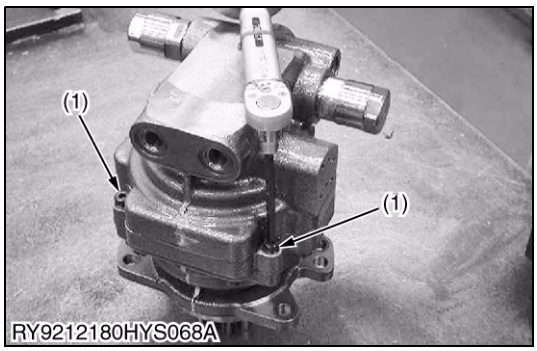
No.	Name of part	Quantity	Notes	No.	Name of part	Quantity	Notes
(1)	Swivel motor assembly	1		(31)	Retainer	2	
(2)	Pinion shaft	1		(32)	Spring C	1	
(3)	Ring seal	1		(33)	Snap ring	1	
(4)	Bearing	1		(34)	Spring assembly	1	
(5)	Body	1		(35)	Brake piston	1	
(6)	Ring seal	1		(36)	O-ring	1	JIS B2401 Class 1B G125
(7)	O-ring	1	JIS B2401 Class 1B G135	(37)	O-ring	1	JIS B2401 Class 1B G110
(8)	Oil seal	1		(38)	Disk plate	1	
(9)	Preload collar	2		(39)	Valve plate	1	
(10)	Ring	1		(40)	O-ring	1	JIS B2401 Class 1B G140
(11)	Carrier 1	1		(41)	Bearing	1	JIS B1521 6201
(12)	Thrust plate	2		(42)	Spring pin	1	JIS B2808 5x12 AW
(13)	Ring	3		(43)	Body H	1	
(14)	Needle	54		(44)	O-ring	2	JIS B2401 Class 1B P22
(15)	B1 gear	3		(45)	Backup ring	4	JIS B2407 T P14
(16)	Screw	4	JIS B1176 M8x35	(46)	O-ring	2	JIS B2401 Class 1B P14
(17)	Screw	8	JIS B1176 M10x35	(47)	Seat	2	
(18)	Plate S	1		(48)	Retainer	2	
(19)	Pin	3		(49)	O-ring	2	JIS B2401 Class 1B P28
(20)	Filter	2		(50)	Poppet	2	
(21)	Bearing	1	JIS B1521 6204Z	(51)	Spring	2	
(22)	Shaft	1		(52)	Spacer	2	
(23)	Pin	1	JIS B1354 B 8x15	(53)	Piston	2	
(24)	Swash-plate	1		(54)	O-ring	2	JIS B2401 Class 1B P18
(25)	Shoe	9		(55)	Cap	2	
(26)	Piston	9		(56)	Check valve	4	
(27)	Shoe holder	1		(57)	O-ring	4	JIS B2401 Class 1B P11
(28)	Barrel holder	1		(58)	Spring	4	
(29)	Pin	3		(59)	Plug	4	
(30)	Cylinder barrel	1		(60)	Screw	4	

RY9212180HYS0078US0

(1) Disassembly Procedures

Prior to disassembly, clean the work area and prepare plastic containers to hold parts.
Clean the areas around motor ports and brush off the paint at each joint with a wire brush.

RY9212091HYS0148US0

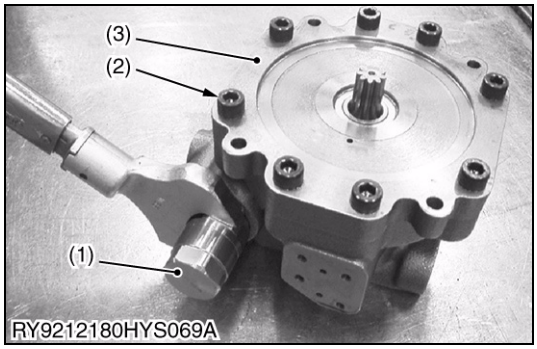


Hydraulic motor

1. Remove the bolt, and then the hydraulic motor assembly from the decelerator unit.

(1) Bolt

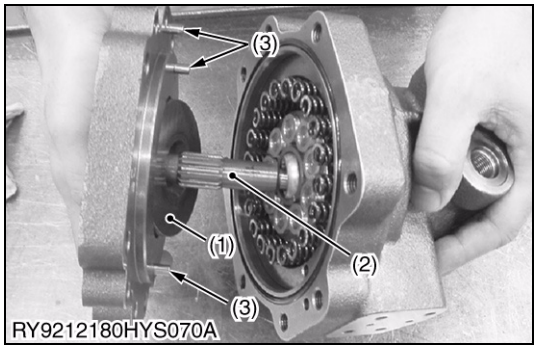
RY9212180HYS0091US0



2. Remove the relief valve assembly. Remove the bolts and then plate S.

(1) Relief valve assembly
(2) Bolt
(3) Plate S

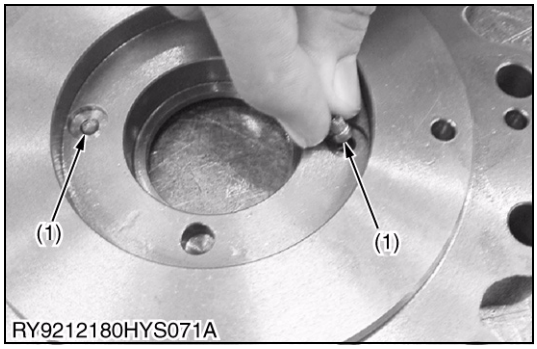
RY9212180HYS0092US0



3. Remove the swash plate and the shaft kit.

(1) Swash-plate
(2) Shaft kit
(3) Pin

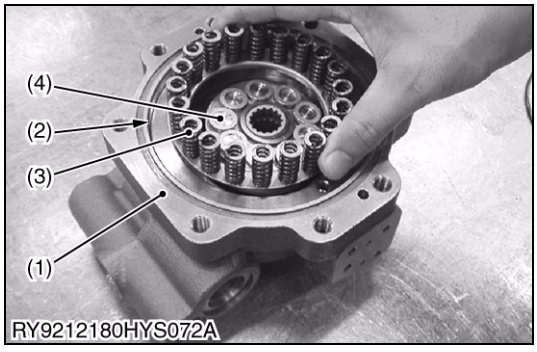
RY9212180HYS0093US0



4. Remove two filters and three pins.

(1) Filter

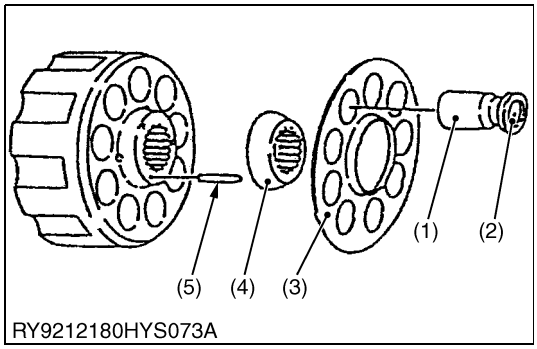
RY9212180HYS0094US0



5. Remove in the order of O-ring, spring assembly and cylinder barrel kit.

(1) Body H
(2) O-ring
(3) Spring assembly
(4) Cylinder barrel kit

RY9212180HYS0095US0

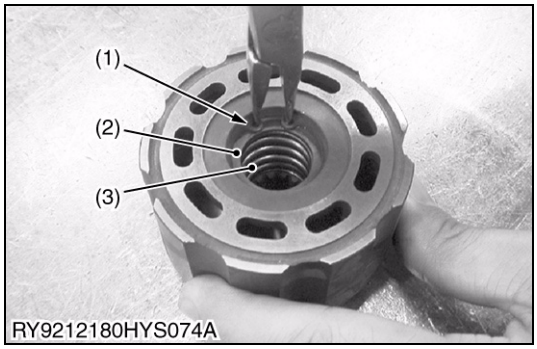


RY9212180HYS073A

6. Disassemble the cylinder barrel kit.

(1) Piston
(2) Shoe
(3) Shoe holder
(4) Barrel holder
(5) Pin

RY9212180HYS0096US0

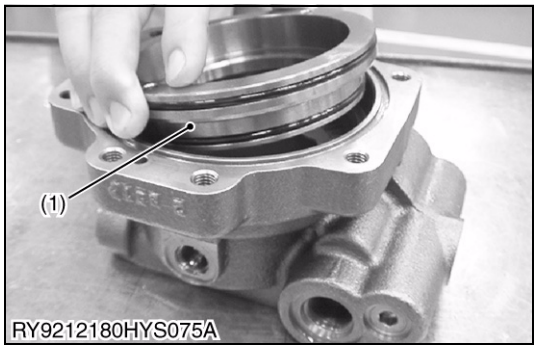


RY9212180HYS074A

7. Remove the snap ring, retainer and spring C.

(1) Snap ring
(2) Retainer
(3) Spring C

RY9212180HYS0097US0



RY9212180HYS075A

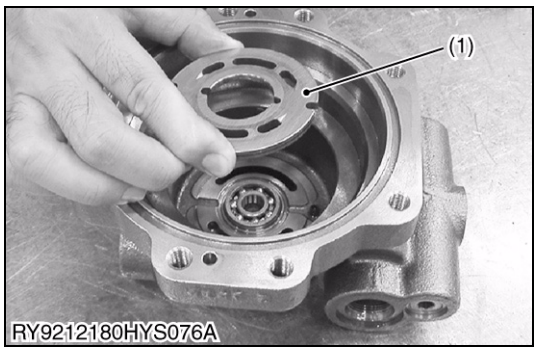
8. Insert compressed air into PP port, remove the brake piston from the body H and then the O-ring.

CAUTION

- **If compressed air is injected suddenly, the brake piston jumps out suddenly.**

(1) Brake piston

RY9212180HYS0098US0

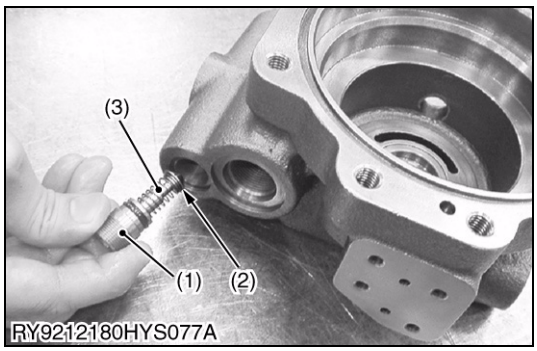


RY9212180HYS076A

9. Remove in the order of disk plate and valve plate.

(1) Valve plate

RY9212180HYS0099US0

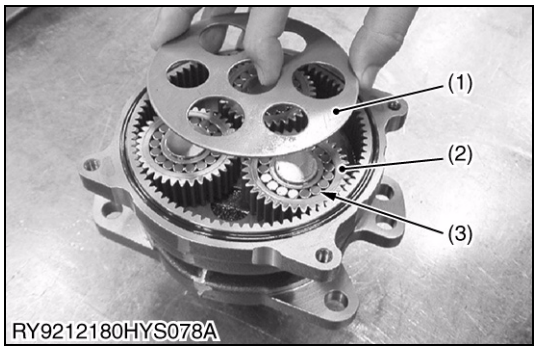


RY9212180HYS077A

10. Remove the plug, then check valve and spring.

(1) Plug
(2) Check valve
(3) Spring

RY9212180HYS0100US0

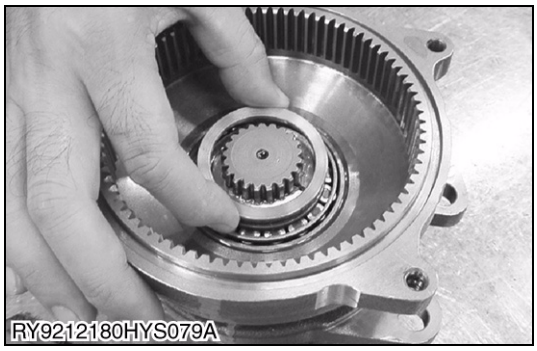


Decelerator

1. Remove the thrust plate. Remove carrier 1, b1 gear, needle and ring.

(1) Thrust plate
(2) b1 gear
(3) Needle

RY9212180HYS0101US0

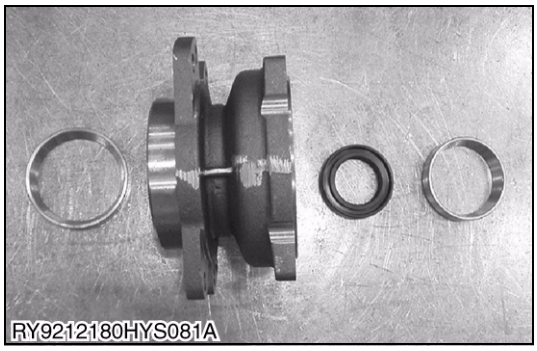


2. Remove the ring and preload collar.

RY9212180HYS0102US0

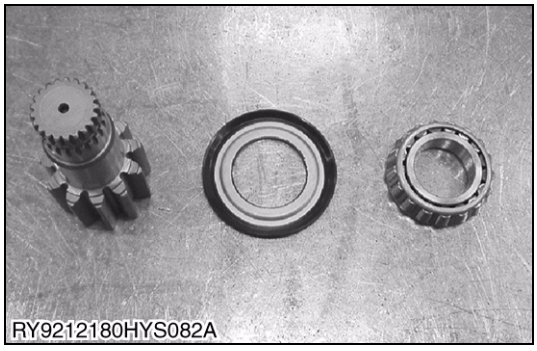
3. Remove the pinion shaft.

RY9212180HYS0103US0



4. Remove the bearing (outer tire) and oil seal.

RY9212180HYS0104US0



5. Remove the bearing (inner tire) and ring seal.

■ **IMPORTANT**

- **Bearings are press-fitting parts, so do not disassemble them when not needed.**

RY9212180HYS0105US0

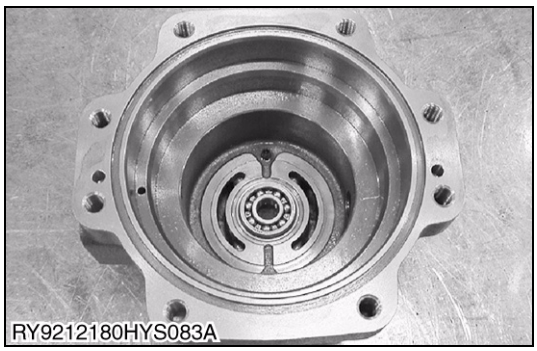
(2) Assembly Procedures

Inspect the mating surfaces of each part.
Any scratches or burrs may cause a leak.
Wash each part off in solvent and dry them with a dryer or compressed air.
Do not wipe parts off with cloth or paper towels as their lint may stick to the parts and cause trouble.

CAUTION

- **Replace used seals with new ones. Also, apply grease to the seals in advance.**

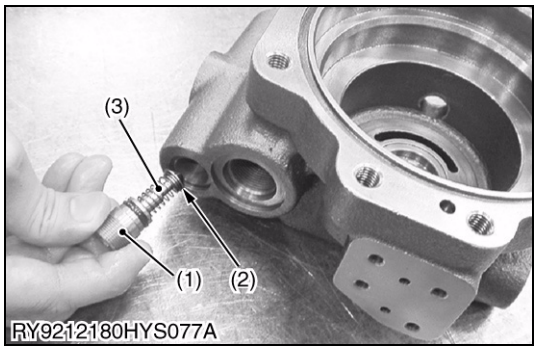
RY9212091HYS0157US0


RY9212180HYS083A

Hydraulic motor

1. Press fit the bearing into body H.

RY9212180HYS0106US0

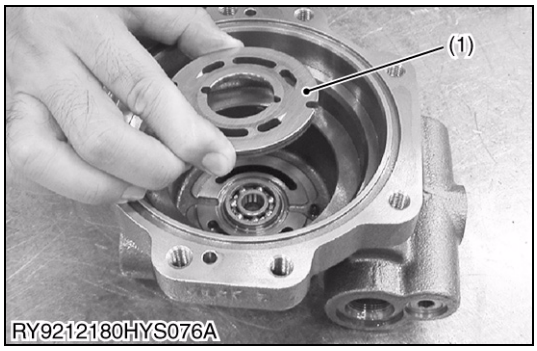


RY9212180HYS077A

2. Install check valve, springs and plugs.

(1) Plug
(2) Check valve
(3) Spring

RY9212180HYS0107US0

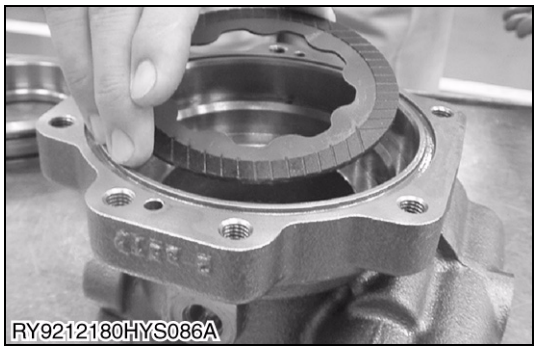


RY9212180HYS076A

3. Install the valve plate with the iron face down.

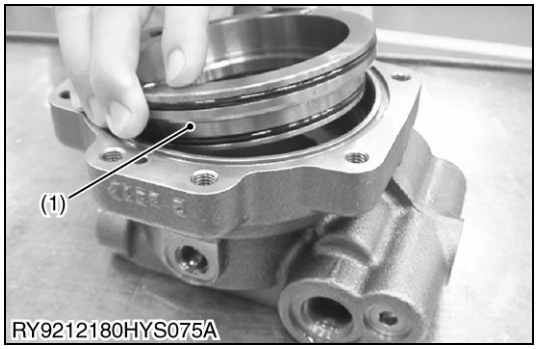
(1) Valve plate

RY9212180HYS0108US0


RY9212180HYS086A

4. Install the disk plate.

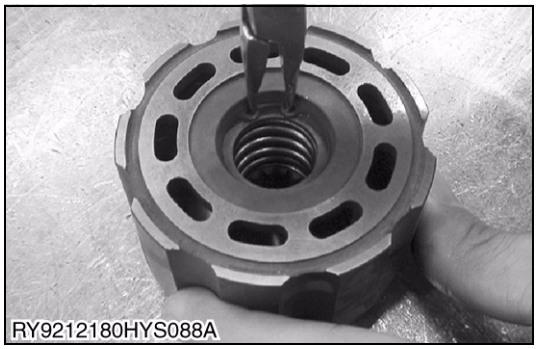
RY9212180HYS0109US0



5. Install the brake piston assembly.

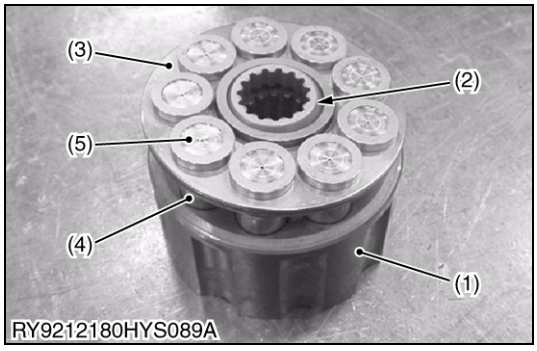
(1) Brake piston assembly

RY9212180HYS0110US0



6. Install the retainer and spring C on the cylinder barrel and secure it with the snap ring.

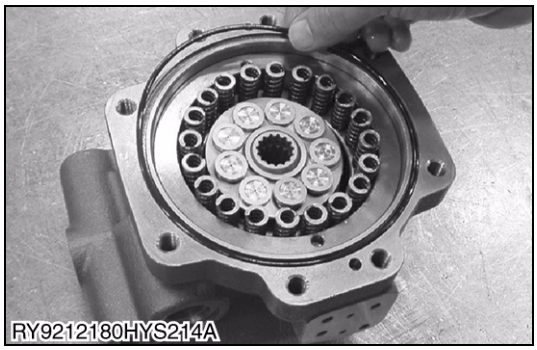
RY9212180HYS0111US0



7. Install three pins, barrel holder, and shoe holder on the cylinder barrel in this order and build the cylinder barrel assembly.

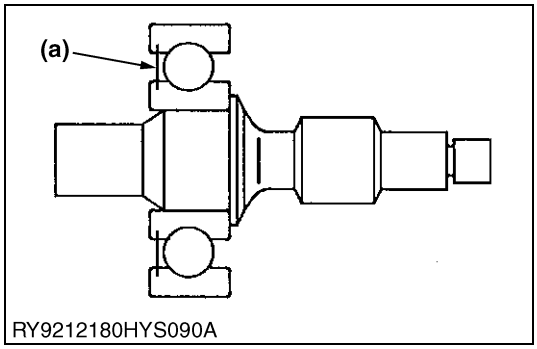
(1) Cylinder barrel
(2) Barrel holder
(3) Shoe holder
(4) Piston
(5) Shoe

RY9212180HYS0112US0



8. Install the cylinder barrel assembly. Install the spring assembly. Install the O-rings.

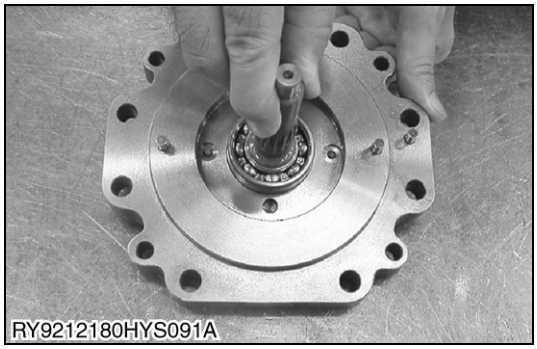
RY9212180HYS0113US0



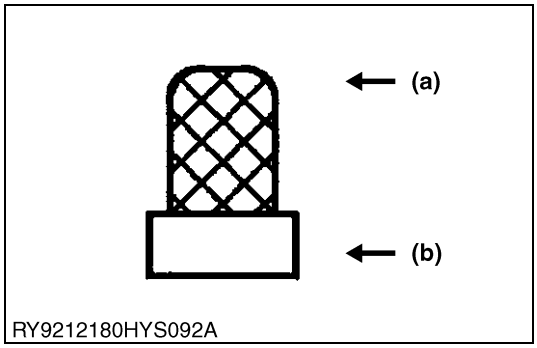
9. Press fit the bearing into shaft.

(a) Shield side

RY9212180HYS0114US0


RY9212180HYS091A

10. Install two filters on plate S. Install the shaft assembly.

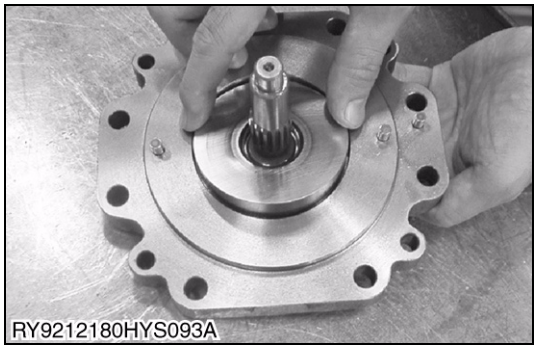


RY9212180HYS092A

■ **IMPORTANT**
- **Be careful of the installation direction of the filter.**

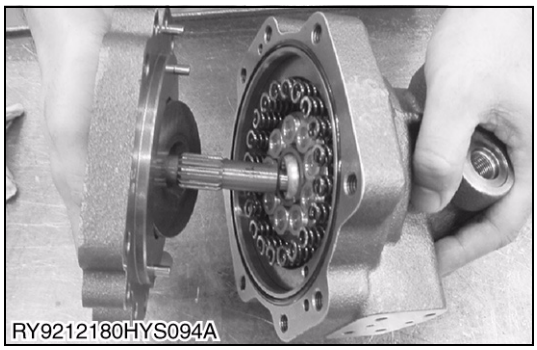
(a) Inserting hole entrance side **(b) Inserting hole back side**

RY9212180HYS0115US0


RY9212180HYS093A

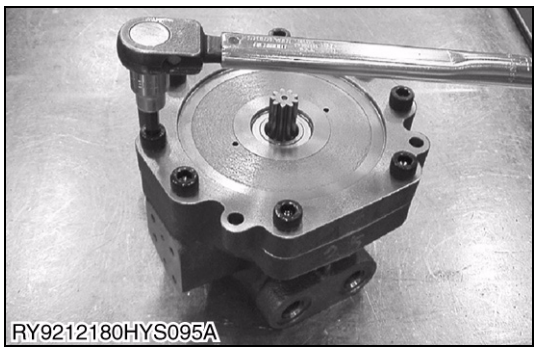
11. Install the swash plate.

RY9212180HYS0116US0


RY9212180HYS094A

12. Fit together the body H and plate S.

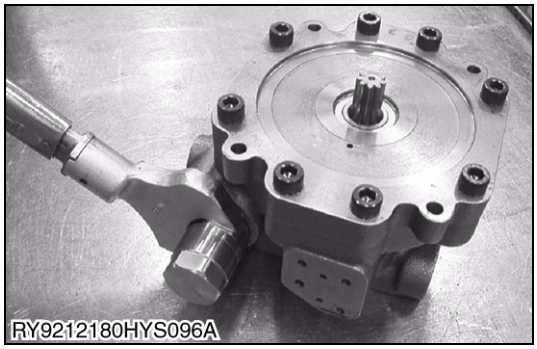
RY9212180HYS0117US0


RY9212180HYS095A

13. Tighten the bolt.

Tightening torque	Bolt	59 N·m 6.0 kgf·m 44 lbf·ft

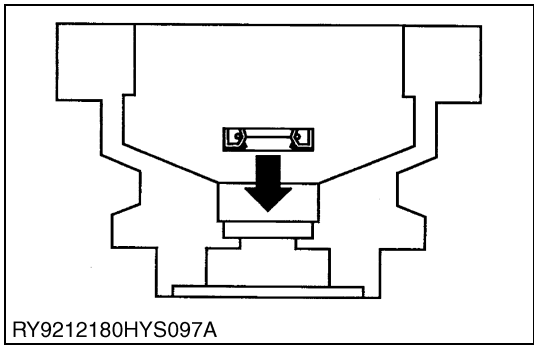
RY9212180HYS0118US0


RY9212180HYS096A

14. Install the relief valve.

Tightening torque	Relief valve	147 N·m 15 kgf·m 108 lbf·ft

RY9212180HYS0119US0

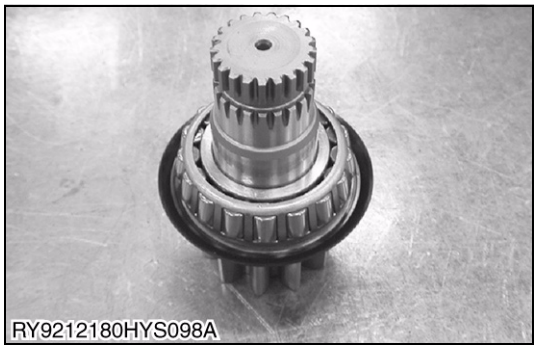

RY9212180HYS097A

Decelerator

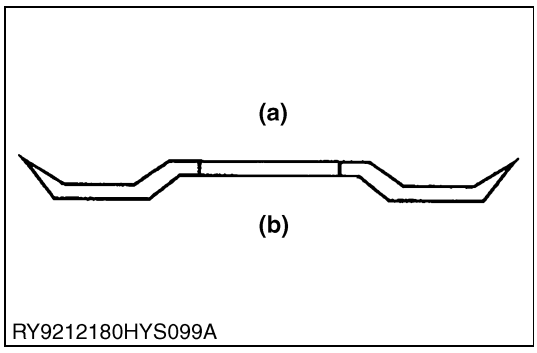
1. Press fit the oil seal.

■ **IMPORTANT**
- **Be careful of the installation direction and install so that it will not tilt.**

RY9212180HYS0120US0


RY9212180HYS098A

2. Install the ring seal on the pinion shaft.

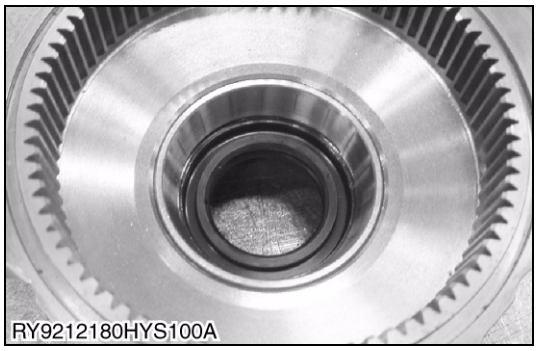


RY9212180HYS099A

■ **IMPORTANT**
- **Be careful of the installation direction.**

(a) Bearing side **(b) Pinion side**

RY9212180HYS0121US0


RY9212180HYS100A

3. Press fit the bearing (outer tire) into the body.

RY9212180HYS0122US0


RY9212180HYS101A

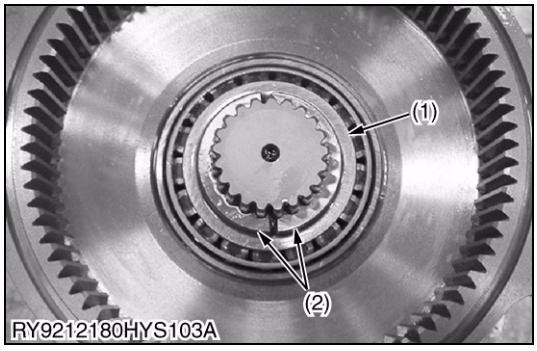
4. Press fit the bearing (outer tire) into the body.

RY9212180HYS0123US0


RY9212180HYS102A

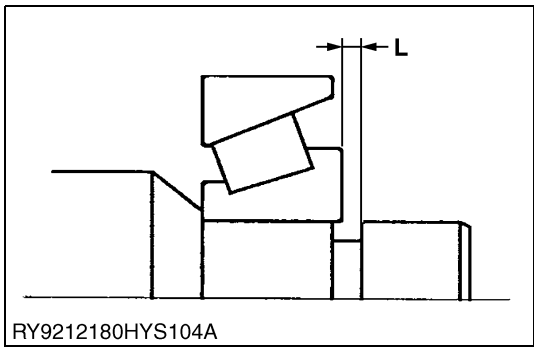
5. Insert grease into the bearing section of the body. Insert the pinion shaft into the body.

RY9212180HYS0124US0



RY9212180HYS103A

6. Turn the body over and press fit the bearing (inner tire). Install the preload collar.



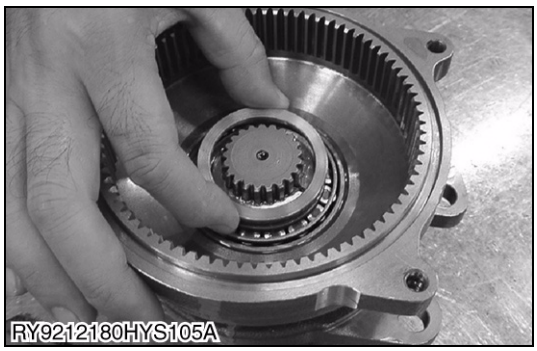
RY9212180HYS104A

■ **IMPORTANT**

- **Make the preload collar 0 to 0.05 mm thicker than the measured value Lof the width between the bearing end face and the groove end face of pinion shaft side.**

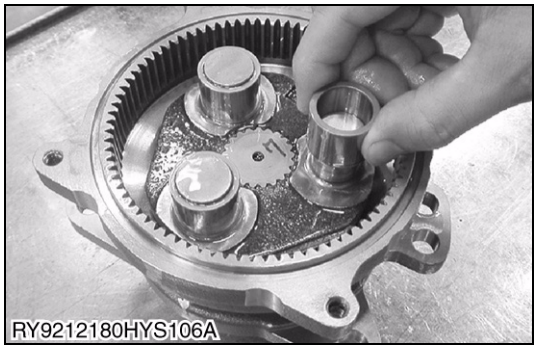
(1) Bearing (inner tire) (2) Preload collar

RY9212180HYS0125US0


RY9212180HYS105A

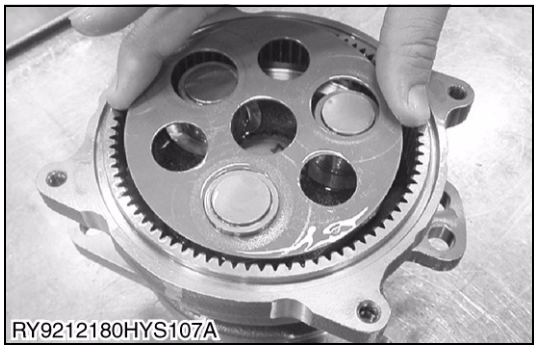
7. Install the ring.

RY9212180HYS0126US0


RY9212180HYS106A

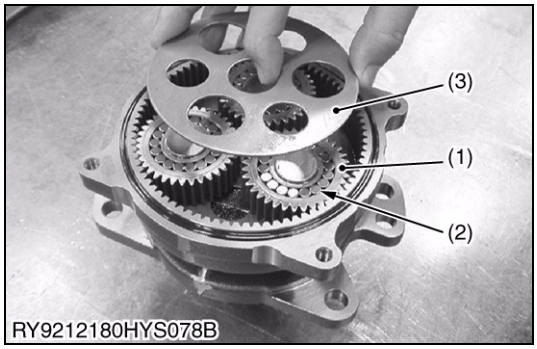
8. Install carrier 1. Install the ring on the shaft of carrier 1.

RY9212180HYS0127US0


RY9212180HYS107A

9. Mount the thrust plate.

RY9212180HYS0128US0

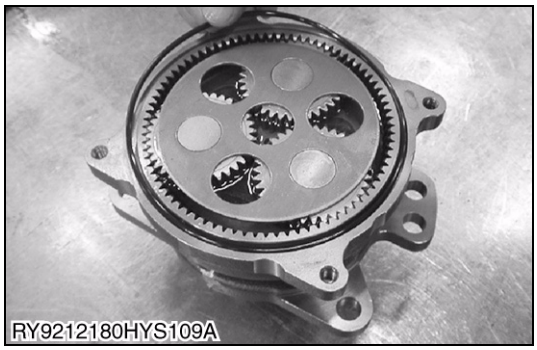


RY9212180HYS078B

10. Install the b1 gear and then the needle on the shaft of carrier 1. Mount the thrust plate.

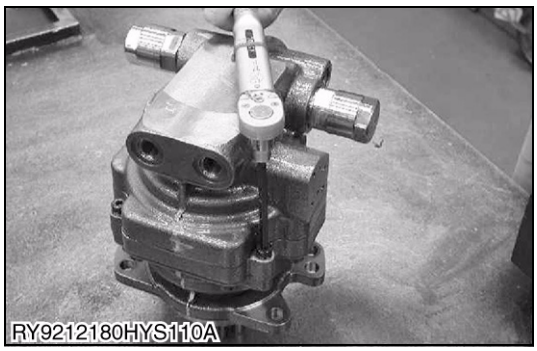
(1) b1 gear
(2) Needle
(3) Thrust plate

RY9212180HYS0129US0


RY9212180HYS109A

11. Fill hydraulic oil into the body up to 3 to 4 mm below from the top of the thrust plate. Install the O-rings.

RY9212180HYS0130US0


RY9212180HYS110A

12. Install the hydraulic motor and body with bolts.

■ **IMPORTANT**

- **Apply thread lock (ThreeBond #1305 or equivalent).**

Tightening torque	Bolt	29 N·m 3.0 kgf·m 22 lbf·ft

RY9212180HYS0131US0

4. SWIVEL JOINT

[1] SWIVEL JOINT REMOVAL AND INSTALLATION

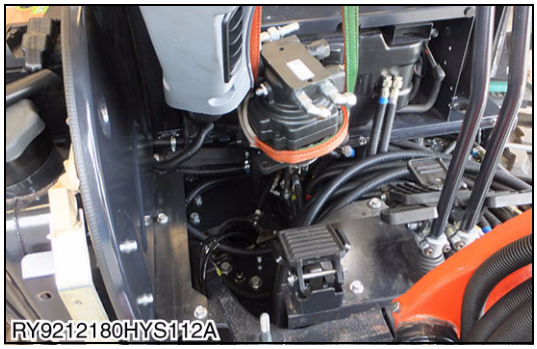
CAUTION

- **Before removing hydraulic devices while interrupting the operation, raise the bucket a little above the ground, lower the blade to the ground and stop the engine.**
- **Each of the devices and the hydraulic oil are hot and under high pressure immediately after operation. If the hydraulic oil reached a high operating temperature, it may cause a burn.**
- **Oil gushing out under pressure has enough force to pierce your skin and may cause you injury. Always allow the temperature to drop and relieve any remaining pressure prior to working to remove any hydraulic equipment.**

RY9212180HYS0079US0

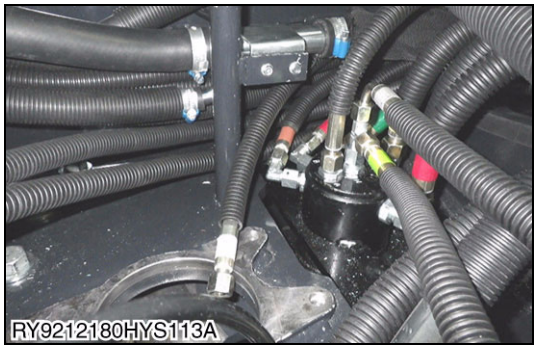
1. Remove the cabin. (Refer to the page "Cabin Removal and Installation")

RY9212180HYS0132US0



2. Make the pressure inside the hydraulic tank negative by using a vacuum pump. Remove the swivel motor. (Refer to the page "Swivel Motor Removal and Installation")

RY9212180HYS0133US0

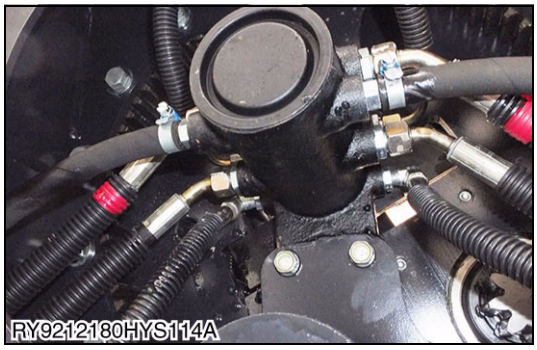


3. Remove all hoses from the swivel joint shaft.

■ **IMPORTANT**

- **Mark the relationship of the hoses.**
- **Plug the disconnected hoses and adapters.**

RY9212180HYS0134US0

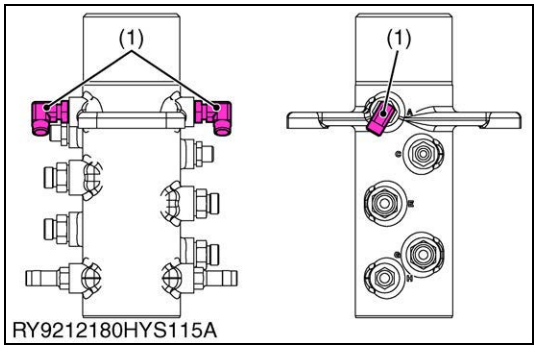


4. Remove all hoses from the swivel joint body.

■ **IMPORTANT**

- **Mark the relationship of the hoses.**
- **Plug the disconnected hoses and adapters.**

RY9212180HYS0135US0



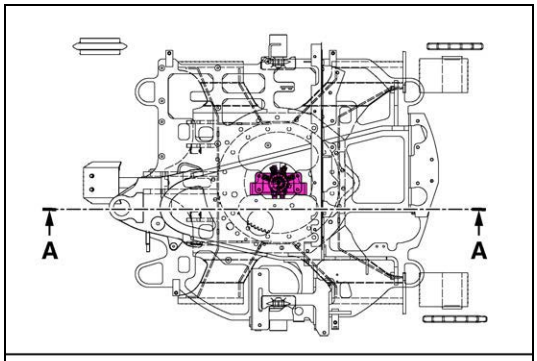
RY9212180HYS115A

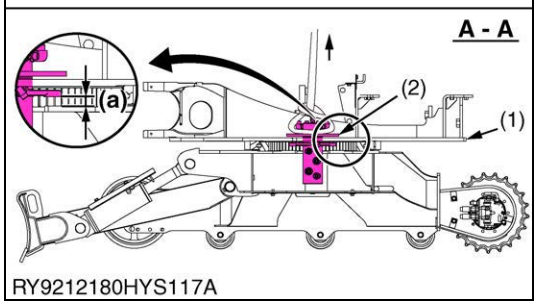
5. Remove the travel 2-speed adapter. Suspend the swivel joint and remove the swivel joint mounting bolts.

Tightening torque	Bolt	77.5 to 90.2 N·m 7.90 to 9.20 kgf·m 57.2 to 66.5 lbf·ft

(1) Travel 2-speed Adapter

RY9212180HYS0136US0





RY9212180HYS117A

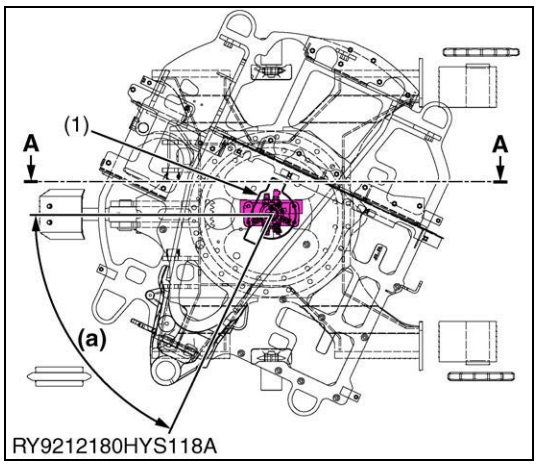
6. Operate the crane, and raise the swivel joint stopper section above the swivel frame. (Raise it about 60 mm above the installed position)

■ **IMPORTANT**

- **Move it to the position where the swivel joint will not interfere even when the swivel frame rotates.**

(1) Swivel Frame
(2) Swivel Joint Stopper Section
(a) About 60 mm (2.34 in.)

RY9212180HYS0137US0

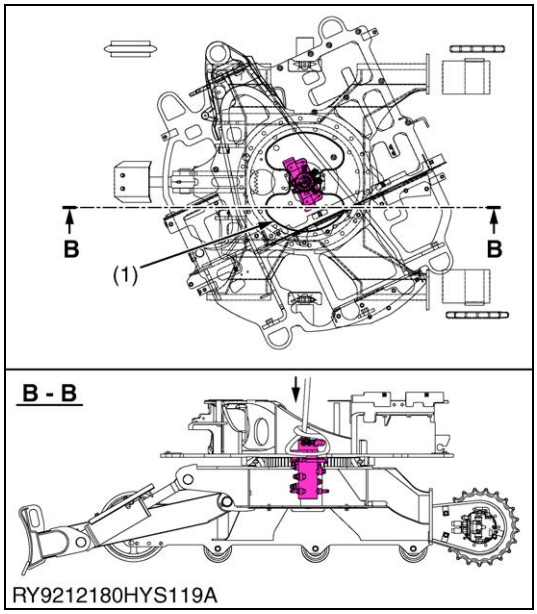


RY9212180HYS118A

7. Turn the swivel frame and rotate the stopper location.

(1) Stopper Location (hole shape)
(a) 65 °

RY9212180HYS0138US0



RY9212180HYS119A

8. Turn the swivel joint, and align the swivel joint stopper section with the swivel frame stopper location. At this point, confirm that the swivel joint installation part does not interfere with the track frame. If it was interfering, turn it to the position where it will not interfere.

(1) Track frame hole shape

RY9212180HYS0139US0

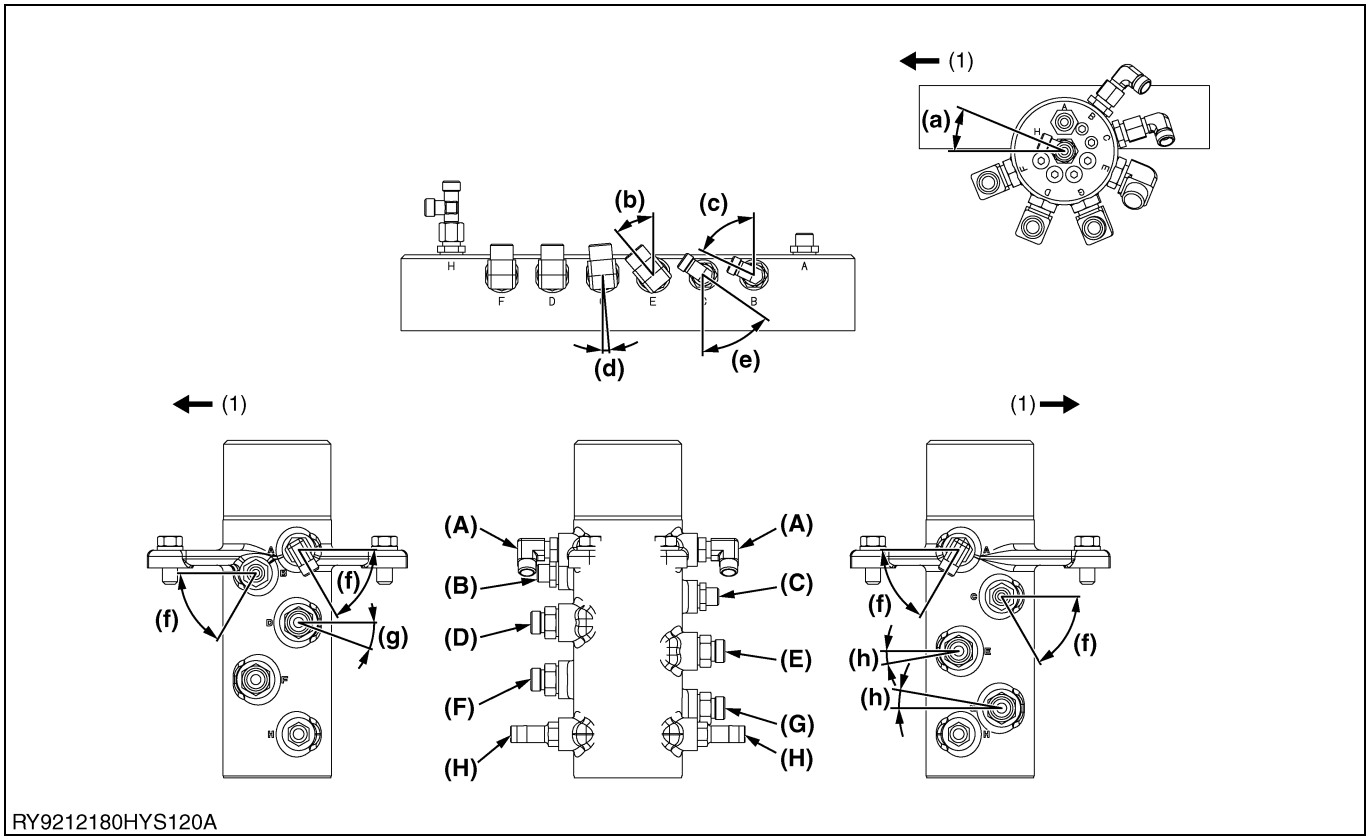

RY9212180HYS116A

9. Operate the crane, and pull the swivel joint downward.

- Swivel joint weight: about 11.5 kg

RY9212180HYS0140US0

Swivel Joint Adapter Angle



RY9212180HYS120A

(1) Machine Front

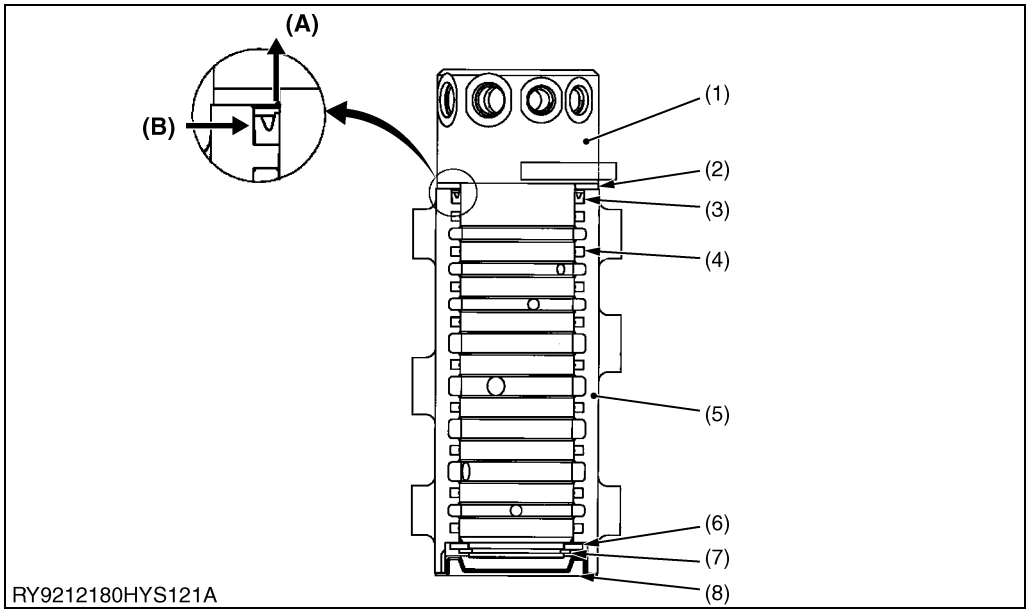
(A) 2-Speed Pilot
(B) Blade (Down)
(C) Blade (Up)
(D) Travel Left (Forward)
(E) Travel Right (Forward)
(F) Travel Left (Backward)
(G) Travel Right (Backward)
(H) Drain

(a) 23 °
(b) 40 °
(c) 67 °
(d) 5 °
(e) 55 °
(f) 60 °
(g) 20 °
(h) 10 °

Tightening torque	G1/4	34 to 45 N·m 3.5 to 4.6 kgf·m 25 to 33 lbf·ft
	G3/8	45 to 65 N·m 4.6 to 6.6 kgf·m 33 to 48 lbf·ft

RY9212180HYS0089US0

Swivel joint assembly diagram



(A) Outer side
(B) Lip

1. U-gasket assembly direction
   Apply grease to the inner and outer surfaces of the U-gasket, and install with the seal lip on the outer side.
2. Coupling the body and shaft
   When coupling the shaft to the body, apply grease to the inner and outer circumferential surfaces of the gasket.

No.	Part Name	Qty	No.	Part Name	Qty
(1)	Shaft	1	(6)	Collar	1
(2)	Collar	1	(7)	External circlip	1
(3)	U-gasket	1	(8)	Plug	1
(4)	Gasket	9	(9)	Plug (PT1/4)	2
(5)	Body	1	(10)	Plug (PT1/8)	4

RY9212180HYS0090US0

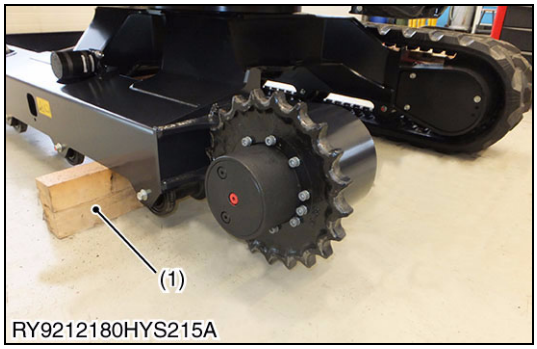
5. TRAVEL MOTOR

[1] TRAVEL MOTOR REMOVAL AND INSTALLATION

CAUTION

- **When removing a hydraulic device after operating the machine, lower the bucket and blade to the ground and turn off the engine.**
- **Each of the devices and the hydraulic oil are hot and under high pressure immediately after operating the machine. If the hydraulic oil reached a high operating temperature, it may cause a burn.**
- **Oil gushing out under pressure has enough force to pierce your skin and may cause you injury. Always allow the temperature to drop and relieve any remaining pressure prior to working to remove any hydraulic equipment.**

RY9212001MBS0004US0



Removing the travel motor

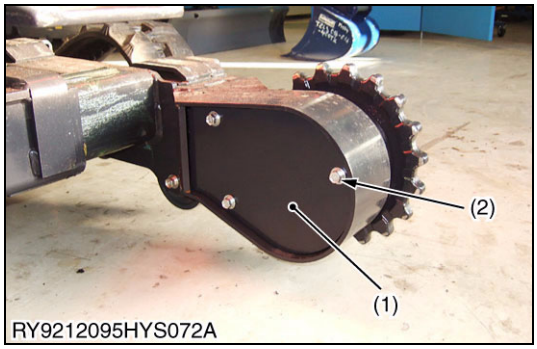
1. Remove the crawler track. Refer to the chapter Crawler Track for the removal and installation of the crawler track.

DANGER

- **Jack up the machine with the front-end and the blade and place timbers under the frame.**

(1) Block

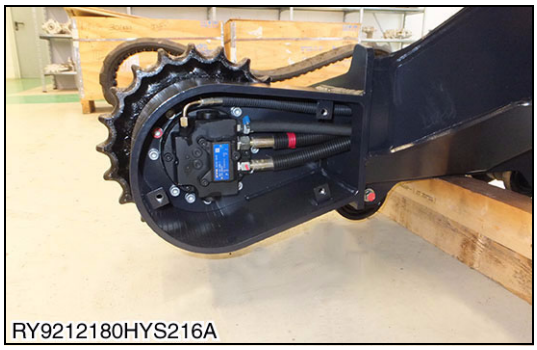
RY9212180HYS0082US0



2. Remove the three cover mounting bolts and remove the cover.

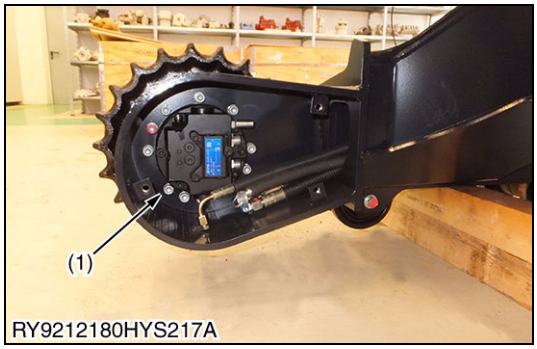
(1) Cover (2) Bolt

RY9212180HYS0083US0



3. Connect a vacuum pump to the breather hose of the hydraulic oil tank and exert negative pressure inside the tank. Disconnect the hydraulic hoses.

RY9212180HYS0084US0



4. Temporarily suspend the travel motor with a nylon sling and remove the 11 bolts.

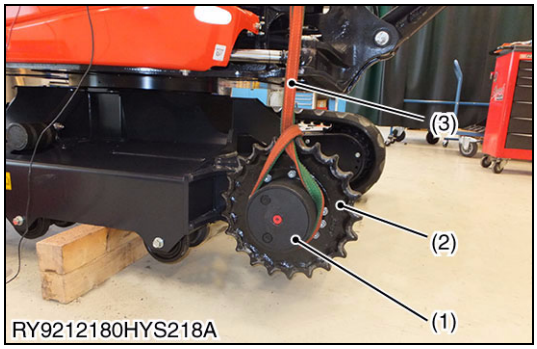
■ IMPORTANT

- **Apply thread lock (Loctite AN302-71 equivalent).**

Tightening torque	Bolt (1)	60.7 to 70.6 N·m 6.2 to 7.2 kgf·m 44.8 to 52.0 lb·ft

(1) Bolt

RY9212180HYS0085US0



5. Suspend the wheel motor ASSY from a crane and remove it.

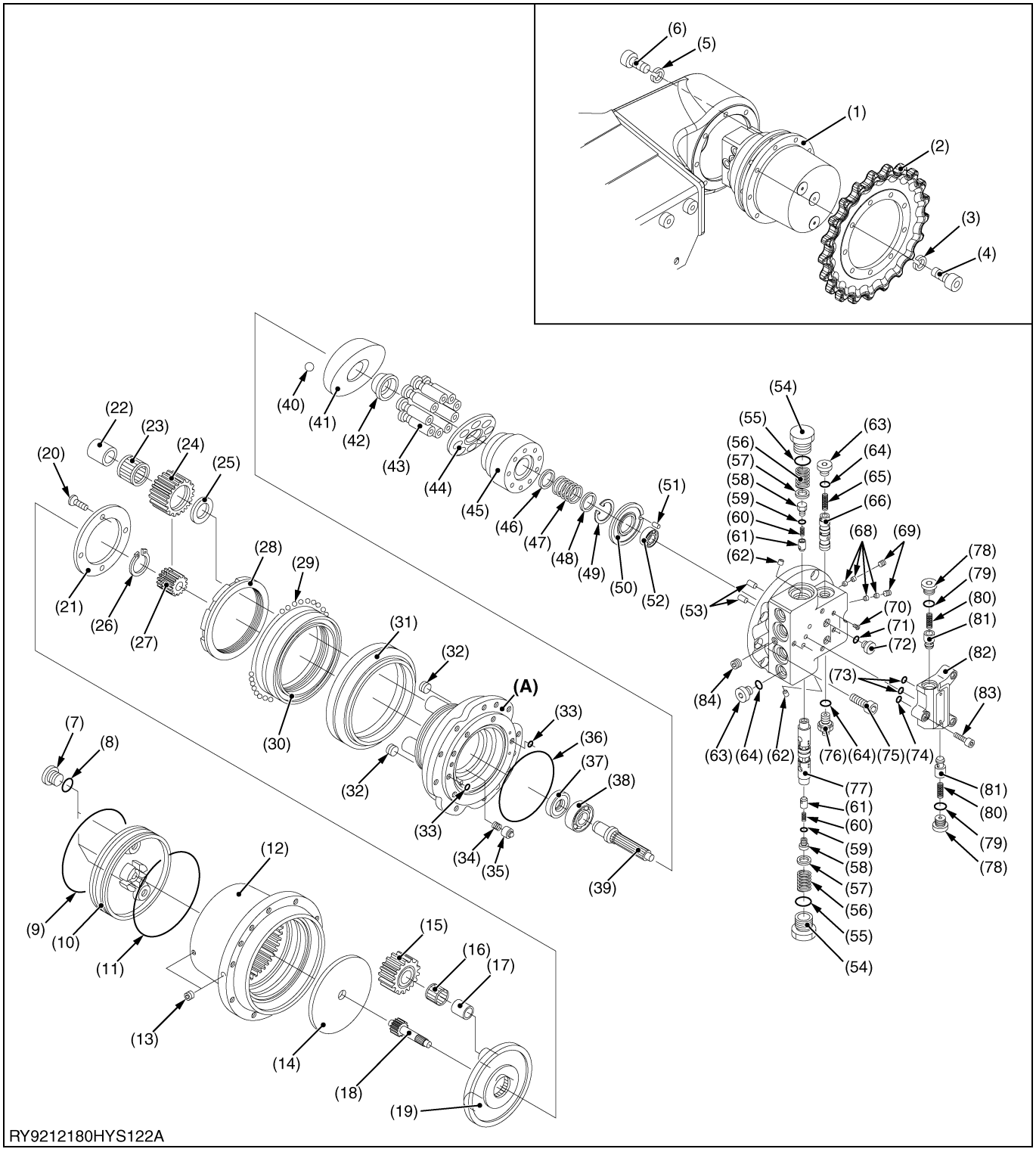
■ **IMPORTANT**
- **Apply thread lock (Loctite AN302-71 equivalent).**

Tightening torque	Sprocket (2)	60.7 to 70.6 N·m 6.2 to 7.2 kgf·m 44.8 to 52.0 lbf·ft

(1) Wheel Motor ASSY
(2) Sprocket
(3) Nylon Sling

RY9212180HYS0086US0

[2] TRAVEL MOTOR DISASSEMBLY/ASSEMBLY PROCEDURES



(To be continued)

(Continued)

(1) Wheel Motor ASSY
(2) Drive Sprocket
(3) Spring Washer
(4) Hex Socket Bolt
(5) Spring Washer
(6) Hex Socket Bolt
(7) Plug
(8) O-Ring
(9) O-Ring
(10) Cover
(11) Wire
(12) Housing
(13) Plug
(14) Plate
(15) Gear
(16) Needle Bearing
(17) Inner Race
(18) Drive Gear
(19) Holder
(20) Screw
(21) Plate
(22) Inner Race
(23) Needle Bearing
(24) Gear
(25) Thrust Washer
(26) Snap Ring
(27) Gear
(28) Ring Nut
(29) Steel Ball
(30) Bearing
(31) Floating Seal
(32) Plug
(33) O-Ring
(34) Spring
(35) Piston ASSY
(36) O-Ring
(37) oil Seal
(38) Ball Bearing
(39) Shaft
(40) Ball
(41) Swashplate
(42) Retainer Holder
(43) Piston ASSY
(44) Retainer Plate
(45) Cylinder Block
(46) Spring Seat
(47) Spring
(48) Washer
(49) Snap Ring
(50) Valve Plate
(51) Pin
(52) Ball Bearing
(53) Straight Pin
(54) Cap
(55) O-Ring
(56) Spring
(57) Spring Seat
(58) Plug
(59) O-Ring
(60) Spring
(61) Check Valve
(62) Orifice
(63) Plug
(64) O-Ring
(65) Spring
(66) Spool
(67) Valve Body
(68) Orifice
(69) Plug
(70) Plug
(71) O-Ring
(72) Plug
(73) O-Ring
(74) O-Ring
(75) Hex Socket Bolt
(76) Plug
(77) Spool
(78) Plug
(79) O-Ring
(80) Spring
(81) Check Valve
(82) Valve Body
(83) Hex Socket Bolt
(84) Plug

(A) Flange Holder

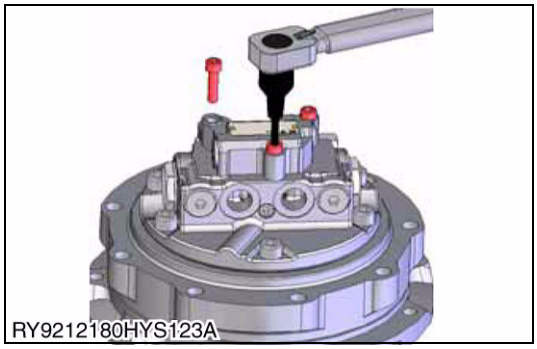
RY9212180HYS0141US0

General Precautions for Assembly/Disassembly Work

Take note of the following points when performing assembly/disassembly work.
1. Perform the work in a clean area and take care that parts do not get any dirt, dust, paint, liquids or other substances on them. Also, have clean containers on hand to put disassembled parts into.
2. Prior to disassembly, clean off any dirt or grime clinging to the outside of the travel motor and wire brush the paint around the joints of each part.
3. Prior to disassembly, mark each part so they can be put back in the same position during assembly.
4. Handle disassembled parts carefully so they are not damaged.
5. Clean disassembled parts well with solvent.
6. Inspect disassembled parts and make sure there is no abnormal wear or burning; remove any burrs or other damage.
7. Replace seals and snap rings with new ones.
8. In this manual, in principle, parts that are "pressed" (bearings, pins, etc.) cannot be disassembled.

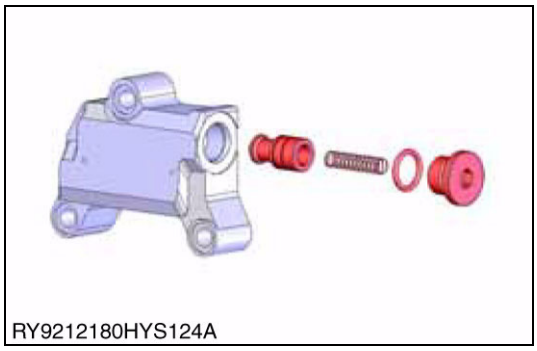
RY9212091HYS0213US0

(1) Disassembly Procedures


RY9212180HYS123A

1. Remove the hex socket bolts, and then the valve assembly.

RY9212180HYS0142US0

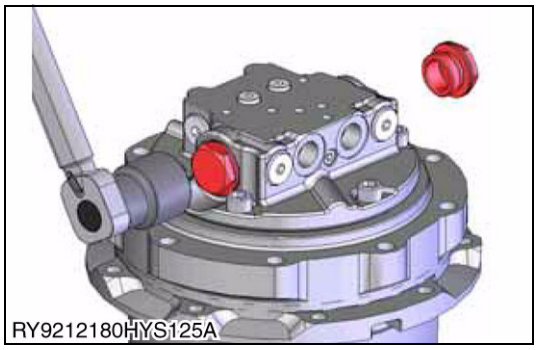

RY9212180HYS124A

2. Remove the plug and then the spring and check valve.

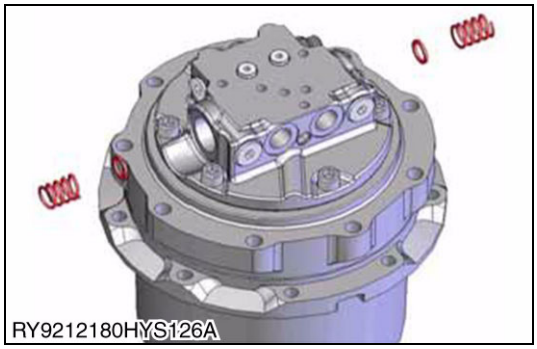
■ **IMPORTANT**

- **If there is no abnormality in the valve assembly, do not disassemble it.**

RY9212180HYS0143US0


RY9212180HYS125A

3. Remove the cap, then the spring, spring sheet and spool.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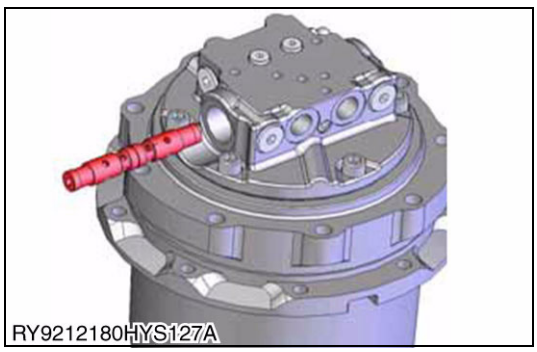
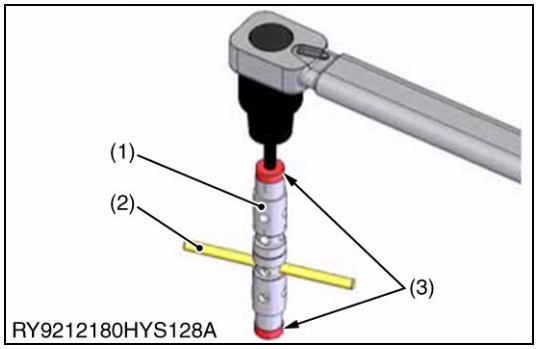

RY9212180HYS127A

■ **IMPORTANT**

- **Remove them so you don't scratch the circumference of the spool.**

RY9212180HYS0144US0



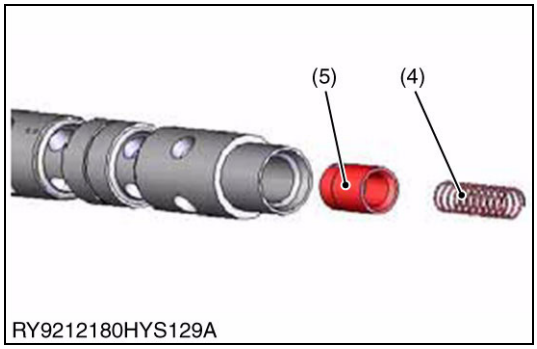
RY9212180HYS128A

4. Insert 5 × 30 pin into the ϕ6 through holes ϕ of the spool and secure it with a vice. Remove the plug and then the spring and check valve.

■ **IMPORTANT**
- **If there is no abnormality in the spool assembly, do not disassemble it.**
- **Check valve must be assembled at the original place of assembly.**

(1) Spool ASSY
(2) Pin (ϕ 5 × 30)
(3) Plug
(4) Spring
(5) Check valve

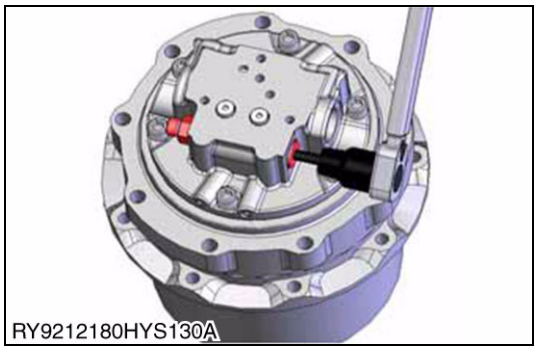
RY9212180HYS0145US0



RY9212180HYS129A

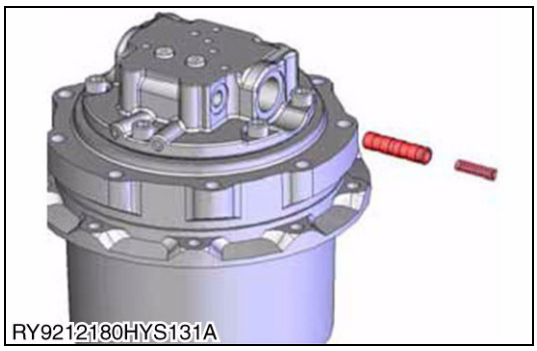
5. Remove the plug.

RY9212180HYS0146US0


RY9212180HYS130A

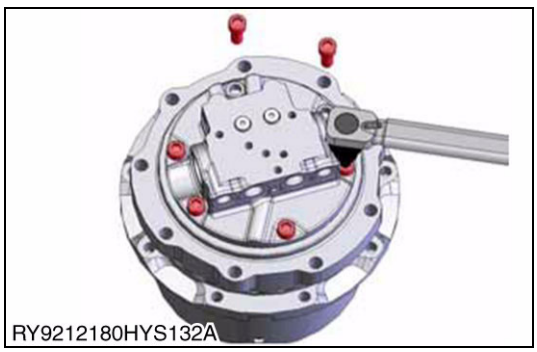
6. Remove the springs and spool assembly.

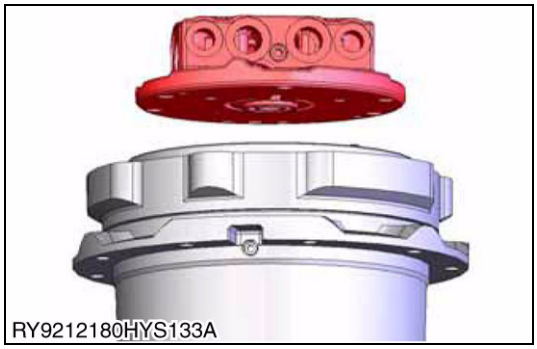
RY9212180HYS0147US0


RY9212180HYS131A

7. Remove the hex socket bolt.

RY9212180HYS0148US0


RY9212180HYS132A


RY9212180HYS133A

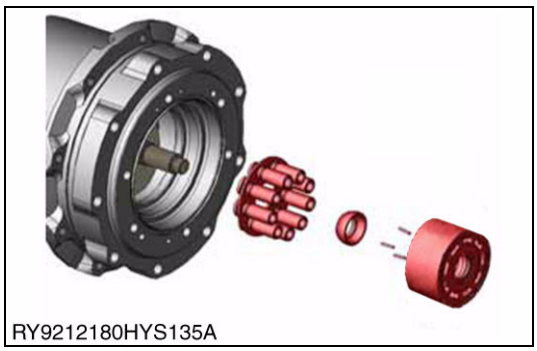
8. Remove the valve body. Use a plastic hammer to remove it when it is hard.

RY9212180HYS0149US0


RY9212180HYS134A

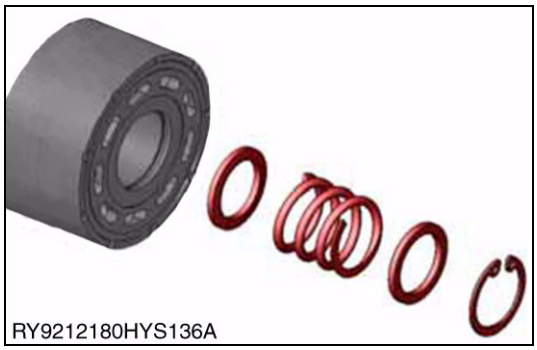
9. Remove the pin, valve plate, and O-rings.

RY9212180HYS0150US0


RY9212180HYS135A

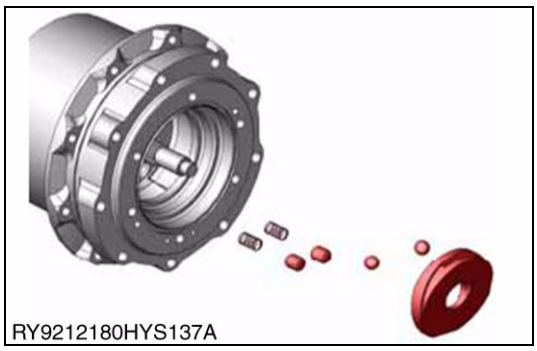
10. Remove the cylinder block, pin, retainer holder, and retainer plate piston.

RY9212180HYS0151US0


RY9212180HYS136A

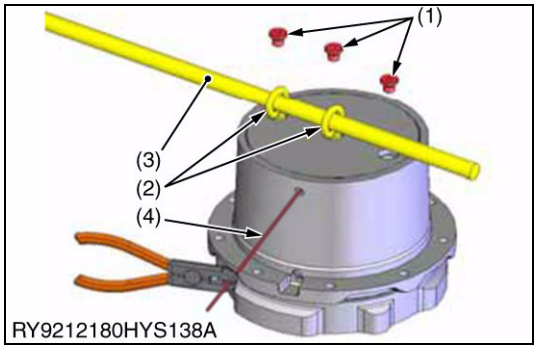
11. Remove the snap ring. Remove the washers, springs and spring sheet.

RY9212180HYS0152US0


RY9212180HYS137A

12. Remove the swash plate, steel ball, piston and spring.

RY9212180HYS0153US0

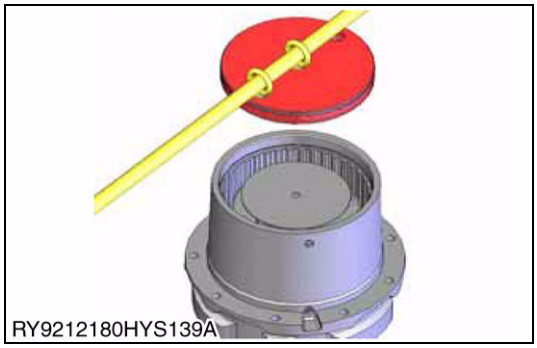


RY9212180HYS138A

13. Remove the plug. Screw an eye bolt (PF 1/4) into the thread hole and insert the rod into the eyebolt hole. Turn the rod until the wire tip becomes visible from the plug hole on the side. Pull the wire tip outside of the hole.

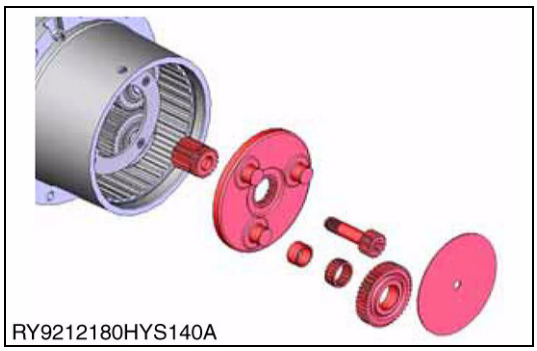
(1) Plug
(2) Eyebolt (PF 1/4)
(3) Rod
(4) Wire

RY9212180HYS0154US0


RY9212180HYS139A

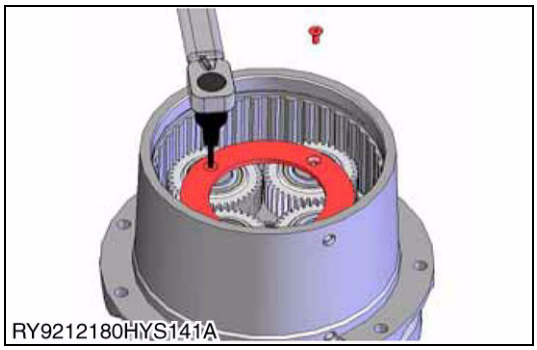
14. Remove the cover.

RY9212180HYS0155US0


RY9212180HYS140A

15. Remove the sun gear, holder, gear, needle bearing, inner race, drive gear and thrust plate.

RY9212180HYS0156US0

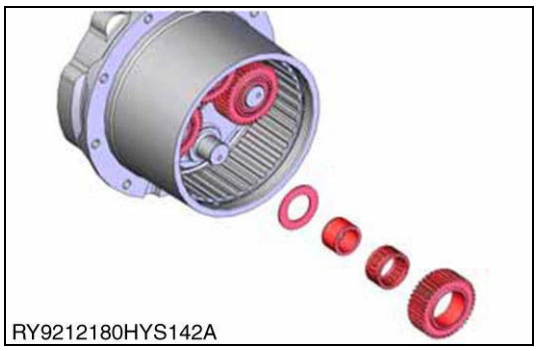

RY9212180HYS141A

16. Remove the thrust plate and screw.

■ **IMPORTANT**

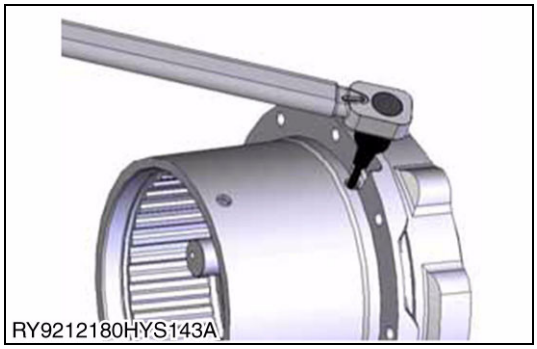
- **As the screw is coated with Loctite, heat it with a heat gun in advance.**

RY9212180HYS0157US0


RY9212180HYS142A

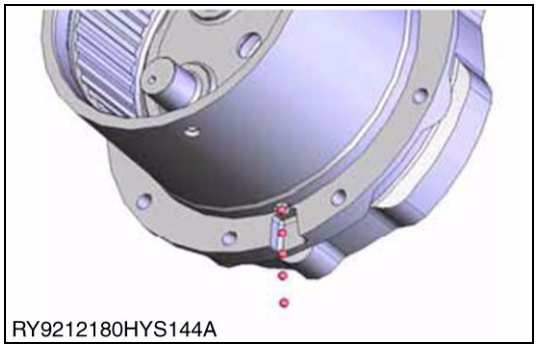
17. Remove the gear, needle bearing, inner race and the thrust washer.

RY9212180HYS0158US0


RY9212180HYS143A

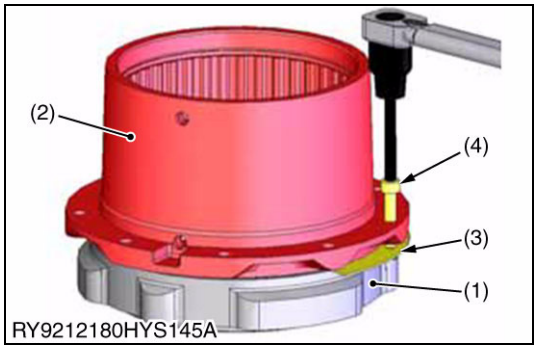
18. Remove the plug.

RY9212180HYS0159US0


RY9212180HYS144A

19. Pull the steel balls out from the plug hole. (109 pcs)

RY9212180HYS0160US0

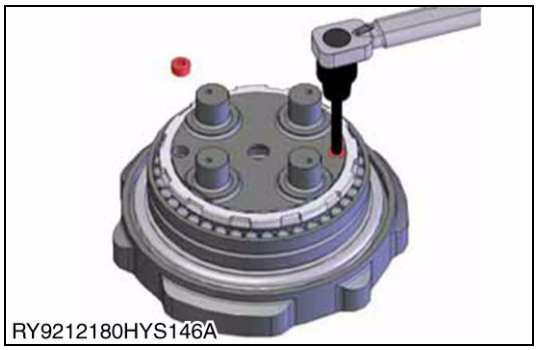


RY9212180HYS145A

20. Insert the plate between the flange holder and the housing, and tighten three bolts equally.

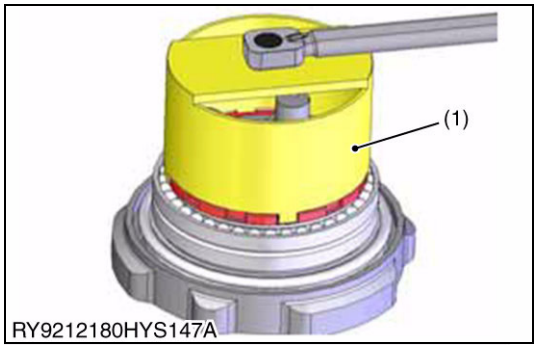
(1) Flange holder
(2) Housing
(3) Plate
(4) Bolt (M12 × 1.75)

RY9212180HYS0161US0


RY9212180HYS146A

21. Remove the plug.

RY9212180HYS0162US0

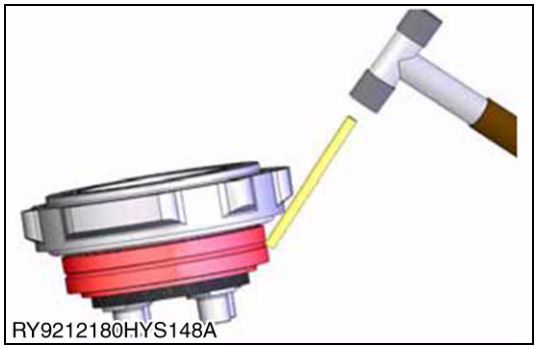


RY9212180HYS147A

22. Remove the ring nut.

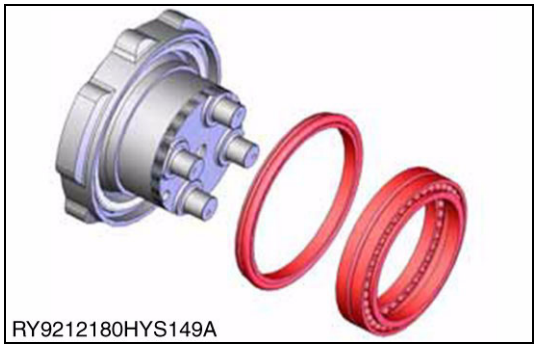
(1) Jig (S-6)

RY9212180HYS0163US0


RY9212180HYS148A

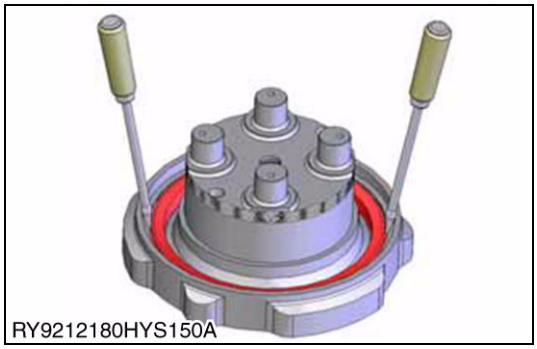
23. Put the rod on the steel ball groove, and remove the angular bearing by hitting it lightly with a hammer.

RY9212180HYS0164US0


RY9212180HYS149A

24. Remove the floating seal and angular bearing.

RY9212180HYS0165US0

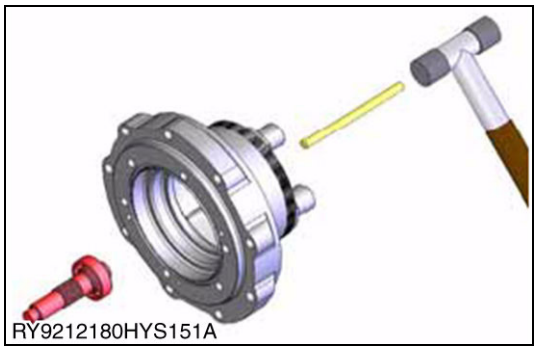

RY9212180HYS150A

25. Remove the floating seal.

■ **IMPORTANT**

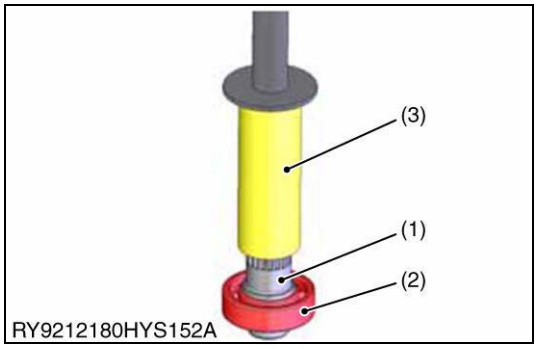
- **Do not scratch the sealing face of the floating seal.**

RY9212180HYS0166US0


RY9212180HYS151A

26. Remove the shaft and oil seal.

RY9212180HYS0167US0



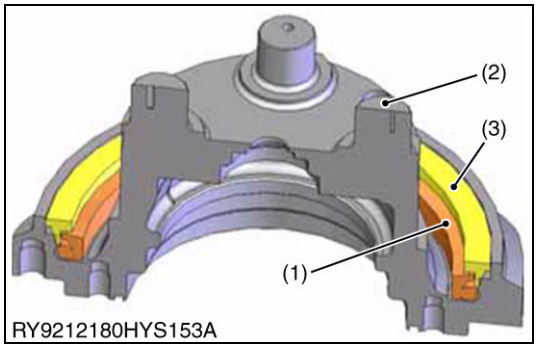
RY9212180HYS152A

27. Remove the ball bearing from the shaft.

(1) Shaft
(2) Ball bearing
(3) Jig (S-8)

RY9212180HYS0168US0

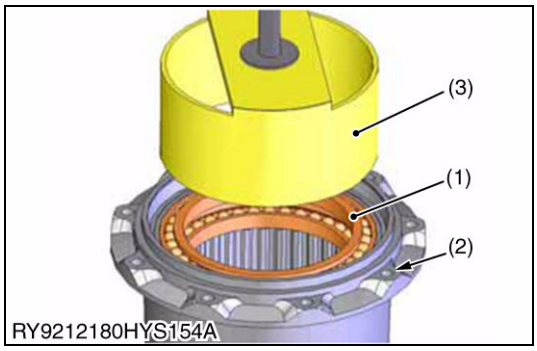
(2) Aassembly Procedures



1. Install the floating seal on the flange holder.

(1) Floating seal
(2) Flange holder
(3) Jig (S-9)

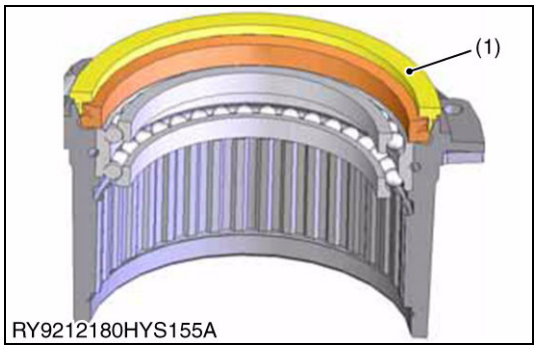
RY9212180HYS0169US0



2. Press fit the bearing into the housing.

(1) Bearing
(2) Housing
(3) Jig (S-10)

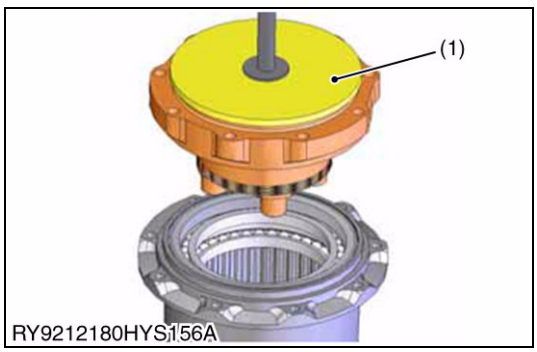
RY9212180HYS0170US0



3. Install the other floating seal on the housing.

(1) Jig (S-9)

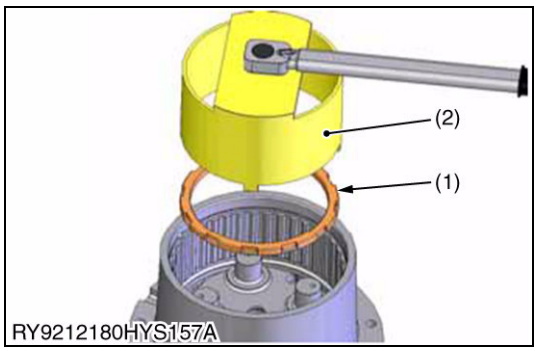
RY9212180HYS0171US0



4. Wipe the sealing face of the floating seal with a clean rag, and apply gear oil on the sealing face. Install the flange holder on the housing.

(1) Jig (S-11)

RY9212180HYS0172US0

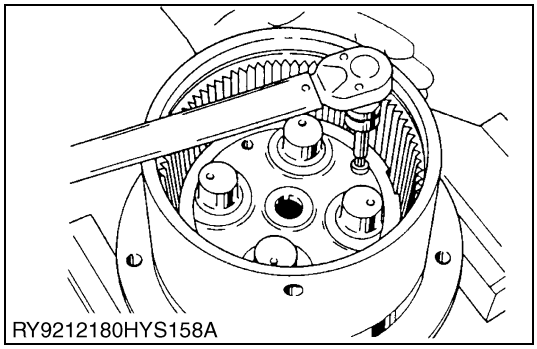


5. Tighten the bearing with the ring nut.

Tightening torque	Ring nut	186.2 to 205.8 N·m 19 to 21 kgf·m 137.4 to 151.7 lbf·ft

(1) Ring nut
(2) Jig (S-6)

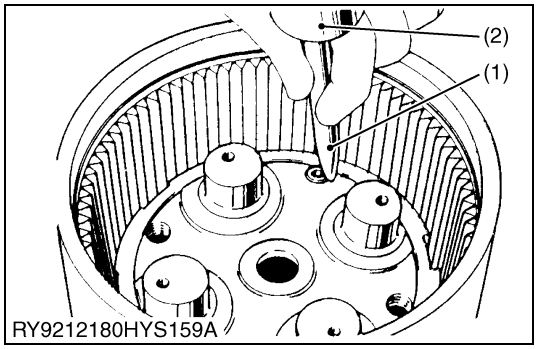
RY9212180HYS0173US0


RY9212180HYS158A

6. Install the plug.

Tightening torque	Plug	9.8 to 19.6 N·m 1.0 to 2.0 kgf·m 7.2 to 14.5 lbf·ft

RY9212180HYS0174US0

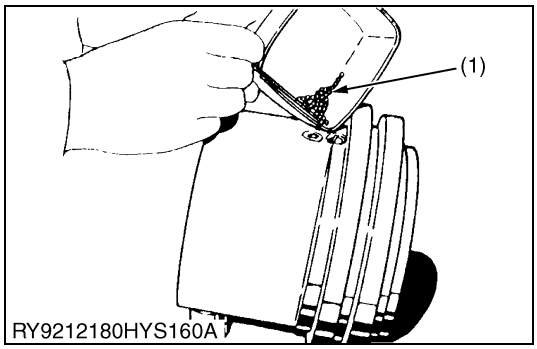


RY9212180HYS159A

7. Swage two places with a punch to prevent loosening of the plug.

(1) Punch (2) Hammer

RY9212180HYS0175US0



RY9212180HYS160A

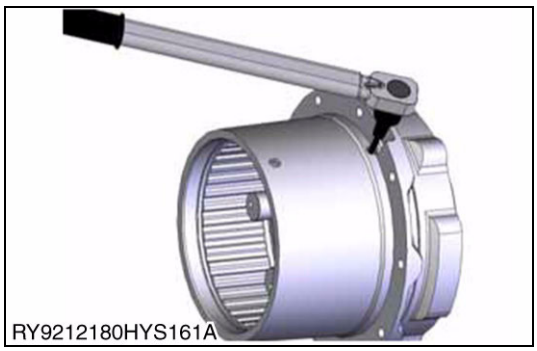
8. Put the steel balls in. (109 pcs)

■ **IMPORTANT**

- **Put them in while hitting the side of the housing with a plastic hammer.**

(1) Steel ball

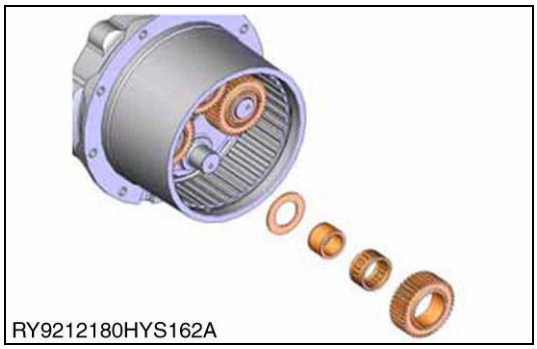
RY9212180HYS0176US0


RY9212180HYS161A

9. Wrap the plug with plumber's tape and tighten it.

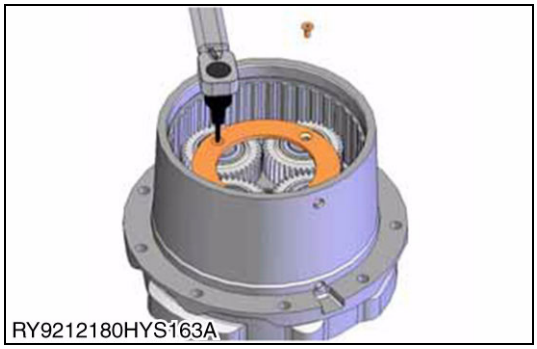
Tightening torque	Plug	6.8 to 8.8 N·m 0.7 to 0.9 kgf·m 5.0 to 6.5 lbf·ft

RY9212180HYS0177US0


RY9212180HYS162A

10. Install the gear, needle bearing, inner race and thrust washer.

RY9212180HYS0178US0

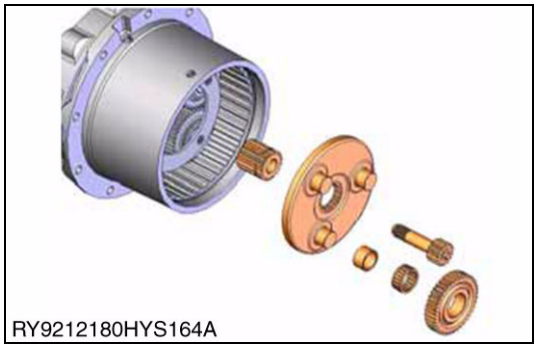

RY9212180HYS163A

11. Tighten the thrust plate with screws.

■ **IMPORTANT**
- **Degrease the parts thoroughly.**
- **Apply thread lock (Loctite #262).**

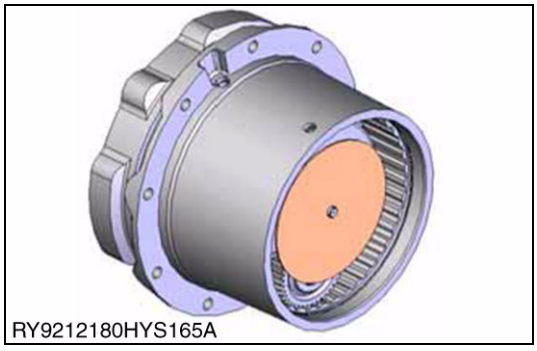
Tightening torque	Screw	12.1 to 13.3 N·m 1.24 to 1.35 kgf·m 8.93 to 9.80 lbf·ft

RY9212180HYS0179US0


RY9212180HYS164A

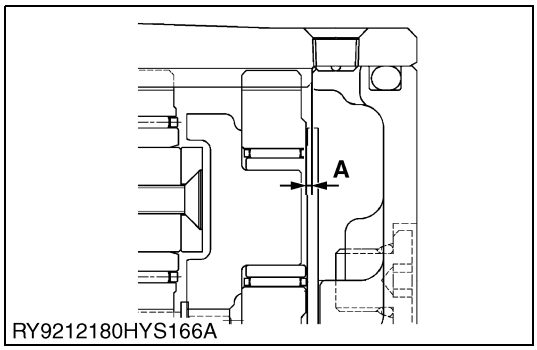
12. Attach the snap ring to the sun gear to install. Install the inner race, needle bearing, drive gear and gear on the holder.

RY9212180HYS0180US0


RY9212180HYS165A

13. Mount the thrust plate.

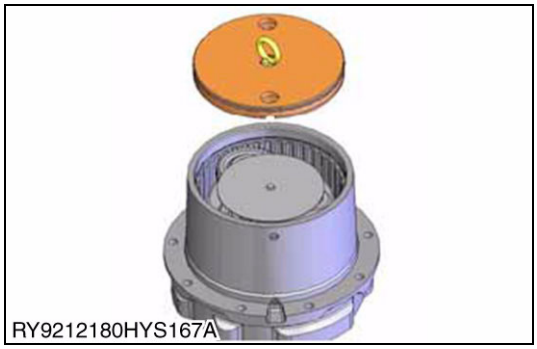
■ **IMPORTANT**
- **There are three kinds of thrust plates with different thickness.**
- **Measure the size and select the right plate.**



RY9212180HYS166A

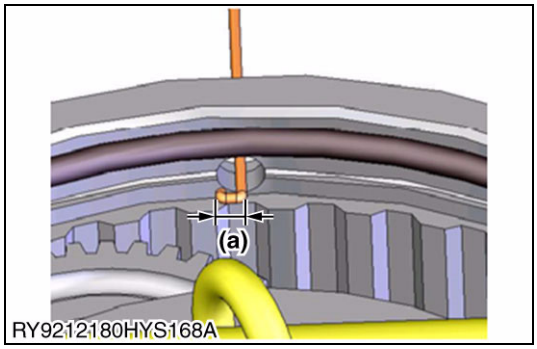
Size **A**	0.3 to 0.7 mm (0.01 to 0.03 in.)	0.8 to 1.3 mm (0.03 to 0.05 in.)	1.4 to 1.8 mm (0.06 to 0.07 in.)
Plate thickness t	1.8 mm (0.07 in.)	2.3 mm (0.09 in.)	2.8 mm (0.11 in.)

RY9212180HYS0181US0


RY9212180HYS167A

14. Install the cover so that the position of plug thread hole of the housing aligns with the notch on the cover.

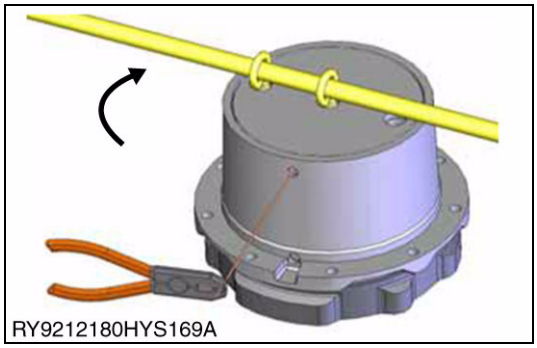
RY9212180HYS0182US0



15. Bend the wire tip according to the diagram. Insert this bending section as if to hook it on the notch of the cover.

(a) 6.0 mm (0.23 in.)

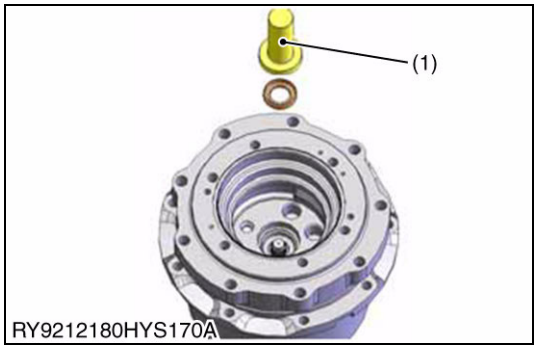
RY9212180HYS0183US0



16. Turn the cover, wind it while sending the wire in, and cut the wire when wound for almost a round. Wrap the plug with seal tape and tighten it.

Tightening torque	Plug	6.8 to 8.8 N·m 0.7 to 0.9 kgf·m 5.0 to 6.5 lbf·ft

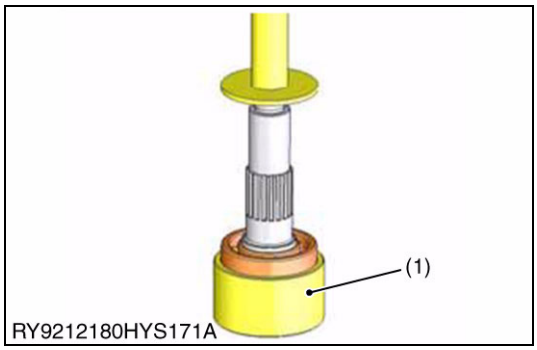
RY9212180HYS0184US0



17. Press fit the oil seal into the flange holder.

(1) Jig (S-12)

RY9212180HYS0185US0



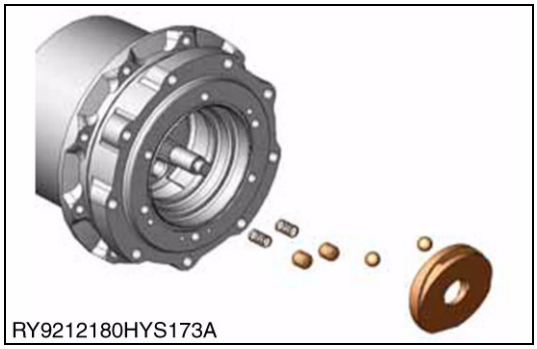
18. Press fit the bearing into shaft.

(1) Jig (S-13)

RY9212180HYS0186US0

19. Grease the slide section and side of the oil seal of the shaft. Press fit the shaft into the flange holder.

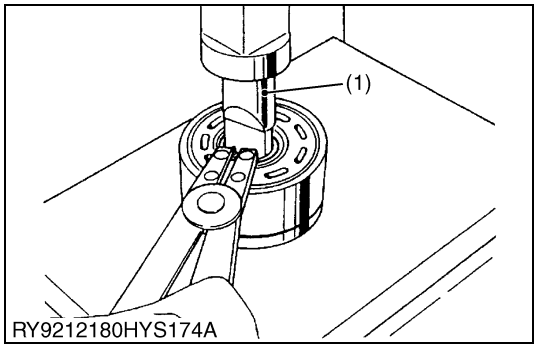
RY9212180HYS0187US0


RY9212180HYS173A

20. Install the steel balls, spring, piston, and swash plate on the flange holder.

■ **IMPORTANT**
- **Apply grease to the spring.**
- **Apply hydraulic oil to the swash plate and pistons.**

RY9212180HYS0188US0

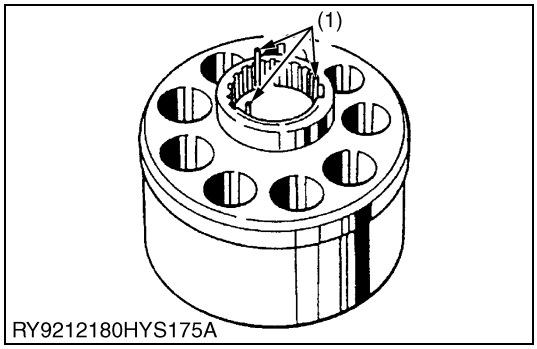


RY9212180HYS174A

21. Install the collar, spring, washer and snap ring on the cylinder block.

(1) Jig (S-15)

RY9212180HYS0189US0

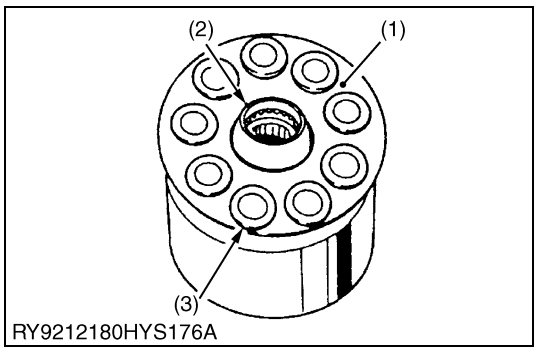


RY9212180HYS175A

22. Apply grease to the pins and insert them into three holes on the cylinder block.

(1) Pin

RY9212180HYS0190US0



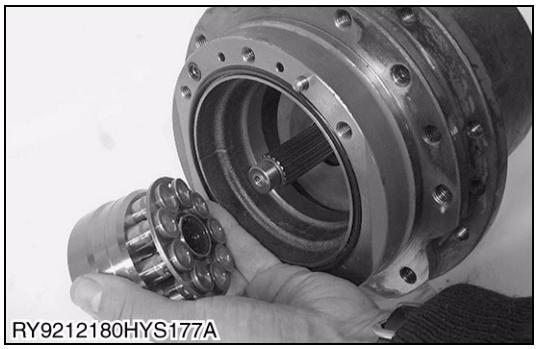
RY9212180HYS176A

23. Install the retainer holder, retainer plate and pistons.

■ **IMPORTANT**
- **Apply hydraulic oil to the hole of the cylinder block.**

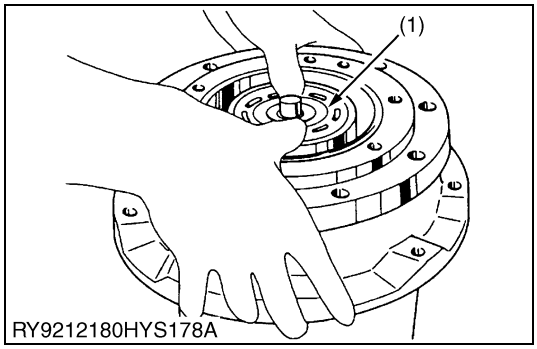
(1) Retainer holder
(2) Retainer plate
(3) Piston

RY9212180HYS0191US0


RY9212180HYS177A

24. Install the cylinder block assembly, using the spline of the shaft as a guide.

RY9212180HYS0192US0



25. Press the cylinder block by hand and check that the spring is working.

■ **IMPORTANT**

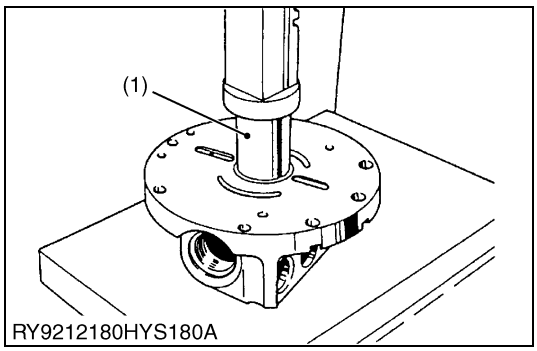
- **Apply hydraulic oil to the sliding section of the cylinder block.**

(1) Cylinder block

RY9212180HYS0193US0

26. Install the pin and O-ring on the flange holder.

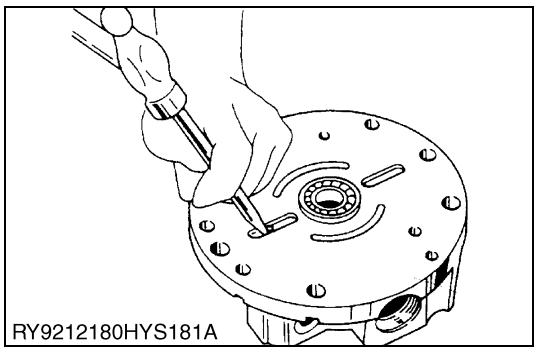
RY9212180HYS0194US0



27. Press fit the bearing into the valve body.

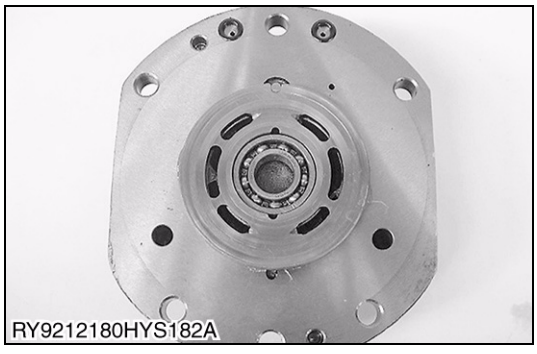
(1) Jig (S-16)

RY9212180HYS0195US0



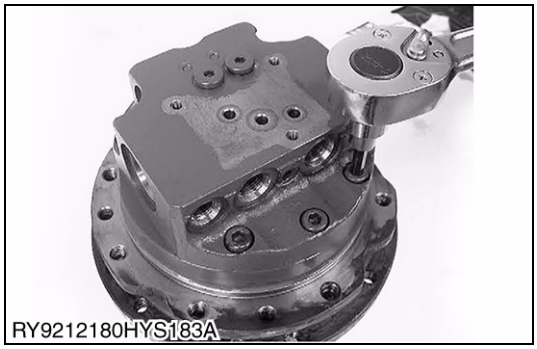
28. Install the pin, and swage one place from the circumference.

RY9212180HYS0196US0



29. Apply grease on the back side of the valve plate and install it on the valve body.

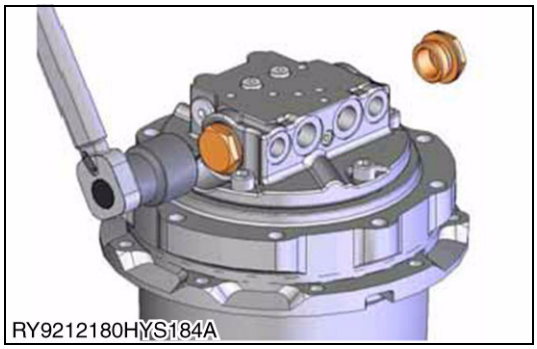
RY9212180HYS0197US0


RY9212180HYS183A

30. Install the valve body and tighten the hex socket bolts.

Tightening torque	Bolt	58.8 to 68.6 N·m 6.0 to 7.0 kgf·m 43.4 to 50.5 lbf·ft

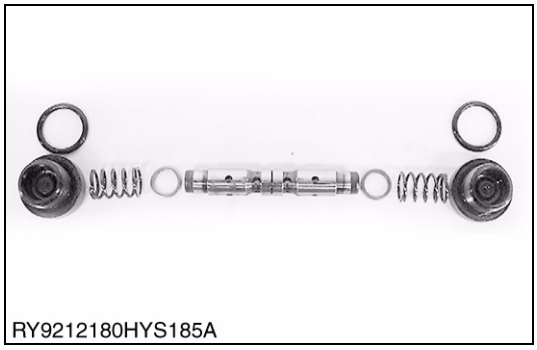
RY9212180HYS0198US0


RY9212180HYS184A

31. Install the cap, O-ring, spring, spring sheet and spool on the valve body.

Tightening torque	Cap	235 to 245 N·m 24.0 to 25.0 kgf·m 173 to 181 lbf·ft

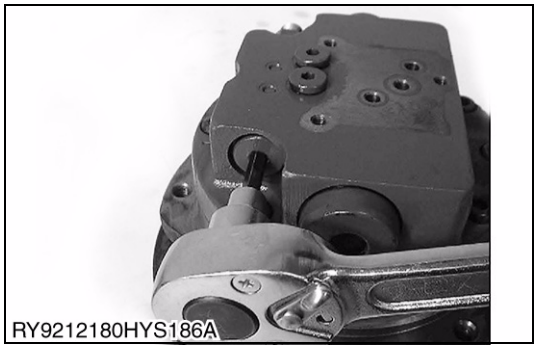
RY9212180HYS0199US0

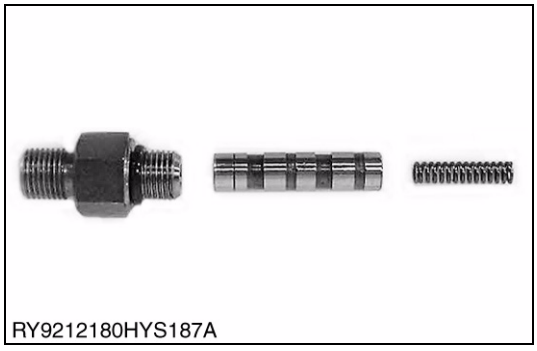

RY9212180HYS185A

32. Install the spring, spool, plug and O-ring.

Tightening torque	Plug	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36 to 43 lbf·ft

RY9212180HYS0200US0


RY9212180HYS186A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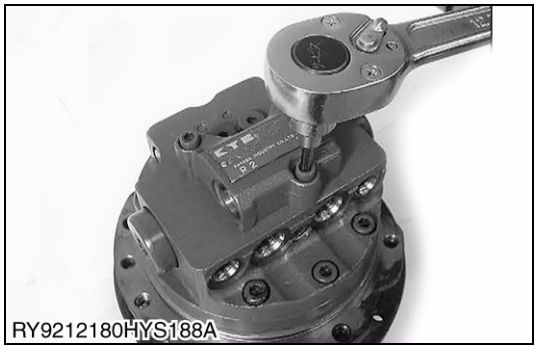
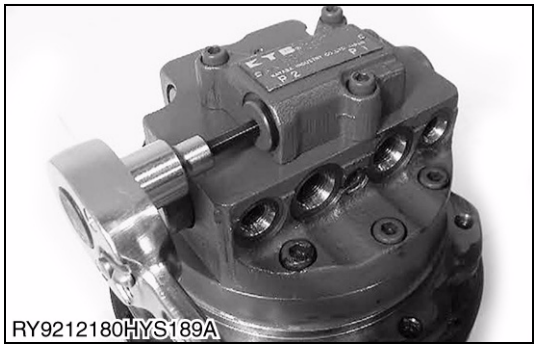

RY9212180HYS188A

33. Install the O-ring on the valve body and tighten with a hex socket bolt.

Tightening torque	Bolt	35.0 to 38.8 N·m 3.6 to 4.0 kgf·m 26.0 to 28.6 lbf·ft

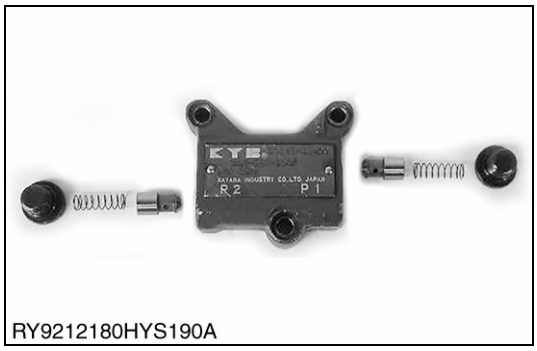
RY9212180HYS0201US0


RY9212180HYS189A

34. Install the spool, spring, and spring sheet on the valve body and tighten the plug.

Tightening torque	Plug	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36 to 43 lbf·ft

RY9212180HYS0202US0

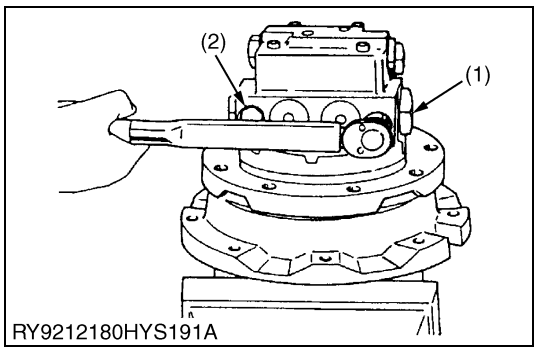

RY9212180HYS190A

35. Assemble the plug fitted with the O-ring.

Tightening torque	Plug	21.6 to 23.6 N·m 2.2 to 2.4 kgf·m 16.0 to 17.4 lbf·ft

(1) Cap (2) Plug

RY9212180HYS0203US0



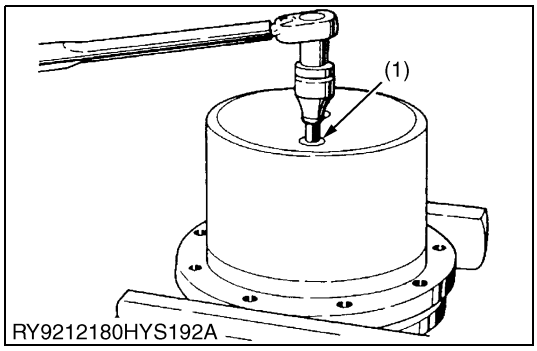
RY9212180HYS191A

36. Fill in 500cc of gear oil from the plug thread hole. Assemble the plug fitted with the O-ring.

Tightening torque	Plug	21.6 to 23.6 N·m 2.2 to 2.4 kgf·m 16.0 to 17.4 lbf·ft

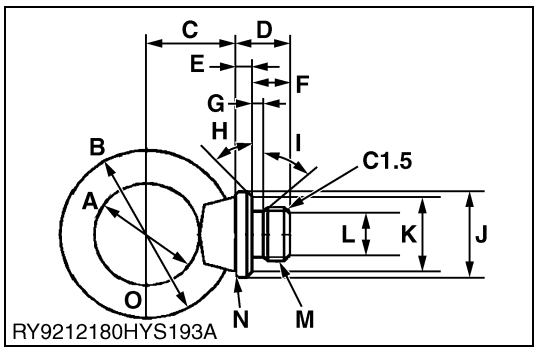
(1) Plug

RY9212180HYS0204US0



RY9212180HYS192A

(3) Special Tools

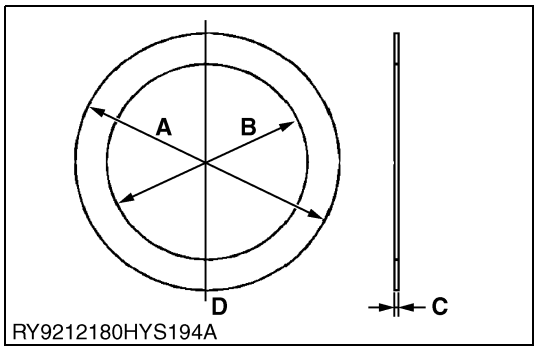


RY9212180HYS193A

(S-2) Eyebolt

A	ϕ 25 mm (ϕ 0.975 in.)
B	ϕ 41 mm (ϕ 1.599 in.)
C	21 mm (0.819 in.)
D	13 mm (0.507 in.)
E	4 mm (0.156 in.)
F	9.0 mm (0.351 in.)
G	2.5 mm (0.098 in.)
H	45 °
I	50 °
J	MAX. ϕ 21 mm (ϕ 0.819 in.)
K	MIN. ϕ 18.5 mm (ϕ 0.722 in.)
L	ϕ 11.2 mm (ϕ 0.473 in.)
M	PF1/4
N	Welding
O	Eyebolt M10
C1.5	Chamfer 1.5 mm

RY9212180HYS0205US0

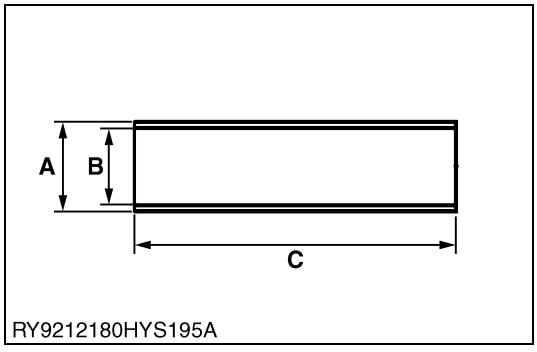


RY9212180HYS194A

(S-5) Housing Removal Tool

A	ϕ 240 mm (ϕ 9.36 in.)
B	ϕ 182 mm (ϕ 7.098 in.)
C	4.0 mm (0.156 in.)
D	Divided

RY9212180HYS0206US0

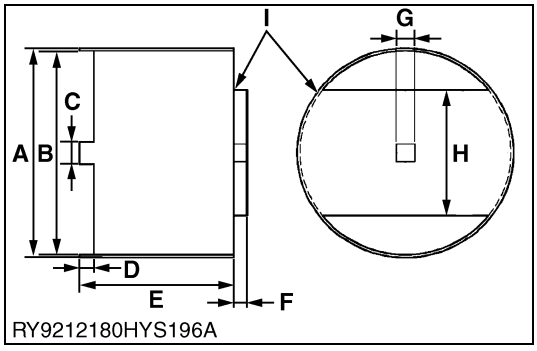


RY9212180HYS195A

(S-8) Ball Bearing Removal Tool

A	ϕ 29 mm (ϕ 1.131 in.)
B	ϕ 25 mm (ϕ 0.975 in.)
C	100 mm (3.9 in.)

RY9212180HYS0207US0



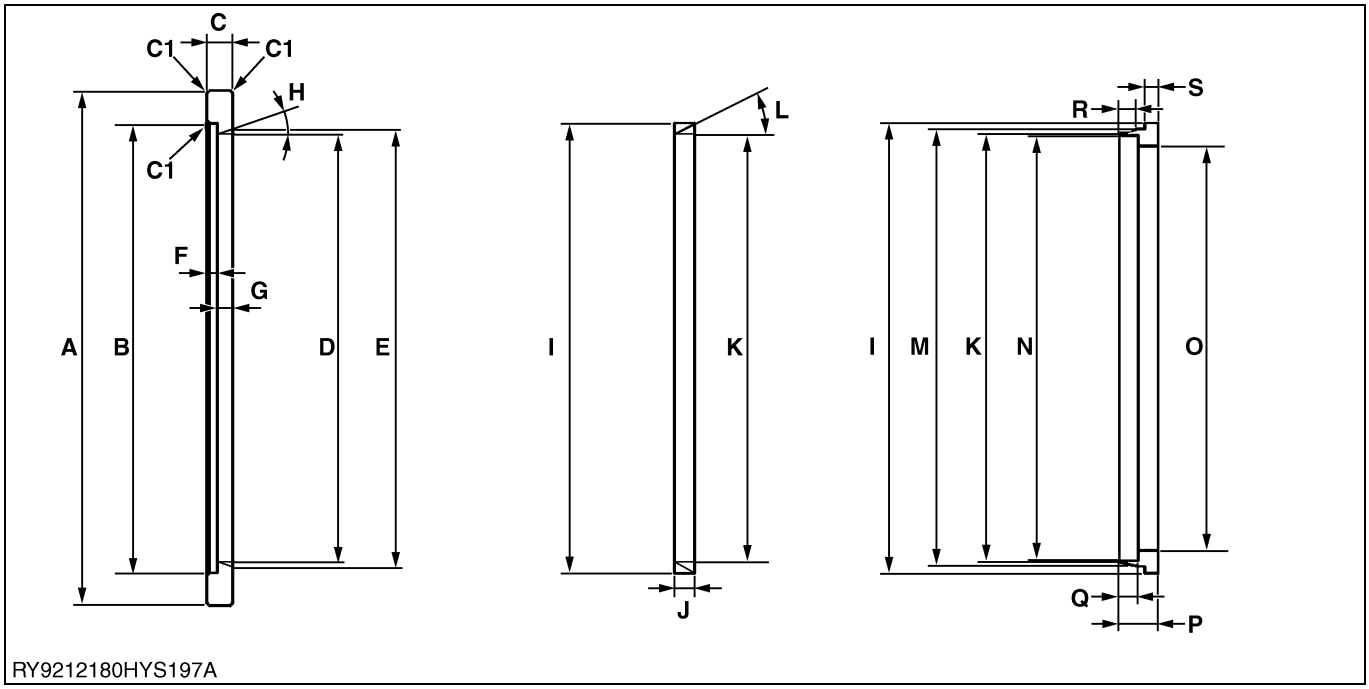
RY9212180HYS196A

(S-6) Ring Nut Fastening Tool

A	ϕ 150 mm (ϕ 5.85 in.)
B	ϕ 146 mm (ϕ 5.694 in.)
C	4-16 mm (0.630 in.)
D	10 mm (0.39 in.)
E	107 mm (4.173 in.)
F	9.0 mm (0.351 in.)
G	□ 12.8 to 13.0 mm (0.499 to 0.507 in.)
H	90 mm (3.51 in.)

RY9212180HYS0208US0

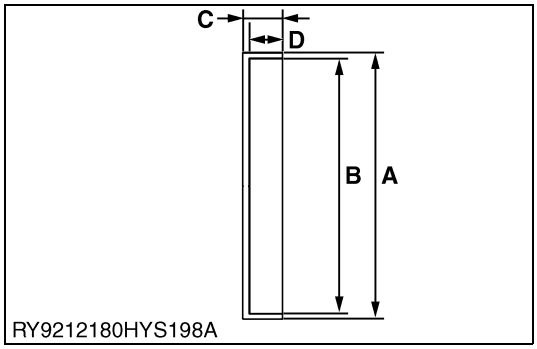
(S-9) Floating Seal Assembly Tool



RY9212180HYS197A

A	ϕ 205 mm (ϕ 7.995 in.)	**K**	ϕ 170.2 ± 0.1 mm (ϕ 7.995 ± 0.004 in.)
B	179.2 to 179.3 mm (6.989 ~ 6.993 in.)	**L**	15 ° ± 1 °
C	10 mm (0.39 in.)	**M**	ϕ 174 mm (ϕ 6.786 in.)
D	170.2 mm (6.638 in.)	**N**	ϕ 169 ± 0.1 mm (ϕ 6.591 ± 0.004 in.)
E	173.4 mm (6.763 in.)	**O**	ϕ 161 mm (ϕ 6.279 in.)
F	4.0 mm (0.156 in.)	**P**	15 mm (0.585 in.)
G	6.0 mm (0.234 in.)	**Q**	7.5 mm (0.293 in.)
H	15 °	**R**	7.0 mm (0.273 in.)
I	ϕ 179.3 to 179.5 mm (ϕ 6.993 ~ 7.001 in.)	**S**	5.0 mm (0.195 in.)
J	8.0 mm (0.312 in.)	**C1**	Chamfer 1.0 mm

RY9212180HYS0209US0

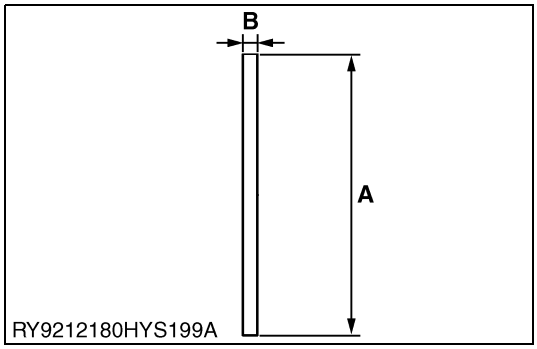


RY9212180HYS198A

(S-10) Angular Bearing Press-in Tool

A	ϕ 165 mm (ϕ 6.435 in.)
B	ϕ 158 mm (ϕ 6.162 in.)
C	24 mm (0.936 in.)
D	20 mm (0.78 in.)

RY9212180HYS0210US0

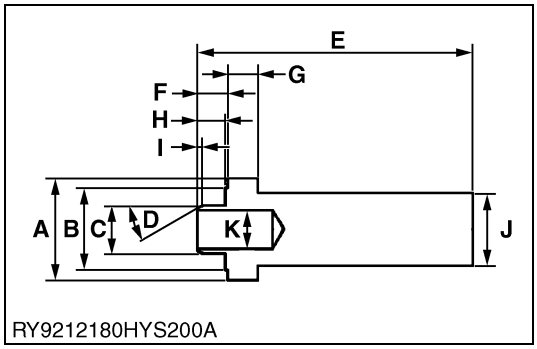


RY9212180HYS199A

(S-11) Flange Holder Press-in Tool

A	ϕ 180 mm (ϕ 7.02 in.)
B	9.0 mm (0.351 in.)

RY9212180HYS0211US0

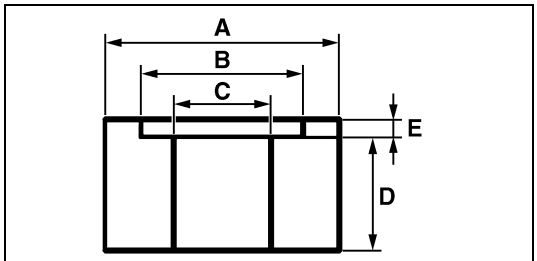


RY9212180HYS200A

(S-12) Oil Seal Press-in Tool

A	ϕ 42 mm (ϕ 1.638 in.)
B	ϕ 34 mm (ϕ 1.326 in.)
C	ϕ 19.6 to 19.8 mm (ϕ 0.764 to 0.772 in.)
D	30 °
E	110 mm (4.29 in.)
F	12 mm (0.468 in.)
G	12 mm (0.468 in.)
H	11 ± 0.1 mm (0.468 ± 0.004 in.)
I	2.0 mm (0.078 in.)
J	ϕ 30 mm (ϕ 1.17 in.)
K	ϕ 16 mm (ϕ 0.624 in.)

RY9212180HYS0212US0

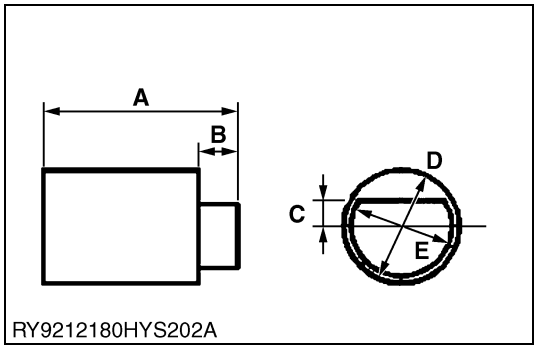


RY9212180HYS201A

(S-13) Ball Bearing Press-in Tool

A	ϕ 60 mm (ϕ 2.34 in.)
B	ϕ 42.005 to 42.100 mm (ϕ 1.640 to 1.642 in.)
C	ϕ 25 mm (ϕ 0.975 in.)
D	35 mm (1.365 in.)
E	5.0 mm (0.195 in.)

RY9212180HYS0213US0

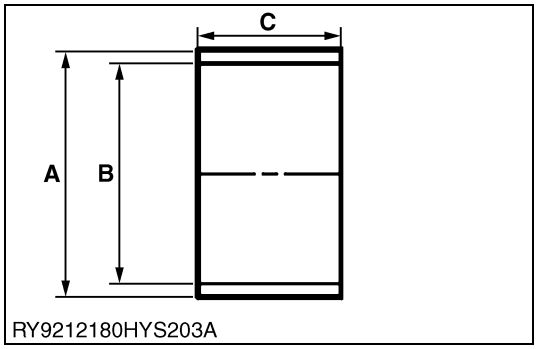


RY9212180HYS202A

(S-15) Snap Ring Assembly Tool

A	50 mm (1.95 in.)
B	10 mm (0.39 in.)
C	7.0 mm (0.273 in.)
D	ϕ 30 mm (ϕ 1.17 in.)
E	ϕ 26 mm (ϕ 1.014 in.)

RY9212180HYS0214US0



RY9212180HYS203A

(S-16) Ball Bearing Press-in Tool

A	ϕ 36 mm (ϕ 1.404 in.)
B	ϕ 32 mm (ϕ 1.248 in.)
C	20 mm (0.78 in.)

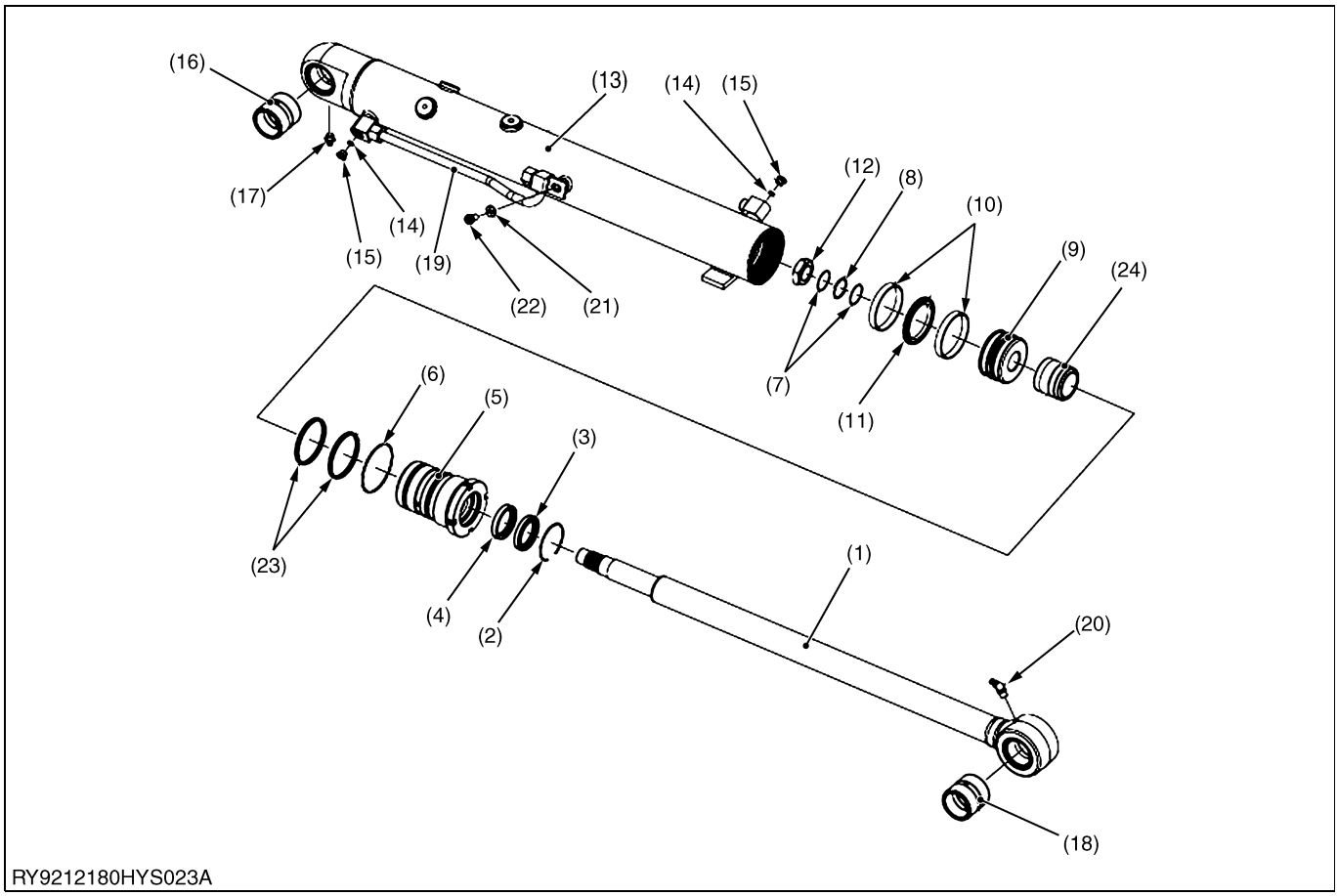
RY9212180HYS0215US0

6. HYDRAULIC CYLINDER

[1] DISASSEMBLY/ASSEMBLY PROCEDURES

(1) Cylinder Components

Boom Cylinder



RY9212180HYS023A

No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Rod	1	(13)	Cylinder tube	1
(2)	Stop ring	1	(14)	O-ring	2
(3)	Wiper ring	1	(15)	Plug	2
(4)	U-ring	1	(16)	Bush	1
(5)	Cylinder head	1	(17)	Grease nipple	1
(6)	O-ring	1	(18)	Bush	1
(7)	Backup ring	1	(19)	Pipe	1
(8)	O-ring	1	(20)	Grease nipple	1
(9)	Piston	1	(21)	Flat metal washer	1
(10)	Guide ring	2	(22)	Bolt	1
(11)	Piston ring	1	(23)	Seal	2
(12)	Nut	1	(24)	Cushion ring	1

RY9212180HYS0001US0

(2) Disassembly Procedures

Cylinder Disassembly

1. Drain the oil from inside the cylinder, and fasten the cylinder bottom in a vice across the bolt width.

RY9212180HYS0002US0

2. Place an anti-rotation device in one position of the cylinder head.

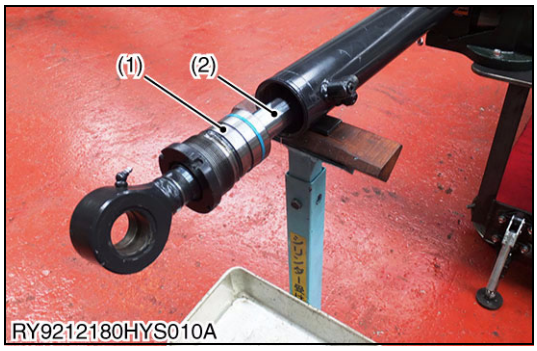
(1) Cylinder Head

RY9212180HYS0003US0

3. Loosen the cylinder head with a hook wrench.
   While loosening the cylinder head screw, remove the cylinder head.

(1) Cylinder Head

RY9212180HYS0004US0

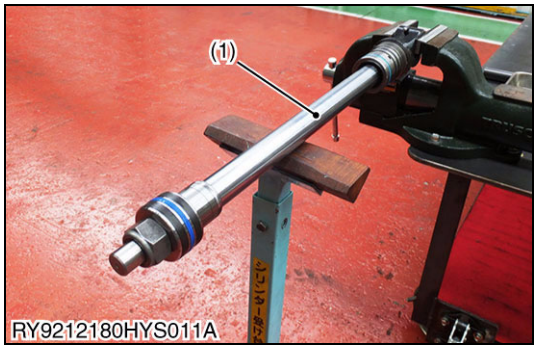


4. Pull out the piston rod assembly together with the cylinder head and place them on a board.

■ **IMPORTANT**
- **Check whether or not the pipe cap has been removed.**
- **Provide an oil receptacle for the port on the cylinder head side.**
- **Draw the piston rod assembly out while keeping it level, to avoid dropping it and damaging parts immediately after it is withdrawn.**

(1) Cylinder Head (2) Piston Rod ASSY

RY9212180HYS0005US0

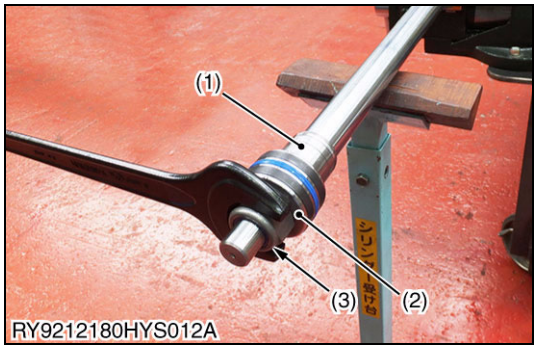


5. Fasten the piston rod assembly in a vice across the bolt width and use a cushioning material.

■ **IMPORTANT**
- **Place the rod on a block of wood.**

(1) Piston Rod ASSY

RY9212180HYS0006US0

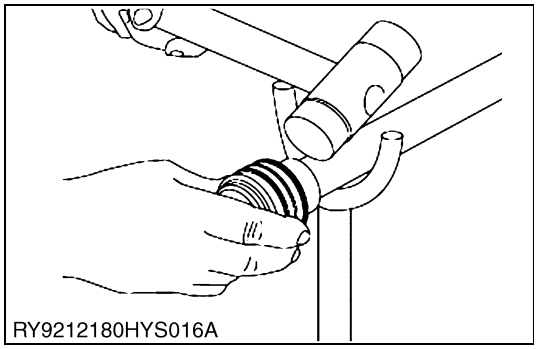


6. Loosen the nut.
   If a large amount of torque is required, use a power wrench with a hydraulic jack or hydraulic cylinder.

■ **IMPORTANT**
- **Do not reuse seals after they are removed.**

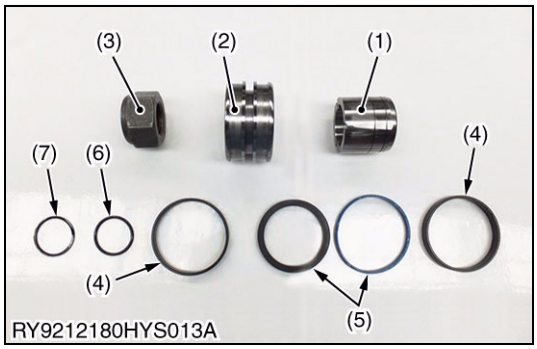
(1) Cushion Ring
(2) Piston
(3) Nut

RY9212180HYS0007US0



7. Use a nylon hammer to remove the piston.

RY9212180HYS0238US0



Piston components

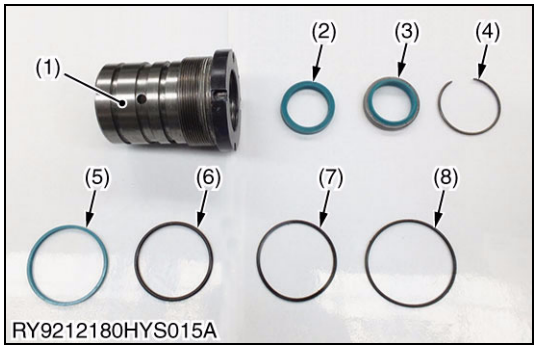
(1) Cushion Ring
(2) Piston
(3) Nut
(4) Guide Ring
(5) Piston Seal
(6) O-Ring
(3) Backup Ring

RY9212180HYS0008US0

8. Remove the rod from the cylinder head.

(1) Cylinder Head

RY9212180HYS0009US0



Cylinder Head Components

(1) Cylinder Head
(2) U-Ring
(3) Wiper Ring
(4) Stop Ring
(5) Oil Seal
(6) O-Ring
(7) Backup Ring
(8) O-Ring

RY9212180HYS0010US0

(3) Assembly Procedures

Precautions on Assembly

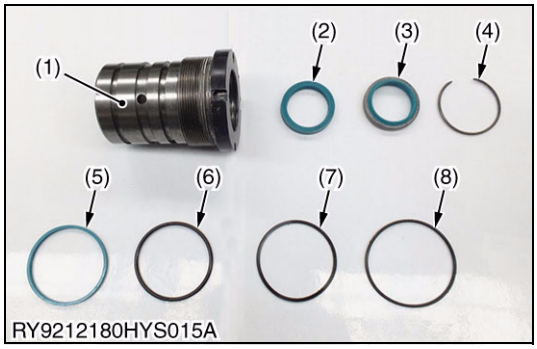
Replacing Seals

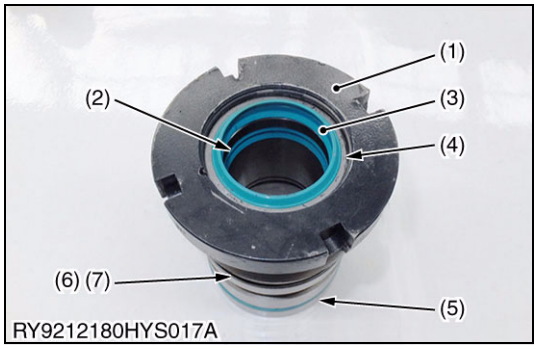
All seals must be replaced when disassembling the cylinder.

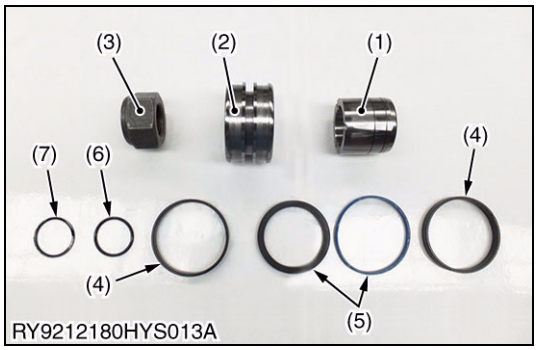
Replacing O-rings

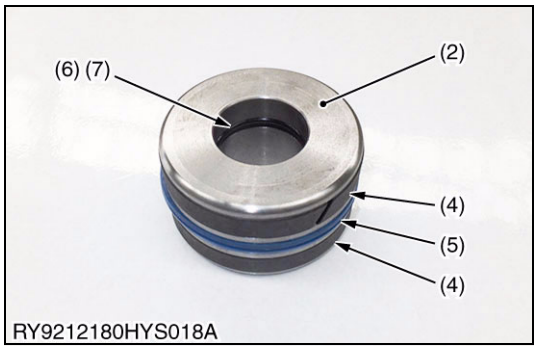
Thoroughly clean the mounting groove before fitting the backup ring and O-ring.
Take care over the backup ring location.
Apply grease or hydraulic fluid to the backup ring and O-ring, for smoothness of assembly.
If not sufficiently lubricated, O-rings may become twisted during assembly, resulting in oil leakage.

RY9212001HYS0444US0









Cylinder Head Assembly

1. Apply hydraulic fluid to the U-ring and install it in the cylinder head.

■ **IMPORTANT**

- **Take care to orient the U-ring correctly during installation.**
- **Place the U-ring in hot water (approx. 90 °C, 194 °F) for about five to ten minutes to soften it prior to installation.**

2. Apply hydraulic oil to the wiper rings and install them in the cylinder head.
3. Install the guide ring.
4. Apply hydraulic oil to the backup and O-rings and install them on the cylinder head.

(1) Cylinder Head
(2) U-Ring
(3) Wiper Ring
(4) Stop Ring
(5) Oil Seal
(6) O-Ring
(7) Backup Ring
(8) O-Ring

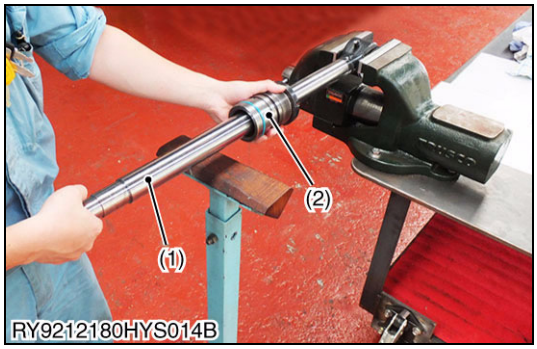
RY9212180HYS0011US0

Piston Assembly

5. Apply hydraulic oil to the O-ring, piston seal and guide rings and install them on the piston.

(1) Cushion Ring
(2) Piston
(3) Nut
(4) Guide Ring
(5) Piston Seal
(6) O-Ring
(7) Backup Ring

RY9212180HYS0012US0



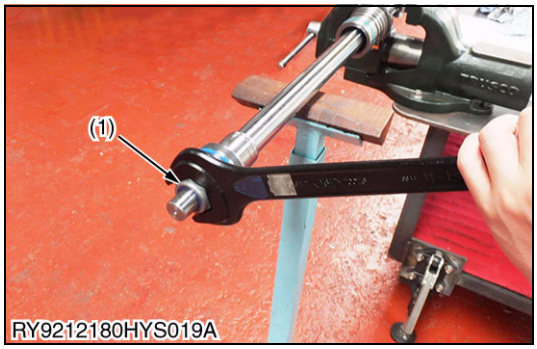
Piston Rod Assembly

6. Fasten the piston rod in a vice, apply hydraulic fluid to the seal of the cylinder head and install on the piston rod.

■ **IMPORTANT**
- **Take care so that the lip of the wiper ring does not catch on the stepped section.**

(1) Piston Rod (2) Cylinder Head

RY9212180HYS0013US0

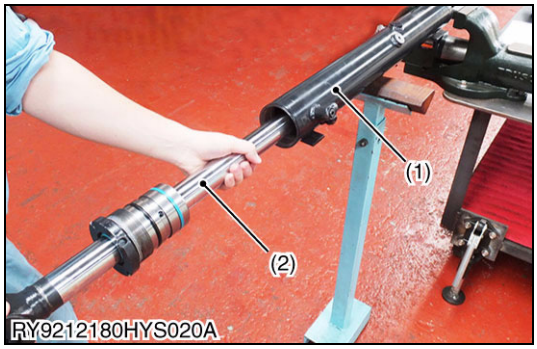


7. Install the Nut.

■ **IMPORTANT**
- **Tighten the nut to the specified torque.**
- **Apply Loctite 262.**

(1) Nut

RY9212180HYS0014US0



8. Hold the cylinder tube level in a vice, apply hydraulic fluid to the piston and insert the piston rod.

(1) Cylinder Tube (2) Piston Rod

RY9212180HYS0015US0

9. Tighten the cylinder head with a hook wrench.

■ **IMPORTANT**
- **Tighten the cylinder head to the specified torque.**
- **Apply Loctite 222.**

(1) Cylinder Head

RY9212180HYS0016US0

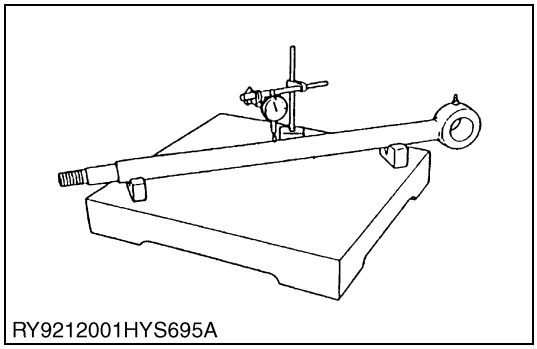
10. Firmly bend the lock washer into the cylinder head groove.

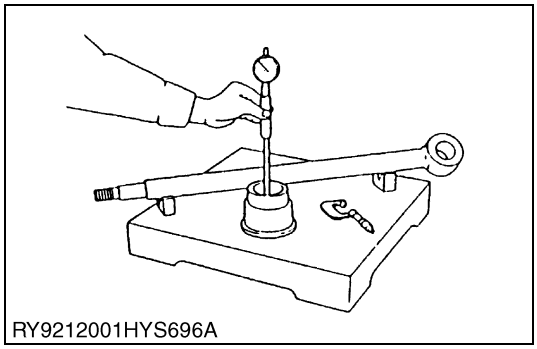
RY9212180HYS0017US0

Tightening Torque

			Remarks
Boom cylinder	Cylinder head	500 to 550 N·m 51.0 to 56.0 kgf·m 369 to 405 lbf·ft	Loctite 222
	Nut	480 to 520 N·m 49.0 to 53.0 kgf·m 354 to 383 lbf·ft	Loctite 262
Arm cylinder	Cylinder head	500 to 550 N·m 51.0 to 56.0 kgf·m 369 to 405 lbf·ft	Loctite 222
	Piston	500 to 600 N·m 51.0 to 61.1 kgf·m 369 to 442 lbf·ft	
	Nut	480 to 520 N·m 49.0 to 53.0 kgf·m 354 to 383 lbf·ft	Loctite 262
Bucket cylinder	Cylinder head	350 to 400 N·m 35.7 to 40.7 kgf·m 259 to 295 lbf·ft	Loctite 222
	Nut	380 to 420 N·m 38.8 to 42.8 kgf·m 281 to 309 lbf·ft	
Swing cylinder	Cylinder head	350 to 400 N·m 35.7 to 40.7 kgf·m 259 to 295 lbf·ft	Loctite 222
	Nut	380 to 420 N·m 38.8 to 42.8 kgf·m 281 to 309 lbf·ft	Loctite 262
Blade cylinder	Cylinder head	600 to 700 N·m 61.2 to 71.3 kgf·m 443 to 516 lbf·ft	Loctite 222
	Nut	480 to 520 N·m 49.0 to 53.0 kgf·m 354 to 383 lbf·ft	Loctite 262

RY9212180HYS0018US0


RY9212001HYS695A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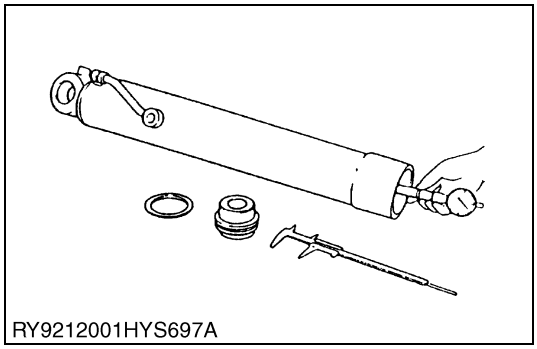

RY9212001HYS697A

Cylinder Inspection

1. Warping of the piston rod

1. Put the piston rod by itself on the V blocks.
2. Set a dial gauge on the center of the rod.
3. Rotate the piston rod and read the measurements on the dial gauge. Warpage equals 1/2 the difference in the readings.
4. Replace any rod that exceeds its usage limit.
   - Factory spec for warpage : 0.005 mm (0.0002 in.) ≥
   - Usage limit for warpage : 0.5 mm (0.02 in.)

2. Wear in the rod and bushings

1. Measure the diameter of the outside of the piston rod and that of the inside of the bushing in the cylinder head and calculate the gap.

	Rod size	Gap
Factory specification	ϕ25 to 40 mm ϕ0.99 to 1.5 in.	0.25 mm ≥ 0.01 in. ≥
	ϕ45 to 75mm ϕ1.8 to 3.0 in.	0.30 mm ≥ 0.01 in. ≥
Allowable limits	ϕ25 to 40 mm ϕ0.99 to 1.5 in.	0.4 mm 0.02 in.
	ϕ45 to 75mm ϕ1.8 to 3.0 in.	0.5 mm 0.02 in.

3. Wear in the tube and piston ring

1. Measure the inside diameter of the cylinder tube.
2. Measure the outside diameter of the piston ring and calculate the clearance.

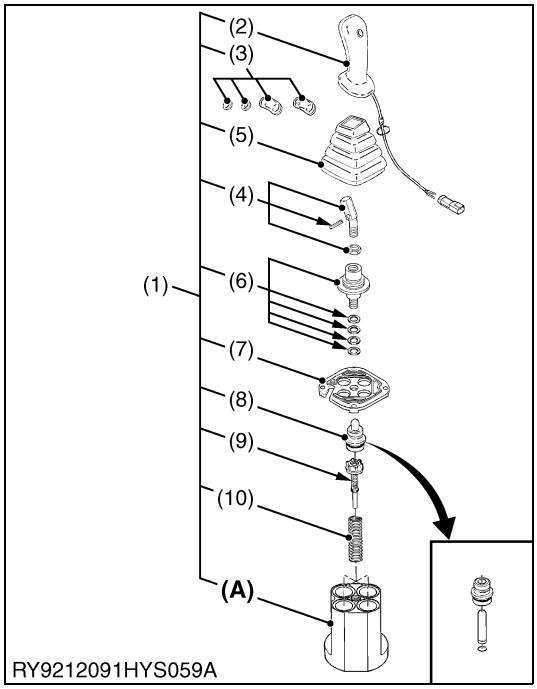
	Rod size	Gap
Factory specification	ϕ60 mm ≥ ϕ2.4 in. ≥	0.05 to 0.30 mm 0.002 to 0.01 in.
	ϕ65 to 115 mm ϕ2.6 to 4.53 in.	0.05 to 0.35 mm 0.002 to 0.01 in.
	ϕ120 mm ≤ ϕ4.72 in. ≤	0.05 to 0.40 mm 0.002 to 0.02 in.
Allowable limits	ϕ60 mm ≥ ϕ2.4 in. ≥	0.60 mm 0.02 in.
	ϕ65 to 115 mm ϕ2.6 to 4.53 in.	0.70 mm 0.03 in.
	ϕ120 mm ≤ ϕ4.72 in. ≤	0.80 mm 0.03 in.

RY9212180HYS0019US0

7. PILOT VALVE

[1] DISASSEMBLY/ASSEMBLY PROCEDURES

(1) Pilot Valve Components

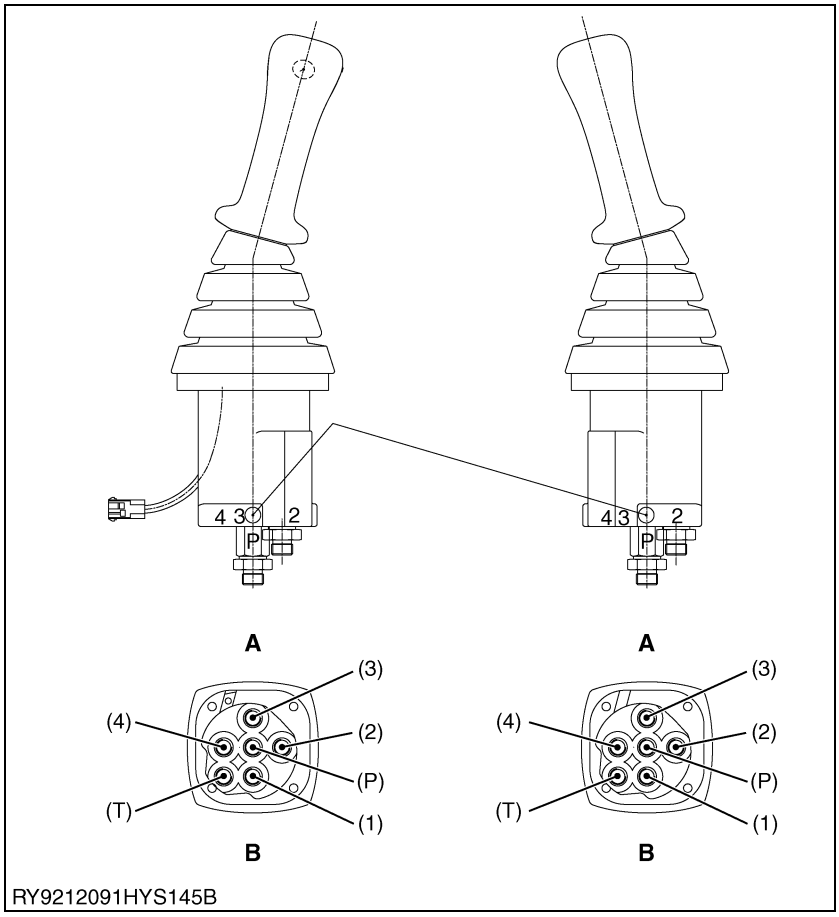


RY9212091HYS059A

No.	Name of part	Qty
(1)	Valve, ASSY **(A)** (2) to (10)	1
(2)	Handle	1
(3)	Button	1
(4)	Lever ASSY	1
(5)	Rubber boot	1
(6)	Nut (disc)	1
(7)	Plate	1
(8)	Plug	4
(9)	Reducing valve ASSY	4
(10)	Spring	4

RY9212091HYS0257US0

Pilot Valve Hydraulic Hose Usage Positions



RY9212091HYS145B

Right P/V

	Position Used	Hose tape color
(1)	Boom up	Gray
(2)	Bucket dump	Pink
(3)	Boom down	Light blue
(4)	Bucket crowd	Brown
(P)	P port	White
(T)	T Port	

Left P/V

	Position Used	Hose tape color
(1)	Arm crowd	Green
(2)	Swivel left	Red
(3)	Arm dump	Blue
(4)	Swivel right	Yellow
(P)	P port	White
(T)	T Port	

A : Front of Vehicle
B : Rear of Vehicle

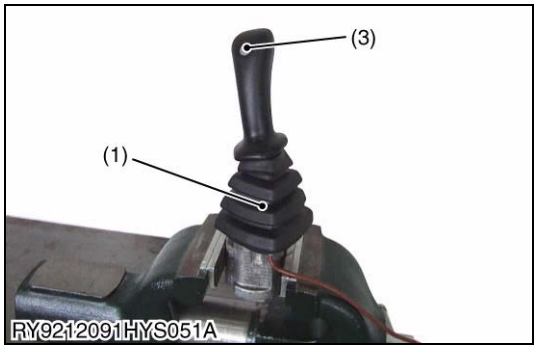
RY9212091HYS0258US0

(2) Disassembly Procedures

CAUTION

- **All of the parts are precisely made, so be very careful in handling them and taking 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.**

RY9212091HYS0284US0



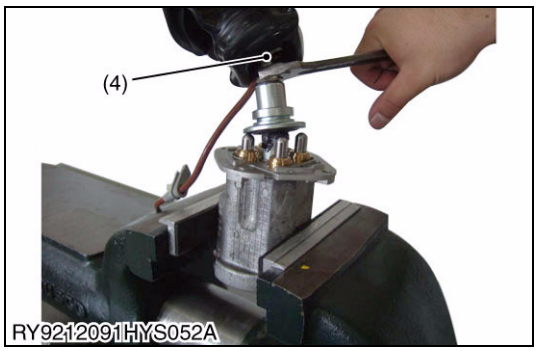
1. Secure the pilot valve in a vice and remove the button.

IMPORTANT

- **When clamping it in a vise, use a sheet of copper to prevent scratching the pilot valve.**

(1) Valve ASSY (3) Button

RY9212091HYS0259US0

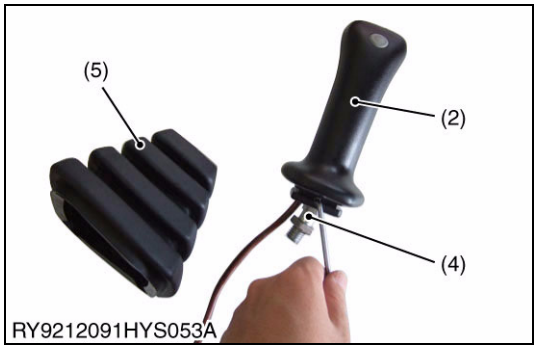


2. Loosen the nut and remove the lever ASSY.

- Tool to use: 19 mm wrench

(4) Lever ASSY

RY9212091HYS0260US0

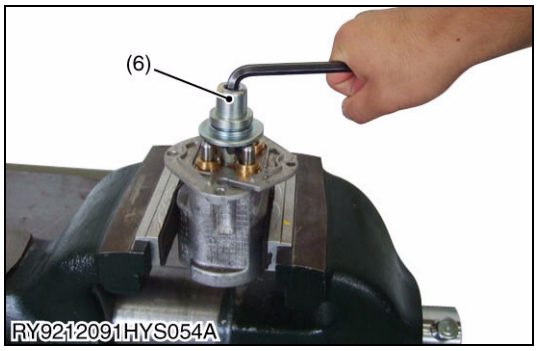


3. Remove the rubber boot from the handle.
   Remove the pin and separate the handle and lever ASSY.

- Tool to use: 19 mm wrench

(2) Handle (5) Lever ASSY
(4) Lever ASSY

RY9212091HYS0261US0



4. Remove the nut (disc).

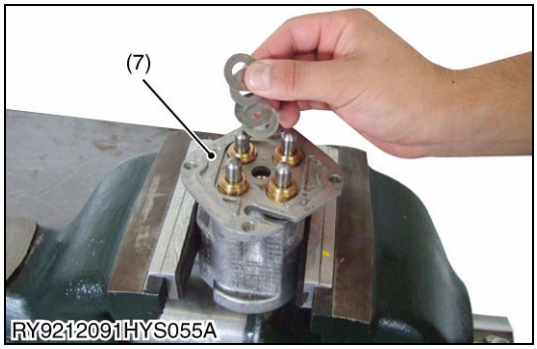
- Tool to use: M8 hex socket

CAUTION

- **When removing the nut (disc), take care that the plug does not pop off.**

(6) Nut (Disc)

RY9212091HYS0262US0



5. Remove the four shims and the plates.

CAUTION
- **When removing the plates, take care that the plug does not pop off.**

(7) Plate

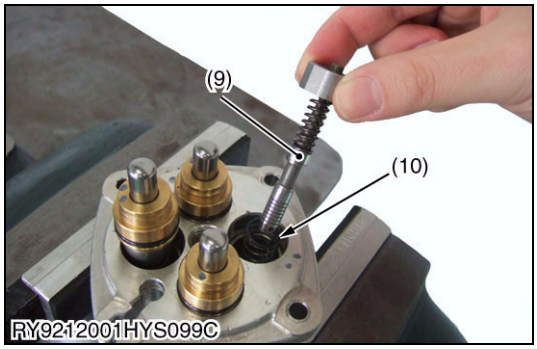
RY9212091HYS0263US0

6. Slip a slotted screwdriver in the groove around the plug to remove it.

CAUTION
- **Take care so the plug does not go flying.**
- **Take care not to damage it by exerting force unevenly.**
- **If a burr is formed, use a whetstone to remove it.**

(8) Plug

RY9212091HYS0264US0



7. Remove the reducing valve ASSY and the return spring.

(9) Reducing Valve ASSY (10) Spring

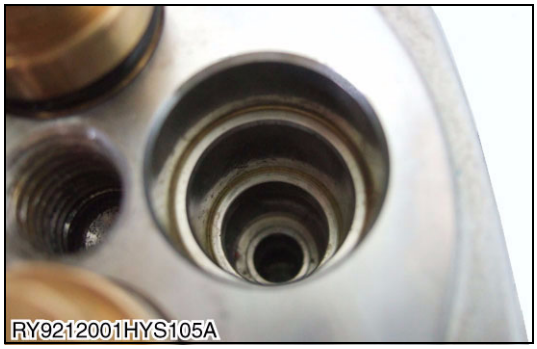
RY9212091HYS0265US0

(3) Assembly Procedures

CAUTION

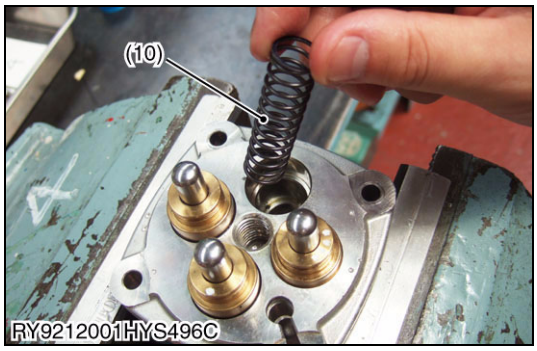
- **Prepare your workbench in the same way as for disassembly.**
- **Follow the same general precautions as in the disassembly.**
- **When assembling the parts, remove all bits of metal or foreign matter from all the parts and make sure there aren't any burrs or dings on the parts.**
- **Replace used O-rings with new ones.**
- **Take care not to damage the O-rings when installing them.**

RY9212091HYS0285US0


RY9212001HYS105A

1. Make sure there aren't any burrs or scratches inside the casing.

RY9212001HYS0487US0



RY9212001HYS496C

2. Install the return spring in the casing.

■ **IMPORTANT**

- **Install it in the same position as before disassembly.**

(10) Spring

RY9212091HYS0266US0

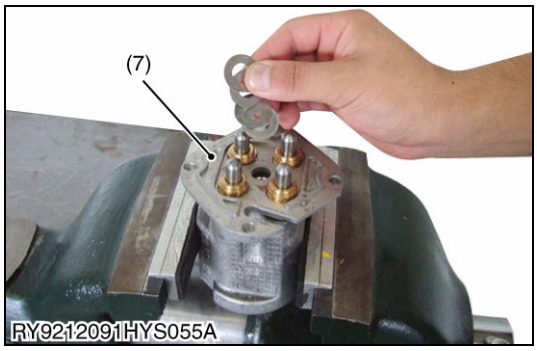

RY9212001HYS497A

3. 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

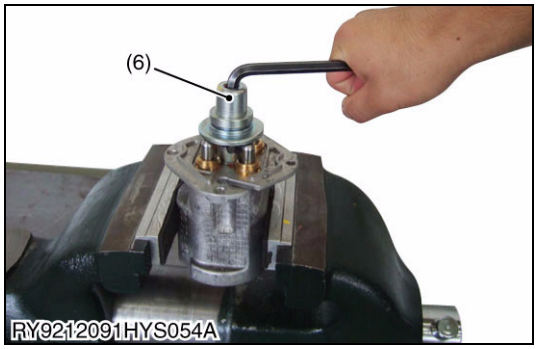


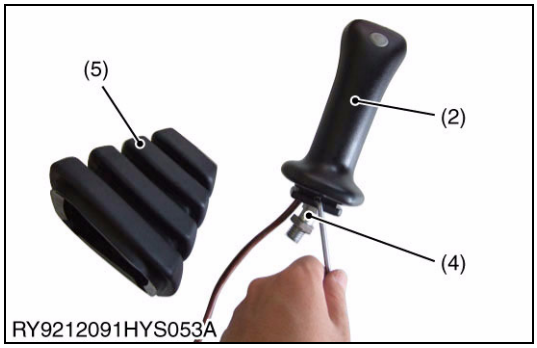
RY9212091HYS055A

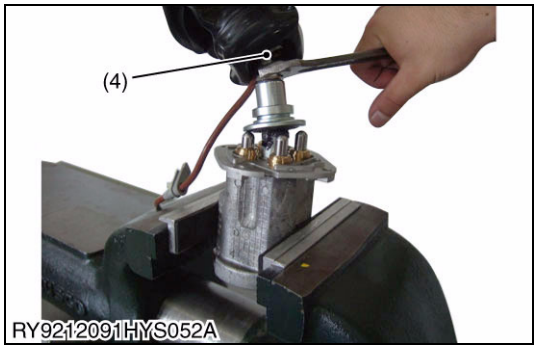
4. Install the plates and four shims.

(7) Plate

RY9212091HYS0267US0







5. Install the nut (disc).

Tightening torque	Nut (6)	45 to 55 N·m 4.6 to 5.6 kgf·m 33 to 41 lbf·ft

Apply thread lock (Loctite 262)

- Tool to use: 8 mm hex socket

(6) Nut (Disc)

RY9212091HYS0268US0

6. Assemble the handle and the lever ASSY.
   Put on the rubber boot.

CAUTION

- **If you tighten it too far, the mechanism will not function properly when the lever is in neutral, so be careful to adjust the nut (disc) to the correct position.**

(2) Handle
(4) Lever ASSY
(5) Rubber Boot

RY9212091HYS0269US0

7. Tighten the lever ASSY.

Tightening torque	Lever ASSY (4)	36 to 44 N·m 3.7 to 4.5 kgf·m 27 to 32 lbf·ft

Apply thread lock (Loctite 262)

- Tool to use: 19 mm wrench

(4) Lever ASSY

RY9212091HYS0270US0

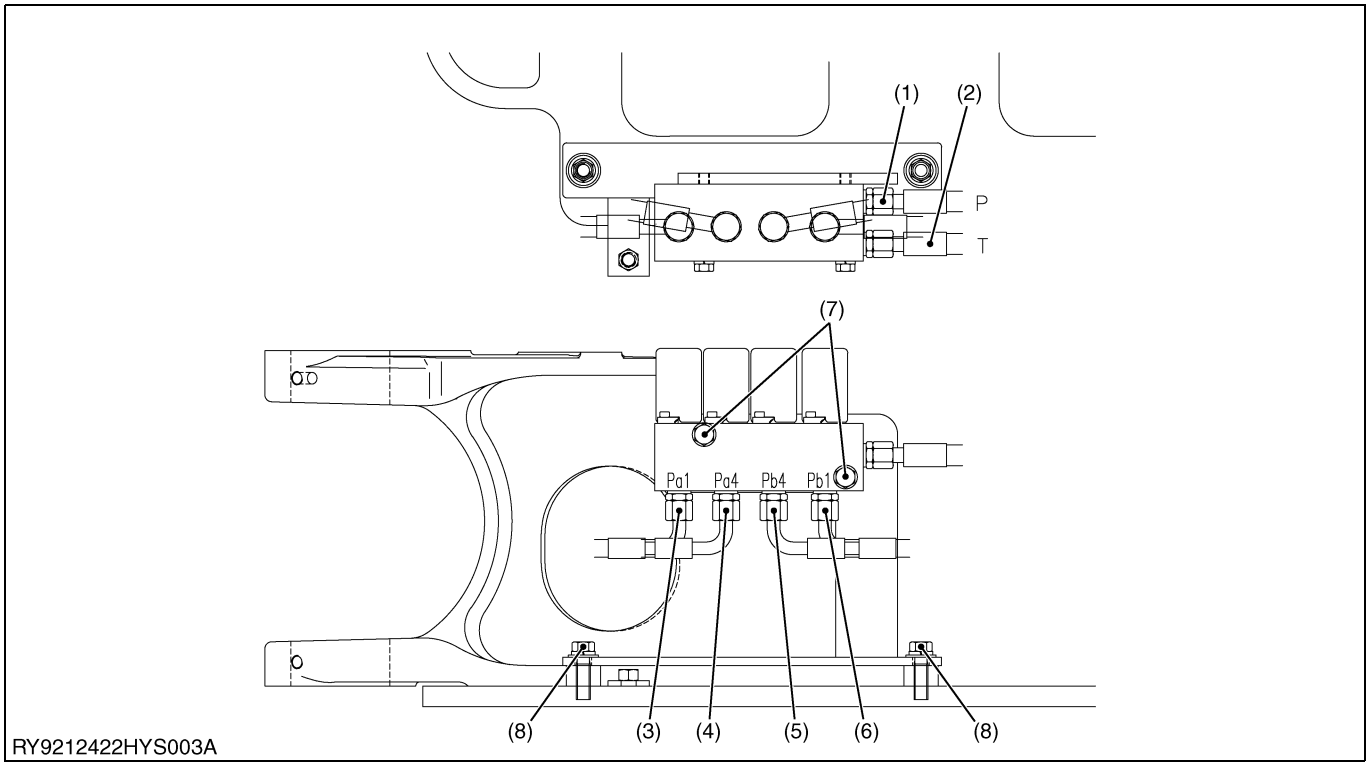
8. Apply grease to the crown of the plugs.

RY9212091HYS0271US0

8. PROPORTIONAL VALVE

[1] INSTALLING

Hi Spec



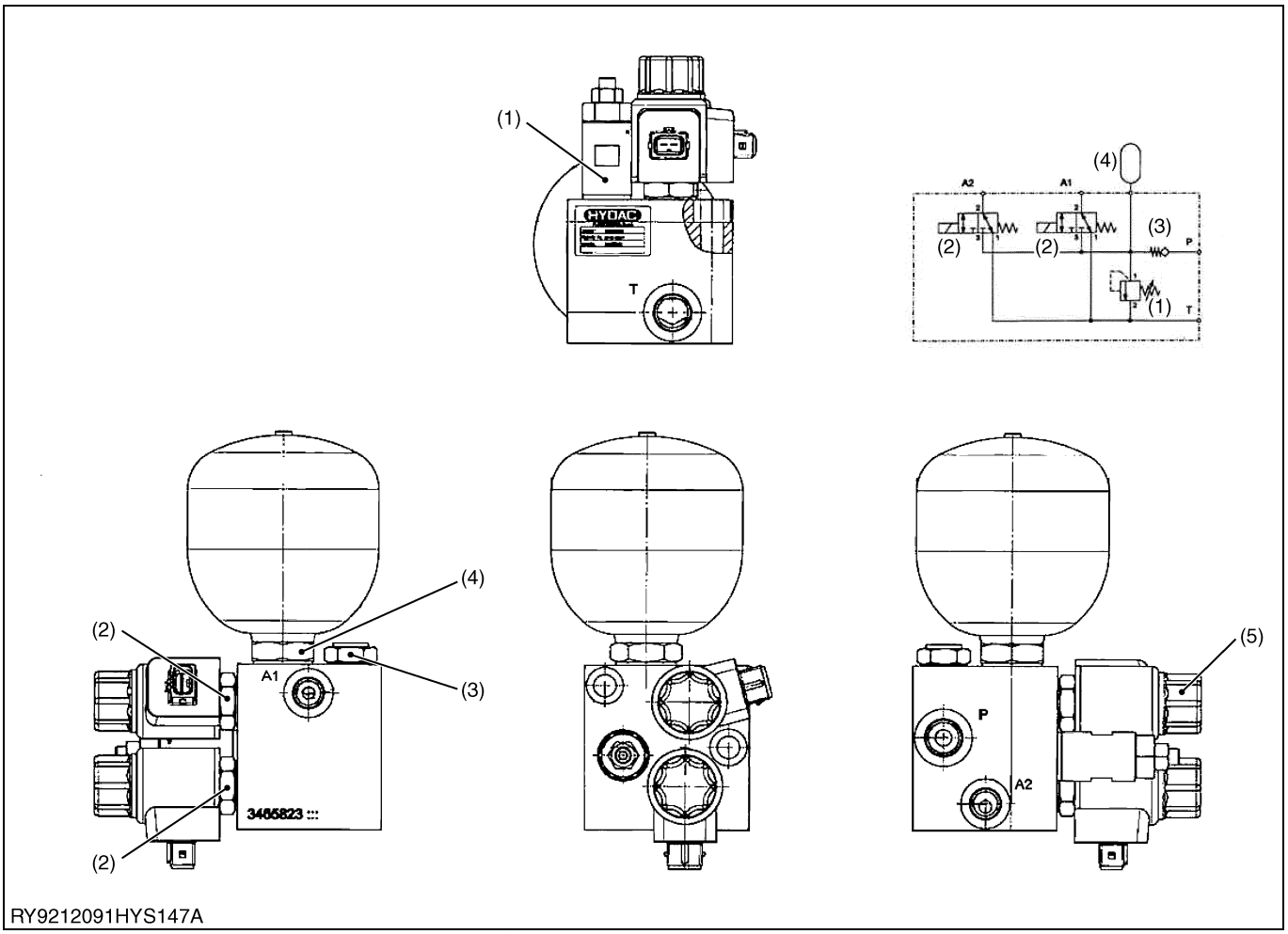
(1) P-Port
(2) T-Port
(3) Pa1 (AUX2 RH/Swing Rod)
(4) Pa4 (AUX1 RH)
(5) Pb4 (AUX2 LH/Swing Bottom)
(6) Pb1 (AUX1 LH)
(7) M8 × 70
(8) M10 × 30

Tightening torque	Adapter (1) to (6)	34.0 to 45.0 N·m 3.5 to 4.6 kgf·m 25.1 to 33.2 lbf·ft

RY9212422HYS0012US0

9. UNLOAD VALVE

[1] ASSEMBLY PROCEDURES



RY9212091HYS147A

No.	Name of part	Tightening torque	Notes
(1)	Relief valve	20 to 30 N·m 2.0 to 3.1 kgf·m 15 to 22 lbf·ft	
(2)	Valve		
(3)	Check valve		
(4)	Accumulator	50 to 60 N·m 5.1 to 6.1 kgf·m 37 to 44 lbf·ft	(Loctite 2701)
(5)	Nut	4 to 6 N·m 0.4 to 0.6 kgf·m 3 to 4 lbf·ft	

■ **IMPORTANT**

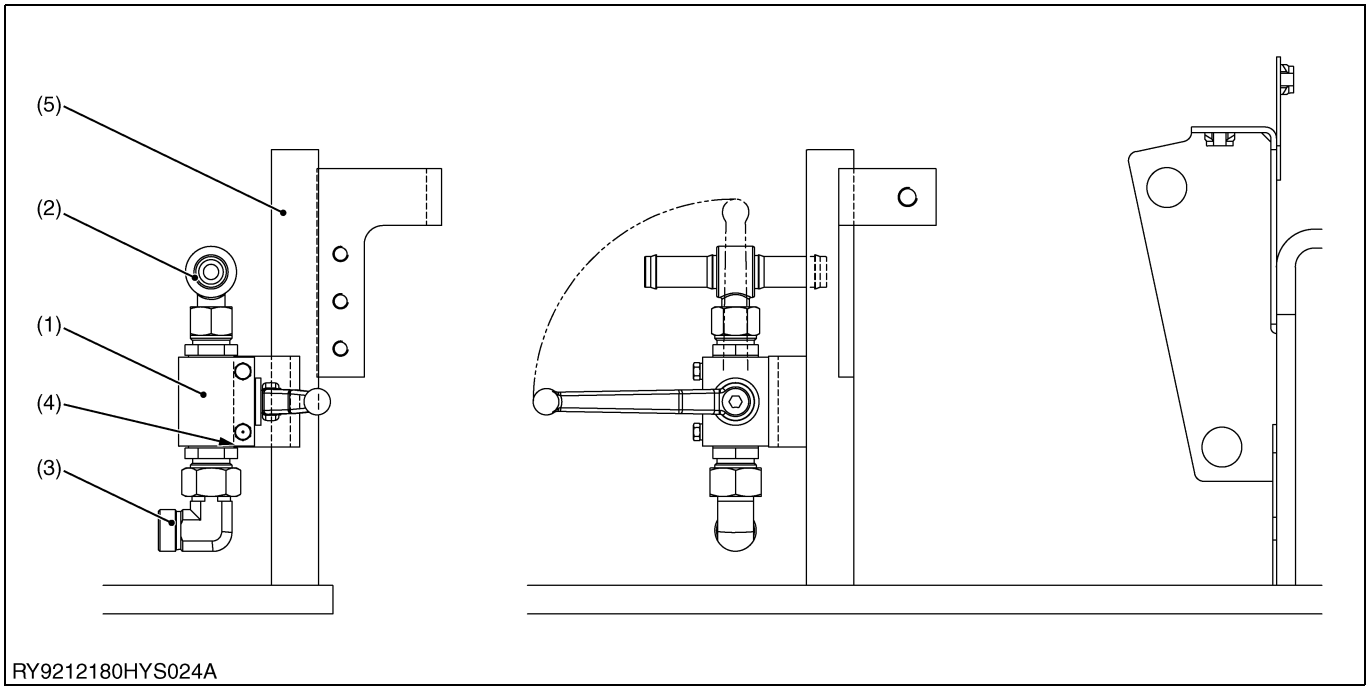
- **This accumulator cannot be filled with gas.**

RY9212091HYS0273US0

10. THIRD LINE VALVE

[1] INSTALLING

STD



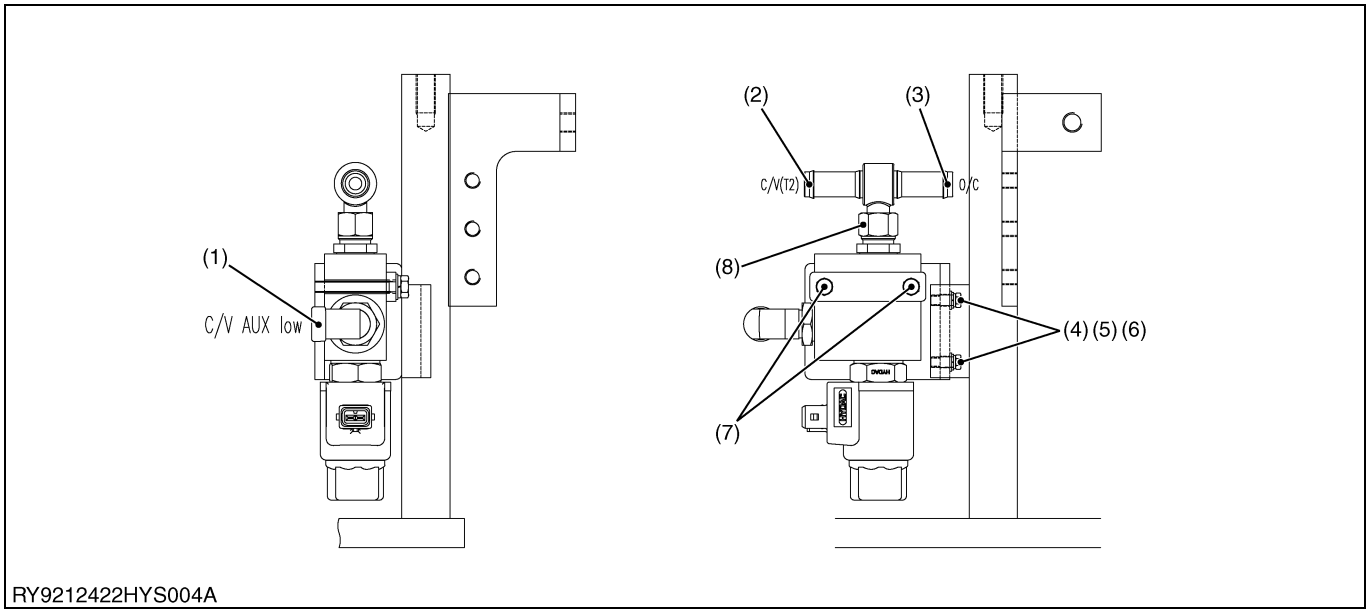
RY9212180HYS024A

(1) Third Line Cock
(2) T Adapter
(3) Adapter
(4) Bolt
(5) Swivel Frame

Tightening torque	Bolt (4)	3.0 to 4.0 N·m 0.3 to 0.4 kgf·m 2.0 to 3.0 lbf·ft
	Adapter	50 to 55 N·m 5.1 to 5.6 kgf·m 37 to 40 lbf·ft

RY9212180HYS0249US0

Hi Spec



RY9212422HYS004A

(1) From Control Valve
(2) From T2
(3) To Oil Cooler
(4) M5 × 12
(5) Spring Washer M5
(6) Washer M5
(7) M6 × 45
(8) Adapter

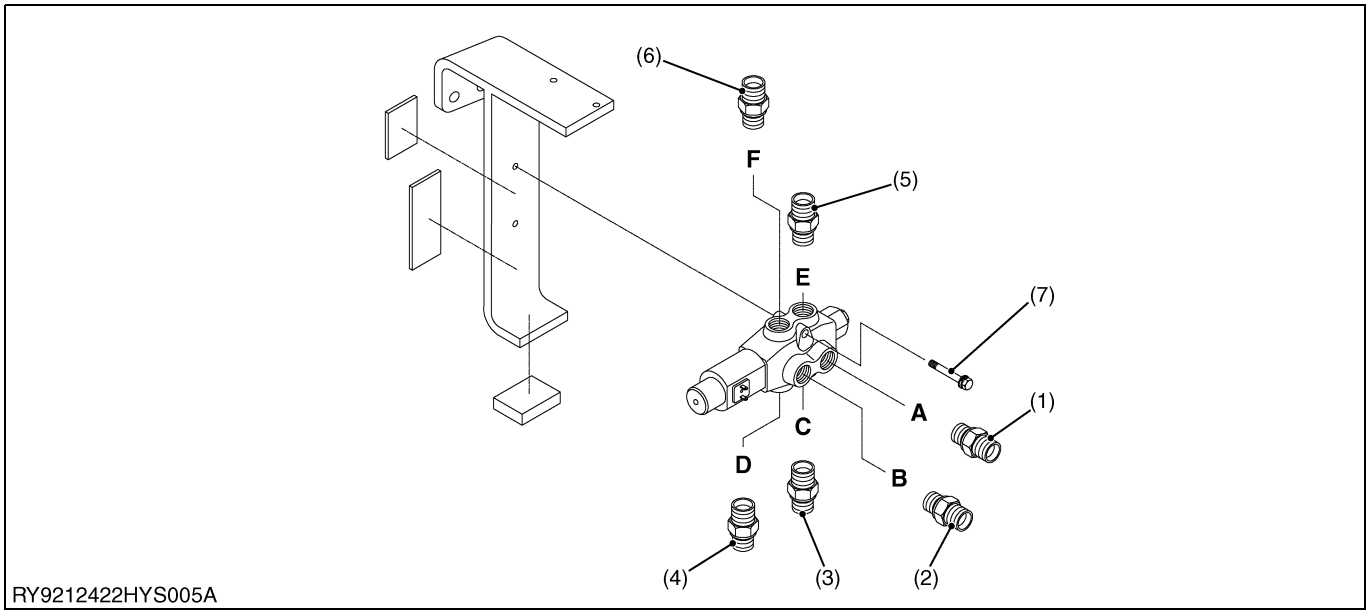
Tightening torque	Bolt (7)	3.0 to 4.0 N·m 0.3 to 0.4 kgf·m 2.2 to 3.0 lbf·ft
	Adapter (8)	50.0 to 55.0 N·m 5.1 to 5.6 kgf·m 36.9 to 40.6 lbf·ft

RY9212422HYS0013US0

11. SELECTOR VALVE

[1] INSTALLING

Hi Spec



RY9212422HYS005A

(1) Port A (from Control Valve)
(2) Port B (from Control Valve)
(3) Port C (to AUX2 R)
(4) Port D (to AUX2 L)
(5) Port E (to Swing Rod)
(6) Port F (to Swing Bottom)
(7) M6 × 55 × 2

■ **IMPORTANT**

- **(5) and (6) are dedicated adapters with orifices inside to adjust the swing speed.**
- **Do not replace to other adapter.**

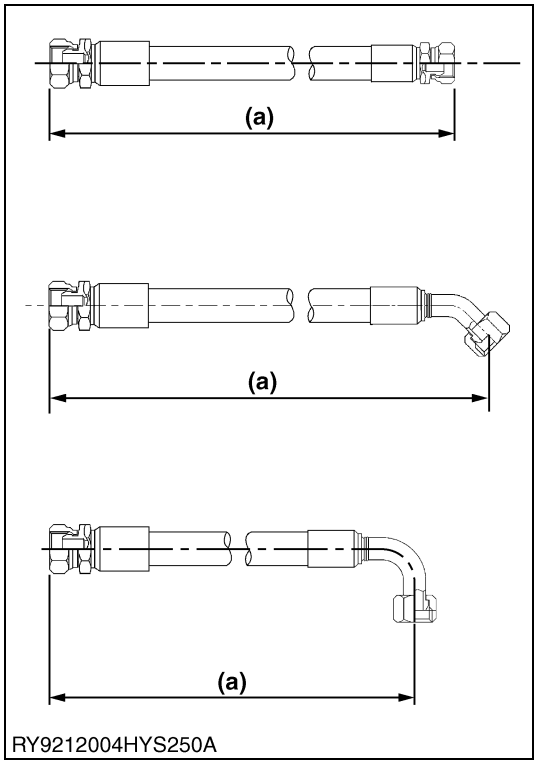
Tightening torque	Adapter (1) to (6)	45.0 to 65.0 N·m 4.6 to 6.6 kgf·m 33.2 to 48.0 lbf·ft
	Bolt (7)	9.8 to 11.3 N·m 1.0 to 5.6 kgf·m 7.2 to 8.3 lbf·ft

RY9212422HYS0014US0

12. HYDRAULIC HOSES

[1] HYDRAULIC HOSE SPECIFICATIONS

(1) Total Length of Hydraulic Hose

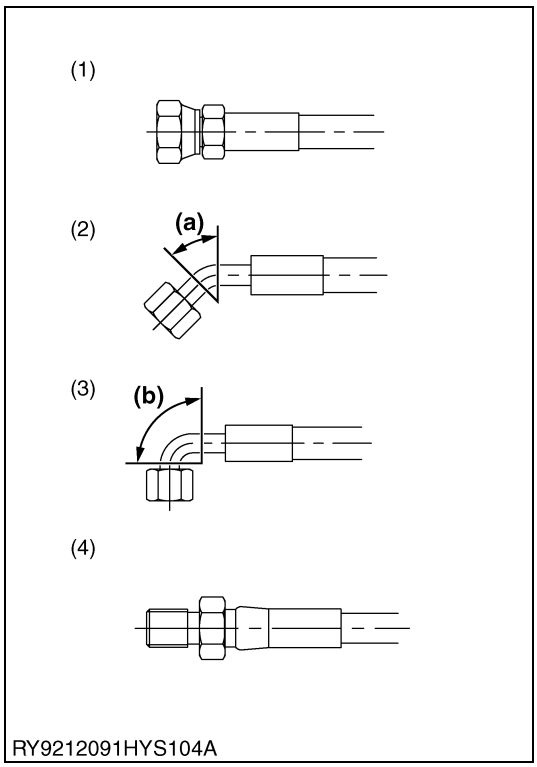


RY9212004HYS250A

(a) Total Length

RY9212004HYS0147US0

(2) Types of Connector Fittings (Screw)



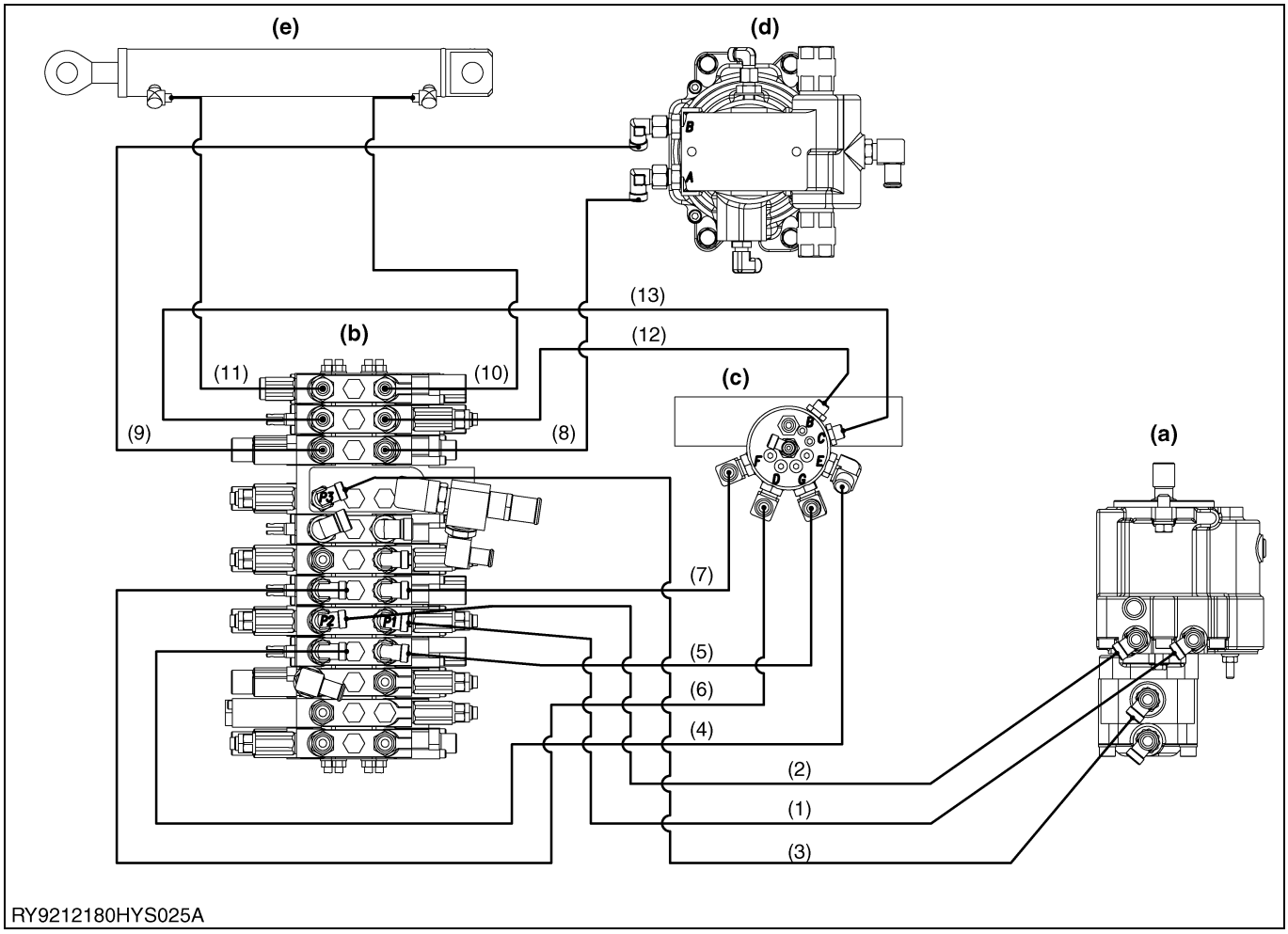
RY9212091HYS104A

(1) C Type (Straight)
(2) CR4 Type (45°)
(3) CR9 Type (90°)
(4) CM Type (Male Thread)

(a) 45 °
(b) 90 °

RY9212091HYS0047US0

[2] DELIVERY HOSE ROUTING (STD)



RY9212180HYS025A

(a) Pump
(b) Control Valve
(c) Swivel Joint
(d) Swivel Motor
(e) Swing Cylinder

(To be continued)

(Continued)

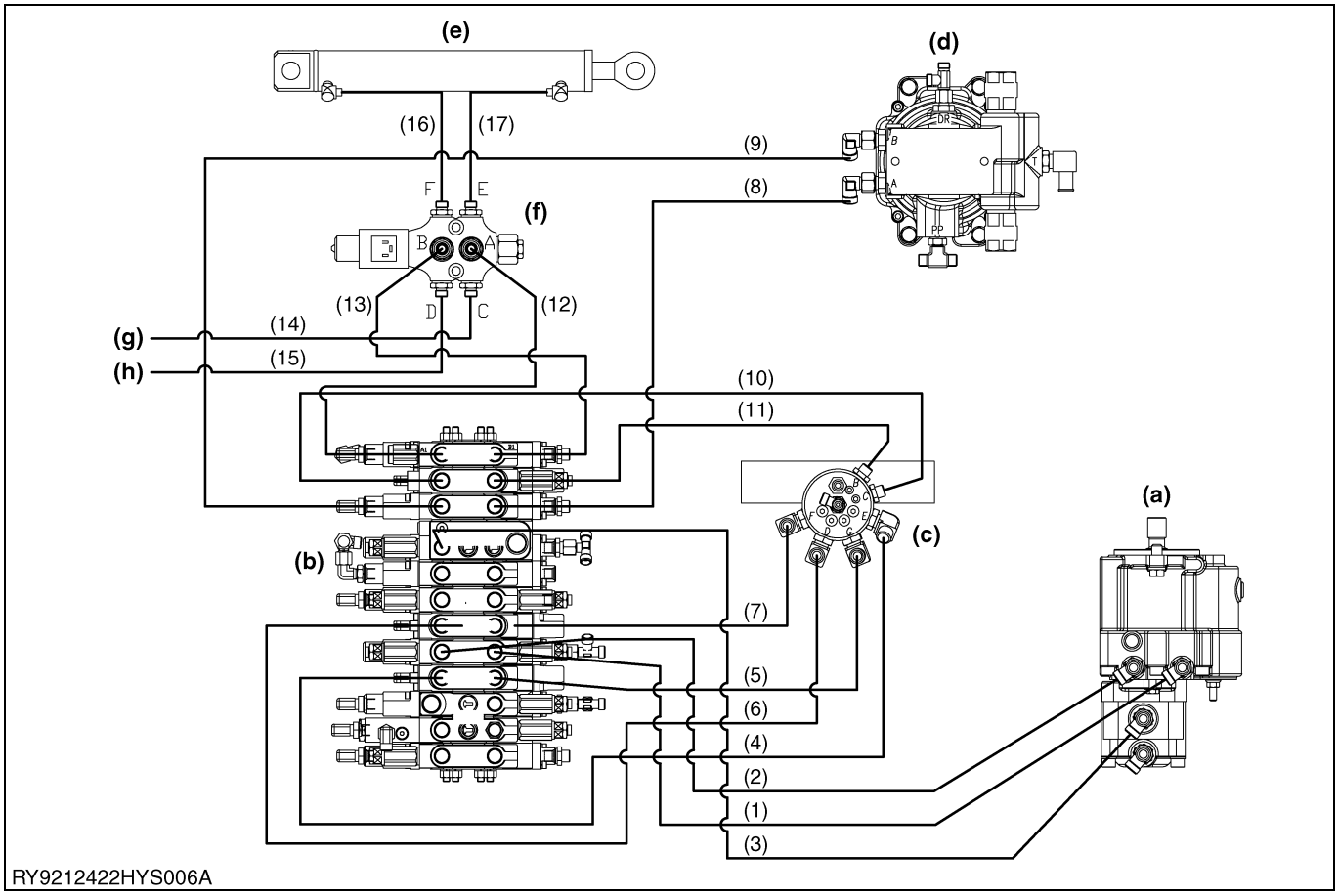
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P1	1020 mm (40.2 in.)	1/2	3 × White	20.6 mm (0.81 in.)	12.7 mm (0.50 in.)	C-C	M22	PWR	Pump (P1) to C/V (P1)
(2)	P2	1030 mm (40.6 in.)	1/2	3 × Red	20.6 mm (0.81 in.)	12.7 mm (0.50 in.)	C-C	M22	PWR	Pump (P2) to C/V (P2)
(3)	P3	1200 mm (47.2 in.)	3/8	3 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	Pump (P3) to C/V (P3)
(4)	Travel right forward	725 mm (28.5 in.)	3/8	2 × Green	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (A7) to R/J (E)
(5)	Travel right reverse	650 mm (25.6 in.)	3/8	2 × Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (B7) to R/J (G)
(6)	Travel left forward	615 mm (24.2 in.)	3/8	2 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (A6) to R/J (D)
(7)	Travel left reverse	560 mm (22.0 in.)	3/8	2 × Red	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (B6) to R/J (F)
(8)	Swivel left	470 mm (18.5 in.)	3/8	2 × Gray	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	C/V (B3) to Swivel motor (L)
(9)	Swivel right	555 mm (21.8 in.)	3/8	2 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	C/V (A3) to Swivel motor (R)
(10)	Swing left	1465 mm (57.7 in.)	1/4	2 × Green	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (B1) to Swing CYL (bottom)
(11)	Swing right	1410 mm (55.5 in.)	1/4	2 × Yellow	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (A1) to Swing CYL (rod)
(12)	Blade down (bottom)	805 mm (31.7 in.)	1/4	2 × Brown	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (B2) to R/J (B)
(13)	Blade down (Rod)	780 mm (30.7 in.)	1/4	2 × Red	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (A2) to R/J (C)

- PWR: Plastic corrugated tube

RY9212180HYS0021US0

[3] DELIVERY HOSE ROUTING (HI SPEC)



(a) Hydraulic Pump
(b) Control Valve
(c) Swivel Joint
(d) Swivel Motor
(e) Swing Cylinder
(f) Selector Valve
(g) AUX2 RH
(h) AUX2 LH

(To be continued)

(Continued)

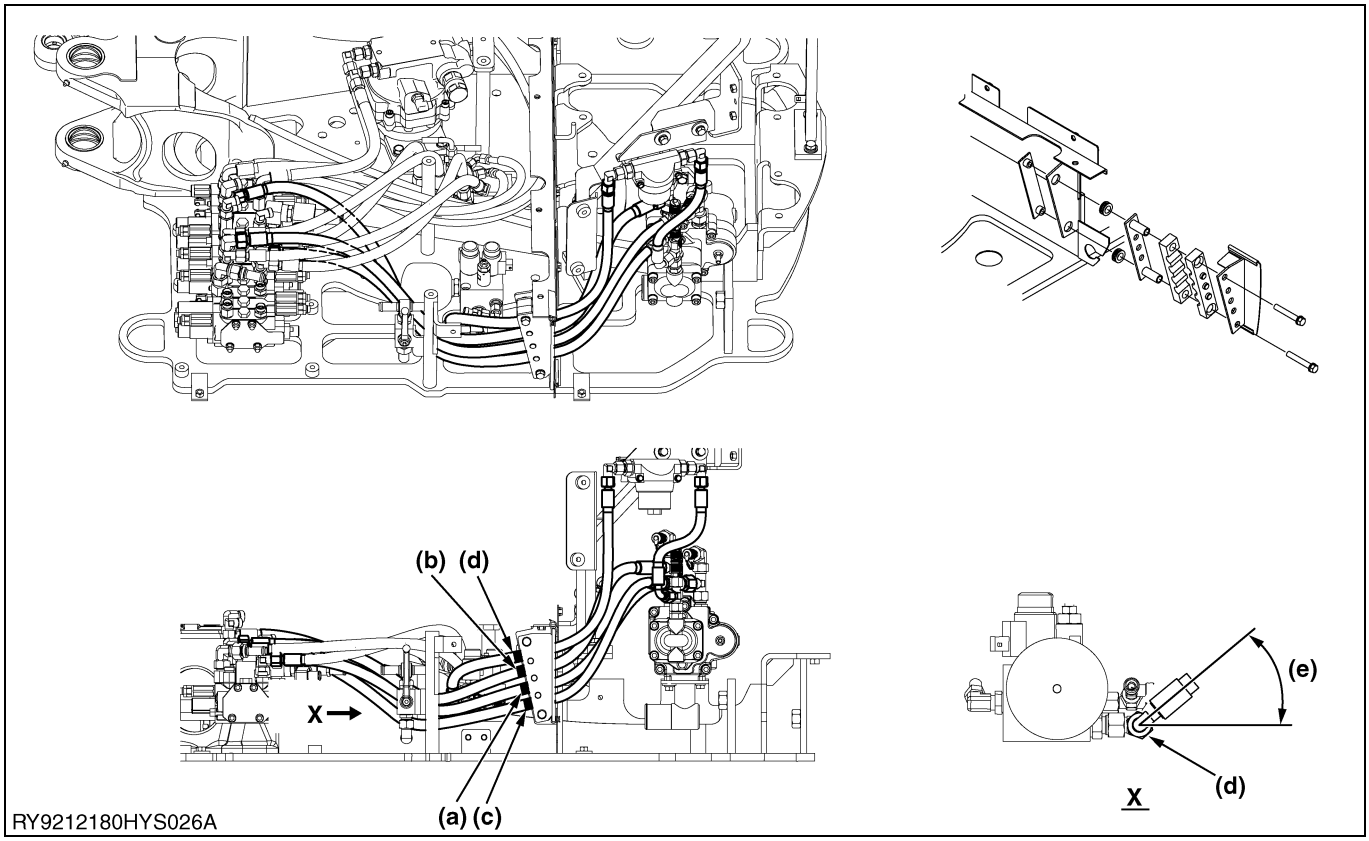
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P1	1020 mm (40.2 in.)	1/2	3 × White	20.6 mm (0.81 in.)	12.7 mm (0.50 in.)	C-C	M22	PWR	Pump (P1) to C/V (P1)
(2)	P2	1030 mm (40.6 in.)	1/2	3 × Red	20.6 mm (0.81 in.)	12.7 mm (0.50 in.)	C-C	M22	PWR	Pump (P2) to C/V (P2)
(3)	P3	1200 mm (47.2 in.)	3/8	3 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	Pump (P3) to C/V (P3)
(4)	Travel right forward	725 mm (28.5 in.)	3/8	2 × Green	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (A7) to R/J (E)
(5)	Travel right reverse	650 mm (25.6 in.)	3/8	2 × Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (B7) to R/J (G)
(6)	Travel left forward	615 mm (24.2 in.)	3/8	2 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (A6) to R/J (D)
(7)	Travel left reverse	560 mm (22.0 in.)	3/8	2 × Red	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (B6) to R/J (F)
(8)	Swivel left	470 mm (18.5 in.)	3/8	2 × Gray	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	C/V (B3) to Swivel motor (L)
(9)	Swivel right	555 mm (21.8 in.)	3/8	2 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	C/V (A3) to Swivel motor (R)
(10)	Blade down (bottom)	805 mm (31.7 in.)	1/4	2 × Brown	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (B2) to R/J (B)
(11)	Blade down (rod)	780 mm (30.7 in.)	1/4	2 × Red	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (A2) to R/J (C)
(12)	Port A	710 mm (28.0 in.)	3/8	2 × Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-CR4	M18	PWR	C/V Swing A1 to 6/2 Port A
(13)	Port B	630 mm (24.8 in.)	3/8	2 × Green	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-CR4	M18	PWR	C/V Swing B1 to 6/2 Port B
(14)	Port C: Boom RH (AUX2)	1660 mm (65.4 in.)	3/8	2 × Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-CM	M18	TEX S20	6/2 Port C to Boom RH
(15)	Port D: Boom LH (AUX2)	1550 mm (61.0 in.)	3/8	2 × Green	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-CM	M18	TEX S20	6/2 Port D to Boom LH
(16)	Port E: Swing cylinder (rod)	450 mm (17.7 in.)	3/8	2 × Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	6/2 Port E to Swing CYL rod
(17)	Port F: Swing cylinder (bottom)	580 mm (22.8 in.)	3/8	2 × Green	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	6/2 Port F to Swing CYL bottom

- PWR: Plastic corrugated tube

RY9212422HYS0006US0

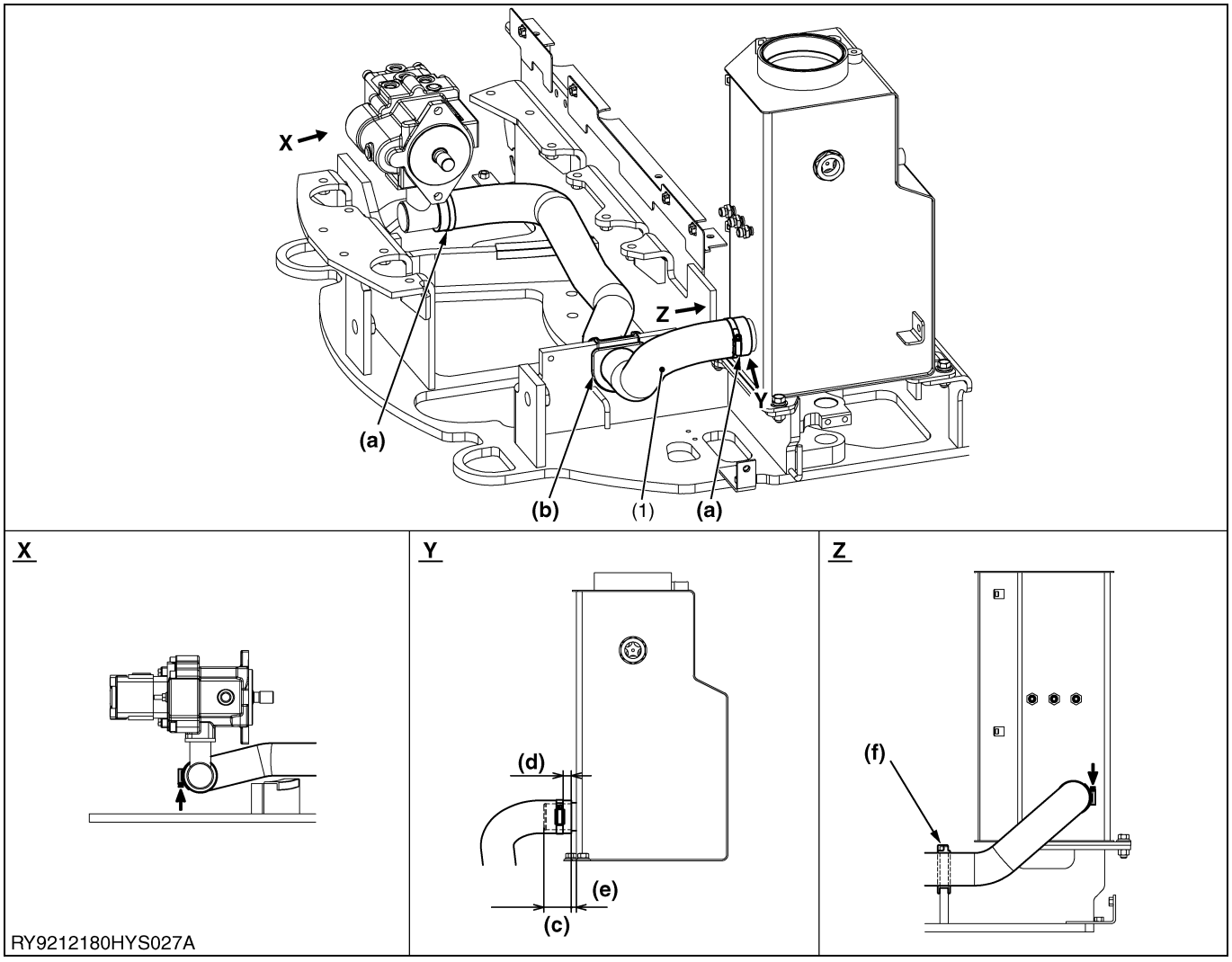
[4] DELIVERY HOSE CLAMP POSITIONS



(a) White
(b) Red
(c) Blue
(d) Yellow
(e) 40 °

RY9212180HYS0022US0

[5] SUCTION HOSE ROUTING



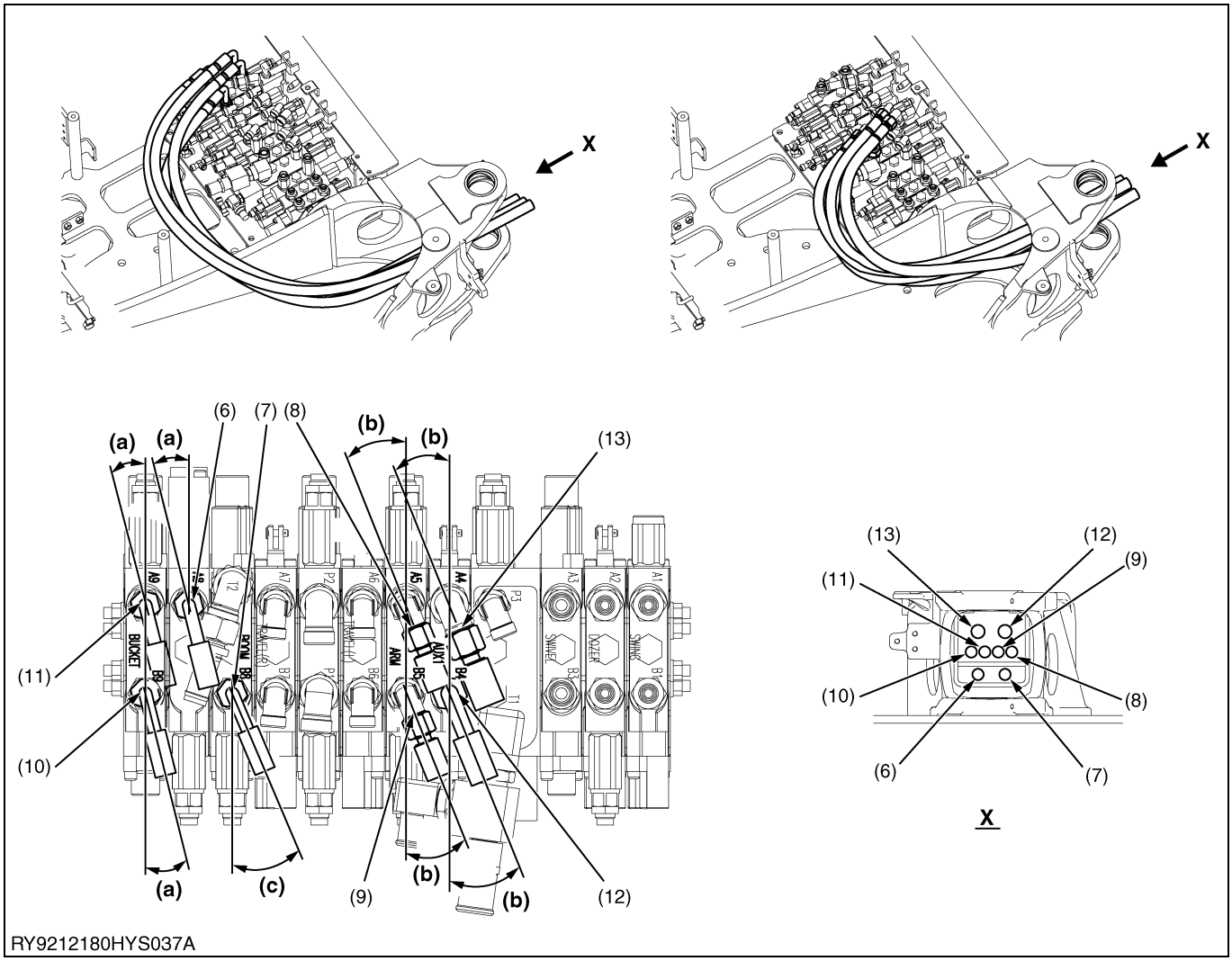
(a) Hose Clamp 50 to 70 mm (2.0 to 2.7 in.) **(b) Grommet** **(c) 50 mm (2.0 in.)** **(d) 15 mm (0.59 in.)** **(e) 9.0 mm (0.35 in.)**

■ Table of Hydraulic Hoses

No.	Function	Position Used
(1)	Suction	Oil tank to Pump

RY9212180HYS0023US0

[6] FRONT HOSE ROUTING



RY9212180HYS037A

(a) 14 ° **(b) 22 °** **(c) 23 °**

■ Table of Hydraulic Hoses

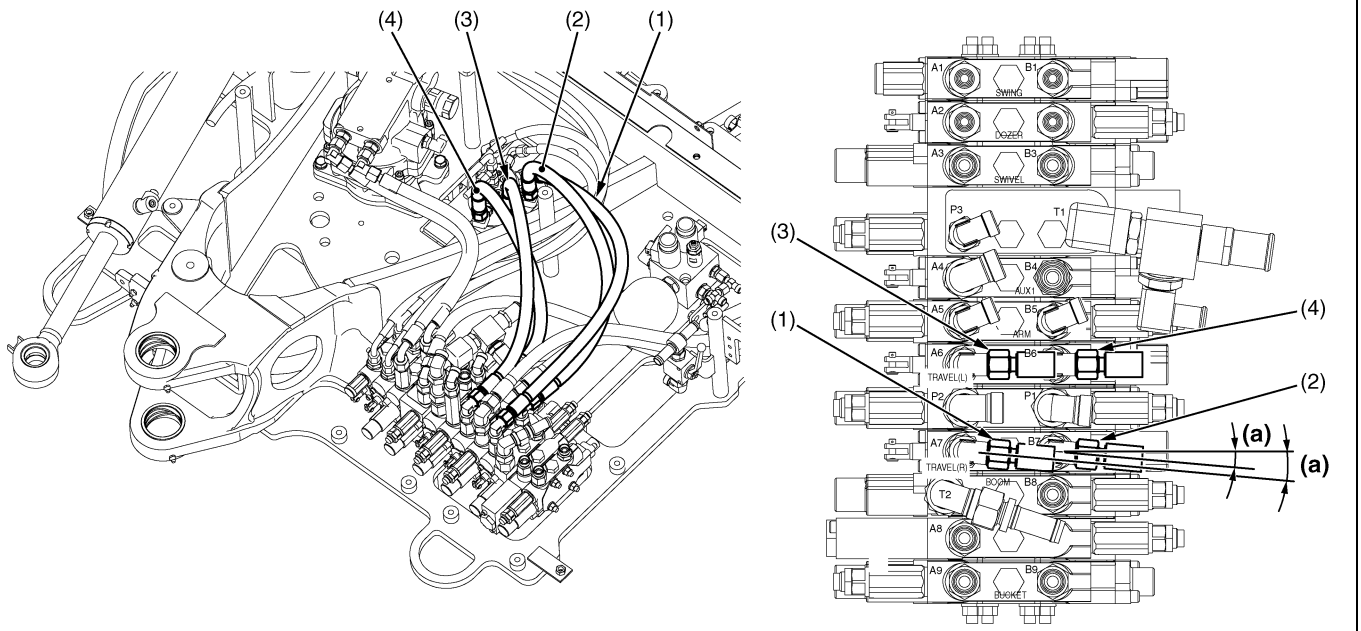
No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(6)	Boom up	1980 mm (77.2 in.)	3/8	2 × Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	C/V (A2) to Boom CYL bottom
(7)	Boom down	1975 mm (77.0 in.)	3/8	2 × Green	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	C/V (B2) to Boom CYL rod
(8)	Arm crowd	1135 mm (44.3 in.)	3/8	2 × Gray	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-CM	M18	PWR	C/V (A5) to Hose
		1860 mm (72.5 in.)					C-C			Hose to Arm CYL bottom
(9)	Arm dump	1175 mm (45.8 in.)	3/8	2 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-CM	M18	PWR	C/V (B5) to Hose
		2125 mm (82.9 in.)					C-C			Hose to Arm CYL rod
(10)	Bucket dump	1445 mm (56.4 in.)	3/8	2 × Orange	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-CM	M18	PWR	C/V (B1) to Hose
		3285 mm (128.1 in.)					C-C			Hose to Bucket CYL rod

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(11)	Bucket crowd	1465 mm (57.1 in.)	3/8	2 × White	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-CM	M18	PWR	C/V (A1) to Hose
		3030 mm (118.1 in.)					C-C			Hose to Bucket CYL bottom
(12)	AUX (LH)	1145 mm (44.7 in.)	1/2	2 × Brown	20.4 mm (0.80 in.)	12.7 mm (0.50 in.)	CR9-CM	M22	PWR	C/V (B6) to Hose
		3350 mm (130.7 in.)					C-C			Hose to AUX LH
(13)	AUX (RH)	1095 mm (42.7 in.)	1/2	2 × White	20.4 mm (0.80 in.)	12.7 mm (0.50 in.)	C-CM	M22	PWR	C/V (A6) to Hose
		3350 mm 130.7 in.)					C-C			Hose to AUX RH

- PWR: Plastic corrugated tube

RY9212180HYS0024US0

[7] TRAVEL HOSE ROUTING



RY9212180HYS039A

(a) 15 °

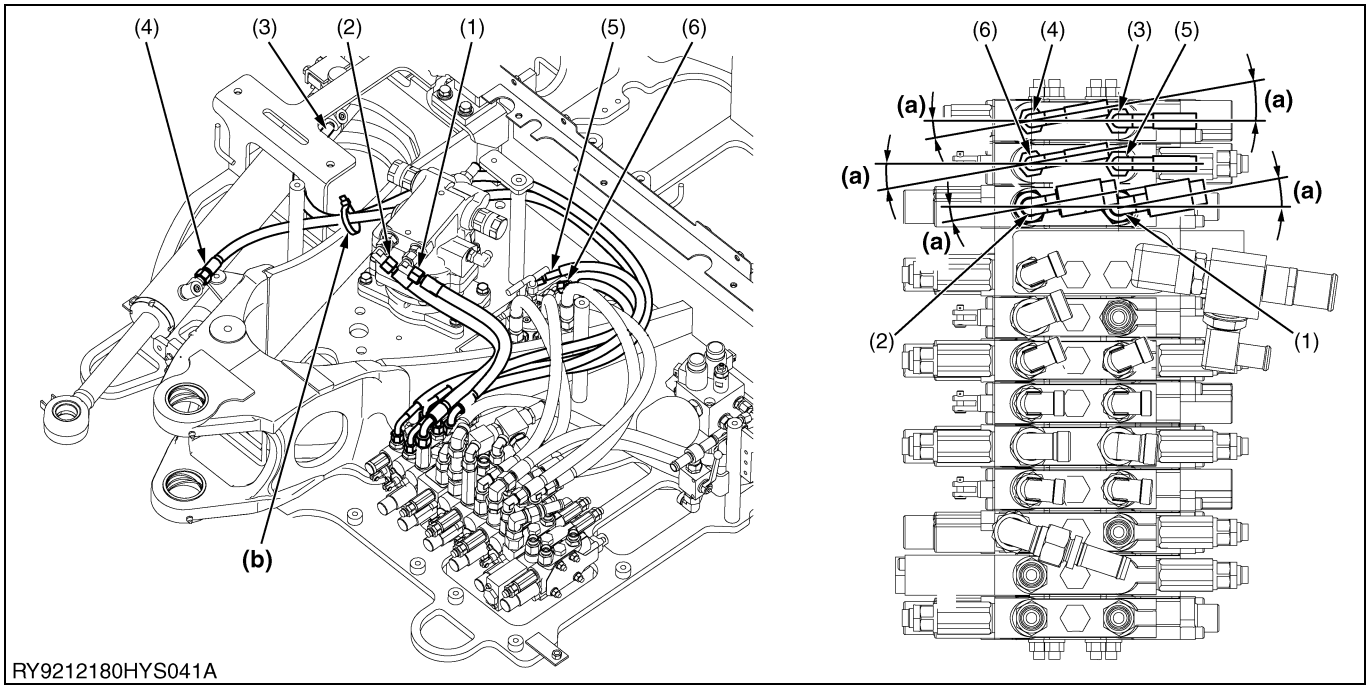
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Travel RH forward	725 mm (28.3 in.)	3/8	Green	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (A3) to R/J (I)
(2)	Travel RH reverse	650 mm (25.4 in.)	3/8	Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (B3) to R/J (H)
(3)	Travel LH forward	615 mm (24.0 in.)	3/8	Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (A4) to R/J (F)
(4)	Travel LH reverse	560 mm (21.8 in.)	3/8	Red	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-C	M18	PWR	C/V (B4) to R/J (E)

- PWR: Plastic corrugated tube

RY9212180HYS0025US0

[8] SWIVEL, BLADE, SWING HOSE ROUTING



(a) 10 ° **(b) Clamp [(3) and (4)]**

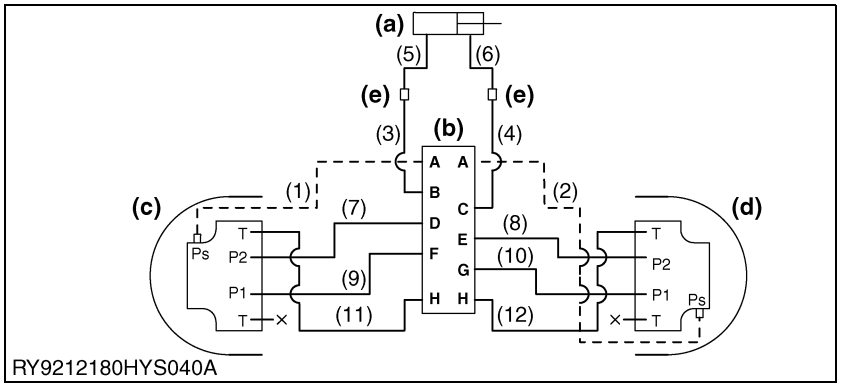
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Swivel LH	470 mm (18.5 in.)	3/8	2 × Gray	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-CR9	M18	PWR	C/V (B7) to Swivel motor (B)
(2)	Swivel RH	555 mm (21.8 in.)	3.8	2 × Blue	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	C-CR9	M18	PWR	C/V (A7) to Swivel motor (A)
(3)	Blade down (bottom)	1465 mm (57.7 in.)	1/4	2 × Green	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	C-CR9	M14	PWR	C/V (B8) to R/J (C)
(4)	Blade up (rod)	1410 mm (55.5 in.)	1/4	2 × Yellow	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	C-CR9	M14	PWR	C/V (A8) to R/J (B)
(5)	Swing LH	805 mm (31.7 in.)	1/4	2 × Brown	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	C-CR9	M14	PWR	C/V (A10) to Swing CYL bottom
(6)	Swing RH	780 mm (30.7 in.)	1/4	2 × Red	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	C-CR9	M14	PWR	C/V (B10) to Swing CYL rod

- PWR: Plastic corrugated tube

RY9212180HYS0026US0

[9] TRACK FRAME HOSE ROUTING



RY9212180HYS040A

(a) Blade Cylinder
(b) Swivel Joint
(c) Wheel Motor LH
(d) Wheel Motor RH
(e) Blade Joint

Swivel Joint side		Travel motor / cylinder side
A	2-speed pilot	LH/RH travel 2-speed
B	Lower blade	Cylinder bottom side
C	Lift blade	Cylinder rod side
D	LH forward	Left A (upper side)
E	RH forward	Right B (upper side)
F	LH reverse	Left B (bottom side)
G	RH reverse	Right A (bottom side)
H	Drain	LH/RH drain port

RY9212180HYS0027US0

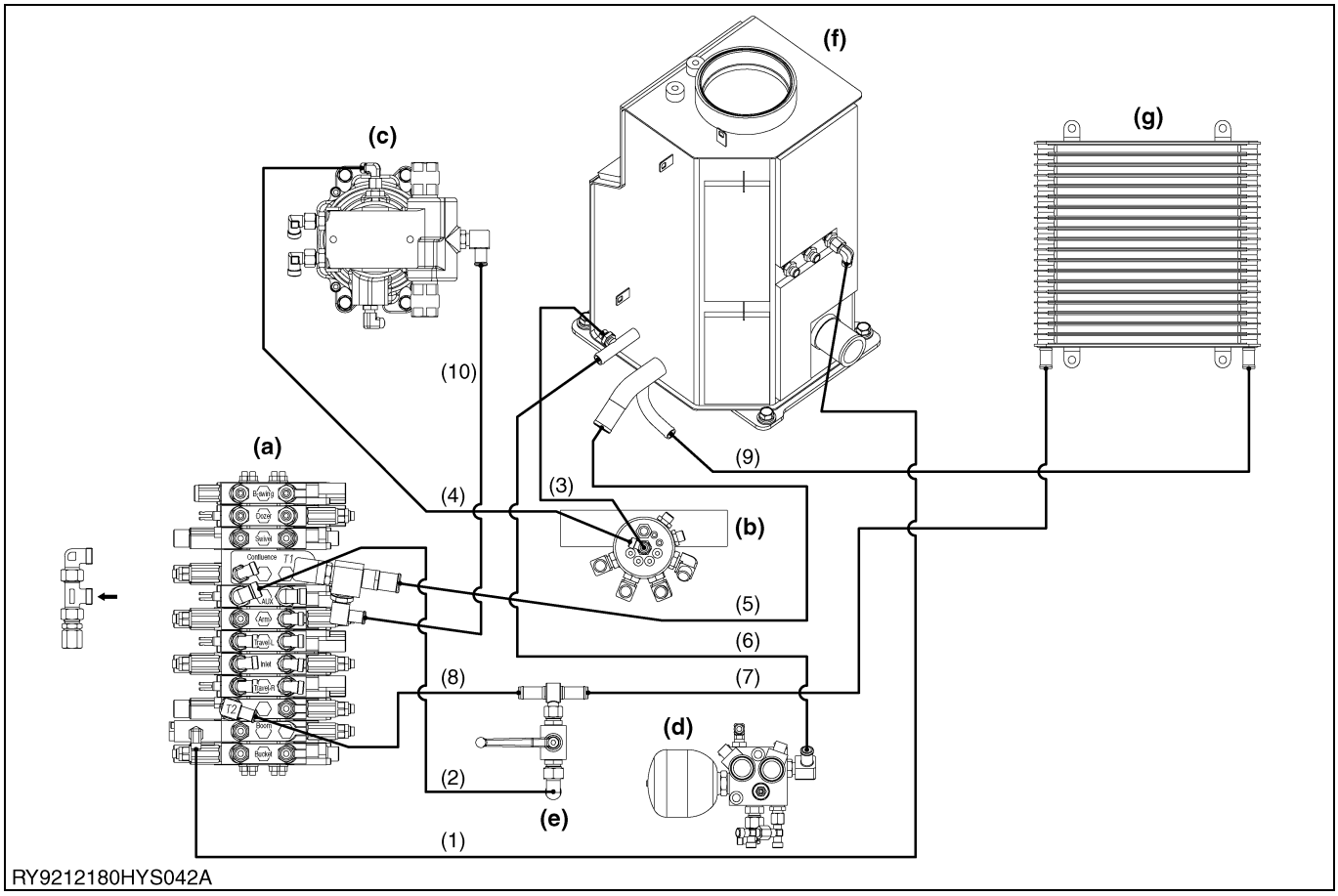
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Travel LH 2-speed	1030 mm (40.6 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	R/J (A) to Travel motor L (Ps)
(2)	Travel RH 2-speed	1030 mm (40.6 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	R/J (A) to Travel motor R (Ps)
(3)	Blade down	300 mm (11.8 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	R/J (B) to Joint
(4)	Blade up	300 mm (11.8 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	R/J (C) to Joint
(5)	Blade down	540 mm (21.1 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	Spring guard	Joint to Blade CYL (bottom)
(6)	Blade up	540 mm (21.1 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	Spring guard	Joint to Blade CYL (rod)
(7)	Travel LH forward	910 mm (35.8 in.)	3/8	–	18.3 mm (0.72 in.)	10 mm (0.39 in.)	CR4-C	M18	PWR	R/J (D) to Travel motor L (P1)
(8)	Travel RH forward	910 mm (35.8 in.)	3/8	–	18.3 mm (0.72 in.)	10 mm (0.39 in.)	CR4-C	M18	PWR	R/J (E) to Travel motor R (P2)
(9)	Travel LH reverse	910 mm (35.8 in.)	3/8	–	18.3 mm (0.72 in.)	10 mm (0.39 in.)	CR4-C	M18	PWR	R/J (F) to Travel motor L (P2)
(10)	Travel RH reverse	910 mm (35.8 in.)	3/8	–	18.3 mm (0.72 in.)	10 mm (0.39 in.)	CR4-C	M18	PWR	R/J (G) to Travel motor R (P1)
(11)	Drain	900 mm (35.4 in.)	1/2	–	19.8 mm (0.78 in.)	12.7 mm (0.50 in.)	–	–	–	R/J (H) to Travel motor L (T)
(12)	Drain	900 mm (35.4 in.)	1/2	–	19.8 mm (0.78 in.)	12.7 mm (0.50 in.)	–	–	–	R/J (H) to Travel motor R (T)

- PWR: Plastic corrugated tube

RY9212180HYS0028US0

[10] RETURN HOSE ROUTING (STD)



RY9212180HYS042A

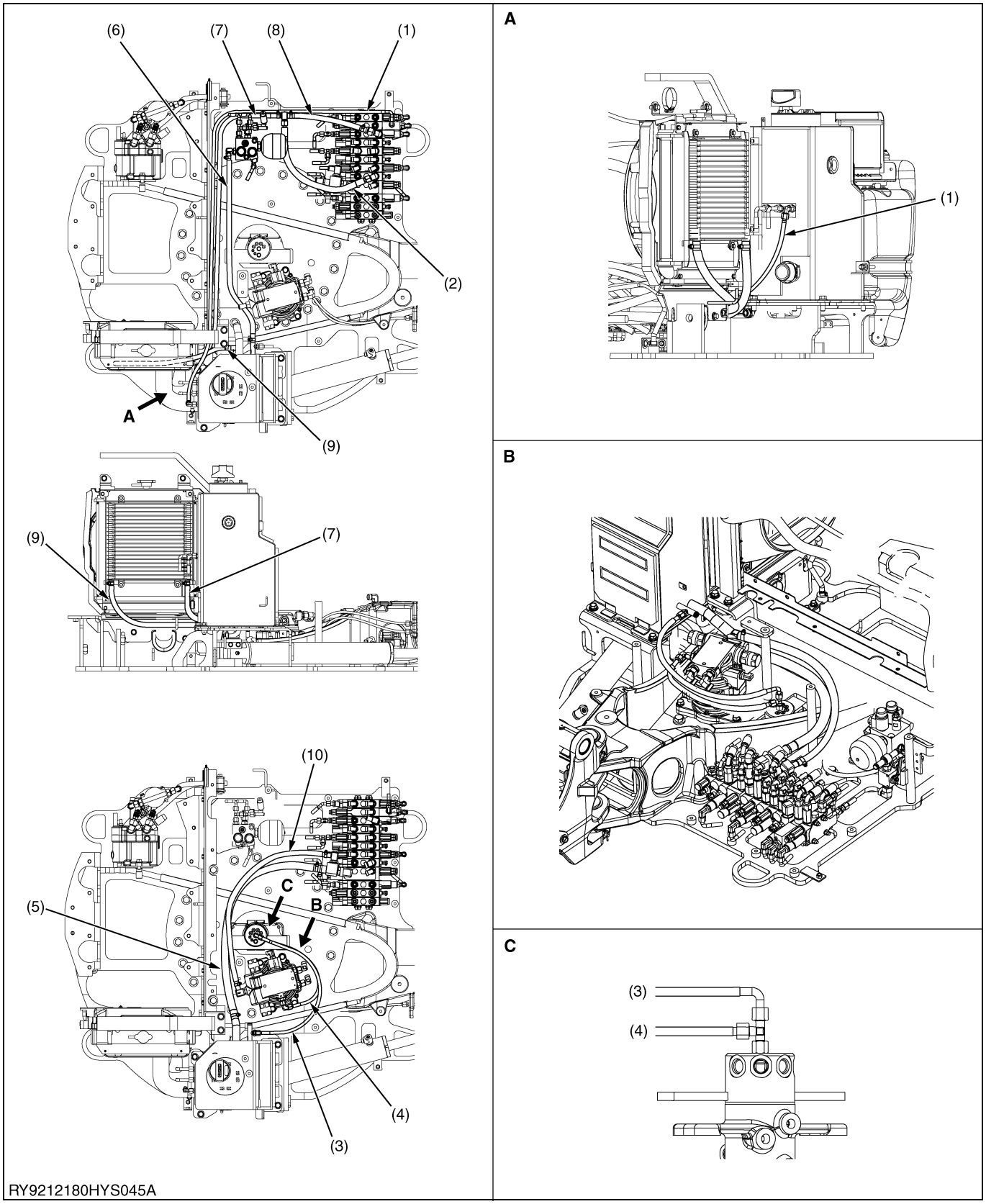
(a) Control Valve **(c) Swivel Motor** **(e) Third Line Valve** **(g) Oil Cooler**
(b) Swivel Joint **(d) Unload Valve** **(f) Oil Tank**

■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Anti-drop check valve return	1845 mm (72.64 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (Dr1) to O/T
(2)	Third line	580 mm (22.8 in.)	1/2	–	20.6 mm (0.81 in.)	12.7 mm (0.50 in.)	C-C	M22	PWR	Third line to C/V AUX Low
(3)	Travel motor drain	665 mm (26.2 in.)	1/4	2 x White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	R/J (H) T/M drain to O/T
(4)	Swivel motor drain	510 mm (20.1 in.)	1/4	2 x Blue	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	C-C	M14	PWR	R/J (H) to S/M drain
(5)	T1	870 mm (33.9 in.)	–	–	36.5 mm (1.44 in.)	25.7 mm (1.01 in.)	–	–	–	C/V (T1) to O/T
(6)	Unload valve return	750 mm (29.5 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	Unload valve (T) to O/T
(7)	Oil cooler IN	1260 mm (49.61 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	Third line to O/C
(8)	T2	300 mm (11.8 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	C/V (T2) to Third line
(9)	Oil cooler OUT	580 mm (22.6 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	O/C to O/T
(10)	Swivel motor makeup	805 mm (31.7 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	S/M to C/V (T1)

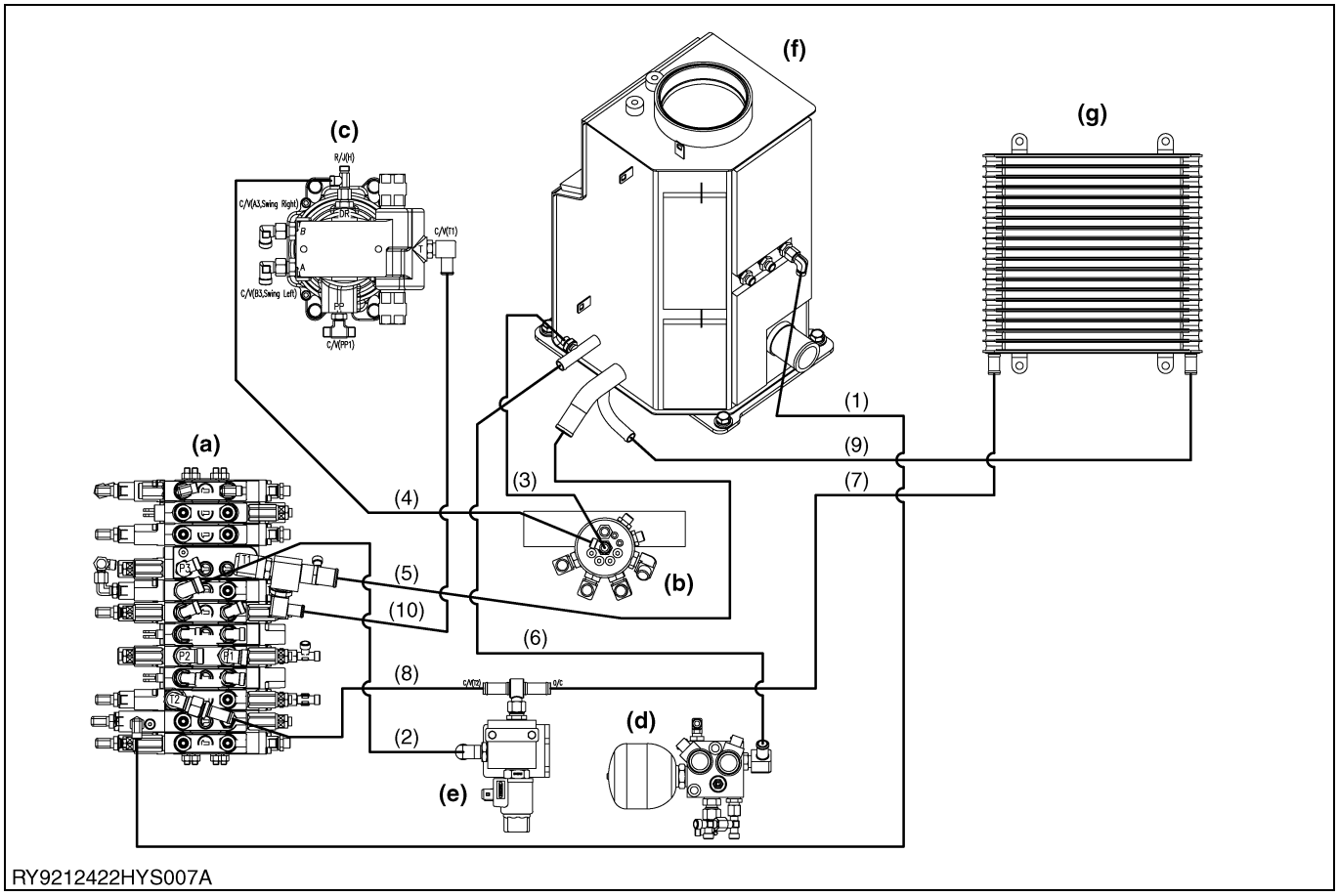
- PWR: Plastic corrugated tube

RY9212180HYS0029US0



RY9212180HYS0239US0

[11] RETURN HOSE ROUTING (HI SPEC)



RY9212422HYS007A

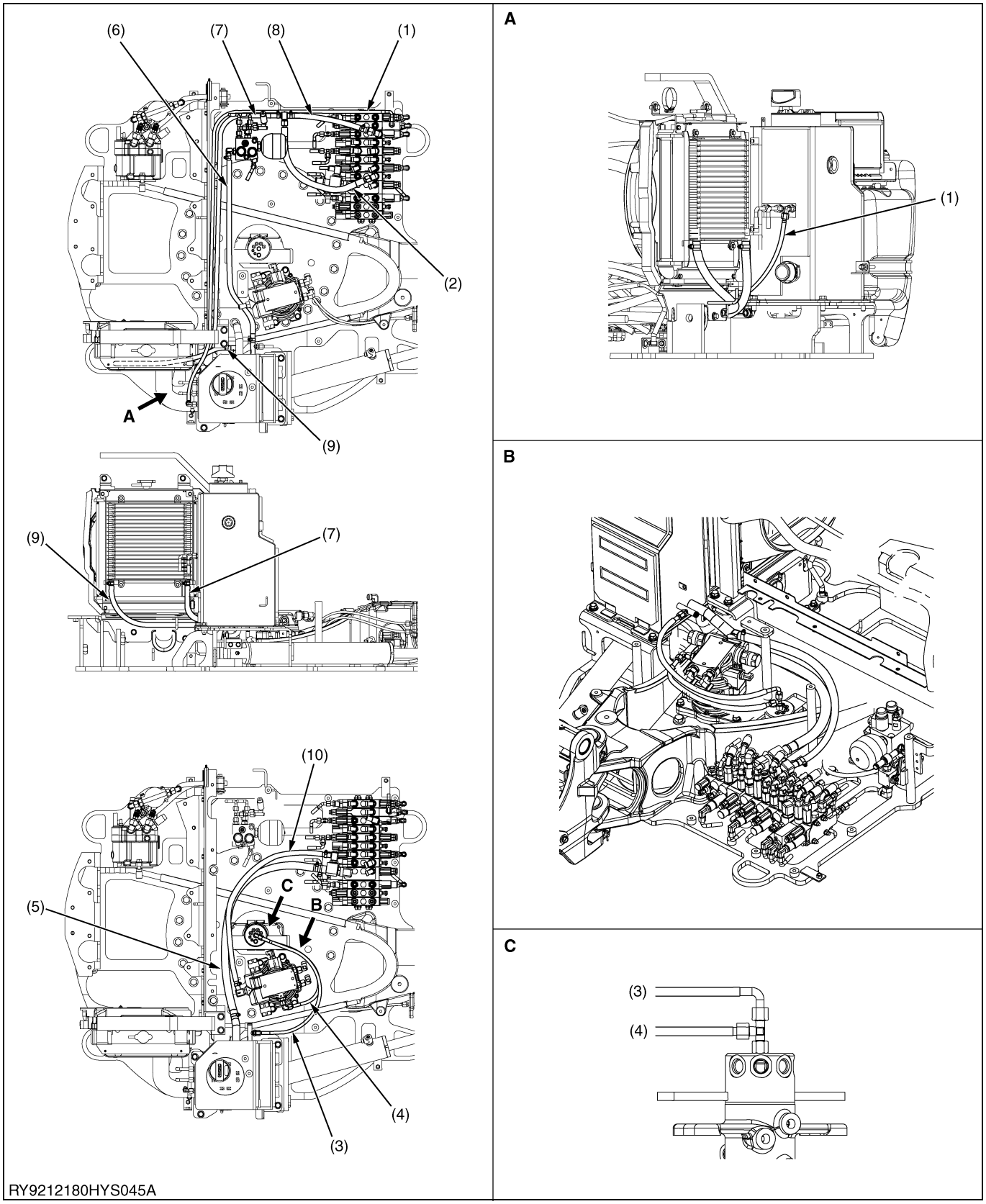
(a) Control Valve **(c) Swivel Motor** **(e) Third Line Valve** **(g) Oil Cooler**
(b) Swivel Joint **(d) Unload Valve** **(f) Oil Tank**

■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Anti-drop check valve return	1845 mm (72.64 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (Dr1) to O/T
(2)	Third line	580 mm (22.8 in.)	1/2	–	20.6 mm (0.81 in.)	12.7 mm (0.50 in.)	C-C	M22	PWR	Third line to C/V AUX Low
(3)	Travel motor drain	665 mm (26.2 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	R/J (H) T/M drain to O/T
(4)	Swivel motor drain	510 mm (20.1 in.)	1/4	2 × Blue	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	C-C	M14	PWR	R/J (H) to S/M drain
(5)	T1	870 mm (33.9 in.)	–	–	36.5 mm (1.44 in.)	25.7 mm (1.01 in.)	–	–	–	C/V (T1) to O/T
(6)	Unload valve return	750 mm (29.5 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	Unload valve (T) to O/T
(7)	Oil cooler IN	1260 mm (49.61 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	Third line to O/C
(8)	T2	300 mm (11.8 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	C/V (T2) to Third line
(9)	Oil cooler OUT	580 mm (22.6 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	O/C to O/T
(10)	Swivel motor makeup	805 mm (31.7 in.)	–	–	23.5 mm (0.93 in.)	15.9 mm (0.63 in.)	–	–	–	S/M to C/V (T1)

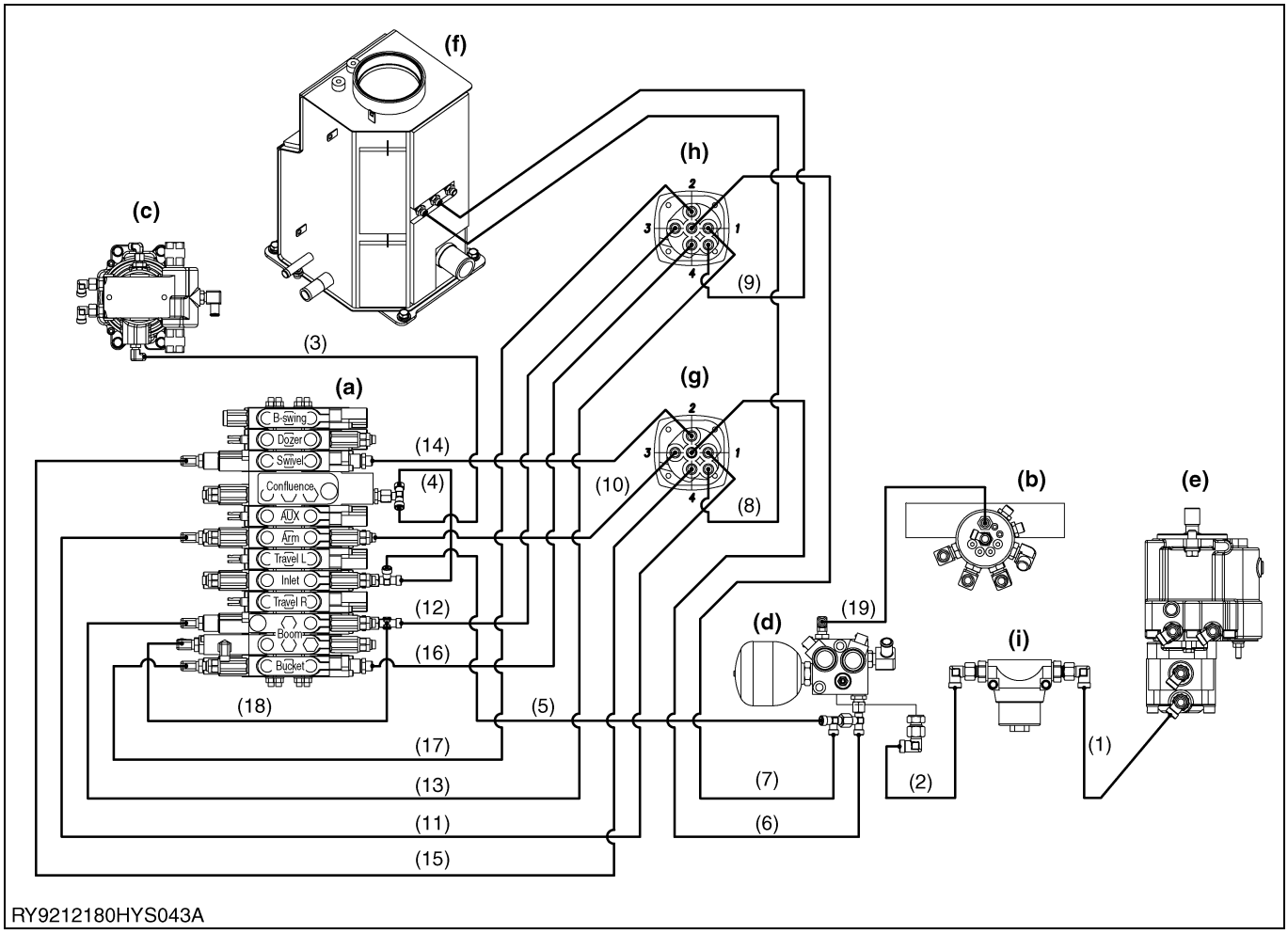
- PWR: Plastic corrugated tube

RY9212422HYS0008US0



RY9212180HYS0239US0

[12] PILOT HOSE ROUTING (STD)



(a) Control Valve
(b) Swivel Joint
(c) Swivel Motor
(d) Unload Valve
(e) Pump
(f) Oil Tank
(g) Pilot Valve (L)
(h) Pilot Valve (R)
(i) Pilot Filter

(To be continued)

(Continued)

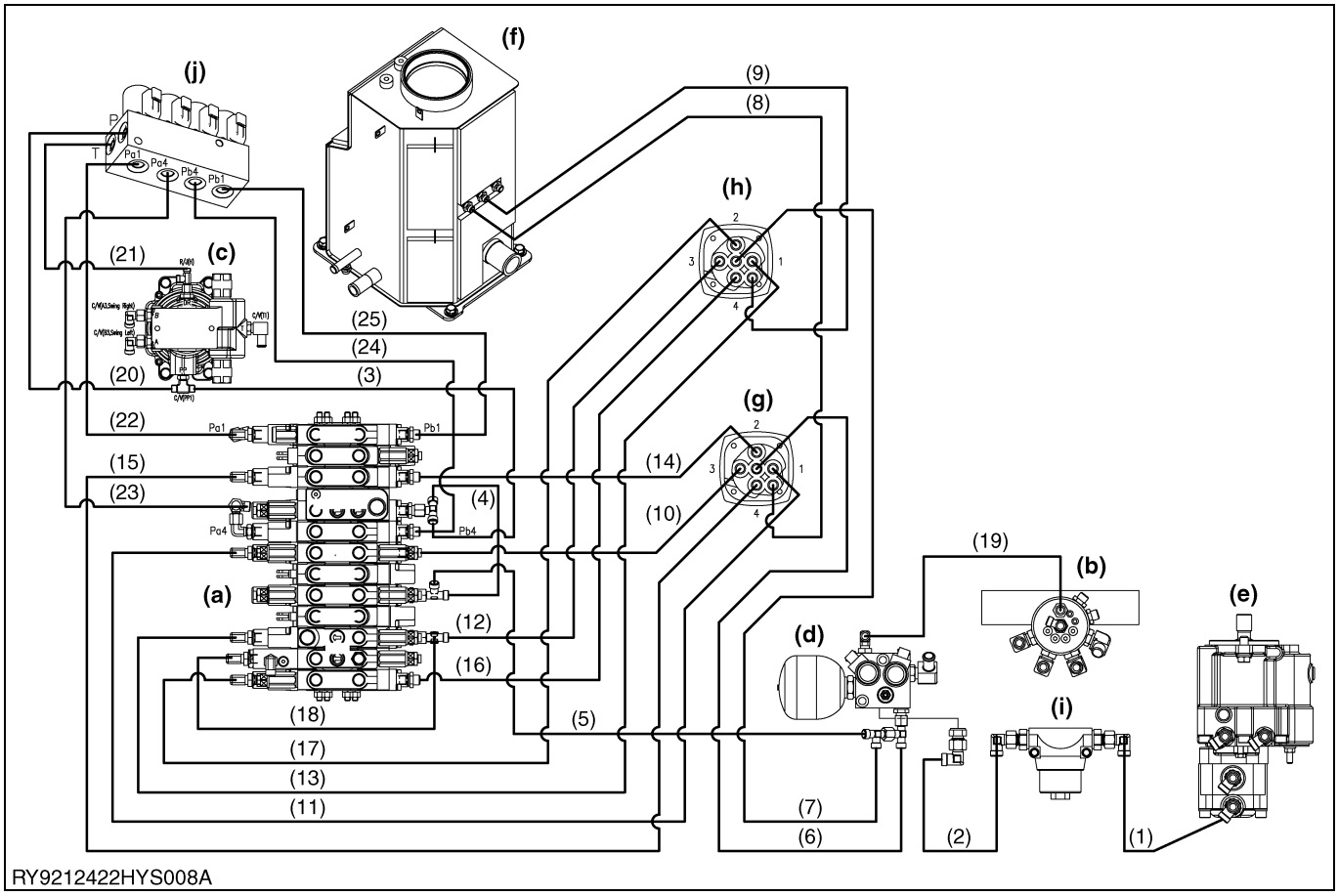
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P4	275 mm (10.8 in.)	3/8	–	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	–	Pump (P4) to Pilot filter
(2)	Unload valve (P)	680 mm (26.8 in.)	3/8	3 x Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	Pilot filter to Unload valve
(3)	Brake release	850 mm (33.5 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (PP1) to S/M (PP)
(4)	Travel straight forward	465 mm (18.3 in.)	1/4	2 × Blue	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to C/V (PP1)
(5)	Travel lock release	370 mm (14.6 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (PP2) to Unload valve (A2)
(6)	Pilot P, LH	915 mm (36.0 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (L, P)
(7)	Pilot P, RH	1300 mm (51.2 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (R, P)
(8)	Pilot T, LH	2050 mm (80.7 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	PV (L, T) to O/T
(9)	pilot T, RH	2365 mm (93.1 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	PV (R, T) to O/T
(10)	Arm dump	1420 mm (55.9 in.)	3/16	2 × Blue	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-C	M14	–	PV (L, 3) to C/V (Pb5)
(11)	Arm crowd	1670 mm (65.7 in.)	3/16	2 × Green	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (L, 1) to C/V (Pa5)
(12)	Boom (down)	1780 mm (70.1 in.)	3/16	2 × Blue, White	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (R, 3) to C/V (Pb8)
(13)	Boom (up)	2075 mm (81.7 in.)	3/16	2 × Gray	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (R, 1) to C/V (Pa8)
(14)	Swivel left	1475 mm (58.1 in.)	3/16	2 × Red	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR4	M14	–	PV (L, 2) to C/V (Pb3)
(15)	Swivel right	1690 mm (66.5 in.)	3/16	2 × Yellow	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (L, 4) to C/V (Pa3)
(16)	Bucket dump	1895 mm (74.6 in.)	3/16	2 × Brown	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR4	M14	–	PV (R, 4) to C/V (Pb9)
(17)	Bucket crowd	2085 mm (82.1 in.)	3/16	2 × Pink	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (R, 2) to C/V (Pa9)
(18)	Load holding valve	300 mm (11.8 in.)	3/16	–	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (Pb8) to C/V (Pb'8)
(19)	2-speed signal	485 mm (19.1 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	Unload valve (A1) to R/J (A)

- PWR: Plastic corrugated tube

RY9212180HYS0030US0

[13] PILOT HOSE ROUTING (HI SPEC)



(a) Control Valve
(b) Swivel Joint
(c) Swivel Motor
(d) Unload Valve
(e) Pump
(f) Oil Tank
(g) Pilot Valve (LH)
(h) Pilot Valve (RH)
(i) Pilot Filter
(j) Proportional Valve

(To be continued)

(Continued)

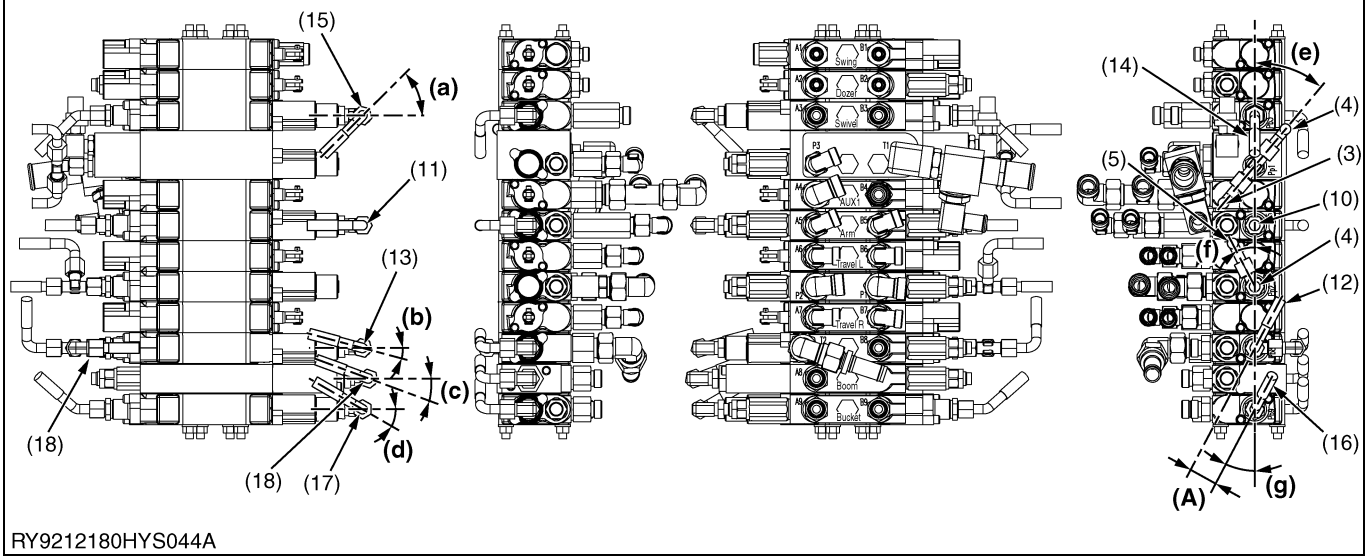
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P4	275 mm (10.8 in.)	3/8	–	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	–	Pump (P4) to Pilot filter
(2)	Unload valve (P)	680 mm (26.8 in.)	3/8	3 × Yellow	17.4 mm (0.69 in.)	9.5 mm (0.37 in.)	CR9-C	M18	PWR	Pilot filter to Unload valve
(3)	Brake release	850 mm (33.5 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (PP1) to S/M (PP)
(4)	Travel straight forward	465 mm (18.3 in.)	1/4	2 × Blue	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to C/V (PP1)
(5)	Travel lock release	370 mm (14.6 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	C/V (PP2) to Unload valve (A2)
(6)	Pilot P, LH	915 mm (36.0 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (LH, P)
(7)	Pilot P, RH	1300 mm (51.2 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (RH, P)
(8)	Pilot T, LH	2050 mm (80.7 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	PV (LH, T) to O/T
(9)	Pilot T, RH	2365 mm (93.1 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	PV (RH, T) to O/T
(10)	Arm dump	1420 mm (55.9 in.)	3/16	2 × Blue	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-C	M14	–	PV (LH, 3) to C/V (Pb5)
(11)	Arm crowd	1670 mm (65.7 in.)	3/16	2 × Green	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (LH, 1) to C/V (Pa5)
(12)	Boom (down)	1780 mm (70.1 in.)	3/16	2 × Blue, White	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (RH, 3) to C/V (Pb8)
(13)	Boom (up)	2075 mm (81.7 in.)	3/16	2 × Gray	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (RH, 1) to C/V (Pa8)
(14)	Swivel LH	1475 mm (58.1 in.)	3/16	2 × Red	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR4	M14	–	PV (LH, 2) to C/V (Pb3)
(15)	Swivel RH	1690 mm (66.5 in.)	3/16	2 × Yellow	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (LH, 4) to C/V (Pa3)
(16)	Bucket dump	1895 mm (74.6 in.)	3/16	2 × Brown	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR4	M14	–	PV (RH, 4) to C/V (Pb9)
(17)	Bucket crowd	2085 mm (82.1 in.)	3/16	2 × Pink	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (RH, 2) to C/V (Pa9)
(18)	Load holding valve	300 mm (11.8 in.)	3/16	–	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (Pb8) to C/V (Pb'8)
(19)	2-speed signal	485 mm (19.1 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	Unload valve (A1) to R/J (A)
(20)	Proportional valve P	830 mm (32.7 in.)	1/4	2 × White	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR9	M14	PWR	Prop valve P to Motor swivel P
(21)	Proportional valve T	1240 mm (48.8 in.)	1/4	–	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR9	M14	PWR	Prop valve T to Motor swivel T
(22)	Proportional valve Pa1	1220 mm (48.0 in.)	1/4	2 × Yellow	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	PWR	Prop valve Pa1 to C/V Pa1
(23)	Proportional valve Pa4	1190 mm (46.8 in.)	1/4	2 × White	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	PWR	Prop valve Pa4 to C/V Pa4
(24)	Proportional valve Pb4	590 mm (23.2 in.)	1/4	2 × Brown	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	PWR	Prop valve Pb4 to C/V Pb4
(25)	Proportional valve Pb1	700 mm (27.6 in.)	1/4	2 × Green	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	PWR	Prop valve Pb1 to C/V Pb1

- PWR: Plastic corrugated tube

RY9212422HYS0009US0

[14] PILOT HOSE ROUTING (CONTROL VALVE)



RY9212180HYS044A

(a) 45 °
(b) 15 °
(c) 20 °
(d) 30 °
(e) 40 °
(f) 27 °
(g) 28 °
(A) Parallel

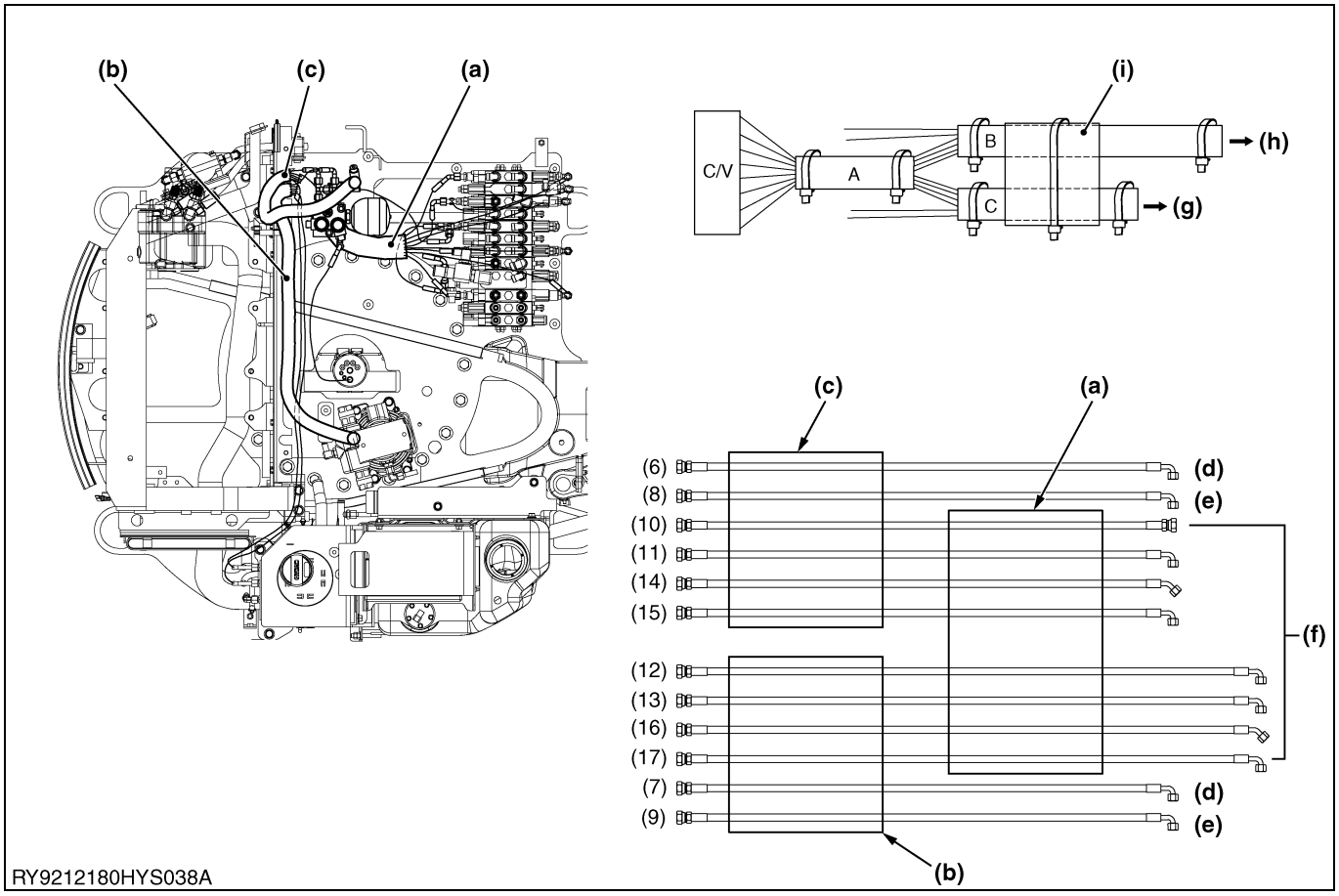
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(3)	Brake release	850 mm (33.5 in.)	1/4	2 × White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9-C	M14	PWR	C/V (PP1) to S/M (PP)
(4)	Travel straight forward	465 mm (18.3 in.)	1/4	2 × Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9-C	M14	–	Unload valve (A2) to C/V (PP1)
(5)	Travel lock release	370 mm (14.6 in.)	1/4	–	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9-C	M14	PWR	C/V (PP2) to Unload valve (A2)
(10)	Arm dump	1420 mm (55.91 in.)	3/16	2 × Blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C-C	M14	–	PV (LH, 3) to C/V (Pb5)
(11)	Arm crowd	1670 mm (65.75 in.)	3/16	2 × Green	8.2 mm (0.3 in.)	4 mm (0.2 in.)	CR9-C	M14	–	PV (LH, 1) to C/V (Pa5)
(12)	Boom (down)	1780 mm (70.08 in.)	3/16	2 ×Blue, White	8.2 mm (0.3 in.)	4 mm (0.2 in.)	CR9-C	M14	–	PV (RH, 3) to C/V (Pb8)
(13)	Boom (up)	2075 mm (81.69 in.)	3/16	2 × Gray	8.2 mm (0.3 in.)	4 mm (0.2 in.)	CR9-C	M14	–	PV (RH, 1) to C/V (Pa8)
(14)	Swivel LH	1475 mm (58.07 in.)	3/16	2 × Red	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C-CR4	M14	–	PV (LH, 2) to C/V (Pb3)
(15)	Swivel RH	1690 mm (66.54 in.)	3/16	2 × Yellow	8.2 mm (0.3 in.)	4 mm (0.2 in.)	CR9-C	M14	–	PV (LH, 4) to C/V (Pa3)
(16)	Bucket dump	1895 mm (74.61 in.)	3/16	2 × Brown	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C-CR4	M14	–	PV (RH, 4) to C/V (Pb9)
(17)	Bucket crowd	2085 mm (82.09 in.)	3/16	2 × Pink	8.2 mm (0.3 in.)	4 mm (0.2 in.)	CR9-C	M14	–	PV (RH, 2) to C/V (Pa9)
(18)	Load holding valve	300 mm (11.8 in.)	3/16	–	8.2 mm (0.3 in.)	4 mm (0.2 in.)	CR9-C	M14	–	PV (Pb8) to C/V (Pb'8)

- PWR: Plastic corrugated tube

RY9212180HYS0031US0

[15] PILOT HOSE ROUTING (OVERHEAD VIEW)



(a) Section A
(b) Section B
(c) Section C
(d) Unload Valve
(e) Oil Tank
(f) Control Valve
(g) P/V, LH
(h) P/V, RH
(i) HEAT INSULATOR

(To be continued)

(Continued)

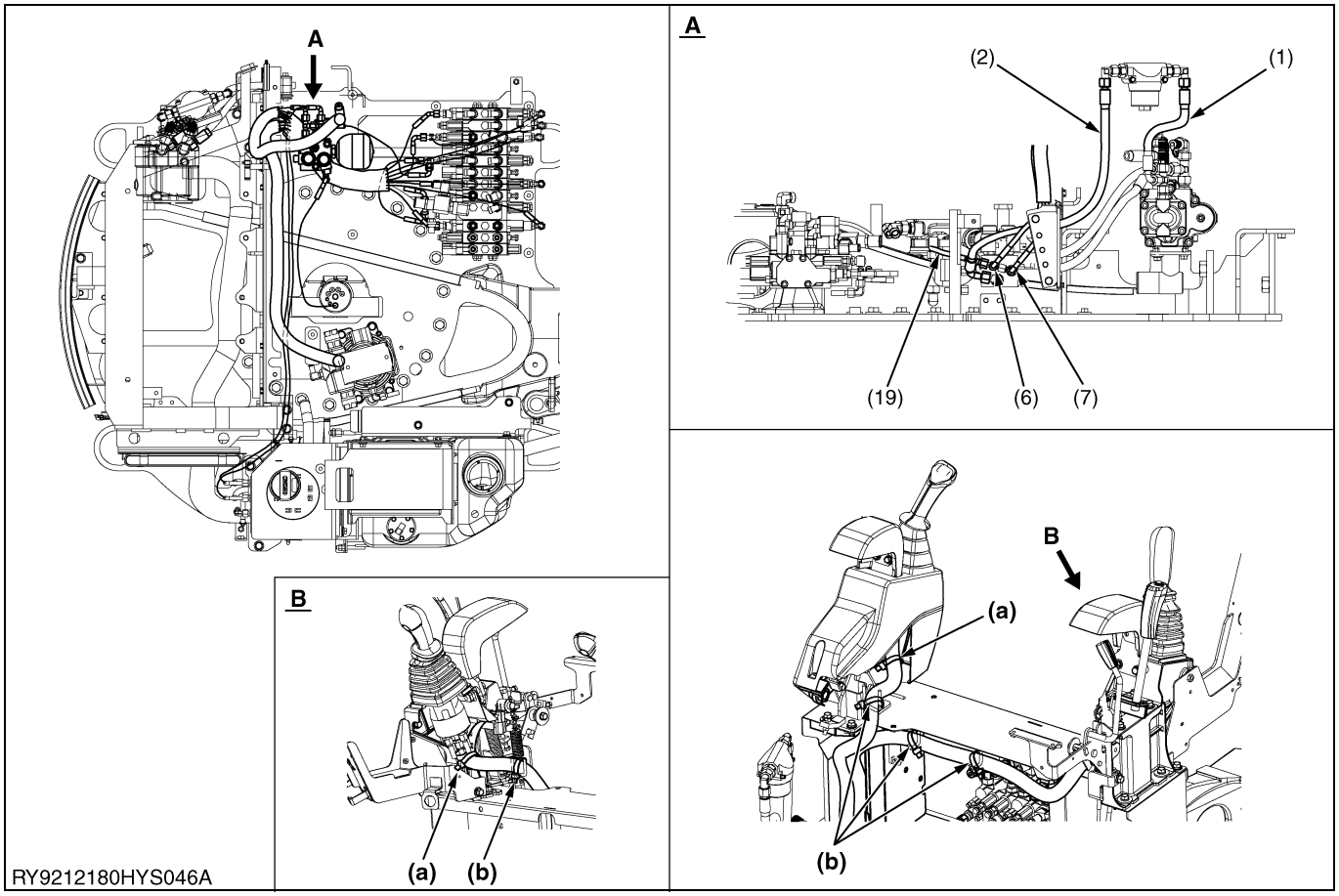
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(6)	Pilot P, LH	915 mm (36.0 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (LH, P)
(7)	Pilot P, RH	1300 mm (51.2 in.)	1/4	2 × White	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (RH, P)
(8)	Pilot T, LH	2050 mm (80.7 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	PV (LH, T) to O/T
(9)	pilot T, RH	2365 mm (93.1 in.)	1/4	–	11.8 mm (0.46 in.)	6.4 mm (0.25 in.)	CR9-C	M14	PWR	PV (RH, T) to O/T
(10)	Arm dump	1420 mm (55.9 in.)	3/16	2 × Blue	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-C	M14	–	PV (LH, 3) to C/V (Pb5)
(11)	Arm crowd	1670 mm (65.7 in.)	3/16	2 × Green	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (LH, 1) to C/V (Pa5)
(12)	Boom (down)	1780 mm (70.1 in.)	3/16	2 × Blue, White	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (RH, 3) to C/V (Pb8)
(13)	Boom (up)	2075 mm (81.7 in.)	3/16	2 × Gray	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (RH, 1) to C/V (Pa8)
(14)	Swivel LH	1475 mm (58.1 in.)	3/16	2 × Red	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR4	M14	–	PV (LH, 2) to C/V (Pb3)
(15)	Swivel RH	1690 mm (66.5 in.)	3/16	2 × Yellow	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (LH, 4) to C/V (Pa3)
(16)	Bucket dump	1895 mm (74.6 in.)	3/16	2 × Brown	8.2 mm (0.32 in.)	4 mm (0.16 in.)	C-CR4	M14	–	PV (RH, 4) to C/V (Pb9)
(17)	Bucket crowd	2085 mm (82.1 in.)	3/16	2 × Pink	8.2 mm (0.32 in.)	4 mm (0.16 in.)	CR9-C	M14	–	PV (RH, 2) to C/V (Pa9)

- PWR: Plastic corrugated tube

RY9212180HYS0032US0

[16] PILOT HOSE ROUTING (AROUND THE DRIVER'S SEAT)



(a) Clamp.

(b) Fasten the bundle of hoses to the seat support with a clamp.

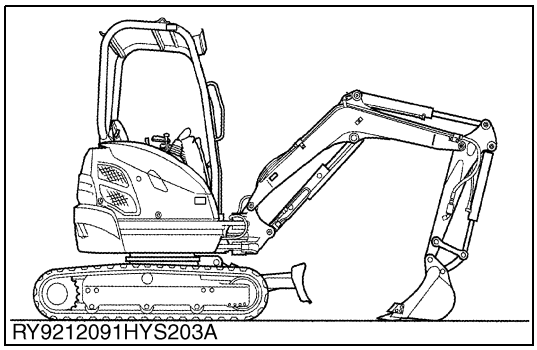
■ Table of Hydraulic Hoses

No.	Function	Hoses					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P4	275 mm (10.8 in.)	3/8	–	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9-C	M18	–	Pump (P4) to Pilot filter
(2)	Unload valve (P)	680 mm (26.8 in.)	3/8	3 × Yellow	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9-C	M18	PWR	Pilot filter to Unload valve
(6)	Pilot P, LH	915 mm (36.0 in.)	1/4	2 × White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (LH, P)
(7)	Pilot P, RH	1300 mm (51.18 in.)	1/4	2 × White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9-C	M14	–	Unload valve (A2) to P/V (RH, P)
(19)	2-speed signal	485 mm (19.1 in.)	1/4	–	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9-C	M14	PWR	Unload valve (A1) to R/J (A)

- PWR: Plastic corrugated tube

RY9212180HYS0033US0

13. MEASURING THE PERFORMANCE OF HYDRAULIC DEVICES


RY9212091HYS203A

Hydraulic System Pressure Release Procedure

1. Place the machine on flat hard ground, lower the bucket and the blade, and stop the engine.

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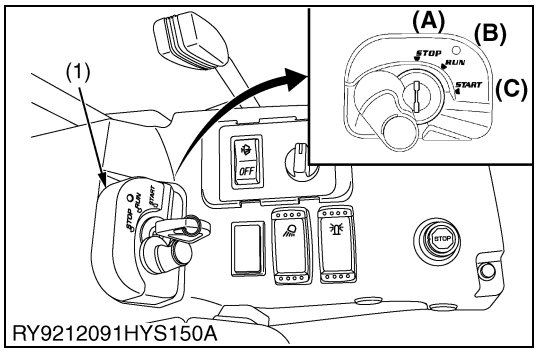

RY9212091HYS150A

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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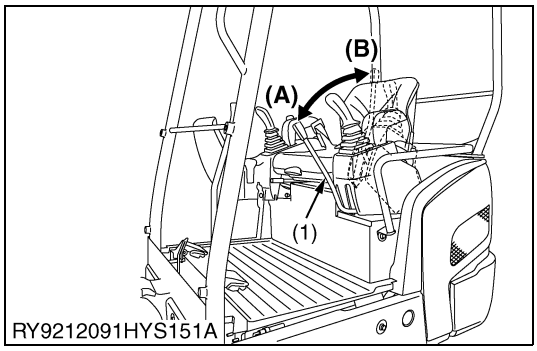

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3. Place the machine lock lever in the release position.

(1) Machine Lock Lever

(A) Release
(B) Lock

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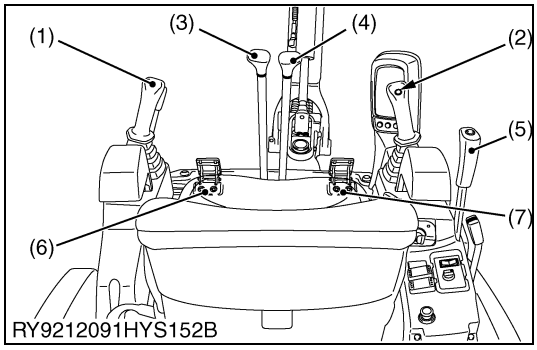

RY9212091HYS152B

4. Operate each control lever for the boom, arm, bucket and swivel to their full stroke.
5. Operate the travel lever, blade lever, swing pedal and service port pedal each to full stroke.
6. Place the machine's lock lever in the "Lock" position, and the engine starter switch to the "STOP" position.

(1) Left machine control lever
(2) Right machine control lever
(3) Travel lever left
(4) Travel lever right
(5) Blade control lever
(6) Service port pedal
(7) Swing pedal

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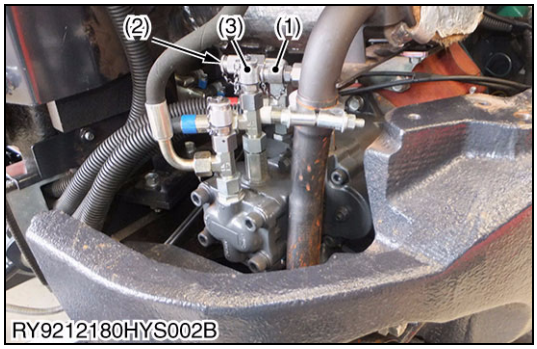

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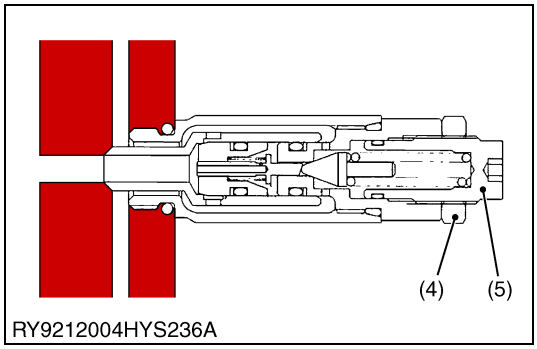

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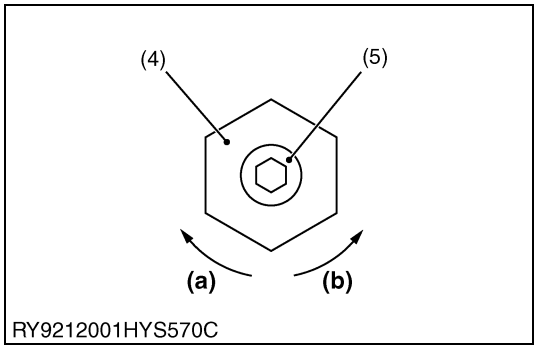

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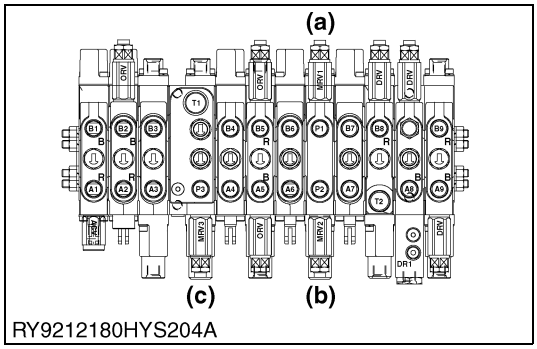


RY9212180HYS204A

Main Relief Valve Pressure

Procedure for Measuring the Main Relief Valve

1. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
2. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic lines.
3. Attach a pressure gauge to the pump pressure detection port.
4. Start and idle the engine, and check that there is no oil leakage.
5. Slowly operate the control lever of the front operation to be measured, operate until the cylinder reaches the end of its stroke, then relieve.
6. In the case of travel, lock the travel section, gradually operate the travel lever, then relieve.
7. Measure three times at maximum engine speed, and take the average value as the measurement.
8. Conduct at oil temperature 50 ± 5 °C (122 ± 9 °F).

Main Relief Valve Adjustment Procedure

1. Loosen the relief valve lock nut (4).
   Use a hexagonal wrench to turn the adjuster screw (5), and tighten the lock nut.
2. Operate the lever at maximum engine speed, and check the pressure setting.

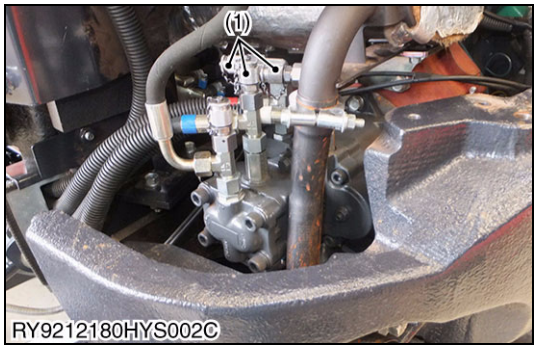
(1) Pump 1 Pressure Detection Port
(2) Pump 2 Pressure Detection Port
(3) Pump 3 Pressure Detection Port
(4) Lock Nut
(5) Adjuster Screw

(a) Pressure Increase
(b) Pressure Decrease

RY9212180HYS0217US0

(a) Main P1 Relief Valve (aP1)
(b) Main P2 Relief Valve (aP2)
(c) Main P3 Relief Valve (aP3)

RY9212180HYS0218US0



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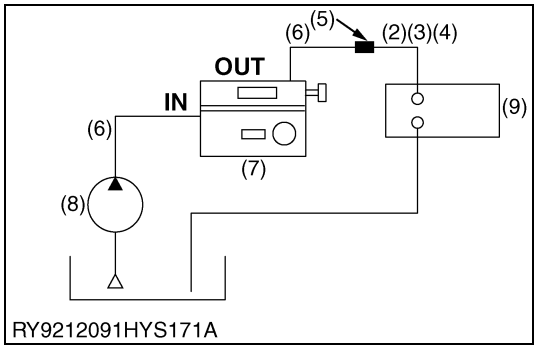


RY9212091HYS171A

Measuring the main pump flow (when measuring P1, P2 and P3 individually)

Measurement preparation

1. Place the machine on hard, flat ground, lower the bucket and the blade and stop the engine.
2. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic line.
3. Connect a vacuum pump.
4. Attach a pressure gauge to the pump pressure detection port.
5. Connect the pipe joint of the pump to be measured to the IN side of the flow gauge with a test hose.
6. Connect the removed hose to a test hose and connect them to the OUT side of the flow meter.
7. Remove the vacuum pump.
8. Start and idle the engine, and check that there is no oil leakage.

Measurement

1. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. Open the loading valve of the flow meter and start the engine. Set the engine speed to maximum, gradually close the loading valve of the flow meter, and measure the flow and engine speed at each pressure level.
3. Perform the measurement 3 times; take the average and use this as the measurement value.

(Pump Performance Inspection Procedure)

The pump performance inspection entails placing a specified pressure load on the pump discharge and taking measurements at a specified engine speed to check the volumetric efficiency.

$$\text{Volumetric efficiency} = \frac{\text{Rated load discharge rate}}{\text{Logical discharge value (Calculated value)}} \times 100\,(\%)$$

RY9212032HYS074A

1. The pump volumetric efficiency is proportional to pump rotational speed and inversely proportional to load pressure so set the engine speed at maximum speed for the test.
2. Volumetric efficiency is the ratio of the discharge amount per revolution (cc/rev) at a specified load and the theoretical discharge amount (calculated value). The specified load is the main relief set pressure.
3. The measurement value of the discharge flow at the specified load must be corrected to one pump revolution because the rotational speed of the pump is reduced from its normal speed.

$$\text{Rated load discharge rate} = \frac{\text{Rated load discharge rate (L/min)} \times 1000}{\text{Rated load pump (rpm)}}$$

RY9212032HYS073A

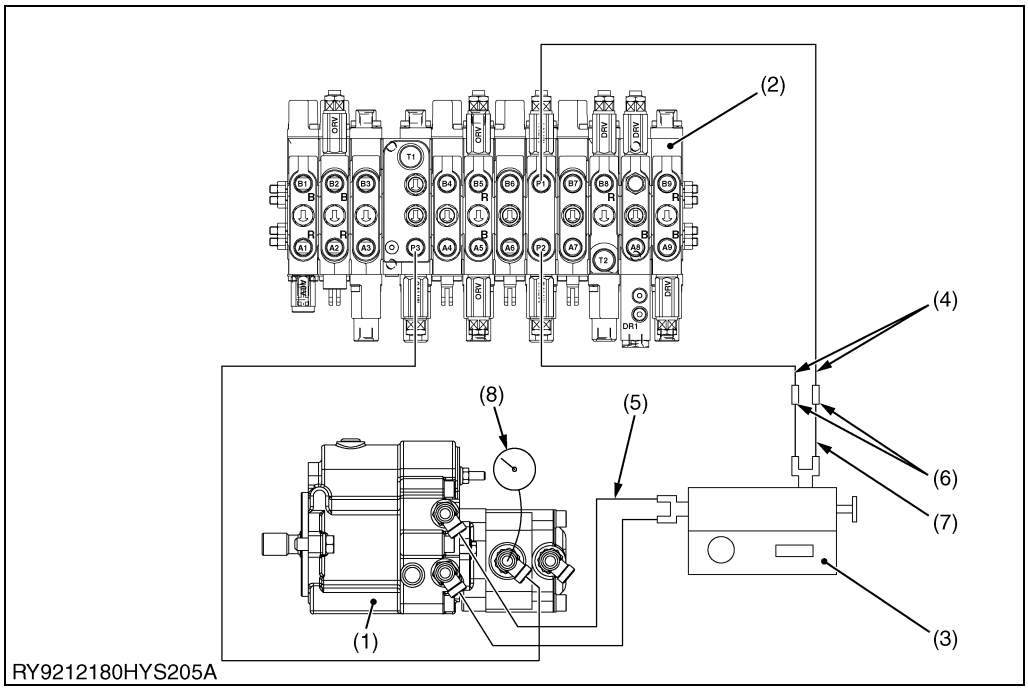
(1) Pump Pressure Detection Port
(2) P1 Hose
(3) P2 Hose
(4) P3 Hose
(5) Adapter
(6) Test Hose
(7) Flow Meter
(8) Pump
(9) Control Valve

RY9212180HYS0219US0

Measuring the main pump flow (when measuring the combined flow of P1 and P2)

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.



(1) Pump
(2) Control Valve
(3) Flow Meter
(4) Delivery Hose
(5) Test hoses
(6) Joint
(7) Test Hose
(8) Pressure Gauge

RY9212180HYS205A

Measurement preparation

1. Place the machine on flat hard ground, lower the bucket and the blade, and stop the engine.
2. Follow the chapter Releasing Pressure in the Hydraulic System to release pressure in the hydraulic line.
3. Use the vacuum pump and attach a pressure gauge to the pressure test port.
4. Disconnect the P1 and P2 delivery hoses on the pump side and plug the disconnected hoses.
5. Connect the test hoses to the P1 and P2 discharge ports and connect them the flow meter on the IN side. (Use the T-joint adapter to combine the flows.)
6. Attach the T-joint adapter to the OUT side of the flow meter and connect the P1 and P2 delivery hoses that were plugged in step 1.
7. Remove the vacuum pump and bleed air from the pump, making sure there are no oil leaks in any of the lines.

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. Set the engine to maximum RPM.
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.

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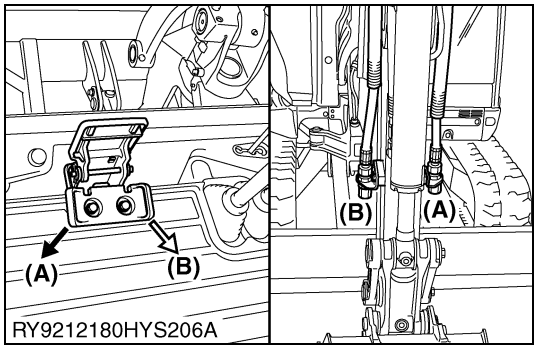

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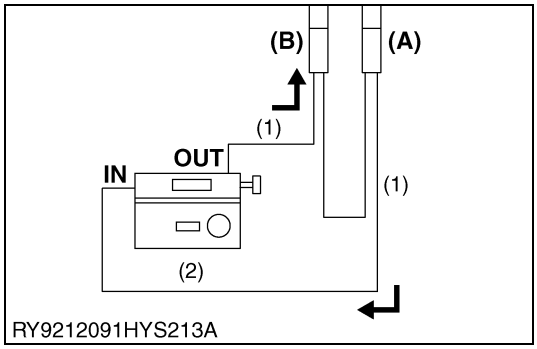

RY9212091HYS213A

Actual AUX PQ Value Measurement

Measurement preparation

1. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
2. Follow the chapter on "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. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. Open the loading valve of the flow meter and start the engine.
3. After bringing the engine to maximum RPM, operate the AUX.
4. Gradually close down the loading valve of the flow meter and measure the flow at each pressure level.
5. Perform the measurement 3 times; take the average and use this as the measurement value.

■ **IMPORTANT**

- **Take care not to make an error in the direction of oil flow and the IN direction of the flow meter.**

(1) Test Hose
(2) Flow Meter
(A) AUX High Pressure Side
(B) AUX Low Pressure Side

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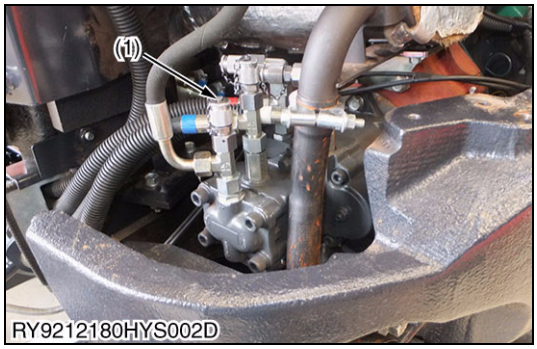

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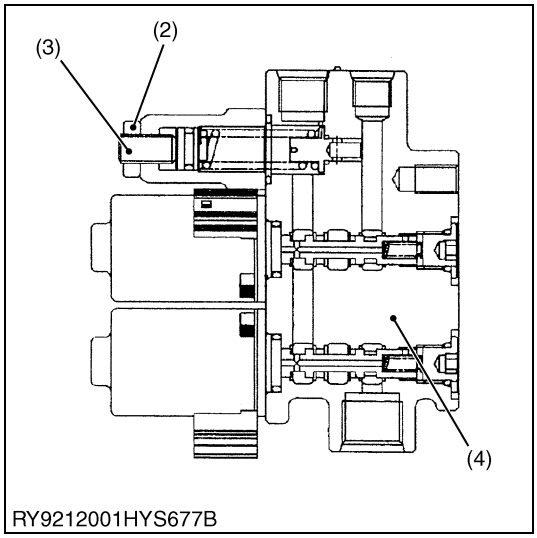

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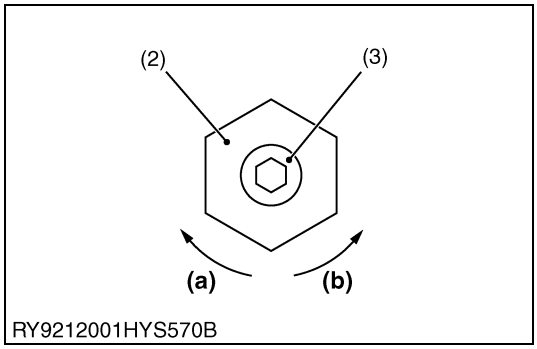

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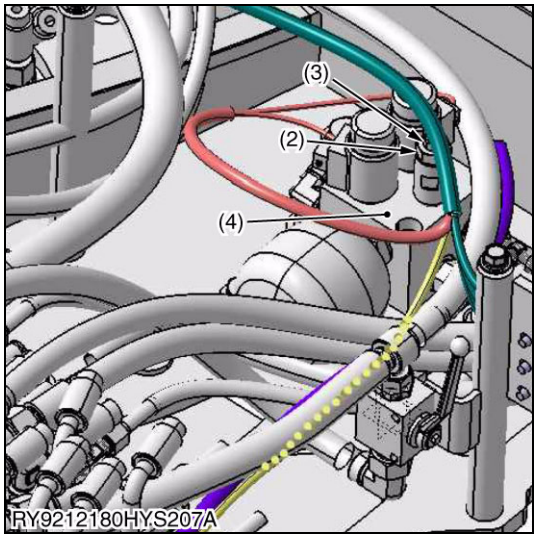


RY9212180HYS207A

Pilot Pressure

Primary Pilot Pressure Measuring Procedure

1. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
2. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic lines.
3. Attach a pressure gauge to the pilot pressure detection port.
4. Start and idle the engine, and check that there is no oil leakage when the machine's lock lever is released.
5. Raise engine speed to maximum rpm, and use the pressure gauge to measure pilot pressure under no load.
   Perform the measurement 3 times; take the average and use this as the measurement value.
   Conduct at oil temperature 50 ± 5 °C (122 ± 9 °F).

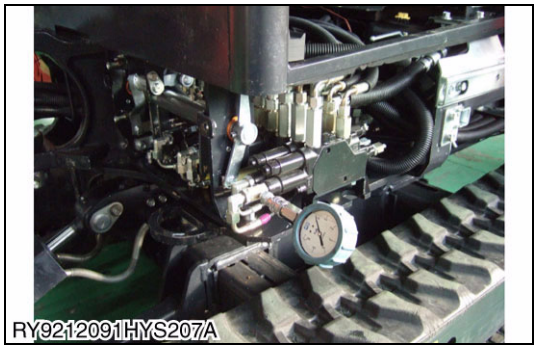
Primary Pilot Pressure Adjustment Method

1. Loosen the relief valve lock nut of the unload valve.
   Adjust by turning the adjuster screw with a hexagonal wrench and then tighten the lock nut.
2. After adjusting, check the set pressure.

(1) Pilot Pressure Detection Port
(2) Lock Nut
(3) Adjuster Screw
(4) Unload Valve

(a) Pressure Increase
(b) Pressure Decrease

RY9212180HYS0222US0


RY9212091HYS207A

Pilot Secondary Pressure Measuring Procedure

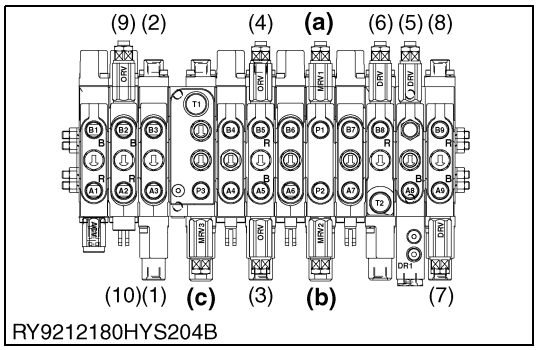
[Purpose]

- 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.

1. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
2. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic lines.
3. Fit a T-joint to the pilot port on the control valve side to be measured, and attach a pressure gauge.
4. Start and idle the engine, then check that there is no oil leakage.
5. Take the engine to maximum RPM, then operate the lever to be measured and take the pilot pressure reading at full stroke.
6. Perform the measurement 3 times, take the average and use this as the measurement value. Conduct at oil temperature 50 ± 5 °C (122 ± 9 °F).

(1) Adapter
(2) Pressure Gauge
(3) Test Hose

RY9212180HYS0223US0



RY9212180HYS204B

(1) Swivel Right
(2) Swivel Left
(3) Arm Crowd
(4) Arm Dump
(5) Boom Up
(6) Boom Down
(7) Bucket Crowd
(8) Bucket Dump
(9) Blade Down
(10) Blade Up

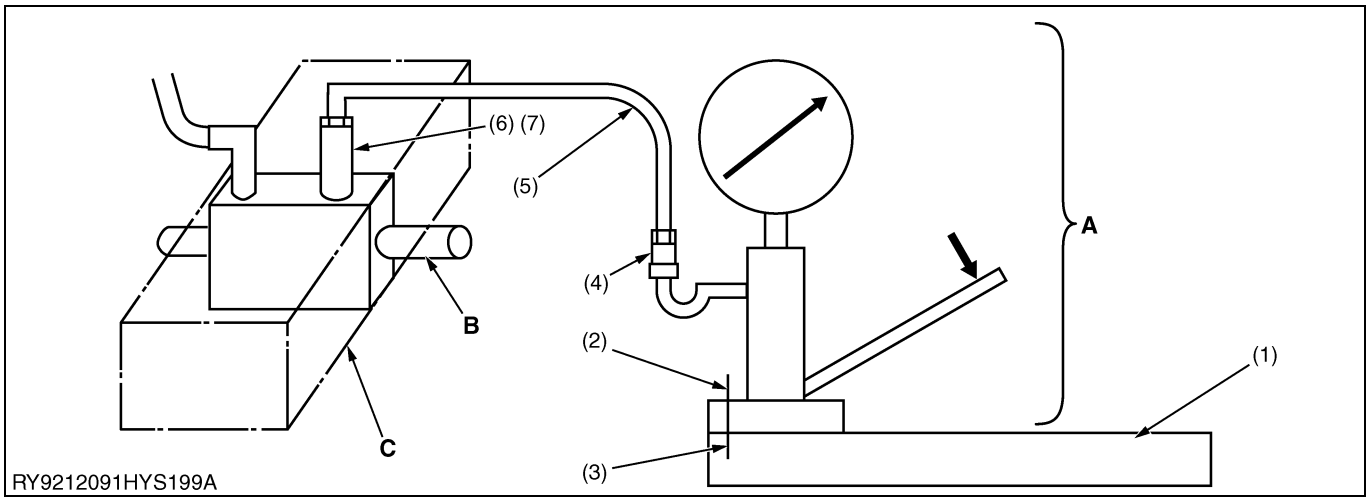
(a) Main P1 Relief Valve(aP1)
(b) Main P2 Relief Valve (aP2)
(c) Main P3 Relief Valve (aP3)

RY9212180HYS0224US0

Overload Relief Valve Pressure Measurement Procedure

■ **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 and AUX) 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.**



A : Injection Pressure Tester **B : Overload Relief Valve Tested** **C : Control Valve**

No.	Parts Name	Qty	Notes
(1)	Support	1	To hold the tester steady, fasten the tester to this support with bolts/nuts (2) and (3).
(2)	Bolt (M10 × 35)	2	
(3)	Nut (M12)	2	
(4)	Pipe joint (M12-G2)	1	Connect the hose and the tester.
(5)	Test hose (1/4)	1	
(6)	Straight pipe joint (S, G3-G2)	1	
(7)	Plug (PT1/8)	1	Plug the pressure detection port of the straight pipe joint (6).

Measurement preparation

1. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
2. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic lines.
3. Using the vacuum pump, disconnect the high pressure hose on the valve suction port fitted for the overload relief valve to be tested and then plug the disconnected hose.
4. Remove the pipe joint from where the hose was disconnected and fit a straight pipe joint (6).
5. Connect a test hose to this pipe joint (6) and to the injection pressure tester.
6. Remove the vacuum pump.

Overload Relief Valve Measurement

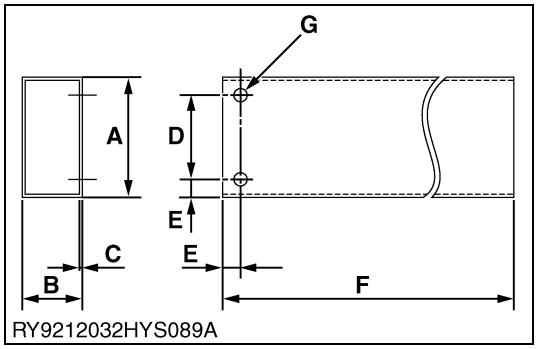
1. Add pressure until the overload relief valve opens and then read the pressure at that point.
2. Perform the measurement 3 times; take the average and use this as the measurement value.

CAUTION

- **Be sure to use a test hose that is durable enough to withstand the set pressure that is being tested.**
- **Be careful to tighten connections fully and to the right ports.**
- **When removing hoses after the tests, loosen the pipe joint (4) and the injection pressure tester slightly and make sure the pressure is relieved before disconnecting any hoses.**

RY9212180HYS0225US0

Measurement Equipment



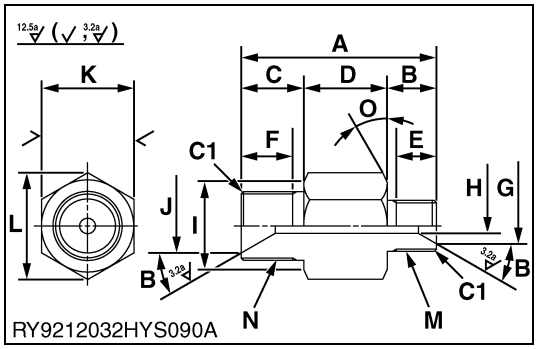
RY9212032HYS089A

(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 quality: STKR400

RY9212091HYS0126US0



RY9212032HYS090A

(4) Pipe joint (M12-G2)

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	30 °

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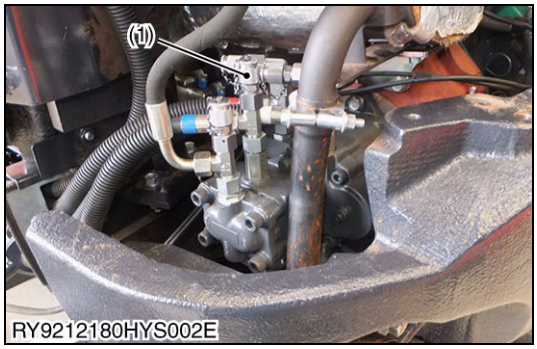
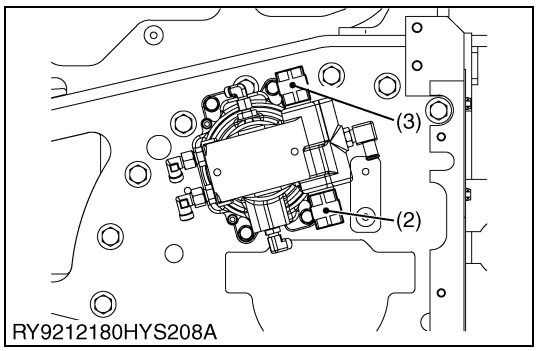




Swivel relief valve pressure

■ **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.**

1. Place the machine on flat hard ground surface, lower the bucket and the blade, and stop the engine.
2. Follow the chapter on "Release of pressure in the hydraulic system" to release pressure in the hydraulic line.
3. Attach a pressure gauge to the pump pressure detection port.
4. Start and idle the engine, and check that there is no oil leakage.
5. Place the bucket against something robust, lock the machine so that it does not move, slowly operate the swivel lever from left to right and from right to left, and take the main relief pressure reading at maximum engine speed.
   Perform the measurement 3 times; take the average and use this as the measurement value.
   Conduct the test at oil temperature 50 ± 5 °C (122 ± 9 °F).

■ **NOTE**

- **Swivel motor's relief valve pressure cannot be measured on the side of pressure detection port of the pump because the main relief valve opens first.**

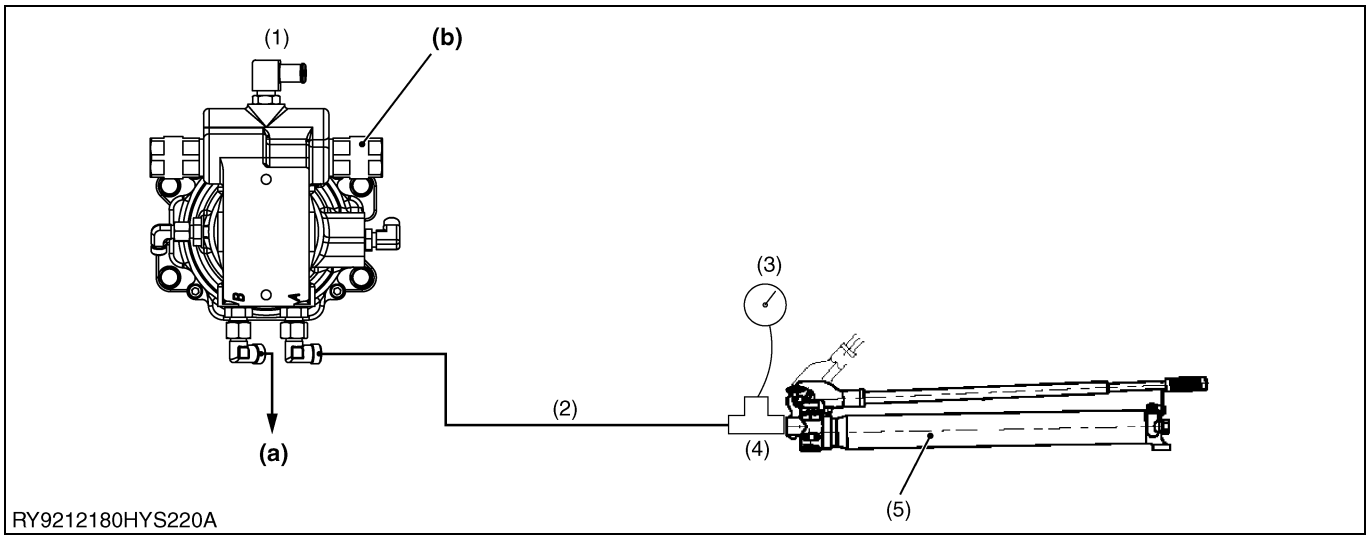
(1) P3
(2) Swivel left relief valve (cSL)
(3) Swivel right relief valve (cSR)

RY9212180HYS0226US0

Overload Relief Valve Pressure Measurement Procedure

■ **IMPORTANT**

- **If a measurement has to be made for some reason, the procedures is as follows.**



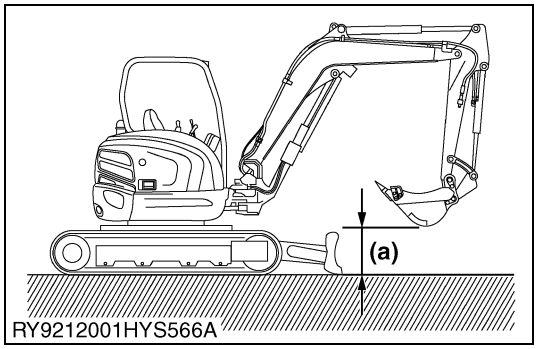
(1) Swivel Motor
(2) Test Hose
(3) Pressure Gauge
(4) T Joint
(5) Hand Pump
(a) To Control Valve
(b) Overload Relief Valve Tested

1. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
2. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic lines.
3. Using the vacuum pump, disconnect the high pressure hose on the swivel motor port fitted for the overload relief valve to be tested and then plug the disconnected hose.
4. Connect the test hose and hand pump to the port which disconnected hose.
5. Remove the vacuum pump.
6. Add pressure until the overload relief valve opens and then read the pressure at that point.
7. Perform the measurement 3 times; take the average and use this as the measurement value.

⚠ CAUTION

- **Be sure to use a test hose that is durable enough to withstand the set pressure that is being tested.**
- **Be careful to tighten connections fully and to the right ports.**
- **When removing hoses after the tests, loosen the release valve of a hand pump and make sure the pressure is relieved before disconnecting any hoses.**

RY9212180HYS0242US0



Swivel Motor Drain Volume

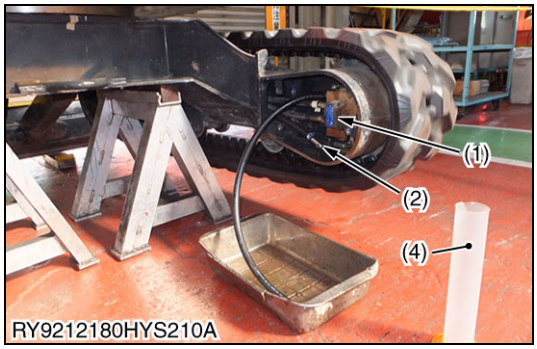
1. Before measuring, operate the swivel left and right repeatedly to sufficiently warm up the swivel motor. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
3. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic lines.
4. Connect a vacuum pump.
5. Disconnect the swivel motor's drain hose from the swivel motor side, and insert a plug in the disconnected hose.
6. Connect a test hose (e.g., low-pressure vinyl hose) to the drain port on the swivel motor side.
7. Remove the vacuum pump.
8. Operate the swivel lever at full stroke for one minute with the engine at maximum rpm, and while maintaining the swivel status at the same speed, collect hydraulic fluid from the drain hose in a receptacle and take the measurement.
9. Take the measurement from right to left and left to right two to three times, and determine the maximum value.

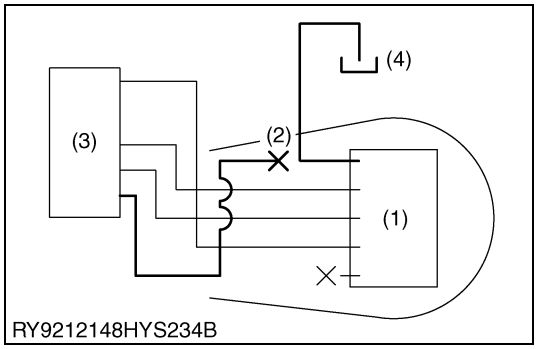
CAUTION

- **Before starting this test, make sure the swivel range is clear of people and obstacles.**

(a) 20 to 40 cm (7.9 to 15.7 in.)

RY9212180HYS0227US0





Travel Motor Drain Volume

1. Before this test, turn on the travel motor and allow it to warm up thoroughly. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. Place the machine on flat, hard ground, lower the bucket and the blade and stop the engine.
3. Follow the chapter on "Releasing Pressure in the Hydraulic System" and release pressure in the hydraulic lines.
4. Connect a vacuum pump.
5. Disconnect the travel motor's drain hose from the travel motor side, and insert a plug in the disconnected hose.
6. Connect a test hose (e.g., low-pressure vinyl hose) to the drain port on the travel motor side.
7. After disconnecting the vacuum pump, start the engine, jack up the machine and raise the crawler above ground level.

CAUTION

- **Place safety blocks and supports under the jacked up machine to prevent it from dropping.**

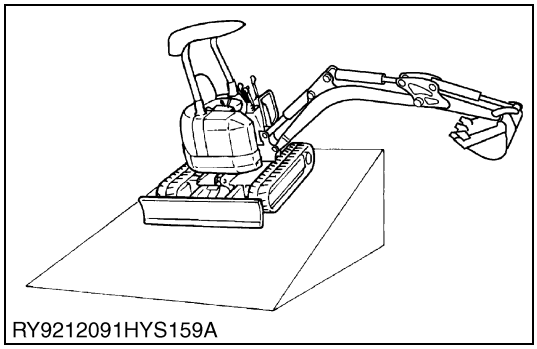
8. Rotate the crawler on the side to be measured for one minute with the engine at maximum rpm, collect hydraulic fluid from the test hose in a receptacle, and take the measurement. Take the measurement from back to front and front to back two to three times, and determine the maximum value.

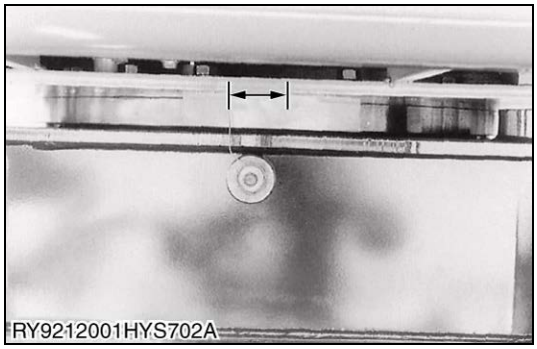
CAUTION

- For safety's sake, keep hands and feet out from under the crawler.

(1) Travel Motor
(2) Plug
(3) Swivel joint
(4) Graduated Cylinder

RY9212180HYS0228US0


RY9212091HYS159A


RY9212001HYS702A

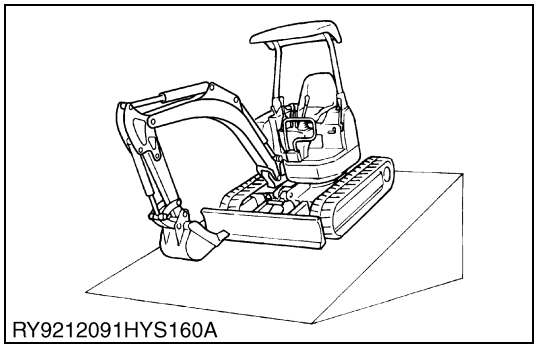
Swivel Block Performance

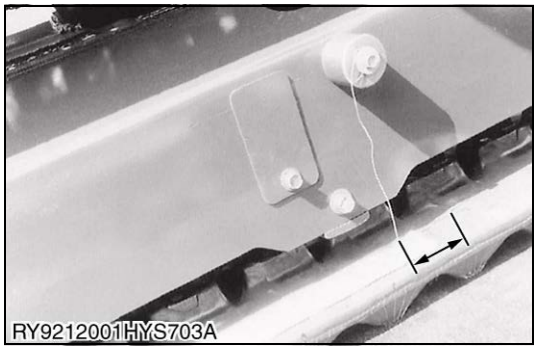
1. Before measuring, operate the swivel left and right repeatedly to sufficiently warm up the swivel motor. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. Place dirt or a weight of the specified weight (JIS heap x specific gravity 1.8) in the bucket.
   Specified weight: 60kg, 140 lbs
3. The ground slope for this test should be 20° and the machine set on the slope with the front perpendicular to the sloping surface.
4. The front attitude should be with the arm cylinder fully compressed and bucket cylinder fully extended, holding the boom on a straight line between the boom base pin and bucket pin.
5. Place markers on the circumference of the swivel bearing and track frame.
6. Start the engine, release the safety lock lever at idling rpm (lever down), and measure the slippage over one minute.
7. Take the measurement from right to left and left to right two to three times, and determine the average value.

CAUTION

- **Before starting this test, make sure the swivel range is clear of people and obstacles.**

RY9212091HYS0077US0

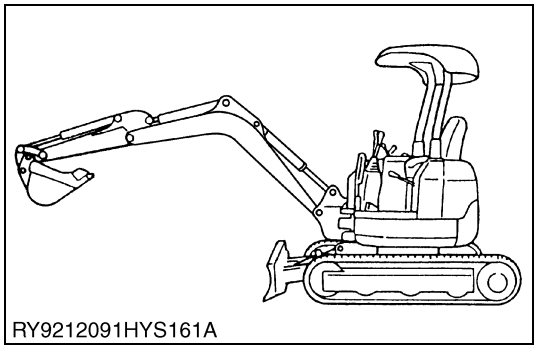

RY9212091HYS160A


RY9212001HYS703A

Travel Block Performance

1. Before this test, turn on the travel motor and allow it to warm up thoroughly. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. For this test, set the machine on hard ground or concrete with a slope angle of 20°.
3. Stop the machine on the slope, and set the front in a travel attitude.
4. Place the travel lever in neutral and stop the engine.
5. Make marks on the track frame and crawler, and measure the slippage over ten minutes.

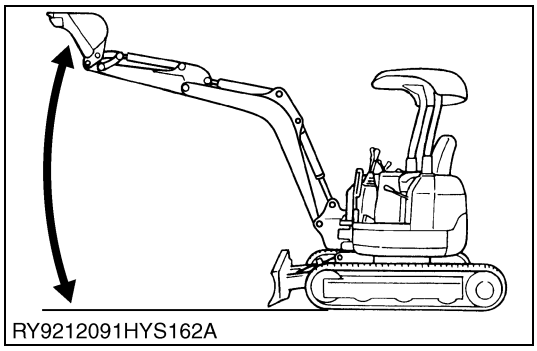
RY9212091HYS0103US0


RY9212091HYS161A

Hydraulic Cylinder Drift Amount

1. Before measuring, repeat front operations and fully warm up each cylinder. Hydraulic oil temperature of 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 on flat hard ground. Specified weight: 60kg, 140 lbs
3. The front attitude should be with 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.
4. Stop the engine, and place marks on the boom, arm and bucket cylinder rods.
5. After ten minutes has elapsed, measure the boom cylinder compression, arm cylinder extension and bucket cylinder compression.

RY9212091HYS0079US0

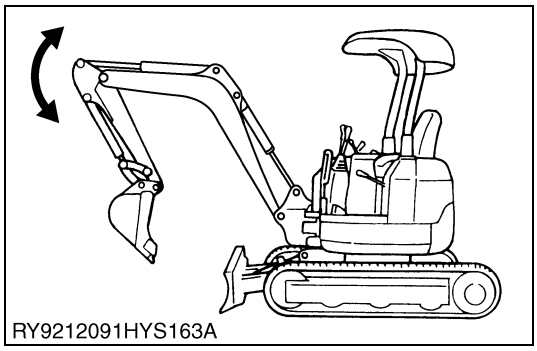

RY9212091HYS162A

Hydraulic Cylinder Operating Time

Boom Cylinder Measurement

1. Before measuring, repeat front operations and fully warm up each cylinder. Hydraulic oil temperature of 50 ± 5 °C (122 ± 9 °F).
2. The attitude for measurement should be with maximum compressed length of the arm cylinder and bucket cylinder.
3. Raise the engine speed to maximum rpm, operate the boom control lever to full stroke, and measure the time it takes to move from the position with the bucket touching the ground (maximum down position) to maximum up position (position above ground). (Do not include cushion operating time)

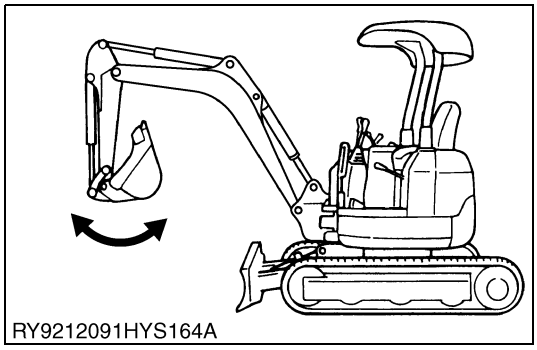
RY9212091HYS0104US0


RY9212091HYS163A

Arm cylinder measurement

1. Before measuring, repeat front operations and fully warm up each cylinder. Set the hydraulic fluid temperature to 50 ± 5 °C (122 ± 9 °F).
2. With the engine at maximum rpm, operate the arm control lever to full stroke, and measure the time required for arm in and out.

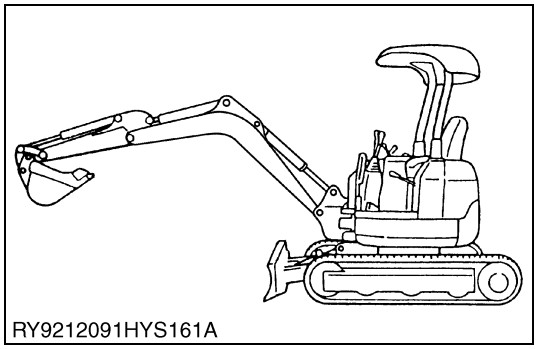
RY9212091HYS0081US0


RY9212091HYS164A

Bucket cylinder measurement

1. Before measuring, repeat front operations and fully warm up each cylinder. Set the hydraulic fluid temperature to 50 ± 5 °C (122 ± 9 °F).
2. With the engine at maximum rpm, operate the bucket control lever to full stroke, and measure the time required for bucket crowd and dump.

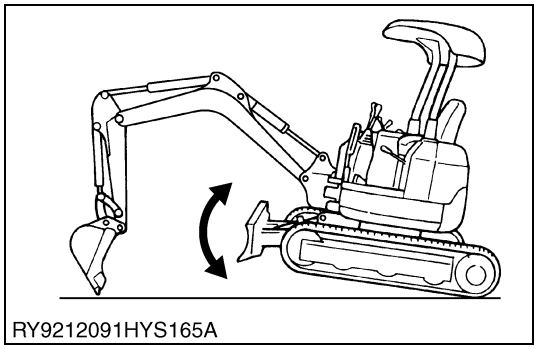
RY9212091HYS0082US0


RY9212091HYS161A

Swing cylinder measurement

1. Before measuring, repeat front operations and fully warm up each cylinder. Set the hydraulic fluid temperature to 50 ± 5 °C (122 ± 9 °F).
2. The front attitude should be with arm cylinder fully compressed, bucket cylinder fully extended, and bucket bottom approximately 1.0 m (40 in.) above ground level.
3. At maximum engine rpm, perform a full throttle stroke swing from left to right and right to left, and measure the time required to achieve this.

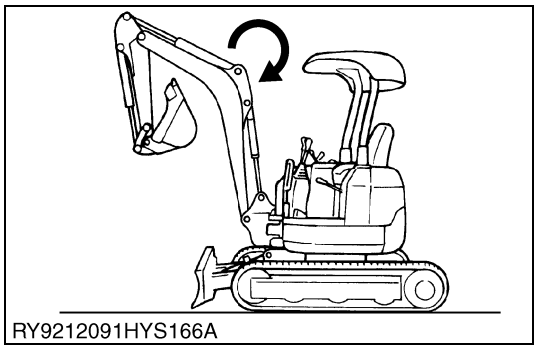
RY9212091HYS0083US0


RY9212091HYS165A

Blade cylinder measurement

1. Before measuring, repeat front operations and fully warm up each cylinder. Set the hydraulic fluid temperature to 50 ± 5 °C (122 ± 9 °F).
2. The vehicle attitude for measurement should be jacked up by the front, assuring full stroke of cylinder, top to bottom.
3. With the engine at maximum rpm, operate the blade control lever to full stroke, and measure the time required for blade up and down operation.

RY9212091HYS0084US0


RY9212091HYS166A

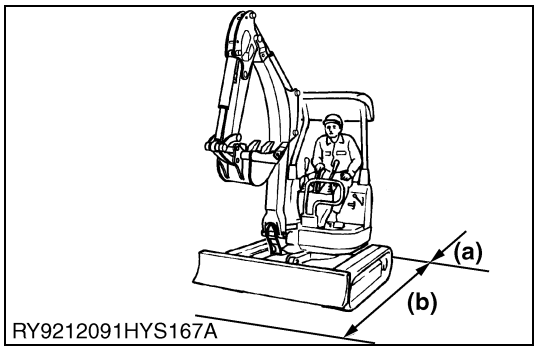
Measurement of required swivel time

1. Before measuring, repeat left-right swivel operation to thoroughly warm up the swivel motor. Set the hydraulic fluid temperature to 50 ± 5 °C (122 ± 9 °F).
2. The attitude for measurement should be with maximum extension of the boom cylinder, arm cylinder and bucket cylinder.
3. At maximum engine rpm, operate the swivel control lever at full stroke, and measure the time taken for three turns of the swivel unit.

CAUTION

- **Before commencing measurement, make sure there are no persons or obstacles within the swivel range.**

RY9212091HYS0085US0



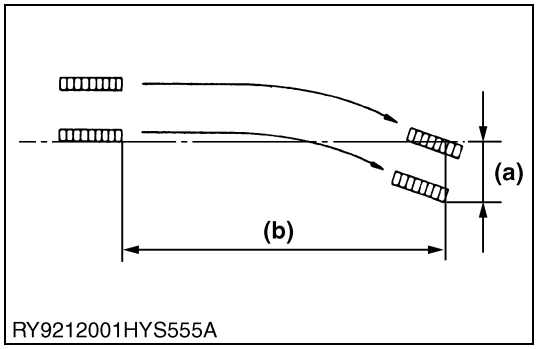
RY9212091HYS167A

Travel Speed

1. Before measuring, adjust the left and right crawlers to even tension, and operate the travel motor to thoroughly warm it up. Set the hydraulic fluid temperature to 50 ± 5 °C (122 ± 9 °F).
2. The measuring attitude should be travel attitude.
3. At maximum engine rpm, perform a 5.0 m (200 in.) run-up and 10 m (390 in.) forward run, and measure the time required.

(a) Run-Up (5.0 m, 200 in.) **(b) Measuring Area (10 m, 390 in.)**

RY9212091HYS0086US0



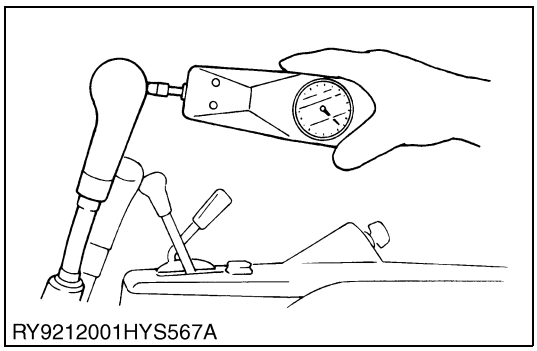
RY9212001HYS555A

Amount of travel drift

1. Before measuring, adjust the left and right crawlers to even tension, and operate the travel motor to thoroughly warm it up. Set the hydraulic fluid temperature to 50 ± 5 °C (122 ± 9 °F).
2. Determine a 10 m travel course on firm, flat ground, and set the measuring attitude to travel attitude.
3. At maximum engine rpm, travel for 10 m (390 in.), and measure the amount of drift **(a)**.
4. Perform the measurement three times, backwards and forwards; determine the average value, and take this as the measured value.

(a) Travel Drift **(b) 10 m, 390 in.**

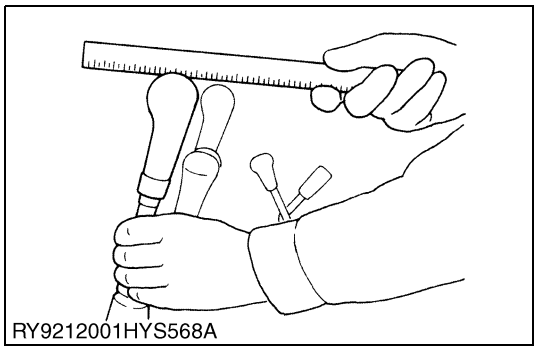
RY9212091HYS0087US0


RY9212001HYS567A

Lever operating force

1. Measurements on left and right control levers.
2. At maximum engine rpm, operate a control lever to full stroke, and take the value just before the stroke end as the measured value.
3. Take three measurements, determine the average and take that as the measured value.

RY9212091HYS0088US0


RY9212001HYS568A

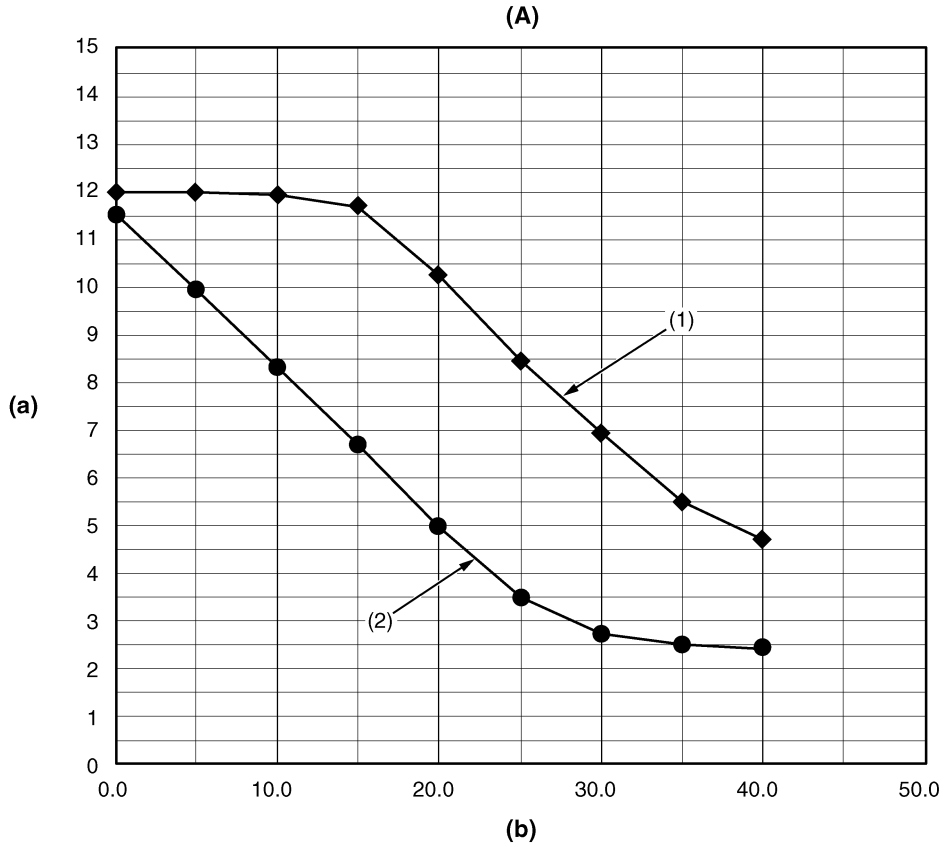
Lever stroke

1. Stop the engine.
2. Move each control lever (travel, arm, bucket, blade and swivel) from neutral to stroke end, and measure at the top center of the grip.
3. If there is backlash in neutral, take two measurements.
4. Measurement is by linear dimensions.
5. Perform the measurement three times, determine the average value, and take this as the measured value.

RY9212091HYS0089US0

14. HYDRAULIC DEVICE PERFORMANCE STANDARDS

Piston Pump P-Q Performance (Measured)



RY9212180HYS221A

(1) P3 = 0.49 MPa (5.0 kgf/cm^2, 71 psi)
(2) P3 = 17.2 MPa (175 kgf/cm^2, 2490 psi)

(A) Horsepower curve

(a) Flow: q1 = q2 (cc/rev) q1: P1 flow q2: P2 flow

(b) Pressure: P1 + P2 (MPa) (Flow meter reading)x2

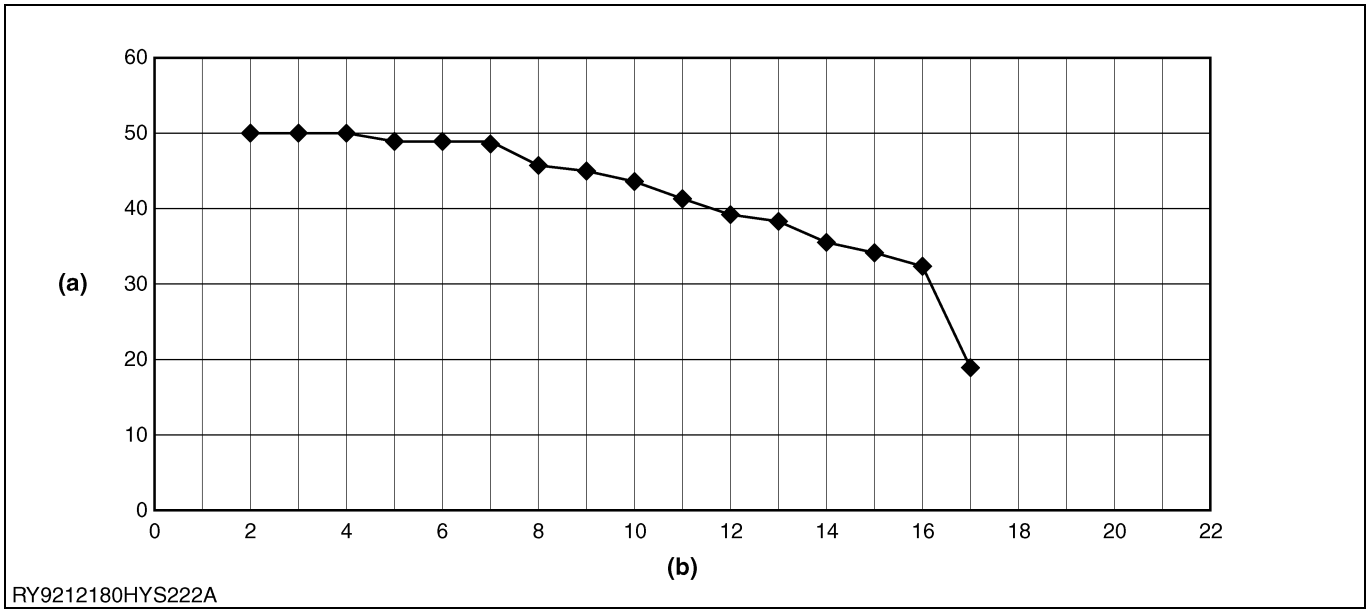
Engine RPM: 2400 rpm			
P3 No-load (P3 = 0.49 MPa)		P3 Relief (P3 = 17.2 MPa)	
Pressure	Flow Rate	Pressure	Flow Rate
0.0 MPa	12.0 cc/rev	0.0 MPa	11.5 cc/rev
5.0 MPa	12.0 cc/rev	5.0 MPa	9.9 cc/rev
10.0 MPa	11.9 cc/rev	10.0 MPa	8.3 cc/rev
15.0 MPa	11.7 cc/rev	15.0 MPa	6.7 cc/rev
20.0 MPa	10.3 cc/rev	20.0 MPa	5.0 cc/rev
25.0 MPa	8.4 cc/rev	25.0 MPa	3.5 cc/rev
30.0 MPa	6.9 cc/rev	30.0 MPa	2.7 cc/rev
35.0 MPa	5.5 cc/rev	35.0 MPa	2.5 cc/rev
40.0 MPa	4.7 cc/rev	40.0 MPa	2.4 cc/rev

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 rate.**

RY9212180HYS0240US0

AUX P-Q Performance (Measured) (STD)



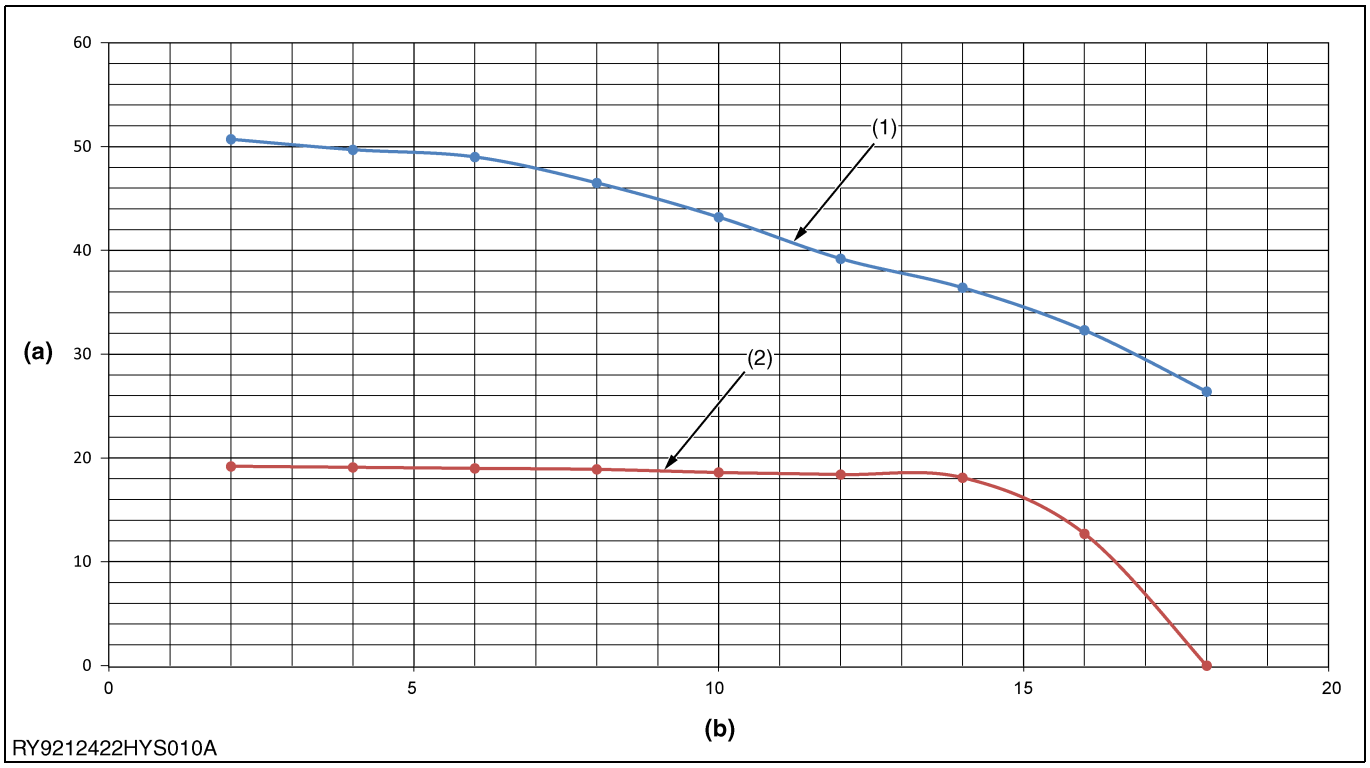
(a) Flow rate (L/min) **(b) Pressure (MPa)**

CAUTION

- **Measured values may vary depending on the machine.**

RY9212180HYS0241US0

AUX P-Q Performance (Measured) (Hi Spec)

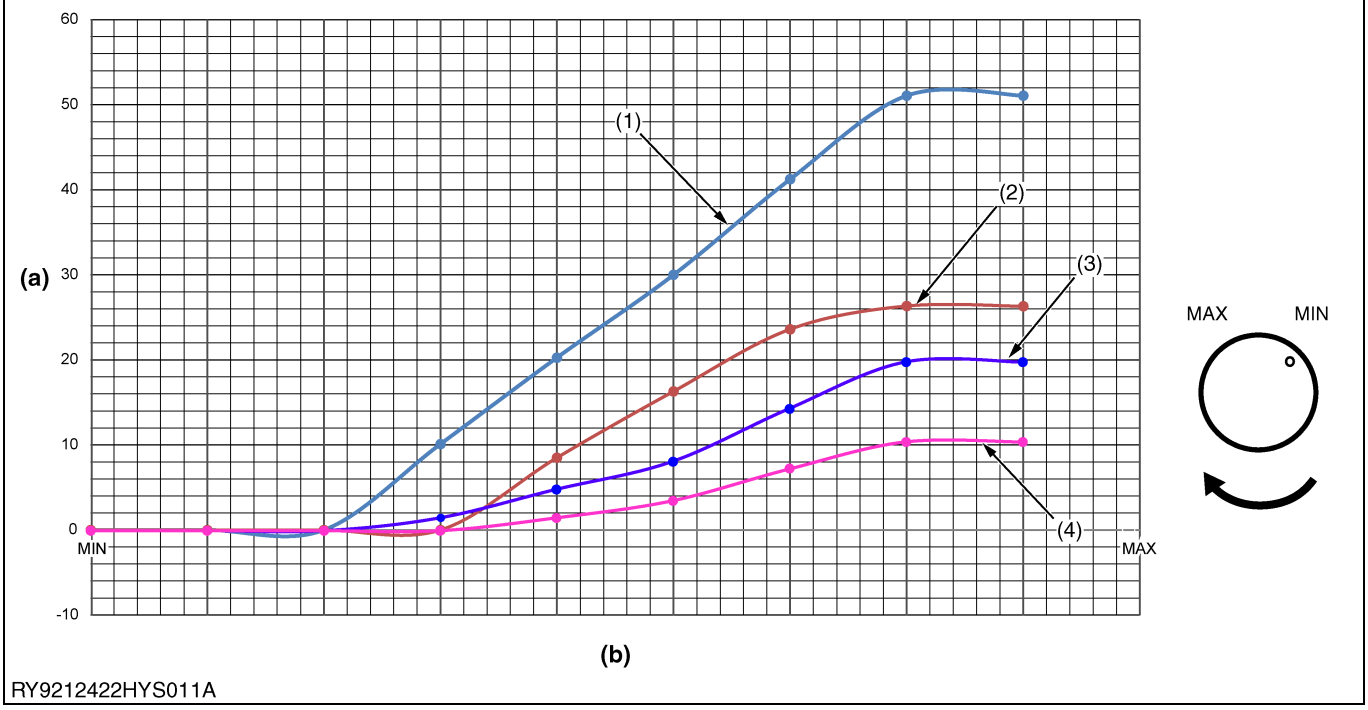


(1) AUX1 (2) AUX2 **(a) Flow rate (L/min)** **(b) Pressure (MPa)**

- Hydraulic oil temperature: 50.0±5 °C
- Engine speed: 2530 rpm
- Back pressure (AUX1)
  Third line open: 9.0 to 6.0 MPa
  Third line closed: 13.5 to 6.0 MPa

RY9212180HYS0254US0

AUX Proportional Performance (Measured) (Hi Spec)



RY9212422HYS011A

(1) AUX1 Left (2530 rpm)
(2) AUX1 Left (1320 rpm)
(3) AUX2 Left (2530 rpm)
(2) AUX2 Left (1320 rpm)
(a) Flow rate (L/min)
(b) Volume

- Hydraulic oil temperature: 50.0±5 °C

RY9212180HYS0255US0

Relief Pressure Table (Measured on New Vehicle)

Item			Notes
P1 Main relief pressure (aP1)		21.4 to 22.9 MPa 219 to 233 kgf/cm^2 3110 to 3320 psi	
P2 Main relief pressure (aP2)			
P3 Main relief pressure (aP3)		17.0 to 18.5 MPa 174 to 188 kgf/cm^2 2470 to 2680 psi	
Pilot relief pressure (aPP)		4.6 to 5.1 MPa 47 to 52 kgf/cm^2 670 to 730 psi	
Boom	Bottom (b1B)	23.0 to 25.0 MPa 230 to 250 kgf/cm^2 3355 to 3645 psi	
	Rod (b1R)		
Arm	Bottom (b2B)		
	Rod (b2R)		
Bucket	Bottom (b3B)		
Blade	Bottom (b4B)		
Swivel motor	Left (LH)	16.7 to 18.7 MPa 170 to 190 kgf/cm^2 2425 to 2715 psi	
	Right (RH)		

RY9212180HYS0229US0

Motor Drain Volume

Item		Factory specification	Allowable limits	Notes
Swivel motor	When turning	≤ 0.5 L/min ≤ 30 cu.in./min	≤ 1.0 L/min ≤ 60 cu.in./min	
	When locked	≤ 3.0 L/min ≤ 200 cu.in./min	≤ 6.0 L/min ≤ 400 cu.in./min	
Travel motor	When turning (1st speed)	≤ 0.2 L/min ≤ 10 cu.in./min	≤ 0.4 L/min ≤ 20 cu.in./min	

RY9212180HYS0231US0

Front Attachment Performance

Item				Notes
Hydraulic cylinder operation time	Boom	Ground → Max. lift	1.9 to 2.5 sec	
		Max. lift → Ground	2.3 to 2.9 sec	
	Arm	Crowd	2.4 to 3.0 sec	
		Dump	2.3 to 2.9 sec	
	Bucket	Crowd	2.2 to 2.8 sec	
		Dump	1.3 to 1.9 sec	
	Swing (STD)	Left	4.0 to 4.6 sec	
		Right	4.6 to 5.2 sec	
	Swing (Hi spec)	Left	4.2 to 4.8 sec	
		Right	4.7 to 5.3 sec	
	Blade	Max. down → Max. up	1.6 to 2.2 sec	
		Max. up → Max. down	2.3 to 2.9 sec	
Hydraulic cylinder drift	Boom	Std. when new	≤ 20 mm ≤ 0.79 in.	
		Usage limit	≤ 100 mm ≤ 3.94 in.	
	Arm	Std. when new	≤ 15 mm ≤ 0.59 in.	
		Usage limit	≤ 75 mm ≤ 3.0 in.	
	Bucket	Std. when new	≤ 10 mm ≤ 0.39 in.	
		Usage limit	≤ 50 mm ≤ 1.97 in.	
	Blade	Std. when new	≤ 25 mm ≤ 0.98 in.	
		Usage limit	≤ 50 mm ≤ 2.00 in.	

RY9212180HYS0257US0

Swivel Performance

Item			Notes
Swivel Block Performance	When stopped	≤ 157 mm ≤ 6.18 in.	
	When Idling		
Swivel speed	3 revs	16.5 to 20.2 sec / 3 revs	

RY9212180HYS0243US0

Travel Performance

Item				Notes
Travel block performance			300 mm 11.8 in.	
Travel speed	Rubber	1st	12.4 to 15.7 sec / 10 m (394 in.)	
		2nd	7.1 to 8.8 sec / 10 m (394 in.)	
Amount of travel drift			≤ 600.0 mm ≤ 23.6 in.	

RY9212180HYS0244US0

Control Lever Load / Stroke

Item				Notes
Lever operating force	Boom		5 to 14 N 0.5 to 1.5 kgf 2.0 to 3.3 lbf	
	Bucket			
	Arm			
	Swivel			
	Blade		20 to 30 N 2.0 to 3.0 kgf 5 to 6 lbf	
	Accelerator		36 to 64 N 3.6 to 6.6 kgf 8 to 14 lbf	
	Travel		15 to 24 N 1.5 to 2.5 kgf 3.3 to 5.5 lbf	
Lever stroke	Boom	Up	62 to 82 mm 2.5 to 3.2 in.	
		Down		
	Arm	Crowd		
		Dump		
	Bucket	Crowd		
		Dump		
	Swivel	Left		
		Right		
	Blade	Up	67 to 87 mm 2.7 to 3.4 in.	
		Down		
	Travel	Front	69 to 89 mm 2.8 to 3.5 in.	
		Rear	71 to 91 mm 2.8 to 3.5 in.	

RY9212180HYS0245US0

15. TROUBLESHOOTING

Front System Troubleshooting

All front operations slow or not moving

Cause	Inspection point	Remedy	Reference page
Defect of the engine itself	Engine speed measurement	Adjust each engine part	–
Insufficient hydraulic fluid volume or oil deterioration	Check hydraulic tank oil level and oil quality	Replenish the hydraulic fluid supply or change the oil	
Suction line (suction filter) blockage	Inspect the suction line (suction filter)	Clean the suction line Replace the suction line	
Pilot relief valve faulty operation or poor pilot pump performance	Test pilot primary pressure	Adjust, clean or replace pilot relief valve Replace pilot pump	
Poor main relief valve operation or seating	Measure main relief valve pressure	Adjust, clean or replace main relief valve	
Defective pump installation coupling	Pump installation coupling inspection	Replace pump coupling	
Pump drive shaft breakage	Pump drive shaft inspection	Replace shaft	
Wear or damage to internal pump parts	Pump inspection	Repair or replace pump	

Either pilot valve right or left does not move or front attachments are slow

Cause	Inspection point	Remedy	Reference page
Pilot valve line filter blockage	Pilot valve line filter blockage inspection	Clean pilot filter line filter	
Defective pilot valve	Measure the pilot secondary pressure of the corresponding cylinder	Pilot valve disassembly, cleaning or replacement	

Low power in entire hydraulic system

Cause	Inspection point	Remedy	Reference page
Pilot relief valve faulty operation or poor pilot pump performance	Test pilot primary pressure	Adjust, clean or replace pilot relief valve Replace pilot pump	
Poor main relief valve operation or seating	Measure main relief valve pressure	Adjust, clean or replace main relief valve	

Only a certain cylinder fails to move or is slow

Cause	Inspection point	Remedy	Reference page
The corresponding pilot valve is faulty	Measure the pilot secondary pressure of the corresponding cylinder	Pilot valve disassembly, cleaning or replacement	
Defective specified pressure of overload relief valve	Inspect overload relief valve of applicable cylinder	Clean overload relief valve seat surface or replace	
Control valve spool sticks	Inspect control valve spool of applicable cylinder	Control valve spool disassembly and cleaning	

Cause	Inspection point	Remedy	Reference page
Defective seal(s) inside the cylinder	Inspect applicable cylinder	Cylinder disassembly and seal replacement	

Low power with certain implements

Cause	Inspection point	Remedy	Reference page
Pilot relief valve faulty operation or poor pilot pump performance	Test pilot primary pressure	Adjust, clean or replace pilot relief valve Replace pilot pump	
Defective specified pressure of overload relief valve	Inspect overload relief valve of applicable cylinder	Clean overload relief valve seat surface or replace	

Major front leak (drift) volume

Cause	Inspection point	Remedy	Reference page
Defective specified pressure of overload relief valve	Inspect overload relief valve of applicable cylinder	Clean overload relief valve seat surface or replace	
Control valve spool sticks	Inspect control valve spool of applicable cylinder	Control valve spool disassembly and cleaning	
Defective seal(s) inside the cylinder	Inspect applicable cylinder	Cylinder disassembly and seal replacement	

RY9212091HYS0090US0

Travel System Troubleshooting

No travel on one side. Slow. Meandering.

Cause	Inspection point	Remedy	Reference page
Crawler tension trouble or earth blockage around crawler	Crawler tension and blockage inspection	Knocking earth off crawler and crawler tension adjustment	–
Defective travel pilot valve operation	Travel pilot valve secondary pressure measurement	Travel pilot valve disassembly, cleaning or replacement	
Sticking of control valve spool	Control valve spool inspection	Control valve spool disassembly and washing	
Sticking of control valve spool	Travel motor counterbalance spool inspection	Travel motor counterbalance valve disassembly, cleaning or replacement	
Defective travel motor	Travel motor drain volume measurement	Travel motor disassembly, replacement	
Internal leak of swivel joint	Remove the travel outlet hose of the swivel joint, plug it and measure the relief pressure	Swivel joint seal replacement	

Front attachments fails to operate during complex operations or while traveling

Cause	Inspection point	Remedy	Reference page
Confluence valve sub-spool sticking	Inspection of control valve confluence valve section spool	Disassembly and washing of control valve spool	
Confluence valve main spool sticking			

RY9212180HYS0232US0

Swivel System Troubleshooting

Swivel speed slow or no swivel

Cause	Inspection point	Remedy	Reference page
Defective pilot valve	Measure travel pilot valve secondary pressure	Pilot valve disassembly, cleaning or replacement	
Swivel section spool sticks	Inspect control valve swivel section spool	Clean spool	
Defective swivel relief specified pressure	Measure swivel relief pressure	Swivel relief valve cleaning or replacement	
Internal defect in the swivel motor	Measure swivel motor drain volume	Swivel motor disassembly, replacement	

Swivel drift

Cause	Inspection point	Remedy	Reference page
Pilot valve spool sticks	Check that the pilot valve spool has returned to neutral	Pilot valve disassembly, cleaning or replacement	
Swivel section spool sticks	Inspect control valve swivel section spool	Control valve spool disassembly and cleaning	
Defective swivel relief specified pressure	Measure swivel relief pressure	Swivel relief valve cleaning or replacement	
Swivel motor make-up poppet sticks or defective seat surface	Inspect swivel motor make-up poppet	Make-up poppet disassembly and cleaning	
Internal defect in the swivel motor	Measure swivel motor drain volume	Swivel motor disassembly, replacement	

RY9212091HYS0092US0

4 ELECTRICAL SYSTEM

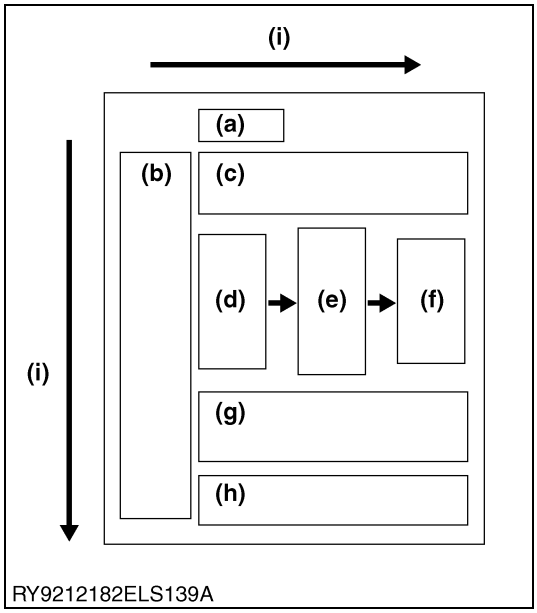
SERVICING

CONTENTS

1. READING THE ELECTRICAL CIRCUIT DIAGRAMS

[1] LAYOUT OF ELECTRICAL CIRCUIT DIAGRAMS

(1) Main Layout



RY9212182ELS139A

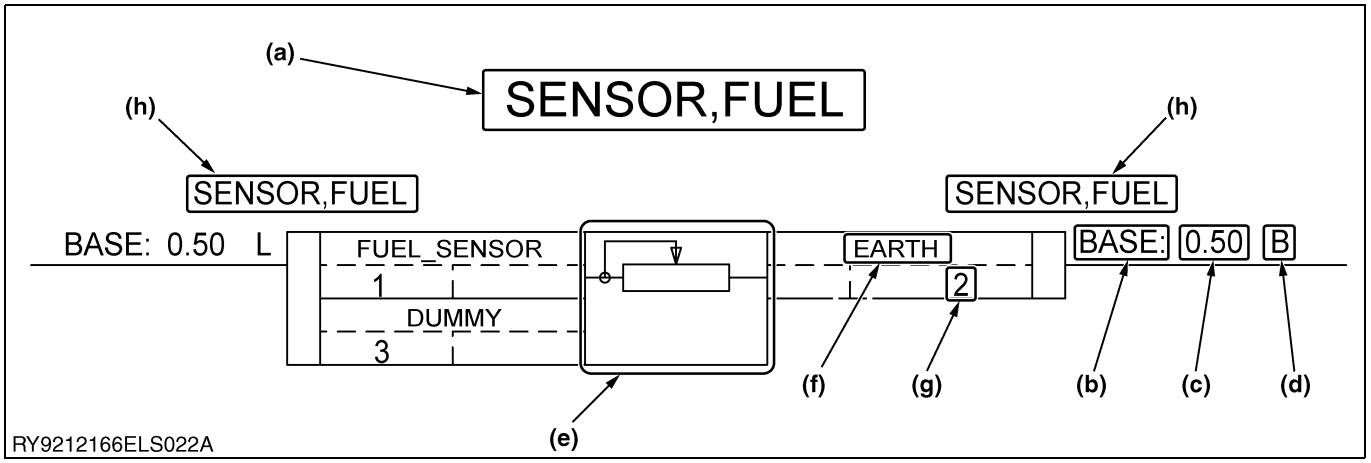
(a)	Battery
(b)	Fuses
(c)	Basic structural components
(d)	Sensors, etc. (input system)
(e)	Machine ECU
(f)	Solenoids, etc. (output system)
(g)	Auxiliary equipment
(h)	Heater
(i)	Basic direction of electrical flow

CAUTION

- **Please note that some items do not conform to this layout.**

RY9212180ELS0111US0

Electrical wiring chart symbols for harnesses and wires



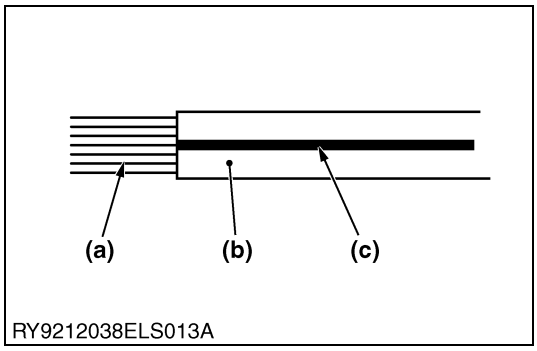
RY9212166ELS022A

	Item	(Example) Contents of illustration	Reference
(a)	Name of part	Sensor, fuel	
(b)	Specification code	All use (common)	Table shown on circuit diagram
(c)	Wire size	0.50 mm^2	
(d)	Wire color	Black	Wire color page
(e)	Unit symbol	Potentiometer with sliding contact	Unit symbol page
(f)	Pin name	Earth	
(g)	Pin No.	2	
(h)	Connector name	Sensor, fuel	Connector diagram

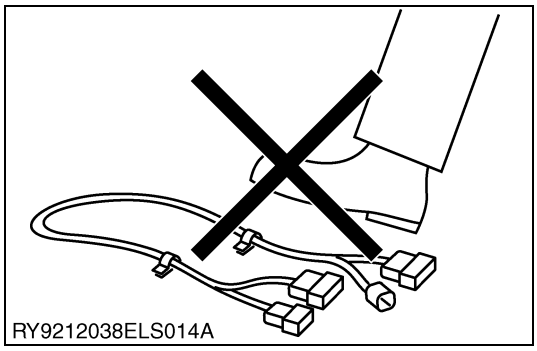
RY9212166ELS0074US0

Colors of Wiring

Color of wiring	Color code
Black	B
Green	G
Blue	L
Pink	P
Red	R
White	W
Yellow	Y
Brown	BR
Gray	GY
Light Green	LG
Orange	OR
Sky Blue	SB



RY9212038ELS013A


RY9212038ELS014A

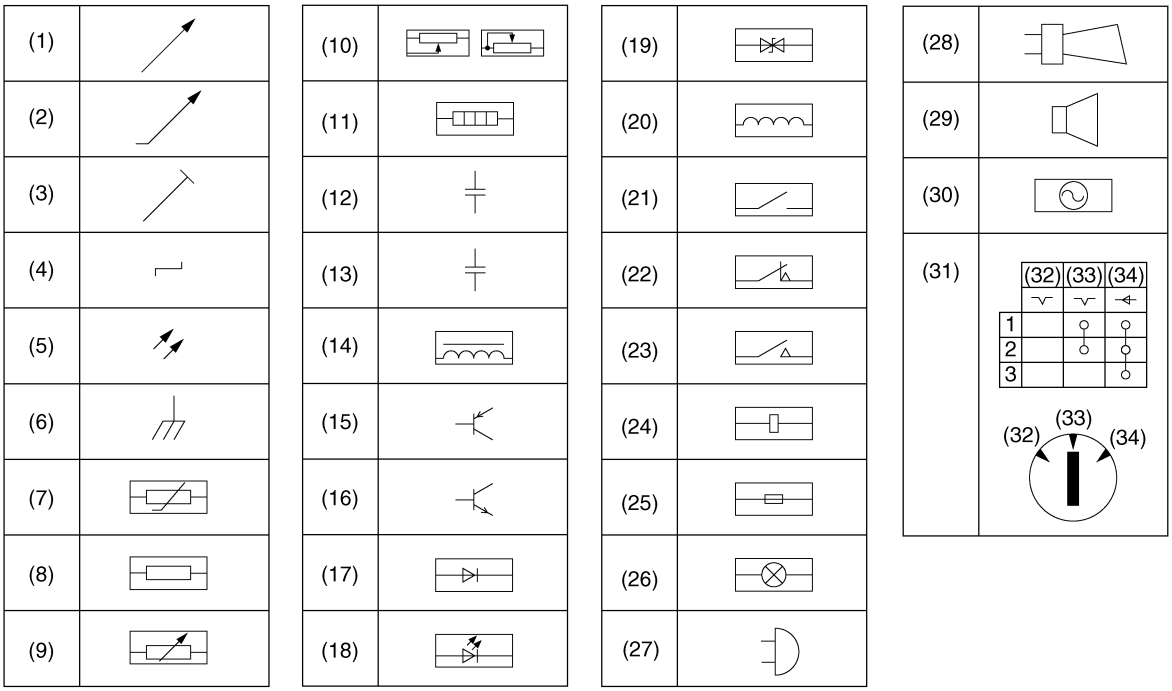
(Ex.)
1.25-Y/R means :
1.25 : Wire size (mm^2)
Y : Base color (yellow)
R : Stripe color (red)

- 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

RY9212166ELS0003US0

Unit symbol

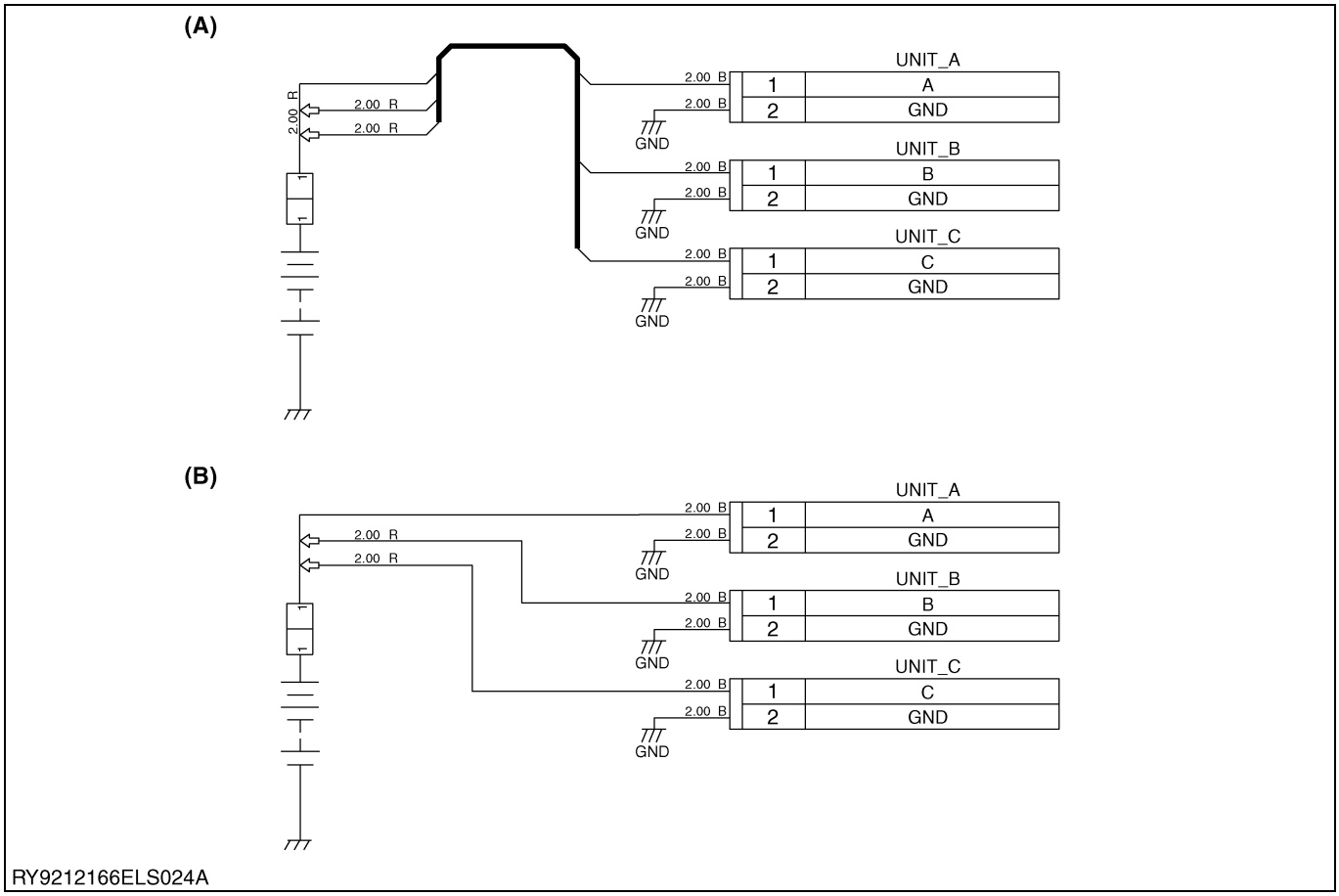


RY9212166ELS093A

(1) Variable
(2) Non-Linear Variable
(3) Fixed Setting
(4) Step Variable
(5) Non Ionizing Radiation (NIR)
(6) Body GND
(7) Thermistor
(8) Resistor
(9) Variable Resistor
(10) Potentiometer with Sliding Contact
(11) Heating Element
(12) Condenser
(13) Electrolytic Capacitor
(14) Magnetic Core Inductance
(15) PNP Transistor
(16) NPN Transistor
(17) Semiconductor Diode
(18) Light-Emitting Diode (LED)
(19) Two-Way Breakdown Diode
(20) Coil
(21) Normally Open Contact
(22) Auto-Resetting Normally Closed Contact
(23) Auto-Resetting Normally Open Contact
(24) Relay Coil
(25) Fuse
(26) Lamp
(27) Buzzer
(28) Horn
(29) Speaker
(30) A/C Voltage Source
(31) Switch
(32) OFF (No Auto-Reset)
(33) ON
(34) START (Auto-Reset)

RY9212166ELS0075US0

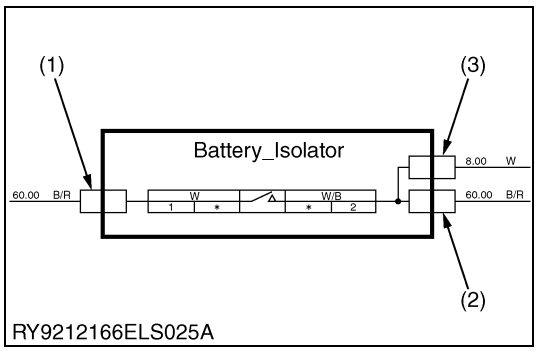
Bus bar markings

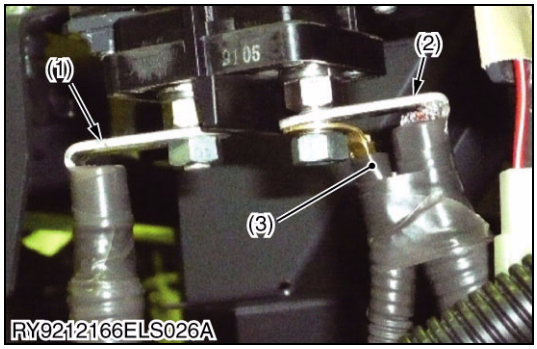


(A) Diagram Using Bus **(B) Diagram Showing All Circuits, Not Using Bus**

1. Diagrams of circuits with a lot of junction branches, such as power supply circuits, are very complicated if depicted literally, so a bus should be used where necessary.
2. A circuit is connected to both sides of the bus.
3. Wire attributes are used respectively for the circuits connected to both sides of the bus. (The circuits forming a pair on each side of the bus must be connected.)

RY9212166ELS0076US0





Battery terminal and composite terminal markings

If terminals are fastened together, such as battery terminals

- Fasten terminals (2) and (3) together with one bolt.

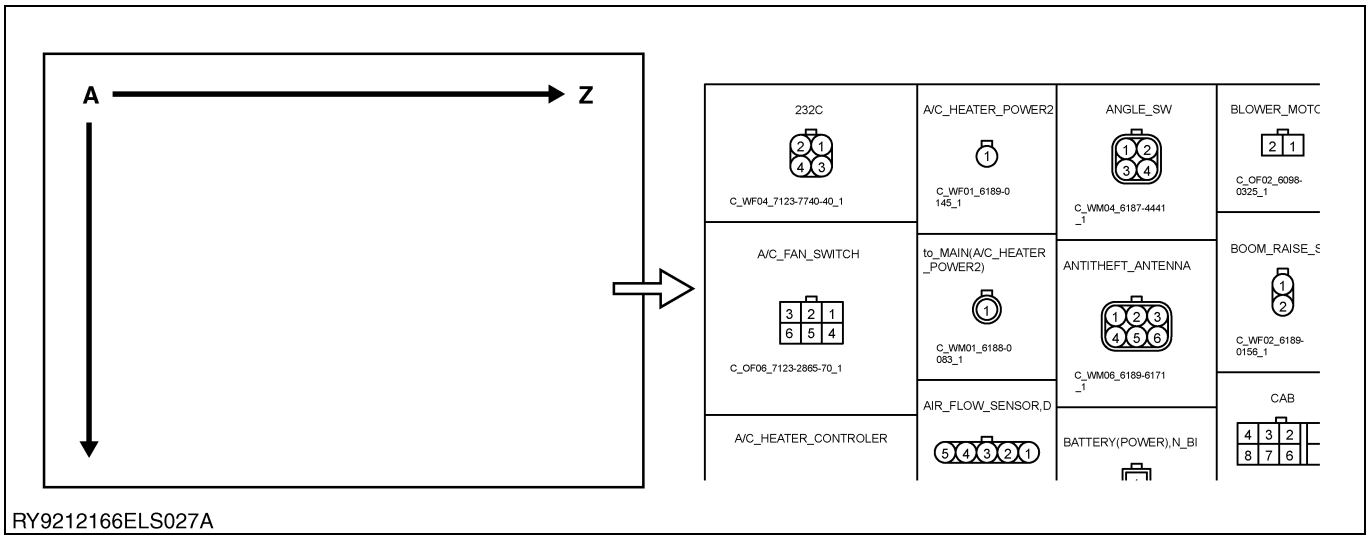
RY9212166ELS0077US0

[2] LAYOUT OF CONNECTOR DIAGRAMS

(1) Main Layout

Connector arrangement sequence

In alphabetical order downwards from top left, and then to column next right.

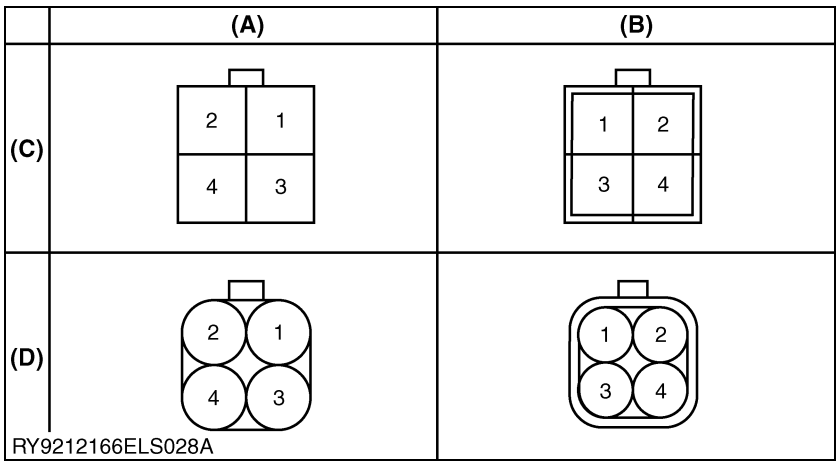


RY9212166ELS027A

RY9212166ELS0078US0

Depiction of Connectors

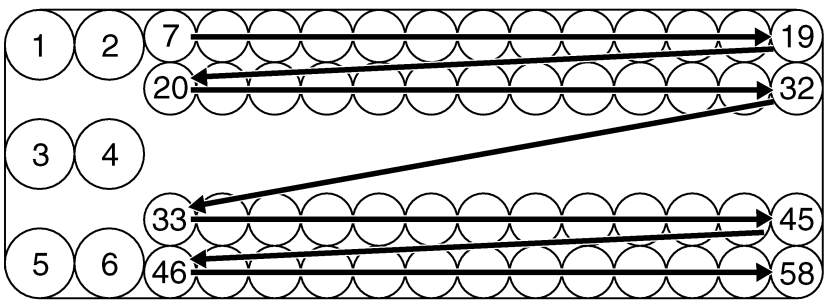
In principle, the connector locking part is shown on the top side.
Female connector terminal numbers start from 1 in the top right corner, looking at the connecting face.
Male connector terminal numbers start from 1 in the top left corner.



RY9212166ELS028A

(A) Female Connector Terminal
(B) Male Connector Terminal
(C) Not Waterproofed
(D) Waterproofed

10 terminals or fewer	Above-stated pin numbers in all cases. Numbers assigned according to numbering specifications.	
11 terminals or more	Manufacturer's instructions given.	Use manufacturer's stated pin numbers.
	Manufacturer's instructions not given.	Numbers assigned according to above-stated numbering specifications.



RY9212166ELS029A

RY9212166ELS0079US0

Group	Separator	Waterproofed / Not waterproofed	Male / Female	No. of Terminals	Separator	Housing	Separator	Identifying suffix	Separator	Comment	Separator
C (Connector)	" _ "	O : Open (not waterproofed) W : Waterproofed	F : Female M : Female	8-pin	" _ "	1234-5678-20 Connector manufacturer's part no.	" _ "	1 - 9 → A - Z	" ("	Alphanumeric characters	") "
		LA : Round automotive terminal	F : Female	01		Hole dia. M○○					
		LE : Claw-shaped automotive terminal	F : Female								
		BA : Automotive battery lead terminal	F : Female								
		CB : Female bullet terminal	F : Female			Blank column					
		CA : Male bullet terminal	M : Male								
		PA : Flat male embedded bullet terminal (w/out cover)	M : Male			Tab width 250 (6.3 mm) 187 (4.75 mm) 110 (2.8 mm)					
		O : Flat male embedded bullet terminal (w/ cover)	M : Male			Manufacturer's sleeve part no. (enter terminal part no. in series column)					
		O : Flat female bullet terminal (w/ cover)	F : Female			Manufacturer's sleeve part no. (enter terminal part no. in series column)	" _ "				
		PA : Flat female bullet terminal (w/out cover)	F : Female			Tab width 250 (6.3 mm) 187 (4.75 mm) 110 (2.8 mm)					
		M : Bolt embedded terminal	M : Male			Bolt size : M○○			Starter, alternator power terminals, etc.		

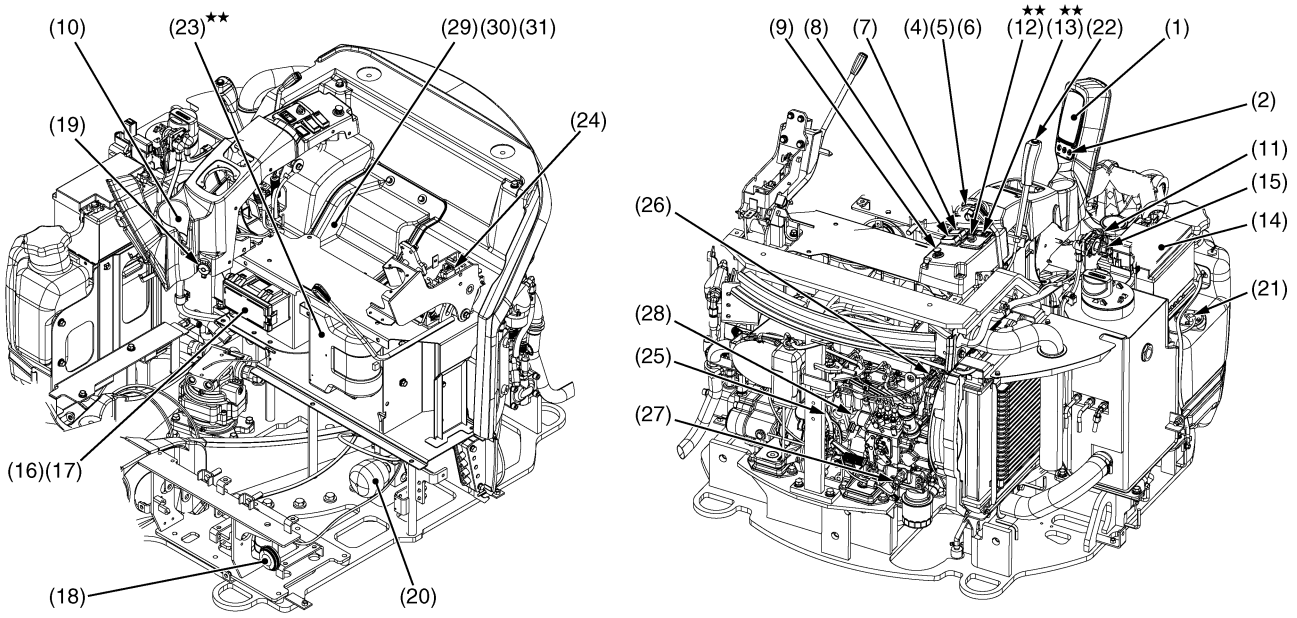
RY9212180ELS0120US0

[3] 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

2. ELECTRONIC DEVICE LAYOUT



RY9212180ELS035A

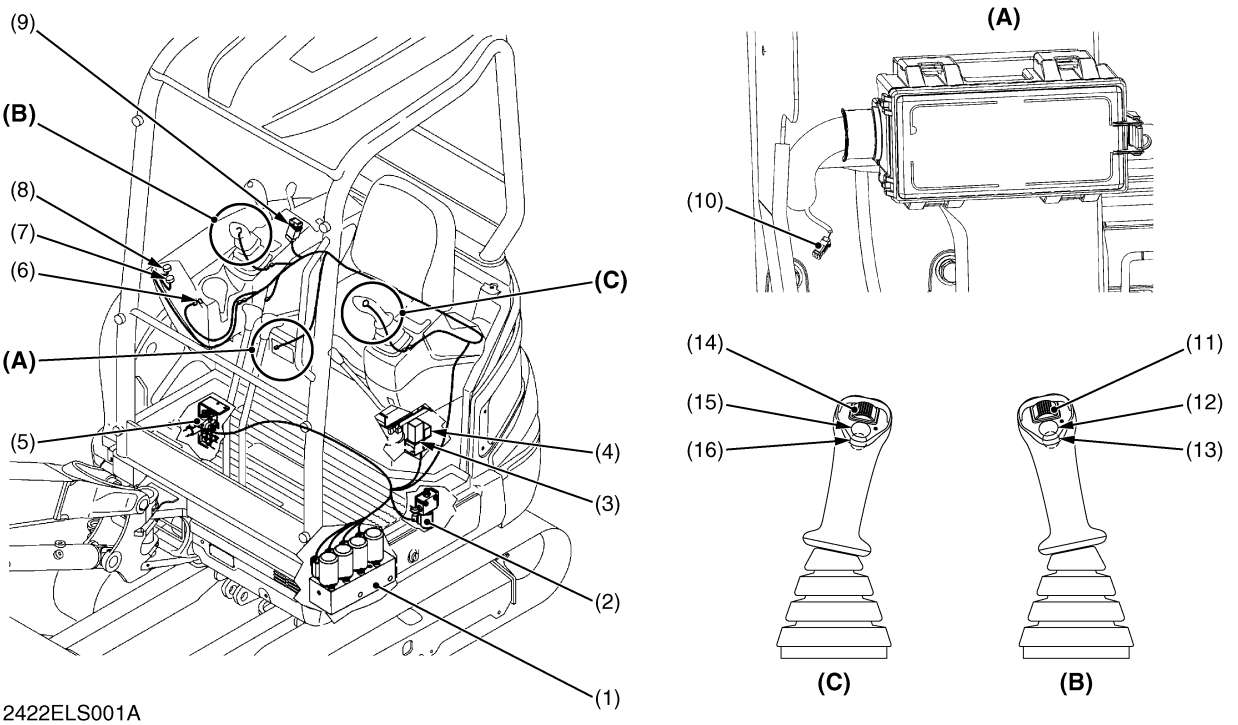
No.	Part Name	No.	Part Name
(1)	LCD meter panel	(17)	Relay
(2)	User setting switch, Display selector switch	(18)	Horn
(3)	ECU (Main)	(19)	Electrical outlet
(4)	Starter switch	(20)	Unload valve
(5)	Key switch	(21)	Fuel sensor
(6)	Antenna	(22)	Travel 2-speed switch
(7)	Worklight switch	(23) ★★	Heater
(8)	Beacon switch	(24)	Lever lock switch
(9)	Engine stop switch	(25)	Fuel pump
(10)	LCD meter buzzer	(26)	Water temperature sensor
(11)	Fuel supply warning switch	(27)	Engine rotation sensor
(12) ★★	Heater switch	(28)	Engine stop solenoid
(13) ★★	Wiper switch	(29)	Engine oil switch
(14)	Battery	(30)	Starter
(15)	Battery isolator	(31)	Alternator
(16)	Fuse box		

[Remarks]

- ★★-mark: Cabin only

RY9212180ELS0116US0

Hi Spec



RY9212422ELS001A

(1) Proportional Valves
(2) Third Line Valve
(3) Relay (Selector Valve)
(4) Relay (Unload)
(5) Selector Valve
(6) Indicator
(7) Flow Control Volume (AUX2)
(8) Flow Control Volume (AUX1)
(9) Switch (Third Line)
(10) Joint Connector
(11) Slide Switch (AUX1)
(12) Switch (Horn)
(13) Switch (AUX1 Hold)
(14) Slide Switch (AUX2)
(15) Switch (Selector)
(16) Non Function

(A) Around the Fuse Box
(B) Control Lever (Right)
(C) Control Lever (Left)

RY9212180ELS0122US0

General explanation for Hi spec

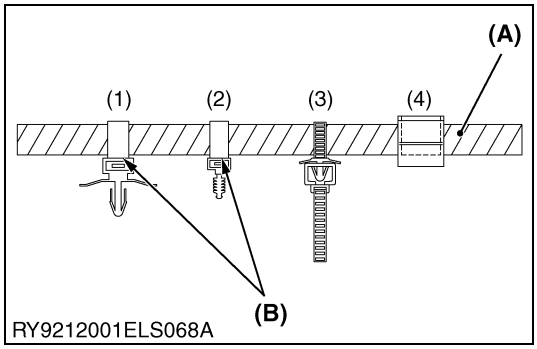
- The additional needed electrical power supplies for HS version are taken from the main harness and secured with separate fuses.
- Switches, solenoid valves and proportional valve are controlled by its 12 V.
- Main control system of the machine is same as U27-4 std. (Meter, ECU, Software)
- Flow control for AUX1 and AUX2 can be adjusted on the meter with rotary switches.
- Select AUX2 or Boom swing by pressing a switch (15).
- Default setting when starting the engine is AUX2. When AUX2 is selected the indication light (6) is OFF.
- Selecting Boom swing operation activates the indicator light (6).
- Pressing AUX1 hold switch (13) activates AUX1 LH permanently (for breaker). As soon as AUX1 hold switch (13) or slide AUX1 (11) is pressed/moved again, AUX1 will be deactivated.

RY9212180ELS0121US0

3. WIRING CIRCUIT

[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

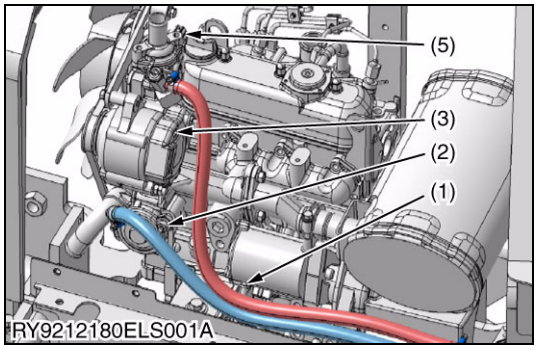


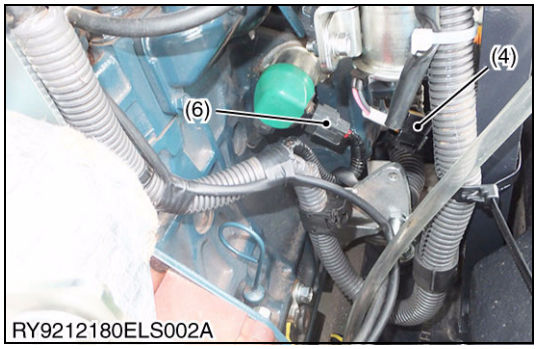
(1) Anchor Type
(Insert Firmly Until it Catches).
(2) Screw Type
(Insert to the End of the Screw).
(3) and (4) Insert Type: Insert Until it Locks.

(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.

RY9212001ELS0025US0

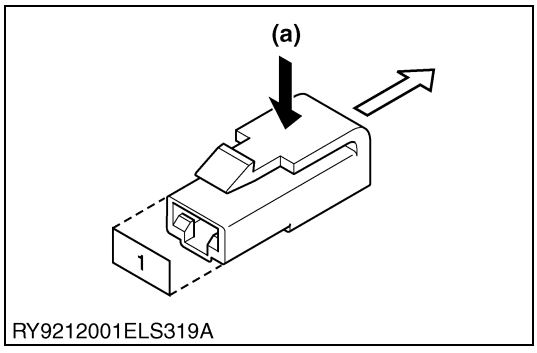
[2] UNPLUGGING ELECTRICAL CONNECTORS AND WIRING LAYOUT





(1) Starter S-Terminal Connector
(2) Engine Oil Switch Connector
(3) Alternator Connector
(4) Fuel Pump Connector
(5) Water Temperature Sensor Connector
(6) Engine Stop Solenoid Connector

RY9212180ELS0001US0

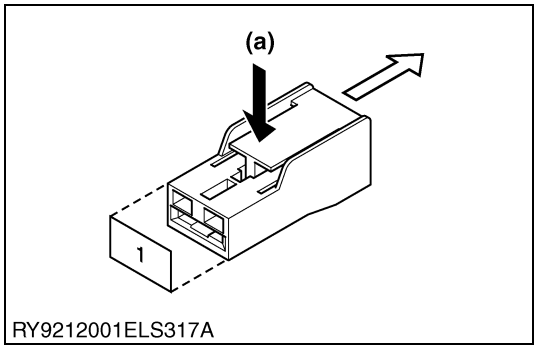


(1) Starter S-terminal Connector

Place Used
Inside engine compartment

(a) Press Lock and Unplug

RY9212180ELS0002US0



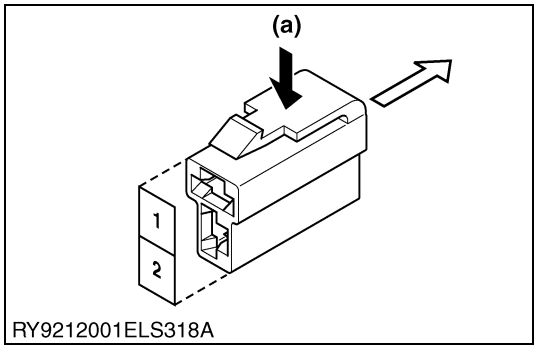
RY9212001ELS317A

(2) Engine oil switch connector

Place Used
Inside engine compartment

(a) Press Lock and Unplug

RY9212180ELS0003US0



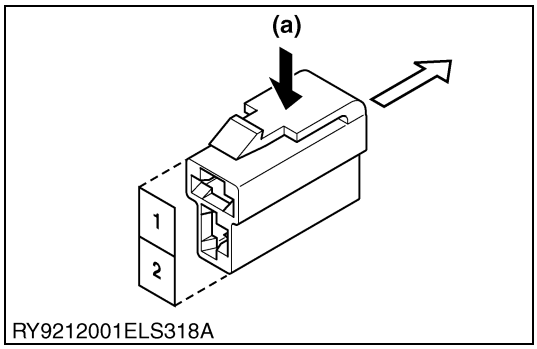
RY9212001ELS318A

(3) Alternator Connector

Place Used
Inside engine compartment

(a) Press Lock and Unplug

RY9212180ELS0005US0



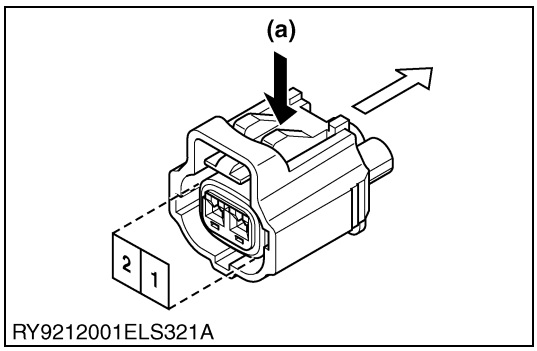
RY9212001ELS318A

(4) Fuel Pump Connector

Place Used
Inside engine compartment

(a) Press Lock and Unplug

RY9212180ELS0006US0



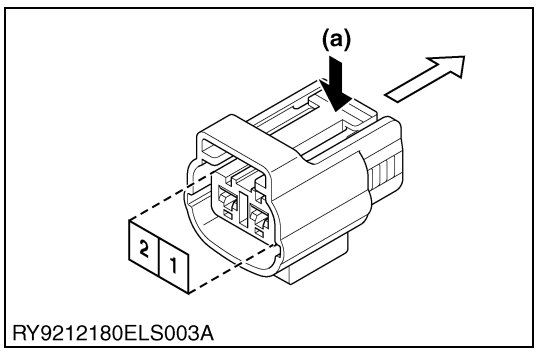
RY9212001ELS321A

(5) Water Temperature Sensor Connector

Place Used
Inside engine compartment

(a) Press Lock and Unplug

RY9212180ELS0007US0



RY9212180ELS003A

(6) Engine Stop Solenoid Connector

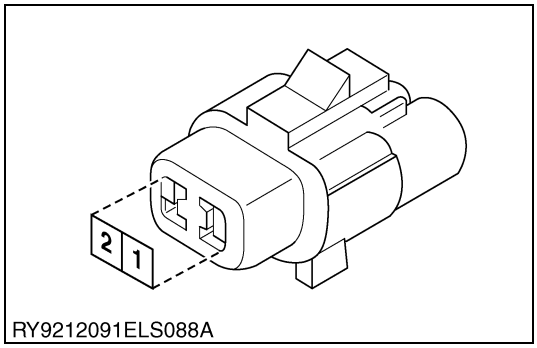
Place Used
Inside engine compartment

(a) Press Lock and Unplug

RY9212180ELS0008US0

(7) Fuel Sensor Connector

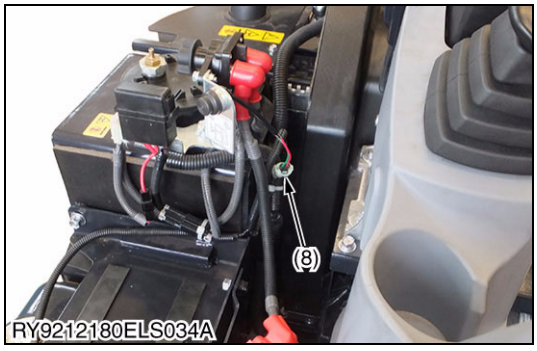
RY9212180ELS0009US0



(7) Fuel Sensor Connector

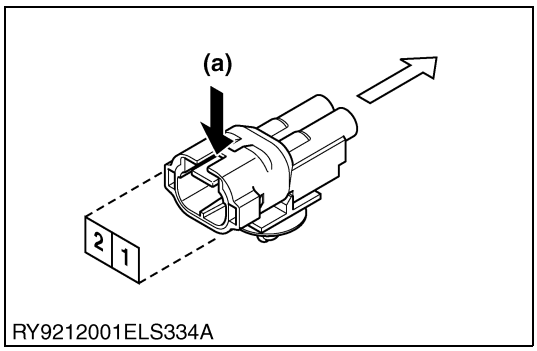
Place Used
Inside right cover

RY9212180ELS0010US0



(8) Fuel Supply Warning Switch Connector

RY9212180ELS0109US0

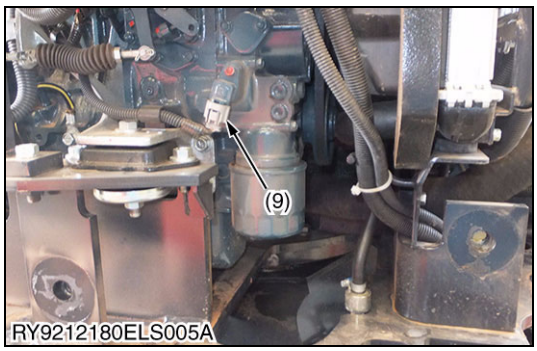


(8) Fuel Supply Warning Switch Connector

Place Used
Above the fuel filler

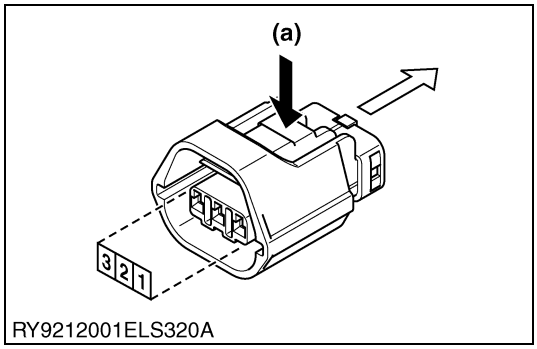
(a) Press Lock and Unplug

RY9212180ELS0011US0



(9) Engine Revolution Sensor Connector

RY9212180ELS0012US0



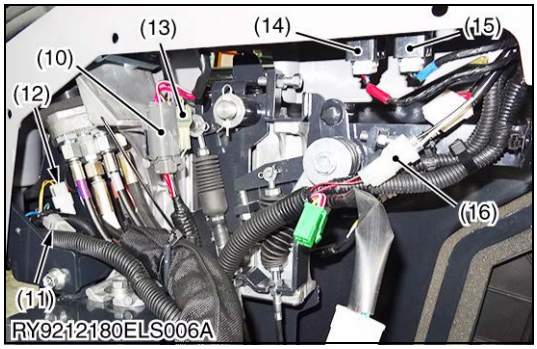
RY9212001ELS320A

(9) Engine Revolution Sensor Connector

Place Used
Inside engine compartment

(a) Press Lock and Unplug

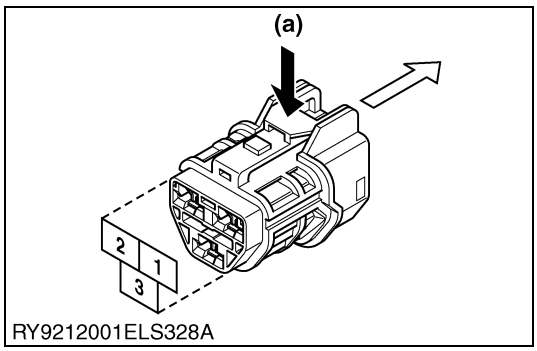
RY9212180ELS0013US0



RY9212180ELS006A

(10) Key Switch Connector
(11) Horn Switch Connector
(12) Meter LCD Buzzer Connector
(13) Anti-Theft Antenna Connector
(14) Work Light Switch Connector
(15) Beacon Switch Connector
(16) Engine Stop Switch Connector

RY9212180ELS0014US0



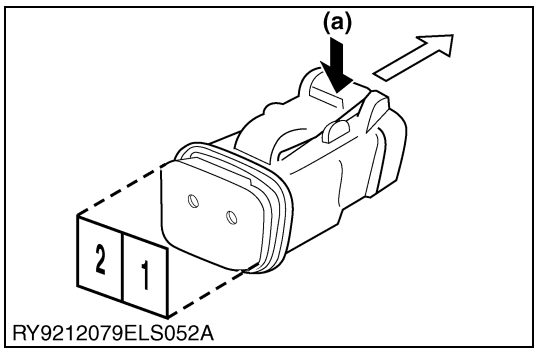
RY9212001ELS328A

(10) Key Switch Connector

Place Used
Inside right control cover

(a) Press Lock and Unplug

RY9212180ELS0015US0



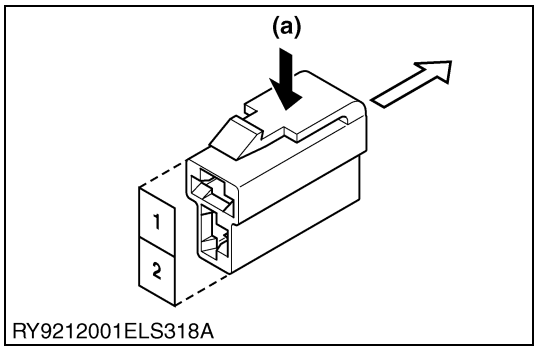
RY9212079ELS052A

(11) Horn Switch Connector

Place Used
Inside right control cover

(a) Press Lock and Unplug

RY9212180ELS0016US0



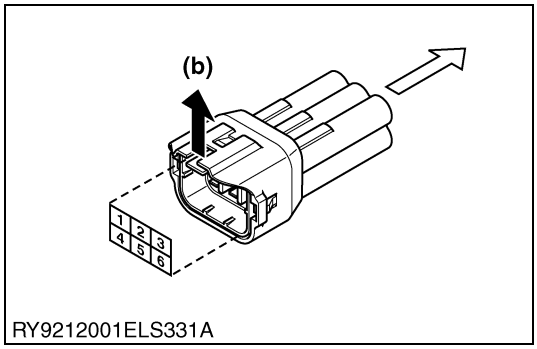
RY9212001ELS318A

(12) Meter LCD Buzzer Connector

Place Used
Inside right control cover

(a) Press Lock and Unplug

RY9212180ELS0017US0



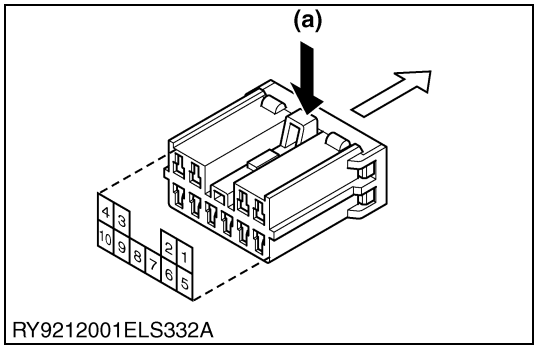
RY9212001ELS331A

(13) Anti-theft Antenna Connector

Place Used
Inside right control cover

(b) Lift Up on the Lock and then Unplug

RY9212180ELS0018US0



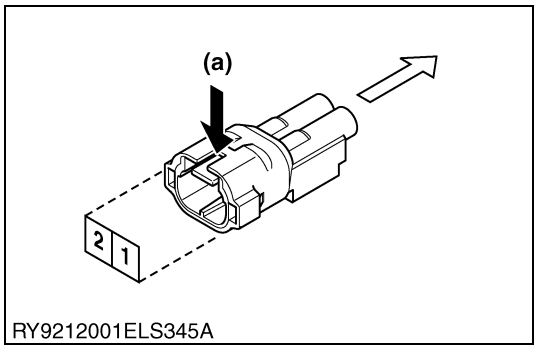
RY9212001ELS332A

(14) Work Light Switch Connector
(15) Beacon Switch Connector

Place Used
Inside right control cover

(a) Press Lock and Unplug

RY9212180ELS0020US0



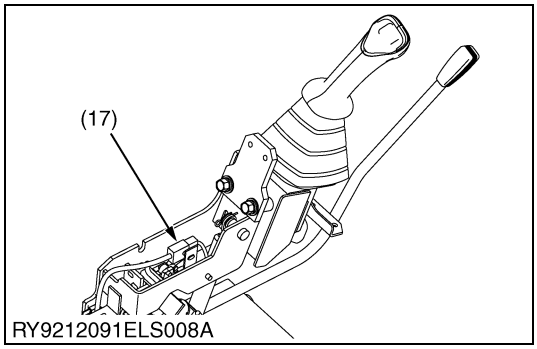
RY9212001ELS345A

(16) Engine Stop Switch Connector

Place Used
Inside right control cover

(a) Press Lock and Unplug

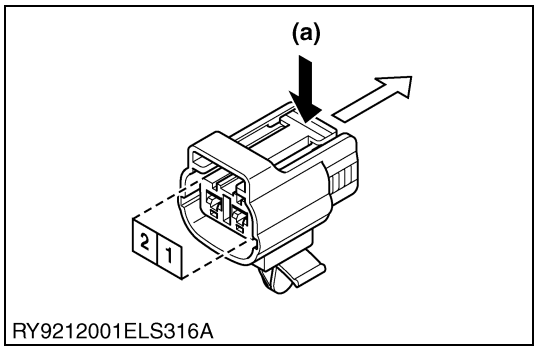
RY9212180ELS0021US0



RY9212091ELS008A

(17) Lever Lock Switch Connector

RY9212091ELS0061US0



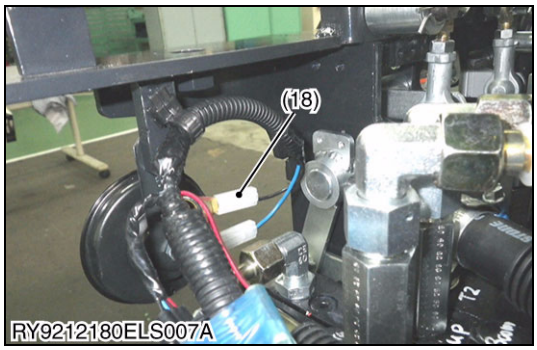
RY9212001ELS316A

(17) Lever Lock Switch Connector

Place Used
Inside left control cover

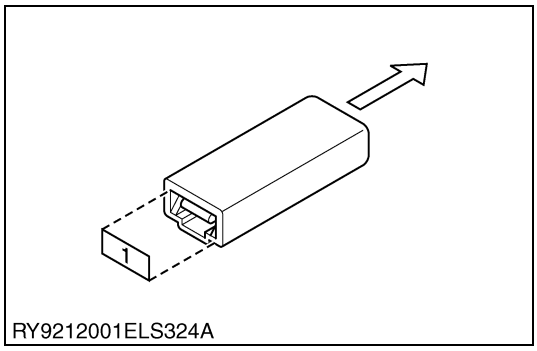
(a) Press Lock and Unplug

RY9212180ELS0022US0



(18) Horn Connector

RY9212180ELS0023US0

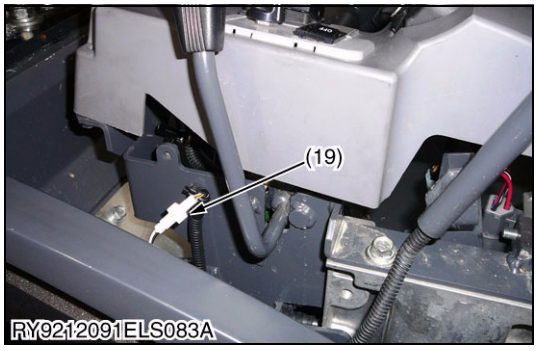


(18) Horn Connector

Place Used
In front of the swivel frame

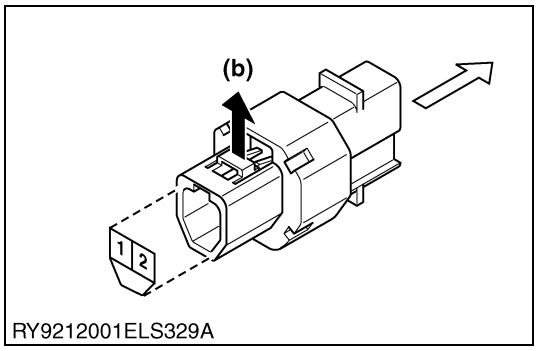
Squeeze the connector and pull

RY9212180ELS0024US0



(19) Travel 2-Speed Switch Connector

RY9212091ELS0064US0

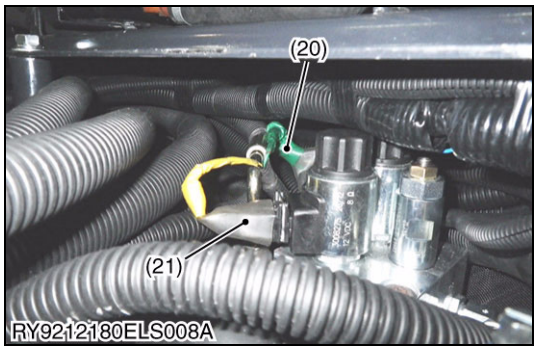


(19) Travel 2-speed Switch Connector

Place Used
Rear of control panel

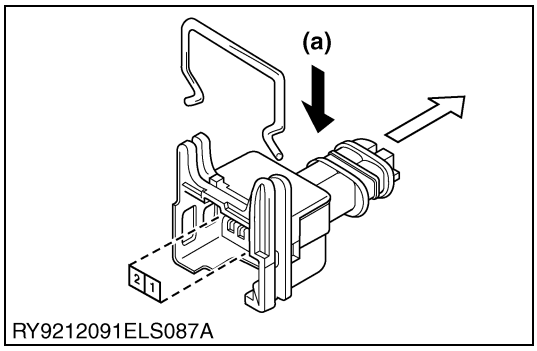
(b) Lift Up on the Lock and then Unplug

RY9212180ELS0026US0



(20) Lever Lock Solenoid Connector (21) Travel 2-Speed Solenoid Connector

RY9212180ELS0027US0



(20) Lever Lock Solenoid Connector

Place Used
Under steps

(21) Travel 2-speed Solenoid Connector

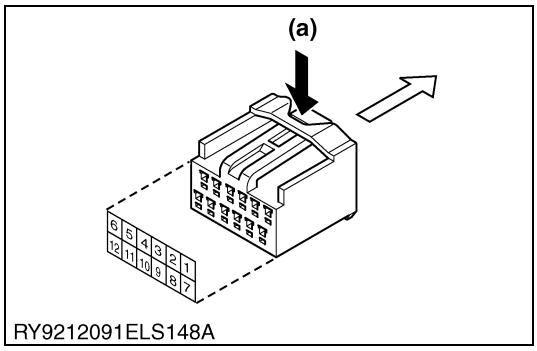
Place Used
Under steps

(a) Press the Retainer and Unplug

RY9212180ELS0028US0

(22) LCD Meter Connector

RY9212180ELS0029US0

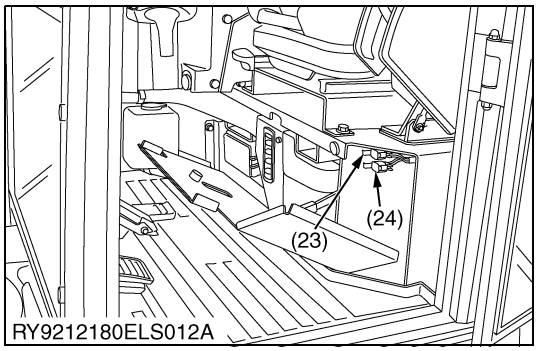


(22) LCD Meter Connector

Place Used
Inside meter panel box

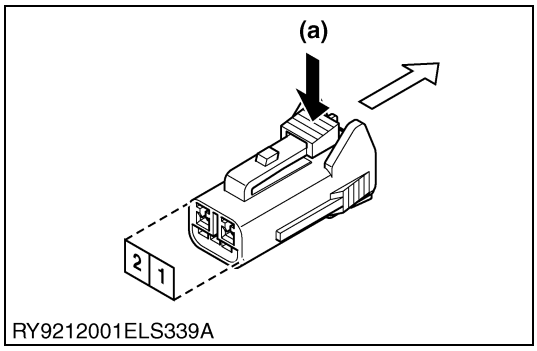
(a) Press Lock and Unplug

RY9212180ELS0030US0



(23) CAN Communication Connector (24) Function Expansion Connector

RY9212180ELS0031US0

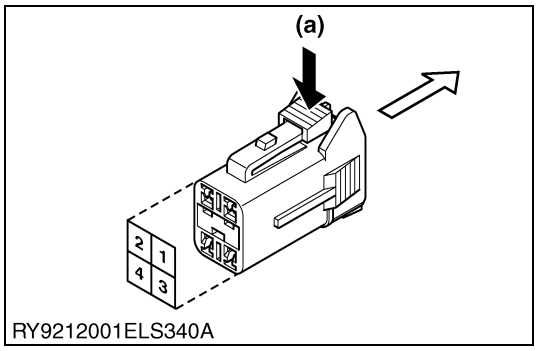


(23) CAN Communication Connector

Place Used
Under the seat

(a) Press Lock and Unplug

RY9212180ELS0032US0

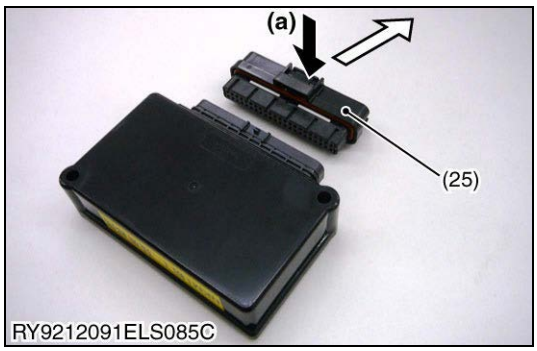


(24) Function Expansion Connector

Place Used
Under the seat

(a) Press Lock and Unplug

RY9212180ELS0033US0

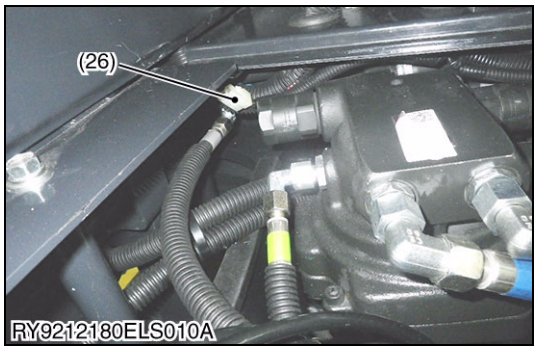


(25) Main ECU Connector

Place Used
Under the seat

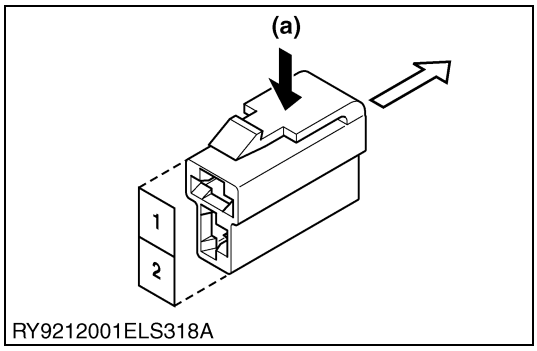
(a) Press Lock and Unplug

RY9212180ELS0034US0



(26) Work Light Harness Connector

RY9212180ELS0035US0

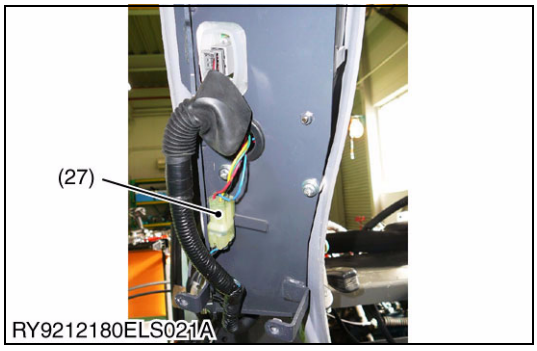


(26) Work Light Harness Connector

Place Used
Swivel frame center

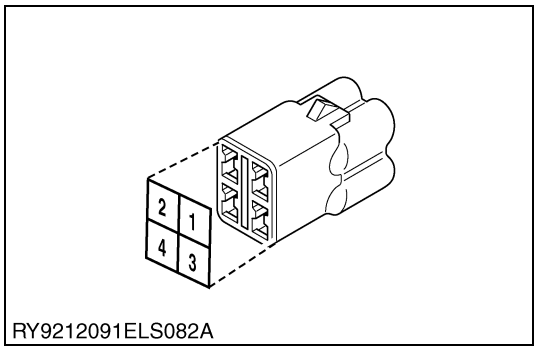
(a) Press Lock and Unplug

RY9212180ELS0036US0



(27) Harness Switch Connector

RY9212180ELS0037US0

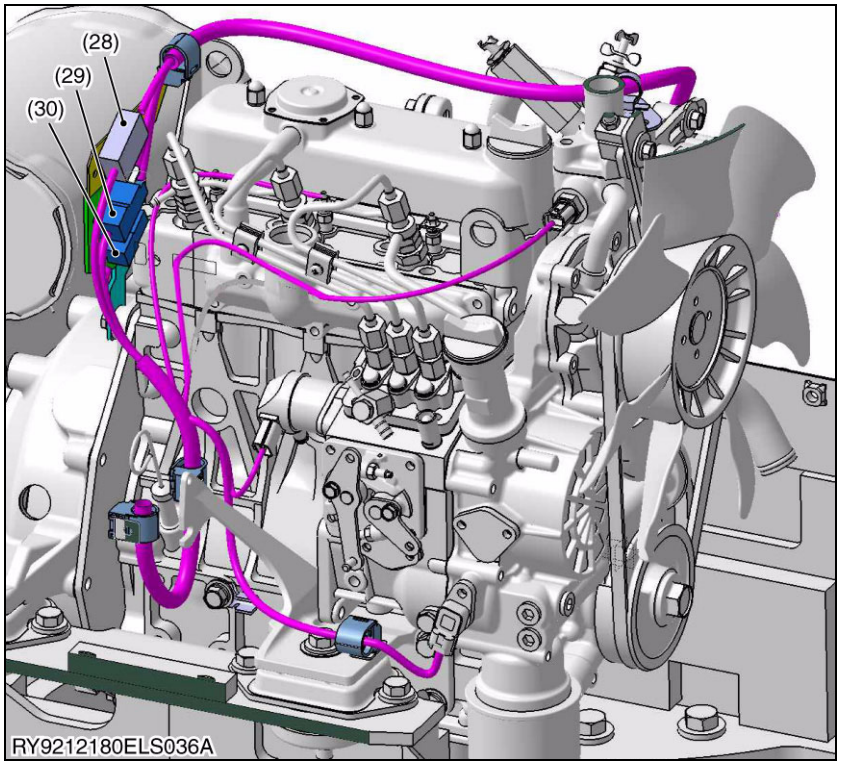


(27) Harness Switch Connector

Place Used
Under the panel

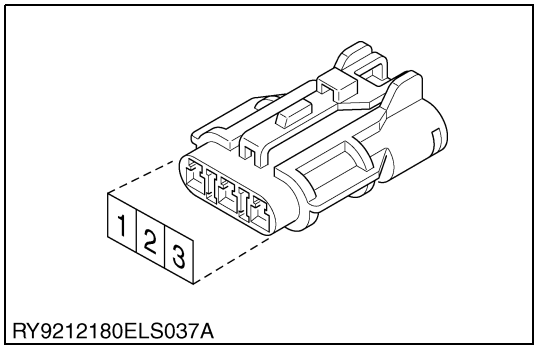
Lift up the lock on the mating connector and unplug

RY9212180ELS0038US0



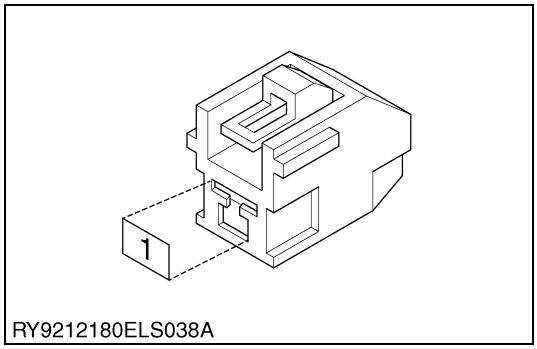
(28) Engine harness connector (Signal)
(29) Engine harness connector (Power)
(30) Engine harness connector (Starter)

RY9212180ELS0112US0



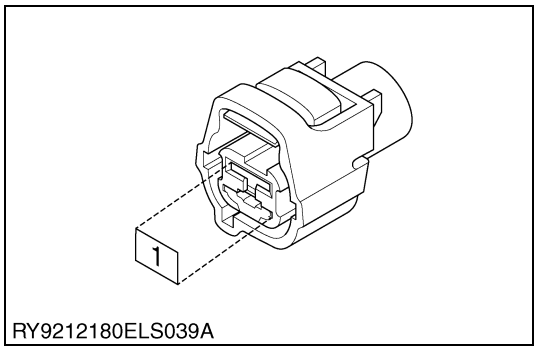
(28) Engine harness connector (Signal)

RY9212180ELS0113US0



(29) Engine harness connector (Power)

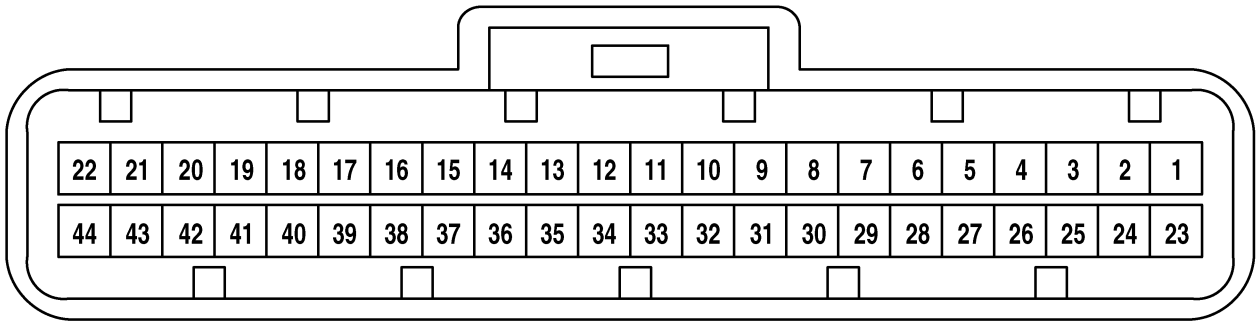
RY9212180ELS0114US0



(30) Engine harness connector (Starter)

RY9212180ELS0115US0

Names of the Terminal Signals of the Main ECU Connector (Harness Side)



RY9212091ELS015A

Connector		Connector	
Terminal	**Signal Name**	**Terminal**	**Signal Name**
1	–	23	CAN H0
2	–	24	CAN L0
3	Engine revolution in	25	CAN H1
4	RXD (Main CPU)	26	CAN L1
5	TXD (Main CPU)	27	Remote wakeup SW
6	User setting switch	28	Display selector SW
7	–	29	Power output
8	Water temperature sensor	30	Fuel sensor
9	Charge	31	Engine oil SW
10	Front worklight SW	32	–
11	Starter SW	33	Travel speed SW (Hand SW)
12	–	34	Lever lock SW
13	TXD (RF unit)	35	–
14	RXD (RF unit)	36	Analog GND
15	Buzzer out	37	+12 V out
16	Antitheft flusher LED	38	+5 V out
17	GND	39	Wake up out
18	–	40	+B (Direct)
19	–	41	Travel speed (Solenoid)
20	–	42	Lever lock solenoid
21	Glow relay	43	AC SW
22	–	44	Alarm

RY9212180ELS0039US0

4. TROUBLESHOOTING (START-UP EQUIPMENT VERSION)

Engine does not start

Inspection point	Cause	Remedy
Check whether "Remove key lamp" has blinked 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.
Is the unload lever up or not? Check whether "Warning lamp" has blinked in yellow.	The lever lock switch is pressed in.	Lift the unload lever and then start the engine.
Check slow-blow & other fuses	Slow-blow &/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
Disconnect the engine stop solenoid connector and measure the voltage at the connector terminals on the harness side.	Break in continuity in the harness or engine stop solenoid relay	Repair the harness Replace the harness and/or the engine stop solenoid relay
Disconnect the lever lock switch connector and measure the voltage at the connector terminals on the harness side.	Break in continuity of the harness and/or lever lock fuse Faulty switch (limit)	Repair the harness Replace the harness and/or the fuse. Replace the switch (limit)

The engine fails to start sometimes.

Inspection point	Cause	Remedy
Is the key on a metal keyring or have a metal key 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.

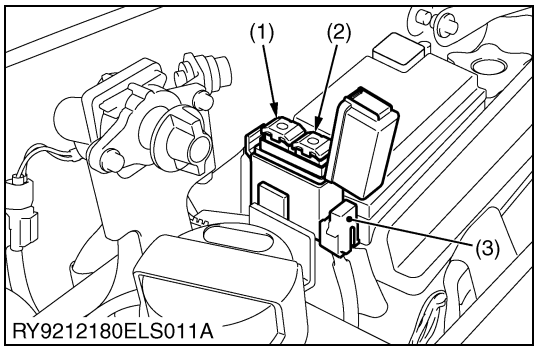
Engine starts even with unregistered keys

Inspection point	Cause	Remedy
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.	Make the anti-theft settings and register the key.

RY9212091ELS0028US0

5. CHECKS

[1] POWER AND GROUND



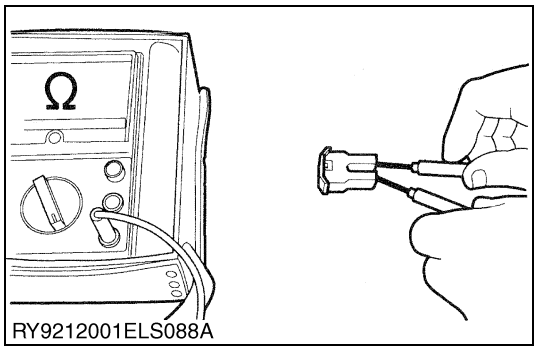
Slow-Blow Fuses

■ **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 (50 A)
(2) Slow-Blow Fuse (60 A)
(3) ECU Main Battery Isolator Mini Fuse (10 A)

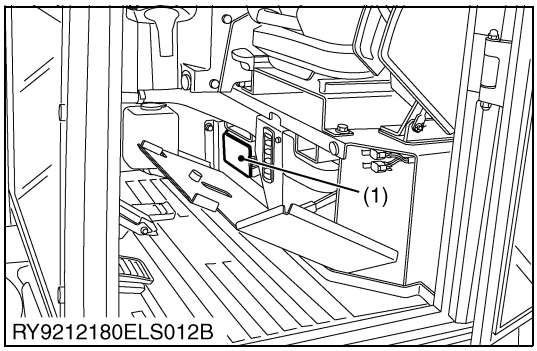
RY9212180ELS0040US0



Inspecting Slow-blow Fuses

Measurement parameter: check continuity across its terminals

RY9212091ELS0048US0



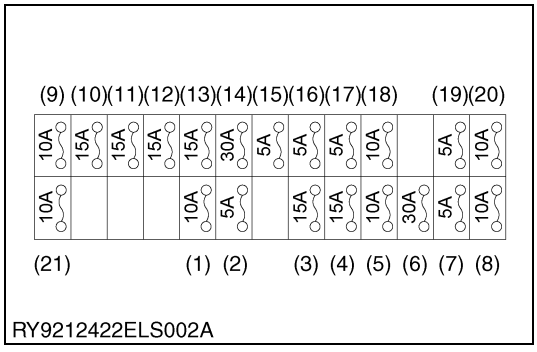
Fuses

■ **IMPORTANT**

- **When replacing a fuse, always use the same capacity fuse and replace it after determining why it blew.**

(1) Fuse Box

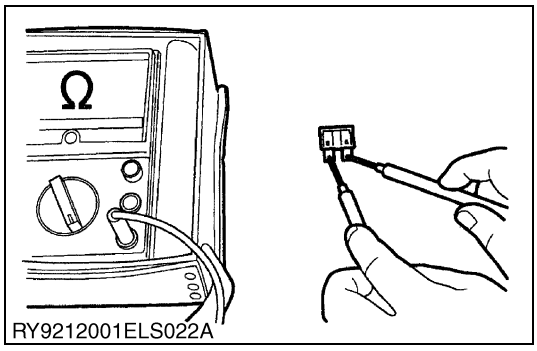
RY9212180ELS0041US0



Fuse capacities and circuits

(1) ECU (+B)
(2) Room Light
(3) Beacon
(4) Work Light
(5) Horn
(6) Engine Stop
(7) Horn Switch
(8) Meter (+B)
(9) Blower Motor
(10) Electrical Outlet
(11) Wiper, Washer
(12) Radio (AC)
(13) Electrical Outlet (Socket)
(14) Starter
(15) Starter (Signal)
(16) Fuel Pump
(17) Relay Source
(18) ECU (AC)
(19) Lever Lock
(20) Alternator
(21) HS Harness (Hi Spec)

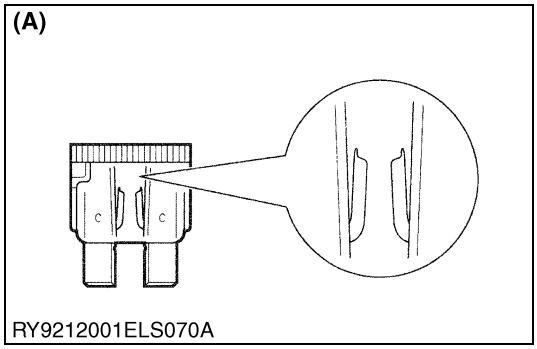
RY9212180ELS0123US0



Inspecting fuses

- Measurement parameter: check continuity across its terminals

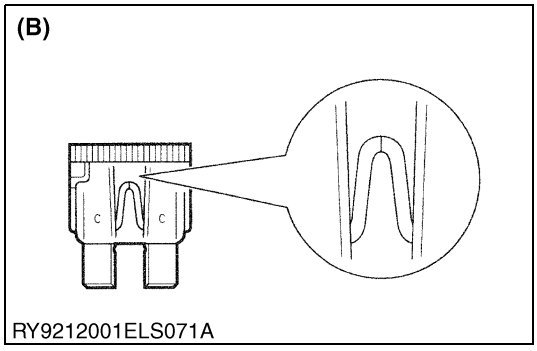
RY9212001ELS0031US0



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.

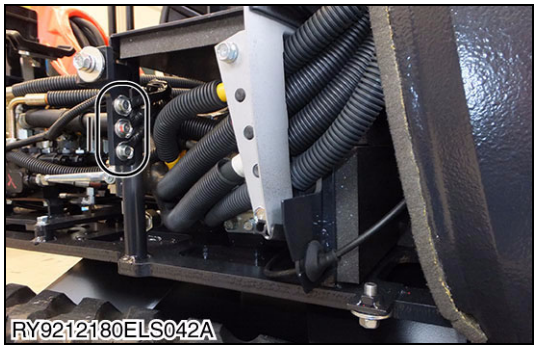
1. When a fuse blows due to an overload of current exceeding its rated capacity.
   An overload current produces a blown fuse such as shown at left **(A)**.
   You should not immediately replace a fuse that blows in this way with a new one.
   The fuse will just blow again when subjected to the overload 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.

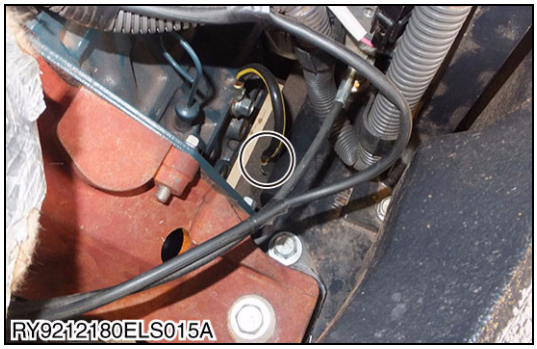


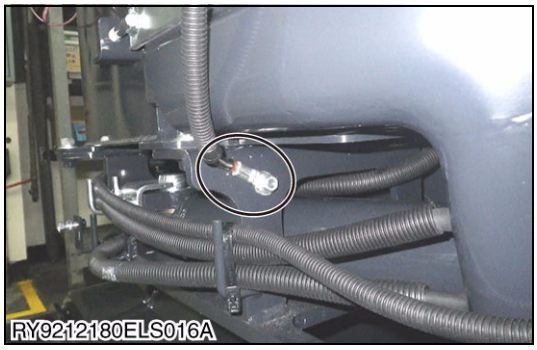
2. When a fuse blows due to a repetitive, intermittent current.
   A repetitive, intermittent current produces a blown fuse such as shown at left **(B)**. In general, this kind of blown fuse occurs after a relatively long period of time, so it does not happen very often.
   With this kind of blown fuse, 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


RY9212180ELS042A

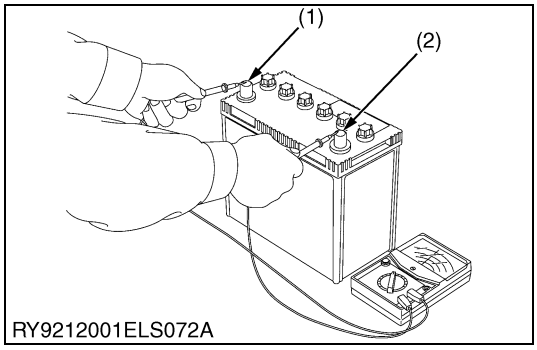

RY9212180ELS015A


RY9212180ELS016A

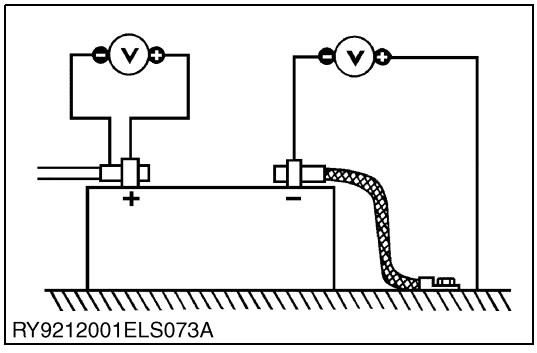
Ground

Check whether GND wire(s) are securely connected to the body.

RY9212180ELS0043US0



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

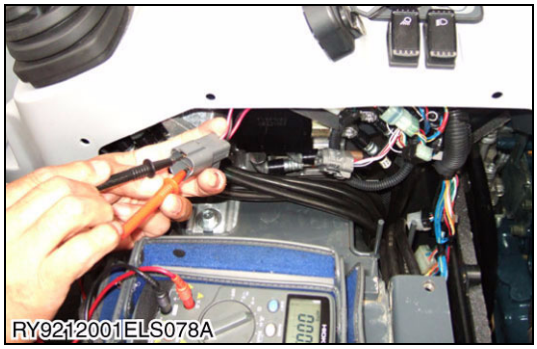
1. Put an electrical load on the battery. (E.g.: Turn the key switch to RUN and turn a worklight on.
2. Connect the (+) side if the circuit tester to the (+) terminal of the battery and the (-) side of the circuit tester to the (+) battery cable. Measure the voltage.
3. Connect the (-) side if the circuit 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.

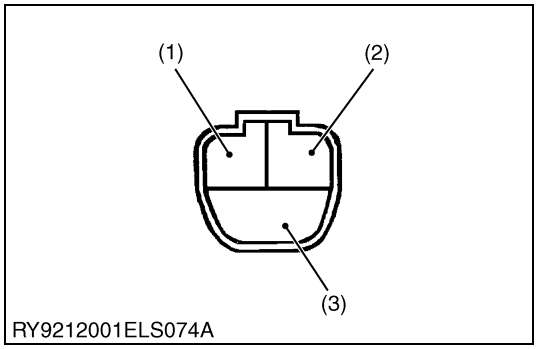
Voltage between terminals	Factory specification	Less than DC 0.1 V

(1) (-) Terminal (2) (+) Terminal

RY9212001ELS0034US0

[2] STARTING AND STOPPING DEVICES


RY9212001ELS078A



RY9212001ELS074A

Key switch

Checks

1. Remove the key switch 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

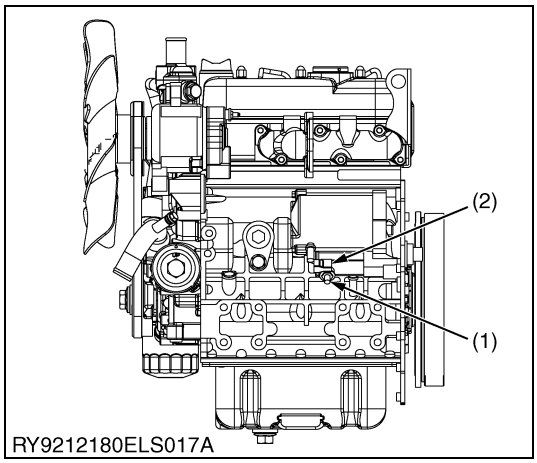
(●—● : Continuity)

Position	(3)	(1)	(2)
STOP			
RUN	●	●	
START	●	●	●

RY9212050ELS011A

(1) Red / White
(2) Black / White
(3) Red

RY9212001ELS0035US0



RY9212180ELS017A

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

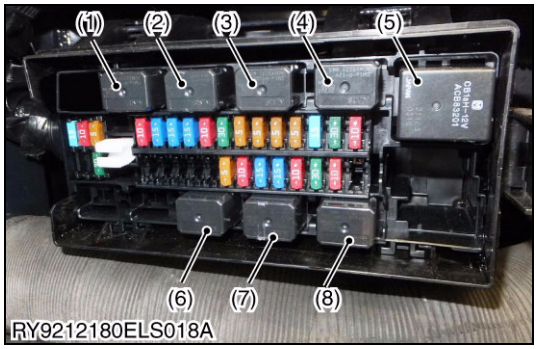
1. Remove the connector from the starter's S terminal.
2. Connect the (+) of the circuit tester to the connector on the harness side and the (–) to the body.
3. Put the machinery operation lock lever in the lock position and measure the voltage with the key switch held in the START position.

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

RY9212180ELS0044US0

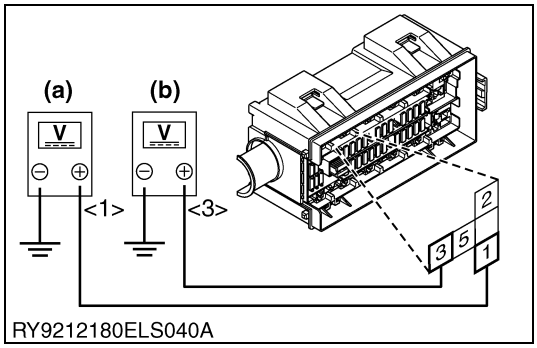


RY9212180ELS018A

Relay capacities and circuits

(1) Starter (20 A)
(2) Horn (20 A)
(3) Engine Stop (20 A)
(4) Heater (20 A)
(5) Cab (40 A)
(6) Glow (20 A)
(7) Beacon (20 A)
(8) Work Light (20 A)

RY9212180ELS0045US0



RY9212180ELS040A

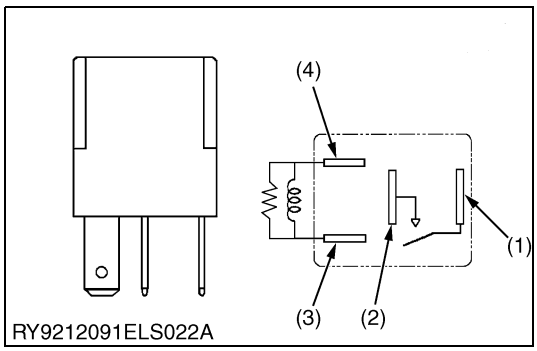
Starter Relay Voltage Test

1. Remove the starter relay.
2. Key Switch: START
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Starter relay fusebox side	<1>	Body GND	–
(b)	Starter relay fusebox side	<3>	Body GND	–

Factory spec.: 11 to 14 V (battery voltage)

RY9212180ELS0046US0



RY9212091ELS022A

Starter Relay Inspection

1. Key Switch: STOP
2. Remove the starter relay.
3. Measure the resistance based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (– terminal side)
(a)	(3)	(4)

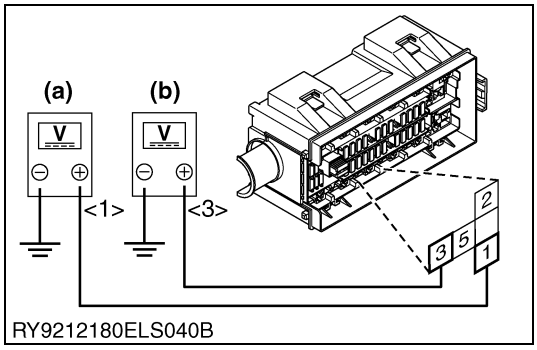
Factory spec.: 108 to 132 Ω

4. Test the continuity based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (– terminal side)
(a)	(1)	(2)

Factory spec.: Not continuous

RY9212180ELS0047US0



RY9212180ELS040B

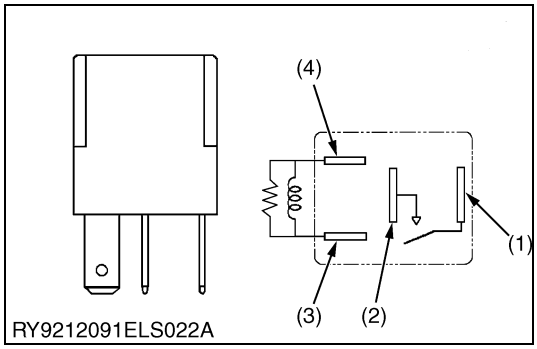
Glow Relay Voltage Test

1. Remove the glow relay.
2. Key Switch: RUN
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(a)	Glow relay fusebox side	<1>	Body GND	–
(b)	Glow relay fusebox side	<3>	Body GND	–

Factory spec.: 11 to 14V (battery voltage)

RY9212180ELS0048US0



RY9212091ELS022A

Glow Relay Inspection

1. Key Switch: STOP
2. Remove the glow relay.
3. Measure the resistance based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (- terminal side)
(a)	(3)	(4)

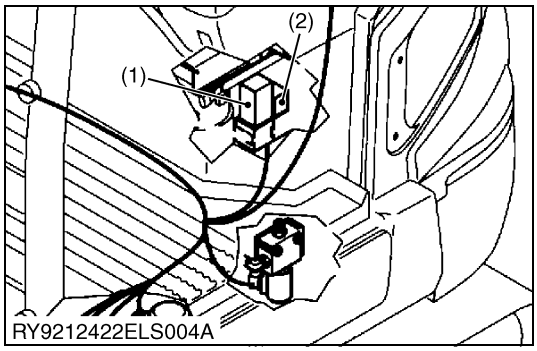
Factory spec.: 108 to 132 Ω

4. Test the continuity based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (- terminal side)
(a)	(1)	(2)

Factory spec.: Not continuous

RY9212180ELS0049US0

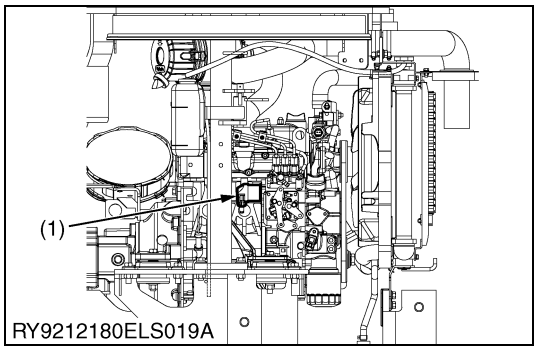


RY9212422ELS004A

Hi spec harness

(1) Selector Valve (AUX2/Swing) (2) Unload

RY9212180ELS0124US0



RY9212180ELS019A

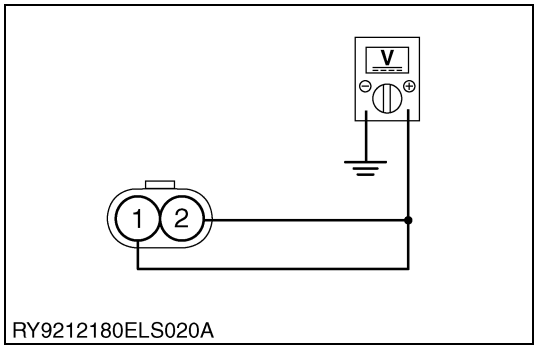
Engine stop solenoid connector voltage

1. Remove the engine stop solenoid's 2P connector.
2. Turn the key switch to RUN and measure the voltage between connector terminal 1 on the wire harness side and the body. Turn the key switch to START and measure the voltage between connector terminal 2 on the wire harness side and the body.
3. If the measurement meets factory specs, it is OK.

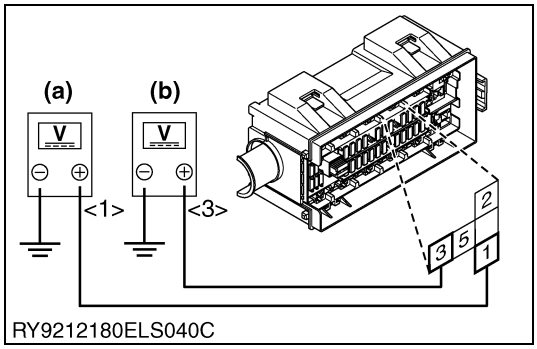
Measured voltage	Factory specification	11 to 14 V (battery voltage)

(1) Engine Stop Solenoid Connector

RY9212180ELS0050US0



RY9212180ELS020A



RY9212180ELS040C

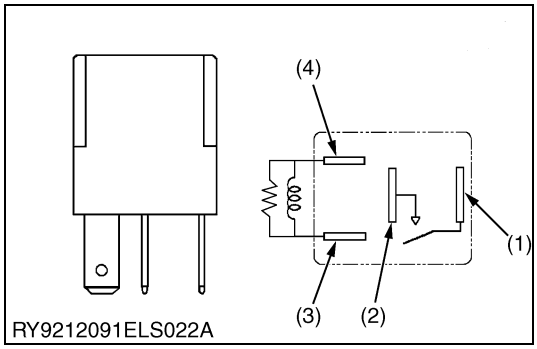
Engine Stop Relay Voltage Test

1. Remove the engine stop relay.
2. Key Switch: RUN
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (- terminal side)	Pin No.
(a)	Engine stop relay fusebox side	<1>	Body GND	–
(b)	Engine stop relay fusebox side	<3>	Body GND	–

Factory spec.: 11 to 14V (battery voltage)

RY9212180ELS0051US0



RY9212091ELS022A

Engine Stop Relay Inspection

1. Key Switch: STOP
2. Remove the engine stop relay.
3. Measure the resistance based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (- terminal side)
(a)	(3)	(4)

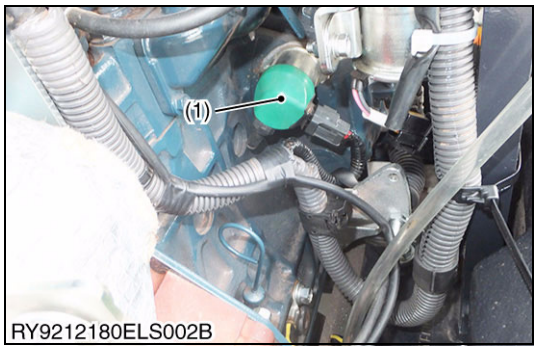
Factory spec.: 108 to 132 Ω

4. Test the continuity based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (- terminal side)
(a)	(1)	(2)

Factory spec.: Not continuous

RY9212180ELS0052US0



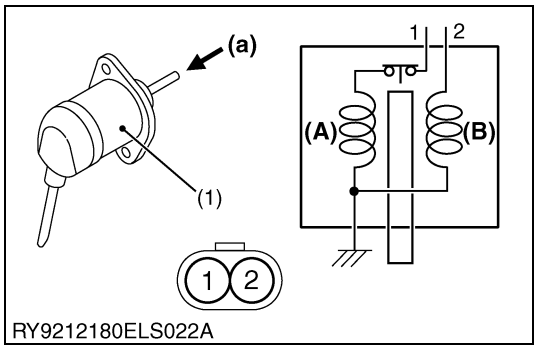
RY9212180ELS002B

Engine stop solenoid

1. Disconnect the engine stop solenoid from the engine.
2. Apply DC 12 V between connector terminal 1 (pull-in coil) and terminal 2 (holding coil) of engine stop solenoid to see if the plunger is attracted.
3. Remove the engine stop solenoid connector.
   Measure the resistance between connector terminal 2 (holding coil) and connector body GND.

Measured items	(+)	(–)	Factory specification
Holding coil	Terminal 2	GND	15.6 Ω

4. If not, replace the engine stop solenoid with new one.

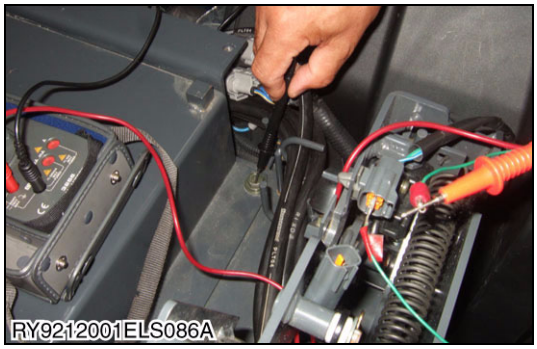


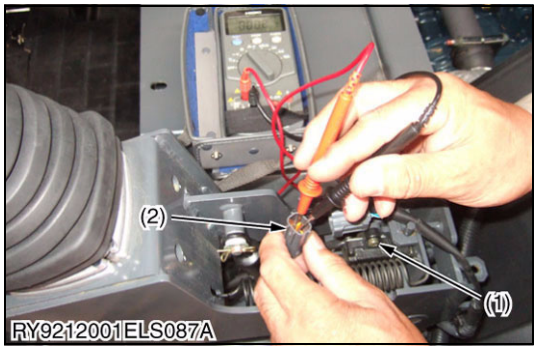
RY9212180ELS022A

(1) Engine Stop Solenoid

(A) Pull-In Coil
(B) Holding Coil
(a) Pull In

RY9212180ELS0053US0


RY9212001ELS086A



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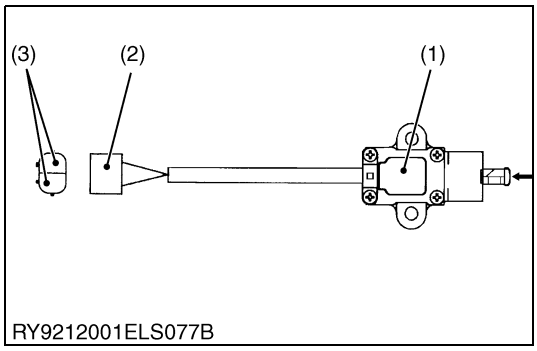
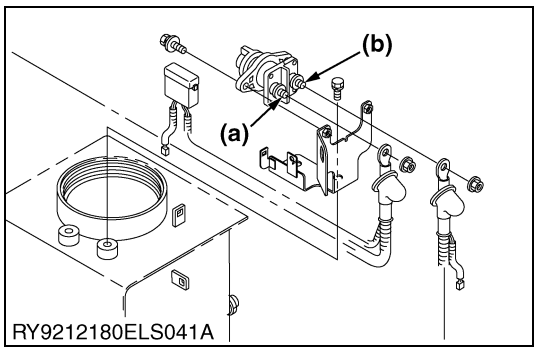
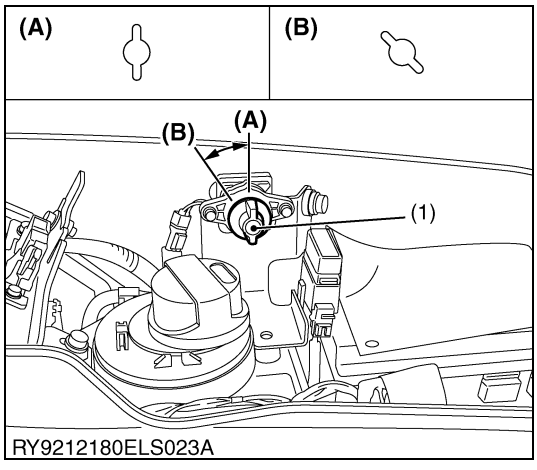


RY9212001ELS077B



RY9212180ELS041A



RY9212180ELS023A

Lever Lock Switch Connector Voltage

1. Remove the 2P connector of the lever lock switch.
2. Turn the key switch to RUN and measure the voltage between the connector terminal (blue/white) on the wire harness side and the body.
3. If the measurement meets factory specs, it is OK.

Measured voltage	Factory specification	11 to 14V (battery voltage)

RY9212180ELS0117US0

Lever Lock Switch

1. Remove the 2P connector of the limit switch.
2. Move the equipment lock lever up and down and check for continuity between the connector terminals when the limit switch is pressed and when it is free.

Key switch circuit table

Position	Black	Black	
FREE (Lever up)			No continuity
PUSH (Lever down)	●	●	Continuity

RY9212050ELS012A

(1) Limit Switch
(2) Connector
(3) Terminals (Black Wire)

RY9212180ELS0118US0

Battery Isolator

1. Remove the (-) battery cable.
2. Remove the (+) battery cable.
3. Use a circuit tester between battery isolator terminals **(a)** and **(b)** and check for continuity.
4. Put the battery isolator in the ON position **(A)** and if there is continuity, it is OK.

Criteria
Normal: Continuity
Error: No continuity

5. Put it in the OFF position **(B)** in the same way and if there is no continuity, it is OK.

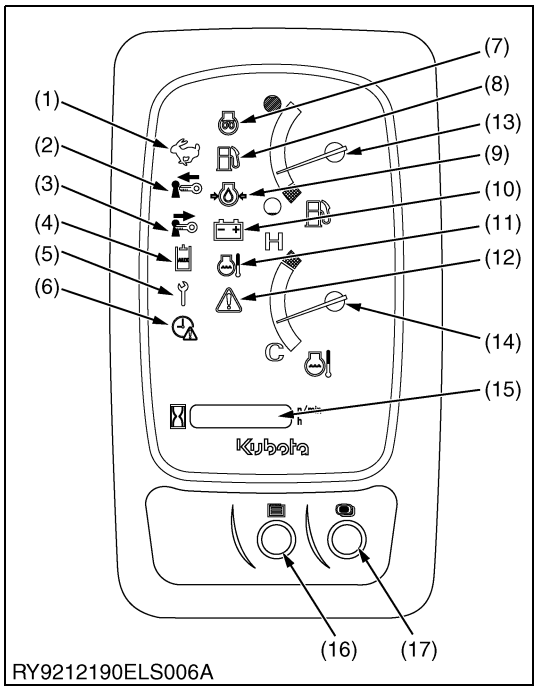
Criteria
Normal: No continuity
Error: Continuity

(1) Battery Isolator
(a) Terminal
(b) Terminal
(A) ON
(B) OFF

RY9212180ELS0054US0

6. METER PANEL

[1] NAMES AND FUNCTIONS OF METERS AND SWITCHES

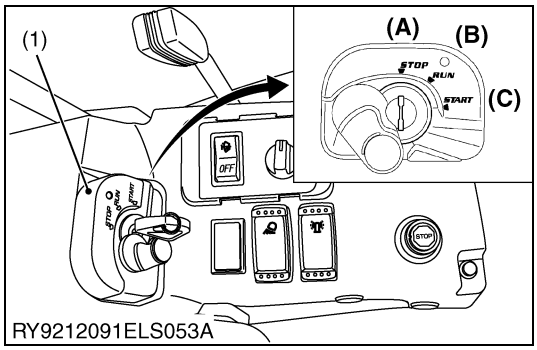


RY9212190ELS006A

No.	Name	Function
(1)	Travel 2-speed lamp	Lights when in 2nd
(2)	Insert key lamp	Blinks during key registration when the key is to be inserted
(3)	Remove key lamp	Blinks during key registration when the key is to be removed, or blinks when key removal has been forgotten
(4)	AUX operating lamp	When set to AUX, blinks when there is an AUX error
(5)	Periodic inspection lamp	Blinks when it is time for a periodic inspection; lights or blinks upon entering the periodic inspection check mode
(6)	Time setting lamp	Blinks while setting the clock; blinks when the time on the clock may be incorrect
(7)	Glow lamp	Lights during glow operation
(8)	Low fuel warning lamp	Blinks when the fuel is low
(9)	Engine oil lamp	Lights when the engine oil pressure switch is ON
(10)	Charging lamp	Lights when the battery is not charging
(11)	Rising water temperature lamp	Blinks when the water temperature is rising
(12)	Warning lamp	Blinks to indicate a warning
(13)	Fuel gauge	
(14)	Water temperature gauge	
(15)	LCD screen	
(16)	User setting switch (SW1)	
(17)	Display selector switch (SW2)	Toggles the display or sets/selects options

RY9212190ELS0025US0

[2] NORMAL MODE



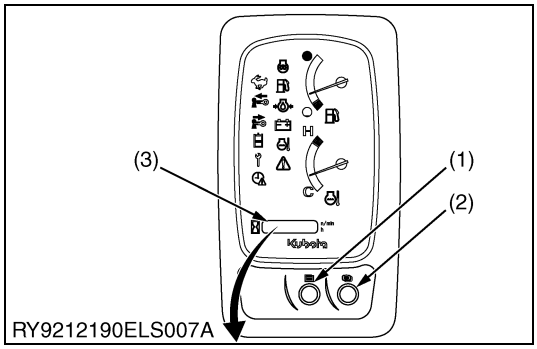
RY9212091ELS053A

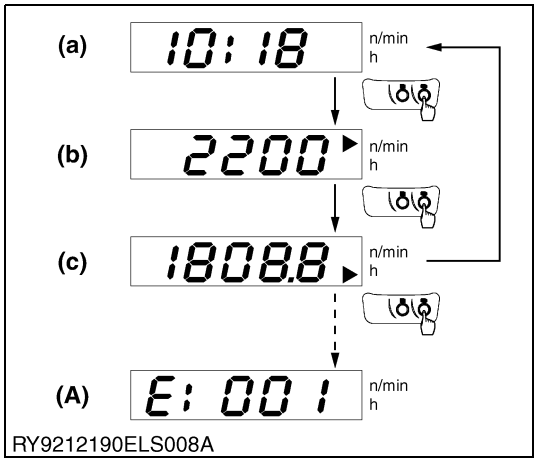
1. Turn the starter key to the position "RUN".

(1) Key Switch

(A) STOP
(B) RUN
(C) START

RY9212091ELS0034US0





2. Pressing SW2 toggles the item displayed on the LCD screen (3) in a loop.

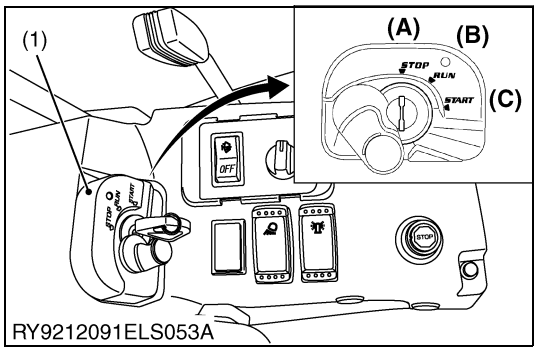
(1) User Setting Switch (SW1)
(2) Display Selector Switch (SW2)
(3) LCD Screen

(a) Clock
(b) Engine RPM
(c) Hour Meter

(A) Error Message (Only Displays to Show a Warning. It Scrolls Through the Error Codes at a Rate of 1/Second in Case of Plural Warning Signs.)

RY9212190ELS0026US0

[3] USER SETTINGS MODE

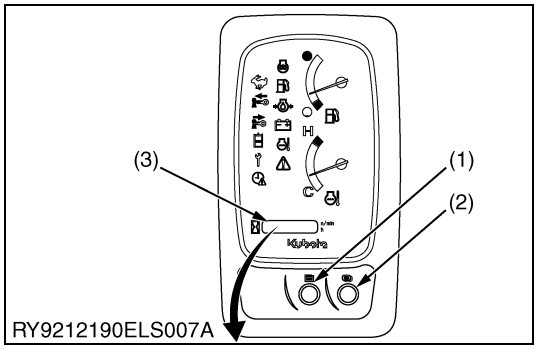


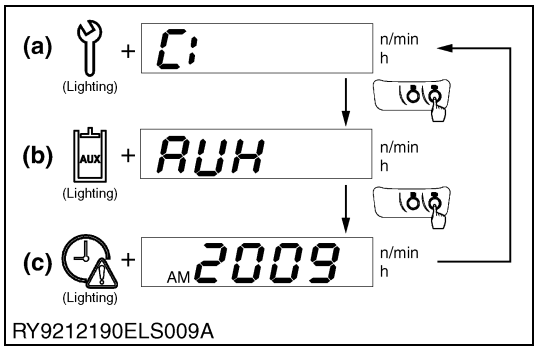
1. Turn the starter key to the position "RUN".

(1) Key Switch

(A) STOP
(B) RUN
(C) START

RY9212091ELS0034US0



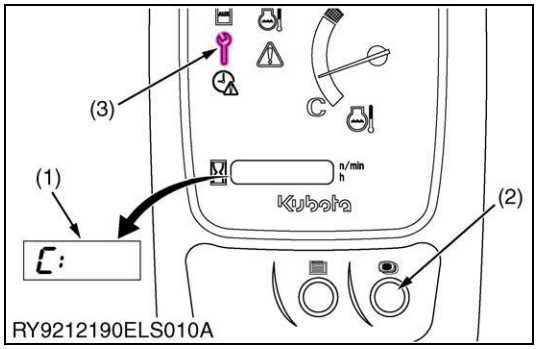


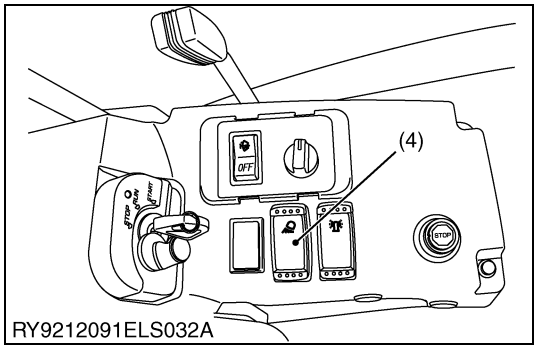
2. Pressing SW1 switches from the normal mode to the user settings mode.
3. Pressing SW2 toggles the item displayed on the LCD screen (3) in a loop.

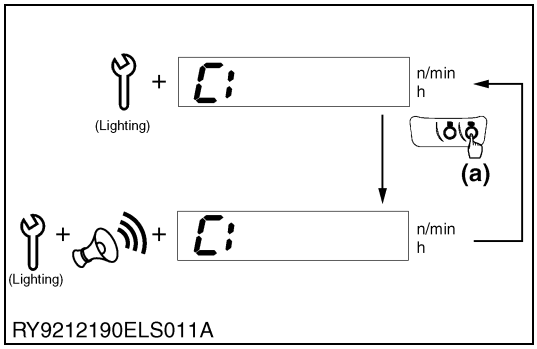
(1) User Setting Switch (SW1)
(2) Display Selector Switch (SW2)
(3) LCD Screen

(a) Periodic Inspection Check Mode
(b) AUX Settings Mode
(c) Time Setting Mode

RY9212180ELS0055US0







Switching to the Periodic Inspection Item Display Screen

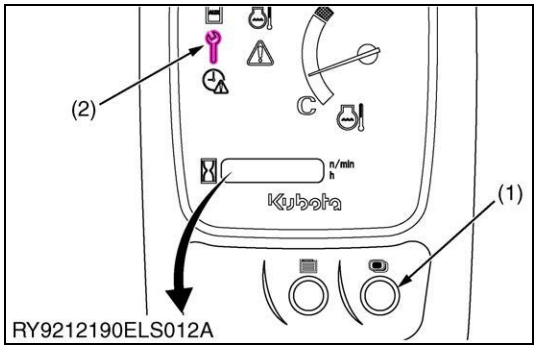
1. After switching to the user settings mode, press SW2 and select the periodic inspection mode.
2. After turning the work light switch ON/OFF once, pressing and holding SW2 switches the display to the periodic inspection item display screen.

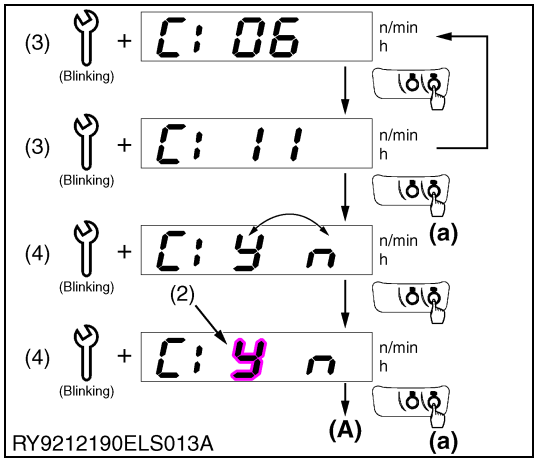
- If there are no periodic inspection items, when SW2 is held down, the buzzer will beep two times and the screen display will not change.

(1) Periodic Inspection Mode
(2) Display Selector Switch (SW2)
(3) Periodic Inspection Light
(4) Work Light Switch

(a) Press and Hold SW2

RY9212190ELS0028US0





Checking Periodic Inspection Items and Operations after the Inspection

1. When there are periodic inspection items, the periodic inspection lamp blinks and the code(s) of items to be inspected are displayed on the LCD screen. (For information on the codes displayed and the periodic inspection items, refer to "Table of Periodic Inspection Items."
2. If there are multiple places to be inspected, pressing SW2 toggles the code display in a loop.
3. Pressing and holding SW2 while the code of a periodic inspection item is displayed switches the screen to the part inspection check screen.
4. Pressing SW2 toggles the selection between YES and NO and the selected item blinks.
5. Once a periodic inspection is complete, select YES and then press and hold SW2 to confirm it. After the buzzer beeps several times and the inspection item disappears, return to the normal mode.
6. If you select NO and then press and hold SW2, thus confirming it, you can allow the periodic inspection item to continue to be displayed.

(1) Display Selector Switch (SW2)
(2) Blinks
(3) Periodic Inspection Item
(4) Checking Inspection Individually

(a) Press and Hold SW2
(A) Normal Mode

RY9212190ELS0029US0

Table of Periodic Inspection Items

When the hour meter has counted up to the hours circled in the maintenance list below, the message appears. The message shows up as follows.

No.	Check points
C: _ _ 1	Engine oil
C: _ _ 2	Hydraulic oil
C: _ _ 3	Air filter element
C: _ _ 4	Fuel filter cartridge
C: _ _ 5	Engine oil filter
C: _ _ 6	Drive unit oil
C: _ _ 7	Hydraulic return filter cartridge
C: _ _ 8	Hydraulic suction filter element
C: _ _ 9	Pilot filter
C: _ 1 0	Front idler and track roller oil
C: _ 1 1	Breather filter

RY9212180ELS0058US0

[4] SERVICE DEALER MODE

(1) Table of Diagnostic / Setting Items

	Number	Item	Display	Notes
[A] Tester (SET-1)	1	Engine RPM	1:OOOO	rpm
	2	Battery voltage	2:OO.O	V
	3	Engine oil	3:ON OFF	
	4	Charge	4:ON OFF	
	5	Starter position	5:ON OFF	
	6	Worklight	6:ON OFF	
	7	Water temperature voltage	7:O.OO	V
	8	Water temperature	8:OO	°C
	9	Fuel voltage	9:O.OO	V
	10	Fuel resistance	10:OOO	Ω
	11	Fuel supply SW	11:ON OFF	
	12	2-speed SW	12:ON OFF	
	13	2-speed solenoid	13:ON OFF	
	14	Lever lock SW	14:ON OFF	
	15	Lever lock solenoid	15:ON OFF	
	16★	Travel alarm pressure sensor / AUX knob (current value)	16:O.OO	V
	17★	AUX knob (left setting value)	17:O.OO	V
	18★	AUX knob (neutral setting value)	18:O.OO	V
	19★	AUX knob (right setting value)	19:O.OO	V
	20★	AUX amperage	20:O.O	A
	21★	AUX hold SW	21:ON OFF	
	22★	AUX SW	22:ON OFF	
	23★	AUX R setting value	23:OO	x 10mA
	24★	AUX L setting value	24:OO	x 10mA
	25	Key type	25:O	Unknown: 0, red:1, black:2, yellow:3, green:4
	26	Key matches	26:ON OFF	
	27	Anti-theft mode	27:ON OFF	
	28	Key presence	28:ON OFF	
	29	Anti-theft antenna	29:ON OFF	
[B] Read Error History (SET-2)			E:OOO	Error item
[C] Clear Entire History (SET-3)			3: Y N	Y: YES, N: NO

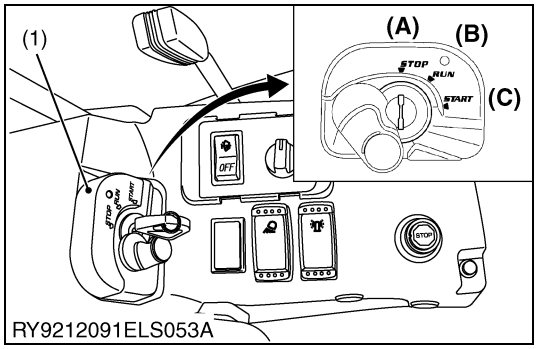
	Number	Item	Display	Notes
[D] Dealer Settings (SET-4)	no-01★	AUX knob setting	nob-R	
	no-02★	AUX activation point setting (with attachment)	2:– – – –	
	no-03★	AUX activation point setting (no attachment)	3:– – – –	
	no-04★	AUX feeling adjustment	4:– – – –	
	no-05	Model setting	5 1:OOO	When ECU replaced
	no-06	Method for eliminating periodic guidance	6: Y N	Y: YES, N: NO
	no-07	Method for displaying periodic guidance	7: Y N	Y: YES, N: NO
	no-08	Periodic inspection offset time adjustment	8: OOOO	h
	no-09	Request to set time to display guidance	9: Y N	Y: YES, N: NO
	no-10★	Travel alarm function	0: Y N	Y: YES, N: NO
[E] Read Entire Error History (SET-5)			E:OOO	Same as with [B] Read error history (SET-2) (Error count displayed even if 0)

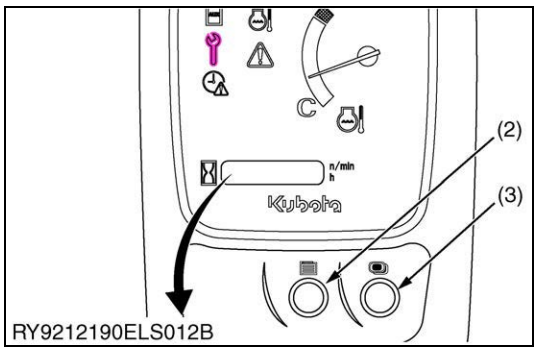
★: The item which is not used by EU specification.

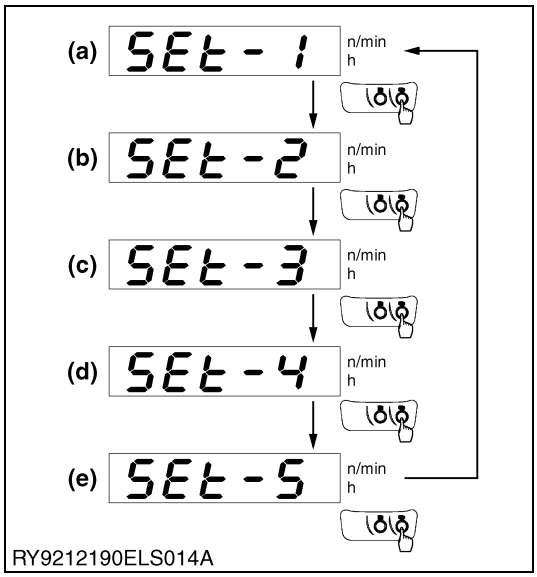
RY9212180ELS0059US0

[A] Tester (SET-1)

Guide to Using the Tester Mode, Check to See the Conditions of the Various Sensors and the Information of Switches







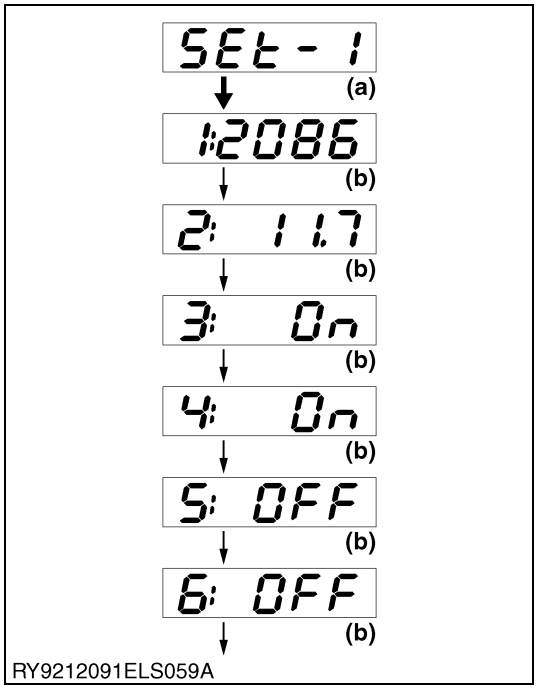
1. With SW2 pressed down, turn the starter key to the [RUN] position to enter the service dealer mode. "SET-1" is displayed on the LCD screen.
2. Pressing SW2 toggles the items displayed on the LCD screen in a loop.
3. Display "SET-1" and press and hold SW2 to enter the SET-1 tester mode. (to [SET-1 Tester Content Description])

(1) Key Switch
(2) User Setting Switch (SW1)
(3) Display Selector Switch (SW2)

(A) STOP
(B) RUN
(C) START

(a) Tester
(b) Read Error History
(c) Clear Error History
(d) Dealer Settings
(e) Read Entire Error History

RY9212190ELS0031US0



RY9212091ELS059A

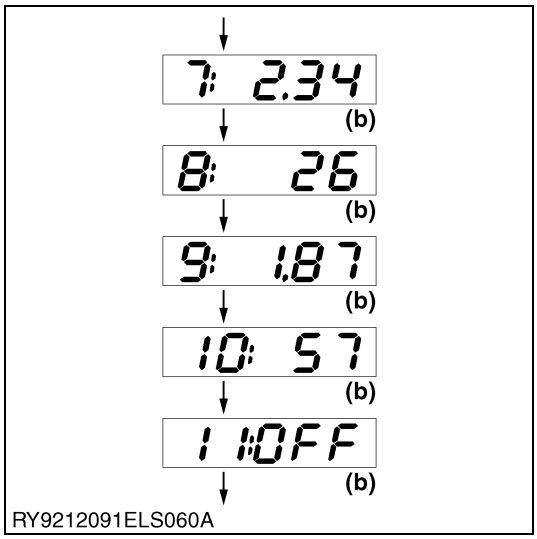
SET-1 Tester Content Description

■ **NOTE**
- **Press SW1: Back**
- **Press SW2: Forward, switch**
- **Press and hold SW1: Back all the way (Return to SET-1)**
- **Press and hold SW2: Set**

Displayed Item	Description
1. Engine RPM	Ex.: 2086 rpm When engine is stopped: 0 rpm
2. Battery voltage	Ex.: 11.7V Battery voltage ±0.5V
3. Engine oil	Before engine start: ON After engine start: OFF
4. Charge	Before engine start: ON After engine start: OFF
5. Tester position	Key at START position: ON Any other position: OFF
6. Work light	Lit: ON Off: OFF

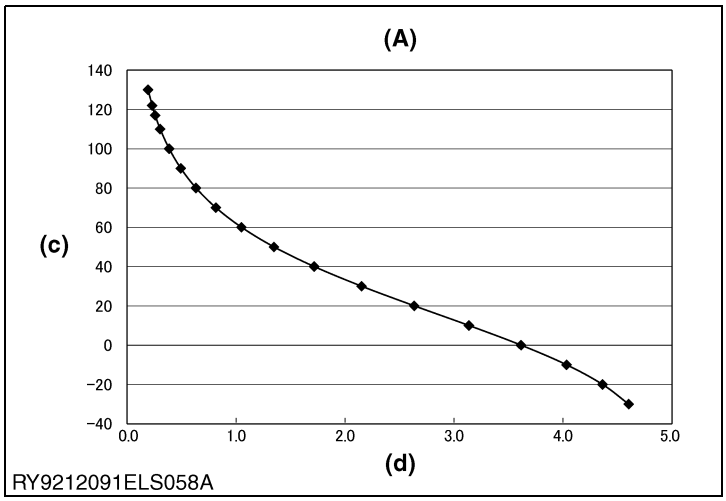
(a) Press and Hold SW2 **(b) Press SW2**

RY9212091ELS0076US0



RY9212091ELS060A

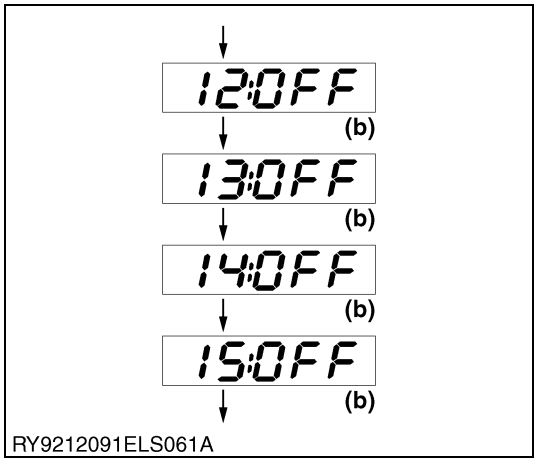
Displayed Item	Description
7. Water temperature voltage	Ex.: 2.34V Ex.: 26°C (78.8°F)
8. Water temperature	Displays water temperature voltage and temperature 0 °C (32 °F) → 3.61 V 100 °C (212 °F) → 0.39 V
9. Fuel voltage	Ex.: 1.87V E: High, F: Low
10. Fuel resistance	Ex.: 57Ω Full (F): 3 ±1Ω Partially full (1/2): 56.5 ±1 Ω Empty (E): 110 ±1Ω
11. Fuel supply switch	Fuel supply warning buzzer activated: ON Fuel supply warning buzzer cancelled: OFF



RY9212091ELS058A

(A) Relationship between Voltage and Water Temperature **(c) Water Temperature (°C)**
(d) Voltage (V)
(b) Press SW2

RY9212091ELS0077US0

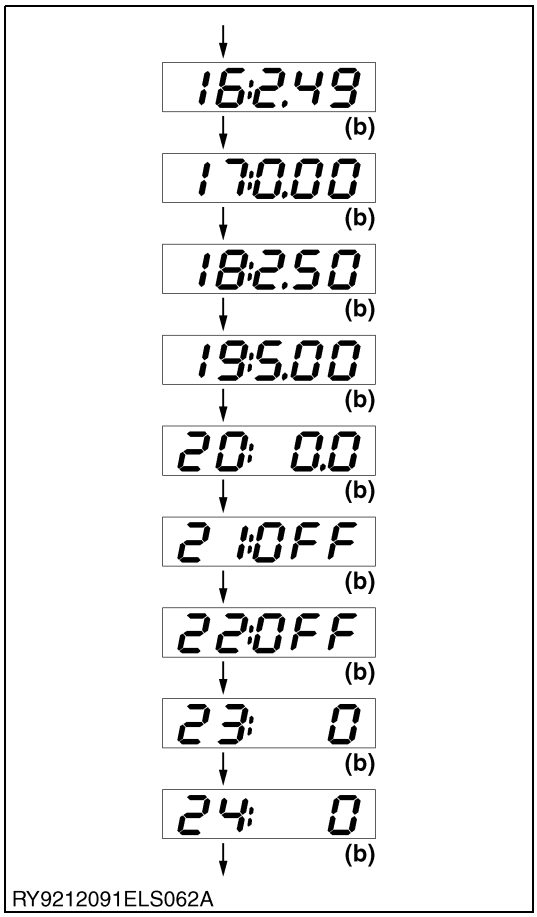


RY9212091ELS061A

Displayed Item	Description
12. Travel 2-speed switch	Press switch: ON Release switch: OFF
13. Travel 2-speed solenoid	Solenoid on: ON Solenoid off: OFF (when lever lock is released)
14. Lever lock switch	Lever lock switch on: ON Lever lock switch off: OFF
15. Lever lock solenoid	Lever lock solenoid on: ON Lever lock solenoid off: OFF

(b) Press SW2

RY9212091ELS0078US0

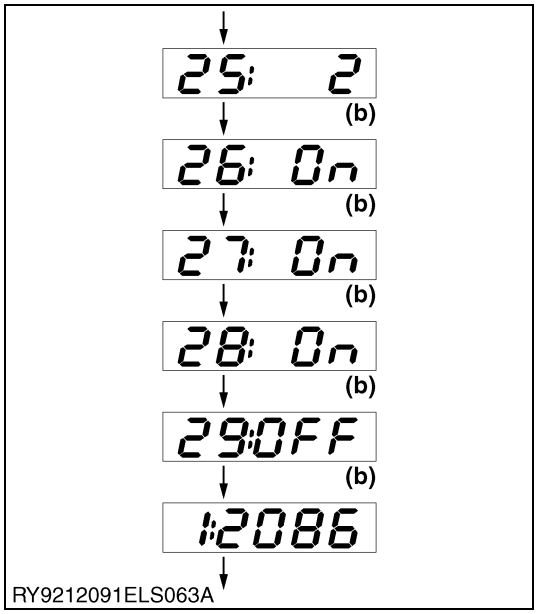


RY9212091ELS062A

Display Item	Description
16. Travel alarm pressure sensor / AUX knob (current value)	Ex: 2.49 V
17. AUX knob (left setting value)	Ex: 0.00 V
18. AUX knob (neutral setting value)	Ex: 2.50 V
19. AUX knob (right setting value)	Ex: 5.00 V
20. AUX amperage	Ex: 0.0 A
21. AUX hold switch	AUX hold activated: ON AUX hold released: OFF
22. AUX activation switch	AUX activation switch on: ON AUX activation switch off: OFF
23. Right AUX setting value	Ex: 0 x 10 mA
24. Left AUX setting value	Ex: 0 x 10 mA

(b) Press SW2

RY9212190ELS0039US0



Displayed Item	Description
25. Key type	Ex.: 2 (black key) Unknown: 0, red:1, black:2, yellow:3, green:4
26. Key matching	Key matches: ON Key does not match: ON (when keys are registered)
27. Anti-theft mode	Set to anti-theft mode: OFF Not set to anti-theft mode: ON
28. Key presence	Key present: ON Key not present: OFF
29. Anti-theft antenna	Antenna normal: OFF Antenna error: ON
Return to 1. Engine RPM	

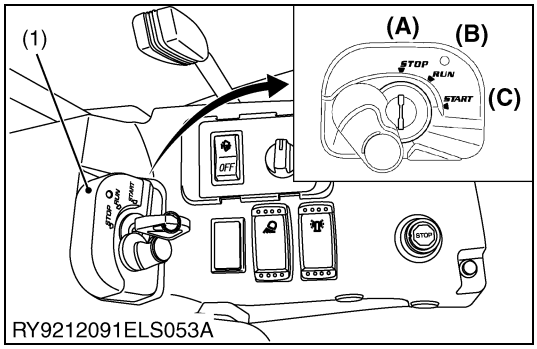
(b) Press SW2

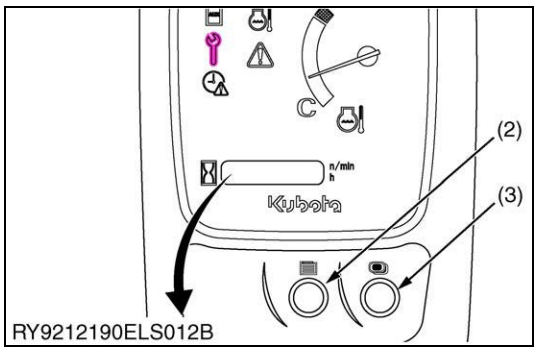
RY9212091ELS0080US0

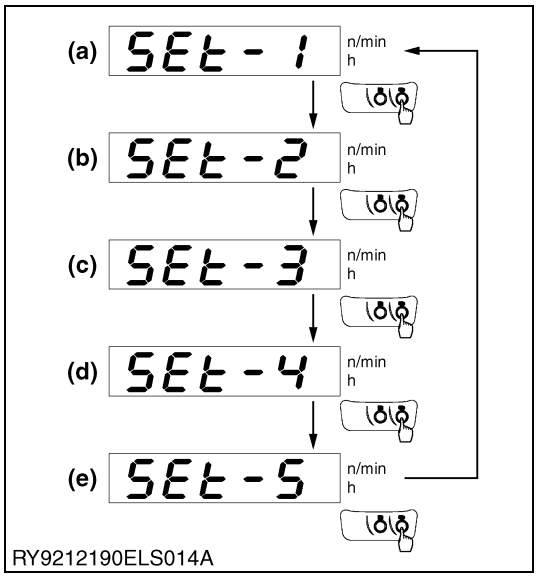
[B] Read Error History (SET-2)

[C] Read Entire Error History (SET-5)

Guide to Checking the History of Errors in the Past







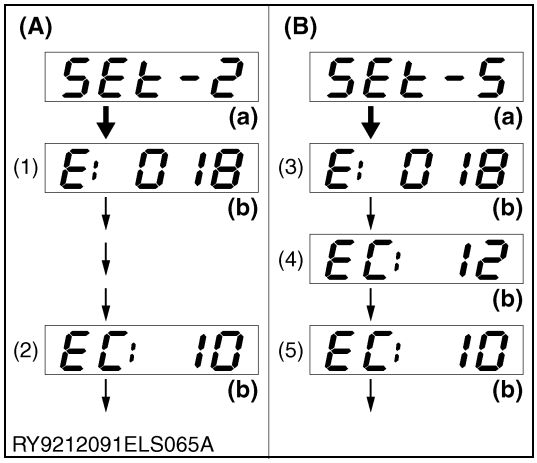
1. With SW2 pressed down, turn the starter key to the [RUN] position to enter the service dealer mode. "SET-1" is displayed on the LCD screen.
2. Pressing SW2 toggles the items displayed on the LCD screen in a loop.
3. Display either SET-2 or SET-5, then press and hold SW2 to enter either the SET-2 read error history mode or the SET-5 read entire error history mode. (To [Guide to SET-2 Reading Error History] or [Guide to SET-5 Reading Entire Error History])

(1) Key Switch
(2) User Setting Switch (SW1)
(3) Display Selector Switch (SW2)

(A) STOP
(B) RUN
(C) START

(a) Tester
(b) Read Error History
(c) Clear Error History
(d) Dealer Settings
(e) Read Entire Error History

RY9212190ELS0034US0



Guide to SET-2 Reading Error History
Guide to SET-5 Reading Entire Error History

■ **NOTE**
- **Press SW1: Back**
- **Press SW2: Forward, switch**
- **Press and hold SW1: Back all the way (Return to SET-2 or SET-5)**
- **Press and hold SW2: Set**

When selecting [SET-2 Read Error History]

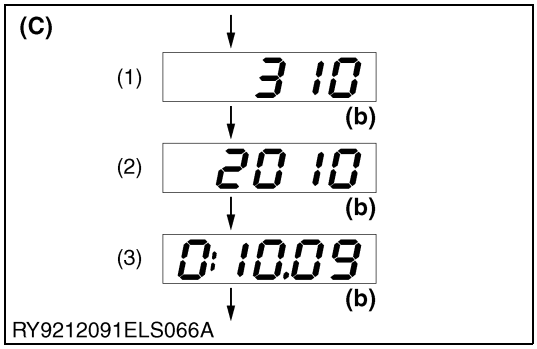
	Displayed Item	Description
(1)	Error item	Ex.: Error code 18 (Displays when an error has occurred. When there are no errors or after the entire error history has been cleard, the screen will display SET-2 and will not change any further)
(2)	No. of errors (Total number of errors does not display)	Ex.: No. of errors is 10

When selecting [SET-5 Read Entire Error History]

	Displayed Item	Description
(3)	Error item	Ex.: Error code 18 (Displays when an error has occurred. Even when there are no errors or the entire error history has been cleared, the content of the error history can be checked)
(4)	Total number of errors	Ex.: No. of errors is 12 (After the entire error history is cleared, the number of errors is not cleared and continues counting up)
(5)	No. of errors	Ex.: No. of errors is 10 (After the entire error history is cleared, the error count is cleared and it displays 0)

(A) SET-2
(B) SET-5
(a) Press and Hold SW2
(b) Press SW2

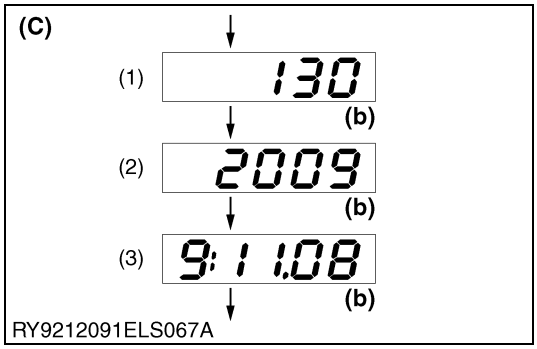
RY9212091ELS0081US0



	Displayed Item	Description
(1)	Hour meter when most recent error occurred	Ex.: 310h
(2)	Year when most recent error occurred	Ex.: 2010
(3)	Month and day when most recent error occurred	Ex.: 2010/10/09 (0: the year's one's digit; 10/09: October 9th)

(C) SET-2, SET-5
(b) Press SW2

RY9212091ELS0082US0

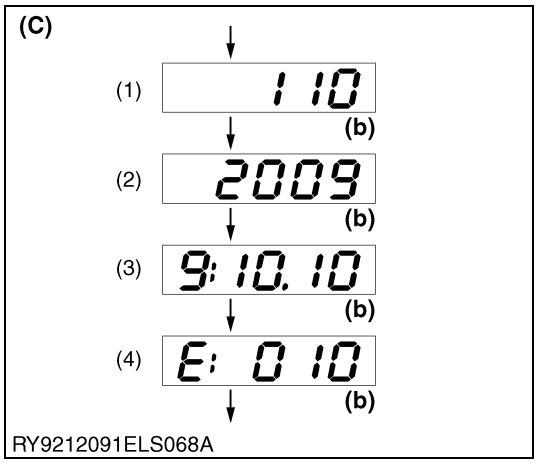


RY9212091ELS067A

	Displayed Item	Description
(1)	After the error history is cleared, hour meter when the first error occurred	Ex.: 130h
(2)	After the error history is cleared, year when the first error occurred	Ex.: 2009
(3)	After the error history is cleared, month and day when the first error occurred	Ex.: 2009/11/08 (0: the year's one's digit; 11/08: November 8th)

(C) SET-2, SET-5 **(b) Press SW2**

RY9212091ELS0083US0

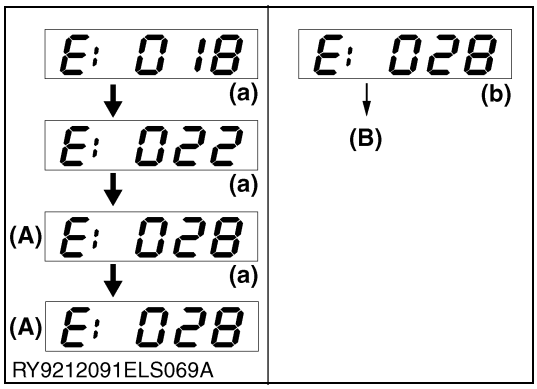


RY9212091ELS068A

	Displayed Item	Description
(1)	Hour meter when first error occurred	Ex.: 110h
(2)	Year when first error occurred	Ex.: 2009
(3)	Month and day when first error occurred	Ex.: 2009/10/10 (0: the year's one's digit; 10/10: October 10th)
(4)	Return to Error Items	

(C) SET-2, SET-5 **(b) Press SW2**

RY9212091ELS0084US0



RY9212091ELS069A

- When there are multiple error items:
  Pressing and holding SW2 while on any step switches the display to the next error item.
  However, once an error item has been displayed, it cannot be displayed again by returning to it.
  After checking the last error item, the display will not switch again even if SW2 is pressed and held.
  To display them again, it is necessary to press and hold SW1 and go all the way back in the service dealer mode screen.

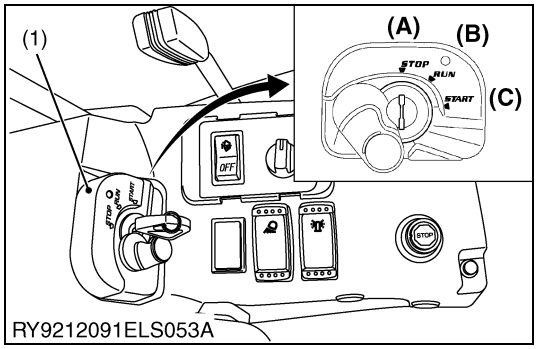
E.g.)
- As **E:028** (External 12 V short error) **(A)** is the last error, the display on the screen will not switch even if SW2 is pressed.

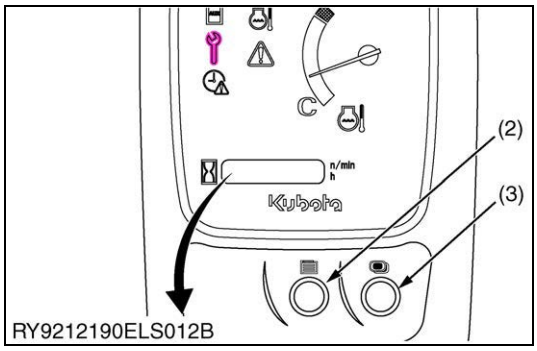
(A) E:028 (External 12 V Short Error) **(a) Press and Hold SW2**
(B) Service Dealer Mode Screen **(b) Press and Hold SW1**

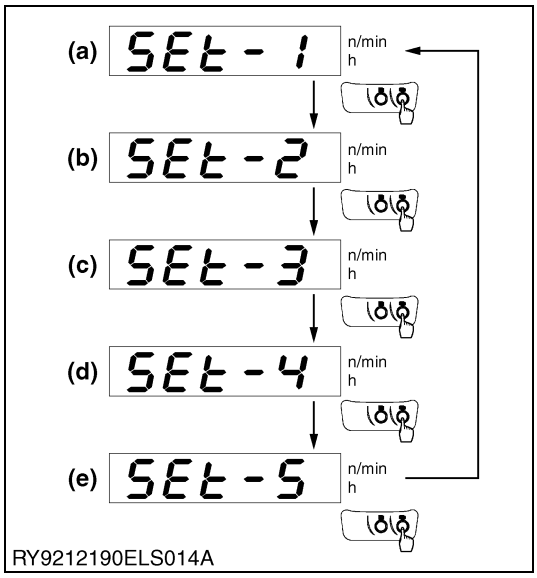
RY9212091ELS0085US0

[D] Clear Error History (SET-3)

Guide to Clearing the History of Errors in the Past







1. With SW2 pressed down, turn the starter key to the [RUN] position to enter the service dealer mode. "SET-1" is displayed on the LCD screen.
2. Pressing SW2 toggles the items displayed on the LCD screen in a loop.
3. Display "SET-3" and press and hold SW2 to enter the SET-3 clear error history mode. (To [Guide to SET-3 Clearing Error History]

(1) Key Switch
(2) User Setting Switch (SW1)
(3) Display Selector Switch (SW2)

(A) STOP
(B) RUN
(C) START

(a) Tester
(b) Read Error History
(c) Clear Error History
(d) Dealer Settings
(e) Read Entire Error History

RY9212190ELS0035US0

Method for Storing Error History Data

E.g.) Occurrence of engine oil pressure error (E:014)

1. The following content is displayed when either the SET-2 error history is read or the SET-5 entire error history is read.
   - When SET-2 error history is read, the item total number of errors does not exist.

Displayed Item	SET-2	SET-5
Engine oil pressure error	E : 014	E : 014
Total number of errors	–	12
No. of errors	10	10
Hour meter when most recent error occurred	120 h	120 h
Year when most recent error occurred	2009	2009
Month and day when most recent error occurred	4/5	4/5
After the error history is cleared, hour meter when first error occurred	100 h	100 h
After the error history is cleared, year when first error occurred	2009	2009
After the error history is cleared, month and day when first error occurred	2/3	2/3
Hour meter when first error occurred	100 h	100 h
Year when first error occurred	2009	2009
Month and day when first error occurred	2/3	2/3

2. When a SET-3 clearing of error history is performed,
   - And a SET-2 error history is read again, it has "No error history." and the screen will not switch.
   - And a SET-5 entire error history is read again, only the "number of errors" is cleared, so 0 is shown; the values for all other items are displayed the same as before performing SET-3.
   - And a SET-5 entire error history is read, the hour meter, year, month and day of the first error and the total number of errors are saved and cannot be deleted.

Displayed Item	SET-2	SET-5
Engine oil pressure error	No error history	E : 014
Total number of errors		12
No. of errors		**0**
Hour meter when most recent error occurred	No error history	120 h
Year when most recent error occurred		2009
Month and day when most recent error occurred		4/5

(To be continued)

(Continued)

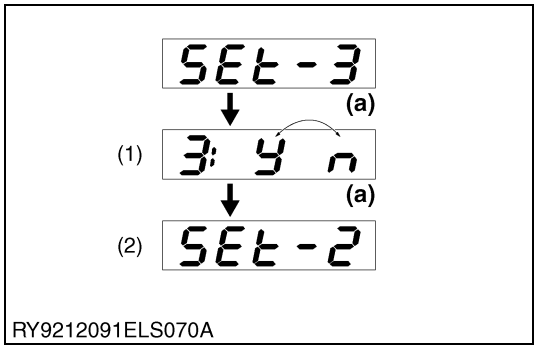
After the error history is cleared, hour meter when first error occurred	No error history	100 h
After the error history is cleared, year when first error occurred		2009
After the error history is cleared, month and day when first error occurred		2/3

Hour meter when first error occurred	No error history	**100 h**
Year when first error occurred		**2009**
Month and day when first error occurred		**2/3**

3. If an engine oil pressure error (E:014) occurs again after performing a SET-3 clearing of error history:
   E.g.) Error recurred on June 7, 2009 with 140h on the hour meter.
   - Given that a SET-5 entire error history is read, the hour meter, year, month and day of the first error are saved and cannot be changed.

Displayed Item	SET-2	SET-5
Engine oil pressure error	E : 014	E : 014
Total number of errors	–	13
No. of errors	1	1
Hour meter when most recent error occurred	140 h	140 h
Year when most recent error occurred	2009	2009
Month and day when most recent error occurred	6/7	6/7
After the error history is cleared, hour meter when first error occurred	140 h	140 h
After the error history is cleared, year when first error occurred	2009	2009
After the error history is cleared, month and day when first error occurred	6/7	6/7
Hour meter when first error occurred	100 h	**100 h**
Year when first error occurred	2009	**2009**
Month and day when first error occurred	2/3	**2/3**

RY9212091ELS0198US0



RY9212091ELS070A

Guide to SET-3 Clearing of Error History

■ **NOTE**
- **Press SW1: Back**
- **Press SW2: Forward, switch**
- **Press and hold SW1: Back all the way (Return to SET-3)**
- **Press and hold SW2: Set**

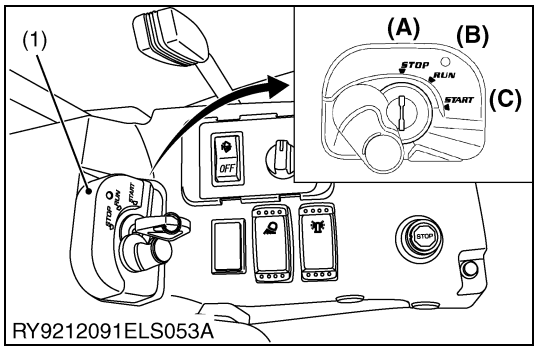
	Description of Display	Operation
(1)	YES/NO selections Y: Clears error history (YES) N: Does not clear (NO)	Select YES/NO by pressing SW2 or SW1. The selected item blinks.
(2)	Return to SET-2 Read Error History	Pressing and holding SW2 confirms the choice and the buzzer beeps three times.

(a) Press and Hold SW2

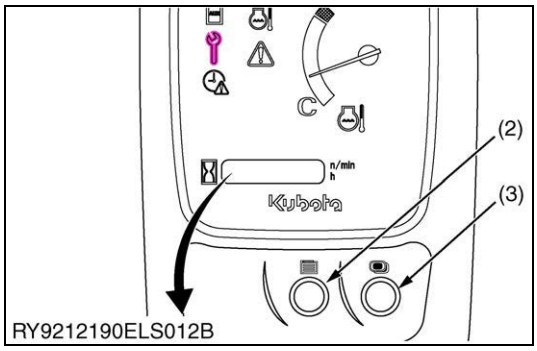
RY9212091ELS0086US0

[E] Dealer Settings (SET-4)

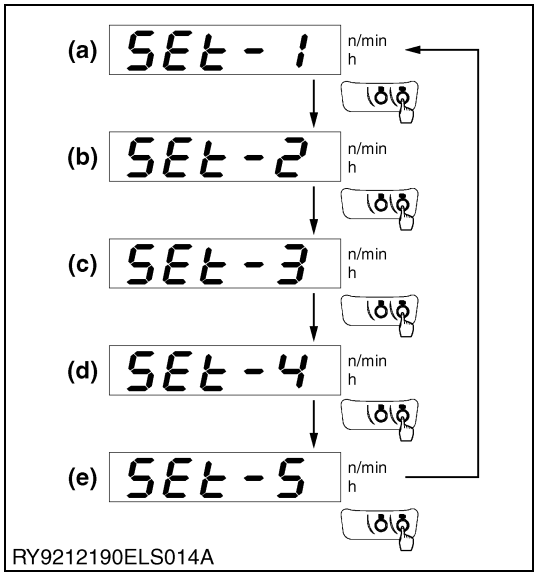
Guide to Making Various Settings, such as Model Settings



RY9212091ELS053A



RY9212190ELS012B



RY9212190ELS014A

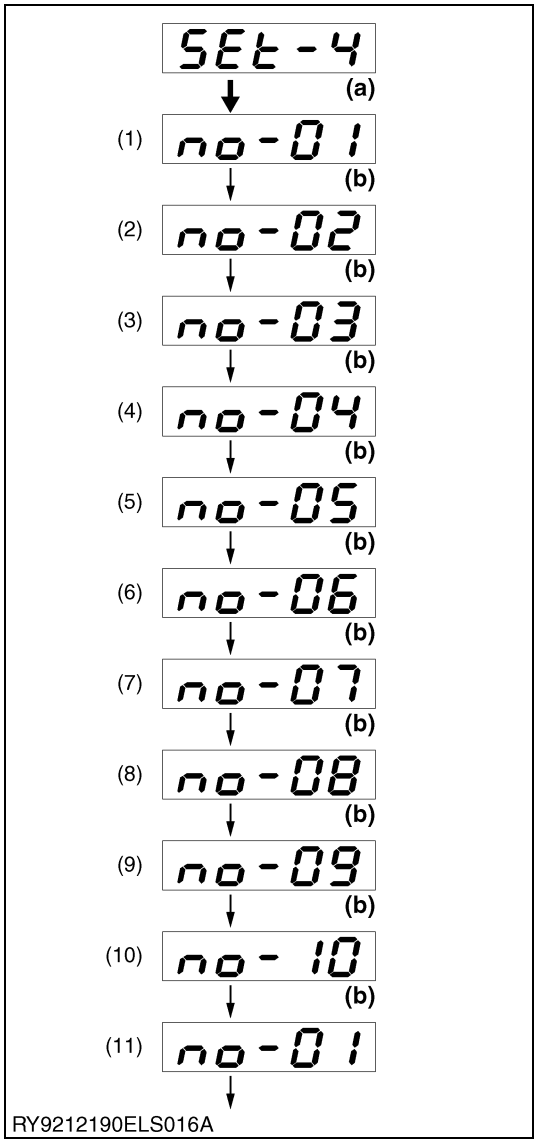
1. With SW2 pressed down, turn the starter key to the [RUN] position to enter the service dealer mode. "SET-1" is displayed on the LCD screen.
2. Pressing SW2 toggles the items displayed on the LCD screen in a loop.
3. Display "SET-4" and press and hold SW2 to enter the SET-4 dealer settings mode. (To [SET-4 Table of Dealer Settings])

(1) Key Switch
(2) User Setting Switch (SW1)
(3) Display Selector Switch (SW2)

(A) STOP
(B) RUN
(C) START

(a) Tester
(b) Read Error History
(c) Clear Error History
(d) Dealer Settings
(e) Read Entire Error History

RY9212190ELS0036US0



RY9212190ELS016A

SET-4 Table of Dealer Settings

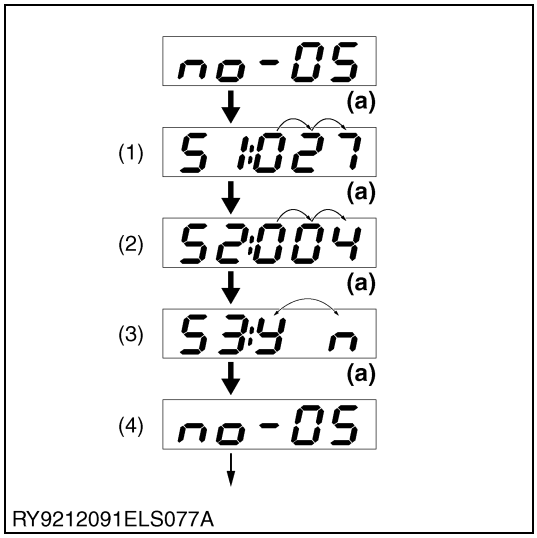
■ **NOTE**
- **Press SW1: Back**
- **Press SW2: Forward, switch**
- **Press and hold SW1: Back all the way (Return to SET-4)**
- **Press and hold SW2: Set**

	Display Item	Description
(1)	AUX knob setting ★	Refer to [Guide to No-01 AUX Knob Settings]
(2)	AUX activation point setting ★ (with attachment)	Refer to [Guide to No-02 AUX Activation Point Setting (with Attachment)]
(3)	AUX activation point setting ★ (no attachment)	Refer to [Guide to No-03 AUX Activation Point Setting (no Attachment)]
(4)	AUX feeling adjustment ★	Refer to [Guide to No-04 AUX Feeling Adjustment]
(5)	Model Setting	Refer to [Guide to No-05 Model Setting]
(6)	Method for displaying periodic guidance	Refer to [Guide to No-06 Methods of Displaying Periodic Guidance]
(7)	Periodic guidance display ON/OFF	Refer to [Guide to No-07 Turning Display of Periodic Guidance ON/OFF]
(8)	Periodic inspection offset time adjustment	Refer to [Guide to No-08 Periodic Inspection Offset Time Adjustment]
(9)	Request to set time to display guidance	Refer to [Guide to No-09 Requesting to Set Time for Guidance Display]
(10)	Travel alarm function ★	Refer to [Guide to No-10 Travel Alarm Function]
(11)	Return to "AUX knob settings"	

★: The item which is not used by EU specification.

(a) Press and Hold SW2 **(b) Press SW2**

RY9212180ELS0056US0



RY9212091ELS077A

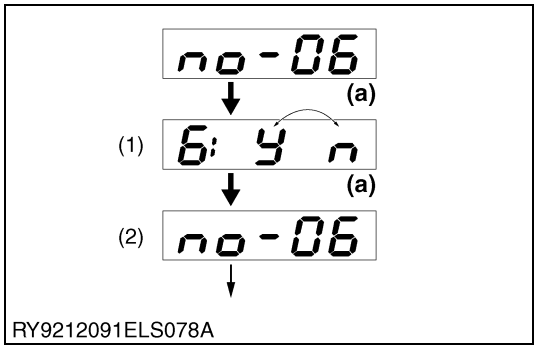
Guide to No-05 Model Setting

Settings required when the main ECU or meter has been replaced by new one:

	Explanation of Display	Operation
(1)	51: No-05 Model, step 1 024: KX015-4 025: KX016-4 026: KX018-4 027: KX019-4 028: U27-4 Press SW2 and shift the digit The selected digit blinks. Press SW1 and SW2 to raise and lower the number	Model setting Enter the setting number and then press and hold SW2
(2)	52: No-05 Model, step 2 001: Japan 002: N. America 003: Australia 004: EU Press SW2 and shift the digit The selected digit blinks. Press SW1 and SW2 to raise and lower the number	Delivery destination setting Enter the setting number and then press and hold SW2
(3)	53: No-05 Model, step 3 Y: Has AUX (YES) N: No AUX (NO) Select YES/NO by pressing SW2 or SW1 The selected item blinks	AUX equipped setting Pressing and holding SW2 completes the setting If U27-4, select "No AUX"
(4)	Return to No-05 Model Setting	The buzzer beeps three times

(a) Press and Hold SW2

RY9212180ELS0057US0



RY9212091ELS078A

Guide to No-06 Method for Eliminating Periodic Guidance

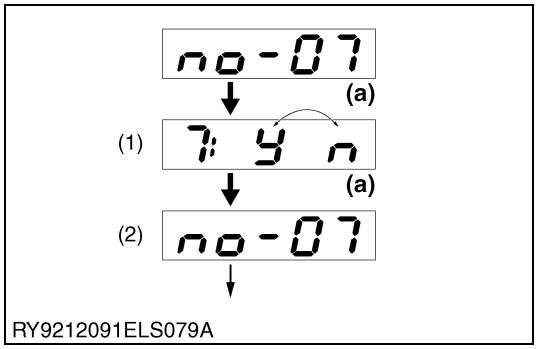
Procedure for changing the deleting steps for the periodic checkup guide

	Explanation of Display	Operation
(1)	Y: Manual N: Auto Select YES/NO by pressing SW2 or SW1 The selected item blinks	YES/NO selections Pressing and holding SW2 completes the setting
(2)	Return to No-06 Method for Eliminating Periodic Guidance	The buzzer beeps three times

- If N: Auto is selected, turning the starter key 10 times allows the content of periodic guidance to be deleted.

(a) Press and Hold SW2

RY9212091ELS0093US0



RY9212091ELS079A

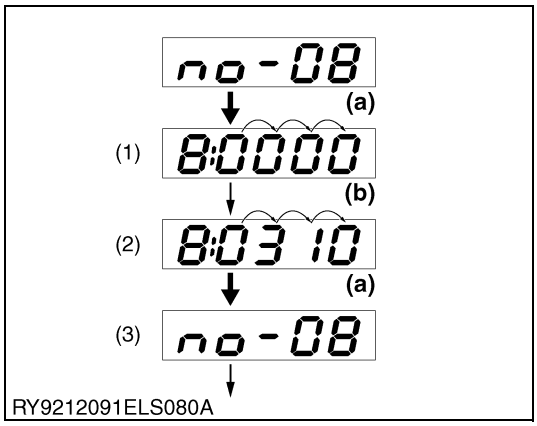
Guide to No-07 Turning Display of Periodic Guidance ON/OFF

Procedure for changing the enable/disable setting for the periodic checkup guide

	Explanation of Display	Operation
(1)	Y: Display N: Do not display Select YES/NO by pressing SW2 or SW1 The selected item blinks	YES/NO selections Pressing and holding SW2 completes the setting
(2)	Return to No-07 Periodic Guidance Display ON/OFF	The buzzer beeps three times

(a) Press and Hold SW2

RY9212091ELS0094US0



RY9212091ELS080A

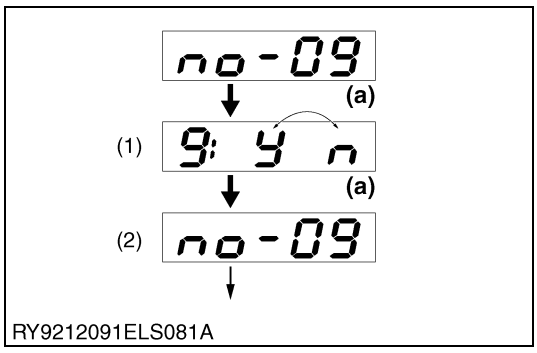
Guide to No-08 Periodic Inspection Offset Time Adjustment

Entering the previous main ECU operating hours when the main ECU has been replaced by new one:

	Explanation of Display	Operation
(1)	Offset time adjustment 8000: Can be adjusted from 0 to 9999h	Pressing and holding SW2 shift the digit right Pressing and holding SW1 shift the digit left The selected digit blinks. Press SW1 and SW2 to raise and lower the number
(2)	Ex.: 310h	Enter the offset time Pressing and holding SW2 completes the setting after ones digit is set
(3)	Return to No-08 Periodic Inspection Offset Time Adjustment	The buzzer beeps three times

(a) Press and Hold SW2 **(b) Press SW2**

RY9212091ELS0095US0



RY9212091ELS081A

Guide to No-09 Requesting to Set Time for Guidance Display

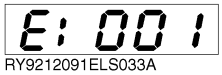
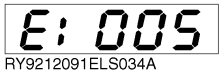
Setting to disable the clock-based warning display

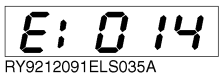
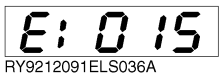
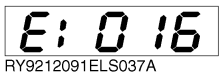
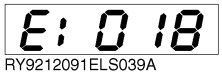
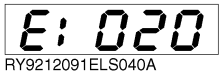
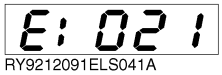
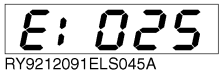
	Explanation of Display	Operation
(1)	Y: Display N: Do not display Select YES/NO by pressing SW2 or SW1 The selected item blinks	YES/NO selections Pressing and holding SW2 completes the setting
(2)	Return to No-09 Guide to Requesting to Set Time for Guidance Display	The buzzer beeps three times

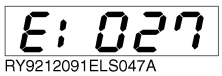
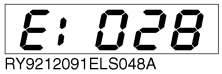
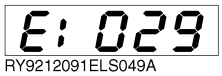
(a) Press and Hold SW2

RY9212091ELS0096US0

Navigation list of messages

	LCD display	LED	Problem / Error	Preliminary Measure
1	CAN system error  RY9212091ELS033A	 (Blinking)	The Controller Area Network (CAN) has developed a fault. Measured values may be incorrect and switches may not function.	The machine can be started and driven. Do not perform any work with the machine.
2	Feed fuel (No display item)	 (Blinking)	This message appears when the fuel level is low and prompts the operator to refuel.	–
3	Periodic check soon (notice) (No display item)	 (Blinking)	This message means that the regular service is due shortly.	Operate the machine as usual.
4	Periodic check passed (Warning) (No display item)	 (Blinking)	This message means that the regular service is due.	The machine can be operated but service must be carried out urgently.
5	Warning temperature rising  RY9212091ELS034A	 (Blinking)	The temperature of the coolant is higher than normal.	Operate the machine only with reduced loads until the temperature is normal again.
6	–	–	–	–
7	Wrong key unable to start (No display item)	 (Blinking)	The machine cannot be started because the wrong key has been inserted.	Use correct key.
8	Registered RED key unable to start (No display item)	 (Blinking)	Try starting the engine with the red key (for registration).	Use correct key.
9	Clock setting request (No display item)	 (Blinking)	Power was interrupted and the clock now has to be set again.	In order to set the clock, press the user setting switch.
10	–	–	–	–
11	Raise the control lever lock	 (yellow) (Blinking)	This message indicates a step in a procedure.	Raise the control lever lock; the indicator turns off.
12	Pull out the key	 (Blinking)	The key must be pulled out.	Pull out the key.
13	Lower the control lever lock	 (yellow) (Blinking)	This message indicates a step in a procedure.	Lower the control lever lock; the indicator turns off.

	LCD display	LED	Problem / Error	Preliminary Measure
14	Oil pressure too low  RY9212091ELS035A	 (red) (Blinking) +  (Lighting)	The engine oil pressure is too low.	Stop the engine immediately. The engine may have developed a fault.
15	Overheat  RY9212091ELS036A	 (Blinking)	The machine is overheated and must cool off by idling.	Allow the machine to cool off by idling. Do not switch the engine off as the coolant could then boil over.
16	Charging system error  RY9212091ELS037A	 (red) (Blinking) +  (Lighting)	The charging system has developed a fault.	Check the V-belt. When the V-belt is OK, let the engine run until the indicator turns off.
17	Fuel sensor error  RY9212091ELS038A	 (red) (Blinking)	The fuel sensor has developed a fault.	–
18	Water temperature sensor error  RY9212091ELS039A	 (red) (Blinking)	The coolant temperature sensor has developed a fault.	The functions of the machine are stable but overheating cannot be excluded.
19	–	–	–	–
20	Lever lock system error  RY9212091ELS040A	 (red) (Blinking)	The electrical system in the control lever lock has developed a fault.	The engine can be started but the machine cannot be set in motion.
21	Travel 2 speed system error  RY9212091ELS041A	 (red) (Blinking)	The electrical system in the travel speed has developed a fault.	The machine can only be set in motion at low speed.
22	–	–	–	–
23	–	–	–	–
24	–	–	–	–
25	Overvoltage  RY9212091ELS045A	 (red) (Blinking)	This is a warning that a higher voltage (from a 24-V battery, for example) is being applied to the electric circuit, or that there is a problem with the alternator.	Switch the engine off immediately and check the battery and the alternator. Restart the engine.
26	–	–	–	–

	LCD display	LED	Problem / Error	Preliminary Measure
27	External 5-V system error  RY9212091ELS047A	 (red) (Blinking)	The 5-V sensor supply line has developed a system fault. The main functions are not available.	The machine can be started and driven. Do not perform any work with the machine.
28	External 12-V system error  RY9212091ELS048A	 (red) (Blinking)	The 12-V sensor supply line has developed a system fault. The main functions are not available.	The machine can be started and driven. Do not perform any work with the machine.
29	Starting the engine  RY9212091ELS049A	 (yellow) (Blinking)	This message indicates a step in a procedure.	Start the engine; the indicator turns off.

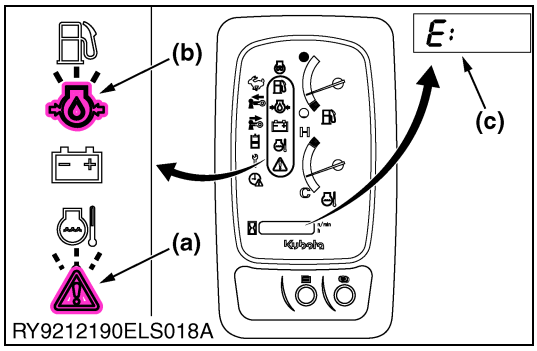
RY9212190ELS0038US0

7. TROUBLESHOOTING (METER PANEL)

[1] ENGINE RELATED SYSTEM

(1) Engine Oil Pressure Error (E:014)

[A] Checking Via the LCD Panel Display



RY9212190ELS018A

1. LCD Panel Display

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.
2. Check if the engine oil lamp **(b)** is lit in red or is off.

(a) Warning Lamp
(b) Engine Oil Lamp
(c) Error Message E:014 (Engine Oil Pressure Error)

RY9212190ELS0001US0

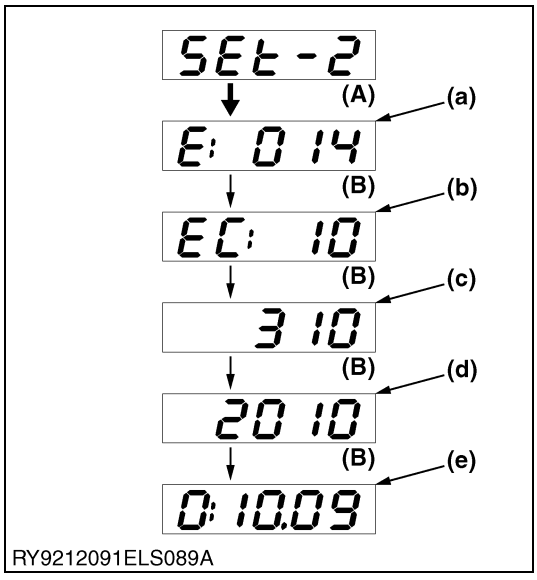
[Test Conditions]

1. Key switch : RUN

- If the engine oil lamp is lit : caused by a short
- If the engine oil lamp is off : caused by break in wiring

Criteria
Normal : no break
Error : has a break
Error : shorted

RY9212091ELS0098US0



RY9212091ELS089A

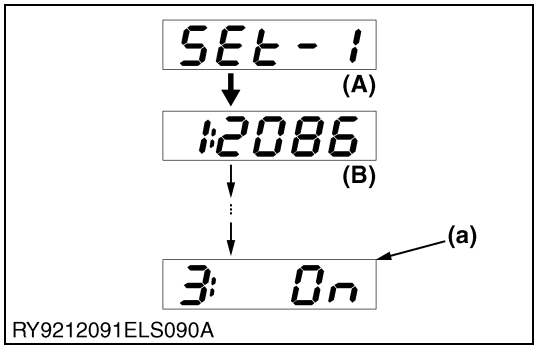
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0099US0



RY9212091ELS090A

3. Tester Mode

1. Select the tester mode.
2. Check the operation of the engine oil switch as per the table below.

	Normal	Oil lamp	Discon-nected	Oil lamp	Shorted	Oil lamp
Key Off	OFF	Not lit	OFF	Not lit	OFF	Not lit
Key On	ON	Lit	OFF	Not lit	ON	Lit
Key Start	OFF	Not lit	OFF	Not lit	ON	Lit

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

(A) Press and Hold SW2
(B) Press SW2
(a) ON/OFF Status of the Engine Oil Switch

RY9212091ELS0100US0

[B] Inspecting Each Device Visually and Physically

1. Checking fuses

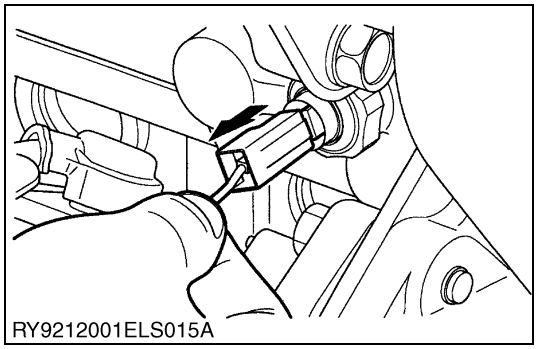
1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0


RY9212001ELS015A

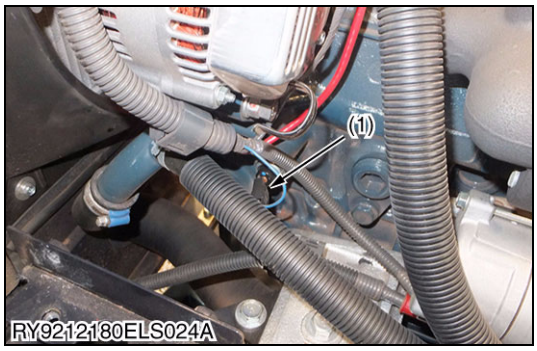
3. Cause of Disconnects

[Inspection Conditions]
1. Key switch: STOP
2. Engine oil switch connector disconnected.
3. Break of wiring continuity somewhere in the middle.

Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the operation of the engine oil switch in the tester mode again.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

RY9212180ELS0110US0



RY9212180ELS024A

4. Cause of Short

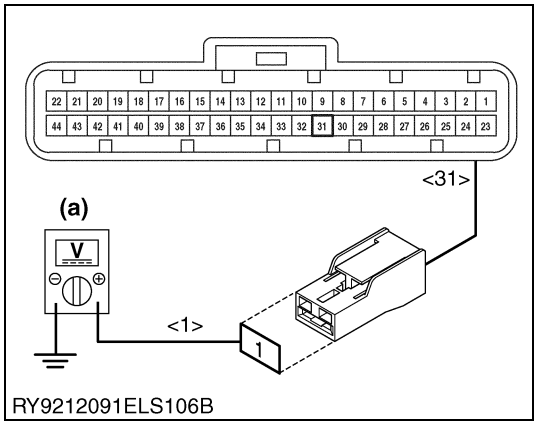
[Inspection Conditions]
1. Key switch: STOP
2. One of the engine oil switch wires is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the operation of the engine oil switch again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

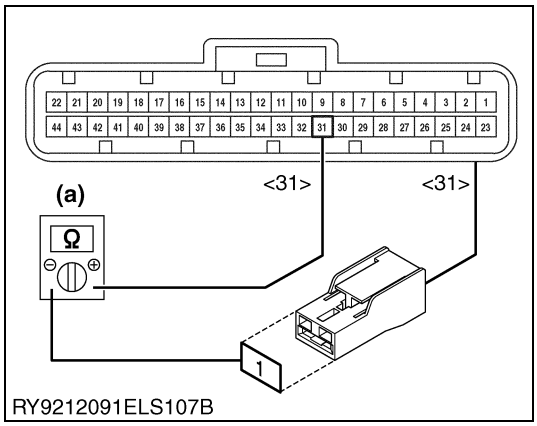
(1) Engine Oil Switch

RY9212180ELS0060US0

[C] Testing with a Circuit Tester



RY9212091ELS106B



RY9212091ELS107B

1. Checking the Voltage

[Test Conditions]

1. Disconnect engine oil switch connector.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Engine oil switch connector	<1>	Body ground	–

Normal: 12 V (battery voltage)
Error: Greatly different from 12 V

RY9212180ELS0061US0

2. Checking Continuity

[Test Conditions]

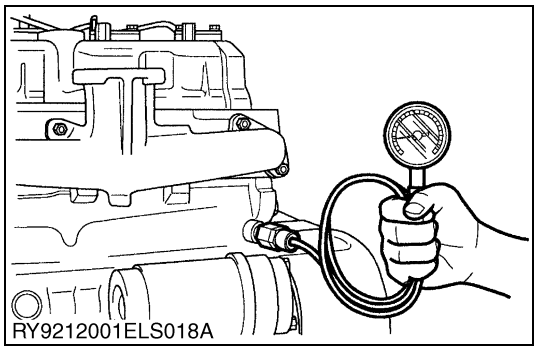
1. Key switch: STOP
2. Disconnect the main ECU connector.
3. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Engine oil switch connector	<1>	Main ECU connector	<31>

Normal: Continuous
Error: Not continuous

RY9212180ELS0062US0

[D] Checking the Equipment Itself


RY9212001ELS018A

1. Measuring the Engine Oil Pressure

[Test Conditions]

1. Disconnect the engine oil switch, attach a pressure gauge and test the pressure.
2. After testing the pressure, reinstall the engine oil switch and tighten it to the specified torque.

Engine Oil Pressure	At idle	Allowable limits	49 KPa 0.5 kgf/cm^2 7.0 psi
	At rated RPM	Factory specification	196 to 441 KPa 2.0 to 4.50 kgf/cm^2 28 to 64 psi
		Allowable limits	147 KPa 1.50 kgf/cm^2 21 psi

Tightening torque	Oil switch tapered screw R1/8	15 to 19 N·m 1.5 to 2.0 kgf·m 10.8 to 14.5 lbf·ft

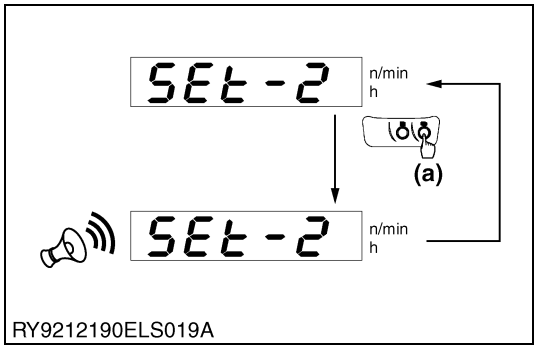
Assessment Criteria
Normal: Within allowable limits
Error: Outside allowable limits

RY9212091ELS0204US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212190ELS019A

3. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

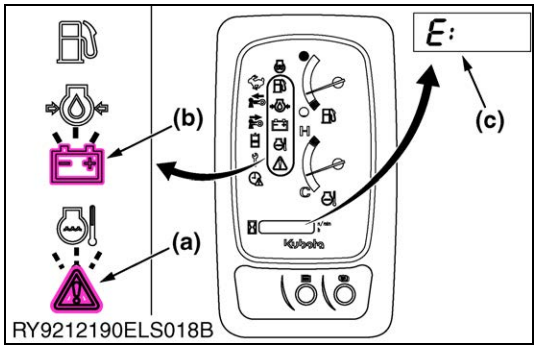
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and Hold SW2

RY9212190ELS0002US0

(2) Charging System Error (E:016)

[A] Checking Via the LCD Panel Display



RY9212190ELS018B

1. LCD Panel Display

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.
2. Check if the charging lamp **(b)** is lit in red or is off.

(a) Warning Lamp
(b) Charging Lamp
(c) Error Message E:016 (Charging System Error)

RY9212190ELS0003US0

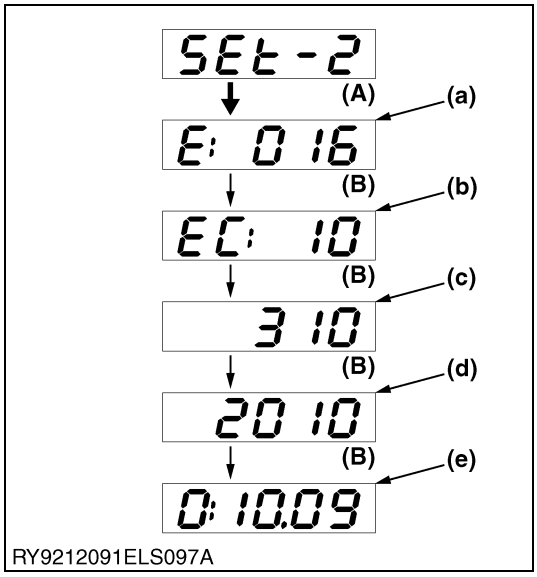
[Inspection Conditions]

1. Key switch: RUN

- If the charging lamp is lit: a short is the cause
- If the charging lamp is not lit: a disconnect is the cause

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

RY9212091ELS0202US0



RY9212091ELS097A

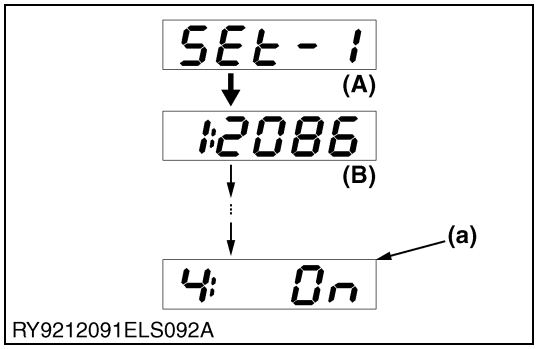
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0108US0



RY9212091ELS092A

3. Tester Mode

1. Select the tester mode.
2. Check the operation of the charging switch as per the table below.

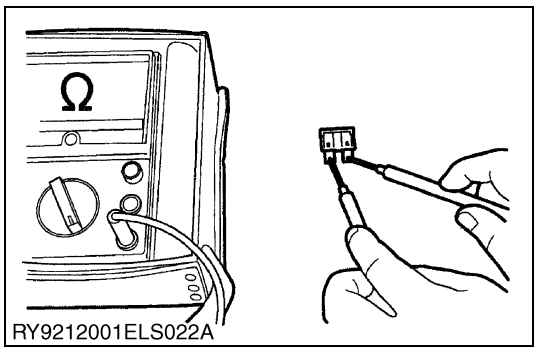
	Normal	Charging lamp	Disconnected	Charging lamp	Shorted	Charging lamp
Key Off	OFF	Not lit	OFF	Not lit	OFF	Not lit
Key On	ON	Lit	OFF	Not lit	ON	Lit
Key Start	OFF	Not lit	OFF	Not lit	ON	Lit

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

(A) Press and Hold SW2
(B) Press SW2
(a) ON/OFF Status of the Charging Switch

RY9212091ELS0109US0

[B] Inspecting Each Device Visually and Physically



RY9212001ELS022A

1. Checking fuses

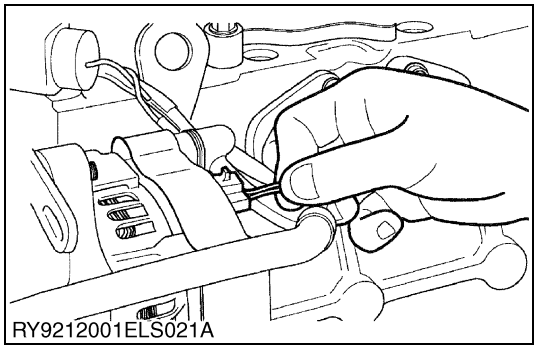
Check whether the alternator fuse (10A) is blown.

RY9212001ELS0064US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0


RY9212001ELS021A

3. Cause of Disconnects

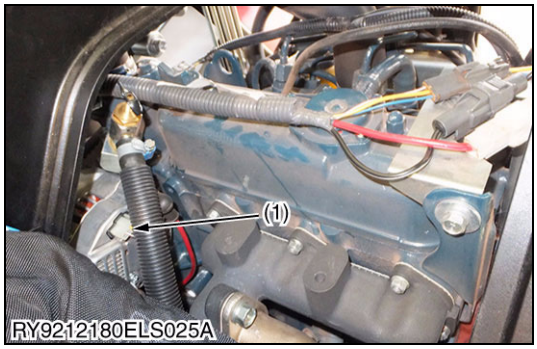
[Inspection Conditions]

1. Key switch: STOP
2. Charging switch connector disconnected.
3. Break of wiring continuity somewhere in the middle.

Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the operation of the charging switch in the tester mode again.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

RY9212180ELS0063US0



4. Cause of Short

[Inspection Conditions]

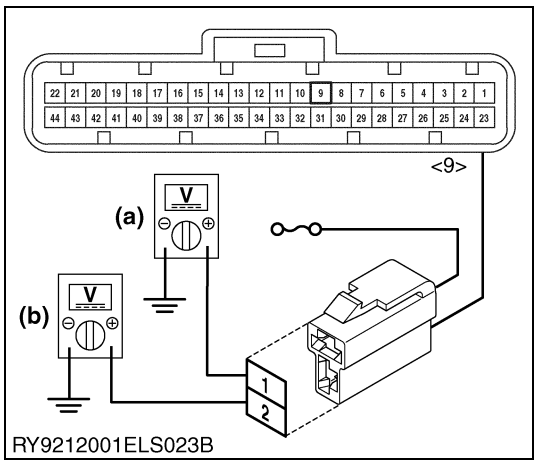
1. Key switch: STOP
2. One of the wires of the charging switch connector is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the operation of the charging switch again in the tester mode.

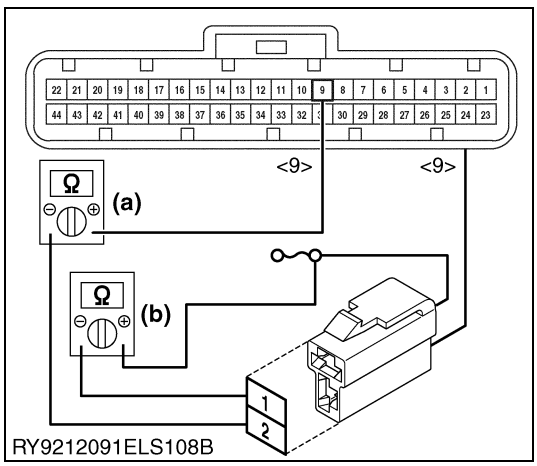
Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) Alternator Connector

RY9212180ELS0064US0

[C] Testing with a Circuit Tester





1. Checking the Voltage

[Test Conditions]

1. Disconnect charging switch connector.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Alternator connector	<1>	Body ground	–
(b)	Alternator connector	<2>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212180ELS0065US0

2. Checking Continuity

[Test Conditions]

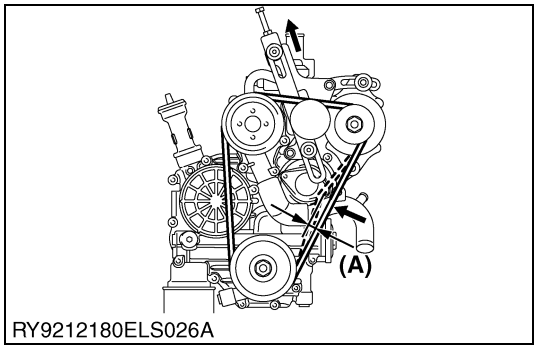
1. Key switch: STOP
2. Disconnect the main ECU connector.
3. Remove the alternator fuse (10A).
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Alternator connector	<2>	Main ECU connector	<9>
(b)	Alternator fuse (10A)	–	Alternator connector	<1>

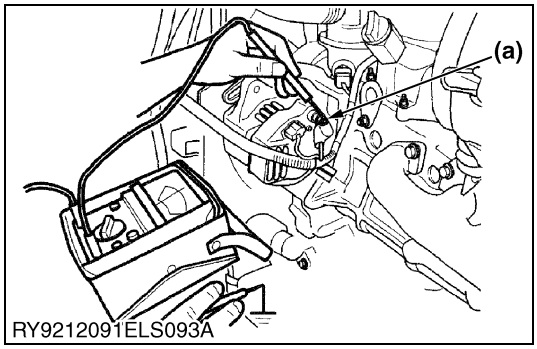
Normal: Continuous
Error: Not continuous

RY9212180ELS0066US0

[D] Testing the Equipment Itself



RY9212180ELS026A



RY9212091ELS093A

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.

Criteria
Normal : Within factory specification
Error : Outside factory specification

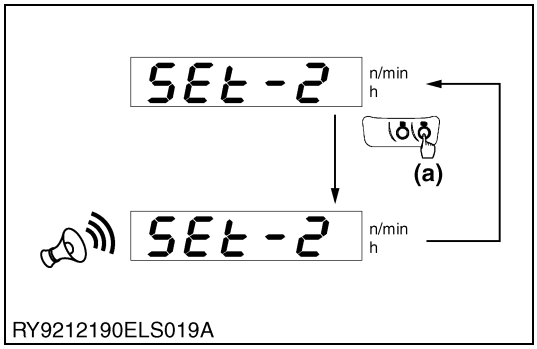
(A) Displacement 7 to 9 mm (0.3 to 0.4 in.)
(a) Terminal B

RY9212180ELS0067US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212190ELS019A

3. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

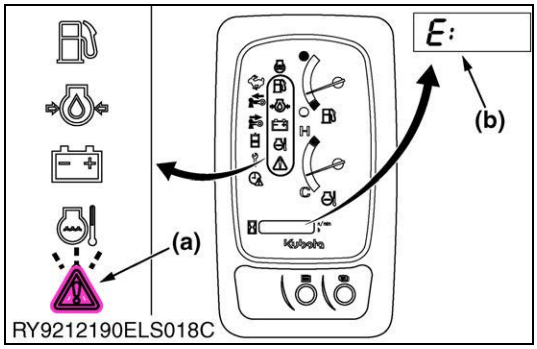
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and Hold SW2

RY9212190ELS0002US0

(3) Fuel Sensor Error (E:017)

[A] Checking Via the LCD Panel Display

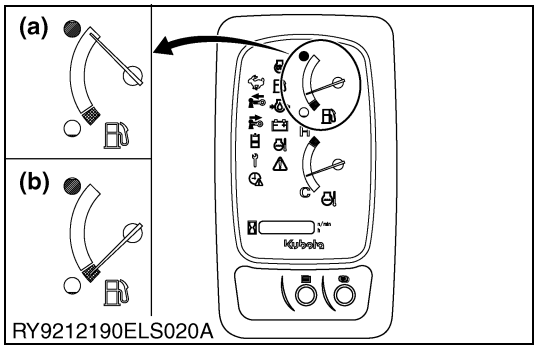


1. LCD Panel Display

Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp
(b) Error Message E:017 (Fuel Sensor Error)

RY9212190ELS0004US0



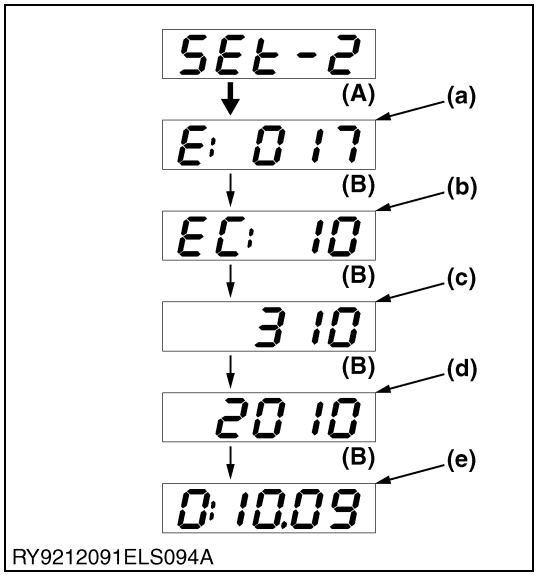
[Inspection Conditions]

1. Key switch: RUN

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

(a) If the Needle is Pegged on the Full Fuel Level Side: the Cause is a Short
(b) If the Needle is Pegged on the Fuel Level Empty Side: the Cause is a Disconnect

RY9212190ELS0005US0



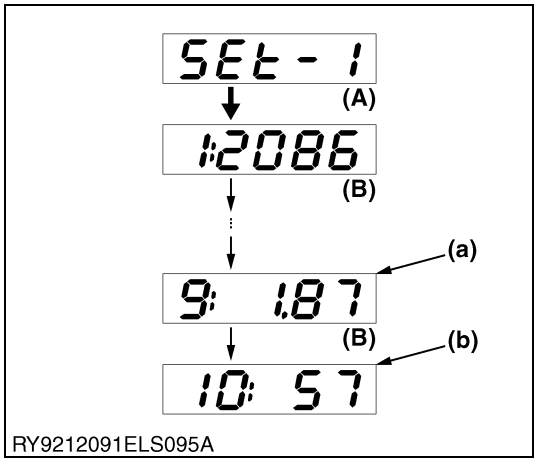
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0117US0



RY9212091ELS095A

3. Tester Mode

1. Select the tester mode.
2. Start the engine.
3. Check the display of fuel resistance values as per the following table.
   - Judge what the fuel sensor error is by looking at the resistance values. Voltages are reference values.

	Voltage (reference value)	Resistance value
Normal	1.87 V	57 Ω
Disconnected	3.76 V	135 Ω ≤
Shorted	0.00 V	0 Ω

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

(A) Press and Hold SW2
(B) Press SW2
(a) Fuel Voltage
(b) Fuel Resistance Value

RY9212091ELS0118US0

[B] Inspecting Each Device Visually and Physically

1. Checking fuses

1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0

RY9212180ELS004B

3. Cause of Disconnects

[Inspection Conditions]
1. Key switch: STOP
2. Fuel sensor connector disconnected.
3. Break of wiring continuity somewhere in the middle.

Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the fuel sensor voltage and resistance in the tester mode again.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

(1) Fuel Sensor

RY9212180ELS0068US0

RY9212180ELS004B

4. Causes when a short

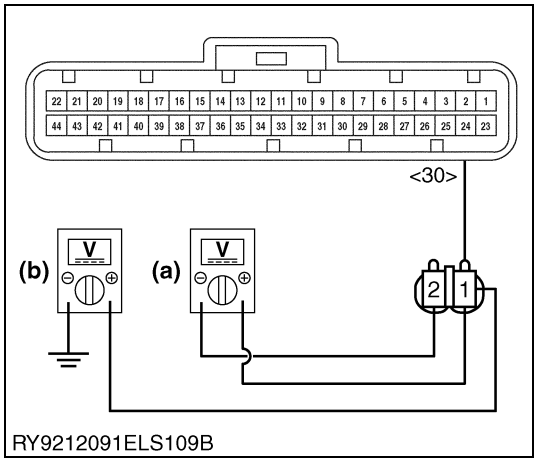
[Test Conditions]
1. Key switch : STOP
2. The fuel sensor wire is pinched against or touching the body. If the insulation is damaged, repair it properly and check the voltage and resistance for the fuel again in the tester mode.

Criteria
Normal : no short
Error : shorted

(1) Fuel Sensor

RY9212180ELS0069US0

[C] Testing with a Circuit Tester



RY9212091ELS109B

1. Checking the Voltage

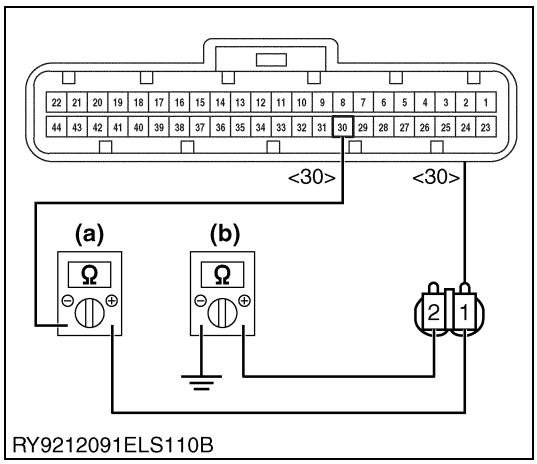
[Test Conditions]

1. Disconnect fuel sensor connector.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Fuel sensor connector	<1>	Fuel sensor connector	<2>
(b)	Fuel sensor connector	<1>	Body ground	–

Normal: About 0.8 V
Error: Greatly different from 0.8 V

RY9212180ELS0070US0



RY9212091ELS110B

2. Checking Continuity

[Test Conditions]

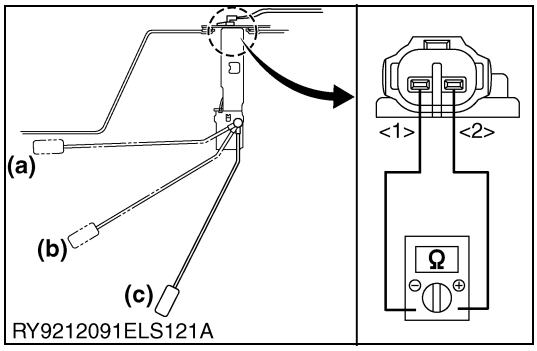
1. Key switch: STOP
2. Disconnect the main ECU connector.
3. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Fuel sensor connector	<1>	Main ECU connector	<30>
(b)	Fuel sensor connector	<2>	Body ground	–

Normal: Continuous
Error: Not continuous

RY9212180ELS0071US0

[D] Checking the Equipment Itself



RY9212091ELS121A

1. Inspecting the Fuel Sensor

[Test Conditions]

1. Key switch: STOP
2. Disconnect connector from the fuel sensor and test the sensor.
3. Refer to the table below for the resistance at given float positions.

Float position	F **(a)**	Standard value (resistance)	3 ± 1 Ω
	1/2 **(b)**		56.5 ± 1 Ω
	E **(c)**		110 ± 2.5 Ω

Assessment Criteria
Normal: Within standard range
Error: Outside standard range

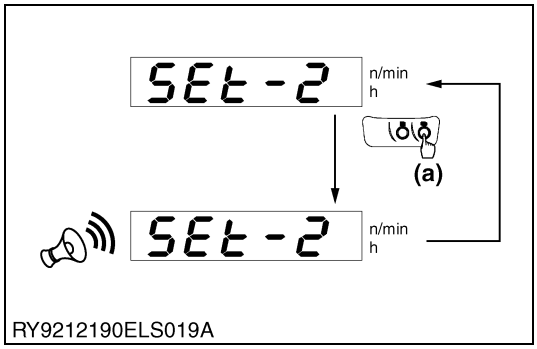
(a) Full Tank
(b) Half Tank
(c) Empty

RY9212180ELS0072US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212190ELS019A

3. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

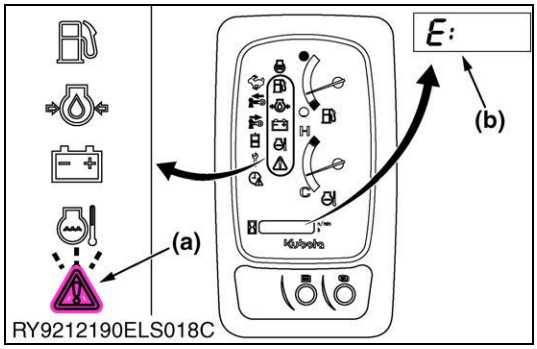
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and Hold SW2

RY9212190ELS0002US0

(4) Water Temperature Sensor Error (E:018)

[A] Checking Via the LCD Panel Display



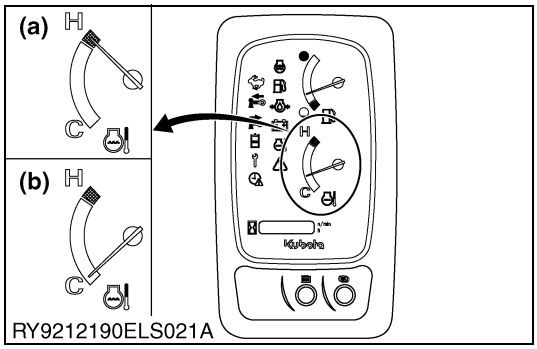
1. LCD Panel Display

Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp

(b) Error Message E:018 (Water Temperature Sensor Error)

RY9212190ELS0006US0



[Inspection Conditions]

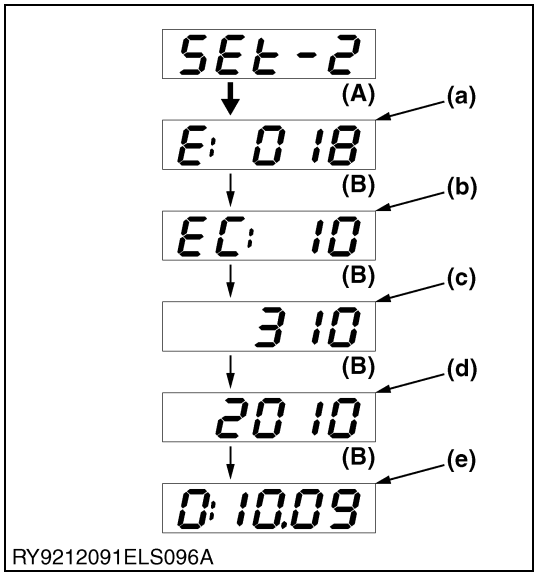
1. Key switch: RUN

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

(a) If the Needle is Pegged on the Water Temperature High Side: the Cause is a Short

(b) If the Needle is Pegged on the Water Temperature Low Side: the Cause is a Disconnect.

RY9212190ELS0007US0



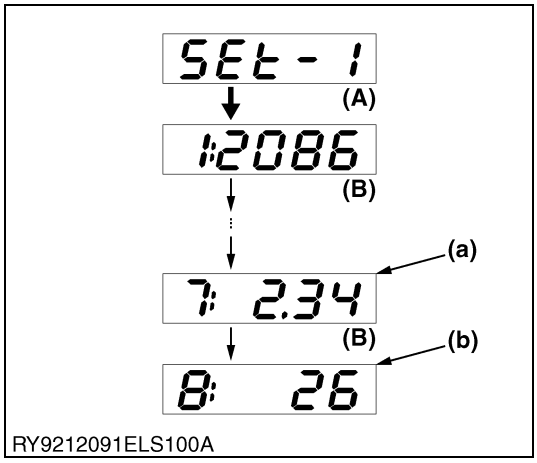
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0126US0



RY9212091ELS100A

3. Tester Mode

1. Select the tester mode.
2. Start the engine.
3. Check the display of water temperature sensor voltage and temperature in the tester mode as per the following table.

	Water temperature voltage	Temperature
Normal	2.34 V	26 °C (78.8 °F)
Disconnected	5.00 V	-50 °C (-58.0 °F)
Shorted	0.00 V	150 °C (302 °F)

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

(A) Press and Hold SW2
(B) Press SW2
(a) Water Temperature Voltage
(b) Water Temperature

RY9212091ELS0127US0

[B] Inspecting Each Device Visually and Physically

1. Checking fuses

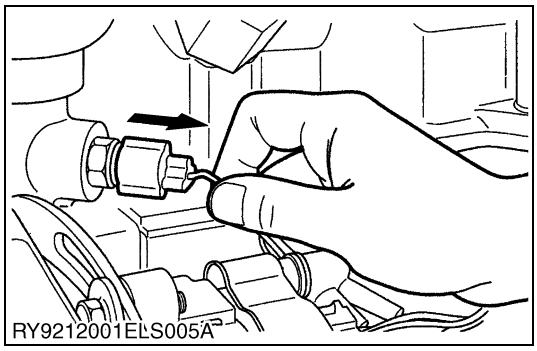
1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0


RY9212001ELS005A

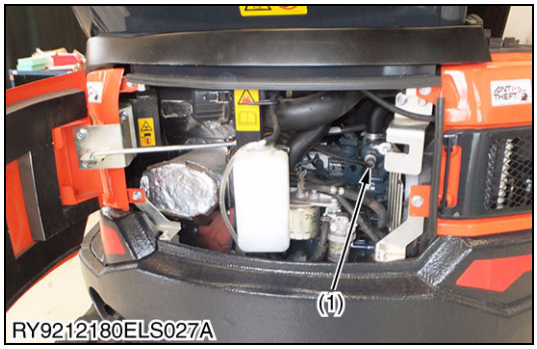
3. Cause of Disconnects

[Inspection Conditions]
1. Key switch: STOP
2. Water temperature sensor connector disconnected.
3. Break of wiring continuity somewhere in the middle.

Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the water temperature sensor voltage and temperature in the tester mode again.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

RY9212180ELS0073US0



RY9212180ELS027A

4. Cause of Short

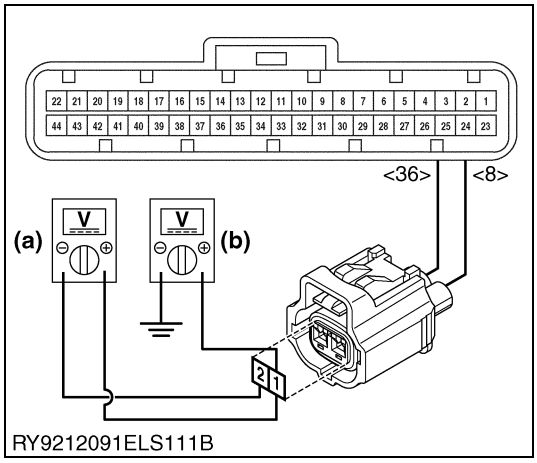
[Inspection Conditions]
1. Key switch: STOP
2. One of the water temperature sensor wires is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the water temperature sensor voltage and temperature again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) Water Temperature Sensor

RY9212180ELS0074US0

[C] Testing with a Circuit Tester



RY9212091ELS111B

1. Checking the Voltage

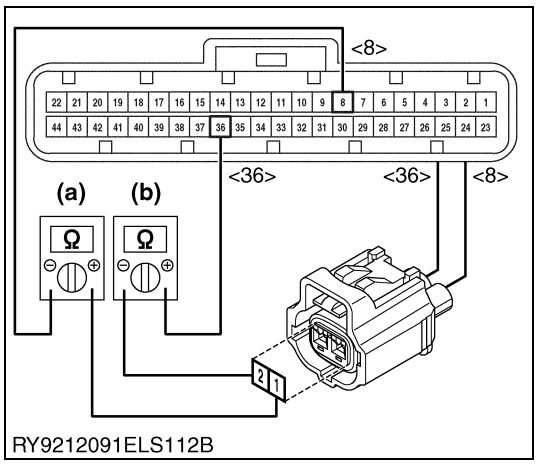
[Test Conditions]

1. Disconnect the water temperature sensor connector.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Water temperature sensor connector	<1>	Water temperature sensor connector	<2>
(b)	Water temperature sensor connector	<1>	Body ground	–

Normal: 5 V
Error: Greatly different from 5 V

RY9212180ELS0075US0



RY9212091ELS112B

2. Checking Continuity

[Test Conditions]

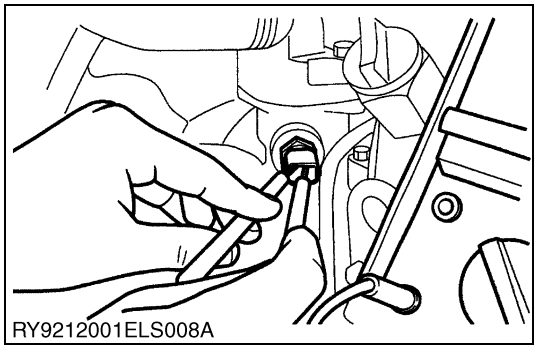
1. Key switch: STOP
2. Disconnect the main ECU connector.
3. Test continuity as per the table below.

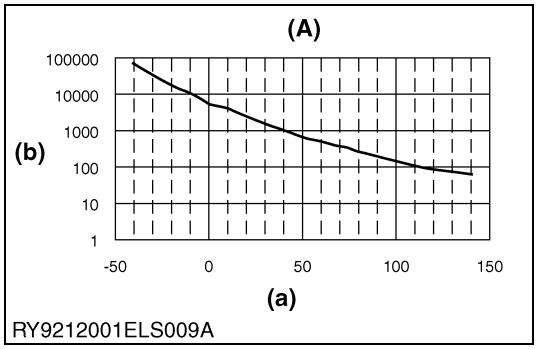
Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Water temperature sensor connector	<1>	Main ECU connector	<8>
(b)	Water temperature sensor connector	<2>	Main ECU connector	<36>

Normal: Continuous
Error: Not continuous

RY9212180ELS0076US0

[D] Checking the Equipment Itself


RY9212001ELS008A



RY9212001ELS009A

1. Inspecting the Water Temperature Sensor

[Test Conditions]

1. Key switch: STOP
2. Disconnect connector from the water temperature sensor and test the sensor.
3. Refer to the table below for the resistance at given water temperatures.
4. Refer to the graph below for the relationship between water temperature and resistance.

Temperature	Resistance value
– 20 °C (– 4 °F)	15.04 kΩ
20 °C (68 °F)	2.45 kΩ
30 °C (86 °F)	1.66 kΩ
40 °C (104 °F)	1.15 kΩ
50 °C (122 °F)	811 Ω
60 °C (140 °F)	584 Ω
70 °C (158 °F)	428 Ω
80 °C (176 °F)	318 Ω
90 °C (194 °F)	240 Ω
100 °C (212 °F)	183.6 Ω
110 °C (230 °F)	141.7 Ω

Assessment Criteria
Normal: Within standard range
Error: Outside standard range

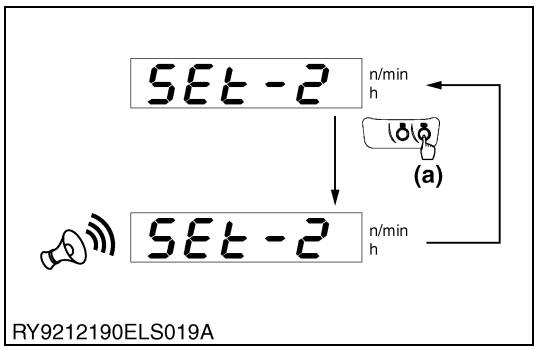
(A) Water Temperature and Resistance
(a) Temperature (°C)
(b) Resistance (Ω)

RY9212180ELS0077US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212190ELS019A

3. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

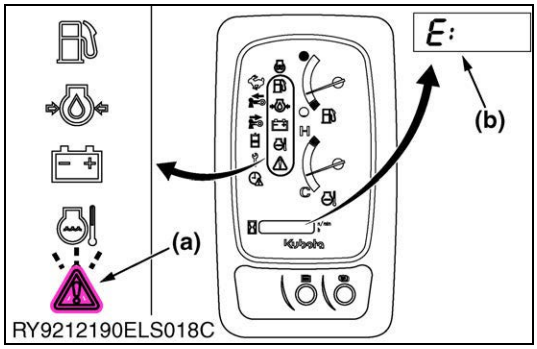
(a) Press and Hold SW2

RY9212190ELS0002US0

[2] MACHINE RELATED SYSTEM

(1) Lever Lock System Error (E:020)

[A] Checking Via the LCD Panel Display



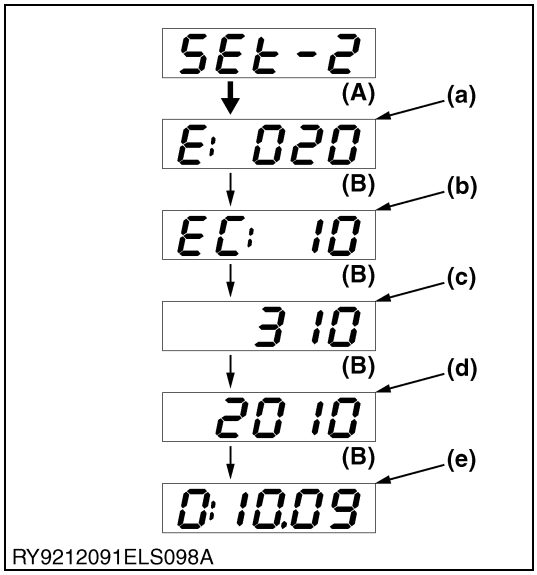
RY9212190ELS018C

1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp
(b) Error Message E:020 (Lever Lock Solenoid Error)

RY9212190ELS0008US0



RY9212091ELS098A

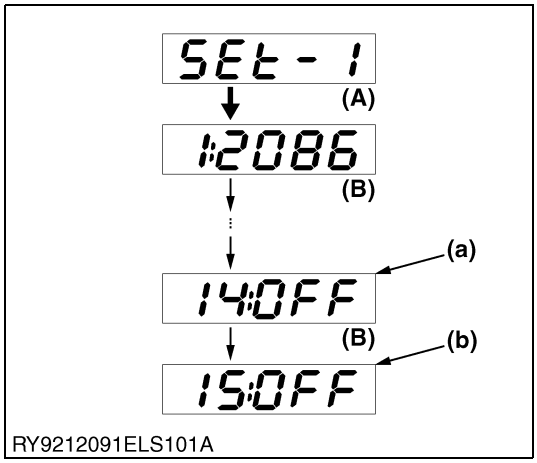
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0134US0



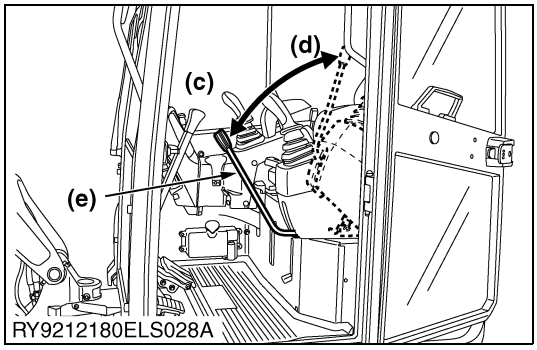
RY9212091ELS101A

3. Tester Mode

1. Select the tester mode.
2. Start the engine.
3. Put the equipment operating lever lock in the [Release] position.
4. Actuate the lever lock switch and lever lock solenoid and check the switch as per the following table.

	Normal	Discon-nected	Shorted
Lever lock switch ON	OFF	OFF	ON
Lever lock switch OFF	ON	OFF	ON
Lever lock solenoid ON	OFF	OFF	ON
Lever lock solenoid OFF	ON	ON	ON

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

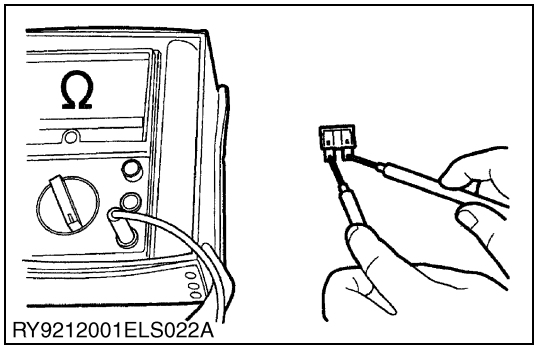


RY9212180ELS028A

(a) ON/OFF Status of the Lever Lock Switch
(b) ON/OFF Status of the Lever Lock Solenoid
(c) Released
(d) Locked
(e) Equipment Operating Lever Lock
(A) Press and Hold SW2
(B) Press SW2

RY9212180ELS0078US0

[B] Inspecting Each Device Visually and Physically



1. Checking fuses

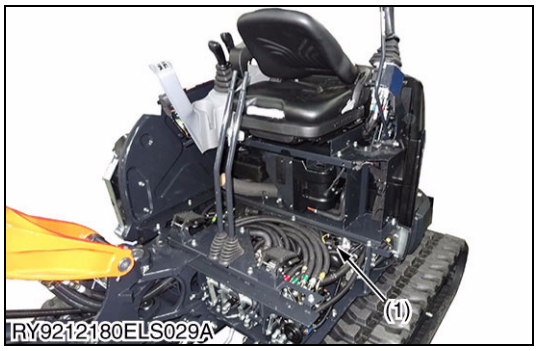
1. Check whether the 5A lever lock fuse is blown.

RY9212001ELS0088US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0

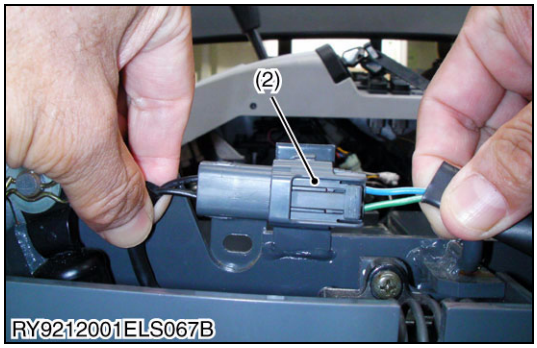


3. Cause of Disconnects

[Inspection Conditions]

1. Key switch: STOP
2. Lever lock switch connector disconnected.
3. Lever lock solenoid connector disconnected.
4. Break of wiring continuity somewhere in the middle.

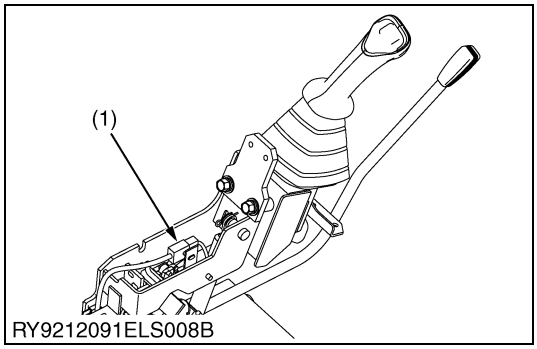
Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the operation of the lever lock switch and solenoid in the tester mode again.



Assessment Criteria
Normal: Not disconnected
Error: Disconnected

(1) Lever Lock Solenoid Connector (2) Lever Lock Switch Connector

RY9212180ELS0079US0



4. Cause of Short

[Inspection Conditions]

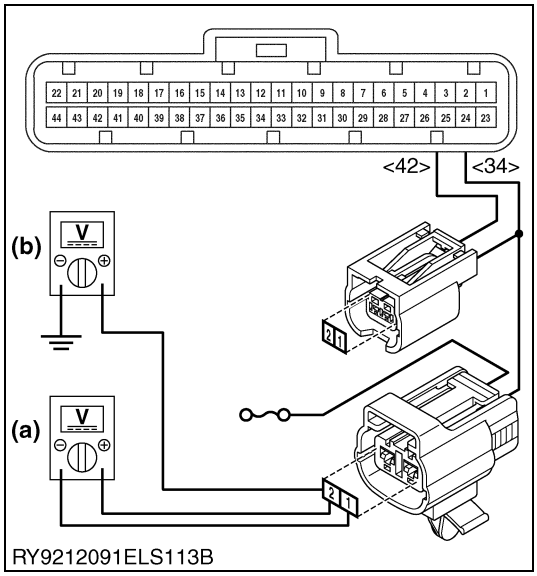
1. Key switch: STOP
2. One of the wires of the lever lock switch connector and/or lever lock solenoid connector is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the operation of the lever lock switch and solenoid again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

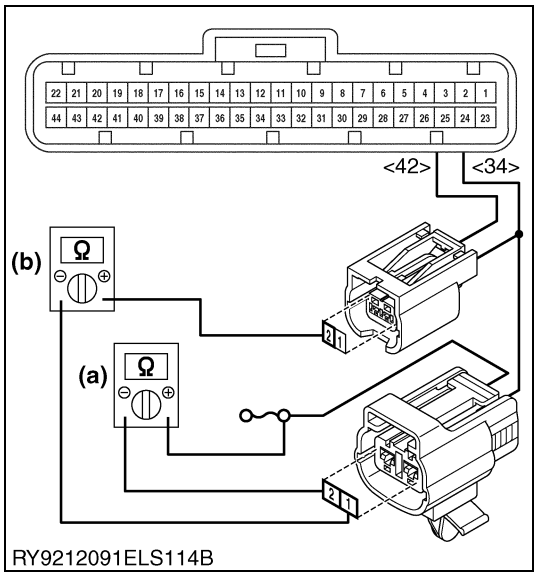
(1) Lever Lock Switch Connector

RY9212180ELS0080US0

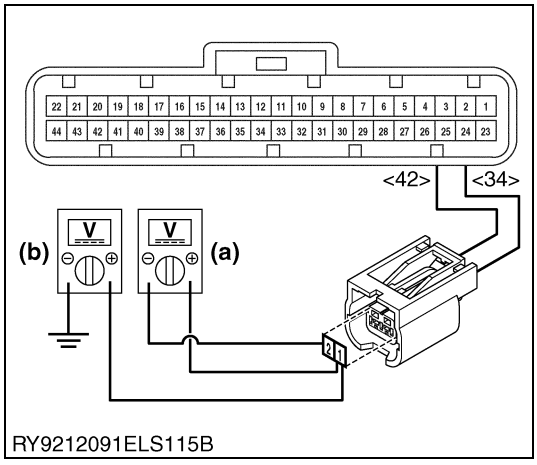
[C] Testing with a Circuit Tester



RY9212091ELS113B



RY9212091ELS114B



RY9212091ELS115B

1. Checking the Voltage (Lever Lock Switch)

[Test Conditions]

1. Disconnect the lever lock switch connector.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Lever lock switch connector	<2>	Lever lock switch connector	<1>
(b)	Lever lock switch connector	<2>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212180ELS0081US0

2. Checking Continuity (Lever Lock Switch)

[Test Conditions]

1. Key switch: STOP
2. Disconnect lever lock switch connector and lever lock solenoid connector.
3. Remove the lever lock fuse (5A).
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Lever lock fuse	–	Lever lock switch connector	<2>
(b)	Lever lock solenoid connector	<2>	Lever lock switch connector	<1>

Normal: Continuous
Error: Not continuous

RY9212180ELS0082US0

3. Checking the Voltage (Lever Lock Solenoid)

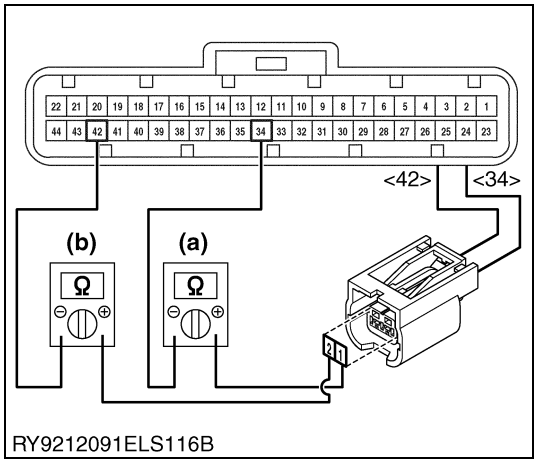
[Test Conditions]

1. Leaving the lever lock switch connected, disconnect lever lock solenoid connector.
2. Key switch: RUN
3. Put the equipment operating lever lock in the [Release] position.
4. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Lever lock solenoid connector	<1>	Lever lock solenoid connector	<2>
(b)	Lever lock solenoid connector	<1>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212180ELS0083US0



RY9212091ELS116B

4. Checking Continuity (Lever Lock Solenoid)

[Test Conditions]

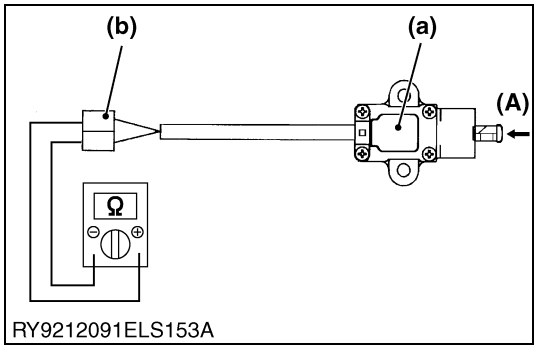
1. Key switch: STOP
2. Disconnect the main ECU connector.
3. Disconnect the lever lock solenoid connector.
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Lever lock solenoid connector	<1>	Main ECU connector	<34>
(b)	Lever lock solenoid connector	<2>	Main ECU connector	<42>

Normal: Continuous
Error: Not continuous

RY9212180ELS0084US0

[D] Checking the Equipment Itself



RY9212091ELS153A

1. Inspecting the Lever Lock Switch

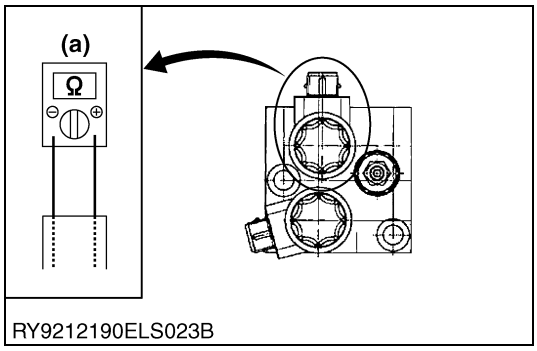
[Inspection Conditions]

1. Key switch: STOP
2. Disconnect the lever lock switch connector from the machine, press the switch and check for simple continuity.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

(a) Lever Lock Switch **(A) Press the Switch**
(b) Lever Lock Switch Connector

RY9212180ELS0085US0



RY9212190ELS023B

2. Inspecting the Lever Lock Solenoid

[Inspection Conditions]

1. Key switch: STOP
2. Disconnect lever lock solenoid connector from the equipment and test the solenoid independently.

Lever lock solenoid	Factory specification	12 Ω ± 10 %

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

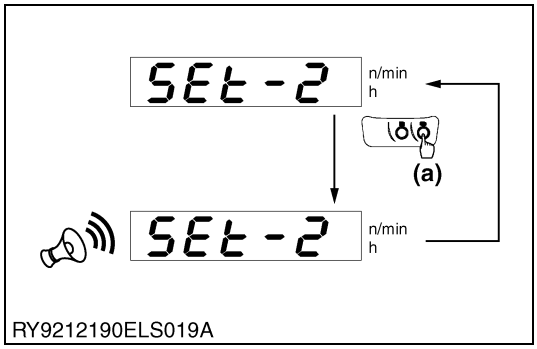
(a) Lever Lock Solenoid Terminals

RY9212180ELS0086US0

3. Settings after replacing device

1. No settings required.

RY9212001ELS0020US0



RY9212190ELS019A

4. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

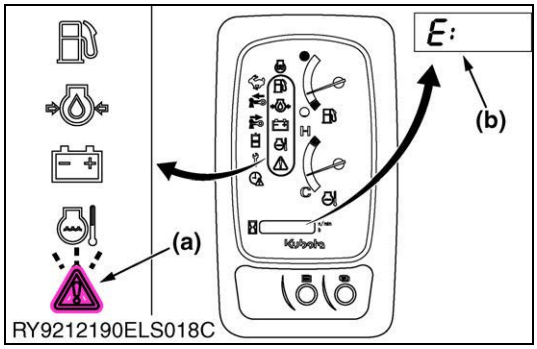
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and Hold SW2

RY9212190ELS0011US0

(2) Travel 2-Speed System Error (E:021)

[A] Checking Via the LCD Panel Display



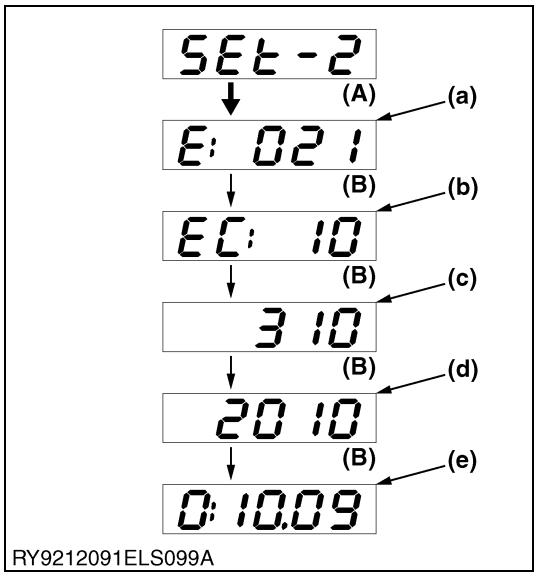
RY9212190ELS018C

1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp
(b) Error Message E:021 (Travel 2-Speed System Error)

RY9212190ELS0012US0



RY9212091ELS099A

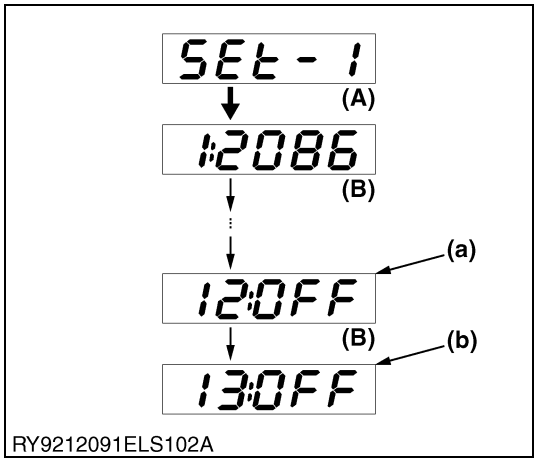
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

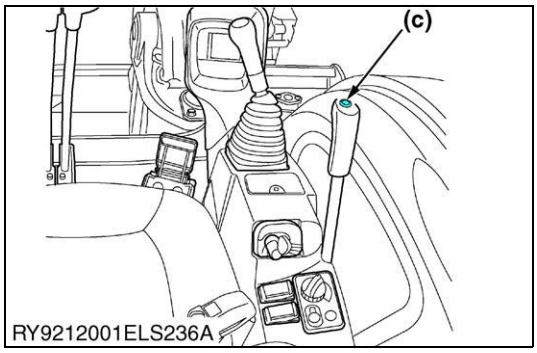
E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0145US0



RY9212091ELS102A



RY9212001ELS236A

3. Tester Mode

1. Select the tester mode.
2. Start the engine.
3. Put the equipment operating lever lock in the [Release] position and press the 2-speed switch.
4. Operate the 2-speed switch and check the operation of the 2-speed switch and 2-speed solenoid as per the table below.

	Normal	2-speed lamp	Dis-con-nected	2-speed lamp	Shorted	2-speed lamp
2-speed switch ON	ON	Lit	OFF	Not lit	ON	Lit
2-speed switch OFF	OFF	Not lit	OFF	Not lit	ON	Lit
2-speed solenoid ON	ON	Lit	ON	Lit	OFF	Lit
2-speed solenoid OFF	OFF	Not lit	OFF	Not lit	OFF	Not lit

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

(a) ON/OFF Status of 2-Speed Switch
(b) ON/OFF Status of 2-Speed Solenoid
(c) 2-Speed Switch
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0146US0

[B] Inspecting Each Device Visually and Physically

1. Checking fuses

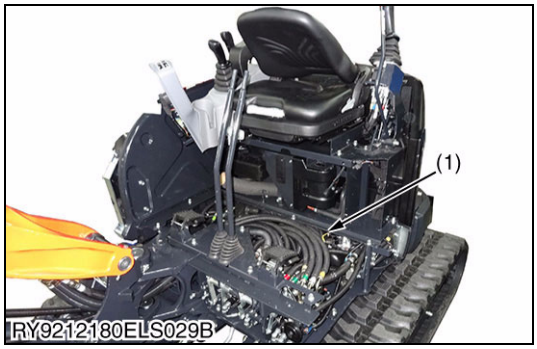
1. Checking fuses is not necessary.

RY9212001ELS0008US0

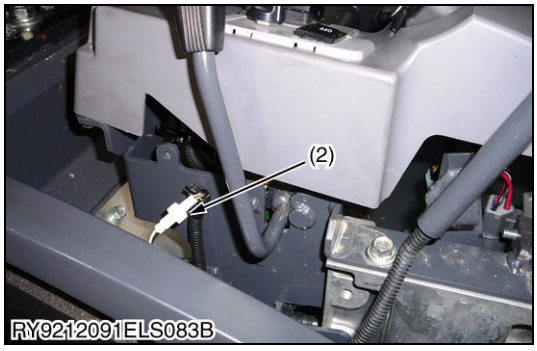
2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0



RY9212180ELS029B



RY9212091ELS083B

3. Cause of Disconnects

[Inspection Conditions]

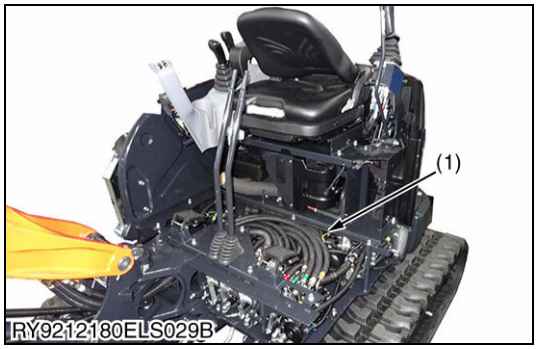
1. Key switch: STOP
2. 2-speed solenoid connector disconnected.
3. 2-speed switch connector disconnected.
4. Break of wiring continuity somewhere in the middle.

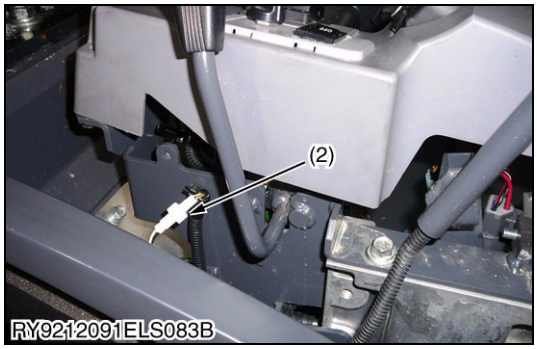
Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the 2-speed switch and solenoid in the tester mode again.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

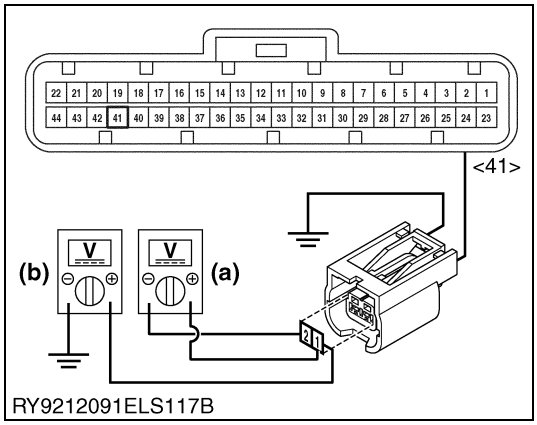
(1) 2-Speed Solenoid Connector (2) 2-Speed Switch Connector

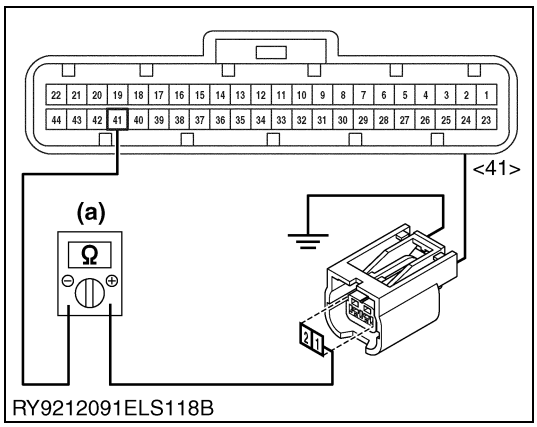
RY9212180ELS0087US0





[C] Testing with a Circuit Tester





4. Cause of Short

[Inspection Conditions]

1. Key switch: STOP
2. One of the wires of the 2-speed switch connector and/or 2-speed solenoid connector is pinched against or is touching the body
   If the insulation is stripped, repair it properly and check the 2-speed solenoid and switch again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) 2-Speed Solenoid Connector (2) 2-Speed Switch Connector

RY9212180ELS0088US0

1. Checking the Voltage (2-Speed Solenoid)

[Test Conditions]

1. Disconnect the travel 2-speed solenoid connector.
2. Key switch: RUN
3. Put the equipment operating lever lock in the [Release] position and press the 2-speed switch.
4. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	2-speed solenoid connector	<1>	2-speed solenoid connector	<2>
(b)	2-speed solenoid connector	<1>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212180ELS0089US0

2. Checking Continuity (2-Speed Solenoid)

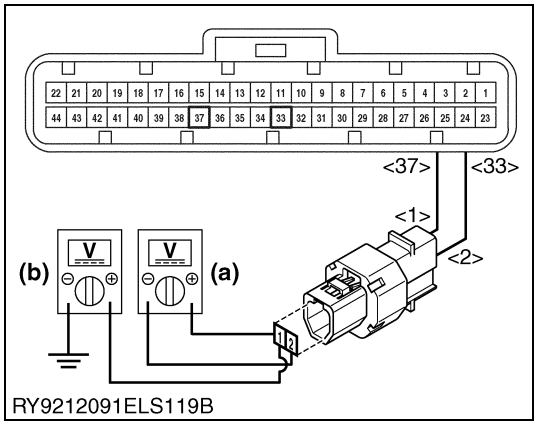
[Test Conditions]

1. Key switch: STOP
2. Disconnect the travel 2-speed solenoid connector.
3. Disconnect the ECU connector.
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	2-speed solenoid connector	<1>	Main ECU connector	<41>

Normal: Continuous
Error: Not continuous

RY9212180ELS0090US0



3. Checking the Voltage (2-Speed Switch)

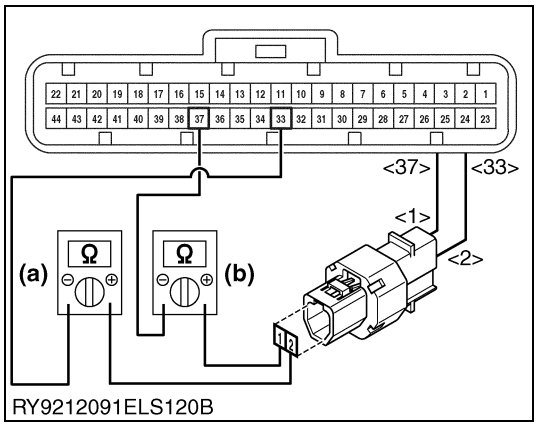
[Test Conditions]

1. Disconnect the 2-speed switch connector.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	2-speed switch connector	<1>	2-speed switch connector	<2>
(b)	2-speed switch connector	<1>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212180ELS0091US0



4. Checking Continuity (2-Speed Switch)

[Test Conditions]

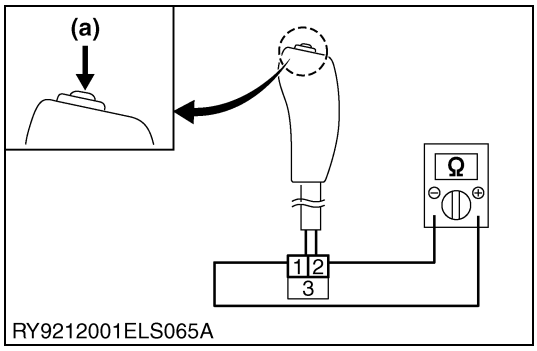
1. Key switch: STOP
2. Disconnect the ECU connector.
3. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	2-speed switch connector	<2>	Main ECU connector	<33>
(b)	2-speed switch connector	<1>	Main ECU connector	<37>

Normal: Continuous
Error: Not continuous

RY9212180ELS0092US0

[D] Checking the Equipment Itself



1. Inspecting the 2-Speed Switch

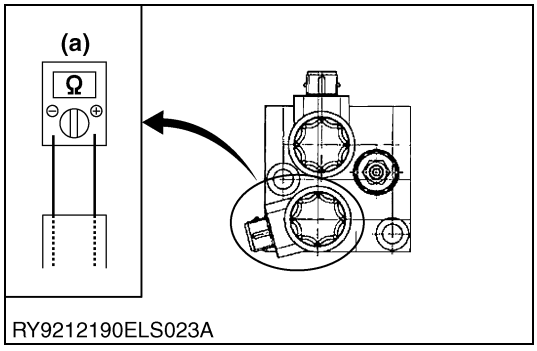
[Inspection Conditions]

1. Key switch: STOP
2. Disconnect the 2-speed switch connector from the machine, press the switch and check for simple continuity.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

(a) 2-Speed Switch

RY9212180ELS0093US0



2. Inspecting the 2-Speed Solenoid

[Inspection Conditions]

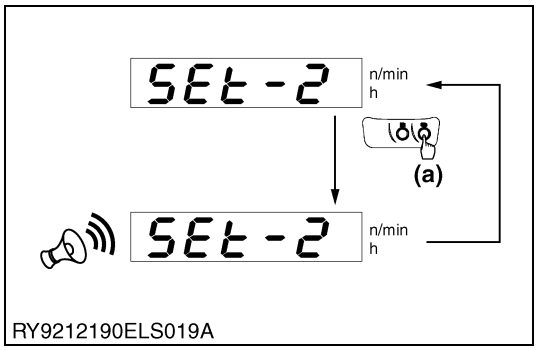
1. Key switch: STOP
2. Disconnect 2-speed solenoid connector from the equipment and test the solenoid independently.

2-speed solenoid	Factory specification	8 Ω ± 15 %

Assessment Criteria
Normal: Within standard range
Error: Outside standard range

(a) 2-Speed Solenoid Terminal

RY9212180ELS0094US0



RY9212190ELS019A

3. Settings after replacing device

1. No settings required.

RY9212001ELS0020US0

4. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

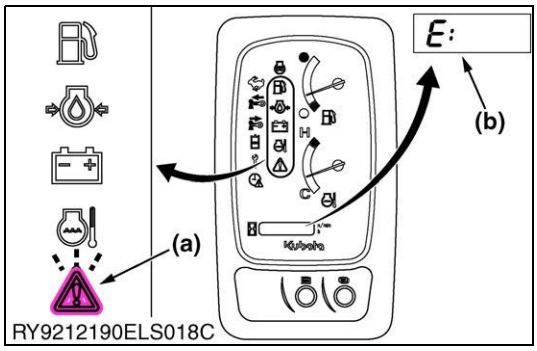
(a) Press and Hold SW2

RY9212190ELS0011US0

[3] POWER SUPPLY SYSTEM

(1) Over-Voltage (E:025)

[A] LCD Panel Display Content



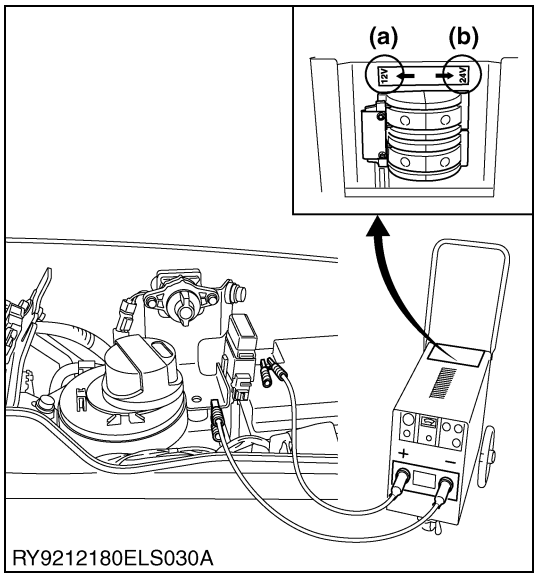
RY9212190ELS018C

1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp
(b) Error Message E:025 (Over-Voltage)

RY9212190ELS0014US0



RY9212180ELS030A

Check whether the machine has been jump started with a 24 V battery.

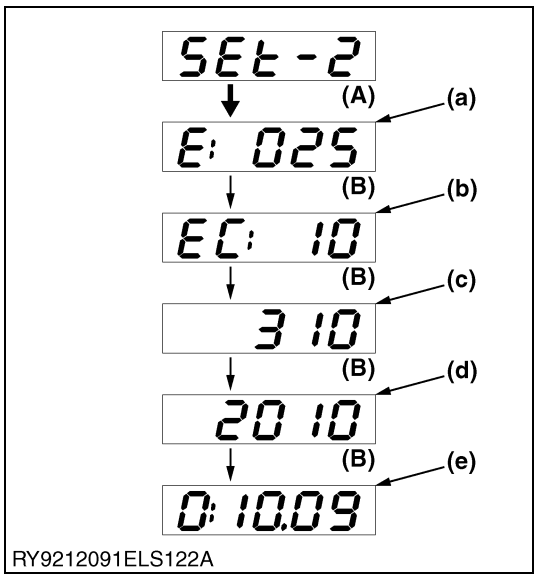
(a) 12 V
(b) 24 V

RY9212180ELS0095US0

2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

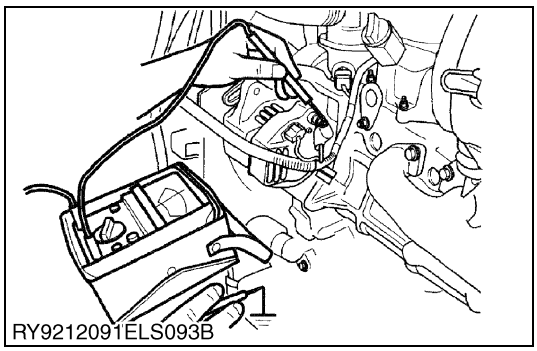
E.g.) Given a history with the last error on October 9, 2010 at 310 hours.



RY9212091ELS122A

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0156US0

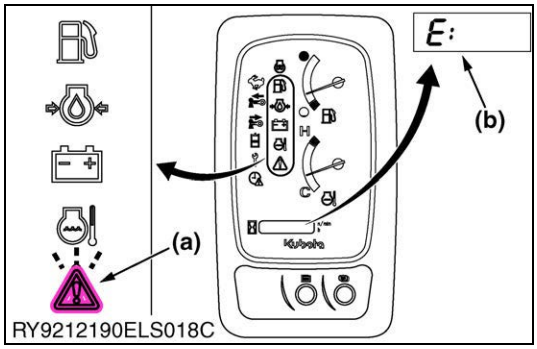

RY9212091ELS093B

The alternator's charging system may be faulty. Refer to the page on charging system errors.

RY9212091ELS0157US0

(2) External 5 V Short Error (E:027)

[A] LCD Panel Display Content



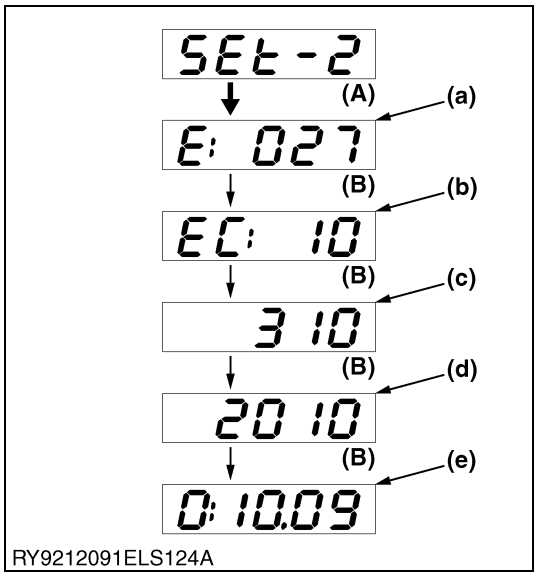
RY9212190ELS018C

1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp
(b) Error Message E:027 (5 V Short Error)

RY9212190ELS0015US0



RY9212091ELS124A

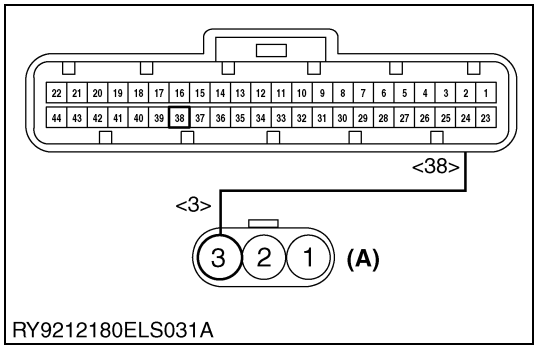
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0159US0



RY9212180ELS031A

3. Inspecting the 5 V Line

[Inspection Conditions]

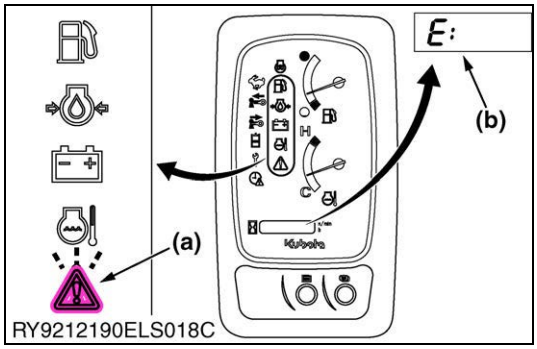
1. Check whether any lines are pinched against or touching the body. If the insulation is stripped, repair it properly and check the meter's display again.

(A) Travel Pressure Sensor

RY9212180ELS0096US0

(3) External 12 V Short Error (E:028)

[A] LCD Panel Display Content



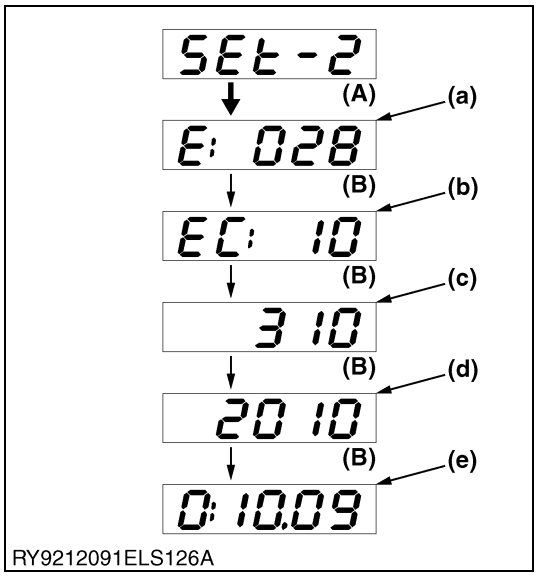
RY9212190ELS018C

1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp
(b) Error Message E:028 (12 V Short Error)

RY9212190ELS0016US0



RY9212091ELS126A

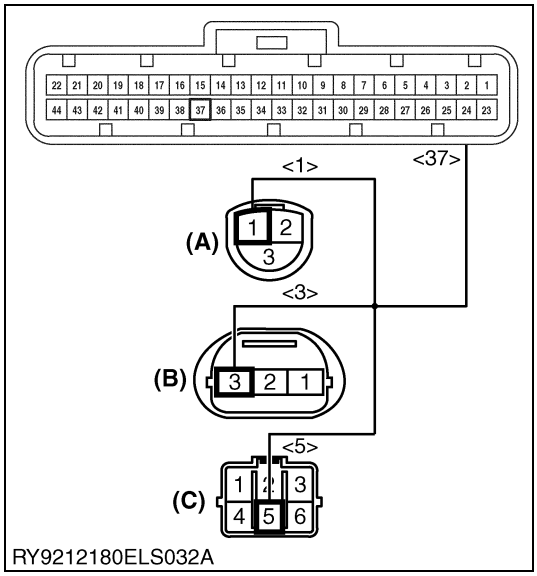
2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0162US0



RY9212180ELS032A

3. Inspecting the 12 V Line

[Inspection Conditions]

1. Check whether any lines are pinched against or touching the body. If the insulation is stripped, repair it properly and check the meter's display again.

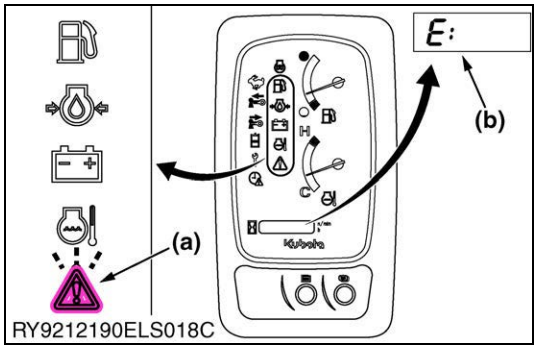
(A) 2-Speed Switch Connector
(B) Engine RPM Sensor Connector
(C) Anti-Theft Connector

RY9212180ELS0097US0

[4] COMMUNICATION SYSTEM

(1) CAN Communication Error (E:001)

[A] LCD Panel Display Content



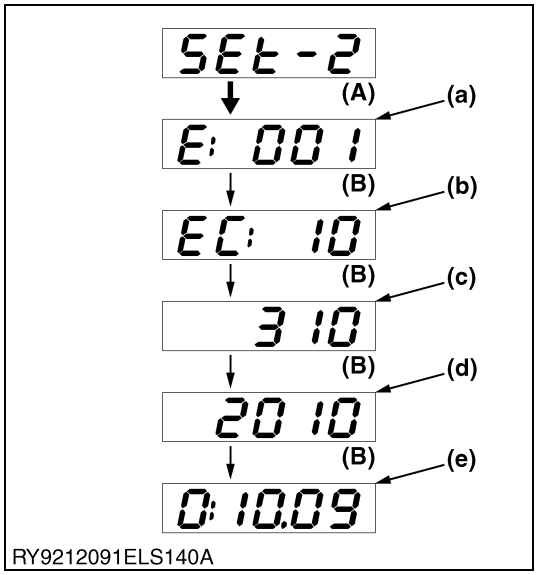
RY9212190ELS018C

1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning Lamp
(b) Error Message E:001 (CAN Communications Error)

RY9212190ELS0017US0



RY9212091ELS140A

2. Reading the Error History

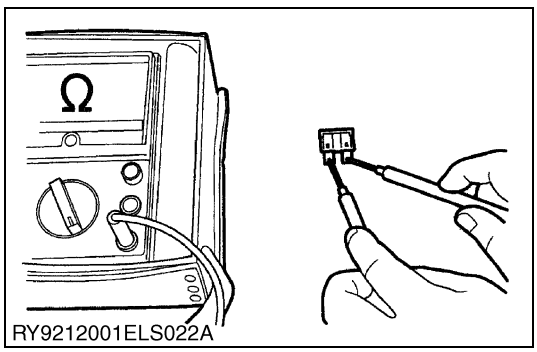
1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error Code
(b) No. of Errors
(c) Hour Meter at Last Occurrence
(d) Date at Last Occurrence (Y)
(e) Date at Last Occurrence (M/D)
(A) Press and Hold SW2
(B) Press SW2

RY9212091ELS0184US0

[B] Inspecting Each Device Visually and Physically



RY9212001ELS022A

1. Checking the Fuse

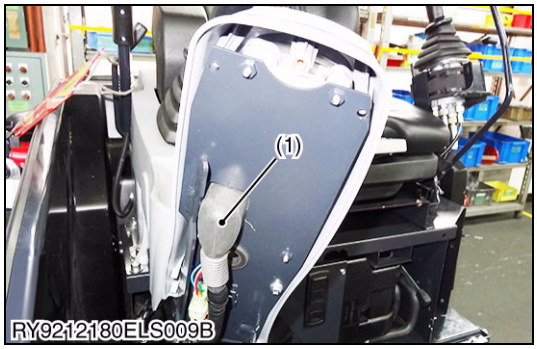
1. Check whether the main ECU (+B) 10 A fuse is blown.

RY9212180ELS0098US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0



3. Cause of Disconnects

[Test Conditions]

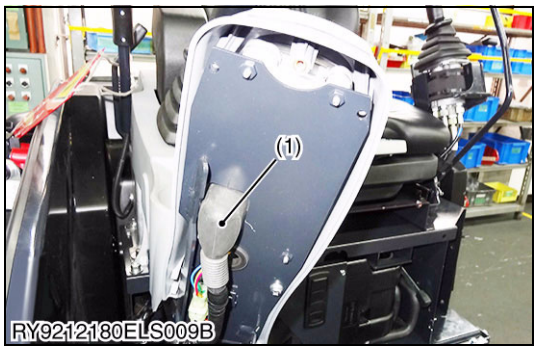
1. Key switch: STOP
2. LCD meter connector disconnected.
3. Break of wiring continuity somewhere in the middle.

Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector in securely.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

(1) LCD Meter Connector

RY9212180ELS0099US0



4. Cause of Short

[Inspection Conditions]

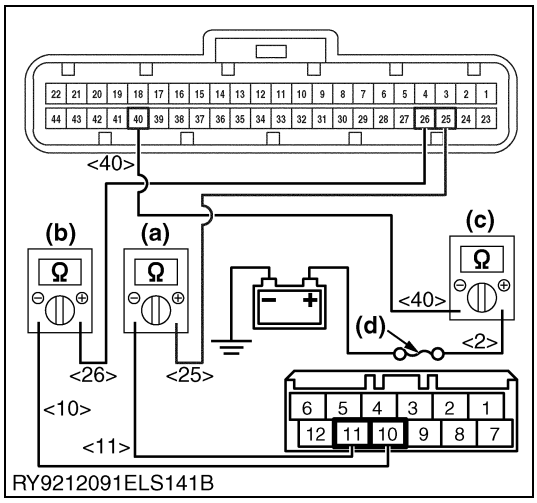
1. Key switch: STOP
2. One of the LCD meter connector wires is pinched against or is touching the body. If the insulation is stripped, repair it properly.

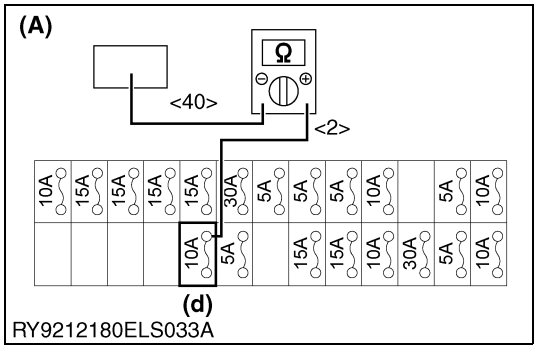
Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) LCD Meter Connector

RY9212180ELS0100US0

[C] Testing with a Circuit Tester





1. Checking Continuity

[Test Conditions]

1. Key switch: STOP
2. Disconnect the main ECU connector.
3. Remove the ECU (+B)10 A fuse.
4. Check for continuity in the combinations shown in the table below.

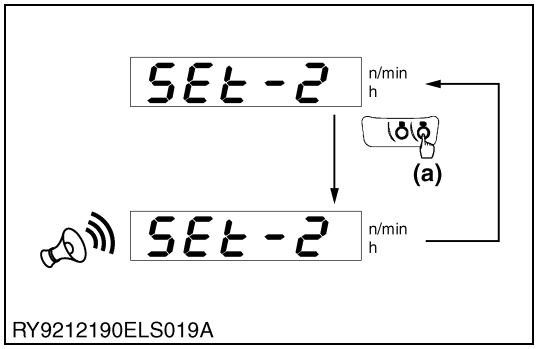
Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Main ECU connector	<25>	LCD meter connector	<11>
(b)	Main ECU connector	<26>	LCD meter connector	<10>
(c)	Meter (+B) 10 A fuse	<2>	Main ECU connector	<40>

Normal: Continuous
Error: Not continuous

(A) (c) Measurement Details **(d) ECU (+B) 10 A Fuse**

RY9212180ELS0101US0

[D] Testing the Equipment Itself



RY9212190ELS019A

1. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

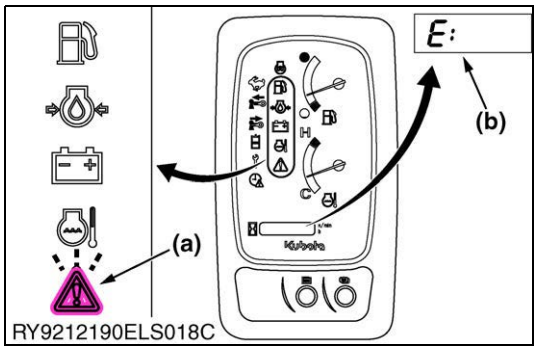
(a) Press and Hold SW2

RY9212190ELS0018US0

[5] ANTI-THEFT SYSTEM

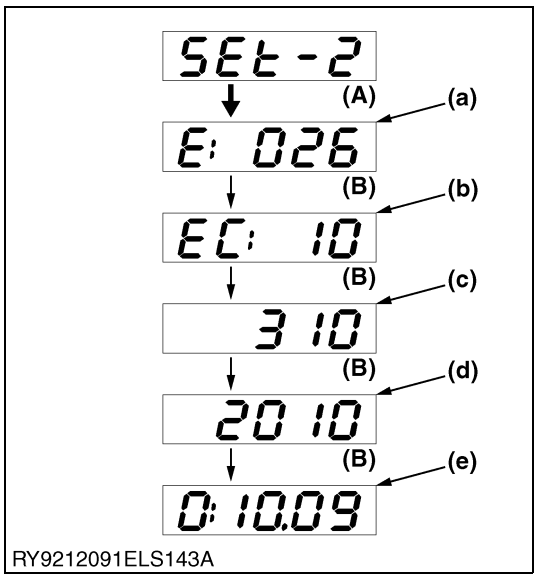
(1) Anti-Theft System Error (E:026)

[A] LCD Panel Display Content

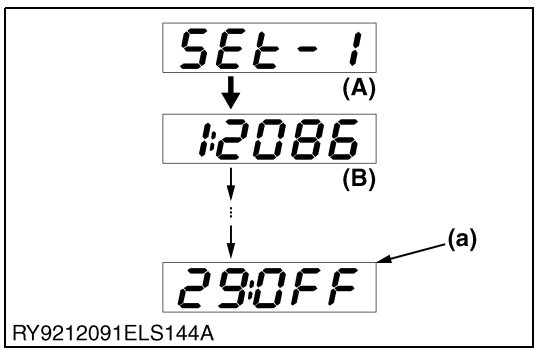


RY9212190ELS018C

RY9212091ELS154B



RY9212091ELS143A



RY9212091ELS144A

1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning lamp
(b) Error message E:026 (Anti-theft system error)

RY9212180ELS0102US0

[Test Conditions]
1. Key switch : STOP
2. Check whether the anti-theft indicator is blinking or not.

(a) Anti-theft indicator

RY9212091ELS0190US0

2. Reading the Error History

1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(a) Error code
(b) No. of errors
(c) Hour meter at last occurrence
(d) Date at last occurrence (Y)
(e) Date at last occurrence (M/D)
(A) Press and hold SW2
(B) Press SW2

RY9212091ELS0191US0

3. Tester Mode

1. Select the tester mode.
2. Check whether the anti-theft antenna is in a normal or error state.

	Normal	Error
Anti-theft antenna	OFF	ON

(A) Press and hold SW2
(B) Press SW2
(a) Anti-theft antenna

RY9212091ELS0192US0

[B] Inspecting Each Device Visually and Physically

1. Checking fuses

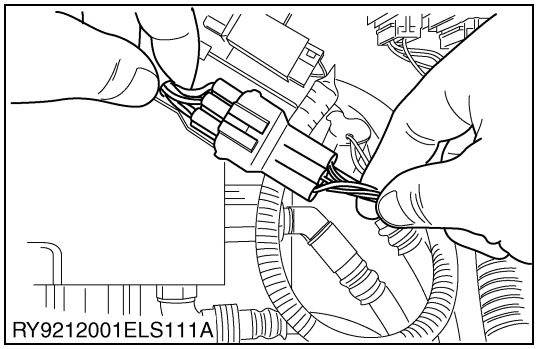
1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0


RY9212001ELS111A

3. Cause of Disconnects

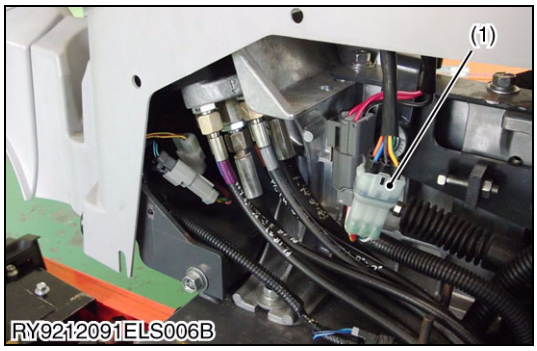
[Test Conditions]

1. Key switch: STOP
2. Anti-theft connector disconnected.
3. Break of wiring continuity somewhere in the middle.

Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the anti-theft antenna in the tester mode again.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

RY9212180ELS0103US0



RY9212091ELS006B

4. Cause of Short

[Test Conditions]

1. Key switch: STOP
2. One of the anti-theft connector wires is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the anti-theft antenna again in the tester mode.

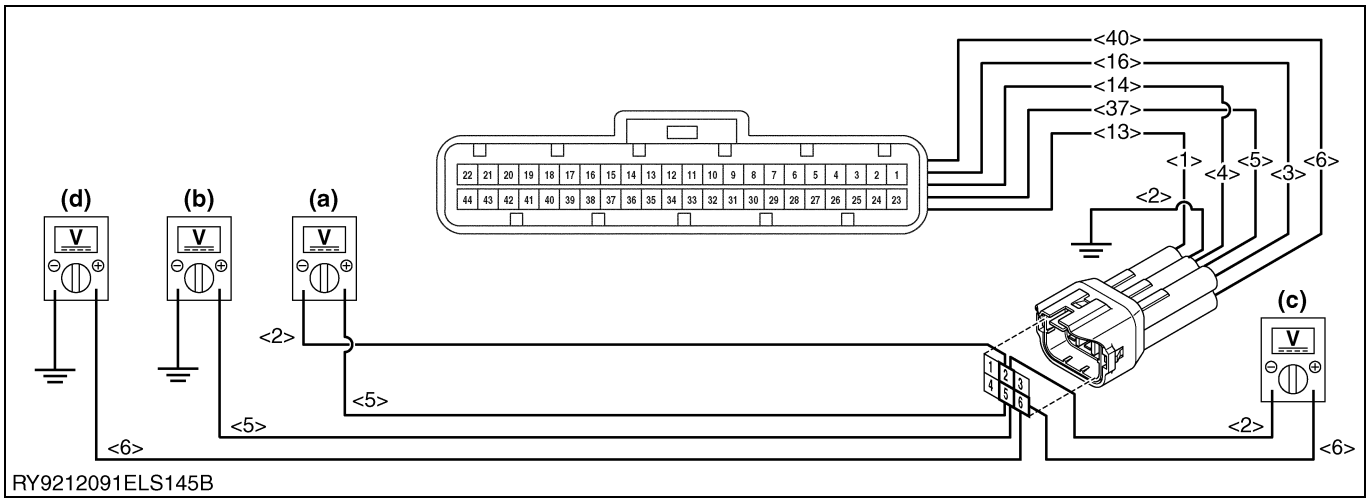
Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) Anti-theft connector

RY9212180ELS0104US0

[C] Testing with a Circuit Tester

1. Checking the Voltage



[Test Conditions]

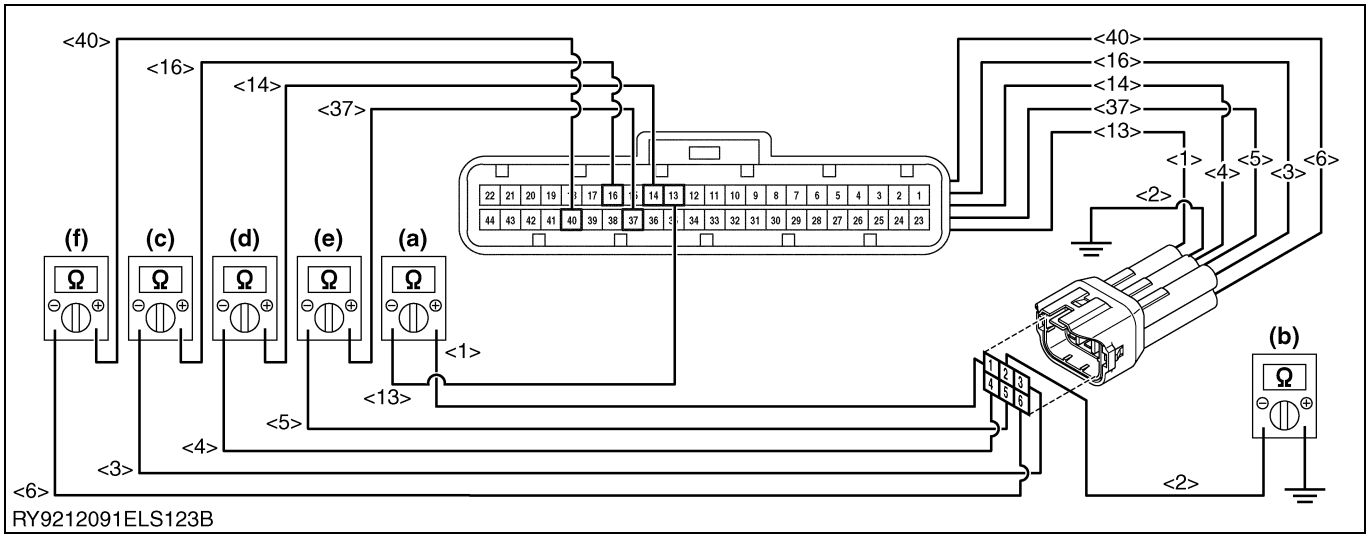
1. Disconnect the anti-theft connector.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Anti-theft connector	<5>	Anti-theft connector	<2>
(b)	Anti-theft connector	<5>	Body ground	–
(c)	Anti-theft connector	<6>	Anti-theft connector	<2>
(d)	Anti-theft connector	<6>	Body ground	–

Normal: Stable at about 10 V
Error: Greatly different from 10 V

RY9212180ELS0105US0

2. Checking Continuity



[Test Conditions]

1. Key switch: STOP
2. Disconnect the anti-theft connector.
3. Disconnect the ECU connector.
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Anti-theft connector	<1>	Main ECU connector	<13>
(b)	Anti-theft connector	<2>	Body ground	–
(c)	Anti-theft connector	<3>	Main ECU connector	<16>
(d)	Anti-theft connector	<4>	Main ECU connector	<14>
(e)	Anti-theft connector	<5>	Main ECU connector	<37>
(f)	Anti-theft connector	<6>	Main ECU connector	<40>

Normal: Continuous
Error: Not continuous

RY9212180ELS0106US0

[D] Checking the Equipment Itself

RY9212091ELS154A

1. Inspecting the Anti-Theft Antenna

[Test Conditions]

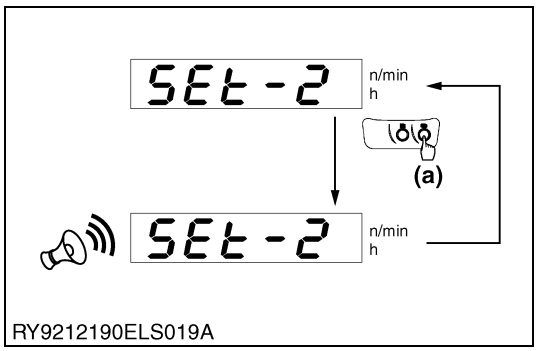
1. Key switch: STOP
2. Replace with a new antenna.
3. Make sure neither the warning lamp nor the warning display comes on.

RY9212091ELS0197US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212190ELS019A

3. Clearing the Error History

1. After fixing the problem, select Clear Error History and clear the history.
2. After clearing the history, read the error history again and make sure the error does not exist anymore.

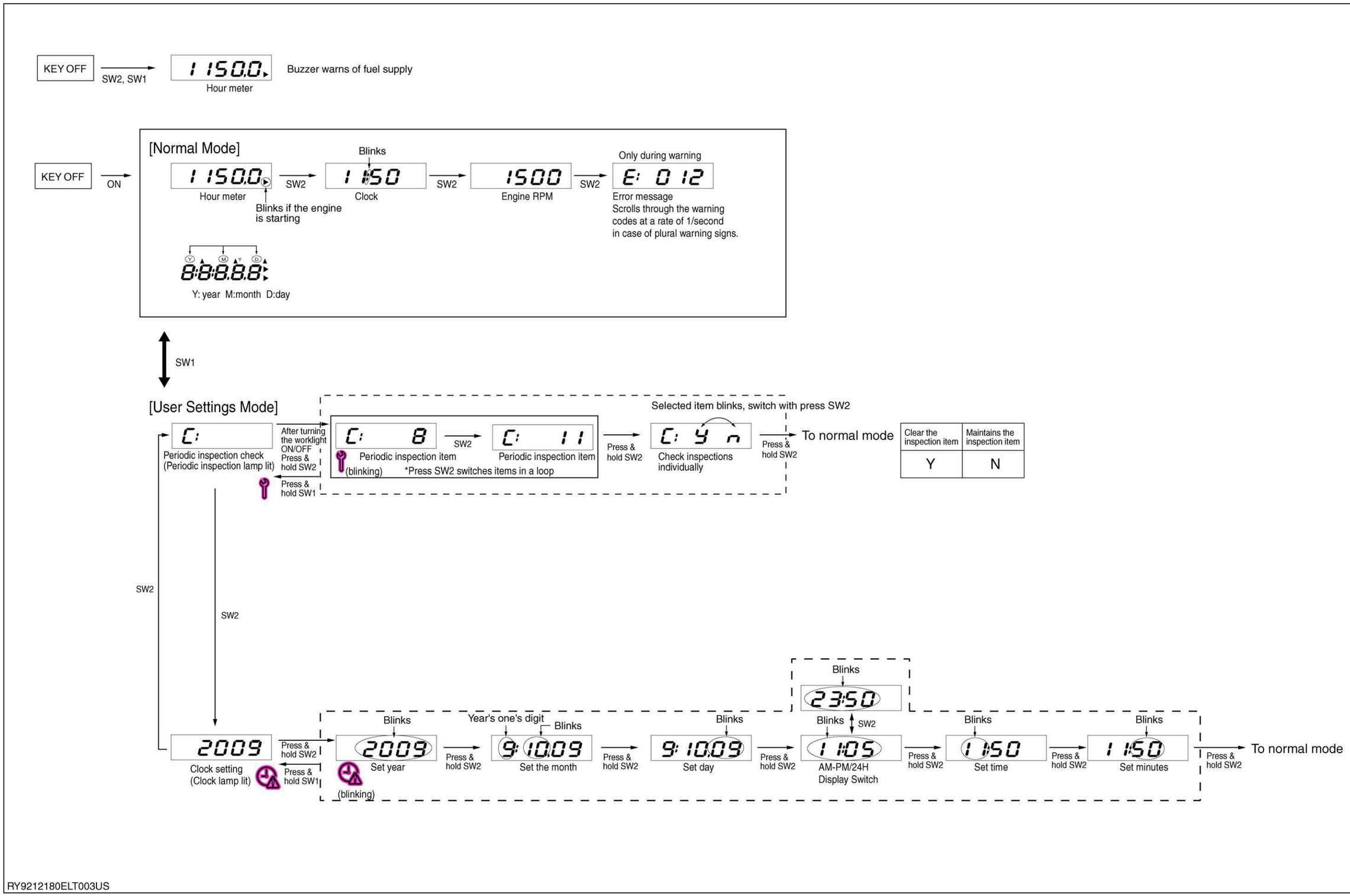
Assessment Criteria
Normal: Error history cleared
Error: Error history failed to clear

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and Hold SW2

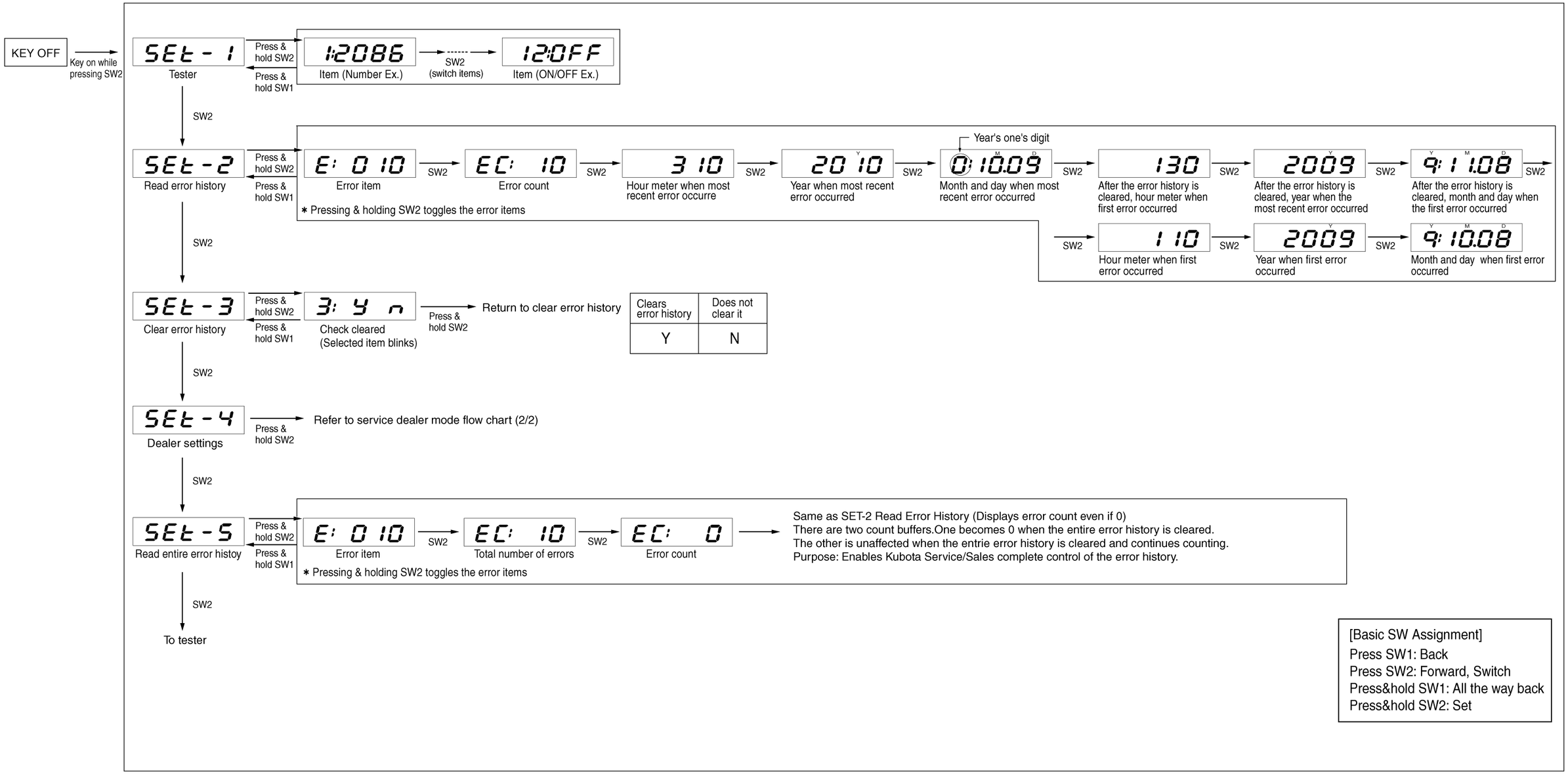
RY9212190ELS0002US0

8. FLOW CHART OF THE NORMAL AND USER SETTINGS MODES



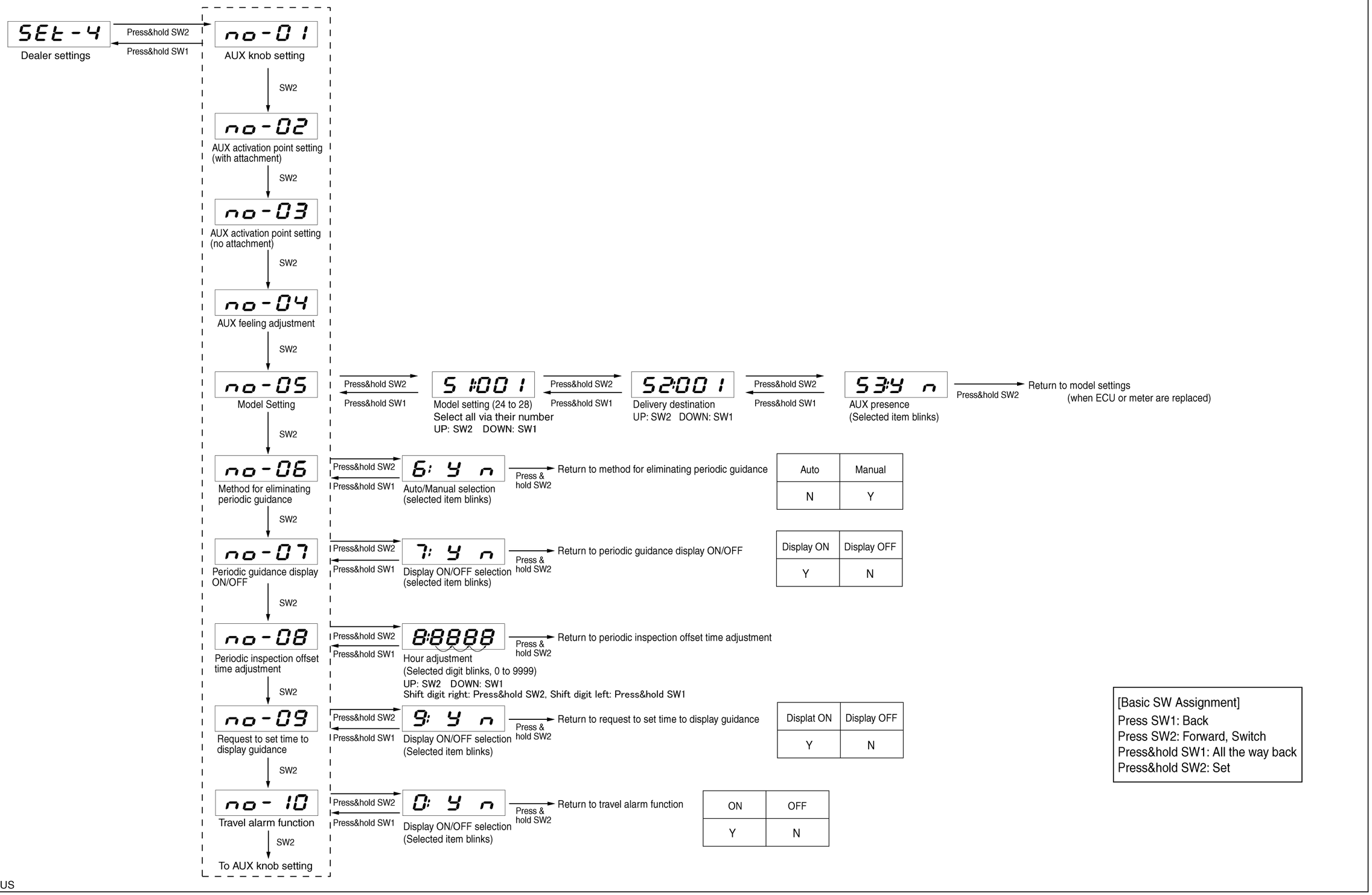
RY9212180ELT003US

9. SERVICE DEALER MODE FLOW CHART (1/2)



RY9212091ELT005US

10. SERVICE DEALER MODE FLOW CHART (2/2)



RY9212180ELT004US

5 CABIN

SERVICING

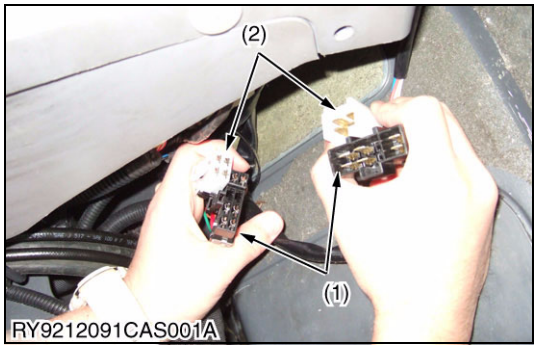
CONTENTS

1. CABIN REMOVAL AND MOUNTING

CAUTION

- **Always disconnect the battery terminals prior to cabin removal or mounting.**

RY9212091CAS0031US0



1. Put the bucket on the ground and stop the engine.

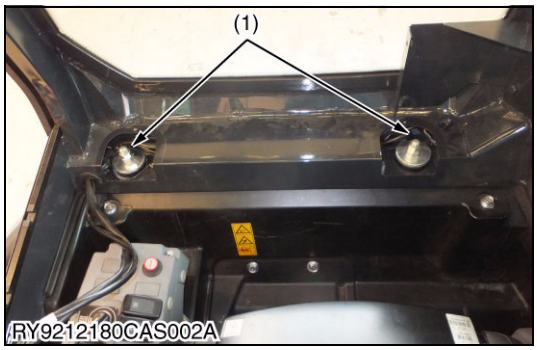
Slide the seat toward the front of the machine and disconnect the two connectors of the cabin harness and the machine's main harness.

(1) Main Harness Connector (2) Wiper Harness Connector

RY9212091CAS0001US0

2. Support the top of the cabin with a nylon sling.

RY9212180CAS0001US0

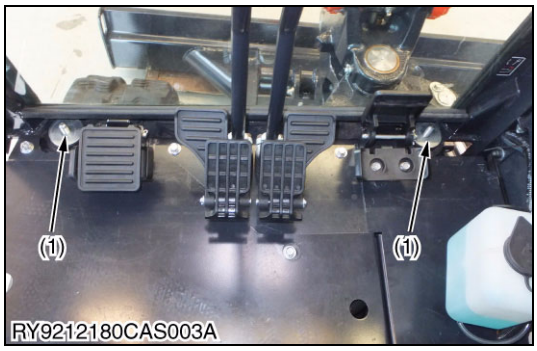


3. Remove the two cabin mounting nuts toward the back of the machine.
4. Remove the floor mat and the two cabin mounting nuts toward the front of the machine.

Tightening torque	Nut (cab)	107.9 to 125.5 N·m 11.0 to 12.8 kgf·m 79.6 to 92.6 lbf·ft

(1) Nut (Cab)

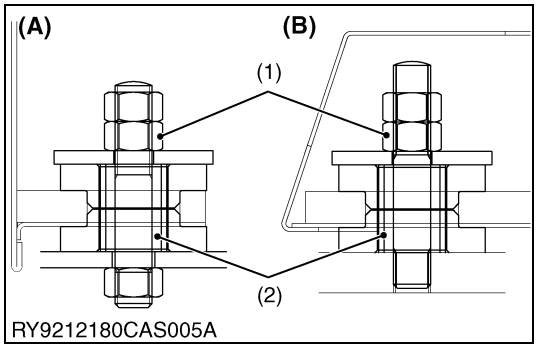
RY9212180CAS0002US0




RY9212180CAS020A

5. Remove the fixing bolt, and allow the washer tank to move.

RY9212180CAS0018US0



RY9212180CAS005A

- Stud Bolt Installation

Tightening torque	Stud (front) Stud (rear)	62 to 73 N·m 6.3 to 7.5 kgf·m 46 to 54 lbf·ft

Apply thread lock (Loctite AN320-72 equivalent).

- Tighten nut

Tightening torque	Nut	107.9 to 125.5 N·m 11.00 to 12.80 kgf·m 79.58 to 92.56 lbf·ft

(1) Nut (Cab)
(2) Stud

(A) 2 Places at Front of Machine
(B) 2 Places at Rear of Machine

RY9212180CAS0003US0

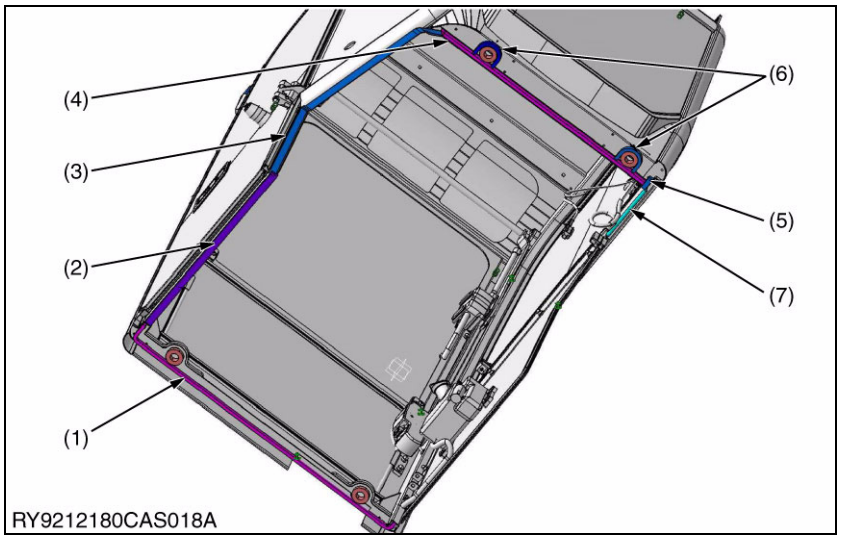
6. Raise the cabin quietly to remove.

CAUTION

- **Do this while moving the washer tank so that it will not interfere with the defroster.**

RY9212180CAS0004US0

Seal Rubber



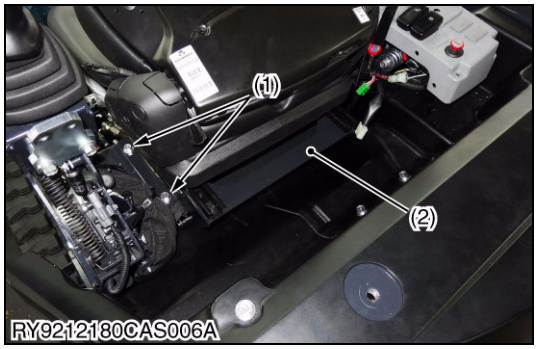
RY9212180CAS018A

(1) Seal Rubber (1020)
(2) Seal Rubber (630)
(3) Seal Rubber (865)
(4) Seal Rubber (700)
(5) Seal Rubber (40)
(6) Seal Rubber (175)
(7) Trim (190)

No empty space between the seal rubbers.

RY9212180CAS0021US0

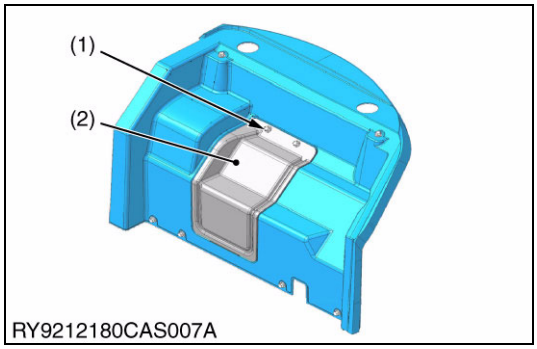
2. HEATER REMOVAL AND INSTALLATION



1. Remove the seat bracket mounting bolts, and then remove the seat.

(1) Bolt (2) Seat Bracket

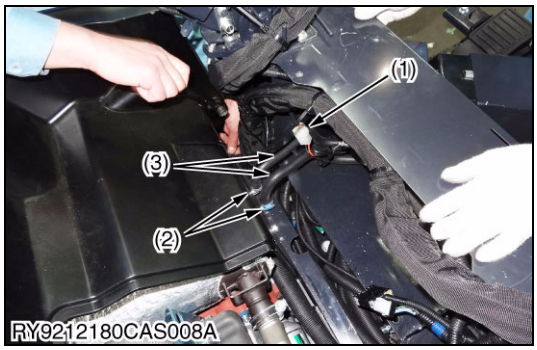
RY9212180CAS0019US0



2. Remove the bolts and then the cover.

(1) Bolt (2) Cover

RY9212180CAS0005US0



3. Remove the 4P connector from the blower motor.
4. Loosen the hose clamp and remove the hose.

CAUTION

- **Make sure the coolant is cool before performing this work.**

(1) 4P Connector (3) Hose
(2) Hose Clamp

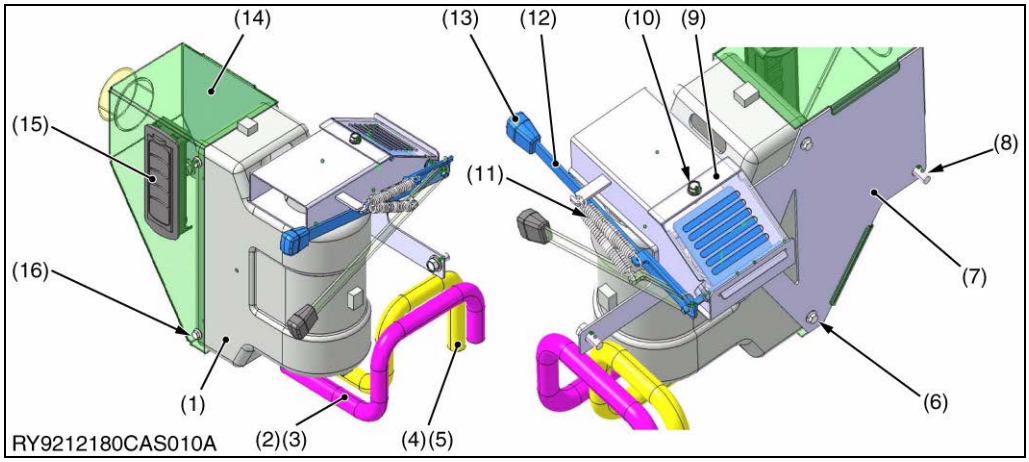
RY9212180CAS0006US0

5. Remove the three bolts and then the heater assembly.

(1) Bolt

RY9212180CAS0007US0

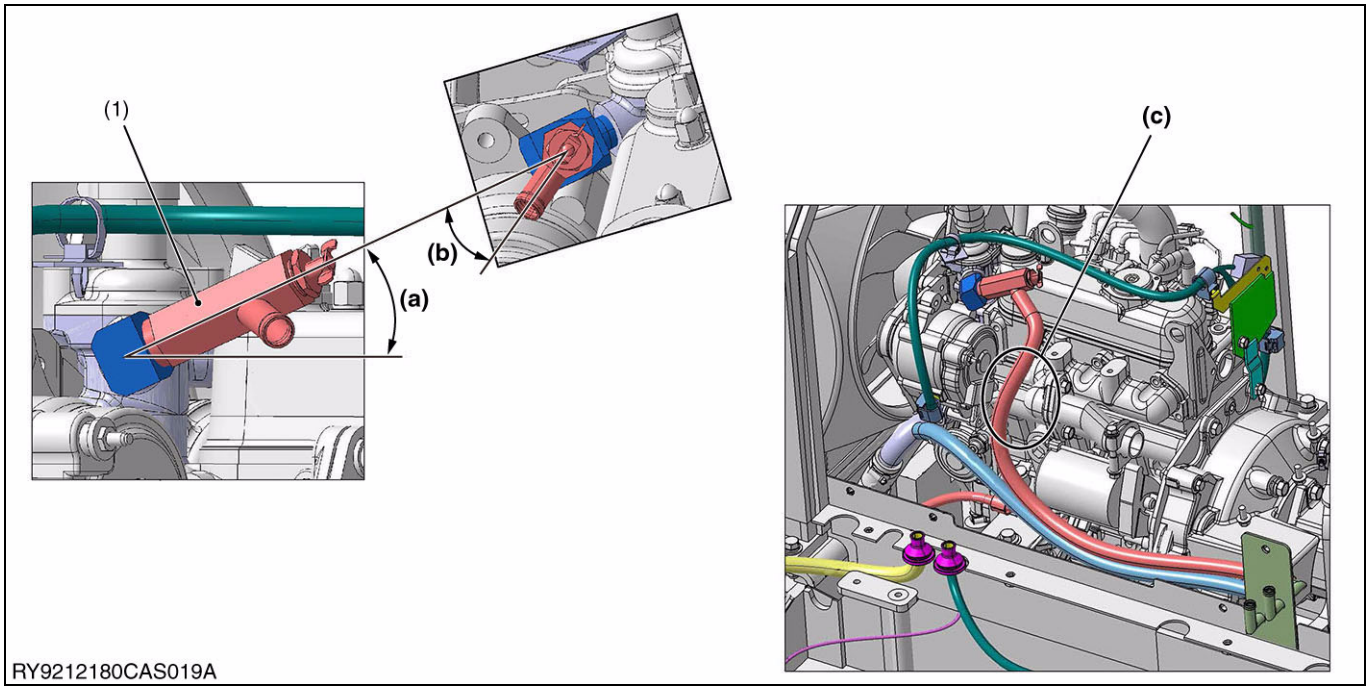
Heater Assy



(1) Heater
(2) Hose
(3) Hose Clamp
(4) Hose
(5) Hose Clamp
(6) Bolt
(7) Bracket
(8) Bolt
(9) Cover
(10) Bolt
(11) Spring
(12) Lever
(13) Grip
(14) Cover
(15) Defroster Grill
(16) Bolt

RY9212180CAS0020US0

Heater Hose Routing



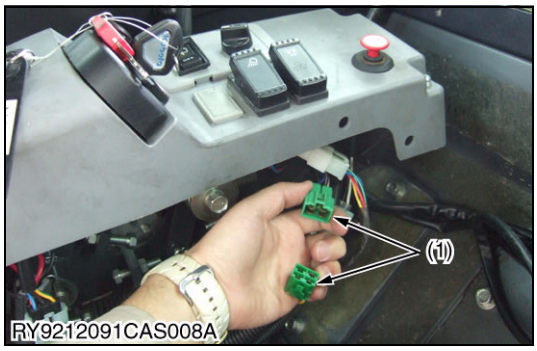
(1) Heater Valve **(a) 25 °** **(b) 30 °** **(c) Do not contact to exhaust.**

RY9212180CAS0008US0

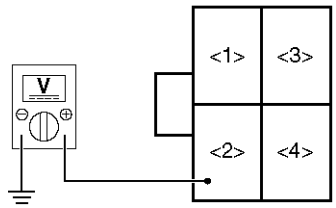
3. CHECKS

[1] HEATER RELATED

(1) Blower Switch

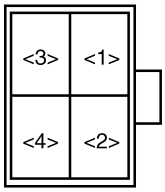


(A)



RY9212180CAS012A

(B)



RY9212091CAS018A

Connector Voltage

1. Remove the 4P connector from the blower switch.
2. Turn the starter switch to [RUN].
3. Measure the voltage between terminal 2 of the connector on the harness side and ground on the body
4. If the voltage is different from the battery voltage (DC 11 to 14 V), then there is a fault in the wire harness, blower motor relay, the fuse and/or the starter switch.

(1) 4P Connector

(A) 4P Connector (Harness Side)

RY9212180CAS0009US0

Blower Switch Test

1. Check the continuity between each of the terminals according to the table below.
2. If continuity exists, it is normal.

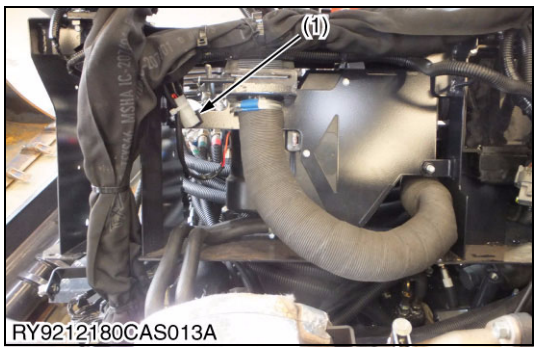
Position	<2>	<3>	<4>	<1>
Rated load		80 W	58 W	135 W
OFF	●			
Lo	●	●	●	
Hi	●	●		●

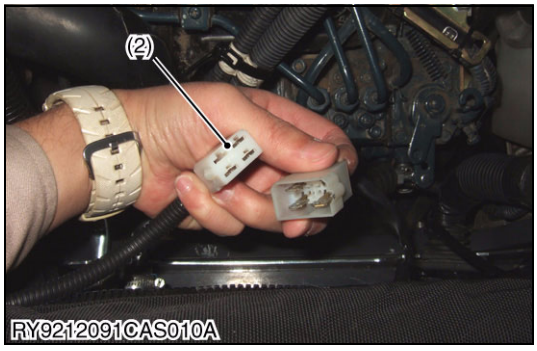
RY9212091CAS019US

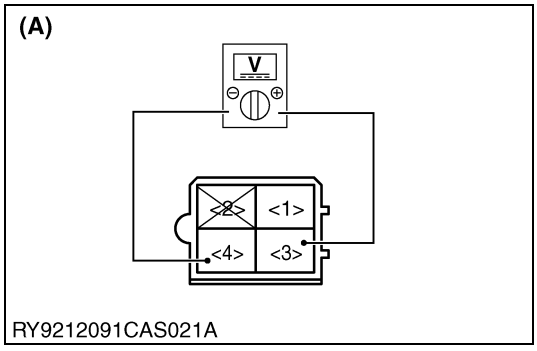
(B) 4P Connector (Switch Side)

RY9212091CAS0006US0

(2) Blower Motor





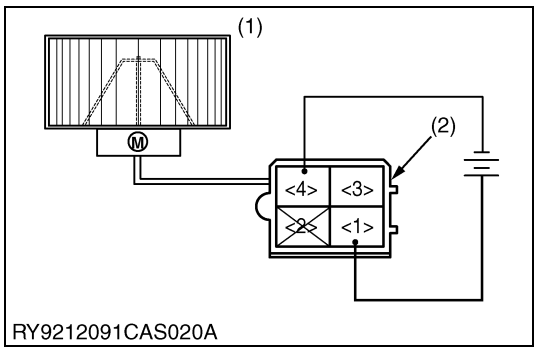


Connector Voltage

1. Remove the 4P connector from the blower motor.
2. Switch the starter switch to [RUN] and the blower switch to HI.
3. Measure the voltage between terminals 3 and 4 of the connector on the switch side.
4. If the voltage is different from the battery voltage (DC 11 to 14 V), then there is a fault in the wire harness, blower motor relay, the fuse and/or the starter switch.

(1) 4P Connector
(2) 4P Connector (Main Harness Side)
(A) 4P Connector (Main Harness Side)

RY9212180CAS0010US0



Blower Motor Test

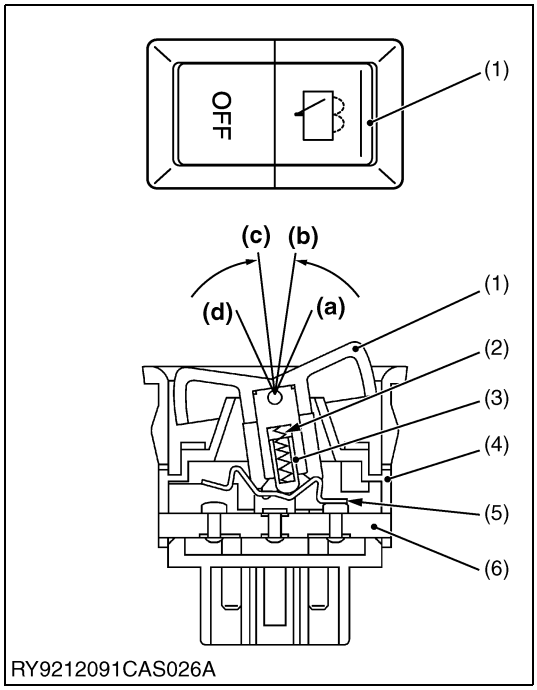
1. Turn the blower motor by hand and check whether it turns smoothly.
2. Remove the 4P connector from the blower motor.
3. Connect a jumper lead from the positive (+) terminal of the battery to either terminal **<1>** or **<3>** of the connector.
4. Connect a jumper lead from the negative (–) terminal of the battery to terminal **<4>** of the connector for just a moment.
5. If the blower motor fails to turn, check the motor.

(1) Blower Motor
(2) 4P Connector (Blower Motor Side)
(3) Battery (12 V)
<1>, <3>:(+) Terminal
<4> :(–) Terminal

RY9212180CAS0011US0

[2] WINDOW WASHER RELATED

(1) Wiper Switch



RY9212091CAS026A

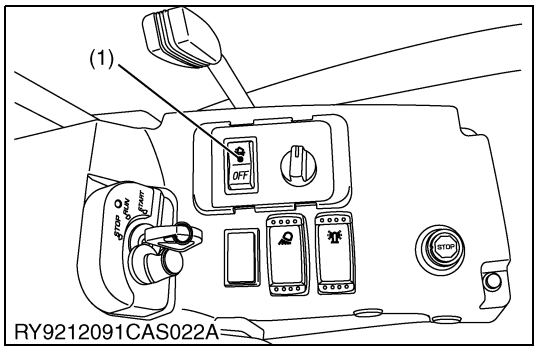
This switch has four positions, namely **(a)**, **(b)**, **(c)**, and **(d)** as indicated in the figure. Turn the starter key to the [RUN] position and press the knob to position **(b)** to operate the wiper motor. If you press it in to position **(a)**, the window washer operates and when you release it, the knob returns automatically from position **(a)** to **(b)**.

Even if you press it to position **(d)** on the [OFF] side, the window washer operates and when released it automatically returns in the same way to position **(c)**.

(1) Knob
(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)

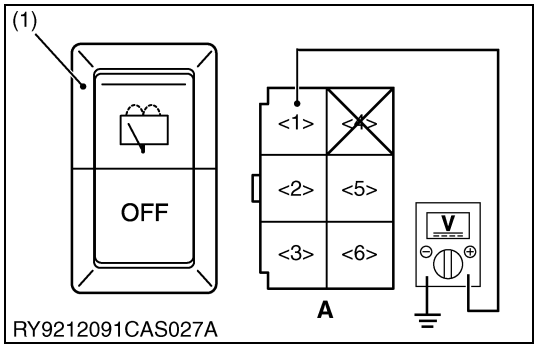
RY9212091CAS0009US0



RY9212091CAS022A

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 it is the same as the battery voltage (DC 11 to 14 V), it is normal.

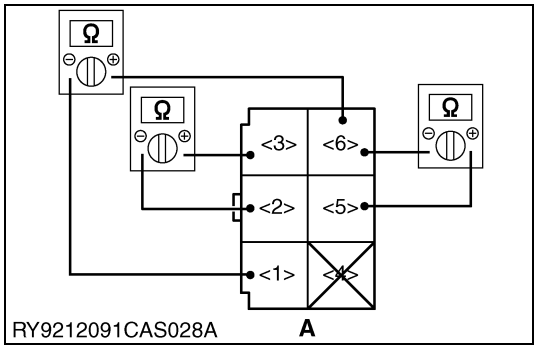


RY9212091CAS027A

(1) Wiper Switch

A : 6P Connector (Harness Side)

RY9212091CAS0010US0



Checking the Wiper Switch

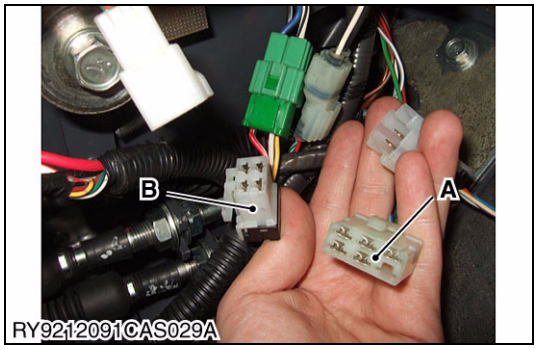
1. Test the continuity between each of the terminals according to the table below.
2. If continuity exists, it is normal.

Position	<3>	<2>	<1>	<6>	<5>
WASH1	●	●		●	●
ON			●	●	
OFF				●	●
WASH2	●	●	●	●	

RY9212001CAS094US

A : 6P Connector (Switch Side)

RY9212091CAS0011US0

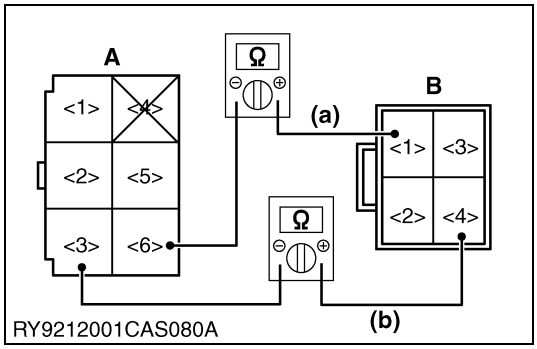


Checking the Cab Wiper Power Harness

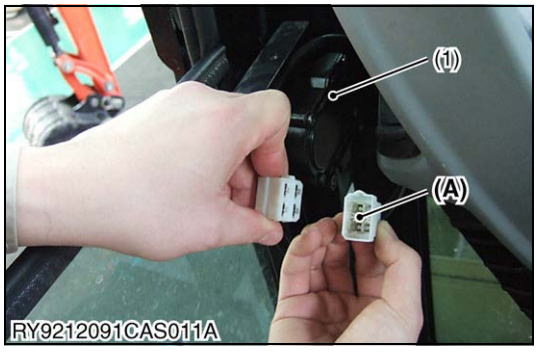
1. Disconnect the 6P connector from the wiper switch and the 4P connector from the cab wiper power harness.
2. Check the continuity between the terminals on both sides of the harness.
3. If continuity exists, it is normal.

(a) Wiper Motor Line
(b) Washer Motor Line
A : 6P Connector
B : 4P Connector

RY9212091CAS0012US0



(2) Wiper Motor

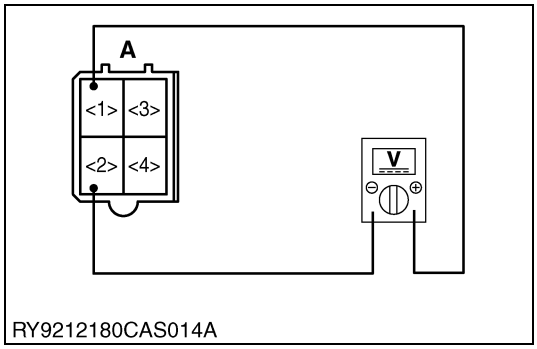


Connector Voltage

1. Remove the wiper cover.
2. Remove the 4P connector from the wiper motor.
3. Switch the starter switch to [RUN] and the window washer to ON.
4. Measure the voltage between terminals 1 and 2 of the connector on the harness side.
5. If it is the same as the battery voltage (DC 11 to 14 V), it is normal.

(1) Wiper Motor
A : 4P Connector (Harness Side)

RY9212180CAS0013US0



RY9212180CAS014A

Testing the Motor Separately

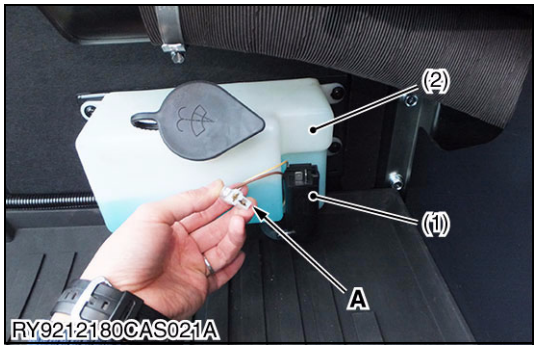
1. Raise the wiper blade so there is no load on it.
2. Switch the starter switch to [RUN] and the wiper switch to ON.
3. If the wiping angle is as in the table, it is normal.

No load wiping angle	Factory specification	58 to 62 °

A : 4P Connector (Harness Side)

RY9212180CAS0014US0

(3) Washer Motor



RY9212180CAS021A

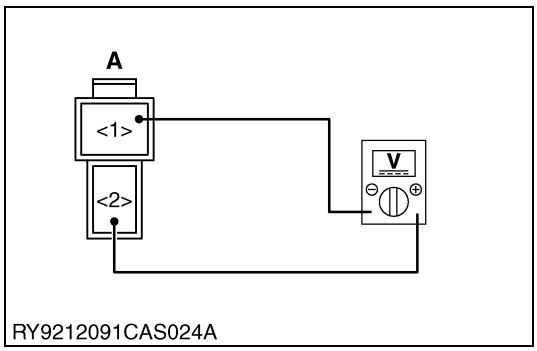
The window washer operates via a small, electric hi-speed motor and consists of a tank, pump and nozzle.

The washer pump is linked to the shaft of the motor and is installed below the tank.

(1) Washer Motor
(2) Tank

A : 2P Connector (Harness Side)

RY9212180CAS0023US0



RY9212091CAS024A

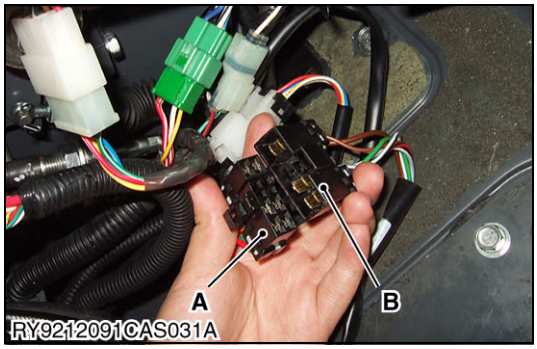
Connector Voltage

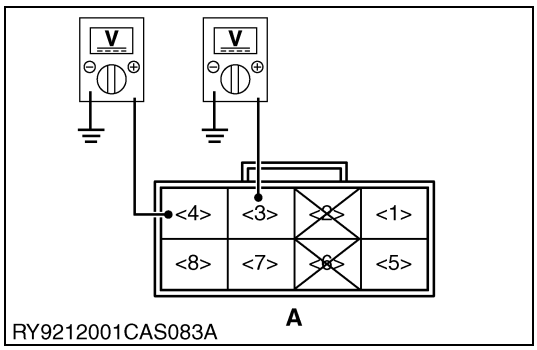
1. Remove the 2P connector from the washer motor.
2. Press down on the [OFF] side of the wiper switch. (so only the window washer operates)
3. Measure the voltage between terminals 1 and 2 of the connector on the harness side.
4. If it is the same as the battery voltage (DC 11 to 14 V), it is normal.

A : 2P Connector (Harness Side)

RY9212091CAS0016US0

[3] LIGHTING EQUIPMENT RELATED



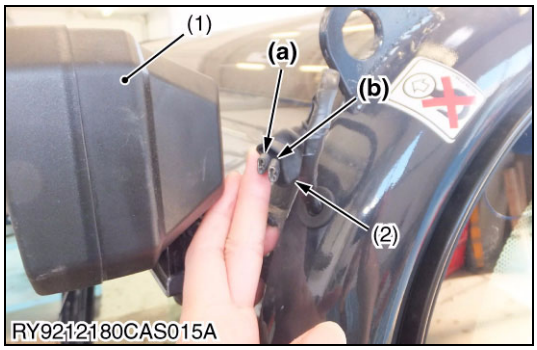


Connector Voltage

1. Disconnect the cab power 8P connector from the wiring harness (Cabin).
2. Measure the voltage between terminal 3 of the connector on the cabin power harness side and ground on the body. (Interior light)
3. Turn the starter switch to [RUN].
4. Measure the voltage between terminal 4 of the connector on the cabin power harness side and ground on the body. (Cab work light)
5. If it is the same as the battery voltage (DC 11 to 14 V), it is normal.

A : 8P Connector (Cab Power Harness Side) **B : 8P Connector (Cab Harness Side)**

RY9212091CAS0017US0

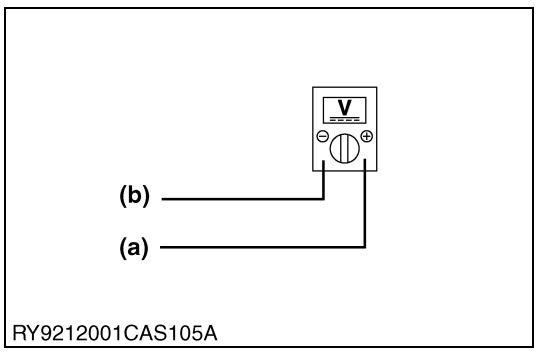


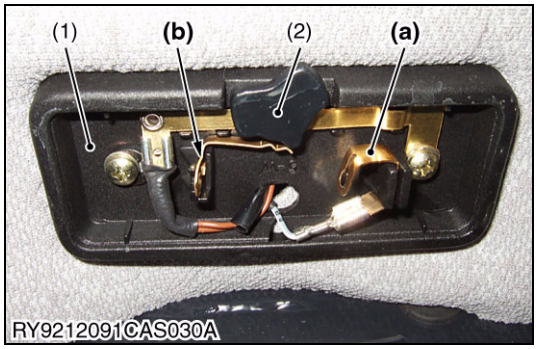
Terminal Voltage (Cab Work Light)

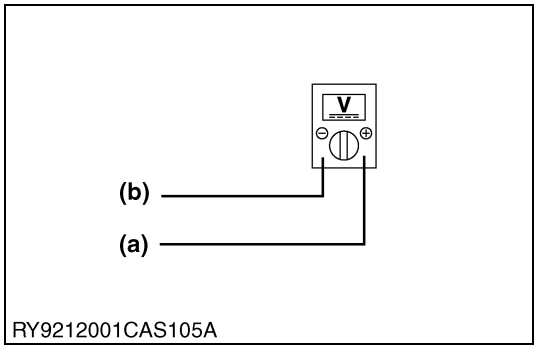
1. Remove the grommet and then the 1P work light harness.
2. Switch the starter switch to [RUN] and the cab work light switch to ON.
3. Measure the voltage between GND and the work light terminal (+) on the harness side.
4. If it is the same as the battery voltage (DC 11 to 14 V), the terminal voltage is normal.

(1) Work Light
(2) Grommet
(a) (+) Terminal
(b) GND Terminal

RY9212180CAS0015US0





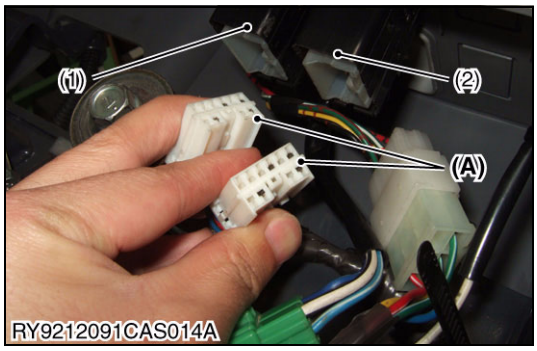


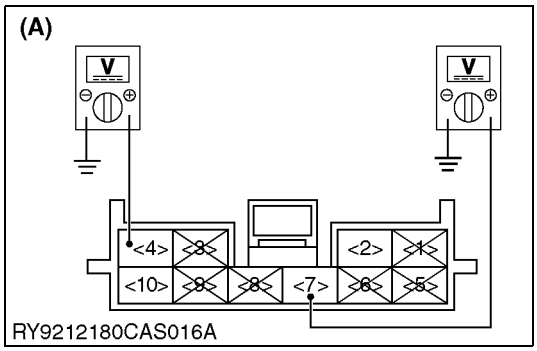
Terminal Voltage (Interior Light)

1. Remove the interior light cover.
2. Remove the bulb. (Pull it out)
3. Switch the interior light switch to [ON].
4. Measure the voltage between GND and the interior light terminal (+).
5. If it is the same as the battery voltage (DC 11 to 14 V), the terminal voltage is normal.

(1) Interior Light Assembly
(2) Interior Light Switch
(a) (+) Terminal
(b) GND Terminal

RY9212091CAS0019US0





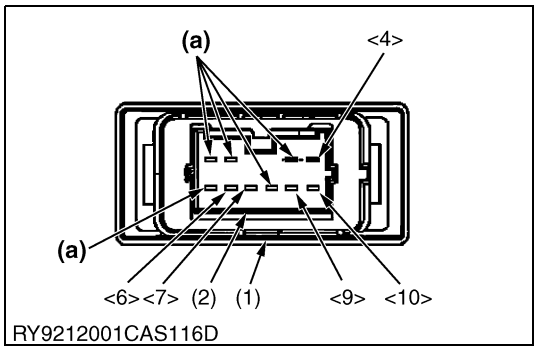
Work Light Switch / Beacon Switch

Connector Voltage

1. Turn the starter switch to [OFF] and disconnect the 10P connector from the cab work light/ beacon switch.
2. Turn the starter switch to [RUN].
3. Measure the voltage between terminal 7 of the connector on the harness side and ground on the body. (Switch voltage)
4. Measure the voltage between terminal 4 of the connector on the harness side and ground on the body. (LED voltage)
5. If it is the same as the battery voltage (DC 11 to 14 V), it is normal.

(1) Work Light Switch
(2) Beacon Switch
(3) 10P Connector (Harness Side)
(A) 10P Connector (Harness Side)

RY9212180CAS0016US0



Checking the Work Light Switch/Beacon Switch

1. Check the continuity between each of the terminals according to the table below.
2. If continuity exists, it is normal.

	<7>	<6>	<9>	<10>	<4>
ON	○	○		○	○
OFF	○		○		

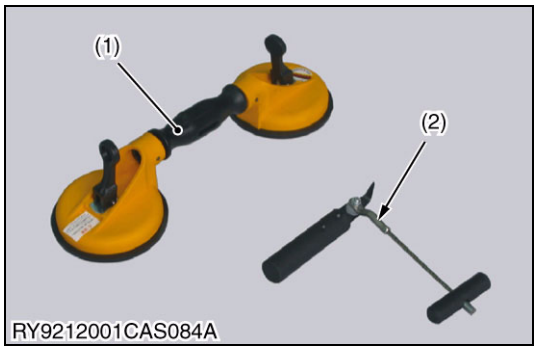
RY9212180CAS017A

(1) Work Light Switch / Beacon Switch
(2) 10P Connector (Switch Side)
(a) (Free)

RY9212180CAS0017US0

4. REMOVAL AND INSTALLATION OF GLASS

[1] PREPARATION



Items required

- Cleaner : Equivalent of Seeker Cleaner 205
- Adhesive : Equivalent of Seeker Flex 250PC-JM
- Primer : Equivalent of Seeker Primer 206
- Scraper
- Awl
- Adhesive cutter
- Glass suction cups (use if needed)

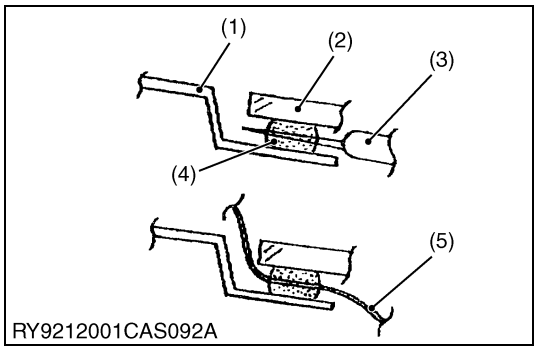
■ **NOTE**

- **The cleaner and adhesive have a short shelf-life (9 to 12 months), so obtain them immediately before use from a nearby manufacturer or a shop that handles auto glass products.**

(1) Glass Suction Cups
(2) Adhesive Cutter

RY9212001CAS0085US0

[2] REMOVING GLASS



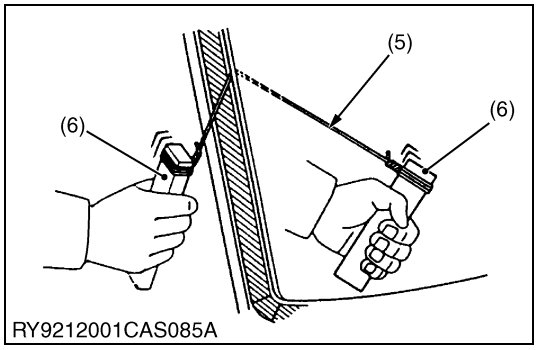
1. Mask off painted surface around the glass to protect them from scratching while removing/installing glass.
2. Remove the glass.

[When using piano wire (damages parts of the glass)]

- Pierce and make a hole in the adhesive with an awl (or knife of glass cutter, etc.).
- Pass the piano wire (or steel wire) through the hole.
- Wrap both ends of the piano wire around a wood block or the like.
- Pull the piano wire along the edge of the window, sawing through the adhesive between the cab and the glass; then remove the glass from the cab.

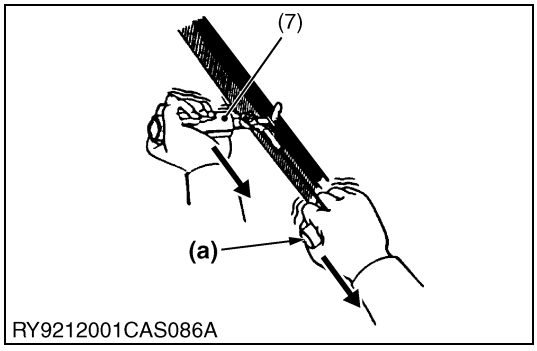
[When using an adhesive cutter (completely ruins the glass)]

- Insert the adhesive cutter into the adhesive.
- Pull on part **(a)** of the cutter and cut the glass out.



CAUTION

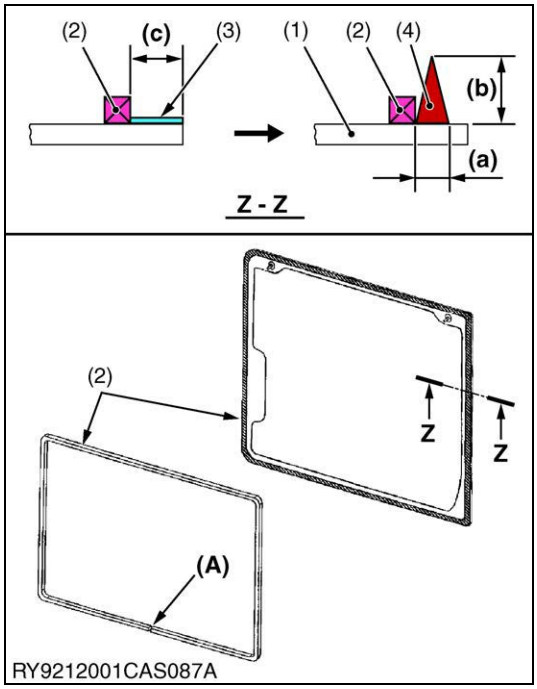
- **If the piano wire gets very hot in one place, it may break. Avoid rubbing it with much force against the edge of the glass.**
- **Be careful not to cut yourself on fragments of glass or the blade of the cutter.**



(1) Cab Frame
(2) Glass
(3) Awl
(4) Adhesive
(5) Piano Wire
(6) Wood
(7) Adhesive Cutter

RY9212001CAS0086US0

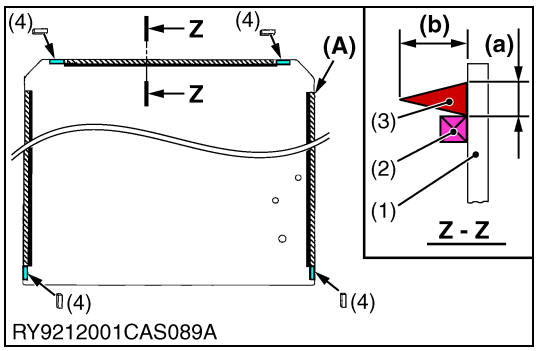
[3] INSTALLING WINDOWS



1. Completely eliminate all old adhesive on the frame of the cab.
2. Use the cleaner to clean the cab frame and the surface of the new glass where adhesive will be applied to get rid of any dirt or oil.
3. Affix the windshield dam to the surface of the new glass where the adhesive will be applied.
4. Apply primer uniformly around the circumference of the windshield dam.
5. Apply adhesive uniformly along the outer circumference of the windshield dam.
6. Apply primer uniformly around the entire circumference of the flange of the cab frame. (Application width: 18 mm (0.71 in.) or more)
7. Make and install a spacer for in between the edge of the glass and the cab's frame so that the glass does not slide down during installation. (holds position and prevents slipping)
8. Press slightly all the way around the edge of the glass from the outside, so the glass touches the shield dam and they stick together.
9. Hold the glass in place with packing tape until the adhesive hardens so the glass does not shift or come off.

(1)	Glass	**(a)**	**At Least 7 mm (0.28 in.)**
(2)	Windshield Dam (W/Adhesive)	**(b)**	**At Least 12 mm (0.47 in.)**
(3)	Primer (Apply)	**(c)**	**12 mm (0.47 in.)**
(4)	Adhesive (Apply)	**(A)**	**Start Affixing Dam Here**

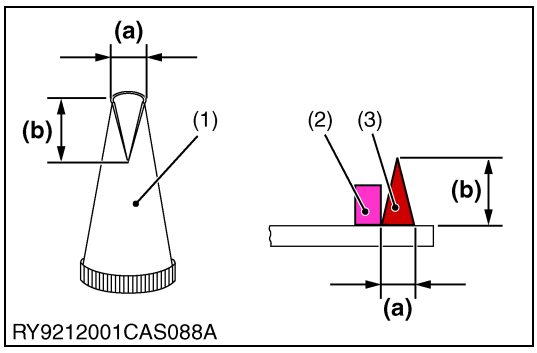
RY9212001CAS0087US0



- For the front window

(1)	Glass	**(a)**	**At Least 7 mm (0.28 in.)**
(2)	Windshield Dam (W/Adhesive)	**(b)**	**At Least 12 mm (0.47 in.)**
(3)	Adhesive (Apply)		
(4)	Fastener (Affix as Male/Female Set)	**(A)**	**Line Up with the Edge of the Frame**

RY9212001CAS0088US0



- Recommended shape of triangular bead

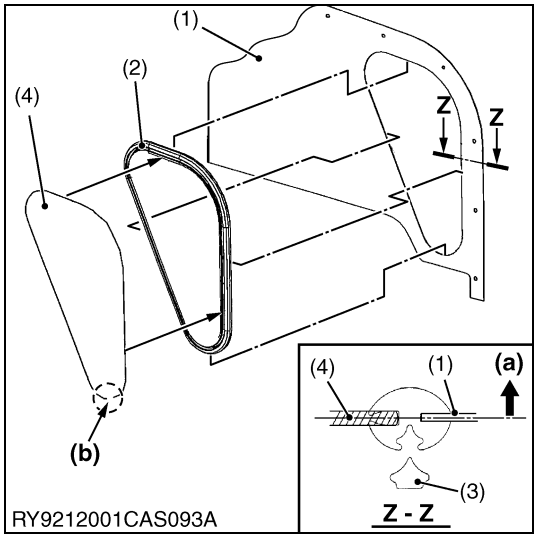
■ **NOTE**

- **Cut the tip of the nozzle of the adhesive cartridge in the shape of a V.**
- **Apply the adhesive to the glass so it forms a uniform triangular bead.**

(1)	Nozzle Tip	**(a)**	**At Least 8 mm (0.31 in.)**
(2)	Windshield Dam (W/Adhesive)	**(b)**	**At Least 12 mm (0.47 in.)**
(3)	Adhesive (Apply)		

RY9212001CAS0089US0

[4] GLASS TRIM TYPE



(When removing)

1. Lift the rubber core by its seam and remove it.
2. Remove the glass to the outside.

(When attaching)

1. From the outside, insert the glass into the glass trim.
2. Insert the rubber core into the groove all the way around the trim.
3. Start inserting the rubber core at the bottom center. (to prevent rain from getting in)

(1) Panel
(2) Glass Trim
(3) Rubber Core
(4) Glass

(a) Inside
(b) Start Here

RY9212001CAS0090US0

5. TROUBLESHOOTING

Air Conditioning System

Problem and/or Situation	Possible Causes	Remedy
Noise	Blower damaged	Repair or 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
	Heater 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)	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
	Filter clogged	Clean or replace
	Vent ducts clogged or detached	Check and repair
Cannot control temperature (temperature adjustment dial faulty)	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)	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

(To be continued)

(Continued)
Wiper

Problem and/or Situation	Possible Causes	Remedy
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 is 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

RY9212180CAS0022US0

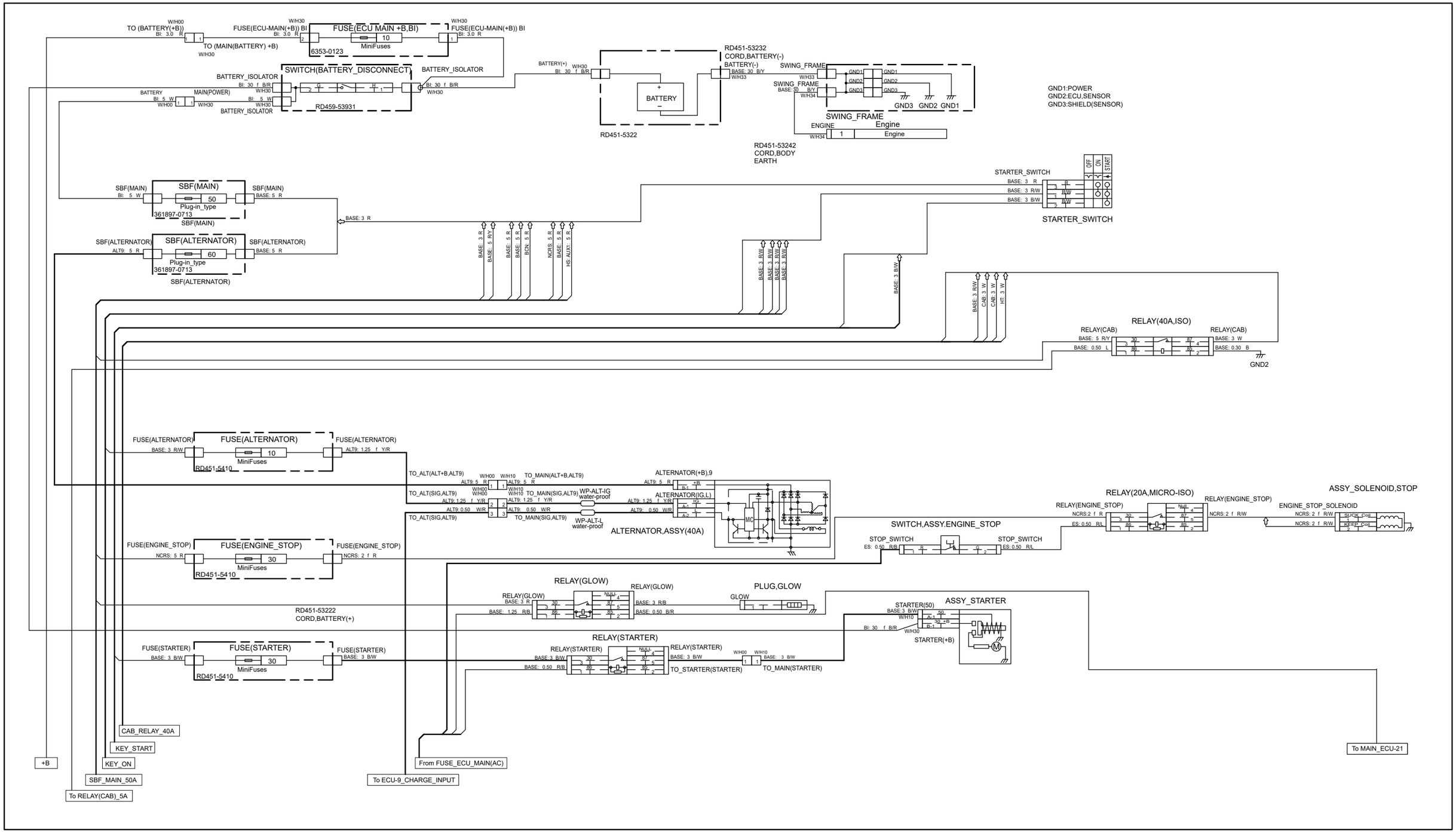
ELECTRICAL CIRCUIT DIAGRAM (U27-4, EU)

Composition Specification Code	Notes
BASE	ALL-USE
AT	Anti-Theft
BI	Battery Isolator
ES	Engine Stop
BCN	Beacon
TRB	Travel Alarm
HT	Heater
AUX1	
HS	HornSW
CAB	CAB(8+4)
CNP	Canopy
N_AB	No. Angle Blade
N_FS	No.Fuel Supply-pump
NCRS	No.CRS
ALT9	1G090-64010
BASE	ALL-USE

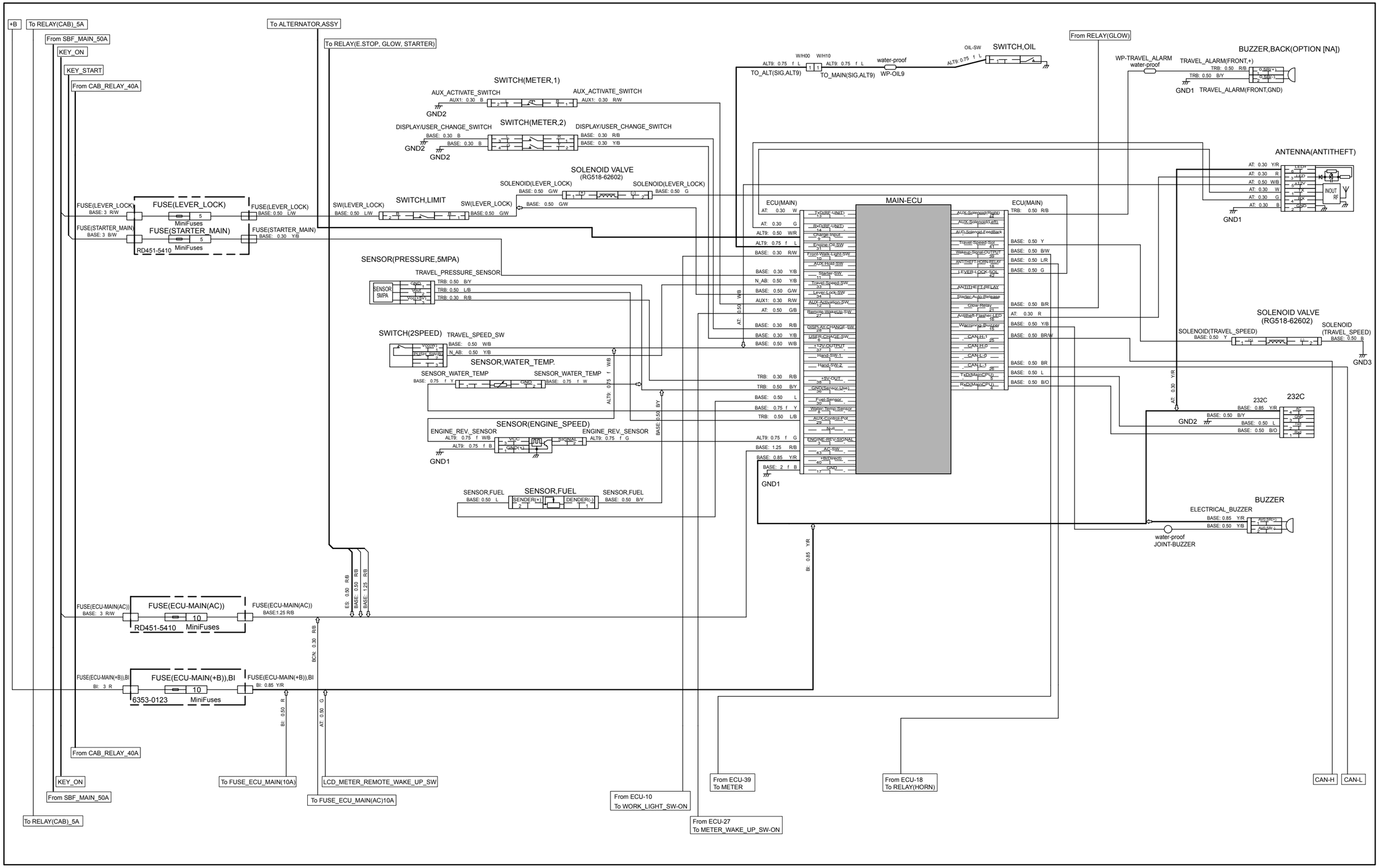
W/H00	RB557-53410	W/H(MAIN,EU,BI)
W/H10	RB557-53470	W/H,ENGINE
W/H12	RH418-53360	W/H(FRONT)
W/H19	RH418-46900	W/H(MAIN,CAB)
W/H23	RH418-53380	W/H(CANOPY,4P)
W/H30	RH418-53220	CORD,BATTERY(1,+)
	RH418-53230	CORD,BATTERY(2,+)
W/H33	RH418-53260	CORD,BATTERY(-)
W/H34	RH418-53270	CORD,BODY EARTH

ELECTRICAL CIRCUIT DIAGRAM (MAIN)

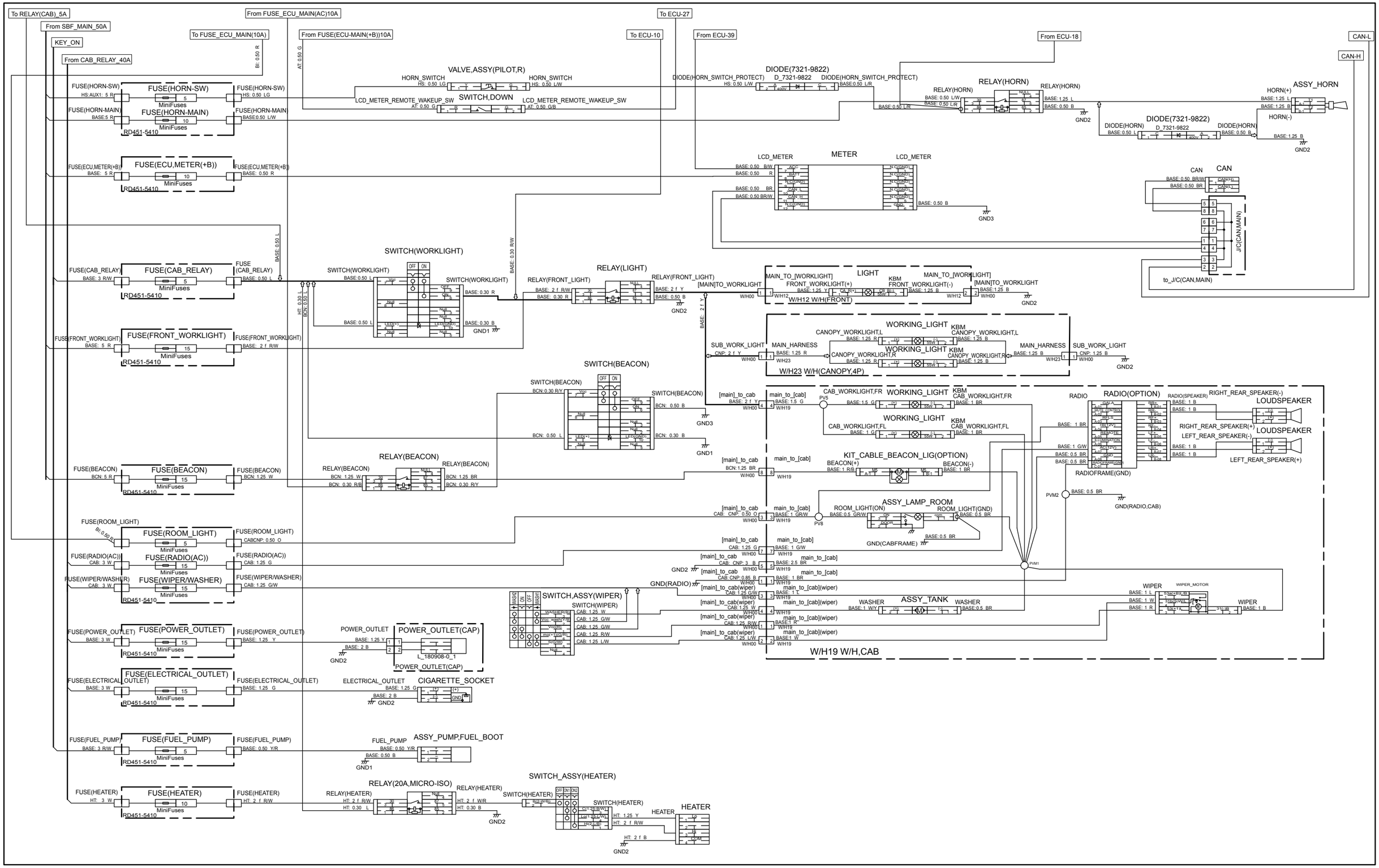
[1] ENGINE START, CHARGING AND POWER



[2] ECU, SENSOR, SOLENOID VALVE



[3] METER, HORN, WORK LIGHT, ACCESSORY



232C

C_WF04_7123-7740-40_1

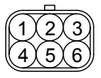
ALTERNATOR (+B), 9

C_LAF01_M6_1

ALTERNATOR (IG, L)

C_OF02_7123-2820_1

ANTITHEFT_ ANTENNA



C_WM06_6189-6171_1

AUX_ ACTIVATE_ SWITCH

C_WF02_6180-2451_1

BATTERY

C_OM01_7122-4113-30_1

MAIN (POWER)

C_OF01_7123-4113-30_1

BATTERY

C_OM01_7122-4113-30_1

MAIN (POWER)

C_OF01_7123-4113-30_1

BATTERY (+)

C_LAF01_M8_1

BATTERY_ ISOLATER

C_LAF01_M8_1

BEACON (+)

C_LAF01_M6_1

BEACON (-)

C_LAF01_M6_1

CAB_WORKLIGHT, FL

C_OF02_180923-0_1

CAB_WORKLIGHT, FR

C_OF02_180923-0_1

CAN

C_WF02_7123-8520-40_1

CANOPY_WORKLIGHT, L

C_OF02_180923-0_1

CANOPY_WORKLIGHT, R

C_OF02_180923-0_1

DIODE (HORN)

C_OF02_6098-0017_1

DIODE (HORN_SWITCH_PROTECT)

C_OF02_6098-0017_1

DISPLAY/USER_CHANGE_SWITCH

C_WF04_6180-4181_1

ECU (MAIN)

C_WF44_1376886-1_1

ELECTRICAL _BUZZER

C_OF02_7123-2820_1

ELECTRICAL _OUTLET

C_OF02_7123-8322_1

ENGINE_REV. _SENSOR

C_WF03_7283-8732-40_1

ENGINE_STOP _SOLENOID

C_WM02_6195-0006_1

FRONT_ WORKLIGHT(+)

C_CBF01_1

FRONT_ WORKLIGHT(-)

C_CAM01_1

FUEL_PUMP

C_OF02_7123-2820_1

FUSE (ALTERNATOR)

C_OF02_Min iFuses_1

FUSE (BEACON)

C_OF02_Min iFuses_1

FUSE(ECU, METER(+B))

C_OF02_Min iFuses_1

FUSE(ECU-MAIN(+B))

C_OF02_Min iFuses_1

FUSE(ECU-MAIN(+B)), B I

C_OF02_Min iFuses_1

FUSE(ECU_ MAIN(AC))

C_OF02_Min iFuses_1

FUSE (ELECTRICAL _OUTLET)

C_OF02_Min iFuses_1

FUSE (ENGINE _STOP)

C_OF02_Min iFuses_1

FUSE(FRONT_ WORKLIGHT)

C_OF02_Min iFuses_1

FUSE(FUEL_ PUMP)

C_OF02_Min iFuses_1

FUSE (HEATER)

C_OF02_Min iFuses_1

FUSE (HORN-MAIN)

C_OF02_Min iFuses_1

FUSE (HORN-SW)

C_OF02_Min iFuses_1

FUSE(LEVER _LOCK)

C_OF02_Min iFuses_1

FUSE(POWER _OUTLET)

C_OF02_Min iFuses_1

FUSE (RADIO(AC))

C_OF02_Min iFuses_1

FUSE(RELAY)

C_OF02_Min iFuses_1

FUSE(ROOM_ LIGHT)

C_OF02_Min iFuses_1

FUSE (STARTER)

C_OF02_Min iFuses_1

FUSE (STARTER _MAIN)

C_OF02_Min iFuses_1

FUSE(WIPER /WASHER)

C_OF02_Min iFuses_1

GLOW

C_LEF01_M4_1

GND (CABFRAME)

C_LAF01_M8_1

GND (RADIO)

C_LAF01_M8_1

GND(RADIO, CAB)

C_LEF01_M5_1

GND1

C_LAF01_7009-1836_1

GND2

C_LAF01_7009-1836_1

GND3

C_LAF01_7009-1836_1

HEATER

C_OF04_180900-0_1

HORN (+)

C_OF01_7123-2010_1

HORN (-)

C_OF01_7123-2010_1

HORN_SWITCH

C_WF02_DT06-2S-CE05_1

LCD_METER

C_OF12_MX34012SF1_1

LCD_METER_REMOTE_ WAKEUP_SW

C_WM02_6187-2802_1

MAIN_HARNESS

C_CAM01_1

SUB_WORK_LIGHT

C_CBF01_1

MAIN_HARNESS

C_CBF01_1

SUB_WORK_LIGHT

C_CAM01_1

MAIN_TO_[WORKLIGHT]

C_OM02_7122-2820_1

[MAIN]_TO_WORKLIGHT

C_OF02_7123-2820_1

OIL-SW

C_OF01_172320-2_1

POWER_ OUTLET

C_OF02_180907-0_1

RADIOFRAME (GND)

C_CAM01_1

RELAY (BEACON)

C_OF05_M-ISO_1

RELAY (CAB)

C_OF04_P-ISO_1

RELAY (ENGINE_ STOP)

C_OF05_M-ISO_1

RELAY(FRONT _LIGHT)

C_OF05_M-ISO_1

RELAY (GLOW)

C_OF05_M-ISO_1

RELAY (HEATER)

C_OF05_M-ISO_1

RELAY (HORN)

C_OF05_M-ISO_1

RELAY (STARTER)

C_OF05_M-ISO_1

SBF (ALTERNATOR)

C_OM02_361897-0713_1

SBF (MAIN)

C_OM02_361897-0713_1

SENSOR, FUEL

C_WF02_6180-2321_1

SENSOR_ WATER_TEMP

C_WF02_178392-6_1

SOLENOID (LEVER_LOCK)

C_WF02_282189-1_1

SOLENOID (TRAVEL_ SPEED)

C_WF02_282189-1_1

STARTER (+B)

C_LAF01_M8_1

STARTER (50)

C_OF01_7123-2810_1

STARTER_SWITCH

C_WF03_7123-6234-40_1

STOP_SWITCH

C_WM02_6187-2801_1

SW (LEVER_LOCK)

C_WF02_6195-0003_1

SWITCH (BEACON)

C_OF10_7123-8307_1

SWITCH (HEATER)

C_OF04_7123-2840-60_1

SWITCH (WIPER)

C_OF06_7123-2860_1

SWITCH (WORKLIGHT)

C_OF10_7123-8307_1

TO_ALT (ALT+B,ALT9)

C_OF01_6098-0441_1

TO_MAIN (ALT+B,ALT9)

C_OM01_6240-1093_1

TO_ALT (SIG,ALT9)

C_WF03_7123-7434-40_1

TO_MAIN (SIG,ALT9)

C_WM03_7222-7434-40_1

TO_MAIN (STARTER)

C_OM01_6098-0822_1

TO_STARTER (STARTER)

C_OF01_6098-0824_1

TRAVEL_ ALARM (FRONT,+)

C_CBF01_1

TRAVEL_ ALARM (FRONT,GND)

C_CAM01_1

TRAVEL_ PRESSURE_ SENSOR

C_WF03_7223-6536-30_1

TRAVEL_ SPEED_SW

C_WM03_6092-0013_1

WASHER

C_OF02_180907-0_1

[BAT]_TO_MAIN

C_OF01_7123-2810_1

TO_BATTERY(+B)

C_OM01_7122-2810_1

[MAIN]_TO_CAB

C_OF08_7123-6083-30_1

MAIN_TO_[CAB]

C_OM08_7122-6083-30_1

[MAIN]_TO_CAB (WIPER)

C_OF04_7123-6040_1

MAIN_TO_[CAB] (WIPER)

C_OM04_7122-6040_1

TO_J/C (CAN,MAIN)

C_WF08_7283-1081-10_1

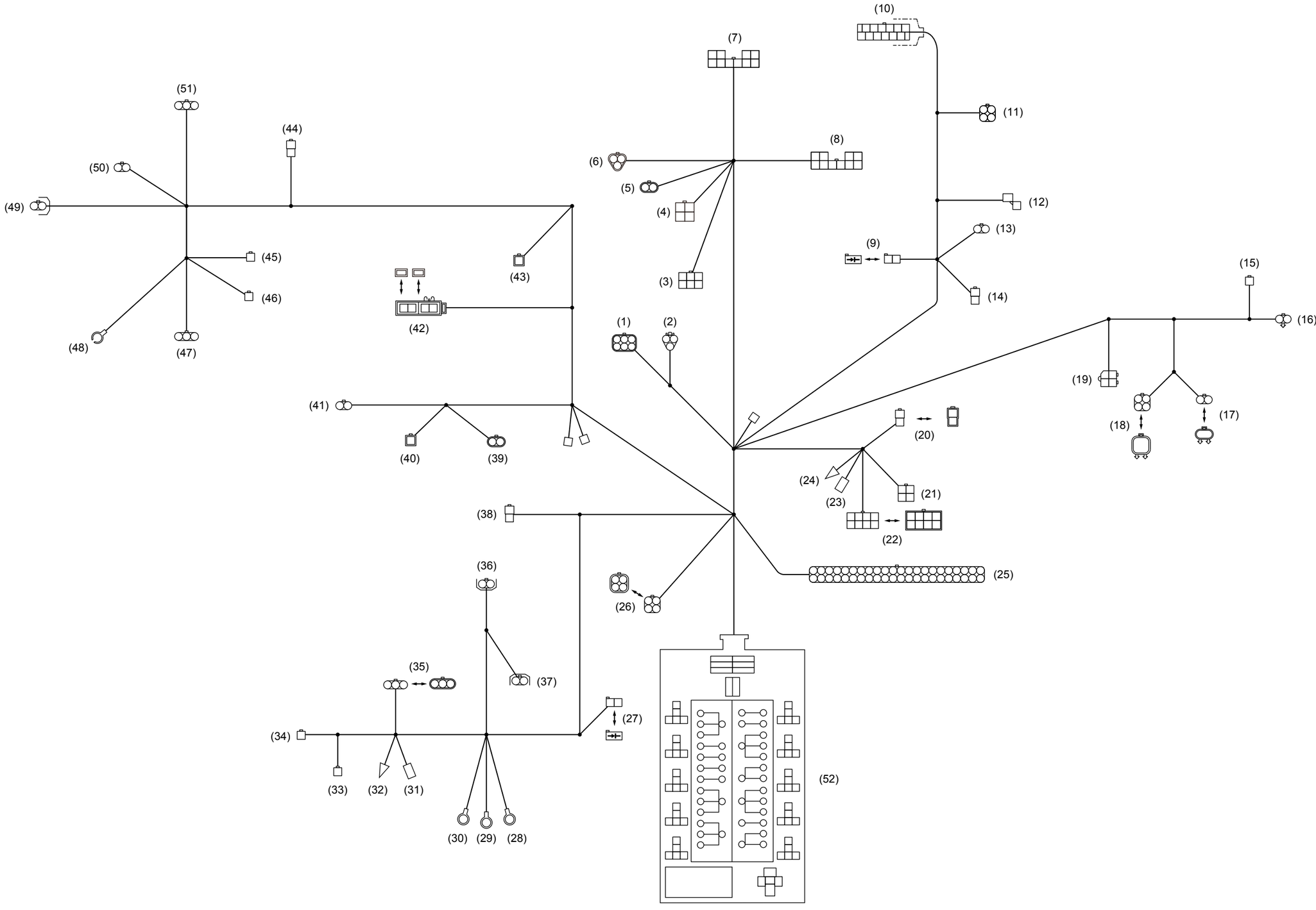
J/C (CAN,MAIN)

C_WM08_7382-1481-10_1

CONNECTOR CHART (U27-4 EU)

WIRE HARNESS (MAIN)

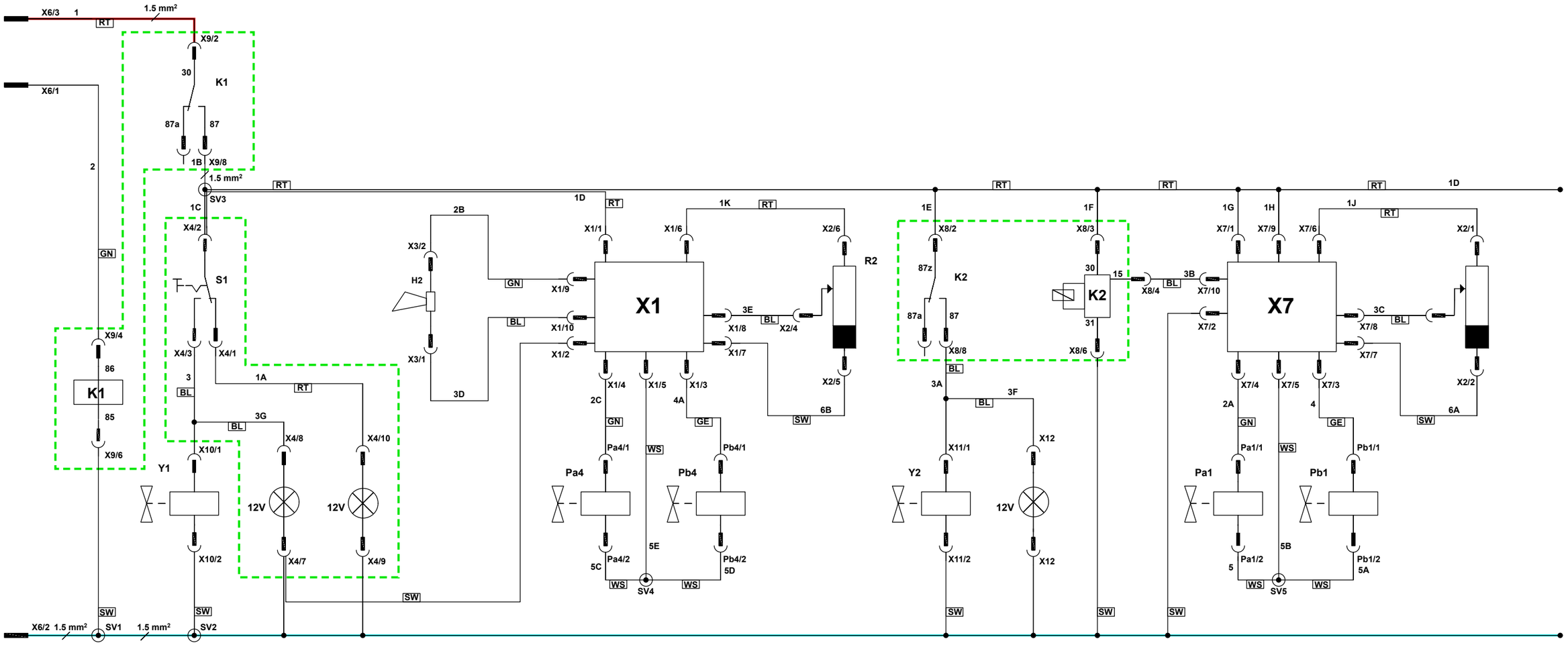
Main Harness



Main Harness

(1) ANTENA UNIT 7322-1461	(2) STARYER SW 7323-6234	(3) WIPER SW 7323-2860	(4) HERTER SW #### ####	(5) STOP SW 7322-9422	(6) TRAVEL SPEED SW 7328-1231	(7) WORK LIGHT SW 7323-8307	(8) BEACON SW 7323-8307	(9) DIODE (HORN SW PROTECT) 7323-7729
(10)METER 7383-8389	(11)USER CHANGE SW 7323-1540	(12)ELECTRICAL OUTRET 7323-8322	(13)HORN SW 7329-1111	(14)ELECTRIC BUZZER 7323-2825	(15) OPTINAL PORT 7387-7436	(16) LEVER LOCK SW 7383-1528	(17) CAN 7323-8520	(18) 232C 7323-7740
(19) HEATER 7323-2149								
(20) POWER OUTLET 7323-2320 / 7386-3246	(21) CAB WIPER HARNESS 7323-6040	(22) CAB HARNESS 7322-6083	(23) SUB WORK LIGHT 7115-1050	(24) SUB WORK LIGHT 7113-1020	(25) ECU (MAIN) 7329-3285			
(26) HI SPEC HARNESS 7329-5822 / 7328-1639	(27) DIODE(HORN) 7323-7229	(28),(29),(30) GND 7009-1324	(31) TRAVEL ALARM 7115-1050	(32) TRAVEL ALARM 7115-1020	(52) FUSE BOX #### ####			
(33) HORN (−) 7322-2010	(34) HORN (+) 7323-2010	(35) TRAVEL PRESSURE SENSOR 7383-7874	(36) TRAVEL SPEED SOL 7319-5326	(37) LEVER LOCK SOL 7319-5326	(38) WORK LIGHT HARNESS 7323-2825	(39) METER REMOTE WAKE UP SW 7322-9422		
(40) BATTERY(SIGNAL) 7322-2810	(41) FUEL SENSOR 7323-9325	(42) SBF 60A Aiternator / 50A Main Power #### ####	(43) BATTERY 7383-7011	(44) FUEL PUMP 7323-2825	(45) ENGINE HARNESS (STARTER) 7387-6972	(46) ENGINE HARNESS (POWER) 7383-3011		
(47) ENGINE HARNESS (SIGNAL) 7323-7434	(48) GLOW PLUG 7010-3026	(49) WATER TEMP SENSOR 7383-7222	(50) ENGINE STOP SOL 7383-1528	(51) ENGINE REV SENSOR 7383-8732				

ELECTRICAL CIRCUIT DIAGRAM (HI SPEC)



Potential	Material	From	To
2	GN 1.0	X6/1	X9/4
1	RT 1.5	X6/3	X9/2
1B	RT 1.5	X9/8	SV3
1E	RT 1.0	X9/8	X8/2
1C	RT 1.0	SV3	X4/2
1G	RT 1.0	SV3	X7/1
1H	RT 1.0	SV3	X7/9
1D	RT 1.0	X4/2	X1/1
1F	RT 1.0	X8/2	X8/3
1A	RT 1.0	X4/1	X4/10
3	BL 1.0	X4/3	X10/1
3G	BL 1.0	X4/3	X4/8
3A	BL 1.0	X8/8	X11/1
3F	BL 1.0	X8/8	X12
3B	BL 1.0	X7/10	X8/4
1J	RT 1.0	X7/6	X2/1
sw (6A)	SW 1.0	X2/2	X7/7
3C	BL 1.0	X2/3	X7/8
2A	GN 1.0	X7/4	Pa1/1
4	GE 1.0	X7/3	Pb1/1
5	WS 1.0	Pa1/2	SV5
5A	WS 1.0	Pb1/2	SV5

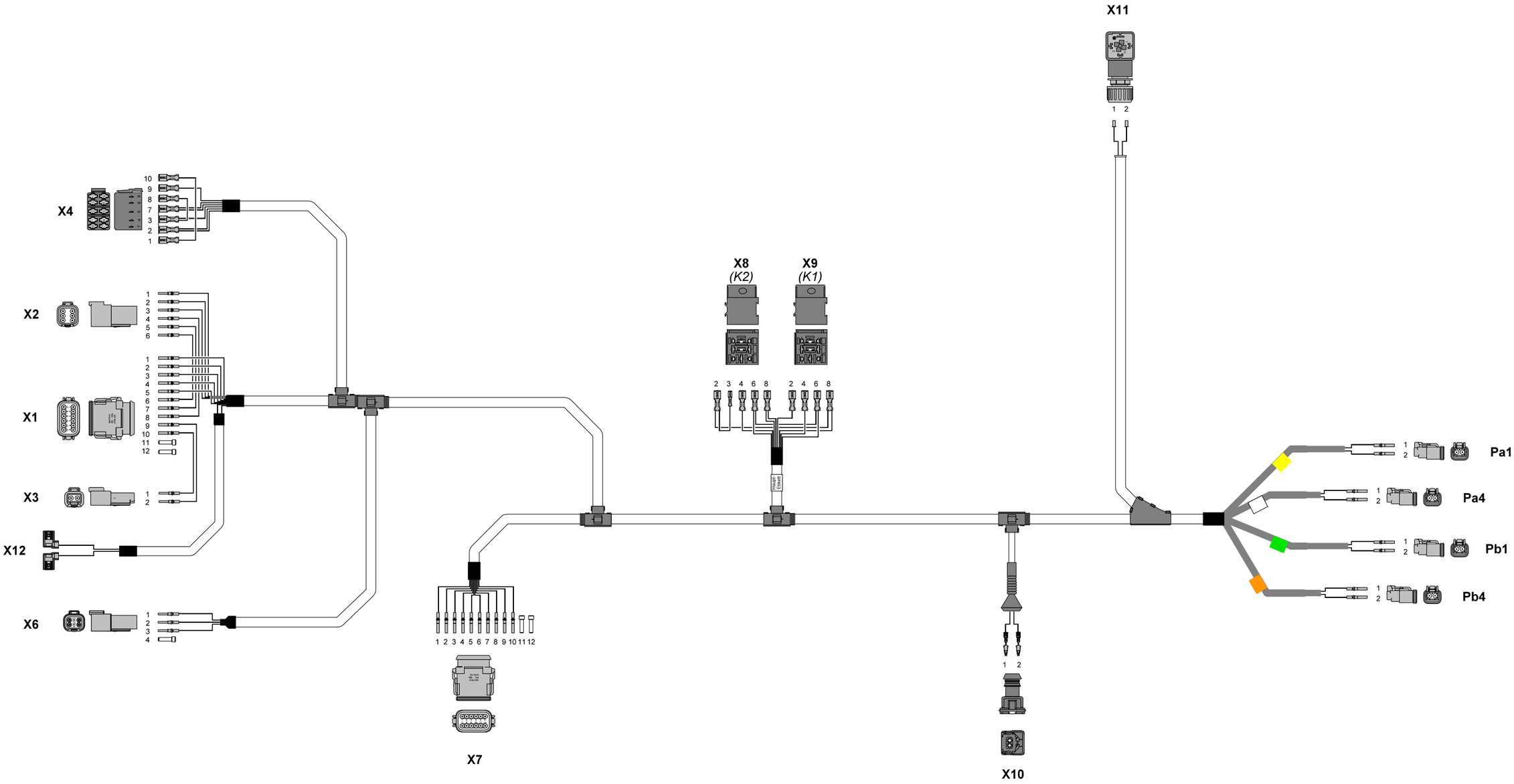
Potential	Material	From	To
5B	WS 1.0	SV5	X7/5
2B	GN 1.0	X1/9	X3/2
3D	BL 1.0	X1/10	X3/1
1K	RT 1.0	X1/6	X2/6
sw (6B)	SW 1.0	X2/5	X1/7
3E	BL 1.0	X2/4	X1/8
2C	GN 1.0	X1/4	Pa4/1
4A	GE 1.0	X1/3	Pb4/1
5C	WS 1.0	Pa4/2	SV4
5D	WS 1.0	Pb4/2	SV4
5E	WS 1.0	SV4	X1/5
sw	SW 1.5	X6/2	SV1
sw	SW 1.0	SV1	X4/9
sw	SW 1.5	SV1	SV2
sw	SW 1.0	X9/6	SV2
sw	SW 1.0	X9/6	X8/6
sw	SW 1.0	X4/7	X1/2
sw	SW 1.0	X4/7	SV1
sw	SW 1.0	X8/6	X10/2
sw	SW 1.0	X11/2	SV2
sw	SW 1.0	X7/2	SV2
sw	SW 1.0	X12	SV2

SV1	SV2	SV3	SV4	SV5
sw	sw	1B	5C	5
sw	sw	1C	5D	5A
sw	sw	1G	5E	5B
sw	sw	1H		
sw				

RT	RED
GN	GREEN
SW	BLACK
WS	WHITE / BLACK
BL	BLUE
GE	YELLOW

K1 : Unload relay
K2 : Selector valve relay
Pa1 : Proportional valve (AUX2_RH)
Pb1 : Proportional valve (AUX2_LH)
Pa4 : Proportional valve (AUX1_RH)
Pb4 : Proportional valve (AUX1_LH)
Y1 : Third line valve
Y2 : Selector valve
X1 : Pilot control lever (RH)
X7 : Pilot control lever (LH)
R1 : Potentiometer (LH)
R2 : Potentiometer (RH)
H2 : Horn switch
H3 : Lamp

WIRE HARNESS (HI SPEC)



X1: Control Lever (RH)
X2: Potentiometer
X3: Horn
X4: Switch (Third Line)
X6: Joint to Main Harness
X7: Control Lever (LH)

X8: Relay (Unload)
X9: Relay (Selector)
X10: Valve (Third Line)
X11: Valve (Selector)
X12: Indicator

Pa1: Proportional Valve (AUX2RH / Swing Rod)
Pa4: Proportional Valve (AUX2LH / Swing Bot)
Pb1: Proportional Valve (AUX1LH)
Pb4: Proportional Valve (AUX1RH)

EDITOR:
KUBOTA CORPORATION
CONSTRUCTION MACHINERY
SERVICE TECHNICAL SUPPORT DEPARTMENT
1-1 NAKAMIYA-OHIKE 1-CHOME, HIRAKATA-CITY, OSAKA, 573-8573, JAPAN
PHONE : (81)72-840-1195
FAX : (81)72-890-2883
E-mail : kbt_g.ce-sv@kubota.com

KUBOTA Corporation

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